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8160, 8260, 8360, 8560

TRACTOR WORKSHOP

TECHNICAL MANUAL



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INTRODUCTION

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FOREWORD

Appropriate service methods and correct repair procedures are essential for the safe, reliable operation of all equipment, as well as the personal safety of the individual performing the repair.

This Service Manual provides troubleshooting, overhaul, and pressure-testing instructions using recommended procedures and equipment. Following these instructions will ensure the safe, efficient, and timely completion of the service or repair.

There are numerous variations in procedures, techniques, tools, and parts for servicing machines, as well as in the skill of the individual doing the work. This manual cannot possibly anticipate all such variations and provide advice or cautions as to each. Accordingly, anyone who departs from the instructions provided in this manual must first establish that their personal safety, the safety of others, and the integrity of the machine will not be compromised by the choice of methods, tools or parts.

The manual is divided into sections which are subdivided into chapters. Each chapter contains information on general operating principles, detailed inspection, overhaul and, where applicable, specific troubleshooting, special tools, and specifications.

Any reference in this manual to right, left, rear, front, top, or bottom is as viewed from the operator's seat, looking forward.

All data and illustrations in this manual are subject to variations in build specification. This information was correct at the time of issue, but New Holland policy is one of continuous improvement, and the right to change specifications, equipment, or design at any time, without notice, is reserved.

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PRECAUTIONARY STATEMENTS

PERSONAL SAFETY

Throughout this manual and on machine decals, you will find precautionary statements ("CAUTION", "WARNING", and "DANGER") followed by specific instructions. These precautions are intended for the personal safety of you and those working with you. Please take the time to read them.



CAUTION: THE WORD "CAUTION" IS USED WHERE A SAFE BEHAVIORAL PRACTICE ACCORDING TO OPERATING AND MAINTENANCE INSTRUCTIONS AND COMMON SAFETY PRACTICES WILL PROTECT THE OPERATOR AND OTHERS FROM ACCIDENT INVOLVEMENT.



WARNING: THE WORD "WARNING" DENOTES A POTENTIAL OR HIDDEN HAZARD WHICH HAS A POTENTIAL FOR SERIOUS INJURY. IT IS USED TO WARN OPERATORS AND OTHERS TO EXERCISE EVERY APPROPRIATE MEANS TO AVOID A SURPRISE INVOLVEMENT WITH MACHINERY.



DANGER: THE WORD "DANGER" DENOTES A FORBIDDEN PRACTICE IN CONNECTION WITH A SERIOUS HAZARD.

FAILURE TO FOLLOW THE "CAUTION", "WARNING", AND "DANGER" INSTRUCTIONS MAY RESULT IN SERIOUS BODILY INJURY OR DEATH.

MACHINE SAFETY

Additional precautionary statements ("ATTENTION" and "IMPORTANT") are followed by specific instructions. These statements are intended for machine safety.

ATTENTION: The word "ATTENTION" is used to warn the operator of potential machine damage if a certain procedure is not followed.

IMPORTANT: The word "IMPORTANT" is used to inform the reader of something he needs to know to prevent minor machine damage if a certain procedure is not followed.

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SAFETY PRECAUTIONS

Practically all service work involves the need to drive the tractor. The operator's manual, supplied with each tractor, contains detailed safety precautions relating to driving, operating, and servicing that tractor. These precautions are as applicable to the service technician as they are to the operator and should be read, understood and practiced by all personnel.

Prior to undertaking any maintenance, repair, overhaul, dismantling or reassembly operations, whether within a workshop facility or in the field, consideration should be given to factors that may have an effect upon safety, not only upon the mechanic carrying out the work, but also upon bystanders.

PERSONAL CONSIDERATIONS

The wrong clothes or carelessness in dress can cause accidents. Check to see that you are suitably clothed.

Some jobs require special protective equipment.

Skin Protection

Used motor oil may cause skin cancer. Follow work practices that minimize the amount of skin exposed and length of time used oil stays on your skin.

Eye Protection

The smallest eye injury may cause loss of vision. Injury can be avoided by wearing eye protection when engaged in chiselling, grinding, discing, welding, and painting.

Breathing Protection

Fumes, dust, and paint spray are unpleasant and harmful. These can be avoided by wearing respiratory protection.

Hearing Protection

Loud noise may damage your hearing, and the greater the exposure the worse the damage. If the noise is excessive, wear ear protection.

Lifting Protection

Avoid injury by correctly handling components. Make sure you are capable of lifting the object. If in doubt get help.

Hand Protection

It is advisable to use a protective cream before work to prevent irritation and skin contamination. After work clean your hands with soap and water. Solvents such as mineral spirit and kerosene may harm the skin.

Foot Protection

Substantial or protective footwear with reinforced toe caps will protect your feet from falling objects. Additionally, oil-resistant soles will help to avoid slipping.

Special Clothing

For certain work it may be necessary to wear flame or acid-resistant clothing.

EQUIPMENT CONSIDERATIONS

Machine Guards

Before using any machine, check to ensure that the machine guards are in position and serviceable. These guards not only prevent parts of the body or clothing coming in contact with the moving parts of the machine, but also ward off objects that might fly off the machine and cause injury.

Lifting Devices

Always ensure that lifting equipment, such as chains, slings, lifting brackets, hooks and eyes, are thoroughly checked before use. If in doubt, select stronger equipment than is necessary.

Never stand under a suspended load or raised implement.

Compressed Air

The pressure from a compressed-air line often exceeds 100 PSI (690 kPa). It is perfectly safe if used correctly. Any misuse may cause injury.

Never use compressed air to blow dust, filing, and dirt away from your work area unless the correct type of nozzle is fitted.

Compressed air is not a cleaning agent; it will only move dust from one place to another. Look around before using an air hose as bystanders may get grit into their eyes, ears, or skin.

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Hand Tools

Many cuts, abrasions and injuries are caused by defective tools. Never use the wrong tool for the job, as this generally leads either to some injury or to a poor job.

When removing or replacing hardened pins, use a copper or brass drift rather than a hammer.

For dismantling, overhaul, and assembly of major and sub-components, always use the Special Service Tools recommended. These will reduce the work effort, labor time, and the repair cost.

Electricity

Electricity has become so familiar in day to day usage, that its potentially dangerous properties are often overlooked. Misuse of electrical equipment can endanger life.

Before using any electrical equipment - particularly portable appliances - make a visual check to make sure that the wiring is not worn or frayed and that the plugs and sockets are intact. Make sure you know where the nearest isolating switch for your equipment is located.

GENERAL CONSIDERATIONS

Solvents

Use cleaning fluids and solvents that are known to be safe. Certain types of fluids can cause damage to components, such as seals, and can cause skin irritation. Solvents should be checked that they are suitable not only for the cleaning of components and individual parts, but also that they do not affect the personal safety of the user.

Housekeeping

Many injuries result from tripping over or slipping on objects or material left lying around by a careless worker. Prevent these accidents from occurring. If you notice a hazard, don't ignore it – remove it.

A clean, hazard-free place of work improves the surroundings and daily environment for everybody.

Fire

Fire has no respect for persons or property. The destruction that a fire can cause is not always fully realized. Everyone must be constantly on guard.

Extinguish matches, cigars, and cigarettes before throwing them away.

Work cleanly, disposing of waste material into proper containers.

Locate the fire extinguishers and find out how to operate them.

Do not panic – warn those near and raise the alarm.

Do not allow or use an open flame near the tractor fuel tank, battery, or component parts.

First Aid

In the type of work that mechanics are engaged in, dirt, grease, and fine dusts settle upon the skin and clothing. If a cut, abrasion or burn is disregarded it may become infected within a short time. Seek medical aid immediately.

Cleanliness

Cleanliness of the tractor hydraulic system is essential for optimum performance. When carrying out service and repairs, plug all hose ends and component connections to prevent dirt entry.

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficiency and working life of a component and lead to costly replacement. Use of a high-pressure washer or steam cleaner is recommended.

OPERATIONAL CONSIDERATIONS

Stop the engine, if at all possible, before performing any service.

Place a warning sign on tractors which, due to service or overhaul, would be dangerous to start. Disconnect the battery leads if leaving such a unit unattended.

Do not attempt to start the engine while standing beside the tractor or attempt to bypass the safety start switch.

Avoid prolonged running of the engine in a closed building or in an area with inadequate ventilation as exhaust fumes are highly toxic.

Always turn the radiator cap to the first stop to allow pressure in the system to dissipate when the coolant is hot.

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Never work beneath a tractor which is on soft ground. Always take the unit to an area which has a hard working surface, preferably concrete.

If it is found necessary to raise the tractor for ease of servicing or repair, make sure that safe and stable supports are installed beneath axle housings, casings, etc., before starting work.

Certain repair or overhaul procedures may necessitate separating the tractor, either at the engine/transmission or transmission/rear axle location. These operations are simplified by the use of the Tractor Splitting Stands. Should this equipment not be available, every consideration must be given to stability, balance and weight of the components, especially if a cab is installed.

Use footsteps or working platforms when servicing those areas of a tractor that are not within easy reach.

Before loosening any hoses or tubes connecting implements to remote control valves, etc., switch off the engine, remove all pressure in the lines by operating levers several times. This will remove the danger of personal injury by oil pressure.

Prior to pressure testing, make sure all hoses and connectors of the tractor and the test equipment are in good condition and tightly sealed. Pressure readings must be taken with the gauges specified. The correct procedure should be rigidly observed to prevent damage to the system or the equipment, and to eliminate the possibility of personal injury.



WARNING: ESCAPING HYDRAULIC/DIESEL FLUID UNDER PRESSURE CAN PENETRATE THE SKIN CAUSING SERIOUS INJURY.

DO NOT USE YOUR HAND TO CHECK FOR LEAKS. USE A PIECE OF CARDBOARD OR PAPER TO SEARCH FOR LEAKS.

STOP THE ENGINE AND RELIEVE PRESSURE BEFORE CONNECTING OR DISCONNECTING LINES.

TIGHTEN ALL CONNECTIONS BEFORE STARTING THE ENGINE OR PRESSURIZING LINES.

IF ANY FLUID IS INJECTED INTO THE SKIN, OBTAIN MEDICAL ATTENTION IMMEDIATELY OR GANGRENE MAY RESULT.

Use "position control" when equipment or implements are required to be attached to the hydraulic linkage either for testing purposes or for transportation.

Always lower equipment to the ground when leaving the tractor.

If high lift attachments are installed on a tractor, beware of overhead power, electric or telephone cables when traveling. Drop the attachment near to ground level to increase stability and minimize risks.

Do not park or attempt to service a tractor on an incline. If unavoidable, take extra care and block all wheels.

Observe recommended precautions as indicated in this Service Manual when dismantling the air-conditioning system as escaping refrigerant can cause frostbite.

Prior to removing wheels and tires from a tractor, check to determine whether additional ballast (liquid or weights) has been added. Seek assistance and use suitable equipment to support the weight of the wheel assembly.

When inflating tires, beware of over inflation – constantly check the pressure. Overinflation can cause tires to burst and result in personal injury.

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HEALTH AND SAFETY PRECAUTIONS

Many of the procedures associated with vehicle maintenance and repair involve physical hazards or other risks to health. This section lists, alphabetically, some of these hazardous operations, materials and equipment associated with them. The precautions necessary to avoid these hazards are identified.

The list is not inclusive; all operations, procedures, and handling of materials should be carried out with health and safety in mind.

ACIDS AND ALKALIS (See Battery Acids, i.e., Caustic Soda, Sulfuric Acid)

Used in batteries and cleaning materials.

Irritating and corrosive to the skin, eyes, nose and throat. Causes burns.

Avoid splashes to the skin, eyes, and clothing. Wear suitable protective gloves and goggles. Can destroy ordinary protective clothing. Do not breathe mists.

Ensure access to water and soap is readily available for splashing accidents.

ADHESIVES AND SEALERS (See Fire)



CAUTION: HIGHLY FLAMMABLE, COMBUSTIBLE.

Generally should be stored in "NO SMOKING" areas; cleanliness and tidiness while in use should be observed, i.e., from applications where possible, disposable paper should be dispensed to cover benches. Containers, including secondary containers, should be labeled.

Solvent-Based Adhesives/Sealers (See Solvents)

Follow manufacturer's Instructions

Water-Based Adhesives/Sealers

Those based on polymer emulsions and rubber lattices may contain small amounts of volatile toxic and harmful chemicals.

Skin and eye contact should be avoided, and adequate ventilation provided during use.

Follow manufacturer's Instructions

Resin-Based Adhesive/Sealers (i.e., Epoxide and Formaldehyde Resin Based)

Mixing should only be carried out in well- ventilated areas as harmful or toxic volatile chemicals may be released.

Skin contact with uncured resins and hardeners can result in irritation, dermatitis, and absorption of toxic, or harmful chemicals through the skin. Splashes can damage the eyes.

Provide adequate ventilation; avoid skin and eye contact. Follow manufacturer's instructions.

Anaerobic, Cyanoacrylate and other Acrylic Adhesives

Many are irritating, sensitizing, or harmful to the skin. Some are eye irritants.

Skin and eye contact should be avoided and the manufacturer's instructions followed.

Cyanoacrylate adhesives (super-glues) must not contact the skin or eyes. If skin or eye tissue is bonded, cover with a clean moist pad and get medical attention. Do not attempt to pull tissue apart. Use in well-ventilated areas as vapors can cause irritation of the nose and eyes.

For two-part systems: See Resin-Based Adhesive/Sealers

Isocyanate (Polyurethane) Adhesive/Sealers (See Resin-Based Adhesives)

Individuals suffering from asthma or respiratory allergies should not work with, or near, these materials as sensitivity reactions can occur.

Any spraying should preferably be carried out in exhaust ventilated booths removing vapors and spray droplets from the breathing zone. Individuals working with spray applications should wear supplied air respirators.

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ANTIFREEZE (See Fire, Solvents, i.e., Isopropanol, Ethylene Glycol, Methanol)



CAUTION: HIGHLY FLAMMABLE, COMBUSTIBLE.

Used in vehicle coolant systems, brake air pressure systems, and windshield washing solutions.

Vapors given off from coolant antifreeze (Glycol) arise only when heated.

Antifreeze may be absorbed through the skin in toxic or harmful quantities. Swallowed antifreeze is fatal if not treated; medical attention must be sought immediately.

BATTERY ACIDS (See Acids and Alkalis)

Gases released during charging are explosive. Never use an open flame or allow sparks near charging or recently charged batteries.

BRAKE AND CLUTCH LININGS AND PADS (See Legal Aspects)

These items may contain asbestos which, if inhaled, may cause lung damage and, in some cases, cancer.

The normal handling and fitting of these items should not cause any hazard, but any drilling, grinding, or filling of friction materials may produce asbestos dust and should only be carried out under strictly controlled conditions.

The dust in brake drums, etc., contains very little asbestos, but care should be taken to avoid inhalation of this dust during servicing of brakes and clutches. The use of drum cleaning units, vacuum cleaning, or damp wiping is preferred to the use of air jets for "blowing-out."

The dust should be collected in a sealed plastic bag and disposed appropriately, according to local laws and regulations.

BRAZING (See Welding)

CHEMICAL MATERIALS - GENERAL (See Legal Aspects)

Chemical materials such as solvents, sealers, adhesives, paints, resin foams, battery acids, antifreeze, oils, and grease should always be used with caution, stored and handled with care. They may be toxic, harmful, corrosive, irritating, or highly flammable, causing hazardous fumes and dusts.

The effects of excessive exposure to chemicals may be immediate or delayed, briefly experienced or permanent, cumulative, superficial, life threatening, or may reduce life expectancy.

CLUTCH LININGS AND PADS (See Brake and Clutch Linings and Pads)

CORROSION PROTECTION MATERIALS (See Solvents, Fire)



CAUTION: HIGHLY FLAMMABLE COMBUSTIBLE.

These materials are varied; the manufacturer's instructions should be followed. They may contain solvents, resins, and petroleum products. Skin and eye contact should be avoided. They should only be sprayed in conditions of adequate ventilation, and not in confined spaces.

CUTTING (See Welding)

DEWAXING (See Solvents and Fuels - Kerosene)

DO'S

Do remove chemical materials from the skin and clothing as soon as practicable. Change heavily soiled clothing and have it cleaned.

Do carefully read and observe hazard and precaution warnings given on material containers (labels) and in any accompanying leaflets, poster or other instructions. Material health and safety data sheets can be obtained from manufacturers.

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Do organize work practices by wearing protective clothing and safety devices to avoid contact with chemical materials; breathing vapors, aerosols, dusts, and fumes; inadequate container labeling; or fire and explosion hazards.

Do wash before job breaks, before eating, smoking, drinking, or using toilet facilities when handling chemical materials.

Do keep work areas clean, uncluttered, and free of spills.

Do store according to national and local regulations.

Do keep chemical materials out of reach of children.

DON'TS

Do not mix chemical materials except under the manufacturer's instructions; some chemicals can form other toxic or harmful chemicals, releasing toxic or harmful fumes, or be explosive when mixed together.

Do not spray chemical materials, particularly those based on solvents, in confined spaces, i.e., when people are inside a vehicle.

Do not apply heat or flame to chemical materials, except under the manufacturer's instructions. Some are highly flammable, and some may release toxic or harmful fumes.

Do not leave containers open. Escaping fumes can build up to toxic, harmful, or explosive concentrations. Some fumes are heavier than air and will accumulate in confined areas, pits, etc.

Do not transfer chemical materials to unlabeled containers.

Do not clean hands or clothing with chemical materials. Chemicals, particularly solvents and fuels, will dry the skin, and may cause irritation with dermatitis. Some can be absorbed through the skin in toxic or harmful quantities.

Do not use emptied containers for other materials, except when they have been cleaned under supervised conditions.

Do not sniff or smell chemical materials. Brief exposure to high concentrations of fumes can be harmful or toxic.

DUSTS

Powder or dusts may be an irritant, harmful or toxic. Avoid breathing dusts from powdery chemical materials, or those arising from dry abrasion operations. Wear respiratory protection if ventilation is inadequate.

ELECTRIC SHOCK

Electric shocks can result from the use of faulty electrical equipment or from the misuse of equipment even in good condition.

Ensure electrical equipment is maintained in good condition and frequently tested.

Ensure flexes, cables, plugs and sockets are not frayed, kinked, cut, cracked, or otherwise damaged.

Ensure electric equipment is protected by the correct rated fuse.

Never use electrical equipment or any other equipment which is in any way faulty. The results could be fatal.

Use reduced voltage equipment for inspection and working lights, where possible.

Ensure the cables of mobile electrical equipment cannot get trapped and damaged, such as in a vehicle hoist.

In Cases of Electrocution:

- Switch off electricity before approaching victim.
- If this is not possible, push or drag the victim from the source of electricity using dry non-conductive material.
- Commence resuscitation if trained to do so.
- **SUMMON MEDICAL ASSISTANCE IMMEDIATELY**

EXHAUST FUMES

These contain asphyxiating, harmful and toxic chemicals, and particles such as carbon oxides, nitrogen oxides, aldehydes, lead, and aromatic hydrocarbons. Engines should only run under conditions of adequate extraction, or general ventilation, not in confined spaces.

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Diesel Engine

Soot, discomfort, and irritation usually give adequate warning signs of hazardous fume concentration.

FIBER INSULATION (See Dusts)

Used in noise and sound insulation.

The fibrous nature of surfaces and cut edge can cause skin irritation. This is usually a physical, not a chemical effect.

Precautions should be taken to avoid excessive skin contact through careful organization of work practices and the use of gloves.

FIRE (See Welding, Foams, Legal Aspects)

Many of the materials found on, or associated with, the repair of vehicles are highly flammable. Some release toxic or harmful fumes if burned.

Observe strict fire safety when storing and handling flammable materials or solvents, particularly near electrical equipment or welding processes.

Before using electrical or welding equipment, be sure there is no fire hazard present.

Have a suitable fire extinguisher available when using welding or heating equipment.

FIRST AID

Apart from meeting any legal requirements, it is desirable for someone in the workshop to be trained in first aid procedures.

Splashes in the eye should be flushed with clean water for at least ten minutes.

Soiled skin should be washed with soap and water.

Inhalation affected individuals should be removed to fresh air immediately.

If chemicals are swallowed, consult a doctor immediately with (label) information on material used.

Do not induce vomiting, unless indicated by manufacturer.

FOAMS - Polyurethane (See Fire)

Used in sound and noise insulation. Cured foams are used in seat and trim cushioning.

Follow manufacturer's instructions.

Unreacted components are irritating and may be harmful to the skin and eyes. Wear gloves and goggles.

Individuals with chronic respiratory diseases, asthma, bronchial medical problems, or histories of allergic diseases should not work with or near uncured materials.

The component's vapors and spray mists can cause direct irritation and/or sensitivity reactions and may be toxic or harmful.

Vapors and spray mists must not be breathed. These materials must be applied with adequate ventilation and respiratory protection. Do not remove respirator immediately after spraying, wait until vapor/mists have cleared.

Burning of the uncured components and the cured foams can generate toxic and harmful fumes.

Smoking, open flames, or the use of electrical equipment should not be allowed during foaming operations until vapors/mists have completely cleared. Any heat cutting of cured foams or partially cured foams should be conducted with extraction ventilation (see Legal Aspects).

FUELS (See Fire, Legal Aspects, Chemicals - General, Solvents)

Used as fuels and cleaning agents.

Gasoline (Petrol)



CAUTION: HIGHLY FLAMMABLE, COMBUSTIBLE.

Swallowing can result in mouth and throat irritation; absorption from the stomach can result in drowsiness and unconsciousness. Small amounts can be fatal to children. Aspiration of liquid into the lungs, i.e., through vomiting, is a very serious hazard.

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Prolonged or repeated contact with gasoline dries the skin and causes irritation and/or dermatitis. Liquid in the eye causes severe pain.

Motor gasoline may contain high quantities of benzene which is toxic upon inhalation; the concentrations of gasoline vapors must be kept very low. High concentrations will cause eye, nose and throat irritation, nausea, headache, depression and symptoms of drunkenness. Very high concentrations will result in rapid loss of consciousness.

Ensure there is adequate ventilation when handling and using gasoline. Great care must be taken to avoid the serious consequences of inhalation in the event of vapor buildup arising from spillages in confined spaces.

Special precautions apply to cleaning and maintenance operations on gasoline storage tanks.

Gasoline should not be used as a cleaning agent. It must not be siphoned by mouth.

Kerosene (Paraffin)

Used also as heating fuel, solvent, and cleaning agent.

CAUTION: FLAMMABLE

Irritation of the mouth and throat may result from swallowing. The main hazard from swallowing arises if liquid aspiration into the lungs occurs. Liquid contact dries the skin and can cause irritation and/or dermatitis. Splashes in the eye may be slightly irritating.

In normal circumstances, the low volatility does not give rise to harmful vapors. Exposure to mists and vapors from kerosene at elevated temperatures should be avoided (mists may arise in dewaxing). Avoid skin and eye contact; be sure there is adequate ventilation.

Diesel Fuel (Gas-Oil) (See Fuels -Kerosene)

CAUTION: COMBUSTIBLE

Gross or prolonged skin contact with high boiling gas oils may cause serious skin disorders, including skin cancer.

GAS CYLINDERS (See Fire)

Gases such as oxygen, acetylene, carbon dioxide, argon, and propane are normally stored in cylinders at pressures of up to 2000 PSI (137.8 bar). Great care should be taken in handling these cylinders to avoid mechanical damage to them or the valve gear attached. The contents of each cylinder should be clearly identified by appropriate markings.

Cylinders should be stored in well-ventilated enclosures and protected from ice, snow, or direct sunlight. Fuel gases, i.e., acetylene and propane, should not be stored in close proximity to oxygen cylinders.

Care should be exercised to prevent leaks from gas cylinders and lines and to avoid sources of ignition.

Only trained personnel should undertake work involving gas cylinders.

GASES (See Gas Cylinder)

GAS SHIELDING WELDING (See Welding)

GAS WELDING (See Welding)

GENERAL WORKSHOP TOOLS AND EQUIPMENT

It is essential that all tools and equipment are maintained in good condition and the correct safety equipment used where required.

Never use tools or equipment for any purpose other than for which they were designed.

Never overload equipment such as hoists, jacks, axle and chassis stands, or lifting slings. Damage caused by overloading is not always immediately apparent and may result in a fatal failure the next time the equipment is used.

Do not use damaged, defective tools or equipment, particularly high-speed equipment such as grinding wheels. A damaged grinding wheel can disintegrate without warning causing serious injury.

Wear suitable eye protection when using grinding, chiseling, or sandblasting equipment.

Wear a suitable breathing mask when using sandblasting equipment, working with asbestos based materials, or using spraying equipment.

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GLUES (See Adhesive and Sealers)

HIGH-PRESSURE AIR, LUBRICATION AND OIL TEST EQUIPMENT (See Lubricants and Greases)

Always keep high-pressure equipment in good condition and regularly maintained, particularly joint and unions.

Never direct a high-pressure nozzle at the skin, as the fluid may penetrate to the underlying tissue and can cause serious injury.

LEGAL ASPECTS

Many laws and regulations make requirements relating to health and safety in the use of materials and equipment in workshops.

Workshops should be familiar, in detail, with these laws and regulations.

LUBRICANTS AND GREASES

Avoid all prolonged and repeated contact with mineral oils, especially used oils. Gross and prolonged skin contact with used oils contaminated during service, i.e., routine service change sump oils, are more irritating and more likely to cause serious effects, including skin cancer.

Wash skin thoroughly after work involving oil. Proprietary hand cleaners may be of value provided they can be removed from the skin with water. Do not use petrol, paraffin, or other solvents to remove oil from the skin.

Lubricants and greases may be slightly irritating to the eyes.

Repeated or prolonged skin contact should be avoided by wearing protective clothing, if necessary. Particular care should be taken with used oils and greases containing lead. Do not allow work clothing to be contaminated with oil. Dry clean or launder such clothing at regular intervals. Discard oil-soaked shoes.

Do not use previously used engine oils as lubricants or for any application where major skin contact is likely to occur. Used oils may only be disposed of in accordance with local regulations.

NOISE INSULATION MATERIAL (See Foams, Fiber Insulation)

PAINTS (See Solvents and Chemical Materials - General)



CAUTION: HIGHLY FLAMMABLE

Paints can contain harmful or toxic pigments, driers, and other components, as well as solvents. Spraying should only be carried out with adequate ventilation.

Two-part or catalyzed paints can also contain harmful and toxic unreacted resins and resin-hardening agents. The manufacturer's instructions should be followed and the section on resin-based adhesives, isocyanate containing adhesive and foams should be consulted.

Spraying should preferably be carried out in exhausted ventilated booths, removing vapor and spray mists from the breathing zone. Individuals working in booths should wear respiratory protection. Those doing small-scale repair work in the open shop should wear supplied air respirators.

PAINT THINNERS (See Solvents)

PRESSURIZED EQUIPMENT (See High-Pressure Air, Lubrication and Oil Test Equipment)

RESISTANCE WELDING (See Welding)

SEALERS (See Adhesives and Sealers)

SOLDER (See Welding)

Solders are mixtures of metals in which the melting point of the mixture is below that of constituent metals (normally lead and tin). Solder application does not normally give rise to toxic lead fumes, provided a gas/air flame is used. Oxyacetylene flames should not be used, as they are much hotter and will cause lead fumes to be released.

Some fumes may be produced by the application of any flame to surfaces coated with grease, etc., and inhalation of these should be avoided.

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Removal of excess solder should be undertaken with care to ensure fine lead dust is not produced, which can cause toxic effects if inhaled. Respiratory protection may be necessary.

Solder spillage and filing should be collected and removed promptly to prevent general air contamination by lead.

High standards of personal hygiene are necessary in order to avoid ingestion of lead or inhalation of solder dust from clothing.

SOLVENTS (See Chemical Materials - General, Fuels [Kerosene], Fire)

Acetone, White spirit, Toluene, Xylene, Trichlorethane.

Used in cleaning materials, dewaxing, paints, plastics, resins, thinners, etc.



CAUTION: HIGHLY FLAMMABLE

Skin contact will degrease the skin and may result in irritation and/or dermatitis following repeated or prolonged contact. Some can be absorbed through the skin in toxic or harmful quantities.

Splashes in the eye may cause severe irritation and could lead to loss of vision.

Brief exposure to high concentrations of vapors or mists will cause eye and throat irritation, drowsiness, dizziness, headaches and, in the worst circumstances, unconsciousness.

Repeated or prolonged exposures to excessive, but lower concentrations of vapors or mists, for which there might not be adequate warning indications, can cause more serious toxic or harmful effects. Aspiration into the lungs, i.e., through vomiting, is the most serious consequence.

Avoid splashes to the skin, eyes, and clothing. Wear protective gloves, goggles, and clothing if necessary.

Ensure good ventilation when in use, avoid breathing fumes, vapors, and spray mists. Keep containers tightly sealed. Do not use in confined spaces.

When the spraying material contains solvents, e.g., paints, adhesives, and coatings, use extraction ventilation or personal respiratory protection in the absence of adequate general ventilation.

Do not apply heat or flame, except under specific and detailed manufacturer's instructions.

SOUND INSULATION (See Fiber Insulation, Foams)

SPOT WELDING (See Welding)

SUSPENDED LOADS

There is always a danger when loads are lifted or suspended. Never work under an unsupported, suspended, or raised load, e.g., jacked-up vehicle, suspended engine, etc.

Always ensure lifting equipment such as jacks, hoists, axle stands, slings, etc., are adequate and suitable for the job, in good condition, and regularly maintained.

Never improvise lifting tackle.

UNDER SEAL (See Corrosion Protection)

WELDING (See Fire, Electric Shock, Gas Cylinders)

Welding processes include Resistance Welding (Spot Welding), Arc Welding, and Gas Welding.

Resistance Welding

This process may cause particles of molten metal to be emitted at high velocity; the eyes and skin must be protected.

Arc Welding

This process emits a high level of ultraviolet radiation which may cause eye and skin burns to the welder and to other persons nearby. Gas-shielded welding processes are particularly hazardous in this respect. Personal protection must be worn and screens used to shield other people.

Metal spatter will also occur; appropriate eye and skin protection is necessary.

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The heat of the welding arc will produce fumes and gases from the metals being welded and from any applied coatings or contamination of the surfaces being worked on. These gases and fumes may be toxic; inhalation should always be avoided. The use of extraction ventilation to remove the fumes from the working area may be necessary, particularly in cases where the general ventilation is poor, or where considerable welding work is anticipated. In extreme cases where adequate ventilation cannot be provided, supplied air respirators may be necessary.

Gas Welding

Oxyacetylene torches may be used for welding and cutting; special care must be taken to prevent leakage of these gases, subsequently reducing the risk of fire and explosion.

The process will produce metal spatter; eye and skin protection is necessary.

The flame is bright and eye protection should be used, but the ultraviolet emission is much less than that from arc welding, and lighter filters may be used.

The process itself produces few toxic fumes, but such fumes and gases may be produced from coatings on the work, particularly during cutting away of damaged parts. Inhalation of the fumes should be avoided.

In brazing, toxic fumes may be released from the metals in the brazing rod. A severe hazard may arise if brazing rods containing cadmium are used. In this event, particular care must be taken to avoid inhalation of fumes; an expert's advice may be required.

SPECIAL PRECAUTIONS MUST BE TAKEN BEFORE ANY WELDING OR CUTTING TAKES PLACE ON VESSELS WHICH HAVE CONTAINED COMBUSTIBLE MATERIALS, I.E., "BOILING" OR "STEAMING OUT" THE INSIDE OF FUEL TANKS.

WHITE SPIRIT (See Solvents)

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PRODUCT IDENTIFICATION

The tractor and major components are identified using serial numbers and/or manufacturing codes. Tractor identification data must be supplied to the dealer when requesting parts or service and will also be needed to aid in identifying the tractor if it is ever stolen.

The following provides the locations of the identification data.

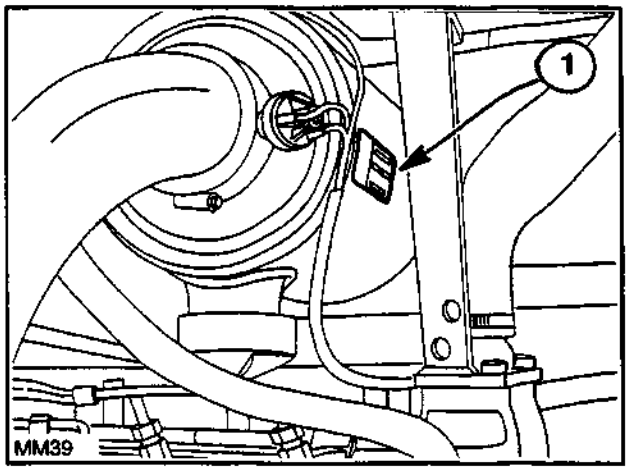
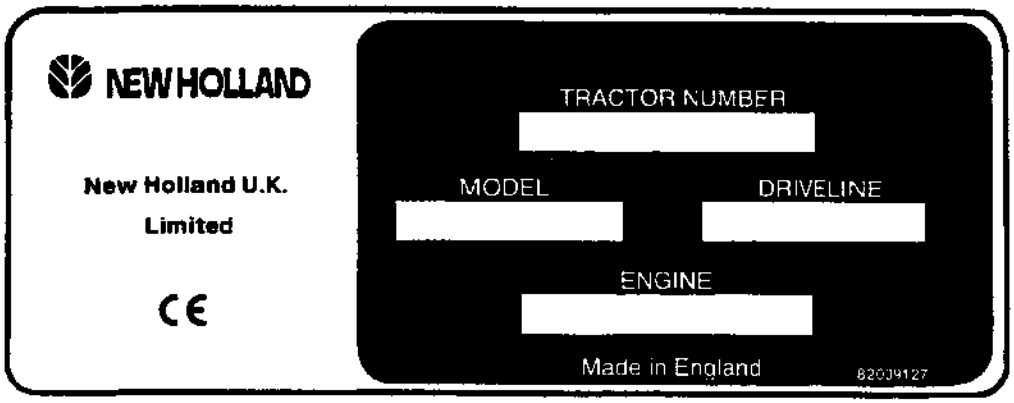


Figure 0-1-1

Vehicle Identification Plate
The vehicle identification plate, 1, is located on the front of the air cleaner, at the right-hand end, as shown. Record the information on the sample identification plate provided below.



Tractor Identification
The serial number and model identification information is stamped on the top of the front support (1). These numbers are also repeated on the vehicle identification plate reproduced above.

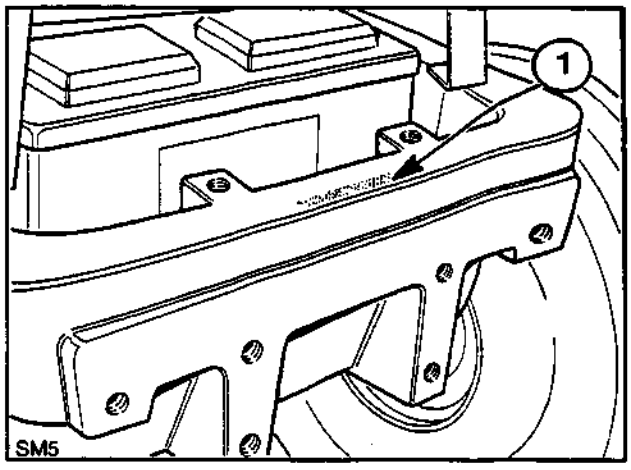


Figure 0-1-2

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Engine Identification
The engine serial number and date code are stamped on a lug (1) protruding from the rear, right-hand side of the engine. This information is repeated on the vehicle identification plate. Record the information below for quick reference.

Serial No. _____

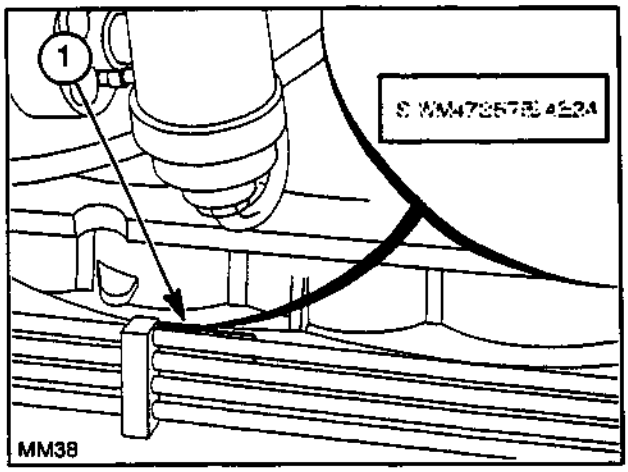


Figure 0-1-3

The engine identification plate is located on the right-hand side of the rocker cover, toward the rear of the engine. Record the information on the identification plate reproduced.

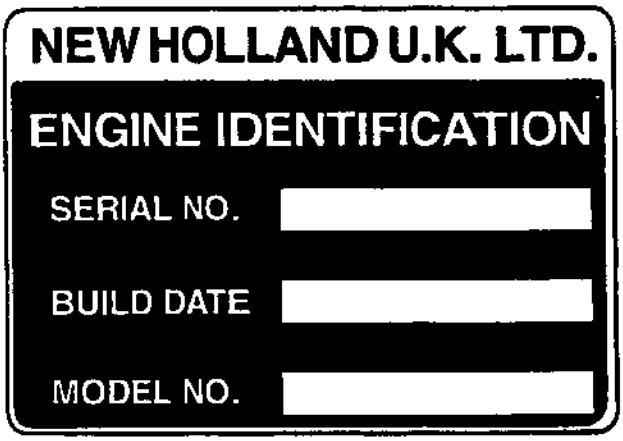


Figure 0-1-4

Driveline Identification
The serial number is stamped on the right-hand side of the axle housing on the lug (1) to which the bracket (2), that supports the cab/platform and auxiliary fuel tank, is bolted. There is no need to remove this bracket since the information is repeated on the vehicle identification plate (Figure 0-1-1). Record the information below for quick reference.

Serial No. _____

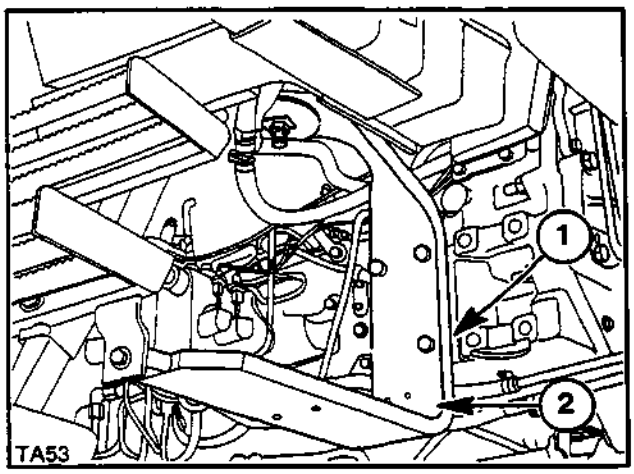


Figure 0-1-5

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SERVICE TECHNIQUES

GENERAL

Clean the exterior of all components before carrying out any form of repair. Dirt and abrasive dust can reduce the efficient working life of a component and lead to costly replacement.

Time spent on the preparation and cleanliness of working surfaces will pay dividends in making the job easier and safer and will result in overhauled components being more reliable and efficient in operation.

Use cleaning fluids which are known to be safe. Certain types of fluid can cause damage to O rings and cause skin irritation. Solvents should be checked that they are suitable for the cleaning of components and also that they do not risk the personal safety of the user.

Replace O rings, seals or gaskets whenever they are disturbed. Never mix new and old seals or O rings, regardless of condition. Always lubricate new seals and O rings with hydraulic oil before installation.

When replacing component parts, use the correct tool for the job.

HOSES AND TUBES

Always replace hoses and tubes if the cone end or the end connections on the hose are damaged.

When installing a new hose, loosely connect each end and make sure the hose takes up the designed position before tightening the connection. Clamps should be tightened sufficiently to hold the hose without crushing and to prevent chafing.

After hose replacement to a moving component, check that the hose does not foul by moving the component through the complete range of travel.

Be sure any hose which has been installed is not kinked or twisted.

Hose connections which are damaged, dented, crushed or leaking, restrict oil flow and the productivity of the components being served. Connectors which show signs of movement from the original swaged position have failed and will ultimately separate completely.

A hose with a chafed outer cover will allow water entry. Concealed corrosion of the wire reinforcement will subsequently occur along the hose length with resultant hose failure.

Ballooning of the hose indicates an internal leakage due to structural failure. This condition rapidly deteriorates and total hose failure soon occurs.

Kinked, crushed, stretched or deformed hoses generally suffer internal structural damage which can result in oil restriction, a reduction in the speed of operation and ultimate hose failure.

Free-moving, unsupported hoses must never be allowed to touch each other or related working surfaces. This causes chafing which reduces hose life.

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O RING FLAT FACE SEAL FITTINGS

When repairing O ring face seal connectors, the following procedures should be observed.



WARNING: NEVER DISCONNECT OR TIGHTEN A HOSE OR TUBE THAT IS UNDER PRESSURE. IF IN DOUBT, ACTUATE THE OPERATING LEVERS SEVERAL TIMES WITH THE ENGINE SWITCHED OFF PRIOR TO DISCONNECTING A HOSE OR TUBE.

1. Release the fittings and separate the hose or tube assembly, then remove and discard the O ring seal from the fitting.
2. Dip a new O ring seal into clean hydraulic oil prior to installation. Install a new O ring into the fitting and, if necessary, retain in position using petroleum jelly.
3. Assemble the new hose or tube assembly and tighten the fitting finger tight, while holding the tube or hose assembly to prevent it from turning.
4. Use two suitable wrenches and tighten the fitting to the specified torque according to the size of the fitting. Refer to the following torque chart.

   NOTE: To ensure a leak-free joint is obtained, it is important that the fittings are not over or under torqued.

O RING FLAT FACE SEAL FITTING TORQUE VALUES

Nominal O.D (in.)	Tube (mm)	Dash Size	Thread Size In.	Swivel Nut Torque Ft. Lbs.	N·m
0.250	6.35	-4	9/16-18	12	16
0.375	9.52	-6	11/16-16	18	24
0.500	12.70	-8	13/16-16	37	50
0.625	15.88	-10	1-14	51	69
0.750	19.05	-12	1 3/16-12	75	102
0.875	22.22	-14	1 3/16-12	75	102
1.000	25.40	-16	1 7/16-12	105	142
1.250	31.75	-20	1 11/16-12	140	190
1.500	38.10	-24	2-12	160	217

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SEALER SPECIFICATIONS

The following sealers should be used as directed in the manual:

Anaerobic sealer	LOCTITE GASKET ELIMINATOR 518
RTV silicone sealer	LOCTITE SUPERFLEX 593, 595 or 596 LOCTITE ULTRA BLUE 587 DOW CORNING SILASTIC 732 GENERAL ELECTRIC RTV 103 OR 108
Pipe sealant	PST 592 PIPE SEALANT WITH TEFLON
Thread-locking compound	LOCTITE 271 THREADLOCKER/SEALANT (red)

HARDWARE TORQUE VALUES

Check the tightness of hardware periodically.

Use the following charts to determine the correct torque when checking, adjusting or replacing hardware on the tractor.

IMPORTANT: DO NOT use the values listed in the charts if a different torque value or tightening procedure is specified in this manual for a specific application. Torque values listed are for general use only.

Make sure fastener threads are clean and not damaged.

NOTE: A torque wrench is necessary to properly torque hardware.

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MINIMUM HARDWARE TIGHTENING TORQUE

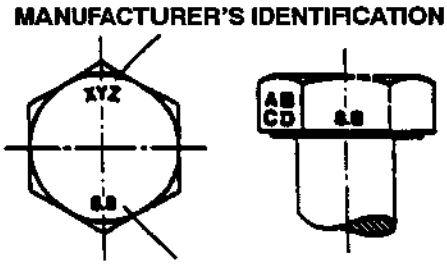
IN FOOT POUNDS (NEWTON-METERS) FOR NORMAL ASSEMBLY APPLICATIONS

METRIC HARDWARE AND LOCKNUTS

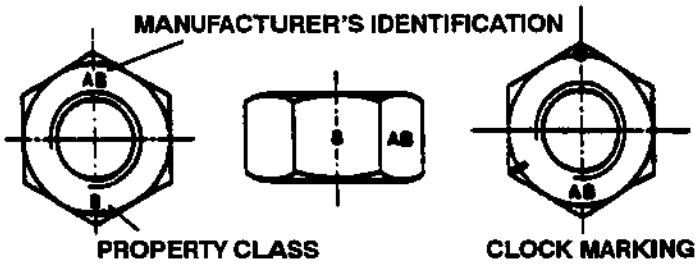
NOMINAL SIZE	CLASS 5.8		CLASS 8.8		CLASS 10.9		LOCKNUT CL.8 W/CL8.8 BOLT
	UNPLATED	PLATED W/ZnCr	UNPLATED	PLATED W/ZnCr	UNPLATED	PLATED W/ZnCr	
M4	15* (1.7)	19* (2.2)	23* (2.6)	30* (3.4)	33* (3.7)	42* (4.8)	16* (1.8)
M6	51* (5.8)	67* (7.6)	79* (8.9)	102* (12)	115* (13)	150* (17)	56* (6.3)
M8	124* (14)	159* (18)	195* (22)	248* (28)	274* (31)	354* (40)	133* (15)
M10	21 (28)	27 (36)	32 (43)	41 (56)	45 (61)	58 (79)	22 (30)
M12	36 (49)	46 (63)	55 (75)	72 (97)	79 (107)	102 (138)	39 (53)
M16	89 (121)	117 (158)	137 (186)	177 (240)	196 (266)	254 (344)	97 (131)
M20	175 (237)	226 (307)	277 (375)	358 (485)	383 (519)	495 (671)	195 (265)
M24	303 (411)	392 (531)	478 (648)	619 (839)	662 (897)	855 (1160)	338 (458)

NOTE: Torque values shown with * are inch pounds.

IDENTIFICATION
HEX CAP SCREW AND CARRIAGE BOLTS
CLASSES 5.6 AND UP



HEX NUTS AND LOCKNUTS
CLASSES 05 AND UP



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MINIMUM HARDWARE TIGHTENING TORQUE

IN FOOT POUNDS (NEWTON-METERS) FOR NORMAL ASSEMBLY APPLICATIONS

INCH HARDWARE AND LOCKNUTS

NOMINAL SIZE	SAE GRADE 2		SAE GRADE 5		SAE GRADE 8		LOCKNUTS		NOMINAL SIZE
	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	GR.B w/GR5 BOLT	GR.C w/GR8 BOLT	
1/4	55* (6.2)	72* (8.1)	86* (9.7)	112* (13)	121* (14)	157* (18)	61* (6.9)	86* (9.8)	1/4
5/16	115* (13)	149* (17)	178* (20)	229* (26)	250* (28)	324* (37)	125* (14)	176* (20)	5/16
3/8	17 (23)	22 (30)	26 (35)	34 (46)	37 (50)	48 (65)	19 (26)	26 (35)	3/8
7/16	27 (37)	35 (47)	42 (57)	54 (73)	59 (80)	77 (104)	30 (41)	42 (57)	7/16
1/2	42 (57)	54 (73)	64 (87)	83 (113)	91 (123)	117 (159)	45 (61)	64 (88)	1/2
9/16	60 (81)	77 (104)	92 (125)	120 (163)	130 (176)	169 (229)	65 (88)	92 (125)	9/16
5/8	83 (112)	107 (145)	128 (174)	165 (224)	180 (244)	233 (316)	90 (122)	127 (172)	5/8
3/4	146 (198)	189 (256)	226 (306)	293 (397)	319 (432)	413 (560)	160 (217)	226 (306)	3/4
7/8	142 (193)	183 (248)	365 (495)	473 (641)	515 (698)	667 (904)	258 (350)	364 (494)	7/8
1	213 (289)	275 (373)	547 (742)	708 (960)	773 (1048)	1000 (1356)	386 (523)	545 (739)	1

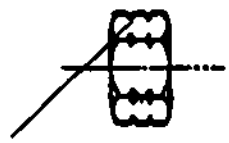
NOTE: Torque values shown with * are inch pounds.

IDENTIFICATION
CAP SCREWS AND CARRIAGE BOLTS



SAE GRADE 2 | SAE GRADE 5 | SAE GRADE 8 | REGULAR NUTS | SAE GRADE 5 HEX NUTS | SAE GRADE 8 HEX NUTS

LOCKNUTS



GRADE IDENTIFICATION
GRADE A NO NOTCHES
GRADE B ONE CIRCUMFERENTIAL NOTCH
GRADE C TWO CIRCUMFERENTIAL NOTCHES



GRADE IDENTIFICATION
GRADE A NO MARKS
GRADE B THREE MARKS
GRADE C SIX MARKS
MARKS NEED NOT BE LOCATED AT CORNERS



GRADE IDENTIFICATION
GRADE A NO MARK
GRADE B LETTER B
GRADE C LETTER C

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SECTION 1

ENGINES

CHAPTER 1

ENGINE

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GROUP 10 – GENERAL FEATURES AND SPECIFICATIONS

Model (T=Turbocharged)		8160	8260	8360 (T)	8560 (T)
No of Cylinders		6	6	6	6
Bore	ins	4.4	4.4	4.4	4.4
	(mm)	111.8	111.8	111.8	111.8
Stroke	ins	5.0	5.0	5.0	5.0
	(mm)	127.0	127.0	127.0	127.0
Displacement	cu in	456	456	456	456
	(cu cm)	7472	7472	7472	7472
Compression Ratio		17:5–1	17:5–1	17:5–1	17:5–1
Cylinder Bore Compression at cranking speed of 200 R.P.M	lbs/in^2	375	375	375	375
	bar	25.5	25.5	25.5	25.5
Firing Order		153624	153624	153624	153624
Idle Speed R.P.M		700 800	700 800	700 800	700 800
Maximum no Load Speed R.P.M		2370–2420	2370–2420	2370–2420	2480 2530
Rated Engine Speed		2200	2200	2200	2300

CYLINDER BLOCK

Taper of Cylinder Bore	0.001 in (0.025mm) Repair Limit 0.005 in (0.127mm) Wear Limit
Cylinder Bore out of Round	0.0015 in (0.030mm) Repair Limit 0.0050 in (0.127mm) Wear Limit
Cylinder Bore Diameters	4.4007–4.4032 in (111.778–111.841mm)
Rear Oil Seal Bore Diameter	5.542–5.546 in (140.77–140.87mm)
Block to Head Surface Flatness	0.003 in (0.08mm) in any 6 in (152mm) 0.001 in (0.03mm) in any 1 in (25.40mm)

CYLINDER HEAD

Valve Guide Bore Diameter	0.3728–0.3738 in (9.469–9.495mm)
Head to Block Surface Flatness	0.001 in (0.03mm) in any 1 in (25.40mm), or 0.005 in (0.127mm) overall limit

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EXHAUST VALVES

Face Angle	44°15'–44°30' Relative to the Head of Valve
Stem Diameter	Std : 0.3701–0.3709 in (9.401–9.421mm) 0.003 in (0.076mm) Oversize : 0.3731–0.3739 in (9.477–9.497mm) 0.015 in (0.38mm) Oversize : 0.3851–0.3859 in (9.781–9.802mm) 0.030 in (0.76mm) Oversize : 0.4001–0.4009 in (10.163–10.183mm)
Head Diameter	1.688–1.698 in (42.88–43.13mm)
Stem to Guide Clearance	0.0019–0.0037 in (0.048–0.094mm)
Lash Clearance (Cold)	0.017–0.021 in (0.43–0.53mm)

INTAKE VALVES

Face Angle	29°15'–29°30' Relative to Head of Valve
Stem Diameter	Std : 0.3711–0.3719 in (9.426–9.446mm) 0.003 in (0.076mm) Oversize : 0.3741–0.3749 in (9.502–9.522mm) 0.015 in (0.381mm) Oversize : 0.3861–0.3869 in (9.807–9.827mm) 0.030 in (0.762mm) Oversize : 0.4011–0.4019 in (10.188–10.208mm)
Head Diameter	1.865–1.875 in (47.37–47.63mm)
Stem to Guide Clearance	0.0009–0.0027 in (0.023–0.069mm)
Lash Clearance (Cold)	0.014–0.018 in (0.36–0.46mm)

VALVE SPRINGS

Number per Valve	1
Free Length Length, loaded at 62–68 lb (28–31kg) Length, loaded at 135–153 lb (61–69kg)	2.390 in (60.70mm) 1.900 in (48.26mm) 1.405 in (35.69mm)

VALVE TIMING

Intake Opening	12° Before Top Dead Center
Intake Closing	38° After Bottom Dead Center
Exhaust Opening	48° Before Bottom Dead Center
Exhaust Closing	12° After Top Dead Center

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VALVE INSERTS

Insert Oversize	Exhaust Valve Insert Counterbore Diameter in Cylinder Head	Intake Valve Seat Insert Counterbore Diameter in Cylinder Head
0.010 in (0.254mm)	1.739–1.740 in (44.17–44.20mm)	1.969–1.970 in (50.01–50.04mm)
0.020 in (0.508mm)	1.749–1.750 in (44.42–44.45mm)	1.979–1.980 in (50.27–50.29mm)
0.030 in (0.762mm)	1.759–1.760 in (44.68–44.70mm)	1.989–1.990 in (50.52–50.55mm)

VALVE SEATS

Exhaust Valve Seat Angle	45°00' – 45°30'
Intake Valve Seat Angle	30°00' – 30°30'
Interference Valve Face Angle to Valve Seat Angle	0°30' – 1°15'
Concentricity With Guide Diameter	0.002 in (0.051mm) Total Indicator Reading Max
Seat Width Exhaust Valve Intake Valve	0.072–0.092 in (1.8–2.3mm) 0.078–0.098 in (1.9–2.5mm)

CAMSHAFT IDLER GEAR

Number of teeth	47
End Play	0.003–0.014 in (0.076–0.35mm)
Bushing Inside Diameter	2.005–2.0015 in (50.813–50.838mm)
Adaptor Outside Diameter	1.9985–1.9990 in (50.762–50.775mm)
Backlash with Crankshaft Gear	0.004–0.014 in (0.10–0.35mm)
Backlash with Camshaft Gear	0.008–0. 022 in (0.20–0.56mm)
Backlash with Fuel Injection Pump	0.004–0.006 in (0.10–0.15 mm)

CAMSHAFT GEAR

Number of Teeth	52
Timing Gear Backlash	0.001–0.015 in (0.025–0.38mm)

ROCKER ARM SHAFT

Shaft Diameter	1.000–1.001 in (25.40–25.43mm)
Shaft Support Internal Diameter	1.002–1.004 in (25.45–25.20mm)

ROCKER ARM

Inside Diameter	1.003–1.004 in (25.48–25.50mm)

TAPPETS

Clearance to Bore	0.0006–0.0021 in (0.015–0.053 mm)

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Tappet Diameter	0.9889–0.9894 in (25.118–25.130mm)
Tappet Bore Diameter	0.9900–0.9910 in (25.15–25.17mm)
CAMSHAFT	
Bearing Journal Diameter	2.3895–2.3905 in (60.693–60.719mm)
Bearing Clearance	0.0010–0.0030 in (0.025–0.076mm)
End Play	0.0020–0.0070 in (0.051–0.18mm)
CONNECTING RODS	
Small End Bushing (Internal Diameter) Normally Aspirated Turbocharged	 1.5005–1.5008 in (38.113–38.120mm) 1.6255–1.6258 in (41.288–41.259mm)
Clearance Bushing to Piston Pin	0.0005–0.0010 in (0.013–0.025mm)
Side Float	0.0050–0.0130 in (0.13–0.33mm)
Maximum Twist	0.0120 in (0.30mm)
Maximum Bend	0.0040 in (0.10mm)
PISTON PIN	
Outside Diameter Normally Aspirated Engine Turbocharged Engine	 1.4998–1.5000 in (38.095–38.100mm) 1.6248–1.6250 in (41.270–41.275mm)
PISTONS	
Skirt to Cylinder Clearance Naturally Aspirated	0.0055–0.0067 in (0.140–0.171mm) New or unrun engine 0.0055–0.011 in. (0.140–0.28mm) For run engines
Skirt to Cylinder Clearance Turbocharged	0.0065–0.0077 in (0.166–0.196mm) New or unrun engine 0.0065–0.011 in (0.166–0.28mm) For run engines
Grading Diameter (at Right Angles to Piston Pin)	4.3951–4.3991 in (111.64–111.74mm) in increments of 0.0005 in (0.0127mm)
Piston Pin Clearance	0.00012–0.00055 in (0.0030–0.0140mm) at 70°F (21°C)
Piston Crown to Block Face, Naturally Aspirated Turbocharged	 0.011–0.023 in (0.28–0.58mm) 0.0–0.012 in (0.0–0.3mm)
PISTON RINGS	
Compression, Number and Location	 2 of,1st and 2nd from the top of the piston
Naturally Aspirated, Top Compression Ring 2nd Compression Ring	 Parallel Sides–Barrelled face Lower side internal chamfer – tapered face
Turbocharged, Top Compression Ring 2nd Compression Ring	 Keystone Tapered sides – Barrelled face Lower side internal chamfer – tapered face
Oil Control, Number and Location Type	 1 of,–Directly above the Piston Pin, Slotted With Expander

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Side Face Clearance To Ring Groove,	
Top Compression Ring	0.0041–0.0060in (0.103–0.153mm)
2nd Compression Ring – Turbocharged	0.0030–0.0049in (0.075–.125mm)
– N.A.	0.0022–0.0042in (0.055–0.105mm)
Oil Control Ring	0.0016–0.0035in (0.040–0.090mm)
Gap Width,	
Top Compression Ring – Turbocharged	0.016–0.036in (0.40–0.90mm)
– N.A.	0.015–0.033in (0.38–0.84mm)
2nd Compression Ring	0.016–0.036in (0.40–0.90mm)
Oil Control Ring	0.016–0.036in (0.40–0.90mm)

CRANKSHAFT

Main Journal Diameter–Blue	3.3713–3.3718 in (85.631–85.644mm)
–Red	3.3718–3.3723 in (85.644–85.656mm)
Main Journal Length (except thrust, rear, or intermediate)	1.455–1.465 in (36.96–37.21mm)
Main Journal Wear Limits	0.005 in (0.127mm) Maximum
Main and Crankpin Fillet Radius	0.12–0.14 in (3.048–3.556mm)
Thrust Bearing Journal Length	1.459–1.461 in (37.06–37.11mm)
Intermediate Bearing Journal Length	1.455–1.465 in (36.96–37.21mm)
Rear Bearing Journal Length	1.495–1.515 in (37.97–38.48mm)
Crankpin Journal Length	1.678–1.682 in (42.62–42.72mm)
Crankpin Diameter – Blue	2.749–2.7500 in (69.840–69.850mm)
– Red	2.750–2.7504 in (69.850–69.860mm)
End Play	0.004–0.008 in (0.10–0.20mm)
Crankpin Out of Round	0.0002 in (0.005mm) Total Indicator Reading
Taper Surface Parallel to Center Line of Main Journal	0.0002 in (0.005mm)
Crankshaft Rear Oil Seal Journal Diameter	4.808–4.814 in (122.12–122.28mm)
Crankshaft Pulley Journal Diameter	1.750–1.751 in (44.45–44.48mm)
Crankshaft Timing Gear Journal Diameter	1.820–1.821 in (46.23–46.25mm)
Crankshaft Flange Runout	0.0015 in (0.038mm) Max

CRANKSHAFT DRIVE GEAR

Number of teeth	26

MAIN BEARING

Liner length (except thrust liner)	1.10–1.11 in (27.94–28.19mm)
Liner Length (Thrust Liner)	1.453–1.455 in (39.91–39.96mm)
Vertical Assembled Bearing Clearance	0.0021–0.0046 in (0.055–0.117mm)

CRANKPIN BEARINGS

Liner Length	1.40–1.41 in (35.56–35.81mm)
Vertical Assembled Bearing Clearance	0.0014–0.0037 in (0.035–0.094mm)

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CRANKSHAFT RE–GRINDING

When re–grinding a crankshaft the main and crankpin journal diameters should be reduced the same amount as the undersize bearings used, and the following dimensions apply. The rear end of the crankshaft should be located on the 60° Chamfer of the pilot bearing bore.

UNDERSIZE BEARING AVAILABLE	MAIN JOURNAL DIAMETERS
0.002 in (0.051mm)	3.3693–3.3698 in (85.580–85.593mm)
0.010 in (0.254mm)	3.3618–3.3623 in (85.390–85.402mm)
0.020 in (0.508mm)	3.3518–3.3523 in (85.136–85.148mm)
0.030 in (0.762mm)	3.3418–3.3423 in (84.882–84.894mm)
0.040 in (1.016mm)	3.3318–3.3323 in (84.628–84.640mm)

UNDERSIZE BEARING AVAILABLE	CRANKPIN JOURNAL DIAMETERS
0.002 in (0.051mm)	2.7476–2.7480 in (69.789–69.799mm)
0.010 in (0.254mm)	2.7400–2.7404 in (69.956–69.606mm)
0.020 in (0.508mm)	2.7300–2.7304 in (69.342–69.352mm)
0.030 in (0.762mm)	2.7200–2.7204 in (69.088–69.098mm)
0.040 in (1.016mm)	2.7100–2.7104 in (68.834–68.844mm)

FLYWHEEL

Runout of Clutch Face (Between Outer Edge of Friction Surface and Mounting Bolt Holes),	0.005 in (0.127mm)
Ring Gear Runout	0.025 in (0.63mm)

OIL PUMP

Rotor Clearance	0.001–0.006 in (0.025–0.15mm)
Rotor to Pump Housing Clearance	0.006–0.011 in (0.15–0.28mm)
Rotor End Play	0.001–0.0035 in (0.025–0.089mm)
Pump Gear to Camshaft Gear Backlash	0.016–0.022 in (0.40–0.56mm)

OIL PRESSURE

Minimum At Engine Idle Speed	18 lbf/in^2 (1.24 bar) at normal operating temperature
Minimum At Engine Rated Speed	40 lbf/in^2 (2.76 bar) at normal operating temperature

OIL FILTER SUPPORT

Relief Valve, Operating Pressure	55–60 lbf/in^2 (3.8–4.1 bars)
Flow Rate	18–20 US gals/min (15–16.6 imp gals/min, 68.1–75.7 l/min.)

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Temperature	Oil Viscosity and Type	API Classification	Engine Oil & Filter Change Period (hours)
Below 10°F (–12°C)	SAE 5W or SAE 5W–30 or SAE 10W–30	CD/SF CD/SF CF–4/SG	150 150 150
10°F to 40°F (–12°C to 4° C)	SAE 10W SAE 10W–30	CD/SF CF–4/SG	200 300
32°F to 90°F (0°C to 32°C)	SAE 20W SAE 15W–40	CD/SF CF–4/SG	200 300
Above 75°F (24°C)	SAE 30W or SAE 15W–40	CF–4/SG	200 300

NOTE: *When using diesel fuel with a sulphur content below 1.0%, Series 3 diesel engine oil with an A.I classification of CD may be used instead of CF–4 oil , but the oil and filter interval must be reduced to 150 hours*

When using diesel fuel with a sulphur content between 1% and 1.3% use only oils listed above but reduce the oil a filter change period to every 50 hours .

ENGINE OIL CAPACITIES (Less Oil Filter)

Model	U.S Qts	Imp Pints	Liters
6 CYL	19.0	31.6	18.0

ENGINE OIL CAPACITIES (With Oil Filter)

Model	U.S Qts	Imp. Pints	Liters
6 CYL	20.0	33.4	19.0

THERMOSTAT

Opening Temperature	174–181°F (79–83°C)
Fully Open	199–205°F (93–96°C)

RADIATOR CAP

Opening Pressure	14.5 lbs/in^2 (1.0 bar)

WATER PUMP

Type	Centrifugal
Drive	Poly V Belt, 8 rib

FAN BELT

Belt Tension	Maintained by Automatic Tensioner

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COOLING SYSTEM CAPACITIES

Model	U.S. Qts	Imp Pts	Liters
8160 with cab	27.5	45.7	26.0
8160 less cab	26.5	44.0	25.0
8260 with cab	27.5	45.7	26.0
8260 less cab	26.5	44.0	25.0
8360 with cab	28.5	47.5	27.0
8360 less cab	27.5	45.7	26.0
8560 with cab	28.5	47.5	27.0
8560 less cab	27.5	45.7	26.0

COOLING FLUID

Content Mixture – Water 50%, Antifreeze 50%.

NOTE: *A replaceable coolant filter/conditioner is installed on the tractor and contains a conditioner in the form of a paste. No additional inhibitor is required.*

FUEL SYSTEM MAIN DATA

Turbocharger type:	Garrett T35
Fuel Supply Pump:	Electric pump – 12Volt / 5 lbf/in2 (0.35 bar)
Fuel Injection Pump	Distributor type, integral speed governor and advance device
BOSCH pump	
8160 model	VE6/12F1100R579–1, Type No: 0 460 426 238
8260 model	VE6/12F1100R579, Type No: 0 460 426 233
8360 model	VE6/12F1100R584–1, Type No: 0 460 426 237
8560 model	VE6/12F1100R584, Type No: 0 460 426 235
Pump rotation	Clockwise
Firing order	1–5–3–6–2–4
Injection pump timing	6° BTDC 8160, 8260, 8360 models 6.5° BTDC 8560 model
Pulley timing mark to pointer check (using piston number 2 depth, from block face)	
MODELS	PISTON No.2 DEPTH
8160–8260 (6°)	4.20 in (106.81 mm)
8360 (6°)	4.23 in (107.37mm)
8560 (6.5°)	4.27 in (108.56mm)
Injectors:	
Type	BOSCH Multi Hole
Quantity, nozzle holes	5
Diameter, nozzle holes	0.254mm 8160, 8360, 8560 models 0.260mm 8260 model
Pressure Setting (all)	Initial setting 3915 lbf/in^2 (270–278 bar) Reset if less than 3480 lbf/in^2 (240 bar)
Injector service interval	1800 hours

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TEST PLAN – 8160 456 cu in. (7.5 liter)

BOSCH VE DISTRIBUTOR TYPE FUEL INJECTION PUMP WITH ELECTRICAL FUEL SHUT–OFF (0.47 in [12mm] diameter plunger, 0.13 in [3.2mm] lift)

PUMP NH NUMBER: 87840634 TYPE NUMBER: 0 460 426 238 SHEET 1 of 1

Test No.	Test Description	Pump rpm	Strokes	Overcheck
1	Return fuel	1100	–	13.2 ± 4.0 gal/hr (50.0 ± 15.0 l/hr)
2	Timing piston travel	900 800 600	– – –	0.071 ± 0.027 in (1.8 ± 0.7mm) 0.047 ± 0.027 in (1.2 ± 0.7mm) 0.016 ± 0.027 in (0.4 ± 0.7mm)
3	Start fuel	100	1000	5.2 cu in min (85.0 cc min.)
4	Full load fuel a) Rated speed b) Set point c) Peak torque d) Port to port variation	 1100 1050 800 –	 1000 1000 1000 1000	 3.6 ± 0.2 in^3 (59.5 ± 3.5 cc) 3.8 ± 0.2 in^3 (62.0 ±3.0 cc) 4.1 ± 0.2 in^3 (67.5 ± 3.5 cc) 0.4 in^3 (6.0 cc max.)
5	Hydraulic torque control	600	1000	3.8 ± 0.2 in^3 (61.5 ±3.0 cc)
6	Governor breakaway	1180	1000	3.0 ± 0.5 in^3 (50.0 ± 8.0 cc)
7	Low idle fuel	375	1000	0.9 ± 0.3 in^3 (15.0 ± 5.0 cc)
8	Fuel shutoff solenoid	375	1000	0.1 ± 0.1 (1.5 ± 1.5 cc)
9	Static timing lock plunger lift on port "B"	–	–	0.039 ± 0.002 in (1.00 ± 0.06mm)
10	Test stand equipment a) Bosch nozzle 1 688 901 110 at 3630–3670 lbf/in^2 (250–253 bar) nozzle opening pressure b) High pressure pipes – 33.1 in (840mm) long with 0.08 in (2.0mm) diameter and 0.24 in O.D. (6.00mm) c) Fuel gallery inlet pressure 4–6 lbf/in^2 (0.3–0.4 bar) d) Calibrating fluid – ISO 4113 at 111°–115°F (44° – 46°C) outlet temperature			

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TEST PLAN – 8260 456 cu in. (7.5 liter)

BOSCH VE DISTRIBUTOR TYPE FUEL INJECTION PUMP WITH ELECTRICAL FUEL SHUT–OFF (0.47 in [12mm] diameter plunger, 0.13 in [3.2mm] lift)

PUMP NH NUMBER: 87840635 TYPE NUMBER: 0 460 426 233 SHEET 1 of 1

Test No.	Test Description	Pump rpm	Strokes	Overcheck
1	Return fuel	1100	–	13.2 ± 4.0 gal/hr (50.0 ± 15.0 l/hr)
2	Timing piston travel	750 600 500	– – –	0.090 ± 0.027 in (2.3 ± 0.7mm) 0.063 ± 0.027 in (1.6 ± 0.7mm) 0.047 ± 0.027 in (1.2 ± 0.7mm)
3	Start fuel	100	1000	2.7 in^3 min (45.0 cc min.)
4	Full load fuel a) Rated speed b) Peak torque c) Port to port variation	 1100 800 –	 1000 1000 1000	 4.0 ± 0.2 in^3 (65.0 ± 3.5 cc) 4.2 ± 0.2 in^3 (69.0 ± 3.5 cc) 0.4 in^3 (6.0 cc max.)
5	Hydraulic torque control	600	1000	4.1 ± 0.2 in^3 (66.5 ±3.0 cc)
6	Governor breakaway	1180	1000	3.4 ± 0.5 in^3 (55.0 ± 8.0 cc)
7	Low idle fuel	375	1000	0.9 ± 0.3 in^3 (15.0 ± 5.0 cc)
8	Fuel shutoff solenoid	375	1000	0.1 ± 0.1 in^3 (1.5 ± 1.5 cc)
9	Static timing lock plunger lift on port "B"	–	–	0.039 ± 0.002 in (1.00 ± 0.06mm)
10	Test stand equipment a) Bosch nozzle 1 688 901 110 at 3630–3670 lbf/in^2 (250–253 bar) nozzle opening pressure b) High pressure pipes – 33.1 in (840mm) long with 0.08 in (2.0mm) diameter and 0.24 in O.D. (6.00mm) c) Fuel gallery inlet pressure 4–6 lbf/in^2 (0.3–0.4 bar) d) Calibrating fluid – ISO 4113 at 111°–115°F (44° – 46°C) outlet temperature			

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TEST PLAN – 8360 456 cu in. (7.5 liter)

BOSCH VE DISTRIBUTOR TYPE FUEL INJECTION PUMP WITH ELECTRICAL FUEL SHUT–OFF (0.47 in [12mm] diameter plunger, 0.13 in [3.2mm] lift)

PUMP NH NUMBER: 87840636 TYPE NUMBER: 0 460 426 237 SHEET 1 of 1

Test No.	Test Description	Pump rpm	Strokes	Overcheck
1	Return fuel	1100	–	13.2 ± 4.0 gal/hr (50.0 ± 15.0 l/hr)
2	Timing piston travel	1100 700 600	– – –	0.094 ± 0.027 in (2.4 ± 0.7mm) 0.055 ± 0.027 in (1.4 ± 0.7mm) 0.032 ± 0.027 in (0.8 ± 0.7mm)
3	Start fuel	100	1000	6.1 in^3 min (100.0 cc min.)
4	Full load fuel a) Rated speed b) Peak torque c) Port to port variation	 1100 800 –	 1000 1000 1000	 4.7 ± 0.2 in^3 (76.5 ± 3.5 cc) 5.2 ± 0.2 in^3 (85.5 ± 3.5 cc) 0.4 in^3 (6.0 cc max.)
5	Boost control	650	1000	5.6 ± 0.2 in^3 @ 8.8 psi (91.5 ± 4.0 cc @ 600 mbar)
6	Unboosted fuel	500	1000	4.9±0.2 in^3 @ 0 psi (81.0 ±4.0 cc @ 0 mbar)
7	Governor breakaway	1180	1000	3.0 ± 0.5 in^3 (48.5 ± 8.0 cc)
8	Low idle fuel	375	1000	0.7 ± 0.3 in^3 (12.0 ± 5.0 cc)
9	Fuel shutoff solenoid	375	1000	0.1 ± 0.1 in^3 (1.5 ± 1.5 cc)
10	Static timing lock plunger lift on port "B"	–	–	0.039 ± 0.002 in (1.00 ± 0.06mm)
11	Test stand equipment a) Bosch nozzle 1 688 901 110 at 3630–3670 lbf/in^2 (250–253 bar) nozzle opening pressure b) High pressure pipes – 33.1 in (840mm) long with 0.08 in (2.0mm) diameter and 0.24 in O.D. (6.00mm) c) Fuel gallery inlet pressure 4–6 lbf/in^2 (0.3–0.4 bar) d) Calibrating fluid – ISO 4113 at 111°–115°F (44° – 46°C) outlet temperature			

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TEST PLAN – 8560 456 cu in. (7.5 liter)

BOSCH VE DISTRIBUTOR TYPE FUEL INJECTION PUMP WITH ELECTRICAL FUEL SHUT–OFF (0.47 in [12mm] diameter plunger, 0.13 in [3.2mm] lift)

PUMP NH NUMBER: 87840637 TYPE NUMBER: 0 460 426 235 SHEET 1 of 1

Test No.	Test Description	Pump rpm	Strokes	Overcheck
1	Return fuel	1150	–	13.2 ± 4.0 gal/hr (50.0 ± 15.0 l/hr)
2	Timing piston travel	1150 700 600	– – –	0.094 ± 0.027 in (2.4 ± 0.7mm) 0.055 ± 0.027 in (1.4 ± 0.7mm) 0.032 ± 0.027 in (0.8 ± 0.7mm)
3	Start fuel	100	1000	5.5 in^3 (90.0 cc min.)
4	Full load fuel a) Rated speed b) Peak torque c) Port to port variation	 1150 800 –	 1000 1000 1000	 5.3 ± 0.2 in^3 (87.5 ± 3.5 cc) 6.1 ± 0.2 in^3 (100.5 ± 3.0 cc) 0.4 in^3 (6.0 cc max.)
5	Boost control	650	1000	6.2 ± 0.2 in^3 @ 8.8 psi (101.0 ± 4.0 cc @ 600 mbar)
6	Unboosted fuel	500	1000	4.9 ± 0.2 in^3 @ 0 psi (80.5 ±4.0 cc @ 0 mbar)
7	Governor breakaway	1250	1000	3.0 ± 0.5 in^3 (49.0 ± 8.0 cc)
8	Low idle fuel	375	1000	1.0 ± 0.3 in^3 (16.0 ± 5.0 cc)
9	Fuel shutoff solenoid	375	1000	0.1 ± 0.1 in^3 (1.5 ± 1.5 cc)
10	Static timing lock plunger lift on port "B"	–	–	0.039 ± 0.002 in (1.00 ± 0.06mm)
11	Test stand equipment a) Bosch nozzle 1 688 901 110 at 3630–3670 lbf/in^2 (250–253 bar) nozzle opening pressure b) High pressure pipes – 33.1 in (840mm) long with 0.08 in (2.0mm) diameter and 0.24 in O.D. (6.00mm) c) Fuel gallery inlet pressure 4–6 lbf/in^2 (0.3–0.4 bar) d) Calibrating fluid – ISO 4113 at 111°–115°F (44° – 46°C) outlet temperature			

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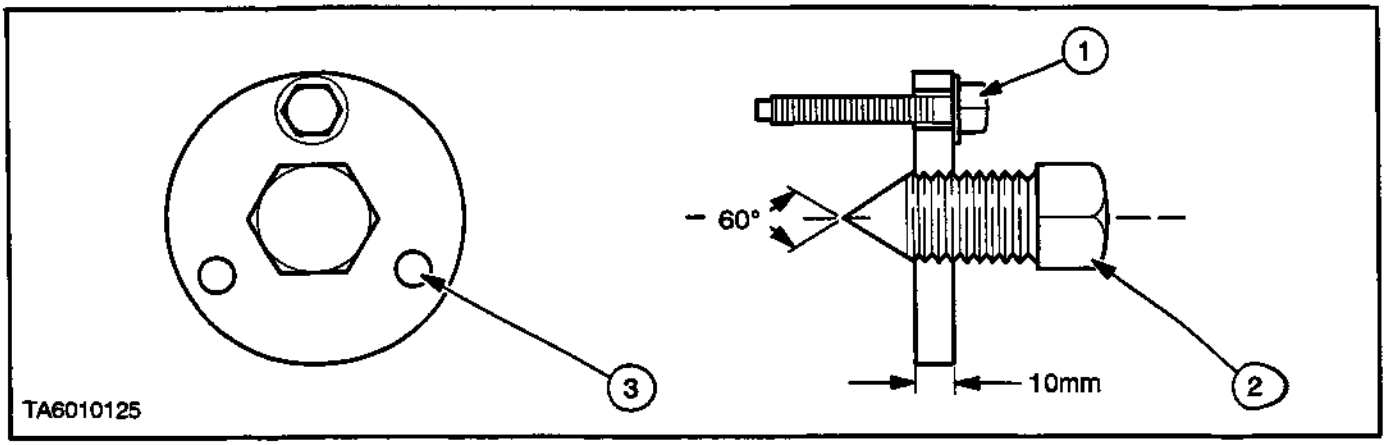
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TORQUE VALUES	ft. lbs.	Nm
Main Bearing Bolts	145	197
Connecting Rod Bolts	110	149
Cylinder Head Bolts (with Engine Cold)	160	217
Intake Manifold–to–Cylinder Head	26	35
Exhaust Manifold–to–Cylinder Head	28	38
Exhaust Pipe–to–Flange	23	31
Flywheel–to–Crankshaft	145	197
Oil Pan Drain Plug	30	41
Valve Rocker Cover Bolts	18	24
Crankshaft Pulley–to–Crankshaft	210	224
Self–Locking Screw – Valve Rocker Arm	18	24
Injector Attachment Bolts	17	23
Cover Bolts (Blanks Oil Drilling)	23	31
Oil Pump to Block	17	23
Water Pump–to–Cylinder Block	48	35
Water Pump Cover–to–Pump	20	27
Oil Pan–to–Cylinder Block (Cast)	28	38
Injector Line Nuts	18	24
Leak–off Tube Banjo Fitting Bolts	4.4	6
Injection Pump–to–Front Cover	18	24
Camshaft Idler Drive Gear–to–Block	175	237
Front Cover–to–Cylinder Block	18	24
Thermostat Housing Bolts	18	24
Camshaft Gear Bolt	51	69
Camshaft Rear Gear Plate Bolts	35	47
Oil Filter Adaptor Bolts	31	42
Oil Filter Mounting Bolt Insert	25	34
Starting Motor–to–Rear Adaptor Plate	23	31
Injection Pump–to–Gear Nut	68	92
Oil Pressure Switch Assembly	23	31
Turbocharger–to–Exhaust Manifold Nut	33	44
Fan Blade to Viscous Unit	21	27
Viscous Unit to Pulley	40	54
Crankshaft Rear Oil Seal Retainer –		
Initial Tightening	9	12
Final Tightening	17	23
Belt Tensioner Pulley Bolt	40	54
Temperature Senders	15	20
Tensioner to Water Pump Bolt	40	54
Idler Pulley Bolt	40	54
Pump Connector to Block	18	24

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SPECIAL TOOLS



Fuel Injection Pump Drive Gear Puller
(Local manufacture)

1. Bolt 5/16–UNF x 2 in. (51mm) with integral washer (3 bolts required)
2. Bolt 3/4x16–UNC x 2 in.(51mm)
3. Three holes 0.375in (9.5mm) dia. on 2.2in (56.87mm) dia. equally spaced material of 0.394 in. (10mm) Plate HRLC P&O Steel
4. Mark tool 295042

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(Prior Tool Numbers, where applicable, shown in brackets)

Description	V. L. Churchill Tool #	Nuday Tool #	FNH Tool #
Adjustable Bridge Puller	518	9539	09539
Shaft Protectors	625-A	9212	09212
Step Plate Adapters	630-S	9210	09210
Bushing Kit	818	9514	09514
Valve Guide Reamer Kit	FT.6202 (SW.502)	2136 (SW.502)	02136
Camshaft Bearings – Remover/Installer Handle	 FT.6203 N6261-A	 1255 (SW.506) 1442	 01255 01442
Water Pump Seal Replacer	FT.6209	4672	04672
Connecting Rod Bushing – Fixture	 N/A	 N/A	 FNH 00053
Crankshaft Seal Replacer Front Seal Rear Seal	 630-16 SW520	 N/A 1301	 T87T-6019-A FNH 01301
Tractor Splitting Stands	MS.2700C	N/A	FTC201387
Compression Test Kit	N/A	N/A	02020
Compression Test Adapter	N/A	N/A	00882
Universal Pressure Test Kit	N/A	N/A	FTC213312
Injection Pump Timing Tool	291755	N/A	291755
Dial Indicator	N/A	N/A	01345
Injection Nozzle Tester	N/A	N/A	01721
Injector Test Adapter	N/A	N/A	01728
Injector Nozzle Socket	N/A	N/A	08126

GREASE and SEALANTS

Code	Number	Name
A	NLG1 Grade 2	Grease
B	ESF–M1C43–A	Grease–Silicone Light Consistency
C	ESE–M4G194–B	Sealer–Anaerobic Low strength
D & J	ESE–M4G195–A	Sealer–Silicone
E & F	SP–M4G9112–A	Sealer–Polyester Urethane
G	ESE–M4G217–A	Sealer–Anaerobic
K	82995772	Thread and Stud Lock
L	82995771	Flexible Gasket Sealant

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FAULT FINDING

IMPORTANT: *When effecting a repair the cause of the problem must be investigated and corrected to avoid repeat failures.*

The following table lists problems and their possible causes with recommended remedial action.

PROBLEM	POSSIBLE CAUSES	REMEDY
Engine does not develop full power	1. Clogged air cleaner	1. Clean or renew element
	2. Fuel line obstructed	2. Clean
	3. Faulty injectors	3. Clean and reset
	4. Incorrect valve clearance adjustment	4. Check and reset
	5. Burnt, worn or sticking valves	5. Replace valves with new or oversize, and/or machine the valve guide bores
	6. Blown head gasket	6. Check head flatness and fit new gasket
	7. Incorrect fuel delivery	7. Check injectors and pump
	8. Low cylinder compression	8. Renew piston rings or re–bore/re–sleeve as necessary
Oil pressure warning light fails to operate	1. Bulb burnt out	1. Renew bulb
	2. Warning Light pressure switch faulty	2. Renew pressure switch
	3. Warning light circuit faulty	3. Check and renew wiring
Excessive exhaust smoke	1. Oil leak on compressor or turbine side of turbocharger, where fitted	1. Overhaul turbocharger
	2. Exhaust leak on exhaust manifold side of turbocharger, where fitted	2. Fit new gasket
	3. Air cleaner dirty or restricted	3. Clean
	4. Excessive fuel delivery	4. Overhaul injection pump and injectors

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PROBLEM	POSSIBLE CAUSES	REMEDY
Engine knocks	1. Diluted or thin oil	1. Check crankshaft bearings for damage, change as required. Drain and refill with specified oil and renew filter. Ascertain cause of dilution
	2. Insufficient oil supply	2. Check oil level and top up as necessary. Overhaul or renew pump as necessary. Check oil filter is not clogged
	3. Low oil pressure	3. Overhaul pump or relief valve as necessary
	4. Excessive crankshaft end play	4. Install new thrust bearing liner
	5. Flywheel or ring gear run–out excessive	5. Skim flywheel or fit new ring gear
	6. Excessive connecting rod or main bearing clearance	6. Install new bearing inserts and/or re–grind crankshaft
	7. Bent or twisted connecting rods	7. Renew connecting rods
	8. Crankshaft journals out–of–round	8. Re–grind crankshaft and fit undersize bearing inserts
	9. Excessive piston–to–cylinder bore clearance	9. Re–bore/re–sleeve block and fit new pistons
	10. Excessive piston ring clearance	10. Fit new pistons and rings
	11. Broken rings	11. Fit new rings, check bore and pistons for damage
	12. Excessive piston pin clearance	12. Fit new piston or pin
	13. Piston pin retainer loose or missing	13. Install new retainer, and check bore/pistons for damage
	14. Excessive camshaft play	14. Install new thrust plate
	15. Imperfections on timing gear teeth	15. Renew timing gear
	16. Excessive timing gear backlash	16. Check and adjust backlash /renew timing gear

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PROBLEM	POSSIBLE CAUSES	REMEDY
Engine overheats	1. Hose connection leaking or collapsed	1. Tighten hose connection, renew hose if damaged
	2. Radiator cap defective or not sealing	2. Renew radiator cap
	3. Radiator leakage	3. Repair/renew radiator
	4. Improper fan belt adjustment	4. Re–adjust fan belt
	5. Radiator fins restricted	5. Clean with compressed air
	6. Faulty thermostat	6. Renew thermostat
	7. Internal engine leakage	7. Check for source of leakage, renew gasket or defective parts
	8. Water pump faulty	8. Overhaul water pump
	9. Exhaust gas leakage into cooling system	9. Renew cylinder head gasket, check head for damage or distortion
	10. Coolant aeration	10. Tighten all connections and check coolant level is correct. Ensure cylinder head gasket has not blown
	11. Cylinder head gasket improperly installed	11. Renew cylinder head gasket
	12. Hot spot due to rust and scale or clogged water jackets	12. Reverse flush entire cooling system
	13. Obstruction to radiator air flow	13. Remove the obstruction
	14. Extended engine idling	14. Do not allow engine to idle for long periods
	15. Oil cooler tube blocked	15. Clean
	16. Radiator core tubes blocked	16. Check free flow
Water temperature gauge fails to reach normal operating temperature	1. Faulty temperature sender	1. Renew sender switch
	2. Incorrect or faulty thermostat	2. Renew thermostat
	3. Faulty water temperature gauge	3. Renew temperature gauge

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PROBLEM	POSSIBLE CAUSES	REMEDY
Low oil pressure	1. Engine oil level low	1. Top up, as necessary
	2. Wrong grade of oil	2. Drain and refill with correct grade of oil
	3. Blocked oil pump sump screen	3. Clean pump screen
	4. Oil pressure relief valve faulty	4. Fit new relief valve
	5. Oil pump worn	5. Renew oil pump
	6. Excessive oil pump rotor and shaft assembly clearance	6. Overhaul pump
	7. Excessive main or connecting rod bearing clearance	7. Install new bearings inserts and / or re–grind crankshaft if necessary
Excessive oil consumption	1. Engine oil level too high	1. Reduce oil level
	2. External oil leaks	2. Renew gaskets and seals, where necessary. Check mating surfaces for damage or distortion
	3. Worn valves, valve guides or bores	3. Renew
	4. Cylinder head gasket leaking	4. Renew gasket. Check head for damage or distortion
	5. Oil loss past the pistons and rings	5. Renew rings and/or rebore/ re–sleeve block as necessary
	6. Oil cooler leak	6. Repair/renew oil cooler assembly
Engine tends to keep firing after fuel is shut off	1. Air cleaner dirty or restricted	1. Clean or renew element
	2. Oil leak on compressor side of turbocharger where fitted	2. Overhaul turbocharger

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DIESEL ENGINE – DESCRIPTION AND OPERATION

The engines are 6 cylinder and available in naturally aspirated and turbocharged forms.

All engines feature cross flow cylinder heads, with the inlet and exhaust manifolds on opposite sides of the cylinder head. The fuel and air combustion process, takes place in the specially designed bowl in the crown of the pistons.

CYLINDER HEAD ASSEMBLY

The cylinder head incorporates valves and springs, with the valve rocker arm shaft assembly bolted to the cylinder block through the cylinder head. Cylinder head retaining bolts are evenly spaced with a six point pattern around each cylinder, this ensures an even clamping load across the cylinder head area.

The intake and exhaust manifolds are bolted to the head, the intake manifold is mounted on the right hand side of the engine, with the diesel injectors mounted outside the rocker cover. The exhaust manifold is mounted on the left hand side of the engine. Water outlet connections and thermostat being attached to the front of the cylinder block directly behind the radiator.

Valve guides are integral in the cylinder head, and valves with oversize stems are available in service. Special replaceable cast alloy valve seats are pressed into each valve port during manufacture, with oversize valve seats also available in service.

All valves are fitted with positive valve rotators, with both Intake and exhaust valves using umbrella type oil seals. Valve clearance is maintained by adjustment of the self locking adjusting screw, mounted in each of the rocker arms.

CAMSHAFT ASSEMBLY

The camshaft runs in 5 replaceable bearings. The camshaft drive gear is in mesh with and driven by the camshaft idler gear which is driven by the crankshaft timing gear.

Camshaft end thrust is controlled by a thrust plate bolted to the block, and located between the camshaft gear and the front camshaft journal.

A helical gear is mounted on the rear of the camshaft, and drives the engine oil lubrication pump mounted forward of the flywheel.

CRANKSHAFT ASSEMBLY

The crankshaft is supported in the cylinder block by 7 main bearings.
The crankshaft is manufactured from steel with machined finished crank webs
End thrust is controlled by a thrust bearing incorporated in the center main bearing of the crankshaft.

An external damper is fitted to the crankshaft pulley to ensure smooth running operation. Front and rear crankshaft oil sealing is effected by one piece seals that are designed for long and durable service life.

CONNECTING RODS

Connecting rods "Teepee" (wedge) shaped at the small end have been designed to reduce the reciprocating weight at the piston end. The connecting rods are of a heavy beam construction and are assembled as a matched set to each engine, attached to the crankshaft, by means of insert–type bearings.

They are retained in position by the connecting rod big end cap and secured by two bolts per rod. The small end of the connecting rod is fitted with a replaceable bronze bushing, through which the free floating piston pin is fitted. The steel pin being held in place within the piston by two snap rings.

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PISTONS

Pistons are constructed of an aluminum silicon alloy with an iron insert for the top ring. The combustion chamber being recessed into the piston crowns.
Each piston has two compression rings and one oil control ring, to reduce friction and increase positive sealing. All rings are located above the piston pin.

MANIFOLDS

The cross flow design aluminum intake, and cast iron exhaust manifolds, are on opposite sides of the cylinder head. This is designed to maintain balanced heat distribution within the cylinder head. The configuration of the manifolds also ensures minimum heat transfer to the intake manifold.

The intake manifold is connected through tubing to the air cleaner and at the inlet of the manifold a tapped hole is provided for installation of a thermostart cold starting aid.

NOTE: *On tractors where cold start equipment is not installed ensure the plug in the intake manifold is kept tight at all times. Considerable damage to the cylinder bores, may be incurred by entry of grit or other foreign material if the plug is left loose or missing. Also dirt and grit may be drawn through the air cleaner connections if they are not properly secured.*

CYLINDER BLOCK ASSEMBLY

The cylinder block is an alloy cast iron with deep cylinder skirts, and water jackets for cooling the cylinders. The cylinder bores are machined integral with the cylinder block, during the manufacturing process.

Cylinders are in line and vertical and numbered from 1 to 6 from the front to the rear of the engine. They can be bored oversize for the fitment of sleeves, which are available in service.

The oil pan which is attached to the bottom of the cylinder block, is the reservoir for the engine oil lubrication system. A cast iron engine front cover and front plate is attached to the front of the engine and covers all of the timing gear assembly.

TIMING GEARS

The crankshaft timing gear is heated and press fitted on to the front of the crankshaft, to a high degree of accuracy during manufacturing. This enables precise timing being maintained during the life of the engine. The crankshaft gear drives the camshaft idler gear which is attached to the front of the cylinder block. The idler gear then drives the camshaft and the injection pump via meshing helical gears.
The camshaft gear is bolted to the front of the camshaft, and is keyed to maintain position of the gear on the camshaft.

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LUBRICATION SYSTEM

Lubrication of the engine, Figure 1-1-1, is maintained by a rotor type oil pump mounted in the rear of the engine block, forward of the flywheel on the left hand side of the engine. The oil pump is driven from the rear of the camshaft and draws oil from the engine oil pan through a tube and screen assembly.

A spring loaded relief valve is integral with the oil filter body mounted on the left hand side of the engine block, and prevents over pressurization of the system.

A spin on type oil filter is mounted externally to its support housing, on the left hand side of the engine. Oil flows from the filter to the main oil gallery, which runs the length of the cylinder block, which also intersects the camshaft follower chamber.

The main gallery also supplies oil to the crankshaft main bearings and connecting rods both big and small ends. The underside of the pistons and pins, are lubricated by oil pressure jets mounted adjacent to each main journal housing.

The camshaft drive gear bushing is pressure lubricated through a drilled passage from the front main bearing. The gear has small oil passages machined on both sides allowing excess oil to escape.

Timing gears are lubricated by splashed oil from the cam follower chamber, and the pressure lubricated camshaft drive gear bushing.

An intermittent flow of oil is directed to the valve rocker arm shaft assembly via a drilled passage in the cylinder block. This is located vertically above No.1 camshaft bearing, and aligns to a hole in the cylinder head. The rotation of the camshaft allows a controlled intermediate flow of lubrication.

The turbocharger where fitted, is supplied with oil from the oil filter support housing, mounted on the left hand side of the engine.

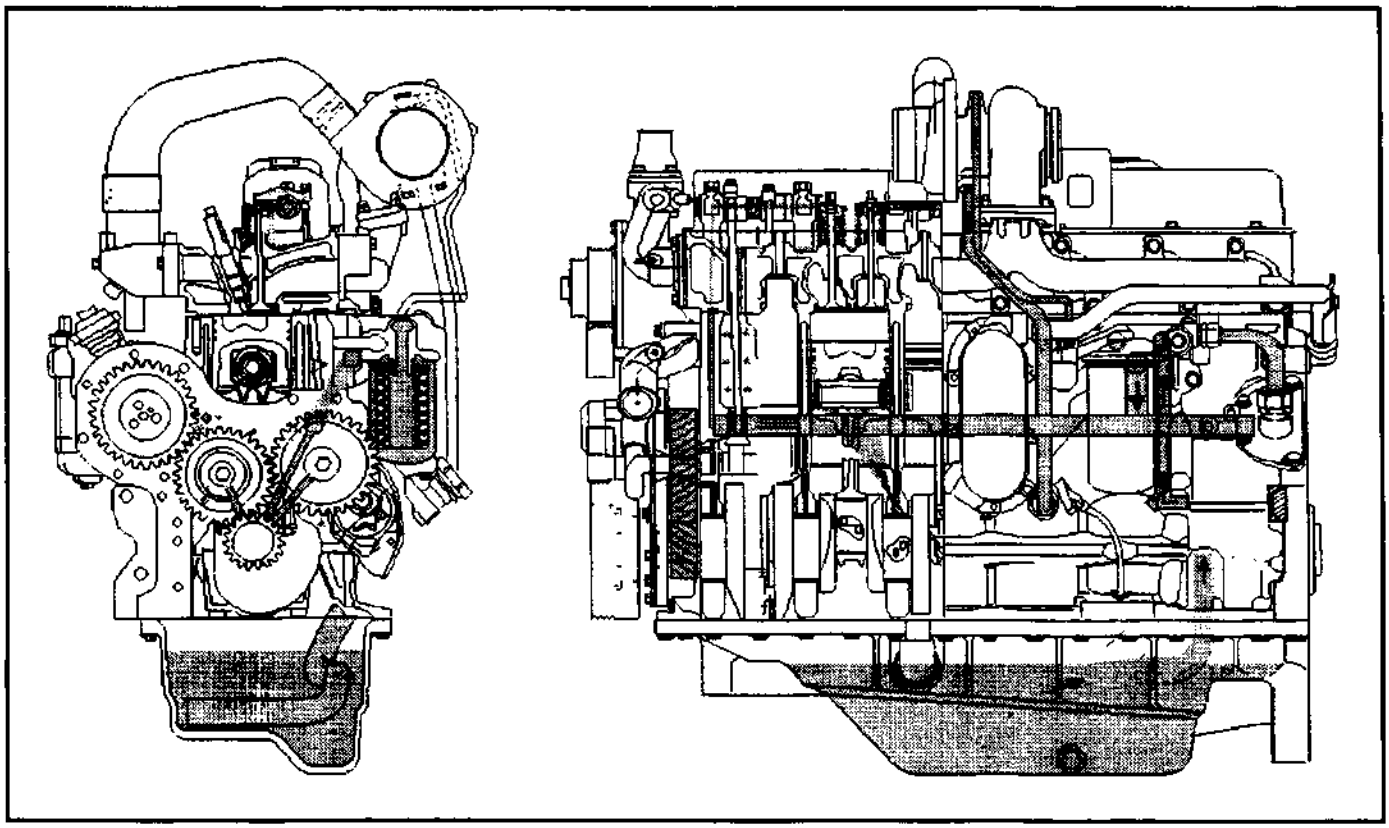


Figure 1-1-1

Engine Lubrication System With Turbocharger Fitted

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COOLING SYSTEM

The function of the water pump mounted at the front of the engine, is to maintain a continuous flow of water around the cooling system. This is essential to ensure correct engine temperature, and performance, during vehicle operation.

The pump is driven by a "Poly V" Belt from the crankshaft pulley, when the engine is running. The fan belt tension is maintained by a spring loaded belt tensioner, bolted to the front cover of the engine.

The cooling system for the new generation of engines, is of the recirculating by–pass type with full length water jackets for each cylinder. The coolant is drawn from the bottom tank of the radiator by the water pump, which passes the coolant to the cylinder block. This coolant then flows through cored passages to cool the cylinder walls.

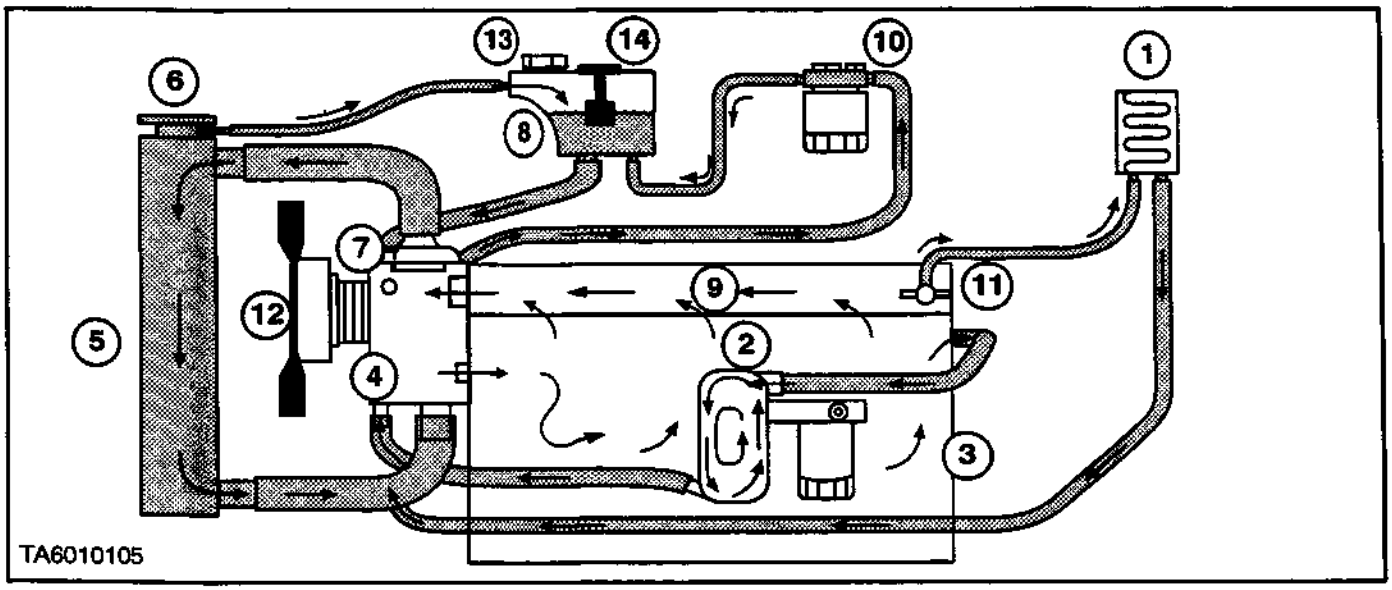
Passages in the cylinder head gasket allow coolant to flow from the cylinder block, into the cylinder head. Cored passages also conduct the coolant to the fuel injector nozzle locations, before re–entering the water pump below the thermostat.

The thermostat is located in the top of the water pump body, and controls the flow of the water as required by temperature changes.

NOTE: *A faulty thermostat may cause the engine to operate at too high (hot), or Low (cold) an operating temperature. If not replaced this could result in a damaged engine, or impaired engine performance.*

When the thermostat is closed a recirculating by–pass is provided to allow the coolant to recirculate from the head to the block to effect a faster warm–up.

Once the engine has reached its normal operating temperature, the thermostat will open and allow water to be drawn through the radiator by the pump action. Cooled water then returns to the engine system.



Cooling System

Figure 1-1-2

1. Cab Heater Core
2. Engine Oil Cooler (Turbo Engines)
3. Engine Block
4. Water Pump
5. Radiator
6. Radiator Blanking Cap
7. Thermostat
8. Header Tank
9. Cylinder Head
10. Water Filter
11. Cab Heater Tap
12. Fan and Viscous Unit
13. System Pressure Cap
14. Cold Coolant Level sender

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Cooling occurs as the coolant passes down through the radiator cores, which are exposed to the air as it is drawn through the radiator by the fan.

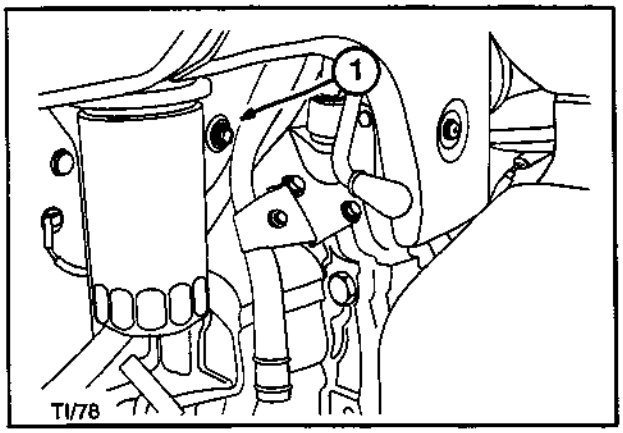


Figure 1-1-3

NOTE: *Do not operate an engine without a thermostat. It is recommended that a solution of a 50% clean water, and 50% antifreeze is used. A replaceable coolant filter/ conditioner is installed on the tractor and contains a conditioner in the form of a paste. No additional inhibitor is required.*

The cooling system incorporates a drain plug (1), Figure 1-1-3, on the left hand side of the cylinder block. The system pressure cap is located on the header tank. The cap on the radiator is a blanking cap and should not be removed unless refilling the system from empty. Normal topping up should occur at the header tank.

The engine cooling fan is mounted on a viscous drive hub (1), Figure 1-1-4, which is belt driven from the crankshaft. The viscous drive allows the fan to operate only when required by the cooling system permitting a faster engine warm up, reduced parasitic power loss when the fan is not engaged and reduced noise levels.

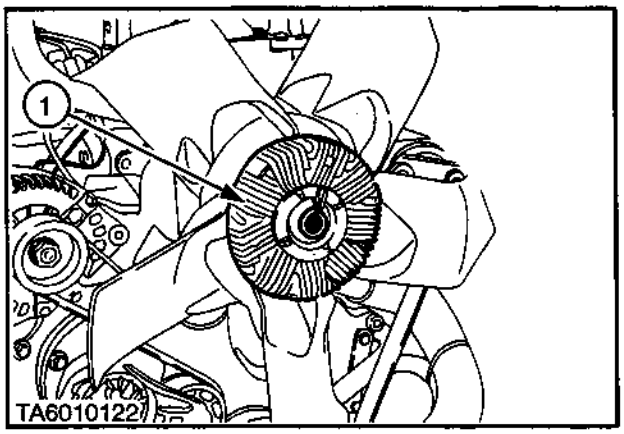


Figure 1-1-4

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Figure 1-1-5 – A, Cool air from radiator, fan idling
Figure 1-1-6 – B, Hot air from radiator, fan driving

Air temperature behind the radiator is sensed by a Bi–metallic coil (4), Figure 1-1-6, located in the center of the fan hub face. As the temperature increases the coil gradually opens a valve (5), Figure 1-1-6, within the hub (3), Figure 1-1-6, which allows a modulated flow of viscous fluid (3), Figure 1-1-5, to pass from an integral reservoir (2), Figure 1-1-5, to the drive area, due to centrifugal force, providing a gradual take up of fan drive.

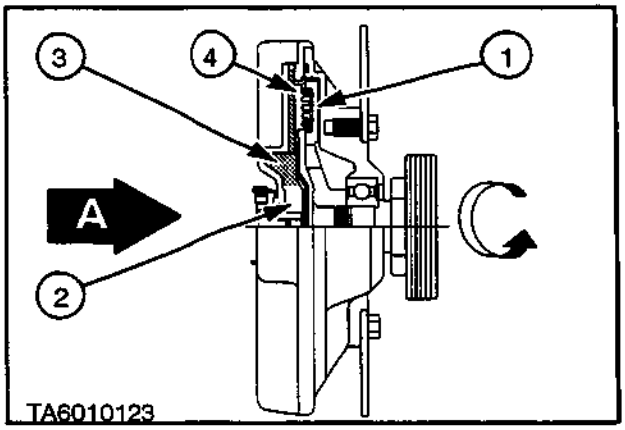


Figure 1-1-5

Within the drive area are two sets of interlocking annular fins, one set on the drive member (1), Figure 1-1-5, and the other on the free–wheeling hub body (4), Figure 1-1-5, to which the fan blade assembly (2), Figure 1-1-6, is attached. Viscous liquid passes between the interlocking blades and the resulting drag transmits torque to the fan. The fluid is then recirculated to the reservoir by a pump plate (6), Figure 1-1-6, incorporated in the drive member (1), Figure 1-1-6.

When the air temperature behind the radiator drops sufficiently, the Bi–metallic coil closes the valve preventing fluid from entering the drive area and the fan hub is allowed to idle with respect to the drive member.

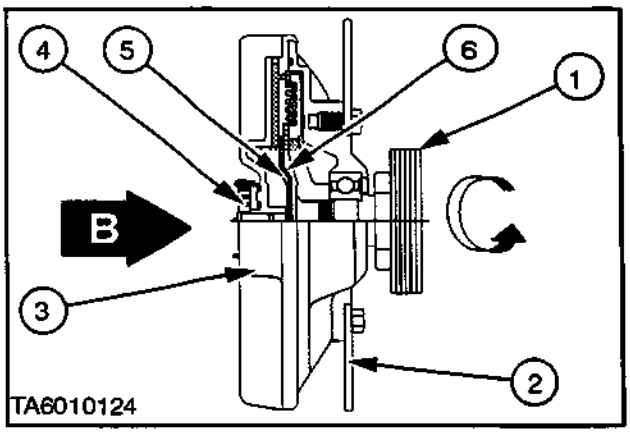
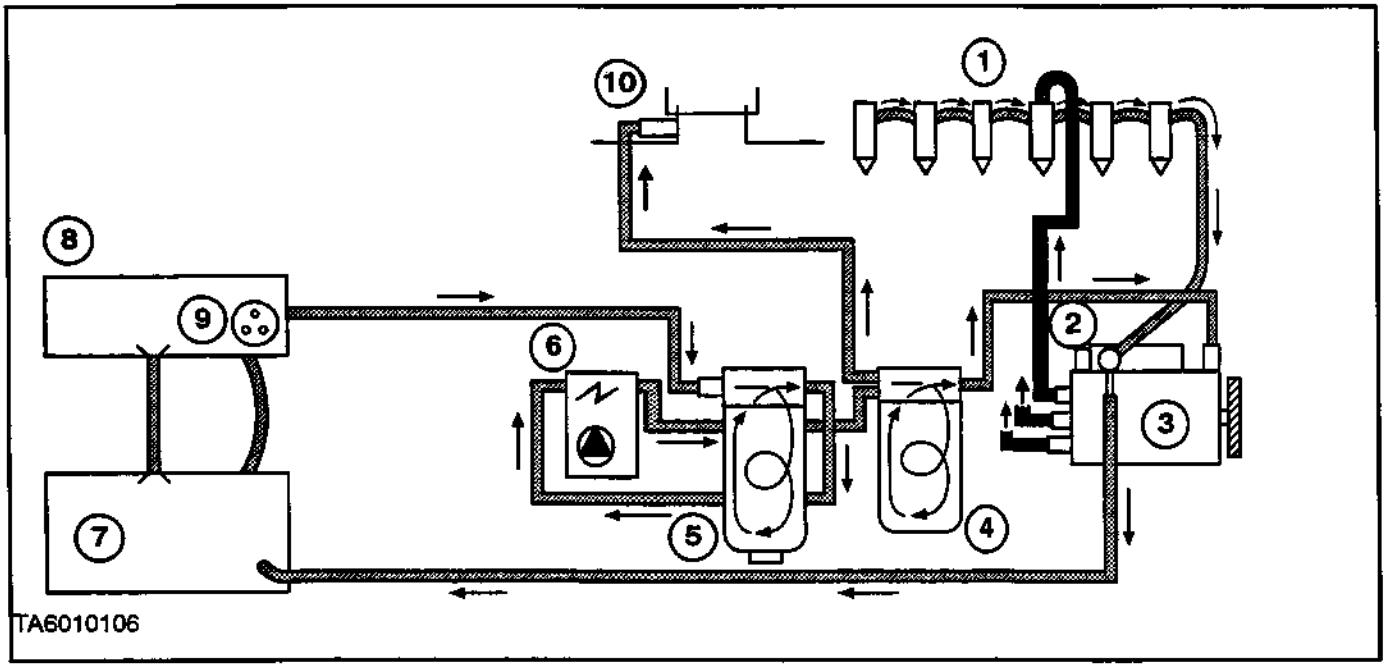


Figure 1-1-6

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FUEL SYSTEM



Fuel System

Figure 1-1-7

1. Injectors
2. Shut–off Solenoid
3. Fuel Injection Pump
4. Fuel Filter
5. Fuel sedimenter
6. Electric Lift Pump
7. Right Hand Fuel Tank
8. Left Hand Fuel Tank
9. Fuel Gauge Sender Unit
10. Thermostart

The diesel fuel system consists of fuel tank, fuel sedimenter, electric lift pump, fuel filter, BOSCH VE distributor type fuel injection pump, fuel injectors, and interconnecting tubes and lines, Figure 1-1-7.

The fuel injection pump is pressure fed from an electric lift pump. Fuel flows from the fuel tank to the sediment separator, through the electric lift pump and then through the fuel filter. From the filter the fuel passes to the transfer pump which is an integral part of the fuel injection pump.

The transfer pump delivers fuel to the injection pump to supply fuel at high pressure to each injector and also provides extra fuel which lubricates and cools the injection pump.

This extra fuel is recirculated, via a fitting on the fuel injection pump governor control housing to the fuel tank, by means of the injector leak off line.

On all models excess fuel that leaks past the needle valve of the injectors is directed back into the fuel tank, by means of the injection leak off line.

Fuel Shut Off (Injection Pump)

All fuel injection pumps are equipped with an electrically operated fuel shut off solenoid.

The fuel shut off solenoid is energized by operation of the ignition switch mounted in the instrument panel.

With the ignition switched "OFF" a spring loaded plunger in the solenoid (held in position by the spring tension), prevents fuel flowing into the pump from the main fuel feed port.

With the ignition switched "ON" the magnetized plunger is energized by an internal coil and is drawn up into the body of the solenoid. Fuel is then allowed to flow through the open port into the pump.

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Fuel Sedimenter

The sedimenter, Figure 1-1-8 is positioned between the fuel tank, and the electric lift pump, on the right hand side of the engine. The fuel enters the sedimenter and flows into the head, to be directed down, and around the edges of the sediment separator cone.

The larger particles of dirt and water (which are heavier than fuel oil), are separated out and sink to the collecting bowl which can be removed and cleaned. The clean fuel is then drawn back through the top of the unit by the electric lift pump and on to the fuel filter.

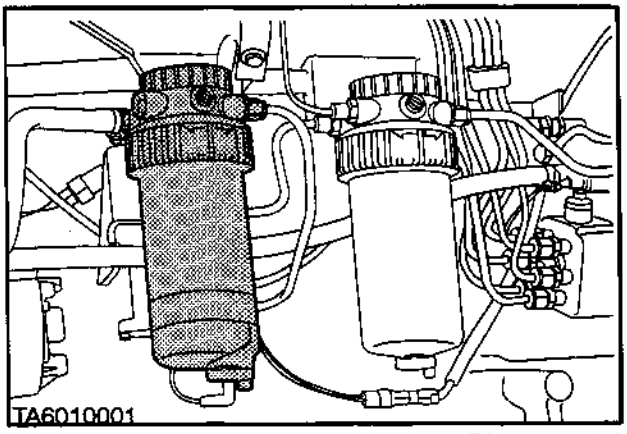


Figure 1-1-8

Electric Lift Pump

An electric fuel pump is fitted to all models. Located behind the sedimenter, (1) Figure 1-1-9, the pump draws fuel from the tank, via the sedimenter and passes fuel under pressure to the filter and onto the fuel injection pump.

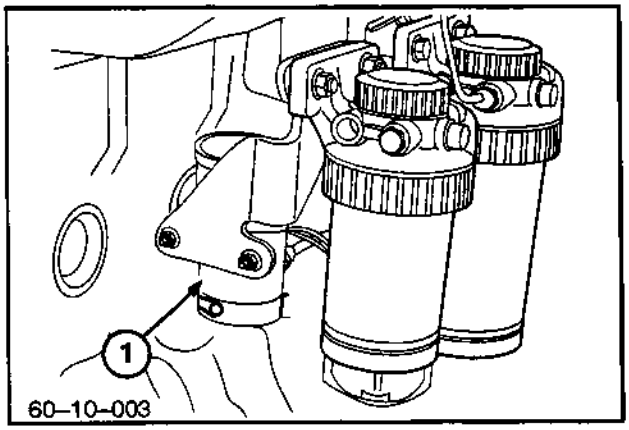


Figure 1-1-9

Fuel Filter

The fuel filter situated to the right hand side of the engine, close to the sedimenter, receives the clean fuel from the electric pump. From the filter head the fuel is directed down, through the filter paper and into the base chamber, Figure 1-1-10.

The filtered fuel then flows up the center tube of the element to the filter head outlet, and into the injection pump.

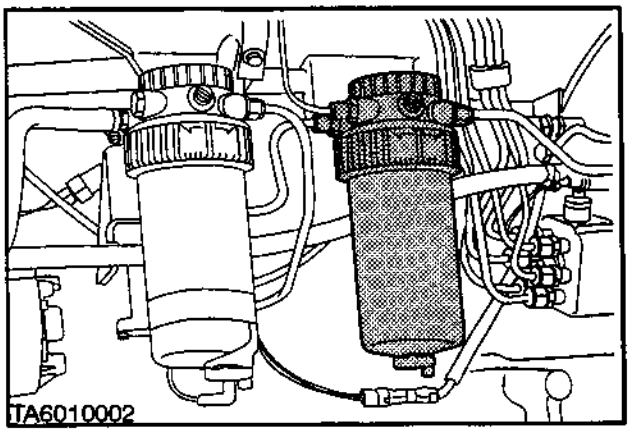


Figure 1-1-10

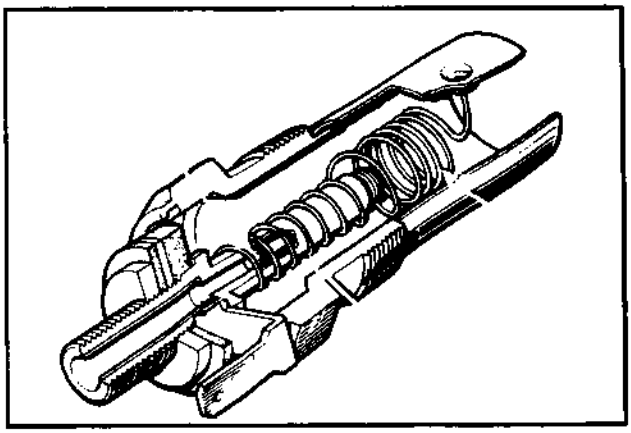
Thermostart

To aid engine starting in cold weather conditions, a thermostart is standard on all models, Figure 1-1-11.

The thermostart is screwed into the inlet of the intake manifold. A fuel line connects the thermostart to the fuel filter head and the electrical terminal is connected to the ignition switch via the electronic management unit which controls the duration of thermostart operation.

When electrical current is applied, by operating the ignition switch, the heater coil is energized.

As the coil heats up a check valve opens which allows fuel to flow over the hot coil. The fuel is ignited by the coil producing a flame in the manifold which heats the intake air prior to it entering the combustion chamber.


Figure 1-1-11

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DIESEL ENGINE STRIPDOWN

In the following procedures and illustrations the engine in the main is shown removed from the tractor.

However there are certain operations that can be performed with the engine still in the tractor, or separated at the connection to the front axle support, or separated from the transmission housing.

The engine overhaul procedure initially describes the assembly process for rebuilding an engine using all new components. Following this section are defined headings which describe detailed repair specifications and procedures, where components are suitable for re–use. Refer to the specifications section to ensure components are serviceable.

Where overhaul of components is required without engine being removed from the tractor refer to the following headings, and the relevant paragraphs, in the main overhaul procedure.

Operations or repairs that can be performed with the engine still in the tractor.

1. Cylinder head and associated inlet and exhaust components.
2. Fuel injection pump and related parts.
3. Water pump, thermostat, and associated components.
4. Oil pump relief valve.
5. Turbocharger.
6. Front timing cover/timing gear removal.
7. Front pulley and damper assembly.

Operations or repairs that can be performed with the engine separated from the front axle

1. Oil pan removal for access to oil pan gasket, crankshaft, bearing shells, piston removal, and oil pump suction tubing.

Operations or repairs that can be performed with the engine separated from the transmission housing, and with oil pan removed

1. Crankshaft rear oil seal and carrier removal, (with oil pan removed).
2. Oil pump and drive gear removal.

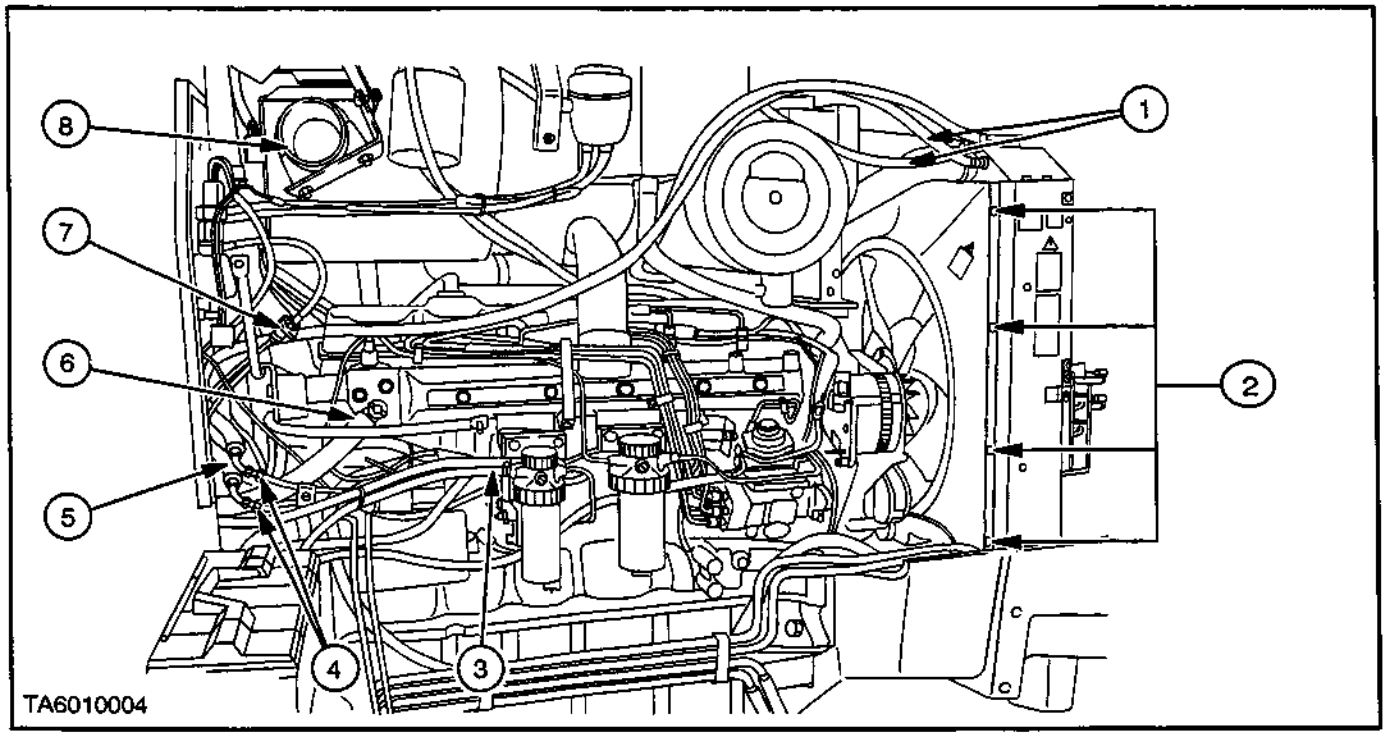
Dismantle the engine following conventional techniques, or by referring to the following removal procedure. Referring to the specification section as necessary.

NOTE: *All gaskets, seals, and 'O' rings must be replaced with new upon re–assembly. Where new sealant is to be applied refer to "Engine Specifications".*

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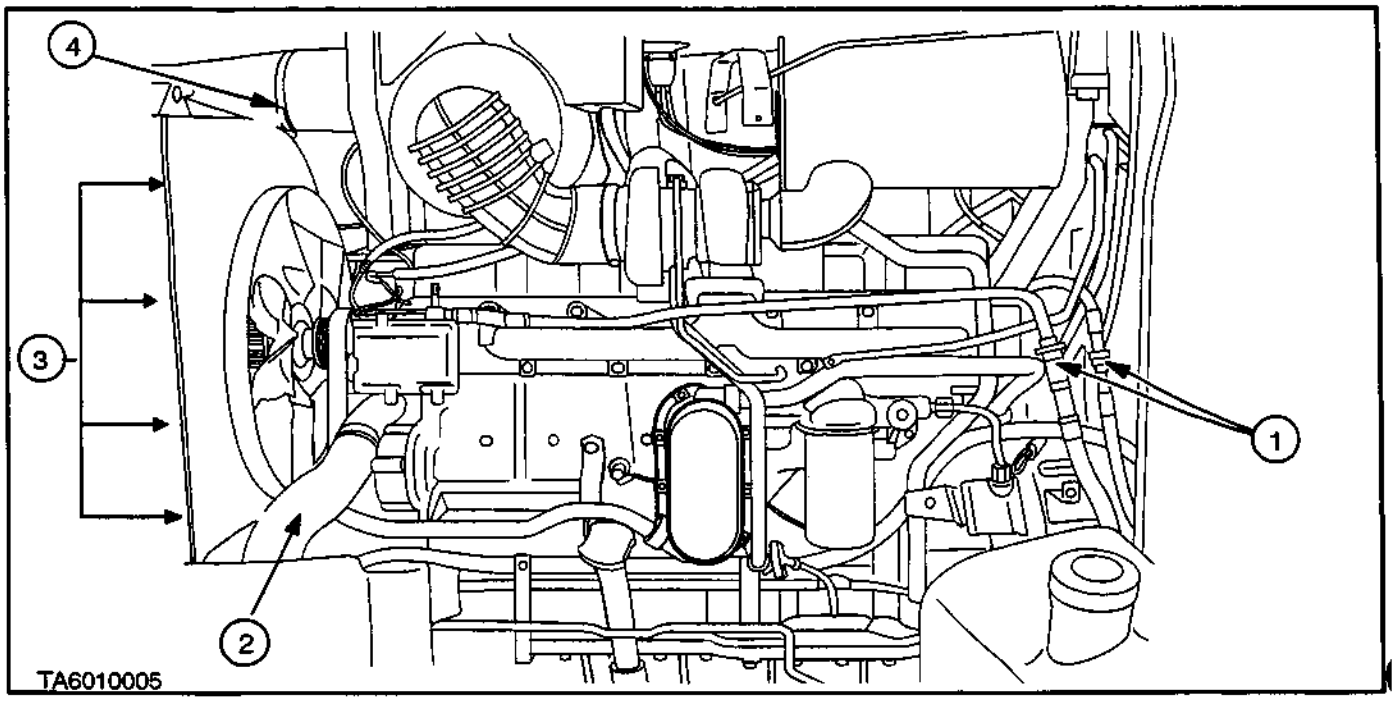
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ENGINE REMOVAL – INSTALLATION (Op. 10 001 10)



Right hand View of Tractor

Figure 1-1-12



Left hand View of Tractor

Figure 1-1-13

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Separating Front Axle from Engine
(with reference to Figures 1-1-12 and 1-1-13)

1. Disconnect **battery**, ground lead first.

2. Disconnect **power steering hoses** from cylinder. Figure 1-1-14.

3. Remove front wheel drive **propshaft guard and propshaft**, if fitted.

4. Disconnect **Front Hitch hydraulic tube**, if fitted and drain oil into a clean container.

5. Disconnect the **front differential lock hydraulic tube** on FWD models. Figure 1-1-15.

6. If **air conditioning** is fitted, withdraw the condenser from the radiator and remove the receiver dryer. Carefully move both items away from the front of the tractor and secure to the side of the engine ensuring that they are not allowed to hang on their tubes.

7. Slide out the **oil cooler** from the radiator and tie up out of the way, again ensuring that the cooler is not allowed to hang on its hoses.

8. Disconnect **electrical connection** to the steering angle sensor, if fitted, Figure 1-1-16.

9. Drain the **cooling system fluid** into a clean container and disconnect the radiator hoses. Disconnection of the radiator lower hose provides a suitable drain point. Place a large clean tray under the vehicle to capture the fluid for future use. Figure 1-1-13, (2)

10. Remove the **radiator fan shroud** hardware, leaving shroud in position. Figures 1-1-12, (2) and 1-1-13, (3).

11. Disconnect **air cleaner** inlet tube. Figure 1-1-13, (4).

12. Position **Splitting Tool, FTC201387** in position. If splitting tool is not available use an overhead crane with suitable straps. Strap at the front and rear of the front support to maintain balance. **NOTE:** *It will be necessary to remove the engine hood.*
Support the engine at the front of the transmission and position wedges between axle and support to prevent articulation. Remove hardware securing the engine to the front support and wheel the front axle and support away from the engine.

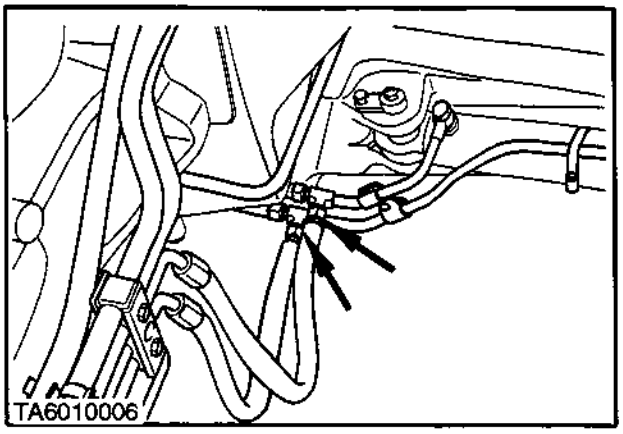


Figure 1-1-14

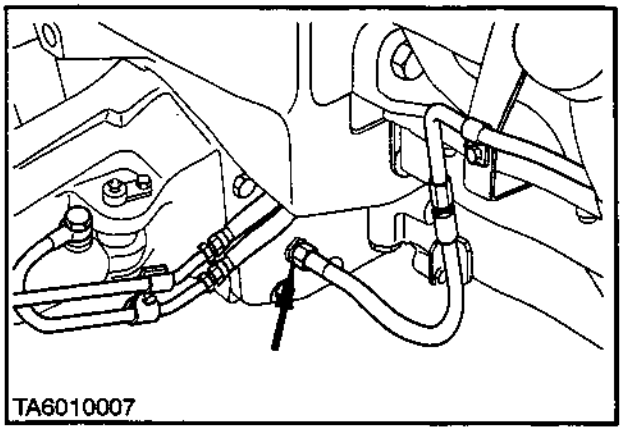


Figure 1-1-15

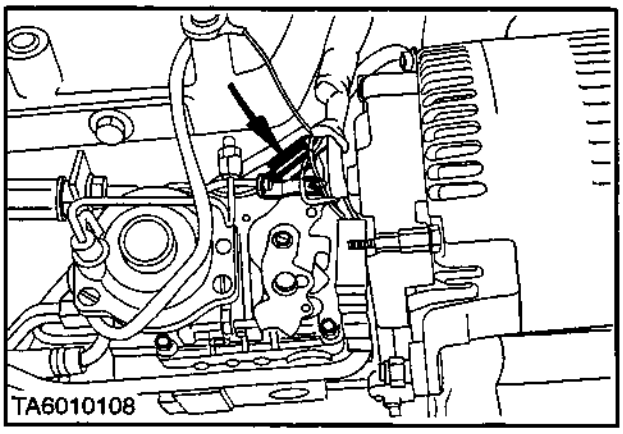


Figure 1-1-16

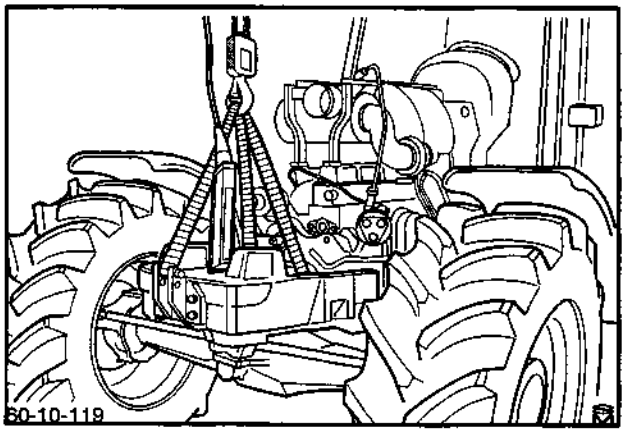


Figure 1-1-17

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Separating Engine From Transmission
(with reference to Figures 1-1-12 and 1-1-13)
With engine previously separated from front axle.

1. Remove the **exhaust muffler**. Figure 1-1-12, (8).
2. Disconnect hood harness connector, Figure 1-1-18 and remove the engine **hood** assembly, Figure 1-1-19.
3. Disconnect **starter motor** wiring and retaining bolts and remove starter motor, Figure 1-1-20.
4. Disconnect the **fuel lines** to the fuel sedimenter and the overflow return to tank, Figure 1-1-12 (3).
5. Disconnect the **main harness** to engine harness connector. Figure 1-1-12 (5).
6. Disconnect **water pipe** to heater shut off tap located at rear of cylinder head, Figure 1-1-12 (6).
7. Disconnect **steering tubes**, near bellhousing, Figure 1-1-12 (4).
8. Disconnect **brake tubes** to master cylinder, Figure 1-1-12 (7).
9. Disconnect **front hitch supply tube**, if fitted.
10. Disconnect the **left hand water hose** to the cab, near bellhousing.
11. Disconnect **air conditioning** at quick release connectors, Figure 1-1-13 (1).
12. Support the engine using a suitable hoist. Support front of transmission with suitable stand. Remove the buckle up bolts between the engine and transmission. Carefully pry the engine from the transmission, ensuring that all wires and tubes are disconnected. Place the engine onto a suitable stand for repair.

Engine Installation

Installation of the engine is the reversal of the removal procedure, noting the following points:

- Ensure all attaching hardware is tightened to the correct torque value as detailed in the specifications.
- After connection of the battery it will be necessary to reset the radio / clock.
- Ensure after installation that all fluid levels are correct prior to start up. Start and run the engine until correct operating temperature is achieved to purge air from cooling system. Stop engine, check for leaks, rectify as required and recheck fluid levels.

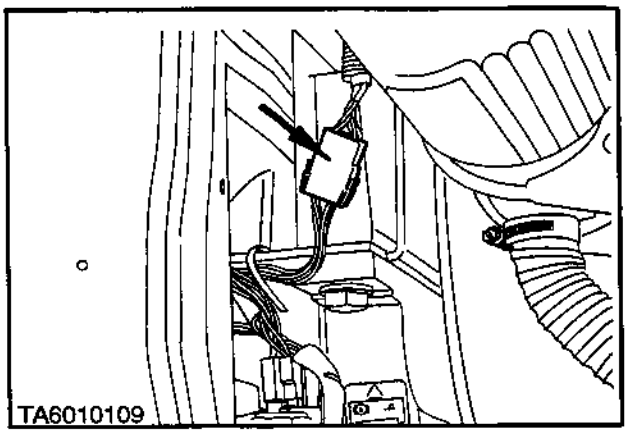


Figure 1-1-18

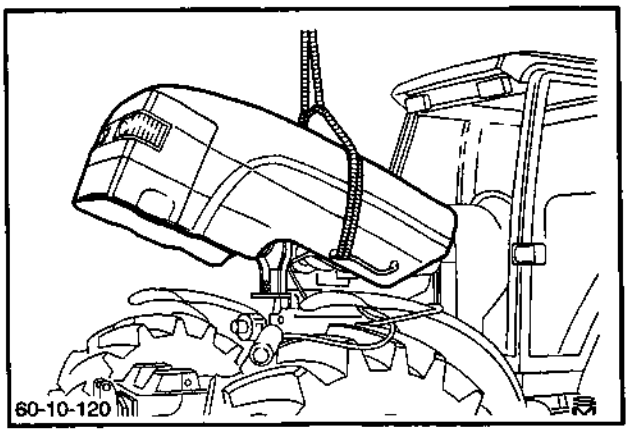
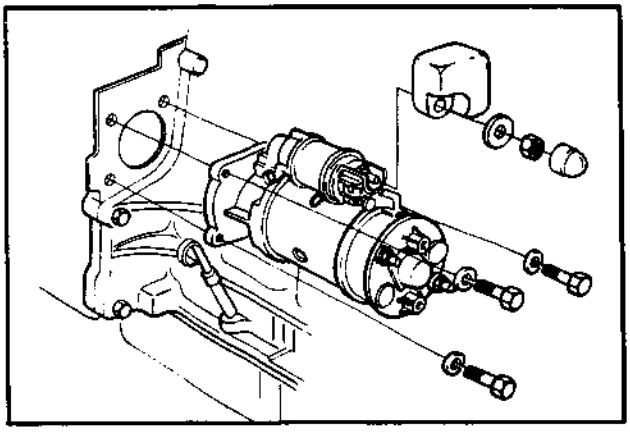


Figure 1-1-19


Figure 1-1-20

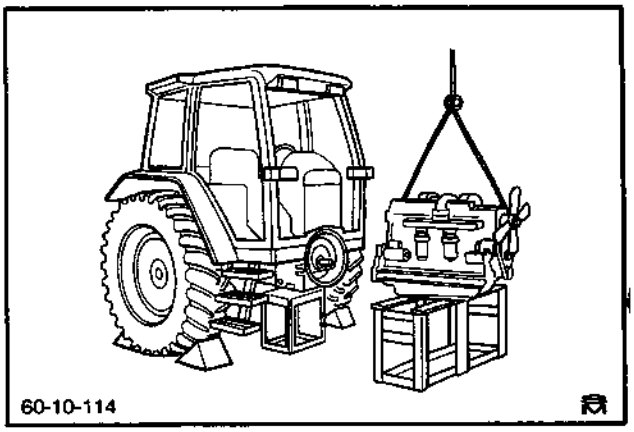


Figure 1-1-21

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ENGINE DISASSEMBLY

Cylinder Head, Valves, And Related Parts

Cylinder head removal

NOTE: *The cylinder head can be removed with the engine installed in the tractor.*

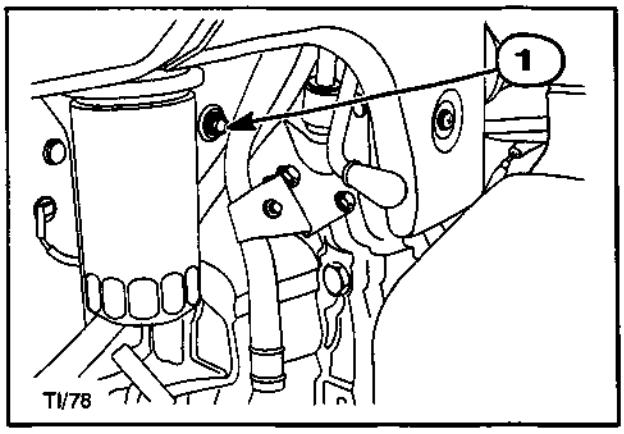


Figure 1-1-22

Remove or disconnect the following components to allow removal of the cylinder head:–

- Remove the engine hood.
- Drain the engine coolant, using the drain plug on the block, (1), Figure 1-1-22, into a clean receptacle.
- Disconnect air cleaner tubes, water hoses to the expansion bottle and water filter and air cleaner to exhaust tube. Disconnect and remove the engine hood frame with the air cleaner and water expansion bottle.
- Disconnect the low pressure fuel lines to the filters, the injector leak off tube, thermostart feed tube, injector to injection pump high pressure tubes and, where fitted, the vacuum tube to boost control unit. (cap all exposed openings).
- Remove the inlet manifold, if necessary.
- Disconnect and remove the rocker cover ventilation tube.
- Remove the turbocharger assembly, if fitted, ensuring all openings are capped to prevent dirt ingress.
- Remove the fan drive belt (1) and the water pump (2), Figure 1-1-23.
- Remove the exhaust manifold if necessary.
- Remove the engine breather tube(3), rocker cover bolts (2),14 of, rocker cover(1) and gasket, Figure 1-1-24.
- Remove the cylinder head bolts which pass through the rocker shaft supports and the rocker shaft assembly together as an assembly. Remove the push rods, check for concentricity and place in a numbered rack for reassembly.

  Remove remaining cylinder head bolts working inwards from the end of the cylinder head, alternately to the center of the cylinder head.
- Carefully lift the cylinder head assembly away from the engine block.

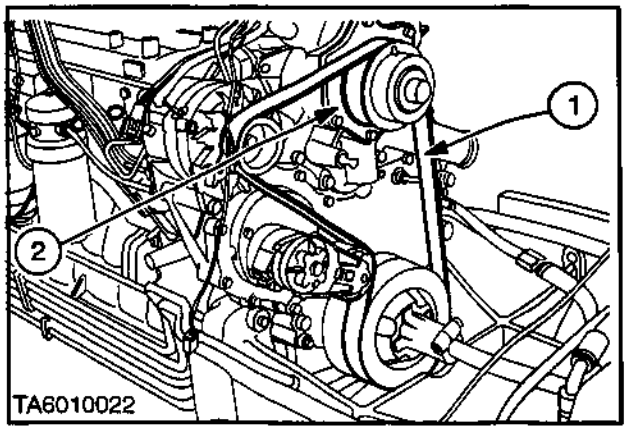


Figure 1-1-23

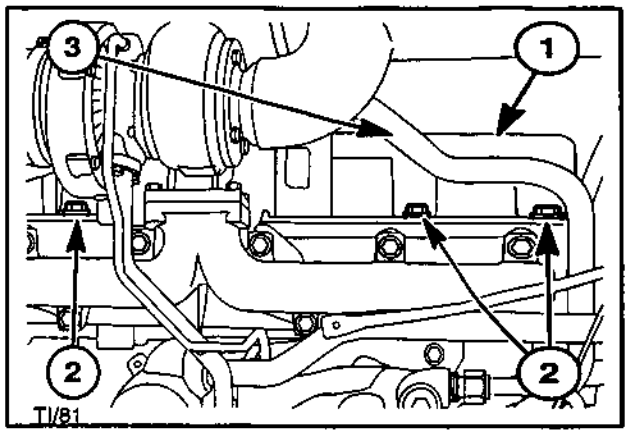


Figure 1-1-24

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CYLINDER HEAD DISASSEMBLY

1. Clean the area surrounding the fuel injectors. Disconnect leak off tubes and remove injectors from the cylinder head Figure 1-1-25.

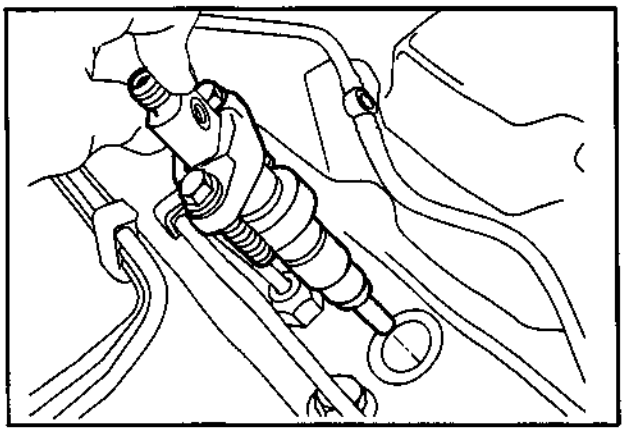


Figure 1-1-25

Rocker Shaft Disassembly

NOTE: *Leave bolts in the rocker shaft supports during removal as they retain the support on the shaft(5), Figure 1-1-26.*

1. Remove the cylinder head bolts (3) and withdraw the supports(2), springs(1), rockers(4) and spacers(6), Figure 1-1-26.

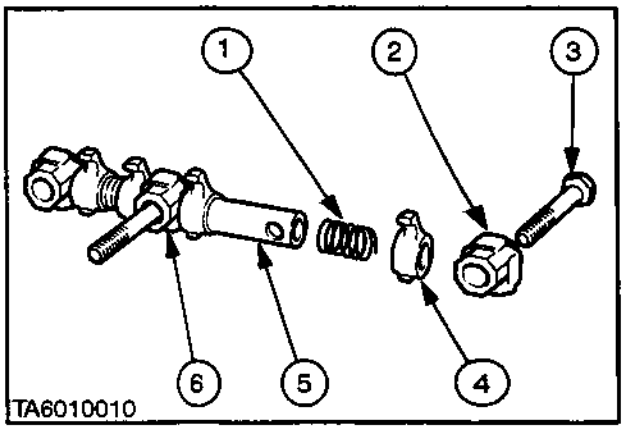


Figure 1-1-26

Valve and Spring Assembly Removal

1. Using a valve spring compressor, (1) remove the retainer locks(2), springs(3), seals, rotators, and place in a numbered rack, Figure 1-1-27.

Inspection and Repair, Cylinder Head

1. Clean the cylinder head, and remove carbon deposits from around the valve heads.

2. Cylinder head core plugs if discolored (rusty), or leaking require changing. Before fitting new plugs remove all old sealer from the cylinder head. Apply sealant G, see "SPECIFICATIONS", to the new plug mating faces, and drive the new plugs into location, Figure 1-1-28.

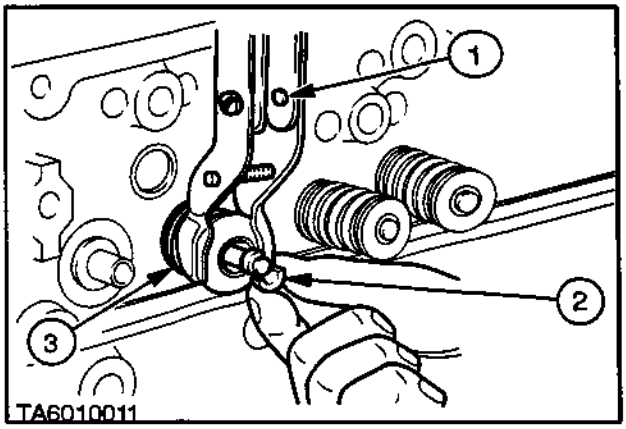


Figure 1-1-27

Core plugs required in the Cylinder Head,

6 of, in the top, and 1 of, in the rear of the cylinder head.
5 of, in the intake face.

3. Scrape all gasket surfaces clean and wash cylinder head in a suitable solvent, also cleaning valve guide bores.

NOTE: *Ensure injector washers have been removed prior to cleaning.*

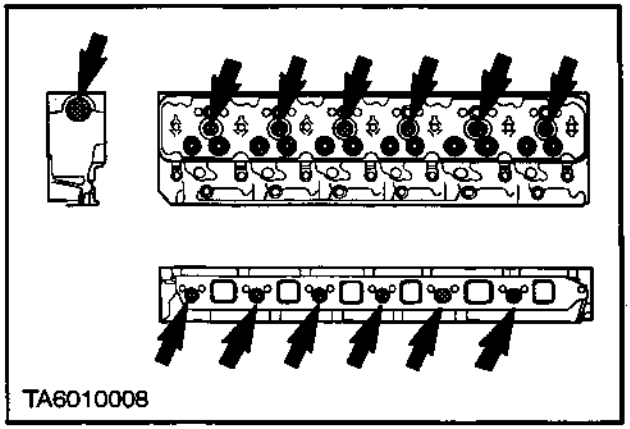


Figure 1-1-28

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4. Inspect cylinder head for nicks and burrs on mating face, Remove using a suitable abrasive and ensure faces are clean after repair.

5. Using a straight edge and feeler gauges, check the flatness of the cylinder head in all directions does not exceed, 0.001 in (0.03mm) in any 1 in (25.4mm), or 0.005 in (0.127mm), overall limit Figure 1-1-29.

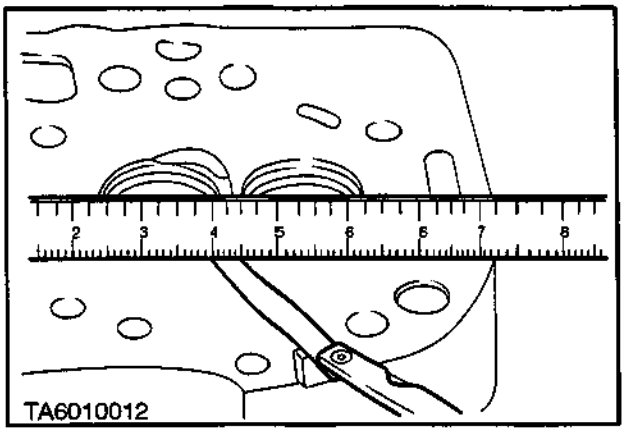


Figure 1-1-29

6. If the cylinder head has been resurfaced, determine all head bolt faces will seat by placing the cylinder head less gasket, on the cylinder block and installing bolts hand tight.

7. Ensure rocker shaft supports are fitted with long bolts. Using a feeler gauge, check clearance between underside of bolt heads and cylinder head or rocker shaft support.

8. If a 0.010 in (0.25mm) feeler gauge can be inserted under the bolt head the bolt has bottomed. Therefore the cylinder block thread must be increased using a 9/16–13 UNC–2A Thread tap. Identify the bolt heads and ensure they are reinstalled in the bolt holes they were checked in.

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Valve Inserts

Insert Oversize	Counter Bore in Cylinder Head	
	Exhaust valve insert	Intake valve insert
0.010 in (0.25mm)	1.739–1.740 in (44.17–44.20mm)	1.969–1.970 in (50.01–50.04mm)
0.020 in (0.58mm)	1.749–1.750 in (44.42–44.45mm)	1.979–1.980 in (50.27–50.29mm)
0.030 in (0.76mm)	1.759–1.760 in (44.68–44.70mm)	1.989–1.990 in (50.52–50.55mm)

NOTE: *Refacing the valve seat should always be co–ordinated with refacing of the valve to ensure a compression tight fit.*

1. Examine the valve seat inserts and reface if pitted, renew if loose or damaged.

2. To install a new valve insert, the cylinder head must be counter bored, as described in the above chart. The new insert must be chilled in dry ice prior to installation.

Valve Seat Specifications, Figure 1-1-30.
1, Valve seat angle,
Intake =30.0°–30.30°
Exhaust =45.0°–45.30°

2, Valve seat width,
Intake =0.078–0.098 in (1.9–2.4mm)
Exhaust =0.072–0.092 in (1.8–2.3mm)

3, Valve Head Face to Cylinder Head Face Depth,
Intake =0.034–0.052 in (0.86–1.32mm)
Exhaust =0.047–0.065 in (1.2–1.6mm)

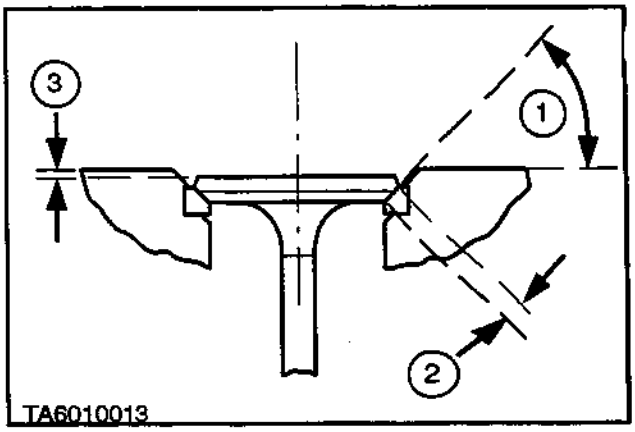


Figure 1-1-30

NOTE: *Valve inserts of 0.010 in (0.25mm) and 0.020 in (0.5mm) oversize on diameter are sometimes installed during manufacture. Cylinder Heads with oversize inserts are stamped so10/os, so20/os, on the exhaust manifold side in line with the valve seat concerned.*

3. Check the width of the valve seat inserts, and as required reface by grinding to dimensions detailed above.

4. Measure the concentricity of valve seats, using a dial indicator and measure concentricity of seat to the valve guide bore.
Total Indicator Reading should not exceed 0.002 in (0.051mm), Figure 1-1-31.

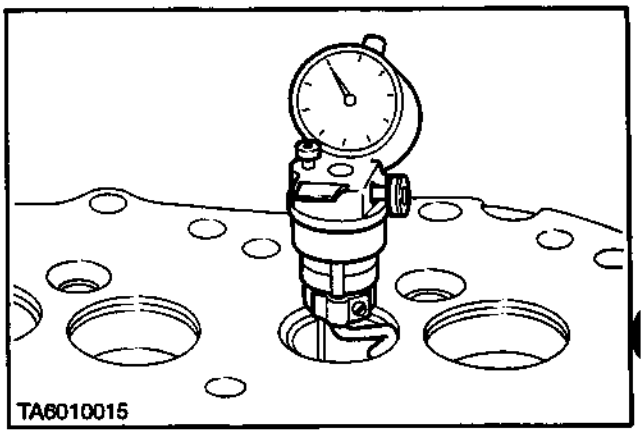


Figure 1-1-31

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5. Use a seat cutter to correct any seat eccentricity, or clean up of pits and grooves. Ensure after any rework that seat width is within specified limits.

6. Rotate a new or refaced valve in the seat using engineering blue, ensure all the blue is transferred to the valve head protrusion, If any blue remains below or around the seat raise or lower the seat accordingly, Figure 1-1-32, in the following manner.

Lower, the valve seats, item 1 Figure 1-1-32, by removing material from the top of seat using a 30° grinding wheel for Exhaust valves and a 15° grinding wheel for Intake valves.

Raise, the valve seats, item 2 Figure 1-1-32, by removing material from the bottom of seat using a, 60° grinding wheel for Exhaust valves and a 45° grinding wheel for Intake valves.

Critical valve points, Figure 1-1-33:
1. Valve land edge
2. Valve head
3. Valve face angle
4. Valve face
5. Valve stem
6. Valve tip

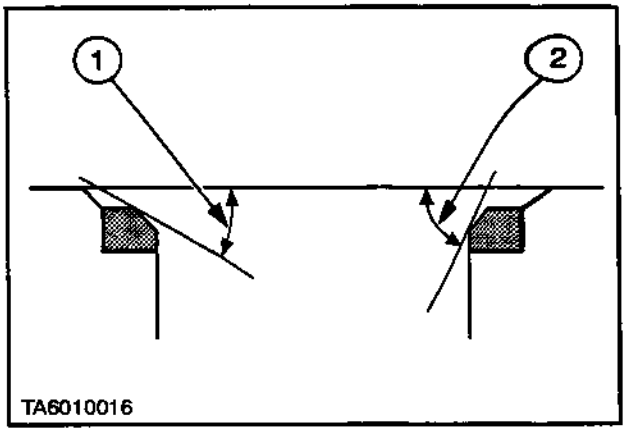


Figure 1-1-32

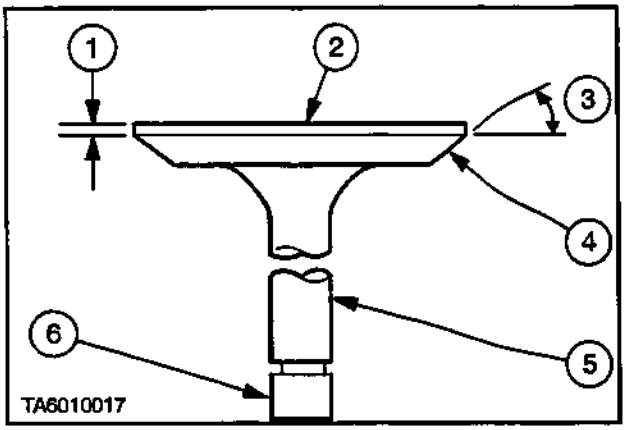


Figure 1-1-33

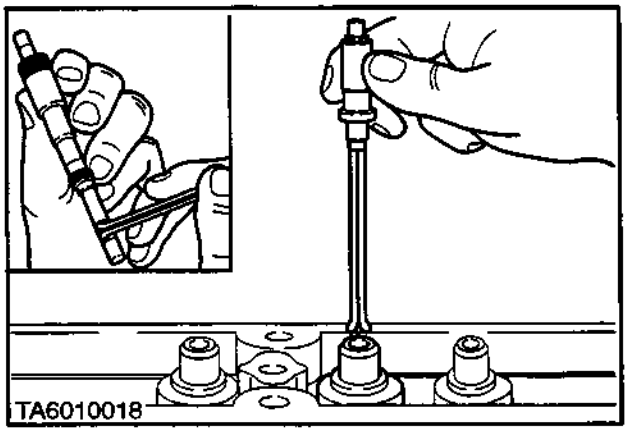


Figure 1-1-34

Valve Guides

1. Using a telescopic gauge, and micrometer, measure the valve guide bore clearance, and ensure it does not exceed,
0.0009–0.0027 in (0.023–0.069mm),
on the intake valve stem,
0.0019–0.0037 in (0.048–0.094mm),
on the exhaust valve stem, Figure 1-1-34.

NOTE: *Production cylinder heads may have one or more machined, oversize valve guide bores, or valves installed, 0.015 in (0.38mm). Such cylinder heads have 15 or VO15OS stamped on the cylinder head exhaust manifold side adjacent to the valve concerned.*

2. Using reamer set, FNH02136, ream out the valve stem guide, with three reamer and pilot combinations as follows:–

3. When going from a standard valve stem to an oversize, always use reamers in sequence.

0.003 in (0.076mm) oversize reamer, and standard diameter pilot.

0.015 in (0.38mm) oversize reamer, and 0.003 in (0.076mm) oversize pilot.

0.030 in (0.76mm) oversize reamer, and 0.015 in (0.38mm) oversize pilot.

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Valve Springs

1. Checked on a flat surface squareness should not exceed 0.060 in (1.52mm), between the square, and spring at the top edge, Figure 1-1-35.

Length of valve springs should be checked on both free length, and loaded length.

Free length = 2.39 in (60.7mm)

Installed length =1.86–1.95 in (47.2–49.5mm)

Loaded length = 1.9 in (48.26mm) using a weight of 62–68 lb (28–31 kg)

Loaded length = 1.4 in (35.69mm) using a weight of 135–153 lb (61–69 kg)

Ensure the valve spring retainer locks are in good condition, and replace if worn or damaged.

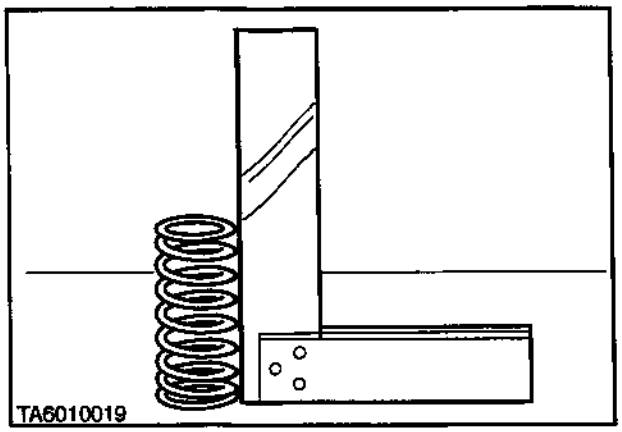


Figure 1-1-35

Rocker Shaft Inspection and Reassembly

1. Inspect rocker arm adjusting screws, and push rod ends of the rocker arm, including the ball end of the screws for nicks, damage, or excessive wear, Figure 1-1-36.

2. Also inspect the inside diameter of the rocker arm for damage or wear. If any of these characteristics are not to specification replace with new parts.

3. Check the ends of the push rods for damage or wear. If not to specification or push rods were found not to be straight during dismantling install new rods.

NOTE: *Do not attempt to straighten bent push rods, replace with new.*

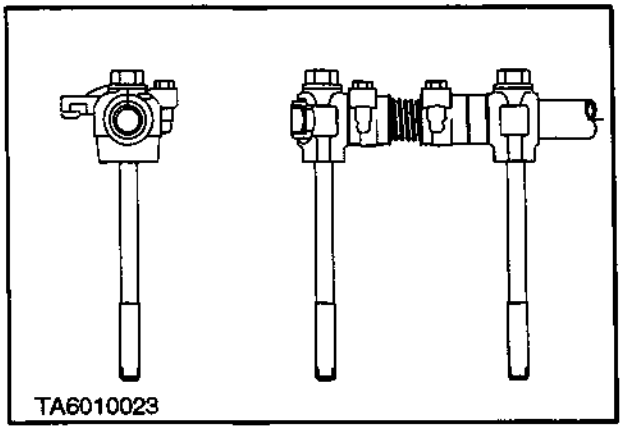


Figure 1-1-36

4. Check the rocker shaft for signs of wear or damage, on internal and external diameters respectively. If not to specification replace with new. If re–used, before reassembly clean thoroughly in solvent making sure all oil passages are clear.

5. Position the shaft identification groove, forwards and upwards. This ensures oil grooves and holes face downwards.

6. Assemble rocker shaft support with long head bolts, ensuring springs and spacers are re–assembled as in, Figure 1-1-37.

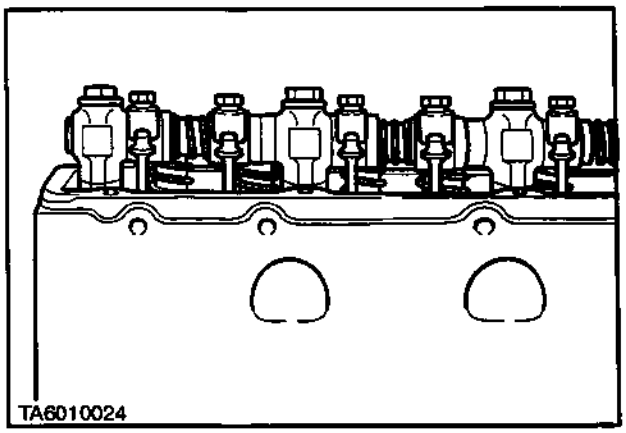


Figure 1-1-37

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CYLINDER HEAD RE–ASSEMBLY

1. Insert the valves into the guide bores from which they were removed and lap with a suitable paste, ensure all traces of paste are removed after lapping.
   Figure 1-1-38: A=Exhaust B=Inlet

2. Lubricate all components with clean engine oil on re–assembly. Use a spring compressor to reassemble the valves, valve springs, retainers, rotators, and collets, and install new umbrella seals.

3. Coat all components with clean engine oil prior to assembly, and insert each push rod into its original position, ensuring each ball end is seated in its cam follower, Figure 1-1-36.

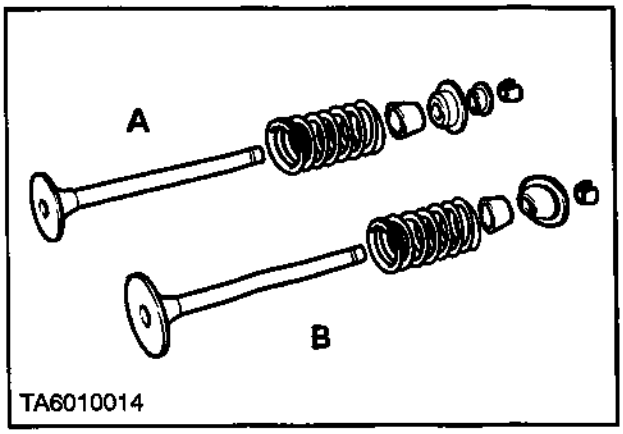


Figure 1-1-38

CYLINDER HEAD INSTALLATION

Installation of the cylinder head assembly and components is the reverse of the removal procedure, observing the following,

1. Install new cylinder head, intake and exhaust manifold gaskets, Figure 1-1-39.

NOTE: *Ensure exhaust manifold gasket is fitted correctly to suit profile of exhaust ports.*

2. Tighten the cylinder head bolts in sequence progressively in three stages, Figure 1-1-40.

Stage1, 115 ft. lbs. (156N m)

Stage2, 140 ft. lbs. (190N m)

Stage3, 160 ft. lbs. (217N m)

NOTE: *Bolts to be lubricated prior to assembly, and should be tightened to torque specification, with the engine cold.*

3. Adjust valve clearance setting with each piston in turn at Top Dead Center, and rockers free to move, Figure 1-1-41.

Intake Valve clearance,
0.014–0.018 in (0.36–0.46mm).

Exhaust Valve clearance,
0.017–0.021 in (0.43–0.53mm).

NOTE: *Valve clearance is to be set, only when the engine is cold.*

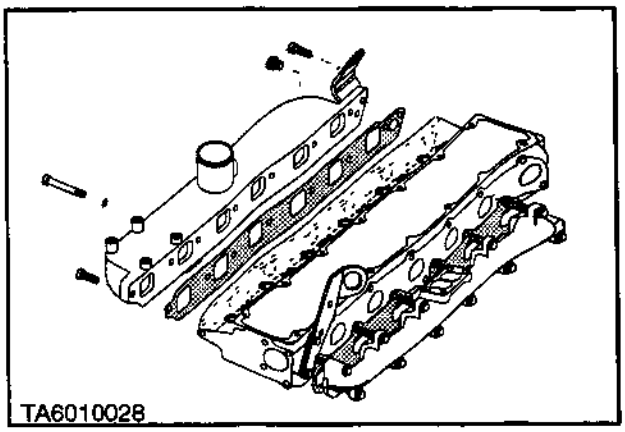


Figure 1-1-39

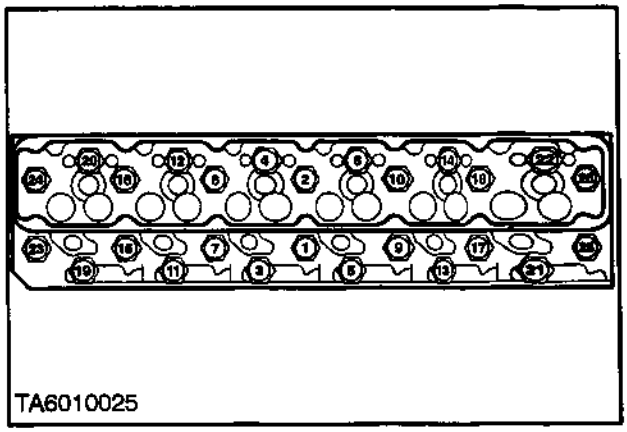
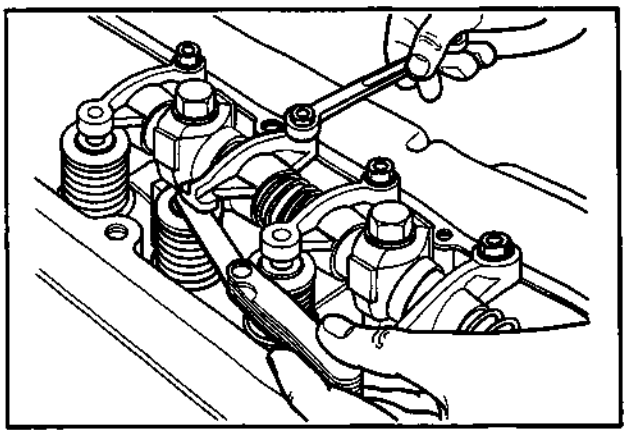


Figure 1-1-40


Figure 1-1-41

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4. Install the injectors with new seat washers, cork seals, and torque to 17 ft. lbs. (23N m) Figure 1-1-42.

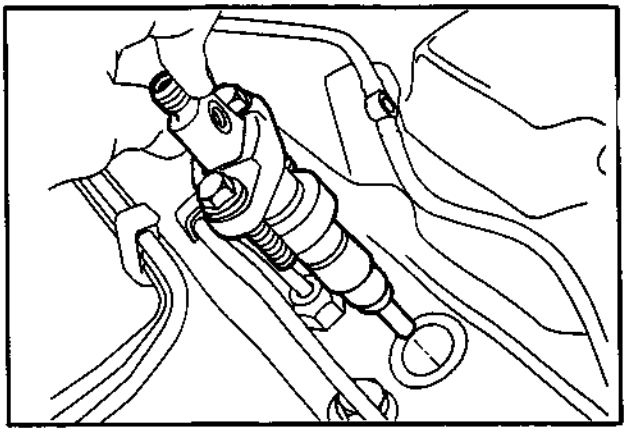


Figure 1-1-42

5. Install the injector lines and torque to 18 ft. lbs. (24Nm). Install the leak off line with new washers, and torque the leak off banjo bolts to, 53 in. lbs. (6Nm).

NOTE: *Hold the leak off plastic tubing when tightening to prevent the pipes pivoting, during torque up.*

6. Exhaust manifold bolts are to be refitted and tightened to a torque of 28 ft. lbs. (38Nm).

7. Intake manifold bolts are to be refitted and tightened to a torque of 28 ft. lbs. (38Nm).

ENGINE FRONT COVER AND TIMING GEAR REMOVAL

NOTE: *Timing cover and gears can only be serviced after removing the radiator.*

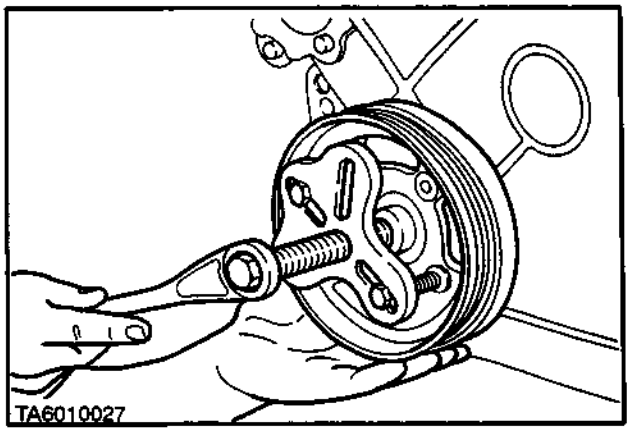


Figure 1-1-43

1. Remove the fan belt, and tensioner, and withdraw the bolt and washer, from the crankshaft pulley.

2. Using puller, FNH09539, and shaft protector FNH09212, remove pulley, spacer and O–ring from the shaft, Figure 1-1-43.

3. Withdraw the bolts retaining the front cover plate, and remove the front plate(1), Figure 1-1-44.

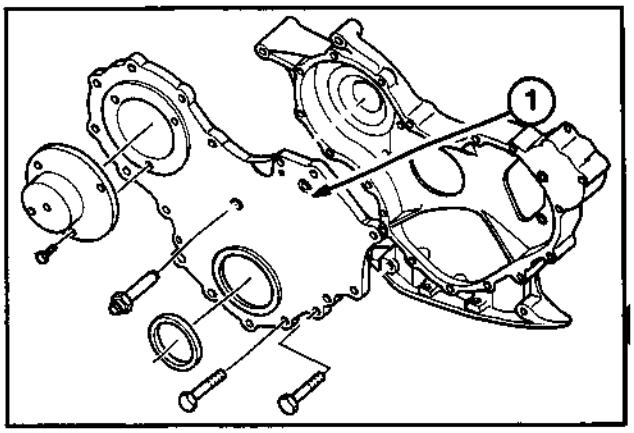


Figure 1-1-44

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NOTE: *The crankshaft timing gear (1), Figure 1-1-45, should not be removed. The gear is heat shrunk on to the crankshaft and aligned to the crankshaft No1 pin, to within 0.004 in (0.10mm). If the gear is damaged a new crankshaft is required.*

4. Before removing the timing gears use a dial indicator or feeler gauge, Figure 1-1-45, to measure the backlash between each set of gears.

5. Rotate the gears and check the backlash at four equal points on the gears. Renew if the backlash exceeds the following:–

Backlash to crankshaft gear,
0.004–0.014 in (0.10–0.35mm)

Backlash to camshaft gear,
0.008–0.022 in (0.20–0.56mm)

Backlash to fuel injection pump gear,
0.004–0.006 in (0.10–0.15mm)

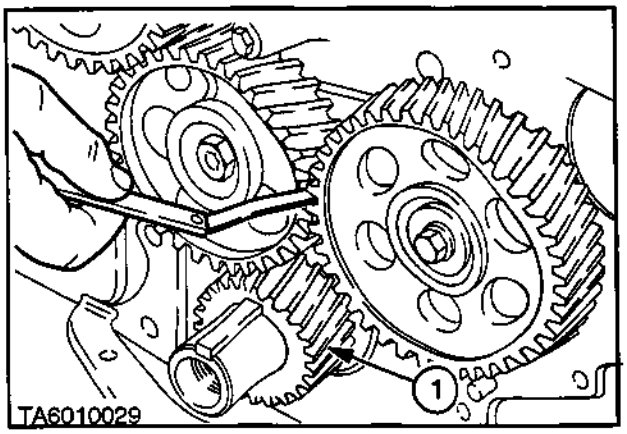


Figure 1-1-45

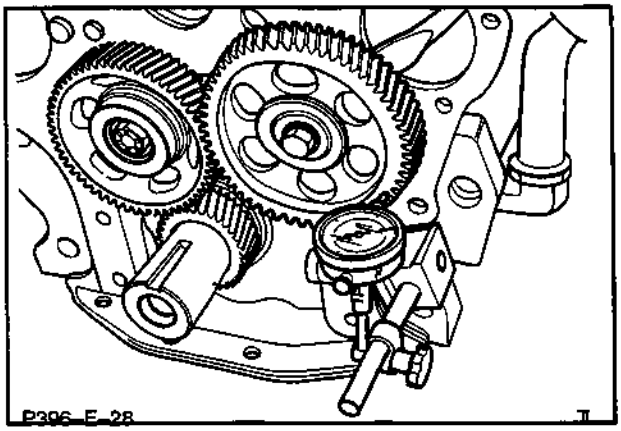


Figure 1-1-46

CAMSHAFT and FUEL INJECTION PUMP DRIVE GEARS REMOVAL

1. Pry the camshaft gear using a lever, away from thrust plate. Using a dial indicator or feeler gauge, check the clearance, Figure 1-1-46, if outside of 0.002–0.007 in (0.076–0.180mm) limit, fit a new camshaft thrust plate, item 1, Figure 1-1-47.

2. Remove the camshaft idler gear retaining bolt, gear, and adaptor from the block, then remove the camshaft gear bolt and disassemble.

3. Remove retaining nut, and washer from the fuel pump and remove the gear from the shaft. Manufacture a suitable gear puller (1) Figure 1-1-48, as shown in Special Tools listing, marked 295042.

4. If required the timing gear rear cover may now be removed. Remove the six retaining bolts and carefully pry the cover from the engine block.

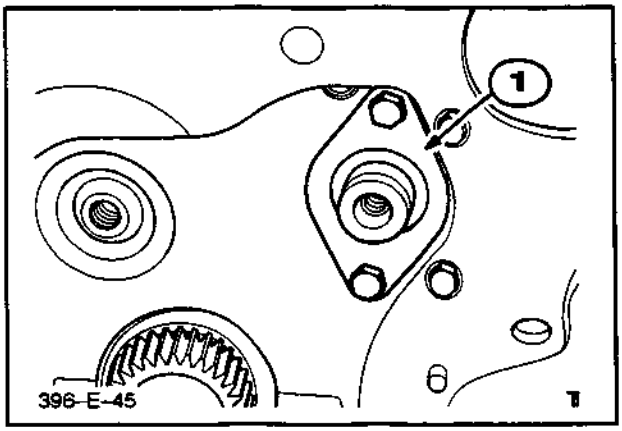


Figure 1-1-47

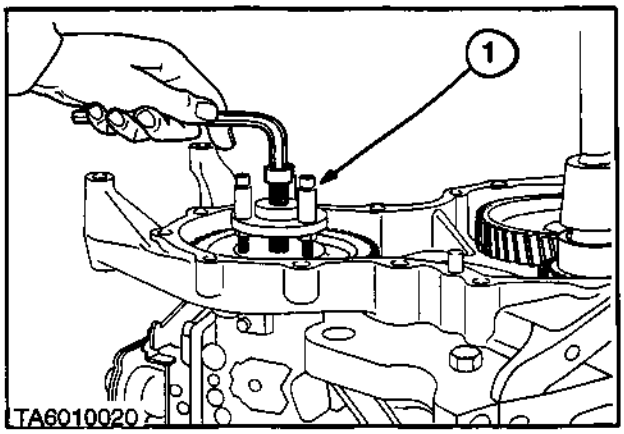


Figure 1-1-48

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Inspection and repair of gears

1. Wash the gears using a suitable solvent, and examine gear teeth for wear, burrs, or scratches. Minor marks can be removed using a fine abrasive, thoroughly clean before re–assembly.

2. Ensure the camshaft idler gear adaptor is free from obstruction and bushing is not damaged. Camshaft key and key–way should be checked for damage and repaired as required.

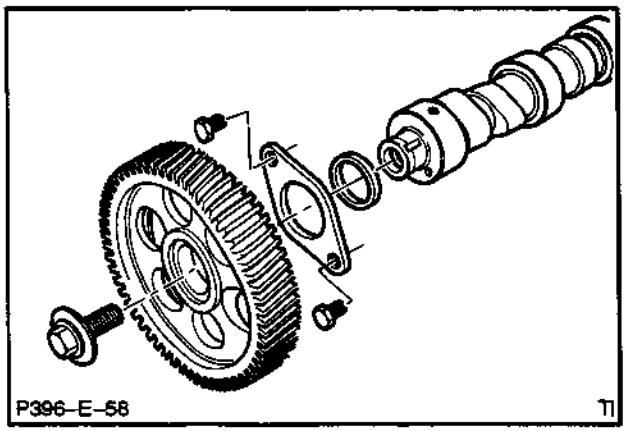


Figure 1-1-49

Installation

1. If the rear cover was removed thoroughly clean the mating surfaces between the cover and engine block, using a suitable solvent cleaner and carefully apply a thin bead, approximately 0.079 in (2mm), of the recommended flexible gasket sealant, Type 'L', to the cover. Assemble the cover to the engine and tighten the two lower retaining bolts to a torque of 28ft. lbs. (37Nm), and the remaining four bolts to a torque of 18ft. lbs. (24Nm)

2. Position piston no.1 at Top Dead Center, install the spacer, key, and camshaft gear, and tighten to 51 ft. lbs. (69N m) Figure 1-1-49.

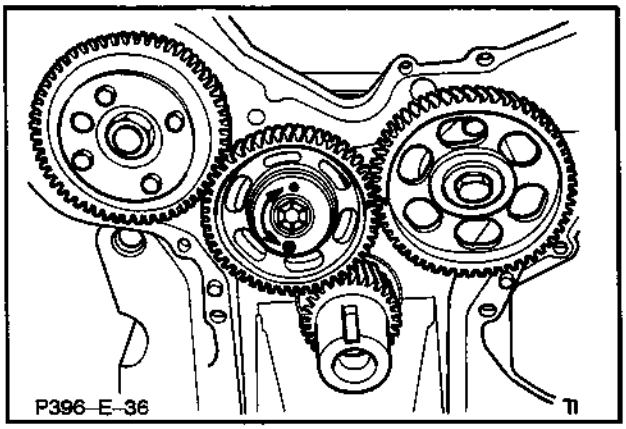


Figure 1-1-50

3. Install the camshaft idler gear to the block, aligning the timing marks to the crankshaft and camshaft gears. Install the eccentric adjuster into the idler gear and initially position the larger of the two holes of the eccentric in the 6–9 O,Clock position, relative to the oil pan face of the block.

4. With piston No1 at Top Dead Center, assemble the 'LOCKED' pre–timed fuel injection pump with a new 'O' ring, aligning the mark on pump flange to the timing mark on the front cover. Torque pump retaining bolts to 18 ft. lbs. (24Nm). Install the pump gear over the pump shaft. Assemble the washer and nut to the shaft, leaving loose at this stage to allow the gear to rotate freely on the pump shaft. Holding the idler gear, check the backlash between the pump and idler gear with a feeler gauge or dial indicator. If the backlash is outside the specification of 0.004–0.006in (0.010–0.015mm), rotate the eccentric until the backlash is correct and tighten the idler gear retaining bolt to a torque value of 180 ft. lbs. (242Nm).

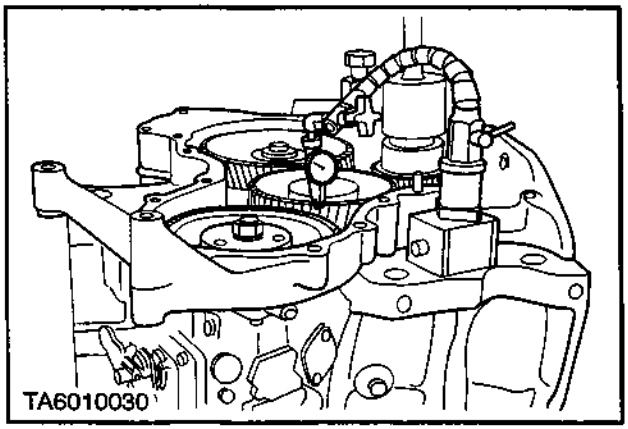


Figure 1-1-51

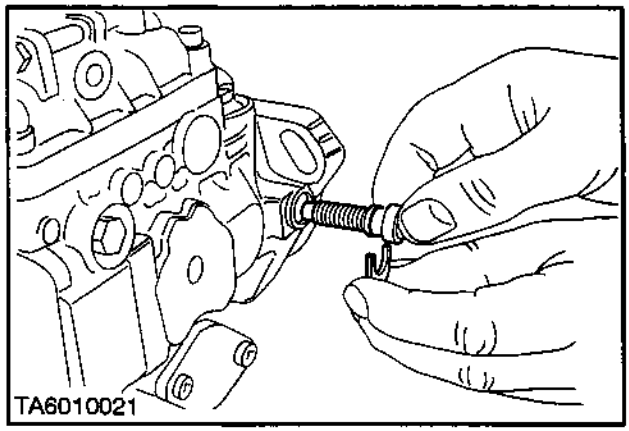


Figure 1-1-52

NOTE: *DO NOT TIGHTEN THE INJECTION PUMP SHAFT NUT AT THIS STAGE. PROCEED TO REASSEMBLE THE FRONT COVER.*

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5. The front oil seal should be replaced, every time the front plate is removed. Drive out the old seal using a punch taking care not to damage the front plate.

6. Coat a new seal in a suitable lubricant, and drive the seal into the rear of the front plate using Tool No 630–16 as in Figure 1-1-53. Alternatively use Tool No T87T–6019–A, and drive the seal into position from the front of the plate.

7. Thoroughly clean the mating surfaces between the cover and plate using a suitable solvent cleaner and carefully apply a thin bead, approximately 0.079 in (2mm), of the recommended flexible gasket sealant, Type 'L', to the front plate. Assemble the plate to the cover and tighten the retaining bolts to a torque of 28ft. lbs. (37Nm).

8. Lubricate the crankshaft, fitting a new 'O' ring(1) first, slide the pulley spacer(2) over the key(4). Place pulley(3), Figure 1-1-55, onto the crankshaft and push fully home, tightening the securing bolt to 210 ft. lbs. (284Nm).
NOTE: *Gentle and careful heating of the center of the pulley will assist fitment. Do not overheat as the damper assembly will be damaged.*

9. Rotate the crankshaft two revolutions, stopping with the cover pointer aligned with either the 6° or 6.5° marking on the front pulley, depending on engine type. (See Note below).

10. Initially tighten the injection pump gear nut to a torque of 15ft. lbs. (20Nm), while holding the gear in a counter clockwise position to remove backlash from gears. 'UNLOCK' the pump by releasing the locking bolt and installing the spacer between the pump body and bolt head. The pump gear retaining nut can now be fully tightened to a torque value of 68ft. lbs. (92Nm).

***NOTE:** Fuel pump (injection) timing is set at 6° Before Top Dead Center (BTDC) for 8160, 8260 and 8360 and 6.5° BTDC on the 8560 model.*

11. Install the access cover for the injection pump gear nut. Clean surfaces and apply a 0.079 in (2mm) bead of flexible gasket sealant, type 'L'. Tighten the retaining bolts to 28ft. lbs. (37Nm).

12. Install the radiator and refill with the specified quantity and type of coolant fluid.

Pulley Timing Mark to Pointer Check, Figure 1-1-56

The degrees BTDC timing, can be equated to a piston depth, using number 2 cylinder, to verify pulley to pointer timing marks. The Number 2 cylinder dimensions are:

Models	**Piston depth, (A)**
8160–8260 (6°)	4.205 in (106.81mm)
8360 (6°)	4.227 in (107.37mm)
8560 (6.5°)	4.274 in (108.56mm)

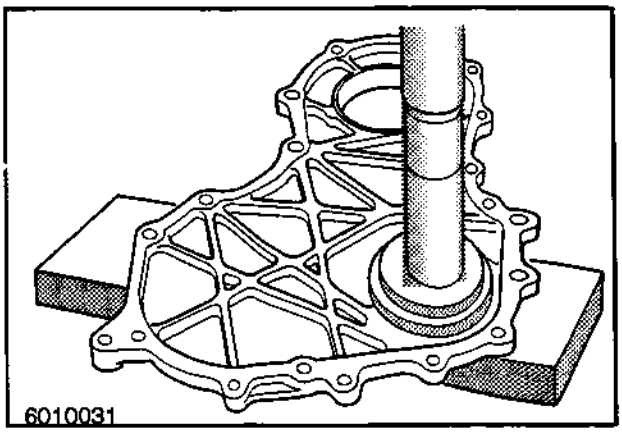


Figure 1-1-53

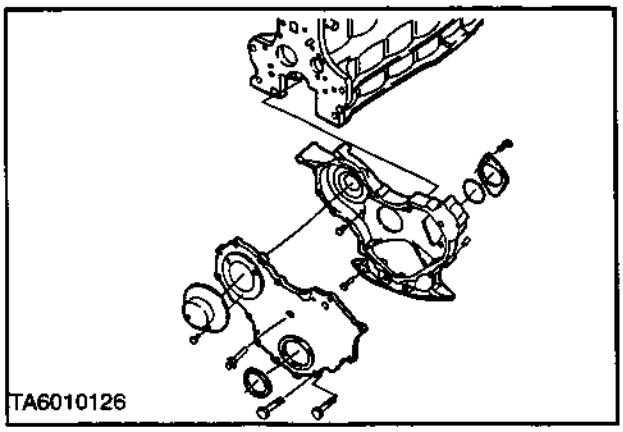


Figure 1-1-54

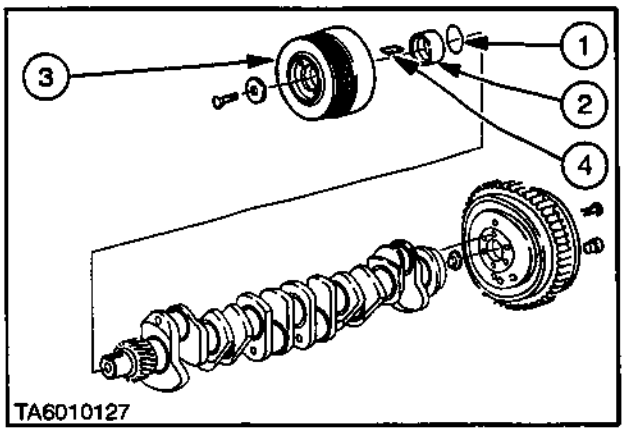


Figure 1-1-55

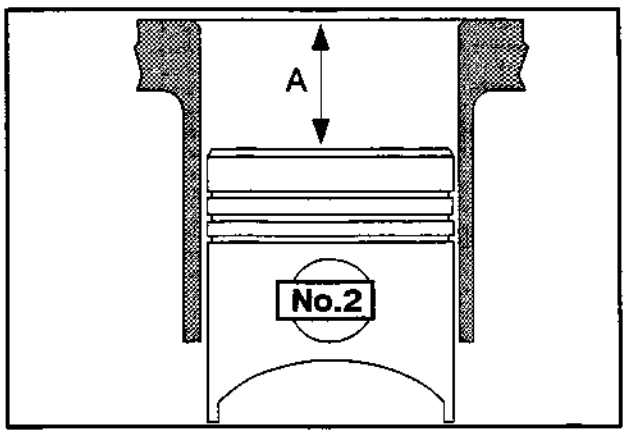


Figure 1-1-56

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OIL PAN REMOVAL

⚠ WARNING ⚠

Due to the weight of the oil pan it is recommended that a hydraulic jack is used to support and lower the oil pan to the ground.

NOTE: *It is necessary to move the front support forward a couple of inches to allow removal of the oil pan. Refer to engine removal at begining of chapter.*

1. Drain engine oil through oil pan plug and remove oil level indicator.
2. Remove oil pan bolts including those through the transmission and lower to ground.

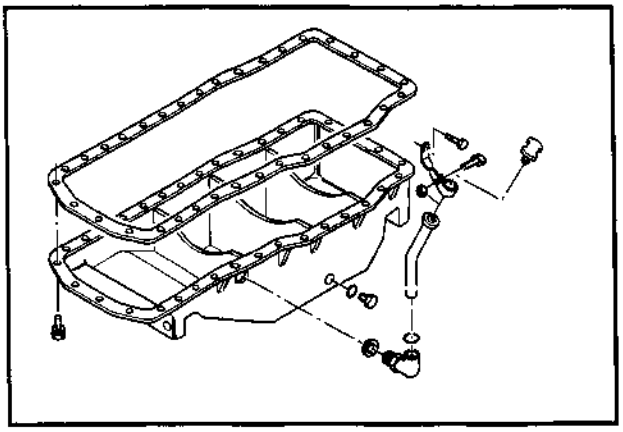


Figure 1-1-57

Inspection and repair

1. Clean gasket material from sump face, clean sump in a suitable solvent, inspect sump for cracks damaged threads or damaged sump face.

Installation

1. Installation is the reverse of removal but with the following requirements.
2. Ensure block face is clean and free of gasket material. Install a new gasket to the oil pan. Ensure sealer is applied to the front plate, and rear oil seal joints.
3. Position the oil pan and install a bolt at each corner finger tight to hold in position, install remaining bolts, and torque to 28 ft. lbs. (38N m).

CONNECTING RODS, BEARINGS, PISTONS, AND RINGS REMOVAL

NOTE: *The connecting rods and pistons can be removed with the engine installed after removal of the cylinder head and oil pan sump .*

1. With cylinder head removed clean off any ridge from the top of the cylinder bores, with a ridge remover to enable removal of the pistons, this is essential if old pistons are to be re–used as failure to do so could result in ring land damage.
2. With the piston at the bottom of the stroke remove the end cap bolts, cap, and liner. Using the handle end of a hammer push the piston assembly out through the top of the block, and remove the bearing liner from the connecting rod, 1-1-59.

NOTE: *Bearing caps and liners must be kept with their respective connecting rods.*

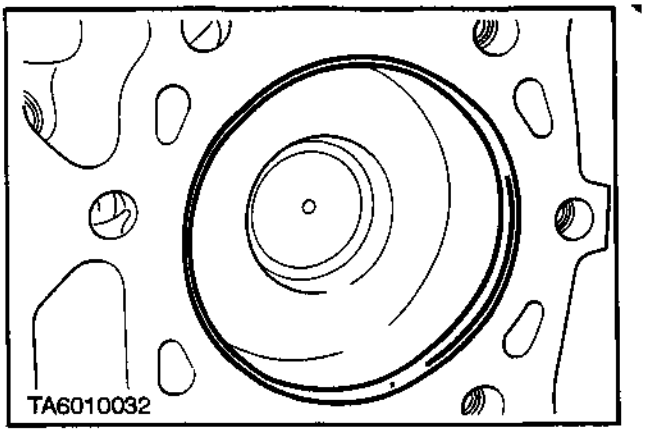


Figure 1-1-58

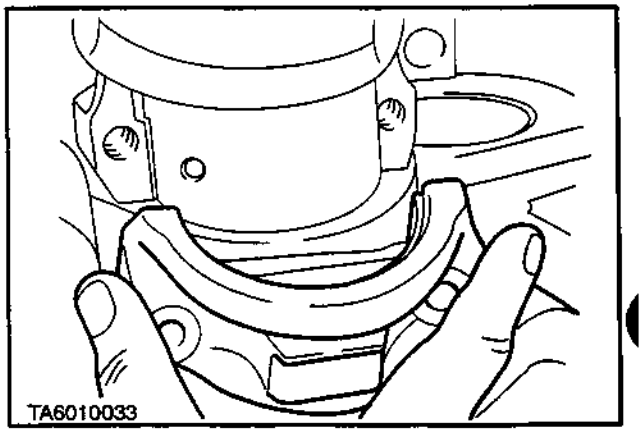


Figure 1-1-59

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3. Turn the crankshaft again and repeat the process for the remaining pistons.

4. Remove piston pin snap rings from each side of piston and remove pin. Using an expander, remove the piston rings.

5. Ensure each piston and rod assembly, remains matched together for re–assembly into the cylinder block.

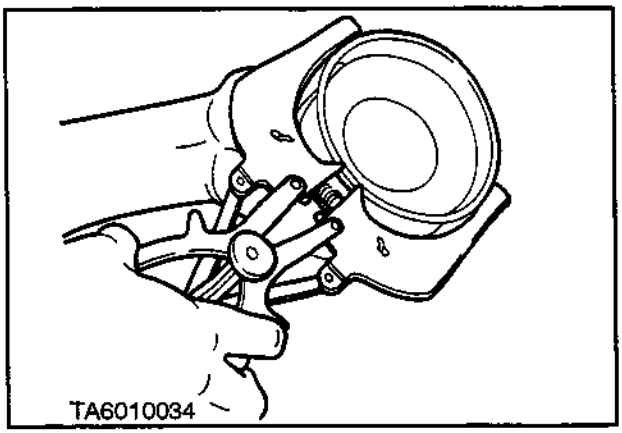


Figure 1-1-60

Inspection and Repair

1. Clean the piston, and connecting rod assembly, in a suitable solvent and inspect for damage to ring lands, skirts, or pin bosses.

2. Check connecting rod components for damage, and place in an alignment fixture to check for distortion, and ensure that any distortion, is within specification as follows.

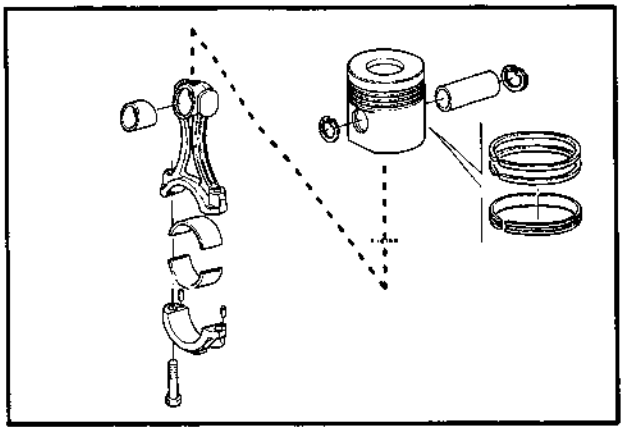


Figure 1-1-61

Maximum Twist 0.012 in (0.30mm).

Maximum Bend 0.004 in (0.10mm).

3. Check piston pin bushing for damage or wear in the following manner.

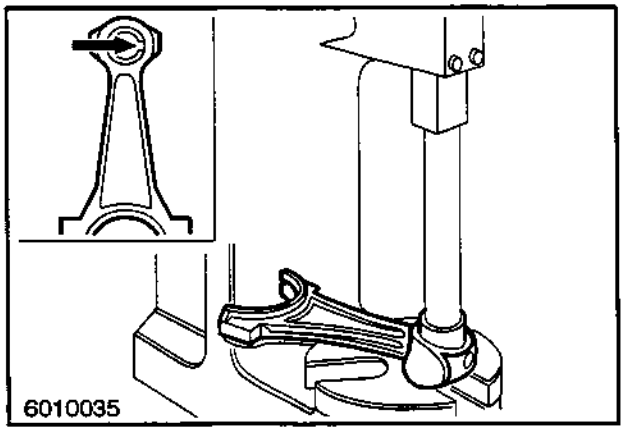


Figure 1-1-62

Measure the outside diameter of the piston pin, and inside diameter of the connecting rod bushing, to the following:–

Piston Pin Outside Diameter

Naturally Aspirated,
1.4998–1.500 in (38.095–38.100mm).
Turbocharged,
1.6248–1.625 in (41.270–41.275mm).

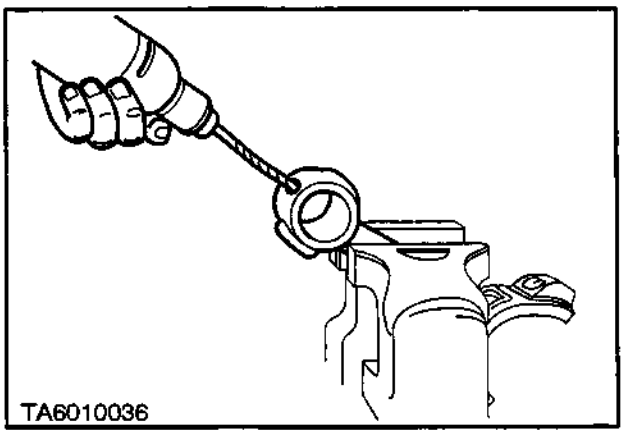


Figure 1-1-63

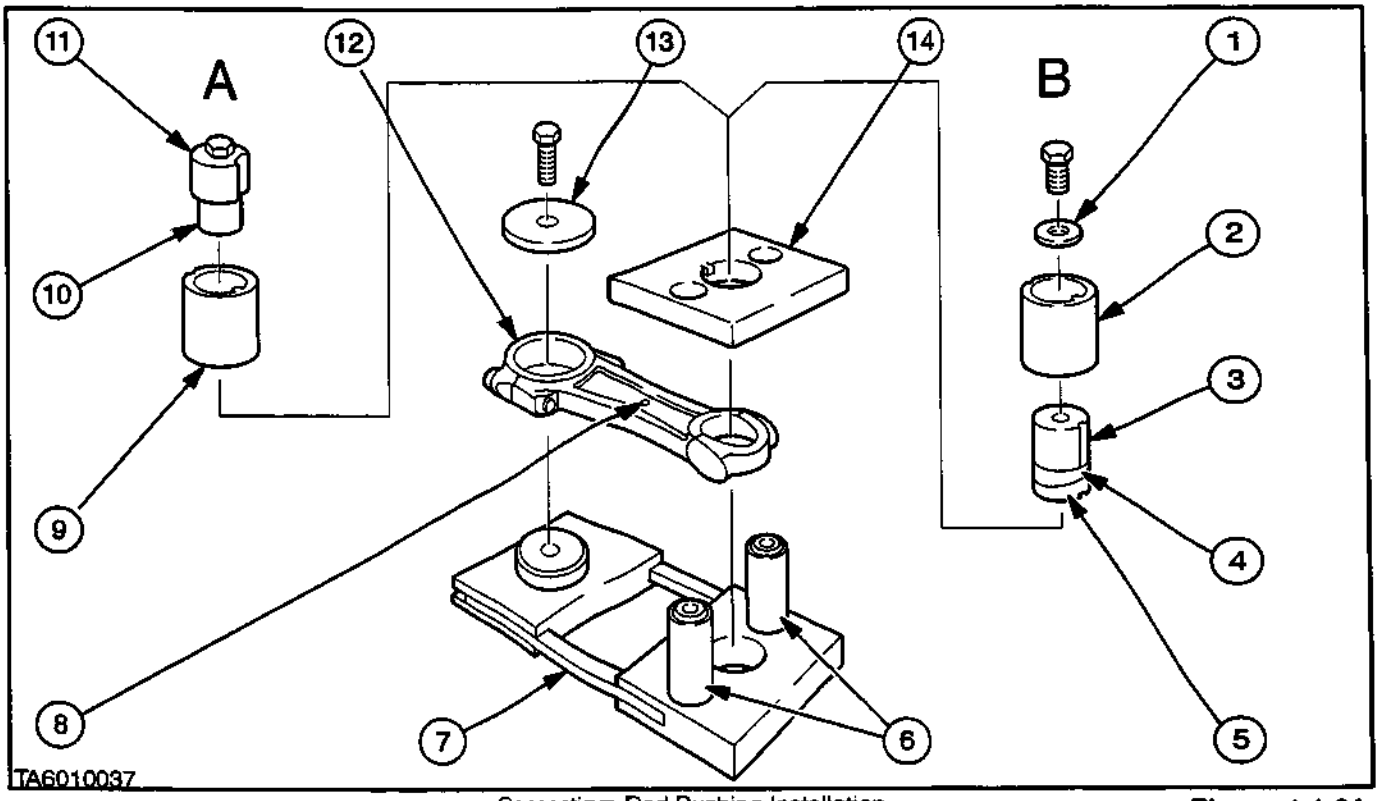
Connecting Rod Bushing Internal Diameter

Naturally Aspirated,
1.5005–1.5008 in (38.113–38.120mm).
Turbocharged,
1.6255–1.6258 in (41.288–41.295mm)

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CONNECTING ROD BUSHING



Connecting Rod Bushing Installation

Figure 1-1-64

A – Removal

1. Washer
2. Collar
3. Installation Insert 1
4. Bushing
5. Installation Insert 2
6. Pins
7. Fixture
8. Connecting Rod Facing up
9. Remover Insert 1
10. Remover Insert 2

B – Installation

11. Remover Insert 3
12. Connecting Rod Location
13. Washer
14. Location Plate

4. If not to specification use tool No FNH 00053, and press out the old bushing using the removal fixture as shown in, Figure 1-1-64. Press fit a new bushing through the fixture using the installation detail, and into the connecting rod as shown in, Figure 1-1-64. After fitting a new bushing ensure all sharp edges and burrs are removed.

NOTE: *Ensure the split in the small end bushing is at right angles to center line of connecting rod, Figure 1-1-62.*

5. Where special tooling is not available for the removal or fitment of the connecting rod bushing, a standard bushing can be fitted in the following manner, Figure 1-1-62.

6. Place the connecting rod securely in a bench press. Manufacture from suitable bar stock, a press tool with the end face ground at an angle, to suit the connecting rod bushing side face. Position the tool on the bushing, and gently drive the bushing from its position. It is recommended a guide is manufactured to assist alignment of the bar stock during this operation.

7. A new bushing can then be fitted in a similar manner, by using a suitable piece of bar stock, with an end face machined flat to suit the standard parallel bushing. Use a guide as described, and gently drive in the new bushing into the connecting rod.

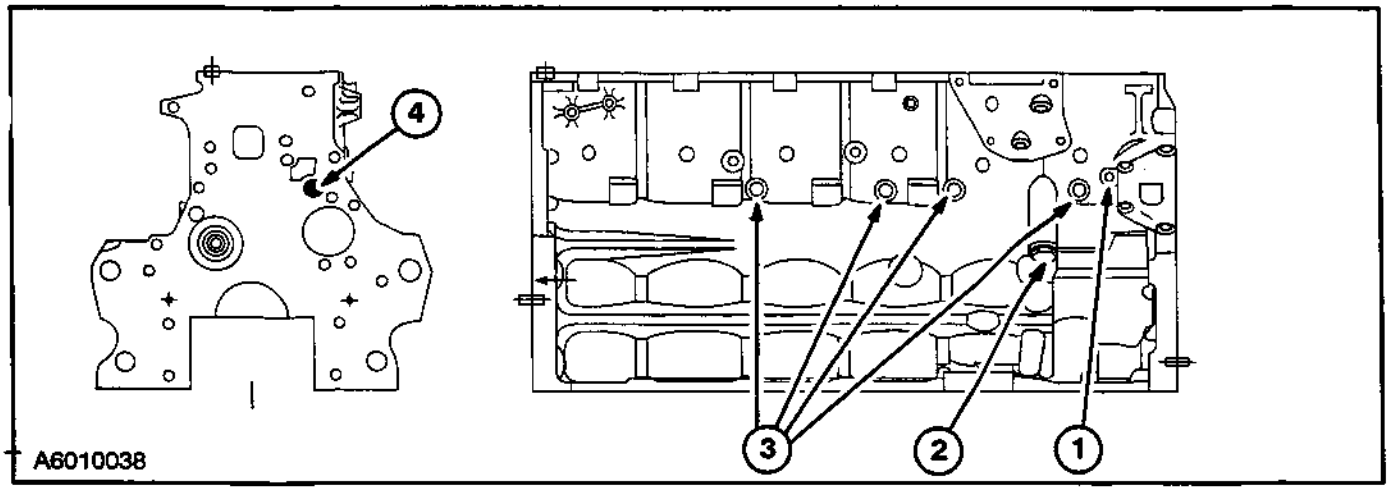
8. After installation grind the side faces of the new bushing to match the side faces of the connecting rod. Ensure all sharp edges are removed, and loose chippings are cleaned from the connecting rod before re–assembly into the engine.

9. With a new bushing fitted drill a hole through the top of the connecting rod using a 0.187 in (4.7mm) bit. Drill through the existing oil hole, Figure 1-1-63.

10. Use an expanding reamer to obtain correct bushing to piston pin clearance referring to specification section. Remove burrs, and chippings, before refitting.

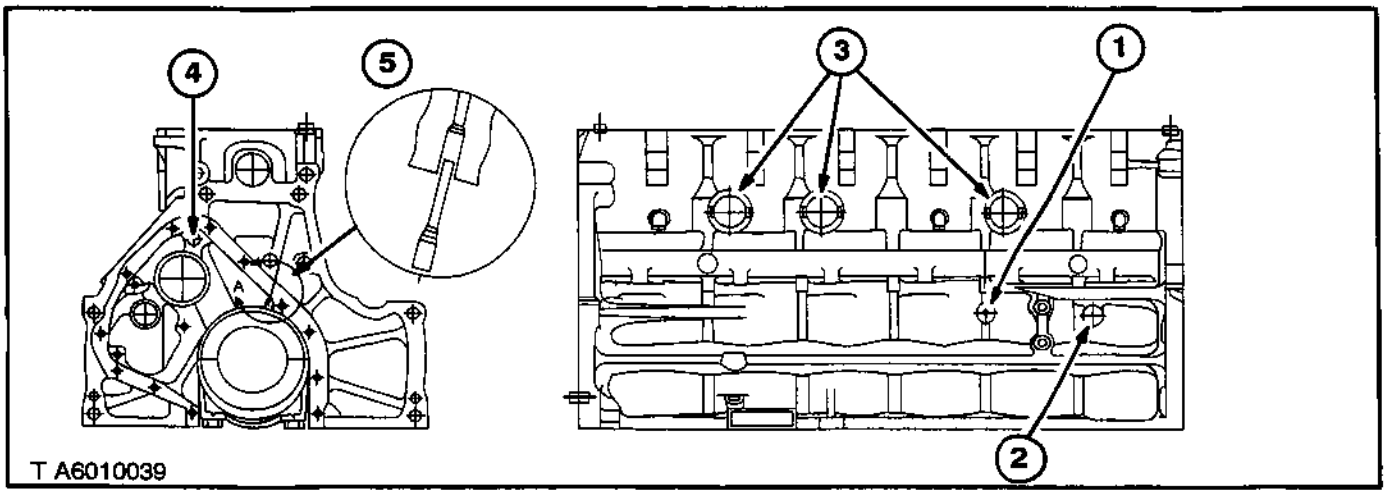
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Cylinder Block Core Plug and Sensor Ports, Front and Left Hand Side

Figure 1-1-65



Cylinder Block Core Plug and Sensor Ports, Rear and Right Hand Side

Figure 1-1-66

CYLINDER BLOCK OVERHAUL

1. Cylinder block plugs, and senders, require changing if leaking or rusty, and must be replaced. Clean the old sealant off the block, and fit new plugs with sealer.
   Figure 1-1-65, refers to the front and left hand side of the cylinder block.

NOTE: *New part mating faces, and threads, should be coated in sealant, refer to "Specifications". Assemble in the following manner.*

Plug (1) torque to 6–10 ft. lbs. (8–14N m)
Use sealant, E.

Plug (2) torque 20–35 ft lbs. (27–47Nm)
Use sealant, E.

Pipe Plug(3) torque to 18–25 ft. lbs. (24–34N m)
Use sealant, E.

Plug (4) drive in to block. Use sealant G.

2. Figure 1-1-66, refers to the rear and right hand side of the block.

Pipe plug (1) torque to 6–10 ft. lbs. (8–14N m).
Use sealant, E.

Pipe plug (2) torque to 18–25 ft. lbs. (24–34N m).
Use sealant, E.

Plug (3) drive into block.
Use sealant, G.

Plug (4) torque to 40–60 ft. lbs. (54–81N m), Use sealant, E.

Oil Jets (5) replace with new if damaged, apply engine oil only on re–assembly "Do not use sealant".

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CYLINDER BORE

1. Check the cylinder bore for scuffing or rings around the ring travel area. Irregularities can be felt by running a finger over the surface. To check out–of–roundness, wear, or taper, use a telescopic gauge, Figure 1-1-67.

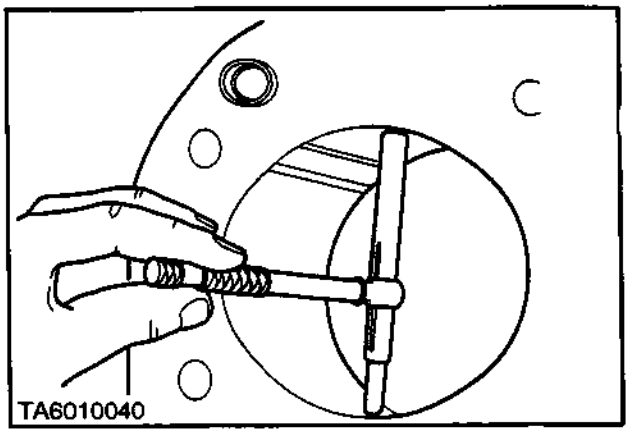


Figure 1-1-67

Measure lengthwise,
A to B, and C to D, and compare dimensions. Variances between the readings will indicate "taper".

Measure crosswise,
C to D, and compare dimensions lengthwise. A to B. Variances will indicate an out–of–round condition.

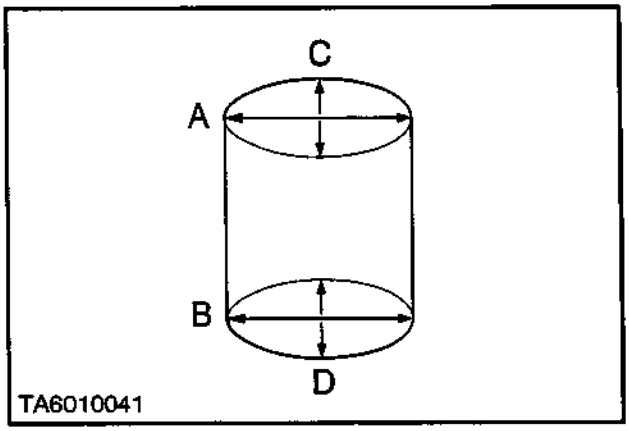


Figure 1-1-68

Specifications

NOTE: *'Repair Limit' refers to the tolerance allowed after a repair has been performed, i.e. the repair must be within the repair limit. The 'Wear Limit' is the tolerance prior to repair.*

Taper of cylinder bore,
repair limit– 0.001 in (0.025mm)
wear limit – 0.005 in (0.127mm)

Cylinder bore out of round,
repair limit – 0.0015 in (0.03mm)
wear limit– 0.005 in (0.127mm)

Cylinder bore diameter,
4.4007–4.4032 in (111.778–111.841mm).

1. Where only minor imperfections exist and bores are to specification, hone the bores prior to installing new piston rings. Provided piston to bore clearance, does not exceed 0.011 in (0.250mm).

2. Sleeving of the cylinder bores becomes expedient when.
   –Oil consumption is high.
   –Replacing sleeves, installed in service.
   –Cylinder bore is damaged beyond re–boring limits.

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SLEEVING – BORING AND HONING

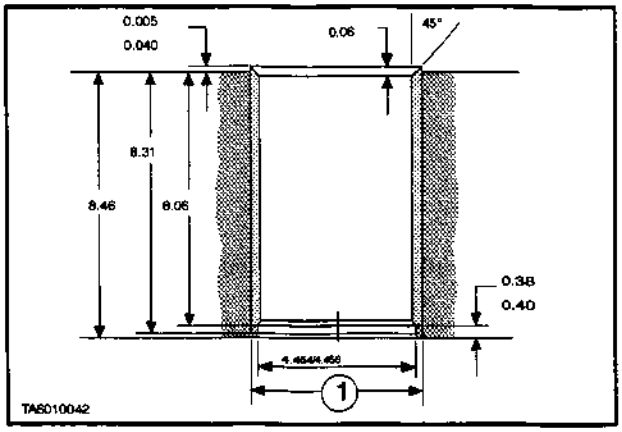


Figure 1-1-69

1. Measure the outside diameter (1) of the sleeve in several places, and average the dimension. Counter bore the cylinder block (see step 2) using the average dimension to obtain a press fit, between bore and sleeve. Interference of sleeve to the cylinder bore to be 0.001–0.003 in (0.025–0.076mm), Figure 1-1-69.

2. Counter bore to a depth of 8.06 in (204.7mm), from the block face, surface finish of the bore is not to exceed 3.12×10^{-3} in (80 microns). Leave a step at the bottom of the bore a minimum of 0.38–0.400 in (9.65–10.16mm), allowing for run out of chamfers.

3. Bore through diameter, to the diameter of, 4.454–4.456 in (113.13–113.18mm).

4. Clean the cylinder bores and thoroughly dry.

5. Grease the sleeve with a general purpose grease and press the sleeve home to the lip in the bore. The top of the sleeve should protrude through the top of the block, 0.005–0.040 in (0.127–1.0mm).

6. Bore the sleeve to,
   4.3985–4.400 in (111.72–111.76mm).

7. Skim the block face, and top of sleeves, to achieve the specified flatness of,
   0.003 in (0.08mm) in any 6 in (152mm)
   0.001 in (0.03mm) in any 1 in (25.4mm).
   A chamfer in the internal diameter at the top of the sleeve to 45° x 0.020 in (0.5mm) should be maintained, to prevent piston damage on re–assembly.

8. Break the sharp edge at the bottom of the sleeve prior to honing.

9. Hone the cylinder bore to,
   Grade A, 4.4007–4.4015 in. (111.78–111.80)
   Grade B, 4.4015–4.4023 in. (111.80–111.82)

NOTE: *Surface finish to be an average of 7.8×10^{-4} to 1.2×10^{-3} in (20 to 30 Microns), cross hatched at 35°–55°.*

Maximum Taper,
0.001 in (0.025mm) through to bottom of the bore.

Maximum Ovality,
0.0015 in (0.038mm)

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Re–Assembly

NOTE: *Pistons that are replaced must be of the same type that were removed and have the same identification letters, and numbers, as embossed on the piston crown*

1. Upon re–assembly with the piston at Top Dead Center, ensure the piston to block height is correct using a dial indicator, Figure 1-1-70.

Naturally Aspirated,
0.011–0.023 in (0.28–0.58mm)

Turbocharged,
00.00–0.012 in (0–0.3mm)

2. Check the piston to bore clearance in the following manner.

A, Measure the cylinder bore diameter at point A, 3.25 in. (82.6mm) from the top of the block.

B, Measure the diameter of the piston at point B, 0.98in (25.0mm) turbocharged engine, 1.11in. (28.2mm) normally aspirated engine from the bottom of the piston.

C, Subtract piston diameter from the bore diameter and the resultant figure for a new, unrun engine should be,

0.0055–0.0067 in (0.140–0.171mm)
Naturally Aspirated
0.0065–0.0077 in (0.165–0.196mm)
Turbocharged engines.

After an engine has run and settled down the maximum bore to piston clearance allowed is 0.250mm (0.011 in.).

NOTE: *Pistons are only available as standard. New pistons should always be fitted if the clearance exceeds specification.*

D, If clearance is "greater" try a similar new piston, if limit is still exceeded it will be necessary to rebore and resleeve.

E, If the clearance is "less" hone bore to obtain desired clearance.

3. Lubricate all of the components with engine oil and assemble the connecting rod, and piston, with the letter or grade mark on the piston, aligned to the pip (1), Figure 1-1-72, on the connecting rod. Install the piston pin and retainers.

4. Check the piston ring gap width, using a feeler gauge, in a vertical position at the top, middle, and bottom of the bore, Figure 1-1-73.

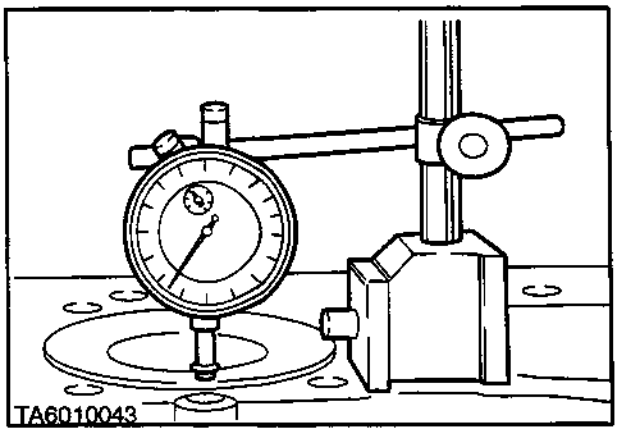


Figure 1-1-70

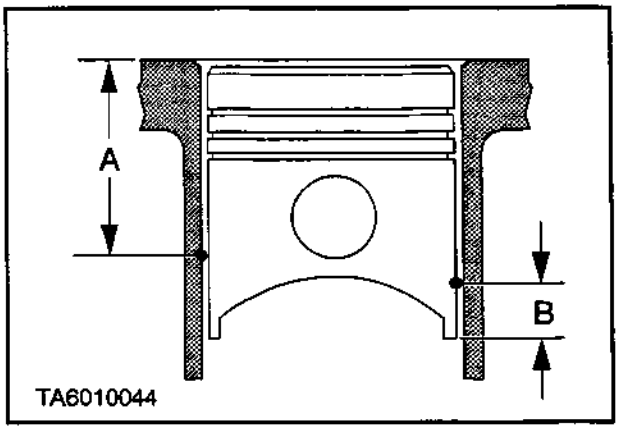


Figure 1-1-71

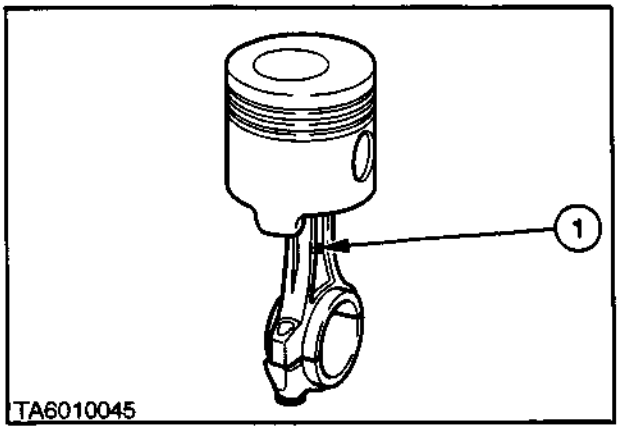


Figure 1-1-72

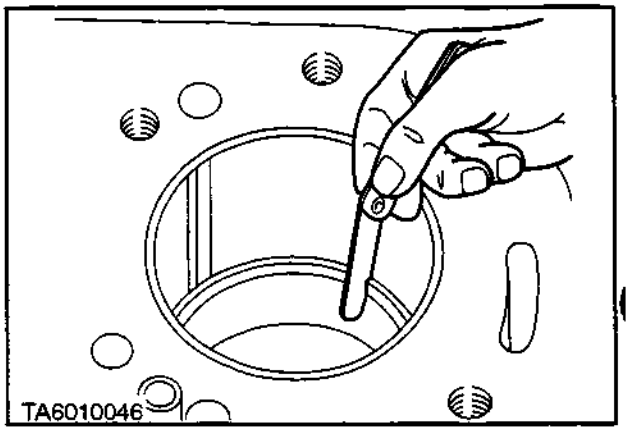


Figure 1-1-73

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Ring Gap Specifications:
0.016–0.036in (0.40–0.90mm), Top compression ring – Turbocharged
0.015–0.033 in (0.38–0.84mm), Top compression ring. – Naturally Aspirated
0.016–0.036in (0.40–0.90mm), 2nd compression ring.
0.016–0.036in (0.40–0.90mm), Oil control ring.

5. Ensure the correct expander is used to remove or install rings, Figure 1-1-74.

6. Using a new piston ring, check with a feeler gauge, the gap between the ring and groove, 1-1-75.

0.0041–0.0060in (0.103–0.153mm), Top compression ring.

0.0030–0.0049in (0.075–0.125mm), 2nd compression ring – Turbocharged.

0.0022–0.0042in (0.055–0.105mm), 2nd compression ring – Naturally Aspirated

0.0016–0.0035in (0.040–0.090mm), Oil control ring.

7. Install the piston rings, but note the following:

8. Install top and second compression rings with the word top towards the top of the piston. Ensure the ring gaps are staggered a minimum of 120° from each other on the diameter, and with no gap on the thrust side of the piston.

Figure 1-1-76 – A = Turbocharged
– B = Naturally Aspirated

NOTE: *Before installing new pistons and rings into a used cylinder bore, remove the high polish from the cylinder walls by honing as previously described.*

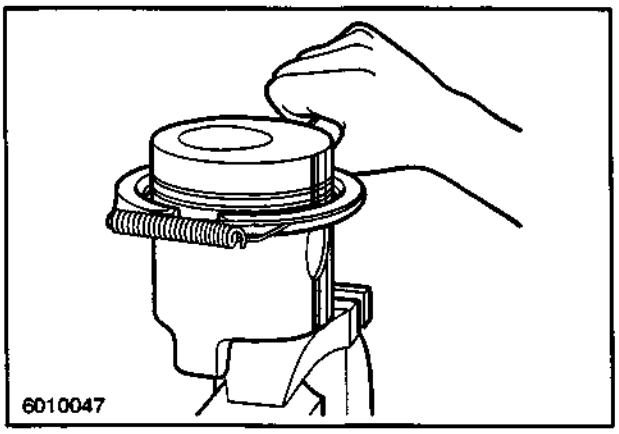


Figure 1-1-74

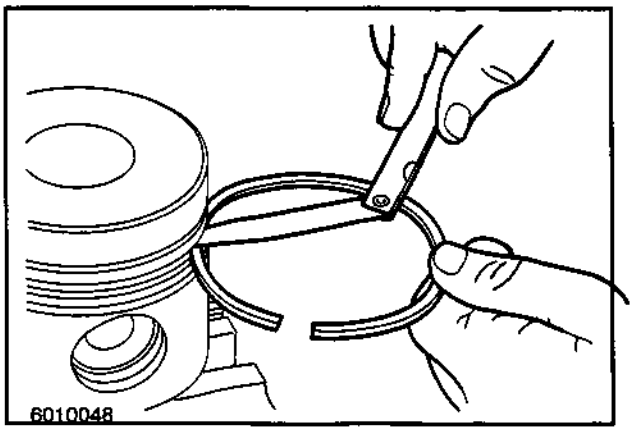


Figure 1-1-75

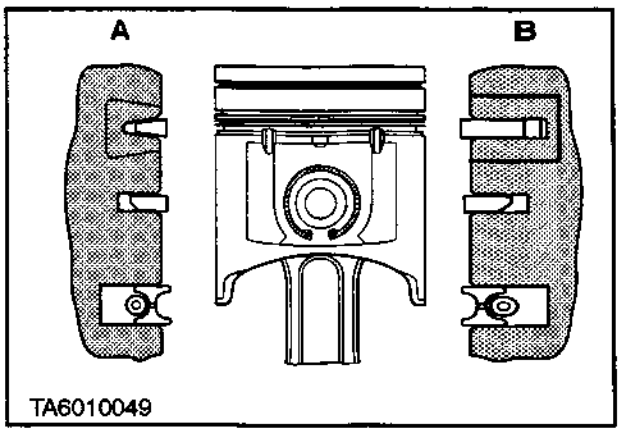


Figure 1-1-76

PISTON ASSEMBLY INSTALLATION, INTO BLOCK

1. Select the correct bearing liners as in the following crankshaft section, and install in the rod and cap, ensure the liner tang locates in the slots of the rod and cap.

2. Turn the crankshaft to position No 1 crankpin at the bottom of the stroke, and lubricate all parts with new engine oil. Using a ring compressor and a soft drive, slide pistons into bores, ensuring grade letter on pistons, is towards the front of the engine, Figure 1-1-77.

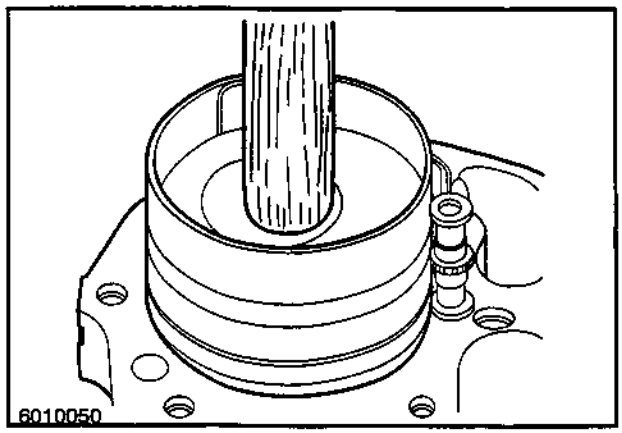


Figure 1-1-77

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3. Ensure the connecting rod bearing liner, seats on the crankpin with the bearing cap fitted, to the connecting rod as a matched assembly. Fit **new** bolts lubricated with oil, and tighten to a torque value of 110 ft. lbs. (149 Nm).

4. Using feeler gauges, check the side clearance of each connecting rod to crankshaft, Figure 1-1-78, 0.005–0.013 in (0.13–0.33mm) and continue for remaining assemblies.

5. Refit the oil pump tube/screen,and oil pan as described, refill engine oil and coolant, and run the engine checking for leaks.

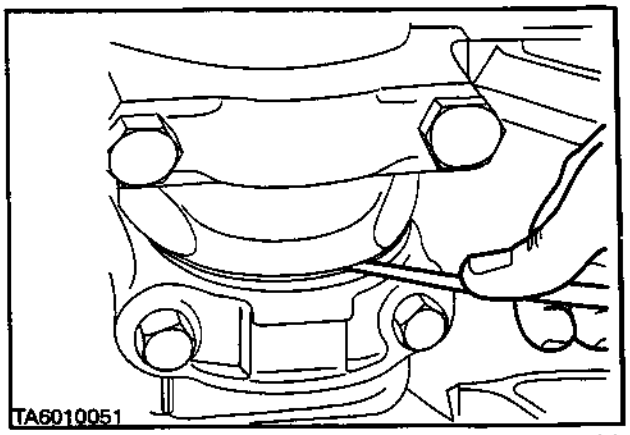
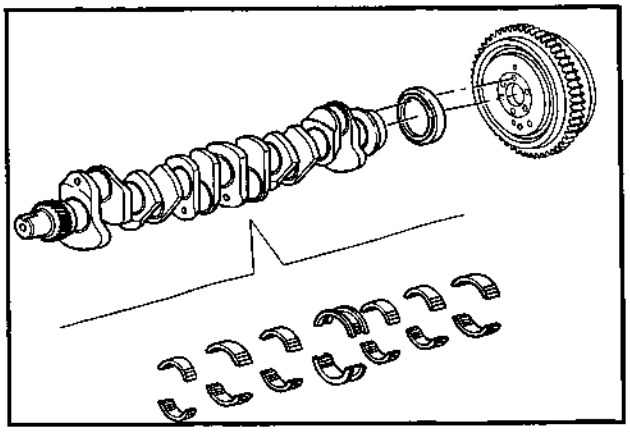


Figure 1-1-78

MAIN BEARINGS, FLYWHEEL, AND CRANKSHAFT

NOTE: *Replaceable bearings are installed in production, to ensure correct crankshaft journal to bearing clearance is maintained in service. The main bearings can be overhauled with the engine in the tractor. The crankshaft can only be serviced after removal from the engine.*

To remove the flywheel, the engine requires to be split from the transmission housing, or removed from the tractor totally.


Figure 1-1-79

MAIN BEARING REMOVAL

1. Remove the oil pan, to gain access to the crankshaft. Remove the main bearing cap from the journal to be repaired; and install only one set at a time. Leave the remainder securely in place.

NOTE: *A bearing removal tool can be fabricated from a 1 in (25mm)x1/8 in (3.18mm) split pin, flatten and bend the head to conform to angle of oil passage in the crankshaft.*

2. Install the bearing removal tool, Figure 1-1-80, in the crankshaft journal oil passage. Turn the crankshaft counter clockwise until the tool forces the bearing out of the cylinder block.

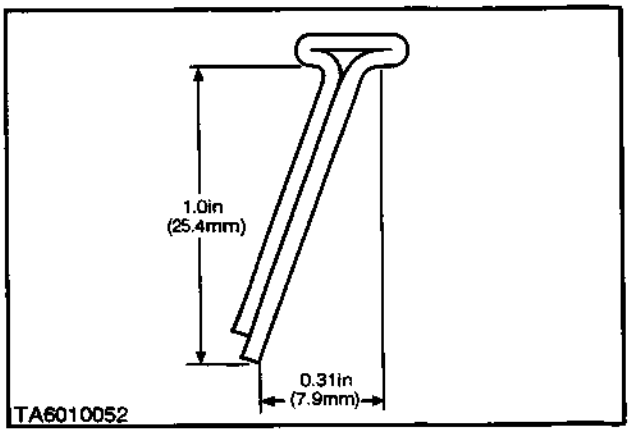


Figure 1-1-80

Inspection and Repair

1. Thoroughly clean bearings, journals, and caps, and inspect for wear, scores, or damage replace as required.

NOTE: *It is recommended that all the main bearings should be replaced if it is found necessary to replace any one set of main bearings.*

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Installation

1. Coat all parts in new engine oil prior to assembly. Position the bearing cap with locking tang, towards the camshaft side of the engine and fit the bolts, tighten evenly to, 140–150 ft. lbs. (190–203Nm).

2. If a new thrust bearing liner is installed the bearing must be aligned as described in the following crankshaft section.

FLYWHEEL REMOVAL

1. To gain access to the flywheel separate the engine to transmission.

2. Prior to removal and using a dial indicator, rotate the flywheel, Figure 1-1-81, and measure to specification 0.005 in (0.127mm) Total Indicator Reading. If not to specification check crankshaft to flywheel seating.

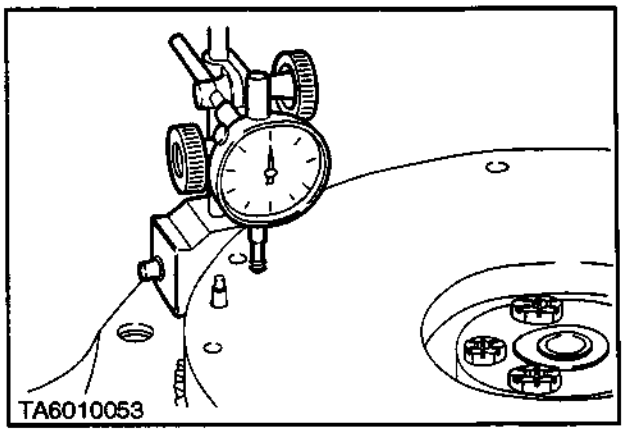


Figure 1-1-81

Inspection and Repair

1. Inspect the flywheel ring gear, and if damaged renew in the following manner,

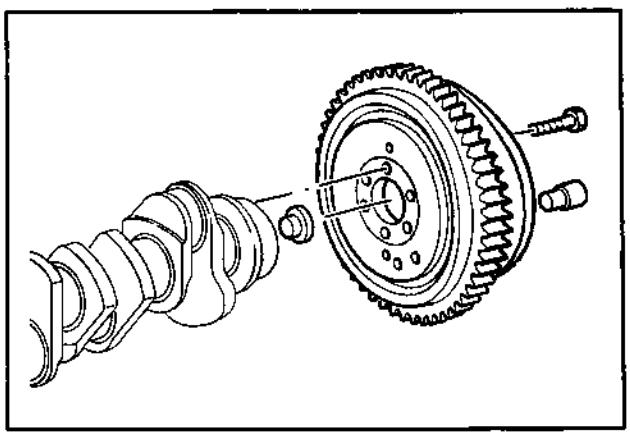
Cut old ring gear free from the flywheel.

Clean the mating surfaces of the new ring gear, and flywheel.

2. Use temperature indicating crayons to mark the side face of the ring gear in six equal places, mark with a 400°F (204°C) crayon at a point 0.5 in (13mm) below the root of the teeth, and mark with a 450°F (212°C) crayon at a point just below root of the teeth.

3. Use an oxy–acetylene torch with a tip size of No.2 maximum, and direct the flame against the internal face of the gear.

4. Quickly place the hot gear on the flywheel, with flat face against the shoulder on the flywheel. The gear to flywheel runout should be checked using a dial indicator and should not exceed a Total Indicator Reading of 0.025 in (0.63mm).


Figure 1-1-82

Installation

1. Clean the crankshaft rear flange and mating surface of the flywheel, and install the flywheel, torque the bolts to, 145 ft. lbs. (197Nm).

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REAR COVER PLATE REMOVAL

1. To gain access to the engine oil pump, camshaft gear, or end of crankshaft remove the oil pan as previously described, and the rear cover, (1), Figure 1-1-83, in the following manner.

Split tractor and remove flywheel as described.

2. With rear of engine exposed loosen and remove the 12 attaching bolts, and gently pry off cover plate.

3. Clean off all sealer, remove crankshaft oil seal, and check for damage or distortion around the sealing faces.

Installation

1. Apply a liberal coating of new engine oil on a new oil seal, and position the rear seal over the end of the crankshaft. Locate tool, No FNH 01301, (1), Figure 1-1-84,on the end of the crankshaft using the three attaching bolts. Tighten evenly, and squarely, until the seal is fully seated.

As an alternative the rear crankshaft oil seal can be installed using the following installation tool.

2. Apply a liberal coating of clean engine oil to the rear seal retainer, seal, and journal. A new seal should be mounted on the crankshaft, then bolt tool 295010, (1), Figure 1-1-85, to the crankshaft end and install the new seal squarely.

3. Secure center stock of tool to crankshaft flange with two screws. Assemble cylinder end plate to center stock and secure with nut and washer as in, Figure 1-1-85. Tighten the nut until outer diameter of tool abuts retainer. Tool must not be over tightened as stress and distortion could be imposed on the retainer.

4. Remove the tool after assembly and check the crankshaft seal run out as shown in, Figure 1-1-86.

NOTE: *The first seal replacement should be pushed into retainer with plain end of tool and subsequent seals with stepped end of tool which will reposition seal 0.060 in (1.52mm) further in.*

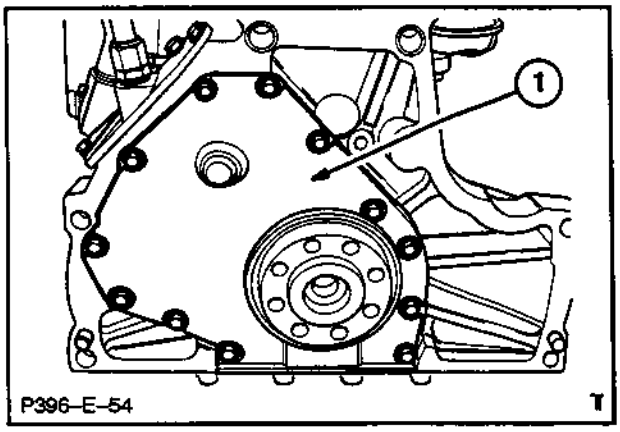


Figure 1-1-83

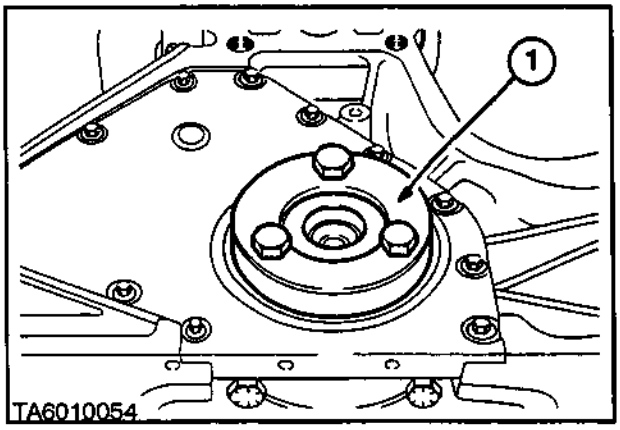


Figure 1-1-84

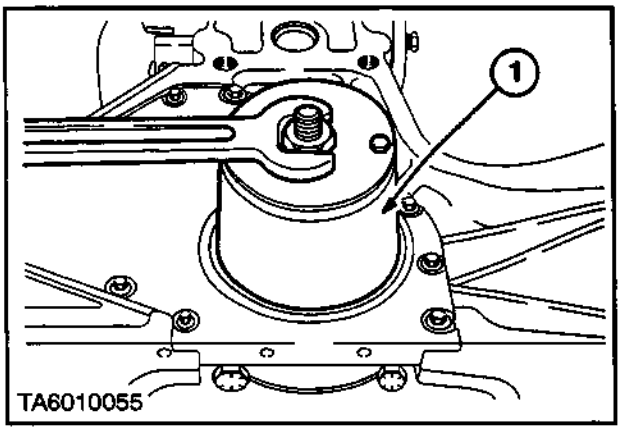


Figure 1-1-85

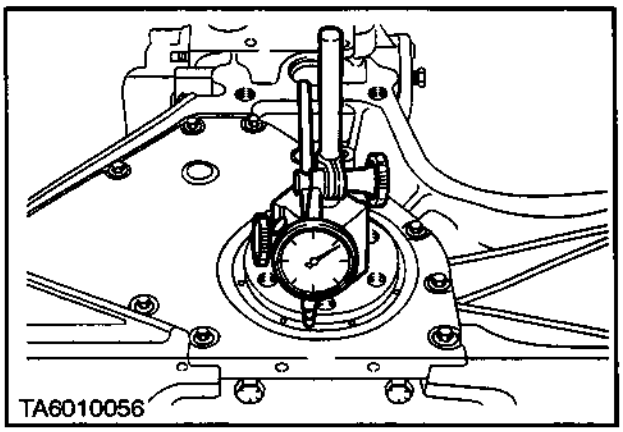


Figure 1-1-86

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5. Ensure rear of block face is clean and free of old sealer, install a new gasket and apply sealer D, to faces (item 1), 1-1-87. With the plate in the recess install and tighten the twelve bolts, in sequence to, 12–17 ft. lbs. (16–23Nm), Figure 1-1-87.

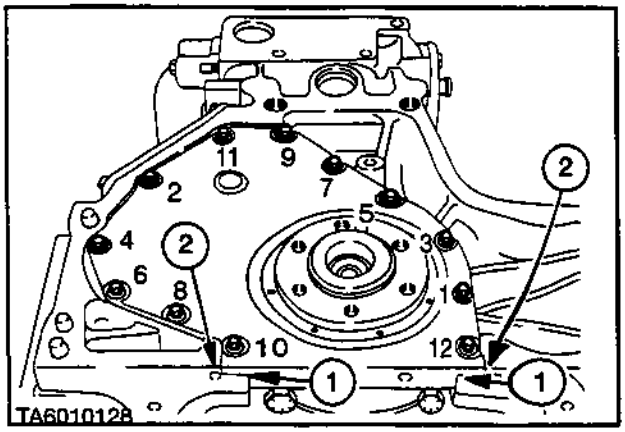


Figure 1-1-87

6. Ensure edges of the retainer and seal assembly are even with edges of block, within 0.003 in (0.08mm), (item 2) Figure 1-1-87. If not to specification, loosen and realign retainer in the recess and repeat the installation procedure.

7. With new crankshaft seal installed, place a dial indicator, on the end of the crankshaft and ensure seal runout is within 0.020 in (0.51mm) Total Indicator Reading, Figure 1-1-88.

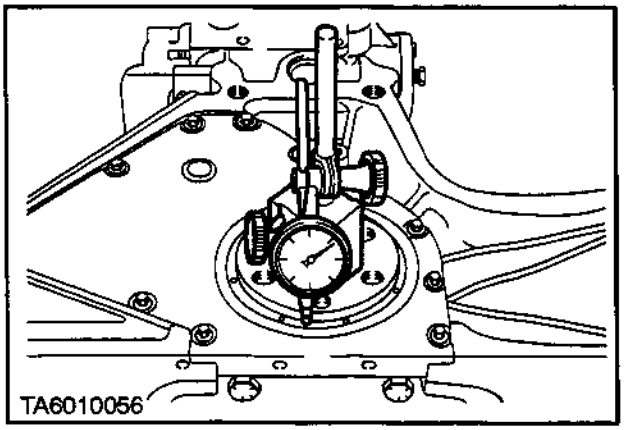


Figure 1-1-88

OIL PUMP REMOVAL

NOTE: *The oil pump can only be removed with the engine split from the transmission, and the flywheel, back plate, engine oil pan, and oil pump tube removed.*

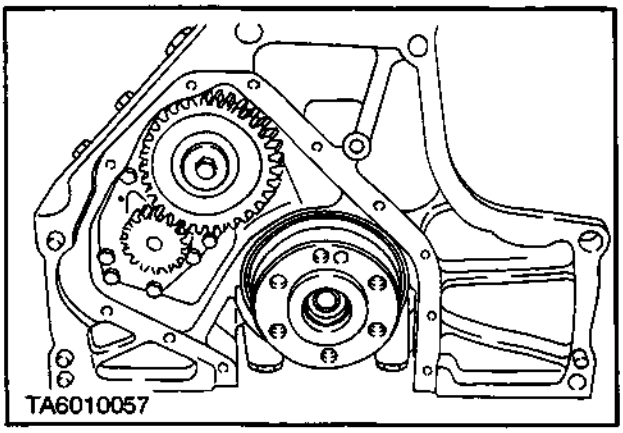


Figure 1-1-89

1. Prior to pump removal check pump gear to camshaft gear backlash does not exceed 0.016–0.022 in (0.40–0.56mm), Figure 1-1-89.

2. Loosen and remove the camshaft gear, to expose the oil pump, detach the 3 pump mounting bolts, and withdraw the pump from the block.

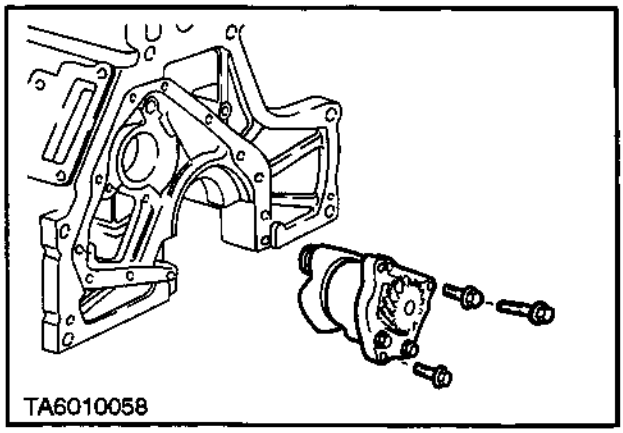


Figure 1-1-90

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Disassembly

1. Loosen and remove the pump face plate to body bolts, 4 of. Disassemble the pump and discard the O–rings, Figure 1-1-91.

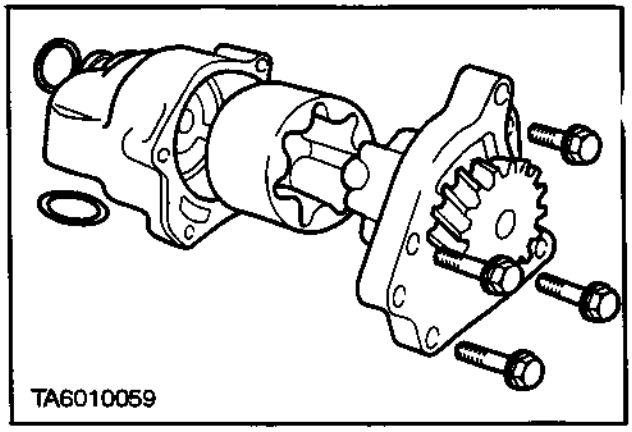


Figure 1-1-91

Inspection and Repair

1. Wash all parts in a suitable solvent and inspect inside of pump plate, and body, for excessive wear or damage. If visually okay check in the following manner.

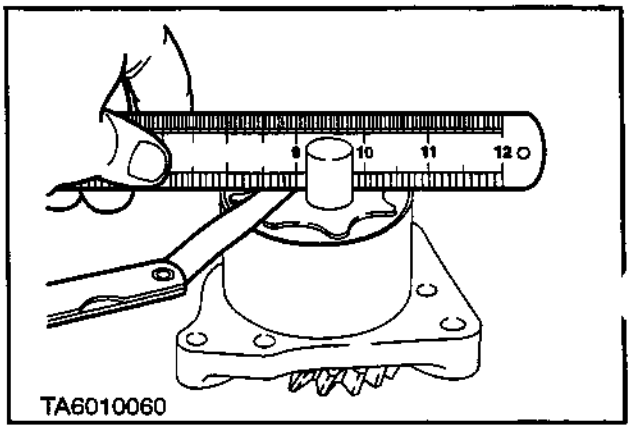


Figure 1-1-92

2. Invert pump plate/rotor assembly, and place outer rotor over inner rotor. Placing a ruler across top of both, slide a feeler gauge, between ruler and inner rotor, gap should be 0.001–0.0035 in (0.025–0.089 mm), Figure 1-1-92.

3. Place outer rotor in pump body and check clearance, by inserting a feeler gauge between the rotor and body. Check to a maximum of 0.022 in (0.55mm), Figure 1-1-93. If exceeded a new pump is required.

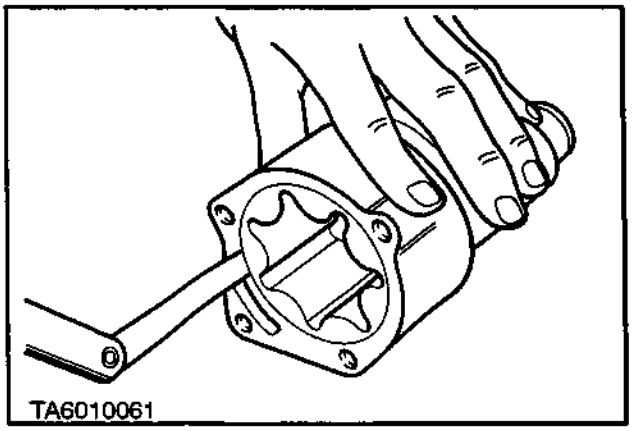


Figure 1-1-93

NOTE: *If not to specification replace the oil pump, as reduced pump pressure through wear could result in reduced engine life.*

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Installation

1. Clean and coat parts in new engine oil. Place outer rotor in pump body, and ensure free rotation. Insert inner rotor, and pump plate assembly, into the body and ensure that shaft is fully seated into bushing.

2. Assemble the front plate to the body and torque the retaining bolts to, 17–21 ft. lbs. (23.0–28.4Nm).

NOTE: *After tightening ensure the drive gear rotates freely by hand, at least 5 revolutions, if not "disassemble" and repeat the exercise.*

3. Fit a new O–Ring, item 1, Figure 1-1-94, to the output tube, lubricate and insert the pump into the block tightening the bolts to, 17–21 ft. lbs. (23.0 – 28.4 Nm).

4. Fit a new O–Ring, item 2 Figure 1-1-94, into the suction port. Lubricate and insert tube/screen assembly(2) into pump(1) through bottom of engine. Fitting a new gasket (4), and torque the attaching bolts (3), Figure 1-1-96, to, 20–25 ft. lbs. (27–34N m).

NOTE: *Plug item 5, in Figure 1-1-96, is factory installed to facilitate machining, and should not be removed during the life of the engine.*

5. Refit gears as previously described along with the rear plate, and flywheel.

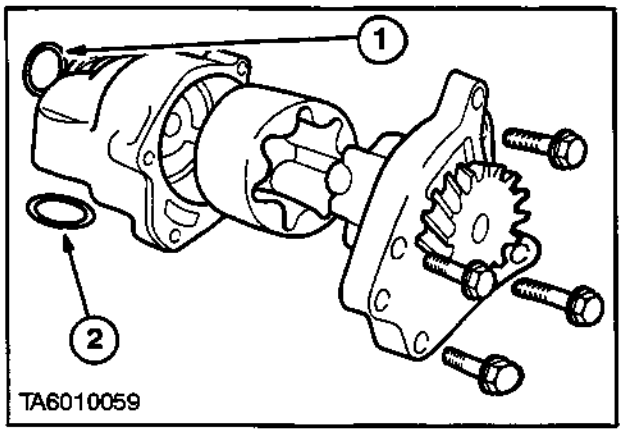


Figure 1-1-94

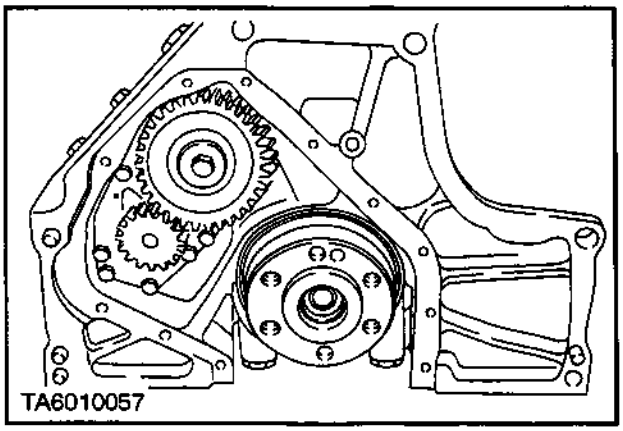


Figure 1-1-95

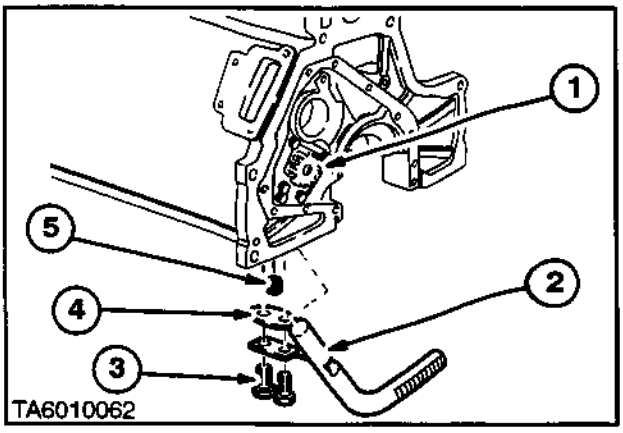


Figure 1-1-96

OIL FILTER SUPPORT ASSEMBLY

Removal

1. Unscrew and discard the old filter, loosen the 4 attaching bolts and oil connections, and remove filter support assembly from the block. Discarding the three O–Rings, Figure 1-1-97, normally aspirated, Figure 1-1-98, turbocharged.

2. Clean the filter support in a suitable solvent.

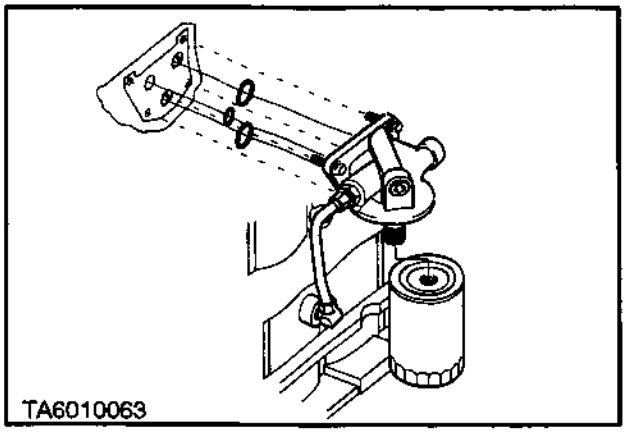


Figure 1-1-97

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3. Remove pressure relief valve plug, removing valve, and spring. To ensure correct operation of the pressure relief valve, check spring length,
Free length = 2.08 in (52.8mm).
Compressed length = 1.46 in (37.0mm) using a weight of 34.3 lbs (15.6 kgs).

4. Clean assembly in a suitable solvent and ensure all ports are free of dirt, Figure 1-1-99.

5. Check the parts for damage, wear, and replace as necessary. Failure to do so could result in premature wear to the engine, due to oil bypassing the filter and returning back to the system.

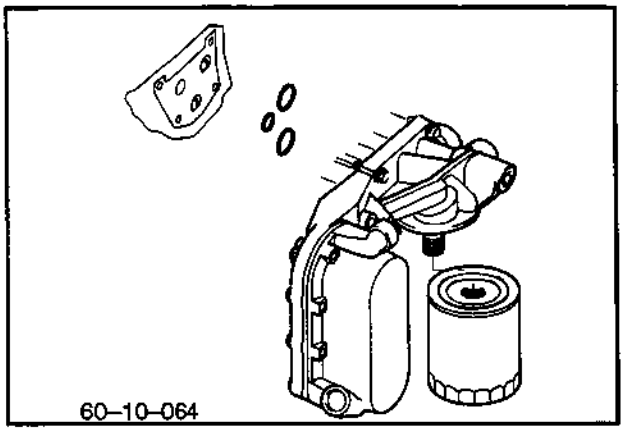


Figure 1-1-98

Installation

1. Lubricate the pressure relief valve(1) and spring(2) and insert into housing, ensuring free movement. Fit a new O–Ring to plug (3) Figure 1-1-99, and torque to, 42 ft. lbs. (55N m). Fit tube to connector and torque to 20 ft. lbs. (27Nm).

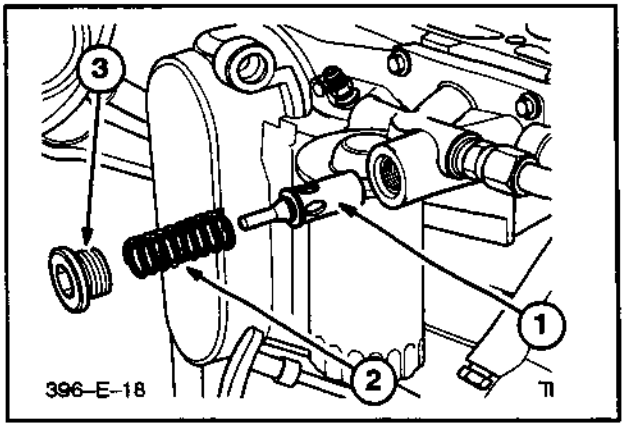


Figure 1-1-99

CRANKSHAFT REMOVAL

1. Remove the engine from the tractor and place on an engine stand.

2. Remove the flywheel, rear cover plate, crankshaft pulley and engine front cover as previously described.

NOTE: *If crankshaft is removed with cylinder head in position ensure all timing marks are realigned prior to re–assembly. This action will prevent possible interference between valves and pistons during reassembly.*

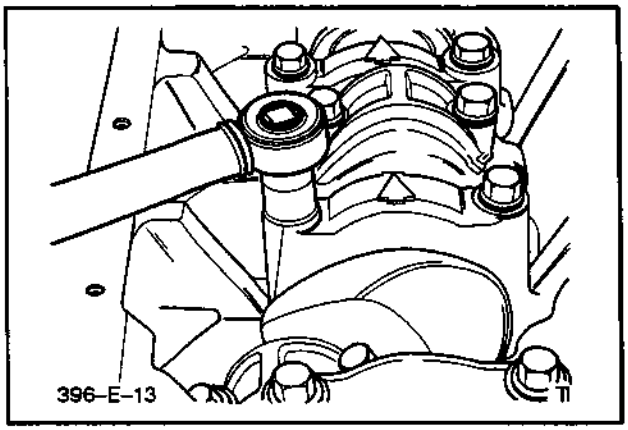


Figure 1-1-100

3. Remove the oil pan and oil pump tube as previously described.

4. Remove the connecting rod caps, main bearing caps and liners, and identify to facilitate re–assembly.

5. Carefully remove crankshaft from cylinder block.

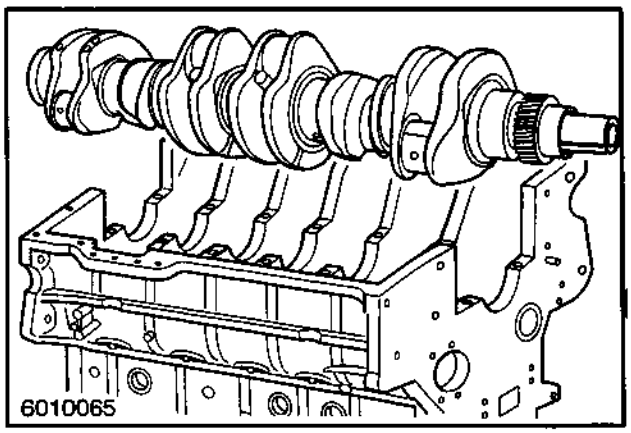


Figure 1-1-101

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Inspection and repair

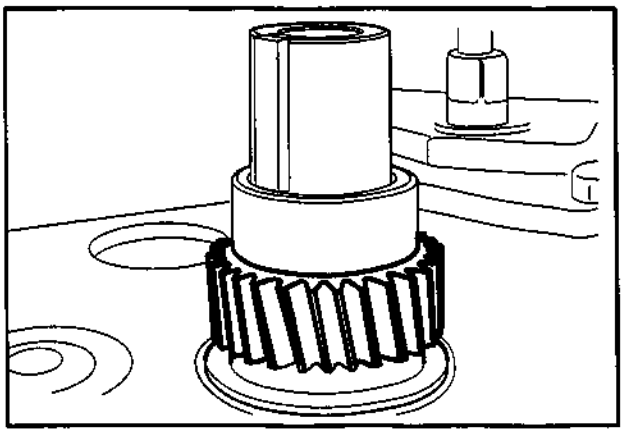


Figure 1-1-102

NOTE: *Current production engines may have a crankshaft with main or crankpin journals ground 0.010 in (0.25mm) undersize. These are identified with the letters 010 MUS and/or 010 PUS respectively, letters being stamped on one of the crankshaft counter balance weights.*

1. If crankshaft timing gear teeth are worn or damaged it will be necessary to replace the complete crankshaft assembly.

2. Wash the crankshaft and drilled passages in a suitable solvent. Dress minor imperfections using an oil stone but for severely marked journals machine to the next undersize bearing size.

3. Measure diameter of each journal, Figure 1-1-103, in four places to determine out–of–round, taper, or wear.
   Measuring, A, compared with B, indicates vertical taper.
   Measuring, C, compared with D, indicates horizontal taper.
   Measuring, A and B, compared with C and D, indicates journal out–of–round.

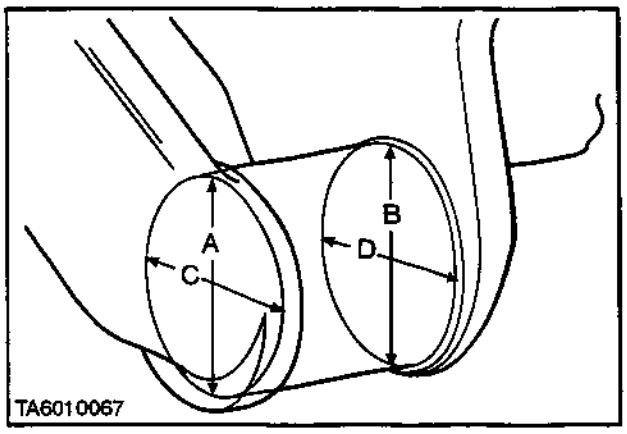


Figure 1-1-103

4. If the journal exceeds specified limits refer to "specifications" at the beginning of the section and refinish journal to the next undersize bearing.

5. Examine the rear oil seal journal for score marks, remove minor imperfections with fine emery cloth, and if severely damaged renew the crankshaft.

CRANKSHAFT RE–ASSEMBLY

1. Check the crankshaft bearing clearance using a plastigauge as follows.

2. Position a piece of correct size plastigauge across the full width of the bearing cap, approximately 0.25 in (6.35mm) off center, Figure 1-1-104.

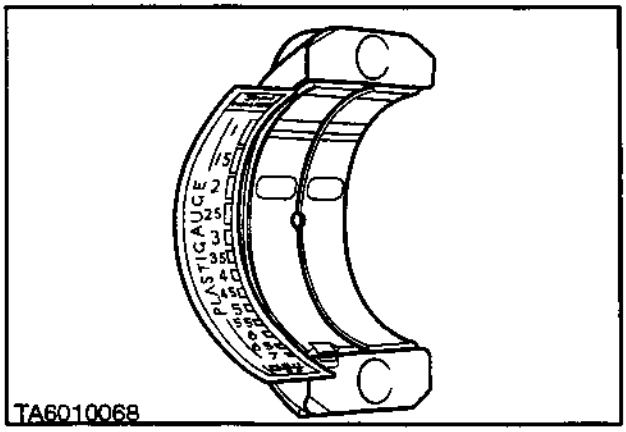


Figure 1-1-104

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3. Install the cap and tighten bolts to 110 ft. lbs. (149Nm).

4. Remove the cap and use the scale to check the width of the flattened plastigauge, Figure 1-1-104.

5. Widest point, of gauge establishes the minimum clearance.

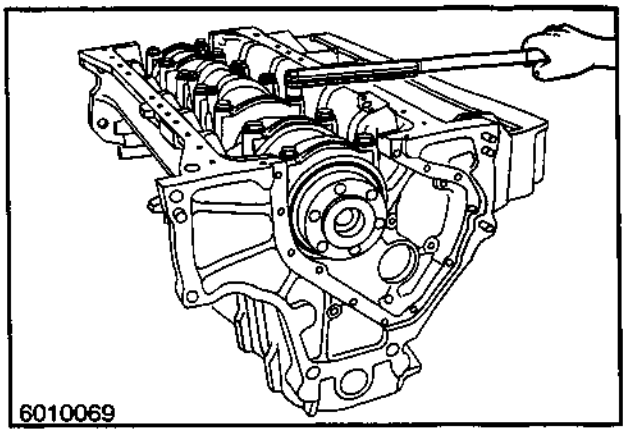


Figure 1-1-105

6. Narrowest point, of gauge establishes maximum clearance. The difference between the two readings is the taper.

NOTE: *Normally main bearing journals wear evenly and will not be out–of–round, but if a bearing which is to specification is fitted to an out–of round journal, ensure liner suits maximum diameter of journal.*

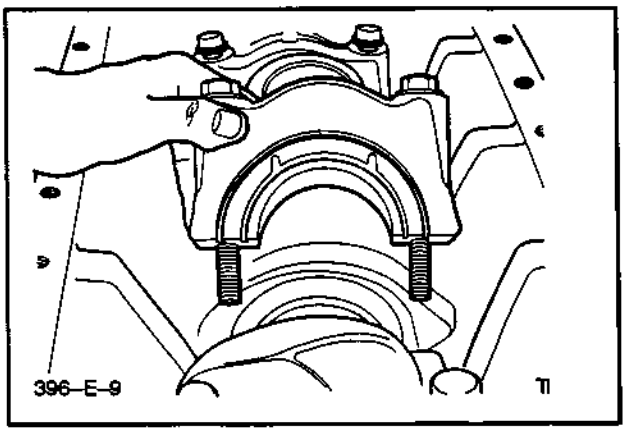


Figure 1-1-106

7. If these combinations of bearings do not produce specified clearance, refinish crankshaft and fit appropriate size service bearings.

IMPORTANT: *Engines may be assembled with bearings of different material, but bearings of the same material must be used on the same journal.*

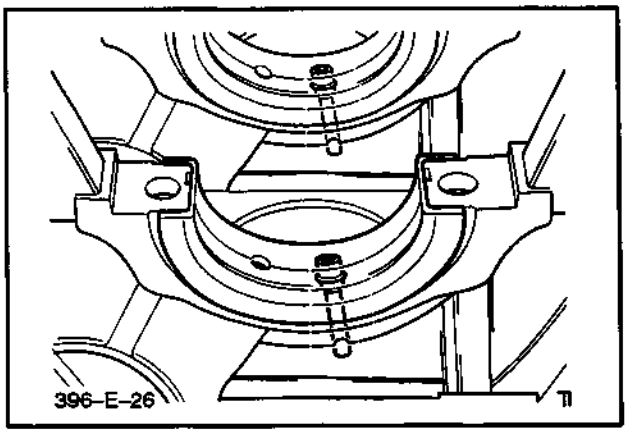


Figure 1-1-107

8. Position the bearings and caps in the block and coat with oil. If the crankshaft has been refinished, fit appropriate size service bearings.

9. Ensure the bearing surfaces are clean and bearing tangs, align with slots in the block and cap.

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10. Align the timing mark on the crankshaft gear, with that of the camshaft idler gear and install the crankshaft. Install a thrust bearing cap with flange type bearing first, installing remaining bearing caps to their original location, Figure 1-1-108.

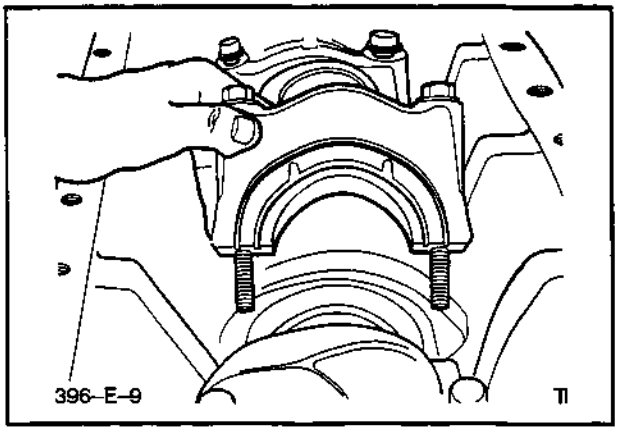


Figure 1-1-108

11. Tighten all bearing caps (except thrust bearing cap, leave finger tight) to a torque of 145 ft. lbs. (197Nm).

12. Pry the crankshaft forward against thrust surface of bearing, hold crankshaft forward and pry bearing cap rearwards taking care not to pry against flange of the bearing. This will align thrust surfaces of both halves of bearing, hold forward pressure on crankshaft and tighten bearing cap bolts to a torque of 145 ft. lbs. (197Nm).

13. Check crankshaft end play with a dial indicator gauge, pry crankshaft towards front of engine and set dial indicator to zero. Pry crankshaft towards rear of engine and note reading on dial if end play exceeds 0.004–0.008 in (0.10–0.20mm) fit a new thrust bearing.

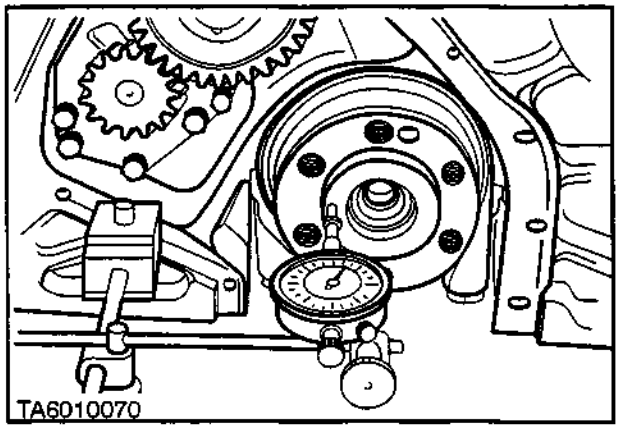


Figure 1-1-109

14. If the end play is less than specification check thrust bearing for burrs, scratches, or dirt, and re–align thrust bearing as in operation 12.

15. Install rear crankshaft oil seal as previously described in back plate removal.

NOTE: *Do not pre–install seal into retainer. To ensure seal concentricity, it must be assembled with rear plate and installation tool when fitted to crankshaft.*

CAMSHAFT REMOVAL

NOTE: *The camshaft bearings and tappets can only be serviced with engine removed from the tractor.*

1. Remove the engine front cover, and cylinder head.

2. Check the camshaft end play, see timing gears section, and remove gear, install a new thrust plate prior to re–assembly if required.

3. After removal of the flywheel, and rear cover, remove the camshaft oil pump drive gear.

4. Invert the engine on the stand, if camshaft bearings are to be replaced, and remove the oil pan.

5. Carefully withdraw the camshaft from the rear of engine.

NOTE: *The front timing gear may be left on and the camshaft removed from the front if required, Figure 1-1-110.*

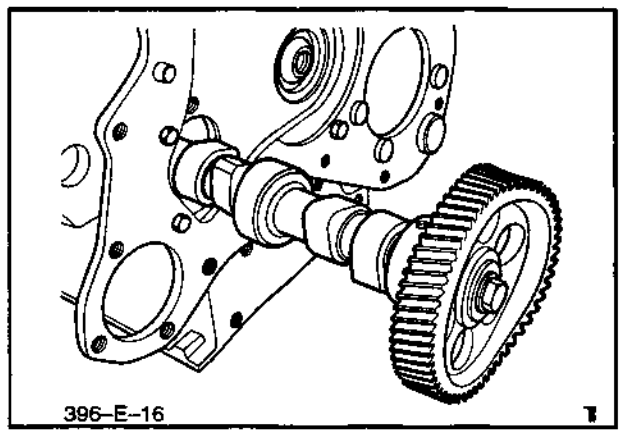


Figure 1-1-110

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6. Lift out the tappets, Figure 1-1-111, and place in a numbered rack for reassembly.

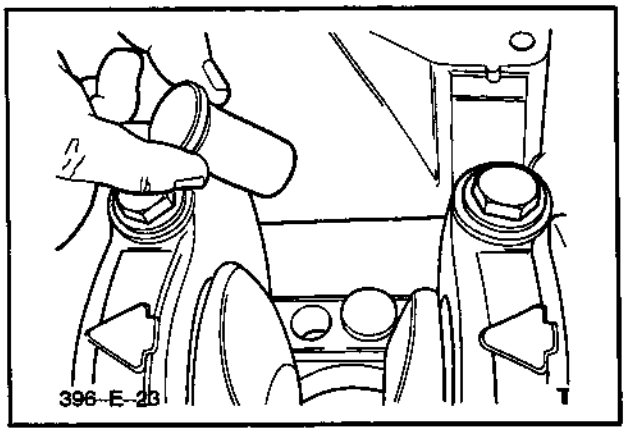


Figure 1-1-111

Inspection and repair

1. Inspect the camshaft journals, lobes, for damage, pitting, or heat discoloration. If any of these conditions exist install a new camshaft.

2. Inspect the oil pump drive gear on camshaft for broken or worn teeth, and mating gear on oil pump. If any wear or damage is apparent fit new gears.

3. Check each tappet for wear or damage and check diameters, if not to specification renew, tappet diameter 0.9889–0.9894 in (25.118–25.130mm), tappet bore diameter 0.9900–0.9910 in (25.15–25.17mm).

4. Measure the diameter and out-of-round condition of bearing journals, if exceeded fit a new camshaft, 2.3895–2.3905 in (60.693–60.719mm).

CAMSHAFT BEARINGS

1. Inspect the camshaft bearings for wear or damage. Measure the clearance between the internal diameter of bearing and outside diameter of respective journal, 0.001–0.003 in (0.025–0.076mm).

2. If specification is exceeded install new bearings using, Remover/Replacer Tool No FNH01255 and handle, Tool No FNH01442, Figure 1-1-112.

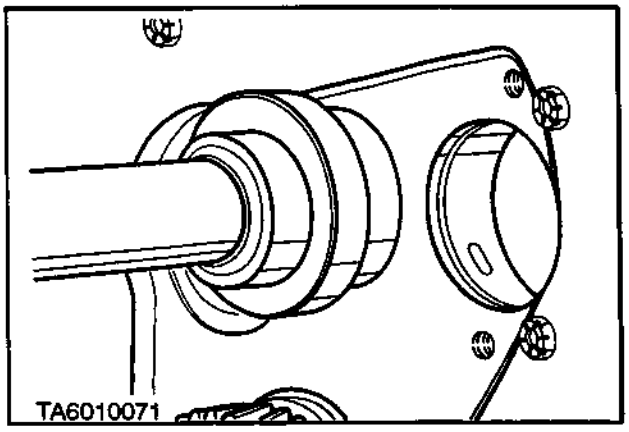


Figure 1-1-112

3. To remove, Position tool against bearing to be removed and attach handle, driving bearing from bore.

4. To install, align oil holes of new bearing with holes in block, and drive bearing into bore using tools as described.

NOTE: *A positive alignment check can only be made with crankshaft removed when a 0.018 in (4.6mm) rod can be passed down the oil passage from the crankshaft main bearing. Bearing is correctly positioned when end of rod passes through oil hole in the bearing.*

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Installation

1. Apply petroleum jelly to each tappet foot, and coat tappet body with oil. Install tappets in bores from which they were removed.

2. Oil camshaft journals and apply petroleum jelly to the cam lobes, and install camshaft into engine.

3. Install new spacer and keyway on end of camshaft.

4. Install camshaft gear, and align the camshaft gear timing mark, and recheck end play.

5. Apply sealant ESE–M2G–114A to the sealing flange of the front cover plate on re–assembly.

ENGINE COMPRESSION TEST

TEST PROCEDURE

1. Be sure battery performance meets specifications.

2. Warm up the engine by operating for a minimum of half an hour at 1200 rev / min

3. Stop the engine and remove the injector and seat washer from No 1 cylinder.

4. Clean the injector bore and with the electric fuel shut off wire disconnected, crank the engine to blow out any loose carbon particles.

5. Install an engine compression test gauge, from kit FNH02020 with adapter FNH00882, into the injector bore, using a new seat washer and the injector mounting bolts.

6. Connect the gauge and hose to the adapter.

7. Crank the engine at 200 rev/min with the electric fuel shut off wire disconnected to prevent engine start up.

8. Observe the gauge reading, and repeat the compression test, steps 5–7 for each cylinder.

TEST READINGS

1. All cylinder compressions should be uniformly within 25 lbf/in^2 (1.7 bar) of each other. See specifications at the beginning of this section for compression specification.

2. A reading of more than the 25 lbf/in^2 (1.7 bar) below the other cylinders indicates leakage at the cylinder head gasket, piston rings or valves.

3. A reading of more than 25 lbf/in^2 (1.7 bar) above the other cylinders indicates excessive carbon deposits on the piston and cylinder head.

4. A low even compression in two adjacent cylinders indicates a cylinder head gasket leak. Check this item before condemning the rings or valves.

TEST CONCLUSION

To determine whether the rings or the valves are at fault, squirt the equivalent of a tablespoon of heavy oil into the combustion chamber. Crank the engine to distribute the oil and repeat the compression test.

The oil will temporarily seal any leakage past the rings. If approximately the same reading is obtained, the rings are satisfactory, but the valves are leaking.

If compression has increased over the original reading, there is leakage past the rings.

During a compression test, if the pressure fails to climb steadily and remains the same during the first two successive strokes, but climbs higher on the succeeding strokes, or fails to climb during the entire test, suspect a sticking valve.

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FUEL SYSTEM

Bosch VE Type Fuel Injection Pump–Removal

Figure 1-1-113 – Arrows denote items to be disconnected for removal.

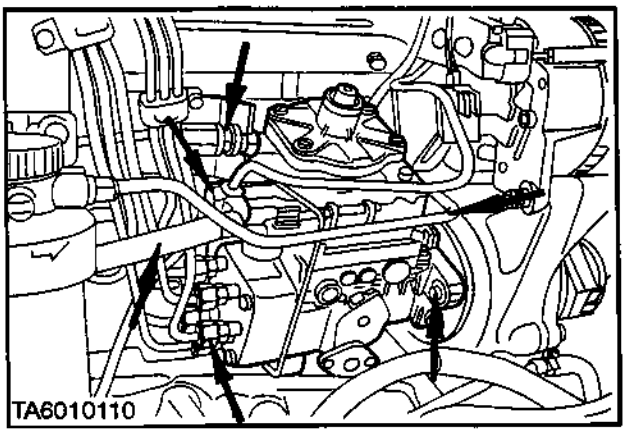


Figure 1-1-113

NOTE: *Ensure that the areas around the injection pump, injectors and front cover access plate are clean.*

1. Disconnect and remove all fuel lines from the injection pump.

2. Disconnect the throttle cable and fuel shut–off solenoid wire.

3. To aid reassembly turn the engine over, clockwise(when viewed from the front), so that the engine cover pointer aligns with the 6° BTDC (6.5° BTDC, 8560) mark on the front pulley, with No.1 cylinder on the compression stroke. This can be verified by removing the valve rocker cover and ensuring that valves 1 and 2 are both closed.

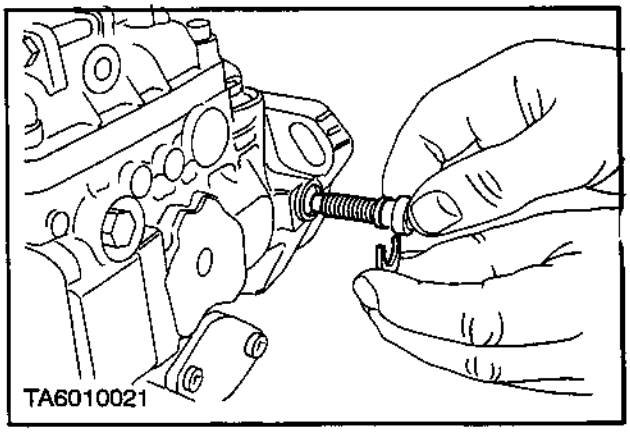


Figure 1-1-114

4. Remove the fan drive belt and then remove the injection pump gear access plate and belt tensioner assembly from the front cover plate.

5. Remove the pump gear nut.

NOTE: *If the pump is only being removed to replace the sealing 'O' ring or for another reason which does not involve rotating the pump shaft or the engine, the pump can be locked into position by removing the spacer plate and tightening the screw, Figure 1-1-114. The pump can then be replaced without having to use the special timing tool.*

6. Using a suitable manufactured puller, as detailed under 'Special Tools', remove the gear. Figure 1-1-115.

7. Withdraw the pump mounting bolts and remove the pump from the front cover. Cap all openings to prevent dirt ingress.

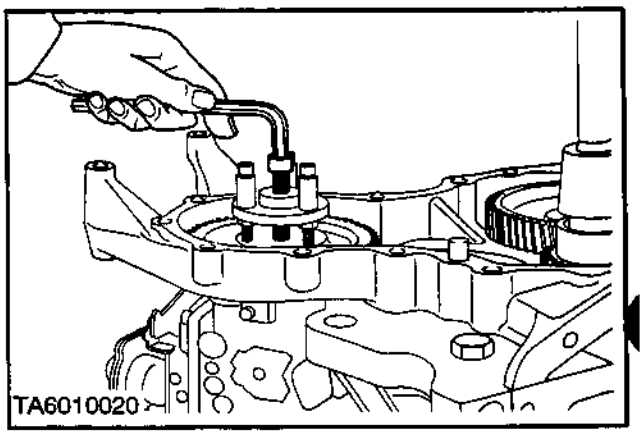


Figure 1-1-115

Inspection

The pump should not be tampered with in any way. If the pump operation is suspect it should be taken to an approved BOSCH agent for testing and repair.

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Installation

The pump timing should be checked prior to installing the pump to the engine using the following procedure:

1. Ensure the pump is in an unlocked condition, i.e, the spacer is between the screw head and the pump body.

2. Rotate the pump so that the shaft keyway groove aligns with the injector outlet, marked 'B', for No.1 cylinder. This positions the pump into the No.1 firing position.

3. Remove the center bolt from the rear of the pump and install special tool No. 291755, and a dial test indicator, FNH01345. Pre–load the gauge approximately 0.098 in (2.5mm) and slowly rotate the pump shaft until the gauge indicates the plunger is at bottom dead center, on commencement of delivery.

4. Set dial gauge to zero. Rotate the pump clockwise (when viewed from the shaft end) until the dial gauge indicates the plunger has moved 0.039in. (1mm). Remove the spacer from the screw head located on the pump body and tighten the screw to lock the pump in position.

5. Remove the D.T.I. gauge and special tool and install and tighten the rear center bolt and washer.

6. Rotate the engine to position No.1 piston at 6° BTDC (6.5° BTDC 8560) compression Stroke (No.1 valves closed), assemble the 'LOCKED' pre–timed fuel injection pump with a new 'O' ring, aligning the mark on pump flange to the timing mark on the front cover. Torque pump retaining bolts to 18 ft. lbs. (24Nm). Position the pump gear and pump gear retaining nut onto the pump shaft and initially tighten to a torque of 15ft. lbs. (20Nm), while holding the gear counter clockwise to remove gear backlash. 'UNLOCK' the pump by releasing the locking bolt and installing the spacer between the pump body and bolt head. Tighten the locking bolt to a torque of 9 ft. lbs. (12Nm). The pump gear retaining nut can now be fully tightened to a torque value of 68ft. lbs. (92Nm).

7. Thoroughly clean the mating surfaces between the cover and plate, (1) Figure 1-1-118, using a suitable solvent cleaner and carefully apply a thin bead, approximately 0.079 in (2mm), of the recommended flexible gasket sealant, see specifications, to the access plate. Assemble the plate to the cover and tighten the retaining bolts to a torque of 18ft. lbs. (24Nm).

8. The remainder of installation is the reverse of removal.

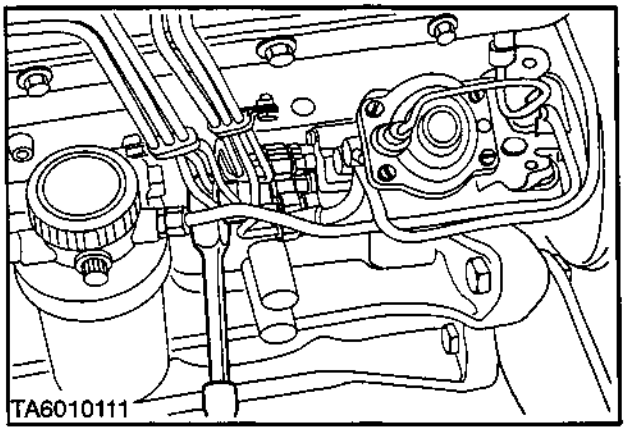


Figure 1-1-116

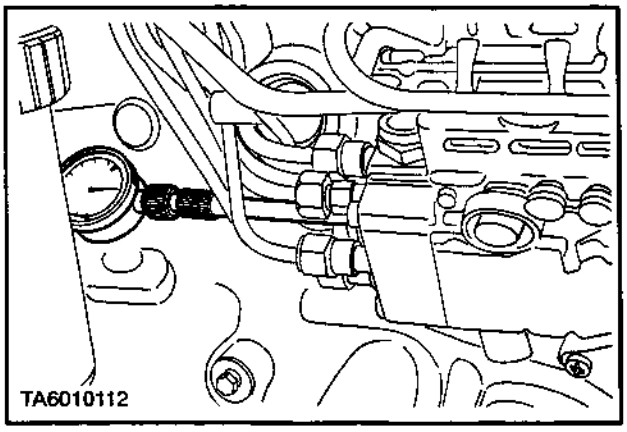


Figure 1-1-117

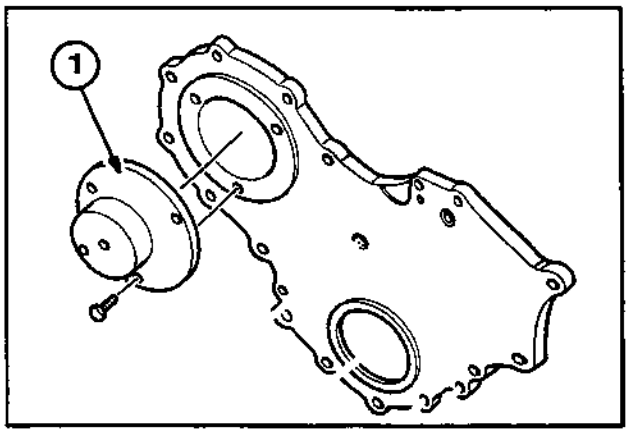


Figure 1-1-118

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Injection System Bleeding

It may be necessary after injection pump removal, replacement of injector high pressure lines or after running out of fuel, to purge the system of air to allow the engine to start.

If the engine fails to start after several turns, after one of the above situations has occurred, bleed the system using the following procedure:

1. Ensure the tractor has adequate fuel and the battery is fully charged.

2. 'Crack' open the nuts of the high pressure lines to each of the injectors. Crank the engine on the starter motor to expel the air. If possible, i.e, with the aid of an assistant, tighten the injector nuts as the engine begins to fire.

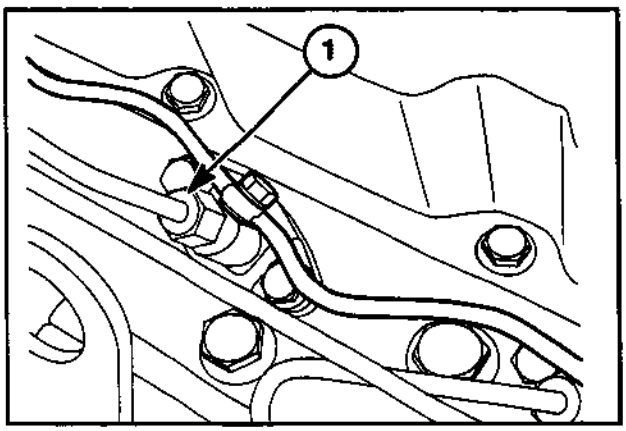


Figure 1-1-119

WARNING

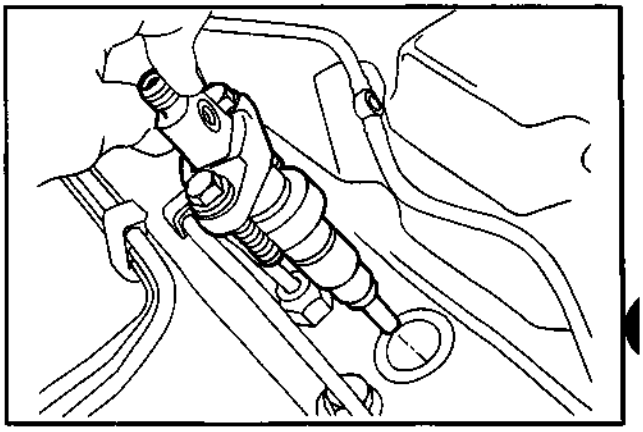
Wear suitable eye and skin protective clothing. Fuel may be expelled under high pressure.

Injector Removal

1. Ensure the areas around the injectors and fuel pump are clean prior to disassembly.

2. Remove the injector high pressure lines, carefully pull the leak off tubes from the injectors, remove the two retaining bolts of each injector and withdraw the injectors from the cylinder head.

NOTE: *Each injector should have a cork seal under the retaining flange, remove the seal from either the cylinder head or injector and discard. New seals should always be installed on reassembly.*


Figure 1-1-120

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Injector Testing and Overhaul

⚠ WARNING ⚠

The spray from a fuel injector tester can pierce human skin with fatal results. When an injector is spraying, the nozzle holder should be turned away from the operator and any other persons.

During the Nozzle Opening Pressure and Spray Pattern Tests, collect the spray in a container partly filled with rags to absorb the spray.

When conducting the Nozzle Seat Leakage Test, release the injector tester pump pressure before touching the nozzle tip with a sheet of blotting paper.

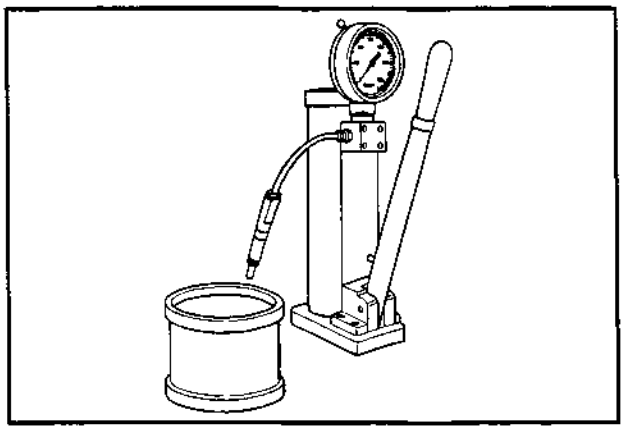


Figure 1-1-121

⚠ WARNING ⚠

The spray is flammable make sure no open flames are in the area of the tester and do not generate excessive vapor.

1. Fill the injector tester, FNH01721, with a calibrating type fuel oil and leave the filler cap loose to prevent a vacuum forming during testing.

2. Prime the tester until oil is emitted from the tester line, then connect the injector.

3. Make sure the knob on the right-hand side of the tester is screwed in to prevent the gauge being over-pressurized if the injector nozzle is blocked.

4. Pump the tester and check the nozzle is free to open. Open the pressure gauge valve and begin injector testing. If the nozzle is blocked or the needle jammed, disassemble the injector.

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5. Nozzle Opening Pressure Setting - Slowly pump the injector tester and observe the pressure at which the needle valve lifts and fuel is injected from the nozzle tip. The minimum acceptable opening pressure is 3480 lbf/in^2 (240 bar). If the opening pressure is below 240 bar, reset to 3915–4031 lbf/in^2 (270–278 bar).

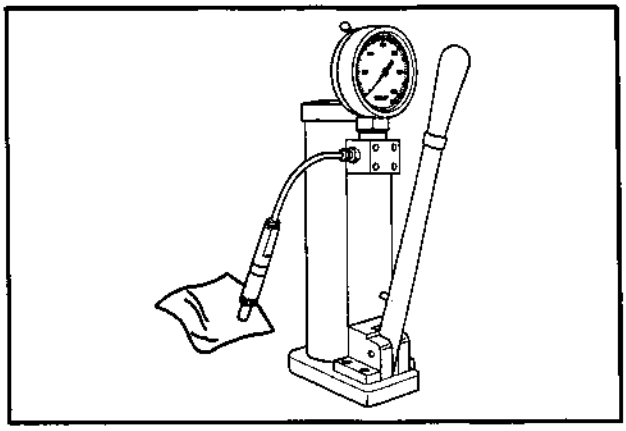


Figure 1-1-122

6. Spray Pattern - Pump the tester rapidly (80 to 90 strokes per/min.) and observe the spray pattern from the holes. An atomized spray free from distortion and irregular streaks of fuel should be observed. The tester is not regarded as providing a suitable test for atomization under working conditions, but gives an indication of the working of the nozzle.

7. Nozzle Seat Leakage - Wipe the nozzle tip dry and apply a pressure 145 lbf/in^2 (10 bar) below the opening pressure. The nozzle tip and bottom face must remain essentially dry and there must be no tendency for blobs of fuel to collect or drip. A slight dampness can be ignored. If there is any leakage from the nozzle seat, the nozzle assembly must be cleaned or replaced.

8. Nozzle Back Leakage - Apply a pressure 145 lbf/in^2 (10 bar) below the opening pressure, then release the handle and time the pressure drop. The pressure should drop 1450–2180 lbf/in^2 (100–150 bar) in 5–45 seconds. If below 5 seconds, the nozzle assembly must be replaced. If above 45 seconds, check for carbon on the valve and/or blocked back leak drillings.

NOTE: *If the injectors meet the tests carried out then refit the injectors to the engine.*

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Disassembly

1. Place the injector in a holding fixture, with the nozzle uppermost. Do not clamp the injector body in a vice. Use socket tool, FNH08126, to loosen the nozzle retaining nut.

2. Remove the nozzle retaining nut, complete with the nozzle body, needle valve and the dowelled adaptor plate.

3. Remove the injector body from the holding fixture, invert and carefully remove the spring seat, spring and adjustment shims. To avoid damage, place all dismantled components in suitable baths of clean fuel oil.

NOTE: *To prevent corrosion of injector components after cleaning, rinse in clean fuel oil and place in a suitable bath of clean fuel oil.*

Inspection and Repair

1. Clean the injector body by soaking in a carbon solvent and brushing with a brass wire brush. Inspect the body for damaged threads and pressure face, making sure the holes in the injector nozzle are thoroughly clean with no signs of corrosion or pitting.

2. Clean the spring and spring seat using a brass wire brush and check for scoring, pitting or corrosion.

3. Clean the dowelled adaptor plate using a brass wire brush. Inspect the plate for loose or bent dowels, a damaged pressure face or corrosion.

4. Clean the needle valve and body by soaking in a carbon solvent and brushing with a brass wire brush. Using the tools included in the Injector Nozzle Cleaning Kit, OEM1068, clean the nozzle as follows:

NOTE: *If the needle valve is in any way damaged or blued, it must be discarded and a new matched needle valve and nozzle body assembly obtained. It is not possible to grind or lap the three special angles on the valve point.*

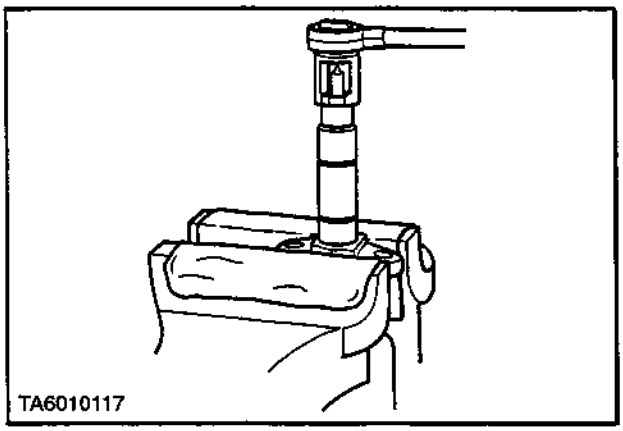


Figure 1-1-123

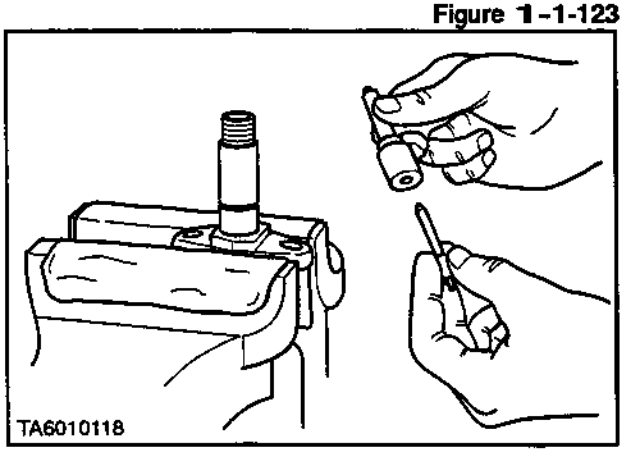


Figure 1-1-124

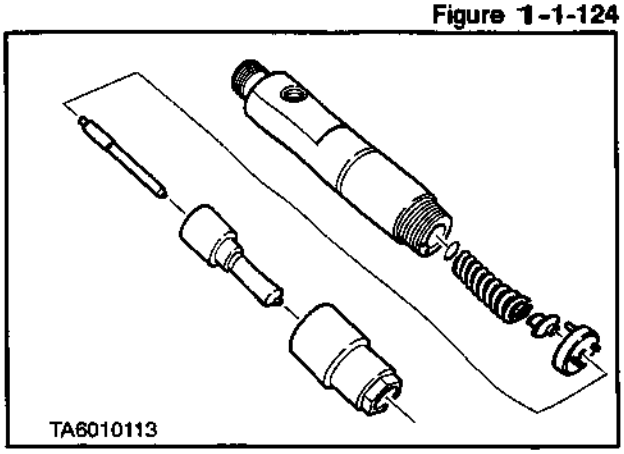
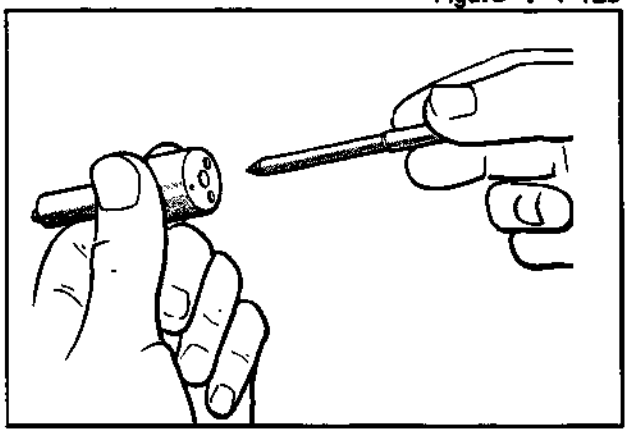


Figure 1-1-125


Figure 1-1-126

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A. Clean the spray holes with a nozzle cleaning wire held in a pin vise so that it protrudes for only 0.06 in. (1.5 mm), thereby giving maximum resistance to bending. Insert the wire into each hole, pushing and rotating gently until each hole is cleared.

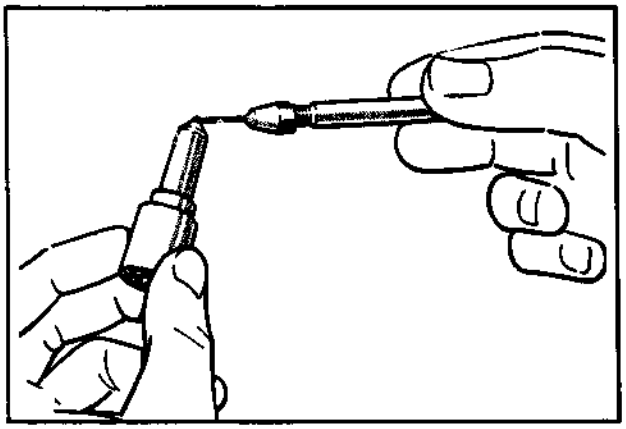


Figure 1-1-127

B. Clean the needle valve seat using the valve seat scraper by rotating and pushing the tool onto the valve seating.

C. Clean the fuel port using the fuel port scraper. Insert the scraper into the port, press hard against the side of the cavity and rotate to clear all carbon deposits from this area.

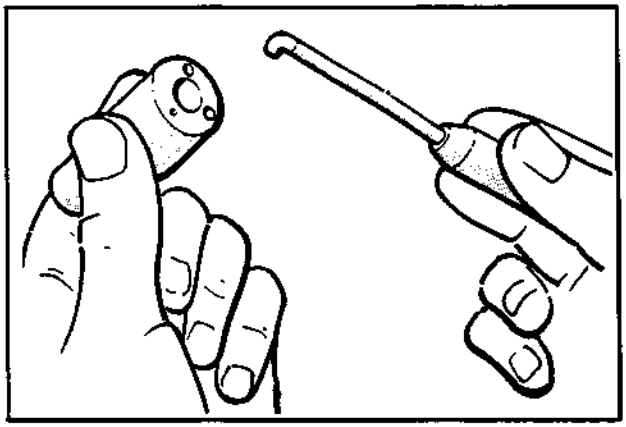


Figure 1-1-128

5. Use a Reverse Flush Nozzle Adaptor on the injector tester and reverse flush the nozzle to remove the carbon loosened during cleaning, Step 4.

6. After flushing the nozzle, polish the valve seat by placing a very small amount of tallow on the end of a polishing stick and rotate in the nozzle.

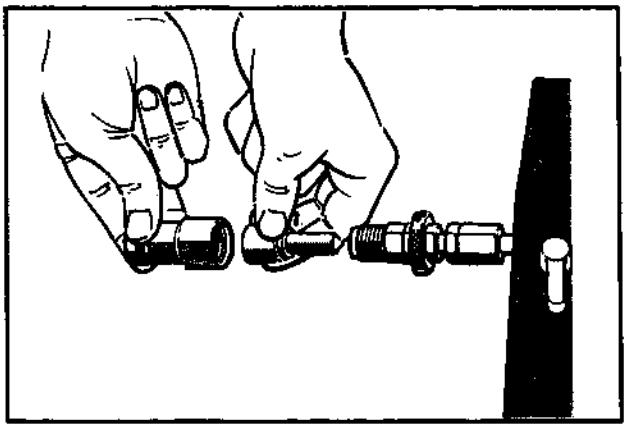


Figure 1-1-129

7. Clean the top of the needle valve using a needle valve scraper.

8. Clean the nozzle retaining nut using a brass wire brush and check to see that the threads are not damaged and are free from carbon deposits.

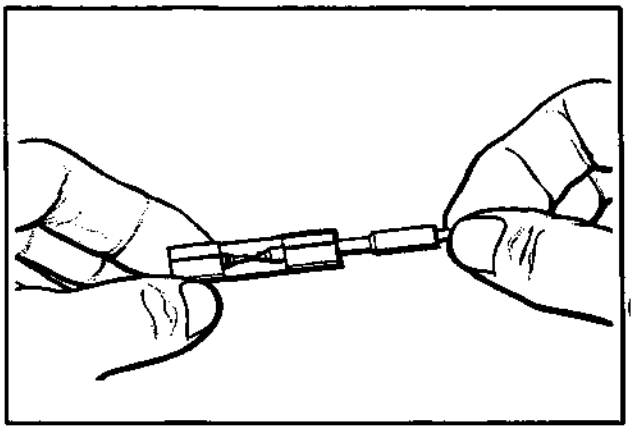


Figure 1-1-130

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Re–assembly

1. Make sure all parts are absolutely clean and undamaged prior to re–assembly. Rinse all parts in clean fuel oil and assemble the components while still wet.

2. Place the shims, spring and spring seat into the injector body bore. Place the injector body into the holding fixture.

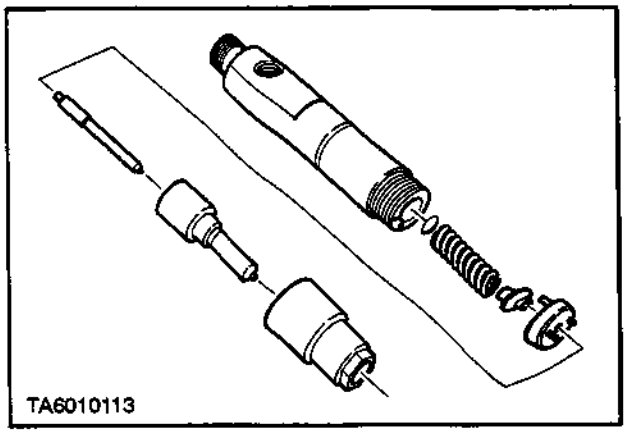
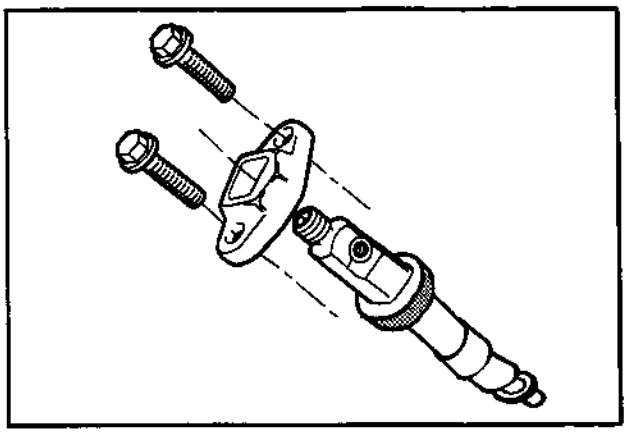


Figure 1-1-131

3. Assemble the needle valve into the nozzle body and then position the dowelled adaptor plate onto the nozzle body. Insert this assembly into the nozzle retaining nut.

4. Carefully assemble the dowelled adaptor plate and the nozzle retaining nut assembly onto the injector body, tighten the retaining nut to 33 ft. lbs (45 Nm) torque.


Figure 1-1-132

To set the nozzle opening pressure, connect the injector to the test rig as described in "Testing" and add or subtract shims from the spring until the specified initial setting opening pressure of between 3915–4031 lbf.in^2 (270–278 bar) is achieved.

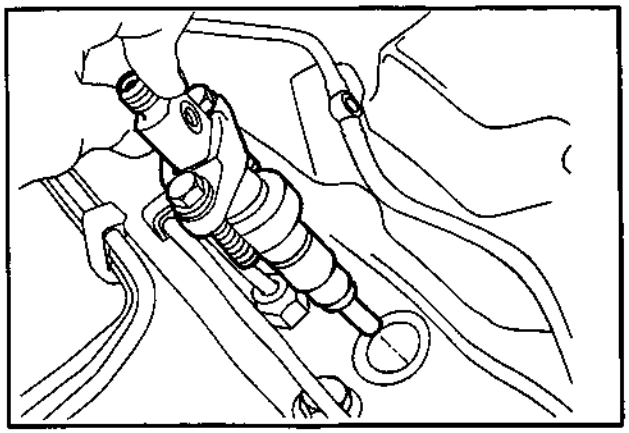
Injector Installation

The installation is the reverse of the removal procedure noting the following points.

1. Install a new cork seal to the underside of the retaining flange.

2. Tighten the retaining bolts to a torque of 17ft. lbs. (23Nm).

3. It may be necessary to bleed the fuel system of air in order to start the engine. Refer to, 'Injection System Bleeding'.


Figure 1-1-133

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Electric Lift Pump – Removal

1. Disconnect the electrical connection.

2. Remove the fuel inlet and outlet tubes.

3. Remove the two support bracket bolts and withdraw the pump from the engine.

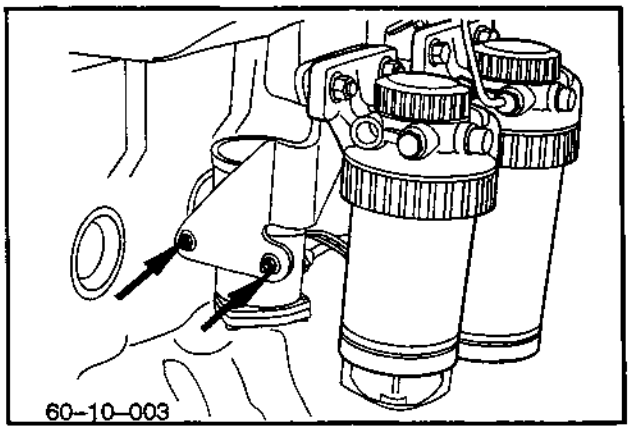


Figure 1-1-134

Electric Pump Testing and Servicing

The electric pump is basically a sealed unit and failure of it will require a new pump to be installed. The pump does contain a filter in the base of the unit which should be cleaned periodically.

Servicing

The pump can be serviced installed on the engine.

NOTE: *Place a suitable container under the pump as there will be some fuel leakage when the pump cover is removed.*

1. To clean the filter remove the cover(2) and seal (1) at the bottom of the pump and withdraw the filter(3).

2. Clean the filter in a suitable cleaning solvent.

3. Reinstall the filter, seal and cover.

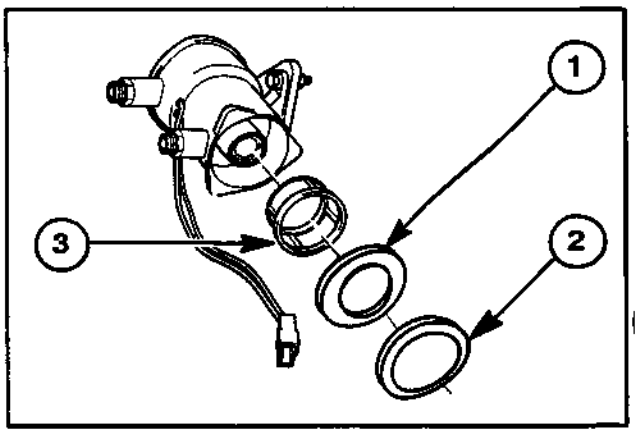


Figure 1-1-135

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Pump Testing

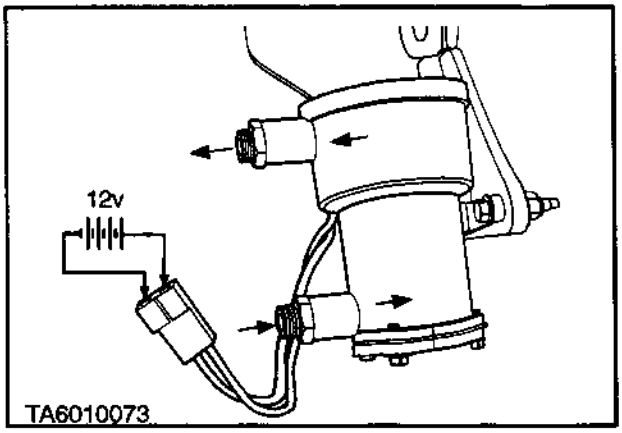


Figure 1-1-136

1. With the pump removed as described above, apply 12 volts onto the connector pins. If the pumps fails to operate a new pump will be required.

2. If the pump can be heard running with voltage applied check the pump output. Place the inlet tube into a container of fuel, place the outlet into an empty container, allow the pump to run for a minute and measure the quantity of fuel delivered.

   NOTE: *Ensure the pump is at approximately the same level as the fuel in the two containers.*

   The pump should deliver a minimum of 0.4 gal/min (1.5L/min).

   Replace the pump if the output is less than specified.

Turbocharger – Removal

With reference to Figure 1-1-137.

1. Lift the engine hood.

2. Remove the exhaust muffler.

3. Disconnect the air cleaner to turbocharger tube (4) and the turbocharger to intake manifold tube(1).

4. Disconnect the oil supply (2) and return (3) tubes from the turbocharger (6). Cap all tube openings to prevent dirt ingress.

NOTE: *Before removing and cleaning the unit look for signs of oil and/or gas leakage, also wheel damage which may not be evident after cleaning.*

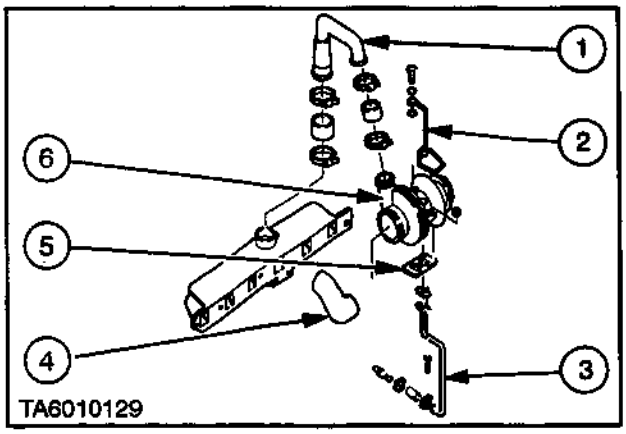


Figure 1-1-137

5. Remove the turbocharger (6) and gasket (5) from the exhaust manifold. Cover the exhaust manifold opening to prevent dirt ingress.

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Turbocharger – Disassembly

NOTE: *Figure 1-1-138 details the only components that are serviced for the turbocharger.*

Before the removal of the end housings the end of each shaft should be rotated with slight pressure in both the axial and radial direction. No sign of contact should be present between the wheels and the housings. If any contact is present, unless another cause such as dirt build up is found, then the bearings may be worn. If the bearings are worn the entire center housing rotating assembly should be replaced.

The cause of bearing failure should be established as they seldom fail during normal operation of a well maintained engine. For example engine oil/filter requires replacement.

The center housing and rotating assembly, item 1 Figure 1-1-138, has been balanced during manufacture under precision conditions. The assembly should not be disassembled in any way and is only serviced as an assembly.

If it has been determined that a major component of the turbocharger needs replacing, use the following procedure to disassemble:

1. Clean the exterior of the turbocharger with a non caustic cleaning solvent.

2. Scribe a mark on the components of the turbocharger to facilitate reassembly.

3. Remove the four bolts from the turbine housing and the six bolts from the compressor housing. Remove the clamp plates and carefully separate the end housings from the center housing rotating assembly.

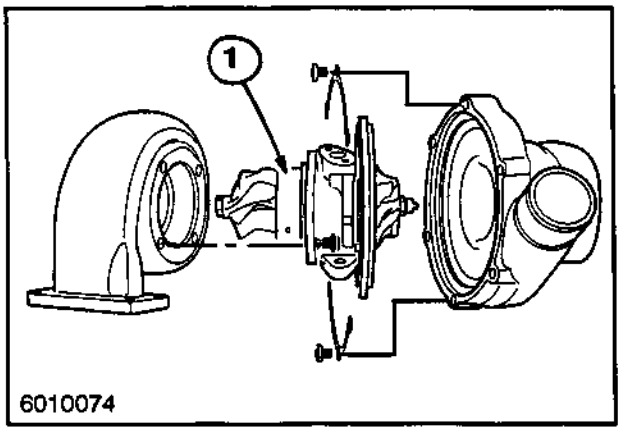


Figure 1-1-138

Cleaning

Before cleaning inspect all parts for burning, rubbing or impact damage that may not be evident after cleaning. Clean all parts in a non caustic solution, using a soft bristle brush, a plastic blade scraper and dry compressed air to remove residue.

- DO NOT – use abrasive cleaning methods which might damage or destroy machined surfaces.
- DO NOT – immerse the center housing and rotating assembly in solvent.
- DO NOT – blow under the compressor wheel with compressed air.
- DO NOT – permit wheel/shaft assembly to spin when blowing off solvent and residue.

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Inspection

Inspect the housings for the following defects:

- Wheel rub damage in the contour area that cannot be polished out with 80 grit silicon carbide abrasive cloth (compressor housing) or 60grit (turbine housing).
- Nicks, dents or distortion that could prevent proper sealing between the housings and the center housing rotating assembly.

A housing should be replaced if any of the above defects are found.

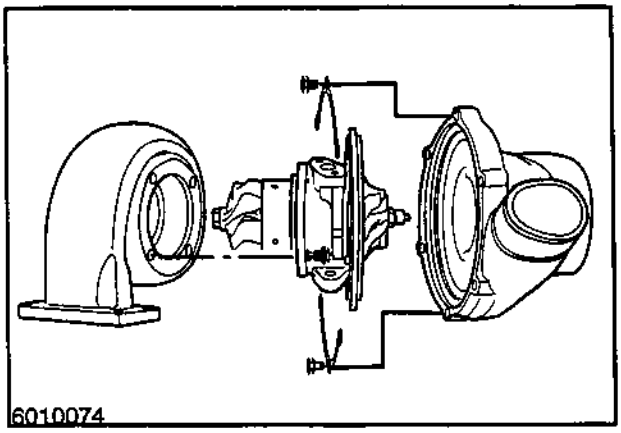


Figure 1-1-139

Center Housing and Rotating Assembly (CHRA)

NOTE: *If there is any compressor or turbine wheel blade damage, the CHRA must be replaced. Operating a turbocharger with damaged blades will result in further damage to component parts or the engine. Blades cannot be straightened in service.*

Reassembly

1. It is recommended that the following parts are replaced after removal:

- The compressor housing clamp plates and bolts
- The turbine housing bolts

2. Ensure all parts to be reassembled are completely clean. If new components are being used transfer the scribe marks from the old components to ensure correct assembly.

3. Assemble the outer housings to the center housing assembly, taking extreme care not to damage the turbine blades. Ensure all scribe marks align and install the new clamp plates and bolts. Coat the bolts in a suitable non–seize compound and tighten to a torque of 16.3ft. lbs. (22Nm) for the turbine housing and 8.1ft. lbs. (11Nm) for the compressor housing.

4. Rotate the turbine by hand ensuring that it rotates freely without rubbing.

Turbocharger – Installation

1. Prior to installation fill the turbocharger center housing with new clean oil, and rotate the main shaft to lubricate the bearings.

2. Installation of the turbocharger, reference Figure 1-1-140, follows the removal procedure in reverse. Install a new manifold gasket (2), and tighten retaining nuts, (1), to 30–35 ft. lbs. (41–47Nm).

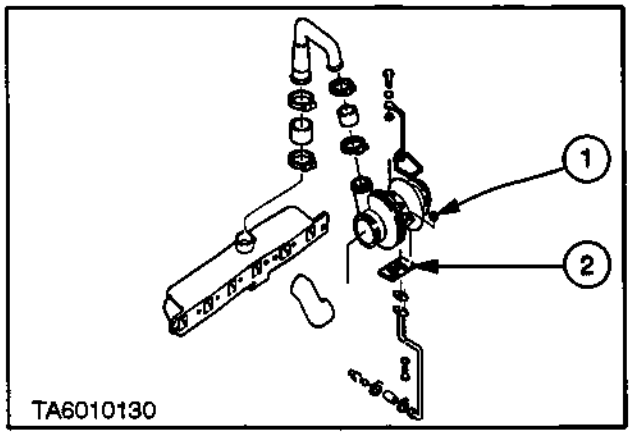


Figure 1-1-140

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3. Replace the washers (2) and re–connect the oil feed tube banjo bolt (1) Figure 1-1-141, and torque to 22–30 ft. lbs. (30–40Nm).

4. The oil feed tube connector, to oil filter head assembly, if disturbed, should be refitted. Apply sealer to connector "See Specifications" and torque to 8–12ft. lbs. (11–16Nm).

5. Apply sealer, "See Specifications", assemble the oil feed tube to the oil filter head connector (3) Figure 1-1-141, and tighten to 13–15 ft. lbs. (18–20Nm).

6. Place a suitable receptacle below the oil outlet port and, **WITH THE SHUT–OFF SOLENOID WIRE DISCONNECTED AT THE FUEL INJECTION PUMP,** crank the engine until oil flows from the outlet port.

7. Reconnect the oil outlet tube (5) Figure 1-1-141, using a new gasket (4) and tighten the retaining bolts at the turbocharger to 15–18 ft. lbs. (20–25Nm).

8. Tighten the oil return tube to cylinder block connector clamps (6), Figure 1-1-141, to 20–30 lb in (2–3Nm).

9. If disturbed, oil return tube to block connector, item (7) Figure 1-1-141, should have sealer applied, "See Specifications" and torqued to 25–35ft. lbs. (34–47Nm).

10. Reconnect the air inlet (8), and outlet (9) tubes, with the hose clamps, and torque to 15–20 lb in (1.7–2.3Nm) for the inlet and 50–65 lb in (6–7Nm) for the outlet, Figure 1-1-141.

11. Reconnect the fuel shut–off solenoid wire.

12. Check the engine oil level and add oil if required. Idle the engine and check all tubes and gaskets for leaks.

13. Run the engine at rated speed and listen for sounds of metallic contact from the turbocharger. If any noise is apparent, stop the engine immediately and correct the cause.

NOTE: *After the unit has obtained operating temperature, the rotating assembly should coast freely to a stop after the engine is stopped. If the rotating assembly jerks to a sudden stop, the cause should be corrected immediately.*

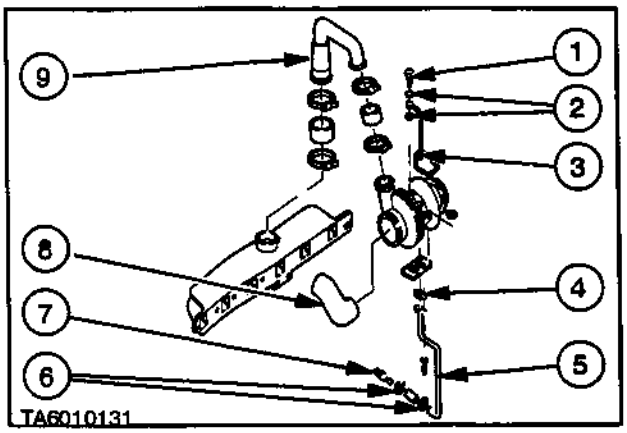


Figure 1-1-141

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Air Cleaner

NOTE: *It is not necessary to remove the complete air cleaner body, as described below, to service the air cleaner elements.*

Removal

1. To remove the air cleaner body from the vehicle, raise the engine hood. Slacken and remove the hose clamps on the aspirator tube to muffler, inlet manifold and/or turbocharger connection when fitted.

2. Remove the air cleaner attaching bolts from the engine hood frame and remove the air cleaner body from the vehicle.

Disassembly

1. Unscrew the wing nut and extract the outer element as the nut is unscrewed, Figure 1-1-142, naturally aspirated models, Figure 1-1-143, turbocharged models.

IMPORTANT: *The inner safety element, Figure 1-1-144, should not be removed or disturbed unless it is damaged or contaminated with dirt by a faulty outer element.*

2. Remove the retaining locknut and extract the inner element, Figure 1-1-144.

Inspection and Repair

1. Clean and examine the outer casing and repair or seal any damaged seams.

Outer Element

1. If dust is present inside the the outer element it must be renewed. If satisfactory clean the element by tapping both ends on the palm of the hand. Do not tap the element against a hard surface as it will be damaged or distorted.

2. Alternatively, compressed air, not exceeding 30 lbf/in^2 (2 bar) may be used. Insert the air line nozzle inside the element and blow the dust from the inside through the element to the outside. Blow loose particles from the outside of the element by holding the nozzle at least 6 in. (150 mm) from the element, Figure 1-1-145.

⚠ WARNING ⚠

Wear eye protection and a face mask when carrying out this operation.

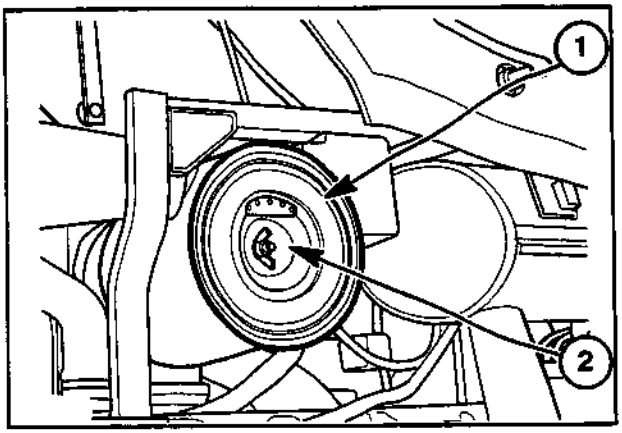


Figure 1-1-142

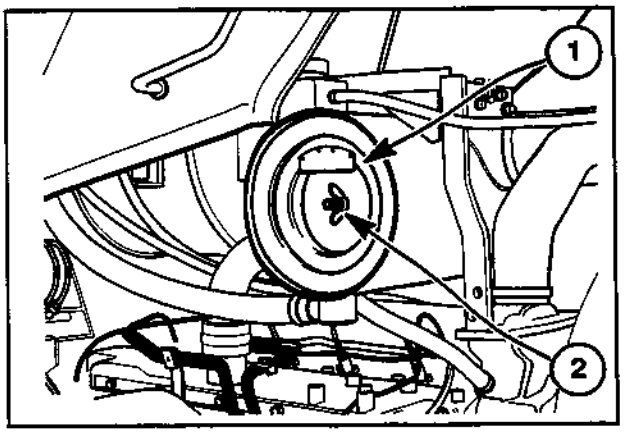


Figure 1-1-143

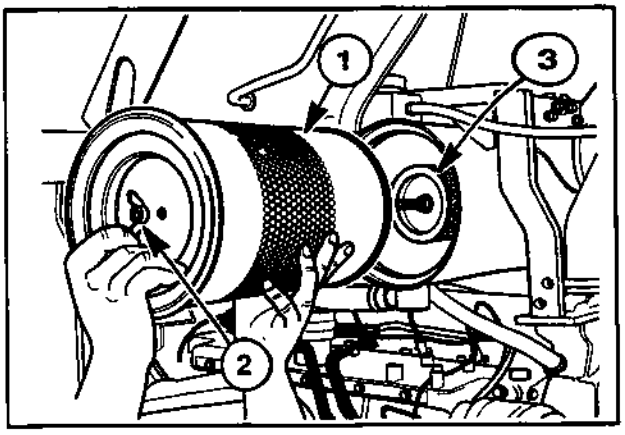


Figure 1-1-144

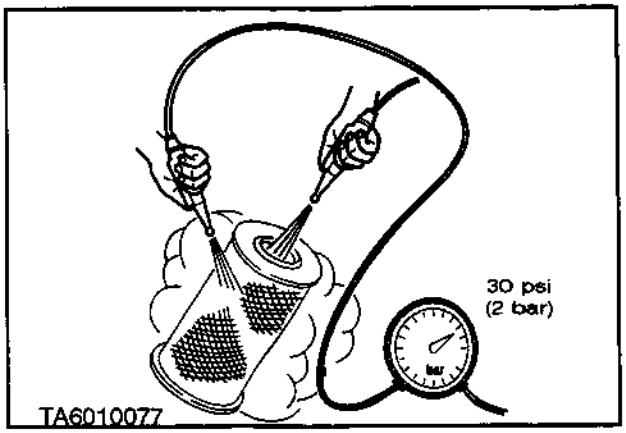


Figure 1-1-145

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If the filter element is undamaged wash the element every 300 hrs, or after five dry cleanings.

IMPORTANT: *Never use oil, petrol, or solvent. Use only water but not hotter than the hand can stand, otherwise the element may be damaged.*

3. Seal the small hole at the closed end of the filter with a strip of adhesive tape and place the filter open end up in a deep flat bottomed container or tub. Add a small amount of non–sudsing washing powder (automatic washing machine type) to the inside of the filter element.
   Add warm water 100° F (35° C) to the inside of the element until the level in the container is just below the open end of the element. Allow the element to soak for at least 15 minutes (but never more than 24 hours) in the cleaning solution.

4. After soaking gently agitate the element being careful not to allow dirty cleaning solution from the container to splash into the inside of the element.

5. Rinse the element in clean cold water allowing water to flow from the inside through the element until the water comes through clear. If using a hose do not use a pressured flow a slow trickle is sufficient. Ensure water is allowed to flow through the entire element.

6. Remove the adhesive tape and shake excess water from the filter element and allow to dry naturally. The element will need 24–48 hours to dry thoroughly. Install a new element at this stage retaining the washed element for the next service.

IMPORTANT: *Do not attempt to dry the element with compressed air or install before thoroughly dry as it may rupture. It is recommended that a new element is installed at this service and the washed element allowed to dry and retained for installation at the next service.*

7. After drying thoroughly, examine the paper pleats carefully, this can be done by inserting a lamp into the middle of the element and observing the element surface. An even, fine pattern of light indicates the element is clean, undamaged and suitable for further service. If this is not the case discard the element.

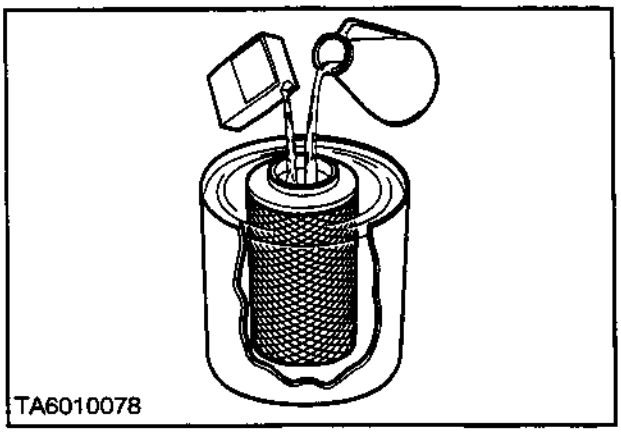


Figure 1-1-146

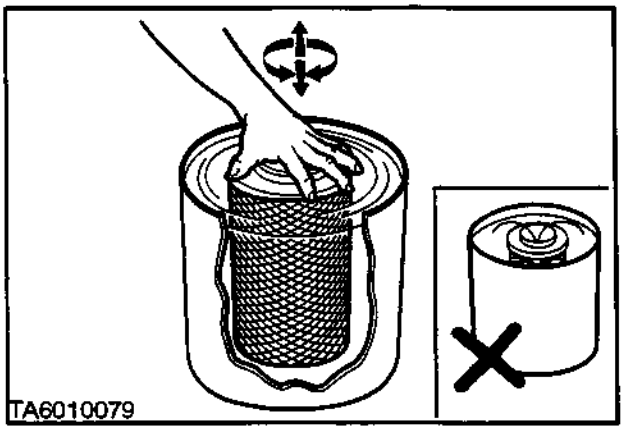
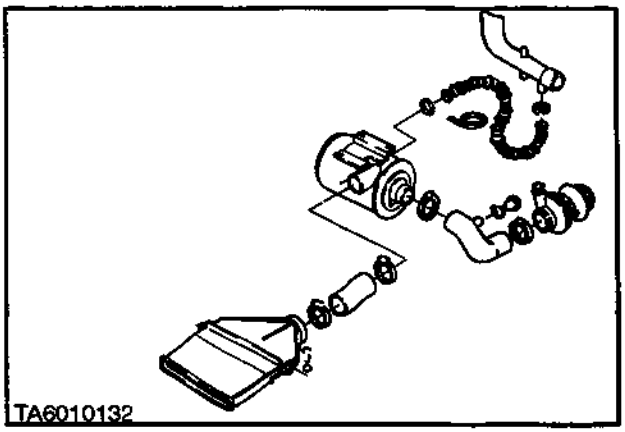


Figure 1-1-147



Turbocharged Air Cleaner Components

Figure 1-1-148

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Inner Element

1. The inner element should not be disturbed unless damaged, or contaminated by dirt through failure of the outer element. The element is impregnated with oil and should therefore only be replaced and not cleaned when contaminated.

2. If the inner element is okay leave assembled in the cleaner body, and change only annually, or every 1200 hours whichever occurs first.

Re–Assembly

1. Clean the inside of the air cleaner casing with a damp, lint–free cloth and install the inner and outer element. Ensure that the rubber sealing rings on the ends are secure and undamaged.

2. Refitting of the filter body to the vehicle, is the reverse procedure to disassembly.

Main Fuel Tank – Removal and Installation

It is necessary to raise the cab approximately 102 mm (4 inches) in order to remove the main fuel tank. Remove the floor mat and remove both front mounting bolts and loosen the two rear mounting bolts. Attach cab lifting tool, FTC213997B. Using a suitable lifting hoist, carefully raise the cab.

NOTE: *It is recommended that the fuel tanks are drained prior to removal from the tractor. If an auxiliary tank is fitted, the fuel from both tanks can be drained from a plug (1) in the auxiliary tank. Figure 1-1-152*

1. Disconnect the battery.

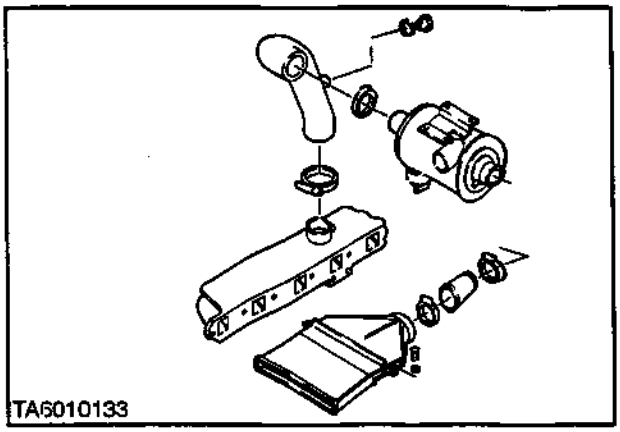
2. Disconnect the wiring harness from the sender, located at the top, front of the tank.

3. Remove the two bolts (2) & (3) Figure 1-1-150, securing the left hand foot step and remove the step.

NOTE: *There is no fuel drain tap or tank bung on the main fuel tank.*

4. Drain the fuel tank. If available, insert a suitable pump into the tank filler inlet to withdraw the fuel.

4A. Another method of emptying the tank is to disconnect the fuel filter feed tube and redirect into a suitable container. Turn on the key start switch to activate the electric fuel pump and allow to empty tank.



Naturally Aspirated Air Cleaner Components
Figure 1-1-149

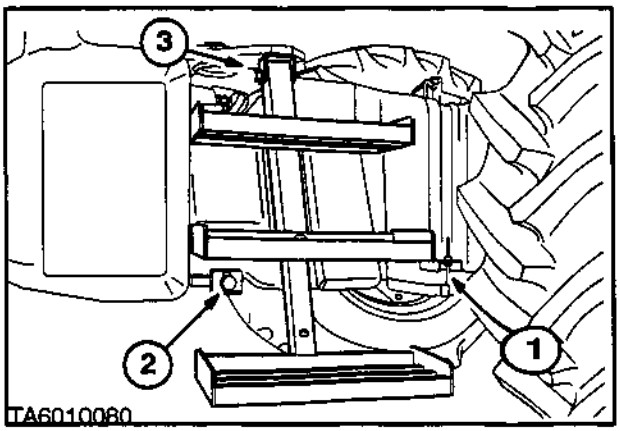


Figure 1-1-150

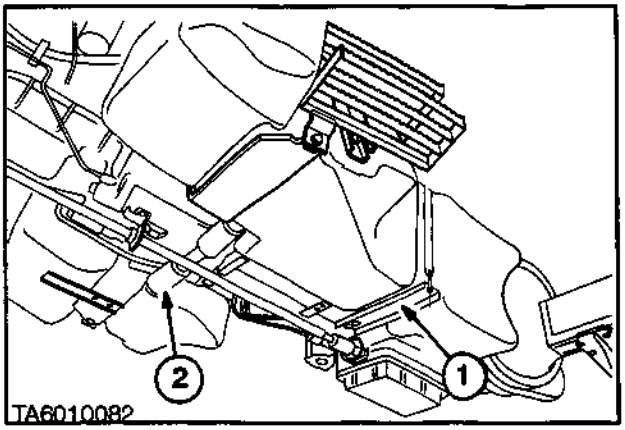


Figure 1-1-151

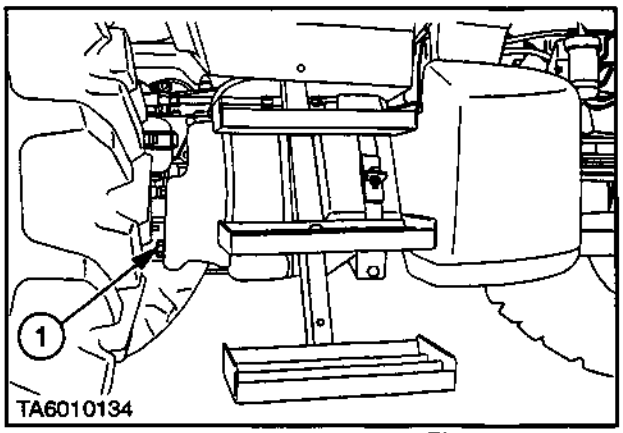


Figure 1-1-152

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5. Disconnect the remainder of the fuel lines, the cross–over tube and the rear vent tube from the tank.

6. Remove the nut (1), Figure 1-1-150, from the fuel tank strap and position strap out of the way. Remove the strap bracket, (1), Figure 1-1-151.

7. Remove the tank from the tractor.

8. Installation is the reverse of the removal.

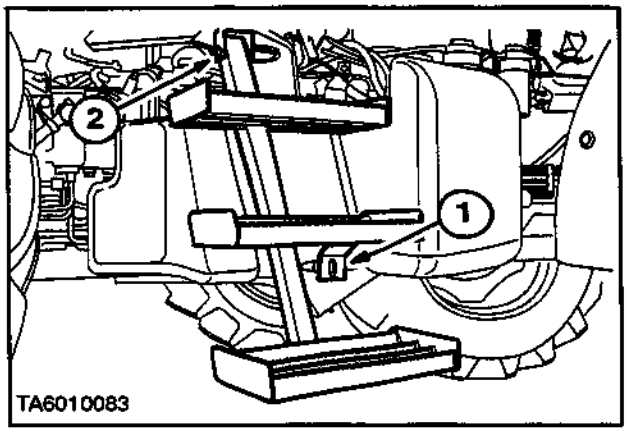


Figure 1-1-153

Auxiliary Fuel Tank Removal and Installation

1. Disconnect the battery.

2. Place a suitable container under the drain plug and drain the fuel. Slacken the worm drive clip on the connector tube, (2), Figure 1-1-151. Remove the right hand foot step, removing bolts (1) and (2) Figure 1-1-153. Disconnect the remaining fuel lines and remove the tank from the tractor.

3. Installation is the reverse of the removal.

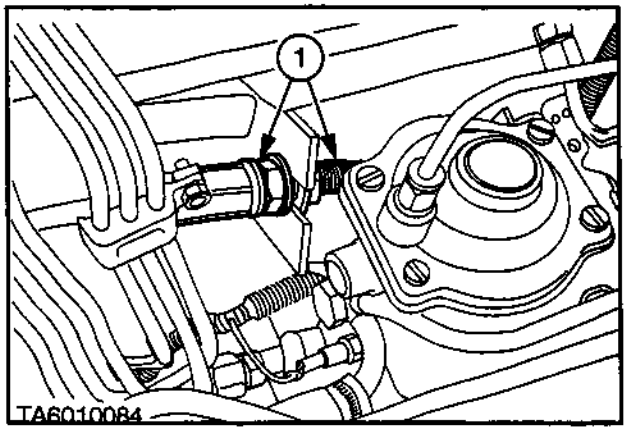


Figure 1-1-154

Foot Throttle Cable Replacement and Adjustment

A single cable directly from the foot pedal operates the fuel pump lever.

1. Raise the engine hood.

2. Slacken the cable adjusting nuts and remove the clip retaining the cable to the fuel injection pump lever.

3. Remove the right hand instrument console lower panel and remove the clip retaining the cable to the foot throttle linkage (1), Figure 1-1-155.

4. Remove the cable from the engine side.

5. Installation is the reverse of removal.

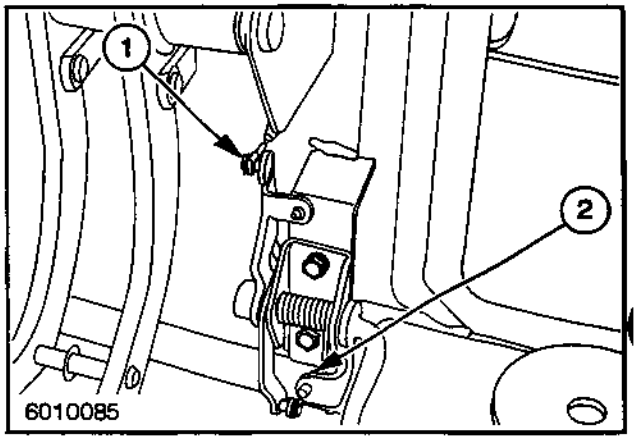


Figure 1-1-155

Adjustment

1. Adjust the cable at the injection pump, Figure 1-1-154, to remove all slack at the idle position. Depress the pedal fully and ensure that full throttle is achieved. If not achieved adjust the stop bolt, (2) Figure 1-1-155, on the pedal to allow further movement. If full throttle is achieved too early in the pedal movement again adjust the pedal stop to coincide with injection pump full throttle.

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Hand Throttle Cable Replacement and Adjustment

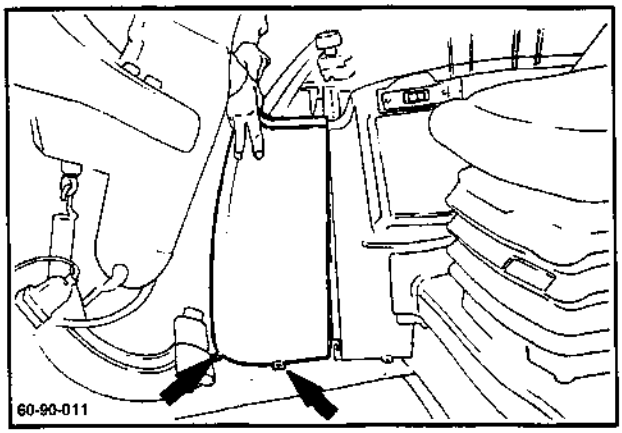


Figure 1-1-156

A single cable from the hand lever attaches to a pivot plate at the foot pedal assembly. This actuates the injection pump, via the foot throttle cable.

1. Remove the transmisson lever console lower panel, Figure 1-1-156. Remove the clip retaining the cable to the lever, (1) Figure 1-1-157, and slacken the outer cable adjusting nuts (2) and (3) Figure 1-1-157, and slide the cable from the bracket.

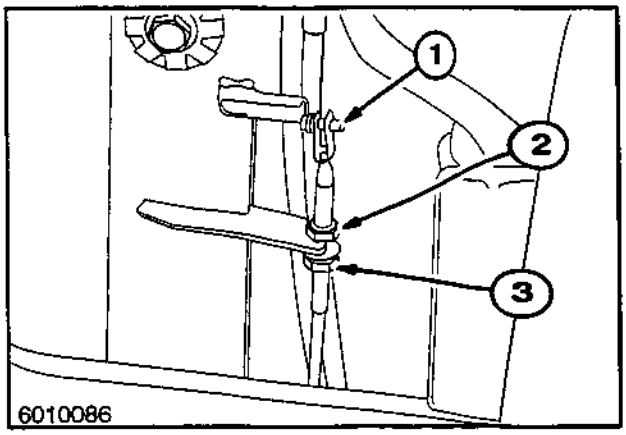


Figure 1-1-157

2. Remove the right hand instrument console lower panel and remove the clip retaining the cable to the pivot plate (1) Figure 1-1-158.

3. Remove the cable from the tractor.

4. Installation is the reverse of removal.

Adjustment

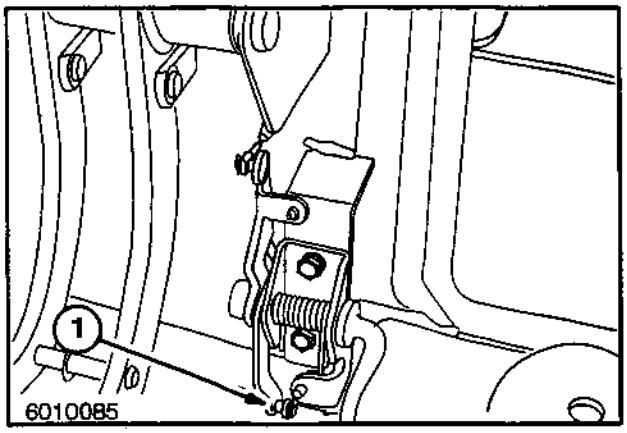


Figure 1-1-158

1. Ensure that the foot throttle cable is correctly adjusted as described above. Adjust the hand throttle cable, using the two outer cable nuts, to remove all slack from the cable when in the idle position. Ensure that there is a slight clearance between the hand throttle pivot plate and the foot throttle assembly.

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COOLING SYSTEM

Radiator Removal

1. Lift the engine hood.

2. Remove the 2 screws securing the air cleaner duct to the top of the radiator. Loosen the hose clamp and remove the duct.

3. Close the cab heater hose tap, situated to the rear of the right hand side of the engine, (1) Figure 1-1-159 and turn the heater control knob in the cab to the coldest setting.

4. Attached to the front of the radiator by means of "D" handle bolts, on the right hand side, is the transmission oil cooler radiator and the air–conditioning condenser (when fitted), Figure 1-1-160.

5. Loosen the "D" bolts of both coolers and slide out, placing them carefully out of the way with their respective hoses still attached. This is important where air conditioning is fitted, as refrigerant could be lost, if hoses are disconnected from the condenser.

6. Place a suitable container under the tractor. Loosen the radiator lower hose at the base of the radiator and drain the coolant off. Remove the radiator cap to speed up the draining, using caution if the system is hot.

⚠ WARNING ⚠

Do not allow anti–freeze to contact skin. Adhere to instructions detailed on anti–freeze container.

7. Disconnect the radiator top hose, and oil cooler pipes in the lower part of the radiator.

8. Loosen the fan shroud screws, (1) Figure 1-1-161 and (1) Figure 1-1-162, placing the fan shroud behind the fan blade.

9. Remove the two bolts securing the radiator to the front support. Ensuring all pipes are disconnected, and looms are unclipped, and away from the radiator assembly. Lift the radiator up and clear of the vehicle.

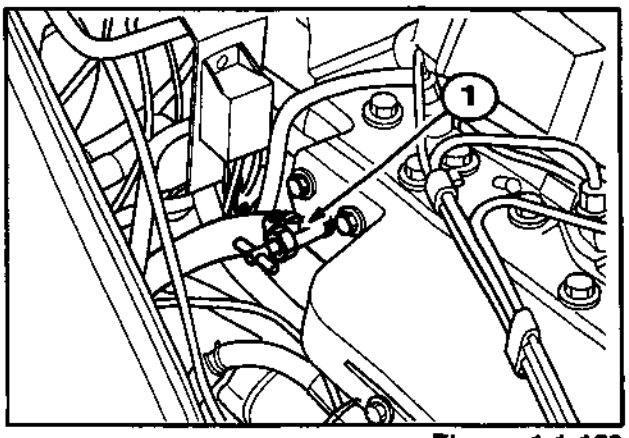


Figure 1-1-159

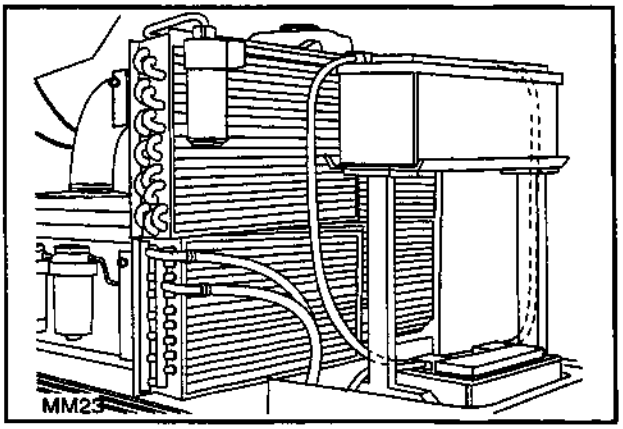


Figure 1-1-160

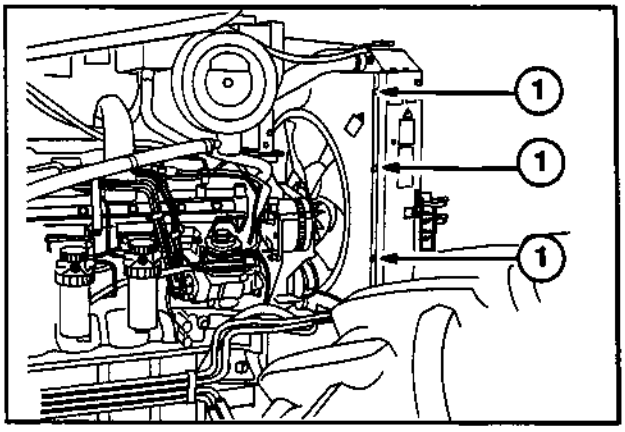


Figure 1-1-161

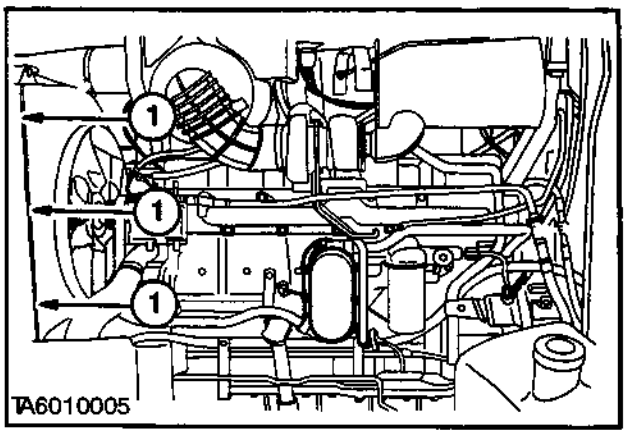


Figure 1-1-162

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Inspection and Repair

1. Inspect the fins for damage and repair as required, ensuring they are free from any obstruction.

2. Check the radiator for leaks, and repair as required. The radiator is fitted with an engine oil heat exchanger in the lower tank which should be checked for leaks. If the lower tank is found to be leaking replace the radiator.

Installation

Installation of the radiator follows the removal procedure in reverse, but upon installation observe the following requirements.

1. Ensure the correct grade, and quantity of antifreeze is added to the coolant. Recommended content mixture is 50% Water, with 50% Antifreeze.

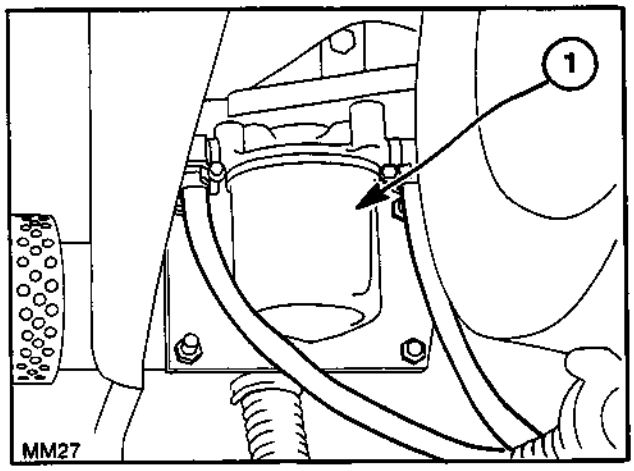


Figure 1-1-163

NOTE: *It is necessary to replace the filter/conditioner if the cooling system is drained or a large water loss has occured, to ensure maximum engine protection is maintained. Item 1, Figure 1-1-163.*

2. Refill the system through the radiator pressure cap until completely full. Re-install the 14.5 lb/in^2 (1 bar) radiator cap and continue filling through the expansion tank until the coolant is seen through the sight glass. Refit expansion cap, 1, Figure 1-1-164.

3. If engine oil cooler tubes have been disturbed check the engine oil level.

4. Run the engine for several minutes checking for leaks, topping up any fluid levels that may have settled during testing.

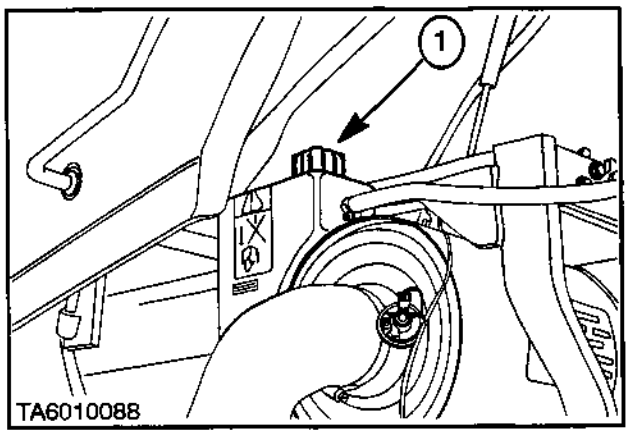


Figure 1-1-164

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Thermostat Removal

1. Drain the coolant system below that of the level of the thermostat housing. Where a cab is fitted, shut off heater hose tap, (1) Figure 1-1-165 and turn the heater control knob in the cab down to the coldest setting.

2. Remove the thermostat housing retaining bolts and move the housing with tube attached to one side.

3. Withdraw the thermostat from the housing, along with the gasket, Figure 1-1-166.

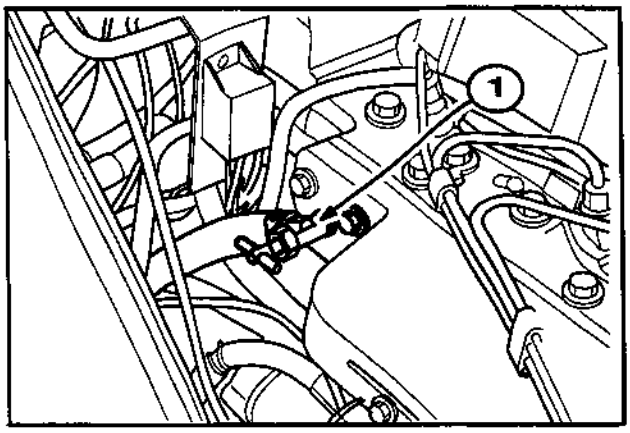


Figure 1-1-165

Inspection and Repair

1. Place the thermostat in a container of water, and raise the temperature to 212°F (100°C). If the thermostat fails to open when hot, or close properly when cooled, it must be replaced, Figure 1-1-167.

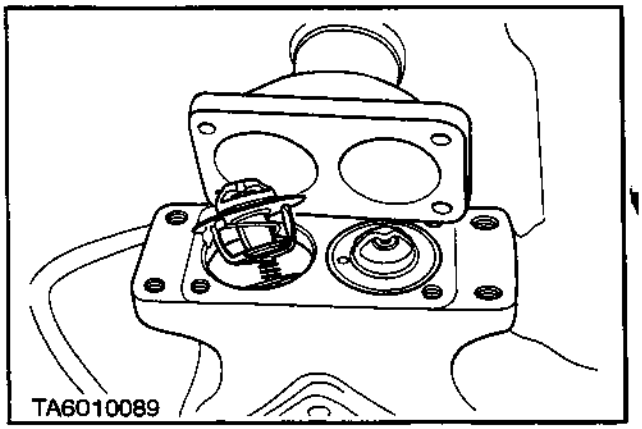


Figure 1-1-166

Installation

Installation of the thermostat is the reverse of the removal procedure but observing the following.

1. Coat a new gasket with sealer and position in the recess on the thermostat housing, prior to installing the thermostat.

2. Coat the edge of the thermostat with grease and install, with the heat element located in the cylinder head.

3. Refit the thermostat housing and torque the two bolts to 15–21 ft. lbs. (20–28Nm).

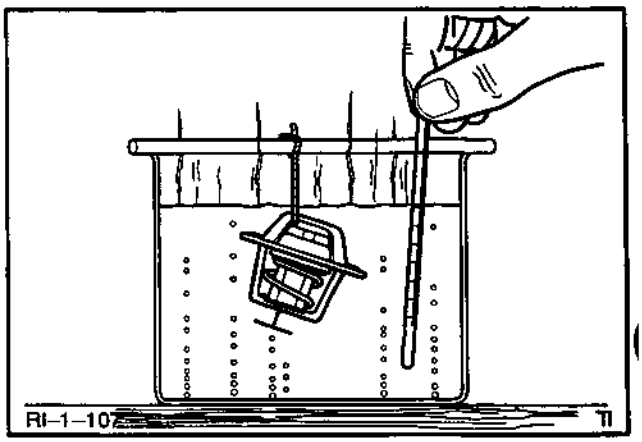


Figure 1-1-167

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Temperature Warning Sender

1. The temperature sender for the gauge is located on the left hand side of the thermostat housing, Figure 1-1-168.

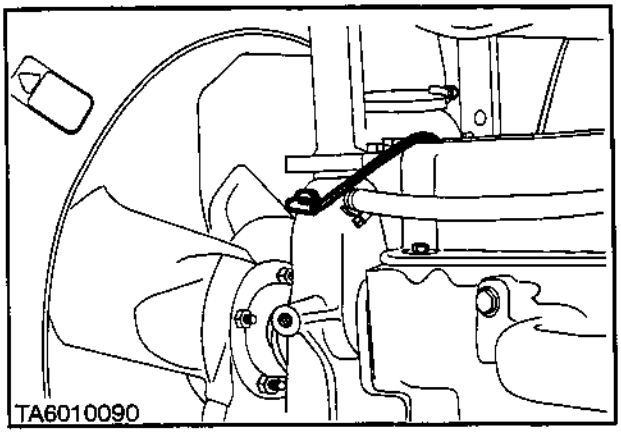


Figure 1-1-168

Installation

1. If the sender is suspected of being faulty refer to the "Electrical System" section to correctly diagnose the fault. If a new sender is to be fitted apply sealant to the threaded portion of the new sender body and torque the sender to, 12–18 ft. lbs. (16–24Nm).

Viscous Clutch Testing

Where it is suspected that the viscous clutch is not operating correctly, it should be tested as follows:–

1. Using an electronic stroboscopic rev/min. counting device, determine the engaged speed of the fan while operating the engine at approx. 1800 rev/min. with the engine coolant temperature above the normal operating range.

2. If the fan speed is less than 85% of the fan pulley speed then the unit is not operating correctly and should be replaced. The following table gives an example of calculating the percentage:

Obseved fan speed	=	2600 rev/min
Engine speed	=	1800 rev/min
Pulley ratio	=	1.67:1
Fan pulley speed	=	1.67x1800=3006
Percentage	=	$\frac{2600 \times 100}{3006}$ = 86.5%

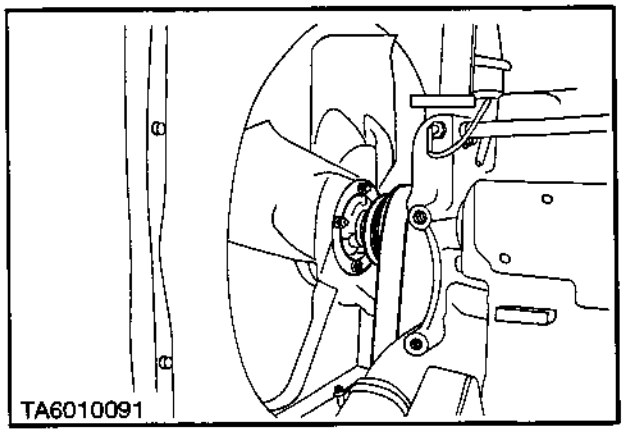


Figure 1-1-169

Viscous Clutch Assembly Removal

1. To remove the fan and clutch assembly (where fitted), hold the pump pulley in a fixed position. Placing an open ended spanner on the nut to the rear of the clutch assembly spacer, undo the nut in a clockwise direction.

NOTE: *Hold the pulley by inserting a suitably sized punch/rod through the hole in the pulley and wedge against the flange of the water pump cover. Figure 1-1-170.*

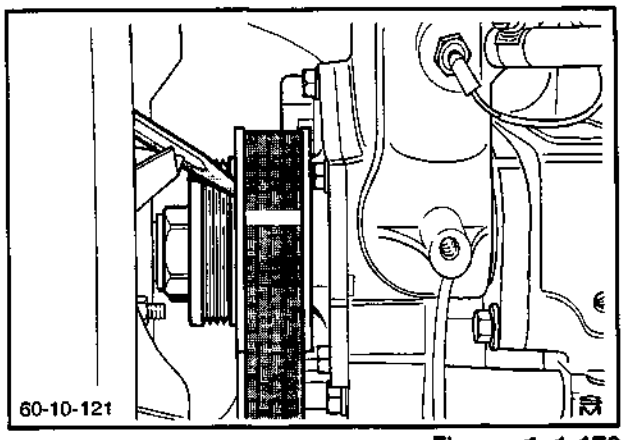


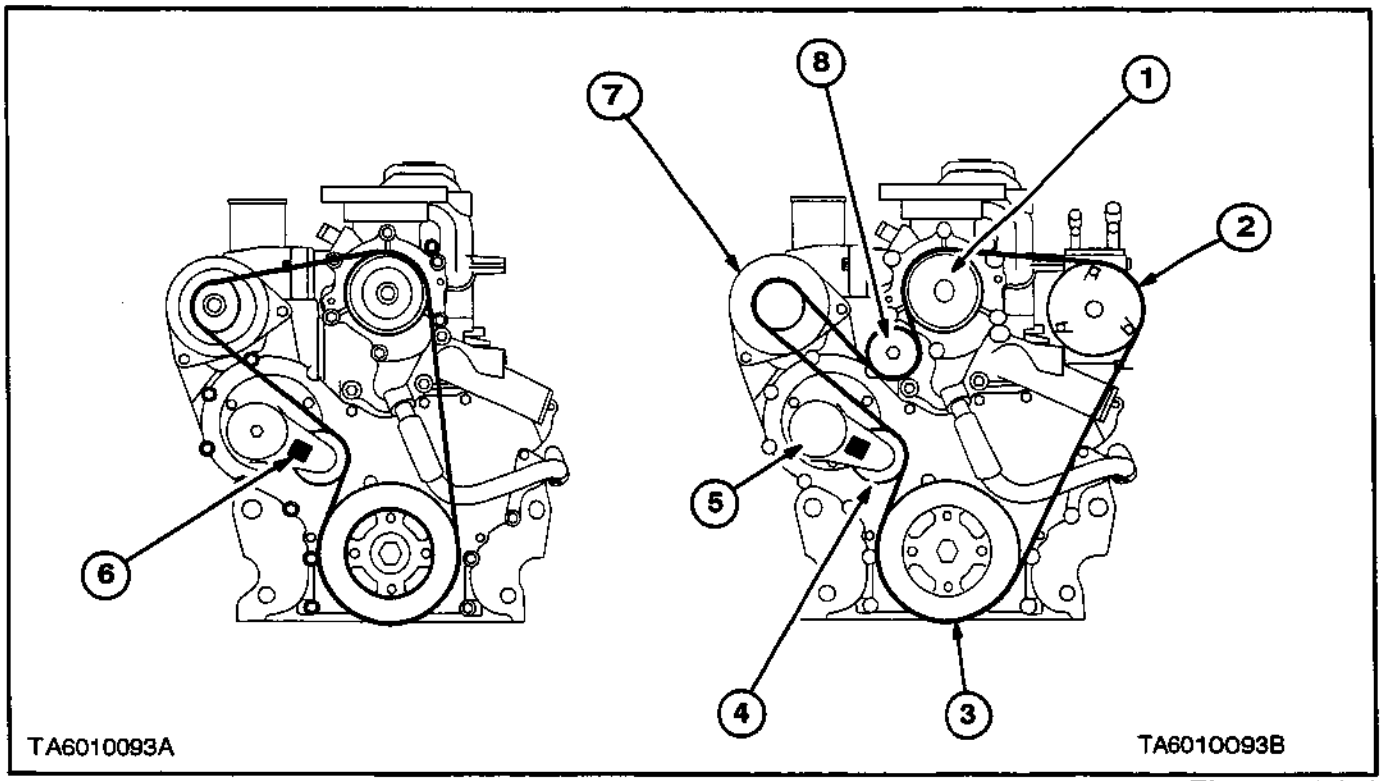
Figure 1-1-170

Installation

1. On re–assembly of the fan assembly tighten the attaching nut in an anti–clockwise direction, and torque to, 40 ft. lbs. (54 Nm).

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Fan Belt Tensioner

Figure 1-1-171

A. Fan Belt Less Air Conditioning

1. Water Pump Pulley
2. Air Conditioning Compressor
3. Crankshaft Pulley
4. Tensioner Pulley

B. Fan Belt With Air Conditioning

5. Tensioner Attaching Bolt
6. 1/2in. (13mm) Square Drive Hole
7. Alternator
8. Idler Pulley with Air Conditioning Only

Fan Blade Removal

1. Remove the viscous clutch assembly as described above. Remove the four nuts retaining the fan blade to the viscous unit and remove the fan.

Re–Assembly

1. Re–assemble the fan blade using the four attaching bolts and torque the bolts to, 15–18 ft. lbs. (20–25 Nm). Re–Install fan and viscous unit.

Fan Belt Tensioner Removal

1. The fan belt should be removed in the following manner. Attach a 13mm (1/2in.) square drive ratchet into the tensioner arm, (6) Figure 1-1-171. Rotate clockwise and remove the fan belt from the pulley and allow the tensioner to return to its untensioned position once the belt has been removed.

2. Remove the tensioner from the pump by loosening and removing the center attaching bolt.

Inspection and Repair

1. Checking of the tensioner assembly operation should be carried out, with the tensioner assembly still attached to the front cover. To check the spring load, place a "break back" torque bar pre–set to, 52–63 ft. lbs. (70–85Nm) on to the pulley attaching bolt. Raise the lever up through an arc of 20° maximum. If the torque bar does not "break" within the range a new tensioner assembly is required.

2. Ensure the tensioner pulley, rotates freely by hand. If not replace with new parts.

Re–Assembly

1. Fit a new pulley to the assembly if required, and torque the attaching bolt to, 34.5–44 ft. lbs. (46.5–60Nm).

2. To re–assemble the arm assembly, position the tensioner on to the front cover, fit the mounting bolt through the assembly, and torque the bolt to, 34.5–44 ft. lbs. (46.5–60Nm).

3. Refitment of the fan belt is the reverse of the removal procedure, but ensure the "Poly V" belt, is positioned correctly onto all of the pulleys.

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Idler Pulley (with Air Conditioning Only)

1. One idler pulley is fitted to the engine. Located on the right hand side of the engine, under the water pump, (1), Figure 1-1-172.

2. Check that the idler pulley rotates freely, if tight or worn, replace with new. Removal and replacement is by the attaching bolt through the center of the idler pulley. Torque the bolt to, 34.5–44 ft. lbs. (46.5–60N m).

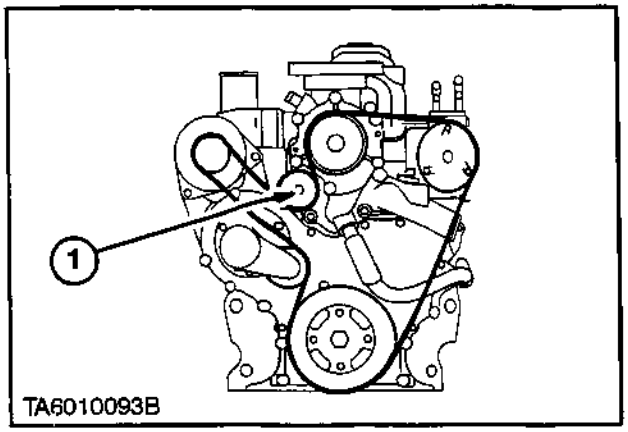


Figure 1-1-172

Water Pump Removal

To overhaul the water pump components, i.e, bearing, impeller or shaft seal, it is only necessary to remove the cover assembly.

1. Drain the cooling system.

2. Remove the fan belt from the vehicle.

3. Remove the bolts securing the fan shroud and move the shroud towards the engine.

4. Remove the six cover bolts, (1) Figure 1-1-173, leaving the body bolted to the cylinder block and withdraw the cover assembly complete with fan and viscous unit. Note the 'O' ring on the rear of the cover.

5. Withdraw the four bolts which pass through the water pump and into the block, and slide the complete pump forward and away from the block. Note the sealing O–ring which may come off with the pump or be left on the block, (1) Figure 1-1-174.

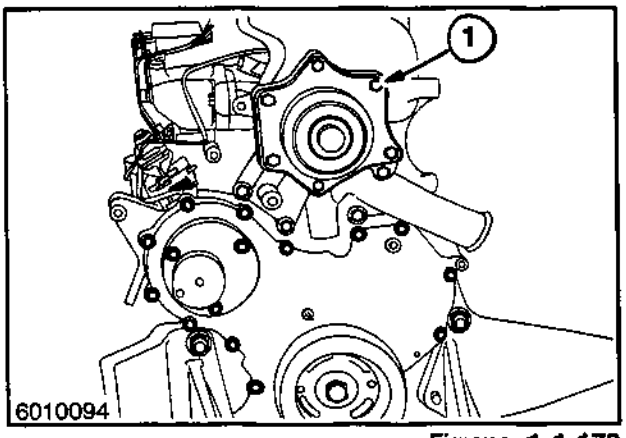


Figure 1-1-173

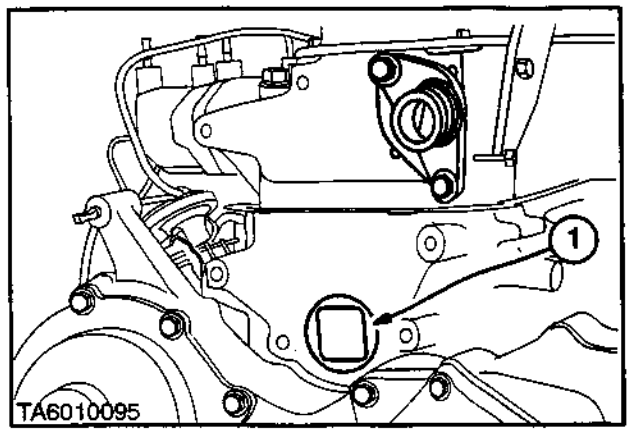


Figure 1-1-174

Disassembly

1. To remove the fan and clutch assembly hold the pump pulley in a fixed position, and placing an open ended spanner on the nut to the rear of the clutch assembly spacer, undo the nut in a clockwise direction.

2. Using a puller and a sleeve slightly smaller than the pulley shaft, ease the pulley from its shaft, Figure 1-1-175.

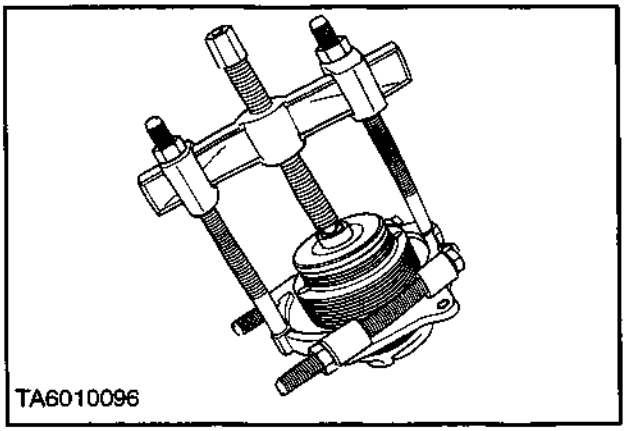


Figure 1-1-175

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3. To remove the impeller/shaft assembly, place the pump body impeller side down. Support the pump in a manner to allow the impeller diameter to drop clear of the pump, as it is pressed out from the pump body, Figure 1-1-176.

NOTE: *Apply pressure to the outer bearing race, and shaft simultaneously to remove, using the correct tool. Do not press the center shaft only, as the shaft may move, leaving the outer bearing case in the pump body.*

4. With the impeller/shaft assembly removed from the pump, place the impeller on supports, and press out the shaft assembly from the impeller, Figure 1-1-177. Remove and discard the seal from the bearing and shaft assembly.

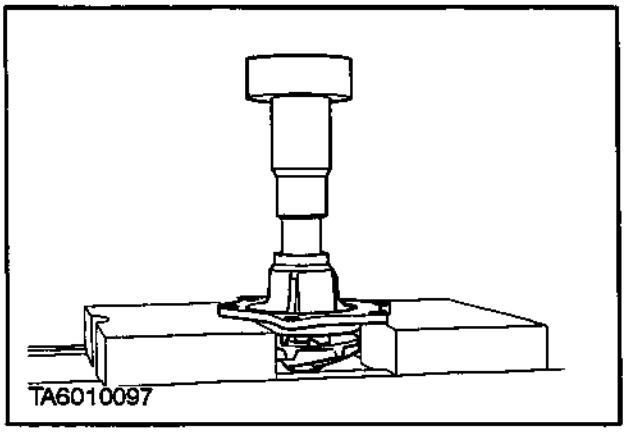


Figure 1-1-176

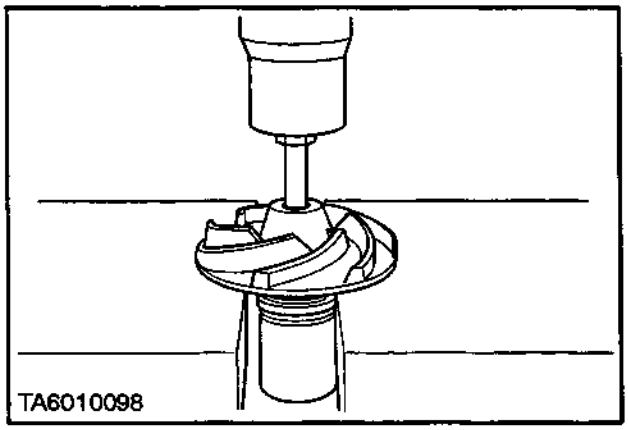


Figure 1-1-177

Inspection and Repair

1. Check the bearing shaft assembly for signs of wear or leaks, and if evident, the assembly must be replaced with new parts.

2. The impeller should be checked for worn or damaged vanes and must be replaced if not to an acceptable standard.

3. Clean and check the pump body for signs of cracks, erosion or leaks. If any of these faults are in evidence and likely to cause pump failure at a later date, the pump body must be repaired or replaced with a new one.

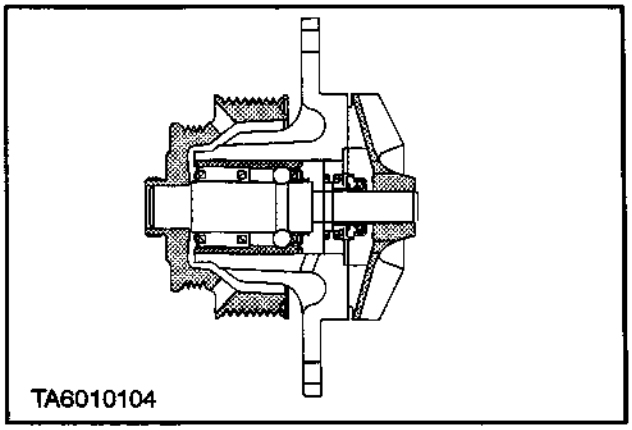


Figure 1-1-178

Re–Assembly

1. To install the bearing into the pump cover, place the cover rear face down onto suitable blocks to allow the shaft to protrude through. Install the bearing with the longer stepped end of the shaft in the body, and using a sleeve that contacts the bearing outer race only, press the bearing into the body. Once installed in the body the bearing case end face must be flush with the pump front face to within 0.000–0.006 in (0.00–0.152mm), Reference "A", Figure 1-1-179.

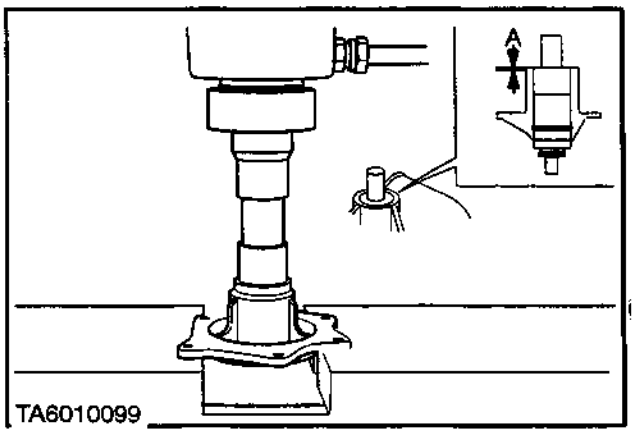


Figure 1-1-179

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2. With the water pump placed front face down and the shaft supported, place the seal assembly on the end of the shaft, with its smallest diameter uppermost. To insert the seal assembly place tool FNH04672 over the seal and press, until the lip on the seal body seats on the pump body, Figure 1-1-180.

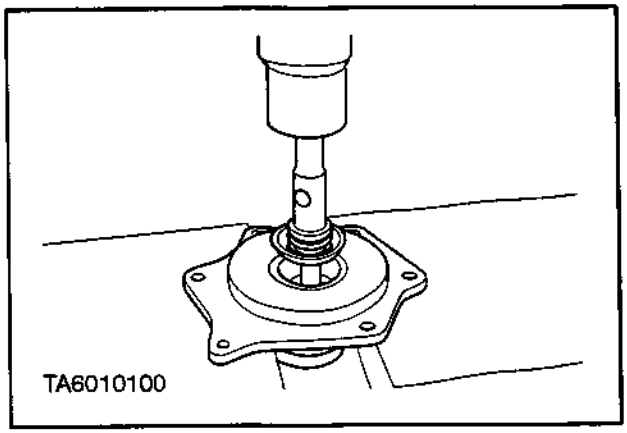


Figure 1-1-180

3. With the water pump rear face up, and the shaft supported, place the impeller over the shaft and press the impeller into the water pump body. Installed correctly the face of the impeller fins to the operating face of the water pump cover should be, 0.010–0.035 in (0.25–0.88mm), Figure 1-1-181.

4. With the pump rear face down and the shaft supported, press the pulley onto the shaft ensuring that the pulley front face to the rear face of the cover is, 3.065–3.075 in (77.85–78.10mm), Figure 1-1-182.

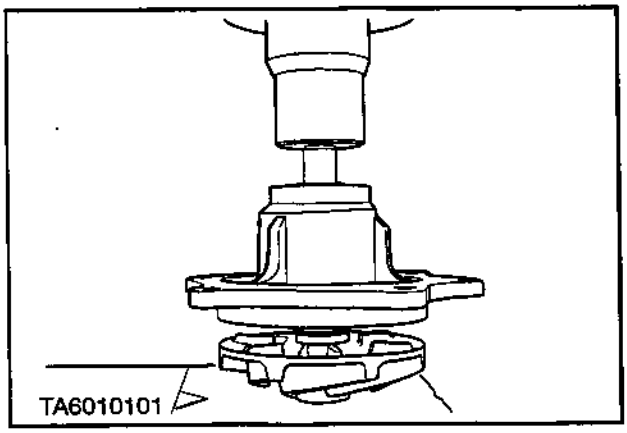


Figure 1-1-181

5. Install the cover assembly, with a new O–ring fitted, onto the pump body, tightening the six retaining bolts to a torque of 12–19 ft. lbs. (17–26 Nm).

6. Ensure after the cover is assembled to the water pump that the pulley/impeller assembly rotates freely by hand prior to re–assembly to the engine. If not disassemble and recheck the relevant dimensions.

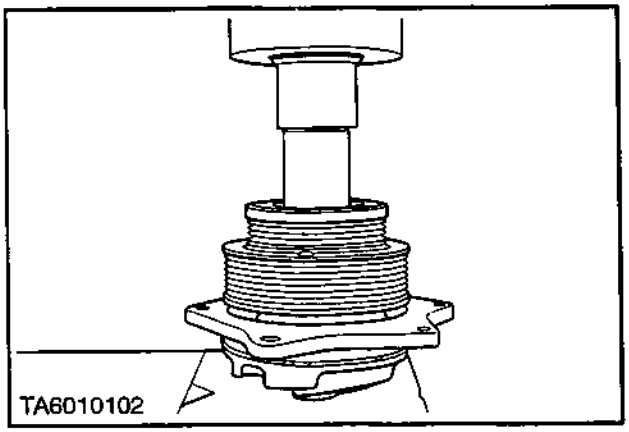


Figure 1-1-182

Installation

1. Installation of the water pump to the engine is the reverse of disassembly, but observing the following requirements.

Clean the block face, and fit a new O–ring between the pump and block face, (1) Figure 1-1-174.

Place the water pump onto the block and install and torque the four pump bolts to 45–50 ft. lbs. (61–68Nm).

Ensure the fan belt tensioner pulley rotates freely, and the swinging arm of the tensioner returns to rest freely. Gently lever the arm up to enable the fan belt to be seated in the grooves on the pulleys. Refit the fan blade assembly.

After installation of the radiator, refill the cooling system as previously described, and run the engine checking for leaks.

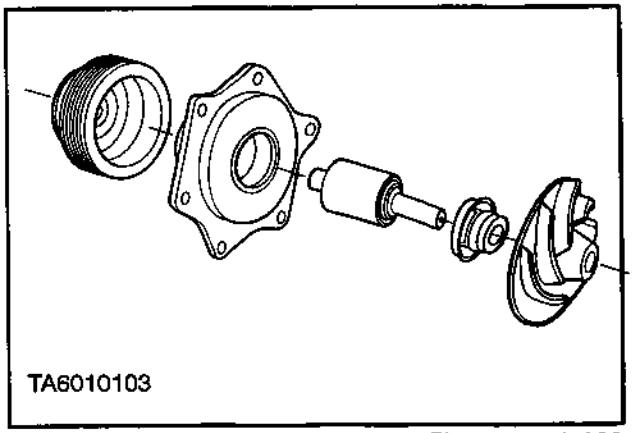


Figure 1-1-183

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8160, 8260, 8360, 8560 TRACTOR REPAIR MANUAL CONTENTS

SECTION 1 - ENGINES



SECTION 2 - ELECTRICAL SYSTEM

SECTION 3 - CLUTCH
SECTION 4 - TRANSMISSIONS
SECTION 5 - MECHANICAL REAR WHEEL DRIVE
SECTION 6 - BRAKES
SECTION 7 - POWER TAKE-OFF
SECTION 8 - HYDRAULIC SYSTEM
SECTION 9 - DRIVE LINES - FWD
SECTION 10 - CAB

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SECTION 2
ELECTRICAL SYSTEM

CHAPTER 1
ELECTRICAL INTRODUCTION

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ELECTRICAL SYSTEM AND FUSES

The electrical system of all tractors consists of various wiring harnesses, instrument clusters, touch panels and various switches. Models fitted with Range Command (semi–powershift) or Dual Command (Hi–Lo) transmissions also use a number of micro–processors to control the transmission and an electronically controlled hydraulic lift system, where fitted.

There are two instrument clusters available, Electronic Instrument Cluster (EIC) and Analog/Electronic Instrument Cluster (AEIC).

The Key start switch has five positions:

1. Thermostart
2. 'Off'
3. Accessory 'on'
4. Warning lamp and instruments 'on'
5. Start

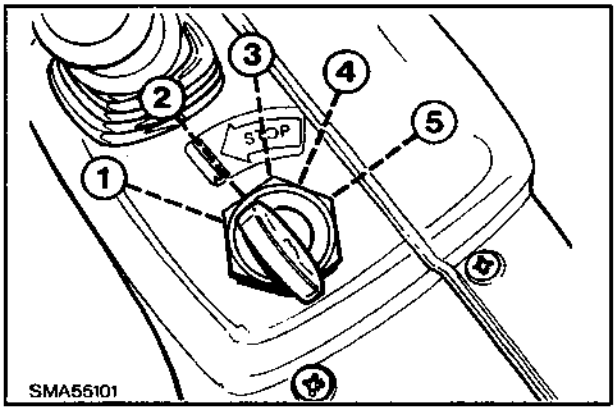


Figure 2-1-1

There are two battery options.

2 x 900 CCA

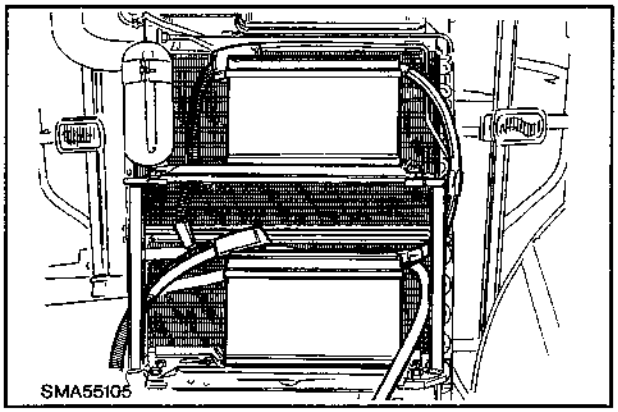


Figure 2-1-2

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There are two alternator options:

70 Amp Standard less cab

100 Amp Standard with cab

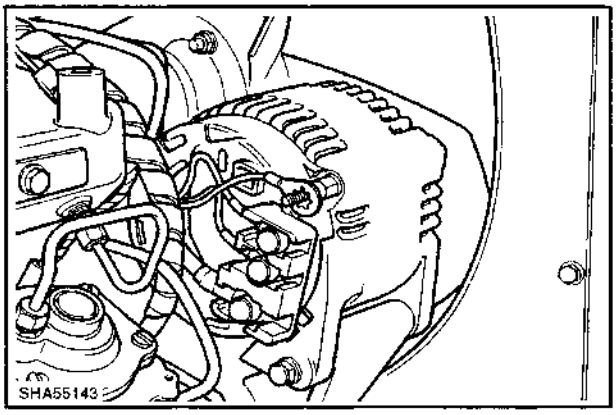


Figure 2-1-3

There are two starter motor options

Bosch 3.6Kw standard

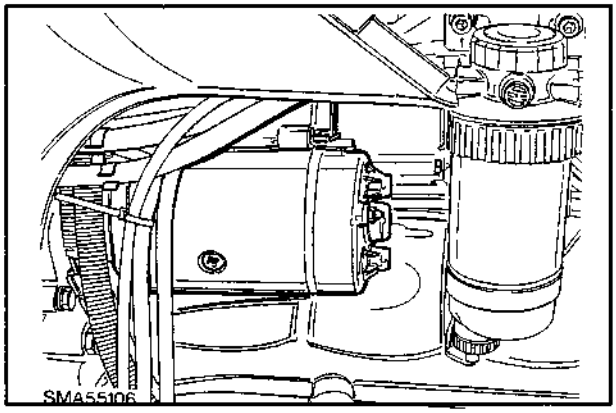


Figure 2-1-4

Fuses and Relays

The Main Distribution Panel (MDP), or fuse box, is located behind the right hand instrument cluster console side panel.

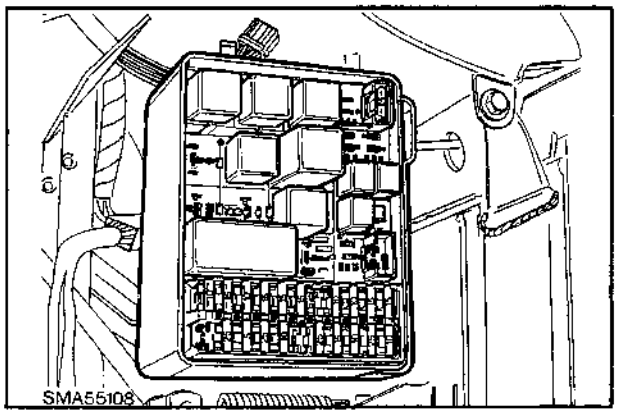


Figure 2-1-5

For primary protection the main supplies from the starter solenoid are fitted with fuse links.

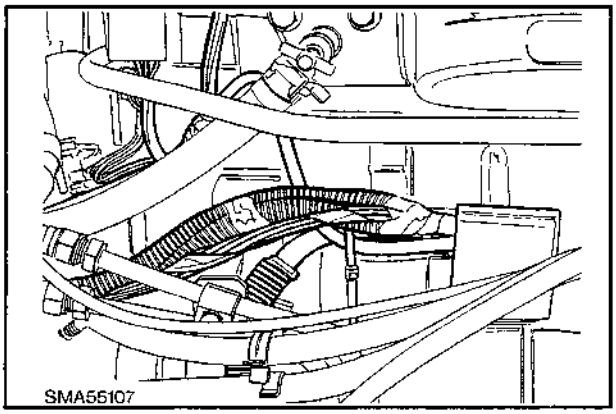


Figure 2-1-6

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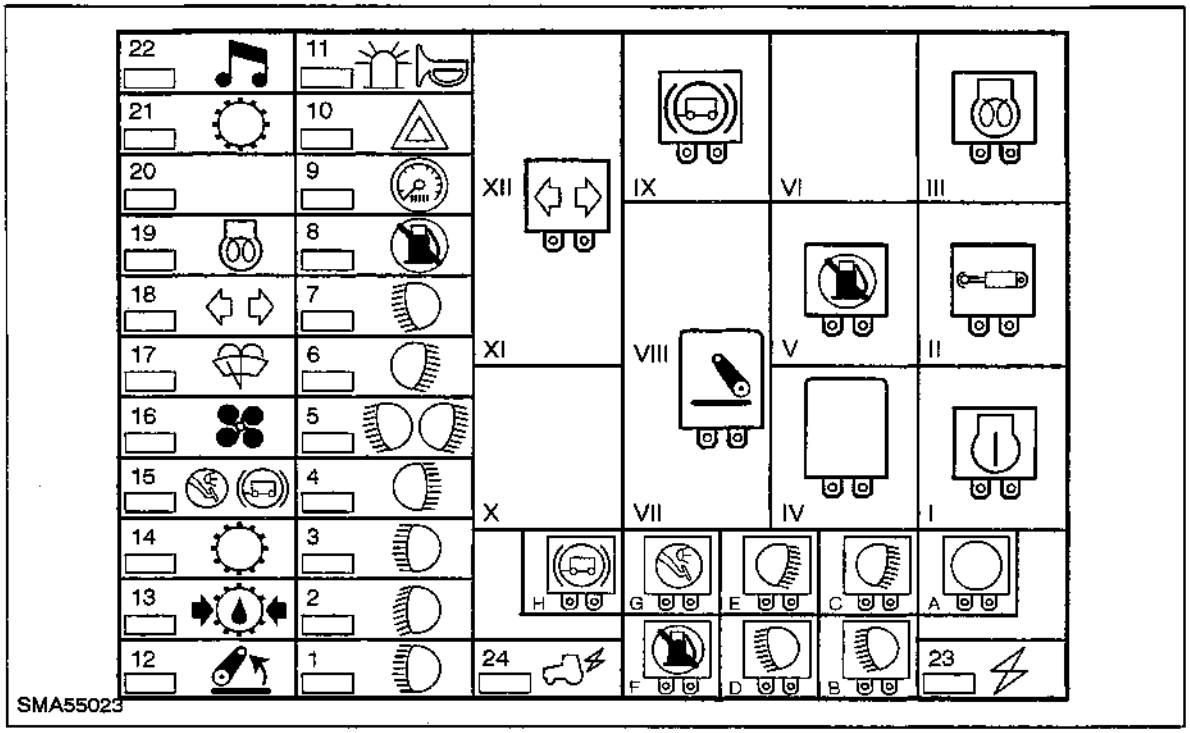
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There are six fuse links fitted:–

2.0mm² (0.003 in²)	Fuses 5/6/7	Worklamps
2.0mm² (0.003 in²)	Fuses 1/2/3/4 10/11/19	Lighting/Hazards Horn, Beacon, Headlamp Flash/ Thermostart
2.0mm² (0.003 in²)	Fuses 12/13/14 20/22/23	EDC / EMU Transmission KAM/Radio Accessory Socket
1.5mm² (0.002 in²)	Fuse 24	Implement Socket
2.0mm² (0.003 in²)	Relay 1 Fuses 9/15/16 17/18	Gauges/Stop Lamps/Heater Fan Wash Wipe Turn Indicators
3.0mm² (0.005 in²)	Main Battery to Alternator Lead	

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Relay	Function
A	Blank *(Air Brakes – Germany/With Cab only)*
B	Worklamp Relay – Front (Roofline)
C	Worklamp Relay – Rear (Roofline)
D	Worklamp Relay – Lower Front
E	Worklamp Relay – Lower Rear
F	Busbar (Fuel Shut Off Relay)
G	Stoplamp Relay
H	Trailer Brake Relay
I	Ignition Relay
II	Hydraulic Diverter Valve Relay

Relay	Function
III	Thermostart Relay
IV	Flasher Unit
V	Fuel Pump Relay
VI	Blank
VII	Front Hitch Control Module
VIII	
IX	Trailer Brake Relay
X	Blank
XI	ISO Module or NASO Module
XII	

No.	Amps.	Circuit
1	15	Headlamp – Main
2	15	Headlamp – Dip
3	10	Sidelamp – Right Hand
4	10	Sidelamp – Left Hand
5	30	Worklamp – Front (Grill Mounted)
6	15	Worklamp – Rear (Fenders)
7	15	Worklamp – Front & Rear (Cab Roof)
8	15	Fuel Shut–Off/Fuel Pump/Water in Fuel
9	10	Gauges/External Switches/Radar
10	20	Hazard Lights
11	10	Horn/Headlamp Flasher/Cigar Lighter/Roof Beacon
12	10	EDC
13	25	EMU Module/Diff Lock/PTO/4WD/ Worklamps/Touch Panel
14	10	Transmission Shuttle
15	30	Stoplamps/Seat Pump/Front Hitch Trailer Brake/Diverter Valve
16	25	Heater Fan
17	20	Wiper Washer/Front Wiper/Rear Wiper/Temperature Control/Console Lamp
18	10	Turn Indicators
19	25	Thermostart
20	5	Keep Alive Memory/EDC/ EMU/Radio
21	25	Transmission Control Module/ Clutch Switch/Gear Shift Indicator/Limp Home
22	5	Radio
23	23	Accessory Socket/Interior Lamp/Cigar Lighter
24	30	Implement Socket

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Micro Processors

The tractor can have a maximum of 4 processors (including an Electronic Instrument Cluster, where fitted). With 3 processors connected to the instrument cluster by a serial link for cluster display.

Electronic Management Unit

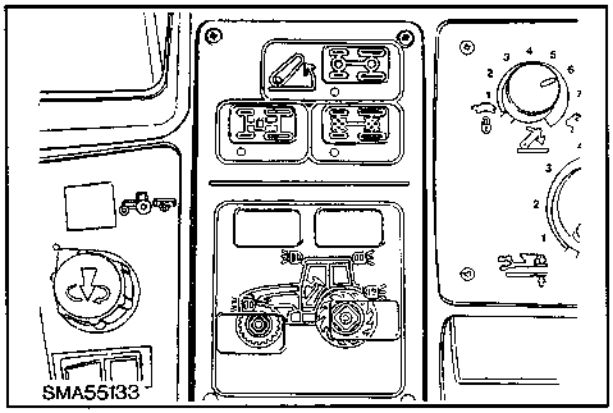


Figure 2-1-7

Electronic Instrument Cluster

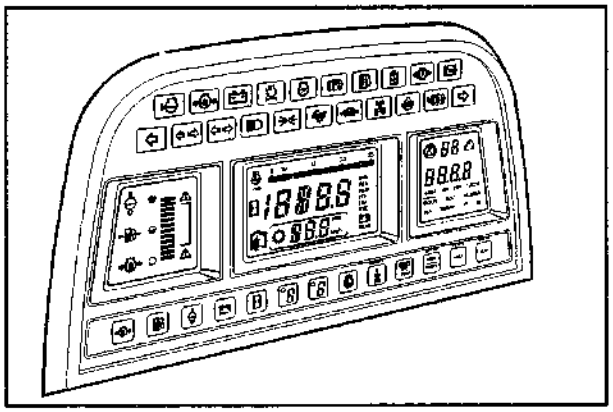


Figure 2-1-8

Electronic Draft Control only or Electronic Draft Control and Hi/Lo transmission processor

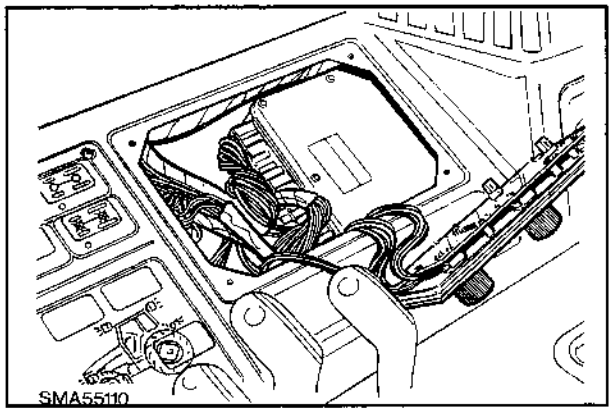


Figure 2-1-9

Semi–powershift transmission processor

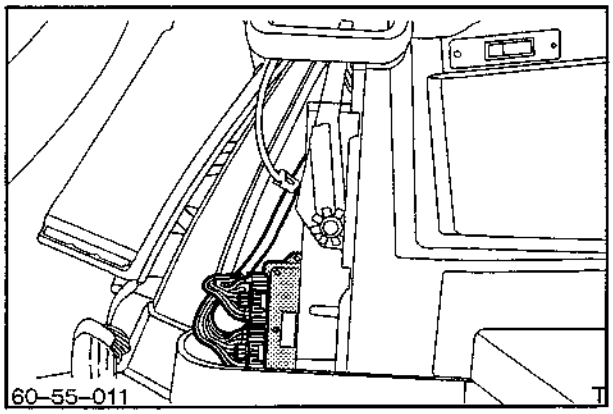


Figure 2-1-10

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CONTROLS AND INSTRUMENTS – LOCATION AND FUNCTION

The information on the following pages identifies, locates and briefly describes the function of the controls and instruments located in the cab.

The controls have been divided into the following areas:

Cab/platform controls – Figure 2-1-11.

Instrument console controls – Figure 2-1-12.

Instrument panels – Figure 2-1-13 to Figure 2-1-15.

Floor-mounted controls – Figure 2-1-16 to Figure 2-1-18.

Overhead controls – Figure 2-1-19 to Figure 2-1-21.

Transmission controls – Figure 2-1-22 to Figure 2-1-25.

P.T.O. Controls – Figure 2-1-26 and Figure 2-1-27.

Electronic Management Unit – Figure 2-1-28 and Figure 2-1-29.

Worklamp switch panel – Figure 2-1-30 and Figure 2-1-31.

Electrical accessory panel – Figure 2-1-32.

Hydraulic controls – Figure 2-1-33 to Figure 2-1-37.

Remote control valves – Figure 2-1-38 to Figure 2-1-41.

IMPORTANT: *The following information in this section is provided as a quick reference guide and is not intended as a replacement of the detailed operational information that appears in the Operators Manual, Section 2 – 'OPERATION'. For details on how to use the controls and check the instruments and warning lights read the whole of Section 2 of the Operators Manual before operating the tractor.*

CAUTION: *Do not operate the tractor until you are thoroughly accustomed with the location and operation of all controls.*

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CAB/PLATFORM CONTROLS

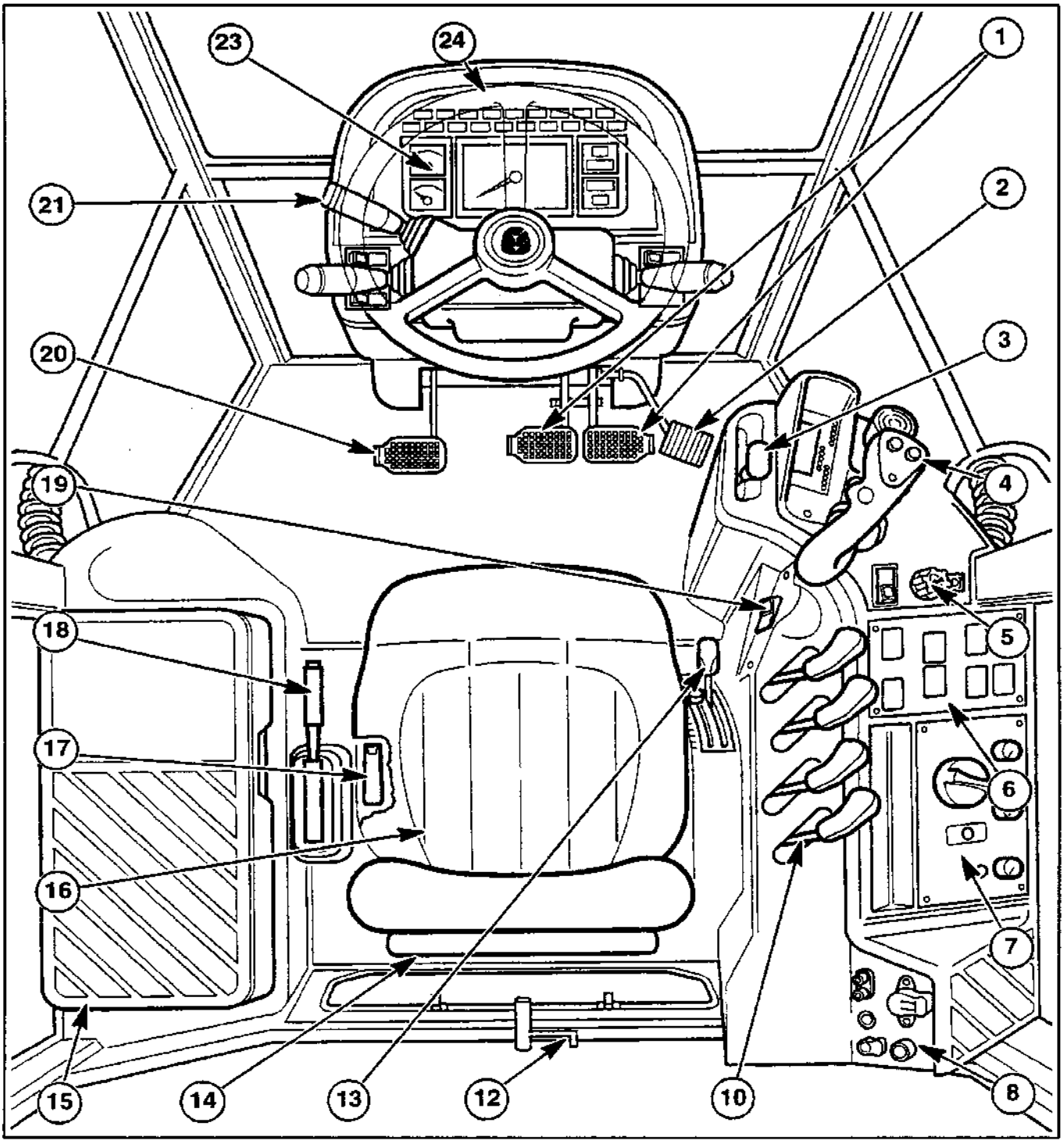


Figure 2-1-11

General View of Tractor Controls

1. Foot brakes
2. Foot throttle
3. Hand throttle
4. Transmission controls
5. P.T.O. controls
6. Electronic Management Unit (EMU)
7. Electronic Draft Control unit
8. Electrical accessory sockets
10. Remote control valve levers
12. Rear window locking handle
13. Hydraulics controls
14. Document storage box
15. Storage box
16. Operator's seat
17. Creeper gears lever (where fitted)
18. Parking brake
19. Fast raise/work switch
20. Clutch/inching pedal
21. Shuttle lever
23. Instrument panel and switches
24. Steering wheel

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INSTRUMENT CONSOLE CONTROLS

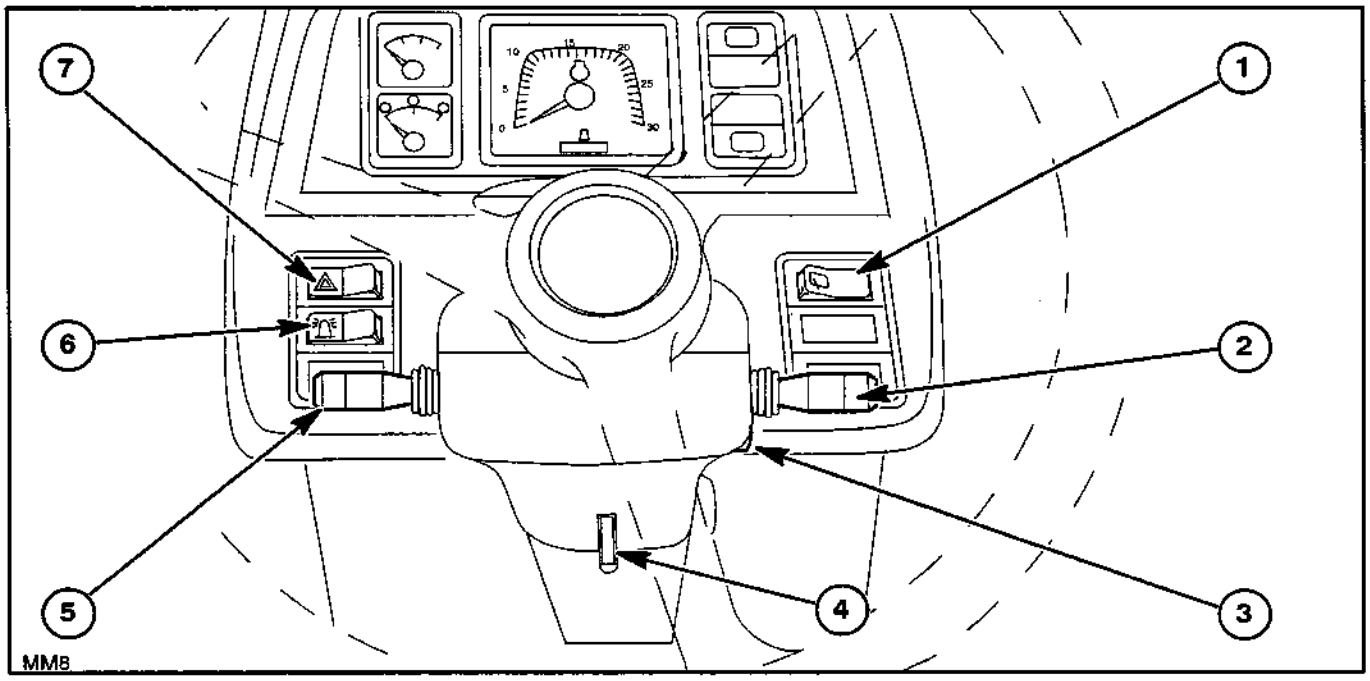


Figure 2-1-12

Instrument Console Controls

1. Rear window wipe/wash control (where fitted)
2. Front windscreen wipe/wash control (with cab only)
3. Key-start/stop switch
4. Steering column tilt/telescopic clamp lever
5. Multi-function switch (lights/turn signals/horn)
6. Roof beacon switch (where fitted)
7. Hazard warning switch

Refer to Operators Manual for complete operating instructions.

INSTRUMENT PANELS

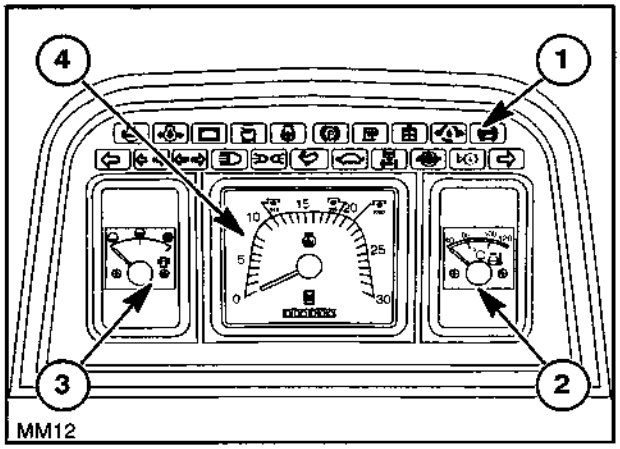


Figure 2-1-13

Analog Instrument Panel

NOTE: NOT USED IN NORTH AMERICA

1. Warning and indicator lights
2. Engine coolant temperature gauge
3. Fuel gauge
4. Speedometer

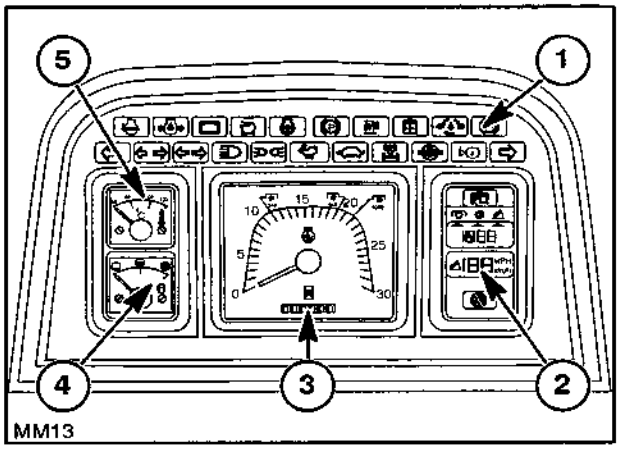


Figure 2-1-14

Analog/Digital Instrument Panel

1. Warning and indicator lights
2. Liquid crystal display panel
3. Speedometer
4. Fuel gauge
5. Engine coolant temperature gauge

Refer to Chapters 4 and 5 of this section for full details

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INSTRUMENT PANELS

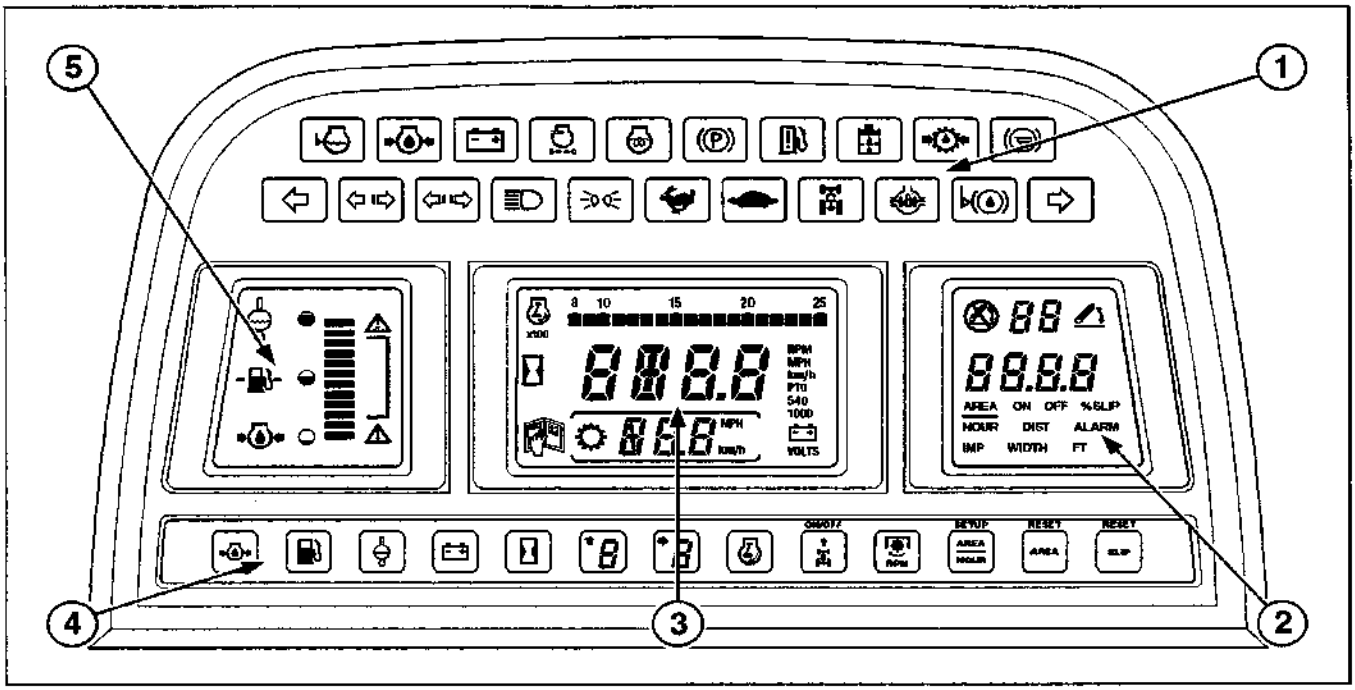


Figure 2-1-15

Electronic Instrument Panel

1. Warning and indicator lights
2. Tractor Performance Monitor (LCD)
3. Central display panel (LCD)
4. Function buttons
5. Bargraph display (LCD)

Refer to Chapter 3 of this Section for full details

FLOOR–MOUNTED CONTROLS

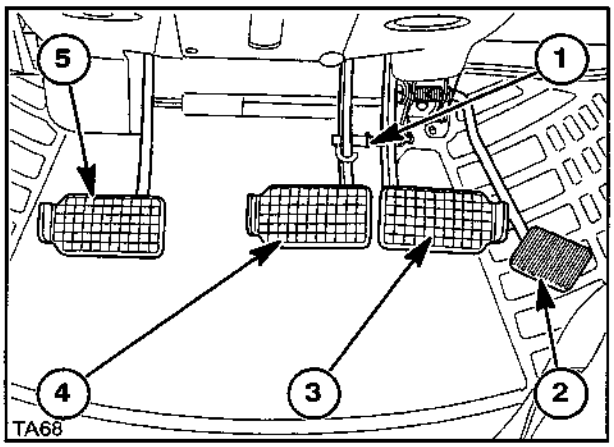


Figure 2-1-16

Foot-operated Controls

1. Brake locking pin
2. Foot throttle
3. Right brake pedal
4. Left brake pedal
5. Clutch pedal

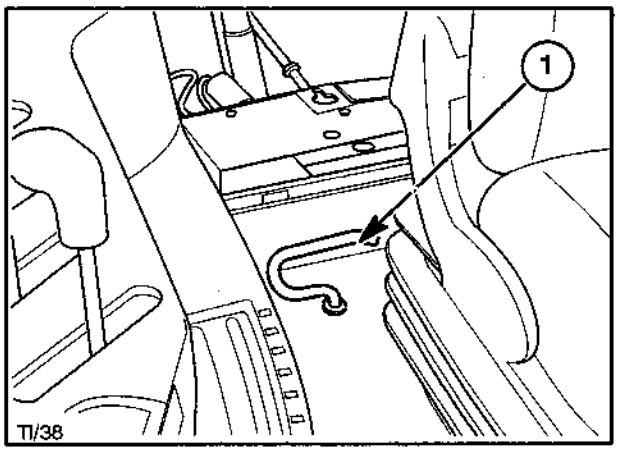


Figure 2-1-17

Floor-mounted Control (right-hand side)

NOTE: NOT USED IN NORTH AMERICA

1. Release lever for automatic pick-up hitch or swivelling tow pin (where fitted) – pull up to release.

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FLOOR–MOUNTED CONTROLS

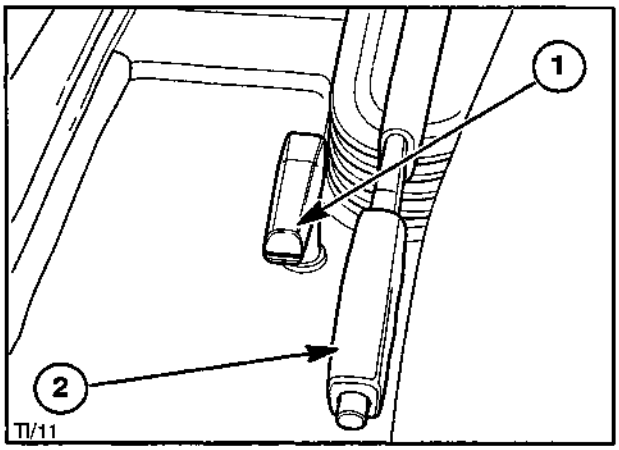


Figure 2-1-18

Floor-mounted Controls (left-hand side)

1. Creeper gears selector (where fitted) – pull up engage creeper gears – push down to disengage.
2. Parking brake

CAB ROOF-MOUNTED CONTROLS

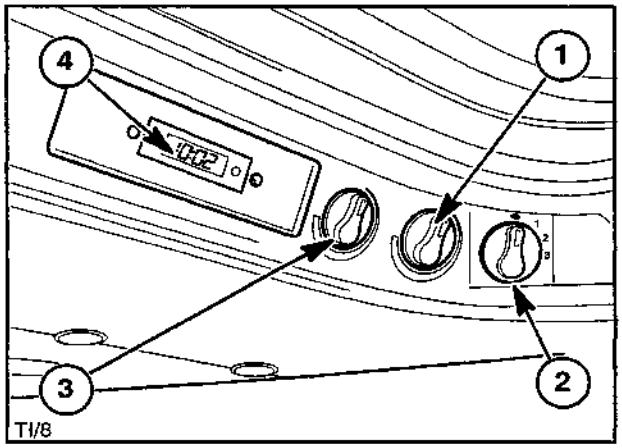


Figure 2-1-19

Roof-mounted Controls

1. Air conditioner temperature control (where fitted)
2. 3-speed blower control
3. Heater temperature control
4. Optional radio/cassette player may be installed in this position

Refer to Operators Manual for complete operating instructions

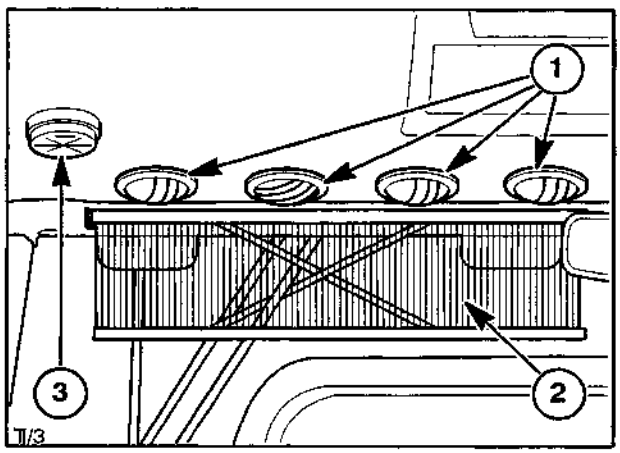


Figure 2-1-20

Roof-mounted Controls

1. Swivelling air vents – press in to open – rotate to direct the air flow.
2. Sun visor
3. Interior light

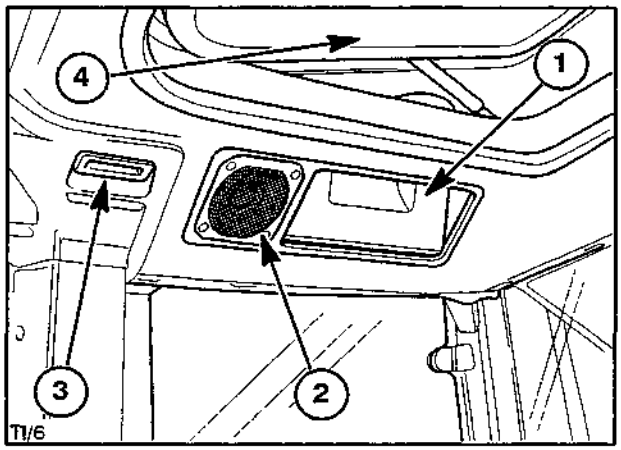


Figure 2-1-21

Roof-mounted Controls

1. Air recirculation vent – push to open.
2. Radio speaker
3. Console light – illuminates when key-start switch turned on.
4. Roof hatch

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TRANSMISSION CONTROLS

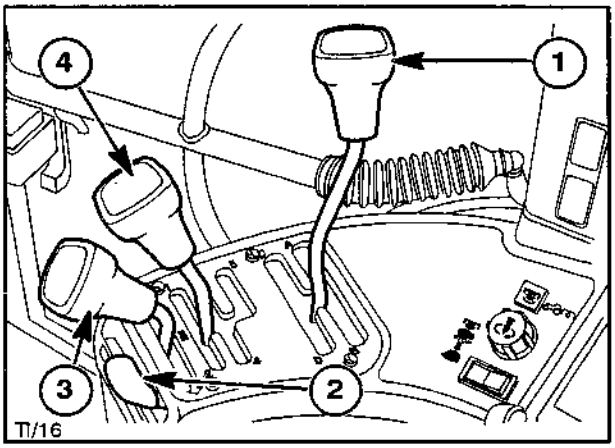


Figure 2-1-22

Controls (mechanical transmission)

NOTE: NOT USED IN NORTH AMERICA

1. Range lever (4 ranges)
2. Hand throttle lever
3. Shuttle lever (forward/reverse)
4. Main shift lever (4 or 5 ratios)

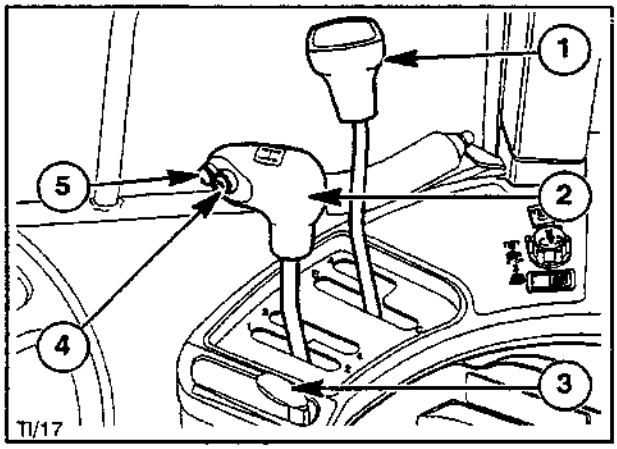


Figure 2-1-23

Controls (Hi–lo transmission)

1. Range lever (3 ranges)
2. Main shift lever (4 ratios)
3. Hand throttle lever
4. Underdrive selector button
5. Direct drive selector button

Refer to Operators Manual for complete operating instructions

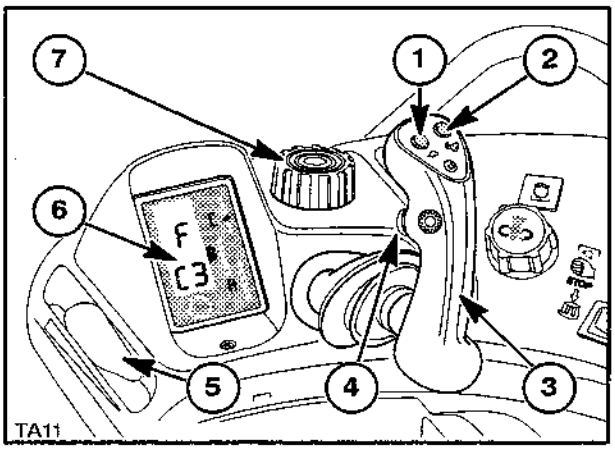


Figure 2-1-24

Controls (semi–powershift transmission)

1. Powershift down button
2. Powershift up button
3. Powershift control (6 ratios)
4. Range change button (3 ranges)
5. Hand throttle lever
6. Gear position display
7. Powershift control adjuster clamp

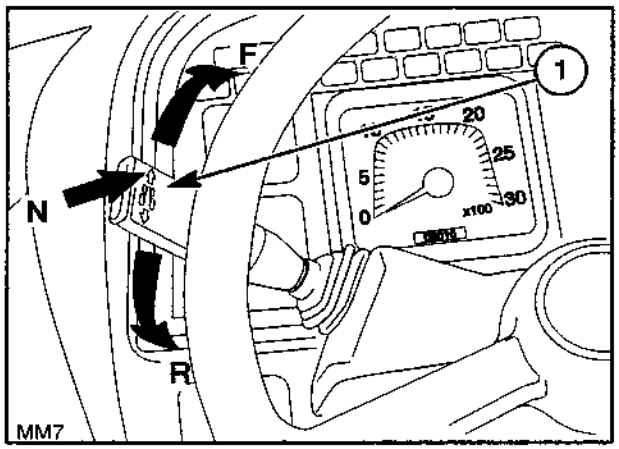


Figure 2-1-25

Controls (Hi–lo and semi–powershift transmissions)

1. Forward/reverse (shuttle) lever – lift and move forward or backwards

   F = Forward
   N = Neutral
   R = Reverse

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P.T.O. CONTROLS

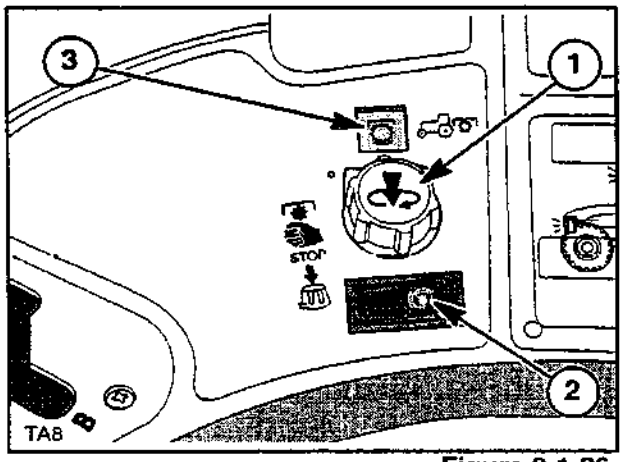


Figure 2-1-26

P.T.O. Controls (right-hand console – front)

Optional front hitch and PTO

1. P.T.O. selector knob – press and rotate.
2. P.T.O. brake override switch
3. P.T.O. indicator lamp

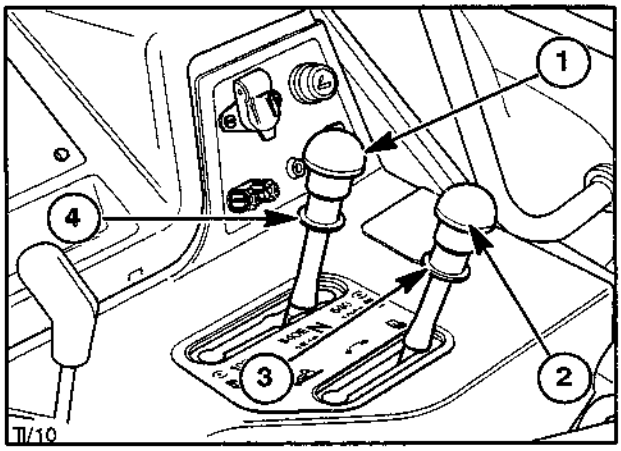


Figure 2-1-27

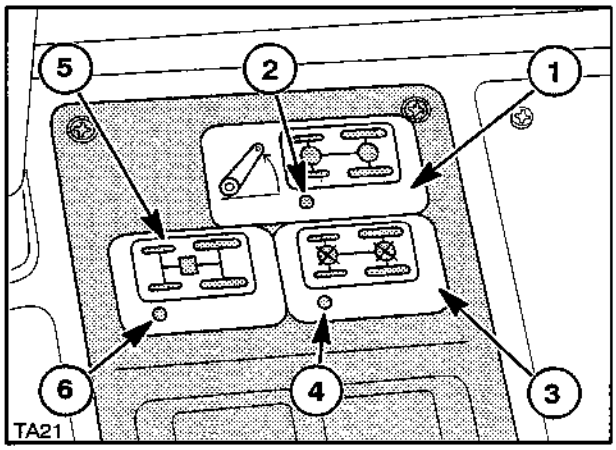
P.T.O. Controls (right-hand console – rear)

NOTE: NOT USED IN NORTH AMERICA

1. P.T.O. speed selector lever (2- or 3-speeds)
2. Ground drive/independent P.T.O. selector lever
3. Safety lock (Ground drive/independent P.T.O. selector lever) – lift safety lock to move lever.
4. Safety lock (P.T.O. speed selector lever) – lift safety lock to move lever.

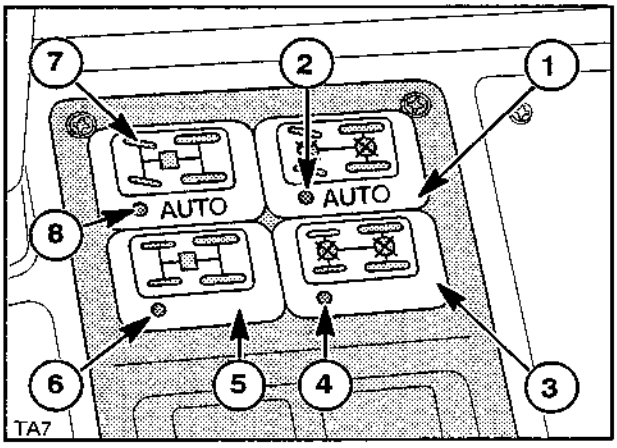
Refer to Operators Manual for complete operating instructions

ELECTRONIC MANAGEMENT UNIT



3-pad Unit (where fitted) Figure 2-1-28

1. Front & rear differential lock switch (semi-automatic mode) – disengages when one brake applied or fast raise/lower switch activated.
2. Indicator lamp
3. Front & rear differential lock switch (manual mode) – disengages when one or both brakes applied.
4. Indicator lamp
5. Front wheel drive switch (manual mode)
6. Indicator lamp



4-pad Unit (where fitted) Figure 2-1-29

1. Front & rear differential lock switch (automatic mode) – disengages when one brake applied, fast raise/-lower switch activated or when steering angle and/or tractor speed exceeds preset limits.
2. Indicator lamp
3. Front & rear differential lock switch (manual mode) – disengages when one or both brakes applied.
4. Indicator lamp
5. Front wheel drive switch (manual mode)
6. Indicator lamp
7. Front wheel drive switch (automatic mode) – disengages when one brake applied or when steering angle and/or tractor speed exceeds preset limits.
8. Indicator lamp

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WORKLAMP SWITCH PANEL

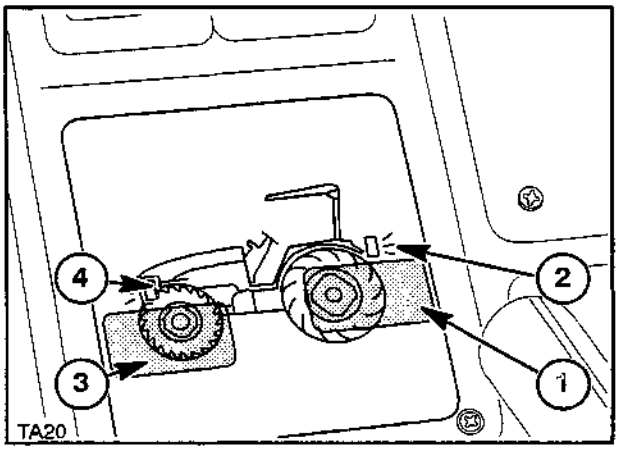


Figure 2-1-30

Switch Panel (tractors less cab)

1. Touch pad – rear, fender-mounted worklamp
2. Indicator lamp – rear, fender-mounted worklamps
3. Touch pad – front, grille-mounted worklamps (and grab rail mounted, if fitted)
4. Indicator lamp – front, grille-mounted worklamps (and grab rail mounted, if fitted)

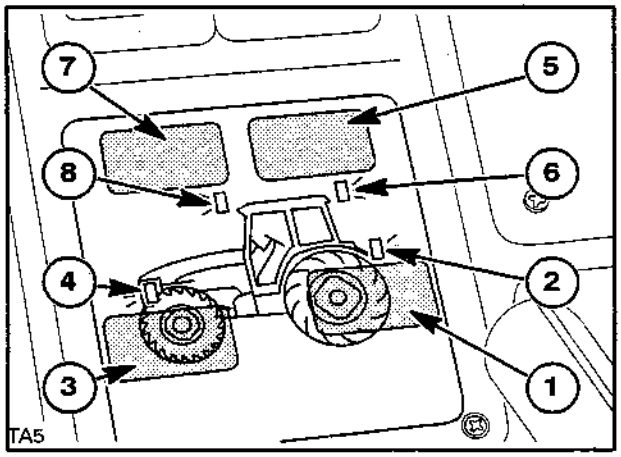


Figure 2-1-31

Switch Panel (tractors with cab)

1. Touch pad – rear, fender-mounted worklamps
2. Indicator lamp – rear, fender-mounted worklamps
3. Touch pad – front, grille-mounted worklamps (and grab rail mounted, if fitted)
4. Indicator lamp – front, grille-mounted worklamps (and grab rail mounted, if fitted)
5. Touch pad – rear, roof-mounted worklamps
6. Indicator lamp – rear, roof-mounted worklamps
7. Touch pad – front, roof-mounted worklamps
8. Indicator lamp – front, roof-mounted worklamps

Refer to Operators Manual for complete operating instructions

ELECTRICAL ACCESSORY PANEL

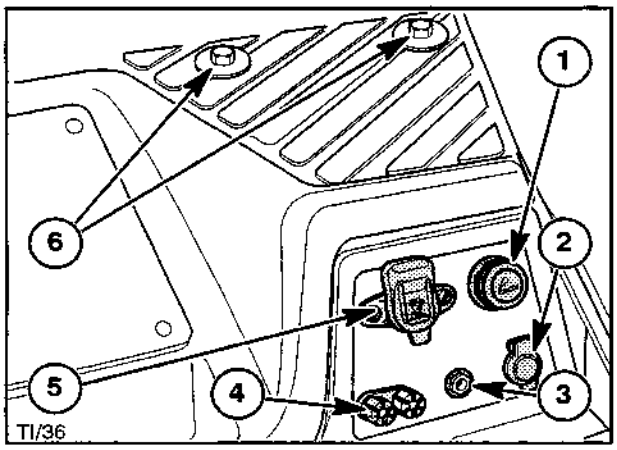


Figure 2-1-32

Electrical Accessory Panel

1. Cigar/cigarette lighter
2. Live 2–pin, 8 amp socket
3. Implement status socket
4. Live 2–pin, screw terminals
5. Live 4–pin, 30 amp socket
6. Implement monitor mounting bolts

HYDRAULICS CONTROLS

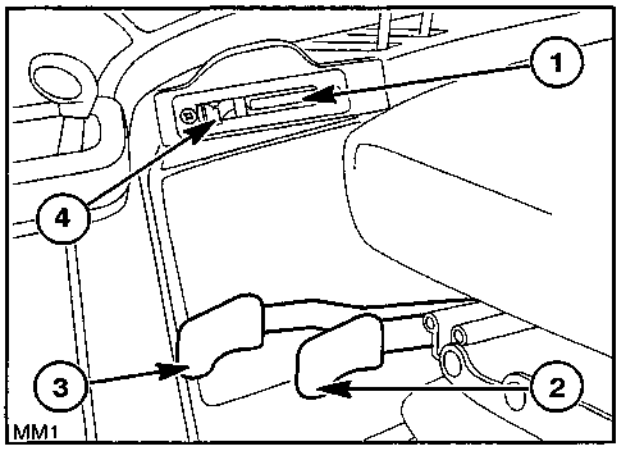


Figure 2-1-33

Hydraulic Controls – Mechanical Lower Link Sensing

NOTE: NOT USED IN NORTH AMERICA

1. Lift-o-Matic fast raise button – will raise 3-point linkage when released and lower when pushed in.
2. Draft Control lever
3. Position Control lever
4. Latch for Lift–o-Matic fast raise button – move rearwad to release Lift-o-Matic button.

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HYDRAULICS CONTROLS

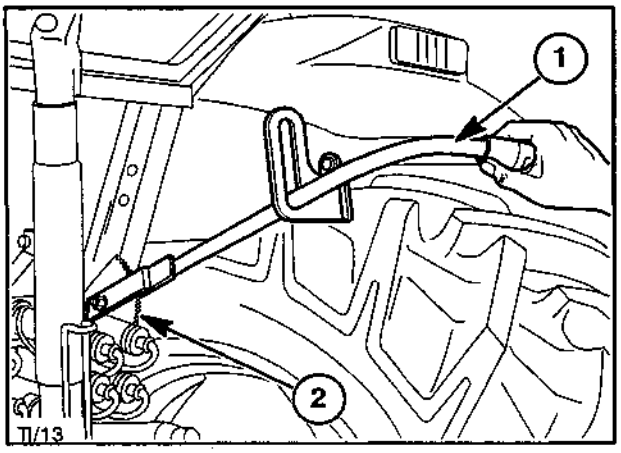


Figure 2-1-34

External Power Lift Control – Mechanical Lower Link Sensing

NOTE: NOT USED IN NORTH AMERICA

1. External power lift control lever – press in to engage toothed sector then lift to raise 3-point linkage in increments.
2. Toothed sector

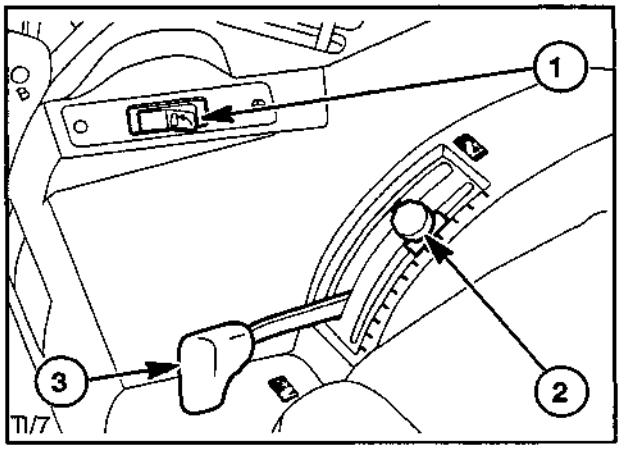


Figure 2-1-35

Hydraulic Controls – Electronic Draft Control

1. Lift-o-Tronic fast raise switch – press rear to raise 3-point linkage, press front to lower. Center position transfers control to the external, fender-mounted switches.
2. Adjustable stop
3. Lift control lever

Refer to Operators Manual for complete operating instructions

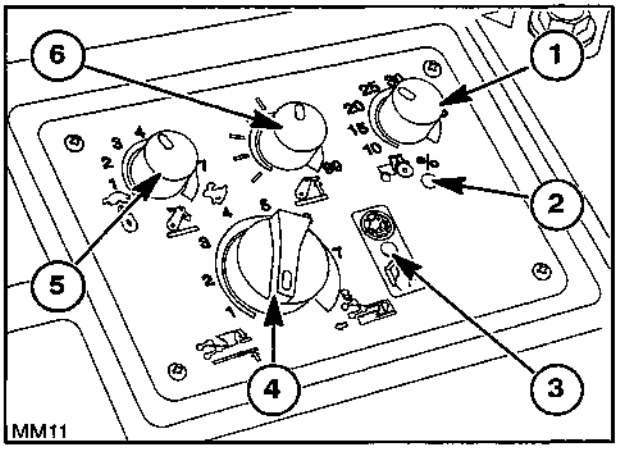


Figure 2-1-36

Electronic Control Panel – Electronic Draft Control

1. Slip limit control knob
2. Slip limit on indicator light
3. Malfunction/disabled warning light
4. Position/Draft sensitivity knob
5. Drop rate control knob
6. Height limit control knob

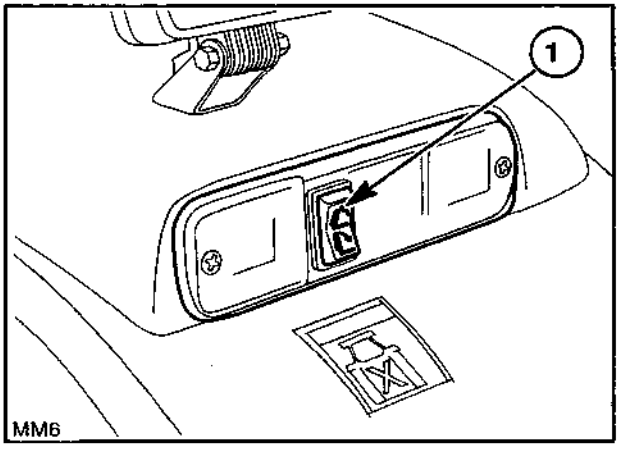


Figure 2-1-37

External Power Lift Control – Electronic Draft Control

1. Fender-mounted raise/lower switch – press top to raise 3-point linkage, press bottom to lower.

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REMOTE CONTROL VALVES

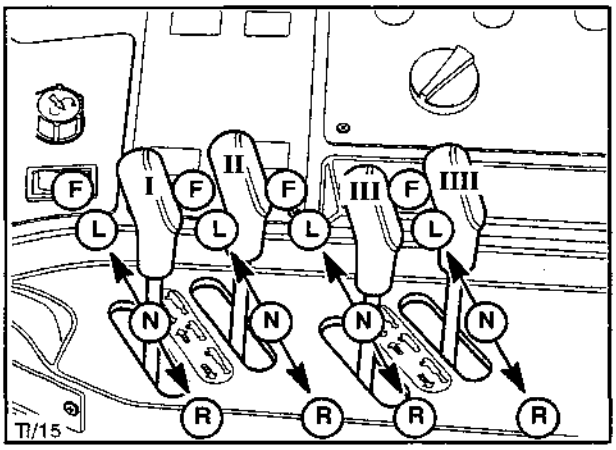


Figure 2-1-38

Remote Control Valve Levers

F = Float position (where available)
L = Lower position
N = Neutral position
R = Raise position

If your tractor has the open center hydraulic system then the float position is not available on valves II and IIII.

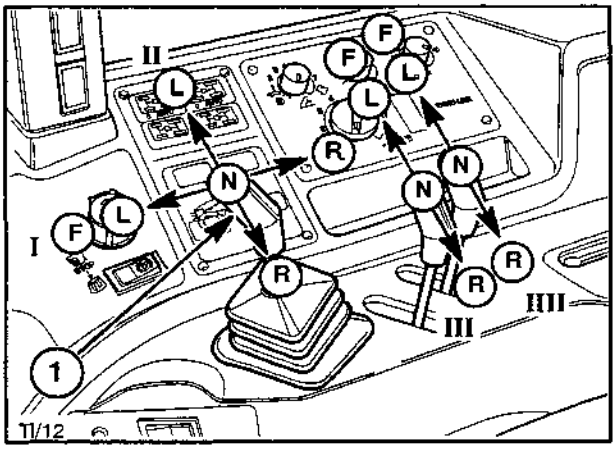


Figure 2-1-39

Remote Control Valve Levers with 'Joystick' Control

1. 'Joystick' control (where fitted)

F = Float position (where available)
L = Lower position
N = Neutral position
R = Raise position

The joystick control actuates remote control valves I and II.

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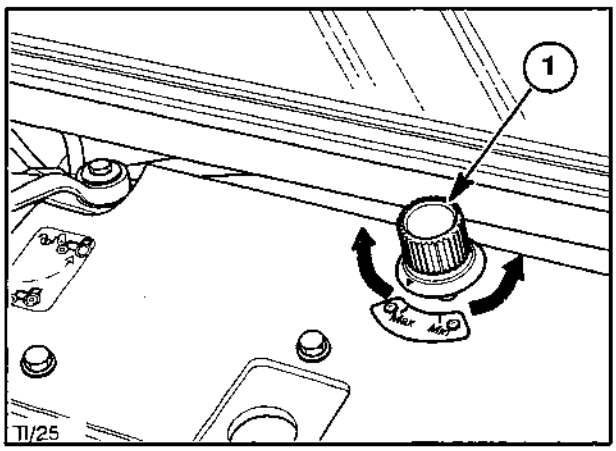


Figure 2-1-40

Flow Control (open center system)

NOTE: NOT USED IN NORTH AMERICA

1. Flow control (controls flow to No I remote valve)

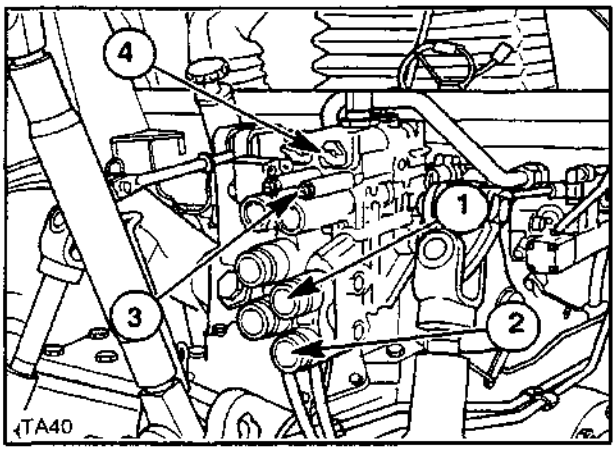


Figure 2-1-41

Remote Control Valves (closed center load-sensing system)

1. Upper (lift) coupler
2. Lower (drop) coupler
3. Detent screw
4. Flow control

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PROTECTING THE ELECTRONIC/ELECTRICAL SYSTEMS DURING CHARGING OR WELDING

PRECAUTIONS

To avoid damage to the electronic/electrical systems, always observe the following:

1. Never make or break any of the charging circuit connections, including the battery connections, when the engine is running.

2. Never short any of the charging components to ground.

3. Do not use a slave battery of higher than 12 volts nominal voltage.

4. Always observe correct polarity when installing the batteries or using a slave battery to jump start the engine. Follow the instructions in the operator's manual when jump starting the tractor. Connect positive to positive and negative to negative.

5. Always disconnect the ground cable from the batteries before carrying out arc welding on the tractor or on any implement attached to the tractor.

- Position the welder ground cable clamp as close to the welding area as possible.
- If welding is to be carried out in close proximity to a computer module, then the module should be removed from the tractor. It is recommended that this procedure be carried out by an authorized dealer.
- Never allow welding cables to lay on, near or across any electrical wiring or electronic component while welding is in progress.

6. Always disconnect the negative cable from the batteries when charging the batteries in the tractor with a battery charger.

⚠ WARNING ⚠

Batteries contain sulphuric acid. In case of contact with skin, flush the affected area with water for five minutes. Seek medical attention immediately. Avoid contact with the skin, eyes or clothing. Wear eye protection when working near batteries.

IMPORTANT: *Failure to disconnect the two ground cable connections at the battery prior to charging the batteries or welding on the tractor or attached implement will result in damage to the electronic and electrical systems.*

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SWITCH REMOVAL AND REPLACEMENT

Switch removal and replacement such as the hazard warning light type of switch, (1), Figure 2-1-42, are best removed from behind the switch, although it is possible to pry the switch out from the front, damage may occur to the paint or plastic of the console.

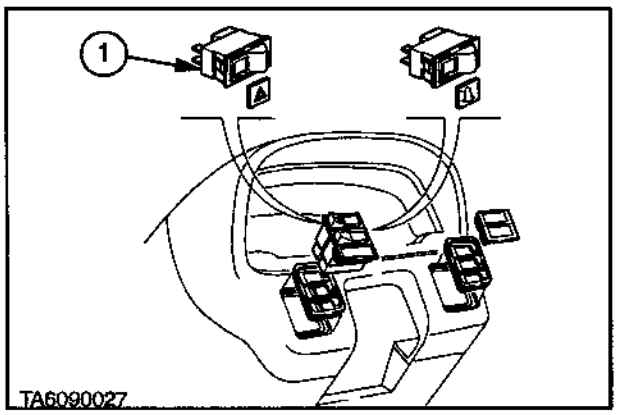


Figure 2-1-42

To remove and replace any of the roof console switches, (heater controls), it is necessary to remove the front panel of the cab roof. Pull of the knob and remove the nut and washer from the switch, from inside the cab and withdraw the switch from the top of the cab.

Key Start Switch – Removal and Replacement

1. Disconnect the tractor battery.
2. Remove the steering column covers.
3. Disconnect the wiring connector to the harness (3) Figure 2-1-43, remove the nut securing the switch (4) Figure 2-1-43, to the cover and withdraw.
4. Replacement is the reversal of the removal procedure.

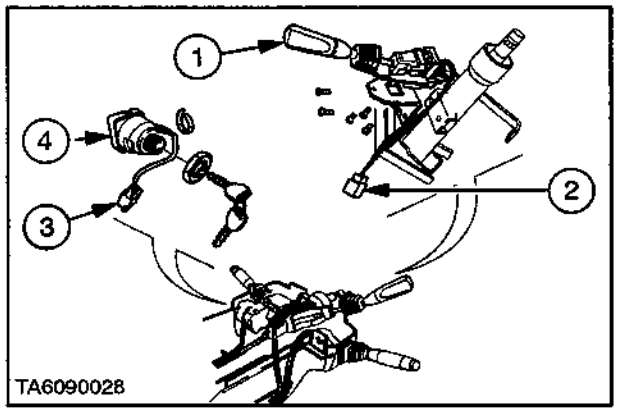


Figure 2-1-43

Shuttle Switch and Multi Function Stalk Switches – Removal and Replacement

1. Disconnect the tractor battery.
2. Remove the steering column covers (1) Figure 2-1-44.
3. Disconnect the wiring connectors (2) Figure 2-1-43 or (2) Figure 2-1-44, to the harness from each switch and remove the screws retaining the switches to the column brackets.
4. Replacement is the reversal of the removal procedure.

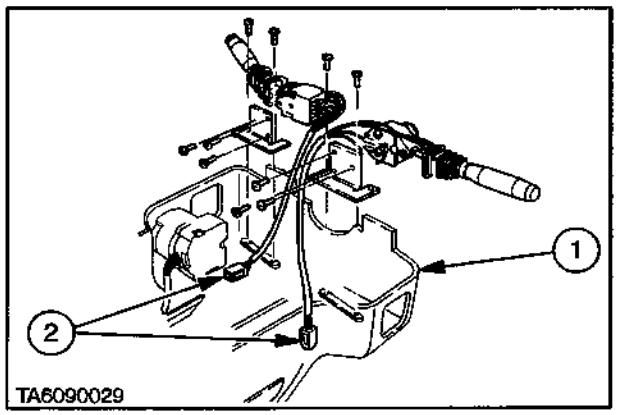


Figure 2-1-44

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P.T.O. Switch Replacement – Figure 2-1-45

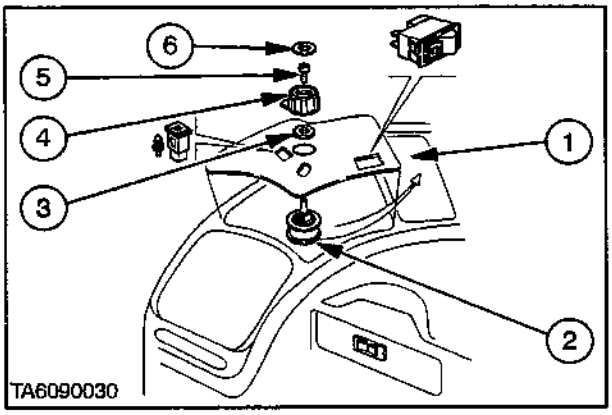


Figure 2-1-45

1. Remove the electronic management unit.

2. Carefully pry the center cap (6) from the knob (4) and remove the retaining screw (5). Pull the knob from the switch (2) and remove the nut (3) securing the switch to the console.

3. Withdraw the switch up through the electronic management unit aperture (1) and note positions of wires before disconnecting.

4. Replacement is the reversal of removal.

Handbrake Switch Replacement – Figure 2-1-46

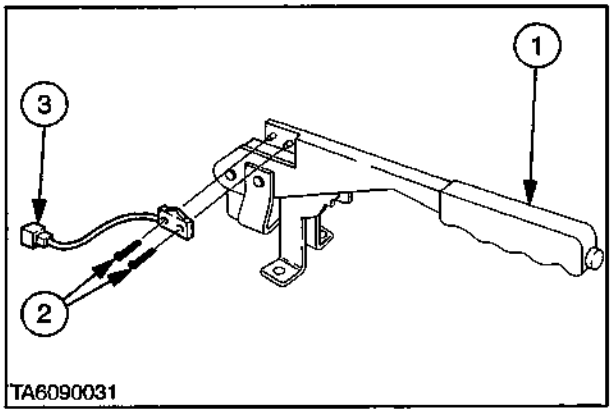


Figure 2-1-46

1. Ensure the handbrake (1) is applied.

2. Disconnect the wiring connector (3) to the harness from the switch.

3. Remove the two split pins (2) retaining the switch and withdraw the switch from the bracket.

4. Replacement is the reversal of removal.

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Clutch Pedal Switch adjustment (semi–powershift and Hi–Lo Transmissions)

Install the diagnostic tool, FNH00874, into the black diagnostic connector, for Hi–Lo transmission or the white diagnostic connector if the transmission is a Semi–powershift type. Turn the key start 'on' and select mode HA.

Depress the clutch pedal and listen for the 'click' of the switch. Note the number displayed. Release the pedal slowly until the switch 'clicks' again and observe the number displayed.

The switch should operate between 8–14.

If the switch operation is outside the range, adjust the switch by loosening the switch retaining screws and sliding in the slots until correct adjustment is obtained.

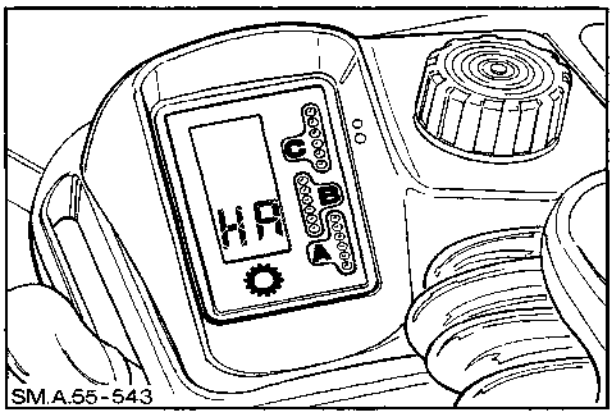


Figure 2-1-47

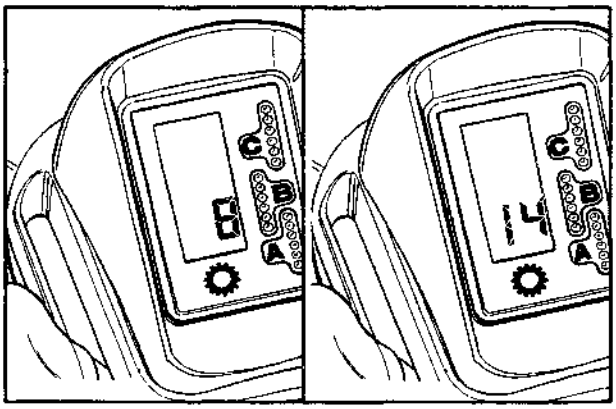


Figure 2-1-48

Brake Pedal Switches Adjustment

Place a 2.5mm (0.10 inch) thick gauge bar between the switch and brake pedal. Loosen the switch retaining screws.

Push the switch towards the brake pedal to the limit of the plunger travel while ensuring that the pedal remains stationary. Tighten the retaining screws and remove the gauge. Repeat for the other switch.

After adjustment ensure that both switches can be heard operating and operating simultaneously.

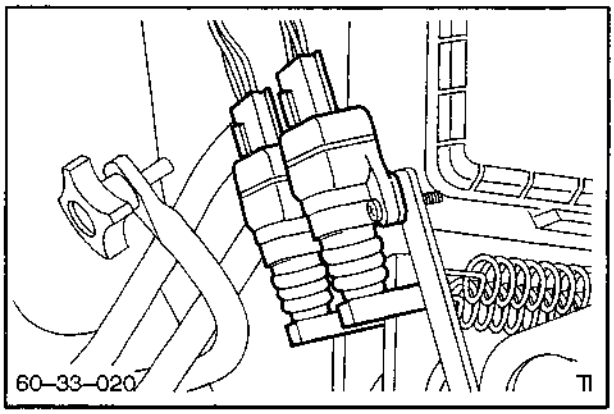


Figure 2-1-49

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COMPONENT TESTING AND SPECIFICATIONS

COMPONENT	TEST SPECIFICATION
Semi–Powershift Transmission	
Reverse range solenoid	Coil resistance 6 to 8Ω @20°C (68°F)
Fast range solenoid	Coil resistance 6 to 8Ω @20°C (68°F)
Medium range solenoid	Coil resistance 6 to 8Ω @20°C (68°F)
Slow range solenoid	Coil resistance 6 to 8Ω @20°C (68°F)
Clutch A, B, C, D & E solenoids	Coil resistance 8 to 11Ω @20°C (68°F)
Low/High synchronizer potentiometer	4kΩ±20% between green and yellow (see explanation 1)
Medium/reverse synchronizer potentiometer	4kΩ±20% between green and yellow (see explanation 1)
Transmission oil temperature sender	3800Ω at 18°C (64°F) – 73Ω at 132°C (270°F)(see table1)
Transmission oil pressure switch	Normally closed
Transmission output speed sensor	800 to 1200Ω between pins 1 and 2
Transmission mid speed sensor	800 to 1200Ω between pins 1 and 2
Hi–Lo Transmission	
Hi–Lo (forward) solenoid	Coil resistance 6 to 8Ω @20°C (68°F)
Shuttle (reverse) solenoid	Coil resistance 6 to 8Ω @20°C (68°F)
Clutches A & B solenoids	Coil resistance 9 to 11Ω @20°C (68°F)
Synchronizer position potentiometer	1kΩ–4kΩ with 1kΩ tolerance either end for out of range checking by processor
Clutch A pressure switch	Normally closed
Clutch B pressure switch	Normally closed
Common components	
Clutch pedal potentiometer	3.1kΩ–3.9kΩ Pedal up /0.64kΩ–2.1kΩ pedal down, between green and black wires.
Front Wheel Drive pressure switch	Normally closed
Diff lock pressure switch	Normally open
Rear axle speed sensor	800 to 1200Ω between pins 1 and 2
Rear PTO speed sensor	680Ω ±15% @20°C (68°F)
Steering angle sensor	1kΩ–5kΩ with 1kΩ tolerance either end for out of range checking by processor
Diff lock/PTO/PTO brake solenoids	Coil resistance 6 to 8Ω @20°C (68°F)

Explanation 1:
The potentiometer should be checked as described in the table and also by operating the potentiometer and checking that a smooth, continuous variation of resistance is observed when a multimeter is applied between either red/yellow or red/green terminals.

Table 1:

Temp °C (°F)	18 (64)	21 (70)	24 (75)	26 (79)	29 (84)	32 (90)	35 (95)	38 (100)	82 (180)	121 (250)	132 (270)
Res. Ω	3800	3340	2940	2600	2300	2030	1800	1600	310	100	73

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Electrical component testing

The method of testing individual electrical components, for example, solenoid coils, speed sensors and potentiometers, is basically the same for each component.

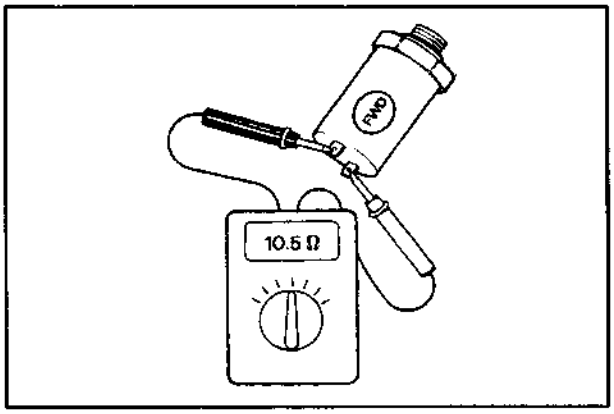


Figure 2-1-50

Each component has within it a coil or wire which has a specified resistance to electrical flow in order for it to function correctly. Therefore, to test a component the resistance of the coil must be checked, usually at 20°C (68°F), using a good quality multimeter between the two coil wires.

A potentiometer is a variable resistor which is dependant on mechanical movement, i.e, clutch pedal movement, to vary the resistance of the component and therefore alter the output voltage.

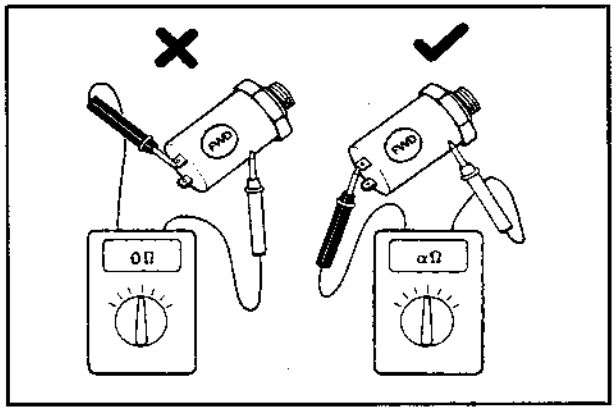


Figure 2-1-51

To check the correct operation of a potentiometer the resistance should be measured at the minimum and maximum positions with a smooth a continuous change of resistance observed between.

Further to checking the resistance value, components should also be checked for a short circuit between the component coil and the component's outer casing by connecting a multimeter between the component terminals and its casing.

Temporary Wiring Harness Repair

The following method to repair wiring is a temporary expedient only. Wiring should be replaced as soon as possible. Replacement of temporary repaired cables with new is particularly important if the tractor is to be used for spraying as chemicals can enter the repaired area, travel up the cable and damage electrical components. Do not attempt to repair the wire on any system sensors as these are sealed and should only be replaced with a new component.

NOTE: *When conducting a cable repair it is important that only RESIN CORED SOLDER is used. Use of other types of solder may result in further cable damage.*

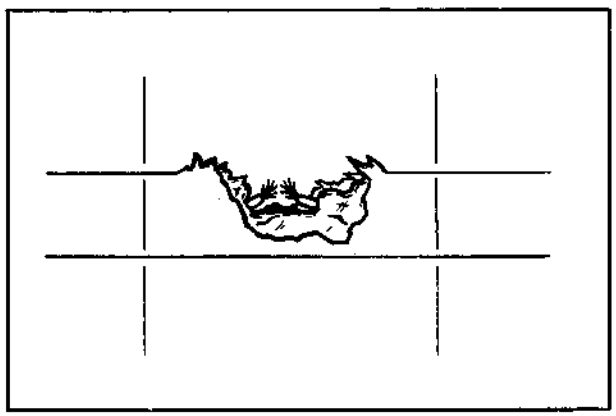


Figure 2-1-52

To carry out a temporary repair, proceed as follows:–

1. Locate damaged portion of cable then cut away outer protective cover on both sides of the damaged area, Figure 2-1-52.

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2. Peel back the cable from both ends of the damaged area and carefully cut away the inner cable cover at the damaged area and strip about 13 mm ($^1/_2$ inch) of insulation from the wires. Do not cut away any wire strands.

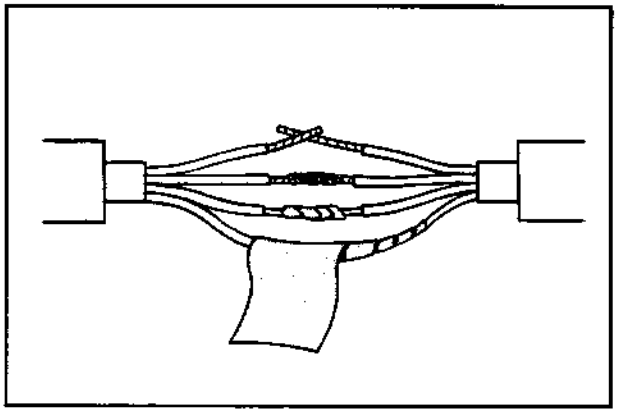


Figure 2-1-53

3. Using a suitable solvent, clean about 50 mm (2 inches) from each cover end. Clean the grey cable cover and the individual leads.

4. Twist two bare leads together for each damaged lead, being careful to match wire colors, then solder the leads using resin cored solder. Tape each repaired lead with vinyl insulation tape, Figure 2-1-53.

5. Wind a layer of vinyl insulation tape up to the grey cable cover at each end of the repair section. Make a paper trough, Figure 2-1-54, then apply silicon rubber compound (non hardening sealant) over the repaired section up to the cover ends. Sufficient sealant must be used to fill the ends of the cut away area.

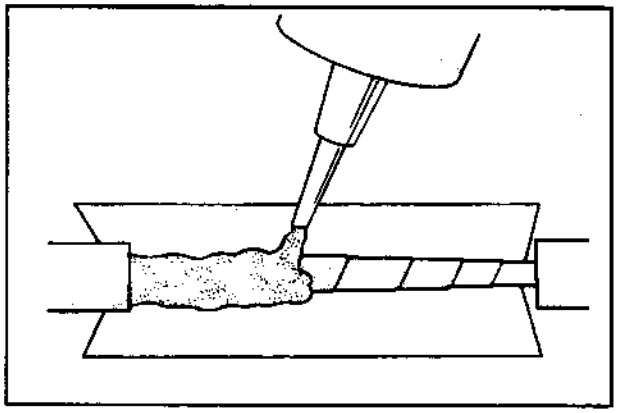


Figure 2-1-54

6. Allow the compound to cure then cover the area with insulating tape taking the tape well over each end of the repair. An overlap of at least 50 mm (2 inches) of tape at each end is necessary, Figure 2-1-55.

7. Check to ensure the repair is satisfactory and secure the repaired cable so that repeat damage is avoided.

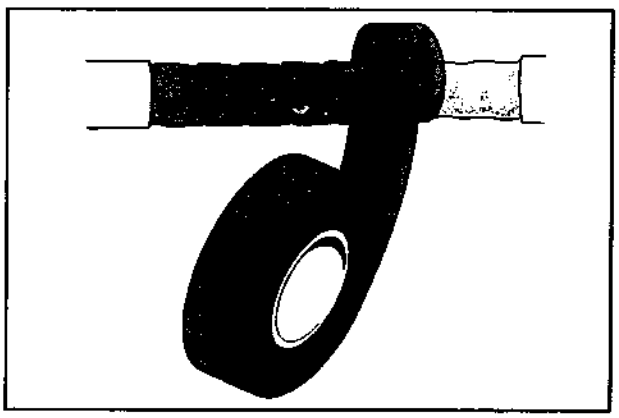


Figure 2-1-55

NOTE: *This is a temporary repair only. Ensure the damaged cable is replaced as soon as possible to prevent ingress of water or chemicals.*

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SECTION 2
ELECTRICAL SYSTEM

CHAPTER 2
ELECTRONIC MANAGEMENT UNIT

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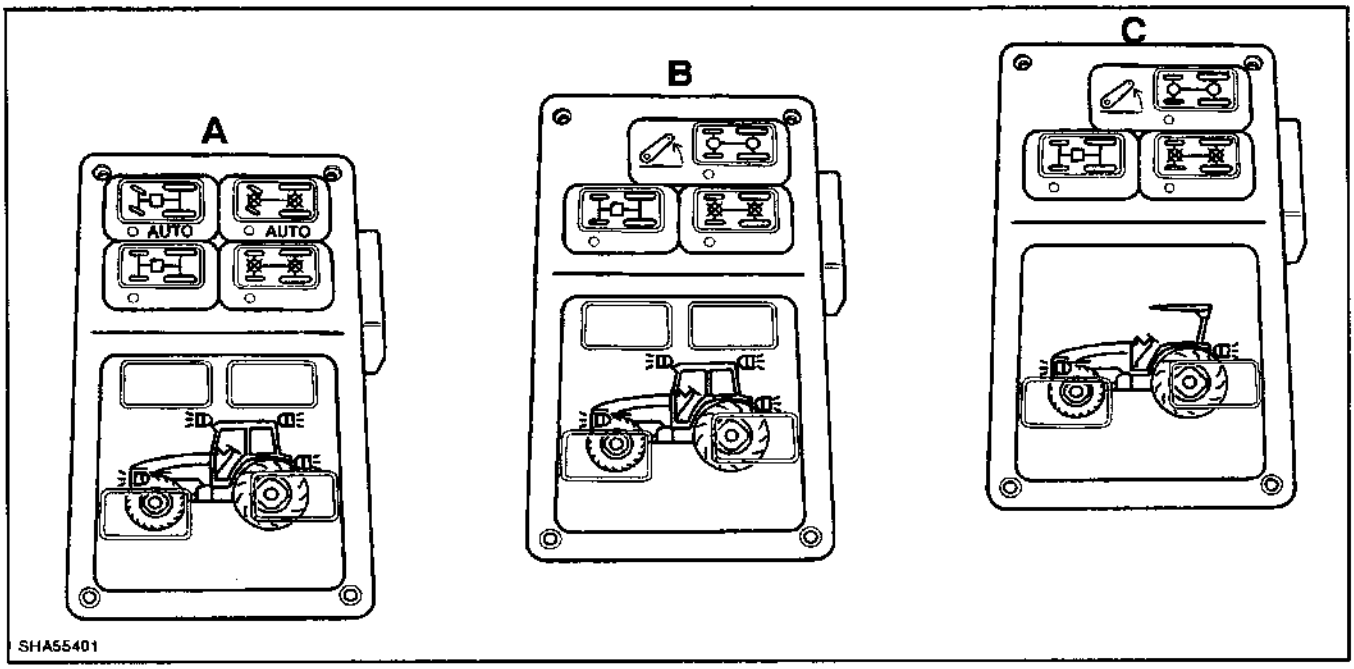


Figure 2-2-1

There are three types of panel used on the 8160-8560 range:–

- with cab Electronic Management Unit with full auto function. (A)
- with cab Touch Panel with one semi automatic function. (B)
- less cab Touch Panel with one semi automatic function. (C)

These units are located on the right hand console.

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All versions of the panel control the FWD, Differential Lock, Front and Rear PTO, Thermostart and Worklamps.

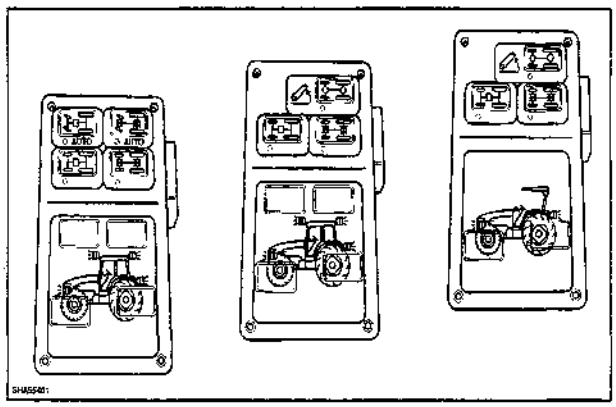


Figure 2-2-2

Semi automatic function provides disengagement of Differential Locks when fast raise switch is activated.

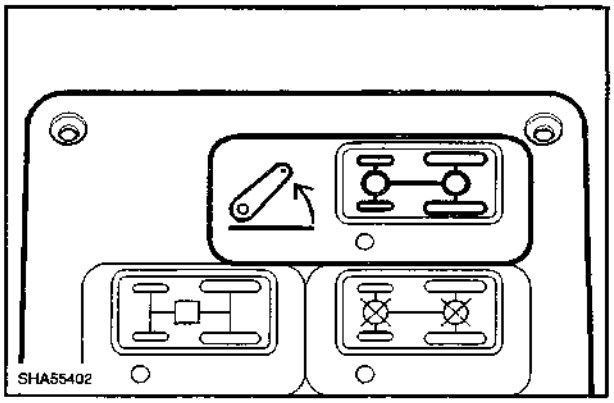


Figure 2-2-3

Full auto version provides auto disengagement of FWD and Differential Lock when certain steering angle and speed conditions have been met.

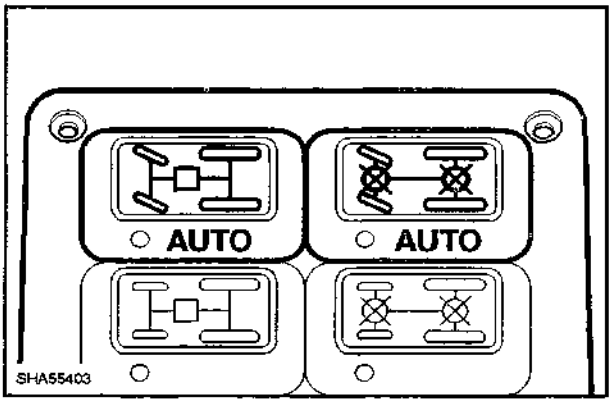


Figure 2-2-4

Less cab version only has two worklamp touch pads.

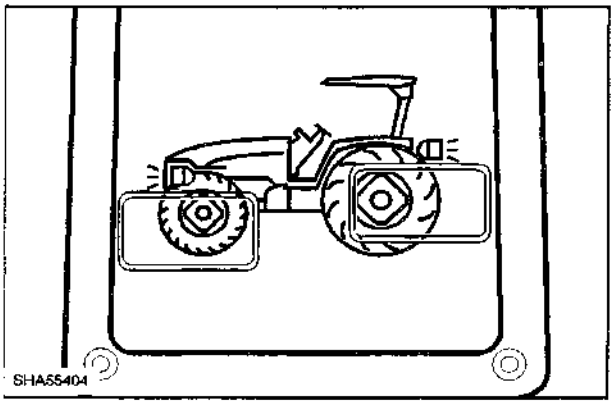


Figure 2-2-5

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ELECTRONIC MANAGEMENT UNIT

With cab electronic management unit with full auto functions.

1 Auto Differential Lock
2 Manual Differential Lock
3 Worklamps
4 Manual FWD
5 Auto FWD

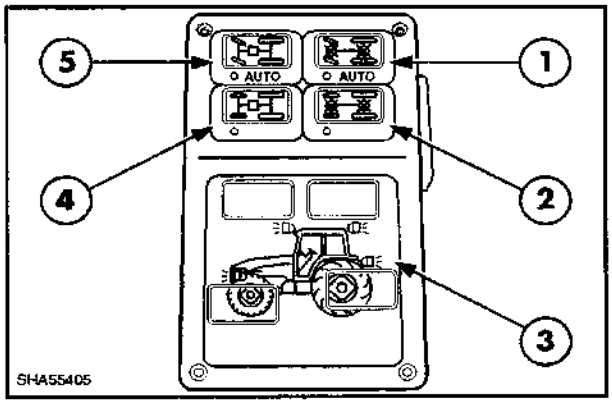


Figure 2-2-6

Auto Differential Lock

The Differential Lock will be temporarily disengaged when :

- either brake pedal is applied
- steering angle is greater than 20° and speed less than 10 Km/h (6 mph)
- steering angle is greater than 10° and speed is between 10–15 Km/h (6–9 mph)
- When the raise/work switch is operated.

Differential lock will permanently disengage if tractor speed exceeds 15 Km/h (9 mph).

If the keystart is switched off when auto differential lock is engaged, the auto Differential lock will re-engage when the engine is restarted.

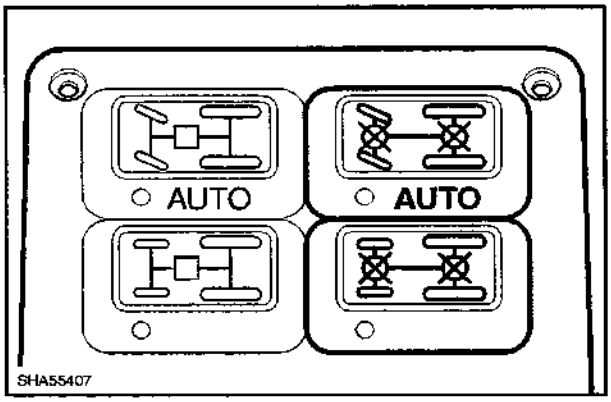


Figure 2-2-7

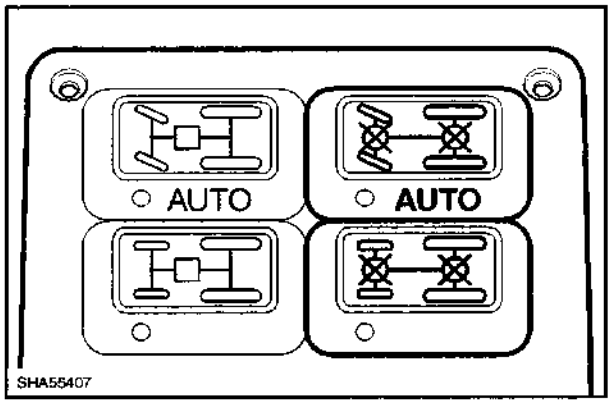


Figure 2-2-8

Manual Differential Lock

The Differential Lock is permanently engaged until either;

the Differential Lock switch is operated

or

the brakes (latched or unlatched) are operated.

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Manual FWD

The FWD remains engaged until the switch is operated.

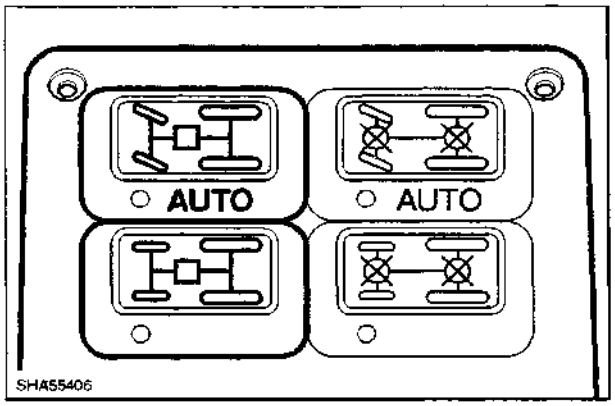


Figure 2-2-9

Auto FWD

The FWD will temporarily disengage when:–

- ground speed exceeds 20 km/h (12 mph)
- steering angle is greater than 25 degrees and tractor speed is between 10–20 km/h (6–10 mph)
- steering angle is greater than 35 degrees and tractor speed is less than 10 km/h (6 mph)

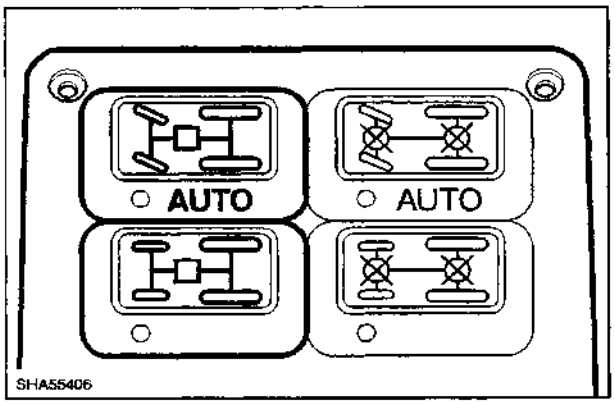


Figure 2-2-10

The steering angle sensor is located on the front right hand wheel, Figure 2-2-11.

The disengaging and re–engaging of the FWD does not function only at the 35 and 25 degrees stated above. A 3 degree range is applied to ensure that at 25 or 35 degrees the unit is not continously engaging/disengaging the FWD. For example if the FWD disengages at 35 degrees it will not re–engage until the steering angle reduces to 32 degrees.

In case of steering angle sensor fault any 'auto' modes are automatically disengaged until fault is rectified.

If the keystart is switched off with the auto FWD engaged, the auto FWD will re–engage when the engine is restarted.

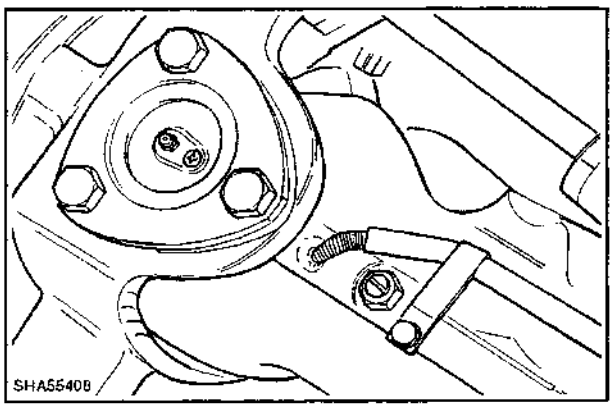


Figure 2-2-11

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TOUCH PANELS

With/Less Cab Touch Panel

1 Semi Automatic Differential Lock
2 Differential Lock
3 Less Cab Worklamps
4 With Cab Worklamps
5 FWD

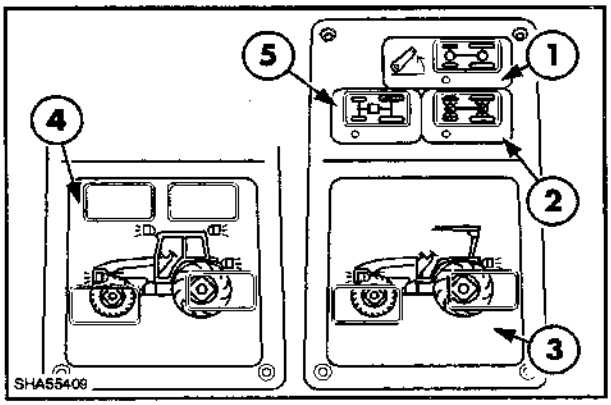


Figure 2-2-12

Semi Automatic Differential Lock (1), Figure 2-2-13

The Differential Lock will temporarily disengage when:–

- either brake pedal is applied
- the lift is operated by the raise/work switch.

If the keystart is switched off, the semi auto Differential lock will re engage when the engine is restarted.

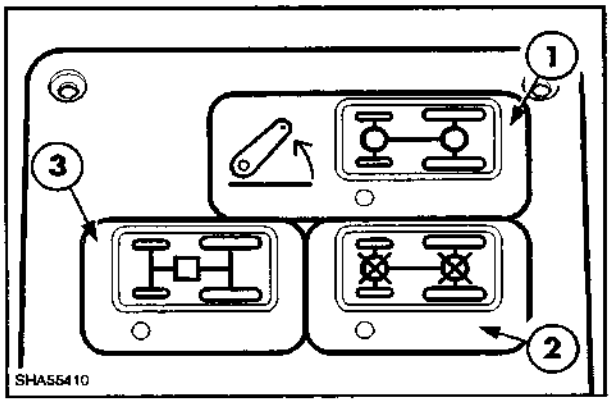


Figure 2-2-13

Manual Differential Lock (2), Figure 2-2-14

Switch functions:

- Differential Lock On until latched or unlatched brakes operated giving permanent disengagement.
- Differential Lock Off.

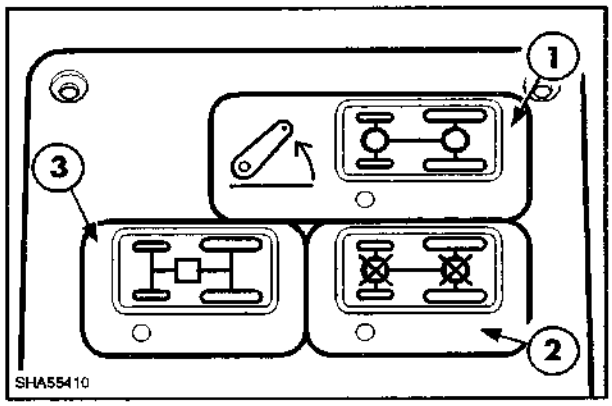


Figure 2-2-14

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TOUCH PANELS

Manual FWD (3)

Switch functions:

- FWD Engaged.
- FWD Disengage, temporarily engaged during latched braking.

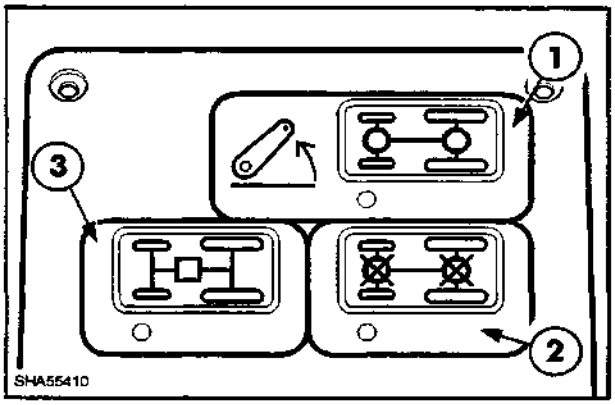


Figure 2-2-15

Worklamp Operation

Worklamps are selected with the Touch Pads in the lower section. There are two types of Touch Pad.

Less cab – 2 sets of worklamps

With cab – 4 sets of worklamps

The worklamps will only operate with the tractor lights on.

During operation, if the tractor lights are switched off, the worklamps will be extinguished. However, if the lights are then turned on again the same worklamps will re–illuminate.

If the key switch and side lights are switched off the worklamps will be permanently extinguished until reselected.

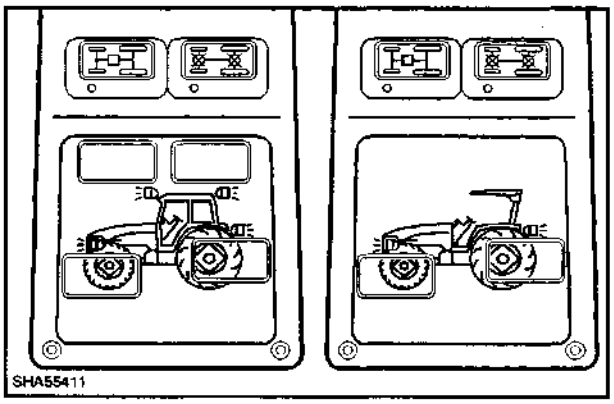


Figure 2-2-16

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OTHER FUNCTIONS

The Electronic Management Unit and Touch Panels also control,

(i) Front and rear PTO operation

(ii) Rear PTO brake operation

(iii) Measurement of rear PTO speed

(iv) Thermostart

(v) Measurement of tractor ground speed if analog electronic instrument cluster (AEIC) fitted

(vi) PTO and handbrake warning system

	Handbrake Released	Handbrake Engaged
Seat unoccupied/ PTO disengage	Intermittent alarm for 2.5 minutes	No alarm *FWD on
Seat unoccupied/ PTO engaged	5 second continuous then intermittent alarm for 2.5 minutes	5 second continuous alarm *FWD on
Seat occupied/ PTO disengaged	No alarm	No alarm *FWD on
Seat occupied/ PTO engaged	No alarm	No alarm *FWD on

NOTES: 1) '*' Overrides all other commands from MAN and AUTO functions on the Electronic Management Unit.
2) 'PTO' refers to front and/or rear PTO.

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CALIBRATION

Ground speed selection

When analog electronic instrument cluster (AEIC) is fitted metric or English speed display may be selected:

- From mph to km/h, depress manual diff lock touch pad while turning key start on.
- From km/h to mph , depress manual FWD touch pad while turning key start on.

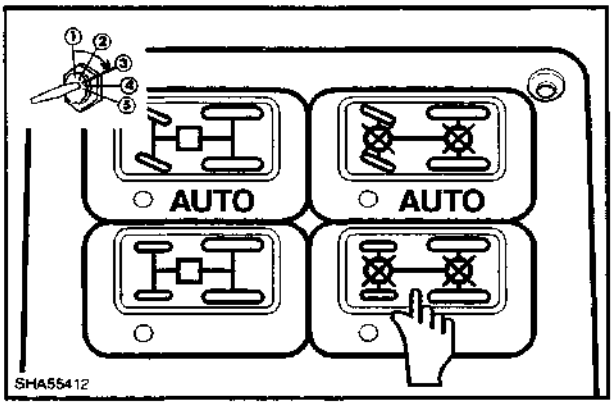


Figure 2-2-17

Wheel speed sensor (all tractors) and steering angle sensor (EMU) calibration.

Enter mode by holding both manual FWD and Differential Lock touch pads and start tractor.

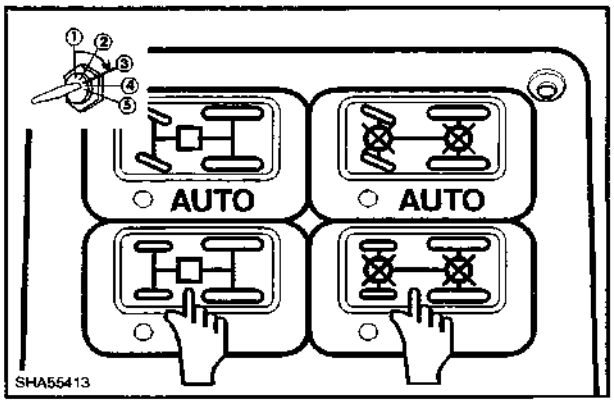


Figure 2-2-18

Mark out 100 meter (109 yd) track, approach start and press manual Differential Lock touch pad.
Drive 100 meters (109 yd) in straight line.

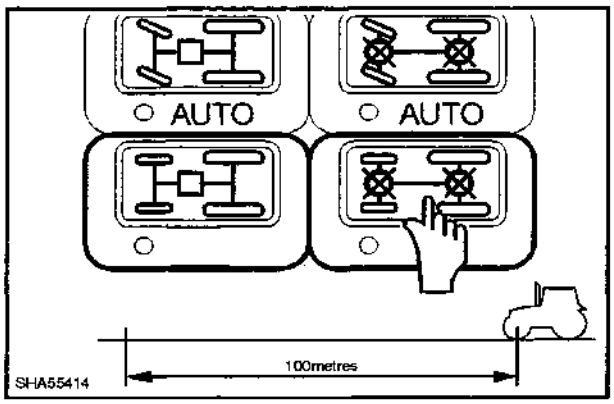


Figure 2-2-19

Press manual Differential Lock touch pad at end of 100 meters (109 yd) and switch off to enter calibration into memory.

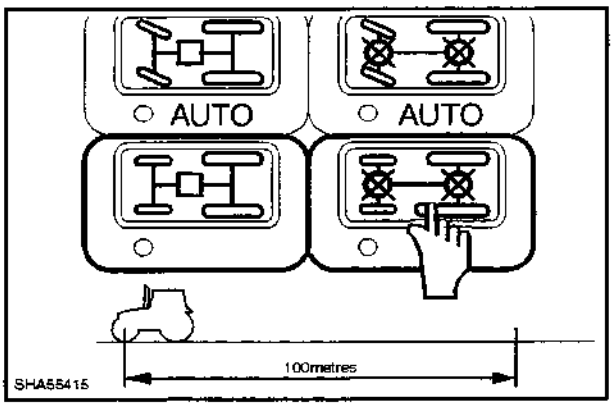


Figure 2-2-20

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ELECTRONIC MANAGEMENT UNIT REMOVAL AND INSTALLATION

Removing Touch Panels from right hand console.

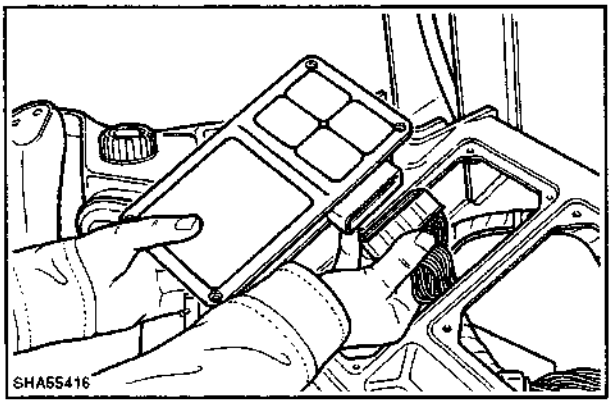


Figure 2-2-21

Touch Panel connection.

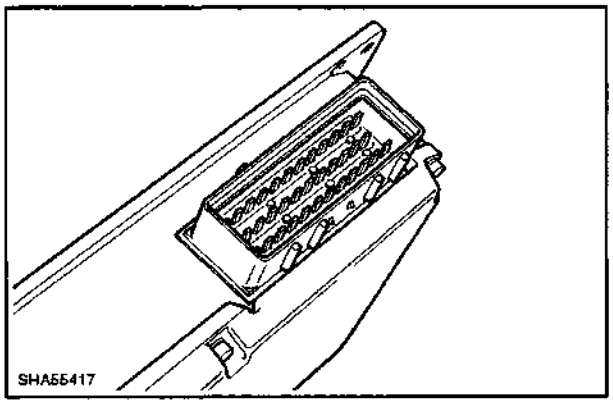


Figure 2-2-22

NOTE: *A new Electronic Management unit or a unit taken from another tractor must be calibrated after installation. Refer to previous page for calibration details.*

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ELECTRONIC MANAGEMENT UNIT ERROR CODES

The Electronic Management Unit has an inbuilt self diagnostic system to assist with the detection of faults should they occur.

If a fault occurs that is related to the Electronic management Unit a two digit code prefixed with a 'P' will be displayed on the instrument cluster. Should more than one fault occur at any one time, the fault with the highest priority will be displayed followed by the lower priority error code. Error codes present at key ON will similarly be displayed.

PRIORITY (1=Highest)	ERROR CODE	ERROR DESCRIPTION
1	P01	Rear PTO brake solenoid stuck off (circuit shorts to ground or module failure)
2	P02	Rear PTO brake solenoid stuck on (circuit shorts to +12V or module failure)
3	P03	Rear PTO brake output open circuit
4	P04	Rear PTO brake driver over temperature (circuit shorts to +12V or module failure)
5	P05	Not used
6	P06	Not used
7	P07	Rear PTO solenoid stuck off (circuit shorts to ground or module failure)
8	P08	Rear PTO solenoid circuit overcurrent (circuit shorts to ground)
9	P09	Not used
10	P10	Not used
11	P11	Front PTO solenoid stuck off (circuit shorts to ground or module failure)
12	P12	Front PTO solenoid circuit overcurrent (circuit shorts to ground)
13	P13	Not used
14	P14	Not used
15	P15	Diff lock solenoid stuck off (circuit shorts to ground or module failure)
16	P16	Diff lock solenoid stuck on (circuit shorts to +12V or module failure)
17	P17	Diff lock output open circuit
18	P18	Diff lock driver overtemperature (circuit shorts to +12V or module failure)
19	P19	Not used
20	P20	Not used
21	P21	FWD solenoid stuck off (circuit shorts to ground or module failure)
22	P22	FWD solenoid stuck on (circuit shorts to +12V or module failure)
23	P23	FWD output open circuit
24	P24	FWD driver overtemperature (circuit shorts to +12V or module failure)
25	P25	Not used
26	P26	Not used
27	P27	PTO speed sensor open circuit
28	P28	Not used
29	P29	Not used
30	P30	Not used
31	P31	Steering sensor out of range – maximum voltage
32	P32	Steering sensor out of range – minimum voltage

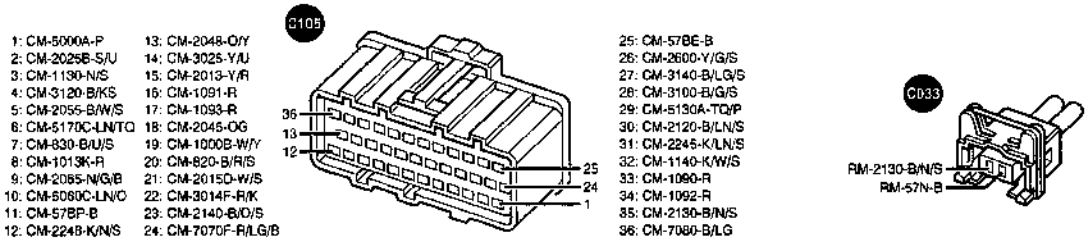
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ERROR CODE P01 – REAR PTO BRAKE SOLENOID STUCK OFF

With the Key start off, disconnect the rear PTO brake solenoid connector C033. Turn the key start on,

- Error P01 displayed
  - YES
  - With the keystart off disconnect connector C105 from electronic management unit. Using a multimeter check for a short circuit between C105–35 and ground. Is a short indicated?
    - YES → Repair short to ground
    - NO → Substitute the electronic management unit
- Error P02 or P02 & P03
  - YES
  - Check resistance of solenoid. Is resistance between 5–11Ω ?
    - YES → Substitute the electronic management unit
    - NO → Replace solenoid valve



1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TO
7: CM-830-B/U/S
8: CM-1013K-R
9: CM-2085-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2248-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B
25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG

ERROR CODE P02 – REAR PTO BRAKE SOLENOID STUCK ON

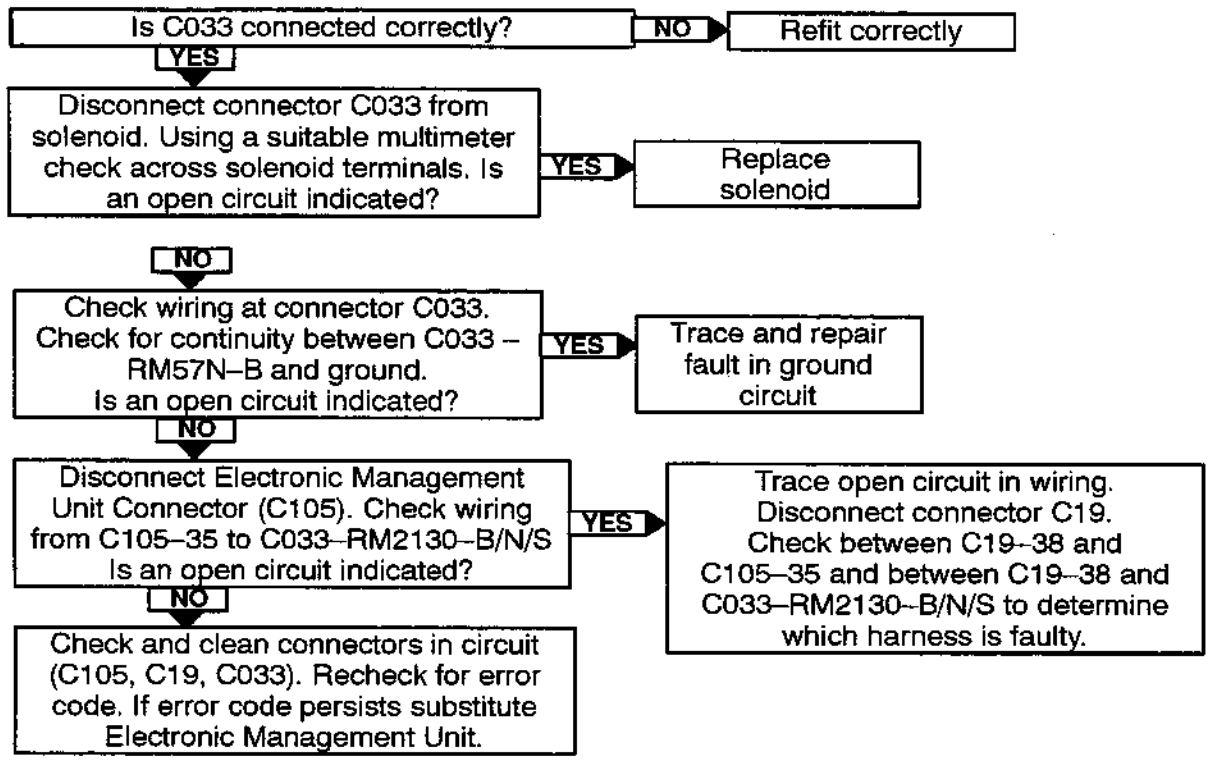
Turn the keystart ON, ensure the FWD and Differential lock are disengaged. Turn the keystart OFF, set the PTO brake switch to the brake applied position, set the front and rear PTO engagement switches to be disengaged. Turn the keystart ON again, are errors P02 and P03 displayed?

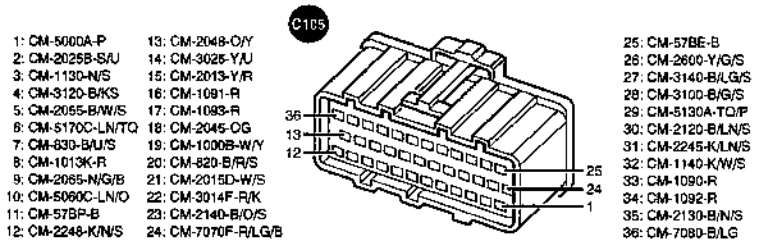
- YES → Refer to fault finding flow chart for Error code P03.
- NO
  - Turn the keystart OFF and ON again. Set the PTO brake switch to the OFF position, P02 should be displayed. Disconnect the rear PTO brake connector, C033 and electronic management unit connector C105. With the keystart ON check for a short to +12v on C105–35. With the keystart OFF, check for a short from C105–35 and the other C105 connector pins. Is a short circuit indicated?
    - YES → Trace short circuit in wiring and repair
    - NO → Substitute Electronic Management Unit

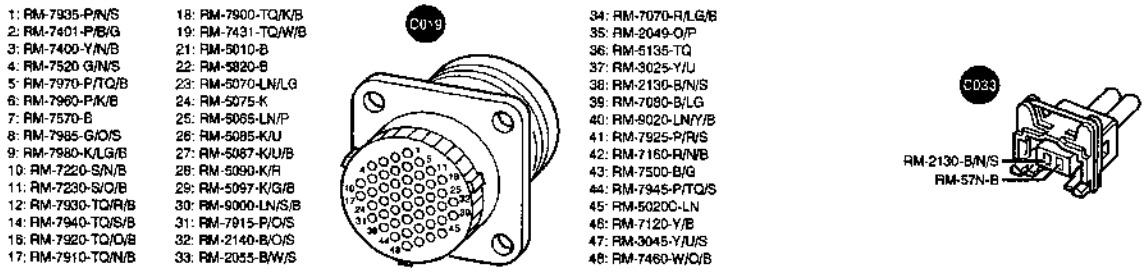
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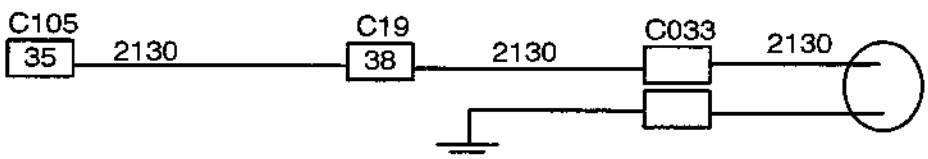
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ERROR CODE P03 – REAR PTO BRAKE OUTPUT OPEN CIRCUIT









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ERROR CODE P04 – REAR PTO BRAKE DRIVER OVER TEMPERATURE

Check for low resistance in rear PTO brake solenoid circuit

↓

Disconnect connector C033. Check coil resistance is approx. 5–11Ω at 20°C (68°F). Replace coil if outside specification.

↓

Check for short circuit between C105–35 and ground. Is a short circuit indicated? **YES** → Trace and repair short to ground

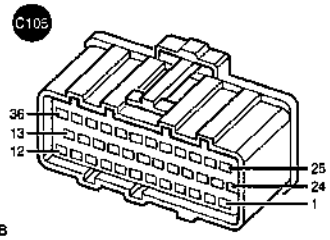
NO ↓

Check for a short circuit between C105–35 and the other pins of C105. Is a short circuit indicated? **YES** → Trace and repair short circuit

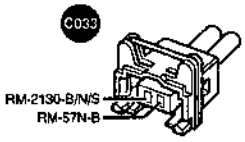
NO ↓

Inspect the connector pins on C105. Refit connector, if error persists substitute the electronic management unit.

1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TQ
7: CM-630-B/U/S
8: CM-1013K-R
9: CM-2065-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2246-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B



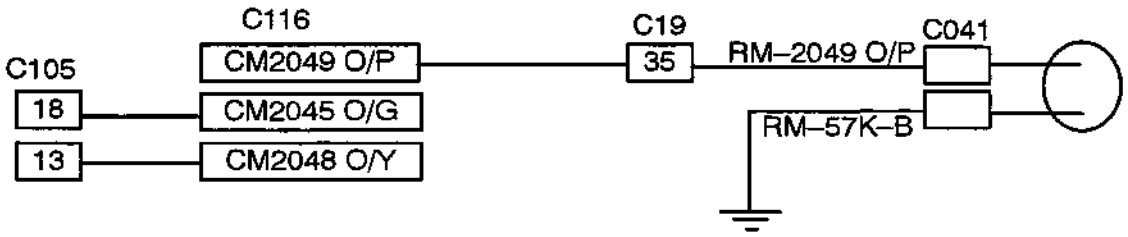
25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG



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ERROR CODE P07 – REAR PTO SOLENOID STUCK OFF
ERROR CODE P08 – REAR PTO SOLENOID CIRCUIT OVERCURRENT



Disconnect PTO solenoid connector, C041. Check coil resistance is approx. 5–11Ω 20°C (68°F). Is coil within specification?
- NO → Replace coil
- YES ↓

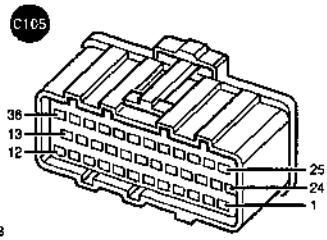
Check each coil terminal to ground. Is a short/partial short to ground indicated?
- YES → Replace coil
- NO ↓

Disconnect PTO switch connectors C116 and check solenoid connector C041, terminal, RM2049–O/P, to ground. Is a short to ground indicated?
- YES → Trace and repair faulty wiring
- NO ↓

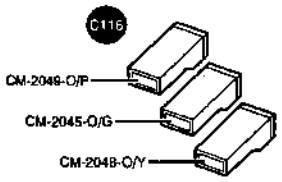
Disconnect E.M.U. connector C105. Check the PTO switch connectors C116, CM2045–O/G and CM2048–O/Y to ground. Is a short to ground indicated?
- YES → Trace and repair faulty wiring
- NO ↓

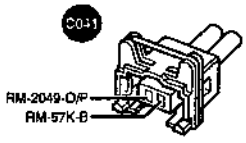
Substitute Electronic Management Unit

1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TQ
7: CM-630-B/U/S
8: CM-1013K-R
9: CM-2065-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2248-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B

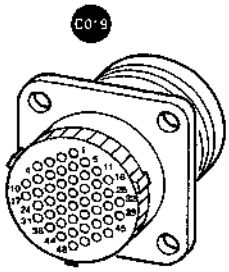


25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG





1: RM-7935-P/N/S
2: RM-7401-P/B/G
3: RM-7400-Y/N/B
4: RM-7520 G/N/S
5: RM-7970-P/TQ/B
6: RM-7960-P/K/B
7: RM-7570-B
8: RM-7985-G/O/S
9: RM-7980-K/LG/B
10: RM-7220-S/N/B
11: RM-7230-S/O/B
12: RM-7930-TQ/R/B
14: RM-7940-TQ/S/B
15: RM-7920-TQ/O/B
17: RM-7910-TQ/N/B
18: RM-7900-TQ/K/B
19: RM-7431-TQ/W/B
21: RM-5010-B
22: RM-5820-B
23: RM-5070-LN/LG
24: RM-5075-K
25: RM-5065-LN/P
26: RM-5085-K/U
27: RM-5087-K/U/B
28: RM-5090-K/R
29: RM-5097-K/G/B
30: RM-9000-LN/S/B
31: RM-7915-P/O/S
32: RM-2140-B/O/S
33: RM-2055-B/W/S

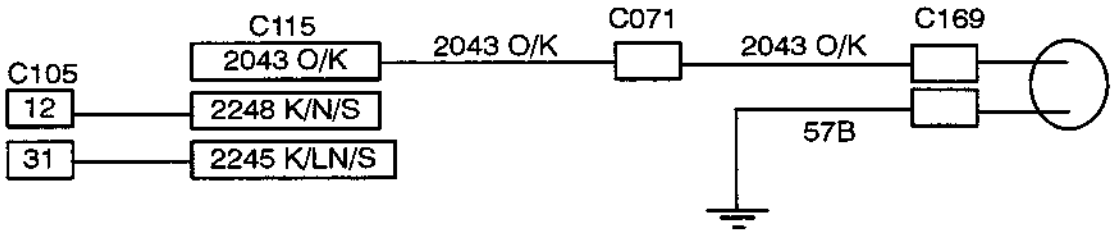


34: RM-7070-R/LG/B
35: RM-2049-O/P
36: RM-5135-TQ
37: RM-3025-Y/U
38: RM-2130-B/N/S
39: RM-7080-B/LG
40: RM-9020-LN/Y/B
41: RM-7925-P/R/S
42: RM-7160-R/N/B
43: RM-7500-B/G
44: RM-7945-P/TQ/S
45: RM-5020C-LN
46: RM-7120-Y/B
47: RM-3045-Y/U/S
48: RM-7460-W/O/B

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ERROR CODE P11 – FRONT PTO SOLENOID STUCK OFF
ERROR CODE P12– FRONT PTO SOLENOID CIRCUIT OVERCURRENT



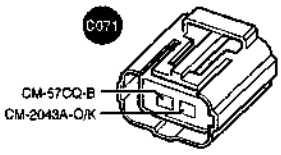
Disconnect front PTO solenoid connector, C169. Check coil resistance is approximately 5–11Ω at 20°C (68°F). Is coil within specification?
- NO → Replace coil
- YES ↓

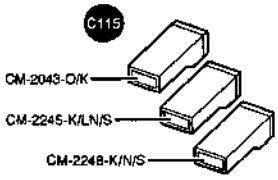
Check each coil terminal to ground. Is a short/partial short to ground indicated?
- YES → Replace coil
- NO ↓

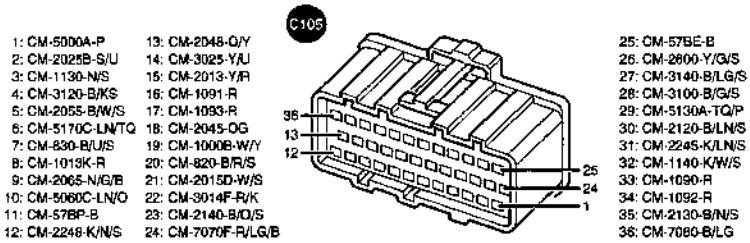
Disconnect PTO switch connectors C115 and check the solenoid connector, C169, terminal 2043 O/K, to ground. Is a short to ground indicated?
- YES → Trace and repair faulty wiring
- NO ↓

Disconnect E.M.U. connector C105. Check the PTO switch connectors C115, 2248–K/N/S and 2245 K/LN/S to ground. Is a short to ground indicated?
- YES → Trace and repair faulty wiring
- NO ↓

Substitute Electronic Management Unit



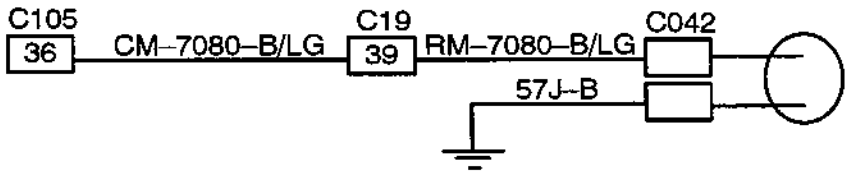




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ERROR CODE P15 – DIFF. LOCK SOLENOID STUCK OFF

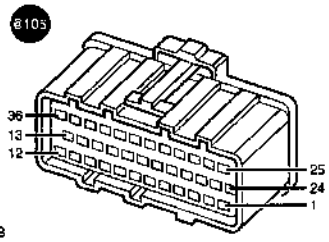


Disconnect differential lock solenoid connector, C042. Turn the keystart ON and select manual differential lock
NOTE: *Keep foot off brake pedals*

- Error P15 displayed → With the keystart off, disconnect C105 from electronic management unit. Using a multimeter, is a short to ground indicated at C105–36?
  - NO → Substitute Electronic Management Unit
  - YES → Disconnect connector C019. Check again for short to ground at C105–36. Is a short to ground indicated?
    - NO → Trace and repair short to ground between C042–RM7080–B/LG and C019
    - YES → Trace and repair short to ground between C105–36 (CM7080–B/LG) and C019.
- Error P16 or P16 and P17 displayed → Check diff lock solenoid resistance. Is resistance 5–11Ω?
  - NO → Replace solenoid
  - YES → Substitute Electronic Management Unit

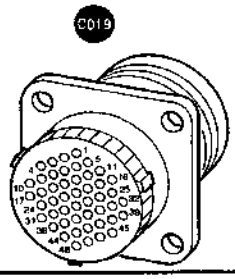
C105

1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TQ
7: CM-830-B/U/S
8: CM-1013K-R
9: CM-2065-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2248-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B
25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG

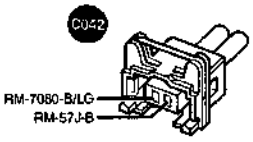


C019

1: RM-7935-P/N/S
2: RM-7401-P/B/G
3: RM-7400-Y/N/B
4: RM-7520 G/N/S
5: RM-7970-P/TQ/B
6: RM-7960-P/K/B
7: RM-7570-B
8: RM-7965-G/O/S
9: RM-7980-K/LG/B
10: RM-7220-S/N/B
11: RM-7230-S/O/B
12: RM-7930-TQ/R/B
14: RM-7940-TQ/S/B
16: RM-7920-TQ/O/B
17: RM-7910-TQ/N/B
18: RM-7900-TQ/K/B
19: RM-7431-TQ/W/B
21: RM-5010-B
22: RM-5820-B
23: RM-5070-LN/LG
24: RM-5075-K
25: RM-5065-LN/P
26: RM-5085-K/U
27: RM-5087-K/U/B
28: RM-5090-K/R
29: RM-5097-K/G/B
30: RM-9000-LN/S/B
31: RM-7915-P/O/S
32: RM-2140-B/O/S
33: RM-2055-B/W/S
34: RM-7070-R/LG/B
35: RM-2049-O/P
36: RM-5135-TQ
37: RM-3025-Y/U
38: RM-2130-B/N/S
39: RM-7080-B/LG
40: RM-9020-LN/Y/B
41: RM-7925-P/R/S
42: RM-7160-R/N/B
43: RM-7500-B/G
44: RM-7945-P/TQ/S
45: RM-5020C-LN
46: RM-7120-Y/B
47: RM-3045-Y/U/S
48: RM-7460-W/O/B



C042



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ERROR CODE P16 – DIFF. LOCK SOLENOID STUCK ON

Turn keystart ON, ensure differential lock is deselected. Key OFF and ON again, P16 should be displayed. Select Manual differential lock, is P17 displayed?

YES → Refer to error P17 fault finding flow chart

NO

Disconnect differential lock connector, C042, and electronic management unit connector, C105. Turn the keystart ON, using a multimeter check for +12v on C105–36. Is a short to +12v indicated?

YES → Trace short to +12v and repair

NO

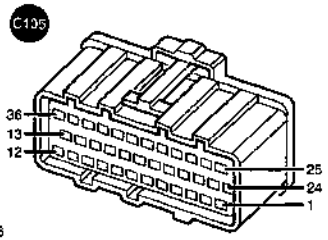
With the keystart OFF, check for a short circuit to one of the other C105 connector pins, is a short circuit indicated?

YES → Trace short in harness and repair

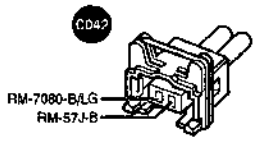
NO

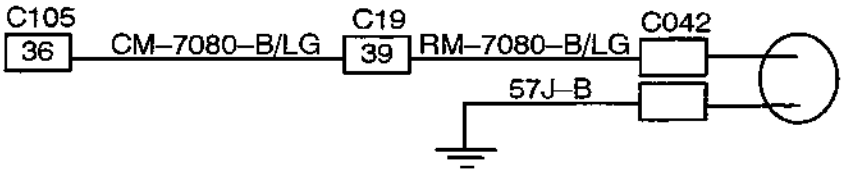
Substitute Electronic Management Unit

1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TQ
7: CM-830-B/U/S
8: CM-1013K-R
9: CM-2065-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2248-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B



25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG

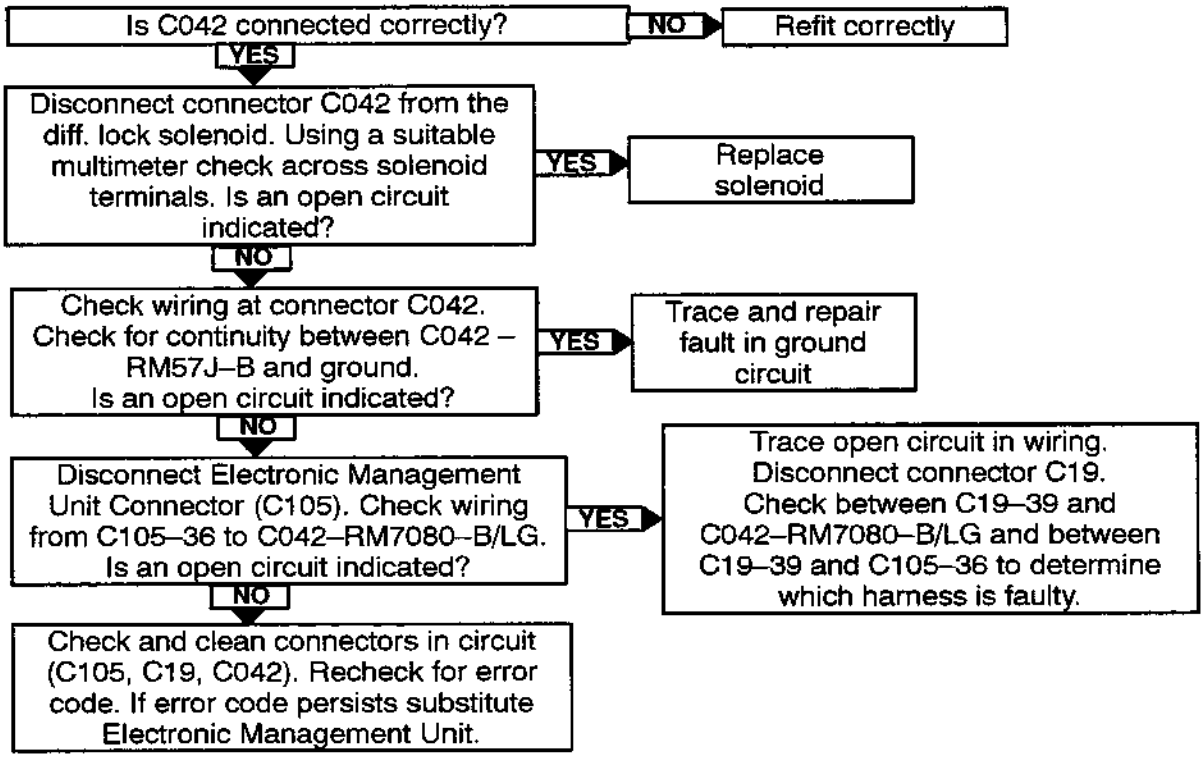




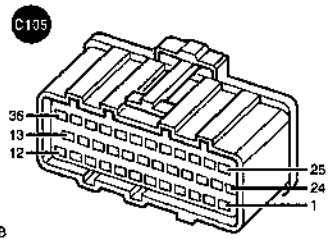
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ERROR CODE P17 – DIFF. LOCK OUTPUT OPEN CIRCUIT

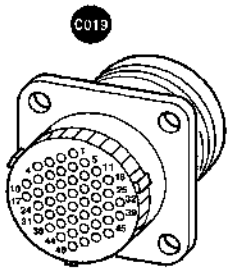


1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TQ
7: CM-830-B/U/S
8: CM-1013K-R
9: CM-2065-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2248-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B

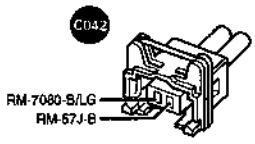


25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG

1: RM-7935-P/N/S
2: RM-7401-P/B/G
3: RM-7400-Y/N/B
4: RM-7520 G/N/S
5: RM-7970-P/TQ/B
6: RM-7960-P/K/B
7: RM-7570-B
8: RM-7985-G/O/S
9: RM-7980-K/LG/B
10: RM-7220-S/N/B
11: RM-7230-S/O/B
12: RM-7930-TQ/R/B
14: RM-7940-TQ/S/B
16: RM-7920-TQ/O/B
17: RM-7910-TQ/N/B
18: RM-7900-TQ/K/B
19: RM-7431-TQ/W/B
21: RM-5010-B
22: RM-5820-B
23: RM-5070-LN/LG
24: RM-5075-K
25: RM-5065-LN/P
26: RM-5085-K/U
27: RM-5087-K/U/B
28: RM-5090-K/R
29: RM-5097-K/G/B
30: RM-9000-LN/S/B
31: RM-7915-P/O/S
32: RM-2140-B/O/S
33: RM-2065-B/W/S



34: RM-7070-R/LG/B
35: RM-2049-O/P
36: RM-5135-TQ
37: RM-3025-Y/U
38: RM-2130-B/N/S
39: RM-7080-B/LG
40: RM-9020-LN/Y/B
41: RM-7925-P/R/S
42: RM-7160-R/N/B
43: RM-7500-B/G
44: RM-7945-P/TQ/S
45: RM-5020C-LN
46: RM-7120-Y/B
47: RM-3045-Y/U/S
48: RM-7480-W/O/B



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ERROR CODE P18 – DIFF. LOCK DRIVER OVER TEMPERATURE

Check for low resistance in differential lock solenoid circuit

↓

Disconnect connector C042. Check coil resistance is approximately 5–11Ω at 20°C (68°F). Replace coil if outside specification.

↓

Check for short circuit between C105–36 and ground. Is a short circuit indicated? — YES → Trace and repair short to ground

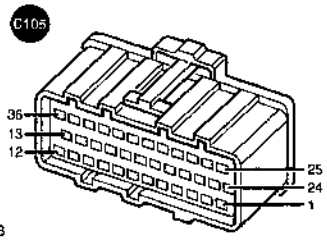
NO ↓

Check for a short circuit between C105–36 and the other pins of C105. Is a short circuit indicated? — YES → Trace and repair short circuit

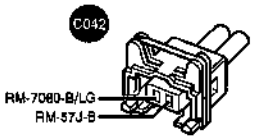
NO ↓

Inspect the connector pins on C105. Refit connector, if error persists substitute the electronic management unit.

1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TQ
7: CM-830-B/U/S
8: CM-1013K-R
9: CM-2065-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2248-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B



25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG



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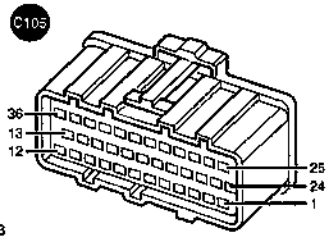
ERROR CODE P21 – 4WD SOLENOID STUCK OFF

With the keystart OFF, disconnect the FWD connector, C034. Turn the keystart ON and ensure that 2WD is selected. Key OFF and ON again.

- P21 displayed
  - With the keystart OFF, disconnect connector C105 from the electronic management unit and check for a short to ground on C105–14. Is a short circuit indicated?
    - NO → Substitute Electronic Management Unit
    - YES → Disconnect connector C19 and check for a short to ground on C105–14. Is a short indicated?
      - NO → Trace and repair short to ground between C034–RM3025–Y/U and C105–14
      - YES → Trace and repair short to ground between C105–14 and ground.
- P22 or P22 and P23 displayed
  - Check solenoid resistance is between 5–11Ω at 20°C (68°F), replace if outside specification.

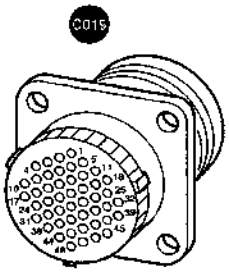
C105

1: CM-5000A-P	13: CM-2048-O/Y	25: CM-57BE-B	
2: CM-2025B-S/U	14: CM-3025-Y/U	26: CM-2600-Y/G/S	
3: CM-1130-N/S	15: CM-2013-Y/R	27: CM-3140-B/LG/S	
4: CM-3120-B/KS	16: CM-1091-R	28: CM-3100-B/G/S	
5: CM-2055-B/W/S	17: CM-1083-R	29: CM-5130A-TQ/P	
6: CM-5170C-LN/TQ	18: CM-2045-OG	30: CM-2120-B/LN/S	
7: CM-830-B/U/S	19: CM-1000B-W/Y	31: CM-2245-K/LN/S	
8: CM-1013K-R	20: CM-820-B/R/S	32: CM-1140-K/W/S	
9: CM-2065-N/G/B	21: CM-2015D-W/S	33: CM-1090-R	
10: CM-5060C-LN/O	22: CM-3014F-R/K	34: CM-1092-R	
11: CM-57BP-B	23: CM-2140-B/O/S	35: CM-2130-B/N/S	
12: CM-2248-K/N/S	24: CM-7070F-R/LG/B	36: CM-7080-B/LG	

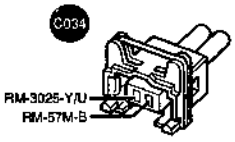


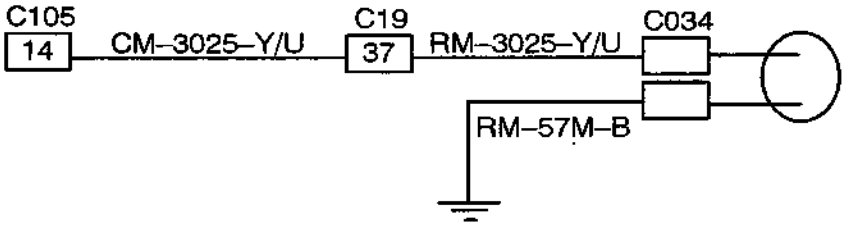
C019

1: RM-7935-P/N/S	18: RM-7900-TQ/K/B	34: RM-7070-R/LG/B	
2: RM-7401-P/B/G	19: RM-7431-TQ/W/B	35: RM-2049-O/P	
3: RM-7400-Y/N/B	21: RM-5010-B	36: RM-5135-TQ	
4: RM-7520 G/N/S	22: RM-5820-B	37: RM-3025-Y/U	
5: RM-7970-P/TQ/B	23: RM-5070-LN/LG	38: RM-2130-B/N/S	
6: RM-7960-P/K/B	24: RM-5075-K	39: RM-7080-B/LG	
7: RM-7570-B	25: RM-5065-LN/P	40: RM-9020-LN/Y/B	
8: RM-7985-G/O/S	26: RM-5085-K/U	41: RM-7925-P/R/S	
9: RM-7980-K/LG/B	27: RM-5087-K/U/B	42: RM-7160-R/N/B	
10: RM-7220-S/N/B	28: RM-5090-K/R	43: RM-7500-B/G	
11: RM-7230-S/O/B	29: RM-5097-K/G/B	44: RM-7945-P/TQ/S	
12: RM-7930-TQ/R/B	30: RM-9000-LN/S/B	45: RM-5020C-LN	
14: RM-7940-TQ/S/B	31: RM-7915-P/O/S	46: RM-7120-Y/B	
16: RM-7920-TQ/O/B	32: RM-2140-B/O/S	47: RM-3045-Y/U/S	
17: RM-7910-TQ/N/B	33: RM-2055-B/W/S	48: RM-7460-W/O/B	



C034





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ERROR CODE P22 – 4WD SOLENOID STUCK ON

turn keystart ON, select manual FWD and turn keystart OFF. Depress both brake pedals and turn the keystart ON and momentarily crank the engine (no need to start engine). Is error P22 displayed?

NO → Tractor okay or possible intermittent fault.

YES → Release brake pedals, is error P23 displayed?

YES → Refer to Error code P23 fault finding flow chart.

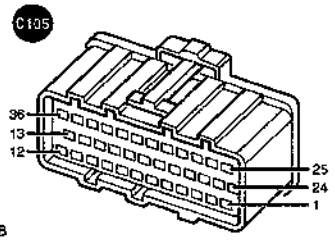
NO → Disconnect the FWD solenoid connector, C034 and electronic management unit connector C105. Using a multimeter check for a short to +12v on C105–14 or a short to one of the other terminals on C105. Is a short circuit indicated?

YES → Trace short circuit and repair

NO → Substitute Electronic Management Unit

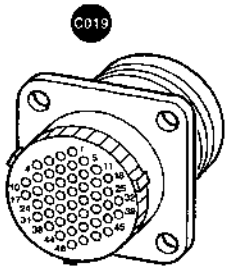
C105

1: CM-5000A-P	13: CM-2048-O/Y	25: CM-57BE-B
2: CM-2025B-S/U	14: CM-3025-Y/U	26: CM-2600-Y/G/S
3: CM-1130-N/S	15: CM-2013-Y/R	27: CM-3140-B/LG/S
4: CM-3120-B/KS	16: CM-1091-R	28: CM-3100-B/G/S
5: CM-2055-B/W/S	17: CM-1093-R	29: CM-5130A-TQ/P
6: CM-5170C-LN/TQ	18: CM-2045-OG	30: CM-2120-B/LN/S
7: CM-830-B/U/S	19: CM-1000B-W/Y	31: CM-2245-K/LN/S
8: CM-1013K-R	20: CM-820-B/R/S	32: CM-1140-K/W/S
9: CM-2065-N/G/B	21: CM-2015D-W/S	33: CM-1090-R
10: CM-5060C-LN/O	22: CM-3014F-R/K	34: CM-1092-R
11: CM-57BP-B	23: CM-2140-B/O/S	35: CM-2130-B/N/S
12: CM-2248-K/N/S	24: CM-7070F-R/LG/B	36: CM-7060-B/LG

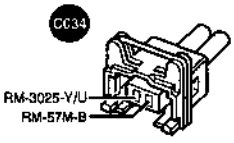


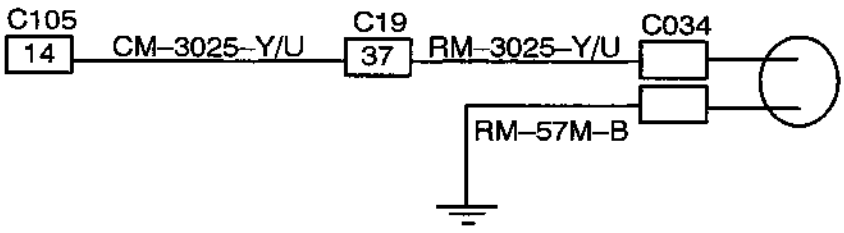
C019

1: RM-7935-P/N/S	18: RM-7900-TQ/K/B	34: RM-7070-R/LG/B
2: RM-7401-P/B/G	19: RM-7431-TQ/W/B	35: RM-2049-O/P
3: RM-7400-Y/N/B	21: RM-5010-B	36: RM-5135-TQ
4: RM-7520 G/N/S	22: RM-5820-B	37: RM-3025-Y/U
5: RM-7970-P/TQ/B	23: RM-5070-LN/LG	38: RM-2130-B/N/S
6: RM-7960-P/K/B	24: RM-5075-K	39: RM-7060-B/LG
7: RM-7570-B	25: RM-5065-LN/P	40: RM-9020-LN/Y/B
8: RM-7985-G/O/S	26: RM-5085-K/U	41: RM-7925-P/R/S
9: RM-7980-K/LG/B	27: RM-5087-K/U/B	42: RM-7160-R/N/B
10: RM-7220-S/N/B	28: RM-5090-K/R	43: RM-7500-B/G
11: RM-7230-S/O/B	29: RM-5097-K/G/B	44: RM-7945-P/TQ/S
12: RM-7930-TQ/R/B	30: RM-9000-LN/S/B	45: RM-5020C-LN
14: RM-7940-TQ/S/B	31: RM-7915-P/O/S	46: RM-7120-Y/B
16: RM-7920-TQ/O/B	32: RM-2140-B/O/S	47: RM-3045-Y/U/S
17: RM-7910-TQ/N/B	33: RM-2055-B/W/S	48: RM-7460-W/O/B



C034

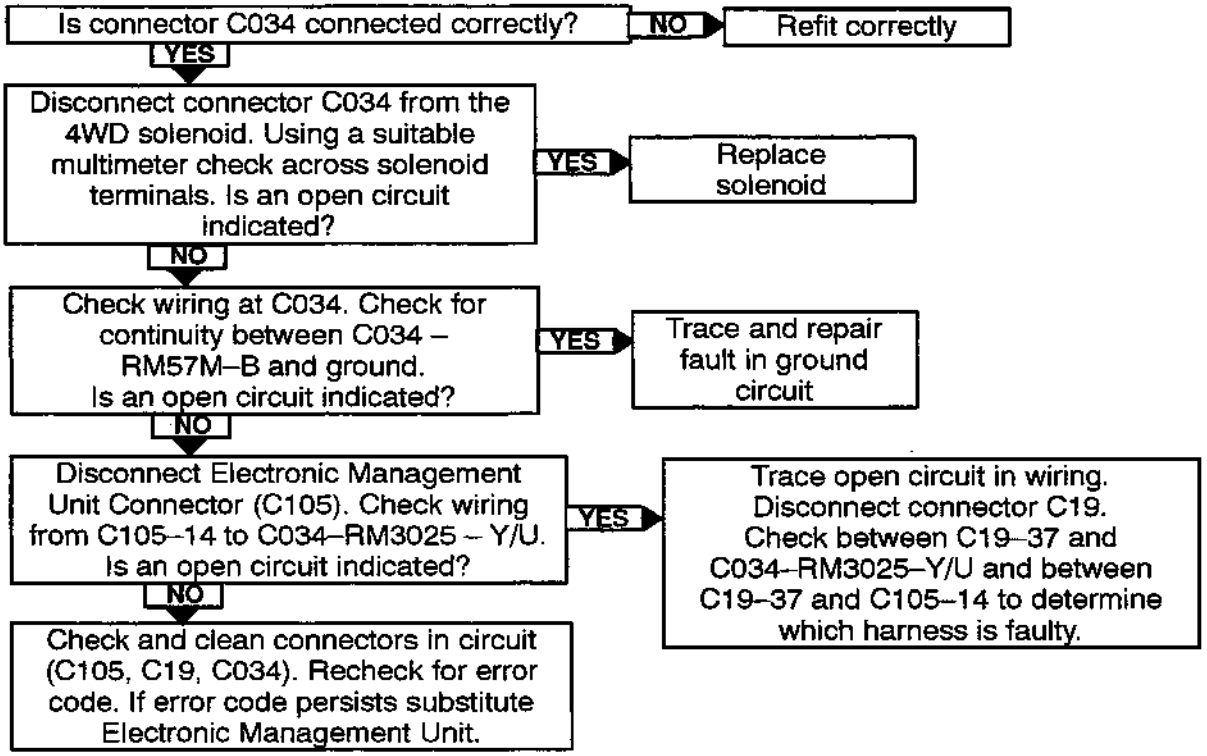




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ERROR CODE P23 – 4WD OUTPUT OPEN CIRCUIT



C105

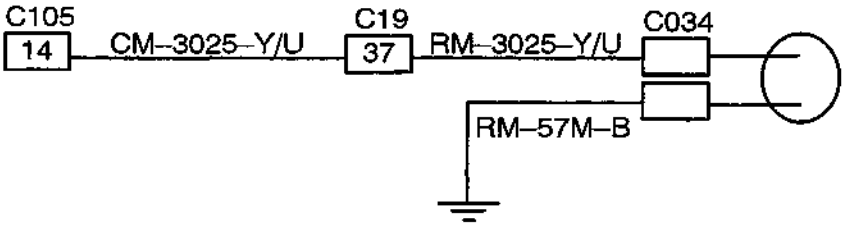
1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TQ
7: CM-830-B/U/S
8: CM-1013K-R
9: CM-2085-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2248-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B
25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG

C019

1: RM-7935-P/N/S
2: RM-7401-P/B/G
3: RM-7400-Y/N/B
4: RM-7520 G/N/S
5: RM-7970-P/TQ/B
6: RM-7960-P/K/B
7: RM-7570-B
8: RM-7985-G/O/S
9: RM-7980-K/LG/B
10: RM-7220-S/N/B
11: RM-7230-S/O/B
12: RM-7930-TQ/R/B
14: RM-7940-TQ/S/B
16: RM-7920-TQ/O/B
17: RM-7910-TQ/N/B
18: RM-7900-TQ/K/B
19: RM-7431-TQ/W/B
21: RM-5010-B
22: RM-5820-B
23: RM-5070-LN/LG
24: RM-5075-K
25: RM-5065-LN/P
26: RM-5085-K/U
27: RM-5087-K/U/B
28: RM-5090-K/R
29: RM-5097-K/G/B
30: RM-9000-LN/S/B
31: RM-7915-P/O/S
32: RM-2140-B/O/S
33: RM-2055-B/W/S
34: RM-7070-R/LG/B
35: RM-2049-O/P
36: RM-5135-TQ
37: RM-3025-Y/U
38: RM-2130-B/N/S
39: RM-7080-B/LG
40: RM-9020-LN/Y/B
41: RM-7925-P/R/S
42: RM-7150-R/N/B
43: RM-7500-B/G
44: RM-7945-P/TQ/S
45: RM-5020C-LN
46: RM-7120-Y/B
47: RM-3045-Y/U/S
48: RM-7460-W/O/B

C034

RM-3025-Y/U
RM-57M-B



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ERROR CODE P24 – 4WD DRIVER OVER TEMPERATURE

Check for low resistance in FWD solenoid circuit.

↓

Disconnect connector C034. Check coil resistance is approximately 5–11 Ω at 20°C (68°F).
Replace coil if outside of specification.

↓

Check for short circuit between C105–14 and ground. Is a short circuit indicated? **YES** → Trace and repair short to ground

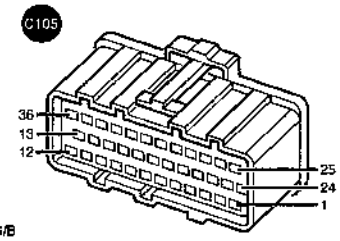
NO ↓

Check for a short circuit between C105–14 and the other pins of C105. Is a short circuit indicated? **YES** → Trace and repair short circuit

NO ↓

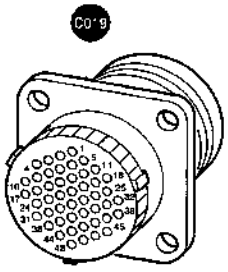
Inspect the connector pins on C105. Refit connector, if error persists substitute the electronic management unit.

1: CM-5000A-P
2: CM-2025B-S/U
3: CM-1130-N/S
4: CM-3120-B/KS
5: CM-2055-B/W/S
6: CM-5170C-LN/TQ
7: CM-830-B/U/S
8: CM-1013K-R
9: CM-2055-N/G/B
10: CM-5060C-LN/O
11: CM-57BP-B
12: CM-2248-K/N/S
13: CM-2048-O/Y
14: CM-3025-Y/U
15: CM-2013-Y/R
16: CM-1091-R
17: CM-1093-R
18: CM-2045-OG
19: CM-1000B-W/Y
20: CM-820-B/R/S
21: CM-2015D-W/S
22: CM-3014F-R/K
23: CM-2140-B/O/S
24: CM-7070F-R/LG/B

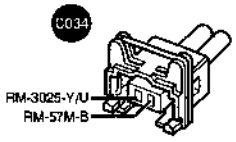


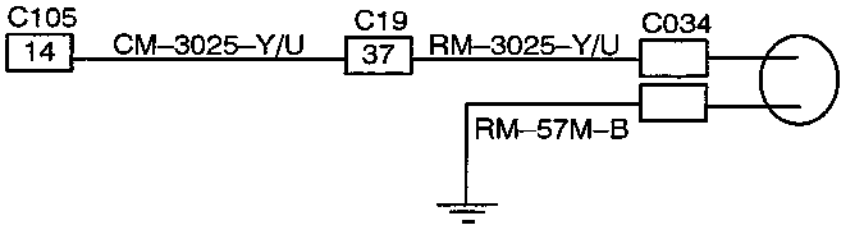
25: CM-57BE-B
26: CM-2600-Y/G/S
27: CM-3140-B/LG/S
28: CM-3100-B/G/S
29: CM-5130A-TQ/P
30: CM-2120-B/LN/S
31: CM-2245-K/LN/S
32: CM-1140-K/W/S
33: CM-1090-R
34: CM-1092-R
35: CM-2130-B/N/S
36: CM-7080-B/LG

1: RM-7935-P/N/S
2: RM-7401-P/B/G
3: RM-7400-Y/N/B
4: RM-7520 G/N/S
5: RM-7970-P/TQ/B
6: RM-7960-P/K/B
7: RM-7570-S
8: RM-7985-G/O/S
9: RM-7980-K/LG/B
10: RM-7220-S/N/B
11: RM-7230-S/O/B
12: RM-7930-TQ/R/B
14: RM-7940-TQ/S/B
16: RM-7920-TQ/O/B
17: RM-7910-TQ/N/B
18: RM-7900-TQ/K/B
19: RM-7431-TQ/W/B
21: RM-5010-B
22: RM-5820-B
23: RM-5070-LN/LG
24: RM-5075-K
25: RM-5065-LN/P
26: RM-5085-K/U
27: RM-5087-K/U/B
28: RM-5090-K/R
29: RM-5097-K/G/B
30: RM-9000-LN/S/B
31: RM-7915-P/O/S
32: RM-2140-B/O/S
33: RM-2055-B/W/S



34: RM-7070-R/LG/B
35: RM-2049-O/P
36: RM-5135-TQ
37: RM-3025-Y/U
38: RM-2130-B/N/S
39: RM-7080-B/LG
40: RM-9020-LN/Y/B
41: RM-7925-P/R/S
42: RM-7160-R/N/B
43: RM-7500-B/G
44: RM-7945-P/TQ/S
45: RM-5020C-LN
46: RM-7120-Y/B
47: RM-3045-Y/U/S
48: RM-7460-W/O/B

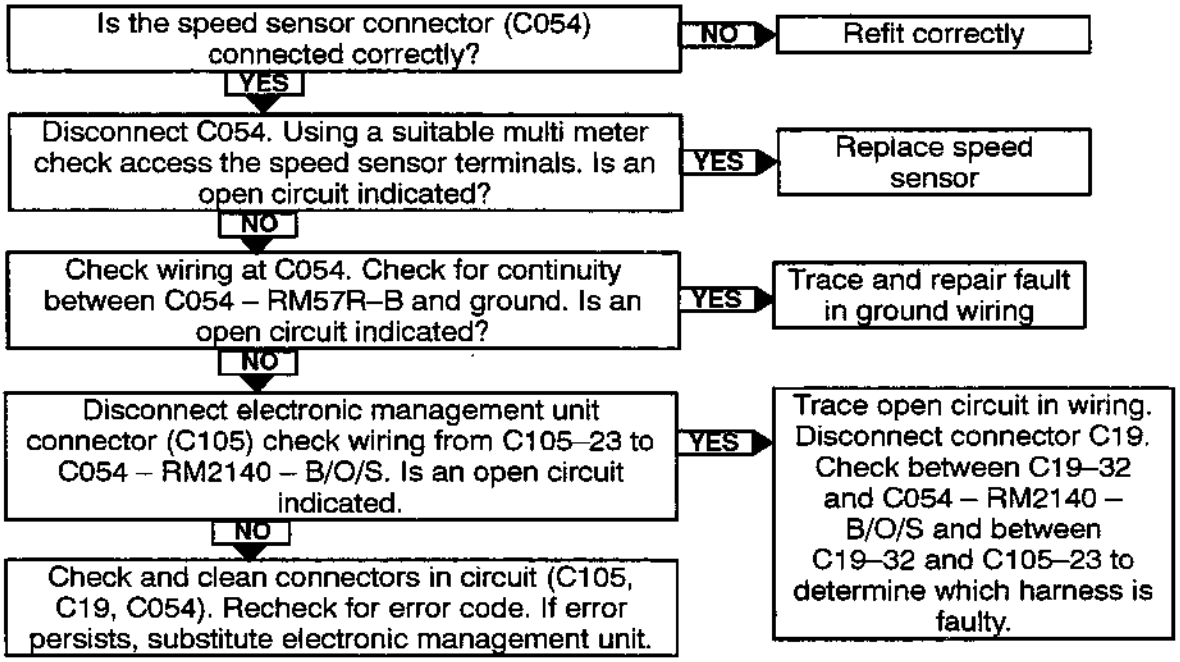


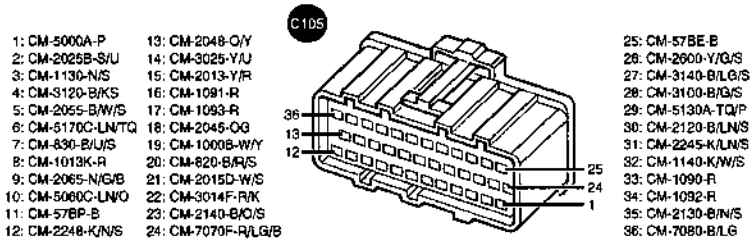


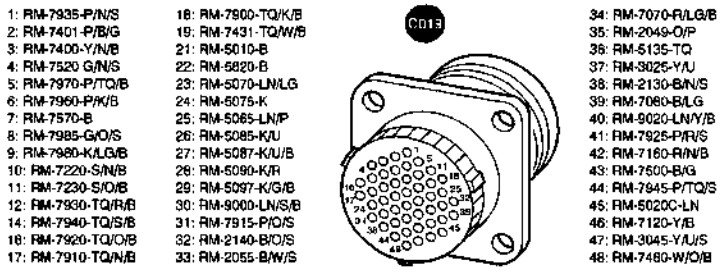
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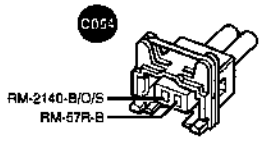
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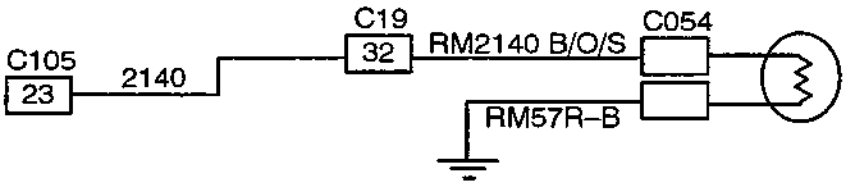
ERROR CODE P27 – PTO SPEED SENSOR OPEN CIRCUIT











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ERROR CODE P31 – STEERING SENSOR OUT OF RANGE – (MAXIMUM VOLTAGE)

Disconnect connector C014. With the keystart ON, check for a short to +12V on the Red, yellow or black wires of the steering sensor. Is a short indicated?
- YES → Locate short and repair
- NO ↓

With the Keystart OFF, check for a short circuit between the red, yellow and black steering sensor wires. Is a short indicated?
- YES → Locate short and repair if possible or replace steering sensor assembly
- NO ↓

Check resistance between red and black wires of steering sensor. Is the resistance 5kΩ–6kΩ?
- NO → Visually inspect the steering sensor wires, connector and connector terminals, if no fault evident replace steering sensor.
- YES ↓

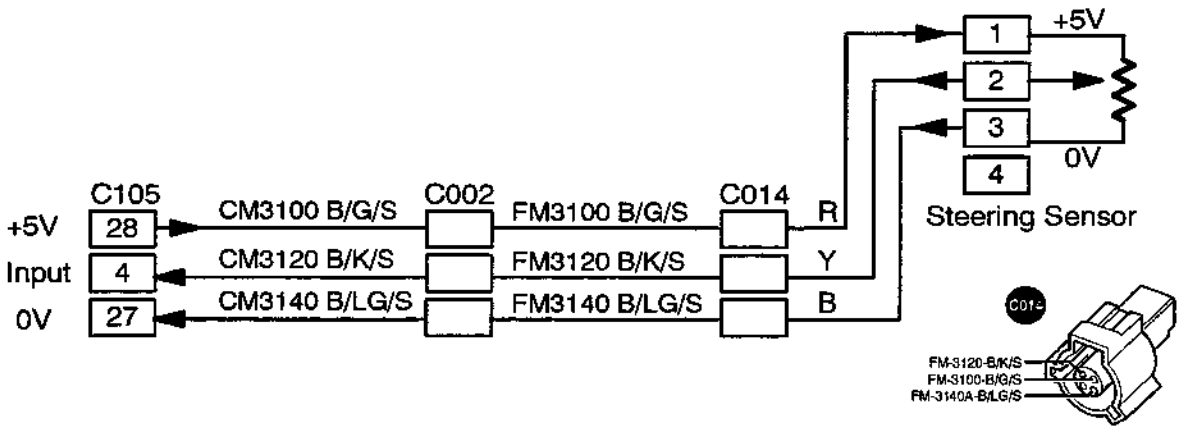
Inspect connector C014 for correct terminal installation. Reconnect C014, is the error code still present?
- NO → Tractor okay
- YES ↓

Disconnect connectors C014 and C105. Turn ON keystart, Are C105–28, C105–4 and C105–27 indicating 0 volts?
- NO → Trace and repair short circuit
- YES ↓

With the Keystart OFF is an open circuit indicated between connector C105 pins, 4, 27 and 28?
- NO → Trace and repair short circuit between C105 pins, 4, 27 and 28.
- YES ↓

Is there continuity between :–
C105–28 and C014–1
C105–4 and C014–2
C105–27 and C014–3?
- NO → Trace and repair open circuit
- YES ↓

Substitute the Electronic Management Unit. Recalibrate after installation



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ERROR CODE P32 – STEERING SENSOR OUT OF RANGE – (MINIMUM VOLTAGE)

Disconnect connector C014. With the keystart OFF, check for a short to ground on the Red, yellow or black wires of the steering sensor. Is a short indicated?
- YES → Locate short and repair
- NO ↓

With the Keystart OFF, check for a short circuit between the red, yellow and black steering sensor wires. Is a short indicated?
- YES → Locate short and repair if possible or replace steering sensor assembly
- NO ↓

Check resistance between red and black wires of steering sensor. Is the resistance 5kΩ–6kΩ?
- NO → Visually inspect the steering sensor wires, connector and connector terminals, if no fault evident replace steering sensor.
- YES ↓

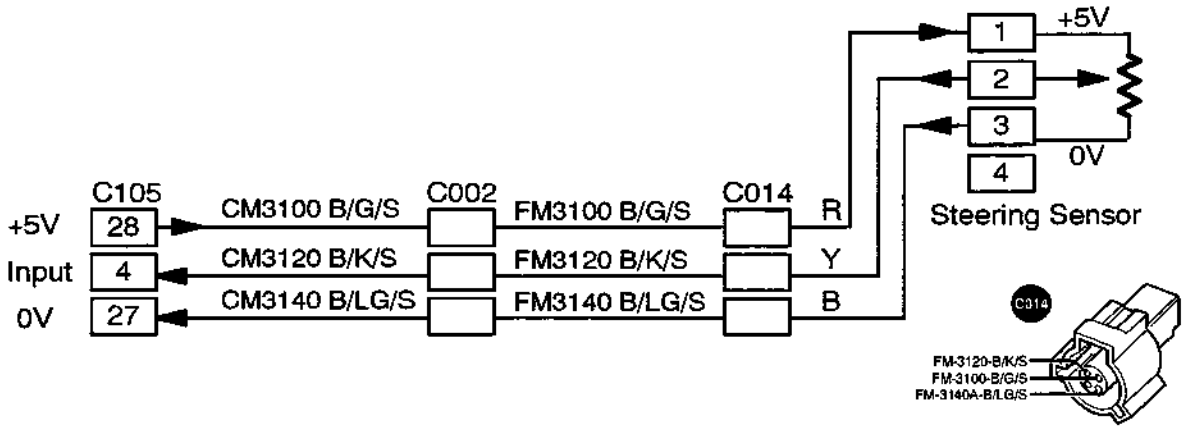
Inspect connector C014 for correct terminal installation. Reconnect C014, is the error code still present?
- NO → Tractor okay
- YES ↓

Disconnect connectors C014 and C105. With keystart OFF, Are C105–28, C105–4 and C105–27 shorted to ground?
- NO → Trace and repair short to ground.
- YES ↓

With the Keystart OFF is an open circuit indicated between connector C105 pins, 4, 27 and 28?
- NO → Trace and repair short circuit between C105 pins, 4, 27 and 28.
- YES ↓

Is there continuity between :–
C105–28 and C014–1
C105–4 and C014–2
C105–27 and C014–3?
- NO → Trace and repair open circuit
- YES ↓

Substitute the Electronic Management Unit. Recalibrate after installation



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SECTION 2
ELECTRICAL SYSTEM
CHAPTER 3
ELECTRONIC INSTRUMENT CLUSTER

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PROGRAMMING CENTRAL LCD 2-3-16
PROGRAMMING PERFORMANCE MONITOR 2-3-18
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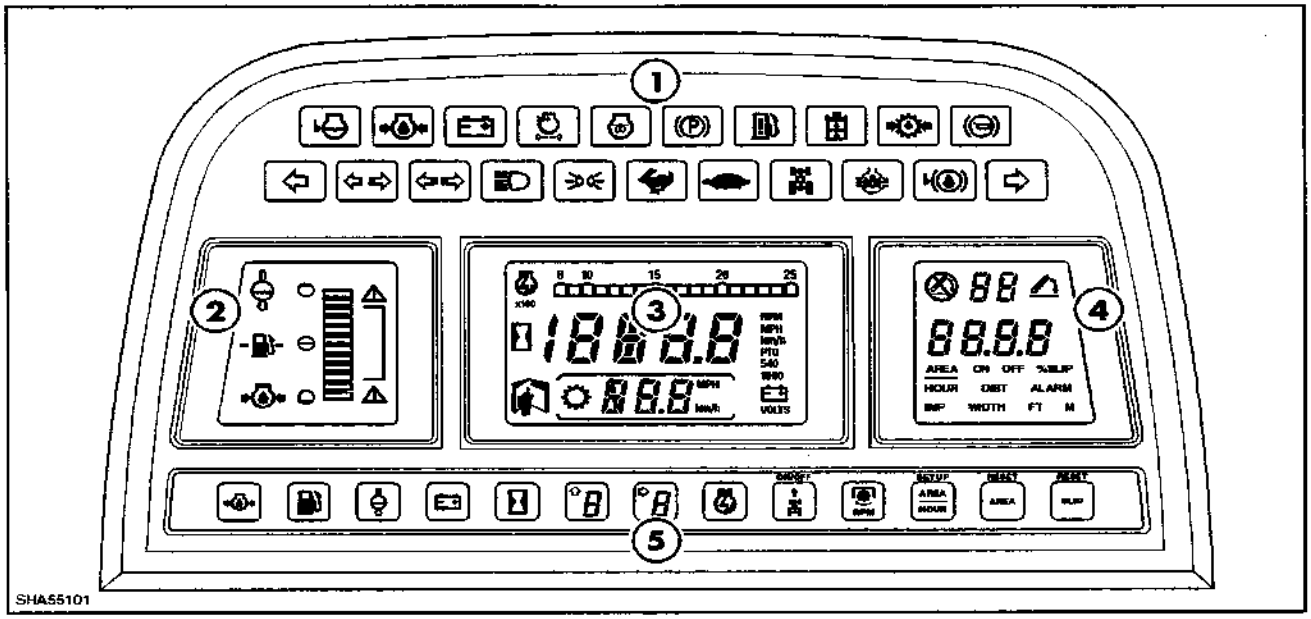


Figure 2-3-1

The Electronic Instrument Cluster consists of five distinct areas:

1. Indicator and Warning Lamps
2. Tractor Condition Bar Graph
3. Central Display
4. Tractor Performance Monitor
5. Function Buttons

Audible Alarm Definitions

Non-critical:
Continuous alarm for 5 seconds only.

Critical:
Intermittent alarm will sound until fault is corrected or engine is switched off.

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AREA 1: INDICATOR AND WARNING LAMPS

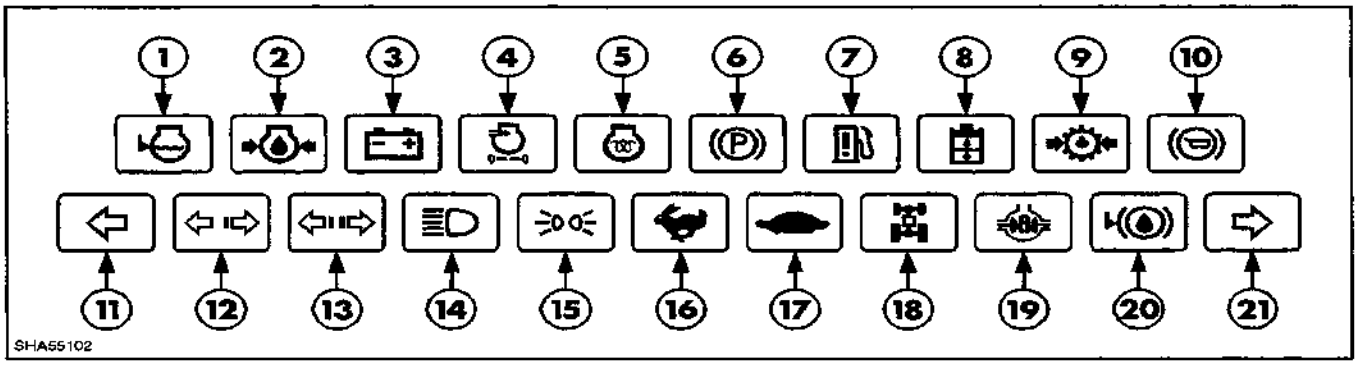


Figure 2-3-2

	Condition	Indicator/ Warning Lamp	Central LCD Display	Audible Alarm
1	Coolant level low	ON	Stop	Critical
2	Engine oil pressure	ON	Stop	Critical
3	Battery voltage:			
	Below 10 volts above 16 volts	ON		Non critical Non critical
4	Air filter restriction	ON		
5	Thermostart	ON		
6	Parking brake on Key on (stopped)	Flashing		
	Parking brake on Ground speed +0.8 kph (0.5 mph)	Flashing		Critical
	Parking brake off Key off	OFF		Critical 2 minutes
7	Water in fuel	ON		Non critical
8	Transmission oil filter blocked Charge pressure low	ON Flashing		Non critical Non critical
9	Transmission oil pressure low	ON	Stop	Critical
10	Trailer brake pressure low	Flashing		Critical
11	Left turn indicator	Flashing		
12	Single trailer indicator	Flashing		
13	Second trailer indicator	Flashing		
14	Main beam on	ON		
15	Side lights on	ON		
16	Hi (power shuttle only)	ON		
17	Lo (power shuttle only)	ON		
18	Front wheel drive engaged	ON		
19	Differential lock engaged	ON		
20	Brake fluid low	ON		
21	Right hand indicator	Flashing		

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CRITICAL ALARMS

COOLANT TEMPERATURE HIGH

With engine running:
Critical audible alarm, stop and left hand display will flash.

With engine off, key on:
The left hand display continues to display maximum bars and coolant symbol.

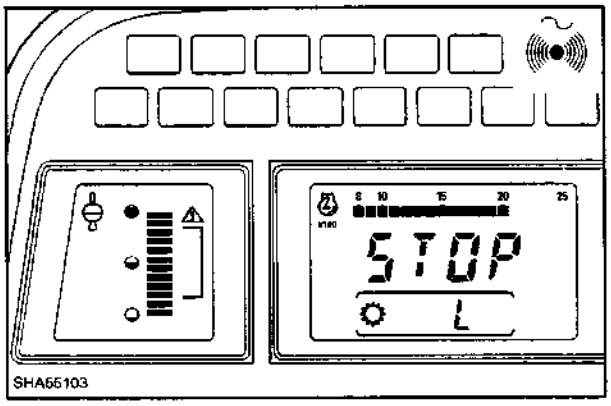


Figure 2-3-3

ENGINE OIL PRESSURE LOW

With engine running:
Critical audible alarm, stop and left hand display will flash. Alarm pressure function will vary with engine speed.

OIL PRESSURE		RPM	ALARM
Bar	lbf/in^2	Less than 500	OFF
0.6	8	500–1500	ON
1.1	16	1500–2000	ON
1.7	24	2000–3000	ON

With engine off, key on:
The left hand display continues to display minimum bars and oil pressure symbol.

NOTE: *If both coolant and oil pressure alarms are activated together, both symbols, high and low symbols and all 12 segments of left hand display flash.*

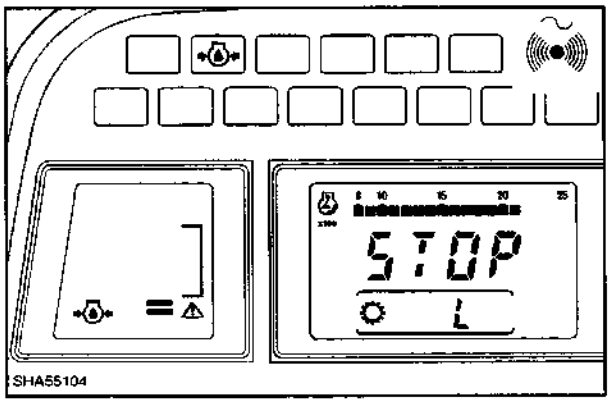


Figure 2-3-4

FUEL LEVEL LOW

Display and alarm are activated as bargraph changes from:–

3 to 2 Segments
2 to 1 Segment

Or when Key switched on (with low fuel).

5 second non critical alarm.

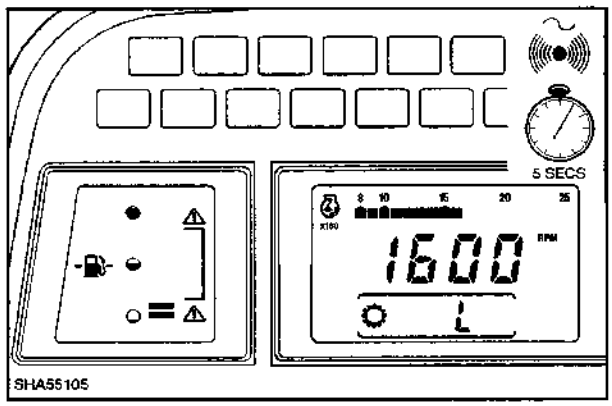


Figure 2-3-5

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AREA 2: TRACTOR CONDITION BAR GRAPHS

FUEL LEVEL

Each segment indicates 1/12 of total fuel capacity.

A low fuel level alarm is activated if the display drops from 3 to 2 segments, and from 2 to 1 segment.

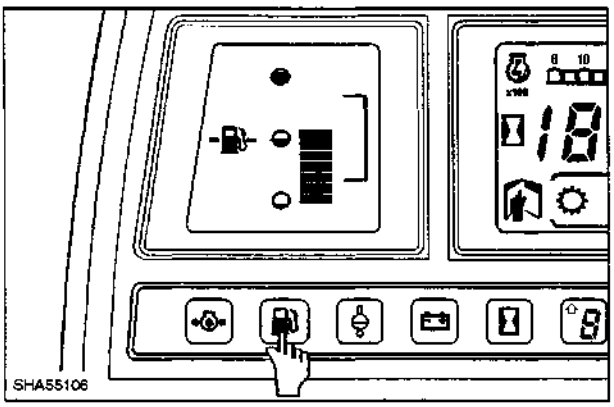


Figure 2-3-6

ENGINE OIL PRESSURE

Each segment indicates approximately 0.56 bar (8 lbf/in^2).

SEG	Bar	lbf/in2	SEG	Bar	lbf/in2
1	0–0.5	0–8	7	3.4–3.9	48–56
2	0.5–1.1	8–16	8	3.9–4.5	56–64
3	1.1–1.7	16–24	9	4.5–5.0	64–72
4	1.7–2.2	24–32	10	5.0–5.6	72–80
5	2.2–2.8	32–40	11	5.6–6.1	80–88
6	2.8–3.4	40–48	12	6.1–6.7	88–96

A low oil pressure alarm will be activated at 0.5–1.7 bar (8–24 lbf/in^2) depending on engine rpm.

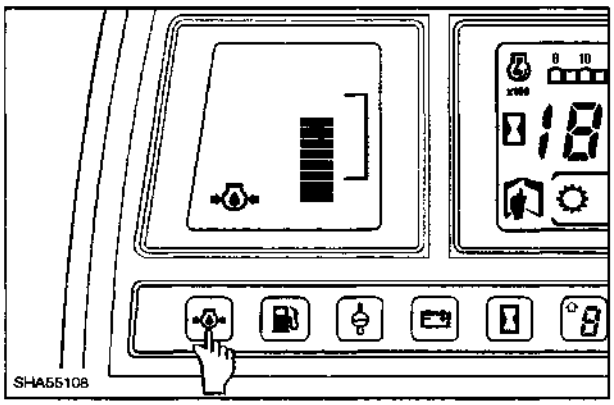


Figure 2-3-7

ENGINE COOLANT TEMPERATURE

Each segment indicates approximately 5-6°C (41–43°F), the first segment is always displayed when temperature below 66°C (150°F).

SEG	°C	SEG	°C
1	60–66 (140–150°F)	7	93–99 (200–210°F)
2	66–71 (150–160°F)	8	99–104 (210–220°F)
3	71–77 (160–170°F)	9	104–110 (220–230°F)
4	77–82 (170–180°F)	0	110–116 (230–240°F)
5	82–88 (180–190°F)	11	116–121 (240–250°F)
6	88–93 (190–200°F)	12	Over 121 (250°F)

Coolant over heating alarm is activated when the display changes from 11 to 12 segments.

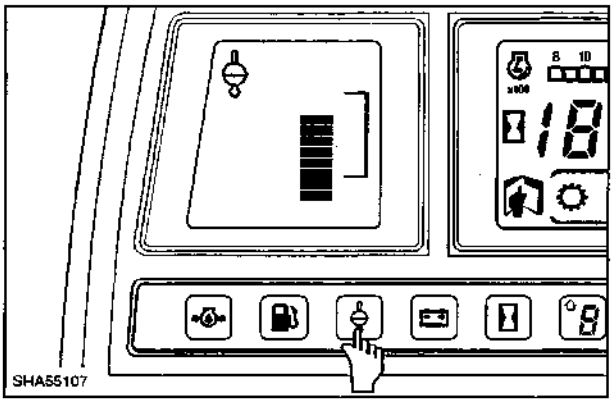


Figure 2-3-8

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AREA 3: CENTRAL DISPLAY

BATTERY VOLTAGE

Digital display indicating to nearest 0.1volt.

Alarm system activated if voltage is less than 10 volts or above 16 volts.

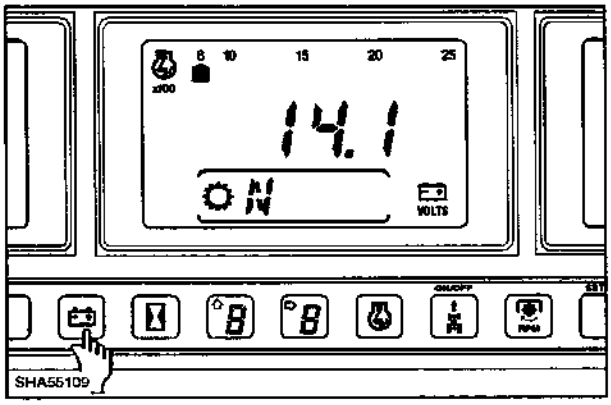


Figure 2-3-9

ENGINE HOURS

Digital display of actual hours of engine running, automatically selected when Key Start switch turned 'ON'.

Readouts 0–1000 hours in 0.1 increments and above 1000 hours in 1 hour increments to maximum 9999 hours.

Recorded hours are stored in the permanent memory and not affected by battery removal.

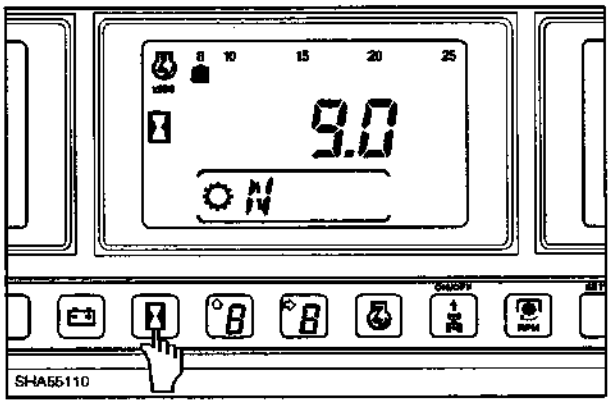


Figure 2-3-10

ENGINE RPM

Digital display to nearest 10 rpm.

Display automatically selected on engine start up.

Permanent 18 segment rpm bargraph display indicates 800–2500 rpm in 100 rpm steps.

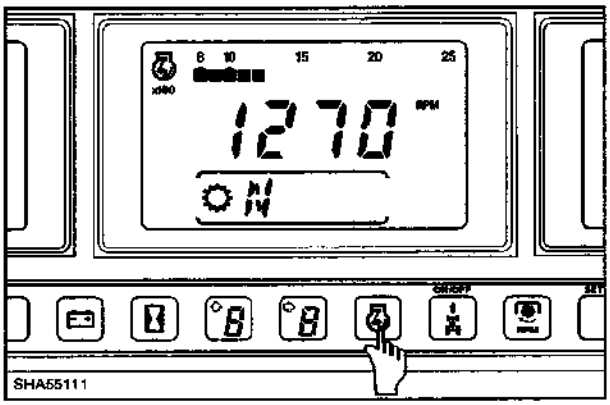


Figure 2-3-11

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GROUND SPEED

Digital display of ground speed km/h or mph (programming). In 'ERPM', display will automatically select ground speed over 20 km/h (12.4 mph).

Ground speed provided by Radar (if fitted) or transmission speed sensor.

Ground speed calibration must be correct to provide accurate ground speed.

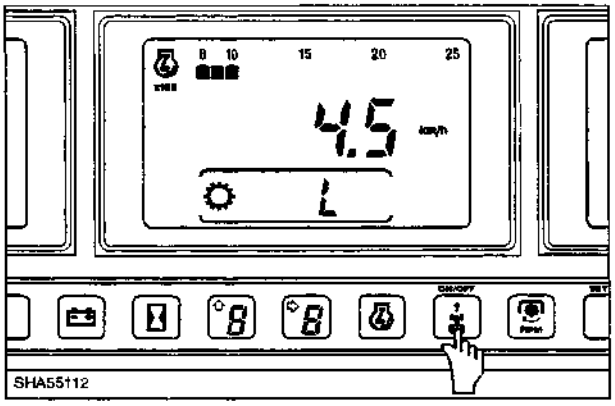


Figure 2-3-12

PTO SPEED

PTO speeds are actual speeds measured by the PTO sensor picking up a signal from the output shaft.

The PTO engaged/overspeed lamp will flash for 10 seconds as the shaft speed rises above 650 rev/min to indicate that if 540 speed is selected, the shaft speed is too high.

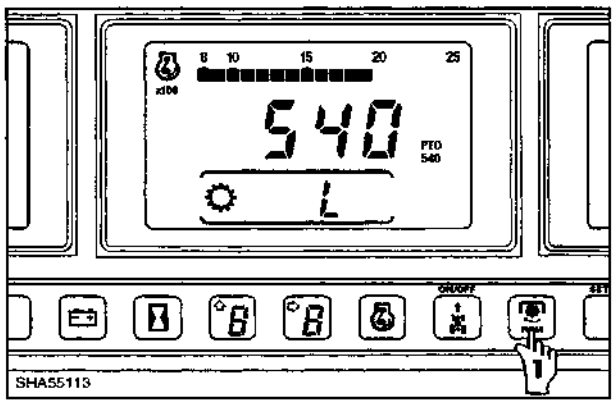


Figure 2-3-13

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AREA 4: TRACTOR PERFORMANCE MONITOR

AREA PER HOUR

Area per hour being worked based on last 5 seconds of operation.

Display will read 0 if either the implement is raised or the tractor is stopped.

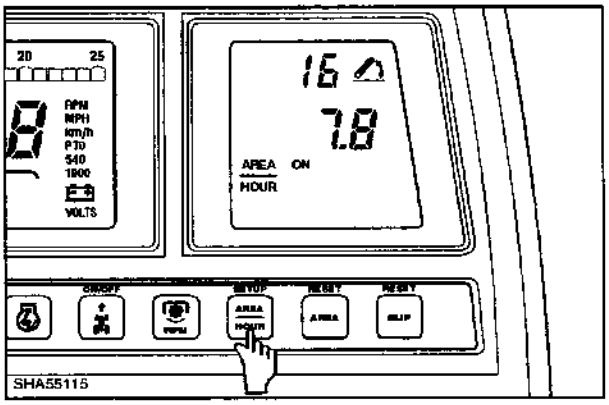


Figure 2-3-14

AREA

Total accumulated area (since last display reset). Area accumulation is automatically switched 'OFF' or 'ON' when the implement is raised or lowered in work, or manually by touching the ON/OFF (ground speed button).

Area display can be set to ZERO by holding down AREA function button for 3 seconds.

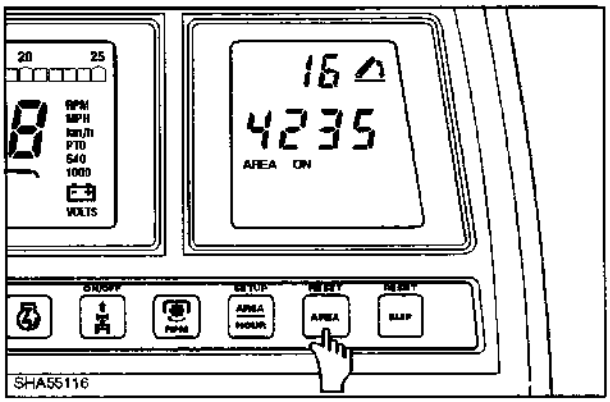


Figure 2-3-15

SLIP (WITH RADAR OPTION ONLY)

Wheel slip percentage (%).

Based on difference between radar (ground speed) sensor and transmission (wheel speed) sensor signals.

To 'zero' slip, hold down SLIP function button for 3 seconds (alarm tone) while tractor speed is less than 16 km/h (10 mph).

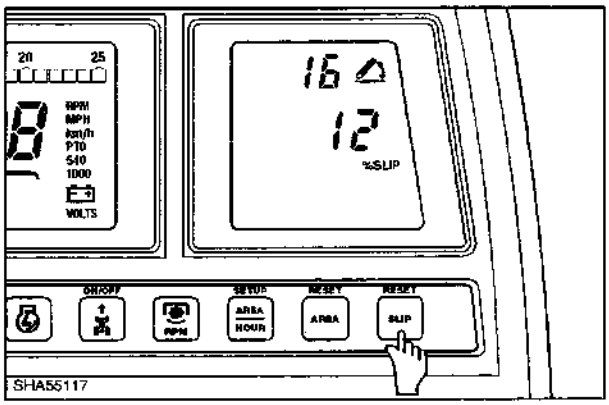


Figure 2-3-16

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AREA 5: FUNCTION KEYS

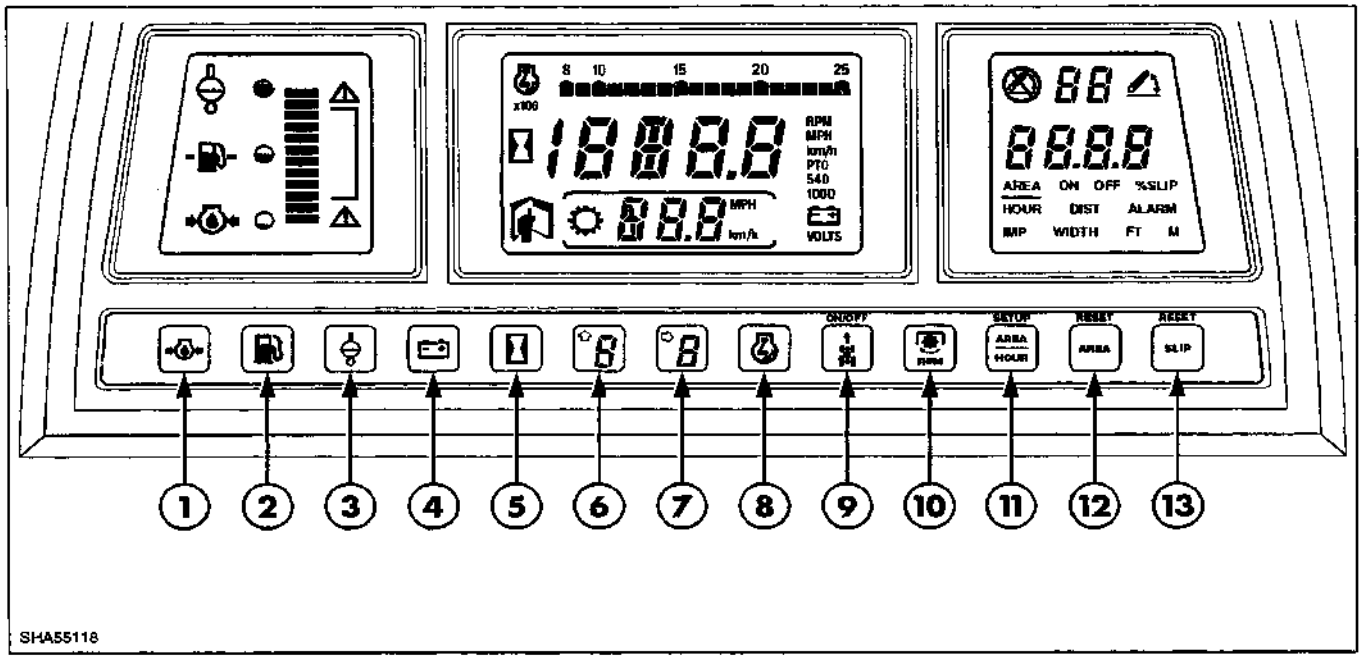


Figure 2-3-17

1 Engine Oil Pressure
2 Fuel Tank Level
3 Engine Coolant Temperature
4 Battery Voltage
5 Engine Hours
6&7 Programming & Diagnostic Functions
8 Engine RPM Digital Readout
9 Ground Speed
10 PTO RPM 540/1000
11 Area/Hour
12 Area Worked
13 Slip %

The liquid crystal displays are selected by touching the appropriate touch sensitive function buttons as shown above.

An audible bleep confirms each function button command.

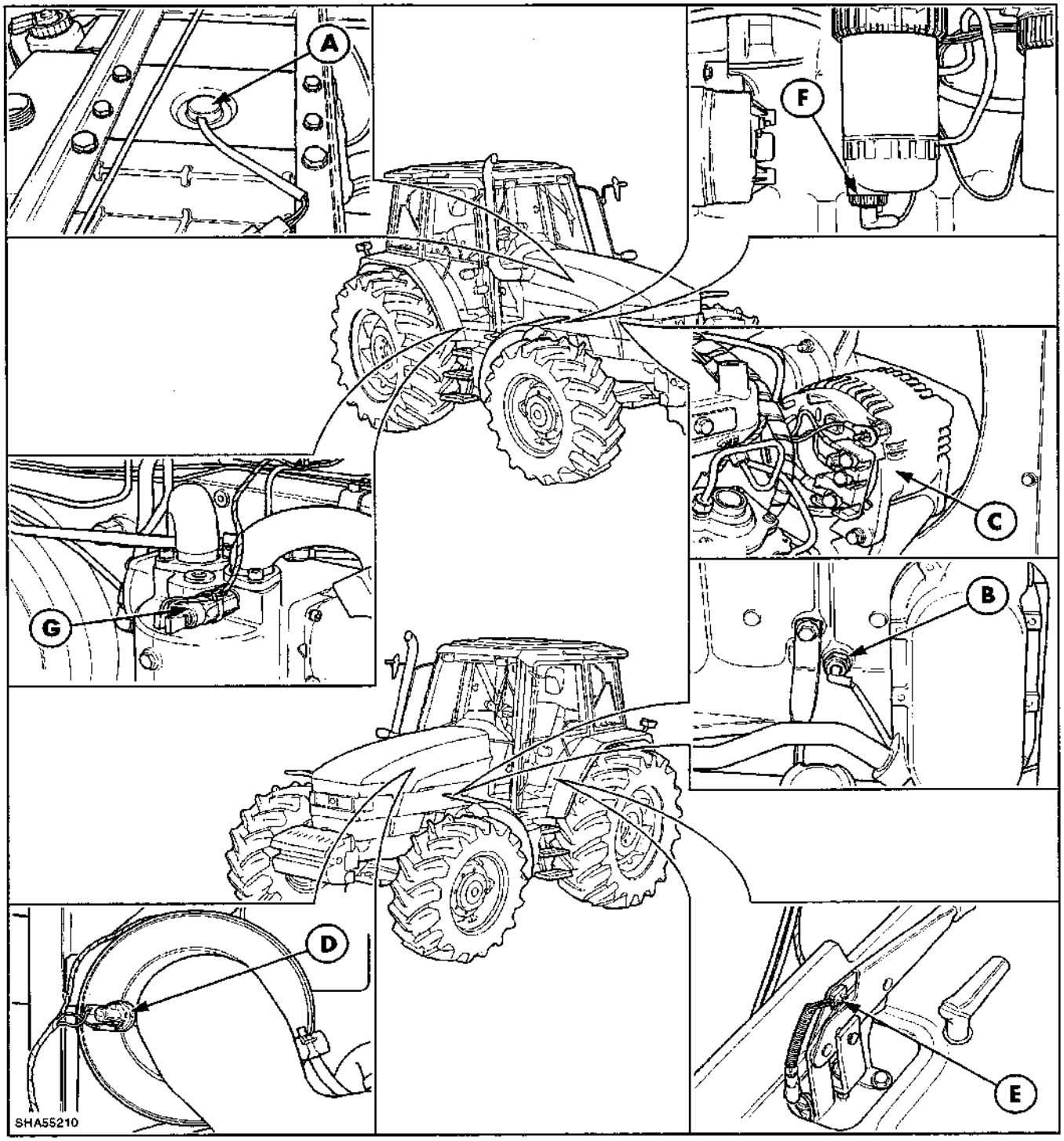
The selected displays are shown on the preceding pages.

The function buttons are disabled during critical and non–critical alarm sequences.

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SENDERS, SENSORS & SWITCHES



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A. ENGINE COOLANT LEVEL SWITCH
Operates as engine coolant level drops to illuminate warning lamp. Uses a normally closed switch.

B. ENGINE OIL PRESSURE SWITCH
Operates as engine oil pressure drops below 0.68 bar (10 lbf/in2) to illuminate warning lamp. Uses a normally closed switch.

C. ALTERNATOR
Provides a square wave signal of 142.5 – 855.0 Hz (480 – 3060 ERPM) for instrument cluster and microprocessor operations.

D. AIR CLEANER RESTRICTION SWITCH
Operates when the vacuum in the air intake system rises above 46.7 mm Hg (25 in H2O) to illuminate warning lamp. Uses a normally open switch.

E. PARKING BRAKE SWITCH
Switch is closed with parking brake applied, a warning lamp and audible alarm with key switch on.
Sounds an alarm when wheel movement is detected above 0.8 km/h (0.5 mph).
Sounds an alarm for 2 minutes with key switch off and park brake released.
NOTE: *FWD is always engaged when park brake is applied.*

F. WATER IN FUEL
Operates when water is detected in the fuel to illuminate warning lamp.

G. INTAKE FILTER RESTRICTION SWITCH (Open Center System)
Operates as the transmission intake vacuum rises above 406mm Hg (228.8 in H2O) to illuminate warning lamp. Switch is normally open.

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SENDERS, SENSORS & SWITCHES

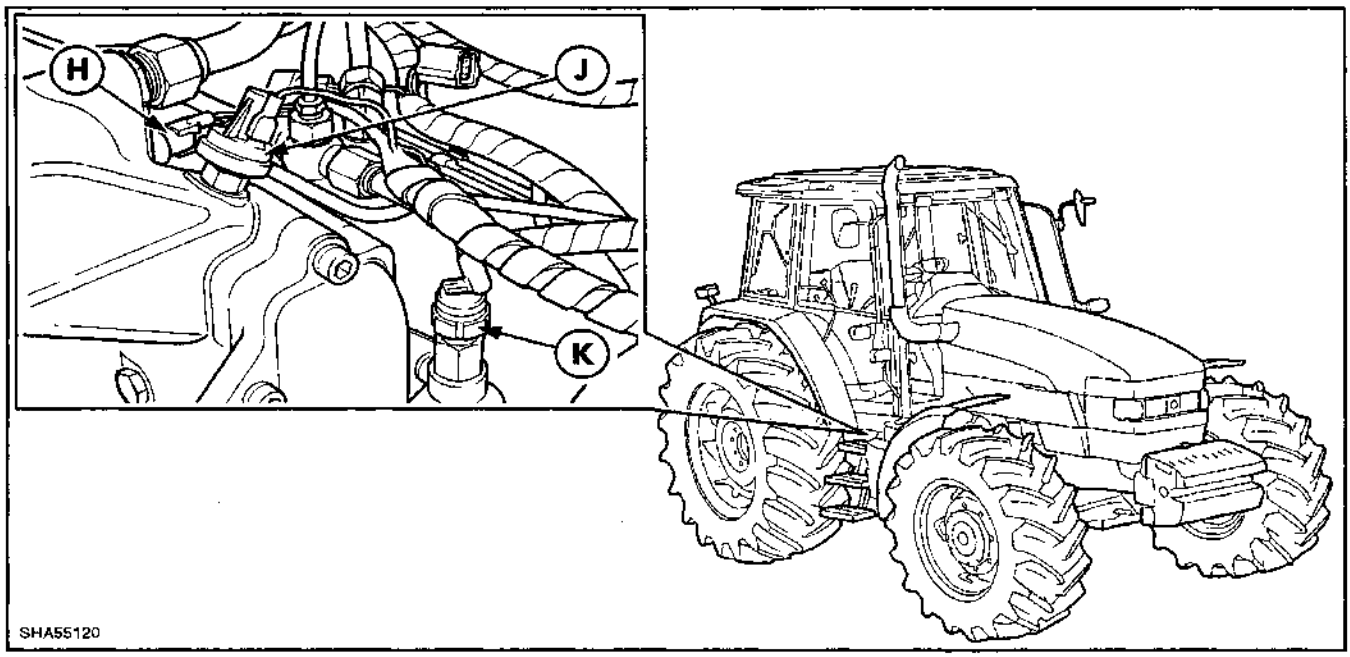


Figure 2-3-18

H. INTAKE FILTER TEMPERATURE SWITCH
Operates as the transmission oil temperature rises above 40°C (104°F) to allow the intake filter restriction switch to function. Switch is normally open.

J. INTAKE FILTER RESTRICTION SWITCH
Operates as the transmission intake vacuum rises above 406mm Hg (228.8 in H2O) to operate warning lamp. Switch is normally open.

K. CHARGE PRESSURE SWITCH
Operates as charge pressure drops below 0.8 bar (12 lbf/in^2) to illuminate warning lamp. Switch is normally closed.

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SENDERS, SENSORS & SWITCHES

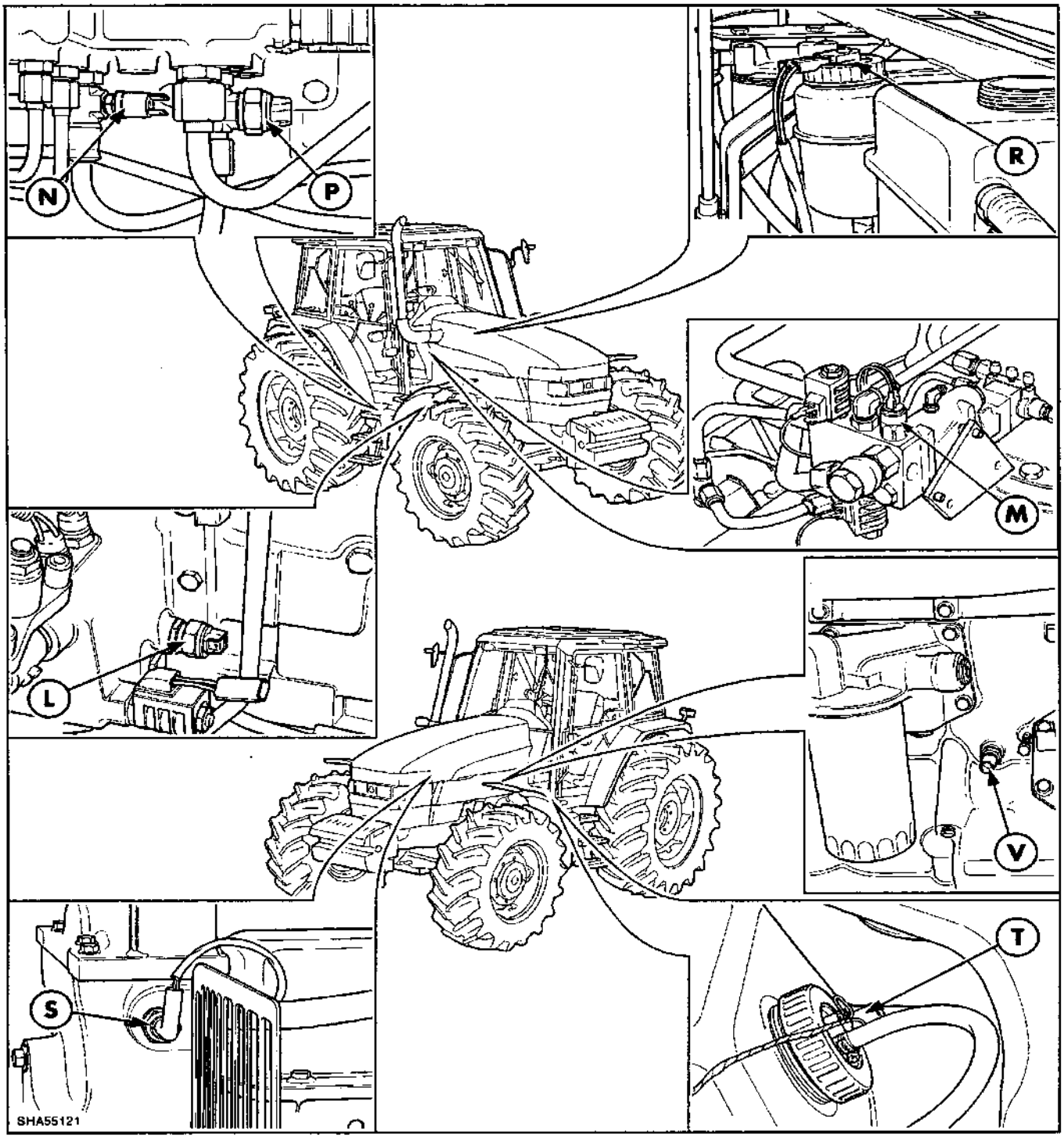


Figure 2-3-19

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SENDERS, SENSORS & SWITCHES

L. TRANSMISSION OIL PRESSURE SWITCH
Operates as transmission oil pressure drops below 11 bar (160 lbf/in2) to operate warning lamp. Switch is normally closed.

M. ITALIAN TRAILER BRAKE SWITCH **(NOTE: NOT USED IN NORTH AMERICA)**
Operates when trailer brakes are applied to illuminate warning lamp.

N. FWD OIL PRESSURE SWITCH
Operates when transmission pressure 16 bar (240 lbf/in2) is absent in FWD line (FWD engaged) to illuminate warning lamp. Switch is normally closed.

P. DIFFERENTIAL LOCK PRESSURE SWITCH
Operates when transmission oil pressure 16 bar (240 lbf/in2) is present in differential lock supply lines to illuminate warning lamp. Switch is normally open.

R. BRAKE/CLUTCH FLUID LEVEL SWITCH
Operates as fluid level drops below minimum to operate warning lamp. Switch is normally closed.

S. ENGINE COOLANT TEMPERATURE SENDER
The temperature sender resistance changes proportionally with coolant temperature causing a modulated signal voltage to be sent back to the instrument cluster to operate the gauge.

SENDER RESISTANCE	GAUGE INDICATION
710 – 580 ohms	Cold
Less than 100 ohms	Hot

T. FUEL TANK SENDER
Signal from sender potentiometer determines fuel level displayed on the gauge.

SENDER RESISTANCE	GAUGE INDICATION
31 – 49 ohms	Full
230 – 250 ohms	Empty

V. ENGINE OIL PRESSURE SENDER
The oil pressure sender resistance changes proportionally with engine oil pressure causing a modulated signal voltage to be sent back to the instrument panel to operate the gauge.

DISPLAY	PRESSURE	
	Bar	lbf/in^2
1 Bar	0 – 0.5	0 – 8
12 Bars	6.1 – 6.7	88 – 96

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SENDERS, SENSORS & SWITCHES

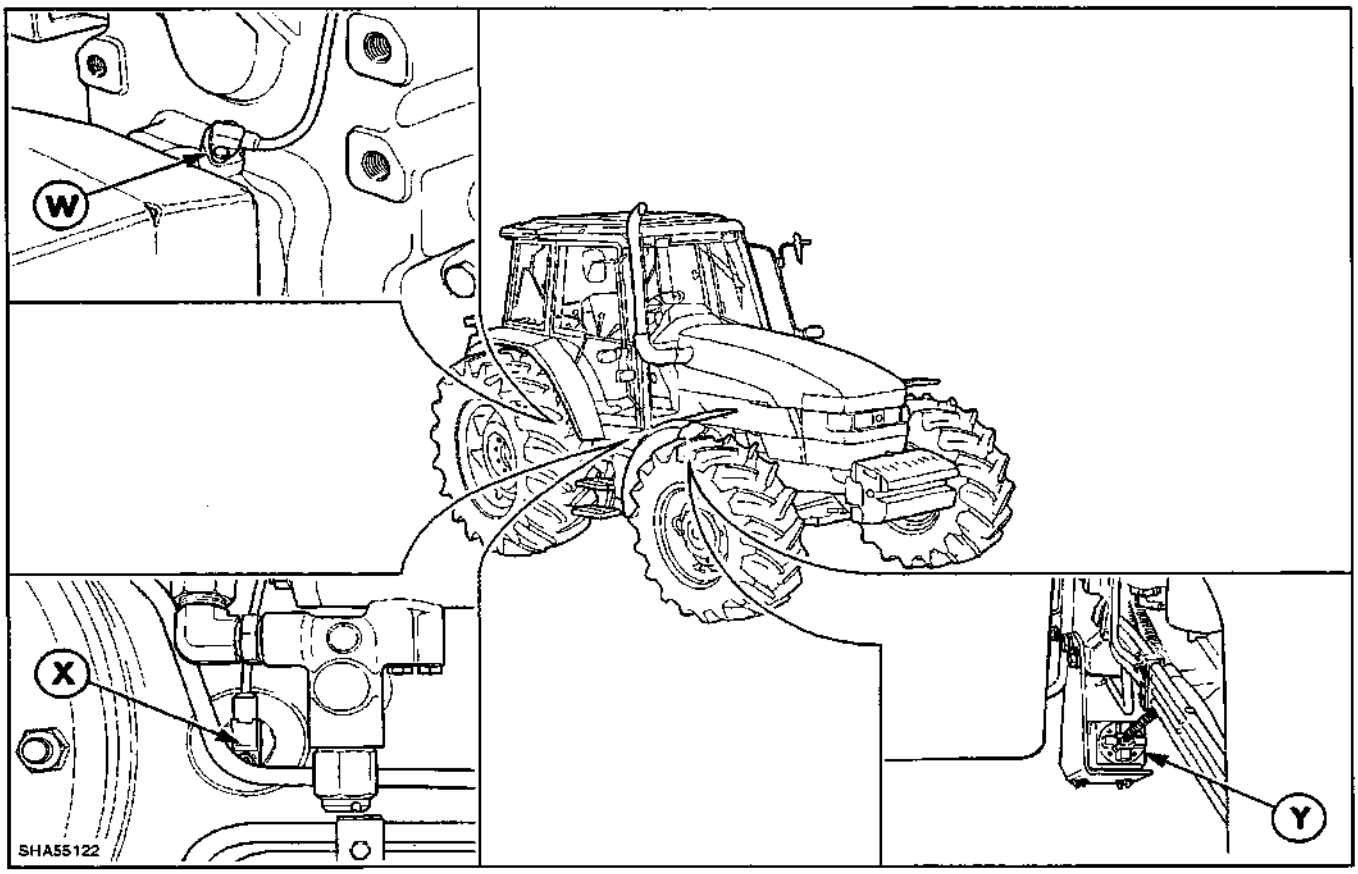


Figure 2-3-20

W. PTO SPEED SENSOR
Sensor output modulates as signal voltage to the instrument cluster to display PTO speed.

X. TRANSMISSION SPEED SENSOR
Senses transmission output (wheel) speed and generates a signal for cluster ground speed display, distance displays, and to compute area accumulations.
When a radar is fitted the transmission speed sensor is used only to compute % slip display.

Y. RADAR SENSOR (Optional)
Senses true ground speed and generates a signal for cluster ground speed, % slip, distance displays and to compute area accumulations.

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SERVICE ALERT SETUP

The next service alert is indicated by the hourmeter symbol flashing for up to 10 hours when the service is due.

The warning can be cancelled by pressing the hourmeter and ground speed function buttons together.

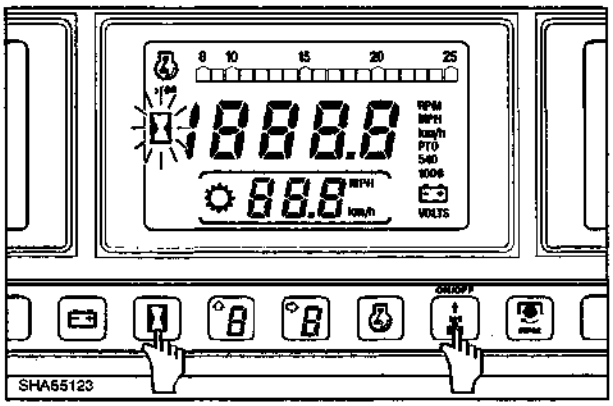


Figure 2-3-21

To enter the program, turn key-start switch on, but do not start the engine. Press and hold the hour function button for 3 seconds, (1) Figure 2-3-23.

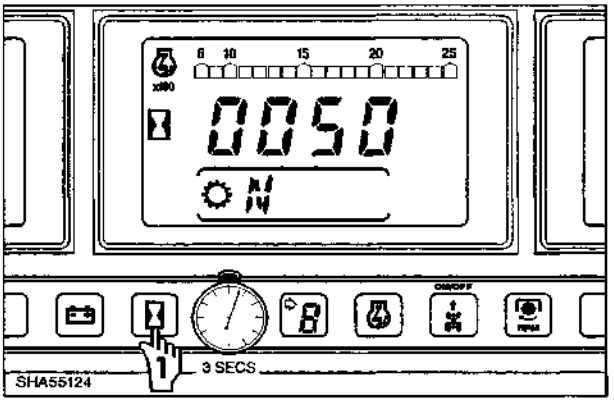


Figure 2-3-22

To program the next service alert use the digit set (3) and digit select, (2) Figure 2-3-24, function buttons.

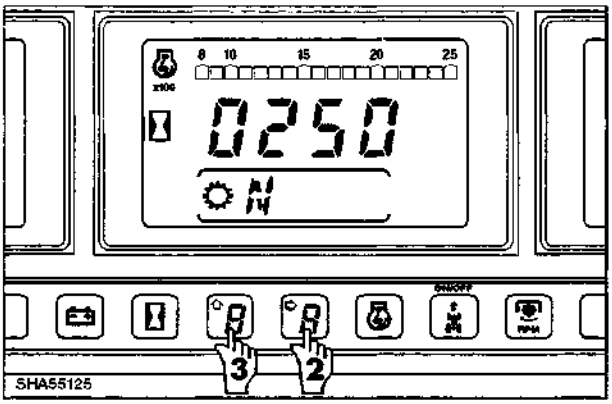


Figure 2-3-23

GROUND SPEED CALIBRATION SETUP

Ground speed calibration number is related to the rear wheel rolling radius (under load) for tractors less Radar. The calibration number is programmed into the center display using digit select and set buttons.

To enter this mode, turn key-start switch on and hold down the ground speed button, (1) Figure 2-3-24, for 4 seconds. Use the digit set (2) and digit select (3) to reprogram the rolling radius.

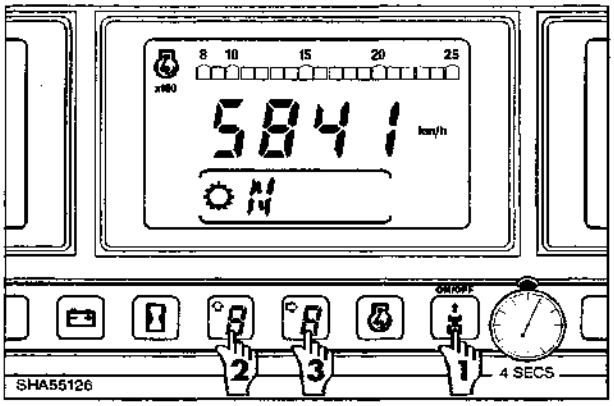


Figure 2-3-24

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For tractors with Radar the calibration number is 4018.

Should tires of a different size be fitted, then the computer module may be recalibration to display a more accurate ground speed

Using the table select the required calibration number.

Rolling Radius		Calibration Number	
in.	mm	8160, 8260, 8360 with 17F/18F x 6R Transmission	All other Transmissions and Models
29.0	737	8873	7986
29.5	749	8731	7858
30.0	762	8582	7724
30.5	775	8438	7595
31.0	787	8310	7479
31.5	800	8175	7357
32.0	813	8044	7240
32.5	826	7917	7126
33.0	838	7804	7024
33.5	851	7685	6916
34.0	864	7569	6812
34.5	876	7465	6719
35.0	889	7356	6621
35.5	902	7250	6525
36.0	914	7155	6440
36.5	927	7055	6349

ALTERNATIVE CALIBRATION PROCEDURE

Start engine and enter ground speed calibration mode.

Measure suitable 122 m (400 ft) course. Drive over course, touch speed button at start and end of course.

Number displayed is new CALIBRATION number, turn off Key Start switch to enter into memory.

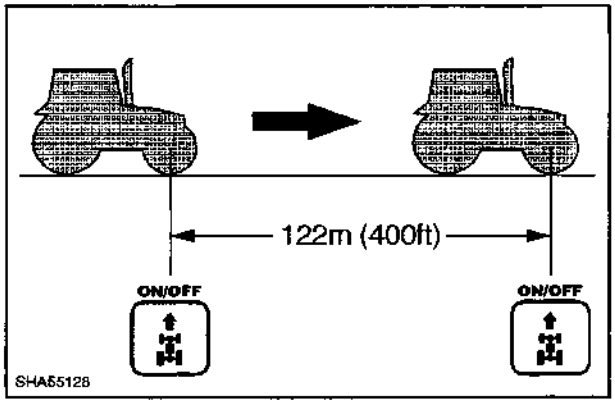


Figure 2-3-25

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TRACTOR PERFORMANCE MONITOR SETUP

1 IMPLEMENT WIDTH

Hold Set Up button to enter programming mode and display implement width.

Use digit select and digit set buttons to revise width setting.

Units:
M = metric ; FT = imperial

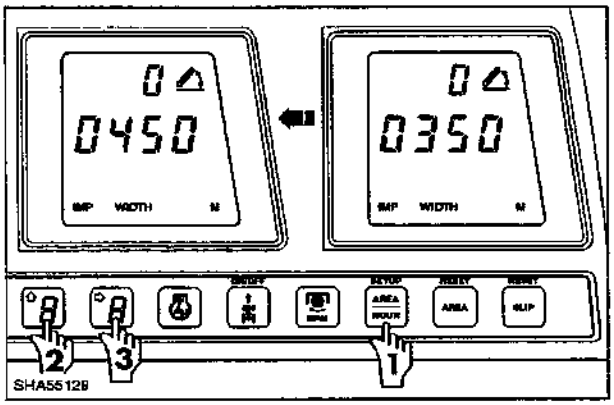


Figure 2-3-26

2 SLIP ALARM

Touch Set Up button to display slip alarm* setting (where Radar fitted).

Use digit set and select buttons to revise slip alarm setting.

Set display to '0' '0' if alarm not required.

*Units without Radar will show AREA PRESET.

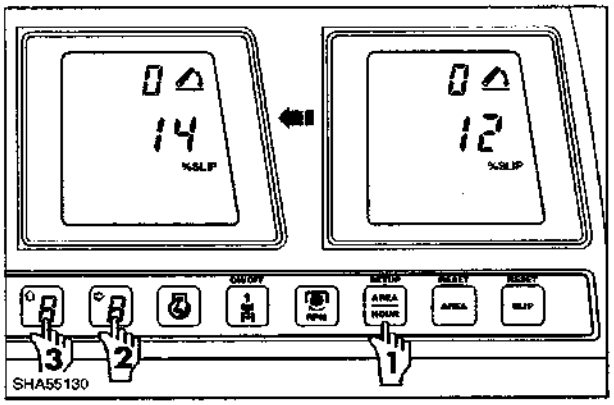


Figure 2-3-27

3 AREA PRESET

Touch Set Up button to display area accumulation reading.

Use digit select and set buttons to preset area reading.

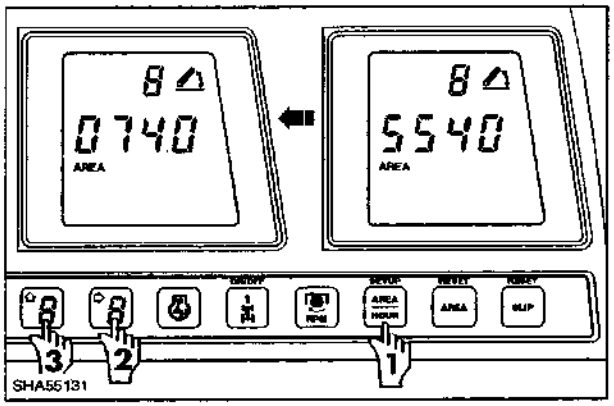


Figure 2-3-28

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TRACTOR PERFORMANCE MONITOR SETUP

4 DISTANCE MEASUREMENT

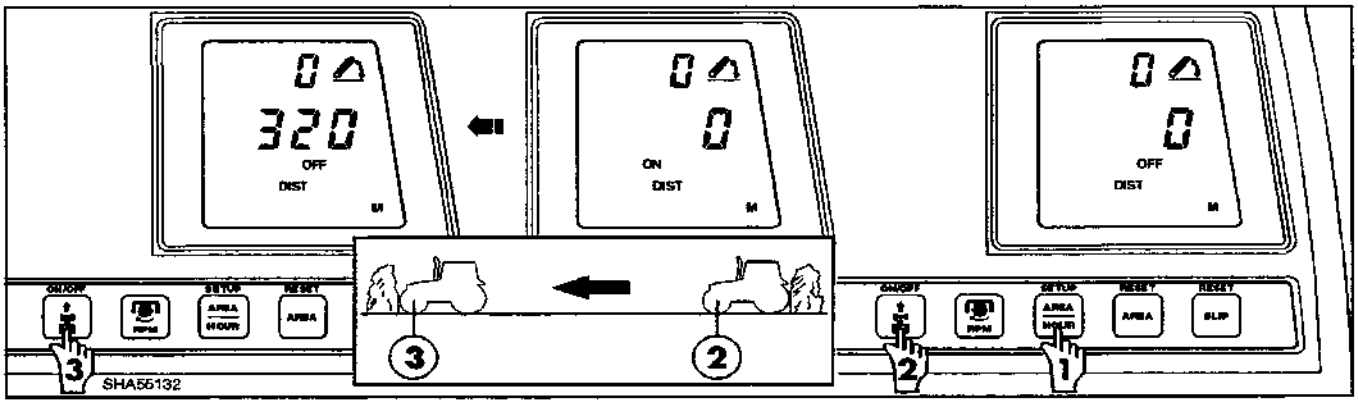


Figure 2-3-29

Touch Set Up button to enter distance measuring mode.

(M or FT will be displayed indicating metric/imperial units).

To measure travelled distance in this mode use ON/OFF switch to start and stop display.

5 SETTING METRIC OR IMPERIAL UNITS

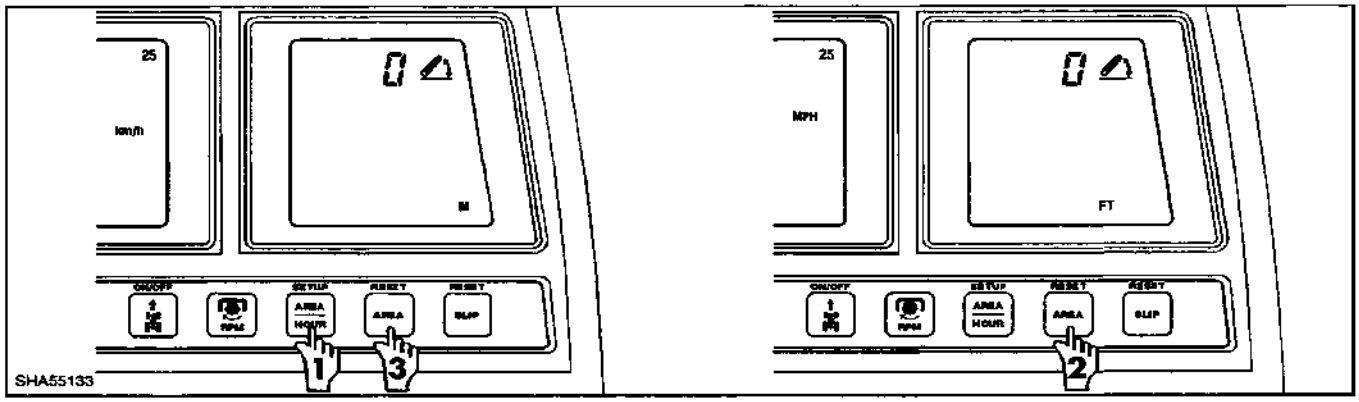


Figure 2-3-30

Touch Set Up button to display units 'M' or 'FT'.

Touching either reset button will change the units displayed.

To exit programming mode hold down Set Up button until the display changes to AREA/HOUR display.

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EIC SERVICEABILITY

Removing Electronic Instrument Cluster

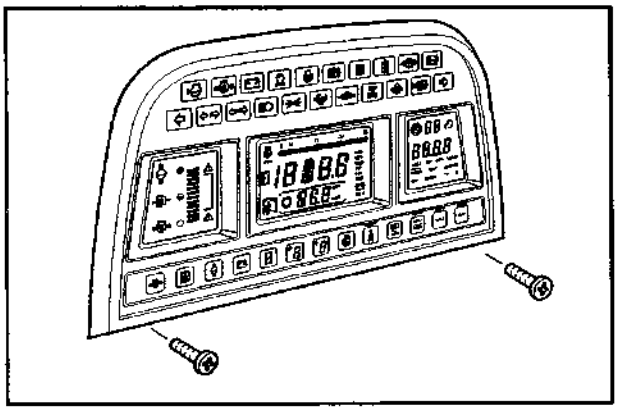


Figure 2-3-31

Rear Cover removed

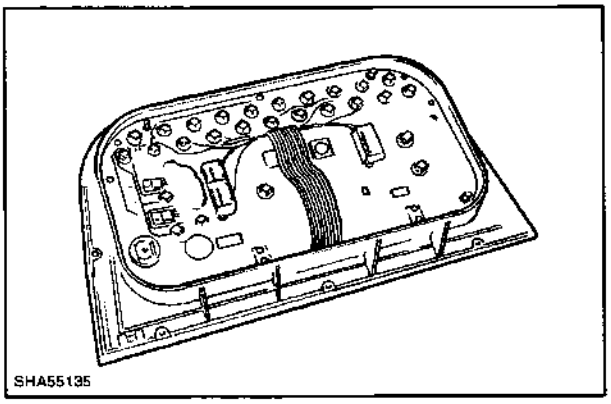


Figure 2-3-32

Bulb replacement

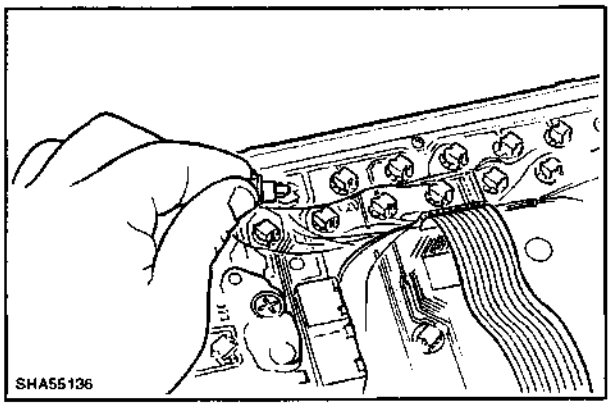


Figure 2-3-33

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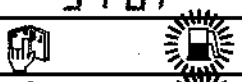
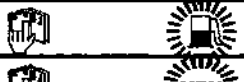
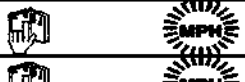
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FAULT CODE CHART

ERROR CODES

The Electronic Instrument Cluster (EIC) features an integral fault diagnosis system which displays error codes on the LCD as shown in the following Table.

These error codes appear when any one of the listed errors occurs. The alarm sounds continuously for a critical alarm and for 5 seconds with a non critical alarm.

SENSOR CONDITION	EIC DISPLAY		ALARM
	Less than 500 rev/min Error Code No.	More than 500 rev/min	
Oil Sender Short to Ground/Open Circuit	1	STOP	Critical
Oil Sender Short to a +ve Voltage	2	STOP	Critical
Fuel Sender Short to Ground	3		Non Critical
Fuel Sender Open Circuit or Short to a +ve Voltage	4		Non Critical
Axle Sender Short to Ground	5		Non Critical
Axle Sender Open Circuit or Short to a +ve Voltage	6		Non Critical
Coolant Temperature Sender Short to Ground	7	STOP	Non Critical
Electronic Draft Control error Serial Link Failure	8		
Transmission error Serial Link Failure	9		
Battery Calibration error	10		
Slip Alarm, Slip constant, Width and Service Hours check	11		Non Critical
Coolant Temperature Sender open circuit or shorted to a +ve Voltage	12	STOP	Critical
Engine Shutdown error	13		

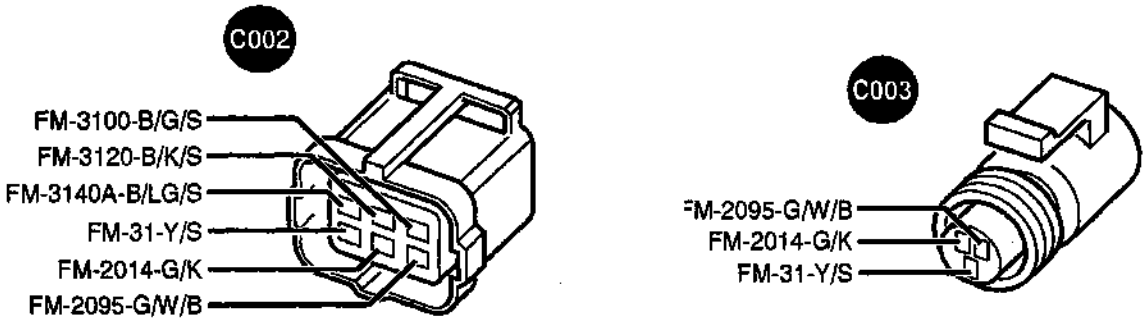
Non EIC Errors – only displayed in the Diagnostic Memory.

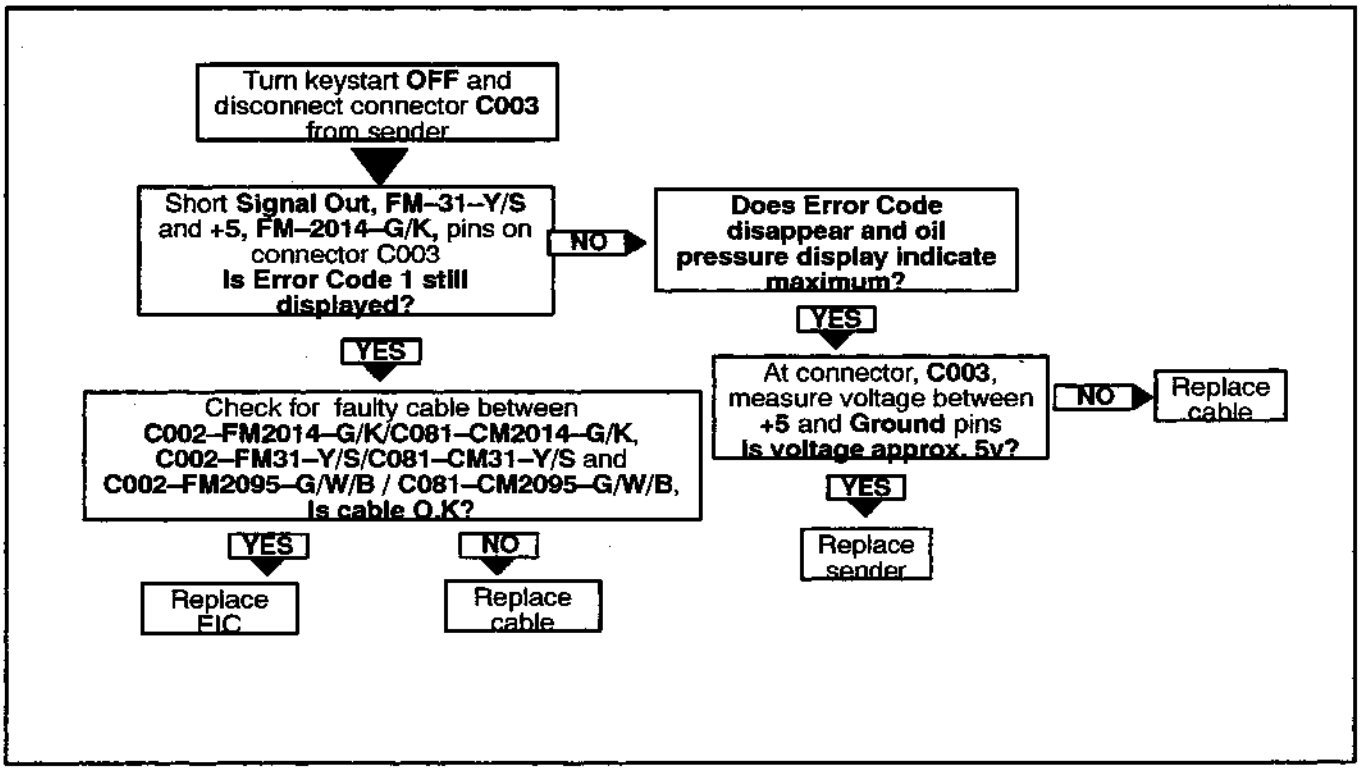
Read Your Manual (RYM)

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ERROR CODE 1 – Engine Oil Pressure Sender Short or Open Circuit

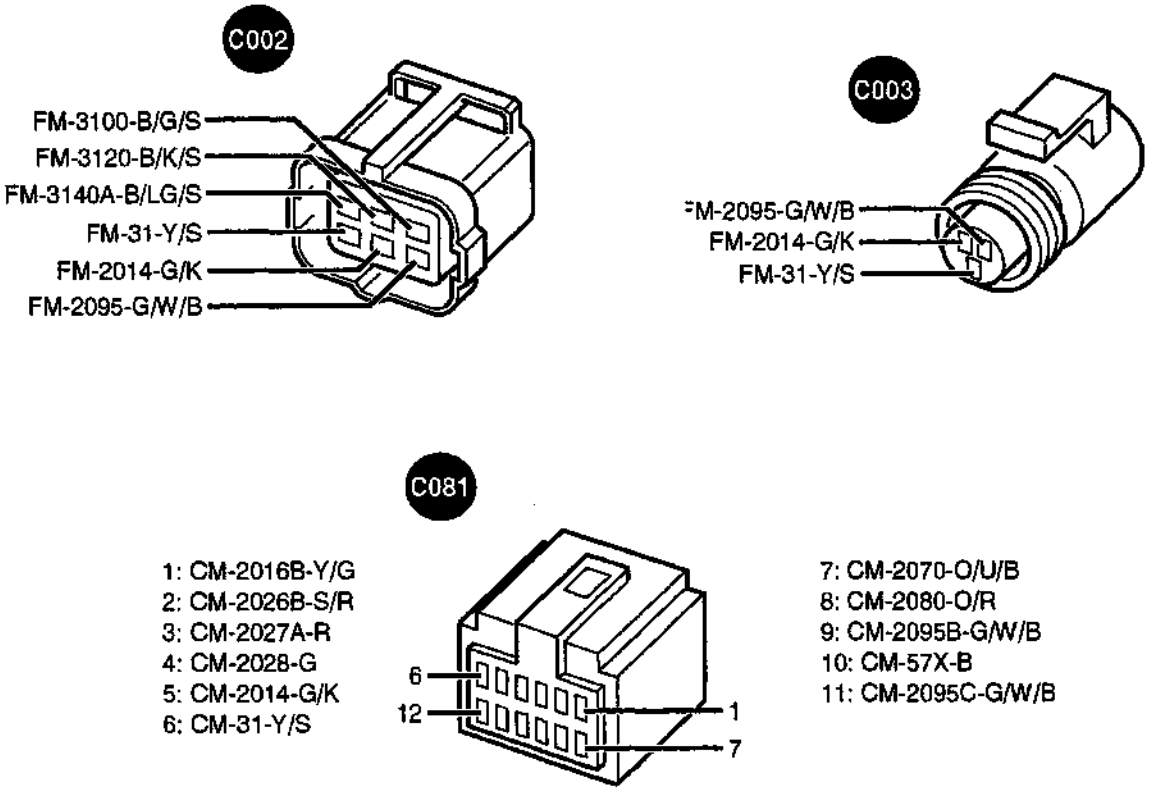


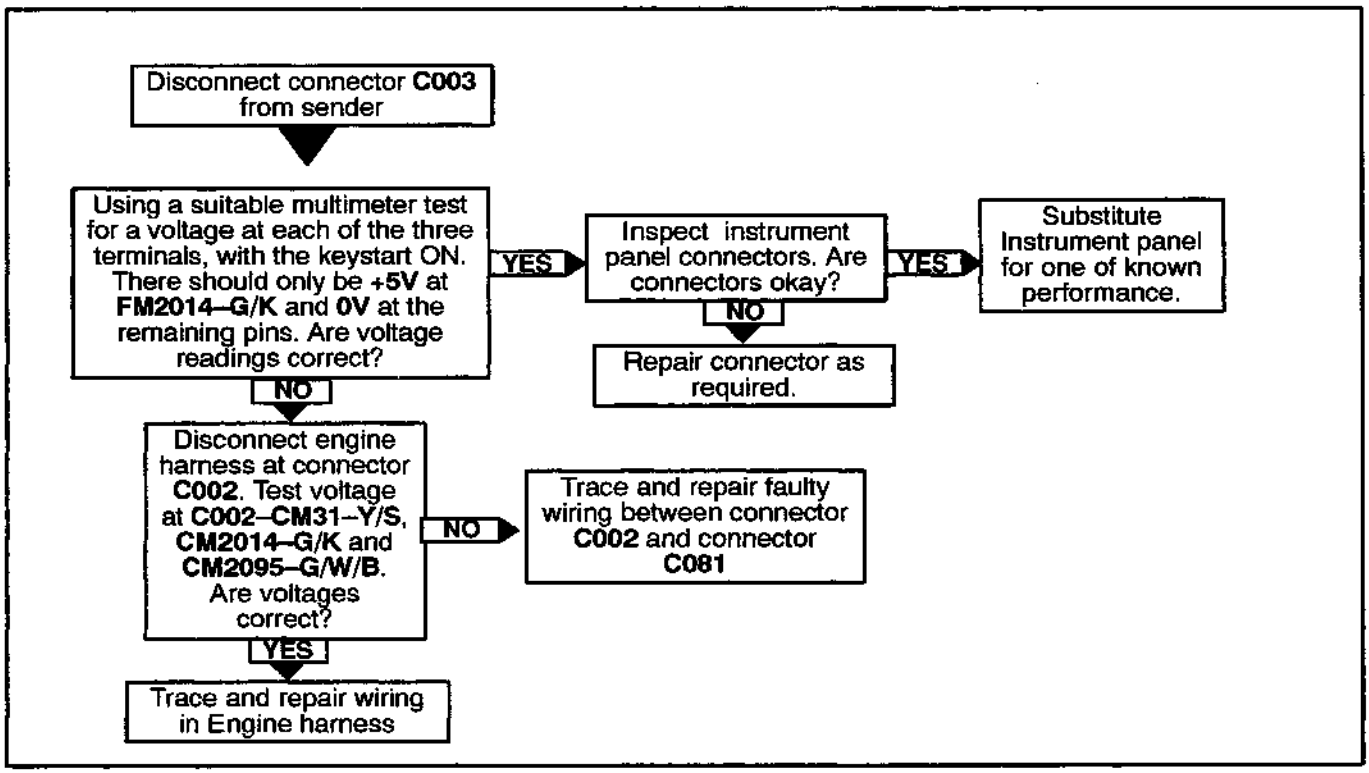


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ERROR CODE 2 – Engine Oil Pressure Sender Short to +ve Voltage

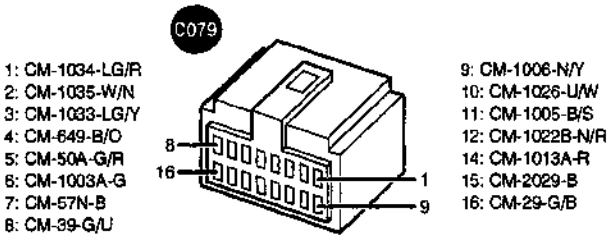


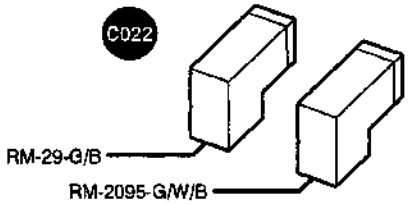


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ERROR CODE 3 – Fuel Tank Level Sender Short to Ground
ERROR CODE 4 – Fuel Tank Level Sender Open Circuit or Short to +12V





Inspect level sender, are the connectors on the terminals clean and tight?
- NO → Repair/replace and recheck
- YES ↓

Disconnect wires from sender unit and connector **C079** from the instrument panel. With a suitable multimeter, check **C022–RM2095–G/W/B** to ground. Is resistance **<10Ω** ?
- NO → Locate and repair open circuit in sender ground wire
- YES ↓

Check the terminals of the sender to ground. Is a short to ground indicated on either terminal?
- YES → Remove sender, repair/replace and ensure there is no short to ground on reassembly
- NO ↓

Check the operation of the sender. Is the resistance within the range: Full 30Ω and Empty 250Ω ?
- NO → Renew sender
- YES ↓

Check **C022–RM29–G/B** to ground. Is a short to ground indicated?
- YES → Trace and repair fault in wiring
- NO ↓

Check between **C022–RM29–G/B** and **C079–16**. Is resistance **<10Ω** ?
- NO → Trace and repair open circuit fault in wiring
- YES ↓

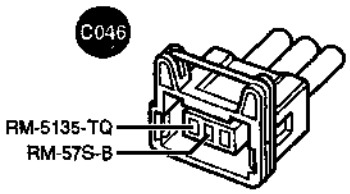
Inspect instrument panel connectors. Are connectors okay?
- YES → Substitute instrument panel for one of known performance and recheck.
- NO ↓

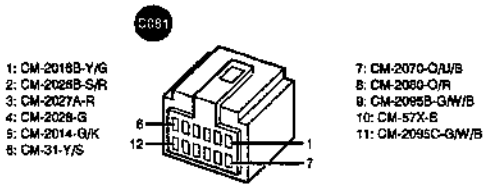
Repair connector as required.

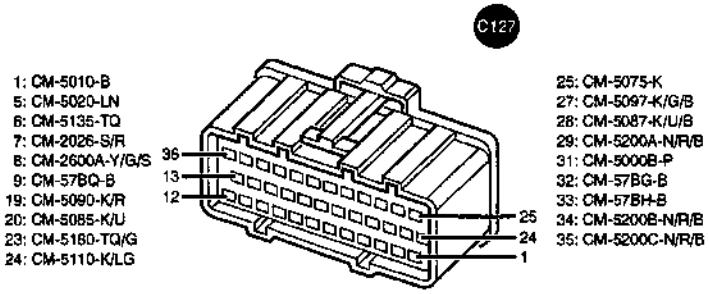
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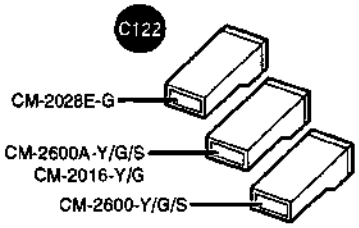
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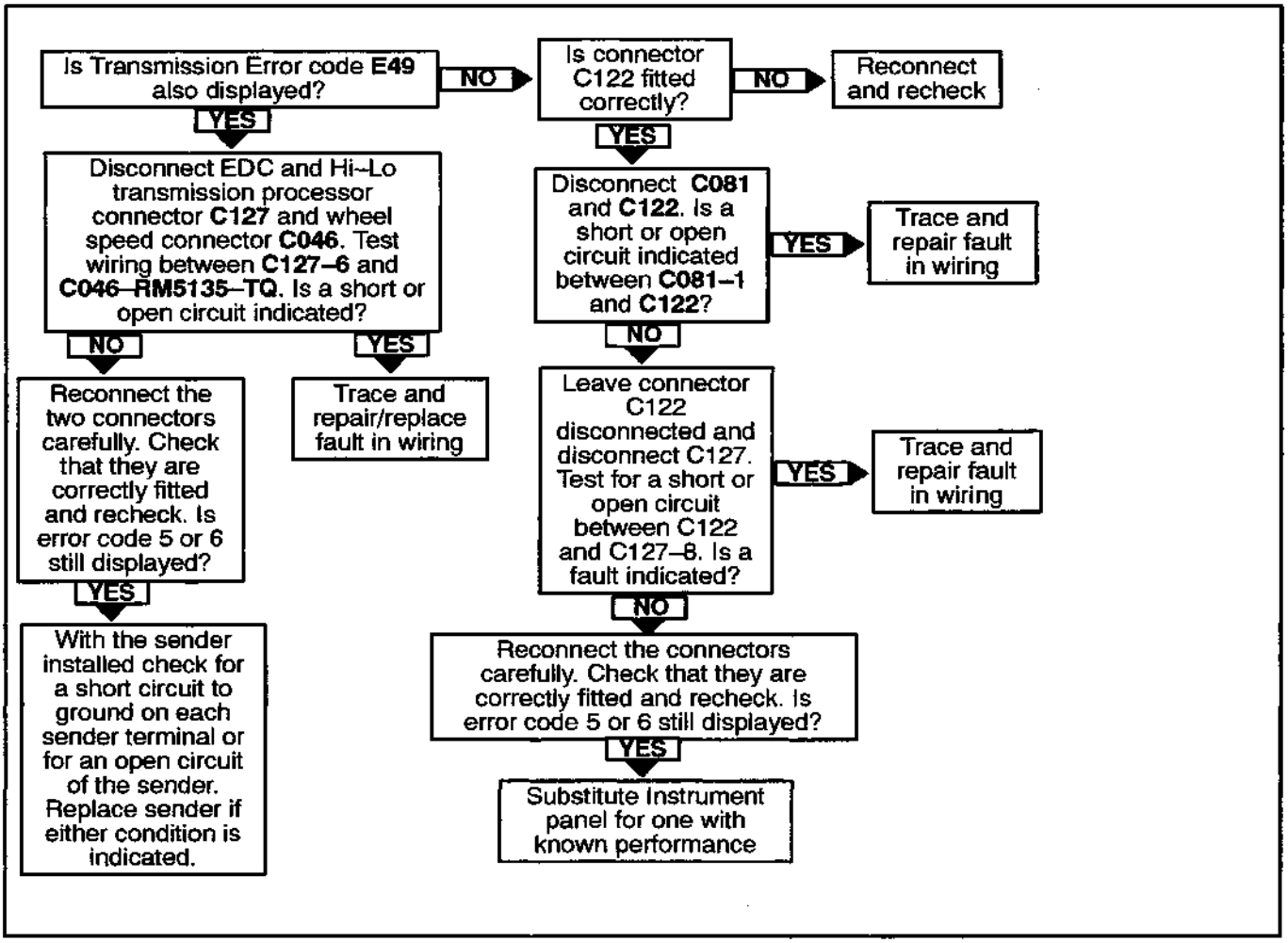
ERROR CODE 5 – Axle Speed Sender Short Circuit
ERROR CODE 6 – Axle Speed Sender Open Circuit







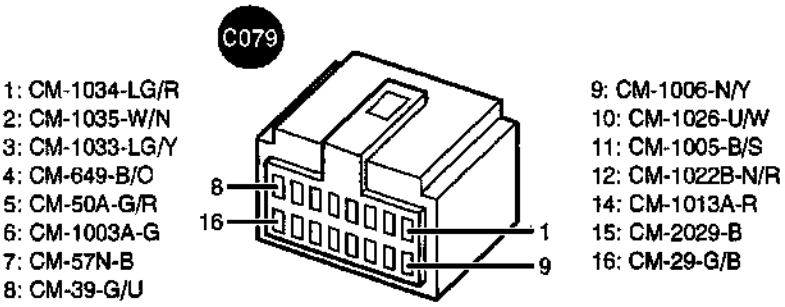


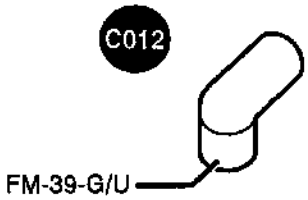


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ERROR CODE 7 – Coolant Temperature Sender Short Circuit





Remove the connector, **C012,** from the sender. Ensure the end of the wire is not contacting any metallic part. Turn keystart ON, engine OFF
Is Error Code 7 displayed?

NO → Renew sender and recheck function.

YES

Remove the instrument panel, disconnect plug **C079**. Disconnect the signal wire from the sender. Measure the resistance between pins **C079–CM39–G/U** and **C079–CM57N–B**
Is the resistance less than 5000Ω?

YES → Locate and repair short circuit in signal wire

NO

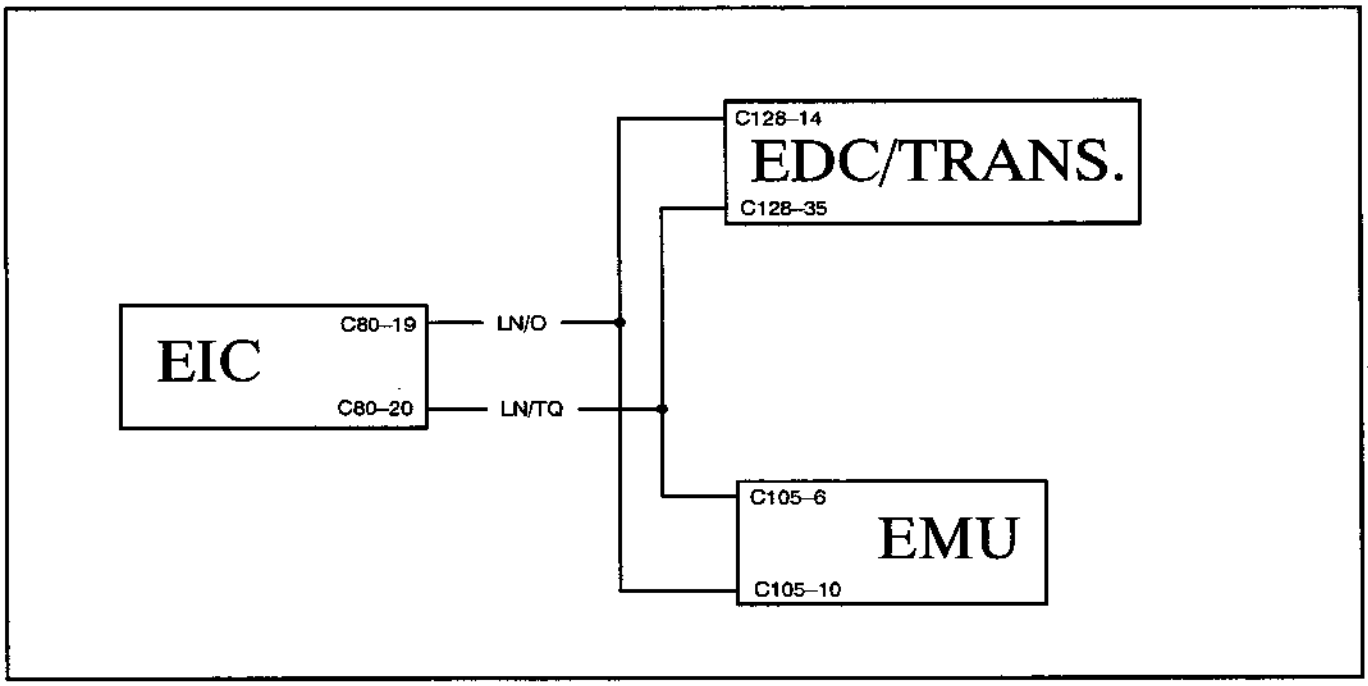
Replace instrument cluster with one of known performance

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ERROR CODE 8 (EDC serial link failure) and 9 (transmission serial link failure) – Communications Error

The Electronic Management Unit module and the combined Electronic Draft Control and Hi–Lo Transmission control module send their display information over a two wire serial communications connection.
Communications errors (8&9) occur when the message received by the instrument panel is not correct. This can be caused by an intermittent connection on the signal wires (LN/O or N/R/B). If these errors are accompanied by reports of intermittent or blank displays in the transmission or hitch position areas, then the circuit wires should be investigated for open circuits, short circuits and intermittent connections.



ERROR CODE 10 – Memory Retention Error of Battery Calibration Constant

Compare the voltage display of instrument panel to a voltmeter reading at the battery. If the readings differ by more than 2.0 volts, then install a new instrument panel and recheck.

ERROR CODE 11 – Memory Retention Error of Operator Setting for Slip Alarm, Slip Zero Reference Constant, Implement Width and Service Hours

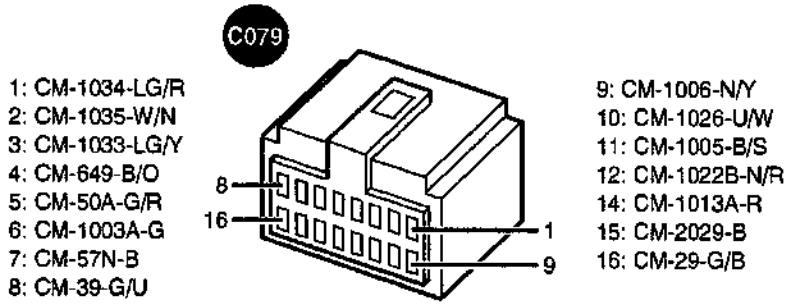
If Error Code 11 persists then replace the instrument panel.

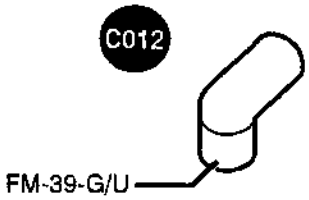
Re–program the constants listed above using the instructions detailed earlier in this Section. Turn keystart OFF and re–check the programmed values. If the values are not correct then replace the instrument panel

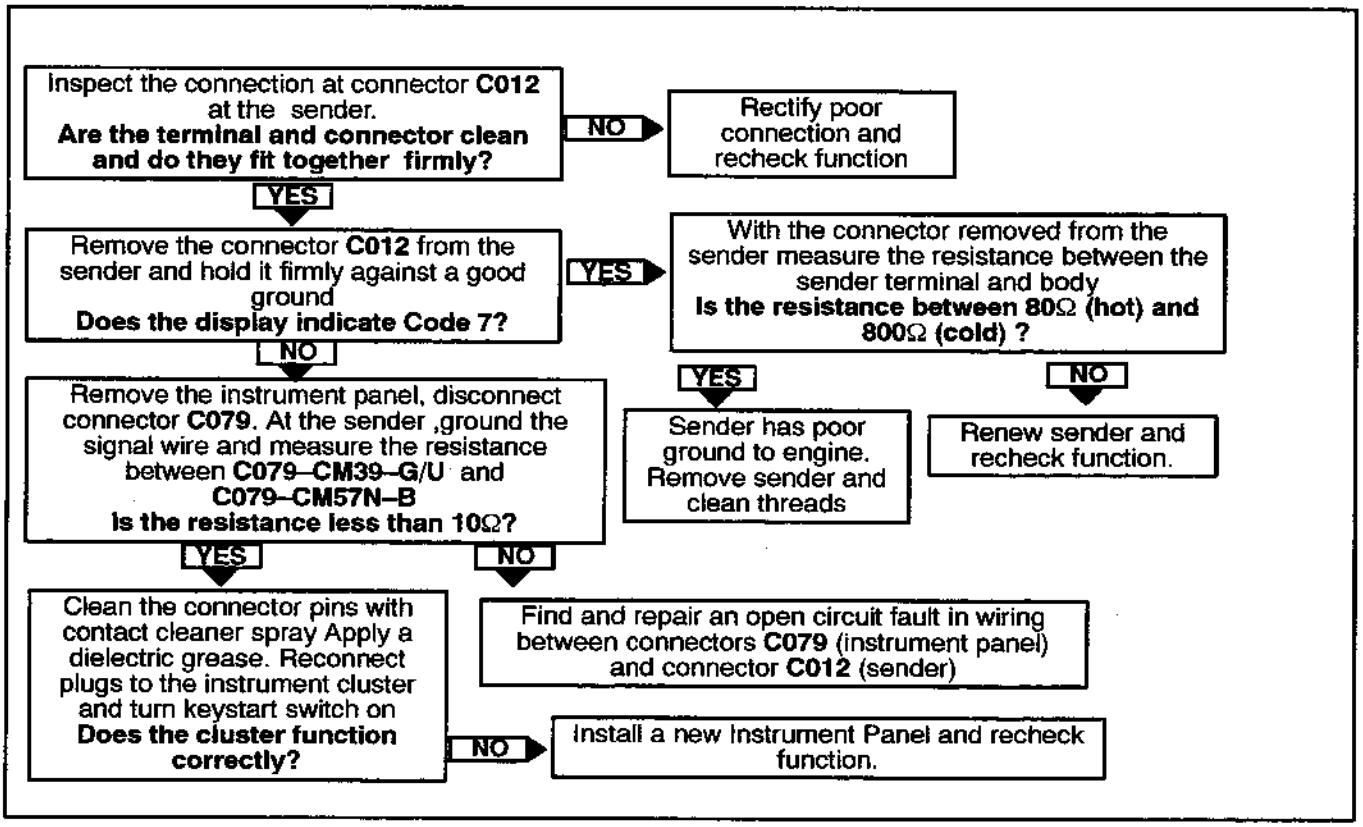
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ERROR CODE 12 – Coolant Temperature Sender Short Circuit



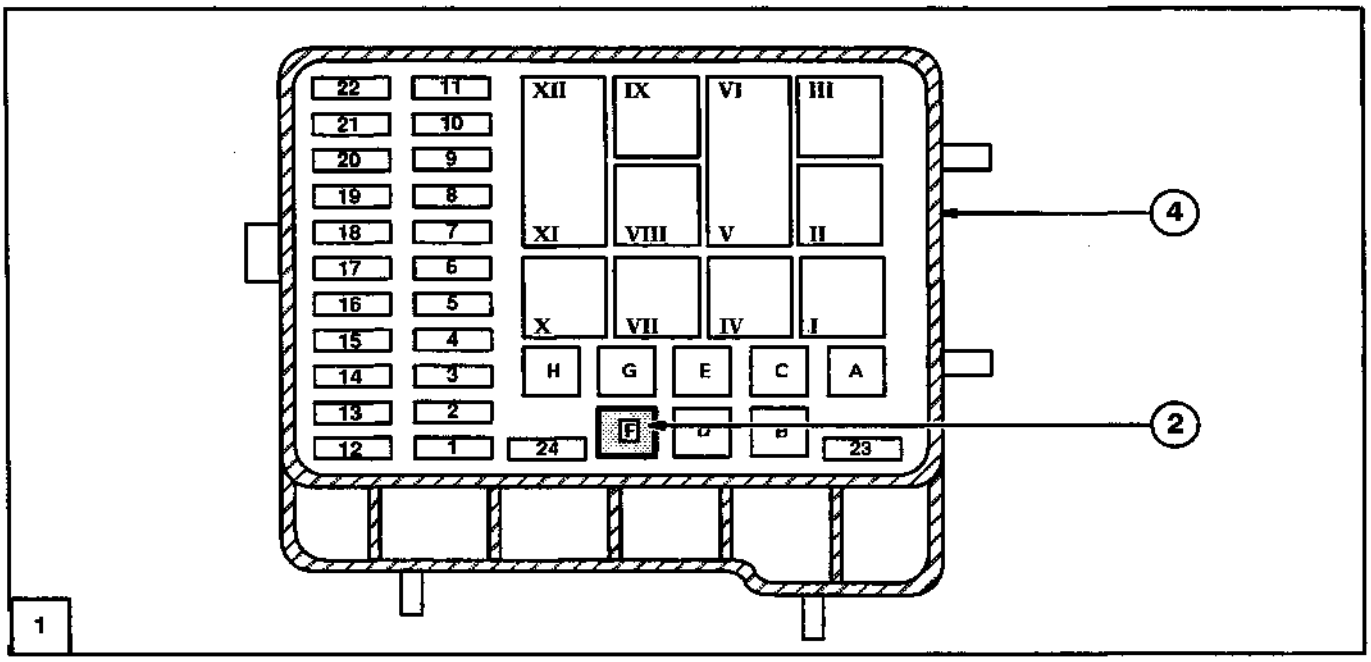




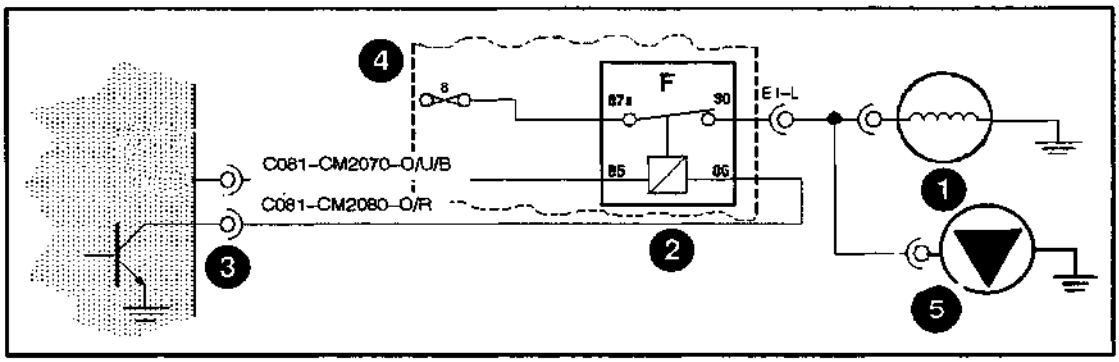
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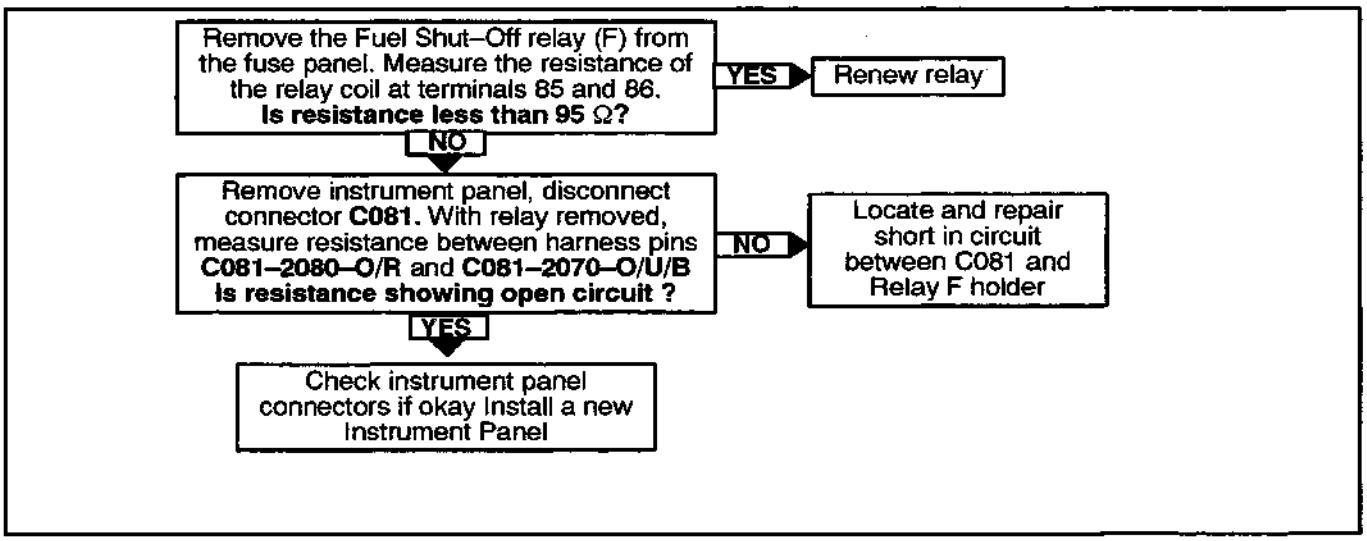
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ERROR CODE 13 – Engine Shut–Down Output Short to a + Voltage



1. Fuel Shut–Off Solenoid
2. Relay 'F'
3. EIC
4. Fuse Panel
5. Fuel Pump

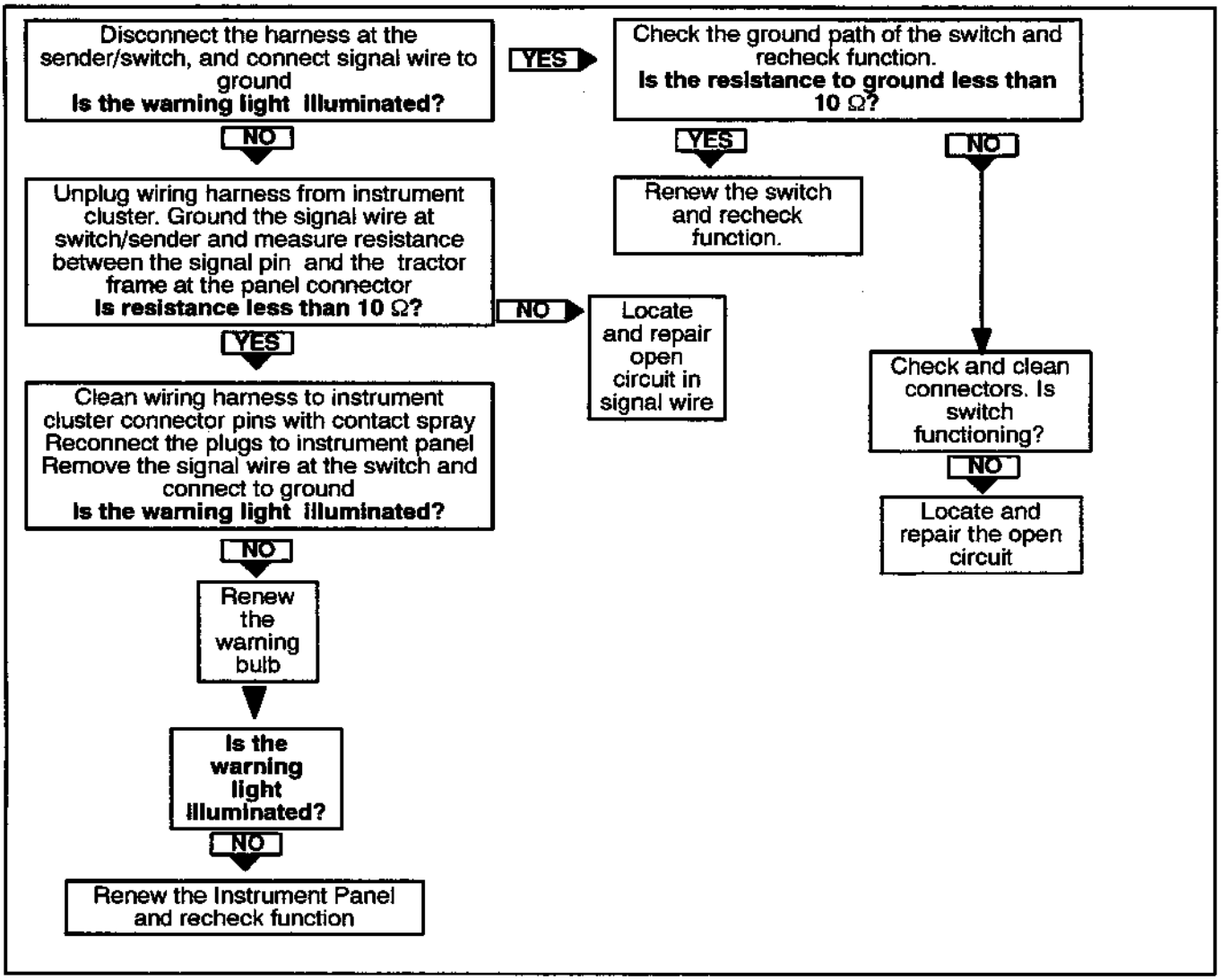




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Common Test Procedure for ALL of the Switch Circuits Connecting to Ground

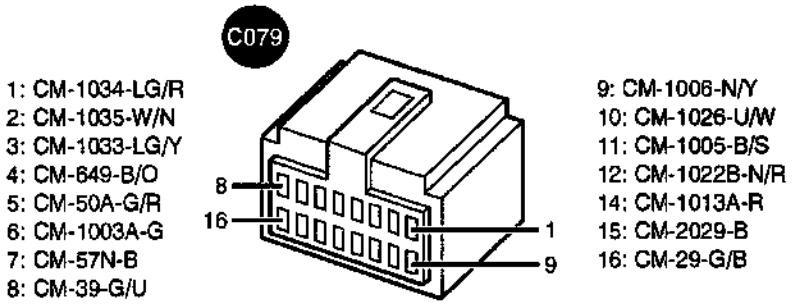


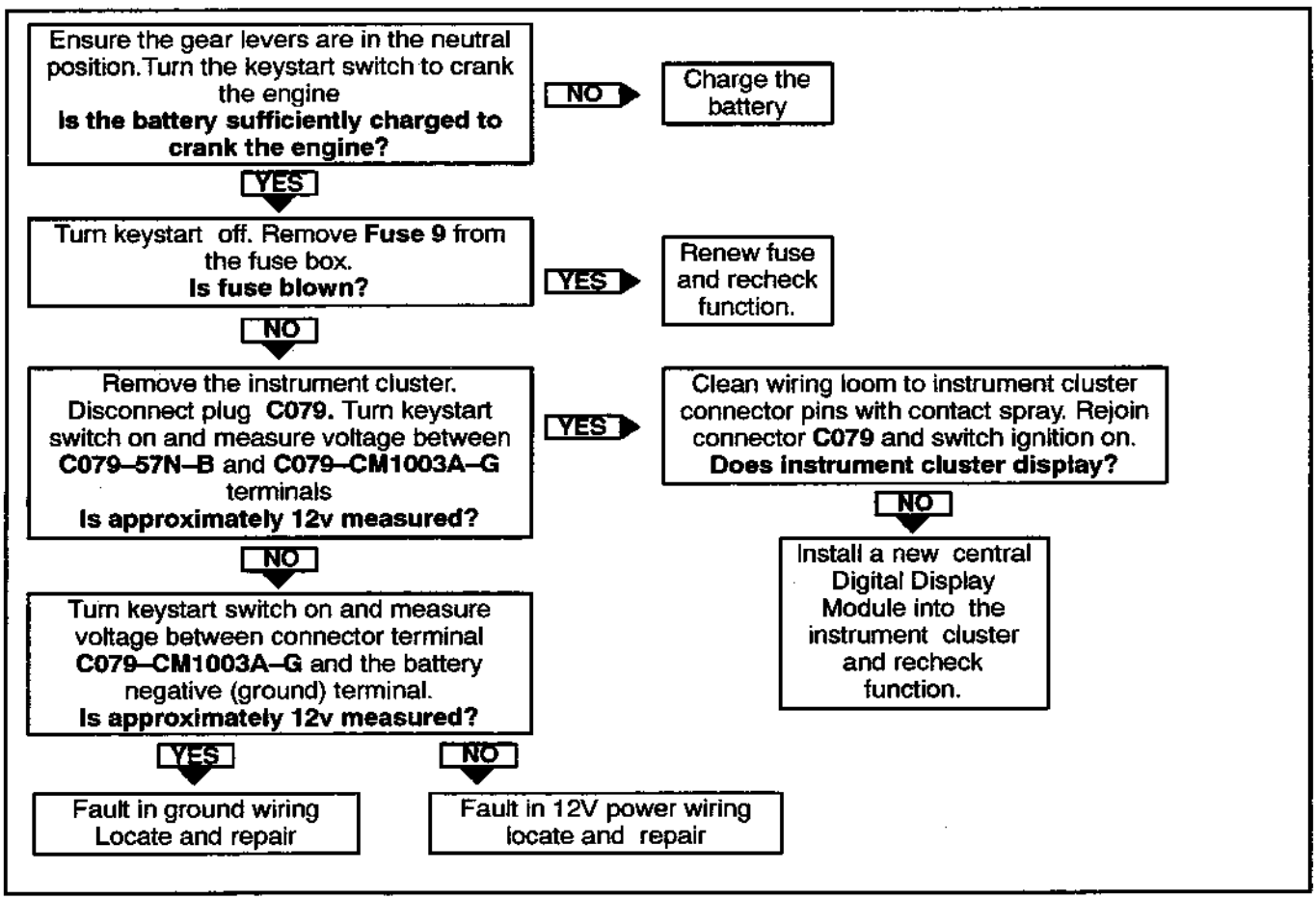
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Instrument Cluster Inoperative

No display on instrument cluster when the keystart switch is turned on.





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DIAGNOSTIC MEMORY

To enter diagnostic memory mode hold down digit set button during key 'ON' and self test sequence.

Touching the digit set button will cycle the display through the memory.

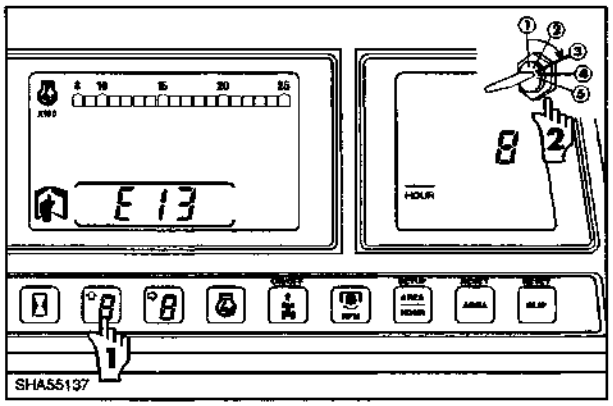


Figure 2-3-34

The error codes will appear on the appropriate display, together with engine hours recorded. Typical examples are illustrated.

NOTE: *Transmission E codes relate only to hi/Lo transmission.*

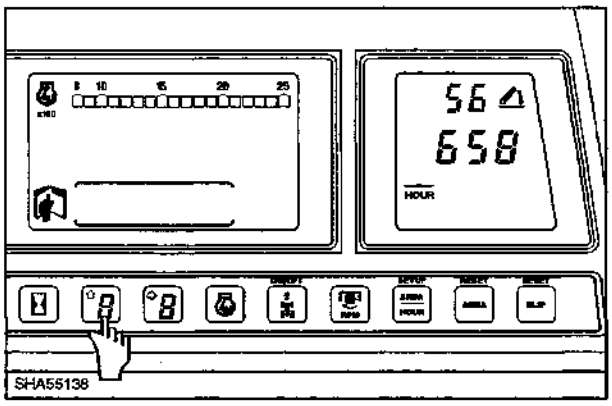


Figure 2-3-35

The memory can be erased by holding down the digit set button for 10 seconds (while in diagnostic memory mode).

To exit mode touch any other display and function button.

The cluster stores up to 10 diagnostic error codes in a permanent memory. The stored 'Services History' can be displayed by entering the Diagnostic Memory Mode.

When in this mode, touching the digit set button will cycle the display through the stored memory.

When 10 error codes are already stored, further error codes occurring will cancel the oldest error code in the memory or update the hours if that code is already stored.

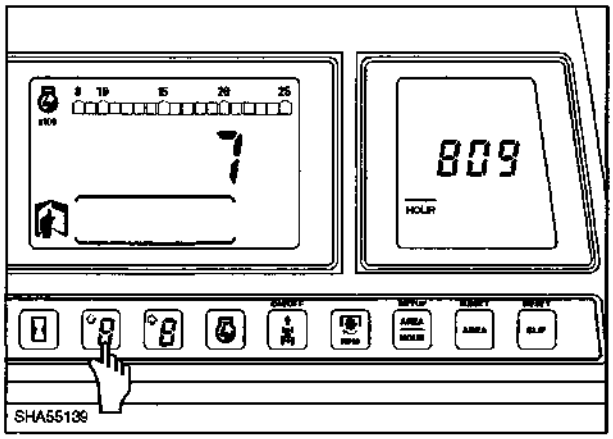


Figure 2-3-36

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INSTRUMENT PANEL BYTE LEVELS

To set bytes, press and hold the battery function button and turn key to ON (Engine off). The display will show

'0' '7'
'7' = Byte number
'0' or '1' = Function

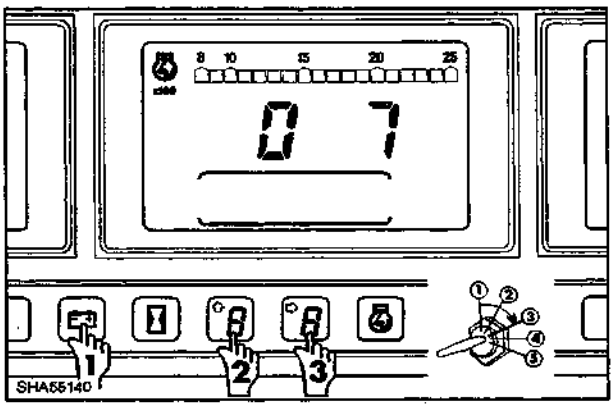


Figure 2-3-37

Use the DIGIT SELECT function switch to select next Byte (15 – 0).

Use the DIGIT SET function switch to select function of Byte ('0' or '1').

BYTE No.

7, 6	EDC Gain – Both should be switched to '0'.
5, 4	Reserved – No effect whether switched to '0' or '1'.
3, 2	Bar Graph Displays – Both should be switched to '1'.
1	Units : Imperial '1' : Metric '0'.
0	Panel Type – should be switched to '1'.
15, 14, 13, 12, 11, 10	Reserved – No effect whether switched to '0' or '1'.
9	Radar Normally switched to '0' If switched to '1' the Tractor Performance Monitor display will be blank when radar not fitted.
8	PTO Switched to '0'.

Engine Speed Constant	–	depress Engine Speed function switch.
Constant	=	017.1
PTO Speed Constant	–	depress PTO Speed function switch.
Constant 540 PTO	=	1900
Constant 1000 PTO	=	2075

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SECTION 2
ELECTRICAL SYSTEM

CHAPTER 4
ANALOG ELECTRONIC INSTRUMENT CLUSTER

CONTENTS

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SENDERS AND SENSORS 2-4-6
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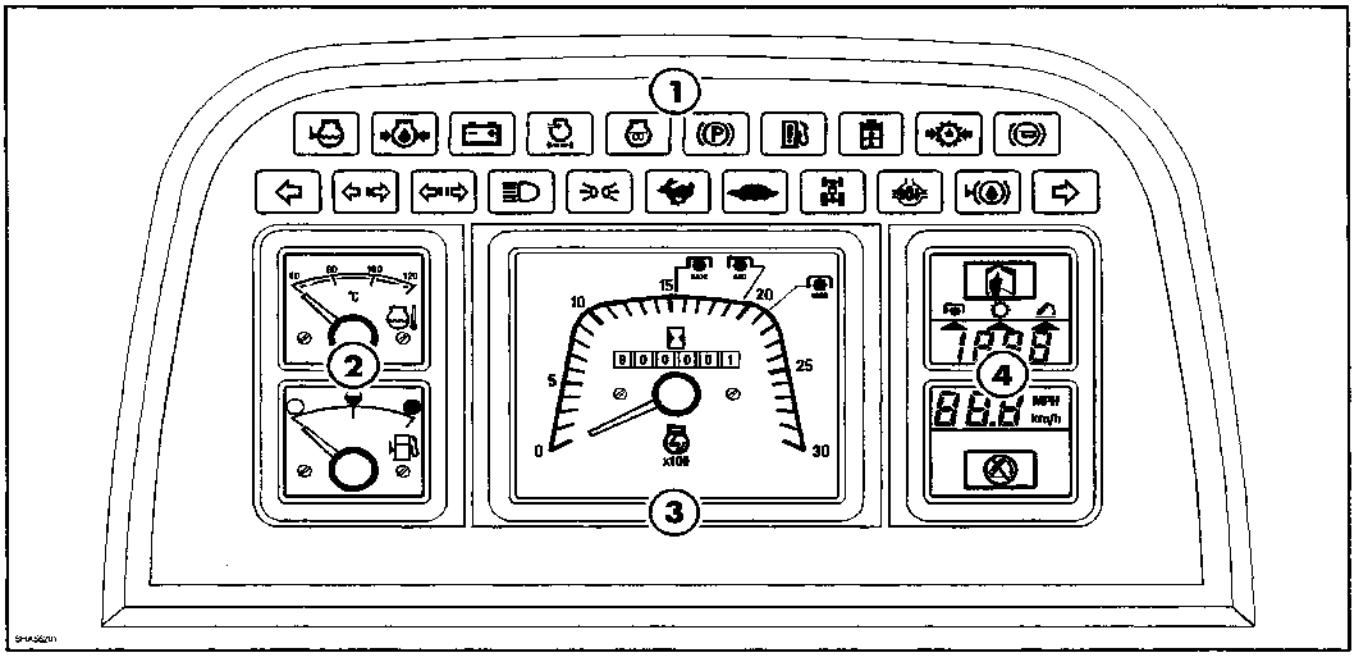


Figure 2-4-1

The Analog Electronic Instrument Cluster consists of four distinct areas:

1. Indicator and Warning Lamps
2. Tractor Condition Gauges
3. Main Tachometer
4. LCD Displays

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AREA 1: INDICATOR AND WARNING LAMPS

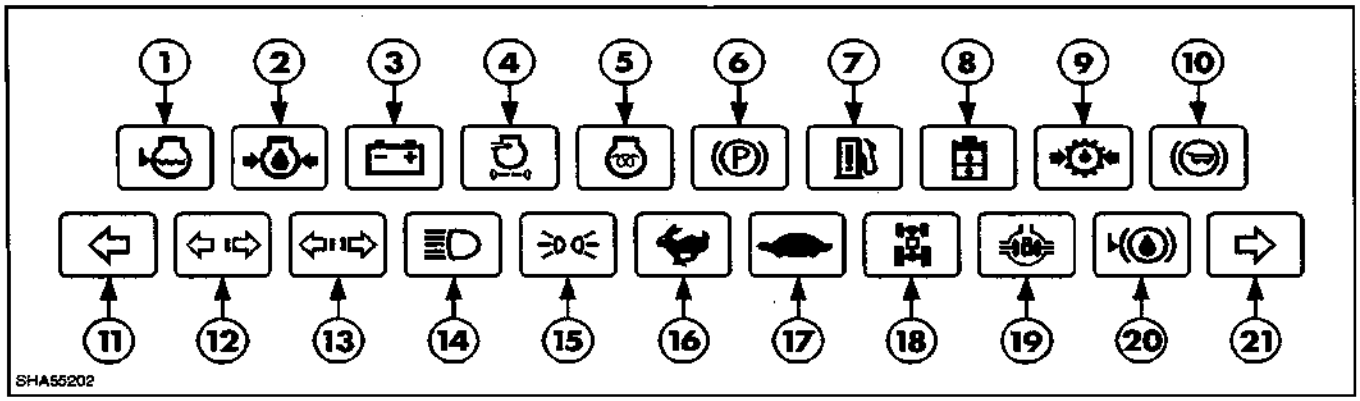


Figure 2-4-2

	Condition	Indicator/Warning Lamp	Audible Alarm
1	Coolant level low	Flashing	Critical
2	Engine oil pressure low	ON	Critical
3	Battery charge low	ON	Non critical
4	Air filter restriction	ON	
5	Thermostat activated	ON	
6	Parking brake on/Key on Parking brake off/Key off	ON None	 2 minutes continuous
7	Water in fuel	ON	
8	Transmission oil filter blocked Charge pressure low	ON Flashing	Non critical
9	Transmission oil pressure low	ON	
10	Trailer brake pressure low	Flashing	
11	Left turn indicator on	Flashing	
12	Single trailer indicator on	Flashing	
13	Second trailer indicator on	Flashing	
14	Headlamp main beam on	ON	
15	Side lights on	ON	
16	Direct drive selected	ON	
17	Under drive selected	ON	
18	Front wheel drive engaged	ON	
19	Differential lock engaged	ON	
20	Brake/clutch fluid low	ON	
21	Right hand indicator on	Flashing	

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AREA 2: TRACTOR CONDITION GAUGES

The Analog panel has two gauges:

Coolant Temperature

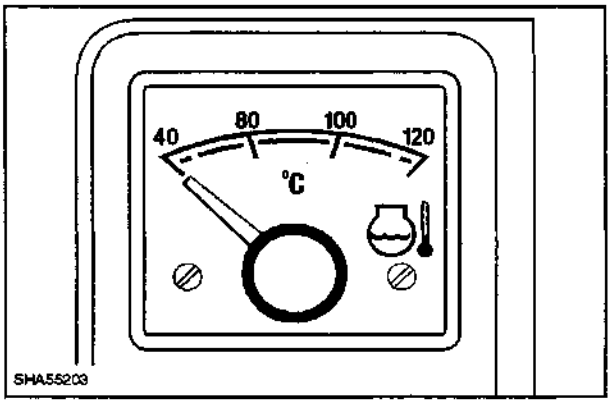


Figure 2-4-3

Fuel Level

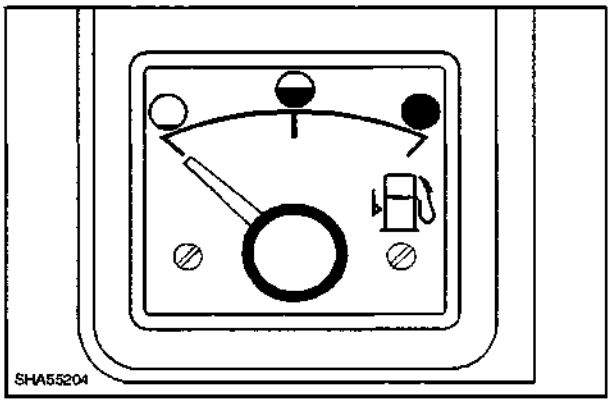


Figure 2-4-4

AREA 3 : MAIN TACHOMETER

The central display is the tachometer showing engine speed and the correct engine speeds for 540/1000 PTO operation, as well as economy 540.

Also in this area is the speedometer for engine hours.

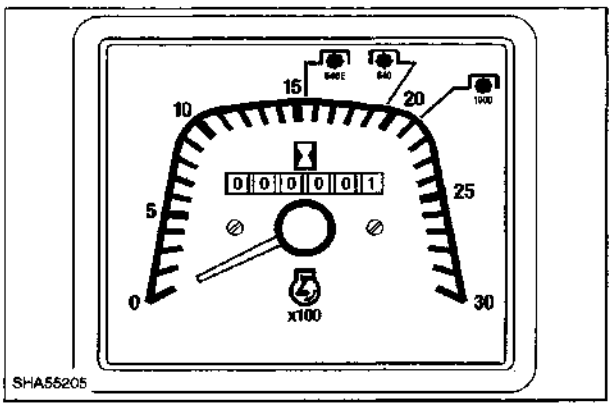


Figure 2-4-5

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AREA 4 : LCD DISPLAYS

Area 4 is the liquid crystal display, which is split into two displays and is also used to display EDC, Electronic Management Unit and Hi/Lo Transmission calibrations.

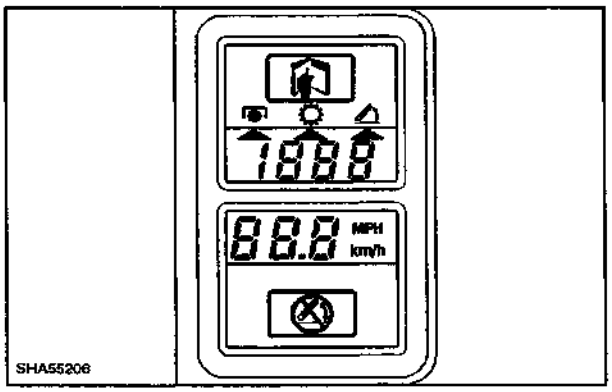


Figure 2-4-6

When the PTO is operated the arrow will point at the PTO symbol to show PTO shaft speed as detected by the sensor.

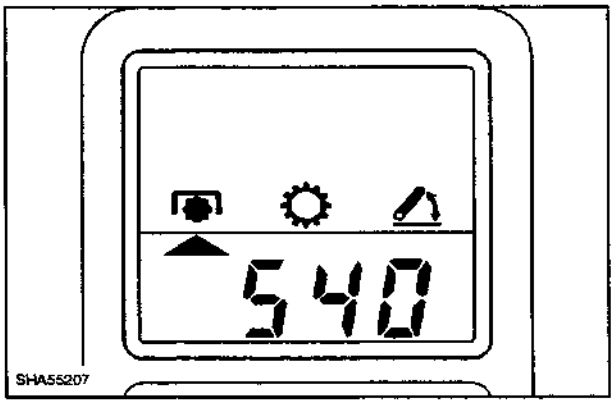


Figure 2-4-7

With the PTO disengaged the arrow will point to the EDC symbol and give the three point hitch linkage position. EDC errors are also displayed.

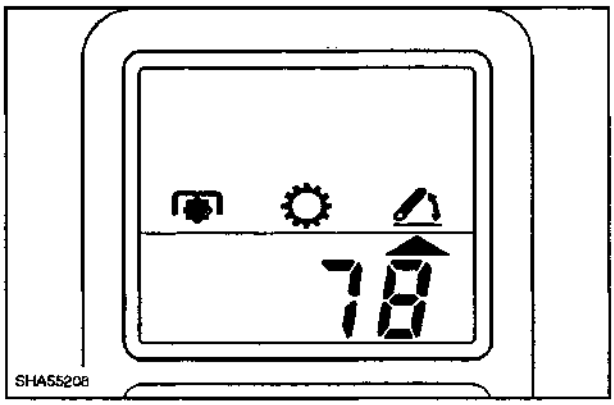


Figure 2-4-8

If the Hi/LO Transmission develops a fault the arrow will be displayed under the transmission symbol and the fault code displayed in the display.

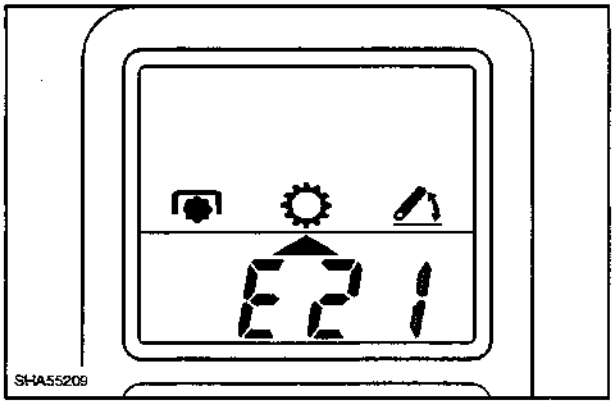


Figure 2-4-9

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SENDERS, SENSORS & SWITCHES

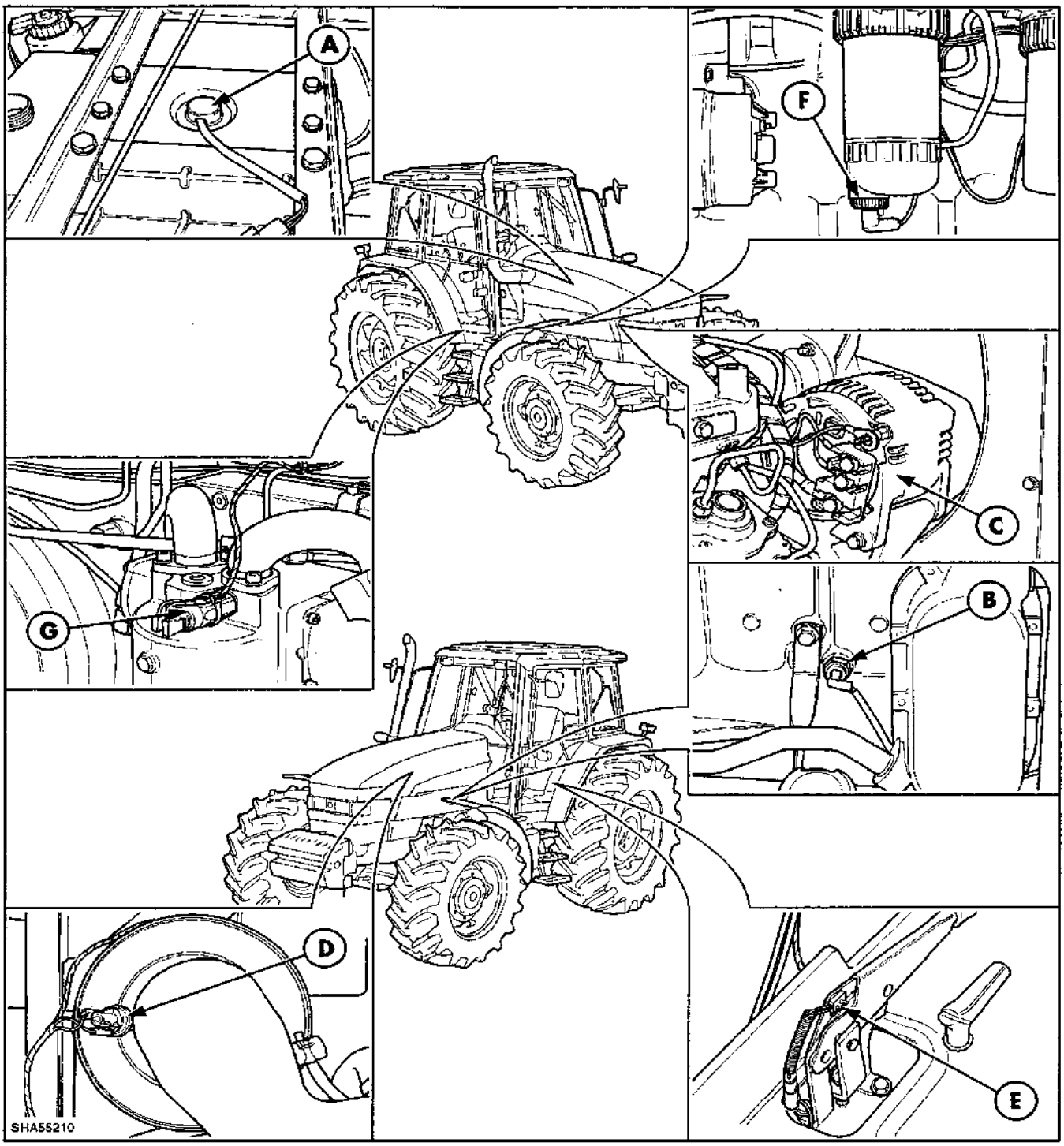


Figure 2-4-10

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SENDERS, SENSORS & SWITCHES

A. ENGINE COOLANT LEVEL SWITCH
Operates as engine coolant level drops to illuminate warning lamp. Uses a normally closed switch.

B. ENGINE OIL PRESSURE SWITCH
Operates as engine oil pressure drops below 0.68 bar (10 lbf/in^2) to illuminate warning lamp. Uses a normally closed switch.

C. ALTERNATOR
Provides a square wave signal of 142.5 – 855.0 Hz (480 – 3060 ERPM) for instrument cluster and microprocessor operations.

D. AIR CLEANER RESTRICTION SWITCH
Operates when the vacuum in the air intake system rises above 46.7 mm Hg (25 in H2O) to illuminate warning lamp. Uses a normally open switch.

E. PARKING BRAKE SWITCH
Switch is closed with parking brake applied, a warning lamp and audible alarm with key switch on.
Sounds an alarm when wheel movement is detected above 0.8 km/h (0.5 mph).
Sounds an alarm for 2 minutes with key switch off and park brake released.
NOTE: *FWD is always engaged when park brake is applied.*

F. WATER IN FUEL
Operates when water is detected in the fuel to illuminate warning lamp.

G. INTAKE FILTER RESTRICTION SWITCH (Open Center System)
Operates as the transmission intake vacuum rises above 406mm Hg (228.8 in H2O) to illuminate warning lamp.
Switch is normally open.

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SENDERS, SENSORS & SWITCHES

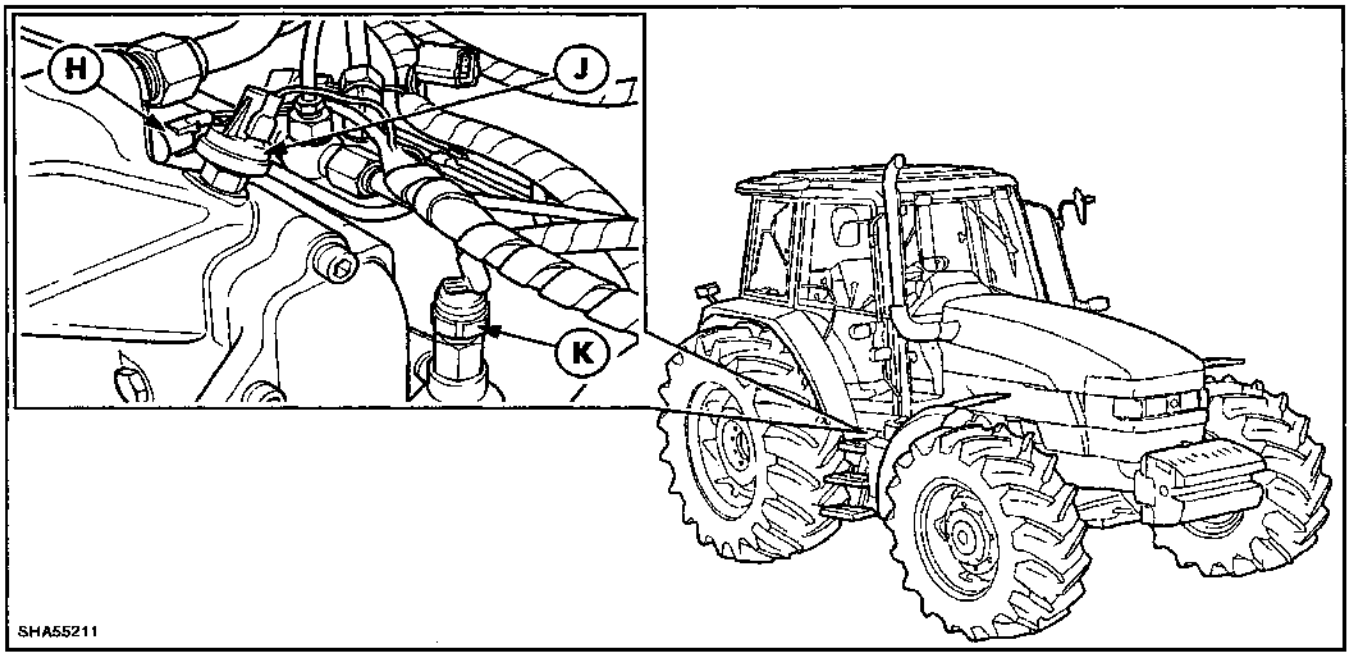


Figure 2-4-11

H. INTAKE FILTER TEMPERATURE SWITCH
Operates as the transmission oil temperature rises above 40°C (104°F) to allow the intake filter restriction switch to function. Switch is normally open.

J. INTAKE FILTER RESTRICTION SWITCH
Operates as the transmission intake vacuum rises above 406mm Hg (228.8 in H_2O) to operate warning lamp. Switch is normally open.

K. CHARGE PRESSURE SWITCH
Operates as charge pressure drops below 0.8 bar (12 lbf/in^2) to illuminate warning lamp. Switch is normally closed.

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SENDERS, SENSORS & SWITCHES

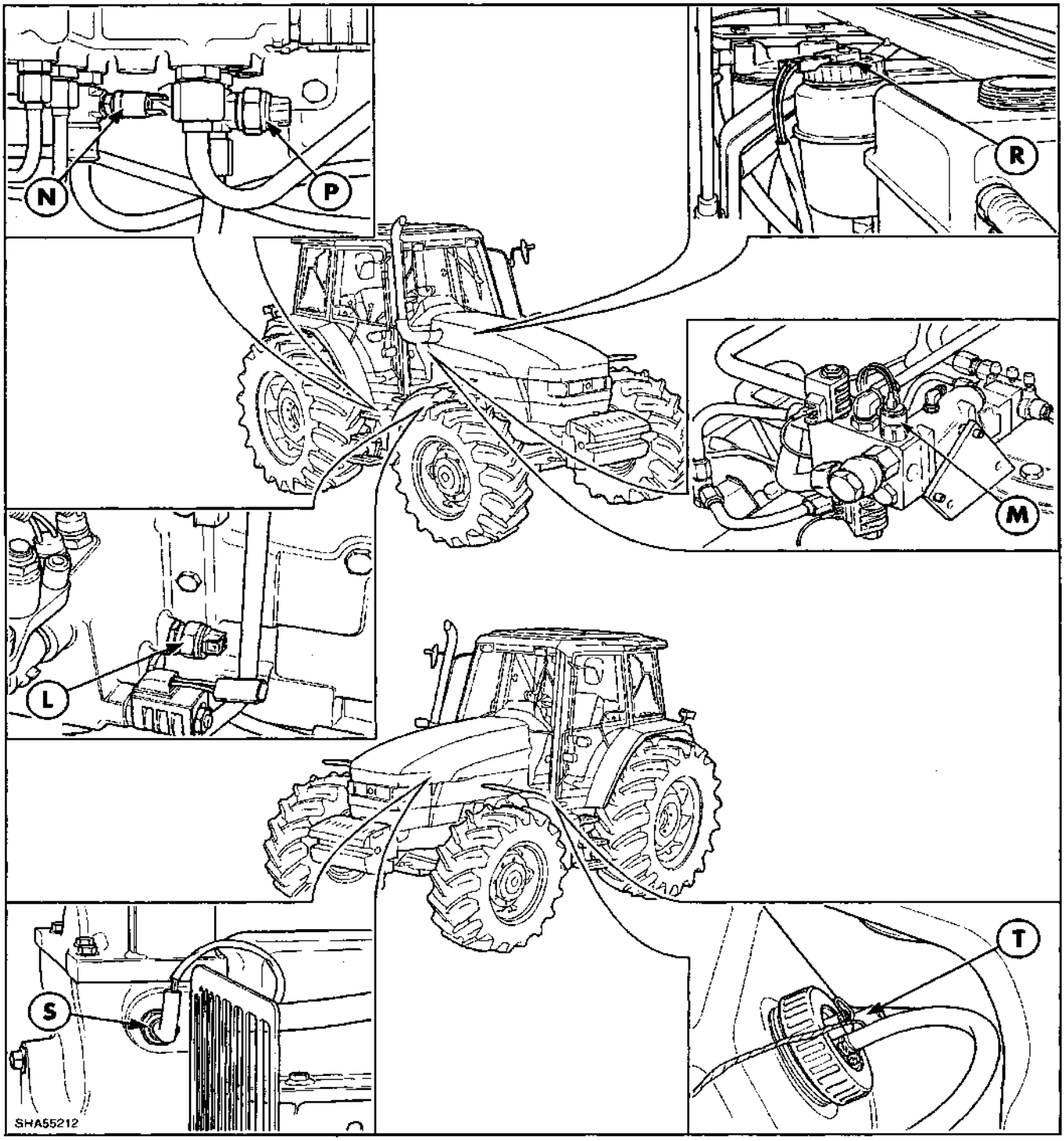


Figure 2-4-12

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SENDERS, SENSORS & SWITCHES

L. TRANSMISSION OIL PRESSURE SWITCH
Operates as transmission oil pressure drops below 11 bar (160 lbf/in^2) to operate warning lamp. Switch is normally closed.

M. ITALIAN TRAILER BRAKE SWITCH
Operates when trailer brakes are applied to illuminate warning lamp.

N. FWD OIL PRESSURE SWITCH
Operates when transmission pressure 16 bar (240 lbf/in^2) is absent in FWD line (FWD engaged) to illuminate warning lamp. Switch is normally closed.

P. DIFFERENTIAL LOCK PRESSURE SWITCH
Operates when transmission oil pressure 16 bar (240 lbf/in^2) is present in differential lock supply lines to illuminate warning lamp. Switch is normally open.

R. BRAKE/CLUTCH FLUID LEVEL SWITCH
Operates as fluid level drops below minimum to operate warning lamp. Switch is normally closed.

S. ENGINE COOLANT TEMPERATURE SENDER
The temperature sender resistance changes proportionally with coolant temperature causing a modulated signal voltage to be sent back to the instrument cluster to operate the gauge.

SENDER RESISTANCE	GAUGE INDICATION
710 – 580 ohms	Cold
Less than 100 ohms	Hot

T. FUEL TANK SENDER
Signal from sender potentiometer determines fuel level displayed on the gauge.

SENDER RESISTANCE	GAUGE INDICATION
31 – 49 ohms	Full
230 – 250 ohms	Empty

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SENDERS, SENSORS & SWITCHES

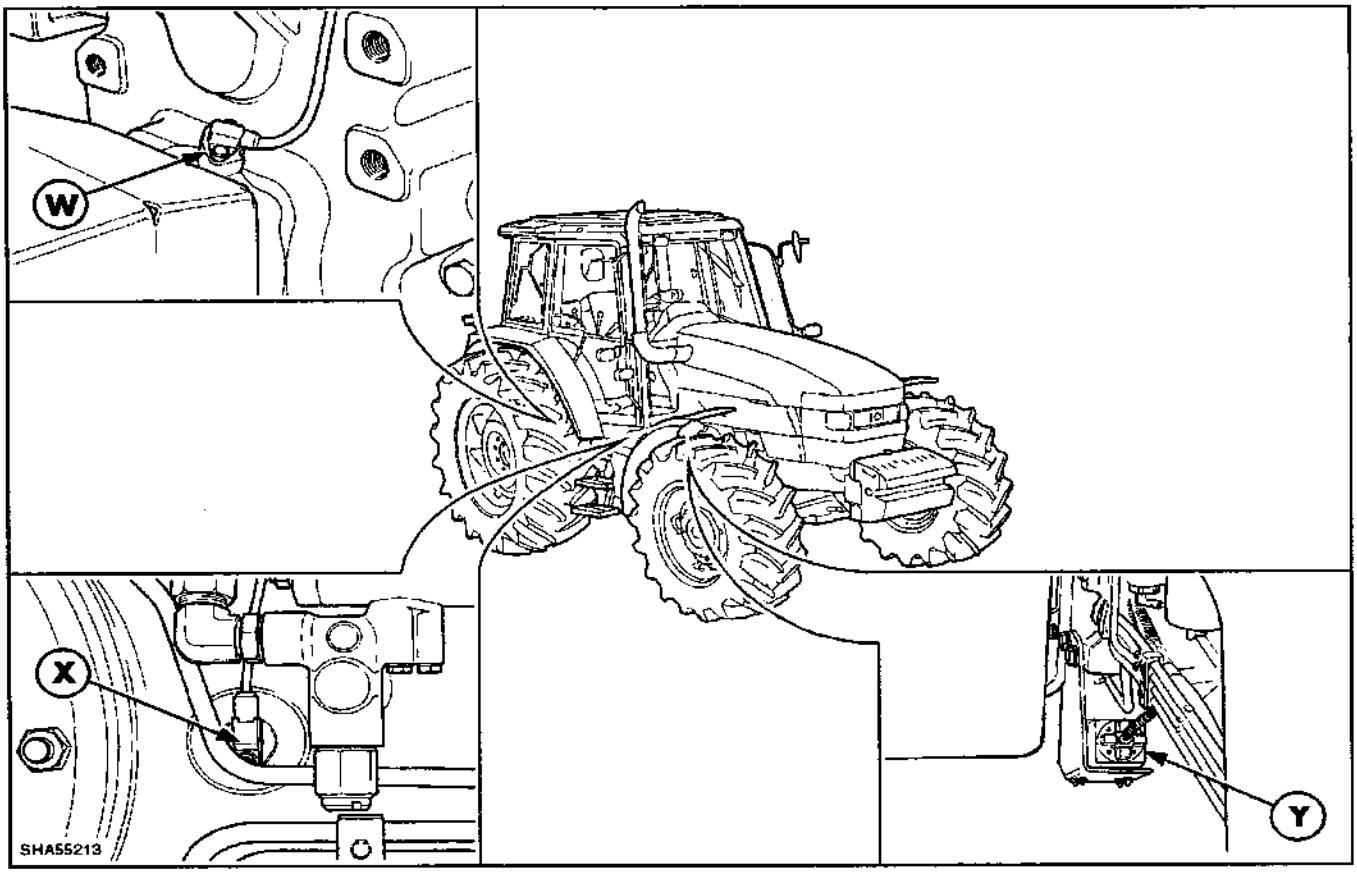


Figure 2-4-13

W. PTO SPEED SENSOR
Sensor output modulates as signal voltage to the instrument cluster to display PTO speed.

X. TRANSMISSION SPEED SENSOR
Senses transmission output (wheel) speed and generates a signal for cluster ground speed display, distance displays, and to compute area accumulations.
When a radar is fitted the transmission speed sensor is used only to compute % slip display.

Y. RADAR SENSOR (Optional)
Senses true ground speed and generates a signal for cluster ground speed, % slip, distance displays and to compute area accumulations.

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SERVICEABILITY

Instrument Cluster removed.

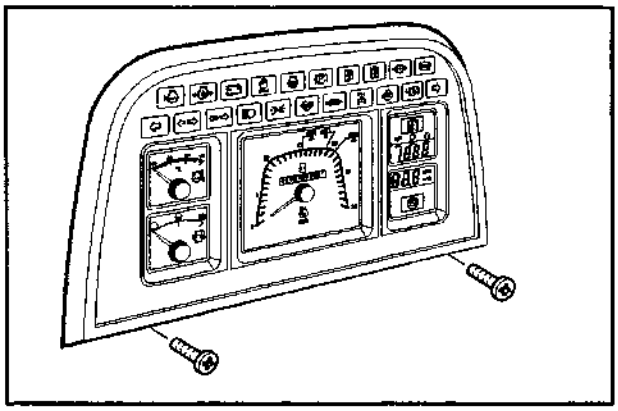


Figure 2-4-14

Rear cover removed.

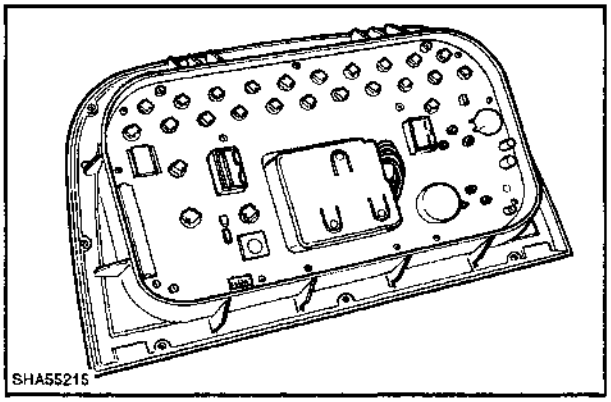


Figure 2-4-15

Dip switch position.

1-5 Set to OFF
6 Set to ON.

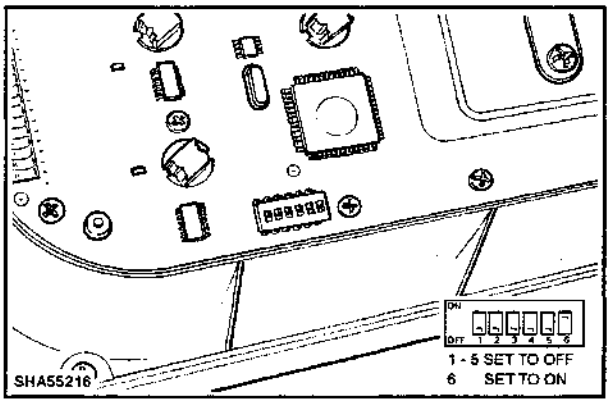


Figure 2-4-16

Bulb replacement.

As well as the bulbs, the gauges and liquid crystal displays can also be replaced seperately.

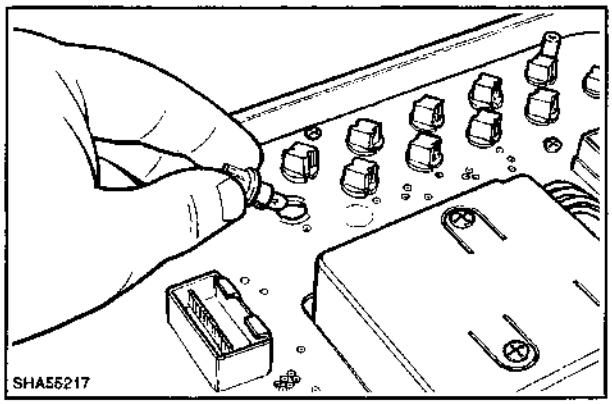


Figure 2-4-17

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SECTION 2
ELECTRICAL SYSTEM

CHAPTER 5
ANALOG INSTRUMENT CLUSTER
(NOTE: NOT USED IN NORTH AMERICA)

CONTENTS

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SENDER, SENSORS & SWITCHES 2-5-5
SERVICEABILITY 2-5-10
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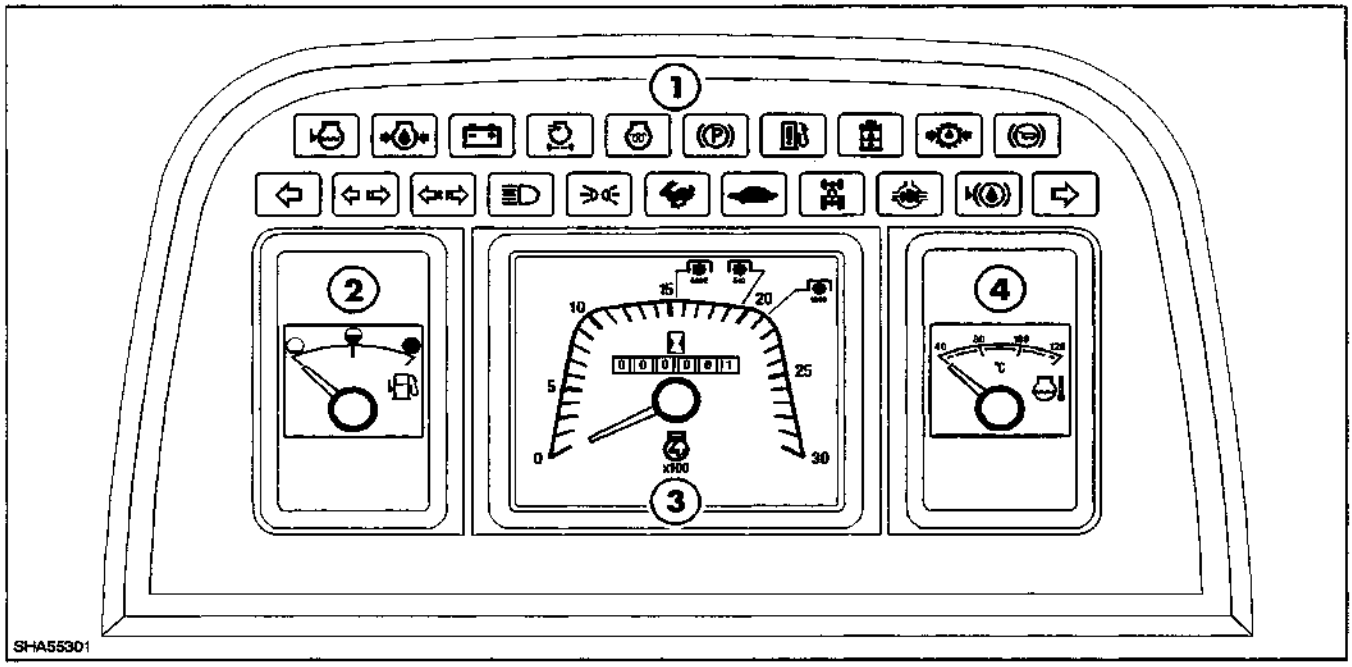


Figure 2-5-1

The Analog Instrument Cluster has four display areas:

1. Indicator and Warning Lamps
2. Fuel Level
3. Main Tachometer Display
4. Engine Temperature

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AREA 1: INDICATOR AND WARNING LAMPS

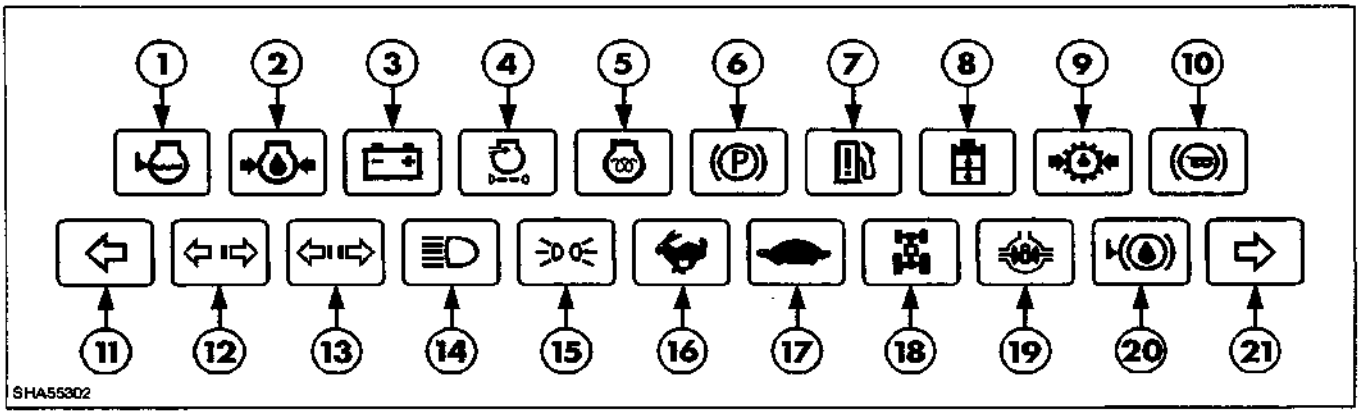


Figure 2-5-2

	Condition	Indicator/ Warning Lamp	Audible Alarm
1	Coolant level low	Flashing	
2	Engine oil pressure low	ON	
3	Battery charge low	ON	
4	Air filter restriction	ON	
5	Thermostart activated	ON	
6	Parking brake on/key on Parking brake off/key off	ON None	 2 minutes continuous
7	Water in fuel	ON	
8	Transmission oil filter blocked	ON	Non critical
9	Transmission oil presssure low Charge pressure low (CCLS pump only)	ON Flashing	
10	Trailer brake pressure low	Flashing	
11	Left turn indicator on	Flashing	
12	Single trailer indicator on	Flashing	
13	Second trailer indicator on	Flashing	
14	Headlamp main beam on	ON	
15	Side lights on	ON	
16	Direct drive selected	ON	
17	Under drive selected	ON	
19	Front wheel drive engaged	ON	
19	Differential lock engaged	ON	
20	Brake/clutch fluid low	ON	
21	Right hand indicator on	Flashing	

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Fuel Level

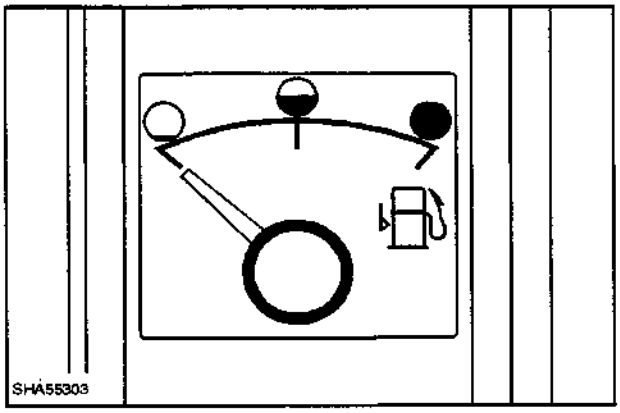


Figure 2-5-3

Tachometer

Displays engine speed and indicates correct speeds for 540/1000 PTO operation.

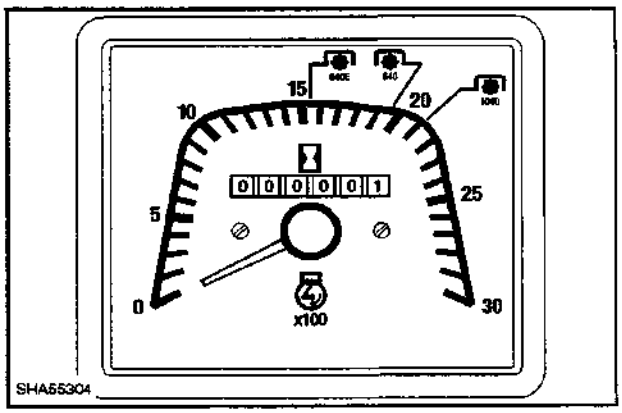


Figure 2-5-4

Coolant Temperature

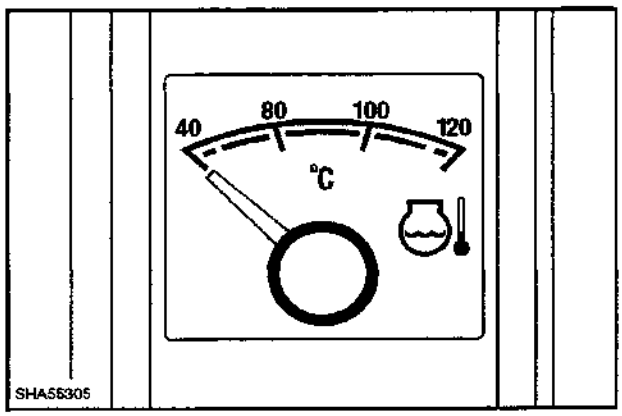


Figure 2-5-5

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SENDERS, SENSORS & SWITCHES

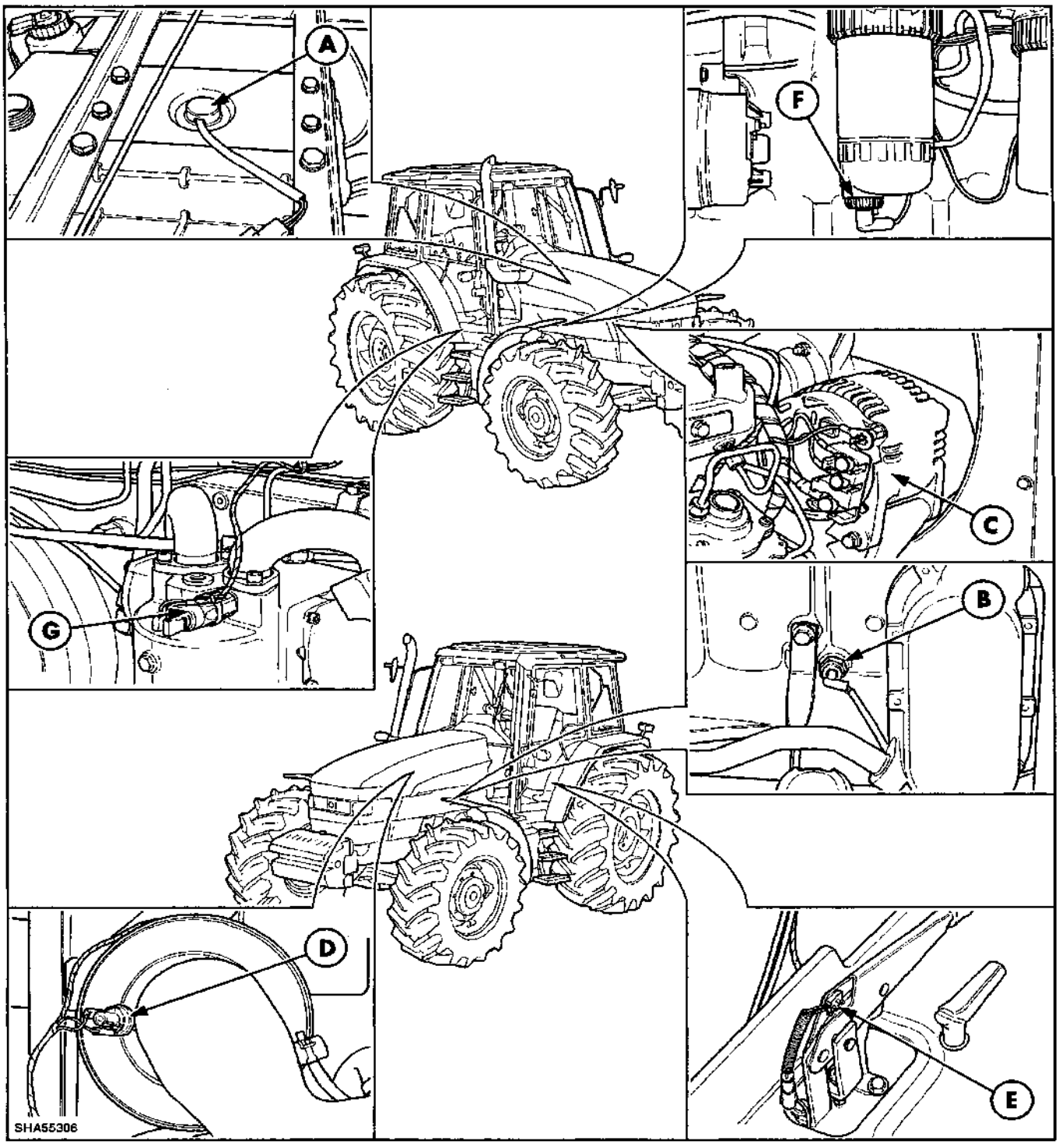


Figure 2-5-6

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SENDERS, SENSORS & SWITCHES

A. ENGINE COOLANT LEVEL SWITCH
Operates as engine coolant level drops to illuminate warning lamp. Uses a normally closed switch.

B. ENGINE OIL PRESSURE SWITCH
Operates as engine oil pressure drops below 0.68 bar (10 lbf/in^2) to illuminate warning lamp. Uses a normally closed switch.

C. ALTERNATOR
Provides a square wave signal of 142.5 – 855 Hz (480 – 3060 ERPM) for instrument cluster and microprocessor operations.

D. AIR CLEANER RESTRICTION SWITCH
Operates as the vacuum in the air intake system rises above 46.7mm Hg (25in H_2O), to illuminate warning lamp.

E. PARKING BRAKE SWITCH
Switch is closed with parking brake applied, a warning lamp and audible alarm with key switch on.
Sounds an alarm when wheel movement is detected above 0.8 km/h (0.5 mph).
Sounds an alarm for 2 minutes with key switch off and park brake released.
NOTE: *FWD is always engaged when park brake is applied.*

F. WATER IN FUEL
Operates when water is detected in the fuel to illuminate warning lamp.

G. INTAKE FILTER RESTRICTION SWITCH (Open Center System)
Operates as the transmission intake vacuum rises above 406mm Hg (228.8 in H_2O) to illuminate warning lamp.

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SENDERS, SENSORS & SWITCHES

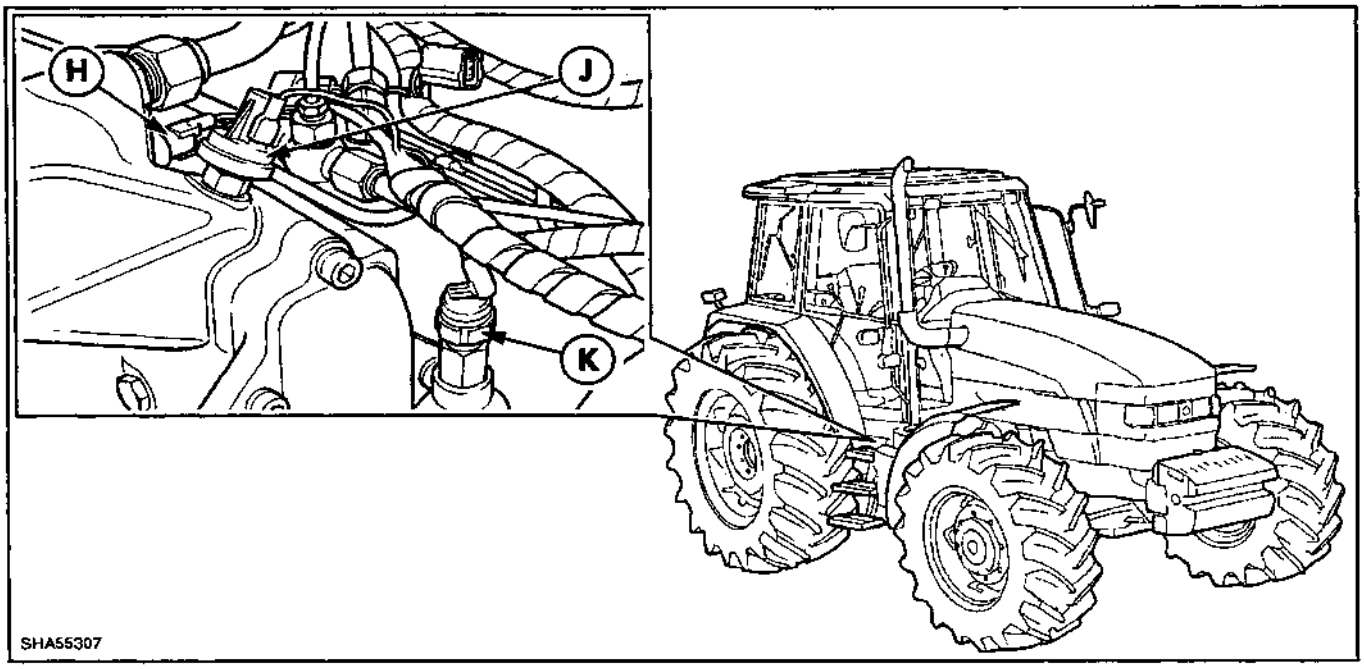


Figure 2-5-7

H. INTAKE FILTER TEMPERATURE SWITCH
Operates as the transmission oil temperature rises above 40°C (104°F) to allow the intake filter restriction switch to function. Switch is normally open.

J. INTAKE FILTER RESTRICTION SWITCH
Operates as the transmission intake vacuum rises above 406mm Hg (228.8 in H_2O) to operate warning lamp. Switch is normally open.

K. CHARGE PRESSURE SWITCH
Operates as charge pressure drops below 0.8 bar (12 lbf/in^2) to illuminate warning lamp. Switch is normally closed.

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SENDERS, SENSORS & SWITCHES

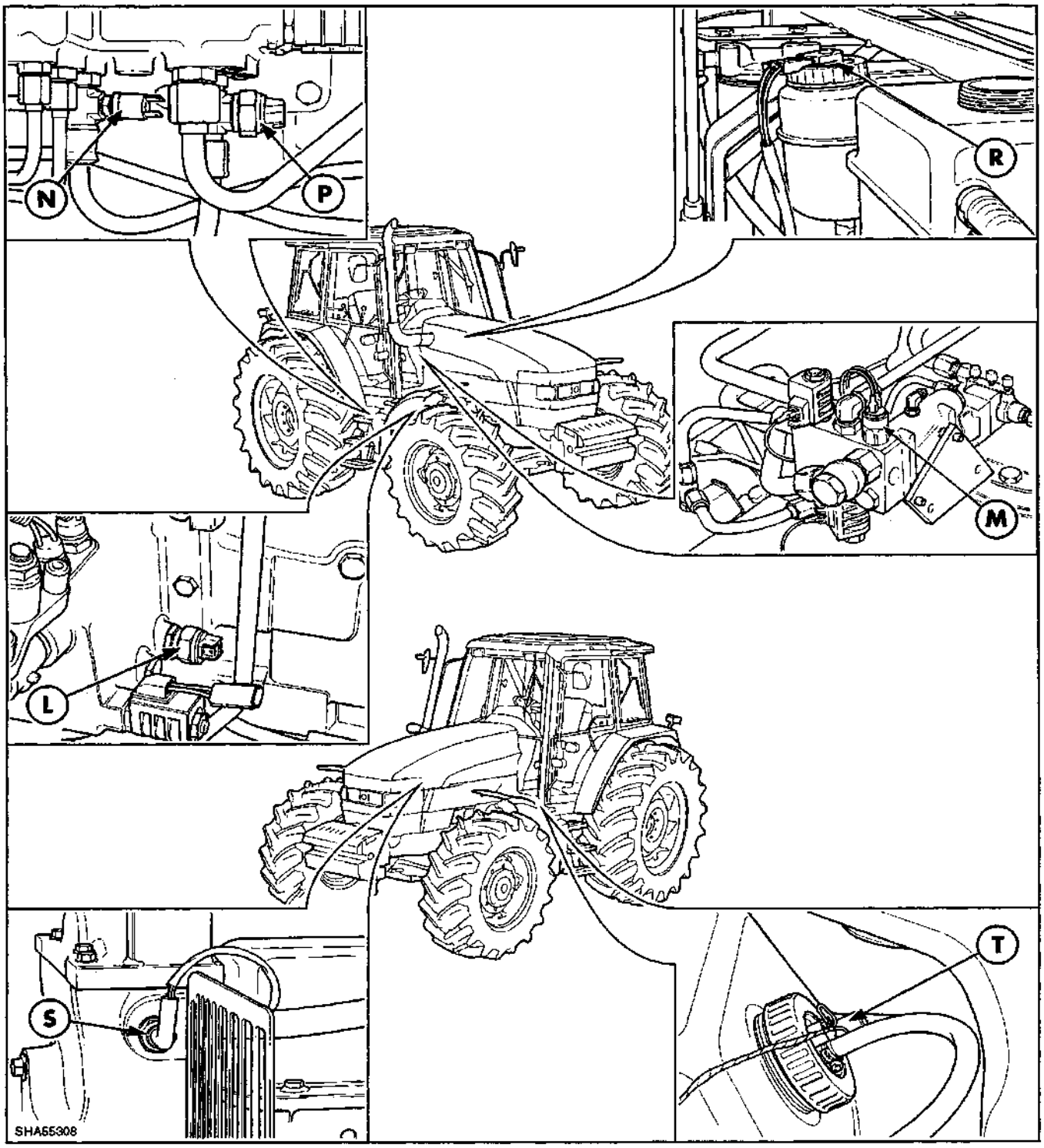


Figure 2-5-8

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SENDERS, SENSORS & SWITCHES

L. TRANSMISSION OIL PRESSURE SWITCH
Operates as transmission oil pressure drops below 11 bar (160 lbf/in^2) to operate warning lamp. Switch is normally closed.

M. ITALIAN TRAILER BRAKE SWITCH
Operates when trailer brakes are applied to illuminate warning lamp.

N. FWD OIL PRESSURE SWITCH
Operates when transmission pressure 16 bar (240 lbf/in^2) is absent in FWD line (FWD engaged) to illuminate warning lamp. Switch is normally closed.

P. DIFFERENTIAL LOCK PRESSURE SWITCH
Operates when transmission oil pressure 16 bar (240 lbf/in^2) is present in differential lock supply lines to illuminate warning lamp. Switch is normally open.

R. BRAKE/CLUTCH FLUID LEVEL SWITCH
Operates as fluid level drops below minimum to illuminate warning lamp. Switch is normally closed.

S. ENGINE COOLANT TEMPERATURE SENDER
The temperature sender resistance changes proportionally with coolant temperature causing a modulated signal voltage to be sent back to the instrument cluster to operate the gauge.

SENDER RESISTANCE	GAUGE INDICATION
710 – 580 ohms	Cold
Less than 100 ohms	Hot

T. FUEL TANK SENDER
Signal from sender potentiometer determines fuel level displayed on the gauge.

SENDER RESISTANCE	GAUGE INDICATION
31 – 49 ohms	Full
230 – 250 ohms	Empty

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SERVICEABILITY

Removing Analog Instrument Cluster.

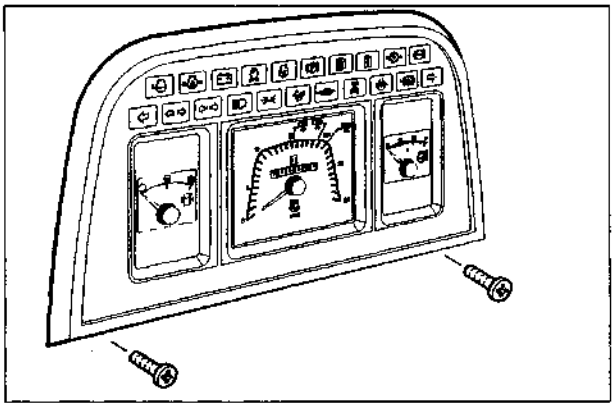


Figure 2-5-9

Rear cover removed.

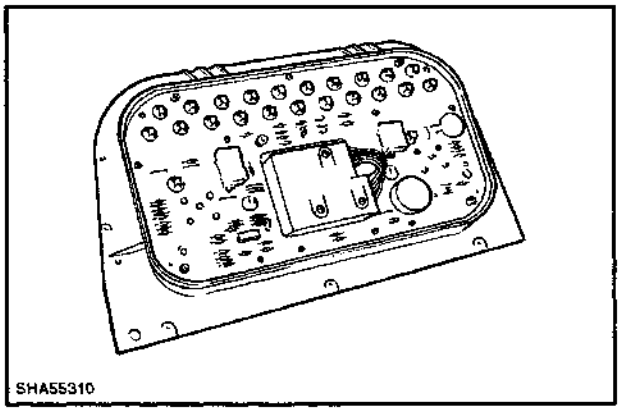


Figure 2-5-10

Bulb replacement.

As well as the bulbs, the gauges can also be replaced seperately.

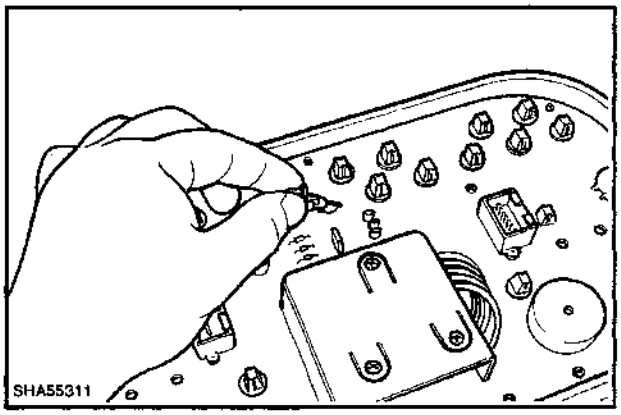


Figure 2-5-11

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SECTION 2
ELECTRICAL SYSTEM

CHAPTER 6
STARTING SYSTEM

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DESCRIPTION AND OPERATION 2-6-3
FAULT FINDING 2-6-6
SYSTEM TESTING 2-6-7
REMOVAL AND INSTALLATION 2-6-9
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55 000 SPECIFICATIONS

	Starter Type Bosch 3.6 Kw
Maximum No Load Current Draw at 11.5 volts and 8000 rev/min.	160 amps
Minimum Brush Length	7.00 mm (0.28 in)
Minimum Commutator Diameter	42.5 mm (1.67 in)
Maximum Armature Shaft End Play	0.4 mm (0.015 in)

TORQUE SPECIFICATIONS

	lbf.ft	Nm
Starting motor to Engine Block Retaining Bolts	25	34
Ground cable Starter End Housing	11.8	16
Solenoid Cable nuts	5	7
Starting Motor End Housing Nuts	7	10
Solenoid Retaining Bolts	4	5

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OPERATION

The type of starting system is dependant on the transmission installed in the tractor. All systems consist of a key start switch, heavy duty wiring, starter motor and solenoid assembly, a starting relay and a clutch pedal switch, these are the components of the basic circuit which is used on the mechanical transmission. Other components are included on the more sophisticated transmissions to ensure that the engine can only be started under the correct conditions.

There are three basic types of transmission, mechanical, Hi/Lo and semi–powershift and hence three starting circuits, which are shown in Figures 2-6-1, 2-6-4 and 2-6-5.

The standard starting motor is a 3.6 Kw (4.8 hp) rated motor. It is a four pole four brush type starter with integral solenoid and positive engagement drive assembly.

The integral solenoid incorporates two windings connected in parallel. One winding is the low resistance 'pull–in' coil, grounded through the motor, while the other is the high resistance 'hold–in' coil grounded via the solenoid body.

When the key start switch is closed with the clutch pedal depressed and the transmission in neutral (except mechanical) the solenoid coils are energized and the solenoid plunger is magnetically attracted into the solenoid core. This movement, transmitted through a pivoted linkage mechanism forces the drive pinion into mesh with the flywheel ring gear. At ring gear to pinion abutment, the solenoid plunger closes a set of contacts to give a direct feed from the battery to all four field coils, providing full power to the starting motor.

At this point one end of the 'pull–in' coil is connected to battery positive through the starter switch while the other end is connected to positive through the solenoid contacts. The 'pull–in' coil is thus by–passed, drawing no current and the 'hold–in' coil alone keeps the solenoid plunger engaged.

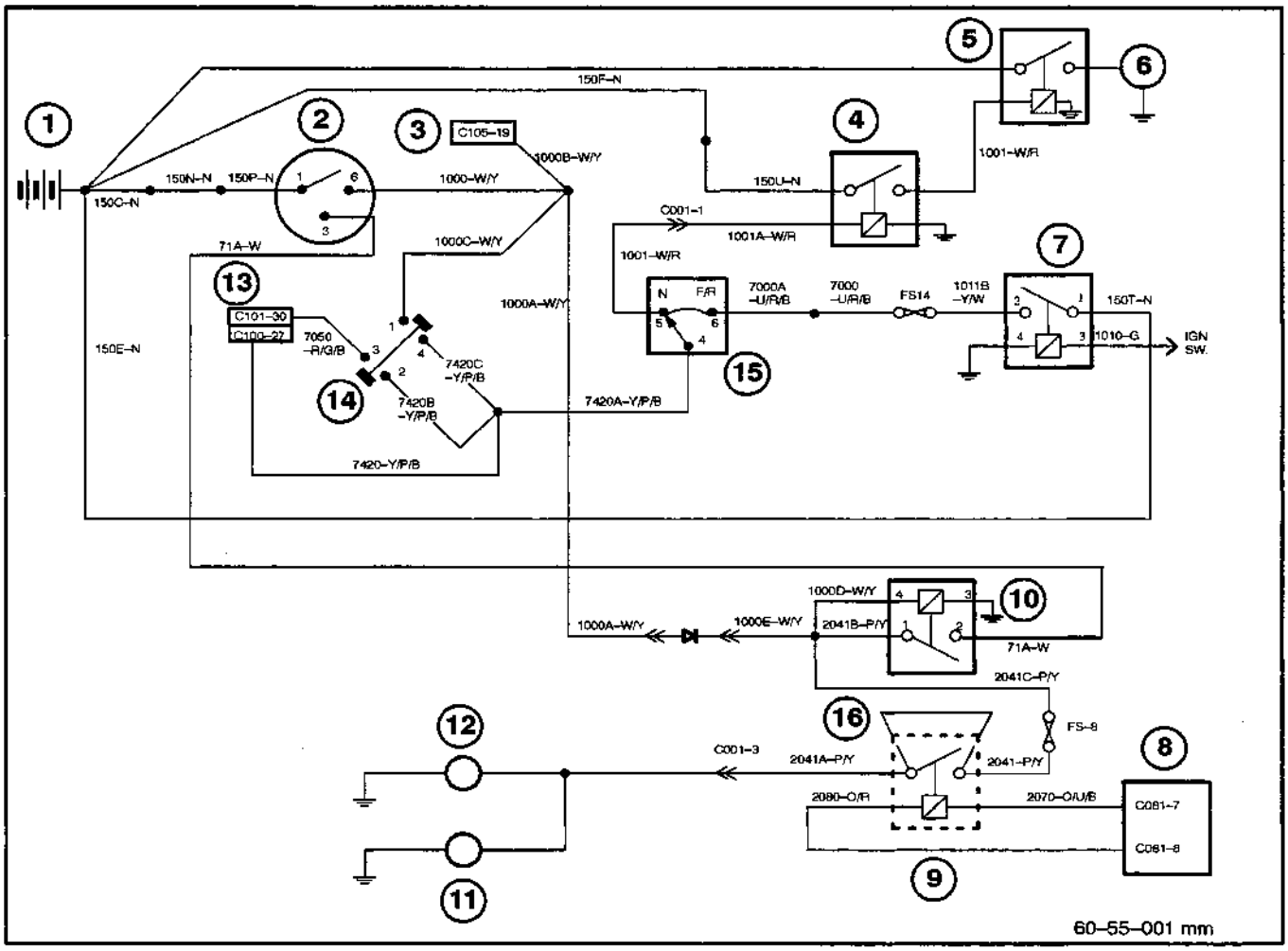
The starter incorporates a single set of contacts and a two piece solenoid plunger which completely closes the contacts even if the pinion and ring gear teeth are misaligned. When this happens, an engagement spring is compressed which forces the pinion into full engagement as soon as the starter begins to turn.

When the key start switch is released, power to the solenoid and motor is removed. The solenoid return spring acting through the pivoted linkage mechanism pulls the drive pinion out of mesh and reopens the solenoid contacts.

Incorporated in the drive pinion assembly is a roller clutch device. This device prevents the armature from rotating excessively if the pinion remains in mesh with the flywheel ring gear after the engine has started.

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Starter Circuit – Semi Powershift Transmission **Figure 2-6-1**

NOTE: NOT USED IN NORTH AMERICA

1. Battery
2. Key Start Switch
3. Electronic Management Unit
4. Starter Relay
5. Starter Solenoid
6. Starter Motor
7. Ignition Relay
8. Digital Instrument Cluster
9. Fuel Shut–off Relay (Dealer Installed Accessory with Digital Instrument Cluster Only)
10. Relay V
11. Fuel Shut Off Solenoid
12. Electric Fuel Pump
13. Transmission Processor
14. Clutch Pedal Switch
15. Forward/Reverse Shuttle Switch
16. Bus Bar Link (Standard)

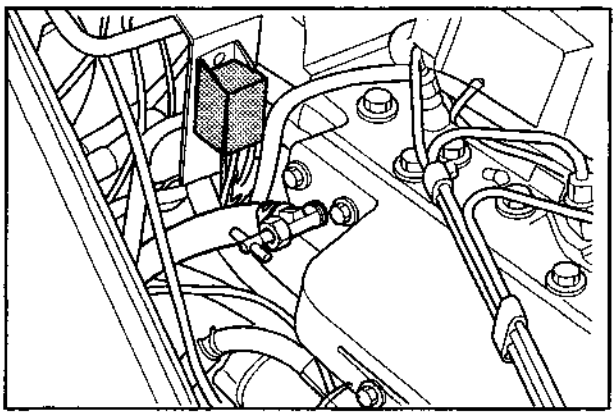


Figure 2-6-2
Starter Relay Location

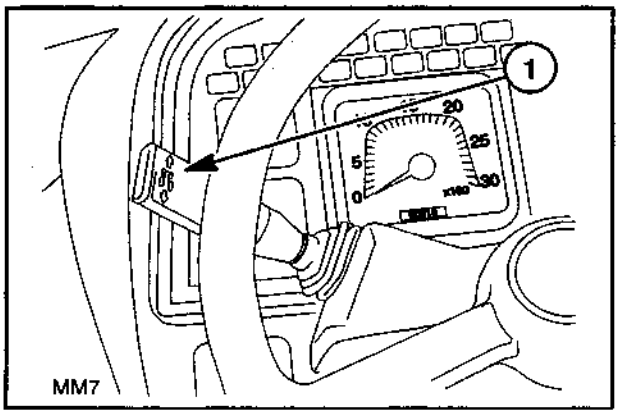
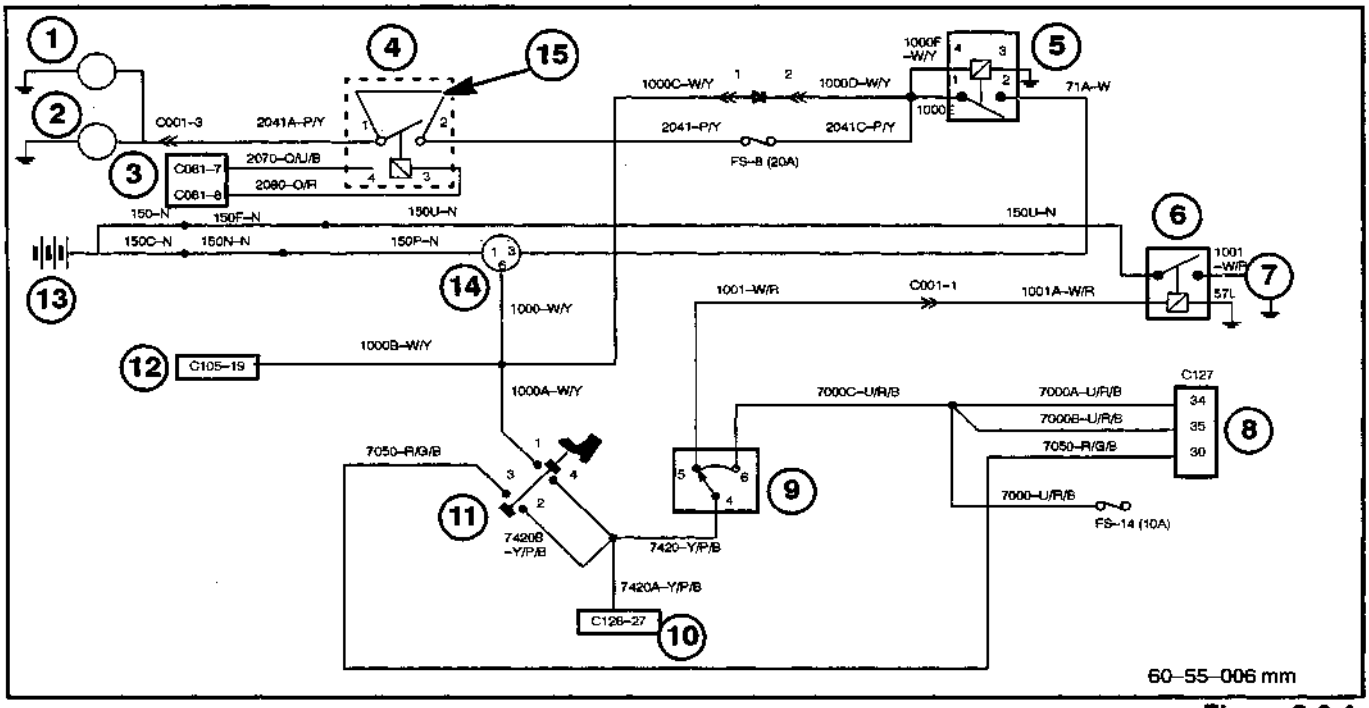


Figure 2-6-3
Shuttle Lever Switch

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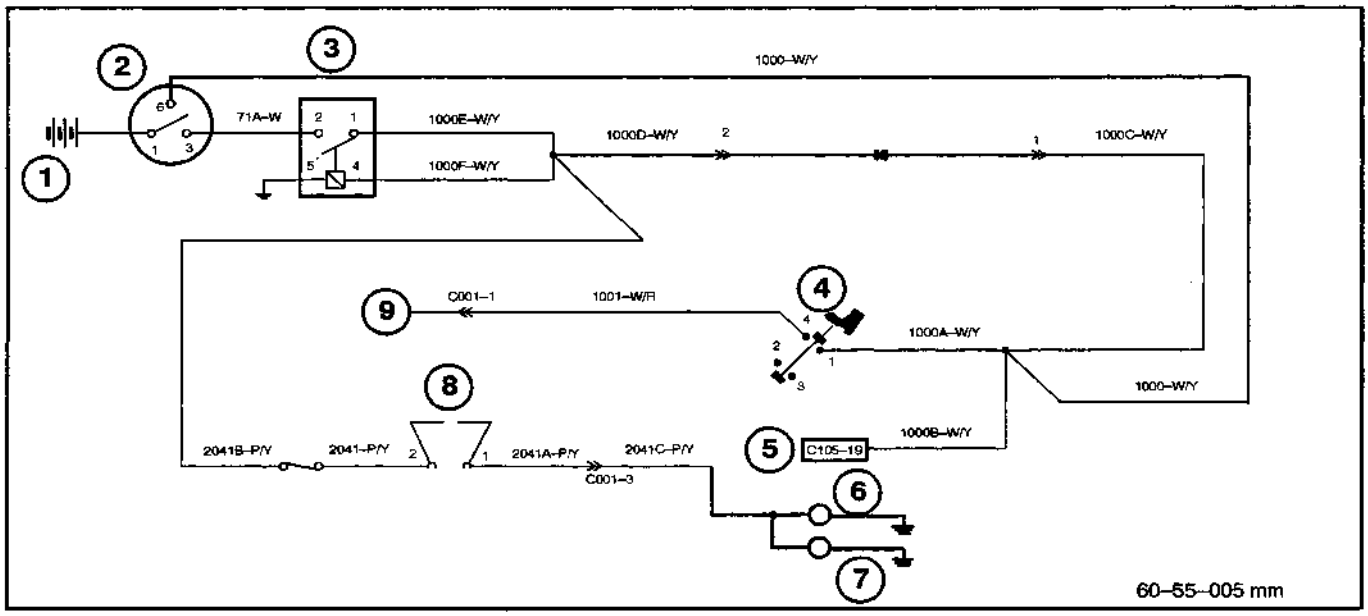
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Starter Circuit – Hi/Lo Transmission

Figure 2-6-4

1. Fuel Shut Off Solenoid
2. Electric Fuel Pump
3. Digital Instrument Cluster
4. Fuel Shut–off Relay (Dealer Installed Accessory with Digital Instrument Cluster Only)
5. Relay V
6. Starter Relay
7. Starter Motor and solenoid
8. Transmission Processor
9. Forward/Reverse Shuttle Switch
10. Transmission Processor
11. Clutch Pedal Switch
12. Electronic Management Unit
13. Battery
14. Key Start Switch
15. Bus Bar Link (Standard)



Starter Circuit – Mechanical Transmission

Figure 2-6-5

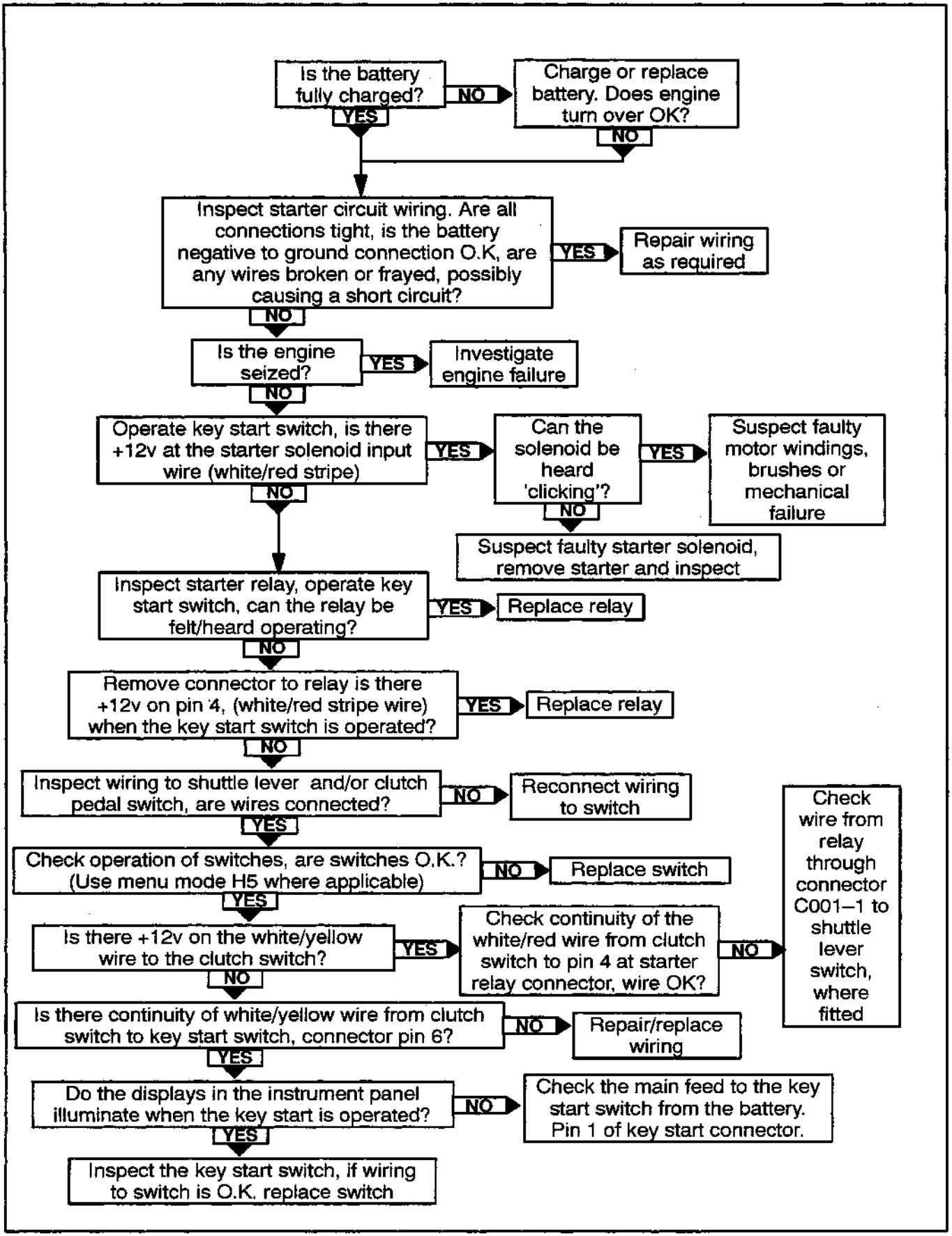
NOTE: NOT USED IN NORTH AMERICA

1. Battery
2. Key Start Switch
3. Relay V
4. Clutch Pedal Switch
5. Electronic Management Unit
6. Fuel Shut Off Solenoid
7. Electric Fuel Pump
8. Bus Bar Link
9. To Engine Harness, same as Semi–powershift and Hi/Lo transmissions

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Engine Does Not Turn Over When Key Start Is Operated, Transmission In Neutral



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STARTER SYSTEM TESTING ON TRACTOR

For easier and rapid diagnosis and for most conclusive test results, it is recommended that a battery–starter tester (high rate discharge tester) incorporating a 0–20 volt voltmeter and a 0–500 amp ammeter be used to diagnose starting system problems.

When using test equipment follow the manufacturers recommended test procedures. If test equipment is not available the following test procedure, using a standard 0–20 volt voltmeter and 0–500 amp ammeter can be used to determine the correct operation of the starter without removing it from the engine.

Before testing:

- Check that the battery is fully charged.
- Check the complete starting system wiring circuit for frayed or broken wires or loose terminal connections.
- Check the engine is not seized.

Starter Motor Circuit Current Draw

1. Disconnect the Battery (3) ground (negative) cable from the battery.
2. Disconnect the battery positive cable from the starter solenoid. Connect the ammeter(1) positive lead to the battery positive terminal and the negative lead to the solenoid input terminal.
3. Reconnect the battery ground (negative) cable to the battery negative terminal.
4. Connect the voltmeter(2) positive lead to the battery positive terminal and the voltmeter negative lead to the battery negative terminal.
5. Disconnect the wire from the fuel injection pump shut off solenoid.
6. Crank the engine while observing the voltmeter and ammeter readings. The voltage should remain steady at around 12 volts with between 250–300 amps being drawn.

- If the current draw is within specification the starting motor (4) is functioning correctly. If the voltage drops during the test proceed to 'Starting System Circuit Resistance'.

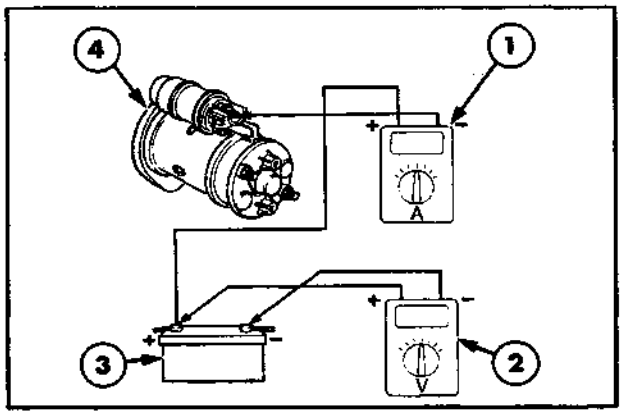


Figure 2-6-6

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- If the current draw is greater than specified, check the circuit as outlined below. If the starting system circuit tests are satisfactory the starting motor is defective and must be disassembled to determine the cause.
- If the current draw is less than specified, the starting motor is defective and must be disassembled to determine the cause.

Starting System Circuit Resistance (Voltage Drop)

If there is an excessive current draw the circuit should be checked by recording voltage drops across the individual components in the circuit

IMPORTANT: *Disconnect the fuel injection pump fuel shut off solenoid wire.*

Battery Positive Cable:

1. Connect the voltmeter positive lead to the battery positive terminal.
2. Connect the voltmeter negative lead to the starting motor solenoid battery terminal.
3. Crank the engine while observing the voltmeter reading. If the voltage exceeds 0.2 volts, check and tighten the cable connections. Recheck the voltage, if still excessive install a new cable.

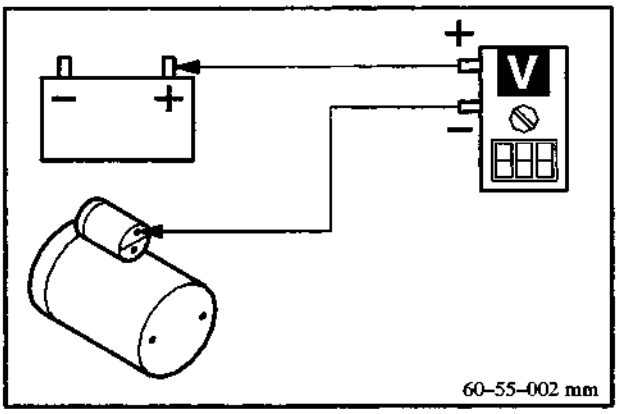


Figure 2-6-7

Starting Motor Ground Connections:

1. Connect the voltmeter positive lead to the starting motor frame.
2. Connect the voltmeter negative lead to the engine block.
3. Crank the engine while observing the voltmeter reading. If the voltmeter reading exceeds 0.2 volts check the ground connections between the starting motor flange and the rear engine plate.

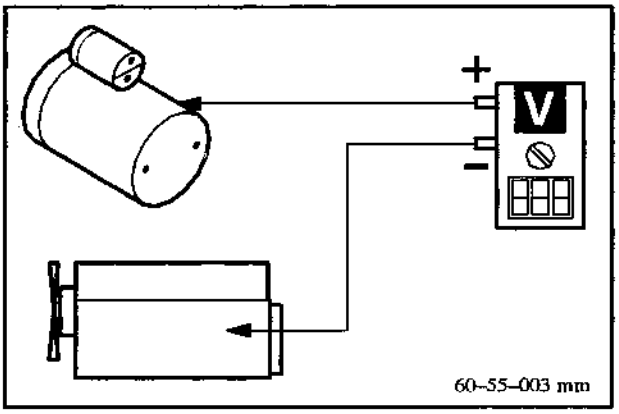


Figure 2-6-8

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Battery Ground Cable:

1. Connect the voltmeter positive lead to the engine block.
2. Connect the voltmeter negative lead to the battery negative terminal.
3. Crank the engine while observing the voltmeter reading. If the reading exceeds 0.2 volts, check and tighten the ground cable connections. Recheck the voltage, if it is still excessive install a new ground cable.

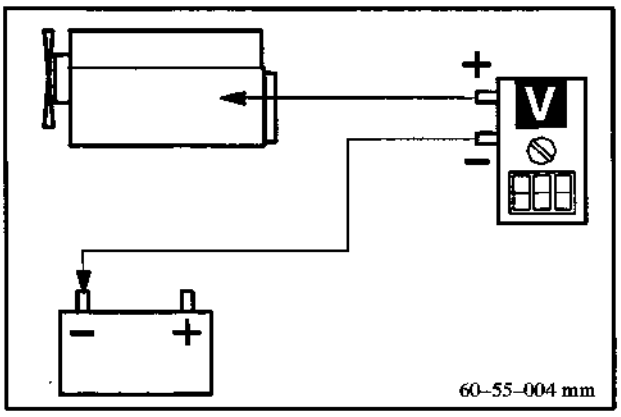


Figure 2-6-9

STARTER MOTOR REMOVAL AND INSTALLATION

1. Disconnect the battery ground (negative) cable from the battery.
2. Remove the protective cover from the solenoid assembly and disconnect the positive cables to the solenoid and the solenoid coil feed wire.
3. Remove the three starting motor mounting bolts and remove the starting motor.
4. Installation is the reverse of the removal procedure.

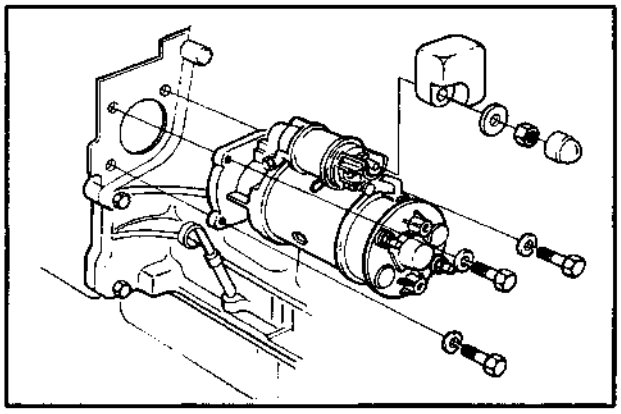
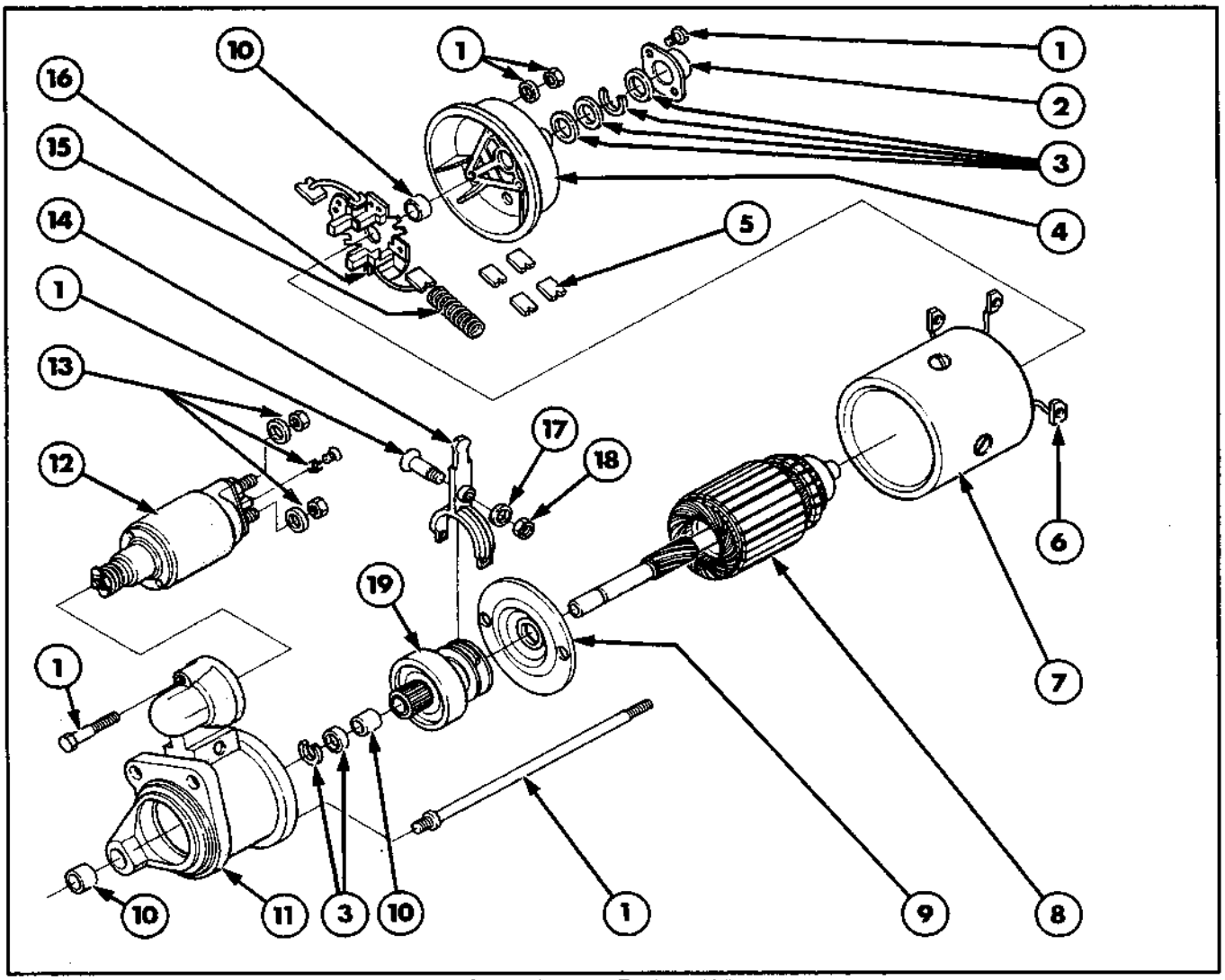


Figure 2-6-10

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Starter Motor – Exploded View

Figure 2-6-11

1. Stud and Bolt Kit
2. End Cap
3. Collar and Ring Assembly, Drive Thrust
4. Brush End Plate Assembly
5. Brush Assembly
6. Brush Assembly
7. Field Coils and Housing Assembly
8. Armature
9. Center Bearing Plate
10. Bushing
11. Housing Assembly
12. Solenoid Assembly
13. Solenoid Hardware Kit
14. Lever Assembly
15. Brush Spring
16. Brush Holder Assembly
17. Washer
18. Nut
19. Drive Assembly

DISASSEMBLY

With reference to Figure 2-6-11.

1. Support the starting motor in a soft jawed vice.

2. Disconnect the thick braided wire from the field coil housing to the solenoid assembly.

3. Remove the three screws from the front housing assembly and withdraw the solenoid assembly. Note that the plunger will remain in the drive engagement lever.

4. Remove the solenoid plunger from the drive engagement lever by gripping the plunger and lifting up the front end and releasing it from the drive engagement lever.

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5. Remove the two end housing nuts and the two screws retaining the end cap and brush plate to the end housing. Remove the 'C' clip and armature shaft end play shims and withdraw the end housing, leaving the brush gear on the commutator. Remove the thin metal washer from the commutator end of the armature.

6. At this stage of disassembly inspect the brushes and commutator. Check for sticking brushes. If necessary, clean brushes and brush channels with a petrol moistened cloth. Check brushes for wear. If worn below the minimum length specified, of 7.00mm (0.276 in), it will be necessary to replace the complete starter motor.

NOTE: *The brushes are not serviced separately. They are spot welded into position and not intended to be replaced during the starter motors service life.*

7. Withdraw the motor casing from the armature and drive end bracket.

8. Withdraw the drive engagement lever pivot pin from the drive end housing.

9. Remove the drive assembly and inner plate retaining snap ring from the armature shaft by driving the securing thrust collar squarely off the snap ring with a suitable diameter tube and then levering the snap ring from the groove.

10. Withdraw the armature and drive assembly.

RE–ASSEMBLY

1. Re–assembly of the starting motor follows the disassembly procedure in reverse.

Prior to installation, the armature end play must be checked and the starting motor no load function must be tested.

Checking the Armature End Play:

1. Secure the starting motor in a vice equipped with soft jaws and attach a dial indicator to the drive end housing flange. Locate the dial indicator pointer on the end of the armature shaft.

2. Lever the armature fully forward and zero the dial indicator. Lever the shaft fully rearwards and record the gauge reading.

3. The gauge reading should not exceed 0.4mm (0.015in). If the reading is greater, inspect the armature assembly and the brush end plate assembly for wear. Replace worn components as required and recheck the end play.

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Starting Motor No–Load Test:

NOTE: *A fully charged battery and a battery starter tester (high rate discharge tester) with a carbon pile (variable load resistor) should be used to perform this test.*

1. Secure the starting motor in a vice equipped with soft jaws.
2. Connect the battery negative cable (4) to the starting motor mounting flange.
3. Connect a short jumper lead (6) between the solenoid battery and solenoid switch terminals.
4. Connect a voltmeter (3) positive lead to the battery positive terminal, the voltmeter negative lead to the battery negative terminal, the ammeter (1) positive lead to the battery positive terminal and the ammeter negative lead to the solenoid battery or starting motor terminal.
5. Hold a hand tachometer (5) on the end of the armature shaft. Actuate the starting motor by adjusting the carbon pile (2) to give 11.7 volts. When the armature rotates between 7500 and 8500 rev/min. the maximum current draw should not exceed 160 amperes.
6. If the starting motor does not perform to specification, check for grounded field coils, a rubbing armature or a distorted armature shaft.

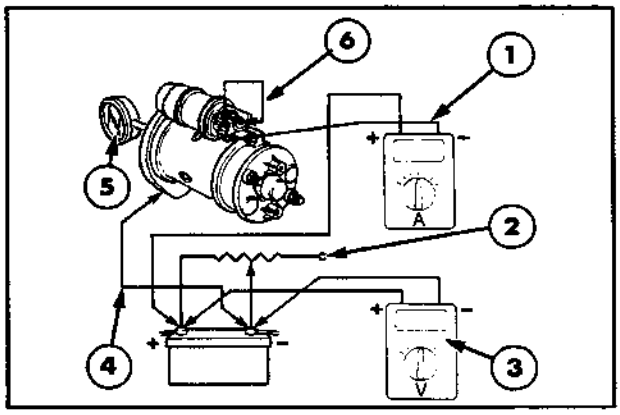


Figure 2-6-12

BENCH TESTS

Armature

1. The commutator face should be clean and free from burnt spots. If necessary remove any burnt spots using fine glass paper, not emery cloth. Finally clean the commutator with a petrol moistened cloth.
2. If it is necessary to skim the commutator ensure the diameter is not reduced below the minimum specified diameter of 42.5mm (1.68 in). Following skimming the commutator should be polished with a fine glass paper and then wiped clean with a petrol moistened cloth.

NOTE: *Do not cut into the commutator metal when recutting insulation slots.*

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3. Armature insulation can be checked by connecting an ohmmeter between the commutator segments and the armature shaft. There should be an infinity reading, i.e, no continuity.

4. To test the armature for short circuits it is necessary to use suitable armature testing equipment, the only alternative is to check the armature by substitution.

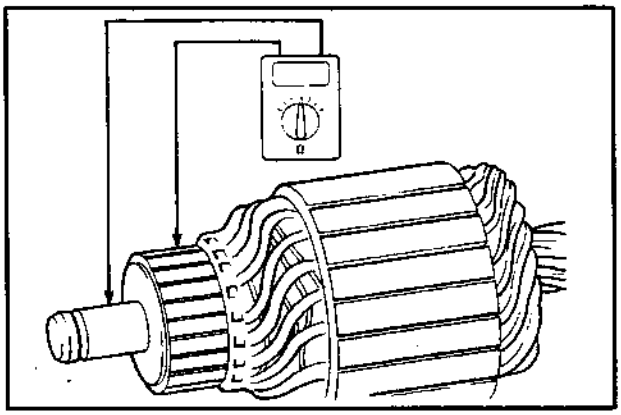


Figure 2-6-13

5. If there is evidence that the armature circumference has been in contact with the pole pieces, then the armature bearings are probably excessively worn. First check that the pole pieces are tight and that the armature runs true in a lathe, then if necessary renew the armature bearings.

Field Coils

1. To test the insulation of the field coils connect an ohmmeter in turn between each of the field winding brushes and a clean unpainted part of the housing. There should be no reading, i.e, no continuity.

2. To test the field winding continuity connect an ohmmeter in turn between each of the field winding brushes and the main feed terminal (thick braided wire). A reading of 1 MΩ should be indicated.

3. If a fault is indicated in the field windings it will be necessary to replace the complete field coils and housing assembly.

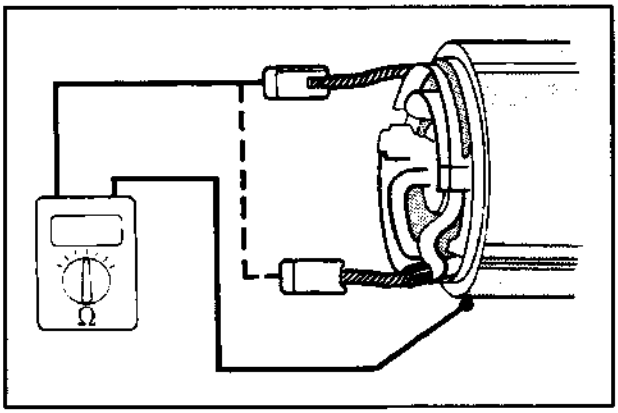


Figure 2-6-14

Bearing Bushings

1. Inspect the bushings in the brush end plate assembly and pinion drive end housing for wear. Install the armature shaft and observe the free play, replace bushings where free play appears excessive. Inspect the field poles for signs of rubbing by the armature which may also have been caused by worn bushings.

Drive Pinion Assembly

1. Check the operation of the roller clutch. The pinion should rotate clockwise only. If the pinion is stuck or rotates in both directions, or if the pinion teeth are damaged install a new drive assembly.

If damaged pinion teeth are evident, check the fly-wheel ring gear teeth as described in Section 10, Engine Systems.

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SECTION 2
ELECTRICAL SYSTEM
CHAPTER 7
CHARGING SYSTEM

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55 000 SPECIFICATIONS

	Alternator Type	
	A127–70	A127–100
Polarity	Negative Ground	
Nominal Voltage	12.0 v	
Maximum Rev/Min.	15,000	18000
Maximum Output	70 Amps	100 Amps
Regulator Controlled Voltage	13.6 – 14.4 v	
Rotor Field Winding Resistance	2.9Ω	2.6 Ω
Stator Field Winding Resistance	0.2Ω	0.075 Ω
New Brush Length	20.0 mm (0.787 in)	
Minimum Brush Length	5.0 mm (0.197 in)	
Brush Spring Pressure	1.3–2.7 N (4.7–9.8 oz)	

TORQUE SPECIFICATIONS

	lbf ft	Nm
Alternator Through Bolts	4.0	5.5
Pulley Retaining Nut	52.0	70
Rectifier Attaching Screws	3.0	4.0
Regulator and Brushbox Screws	2.0	2.7
Terminal Nuts	2.0	2.7

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Description and Operation

Magnet Marelli (Lucas) A127 type alternators are fitted to all models. Used in 70 Amp form with an external cooling fan and in 100 Amp form with an internal cooling fan. The alternator is mounted high at the front of the engine and is driven from a crankshaft pulley via a 'poly vee' drive belt. The alternators feature integral regulators.

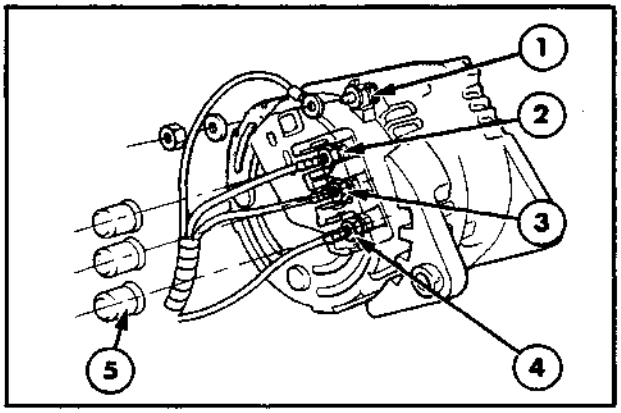


Figure 2-7-1

100 Amp Alternator

1. Ground Connection
2. Engine Speed Sensor Connection (W Terminal)
3. Warning Lamp (D+ terminal)
4. Output Connection (B+ Terminal)
5. Protective Terminal Sleeve

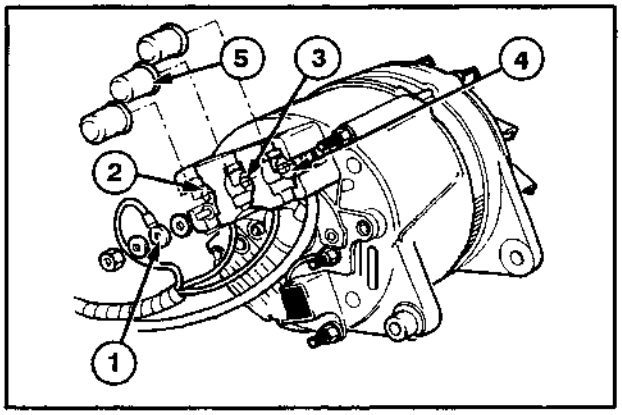


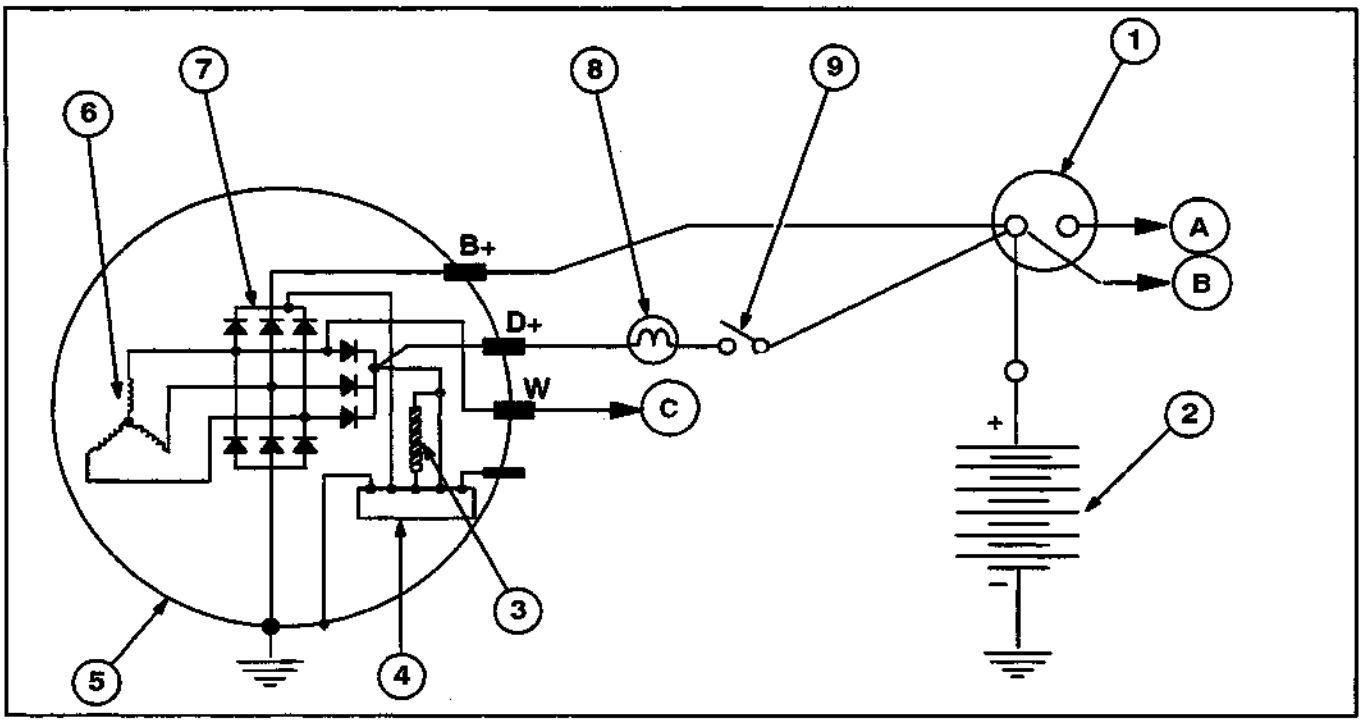
Figure 2-7-2

70 Amp Alternator

1. Ground Connection
2. Engine Speed Sensor Connection (W Terminal)
3. Warning Lamp (D+ terminal)
4. Output Connection (B+ Terminal)
5. Protective Terminal Sleeve

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Alternator Charging Circuit

Figure 2-7-3

A To Starter Motor
B To Starter Relay
C Speed Sensor Terminal to: Diagnostic Plug, EDC Module (CN1–34), EMU (C105–21), Semi–powershift module (CN1–15) and Instrument Panel

1. Starter Solenoid
2. Battery
3. Rotor Field Winding
4. Regulator
5. Alternator Frame
6. Stator Output Windings (45/70 Amp Alternators)
7. Rectifier Pack
8. Charge Indicator Lamp
9. Key Start Switch

Alternator Operation

With reference to Figure 2-7-3.

When the key start switch is turned on a small current flows from the battery through the rotor field wiring. The circuit is made via the charge indicator warning lamp, alternator terminal 'D+' the rotor field winding, the alternator regulator and ground.

At this stage the warning light is illuminated and the rotor partially magnetized.

When the engine is started and the partially magnetized rotor revolves within the stator windings a 3–phase alternating current is generated. A constant portion of the generated current is converted to direct current by the three field diodes incorporated in the rectifier pack.

This direct current is fed back to supplement the current flowing through the rotor field winding.

This action results in an ever increasing magnetic influence of the rotor along with an associated rapid rise in generated output current and voltage.

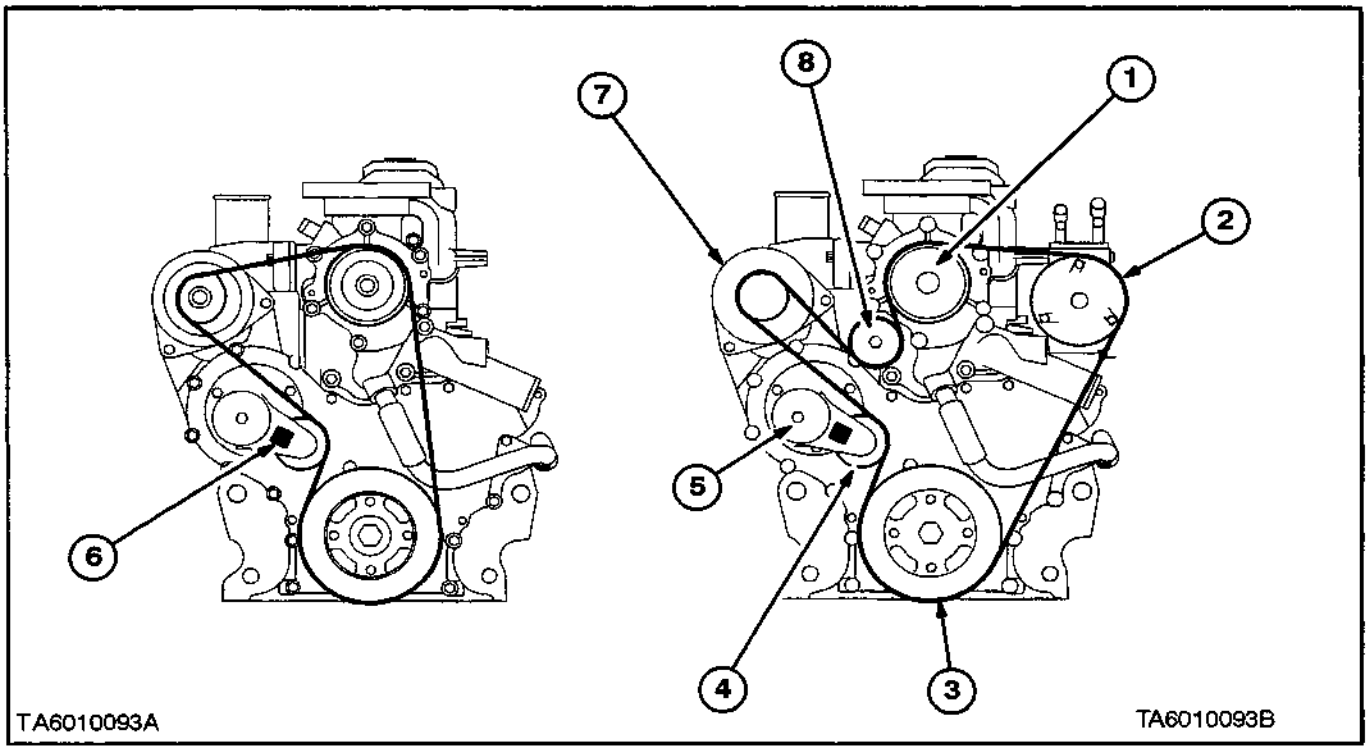
During the rise in generated output voltage (reflected at the 'D+' terminal) the brilliance of the warning lamp is reduced and when the voltage at the 'D+' terminal equates to that at the battery side of the warning light the lamp is extinquished.

The voltage continues to rise until the predetermined regulated voltage level is reached.

In the event of drive belt breakage the voltage will not build up within the alternator and so the charge indicator light will remain on to indicate failure.

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Fan Belt Tensioner

Figure 2-7-4

A. Fan Belt Less Air Conditioning

1. Water Pump Pulley
2. Air Conditioning Compressor (optional)
3. Crankshaft Pulley
4. Tensioner Pulley

B. Fan Belt With Air Conditioning

5. Tensioner Attaching Bolt
6. 1/2 inch (13 mm) Square Drive Hole
7. Alternator
8. Idler Pulley

SYSTEM TESTING AND FAULT FINDING

Service Precautions

To avoid damage to the components of the alternator charging system, service precautions must be observed as follows:

- **NEVER** make or break any of the charging circuit connections, including the battery, when the engine is running.
- **NEVER** short any of the charging components to ground.
- **ALWAYS** disconnect the battery ground cable (negative) when charging the battery on the tractor using a battery charger.
- **ALWAYS** observe correct polarity when installing the battery or using a slave battery to start the engine.

CONNECT POSITIVE TO POSITIVE AND NEGATIVE TO NEGATIVE

Preliminary Checks

Prior to electrical testing thoroughly inspect the charging and electrical system.

Check all leads and connections for continuity and tightness.

1. **Check the battery**

Using a hydrometer check the individual battery cells. The battery should be at least 70% charged and in good condition.

2. **Check the drive belt**

Inspect the alternator drive belt and pulley, ensuring that both are clean, free from oil and grease and in good condition.

The alternator drive belt is automatically tensioned by a spring tensioner mounted at the front of the engine, shown in Figure 2-7-4. If the the belt tension is suspect, check the tensioner assembly as follows:

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Fan Belt Tensioner Removal

1. The fan belt should be removed in the following manner. Place a lever with 1/2 inch (13 mm) square drive attachment into the 1/2 inch (13 mm) square hole of the tensioner arm and rotate the lever clockwise. Remove the fan belt from the pulley and allow the tensioner to return to its untensioned position once the belt has been removed.

2. Remove the tensioner from the pump by loosening and removing the center attaching bolt, item 6 Figure 2-7-4.

Inspection and Repair

1. Checking of the tensioner assembly operation should be carried out, with the tensioner assembly still attached to the front plate fuel injection pump gear cover. To check the spring load, place a "break back" torque bar pre–set to, 52 – 63 lbf ft (70 – 85 Nm) (7.1 – 8.7 kgf.m), into the pulley arm 1/2 inch (13 mm) square drive hole. Raise the lever up through an arc of 20° maximum. If the torque bar does not "break" within the range a new tensioner assembly is required.

2. Ensure the tensioner pulley rotates freely by hand. If not replace with new parts.

Re–Assembly

1. Fit a new pulley to the assembly if required, and torque the attaching bolt to, 34.5 – 44 lbf ft (46.5 – 60 Nm).

2. To re–assemble the arm assembly, position the tensioner on to the front plate fuel injection pump gear cover, fit the mounting bolt through the assembly, and torque the bolt to, 34.5 – 44 lbf.ft (46.5 – 60 Nm).

3. Refitment of the fan belt is the reverse of the removal procedure, but ensure the "Poly V" belt, is positioned correctly onto all of the pulleys.

3. Check the Warning Lamp

Turn on the key start switch and check that the warning lamp is fully illuminated.

If the warning lamp is not fully illuminated check the bulb. If the bulb is not the cause of the fault carry out the Alternator wiring connections test as detailed under 'initial tests' in this section.

If the warning lamp is illuminated start the engine and run above idling speed. The lamp should go out.

If the lamp does not go out, stop the engine and remove the wire from the D+ terminal. If the lamp now goes out a faulty alternator component is indicated. Conduct the 'Alternator components tests' as detailed in this section.

If the warning lamp remains illuminated, check for a short circuit to ground between the 'D+' cable end and the warning lamp.

INITIAL TESTS

The initial tests may be performed without removing any of the charging circuit components from the tractor and enable the following items to be checked:

- Alternator wire connections
- Alternator charging current and controlled voltage
- Alternator charging circuit volt drops
- Alternator maximum output performance

Test equipment required:

- Voltmeter (0–30 volts moving coil type)
- Millivoltmeter (0–1 volt)
- Ammeter (0–110 Amperes moving coil type)
- 1.5 Ohm 110 Amperes variable load resistor

NOTE: *Most commercial test equipment incorporates several testing devices within a single unit . Use such equipment in accordance with the manufacturers instructions.*

1. Alternator Wiring Connections Test

With reference to Figure 2-7-5.

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1. Disconnect the battery
2. Disconnect the B+(2) and D+(3) terminals from the alternator.
3. Reconnect the battery and turn the key start on but do not start the engine. Connect a voltmeter(4) between each terminal and ground, (1). Battery voltage should be registered.

If battery voltage is not registered a continuity fault in the external cable circuitry must be traced and remedied, refer to the circuit diagram shown in Figure 2-7-3.

4. Connect the D+ terminal, warning lamp (brown/yellow) wire, to ground. The warning lamp should illuminate.
5. Disconnect the battery and reconnect the removed alternator cable connections to the alternator.

NOTE: *If the warning lamp fails to illuminate when the cable is reconnected to the alternator, a fault is indicated in the alternator regulator or rotor circuits. Ensure that the D+ terminal is clean and then conduct the alternator component tests as detailed in this section.*

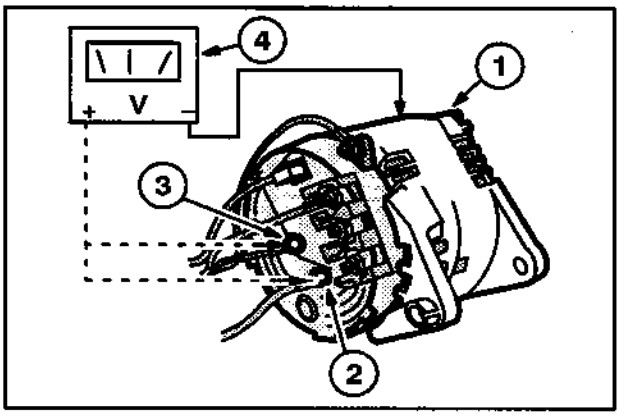


Figure 2-7-5

2. Charging Current And Controlled Voltage Tests

With reference to Figure 2-7-6.

1. Ensure all tractor electrical components are switched off and the key start switch is in the 'off' position.
2. Disconnect the battery negative terminal and disconnect the B+ terminal(4) of the alternator.
3. Connect an ammeter(1), between the removed (brown) cable(3) and the B+ alternator terminal.
4. Connect a voltmeter(2) between the alternator B+ terminal and ground
5. Reconnect the battery. Start and run the engine at 2000 rev/min. and observe the ammeter and voltmeter readings.

The voltmeter should register in excess of battery voltage and when the ammeter reading falls below 10 Amperes the voltmeter reading should stabilize at 13.6–14.4 volts.

If the voltmeter reading exceeds 14.4 volts the alternator regulator must be replaced as described in this section. (when a new regulator has been installed conduct tests 4 and 5).

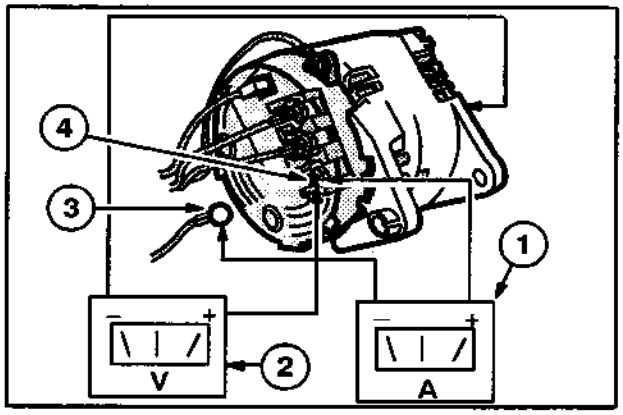


Figure 2-7-6

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If the voltmeter reading is below 13.6 volts a faulty alternator component or a high resistance fault in the external connections of the charging system is indicated.

If the ammeter registers zero amperes a faulty alternator component is indicated. Turn off the engine and conduct the 'alternator component tests' as detailed in this chapter.

3. Charging Circuit Volt Drop Tests

(a) Insulated–Side Volt Drop Tests

With reference to Figure 2-7-7.

Ensure the key start switch is in the 'off' position.

1. Disconnect the battery negative cable and disconnect the B+ cable(1) from the alternator
2. Connect a millivoltmeter(4) between the battery positive terminal and the B+ cable(5). (Positive side to cable).
3. Securely connect an ammeter(2) between the B+ terminal of the alternator and the B+ cable (negative side to cable)
4. Reconnect the battery negative cable and connect a variable load resistor(3), with the slider in the minimum current draw position (maximum resistance), across the battery terminals.
5. Start the engine and increase the speed to 2000 rev/min.
6. Slowly increase the current loading of the resistor (decrease resistance) until the ammeter registers 70 or 100 Amperes depending on alternator type.
7. Observe the millivoltmeter reading which should not exceed 400 millivolts.

If the reading is in excess of 400 millivolts, a high resistance fault is indicated in the external circuitry.

If the required alternator output cannot be achieved and the millivoltmeter reading is less than 400 millivolts, then a faulty alternator component is indicated. Conduct the' alternator component tests' as detailed in this section.

8. Stop the engine.

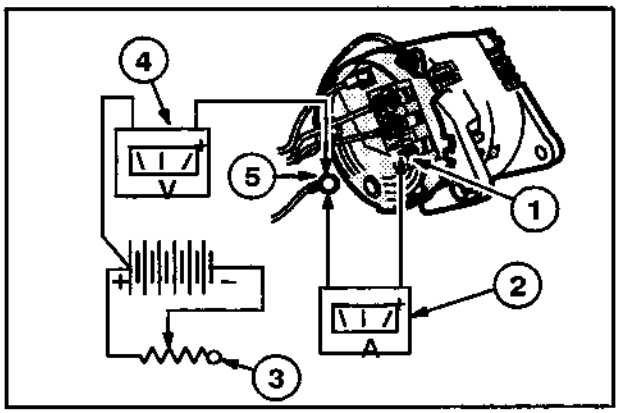


Figure 2-7-7

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(b) Ground–Side Volt Drop Test

With reference to Figure 2-7-8.

1. Ensure the key start switch is in the 'off' position.
2. The circuit is the same as that used in the previous test except for the millivoltmeter(4) which is now connected between the battery negative terminal and the alternator frame (negative side to frame).

NOTE: *Ensure the variable load resistor(3) is in the minimum current draw position (maximum resistance).*

3. Start the engine and increase the speed to 2000rev/min.
4. Slowly increase the current loading of the resistor (decrease resistance) until the ammeter(2) registers 70 or 100 Amperes depending on alternator type.
5. Observe the voltmeter reading which should not exceed 200 millivolts.

If the reading is in excess of 200 millivolts a high resistance fault is indicated in the external circuitry.

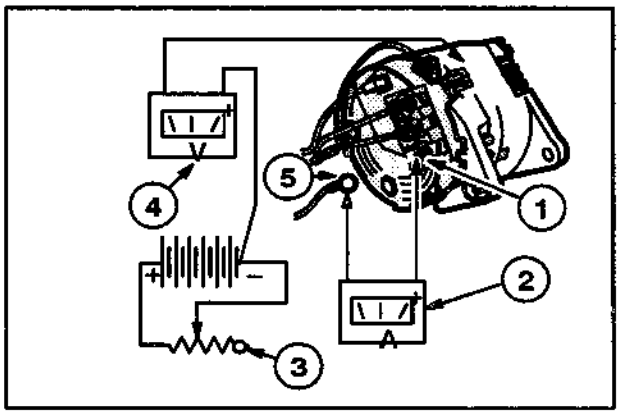


Figure 2-7-8

If the required alternator output cannot be achieved and the millivoltmeter reading is less than 200 millivolts then a faulty alternator component is indicated. Conduct the alternator component tests as detailed in this section.

6. Stop the engine.

4. Alternator Maximum Output Performance Test

With reference to Figure 2-7-9.

1. Ensure the key start switch is in the 'off' position.
2. Disconnect the battery negative cable and disconnect the B+ cable (5) from the alternator.
3. Securely connect an ammeter(2) between the B+ terminal(1) of the alternator and the B+ cable (negative side to cable).
4. Connect a voltmeter(4) between the alternator B+ terminal and ground.
5. Reconnect the battery, start and increase the engine speed to 2000 rev/min.

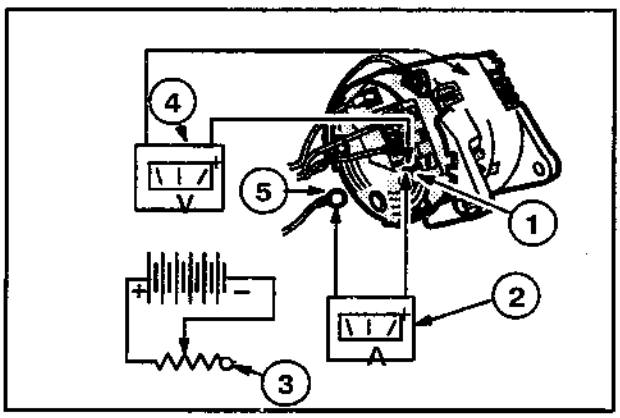


Figure 2-7-9

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6. Slowly increase the the current loading of the resistor(3) (decrease resistance) until the ammeter registers either 70 or 100 Amperes depending on alternator type.

7. Observe the voltmeter reading which should not fall below 13.6 volts

If the reading falls below 13.6 volts a faulty alternator component is indicated. Conduct the 'alternator component tests' as detailed in this section.

ALTERNATOR COMPONENT TESTS

The component tests which should only be conducted if the INITIAL TESTS have indicated a faulty alternator component, will enable the following items to be checked:

- Regulator
- Rotor Field Winding Continuity
- Brushes and Springs and Rotor Slip Rings

NOTE: *The component tests detailed previously may be performed with the alternator installed on the tractor. Testing of the other alternator components will necessitate removal of the alternator from the tractor. Refer to the 'Overhaul' section of this Chapter.*

IMPORTANT: *Prior to removal of the alternator cables from the alternator ensure that the key start switch is in the 'off' position and the battery negative cable is disconnected.*

Test equipment required:

- 12 volt battery
- Multimeter
- 2.2 Watt Test Lamp

1. Regulator and Rotor Field Circuit Test

With reference to Figure 2-7-10

1. Disconnect all of the alternator cables.

2. Connect a 12 volt battery and a 2.2 Watt test lamp(2) in series between the D+(1) and the alternator frame (negative side to frame).

3. The test lamp should illuminate.

If the test lamp is not illuminated a fault is indicated in the rotor circuit. Check brushes, slip rings and continuity of rotor field windings.

If examination indicates these parts to be satisfactory the regulator may be suspect.

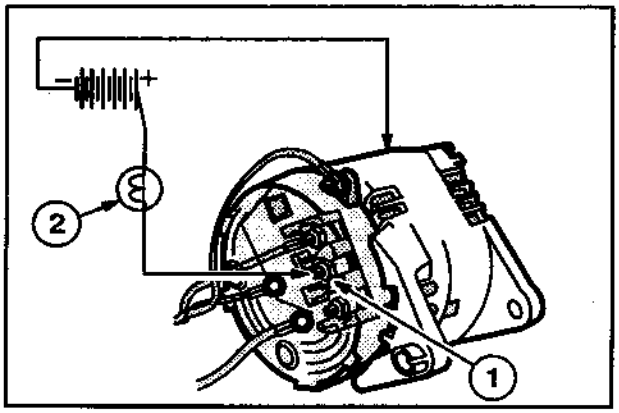


Figure 2-7-10

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2. Rotor Field Winding Continuity Test

With reference to Figure 2-7-11

1. Remove the regulator and brushbox assembly as described in this chapter.
2. Connect an ohmmeter(3) between the two slip rings(2). The resistance should read 2.6 ohms at 20°C (68°F).

If the resistance is outside of the specification renew the rotor(1) as detailed in the following overhaul section.

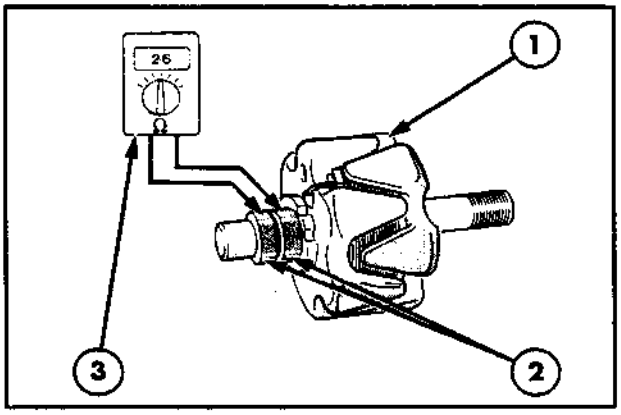


Figure 2-7-11

3. Brushes–and–Springs and Rotor Slip Rings

1. Remove the regulator and brushbox assembly as described in this Chapter.
2. Ensure the brushes and slip rings are clean and check for freedom of movement of the brushes in the brushbox moulding.
3. Check the brush spring pressure with a push type spring gauge and record the spring pressure when the brush end face is flush with the moulding. Install a new regulator and brushbox assembly if the pressure is less than specified.

If the visible length of the brushes(1) in the free position is less than 0.25 in. (5mm) this is a probable cause of open circuit in the field circuit and the regulator and brushbox assembly should be renewed, Figure 2-7-12.

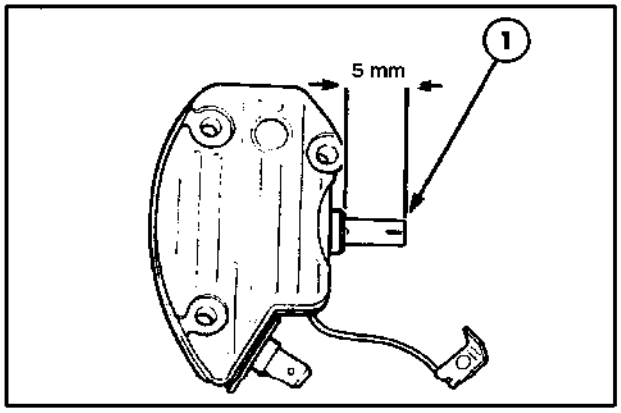


Figure 2-7-12

NOTE: *The brushes are an integral part of the regulator and brushbox assembly and cannot be replaced as individual items.*

ALTERNATOR OVERHAUL AND COMPONENT TESTING

Alternator Removal

With reference to Figure 2-7-13

1. Disconnect the battery negative cable.
2. Disconnect the four cables from the rear of the alternator.
3. Remove the alternator drive belt in the following manner. Place a lever with socket attachment, onto the tensioner retaining bolt and gently lever the tensioner up, Figure 2-7-4. Remove the fan belt from the pulley, and allow the tensioner to return to its untensioned position once the belt has been removed.
4. Remove the alternator arm(2) and the lower mounting through bolts and remove the alternator(1) from the engine bracket(3).

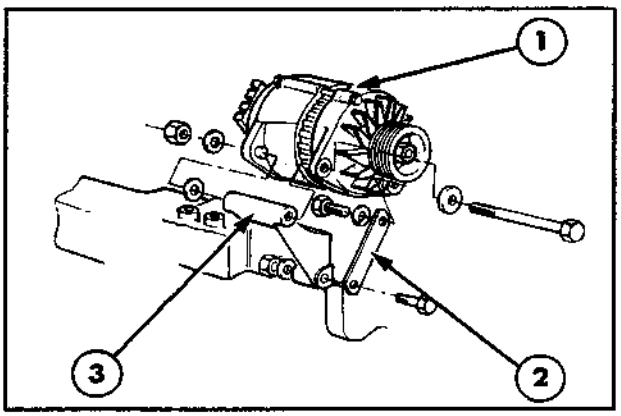
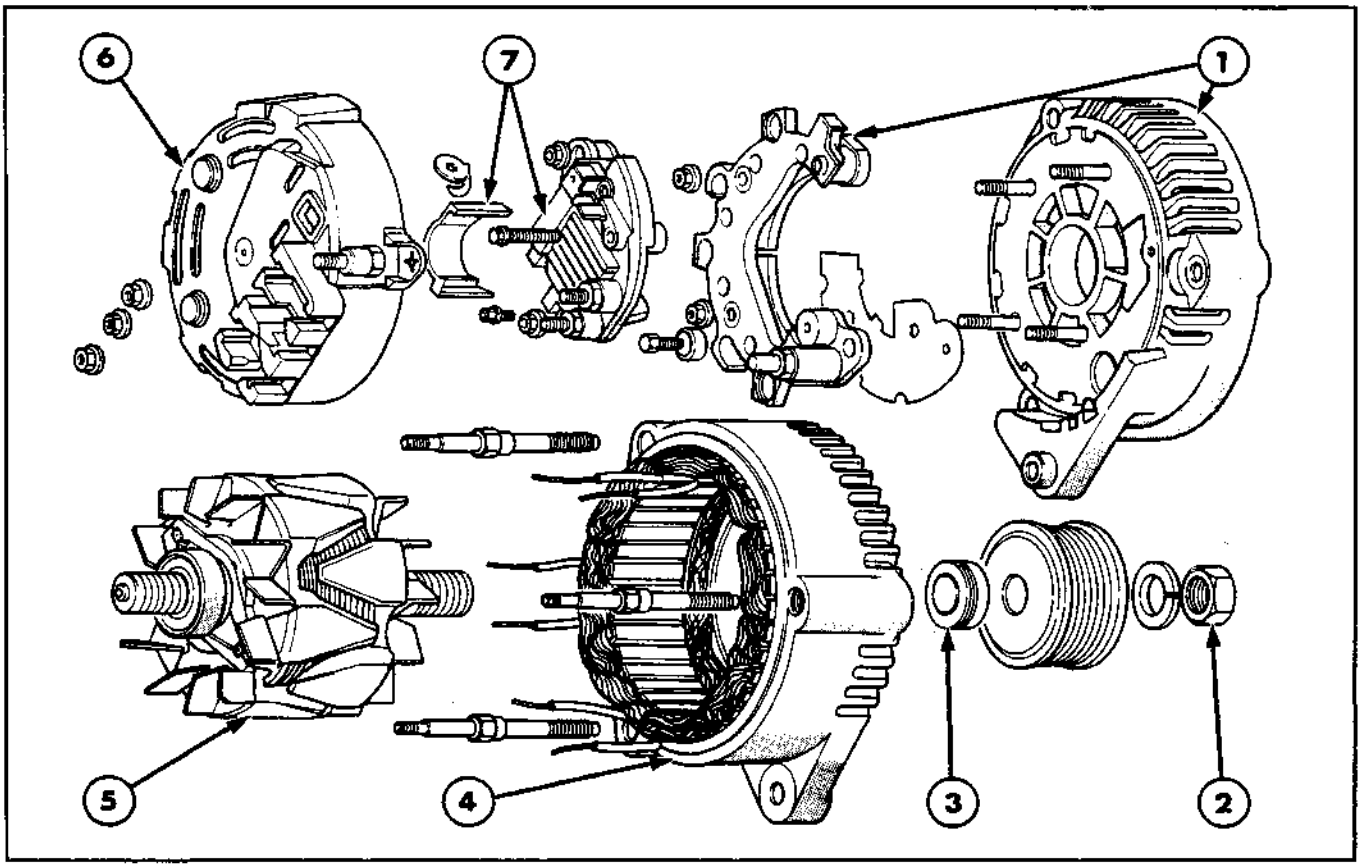


Figure 2-7-13

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100 Amp Alternator Components

Figure 2-7-14

1. Rectifier and Housing Assembly
2. Pulley Retaining Nut
3. Spacer
4. Stator and Housing Assembly
5. Rotor Assembly
6. End Cover
7. Regulator and Brushbox Assembly

Disassembly – 100 Amp Alternator

With reference to Figure 2-7-14

1. Remove the three nuts securing the plastic end cover.

2. Remove the nut securing the blue wire to the warning lamp terminal and disconnect the wire. Remove the two bolts and two nuts securing the regulator and brushbox assembly, withdraw the assembly from the alternator.

3. Using a suitable soldering iron, unsolder the six wires from the stator to rectifier.

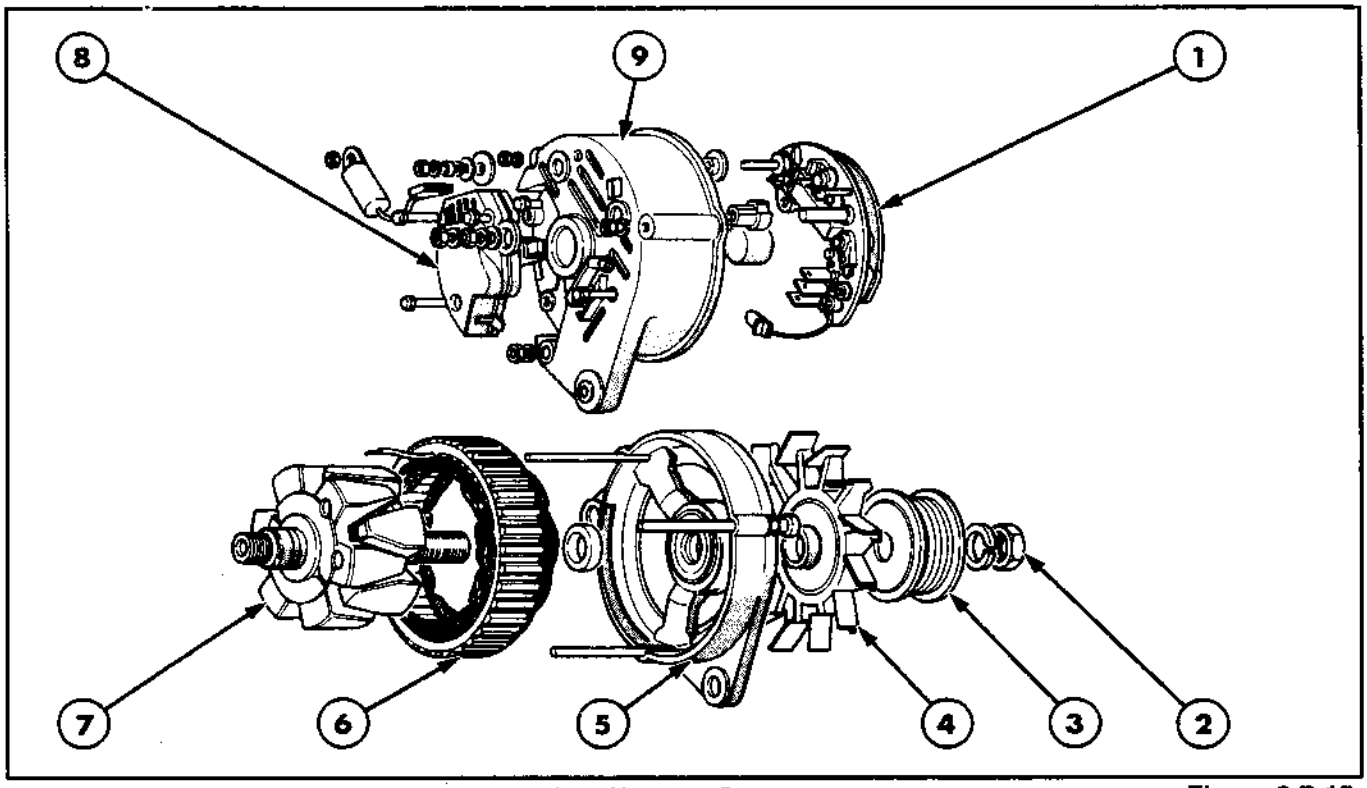
4. Remove the three nuts securing the two halves of the outer casing. Mark each half of the casing to aid reassembly and carefully pull the casing apart, it may be necessary to gently tap the casing on the mounting lugs.

5. Remove the nut securing the pulley to the rotor shaft and withdraw the rotor from the casing.

6. It is not necessary to remove the rectifier from the casing as these are serviced as one unit.

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70 Amp Alternator Components **Figure 2-7-15**

1. Rectifier assembly
2. Pulley Retaining Nut
3. Pulley
4. Cooling Fan
5. Front End Housing
6. Stator
7. Rotor
8. Regulator and Brushbox assembly
9. Rear End Housing

Disassembly – 70 Amp Alternator

With reference to Figure 2-7-15.

1. Remove the four nuts securing the terminal block to the alternator.

2. Remove the nut from the temperature sensor terminal block.

3. Remove the three securing bolts and withdraw the regulator/brushbox assembly.

4. Unscrew and remove the remaining three nuts from the alternator through bolts. With a soft mallet tap the threaded end of the through bolts to release the spline at the hexagon head end.

5. Mark the alternator front end bracket, stator and rear end bracket to ensure correct alignment on reassembly.

6. Gently tap the rear face of the alternator front end bracket to separate the front end bracket and rotor assembly from the rear end bracket, stator and rectifier assembly.

7. Remove the nuts, washers and insulators from the stud terminals on the alternator rear end bracket and the two rectifier retaining screws. Remove the stator and rectifier from the rear end bracket.

8. Unsolder the stator leads from the tags on the rectifier, using a pair of pliers as a heat sink to prevent the diodes from overheating.

9. Remove the nut, washer, pulley, fan and spacer from the rotor shaft.

10. Press the rotor shaft out of the front end bracket bearing.

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COMPONENT TEST

Rectifier Assembly – Diode Testing 100 Amp Alternator

With reference to Figure 2-7-16.

1. Test each of the nine diodes separately, using a multimeter with a diode check facility or a multimeter set on the resistance scale.

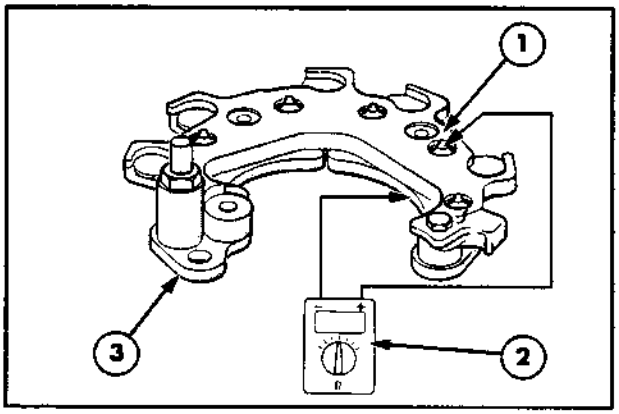


Figure 2-7-16

2. Connect one test lead onto the lower plate(3) and the other to the diode pin(1). On a multimeter(2) with the diode check facility, note if a reading of 0.49 (volts) is shown. Reverse the test lead connections. The meter should indicate 0.49 (volts) during one half of the test and 0 volts with the leads reversed. Repeat this test on all nine diodes. If any one diode fails this test it will be necessary to replace the rectifier and housing assembly.

3. Where only an ohmmeter is available repeat the above test observing the following results, 0 ohms with leads in one direction and when the test leads are reversed a reading of between 900–1000KΩ, again if any one diode fails this test it will be necessary to replace the rectifier and housing assembly.

Rectifier Assembly – Positive / Negative Diode Testing 70 Amp Alternators

With reference to Figure 2-7-17. Test each of the six diodes separately as follows:

1. Connect a multimeter (2) in series with one of the diodes. One test lead is applied to the diode connecting pin(1) and the other lead to the plate into which the diode is mounted.

2. Note the resistance shown on the multimeter. Reverse the test lead connections.

3. The multimeter should indicate an open circuit (infinity ohms) during one half of the test only. If any one diode fails this test the complete rectifier will need replacing.

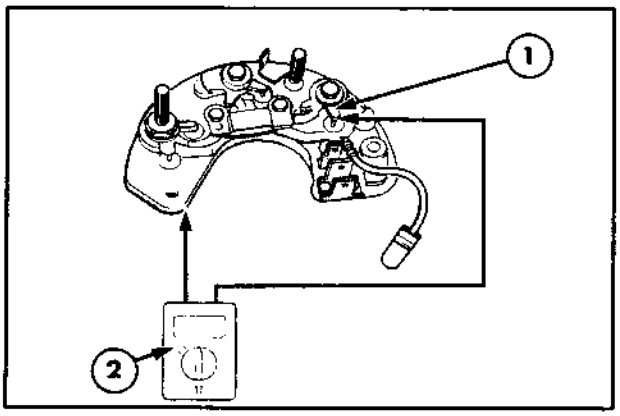


Figure 2-7-17

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Rectifier Assembly – Field Diode Testing 70 Amp Alternators

With reference to Figure 2-7-18. Test each field diode separately as follows:

1. Connect a multimeter (2) in series with the field diode module. Apply the negative test lead to the D+ terminal connection (1) and the other lead in turn to each of the field diode connections (3).

2. Note the resistance shown on the multimeter. Reverse the test lead connections.

3. The multimeter should indicate an open circuit (infinity ohms) during one half of the test only. If any one diode fails this test the complete rectifier will need replacing.

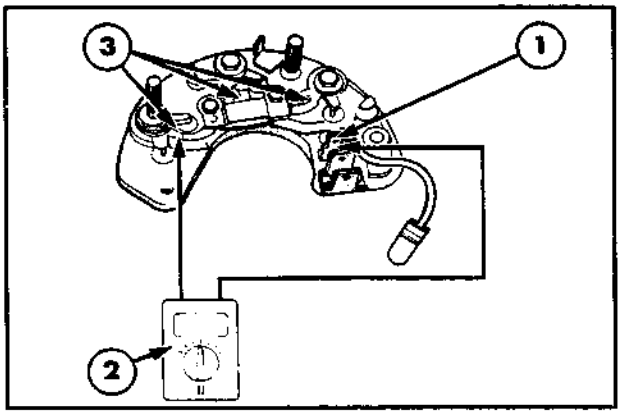


Figure 2-7-18

Rectifier Insulation 100 Amp Alternator

With reference to Figure 2-7-19.

1. Check the insulation of the rectifier to the casing. With an ohmmeter (2), connect the test leads between the alternator casing (3) and the positive plate of the diodes (1). An infinity reading should be displayed, therefore indicating an open circuit. If a resistance of any kind is indicated, i.e, a short circuit, the rectifier and housing assembly should be replaced.

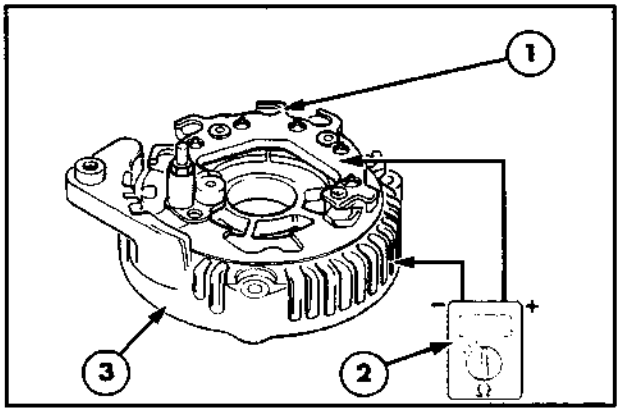


Figure 2-7-19

Stator Test – Winding Continuity 100 Amp Alternator

With reference to Figure 2-7-20.

1. Connect the ohmmeter (2) test leads between the pairs of wires, A, B and C. There should be a small resistance of 0.1Ω, between each pair of wires. If a resistance higher than this is registered it will indicate a possible break within the winding, i.e, an open circuit. A lower reading, for example 0.0Ω will indicate a short circuit within the winding. If any one of the three pairs of wires fail the test a new stator (1) and housing assembly will be required.

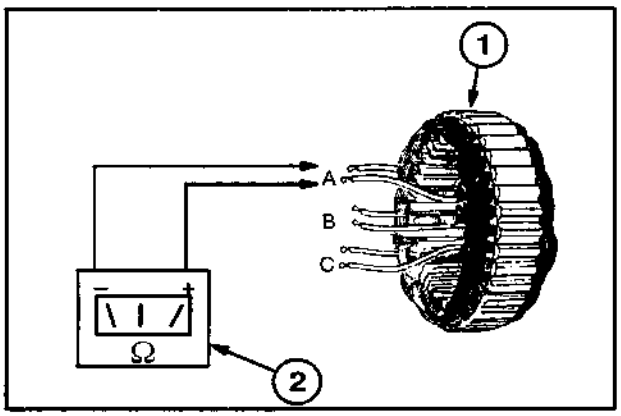


Figure 2-7-20

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Stator Test – Winding Continuity
70 Amp Alternators

With reference to Figure 2-7-21

1. Connect the ohmmeter(3) test leads between the A, B and C wires(2). There should be a small resistance of 0.1Ω, between each of the wires. If a resistance higher than this is registered it will indicate a possible break within the winding, i.e, an open circuit. A lower reading, for example 0.0Ω will indicate a short circuit within the winding. If the test proves unsatisfactory a new stator(1) and housing assembly will be required.

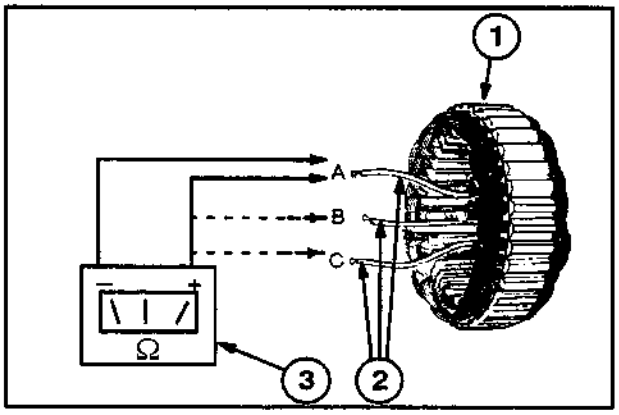


Figure 2-7-21

Stator Test – Insulation
100 Amp Alternator

With reference to Figure 2-7-22.

1. Check the insulation of each pair of windings to each other and then each pair to the alternator casing. There should be no continuity between the three pairs of windings and no continuity to the casing. If any ohmmeter(2) reading other than open circuit is indicated in any test it will be necessary to replace the stator(1) and housing assembly.

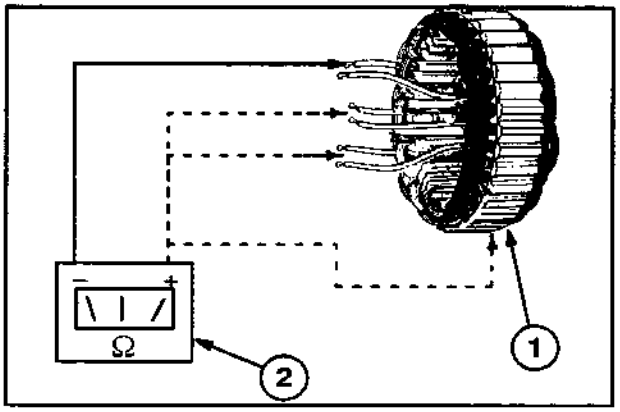


Figure 2-7-22

Stator Test – Insulation
45 and 70 Amp Alternators

With reference to Figure 2-7-23

1. Check the insulation of each winding to the alternator casing. There should be no continuity between the winding and the casing. If any ohmmeter(2) reading other than open circuit is indicated it will be necessary to replace the stator(1) assembly.

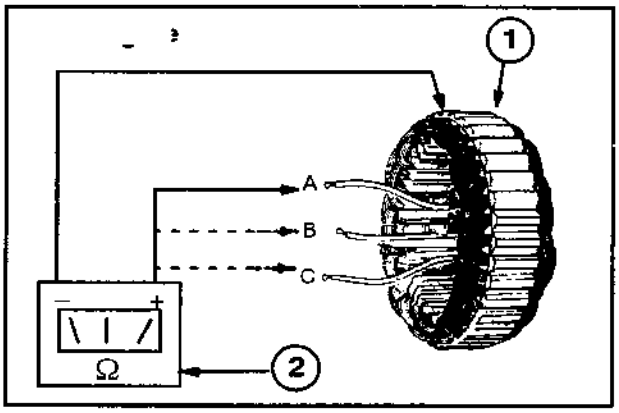


Figure 2-7-23

Rotor Test

Prior to performing component tests on the rotor the following slip ring inspection should be carried out.

1. Ensure the slip rings are clean and smooth. If necessary the slip rings may be cleaned with a petrol moistened cloth. If the slip rings are burnt and require re–finishing use very fine glass paper (not emery cloth) and wipe clean.

NOTE: *Ensure the re–finishing glass paper is sufficiently fine to produce a highly polished slip ring surface otherwise excessive brush wear will occur.*

2. If the slip rings are excessively worn a new rotor must be installed.

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Rotor Field winding Continuity

with reference to Figure 2-7-24

1. Connect an ohmmeter(3) between the two slip rings(2). The resistance should read 2.6 ohms at 20°C (68°F).

If the resistance is outside of the specification renew the rotor(1).

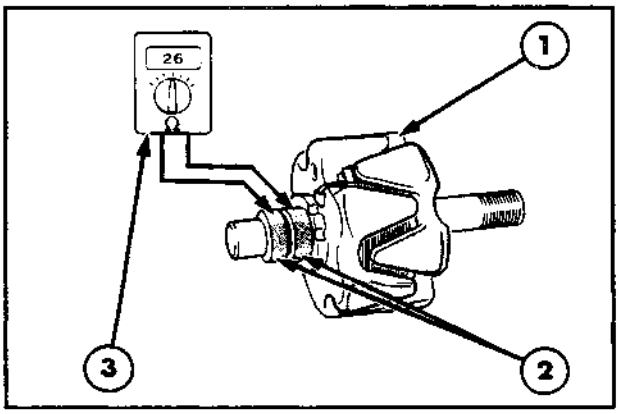


Figure 2-7-24

Rotor Field Winding Insulation

With reference to Figure 2-7-25.

1. Using an ohmmeter(3) test between each of the slip rings(2) and the rotor poles(1). An infinity reading should be indicated in each case. If any resistance reading is indicated the rotor assembly must be replaced.

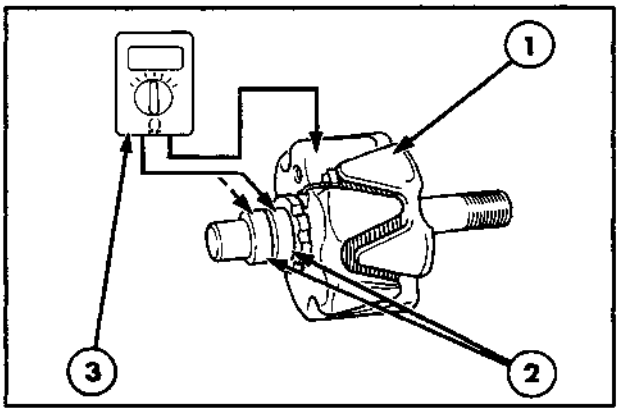


Figure 2-7-25

INSPECTION AND REPAIR

1. Inspect the rotor poles and stator for signs of rubbing. Areas of rubbing indicates possible worn bearings, misaligned housings or a bent rotor assembly shaft.

NOTE: *Both end bearings of the 100 Amp alternator and the front bearing of the 70 Amp alternator are not serviced separately. It will be necessary to either obtain a new rectifier and housing or stator assembly to renew worn bearings.*

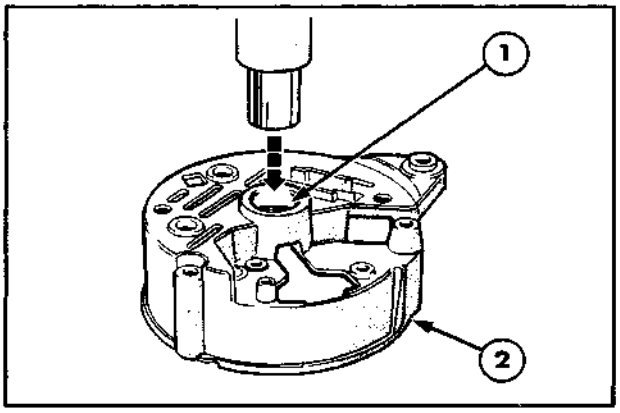


Figure 2-7-26

2. Inspect the roller bearing(1) of the 70 Amp alternator located in the rear (slip ring) end bracket(2) for wear and damage

3. If bearing replacement is necessary support the housing (rear end bracket) and using a suitable size mandrel carefully drive out the bearing, Figure 2-7-26.

4. Clean and examine all components.

5. Press the new bearing(2) into the housing(1). The bearing should be positioned .020–.028in (0.50–0.70mm) proud of the inner face of the bearing boss as shown at item (3), Figure 2-7-27.

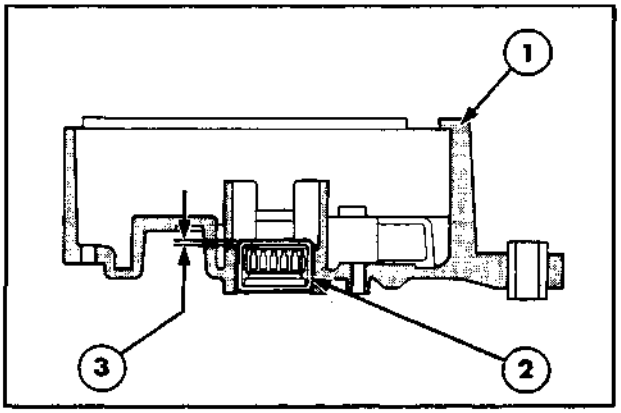


Figure 2-7-27

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RE–ASSEMBLY

1. Re–assembly of the alternator follows the disassembly procedure in reverse.

On reassembly of the 70 Amp alternators observe the following:

- To avoid misalignment of the end brackets, install the stator assembly in the drive end bracket then assemble the slip ring end bracket to the stator laminations.

INSTALLATION

1. Installation of the alternator is the removal procedure in reverse.

On installation observe the following:

- Ensure the battery ground (negative) cable is disconnected from the battery when installing the alternator.
- Adjust the alternator drive belt as previously described in this Chapter.

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SECTION 2
ELECTRICAL SYSTEM

CHAPTER 8
BATTERY

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SPECIFICATIONS

	Standard
Capacity (Ampere hour at 20 hour rate)	95
Cold Cranking Ampere Rating	900
Voltage	12
Cells	6
Ground Terminal	Negative

DESCRIPTION AND OPERATION

All tractor models feature two 12 volt, negative ground, 'maintenance free' lead calcium (Pb–Ca) type batteries, of six cell construction.

NOTE: *'Maintenance Free' means that under normal charging conditions the battery does not loose water from the electrolyte. Conditions that may cause water loss include prolonged charging above 14.4volts where gassing occurs as it approaches full charge. This can be caused by a faulty charging system or boost/recovery charging equipment.*

Dual 95 ampere hour at 20 hours, 900 c.c.a, (cold cranking amps) batteries is the standard.

The batteries are mounted in front of the radiator on all models, one on top of the other and are wired in parallel.

Wiring the batteries in parallel adds the c.c.a. capacity of the batteries.

The battery has four major functions:

- To provide a source of current for starting, lighting and instrumentation.
- To help control the voltage in the electrical system.
- To furnish current when the electrical demands exceed the alternator output.
- To support quiescent loads from radio and micro processor memory.

The battery is constructed in such a manner that each cell contains positive and negative plates placed alternatively next to each other. Each positive plate is separated from a negative plate by a non–conducting porous envelope separator. If any of the positive plates should make contact with negative plates within a cell, the cell will short circuit and suffer irrepairable damage. All of the positive plates are welded to a bus–bar, forming a positive terminal and all of the negative plates are welded to a similar bus–bar forming a negative terminal.

Each positive plate is composed of a lead grid with lead peroxide pasted into the grid openings. The negative plates are composed of a lead grid with spongy lead pasted into the grid openings.

The plates are submerged in a liquid electrolyte solution of diluted sulphuric acid.

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REMOVAL AND INSTALLATION

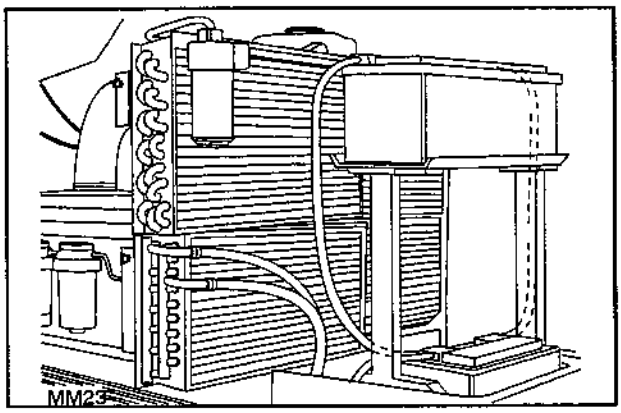


Figure 2-8-1

Top Battery

1. Lift the engine hood.
2. First disconnect the ground lead from the tractor frame to the **lower** battery negative terminal and secure away from frame.
3. Disconnect the positive and negative leads from the top battery and secure away from battery.
4. Loosen the bolts of both clamps and slide one clamp away.
5. Using the flexible handles at each end of the battery, lift the battery from the tractor.

Lower Battery

Remove the top battery tray and supports.

1. Disconnect the positive lead from the battery terminal and secure out of the way.
2. Loosen the bolts securing both battery clamps and slide one clamp out of the way.
3. Using the flexible handles at each end of the battery, lift the battery from the tractor.

Installation

1. Installation of the battery is the removal procedure in reverse, observing the following points:

- Ensure that the battery is clean and dry and that the vent caps are fully installed. Smear the terminals with petroleum jelly (vaseline or equivalent), do not use conventional lubricating greases as these can promote electrolytic corrosion.
- Ensure the battery tray and clamps are clean and free from stones or small objects which may puncture the battery casing.
- Ensure that the battery terminal polarity is correct and that the terminal connections are sufficiently tight, but not overtightened.
- The radio, if fitted, will lose its stored information and will require re–programming. It should be noted that on models with electronic instrument panel and micro–processors, that these components will not lose their memories, i.e, electronic draft control and transmission calibrations will not be affected.

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BATTERY MAINTENANCE AND TESTS

Specific Gravity

The specific gravity of the battery electrolyte indicates the state of charge. Fully charged the specific gravity of the electrolyte is 1.280 minimum at 25°C (77°F).

Alternatively the approximate state of charge can be measured by using an accurate digital volt meter (+/– 0.01V) as follows:–

Less than 10.5V Battery un–serviceable*
Less than 11.8V Battery discharged
Less than 12.3V Battery 1/2 charged
Better than 12.6V Battery fully charged

* See note under tests for possible recovery of a mildly sulphated battery.

Battery voltage to be taken with the battery unloaded and:–
A) After the battery has rested unloaded for at least 4 hours.
B) If the vehicle has recently run or battery has recently been charged, switch on headlamps for 2 minutes.

When a battery discharges, sulphuric acid in the electrolyte combines chemically with the plates and this action lowers the specific gravity of the solution.

A battery hydrometer will determine the specific gravity of the electrolyte in a cell and the amount of unused sulphuric acid in the solution is a measure of the degree of charge of that cell.

The lower the temperature at which a battery is required to operate, the more necessary it is that the battery is maintained in a fully charged condition. For example a battery with a low specific gravity of 1.225 at 27°C (80°F) will operate the starting motor at warm ambient temperatures but may not, due to lower battery efficiency at a low temperature.

Table 1 shows the effect of temperature on the efficiency of a typical battery.

Table 1

Temperature	Efficiency of a Fully Charged Battery
25.0°C (77.0°F)	100%
–4.5°C (23.9°F)	82%
–24.0°C (–11.2°F)	64%
–27.5°C (–17.5°F)	58%
–31.0°C (–23.8°F)	50%
–34.5°C (–30.1°F)	40%
–37.5°C (–35.5°F)	33%

Maximum battery life will be obtained if the correct care and periodic inspection is given. It is important that output capacity should not be exceeded by constant and excessive overloading and that charging requirements are maintained.

Servicing The Battery

⚠ WARNING ⚠

Batteries contain sulphuric acid and during charging generate a highly explosive mixture of hydrogen and oxygen gases.

- *Never use equipment that generates flames or sparks in order to control electrolyte level*
- *Do not remove the battery cover plugs without protection for eyes and hands.*

When servicing a battery the following steps should be observed:

1. Maintain the electrolyte to the recommended level of 17 mm (0.67 in.) above the plates. If this is not observed the acid will reach a high concentration that will damage the separators and impair the performance of the plates.
2. Use only distilled or de–mineralized water, do not overfill and never use tap water or water from a rain barrel or other source.
3. Always keep the battery at least 75% charged otherwise the plates will become sulphated and loss of efficiency will result with possible damage from freezing at low temperatures.
4. Avoid overcharging the battery as excessive charging will create high internal heat that will cause plate grid deterioration and produce water loss.
5. When fast charging ensure the battery temperature does not exceed 50°C (122°F).

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6. Do not add sulphuric acid to a cell unless the electrolyte has been lost through spilling. Before replenishing ensure the solution is at the correct specific gravity. A slow charge is the only method to be employed to fully charge a battery. A high rate charger can be used to quickly boost the battery capacity but this must be followed by a slow charge rate to bring the battery to full capacity.

Dry Charged Batteries

Dry charged batteries must be prepared for service as follows:

1. Remove the battery cell vent plugs.
2. Fill each cell to the recommended level with electrolyte of 1.260 specific gravity.

NOTE: *The electrolyte must be diluted sulphuric acid preferably at a temperature of 21°–32°C (70°–90°F).*

3. After filling, allow the battery to stand for 15 minutes then re–check the electrolyte level and top up if necessary.
4. Charge the battery for 4 hours at a rate of 5–8 amperes and check that all cells are gassing freely.
5. Install the battery cell vent plugs.

Charging The Battery

Before charging a battery:

1. Thoroughly clean the battery casing and cell covers with dilute ammonia or hot water and clean the terminals.
2. Check the level of the electrolyte in each cell and, if below plates, add distilled water to bring above plate level.

Normal (Top–up) Charging

1. With a slow charger use a rate of 3 to 6 amperes for the time necessary to bring the battery to full charge. This may take 36 hours or more if the battery is heavily discharged. A severely sulphated battery might not accept a charge. When the battery is fully charged the cells will gas freely and the specific gravity will remain constant. Remove the charger after three consecutive hydrometer readings taken at hourly intervals indicate that the specific gravity has stopped rising.
2. When using a fast or high rate of charge carefully follow the manufacturers instructions. High rate charging raises the temperature of the electrolyte and unless the charger is equipped with an automatic time or temperature device, the electrolyte temperature could exceed 50°C (122°F), which may cause violent battery gassing and damage to internal components.
3. Re–check the level of electrolyte in each cell and add distilled water as necessary.

⚠ WARNING ⚠

When a battery is being charged an explosive gas is produced. Do not smoke or use an exposed flame when checking the electrolyte level and ensure the charger is switched off before connecting or disconnecting to avoid sparks which could ignite the gas.

Recharging Deeply Discharged Batteries

The recommended method to recharge a maintenance free Pb–Ca battery is to use a constant voltage charger. For deeply discharged batteries a 48 hours charging period at 16volts is recommended, with current limitation, (47.5A for 95Ah).

This system is self regulating: high current is delivered at the beginning (when battery voltage is low), lower and lower current is then absorbed when battery reaches full charge (and its voltage is high).

If only constant current chargers are available it is recommended to use the current levels and times shown Table 2 below. The figures are intended for deeply discharged batteries. If the battery is only 50% discharged use one half of the time listed (slow charge programs). For other states of discharge reduce proportionally the time of charge. Whenever possible use the slowest charge program to increase the battery's life.

If when charging the battery, violent gassing or spewing of electrolyte occurs, or the battery case feels hot (50°C [122°F] or greater), reduce or temporarily halt charging to avoid damaging the battery.

Table 2	Battery Type
	95Ah (900 cca)
Slow Charge Programs	25hrs at 5A 12.5hrs at 10A
Fast charge Program (emergencies only)	7hrs at 18A

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Tests

Before commencing battery tests check the battery for clogged vents, corrosion, raised vent plugs or a cracked case.

Test equipment required:

- Hydrometer
- Battery starter tester (High rate discharge tester)
- Thermometer
- Battery Charger

Specific Gravity: This test will determine the state of battery charge.

1. With the float in the vertical position take the reading.
2. Adjust the hydrometer reading for electrolyte temperature variations by subtracting 4 points (0.004 specific gravity) for every 5.5°C (10°F) below the temperature at which the hydrometer is calibrated and by adding 4 points (0.004 specific gravity) for every 5.5°C (10°F) above this temperature.

The following examples are calculated using a hydrometer calibrated at 30°C (86°F).

Example 1:
Temperature below 30°C (86°F)

Electrolyte temperature	19°C (66°F)
Hydrometer reading	1.270
Subtract $\frac{11.0}{5.5}$ x 0.004	0.008
Corrected specific gravity =	1.262

Example 2:
Temperature above 30°C (86°F)

Electrolyte temperature	40°C (104°F)
Hydrometer reading	1.220
Add $\frac{10.0}{5.5}$ x 0.004	0.007
Corrected specific gravity =	1.227

3. Use the following table to determine the state of charge.

State of Charge	Corrected Specific Gravity @15°C (59°F)	Corrected Specific Gravity @25°C (77°F)	Average Battery Voltage
100%	1.295	1.287	12.76
75%	1.253	1.246	12.52
50%	1.217	1.210	12.30
25%	1.177	1.170	12.06
Discharged	1.137	1.130	11.84

NOTE: *Specific gravity should not vary more than 0.025 points between cells.*

4. If the specific gravity is 1.280 or more the battery is fully charged and in good operating condition.
5. Should the corrected specific gravity be below 1.280, charge the battery and inspect the charging system to determine the cause of the low battery charge.

NOTE: *If distilled water has recently been added the battery should be recharged for a short period otherwise accurate hydrometer readings will not be obtained.*

If the battery has been charged under static conditions, denser electrolyte will accumulate at the bottom of the cells. The battery should be shaken periodically to mix the electrolyte, this will improve the charge rate and provide a more accurate hydrometer reading when tested.

Performance Test: The performance test is to determine if the battery has adequate capacity to turn the engine. The voltage reading obtained is used to determine the battery condition. Prior to testing, ensure the electrolyte level is correct and the open circuit voltage is 12.5V or more. The battery may be tested on or off the tractor.

1. Set the current control switch of the battery starter tester (high rate discharge tester) to the 'off' position and the voltage selector switch equal to, or slightly higher than, the rated battery voltage. Connect the tester positive leads to the battery positive terminal and the negative leads to the negative battery terminal.
2. Turn the current control knob until the ammeter reading is half the CCA rating of the battery and take the voltage reading.

- If the reading is 9.6 volts or more after 15 seconds, the battery has an acceptable output capacity and will readily accept a normal charge.

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- If however the reading is below 9.6 volts, the battery is considered unsatisfactory for service and should be test charged as described below.

CAUTION: *Do not leave the high discharge load on the battery for periods longer than 15 seconds.*

Test Charging: This test is designed only for batteries that have failed the previous capacity test.

1. Attach the battery starter (high rate discharge tester) positive leads to the battery positive terminal and the negative leads to the battery negative terminal.

2. Connect the battery charger positive lead to the battery positive terminal and the negative lead to the battery negative terminal.

3. Turn the charger timer past a '3 minutes' charge indication and then back to the '3 minutes' mark.

4. Set the charging rate as close as possible to 40 amperes.

5. After 3 minutes at this fast charge take the voltmeter reading.

- If the total voltage is over 15.5 volts the battery is unsatisfactory and is probably sulphated or worn out and should be replaced.

NOTE: *A mildly sulphated battery can be recovered by using a multiple battery type charger, with an open circuit upper voltage limit of 50 volts. Owing to the high resistance of a sulphated battery, it will primarily require a high voltage setting to overcome the resistance of the sulphation, initially there may be no visible acceptance of the charge. After a few minutes of inactivity a small charge will be apparent, followed by a rapid increase in the charge rate. The charge rate must not exceed 14.0 amperes or the electrolyte temperature 50° C (122° F). When the ampere rate has stabilized, reset the volts until the charge rate is a steady 5 amperes. Continue at this rate until the electrolyte specific gravity stops rising at approximately 1.275–1.280 at 20° C (68° F), this can take up to 48 hours of charging. Stand the battery for 24 hours and then conduct the capacity test detailed previously.*

- If the total voltage is under 15.5 volts, test the specific gravity of each cell and re–charge the battery to the following scale:

Specific Gravity	Fast charge up to:
1.150 or less	60 minutes
1.151 to 1.175	45 minutes
1.176 to 1.200	30 minutes
1.201 to 1.225	15 minutes (Slow charge only)

NOTE: *When battery problems are experienced the fan belt tension and the complete charging system should be checked.*

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Common Causes of Battery Failures

1. Internal open circuit.
2. Internal short circuit.
3. Loss of electrolyte.
4. Separation of active materials from grids.
5. Accumulation of sulphate crystals too large to disperse.

These failures are normally caused by the following:

1. Failure of inter cell components.
2. Excessive crystal growth may puncture the separators and cause short circuits.
3. Excessive over charging (charging system malfunction, boost/recovery techniques with high voltage, operation in very high temperatures.
4. Freeezing of electrolyte.
   A fully charged battery does not freeze until –65°C (–85°F). A 50% charged battery freezes between –17°C (1°F) and –27°C (–17°F). Fully discharged batteries freeze at –3°C to –11°C (27 to 12°F). Excessively high boost charging and gassing will also cause separation of active materials from the grids. Separation destroys the chemical function of the battery.
5. Crystal growth occurs whenever batteries are left discharged. High temperatures and extended discharged periods increase this condition. At room temperature after one week the battery is unlikely to recover on the vehicle. Recharge will require a higher constant voltage. After 3 weeks the battery will have suffered permanent degradation and the procedure detailed previously for charging a 'Deeply Discharged' battery should be followed.

When fully charged, batteries have a long shelf life. The lead calcium type batttery self discharges at 3% per month. This means that it will take 16 months to drop to 50% charged. On the tractor the quiescent load is about 50mA. To predict rundown on a static vehicle this should be added as approximately 8Ah per week.

It is worth stressing that when cranking, if a battery starts to fade, it is beneficial to stop and allow two minutes for the battery to recover. The recovery time should be increased as the temperature decreases.

With the dual battery set up, an old battery should not be used with a new one. One battery will always fail first. If the battery has given the service life expected, change both batteries. If one has failed early, i.e, through manufacturing defect, then it is acceptable to replace just one battery.

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SECTION 2
ELECTRICAL SYSTEM
CHAPTER 9
WIRING DIAGRAMS

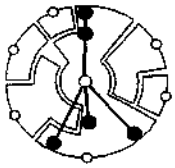
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SYMBOLS USED IN WIRING CIRCUITS

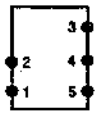

Keystart Switch


Motor


Fuse



Battery



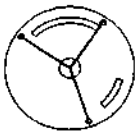
Radio Connector

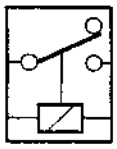

Solenoid


Interior Lamp

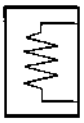

Solenoid

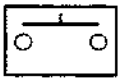

PWM Solenoid

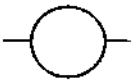

PTO Switch


Relay


Accessory Socket

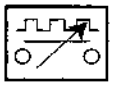

Cigar Lighter

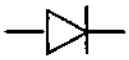

Pressure Switch

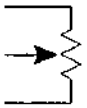

Motor

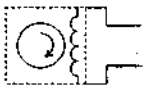

Radar


Lamp

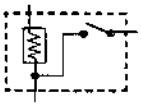

De–icing Thermostat


Diode


Potentiometer


Speed Sensor


Electrical Pressure Gauge


Combined Pressure Sender/switch Assembly


Switch


Draft Pin


Thermostart

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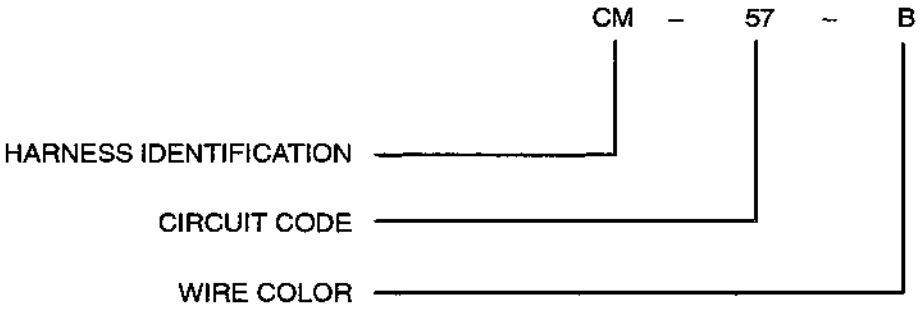
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WIRE COLOR CODES AND IDENTIFICATION

WIRE COLOR CODES

B	–BLACK
N	–BROWN
LN	–LIGHT BROWN
S	–SLATE
R	–RED
O	–ORANGE
Y	–YELLOW
G	–GREEN
LG	–LIGHT GREEN
U	–BLUE
TQ	–TURQUOISE
P	–PURPLE
K	–PINK
W	–WHITE

WIRE DIAGRAM IDENTIFICATION CODES



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RANGE COMMAND (SEMI–POWERSHIFT) MODEL TRACTORS

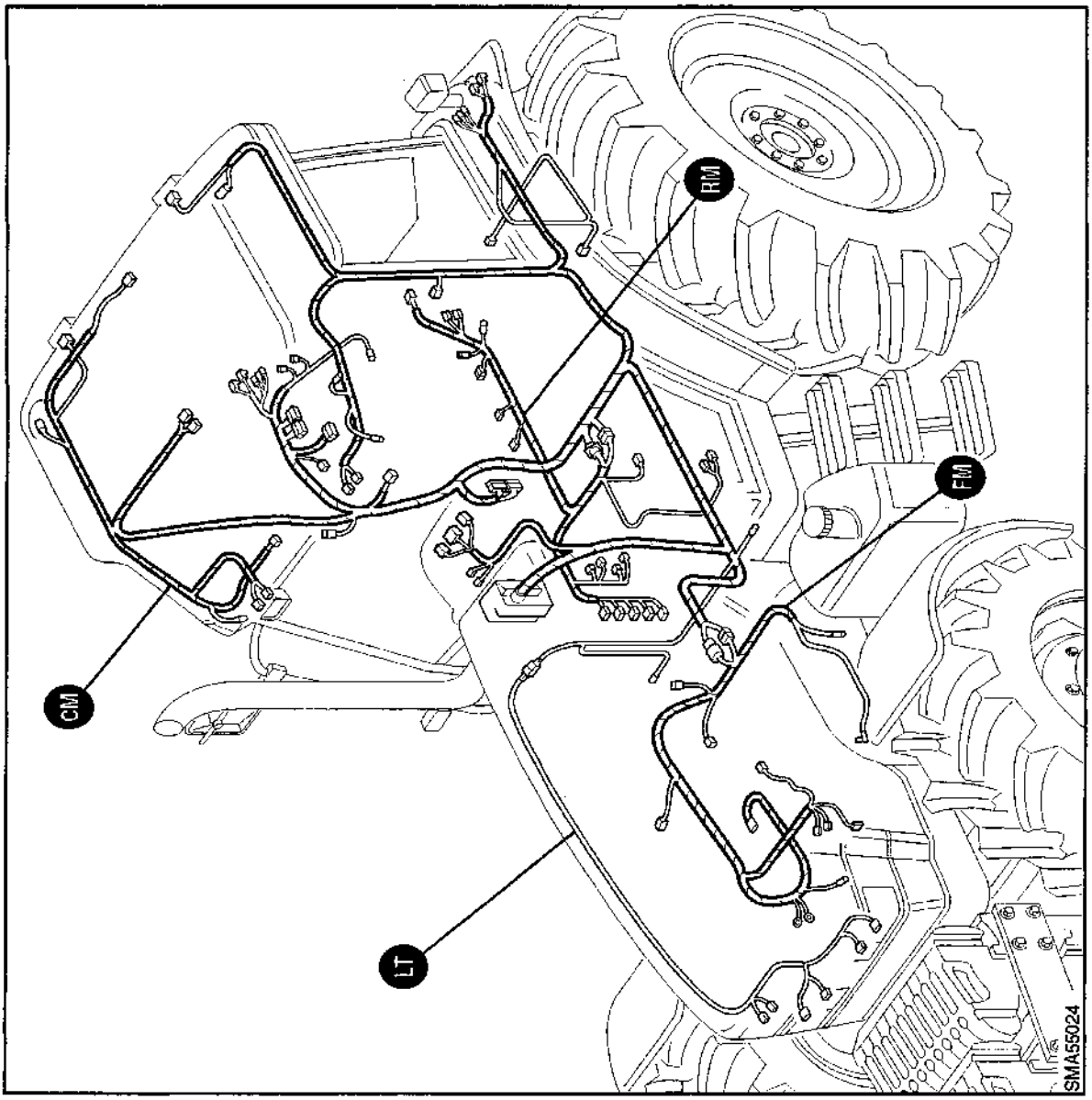
ELECTRICAL HARNESSES AND CIRCUITS

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There are Four Main Harnesses used on Cabbed Tractors.

LT – Lighting
FM – Front Main (Engine Harness)
RM – Rear Main (Chassis Harness)
CM – Cab Main

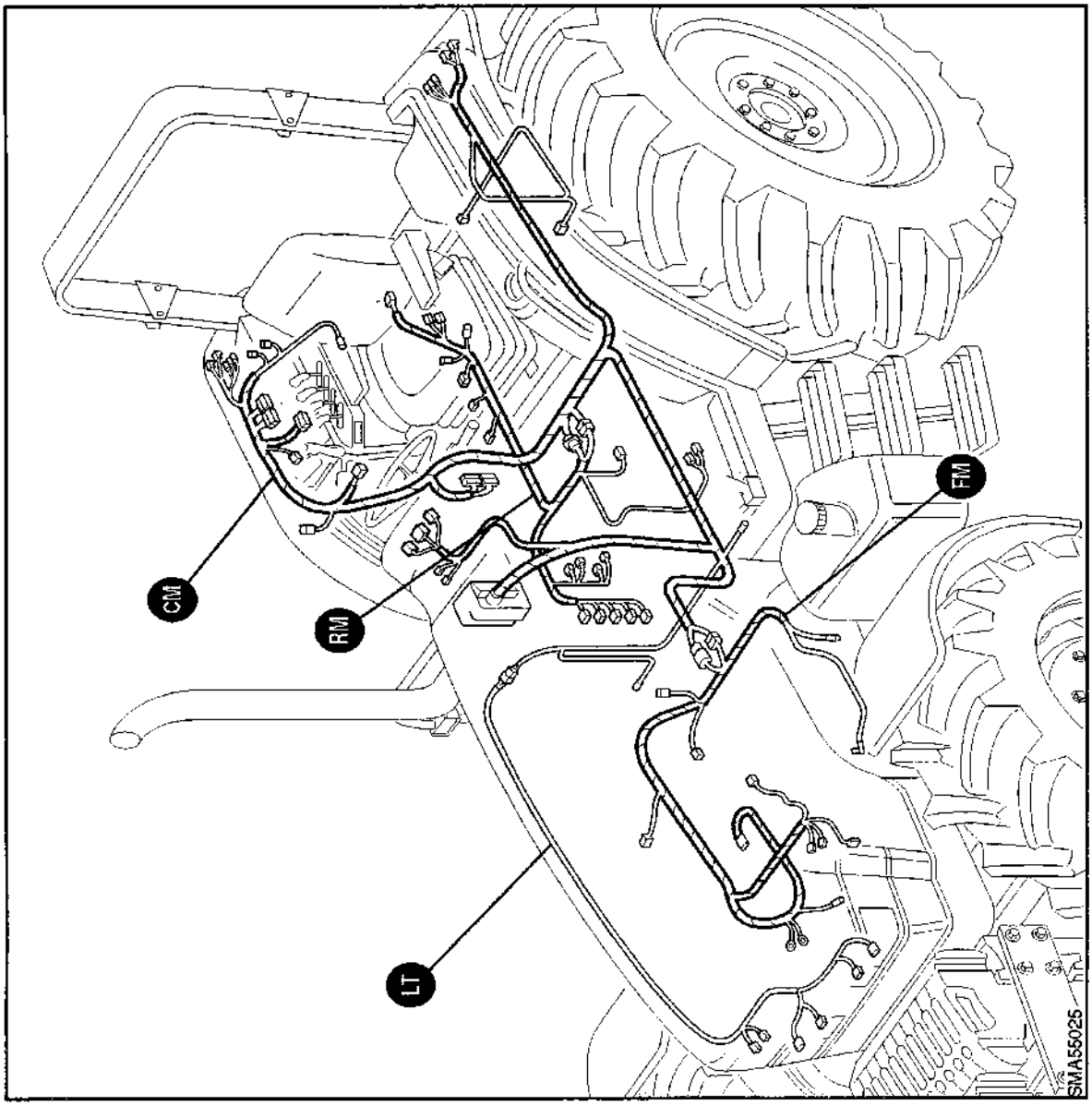


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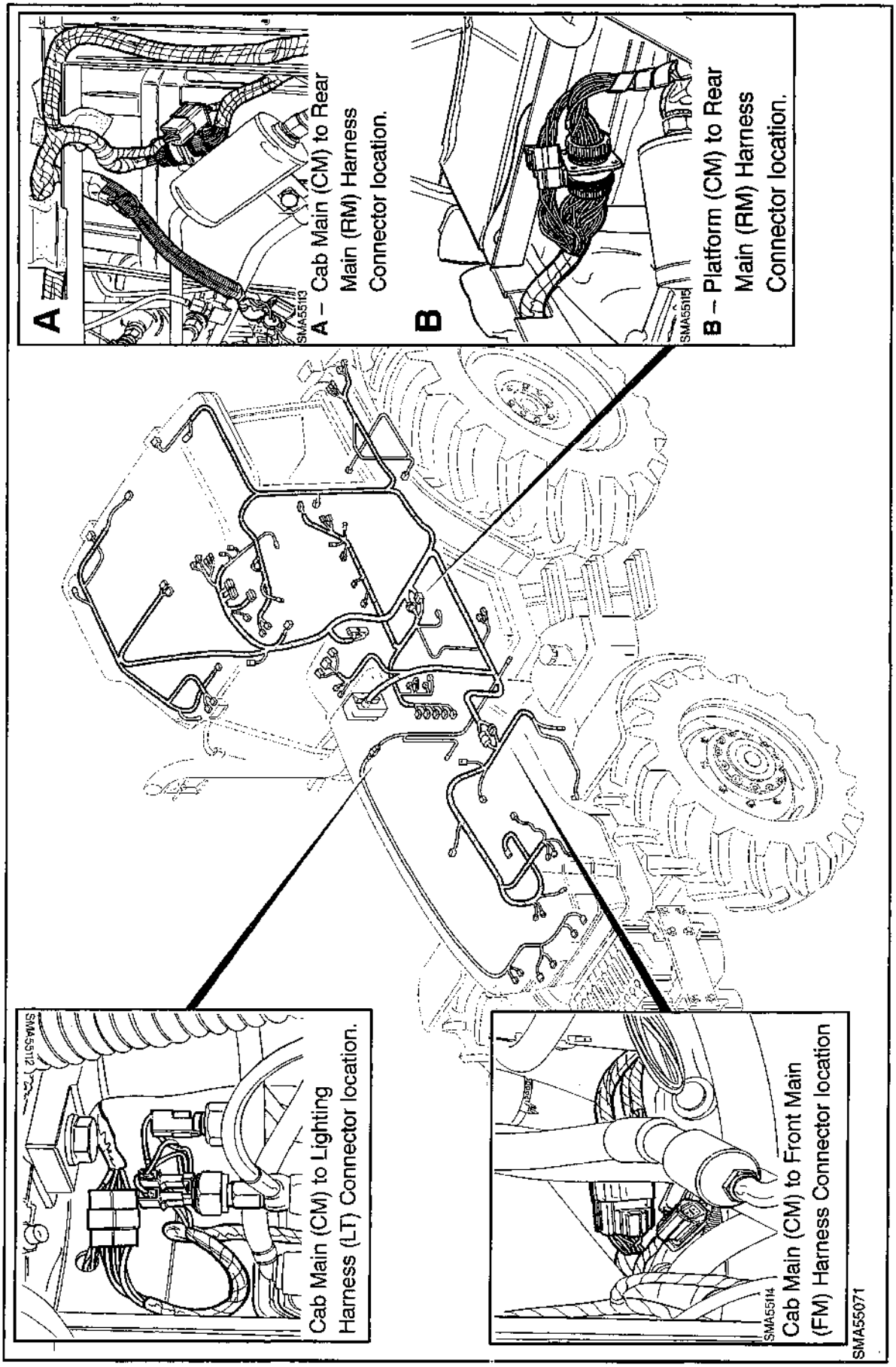
There are Four Main Harnesses used on Platform Tractors.

LT – Lighting
FM – Front Main (Engine Harness)
RM – Rear Main (Chassis Harness)
CM – Cab Main (Platform Harness)



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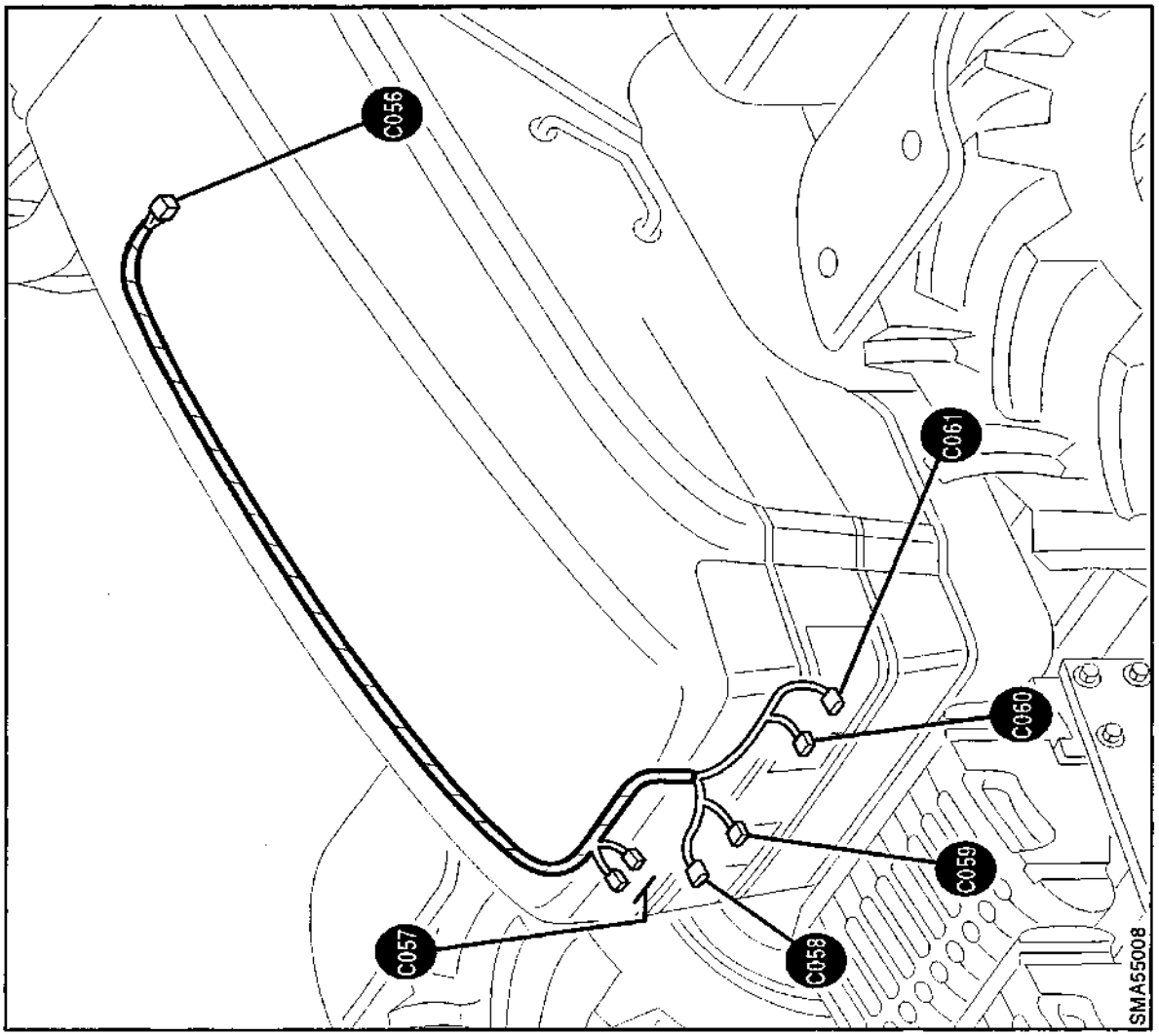
LIGHTING HARNESS CONNECTORS

Connector No.	Component	Harness
C056	Headlamp Harness	LT
C057	Horn	LT
C058	Right Hand Worklamp	LT
C059	Right Hand Headlamp	LT
C060	Left Hand Headlamp	LT
C061	Left Hand Worklamp	LT

Connector No.	Component	Harness

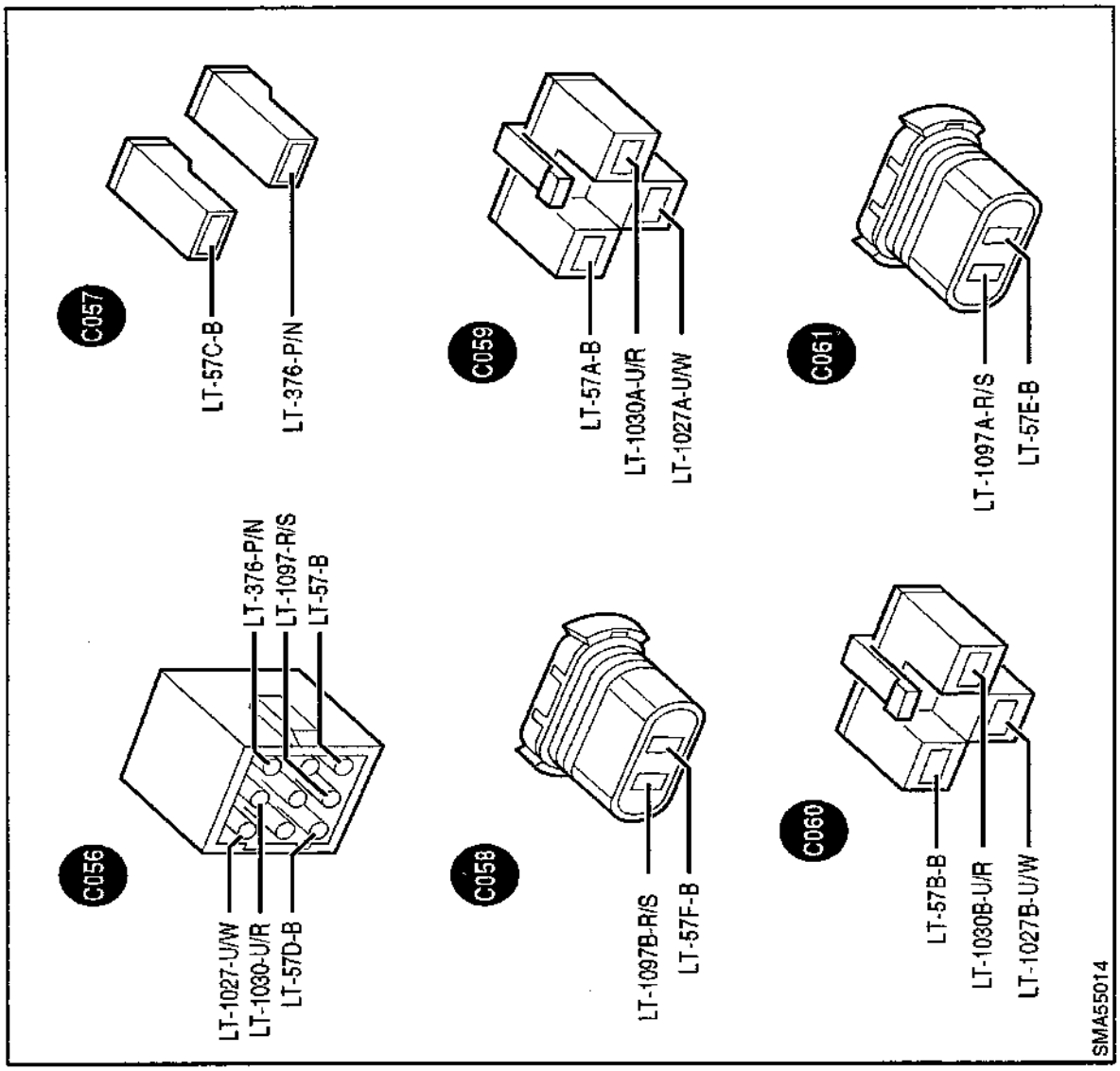
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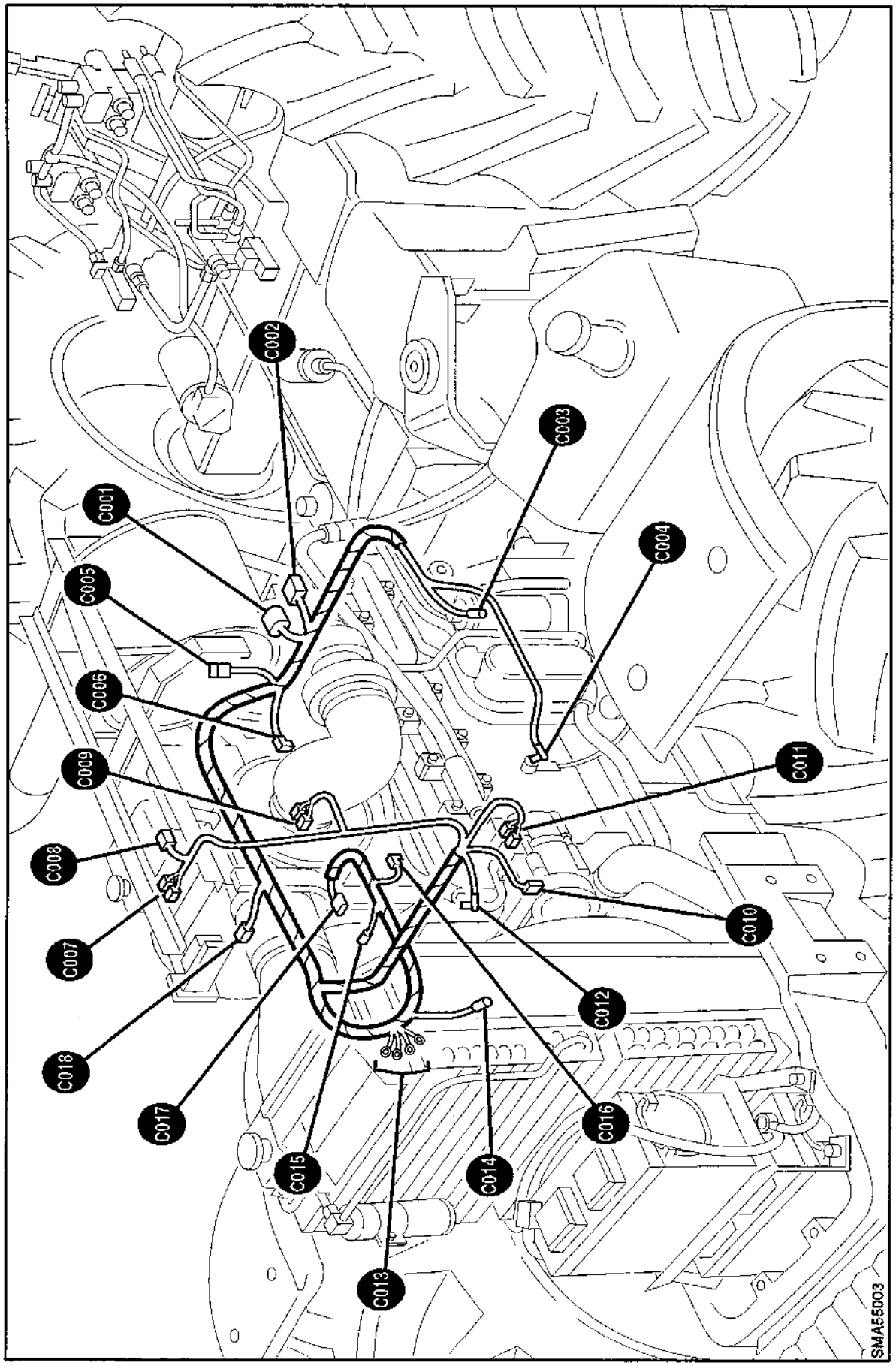
FRONT MAIN (ENGINE) HARNESS CONNECTORS

Connector No.	Component	Harness
C001	Front Main Bulkhead Connector M1	FM
C002	Front Main Bulkhead Connector M2	FM
C003	Oil Pressure Sender	FM
C004	Oil Pressure Switch	FM
C005	Starter Relay	FM
C006	Starter Solenoid	FM
C007	Brake Fluid Reservoir	FM
C008	Engine Coolant Level	FM
C009	Vacuum Switch	FM
C010	Air-Con Switch	FM
C011	De-Icing Thermostat	FM
C012	Temperature Sender	FM
C013	Alternator	FM
C014	Steering Sensor	FM
C015	Fuel Shut-Off Solenoid	FM
C016	Fuel Pump	FM
C017	Water in Fuel Sensor	FM
C018	Thermostart	FM

Connector No.	Component	Harness

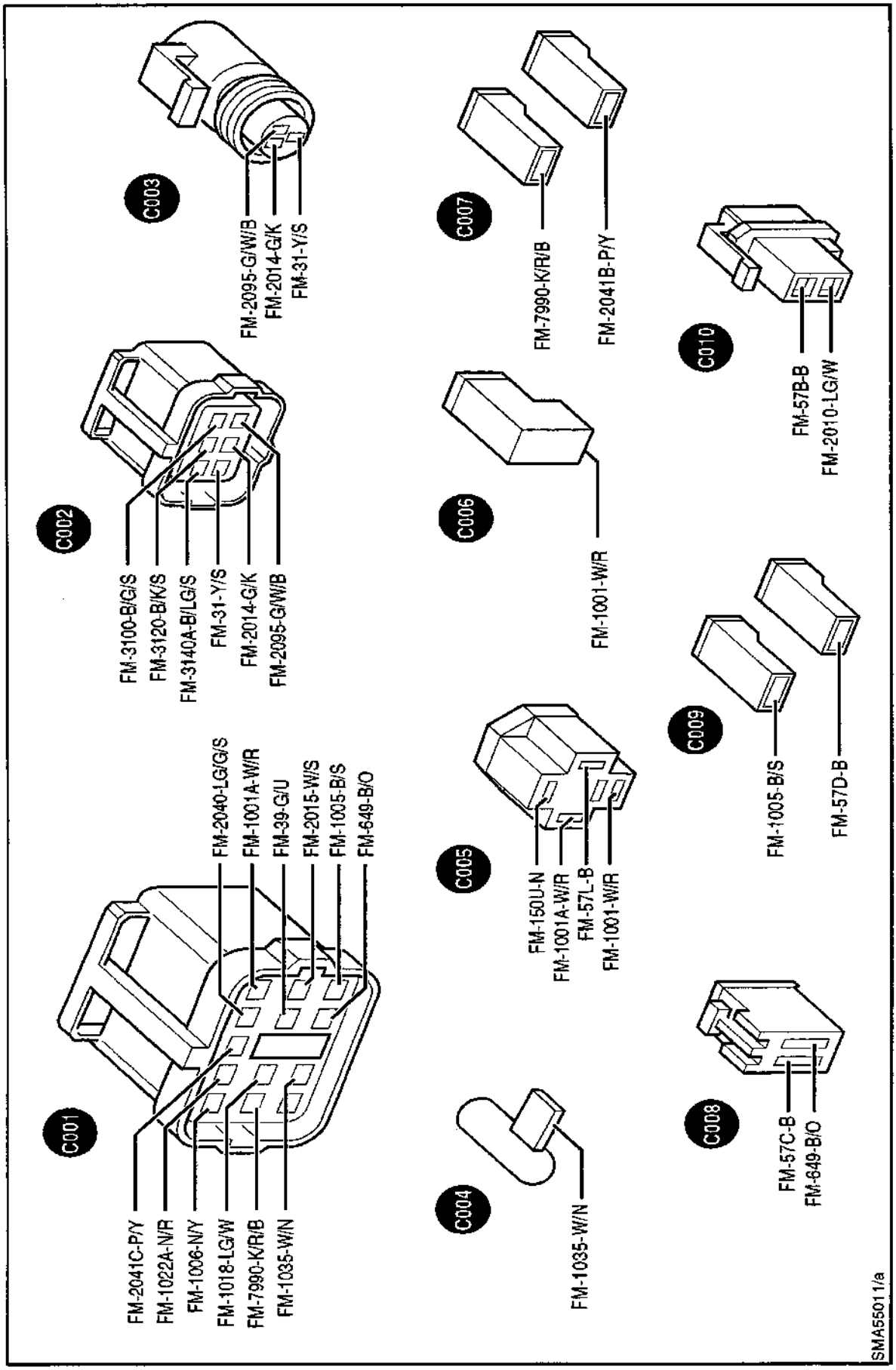
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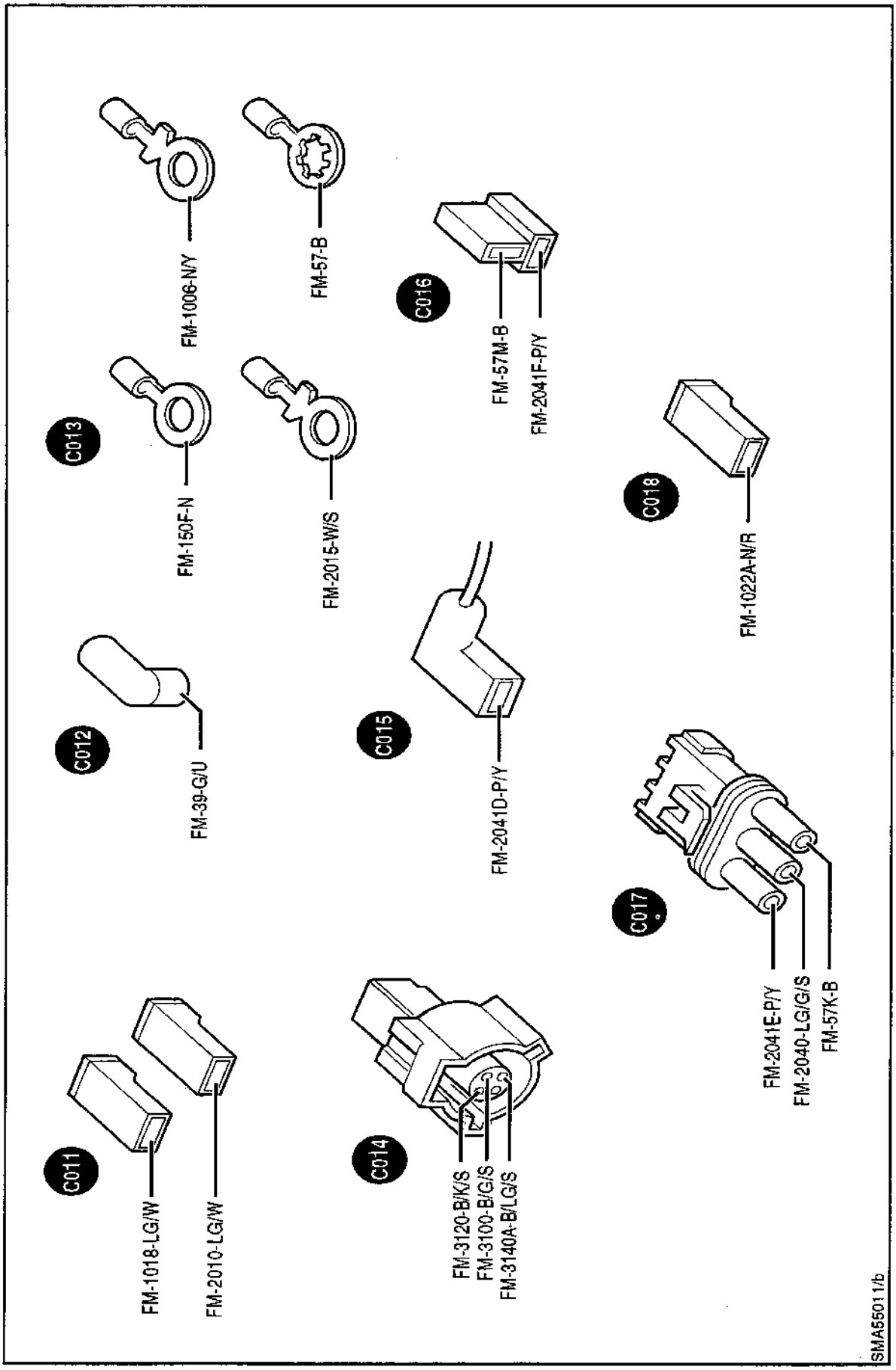
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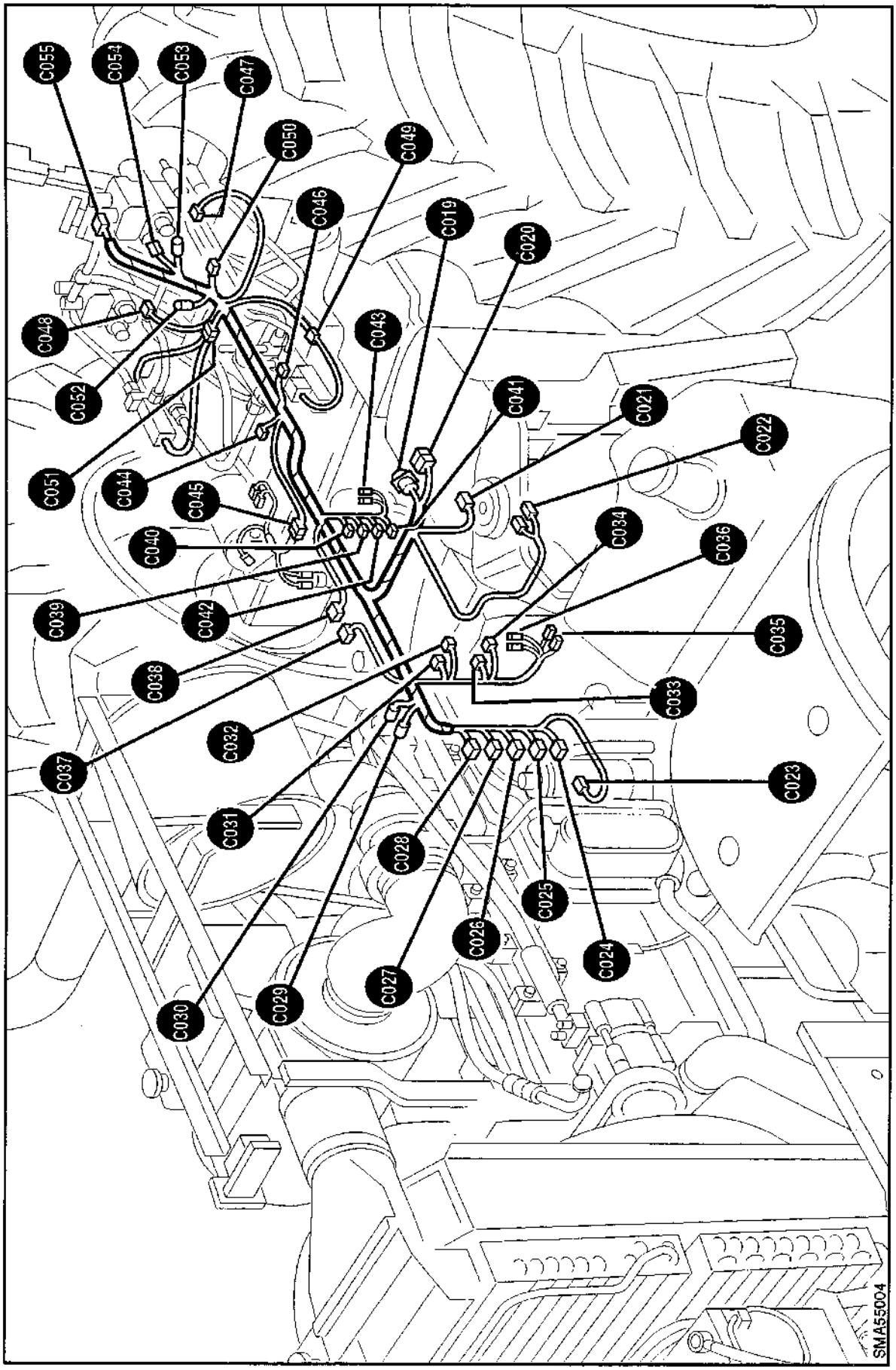
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REAR MAIN (CHASSIS) HARNESS CONNECTORS

Connector No.	Component	Harness
C019	Rear Main Extension Connector 1	RM
C020	Rear Main Extension Connector 2	RM
C021	Creeper Engaged Switch	RM
C022	Fuel Tank Sender	RM
C023	Transmission Oil Temp Sender	RM
C024	Clutch E	RM
C025	Clutch D	RM
C026	Clutch C	RM
C027	Clutch B	RM
C028	Clutch A	RM
C029	Slow/Fast Potentiometer	RM
C030	Medium/Reverse Potentiometer	RM
C031	Medium Range Solenoid	RM
C032	Transmission Low Range Solenoid	RM
C033	PTO Brake	RM
C034	Front Wheel Drive Solenoid	RM
C035	Front Wheel Drive Switch	RM
C036	Pressure Switch	RM
C037	Intermediate Speed P.U.	RM
C038	Output Speed P.U.	RM
C039	High Range Solenoid	RM
C040	Reverse Range Solenoid	RM
C041	PTO Solenoid	RM
C042	Diff Lock Solenoid	RM
C043	Diff Lock Switch	RM
C044	Switch Ground Speed PTO Engaged	RM
C045	Pump Connector	RM
C046	Axle Speed Sensor	RM
C047	Left Hand Draft Pin	RM
C048	Right Hand Draft Pin	RM
C049	Diverter Valve Connector	RM
C050	Trailer Brake Connector	RM
C051	EDC Valve Connector	RM
C052	Rockshaft Potentiometer	RM
C053	Hydraulic Remote Valve Solenoid	RM
C054	PTO Speed Sensor	RM
C055	Trailer Socket	RM

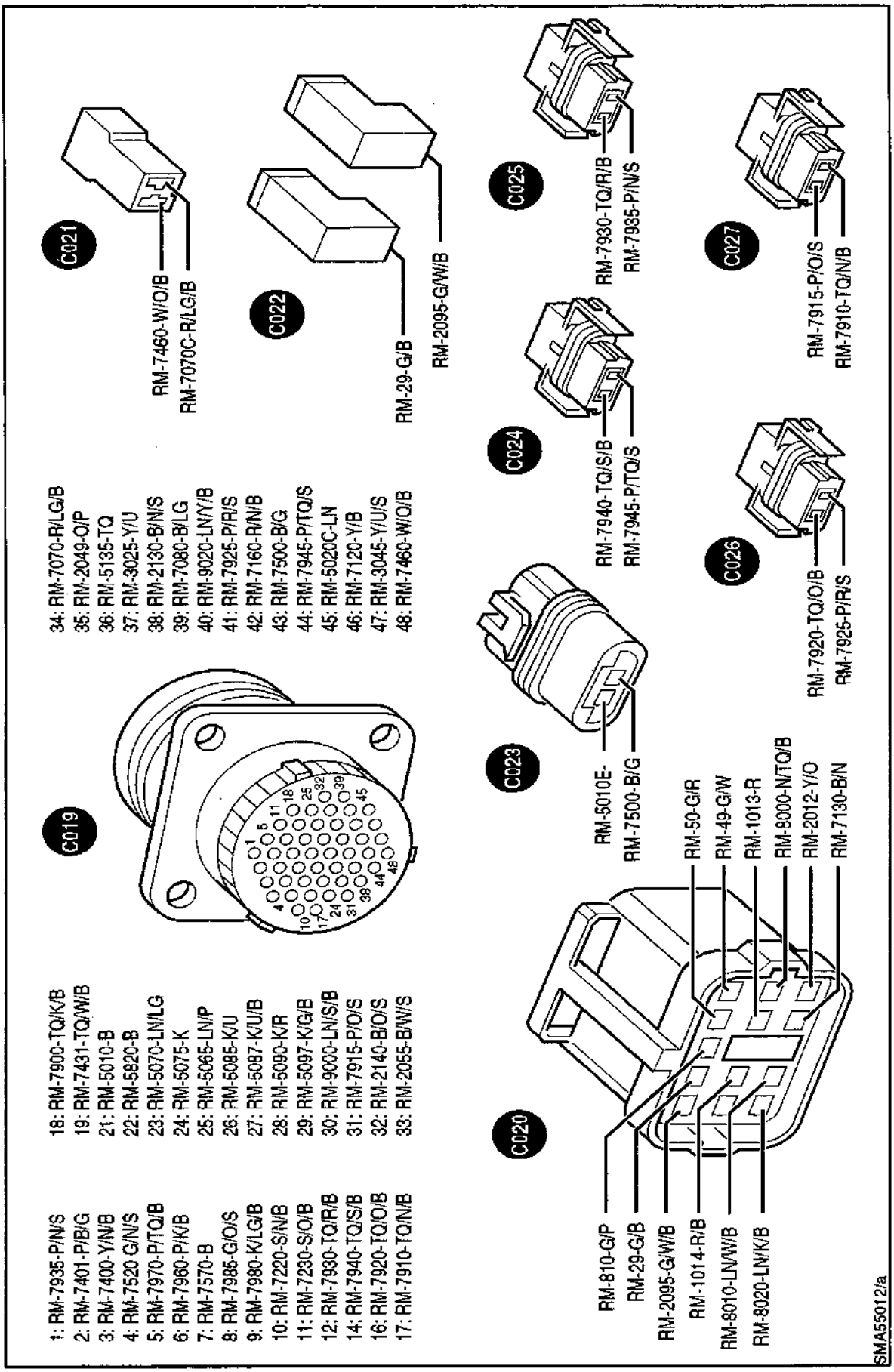
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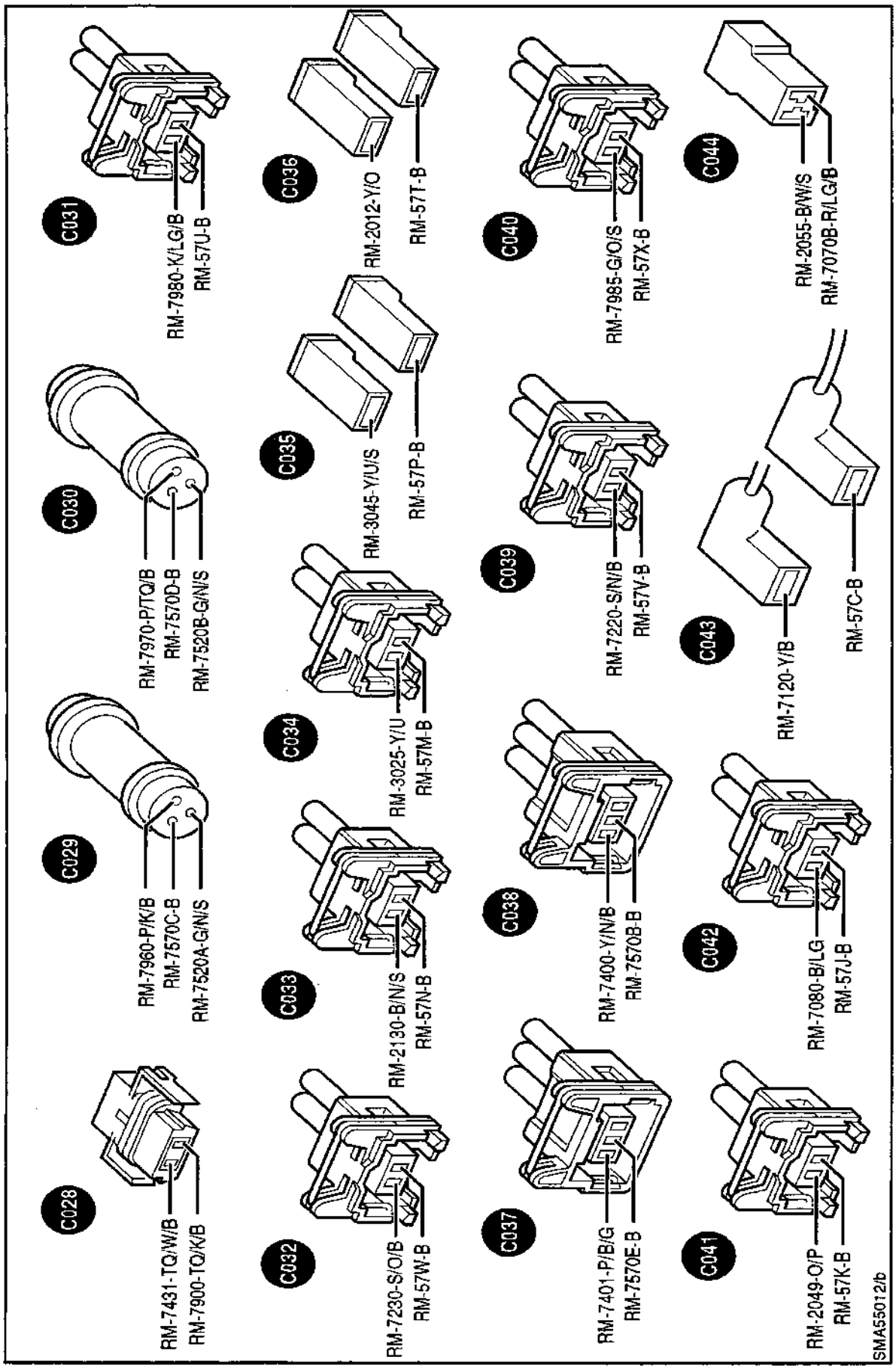
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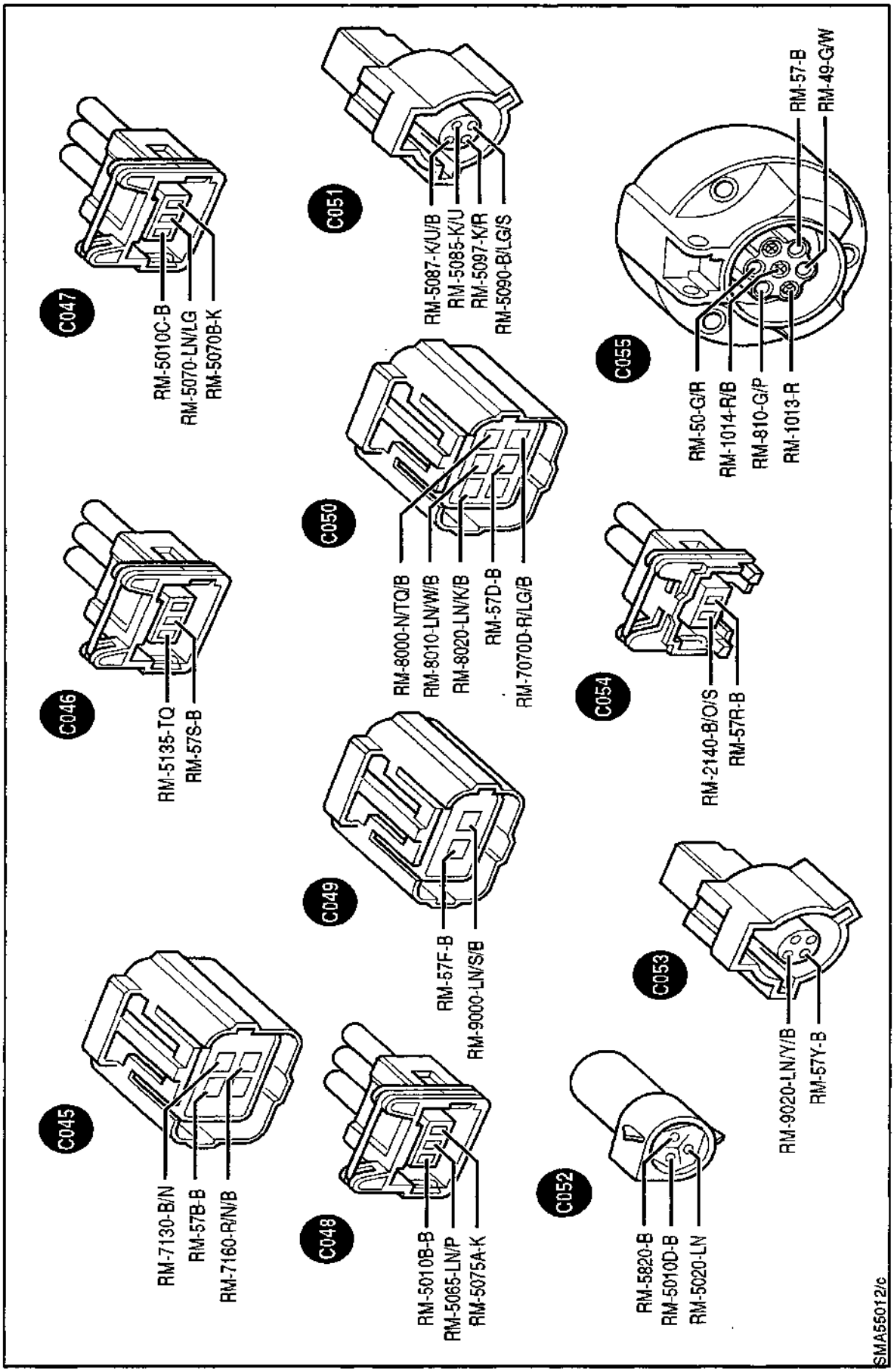
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CAB MAIN (PLATFORM) HARNESS CONNECTORS

Connector No.	Component	Harness
C001	Cab Main Bulkhead Connector M1	CM
C002	Cab Main Bulkhead Connector M2	CM
C019	Cab Main Extension Connector 1	CM
C020	Cab Main Extension Connector 1	CM
C065	Headlamp Harness Connector	CM
C062	Right Hand Stop Lamp Switch	CM
C063	Left Hand Stop Lamp Switch	CM
C064	Right Hand Lower Front Worklamp	CM
C065	Left Hand Lower Front Worklamp	CM
C066	Right Side Lamp	CM
C067	Left Side Lamp	CM
C068	Radar	CM
C069	Starter Solenoid (Cab Main)	CM
C070	Main Bulkhead Hitch Connector M3	CM
C071	Main Bulkhead Hitch Connector M4	CM
C072	Starter Switch	CM
C073	Windshield Wiper Switch	CM
C074	Turn Switch	CM
C075	Shuttle Switch	CM
C076	Clutch Switch	CM
C077	Clutch Potentiometer	CM
C078	Rear Wiper Switch	CM
C079	Instrument Cluster 'A'	CM
C080	Instrument Cluster 'B'	CM
C081	Instrument Cluster 'C'	CM
C082	Beacon Switch	CM
C083	Hazard Switch	CM
C084	Left Hand Upper Front Worklamp	CM
C085	Right Hand Upper Front Worklamp	CM
C086	Left Hand NASO Front Flasher	CM
C087	Right Hand NASO Front Flasher	CM
C088	Front Wiper Motor	CM
C089	Trailer Brake Gauge Lamp	CM
C090	Left hand Door Switch	CM
C091	Right hand Door Switch	CM
C092	Console Lamp	CM
C093	Left Hand NASO Rear Flasher	CM
C094	Right Hand NASO Rear Flasher	CM
C095	Left Hand Rear Licence/Worklamp	CM
C096	Right Hand Rear Licence/Worklamp	CM
C097	Left Hand Beacon	CM
C098	Right Hand Beacon	CM
C099	Interior Lamp	CM
C100	TCM Connector 1	CM
C101	TCM Connector 2	CM
C102	Fast Raise/Lower Switch	CM
C103	Gear Shift Connector	CM
C104	Gear Shift Indicator	CM
C105	EMU Connector	CM
C106	Radio A	CM
C107	Radio B	CM
C108	Clock	CM

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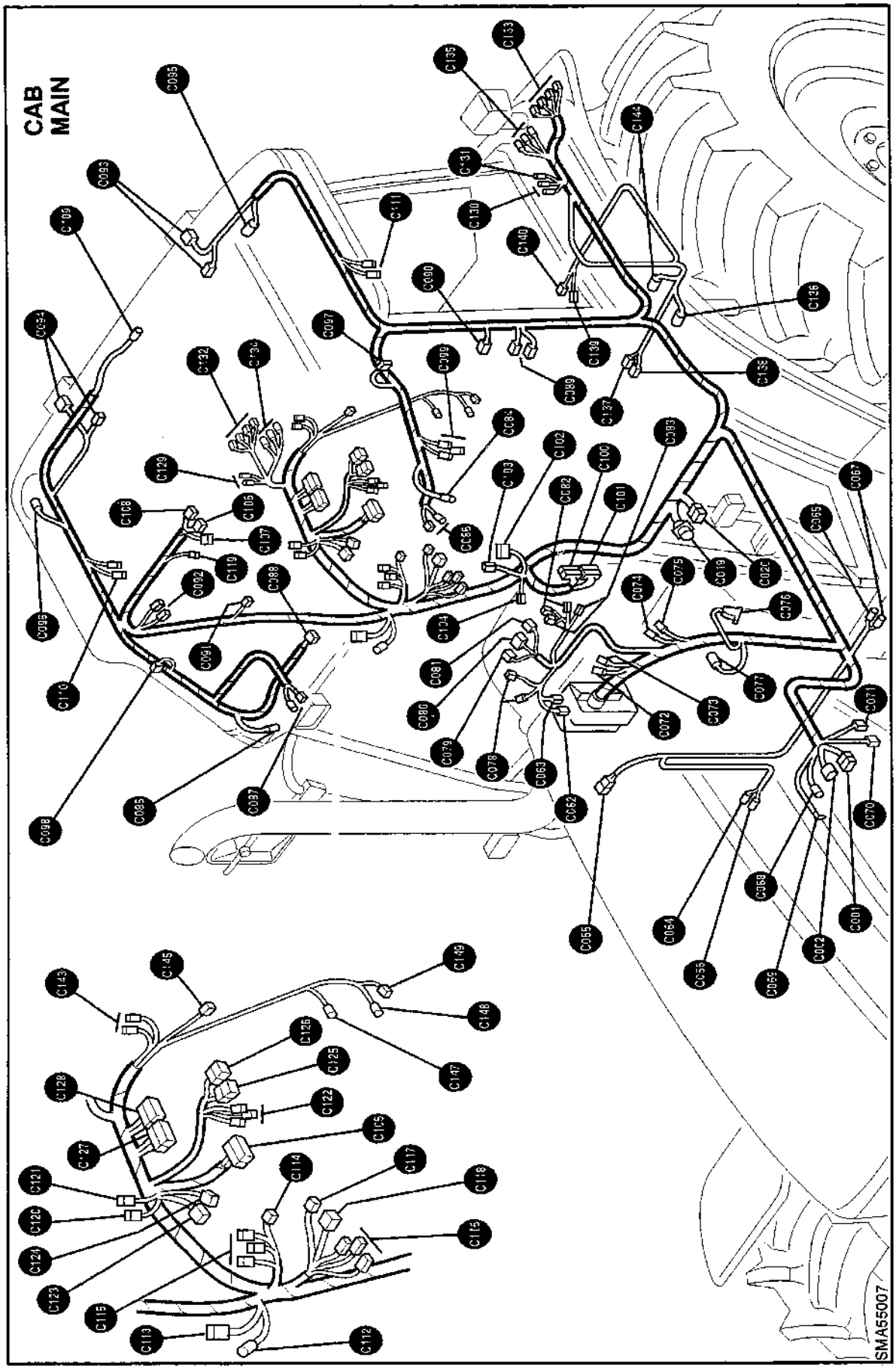
CAB MAIN (PLATFORM) HARNESS CONNECTORS

Connector No.	Component	Harness
C109	Rear Wiper Motor	CM
C110	Right hand Speaker	CM
C111	Left hand Speaker	CM
C112	Front Hitch Override	CM
C113	Front Hitch Potentiometer	CM
C114	PTO Engaged Lamp	CM
C115	Front PTO Switch	CM
C116	Rear PTO Switch	CM
C117	Rear PTO Engaged Lamp	CM
C118	Rear PTO Brake Switch	CM
C119	Heater Air-Con Connector	CM
C120	EDC Control Panel 1	CM
C121	EDC Control Panel 2	CM
C122	Ground Speed Sensor	CM
C123	Limp Home Connector 2	CM
C124	Limp Home Connector 1	CM
C125	Diagnostic Plug TCM	CM
C126	Diagnostic Plug EDC	CM
C127	EDC Module CN2	CM
C128	EDC Module CN1	CM
C129	Worklamp Right Hand Fender	CM
C130	Worklamp Left Hand Fender	CM
C131	Licence Plate Lamp	CM
C132	Rear Lamp Right Hand Fender	CM
C133	Rear Lamp Left Hand Fender	CM

Connector No.	Component	Harness
C134	HPL Raise/Lower Right Hand Switch	CM
C135	HPL Raise/Lower Left Hand Switch	CM
C136	Handbrake	CM
C137	PTO Alarm Seat Switch	CM
C138	Seat Pump	CM
C139	Front Washer Motor	CM
C140	Rear Washer Motor	CM
C143	Implement Socket	CM
C144	Air Brake Connector	CM
C145	Rear Socket Connector	CM
C147	Remote Valve Switch	CM
C148	Diverter Valve	CM
C149	Quadrant Potentiometer	CM

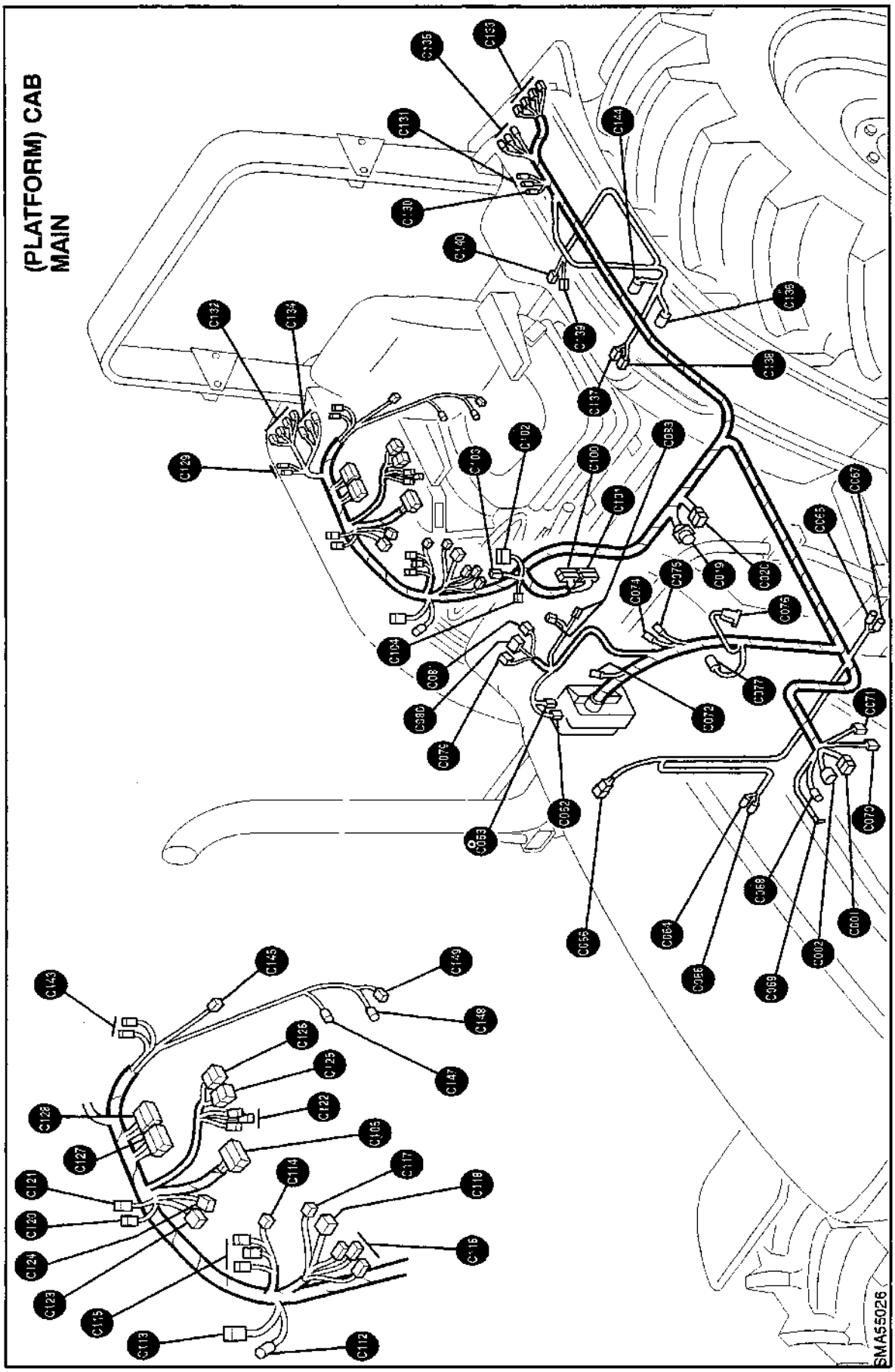
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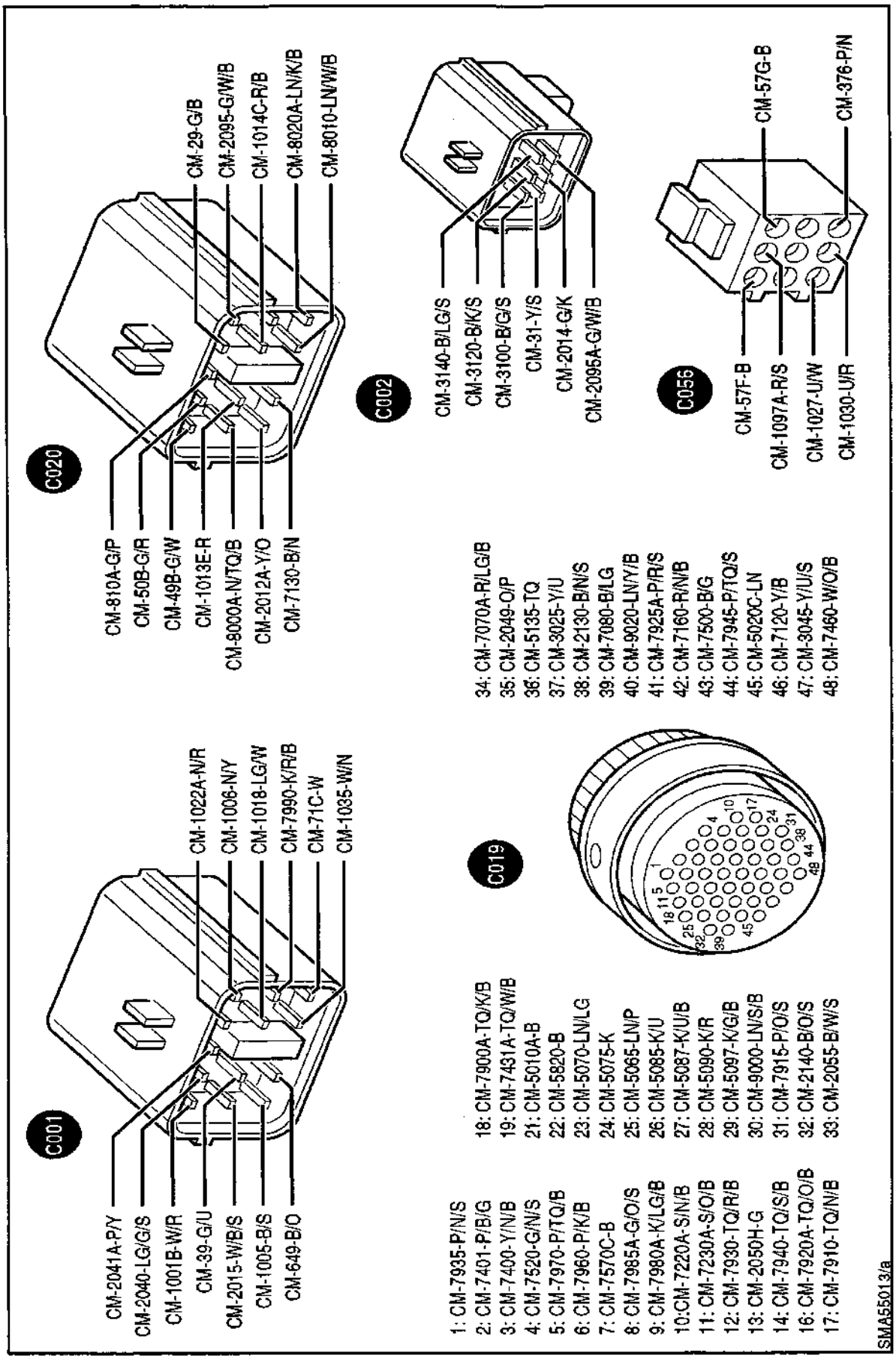
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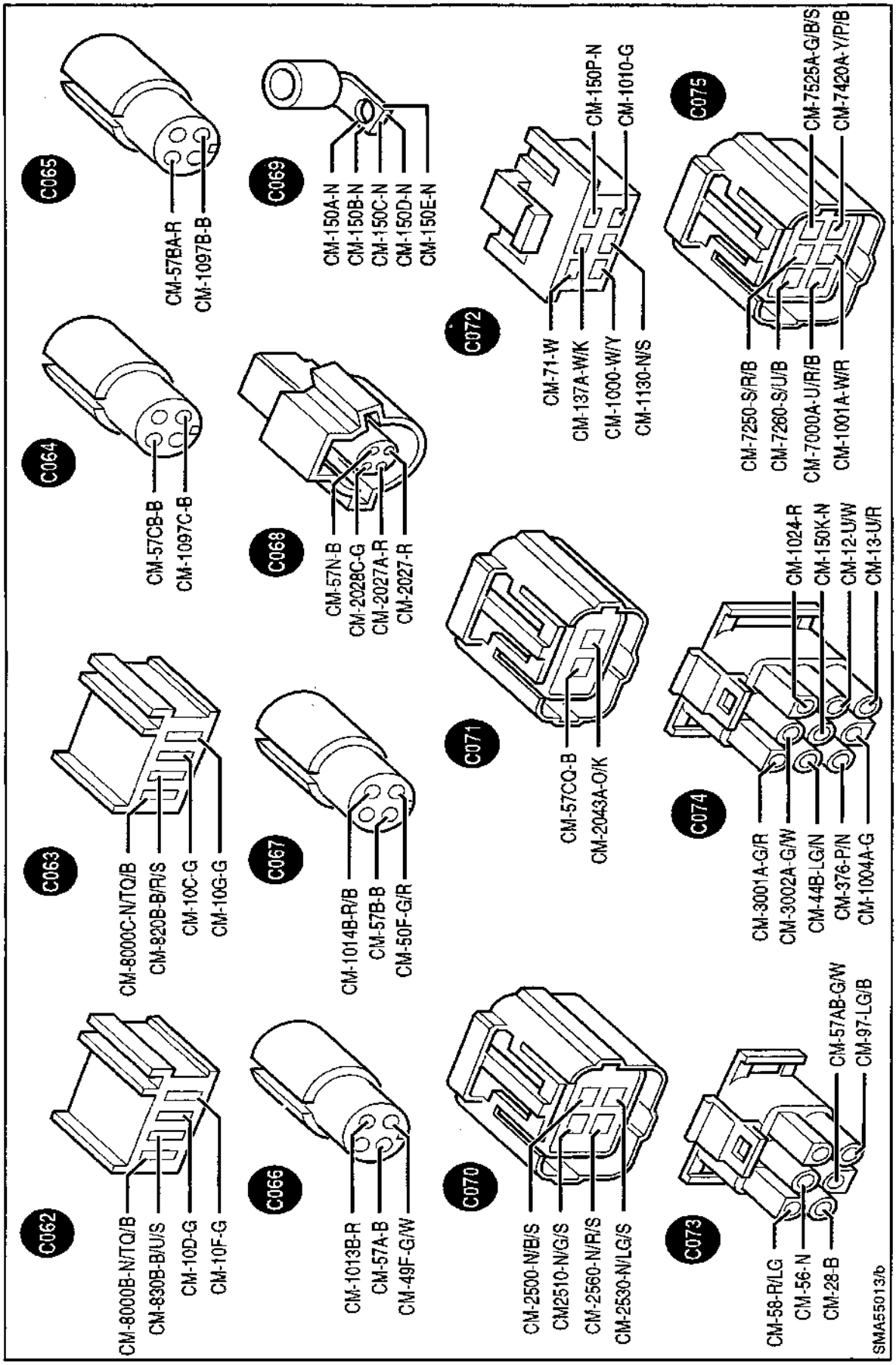
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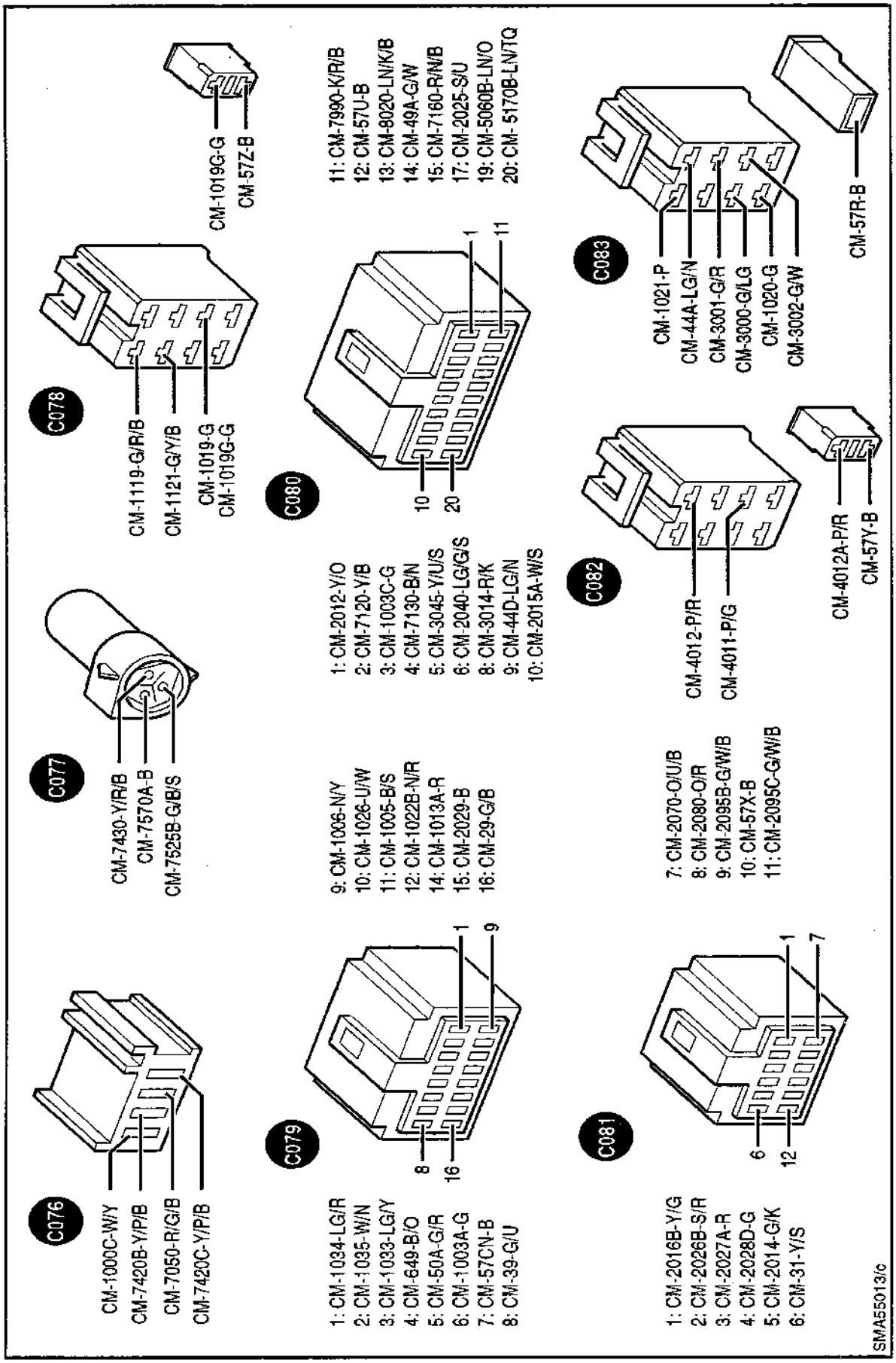
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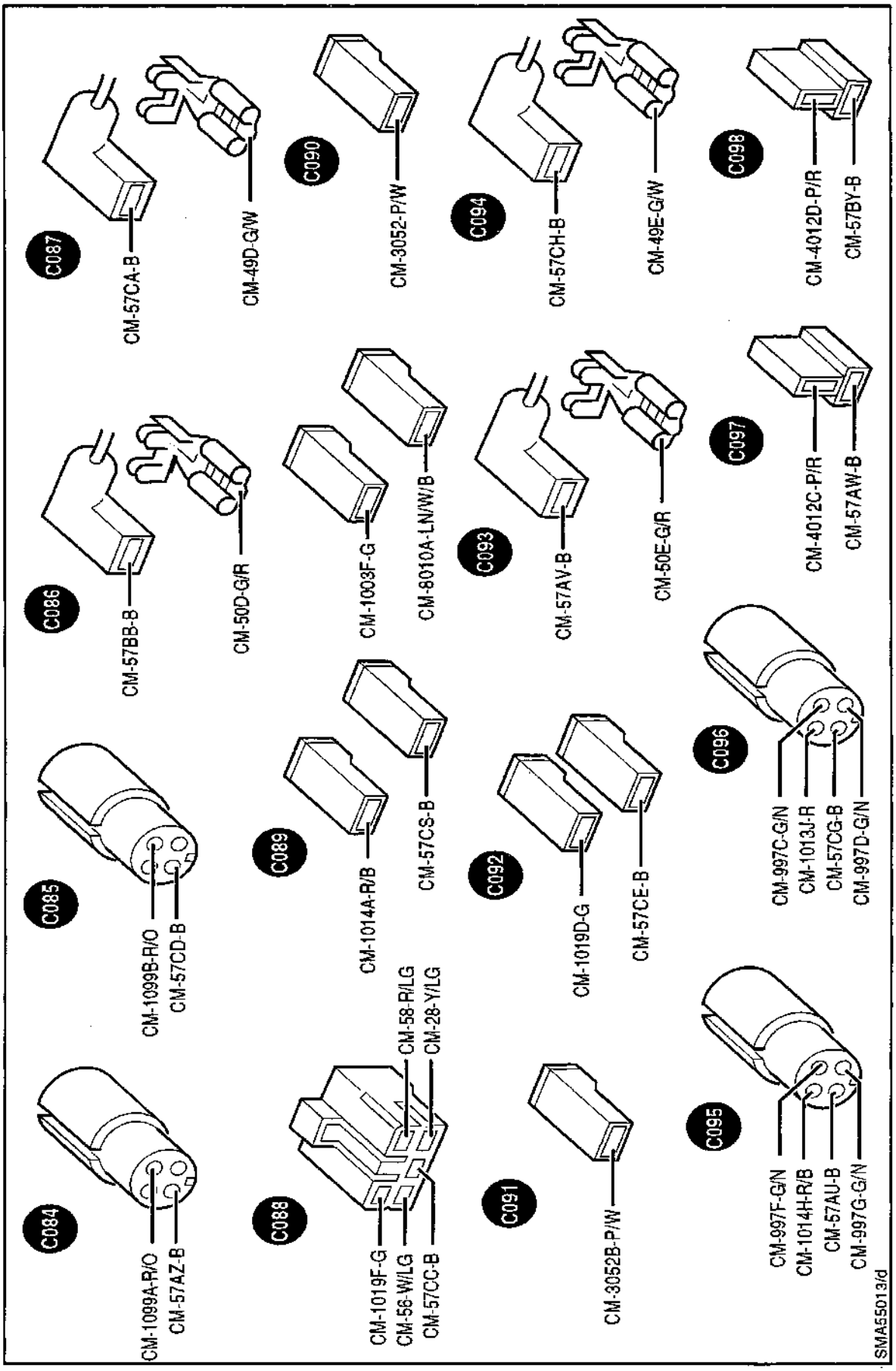
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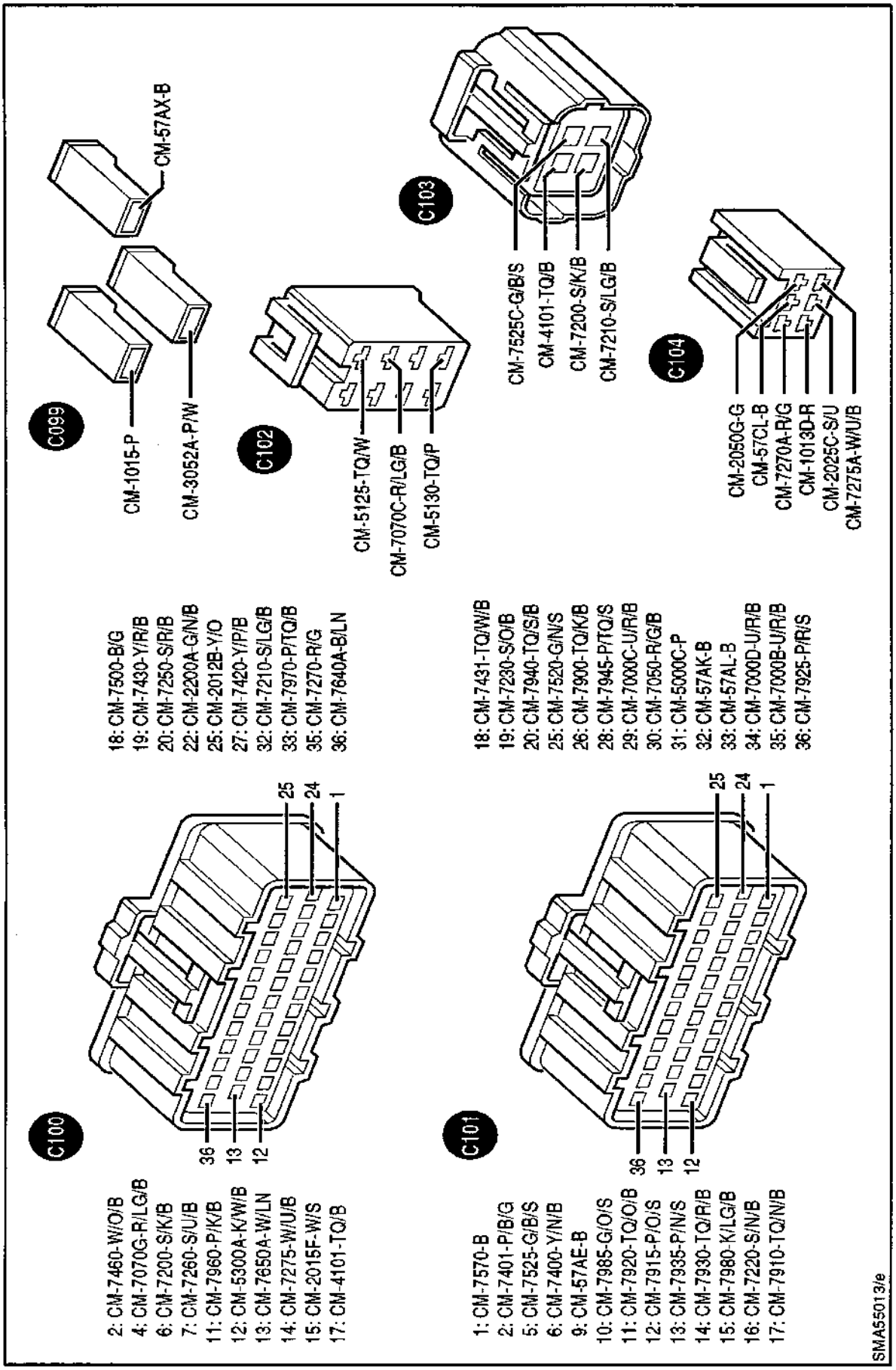
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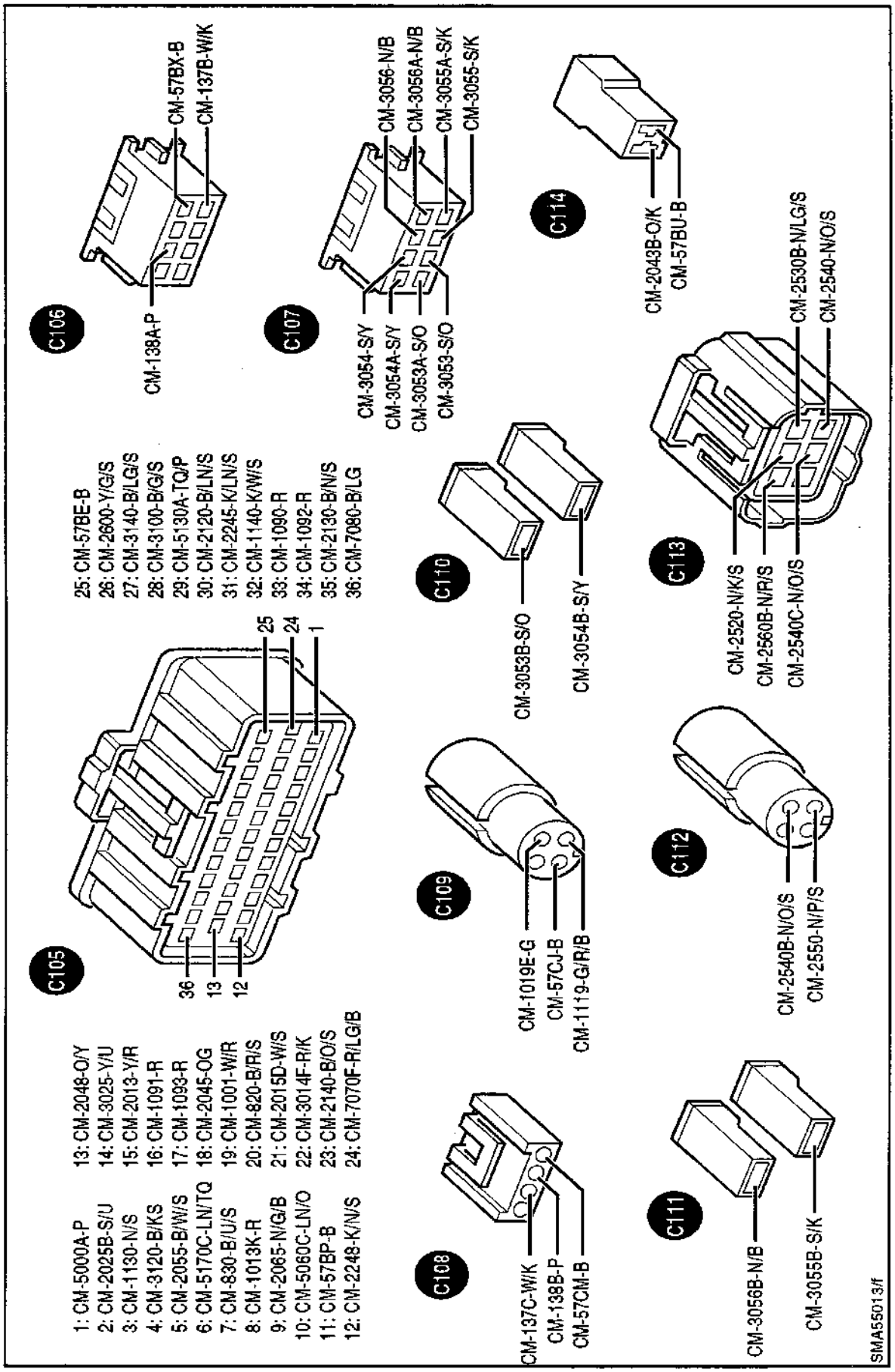
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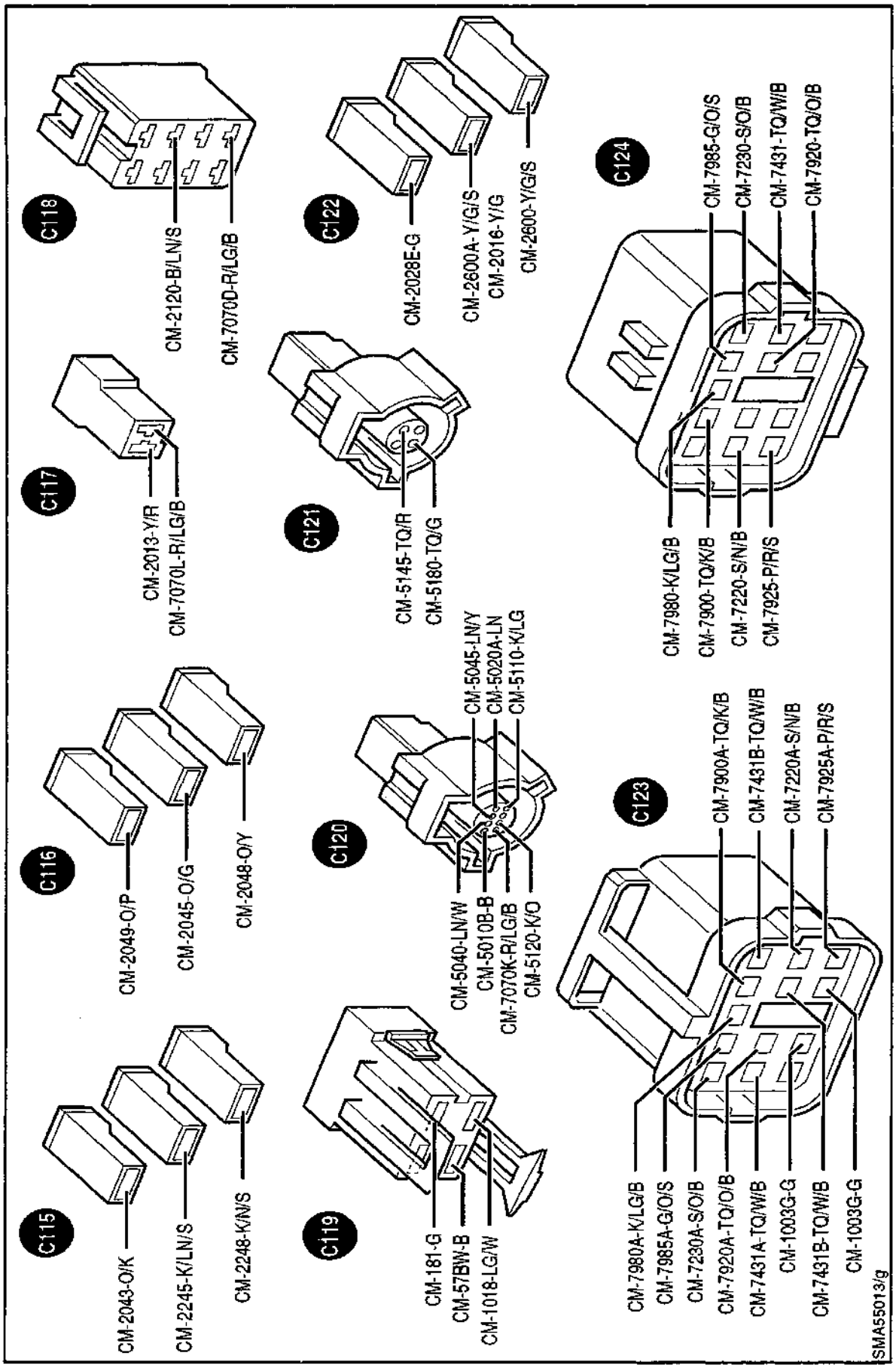
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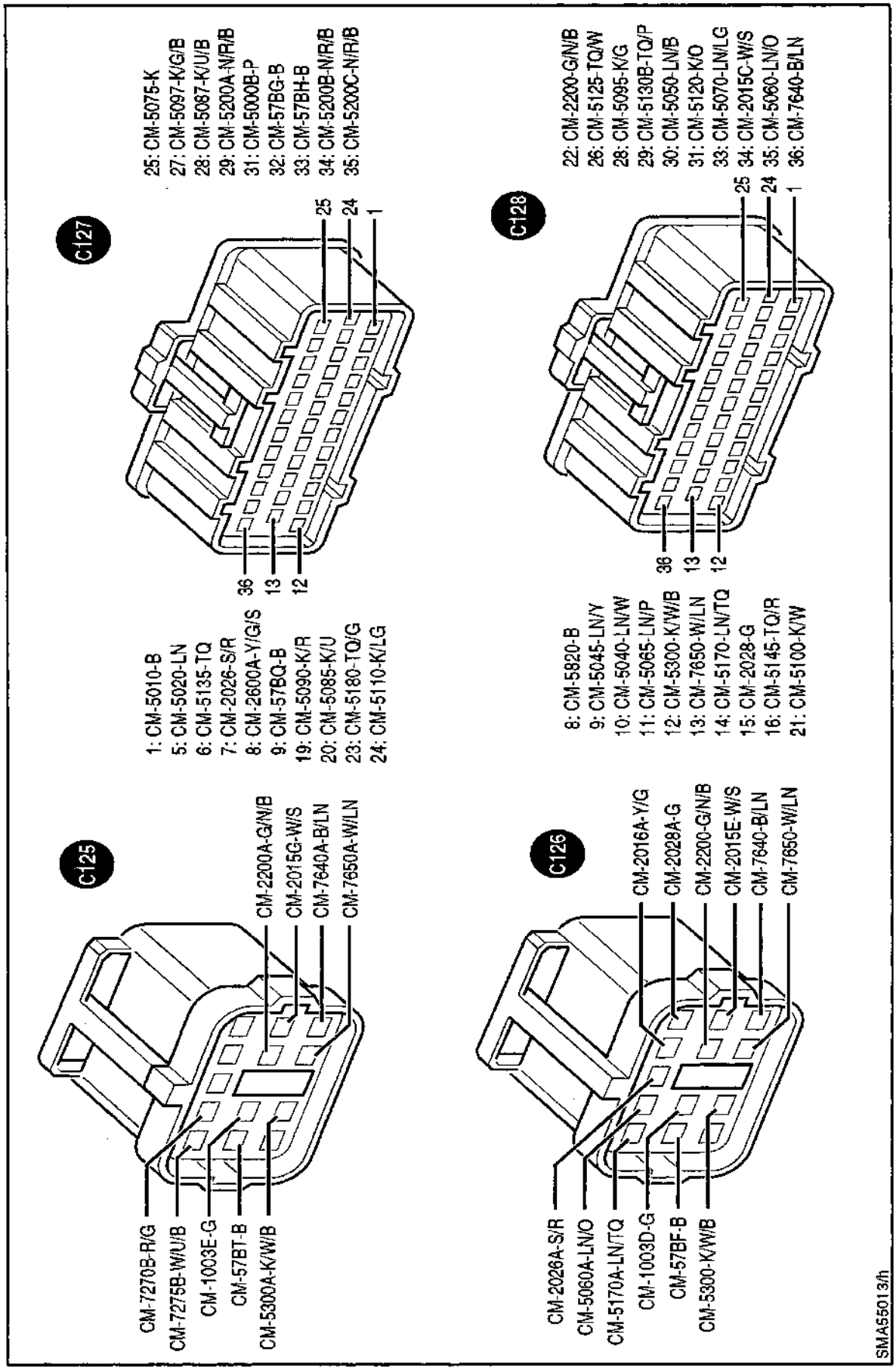
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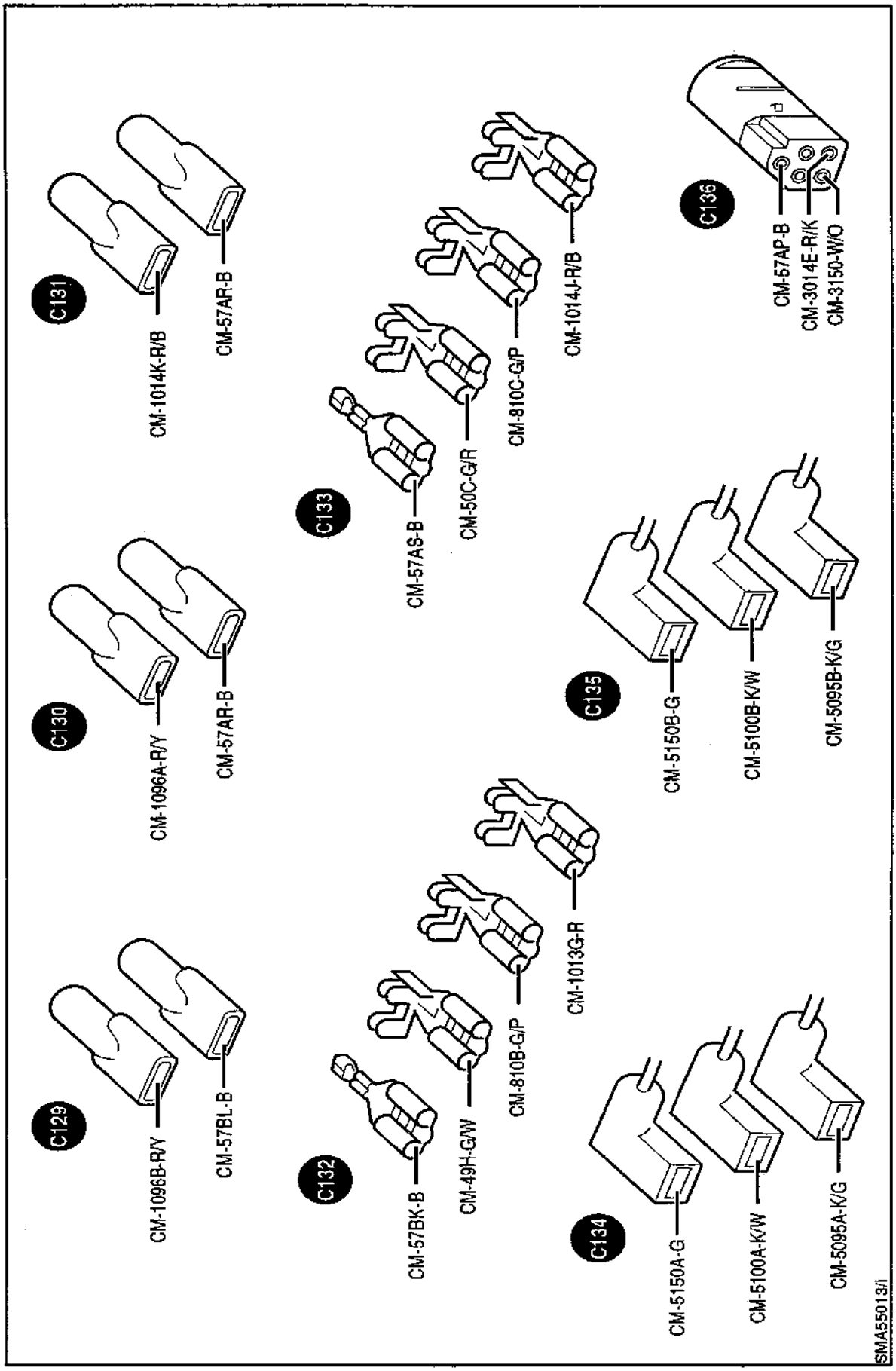
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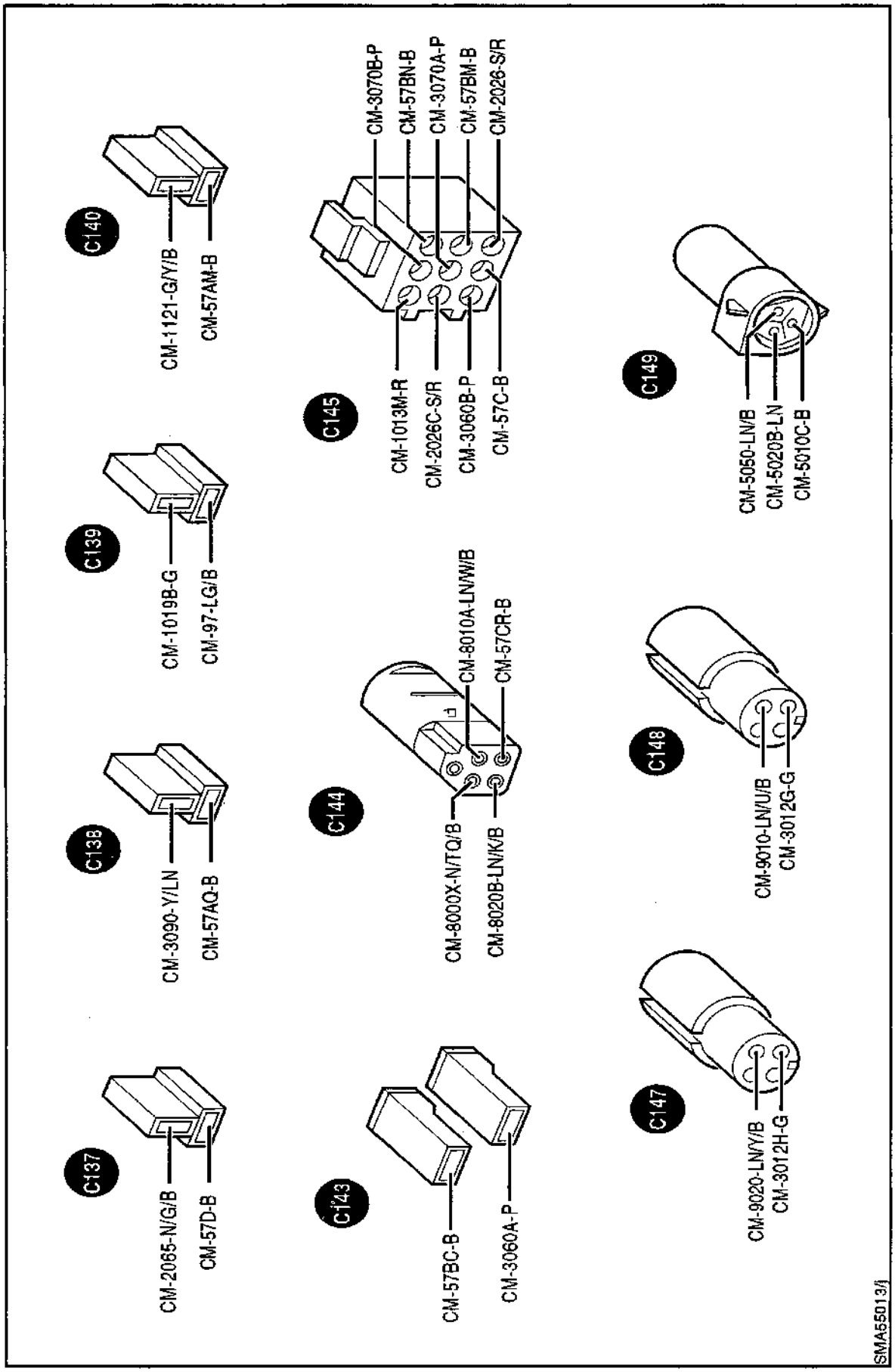
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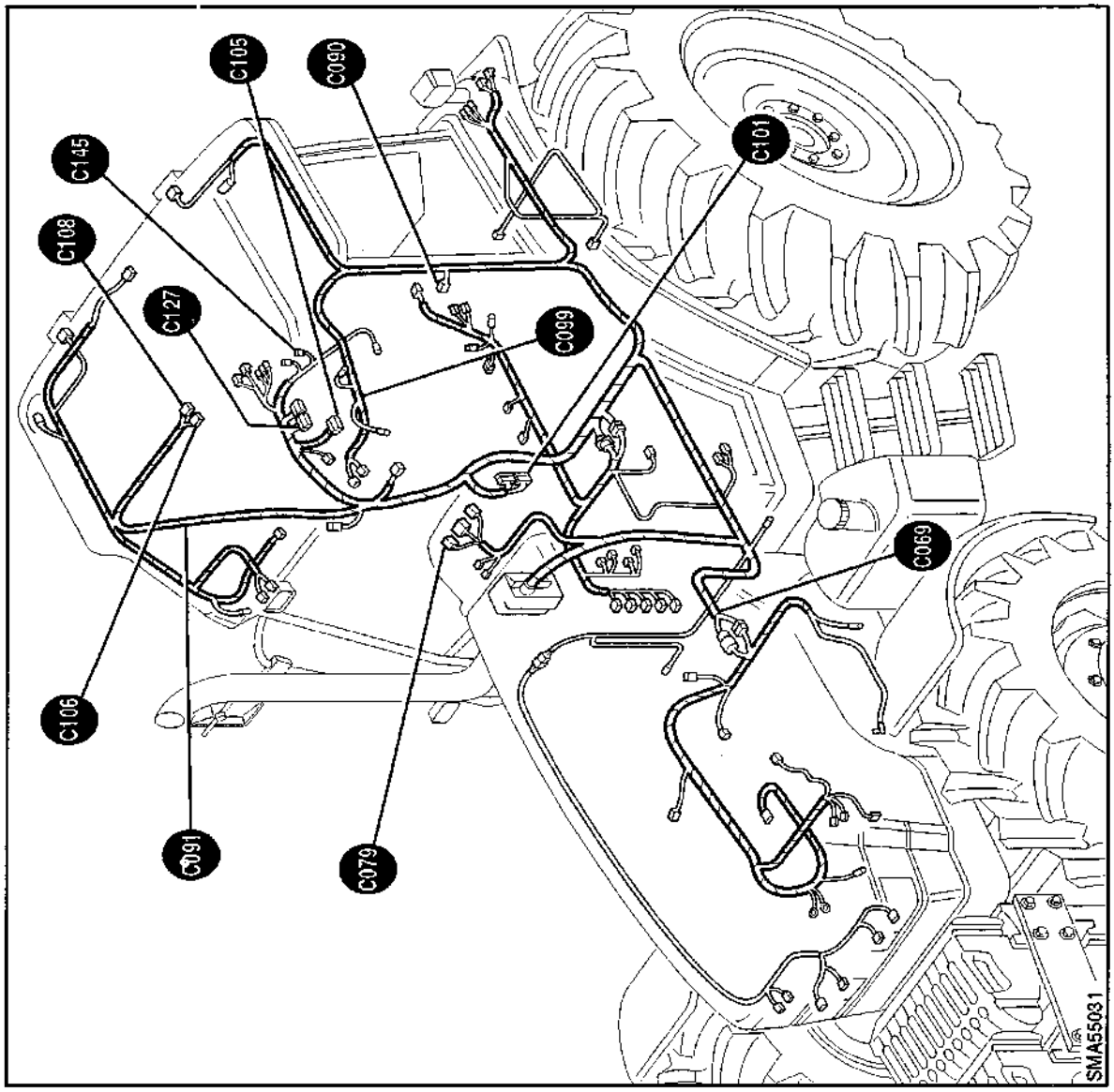


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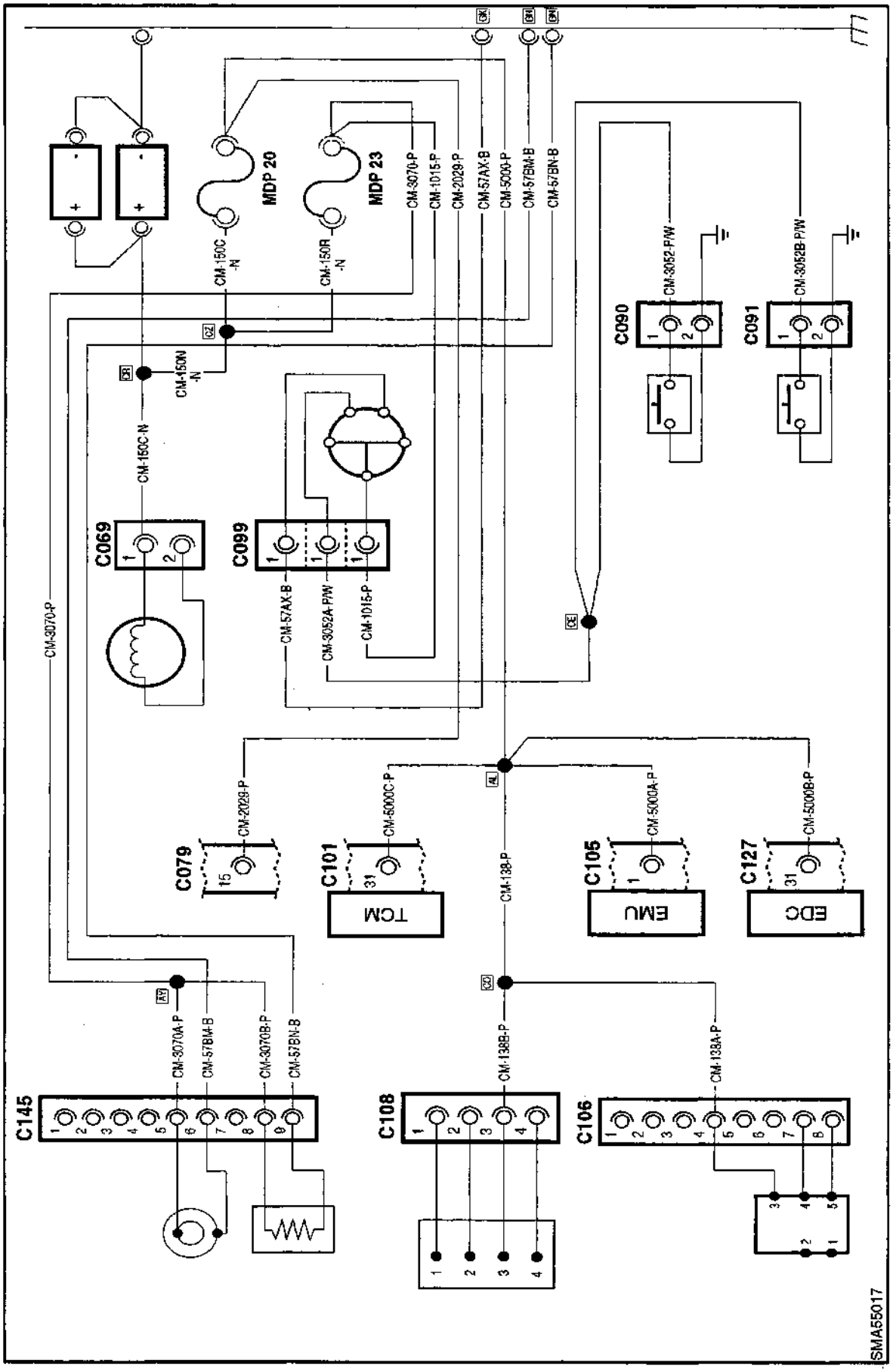
BASIC LIVE

- **C069** – Starter Solenoid
- **C079** – Instrument Cluster 'A'
- **C090** – Left Hand Door Switch
- **C091** – Right Hand Door Switch
- **C099** – Interior Lamp
- **C101** – TCM Connector 2
- **C105** – EMU Connector
- **C106** – Radio A
- **C108** – Clock
- **C127** – EDC Module Connector 2
- **C145** – Rear Socket Connector



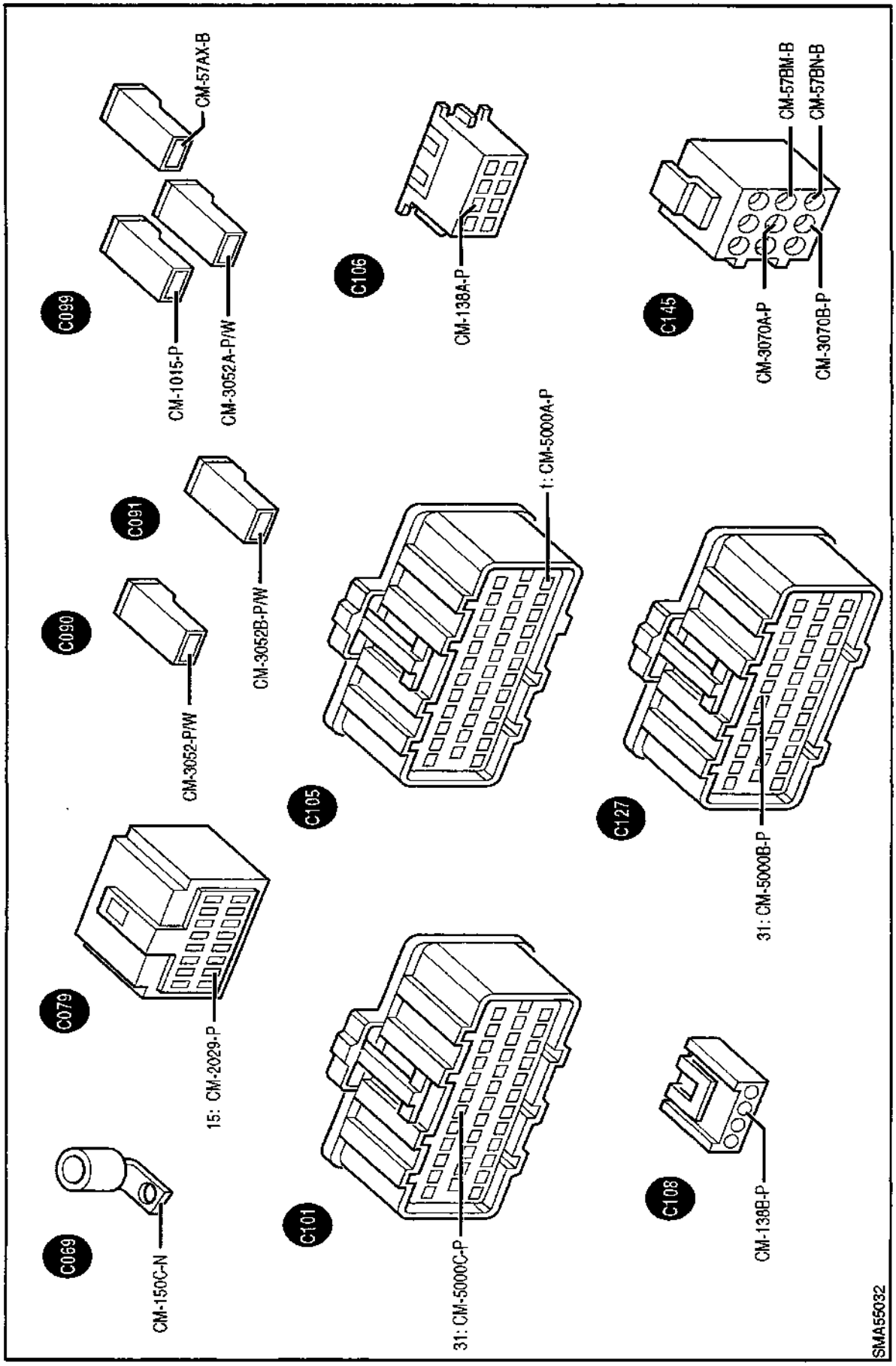
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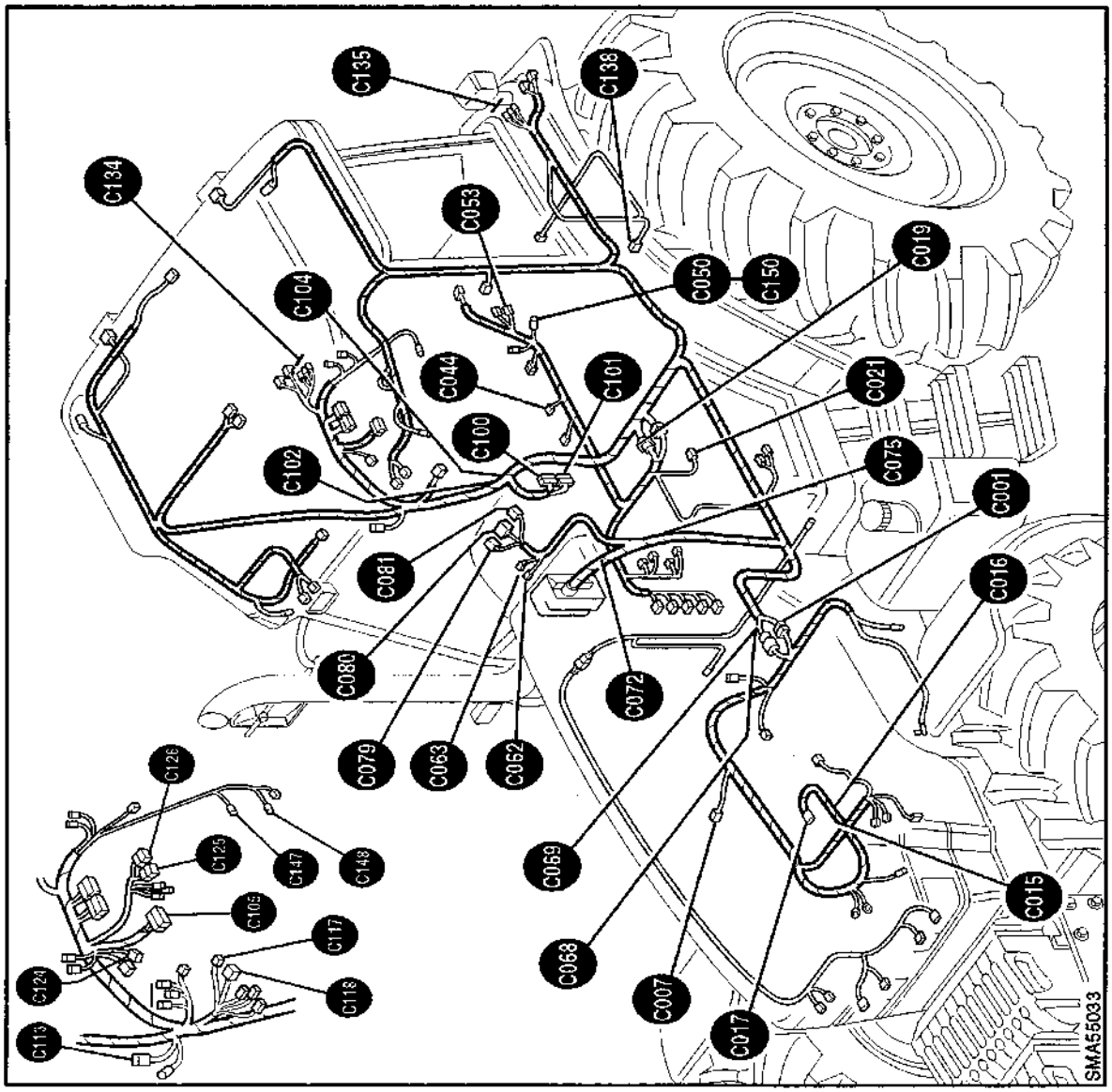


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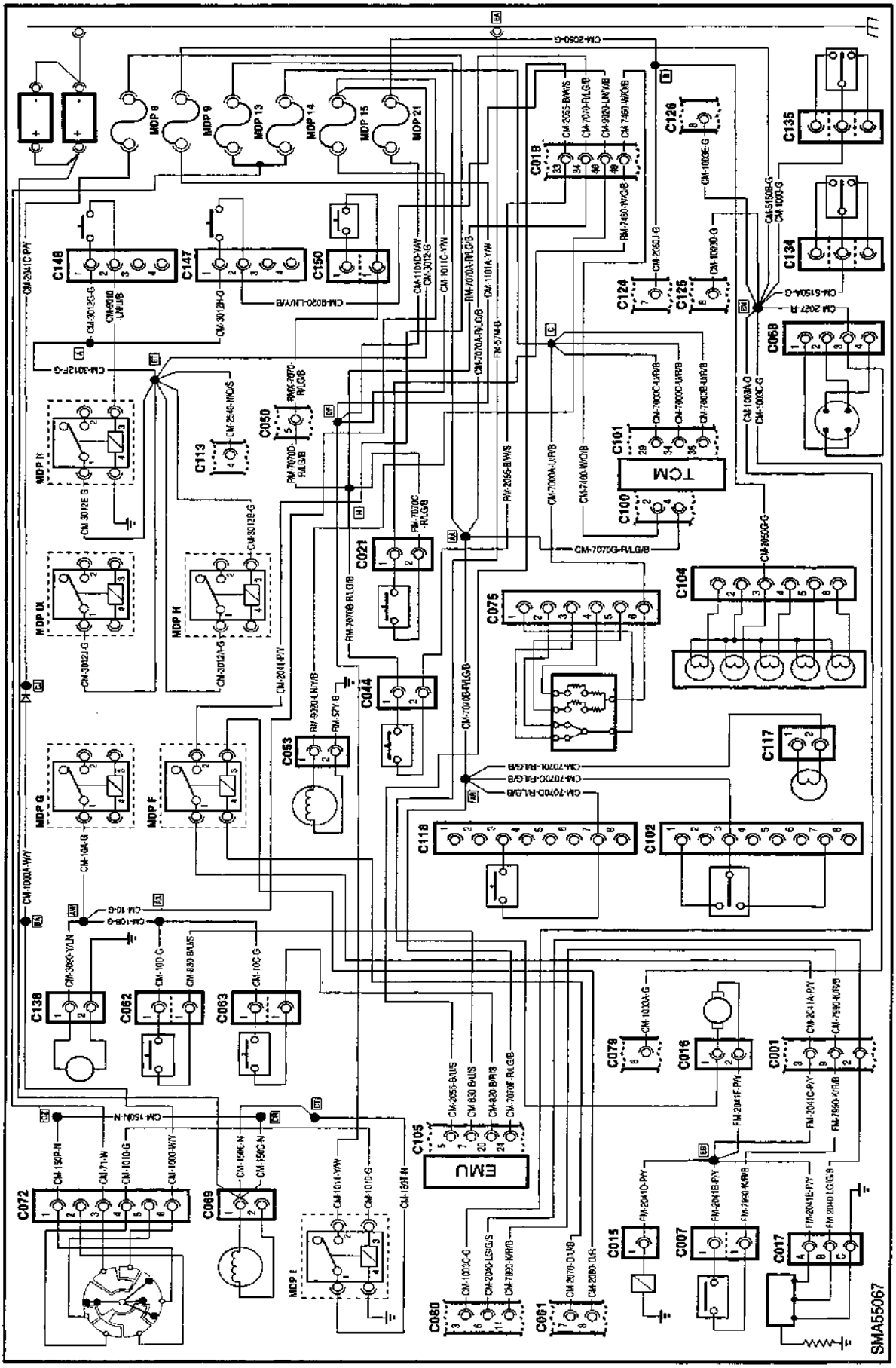
IGNITION ON 1

- C001 – Front Main Bulkhead Connector
- C007 – Brake Fluid Reservoir
- C015 – Fuel Shut Off Solenoid
- C016 – Fuel Pump
- C017 – Water in Fuel Sensor
- C019 – Rear Main Extension Connector 1
- C021 – Creeper Engaged Switch
- C044 – Ground Speed PTO Engaged
- C050 – Trailer Brake
- C053 – Hydraulic Remote Valve Solenoid
- C062 – RH Stop Lamp Switch
- C063 – LH Stop Lamp Switch
- C068 – Radar
- C069 – Starter Solenoid (Cab Main)
- C072 – Starter Switch
- C075 – Shuttle Switch
- C079 – Instrument Cluster A
- C080 – Instrument Cluster B
- C081 – Instrument Cluster C
- C100 – TCM Connector 1
- C101 – TCM Connector 2
- C102 – Fast Raise / Lower Switch
- C104 – Gear Shift Indicator
- C105 – EMU Connector
- C113 – Front Hitch Potentiometer
- C117 – Rear PTO Engaged Lamp
- C118 – Rear PTO Brake Switch
- C124 – Limp Home Connector
- C125 – Diagnostic Plug TCM
- C126 – Diagnostic Plug EDC
- C134 – HPL Raise/Lower RH Switch
- C135 – HPL Raise/Lower LH Switch
- C138 – Seat Pump
- C147 – Remote Valve Switch
- C148 – Diverter Valve Switch
- C150 – Pressure Switch 100



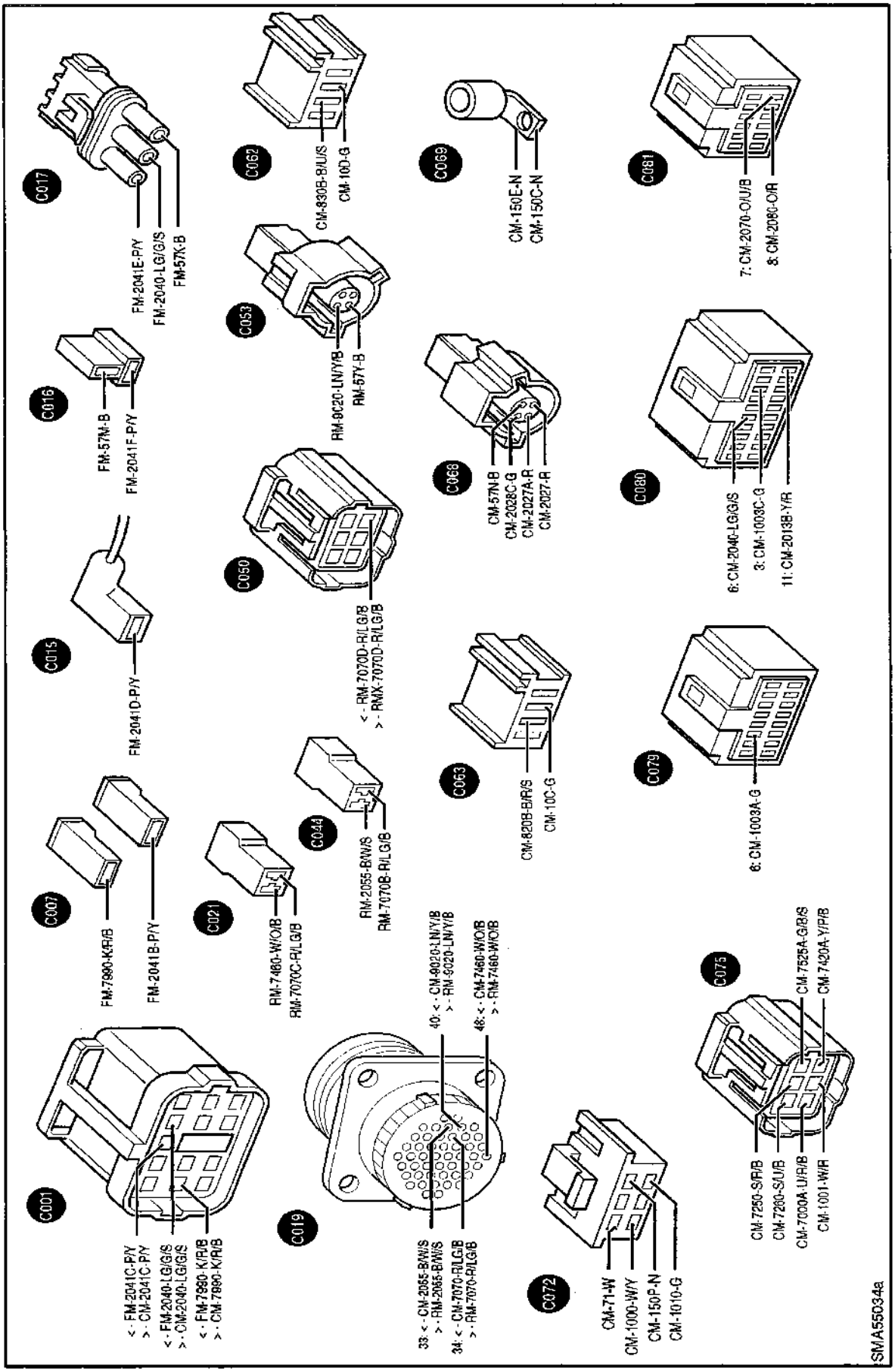
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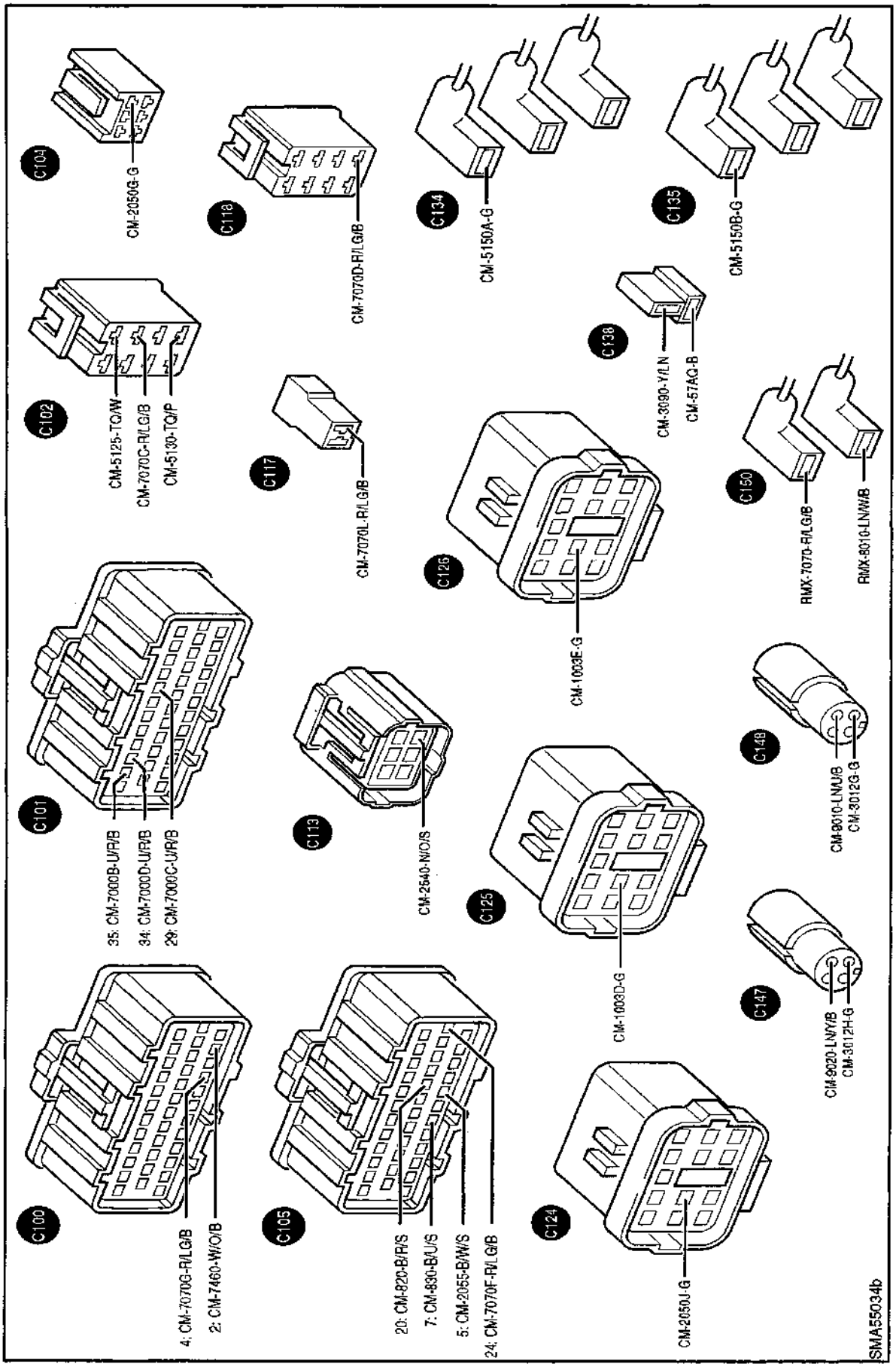
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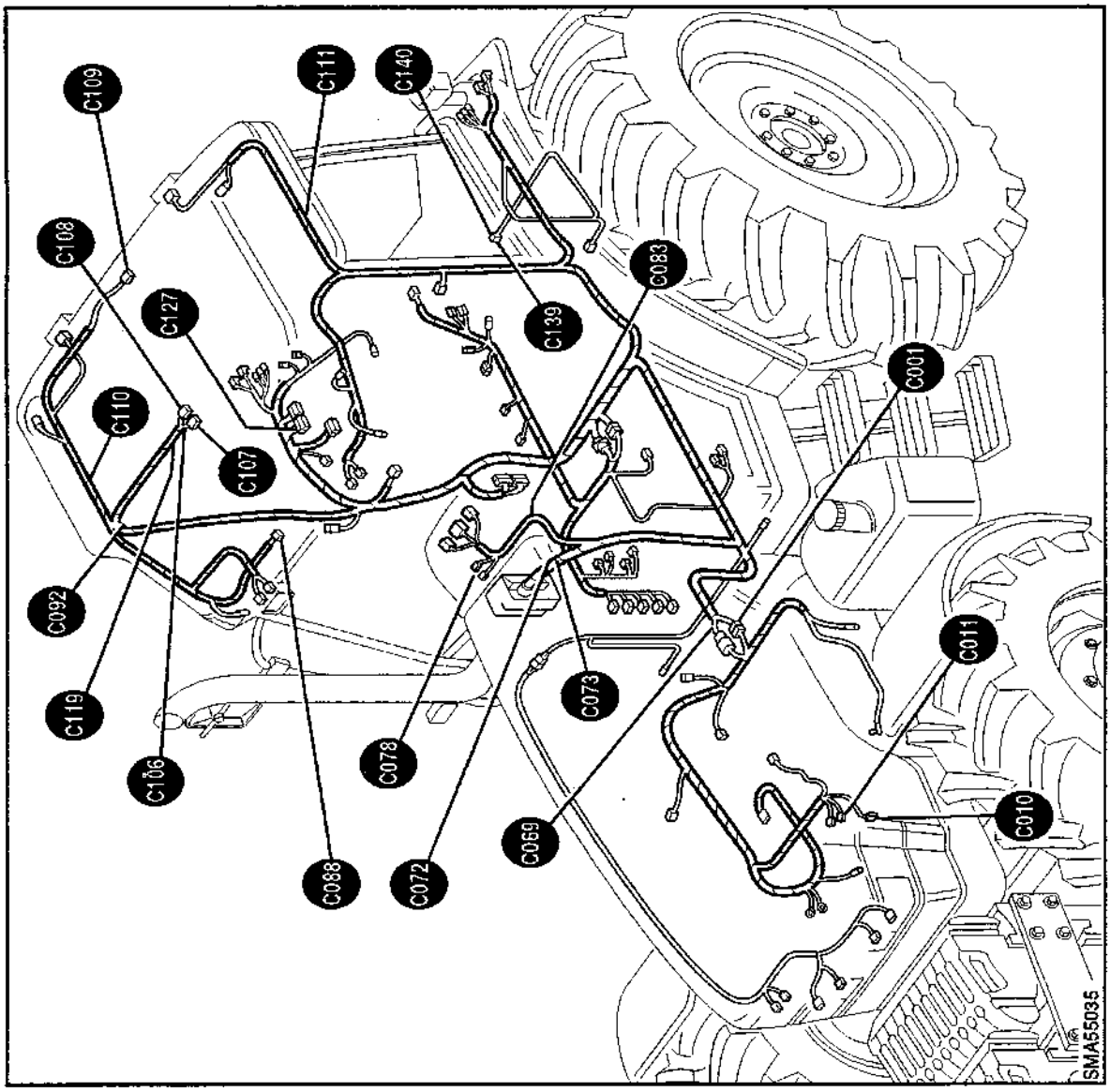


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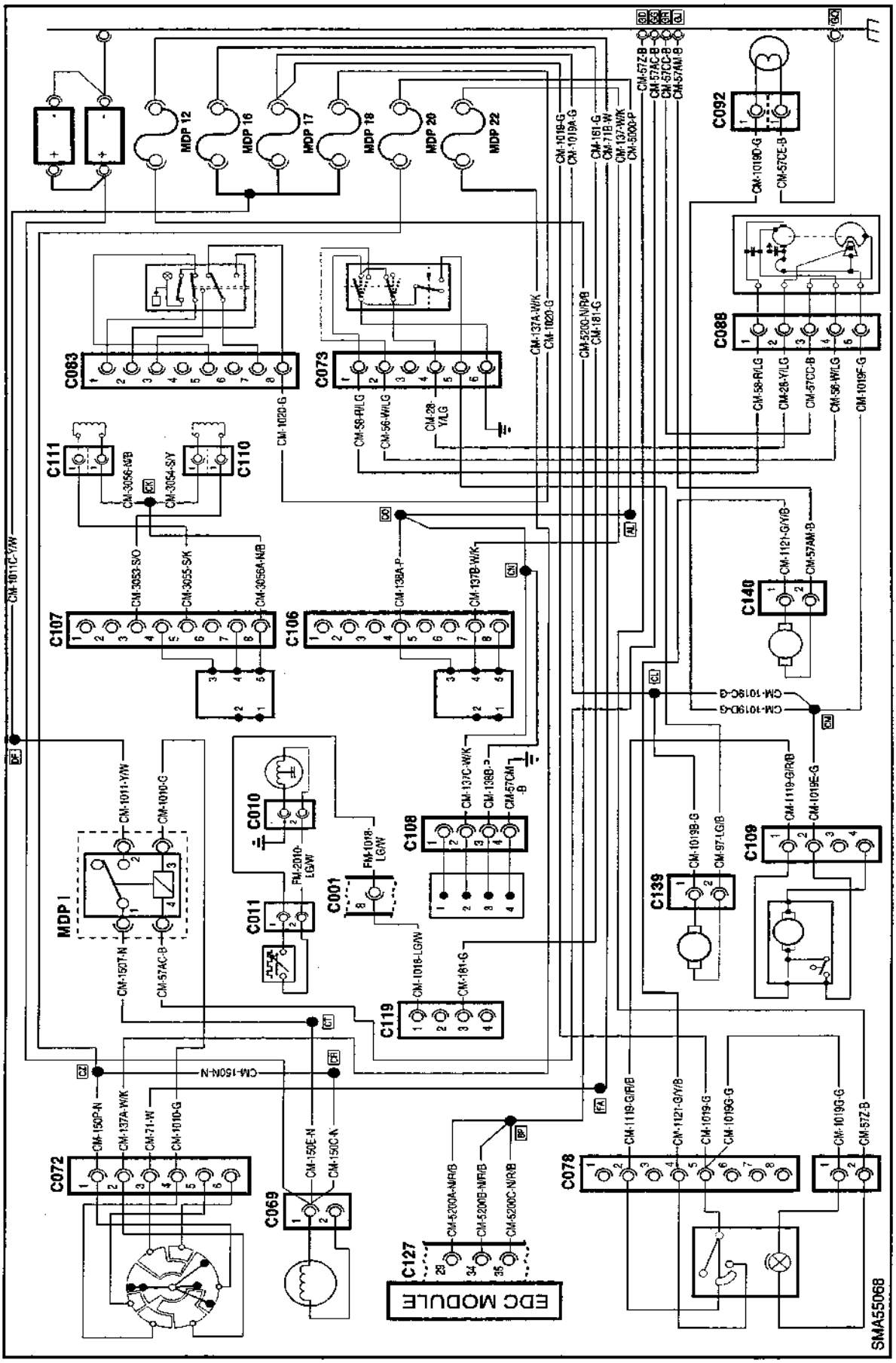
IGNITION ON 2

C001	– Main Bulkhead Connector M1
C010	– Air Con-Switch
C011	– De-Icing Thermostat
C069	– Starter Solenoid (Cab Main)
C072	– Starter Switch
C073	– Windshield Wiper Switch
C078	– Rear Wiper Switch
C083	– Hazard Switch
C088	– Front Wiper Motor
C092	– Console Lamp
C106	– Radio A
C107	– Radio B
C108	– Clock
C109	– Rear Wiper Motor
C110	– Right Hand Speaker
C111	– Left Hand Speaker
C119	– Heater Air-Con Connector
C127	– EDC Module CN2
C139	– Front Washer Motor
C140	– Rear Washer Motor



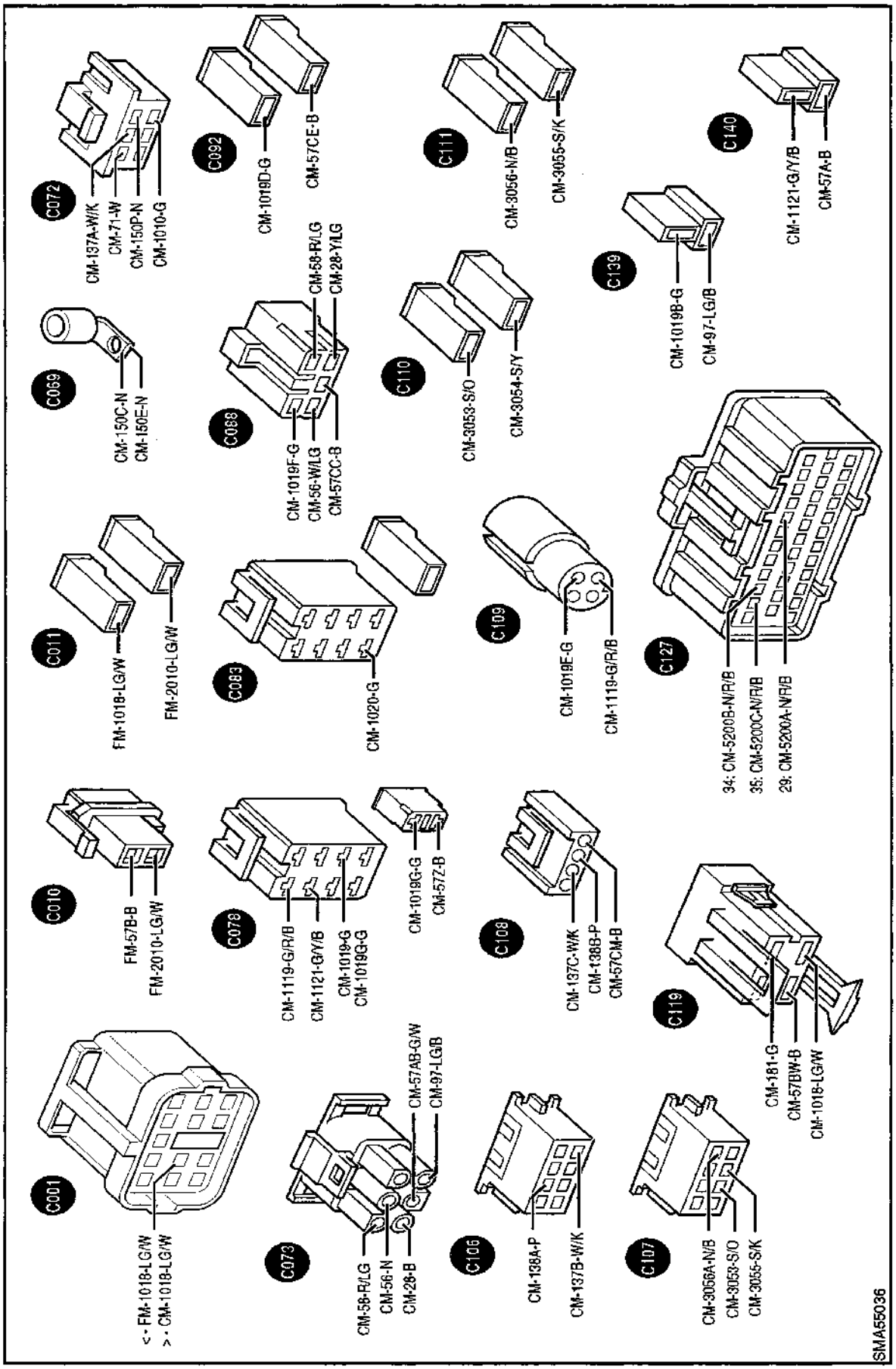
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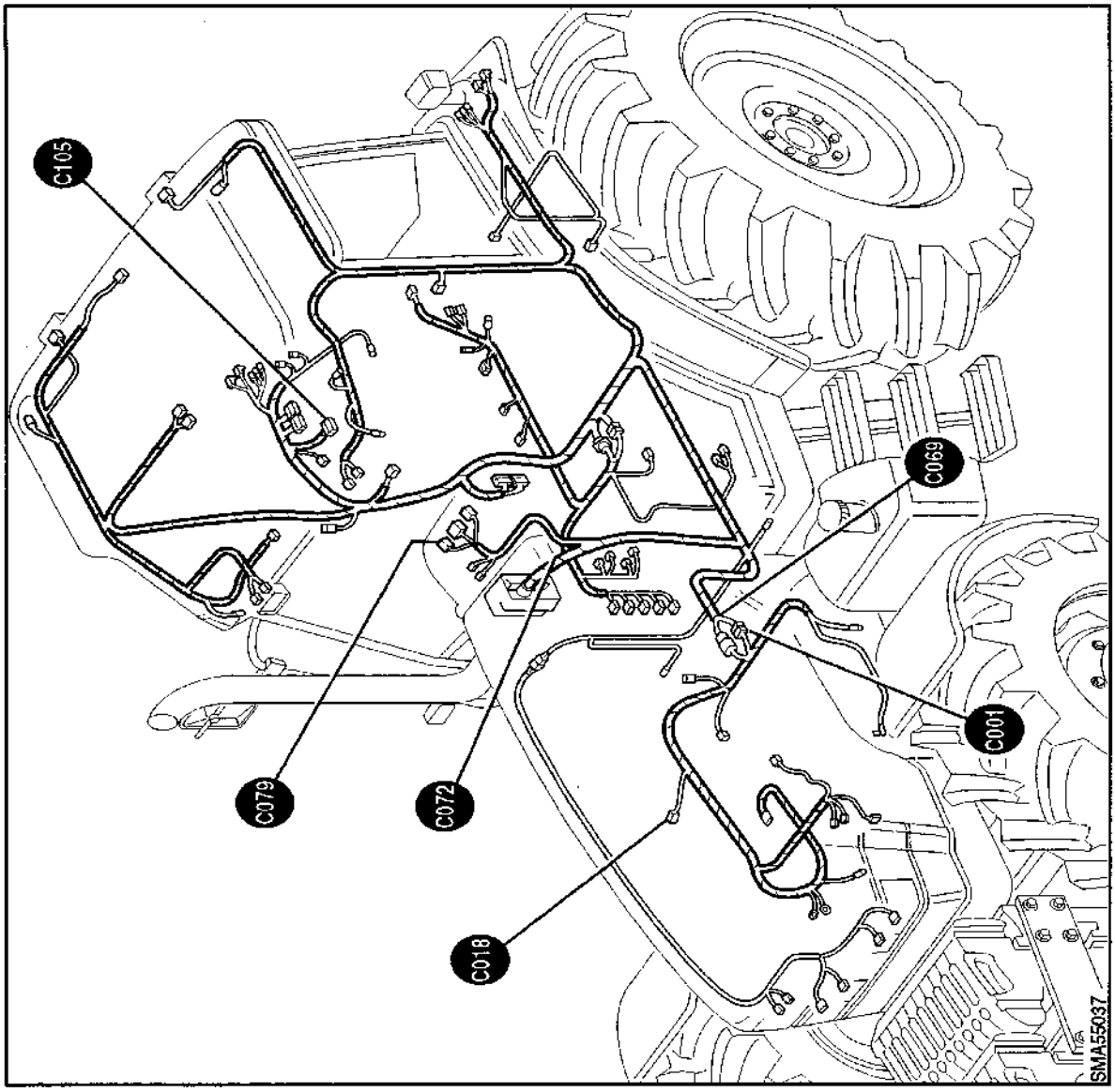


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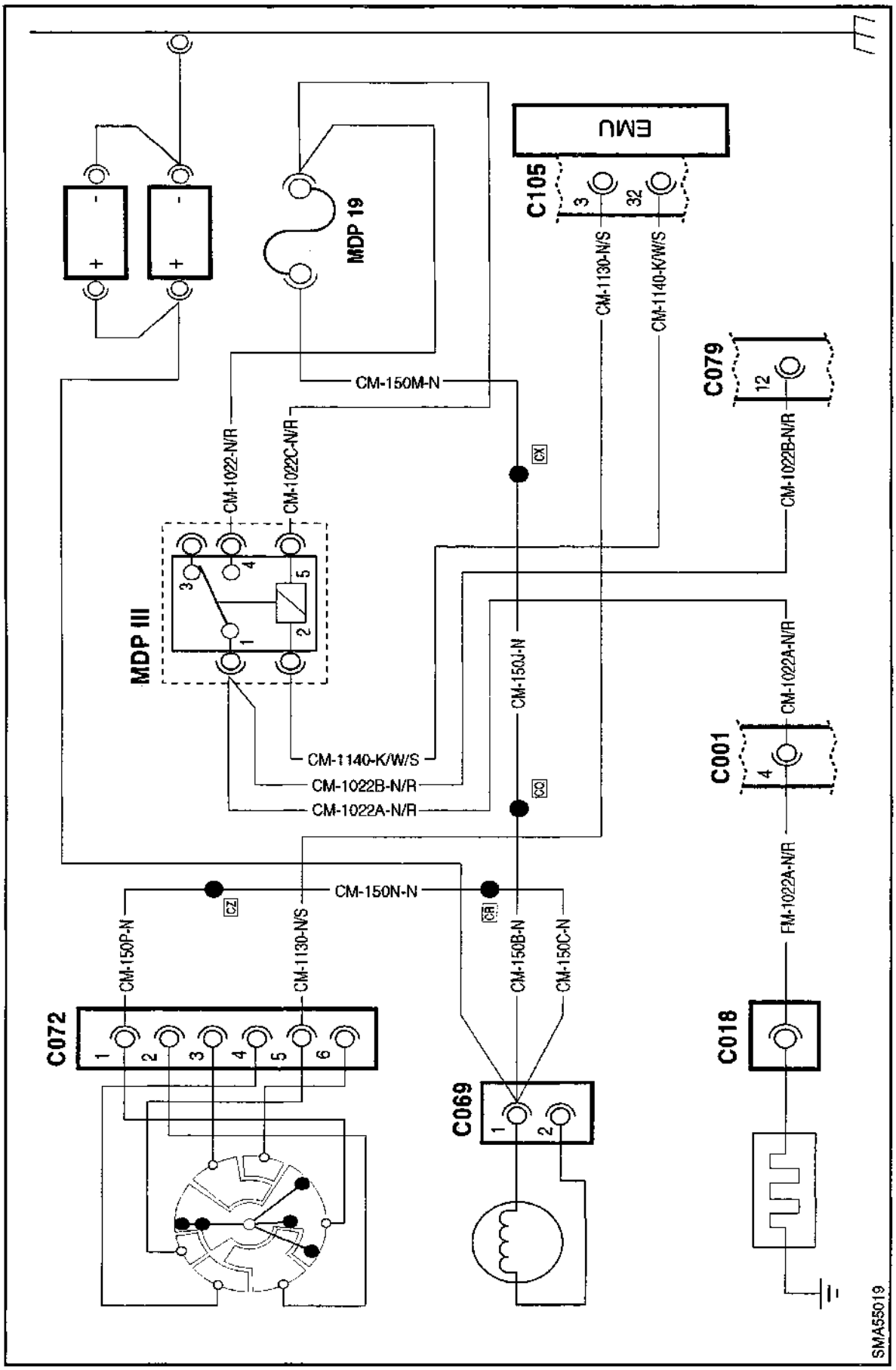
THERMOSTART

C001 – Main Bulkhead Connector M1
C018 – Thermostart
C069 – Starter Solenoid
C072 – Starter Switch
C079 – Instrument Cluster 'A'
C105 – EMU Connector



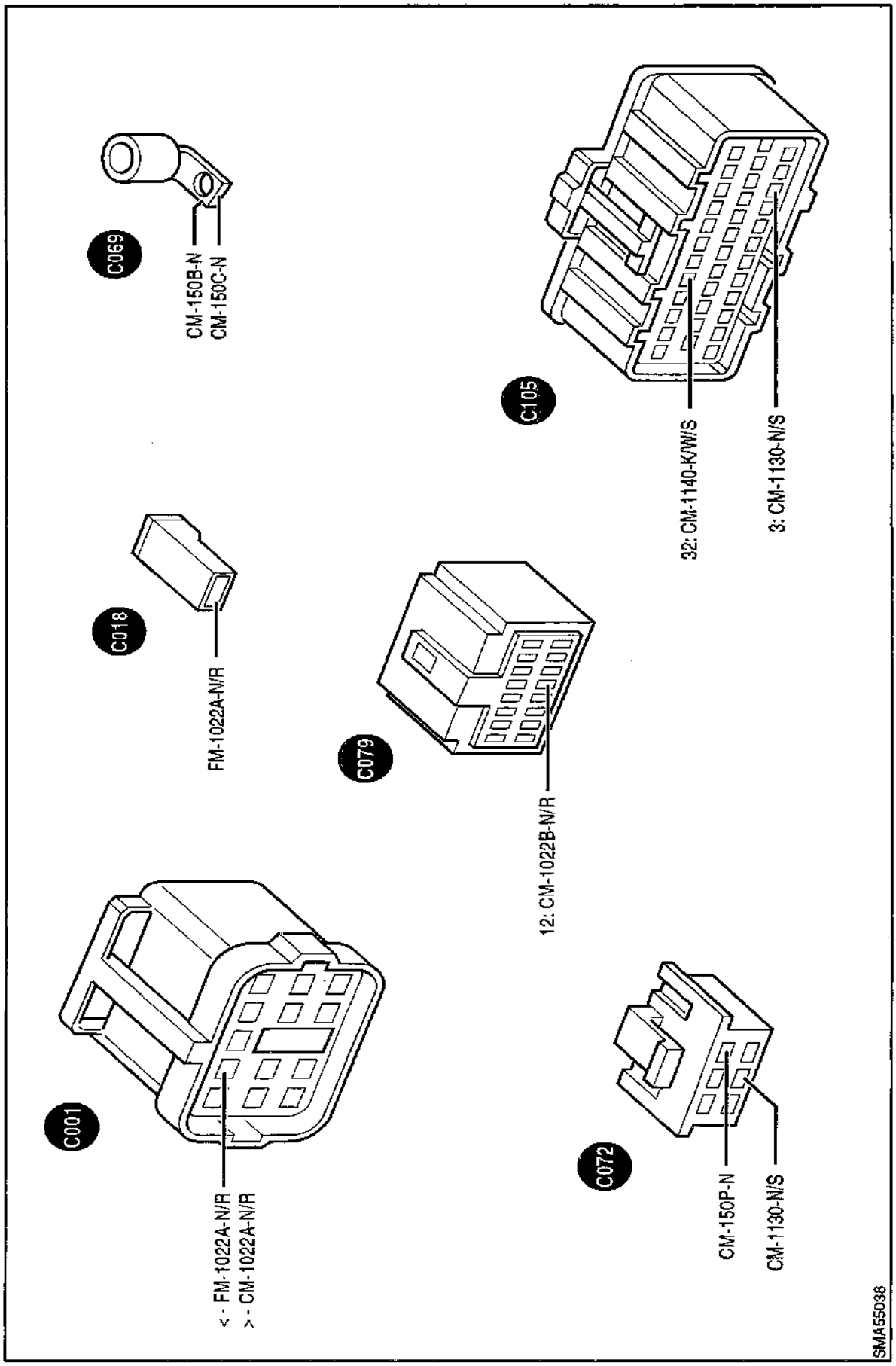
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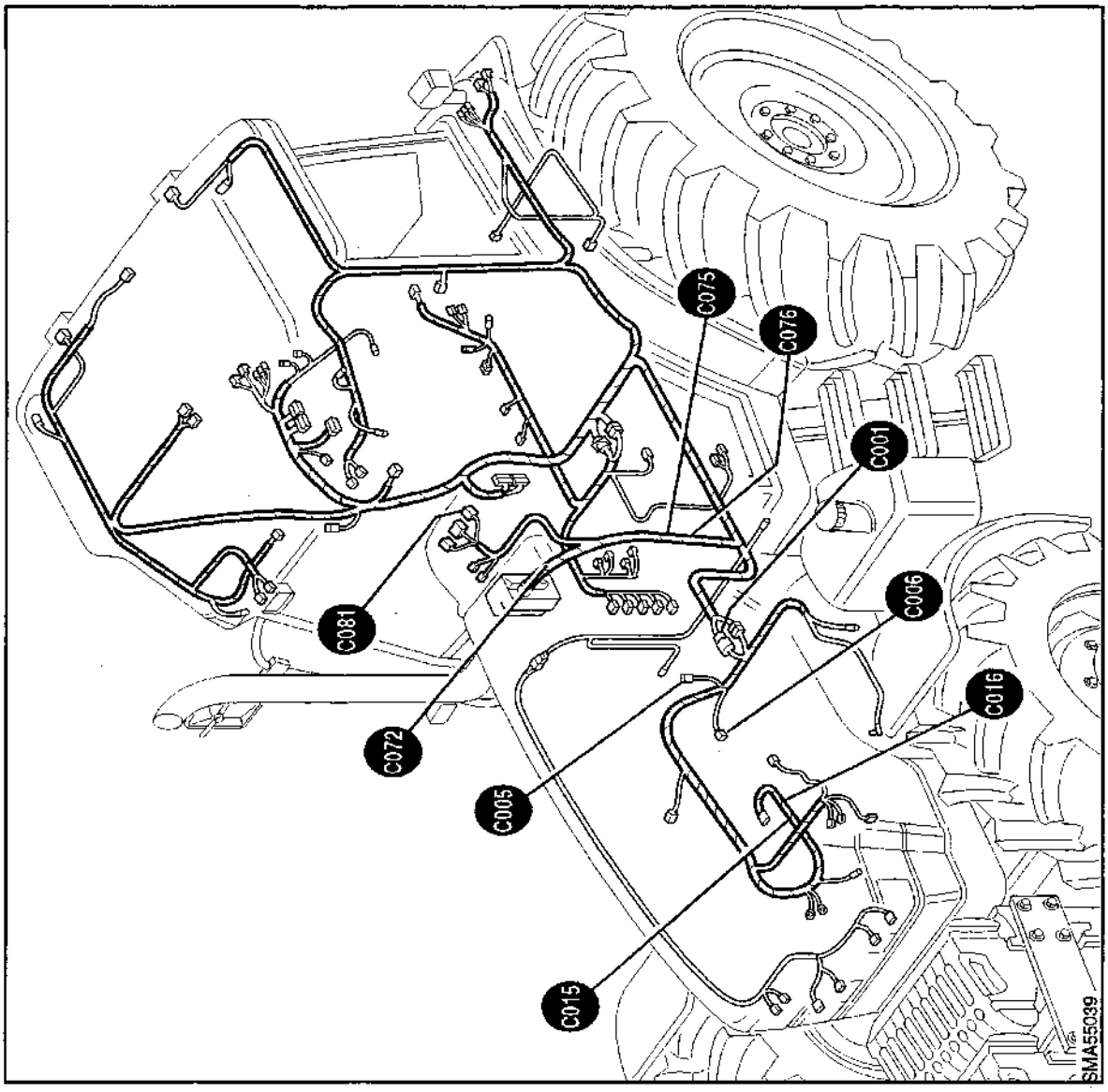


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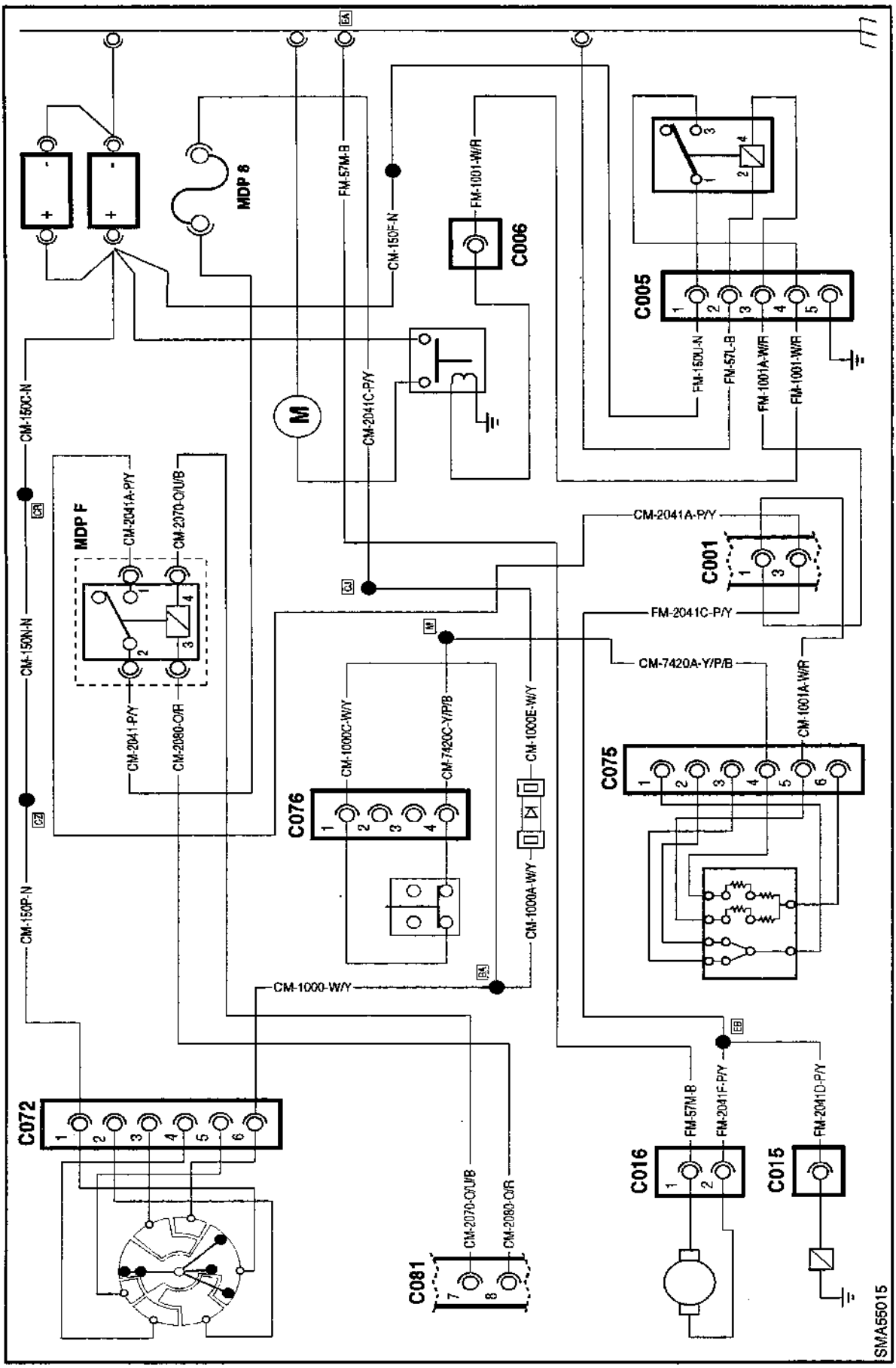
ENGINE STARTING

C001 – Main Bulkhead Connector
C005 – Starter Relay
C006 – Starter Solenoid
C015 – Fuel Shut-Off Solenoid
C016 – Fuel Pump
C072 – Starter Switch
C075 – Shuttle Switch
C076 – Clutch Switch
C081 – Instrument Cluster 'C'



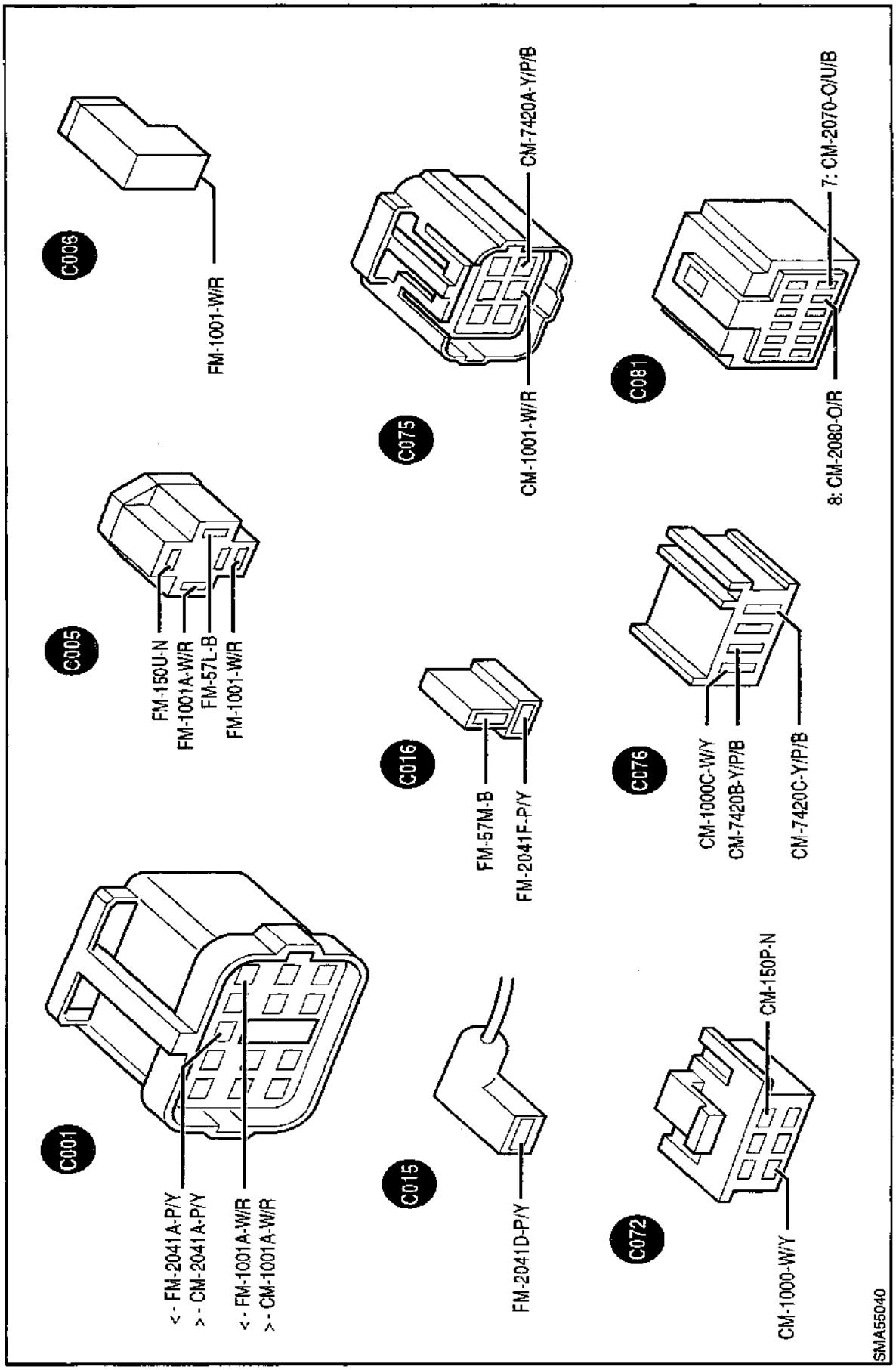
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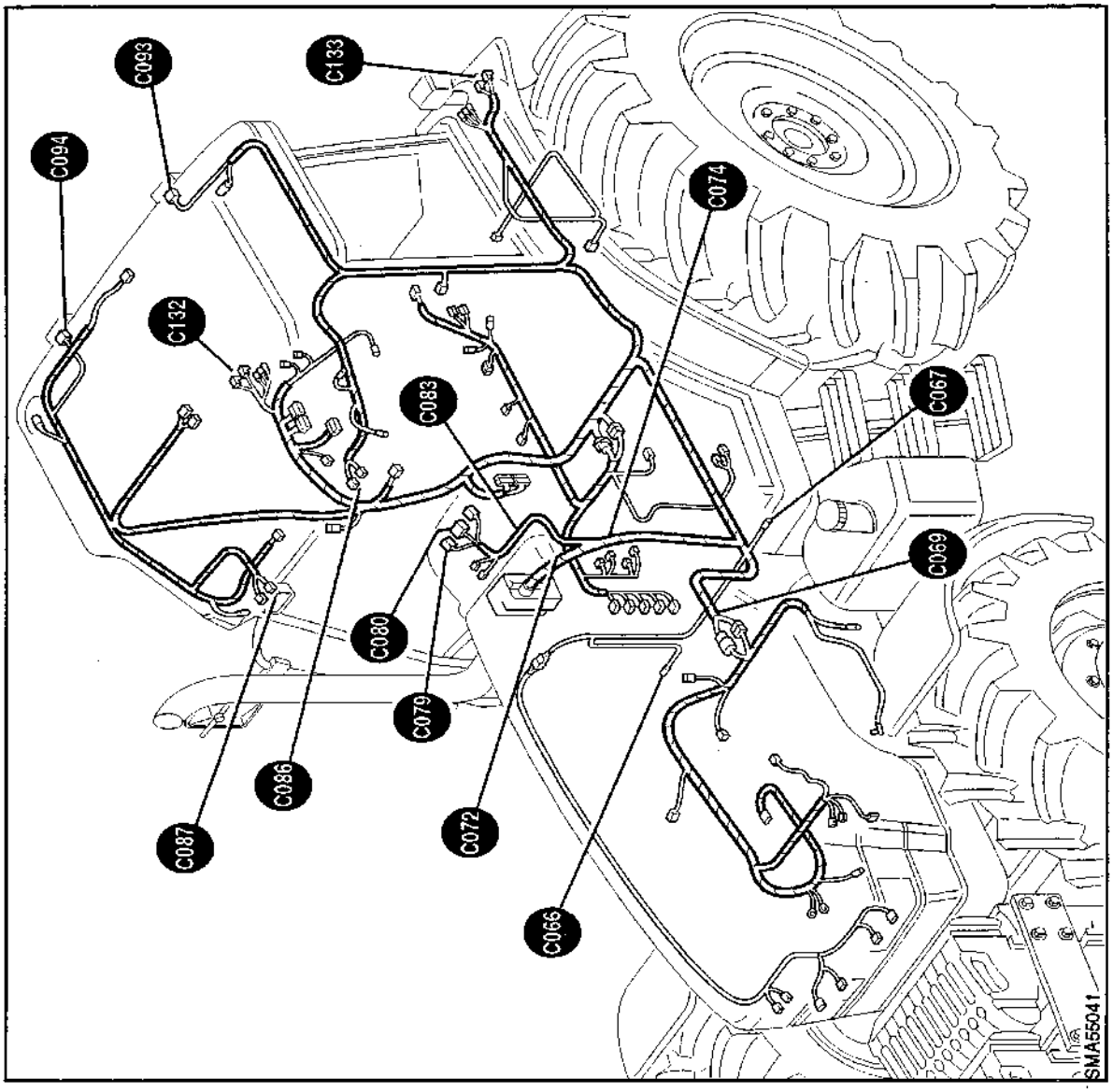


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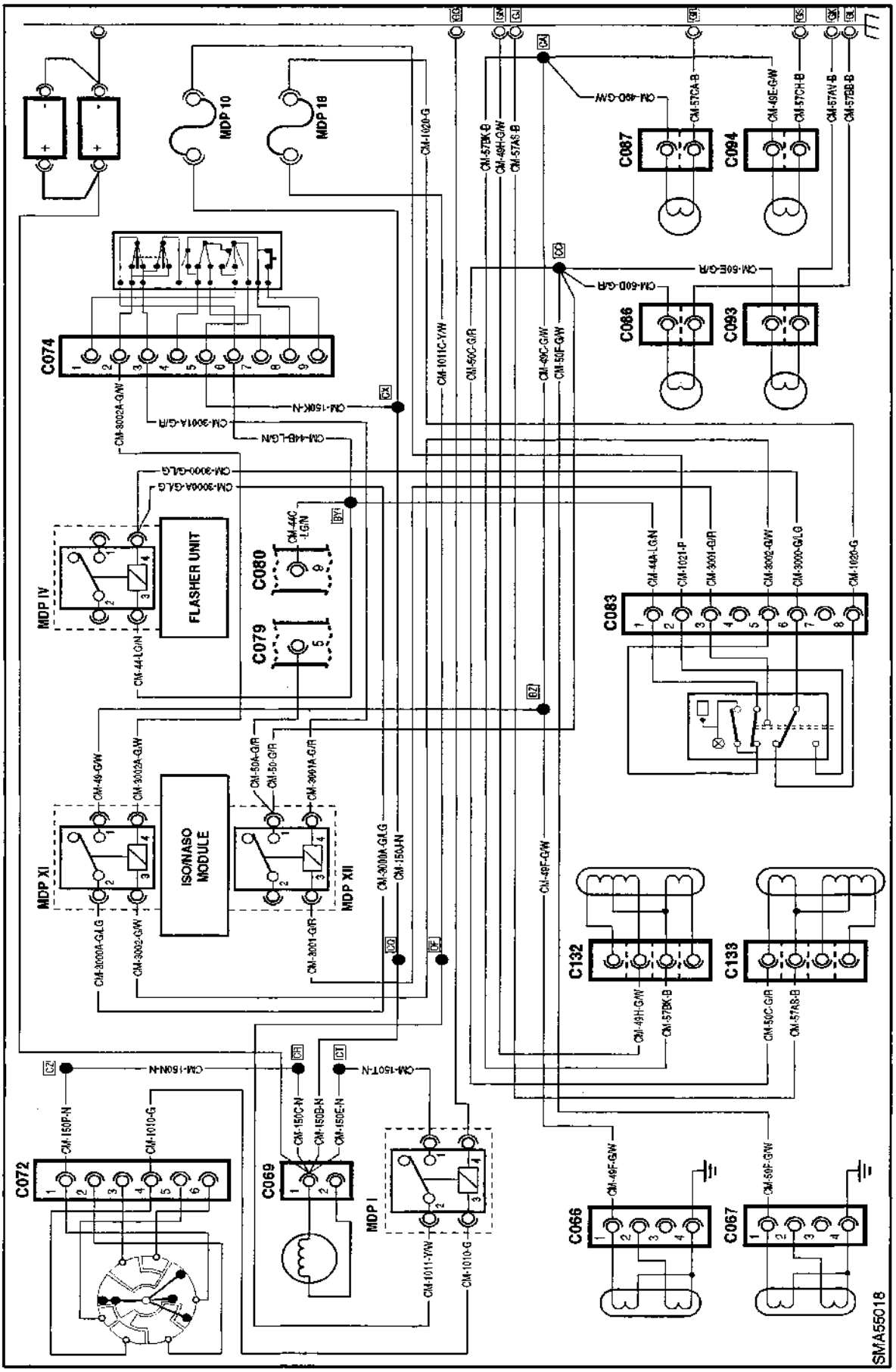
INDICATOR & HAZARDS

C066	– Right Hand Side Lamp
C067	– Left Hand Side Lamp
C069	– Starter Solenoid
C072	– Starter Switch
C074	– Turn Switch
C083	– Hazard Switch
C086	– L/H Front NASO Flasher
C087	– R/H Front NASO Flasher
C093	– L/H Rear NASO Flasher
C094	– R/H Rear NASO Flasher
C132	– R/H Fender NASO Flasher
C133	– L/H Fender NASO Flasher



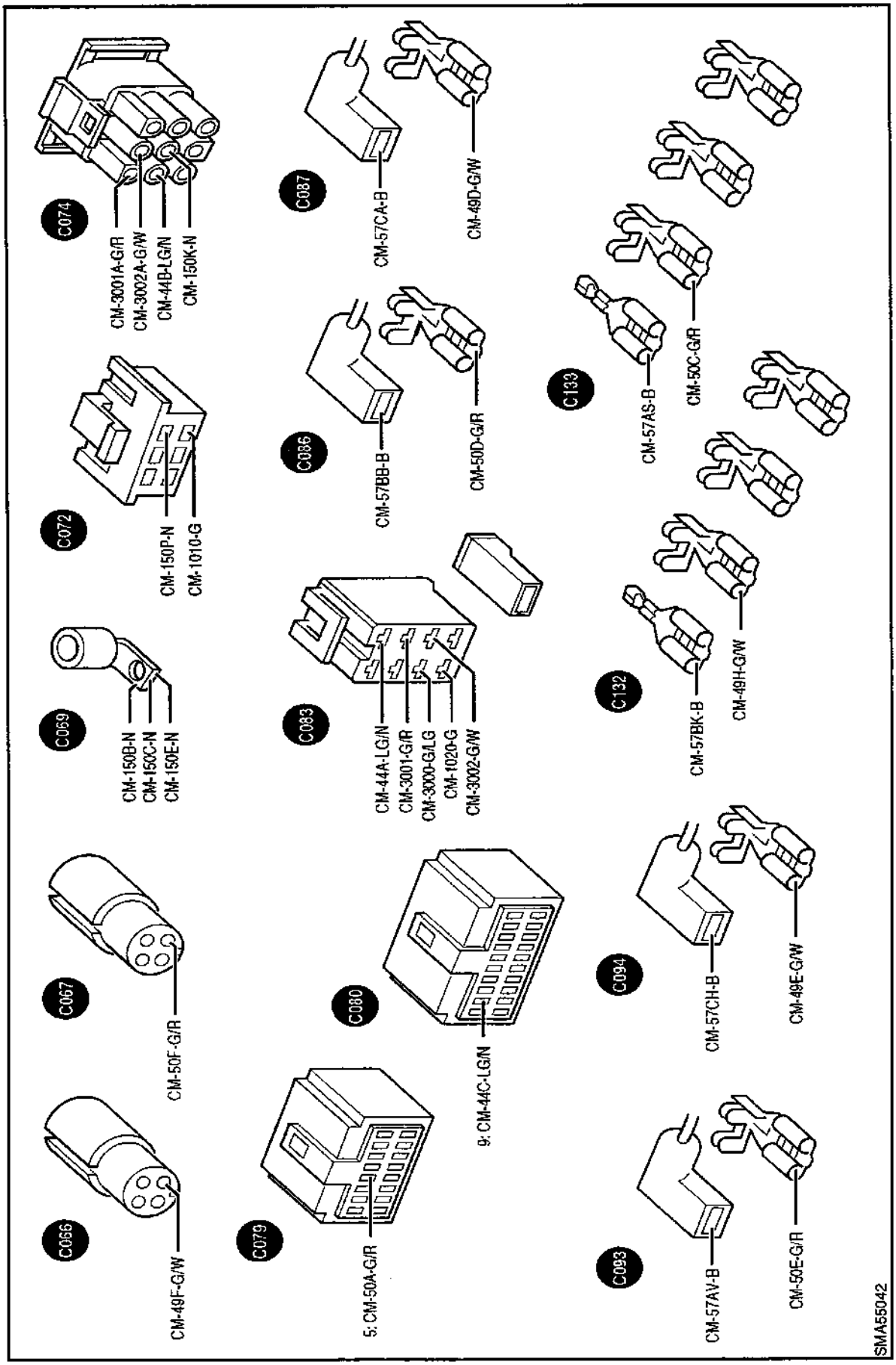
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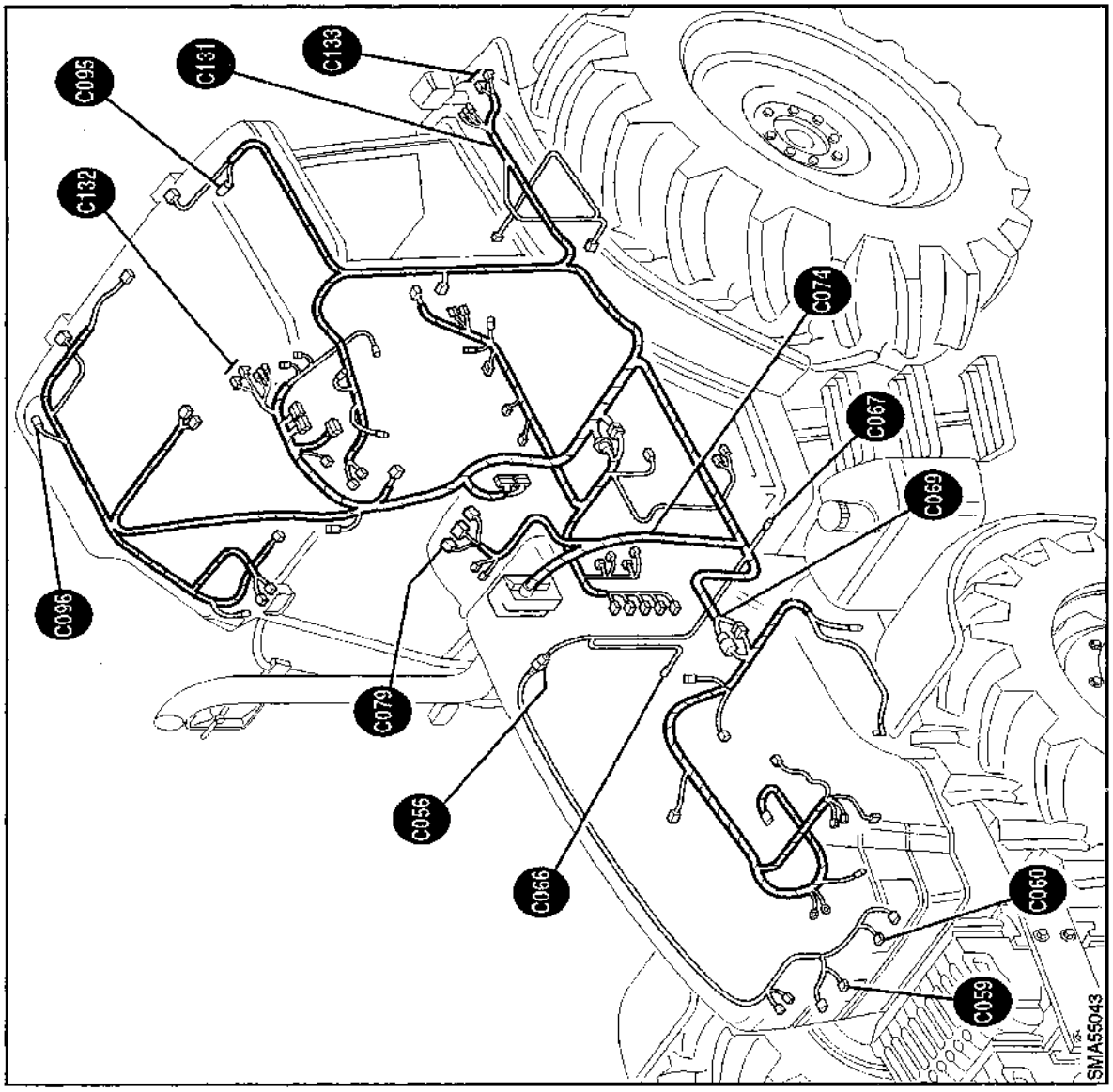


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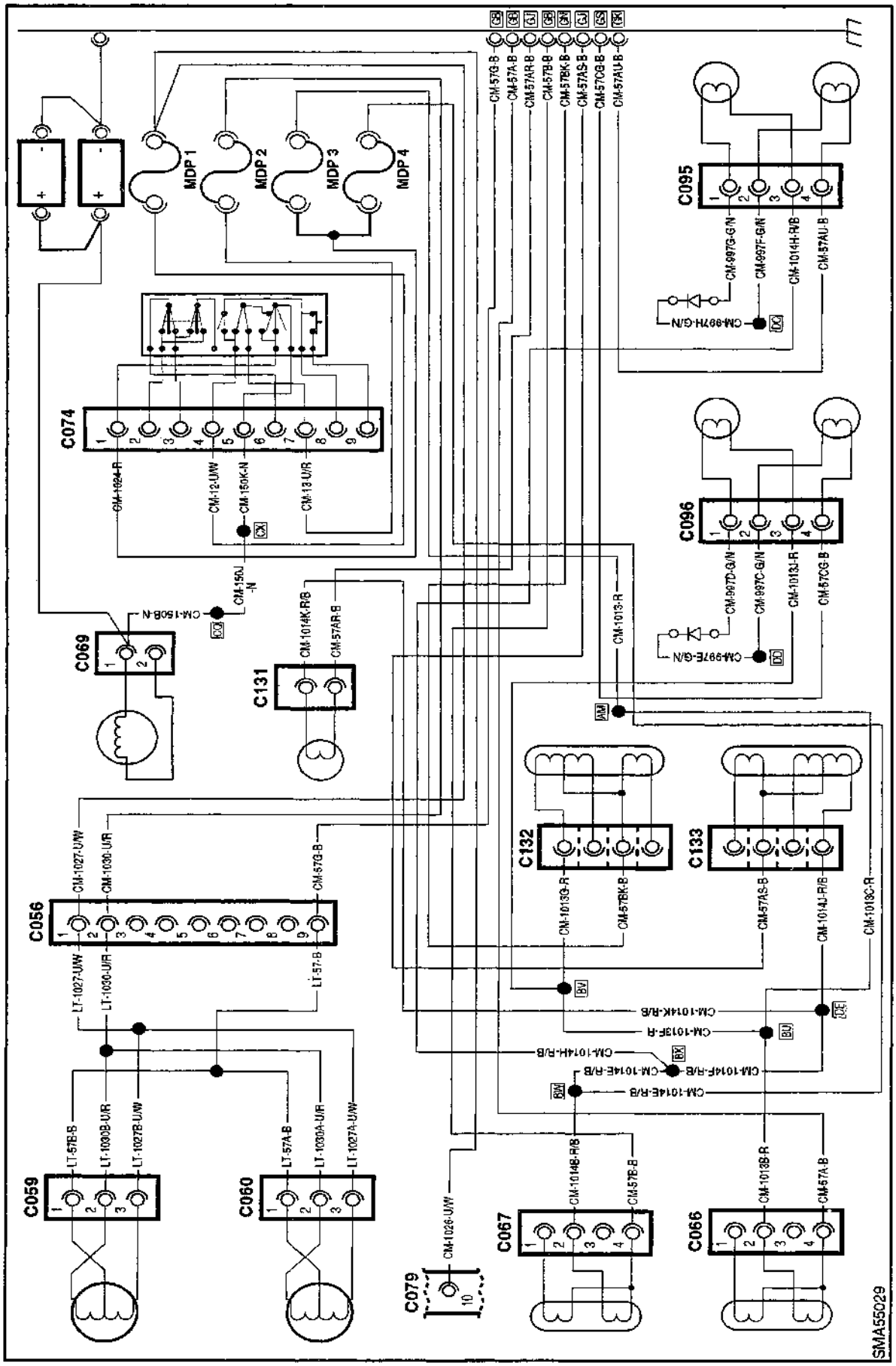
LIGHTING

C056 – Headlamp harness Connector
C059 – Right Hand Headlamp
C060 – Left Hand Headlamp
C066 – Right Side Lamp
C067 – Left Side Lamp
C069 – Starter Solenoid (Cab Main)
C074 – Turn Switch
C079 – Instrument Cluster 'A'
C095 – LH Rear License /Worklamp
C096 – RH Rear License /Worklamp
C131 – Licence Plate Lamp
C132 – Rear Lamp RH Fender
C133 – Rear Lamp LH Fender



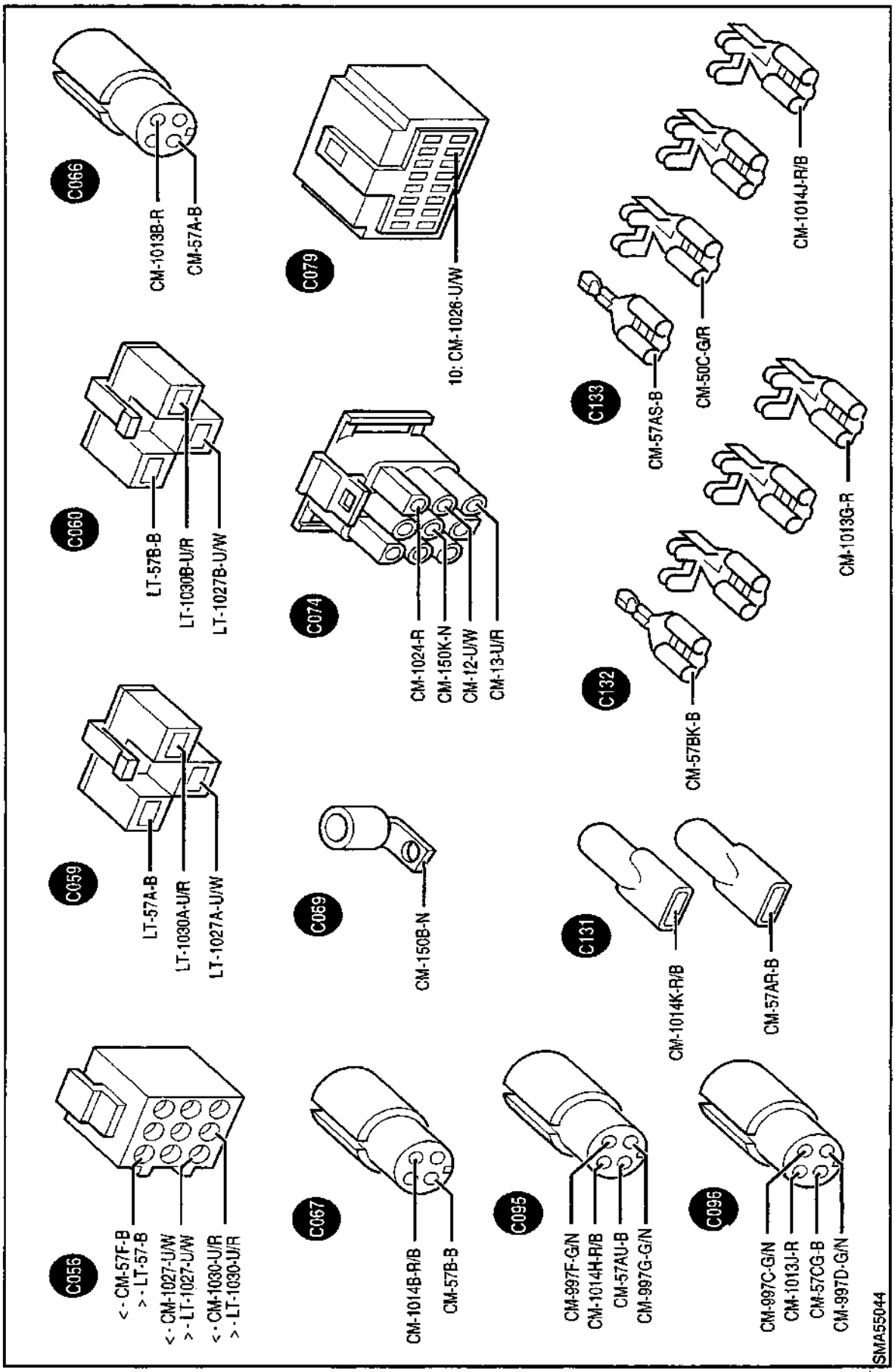
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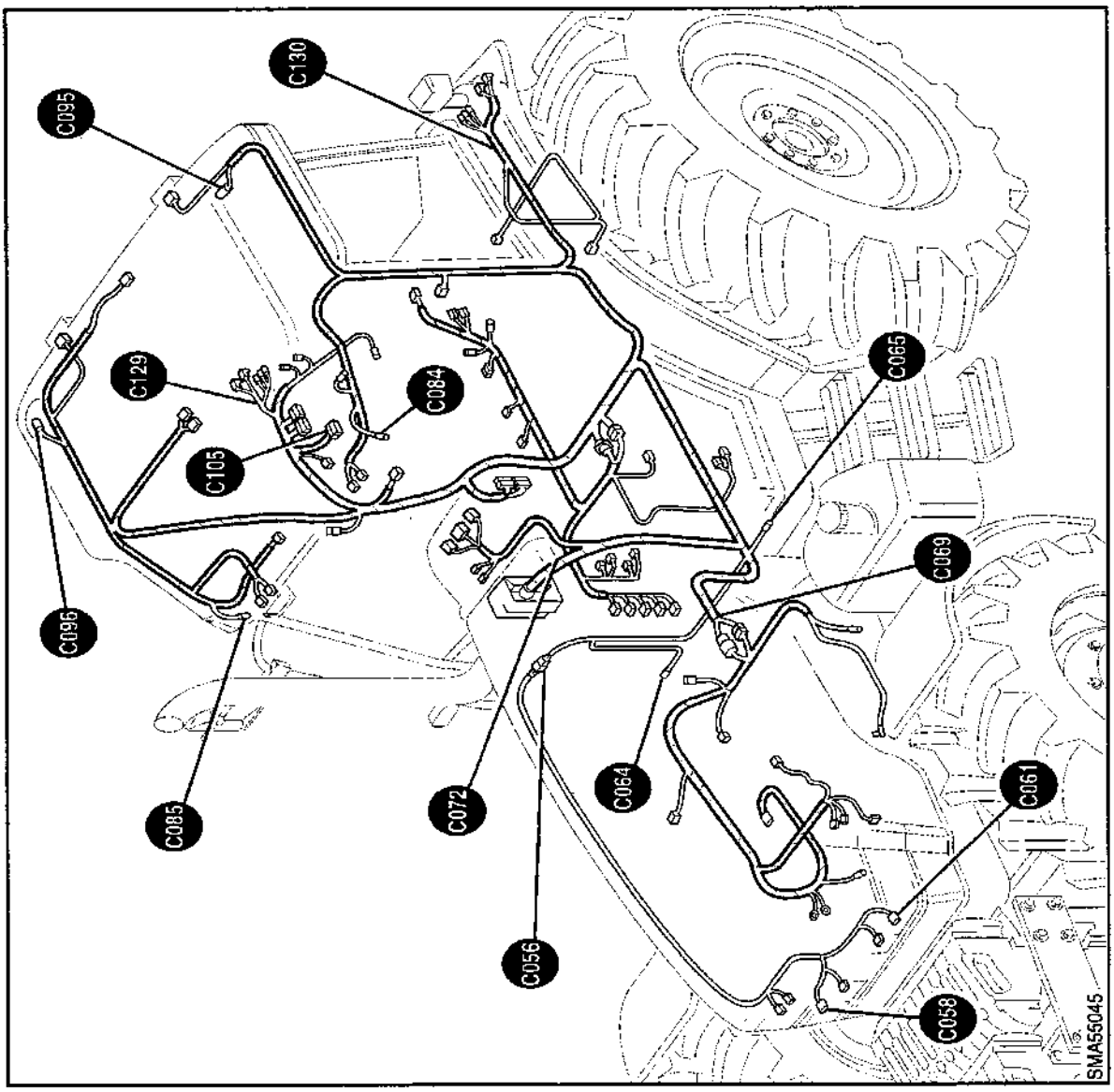


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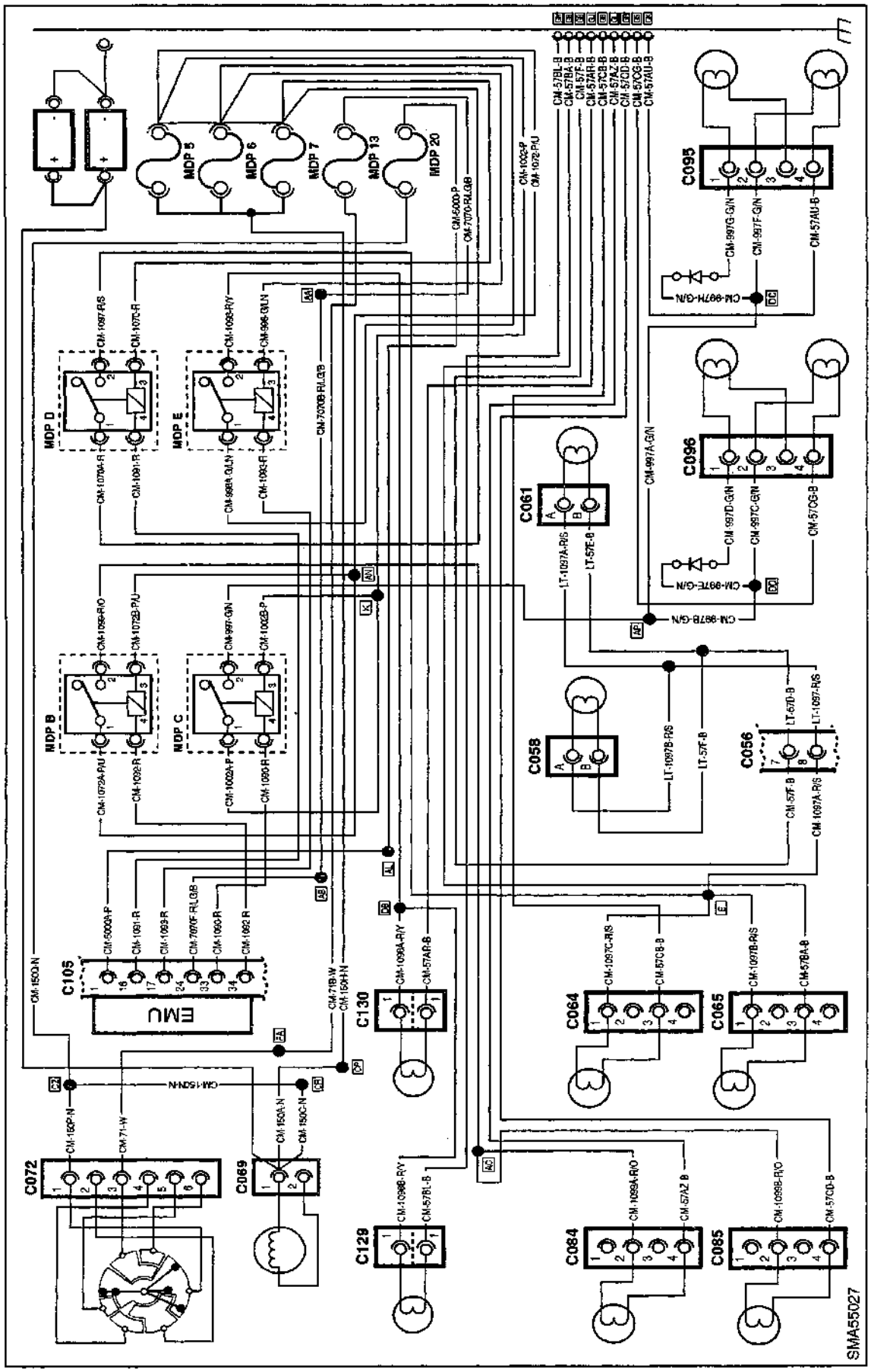
WORKLAMPS

C056	– Headlamp Connector
C058	– Right Hand Worklamp
C061	– Left Hand Worklamp
C064	– Right Hand Worklamp
C065	– Starter Solenoid (Cab Main)
C069	– Starter Switch
C072	– Starter Switch
C084	– LH Upper Front Worklamp
C085	– RH Upper Front Worklamp
C095	– LH Rear License / Worklamp
C096	– RH Rear License / Worklamp
C105	– EMU Connector
C129	– Worklamp RH Fender
C130	– Worklamp LH Fender



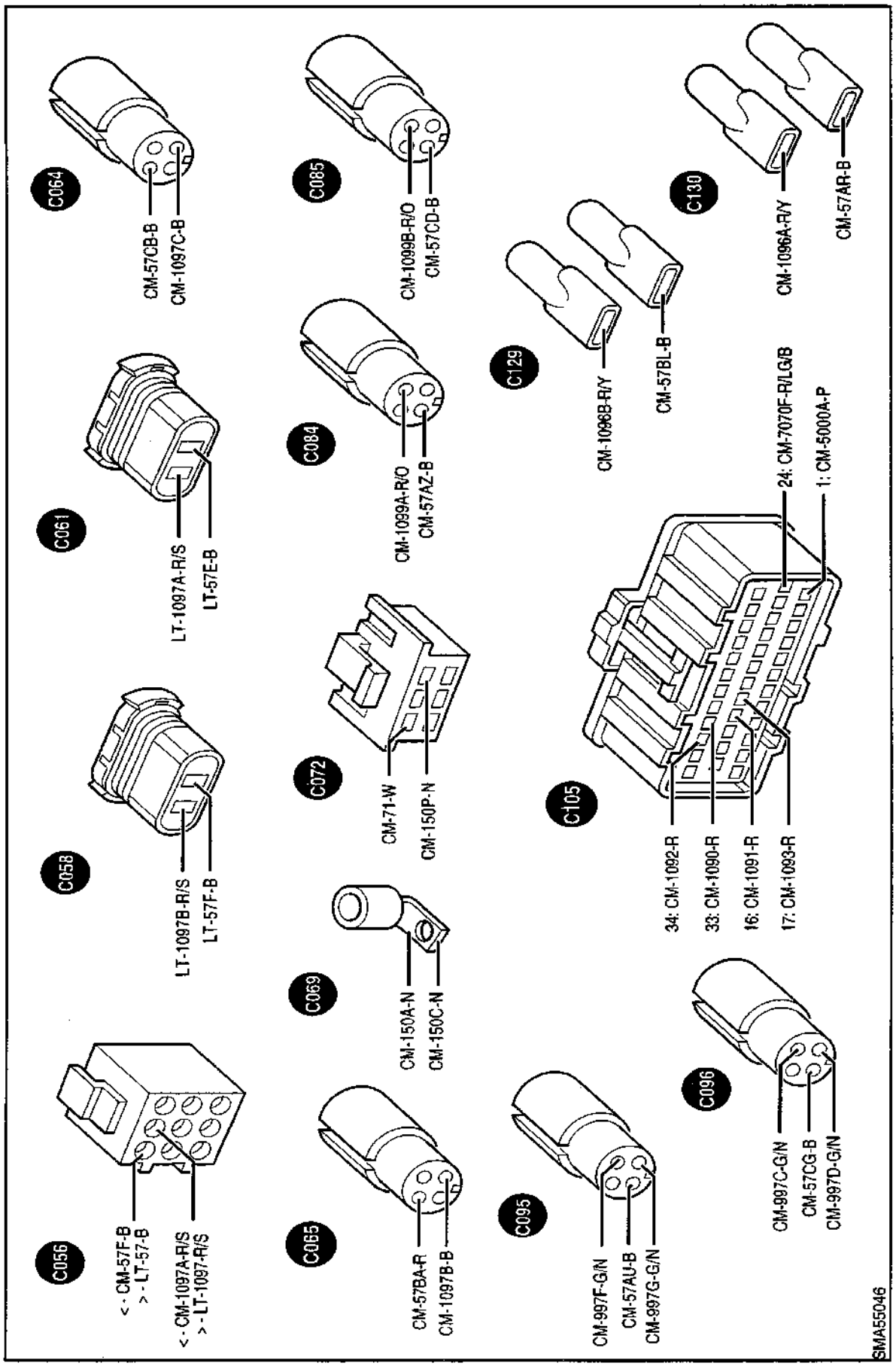
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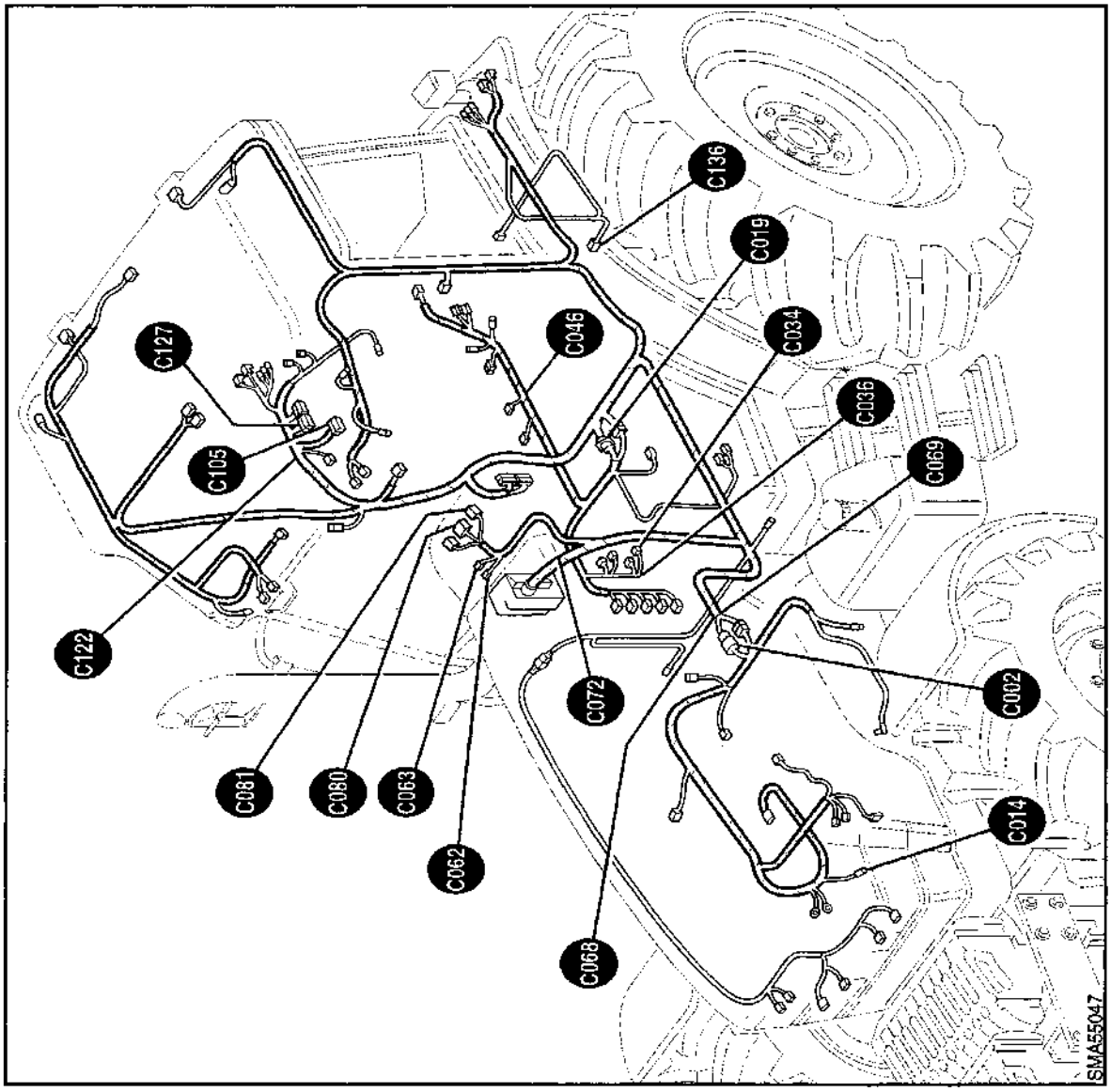


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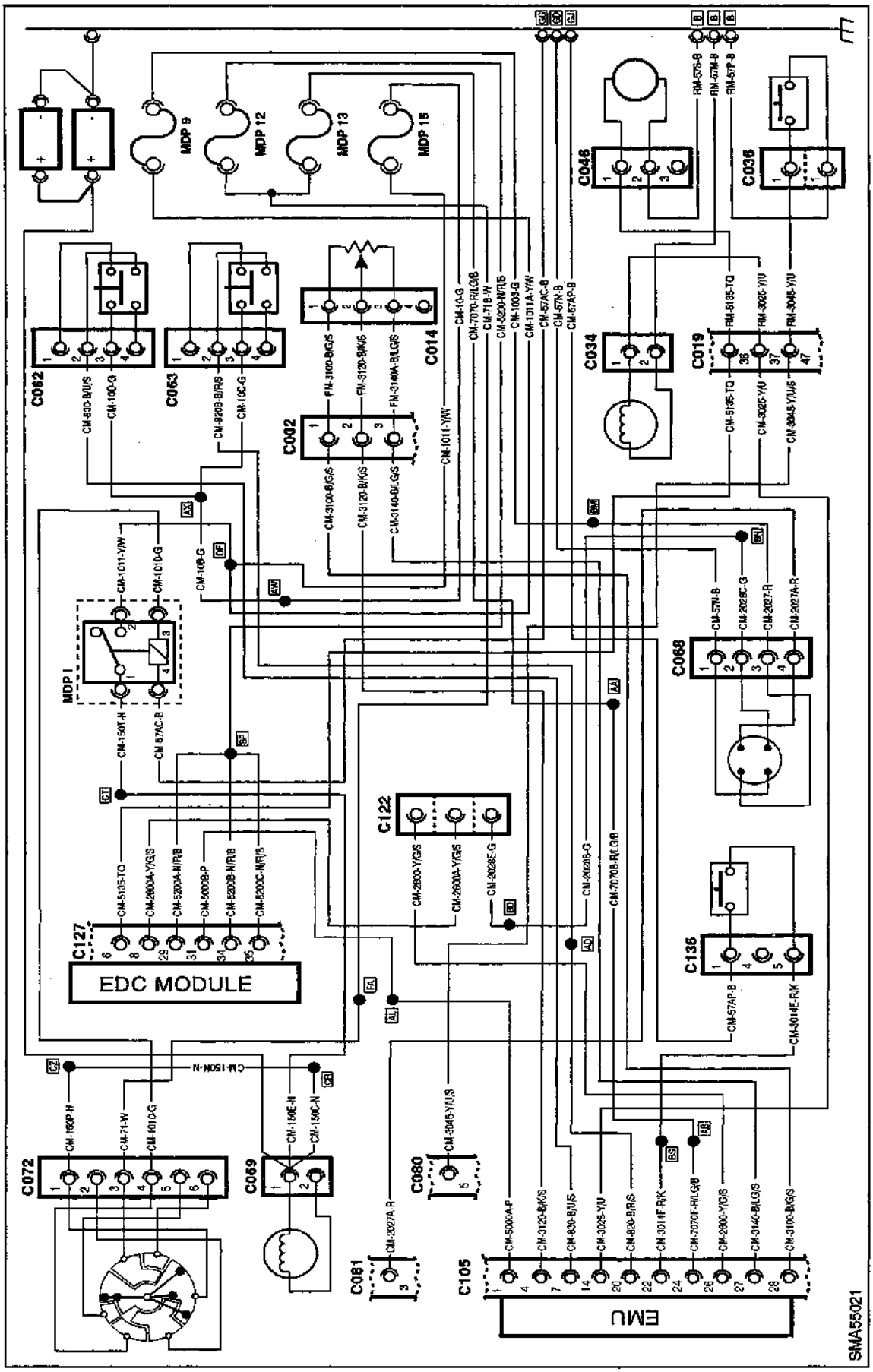
FRONT WHEEL DRIVE

C002	– Main Bulkhead Connector M2
C014	– Steering Sensor
C019	– Extension Harness Connector
C034	– Front Wheel Drive Solenoid
C036	– Pressure Switch
C046	– Axle Speed Sensor
C062	– R/H Stop Lamp Switch
C063	– L/H Stop Lamp Switch
C068	– Radar
C069	– Starter Solenoid
C072	– Starter Switch
C080	– Instrument Cluster 'B'
C081	– Instrument Cluster 'C'
C105	– EMU Connector
C122	– Ground Speed Sensor
C127	– EDC Module Connector 2
C136	– Handbrake



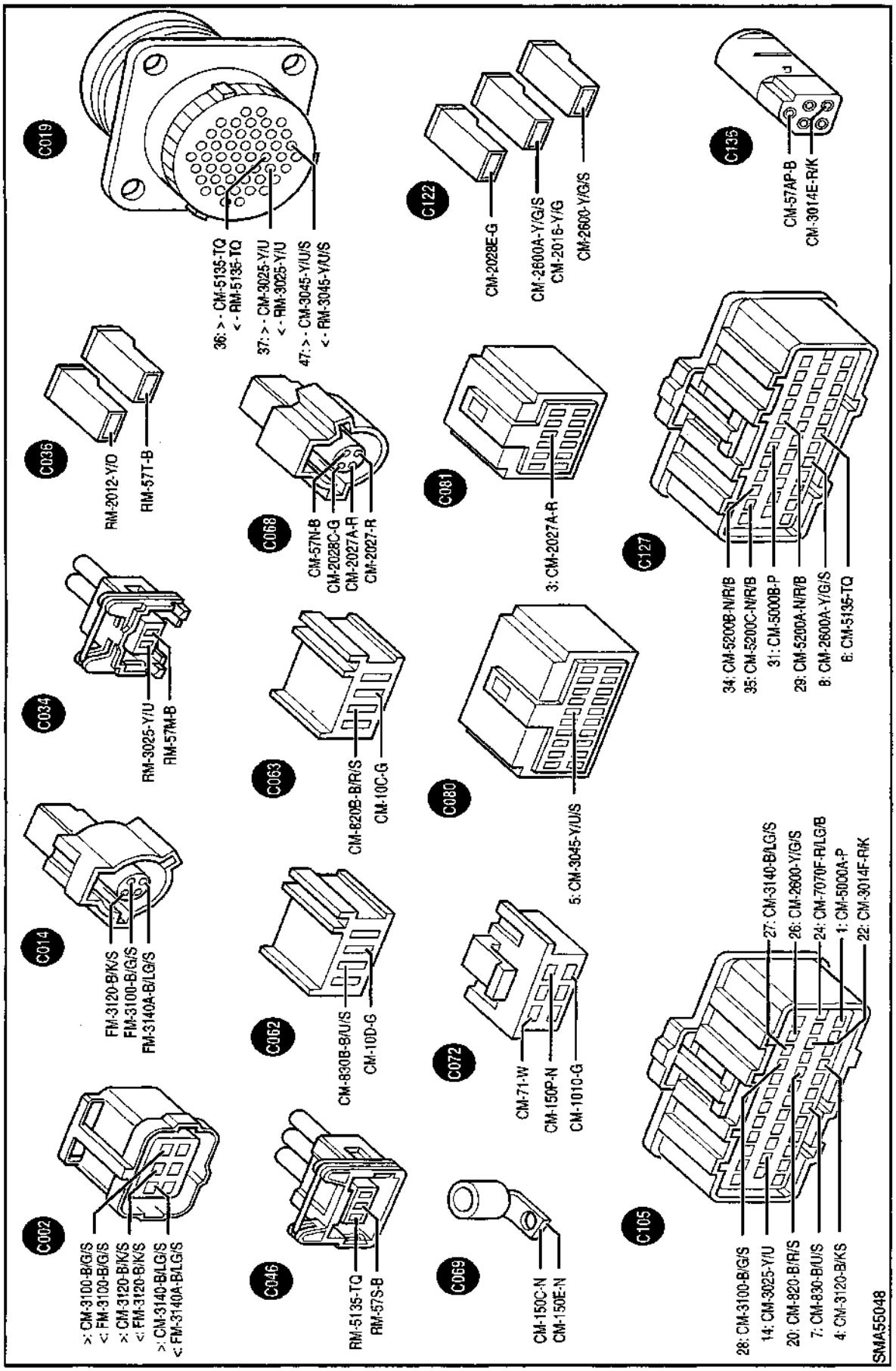
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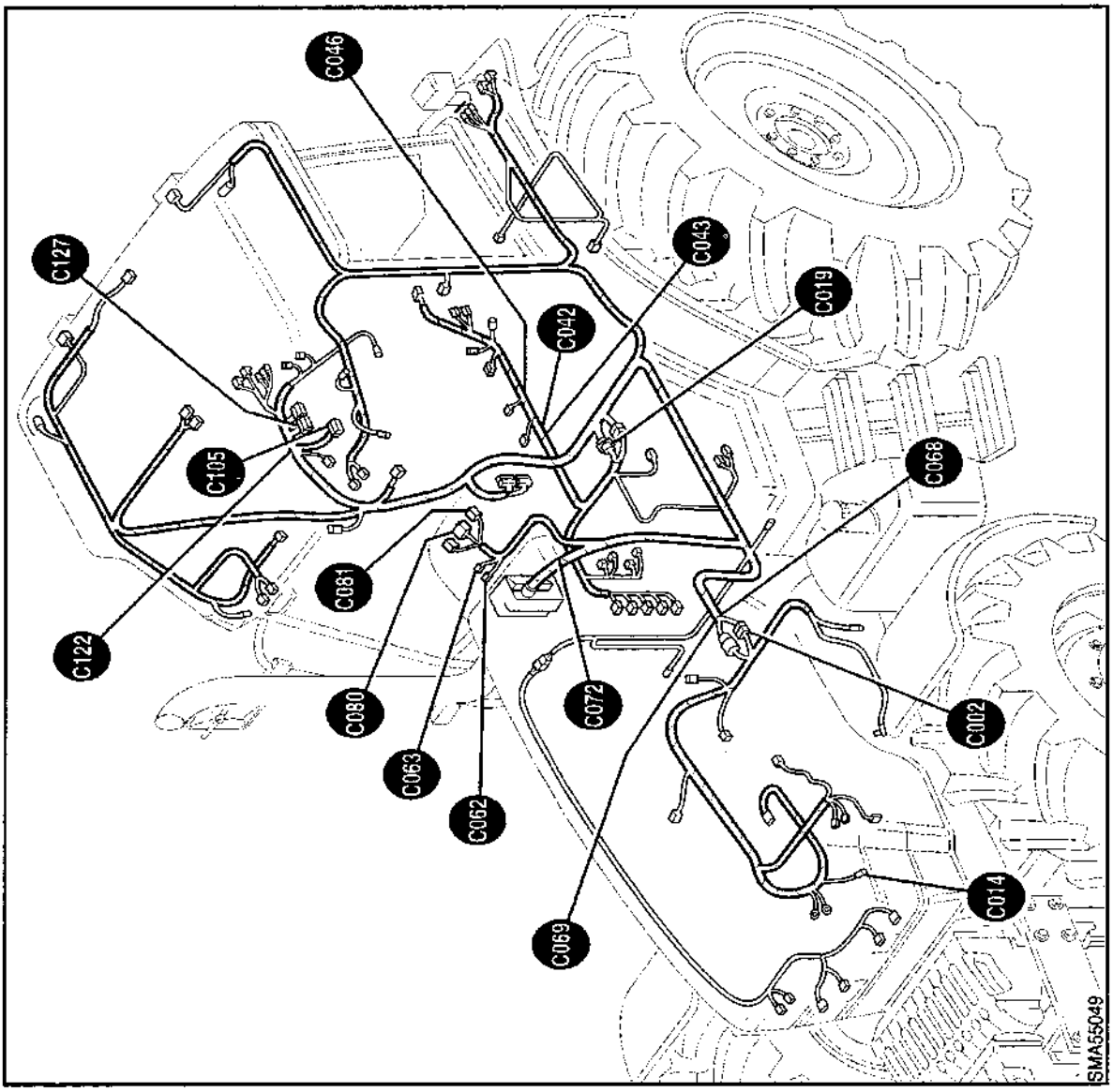


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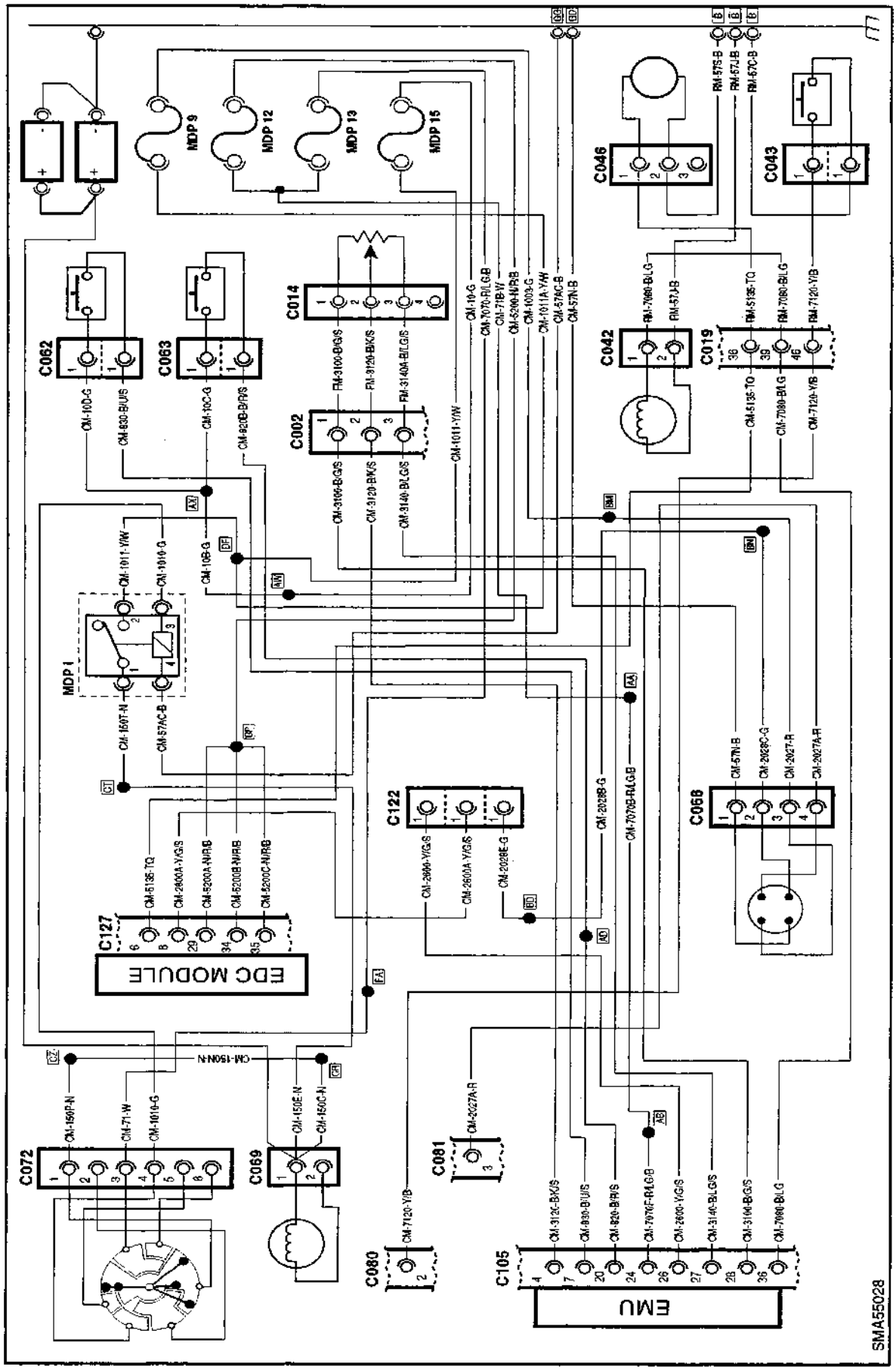
DIFF – LOCK

C002	– Main Bulkhead Connector M2
C014	– Steering Sensor
C019	– Extension Harness Connector
C042	– Diff Lock Solenoid
C043	– Diff Lock Switch
C046	– Axle Speed Sensor
C062	– R/H Stop Lamp Switch
C063	– L/H Stop Lamp Switch
C068	– Radar
C069	– Starter Solenoid
C072	– Starter Switch
C080	– Instrument Cluster 'B'
C081	– Instrument Cluster 'C'
C105	– EMU Connector
C122	– Ground Speed Sensor
C127	– EDC Module Connector 2



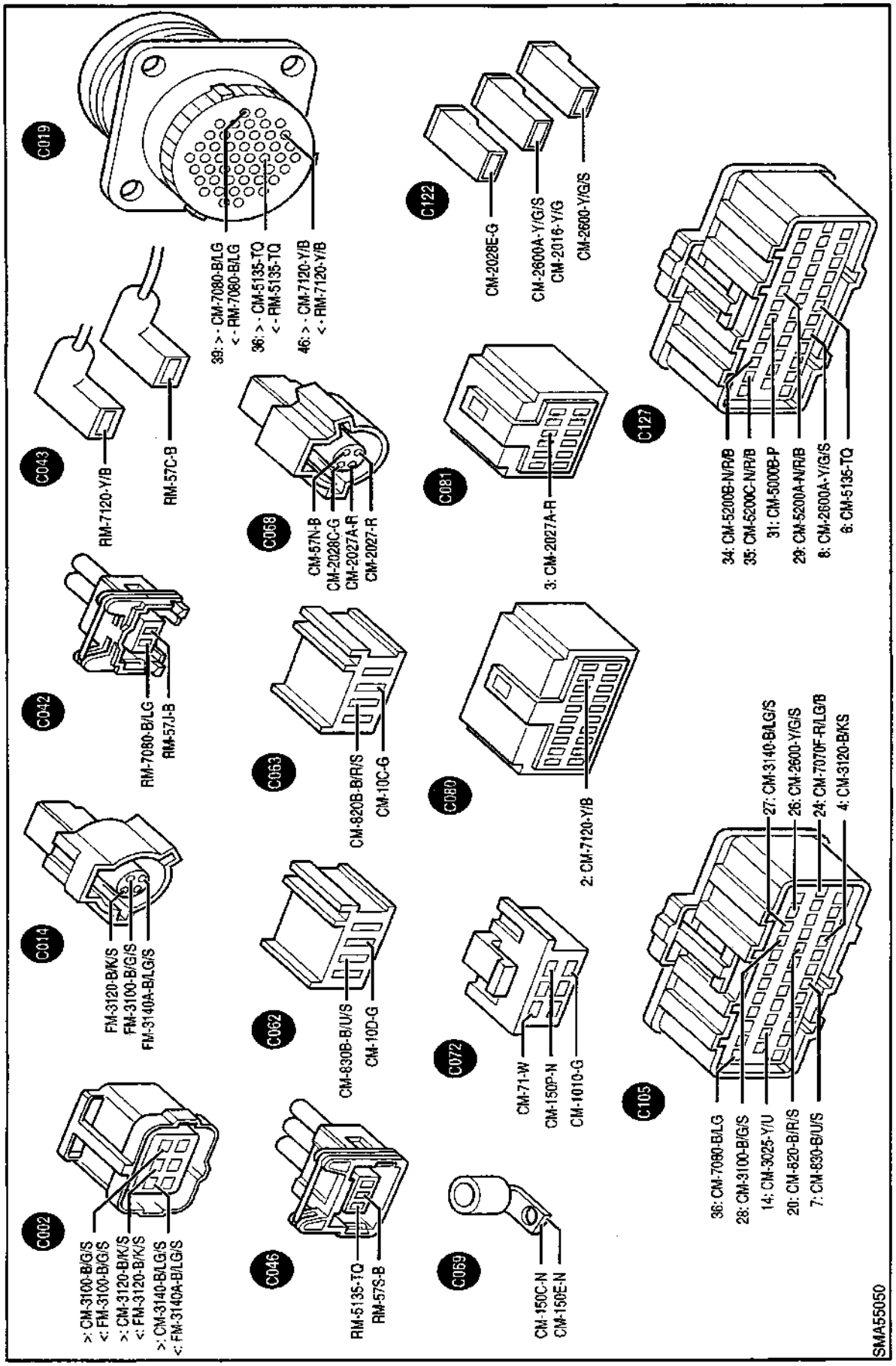
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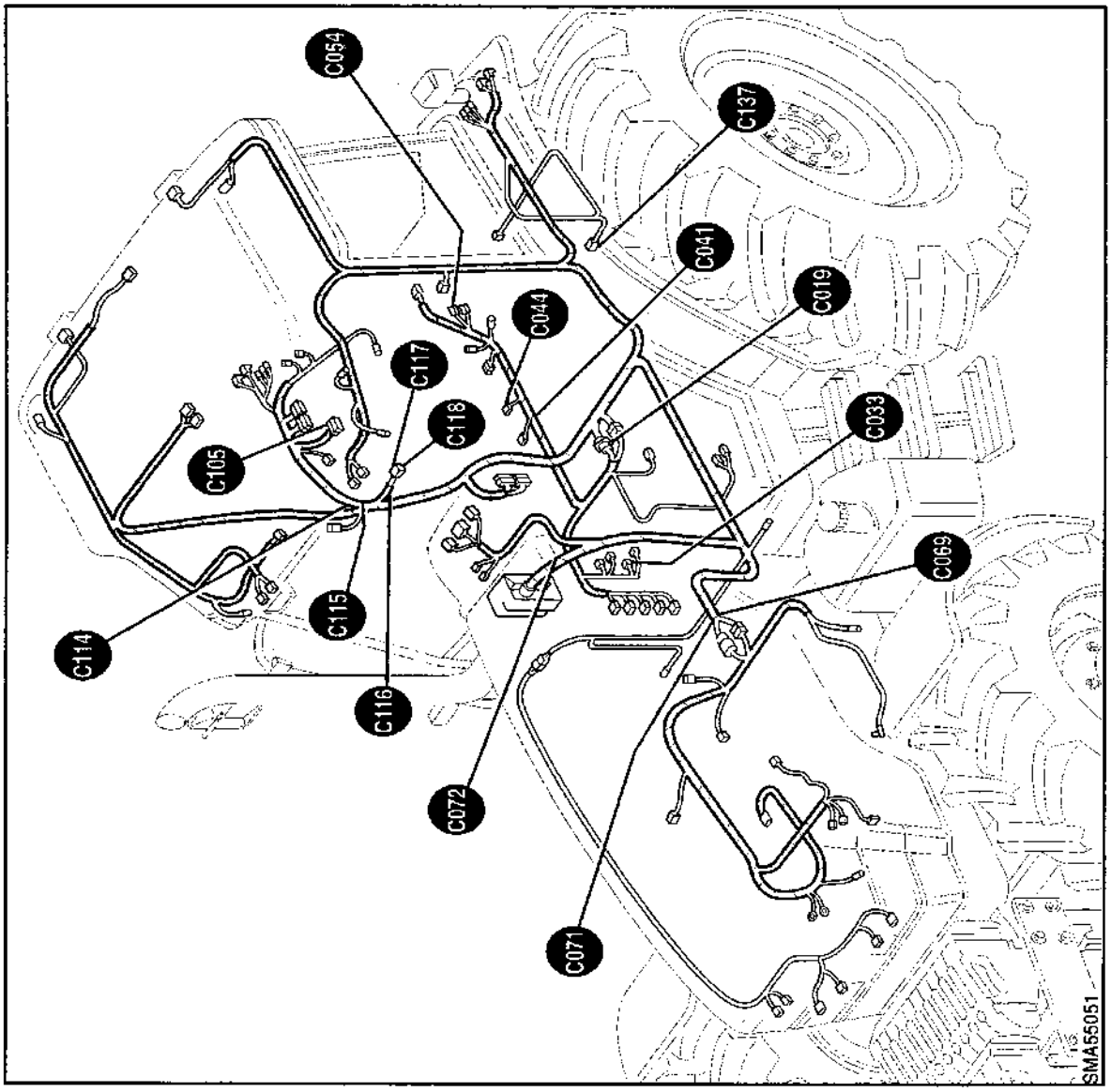


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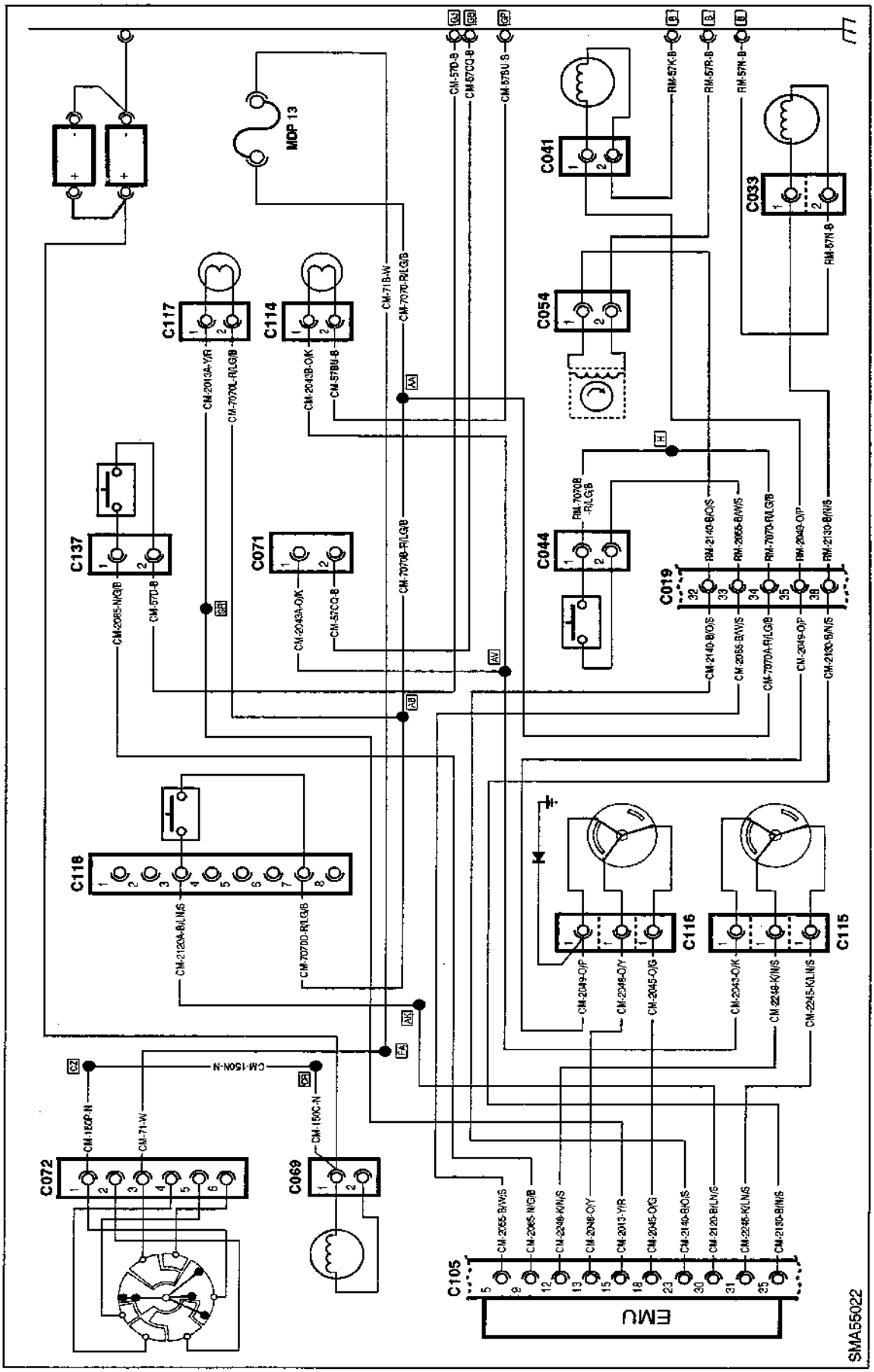
POWER TAKE-OFF

C019 – Extension Harness Connector
C033 – Diff Lock Solenoid
C041 – PTO Solenoid
C044 – Switch Ground Speed PTO Engaged
C054 – PTO Speed Sensor
C069 – Starter Solenoid
C071 – Main Bulkhead Hitch Connector
C072 – Starter Switch
C105 – EMU Connector
C114 – PTO Engaged Lamp
C115 – EDC Module Connector 2
C116 – Rear PTO Switch
C117 – Rear PTO Engage Lamp
C118 – Rear PTO Brake Switch
C137 – PTO Alarm Seat Switch



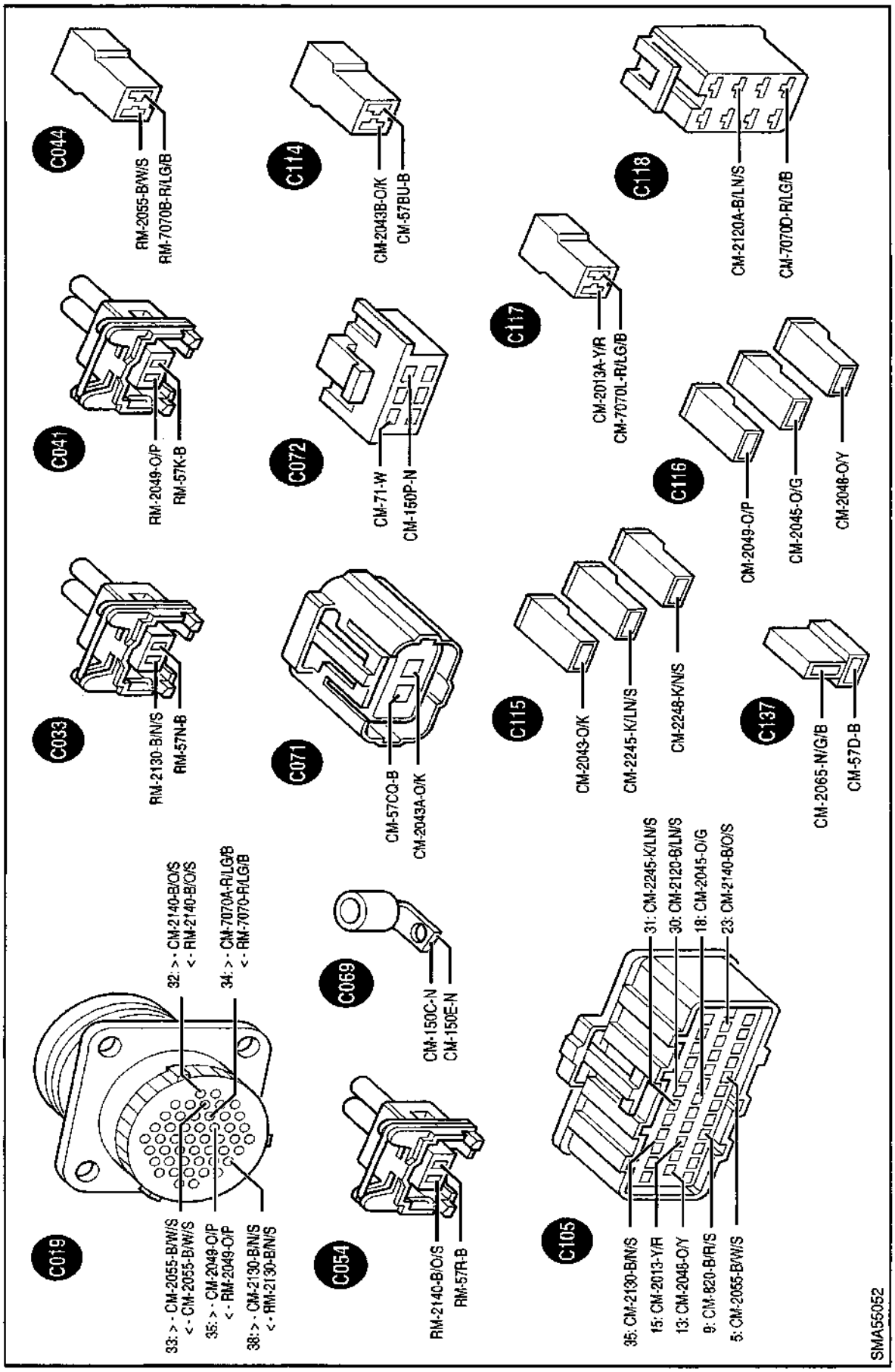
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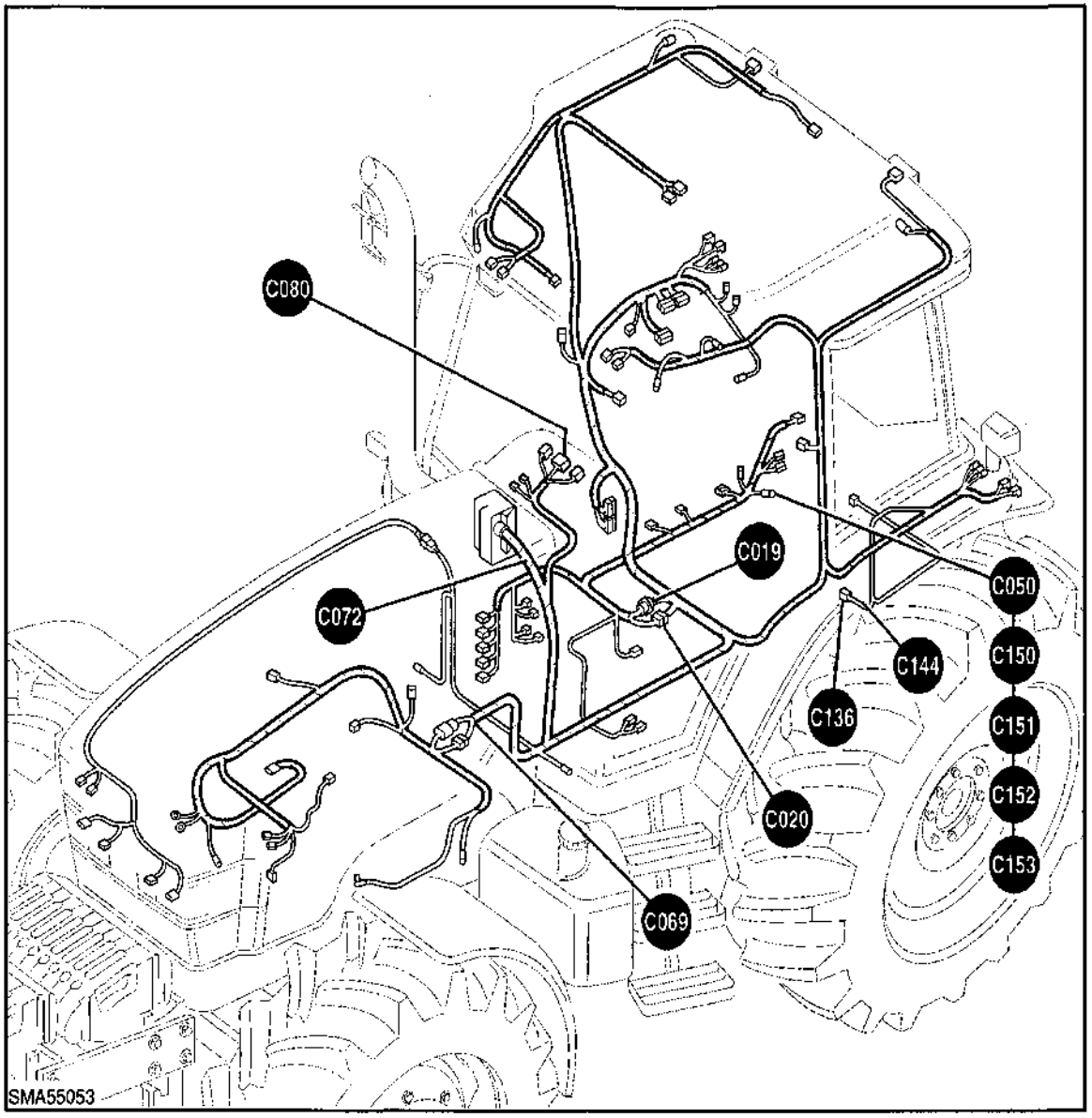
ITALIAN TRAILER BRAKE

NOTE: NOT USED IN NORTH AMERICA

C019 – Main Extension Connector 1
C020 – Main Extension Connector 2
C050 – Trailer Brake Connector
C069 – Starter Solenoid
C072 – Starter Switch
C080 – Instrument Cluster 'B'
C136 – Handbrake
C144 – Air Brake Connector

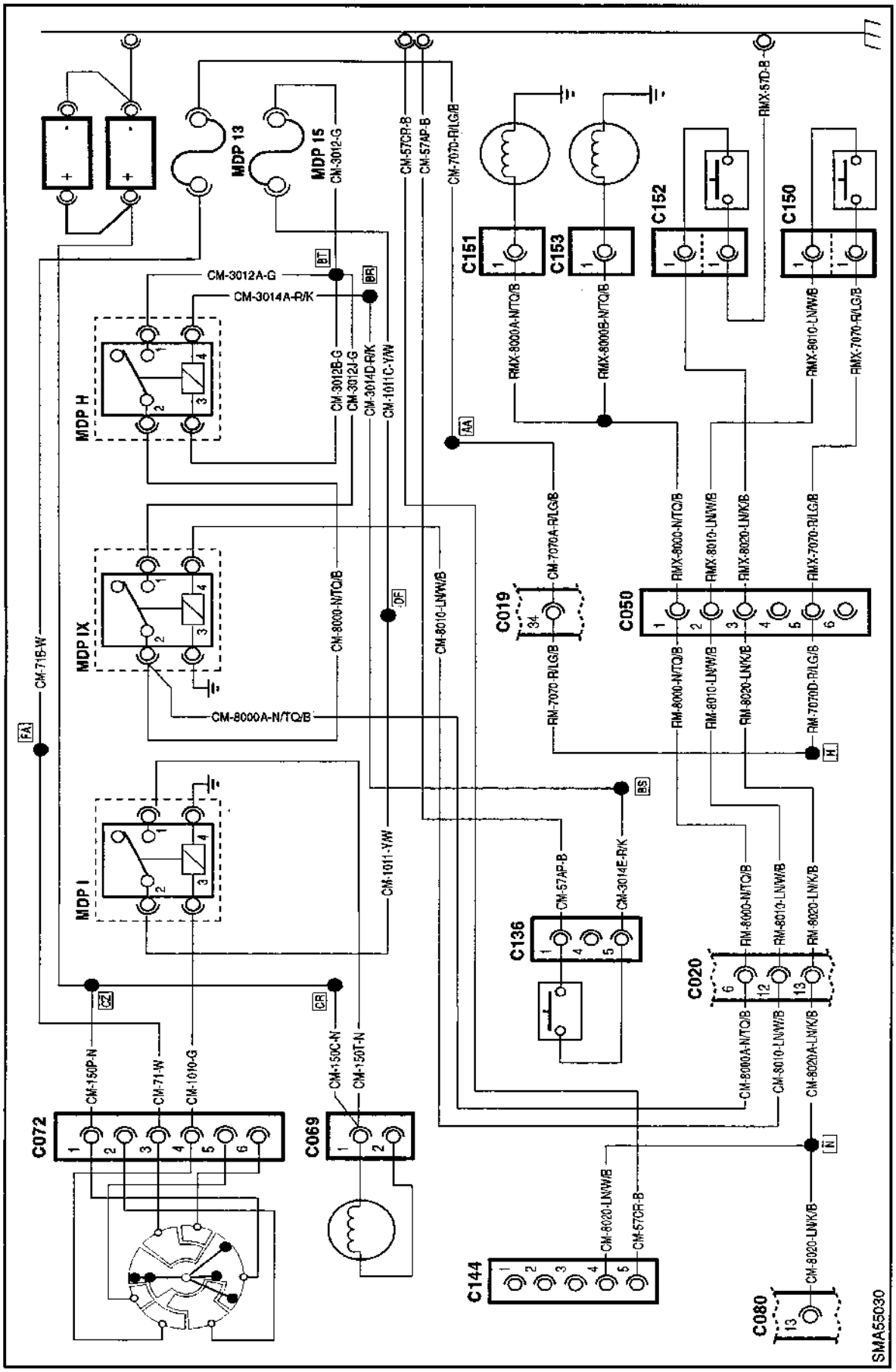
Trailer Brake Extension Harness

C150 – Pressure Switch 100
C151 – Solenoid Valve
C152 – Pressure Switch 101
C153 – Solenoid Valve



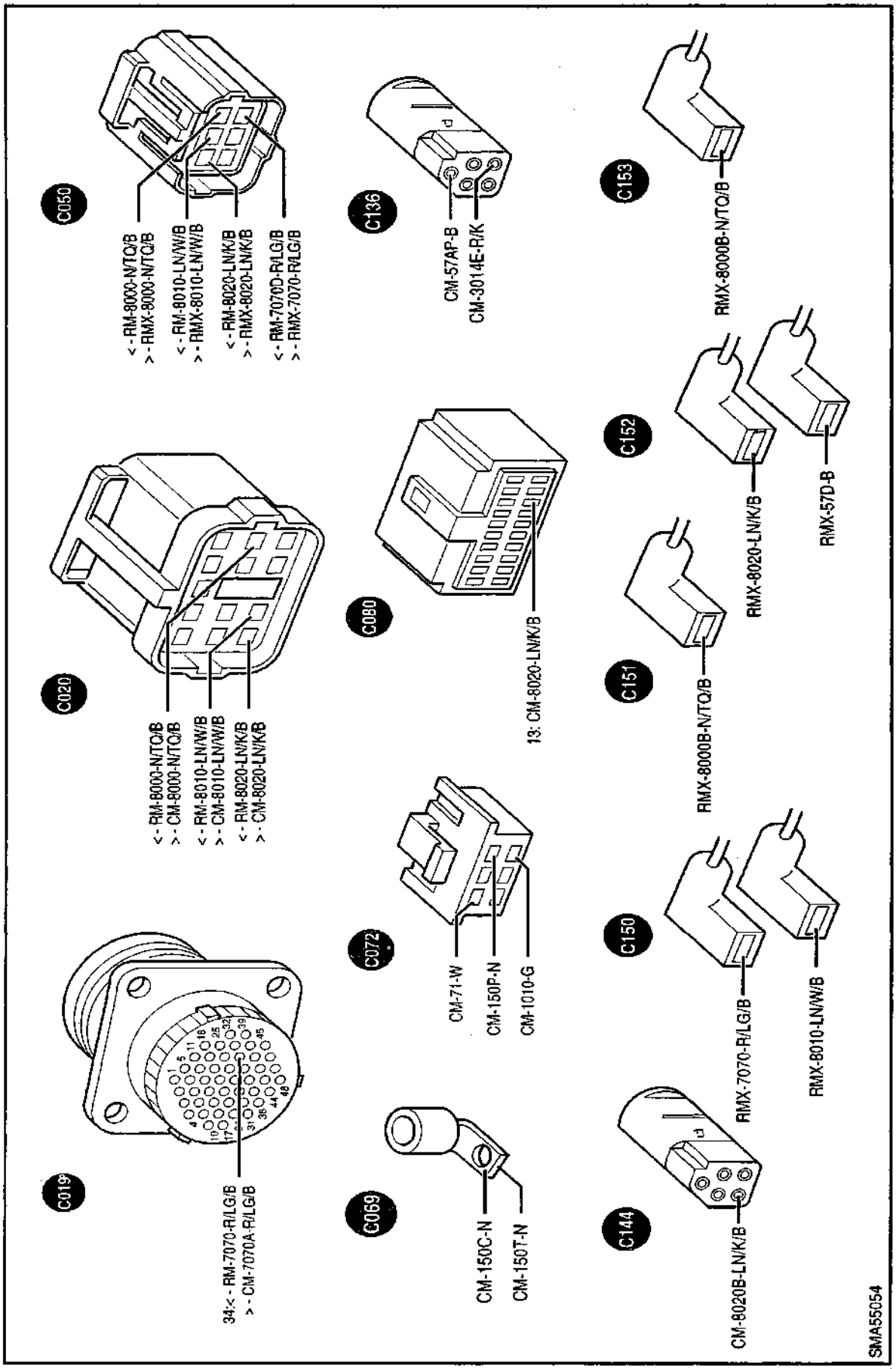
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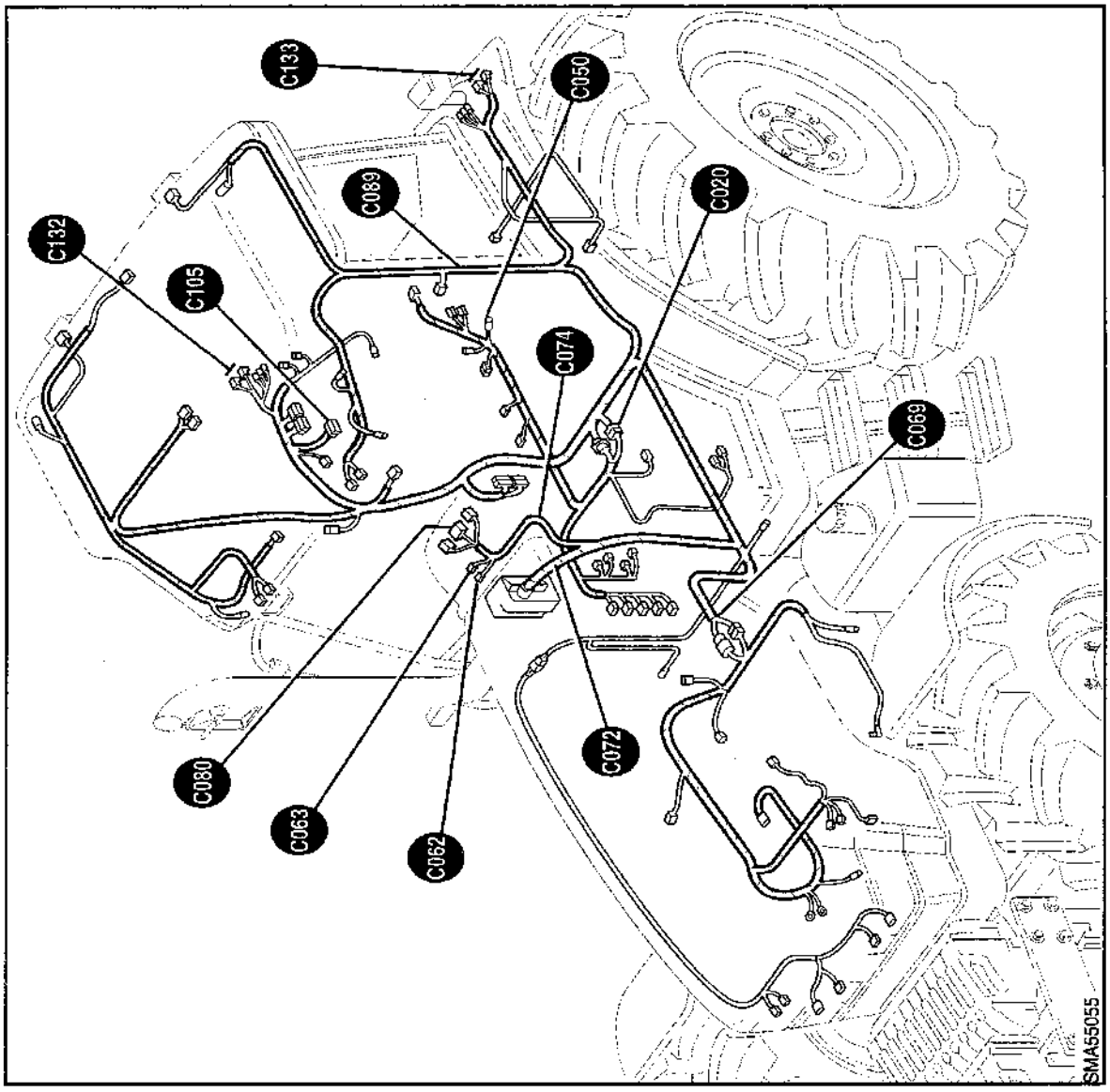
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AIR TRAILER BRAKE

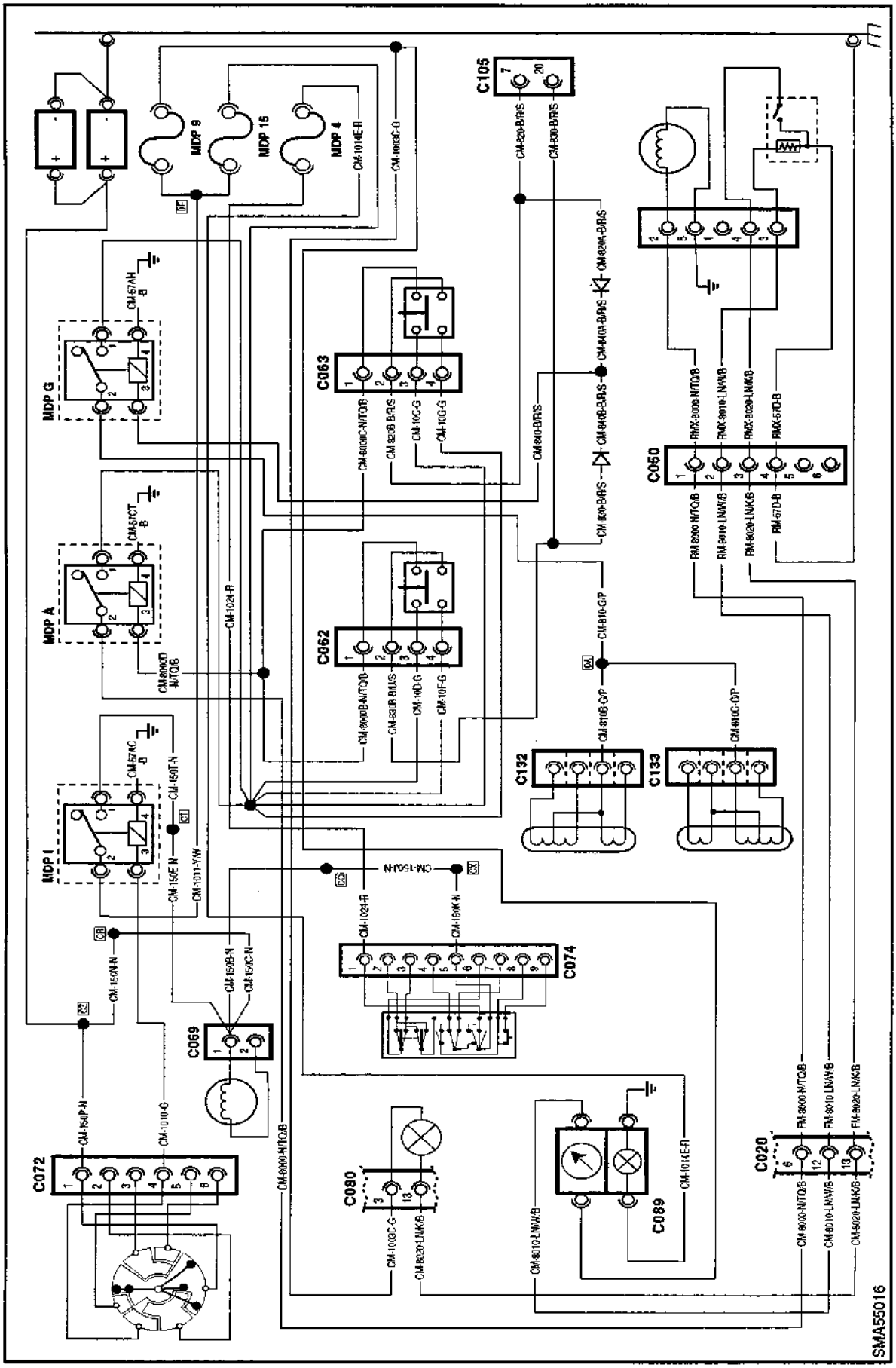
NOTE: NOT USED IN NORTH AMERICA

C020 – Main Extension Connector
C050 – Trailer Brake Connector
C062 – RH Stop Lamp Switch
C063 – LH Stop Lamp Switch
C069 – Starter Solenoid (Cab Main)
C072 – Starter Switch
C074 – Turn Switch
C080 – Instrument Cluster 'B'
C089 – Trailer Brake Gauge Lamp
C105 – E.M.U Connector
C132 – Right Hand Stop Lamp
C133 – Left Hand Stop Lamp



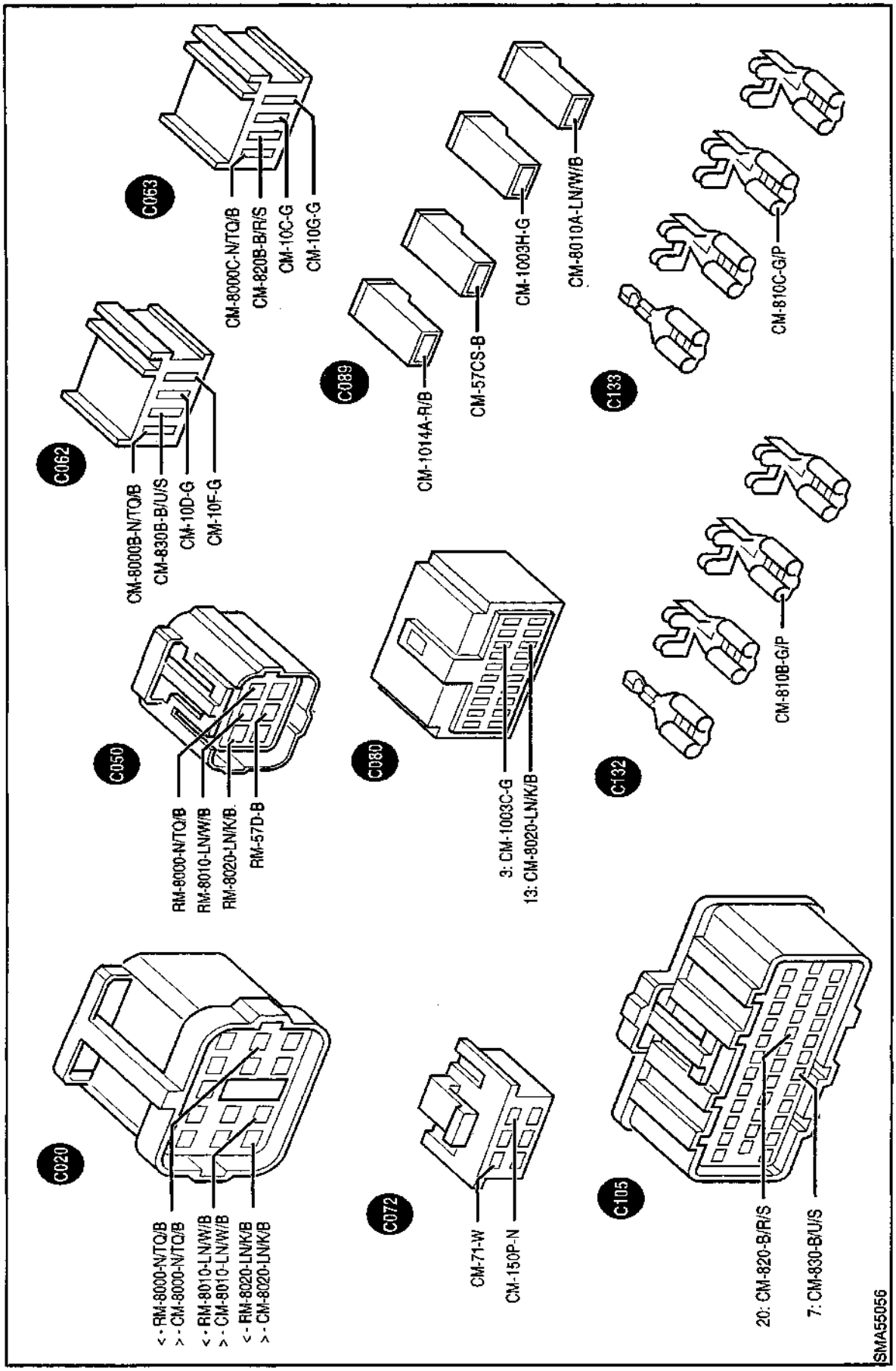
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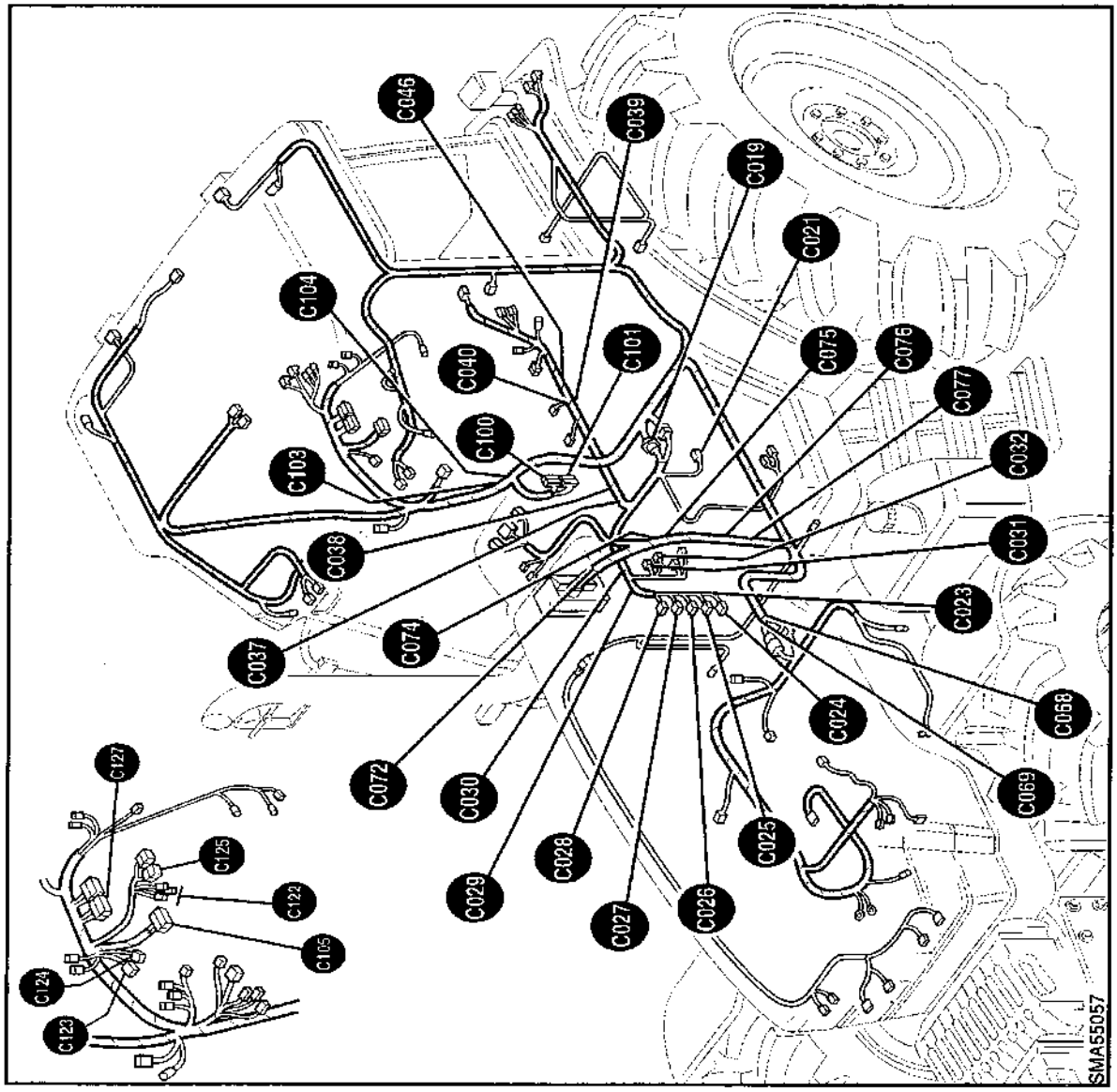


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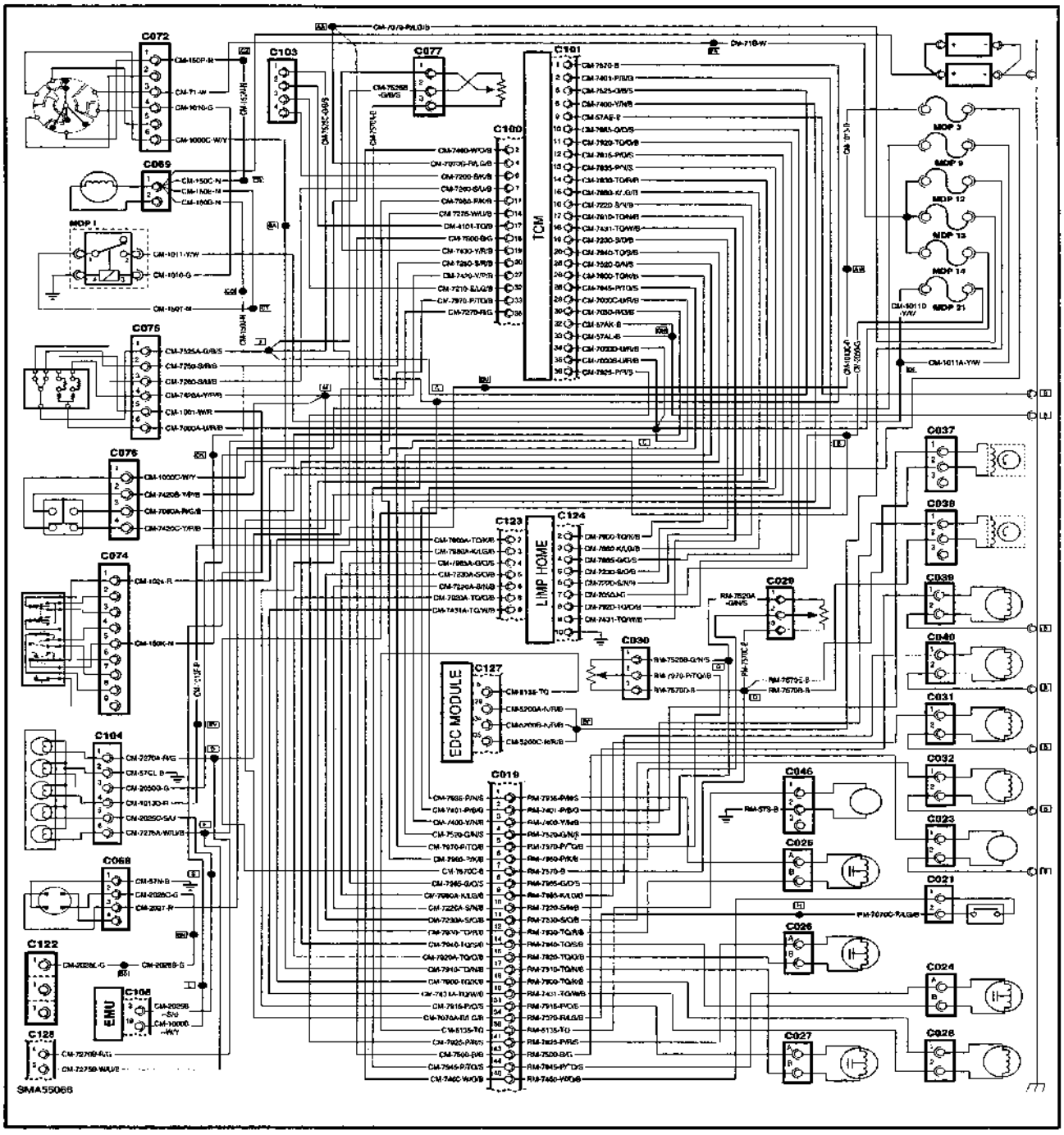
TRANSMISSION

C019 – Rear Main Extension Connector 1
C021 – Creeper Engaged Switch
C023 – Transmission Oil Temp Sender
C024 – Clutch E
C025 – Clutch D
C026 – Clutch C
C027 – Clutch B
C028 – Clutch A
C029 – Slow / Fast Potentiometer
C030 – Medium / Reverse Potentiometer
C031 – Medium Range Solenoid
C032 – Transmission Low Range Solenoid
C037 – Intermediate Speed P.U.
C038 – Output Speed P.U.
C039 – High Range Solenoid
C040 – Reverse Range Solenoid
C046 – Axle Speed Sensor
C068 – Radar
C069 – Starter Solenoid (Cab Main)
C072 – Starter Switch
C074 – Turn Switch
C075 – Shuttle Switch
C076 – Clutch Switch
C077 – Clutch Potentiometer
C100 – TCM Connector 1
C101 – TCM Connector 2
C103 – Gear Shift Connector
C104 – Gear Shift Indicator
C105 – EMU Connector
C122 – Ground Speed Sensor
C123 – Limp Home Connector 2
C124 – Limp Home Connector 1
C125 – Diagnostic Plug TCM
C127 – EDC Module



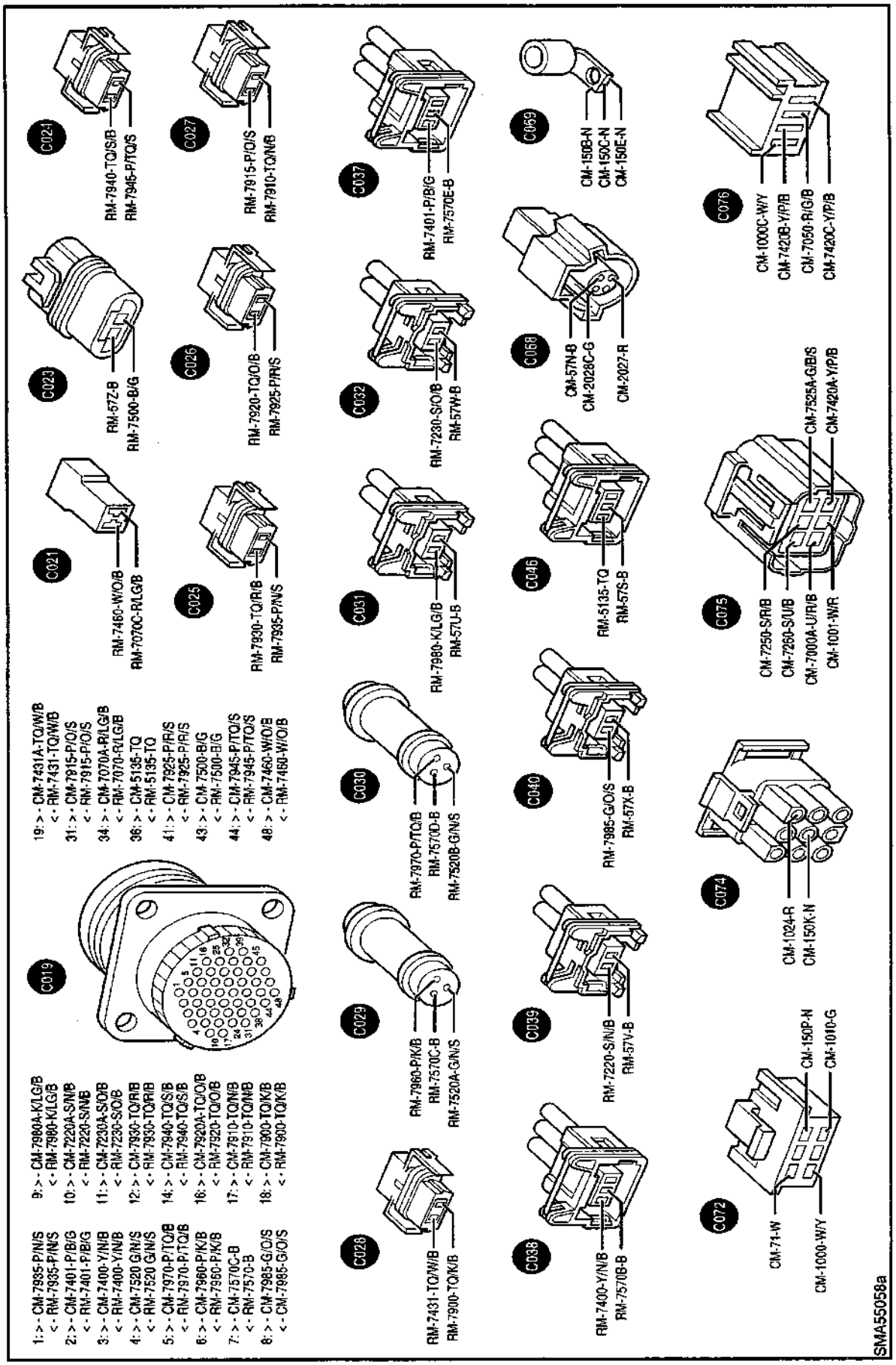
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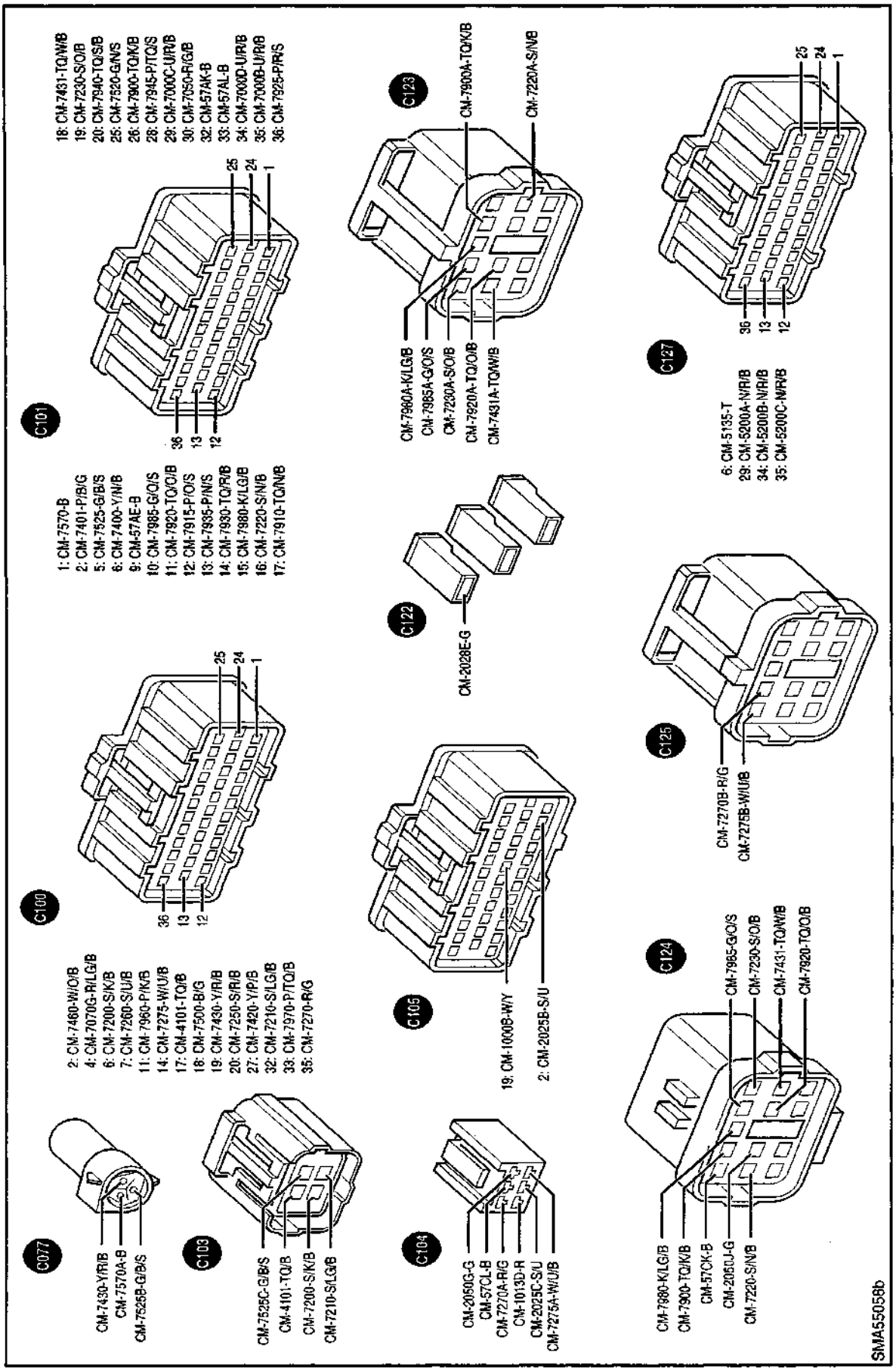
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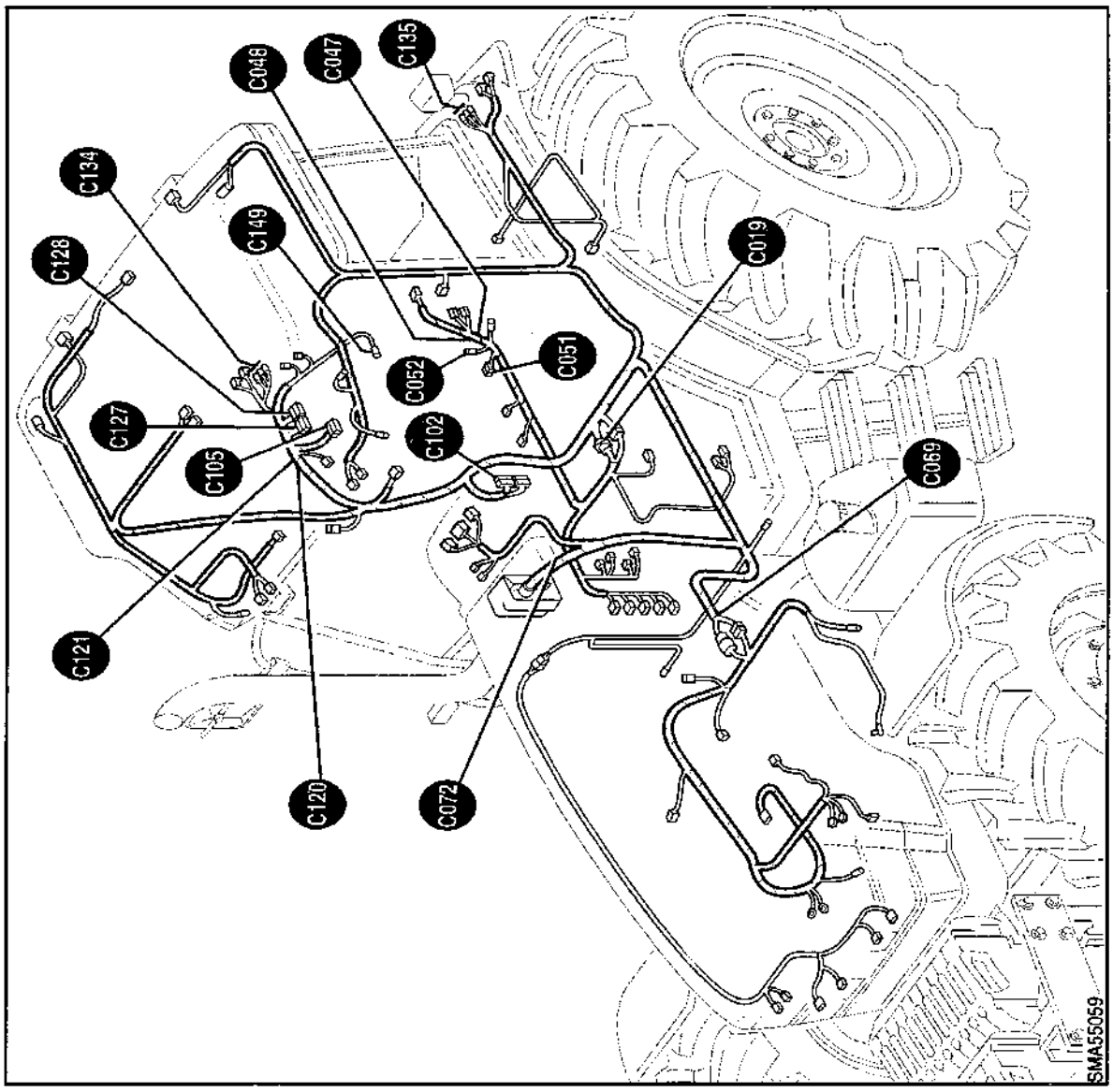


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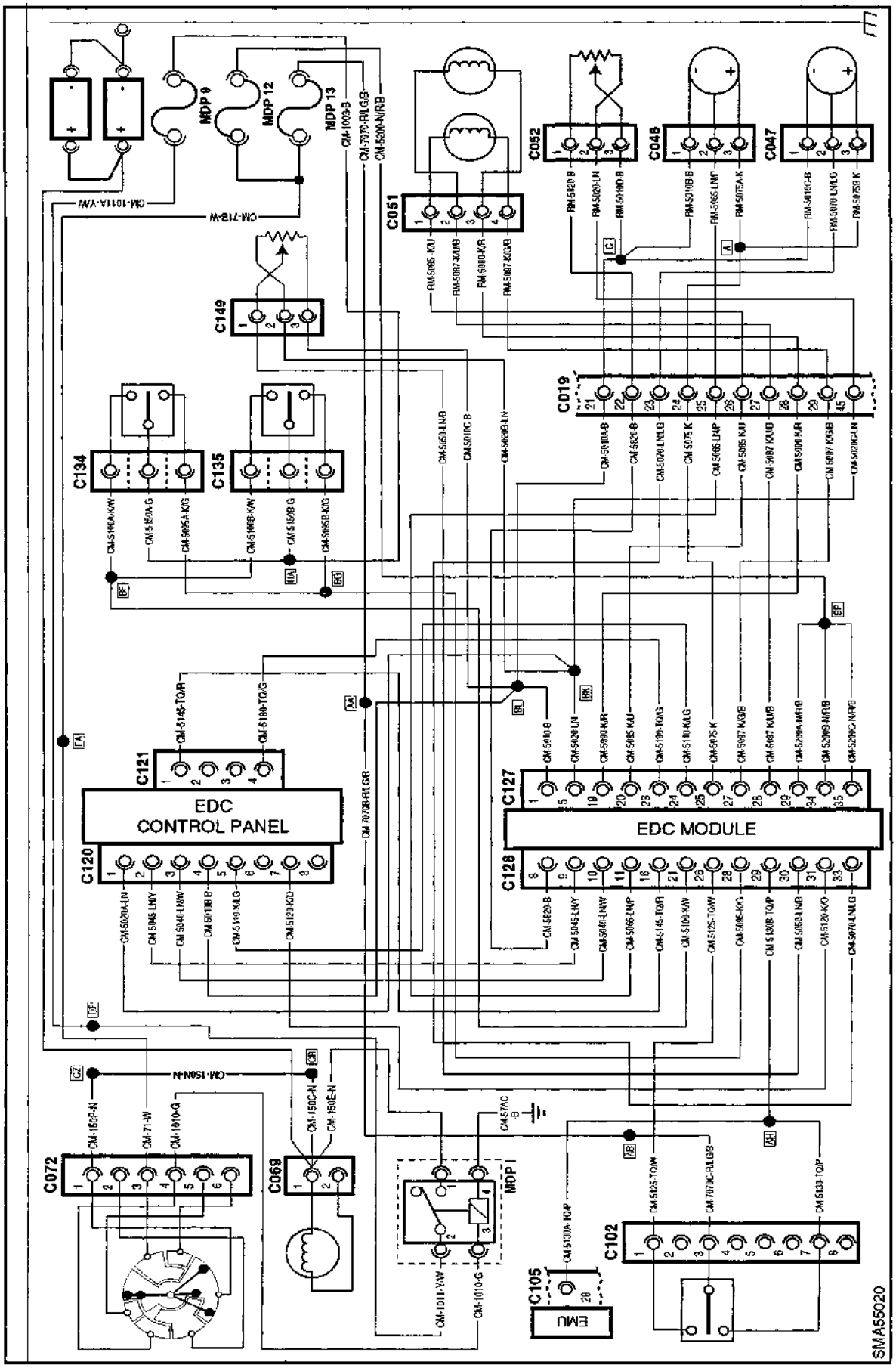
ELECTRONIC DRAFT CONTROL

C019 – Extension Harness Connector
C047 – Left Hand Draft Pin
C048 – Right Hand Draft Pin
C051 – EDC Valve Connector
C052 – Rockshaft Potentiometer
C069 – Starter Solenoid
C072 – Starter Switch
C102 – Fast Raise/Low Switch
C105 – EMU Connector
C120 – EDC Control Panel 1
C121 – EDC Control Panel 2
C128 – EDC Module Connector 2
C127 – EDC Module Connector 1
C134 – HPL Raise/Lower Switch R/H
C135 – HPL Raise/Lower Switch L/H
C149 – Quadrant Potentiometer



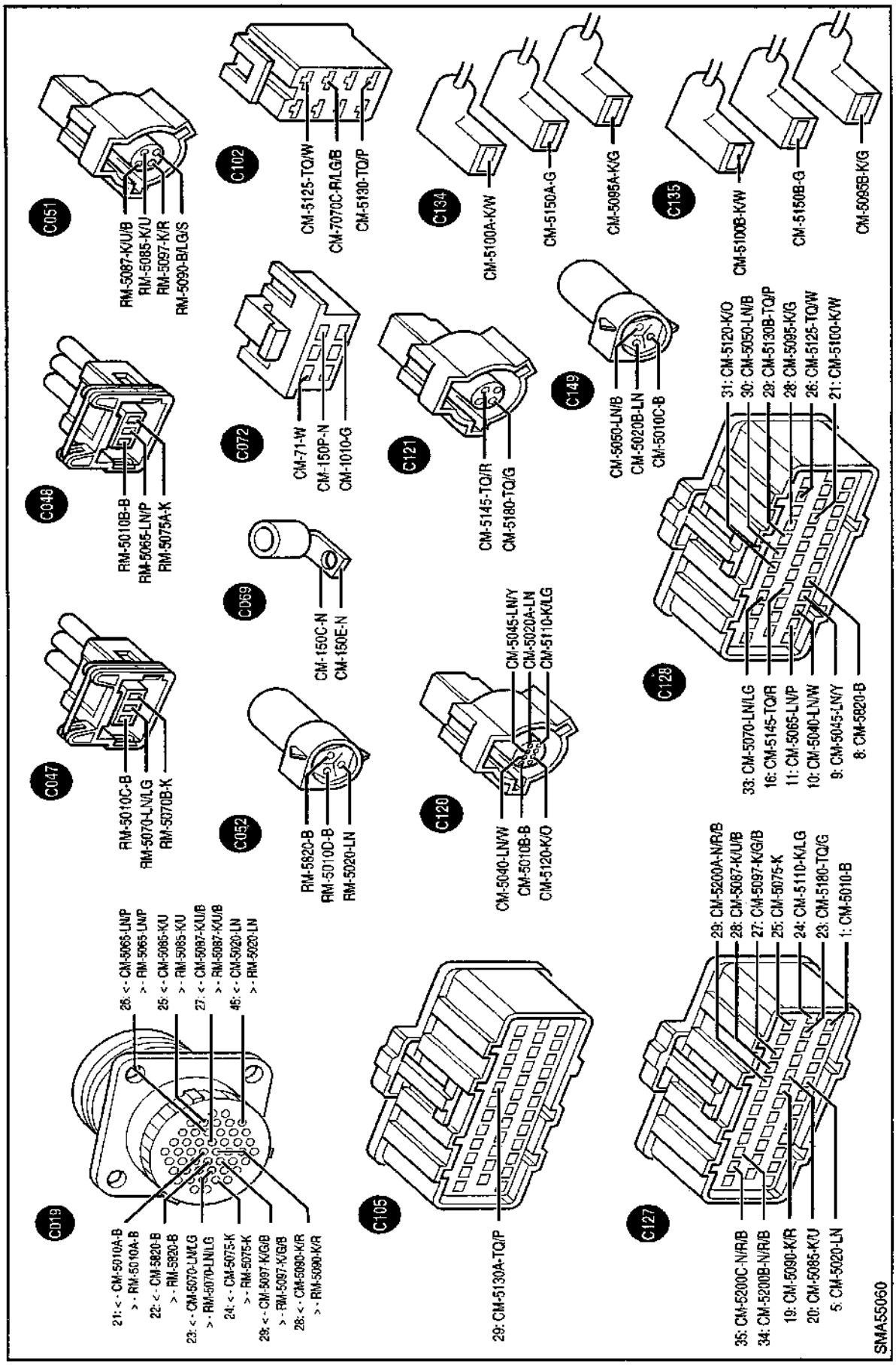
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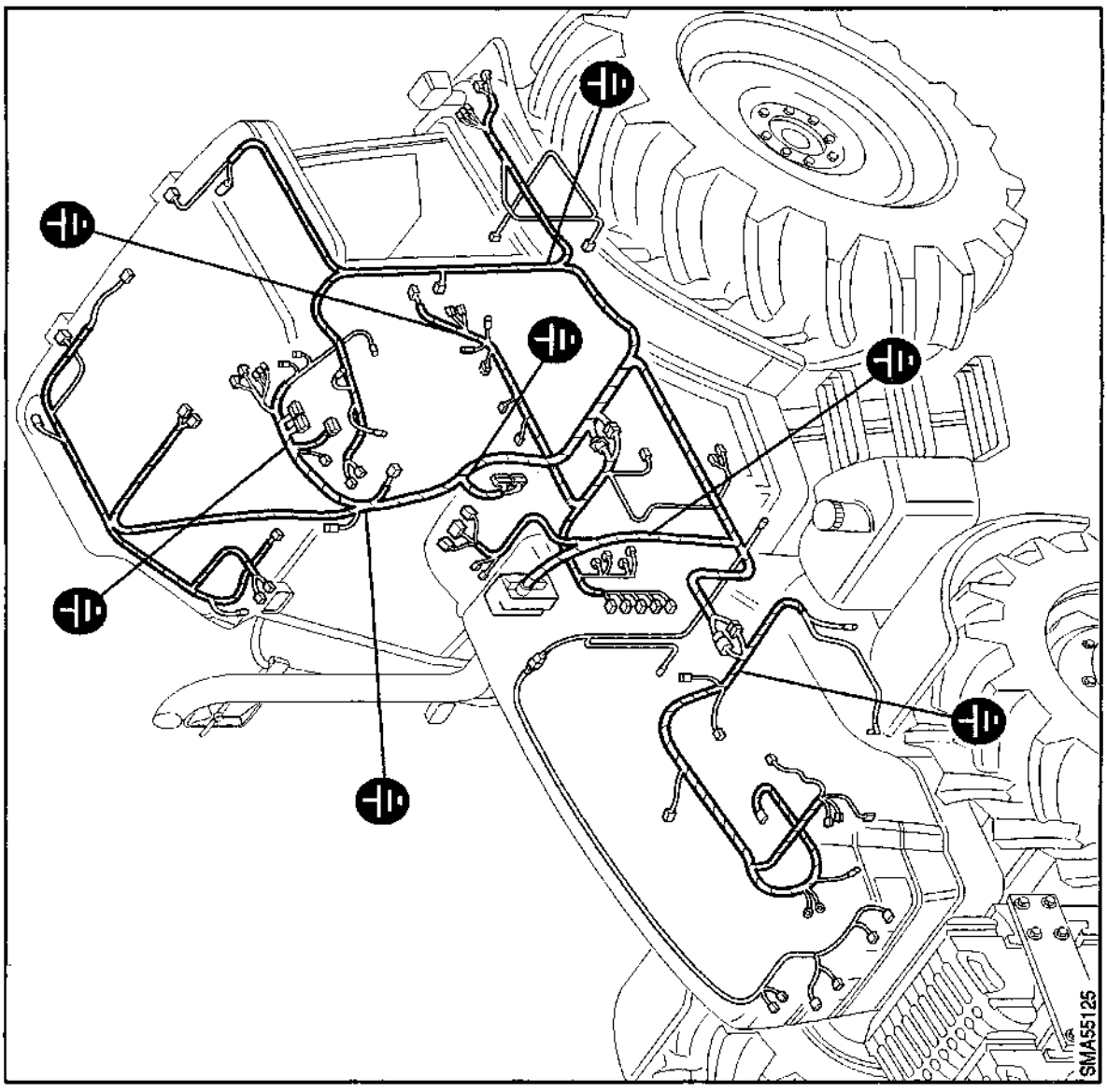
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GROUND POINT LOCATION



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DUAL COMMAND (Hi–Lo TRANSMISSION) MODEL TRACTORS

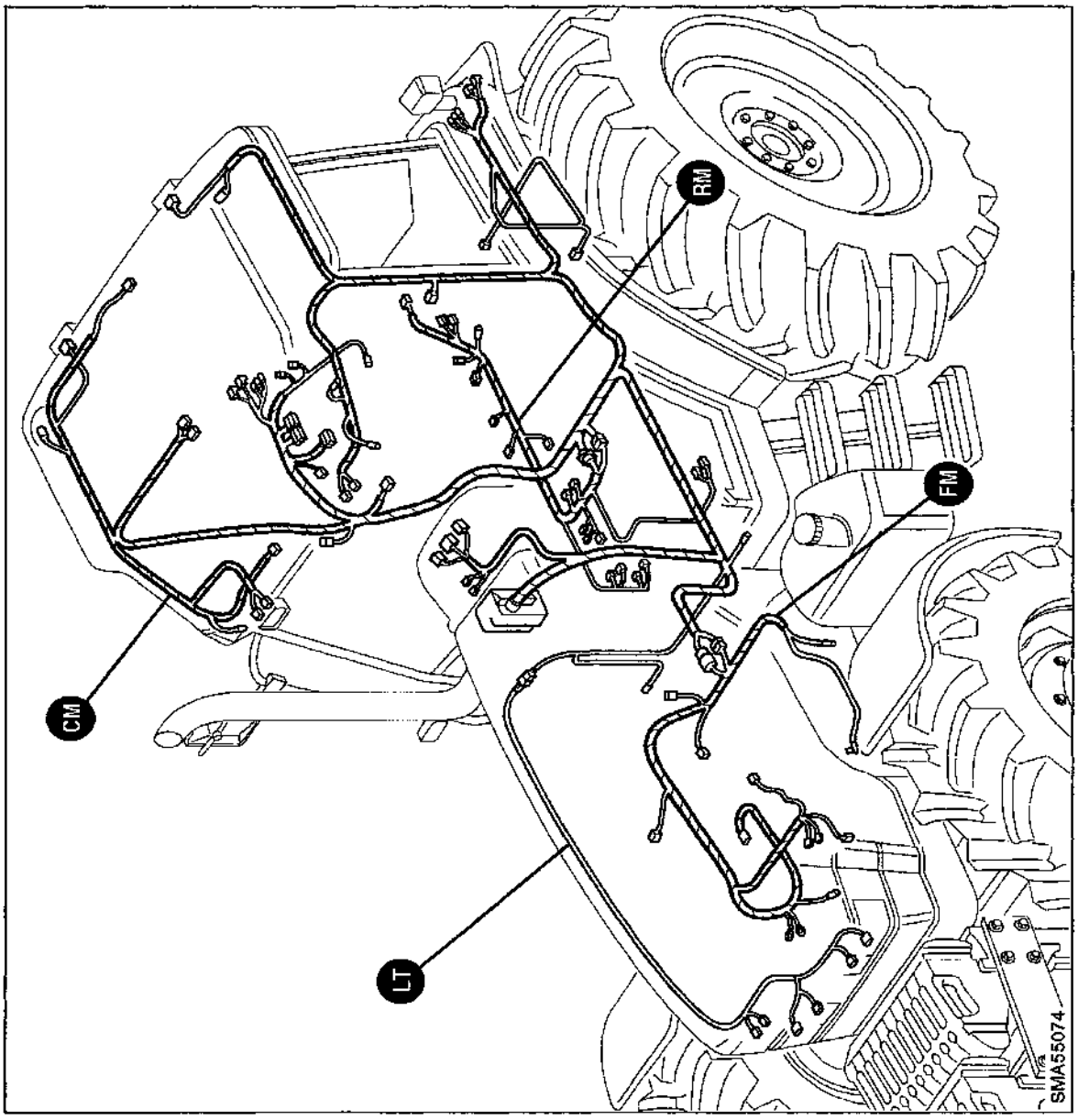
ELECTRICAL HARNESSES AND CIRCUITS

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There are Four Main Harnesses used on Cabbed Tractors.

LT – Lighting
FM – Front Main (Engine Harness)
RM – Rear Main (Chassis Harness)
CM – Cab Main

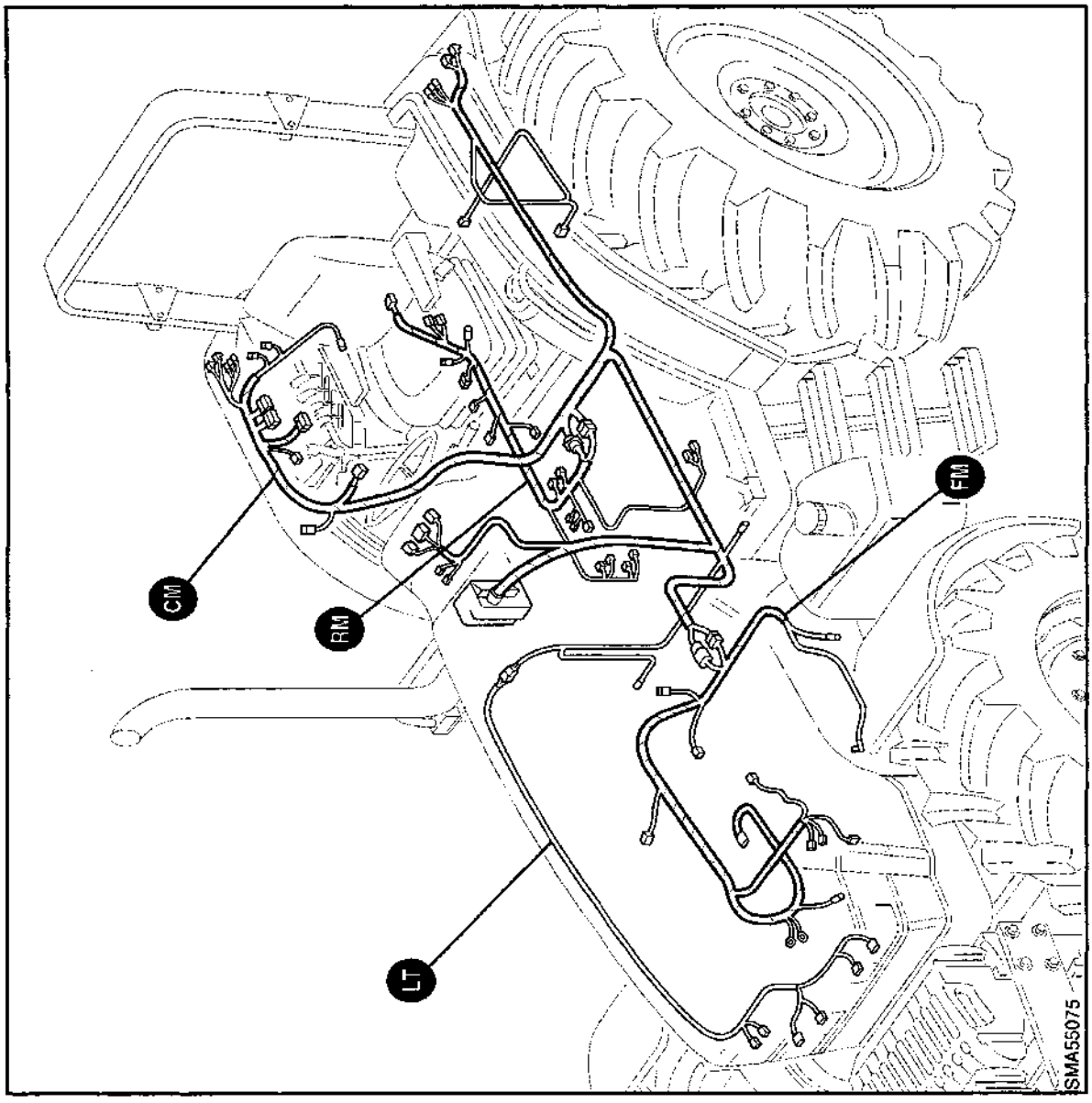


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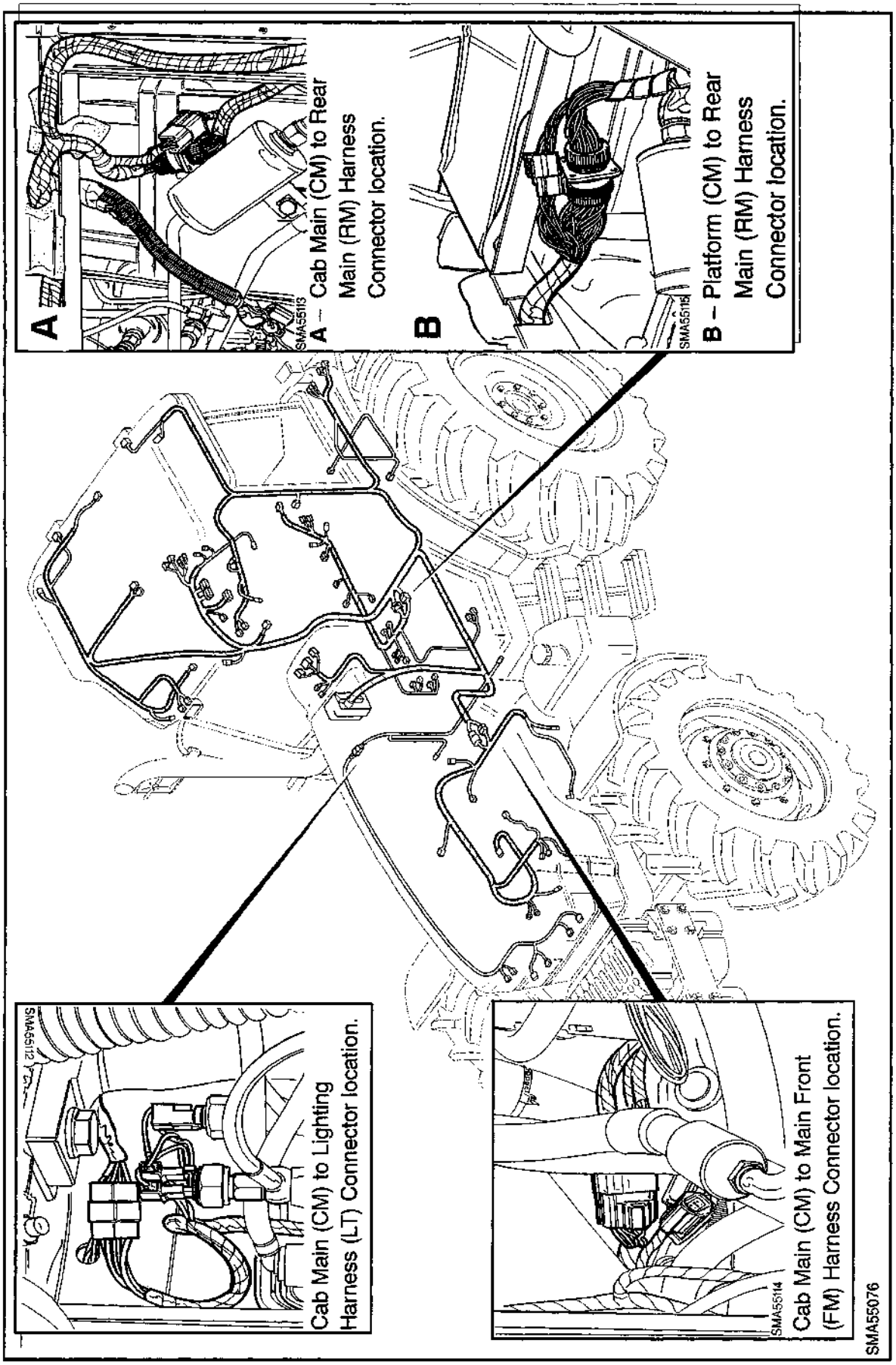
There are Four Main Harnesses used on Platform Tractors.

LT – Lighting
FM – Front Main (Engine Harness)
RM – Rear Main (Chassis Harness)
CM – Cab Main (Platform Harness)



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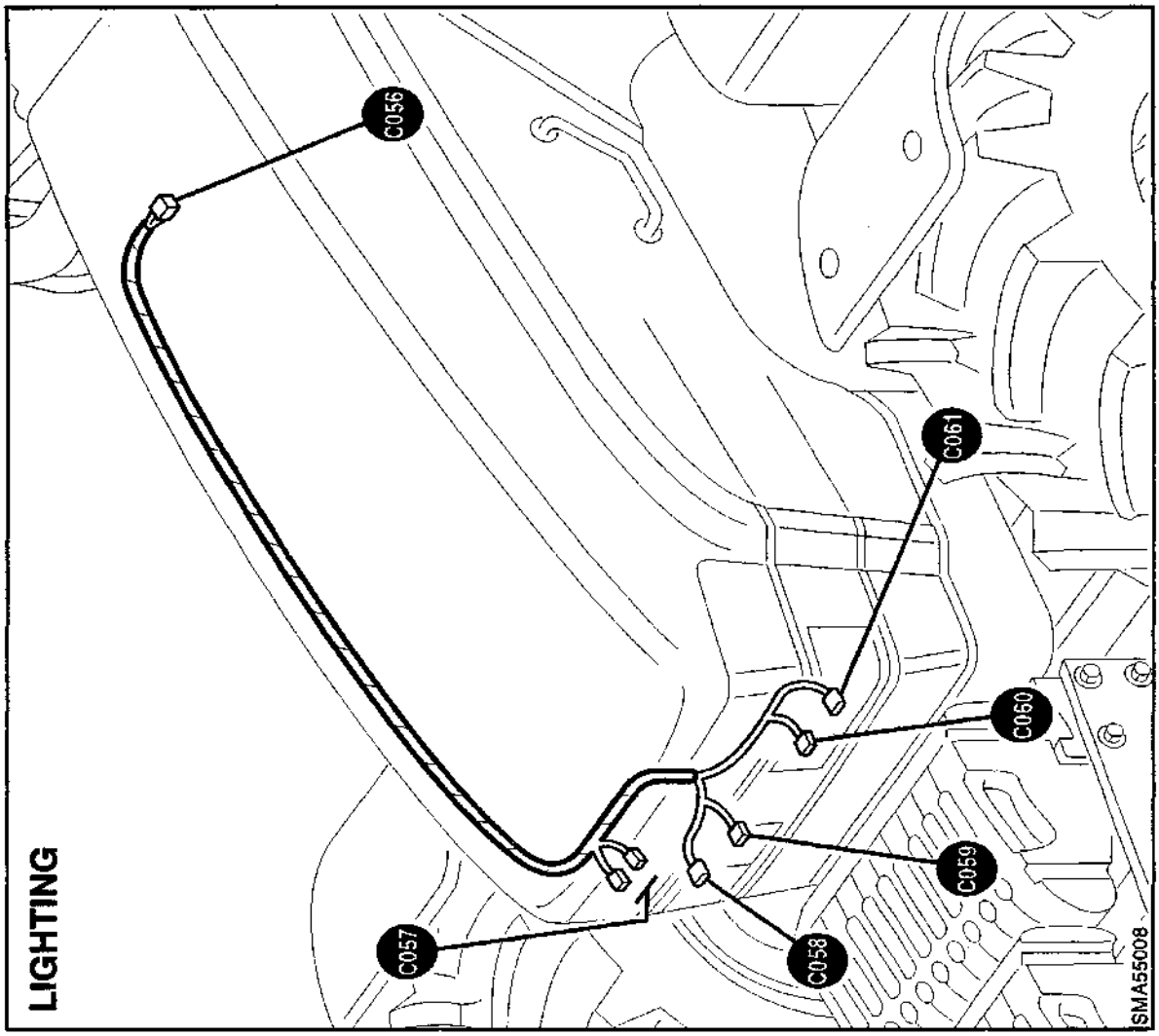
LIGHTING HARNESS CONNECTORS

Connector No.	Component	Harness
C056	Headlamp Harness	LT
C057	Horn	LT
C058	Right Hand Worklamp	LT
C059	Right Hand Headlamp	LT
C060	Left Hand Headlamp	LT
C061	Left Hand Worklamp	LT

Connector No.	Component	Harness

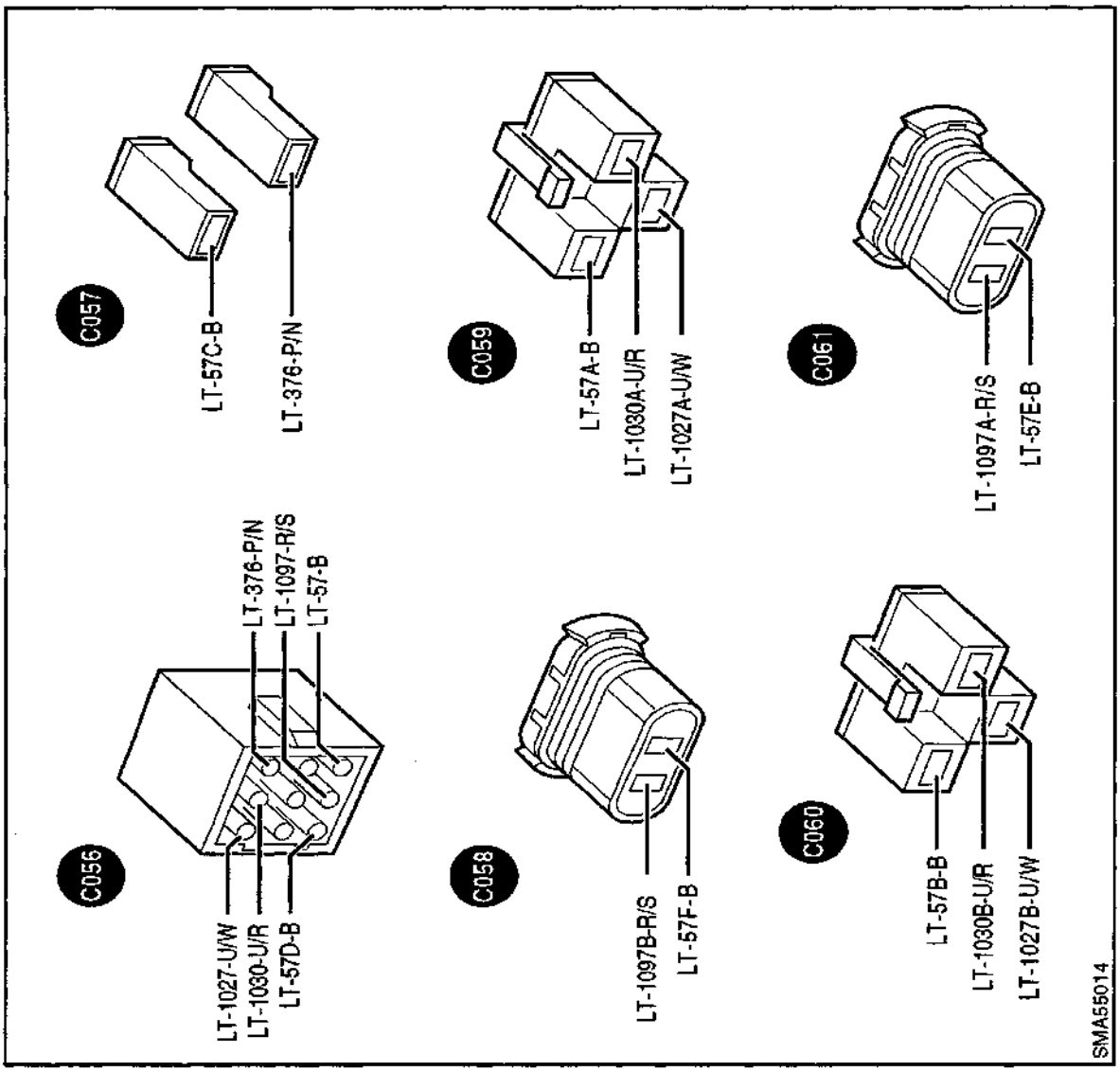
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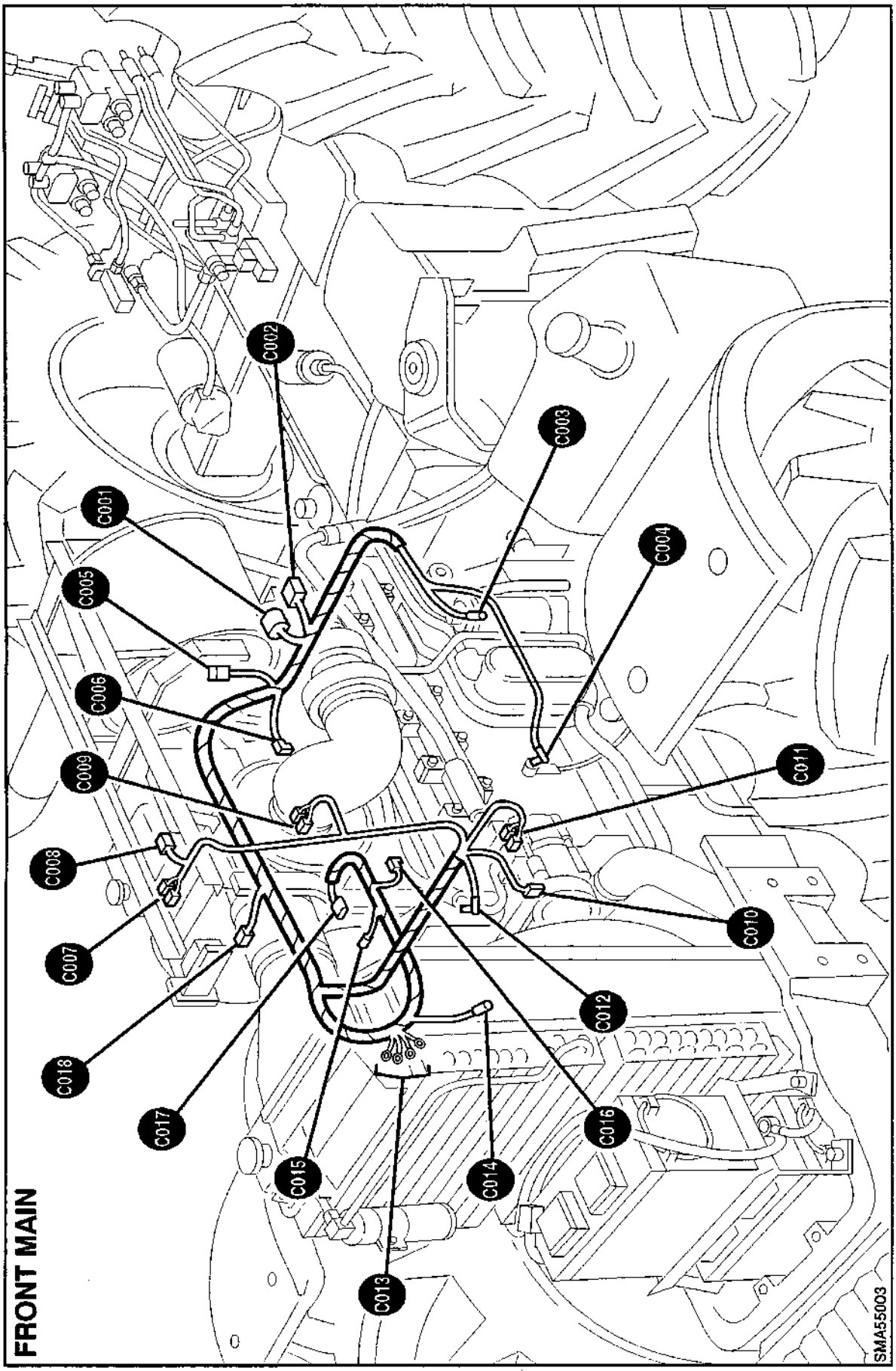
FRONT MAIN (ENGINE) HARNESS CONNECTORS

Connector No.	Component	Harness
C001	Front Main Bulkhead Connector M1	FM
C002	Front Main Bulkhead Connector M2	FM
C003	Oil Pressure Sender	FM
C004	Oil Pressure Switch	FM
C005	Starter Relay	FM
C006	Starter Solenoid	FM
C007	Brake Fluid Reservoir	FM
C008	Engine Coolant Level	FM
C009	Vacuum Switch	FM
C010	Air-Con Switch	FM
C011	De-Icing Thermostat	FM
C012	Temperature Sender	FM
C013	Alternator	FM
C014	Steering Sensor	FM
C015	Fuel Shut-Off Solenoid	FM
C016	Fuel Pump	FM
C017	Water in Fuel Sensor	FM
C018	Thermostart	FM

Connector No.	Component	Harness

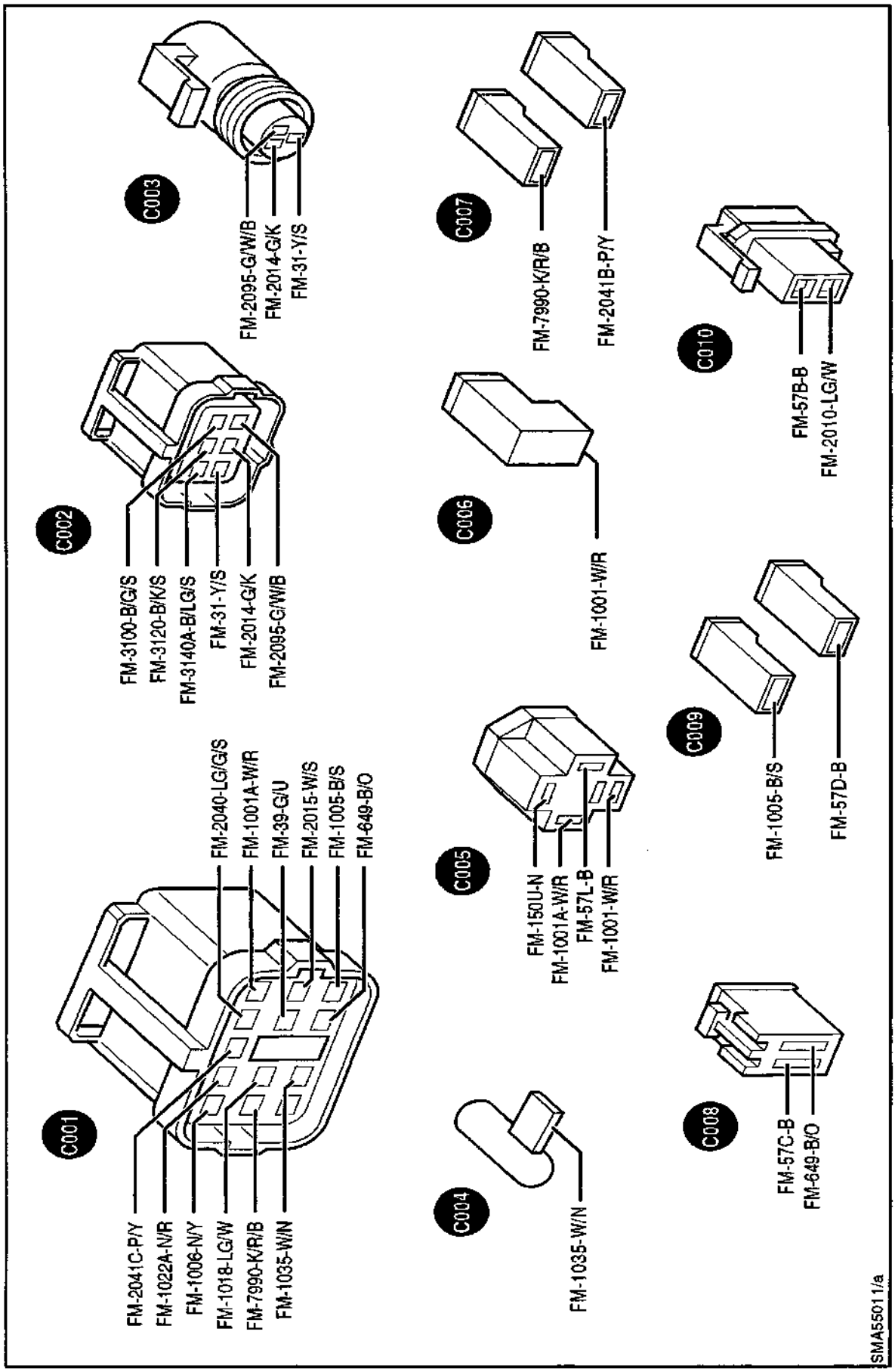
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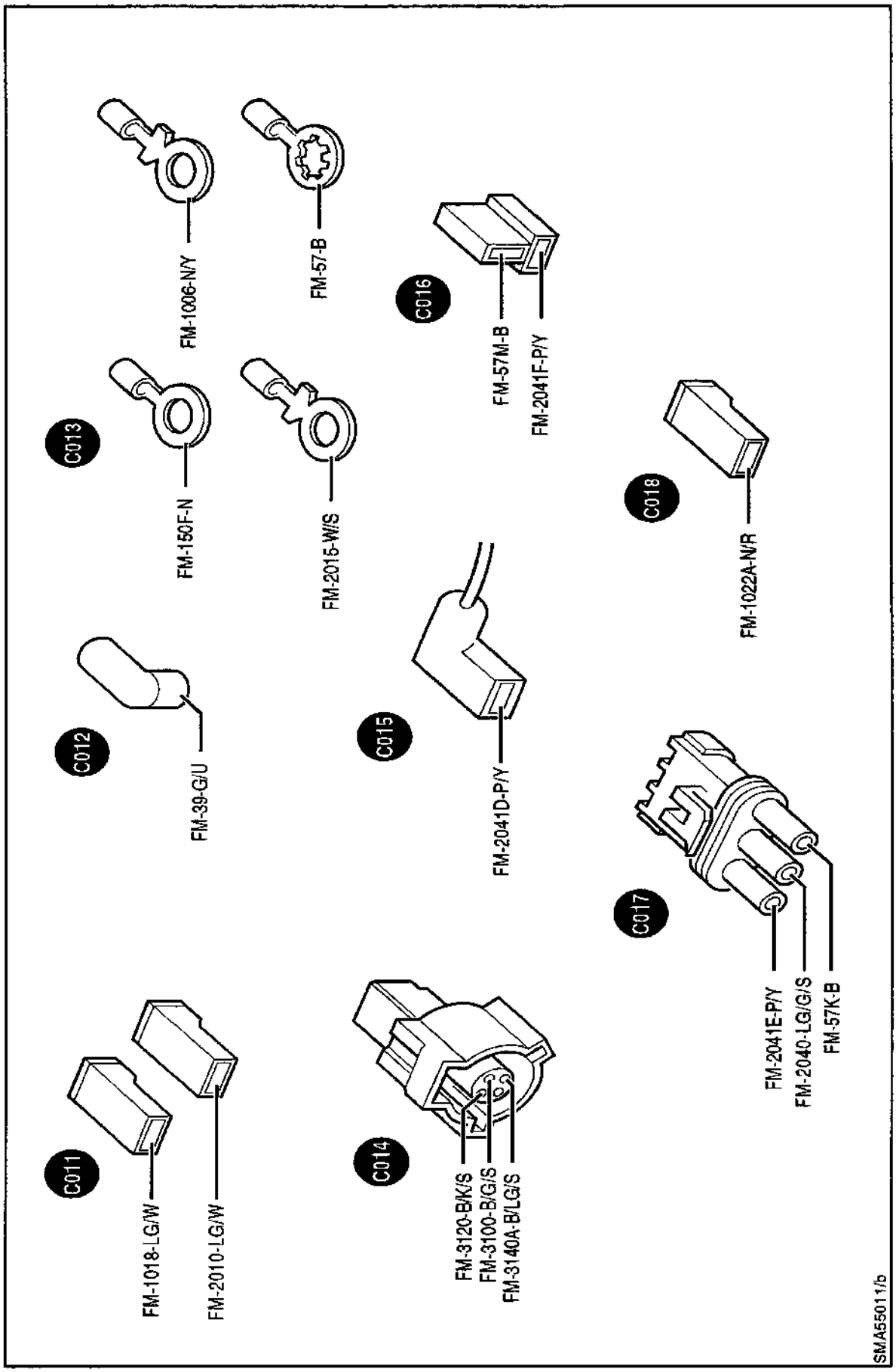
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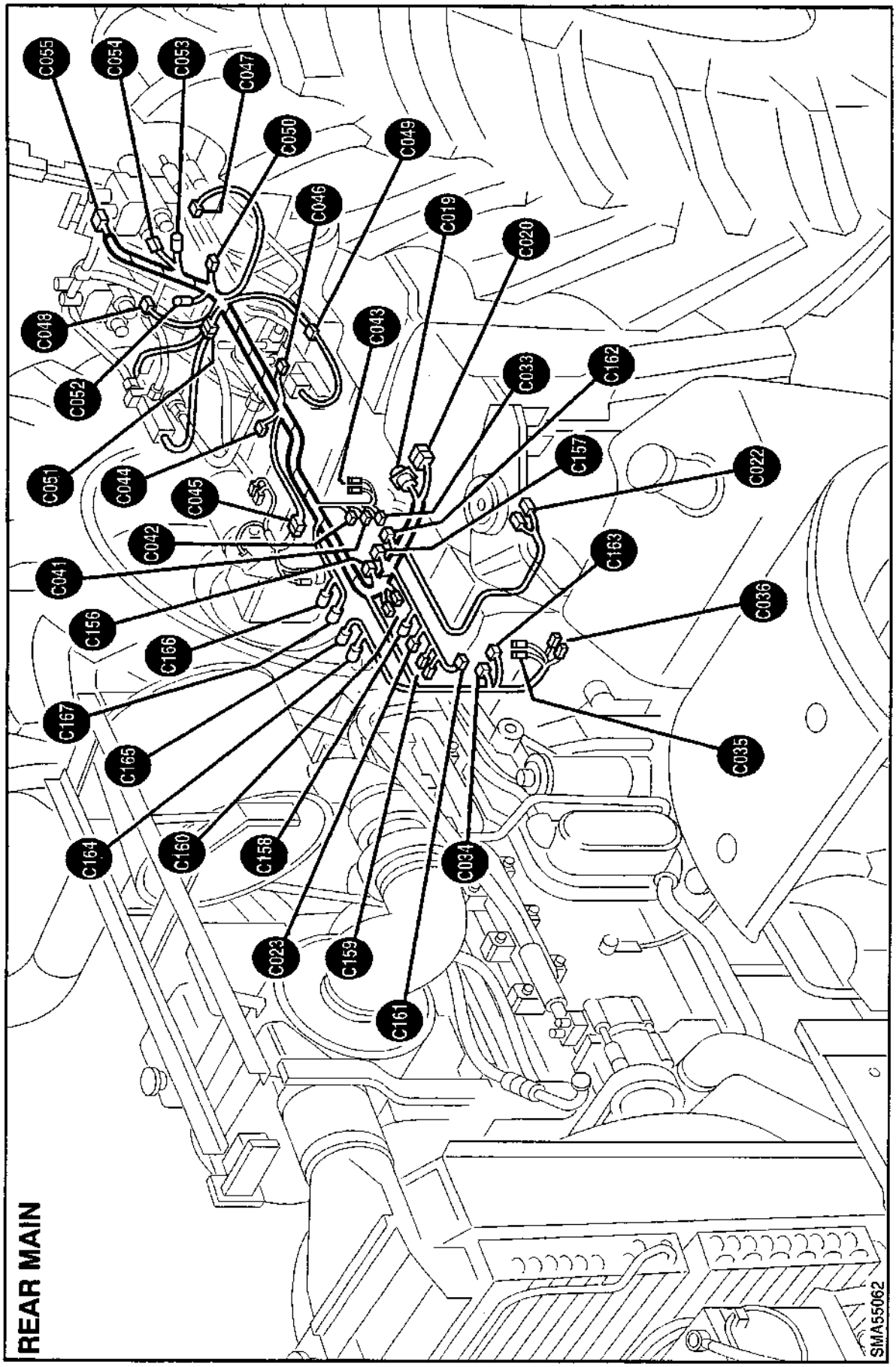
REAR MAIN (CHASSIS) HARNESS CONNECTORS

Connector No.	Component	Harness
C019	Rear Main Extension Connector 1	RM
C020	Rear Main Extension Connector 2	RM
C022	Fuel Tank Sender	RM
C023	Transmission Oil Temp Sender	RM
C033	PTO Brake	RM
C034	Front Wheel Drive Solenoid	RM
C035	Front Wheel Drive Switch	RM
C036	Pressure Switch	RM
C041	PTO Solenoid	RM
C042	Diff Lock Solenoid	RM
C043	Diff Lock Switch	RM
C044	Switch Ground Speed PTO Engaged	RM
C045	Pump Connector	RM
C046	Axle Speed Sensor	RM
C047	Left Hand Draft Pin	RM
C048	Right Hand Draft Pin	RM
C049	Diverter Valve Connector	RM
C050	Trailer Brake Connector	RM
C051	EDC Valve Connector	RM
C052	Rockshaft Potentiometer	RM
C053	Hydraulic Remote Valve Solenoid	RM

Connector No.	Component	Harness
C054	PTO Speed Sensor	RM
C055	Trailer Socket	RM
C156	Reverse Synchro Solenoid	RM
C157	Forward Synchro Solenoid	RM
C158	Synchro Position Potentiometer	RM
C159	Clutch Pressure Switch (A)	RM
C160	Clutch Pressure Switch (B)	RM
C161	Clutch A (Low)	RM
C162	Clutch B (High)	RM
C163	Dump Solenoid	RM
C164	Gear Switch 1	RM
C165	Gear Switch 2	RM
C166	Range Switch 3	RM
C167	Range Switch 4	RM

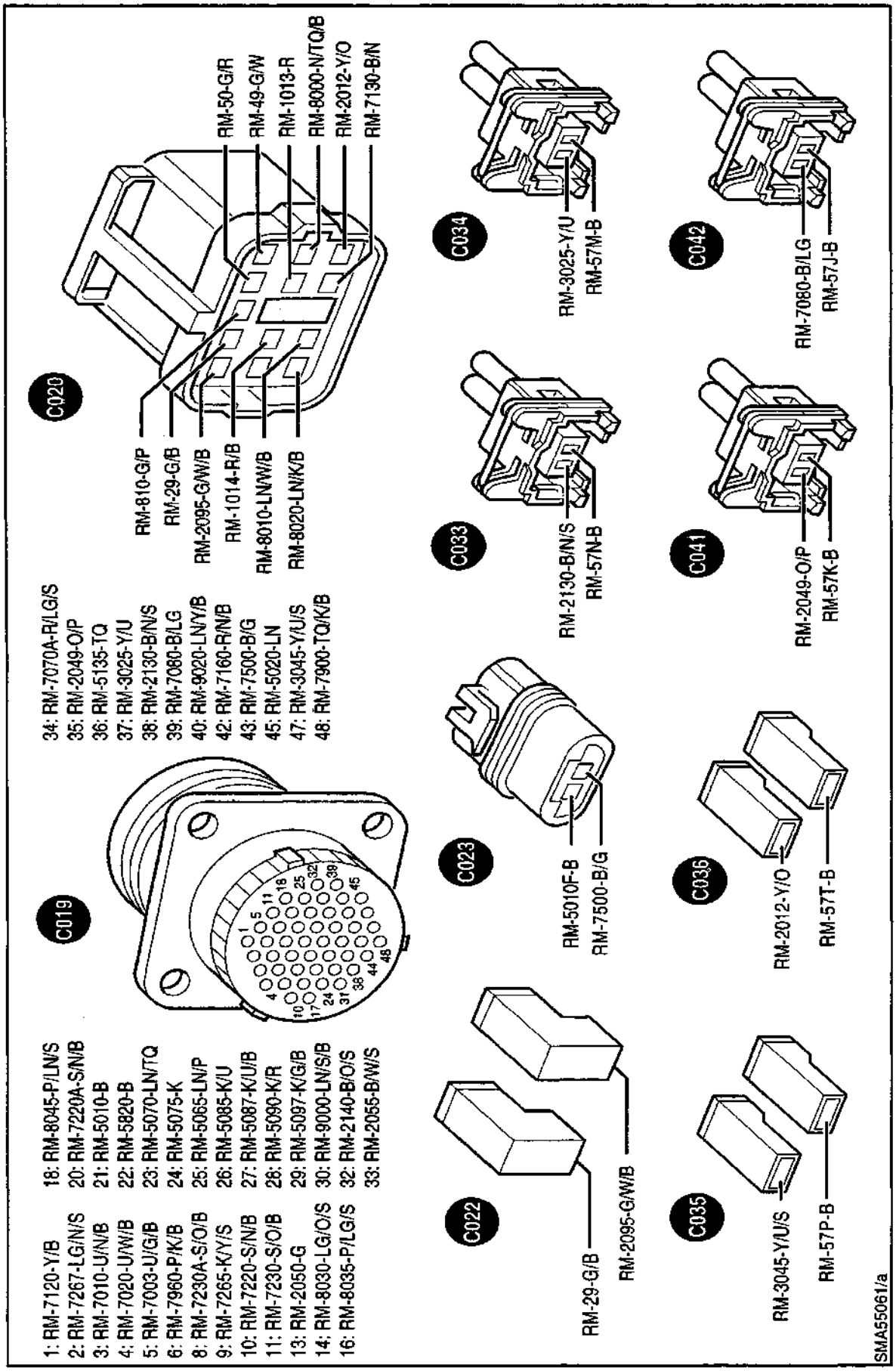
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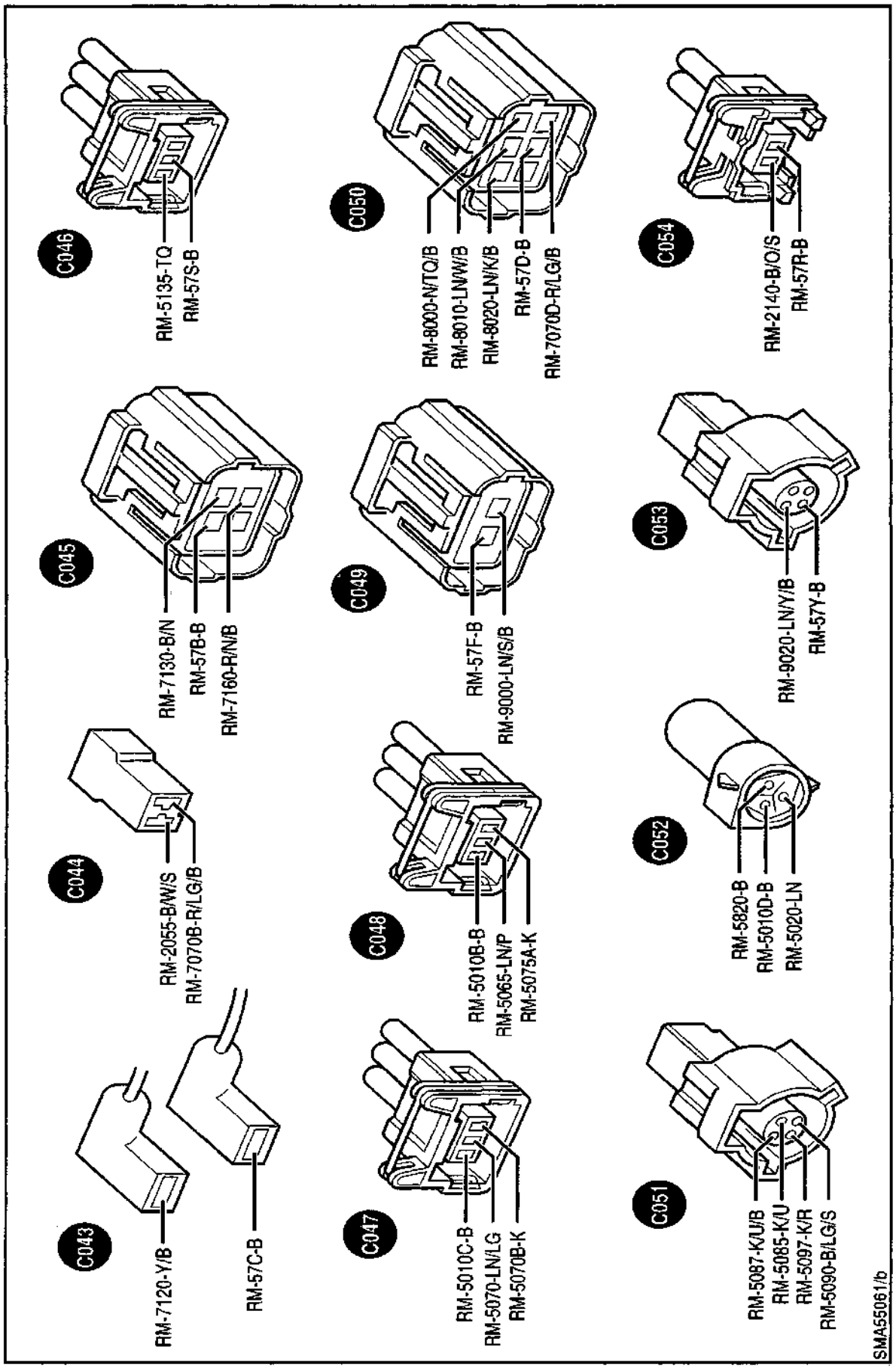
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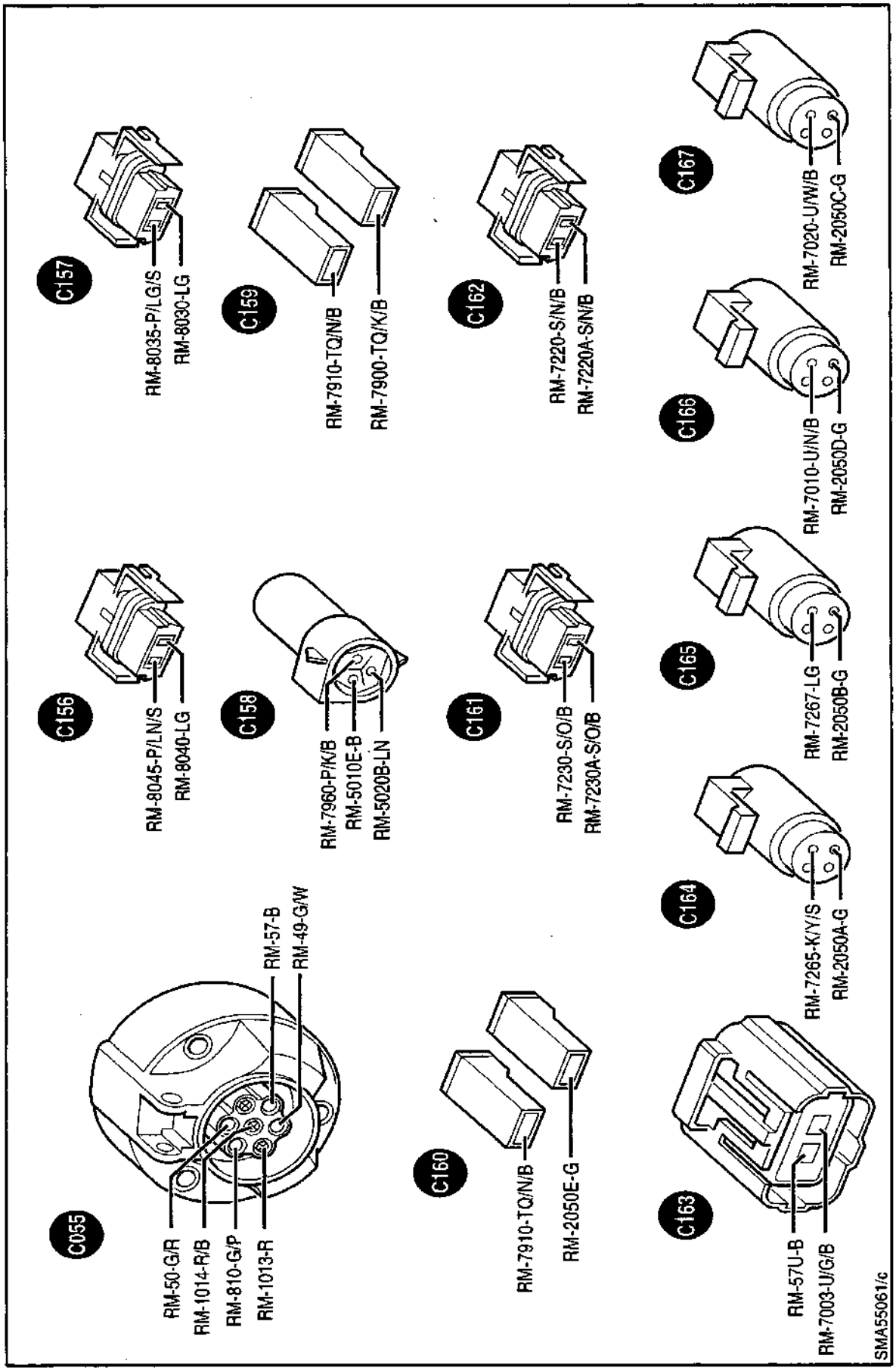
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CAB MAIN (PLATFORM) HARNESS CONNECTORS

Connector No.	Component	Harness
C001	Cab Main Bulkhead Connector M1	CM
C002	Cab Main Bulkhead Connector M2	CM
C019	Cab Main Extension Connector 1	CM
C020	Cab Main Extension Connector 1	CM
C065	Headlamp Harness Connector	CM
C062	Right Hand Stop Lamp Switch	CM
C063	Left Hand Stop Lamp Switch	CM
C064	Right Hand Lower Front Worklamp	CM
C065	Left Hand Lower Front Worklamp	CM
C066	Right Side Lamp	CM
C067	Left Side Lamp	CM
C068	Radar	CM
C069	Starter Solenoid (Cab Main)	CM
C070	Main Bulkhead Hitch Connector M3	CM
C071	Main Bulkhead Hitch Connector M4	CM
C072	Starter Switch	CM
C073	Windshield Wiper Switch	CM
C074	Turn Switch	CM
C075	Shuttle Switch	CM
C076	Clutch Switch	CM
C077	Clutch Potentiometer	CM
C078	Rear Wiper Switch	CM
C079	Instrument Cluster 'A'	CM
C080	Instrument Cluster 'B'	CM
C081	Instrument Cluster 'C'	CM
C082	Beacon Switch	CM
C083	Hazard Switch	CM
C084	Left Hand Upper Front Worklamp	CM
C085	Right Hand Upper Front Worklamp	CM
C086	Left Hand NASO Front Flasher	CM
C087	Right Hand NASO Front Flasher	CM
C088	Front Wiper Motor	CM
C089	Trailer Brake Gauge Lamp	CM
C090	Left hand Door Switch	CM
C091	Right hand Door Switch	CM
C092	Console Lamp	CM
C093	Left Hand NASO Rear Flasher	CM
C094	Right Hand NASO Rear Flasher	CM
C095	Left Hand Rear License/Worklamp	CM
C096	Right Hand Rear License/Worklamp	CM
C097	Left Hand Beacon	CM
C098	Right Hand Beacon	CM
C099	Interior Lamp	CM
C100	TCM Connector 1	CM
C101	TCM Connector 2	CM
C102	Fast Raise/Lower Switch	CM
C103	Gear Shift Connector	CM
C104	Gear Shift Indicator	CM
C105	EMU Connector	CM
C106	Radio A	CM
C107	Radio B	CM
C108	Clock	CM

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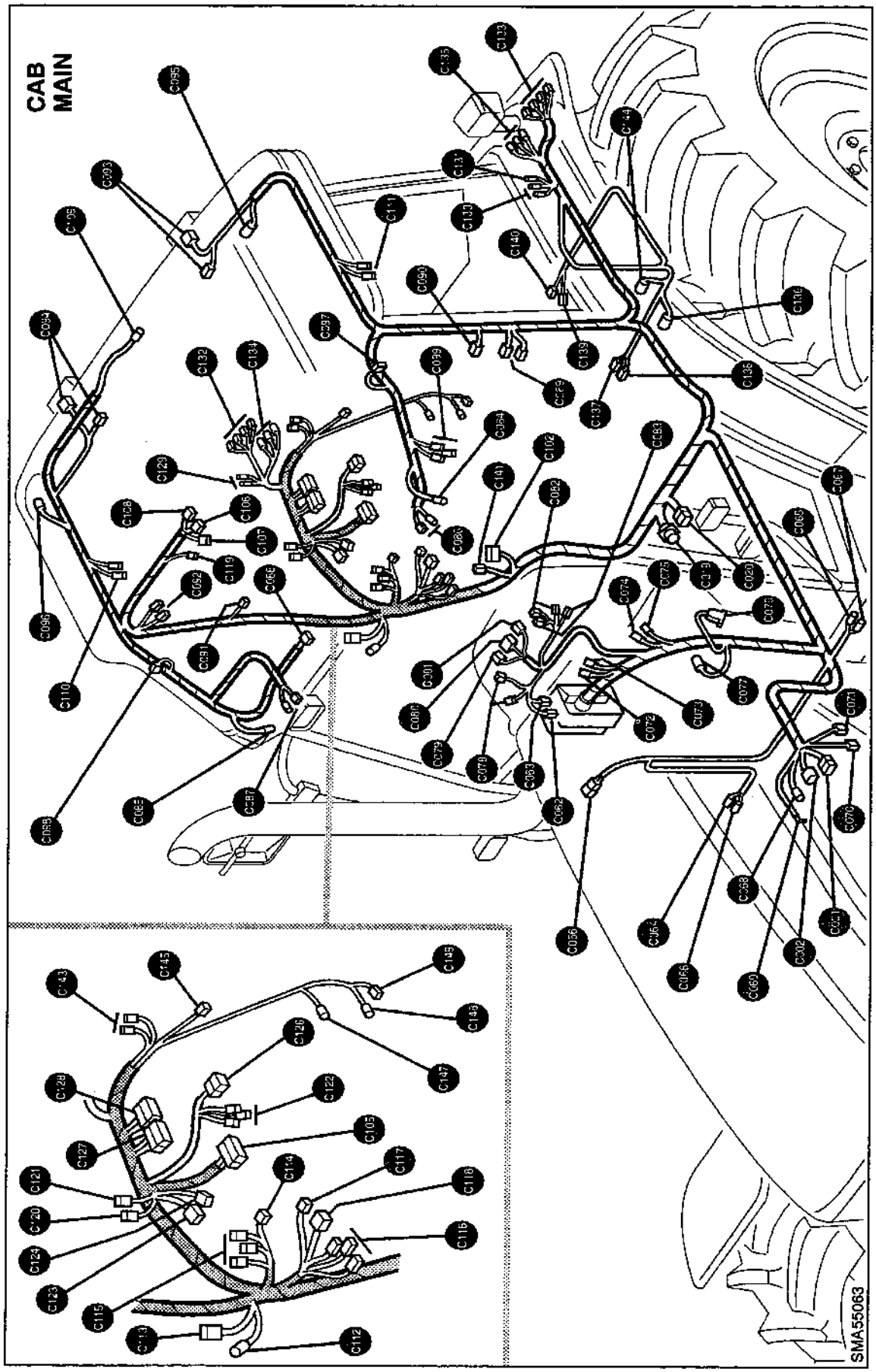
CAB MAIN (PLATFORM) HARNESS CONNECTORS

Connector No.	Component	Harness
C109	Rear Wiper Motor	CM
C110	Right hand Speaker	CM
C111	Left hand Speaker	CM
C112	Front Hitch Override	CM
C113	Front Hitch Potentiometer	CM
C114	PTO Engaged Lamp	CM
C115	Front PTO Switch	CM
C116	Rear PTO Switch	CM
C117	Rear PTO Engaged Lamp	CM
C118	Rear PTO Brake Switch	CM
C119	Heater Air-Con Connector	CM
C120	EDC Control Panel 1	CM
C121	EDC Control Panel 2	CM
C122	Ground Speed Sensor	CM
C123	Limp Home Connector 2	CM
C124	Limp Home Connector 1	CM
C125	Diagnostic Plug TCM	CM
C126	Diagnostic Plug EDC	CM
C127	EDC Module CN2	CM
C128	EDC Module CN1	CM
C129	Worklamp Right Hand Fender	CM
C130	Worklamp Left Hand Fender	CM
C131	License Plate Lamp	CM
C132	Rear Lamp Right Hand Fender	CM
C133	Rear Lamp Left Hand Fender	CM

Connector No.	Component	Harness
C134	HPL Raise/Lower Right Hand Switch	CM
C135	HPL Raise/Lower Left Hand Switch	CM
C136	Handbrake	CM
C137	PTO Alarm Seat Switch	CM
C138	Seat Pump	CM
C139	Front Washer Motor	CM
C140	Rear Washer Motor	CM
C141	Gear Shift Connector	CM
C143	Implement Socket	CM
C144	Air Brake Connector	CM
C145	Rear Socket Connector	CM
C147	Remote Valve Switch	CM
C148	Diverter Valve	CM
C149	Quadrant Potentiometer	CM

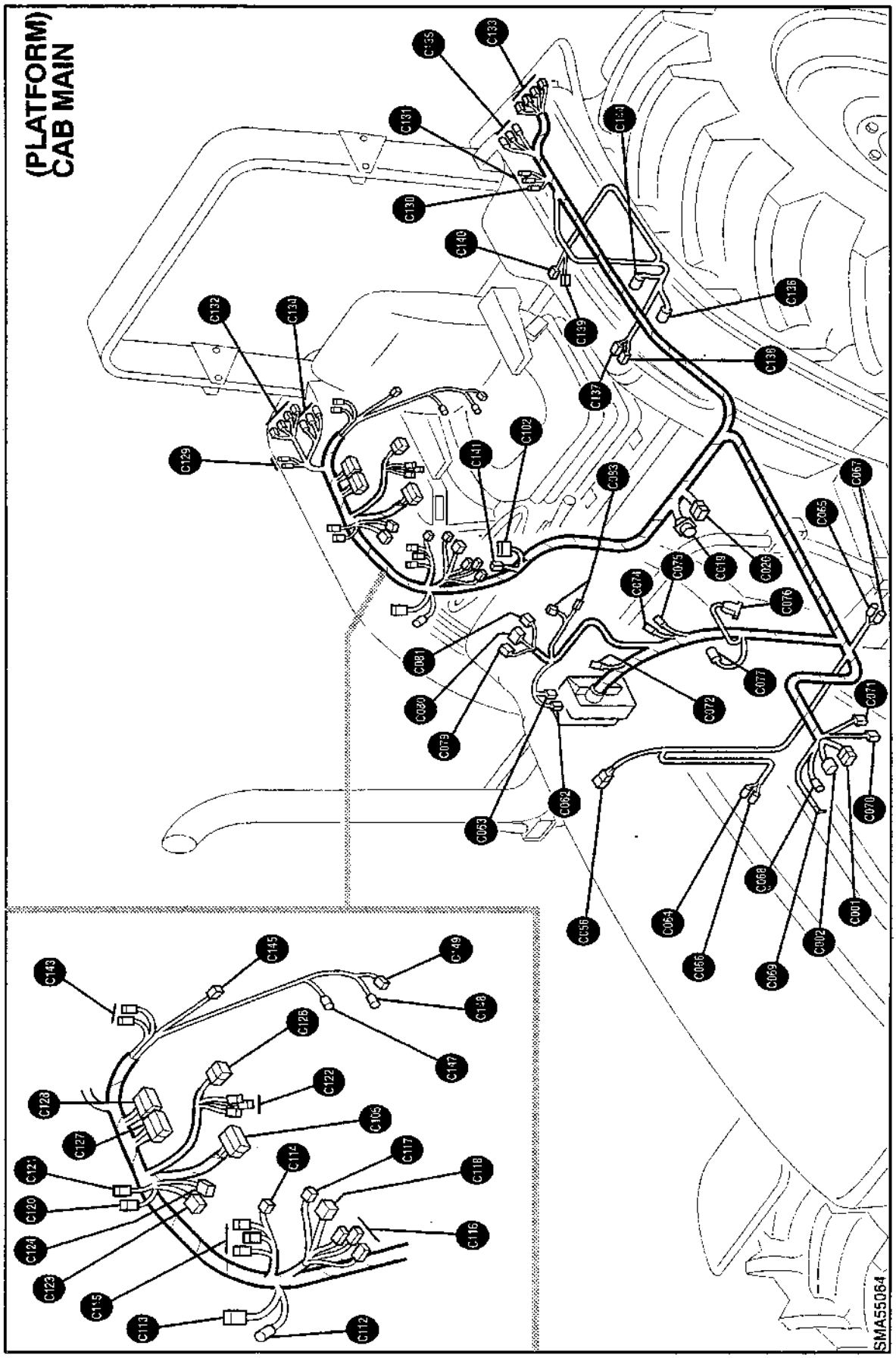
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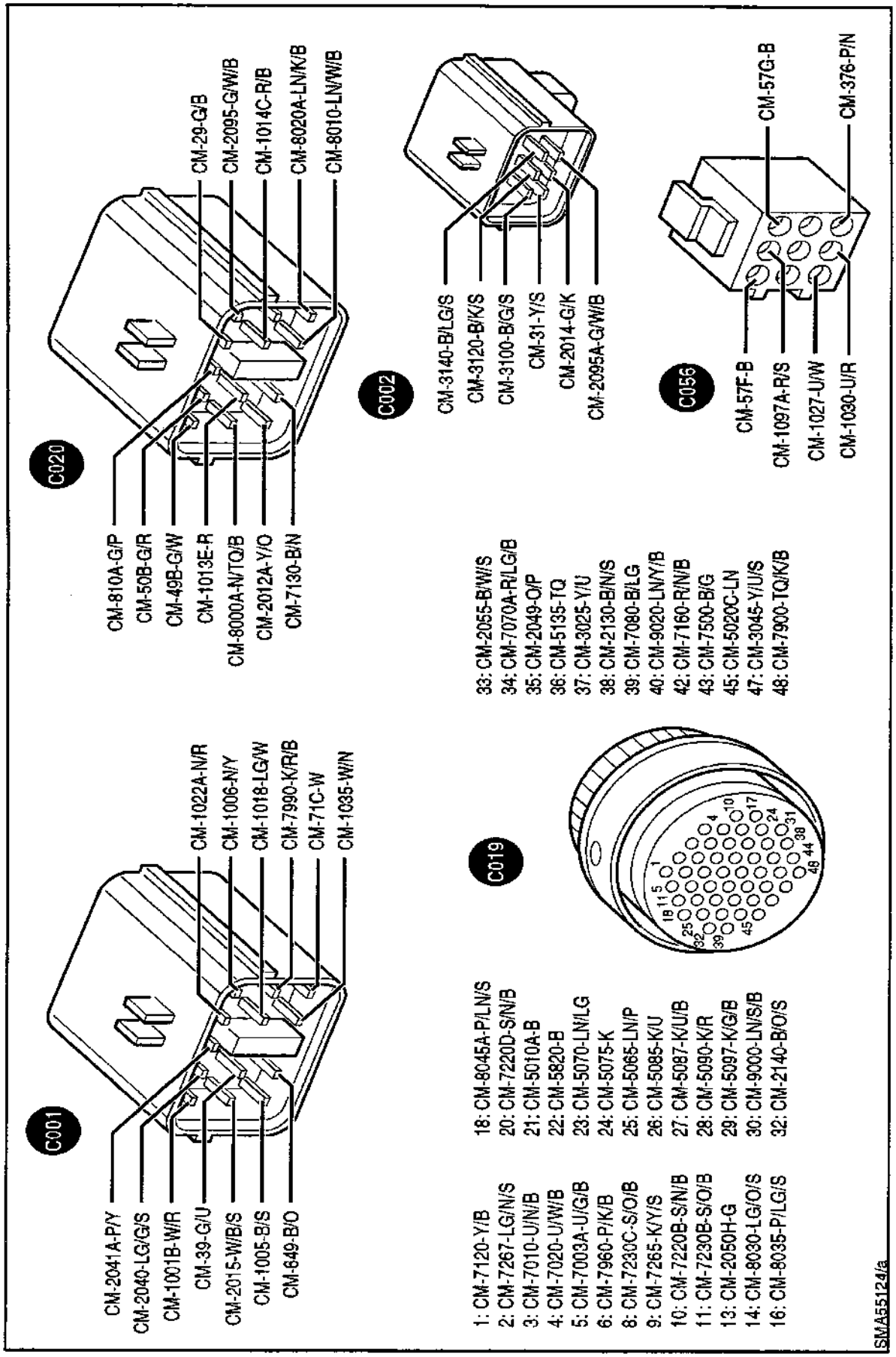
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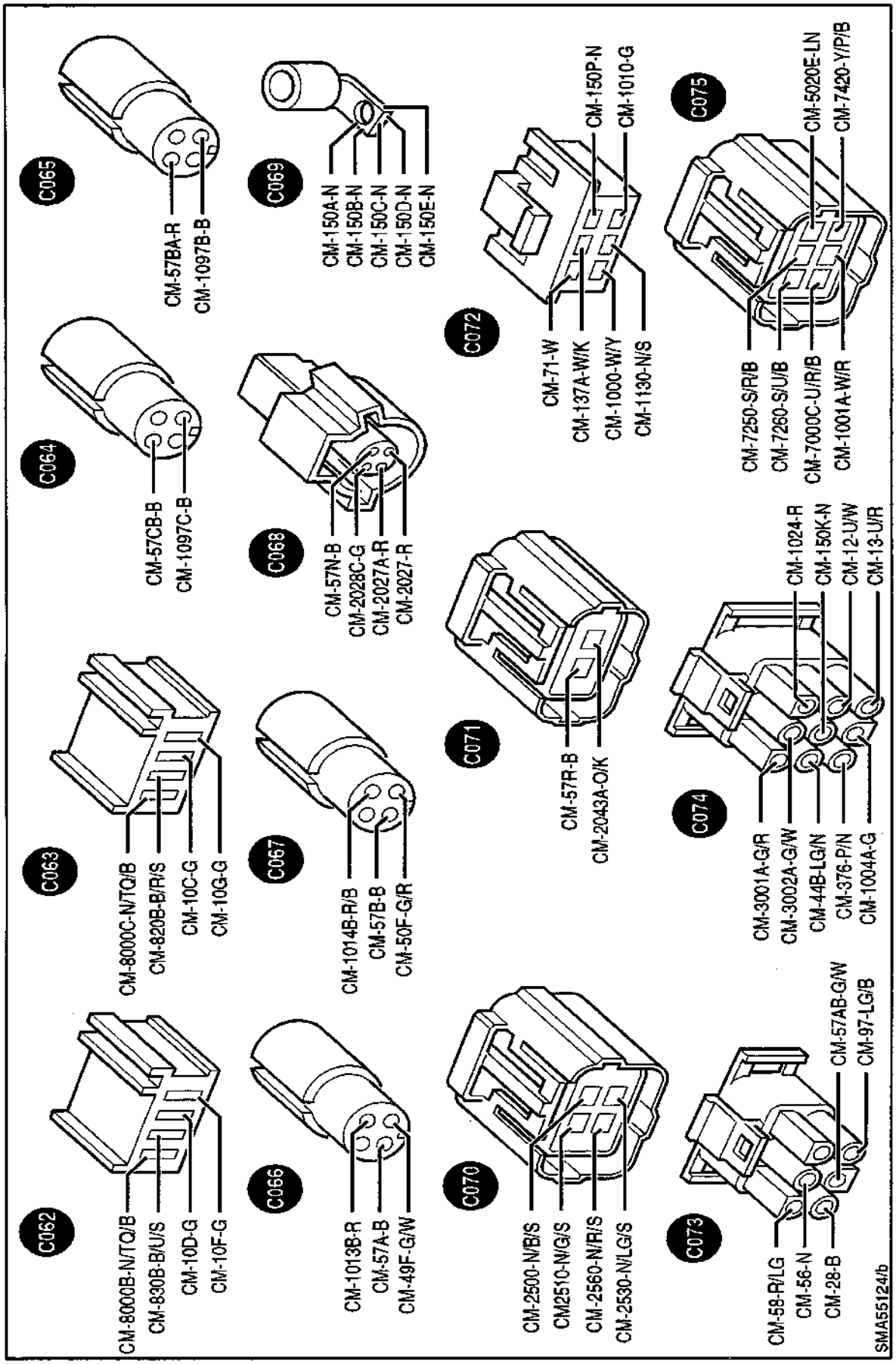
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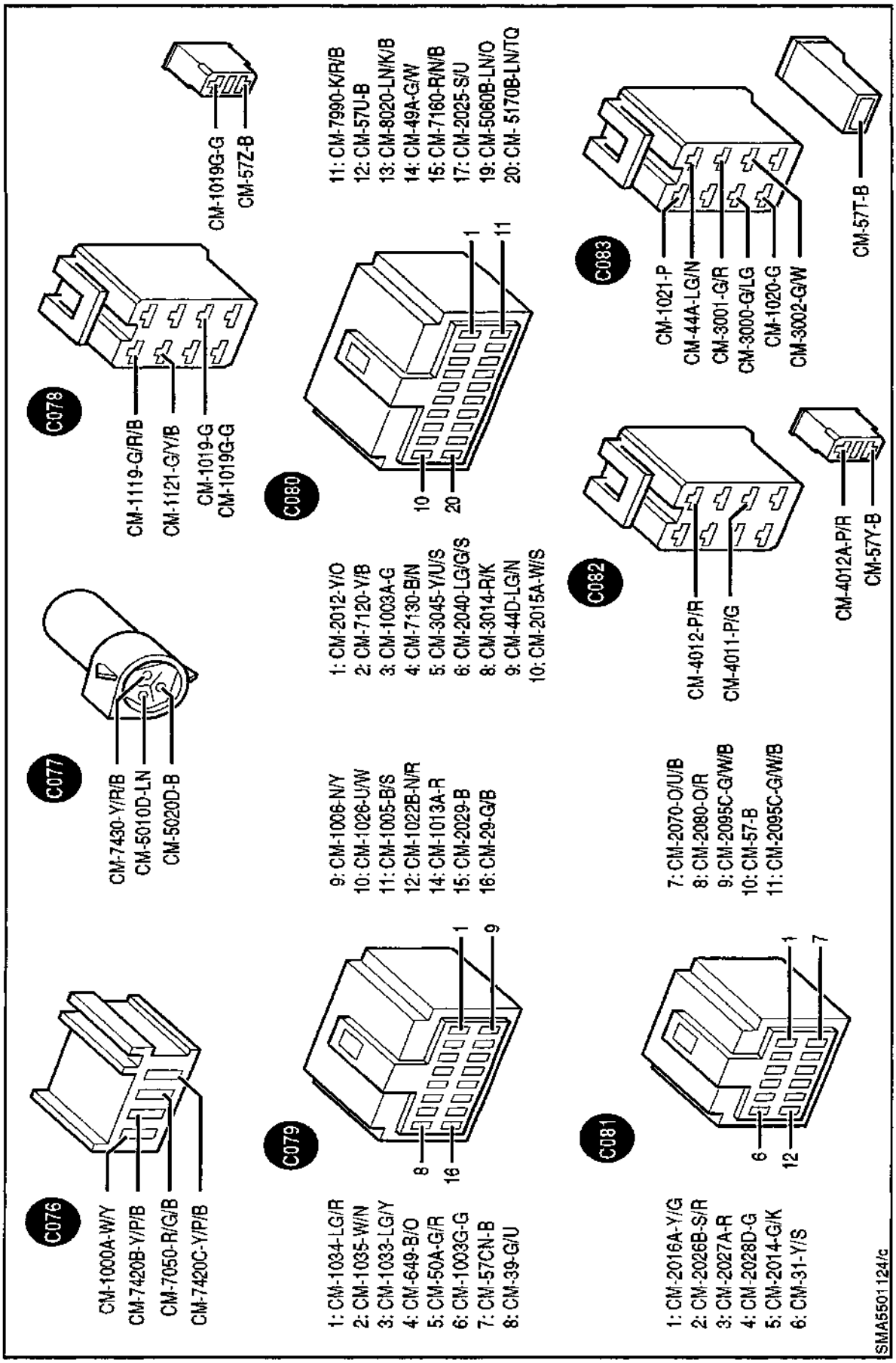
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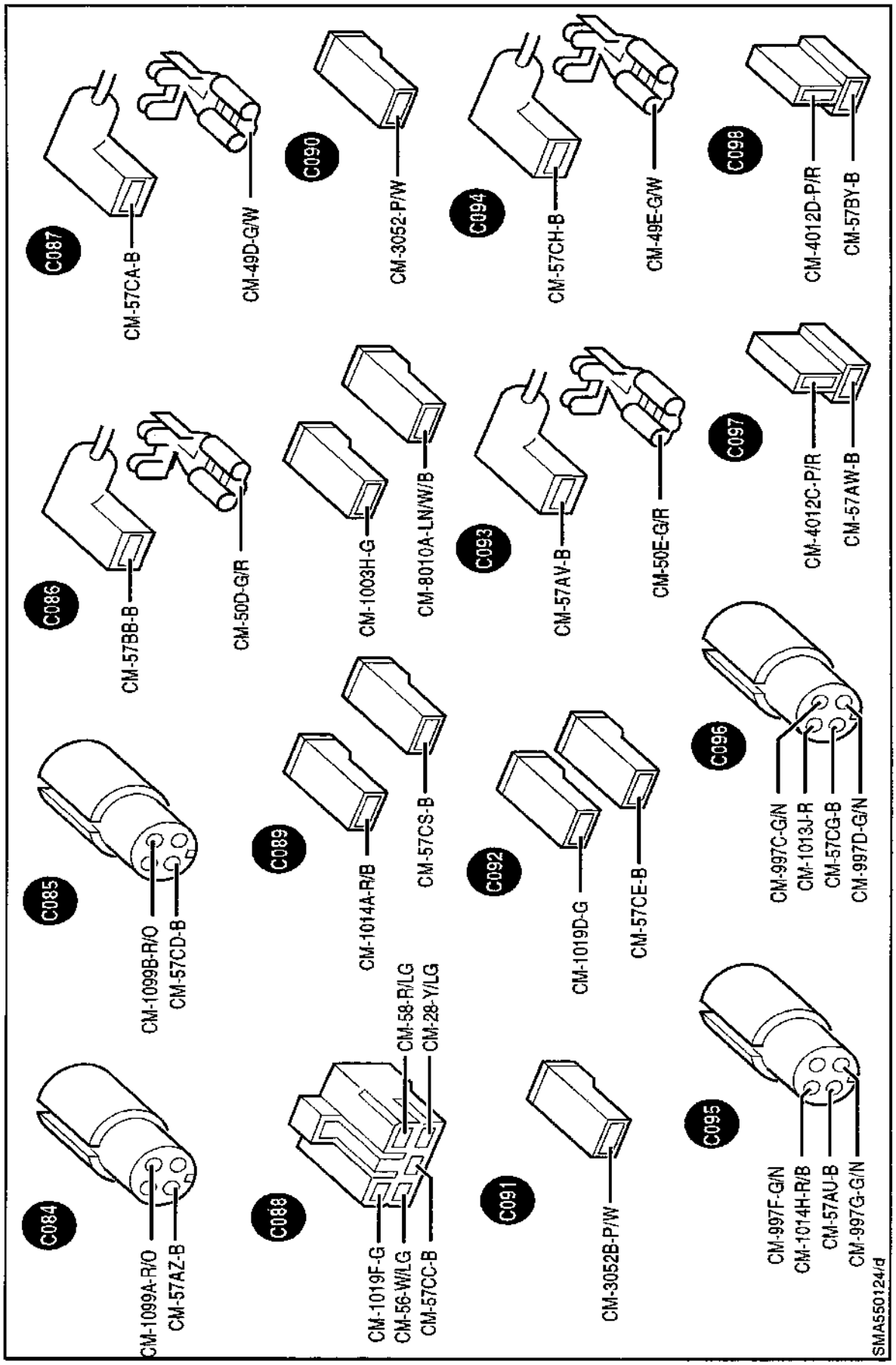
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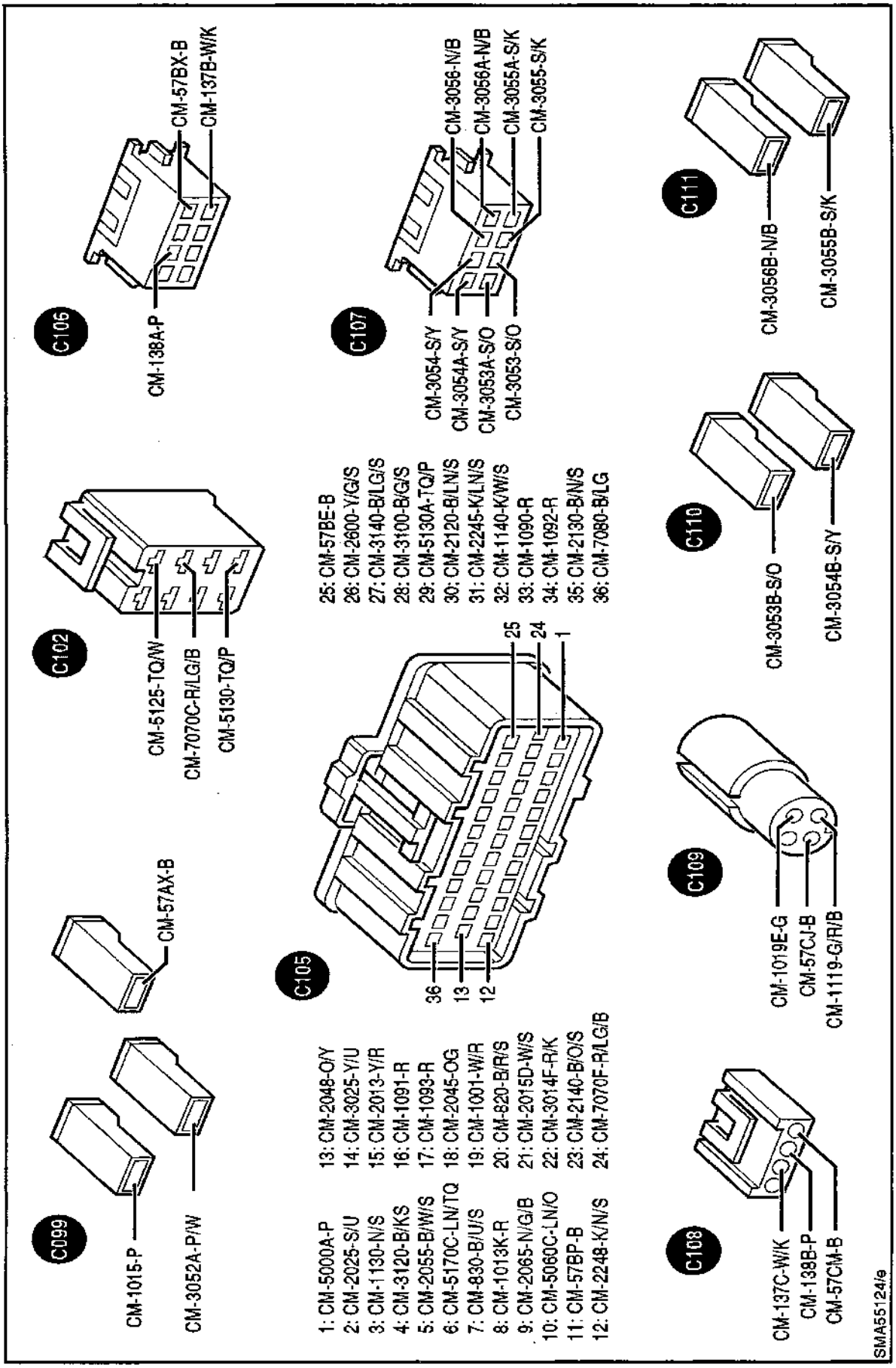
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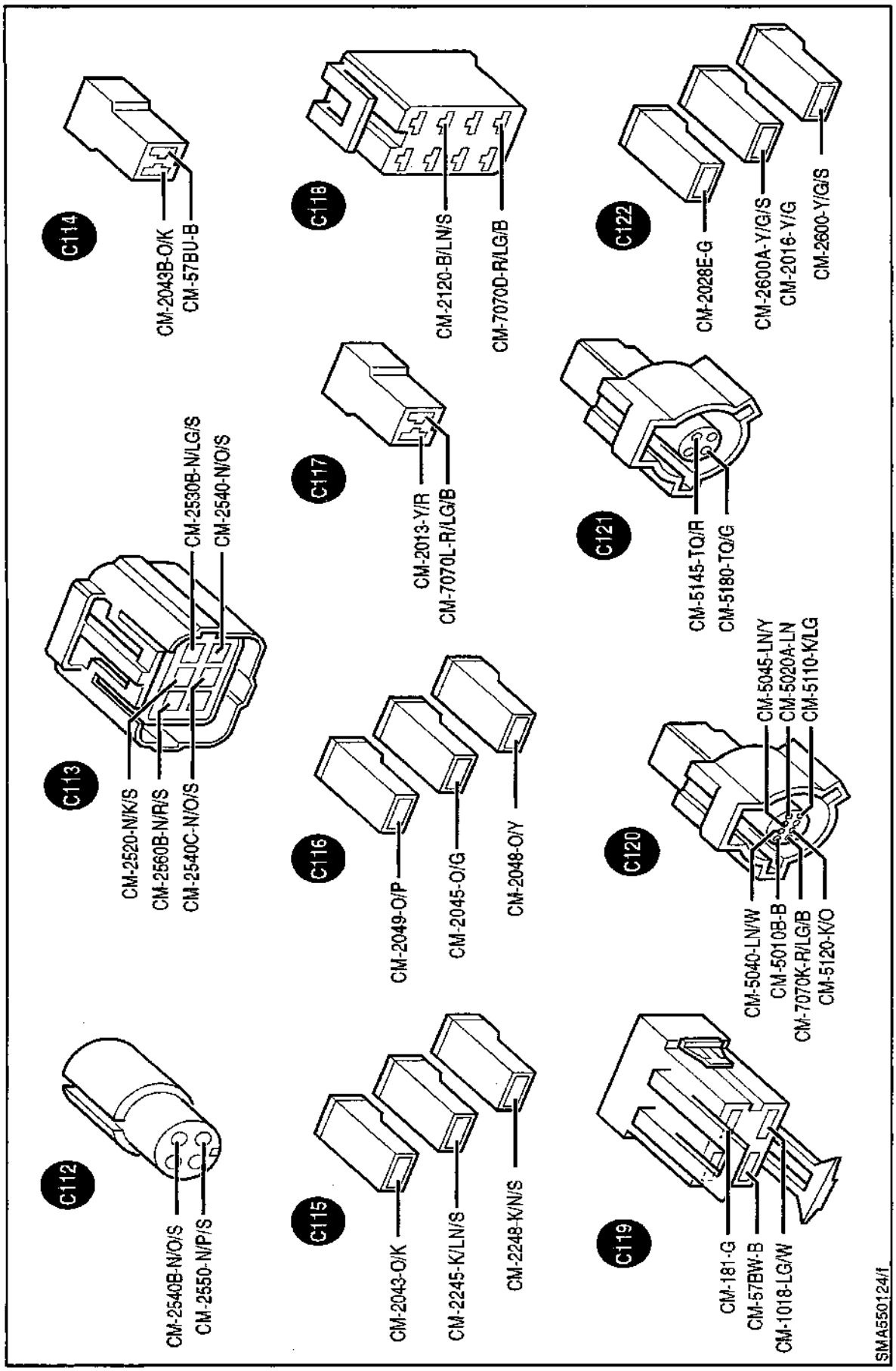
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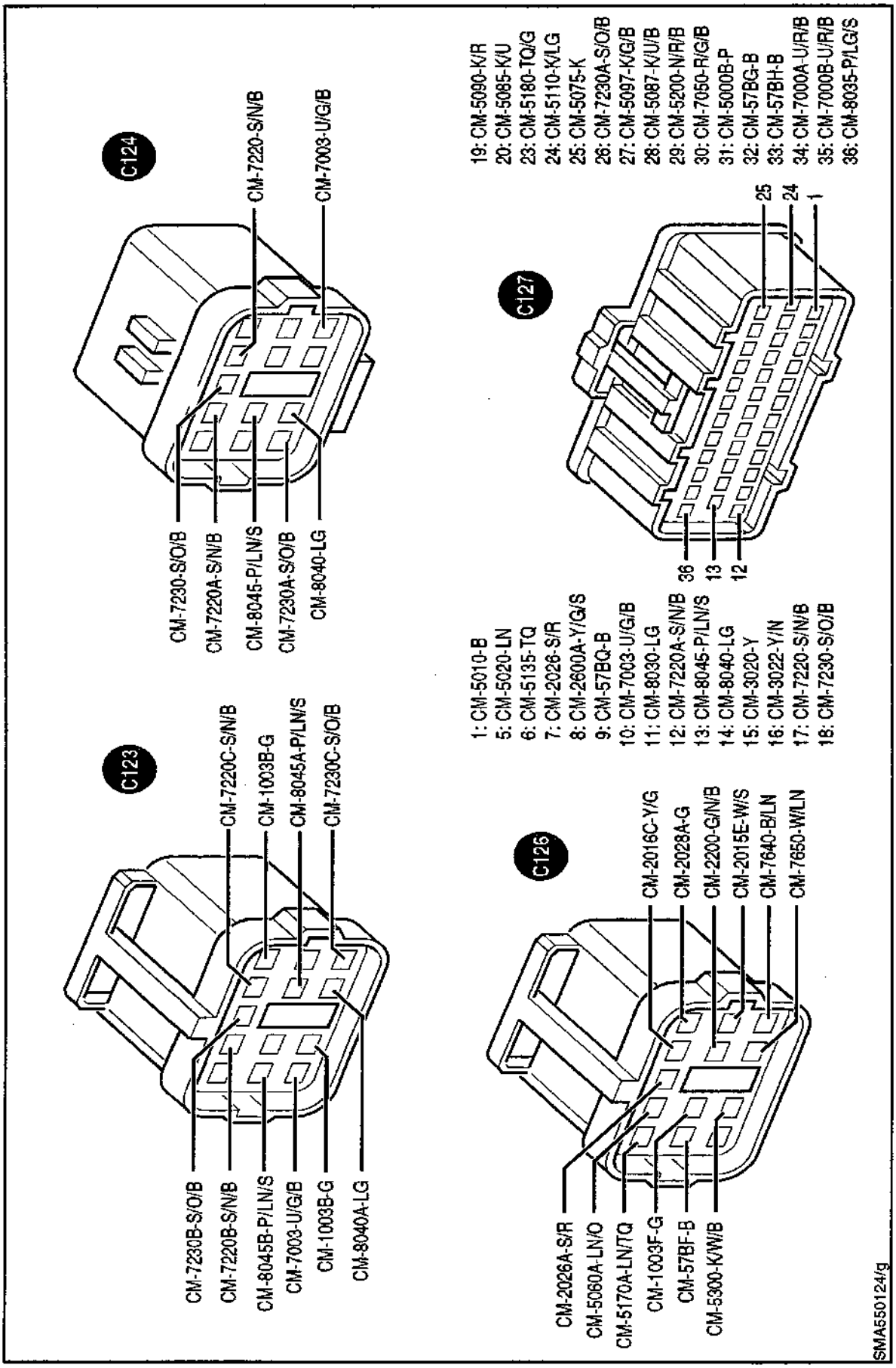
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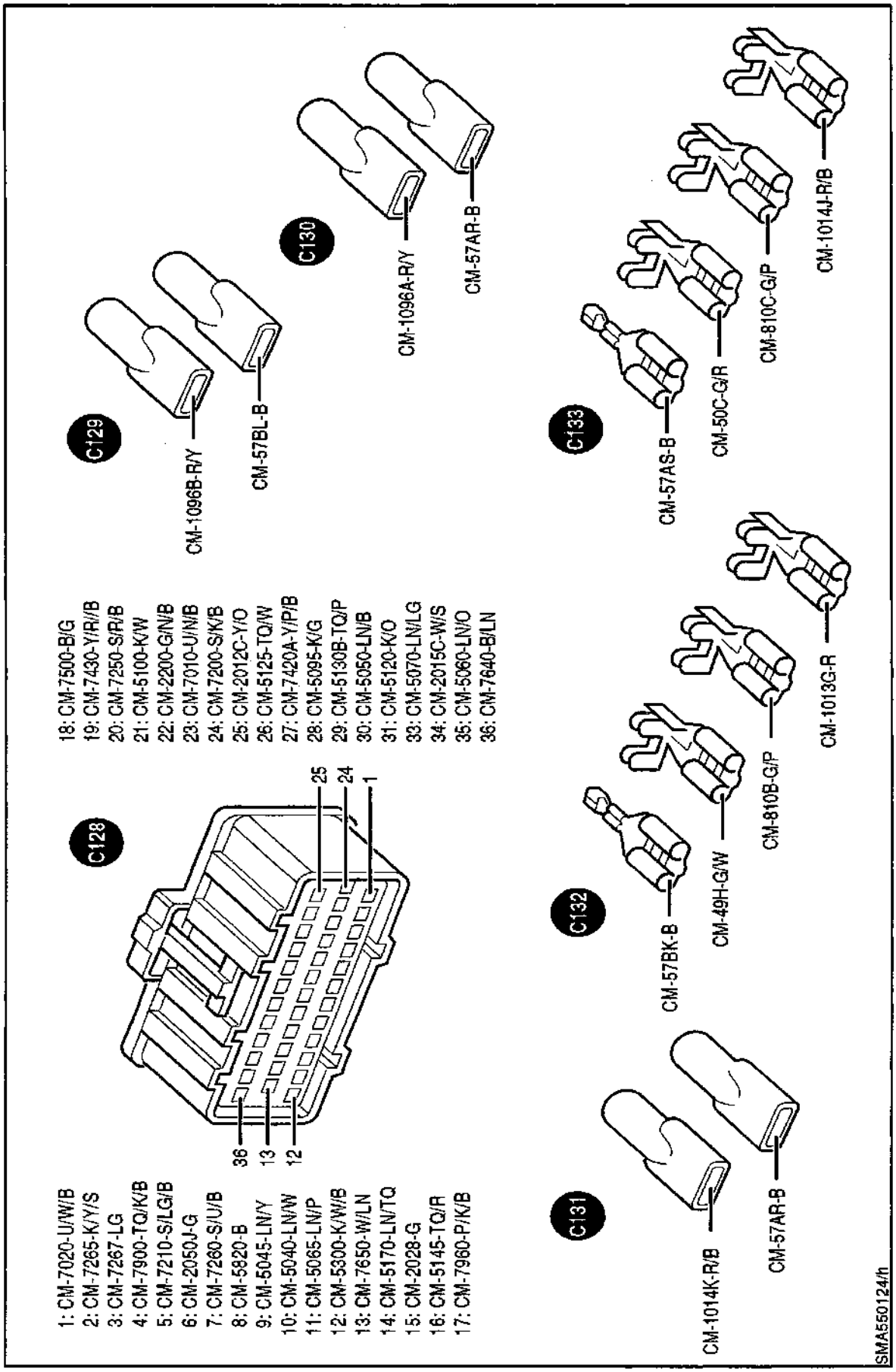
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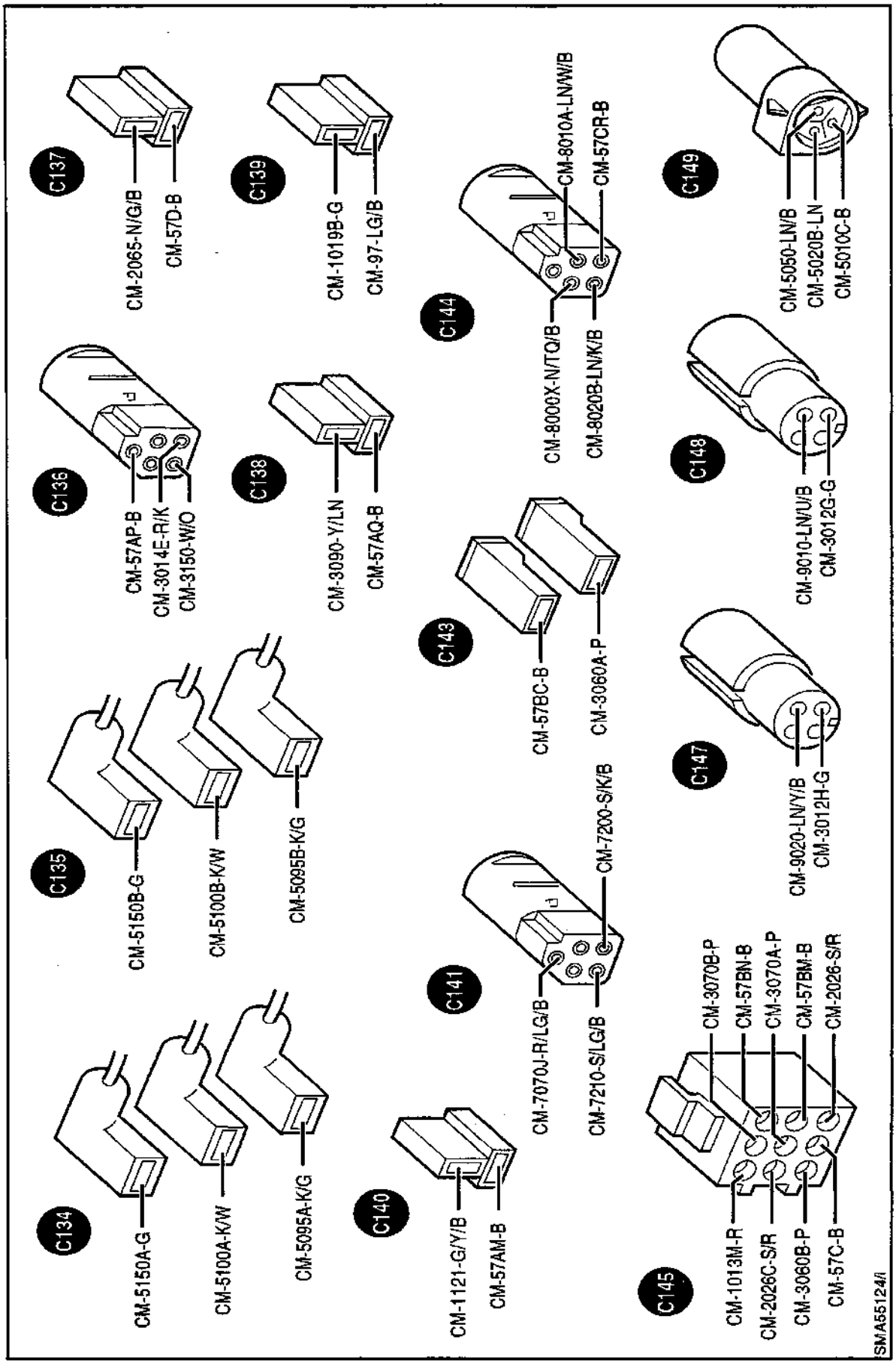
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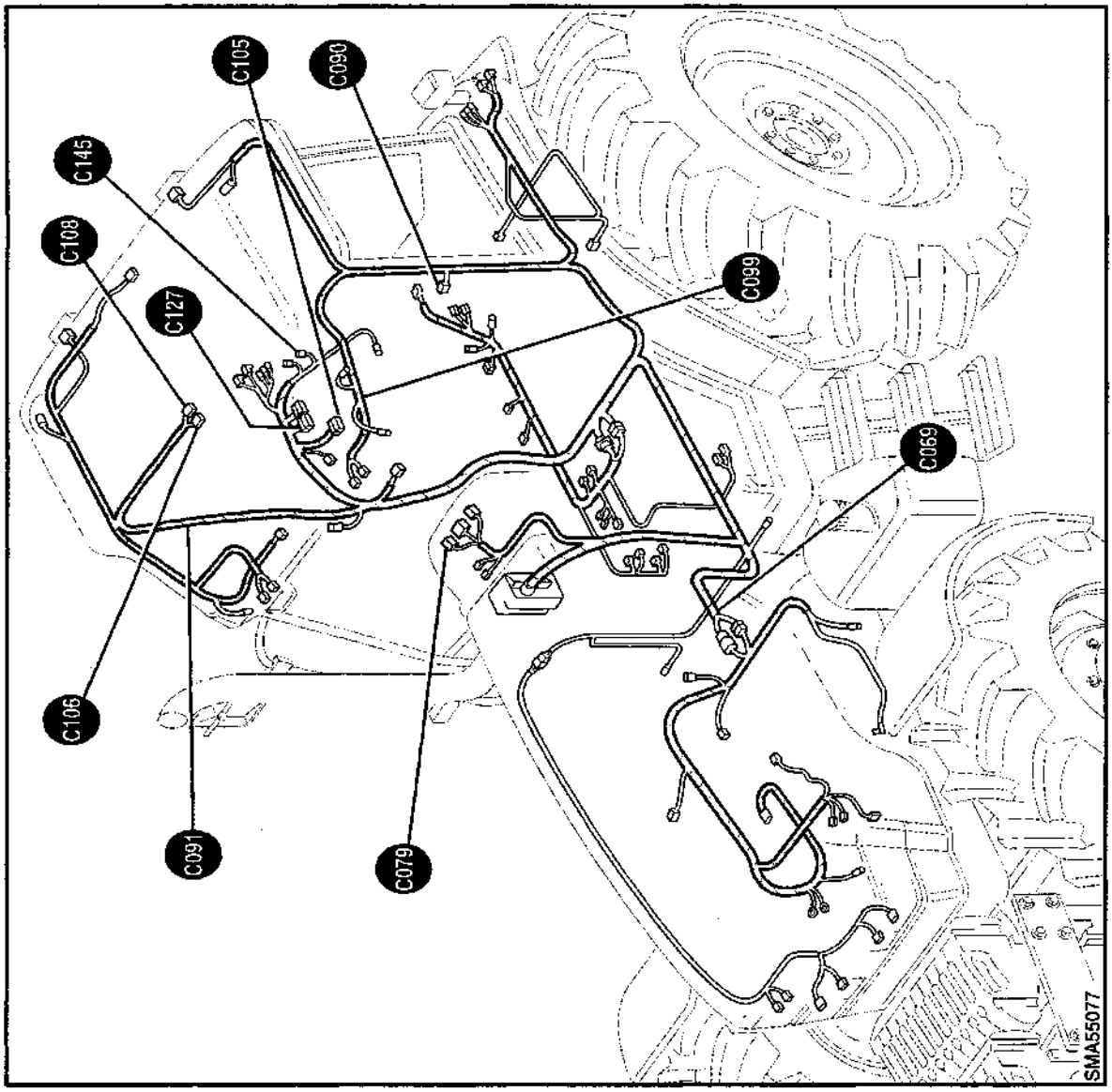


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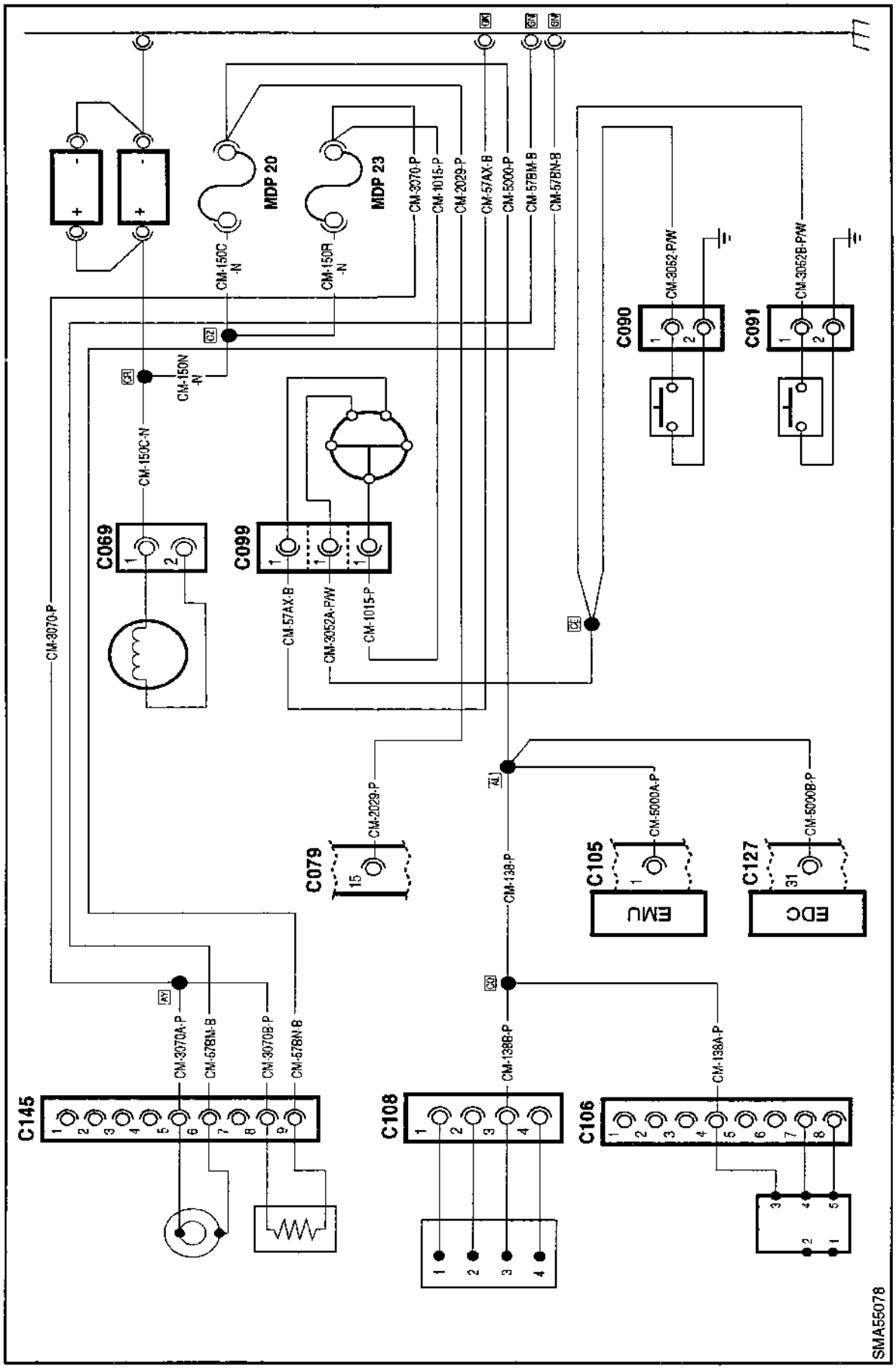
BASIC LIVE

- C069 – Starter Solenoid
- C079 – Instrument Cluster 'A'
- C090 – Left Hand Door Switch
- C091 – Right Hand Door Switch
- C099 – Interior Lamp
- C105 – EMU Connector
- C106 – Radio A
- C108 – Clock
- C127 – EDC Module Connector CN2
- C145 – Rear Socket Connector



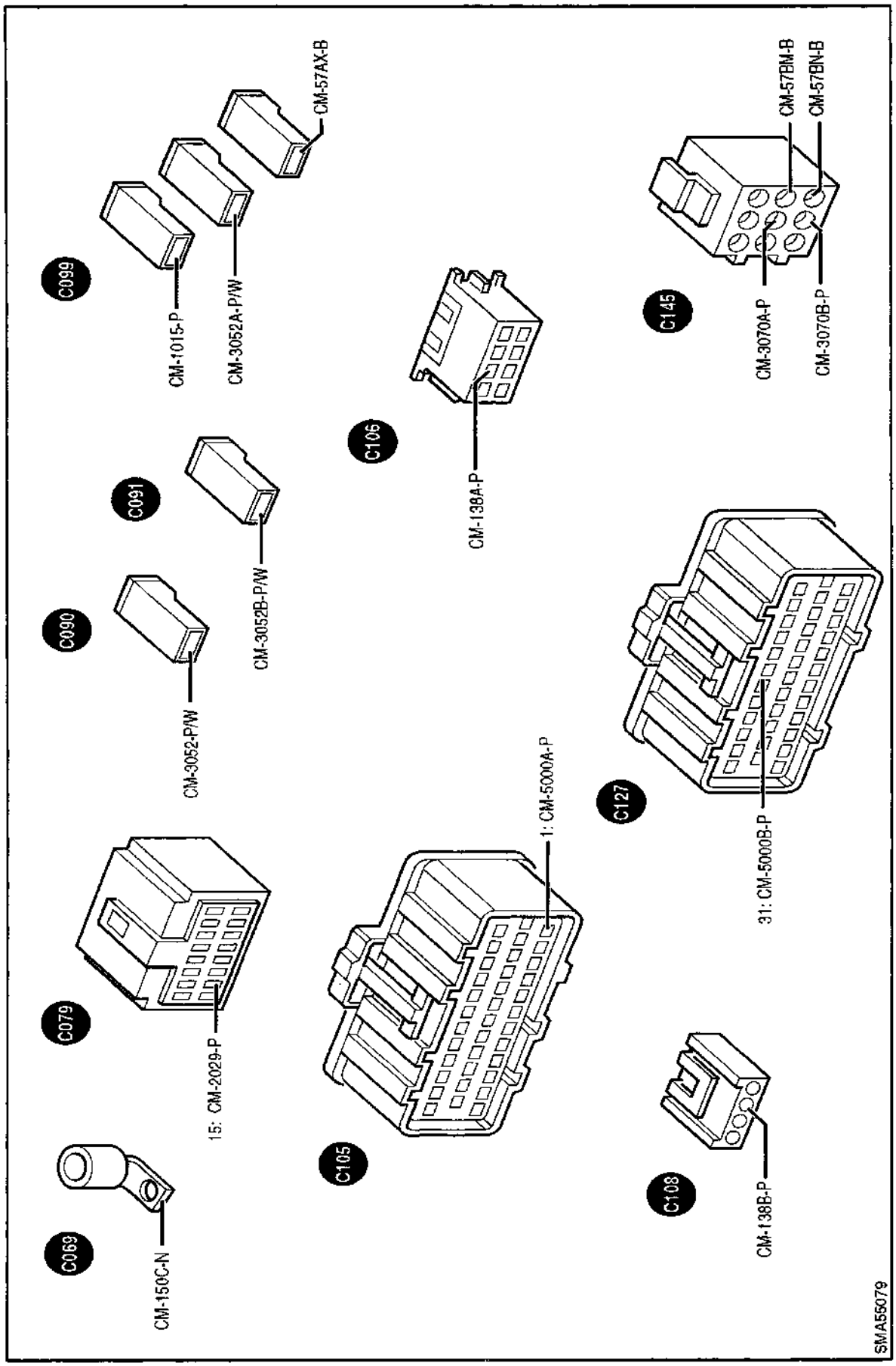
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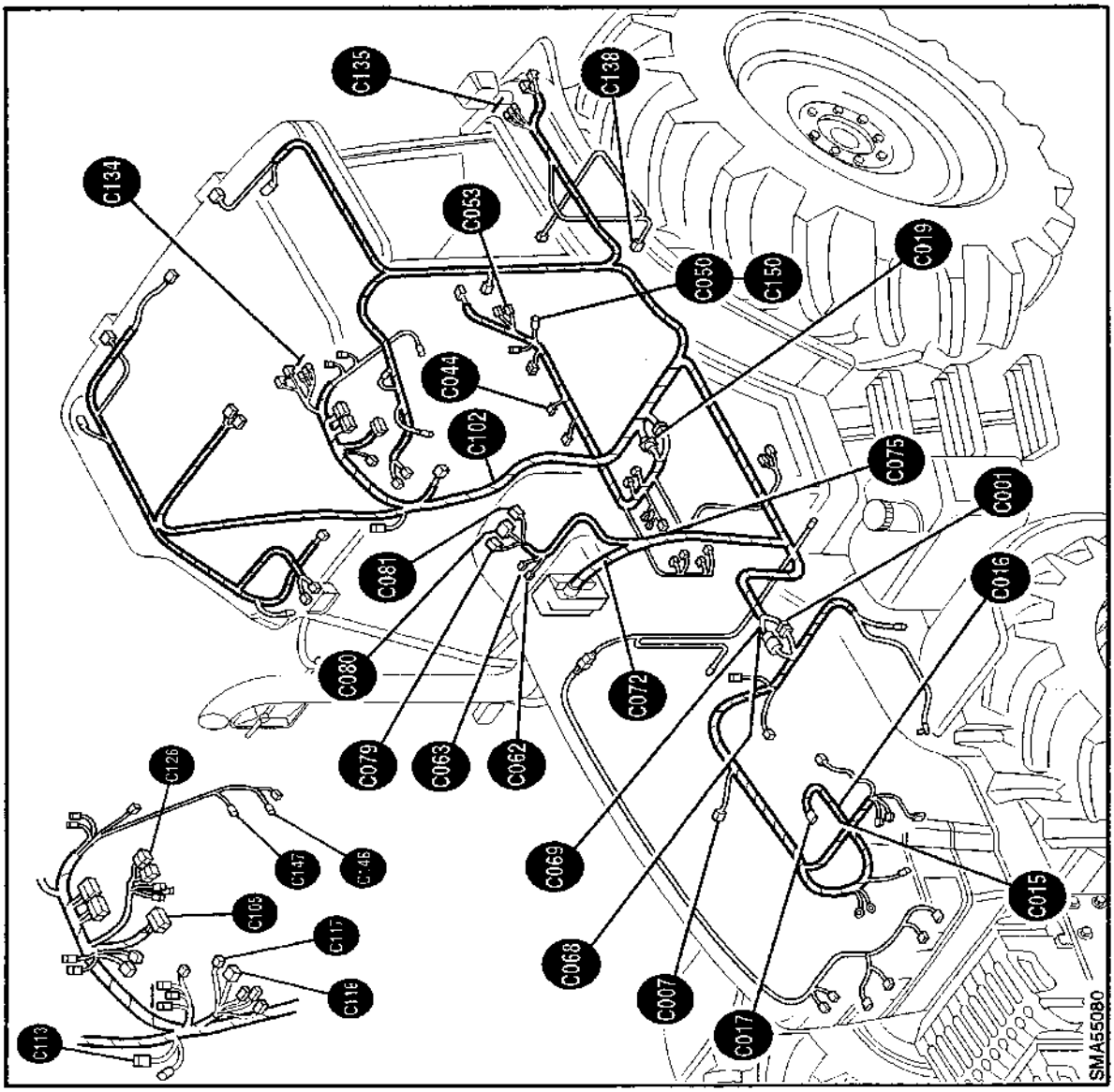


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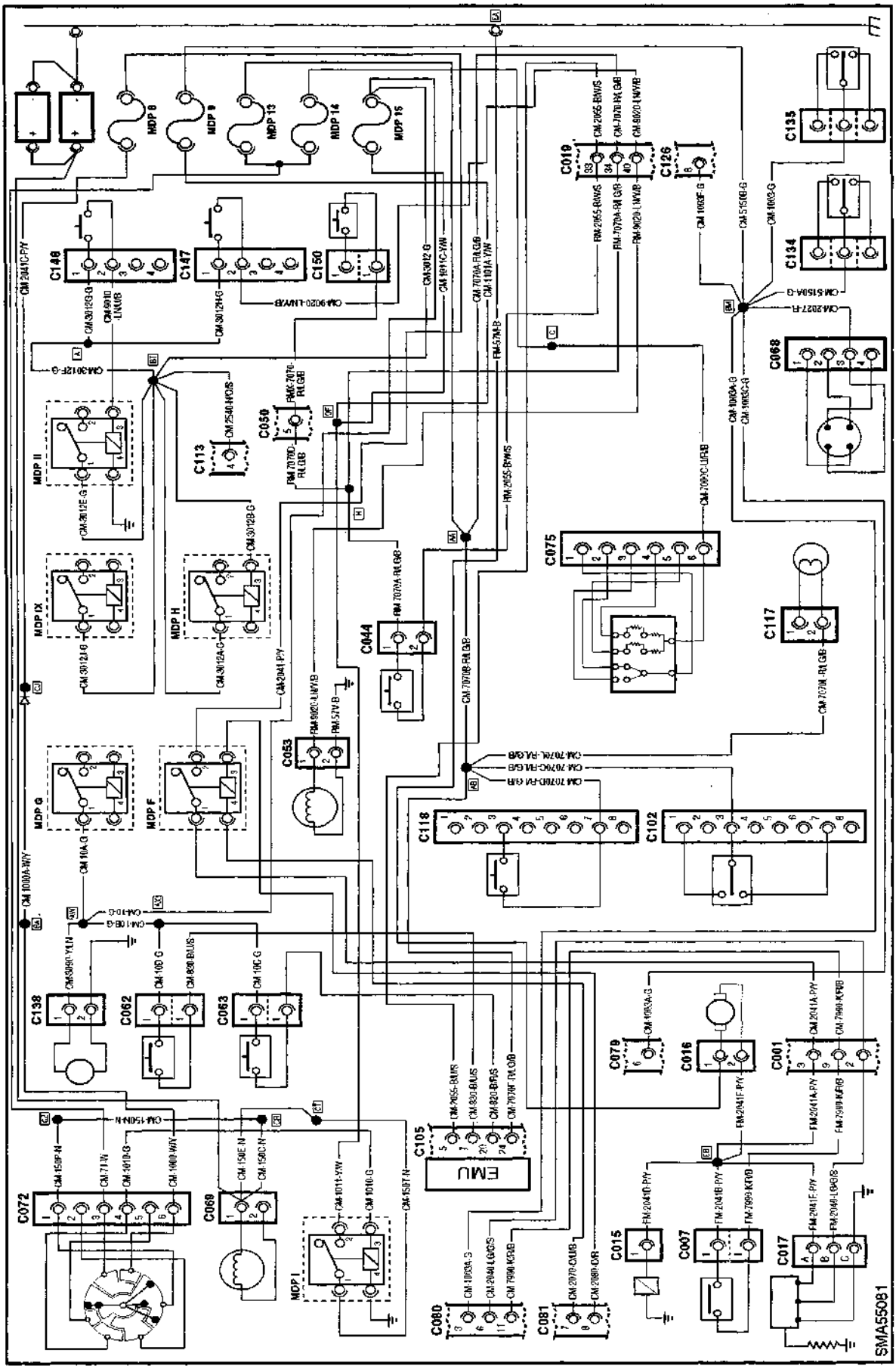
IGNITION ON 1

- C001 – Front Main Bulkhead Connector
- C007 – Brake Fluid Reservoir
- C015 – Fuel Shut Off Solenoid
- C016 – Fuel Pump
- C017 – Water in Fuel Sensor
- C019 – Rear Main Extension Connector 1
- C044 – Ground Speed PTO Engaged
- C050 – Trailer Brake
- C053 – Hydraulic Remote Valve Solenoid
- C062 – RH Stop Lamp Switch
- C063 – LH Stop Lamp Switch
- C068 – Radar
- C069 – Starter Solenoid (Cab Main)
- C072 – Starter Switch
- C075 – Shuttle Switch
- C079 – Instrument Cluster A
- C080 – Instrument Cluster B
- C081 – Instrument Cluster C
- C102 – Fast Raise / Lower Switch
- C105 – EMU Connector
- C113 – Front Hitch Potentiometer
- C117 – Rear PTO Engaged Lamp
- C118 – Rear PTO Brake Switch
- C126 – Diagnostic Plug EDC
- C134 – HPL Raise/Lower RH Switch
- C135 – HPL Raise/Lower LH Switch
- C138 – Seat Pump
- C147 – Remote Valve Switch
- C148 – Diverter Valve Switch
- C150 – Pressure Switch 100



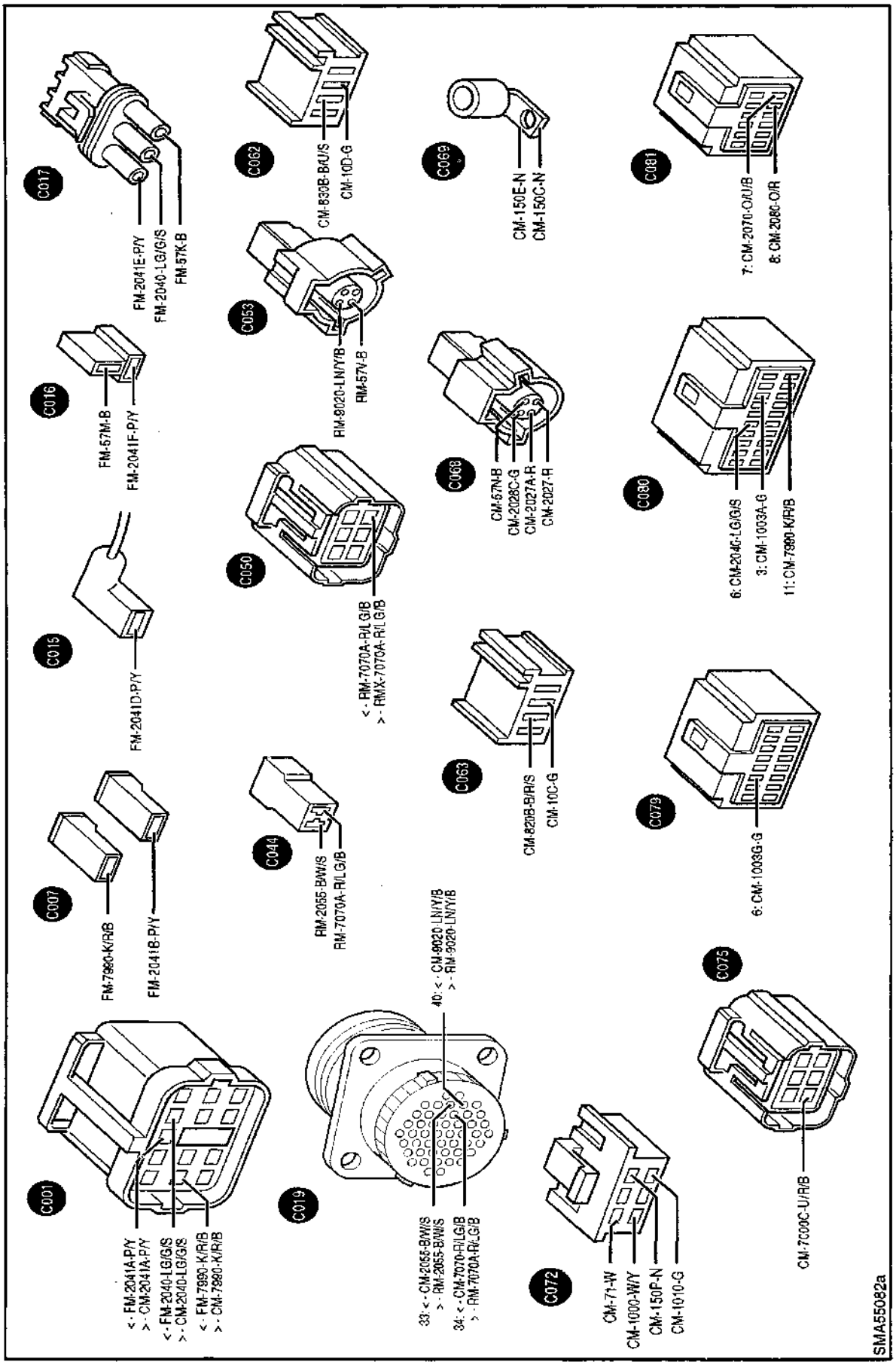
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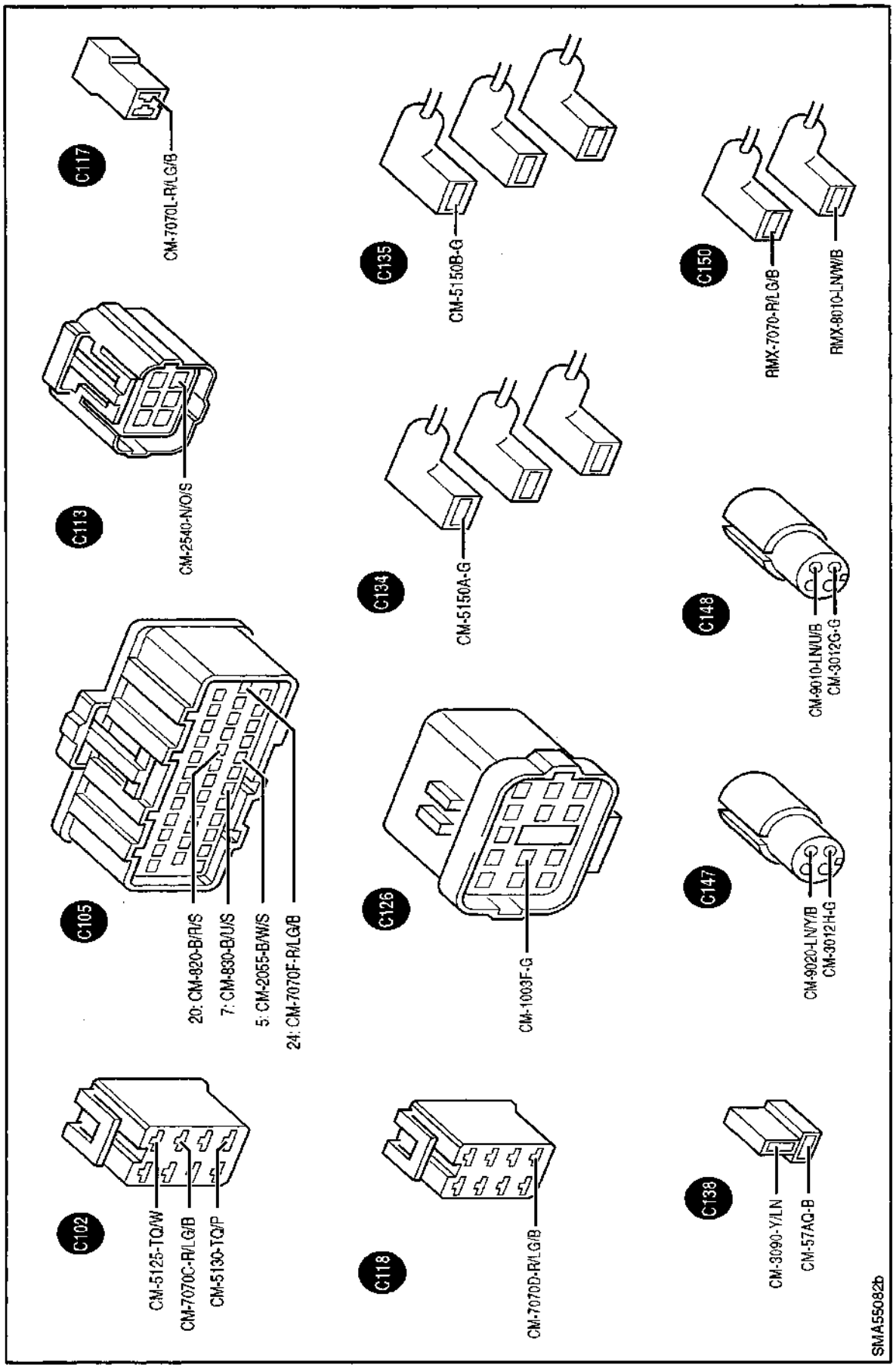
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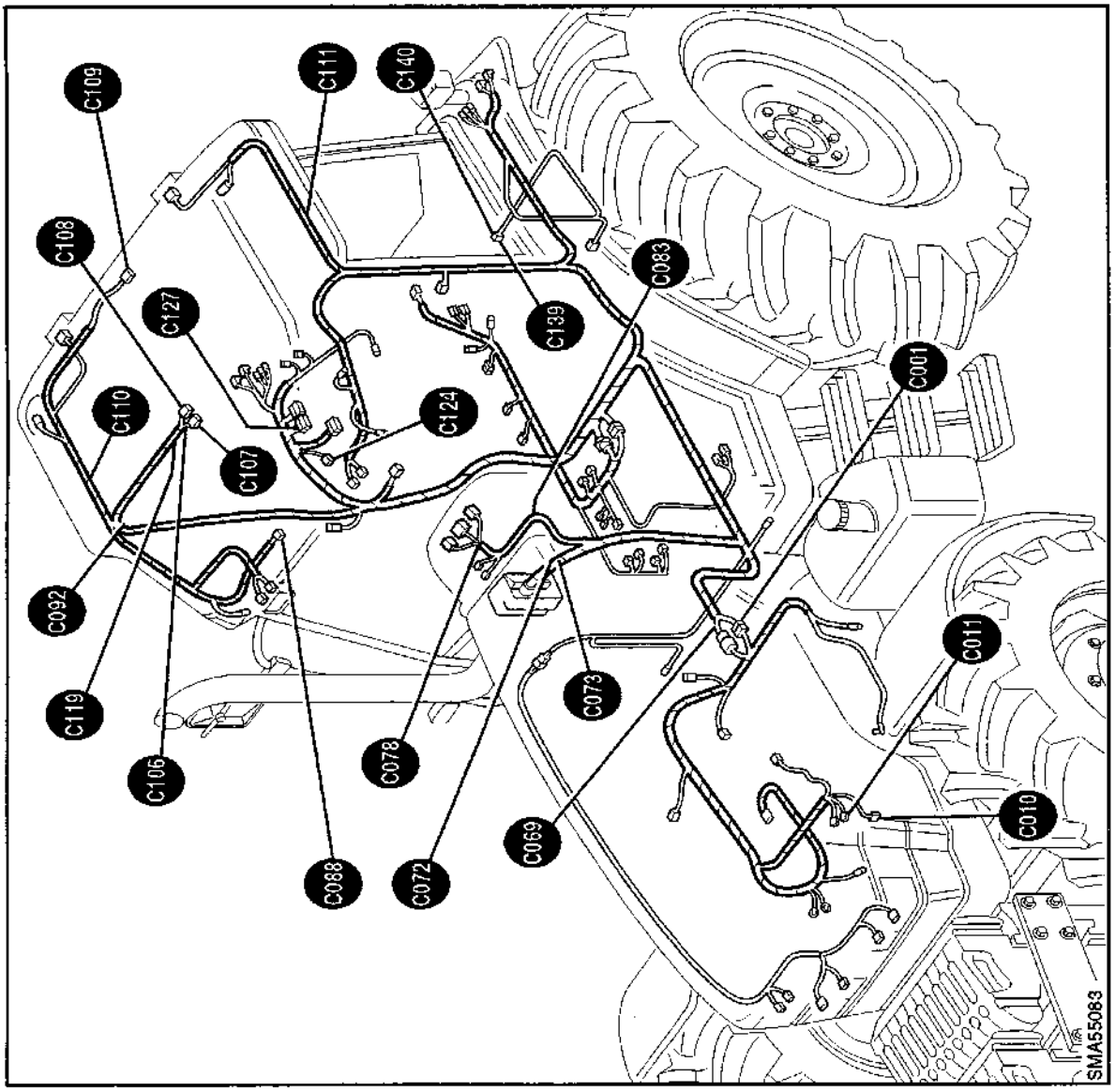


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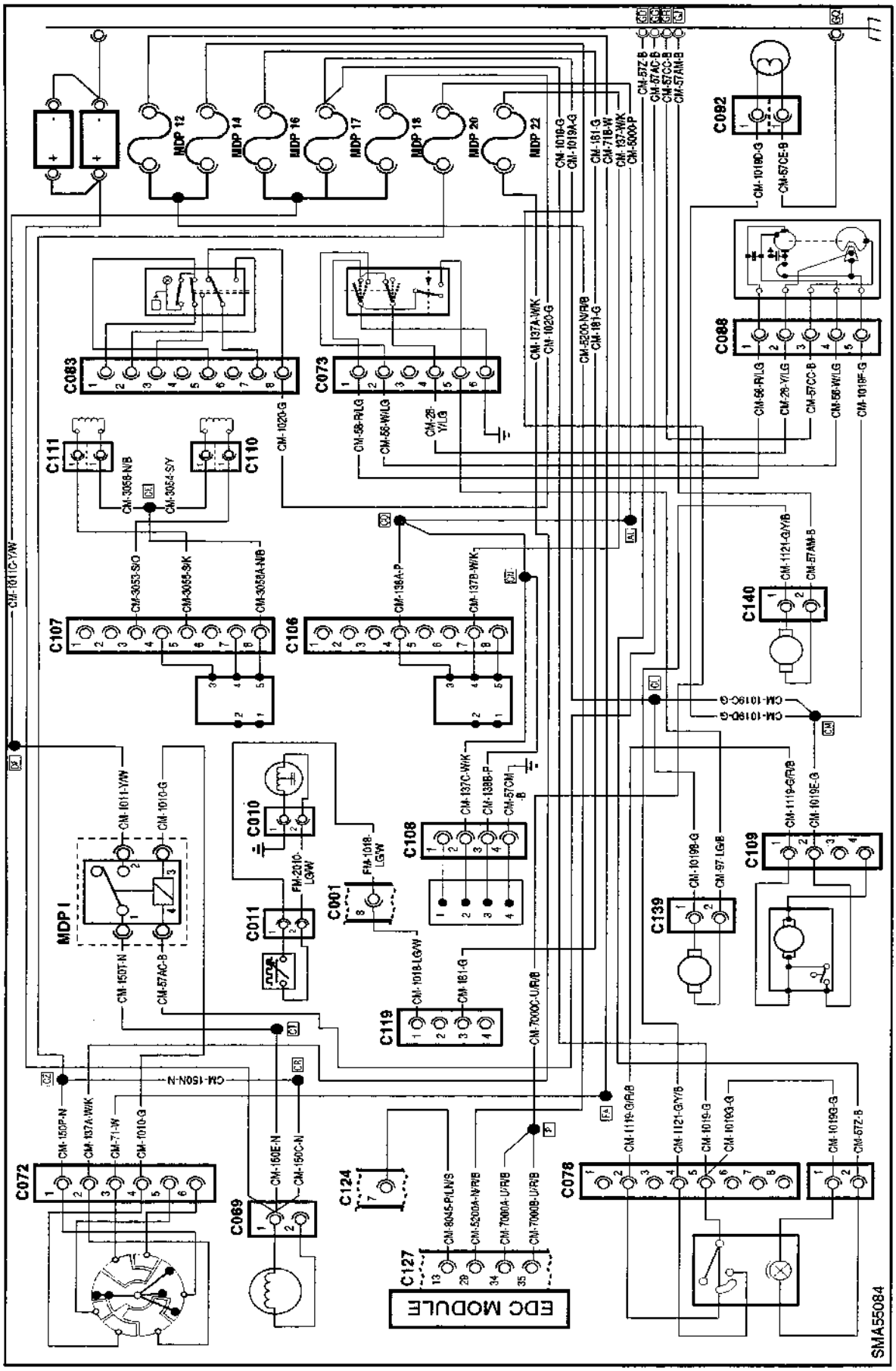
IGNITION ON 2

C001	– Main Bulkhead Connector M1
C010	– Air Con-Switch
C011	– De-Icing Thermostat
C069	– Starter Solenoid (Cab Main)
C072	– Starter Switch
C073	– Windshield Wiper Switch
C078	– Rear Wiper Switch
C083	– Hazard Switch
C088	– Front Wiper Motor
C092	– Console Lamp
C106	– Radio A
C107	– Radio B
C108	– Clock
C109	– Rear Wiper Motor
C110	– Right Hand Speaker
C111	– Left Hand Speaker
C119	– Heater Air-Con Connector
C124	– Limp Home Connector
C127	– EDC Module CN2
C139	– Front Washer Motor
C140	– Rear Washer Motor



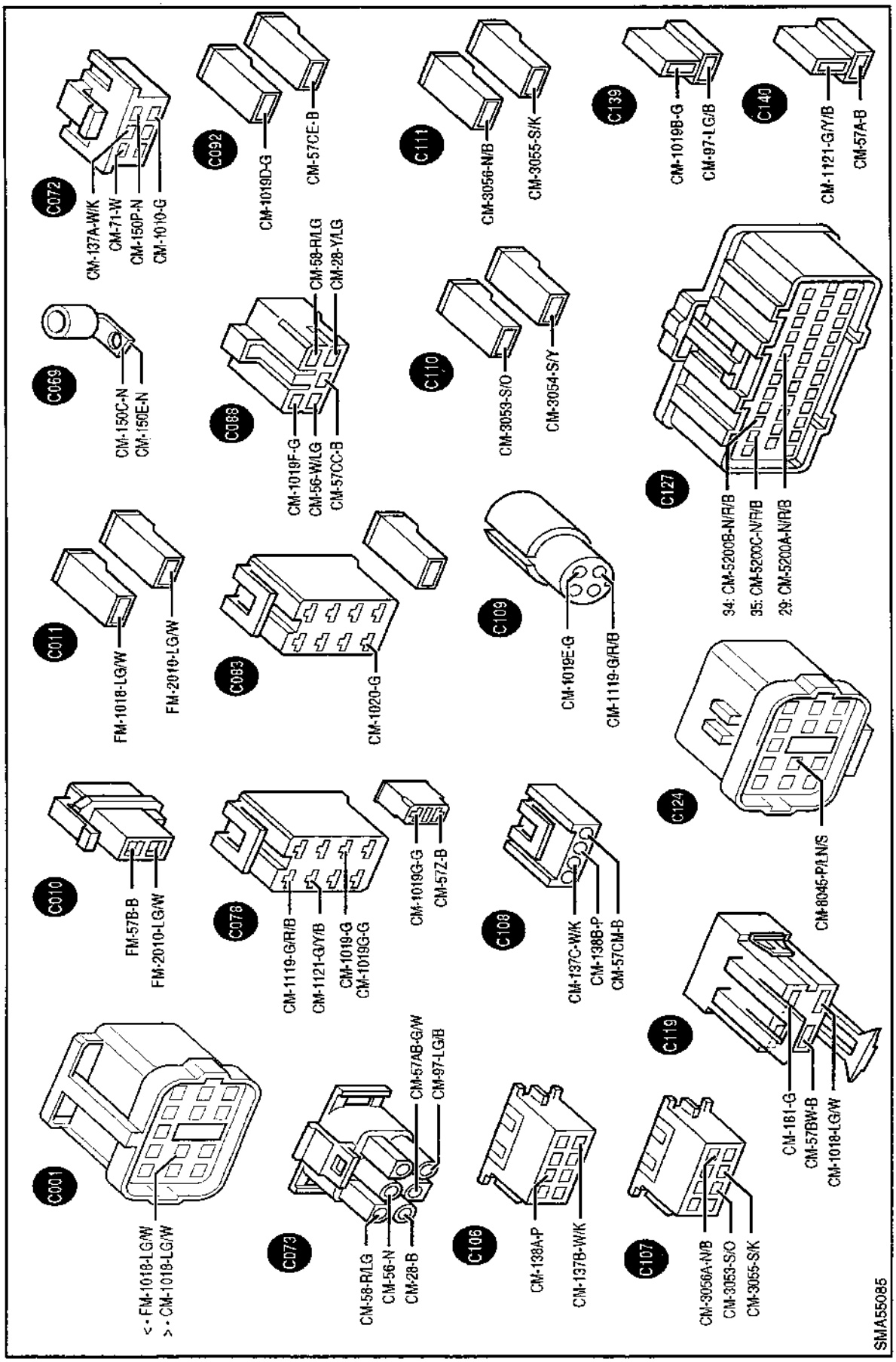
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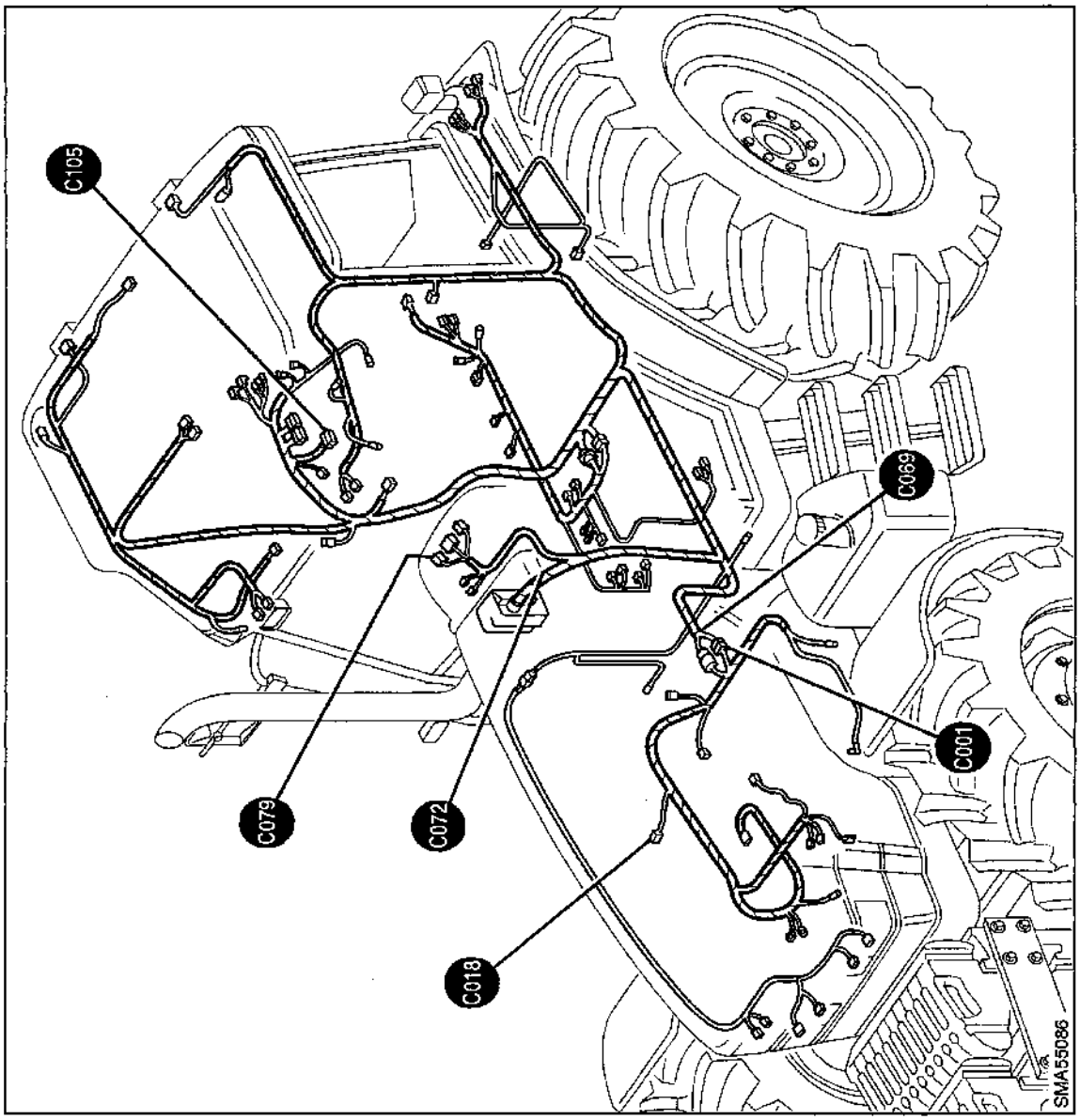


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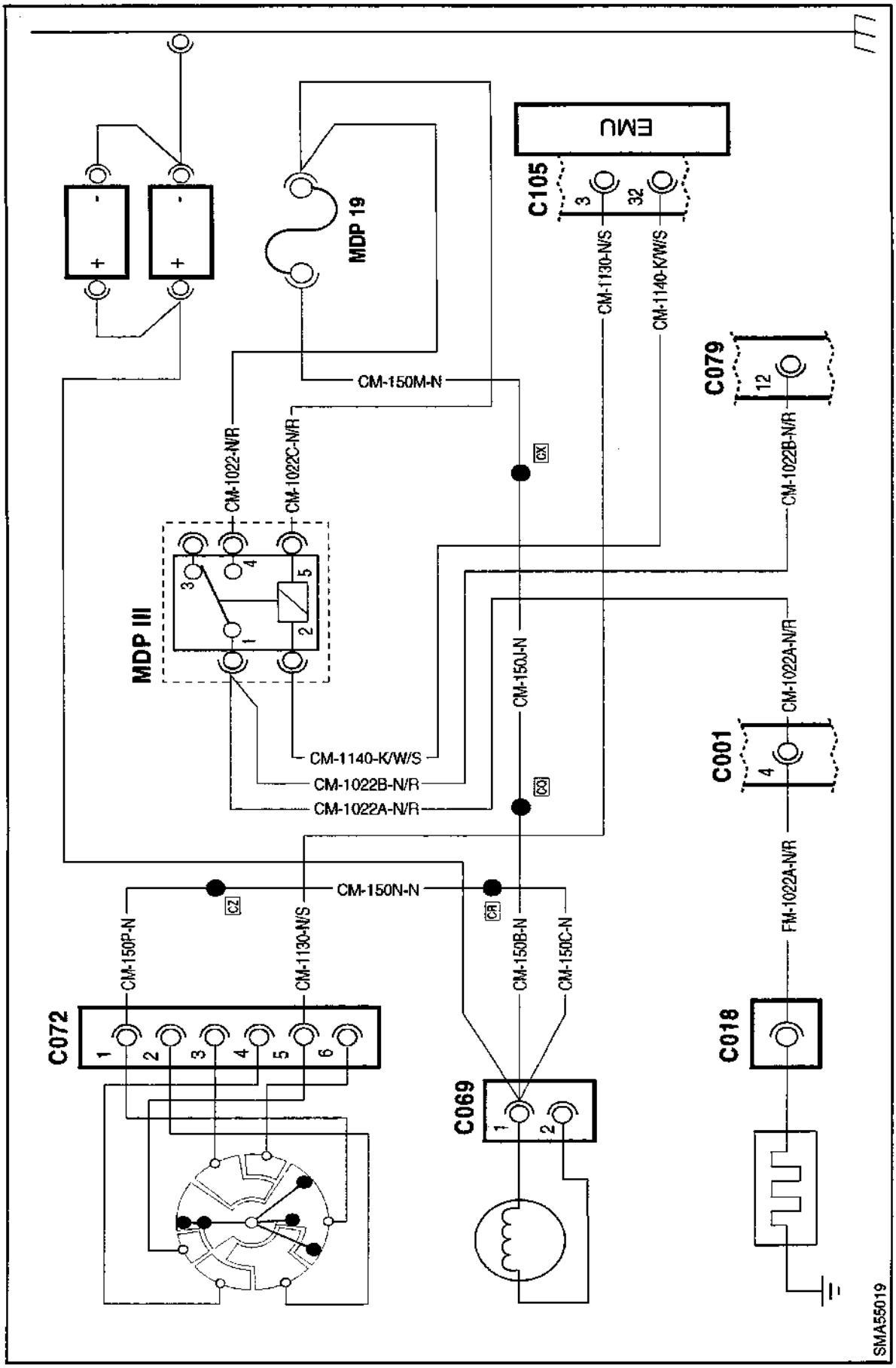
THERMOSTART

C001 – Main Bulkhead Connector M1
C018 – Thermostart
C069 – Starter Solenoid
C072 – Starter Switch
C079 – Instrument Cluster 'A'
C105 – EMU Connector



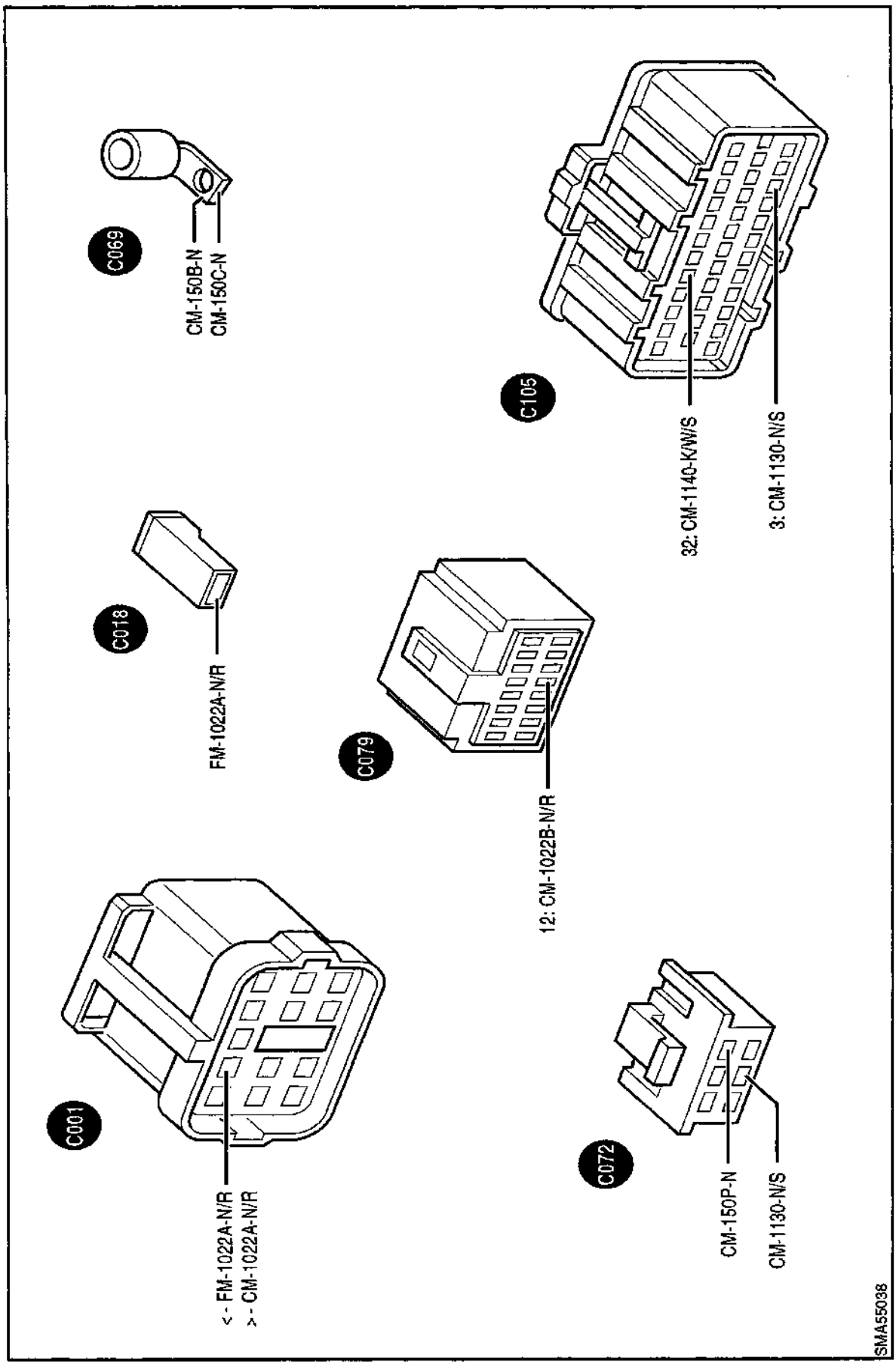
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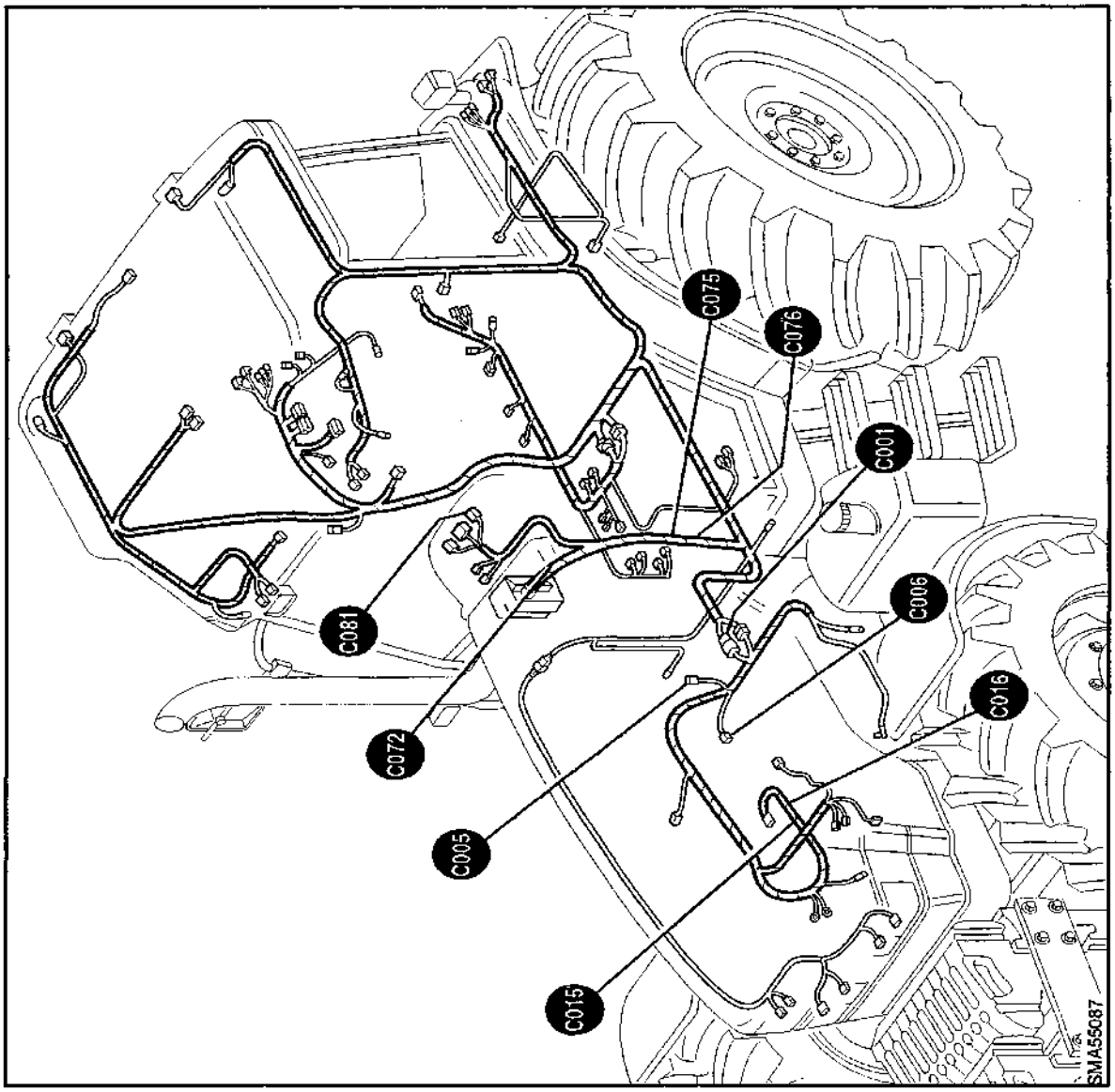


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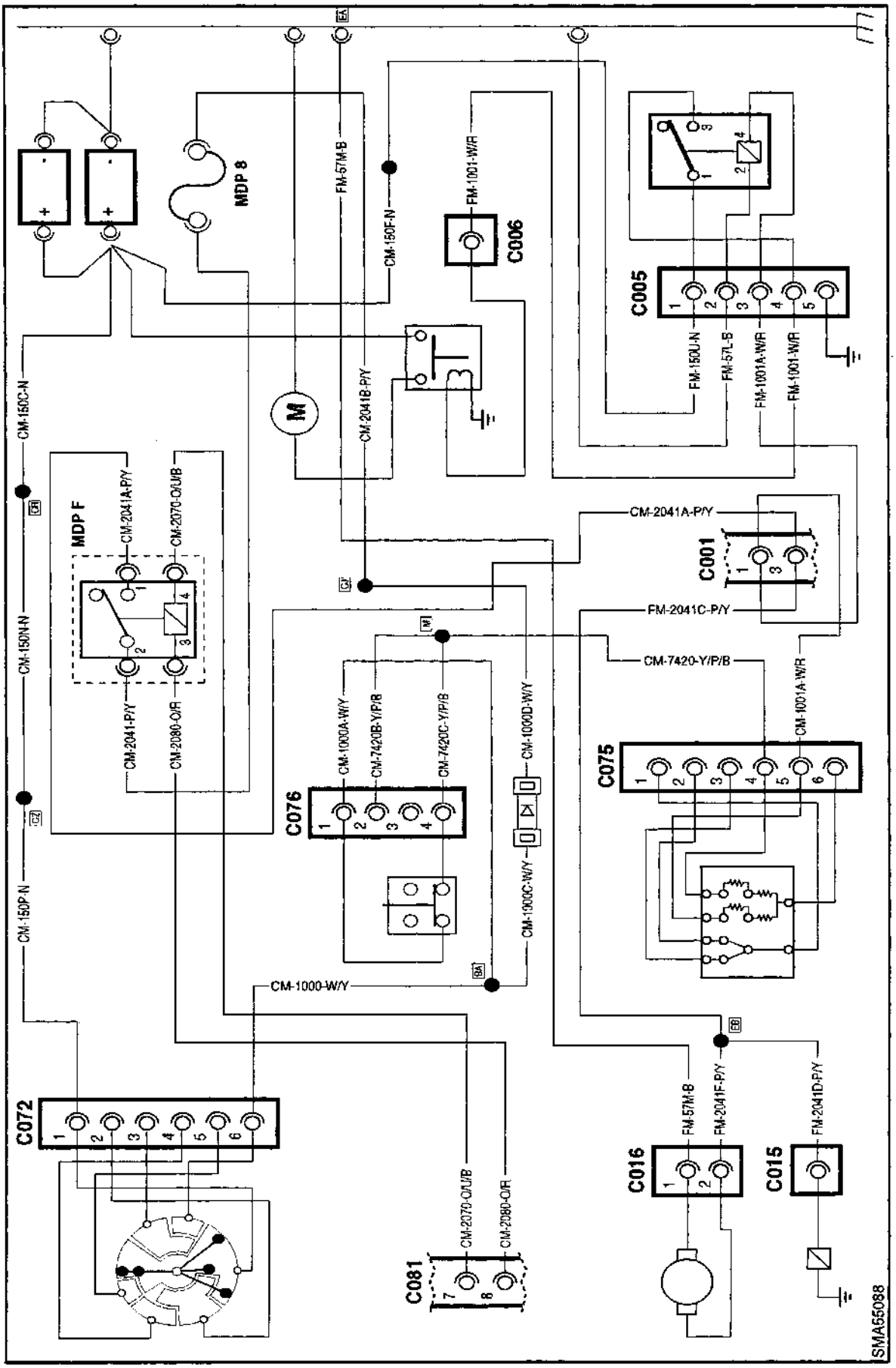
ENGINE STARTING

C001 – Main Bulkhead Connector
C005 – Starter Relay
C006 – Starter Solenoid
C015 – Fuel Shut-Off Solenoid
C016 – Fuel Pump
C072 – Starter Switch
C075 – Shuttle Switch
C076 – Clutch Switch
C081 – Instrument Cluster 'C'



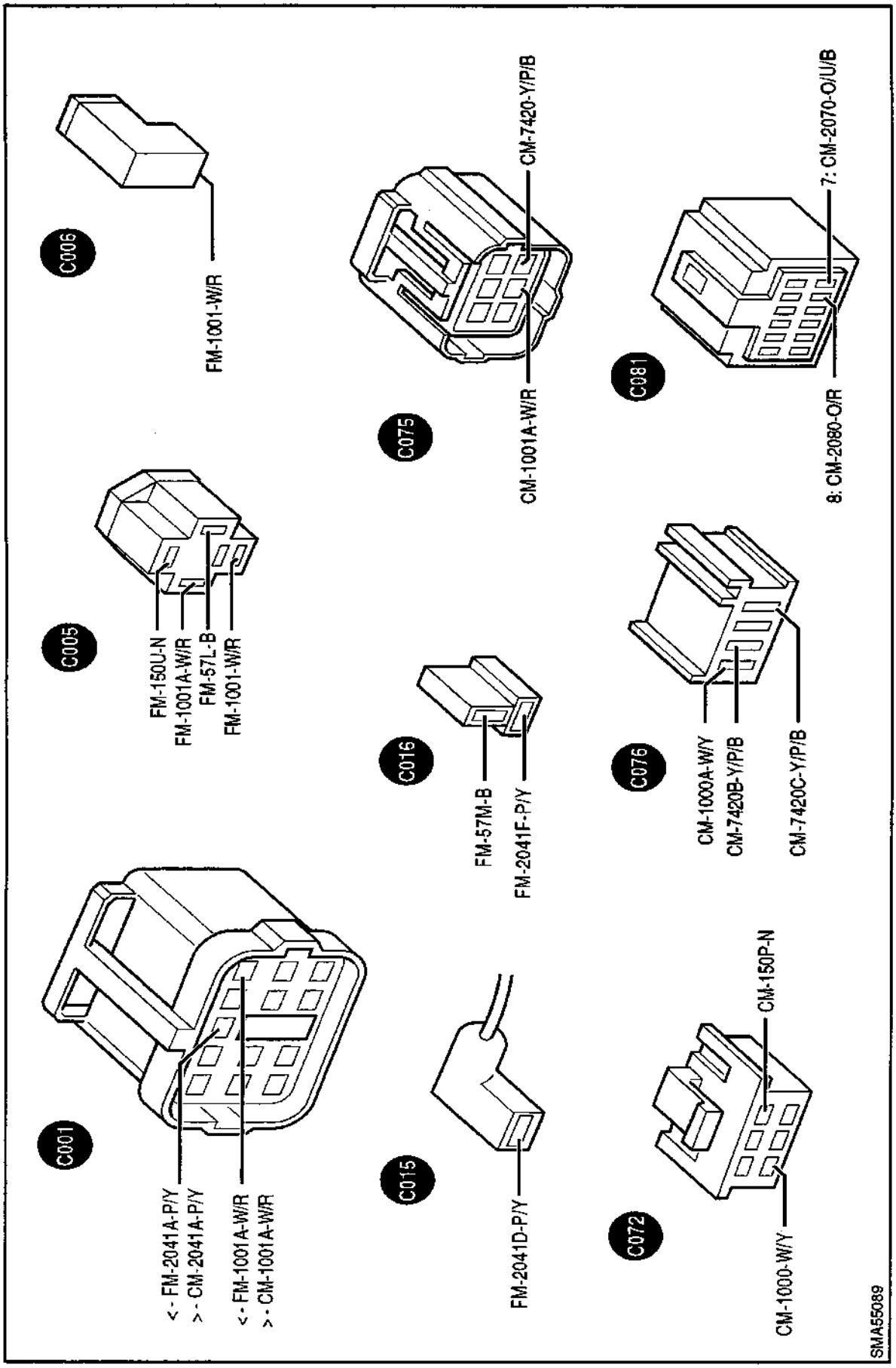
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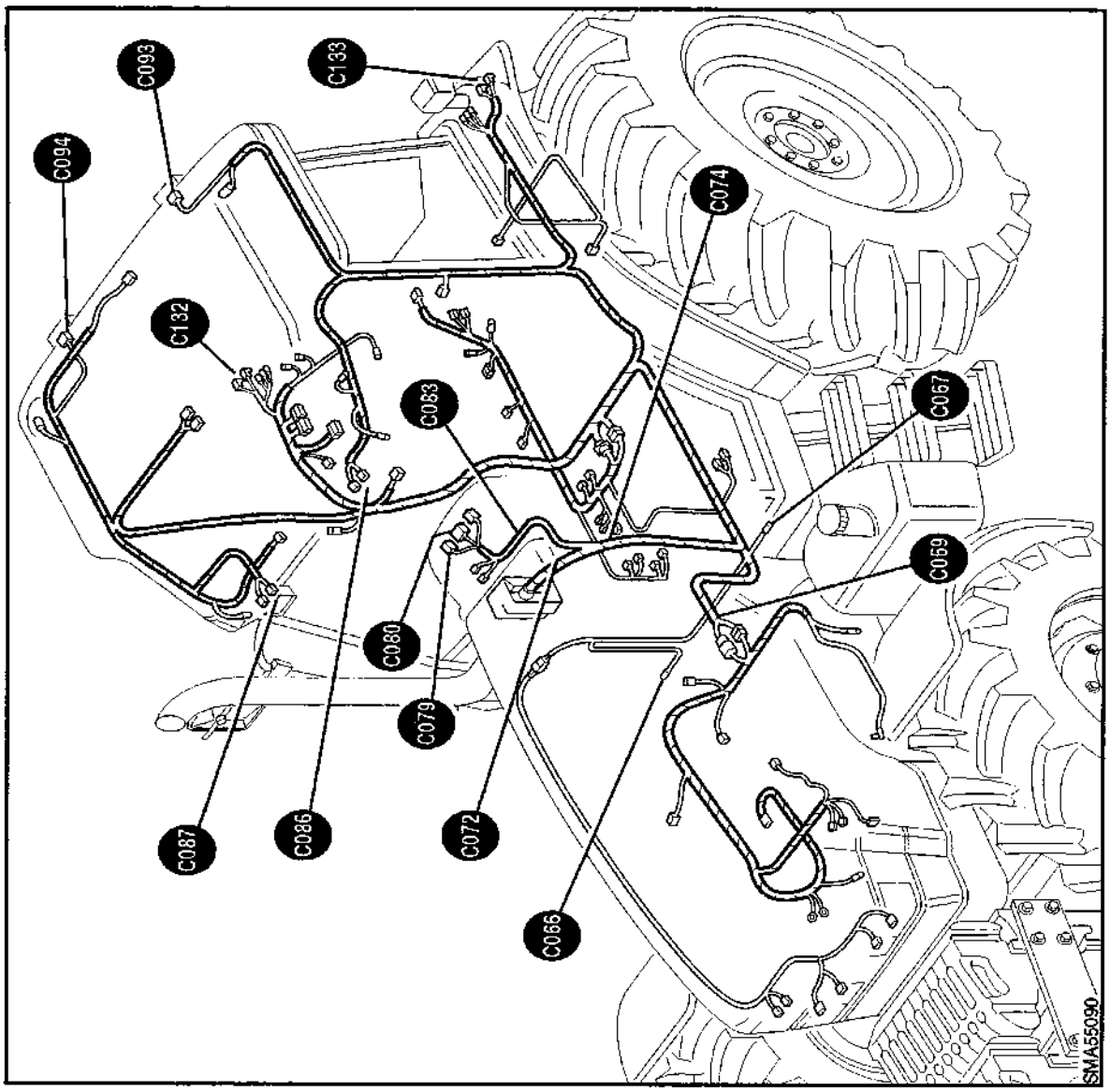


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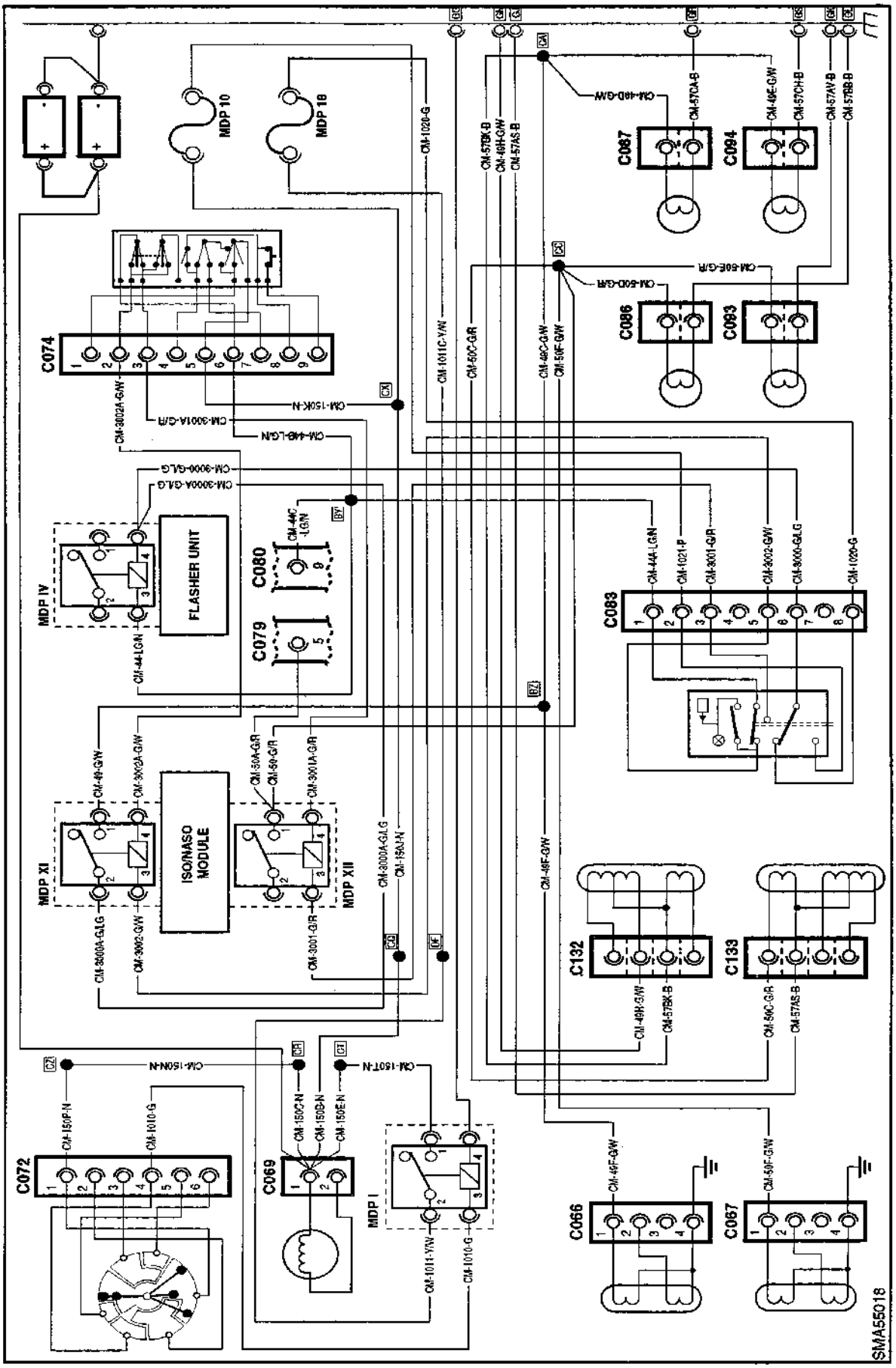
INDICATOR & HAZARDS

C066	– Right Hand Side Lamp
C067	– Left Hand Side Lamp
C069	– Starter Solenoid
C072	– Starter Switch
C074	– Turn Switch
C079	– Instrument Cluster 'A'
C080	– Instrument Cluster 'B'
C083	– Hazard Switch
C086	– L/H Front NASO Flasher
C087	– R/H Front NASO Flasher
C093	– L/H Rear NASO Flasher
C094	– R/H Rear NASO Flasher
C132	– R/H Fender NASO Flasher
C133	– L/H Fender NASO Flasher



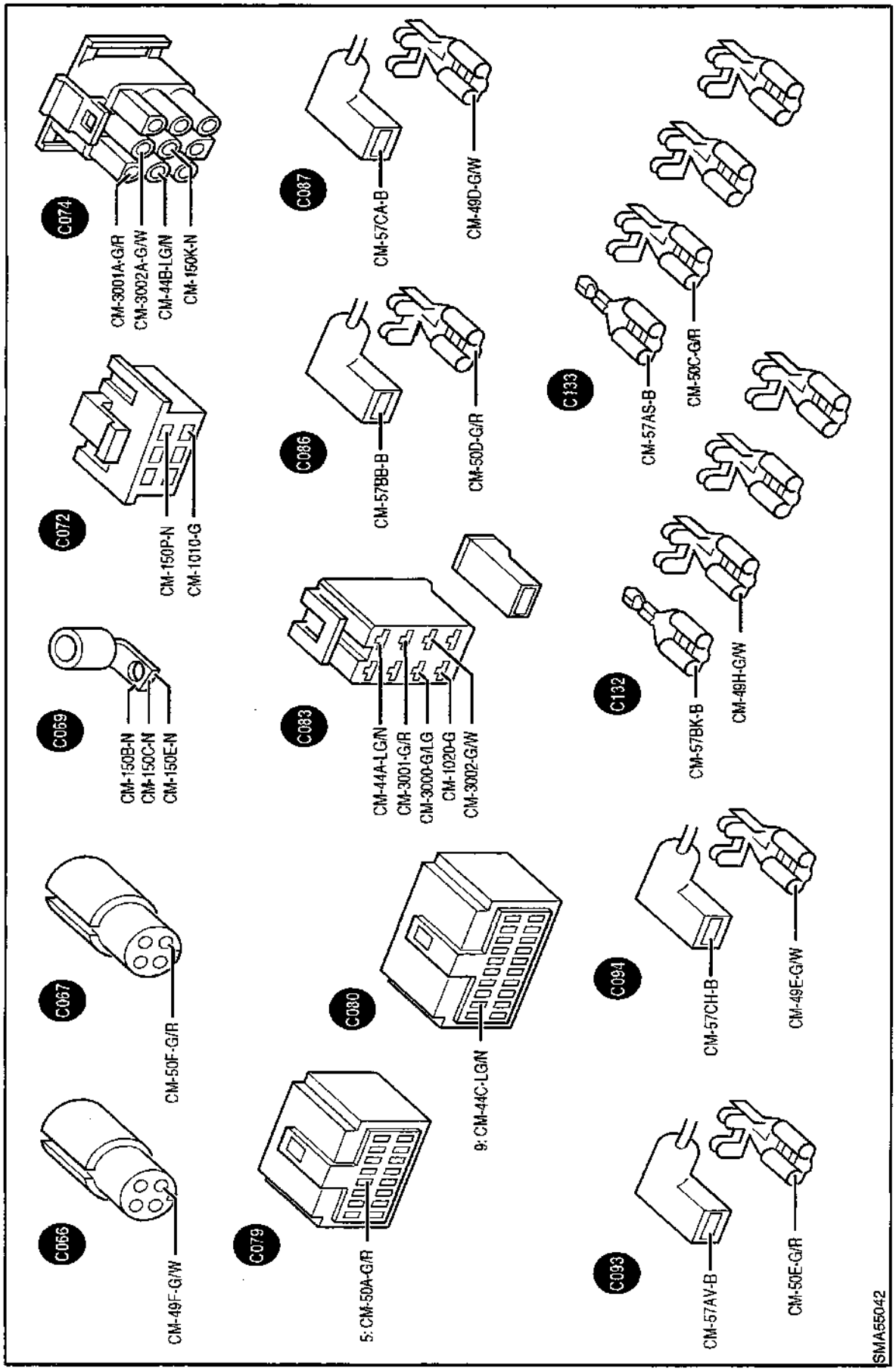
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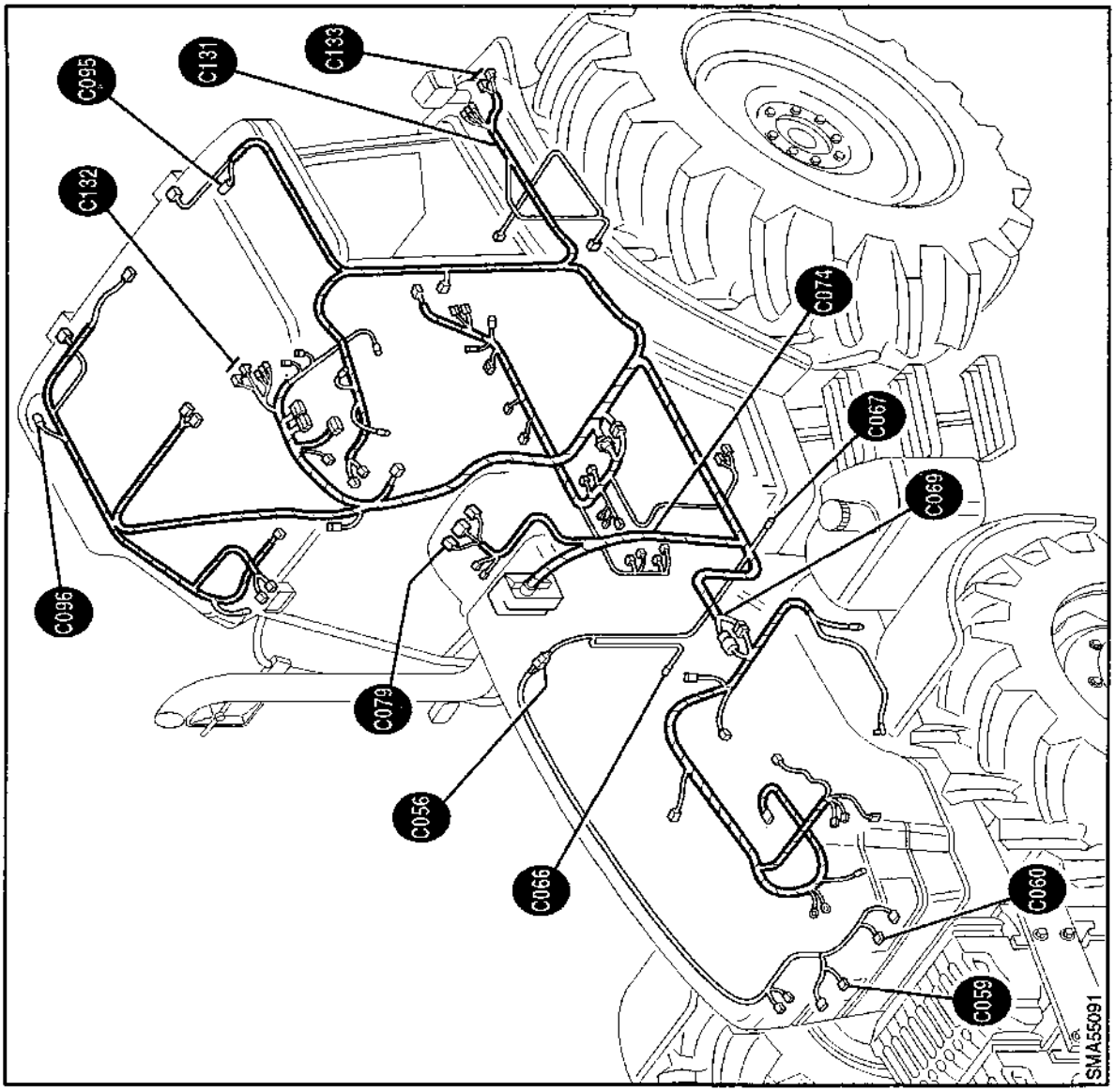


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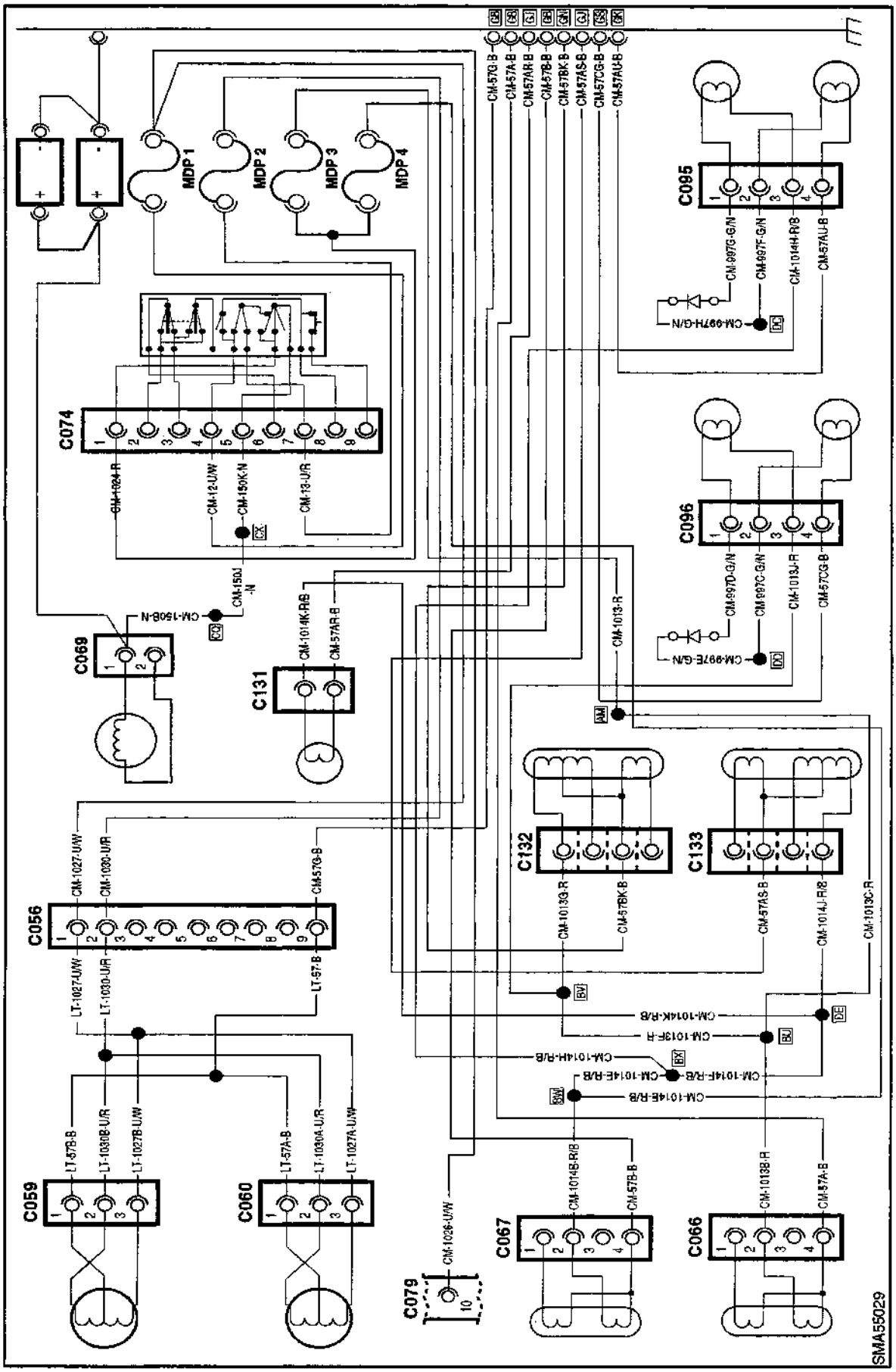
LIGHTING

C056	– Headlamp harness Connector
C059	– Right Hand Headlamp
C060	– Left Hand Headlamp
C066	– Right Side Lamp
C067	– Left Side Lamp
C069	– Starter Solenoid (Cab Main)
C074	– Turn Switch
C079	– Instrument Cluster 'A'
C095	– LH Rear License /Worklamp
C096	– RH Rear License /Worklamp
C131	– Licence Plate Lamp
C132	– Rear Lamp RH Fender
C133	– Rear Lamp LH Fender



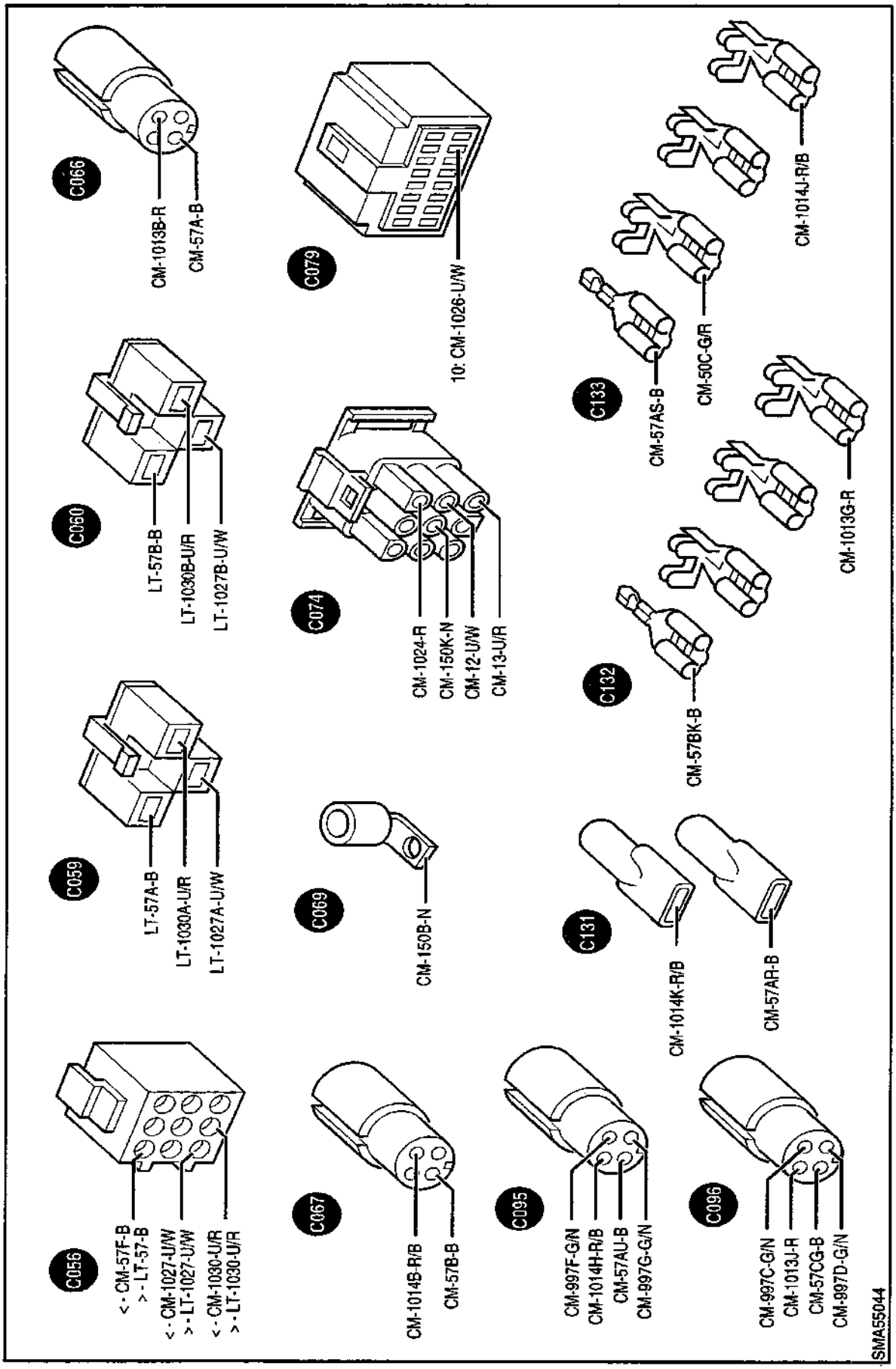
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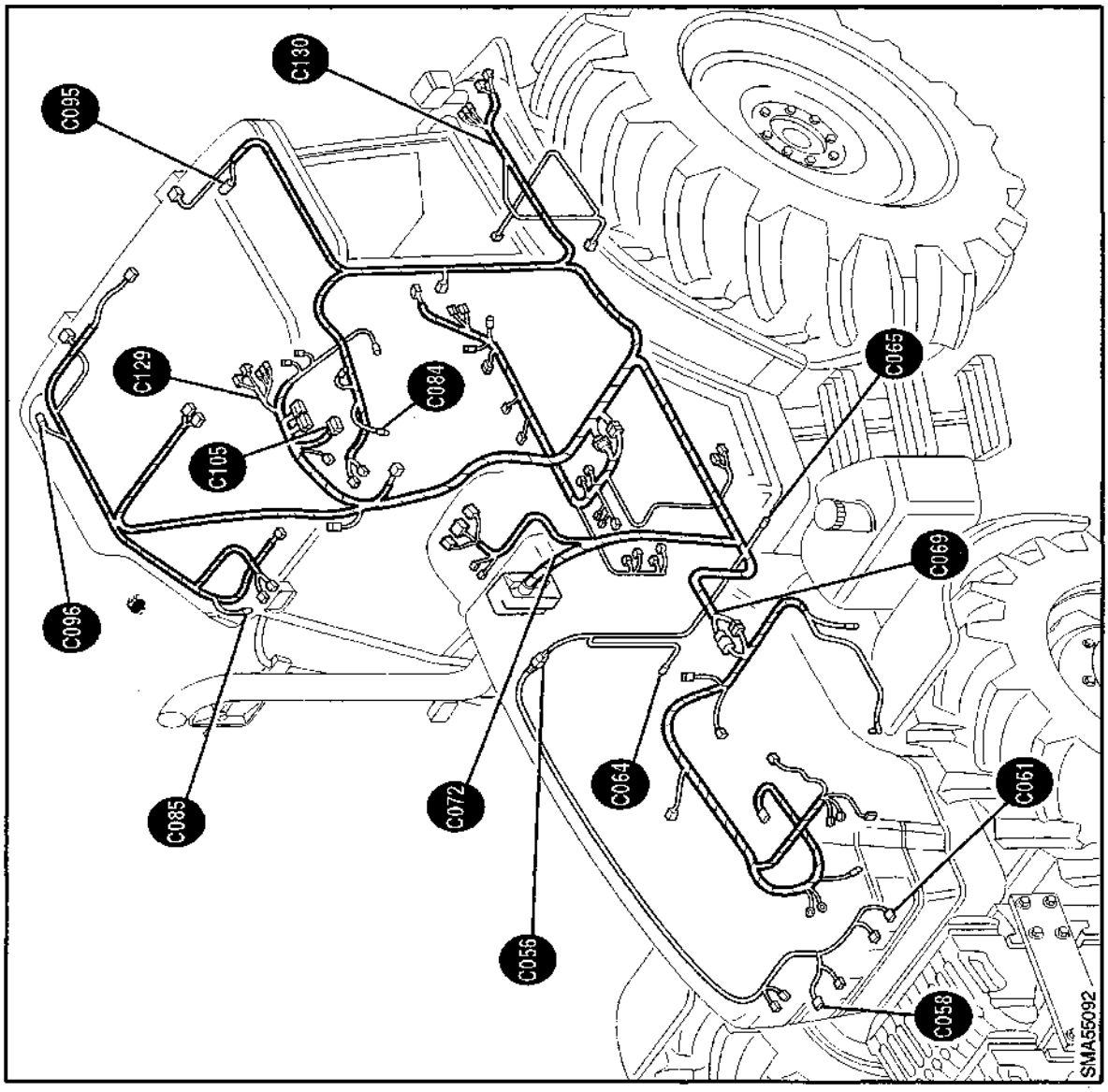


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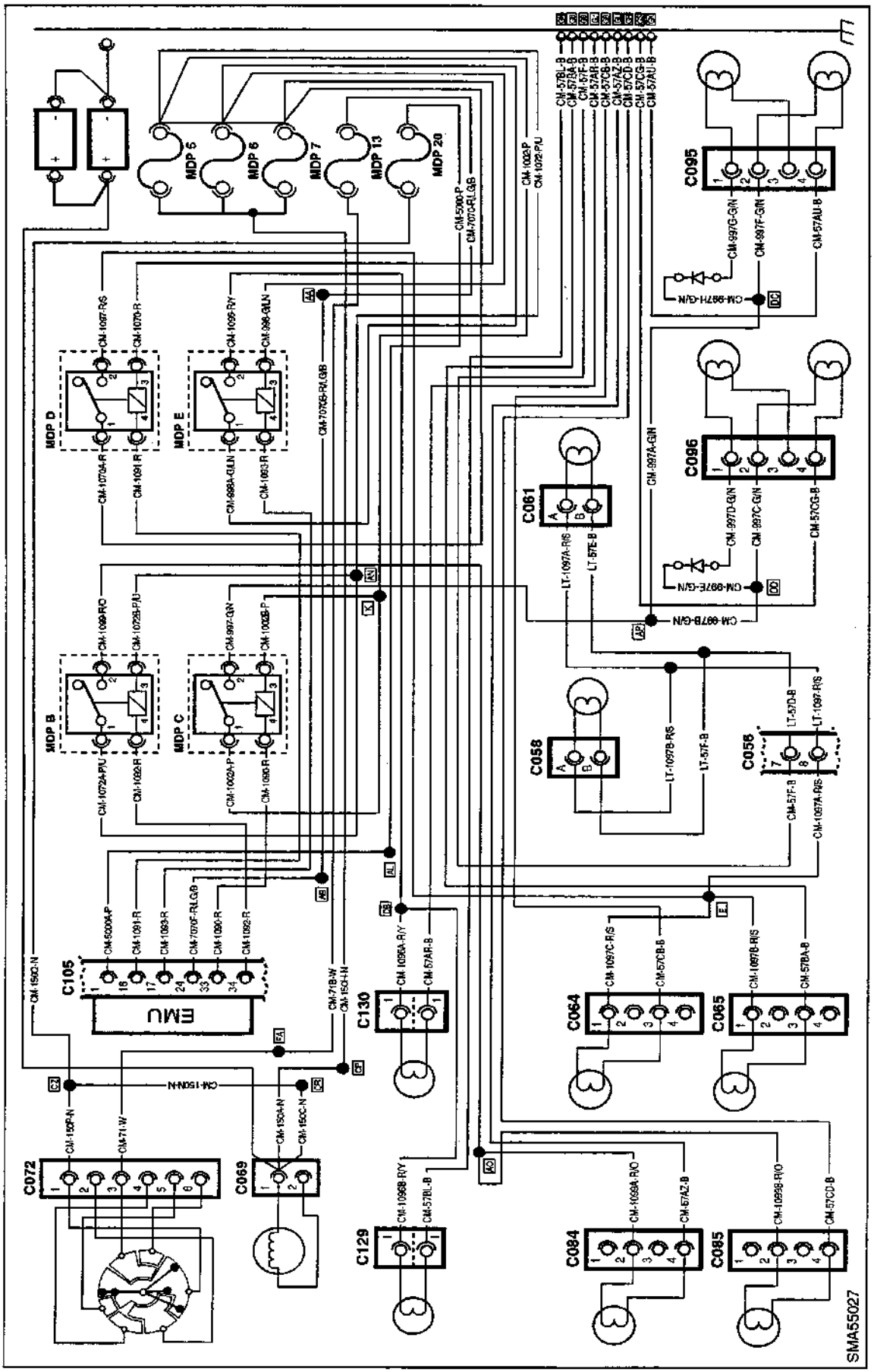
WORKLAMPS

C056	– Headlamp Connector
C058	– Right Hand Worklamp
C061	– Left Hand Worklamp
C064	– Right Hand Worklamp
C065	– Starter Solenoid (Cab Main)
C069	– Starter Switch
C072	– Starter Switch
C084	– LH Upper Front Worklamp
C085	– RH Upper Front Worklamp
C095	– LH Rear License / Worklamp
C096	– RH Rear License / Worklamp
C105	– EMU Connector
C129	– Worklamp RH Fender
C130	– Worklamp LH Fender



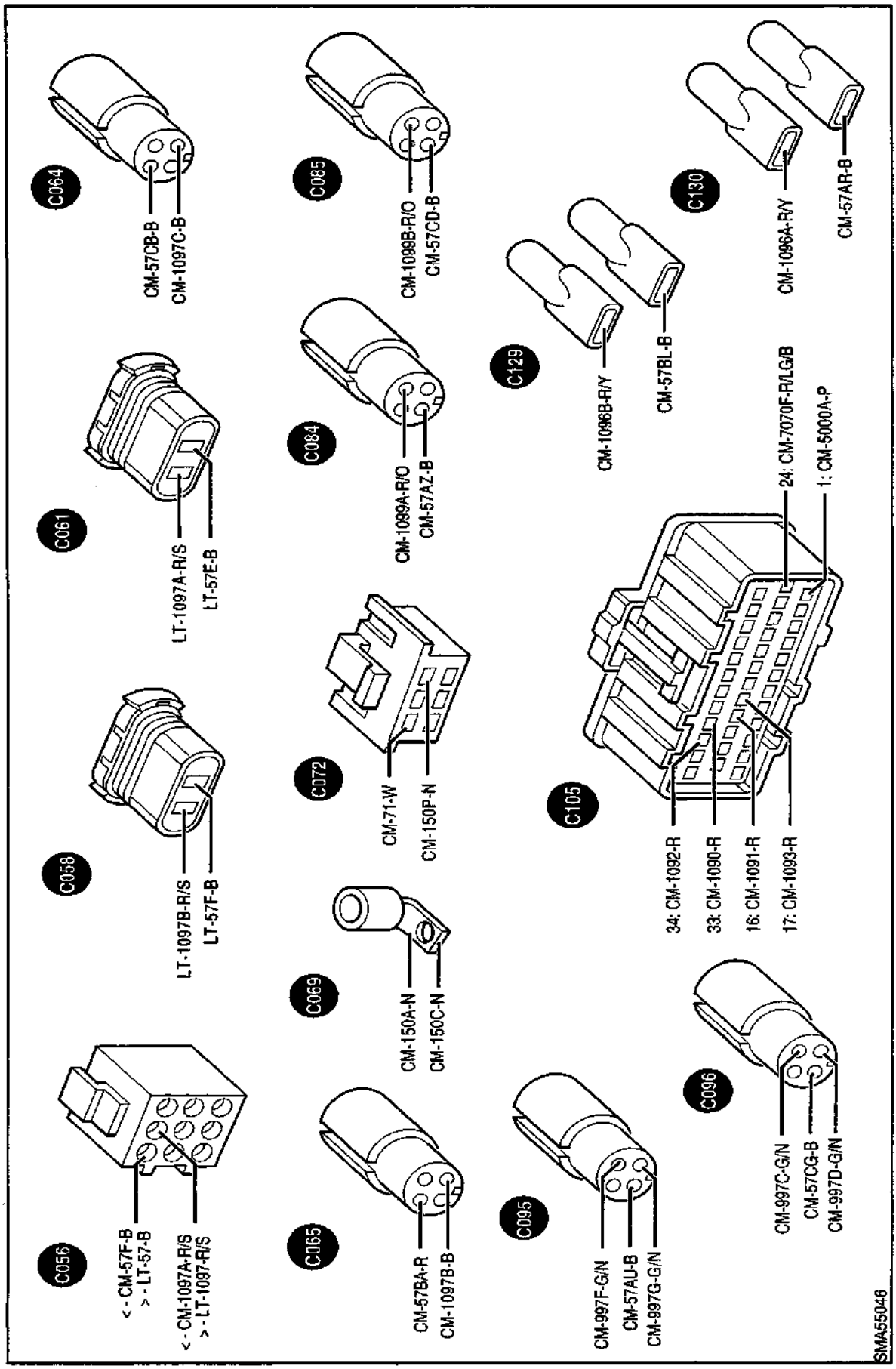
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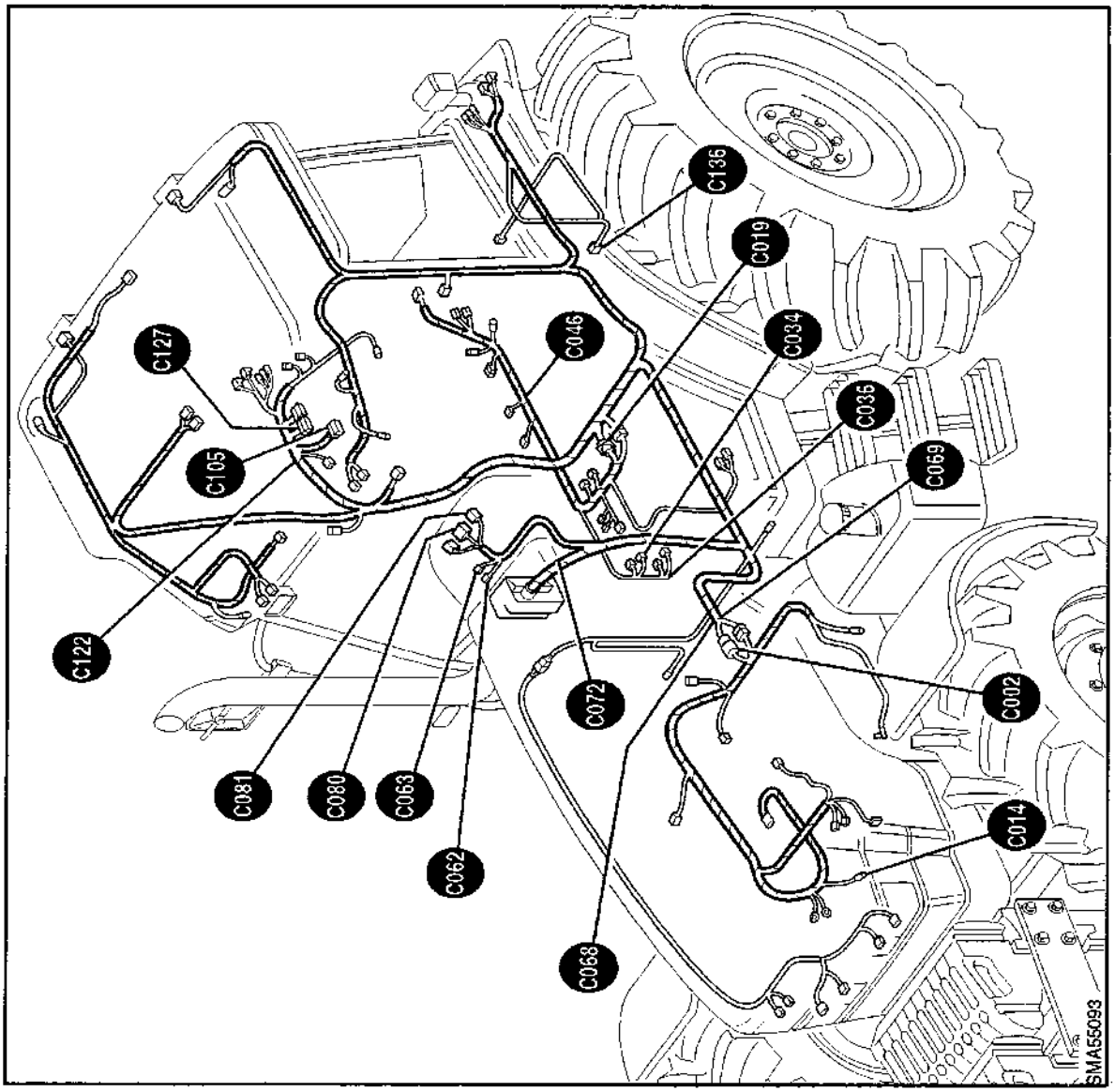


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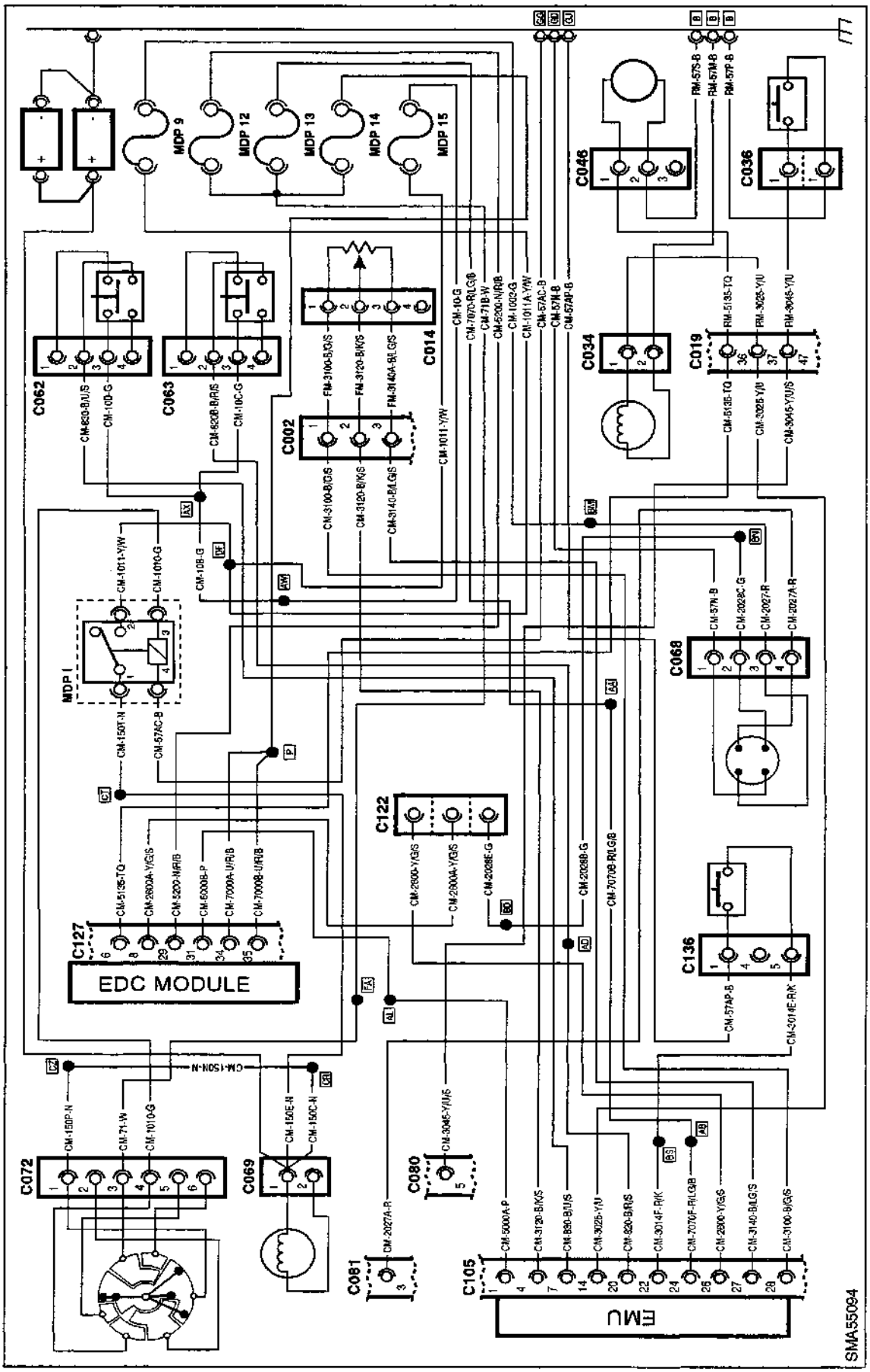
FRONT WHEEL DRIVE

C002	– Main Bulkhead Connector M2
C014	– Steering Sensor
C019	– Extension Harness Connector
C034	– Front Wheel Drive Solenoid
C036	– Pressure Switch
C046	– Axle Speed Sensor
C062	– R/H Stop Lamp Switch
C063	– L/H Stop Lamp Switch
C068	– Radar
C069	– Starter Solenoid
C072	– Starter Switch
C080	– Instrument Cluster 'B'
C081	– Instrument Cluster 'C'
C105	– EMU Connector
C122	– Ground Speed Sensor
C127	– EDC Module Connector CN2
C136	– Handbrake



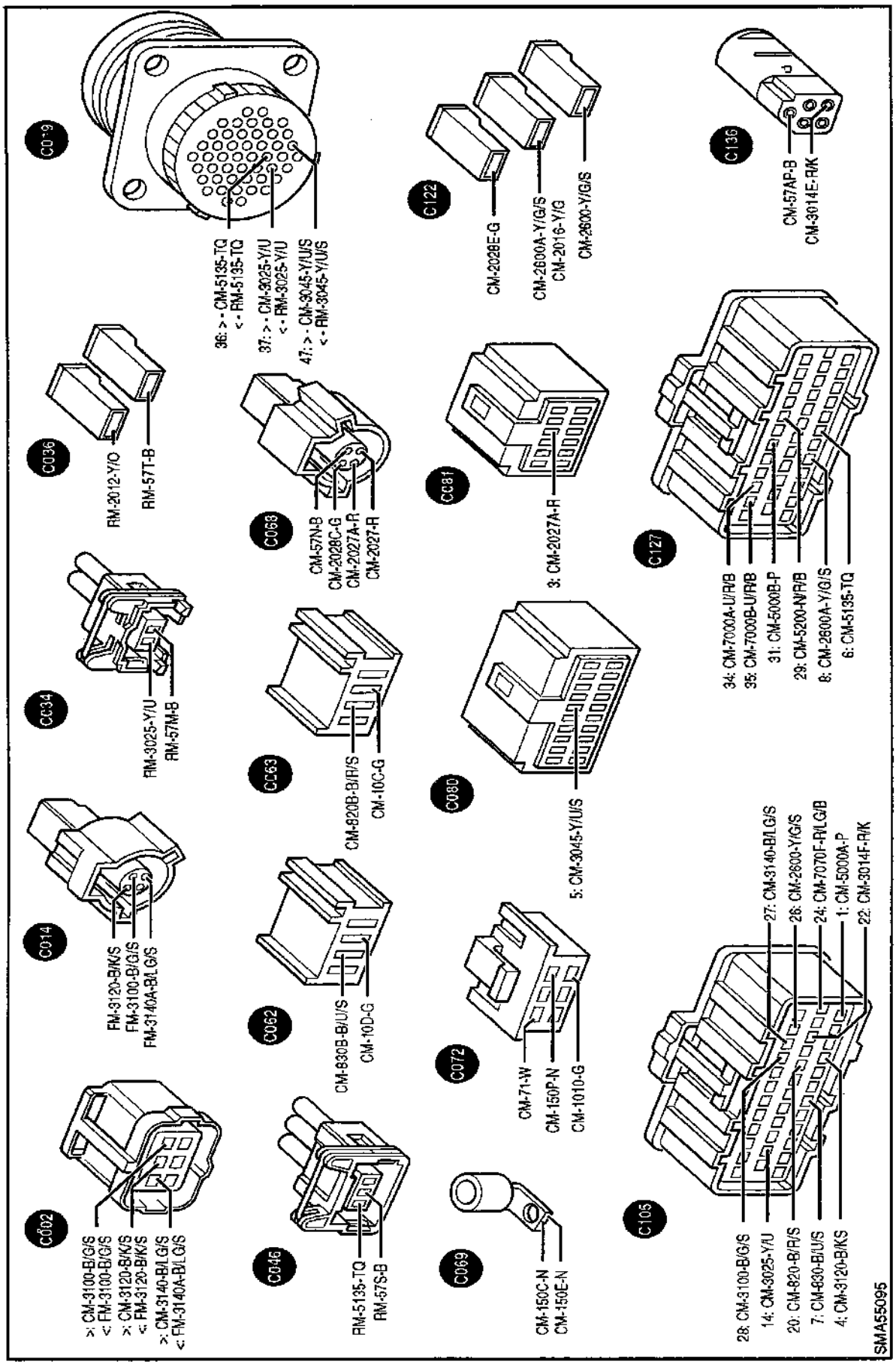
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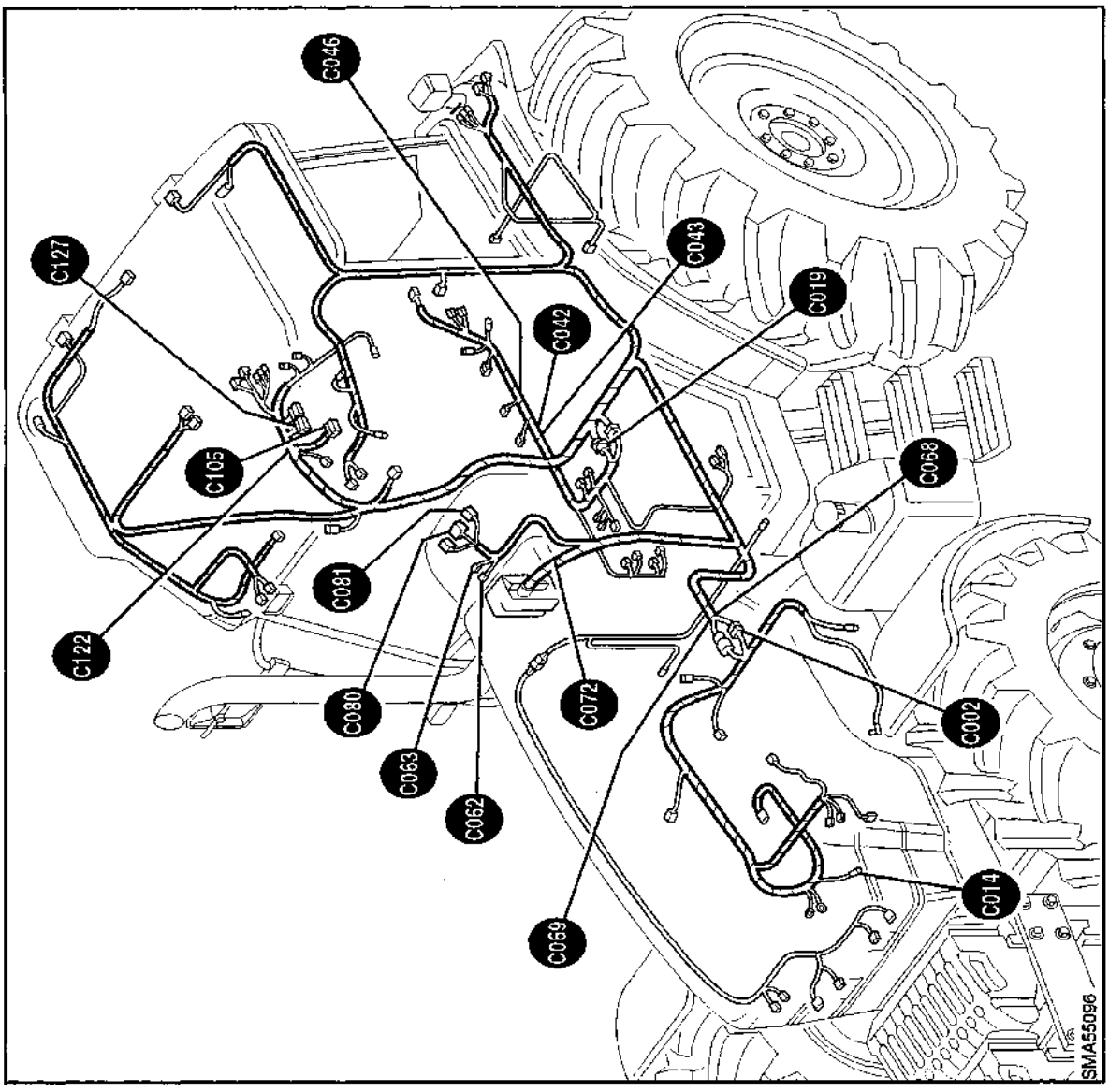


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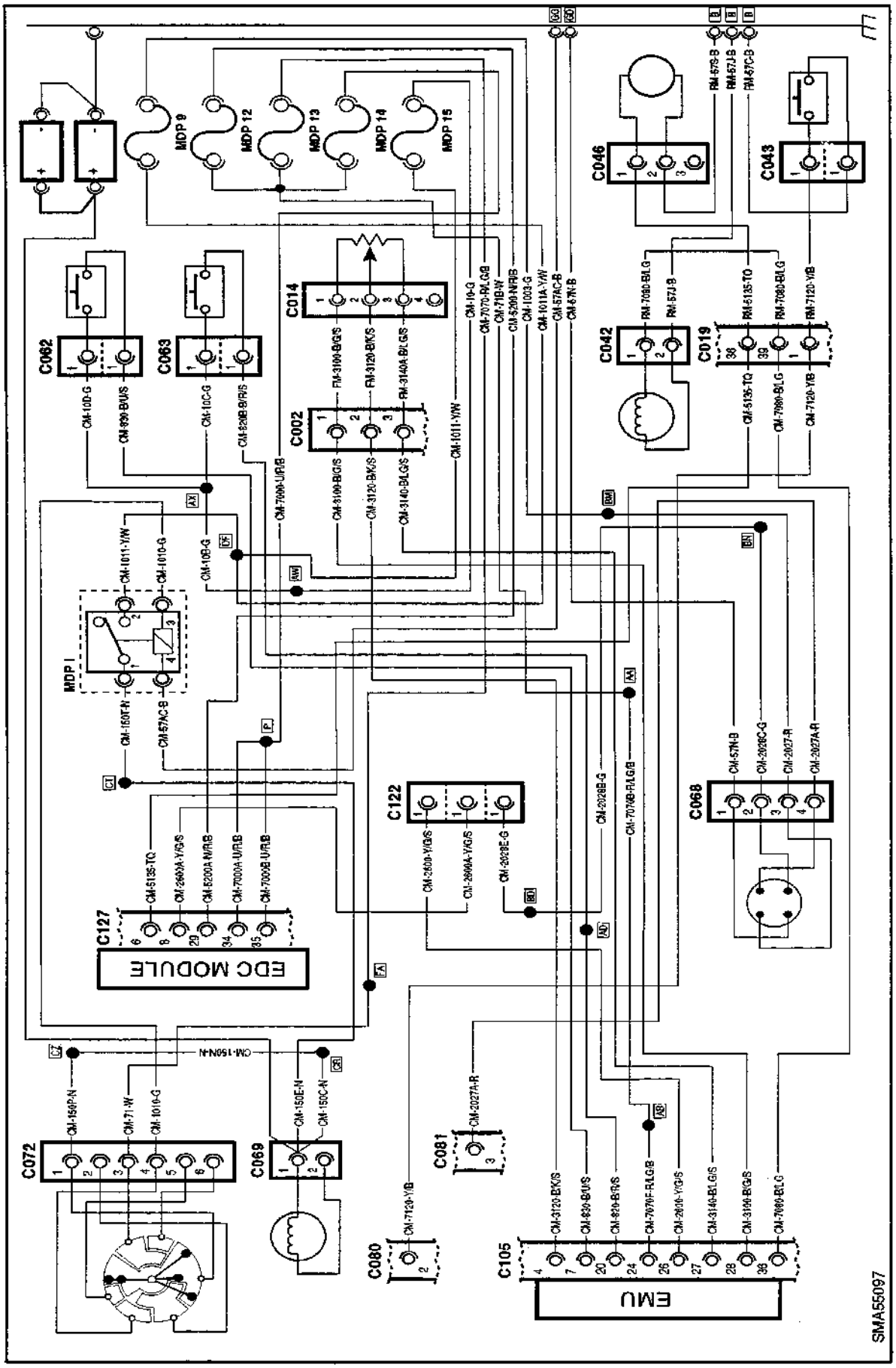
DIFF – LOCK

C002	– Main Bulkhead Connector M2
C014	– Steering Sensor
C019	– Extension Harness Connector
C042	– Diff Lock Solenoid
C043	– Diff Lock Switch
C046	– Axle Speed Sensor
C062	– R/H Stop Lamp Switch
C063	– L/H Stop Lamp Switch
C068	– Radar
C069	– Starter Solenoid
C072	– Starter Switch
C080	– Instrument Cluster 'B'
C081	– Instrument Cluster 'C'
C105	– EMU Connector
C122	– Ground Speed Sensor
C127	– EDC Module Connector CN2



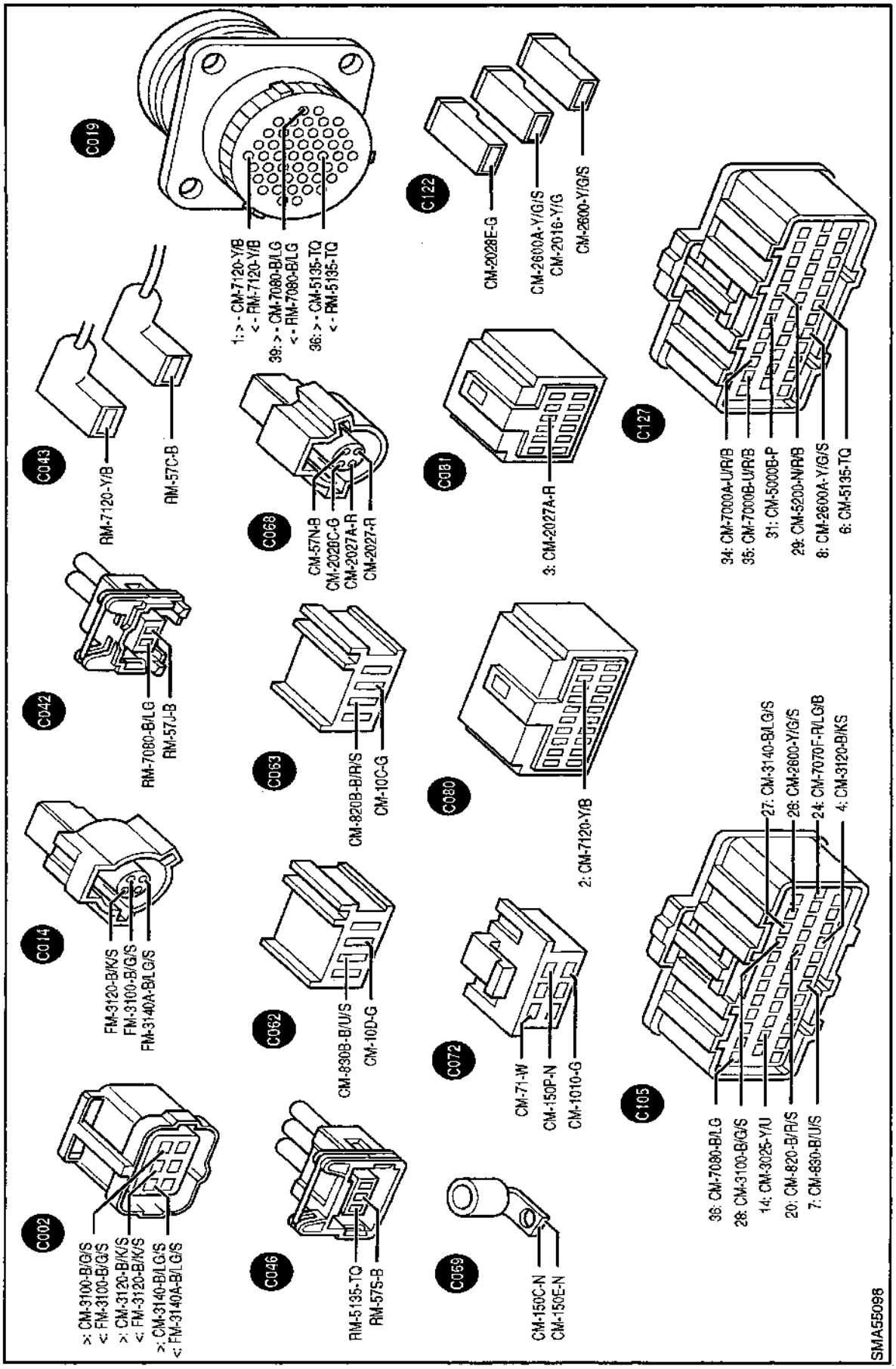
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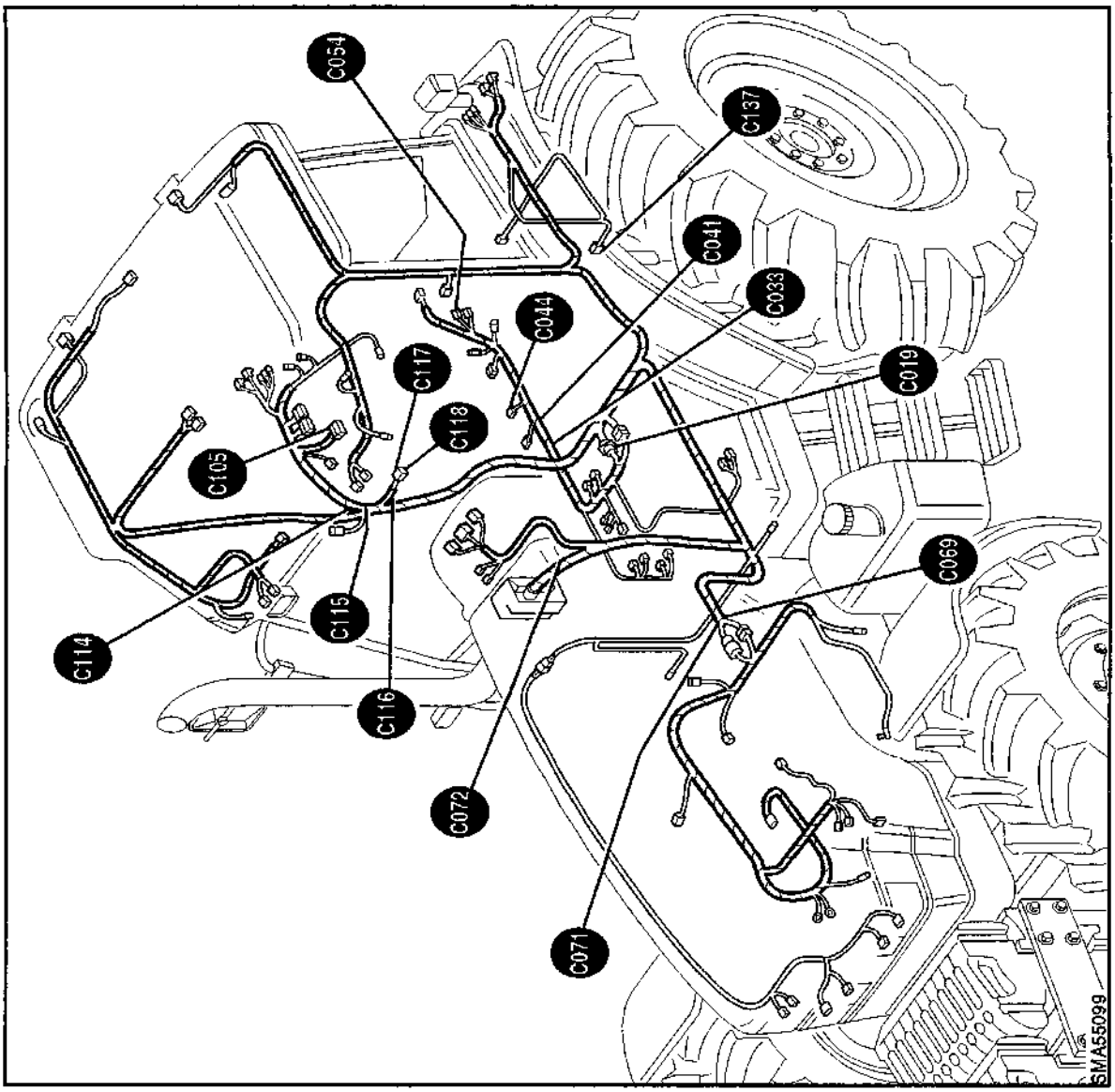


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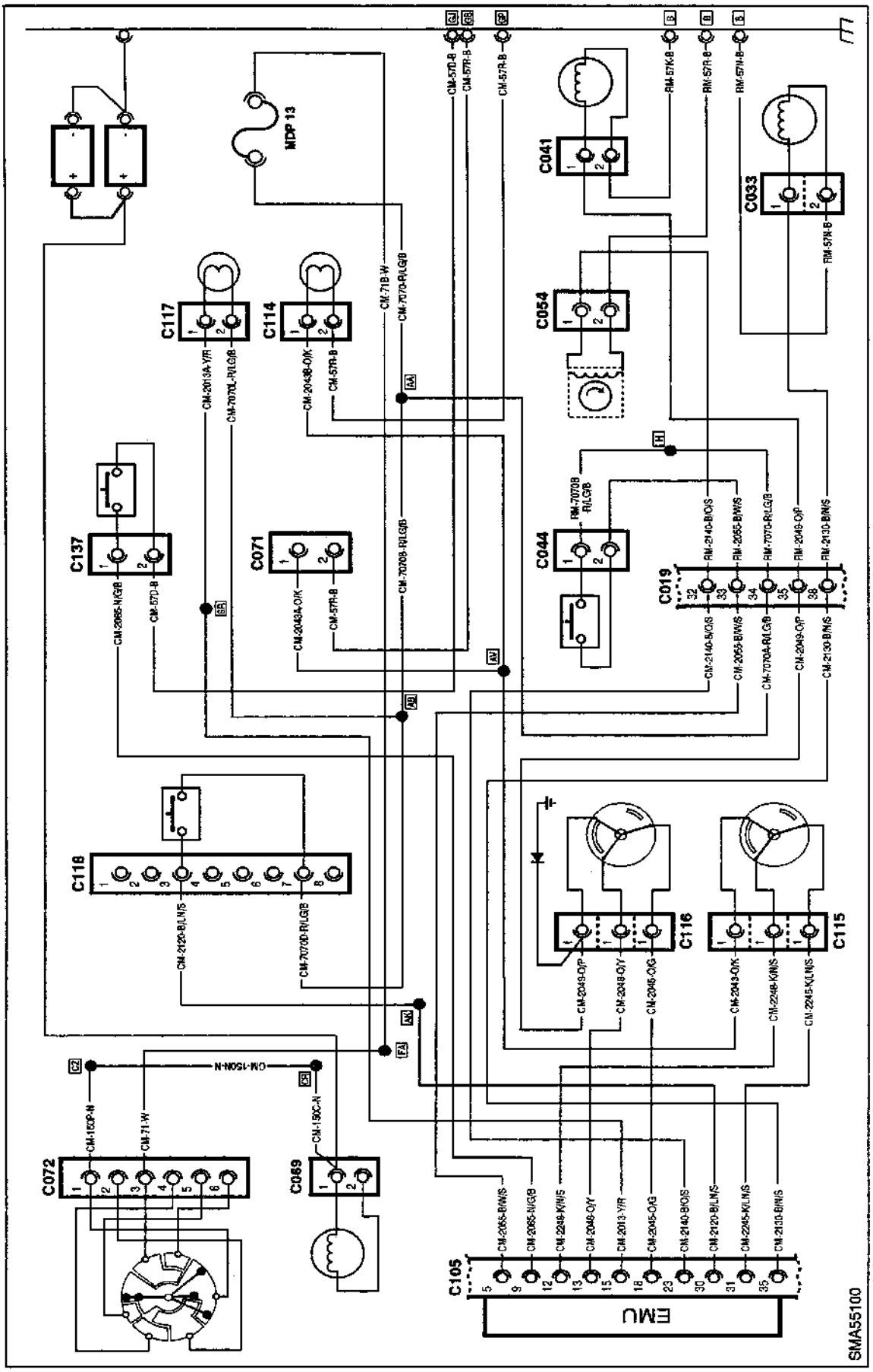
POWER TAKE-OFF

C019 – Extension Harness Connector
C033 – Diff Lock Solenoid
C041 – PTO Solenoid
C044 – Switch Ground Speed PTO Engaged
– (or Link Wire)
C054 – PTO Speed Sensor
C069 – Starter Solenoid
C071 – Main Bulkhead Hitch Connector
C072 – Starter Switch
C105 – EMU Connector
C114 – PTO Engaged Lamp
C115 – Front PTO Switch
C116 – Rear PTO Switch
C117 – Rear PTO Engage Lamp
C118 – Rear PTO Brake Switch
C137 – PTO Alarm Seat Switch



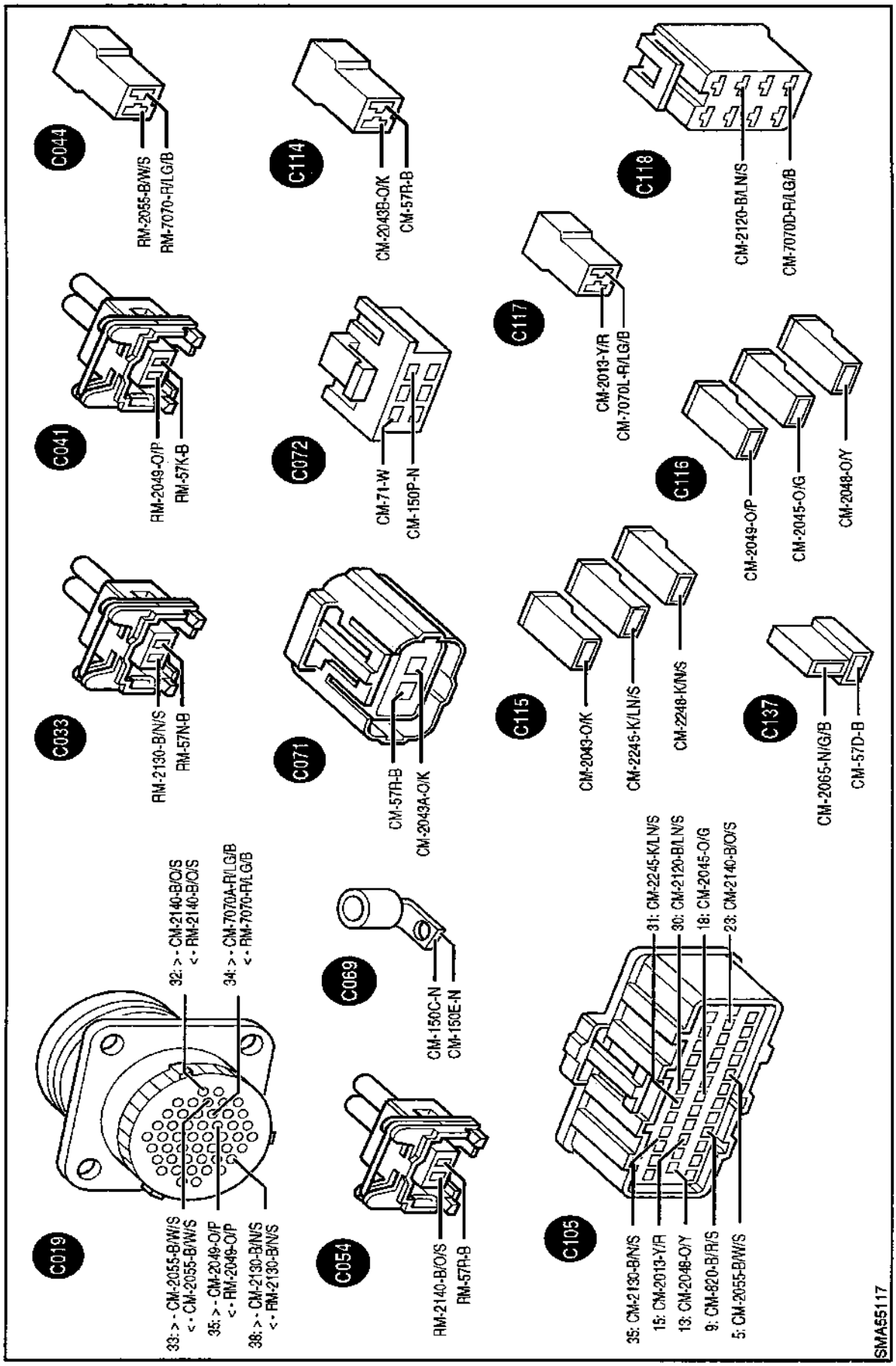
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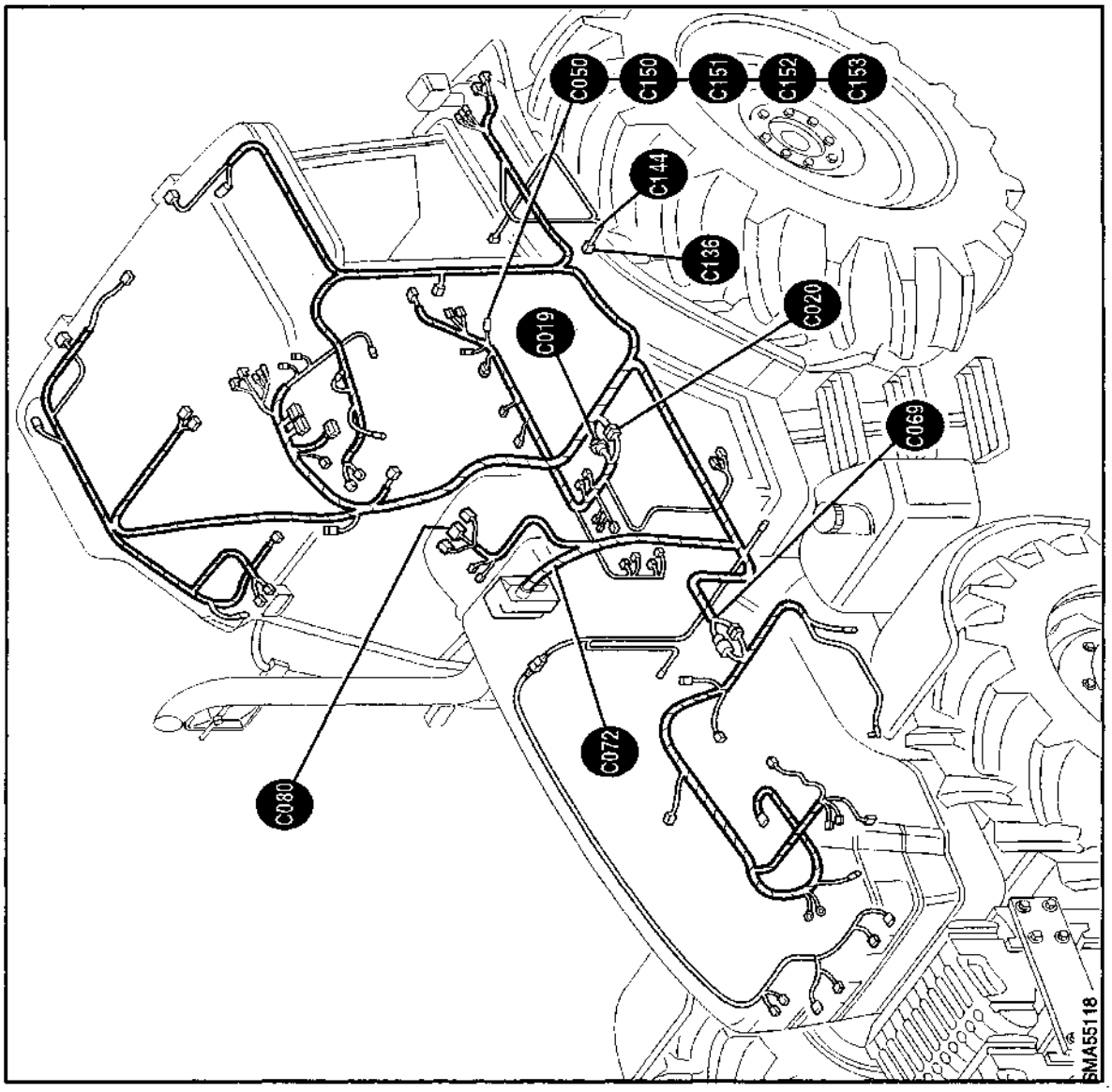
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ITALIAN TRAILER BRAKE

C019 – Main Extension Connector 1
C020 – Main Extension Connector 2
C050 – Trailer Brake Connector
C069 – Starter Solenoid
C072 – Starter Switch
C080 – Instrument Cluster 'B'
C136 – Handbrake
C144 – Air Brake Connector

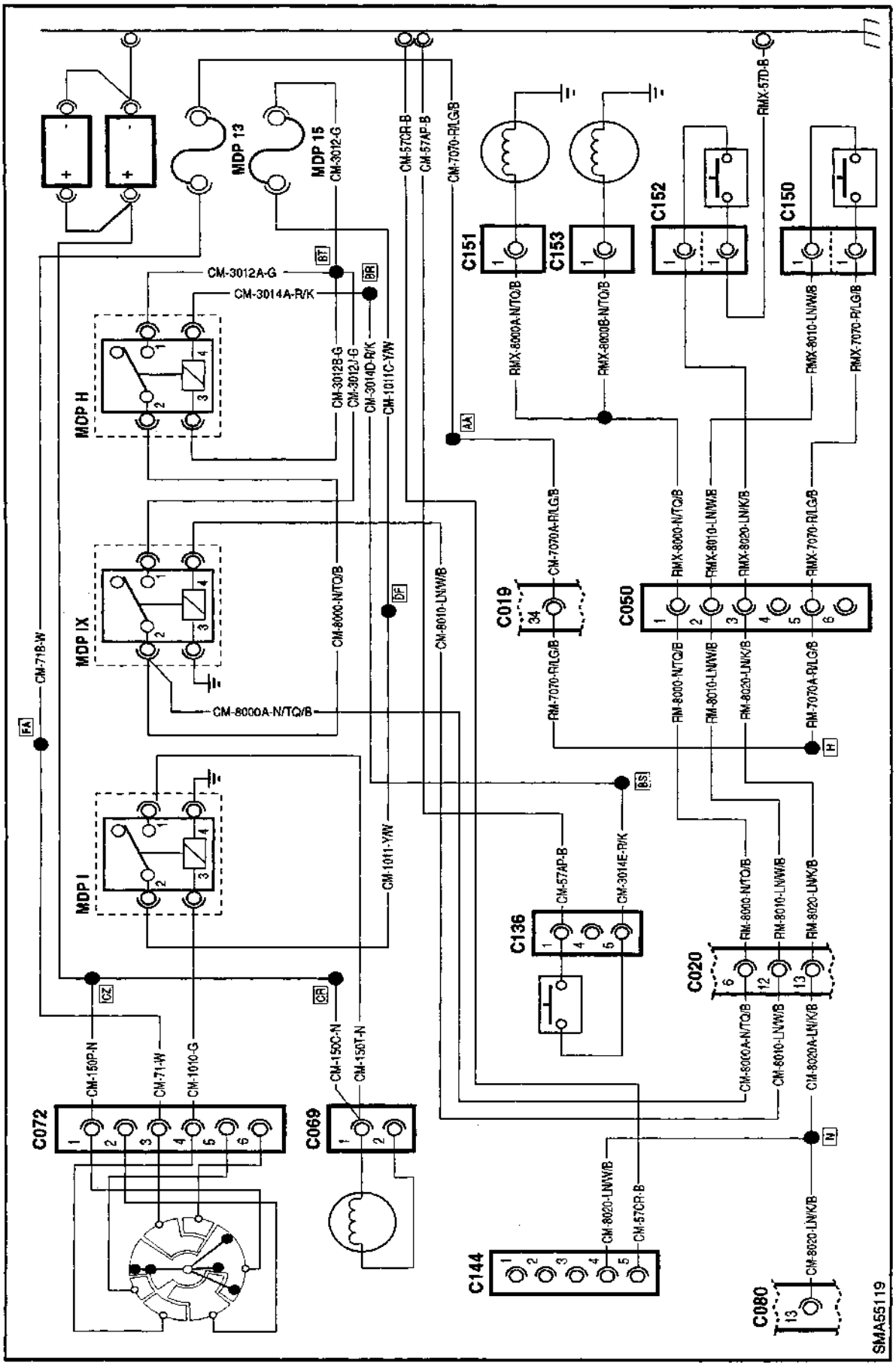
Trailer Brake Extension Harness

C150 – Pressure Switch 100
C151 – Solenoid Valve
C152 – Pressure Switch 101
C153 – Solenoid Valve



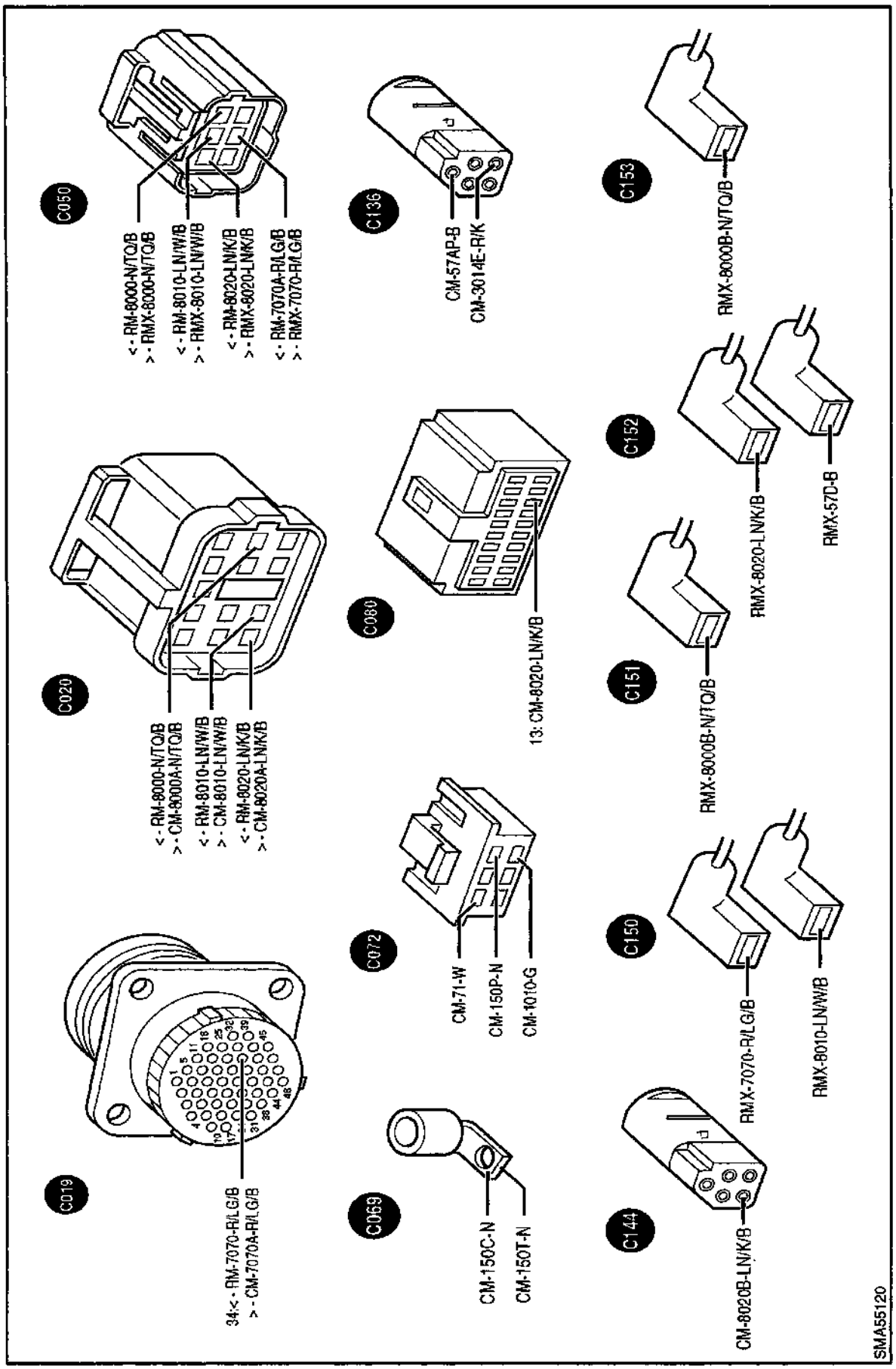
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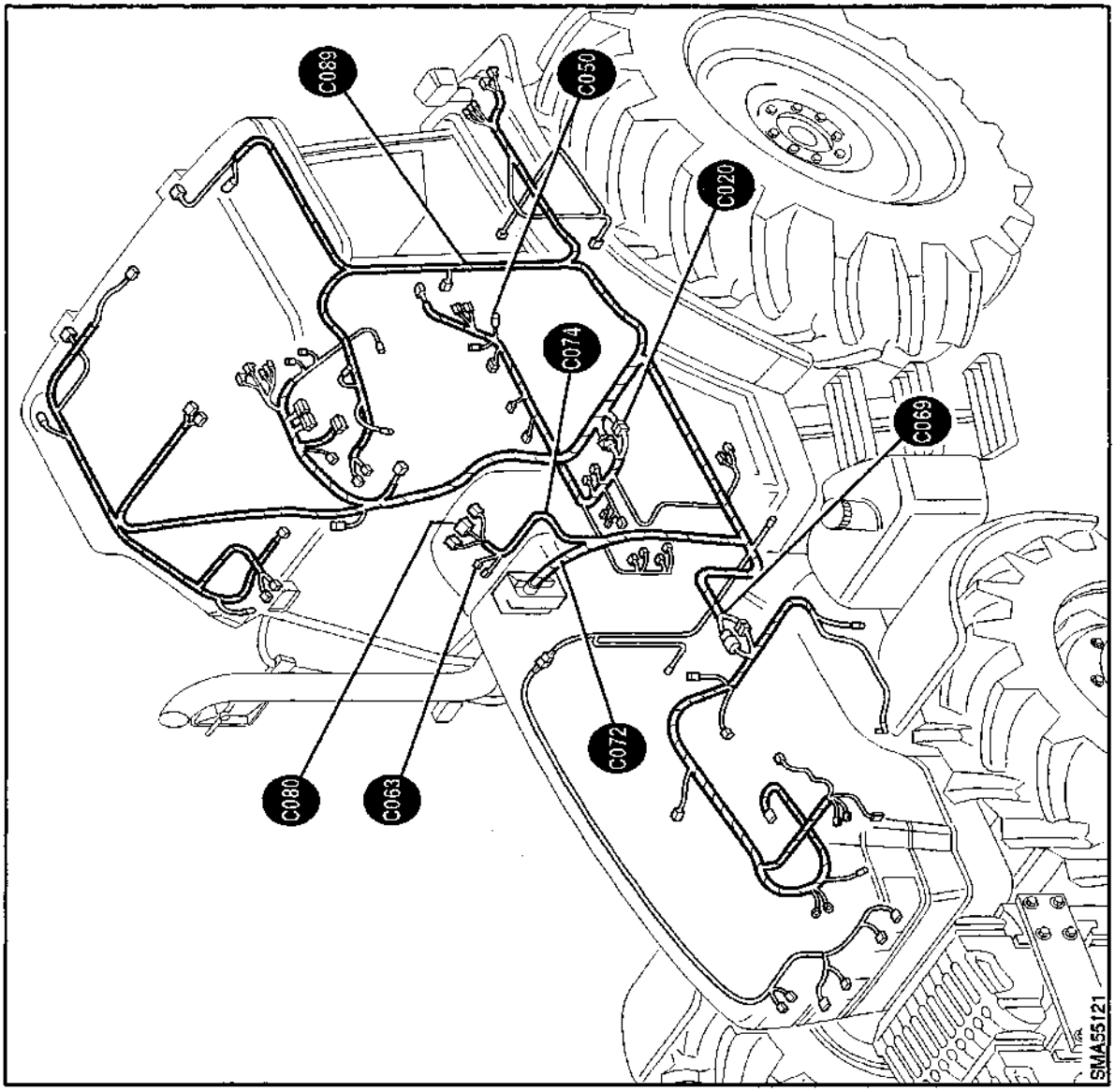


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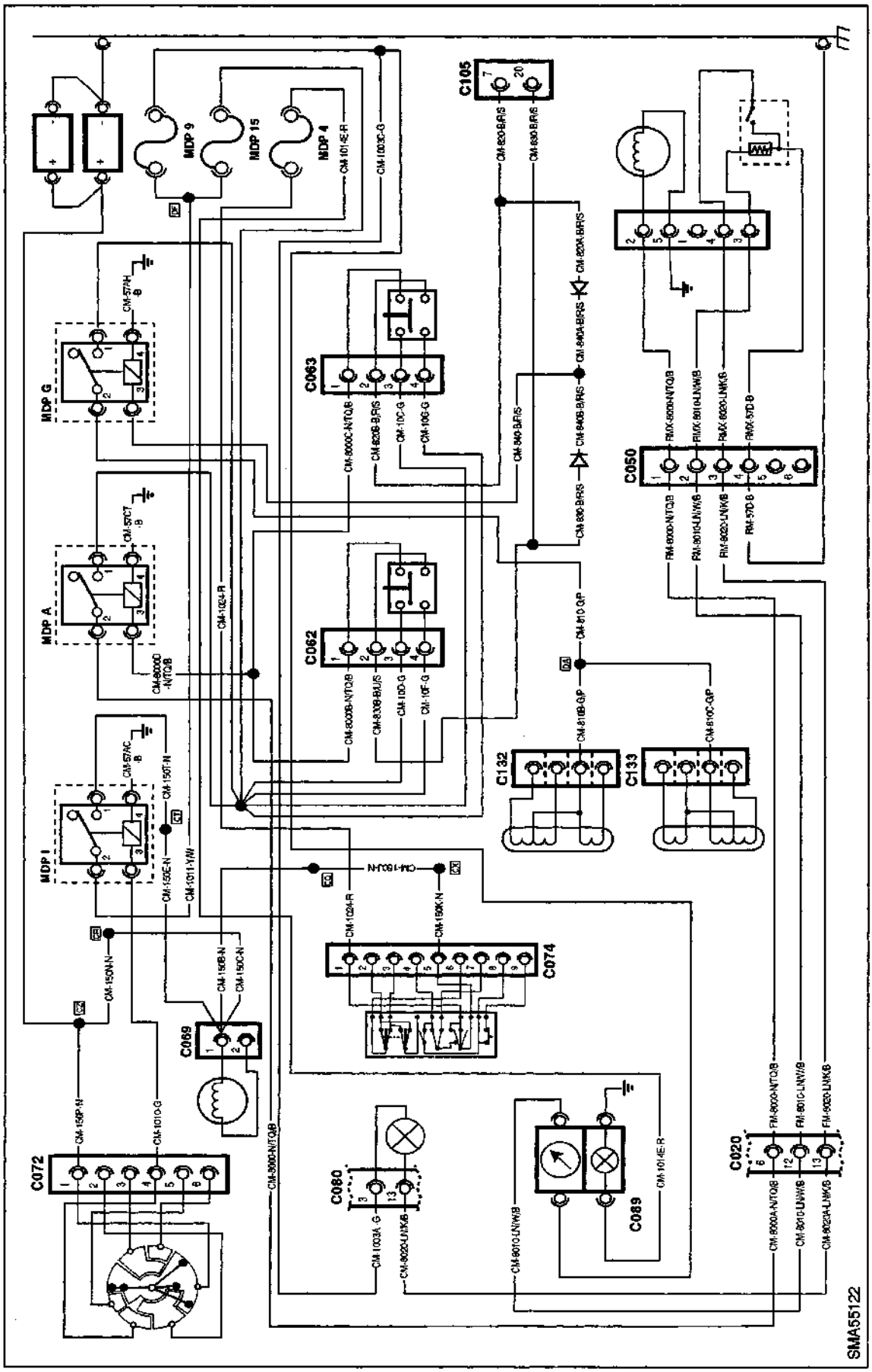
AIR TRAILER BRAKE

C020	– Main Extension Connector	
C050	– Trailer Brake Connector	
C062	– RH Stop Lamp Switch	
C063	– LH Stop Lamp Switch	
C069	– Starter Solenoid (Cab Main)	
C072	– Starter Switch	
C074	– Turn Switch	
C080	– Instrument Cluster 'B'	
C089	– Trailer Brake Gauge Lamp	
C105	– EMU Connector	
C132	– Rear Lamp RH Fender	
C133	– Rear Lamp LH Fender	



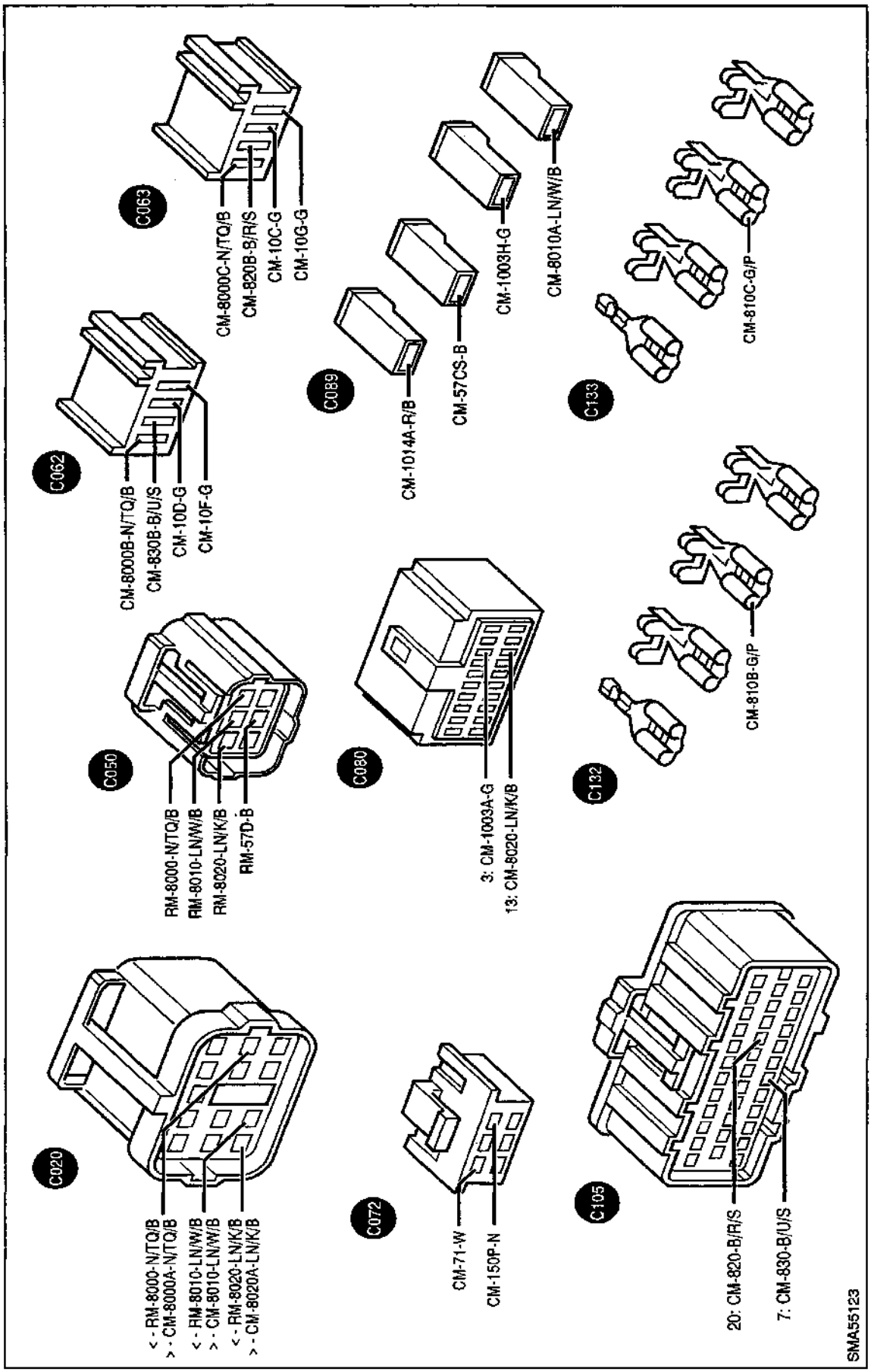
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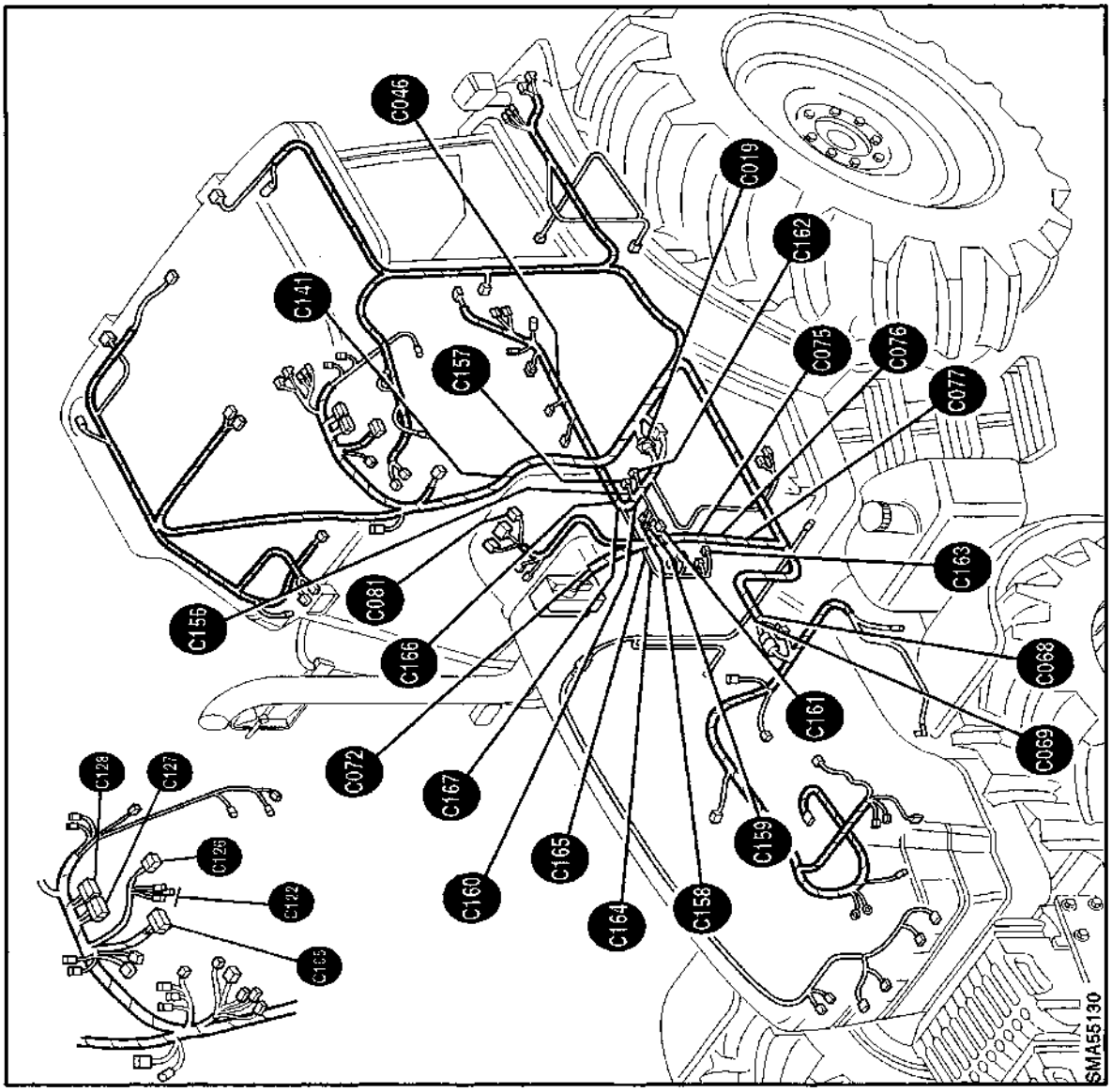


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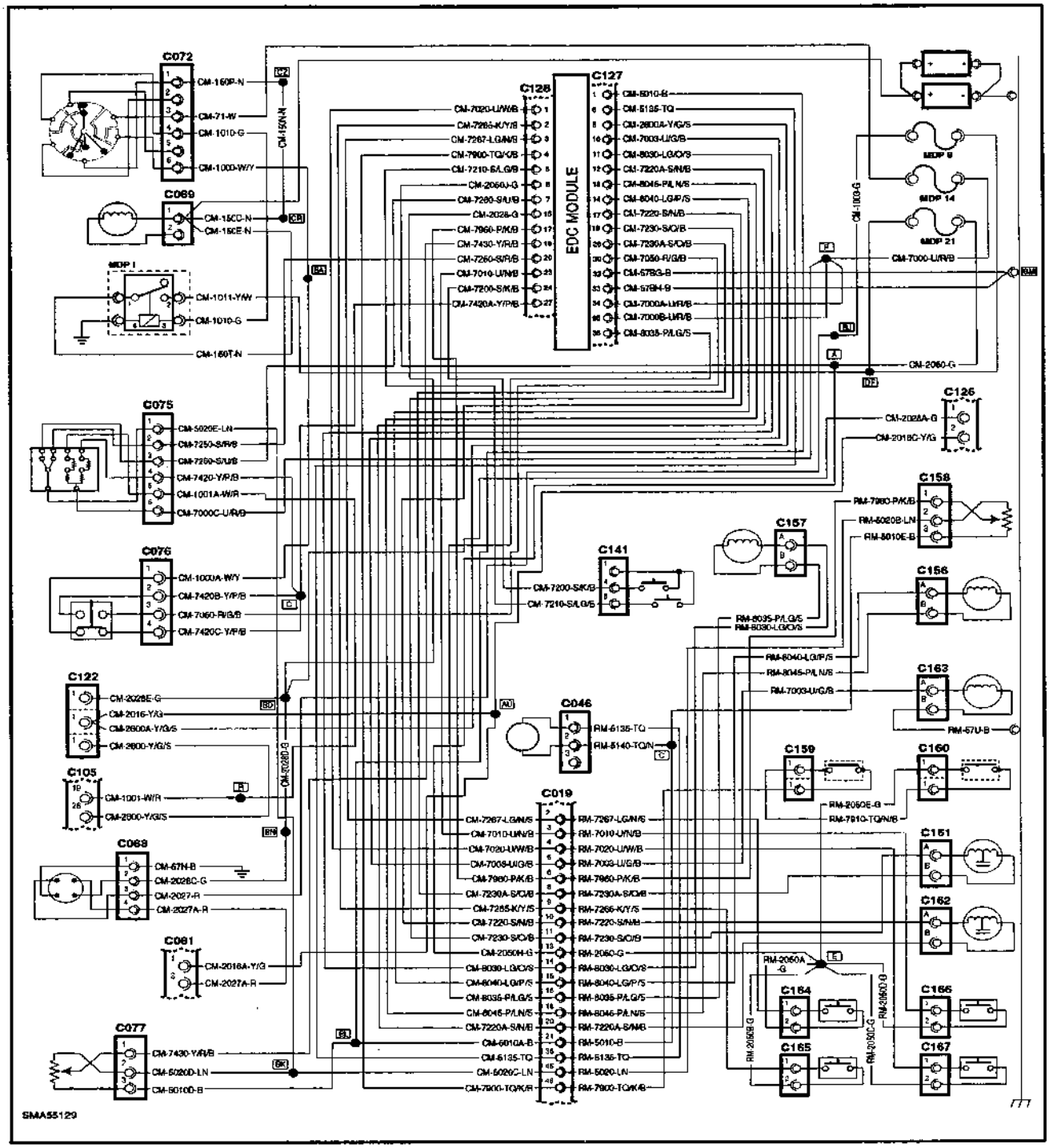
TRANSMISSION

C019	– Rear Main Extension Connector 1
C046	– Axle SPeed Sensor
C068	– Radar
C069	– Starter Solenoid (Cab Main)
C072	– Starter Switch
C075	– Shuttle Switch
C076	– Clutch Switch
C077	– Clutch Potentiometer
C081	– Instrument Cluster C
C105	– EMU Connector
C122	– Ground Speed Sensor
C126	– Diagnostic Plug
C127	– EDC Module CN2
C128	– EDC Module CN1
C141	– Gear Shift Connector
C156	– Reverse Synchro Solenoid
C158	– Forward Synchro Solenoid
C159	– Clutch Pressure Switch (A)
C160	– Clutch Pressure Switch (B)
C161	– Clutch A (Low)
C162	– Clutch B (High)
C163	– Dump Solenoid
C164	– Gear Switch 1
C165	– Gear Switch 2
C166	– Range Switch 3
C167	– Range Switch 4



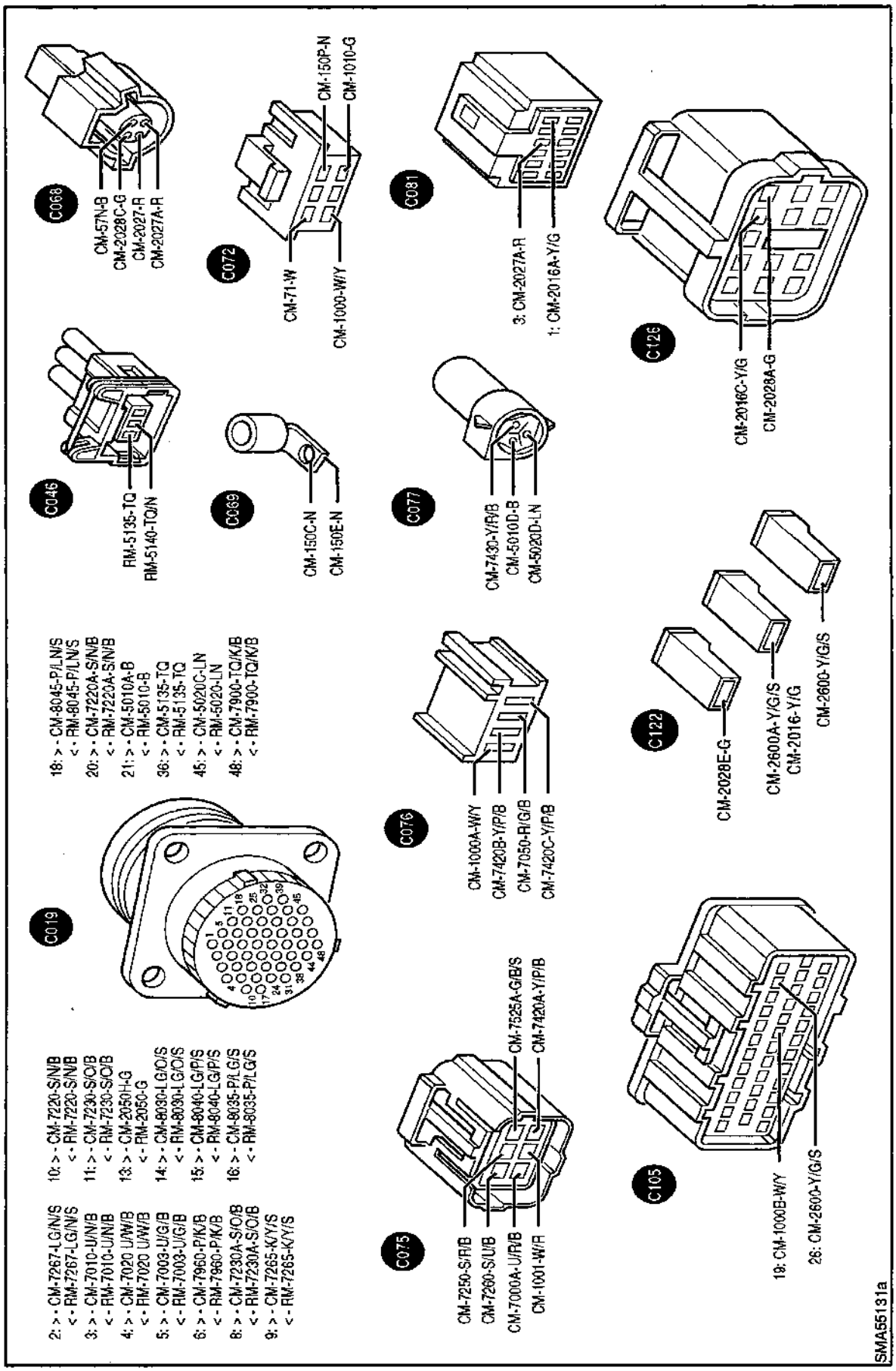
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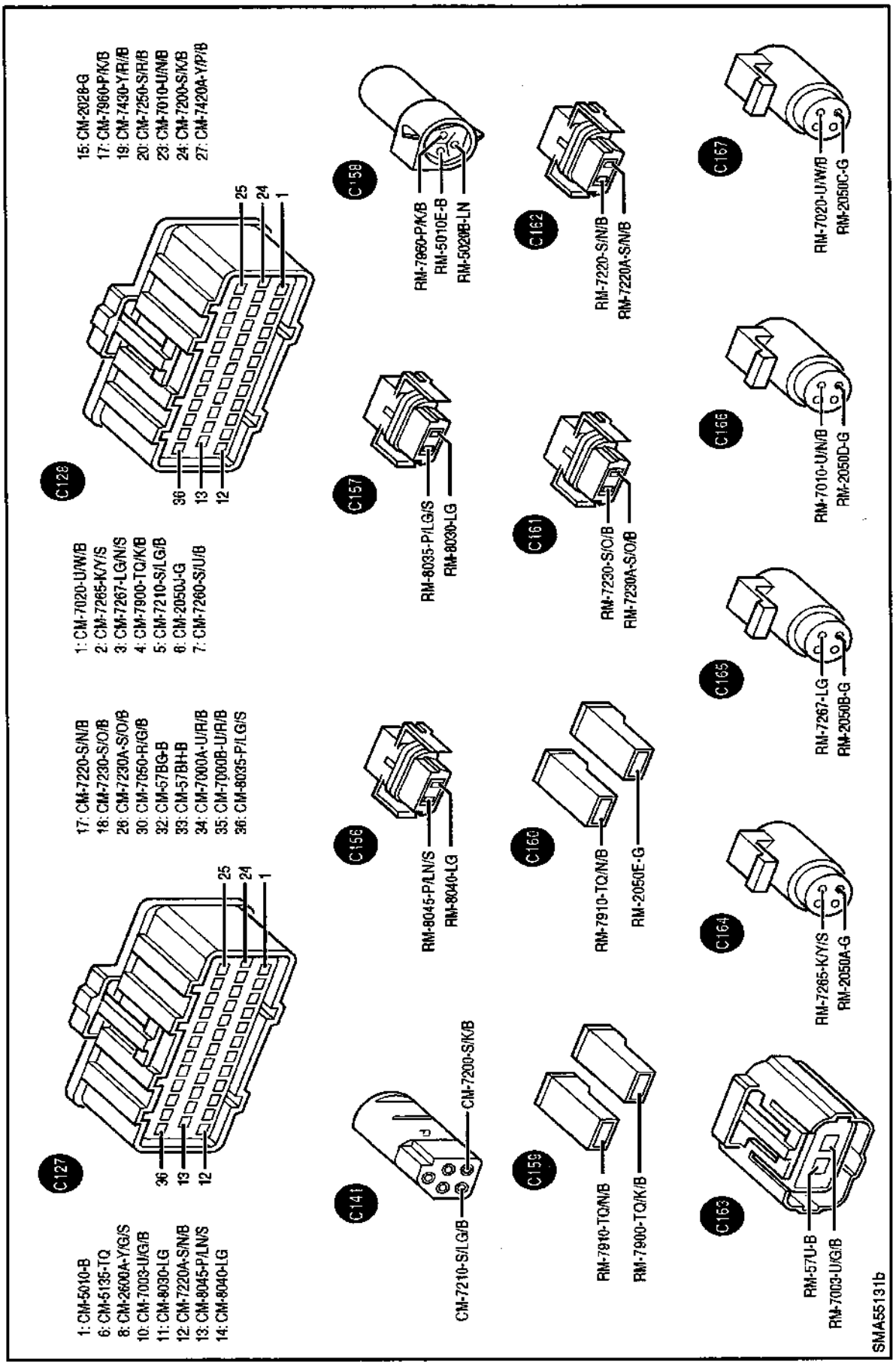
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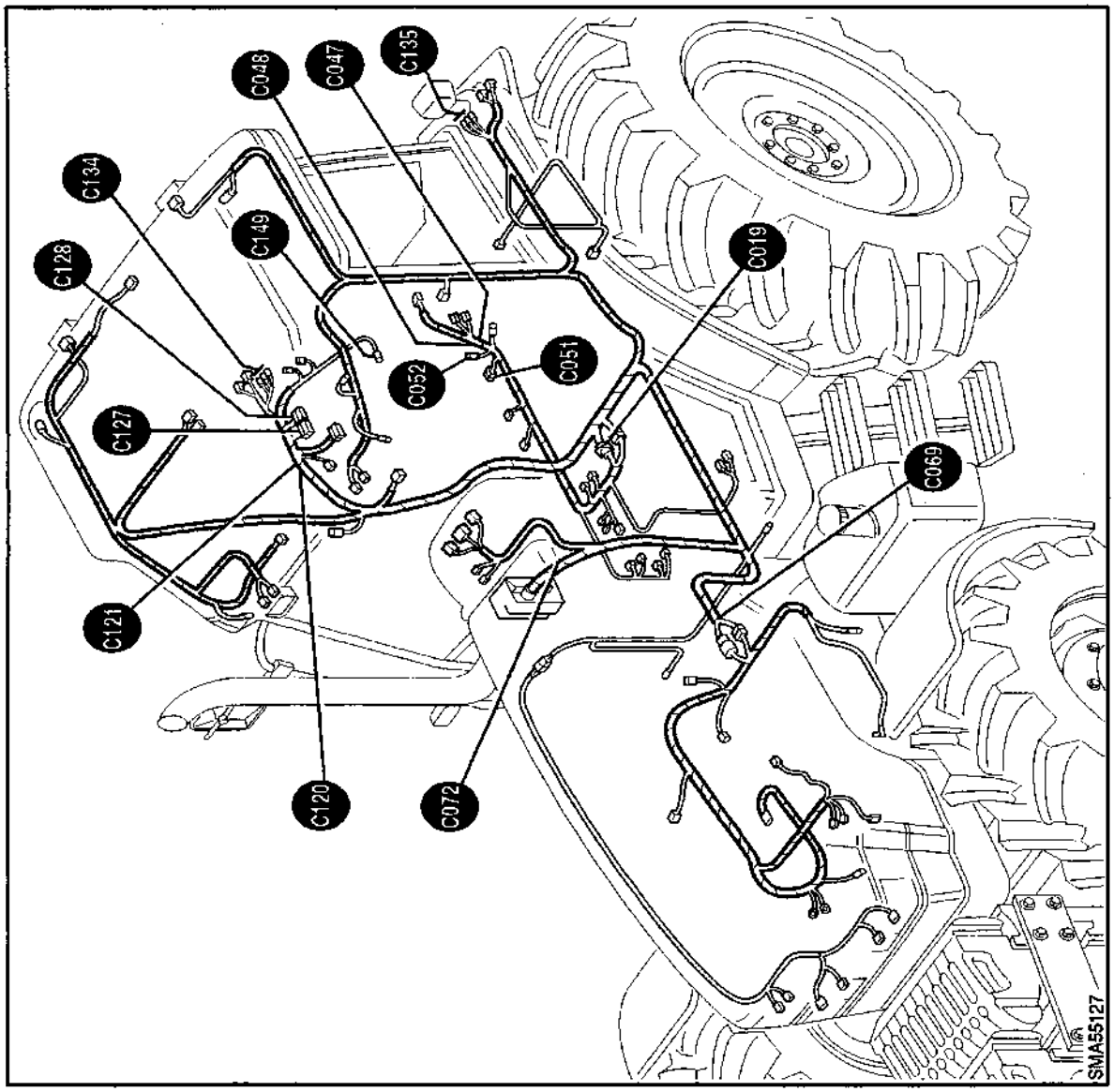


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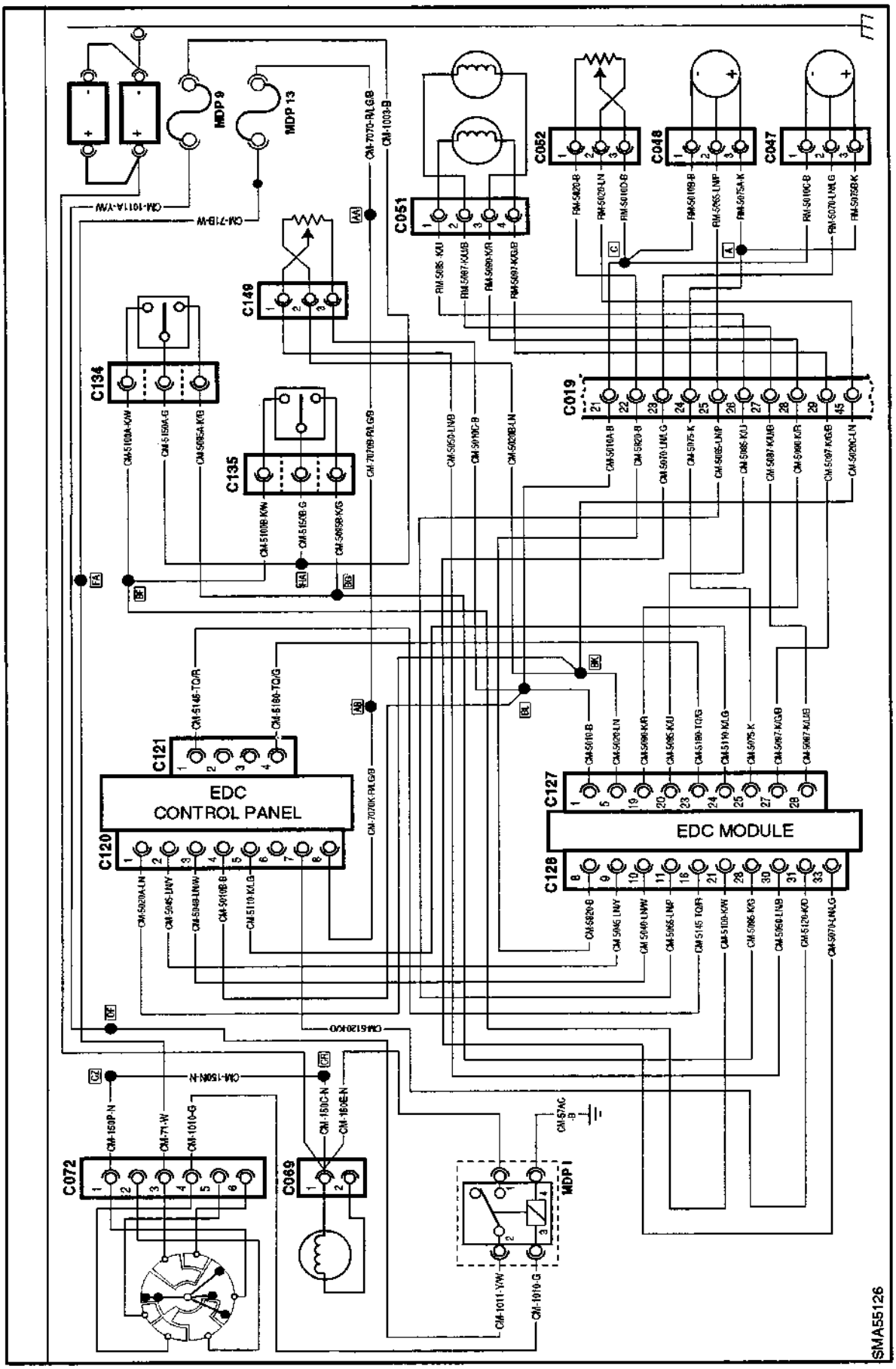
ELECTRONIC DRAFT CONTROL

C019	– Extension Harness Connector
C047	– Left Hand Draft Pin
C048	– Right Hand Draft Pin
C051	– EDC Valve Connector
C052	– Rockshaft Potentiometer
C069	– Starter Solenoid
C072	– Starter Switch
C120	– EDC Control Panel 1
C121	– EDC Control Panel 2
C128	– EDC Module Connector CN1
C127	– EDC Module Connector CN2
C134	– HPL Raise/Lower Switch R/H
C135	– HPL Raise/Lower Switch L/H
C149	– Quadrant Potentiometer



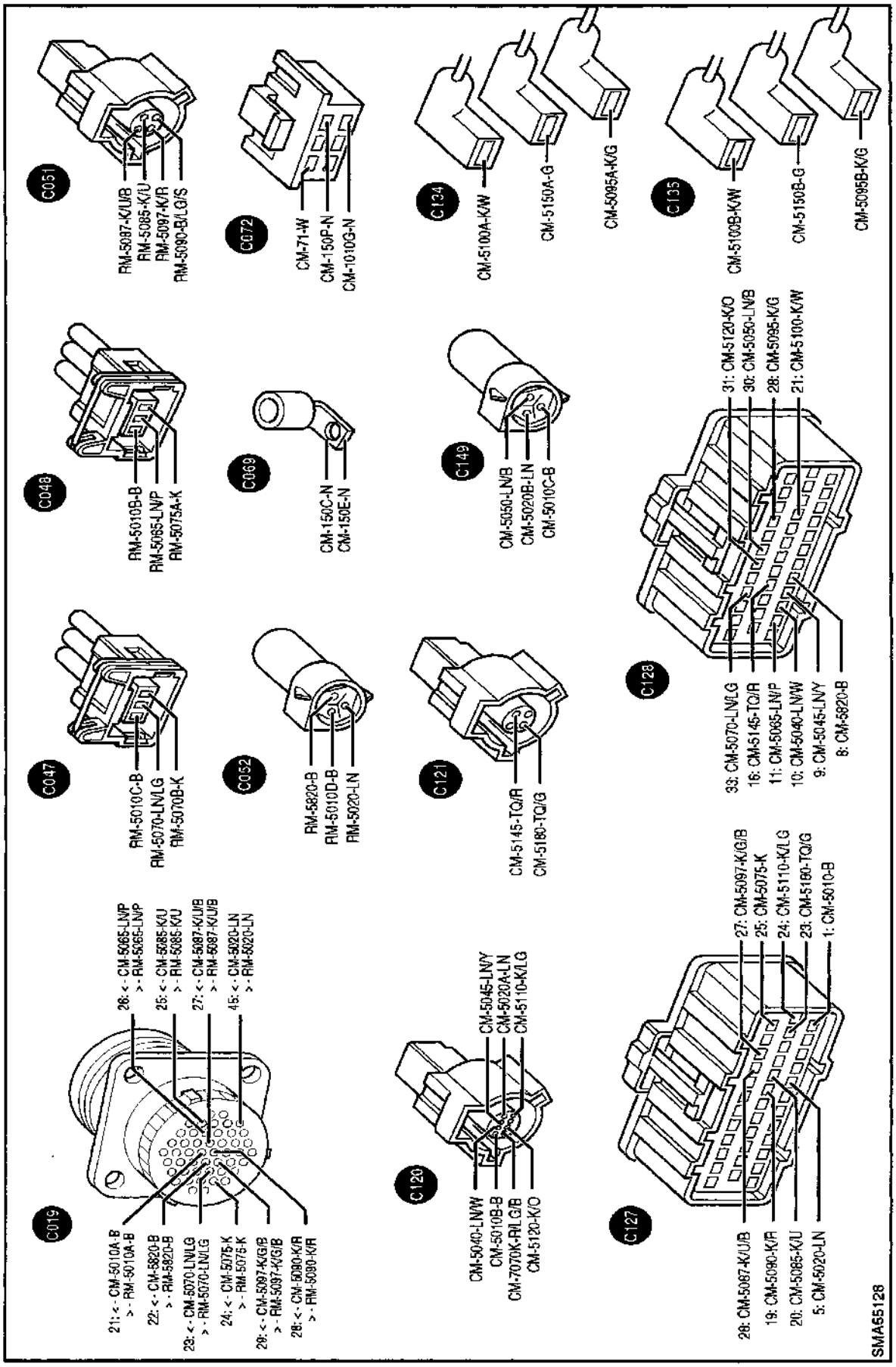
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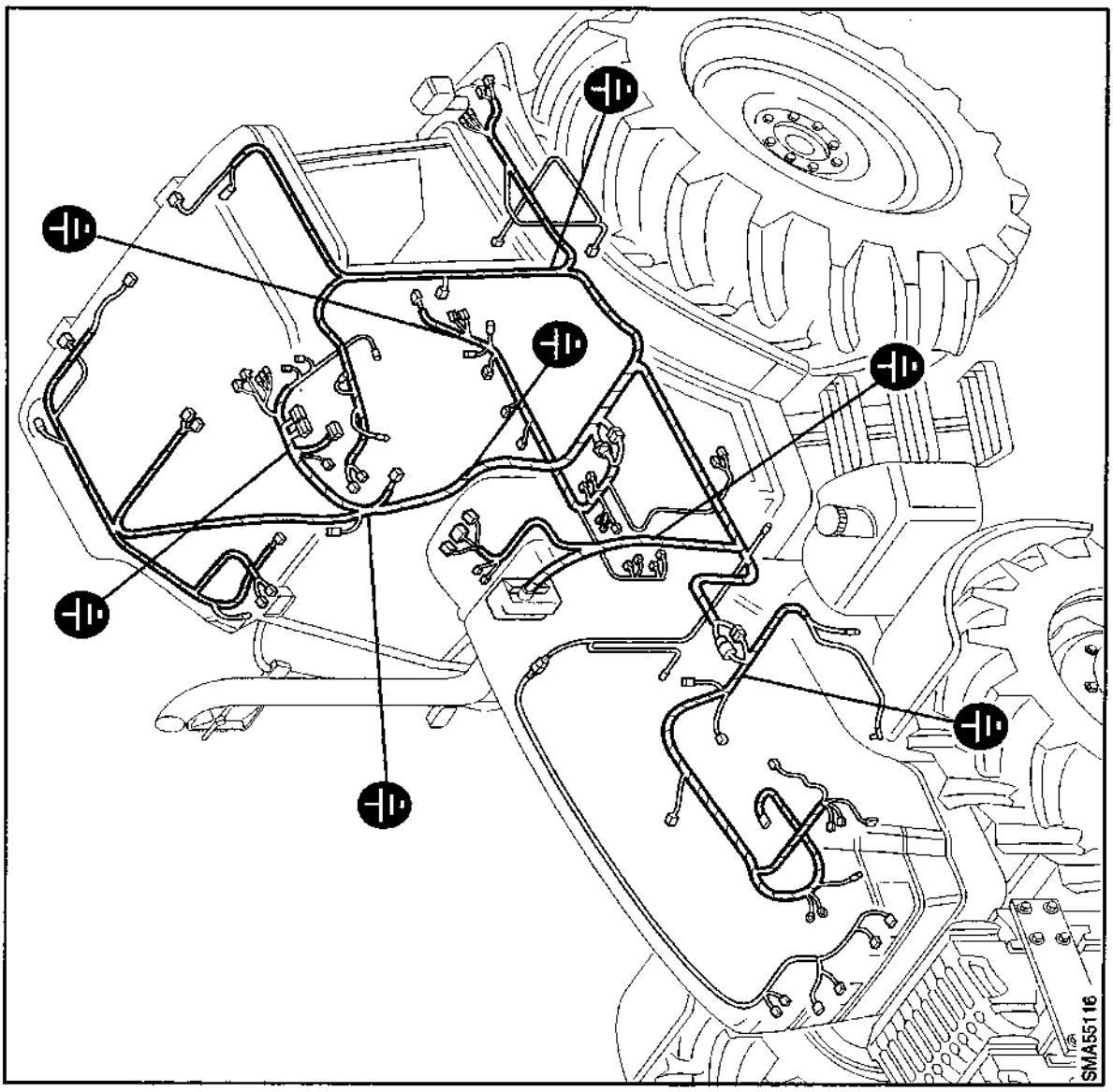
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GROUND POINT LOCATION



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SHUTTLE COMMAND (MECHANICAL TRANSMISSION) MODEL TRACTORS

ELECTRICAL HARNESSES AND CIRCUITS

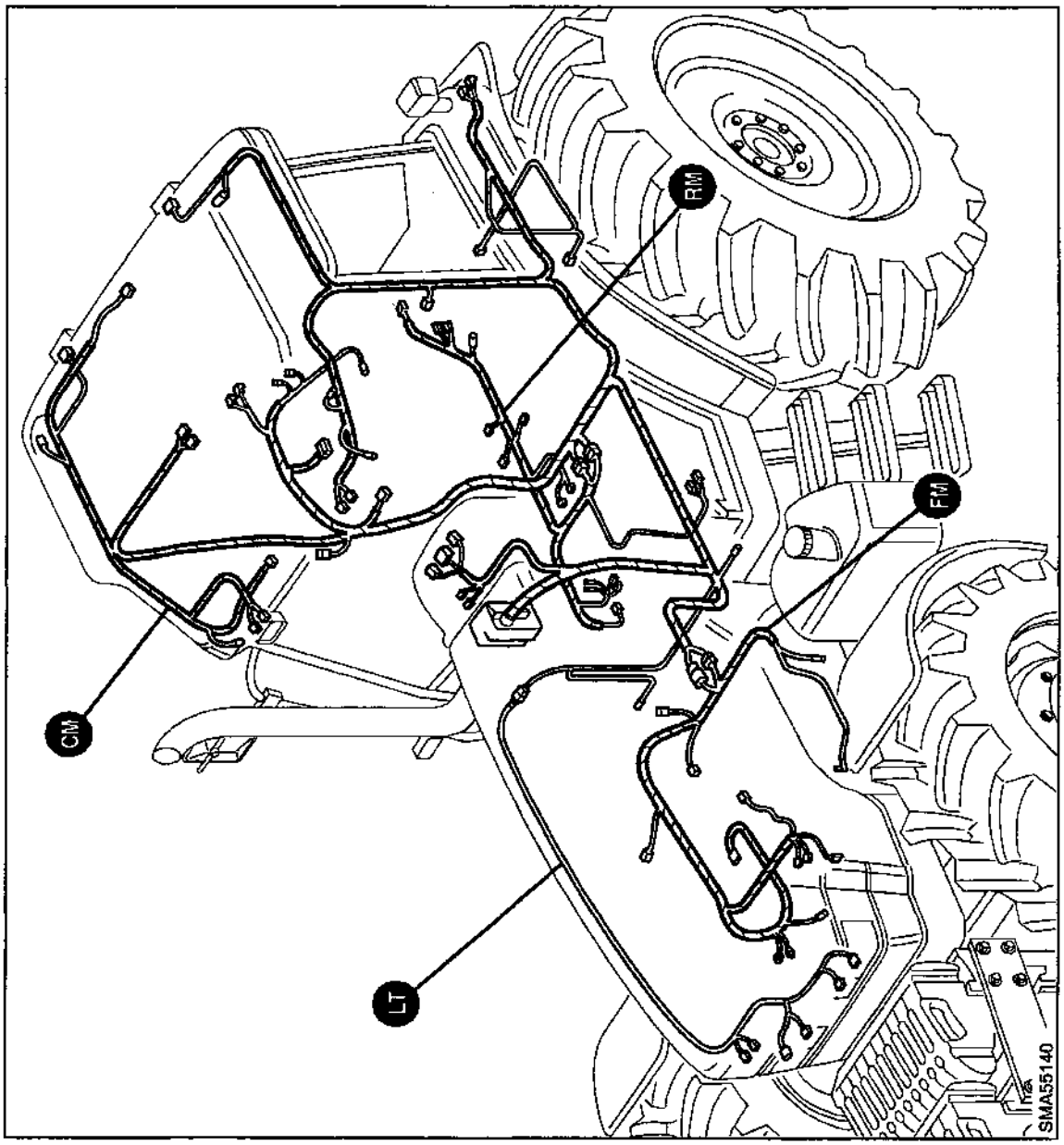
NOTE: NOT USED IN NORTH AMERICA

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There are Four Main Harnesses used on Cabbed Tractors.

LT – Lighting
FM – Front Main (Engine Harness)
RM – Rear Main (Chassis Harness)
CM – Cab Main

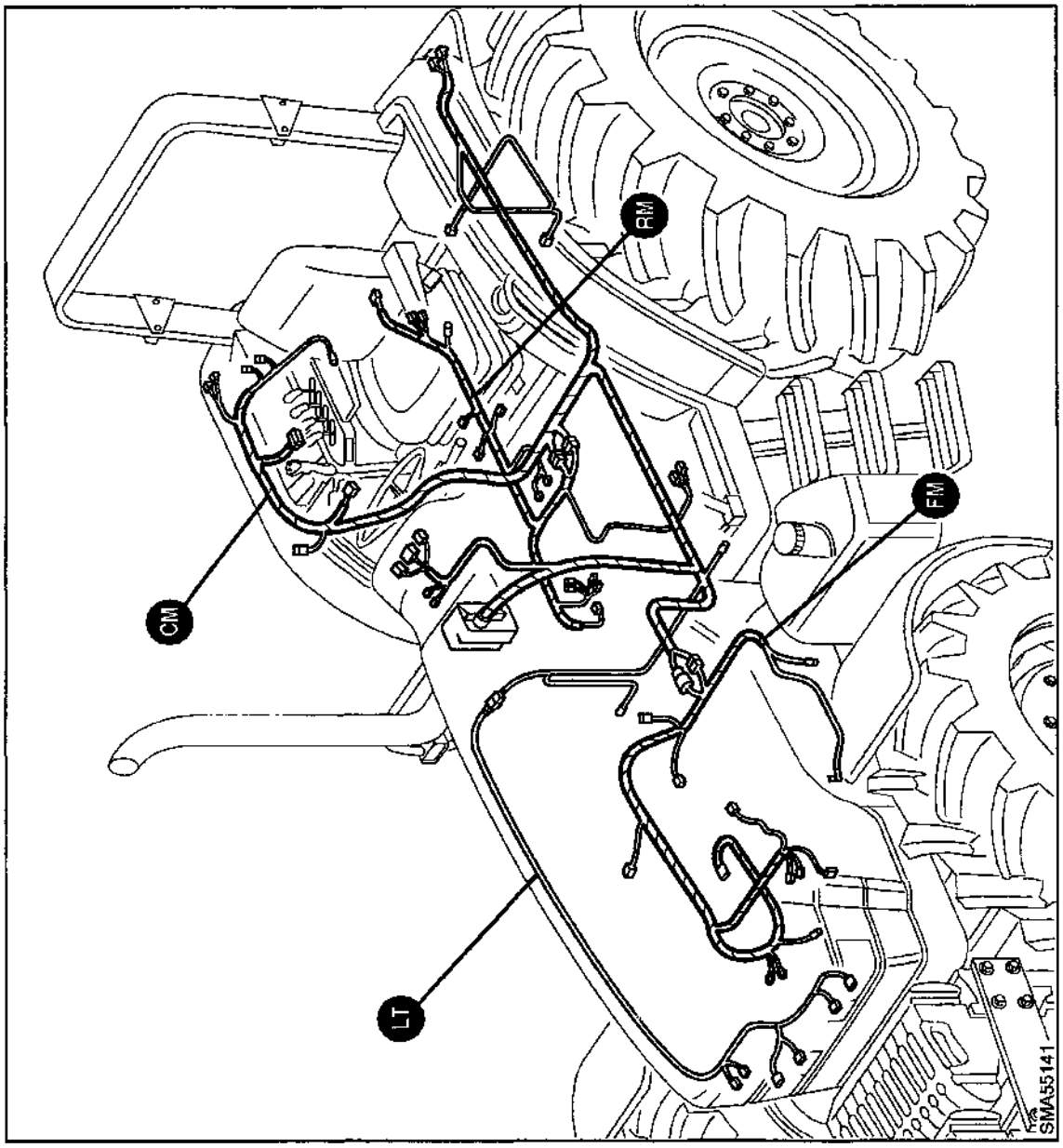


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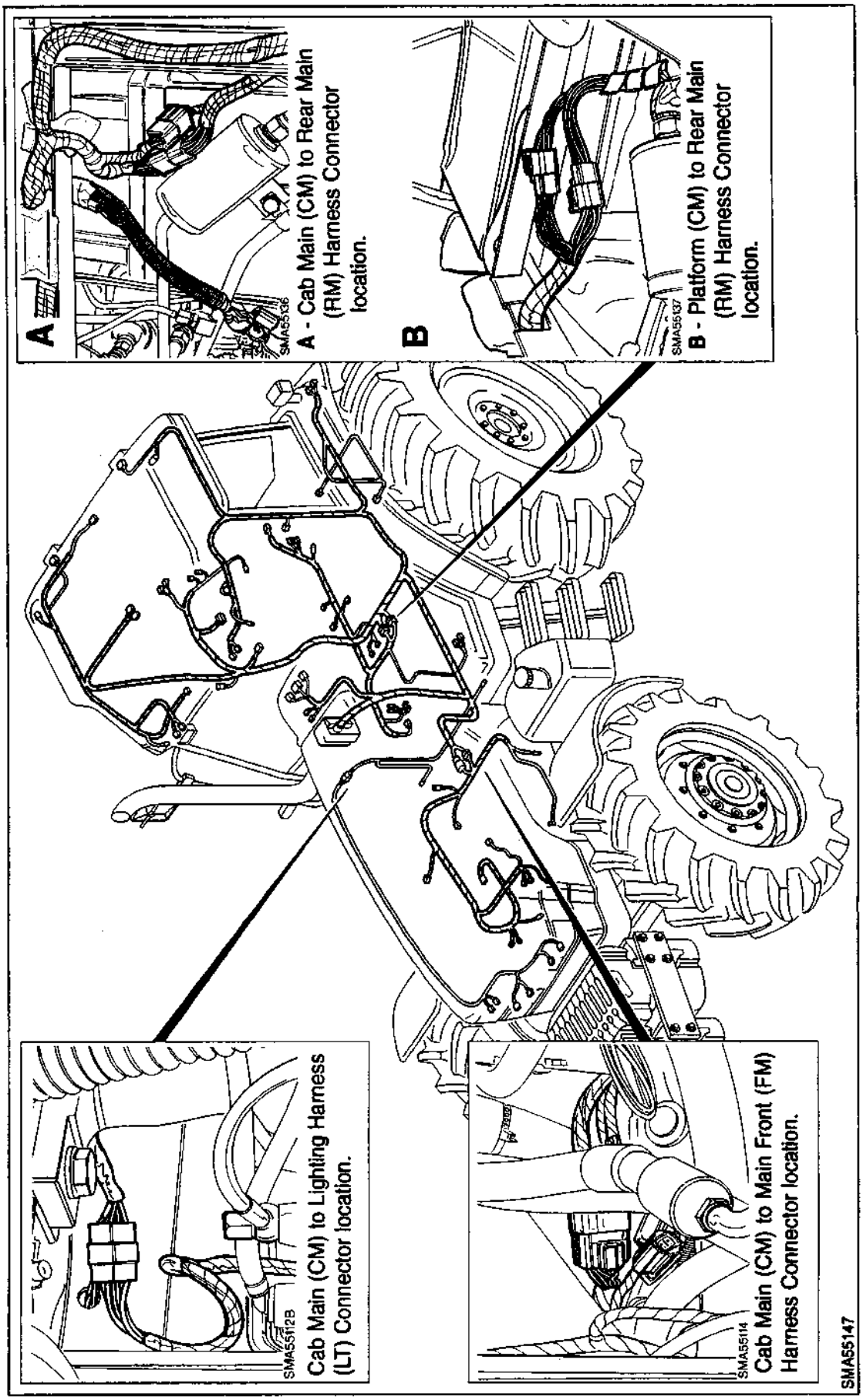
There are Four Main Harnesses used on Platform Tractors.

LT – Lighting
FM – Front Main (Engine Harness)
RM – Rear Main (Chassis Harness)
CM – Cab Main (Platform Harness)



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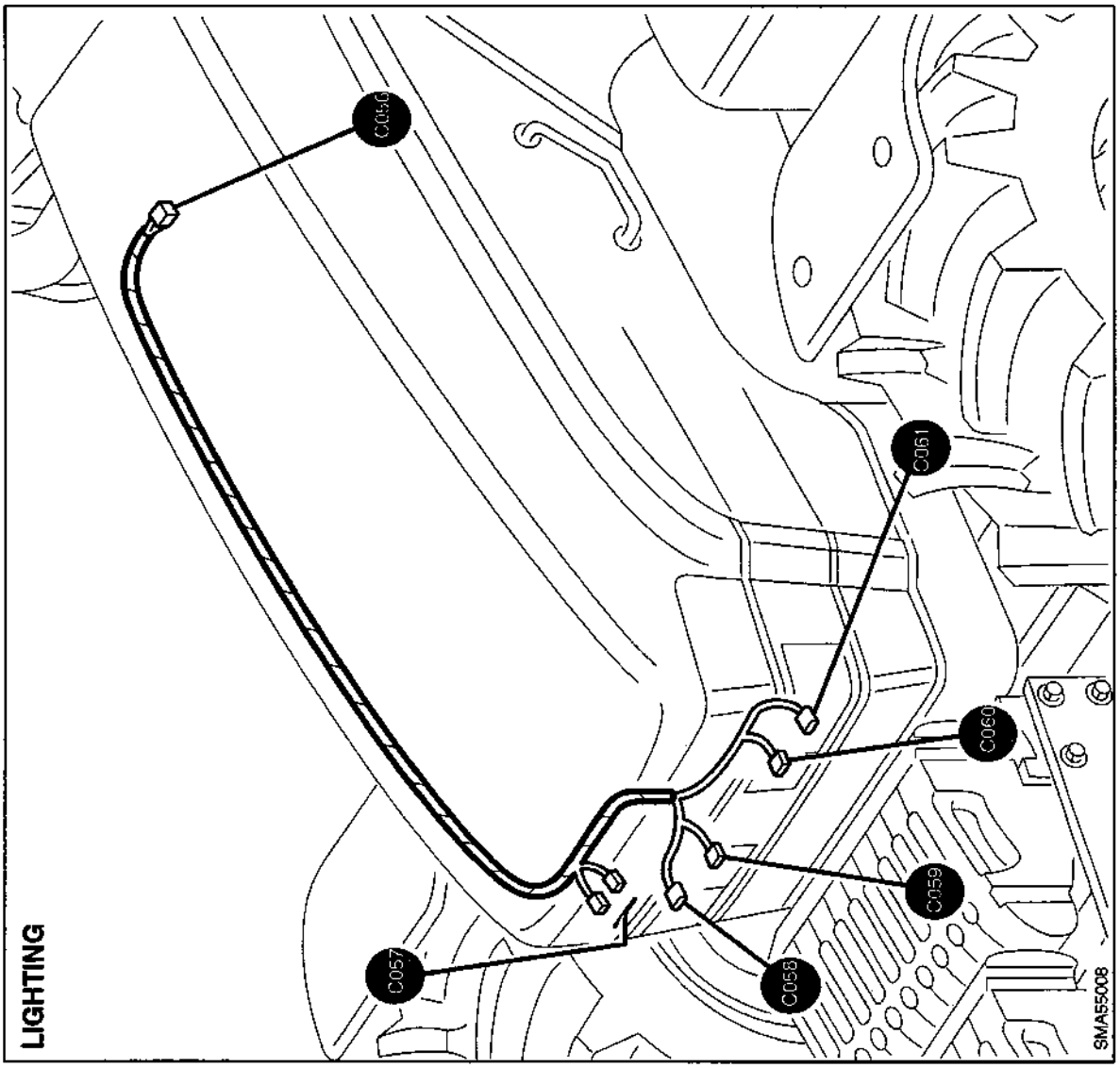
LIGHTING HARNESS CONNECTORS

Connector No.	Component	Harness
C056	Headlamp Harness	LT
C057	Horn	LT
C058	Right Hand Worklamp	LT
C059	Right Hand Headlamp	LT
C060	Left Hand Headlamp	LT
C061	Left Hand Worklamp	LT

Connector No.	Component	Harness

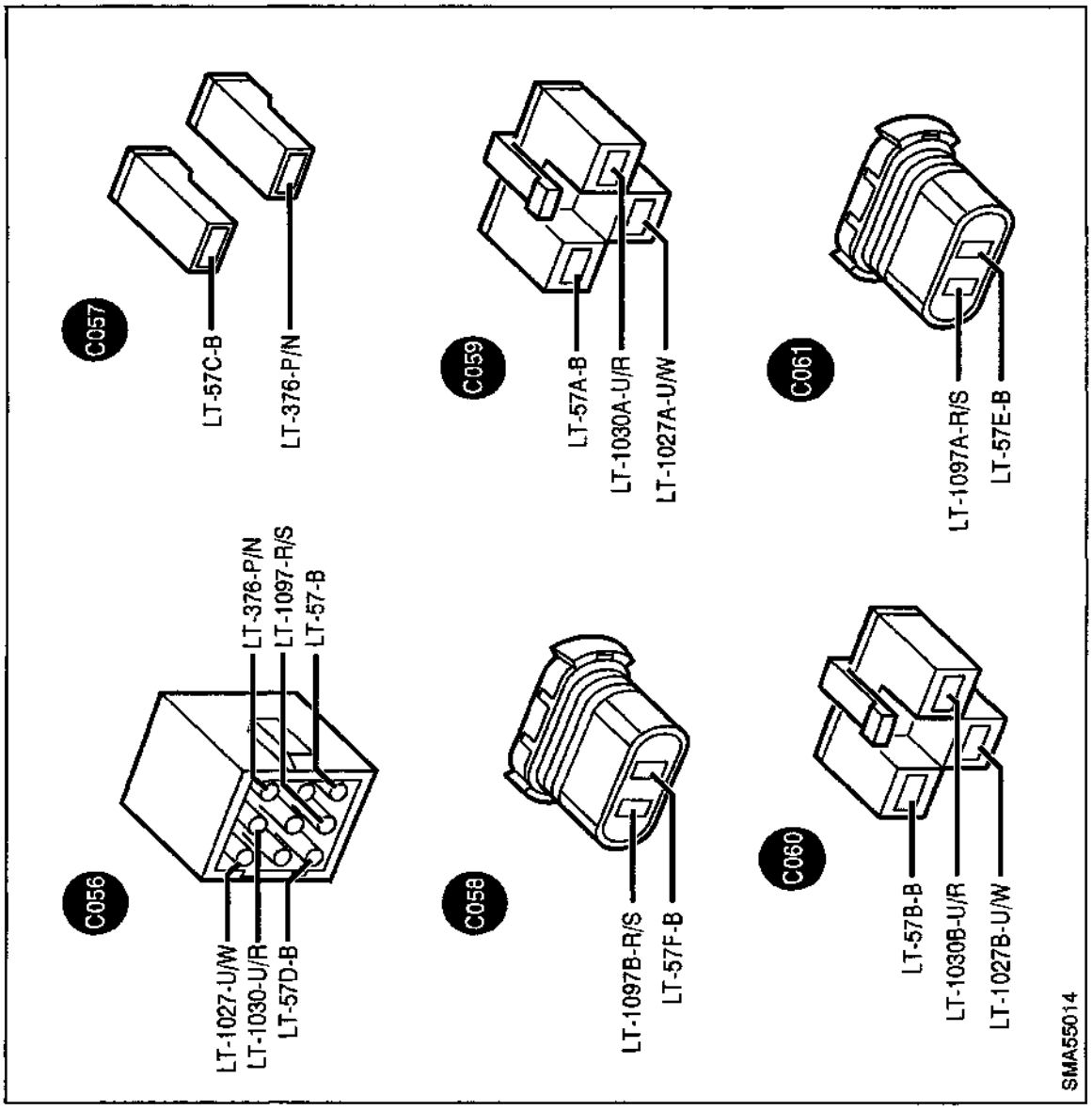
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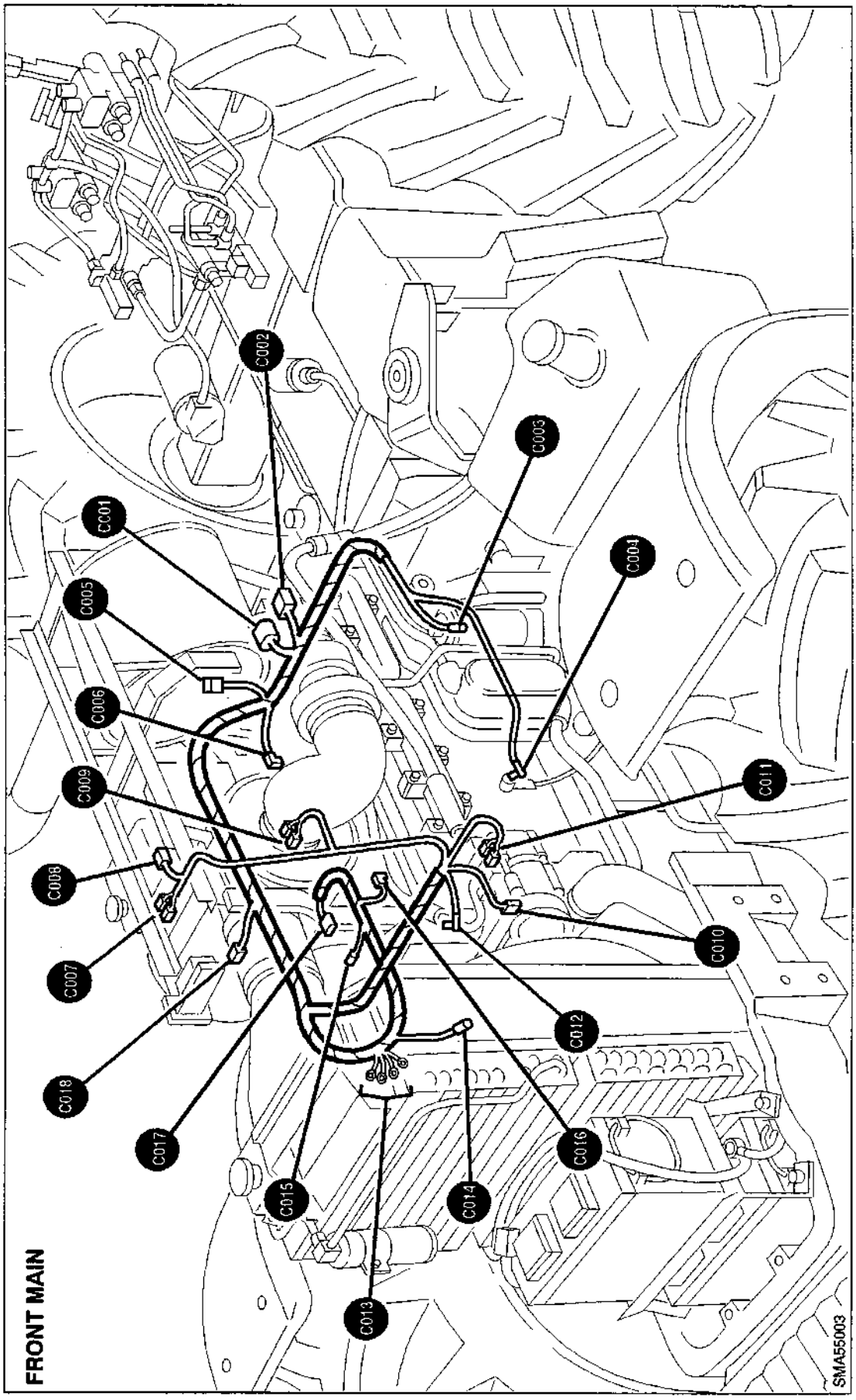
ENGINE HARNESS CONNECTORS

Connector No.	Component	Harness
C001	Front Main Bulkhead Connector M1	FM
C002	Front Main Bulkhead Connector M2	FM
C003	Oil Pressure Sender	FM
C004	Oil Pressure Switch	FM
C005	Starter Relay	FM
C006	Starter Solenoid	FM
C007	Brake Fluid Reservoir	FM
C008	Engine Coolant Level	FM
C009	Vacuum Switch	FM
C010	Air-Con Switch	FM
C011	De–Icing Thermostat	FM
C012	Temperature Sender	FM
C013	Alternator	FM
C014	Steering Sensor	FM
C015	Fuel Shut-Off Solenoid	FM
C016	Fuel Pump	FM
C017	Water in Fuel Sensor	FM
C018	Thermostart	FM

Connector No.	Component	Harness

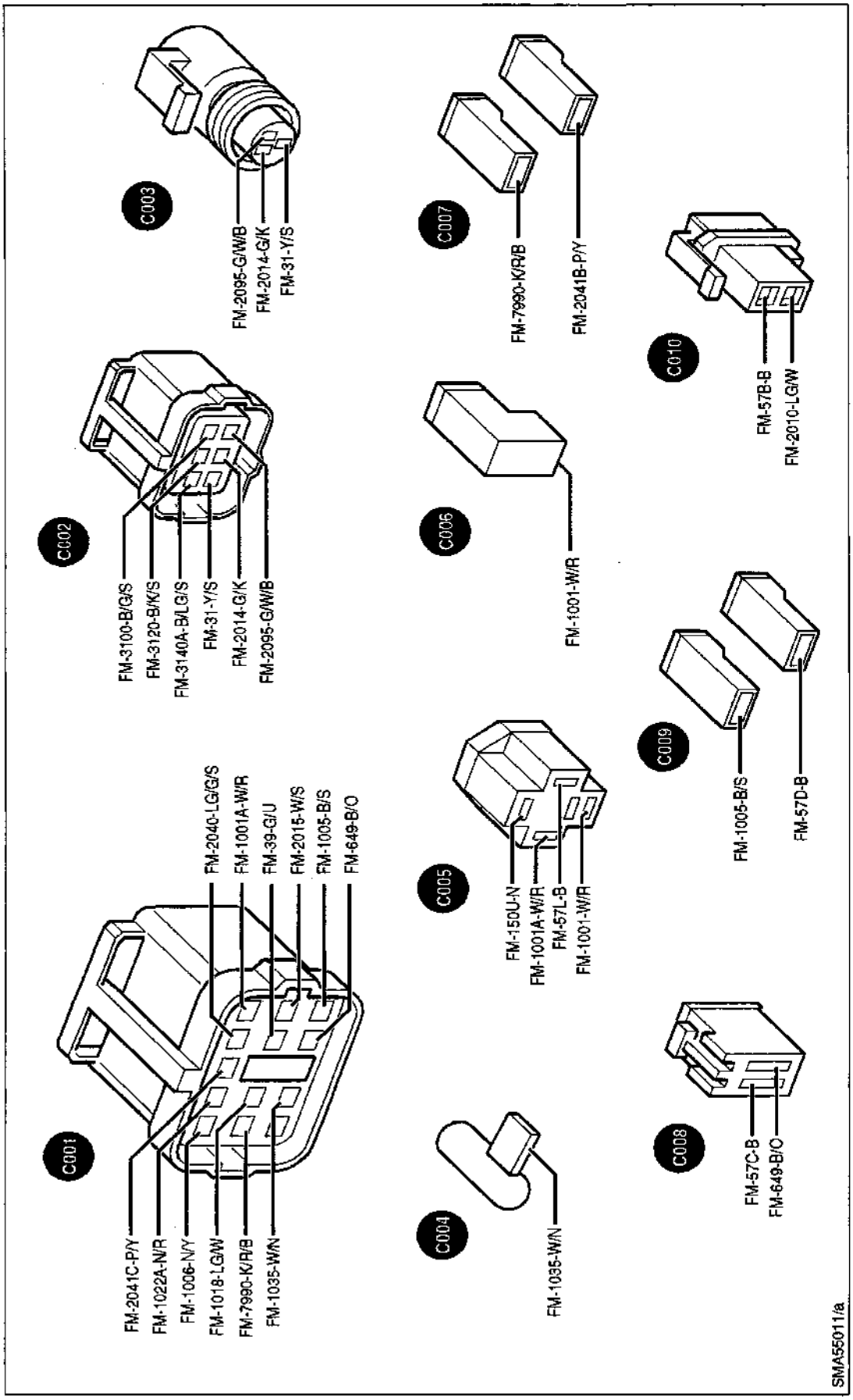
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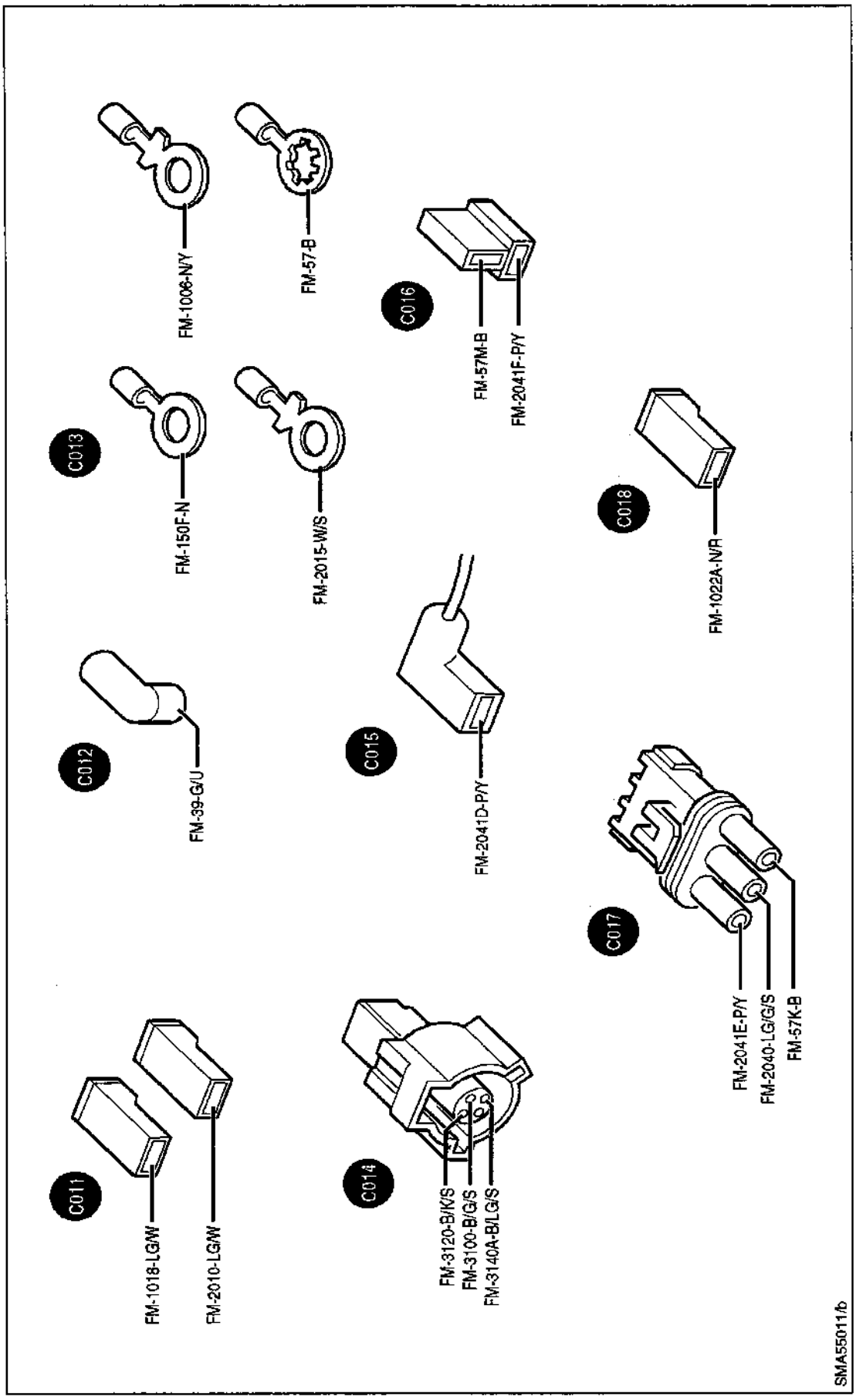
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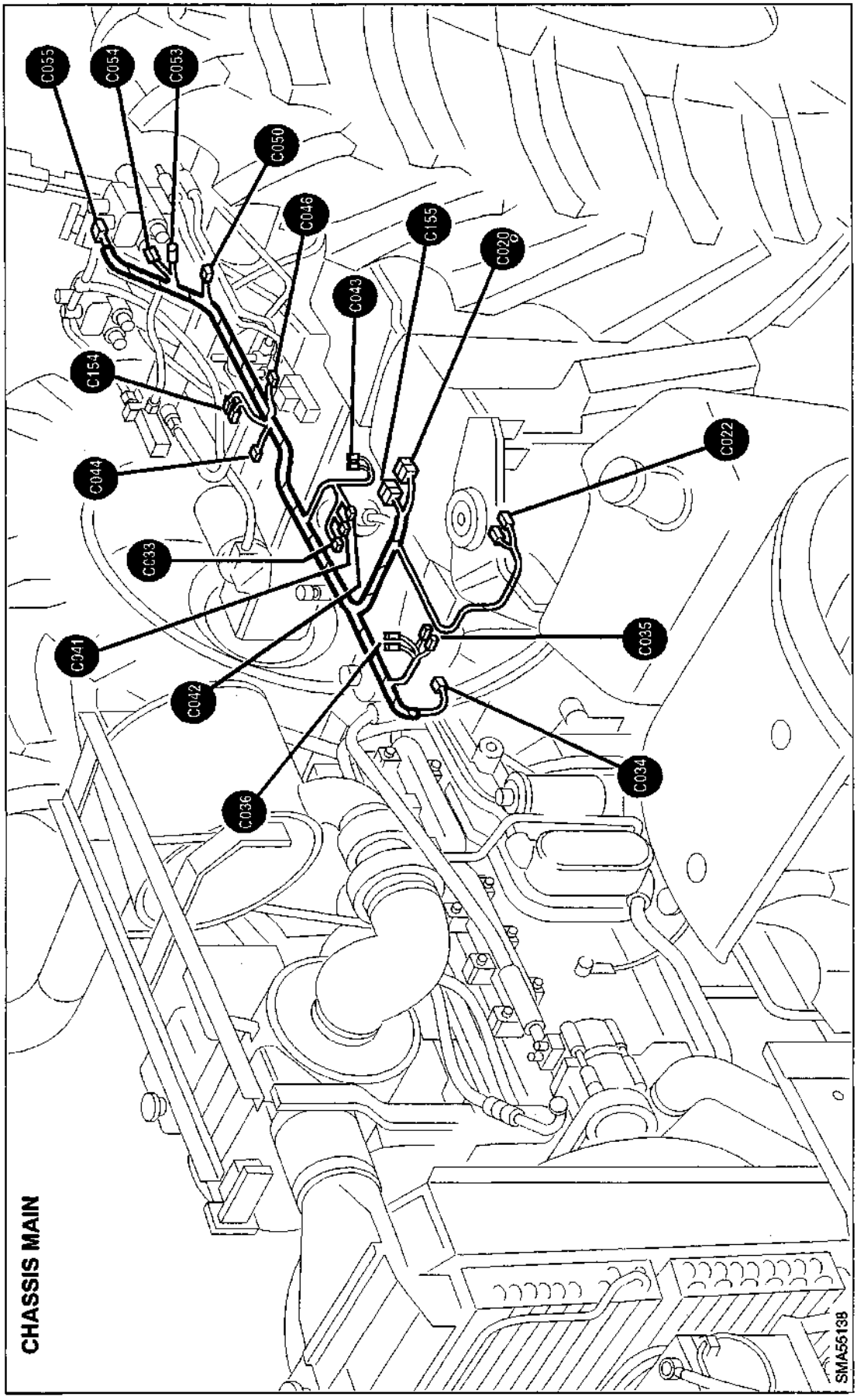
CHASSIS HARNESS CONNECTORS

Connector No.	Component	Harness
C020	Rear Main Extension Connector 2	RM
C022	Fuel Tank Sender	RM
C033	PTO Brake	RM
C034	Front Wheel Drive Solenoid	RM
C035	Front Wheel Drive Switch	RM
C036	Pressure Switch	RM
C041	PTO Solenoid	RM
C042	Diff Lock Solenoid	RM
C043	Diff Lock Switch	RM
C044	Switch Ground Speed PTO Engaged	RM
C046	Axle Speed Sensor	RM
C050	Trailer Brake Connector	RM
C053	Hydraulic Remote Valve Solenoid	RM
C054	PTO Speed Sensor	RM
C055	Trailer Socket	RM
C154	Vacuum Switch	RM
C155	Rear Main Extension Connector 1	RM

Connector No.	Component	Harness

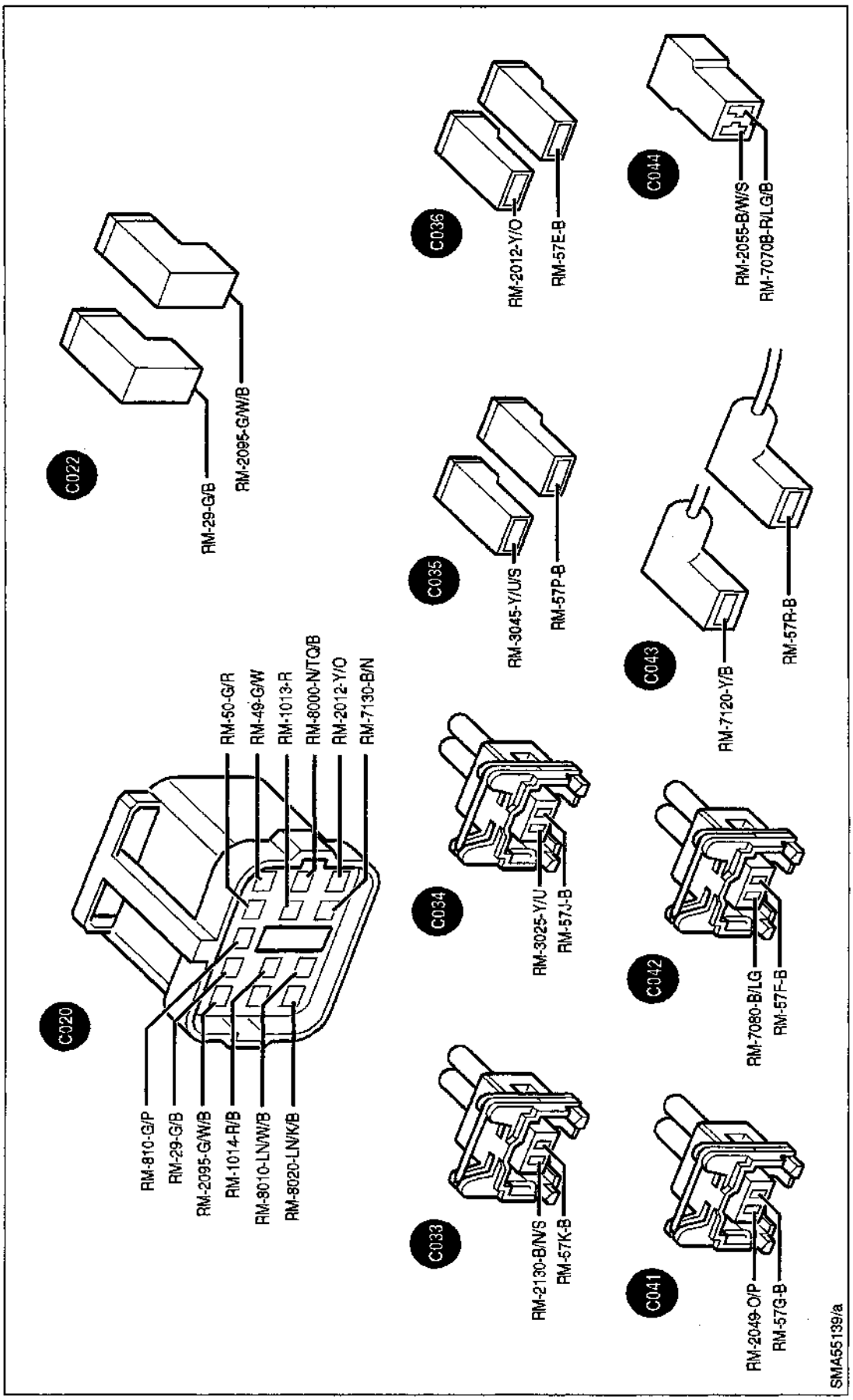
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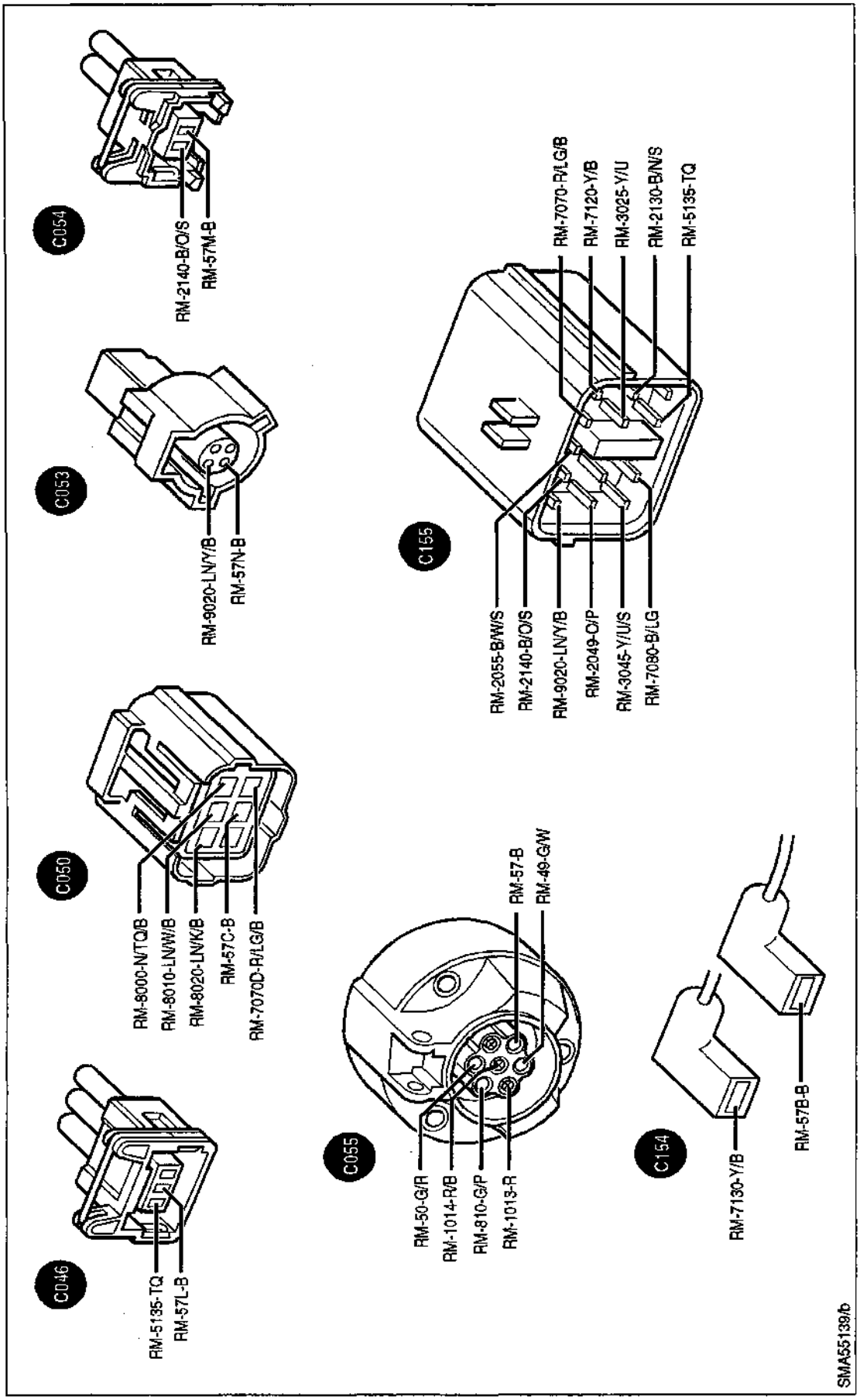
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CAB/PLATFORM HARNESS CONNECTORS

Connector No.	Component	Harness
C001	Cab Main Bulkhead Connector M1	CM
C002	Cab Main Bulkhead Connector M2	CM
C020	Cab Main Extension Connector 2	CM
C056	Headlamp Harness Connector	CM
C062	Right Hand Stop Lamp Switch	CM
C063	Left Hand Stop Lamp Switch	CM
C064	Right Hand Lower Front Worklamp	CM
C065	Left Hand Lower Front Worklamp	CM
C066	Right Side Lamp	CM
C067	Left Side Lamp	CM
C068	Radar	CM
C069	Starter Solenoid (Cab Main)	CM
C070	Main Bulkhead Hitch Connector M3	CM
C071	Main Bulkhead Hitch Connector M4	CM
C072	Starter Switch	CM
C073	Windshield Wiper Switch	CM
C074	Turn Switch	CM
C076	Clutch Switch	CM
C078	Rear Wiper Switch	CM
C079	Instrument Cluster 'A'	CM
C080	Instrument Cluster 'B'	CM
C081	Instrument Cluster 'C'	CM
C082	Beacon Switch	CM
C083	Hazard Switch	CM
C084	Left Hand Upper Front Worklamp	CM
C085	Right Hand Upper Front Worklamp	CM

Connector No.	Component	Harness
C086	Left Hand NASO Front Flasher	CM
C087	Right Hand NASO Front Flasher	CM
C088	Front Wiper Motor	CM
C089	Trailer Brake Gauge Lamp	CM
C090	Left hand Door Switch	CM
C091	Right hand Door Switch	CM
C092	Console Lamp	CM
C093	Left Hand NASO Rear Flasher	CM
C094	Right Hand NASO Rear Flasher	CM
C095	Left Hand Rear License/Worklamp	CM
C096	Right Hand Rear License/Worklamp	CM
C097	Left Hand Beacon	CM
C098	Right Hand Beacon	CM
C099	Interior Lamp	CM
C105	EMU Connector	CM
C106	Radio A	CM
C107	Radio B	CM
C108	Clock	CM
C109	Rear Wiper Motor	CM
C110	Right hand Speaker	CM
C111	Left hand Speaker	CM
C112	Front Hitch Overide	CM
C113	Front Hitch Potentiometer	CM
C114	PTO Engaged Lamp	CM
C115	Front PTO Switch	CM
C116	Rear PTO Switch	CM

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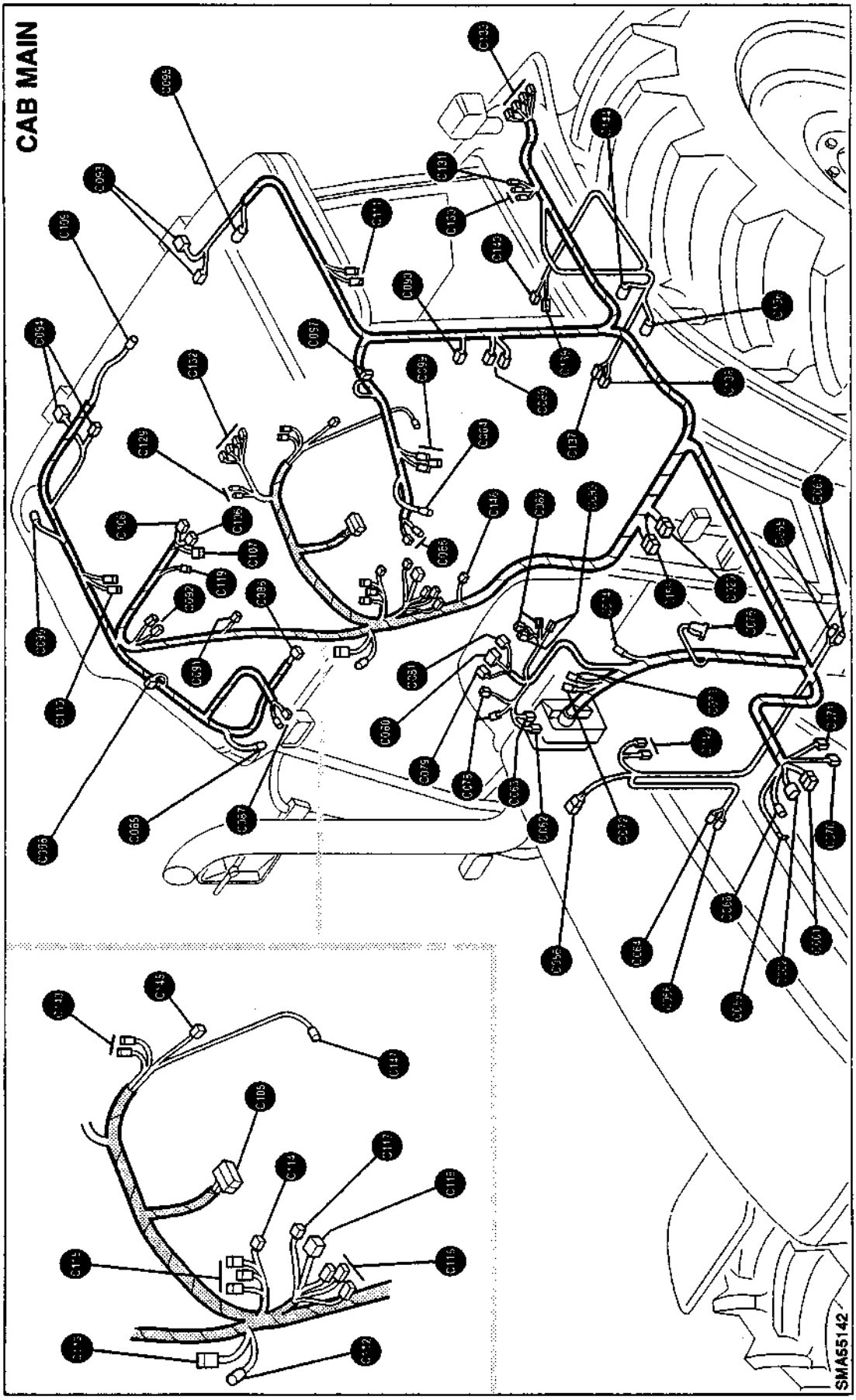
CAB/PLATFORM HARNESS CONNECTORS

Connector No.	Component	Harness
C117	Rear PTO Engaged Lamp	CM
C118	Rear PTO Brake Switch	CM
C119	Heater Air-Con Connector	CM
C129	Worklamp Right Hand Fender	CM
C130	Worklamp Left Hand Fender	CM
C131	License Plate Lamp	CM
C132	Rear Lamp Right Hand Fender	CM
C133	Rear Lamp Left Hand Fender	CM
C136	Handbrake	CM
C137	PTO Alarm Seat Switch	CM
C138	Seat Pump	CM
C139	Front Washer Motor	CM
C140	Rear Washer Motor	CM
C142	Clutch Fluid Reservoir Switch	CM
C143	Implement Socket	CM
C144	Air Brake Connector	CM
C145	Rear Socket Connector	CM
C146	Lift–O–Matic	CM
C147	Remote Valve Switch	CM
C155	Cab Main Extension Connector 1	CM

Connector No.	Component	Harness

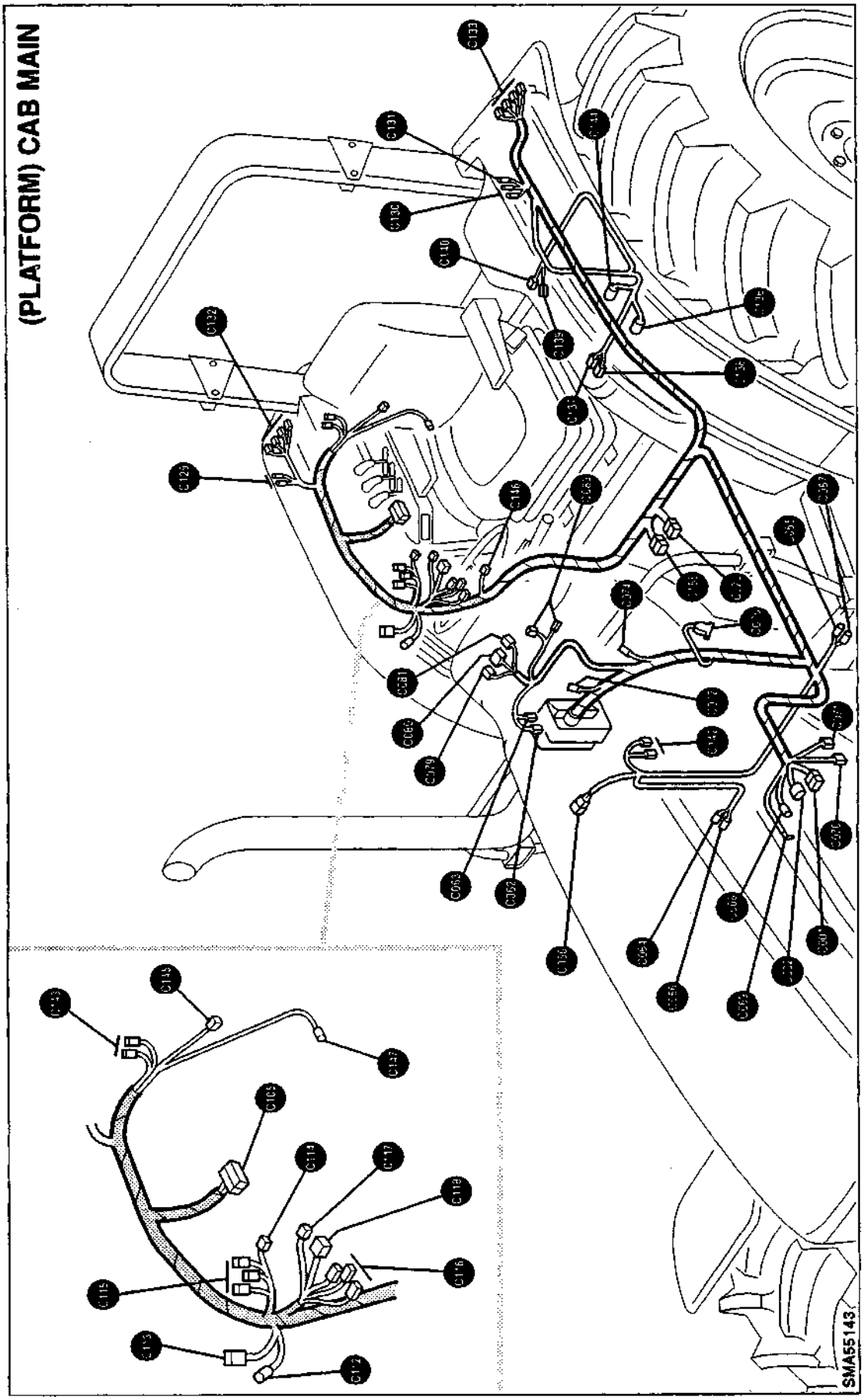
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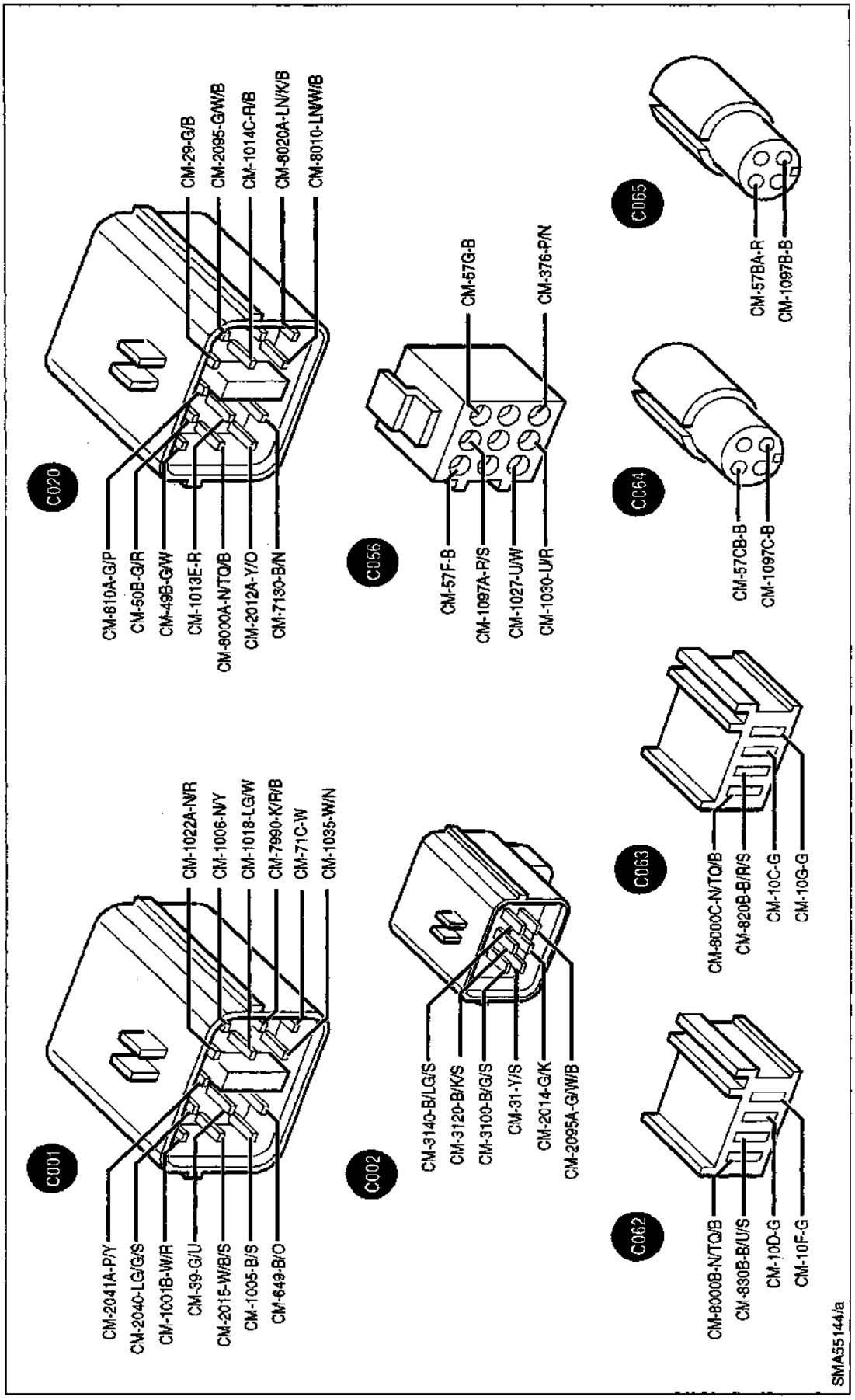
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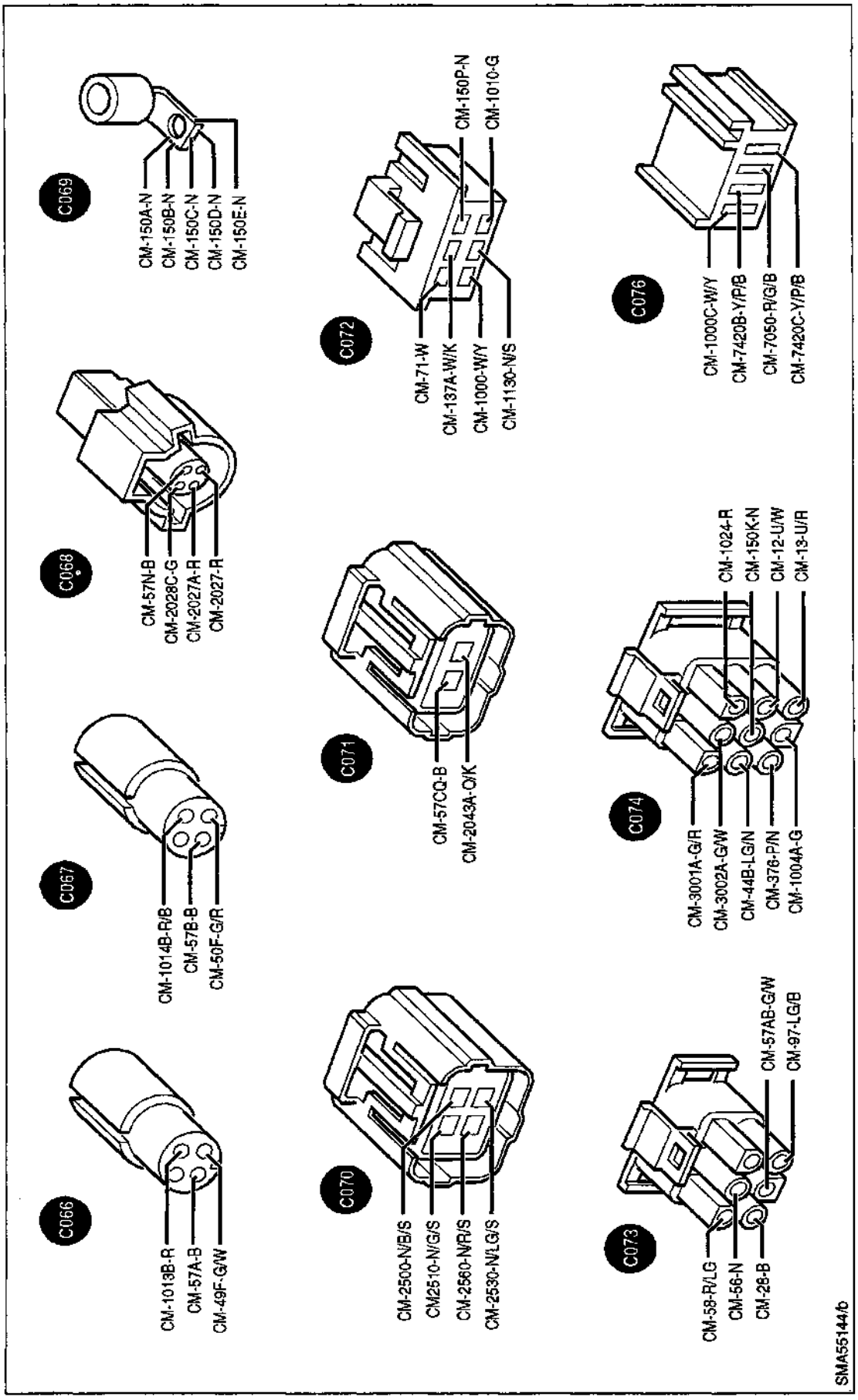
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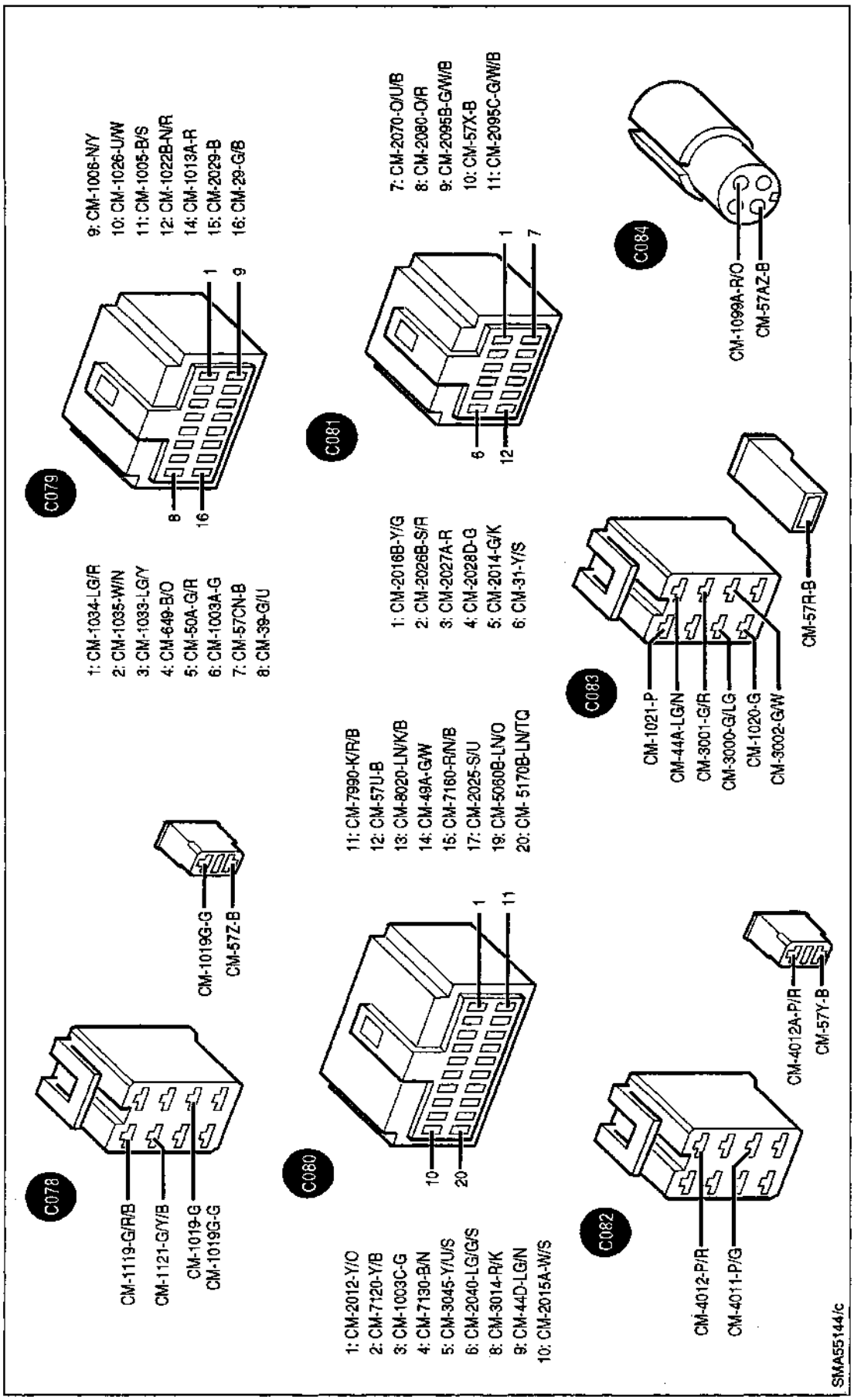
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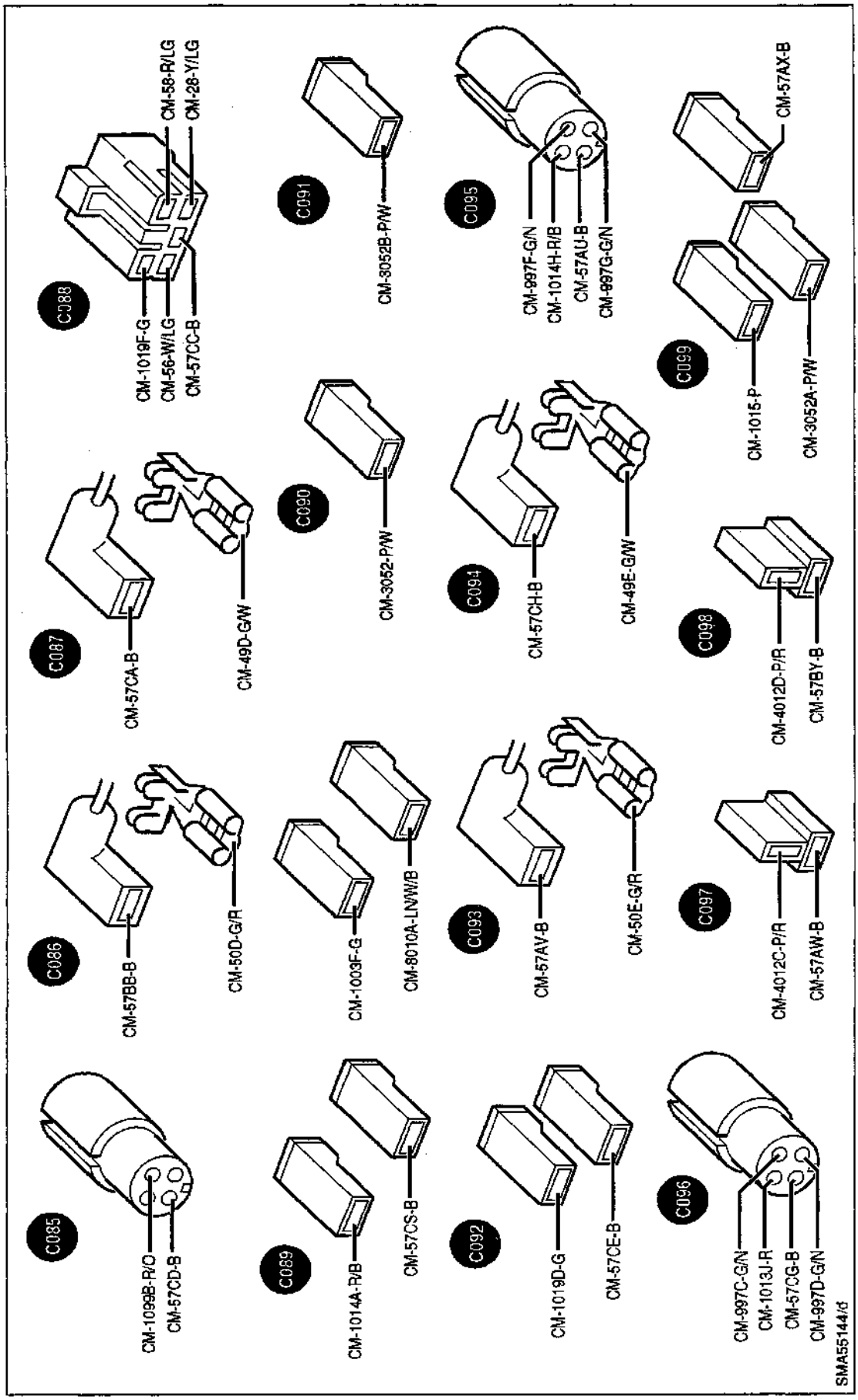
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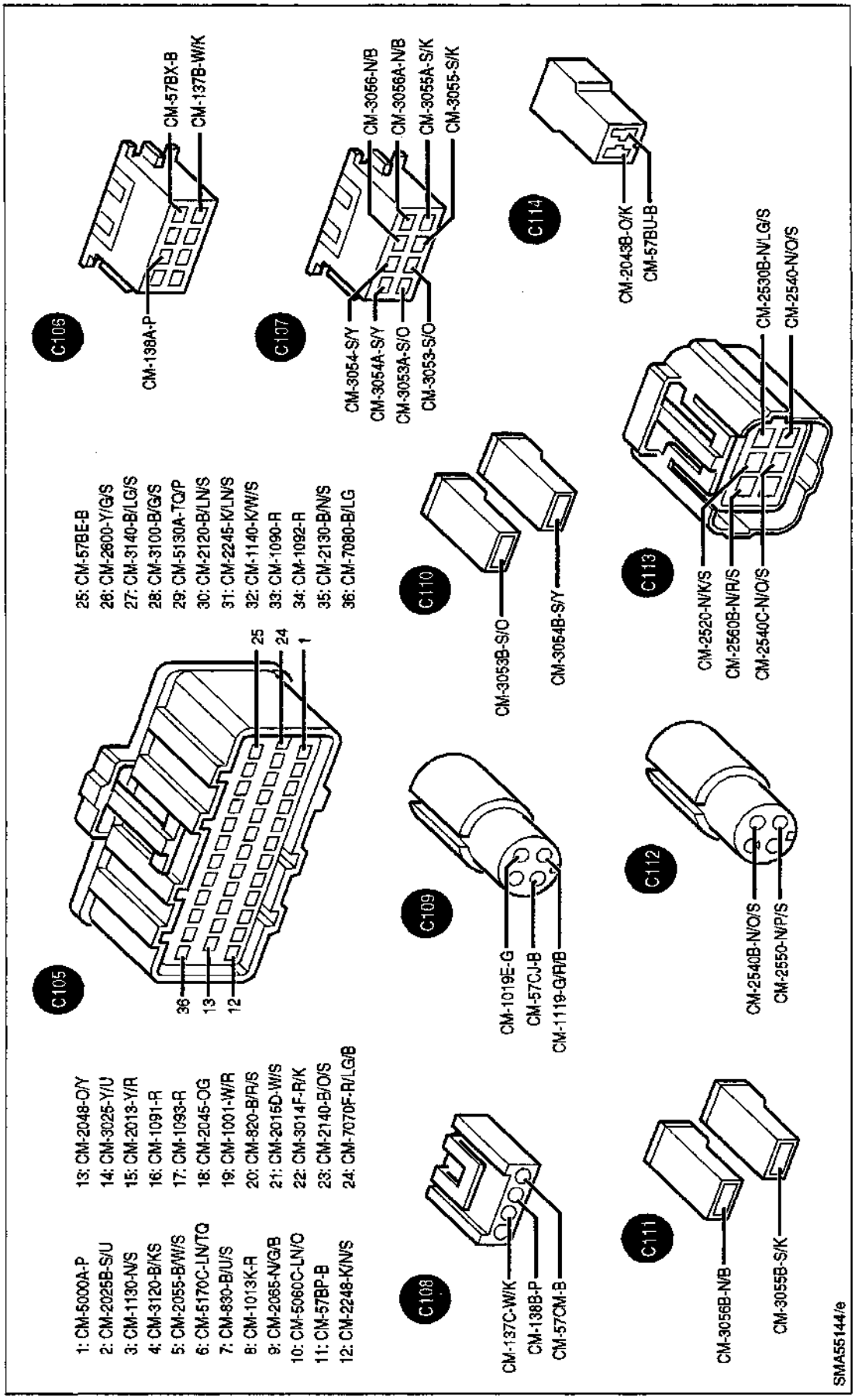
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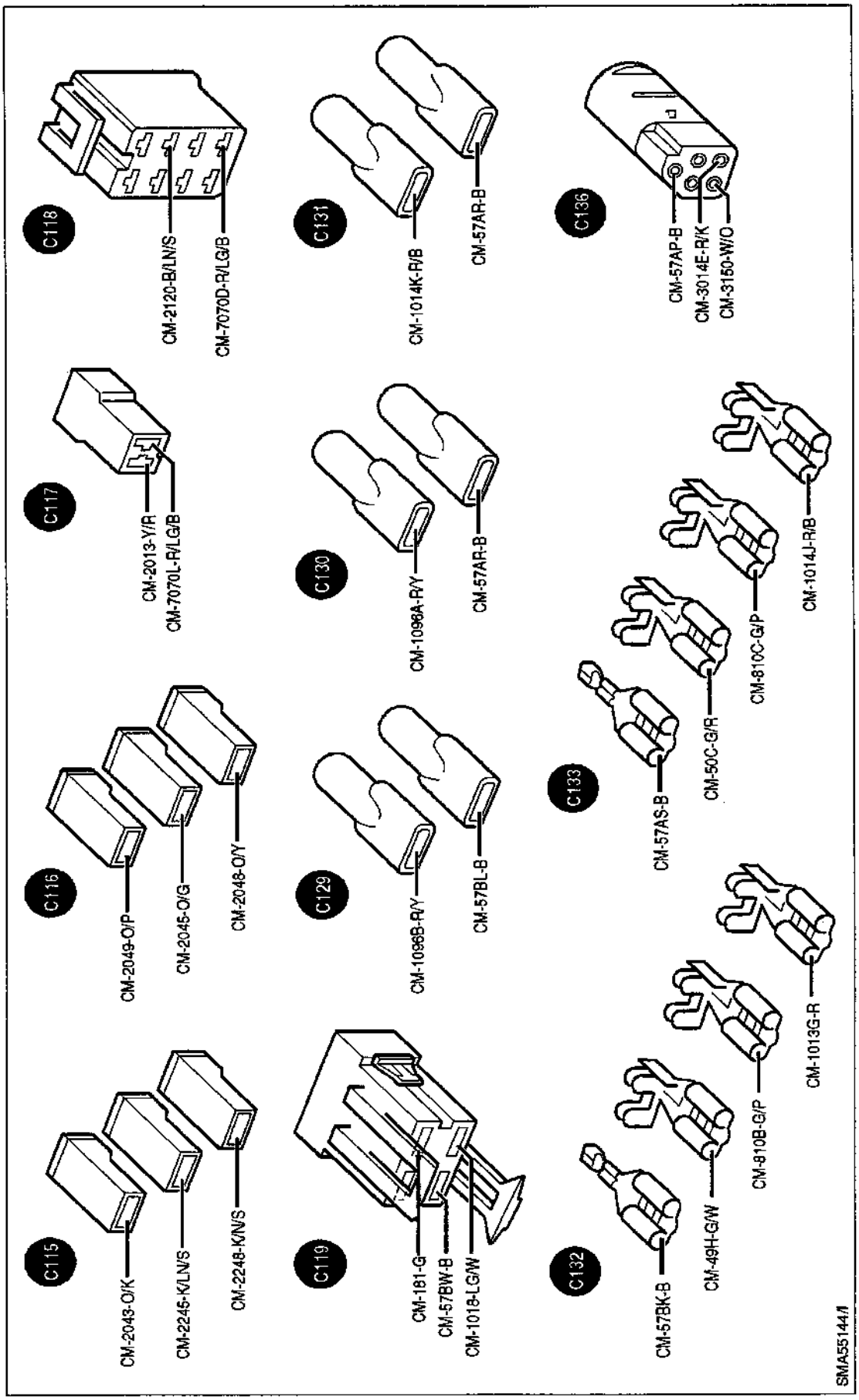
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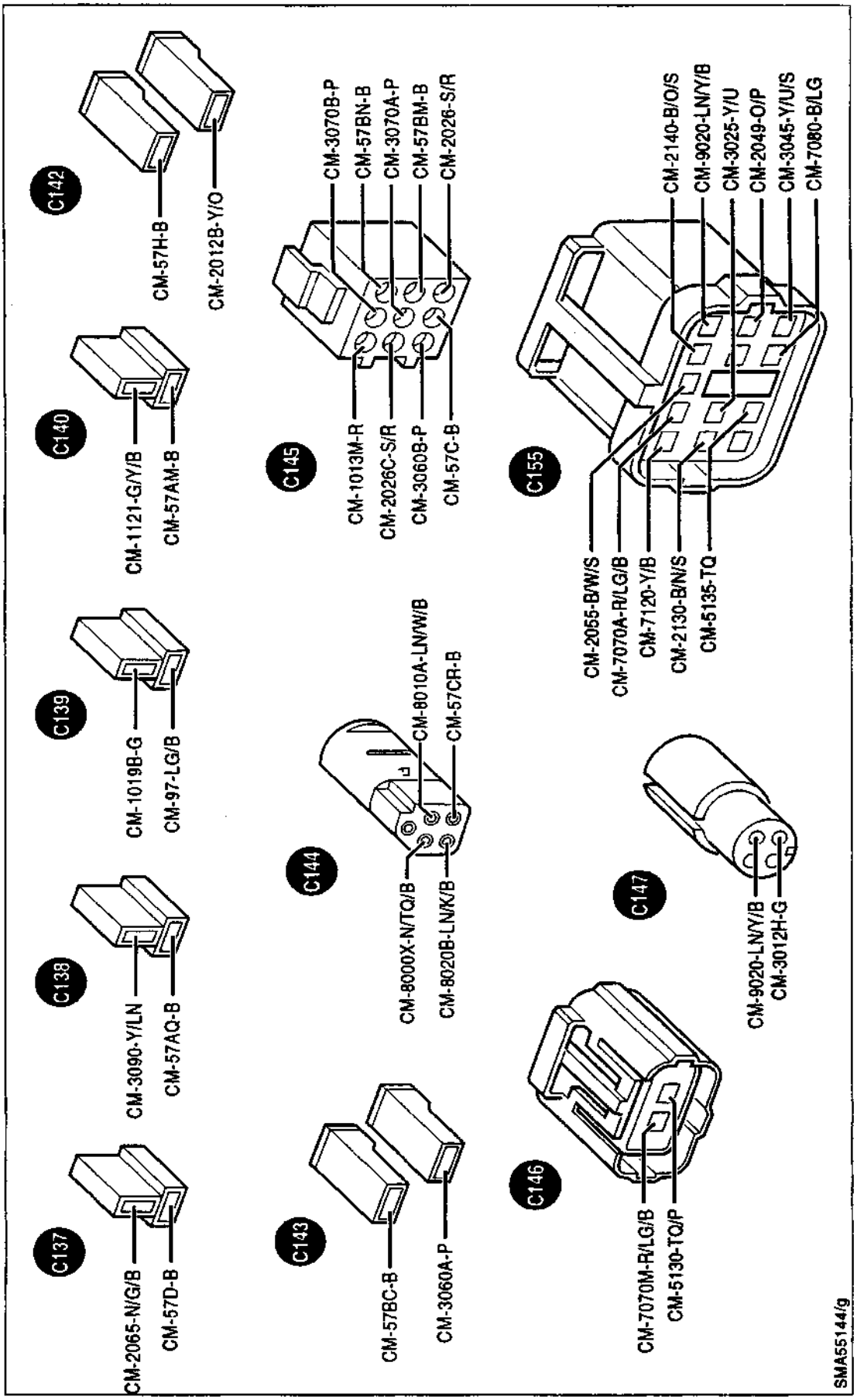
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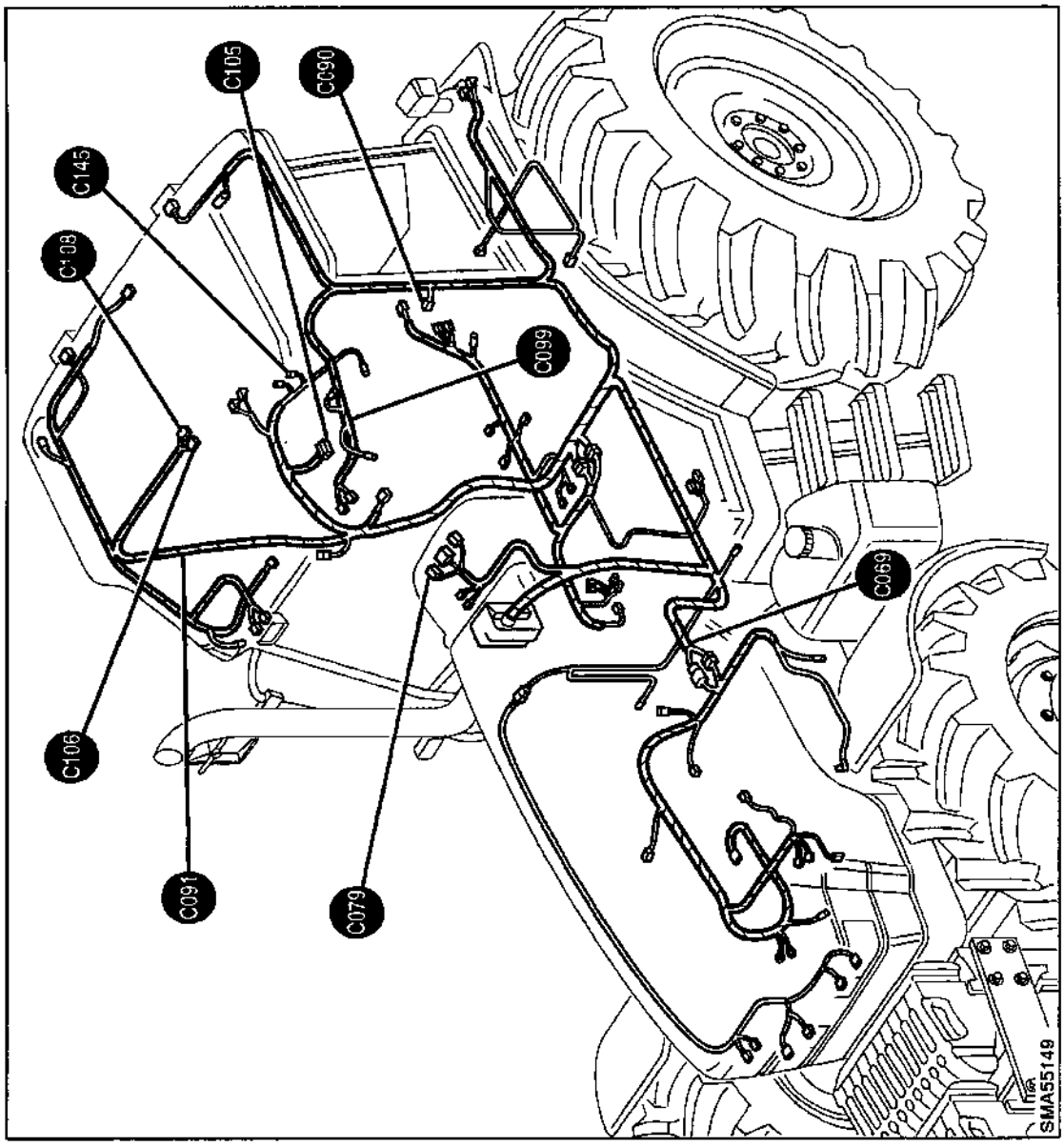


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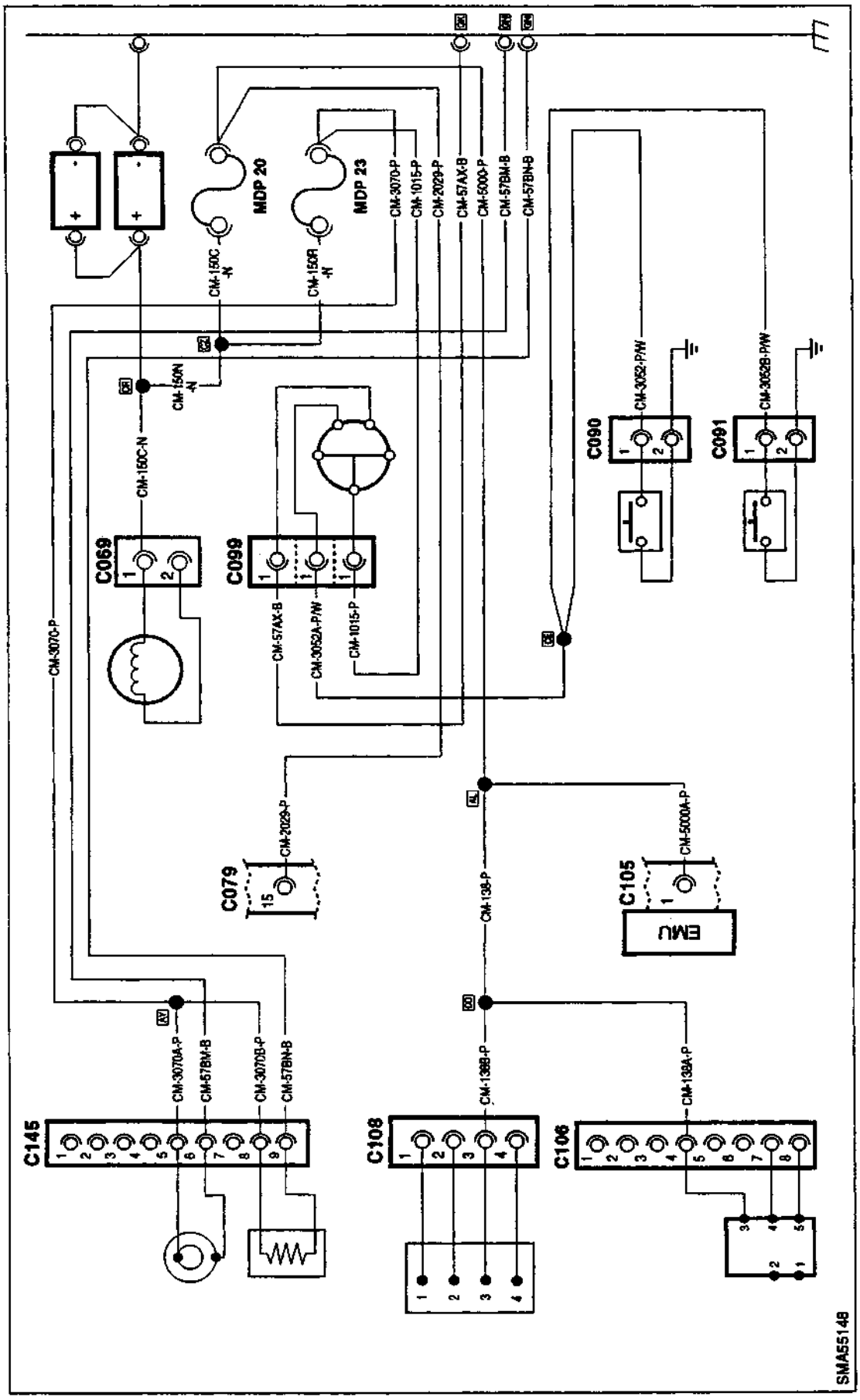
BASIC LIVE

C069 – Starter Solenoid
C079 – Instrument Cluster 'A'
C090 – Left Hand Door Switch
C091 – Right Hand Door Switch
C099 – Interior Lamp
C105 – EMU Connector
C106 – Radio A
C108 – Clock
C145 – Rear Socket Connector



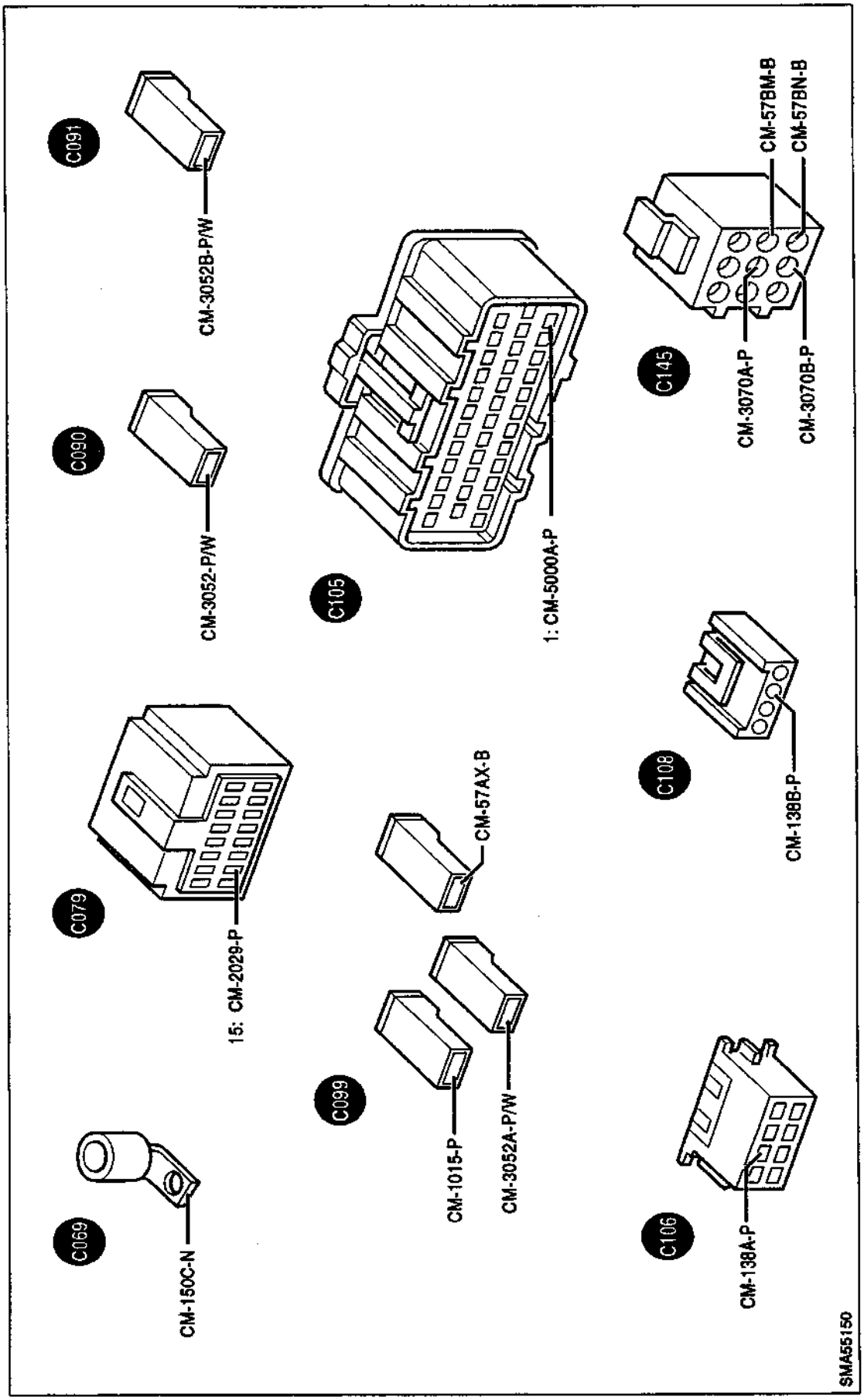
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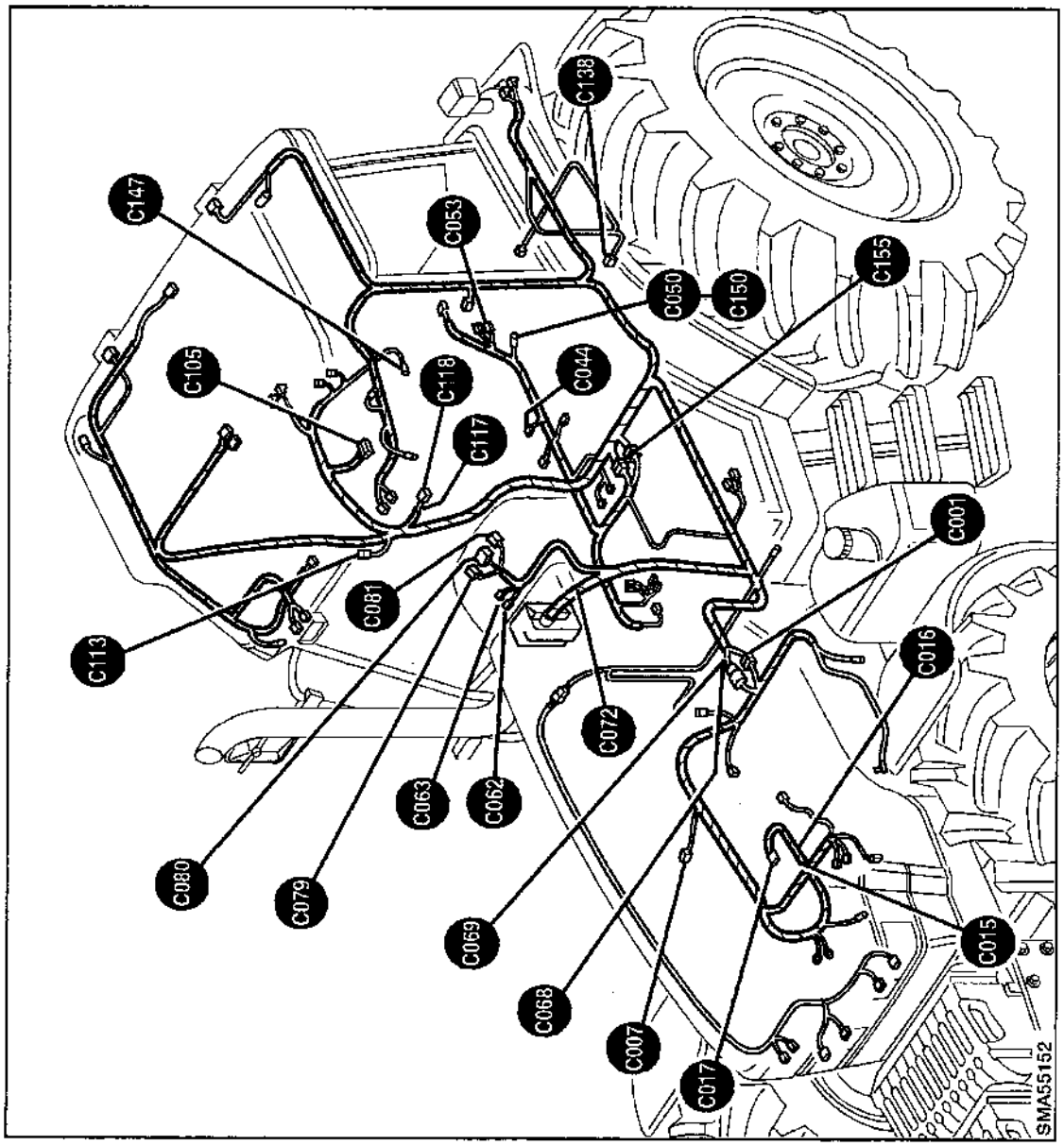


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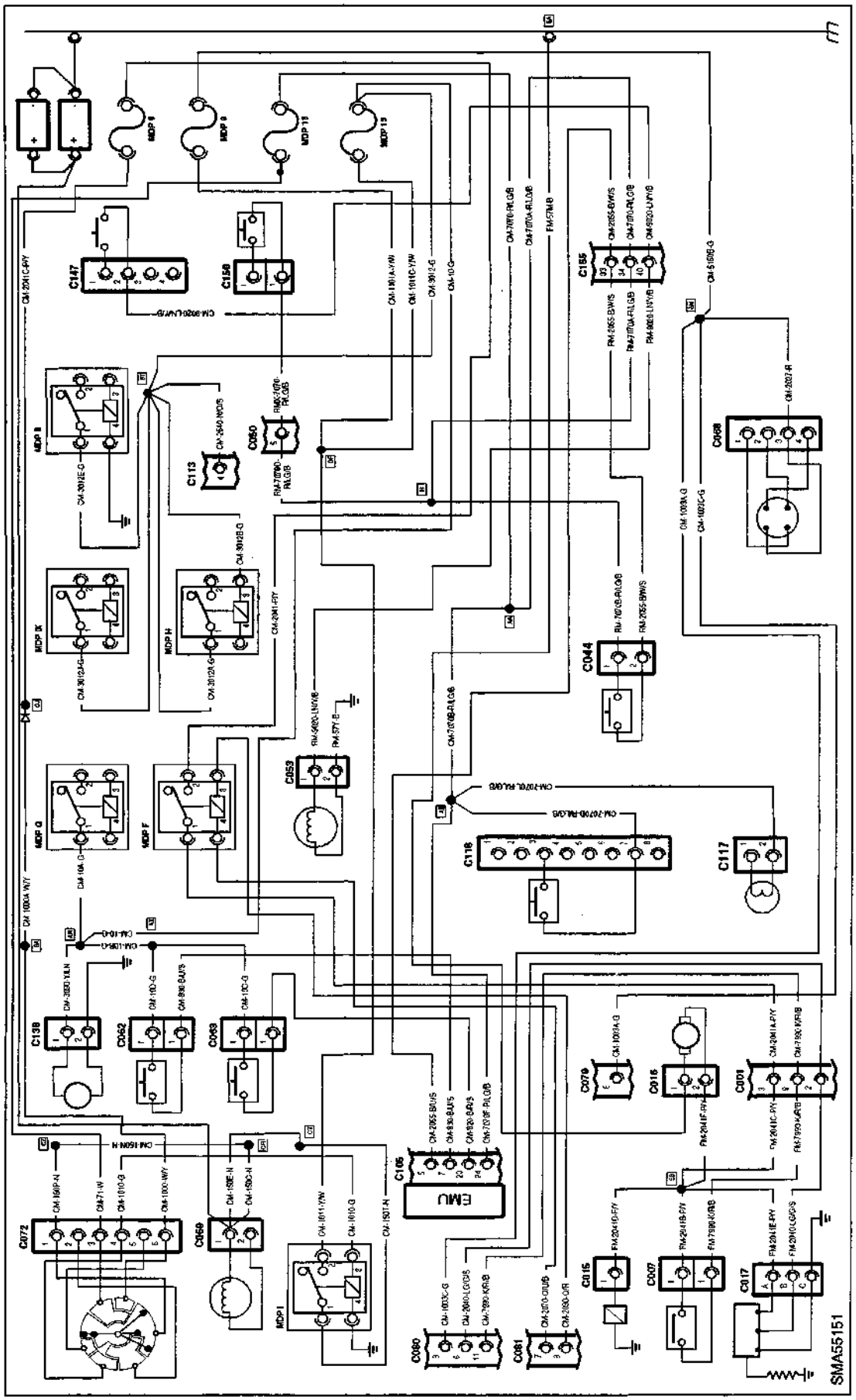
IGNITION ON 1

C001 – Front Main Bulkhead Connector
C007 – Brake Fluid Reservoir
C015 – Fuel shut Off Solenoid
C016 – Fuel Pump
C017 – Water in Fuel Sensor
C044 – Group Speed PTO Engaged
C050 – Trailer Brake
C053 – Hydraulic Remote Valve Solenoid
C062 – RH Stop Lamp Switch
C063 – LH Stop Lamp Switch
C068 – Radar
C069 – Starter Solenoid (Cab Main)
C072 – Starter Switch
C079 – Instrument Cluster A
C080 – Instrument Cluster B
C081 – Instrument Cluster C
C105 – EMU Connector
C113 – Front Hitch Potentiometer
C117 – Rear PTO Engaged Lamp
C118 – Rear PTO Brake Switch
C138 – Seat Pump
C147 – Remote Valve Switch
C150 – Pressure Switch 100
C155 – Rear Main Extension Connector 1



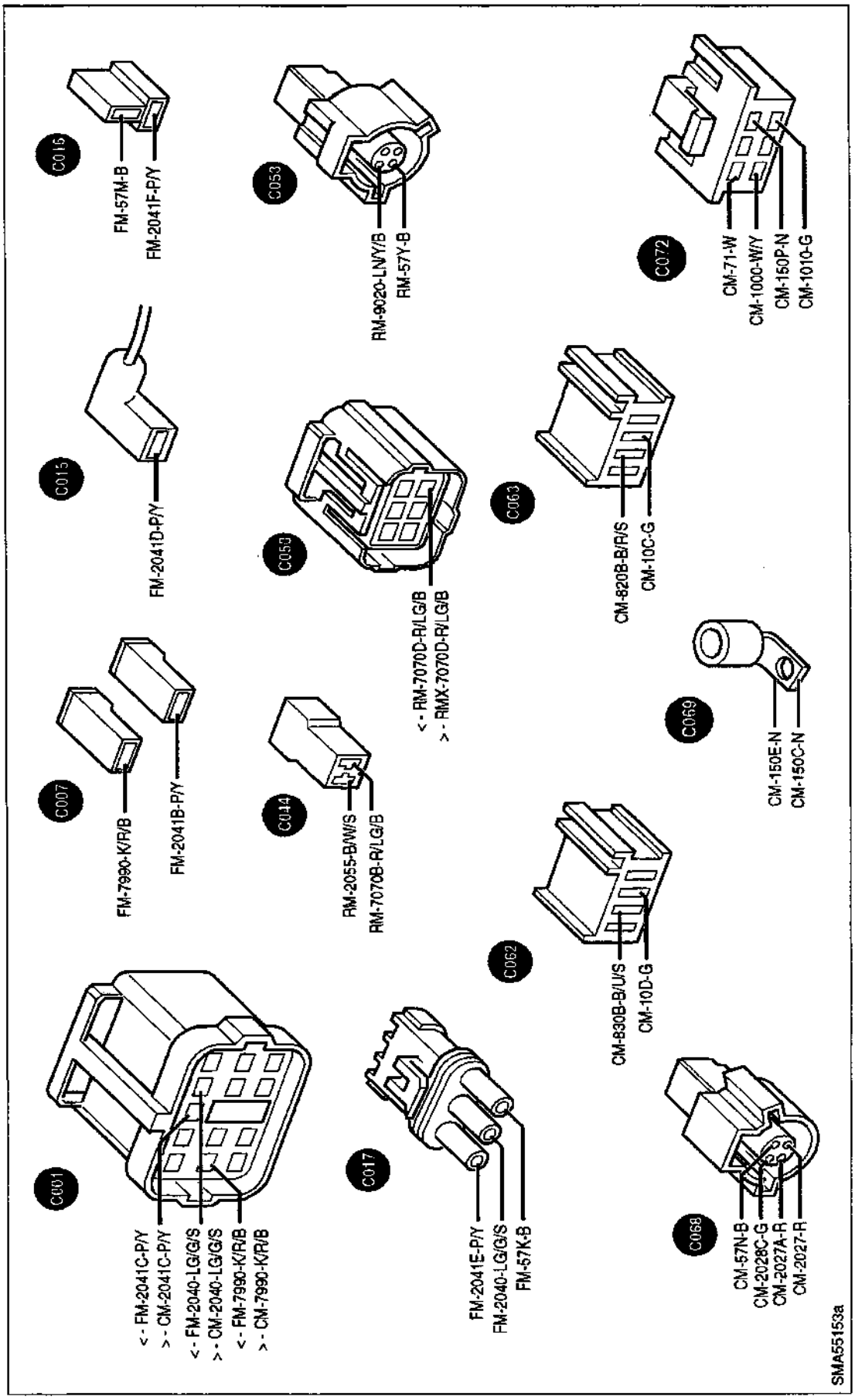
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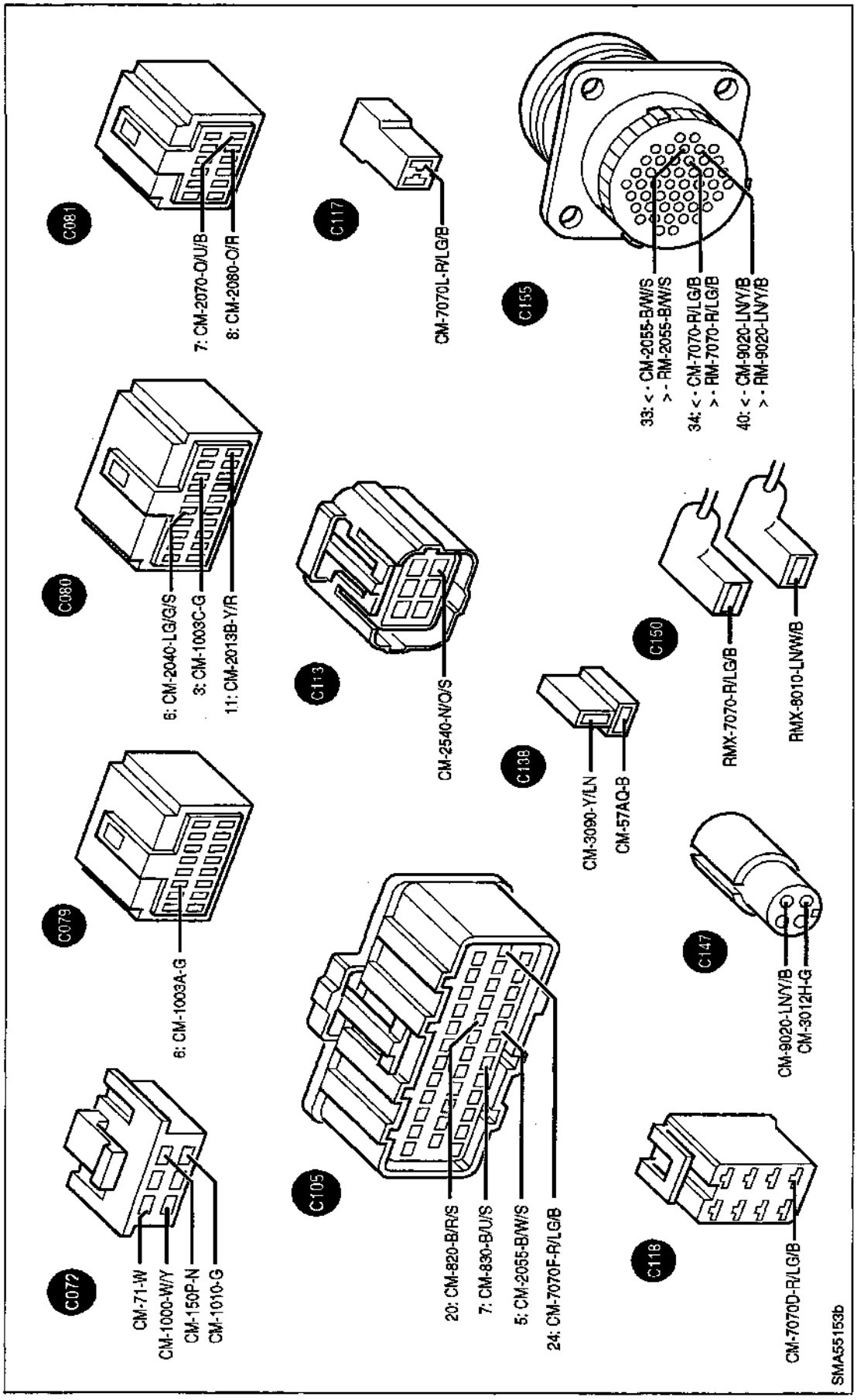
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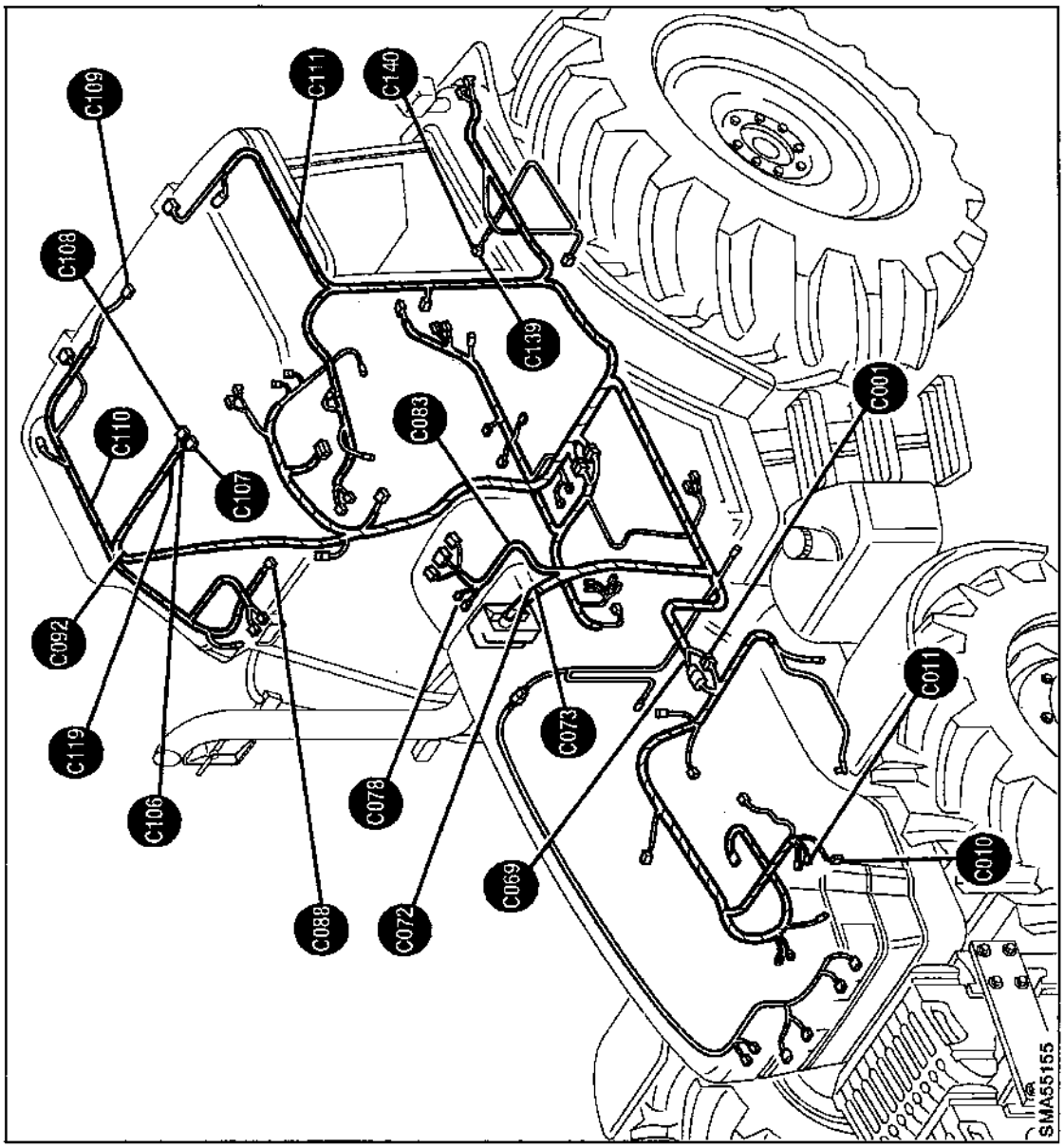


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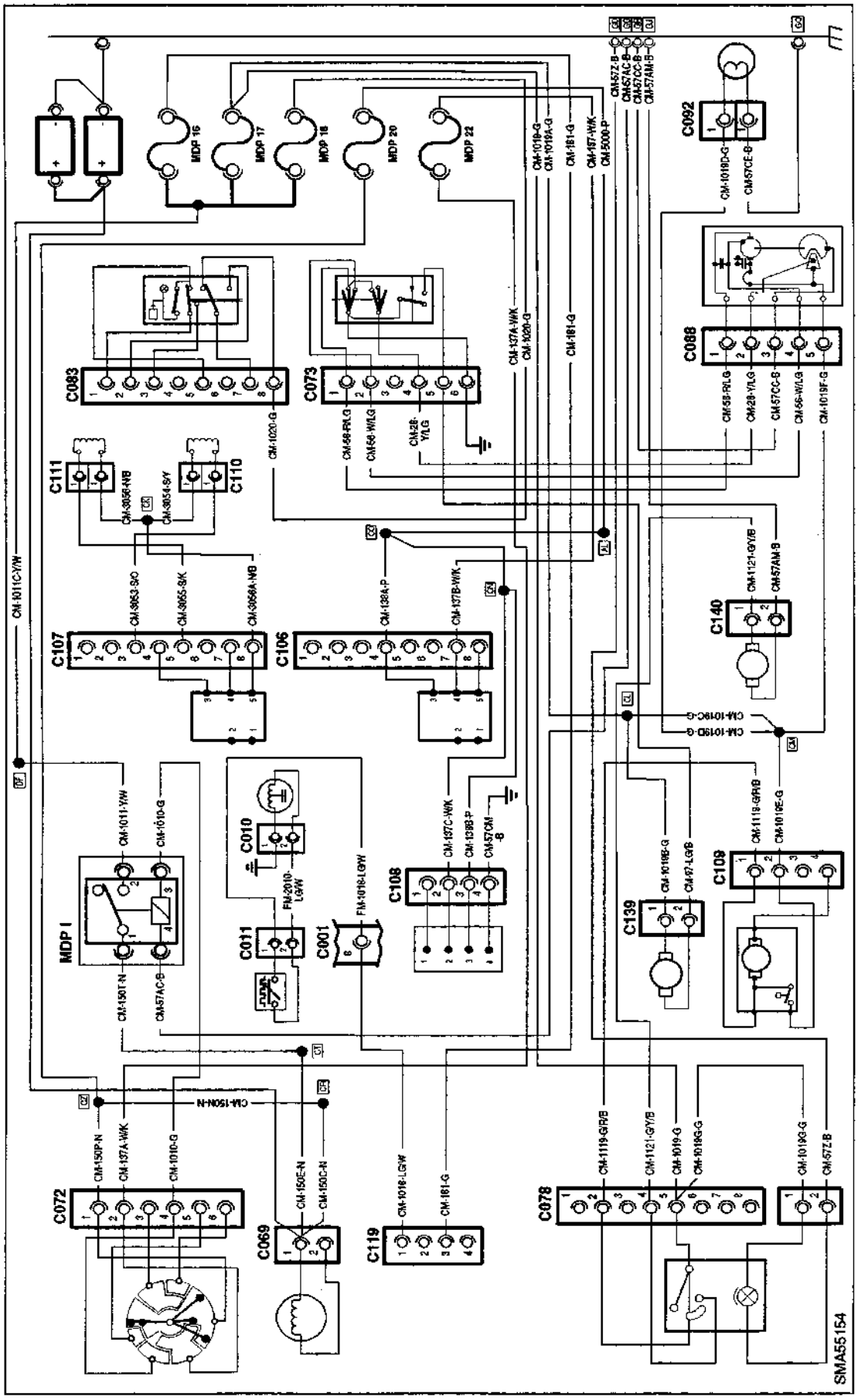
IGNITION ON 2

C001 – Main Bulkhead Connector M1
C010 – Air Con–Switch
C011 – De–Icing Thermostat
C069 – Starter Solenoid (Cab Main)
C072 – Starter Switch
C073 – Windshield Wiper Switch
C078 – Rear Wiper Switch
C083 – Hazard Switch
C088 – Front Wiper Motor
C092 – Console Lamp
C106 – Radio A
C107 – Radio B
C108 – Clock
C109 – Rear Wiper Motor
C110 – Right Hand Speaker
C111 – Left Hand Speaker
C119 – Heater Air–Con Connector
C139 – Front Washer Motor
C140 – Rear Washer Motor



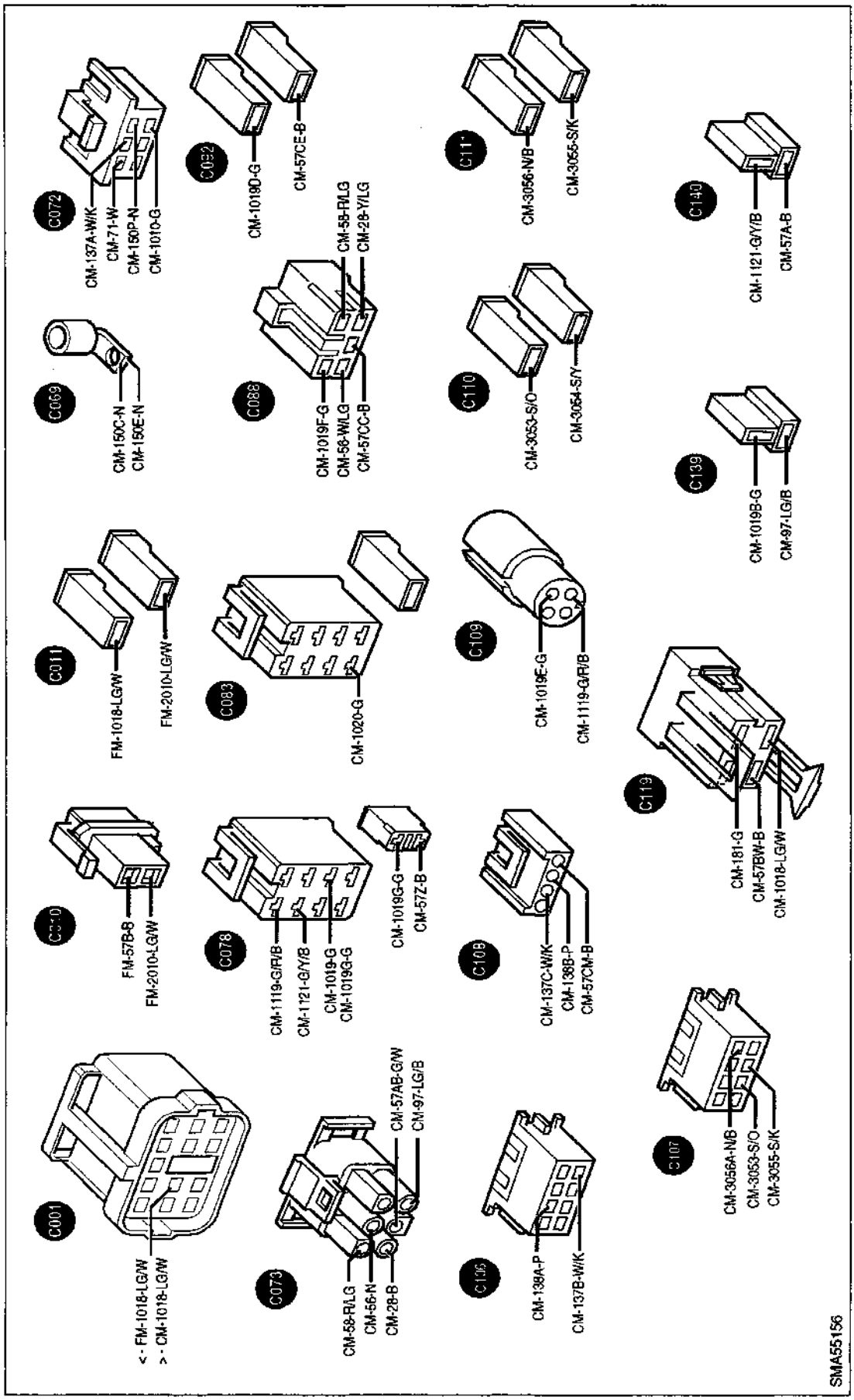
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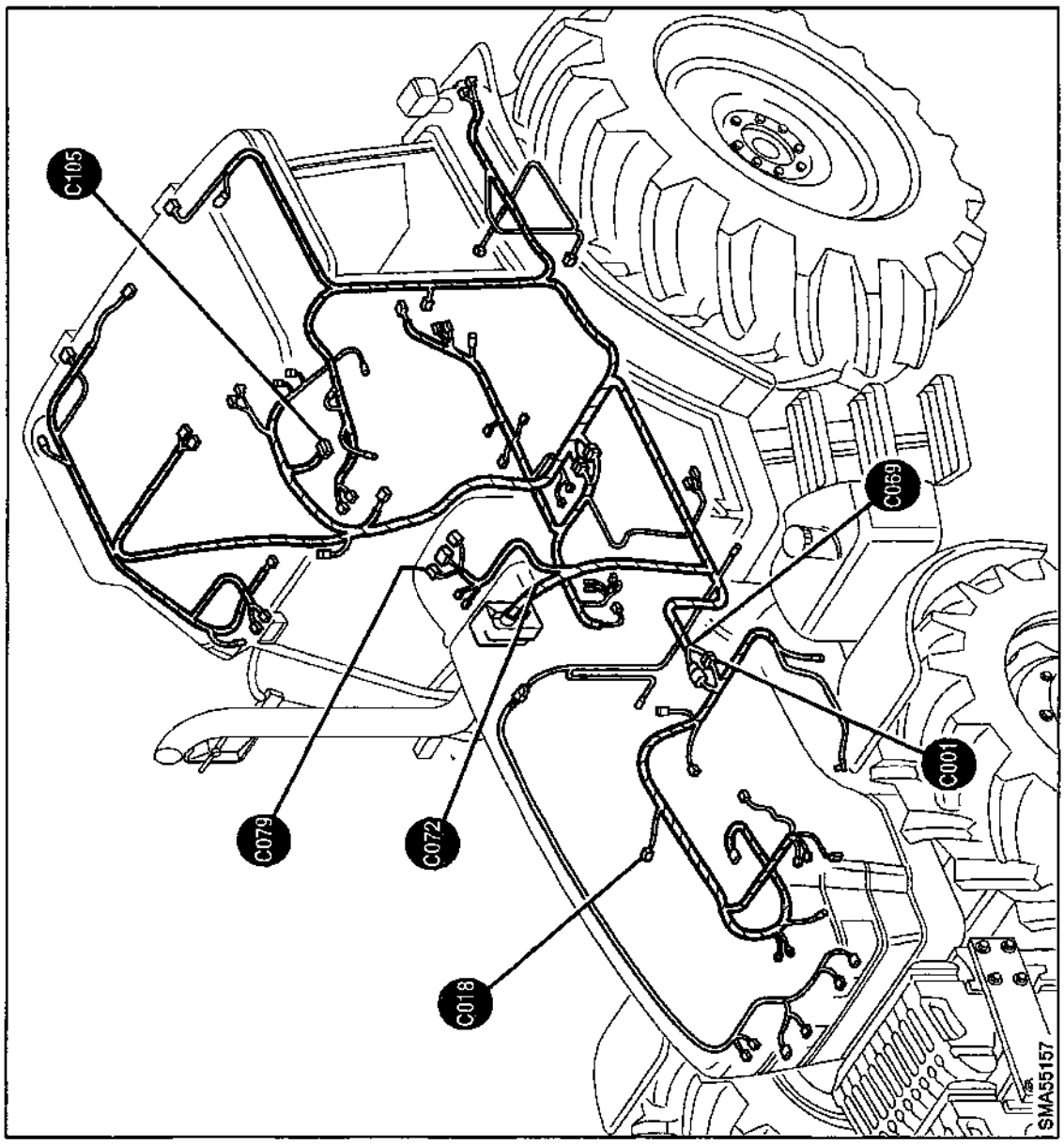


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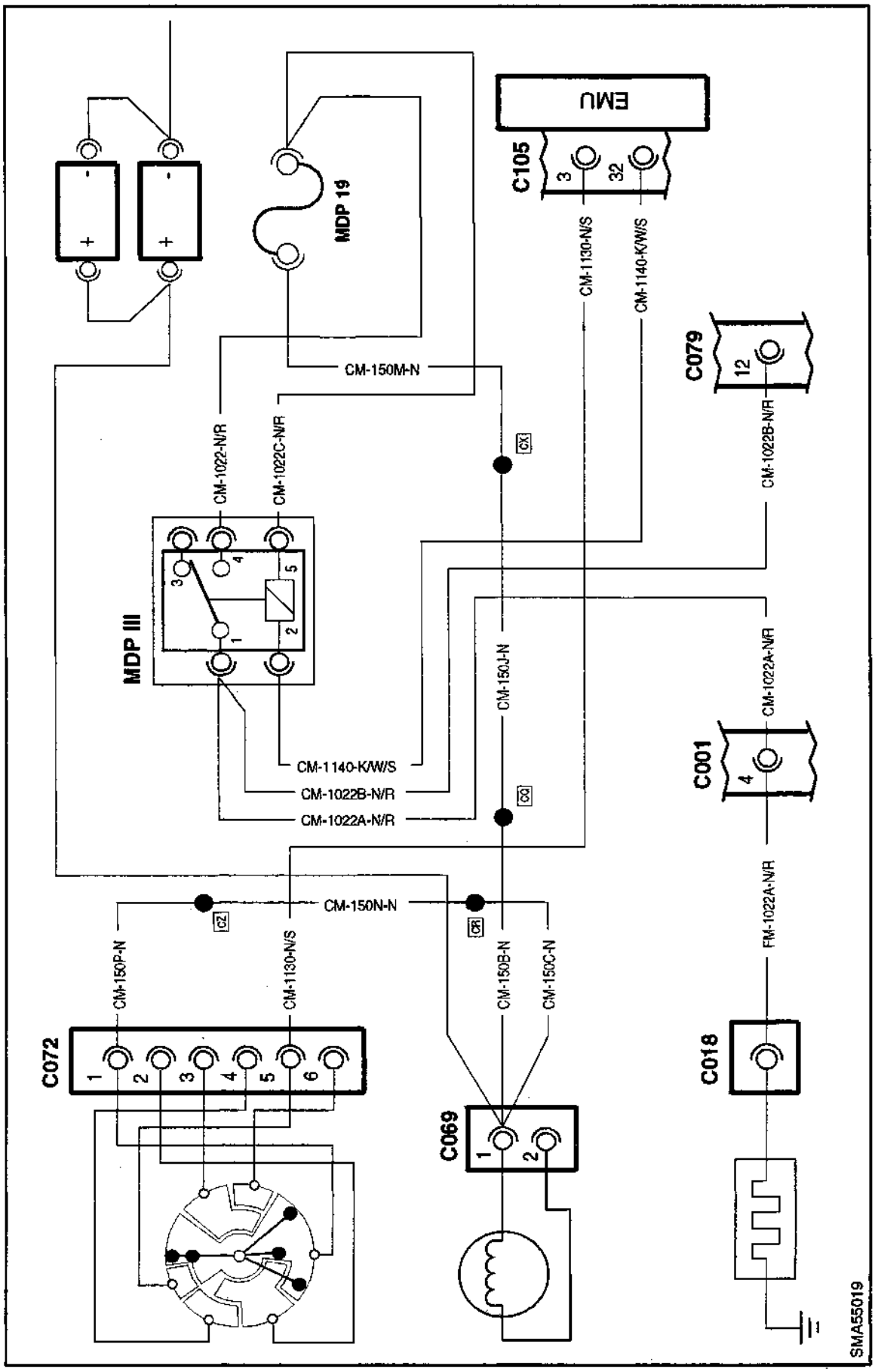
THERMOSTART

C001 – Main Bulkhead Connector M1
C018 – Thermostart
C069 – Starter Solenoid
C072 – Starter Switch
C079 – Instrument Cluster 'A'
C105 – EMU Connector



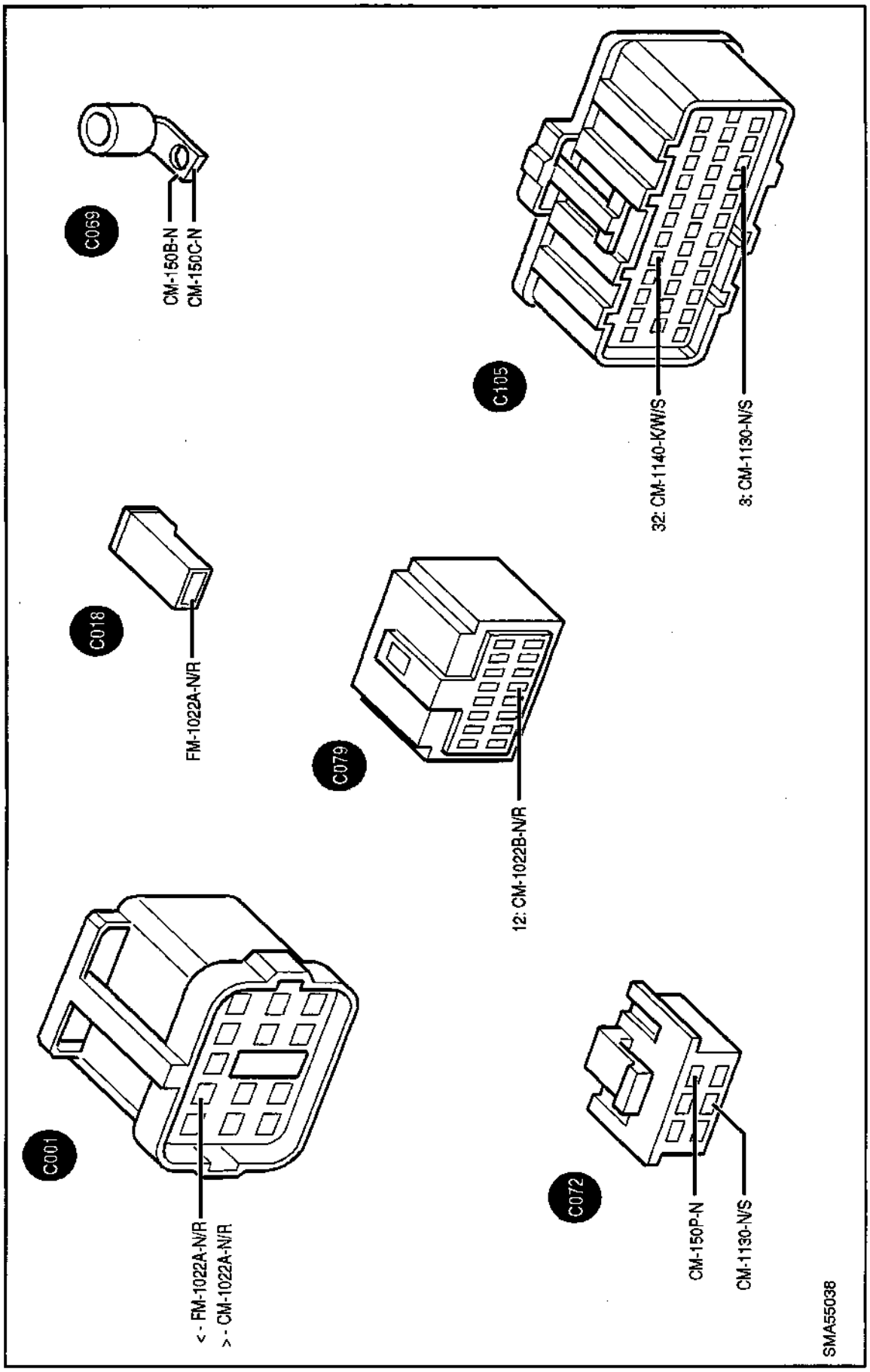
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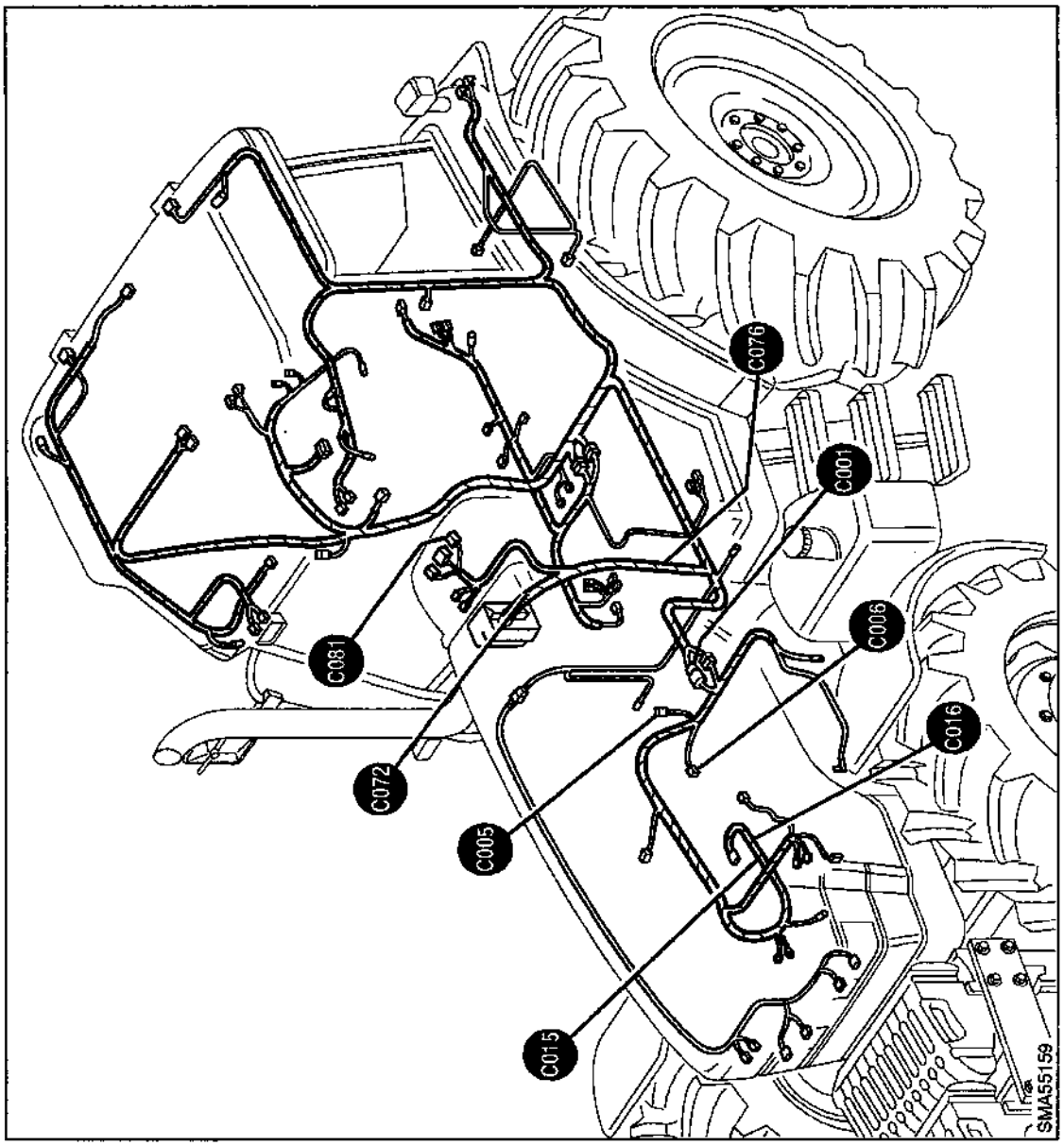


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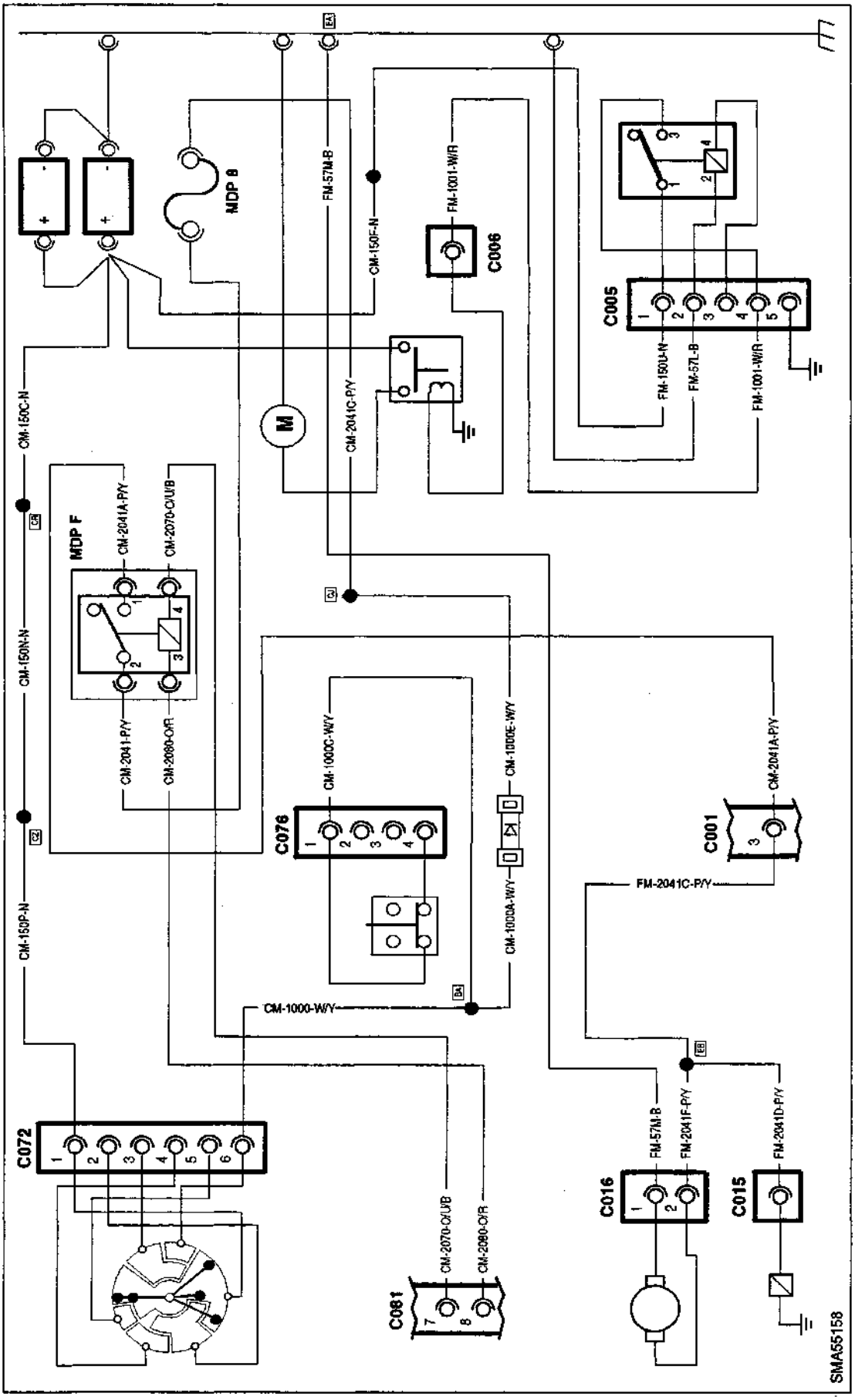
ENGINE STARTING

C001 – Main Bulkhead Connector
C005 – Starter Relay
C006 – Starter Solenoid
C015 – Fuel Shut–Off Solenoid
C016 – Fuel Pump
C072 – Starter Switch
C076 – Clutch Switch
C081 – Instrument Cluster 'C'



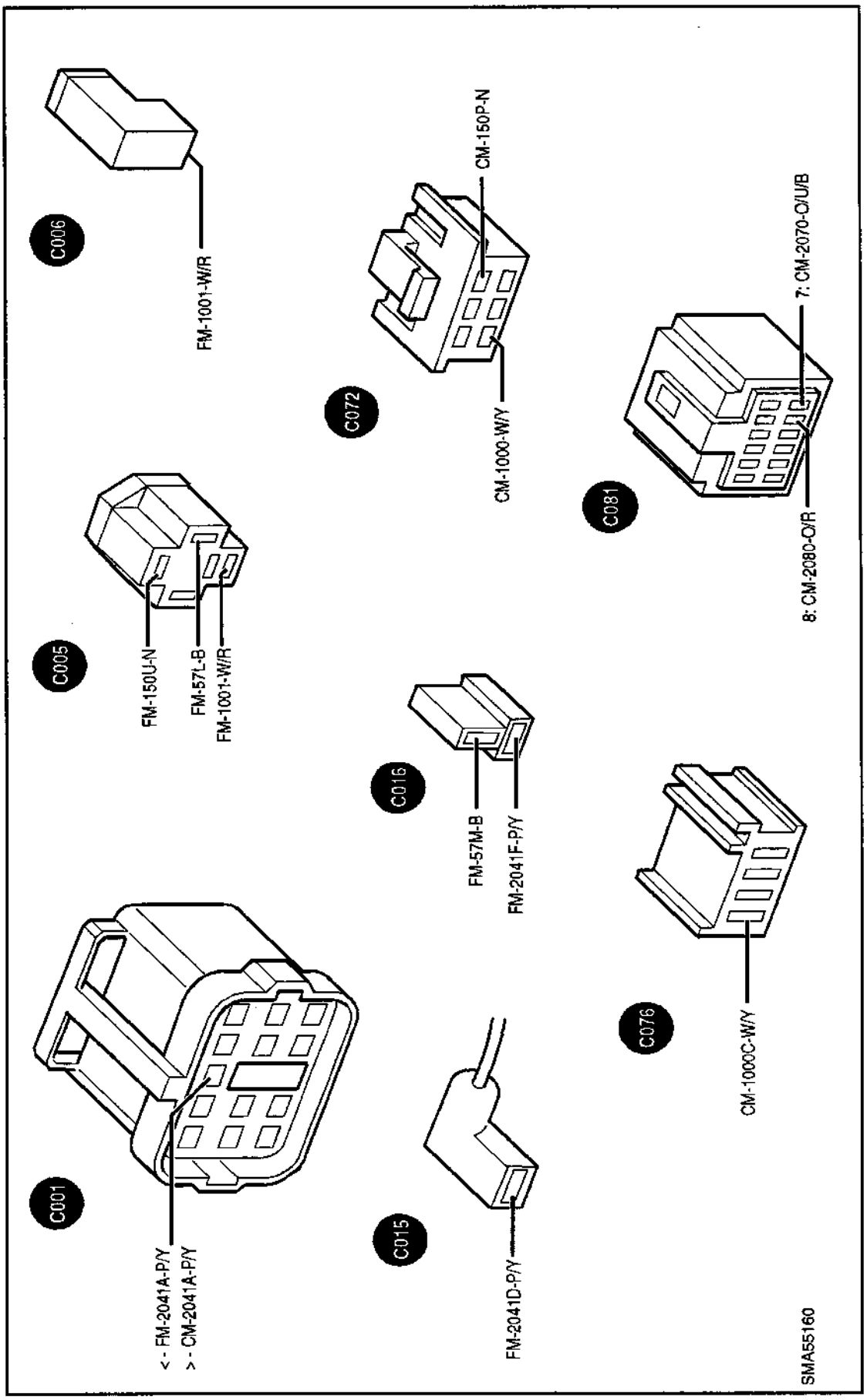
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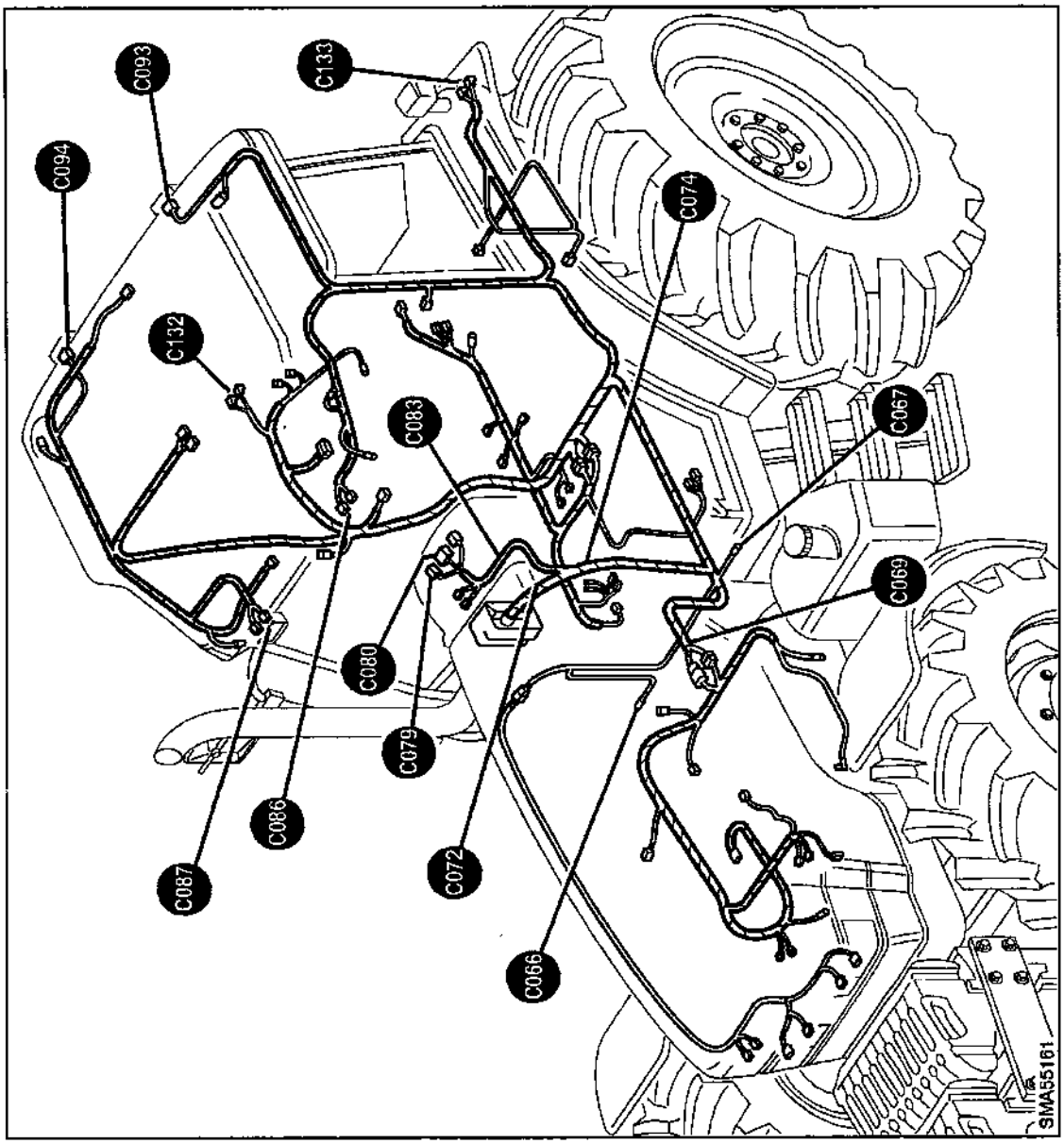


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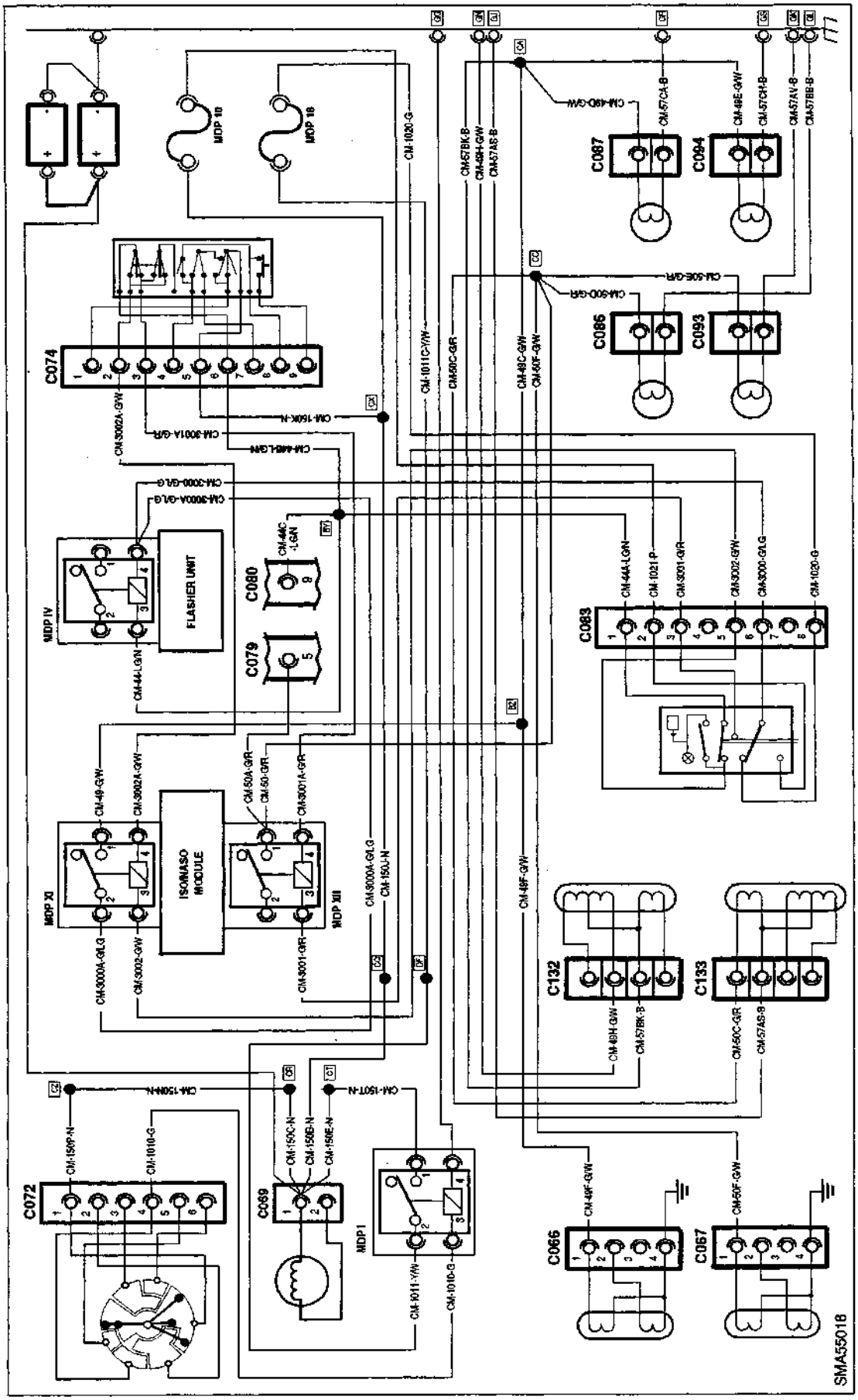
INDICATORS & HAZARDS

C066 – Right Hand Side Lamp
C067 – Left Hand Side Lamp
C069 – Starter Solenoid
C072 – Starter Switch
C074 – Turn Switch
C079 – Instrument Cluster A
C080 – Instrument Cluster B
C083 – Hazard Switch
C086 – L/H Front NASO Flasher
C087 – R/H Front NASO Flasher
C093 – L/H Rear NASO Flasher
C094 – R/H Rear NASO Flasher
C132 – R/H Fender Rear Lamp
C133 – L/H Fender Rear Lamp



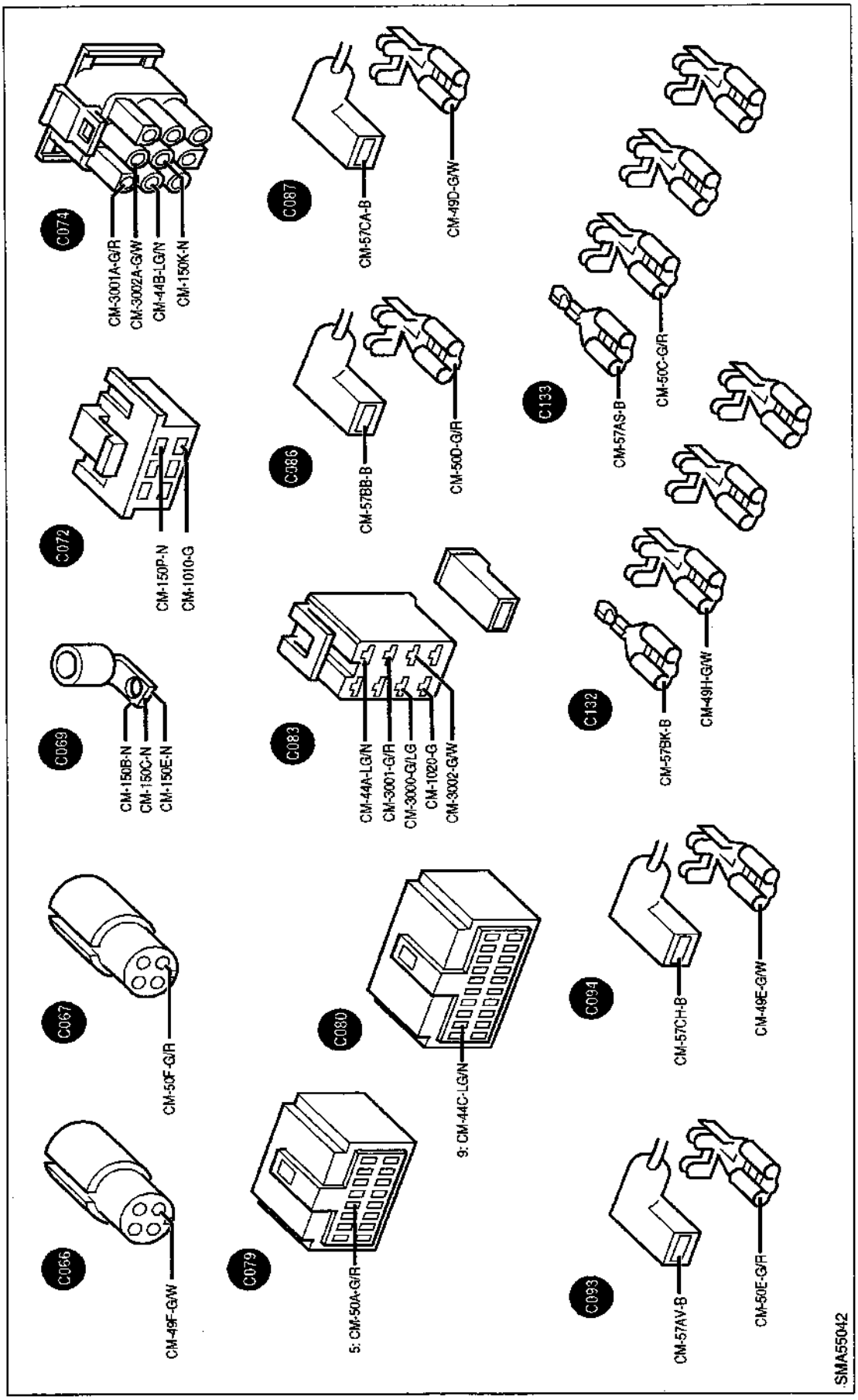
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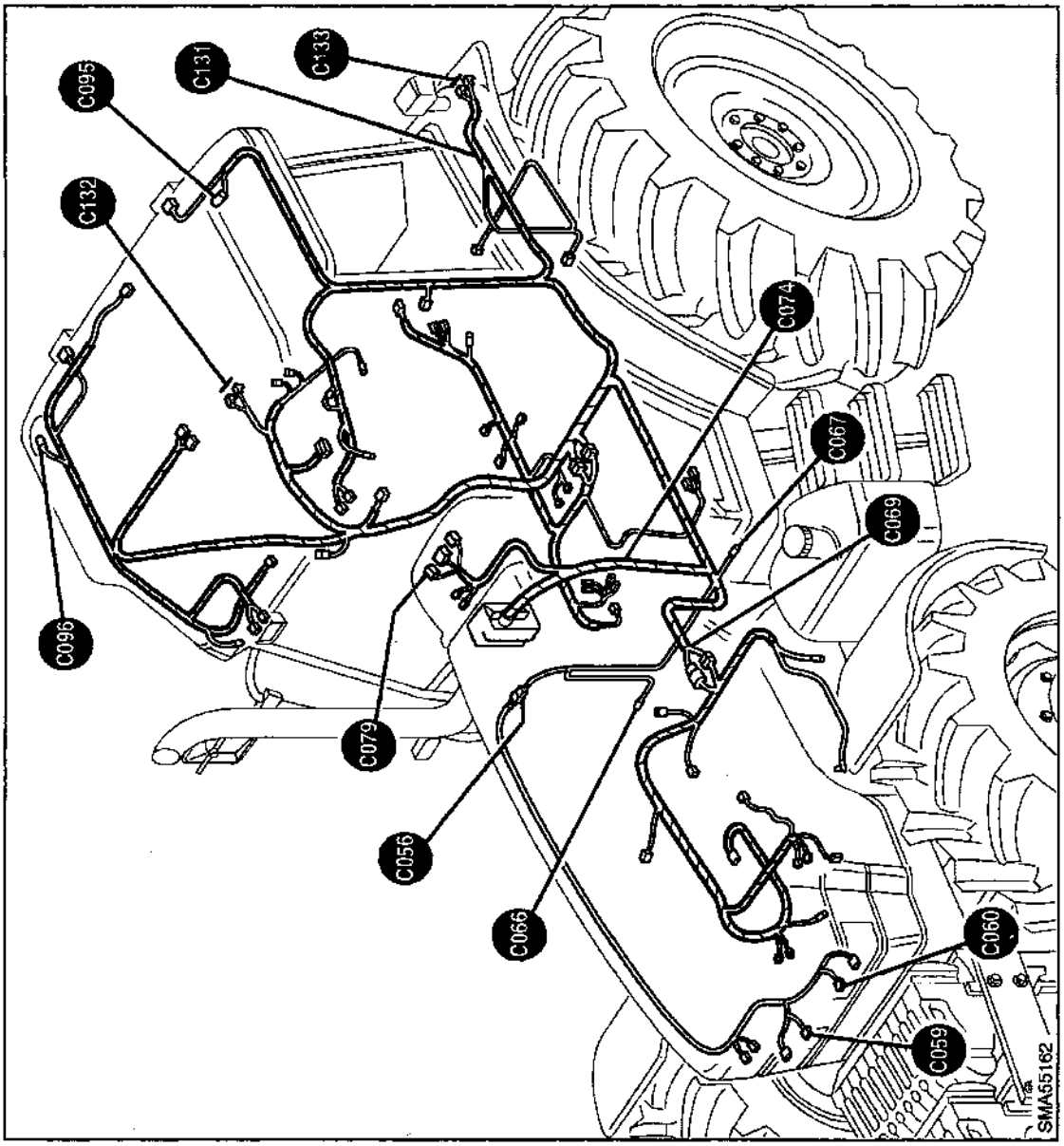


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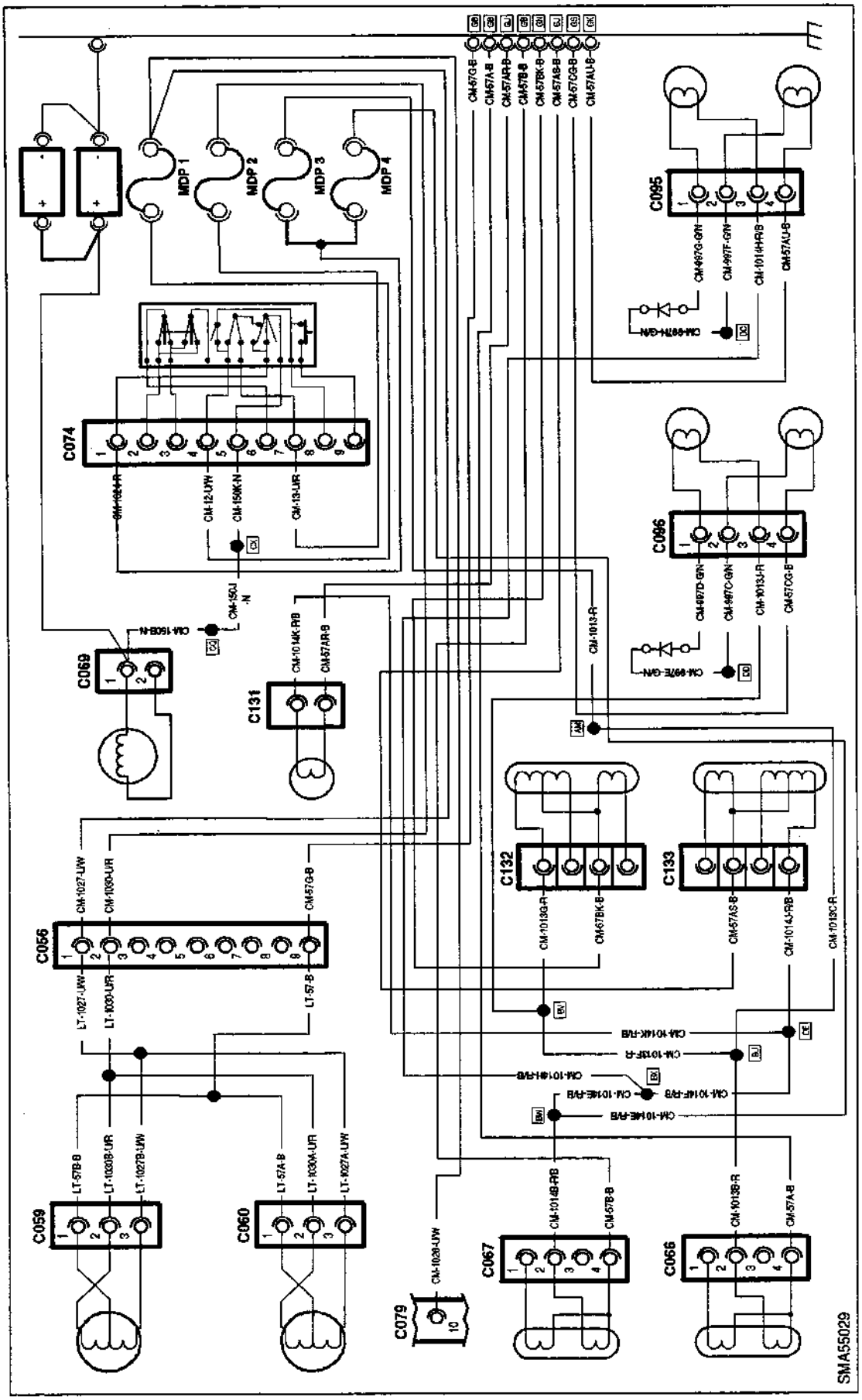
LIGHTING

C056 – Headlamp Harness Connector
C059 – Right Hand Headlamp
C060 – Left Hand Headlamp
C066 – Right Side Lamp
C067 – Left Side Lamp
C069 – Starter Solenoid (Cab Main)
C074 – Turn Switch
C079 – Instrument Cluster 'A'
C095 – LH Rear License/WorkLamp
C096 – RH Rear License/WorkLamp
C131 – License Plate Lamp
C132 – Rear Lamp RH Fender
C133 – Rear Lamp LH Fender



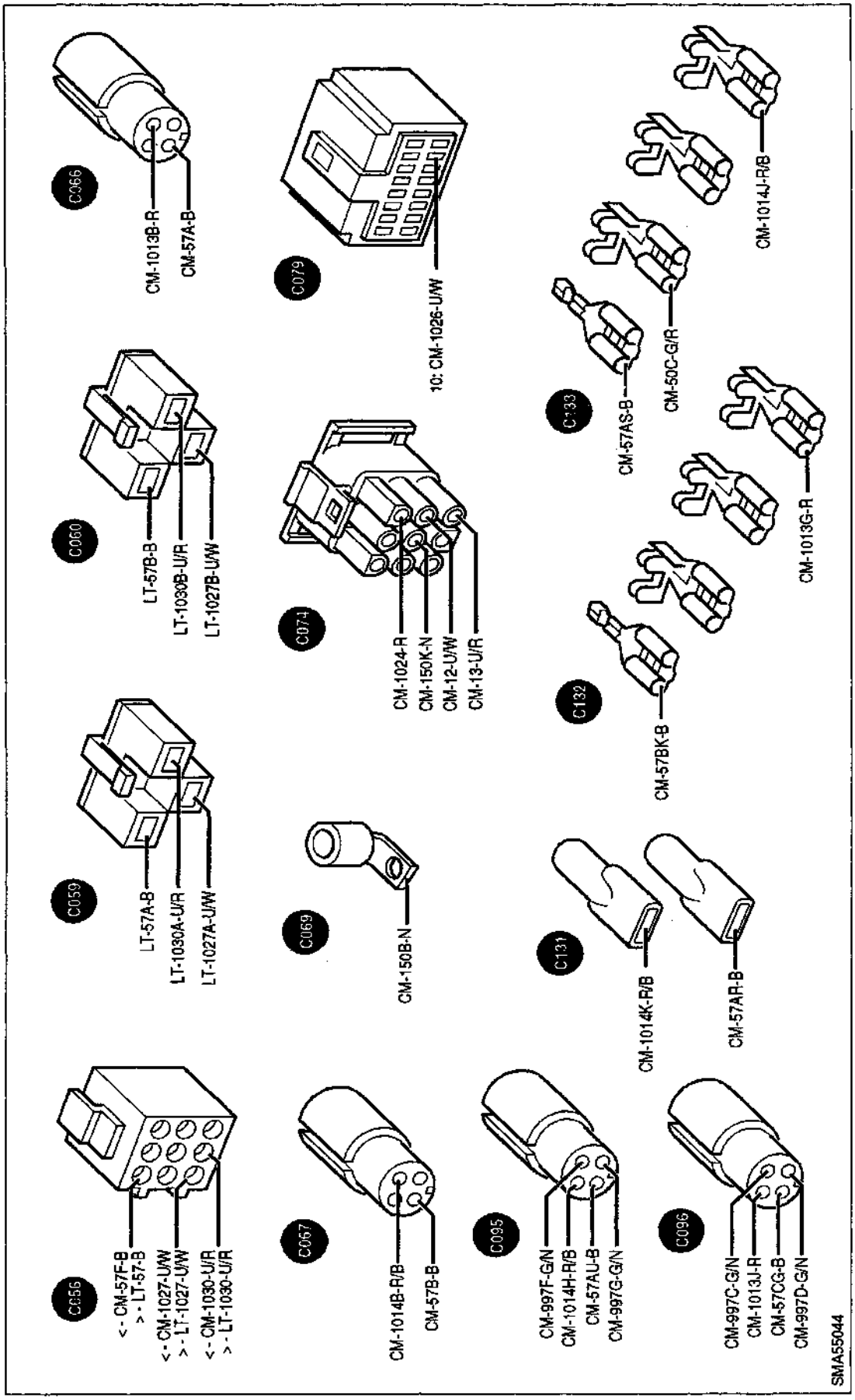
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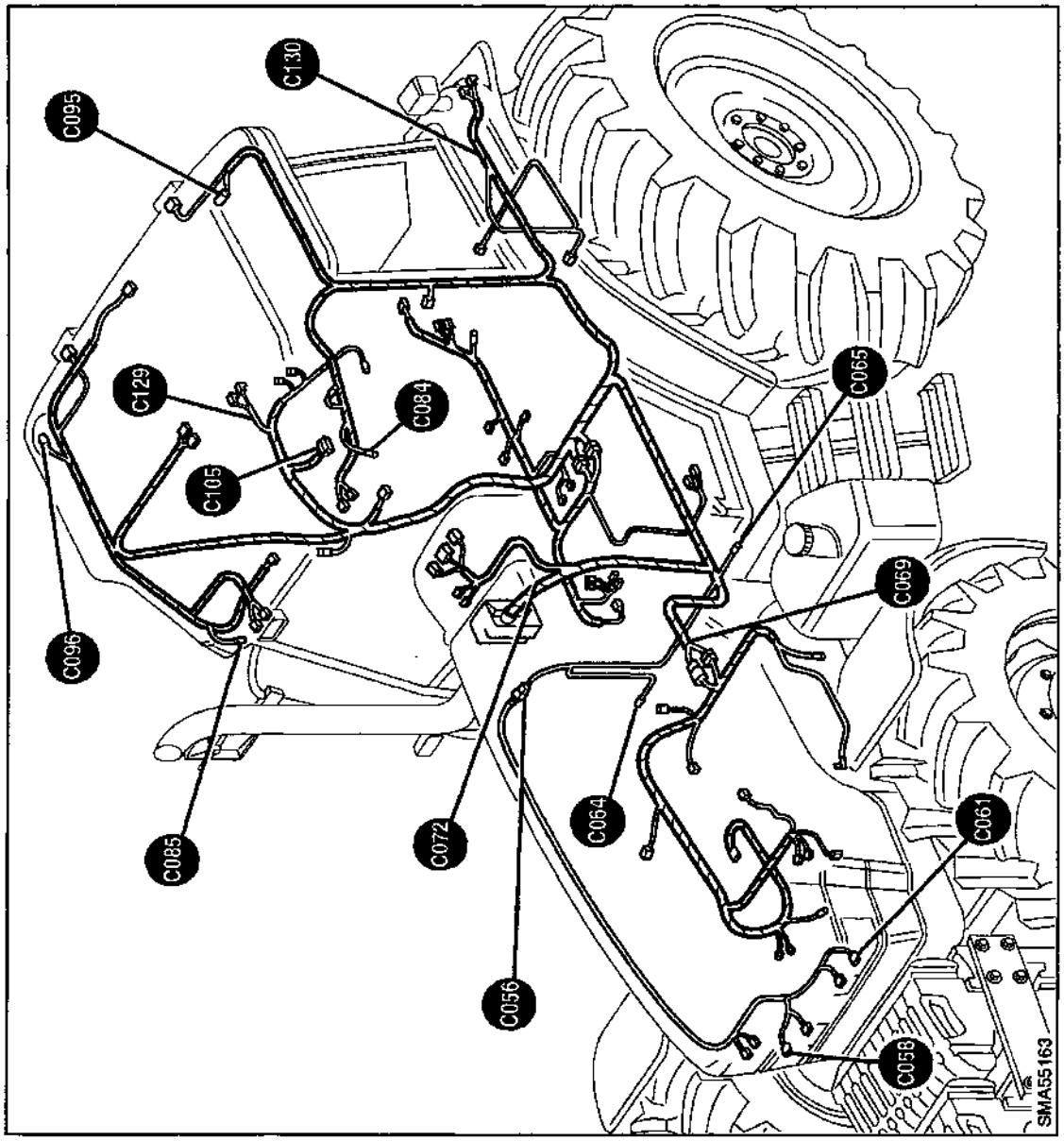


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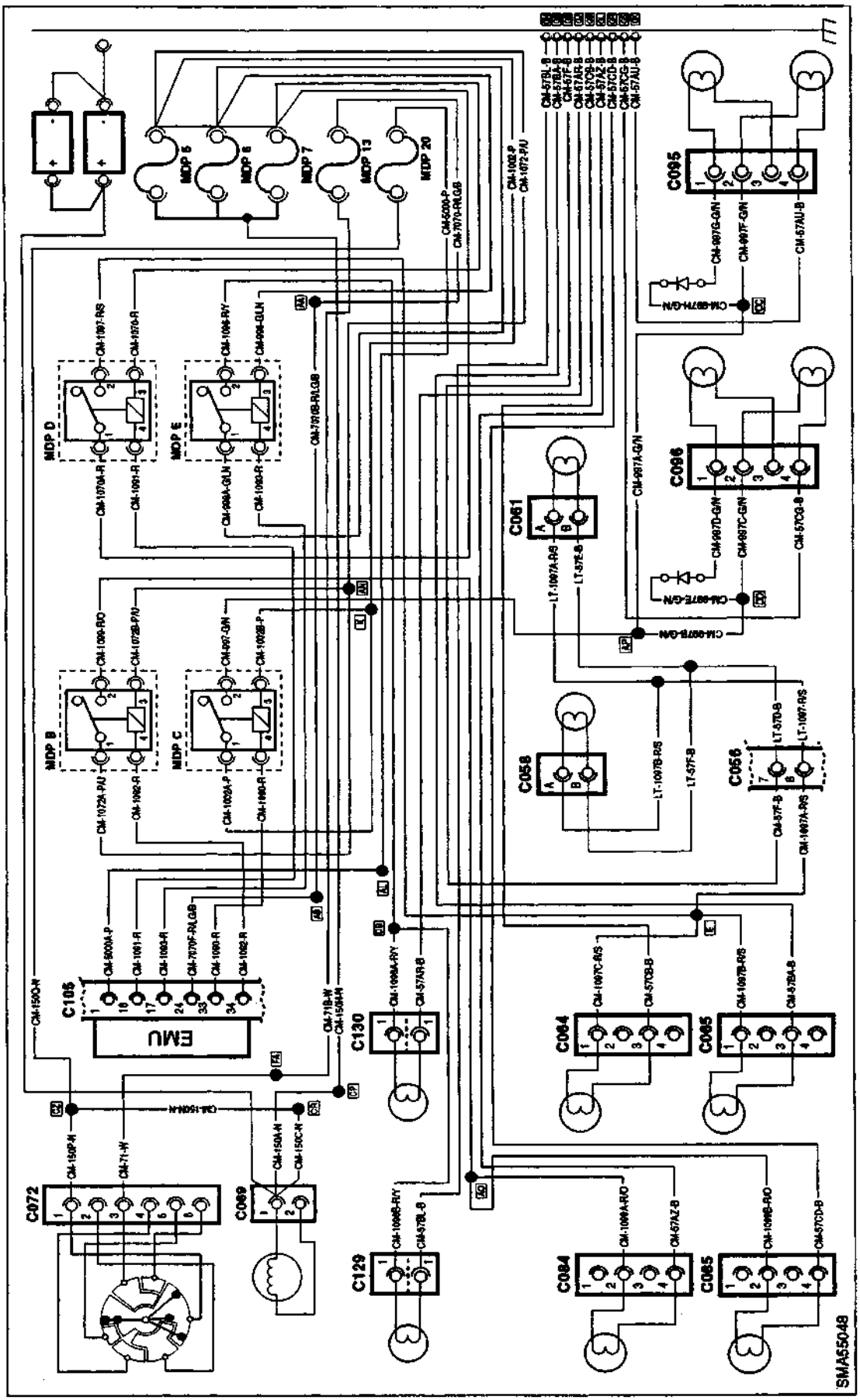
WORKLAMPS

C056 – Headlamp Connector
C058 – Right Hand Worklamp
C061 – Left Hand Worklamp
C064 – RH Lower Front Worklamp
C065 – LH Lower Front Worklamp
C069 – Starter Solenoid (Cab Main)
C072 – Starter Switch
C084 – LH Upper Front Worklamp
C085 – RH Upper Front Worklamp
C095 – LH Rear License/Worklamp
C096 – RH Rear License/Worklamp
C105 – EMU Connector
C129 – Worklamp RH Fender
C130 – Worklamp LH Fender



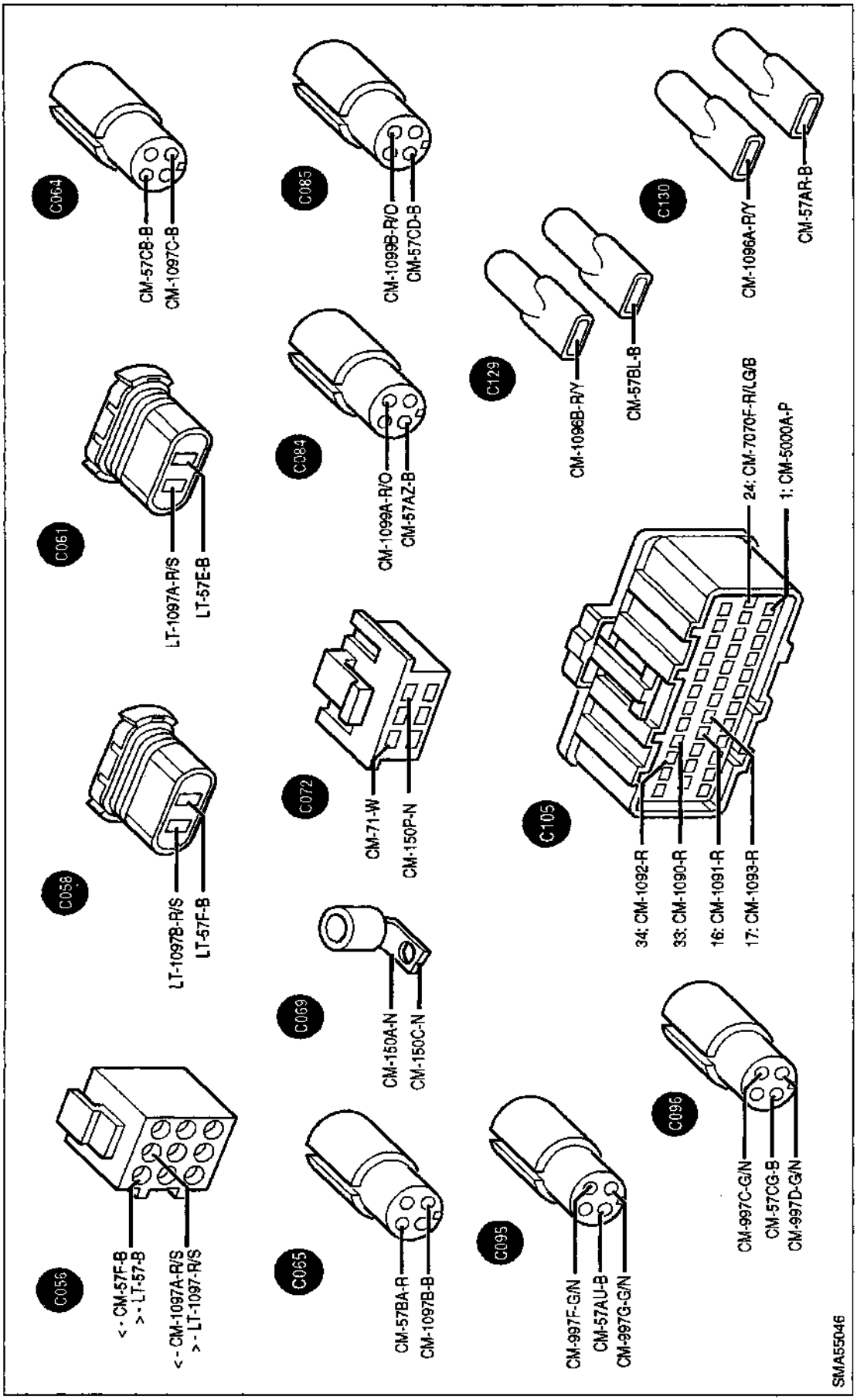
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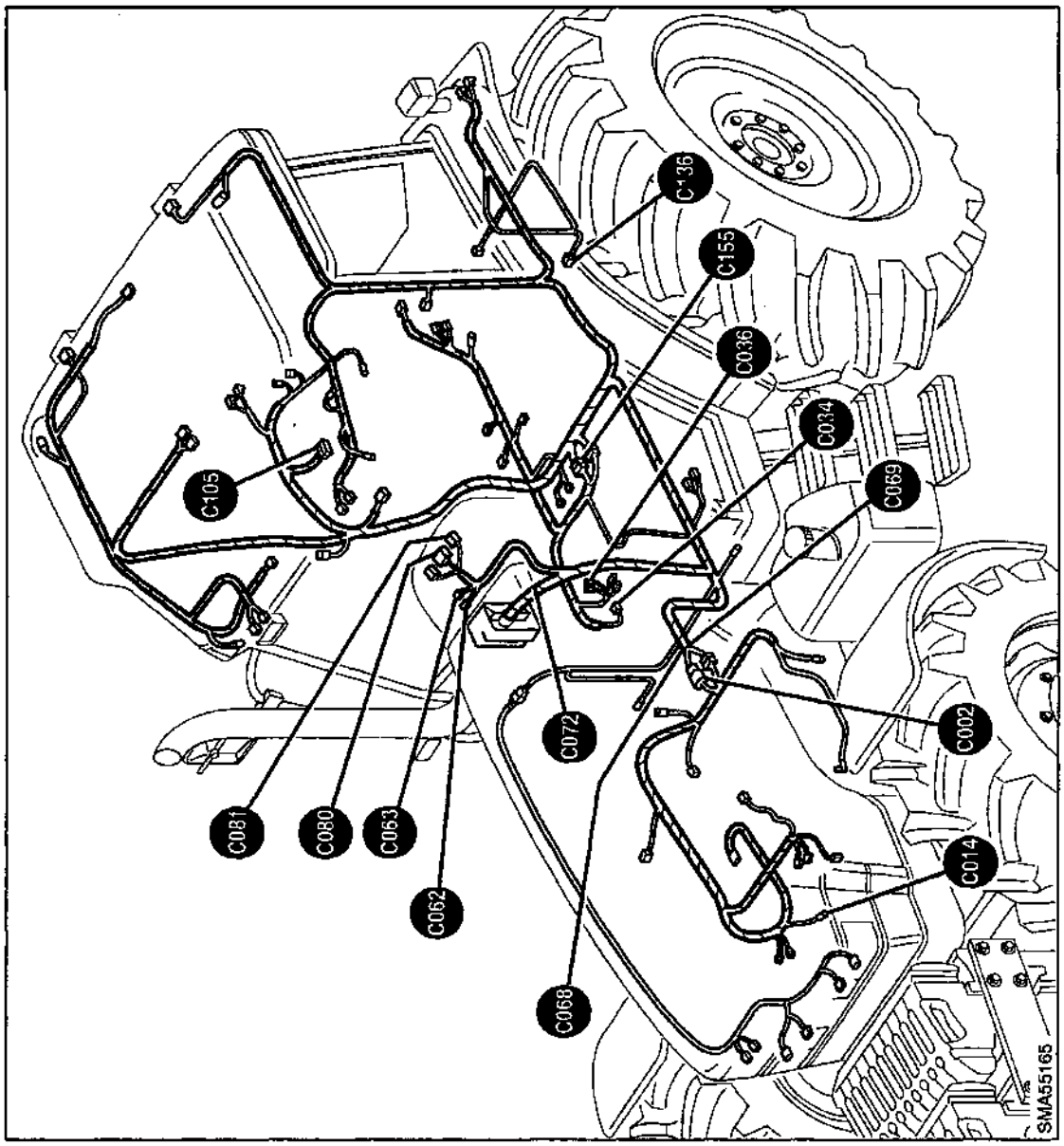


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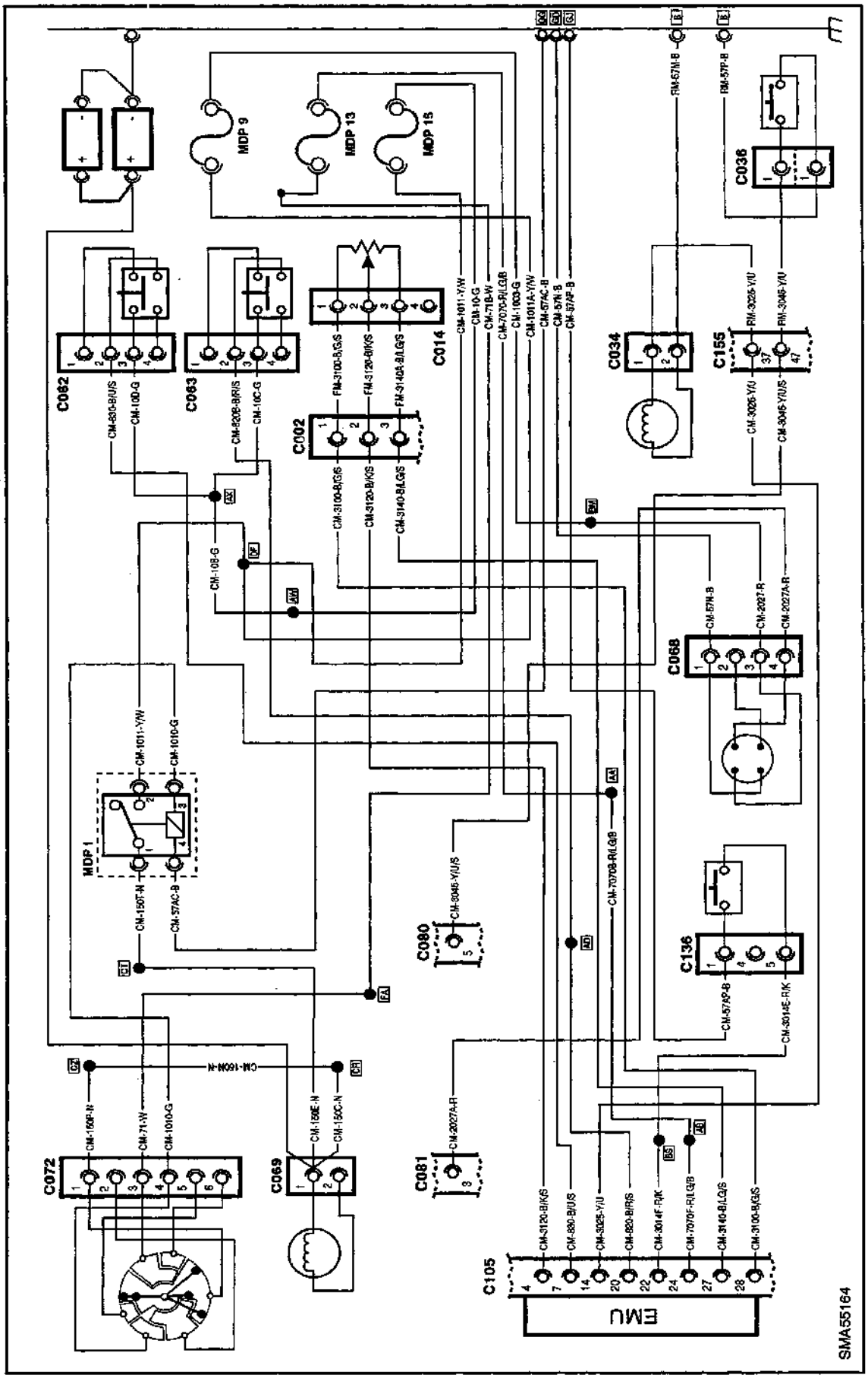
FRONT WHEEL DRIVE

C002 – Main Bulkhead Connector M2
C014 – Steering Sensor
C034 – Front Wheel Drive Solenoid
C036 – Pressure Switch
C062 – R/H Stop Lamp Switch
C063 – L/H Stop Lamp Switch
C068 – Radar
C069 – Starter Solenoid
C072 – Starter Switch
C080 – Instrument Cluster 'B'
C081 – Instrument Cluster 'C'
C105 – EMU Connector
C136 – Handbrake
C155 – Extension Harness Connector



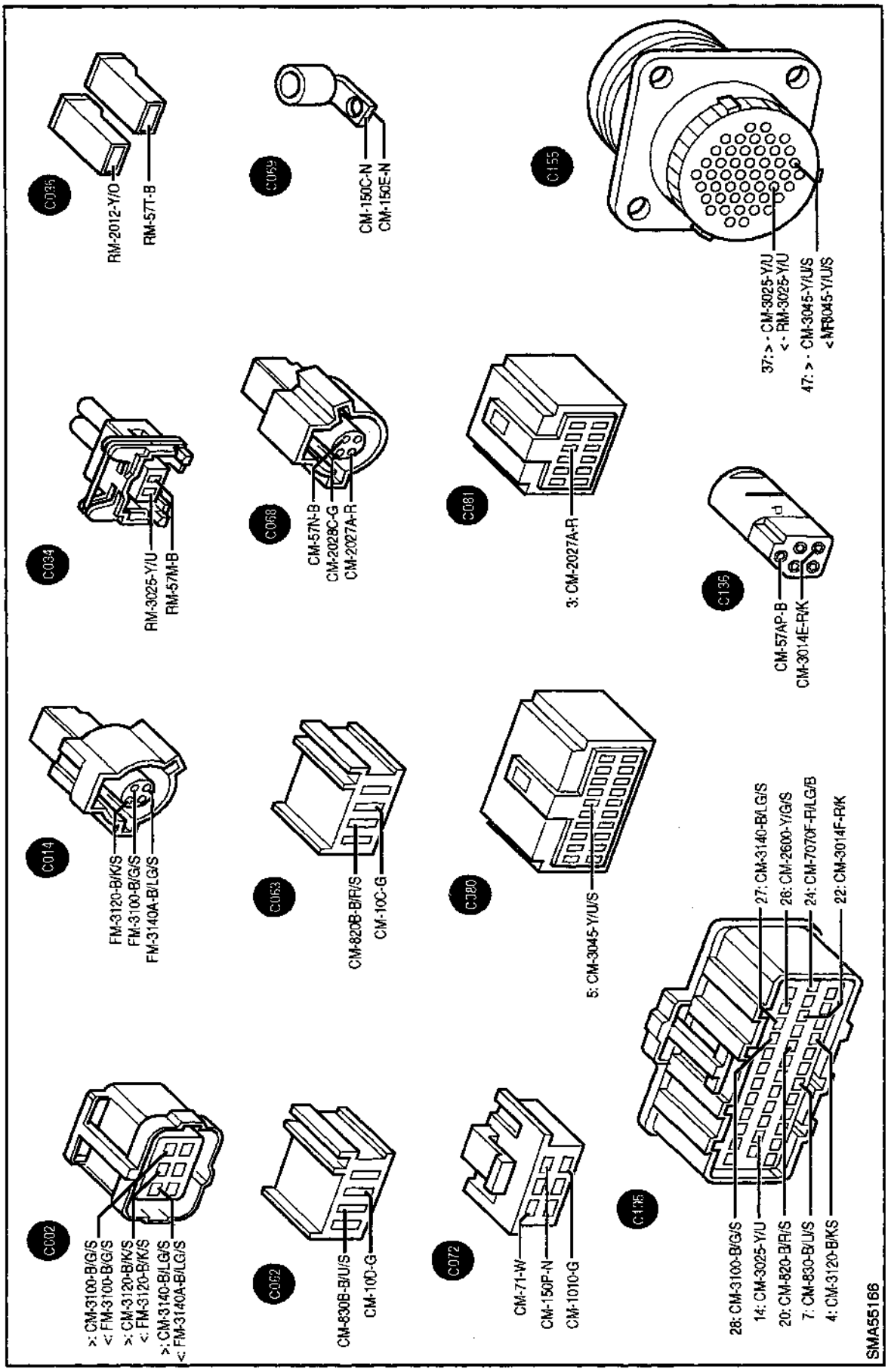
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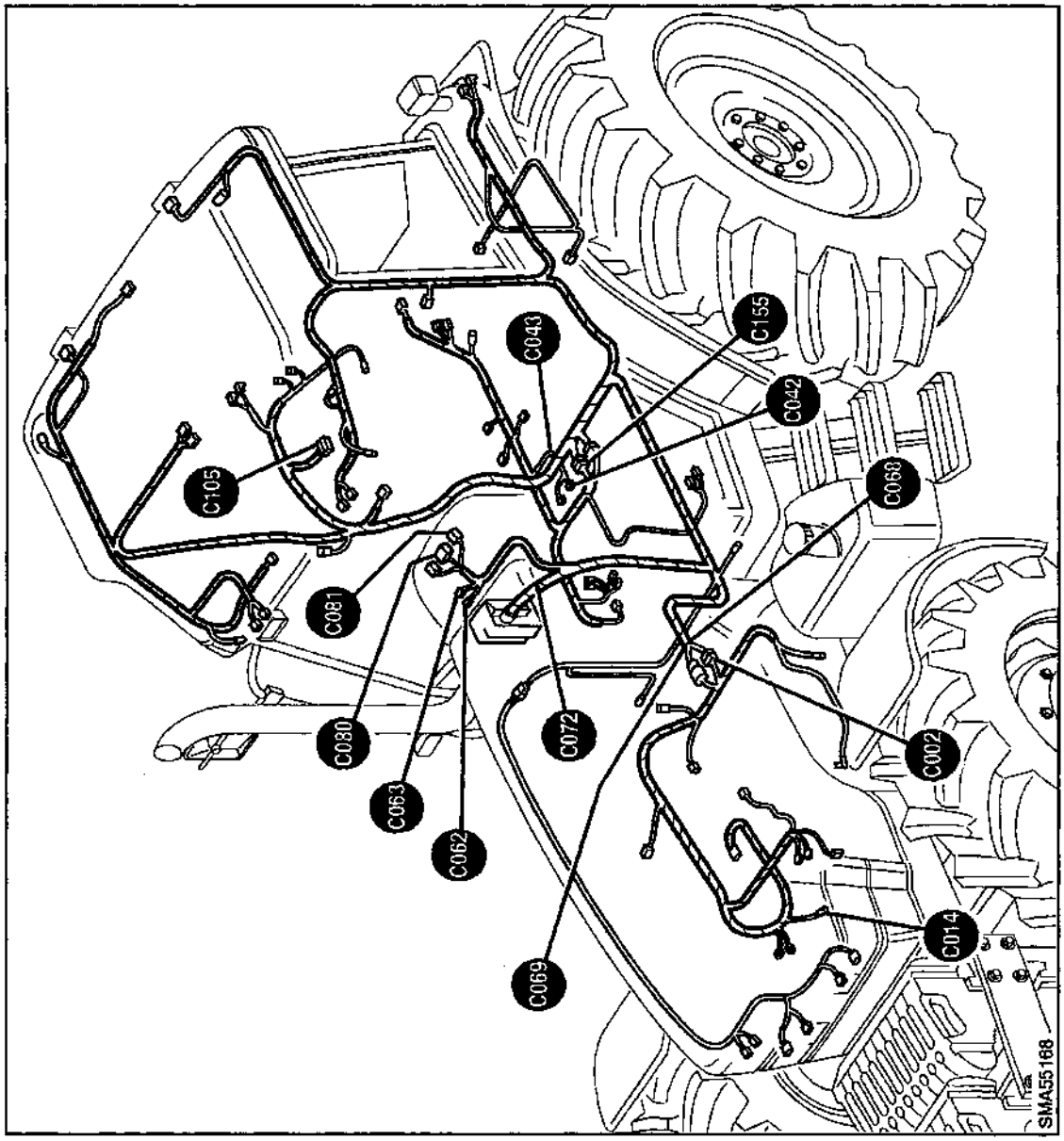


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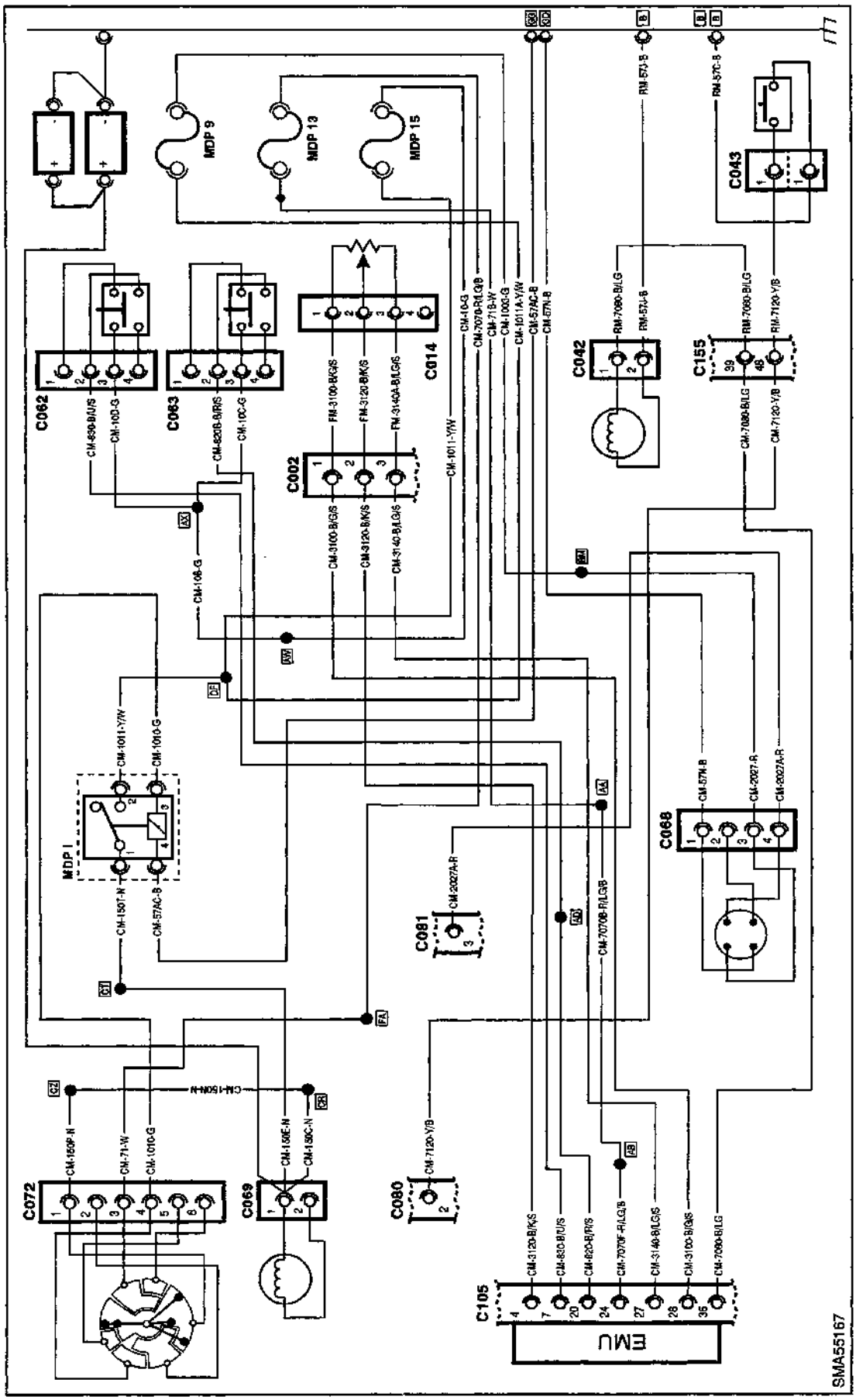
DIFF – LOCK

C002 – Main Bulkhead Connector M2
C014 – Steering Sensor
C042 – Diff Lock Solenoid
C043 – Diff Lock Switch
C062 – R/H Stop Lamp Switch
C063 – L/H Stop Lamp Switch
C068 – Radar
C069 – Starter Solenoid
C072 – Starter Switch
C080 – Instrument Cluster 'B'
C081 – Instrument Cluster 'C'
C105 – EMU Connector
C155 – Extension Harness Connector



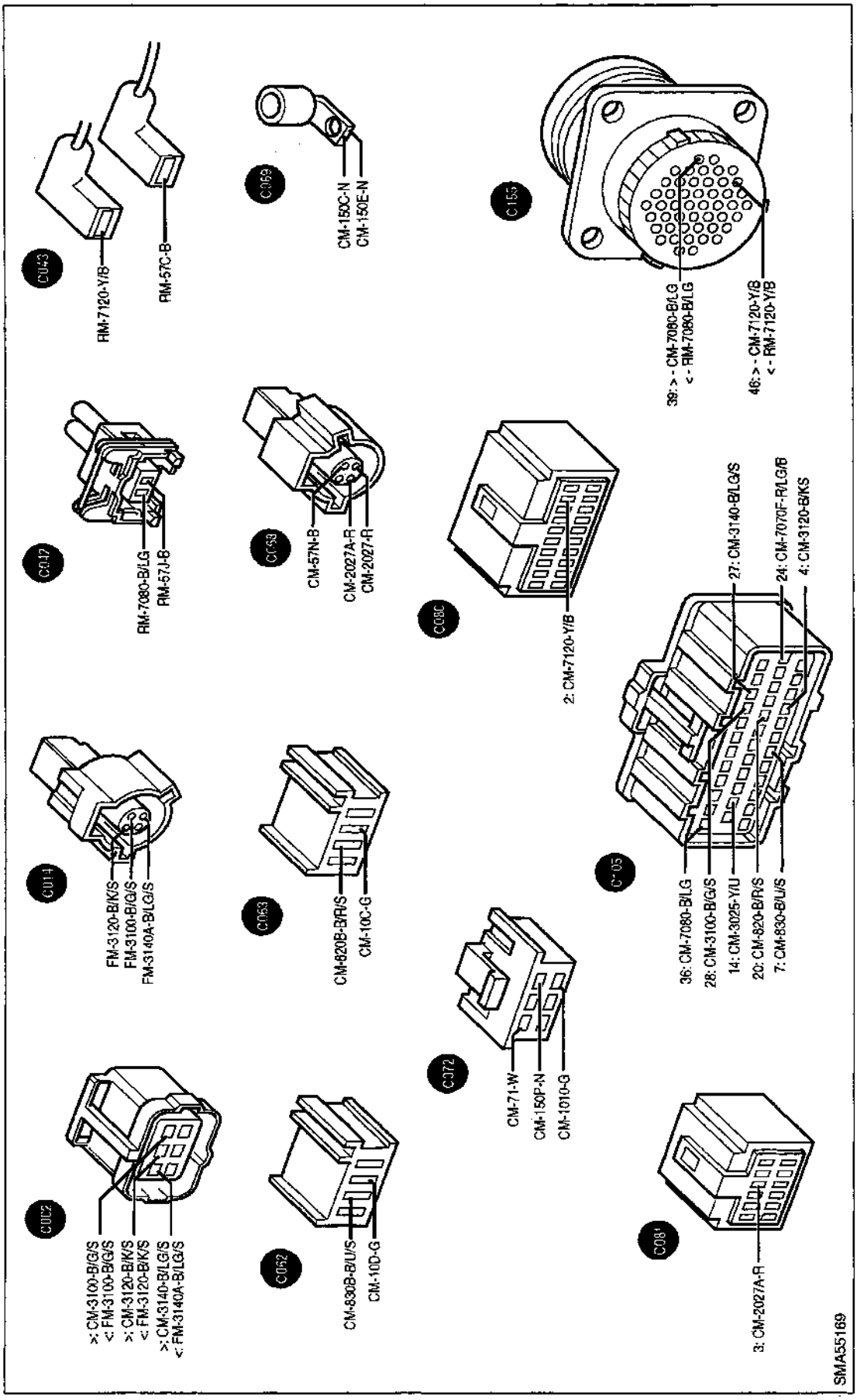
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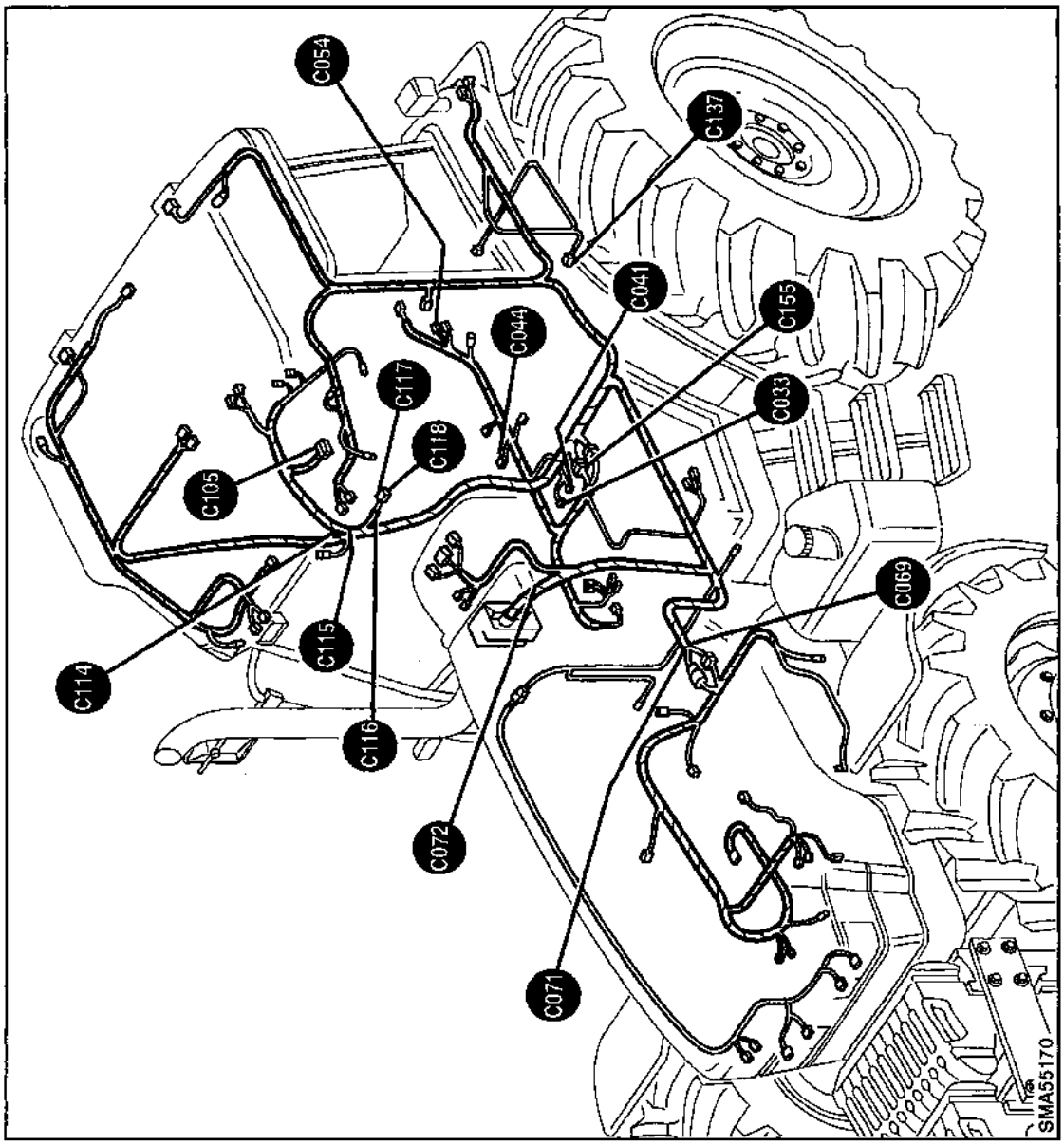


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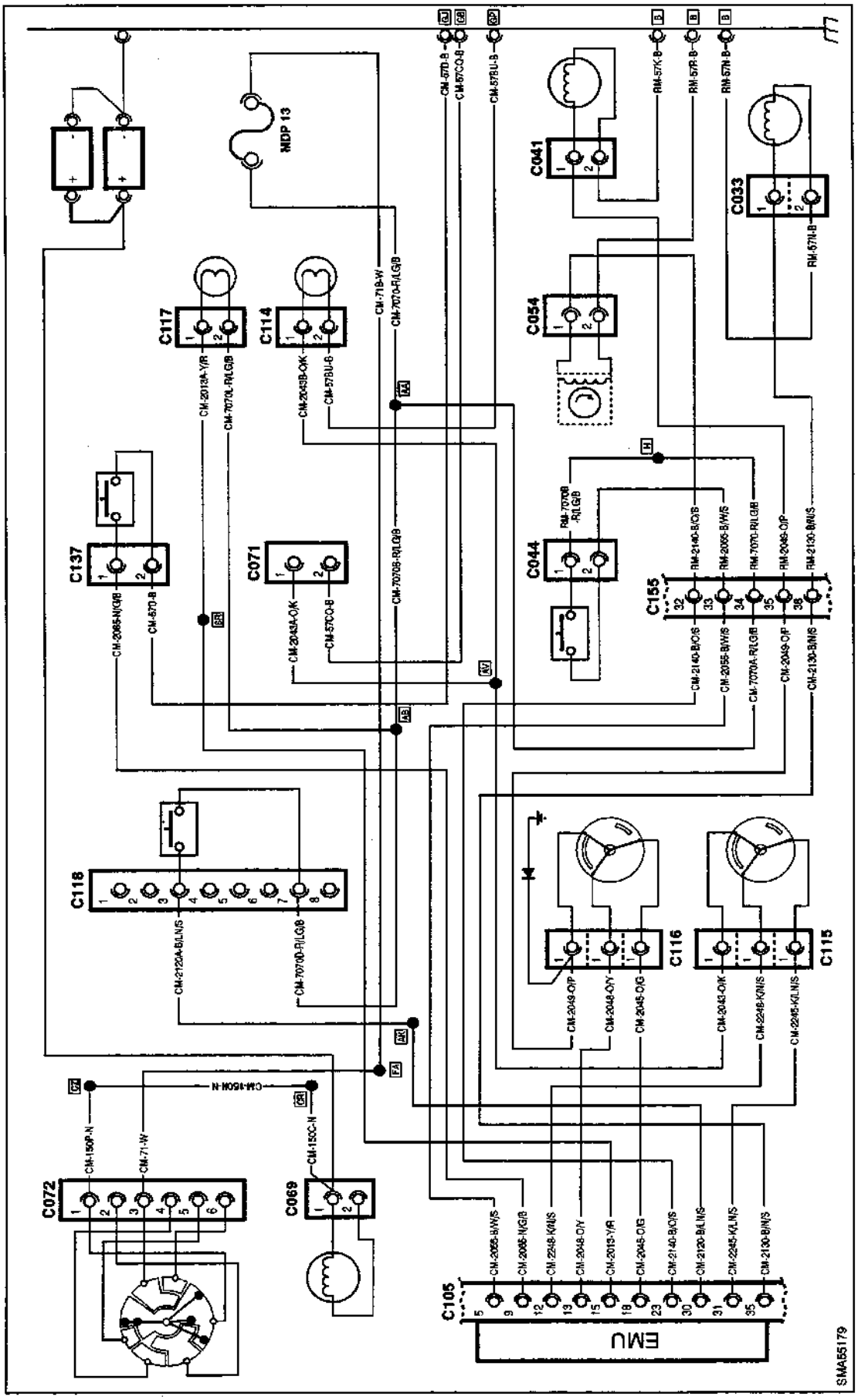
POWER TAKE-OFF

C033 – PTO Brake
C041 – PTO Solenoid
C044 – Switch Gound Speed PTO Engaged (or Link Wire)
C054 – PTO Speed Sensor
C069 – Starter Solenoid
C071 – Main Bulkhead Hitch Connector
C072 – Starter Switch
C105 – EMU Connector
C114 – PTO Engaged Lamp
C115 – Front PTO Switch
C116 – Rear PTO Switch
C117 – Rear PTO Engaged Lamp
C118 – Rear PTO Brake Switch
C137 – PTO Alarm Seat Switch
C155 – Extension Harness Connector



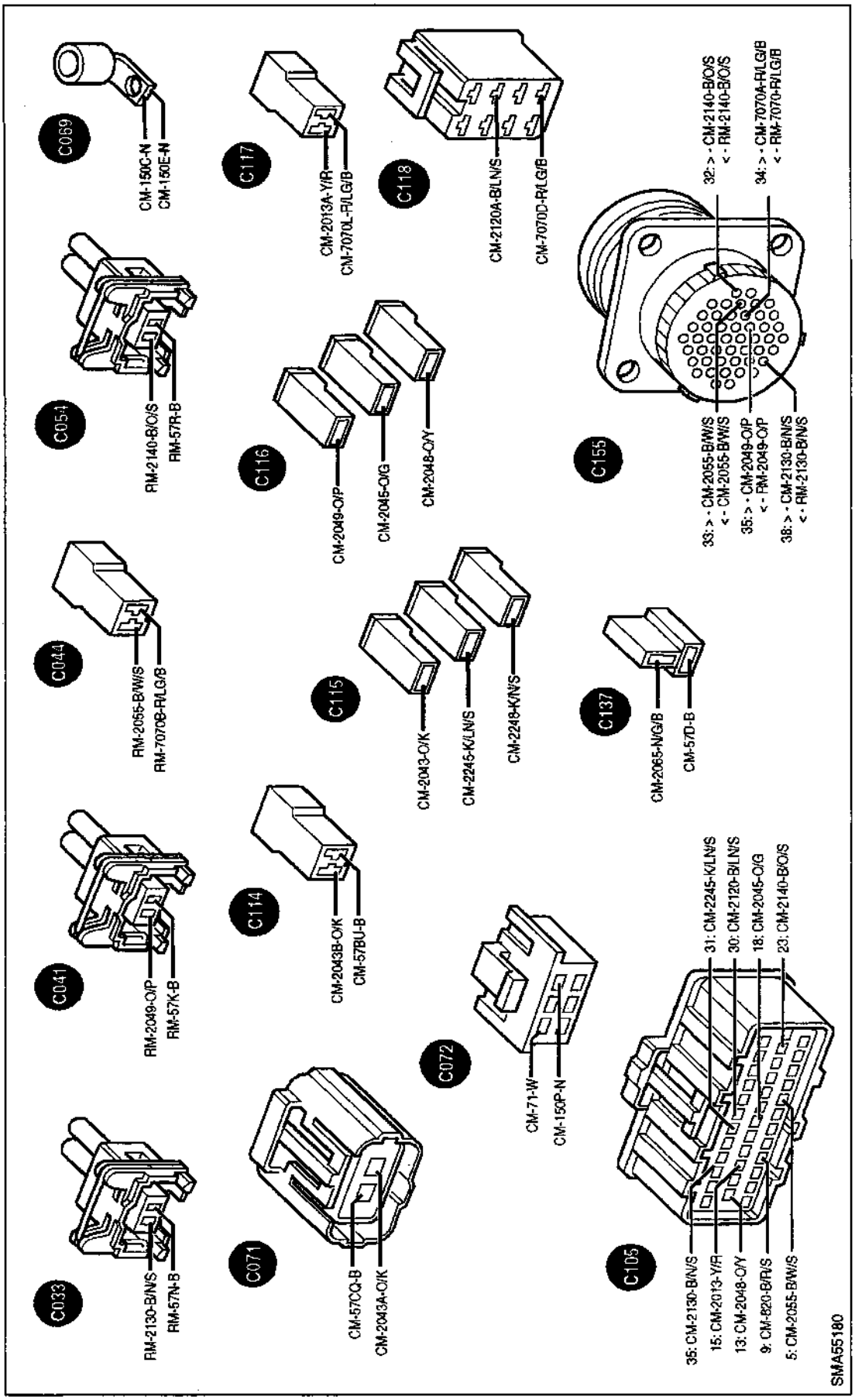
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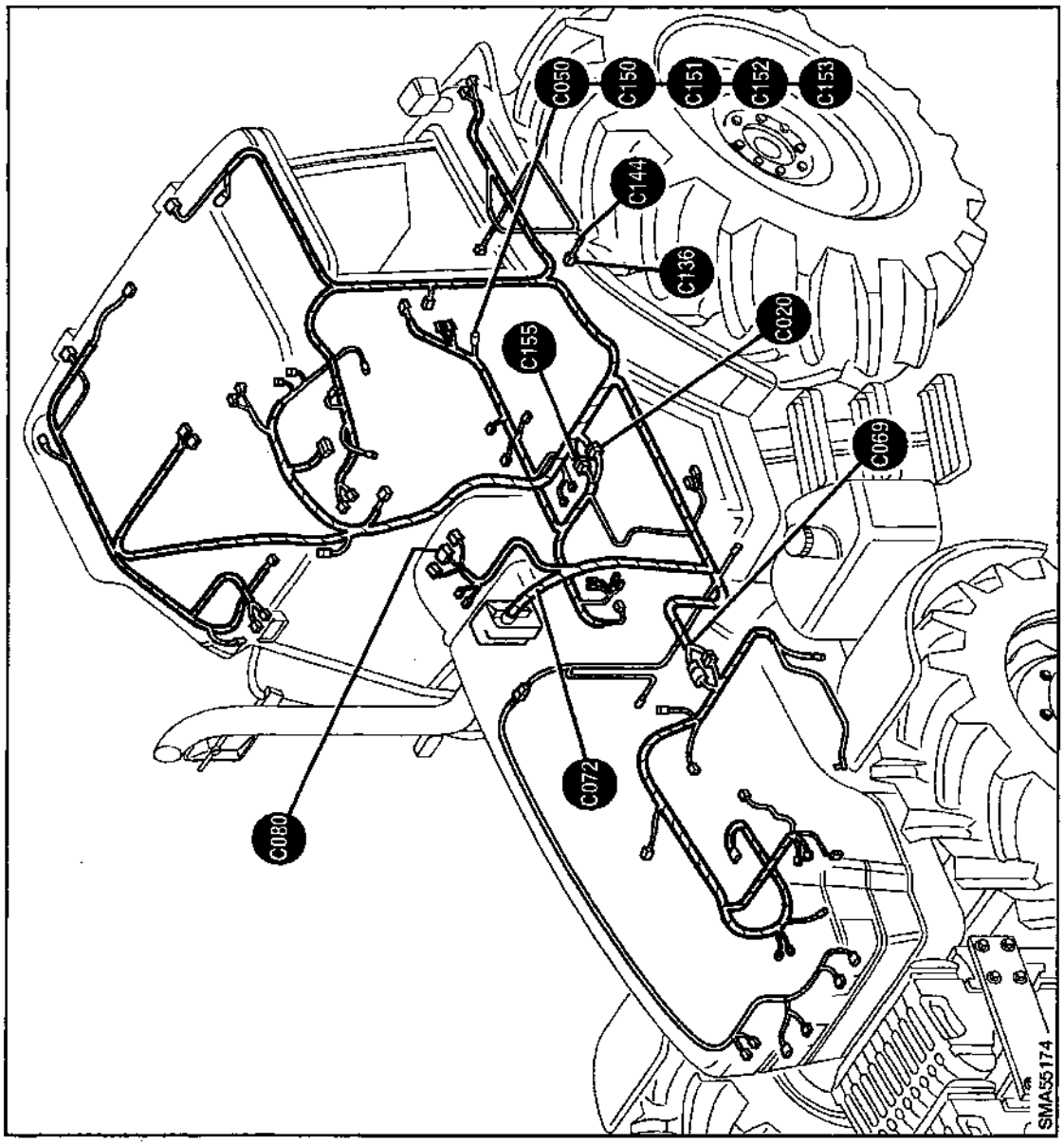
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ITALIAN TRAILER BRAKE

C020 – Main Extension Connector 2
C050 – Trailer Brake Connector
C069 – Starter Solenoid
C072 – Starter Switch
C080 – Instrument Cluster 'B'
C136 – Handbrake
C144 – Air Brake Connector
C155 – Main Extension Connector 1

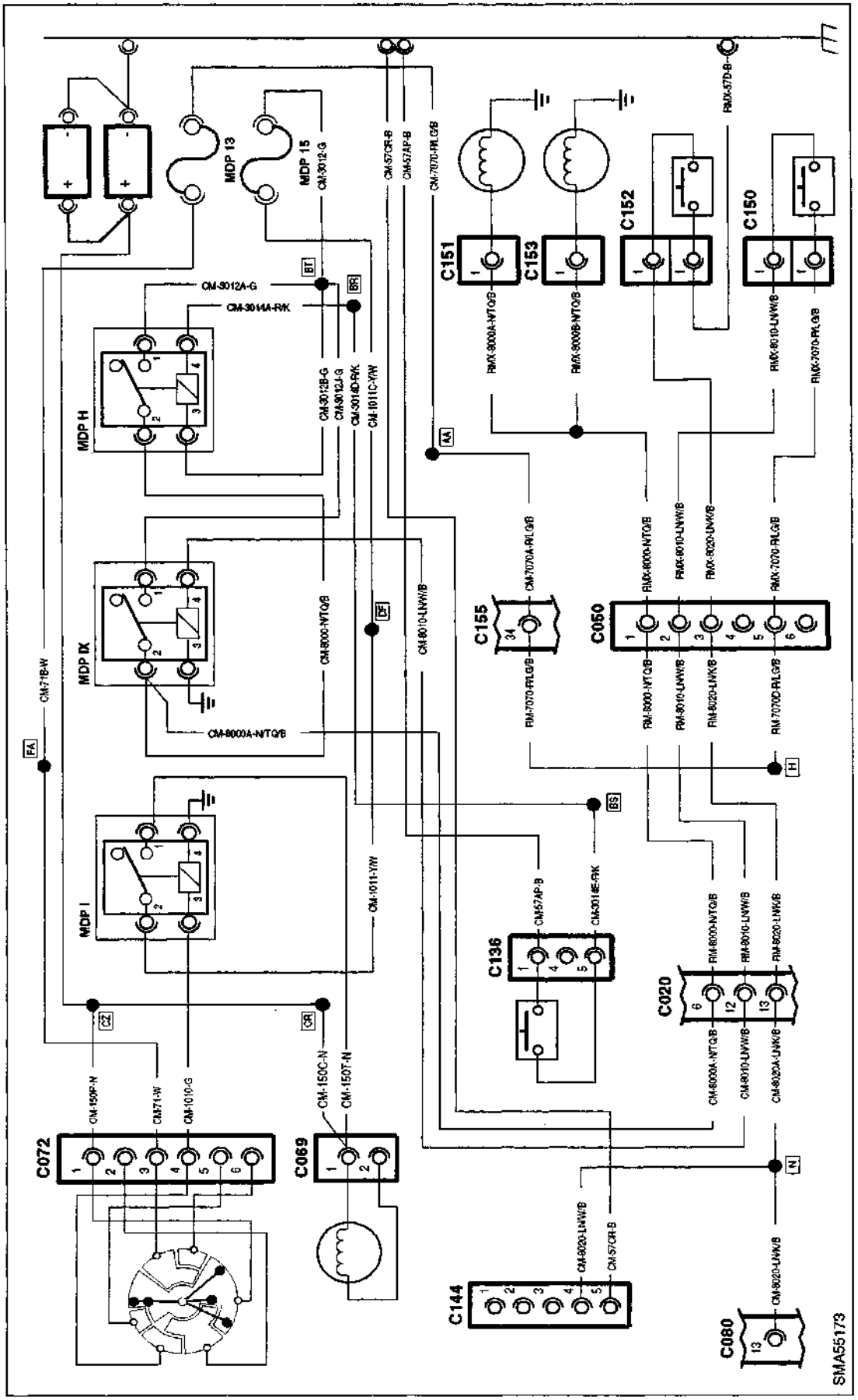
Trailer Brake Extension Harness

C150 – Pressure Switch 100
C151 – Solenoid Valve
C152 – Pressure Switch 101
C153 – Solenoid Valve



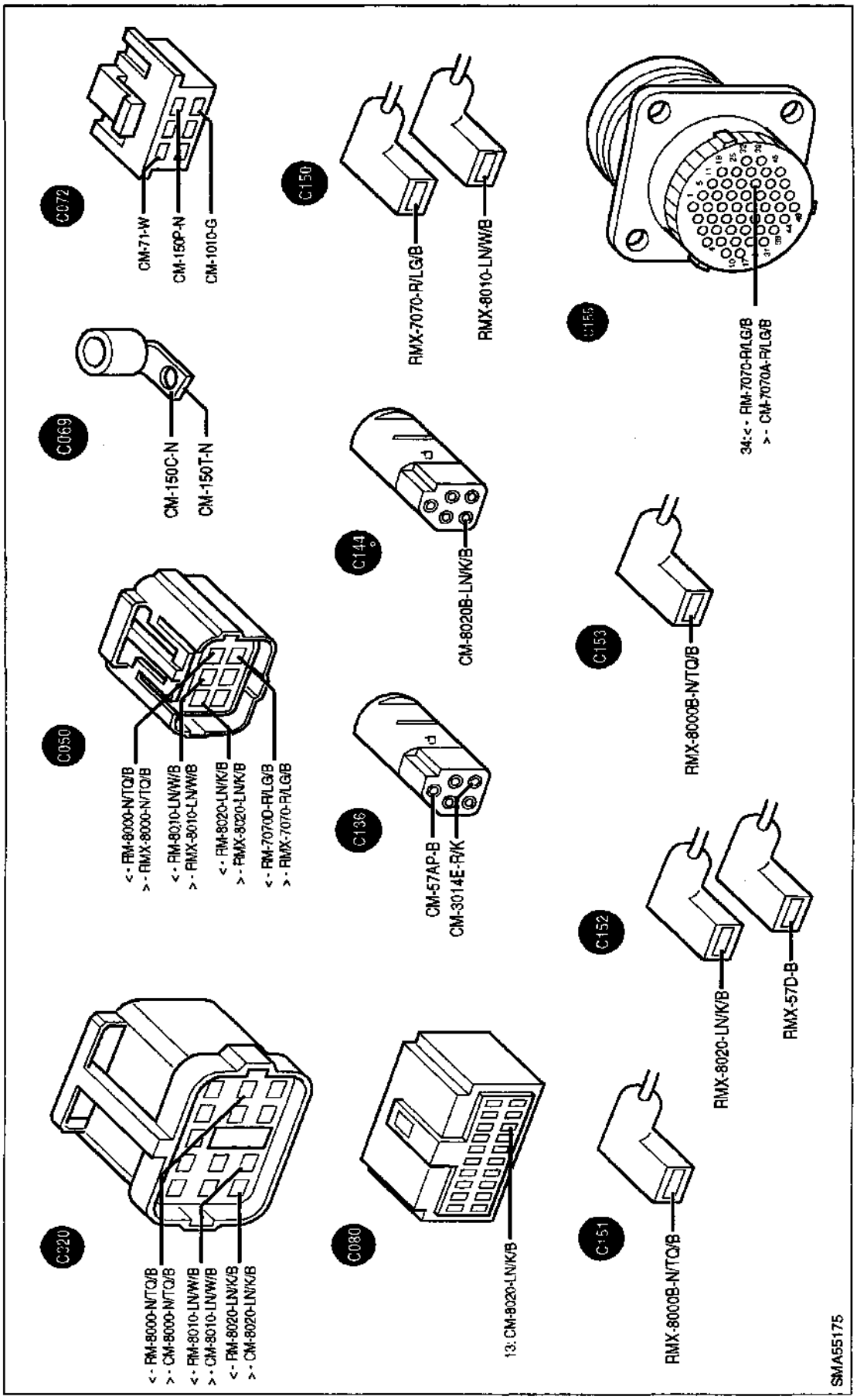
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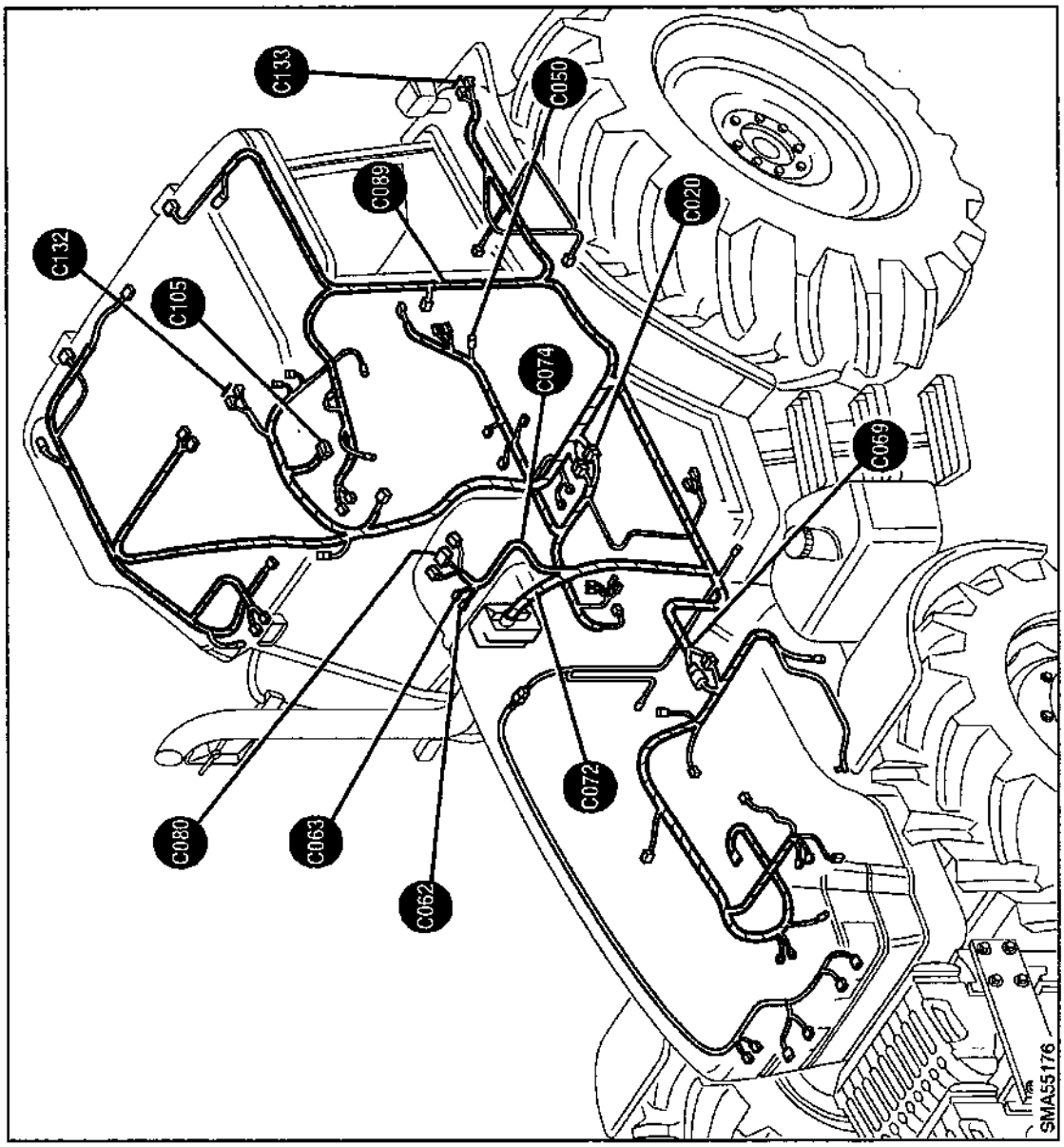


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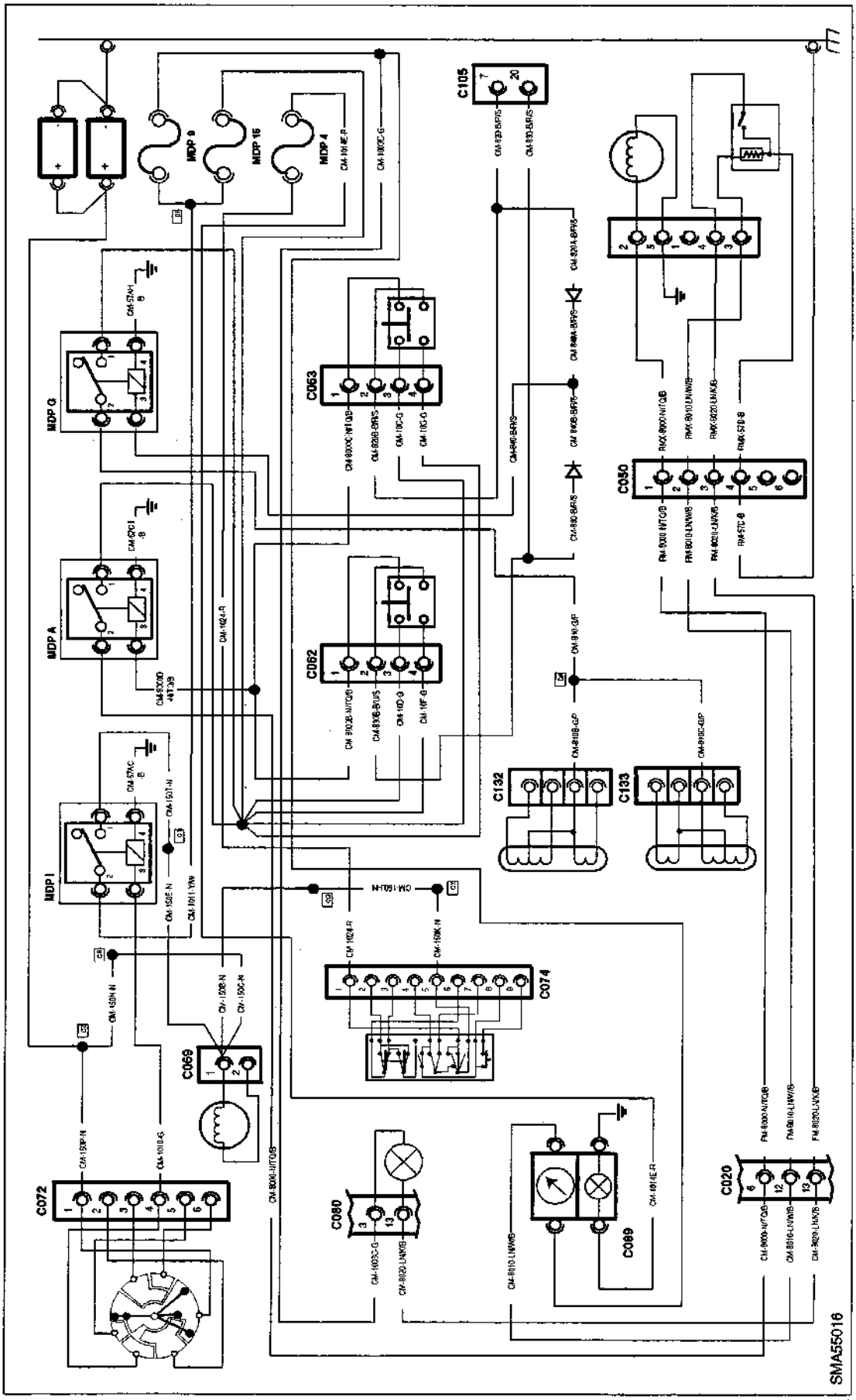
AIR TRAILER BRAKE

C020 – Main Extension Connector
C050 – Trailer Brake Connector
C062 – RH Stop Lamp Switch
C063 – LH Stop Lamp Switch
C069 – Starter Solenoid (Cab Main)
C072 – Starter Switch
C074 – Turn Switch
C080 – Instrument Cluster 'B'
C089 – Trailer Brake Gauge Lamp
C105 – EMU Connector
C132 – Rear Lamp RH Fender
C133 – Rear Lamp LH Fender



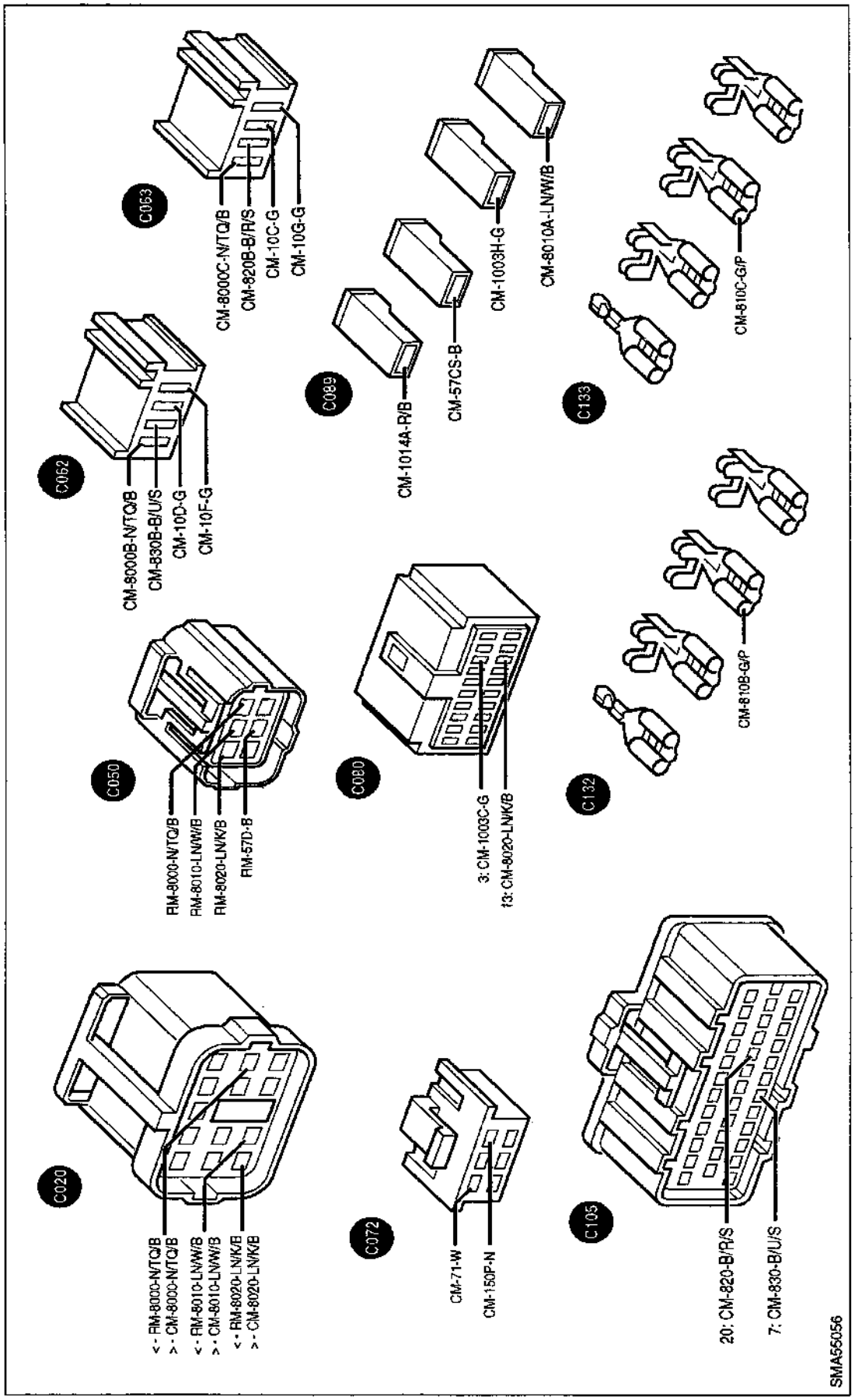
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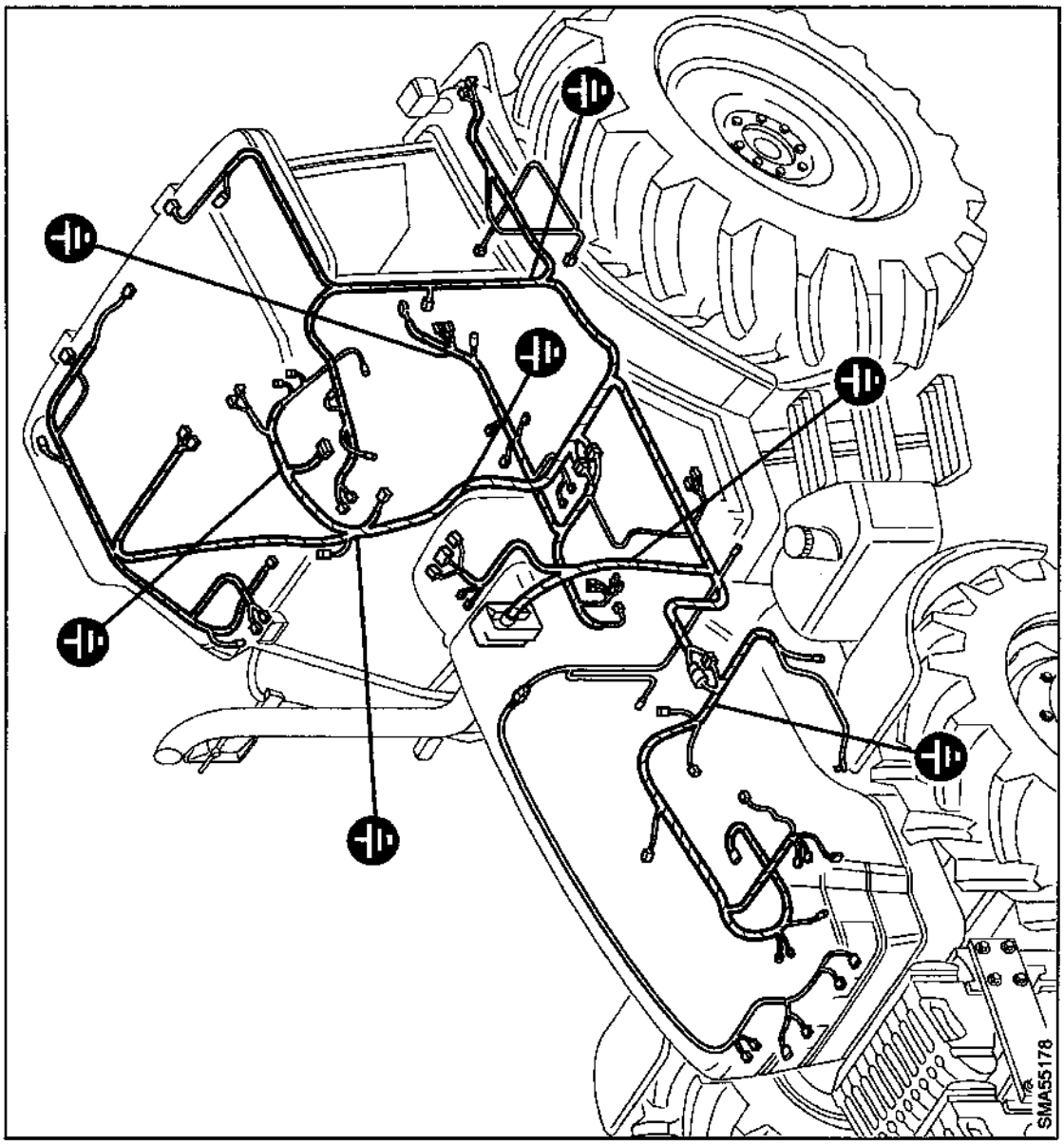
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GROUND POINT LOCATION



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8160, 8260, 8360, 8560 TRACTOR REPAIR MANUAL CONTENTS

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SECTION 7 - POWER TAKE-OFF
SECTION 8 - HYDRAULIC SYSTEM
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SECTION 3

CLUTCH

CHAPTER 1

CLUTCH

(NOTE: NOT USED IN NORTH AMERICA)

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18 000 – SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

13" LUK CLUTCH SPECIFICATIONS

Type	Single, Dry–plate with Torsion Springs
Control	Hydraulic Operation, Pedal Control
Clutch Release Mechanism	Diaphragm Spring
Clutch Disc Lining	Cerametallic Pads
Clutch Disc Thickness (under a 9750 N –994 kg [2194–2192 lb] load)	9.8 to 10.6 mm (0.386 to 0.417 in)
Spline Backlash on Transmission Drive Shaft	0.076 to 0.136 mm (0.003 to 0.005 in)
Clutch Release Sleeve to Mount Clearance	0.060 to 0.136 mm (0.002 to 0.005 in)
Clutch Release Pedal to Mount Adjustment	see page 3-1-16

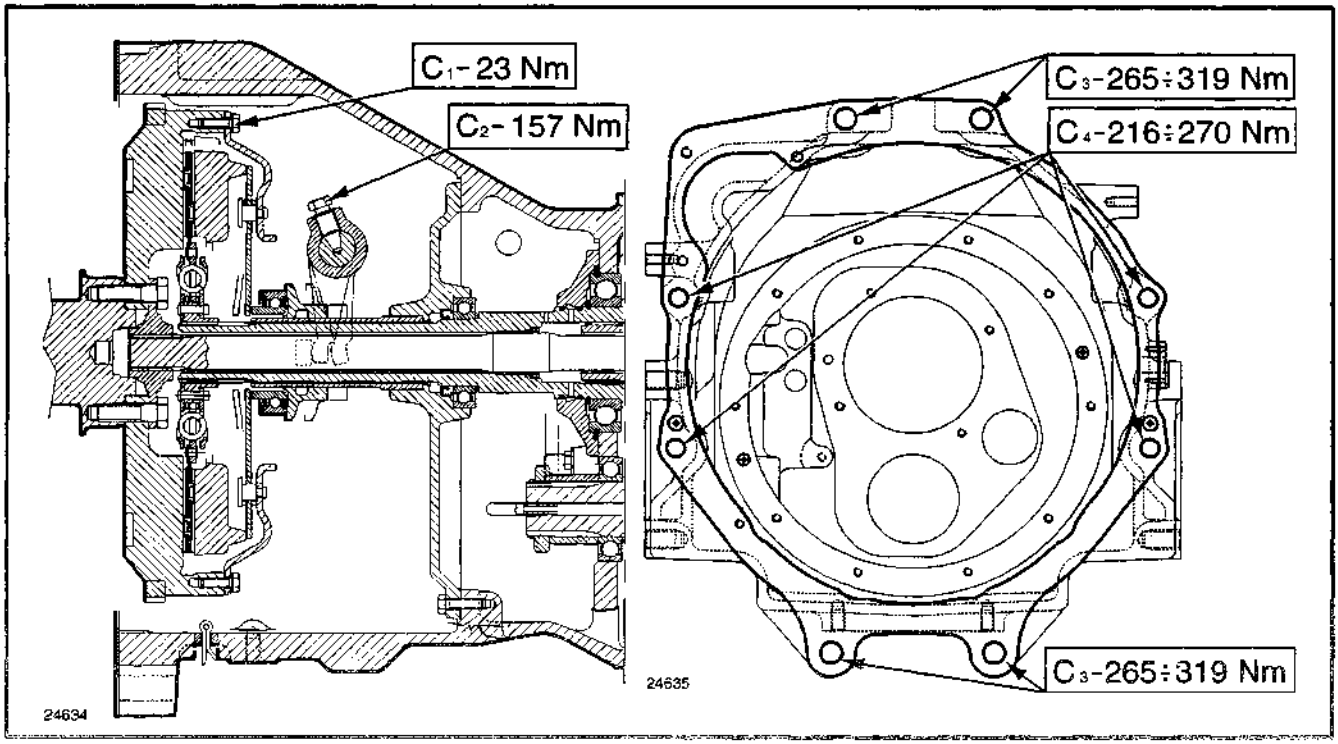
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14" LUK CLUTCH SPECIFICATIONS

Type	Single, Dry–Plate with Torsion Springs
Control	Hydraulic Operation,
Clutch Release Mechanism	Pedal Control
Clutch Disc Lining	Diaphragm Spring
Clutch Disc Thickness (under a 9750 N –994 kg [2194–2192 lb] load)	Cerametallic Pads
Spline Backlash on Transmission Drive Shaft	10.3 to 11.1 mm (0.406 to 0.437 in)
Clutch Release Sleeve to Mount Clearance	0.060 to 0.136 mm (0.002 to 0.005 in)
Clutch Release Pedal to Mount Adjustment	see page 3-1-16

TIGHTENING TORQUE

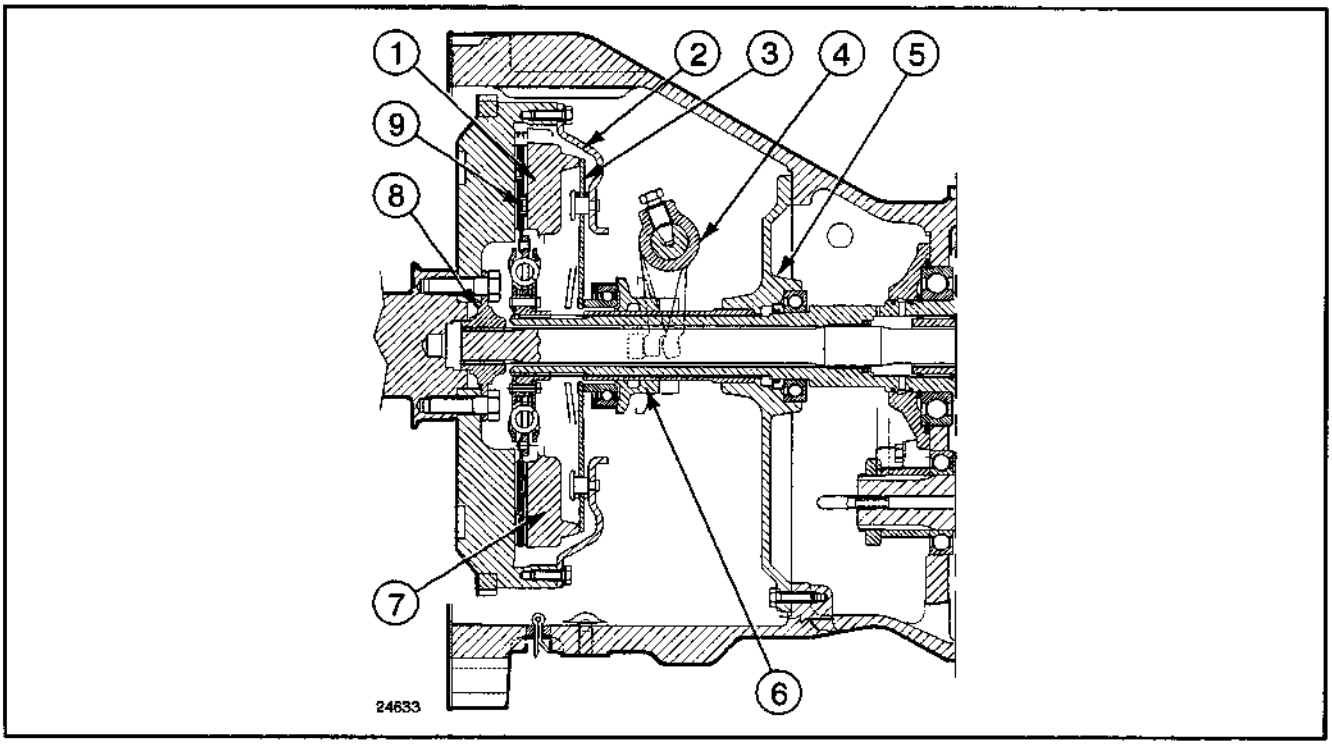


DESCRIPTION	Thread Size	Tightening Torque	
		Nm (lbf ft)	kgm (lbf ft)
Clutch to engine flywheel retaining screws (C_1)	M 8 x 1,25	23 (17)	2,4 (17.3)
Lever lock to clutch release fork screws (C_2)	M 16 x 1,5	157 (116)	16 (115)
Clutch housing to engine retaining screws and nuts (C_3)	3/4"– 16 UNF	265 ÷ 319 (195) (235)	27 ÷ 32,5 (195) (234)
Clutch housing to engine retaining screws and nuts (C_4)	M 16 x 1,5	216 ÷ 270 (159) (199)	22 ÷ 27,5 (159) (198)

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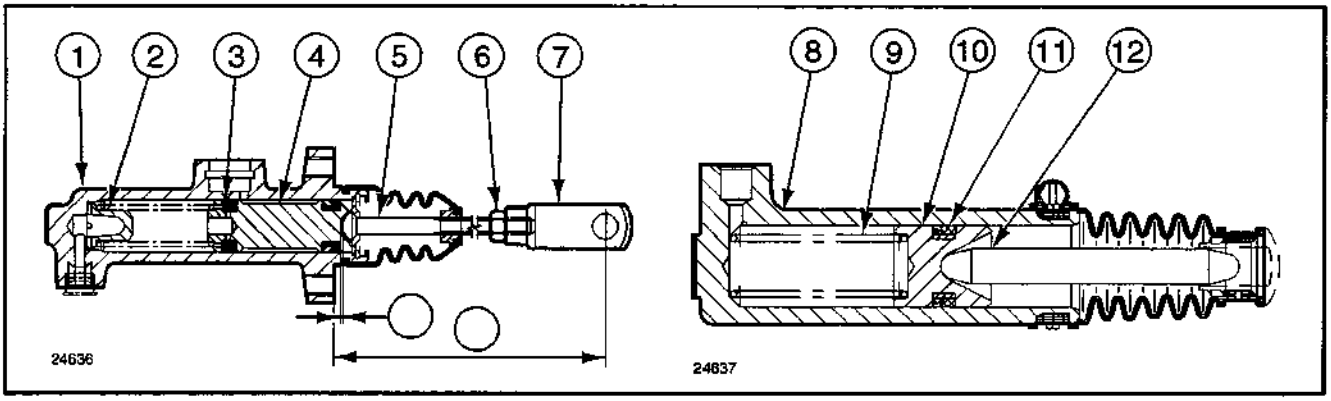
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13" and 14" LUK Clutches – Longitudinal sectional view



13" and 14" LUK Clutches – Longitudinal sectional view

1. 13" LUK Clutch
2. Clutch cover
3. Diaphragm spring
4. Sleeve drive fork
5. Fixed sleeve cover
6. Release sleeve and bearing
7. 14" LUK Clutch



Hydraulic clutch control assembly

a. Drive pump
b. Bottom hydraulic cylinder
G = 0.1 to 1.4 mm (0.004 to 0.055 in). Rod clearance (5) with clutch pedal released.
D = 137.5 to 138 mm (5.41 to 5.43 in). Fork center (7) distance from pump body mounting plate
1. Pump body
2. Spring
3. Seal
4. Plunger
5. Rod
6. Locknut
7. Fork
8. Bottom cylinder
9. Spring
10. Piston
11. Seal
12. Pin

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SPECIAL TOOLS

Caution – Operations described in this section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to perform service operations covered by this section of the Manual:

	292320	Tractor separation stand
X	**293974**	Clutch centring spigot (on tractor)

DESCRIPTION AND OPERATION

The 16x16 and 20x16 transmission clutch is operated hydraulically. It includes a dry clutch disc with cerametallic pads. As usual, the clutch is located in front of the transmission and connects the engine to the transmission drive shaft. The hydraulic operation is controlled by the pump and bottom cylinder and needs no adjustment. The clutch is composed of the clutch housing, clutch pressure plate, diaphragm spring and friction plate. The clutch is maintenance–free.

Operation

When the clutch is engaged, the clutch pressure plate pushes the clutch disc against the engine flywheel under the action of the spring.

The friction between the clutch disc cerametallic pads and the flywheel and pressure plate surfaces transmits the engine power to the transmission drive shaft.

The clutch pedal is connected to the clutch release bearing by means of hydraulic and linkage components.

When the clutch pedal is pressed, the clutch release bearing moves forward and discharges the diaphragm spring. Consequently, the clutch pressure plate beaks off and releases the clutch disc from the flywheel. The transfer of engine power to the transmission is stopped.

When the clutch pedal is released, the clutch release bearing disengages the diaphragm spring which acts on the clutch pressure plate and causes the engine flywheel, clutch disc and clutch housing to come in contact. The flow of power from the engine and transmission is re–established.

TROUBLESHOOTING

Problem	Possible Causes	Correction
Clutch slips	1. Lack of clearance (G, page 3-1-4) between rod and hydraulic pump plunger.	Replace hydraulic pump
	2. Clutch disc (9), pressure plate and/or flywheel wear.	Replace clutch disc; replace clutch if necessary and grind the flywheel.
	3. Damaged or bent diaphragm spring (3).	Replace clutch.
	4. Oil or grease on disc friction material (9) .	Replace clutch disc; repair leak of lubricant into clutch housing; thoroughly clean friction surfaces.

(to be continued)

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TROUBLESHOOTING

(cont'd)

Clutch grabs	1. Stiff external control linkage.	Check and lubricate linkage pivot points.
	2. Warped clutch disc (9, page 3-1-4).	Replace clutch disc.
	3. Clutch disc (9) slides with difficulty over clutch shaft.	Remove clutch and check meshing. Replace faulty parts as necessary.
	4. Clutch disc (9) with damaged damper springs or loose at hub (loose rivets).	Replace clutch disc.
	5. Oil or grease on disc friction material (9) .	Replace clutch disc; repair leak of lubricant into clutch housing; thoroughly clean friction surfaces.
	6. Diaphragm spring (3) with broken elements.	Replace clutch.
Clutch fails to disconnect and drags	1. Warped clutch disc (9).	Replace clutch disc.
	2. Seizure of external controls.	Check and replace faulty items; lubricate.
	3. Hydraulic drive pump and/or bottom cylinder failure.	Overhaul or replace pump and/or cylinder.
	4. Clutch disc (9) slides with difficulty along the shaft.	Release disc and replace disc or shaft, as necessary.
	5. Control misadjustment.	Adjust control (see page 3-1-16).
	6. Air inside the clutch release hydraulic circuit.	Bleed hydraulic system (see page 3-1-19) and replace pump and/or bottom cylinder seals, as necessary.
	7. Diaphragm spring (3) with broken elements and/or damaged clutch release bearing.	Replace clutch and/or bearing.
Clutch noise at engagement and/or disengagement	1. Warped clutch disc (9).	Replace disc.
	2. Damaged clutch disc (9) damper springs.	Replace disc.
	3. Excess backlash on clutch disc (9) to hub meshing splines.	Replace disc and shaft, as necessary.
Clutch noise at disengagement	1. Worn clutch release bearing	Replace bearing.
Clutch control pedal hardness	1. Broken or disconnected clutch return spring.	Replace or hook–up clutch return spring.
	2. Seized pump plunger.	Overhaul or replace pump.
	3. Stiff external control linkage.	Check and lubricate linkage pivot points.
	4. Hard pedal.	Check and lubricate linkage.

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LUK CLUTCH

Removal–Installation (Op. 18 110 10)

It is necessary to separate the engine with attached front axle or live axle from the transmission to gain access to the clutch.

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks. Ensure that no–one is in the vicinity of the load to be lifted.

Proceed as follows:

1. Open and raise engine hood.
2. Disconnect negative cable (4) from battery and insulate properly.

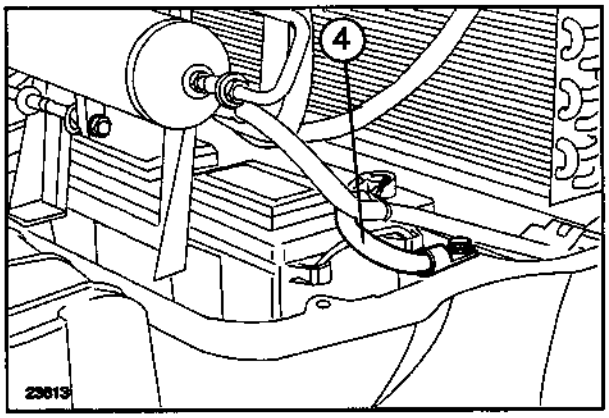


Figure 3-1-1

3. Connect engine hood to a hoisting equipment using a nylon cable (1) and disconnect dampers (2) (one on LH side and one on RH side).

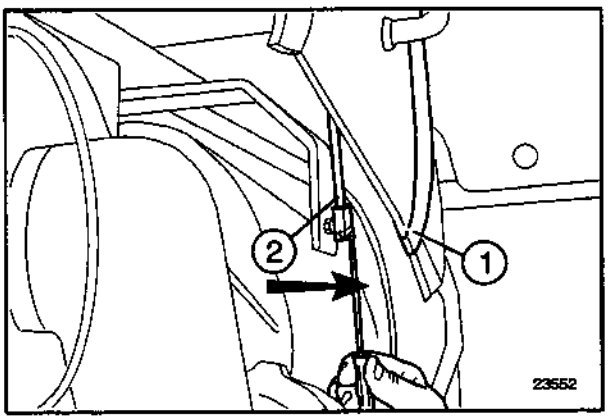


Figure 3-1-2

4. Loosen screws (3) which retain engine hood to engine, disconnect front light electrical harness and remove hood using the hoist. Ensure that the hood is displaced without obstructions and that no other components are interfering.

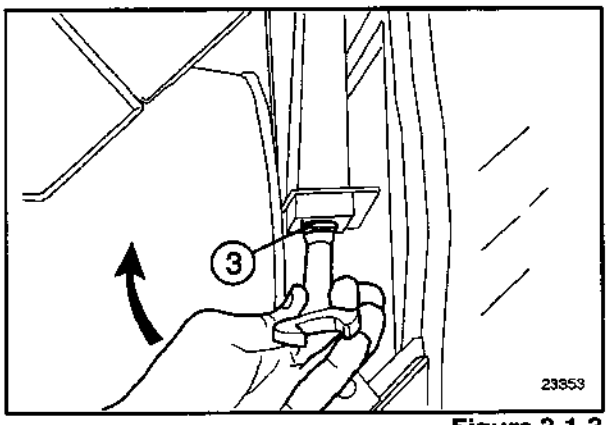


Figure 3-1-3

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5. If front ballast is fitted, thread a nylon cable (2) through first ballast, unscrew support plate retaining screws and remove ballast using a hoist.
6. Unscrew retaining screws of the second rows of ballast and slide them out one at a time.

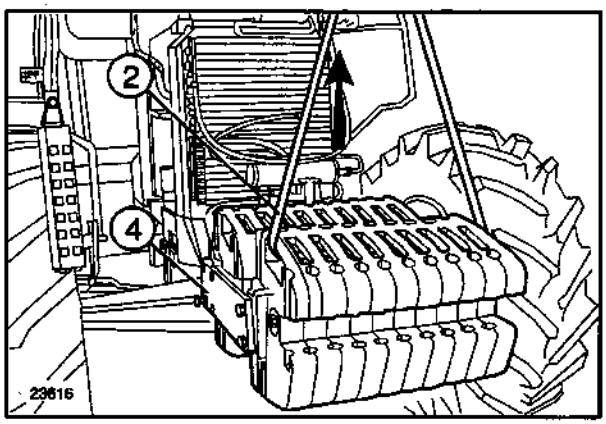


Figure 3-1-4

7. Unscrew the retaining screws and remove side panels (1) (one on each side).

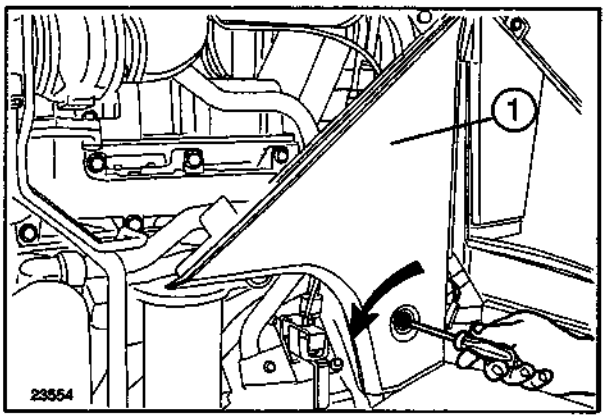


Figure 3-1-5

8. Loosen the drain plug (3) and drain oil from rear transmission and transmission/clutch housings into a suitable container (the specified quantity is indicated on page 0-1-22, section 00).

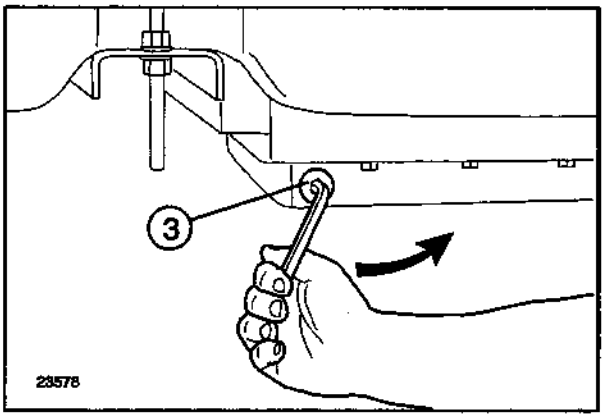


Figure 3-1-6

9. Loosen the retaining clamp and remove the sleeve (5) from the cooler to drain the engine cooling system. Unscrew and remove the cooler cap to favor drainage.

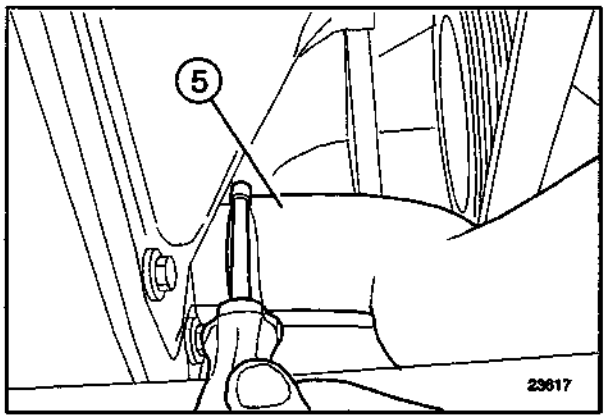


Figure 3-1-7

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10. Loosen retaining screws and remove protection from the live axle drive shaft.

11. Remove circlip (4) and slide out the sleeve (5). Repeat for transfer box circlip and sleeve.

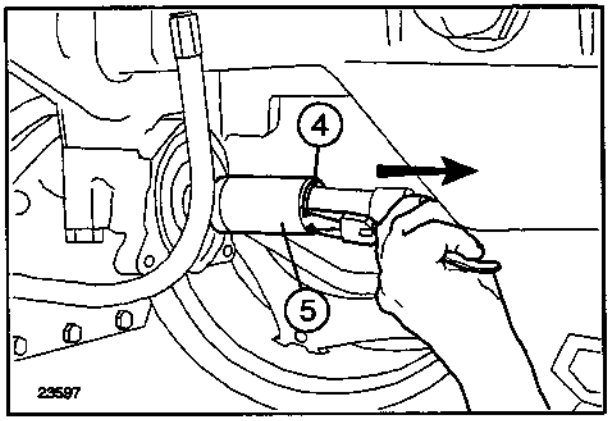


Figure 3-1-8

12. Loosen the bearing support retaining screws to the clutch/transmission housing, disconnect and remove the front differential lock control line (2).

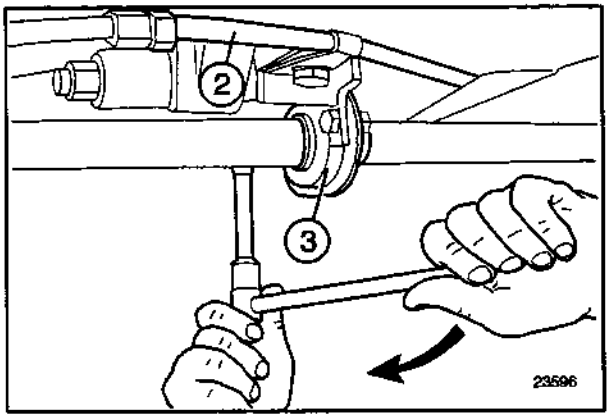


Figure 3-1-9

13. Disconnect light connector (5) located on the rail on both tractor sides.

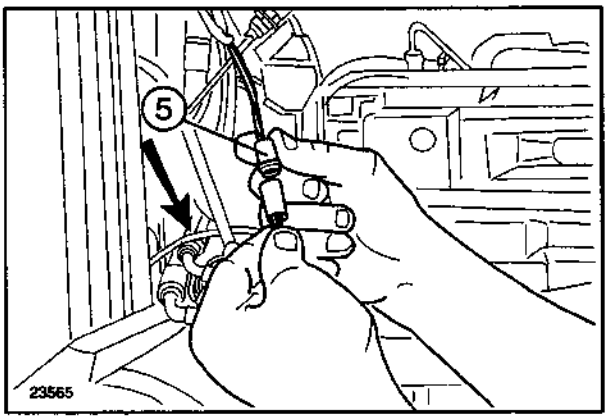


Figure 3-1-10

14. Disconnect the engine heater connecting lines (6) located under the right side of the cabin.

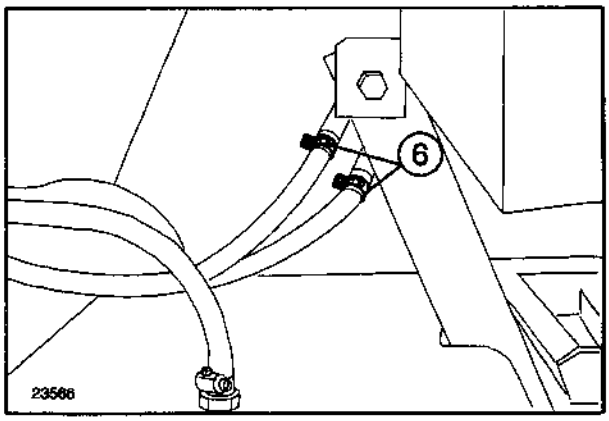


Figure 3-1-11

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15. Unscrew the retaining nut and disconnect the throttle control cable (7) from the injection pump.

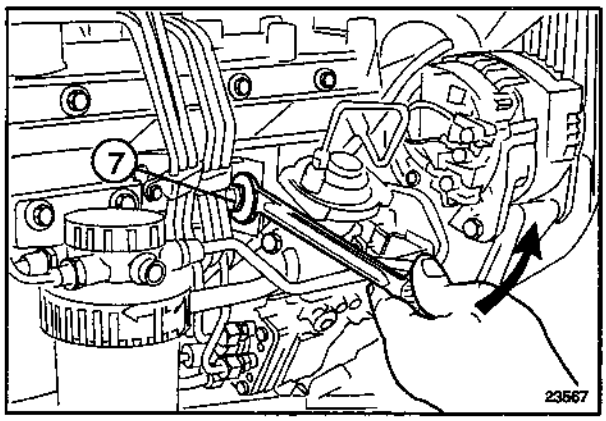


Figure 3-1-12

16. Disconnect the lines (5) connecting the hydrostatic steering motor to the steering hydraulic cylinders.

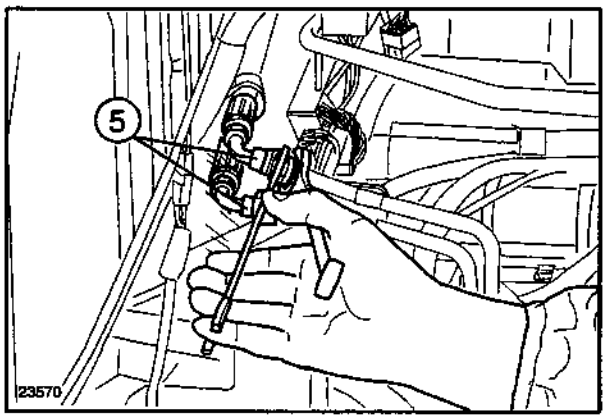


Figure 3-1-13

17. Loosen the clamp and disconnect the fuel supply line (1).

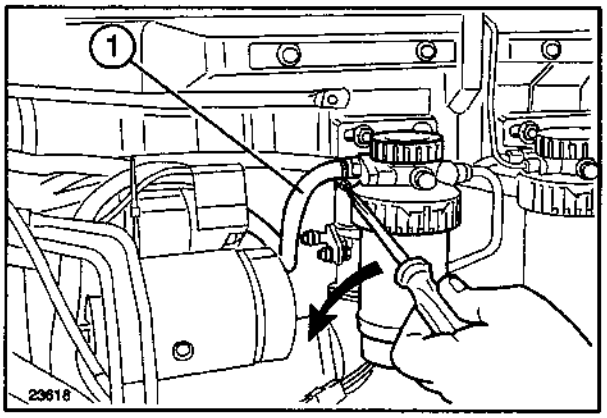


Figure 3-1-14

18. Loosen the clamp and disconnect the fuel return line (2) to tank.

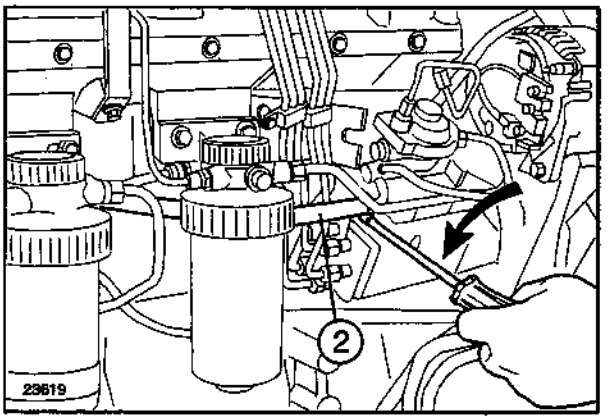


Figure 3-1-15

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19. Unscrew the brakes line support bracket (7).

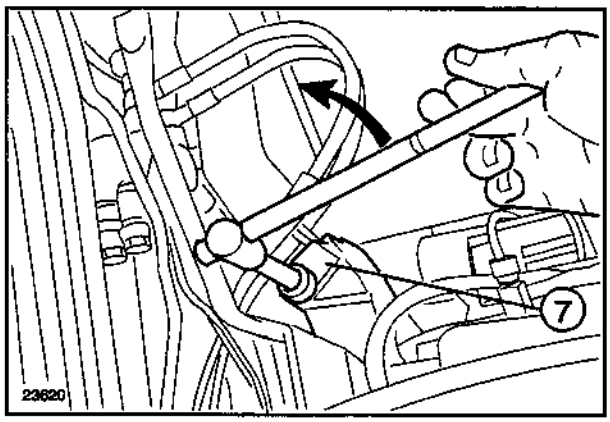


Figure 3-1-16

20. Disconnect both engine to cabin connectors (5 and 6).

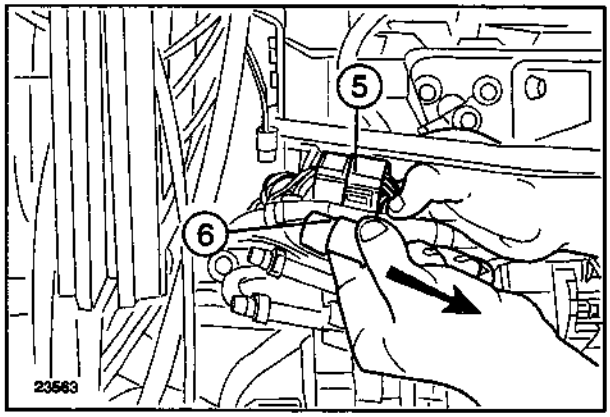


Figure 3-1-17

21. Disconnect radar (4) and fuel filter connectors (3). Remove protection and disconnect both connectors (1 and 2) from starting motor.

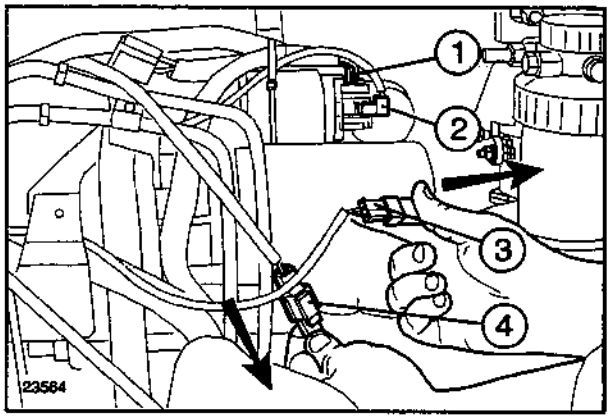


Figure 3-1-18

22. Loosen retaining screws and remove radar (8) together with its support bracket.

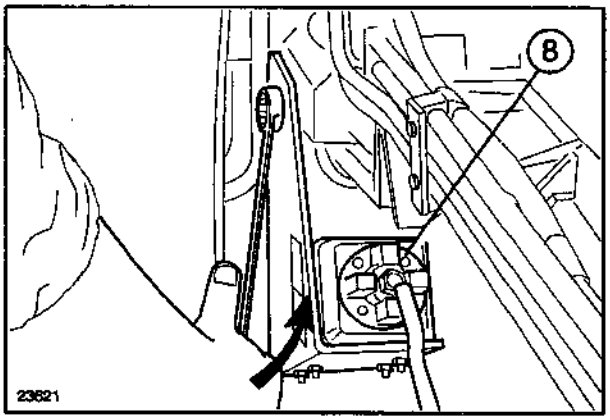


Figure 3-1-19

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23. Loosen clamps and remove hoses from transmission oil cooler piping (1).

24. Loosen the bracket which retains the hydrostatic steering and transmission oil cooler lines.

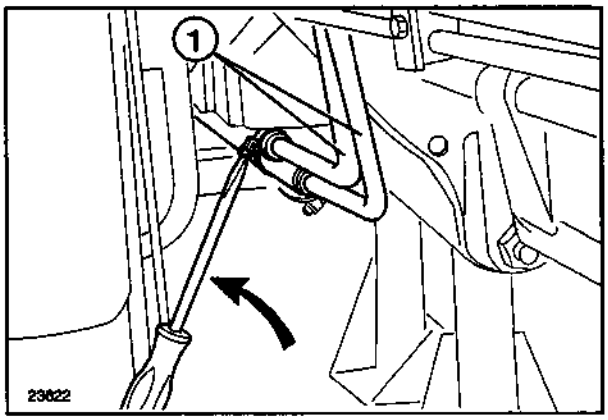


Figure 3-1-20

25. Unscrew fittings and disconnect air conditioning system lines (6).

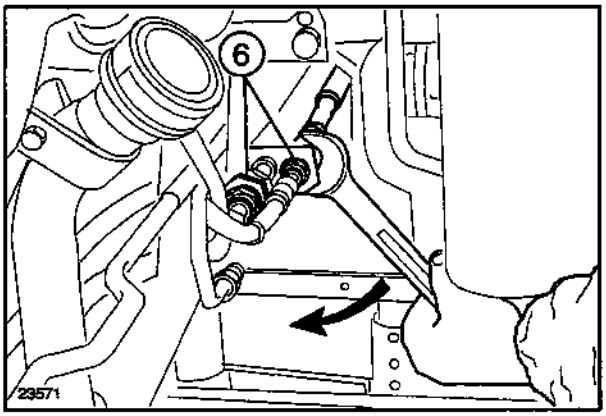


Figure 3-1-21

26. Install special stand tool no. **292320** placing the stationary stand under the transmission/clutch housing and the trolley under the engine oil sump.

27. Place two wooden blocks (one on each side) between the live axle support and live axle to prevent the engine from oscillating.

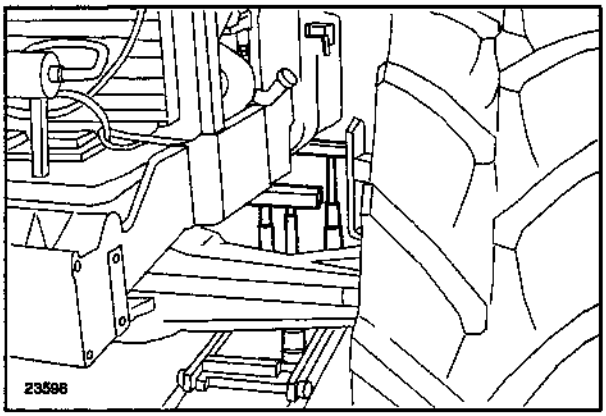


Figure 3-1-22

28. Loosen retaining screws and remove starter motor (1).

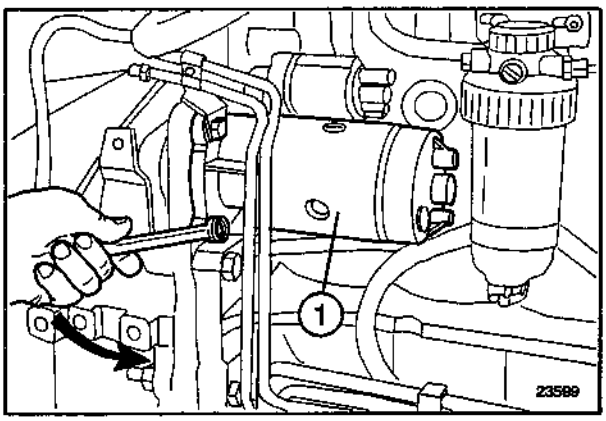


Figure 3-1-23

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29. Loosen the screws which attach the engine to the transmission/clutch housing.

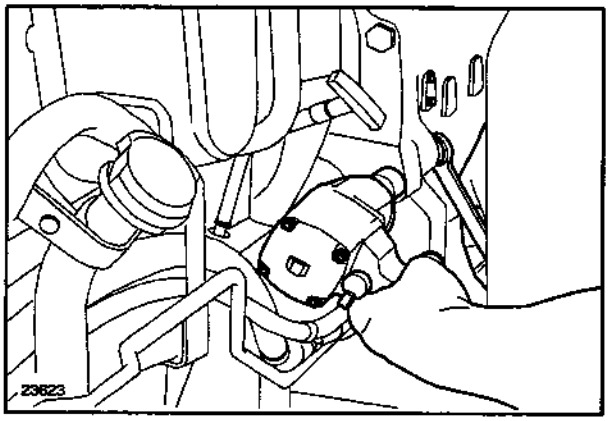


Figure 3-1-24

30. Loosen the screw (2) attaching the metal spacer to the transmission/clutch housing.

31. Separate engine from the transmission/clutch housing.

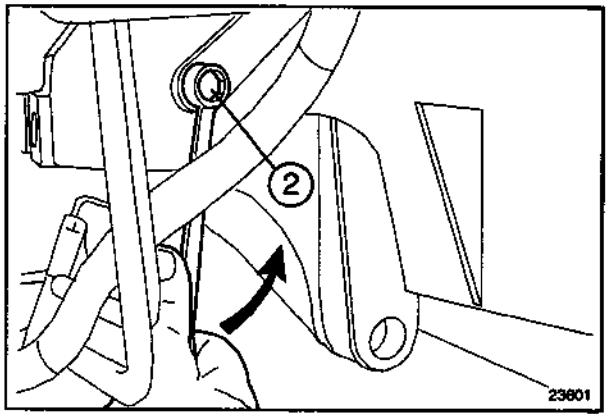


Figure 3-1-25

32. Loosen the screws which retain the clutch to the engine flywheel and remove the clutch assembly using the spigot tool no. **293974** (1).

33. Check disc for wear and replace if pad retaining rivets are flush or almost flush with the pads.

34. Reassemble the clutch taking care of the following:
- Reassembly follows the disassembly procedure in reverse, from step no. 33 back to step no. 1;
- Comply with tightening torque indicated on page 2;
- Apply **AMBRA G75MD** grease on the splines for clutch disc positioning;
- Position clutch onto engine flywheel using the spigot tool no. **293974**;
- Thoroughly clean and degrease mating surfaces and apply a circle of sealer with approx. 2 mm (0.079 in) of diameter as shown in figures on page 3-1-14 before reassembling housings, supports and covers.

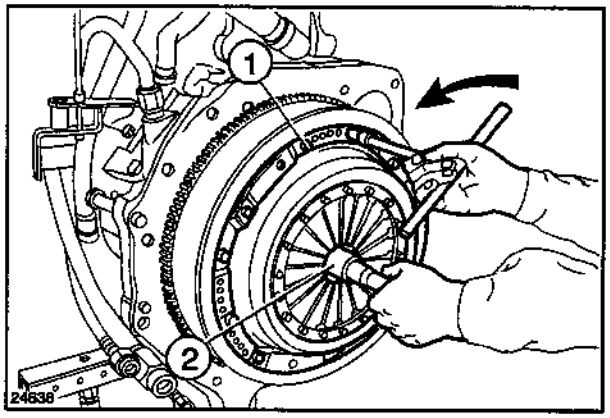


Figure 3-1-26

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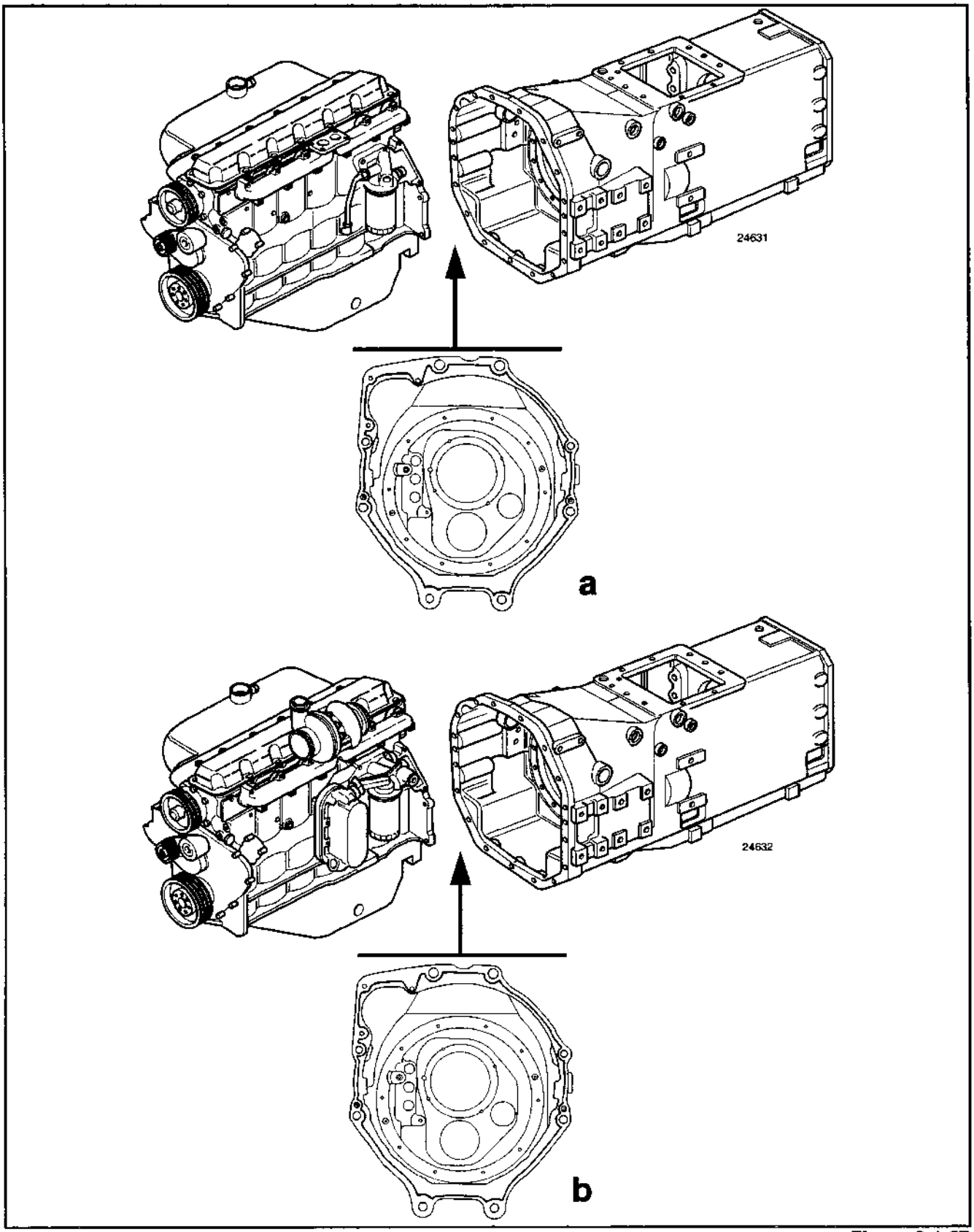


Figure 3-1-27

Diagram for sealer application before mounting engine to transmission/clutch housing.

Sealers to be used are detailed on page 0-1-19, section 00.

a. Models 100 HP (75 kw) and 115 HP (86.2 kw)
b. Models 135 HP (101.2 kw) and 160 HP (120 kw)

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CLUTCH HYDRAULIC CONTROL

Removal–Installation (Op. 18 104 15 – 18 104 30)

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

Detach the clutch control assembly as follows:

1. Open engine hood.

2. Disconnect negative cable (4) from battery and insulate properly.

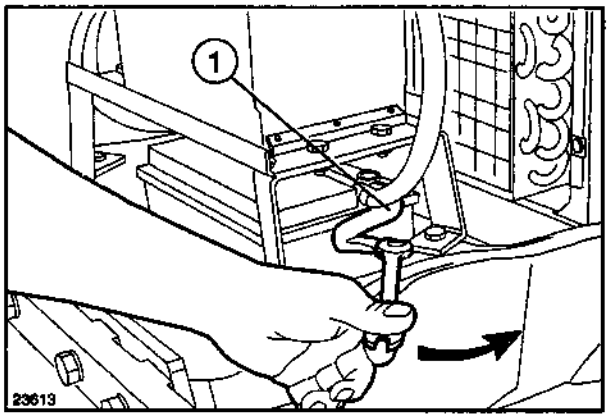


Figure 3-1-28

3. Loosen retaining screws and remove the side panel (1).

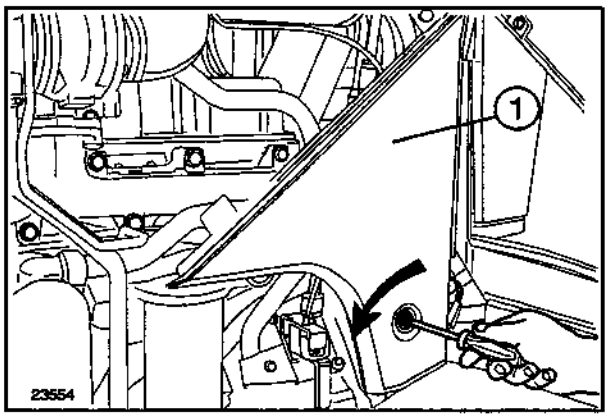


Figure 3-1-29

4. Remove retaining screws (1 and 2) and remove protection from left side.

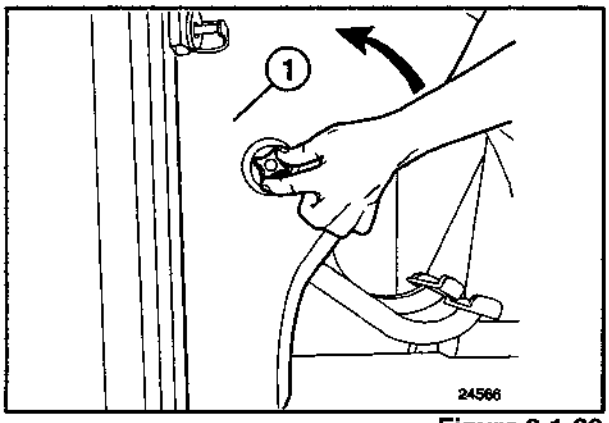


Figure 3-1-30

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5. Disconnect the electrical connector from clutch control hydraulic circuit tank.

6. Disconnect the clutch release line (1) from pump.

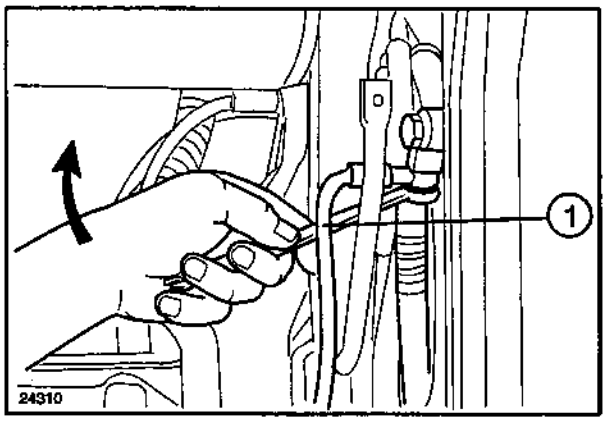


Figure 3-1-31

7. Remove the split pin and slide out the pivot pin (2). Loosen retaining screws (1) and withdraw the clutch release pump from front side.

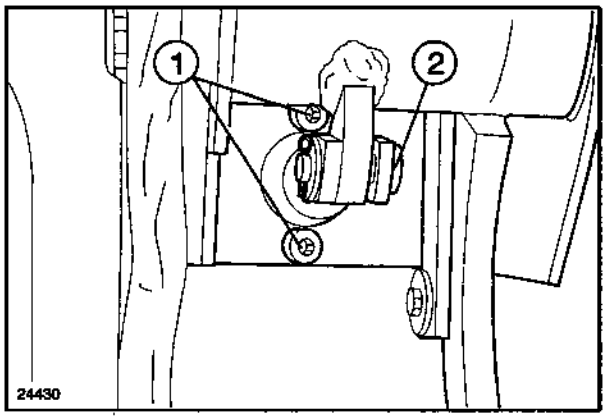


Figure 3-1-32

8. Unscrew the clutch release line (1), remove the retaining screw (2) and nuts (4). Remove the hydraulic cylinder (3).

9. Reinstallation of the clutch control assembly follows the removal procedure in reverse. After installation, carry out pedal adjustment as described below.

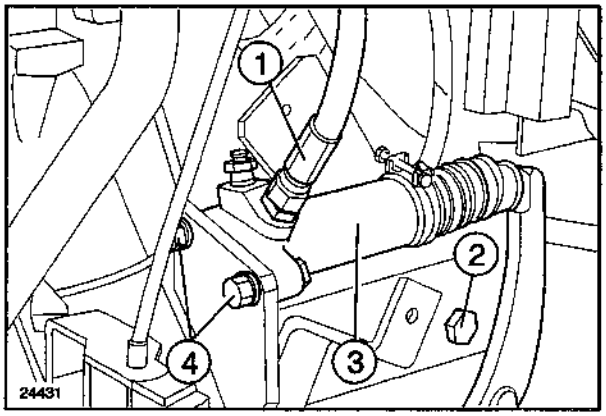


Figure 3-1-33

Clutch pedal adjustment

10. Adjust distance (D, page 3-1-4) before reassembling the control pump.

11. With the clutch pedal (1) connected to the fork (2), check distance (H) from the middle of pedal to the mat top. It should be approx. 190 mm (7.48 in).

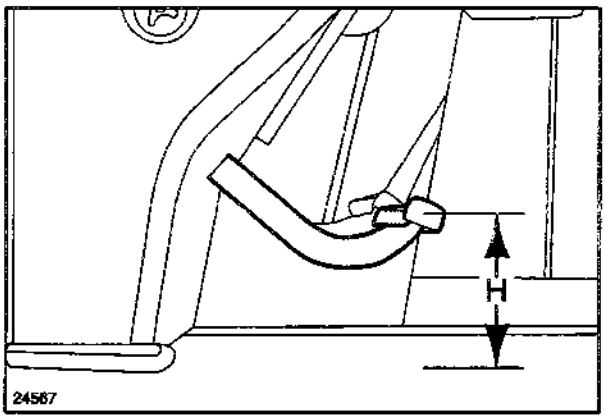


Figure 3-1-34

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12. If it is necessary to adjust it, loosen the locknut (1), remove the pin (3) and screw in or out the screw on the fork (2) until obtaining the specified distance (H, Figure 3-1-34). Then check that the pedal (9) can travel along 170 mm (6.69 in) (A).

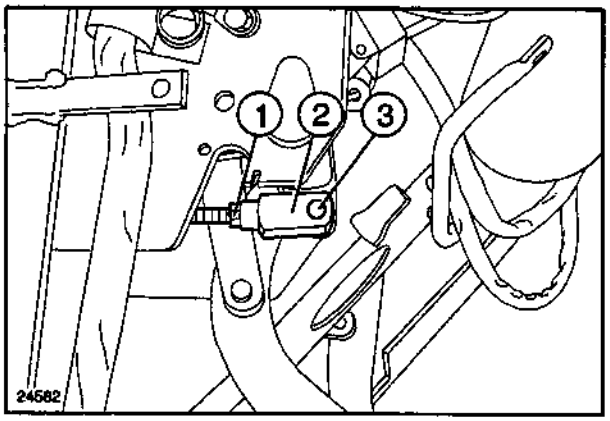


Figure 3-1-35

CLUTCH HYDRAULIC CONTROL ASSEMBLY

Disassemble–Reassemble (Op. 18 104 18 – 18 104 33).

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

⚠ WARNING ⚠

Always use appropriate tools to align holes. NEVER USE YOUR HANDS OR FINGERS.

Proceed as follows:

1. Put the pump in a vise and slide the tank (1) out of the pump body (2).

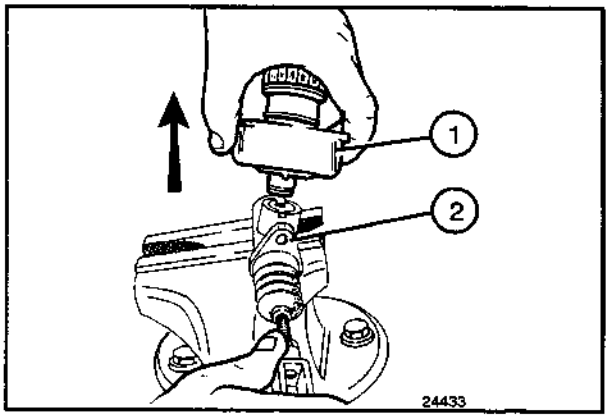


Figure 3-1-36

2. Back off the rubber sleeve (2), remove circlip (3) and withdraw the entire rod assembly (1) completely.

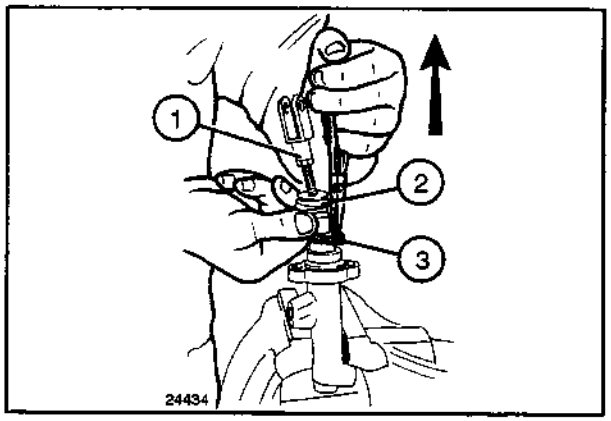


Figure 3-1-37

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3. Recover piston (1) and spring (2).

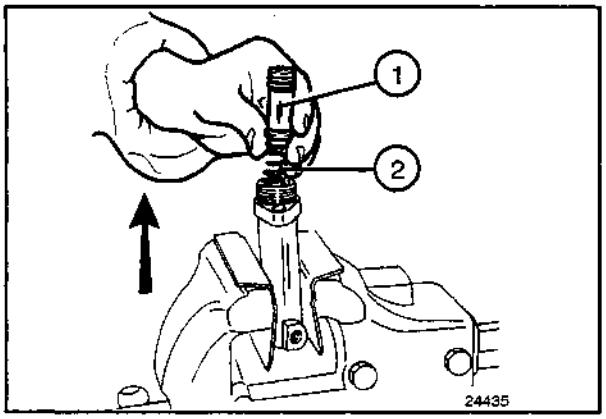


Figure 3-1-38

4. Place the bottom hydraulic cylinder (1) in a vise, release the spring clip (2) and remove the sleeve (3).

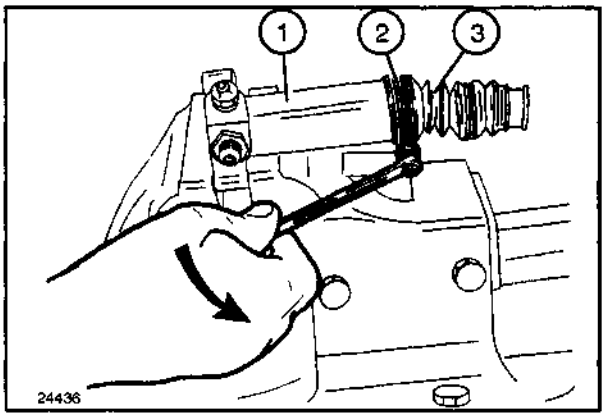


Figure 3-1-39

5. Blow out the piston (1) and spring using compressed air.

6. Reassemble the clutch control hydraulic pump and bottom hydraulic cylinder taking into account the following:

   – Reassembly follows the disassembly procedure in reverse, from step no. 5 back to step no. 1;
   – Check seals for proper condition and replace them if necessary;
   – Check sliding surfaces of the pistons and bores.

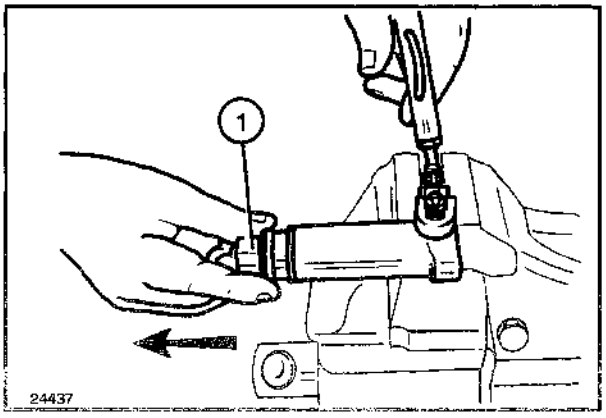


Figure 3-1-40

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CLUTCH HYDRAULIC CONTROL ASSEMBLY

Clutch control hydraulic circuit bleeding (Op. 18 104 05).

Bleeding of air should be performed each time the clutch control hydraulic circuit is subject to maintenance or repair operations.

Proceed as follows:

1. Thoroughly clean the external area of the assembly around the bleed screw (1, Figure 3-1-42) and hydraulic oil reservoir cover (1).

2. Ensure that the tank (1) is being filled before and during bleeding.

Note – Filter bled oil accurately before reuse.

---

3. Press clutch pedal **slowly along all its travel** to pressurize oil.

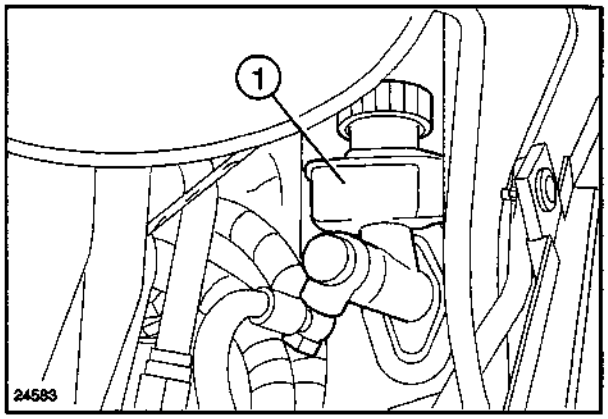


Figure 3-1-41

4. Hold the clutch pedal down and unscrew the bleeding screw (1) by half a turn. Let drain oil with air bubbles.

5. Screw in the screw (1) and repeat the above steps until oil free of air comes out.

6. Press again the clutch pedal to pressurize the circuit. This condition exists when pedal operation is felt normal again.

7. Upon completion of bleeding, top up oil in the reservoir to correct level (1, Figure 3-1-41).

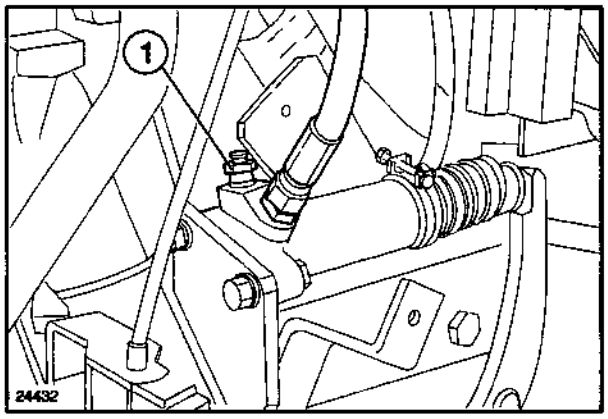


Figure 3-1-42

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SECTION 4

TRANSMISSIONS

CHAPTER 1

RANGE COMMAND TRANSMISSION

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SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

SPECIFICATIONS – SEMI–POWERSHIFT TRANSMISSION AND RANGE GEARS

Transmission	3–speed with constant–mesh gears controlled by five independent clutches.
Gear type	helical toothed
Range gears	cascade–scheme, with 3 forward ranges and 1 reverse range for a total of 18 forward and 6 reverse speeds
– Gear type	helical toothed
– Reduction ratios:	
Low	(24 x 15) : (46 x 55) = 1 : 7.03
Normal	(24 x 25) : (46 x 37) = 1 : 2.84
High	1
Speed and range shift controls	by three buttons located on the control lever, forced–fed by a gear pump (same as the power steering circuit pump)
Shift and range gear lubrication	
Number of driven discs–Clutch A	7
– Thickness of driven discs – Clutch A in (mm)	0.104 to 0.108 (2.65 to 2.75)
Number of drive discs – Clutch A	7
– Thickness of drive discs – Clutch A in (mm)	0.071 to 0.079 (1.80–2.00)
Multi–pack clutch A thickness under a load of 359 lb	
– (163 kg) in (mm)	1.29 to 1.30 (32.7 to 32.9)
Number of Belleville springs – Clutch A	9
– Free spring length – Clutch A in (mm)	0.165 (4.2)
– Compressed spring length under a load of 474 lb	
(215 kg) in (mm)	0.129 (3.28)

(to be continued)

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SPECIFICATIONS – SEMI–POWERSHIFT TRANSMISSION AND RANGE GEARS

Number of driven discs–Clutch B	in (mm)	7
– Thickness of driven discs – Clutch B	in (mm)	0.104 to 0.108 (2.65 to 2.75)
Number of drive discs – Clutch B	in (mm)	7
– Thickness of drive discs – Clutch B	in (mm)	0.071 to 0.079 (1.80–2.00)
Multi–pack clutch B thickness under a load of 359 lb (163 kg)	in (mm)	1.29 to 1.30 (32.7 to 32.9)
Number of Belleville springs – Clutch B	in (mm)	9
– Free spring length – Clutch B	in (mm)	0.165 (4.2)
–Compressed spring length under a load of 474 lb (215 kg)	in (mm)	0.129 (3.28)
Number of driven discs–Clutch C	in (mm)	8
– Thickness of driven discs – Clutch C	in (mm)	0.106 to 0.110 (2.70 to 2.80)
Number of drive discs – Clutch C	in (mm)	8
– Thickness of drive discs – Clutch C	in (mm)	0.059 (1.5)
Multi–pack clutch C thickness under a load of 359 lb (163 kg)	in (mm)	1.03 to 1.04 (26.2 to 26.4)
Number of Belleville springs – Clutch C	in (mm)	6
– Free spring length – Clutch C	in (mm)	0.161 (4.1)
– Compressed spring length under a load of 401 lb (182 kg)	in (mm)	0.127 (3.22)
Number of driven discs–Clutches D–E	in (mm)	6
– Thickness of driven discs – Clutches D–E	in (mm)	0.106 to 0.110 (2.70 to 2.80)
Number of drive discs – Clutches D–E	in (mm)	6
– Thickness of drive discs – Clutches D–E	in (mm)	0.059 (1.5)
Multi–pack clutches D–E thickness under a load of 359 lb (163 kg)	in (mm)	1.03 to 1.04 (26.2 to 26.4)
Number of Belleville springs – Clutches D–E	in (mm)	6
–Free spring length – Clutches D–E	in (mm)	0.161 (4.1)
– Compressed spring length under a load of 401 lb (182 kg)	in (mm)	0.127 (3.22)
PTO drive shaft (7) diameter at the bushing	in (mm)	1.258 to 1.259 (31.950 to 31.975)
Press–fit bushing inner diameter	in (mm)	*1.259 to 1.263 (31.990 to 32.085)
PTO drive shaft to bushings clearance	in (mm)	0.0006 to 0.005 (0.015 to 0.135)
Transmission input shaft adjust shim (6)	mm	3.80 – 3.85 – 3.90 –3.95 – 4.00 – 4.05 – 4.10 – 4.15 – 4.20 – 4.25 – 4.30 – 4.35 – 4.40 – 4.45 – 4.50 – 4.55 – 4.60 – 4.65 – 4.70 – 4.75 – 4.80
Transmission input shaft bearing adjustment		see pag. 4-1-47
Transmission output shaft adjust shim (26)	mm	9.80 – 9.825 – 9.85 – 9.875 – 9.90 – 9.925 – 9.95 – 9.975 – 10.00 – 10.025 – 10.05 – 10.075 – 10.10 – 10.125 – 10.15 – 10.175 – 10.20 – 10.225 – 10.25 – 10.275 – 10.30 – 10.325 – 10.35 – 10.375 – 10.40 – 10.425 – 10.45 – 10.475 – 10.50 – 10.525 – 10.55 – 10.575 – 10.60 – 10.625 – 10.65 – 10.675 – 10.70
Transmission output shaft bearing adjustment		see pag. 4-1-48
Transmission output shaft thrust washer	in (mm)	0.156 to 0.158 (3.95 to 4.00)

* Final dimension to be obtained without grinding

(to be continued)

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SPECIFICATIONS – SEMI–POWERSHIFT TRANSMISSION AND RANGE GEARS

(continued)

Range gear input shaft bearing adjustment	see pag. 4-1-49
Range gear input shaft bearing adjust shims (12, Figure 4-1-11) ... mm	1.70 – 1.75 – 1.80 –1.85 – 1.90 –1.95 – 2.00 – 2.05 – 2.10 – 2.15 – 2.20 – 2.25 – 2.30 –2.35 – 2.40 – 2.45 – 2.50 – 2.55 – 2.60 – 2.65 – 2.70 – 2.75 – 2.80 – 2.85 – 2.90 – 2.95 – 3.00 – 3.10 – 3.20 – 3.30
Range gear output shaft bearing adjustment	see pag. 4-1-49
Range gear output shaft adjust shims (14, Figure 4-1-11) ... mm	1.70 –1.75 – 1.80 –1.85 – 1.90 –1.95 – 2.00 – 2.05 – 2.10 – 2.15 – 2.20 – 2.25 – 2.30 –2.35 – 2.40 – 2.45 – 2.50 – 2.55 – 2.60 – 2.65 – 2.70 – 2.75 – 2.80 – 2.85 – 2.90 – 2.95 – 3.00 – 3.10 – 3.20 – 3.30
Implement pressure regulation valve spring (9, Figure 4-1-12):	
– Free spring length ... in (mm)	5.0 (127)
– Compressed spring length under a load of 62.6 to 68.3 lb (28.4 to 31 kg) ... in (mm)	102.5 (4.04)
Implement working pressure ... lbf/in^2 (bar)	242 to 256 (16.7 to 17.6)
Lubrication pressure regulation valve spring (32, Figure 4-1-11):	
– Free spring length ... in (mm)	1.40 (35.5)
– Compressed spring length under a load of 8.4 to 9.2 lb (3.8 to 4.2 kg) ... in (mm)	1.00 (25.5)
Lubrication pressure ... lbf/in^2 (bar)	39.8 to 49.8 (2.7 to 3.4)

SPECIFICATIONS – CREEPER GEARS

Type	epicyclic spur gear set
– Reduction ratio:	20 : (20+100) = 1:6
Control type	through a lever on LH side of the driver's seat
Creeper housing and driven gear thrust washer thickness ... in (mm)	0.058 to 0.060 (1.465 to 1.535)

TIGHTENING TORQUE

	Thread size	Tightening Torque	
		N·m	ft. lbs.
Bolts and nuts, clutch/transm housing to engine	(see C_3 and C_4, page 3-1-3, Sec. 3)		
Bolts, clutch/transm housing to rear axle housing	M14 x 1.5	176	130

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(continued)

Bolts, clutch front cover (C_1)	M8 x 1.25	23	17
Bolts, transmission housing cover (C_2)	M10 x 1.25	49	36
Bolts, range rear bearing retaining plate (C_3)	M10 x 1.25	49	36
Nut, range output shaft (C_4)	M47.5 x 1.5	294	217
Nut, transmission output shaft (C_5)	M45 x 1.5	490	361
Bolts, damper to flywheel(C_6)	M12 x 1.25	23	17
Screws, range drive piston housing(C_7)	M10 x 1.25	49	36
Screw, solenoid valve(C_8) (*)	–	5.4to81	4 to 6
Screw, solenoid valve pin(C_9) (*)	–	47to54	35–40
Bolts, range rear bearing support plate	M14 x 1.5	142	105
Bolts, transmission input shaft cover plate	M8 x 1.25	23	17

(*) Apply a couple of drops of Loctite 542

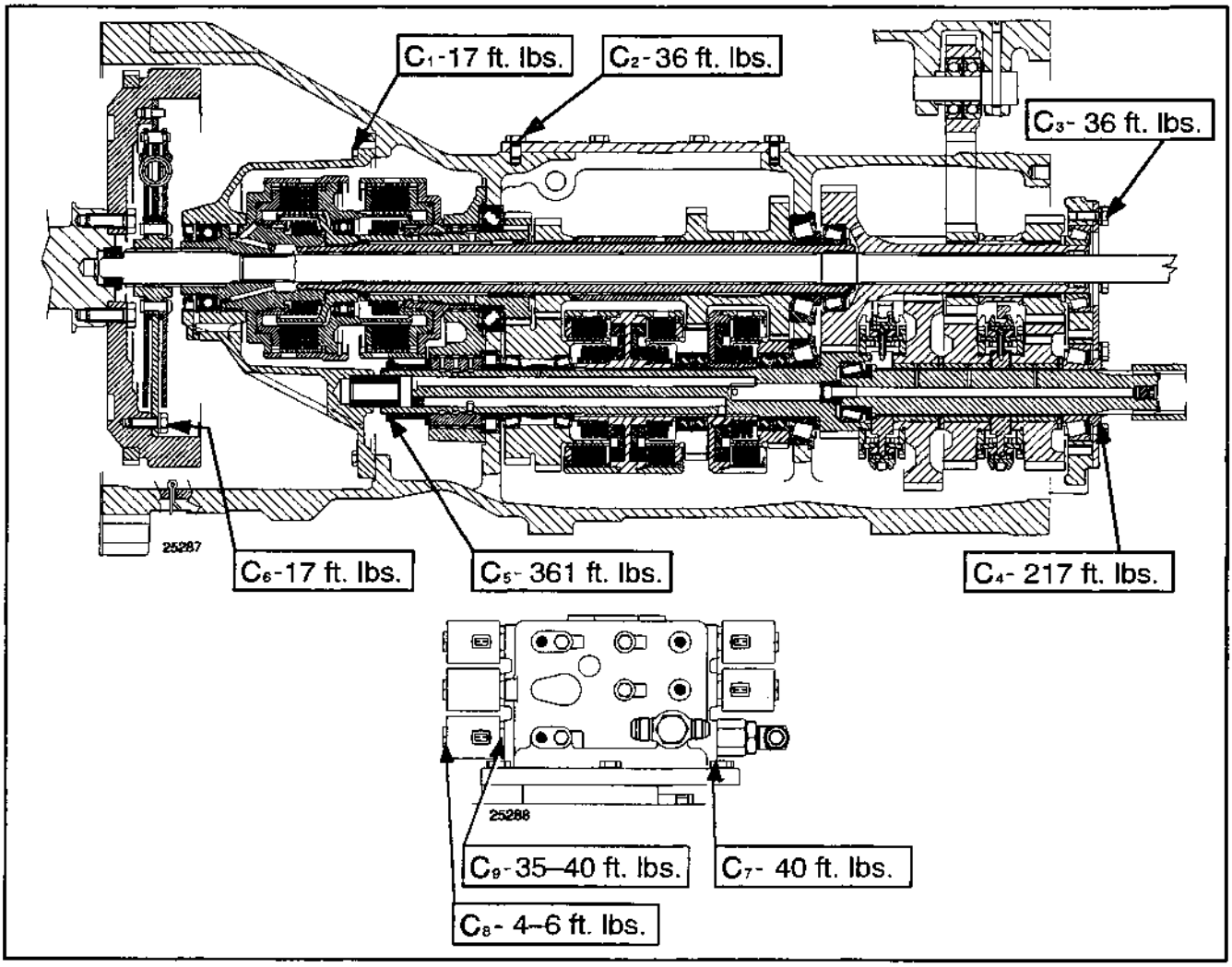


Figure 4-1-1

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SPECIAL TOOLS

Caution – Operations described in this Section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to carry out the different operations described in this Section:

FTC201387		Tractor separation stand.
	293343	Output shaft spanner.
X	**293805**	Driven shaft retainer.
FTC213997B		Cab lifting, fixture.
X	**293808**	Output shaft retaining tool.
	292176	Range input and output shaft end play test tool (use with tools nos. **50013** and **50018**).
	291525	Transmission and rear axle housing alignment pins.
X	**293869**	Output shaft bearing installer (use with tool no. **50108**).
X	**293975**	Clutch C drum bearing adjustment tool.
	295021	Clutch spring compressor.
	294035	Pressure test kit (use with tool no. **295024**).
	295024	Fitting (kit no. **294035**).
	295047	Adapter (use with tool no. **293975** or **293510**).
	295049	Range gear output shaft retaining tool.

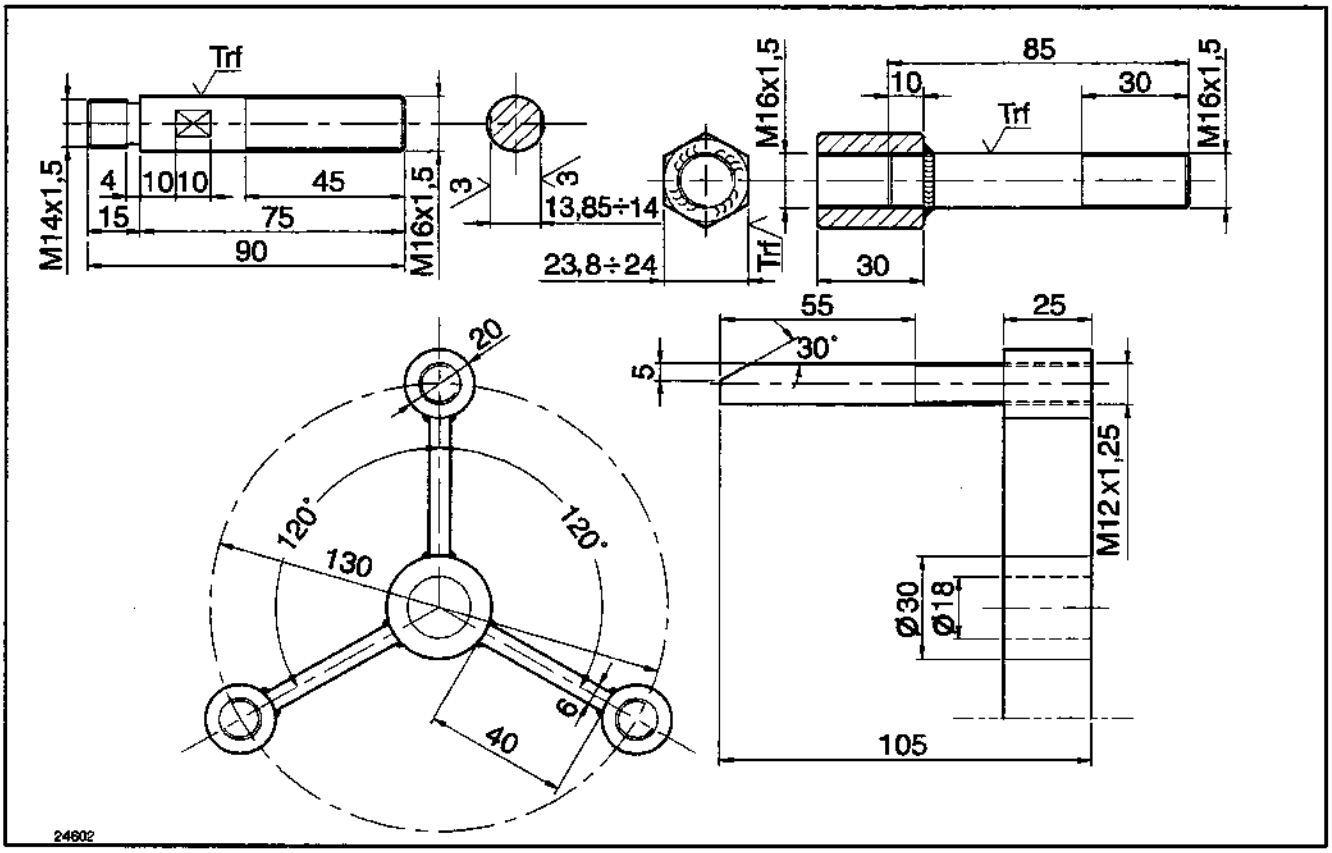


Figure 4-1-2

Tool to be fabricated for range input and output shaft bearing adjustment (Mark tool with no. 50018 – Dimensions in mm).
Fabricate tool using Aq 42 material.

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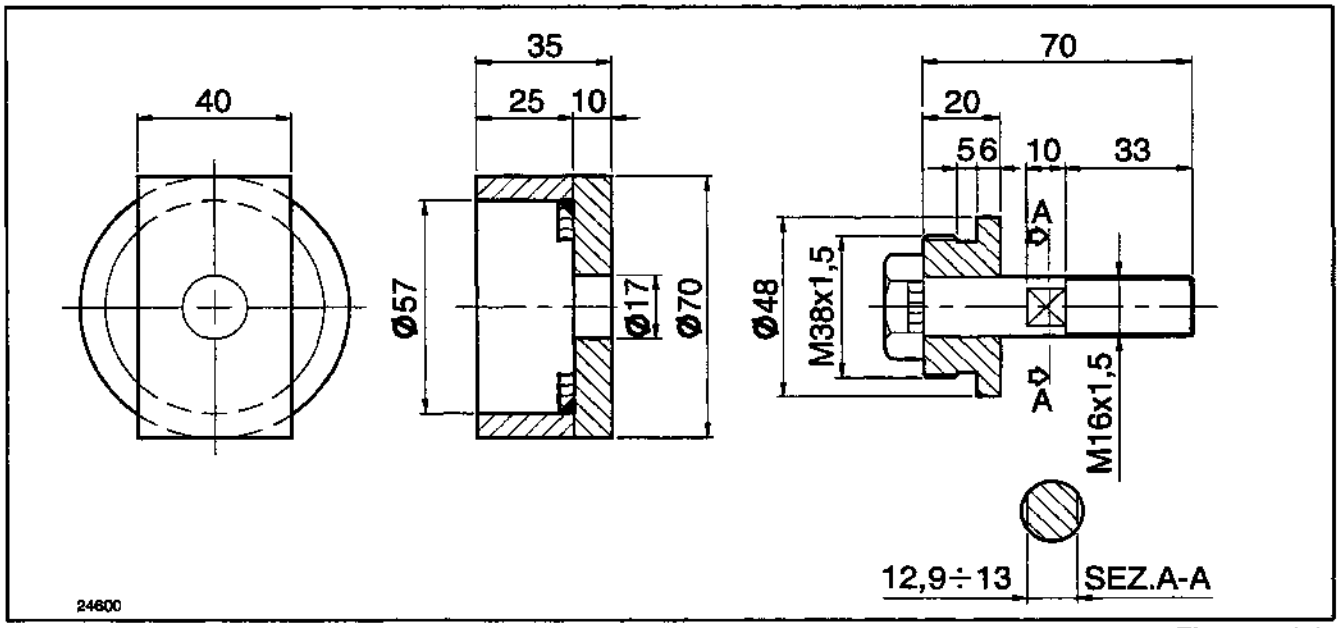


Figure 4-1-3

Tool to be fabricated for range input shaft taper bearing assembly (Mark tool with no. 50013 – Dimensions in mm).
Fabricate tool using UNI C40 material. – Use only part (a).

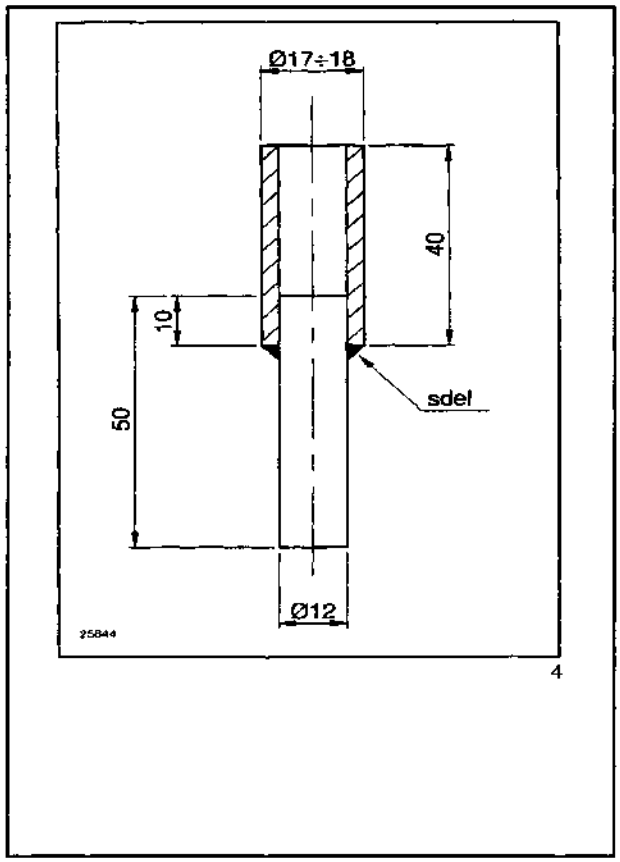


Figure 4-1-4

Tool to be fabricated for clutch B circlip assembly(Mark tool with no. 50115 – Dimensions in mm).
Fabricate tool using UNI C40 material. Make 3.

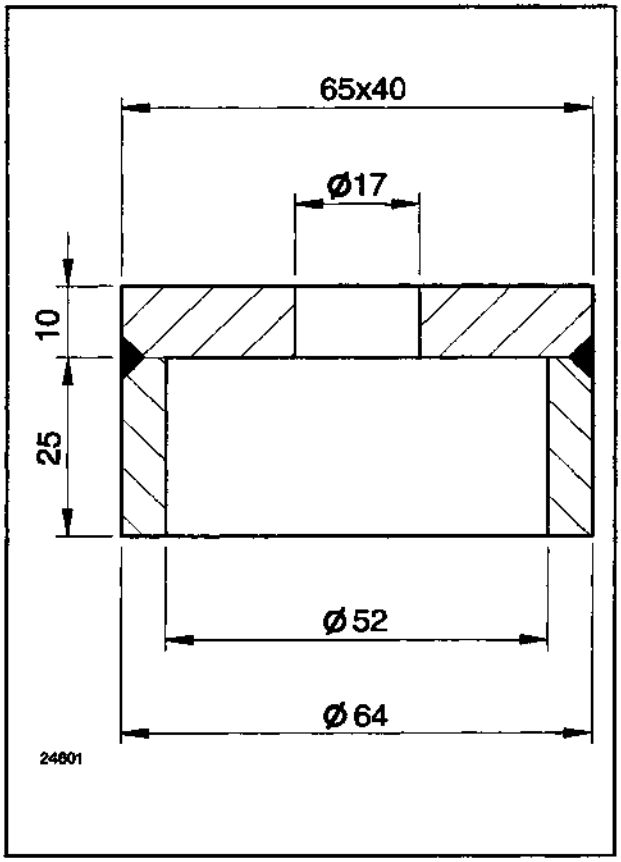


Figure 4-1-5

Tool to be fabricated for range output shaft bearing assembly (Mark tool with no. 50061 – Dimensions in mm).
Fabricate tool using C30 material.

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Tool to be fabricated for range input shaft bearing assembly (Mark tool with no. 50060 – Dimensions in mm.)
Fabricate tool using C30 material.

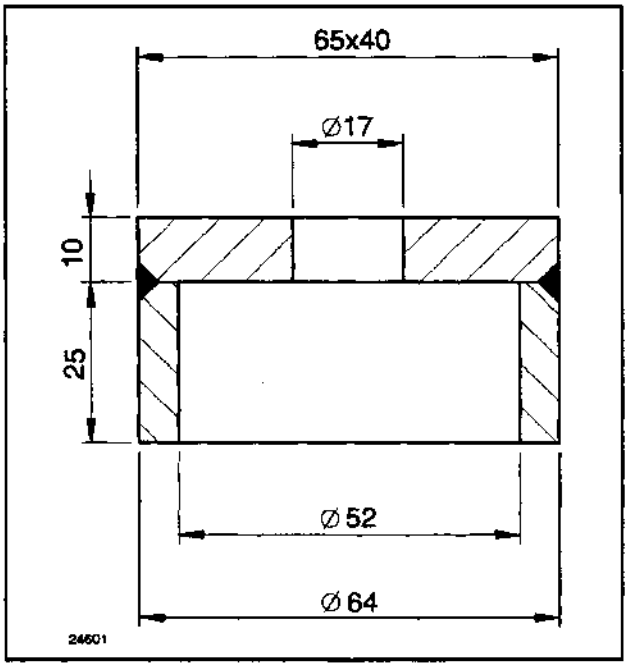


Figure 4-1-6

Bracket to be fabricated to fix the transmission on the rotary stand. Use with bracket tool no. 293971 (Mark tool with no. 50110 – Dimensions in mm).
Fabricate tool using Fe 42 C material.

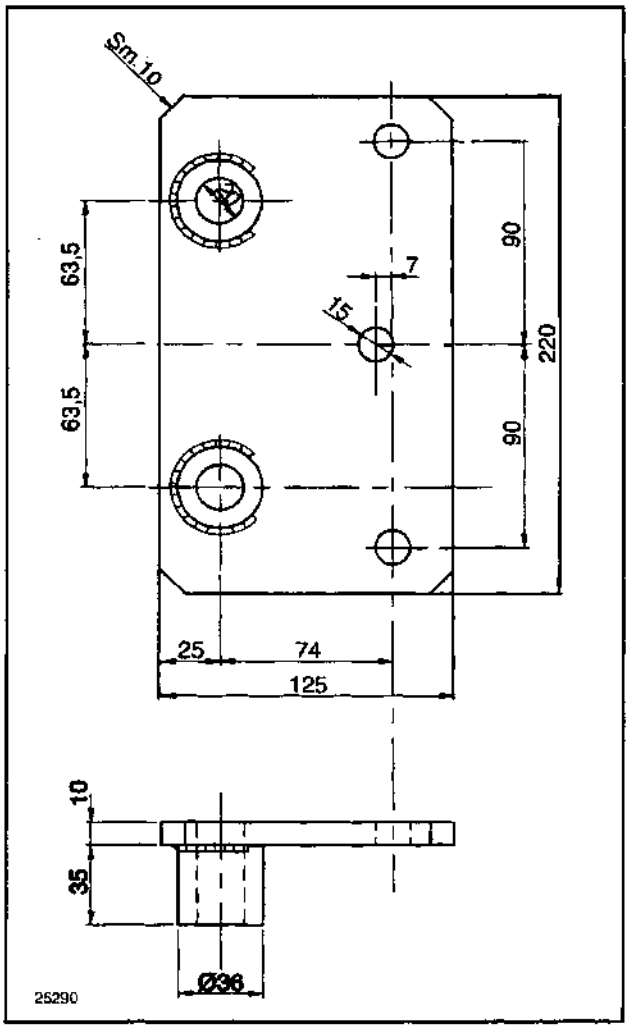


Figure 4-1-7

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Tool to be fabricated for input and output shaft bearing assembly (Mark tool with no. 50108 – Dimensions in mm).
Fabricate tool using UNI C40 material.

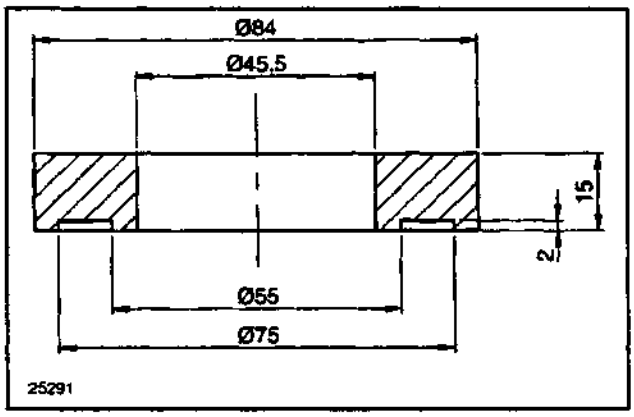


Figure 4-1-8

Alignment pins to be fabricated for engine and speed clutch/transmission housing removal/ installation (Mark tool with no. 50117 – Dimensions in mm).
Fabricate tool using UNI C40 material.

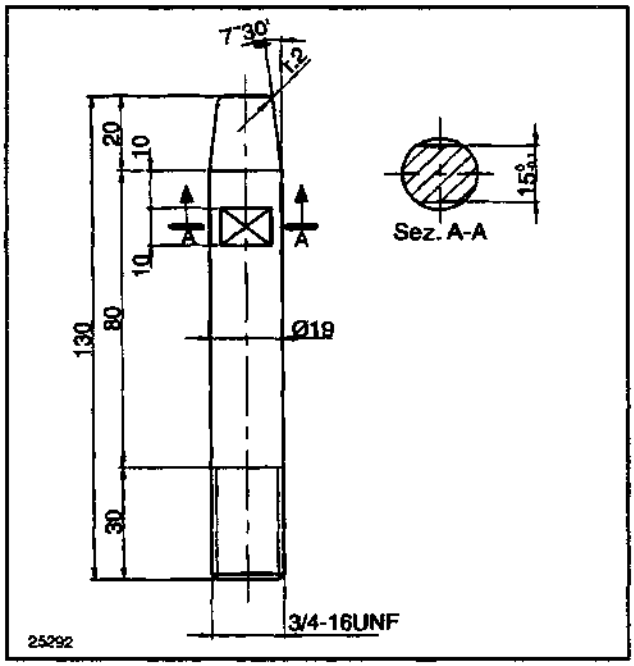


Figure 4-1-9

Adapter to be fabricated for reverse idler gear pin removal (Mark tool with no. 50143 – Dimensions in mm).
Fabricate tool using UNI C40 material.

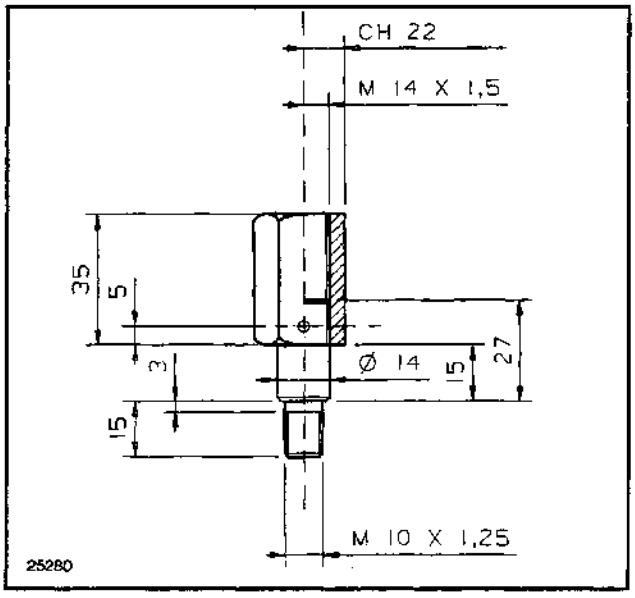


Figure 4-1-10

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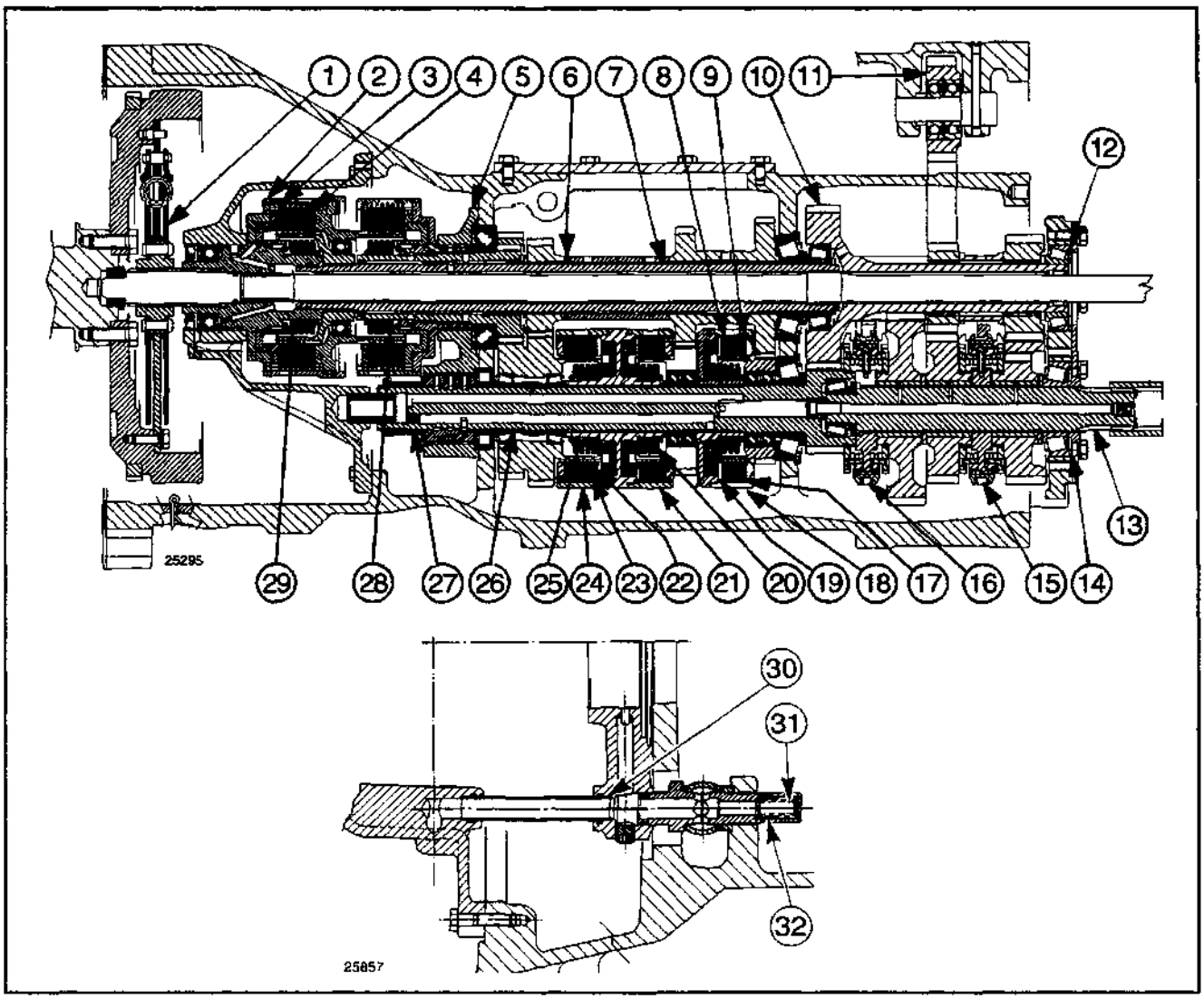


Figure 4-1-11

Transmission Longitudinal and Cross Sections

1. .Damper coupler.
2. Clutch housing.
3. Clutch A drive discs.
4. Clutch A driven discs.
5. Cover plate.
6. Transmission input shaft adjust shim
7. Transmission input shaft.
8. Clutch D driven discs.
9. Clutch D drive discs.
10. Range gear input shaft.
11. Reverse idler gear.
12. Range input shaft adjust shim.
13. Range output shaft.
14. Range output shaft adjust shim.
15. Medium range and reverse control synchronizer.
16. Low and high range control synchronizer.
17. Clutch E driven discs.
18. Clutch E housing.
19. Clutch E drive discs.
20. Belleville springs, clutches D and E.
21. Clutch D housing.
22. Clutch C driven discs.
23. Clutch C drive discs.
24. Clutch C housing.
25. Clutch C Belleville springs.
26. Transmission driven gear end play adjust shim
27. Transmission driven shaft.
28. Clutch B Belleville springs.
29. Clutch A Belleville springs.
30. Range gear and transmission lubrication control line.
31. Valve spring (32).
32. Lubrication pressure regulation valve

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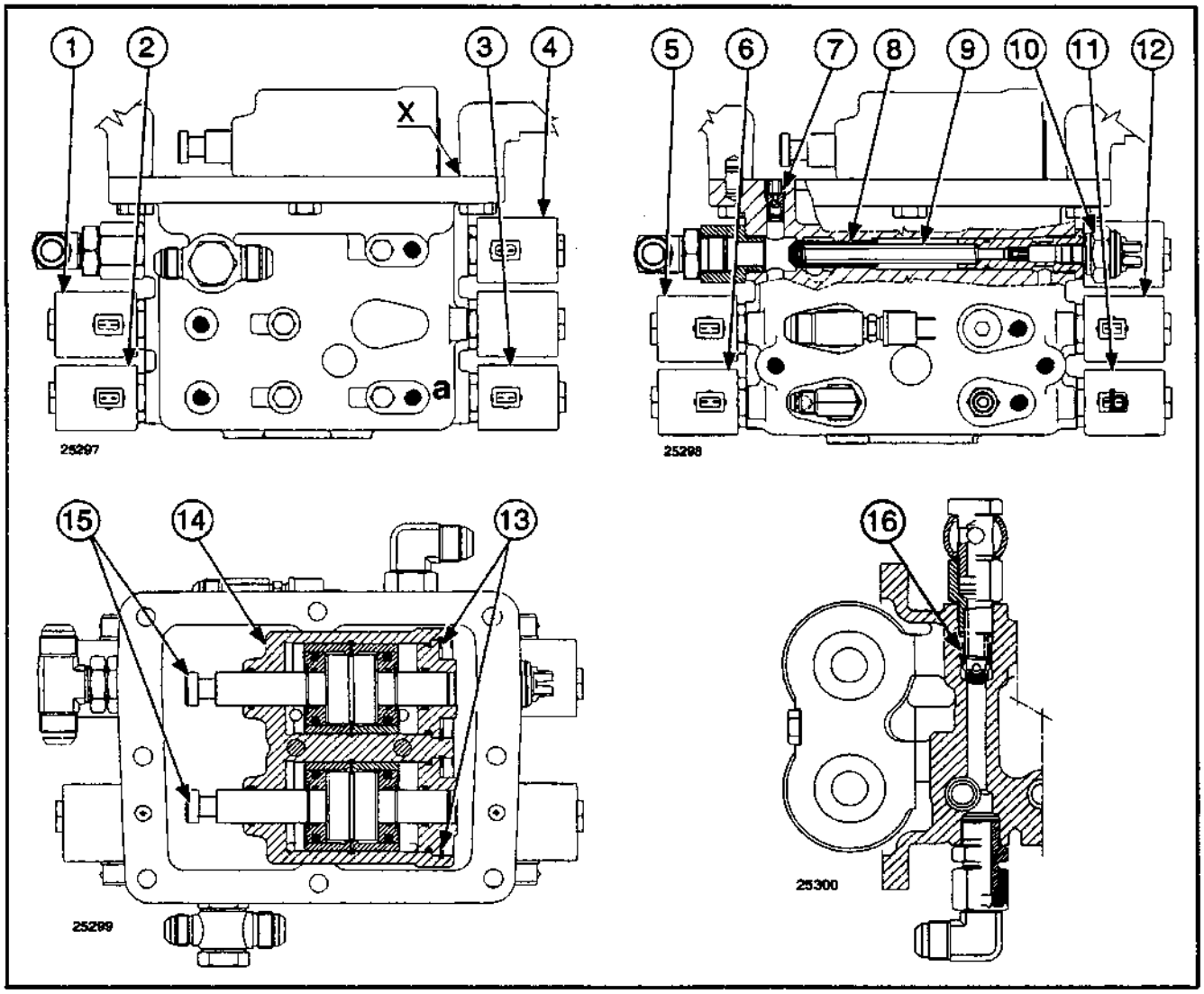


Figure 4-1-12

Range Control Valve Assembly Sections and Views

a. Top view.
b. Bottom view.
1. Reverse solenoid valve.
2. High range solenoid valve.
3. Low range solenoid valve.
4. Medium range solenoid valve.
5. Diff lock solenoid valve.
6. PTO solenoid valve.
7. Valve.
8. Implement pressure regulation valve.
9. Valve (8) spring.
10. Pressure sensor.
11. PTO brake solenoid valve.
12. FWD solenoid valve.
13. Circlips.
14. Piston housing.
15. Range drive pistons.
16. By–pass valve.

Note – During installation apply liquid gasket on surfaces marked with an **X** as detailed on page 4-1-46.

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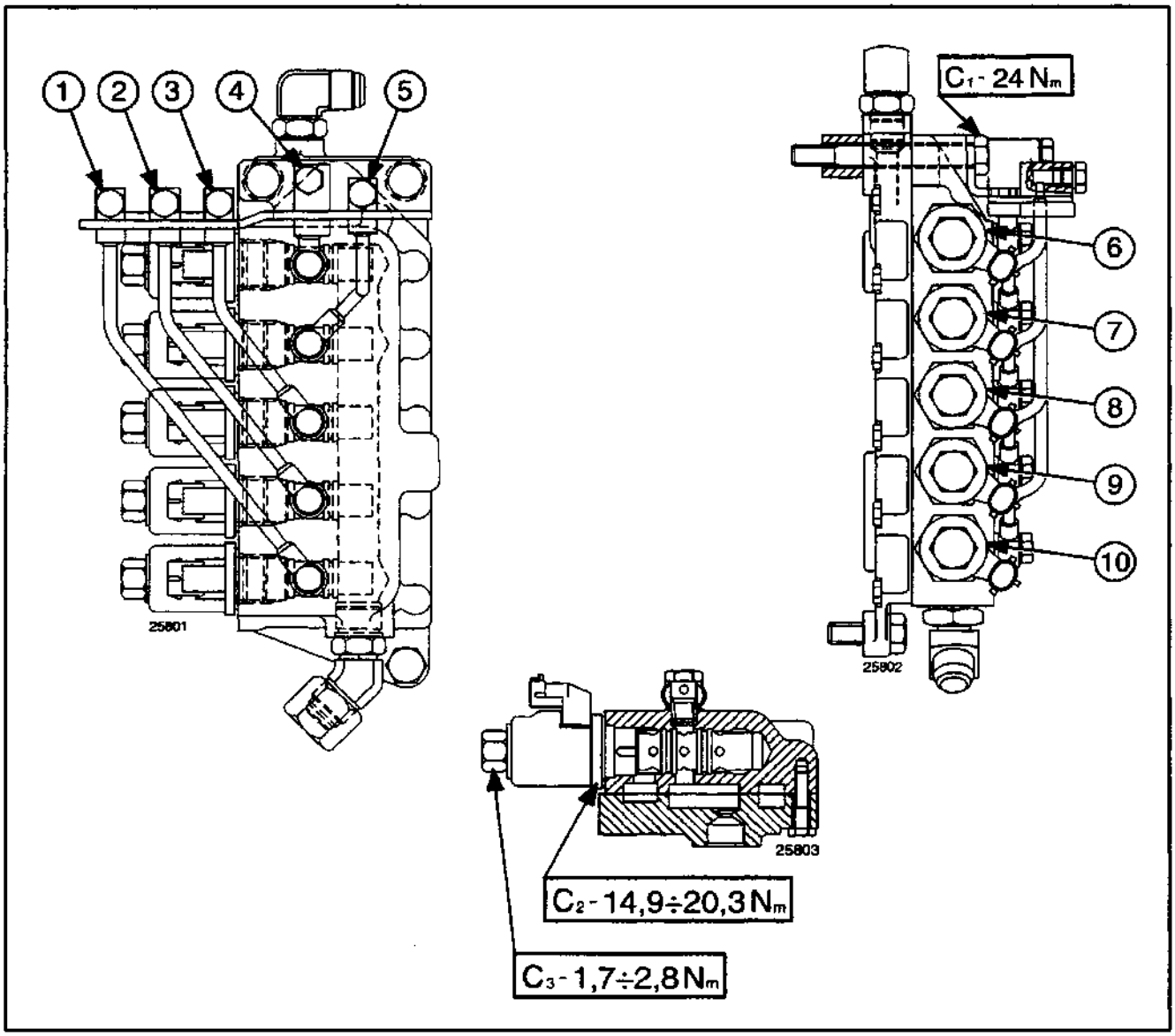


Figure 4-1-13

SEMI–POWERSHIFT Transmission Control Valve Assembly Sections and Views

C_1. SEMI–POWERSHIFT control valve retaining screw, 18.0 ft. lbs. (24.5 Nm).
C_2. Solenoid valve pin retaining screw, 11.0 to 15.0 ft. lbs. (14.9 to 20.3 Nm).
C_3. Solenoid valve retaining screw, 1.27 to 2.06 ft. lbs. (1.72 to 2.79 Nm).
1. Pressure test port – Clutch E.
2. Pressure test port – Clutch D.
3. Pressure test port – Clutch C.
4. Pressure test port – Clutch A.
5. Pressure test port – Clutch B.
6. Clutch A control solenoid valve.
7. Clutch B control solenoid valve.
8. Clutch C control solenoid valve.
9. Clutch D control solenoid valve.
10. Clutch E control solenoid valve.

Note: Apply a couple of drops of Loctite 542 to screws C_2 and C_3.

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DESCRIPTION AND OPERATION

The SEMI–POWERSHIFT transmission is actuated by 5 wet clutches which allow hydraulic engagement of 6 speed gears or ratios per range. Speed selection is electronically managed by the Electronic Management Unit (EMU).

Clutch design allows shifting from one speed into another when the tractor is moving. Clutches are operated by the control oil from the respective solenoid valves located into the control valve assembly attached to the right side of the speed clutch/transmission housing.

Shifts from one speed gear or ratio into another is done using the relevant shift lever located at the right side of the operator's seat.

There are three buttons on the lever. Buttons (1 and 2) are located on the rear of the lever and are used for shifting through all the ratios within the same range.

To shift from one range into another, press one of the above buttons (1 or 2) while pressing the button (3) located to the front of the lever.

The range gears are operated by two hydraulic cylinders acting on two synchronizers. Hydraulic cylinders are actuated by control oil from the respective solenoid valves located into the control valve assembly attached to the right side of the speed clutch/transmission housing.

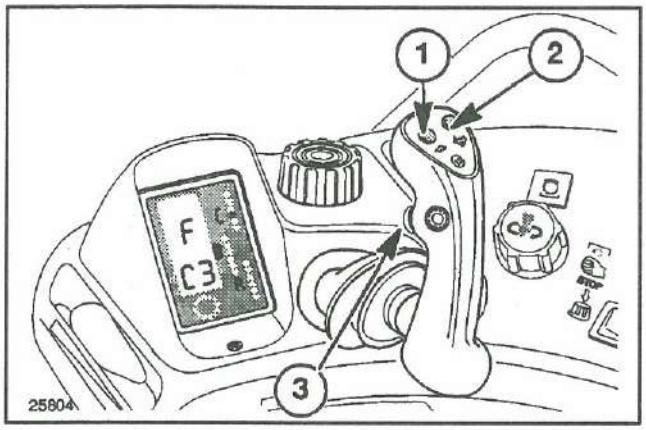


Figure 4-1-14

The transmission and range gear assembly provide:
- 18 forward and 6 reverse ratios in the 25 mph, FWD (40 KPH) option;
- 31 forward and 12 reverse ratios in the 25 mph, FWD (40 KPH) option fitted with creeper gears;
- 17 forward and 6 reverse ratios in the 19 mph (30 KPH) option;
- 30 forward and 12 reverse ratios in the 19 mph (30 KPH) option fitted with creeper gears.

The SEMI–POWERSHIFT transmission is not fitted with a central clutch on the engine flywheel. Consequently, the clutch pedal should not be pressed for speed or range shifting.

The clutch pedal should be used to stop the tractor, connect implements and operate the tractor in restricted areas.

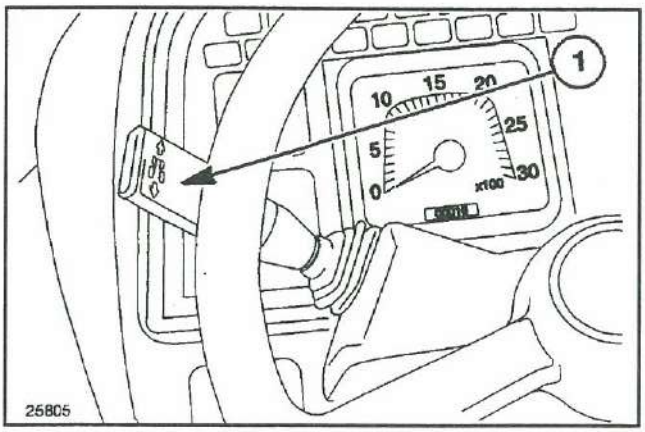


Figure 4-1-15

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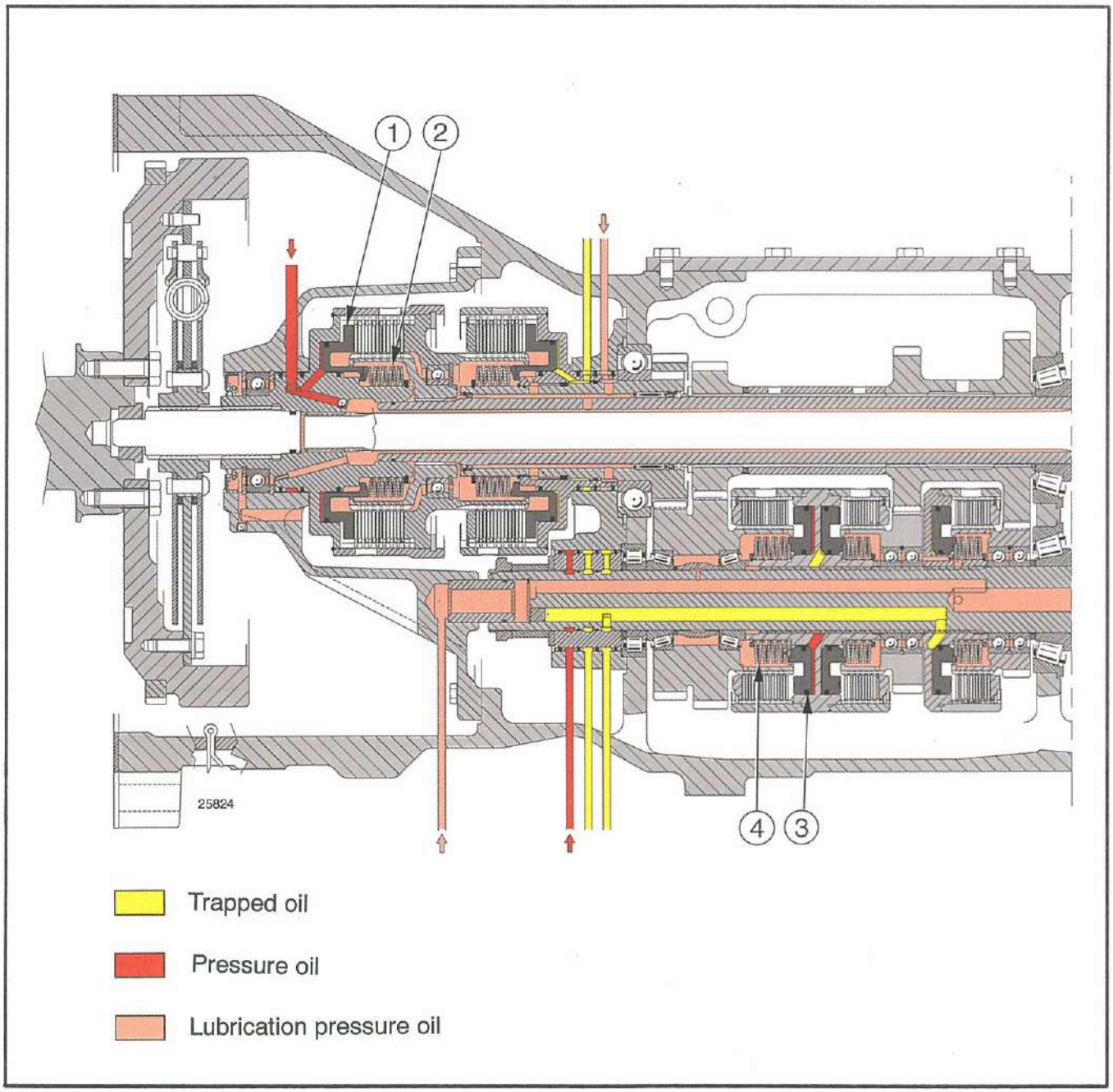


Figure 4-1-16

SEMI–POWERSHIFT Transmission Oil Flow with 1st Gear Forward Engaged

When the 1st gear or ratio is selected using the control buttons (1 and 3, Figure 4-1-13), the solenoid valves (6 and 8, Figure 4-1-12) direct oil from the hydraulic pump to clutches A and C, respectively.
Oil reaches the pistons (1 and 3), moves them against the force of the Belleville springs (2 and 4, respectively) and compresses the two clutches A and C. The 1st gear or ratio is engaged.

Pressure oil lubrication is guaranteed to all the SEMI–POWERSHIFT transmission components. Oil pressure is regulated by the valve (2, Figure 4-1-10).
If the clutch pedal is pressed, the solenoid valves (6 and 8) stop sending oil to the clutches A and C and consequently pistons (1 and 3) are pushed away from the clutch discs by the action of the Belleville springs (2 and 4). Clutches are then released.

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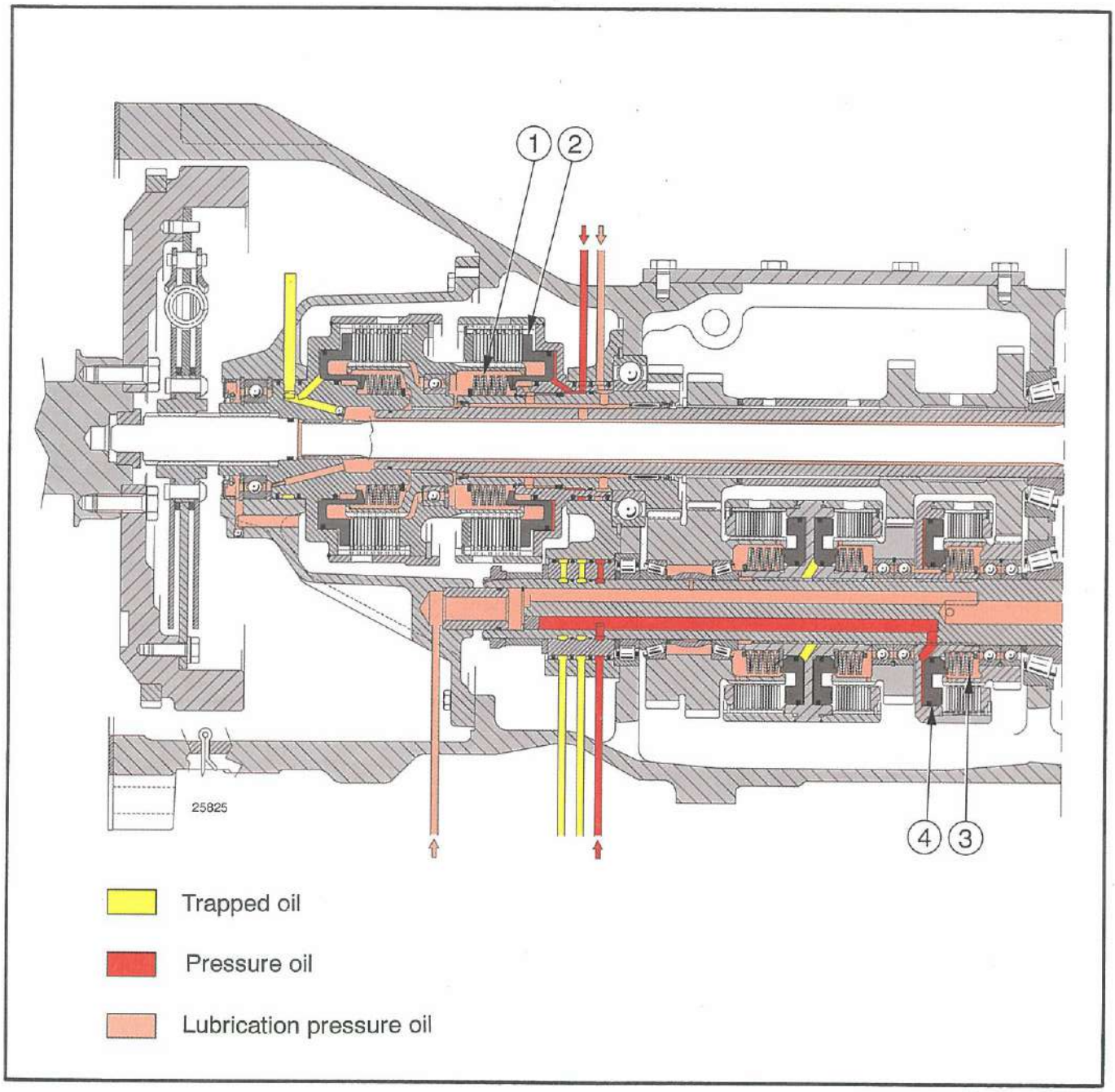


Figure 4-1-17

SEMI–POWERSHIFT Transmission Oil Flow with 6th Gear Forward Engaged

When the 6th gear or ratio is selected using the control buttons (1 and 3, Figure 4-1-13), the solenoid valves (7 and 10, Figure 4-1-12) direct oil from the hydraulic pump to clutches B and E, respectively.
Oil reaches the pistons (2 and 4), moves them against the force of the Belleville springs (1 and 3, respectively) and compresses the two clutches B and E. The 6th gear or ratio is engaged.

Pressure oil lubrication is guaranteed to all the SEMI–POWERSHIFT transmission components. Oil pressure is regulated by the valve (32, Figure 4-1-10).
If the clutch pedal is pressed, the solenoid valves (7 and 10) stop sending oil to the clutches B and E and consequently pistons (2 and 4) are pushed away from the clutch discs by the action of the Belleville springs (1 and 3). Clutches are then released.

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SEMI–POWERSHIFT TRANSMISSION HOUSING

Removal – Installation

DANGER

Lift and handle all heavy components using lifting equipment of appropriate capacity.Ensure that units or parts are supported by suitable slings or hooks.Ensure that no–one is in the vicinity of the load to be lifted.

Remove the transmission housing from the tractor as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.



Figure 4-1-18

3. Connect the engine hood to a hoist using a nylon cable (1) and disconnect the shock absorbers (2) (one on the LH side and one on the RH side).

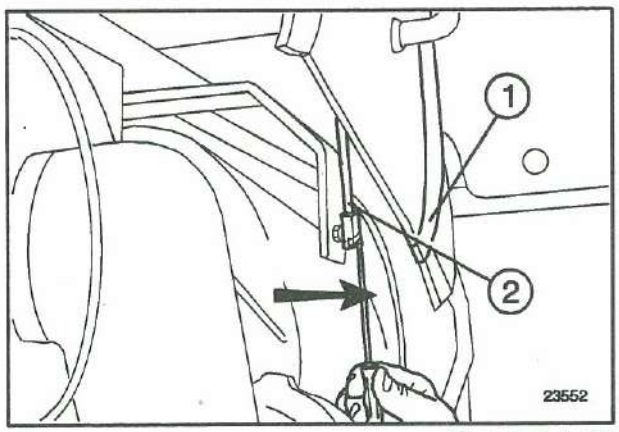


Figure 4-1-19

4. Loosen the screws (3) which retain engine hood to engine, disconnect front light electrical connector, C056, and remove hood using the hoist. Ensure that the hood is displaced without obstructions and that no other components are interfering.

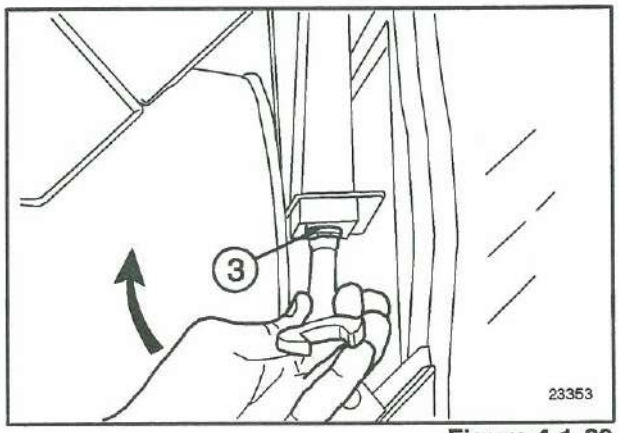


Figure 4-1-20

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5. Unscrew the retaining screws and remove side panels (1) (one on each side).

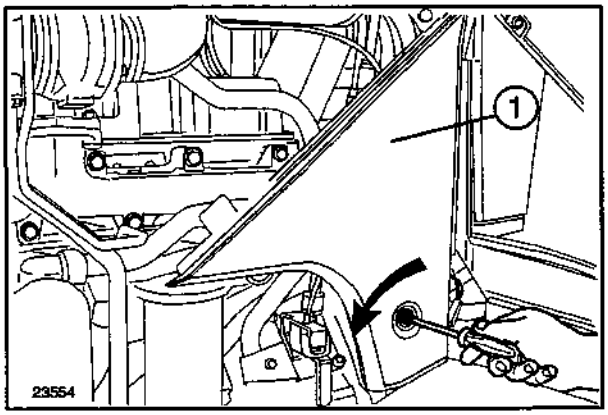


Figure 4-1-21

6. Jack up rear tractor and place two suitable stands (2) under the final drive cases to raise the wheels off the ground. If necessary, detach lift rods from lower links.

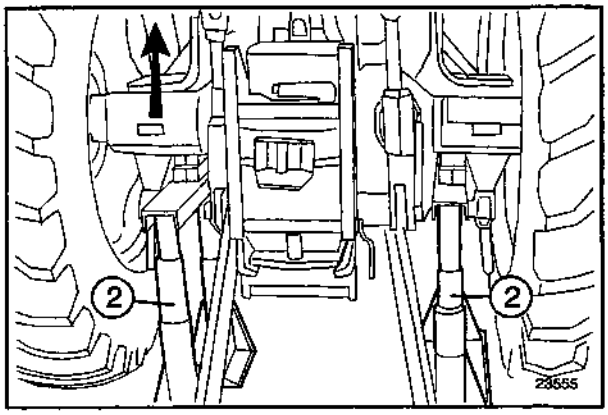


Figure 4-1-22

7. Sling the wheel using a nylon cable (3), unscrew the attaching nuts and remove the wheel. Repeat for the left wheel.

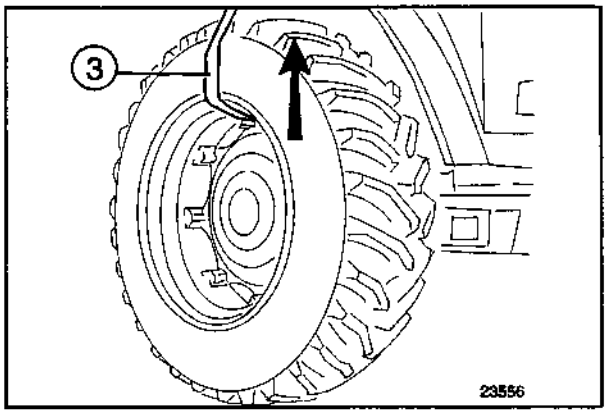


Figure 4-1-23

8. Loosen the two screws on the cab roof and fix tool **FTC213997B** (4) using two appropriate bolts. Connect tool to a hoist and remove slack in preparation for cab removal.

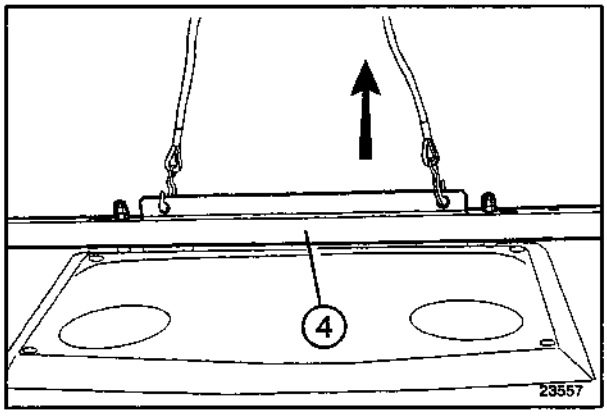


Figure 4-1-24

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9. Detach connectors at the wind–washer primers. Detach windscreen washer bottle (1) lines and remove tank.

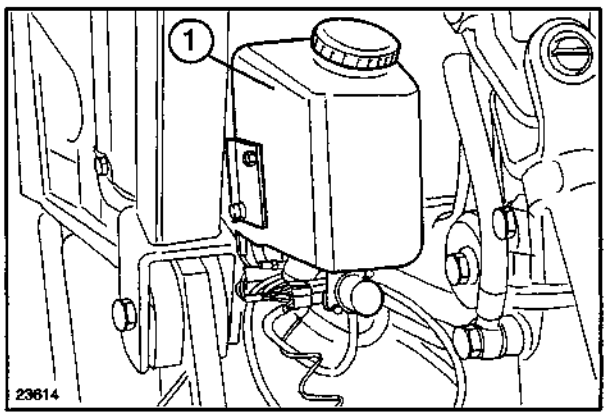


Figure 4-1-25

10. Remove the clip and detach the creep gear control idler lever (2). Loosen the parking brake control cable retaining screw (3).

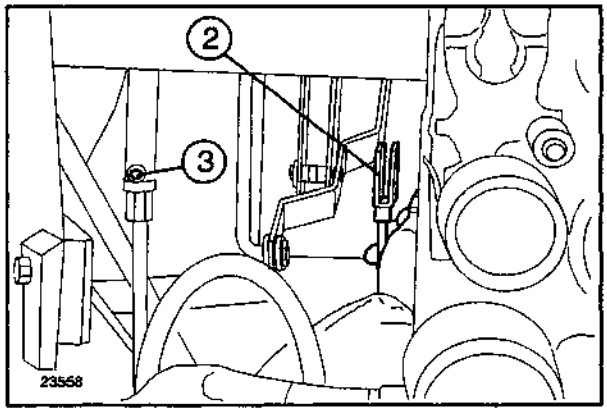


Figure 4-1-26

11. Remove the pin and withdraw the pin securing the fork (4) to the parking brake actuator lever. Loosen the nut securing the cable to the fork (4) and release cable.

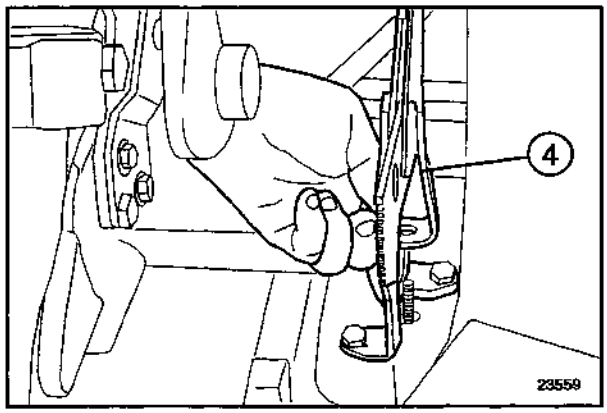


Figure 4-1-27

12. Loosen the attaching nut and detach the ground cable (5) between the cab and rear axle.

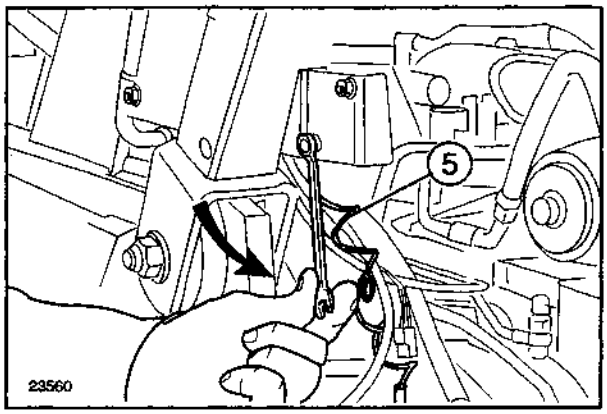


Figure 4-1-28

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13. Release the clamp (1) and detach the main tank bleeding line.

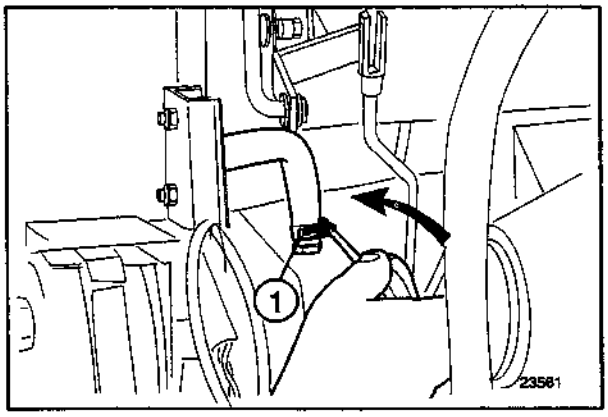


Figure 4-1-29

14. Detach the ground synchronized PTO control cable (2) from the rail. (Not used in North America).

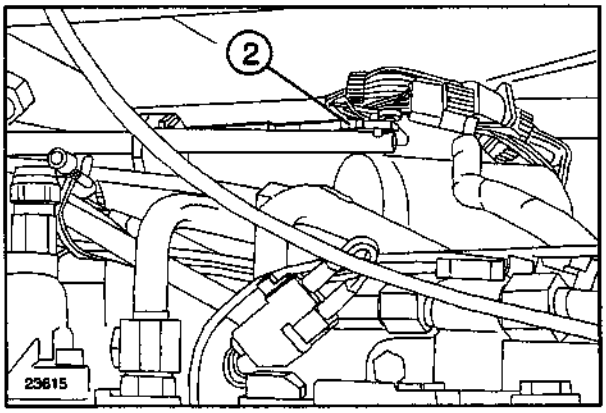


Figure 4-1-30

15. Detach the two connectors (3 and 4) located under the cab floor. Connectors C019 and C020.

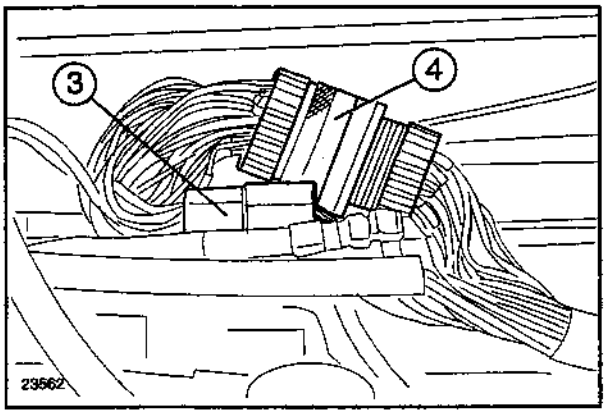


Figure 4-1-31

16. Detach both engine to cab connectors (5 and 6). Connectors C001 and C002.

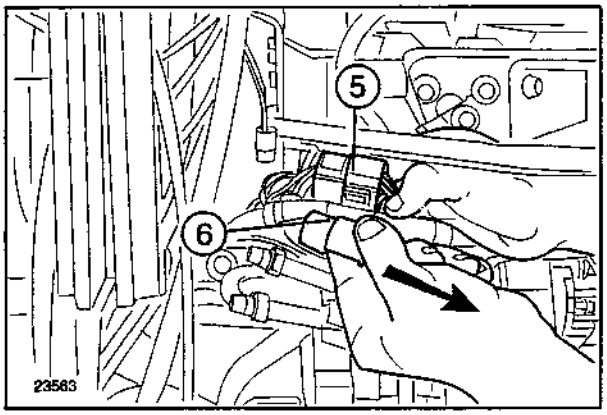


Figure 4-1-32

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17. Disconnect radar and fuel filter connectors (4 and 3, respectively). Remove protection and disconnect connectors (1 and 2) from starting motor.

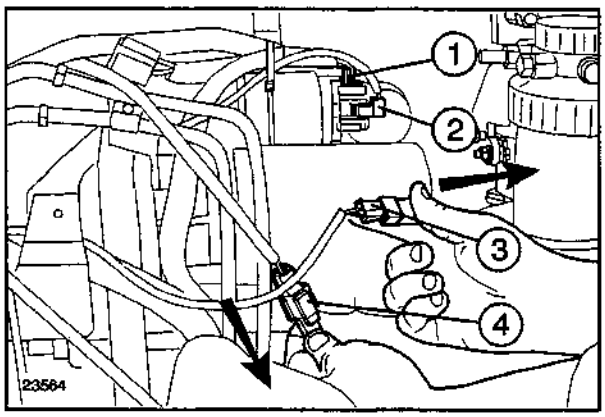


Figure 4-1-33

18. Detach light connector (5) located on the handrail (repeat for both tractor sides).

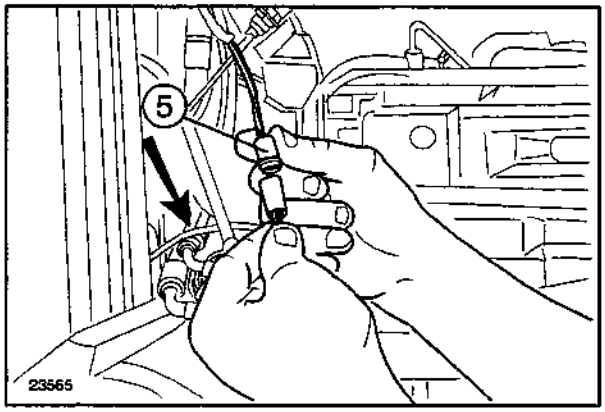


Figure 4-1-34

19. Detach heater to engine connecting lines (6) located under the right hand front side of the cab.

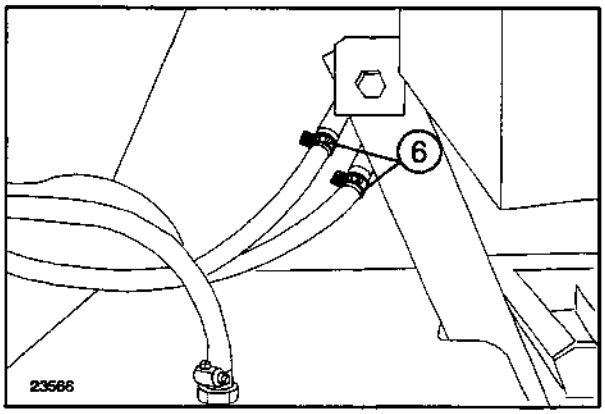


Figure 4-1-35

20. Loosen the nut and detach the throttle control cable (7) from injection pump.

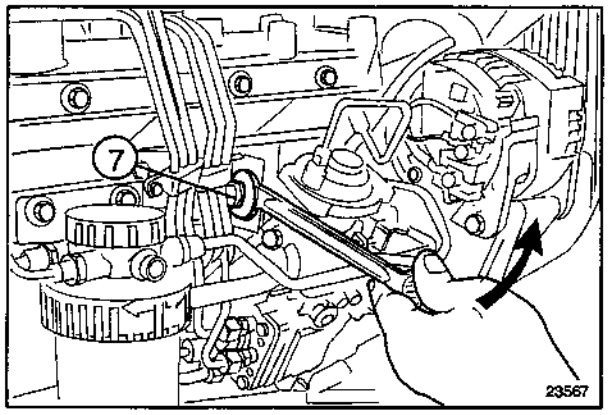


Figure 4-1-36

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21. Detach connectors (1) from brake pumps.

22. Loosen fittings (2) and detach brake control hoses.

23. Detach the brake pump lines to the tank.

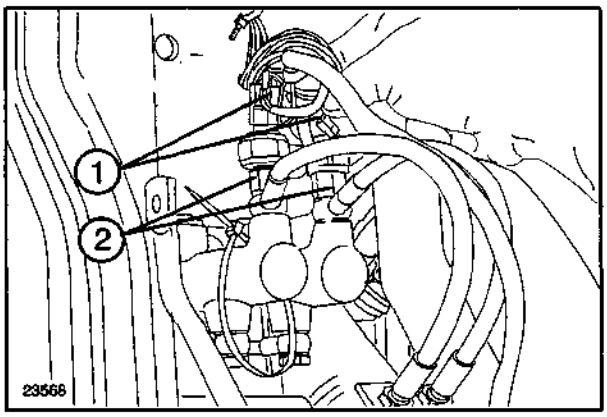


Figure 4-1-37

24. Loosen the power steering valve connecting lines (4) to the control pump.

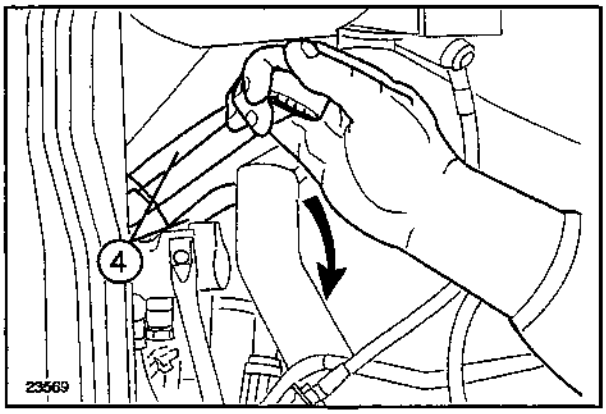


Figure 4-1-38

25. Detach the power steering valve connecting lines (5) to the steering cylinders.

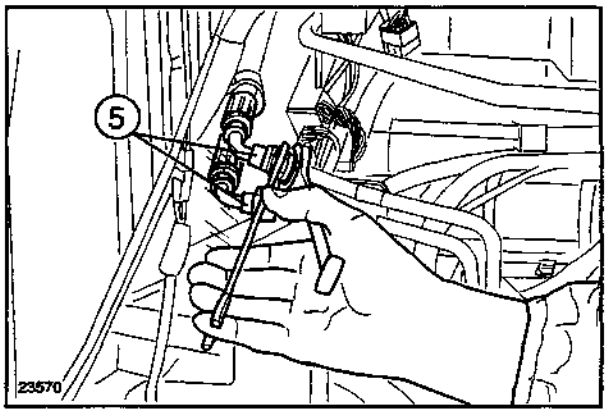


Figure 4-1-39

26. Loosen fittings and detach the air conditioning lines (6).

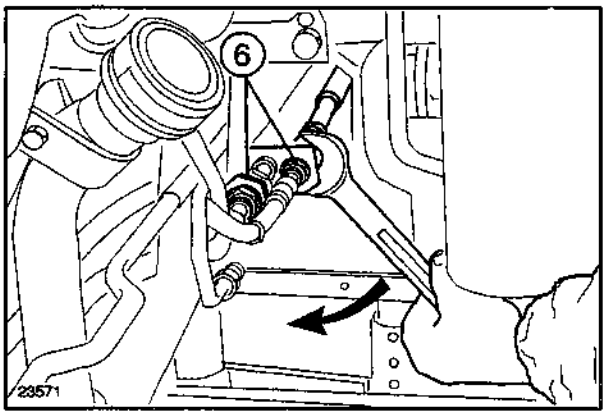


Figure 4-1-40

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27. Loosen the locknut, slide out the cotter pin and detach the PTO control cable (1). (Not used in North America).

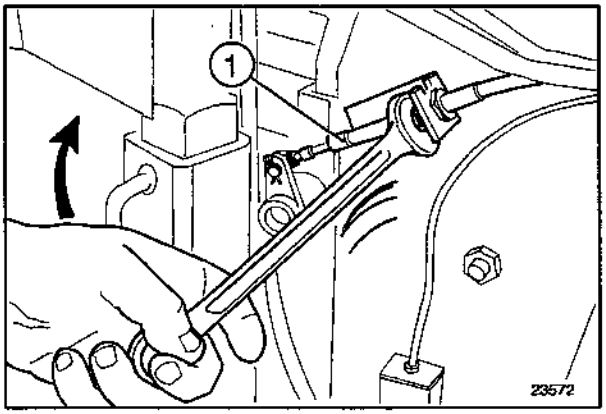


Figure 4-1-41

28. Slide out cotter pins and pins (2), loosen the retaining screws (3) and detach the auxiliary valve control cables, right hand side.

29. If auxiliary valves are fitted also on left hand side, repeat step 28 for left hand side auxiliary valves.

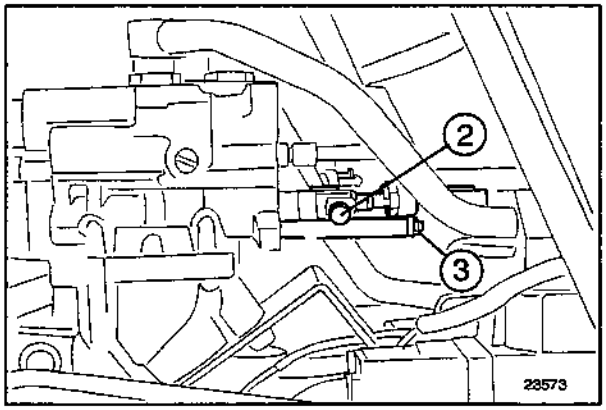


Figure 4-1-42

30. Loosen the screw attaching steps (6) to the bracket.

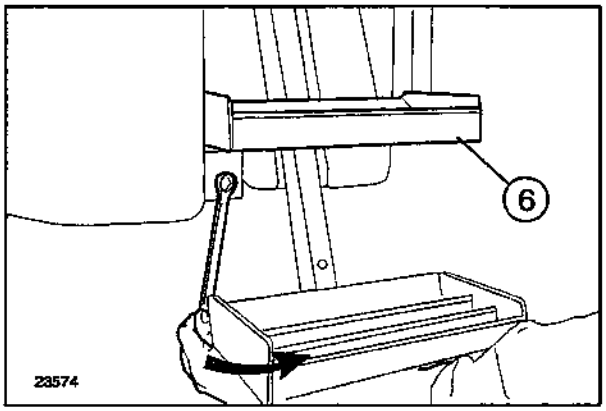


Figure 4-1-43

31. Loosen the screw attaching steps (1) to the cab platform.

32. Repeat steps 30 and 31 on opposite side and remove steps.

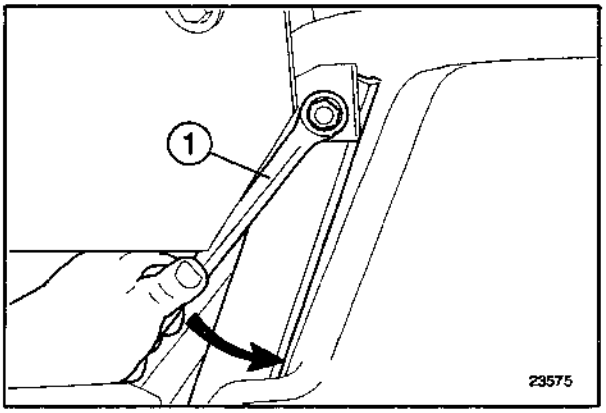


Figure 4-1-44

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33. Raise the cab mat (2) and loosen the cab mounting bolt while holding the locknut under the cab floor. Retrieve bolt and washer. Repeat for both tractor sides.

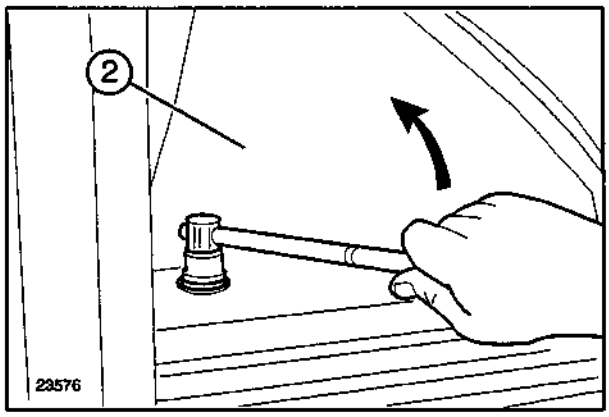


Figure 4-1-45

34. Loosen the rear cab bolts (on both sides).

35. Slowly raise the cab taking care that no components are connected, hooked or interfering. Remove the cab and lower on a suitable support base.

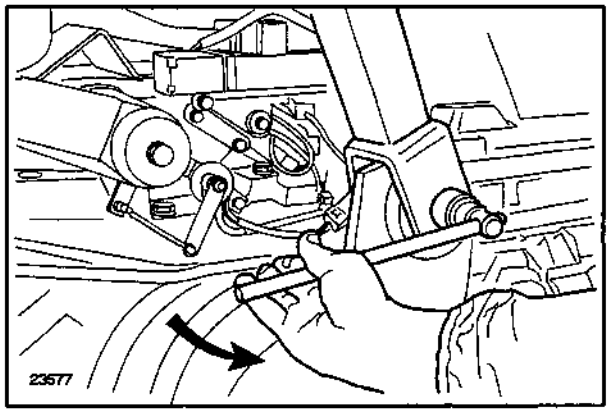


Figure 4-1-46

36. Loosen the plug (3) and drain oil from the rear axle and transmission housing into a suitable container (Standard oil capacity is 23.7 gallons for model 8160–8360 and 26.4 gallons for model 8560 equipped with Range Command Transmissions).

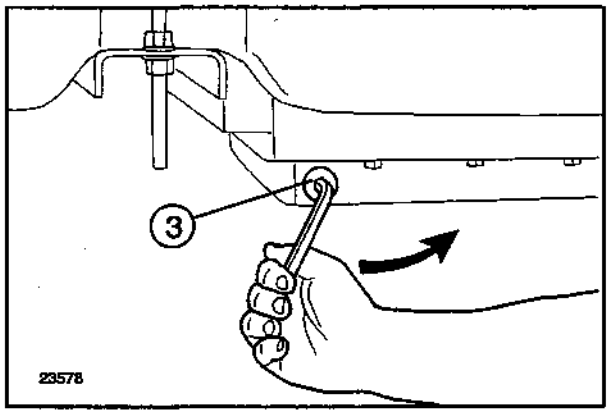


Figure 4-1-47

37. Drain fuel tanks, then loosen the clamp (1) retaining the connecting line between the main and auxiliary tanks.

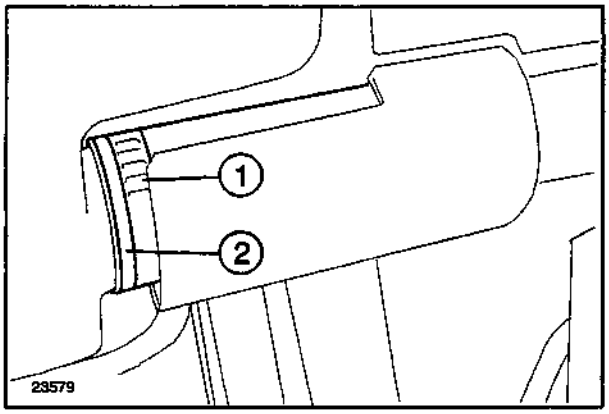


Figure 4-1-48

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38. Loosen the clamp and detach the bleeding line (3) between the main and auxiliary tanks.

39. Detach the fuel return line (2) from the injection pump to the auxiliary tank. Remove auxiliary tank.

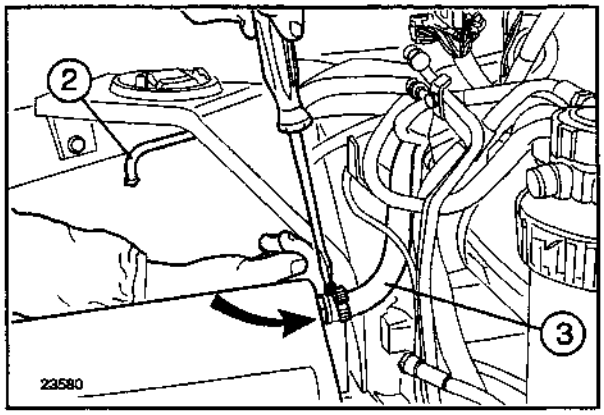


Figure 4-1-49

40. Loosen the clamp and detach the injection pump supply line (5). Detach connectors (4), then unscrew and remove the fuel level sensor assembly.

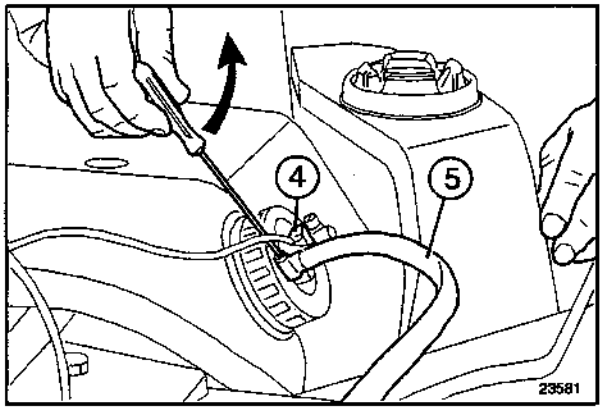


Figure 4-1-50

41. Loosen the nut of the metal strap (6) securing the main tank. Remove the strap and tank.

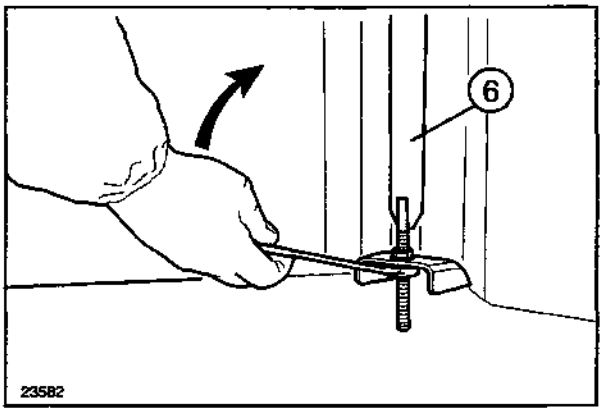


Figure 4-1-51

42. Loosen the retaining screws and remove the cab and fuel tank support bracket (1). (Repeat on both sides of the transmission housing).

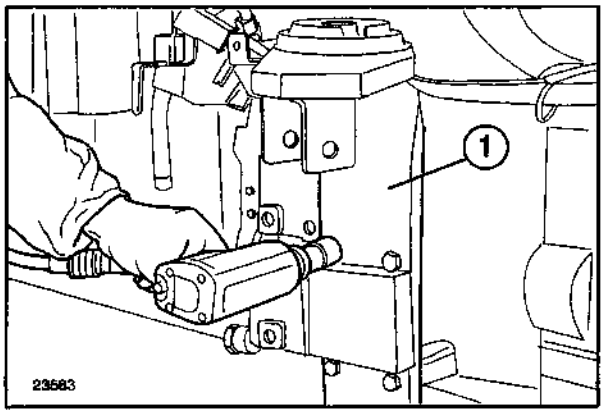


Figure 4-1-52

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43. Loosen the retaining screws and remove the main tank support bracket (2)

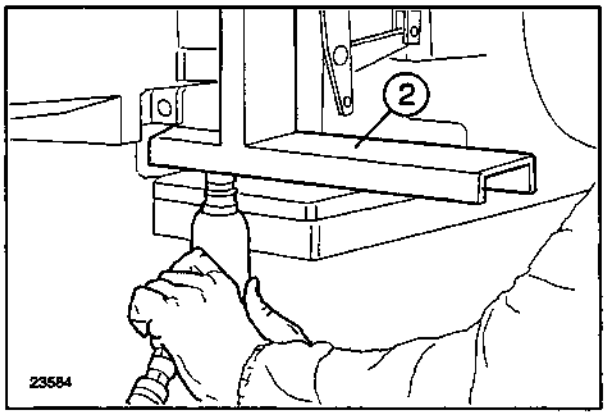


Figure 4-1-53

44. Loosen the attaching screws and remove the radar unit and mounting bracket (3).

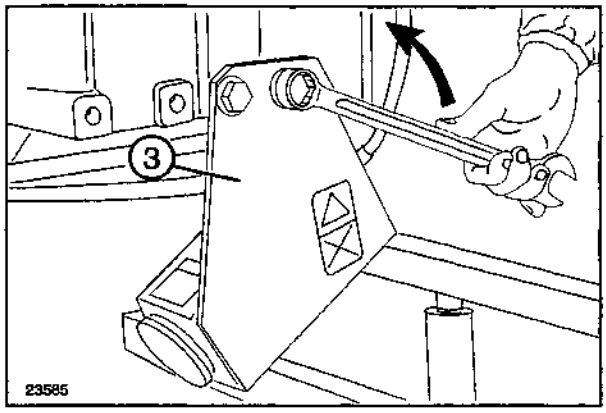


Figure 4-1-54

45. Loosen the attaching screws and remove the brake control line bracket (4).

Note: Do not bend the brake control tubes sharply when moving them away from the transmission housing to avoid damages.

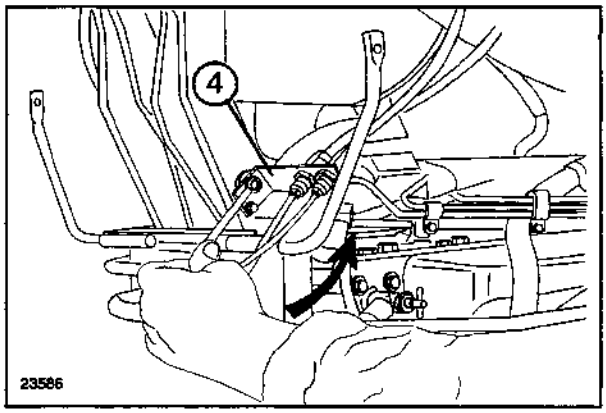


Figure 4-1-55

46. Loosen the clamps and separate the rear axle oil cooler hoses (1) from tubes.

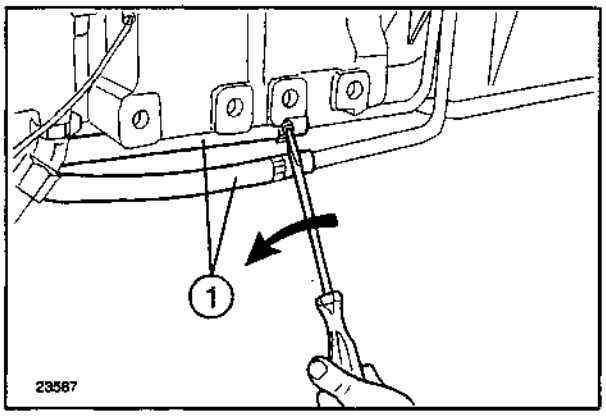


Figure 4-1-56

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47. Detach and remove the accumulator (2) tubes, loosen the retaining screws and remove accumulator.

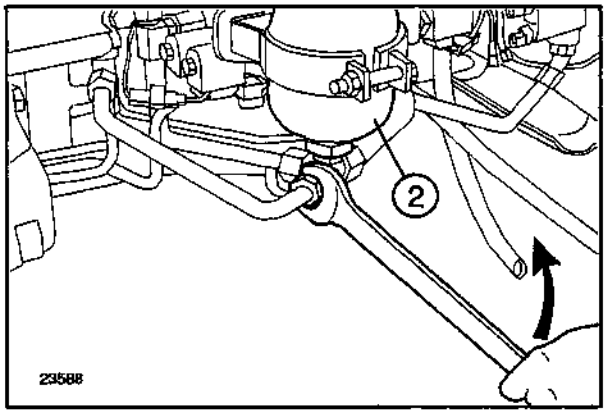


Figure 4-1-57

48. Detach all connectors from the range control valve assembly, SEMI–POWERSHIFT clutch control valve assembly and different sensors.

Note: Before detaching connectors from both control valve housings, mark each connector and respective solenoid valve to assist reassembly and avoid reversal of connections.

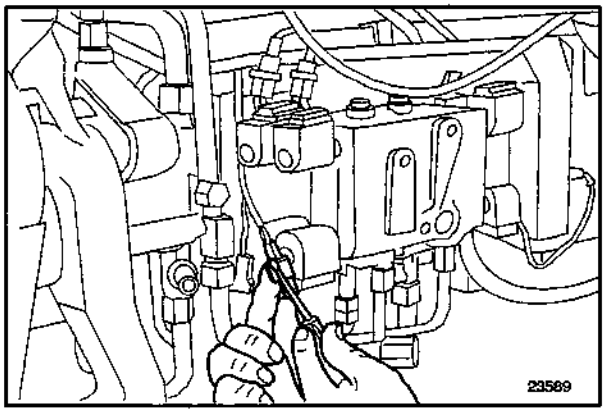


Figure 4-1-58

49. Detach and remove the PTO and lift lubrication valve (3) and by–pass valve (4) lines.

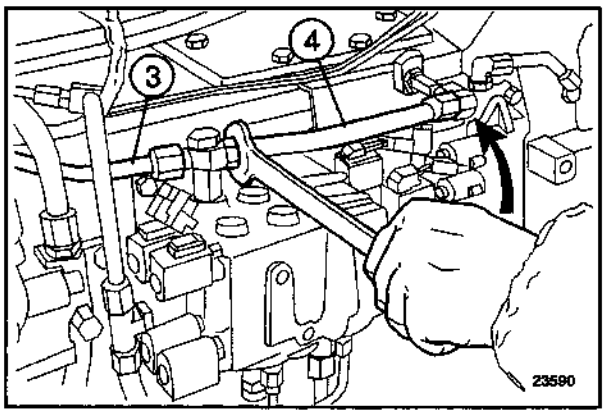


Figure 4-1-59

50. Detach and remove the power steering supply and return lines (1 and 2).

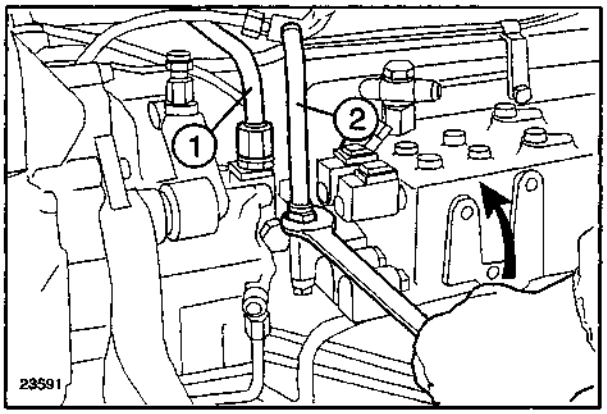


Figure 4-1-60

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51. Disconnect all accessory control lines from their fittings located in the lower part of the range control valve assembly (3).

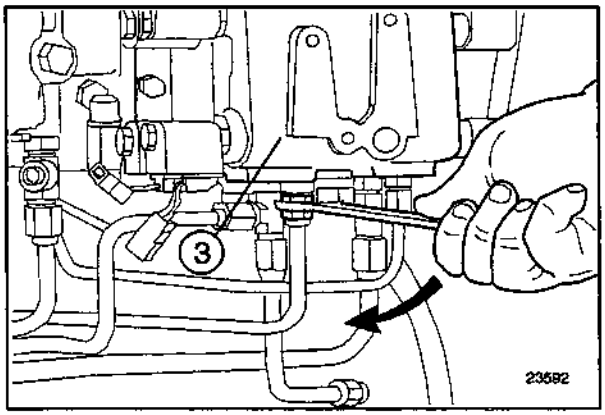


Figure 4-1-61

52. Loosen retaining screws and remove the range control valve housing (3) using two alignment pins.

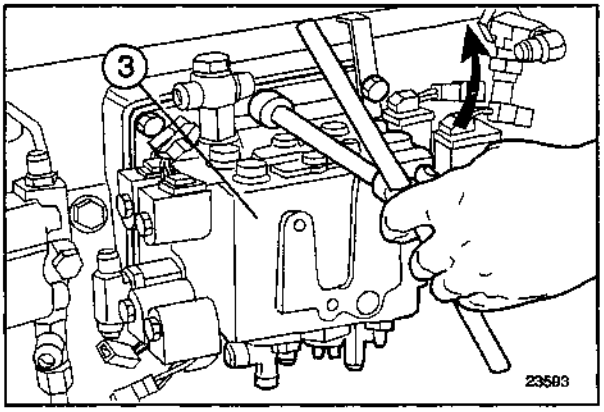


Figure 4-1-62

53. Detach hose from the by–pass valve (4).

54. Disconnect and remove the clutch A control line (5).

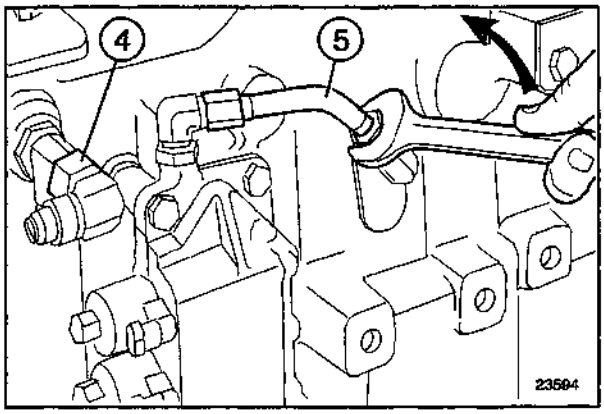


Figure 4-1-63

55. Release retaining screws and remove the SEMI–POWERSHIFT control valve assembly (1).

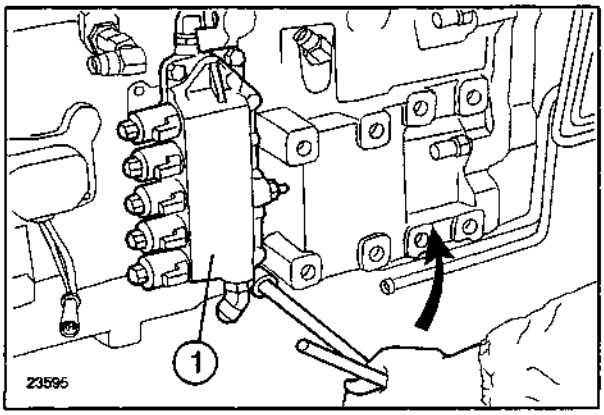


Figure 4-1-64

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56. Loosen the retaining screws and remove the propshaft guard.

57. Remove circlip (4) and slide out sleeve (5). Repeat for transfer box circlip and sleeve.

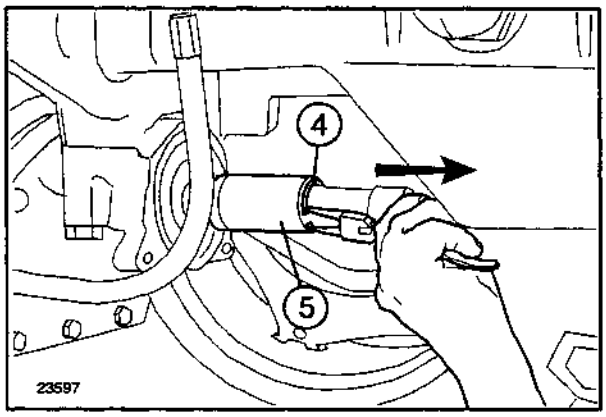


Figure 4-1-65

58. Loosen the bearing–support (3) retaining screws at the transmission housing, detach and remove the front diff lock control line (2).

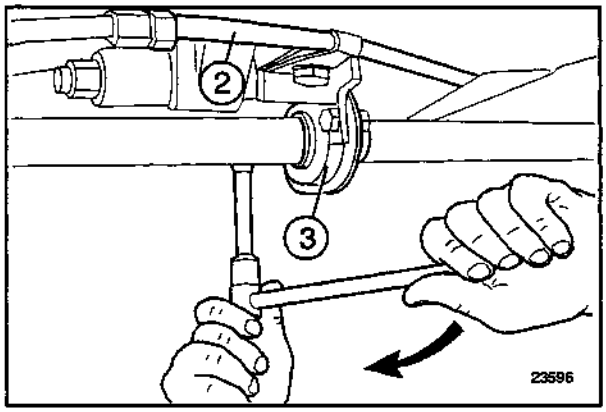


Figure 4-1-66

59. Properly support the engine and front axle assembly, and the transmission and rear axle assembly in preparation for separation.

60. Place two wooden wedges (one each side) between the front axle support and front axle to prevent engine oscillation.

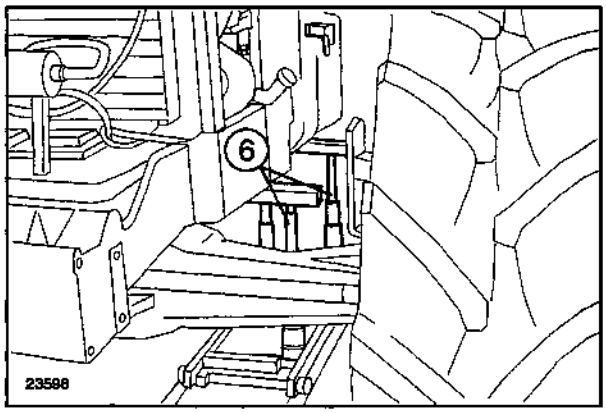


Figure 4-1-67

61. Loosen the retaining screws and remove starting motor (1).

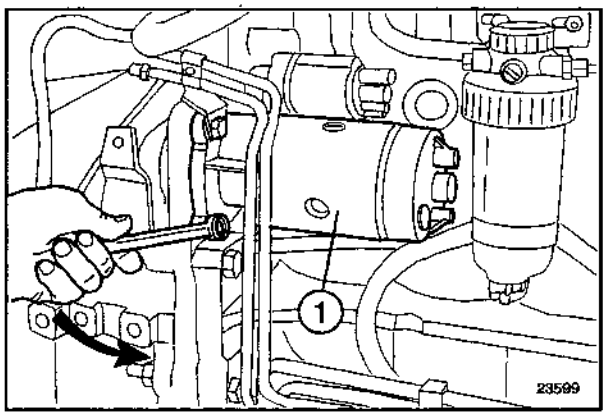


Figure 4-1-68

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62. Remove the transmission housing to engine attaching bolts.

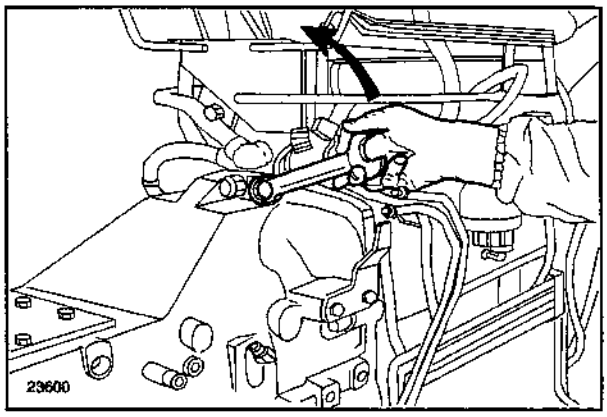


Figure 4-1-69

63. Loosen the metal spacer retaining screw (2) at the transmission housing.

64. Separate the engine from the transmission housing.

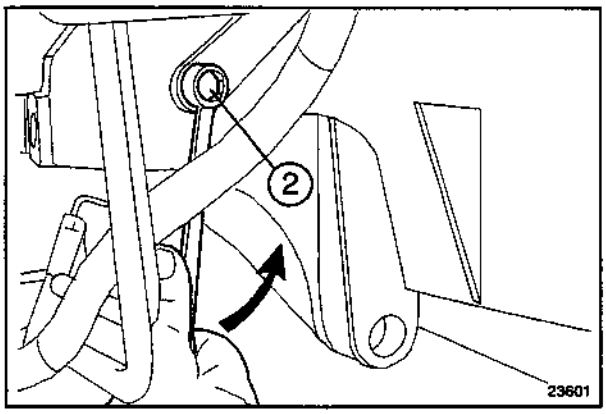


Figure 4-1-70

65. Loosen two bolts from the transmission housing top cover (3), screw in chains with hooks to the housing and keep them tensioned using a hoist.

66. Place a stationary stand under the draft sensing unit bracket and under the rear axle housing.

67. Detach the transmission housing retaining bolts and remove the housing.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

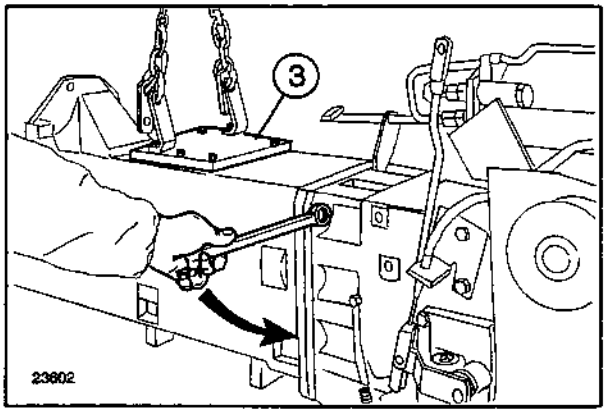


Figure 4-1-71

68. Reinstall the transmission housing to the rear axle housing and engine observing the following:
- Reinstallation follows the removal procedure in reverse, from step 67 back to step 1.
- Before reassembling housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant following the pattern shown in the figure on page 4-1-30.
- Tighten to correct torque as detailed on page 4-1-4.

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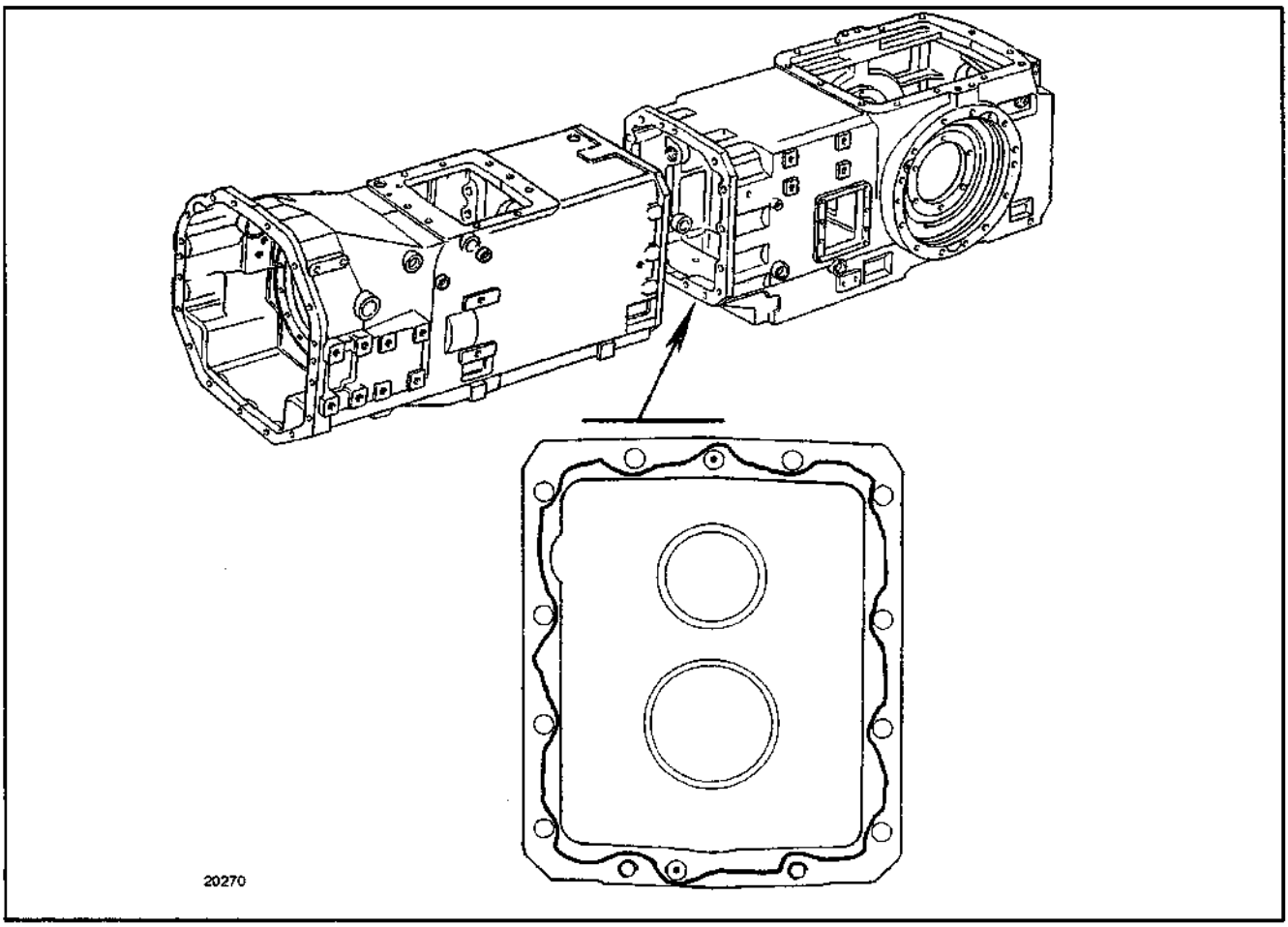


Figure 4-1-72

Pattern for application of sealant during installation of the transmission housing to rear axle housing.

Sealants to be used are listed on page 0-1-19, Section 00

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SEMI–POWERSHIFT TRANSMISSION

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Prior to servicing the SEMI–POWERSHIFT transmission, it is necessary to remove the transmission housing following the procedure detailed on pages 4-1-16 to 4-1-29.

1. Fix the transmission housing on a suitable stand.
2. Perform steps 3 to 5 to remove the range and transmission control valve assemblies, if not previously removed.

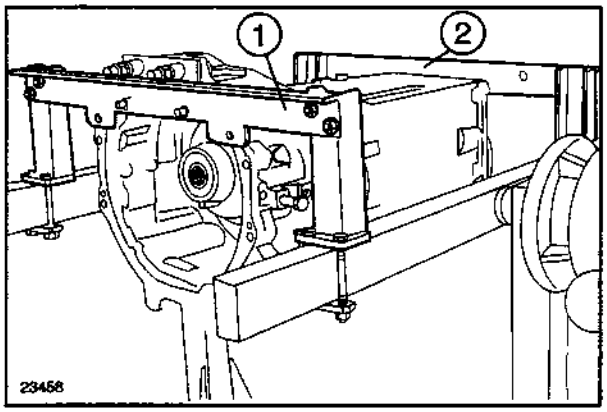


Figure 4-1-73

3. Detach the line (3) from transmission control valve assembly and transmission housing.

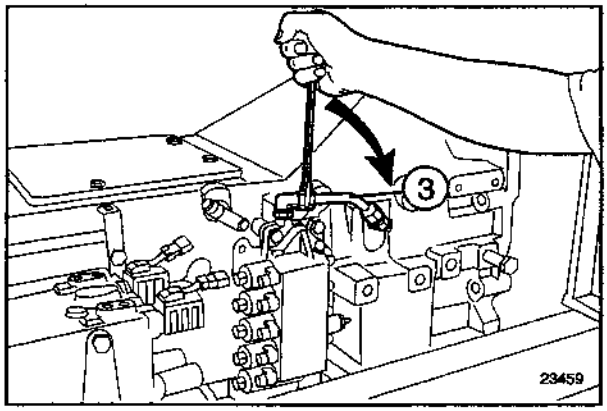


Figure 4-1-74

4. Loosen the transmission control valve housing retaining screws (4) and remove housing

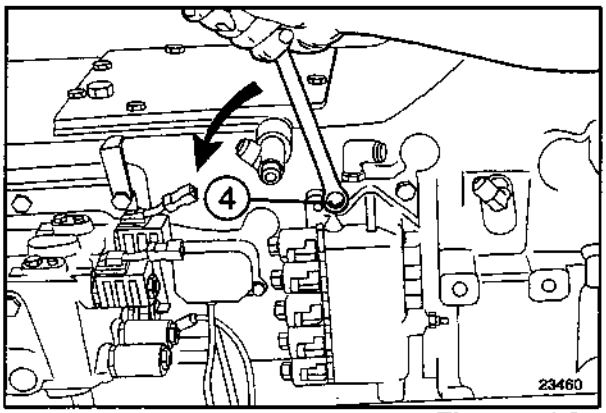


Figure 4-1-75

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5. Withdraw control lines (3) of clutches B, C, D and E and discharge fitting (1). Loosen and remove clutch A control line (2).

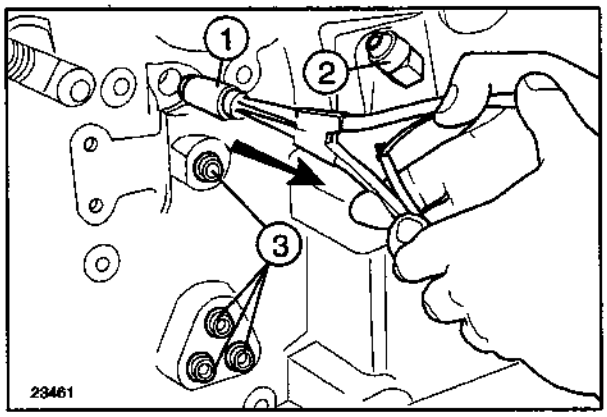


Figure 4-1-76

6. Loosen retaining screws and remove the range control valve assembly (1) using a 80 mm (3.15 in) long bolt as an alignment pin.

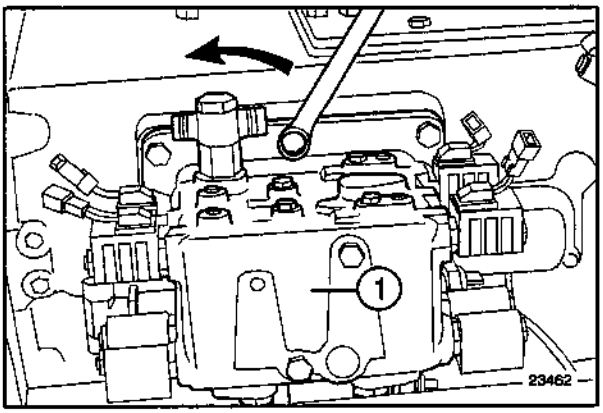


Figure 4-1-77

7. Loosen retaining screws and slide the guard (5) to one side by a few centimeters, along the wires

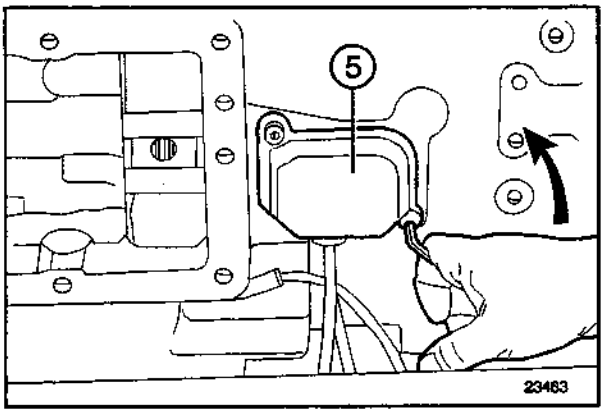


Figure 4-1-78

8. Remove retaining rings and washers. Slide out sensors (6).

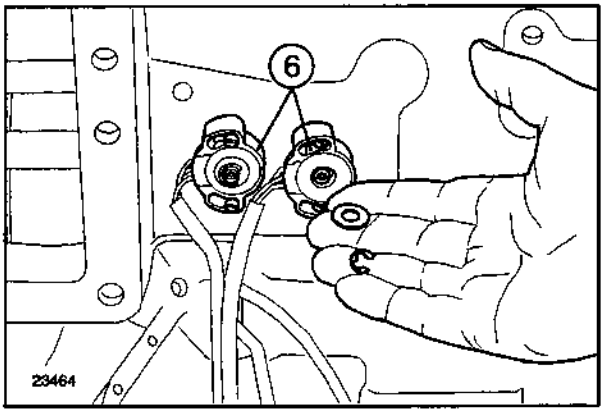


Figure 4-1-79

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9. Loosen retaining bolts and remove sensors (1 and 2).

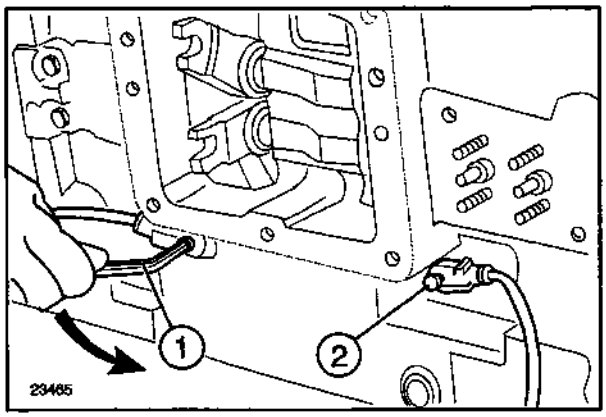


Figure 4-1-80

10. Loosen retaining bolts and detach cover (3).

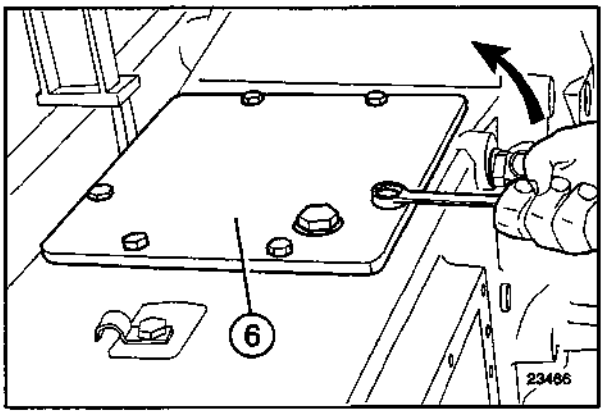


Figure 4-1-81

11. Loosen the bolts attaching the clutch A cover (3) to the transmission housing. Insert three, (M8), bolts (4) into the special holes and screw them in until detaching the cover (3) along with clutch A from the transmission housing.

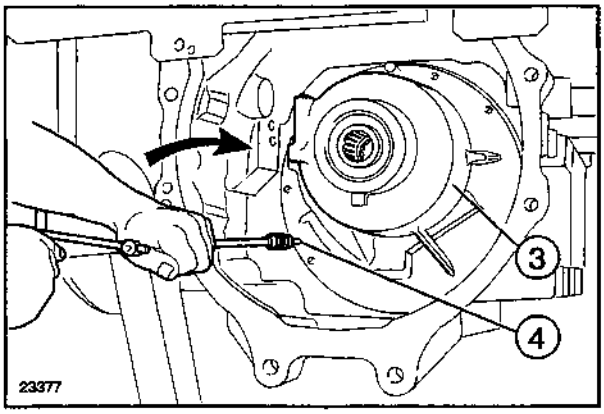


Figure 4-1-82

12. Remove circlip (5) and retrieve clutch discs and centering springs from clutch B.

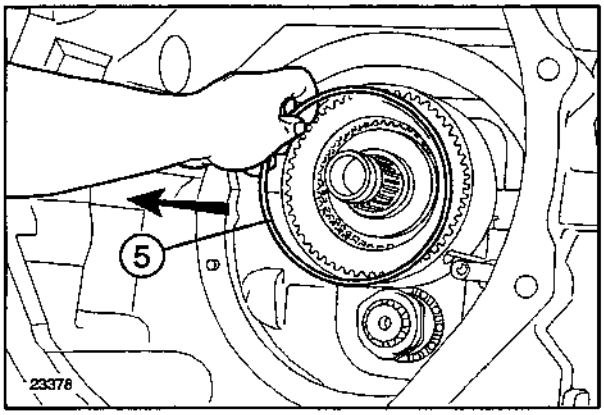


Figure 4-1-83

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13. Assemble tool no. **295021** (6) on clutch B bell housing, turn the tool bolt to compress clutch B release Belleville springs and remove spring retaining ring. Remove tool from the bell housing and retrieve Belleville springs.
14. Blow compressed air into the oil supply hole to clutch B to expel the clutch drive piston.

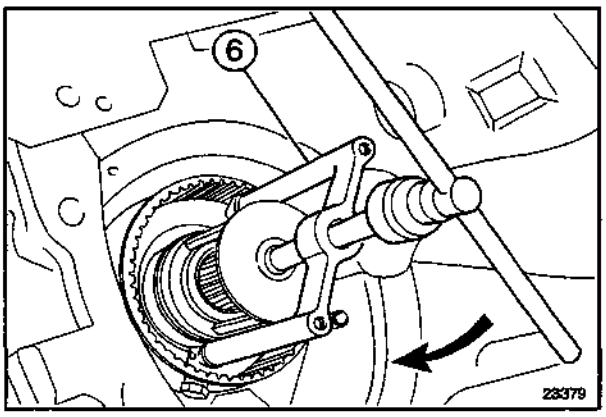


Figure 4-1-84

15. Remove the retaining ring (1) and withdraw the clutch B bell housing.

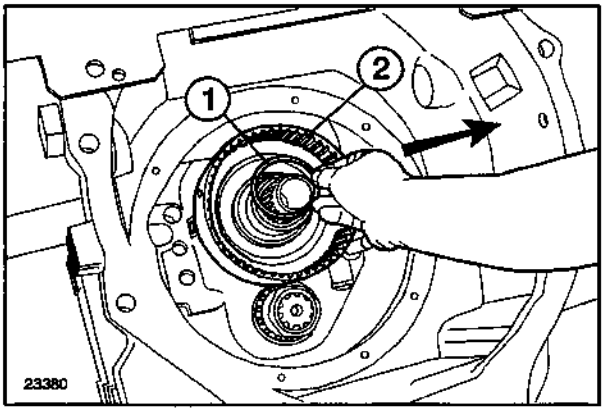


Figure 4-1-85

16. Loosen the cover (1) retaining screws, place tool no. **295049** (2) on the transmission housing, select low range, loosen the output shaft locknut using wrench tool no. **293343** (3) and retrieve cover.

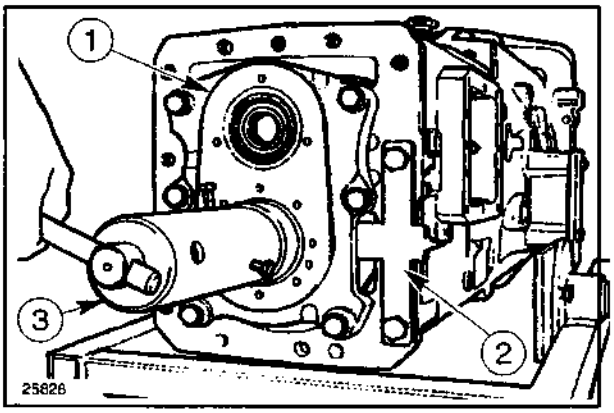


Figure 4-1-86

17. Remove retaining bolts and detach the range gear output and input shaft bearing cap (1).

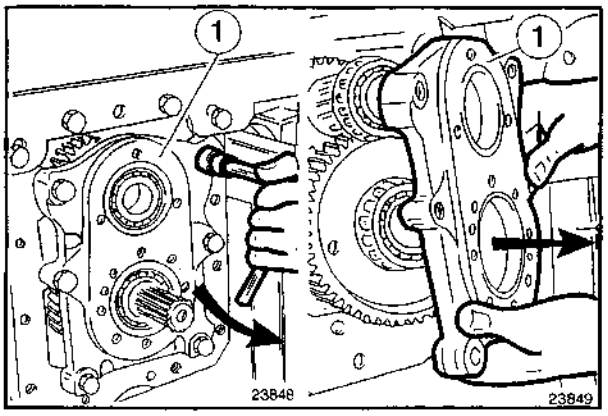


Figure 4-1-87

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18. Using a puller (1) and a suitable insert, remove the medium range driven gear, bearing and bushing.

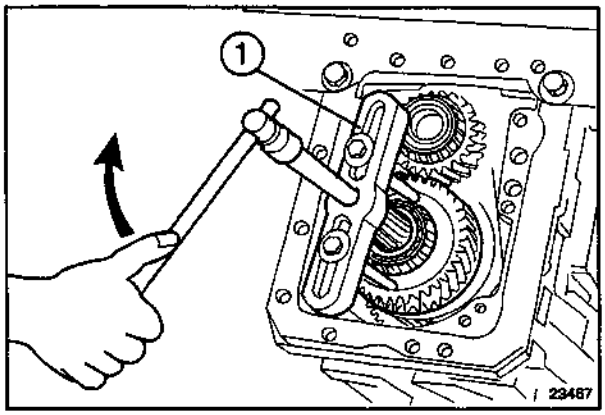


Figure 4-1-88

19. Using a puller (2) and suitable support insert, remove the medium range drive gear, bearing and bushing.

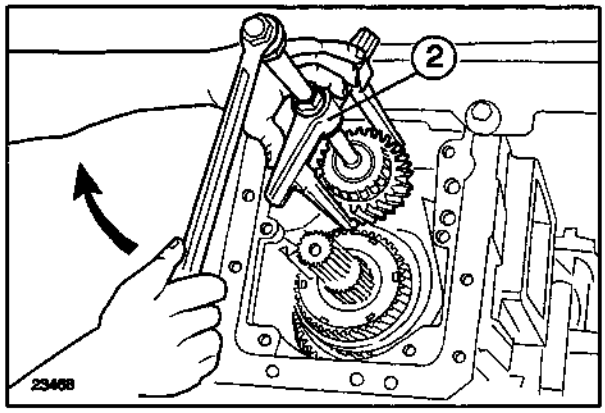


Figure 4-1-89

20. Loosen the plugs (3) and retrieve springs and actuating balls. Remove plug from the transmission housing and withdraw the medium and reverse control fork lock pin.

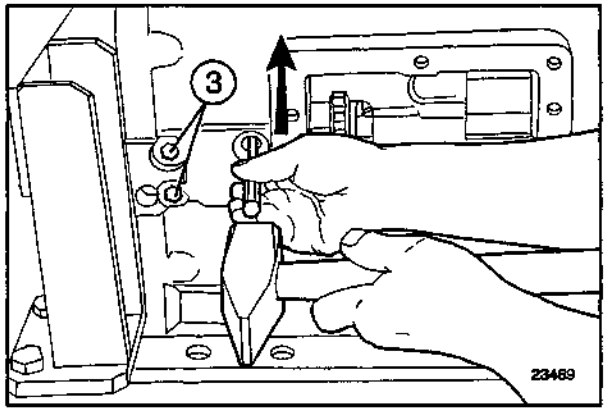


Figure 4-1-90

21. Slide out the range selector dog (4) retaining spring pins and remove rails.

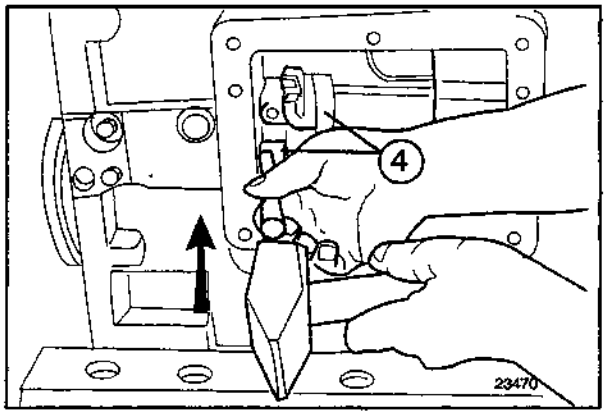


Figure 4-1-91

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22. Remove the medium and reverse control fork (1) along with the synchronizer (2).

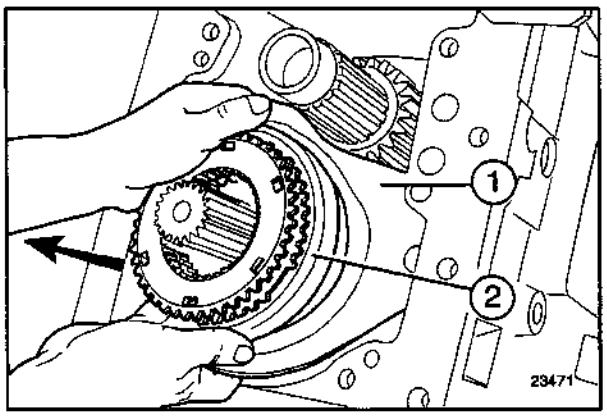


Figure 4-1-92

23. Remove the reverse driven and drive gears (3 and 4, respectively).

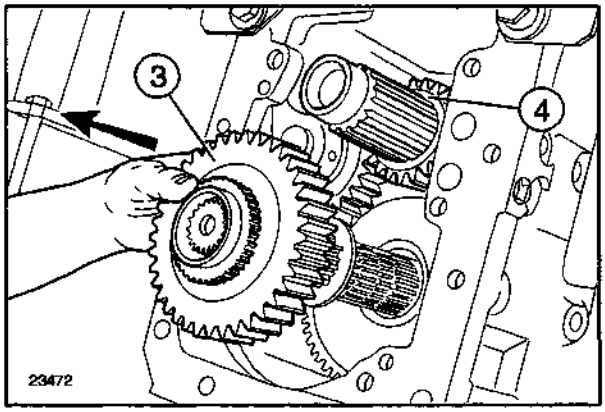


Figure 4-1-93

24. Loosen the reverse idler gear shaft setscrew (5).

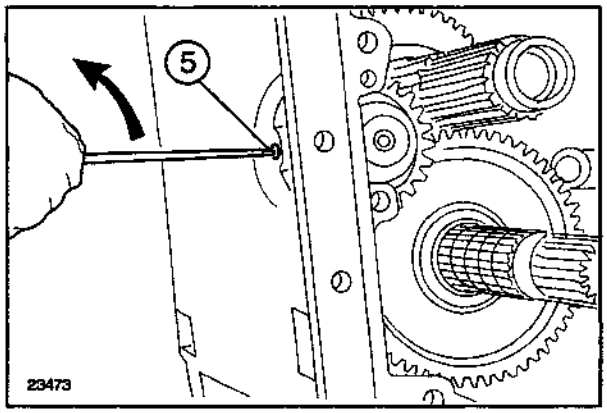


Figure 4-1-94

25. Mount adapter tool no. **50143** (7) and slide puller (6) on the reverse idler gear shaft (8). Remove reverse idler shaft, bearings, gear and spacer.

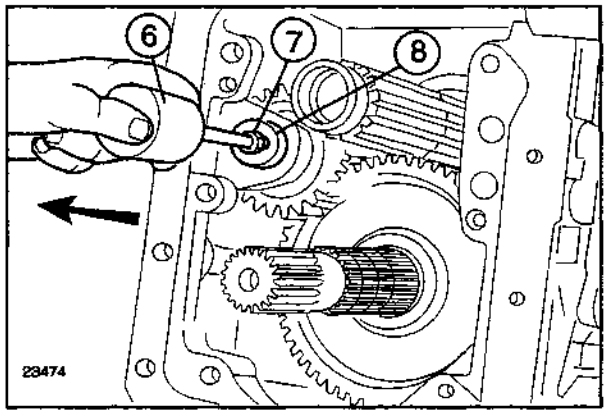


Figure 4-1-95

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26. Slide out the low range driven gear (1).

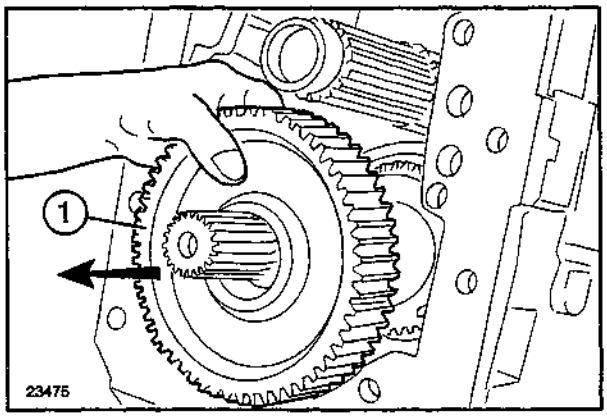


Figure 4-1-96

27. Remove the low and high range control fork (4), synchronizer (3) and output shaft (2).

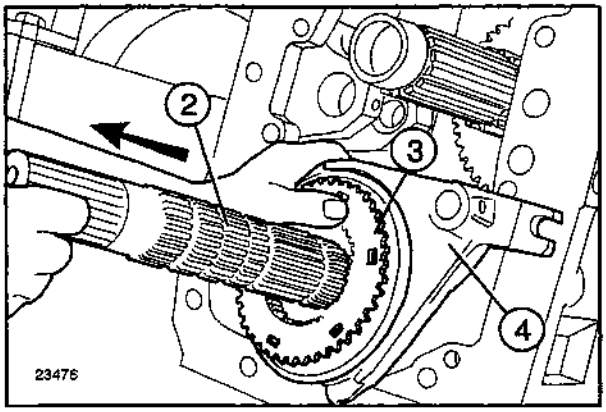


Figure 4-1-97

28. Remove input shaft (5).

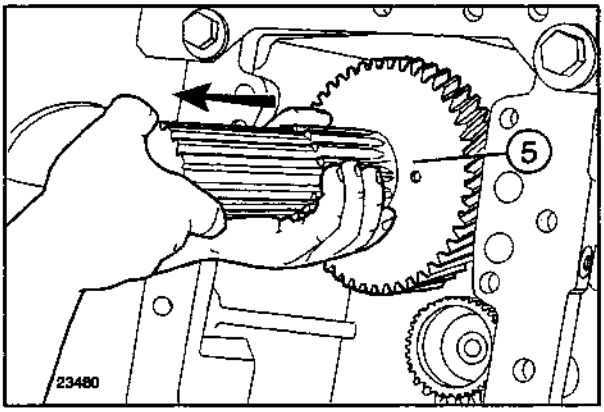


Figure 4-1-98

29. Slide out pins (6) from the range control fork positioning rheostats. Retrieve bushings and seals at the outside of the transmission housing.

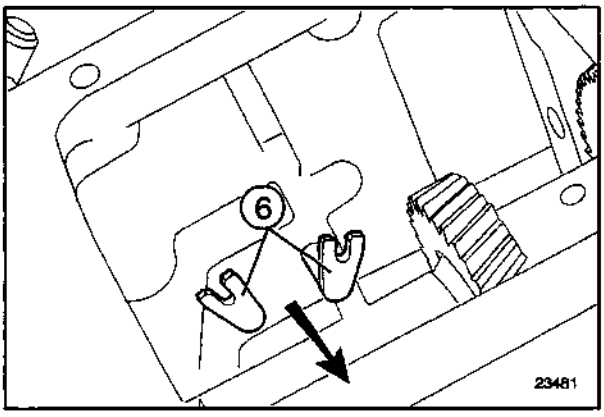


Figure 4-1-99

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30. Loosen the retaining screws and remove the front cover plate (1).

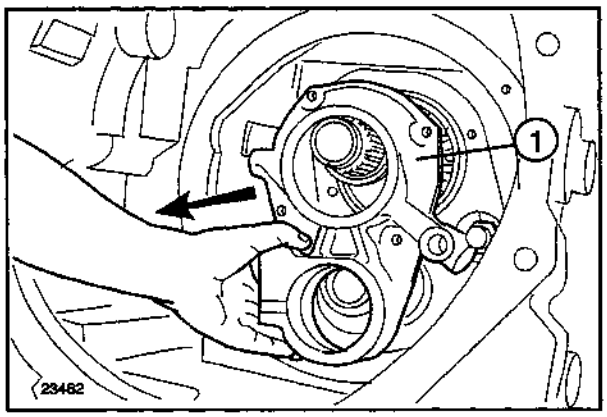


Figure 4-1-100

31. Slide out the drive gear (2) and bearing (3).

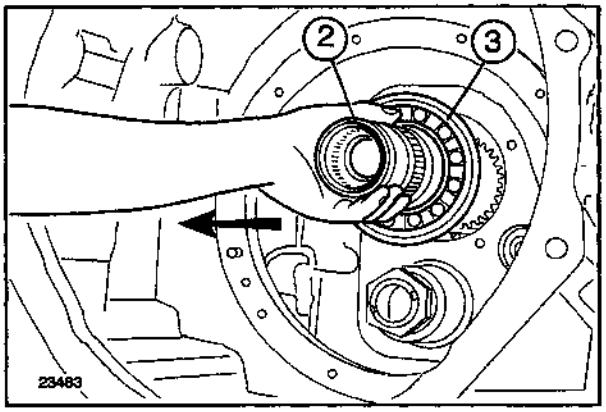


Figure 4-1-101

32. Remove the ring (4) retaining the gears on the input shaft.

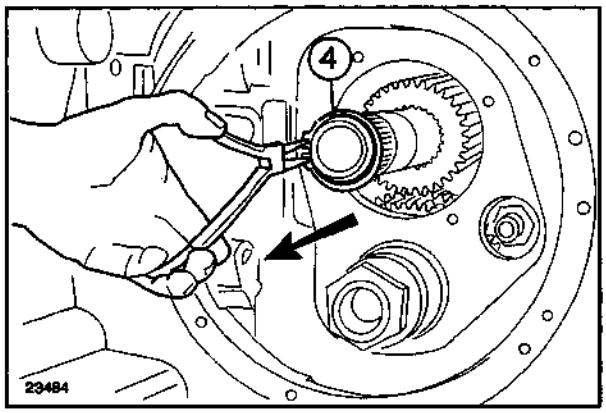


Figure 4-1-102

33. Slide out the input shaft (5) with the bearing inner races from the opposite side of the housing. Retrieve gears, thrust washer and adjust shim.

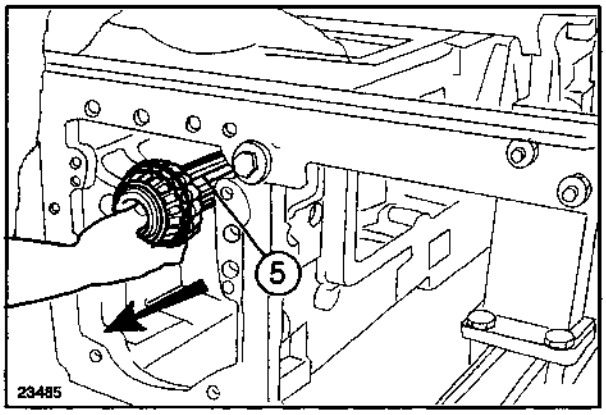


Figure 4-1-103

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34. Install tool no. **293808** (1) on the output shaft, insert a wrench (2) to hold the shaft in position, screw tool no. **293805** (3) to the housing and tighten the tool screw to support the tool.

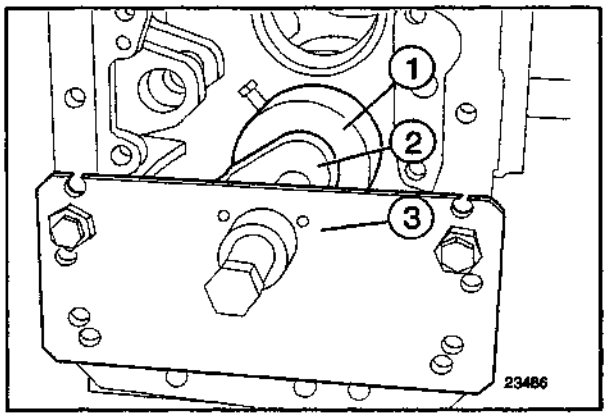


Figure 4-1-104

35. Straighten and loosen the nut, retrieve the bushing and Belleville spring.

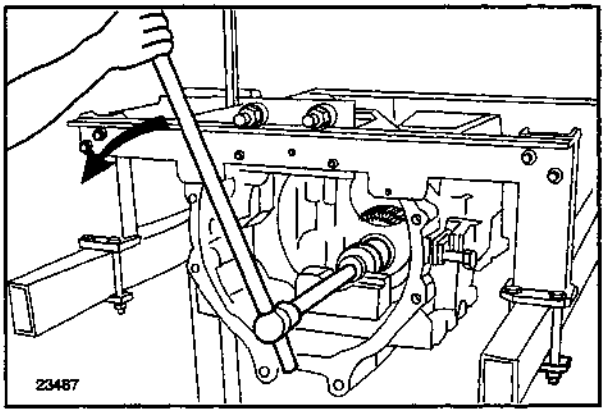


Figure 4-1-105

36. Withdraw the manifold (4) and bearing thrust washer from the output shaft. Detach tool no. **293805** (3), wrench (2) and tool no. **293808** (1) from rear side.

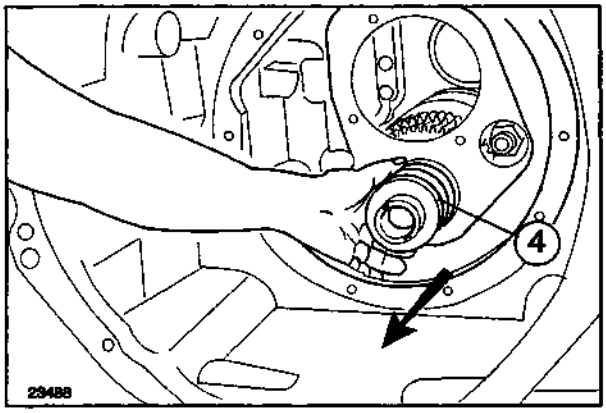


Figure 4-1-106

37. Remove the output shaft (5) seals and, using an aluminum punch and a hammer, partially remove the shaft.

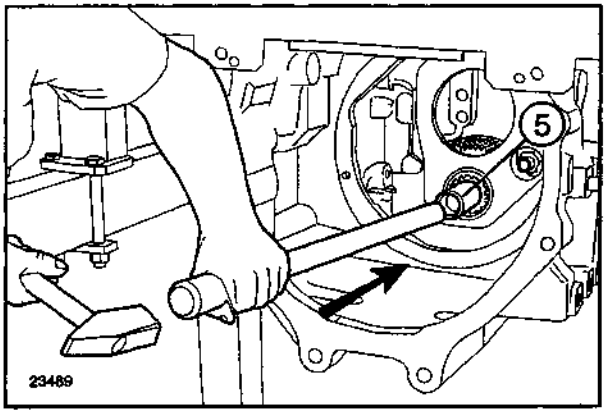


Figure 4-1-107

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38. Turn the transmission housing upright, withdraw the output shaft (1) and retrieve the clutch/gear/bearing assembly along with the bearing.

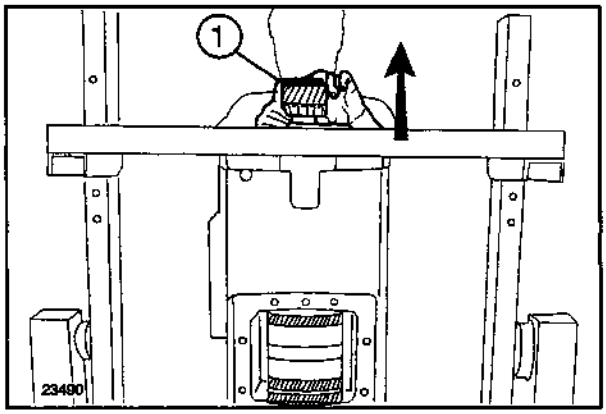


Figure 4-1-108

39. Loosen the lubrication oil fitting (2) and retrieve inner bushing.

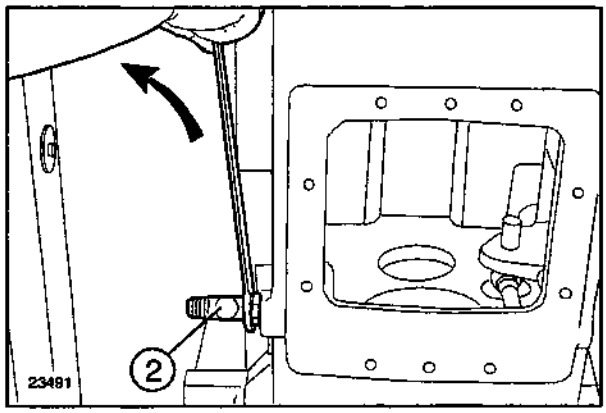


Figure 4-1-109

40. Detach the fitting from the housing and slide out the lubrication line from the inside of the transmission housing.

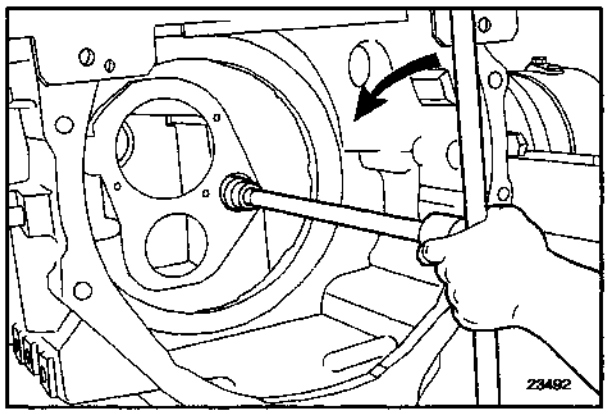


Figure 4-1-110

41. Dismantle the clutch C by removing the circlip (3) and collecting the clutch driven and drive discs.

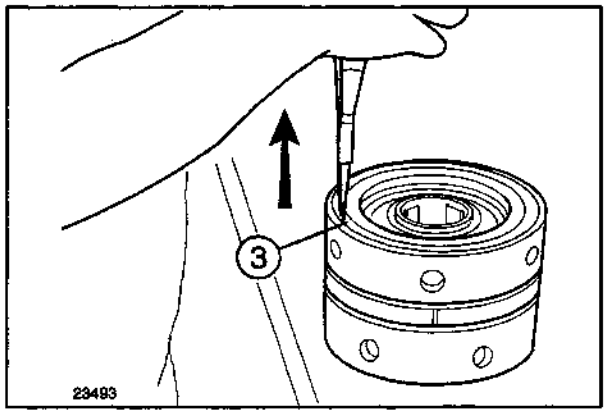


Figure 4-1-111

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42. Fix tool no. **295021** (1) to the clutch bell housing, screw in the tool bolt until compressing the Belleville springs, then remove the spring retaining ring. Loosen tool bolt, retrieve Belleville springs and detach tool from the clutch bell housing.

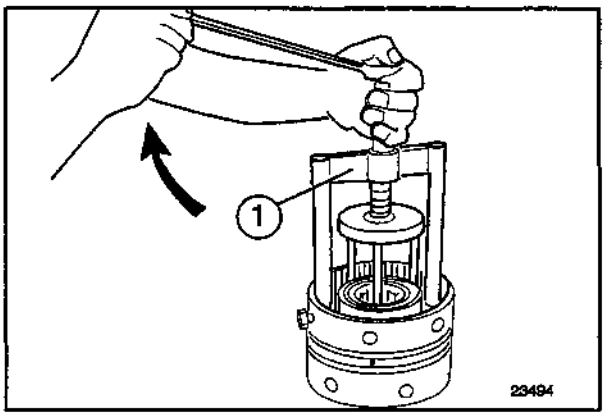


Figure 4-1-112

43. Screw two 5 mm bolts into the special holes in the piston (2), then withdraw piston pulling it out using the bolts.

44. Repeat steps 40 to 42 to disassemble clutches D and E.

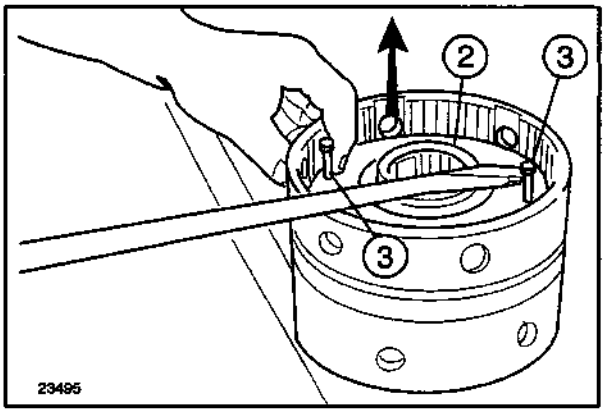


Figure 4-1-113

45. Remove the retaining ring (2), the bearing inner lock ring and retrieve the hubs of the clutches A and B (1) along with the bearing and clutch A discs and centering springs.

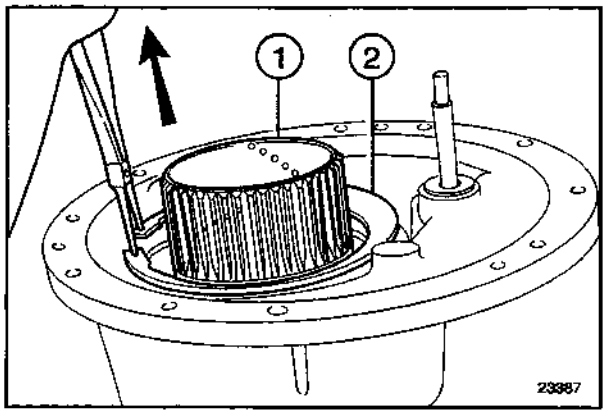


Figure 4-1-114

46. Remove seal (3).

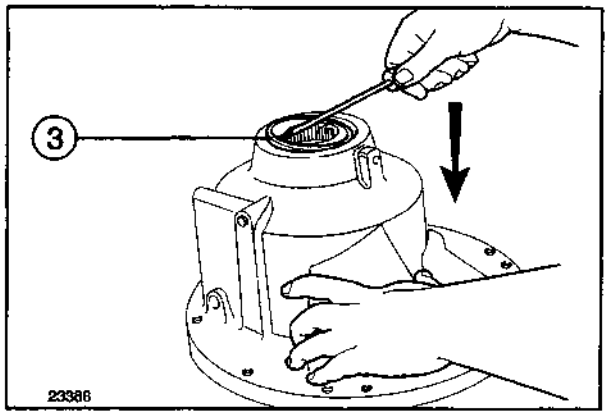


Figure 4-1-115

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47. Remove the outer (4) and inner circlips and, from the outside of clutch A (5), withdraw clutch A from the cover. Retrieve the bearing.

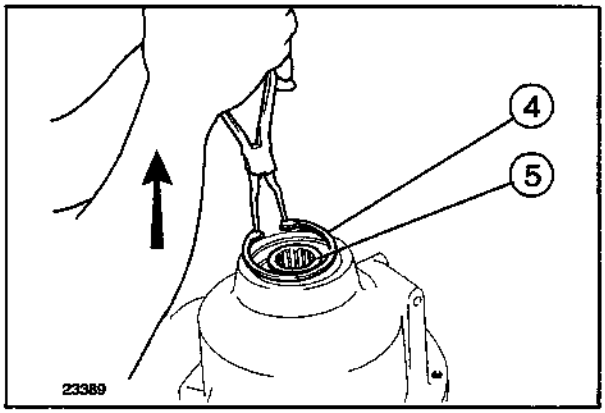


Figure 4-1-116

48. Position tool no. **295021** (6) on clutch A (5), turn the tool bolt to compress the clutch release Belleville springs and remove the retaining ring. Disassemble tool no. **295021** (6) and retrieve Belleville springs.

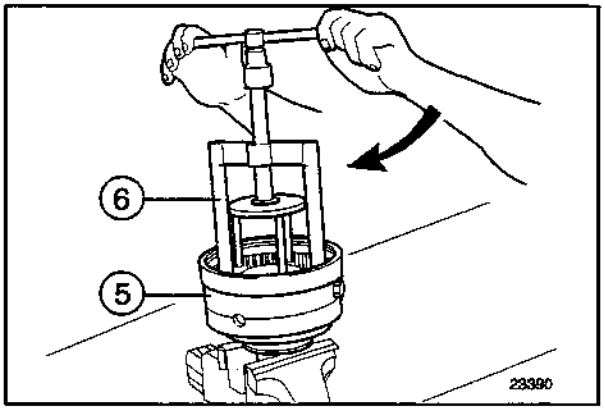


Figure 4-1-117

49. Place the clutch A bell housing on the cover (2), blow compressed air into the control oil inlet hole and remove the piston (1).

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

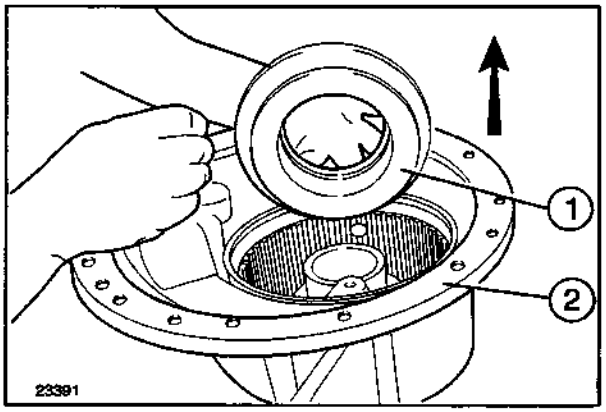


Figure 4-1-118

50. Reinstall the SEMI–POWERSHIFT transmission into the transmission housing observing the following:

- Reinstallation follows the removal procedure in reverse, from step 49 back to step 1.
- Refer to figures on pages 4-1-10, 4-1-11, and 4-1-12 for correct orientation of the different parts.
- Ensure the housing is thoroughly cleaned (especially inner compartments).
- Check seals and replace if damaged.
- Before reassembling housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant following the pattern shown in the figure on page 4-1-46.
- Tighten to correct torque as detailed on page 4-1-4.
- Carry out following operations and adjustments as detailed on pages 4-1-47 to 4-1-50 (**Note:** some operations must be completed prior to reassembly).

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51. While assembling clutches C, D, and E and their shafts to the transmission housing, take care to match reference marks (1). Reference step 38.

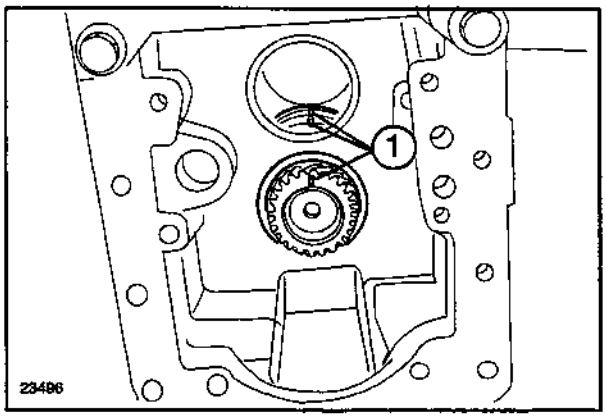


Figure 4-1-119

52. Install front bearing (7) using tools no. **50108** (6) and **293869** (5). Reference step 36.

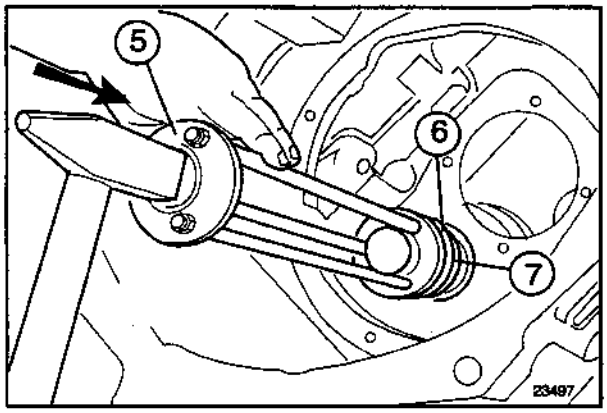


Figure 4-1-120

53. Assemble retaining tool no. **293808** (1) on the transmission output shaft, insert a wrench (3) to hold it and support tool (1) by attaching tool no. **293805** (2) to the housing. Reference step 34.

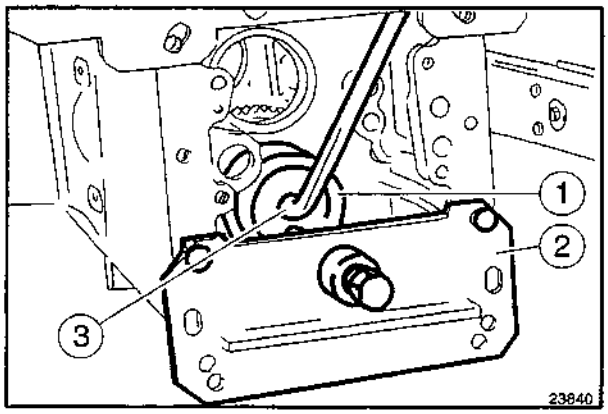


Figure 4-1-121

54. After installing the details of the output shaft, lock the shaft with the nut. Torque nut to 361 ft. lbs. (490 Nm) and stake lock ring on nut to groove in the shaft. Temporarily install the front cover (9) and insert the three clutch control lines (8).

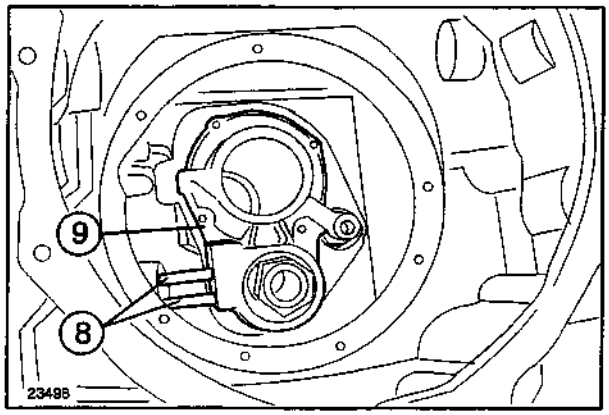


Figure 4-1-122

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55. Blow compressed air into the lines (1) and check for correct operation of the clutches C, D, and E. After this test, remove lines (1) and detach front cover. Install the input shaft complete with its accessory parts. After installing the front cover and tightening attaching bolts, perform again the above test to check that there are no leaks from the manifold. References steps 30–33.

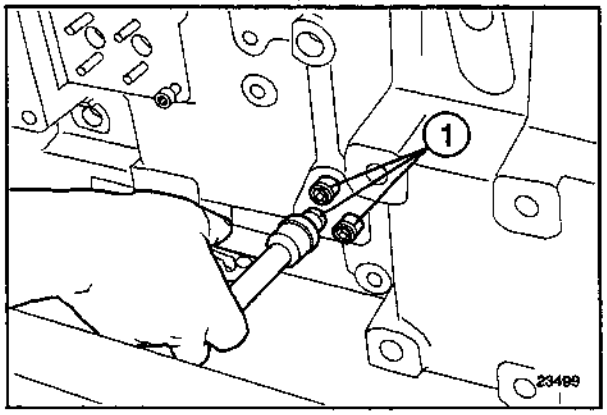


Figure 4-1-123

56. Upon reassembly of the clutch A, install the bearing (1), then raise the hub (8) using a suitable tool and insert the circlip (10).

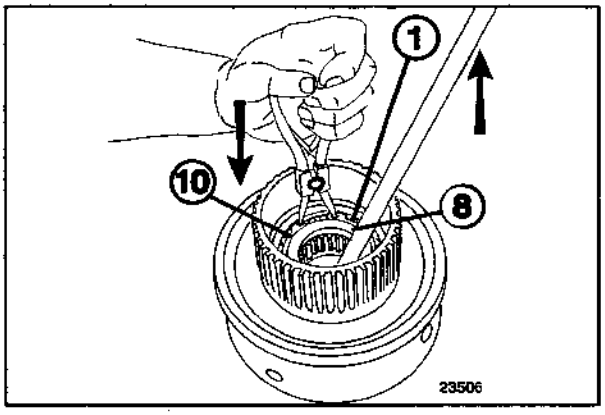


Figure 4-1-124

57. While reinstalling the circlip (1) on to the clutch cover (8), check that the oil leak off hole (7) is exactly in the middle of the outer circlip ends.

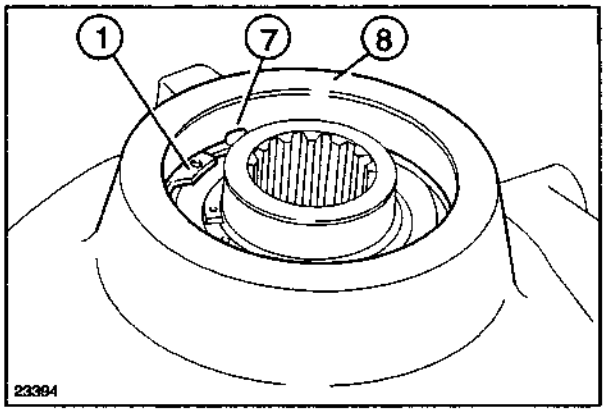


Figure 4-1-125

58. To assist assembly of clutch B disc retaining ring, insert two suitable dowels (1) into two oil discharge holes to keep the clutch centering springs pressed.

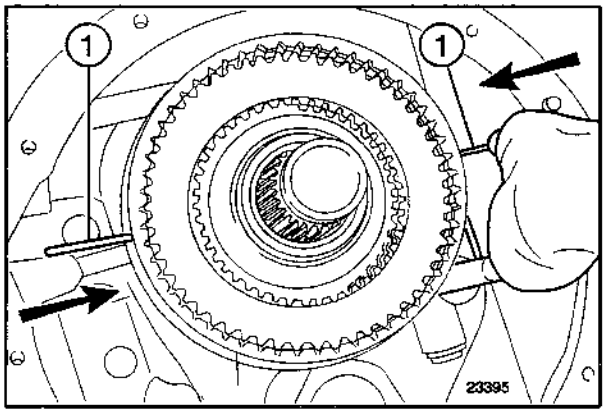


Figure 4-1-126

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59. Using a expanding puller tool (5), position tool no. **50018** (3) with three legs tool no. **50115** (2) (see page 4-1-7). Turn the puller screw to clamp the clutch disc and endplate, and position the clutch disc retaining ring into its seat.

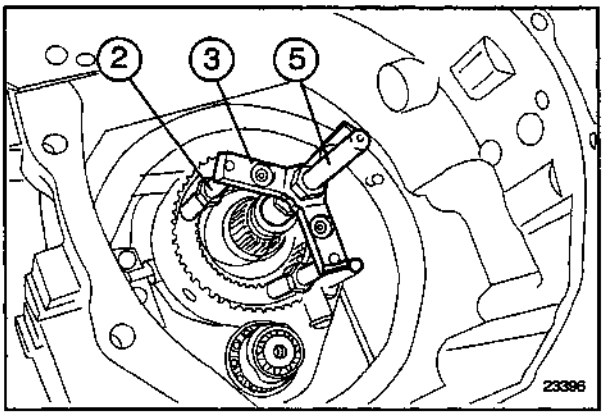


Figure 4-1-127

60. With the clutch A housing assembled to the transmission housing, press–fit the bearing (7) using tool no. **293869**. Fix bearing with the retaining rings and install the seal.

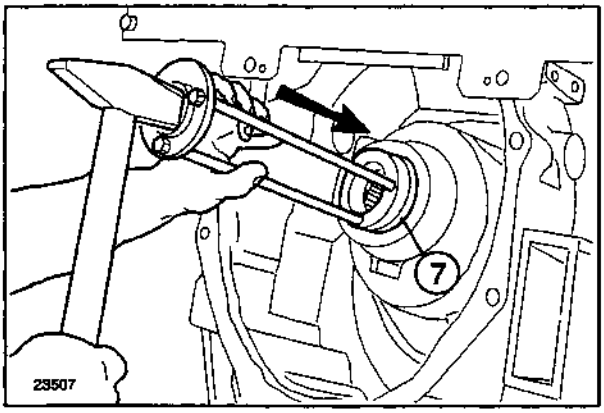


Figure 4-1-128

61. Heat and press–fit the bearing (3) on to the input shaft using tool no. **50060** (2) shown on page 4-1-8. Using tool no. **50013** (1) (see page 4-1-7), keep the bearing properly seated against the gear during cooling.

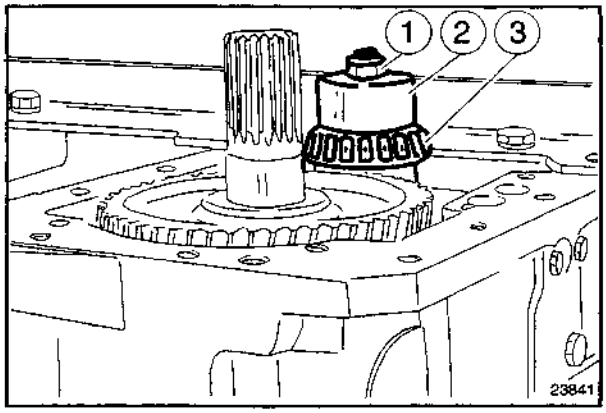


Figure 4-1-129

62. Heat and press–fit the bearing (1) on to the output shaft using tool no. **50061** (2) shown on page 4-1-7. Using tool no. **50018** threaded rod (3) (see page 4-1-6), keep the bearing properly seated against the gear during cooling.

Note: Remove tools nos. 50060 (2, Figure 4-1-129) and 50061 (2, Figure 4-1-130) when the bearings (3 and 1) have completely cooled down.

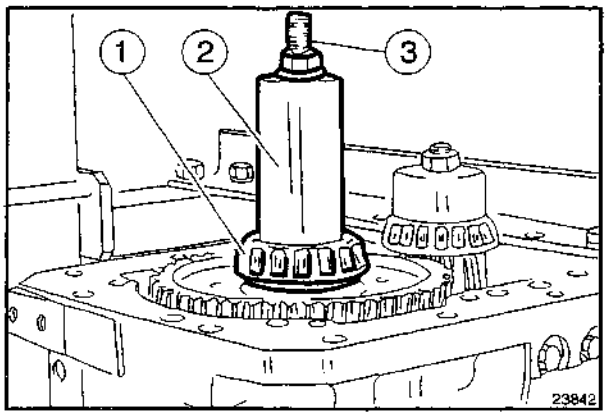


Figure 4-1-130

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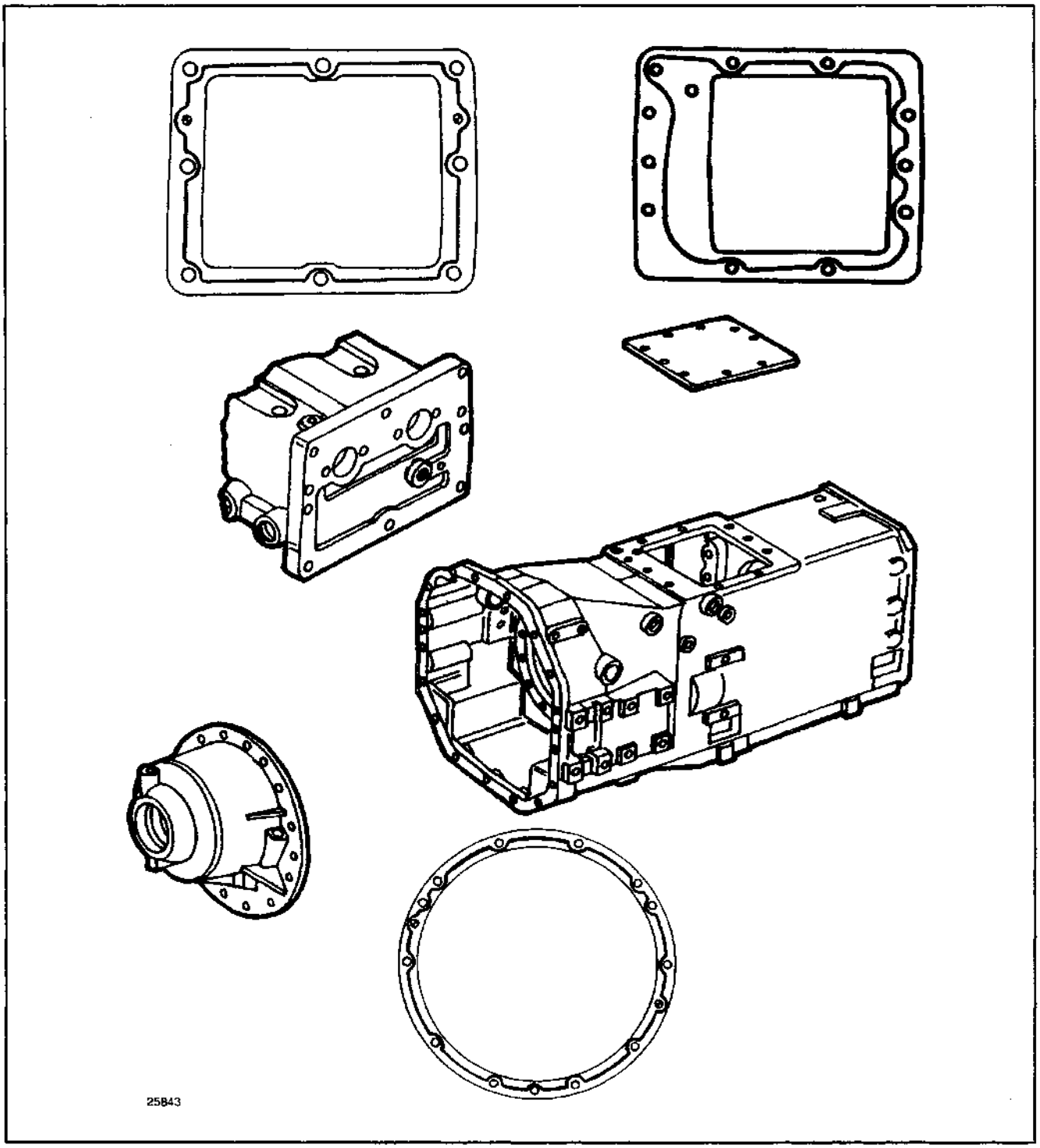


Figure 4-1-131

Pattern for application of sealant during installation of: range control valve housing, top cover, front cover of clutches A and B.

Sealants to be used are listed on page 0-1-19, Section 00.

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TRANSMISSION HOUSING

Transmission input shaft end play adjustment

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

63. Place the transmission input shaft (1) on a bench, slide on the gear cluster (6), spacer (5), a 3.5 mm test shim (4), gear (3). Lock the assembly with a circlip (2).

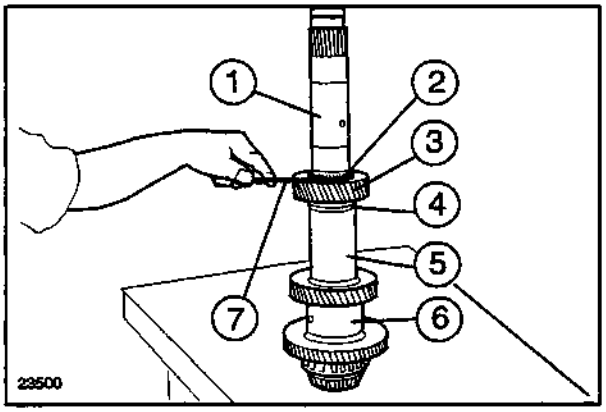


Figure 4-1-132

64. Settle the assembly. Using a feeler gauge (7), measure the end play between the circlip (2) and gear (3).

65. Shim to be assembled is given by the measured dimension plus the test shim minus the specified end play.

Example:

Gauge reading:= 0.90 mm
Test shim= 3.50 mm
Specified end play= 0 to 0.15 mm
Shim to be assembled: = 0.90 + 3.50 – 0.10 = 4.30 mm.

Note: Available adjust shims are detailed on page 4-1-3.

66. Remove circlip (2), withdraw the gear (3) as previously found in step 65 and test shim (4). Add shim (8) as previously found, gear (3) and lock the assembly with the circlip (2).

67. Settle the assembly. Using a feeler gauge (7) check that end play is to specification.

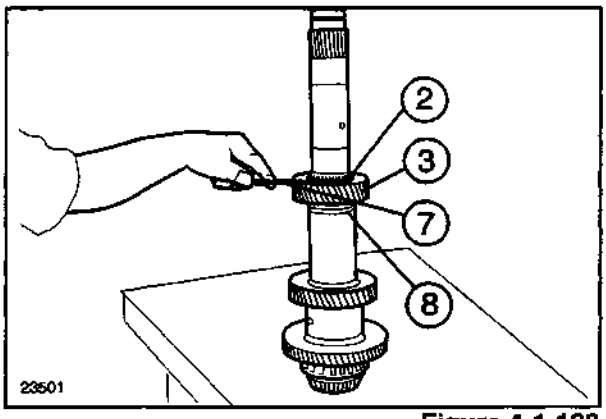


Figure 4-1-133

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TRANSMISSION HOUSING

Transmission driven gear bearing adjustment

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

68. Place tool no. **293975** (6) in a vise, add bearings (2 and 5), spacer (4), test shim (3), tool no. **295047** (1) and tighten the tool nut(6).

69. Using a depth gauge, measure the distance (L1) between end of tool no. **293975** and top of the tool retaining threaded pin. Dismantle the assembly.

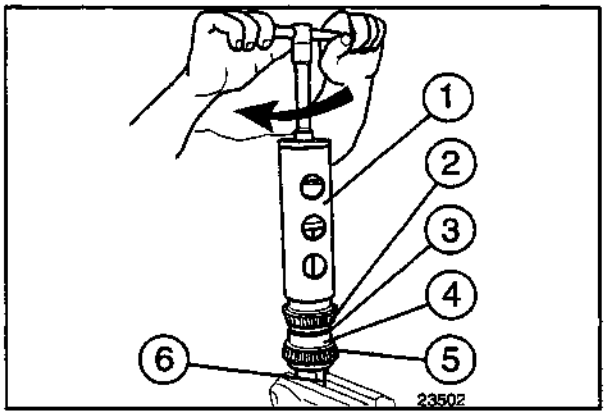


Figure 4-1-134

70. Insert the two bearings (2 and 5), gear (7), tool no. **295047** (4) on tool no. **293975** (6) and tighten the tool nut (6). Using a depth gauge, measure the distance (L) between the end of tool no. **293975** and top of the tool retaining threaded pin.

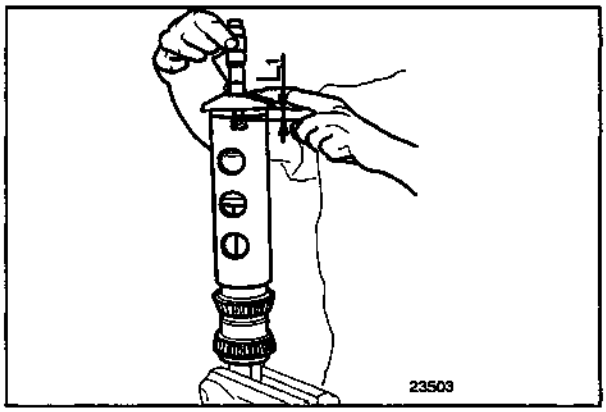


Figure 4-1-135

71. Adjust shim to be assembled is given by:

$S = L - L_1 + P - 0.05$ mm

where

S = Adjust shim to be assembled to output shaft

L and L_1 = Readings on tool no **293975**.

P = Test shim.

0.05 mm = Decrease necessary to compensate for bearing increased load deriving from tightening of the transmission output shaft locknut

If necessary, round off the value (S) to the previous 0.025 mm.

Example:

Reading **L** = 18.53 mm

Reading L_1 = 11.30 mm

Test shim = 3.00 mm

Adjust shim to be assembled

S = 18.53 – 11.30 + 3.00 – 0.05 = 10.18 mm.

Adjust shim to be assembled is 10.175 mm.

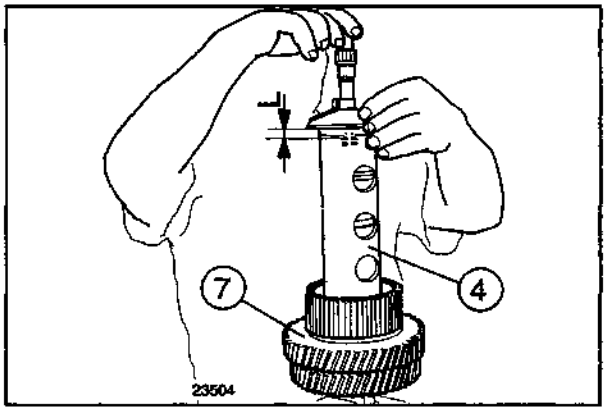


Figure 4-1-136

Note: Available adjust shims for the SEMI–POWER-SHIFT transmission driven gear are listed on page 4-1-3.

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TRANSMISSION HOUSING

Range input and output shaft taper bearing adjustment

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

72. Install cover (2) without adjust shim. Install tool no. **50013**, threaded portion, (1) on to the input shaft (see page 4-1-7).

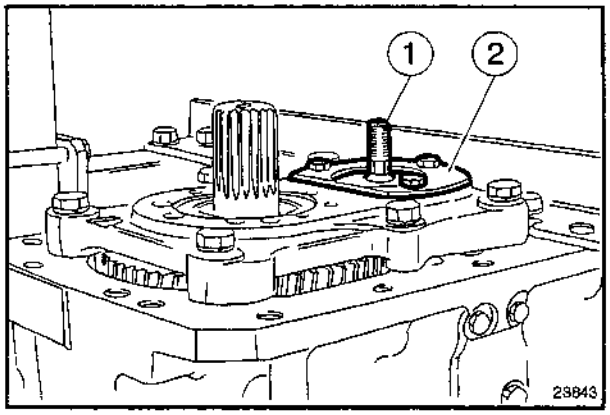


Figure 4-1-137

73. Screw installer tool no. **292176** (2) on tool no. **50013** (3). Place a dial indicator (1) with the stylus touching the bearing inner race. Turn the shafts to settle the bearing rollers, reset dial to zero ensuring that the assembly is bottoming. Through the lever of installer tool no. **292176** (2). bring the assembly to touch the cover (4) and read the travel (L) on the dial indicator.

Adjust shim to be added is given by:
S = L – (0.02 – 0.08 mm)
where:
S = Adjust shim.
L = Travel reading.
0.02 to **0.08 mm** =Input shaft bearing end play.

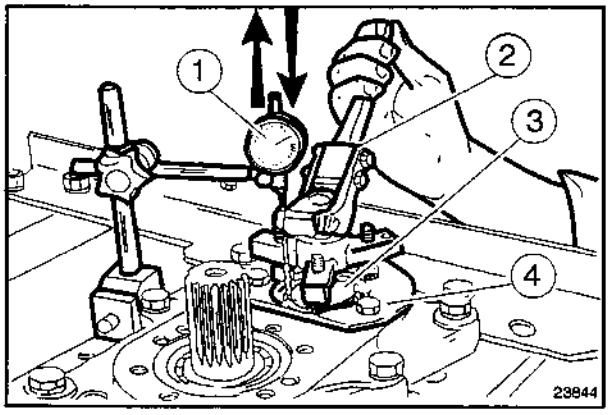


Figure 4-1-138

Note: Available adjust shims for the range input shaft bearings are listed on page 4-1-4.

74. Dismantle tools (2 and 3), remove cover (4), assemble the shim as previously found, reinstall cover (4) and tools (2 and 3). Repeat step 73 to check that end play is to specification, 0.02 to 0.08 mm.
Remove tools (2 and 3).

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75. Install disc (1) with a test shim (Sp).

Note: It is necessary to fit a test shim to the lower shaft only as the clearance between the medium range gear and end cover is minimal.

Remove output shaft lubrication plug.Assemble tool no. **50018** (4) (see on page 4-1-6), installer tool no. **292176** (3) and dial indicator (2). Ensure indicator stylus is located on the bearing inner race.
Turn the shafts to settle the bearing rollers and reset the indicator ensuring that the assembly is bottoming.Using the lever of installer tool no. **292176** (3) bring assembly to touch the disc (1) and read travel (H) on the dial indicator.
Shim to be assembled is given by:

S_1 = H + Sp – (0.02 to 0.08 mm)

where:
S_1 = Adjust shim.
Sp = Test shim.
H = Travel reading.
0.02 to **0.08 mm** = Output shaft bearing end play.

Note: Available adjust shims for the range output shaft bearings are listed on page 4-1-4.

76. Dismantle tools (3 and 4), remove disc (1), replace test shim (Sp) with adjust shim (S_1), reinstall disc (1) and tools (3 and 4). Repeat step 69 to check that end play is to specification, 0.02 to 0.08 mm. Remove tools (3 and 4) and screw in the output shaft lubrication plug.

Note: This procedure is shown with the creeper option. If creeper is not installed, use the same procedure utilizing the one piece bearing retaining plate.

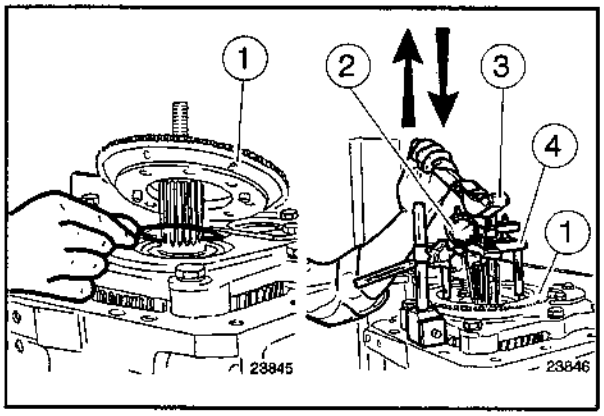


Figure 4-1-139

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SEMI–POWERSHIFT RANGE CONTROL VALVE ASSEMBLY

Removal – Installation

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks.
Ensure that no–one is in the vicinity of the load to be lifted.

Remove the SEMI–POWERSHIFT range control valve assembly as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

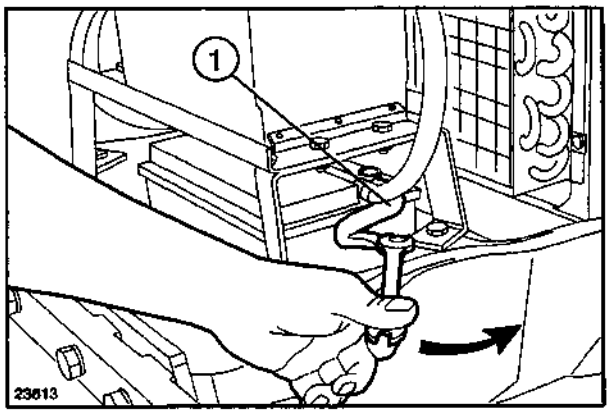


Figure 4-1-140

3. Loosen the screw attaching the steps (6) to the bracket.

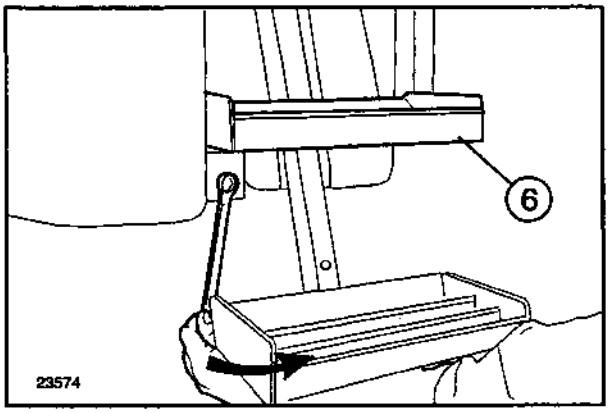


Figure 4-1-141

4. Loosen the screw attaching the steps (1) to the cab platform.

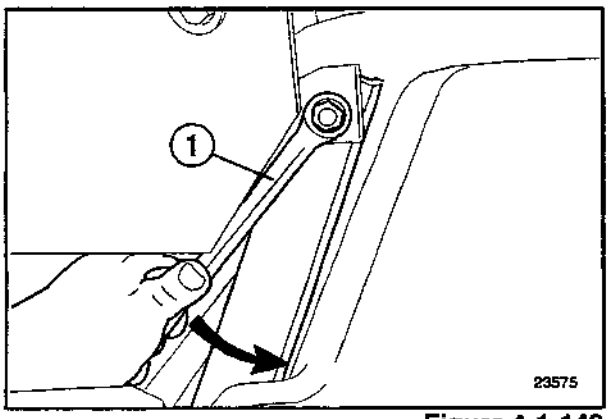


Figure 4-1-142

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5. Drain fuel tanks, then loosen the clamp (1) retaining the fuel line between the main and auxiliary tanks.

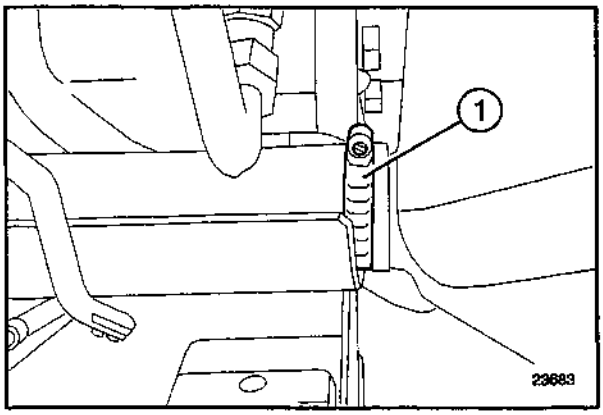


Figure 4-1-143

6. Loosen the clamp and detach the bleeding line (3) between the main and auxiliary tanks.
7. Detach the fuel return line (2) from the pump to the auxiliary tank. Remove the auxiliary tank.

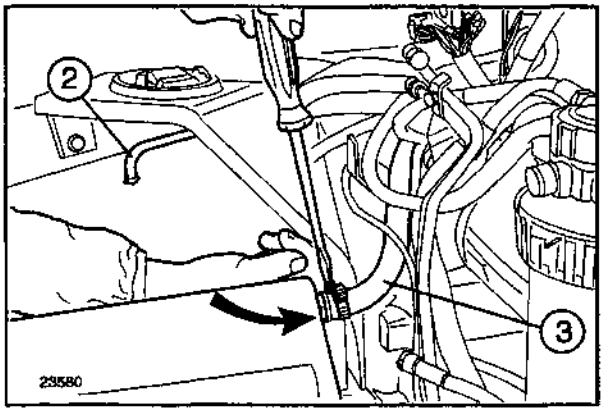


Figure 4-1-144

8. Detach and remove the accumulator (2) tubes. Loosen the retaining screws and remove accumulator.

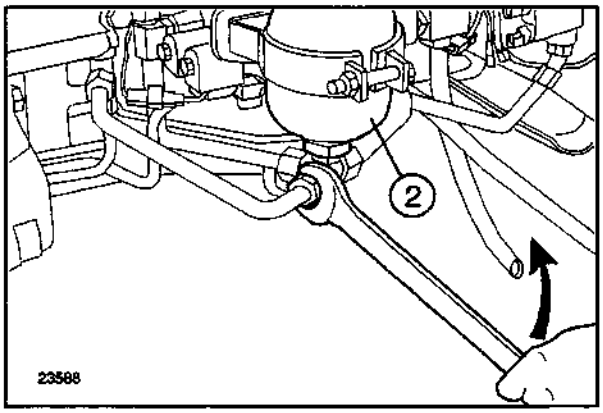


Figure 4-1-145

9. Detach all connectors from the range control valve assembly and sensors.

Note: Before detaching connectors from the control valve housing, mark each connector and respective solenoid valve to assist reassembly and avoid reversal of connections.

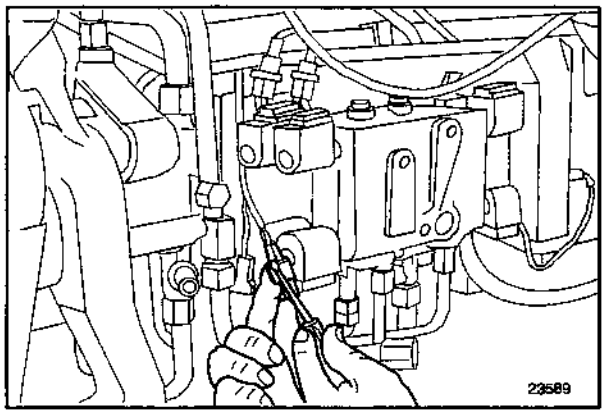


Figure 4-1-146

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10. Loosen retaining screws and remove accumulator (1).

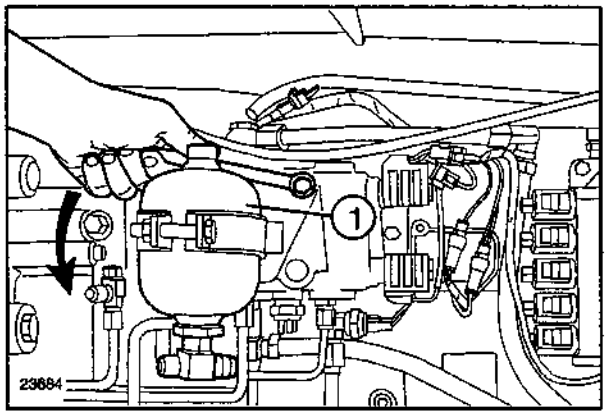


Figure 4-1-147

11. Disconnect all accessory control lines from their fittings located in the lower part of the range control valve housing (2).

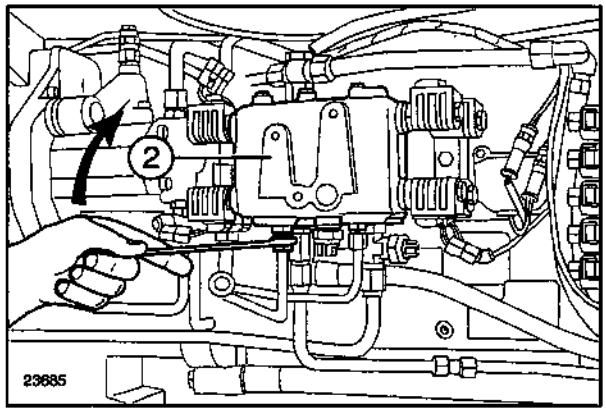


Figure 4-1-148

12. Loosen PTO and lift lubrication line fittings (3 and 4), loosen retaining screws and remove the SEMI–POWERSHIFT range control valve assembly using two alignment pins.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

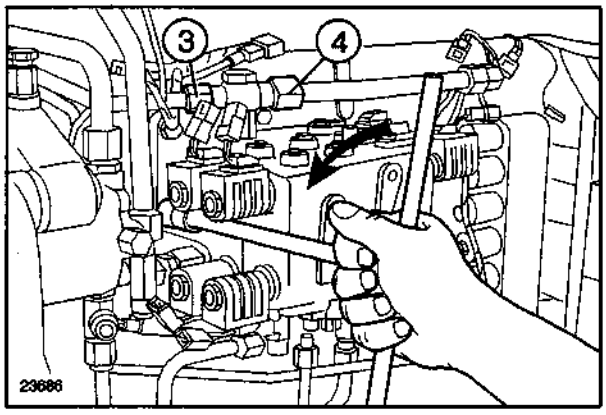


Figure 4-1-149

13. Reinstall the SEMI–POWERSHIFT range control valve assembly to the transmission housing observing the following:

- Reinstallation follows the removal procedure in reverse, from step 12 back to step 1.
- Before reassembling the SEMI–POWERSHIFT range control valve assembly thoroughly clean and degrease mating surfaces and apply a 2 mm (0.079 in) bead of sealant following the pattern shown in the figure on page 4-1-46.
- Tighten to correct torque as detailed on page 4-1-4, 4-1-5 and 4-1-12.

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SEMI–POWERSHIFT RANGE CONTROL VALVE ASSEMBLY

Disassembly–Reassembly

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

To overhaul the SEMI–POWERSHIFT range control assembly it is necessary to remove it from the transmission housing following the removal–installation procedure described on pages 4-1-51 to 4-1-53.

1. Loosen the screw (1) and remove the diff lock solenoid valve (2).

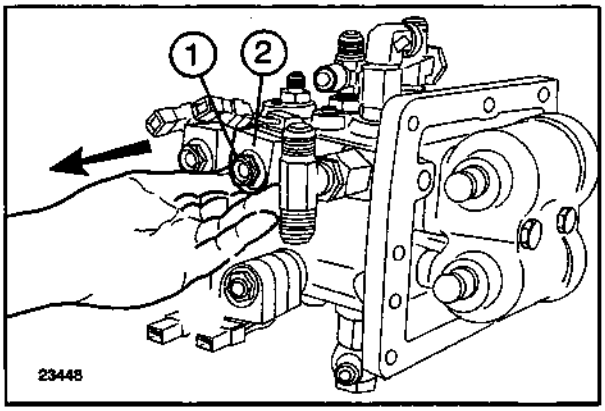


Figure 4-1-150

2. Loosen the fitting (3). Loosen plug on opposite side.

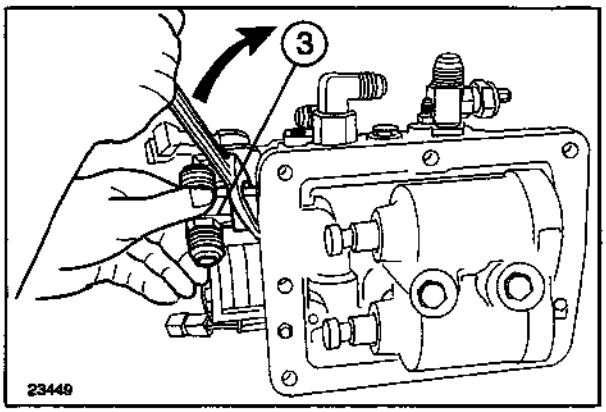


Figure 4-1-151

3. Retrieve the pressure regulation valve (4) and spring (5).

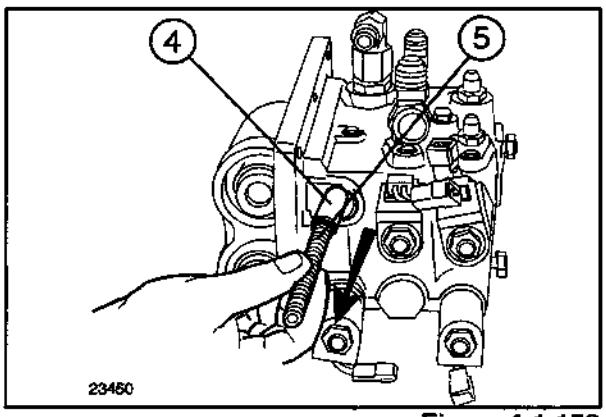


Figure 4-1-152

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4. Loosen the fitting (1) and retrieve the by–pass valve.

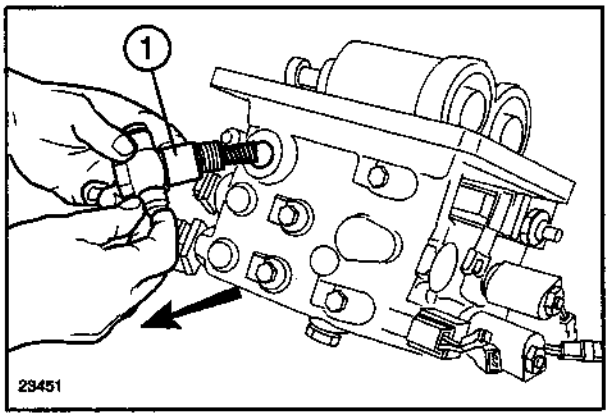


Figure 4-1-153

5. Remove the FWD pressure sensor (2).

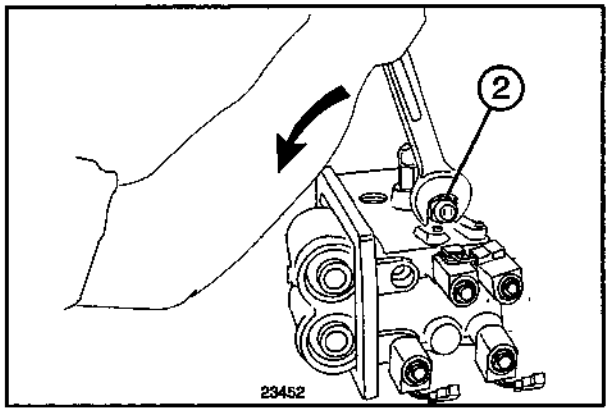


Figure 4-1-154

6. Loosen retaining screws and remove the range drive pistons (3).

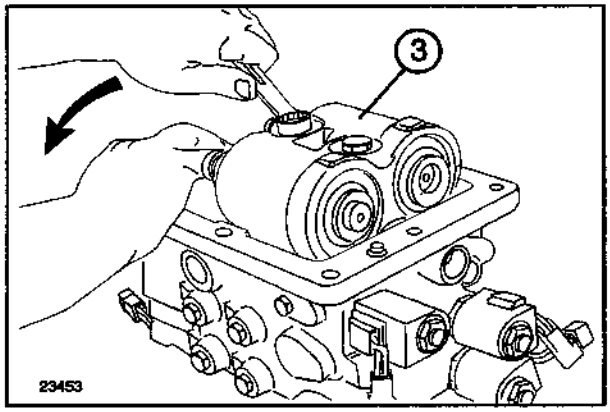


Figure 4-1-155

7. Loosen the oil suction valve (4), figure 4-1-56 (for the power steering circuit when the engine is shut–off) and all solenoid valves.

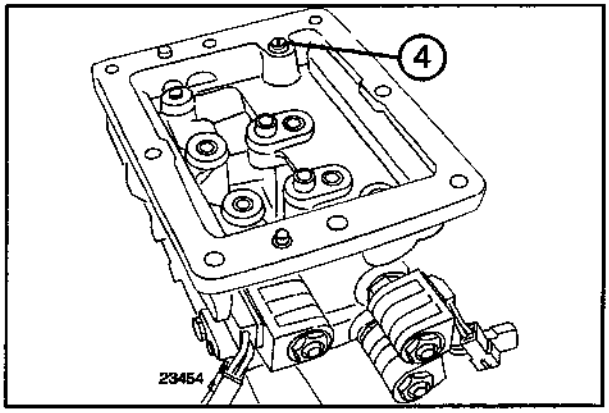


Figure 4-1-156

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8. Remove the retaining ring (1). Remove the sliding guide cover, inner ring and piston.

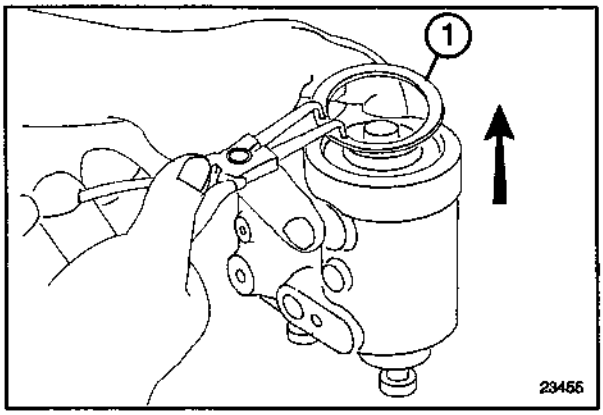


Figure 4-1-157

9. Using a suitable punch, drive out the inner retaining ring (2) and retrieve inner ring.

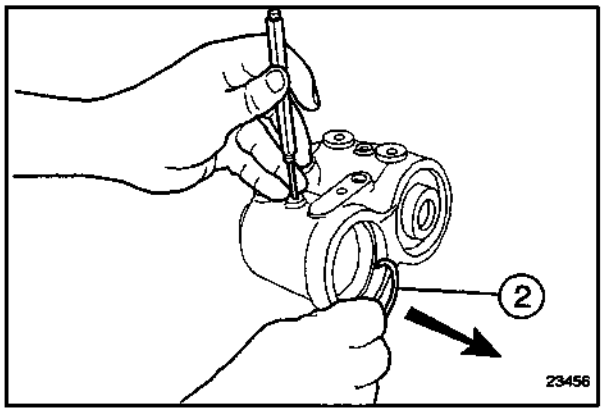


Figure 4-1-158

10. Range drive piston components.

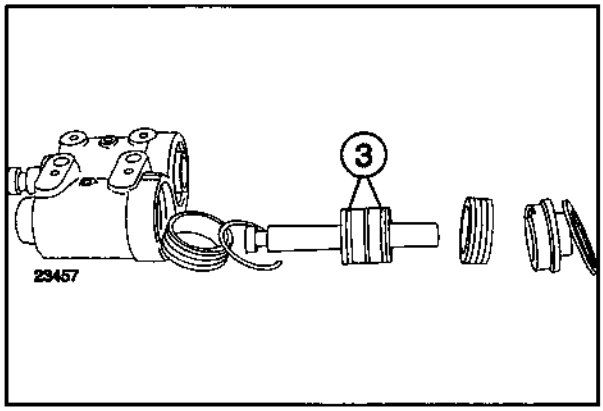


Figure 4-1-159

Note: If it is necessary to replace the seals (3) and back–up rings, insert them in as fast as possible to prevent bending. Wait 15 minutes before installing the piston into the bore.

11. Reassemble the SEMI–POWERSHIFT range control valve assembly observing the following:
    - Reassembly follows the disassembly procedure in reverse, from step 10 back to step 1.
    - Refer to figures on page 4-1-11 for correct orientation of different components.
    - Ensure all components are thoroughly cleaned.
    - Check seals and replace if damaged.
    - Tighten to correct torque as detailed on page 4-1-4, 4-1-5 and 4-1-12.

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SEMI–POWERSHIFT RANGE CONTROL SOLENOID VALVE

Replacement

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Replace one of the solenoid valves from the SEMI–POWERSHIFT range control valve assembly as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

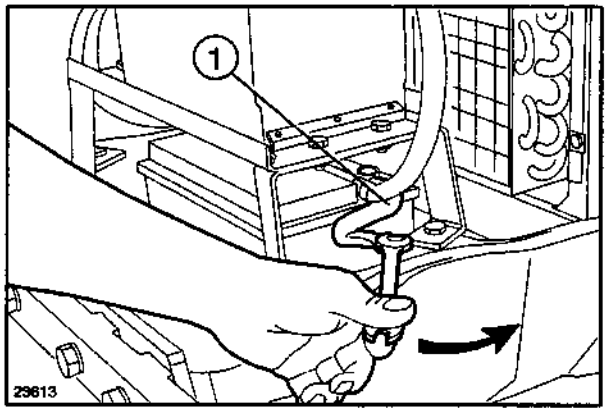


Figure 4-1-160

3. Detach connector (1) from the solenoid valve.

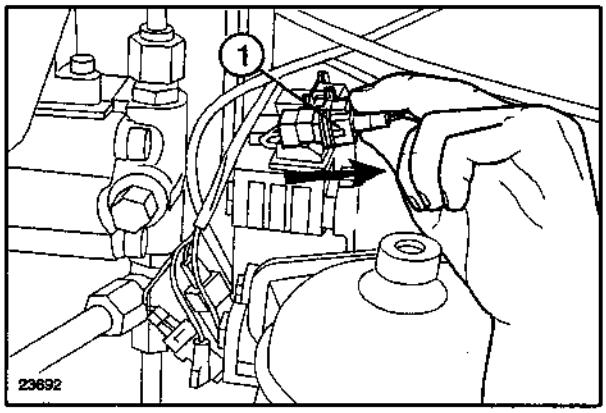


Figure 4-1-161

4. Loosen the retaining nut (2) and remove the solenoid (3).

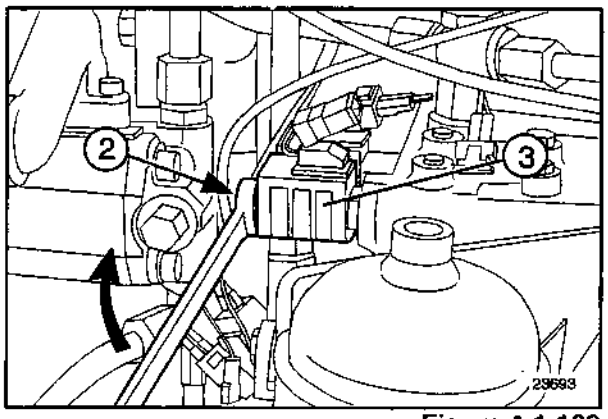


Figure 4-1-162

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5. Unscrew the pin (1) and slide it out.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

6. Reinstall the solenoid valve into the SEMI–POWERSHIFT range control valve assembly observing the following:
   - Reinstallation follows the removal procedure in reverse, from step 5 back to step 1.
   - Check seals and replace if damaged.
   - Tighten to correct torque as detailed on page 4-1-4.

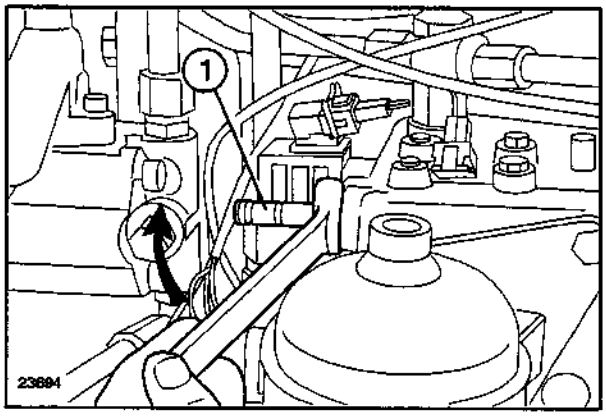


Figure 4-1-163

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SEMI–POWERSHIFT TRANSMISSION CONTROL VALVE ASSEMBLY

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Remove the SEMI–POWERSHIFT TRANSMISSION control valve assembly as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

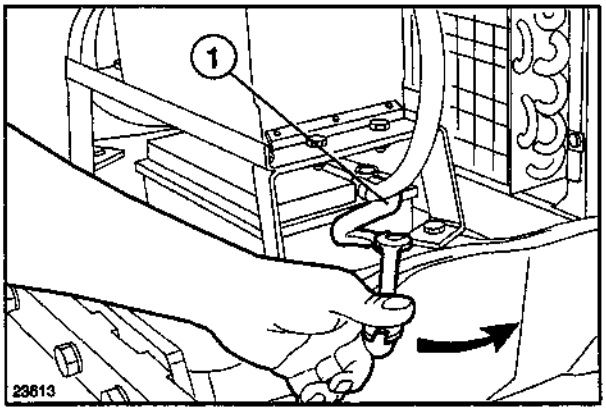


Figure 4-1-164

3. Loosen the screw attaching the steps (6) to the bracket.

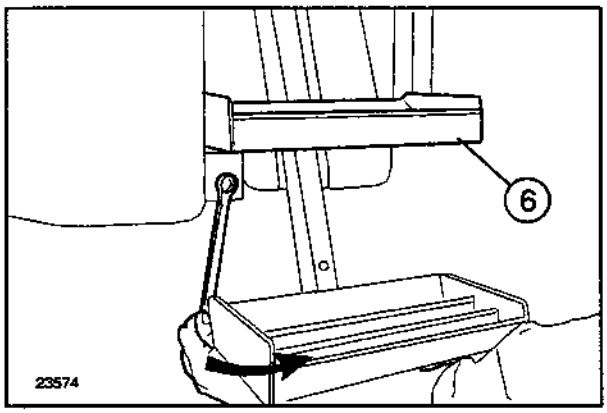


Figure 4-1-165

4. Loosen the screw attaching the steps (1) to the cab platform.

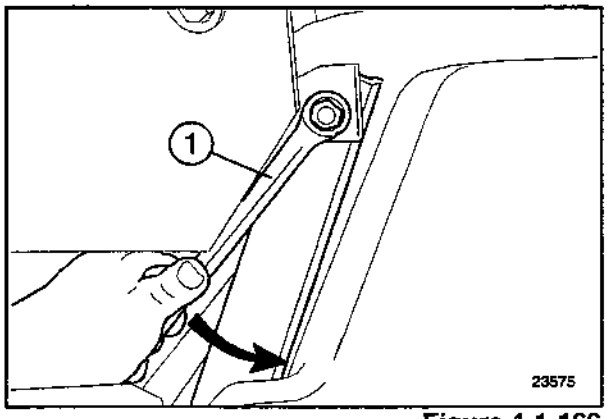


Figure 4-1-166

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5. Drain fuel tanks, then loosen the clamp (1) retaining the fuel lines between the main and auxiliary tanks.

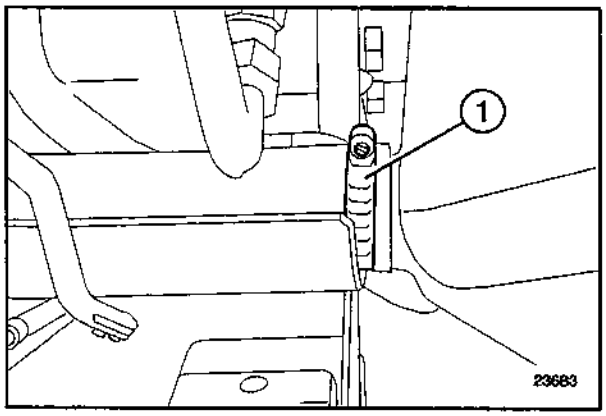


Figure 4-1-167

6. Loosen the clamp and detach the bleeding line (3) between the main and auxiliary tanks.
7. Detach the fuel return line (2) from the pump to the auxiliary tank. Remove the auxiliary tank.

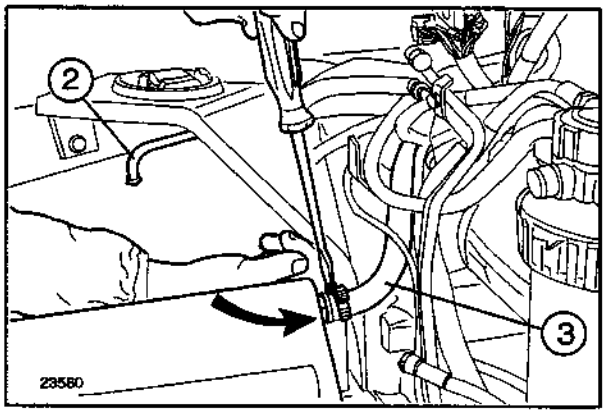


Figure 4-1-168

8. Detach all connectors (4) from the SEMI–POWERSHIFT clutch control solenoid valve assembly.

Note: Before detaching connectors from the control valve housing, mark each connector and respective solenoid valve to assist reassembly and avoid reversal of connections.

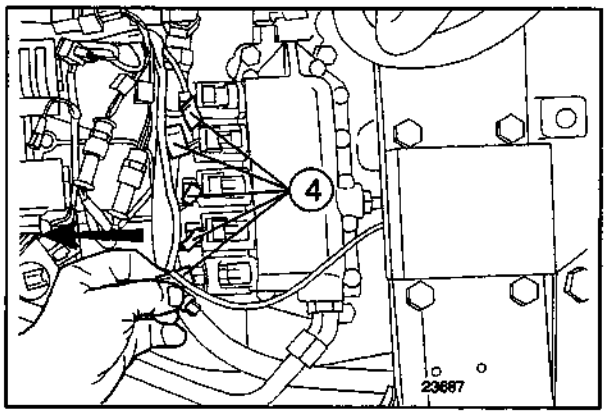


Figure 4-1-169

9. Disconnect lines (5 and 6), loosen retaining screws and remove the control valve housing.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

10. Reinstall the SEMI–POWERSHIFT control valve assembly observing the following:
    –Reinstallation follows the removal procedure in reverse, from step 9 back to step 1.
    –Tighten to correct torque as detailed on page 4-1-12.

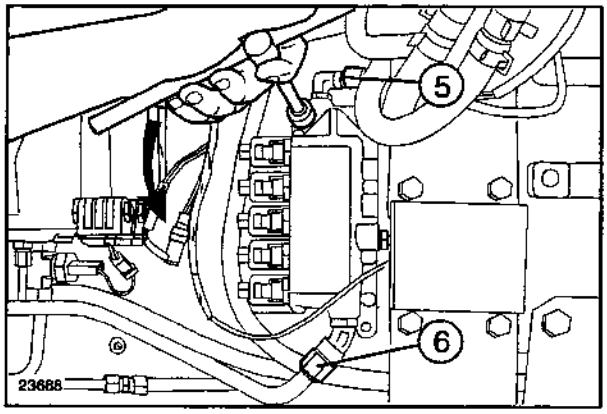


Figure 4-1-170

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SEMI–POWERSHIFT TRANSMISSION SOLENOID VALVE

Replacement

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Replace one of the solenoid valves from the SEMI–POWERSHIFT transmission control valve assembly as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

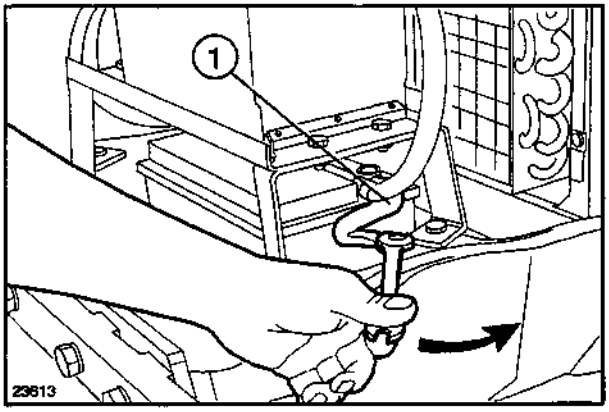


Figure 4-1-171

3. Loosen the screw attaching the steps (6) to the bracket.

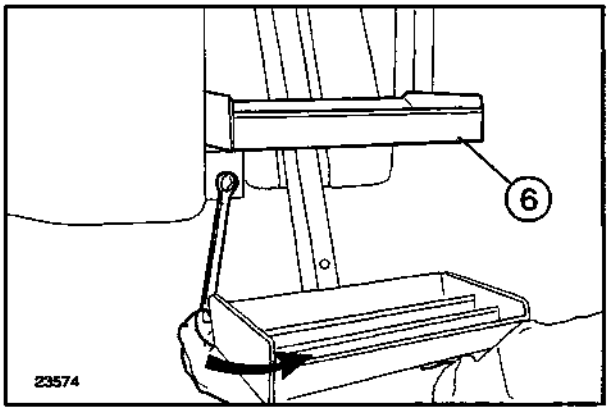


Figure 4-1-172

4. Loosen the screw attaching the steps (1) to the cab platform.

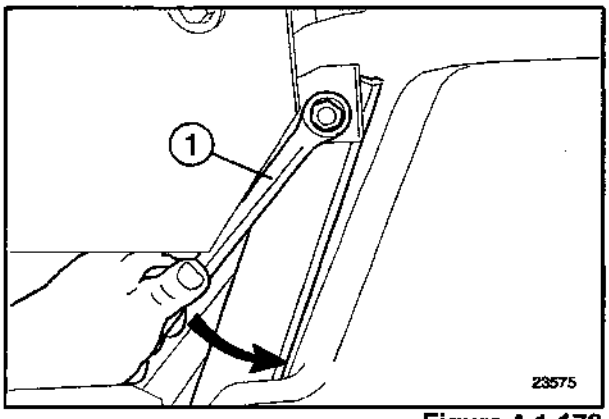


Figure 4-1-173

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5. Drain fuel tanks, then loosen the clamp (1) retaining the fuel line between the main and auxiliary tanks.

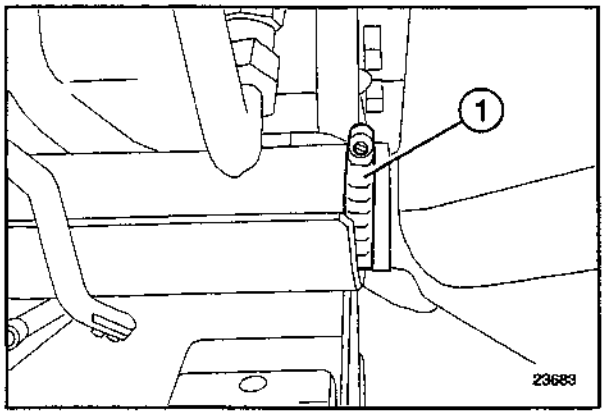


Figure 4-1-174

6. Loosen the clamp and detach the bleeding line (3) between the main and auxiliary tanks.
7. Detach the fuel return line (2) from the pump to the auxiliary tank. Remove the auxiliary tank.

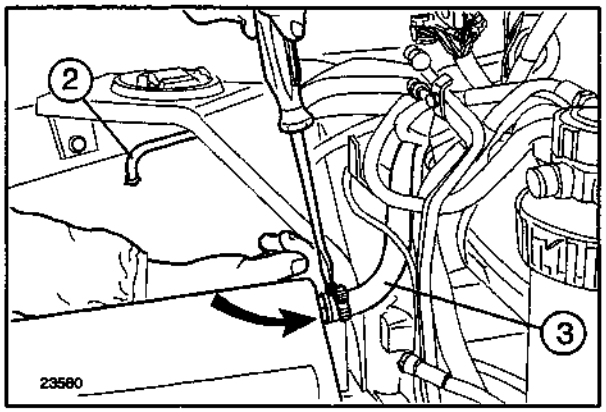


Figure 4-1-175

8. Detach connector (4) from the solenoid valve to be replaced.

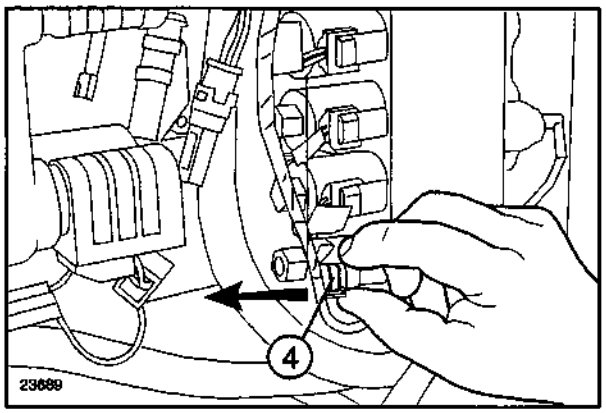


Figure 4-1-176

9. Unscrew the locknut (6) and remove solenoid (5).

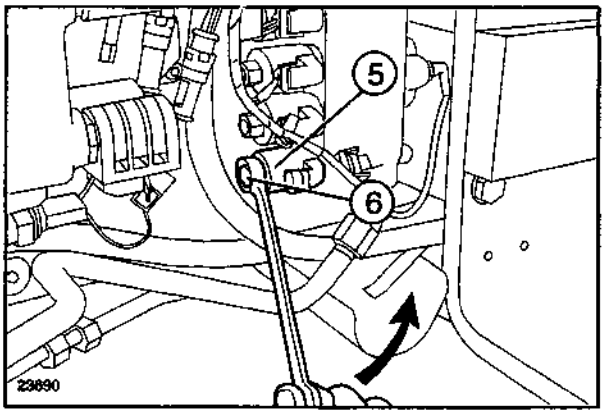


Figure 4-1-177

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10. Unscrew the pin (1) and slide it out.

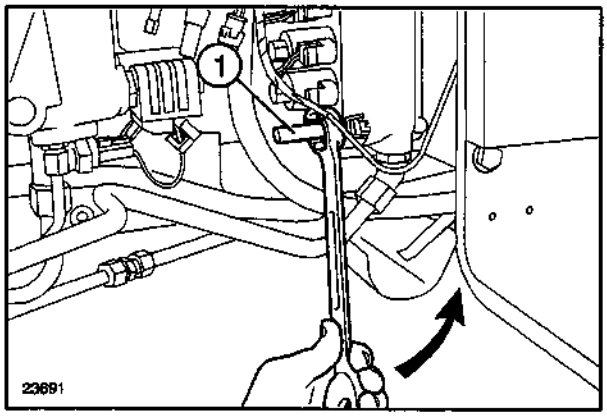


Figure 4-1-178

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

11. Reinstall the solenoid valve into the SEMI–POWERSHIFT transmission control valve assembly observing the following:

- Reinstallation follows the removal procedure in reverse, from step 10 back to step 1.
- Check seals and replace if damaged.
- Tighten to correct torque as detailed on page 4-1-12.

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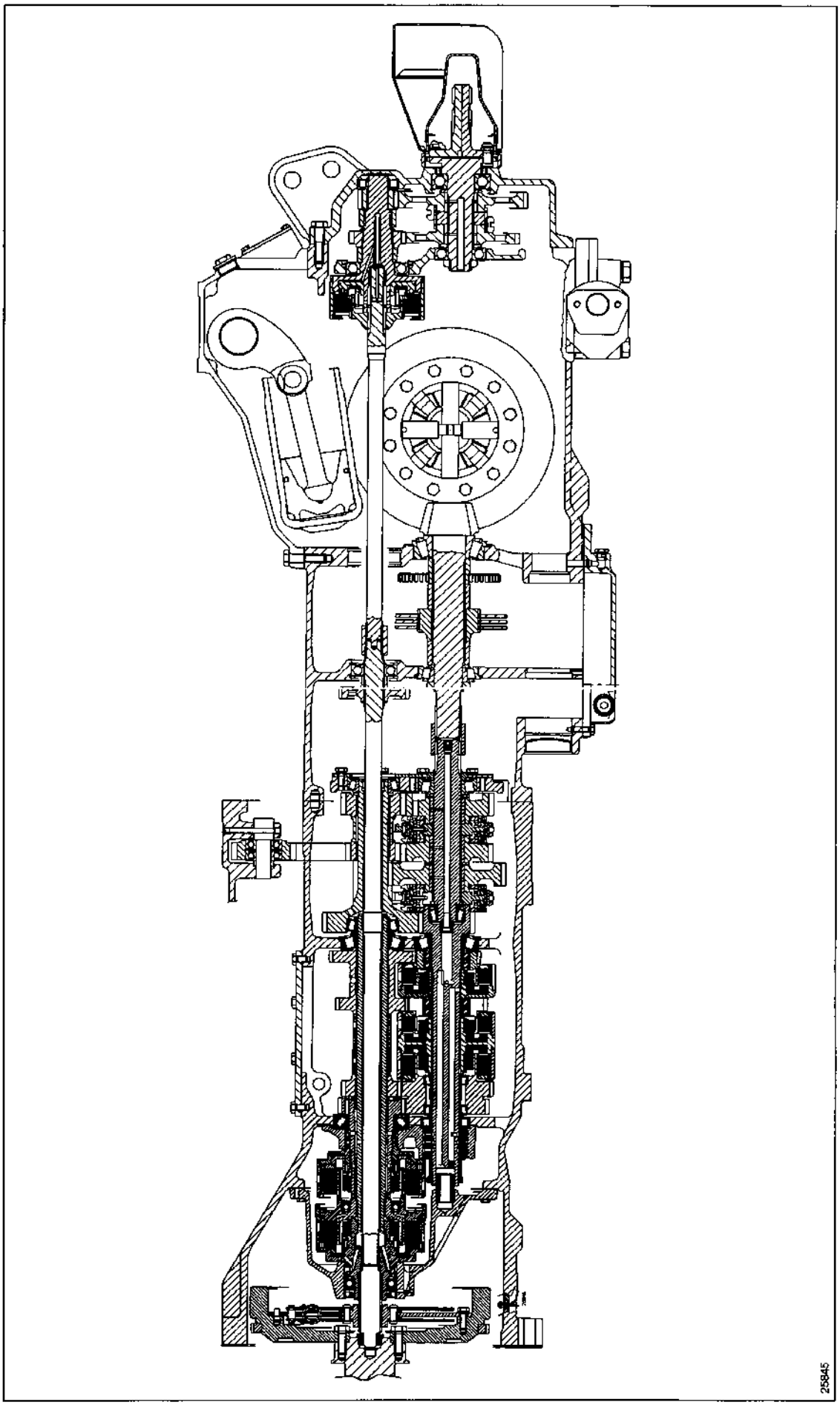


Figure 4-1-179
Drive Line Longitudinal View

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SECTION 4

TRANSMISSIONS

CHAPTER 2

RANGE COMMAND TRANSMISSION

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INTRODUCTION 4-2-2
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Introduction

The transmission electronic management system has an inbuilt self diagnostic facility. This facility utilizes the digital display of the gear shift handle assembly to indicate, in coded format, any malfunction in the electrical and electronic circuitry and in the micro–processor. It should be noted that the self diagnostic capability is generally limited to diagnosis of the electrical and electronic circuitry and related components, however, there are some codes, which can be generated if pressure switch circuits are not closed because of an actual lack of hydraulic pressure. Any malfunction of the mechanical and hydraulic components must be diagnosed using conventional techniques, performance characteristics and tooling, such as pressure testing equipment. Full guidance for both electrical self diagnosis and conventional diagnosis is contained within this section.

Trouble–shooting and fault finding should always be carried out in a logical and planned sequence, many apparent faults associated with electronic components are often hastily diagnosed and result in the replacement of expensive components. An extra few minutes confirming the apparent fault will result in a more positive and cost effective repair.

With the use of micro–processors it is often that this item is blamed for any malfunction but the real truth is that this item is usually sound and that the fault is due to poor contacts in the associated connectors.

Each connector illustrated and identified in the wiring diagrams in Section 2 Chapter 9 and referred to in the following fault finding procedure, has the same identification reference. For example, the main transmission processor connectors are referred to as Connectors C100 and C101 in the illustration and also referred to as C100 and C101 in the fault finding procedure. Often in the fault finding flow chart the connector and pin are abbreviated and will read, for example, C100–21. The C100 refers to the connector and the 21 to the pin number. Alternatively, for connectors with fewer pins, the identification will read, C014–FM3100–B/G/S. This is broken down as follows:

C014	Connector number
FM3100	Front Main harness, circuit number 3100
B/G/S	Wire color

Refer to Section 2 Chapter 9 for complete wiring diagrams.

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Where the fault finding procedure requires checks for continuity a visual inspection of the wiring should be made prior to conducting tests to ensure that obvious 'mechanical' damage has not occurred to the harness or the connectors.

A good quality multimeter is an essential item to perform fault finding. It should be capable of measuring resistance of at least 20,000 ohms and measuring voltage and current. When using the multimeter it is good practice to select a high range and work downwards to avoid damaging the instrument.

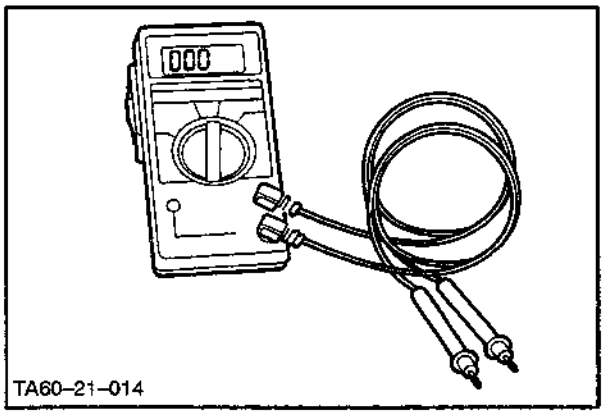


Figure 4-2-1

IMPORTANT: *Care should be used when using the multimeter, only use the instrument as instructed to avoid damage to the internal elements of the micro–processor. When checking the continuity of wiring, sensors or switches it is necessary to isolate the electronic micro–processor and ensure the keystart is turned off to prevent possible further damage. The keystart should only be switched on and the processor connected where specifically instructed in the fault finding procedure.*

If it is found necessary to clean the connectors a contact spray should be used. DO NOT USE ANY OTHER METHOD FOR CLEANING TERMINALS. Do not use a cleaner that contains Trichloro–ethylene, this solvent will damage the plastic body of the connector. It is preferable to use a cleaner with a Freon T.F. base.

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LIMP HOME

⚠ WARNING ⚠

Care should be taken when operating the tractor with the limp home harness connected. Clutch engagement will be harsher than normal. Do not leave the limp home harness connected when the operation has been completed.

In the unlikely event of an electrical fault developing within the transmission that renders the tractor immobile, for example, failure of the supply voltage to the PWM valves, the emergency 'Limp Home Harness', Special Tool No. NH.21–100 for Semi–Powershift and Hi–Lo transmissions, is available to enable the tractor to be driven onto a transporter or hard standing, in order that the repair can be carried out in a suitable location. The Limp Home device **is not and must not** be used as a means to continue operating the tractor in its work environment.

To engage and operate the 'Limp Home Harness' proceed as follows:–

1. Apply the parking brake.

2. Stop the engine and turn keystart off.

3. Remove the electronic draft control panel.

4. Locate and disconnect the cab main harness access connector, Figure 4-2-3, enabling the connection of the limp home harness connector, Figure 4-2-2, marked with 'HARNESS', into the cab main harness of the tractor, Figure 4-2-5.

5. Connect the other connector of the Limp Home harness, Figure 4-2-2, marked 'DIAGNOSTIC', to the 'WHITE' diagnostic plug, Figure 4-2-5.

6. Start the vehicle.

7. Select forward or reverse by operating forward/reverse switch, (2) Figure 4-2-2, for 2 seconds on the Limp home harness control box. Return the switch to the center position.

8. Operate the momentary switch, (1) Figure 4-2-2, of the Limp Home Harness to move the vehicle. If necessary, depress the foot throttle to increase engine speed.

9. When the tractor has been delivered to the repair area, disconnect the Limp Home Harness and reconnect the limp home access connector of the cab main harness and proceed with diagnosing and repairing the fault.

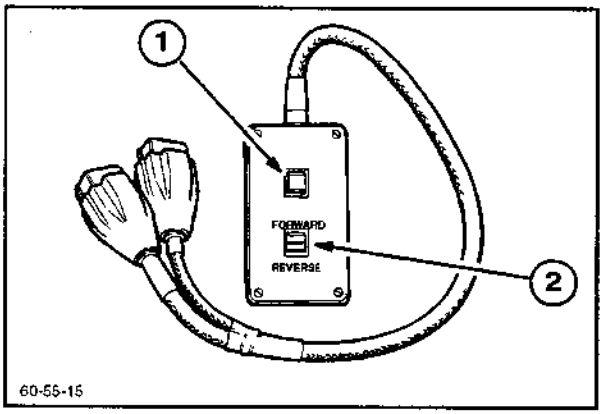


Figure 4-2-2

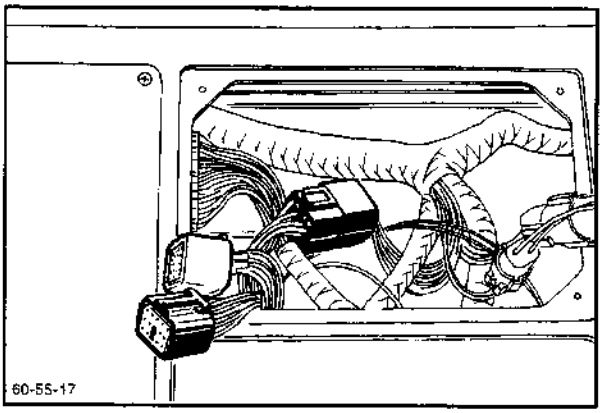


Figure 4-2-3

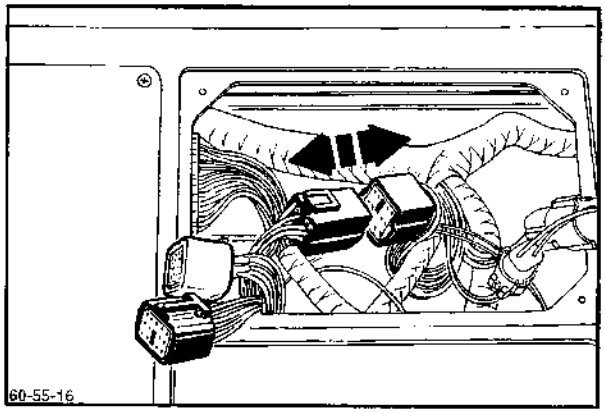


Figure 4-2-4

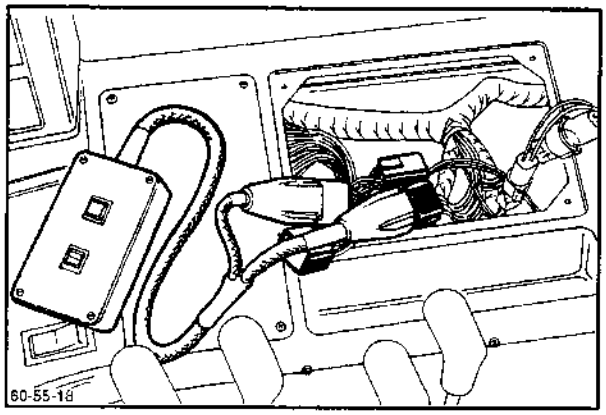


Figure 4-2-5

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PRESSURE TESTING

Transmission Clutches, A,B,C,D and E

1. Prepare the tractor for pressure testing:

(i) Ensure the handbrake is fully applied and wheels chocked.

(ii) Install diagnostic switch, Tool No. FNH00874 into the white diagnostic plug of the tractor harness.

(iii) Start and run the tractor to warm the transmission oil to a minimum operating temperature of 122°F (50°C).

2. Install suitable pressure gauges (0–600 lbf/in^2, 0–40 bar), five if available, into each of the clutch pressure test points, located in the raised horizontal manifold, under the right hand foot step. Figure 4-2-7. Reference Figure 4-2-6 for gauge, hose and adaptor details:
   1. Pressure gauge, FT8503A, with adaptor FT8503–8
   2. Adaptor, FNH00877-8 (10–1.00 mm x 7/16 JIC)
   3. Hose, (Finis Code 3936707)

3. Start the engine and enter HJ mode. Depress the clutch pedal and move the shuttle lever into forward. Release the clutch. The upper character on the display will show 'A', indicating that clutch 'A' solenoid will be energized. To energize the solenoid press and hold the downshift button and observe the pressure reading on the gauge which should be 246±14.5 lbf/in^2 (17±1 bar).

4. To select other clutches, B, C ,D or E, repeatedly press the upshift button and then depress the downshift button to energize the solenoid.

5. The pressure can be controlled with the clutch pedal. When the pedal is depressed the lower two digits will change to a number 0–16 indicating the approximate pressure in bars, as long as the clutch pedal is correctly calibrated. With the pedal fully released 'FP' will be displayed indicating Full Pressure.

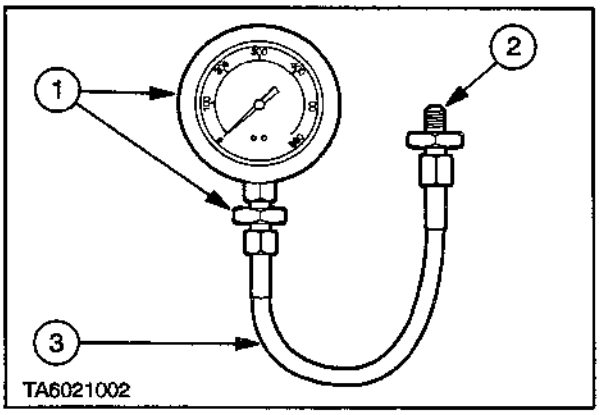


Figure 4-2-6

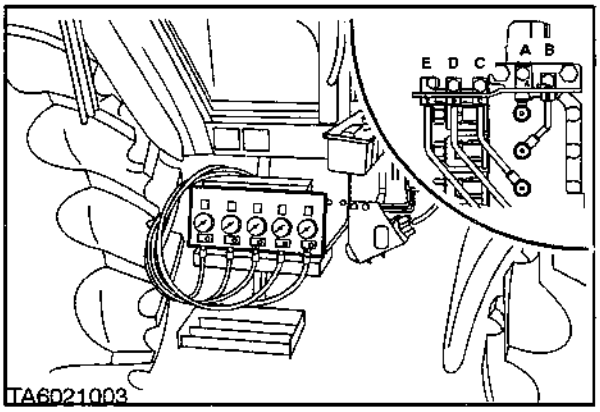


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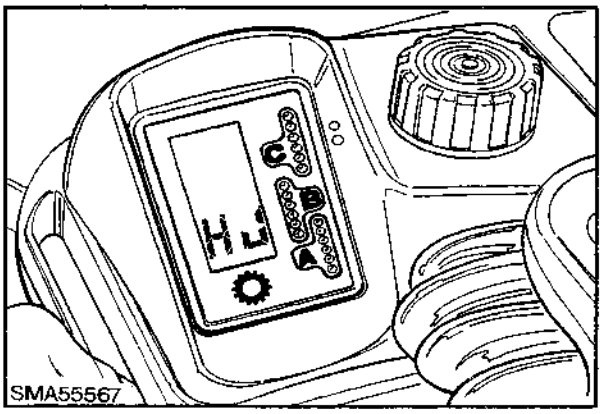


Figure 4-2-8

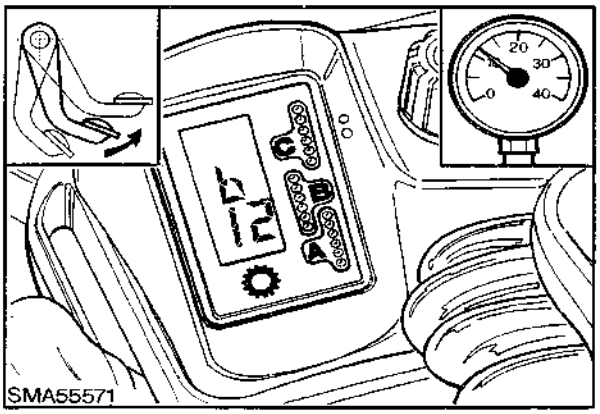


Figure 4-2-9

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Low, Medium, High and Reverse Synchronizer Pressure testing

Figure 4-2-10 – 1. Reverse synchronizer test point (R)
2. High synchronizer test point (F)

Figure 4-2-11 – 1. Low synchronizer test point (S)
2. Medium synchronizer test point (M)

Due to the operating characteristics of the transmisson it is not possible to pressure test the synchronizer circuits during normal tractor operation.

To check the pressure within the synchronizer circuits it is recommended that the clutch calibration procedure using, H1, mode 'N' is used.

1. Prepare the tractor for pressure testing:

(i) Ensure the handbrake is fully applied and wheels chocked.

(ii) Install diagnostic switch, Tool No. FNH00874 into the white diagnostic plug of the tractor harness.

(iii) Start and run the tractor to warm the transmission oil to a minimum temperature of 122°F (50°C).

2. Install suitable pressure gauges, Figure 4-2-12,
   1. Pressure gauge, FT8503A, with adaptor FT8503–8
   2. Adaptor, NH.35–102 (10–1.25 mm x 7/16 JIC)
   3. Hose, (Finis Code 3936707), (0–600 lbf/in^2, 0–40 bar), four if available, into each of the synchronizer pressure test points, located in the transmission side cover, Figure 4-2-13.

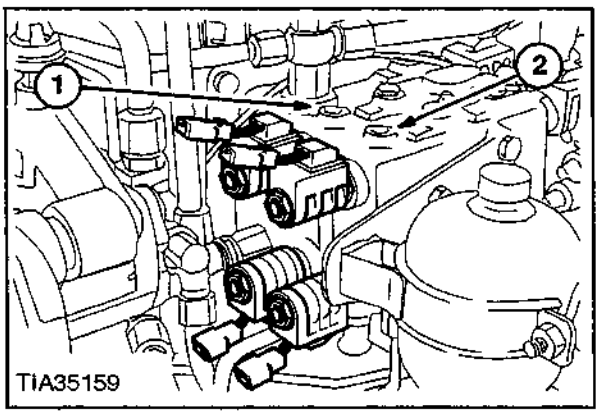


Figure 4-2-10

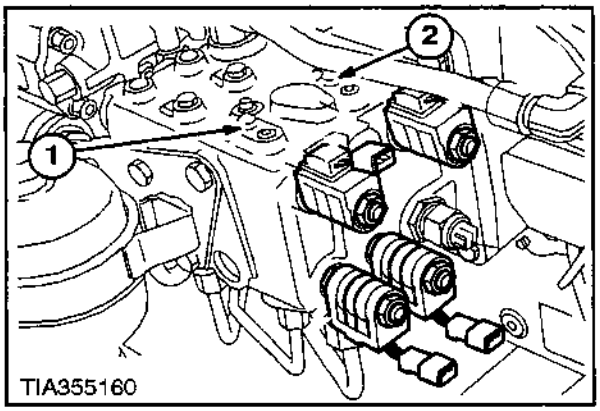


Figure 4-2-11

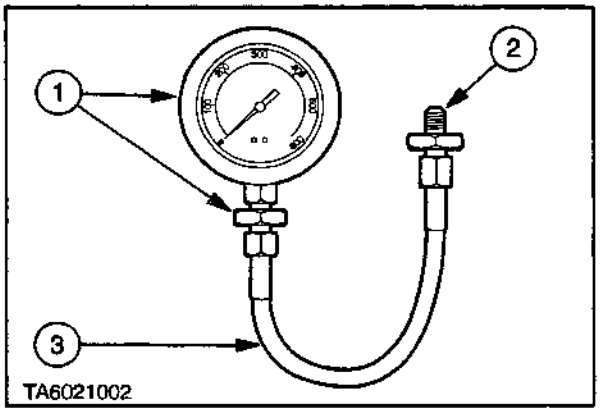


Figure 4-2-12

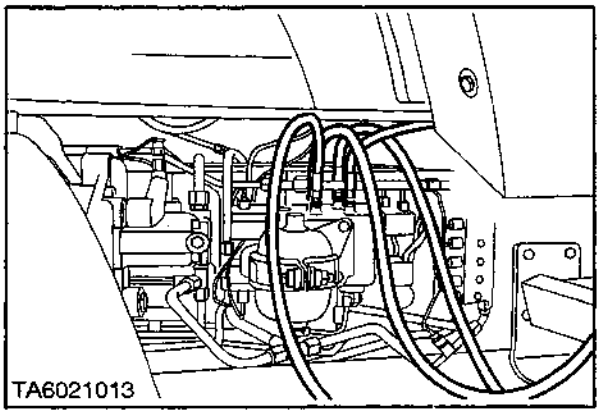


Figure 4-2-13

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3. Srart the engine and enter mode H1.

4. Depress the clutch pedal and position the shuttle lever in forward.

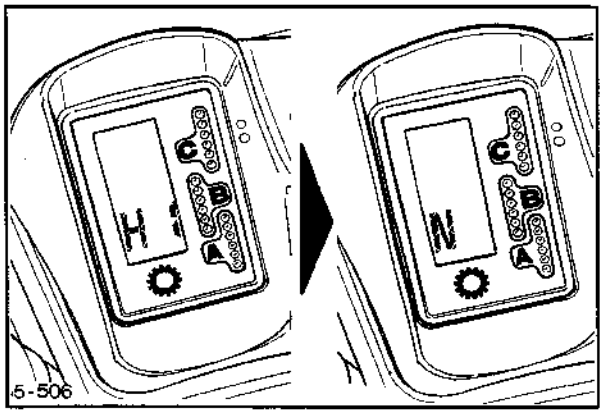


Figure 4-2-14

5. Set engine speed to 1100 rev/min.

6. Cycle through H1 to 'N', using the upshift button.

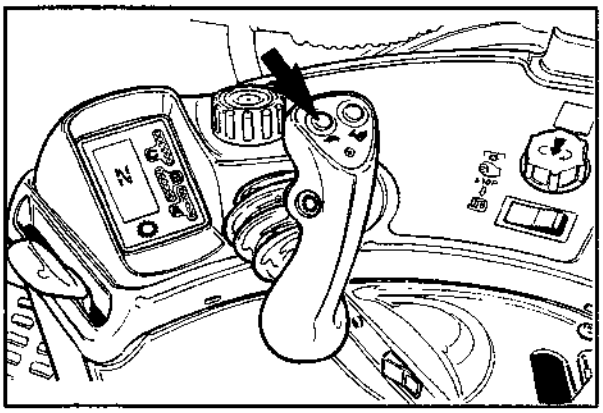


Figure 4-2-15

7. Depress the downshift button to activate all of the synchronizer solenoids.

8. Each gauge should indicate 246±14.5 lbf/in^2 (17±1 bar) when the solenoids are activated and zero when deactivated, Figure 4-2-16.

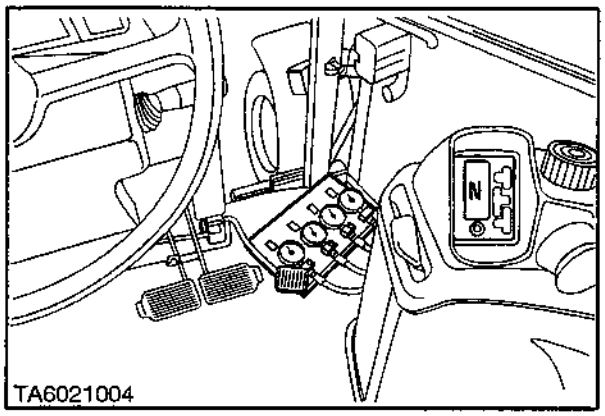


Figure 4-2-16

9. If all gauges read low, suspect a fault in the low pressure hydraulic system, refer to section 8.

10. If one or more gauges read correct and the other gauges are low this indicates that the hydraulic system is okay and that the fault lies within the transmission assembly. Remove and inspect the solenoid valve assembly, if no fault is found remove the transmission side cover and inspect the operating piston and seals.

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CLUTCH AND SYNCHRONIZER CALIBRATION

The Semi–powershift transmission has 5 clutch packs and 2 synchronizers that require periodic calibration to compensate for wear. Calibration should be necessary only if a deterioration in gear shift quality is noted.

NOTE: *During the calibration procedure the electronic management system detects precisely the point at which the clutches start to engage . The engagement is detected by a reduction in engine speed. During calibration it is essential that no action is taken to cause the engine speed to vary. Be sure that the air conditioner and all electrical equipment is switched off. Do not operate the PTO or any hydraulic lever or move the hand or foot throttle.*

There are two methods to enter the calibration mode:
(i) Through the white diagnostic connector, using special tool No. FNH00874 and menu mode H1, or,
(ii) By depressing both up/down shift buttons together during start up.

Tractor Preparation

NOTE: *The clutches can be adjusted when the transmission oil temperature is at 68°F (20°C) and 122°F (50°C) or over. The clutches should be adjusted when the transmission oil temperature is at 140°F (60°C) or over.*

Park the tractor on level ground, away from obstacles (in case of unexpected tractor movement).

Apply handbrake, switch off all electrical equipment and air conditioning if fitted. Stop the engine and place remote levers in neutral and lower hydraulic equipment to the ground.

Place the shuttle in neutral. Block the wheels, front and rear.

Either, (i) Install tool FNH00874 into the diagnostic plug or (ii) press and hold both Up/down shift buttons and start the engine. Select H1 by depressing the diagnostic switch once.

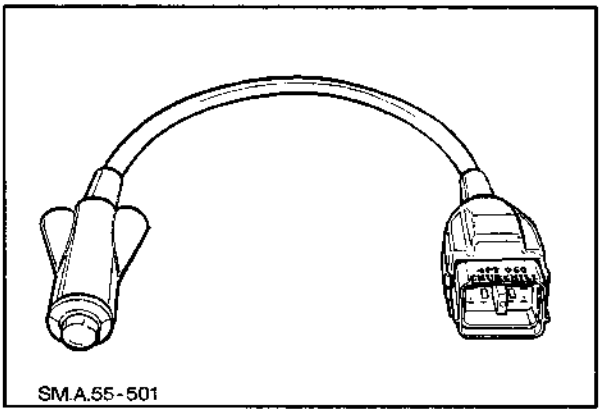


Figure 4-2-17

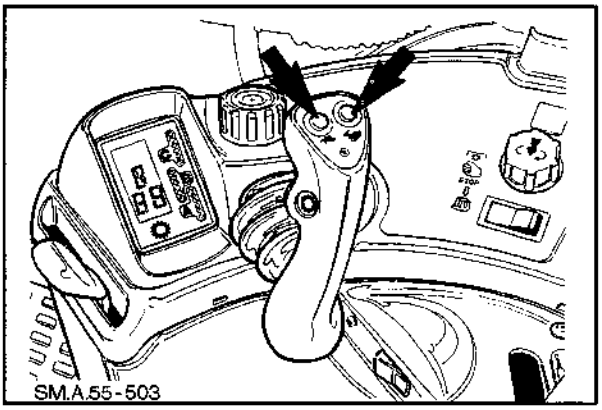


Figure 4-2-18

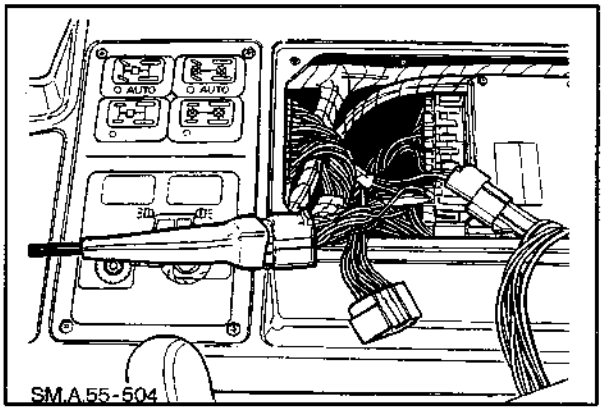


Figure 4-2-19

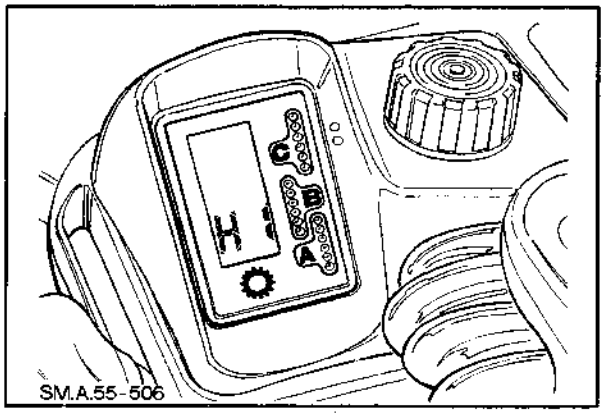


Figure 4-2-20

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Release the buttons. The display will change to show transmission temperature. Press the up or downshift button to proceed.

If the temperature is less than 50°F (10°C) Error Code 'U19' will be displayed. If the temperature is between 50°F (10°C) and 68°F (20°C) "CL" will be displayed. If the temperature is above 122°F (50°C), "CH" will be displayed.

If 'U19' is displayed calibration will not be possible and the oil will have to be warmed before proceeding.

If 'CL' is displayed after 4 seconds the display will return to oil temperature and the tractor may be operated to obtain the correct transmission oil temperature. If it is not practical to wait for the oil temperature to change press either of the up or down shift buttons while 'CL' is being displayed. The display will then show an 'A' and calibration can proceed.

If 'CH' is displayed, press either the up or down shift buttons to display 'A' and proceed with the calibration.

Move the shuttle lever to forward and release the clutch pedal.

Set engine speed to 1200 ERPM ±100.

The transmission is now ready for calibration.

Press and hold the downshift button to calibrate clutch A.

If the start up procedure was incorrect a "U" error code will appear. See page 4-2-30 for a listing of error codes.

Hold the downshift button until the engine speed decreases by 50 RPM and the calibration number stops increasing.

Release the downshift button, the display will change to 'b', indicating that clutch B is ready for calibration. Hold the downshift button until the engine speed decreases by 50 RPM and the calibration number stops increasing.

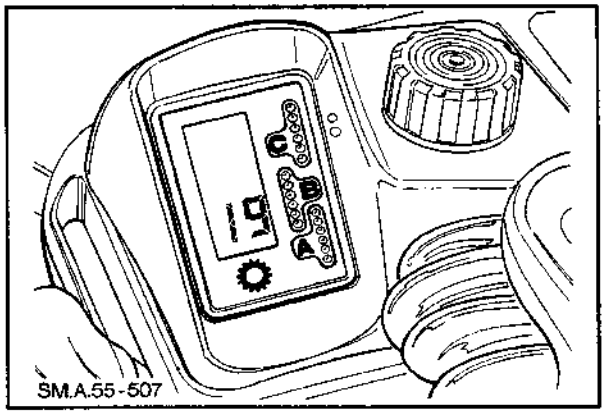


Figure 4-2-21

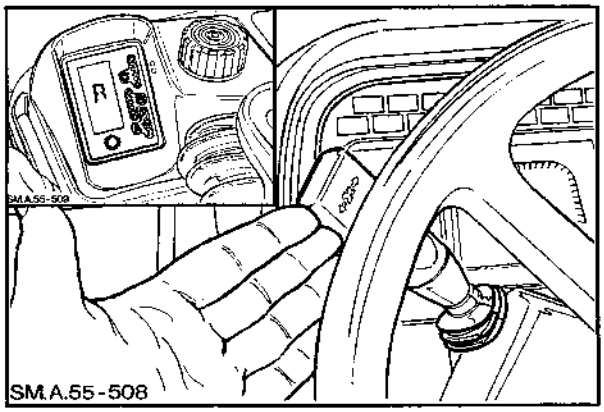


Figure 4-2-22

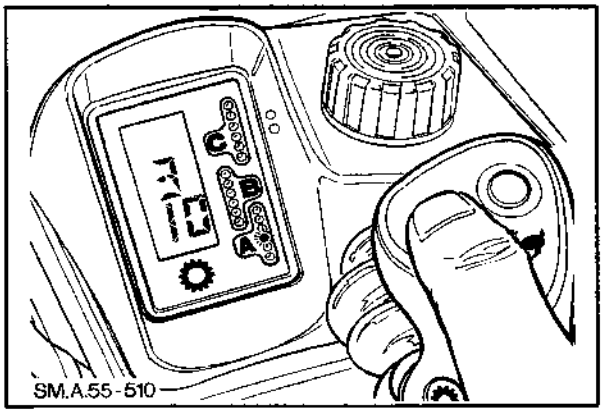


Figure 4-2-23

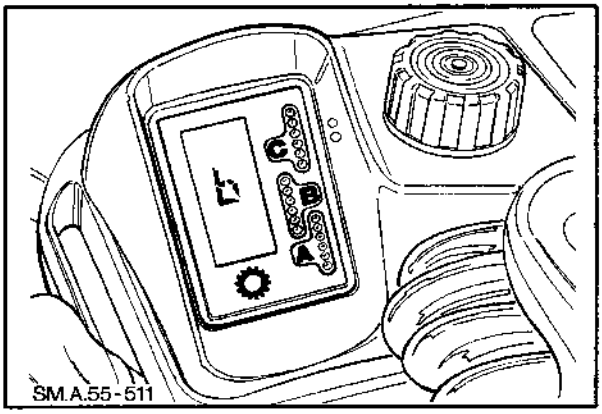


Figure 4-2-24

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Repeat the above steps for clutches C, D and E. After clutch E has been calibrated, release the downshift button and the display will change to F.

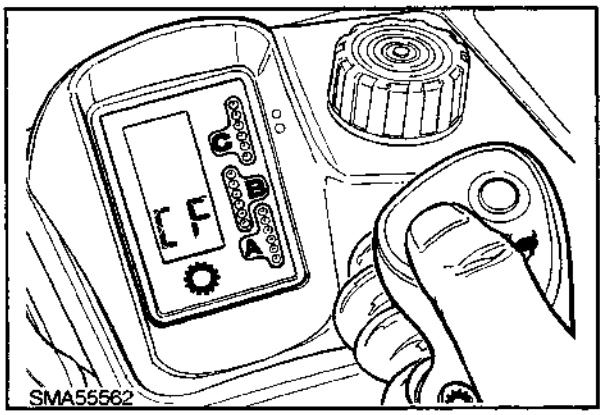


Figure 4-2-25

Press the downshift button again. The synchronizers will be shifted to neutral and synchronizer stroke relationship will be checked. If satisfactory the display will show 'CF'.

Pressing the downshift button again will select mode 'N'. This mode engages clutches A and C with the synchronizers in neutral. This can be used to 'free' transmission components that may be suspected of sticking , i.e,synchronizers. It should be noted that if a synchronizer is not actually in neutral, this mode can cause the tractor to move.

When the display alternates between 'N' and '750' this indicates that the mode has completed.

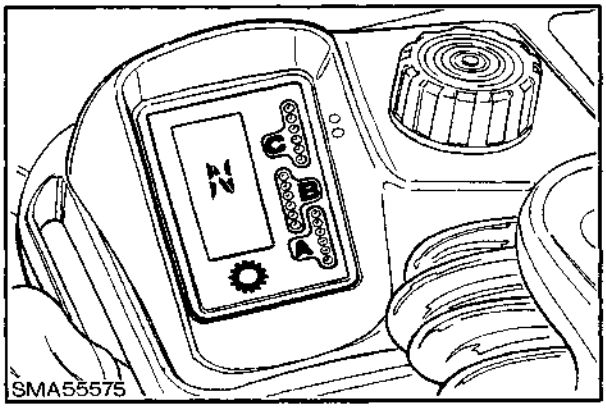


Figure 4-2-26

Turn the key start switch off for at least 2 seconds to store the calibration values.

NOTES: *Transmission output speed and clutch pedal position are constantly monitored. Calibration cannot proceed unless the tractor is stationary and the clutch pedal released.*

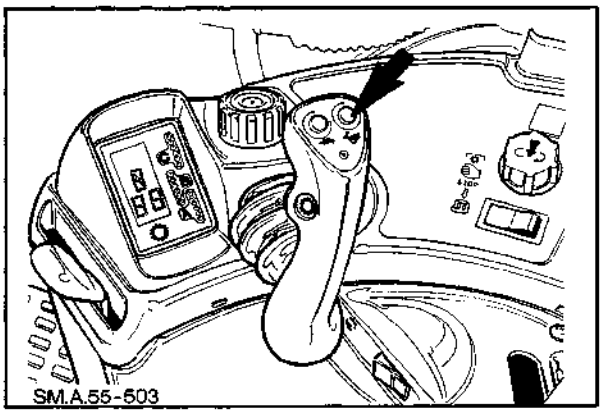


Figure 4-2-27

Repeatedly depressing the upshift button will cycle through each clutch mode, enabling a particular clutch to be calibrated several times if required.

During each clutch calibration the synchronizer positions are also calibrated:–

- During Clutch A – Mid range synchronizer calibrated
- During Clutch B – Reverse range synchronizer calibrated
- During Clutch C and D – High range synchronizer calibrated
- During Clutch E – Low range synchronizer calibrated

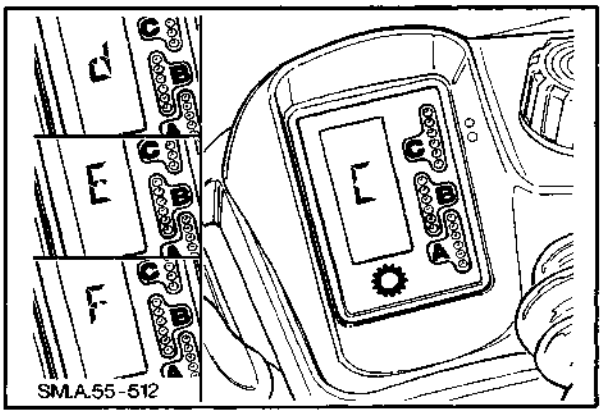


Figure 4-2-28

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TRANSMISSION DIAGNOSTIC ROUTINE

The Semi Powershift Tractors have a built in electronic diagnostic system.

To gain access to the diagnostic "H" routine it is necessary to use tool No. FNH00874.

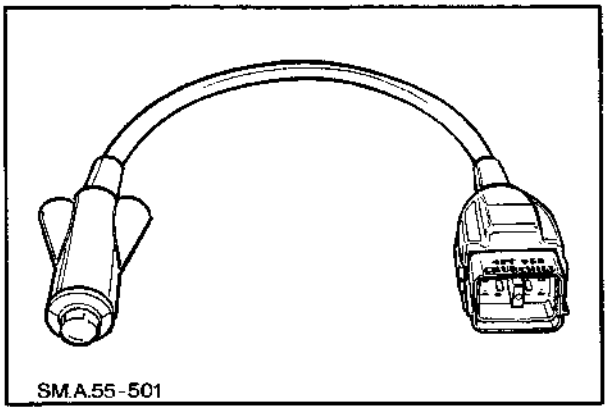


Figure 4-2-29

The tractor's diagnostic connectors are located under the right hand electronic draft control (EDC) panel.

White - Transmission
Black - Electronic Draft Control (EDC)

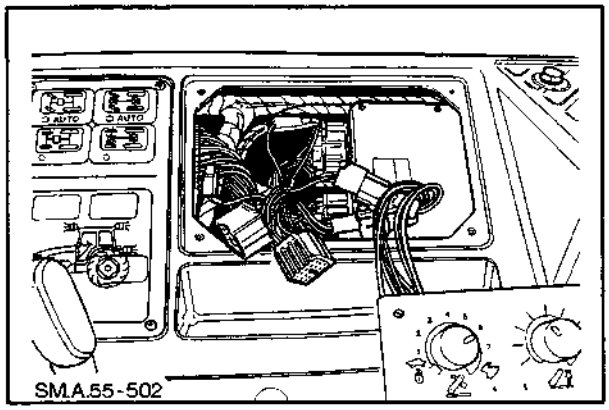


Figure 4-2-30

The transmission display unit is used to show transmission information and the instrument cluster for EDC information.

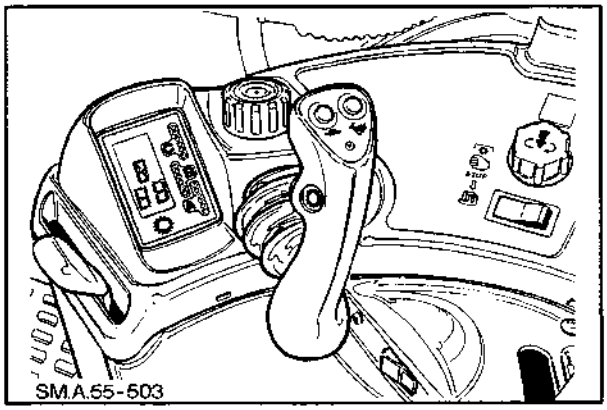


Figure 4-2-31

Connect Tool FNH00874 to the white connector and turn key on.

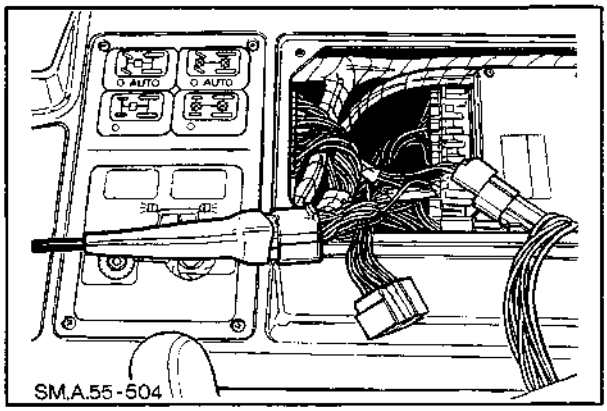


Figure 4-2-32

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The Transmission Display Unit (TDU) will display "HH" to indicate that the "H" menu has been activated.

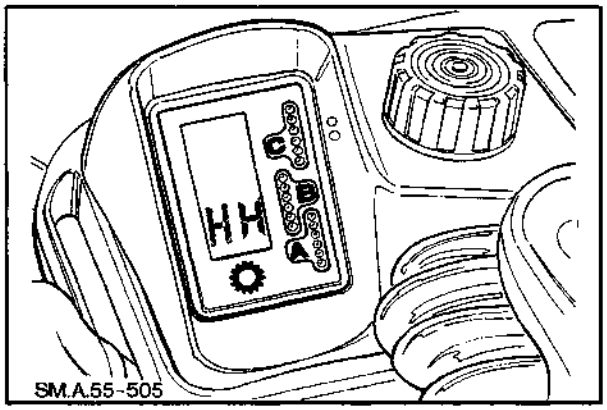


Figure 4-2-33

HH	Transmission Service Menu
H1	Clutch and synchronizer calibration
H2	View clutch calibration
H3	Clutch calibration temperature review
H4	Software revision level
H5	Switch test
H6	Synchronizer calibration view
H7	Not used
H8	Non volatile memory reset
H9	Voltmeter
HA	Clutch pedal position view (%)
HB	Transmission oil temperature compensation factor adjustment
HC	Transmission oil temperature display
HD	Synchronizer shift/view position mode
HE	Quickfill duration adjustment
HF	Manual clutch calibration adjustment
HJ	Clutch pressure test mode

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H1 CLUTCH AND SYNCHRONIZER CALIBRATION

Used to calibrate the 5 clutch packs and the position of 2 synchronizers.
See CALIBRATION section of this chapter for full details.

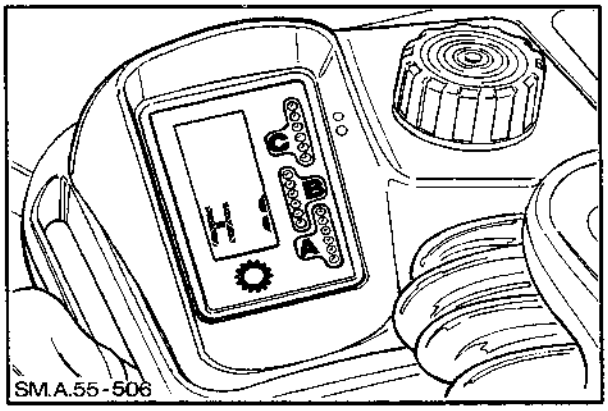


Figure 4-2-34

H2 VIEW CLUTCH CALIBRATIONS

Here each clutch calibration is displayed.

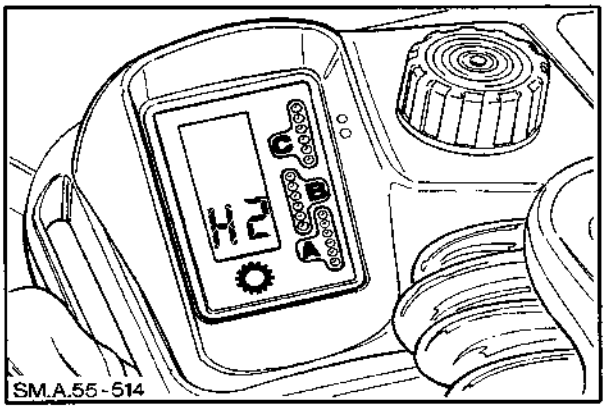


Figure 4-2-35

Clutch "A" and then its calibration number is displayed.

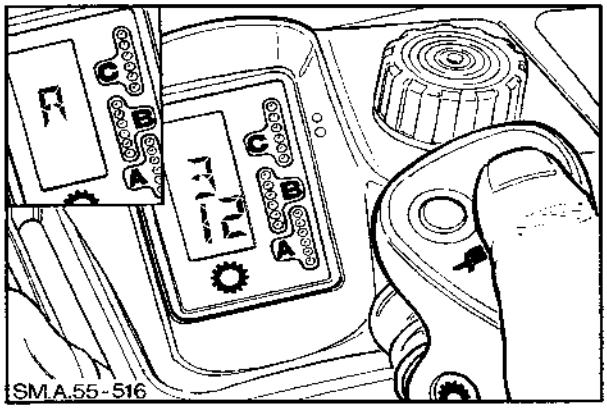


Figure 4-2-36

Progress through by pressing the upshift button.

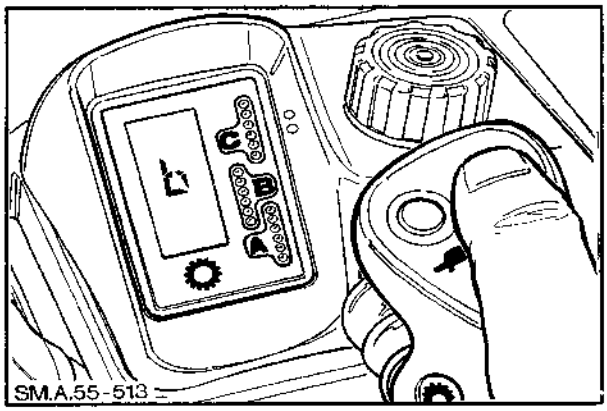


Figure 4-2-37

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H3 CLUTCH CALIBRATION TEMPERATURE VIEW

Shows the transmission temperature when each clutch was last calibrated.

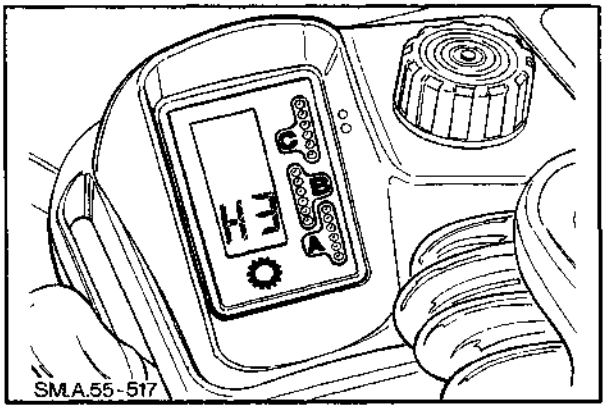


Figure 4-2-38

Displays "A" first with temperature.

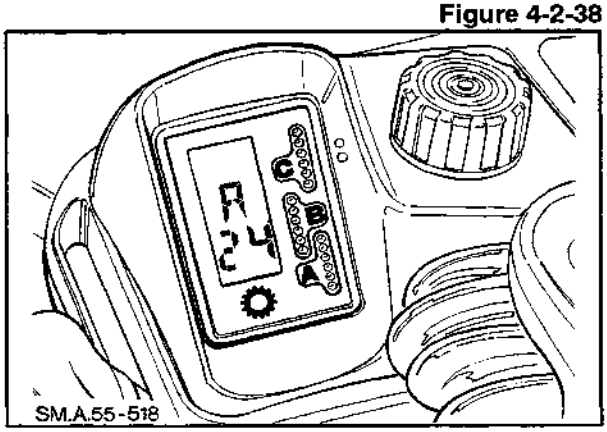


Figure 4-2-39

To progress through press the upshift button.

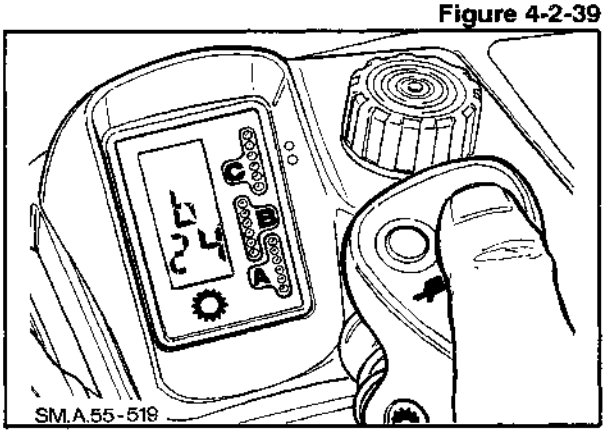


Figure 4-2-40

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H4 SOFTWARE REVISION LEVEL

Display the software installed into the processor.

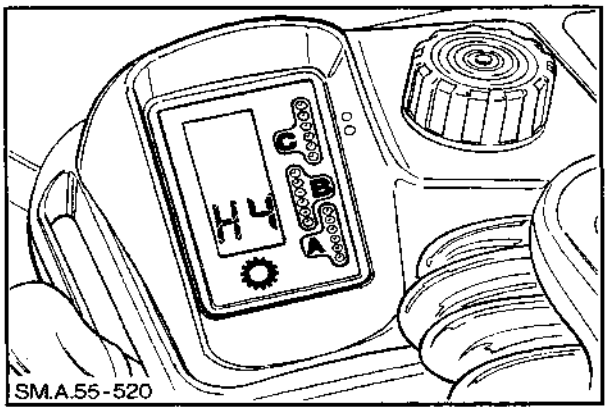


Figure 4-2-41

The display shows 4 figures consecutively.

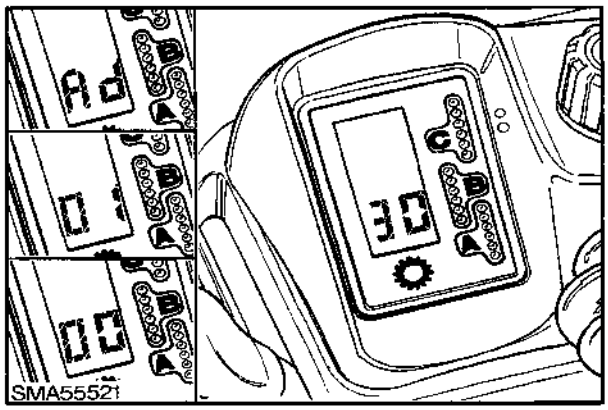


Figure 4-2-42

AD - Semi Powershift
01 - Production software level
00 -Prototype software level
30/40 -Transmission type, 19 or 25 mph (30 or 40 kph)

H5 SWITCH TEST

It is possible in "H5" to test the function of all switches used in the transmission electrical system.

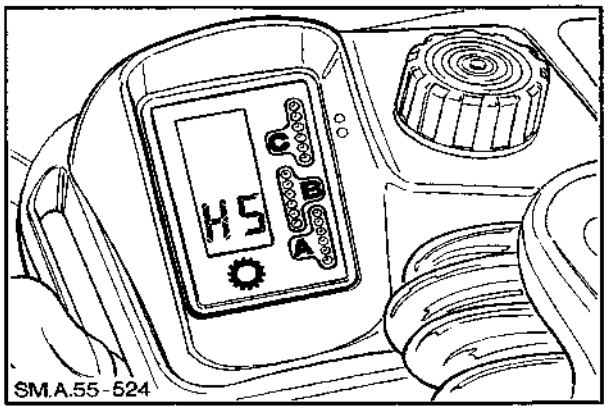


Figure 4-2-43

The display will show a code number.

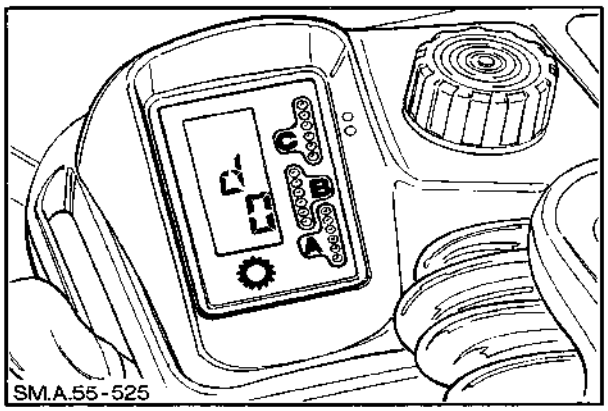


Figure 4-2-44

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When a switch is operated, its code will be displayed and an audible tone heard to indicate correct function.

If a switch's code is not displayed and the tone not heard, then the switch is not functioning correctly or the wiring to it is at fault.

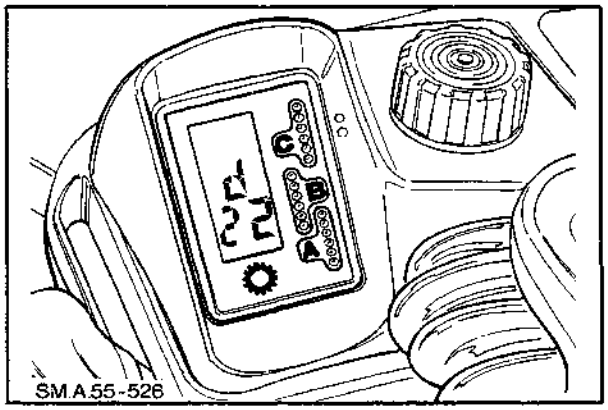


Figure 4-2-45

Identifier	Switch/Input	Special Requirements
d20	Clutch pedal potentiometer	
d21	Clutch pedal switch	Shuttle lever in forward
d22	Forward switch	Clutch pedal down
d23	Reverse switch	Clutch pedal down
d24	Downshift switch	
d25	Upshift switch	
d26	Range change button	
d27	Mid/Reverse synchro pot	
d28	Low/High synchro pot	
d29	Oil Temperature switch	
d30	Oil pressure switch	
d31	Creeper switch	

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H6 SYNCHRONIZER CALIBRATION VIEW

Displays the values stored in the microprocessor

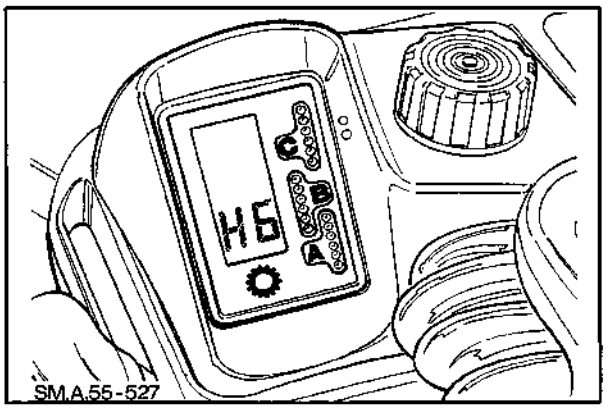


Figure 4-2-46

'1' is displayed first, followed by its calibration number. There are 6 views:

1	Slow (low)	362–912
2	Medium (mid)	50–601
3	Fast (high)	50–601
4	Reverse	362–912
5	Slow/Fast (neutral)	242–722
6	Med/Reverse (neutral)	242–722

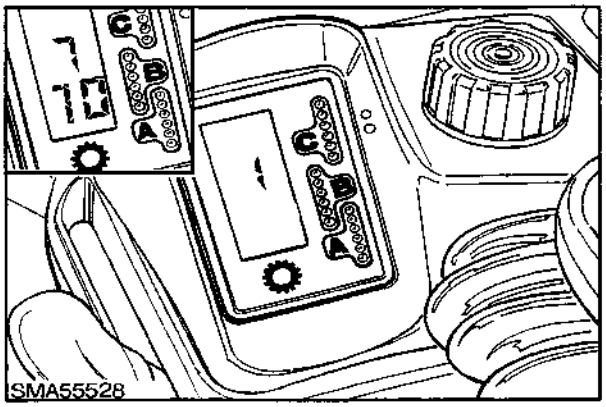


Figure 4-2-47

Progress through by pressing the upshift button.

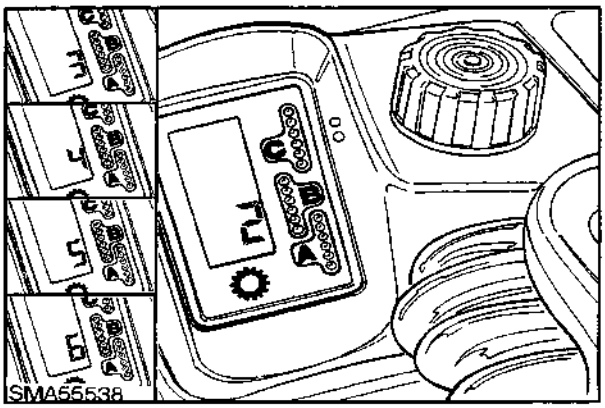


Figure 4-2-48

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H7 NOT USED

H7 will be displayed when cycling through the H menu but does not have a function.

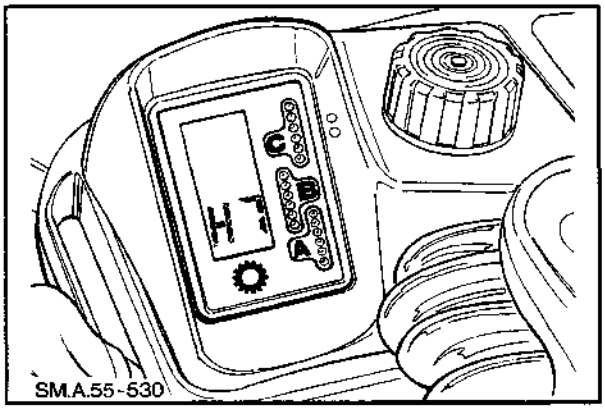


Figure 4-2-49

H8 NON VOLATILE MEMORY RESET

Used to reset (clear) all calibration figures in the processor.

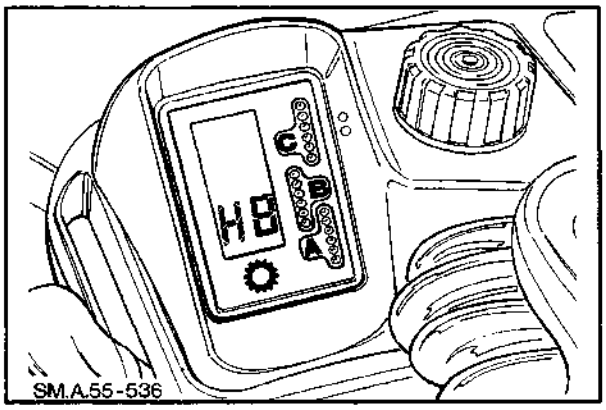


Figure 4-2-50

With H8 selected the procedure is automatic.

The display changes from "H8" to "EE" to "HH", indicating the processor is now reset.

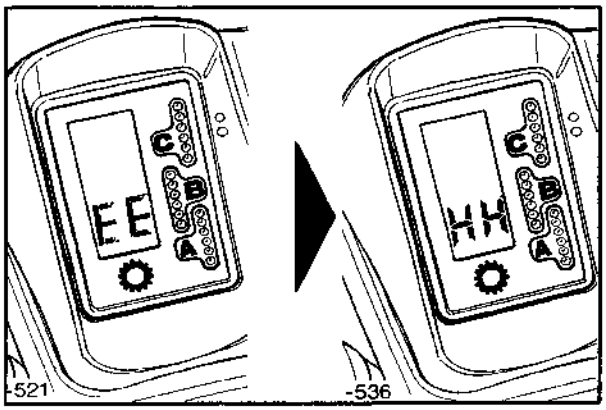


Figure 4-2-51

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H9 VOLT METER

Allows various voltage tests to be carried out on the inputs and outputs of the Transmission Control Module (TCM).

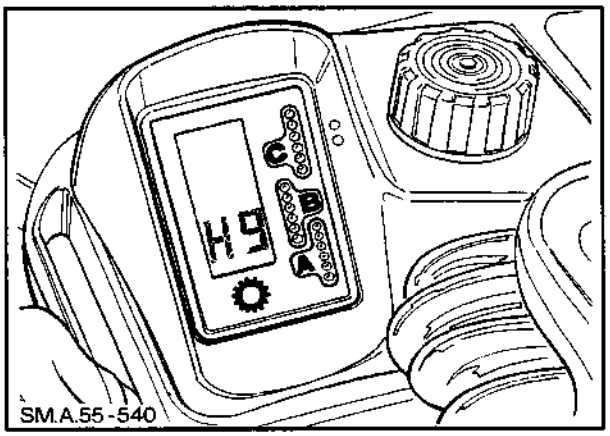


Figure 4-2-52

There are 26 channels which can be accessed.

Use the upshift button to select the required channel.

NOTE: *Channels 21 through to 26, inclusive, are spare channels which have no function.*

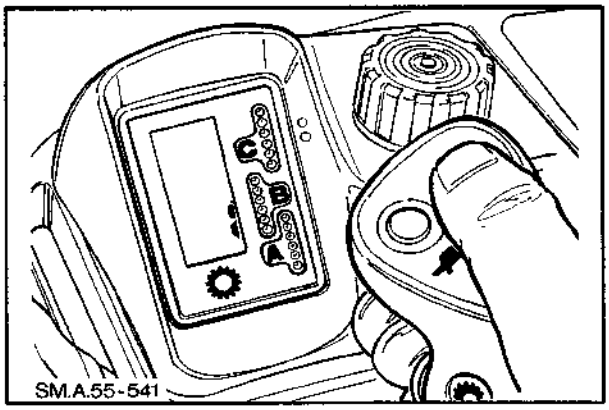


Figure 4-2-53

On entering the desired channel a value will be displayed. Compare the value displayed with the value shown in the table on the following page.

NOTE: *The value is the output voltage from the processor displayed as a percentage. This cannnot be directly translated into a voltage due to the internal processes of the module.*

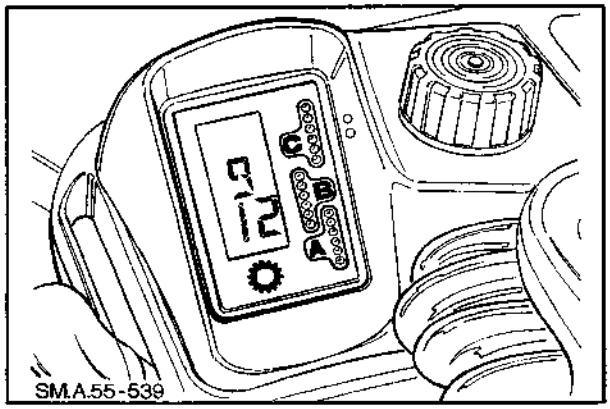


Figure 4-2-54

If the value displayed varies by more than 5% to that in the table a fault is indicated in either the component or the wiring relevant to that channel.

NOTE: *It is worthwhile checking the connectors of the affected circuit, including the processor connectors, prior to replacing any components.*

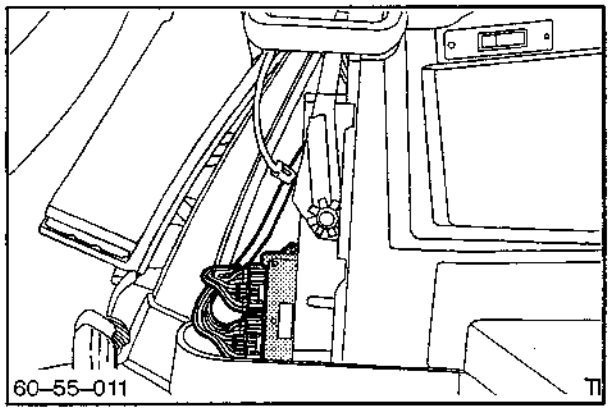


Figure 4-2-55

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Channel	Description	Typical Value
0	Clutch pedal position	91% released 26% depressed
1	Slow/Fast synchro	24% Fast range 45% Neutral 71% Slow range
2	Med/Rev synchro	24% Med range 45% Neutral 71% Slow range
3	Upshift switch	30% Released 67% Depressed
4	Downshift switch	30% Released 67% Depressed
5	Range shift switch	30% Released 67% Depressed
6	Forward switch	30% Released (Neutral) 67% Depressed (Forward)
7	Reverse switch	30% Released (Neutral) 67% Depressed (Reverse)
8	Temperature sender	71% @ 32°F (0°C) 46% @ 86°F (30°C) 26% @ 140°F (60°C) 14% @ 194°F (90°C)
9	+12v supply	43%
10	+12v supply	43%
11	Clutch pedal switch	43% Pedal up, forward 0% pedal down, neutral
12	5 volt sensor supply	50%
13	8 volts sensor supply	80%
14	Clutch A current	0% Clutch off 60% Clutch on
15	Clutch B current	0% Clutch off 60% Clutch on
16	Clutch C current	0% Clutch off 60% Clutch on
17	Clutch D current	0% Clutch off 60% Clutch on
18	Clutch E current	0% Clutch off 60% Clutch on
19	Rear speed diagnostic volts	49%
20	Mid speed diagnostic volts	49%

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HA CLUTCH PEDAL POSITION

Displays clutch pedal position as a percentage.

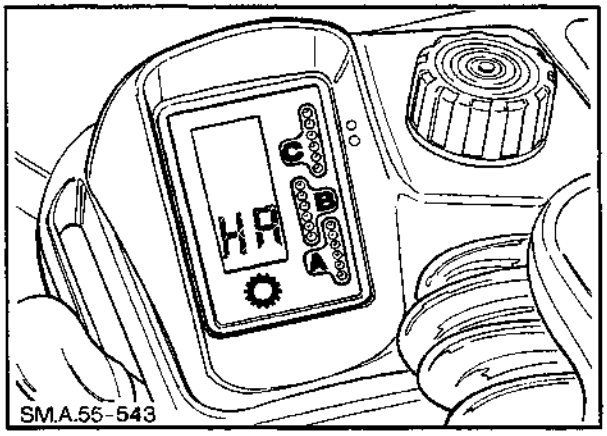


Figure 4-2-56

0 = fully down
99 = fully up

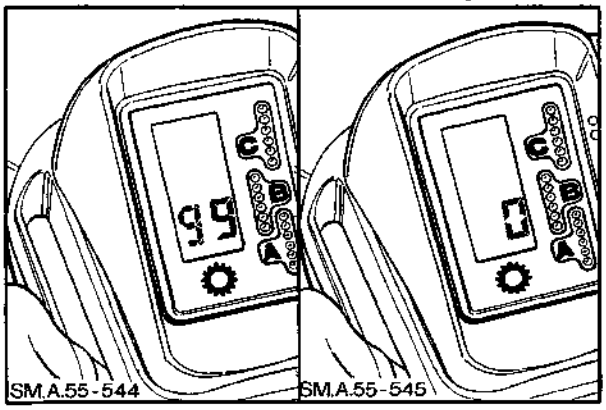


Figure 4-2-57

HB TEMPERATURE COMPENSATION FACTOR

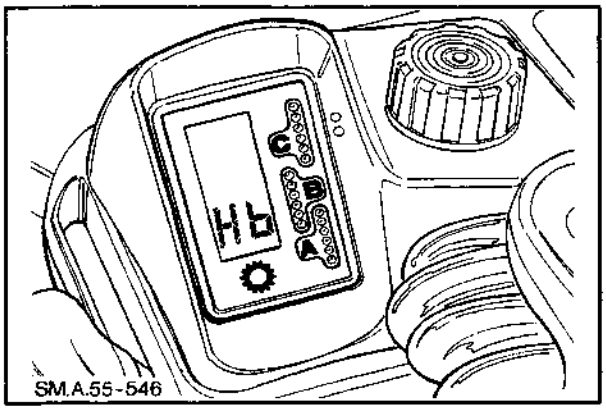


Figure 4-2-58

Factory set at 16.

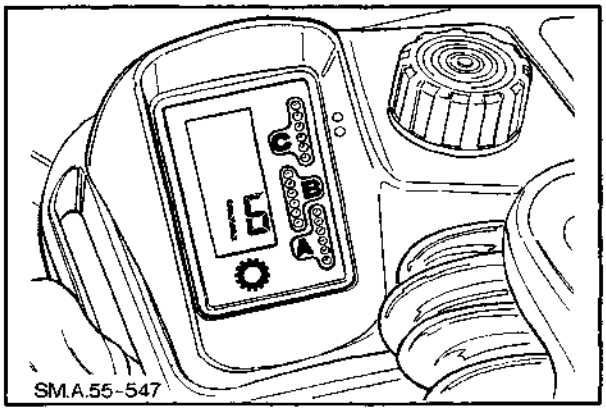


Figure 4-2-59

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HC TRANSMISSION OIL TEMPERATURE DISPLAY

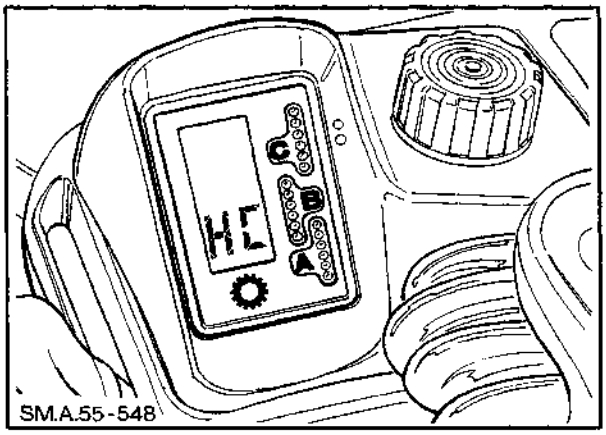


Figure 4-2-60

Displays transmission temperature in degrees Celsius.

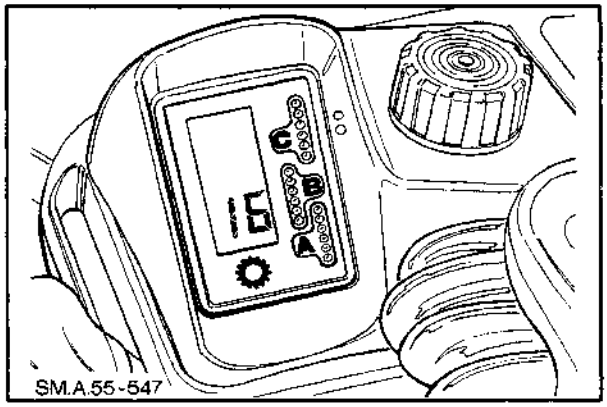


Figure 4-2-61

HD SYNCHRONIZER SHIFT/POSITION MODE

Checks operation of the 2 synchronizers.

The engine must be running with the transmission in neutral and clutch pedal released.

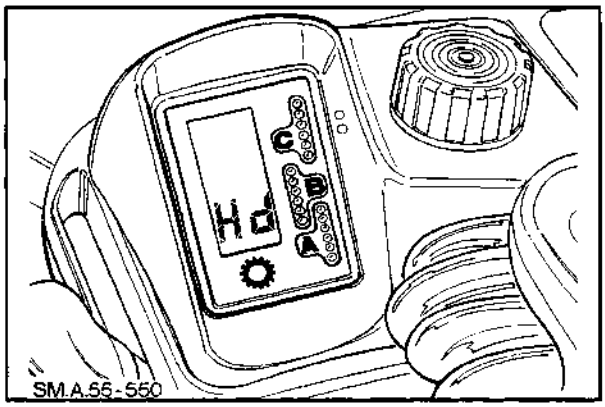


Figure 4-2-62

Transmission display, B1, indicates Med/Rev synchronizer operation.

Press and hold the downshift button to display the 'Mid' position as a % of potentiometer movement (approx 25%). (b)

Press the upshift button for Reverse (75%). (R)

Press both together for Neutral (50%). (N)

An LED will flash to indicate which gear is selected for each check. Return synchronizer to neutral prior to proceeding to next test.

If the clutch pedal is then depressed, a similar check can be carried out for the Low/High synchronizer.

High = approx 25% – downshift button (C)
Neutral = approx 50% – both buttons (N)
Low = approx 75% – upshift button (A)

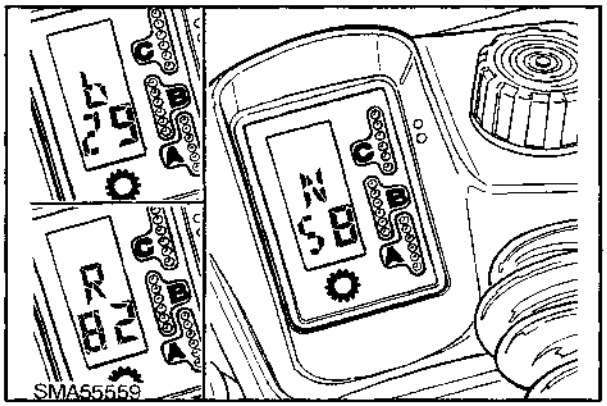


Figure 4-2-63

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HE QUICK FILL ADJUSTMENT.

Allows the amount of time to fill the clutch pack to be adjusted.

This can be carried out with the engine running.

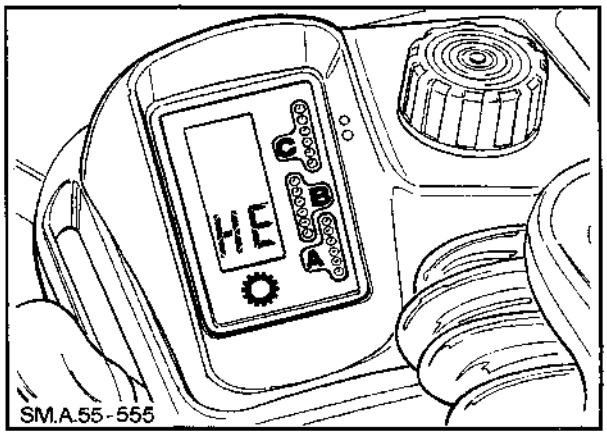


Figure 4-2-64

"A" appears in the display followed by the quick fill calibration figure.

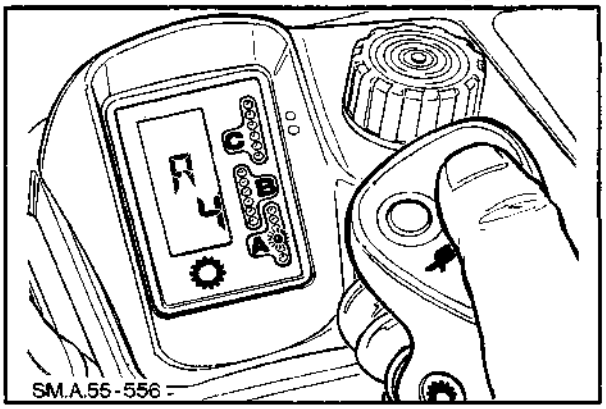


Figure 4-2-65

Adjust the quick fill time using the upshift/downshift buttons.

Change clutch by pressing the range button.

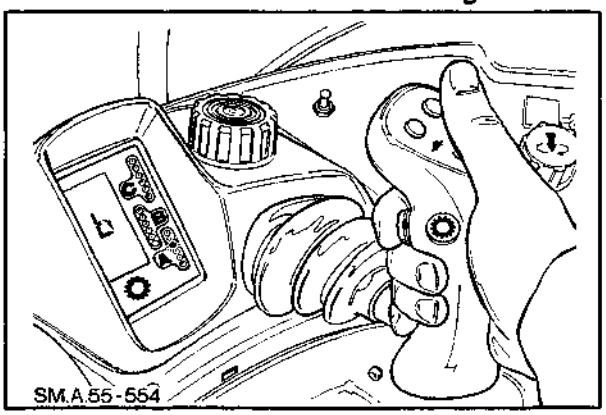


Figure 4-2-66

By selecting forward, the delay in engaging drive can be checked.

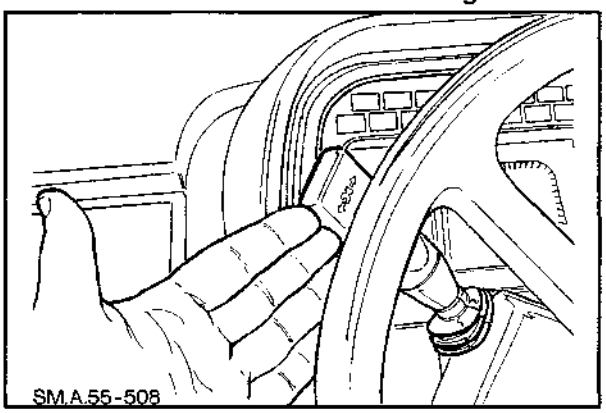


Figure 4-2-67

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HF MANUAL CLUTCH CALIBRATION ADJUSTMENT

Allows the clutch bite to be manually adjusted. This can be carried out with the engine running.

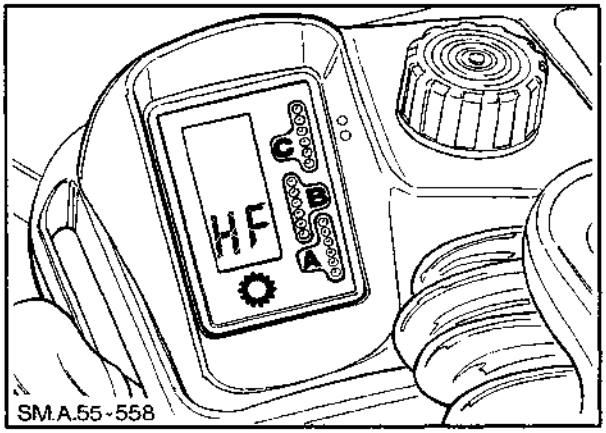


Figure 4-2-68

"A" appears followed by the clutch calibration figure "H1".

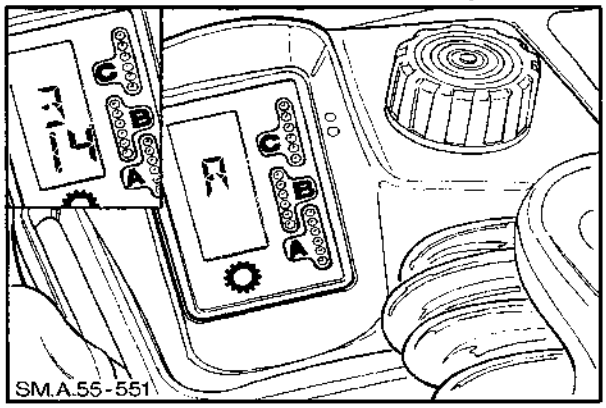


Figure 4-2-69

Adjust the calibration figure using the upshift or downshift buttons.

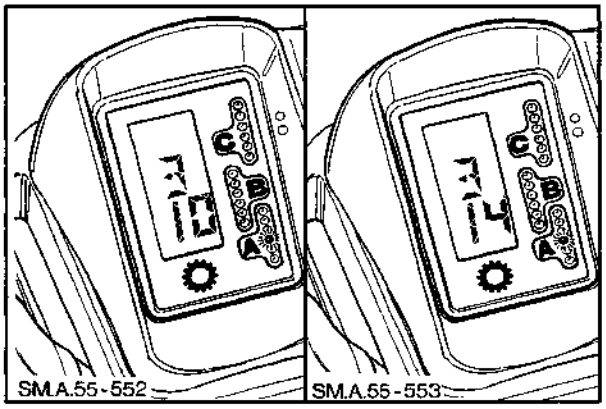


Figure 4-2-70

Change the clutch to be adjusted using the range button.

By selecting forward or releasing the clutch, the clutch engagement bite point can be checked.

The display will show % clutch pedal position.

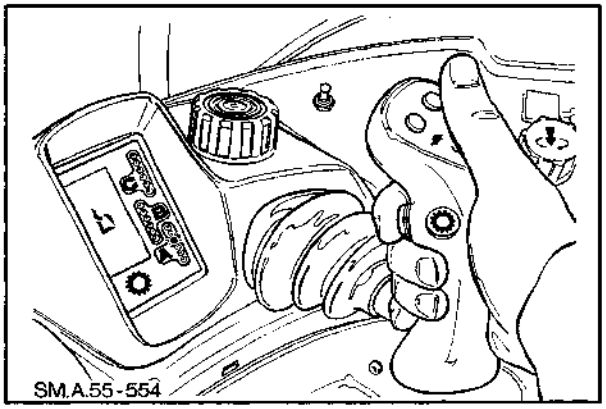


Figure 4-2-71

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HJ CLUTCH PRESSURE TEST MODE

This test mode is for use in pressure testing the transmission clutches, A, B, C, D and E.

It enables each clutch to be energized independently and allows operation of the clutch pedal to control the pressure.

Refer to the pressure testing section of this Chapter for details of full operating instructions.

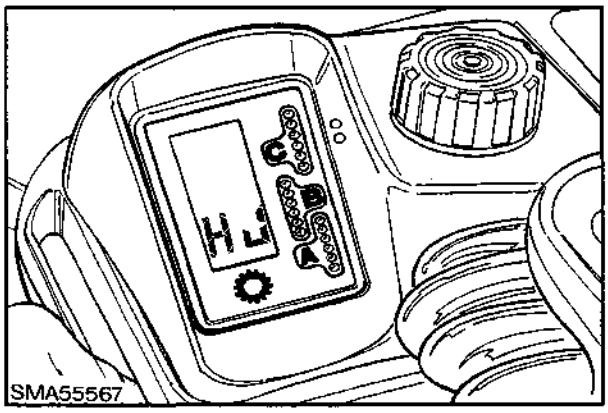


Figure 4-2-72

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ERROR CODES

Semi–Powershift Error Display Logic

1. Errors are displayed on the liquid crystal display portion of the gear shift and display assembly. A semi–powershift transmission error code is prefixed with an 'F'.

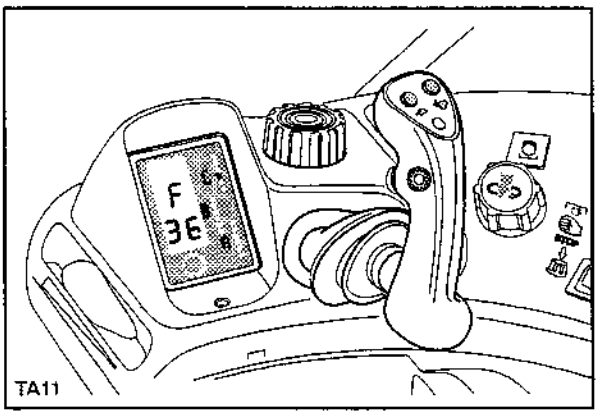


Figure 4-2-73

NOTE: *Some very early tractors may have an 'E' prefix displayed instead of an 'F'.*

2. Error codes always flash.

3. Generally, error codes accompanied by a pulse alarm signal require action by the operator, and the alarm will continue until the operator takes action.

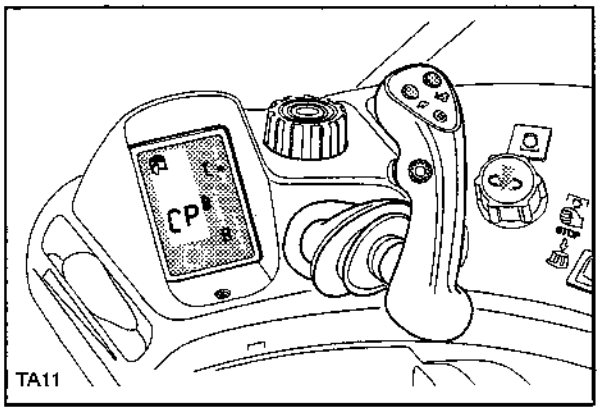


Figure 4-2-74

a) "CP" can be cleared by cycling the clutch pedal. In most cases the shuttle lever can also be used to clear "CP".

b) Most other errors, accompanied by a pulse alarm, can be cleared by cycling the shuttle lever. Under certain conditions, the pulse alarm will continue for 4 seconds while the lever is in neutral.

4. Other error codes, those not accompanied by a pulse alarm are accompanied by a steady 5 second alarm which then stops. If the error clears during the 5 second period the alarm will stop when the error clears.

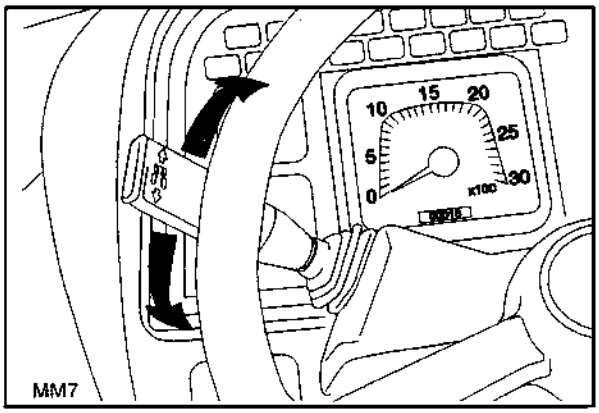


Figure 4-2-75

5. After the 5 second period the alarm will alternate with normal gear information on the gear display if the transmission is still operable. If the transmission is disabled, only the error code will be displayed.

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6. Errors have priority. Errors accompanied by the pulse alarm will not allow lower priority errors to be displayed, but pulse alarm errors are usually temporary in nature. For errors without pulse alarm:

a) If a lower priority error occurs when a higher priority error is being displayed, the lower priority error will be displayed for 5 seconds AFTER the higher priority has been displayed for at least 5 seconds. Then the display will return to the higher priority error.

b) If a higher priority error occurs when a lower priority error is being displayed, the higher priority error will interrupt the display of the lower priority error. If the lower priority error has not been displayed for 5 seconds yet it will return for 5 seconds after the higher priority error has been displayed. For example, if there are several errors at start up, due to a major harness wiring fault, the errors will all be displayed once, for 5 seconds each, in priority order, before the display returns to displaying only the highest priority error.

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Error Code Listing

ERROR CODE	ERROR DESCRIPTION	PRIORITY	TRANS. STATUS	ALARM MODE
F02	Fast/Slow Synchro – bad calibration value in NVM or not calibrated	42	Enabled	
F03	M/R Synchro – bad calibration value in NVM or not calibrated	41	Enabled	
F11	Inching pedal potentiometer undervoltage	14 & 71	Disabled Enabled	Pulse
F12	Inching pedal potentiometer overvoltage	13 & 70	Disabled Enabled	Pulse
F13	Upshift and downshift switches both closed	78	Enabled	
F20	Synchronizer did not engage – range shift	23	Enabled	
F21	Coils disconnected – Limp home or harness error	1	Disabled	
F22	Synchronizer did not disengage – range shift	24	Enabled	
F23	Creeper engaged, speed or gear to high	35	Enabled	
F24	All clutches/synchronizers need calibration	11	Disabled	
F27	ERPM to low – circuit open or short	60	Enabled	
F31	Synchronizer did not engage – shuttle shift	19	Disabled	Pulse
F32	Synchronizer did not engage after power up	20	Disabled	Pulse
F33	Synchronizer did not disengage – shuttle or neutral	21	Disabled	Pulse
F34	Synchronizer did not disengage after power up	22	Disabled	Pulse
F35	Failed to engage previous range after error codes F20 & F22	18	Disabled	Pulse
F36	Synchronizer not engaged (possibly jumped out)	17	Disabled	Pulse
F37	Solenoid power switch circuit open	31	Disabled	
F38	Disabled range selected by operator	25 & 16 & 15	Enabled Disabled Disabled	 Pulse Pulse
F40	Medium/reverse synchronizer potentiometer overvoltage	43	Enabled	
F41	Medium/reverse synchronizer potentiometer undervoltage	44	Enabled	
F42	Fast/slow synchronizer potentiometer overvoltage	45	Enabled	
F43	Fast/slow synchronizer potentiometer undervoltage	46	Enabled	
F44	Medium/reverse synchronizer potentiometer out of calibrated range	76	Enabled	
F45	Fast/slow synchronizer potentiometer out of calibrated range	77	Enabled	
F47	Solenoid power switch misadjusted (clutch pedal)	69	Enabled	
F48	Solenoid power switch circuit short to 12 volts	68	Enabled	
F49	Wheel speed sensor circuit open	47	Enabled	
F50	Wheel speed sensor circuit short	48	Enabled	

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ERROR CODE	ERROR DESCRIPTION	PRIORITY	TRANS. STATUS	ALARM MODE
F51	Temperature sensor circuit open	66	Enabled	
F52	Temperature sensor circuit short to ground	67	Enabled	
F53	Regulated 5/7 volts too high	7	Disabled	
F54	Regulated 5/7 volts too low	8	Disabled	
F55	Regulated 8 volts too high	9	Disabled	
F56	Regulated 8 volts too low	10	Disabled	
F59	Forward/reverse/neutral switch disagreement	12	Disabled	Pulse
F60	Upshift input undervoltage	50	Enabled	
F61	Upshift input overvoltage	51	Enabled	
F62	Downshift input undervoltage	52	Enabled	
F63	Downshift input overvoltage	53	Enabled	
F64	Range shift input undervoltage	54	Enabled	
F65	Range shift input overvoltage	55	Enabled	
F66	Forward input undervoltage	56	Enabled	
F67	Forward input overvoltage	57	Enabled	
F68	Reverse input undervoltage	58	Enabled	
F69	Reverse input overvoltage	59	Enabled	
F73	Mid speed sensor circuit open	79	Enabled	
F74	Mid speed sensor circuit short to ground or 12V	80	Enabled	
F75	Swapped mid and rear speed sensors	82	Enabled	
F77	No signal from wheel speed sensor	49	Enabled	
F78	No signal from mid speed sensor	81	Enabled	
F79	Engine RPM >3000	34	Enabled	Pulse
F80	Wheel speed too high for gear selected	33	Enabled	Pulse
F81	Proper ratio not detected	30	Disabled	Pulse
F1A	Clutch A open or short to ground	36	Disabled	
F1b	Clutch B open or short to ground	37	Disabled	
F1C	Clutch C open or short to ground	38	Disabled	
F1d	Clutch D open or short to ground	39	Disabled	
F1E	Clutch E open or short to ground	40	Disabled	
F2A	Clutch A short to 12V	2	Disabled	
F2b	Clutch B short to 12V	3	Disabled	
F2C	Clutch C short to 12V	4	Disabled	
F2d	Clutch D short to 12V	5	Disabled	
F2E	Clutch E short to 12V	6	Disabled	

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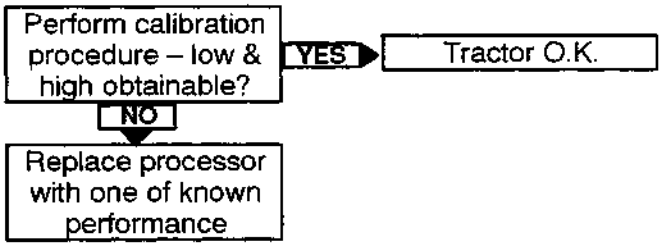
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ERROR CODE	ERROR DESCRIPTION	PRIORITY	TRANS. STATUS	ALARM MODE
F1P	Reverse solenoid open or shorted to ground	27 & 73	Disabled Disabled	Pulse Steady
F1L	Slow range solenoid open or shorted to ground	28 & 74	Disabled Disabled	Pulse Steady
F1U	Mid range solenoid open or shorted to ground	26 & 72	Disabled Disabled	Pulse Steady
F1h	Fast range solenoid open or short to ground	29 & 75	Disabled Disabled	Pulse Steady
FCA	Clutch A not calibrated	61	Enabled	
FCB	Clutch B not calibrated	62	Enabled	
FCC	Clutch C not calibrated	63	Enabled	
FCD	Clutch D not calibrated	64	Enabled	
FCE	Clutch E not calibrated	65	Enabled	
CP	Depress clutch pedal or select neutral to re–enable	32	Disabled	Pulse
	CALIBRATION ERRORS			
U19	Oil temperature below 68°F (20°C)			
U21	Engine RPM too low			
U22	Engine RPM too high			
U23	Shuttle lever is in neutral			
U26	Clutch pedal is not released			
U31	Output speed sensed – tractor is moving			
U36	Maximum allowed clutch calibration value exceeded			
U37	ERPM dropped too soon during clutch cal			
U81	No mid–reverse synchro movement sensed			
U82	No low–high synchro movement sensed			
U83	Synchro potentiometer connectors swapped			
U84	Reverse and high synchro solenoid connectors swapped			
U85	Mid and low synchro solenoid connectors swapped			
U86	Mid–reverse synchro neutral error			
U87	Low–high synchro neutral error			
U88	Mid–rev synchronizer calibration values out of tolerance			
U89	Low–high synchronizer calibration values out of tolerance			
	CALIBRATION MESSAGES			
CF	Calibration procedure completed successfully			
CH	Oil temperature above 122°F (50°C)– Press upshift to proceed			
CL	Oil temperature between 50 and 68°F (10 and 20°C) – press upshift to proceed			

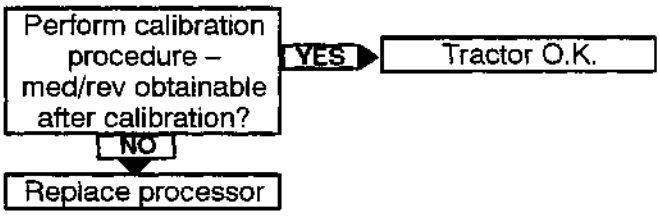
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ERROR CODE F02
FAST/SLOW SYNCHRO UNCALIBRATED OR BAD CALIBRATION
EFFECT – Cannot obtain low or high range & mid range (if applicable) selected automatically



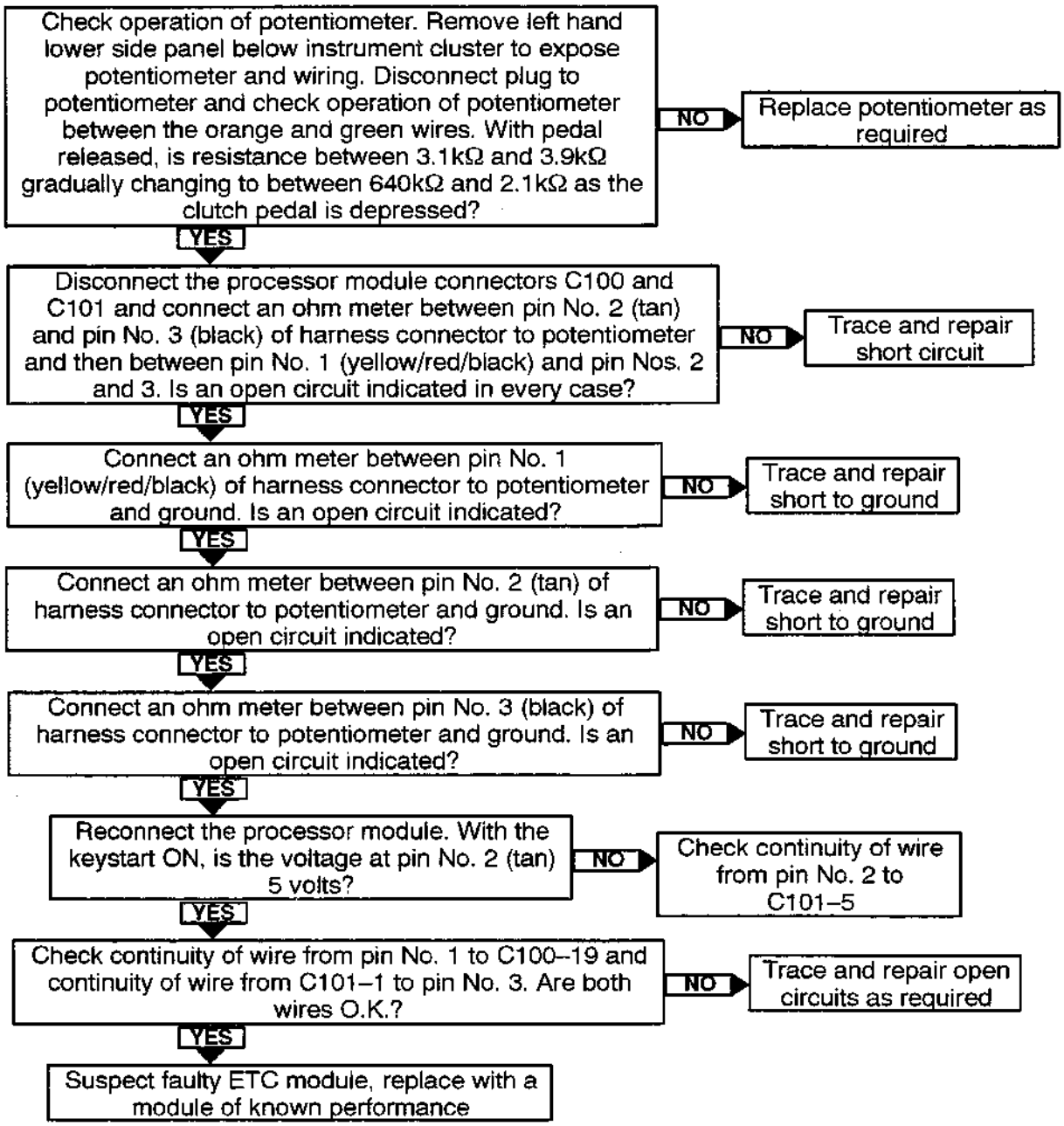
ERROR CODE F03
MED/REV SYNCHRO UNCALIBRATED OR BAD CALIBRATION
EFFECT – Cannot obtain mid or reverse range & low range (if obtainable)



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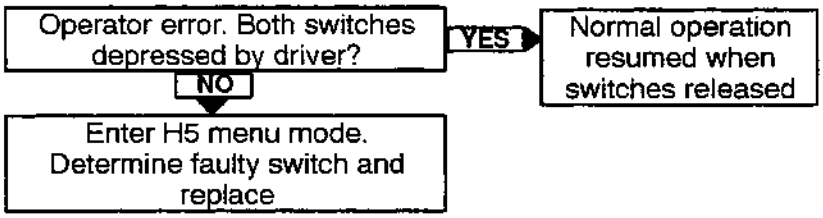
ERROR CODES;
F11 – CLUTCH POT OPEN CIRCUIT
F12 – CLUTCH POT SHORT TO +12V
EFFECTS – Occurrence while driving will disable transmission. Cycling shuttle lever will re–enable Transmission. Tractor may be used on shuttle lever. If CP Depressed Transmission will disable again until cleared by cycling shuttle lever.
For transmission wiring diagram and connector location refer to the end of this Section.



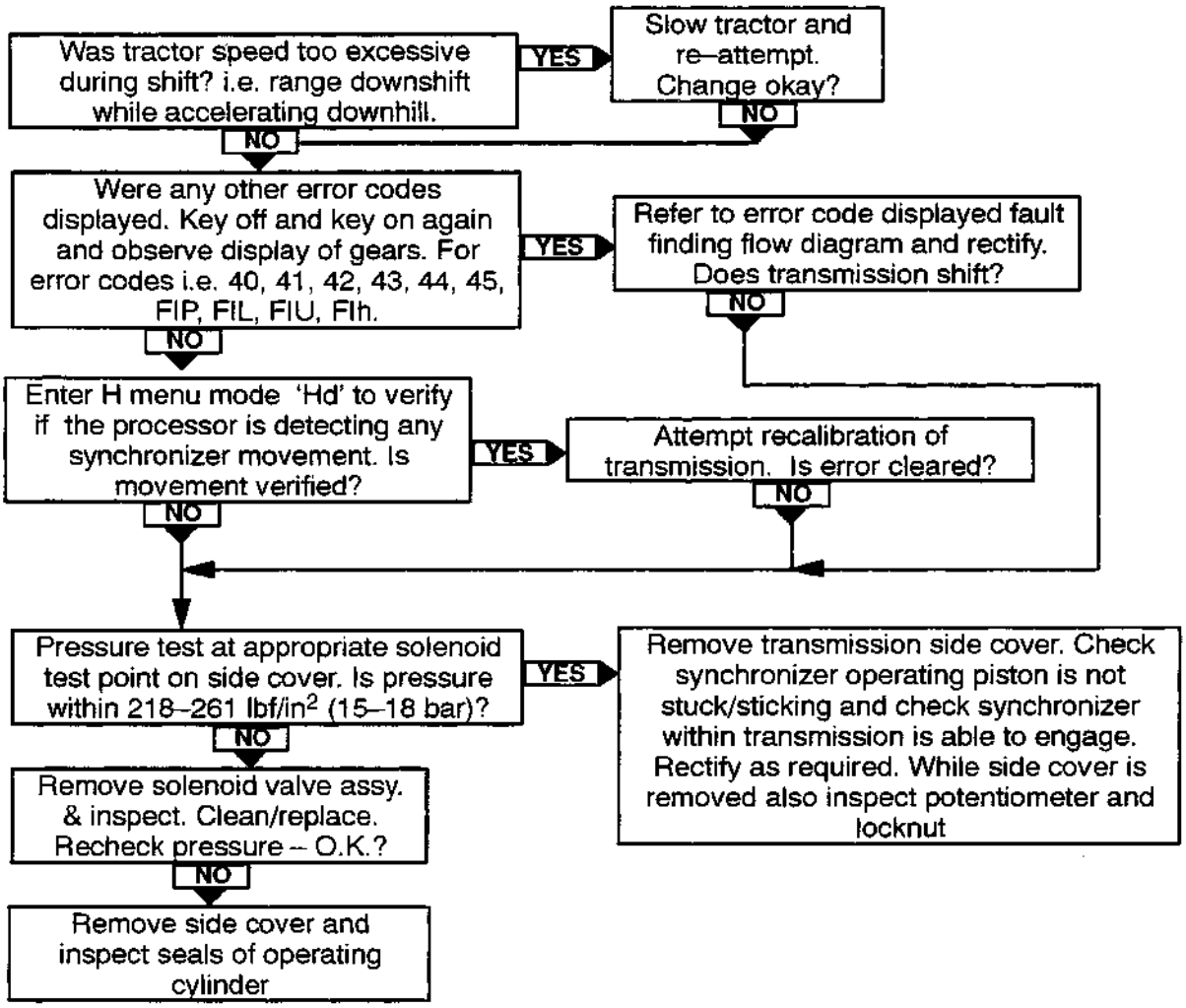
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ERROR CODE F13
UPSHIFT & DOWNSHIFT SWITCHES BOTH CLOSED
EFFECT – Tractor will continue to drive but attempts to shift will not be recognized.



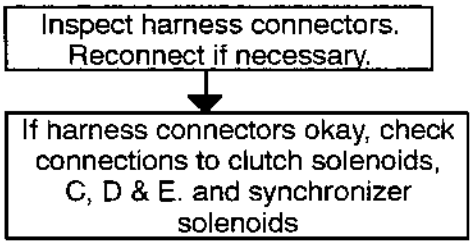
ERROR CODE F20
RANGE SHIFT SYNCHRONIZER DID NOT ENGAGE
EFFECT – Transmission attempts change and returns to previously engaged range



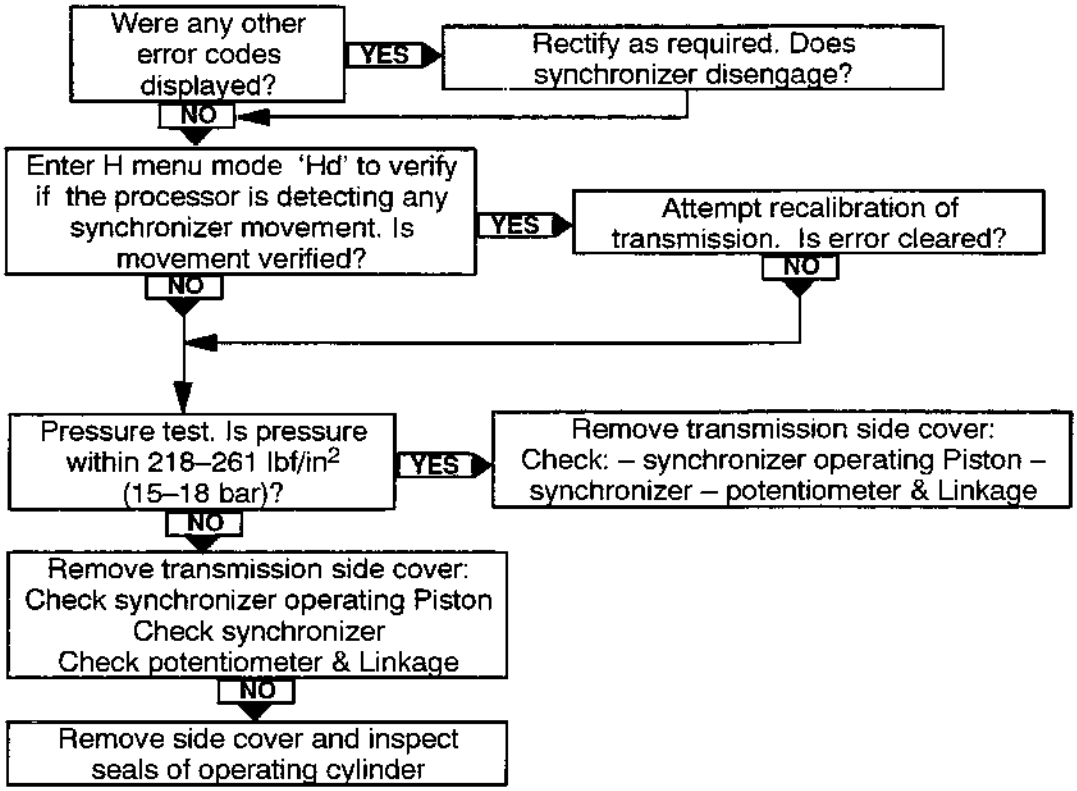
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ERROR CODE F21
TRANSMISSION EXTENSION HARNESS TO MAIN HARNESS DISCONNECTED.
EFFECT – Transmission inoperable



ERROR CODE F22
RANGE SYNCHRONIZER DID NOT DISENGAGE
EFFECT – Transmission attempts change and returns to previously engaged range



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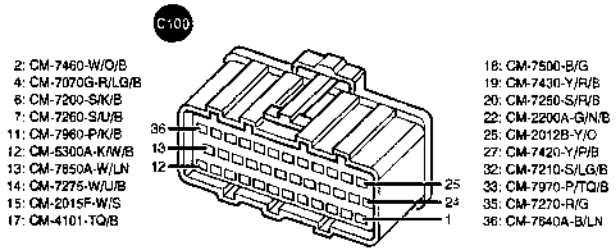
ERROR CODE F23
CREEPER ENGAGED (SPEED OR GEAR TOO HIGH)
EFFECT – Upshifts are inhibited.

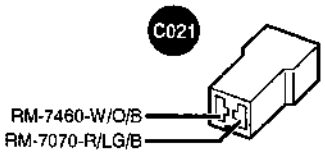
Downshift to C1 (or lower) [shifting to neutral or depressing clutch will also cause transmission to downshift to C1.]
YES → Tractor only

Does error code occur on less creeper tractors or when creep is disengaged?
NO → Tractor only
YES

Suspect creeper switch or wiring going open circuit. Use mode H5 to check switch transition. Is a transition sensed in H5?
YES → Replace processor for one of known performance
NO

Check switch adjustment. If Okay check switch operation. If Okay check wiring from C100–2 to switch, C021–RM7460–W/O/B, for open circuit and check other side of switch for +12V with Ignition on. Repair as required.





ERROR CODE F24
ALL CLUTCHES & SYNCHRONIZERS REQUIRE CALIBRATION
EFFECT – Transmission is disabled.

Has a new processor been installed
YES → Perform calibration
NO

Calibration values have been corrupted in processor. Attempt calibration. If unable to maintain calibration install a new processor.

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ERROR CODE F27
ERPM SIGNAL NOT PRESENT
EFFECT – No speed matching. Delay in upshifts after auto take off. Minor reduction in shift performance (2,300 rpm assumed by processor)

Is the alternator drive belt broken?
YES → Replace drive belt
NO

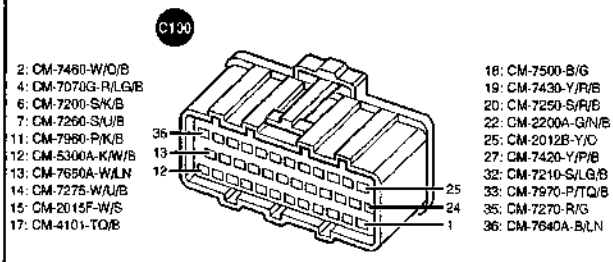
Establish if there is a speed output from the alternator. Connect a volt meter between the alternator speed connector and ground. Is there approximately 7 volts when the engine is running?
NO → Repair or replace alternator
YES

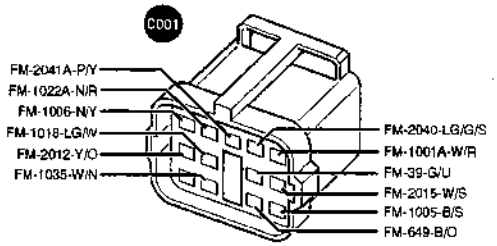
The following checks must be carried out with the engine stopped and keystart switched OFF

Check alternator wiring for continuity: Disconnect connector C100 from processor module and check between C100–15 and alternator speed sender connection. Is resistance less than 10Ω?
YES → Check for short circuit in wiring. With C100 disconnected and alternator wire disconnected check resistance to ground from pin C100–15. Is resistance less than 10Ω.
YES → Locate and repair short circuit to ground
NO → Suspect TCM module. Substitute with a module of known performance
NO

Check for continuity between C100–15 and C001–CM2015–W/B/S. Is wire O.K.?
NO → Locate and repair open circuit
YES

Check for continuity between alternator connector and C001–FM2015–W/S. Is wire O.K.?
NO → Locate and repair open circuit

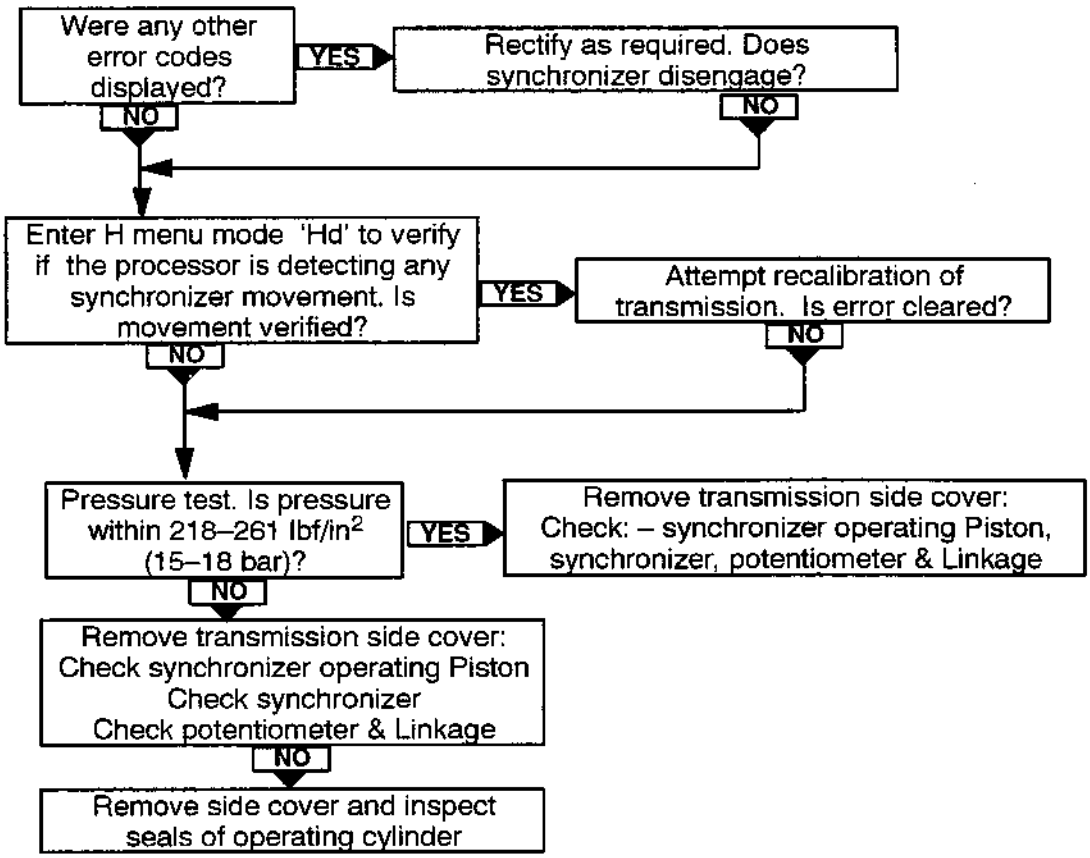




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ERROR CODE F31
SYNCHRONIZER DID NOT ENGAGE DURING SHUTTLE SHIFT
EFFECT – Transmission disabled.



ERROR CODE F32
HIGH RANGE SYNCHRONIZER DID NOT ENGAGE DURING START UP SEQUENCE, WITHIN SPECIFIED TIME. (THIS IS PART OF A SYSTEM TEST DURING START UP)
EFFECT – Transmission disabled

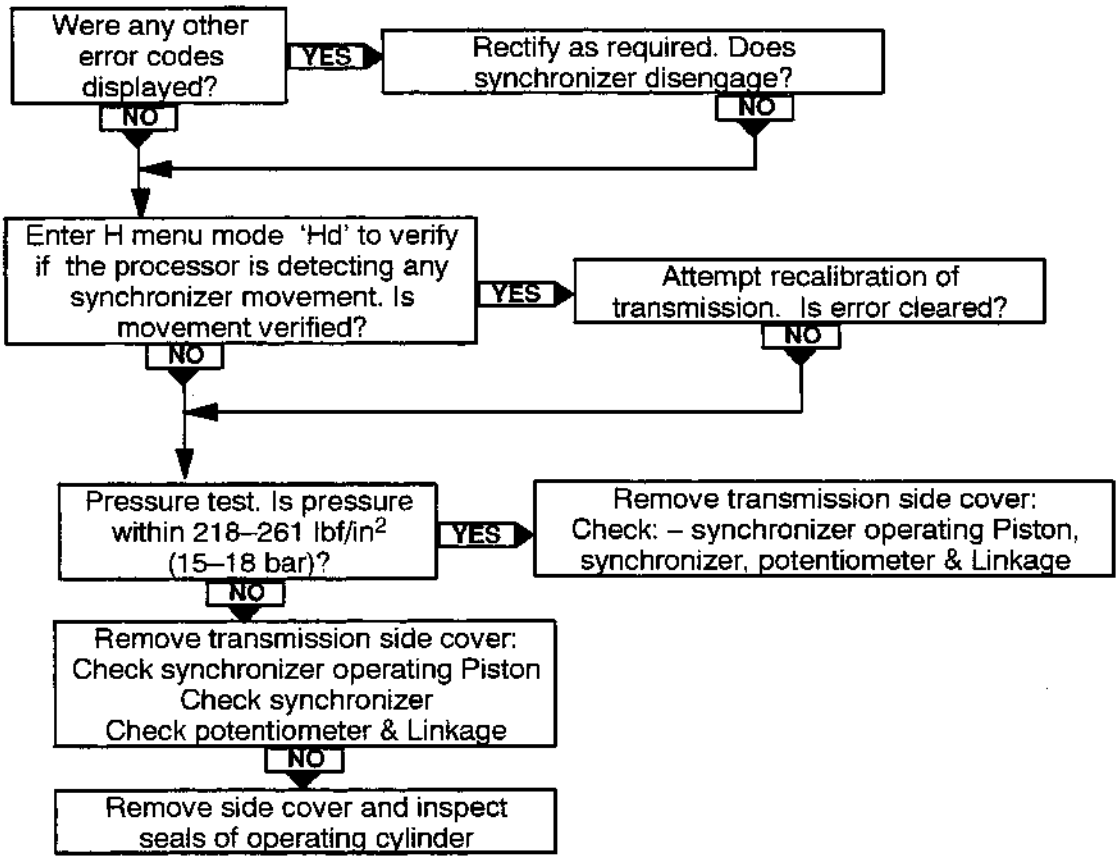
If low oil pressure light is on repair low pressure circuit as described in hydraulic section.

Otherwise, cycle shuttle lever. If problem still persists a different error code will occur, probably F31. Refer to new error code page.

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ERROR CODE F33
SYNCHRONIZER DID NOT DISENGAGE, SHUTTLE OR NEUTRAL
EFFECT – Transmission disabled



ERROR CODE F34
SYNCHRONIZER DID NOT DISENGAGE AFTER POWER UP. (PART OF START UP SEQUENCE)
EFFECT – Transmission disabled

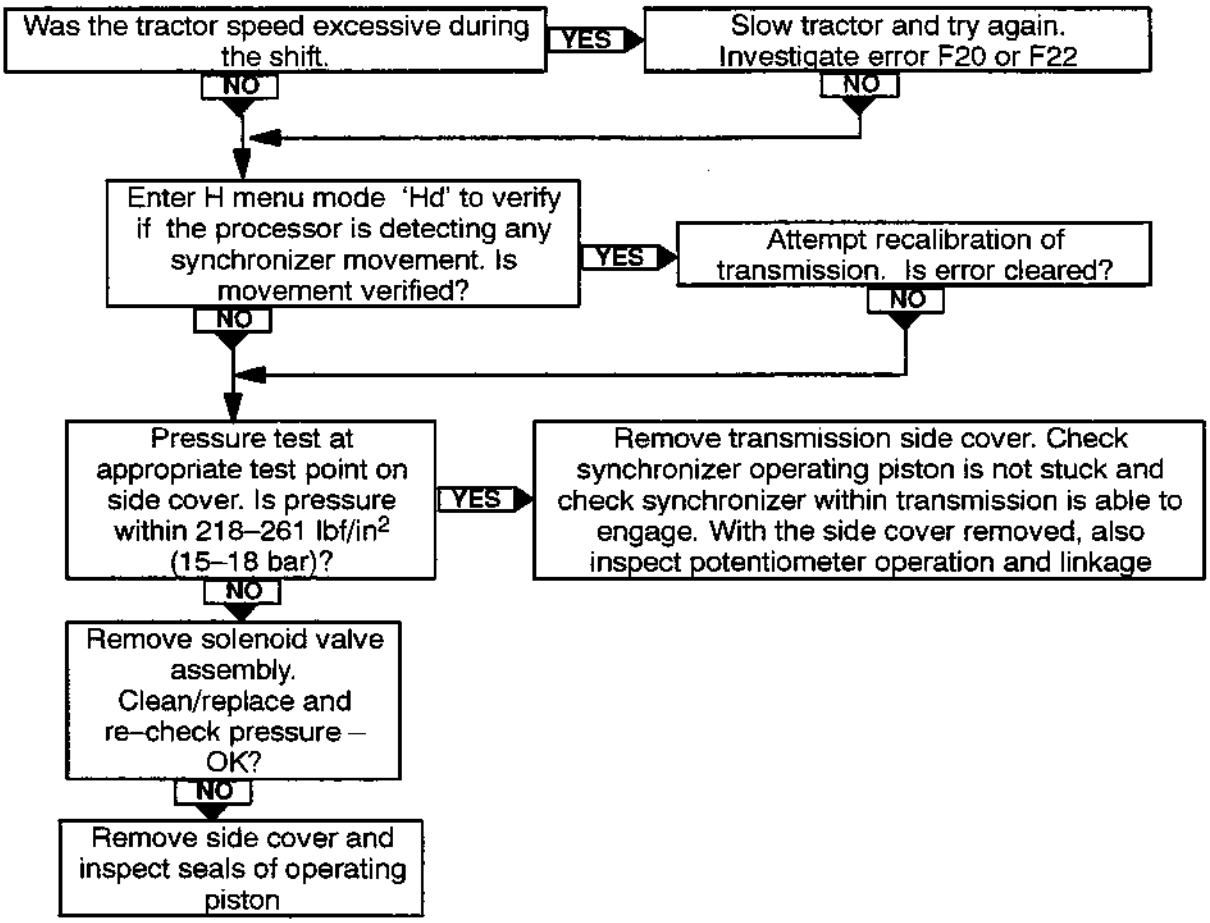
If low oil pressure light is on repair low pressure circuit as described in hydraulic section.

Otherwise, cycle shuttle lever. If problem still persists a different error code will occur, probably F33. Refer to new error code page.

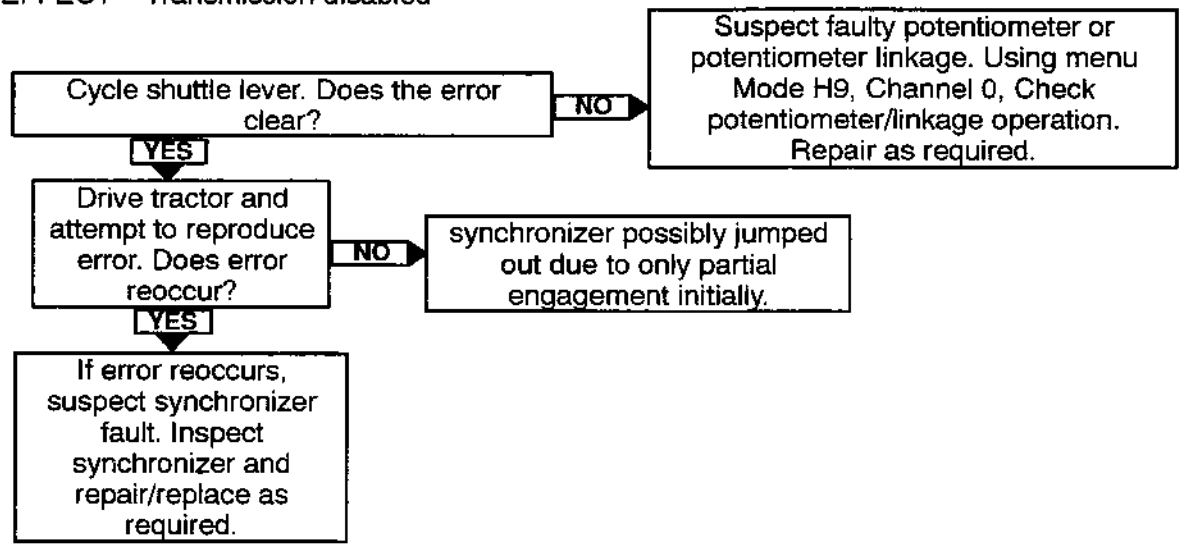
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ERROR CODE F35
SYNCHRONIZER FAILED TO ENGAGE PREVIOUS RANGE AFTER ERROR F20 OR F22.
EFFECT – Transmission disabled
RECOVER – Cycle shuttle lever to try again or select another range while in neutral.



ERROR CODE F36
SYNCHRONIZER DISENGAGED WITHOUT DRIVER INITIATION
EFFECT – Transmission disabled



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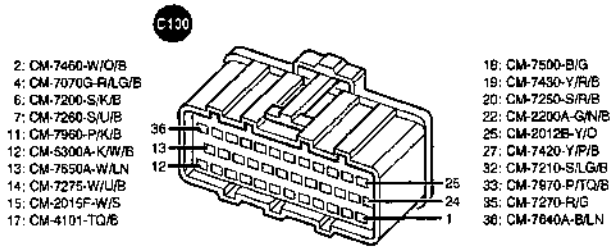
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ERROR CODE F37
CLUTCH PEDAL SWITCH OPEN CIRCUIT
EFFECT – Transmission disabled

Cycle clutch pedal. Does error clear?
YES → Switch was temporarily stuck. Inspect switch. Clean or replace.
NO

Remove steering column left hand side panel. Disconnect switch connector and test operation of switch using multimeter. Does switch function OK?
NO → Adjust or replace switch as required
YES

Disconnect connectors C100 & C101 from processor and check for open circuit between C100–27 and switch and C100–30 and switch. Trace fault and repair wiring.



ERROR CODE F38
DISABLED RANGE SELECTED BY OPERATOR

(i) synchronizer range shift (to Mid) not completed
(ii) synchronizer for/rev not completed
(iii) Reverse not selected from a gear higher than C1

NOTE: This error code will be displayed in conjunction with another error code, usually informing of a solenoid or potentiometer failure.

For items (i) and (ii)

Key off and key on. Observe error codes. Rectify error codes and attempt selection of ranges. Error F38 will be eliminated if other faults are rectified.

(iii) If reverse has been attempted in a gear higher than C1 when there was a wheel speed sender error (F49, F50 or F77) reverse will not be selected. The transmission will be disabled but can be recovered, to forward drive, by cycling the shuttle lever or clutch pedal. Reverse cannot be obtained for 10 seconds. The processor then assumes that the tractor has slowed sufficient to make the shift. Rectifying the wheel speed sender error will eliminate the reoccurrence of F38.

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ERROR CODE F40
MEDIUM/REVERSE SYNCHRONIZER POTENTIOMETER OVERVOLTAGE
EFFECT – Med/Reverse ranges cannot be obtained.

Disconnect connector, C030, to med/rev synchronizer potentiometer. Key on tractor. Using a voltmeter, check voltage on each pin, one should have 8 volts, other two should be 0 volts. Are voltages correct?

NO → Trace short circuit in wiring and repair

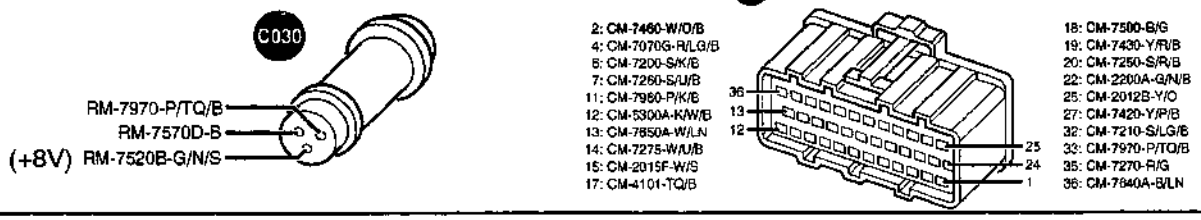
YES

Remove med/rev synchronizer potentiometer from transmission and check operation using multimeter. Does the meter show a smooth increase/decrease in OHMS as the potentiometer. is operated?

NO → Replace potentiometer

YES

Suspect faulty processor.
Substitute with one of known performance



ERROR CODE F41
MEDIUM/REVERSE SYNCHRONIZER POTENTIOMETER UNDERVOLTAGE
EFFECT – Med and rev ranges cannot be obtained

Disconnect connector to med/rev synchronizer potentiometer and disconnect processor connectors C100 & C101. Check for a short to ground or an open circuit from C100–33 to the potentiometer, C030 connector. Is either indicated?

YES → Trace short or open circuit in wiring and repair

NO

Remove potentiometer and check operation using a multimeter. Does the meter show a smooth increase/decrease in OHMS as the potentiometer is operated?

NO → Replace potentiometer

YES

Substitute processor for one of known performance

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ERROR CODE F42
FAST/SLOW SYNCHRONIZER POTENTIOMETER OVERVOLTAGE
EFFECT – Low and high ranges cannot be obtained.

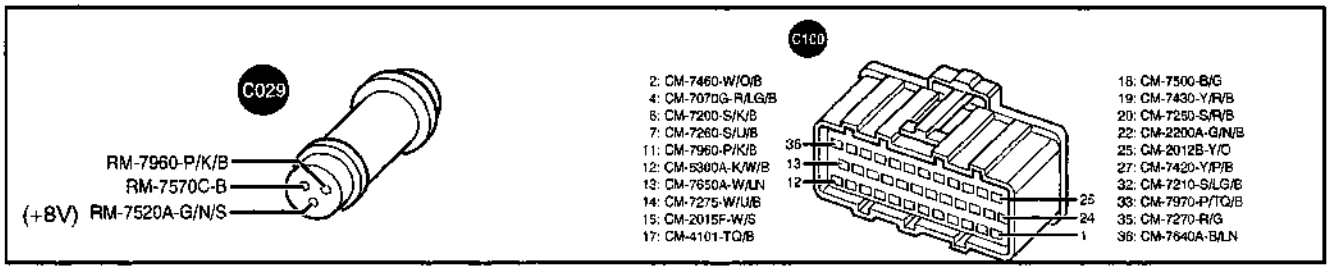
Disconnect connector C029 to fast/slow synchronizer potentiometer. Key on tractor, using a voltmeter. Check voltage on each pin, one should have 8 volts, other two should be 0 volts. Are voltages correct?

NO → Trace short circuit in wiring and repair

YES → Remove fast/slow synchronizer potentiometer from transmission and check operation using multimeter. Does the meter show a smooth increase/decrease in OHMS as the potentiometer. is operated?

NO → Replace potentiometer

YES → Suspect faulty processor. Substitute with one of known performance



ERROR CODE F43
FAST/SLOW SYNCHRONIZER POTENTIOMETER UNDERVOLTAGE
EFFECT – Low and high ranges cannot be obtained

Disconnect connector C029 to fast/slow synchronizer potentiometer and disconnect processor connectors C100 & C101. Check for a short to ground or an open circuit from C100–11 to the potentiometer connector. Is either indicated?

YES → Trace short or open circuit in wiring and repair

NO → Remove potentiometer and check operation using a multimeter. Does the meter show a smooth increase/decrease in OHMS as the potentiometer is operated?

NO → Replace potentiometer

YES → Substitute processor for one of known performance

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ERROR CODE F44
MEDIUM/REVERSE SYNCHRONIZER POTENTIOMETER OUT OF CALIBRATED RANGE

EFFECTS – Transmission functions normally but may lead to premature detection of synchronizer engagement and subsequent synchronizer damage.

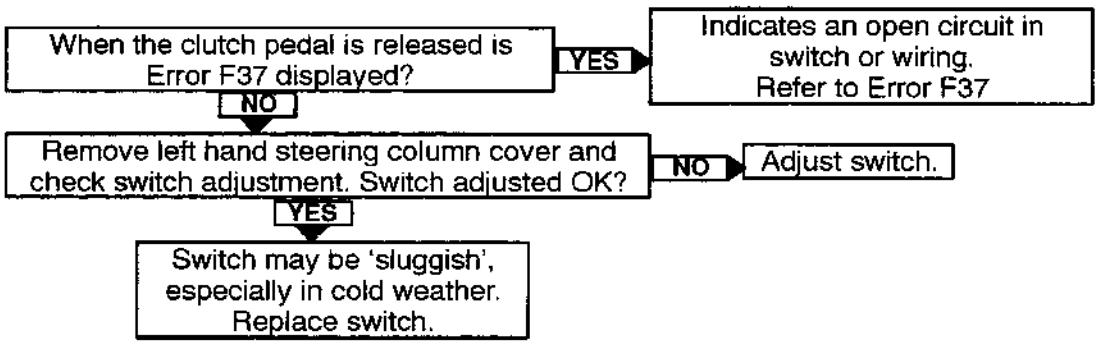
Perform clutch and synchronizer calibration routine to clear error.
NOTE: This error may be indicating wear on transmission components or a failing potentiometer.

ERROR CODE F45
FAST/SLOW SYNCHRONIZER POTENTIOMETER OUT OF CALIBRATED RANGE

EFFECTS – Transmission functions normally but may lead to premature detection of synchronizer engagement and subsequent synchronizer damage.

Perform clutch and synchronizer calibration routine to clear error.
NOTE: This error may be indicating wear on transmission components or a failing potentiometer.

ERROR CODE F47
CLUTCH PEDAL SWITCH MISADJUSTED
EFFECT – Inching may be jerky and at a higher than normal pedal position.



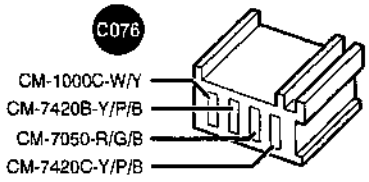
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ERROR CODE F48
CLUTCH PEDAL SWITCH SHORT CIRCUIT
EFFECT – No effect on normal operation but will not cut off power to any clutch solenoids.

Remove steering column left hand side cover and check switch adjustment and operation – OK?
NO → Adjust or replace switch
YES

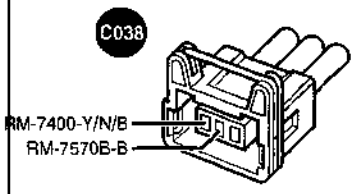
Disconnect clutch switch connector, C076. With key start 'ON' check for voltage on C076–CM7050–R/G/B Voltage should be zero.
If voltage is evident trace and repair short circuit in wiring.

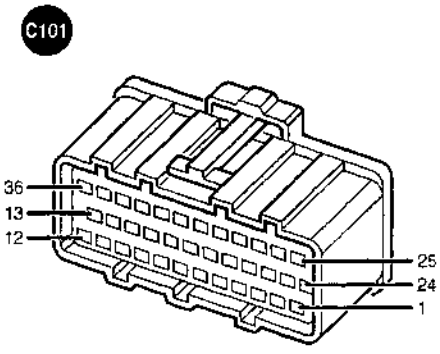


ERROR CODES;
F49 – TRANSMISSION OUTPUT SPEED SENSOR OPEN CIRCUIT
F50 – TRANSMISSION OUTPUT SPEED SENSOR SHORT TO GROUND
EFFECT – (i) Upshifts in high range are inhibited
(ii) 1–2 second delay in allowing upshifts after clutchless take off

Disconnect processor connectors C100 & C101 and disconnect transmission output speed sensor connector, C038.Test wiring for open/short circuit to C101–6 and repair as required. If wiring checks out OK test sensor.

With the sender installed in the transmission, check for a short to ground on each sender terminal. Check resistance of the sender which should be approximately 0.8–1.2KΩ at 20°C (68°F). Replace if outside specification.





1: CM-7570-B
2: CM-7401-P/B/G
5: CM-7525-G/B/S
6: CM-7400-Y/N/B
9: CM-57AE-B
10: CM-7985-G/O/S
11: CM-7920-TQ/O/B
12: CM-7915-P/O/S
13: CM-7935-P/N/S
14: CM-7930-TQ/R/B
15: CM-7980-K/LG/B
16: CM-7220-S/N/B
17: CM-7910-TQ/N/B

18: CM-7431-TQ/W/B
19: CM-7230-S/O/B
20: CM-7940-TQ/S/B
25: CM-7520-G/N/S
26: CM-7900-TQ/K/B
28: CM-7945-P/TQ/S
29: CM-7000C-U/R/B
30: CM-7050-R/G/B
31: CM-5000C-P
32: CM-57AK-B
33: CM-57AL-B
34: CM-7000D-U/R/B
35: CM-7000B-U/R/B
36: CM-7925-P/R/S

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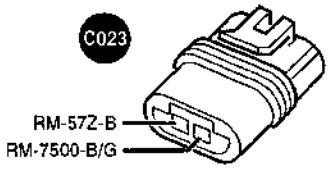
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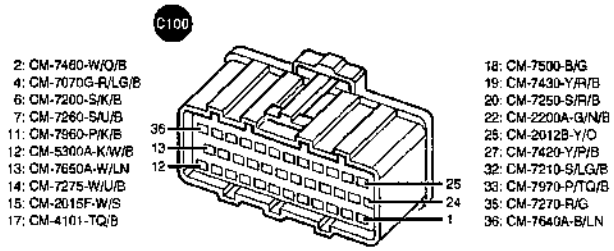
ERROR CODES;
F51 – TEMPERATURE SENDER OPEN CIRCUIT
F52 – TEMPERATURE SENDER SHORT TO GROUND
EFFECT – Hot oil is assumed, if oil is cold sluggish shifting and a higher than normal clutch pedal position will be apparent.

Disconnect processor connectors C100 & C101 and disconnect temperature sender, C023. Test the wiring for open/short circuit to C100–18 and repair as required. If wiring checks out OK test temperature sender.

↓

With the sender installed check for a short to ground, and an open circuit from the terminal of the sender to the chassis.





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ERROR CODES;
F53 – 5 VOLT REFERENCE VOLTAGE TOO HIGH
F54 – 5 VOLT REFERENCE VOLTAGE TOO LOW
EFFECT – Transmission disabled

Disconnect the following components, one at a time, to isolate area of fault.

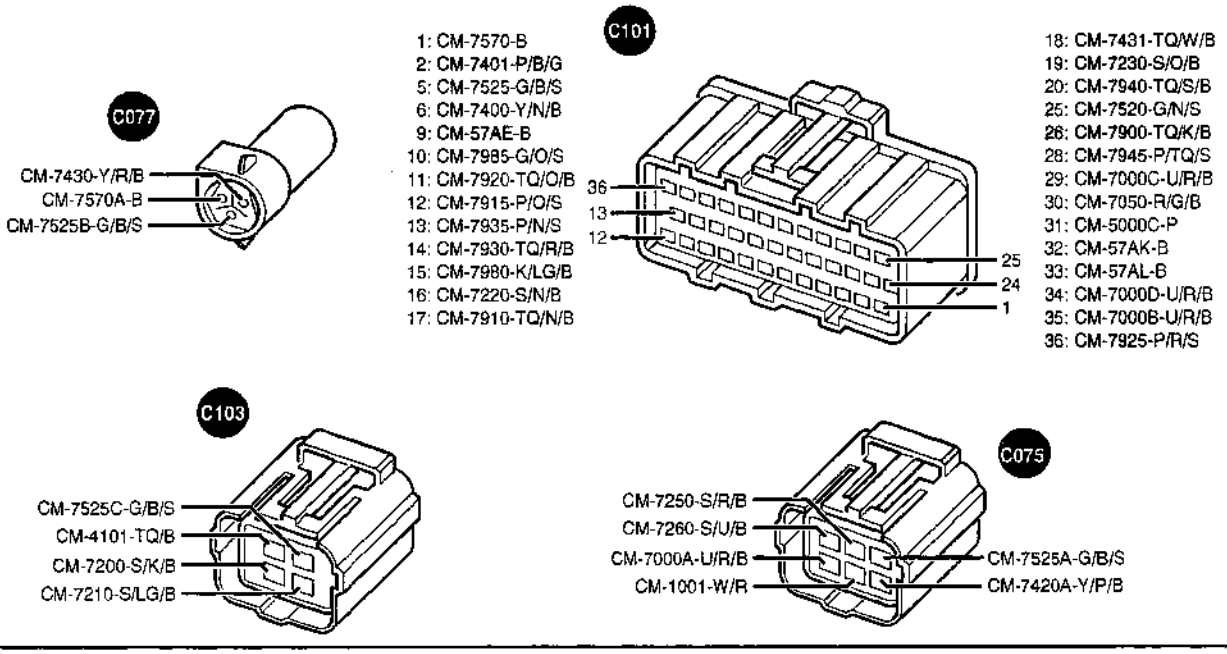
Disconnect Clutch Pedal potentiometer, C077, are F53/54 cleared?
NOTE: *Should cause error F11 if potentiometer is faulty*
YES → Replace potentiometer
NO

Disconnect forward/reverse connector, C075, (under steering column shroud). Are F53/54 cleared?
NOTE: *Should cause errors F66 and F68 if switches are faulty.*
YES → Replace forward/reverse switch
NO

Disconnect the upshift/downshift and range switches connector, C103. Are F53/54 cleared?
NOTE: *Should cause errors F60 and F62 if switches are faulty.*
YES → Replace upshift/downshift & range switch assembly
NO

Check wiring from each of the above components back to processor connector C101–5. Is either a short or open circuit indicated?
YES → Trace and repair faulty wiring
NO

Suspect faulty processor. Replace with one of known performance



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ERROR CODES;
F55 – REGULATED 8 VOLTS SUPPLY TOO HIGH
F56 – REGULATED 8 VOLTS SUPPLY TOO LOW
EFFECT – Transmission disabled

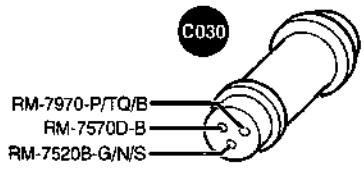
Remove the following components one at a time to attempt to isolate area of fault.

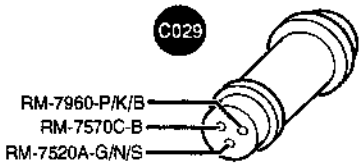
Disconnect transmission Mid/Rev Synchronizer Potentiometer, C030. Are F55/56 cleared?
NOTE: *Should cause errors F41 or F44 if potentiometer faulty.*
YES → Replace mid/Rev Synchronizer Potentiometer
NO

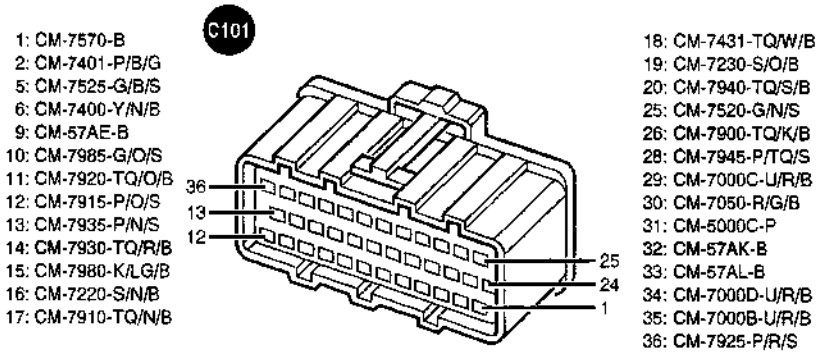
Disconnect transmission Low/High Synchronizer potentiometer, C029. Are F55/56 cleared?
NOTE: *Should cause errors F43 or F45 if potentiometer faulty.*
YES → Replace low/high synchronizer potentiometer
NO

Check wiring back from each of the above components to C101–25. Is either a short or open circuit indicated?
YES → Trace faulty wiring and repair
NO

Suspect faulty processor. Replace with one of known performance.





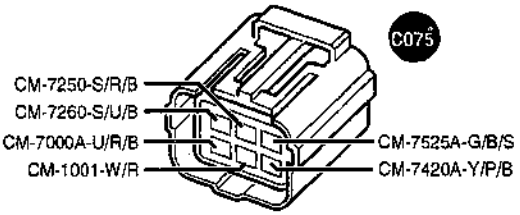


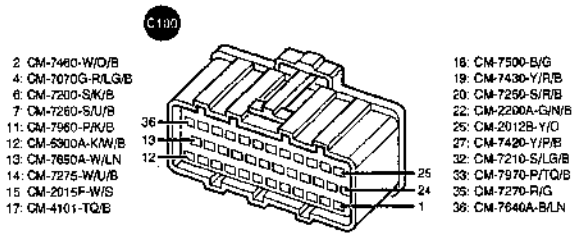
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ERROR CODE F59
FORWARD/REVERSE/NEUTRAL SWITCH DISAGREEMENT
(MORE THAN ONE SWITCH ENGAGED)
EFFECT – Transmission is Disabled

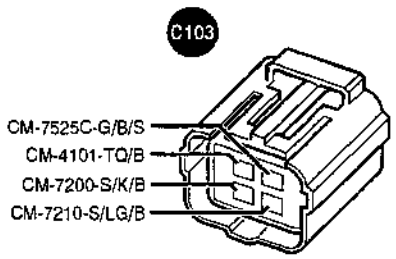
Disconnect processor connectors C100 & C101. Disconnect connector, C075, to FNR switch. Is an open circuit indicated between C100–27 and neutral switch?
YES → Trace and repair wiring
NO → Replace forward/neutral reverse switch.

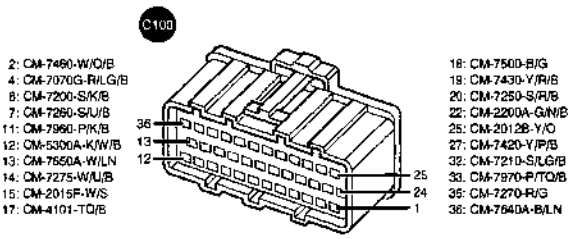




ERROR CODES;
F60 – UPSHIFT SWITCH INPUT VOLTAGE LOW
F61 – UPSHIFT SWITCH INPUT VOLTAGE HIGH
EFFECT – Upshift switch will not function, higher gears cannot be selected.
NOTE: If required, key off and restart to select B1/R1.

Disconnect processor connectors C100 & C101, and disconnect connector, C103, to upshift/downshift/range shift assembly. Using a suitable multimeter, check between C100–32 & C103–CM7210–S/LG/B. For: (1) Open Circuit (2) Short to ground. Is either condition indicated?
YES → Trace and repair faulty wiring
NO → Reconnect processor connectors. Leave up/down range switch assembly disconnected with key start on. Check for voltage on C103–CM7210–S/LG/B. Is +5v, +8v or +12V indicated?
YES → Trace and repair short circuit, using voltage previously indicated to determine possible area of faults.
NO → Reconnect up/down/range switch connector if error is still indicated. Inspect connector and check operation of switches with multimeter. If no fault found, substitute module with one of known performance.





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ERROR CODES;
F62 – DOWNSHIFT SWITCH INPUT VOLTAGE LOW
F63 – DOWNSHIFT SWITCH INPUT VOLTAGE HIGH
EFFECT – Downshift switch will not function, lower gears cannot be selected.
NOTE: If required, key on and restart to select B1/R1.

Disconnect processor connectors C100 & C101, and disconnect connector, C103, to upshift/downshift/range shift assembly. Using a suitable multimeter, check between C100–6 & C103–CM7200–S/K/B. For: (1) Open Circuit (2) Short to ground. Is either condition indicated?

YES → Trace and repair faulty wiring

NO

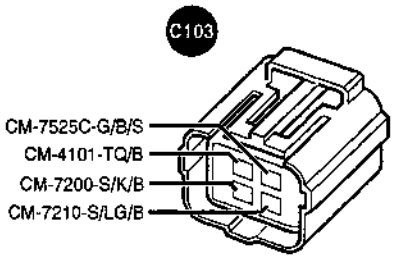
Reconnect processor connectors. Leave up/down range switch assembly disconnected with key start on. Check for voltage on C103–CM7200–S/K/B. Is +5v, +8v or +12V indicated?

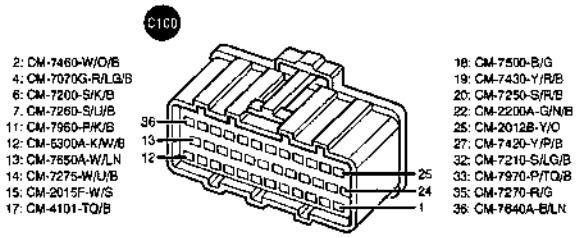
YES

Trace and repair short circuit, using voltage previously indicated to determine possible area of faults.

NO

Reconnect up/down/range switch connector if error is still indicated. Inspect connector and check operation of switches with multimeter. If no fault found, substitute module with one of known performance.





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ERROR CODES;
F64 – RANGE SWITCH INPUT VOLTAGE LOW
F65 – RANGE SWITCH INPUT VOLTAGE HIGH
EFFECT – Range switch will not function. Another range may be selected by depressing the clutch pedal or shifting into neutral.

Disconnect processor connectors C100 & C101, and disconnect connector, C103 to upshift/downshift/range shift assembly. Using a suitable multimeter, check between C100–17 & C103–CM4101–TQ/B. For: (1) Open Circuit (2) Short to ground. Is either condition indicated?

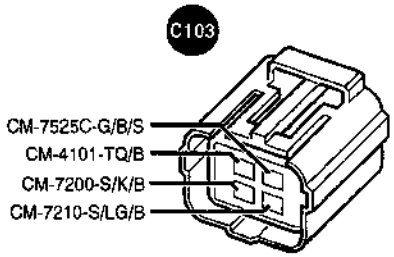
YES → Trace and repair faulty wiring

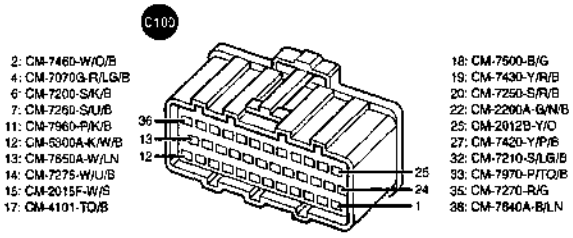
NO

Reconnect processor connectors. Leave up/down range switch assembly disconnected with key start on. Check for voltage on C103–CM4101–TQ/B. Is +5v, +8v or +12V indicated?

YES → Trace and repair short circuit, using voltage previously indicated to determine possible area of faults.

NO → Reconnect up/down/range switch connector if error is still indicated. Inspect connector and check operation of switches with multimeter. If no fault found, substitute module with one of known performance.





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ERROR CODES;
F66 – FORWARD SWITCH INPUT VOLTAGE TOO LOW
F67 – FORWARD SWITCH INPUT VOLTAGE TOO HIGH
EFFECT – Tractor will operate normally, except there will be a short delay recognizing that forward has been selected.

Disconnect processor connectors C100 & C101, and disconnect connector, C075 to forward/reverse/neutral switch assembly. Using a suitable multimeter, check between C100–20 & C075–CM7250–S/R/B. For: (1) Open Circuit (2) Short to ground. Is either condition indicated?

YES → Trace and repair faulty wiring

NO

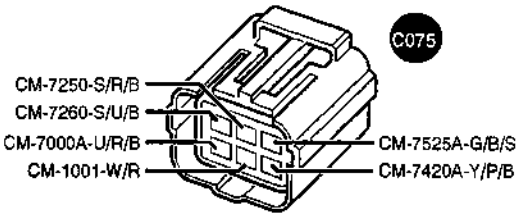
Reconnect processor connectors. Leave forward/reverse/neutral switch assembly disconnected with key start on. Check for voltage on C075–CM7250–S/R/B. Is +5v, +8v or +12V indicated?

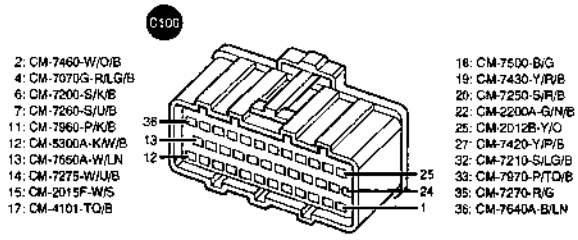
YES

Trace and repair short circuit, using voltage previously indicated to determine possible area of faults.

NO

Reconnect forward/reverse/neutral switch connector if error is still indicated. Inspect connector and check operation of switches with multimeter. If no fault found, substitute module with one of known performance.





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ERROR CODES;
F68 – REVERSE SWITCH INPUT VOLTAGE TOO LOW
F69 – REVERSE SWITCH INPUT VOLTAGE TOO HIGH
EFFECT – Tractor will operate normally, except there will be a slight delay recognizing that reverse has been selected.

Disconnect processor connectors C100 & C101, and disconnect connector, C075 to forward/reverse/neutral switch assembly. Using a suitable multimeter, check between C100–7 & C075–CM7260–S/U/B. For: (1) Open Circuit (2) Short to ground. Is either condition indicated?

YES → Trace and repair faulty wiring

NO

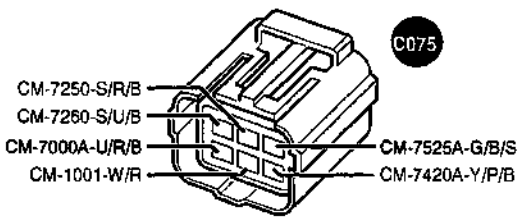
Reconnect processor connectors. Leave forward/reverse/neutral switch assembly disconnected with key start on. Check for voltage on C075–CM7260–S/U/B. Is +5v, +8v or +12V indicated?

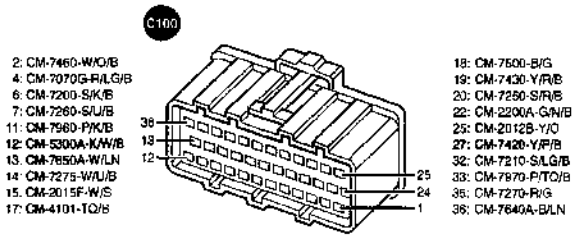
YES

Trace and repair short circuit, using voltage previously indicated to determine possible area of faults.

NO

Reconnect forward/reverse/neutral switch connector if error is still indicated. Inspect connector and check operation of switches with multimeter. If no fault found, substitute module with one of known performance.





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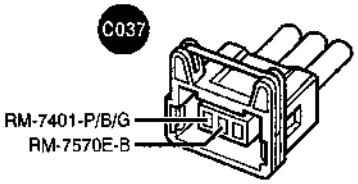
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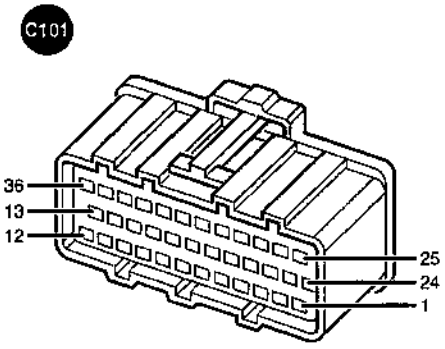
ERROR CODES;
F73 – MID SPEED SENSOR OPEN CIRCUIT
F74 – MID SPEED SENSOR SHORT CIRCUIT
EFFECT – Centrifugal compensation assumes 2300 rpm for clutch B, minor shift performance loss at other speeds. Gears affected 2, 4 and 6.

Is the mid speed sensor connected to harness
NO → Reconnect connector, C037
YES ↓

Disconnect mid speed sender connector, C037, to harness and disconnect C100 & C101 from the processor. With a suitable multimeter check wiring from C101–2 to C037–RM7401–P/B/G. For open/short circuit. Is fault found?
YES → Trace and repair wiring fault
NO ↓

With the mid speed sensor installed, check between the sensor connector terminals for a short or open circuit within the sensor. Replace the sensor assembly if a fault is indicated.

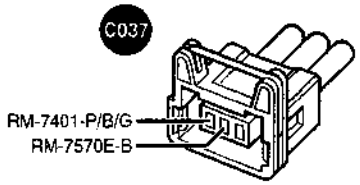


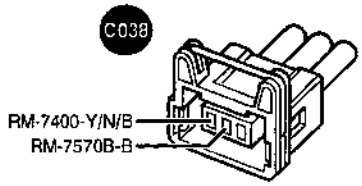


1: CM-7570-B
2: CM-7401-P/B/G
5: CM-7525-G/B/S
6: CM-7400-Y/N/B
9: CM-57AE-B
10: CM-7985-G/O/S
11: CM-7920-TQ/O/B
12: CM-7915-P/O/S
13: CM-7935-P/N/S
14: CM-7930-TQ/R/B
15: CM-7980-K/LG/B
16: CM-7220-S/N/B
17: CM-7910-TQ/N/B
18: CM-7431-TQ/W/B
19: CM-7230-S/O/B
20: CM-7940-TQ/S/B
25: CM-7520-G/N/S
26: CM-7900-TQ/K/B
28: CM-7945-P/TQ/S
29: CM-7000C-U/R/B
30: CM-7050-R/G/B
31: CM-5000C-P
32: CM-57AK-B
33: CM-57AL-B
34: CM-7000D-U/R/B
35: CM-7000B-U/R/B
36: CM-7925-P/R/S

ERROR CODE F75
SWAPPED MID AND REAR SPEED SENSORS
EFFECT – After error is detected the tractor will operate normally.

Swap speed sensor connectors, C037 and C038.

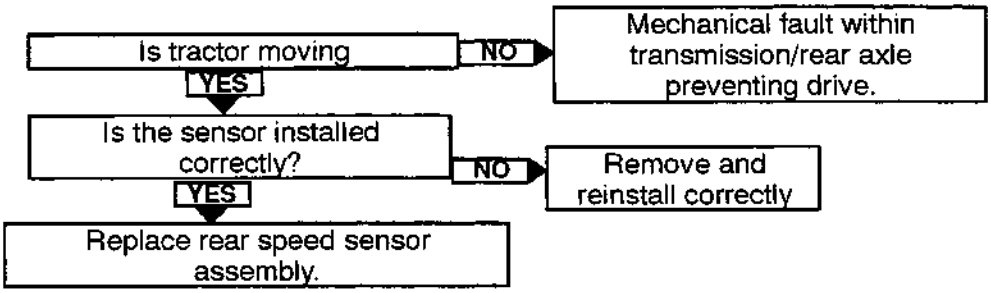




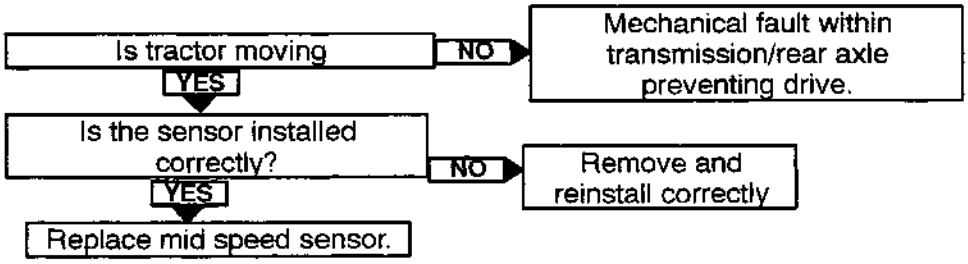
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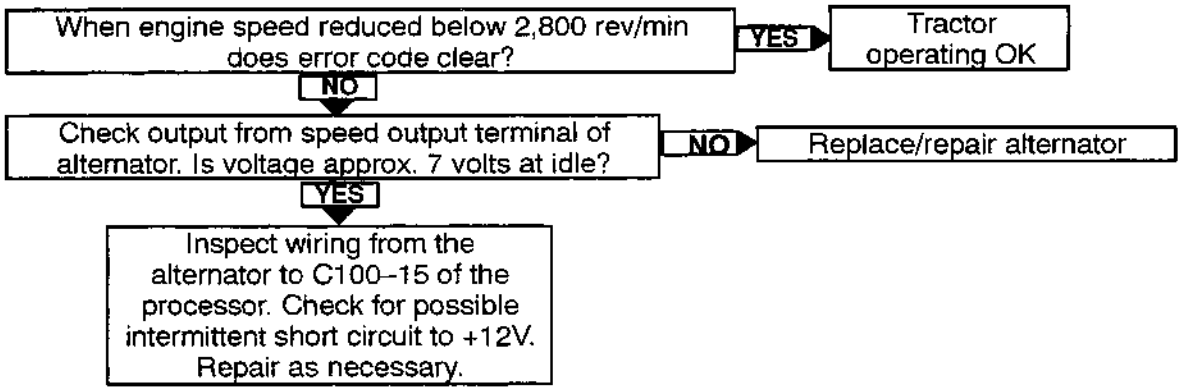
ERROR CODE F77
NO SIGNAL FROM REAR WHEEL SPEED SENSOR.
EFFECT – Upshifts in high range inhibited. Jerky or sluggish shuttle shifting and automatic take off generally poor shifting.



ERROR CODE F78
NO SIGNAL FROM MID SPEED SENSOR.
EFFECT – Centrifugal compensation assumes 2,300 rpm for Clutch B. Minor shift quality loss at other speeds, only affect gears 2, 4 and 6.



ERROR CODE F79
ENGINE RPM EXCEEDS 3000 REV/MIN.
EFFECT – General shift quality poor and/or delayed.



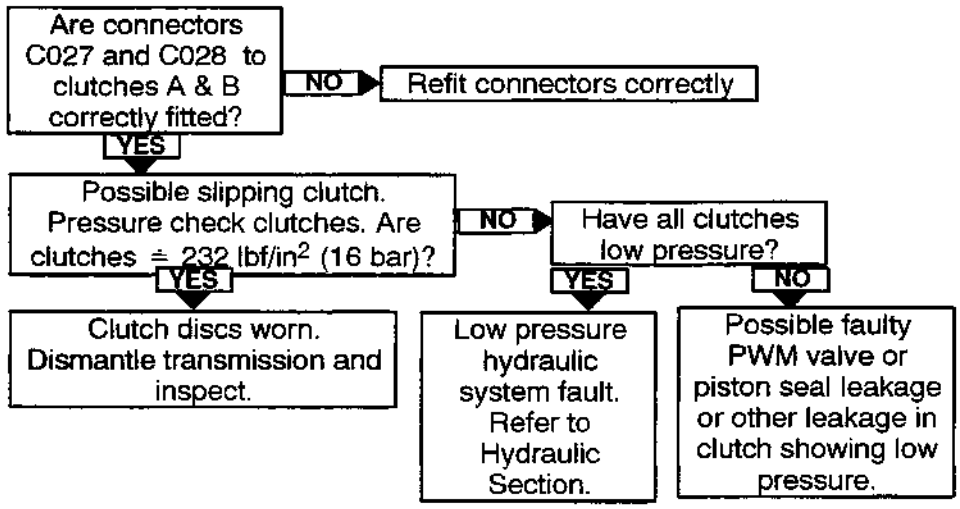
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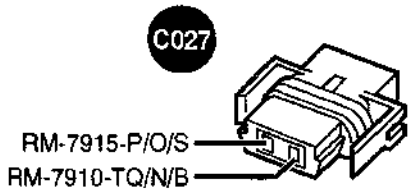
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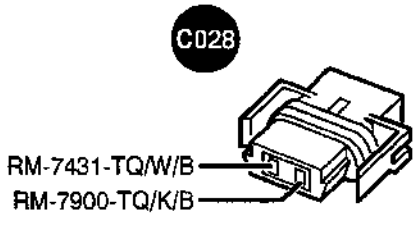
ERROR CODE F80
TRANSMISSION OUTPUT REV/MIN TOO HIGH FOR SELECTED GEAR.
EFFECT – None

Self clearing when speed OK for gear selected.

ERROR CODE F81
CORRECT RATIO NOT DETECTED (OUTPUT SPEED TOO LOW FOR GEAR SELECTED)
EFFECT – Transmission disabled.







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ERROR CODE CP
DEPRESS CLUTCH PEDAL TO RE–ENABLE TRANSMISSION
EFFECT – Transmission disabled.

Depress clutch pedal or cycle shuttle switch to re–enable transmission. If CP does not extinguish proceed.

Inspect for loose harness connectors at C100, C101, C019 and C001. Are any connections loose?
- YES → Inspect connector and ensure a tight fit. Is Error Code eliminated?
  - YES → Test drive tractor to ensure code does not re–appear
  - NO ↓
- NO ↓

Check for an intermittent short to ground on the neutral start switch wiring:
With the keystart OFF and the FNR lever in either F or R, connect a continuity meter between connector C100–27 and ground. An open circuit should be indicated. Twist the harness from C100 to the shuttle switch. Is continuity indicated at any time?
- YES → Locate and repair short circuit
- NO ↓

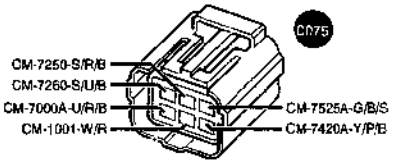
Check for an intermittent short to ground on the shuttle switch wiring: With the keystart OFF and the FRN lever in N, connect a continuity meter between connector C100–27 and C075–CM7420–Y/P/B. Continuity should be indicated. Twist the harness from C100 down to C075. Is an open circuit indicated at any time?
- YES → Locate and repair open circuit
- NO ↓

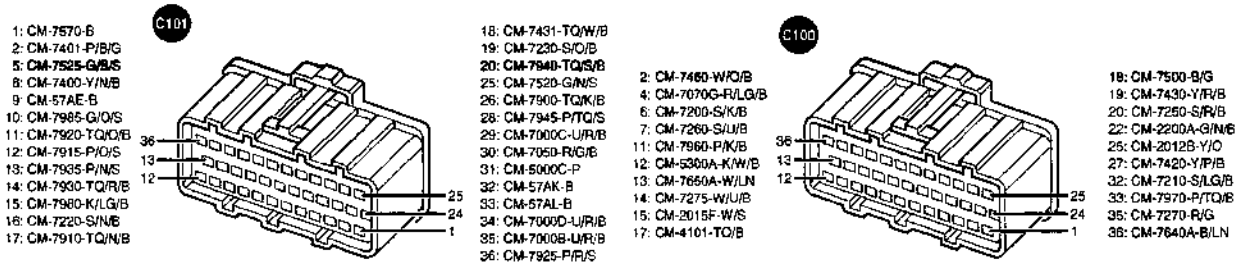
Check for an intermittent fault in +12V supply to processor module. Check for continuity between fuse 13 output and C101–34 and C101–35. Is an open circuit indicated at any time?
- YES → Locate and repair open circuit
- NO ↓

Check for an intermittent fault in ground wiring to processor module. Check for continuity between C101–32, C101–33 and C101–9 and ground. Is an open circuit indicated at any time?
- YES → Locate and repair open circuit
- NO ↓

Remove and inspect the shuttle neutral switch. Replace with a switch of known performance. Test drive tractor. Is Error Code eliminated?
- YES → Discard of removed switch
- NO ↓

Substitute processor with one of known performance





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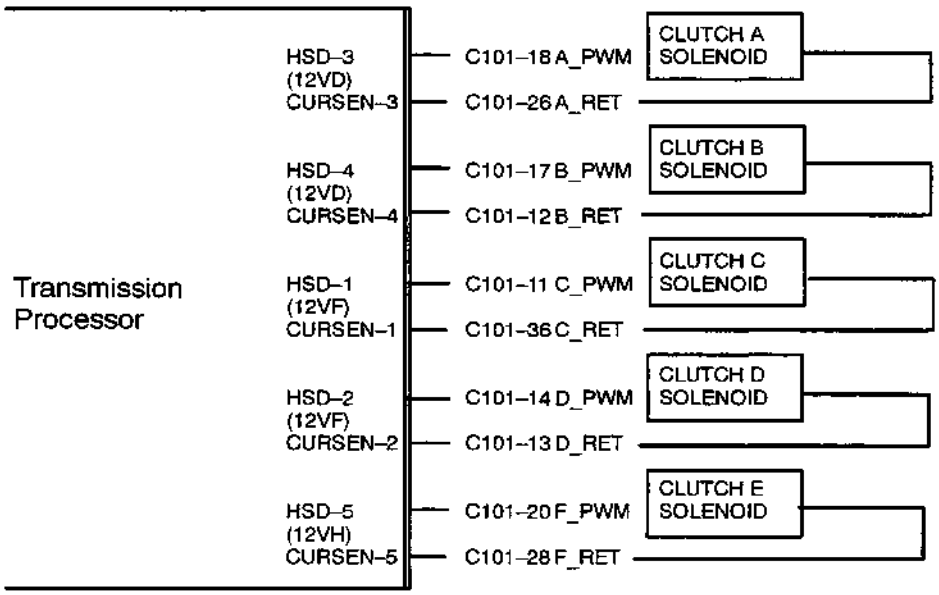
SEMI–POWERSHIFT (18 x 6)
CALIBRATIONS, FAULT FINDING & PRESSURE TESTING

F1A – CLUTCH A OPEN OR SHORT TO GROUND
F2A – CLUTCH A SHORT TO 12V
F1B – CLUTCH B OPEN OR SHORT TO GROUND
F2B – CLUTCH B SHORT TO 12V
F1C – CLUTCH C OPEN OR SHORT TO GROUND
F2C – CLUTCH C SHORT TO 12V
F1D – CLUTCH D OPEN OR SHORT TO GROUND
F2D – CLUTCH D SHORT TO 12V
F1E – CLUTCH E OPEN OR SHORT TO GROUND
F2E – CLUTCH E SHORT TO 12V

Error codes F1A through to F2E indicate either a short or open circuit in the wiring of one of the PWM solenoids. Using a suitable multimeter check the wiring from the PWM solenoid back to the processor module. Locate the short/open circuit, repair or replace wiring as necessary.

If wiring is okay disconnect the PWM solenoid from the harness and check that the resistance of the PWM coil is approximately 10Ω at 68°F (20°C). If not, replace the PWM solenoid.

If wiring and PWM solenoids are okay replace the micro processor with one of known performance.



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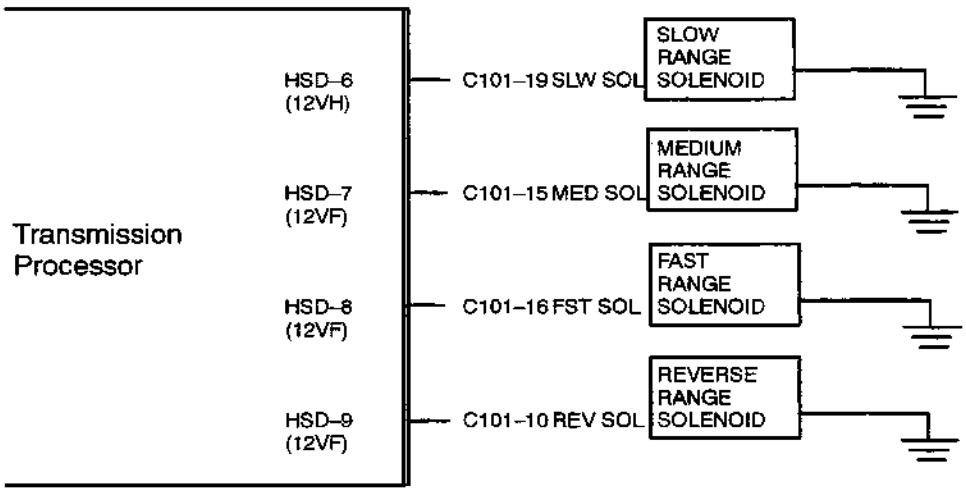
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SEMI–POWERSHIFT (18 x 6)
CALIBRATIONS, FAULT FINDING & PRESSURE TESTING

F1P – REVERSE SOLENOID OPEN OR SHORTED TO GROUND
F1L – SLOW RANGE SOLENOID OPEN OR SHORTED TO GROUND
F1U – MID RANGE SOLENOID OPEN OR SHORTED TO GROUND
F1H – FAST RANGE SOLENOID OPEN OR SHORTED TO GROUND

Error codes F1P, F1L, F1U and F1H indicate open or short circuits to ground in the wiring to the solenoid. Using a suitable multimeter check the wiring from the solenoid back to the processor. Locate the wiring fault and repair or replace wiring as necessary.

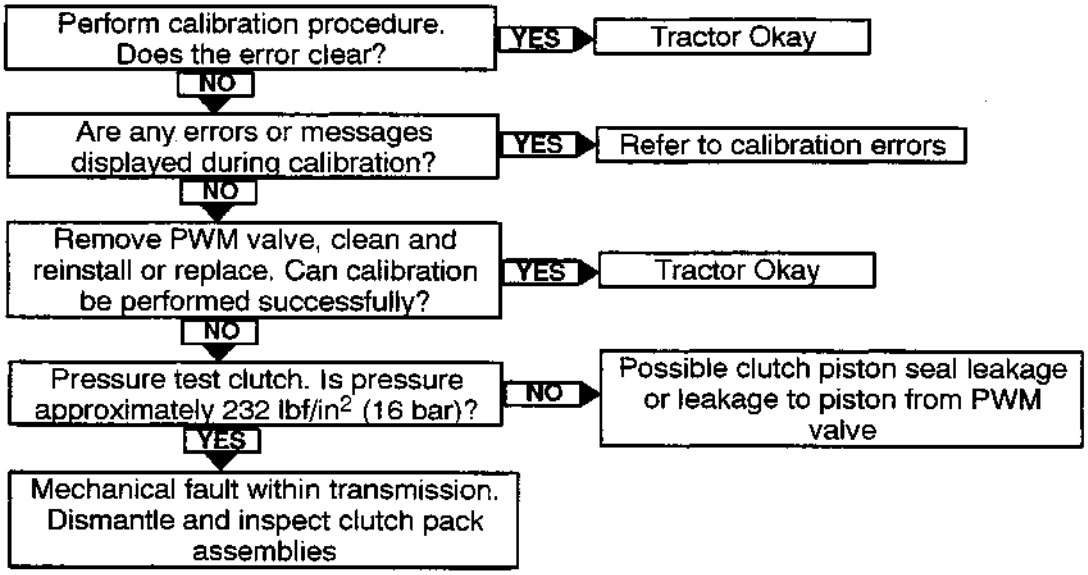
If wiring is okay, disconnect the solenoid from the harness and check the solenoid resistance is approximately 6–8Ω at 68°F (20°C). If not correct or open/short circuit is indicated replace solenoid.



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ERROR CODES;
FCA – CLUTCH A NOT CALIBRATED
FCB – CLUTCH B NOT CALIBRATED
FCC – CLUTCH C NOT CALIBRATED
FCD – CLUTCH D NOT CALIBRATED
FCE – CLUTCH E NOT CALIBRATED
EFFECTS – Poor clutch performance of uncalibrated clutch.



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CALIBRATION ERRORS AND MESSAGES

U19 – Oil temperature below 40°F (10°C)

Warm oil to above 40°F (10°C) before processing with calibration.

U21 – Engine RPM too low

Increase engine RPM to 1200 ± 100

U22 – Engine RPM too high

Reduce engine RPM to 1200 ± 100

U23 – Shuttle lever is in neutral

Place shuttle lever in forward

U26 – Clutch pedal not released

Release clutch pedal

U31 – Output speed sensed – tractor moving

Ensure handbrake is applied and wheels choked. If error persists check that the Mid and Rear transmission speed sensor connectors are not swapped, if okay then possible mechanical fault within transmission.

U36 – Maximum allowed clutch calibration value exceeded

Current value exceeded without lugging engine down. Possible PWM valve faulty. Low Hydraulic Pressure fault or a faulty synchronizer not transmitting drive.

U37 – Engine RPM dropped too soon

Engine lugged down too soon. Possible PWM fault or mechanical fault within transmission.

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CALIBRATION ERRORS AND MESSAGES (Continued)

U81 – No Mid/Reverse synchronizer movement sensed

U82 – No Low/High synchronizer movement sensed

Mechanical fault to synchronizer potentiometer or Low/No Hydraulic Pressure to synchronizer piston. Pressure test – if low pressure, remove and inspect solenoid valve. If pressure good suspect stuck piston – remove side cover and inspect.

U83 – synchronizer potentiometer connectors swapped

Assemble connectors correctly

U84 – Reverse and high synchronizer solenoid connectors swapped

Assemble connectors correctly

U85 – Mid and low synchronizer solenoid connectors swapped

Assemble connectors correctly

U86 – Mid/Reverse synchronizer neutral error

U87 – Low/High synchronizer neutral error

synchronizer NOT in neutral: Enter HD MODE, confirm synchronizer operational if neutral error confirmed suspect mechanical fault with synchronizer. Remove side cover and inspect. With side removed also inspect linkage to potentiometer.

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CALIBRATION ERRORS AND MESSAGES (Continued)

U88 – Mid/Reverse synchronizer calibration values out of tolerance

U21 – Low/High synchronizer calibration values out of tolerance

Check potentiometer operation, removed from transmission, if to specification remove side cover and inspect potentiometer linkage.

CF – Calibration procedure completed successfully

CH – Oil temperature above 122°F (50°C)

Message for information only. Press upshift to proceed.

CL – Oil Temperature between 40 and 68 degrees F (10 and 20°C)

Message for information only. Press upshift to proceed.

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SECTION 4

TRANSMISSIONS

CHAPTER 3

DUAL COMMAND TRANSMISSION

CONTENTS

SPECIFICATIONS 4-3-2
TIGHTENING TORQUE 4-3-5
SPECIAL TOOLS 4-3-7
SECTIONAL VIEWS 4-3-11
DESCRIPTION AND OPERATION 4-3-13
TROUBLESHOOTING ..... SEE CHAPTER 4
REMOVAL – INSTALLATION – OVERHAUL 4-3-16
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SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

SPECIFICATIONS – DUAL COMMAND TRANSMISSION & RANGE GEARS

Transmission	4–speed with constant–mesh gears and synchronizers on all speed gears, controlled by two independent clutch packs
Gear type	Helically toothed
Range gears	Cascade–scheme, with 3 forward and 3 reverse ranges for a total of 12 forward and 12 reverse speeds
–Gear type	Helically toothed
– Reduction ratios:	
Low	(24 x 15) : (46 x 55) = 1 : 7.03
Normal	(24 x 29) : (46 x 37) = 1 : 2.45
High	1
Speed and range shift controls	Independent, by two hand levers at the operator's right side and two push–buttons located on the main shift lever
Speed and range gear lubrication	Forced–fed by a gear pump (same as the power steering circuit pump)
Number of driven discs–Clutch A	7
– Thickness of driven discs – Clutch A in (mm)	0.104 to 0.108 (2.65 to 2.75)
Number of drive discs – Clutch A	7
– Thickness of drive discs – Clutch A in (mm)	0.071 to 0.079 (1.80 – 2.00)
Multi–pack clutch thickness under a load of 359 ft. lbs. (163 kg) in (mm)	1.29 to 1.30 (32.7 to 32.9)
Number of Belleville springs – Clutch A	9
– Free length in (mm)	0.165 (4.2)
–Compressed length under a load of 474 ft. lbs. (215 kg)in (mm)	0.129 (3.28)

(to be continued)

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SPECIFICATIONS – DUAL COMMAND TRANSMISSION AND RANGE GEARS

(continued)

Number of driven discs–Clutch B	7
–Thickness of driven discs – Clutch B in (mm)	0.104 to 0.108 (2.65 to 2.75)
Number of drive discs – Clutch B	7
– Thickness of drive discs – Clutch B in (mm)	0.071 to 0.079 (1.80–2.00)
Multi–pack clutch B thickness under a load of 359 ft. lbs. (163 kg) in (mm)	1.29 to 1.30 (32.7 to 32.9)
Number of Belleville springs – Clutch B	9
– Free length in (mm)	0.165 (4.2)
– Compressed length under a load of 474 ft. lbs. (215 kg) in (mm)	0.129 (3.28)
Speed driven gear inner diameter in (mm)	2.364 to 2.366 (60.060 to 60.090)
Bushing outer diameter in (mm)	2.361 to 2.362 (59.981 to 60.000)
Gears to bushings clearance in (mm)	0.002 to 0.004 (0.060 to 0.109)
Speed output shaft diameter in (mm)	1.944 to 1.945 (49.375 to 49.391)
Bushing inner diameter in (mm)	1.945 to 1.946 (49.400 to 49.430)
Shaft to bushings clearance in (mm)	0.0003 to 0.002 (0.009 to 0.055)
Range driven gear inner diameter in (mm)	2.364 to 2.366 (60.060 to 60.090)
Bushing outer diameter in (mm)	2.361 to 2.362 (59.981 to 60.000)
Gears to bushings clearance in (mm)	0.002 to 0.004 (0.060 to 0.109)
Range output shaft diameter in (mm)	1.944 to 1.945 (49.375 to 49.391)
Bushing inner diameter in (mm)	1.945 to 1.946 (49.400 to 49.430)
Shaft to bushings clearance in (mm)	0.0003 to 0.002 (0.009 to 0.055)
PTO drive shaft diameter (at the bushing) in (mm)	1.258 to 1.259 (31.950 to 31.975)
Press–fit bushing inner diameter in (mm)	*1.259 to 1.263 (31.990 to 32.085)
PTO drive shaft to bushings clearance in (mm)	0.0006 to 0.005 (0.015 to 0.135)
Shuttle gear end play adjust ring (9, Figure 4-3-11) in (mm)	0.197–0.203–0.209 (5.00–5.15–5.30)
	See page 4-3-41
Shuttle gear end play adjustment	0.156 – 0.158 (3.95–4.00)
Speed output shaft thrust washer in (mm)	
Range input shaft bearing adjustment	see page 4-3-46
Range input shaft bearing adjust shims (12, Figure 4-3-11) mm	1.70 – 1.75 – 1.80 –1.85 – 1.90 – 1.95 – 2.00 – 2.05 – 2.10 – 2.15 – 2.20 – 2.25 – 2.30 –2.35 – 2.40 – 2.45 – 2.50 – 2.55 – 2.60 – 2.65 – 2.70 – 2.75 – 2.80 – 2.85 – 2.90 – 2.95 – 3.00 – 3.10 – 3.20 – 3.30
Range output shaft bearing adjustment	see page 4-3-46
Range output shaft adjust shims (13, Figure 4-3-11) mm	1.70 –1.75 – 1.80 –1.85 – 1.90 – 1.95 – 2.00 – 2.05 – 2.10 – 2.15 – 2.20 – 2.25 – 2.30 –2.35 – 2.40 – 2.45 – 2.50 – 2.55 – 2.60 – 2.65 – 2.70 – 2.75 – 2.80 – 2.85 – 2.90 – 2.95 – 3.00 – 3.10 – 3.20 – 3.30

* Final dimension to be obtained without grinding

(to be continued)

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SPECIFICATIONS – DUAL COMMAND TRANSMISSION AND RANGE GEARS

(continued)

Implement pressure regulating valve spring (12, Figure 4-3-12):	
– Free length ..... in (mm)	5.00 (127)
– Compressed length under a load of	4.04 (102.5)
62.6 to 68.3 ft. lbs. (28.4 to 31 kg) ..... in (mm)	242 to 255 (16.7 to 17.6)
Implement working pressure ..... lbf/in^2 (bar)	
Lubrication pressure regulating valve spring (28, Figure 4-3-11):	
– Free length ..... in (mm)	1.14 (29)
– Compressed length under a load of	0.964 (24.5)
10.8 to 12.0 ft. lbs. (4.94 to 5.46 kg) ..... in (mm)	64 to 86 (4.4 to 5.9)
Lubrication pressure ..... lbf/in^2 (bar)	

SPECIFICATIONS – CREEP GEARS

Gear type	Epicyclic spur gear set
Reduction ratio	20 : (20+100) = 1:6
Control	By a dedicated lever at the operator's left side
Creeper support and driven gear thrust washer thickness ..... in (mm)	0.058 to 0.060 (1.465 to 1.535)

SPECIFICATIONS – SHUTTLE GEARS

type	Mechanical, with helically toothed gears
Engagement	Through a synchronizer
Reduction ratio	(43 x 37 x 39) : (37 x 39 x 44) = 1 : 1.02
Driven gear bearing adjust shims (19, Figure 4-3-11) ..... mm	2.55 – 2.60 – 2.65 – 2.70 – 2.75 – 2.80 – 2.85 – 2.90 – 2.95 – 3.00 – 3.05 – 3.10 – 3.15
Driven gear bearing adjustment	see page 4-3-44

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TIGHTENING TORQUE

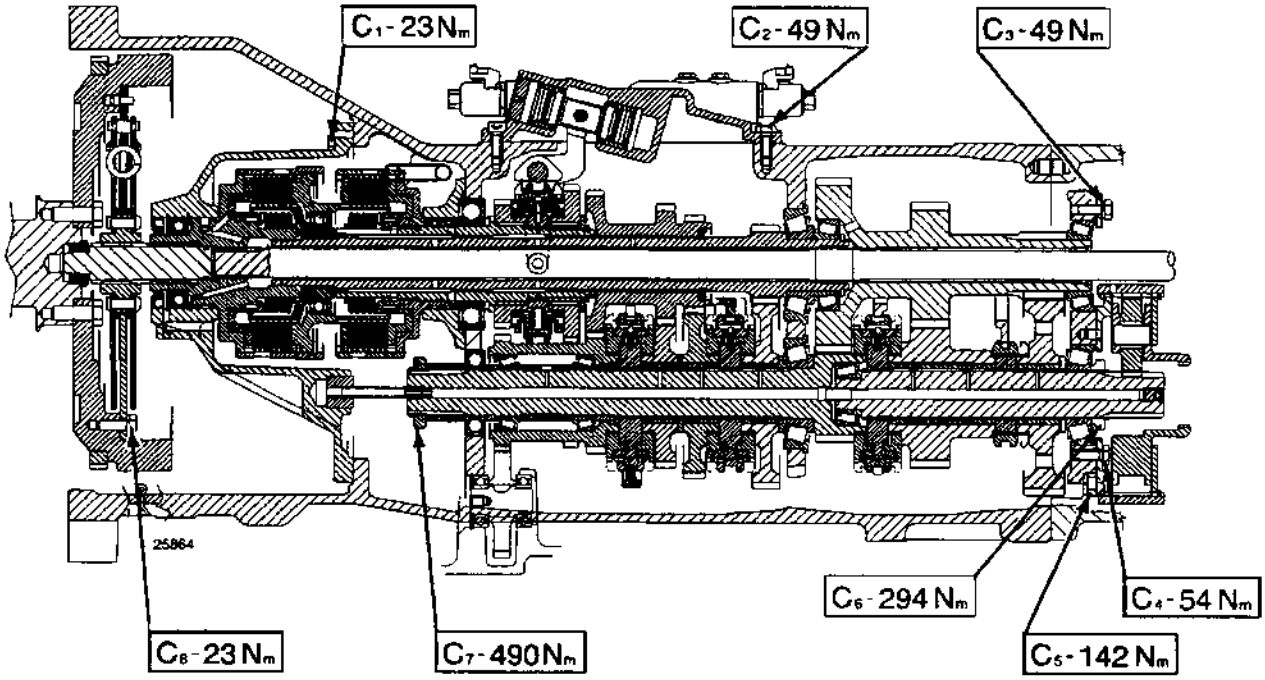
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DESCRIPTION	Thread size	Torque ft. lbs. (Nm)
Bolts and nuts, transm housing to engine	(see C_3 and C_4, page 3-2-3, Sec. 3)	
Bolts, transm housing to rear axle	M14 x 1.5	130 (176)
Bolts, cab to rubber mounts SILENTBLOCK	–	251 to 309 (340 to 420)
Bolts, cab support bracket (front)	–	84 to 109 (114 to 148)
Bolts, cab support bracket (rear)	–	184 to 228 (250 to 309)
Bolts, clutch housing front cover (C_1)	M8 x 1.25	16.9 (23)
Bolts, transmission housing cover (C_2)	M10 x 1.25	36.1 (49)
Bolts, range rear bearing retaining plate (C_3)	M10 x 1.25	36.1 (49)
Bolts, creeper gear fixed plate (C_4)	M10 x 1.25	39.8 (54)
Bolts, range rear bearing support plate(C_5)	M14 x 1.5	105 (142)
Nut, range output shaft (C_6)	M47.5 x 1.5	217 (294)
Nut, speed output shaft (C_7)	M45 x 1.5	361 (490)
Bolts, damper assembly to flywheel (C_8)	M12 x 1.25	16.9 (23)
Screw, solenoid valve (C_9) (*)	–	4.0 to 59.7 (5.4 to 81)
Screw, solenoid valve pin (C_{10}) (*)	–	34.6 to 39.8 (47 to 54)
Bolts, range and speed control lever support (C_{11})	M10 x 1.25	36.1 (49)
Plug, lubrication pressure regulating valve	M18 x 1.5	36.1 (49)
Bolts, transmission input shaft support cover	M8 x 1.25	16.9 (23)

(*) Apply a couple of drops of Loctite 542

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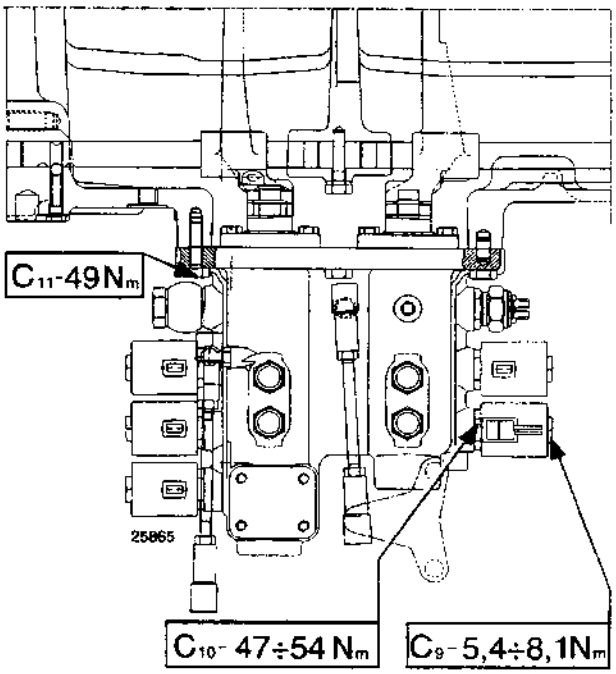


Figure 4-3-1

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SPECIAL TOOLS

Caution – Operations described in this Section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to carry out the different operations described in this Section.

	FTC213997B	Cab lifting fixture
	FTC201387	Tractor separation stand
	293343	Output shaft nut wrench.
X	**293805**	Driven shaft retainer (use with tool no. **50062**)
X	**293808**	Output shaft retaining tool
	292176	Range input and output shaft end play test tool (use with tools nos. **50013** and **50018**)
	291525	Transmission and rear axle housing alignment pins
X	**293869**	Output shaft bearing installer (use with tool no. **50108**)
	292888	Clutch cover alignment pins
	295021	Clutch spring compressor
	292870	Pressure test kit (use with tool no. **295024**)
	295024	Fitting (kit no. **292870**)
	295049	Range output shaft retaining tool

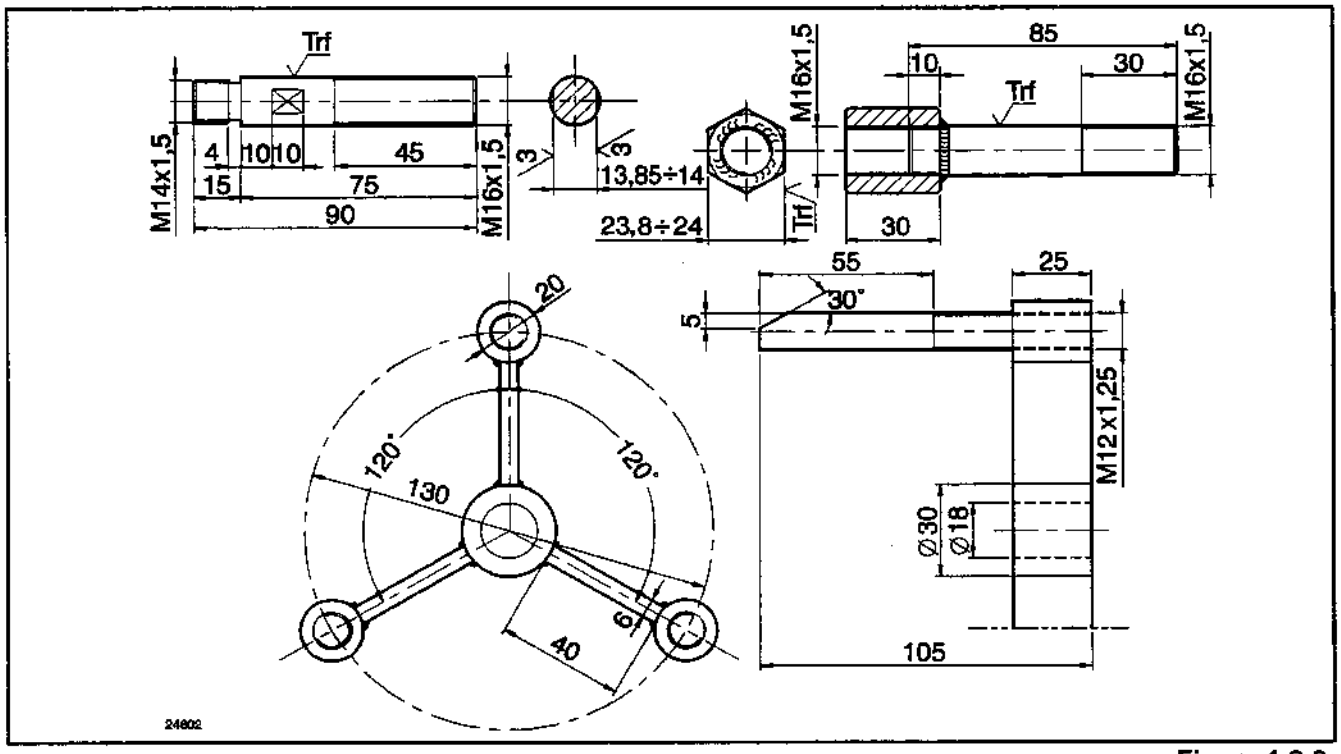


Figure 4-3-2

Tool to be fabricated for range input and output shaft bearing adjustment (Mark tool with no. 50018 – Dimensions in mm).
Fabricate tool using Aq42 material.

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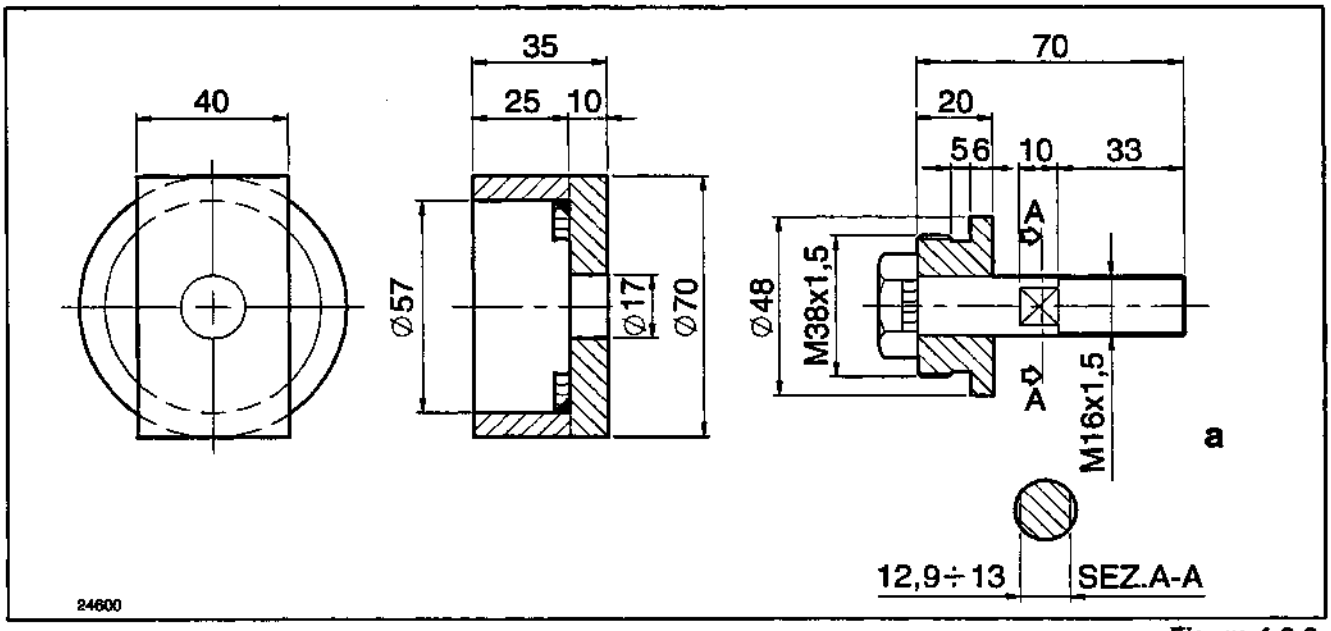


Figure 4-3-3

Tool to be fabricated for range input shaft taper bearing assembly (Mark tool with no. 50013 – Dimensions in mm).
Fabricate tool using UNI C40 material. – Use only part (a)

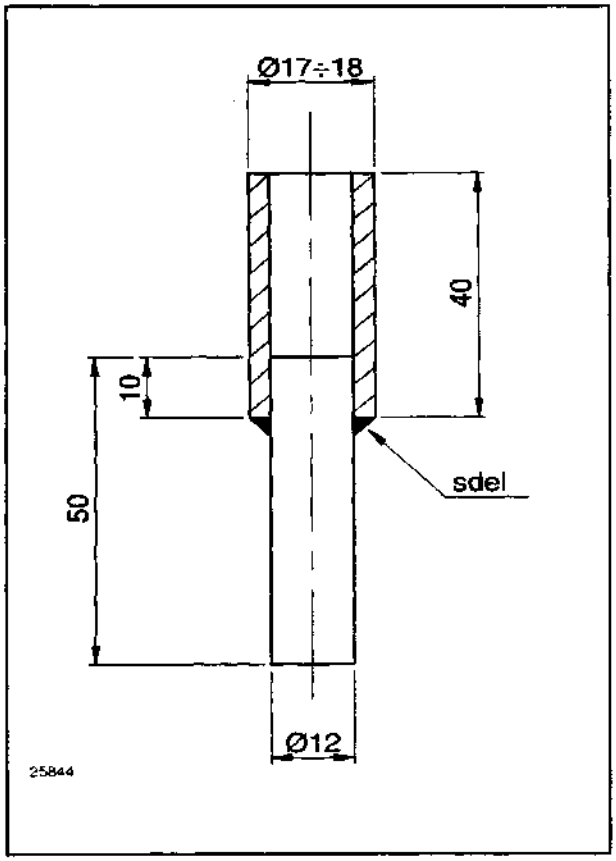


Figure 4-3-4

Tool to be fabricated for clutch B snap ring (Mark tool with no. 50115 – Dimensions in mm Fabricate tool using UNI C40 material.

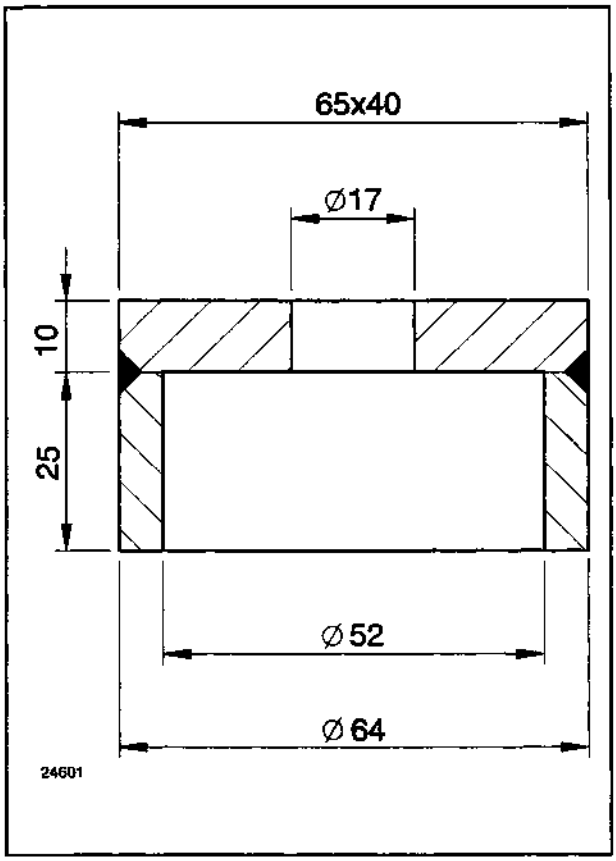


Figure 4-3-5

Tool to be fabricated for range output shaft bearing assembly (Mark tool with no. 50061 – Dimensions in mm).
Fabricate tool using C30 material.

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Tool to be fabricated for range input shaft bearing assembly (Mark tool with no. 50060 – Dimensions in mm).
Fabricate tool using C30 material.

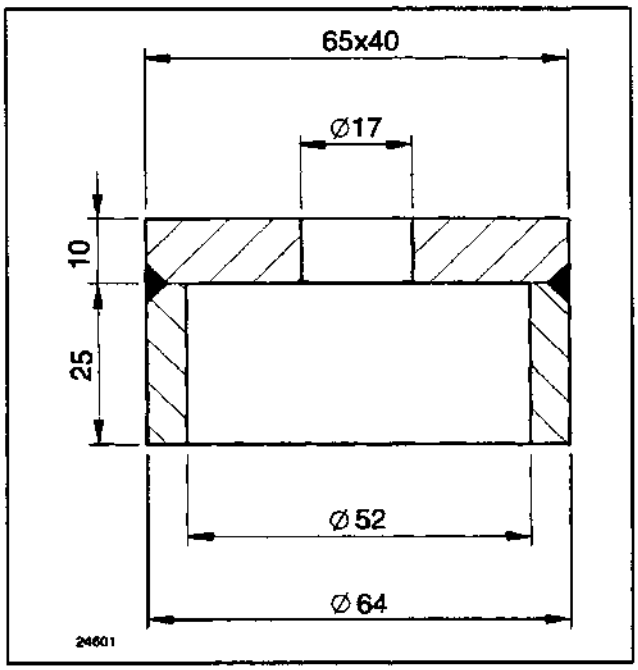


Figure 4-3-6

Bracket to be fabricated to place the transmission on the rotary stand, to be used with bracket tool no. 293971. (Mark tool with no. 50110 – Dimensions in mm).
Fabricate tool using Fe 42 C material.

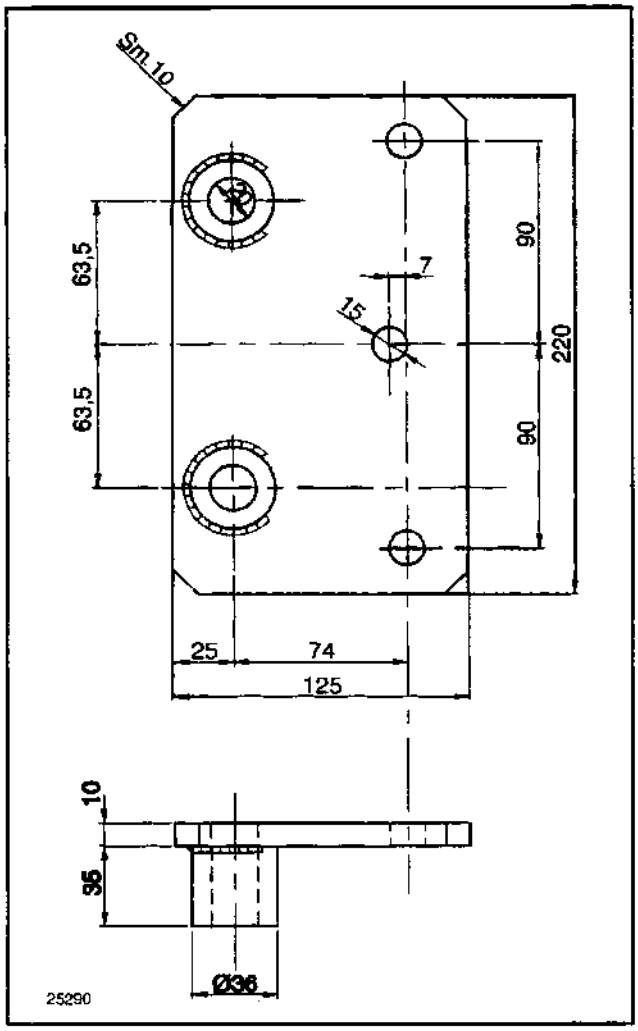


Figure 4-3-7

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Tool to be fabricated for input and output shaft bearing assembly. (Mark tool with no. 50108 – Dimensions in mm).
Fabricate tool using UNI C40 material.

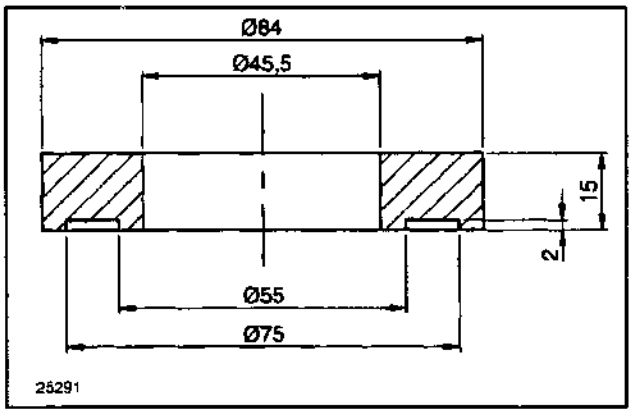


Figure 4-3-8

Alignment pins for engine and transmission housing and engine removal/installation. (Mark tool with no. 50117 – Dimensions in mm).
Fabricate tool using UNI C40 material.

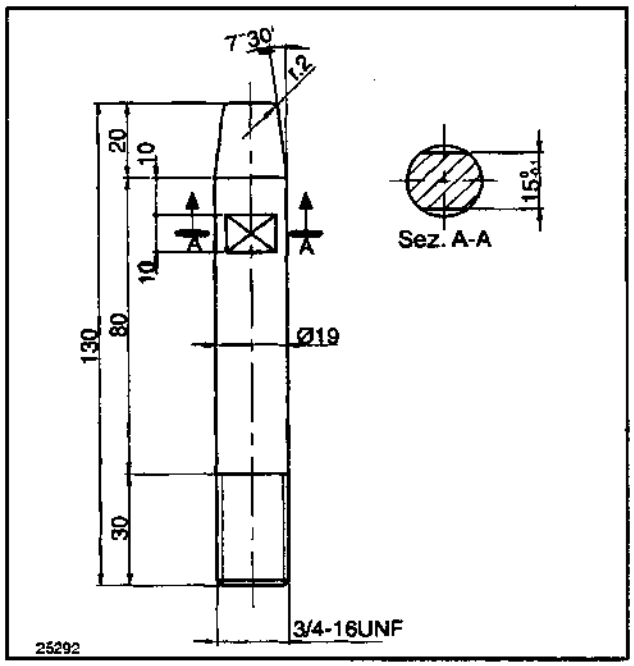


Figure 4-3-9

Adapter for reverse idler gear pin removal. (Mark tool with no. 50143 – Dimensions in mm).
Fabricate tool using UNI C40 material.

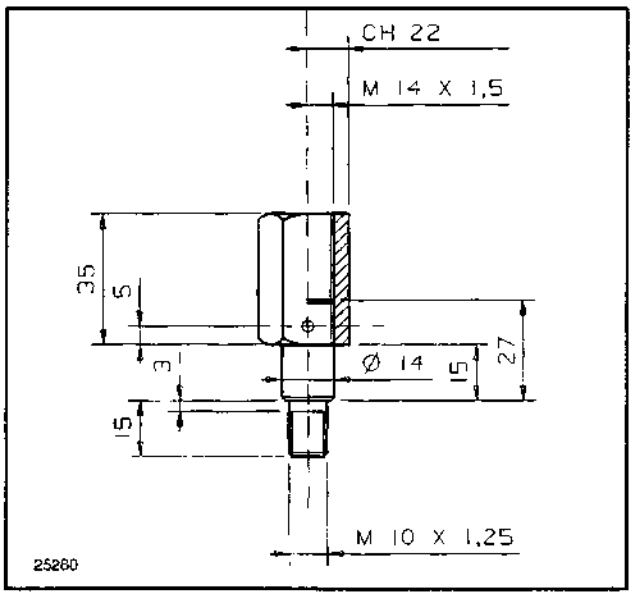


Figure 4-3-10

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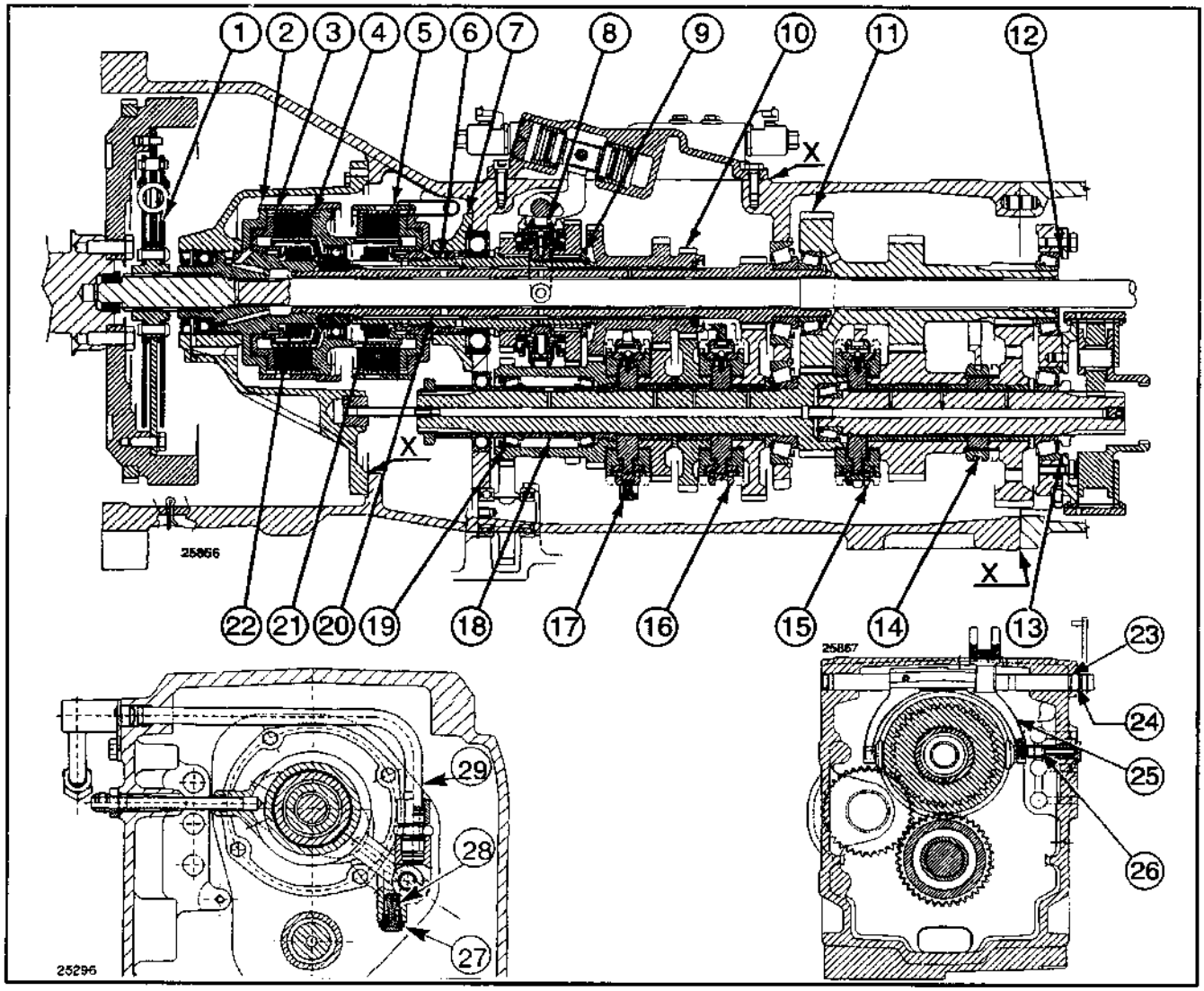


Figure 4-3-11

Transmission Longitudinal and Sectional Views

1. Damper coupler
2. Clutch A housing
3. Clutch A drive discs
4. Clutch A driven discs
5. Clutch B housing
6. Direct drive and reverse drive shaft
7. Cover plate
8. Shuttle control synchronizer
9. Shuttle adjust shim
10. Speed drive gear
11. Range input shaft
12. Range input shaft adjust shim
13. Range output shaft adjust shim
14. Low range control sleeve
15. Medium and high range control synchronizer
16. 1st and 2nd speed control synchronizer.
17. 3rd and 4th speed control synchronizer
18. Speed output shaft
19. Speed driven gear adjust shim
20. Under drive drive shaft
21. Clutch B Belleville springs
22. Clutch A Belleville springs
23. O ring
24. Shuttle control lever
25. Shuttle control fork
26. Fork (25) stop pawl
27. Lubrication pressure regulating valve
28. Valve (27) spring
29. Speed and range gear lubrication hose

Note: During installation apply liquid gasket on surfaces marked with an **X** as detailed on page 4-3-48

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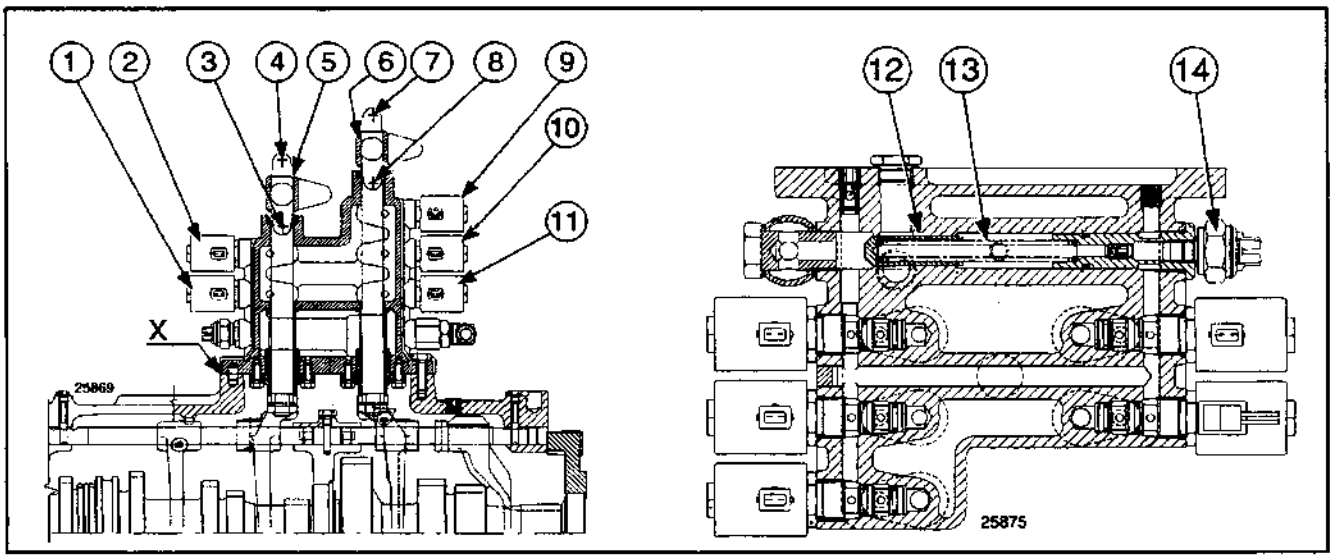


Figure 4-3-12

Range and Speed Control Assembly Sectional Views

1. FWD solenoid control valve
2. DUAL COMMAND control valve oil supply solenoid valve
3. Control cable attach point
4. Control cable attach point
5. Speed gear control rail
6. Range gear control rail
7. Control cable attach point
8. Control cable attach point
9. PTO brake solenoid control valve
10. PTO solenoid control valve
11. Diff lock solenoid control valve
12. Implement pressure regulating valve
13. Valve (12) spring
14. Pressure sensor

Note: During installation apply liquid gasket on surfaces marked with an **X** as detailed on page 4-3-48.

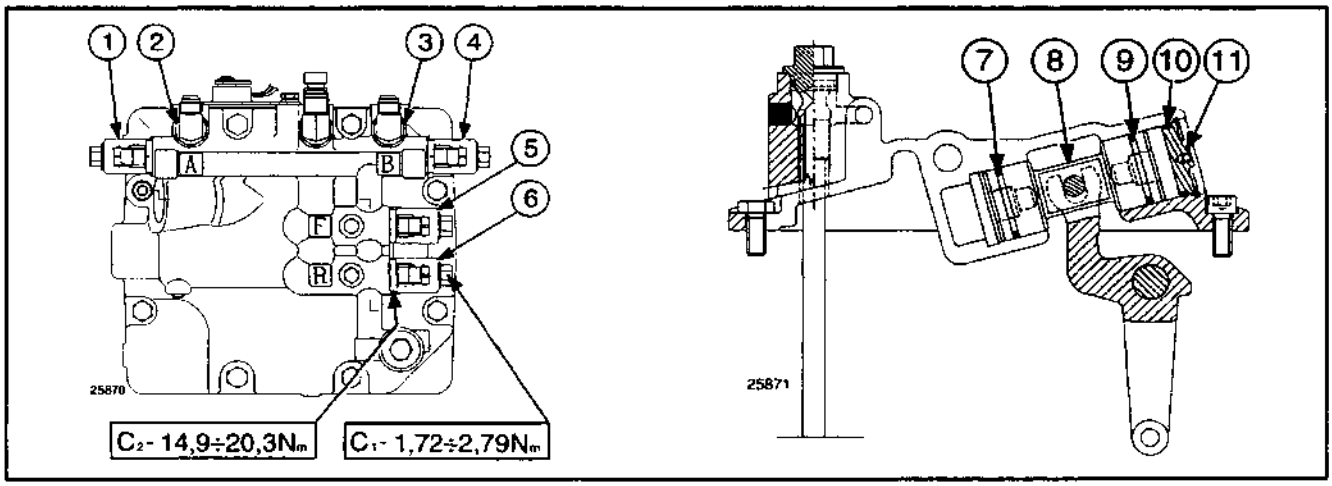


Figure 4-3-13

DUAL COMMAND Control valve – View and Cross Section

C_1. Solenoid valve 1.27 to 2.06 ft. lbs. (1.72 to 2.79 N·m)
C_2. Solenoid pin 11.0 to 15.0 ft. lbs. (14.9 to 20.3 N·m)
1. Clutch A solenoid control valve
2. Clutch A oil supply fitting
3. Clutch B oil supply fitting.
4. Clutch B solenoid control valve
5. Forward speed solenoid control valve.
6. Reverse speed solenoid control valve
7. O ring.
8. Drive piston
9. O ring
10. Snap ring
11. Cover

Note: Apply a couple of drops of Loctite 542 to screws C_1 and C_2.

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DESCRIPTION AND OPERATION

The DUAL COMMAND transmission is actuated by 2 multi–pack clutches in oil bath, which allow hydraulic control of 4 speed gears or ratios in each range, both forward and reverse.

Speed gears are selected using the main shift lever (2) located at the right side of the operator's seat. Range gears are selected using lever (1).

To shift through speed or range gears, it is necessary to press the clutch pedal to end of travel and move the lever (1 or 2) involved.

On the main shift lever there are two buttons, identified with a turtle and a hare, respectively. By pressing these buttons it is possible to select direct drive or under drive within the same speed gear or ratio. This is obtained hydraulically and with the tractor on the move.

Clutch A controls under drive, clutch B controls direct drive and reverse gears.

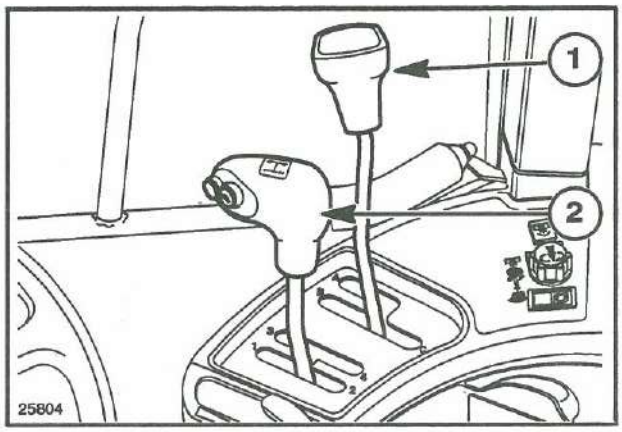


Figure 4-3-14

Range gears provide 3 ranges, namely high, medium and low. High and medium ranges are engaged through a synchronizer while the low range is engaged through a sliding sleeve.

Shuttle gears allow to shift through the 3 ranges also in reverse.

The DUAL COMMAND transmission with range and shuttle gear assemblies provides:
– 23 forward and 12 reverse ratios in the 19 MPH (30 KPH) option;
– 46 forward and 24 reverse ratios in the 19 MPH (30 KPH) option fitted with creeper gears.

To shuttle from forward to reverse, it is necessary to move the lever at the left of the steering wheel. It is not necessary to press the clutch pedal, but engine rpm and tractor speed must be reduced.

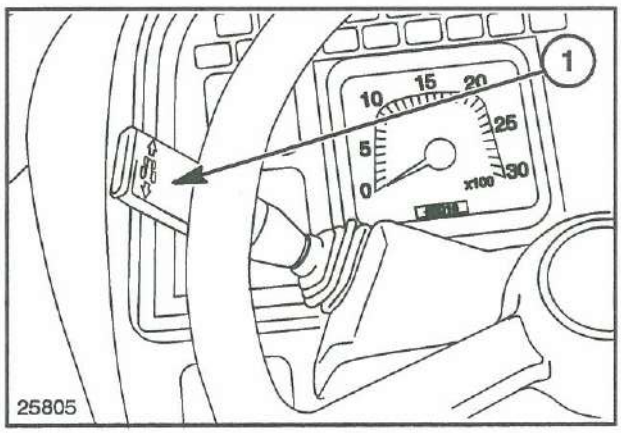


Figure 4-3-15

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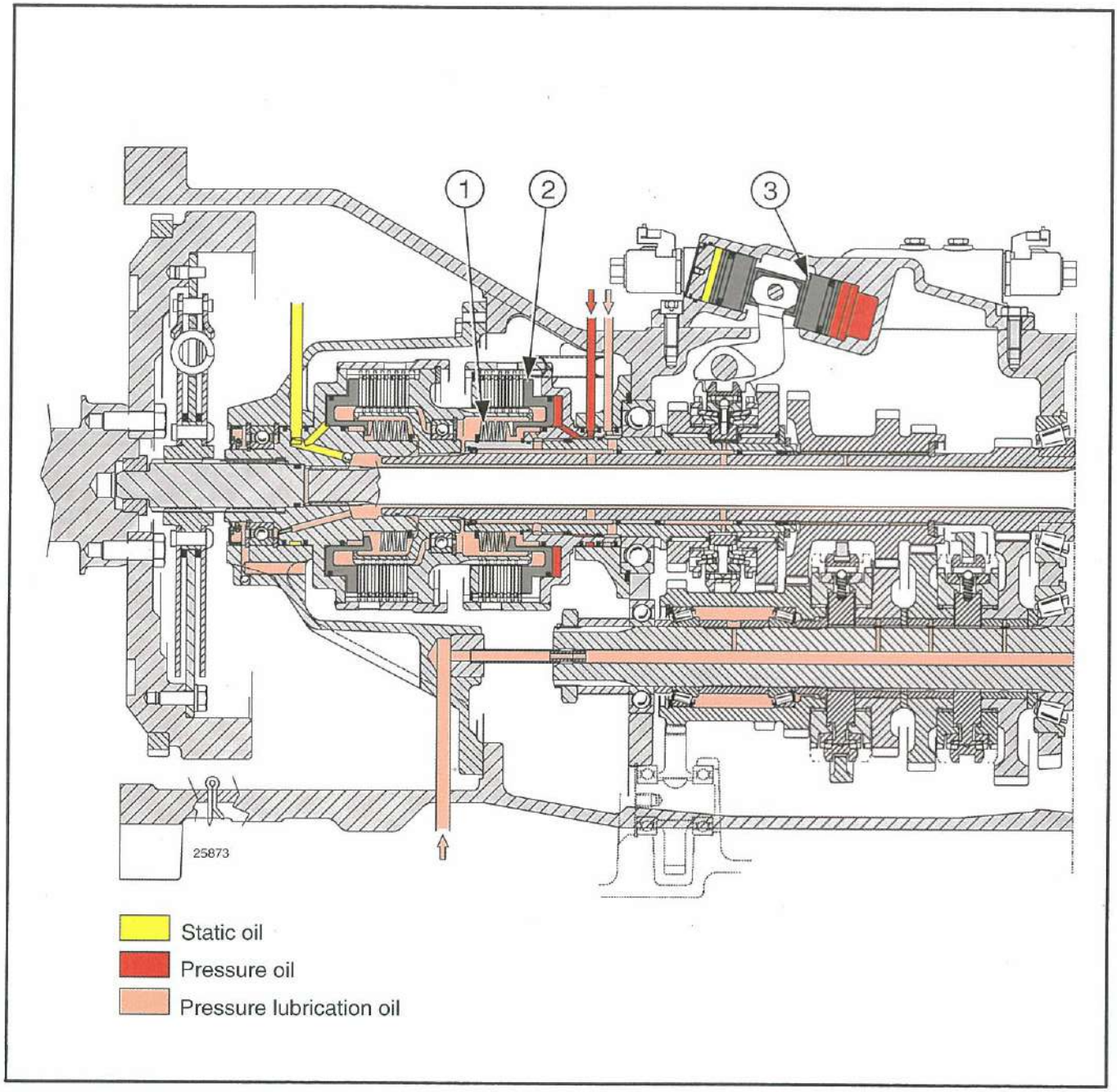


Figure 4-3-16

DUAL COMMAND Transmission Oil Flow with Direct Drive Engaged

Direct drive is selected using the button (hare symbol) on the lever (2, Figure 4-3-14). The double piston (3) is in the position of forward engaged. Oil from the hydraulic pump flows through the solenoid valve (4, Figure 4-3-14) and enters clutch B.
Oil moves the piston (2) against the force of the Belleville springs (1) and compresses clutch B. Under these conditions, direct drive is engaged.

Pressure oil lubrication is guaranteed to all the DUAL COMMAND transmission components. Oil pressure is regulated by the valve (14, Figure 4-3-12).
If the clutch pedal is pressed to shift the speed gear, the solenoid valve (4, Figure 4-3-13) stops sending oil to clutch B and consequently the piston (2) is pushed away from the clutch discs under the action of the Belleville springs (1). The clutch is released.

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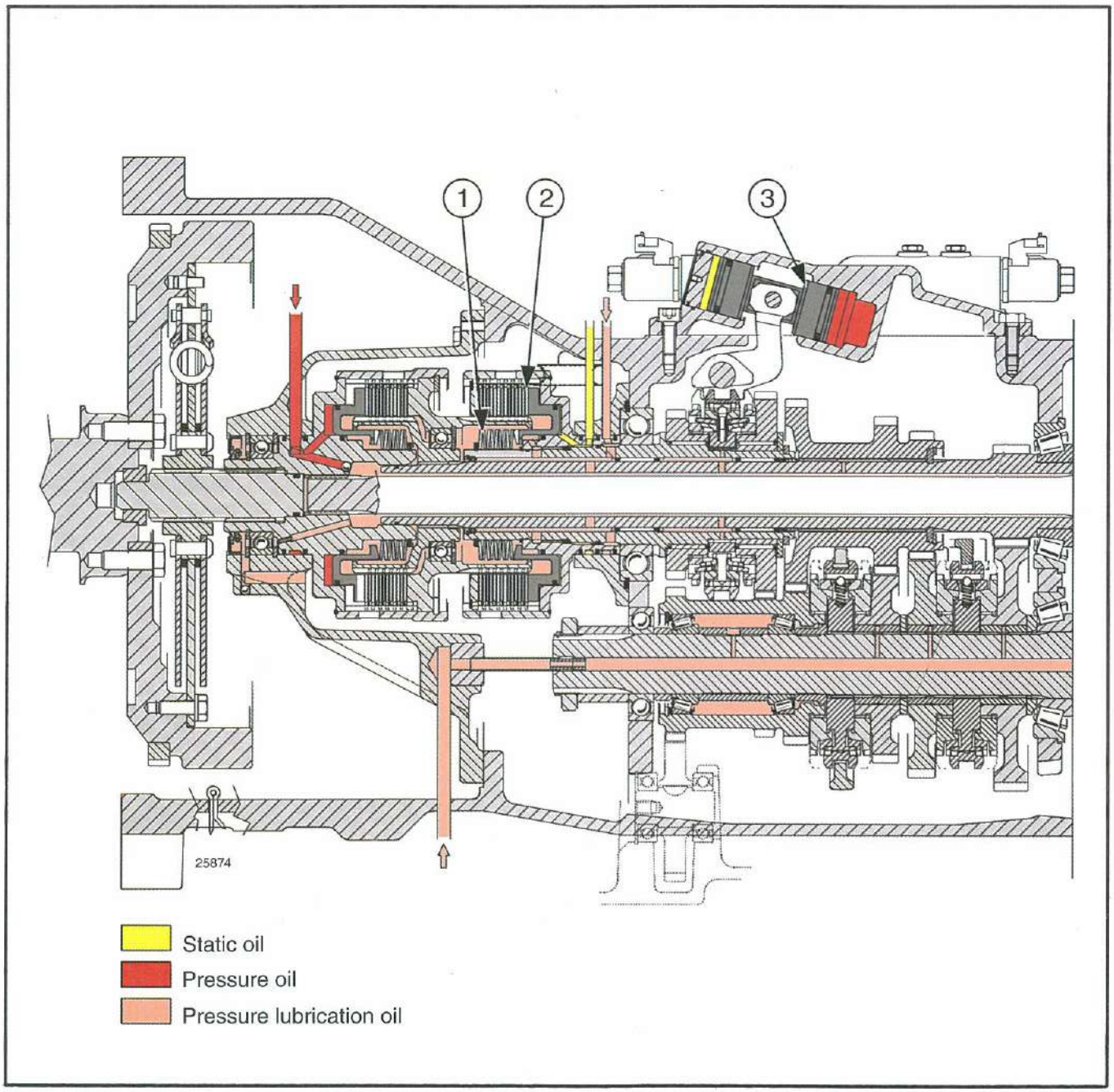


Figure 4-3-17

DUAL COMMAND Transmission Oil Flow with Under Drive Engaged

Under drive is selected using the button (turtle symbol) on the lever (2, Figure 4-3-14). The double the piston (3) is in the position of forward engaged. Oil from the hydraulic pump flows through the solenoid valve (1, Figure 4-3-13) and enters clutch A.
Oil moves piston (1) against the force of the Belleville springs (2) and compresses clutch A. Under these conditions, under drive is engaged.

Pressure oil lubrication is guaranteed to all the DUAL COMMAND transmission components. Oil pressure is regulated by the valve (14, Figure 4-3-12).
If the clutch pedal is pressed to shift the speed gear, the solenoid valve (1, Figure 4-3-13) stops sending oil to clutch A and consequently the piston (1) is pushed away from the clutch discs under the action of the Belleville springs (2). The clutch is released.

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DUAL COMMAND TRANSMISSION HOUSING
Removal – Installation

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks.
Ensure that no–one is in the vicinity of the load to be lifted.

Remove the DUAL COMMAND transmission housing from the tractor as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

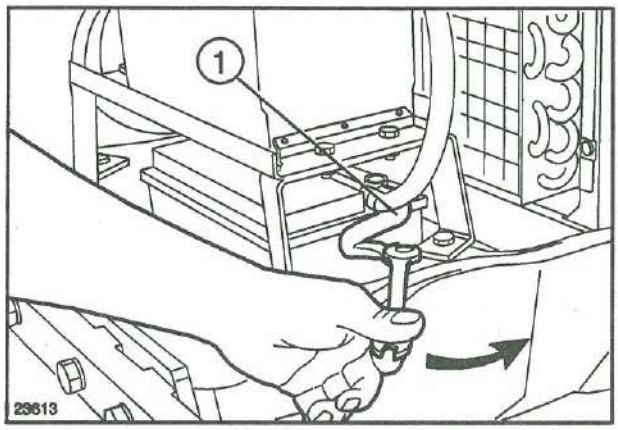


Figure 4-3-18

3. Connect the engine hood to a hoist using a nylon cable (1) and disconnect the shock absorbers (2) (one on the LH side and one on the RH side).

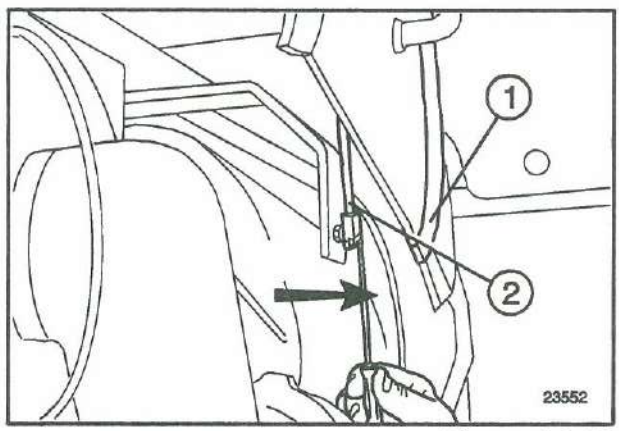


Figure 4-3-19

4. Loosen the screws (3) which retain engine hood to engine, disconnect front light electrical connector, C056, and remove hood using the hoist. Ensure that the hood is displaced without obstructions and that no other components are interfering.

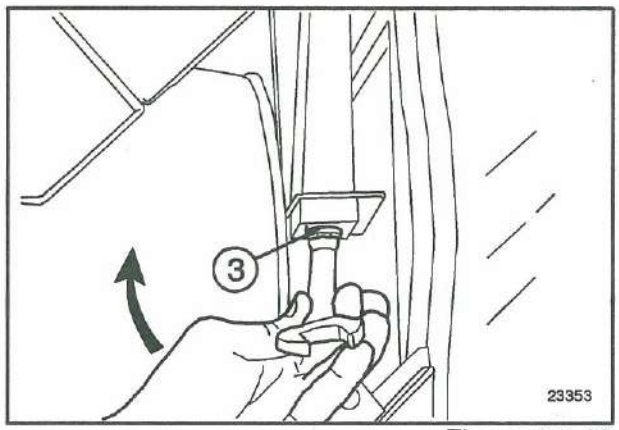


Figure 4-3-20

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5. Unscrew the retaining screws and remove side panels (1) (one on each side).

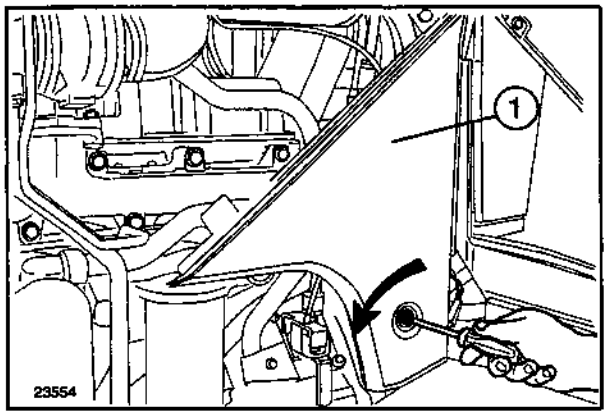


Figure 4-3-21

6. Jack up rear tractor and place two suitable stands (2) under the final drive cases to raise the wheels off the ground. If necessary, detach lift rods from lower links.

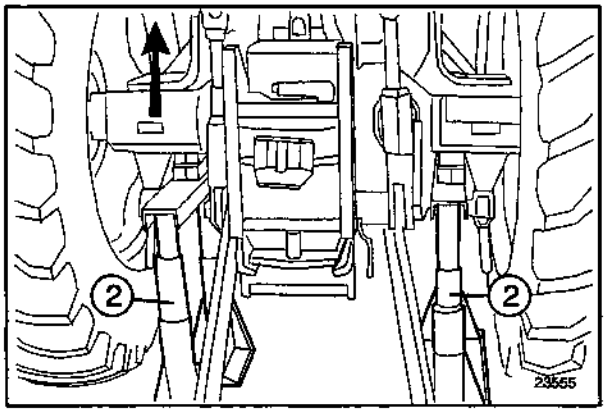


Figure 4-3-22

7. Sling the wheel using a nylon cable (3), unscrew the attaching nuts and remove the wheel. Repeat for the left wheel.

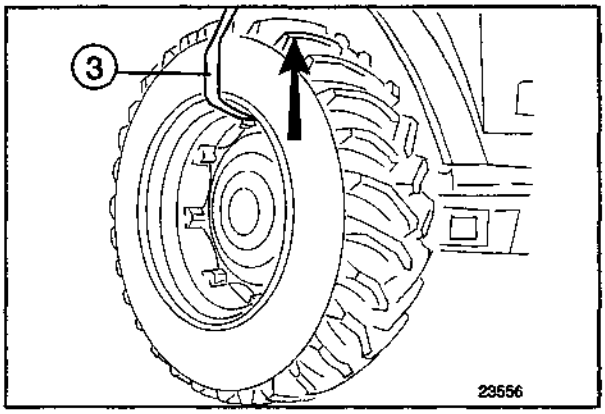


Figure 4-3-23

8. Loosen the two screws on the cab roof and fix tool **FTC213997B** (4) using two appropriate bolts. Connect tool to a hoist and remove slack in preparation for cab removal.

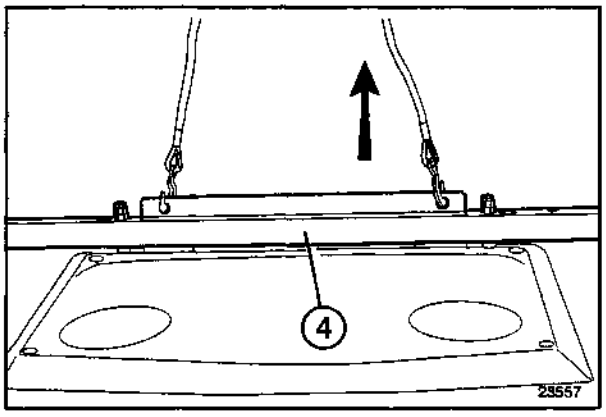


Figure 4-3-24

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9. Detach connectors at the windscreen primers. Detach washer bottle (1) lines and remove bottle.

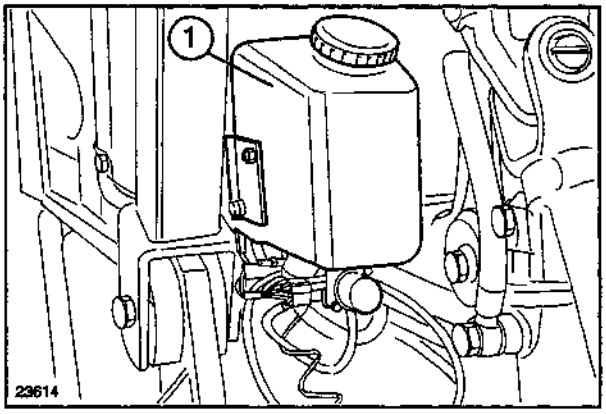


Figure 4-3-25

10. Remove the clip and detach the creep gear control idler lever (2). Loosen the parking brake control cable retaining screw (3).

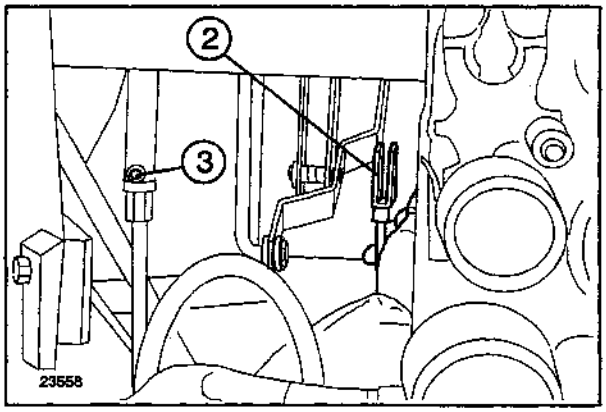


Figure 4-3-26

11. Remove the pin and withdraw the pin securing the fork (4) to the parking brake actuator lever. Loosen the nut securing the cable to the fork (4) and release cable.

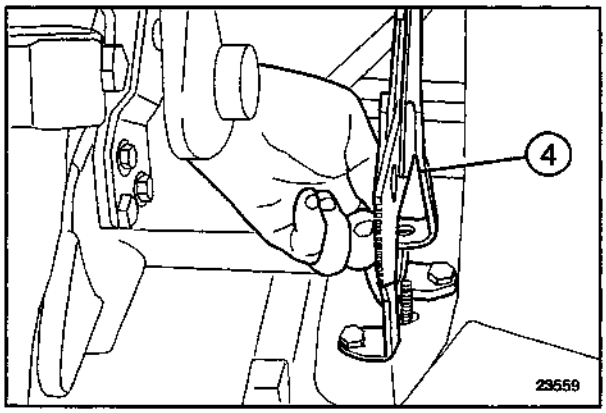


Figure 4-3-27

12. Loosen the attaching nut and detach the ground cable (5) between the cab and rear axle.

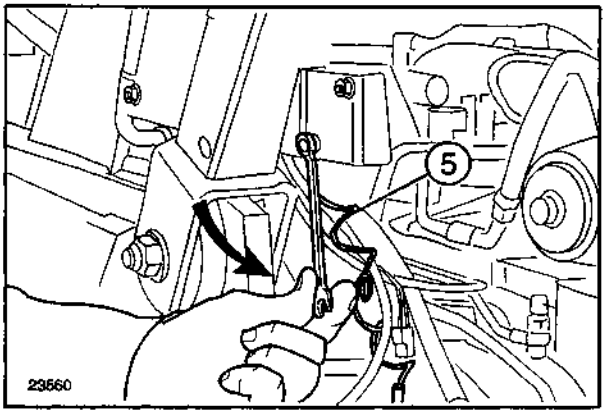


Figure 4-3-28

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13. Release the clamp (1) and detach the main tank bleeding line.

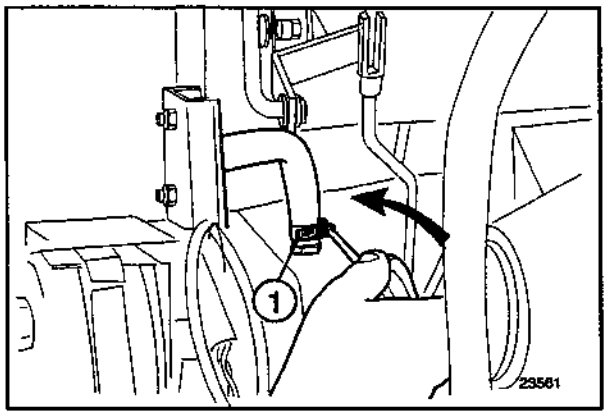


Figure 4-3-29

14. Detach the ground synchronized PTO control cable (2) from the rail. (Not used in North America)

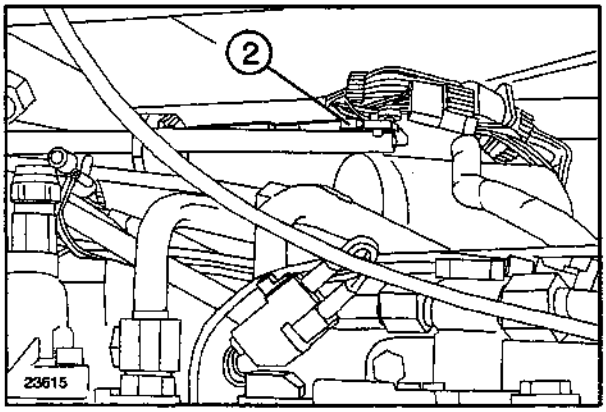


Figure 4-3-30

15. Detach the two connectors (3 and 4) located under the cab floor. Connectors C019 and C020.

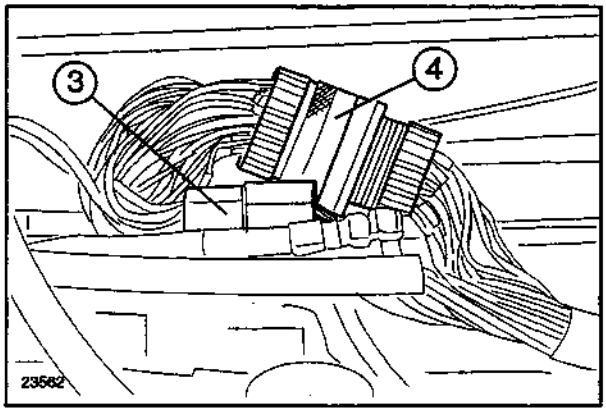


Figure 4-3-31

16. Detach both engine to cab connectors (5 and 6). Connectors C001 and C002.

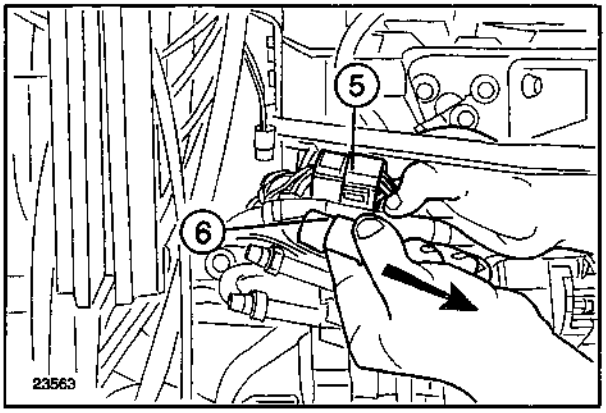


Figure 4-3-32

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17. Disconnect radar and fuel filter connectors (4 and 3, respectively). Remove protection and disconnect connectors (1 and 2) from starting motor.

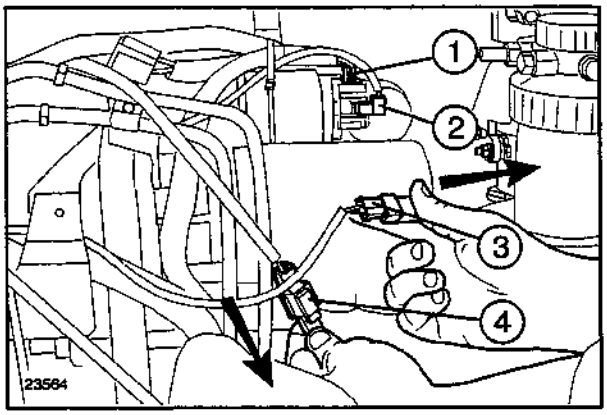


Figure 4-3-33

18. Detach light connector (5) located on the handrail (repeat for both tractor sides).

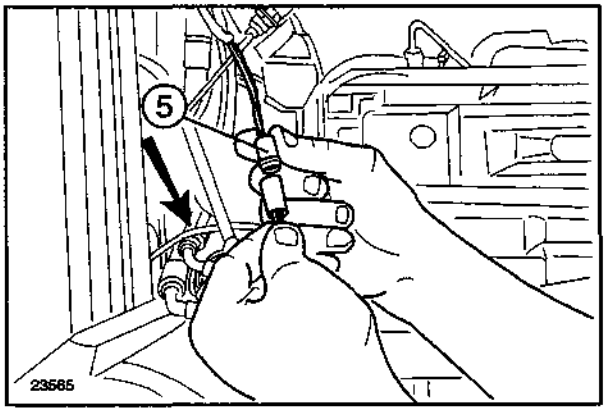


Figure 4-3-34

19. Detach heater to engine connecting lines (6) located under the right hand front side of the cab.

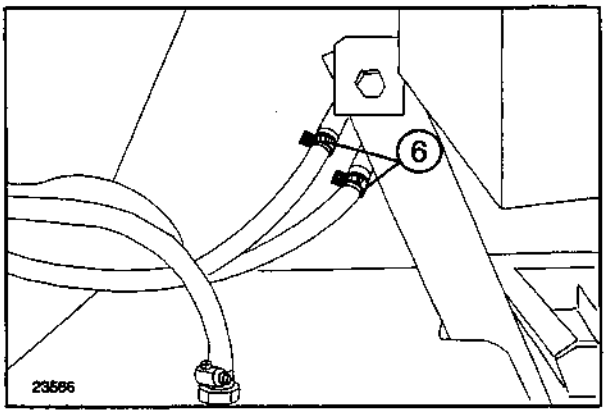


Figure 4-3-35

20. Loosen the nut and detach the throttle control cable (7) from injection pump.

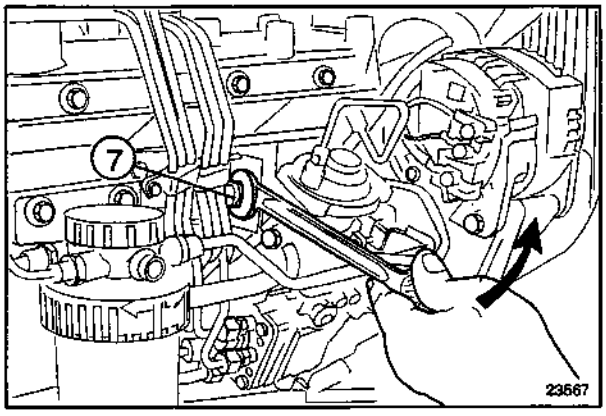


Figure 4-3-36

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21. Detach connectors (1) from brake pumps.

22. Loosen fittings (2) and detach brake control hoses.

23. Detach the brake pump lines to the tank.

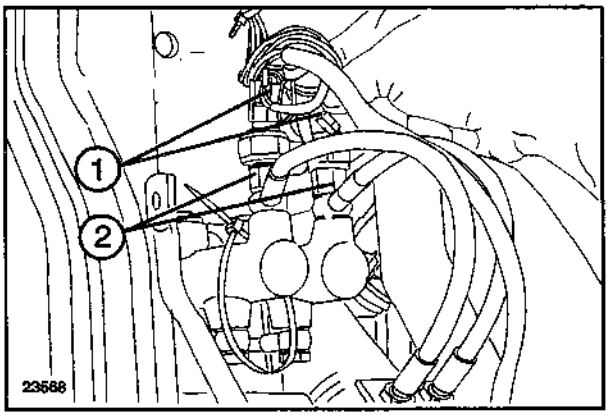


Figure 4-3-37

24. Loosen the power steering valve connecting lines (4) to the control pump.

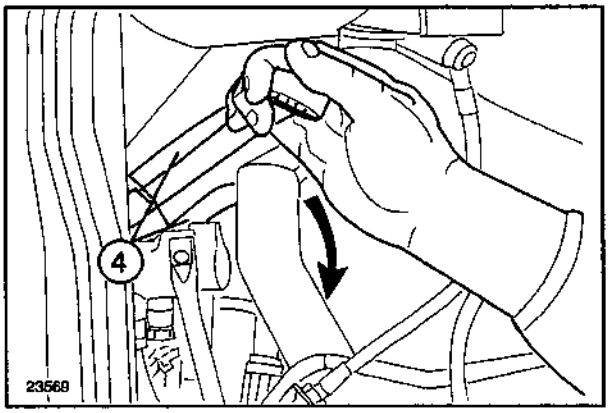


Figure 4-3-38

25. Detach the power steering valve connecting lines (5) to the steering cylinders.

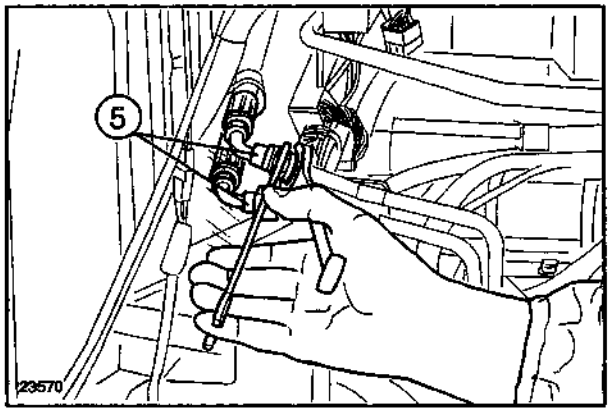


Figure 4-3-39

26. Loosen fittings and detach the air conditioning lines (6).

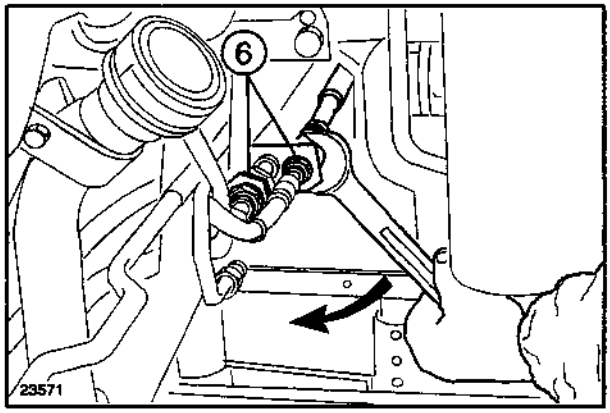


Figure 4-3-40

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27. Loosen the locknut, slide out the cotter pin and detach the PTO control cable (1). (Not used in North America).

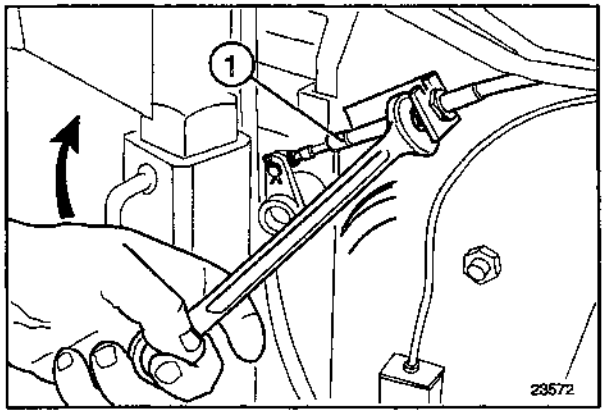


Figure 4-3-41

28. Slide out cotter pins and pins (2), loosen retaining screws (3) and detach the remote valve control cables, right hand side.

29. If remote valves are fitted also on left hand side, repeat step 28 for left hand side remote valves.

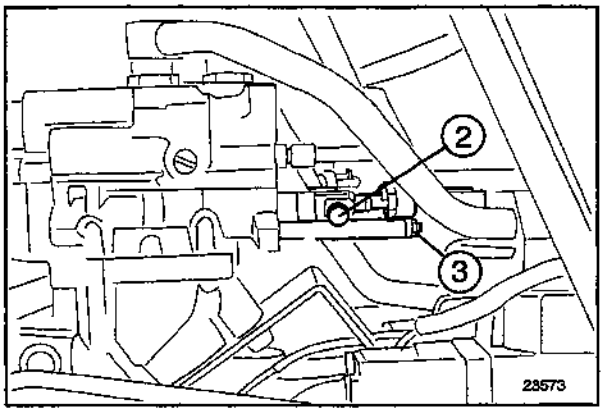


Figure 4-3-42

30. Loosen the screw attaching steps (6) to the bracket.

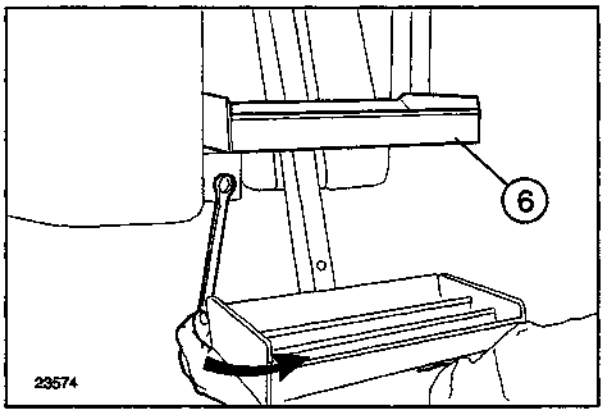


Figure 4-3-43

31. Loosen the screw attaching steps (1) to the cab platform.

32. Repeat steps 30 and 31 on opposite side and remove steps.

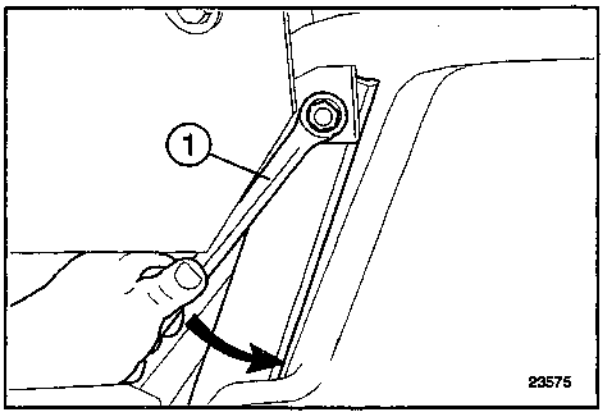


Figure 4-3-44

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33. Raise the cab mat (2) and loosen the cab mounting bolt while holding the locknut under the cab floor. Retrieve bolt and washer. Repeat for both tractor sides.

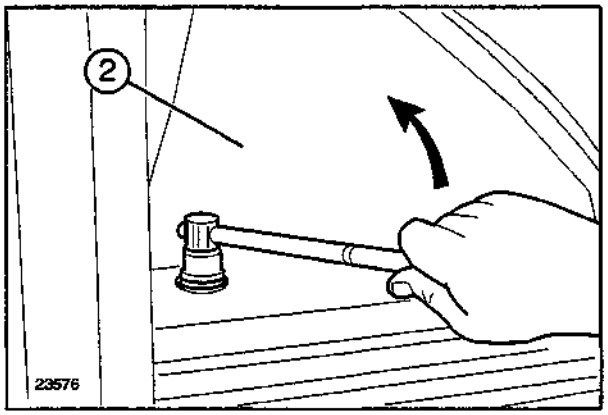


Figure 4-3-45

34. Loosen the rear cab bolts (on both sides).

35. Slowly raise the cab taking care that no components are connected, hooked or interfering. Remove the cab and lower on a suitable support base.

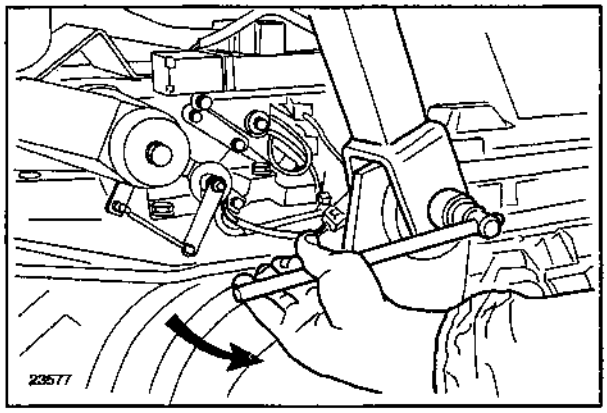


Figure 4-3-46

36. Loosen the plug (3) and drain oil from the rear axle and transmission housings into a suitable container (standard oil capacity is 19.2 gallons for all models of tractors equipped with Dual Command transmissions).

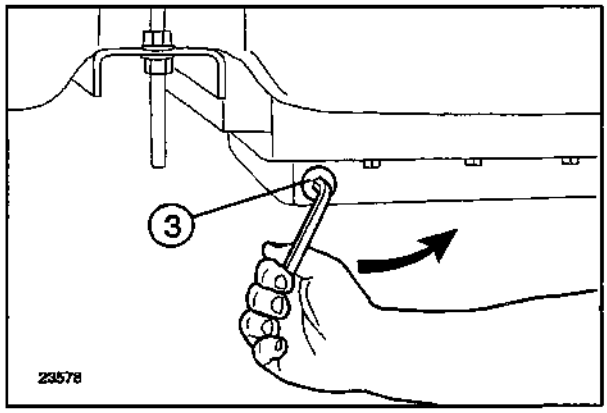


Figure 4-3-47

37. Drain fuel tanks, then loosen the clamp (1) retaining the connecting line between the main and auxiliary tanks.

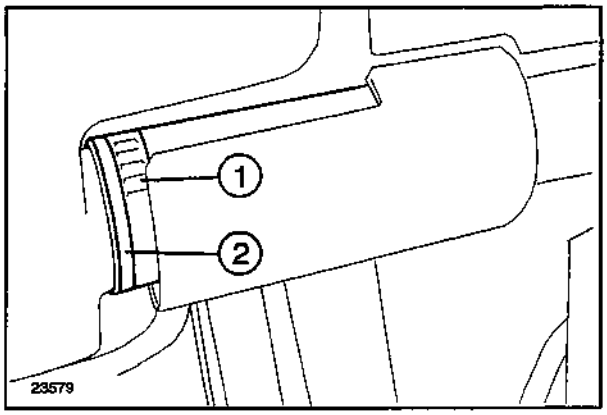


Figure 4-3-48

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38. Loosen the clamp and detach the bleeding line (3) between the main and auxiliary tanks.

39. Detach the fuel return line (2) from the injection pump to the auxiliary tank. Remove auxiliary tank.

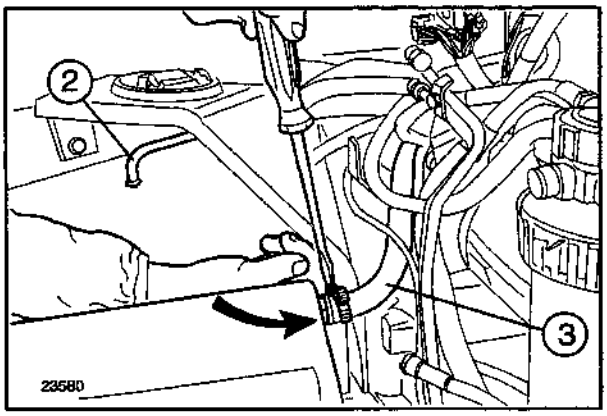


Figure 4-3-49

40. Loosen the clamp and detach the injection pump supply line (5). Detach connectors (4), then unscrew and remove the fuel level sensor assembly.

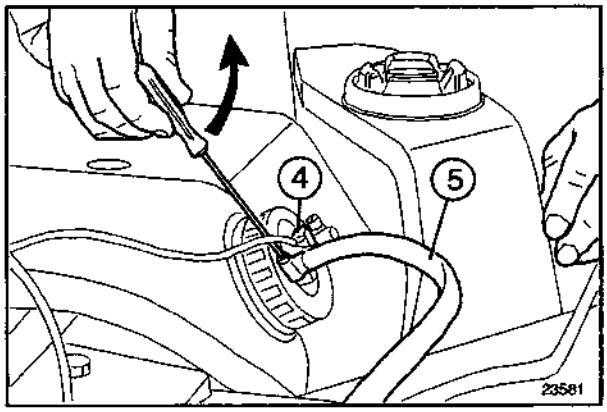


Figure 4-3-50

41. Loosen the nut of the metal strap (6) securing the main tank. Remove the strap and tank.

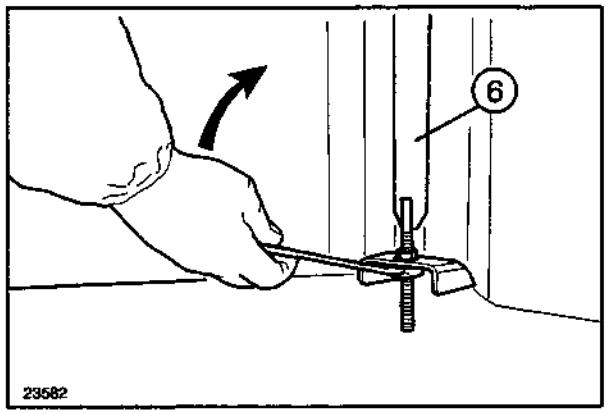


Figure 4-3-51

42. Loosen the retaining screws and remove the cab and fuel tank support bracket (1). (Repeat on both sides of the transmission housing).

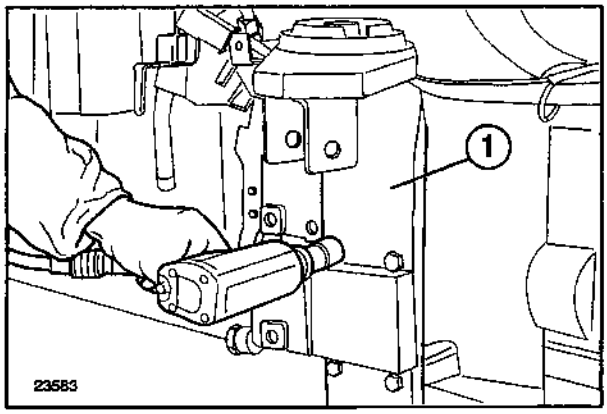


Figure 4-3-52

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43. Loosen the retaining screws and remove the main tank support bracket (2).

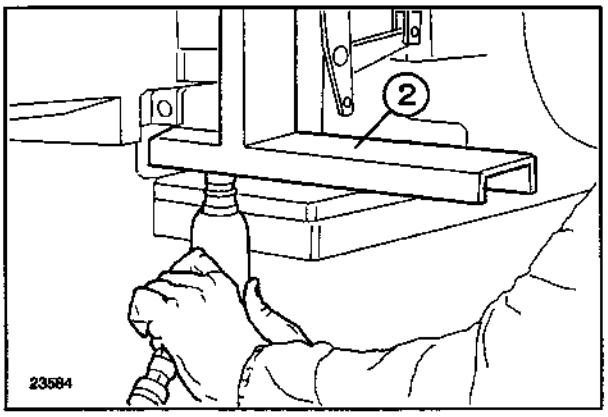


Figure 4-3-53

44. Loosen the attaching screws and remove the radar unit and mounting bracket (3).

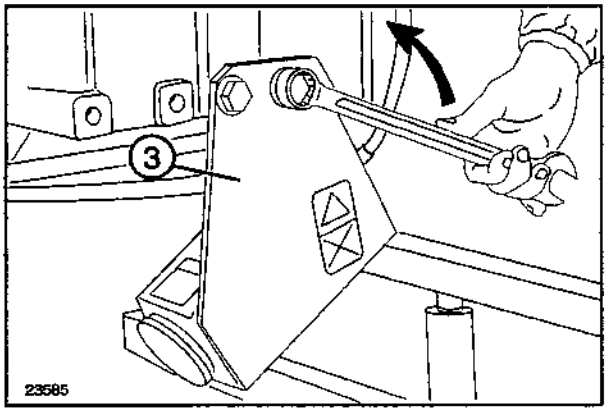


Figure 4-3-54

45. Loosen the attaching screws and remove the brake control line bracket (4).

Note: Do not bend the brake control tubes sharply when moving them away from the transmission housing to avoid damages.

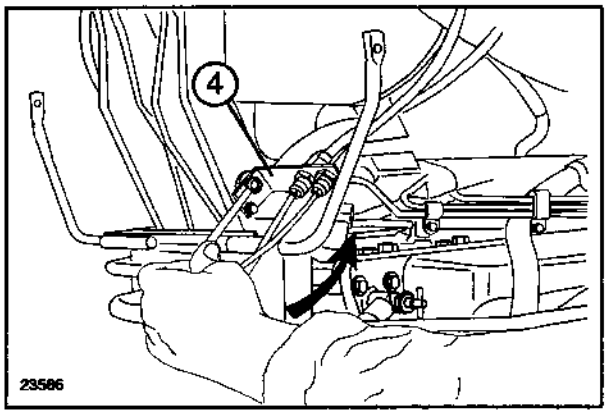


Figure 4-3-55

46. Loosen the clamps and separate the oil cooler hoses (1) from tubes.

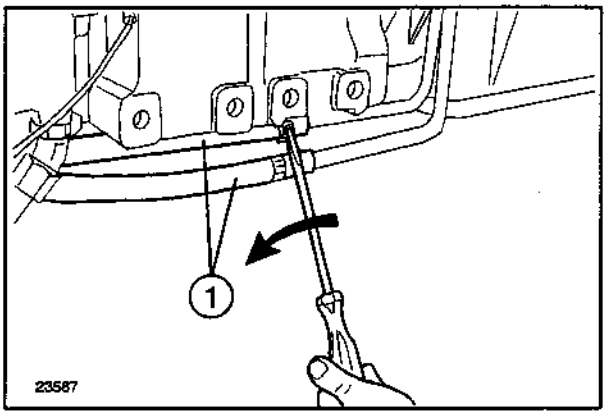


Figure 4-3-56

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47. Loosen retaining screws and detach speed and range gear control cables (1 and 2).

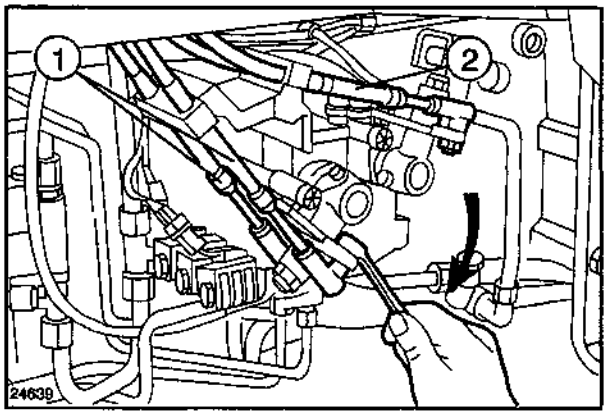


Figure 4-3-57

48. Detach all connectors from the speed and range control valve assembly and from rail position sensors.

Note: Before detaching connectors, mark each connector and respective solenoid valve or position sensor to assist reassembly and avoid reversal of connections.

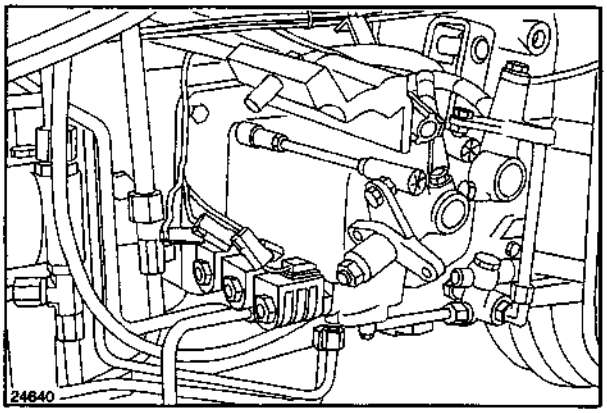


Figure 4-3-58

49. Loosen the retaining screws and remove the propshaft guard.

50. Remove snap ring (4) and slide out sleeve (5). Repeat for transfer box snap ring and sleeve.

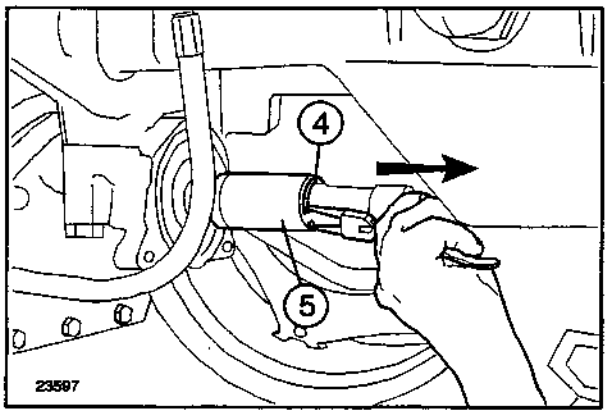


Figure 4-3-59

51. Loosen the bearing–support (3) retaining screws at the transmission housing, detach and remove the front diff lock control line (2).

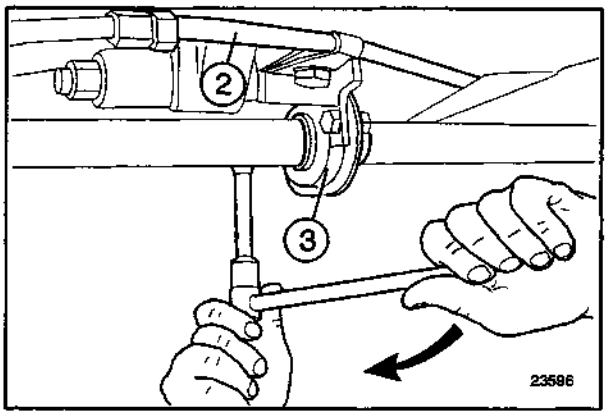


Figure 4-3-60

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52. Properly support the engine and front axle assembly, and the transmission and rear axle assembly in preparation for separation.

53. Place two wooden wedges (one each side) between the front axle support and front axle to prevent engine oscillation.

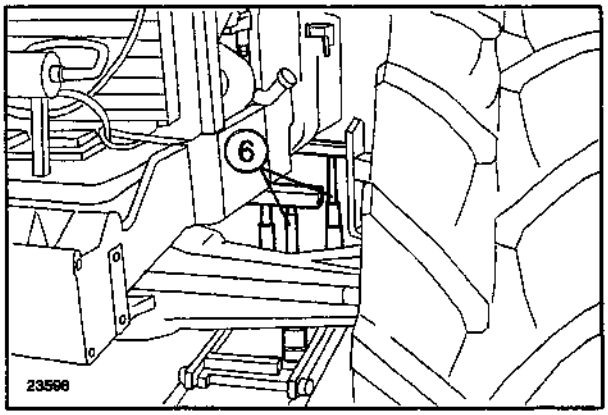


Figure 4-3-61

54. Loosen the retaining screws and remove starting motor (1).

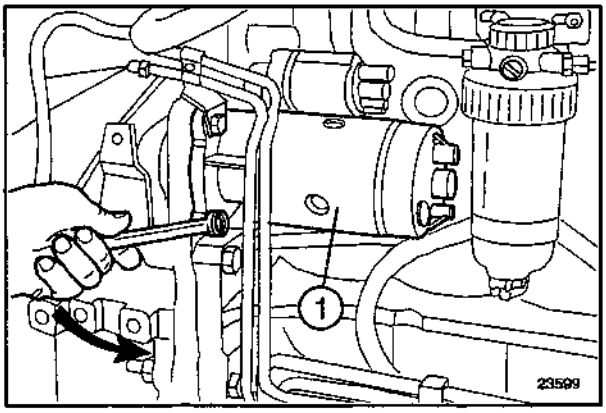


Figure 4-3-62

55. Remove the transmission housing to engine attaching bolts.

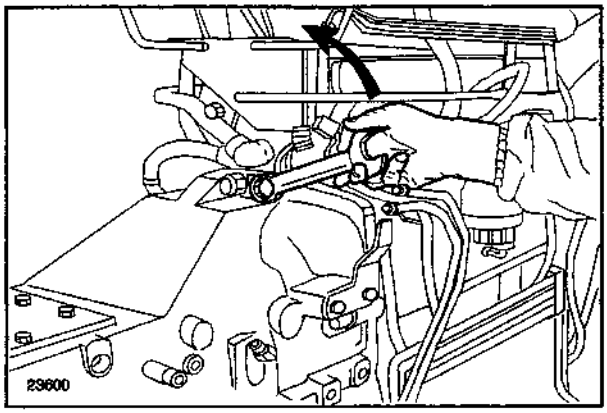


Figure 4-3-63

56. Loosen the metal spacer retaining screw (2) at the transmission housing.

57. Separate the engine from the transmission housing.

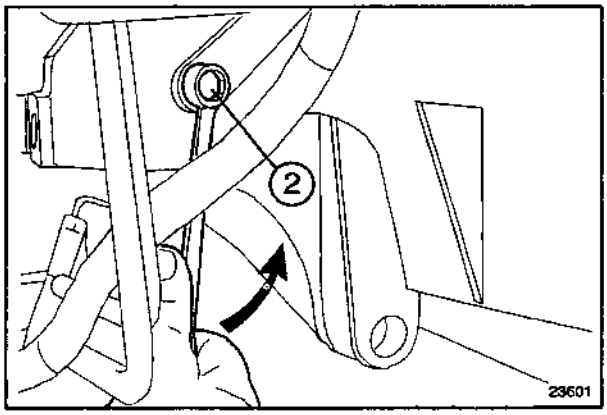


Figure 4-3-64

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58. Loosen two bolts from the transmission housing top cover (1), screw in two eyebolts, secure two cables and keep them tensioned using a hoist.
59. Place a stationary stand under the draft sensing unit bracket and under the rear axle housing.
60. Loosen the transmission housing to rear axle housing attaching bolts and remove the housing.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

61. Reinstall the transmission housing to the rear axle housing and engine observing the following:
    - Reinstallation follows the removal procedure in reverse, from step 60 back to step 1.
    - Before reassembling housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a 2 mm (0.079 in). bead of sealant following the pattern shown in the figure on page 4-3-29 and on page 3-1-14, Section 3.
    - Tighten to correct torque as detailed on page 4-3-5.

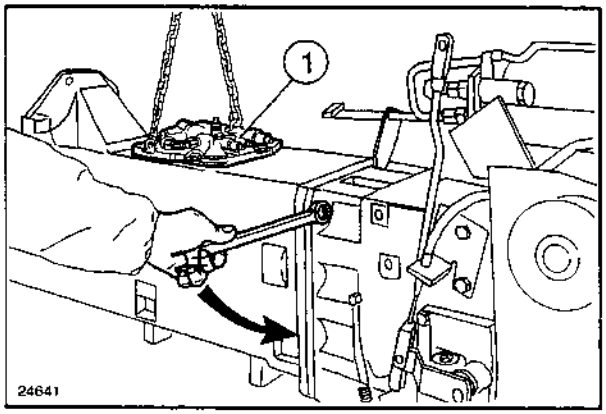


Figure 4-3-65

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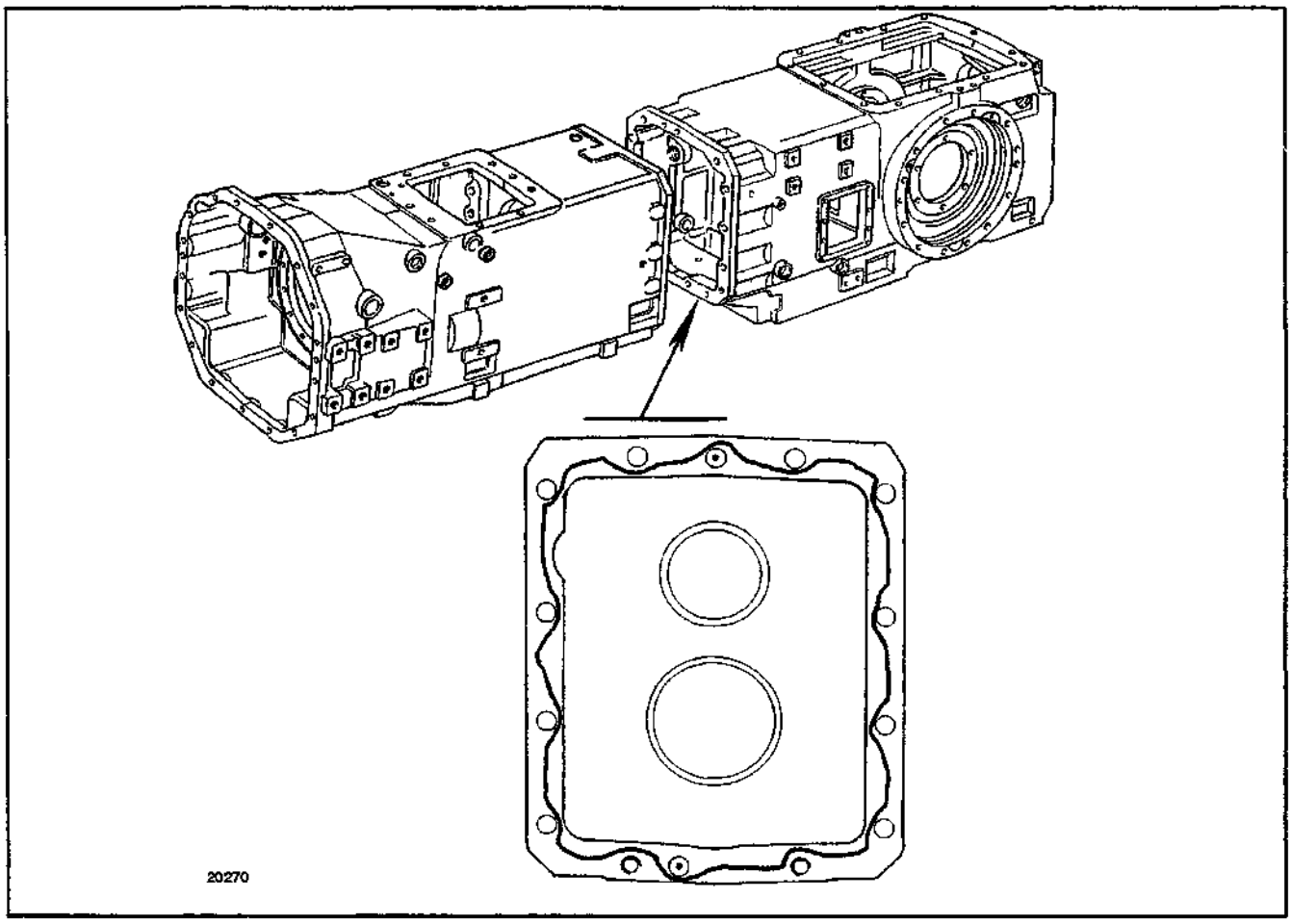


Figure 4-3-66

Pattern for application of sealant during installation of the speed clutch–transmission housing to rear axle housing.

Sealants to be used are listed on page 0-1-19, Section 00

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DUAL COMMAND TRANSMISSION

Disassembly–Reassembly

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Prior to servicing the DUAL COMMAND transmission, it is necessary to remove the transmission housing following the procedure detailed on pages 4-3-16 to 4-3-28.
Then, proceed as follows:

1. Fix the transmission housing on a suitable stand.
2. Perform steps 3 to 5 to remove the range valve and control assembly, if not previously removed.
3. Loosen retaining screws and remove rheostat (1) from the DUAL COMMAND valve.

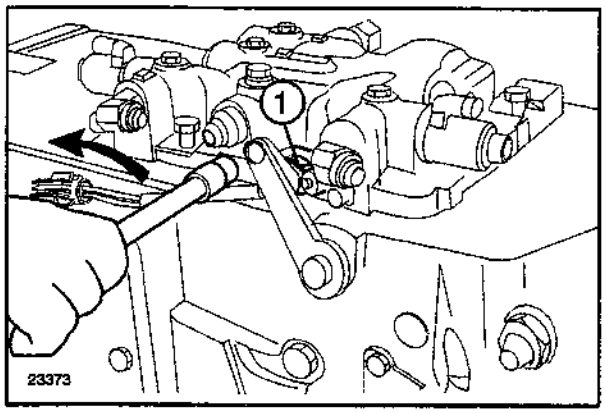


Figure 4-3-67

4. Loosen retaining screws and detach the DUAL COMMAND transmission valve (2) using a lever.

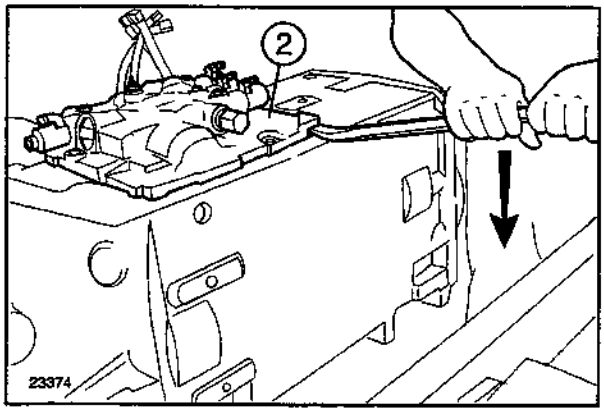


Figure 4-3-68

5. Loosen retaining screws and remove the DUAL COMMAND range and speed rail assembly (3).

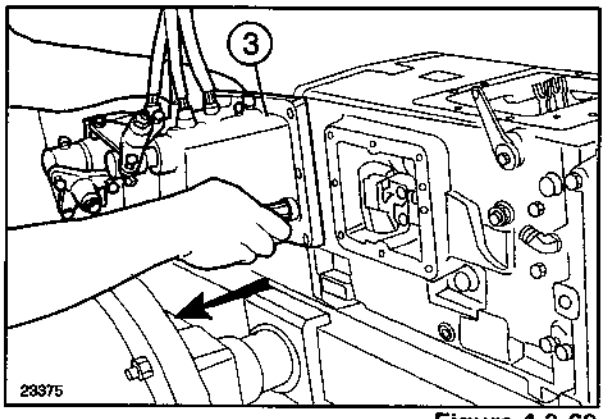


Figure 4-3-69

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6. Detach oil supply fittings (1 and 2) to clutches A and B, respectively.

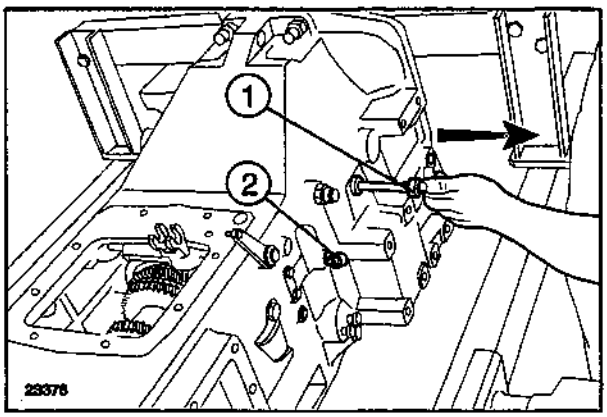


Figure 4-3-70

7. Loosen the screws retaining clutch A cover (3) to the transmission housing. Screw in 3, (M8), bolts (4) into the special holes until complete separation of the cover (3). Remove the cover along with clutch A from the transmission housing.

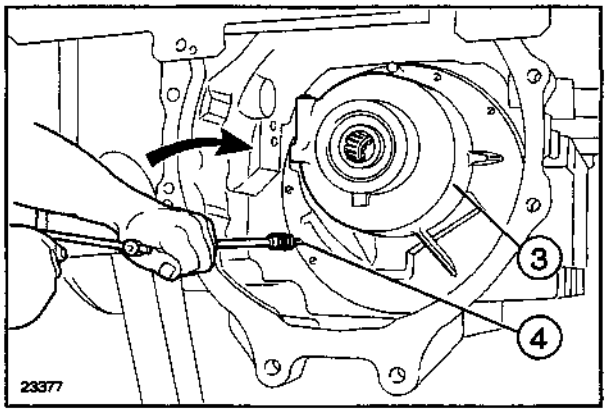


Figure 4-3-71

8. Remove snap ring (5) and retrieve clutch discs and centering springs.

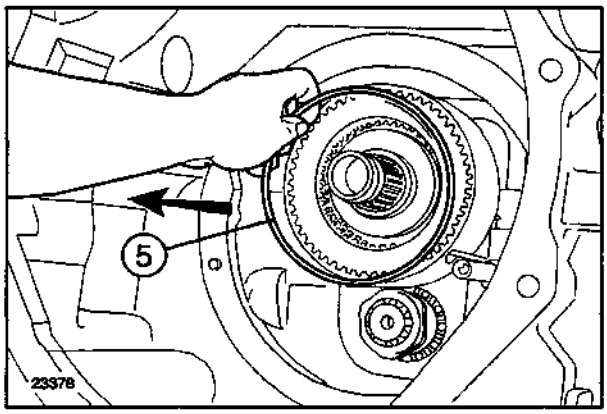


Figure 4-3-72

9. Assemble tool no. **295021** (6) on clutch B bell housing, turn the tool bolt to compress clutch release Belleville springs and remove Belleville spring retaining ring. Remove tool from the bell housing and retrieve Belleville springs.
10. Blow compressed air into the oil supply hole to clutch B to expel clutch B drive piston.

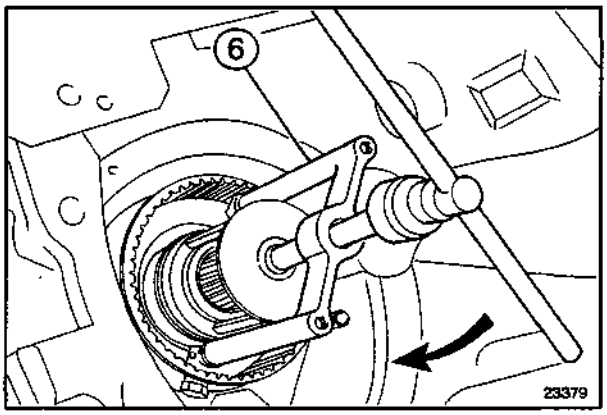


Figure 4-3-73

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11. Remove the retaining ring (1) and withdraw clutch B bell housing (2).

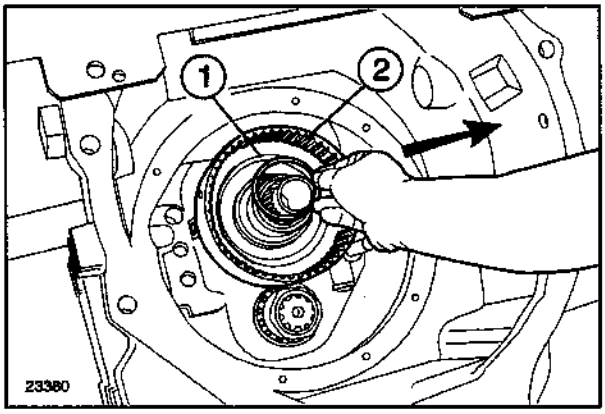


Figure 4-3-74

12. Loosen the lubrication line (4) fitting. Loosen screws retaining the cover (3) with the valve and remove cover.

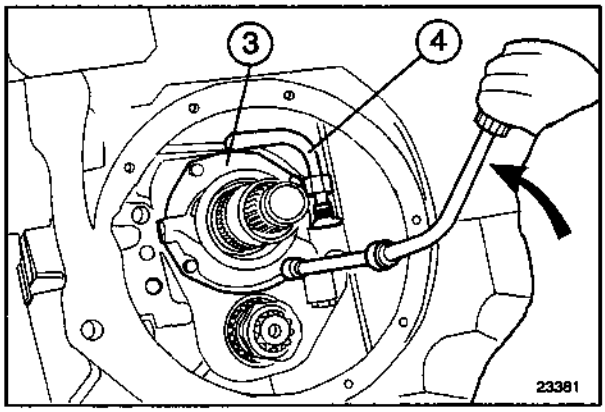


Figure 4-3-75

13. Remove lubrication oil outer fitting (5) and retrieve washer and seal. Retrieve the line (4) from inside the housing.

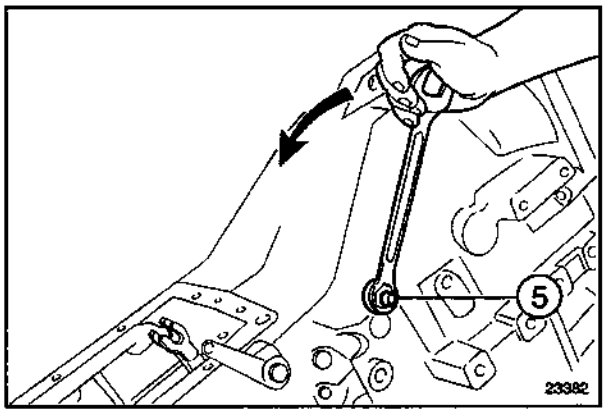


Figure 4-3-76

14. Loosen the cover (1) retaining screws, place tool no. **295049** (2) on the transmission housing, select low range, loosen the output shaft locknut using wrench tool no. **293343** (3) and retrieve cover (1).

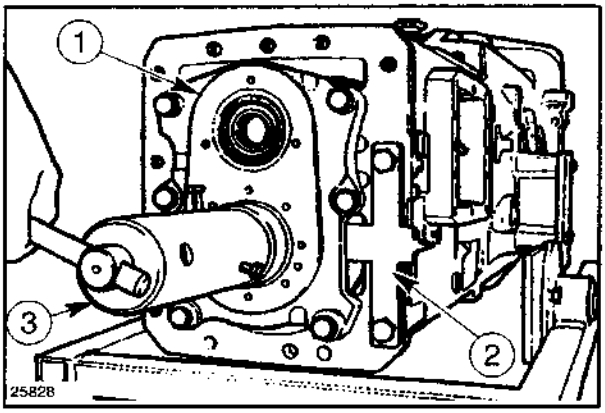


Figure 4-3-77

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15. Remove retaining bolts and detach the range output and input shaft bearing cap (1).

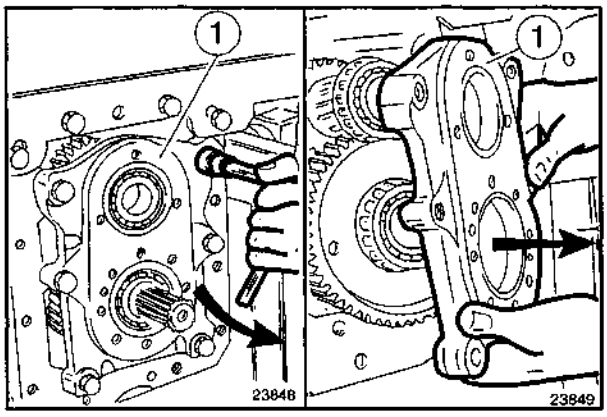


Figure 4-3-78

16. Using a puller (1) and a suitable insert (2), remove gear (3), bearing and bushing. Be careful to keep the upper shaft moved to one side to provide clearance for gear removal.

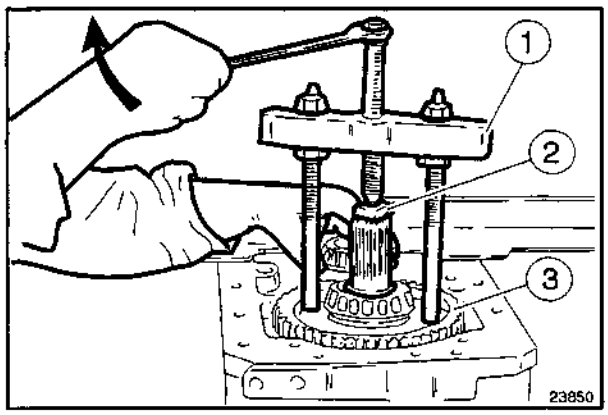


Figure 4-3-79

17. Loosen the plugs (1) and retrieve springs and actuating balls. Remove plug (2).

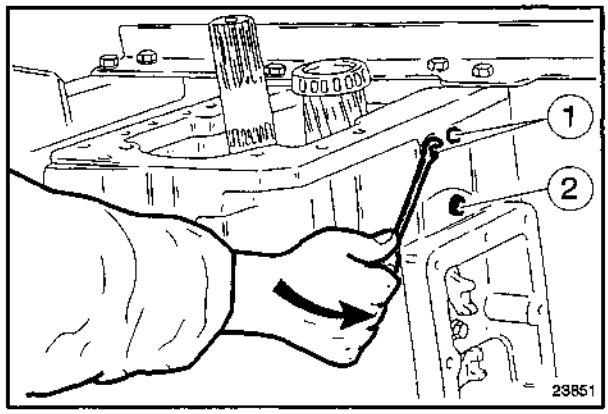


Figure 4-3-80

18. Slide out the low and medium–low range control fork retaining springs (1). Also, slide out spring pins (7) from both range selector dogs.

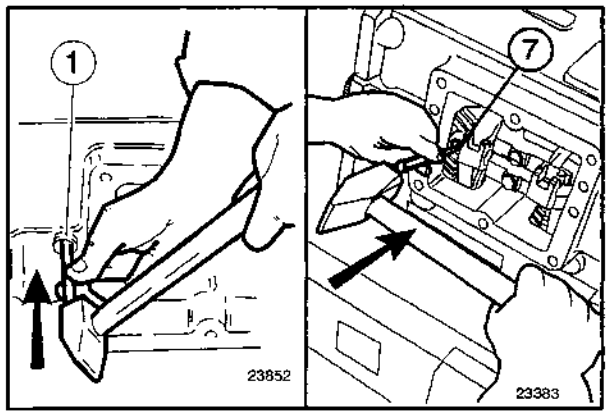


Figure 4-3-81

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19. Remove the fork (1) along with the engagement sleeve, withdraw the rail (2) and retrieve selector dog (3).

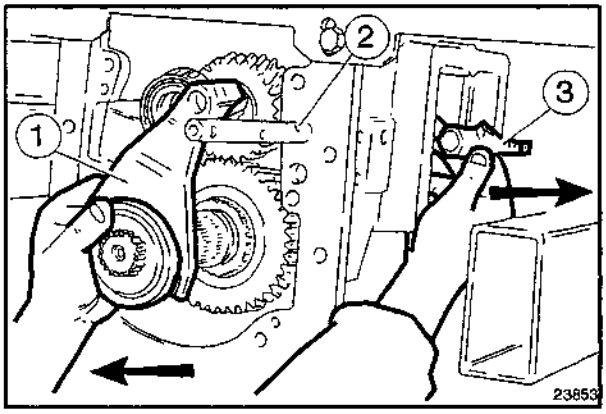


Figure 4-3-82

20. Withdraw the control rail (1) and safety pawl (2) from both rails (1 and 2, Figure 4-3-82).

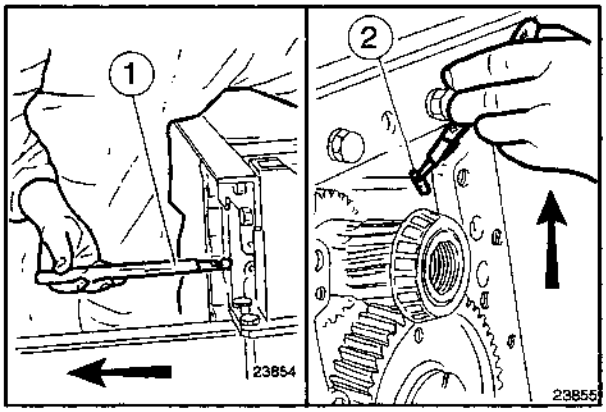


Figure 4-3-83

21. Withdraw the medium–low and medium–high gears (1 and 2, respectively) along with their inner bushings and thrust washer (3).

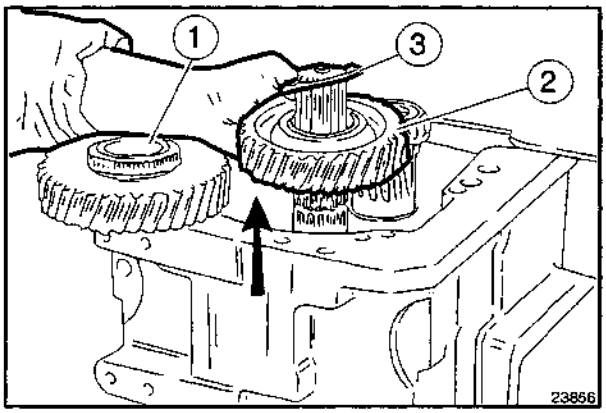


Figure 4-3-84

22. Remove the synchronizer (1) (if fitted) or the engagement sleeve along with the control rail and output shaft (2).

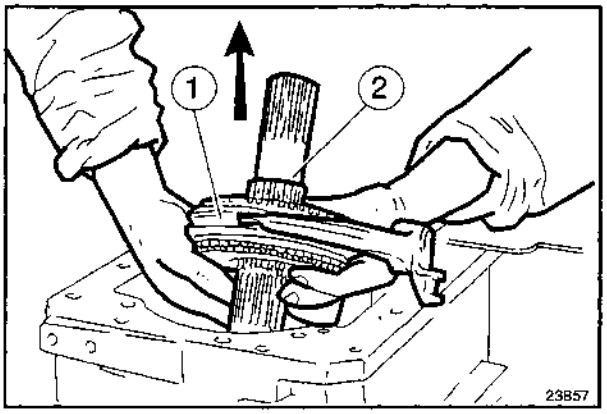


Figure 4-3-85

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23. Remove the range input shaft (1).

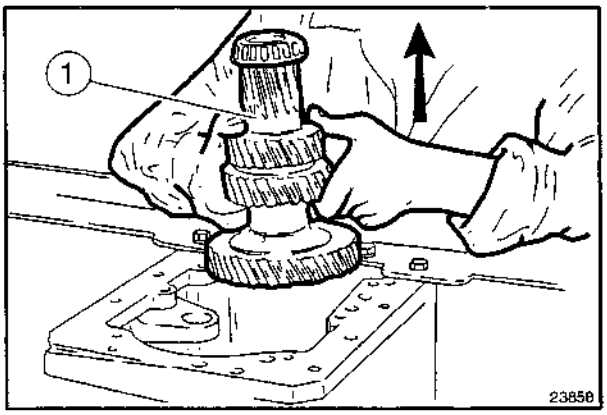


Figure 4-3-86

24. Loosen the plug (1) and retrieve spring and actuating pawl.

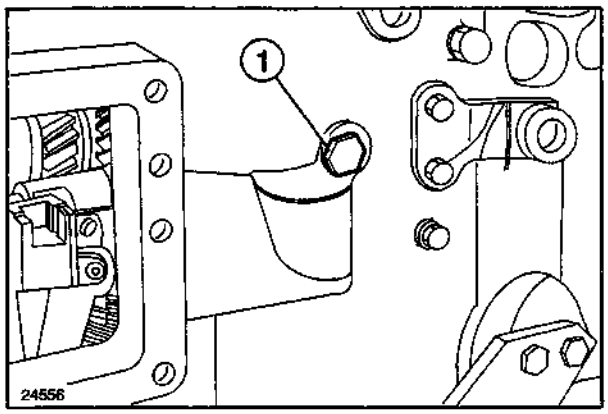


Figure 4-3-87

25. Partially slide out the spring pin until releasing the control lever (3) from the fork (1). Remove control lever and fork.

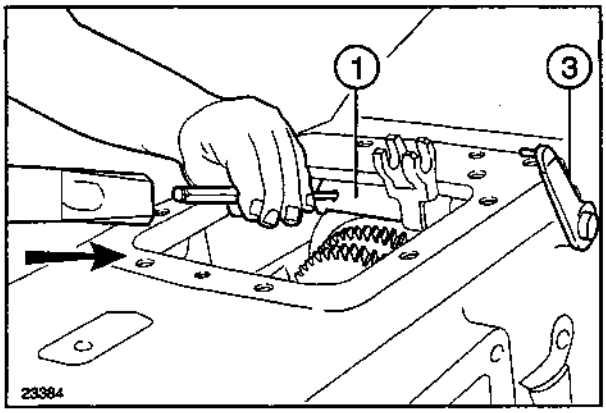


Figure 4-3-88

26. Remove the snap ring (1), withdraw the input shaft from the rear side of the transmission housing.

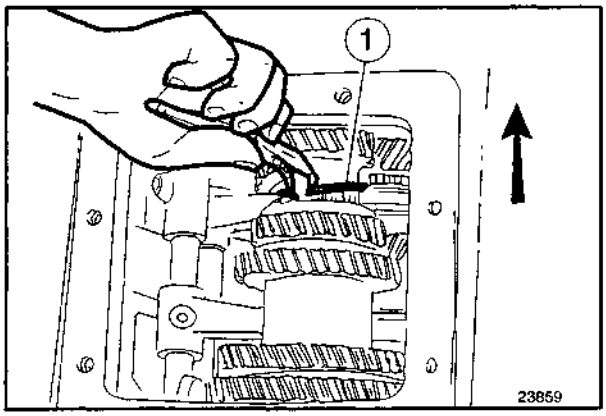


Figure 4-3-89

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27. While sliding out the shaft, retrieve drive gear, snap ring (2) and half–rings (1).

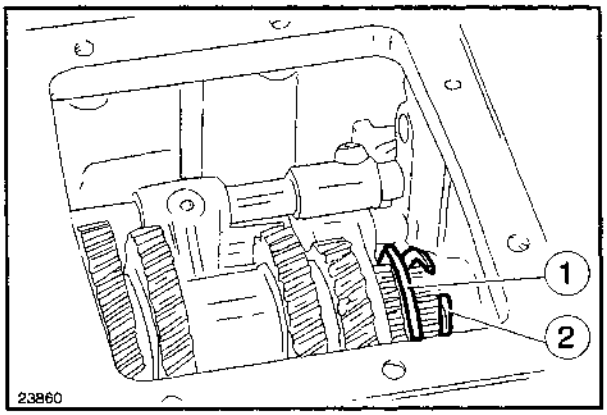


Figure 4-3-90

28. Also retrieve oil seal (2) and bushing (1) from the input shaft front side.

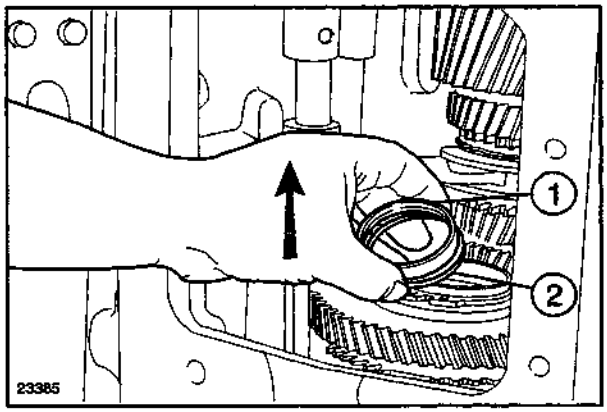


Figure 4-3-91

29. Remove the snap ring (1) and retrieve adjust shim (2).

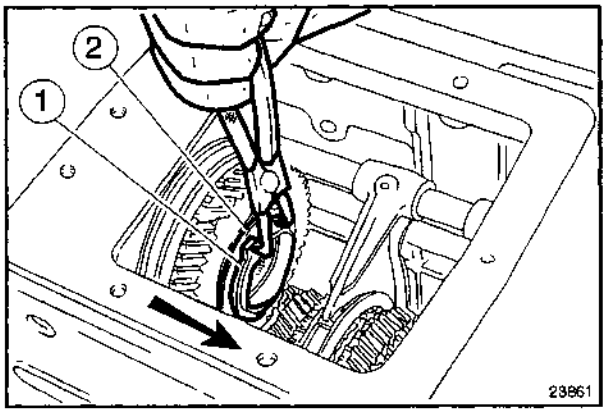


Figure 4-3-92

30. Slide out the shaft along with the bearing from the transmission housing front side. At the same time, retrieve the shuttle gears and control synchronizer assembly from the inner side of the housing.

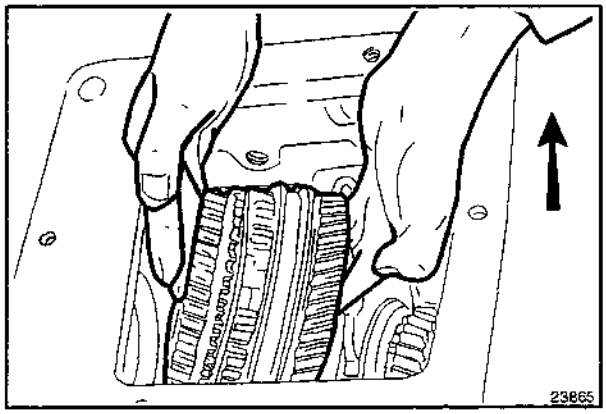


Figure 4-3-93

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31. Remove the snap ring and, using adapter tool no. **50143** (1, see page 4-3-10) and a slide puller, remove the reverse idler gear pin. Leave gear inside.

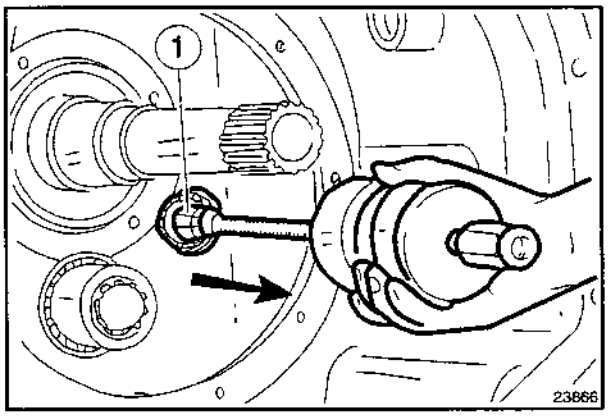


Figure 4-3-94

32. Loosen plugs (1) and remove springs and actuating balls.

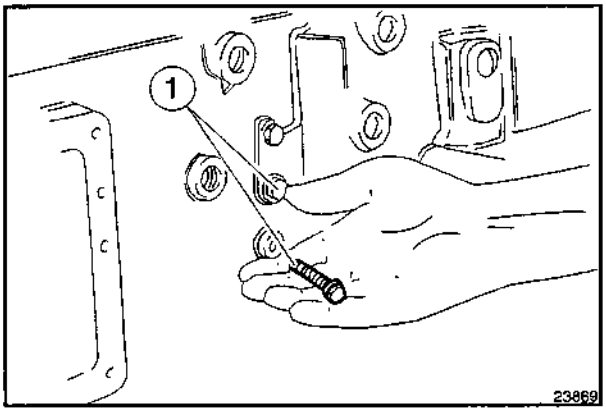


Figure 4-3-95

33. Loosen the stop plugs (5), slide out the two selector dog (6) retaining spring pins and the inner fork retaining spring pin.

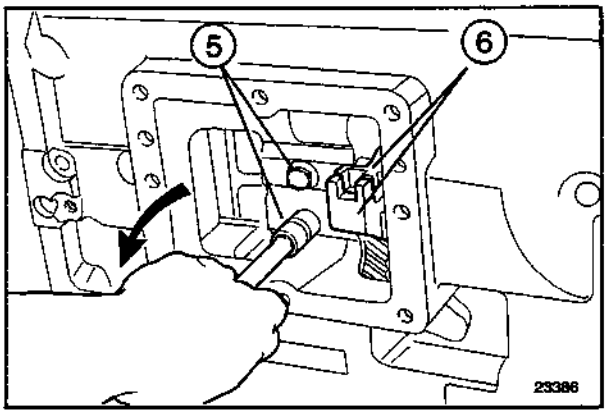


Figure 4-3-96

34. Slide out the rails from the rear side and retrieve forks and selector dog.

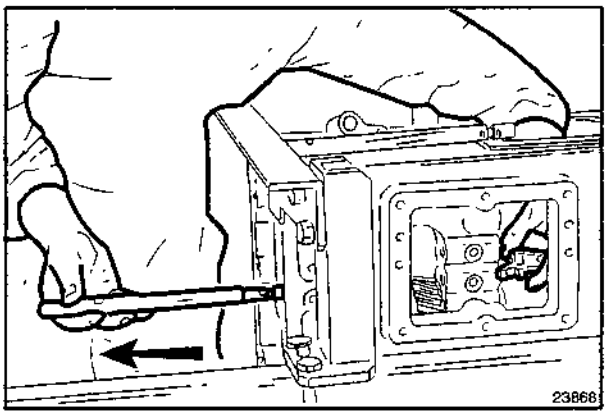


Figure 4-3-97

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35. Install tool no. **293808** (1) on the output shaft, insert a wrench (2) to hold the shaft in position, screw tool no. **293805** to the housing and tighten the tool screw to support the tool.

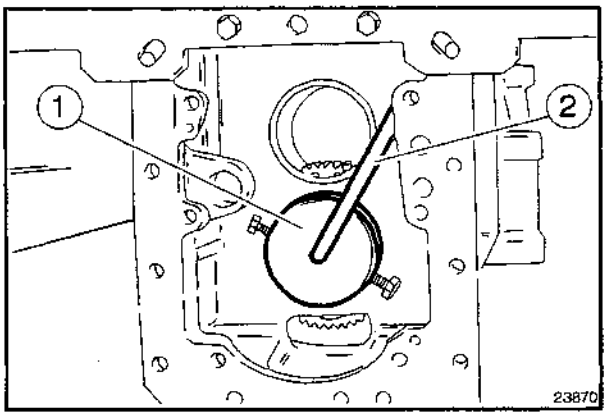


Figure 4-3-98

36. Straighten the transmission output shaft locknut, loosen the locknut and retrieve the bushing.

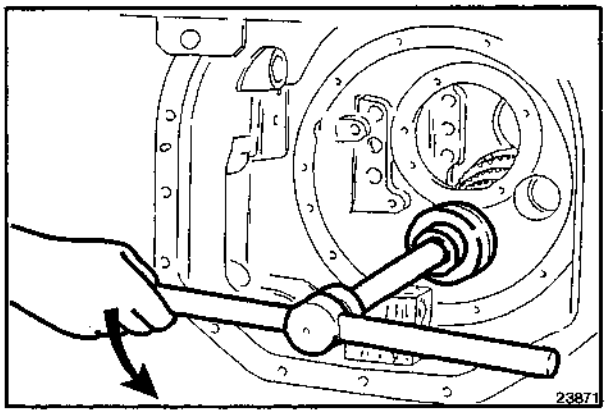


Figure 4-3-99

37. Using an aluminum punch from the front side, release shaft from bearing.

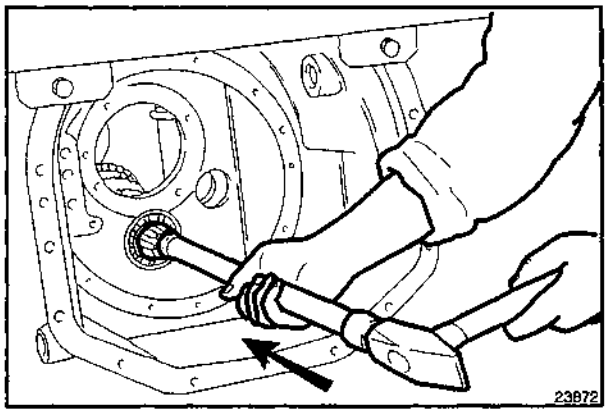


Figure 4-3-100

38. Set the transmission housing upright, withdraw the output shaft (1) and retrieve the group of gears.

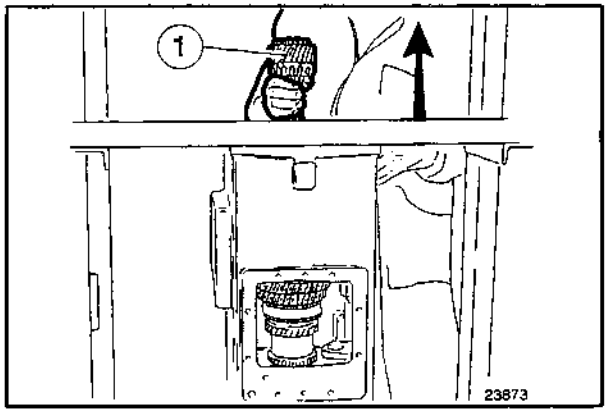


Figure 4-3-101

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39. Remove snap ring (2), bearing inner retaining ring and retrieve hubs for clutches A and B (1) along with the bearing and clutch A discs along with the centering springs.

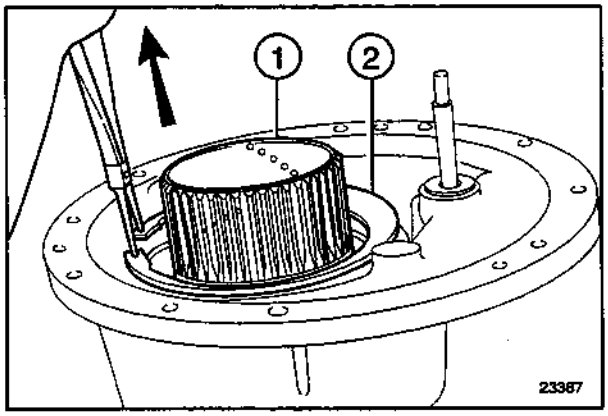


Figure 4-3-102

40. Remove seal (3).

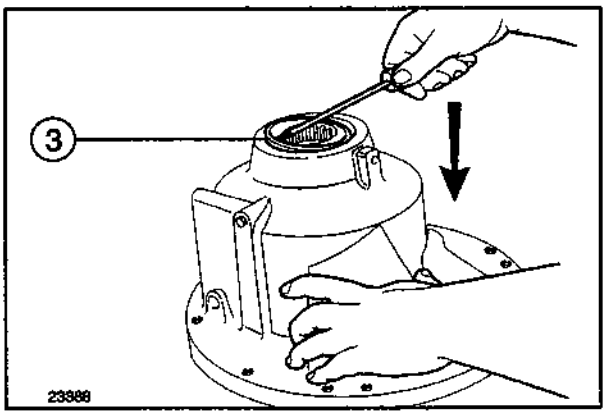


Figure 4-3-103

41. Remove outer (4) and inner snap rings. Acting on the outer side of clutch A (5), slide out clutch from cover. Retrieve the bearing.

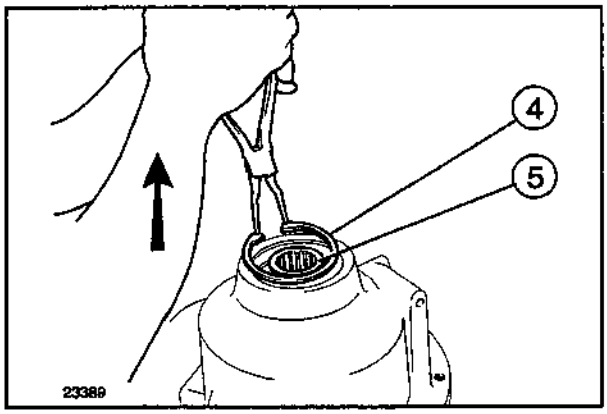


Figure 4-3-104

42. Position tool no. **295021** (6) on clutch A (5). Turn the tool screw to compress the clutch release Belleville springs and remove stop ring. Remove tool no. **295021** (6) and retrieve Belleville springs.

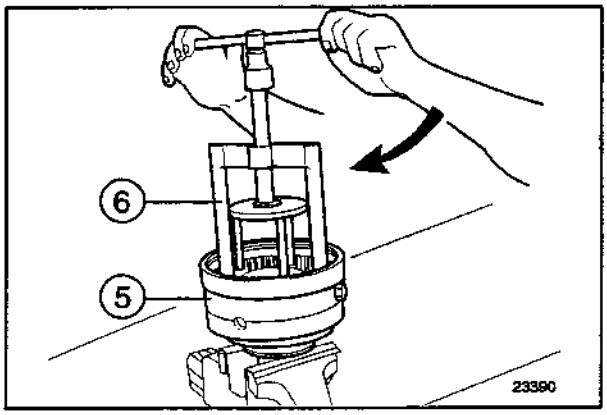


Figure 4-3-105

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43. Place clutch A bell housing on the cover (2), blow compressed air into control oil supply hole and remove piston (1).

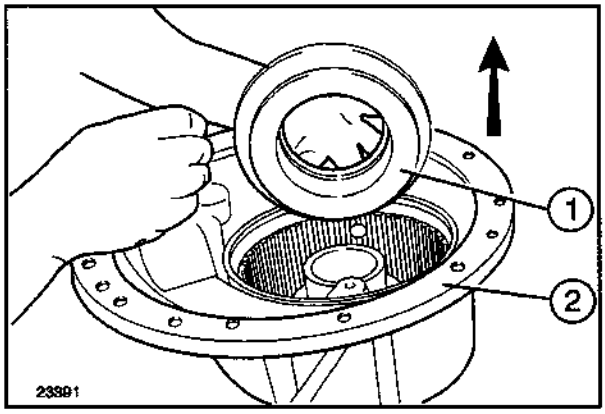


Figure 4-3-106

44. Loosen the lubrication oil pressure regulating valve (3). Disassemble the valve and inspect components.

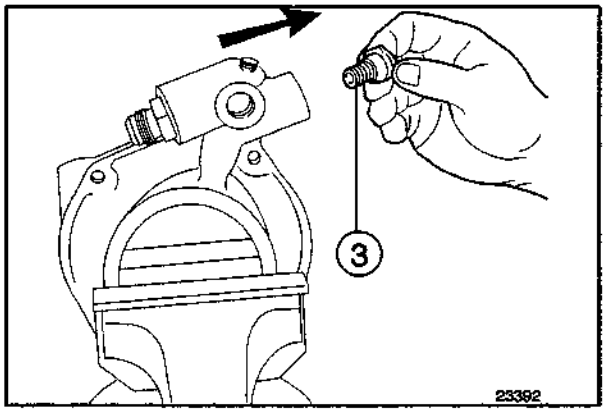


Figure 4-3-107

45. Reassemble the speed and range gears into the transmission housing observing the following:

- Reassembly follows the disassembly procedure in reverse, from step 44 back to step 1.
- Refer to figures on pages 4-3-11 and 4-3-12 for correct orientation of the different parts.
- Ensure the housing is thoroughly cleaned (especially inner compartments).
- Check seals and replace if damaged.
- Before reassembling housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a 2 mm (0.079 in) bead of sealant following the pattern shown in the figure on page 4-3-48.
- Tighten to correct torque as detailed on page 4-3-5.
- Consider the following operations and perform adjustments as detailed on pages 4-3-44 to 4-3-47.

46. After removing the snap ring and thrust washer, disassemble the transmission input shaft bearings using tools nos. **293805** (1) and **50062** (2) (see on page 4-5-7, Chapter 5). Heat the bearings to reinstall them and settle using a brass punch.

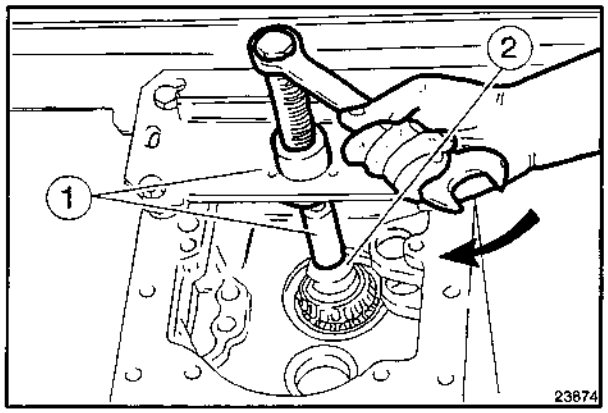


Figure 4-3-108

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47. Mount retaining tool no. **293808** (1) on the transmission output shaft and insert a wrench (3) to hold it in place. Support tool (1) using tool no. **293805** (2) attached to the housing.

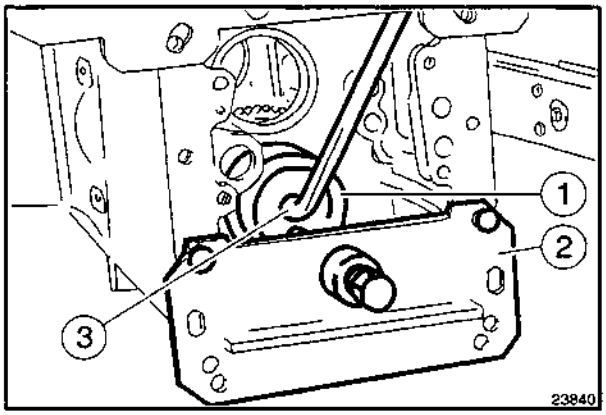


Figure 4-3-109

48. Press–fit front bearing (2) on to the transmission output shaft using tool no. **293869** (1).

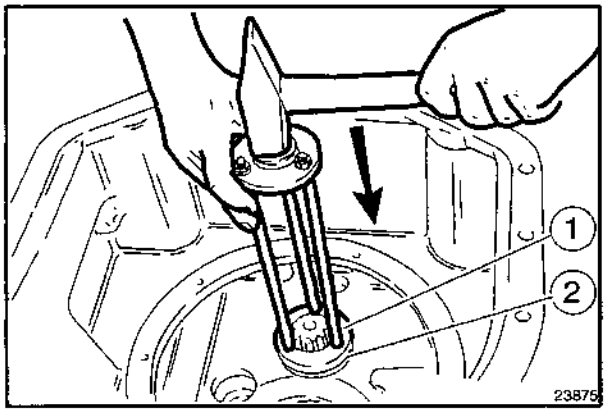


Figure 4-3-110

49. When reassembling the forward/reverse gears and synchronizer, use a feeler gauge (9), check that clearance is to specification (0.01 to 0.15 mm). Adjust shims available are listed on page 4-3-3.

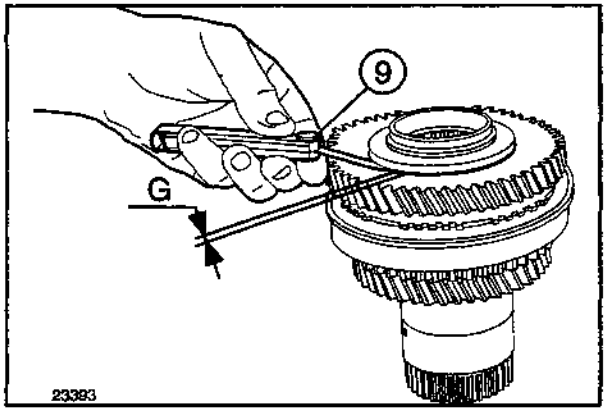


Figure 4-3-111

50. When reassembling clutch A, reassemble bearing (1), then raise the hub (8) using a suitable tool and insert the snap ring (10).

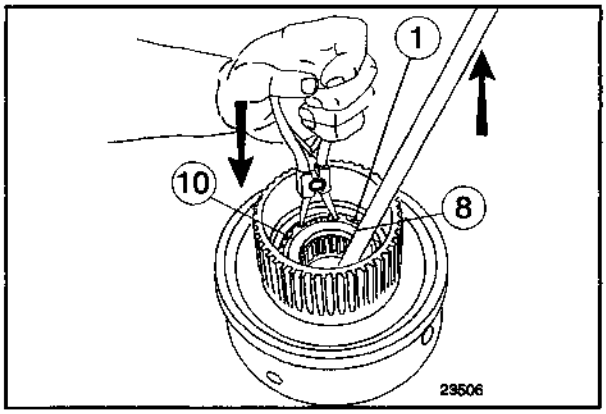


Figure 4-3-112

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51. When reassembling the snap ring to the clutch cover (8), ensure that the leak oil discharge hole (7) is exactly in–between the two ends of the outer snap ring (1).

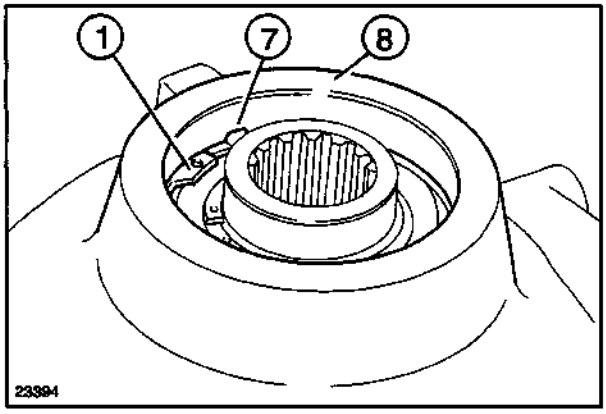


Figure 4-3-113

52. To assist reassembly of clutch B disc retaining ring, it is necessary to insert two suitable dowels (1) into two oil discharge holes to keep the clutch disc centering springs compressed.

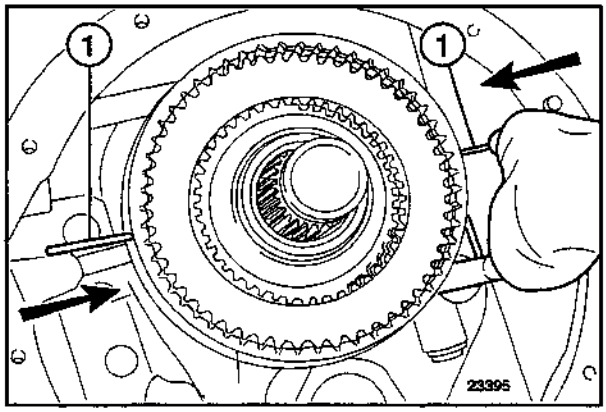


Figure 4-3-114

53. Using a expanding puller tool (5), position tool no. **50018** (3) with three legs tool no. **50115** (2). Turn the puller screw to clamp the clutch disc and endplate, and position the clutch disc retaining ring into its seat.

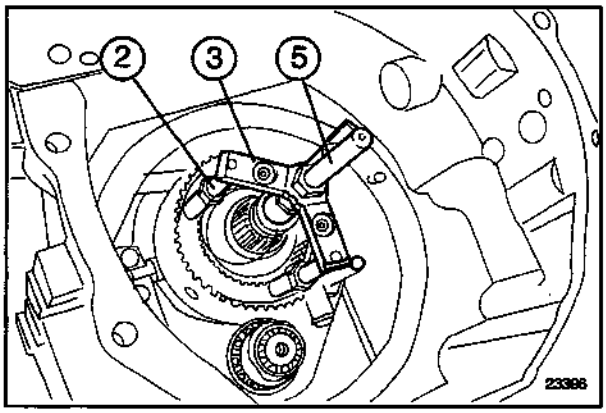


Figure 4-3-115

54. With the clutch A housing assembled to the transmission housing, press–fit the bearing (7) using tool no. **293869**. Fix bearing with the retaining rings and install the seal.

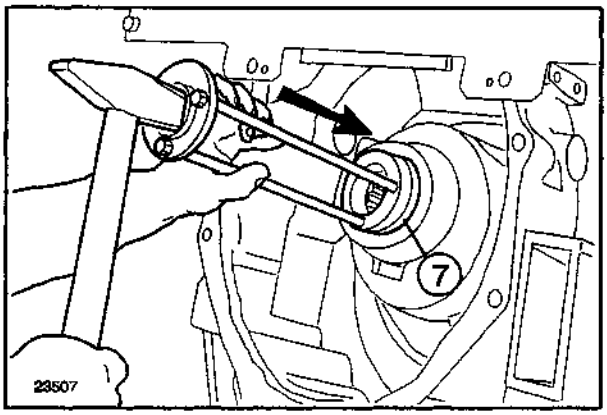


Figure 4-3-116

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55. Prior to transmission housing installation, it is necessary to position the drive shaft (1) and seal (2).

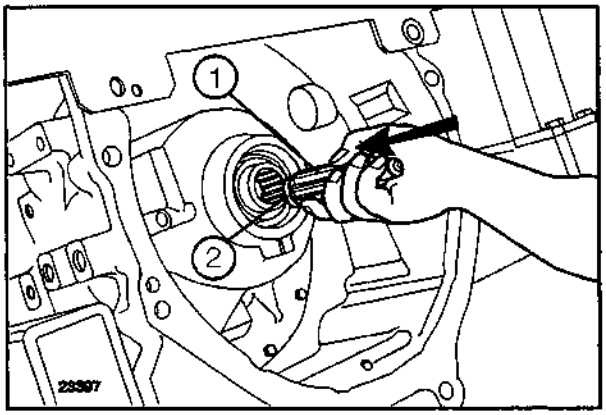


Figure 4-3-117

56. Heat and press–fit the bearing (3) on to the input shaft using tool no. **50060** (2) shown on page 4-3-9. Using tool no. **50013** (1) (see page 4-3-8), keep the bearing properly seated during cooling.

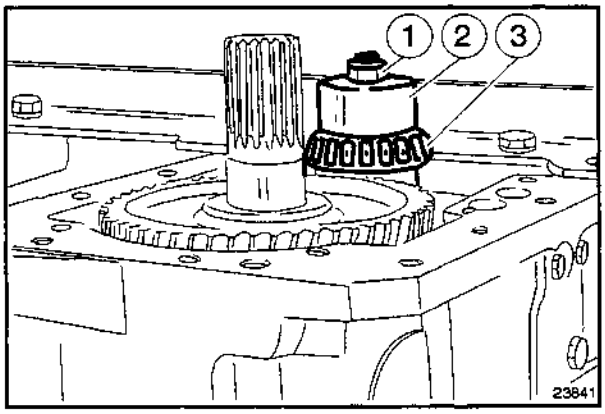


Figure 4-3-118

57. Heat and press–fit the bearing (1) on to the output shaft using tool no. **50061** (2) shown on page 4-3-8. Using tool no. **50018** threaded rod (3) (see page 4-3-7), keep the bearing properly seated during cooling.

Note: Remove tools nos. **50060** (2, Figure 4-3-118) and **50061** (2, Figure 4-3-119) when the bearings (1 and 3) have completely cooled down.

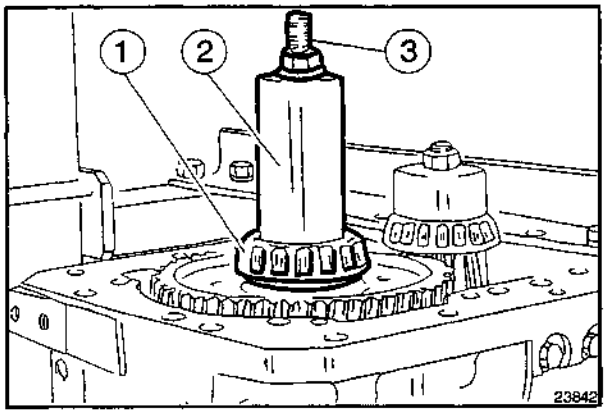


Figure 4-3-119

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DUAL COMMAND TRANSMISSION HOUSING

Shuttle gear bearing adjustment

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

58. Remove the snap ring (5) and slide out adjust shim (4), front bearing (3), spacer (2) and rear bearing (1).

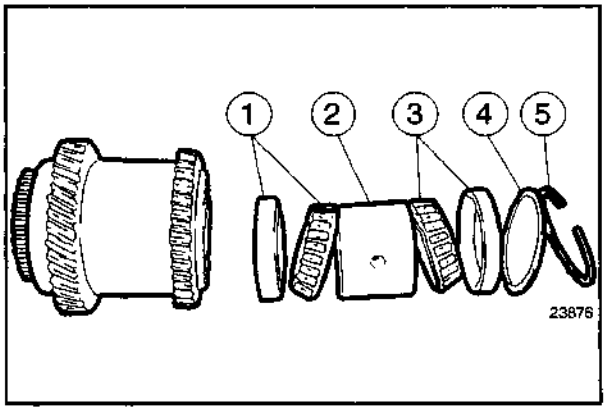


Figure 4-3-120

59. Reassemble all parts without the adjust shim. Ensure the assembly is bottoming. Measure distance (L_1) from top of gear (2) to the bearing outer race (1).

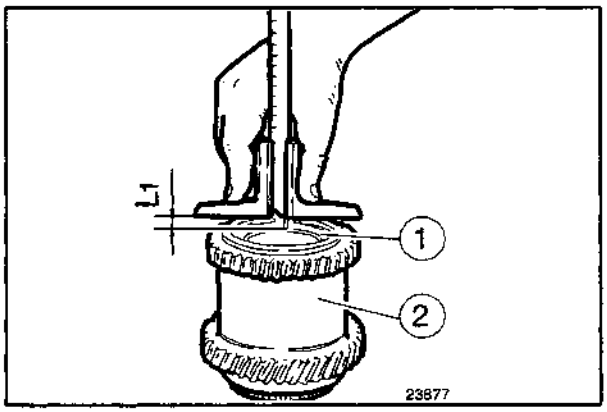


Figure 4-3-121

60. Place the gear on a suitable bushing (1) to have the inner assembly pushed up. Ensure also the snap ring is pushed up.

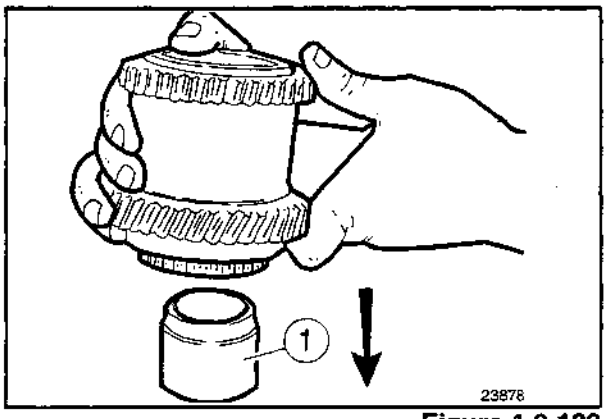


Figure 4-3-122

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61. Measure distance (L_2) from top of gear (2) to the bearing outer race(1). Adjust shim (2, Figure 4-3-124) to be added is given by:

$S = L_1 - L_2 - 0.05$ mm

where:
S = Adjust shim (2).
L_1 and L_2 = Readings on the gear
0.05 mm = Decrease necessary to compensate for bearing increased pre–load deriving from tightening of the transmission output shaft locknut.
If necessary, round off the value (S) to the previous 0.05 mm.

Example:
Reading L_1 = 10.25 mm.
Reading L_2 = 7.33 mm.
Adjust shim:
S = 10.25 – 7.33 – 0.05 = 2.87 mm.
Adjust shim to be assembled is 2.85 mm.

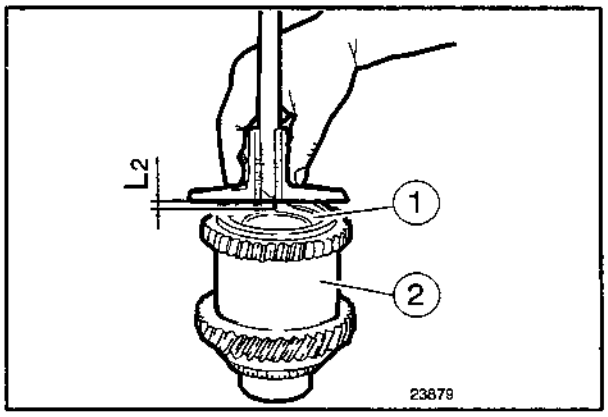


Figure 4-3-123

Note: Available adjust shims for the shuttle driven gear are listed on page 4-3-4.

62. Remove snap ring (1), assemble adjust shim (2) as previously found and lock the assembly reinstalling snap ring (1).

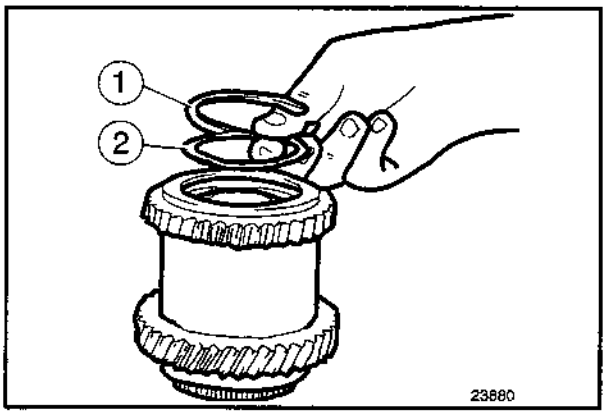


Figure 4-3-124

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DUAL COMMAND TRANSMISSION HOUSING

Range Input and Output Shaft Taper Bearing Adjustment

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

63. Install cover, (2) Figure 4-3-125, without the adjust shim. Install tool no. **50013**, threaded portion, (1) (see page 4-3-8) on to the input shaft.

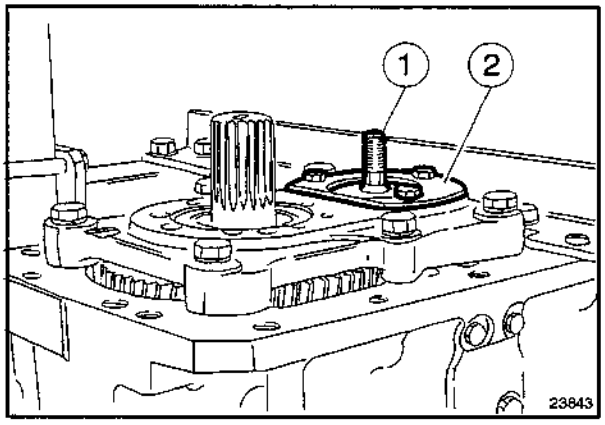


Figure 4-3-125

64. Screw installer tool no. **292176**, (2) Figure 4-3-126 on tool no. **50013** (3). Place a dial indicator (1) with the stylus touching the bearing inner race. Turn the shafts to settle the bearing rollers, reset gauge to zero ensuring that the assembly is bottoming. Through the lever of installer tool no. **292176** (2), bring the assembly to touch the cover (4) and read the travel (L) on the dial indicator.

Adjust shim to be added is given by:

S = L– (0.02 to 0.08 mm)

where:
S = Adjust shim
L = Travel reading
0.02 to 0.08 mm = Input shaft bearing end play.

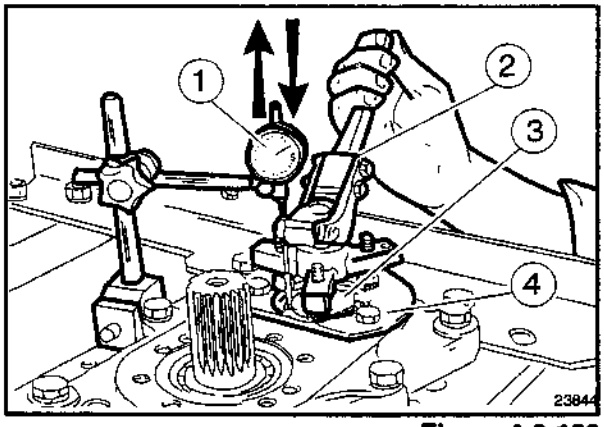


Figure 4-3-126

Note: Available adjust shims for the range input shaft bearings are listed on page 4-3-3.

65. Dismantle tools (2 and 3), remove cover (4), assemble the shim as previously found, reinstall cover (4) and tools (2 and 3). Repeat step 64 and check end play is to specification, 0.02 to 0.08 mm. Remove tools (2 and 3).

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66. Install disc (1) with a test shim. **Note:** It is necessary to fit a test shim to the lower shaft only as the clearance between the low range gear and end cover is minimal. Remove output shaft lubrication plug.Assemble tool no. **50018** (4) (see on page 4-3-7), installer tool no. **292176** (3) and dial indicator (2). Ensure the indicator stylus is on the bearing inner race.
Turn the shafts to settle the bearing rollers and reset gauge to zero ensuring that the assembly is bottoming.
Using the lever of installer tool no. **292176** (3) bring assembly to touch the disc (1) and read travel (H) on the dial indicator.
Shim to be added is given by:

S_1 = H + Sp – (0 to 0.06 mm)

where:

S_1 = Adjust shim.
Sp =Travel reading.
H = Output shaft bearing end play.
0 to **0.06 mm** = Output shaft bearing end play.

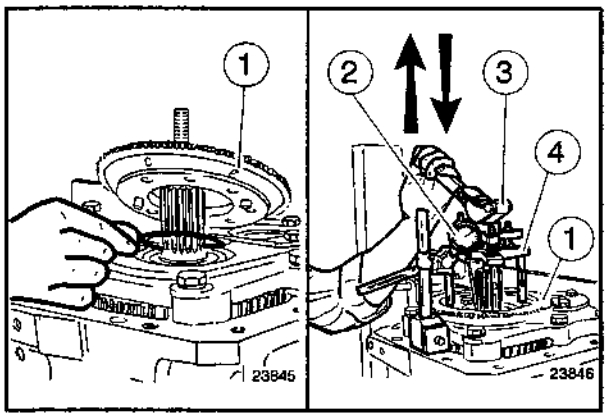


Figure 4-3-127

Note: Available adjust shims for the range output shaft bearings are listed on page 4-3-3.

67. Dismantle tools (3 and 4), remove disc (1), replace test shim (Sp) with adjust shim (S_1), reinstall disc (1) and tools (3 and 4). Repeat step 66 to check end play is to specification, 0 to 0.06 mm. Remove tools (3 and 4) and screw in the output shaft lubrication plug.

Note: This procedure is shown with the creeper option. If creeper is not installed, use this same procedure utilizing the one piece bearing retaining plate.

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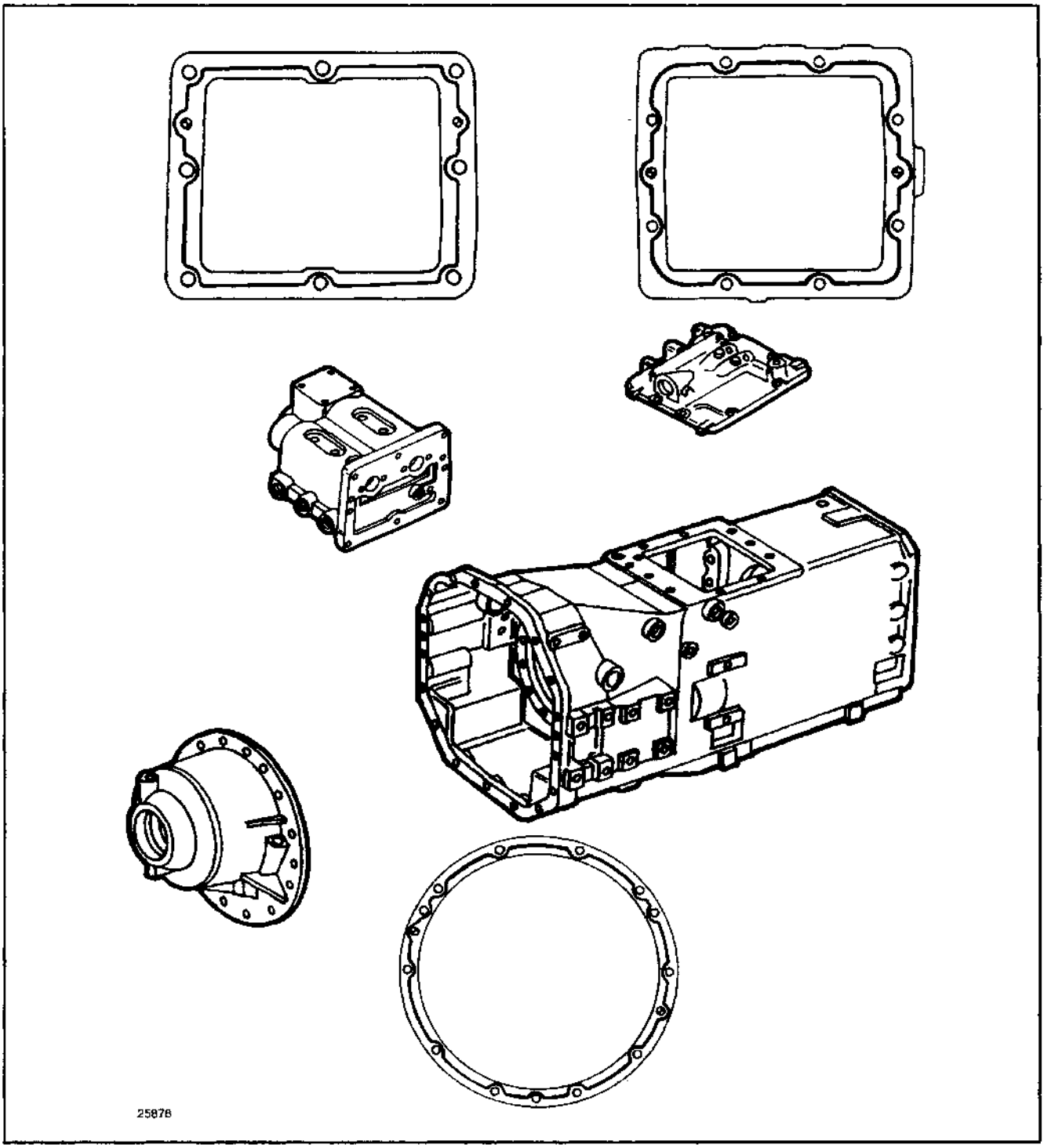


Figure 4-3-128

Pattern for application of sealant during installation of speed and range control assembly, upper cover and front cover of clutches A and B.

Sealants to be used are listed on page 0-1-19, Section 00.

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DUAL COMMAND TRANSMISSION VALVE

Removal–Installation Disassembly–Assembly

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

To service the DUAL COMMAND transmission valve, it is necessary to remove the cab following the procedure described on pages 4-3-16 to 4-3-23.
Proceed as follows:

1. Loosen retaining screws and remove rheostat (1) from the DUAL COMMAND valve.

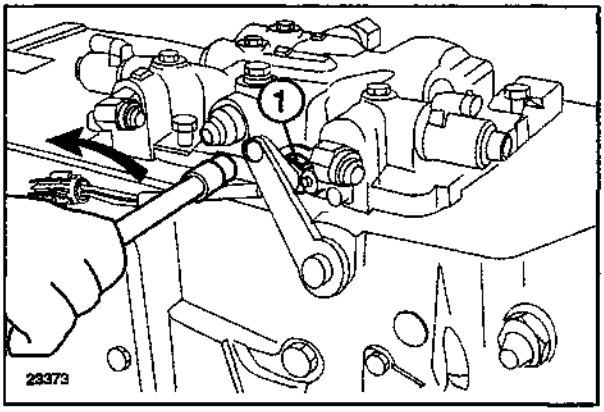


Figure 4-3-129

2. Loosen retaining screws and detach the DUAL COMMAND transmission valve (2) using a lever.

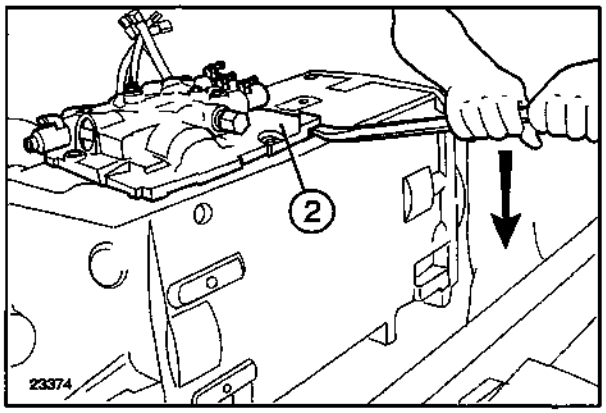


Figure 4-3-130

3. Remove the retaining ring (3). Using a screwdriver, retrieve piston (4).

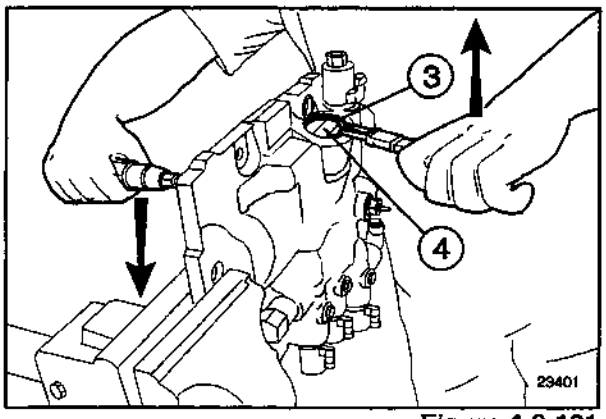


Figure 4-3-131

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4. Using a screwdriver, remove the O ring (1) from the piston seat.

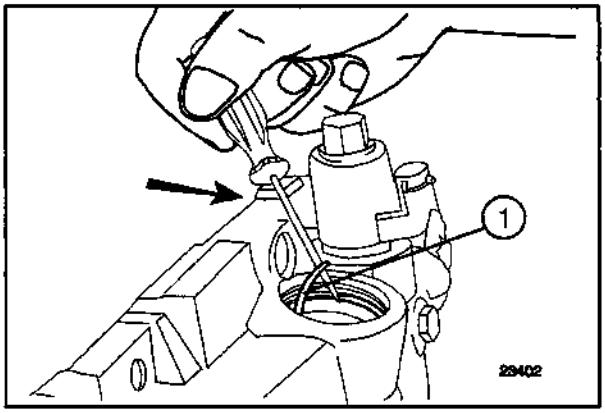


Figure 4-3-132

5. Slide out piston assembly (2).

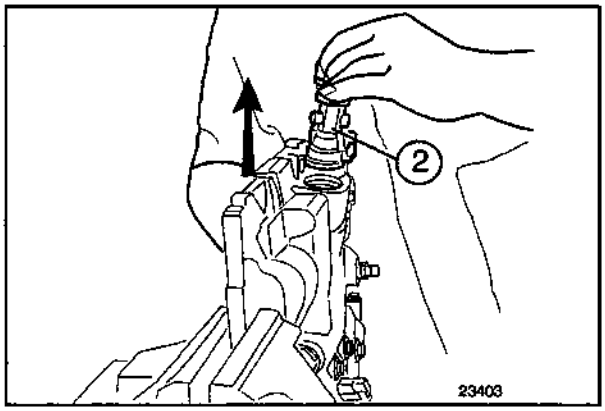


Figure 4-3-133

6. Remove the snap ring (3) and withdraw the bushing.

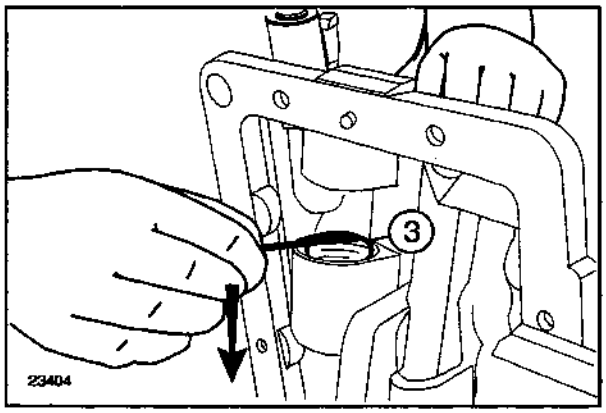


Figure 4-3-134

7. Remove the oil temperature sensor (4).

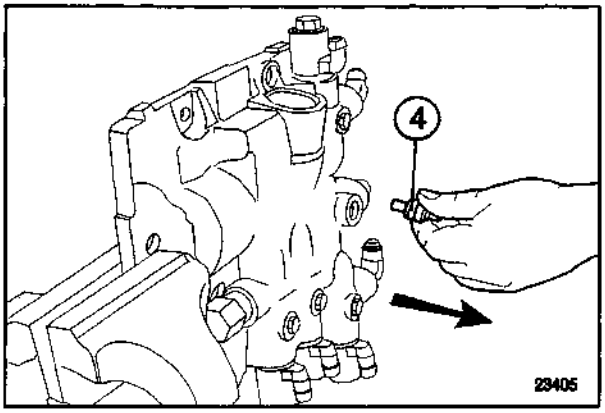


Figure 4-3-135

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8. Loosen the locknut (1) and slide out solenoid valve (2).

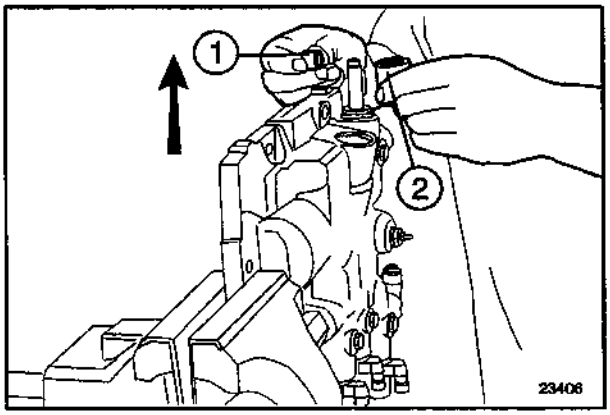


Figure 4-3-136

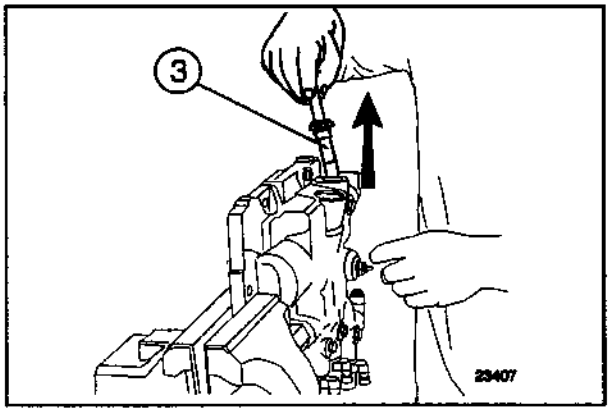


Figure 4-3-137

9. Loosen valve pin (3) and slide it out.

10. Reassemble and reinstall the DUAL COMMAND transmission valve observing the following:
   - Reassembly and reinstallation follow the disassembly and removal procedures in reverse, from step 9 back to step 1.
   - Refer to figures on page 4-3-12 for correct orientation of the different parts.
   - Ensure the valve body is thoroughly clean (especially inner compartments).
   - Check seals and replace if damaged.
   - Before reinstalling the DUAL COMMAND transmission valve, thoroughly clean and degrease mating surfaces and apply a 2 mm (0.079 in) bead of sealant following the pattern shown in the figure on page 4-3-48.
   - Tighten to correct torque as detailed on page 4-3-5 and 4-3-12.

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DUAL COMMAND TRANSMISSION CONTROL ASSEMBLY

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Remove the DUAL COMMAND transmission control assembly as follows:

1. Open and raise engine hood.

2. Detach the negative cable (1) from the battery and insulate.

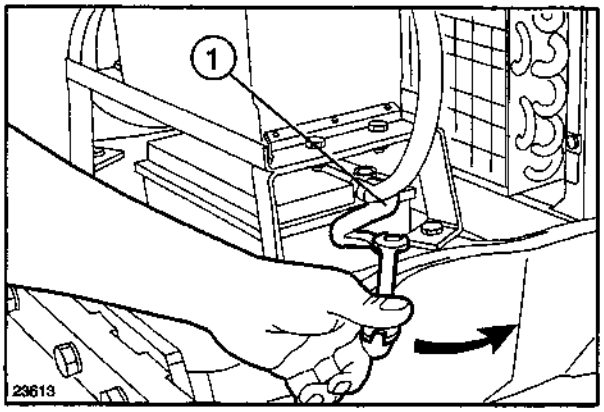


Figure 4-3-138

3. Raise rear tractor, place a stationary stand (1) under the RH final drive case and remove rear RH wheel.

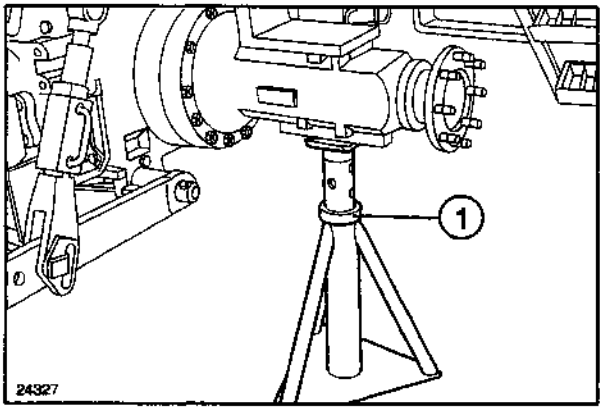


Figure 4-3-139

4. Disconnect speed and range control cables (1) from rails (2) and supports (3).

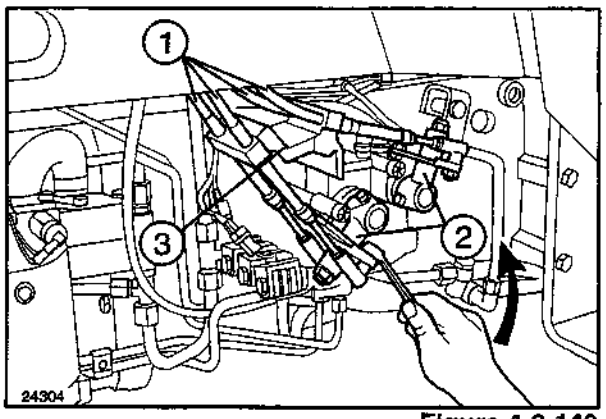


Figure 4-3-140

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5. Detach all electrical connectors (1) from solenoid valves and sensors.

Note: Before detaching connectors from the control assembly, mark each connector and respective solenoid valve or sensor to assist reassembly and avoid reversal of connections.

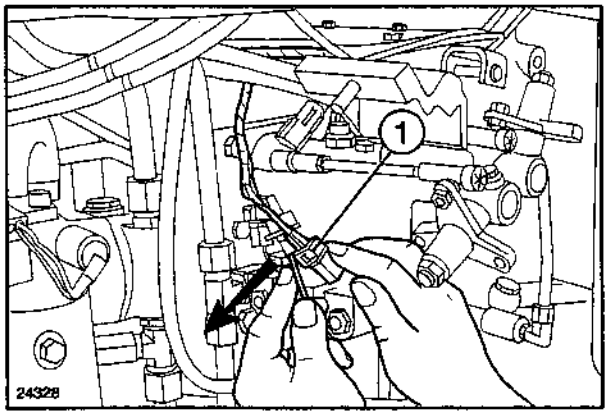


Figure 4-3-141

6. Loosen all lines (1) from the speed and range control rail assembly.

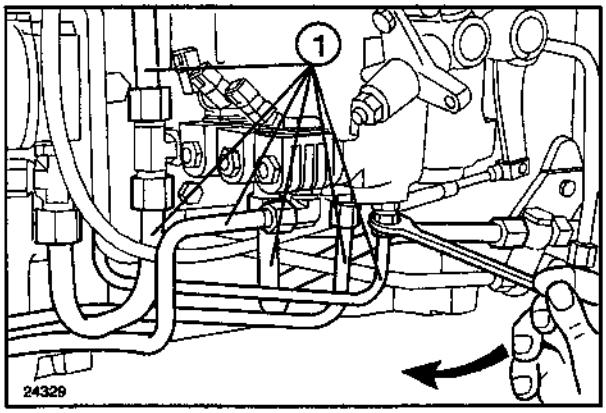


Figure 4-3-142

7. Loosen two retaining screws and insert two alignment pins (1) into the holes. Loosen all retaining screws and remove control assembly.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

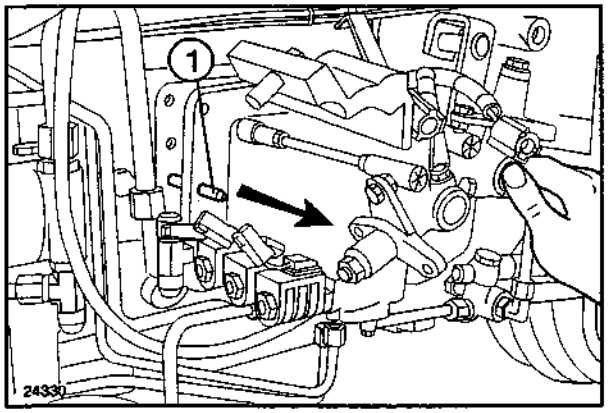


Figure 4-3-143

8. Reinstall the speed and range control rail assembly to the transmission housing observing the following:
   - Reinstallation follows the removal procedure in reverse, from step 7 back to step 1.
   - Before reassembling the speed and range control rail assembly to the transmission housing, thoroughly clean and degrease mating surfaces and apply a 2 mm (0.079 in) bead of sealant following the pattern shown in the figure on page 4-3-48.
   - Tighten to correct torque as detailed on page 4-3-5 and 4-3-12.

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DUAL COMMAND TRANSMISSION CONTROL ASSEMBLY

Disassembly–Assembly

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

To service the DUAL COMMAND transmission control assembly it is necessary to remove it from the transmission housing following the procedure described on pages 4-3-52 and 4-3-53.
Proceed as follows:

1. Remove the four sensors (1) indicating the gear engaged.

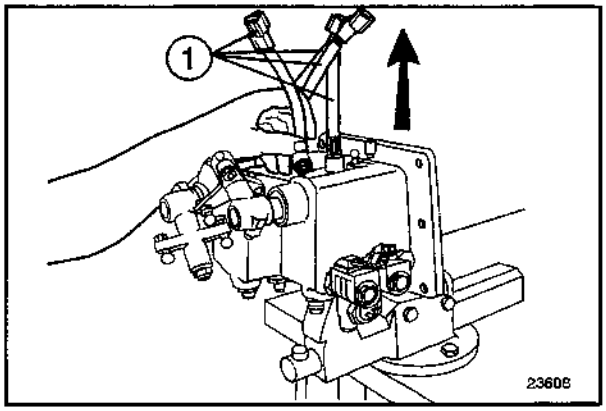


Figure 4-3-144

2. Remove control cables (2 and 3) and idler levers (4 and 5) from the outer side of the assembly.

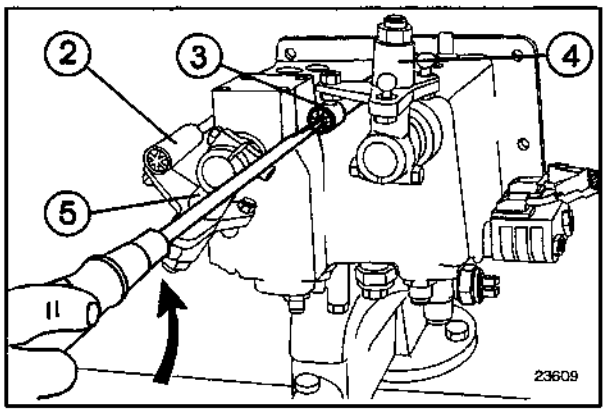


Figure 4-3-145

3. Acting from the control assembly inner side, loosen retaining screws and remove speed and range control levers (6 and 7).

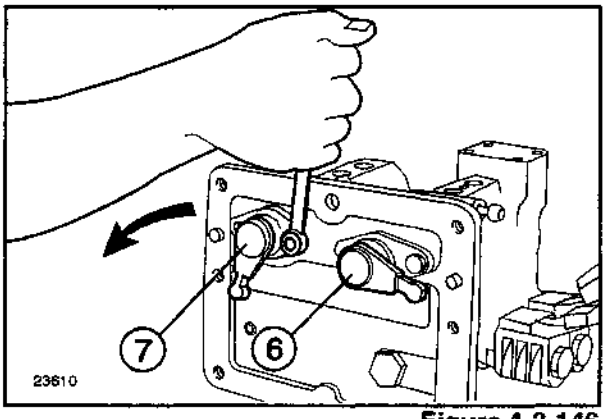


Figure 4-3-146

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4. Disassemble the power steering oil suction valve (1).

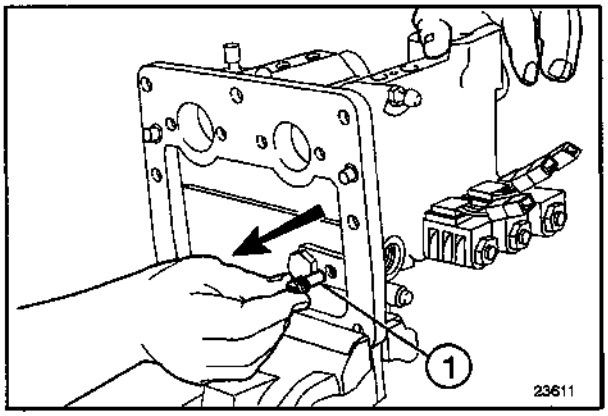


Figure 4-3-147

5. Loosen the auxiliary service circuit oil pressure regulating valve (2) and retrieve spring and piston.

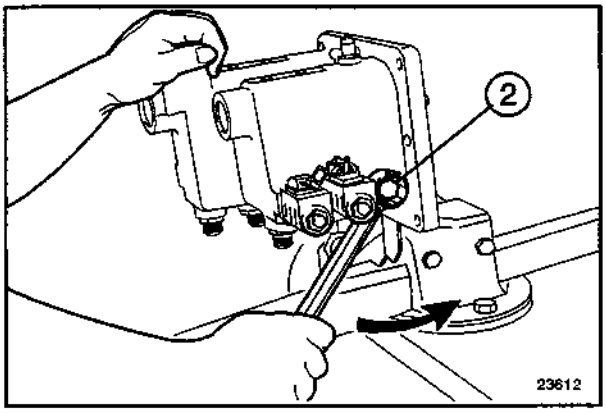


Figure 4-3-148

6. Loosen the nut (2) and slide out the solenoid valve.

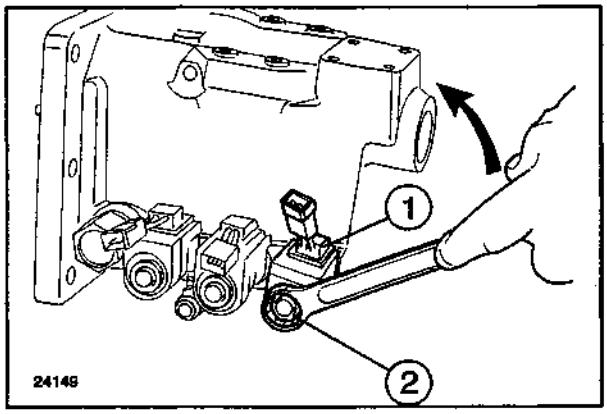


Figure 4-3-149

7. Loosen valve pin (1) and slide it out.

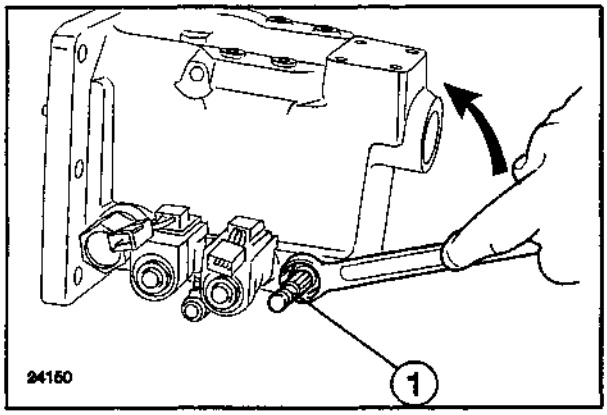


Figure 4-3-150

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8. Loosen pressure sensors and fittings.

9. Reassemble the DUAL COMMAND transmission control assembly observing the following:
   - Reassembly follows the disassembly procedure in reverse, from step 8 back to step 1.
   - Refer to figures on page 4-3-12 for correct orientation of different components.
   - Check seals and replace if damaged.
   - Upon reassembly, ensure that, with the inner transmission control rail in the normal position (rail fully in), the line passing for the cable attach points (1 and 2) is parallel to the control rail. If not, act on the adjustable cable (3) until correct length is obtained.
     Repeat for attach points (5 and 6) and act on adjustable cable (4) if necessary.
   - Tighten to correct torque as detailed on page 4-3-5 and 4-3-12.

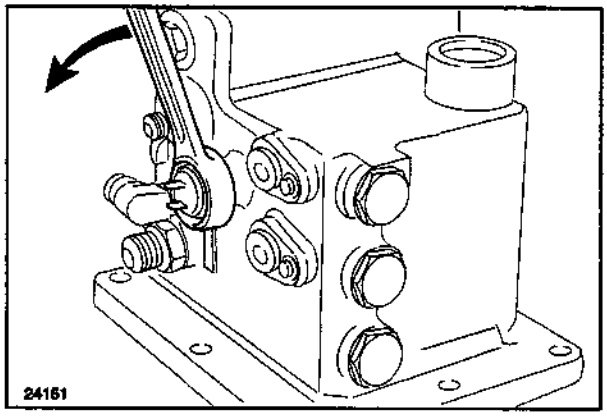


Figure 4-3-151

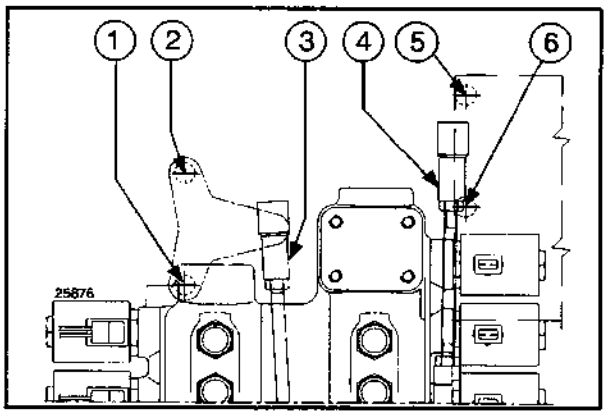


Figure 4-3-152

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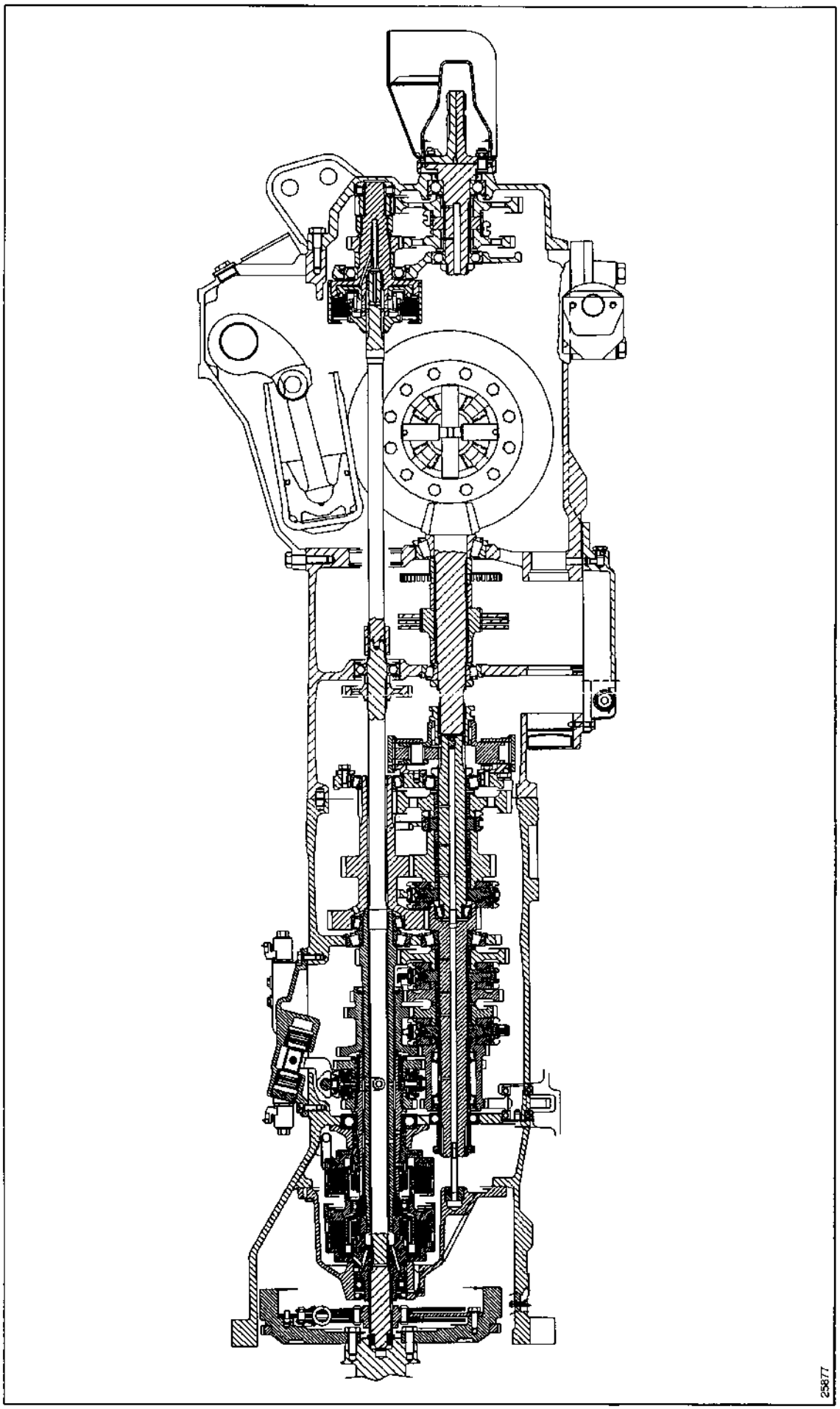


Figure 4-3-153
Drive Line Longitudinal View

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SECTION 4

TRANSMISSIONS

CHAPTER 4

DUAL COMMAND TRANSMISSION

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Introduction

The transmission electronic management system has an inbuilt self diagnostic facility. This facility utilizes the digital display of the gear shift handle assembly to indicate, in coded format, any malfunction in the electrical and electronic circuitry and in the micro–processor. It should be noted that the self diagnostic capability is generally limited to diagnosis of the electrical and electronic circuitry and related components, however, there are some codes, which can be generated if pressure switch circuits are not closed because of an actual lack of hydraulic pressure. Any malfunction of the mechanical and hydraulic components must be diagnosed using conventional techniques, performance characteristics and tooling, such as pressure testing equipment. Full guidance for both electrical self diagnosis and conventional diagnosis is contained within this section.

Trouble–shooting and fault finding should always be carried out in a logical and planned sequence, many apparent faults associated with electronic components are often hastily diagnosed and result in the replacement of expensive components. An extra few minutes confirming the apparent fault will result in a more positive and cost effective repair.

With the use of micro–processors it is often that this item is blamed for any malfunction but the real truth is that this item is usually sound and that the fault is due to poor contacts in the associated connectors.

Each connector illustrated and identified in the wiring diagrams in Chapter 9 Section 2 and referred to in the following fault finding procedure, has the same identification reference. For example, the main transmission processor connectors are referred to as Connectors C100 and C101 in the illustration and also referred to as C100 and C101 in the fault finding procedure. Often in the fault finding flow chart the connector and pin are abbreviated and will read, for example, C100–21. The C100 refers to the connector and the 21 to the pin number. Alternatively, for connectors with fewer pins, the identification will read, C014–FM3100–B/G/S. This is broken down as follows:

C014	Connector number
FM3100	Front Main harness, circuit number 3100
B/G/S	Wire color

Reference will have to be made to the wiring chapter of Section 2 to correctly identify the pin in question.

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Where the fault finding procedure requires checks for continuity a visual inspection of the wiring should be made prior to conducting tests to ensure that obvious 'mechanical' damage has not occurred to the harness or the connectors.

A good quality multimeter is an essential item to perform fault finding. It should be capable of measuring resistance of at least 20,000 ohms and measuring voltage and current. When using the multimeter it is good practice to select a high range and work downwards to avoid damaging the instrument.

IMPORTANT: *Care should be used when using the multimeter, only use the instrument as instructed to avoid damage to the internal elements of the micro–processor. When checking the continuity of wiring, sensors or switches it is necessary to isolate the electronic micro–processor and ensure the keystart is turned off to prevent possible further damage. The keystart should only be switched on and the processor connected where specifically instructed in the fault finding procedure.*

If it is found necessary to clean the connectors a contact spray should be used. DO NOT USE ANY OTHER METHOD FOR CLEANING TERMINALS. Do not use a cleaner that contains Trichloro–ethylene, this solvent will damage the plastic body of the connector. It is preferable to use a cleaner with a Freon T.F. base.

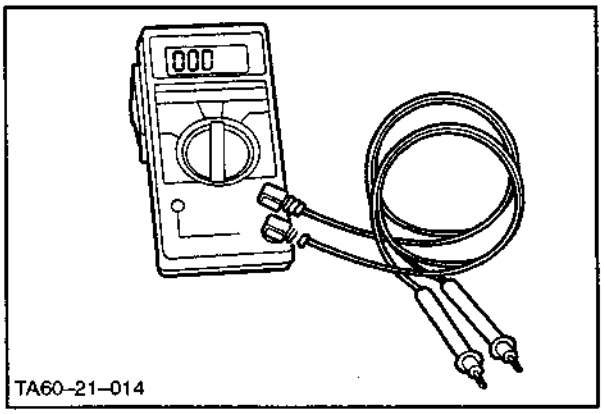


Figure 4-4-1

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CLUTCH AND SYNCHRONIZER CALIBRATION

The Hi–Lo transmission has wet multi–plate clutches that require periodic calibration to compensate for wear. Calibration should only be necessary if a deterioration in gear shift quality is noted.

NOTE: *During the calibration procedure the electronic management system detects precisely the point at which the clutches start to engage . The engagement is detected by a reduction in engine speed. During calibration it is essential that no action is taken to to cause the engine speed to vary. Be sure that the air conditioner and all electrical equipment is switched off. Do not operate the PTO or any hydraulic lever or move the hand or foot throttle.*

There are two methods to enter the calibration mode:
(i) Through the diagnostic connector, using special tool No. FNH00874 and menu mode H1, or,
(ii) By depressing both Hi and Lo bottons on the shift lever during start up.

Tractor Preparation

NOTE: *The clutches can be adjusted when the transmission oil is at a temperature of 68°F (20°C) or over. The clutches should be adjusted when the transmission oil is at 140°F (60°C) or over.*

Park the tractor on level ground, away from obstacles (in case of unexpected tractor movement).

Apply handbrake, switch off all electrical equipment and air conditioning if fitted. Stop the engine and place remote levers in neutral and lower hydraulic equipment to the ground.

Place all the shift levers in neutral. Block the wheels, front and rear.

Either, (i) Install tool FNH00874 into the diagnostic plug and select H1 by depressing the diagnostic switch once or (ii) press and hold both the Hi and Lo buttons and start the engine.

"CAL' will appear in the transmission display, (release Hi and Lo buttons).

Set engine speed to 1200 ERPM ±100.

Select forward, first gear, high range (C) and release the clutch.

The transmission is now ready for calibration.

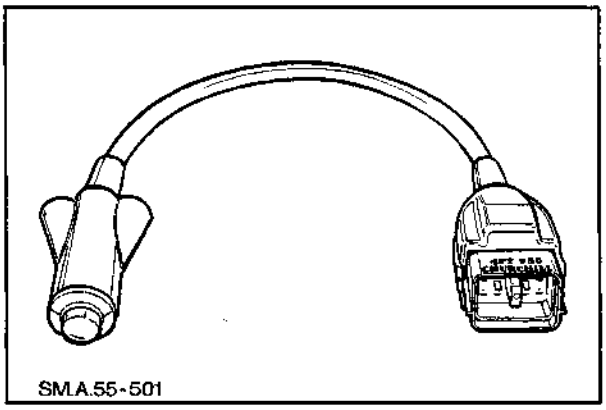


Figure 4-4-2

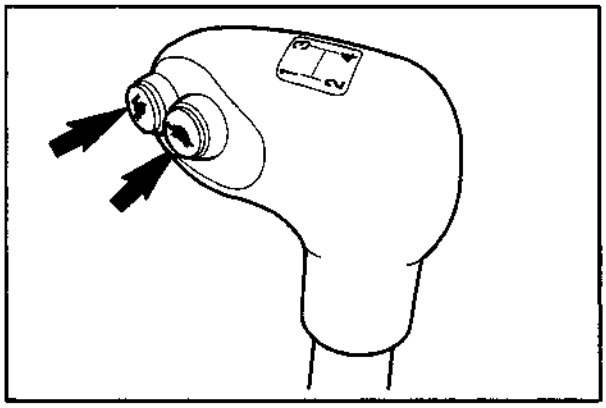


Figure 4-4-3

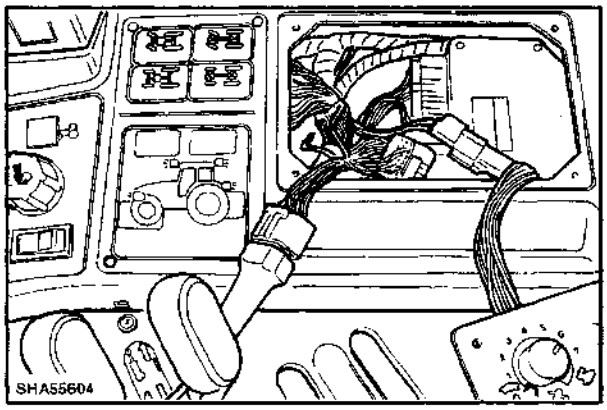


Figure 4-4-4

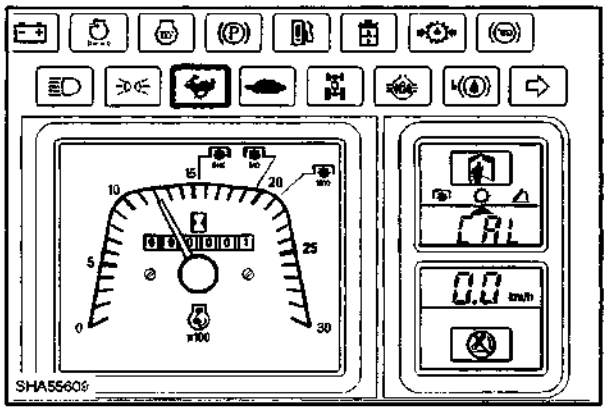


Figure 4-4-5

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Press and hold upshift button to calibrate clutch Hi.

If the start up procedure was incorrect a "U" code will appear. See 'Error Codes' on page 4-4-24.

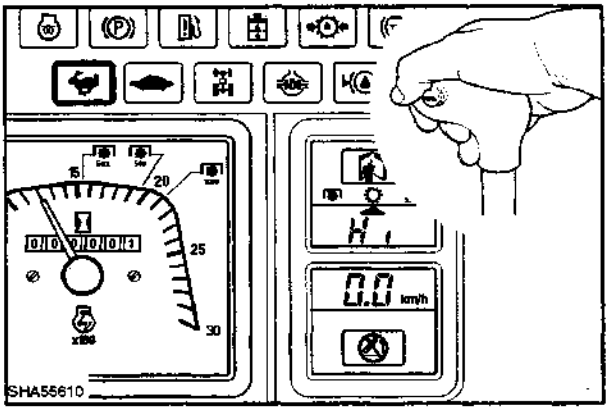


Figure 4-4-6

After a few seconds the displayed Hi is replaced by a number which increases during calibration.

Hold the upshift button until the engine speed decreases by 50 RPM and the number stops increasing.

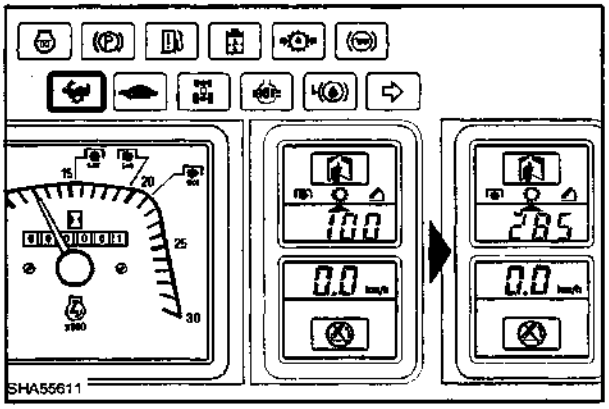


Figure 4-4-7

Press the down shift button to calibrate the Lo clutch in the same manner as the Hi clutch.

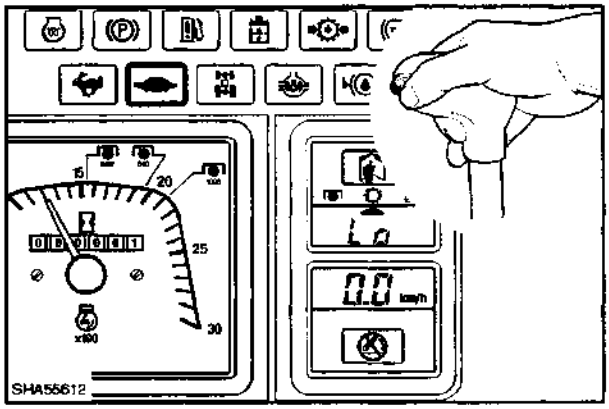


Figure 4-4-8

Synchronizer Calibration

To calibrate the synchronizer, at any stage after initial tractor preparation, press both the Hi and Lo buttons and hold.

"SOC" appears during calibration.

"END" displays to signify completion.

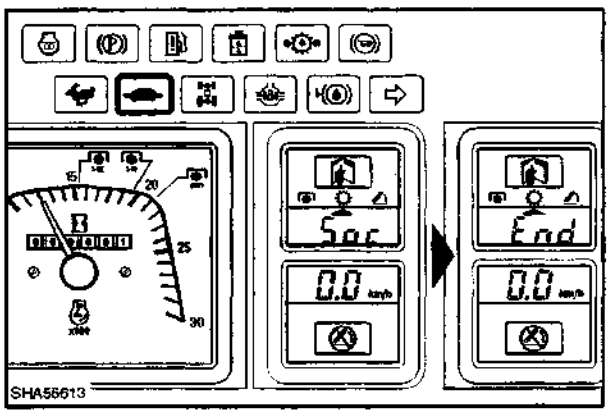


Figure 4-4-9

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PRESSURE TESTING

Transmission Clutches A and B

1. Prepare the tractor for pressure testing:

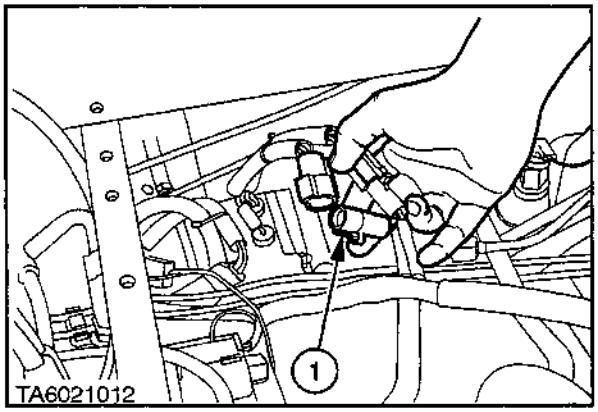


Figure 4-4-10

(i) Remove the instrument console side covers, lift and remove cab rubber mat and remove the floor pan.

(iii) Ensure the handbrake is fully applied and wheels chocked.

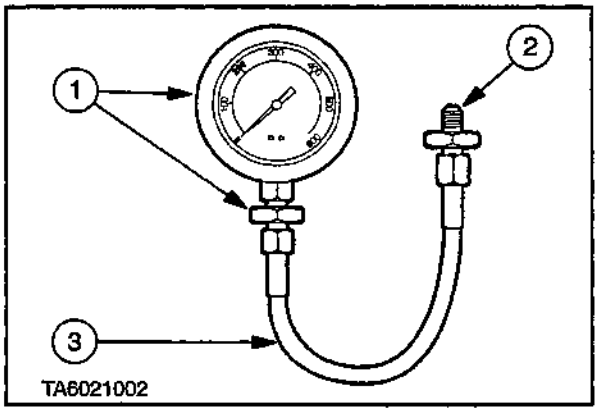


Figure 4-4-11

(iv) Disconnect a range switch connector and install Special Tool FNH00875 (bypass connector) into the harness, (1) Figure 4-4-10.

(v) Start and run the tractor to warm the transmission oil to a minimum temperature of 140°F (60°C).

2. Install suitable pressure gauges, (0–600 lbf/in^2, 0–40 bar), Figure 4-4-11.
   1. Pressure gauge, FT8503A, with adaptor FT8503–8
   2. Adaptor, FNH00877-8 (10–1.00mm x 7/16 JIC)
   3. Hose, (Finis Code 3936707)

Into clutch A and B pressure test points. Figure 4-4-12.

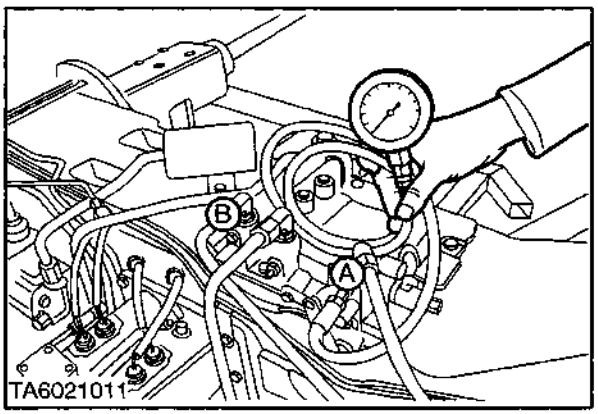


Figure 4-4-12

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3. Start the engine, engage **1st GEAR**, and shuttle to **FORWARD**, leaving the **RANGE IN NEUTRAL**. Increase engine speed to approx 1200 rev/min.

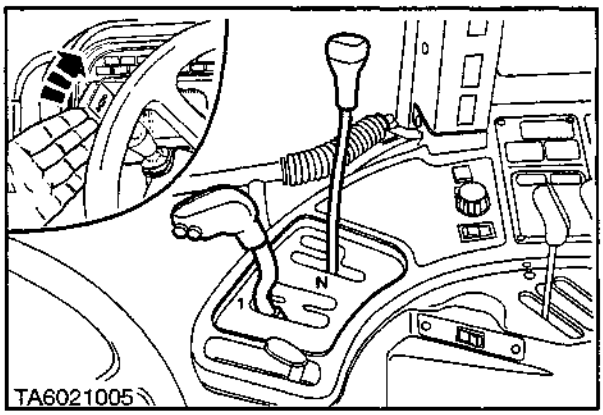


Figure 4-4-13

4. Using the Hi–Lo buttons on the main shift lever, switch between Hi and lo drive and observe the gauges.

Each clutch should obtain 235–261 lbf/in^2 (16–18 bar) maximum pressure, when fully engaged and zero pressure when disengaged.

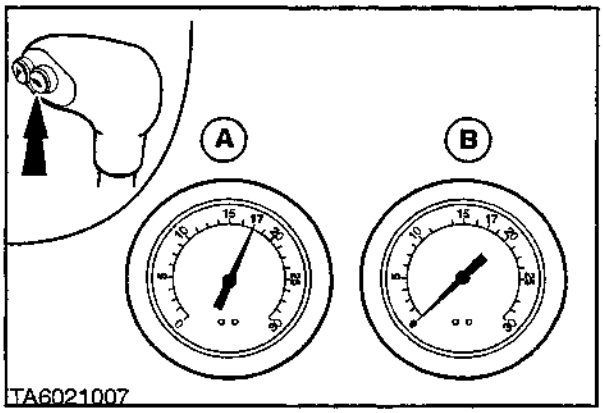


Figure 4-4-14

During the swapping of clutches there is an overlap period where both clutches have approximately 75 lbf/in^2 (5 bar) at the crossover point.

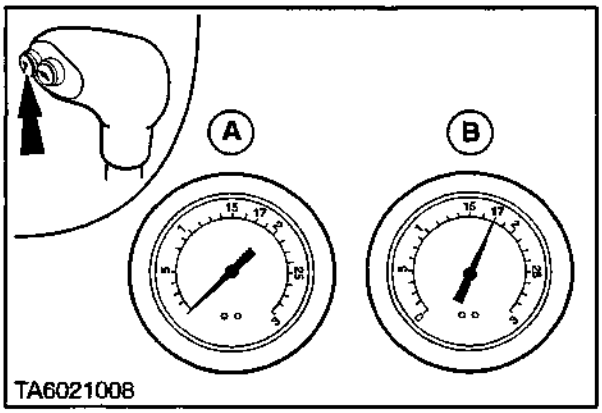


Figure 4-4-15

When the clutch pedal is depressed a gradual reducing of pressure should be seen and when the clutch pedal switch has operated, zero pressure should be indicated on the gauge. When releasing the clutch the opposite of disengaging should be seen with a gradual and smooth increase of pressure up to maximum pressure.

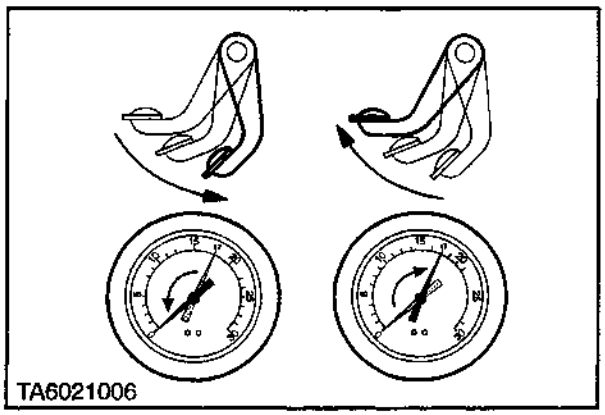


Figure 4-4-16

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Shuttle Synchronizer Operating Piston Pressure Testing

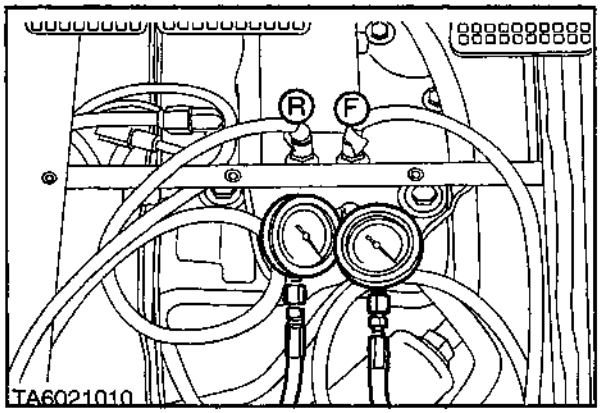


Figure 4-4-17

NOTE: *Due to the operating characteristics of the synchronizer it is not possible to accurately pressure test the synchronizer operating piston during normal tractor operation. The synchronizer will only take the required pressure to move and then the pressure will be cut. This would be seen only as a momentary blip on a pressure gauge. Therefore the following procedure, using the calibration mode, should be used to determine if full pressure is being achieved.*

1. Prepare the tractor as described for testing the A and B clutches.

NOTE: *If only pressure testing the synchronizer piston it is not necessary to install the range switch bypass connector, tool number FNH00875.*

2. Install the pressure gauges, adaptors and hoses into the test points located in the top cover, Figure 4-4-17.

3. Enter the calibration mode for the synchronizer:–

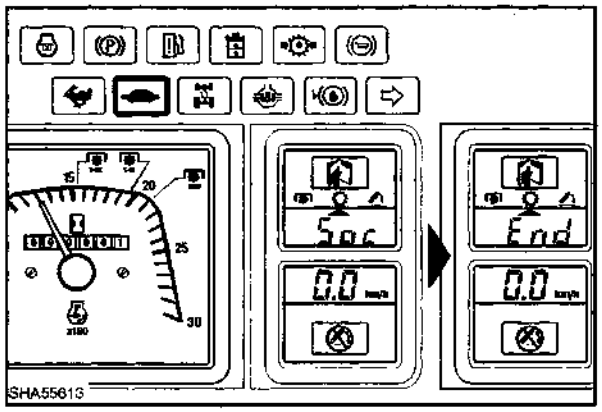


Figure 4-4-18

(i) Press and hold engaged, both the Hi–Lo shift buttons on the main lever. With the buttons depressed start the engine.

(ii) 'CAL' will be displayed on the instrument panel. Release the buttons.

(iii) Press and hold in both the Hi–Lo shift buttons again. After a few seconds 'SOC' will be displayed and the synchronizer calibration will commence.

The table (Figure 4-4-19) shows the synchronizer calibration stages and at what stage pressure can be expected to be seen.

Stage	Pressures	
	Forward (F)	Reverse (R)
1	NO	NO
2	NO	YES
3	B CLUTCH PRESSURIZED	
4	NO	NO
5	YES	NO

Figure 4-4-19

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LIMP HOME

⚠ WARNING ⚠

Care should be taken when operating the tractor with the limp home harness connected. Clutch engagement will be harsher than normal. Do not leave the limp home harness connected when the operation has been completed.

In the unlikely event of an electrical fault developing within the transmission that renders the tractor immobile, for example, failure of the supply voltage to the PWM valves, the emergency 'Limp Home Harness', Special Tool No. NH.21–100 for Semi–Powershift and Hi–Lo transmissions, is available to enable the tractor to be driven onto a transporter or hard standing, in order that the repair can be carried out in a suitable location. The Limp Home device **is not and must not** be used as a means to continue operating the tractor in its work environment.

To engage and operate the 'Limp Home Harness' proceed as follows:–

1. Apply the parking brake.

2. Stop the engine and turn keystart off.

3. Remove the electronic draft control panel.

4. Locate and disconnect the cab main harness access connector, Figure 4-4-21, enabling the connection of the limp home harness connector, marked with 'HARNESS', Figure 4-4-20, into the cab main harness of the tractor, Figure 4-4-23.

5. Connect the other connector of the Limp Home harness Figure 4-4-20, marked 'DIAGNOSTIC', to the 'BLACK' diagnostic plug, Figure 4-4-23.

6. Start the vehicle.

7. Select forward or reverse using the switch, (2) Figure 4-4-20, on the Limp home harness control box.

8. Operate the momentary switch, (1) Figure 4-4-20, of the Limp Home Harness to move the vehicle. If necessary, depress the foot throttle to increase engine speed.

9. When the tractor has been delivered to the repair area, disconnect the Limp Home Harness and reconnect the limp home access connector of the cab main harness and proceed with diagnosing and repairing the fault.

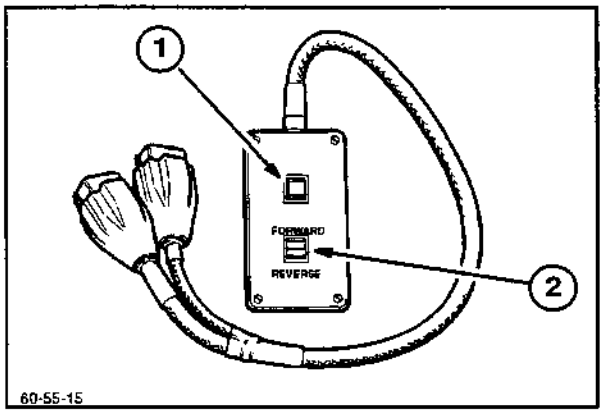


Figure 4-4-20

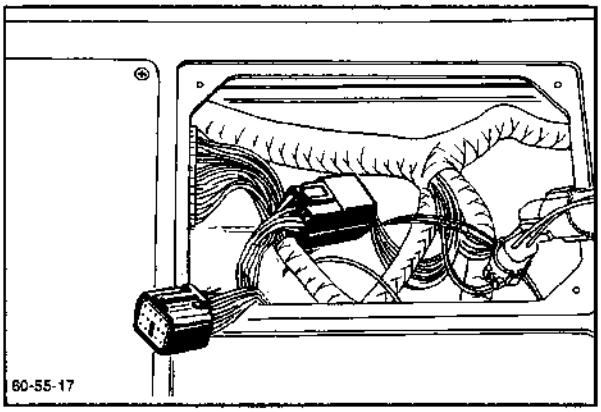


Figure 4-4-21

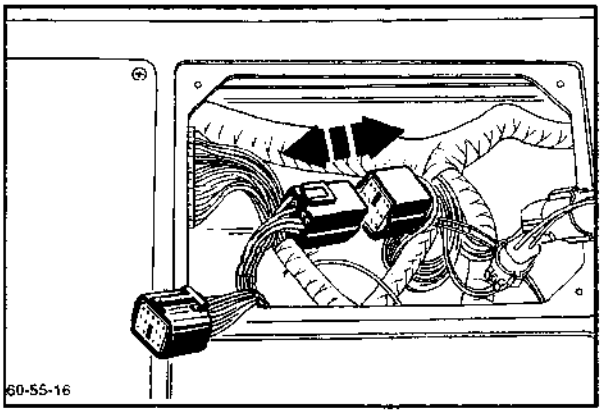


Figure 4-4-22

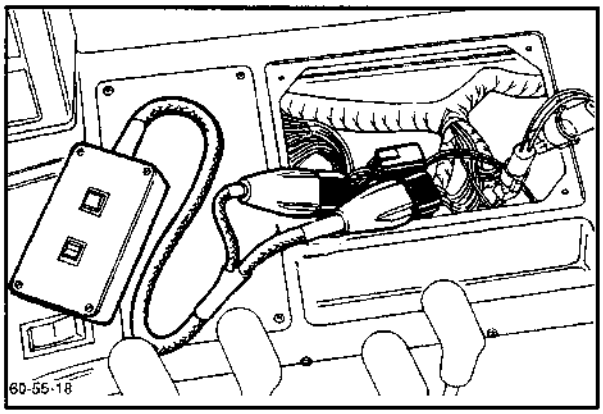


Figure 4-4-23

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TRANSMISSION DIAGNOSTICS

The tractors with Hi–Lo transmission has a built in diagnostic system. To gain access to the diagnostic 'H' menu mode routine it is necessary to use tool FNH00874.

The tractors diagnostic connector is located under the right hand electronic draft control (EDC) panel.

The instrument cluster is used to display the information, EIC and AEIC clusters.

NOTE: *Both instrument clusters show the same information, so for ease of explanation, only one cluster type is illustrated.*

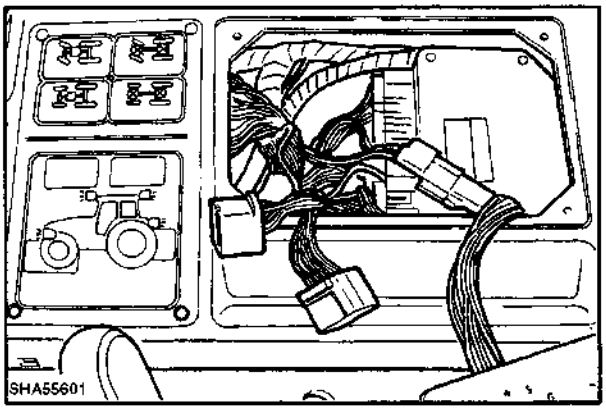


Figure 4-4-24

Connect Tool FNH00874 to the diagnostic connector and turn key.

The LCDs will change to display "HH" to indicate that the "H" menu has been activated.

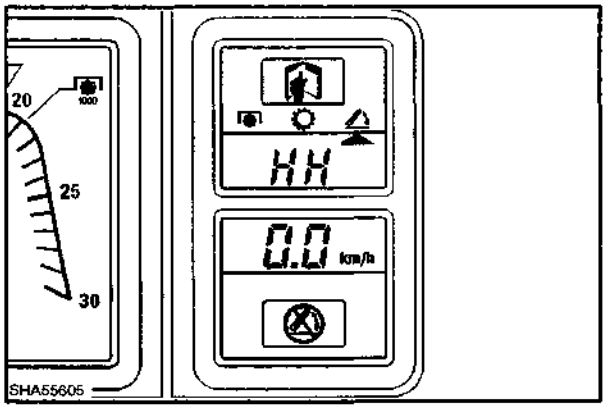


Figure 4-4-25

HH	Service Menu
H1	Clutch calibration
H2	View clutch calibration
H3	EDC valve calibration values
H4	Software revision level
H5	Switch test
H6	Low clutch quick fill adjust
H7	High clutch quick fill adjust
H8	Non volatile memory reset
H9	Voltmeter
HA	Clutch pedal position view (%)
HB	PWM temperature compensation factor
HC	Transmission temperature
HD	Synchronizer potentiometer check
HE	Fly shift manual adjust

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H1 CLUTCH AND SYNCHRONIZER CALIBRATION

This mode is used to calibrate the Hi and Lo clutch packs.
See CALIBRATIONS section of this Chapter for full details.

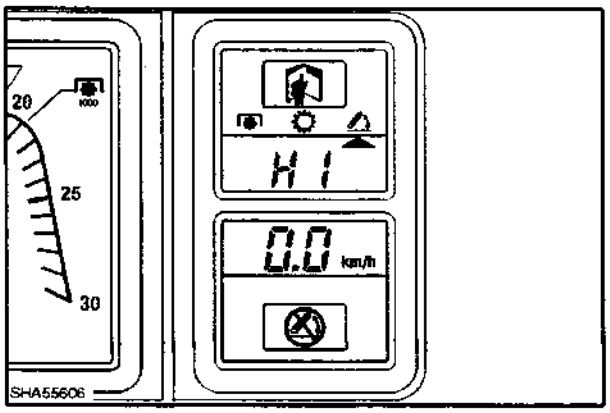


Figure 4-4-26

H2 CLUTCH CALIBRATION VIEW

Displays the previous clutch calibrations.

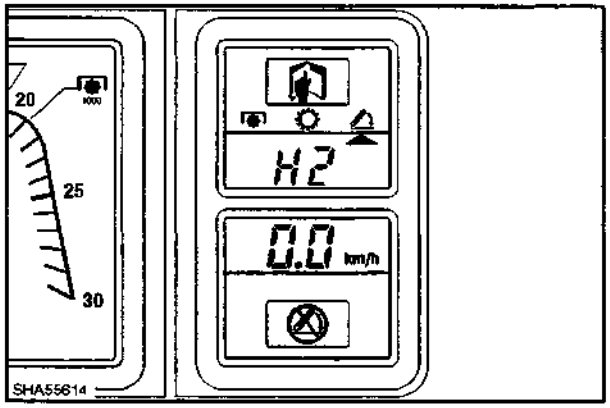


Figure 4-4-27

The display will show 'Lo' clutch calibration number and then 'Hi' clutch calibration number.

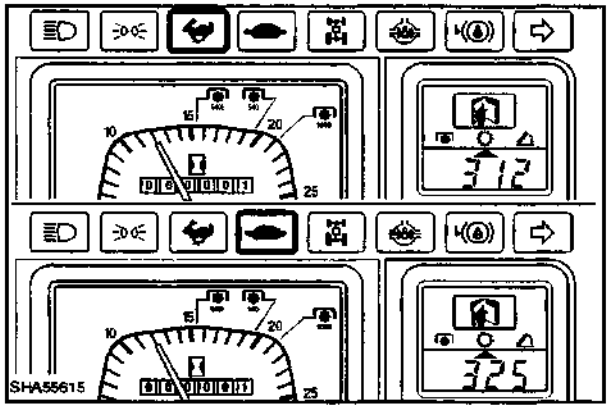


Figure 4-4-28

H3 EDC VALVE CALIBRATION VALUES.

Displays information relating to EDC set up. See Section 8, Hydraulics.

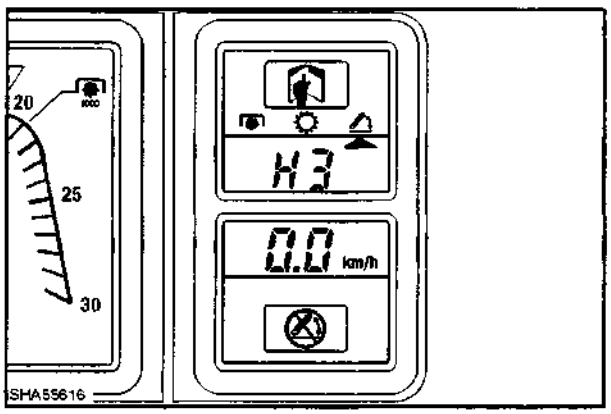


Figure 4-4-29

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H4 SOFTWARE REVISION LEVEL.

Displays the software installed into the processor.

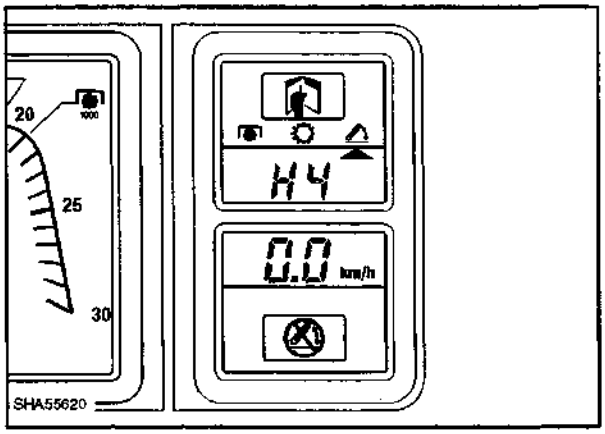


Figure 4-4-30

The display shows 5 figures consecutively.

AC - Hi/Lo
01 - Production software level
00 - Prototype software level
30/40 - 19 or 25 mph (30 or 40 kph)

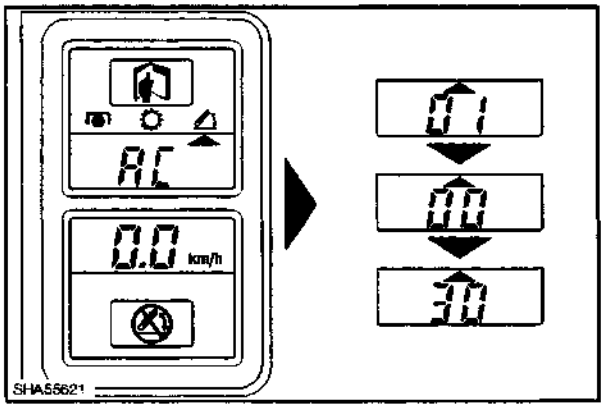


Figure 4-4-31

H5 SWITCH TEST

Tests the function of all switches used in the transmission or EDC system.

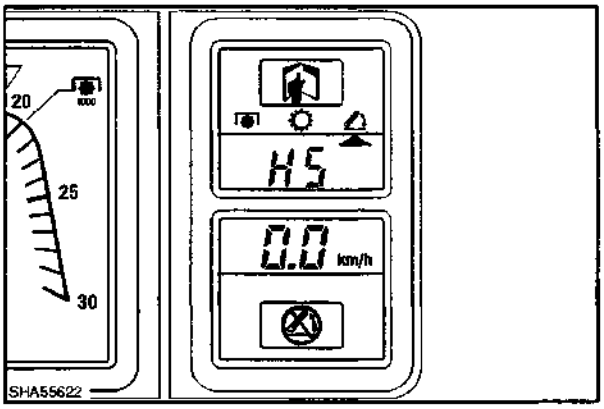


Figure 4-4-32

The display will show "d0".

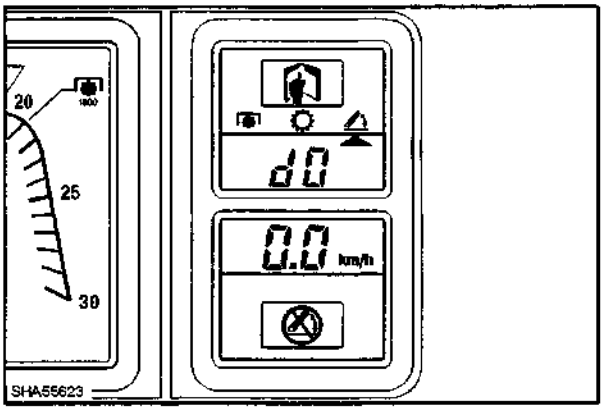


Figure 4-4-33

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When a switch is operated, its code will be displayed and an audible tone heard to indicate correct function.

If the code does not appear and the tone sound, the switch or the wiring to the switch is at fault.

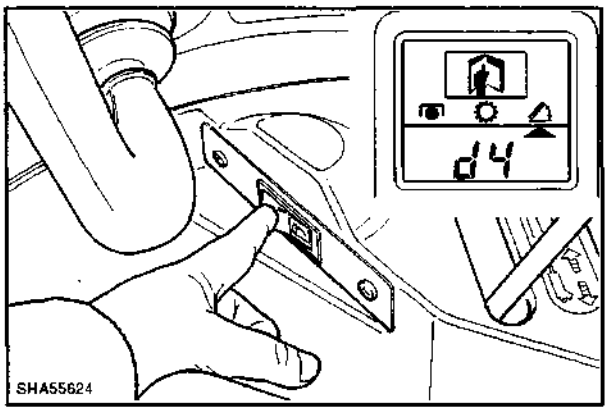


Figure 4-4-34

Switch Code	Switch Description	Special Requirements
d1	External lower switch	
d2	External raise switch	
d3	work switch	
d4	Raise switch	
d71	Clutch pedal switch	Shuttle lever in forward
d74	Downshift switch	
d75	Upshift switch	
d81	1, 2, or 4 in gear	
d82	3 or 4 in gear	
d83	Low or medium range in gear	
d85	Neutral safety start switch	Clutch pedal down, shuttle lever from forward to neutral
d91	Transmission pressure switch	
d93	Fuse 21 sense	
d95	Shuttle lever in forward	
d96	Shuttle lever in reverse	
d98	Medium or high range in gear	

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H6 LOW CLUTCH QUICK FILL ADJUSTMENT

Adjusts the time taken for the initial partial fill of the clutch.

This adjustment can be carried out with the engine running and a gear selected.

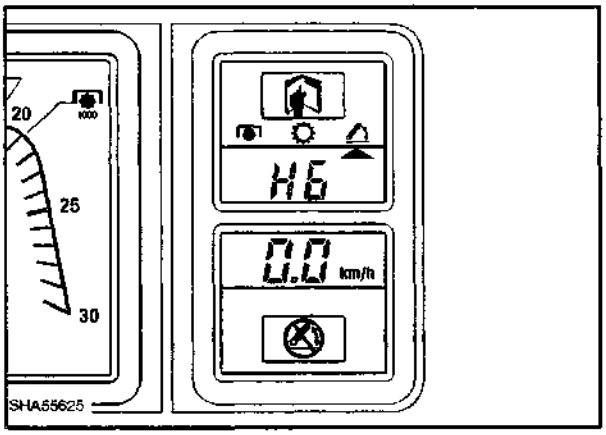


Figure 4-4-35

The display will show a fill time value.

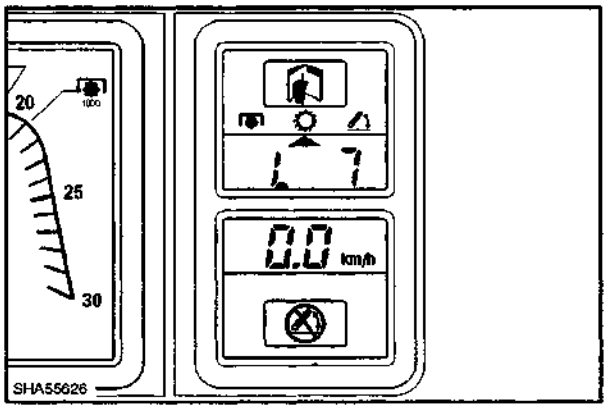


Figure 4-4-36

Increase or decrease the figure with the upshift/downshift buttons with the clutch pedal depressed.

Slowly release the clutch pedal.

If the figure is too high a small 'bump' (forward movement) is felt, decrease the figure until the 'bump' disappears.

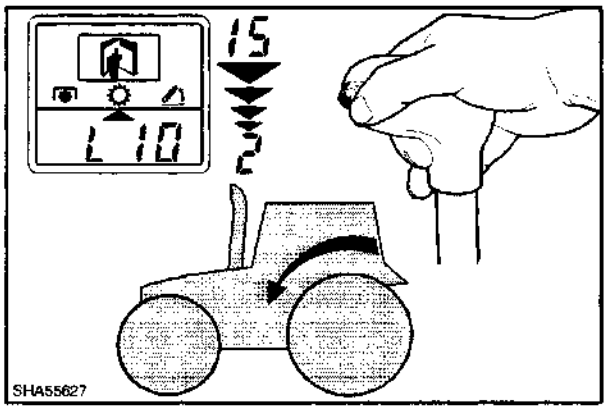


Figure 4-4-37

H7 HIGH CLUTCH QUICKFILL ADJUSTMENT

A similar calibration can be carried out for the high clutch. Displays the H (for high) and the clutch fill time value.

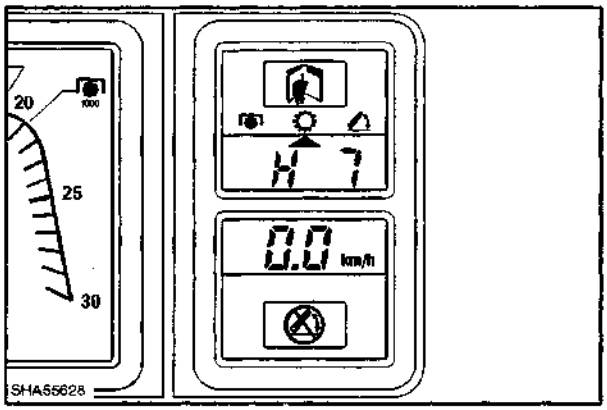


Figure 4-4-38

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H8 NON VOLATILE MEMORY RESET

Used to reset (clear) all calibration figures in the processor.

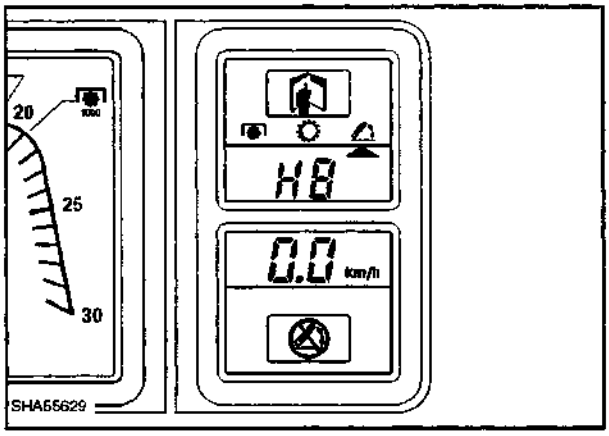


Figure 4-4-39

With H8 selected the procedure is automatic.

The display changes from "H8" to "EE" to "HH", indicating the processor is now reset.

NOTE: *This will also erase EDC calibration figures.*

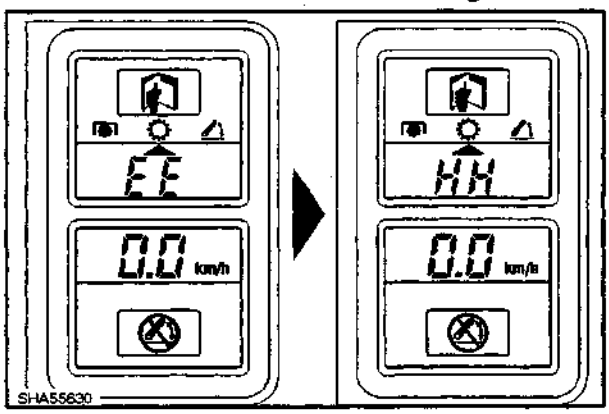


Figure 4-4-40

H9 VOLT METER

Allows various voltage tests to be carried out on the inputs and outputs of the processor.

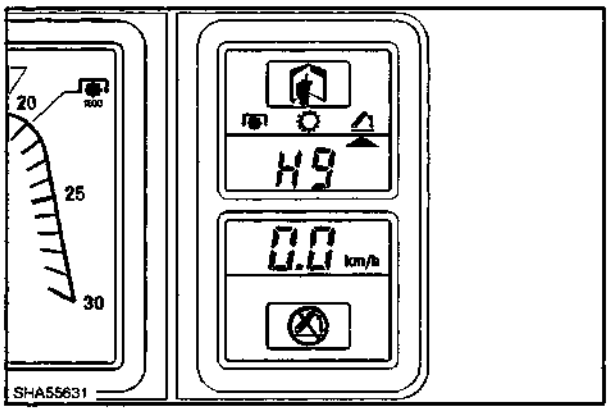


Figure 4-4-41

There are 37 channels which can be accessed.

To select a channel use the upshift and downshift buttons.

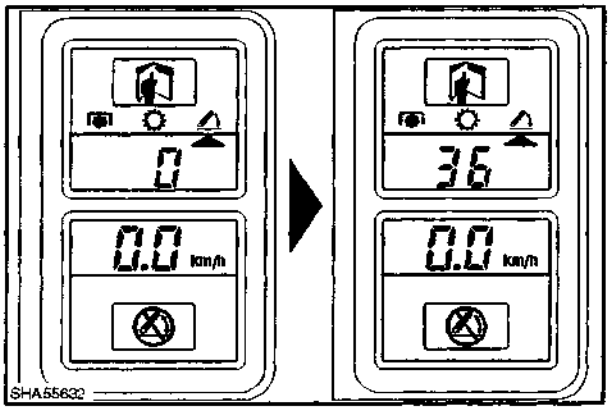


Figure 4-4-42

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On reaching the desired channel release the upshift/downshift button and the channel number will be replaced by a value. Compare the value displayed with the value shown in the table on the following page.

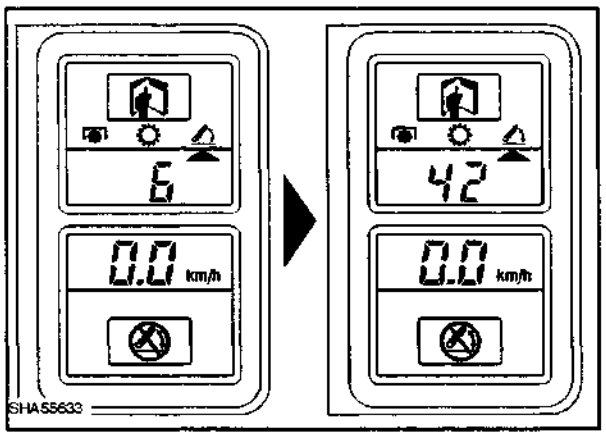


Figure 4-4-43

NOTE: *The value is the output voltage from the processor displayed as a percentage. This cannot be directly translated into a voltage due to the internal processes of the module.*

If the value displayed varies by more than 5% to that in the table a fault is indicated in either the component or the wiring relevant to that channel.

NOTE: *It is worthwhile checking the connectors of the affected circuit, including the processor connectors, prior to replacing any components.*

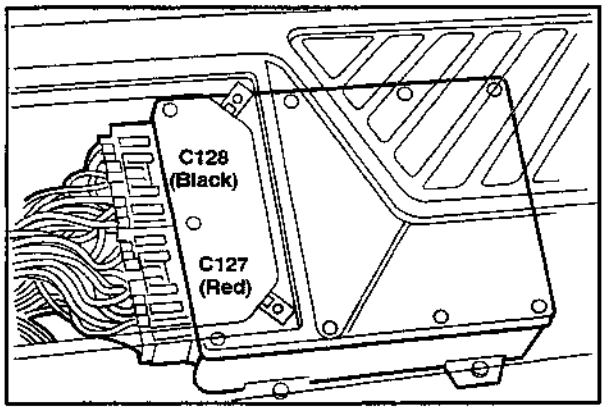


Figure 4-4-44

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Channel	Description	Typical Value
0	Clutch pedal position	91% released 26% depressed
1	Transmission oil temperature	75% at 104°F (40°C)
2	40 degree oil hydraulic oil temperature switch	96% > 104°F (40°C) 2% < 104°F (40°C)
3	Fuse 12 sense	96%
4	Not applicable to service	–
5	5 volt reference	49%
6	12 volt Vf input	42%
7	12 volt Vd input	3%
8	12 volt Vh input	41%
9	8 volt reference	79%
10	Solenoid for synchro in high, fast current sense	3% off
11	Solenoid for synchro in reverse, fast current sense	3% off
12	Low clutch solenoid, fast current sense	0% Clutch engaged/ out of gear 32% Pedal released in underdrive
13	High clutch solenoid, fast current sense	0% Clutch engaged/ out of gear 32 % pedal released in direct drive
14	Solenoid for synchro in high, current sense	0% off 93% max
15	Solenoid for synchro in reverse, current sense	0% off 93% max
16	Low clutch solenoid current sense	0% Clutch engaged/ out of gear 82% pedal released in low
17	High clutch solenoid current sense	0% Clutch engaged/ out of gear 82% pedal released in high
20	Wheel speed sensor DC check	64%
36	Shuttle lever in forward	26% off (Neutral), 61% on (Forward)
37	Shuttle lever in reverse	26% off (Neutral), 61% on (Reverse)

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HA CLUTCH PEDAL POSITION VIEW

Used to show position of the clutch pedal.

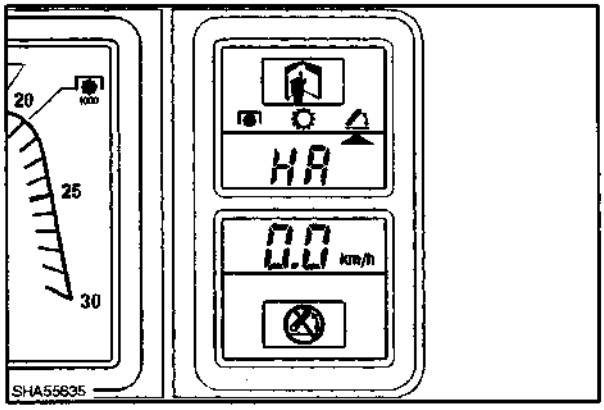


Figure 4-4-45

As the pedal is cycled from up to down the display shows percentage (%) pedal position;

0 = fully down

99 = fully up

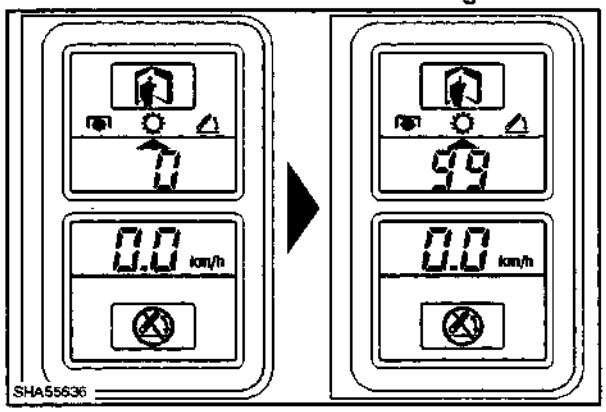


Figure 4-4-46

HB PWM COMPENSATION FIGURE

This is not used.

NOTE: *Factory set to 16.*

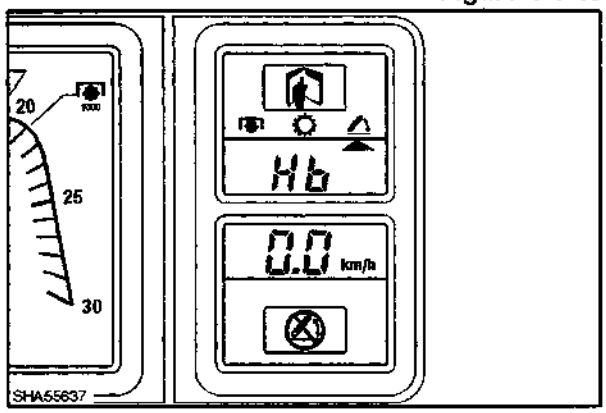


Figure 4-4-47

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HC TRANSMISSION OIL TEMPERATURE VIEW

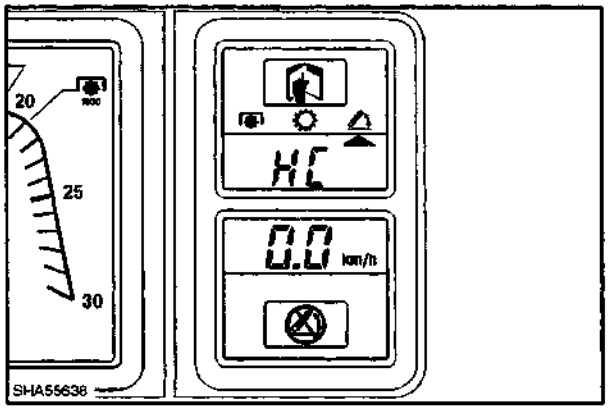


Figure 4-4-48

Shows transmission oil temperature in degrees Celsius.

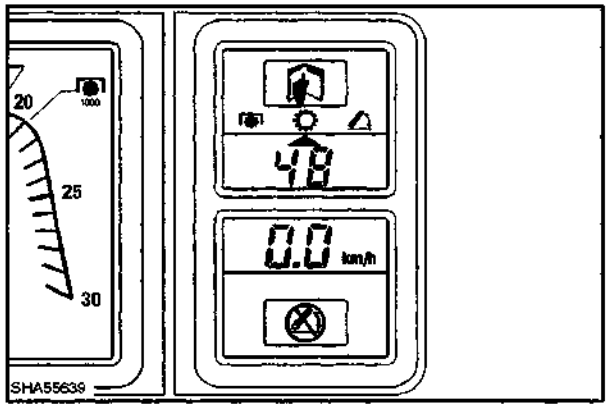


Figure 4-4-49

HD SYNCHRONIZER POTENTIOMETER CHECK

Checks the operation of the forward/reverse synchronizer.

The engine must be running with the transmission in neutral and the clutch released.

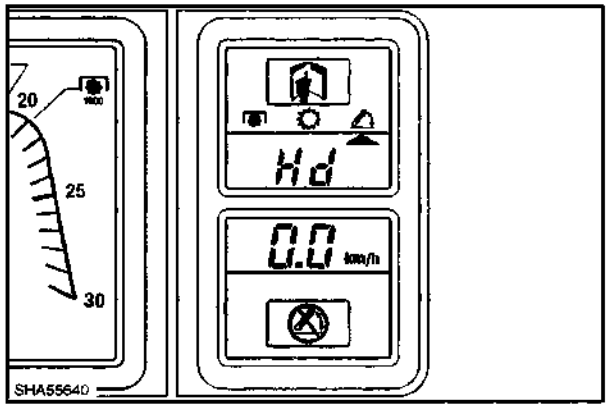


Figure 4-4-50

The Hi/Lo indicator lamps flash to indicate test mode.

Press and hold the downshift to display reverse position indicated as a % of potentiometer movement – approx 75(%).

Press and hold upshift for forward – approx 25(%).

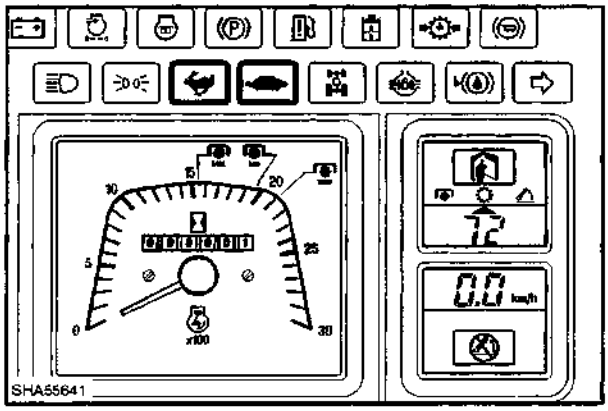


Figure 4-4-51

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HE FLYSHIFT MANUAL ADJUST

The flyshift delay after a clutched mechanical gear shift can be adjusted to suit various operating speeds.

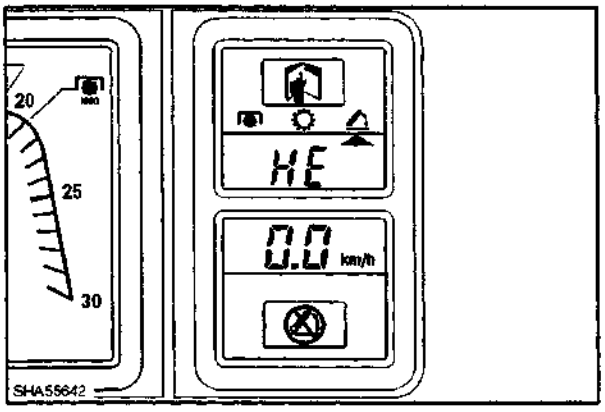


Figure 4-4-52

The figure that displays is the ground speed over which the flyshift delay is eliminated;

3, 4, or 8 mph.

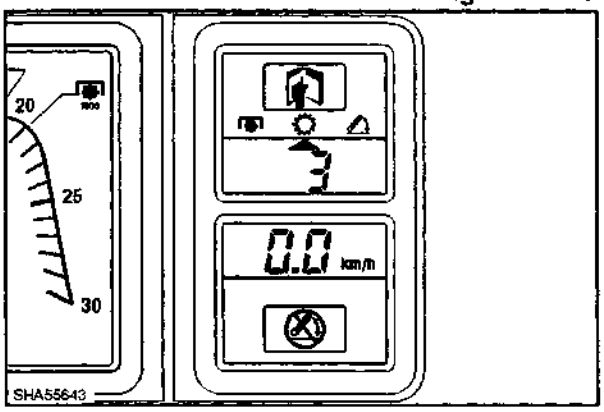


Figure 4-4-53

Change the ground speed by using the upshift or down shift buttons.

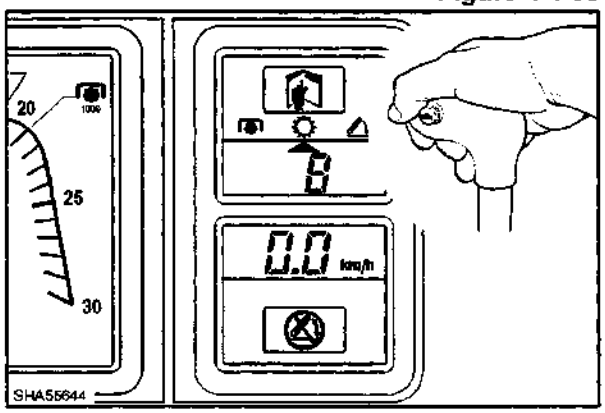


Figure 4-4-54

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ERROR CODES

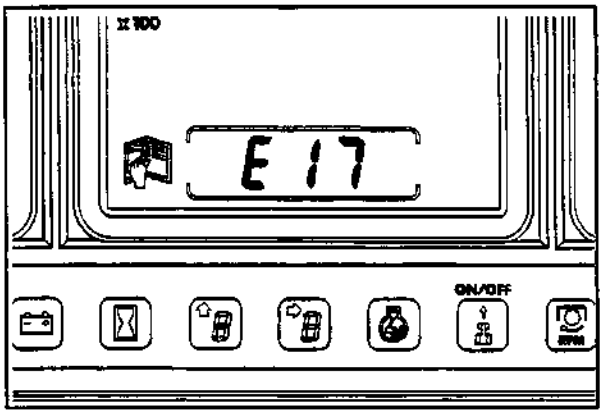


Figure 4-4-55

Hi–Lo Transmission Error Display Logic

1. Errors are displayed on the rght hand liquid crystal display of the AEIC panel or the center display of EIC panels.

2. Error codes always flash.

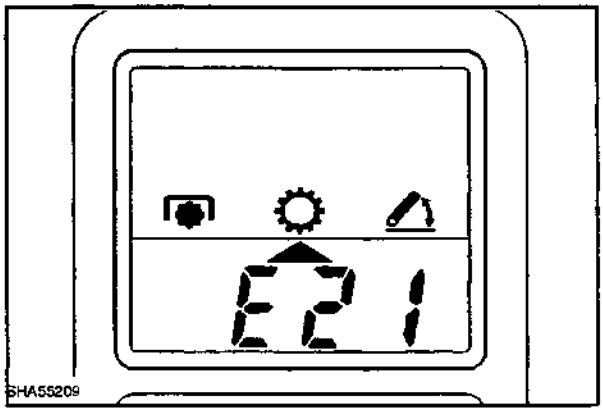


Figure 4-4-56

3. Generally, error codes accompanied by a pulse alarm signal require action by the operator, and the alarm will continue until the operator takes action.

a) "CP" can be cleared by cycling the clutch pedal. In most cases the shuttle lever can also be used to clear "CP".

b) Most other errors, accompanied by a pulse alarm, can be cleared by cycling the shuttle lever. Under certain conditions, the pulse alarm will continue for 4 seconds while the lever is in neutral.

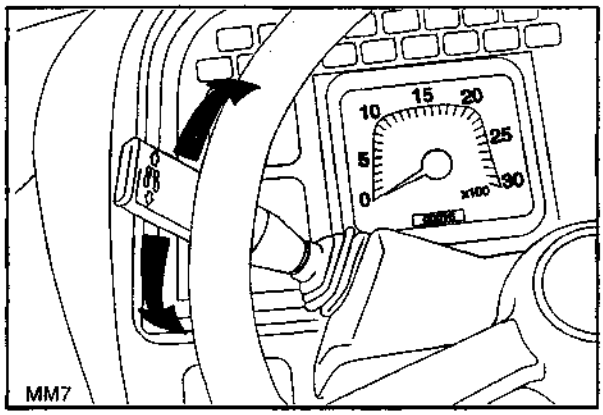


Figure 4-4-57

4. Other error codes, those not accompanied by a pulse alarm are accompanied by a steady 5 second alarm which then stops. If the error clears during the 5 second period the alarm will stop when the error clears.

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5. After the 5 second period the alarm will cease if the transmission is still operable. If the transmission is disabled, only the error code will be displayed.

6. Errors have priority. Errors accompanied by the pulse alarm will not allow lower priority errors to be displayed, but pulse alarm errors are usually temporary in nature. For errors without pulse alarm:

a) If a lower priority error occurs when a higher priority error is being displayed, the lower priority error will not be displayed until the higher priority error is cleared. If the lower priority error is a result of the higher priority error it will not be displayed.

b) If a higher priority error occurs when a lower priority error is being displayed, the higher priority error will interrupt the display of the lower priority error and will continue to be displayed until cleared.

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Error Code Listing

ERROR CODE	ERROR DESCRIPTION	PRIORITY	TRANS. STATUS	DISPLAY MODE
E21	Chassis harness disconnected	1	Disable	Latched
E34	Fuse 14 Blown	2	Disable	Latched
E32	Clutch hydraulic pressure detected	3	Disable	Latched
E53	5 volt reference failed, shorted to 12 volts	4	Disable	Latched
E54	5 volt reference failed short to ground	5	Disable	Latched
E12	Clutch pedal potentiometer signal too high	6	Disable	Latched
E11	Clutch pedal potentiometer signal too low	7	Enabled	Latched
E61	Synchronizer potentiometer signal too high	8	Disable	Latched
E62	Synchronizer potentiometer signal too low	9	Disable	Latched
E46	Fuse 21 blown	10	Enabled	Latched
E33	Clutch pressure switch, open or short circuit	11	Enabled	Latched
E39	High clutch solenoid open circuit	12	Enabled	Latched
E38	High clutch solenoid short circuit	13	Enabled	Latched
E41	Low clutch solenoid open circuit	14	Enabled	Latched
E40	Low clutch solenoid short circuit	15	Enabled	Latched
E66	Reverse solenoid open circuit	16	Enabled	Latched
E68	Reverse solenoid short circuit	17	Enabled	Latched
E65	High solenoid open circuit	18	Enabled	Latched
E67	High solenoid short circuit	19	Enabled	Latched
E37	Clutch disconnect switch open circuit	20	Enabled	Latched
E24	Synchronizer not calibrated	21	Enabled	Latched
E70	Unable to initialize synchronizer during start–up	22	Enabled	Latched
E47	Clutch disconnect switch misadjusted high	23	Enabled	Latched
E48	Clutch disconnect switch short circuit/misadjusted	24	Enabled	Latched
E51	Transmission temperature sensor open circuit	25	Enabled	Latched
E52	Transmission temperature sensor short circuit	26	Enabled	Latched
E24	Both clutches not calibrated	27	Enabled	Latched
E64	Synchronizer failed to engage reverse	28	Enabled	Latched
E63	Synchronizer failed to engage high	29	Enabled	Latched
E59	Forward/neutral/reverse switch disagreement	30	Enabled	Latched
CP	Depress clutch pedal to enable transmission	31	Disable	Latched
EHi	Hi clutch not calibrated	32	Enabled	Latched
ELo	Lo clutch not calibrated	33	Enabled	Latched
E55	Forward switch failed to +8V or +12V	34	Enabled	Latched

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ERROR CODE	ERROR DESCRIPTION	PRIORITY	TRANS. STATUS	DISPLAY MODE
E56	Forward switch failed to ground or open circuit	35	Enabled	Latched
E57	Reverse switch failed to +8V or +12V	36	Enabled	Latched
E58	Reverse switch failed to ground or open circuit	37	Enabled	Latched
E13	Up and downshift switches both on	38	Enabled	Temporary
E49	Wheel speed sensor circuit open or short circuit	39	Enabled	Temporary
E26	ERPM speed too high	40	Enabled	Temporary
E27	ERPM speed too low	41	Enabled	Temporary

Clutch Spring Pressure Calibration Error Codes

ERROR CODE	ERROR DESCRIPTION
U20	Correct start up procedure not used
U21	Engine rev/min too low
U22	Engine rev/min too high
U23	Forward/reverse shuttle lever not in forward
U24	Main shift lever is not in gear
U25	Range lever not in gear
U26	Clutch pedal not fully released
U27	Hi Clutch calibration is too low
U28	Hi Clutch calibration is too high
U29	Lo Clutch calibration is too low
U30	Lo Clutch calibration is too high
U31	Wheel motion detected during calibration
U37	Synchronizer shuttle mode calibration
U38	Synchronizer Hi–Lo mode calibration

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ERROR CODE
E21 – CHASSIS HARNESS DISCONNECTED
EFFECT – Transmission disabled

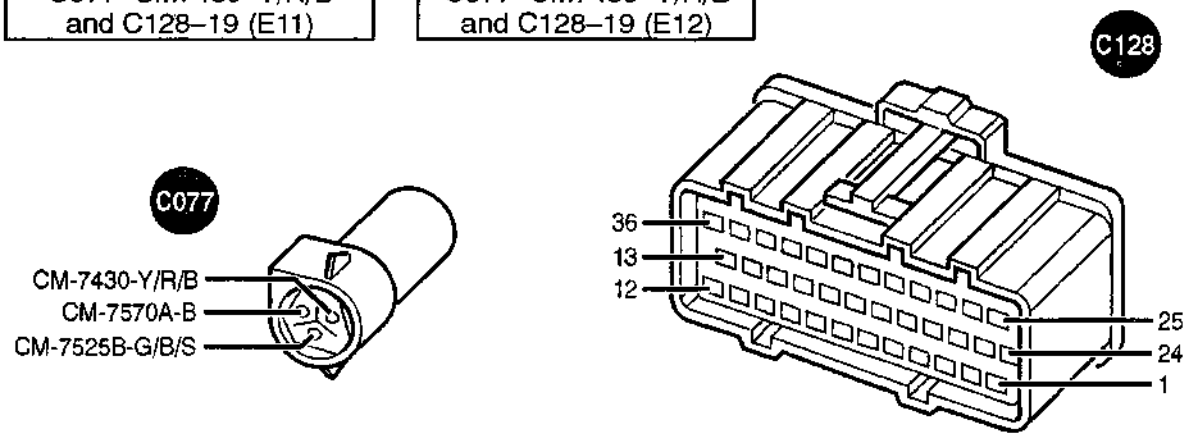
Inspect main harness connectors

ERROR CODE
E24 – SYNCHRONIZER AND CLUTCHES NOT CALIBRATED
EFFECT – Transmission disabled

Has a new processor been installed or H8 used without performing calibration after installation?
YES → Perform calibration procedures
NO → Calibration values have corrupted in processor. Attempt calibration. If error occurs again replace processor.

ERROR CODES;
E11 – CLUTCH PEDAL POTENTIOMETER SIGNAL TOO LOW
E12 – CLUTCH PEDAL POTENTIOMETER SIGNAL TOO HIGH
EFFECTS – Transmission disabled

Using Diagnostic 'H' menu, select H9, Channel 0, (clutch pedal position mode). Is the clutch operation within the typical values of 91 released and 26 depressed?
YES → Wiggle test potentiometer wiring while in H9, Channel 0. If readings become erratic trace and repair fault in wiring. If no fault evident install new processor.
NO → Disconnect potentiometer. Check operation using suitable multimeter. Is potentiometer O.K.?
NO → Replace potentiometer
YES → Check for short to ground or open circuit between C077–CM7430–Y/R/B and C128–19 (E11)
YES → Check for short to +12V or +8V between C077–CM7430–Y/R/B and C128–19 (E12)



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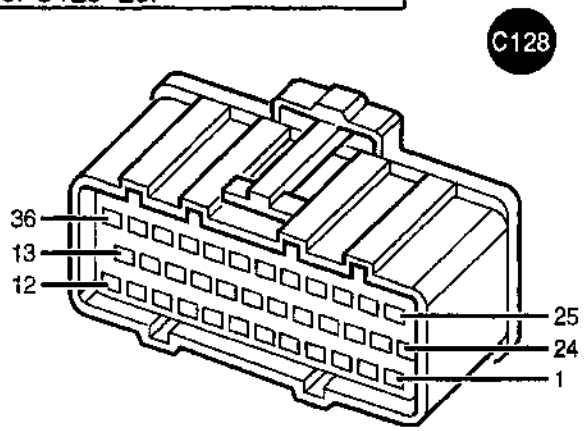
ERROR CODE
E13 – UP AND DOWNSHIFT SWITCHES BOTH ON
EFFECTS – No shift triggered

Operator error – Both switches pressed together? → YES → Tractor functioning normally
NO

Use Diagnostic menu mode H5, are switches functioning correctly? → YES → Wiggle test switch wiring while in H5 mode. If readings become erratic trace and repair fault in wiring. If no fault evident install new processor.
NO

Disconnect switch connector from harness. Check operation of switches using a suitable multimeter. Is a switch fault indicated? → YES → Replace switch
NO

Check for a short circuit in harness wiring. Disconnect C128 from processor and check between C128–24 and C128–25 for a short circuit or a short to +12V on either C128–24 or C128–25.



ERROR CODE
E26 – ERPM TOO HIGH
EFFECTS – Poor shift quality and possibly unable to perform calibration

Has engine exceeded 3,500 rev/min for three seconds or longer? → YES → Tractor functioning normally
NO

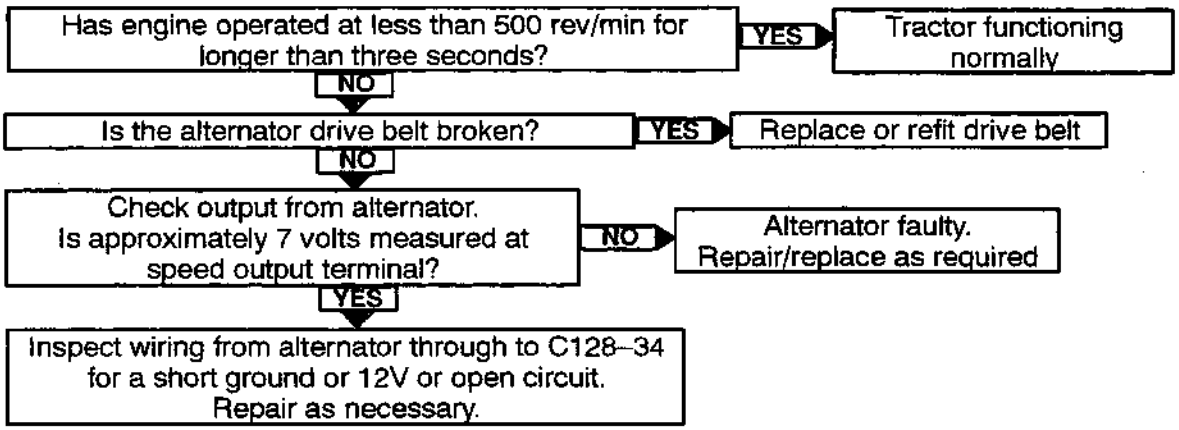
Check output from alternator. Is approximately 7 volts measured at alternator speed output terminal? → NO → Replace/repair alternator
YES

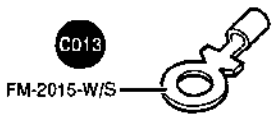
Inspect wiring from alternator through to C128–34 for intermittent open/short circuit repair as necessary.

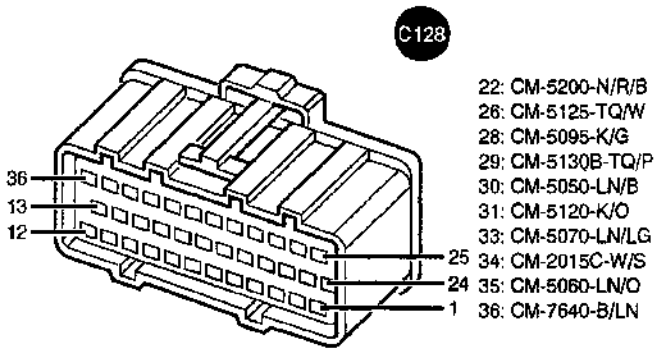
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ERROR CODE
E27 – ERPM TOO LOW
EFFECTS – Poor shift quality and possibly unable to perform calibration







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ERROR CODE
E32 – CLUTCH HYDRAULIC PRESSURE DETECTED WHEN NOT COMMANDED (SHUTTLE LEVER IN NEUTRAL)
EFFECTS – Transmission disabled

Pressure test clutches A & B to determine area of fault.

↓

Remove PWM solenoid valve assembly affected. Inspect and clean/replace. Is the error cleared?

YES → Tractor OK. Discard old PWM if replaced.

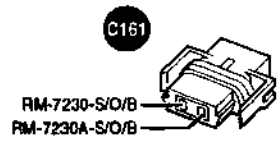
NO ↓

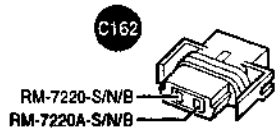
With the cab floor removed and engine running, shuttle lever in neutral.
WARNING: *Ensure wheels are chocked and handbrake applied.*
Is voltage indicated at the PWM solenoid, C161 or C162?

NO → Possible top cover fault allowing hydraulic oil to clutch

YES ↓

Replace processor with one of known performance





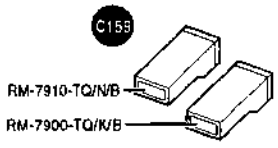
ERROR CODE
E33 – CLUTCH PRESSURE SWITCH OPEN/SHORT CIRCUIT
EFFECTS – Disables the dump logic software and also displays E32. Transmission remains operative.

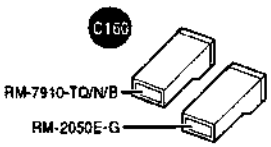
Remove pressure switches from transmission top cover and check operation. Are switches functioning correctly?

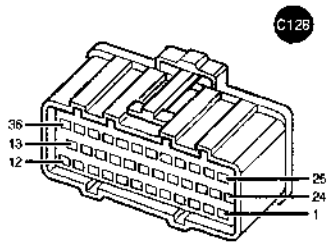
NO → Replace faulty switch

YES ↓

Disconnect processor connectors. Check wiring between C128–4 and switch connectors, C159 and C160, for open/short circuit repair/replace wiring as necessary.



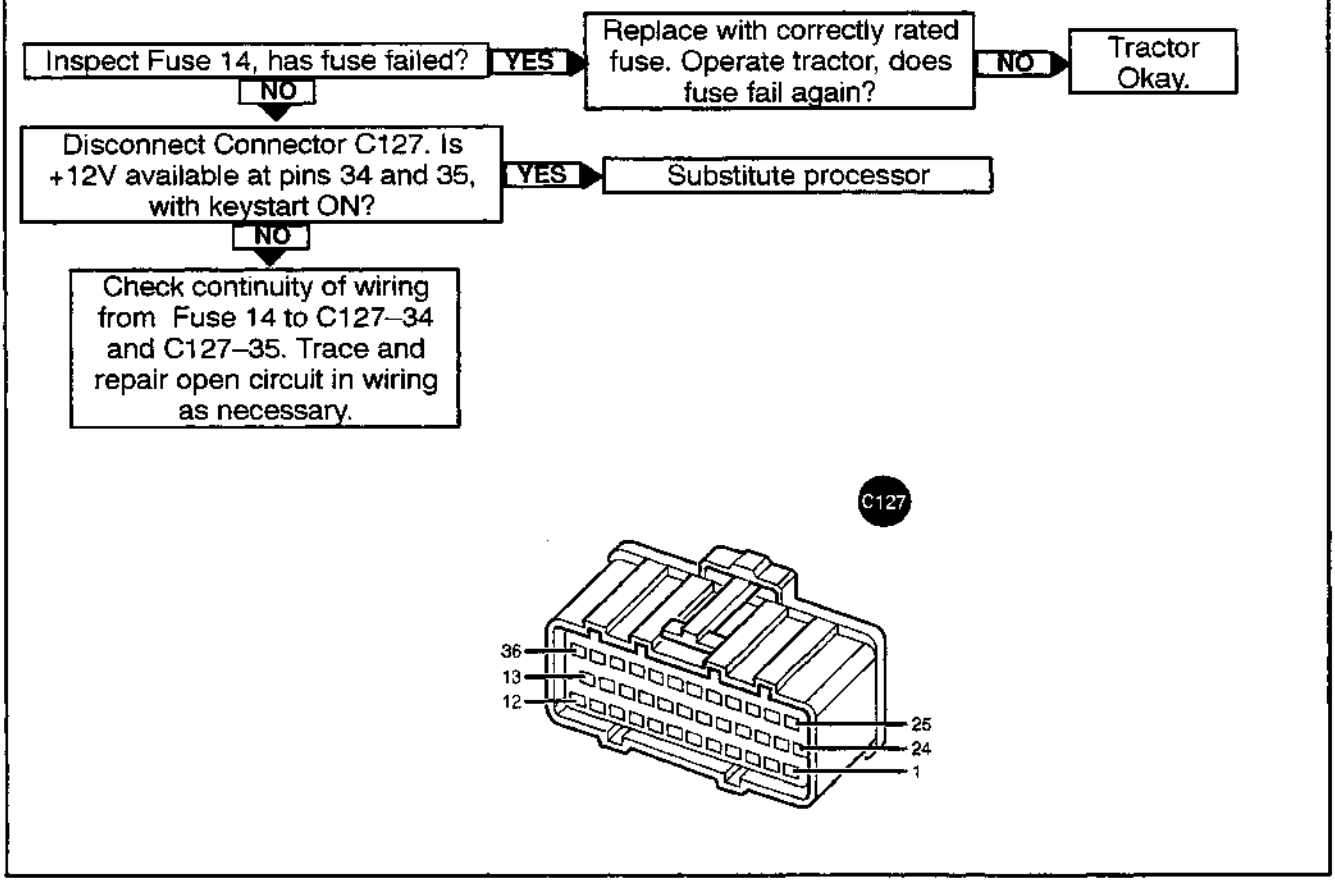




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ERROR CODE
E34 – FUSE 14 BLOWN
EFFECTS – Transmission disabled.



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ERROR CODE
E37 – CLUTCH PEDAL SWITCH OPEN CIRCUIT
EFFECTS – Transmission disabled.

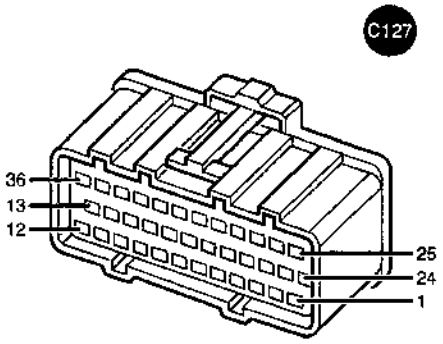
Is the clutch pedal switch adjusted correctly.
NO → Adjust switch
YES ↓

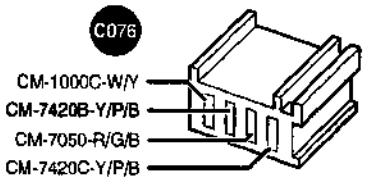
Using Diagnostic Menu Mode H5 (switch diagnostics), operate clutch, is switch functioning correctly?
YES → Wiggle test the wiring while in H5 mode. Listen for intermittent fault.
NO ↓

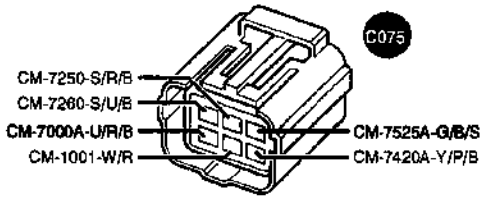
Wiggle test the wiring while in H5 mode. Is contact made indicating switch okay?
YES ↓
NO → Disconnect the clutch pedal switch, connector C076. Using a suitable multimeter, is the switch functioning OK?
NO → Replace switch and adjust
YES ↓

Disconnect processor connectors and check for an open circuit between C127–30 and the neutral switch (shuttle lever), C075. Is an open circuit indicated?
NOTE: Clutch pedal switch must be connected and pedal released.
YES → Repair/replace wiring as necessary
NO ↓

Clutch pedal switch may still be at fault, performing sluggishly, especially in cold weather. Replace switch.







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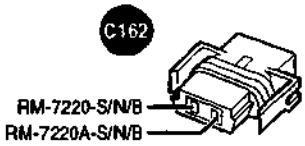
ERROR CODES;
E38 – CLUTCH 'B' SOLENOID (HIGH/REVERSE) SHORT CIRCUIT
E39 – CLUTCH 'B' SOLENOID OPEN CIRCUIT
EFFECTS – Transmission disabled.

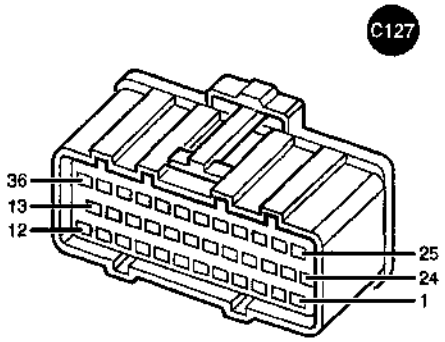
With the cab floor removed, disconnect connector C162 to Clutch B. With a suitable multimeter check the solenoid for open/short circuit. Is a solenoid fault indicated?

YES → Replace solenoid

NO

Disconnect processor connectors. Check for short to ground or an open circuit between C127–17 and C127–12 and the solenoid harness side connector, C162. Repair/replace wiring as necessary.





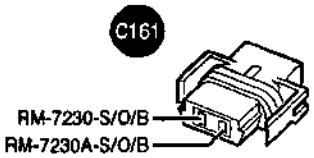
ERROR CODES;
E40 – CLUTCH 'A' (LOW) SOLENOID SHORT CIRCUIT
E41 – CLUTCH 'A' SOLENOID OPEN CIRCUIT
EFFECTS – Transmission disabled.

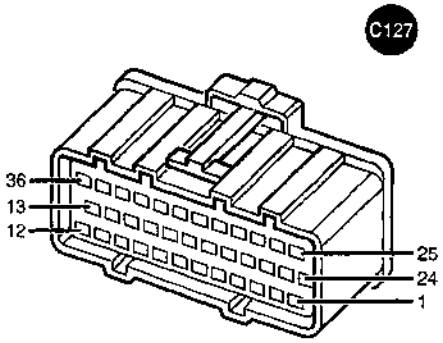
With the cab floor removed, disconnect connector C161 to Clutch A. With a suitable multimeter check the solenoid for open/short circuit. Is a solenoid fault indicated?

YES → Replace solenoid

NO

Disconnect processor connectors. Check for short to ground or an open circuit between C127–18 and C127–26 and the solenoid harness side connector, C161. Repair/replace wiring as necessary.

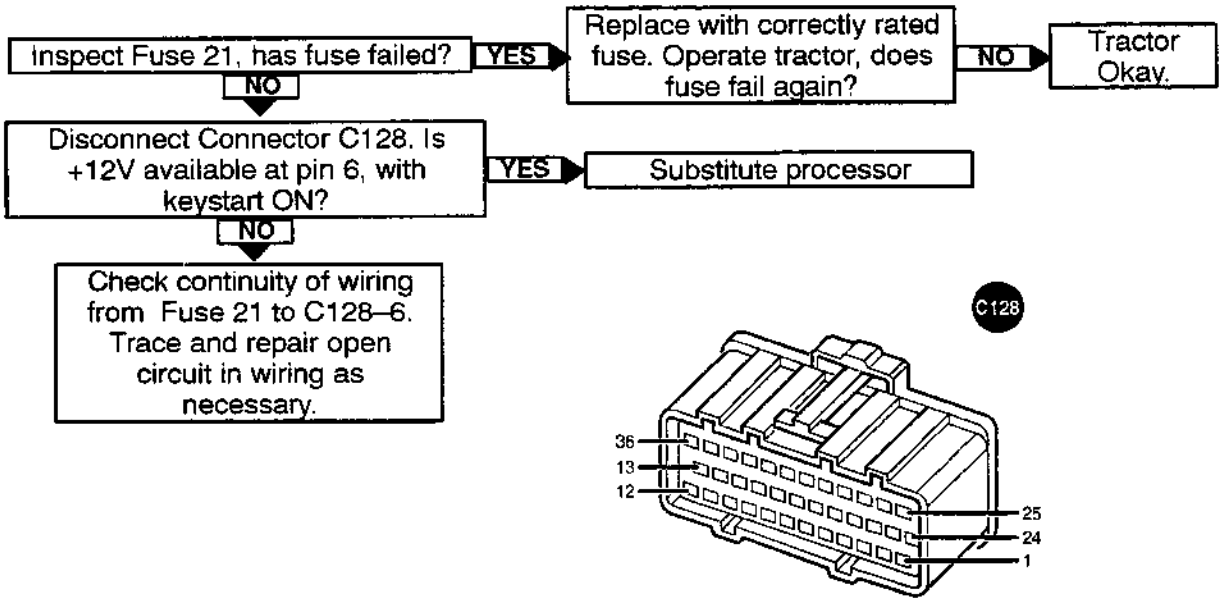




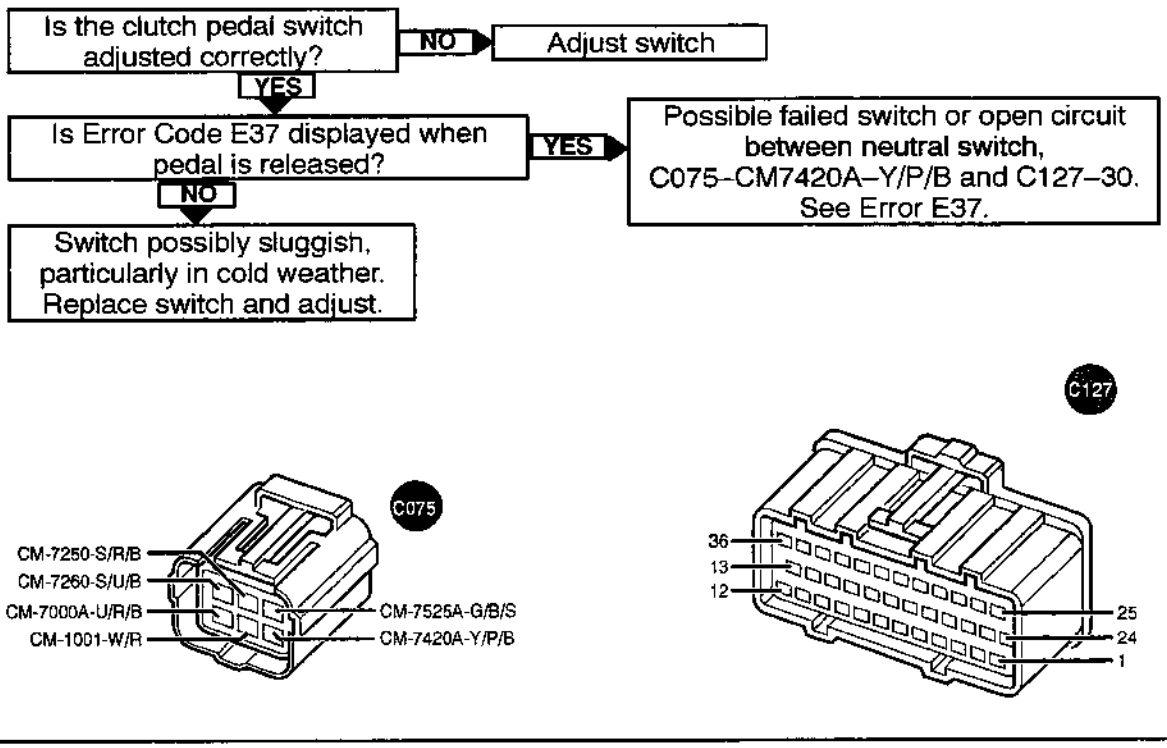
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ERROR CODE
E46 – FUSE 21 OPEN CIRCUIT
EFFECTS – Transmission disabled



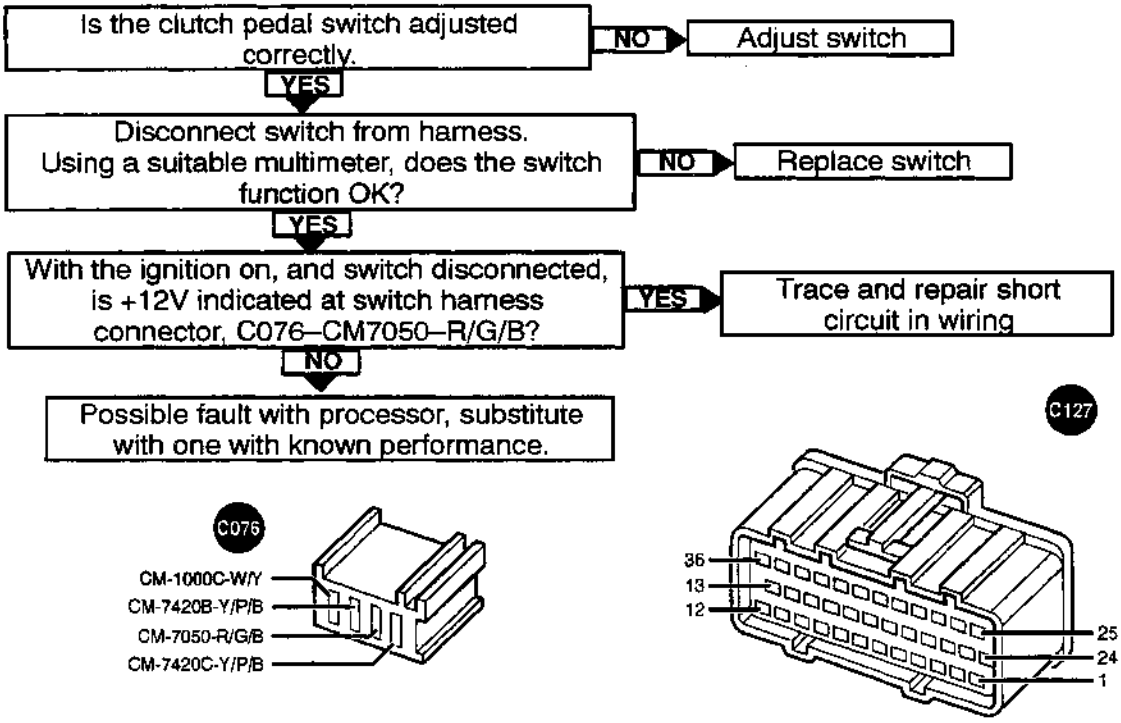
ERROR CODE
E47 – CLUTCH PEDAL SWITCH SET TOO HIGH
EFFECTS – Inching jerky and high pedal position



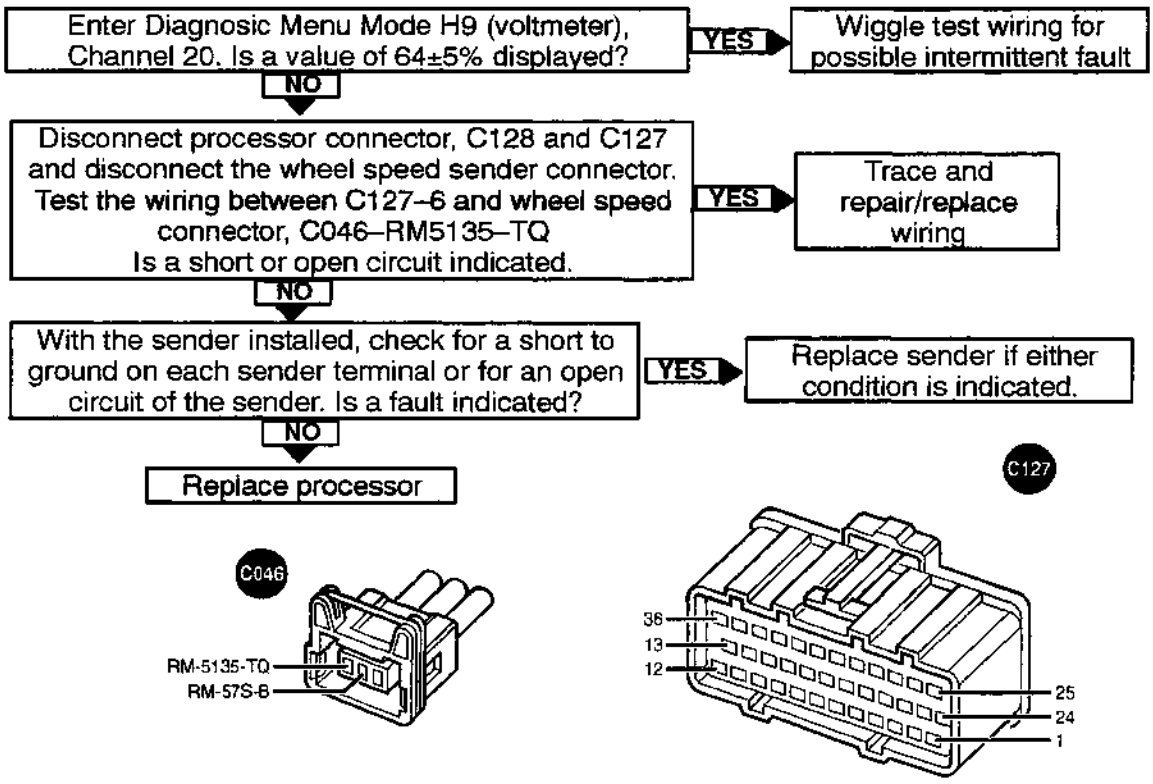
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ERROR CODE
E48 – CLUTCH PEDAL SWITCH SET TOO LOW
EFFECTS – Tractor performs normally but clutch pedal will not cut off power to clutch solenoids.



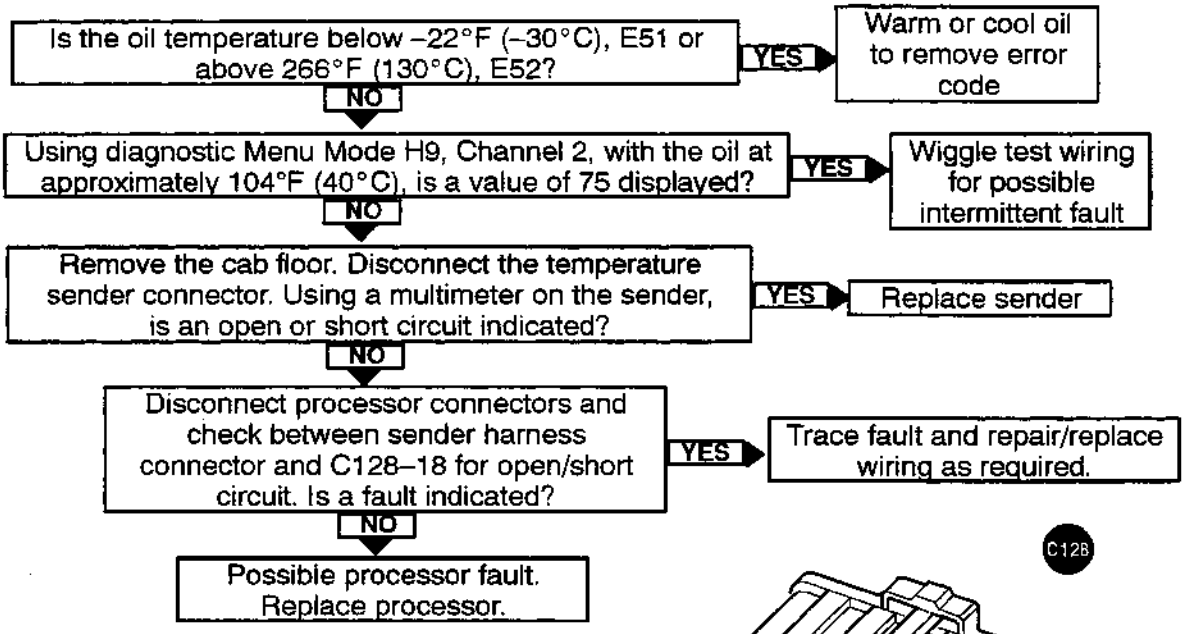
ERROR CODE
E49 – WHEEL SPEED SENSOR SHORT OR OPEN CIRCUIT
EFFECTS – Shift quality generally poor

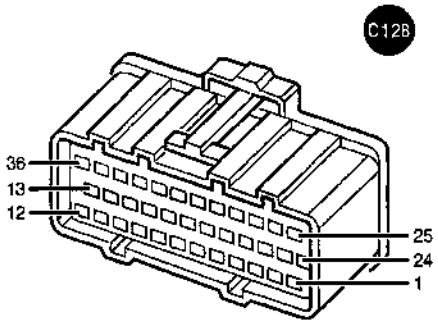


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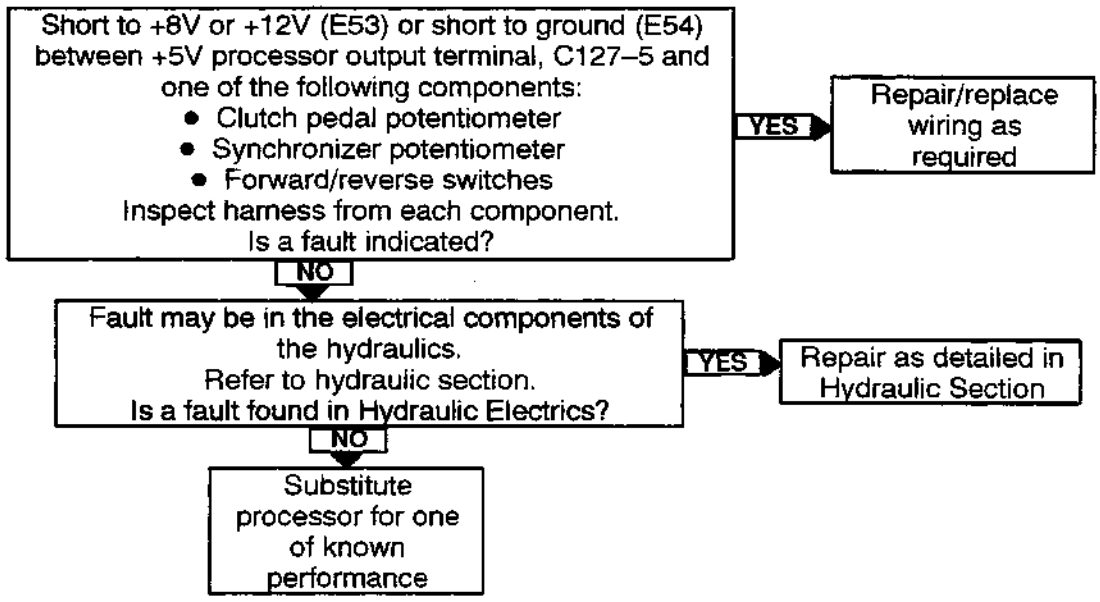
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ERROR CODES;
E51 – TEMPERATURE SENDER OPEN CIRCUIT
E52 – TEMPERATURE SENDER SHORT CIRCUIT
EFFECTS – Slow shifting and clutch pedal higher than normal during inching.





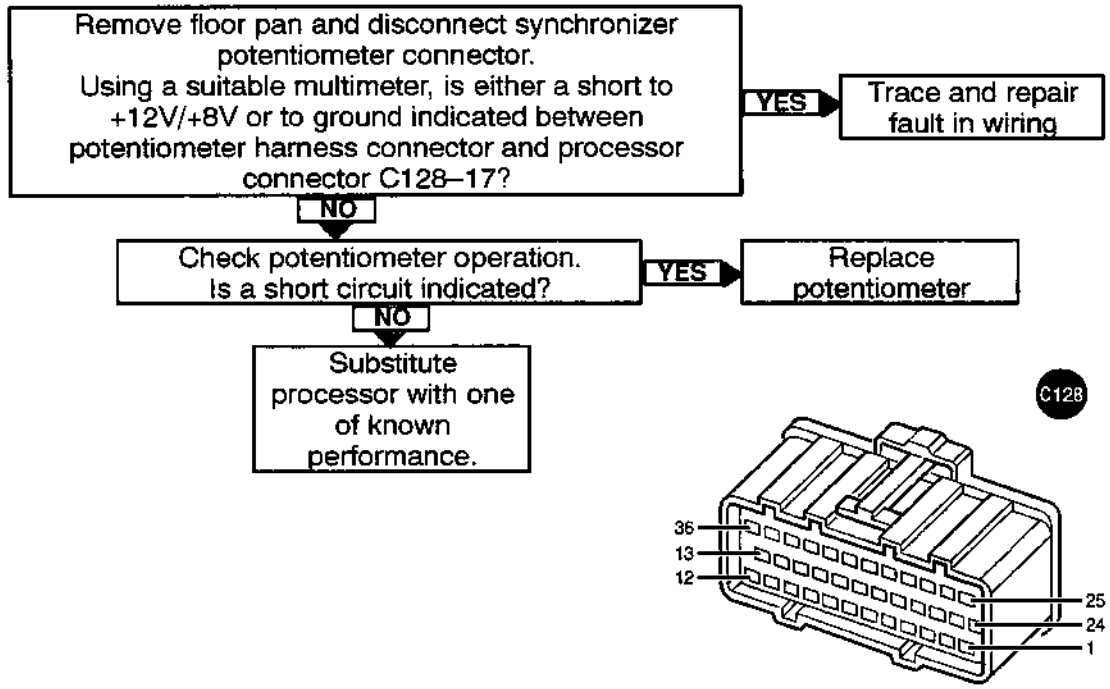
ERROR CODES;
E53 – 5 VOLT REFERENCE FAILED HIGH (SHORT TO (+8V or +12V)
E54 – 5 VOLT REFERENCE FAILED LOW (SHORT TO GROUND)
EFFECTS – Transmission disabled.



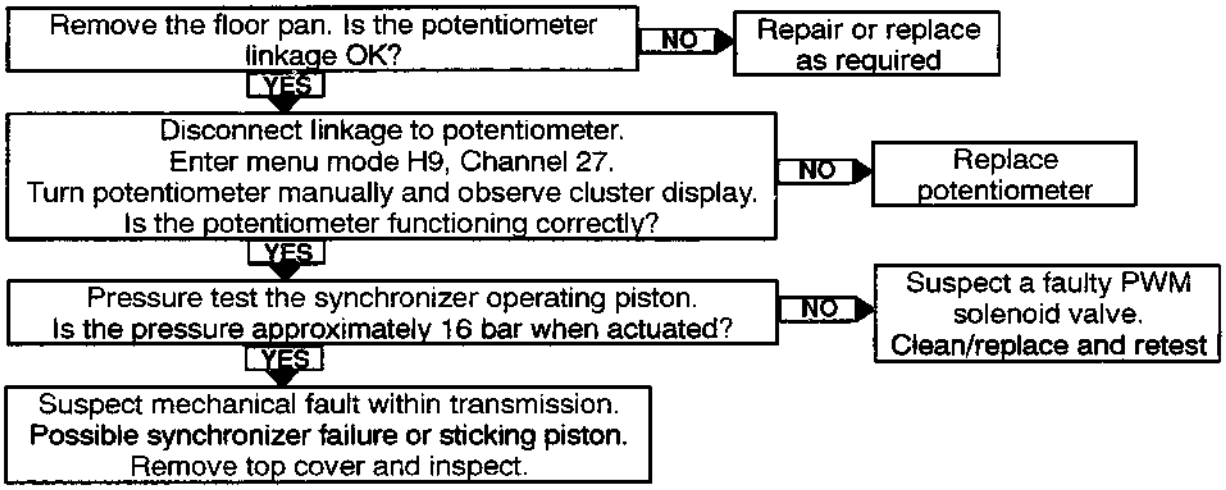
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ERROR CODES;
E61 – SYNCHRO POTENTIOMETER SIGNAL TOO HIGH
E62 – SYNCHRO POTENTIOMETER SIGNAL TOO LOW
EFFECTS – The synchronizer is disabled



ERROR CODES;
E63 – SYNCHRONIZER NOT FULLY ENGAGING HI–LO (FORWARD) POSITION
E64 – SYNCHRONIZER NOT FULLY ENGAGING SHUTTLE (REVERSE) POSITION
EFFECTS – If the previously engaged mode can be reselected, the error is cleared and the shift can be re–attempted. If synchronizer cannot be engaged only lo–forward drive will be possible.



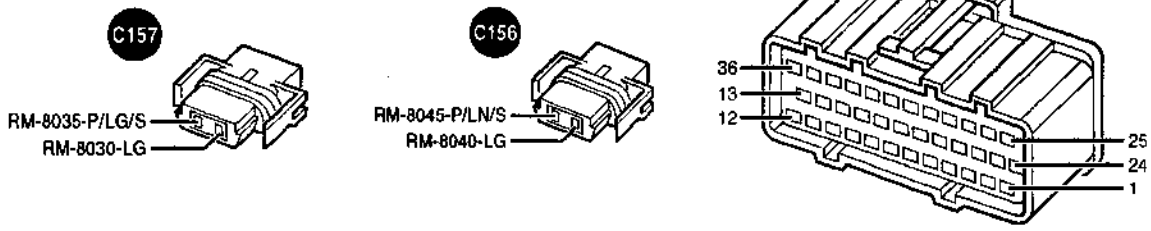
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ERROR CODES;
E65 – HI/LO (FORWARD DRIVE) SOLENOID OPEN CIRCUIT
E66 – SHUTTLE (REVERSE DRIVE) SOLENOID OPEN CIRCUIT
EFFECTS – Transmission disabled.

Remove floor pan and disconnect affected solenoid. Test across solenoid terminals with a suitable multimeter. Is an open circuit indicated?
YES → Replace solenoid
NO

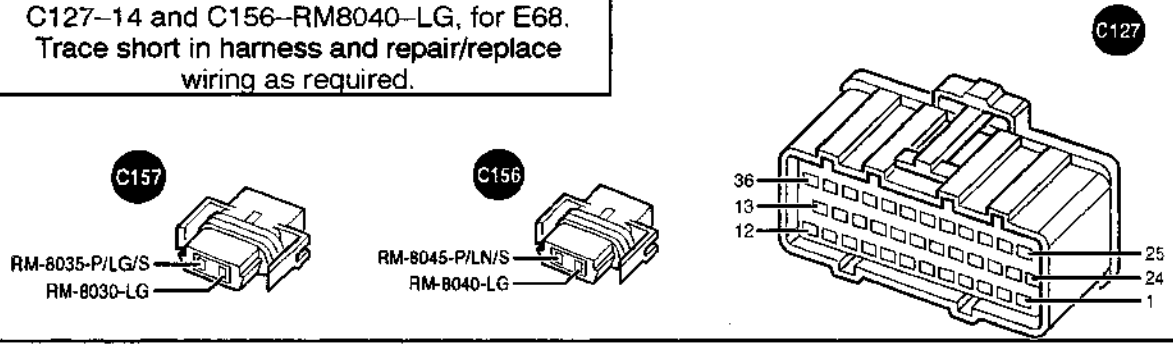
Disconnect processor connectors.
Test for an open circuit between C127–11 and C157–RM8030–LG, and between C127–36 and C157–RM8035–P/LG/S, for E65.
Test for an open circuit between C127–13 and C156–RM8045–P/LN/S, for E66.
Trace fault and repair/replace wiring as required.



ERROR CODES;
E67 – HI–LO (FORWARD) SOLENOID SHORT CIRCUIT
E68 – SHUTTLE (REVERSE) SOLENOID SHORT CIRCUIT
EFFECTS – Transmission disabled.

Remove floor pan and disconnect affected solenoid. Test across solenoid terminals and from each terminal to ground with a suitable multimeter. Is a short circuit indicated?
YES → Replace solenoid
NO

Disconnect processor connectors.
Test for a short circuit between C127–11 and C157–RM8030–LG, and between C127–36 and C157–RM8035–P/LG/S, for E67.
Test for a short circuit between C127–13 and C156–RM8045–P/LN/S, and between C127–14 and C156–RM8040–LG, for E68.
Trace short in harness and repair/replace wiring as required.



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ERROR CODE
CP – GEAR SELECTED WITHOUT CLUTCH PEDAL DEPRESSED
EFFECTS – Transmission disabled.

Cycle the clutch pedal or shuttle lever to clear error code.

ERROR CODE
EHI – CLUTCH B NOT CALIBRATED
EFFECTS – Transmission disabled

Was clutch 'B' calibrated after a change of processor or after using H8 (memory clear) mode?
- NO → Perform calibration to clear error code
- YES → Replace processor with one of known performance

ERROR CODE
EL0 – CLUTCH A NOT CALIBRATED
EFFECTS – Transmission disabled

Was clutch 'A' calibrated after a change of processor or after using H8 (memory clear) mode?
- NO → Perform calibration to clear error code
- YES → Processor possibly corrupted. Replace with one of known performance

ERROR CODE
E70 – UNABLE TO INITIALIZE SYNCHRONIZER DURING START UP PROCEDURE
EFFECTS – Transmission operable in 'Low Forward' only.

Remove floor pan. Is linkage to synchronizer potentiometer OK?
- NO → Repair linkage
- YES → Disconnect linkage to potentiometer. Enter menu mode H9, channel 27, and manually operate potentiometer. Is the potentiometer functioning correctly?
  - NO → Replace potentiometer
  - YES → Suspect fault within transmission. Remove top cover. Inspect synchronizer and operating piston.

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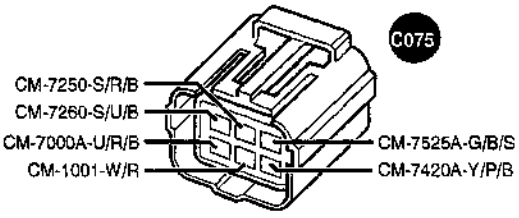
ERROR CODES;
E55 – FORWARD SWITCH FAILED TO +8V OR +12V
E56 – FORWARD SWITCH FAILED TO GROUND OR OPEN CIRCUIT
EFFECTS – Transmission enabled

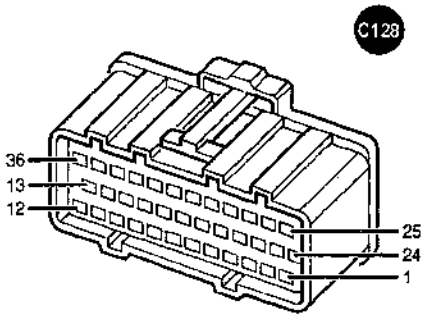
Using diagnostic Menu Mode H5 (switch diagnostics), operate forward switch, is switch functioning okay?
YES → Suspect intermittent fault. Wiggle test wiring from the forward switch to the processor.
NO

Disconnect FNR switch connector C075. From C075–CM7250–S/R/B, with the ignition 'ON', is +8V or +12V indicated (E55) or, with the ignition 'OFF', is a short to ground indicated (E56)?
YES → Trace and repair fault in wiring
NO

With the Keystart OFF, disconnect processor connector, C128. Check for an open circuit between C128–20 and C075–CM7250–S/R/B. Is an open circuit indicated?
YES → Trace and repair fault in wiring
NO

Substitute FNR switch assembly for one of known performance.





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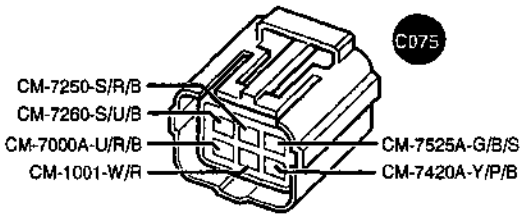
ERROR CODES;
E57 – REVERSE SWITCH FAILED TO +8V OR +12v
E58 – REVERSE SWITCH FAILED TO GROUND OR OPEN CIRCUIT
EFFECTS – Transmission enabled

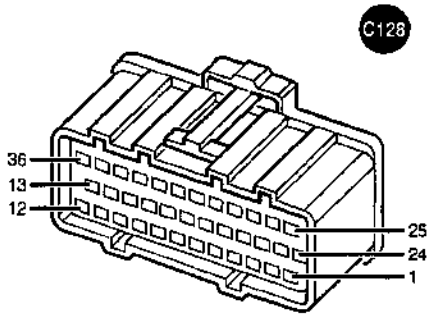
Using diagnostic Menu Mode H5 (switch diagnostics), operate reverse switch, is switch functioning okay?
YES → Suspect intermittent fault. Wiggle test wiring from the reverse switch to the processor.
NO

Disconnect FNR switch connector, C075. From C075–CM7260–S/U/B, with the ignition 'ON'. is +8V or +12V indicated (E57) or, with the ignition 'OFF', is a short to ground indicated (E58)?
YES → Trace and repair fault in wiring
NO

Disconnect processor connector C128. Check for an open circuit between C128–7 and C075–CM7260–S/U/B. Is an open circuit indicated?
YES → Trace and repair fault in wiring
NO

Substitute FNR switch assembly for one of known performance.





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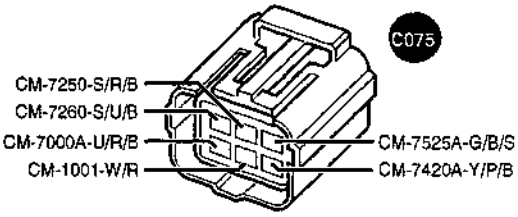
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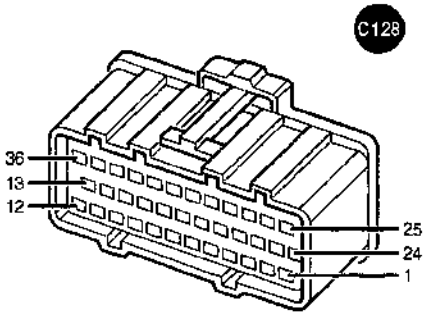
ERROR CODE
E59 – FORWARD/NEUTRAL/REVERSE SWITCH DISAGREEMENT (MORE THAN ONE SWITCH OR NO SWITCHES APPLIED)
EFFECTS – Transmission enabled

Using diagnostic Menu Mode H5 (switch diagnostics), operate shutttle lever, are switches functioning okay?
YES → Suspect intermittent fault. Wiggle test wiring from the shuttle lever switch to the processor.
NO

Disconnect shuttle switch assembly connector, C075 and processor connector, C128. Is an open circuit indicated between C075–CM7420A–Y/P/B and C128–27?
YES → Trace and repair fault in wiring
NO

Clean/replace the switch assembly





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CLUTCH CALIBRATION ERROR CODES

U20 – CORRECT START UP PROCEDURE WAS NOT USED

Depress and release clutch pedal and proceed with clutch calibration

U21 – ENGINE REV/MIN TOO LOW

Adjust to 1200 rev/min ± 100 rev/min

U22 – ENGINE REV/MIN TOO HIGH

Adjust to 1200 rev/min ± 100 rev/min

U23 – FORWARD/REVERSE SHUTTLE LEVER IS NOT IN FORWARD

Position lever into forward mode

U24 – MAIN SHIFT LEVER IS NOT IN GEAR

Position main range lever into 1st gear

U25 – RANGE LEVER NOT IN GEAR

Position range lever into high range

U26 – CLUTCH PEDAL NOT FULLY RELEASED

Release clutch pedal and/or check pedal operation

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U27 – HI (B) CLUTCH CALIBRATION IS TOO LOW (ENGINE REV/MIN DROPPED TOO SOON)

Check PWM valve for sticking or dirt ingress. Clean or replace valve.

↓

If PWM is not faulty, suspect mechanical fault within Clutch 'B' assembly.

U28 – HI (B) CLUTCH CALIBRATION IS TOO HIGH. (MAX. ALLOWED CALIBRATION VALUE EXCEEDED WITHOUT DROPPING ENGINE REV/MIN.)

Check PWM valve for sticking or dirt ingress

↓

Check hydraulic pressure in Clutch 'B'

↓

If hydraulics OK, suspect mechanical failure, possibly synchronizer fault not connecting transmission to engine.

U29 – LO (A) CLUTCH CALIBRATION IS TOO LOW (ENGINE REV/MIN DROPPED TOO SOON)

Check PWM valve for sticking or dirt ingress. Clean or replace valve.

↓

If PWM is not faulty, suspect mechanical fault within Clutch 'A' assembly.

U30 – LO (A) CLUTCH CALIBRATION IS TOO HIGH. (MAX. ALLOWED CALIBRATION VALUE REACHED WITHOUT DROPPING ENGINE REV/MIN.)

Check PWM valve for sticking or dirt ingress

↓

Check hydraulic pressure in Clutch 'A'

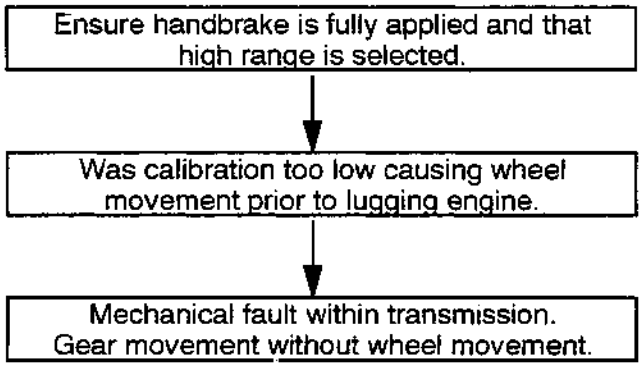
↓

If hydraulics OK, suspect mechanical failure, possibly synchronizer fault not connecting transmission to engine.

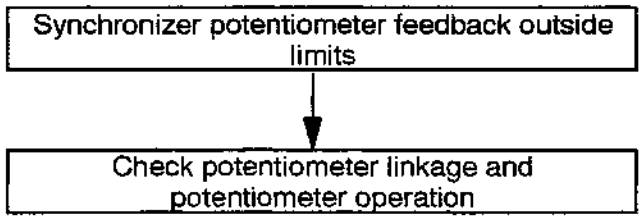
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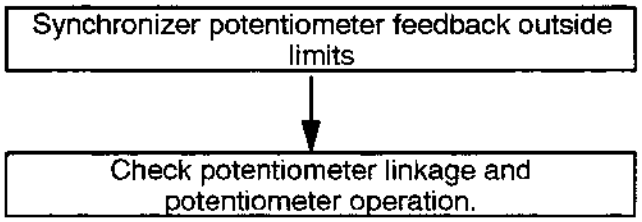
U31 – WHEEL MOTION DETECTED DURING CALIBRATION



U37 – SYNCHRONIZER SHUTTLE (REVERSE) MODE CALIBRATION



U38 – SYNCHRONIZER Hi–LO (FORWARD) MODE CALIBRATION



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SECTION 4

TRANSMISSIONS

CHAPTER 5

MECHANICAL TRANSMISSION

(NOTE: NOT USED IN NORTH AMERICA)

CONTENTS

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21 000 –SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

SPECIFICATIONS

Transmission	4–speed with constant–mesh gears and synchronizers on all speed gears
Gear type	helically toothed
Range gears	cascade–scheme, with 4 forward ranges and 4 reverse ranges for a total of 16 forward and 6 reverse speeds
– Gear type	helically toothed
– Reduction ratios:	
Low	(24 x 15) : (46 x 55) = 1 : 7.03
Medium	(24 x 26) : (46 x 40) = 1 : 2.95
Normal	(24 x 29) : (46 x 37) = 1 : 2.45
High	1
Speed and range shift controls	independent, by two hand levers located at the operator's right side
Speed and range gear lubrication	forced–fed by a gear pump (same as the power steering circuit pump)
Speed driven gear (10, page 4-5-9) inner diameter in (mm)	2.364 to 2.366 (60.060 to 60.090)
Bushing (11) outer diameter in (mm)	2.361 to 2.362 (59.981 to 60.000)
Gears to bushings clearance in (mm)	0.002 to 0.004 (0.060 to 0.109)
Speed output shaft (13) diameter in (mm)	1.944 to 1.945 (49.375 to 49.391)
Bushing (11) inner diameter in (mm)	1.945 to 1.946 (49.400 to 49.430)
Shaft to bushings clearance in (mm)	0.0004 to 0.002 (0.009 to 0.055)
Range (8) driven gear inner diameter in (mm)	2.364 to 2.366 (60.060 to 60.090)
Bushing (9) outer diameter in (mm)	2.361 to 2.362 (59.981 to 60.000)
Gears to bushings clearance in (mm)	0.002 to 0.004 (0.060 to 0.109)
Range output shaft (7) diameter in (mm)	1.944 to 1.945 (49.375 to 49.391)
Bushing (9) inner diameter in (mm)	1.945 to 1.946 (49.400 to 49.430)
Shaft to bushings clearance in (mm)	0.0004 to 0.002 (0.009 to 0.055)

(to be continued)

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(continued)

PTO drive shaft (3, page 4-5-9) diameter (at the bushings) .. in (mm) Press–fit bushing (1) inner diameter ..... in (mm) PTO drive shaft to bushings clearance ..... in (mm)	 1.258 to 1.259 (31.950 to 31.975) *1.259 to 1.263 (31.990 to 32.085) 0.0006 to 0.005 (0.015 to 0.135)
Speed input shaft rear bearing (2) thrust washer ..... mm Range input shaft bearing adjustment ..... Range input shaft (4) adjust shims ..... mm Range output shaft bearing adjustment ..... Range output shaft (5) adjust shims ..... mm	 2.950 to 3.000 see page 4-5-49 1.70 –1.75 – 1.80 –1.85 – 1.90 –1.95 – 2.00 – 2.05 – 2.10 – 2.15 – 2.20 – 2.25 – 2.30 –2.35 – 2.40 – 2.45 – 2.50 – 2.55 – 2.60 – 2.65 – 2.70 – 2.75 – 2.80 – 2.85 – 2.90 – 2.95 – 3.00 – 3.10 – 3.20 – 3.30 see page 4-5-49 1.70 –1.75 – 1.80 –1.85 – 1.90 1.95 – 2.00 – 2.05 – 2.10 – 2.15 – 2.20 – 2.25 – 2.30 –2.35 – 2.40 – 2.45 – 2.50 – 2.55 – 2.60 – 2.65 – 2.70 – 2.75 – 2.80 – 2.85 – 2.90 – 2.95 – 3.00 – 3.10 – 3.20 – 3.30
Implement pressure regulating valve spring (8, page 4-5-12): –Free length ..... in (mm) –Compressed length under a load of 278 to 304 N (28.4 to 31 kg) (62.6 to 68.4 lbf) ..... in (mm) Implement working pressure ..... lbf/in^2 (kg/cm^2) (bar)	 5.0 (127) 4.04 (102.5) 242 to 255 (17 to 18) (16.7 to 17.6)
Lubrication pressure regulating valve spring (7, page 4-5-12): –Free length ..... in (mm) –Compressed length under a load of 84 to 90 N (8.6 to 9.2 kg) (19 to 20 lbf) ..... in (mm) Lubrication pressure ..... lbf/in^2 (kg/cm^2) (bar)	 1.654 (42) 0.964 (24.5) 99 to 120 (7 to 8.5) (6.8 to 8.3)

* Final dimension to be obtained without grinding

SPEED AND RANGE GEARS (40 KPH [25 MPH] option)

Transmission ..... Gear type ..... Range gears	5–speed with constant–mesh gears and synchronizers on all speed gears helically toothed cascade–scheme, with 4 forward ranges and 4 reverse ranges for a total of 20 forward and 6 reverse speeds
For other values not shown herein refer to the previous table: SPEED AND RANGE GEARS	

CREEPER GEARS

Type ..... Reduction ratio: ..... Control type ..... Thickness of thrust washers (6, page 4-5-9) between driven gears and creeper support ..... in (mm)	epicyclic spur gear se. 20 : (20+100) = 1:6 through a lever located at the operator's left side 0.058 to 0.060 (1.465 to 1.535)

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SHUTTLE GEARS

Type	Mechanical, with helically toothed gears, assembled as a standard
Engagement	
Reduction ratio	(43 x 37 x 39) : (37 x 39 x 44) = 1 : 1.02
Control	through a synchronizer
Driven gear bearing adjust shims (12, page 4-5-9) ..... mm	2.55 – 2.60 – 2.65 – 2.70 – 2.75 – 2.80 – 2.85 – 2.90 – 2.95 – 3.00 – 3.05 – 3.10 – 3.15
Driven gear bearing adjustment	see page 4-5-47

TIGHTENING TORQUE

	Thread size	Torque	
		ft. lbs. (Nm)	ft. lbs. (kgm)
Bolts and nuts, speed clutch/transm housing to engine	(see C and C, page 3-1-3, Sec. 3)		
Bolts, speed clutch/transm housing to rear axle housing	M14 x 1.5	130 (176)	130 (18)
■ Setscrew, clutch release fork lever (C_1, page 4-5-5)	M16 x 1.5	116 (157)	116 (16)
Bolts, transmission housing cover (C_2)	M10 x 1.25	36 (49)	36 (5)
Screws, range rear bearing retaining plate (C_3)	M10 x 1.25	36 (49)	36 (5)
Nut, range output shaft (C_4)	M47.5 x 1.5	217 (294)	217 (30)
Screw, solenoid valve pin (C_5) (*)	–	35 to 40 (47 to 54)	35 to 40 (4.8 to 5.5)
Screw, solenoid valve (C_6) (*)	–	4.0 to 6.0 (5.4 to 8.1)	4.0 to 6.0 (0.55 to 0.83)
Screws, range and transmission control lever support (C_7)	M10 x 1.25	36 (49)	36 (5)
Fitting, transmission control lever support inlet (C_8)	M22 x 1.5	61 (83)	61 (8.5)
Plug, lubrication pressure regulating valve(C_9)	M18 x 1.5	36 (49)	36 (5)
Screws, creeper gear fixed plate (C_{10})	M10 x 1.25	40 (54)	40 (5.5)
Screws, clutch housing front cover (C_{11})	M8 x 1.25	17 (23)	17 (2.4)
Nut, transmission output shaft (C_{12})	M45 x 1.5	361 (490)	361 (50)
Bolts, transmission input shaft support cover	M8 x 1.25	17 (23)	17 (2.4)
Screws, range rear bearing support plate	M14 x 1.5	105 (142)	105 (14.5)
Bolts, cab to rubber mounts SILENT BLOCK	–	251 to 309 (340 to 420)	251 to 309 (34.7 to 42.8)
Bolts, cab support bracket (front)	–	84 to 109 (114 to 148)	84 to 109 (11.6 to 15.1)
Bolts, cab support bracket (rear)	–	184 to 228 (250 to 309)	184 to 228 (25.5 to 31.5)

(*) Apply a couple of drops of Loctite 542

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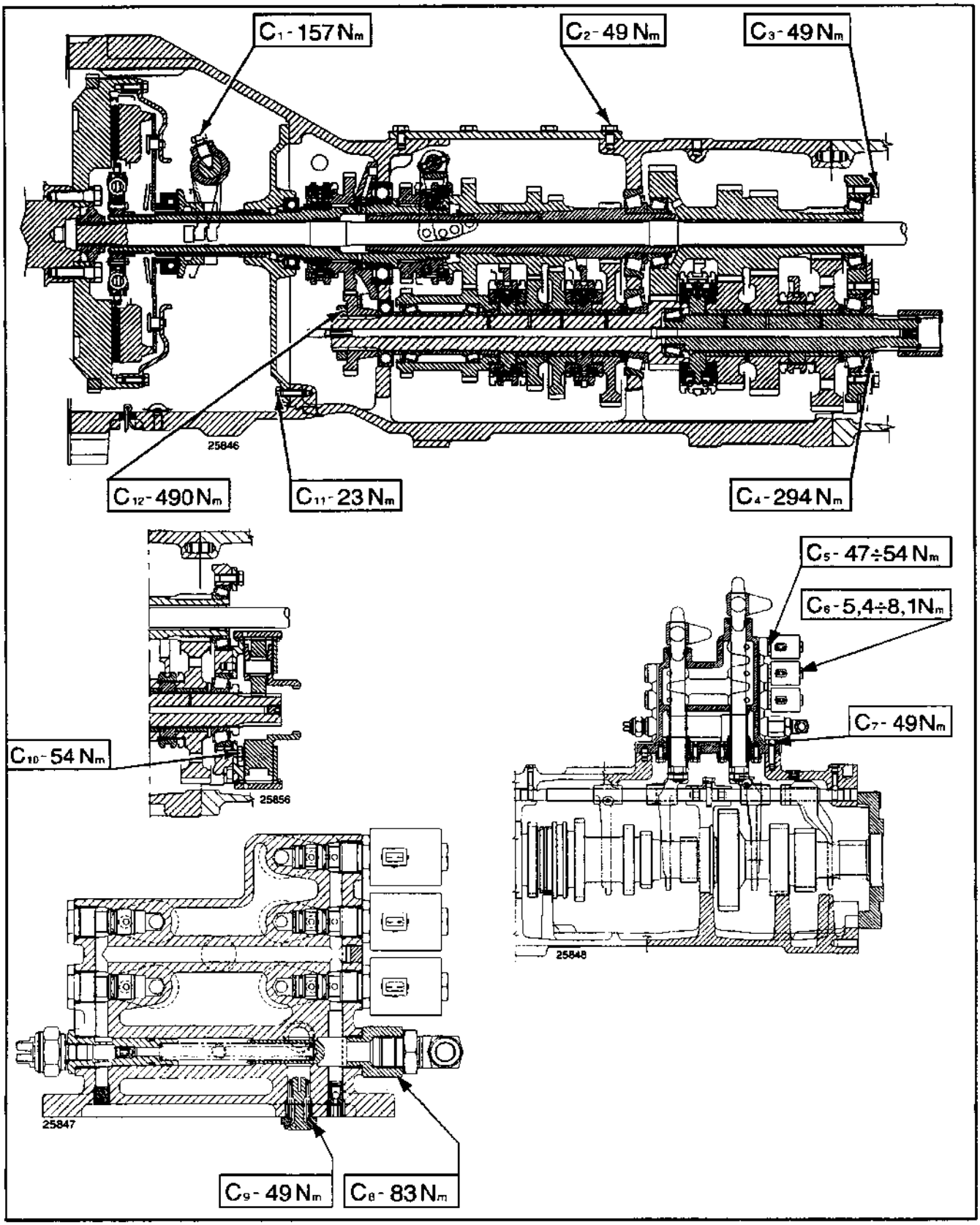


Figure 4-5-1

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SPECIAL TOOLS

Caution – Operations described in this Section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X).**
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to carry out the different operations described in this Section.

	295027	Cab lifting adapter (use with tool no. **290740**)
	290740	Cab lifting hook (use with tool no. **295027**)
	291215	Range control lever spring hook
	290090	Overhaul rotary stand
	292320	Tractor separation stand
	291517	Transmission housing lifting hook
	293971	Transmission overhaul front bracket (use with tool no. **290090**)
	293972	Transmission overhaul rear bracket (use with tool no. **290090**)
	293343	Output shaft nut wrench
X	**293805**	Input shaft puller (use with tool no. **50062**) or output shaft retaining tool
X	**293808**	Output shaft retaining tool
	292313	Reverse idler gear pin puller adapter
	292927	Slide hammer
	292176	Range input and output shaft end play test tool (use with tools nos. **50013** and **50018**)
	291051	Range input shaft bearing and gear puller
	291525	Transmission and rear axle housing alignment pins
X	**293869**	Output shaft bearing installer
X	**293992**	Installer for assembling bushings on the PTO drive shaft (use with tool no. **293800**)
X	**293993**	Installer for assembling the shuttle input shaft to PTO shaft seal (use with tool no. **293800**)
	293800	Handle
	294000	PTO drive shaft bushing puller
	295049	Range output shaft retaining tool

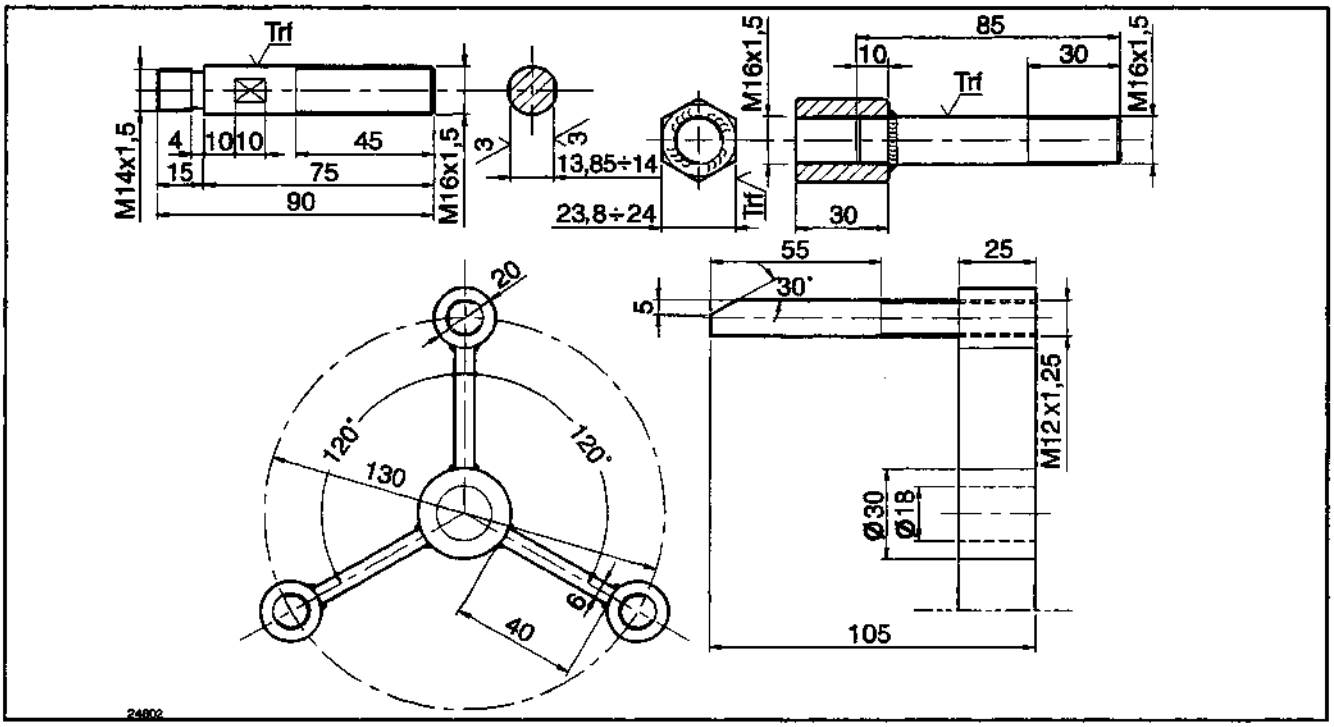


Figure 4-5-2

Tool to be fabricated for range input and output shaft bearing adjustment (Mark tool with no. 50018 – Dimensions in mm). Fabricate tool using Aq 42 material.

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Tool to be fabricated for range input shaft bearing assembly (Mark tool with no. 50060 – Dimensions in mm).
Fabricate tool using UNI C30 material.

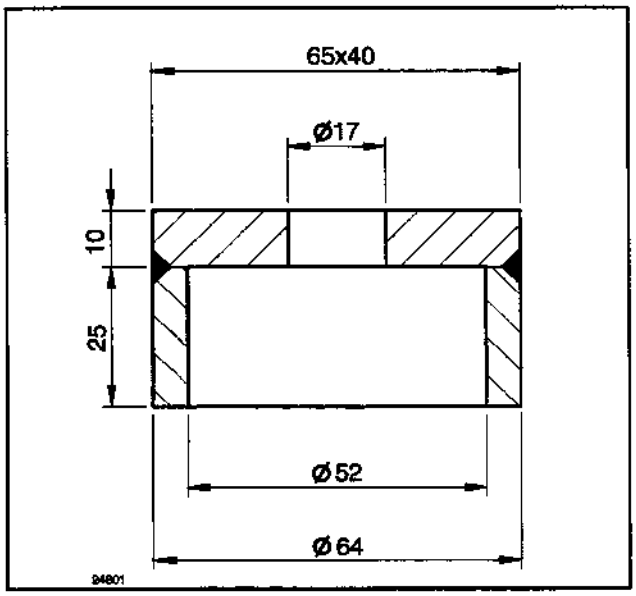


Figure 4-5-3

Tool to be fabricated for input shaft bearing removal(Mark tool with no. 50062 – Dimensions in mm).
Fabricate tool using UNI Fe 42 C material.

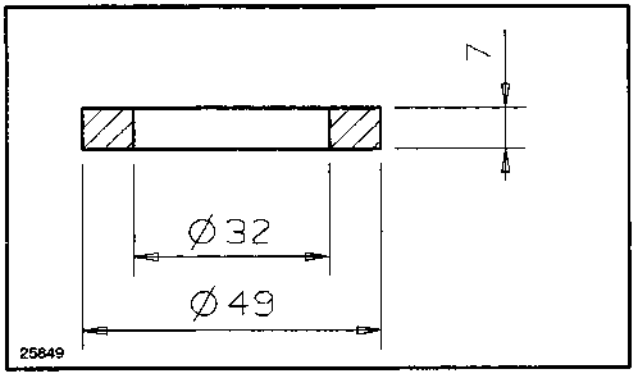


Figure 4-5-4

Tool to be fabricated for range output shaft bearing assembly (Mark tool with no. 50061 – Dimensions in mm).
Fabricate tool using UNI C30 material.

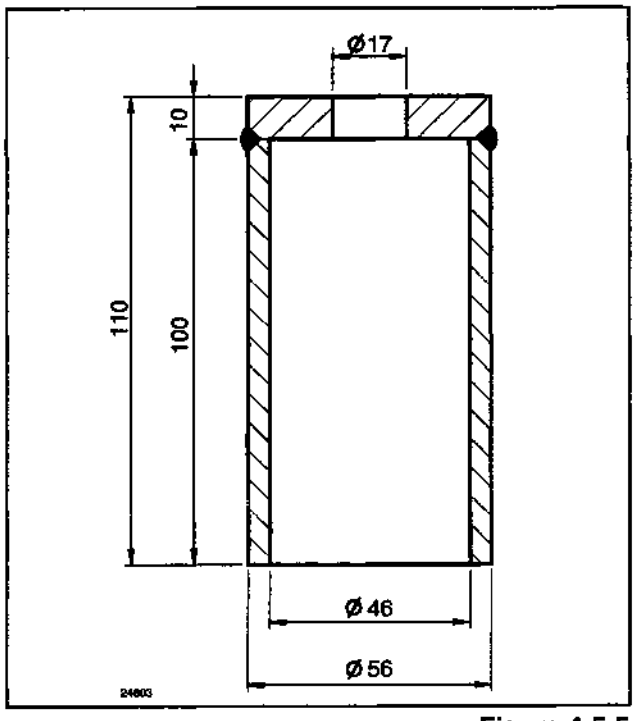


Figure 4-5-5

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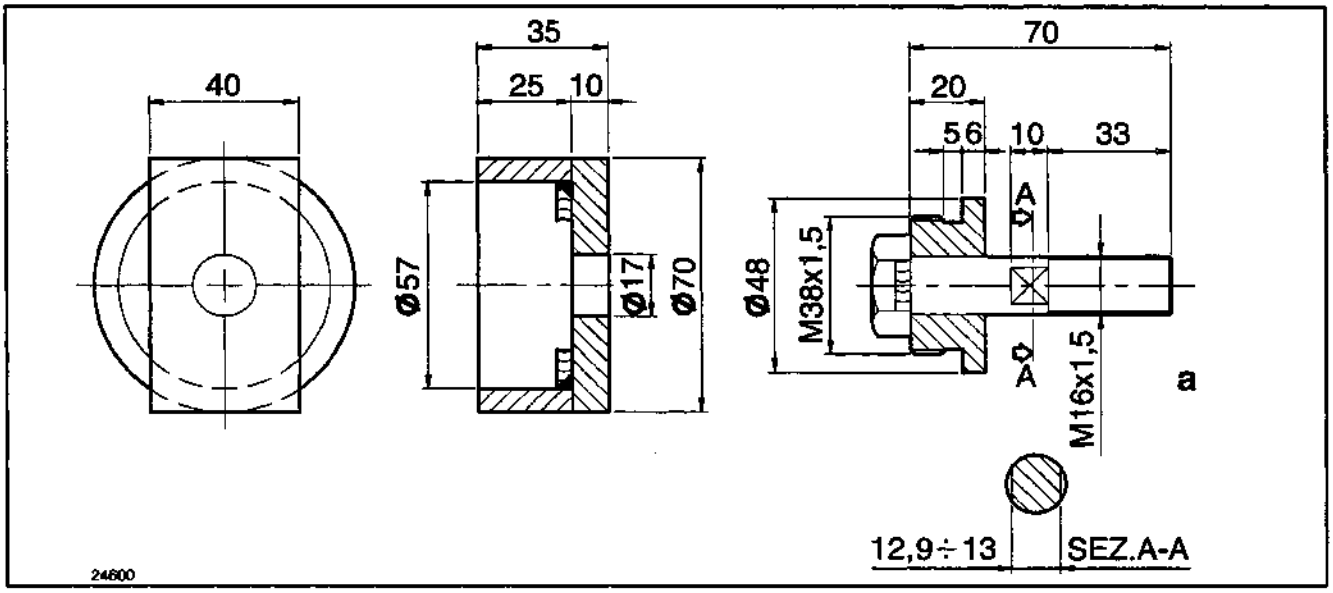


Figure 4-5-6

Tool to be fabricated for range input shaft taper bearing assembly (Mark tool with no. 50013 – Dimensions in mm).
Fabricate tool using UNI C40 material. – Use only part (a)

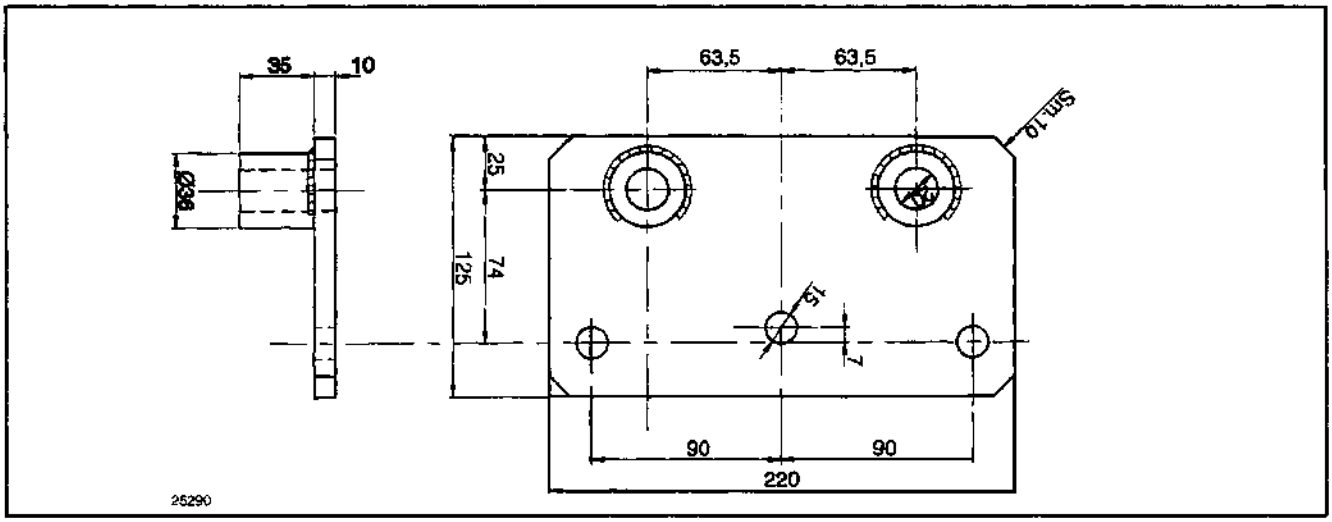


Figure 4-5-7

Tool to be fabricated to adapt the transmission overhaul front bracket (tool no. 293971). (Mark tool with no. 50110 –Fabricate tool using UNI Fe 42 C material.

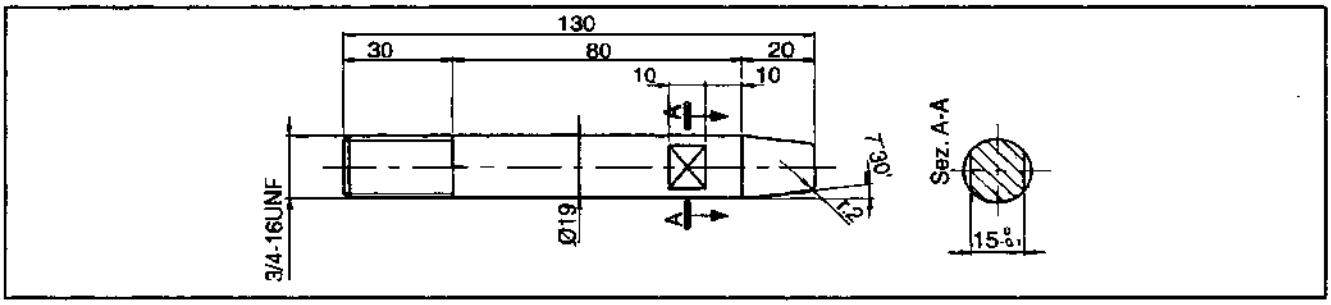


Figure 4-5-8

Tool to be fabricated for location and alignment during engine/transmission housing installation. (Mark tool with no. 50117 – Dimensions in mm). Fabricate tool using UNI C40 material. Make 2

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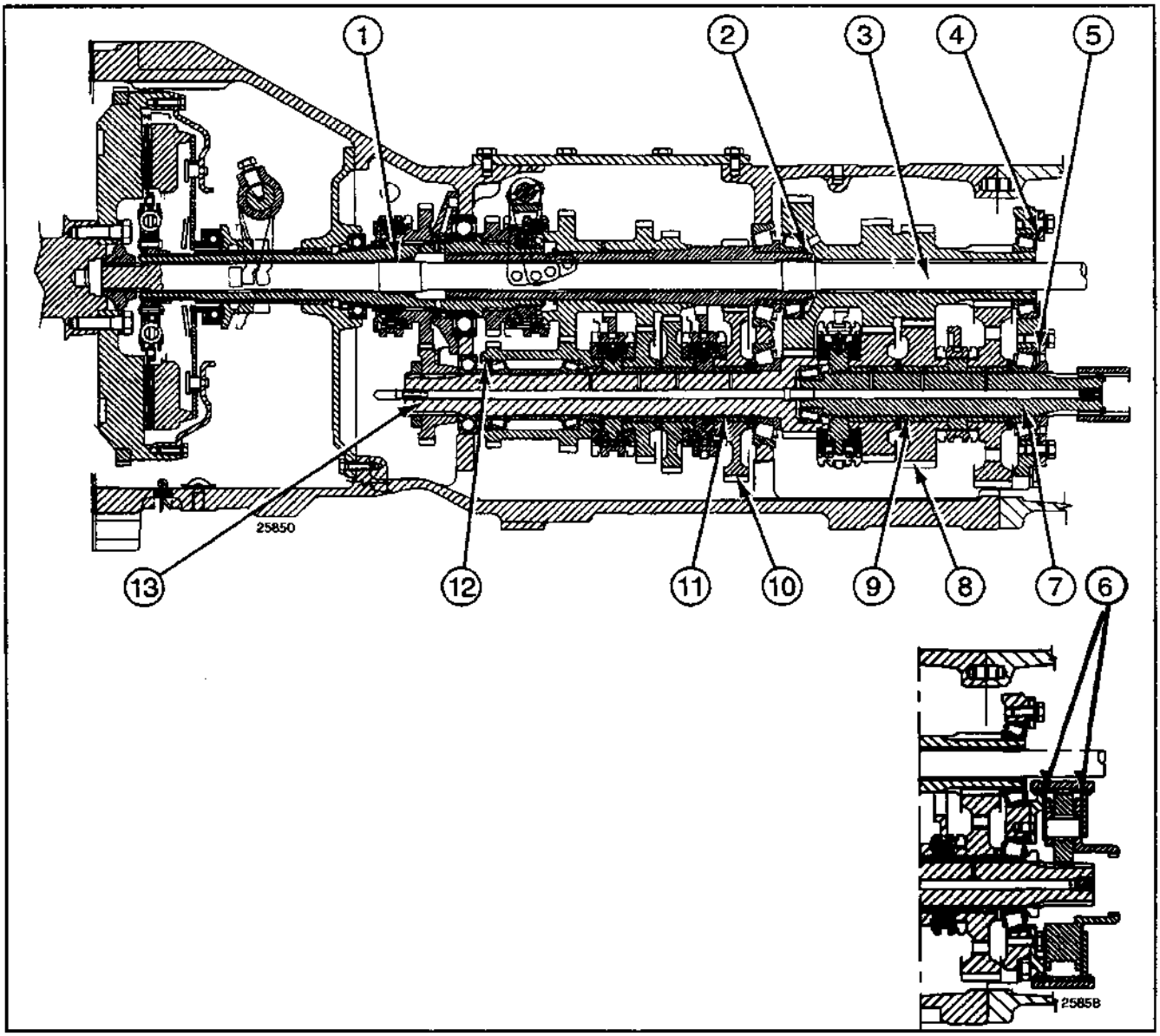


Figure 4-5-9

Longitudinal Views – 25 MPH (40 KPH) Transmission with 5th Speed and Creeper Gears

1. PTO shaft centering bushings
2. Transmission input shaft rear bearing thrust washer
3. PTO drive shaft
4. Range input shaft bearing adjust shims
5. Range output shaft bearing adjust shims
6. Thrust washers between driven gears and creeper gears support
7. Range output shaft
8. Range driven gears
9. Range driven gear bushings
10. Speed driven gears
11. Speed driven gear bushings
12. Shuttle driven gear bearing adjust shims
13. Transmission output shaft

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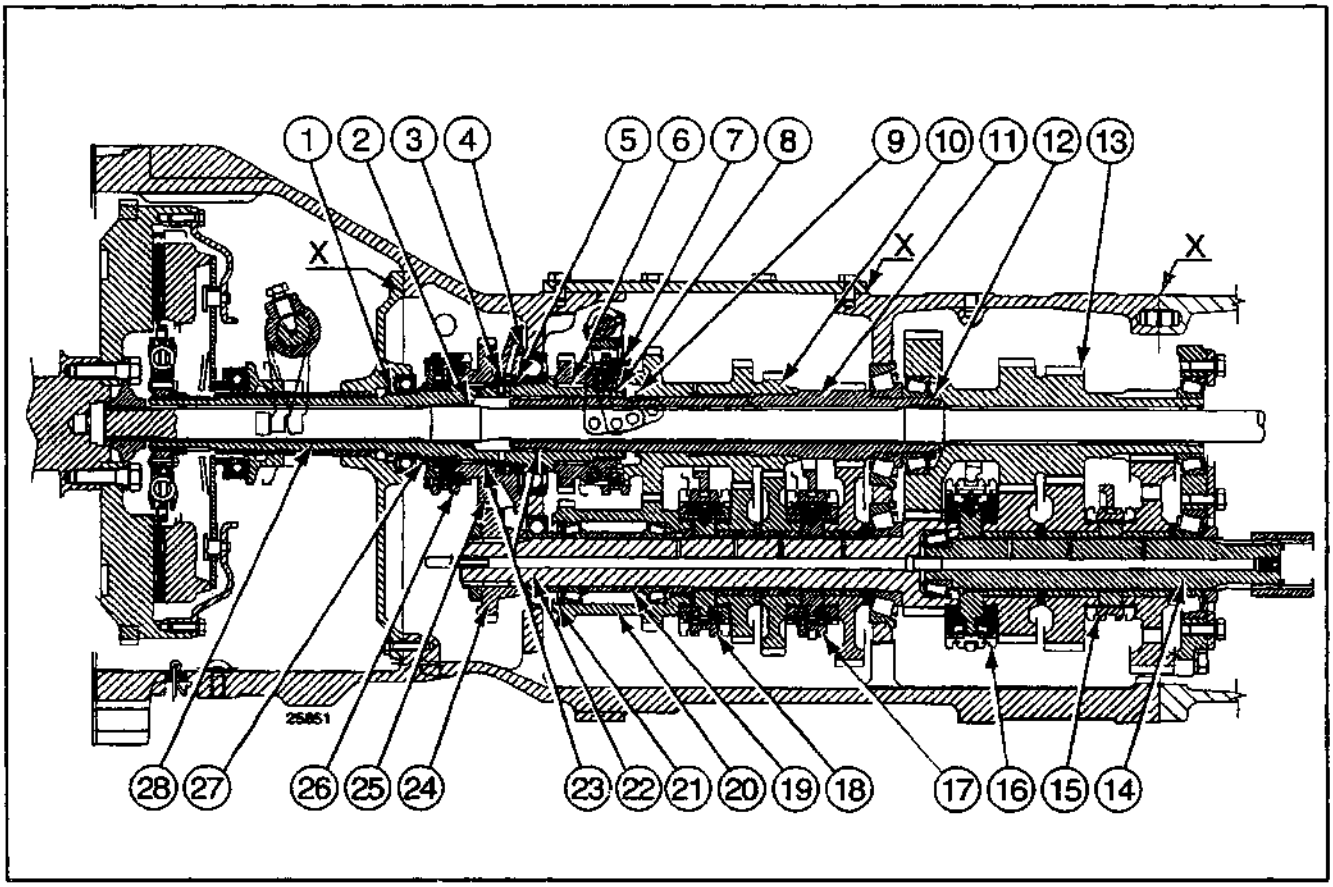


Figure 4-5-10

Longitudinal View – 25 MPH (40 KPH) Transmission with 5th Speed and Range Gears

1. Seal
2. Seal
3. O ring
4. Circlip
5. Circlip
6. Taper bearing
7. Shuttle synchronizer
8. Circlip
9. Circlip
10. Seal
11. Transmission input shaft
12. Seal
13. Range input shaft
14. Range output shaft
15. Low and medium–low range engagement sleeve
16. High and medium–high range engagement syn chronizer
17. 1st and 2nd gear synchronizer
18. 3rd and 4th gear synchronizer
19. IShuttle driven gear
20. Spacer
21. Circlip
22. Transmission output shaft
23. Taper bearing
24. 5th speed driven gear
25. .5th speed drive gear
26. 5th gear synchronizer
27. Circlip
28. Shuttle input shaft

Note: During installation apply sealant on surfaces marked with an **X** as detailed on page 4-5-46.

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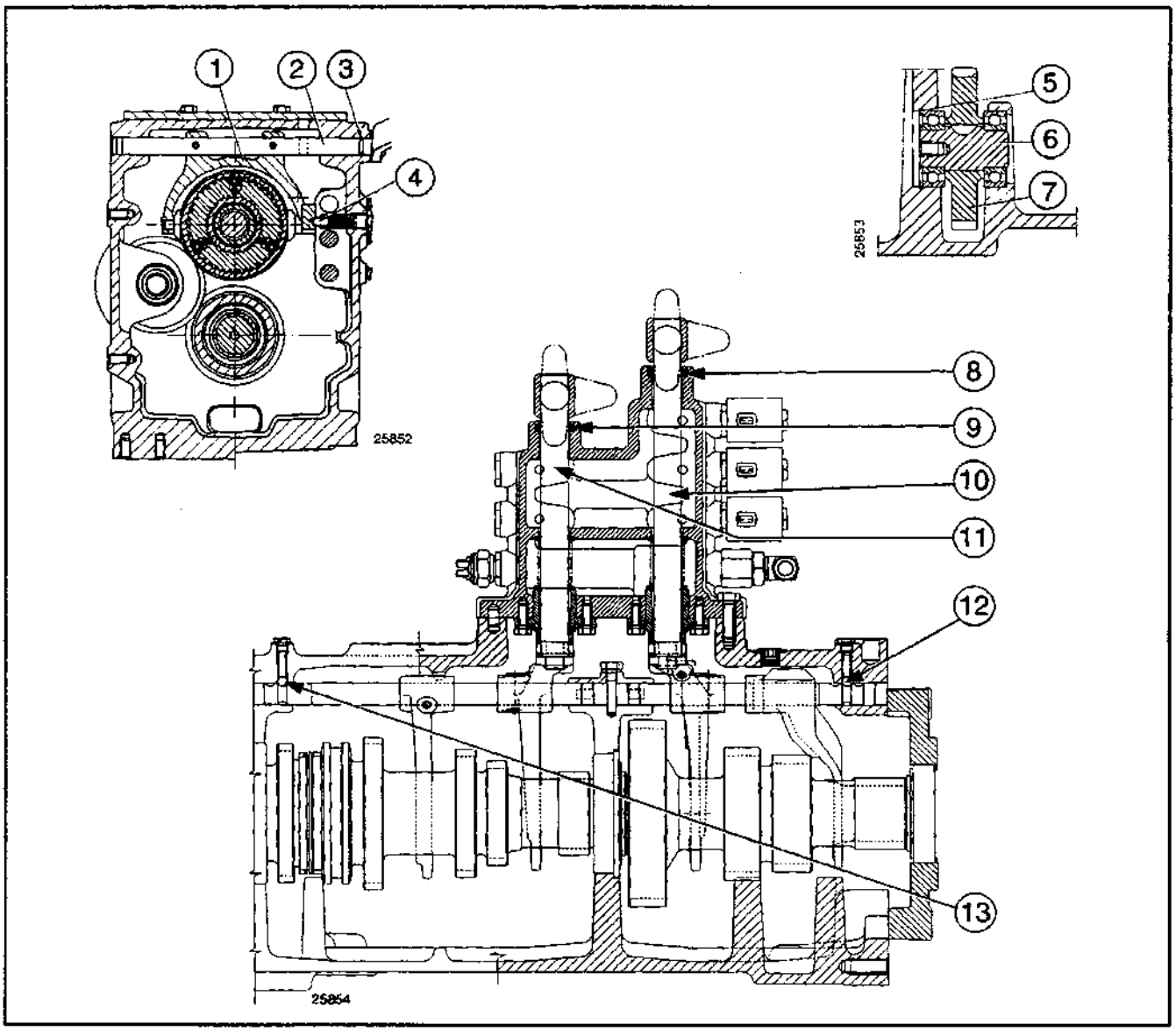


Figure 4-5-11

Transmission Control Lever Support Longitudinal Views and Transmission Cross Sections

1. Shuttle control fork
2. Shuttle control inner lever
3. O ring
4. Fork detent (1)
5. Retaining ring
6. Reverse pin
7. Shuttle reverse idler gear
8. O ring
9. O ring
10. Range control idler lever
11. Speed control idler lever
12. Actuating balls and springs
13. Actuating balls and springs

Note: During installation apply sealant on surfaces marked with an **X** as detailed on page 4-5-46.

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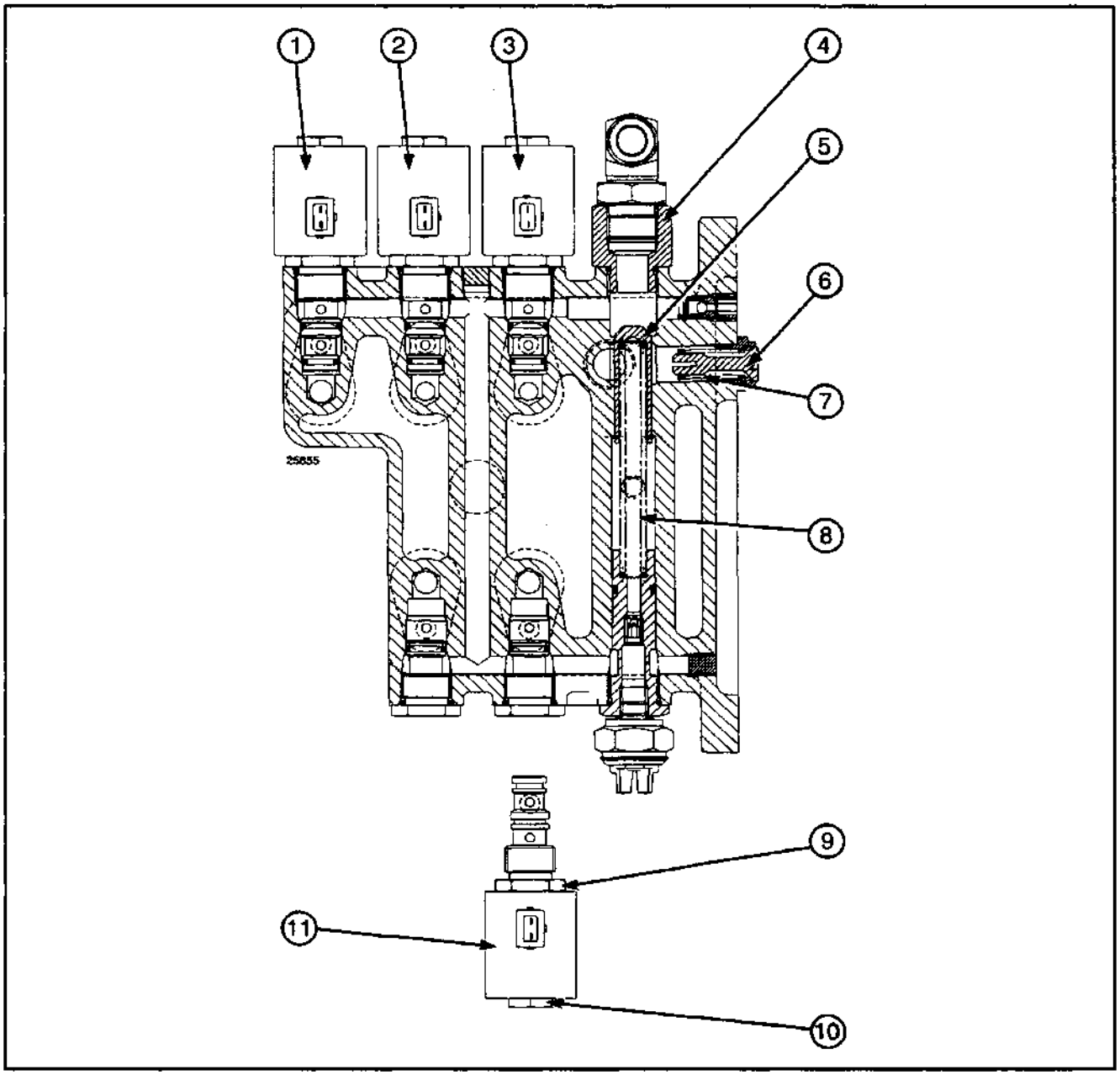


Figure 4-5-12

Speed and Range Control Lever Support Cross Section and Solenoid Valve Arrangement

1. PTO brake solenoid control valve
2. PTO solenoid control valve
3. Diff lock solenoid control valve
4. Inlet fitting
5. Implement pressure regulating valve (242 to 255 lbf/in^2 – 17 to 18 kg/cm^2) (16.7 to 17.6 bar)
6. Lubrication pressure regulating valve (99 to 120 lbf/in^2 – 7 to 8.5 kg/cm^2) (6.8 to 8.3 bar)
7. Lubrication pressure regulating valve spring
8. Implement pressure regulating valve spring
9. Solenoid valve pin
10. Solenoid valve
11. FWD engagement solenoid valve.

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DESCRIPTION AND OPERATION

Standard transmission (19 MPH) (30 KPH)

The standard transmission is fitted with range and shuttle gears and provides a total of 16 forward and 16 reverse speed gears or ratios. Transmission controls consist in three different levers, as follows:

The main shift lever selects four speed ratios through synchronized engagement sleeves.

The range lever shifts through the low and medium–low ranges by means of a non–synchronized engagement sleeve and through the high and medium–high ranges by means of a synchronized sleeve.

The shuttle lever selects the direction of movement of the tractor.

Optional transmission (25 MPH) (40 KPH)

The 25 MPH (40 KPH) option transmission is fitted with range and shuttle gears and provides a total of 20 forward and 16 reverse speed gears or ratios. Transmission controls consist in three different levers, as follows:

The main shift lever selects five speed gears or ratios through a synchronized engagement sleeve.

Refer to the previous description above for the **range and shuttle lever** operation.
This transmission differs from the standard version described above in the addition of the 5th speed ratio.

Note: With the 5th speed gear engaged, a special device prevents the shuttle lever to be moved to the reverse position.

TROUBLESHOOTING – TRANSMISSION AND RANGE GEARS

Problem	Possible Cause	Correction
Noisy operation with range lever in neutral and main lever engaged.	1. Input and output shaft support bearing misadjusted	Remove speed clutch/transmission housing and adjust bearings (see page 4-5-49).
	2. Failed or defective inner component	Remove housing, overhaul transmission and replace faulty parts.
	3. Internal component seizure due to poor lubrication	Overhaul transmission and top up oil to correct level.
Noisy operation with tractor stationary, idling engine and transmission in neutral	1. Faulty clutch plate springs	Replace clutch plate.
Self–disengagement of speed, range and shuttle gears	1. External linkage and levers misadjusted.	Adjust correctly.
	2. Failed control rail retaining springs	Replace springs.
	3. Damaged synchronizer engagement teeth	Remove speed clutch/transmission housing and replace synchronizer.
	4. Partial engagement travel	Correct reasons for problem and restore full travel.
Difficult engagement of speed, range and shuttle gears	1. External linkage and levers misadjusted.	Adjust correctly.
	2. External levers or linkage hardened and/or seized.	Check pivot points and lubricate.
	3. Central clutch drags	See page 3-1-5, Section 3.
	4. Faulty synchronizer	Remove speed clutch/transmission housing and replace synchronizer.
	5. Internal control items (rails, forks and sleeves) slide with difficulty	Overhaul control items

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SPEED CLUTCH / MECHANICAL TRANSMISSION HOUSING
Removal – Installation (Op. 21 114 10)

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.Ensure that units or parts are supported by suitable slings or hooks.Ensure that no–one is in the vicinity of the load to be lifted.

Remove the mechanical speed clutch/transmission housing as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

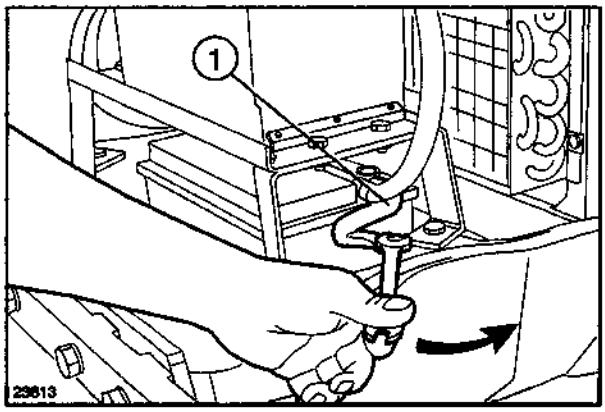


Figure 4-5-13

3. Connect the engine hood to a hoist using a nylon cable (1) and disconnect the shock absorbers (2) (one on the LH side and one on the RH side).

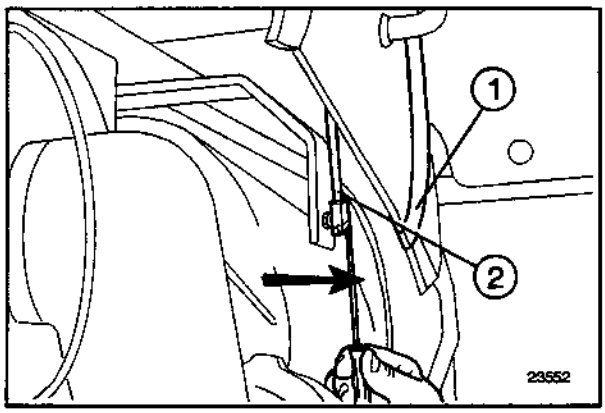


Figure 4-5-14

4. Loosen the screws (3) which retain engine hood to engine, disconnect front light electrical connectors and remove hood using the hoist. Ensure that the hood is displaced without obstructions and that no other components are interfering.

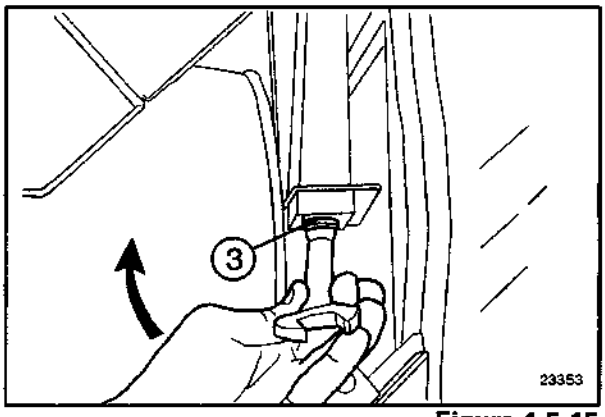


Figure 4-5-15

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5. Unscrew the retaining screws and remove side panels (1) (one on each side).

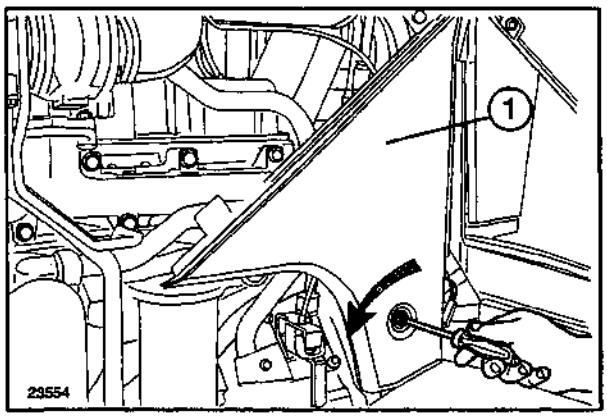


Figure 4-5-16

6. Jack up rear tractor and place two suitable stands (2) under the final drive cases to raise the wheels off the ground. If necessary, detach lift rods from lower links.

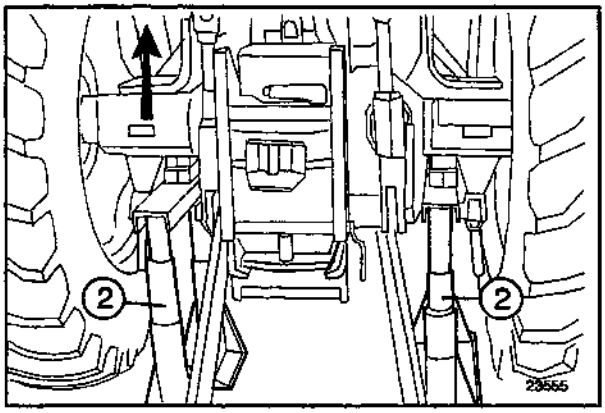


Figure 4-5-17

7. Sling the wheel using a nylon cable (3), unscrew the attaching nuts and remove the wheel. Repeat for the left wheel.

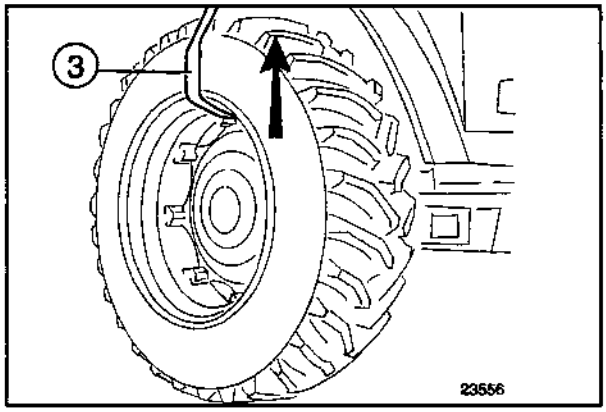


Figure 4-5-18

8. Loosen the two screws on the cab roof and fix tool no. **295027** (4) using two appropriate bolts. Connect tool to a hoist using hook tool no. **290740** and keep hook tensioned.

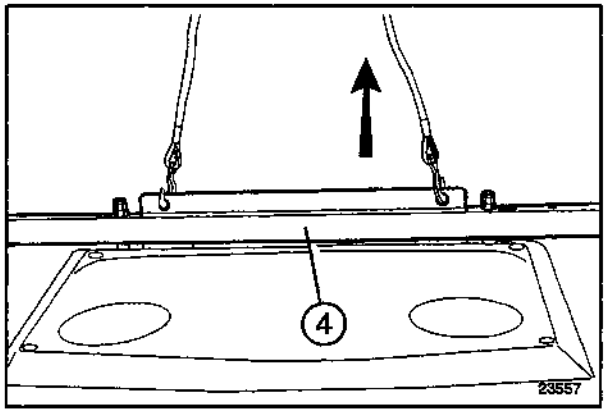


Figure 4-5-19

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9. Detach connectors at the windscreen primers. Detach washer bottle (1) lines and remove bottle.

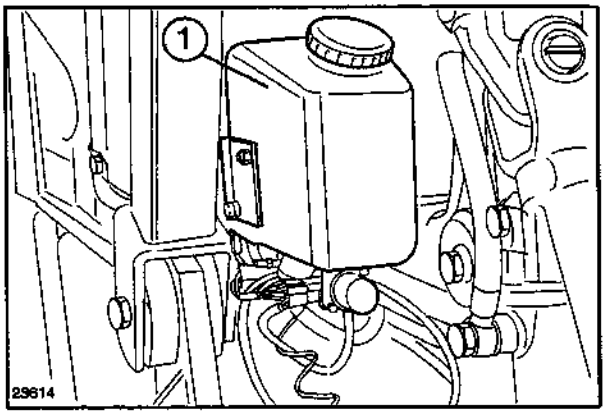


Figure 4-5-20

10. Remove the clip and detach the creeper gear control idler lever (2). Loosen the parking brake control cable retaining screw (3).

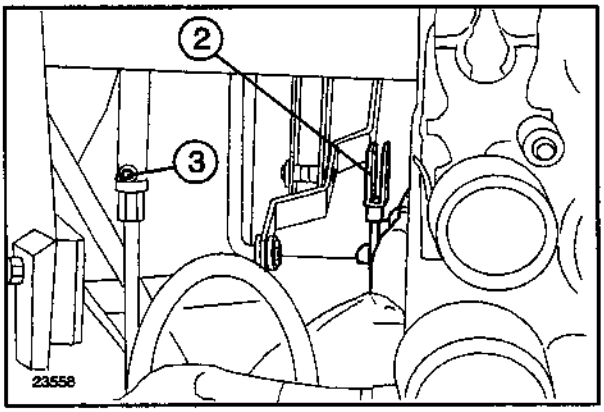


Figure 4-5-21

11. Remove the pin and withdraw the pin securing the fork (4) to the parking brake actuator lever. Loosen the nut securing the cable to the fork (4) and release cable.

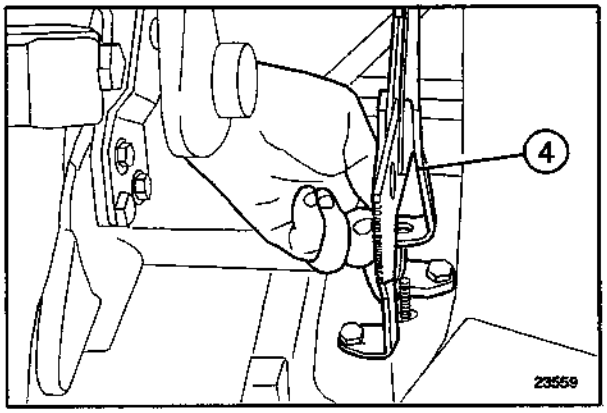


Figure 4-5-22

12. Loosen the attaching nut and detach the ground cable (5) between the cab and rear axle.

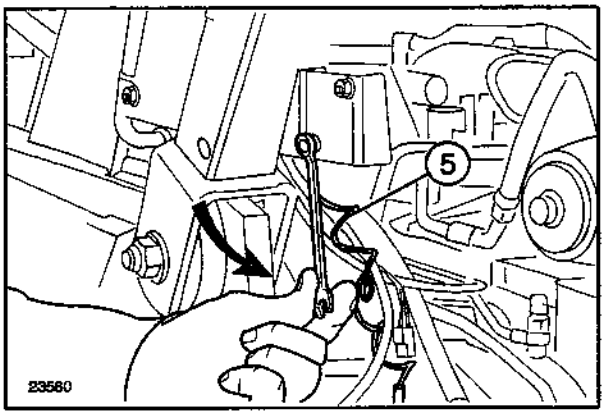


Figure 4-5-23

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13. Release the clamp (1) and detach the main tank bleeding line.

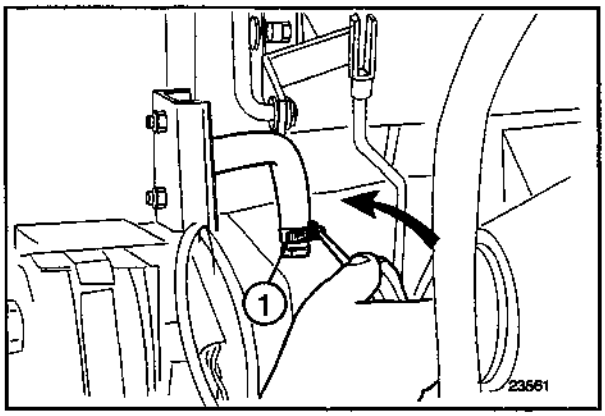


Figure 4-5-24

14. Detach the ground synchronized PTO control cable (2) from the rail.

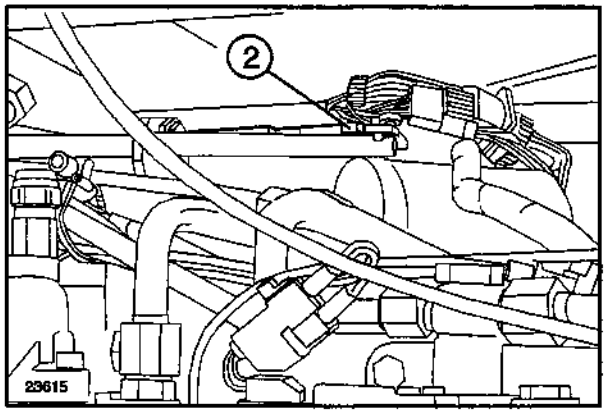


Figure 4-5-25

15. Detach the two connectors (3 and 4) located under the cab floor.

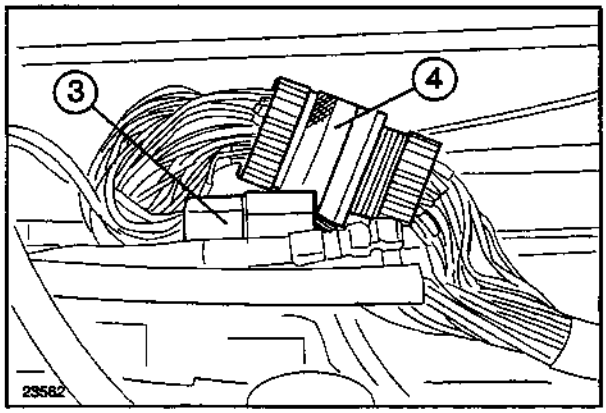


Figure 4-5-26

16. Detach both engine to cab connectors (5 and 6).

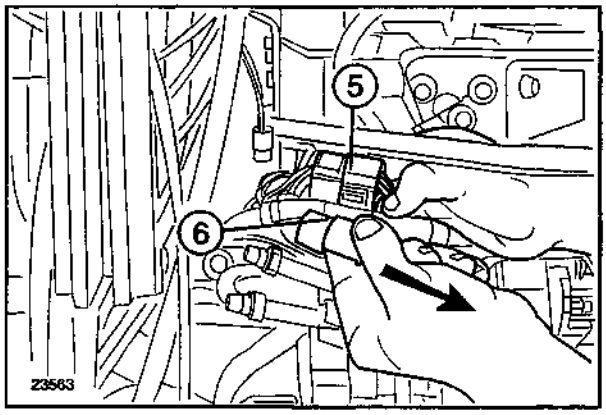


Figure 4-5-27

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17. Disconnect radar and fuel filter connectors (4 and 3, respectively). Remove protection and disconnect connectors (1 and 2) from starting motor.

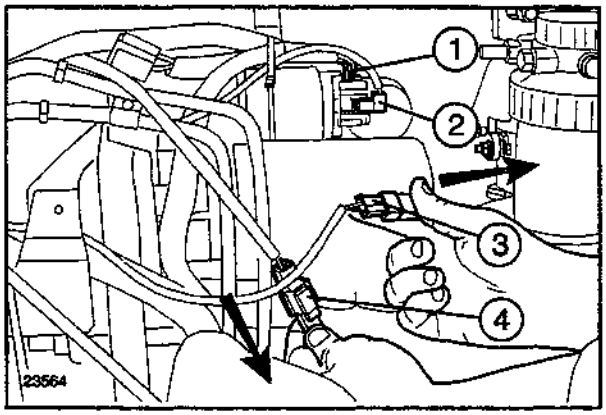


Figure 4-5-28

18. Detach light connector (5) located on the handrail (repeat for both tractor sides).

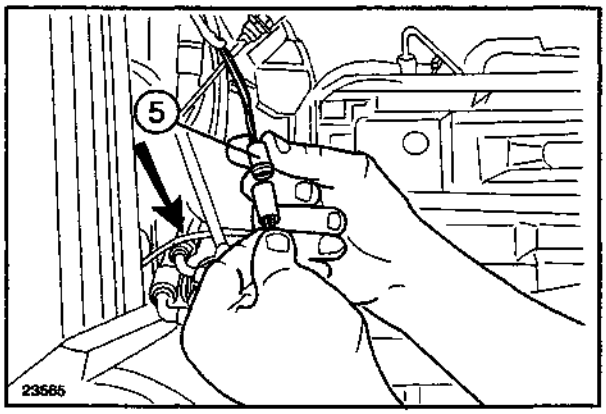


Figure 4-5-29

19. Detach heater to engine connecting lines (6) located under the right hand front side of the cab.

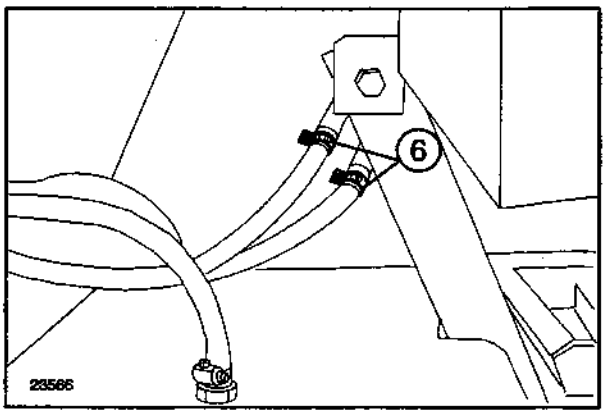


Figure 4-5-30

20. Loosen the nut and detach the throttle control cable (7) from injection pump.

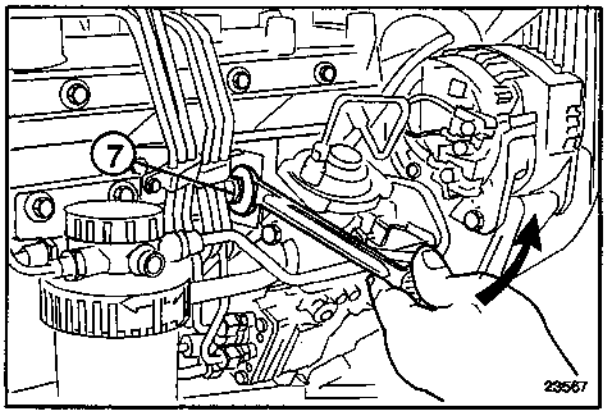


Figure 4-5-31

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21. Detach connectors (1) from brake pumps.

22. Loosen fittings (2) and detach brake control hoses.

23. Detach the brake pump lines to the tank.

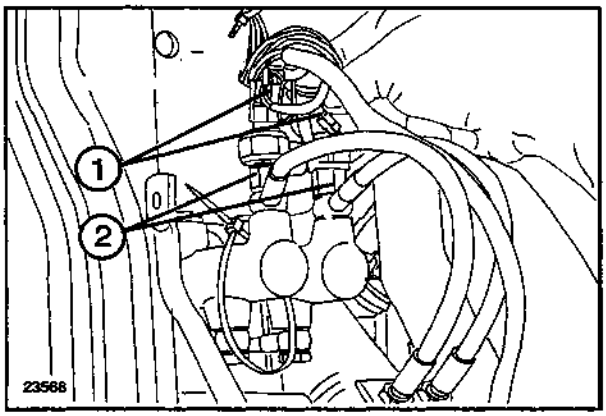


Figure 4-5-32

24. Loosen the power steering valve connecting lines (4) to the control pump.

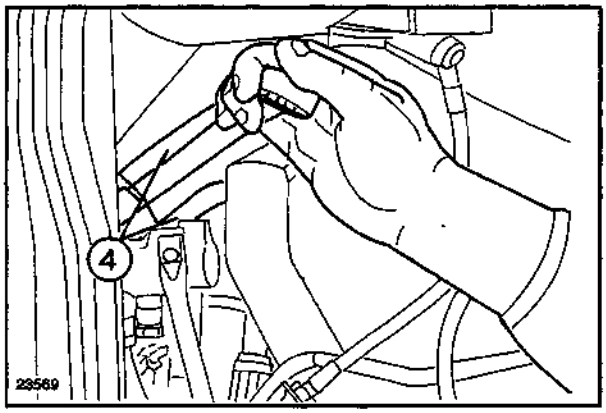


Figure 4-5-33

25. Detach the power steering valve connecting lines (5) to the steering cylinders.

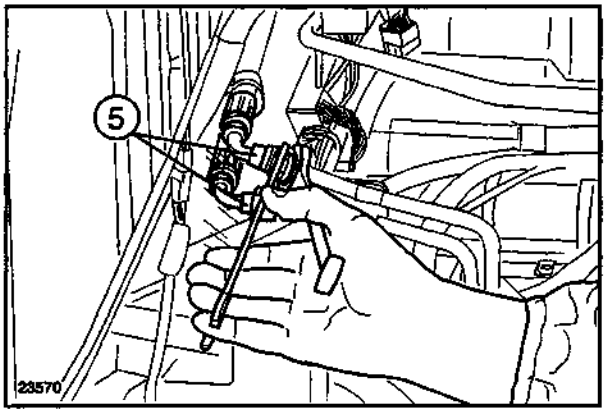


Figure 4-5-34

26. Loosen fittings and detach the air conditioning lines (6).

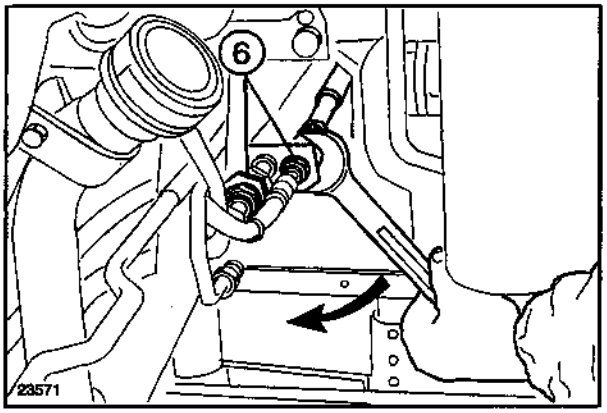


Figure 4-5-35

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27. Loosen the locknut, slide out the cotter pin and detach the PTO control cable (1).

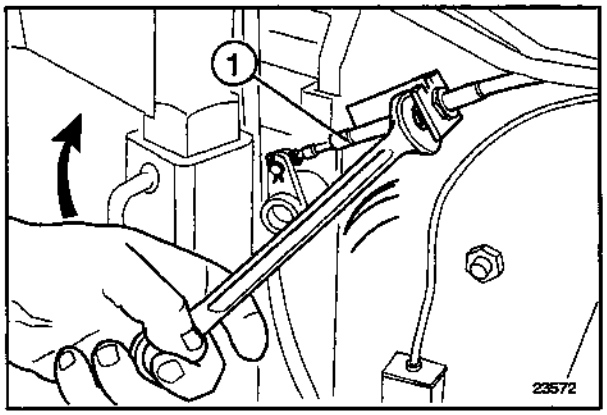


Figure 4-5-36

28. Slide out cotter pins and pins (2), loosen retaining screws (3) and detach the auxiliary valve control cables, right hand side.

29. If auxiliary valves are fitted also on left hand side, repeat step 28 for left hand side auxiliary valves.

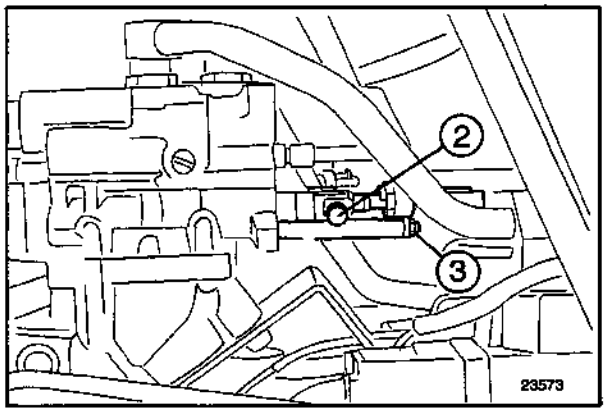


Figure 4-5-37

30. Loosen the screw attaching the steps (6) to the bracket.

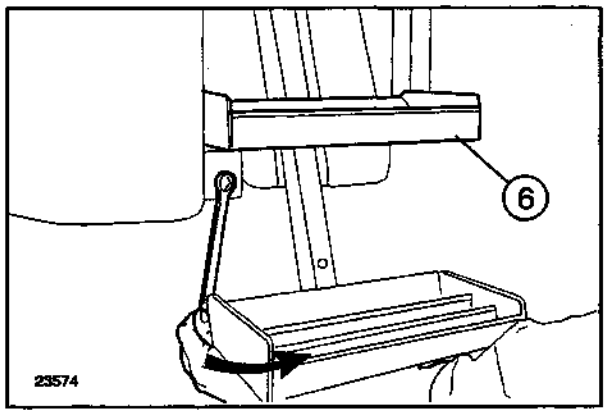


Figure 4-5-38

31. Loosen the screw attaching the steps (1) to the cab platform.

32. Repeat steps 30 and 31 on opposite side and remove steps.

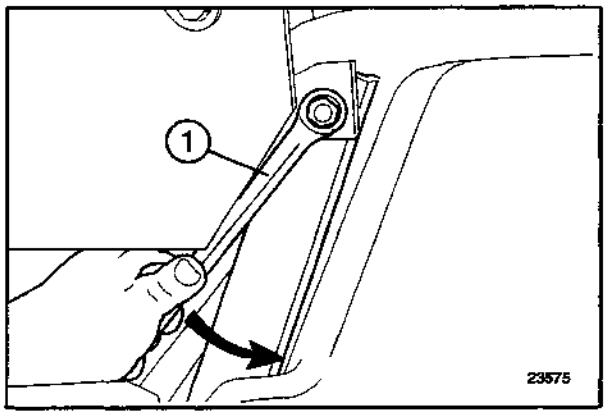


Figure 4-5-39

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33. Raise the cab mat (2) and loosen the cab mounting bolt while holding the locknut under the cab floor. Retrieve bolt and washer. Repeat for both tractor sides.

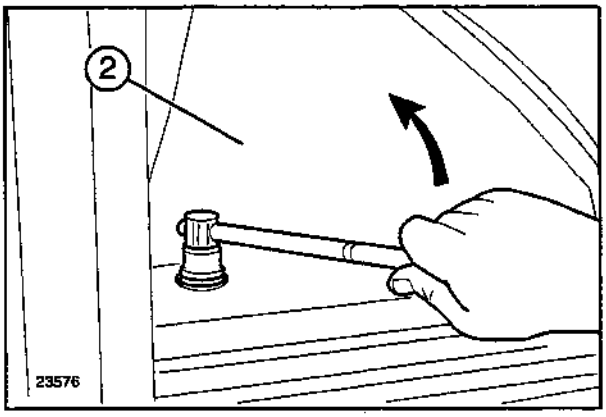


Figure 4-5-40

34. Loosen the rear cab bolts (on both sides).

35. Slowly raise the cab taking care that no components are connected, hooked or interfering. Remove the cab and lower it on a suitable support base.

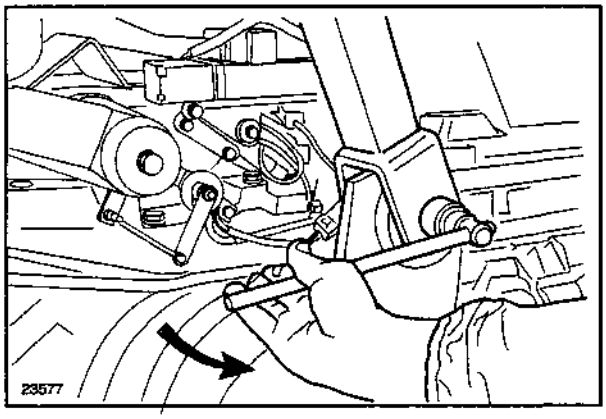


Figure 4-5-41

36. Loosen the plug (3) and drain oil from the rear axle and speed clutch/transmission housing into a suitable container (see specified quantity on page 0-1-19, Section 00).

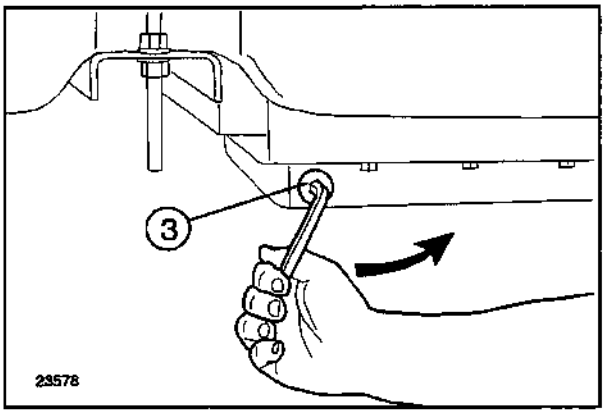


Figure 4-5-42

37. Drain fuel tanks, then loosen the clamp (1) retaining the connecting line between the main and auxiliary tanks.

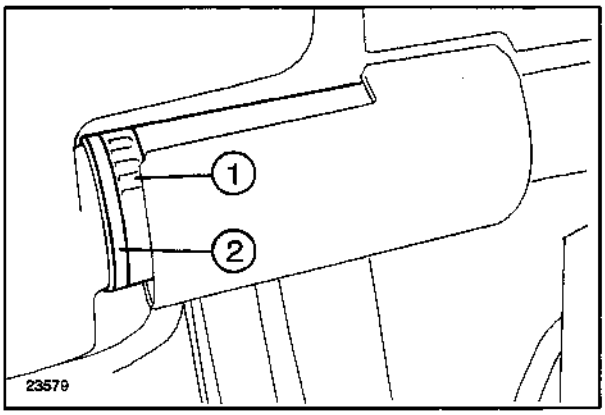


Figure 4-5-43

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38. Loosen the clamp and detach the bleeding line (3) between the main and auxiliary tanks.

39. Detach the fuel return line (2) from the injection pump to the auxiliary tank. Remove auxiliary tank.

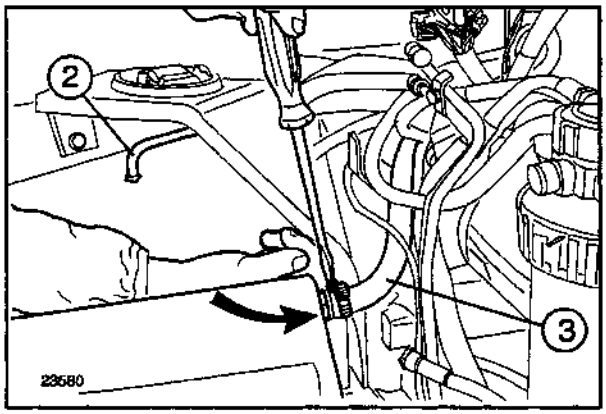


Figure 4-5-44

40. Loosen the clamp and detach the injection pump supply line (5). Detach connectors (4), then unscrew and remove the fuel level sensor assembly.

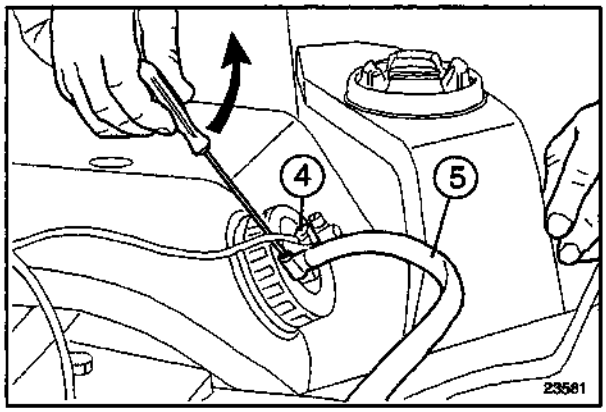


Figure 4-5-45

41. Loosen the nut of the metal strap (6) securing the main tank. Remove the strap and tank.

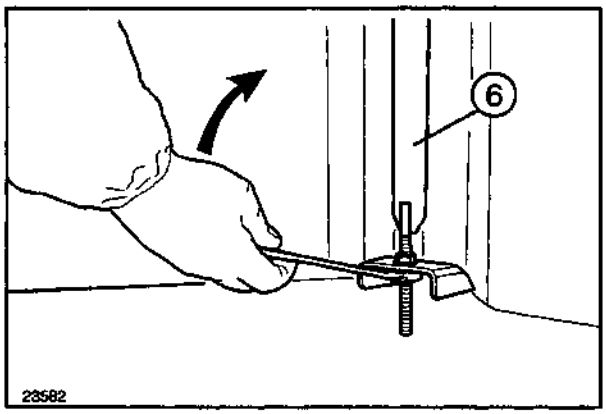


Figure 4-5-46

42. Loosen the retaining screws and remove the cab and fuel tank support bracket (1). (Repeat on both sides of the speed clutch–transmission housing).

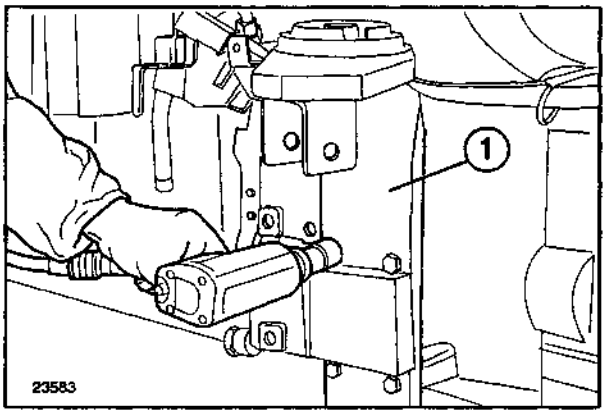


Figure 4-5-47

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43. Loosen the retaining screws and remove the main tank support bracket (2).

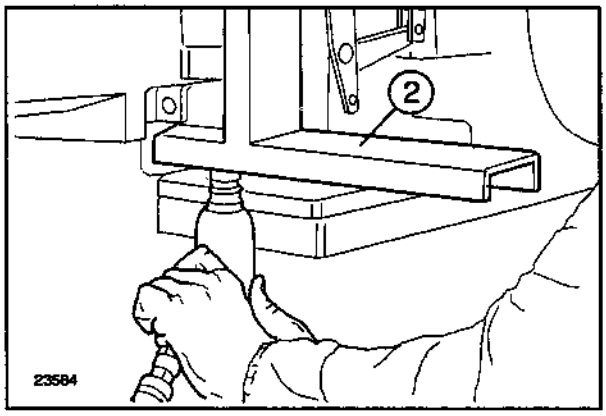


Figure 4-5-48

44. Loosen the attaching screws and remove the radar unit and mounting bracket (3).

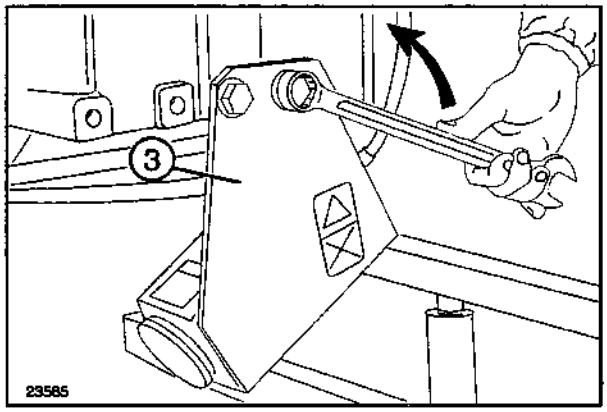


Figure 4-5-49

45. Loosen the attaching screws and remove the brake control line bracket (4).

Note: Do not bend the brake control tubes sharply when moving them away from the speed clutch/transmission housing to avoid damages.

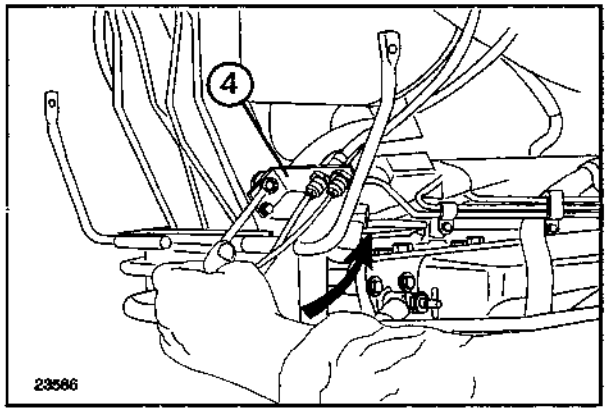


Figure 4-5-50

46. Loosen the clamps and separate the rear axle oil cooler hoses (1) from tubes.

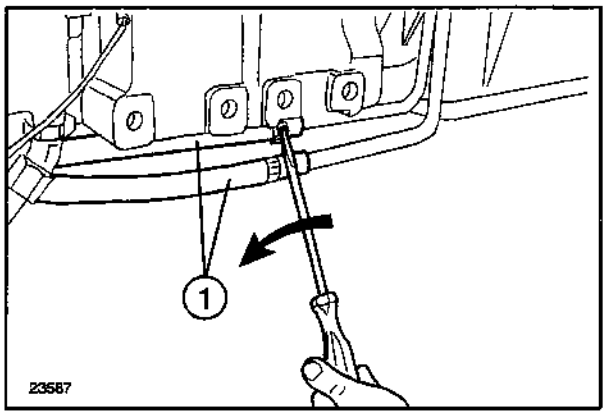


Figure 4-5-51

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47. Detach and remove the range and speed control cables (1) from the rails (2) and brackets (3).

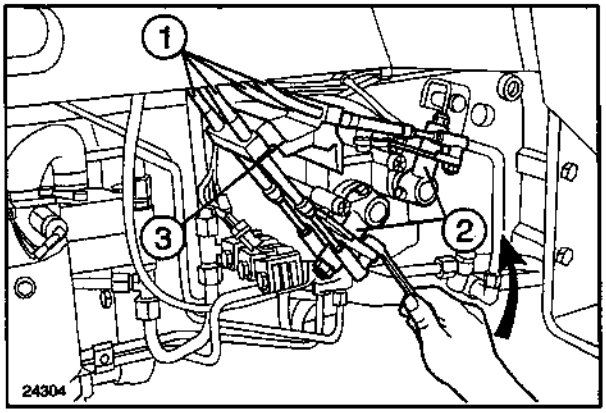


Figure 4-5-52

48. Detach all connectors from the solenoid valves in the range and speed control assembly.

Note: Before detaching connectors from the control assembly, mark each connector and respective solenoid valve.

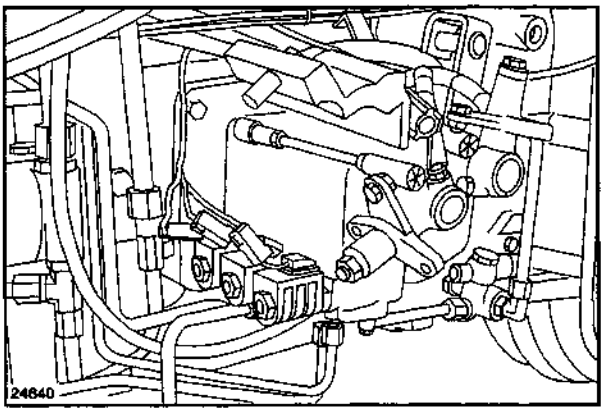


Figure 4-5-53

49. Detach the shuttle control cable (1) and bracket.

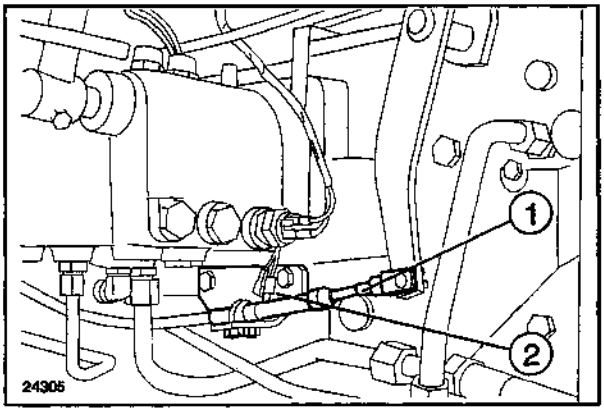


Figure 4-5-54

50. Loosen the retaining screws and remove the propshaft guard.

51. Remove circlip (4) and slide out sleeve (5). Repeat for transfer box circlip and sleeve.

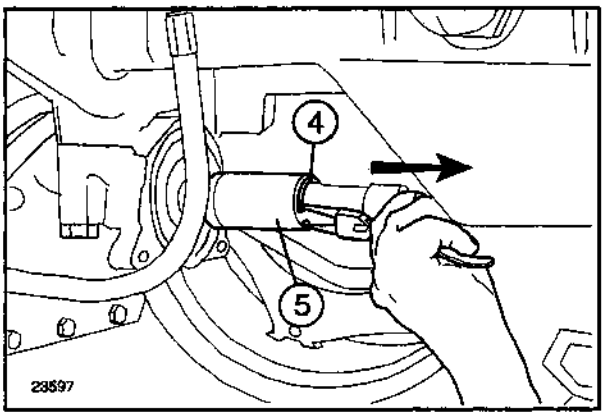


Figure 4-5-55

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52. Loosen the bearing–support (3) retaining screws at the speed clutch/transmission housing, detach and remove the front diff lock control line (2).

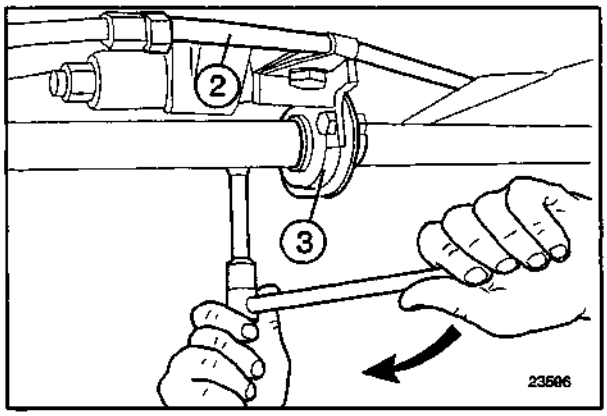


Figure 4-5-56

53. Place stand tool no. **292320** with one of the two trolley jacks (6) under the engine and the other under the speed clutch/transmission housing.

54. Place two wooden wedges (one each side) between the front axle support and front axle to prevent engine oscillation.

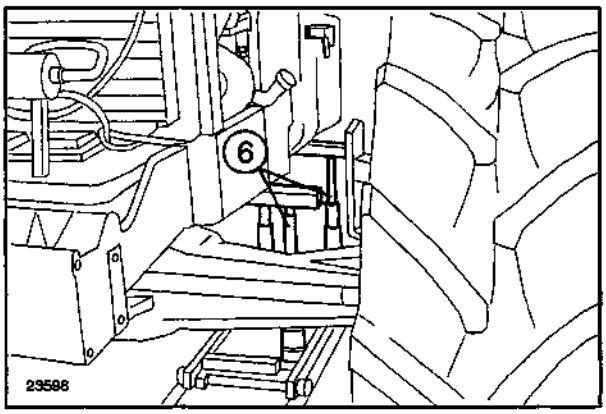


Figure 4-5-57

55. Loosen the retaining screws and remove starting motor (1).

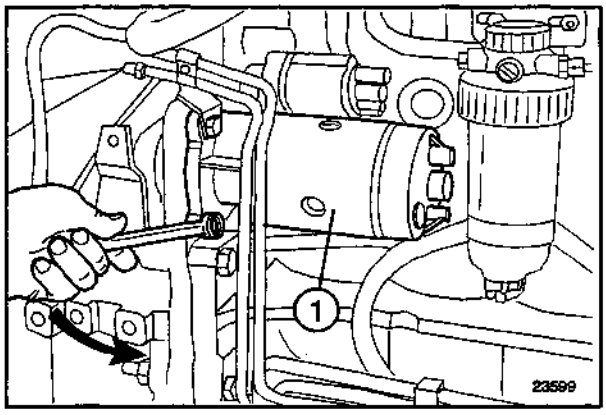


Figure 4-5-58

56. Remove the speed clutch/transmission housing to engine attaching bolts.

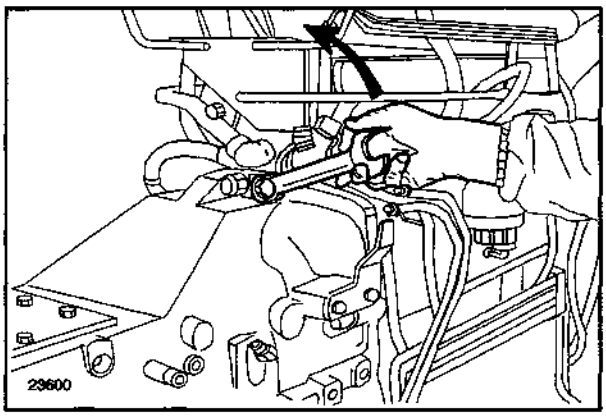


Figure 4-5-59

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57. Loosen the metal spacer retaining screw (2) at the speed clutch/transmission housing.

58. Separate the engine from the speed clutch/transmission housing.

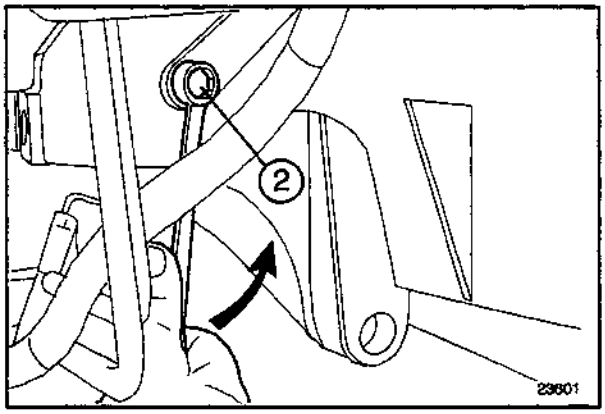


Figure 4-5-60

59. Separate the engine from the speed clutch/transmission housing.

60. Loosen and remove two bolts from the speed clutch/transmission housing upper cover (3), screw in chains of hook tool no. **291517** to the housing and keep them tensioned using a hoist.

61. Place a stationary stand under the draft sensing unit bracket. Place the trolley jack of stand tool no. **292320** under the rear axle housing.

62. Detach the speed clutch/transmission housing retaining bolts and remove the housing.

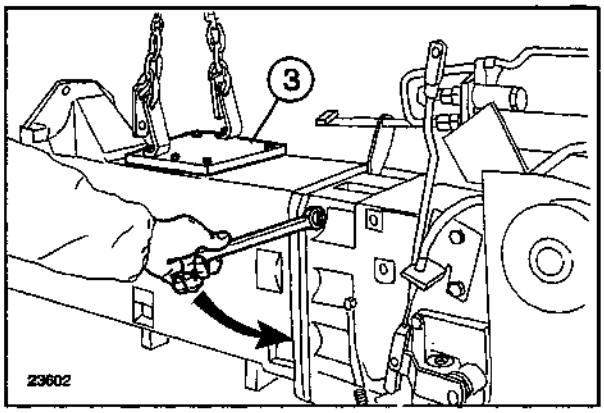


Figure 4-5-61

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

63. Reinstall the speed clutch/transmission housing to the rear axle housing and engine observing the following:

- Reinstallation follows the removal procedure in reverse, from step 61 back to step 1.
- Before reassembling housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant following the pattern shown in the figure on page 4-5-27 and on page 3-1-14 of Section 3.
- Tighten to correct torque as detailed on page 4-5-4.

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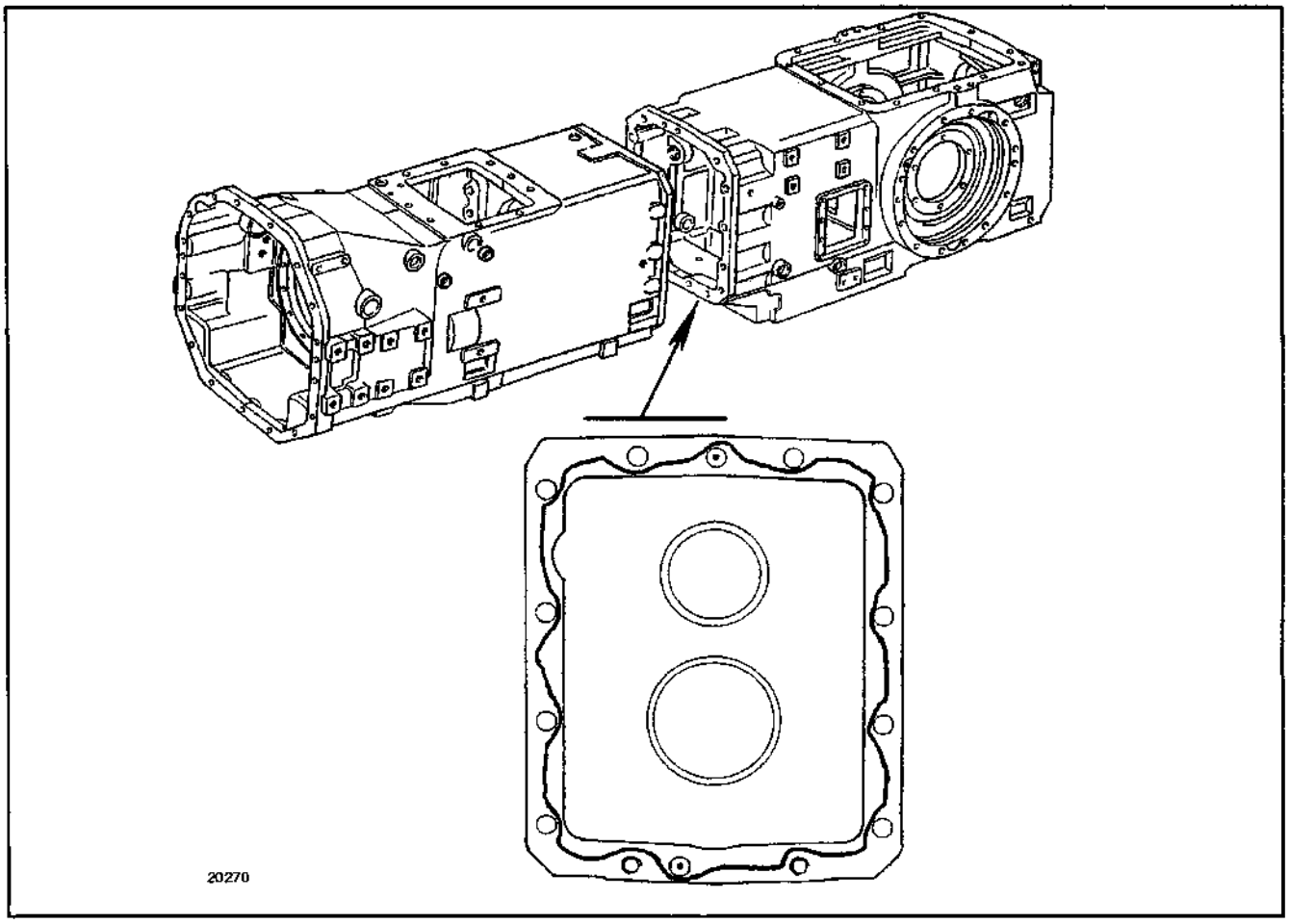


Figure 4-5-62

Pattern for application of sealant during installation of the speed clutch–transmission housing to rear axle housing.

Sealants to be used are listed on page 1-1-16, Section 1

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PLATFORM

Removal–Installation (Op. 90 110 36)

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Remove the platform as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

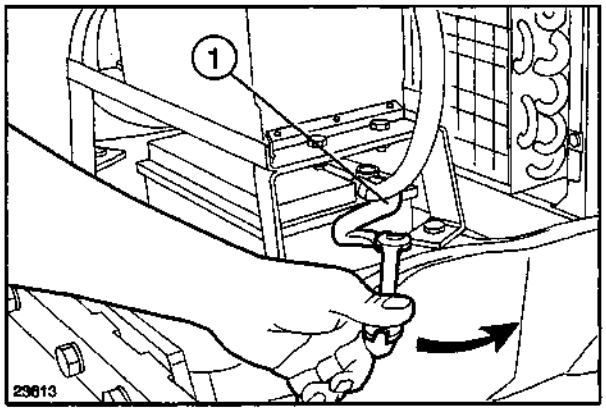


Figure 4-5-63

3. Using a hoist, raise rear tractor, place two stationary stands (1) under the final drive cases, lower the tractor, loosen retaining bolts and remove rear wheels.

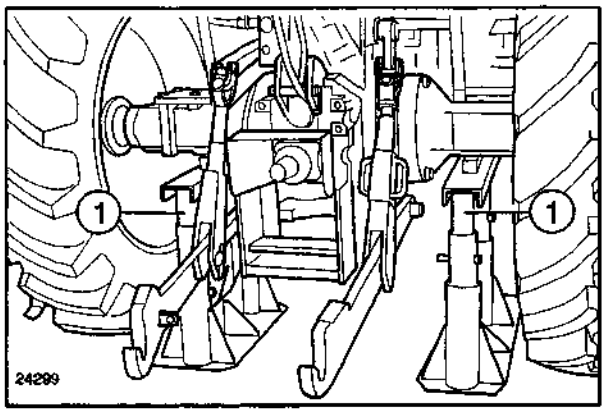


Figure 4-5-64

4. Detach the parking brake control cable (1) from the rail (3) and support bracket (2).

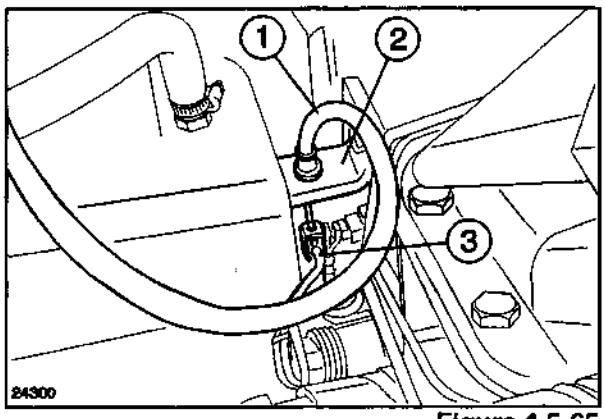


Figure 4-5-65

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5. Loosen the retaining clamp and detach the bleeding hose (1) from the tube.

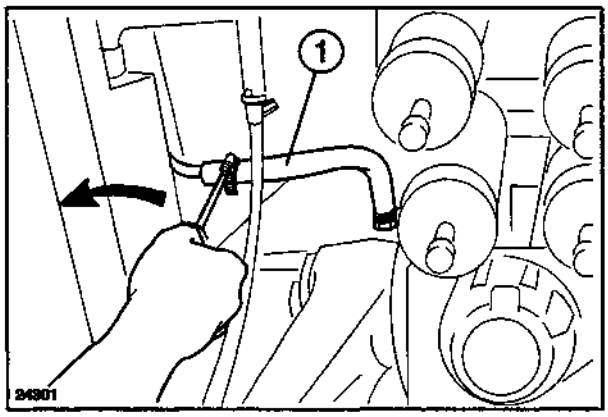


Figure 4-5-66

6. Detach the auxiliary valve control cables (1).

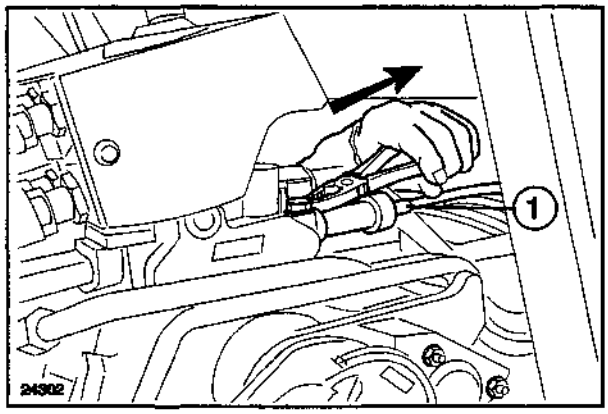


Figure 4-5-67

7. Detach the lift control levers (1) and the Lift–O–Matic control cable (2).

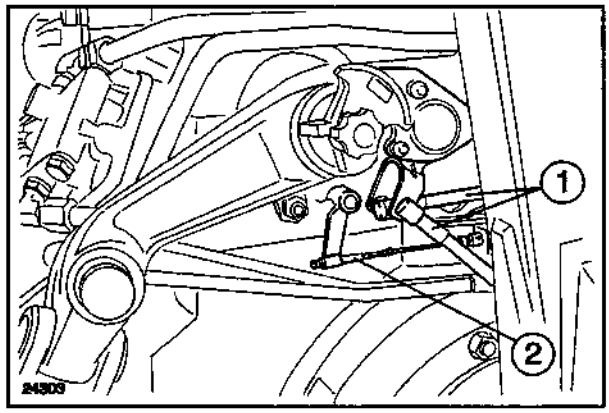


Figure 4-5-68

8. Detach the range and speed control cables (1) from the rails (2) and brackets (3).

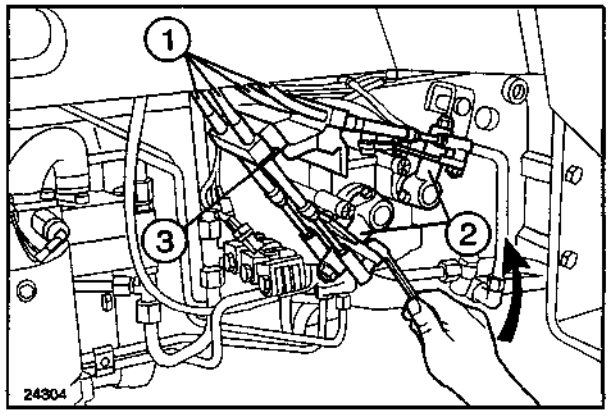


Figure 4-5-69

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9. Detach the shuttle control cable (1) and fastening bracket.

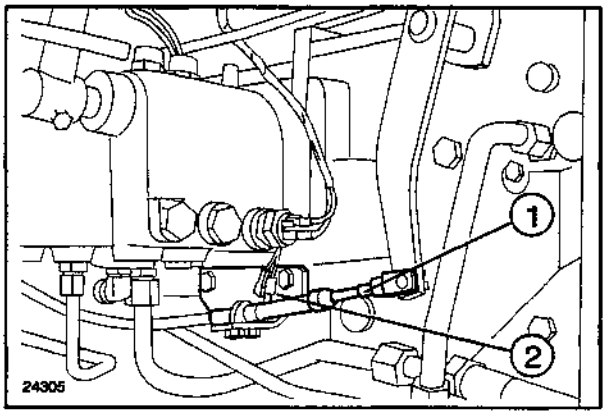


Figure 4-5-70

10. Disconnect the two electrical connectors (1) located under the platform in correspondence with the range and speed control rail assembly.

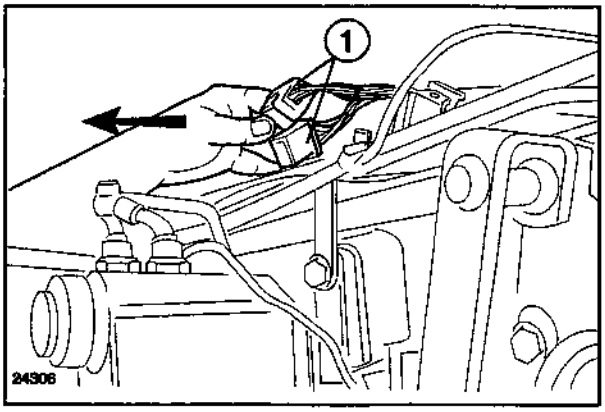


Figure 4-5-71

11. Release retaining screws and remove side panels (1) (one on each side).

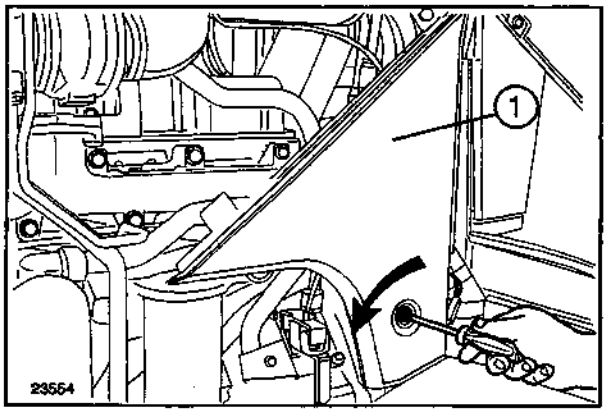


Figure 4-5-72

12. Detach connectors (1) from brake pumps.
13. Loosen fittings (2) and detach brake control hoses.
14. Detach the brake pump lines to the tank.

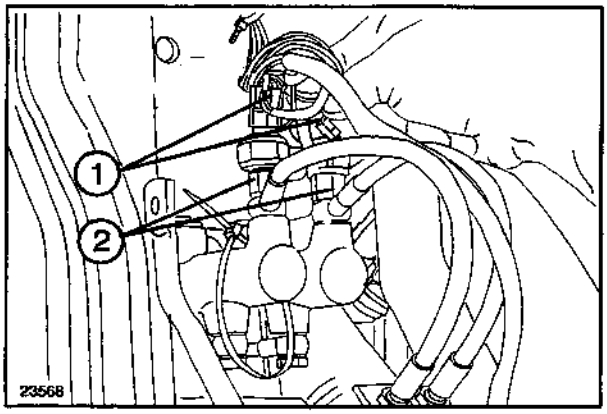


Figure 4-5-73

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15. Detach the power steering supply and return lines (1) (at the fittings under the platform).

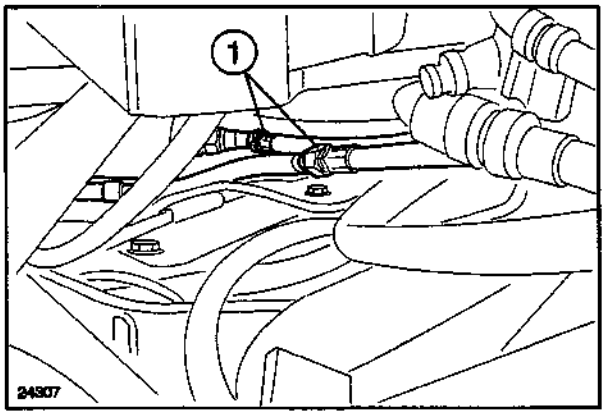


Figure 4-5-74

16. Detach the steering cylinder control lines (5).

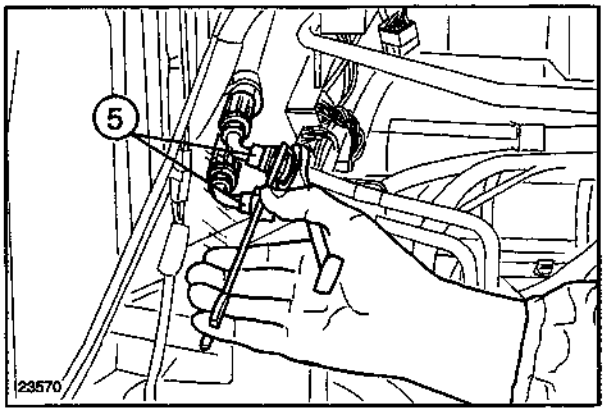


Figure 4-5-75

17. Disconnect all electrical connections (1) between the platform and engine.

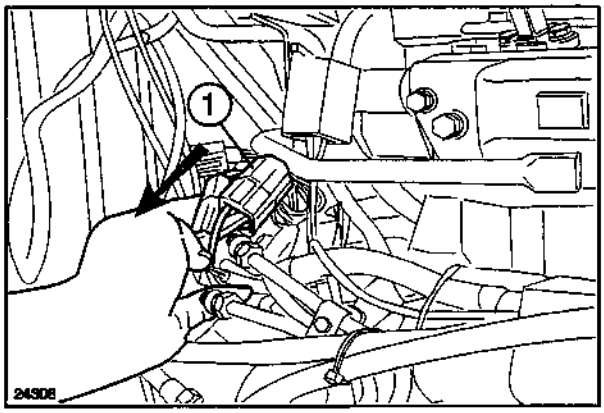


Figure 4-5-76

18. Disconnect electrical cables (1) from starting motor.

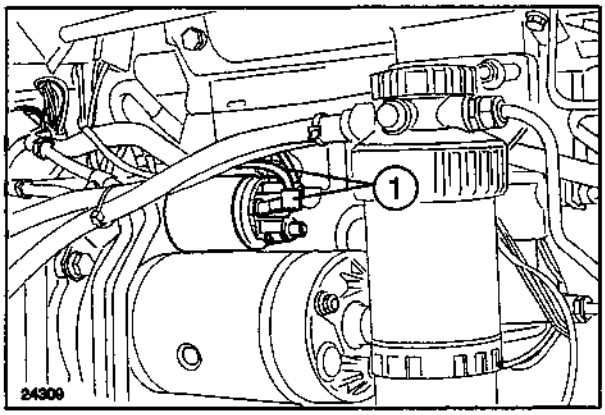


Figure 4-5-77

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19. Unscrew the locknut and detach throttle control cable (7) from injection pump.

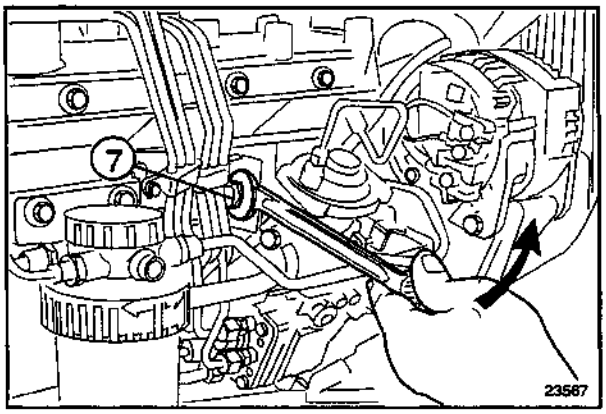


Figure 4-5-78

20. Detach the clutch release control line (1) from the pump.

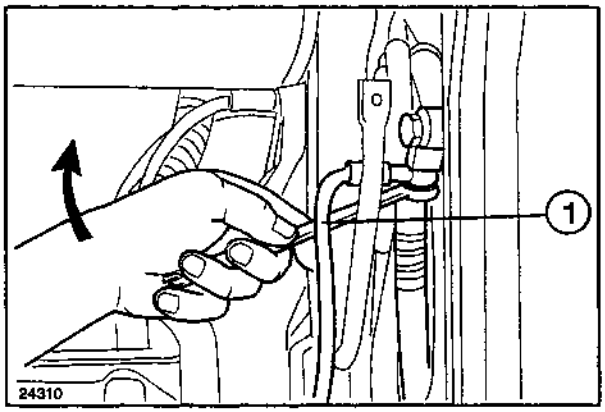


Figure 4-5-79

21. Loosen the screws (1) securing the hood support to the instrument panel support.

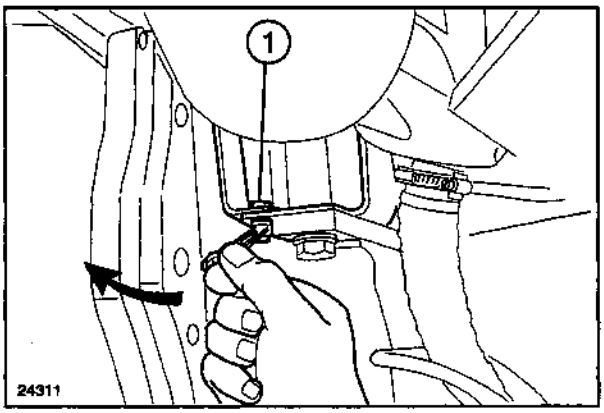


Figure 4-5-80

22. Sling the platform and connect it to a hoist. Loosen front retaining bolts (1).

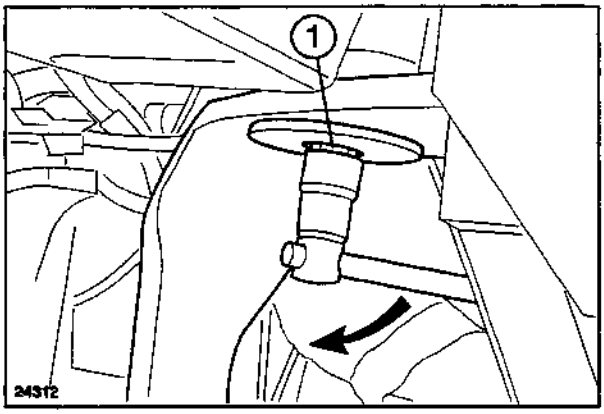


Figure 4-5-81

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23. Loosen rear platform retaining bolts (1).

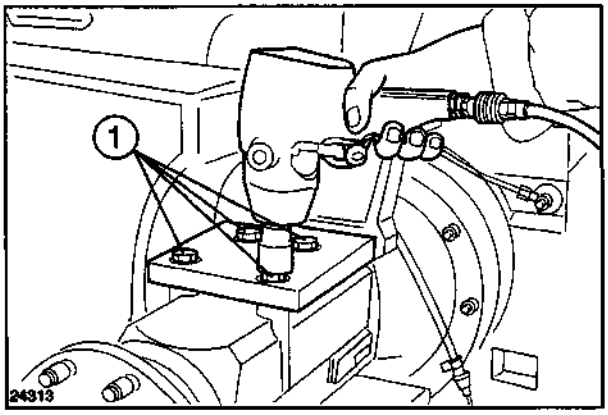


Figure 4-5-82

24. Remove the platform using a hoist.

25. Reinstall the platform observing the following:

- Reinstallation follows the removal procedure in reverse, from step 23 back to step 1.
- Tighten to correct torque as detailed on page 4-5-4.

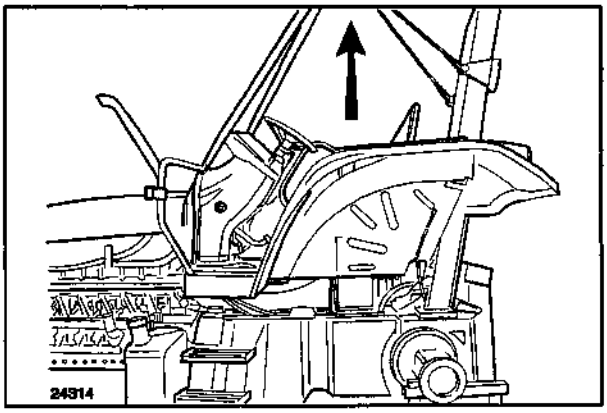


Figure 4-5-83

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MECHANICAL TRANSMISSION

Removal–Installation of Speed and Range Gears (Op. 21 114 85)

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

To overhaul the mechanical transmission, it is necessary to remove the transmission housing following the procedure detailed on pages 4-5-14 to 4-5-27.
Then proceed as follows:

1. Fix the transmission housing on the rotary stand tool no. **290090** using front and rear brackets, tools nos. **293971** (1) and **293972** (2), respectively.

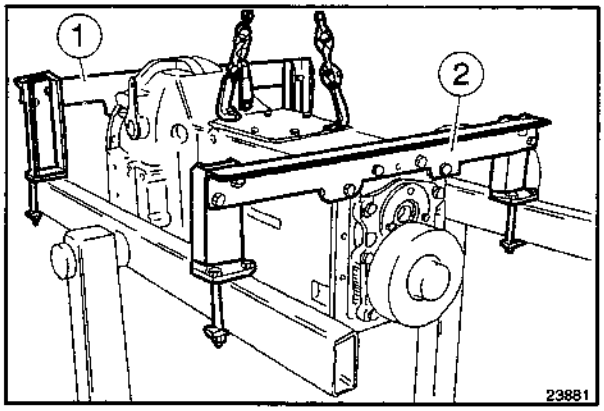


Figure 4-5-84

2. Loosen retaining bolts and remove upper cover (1).

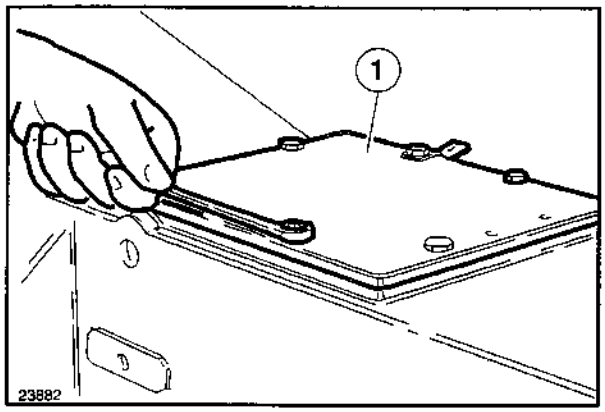


Figure 4-5-85

3. Loosen the cover (1) retaining bolts, position tool no. **295049** (2) on the transmission housing, loosen the output shaft locknut using wrench tool no. **293343** (3) and retrieve cover (1).

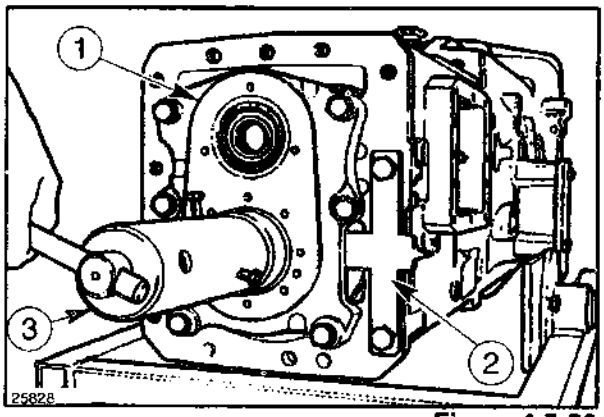


Figure 4-5-86

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4. Remove retaining screws and detach the range input and output shaft rear bearing support (1).

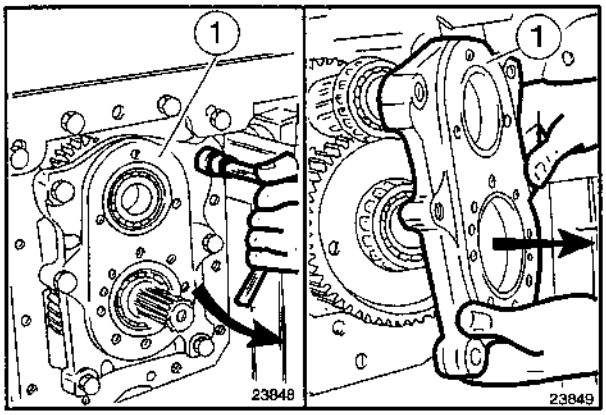


Figure 4-5-87

5. Using puller tool no. **291051** (1) and a suitable insert (2) remove the gear (3) along with the bearing and bushing. Take care to keep the input shaft bearing off.

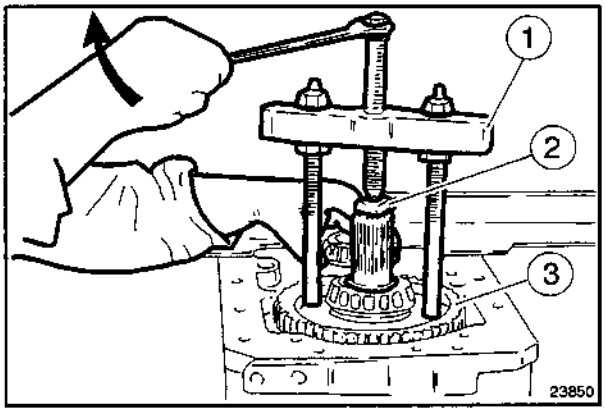


Figure 4-5-88

6. Loosen the plugs (1) and retrieve the actuating balls and springs. Remove plug (2).

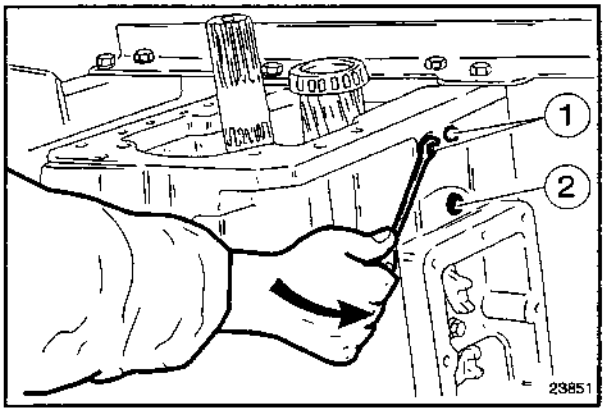


Figure 4-5-89

7. Withdraw spring pins (1) securing the low and medium–low range control fork. Withdraw the spring pins (7) from the two range selector dogs.

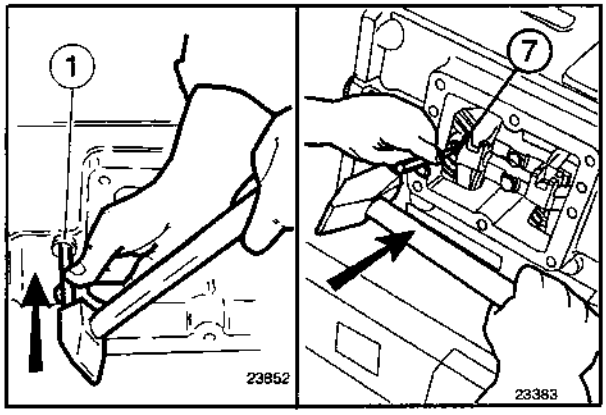


Figure 4-5-90

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8. Remove the fork (1) along with the engagement sleeve, slide out the rail (2) and retrieve the selector dog (3).

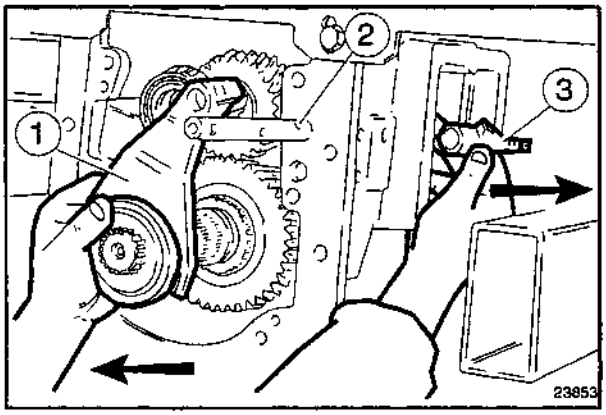


Figure 4-5-91

9. Slide out the control rail (1) and safety pin (2) of both rails (1) and (2, Figure 4-5-91).

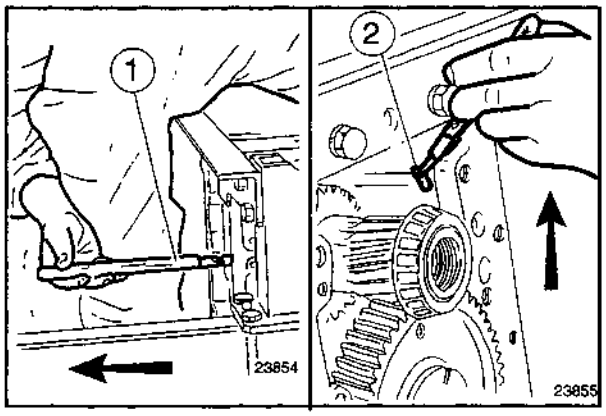


Figure 4-5-92

10. Slide out the medium–low and medium–high range gears (1 and 2, respectively) along with the inner bushings and thrust pad (3).

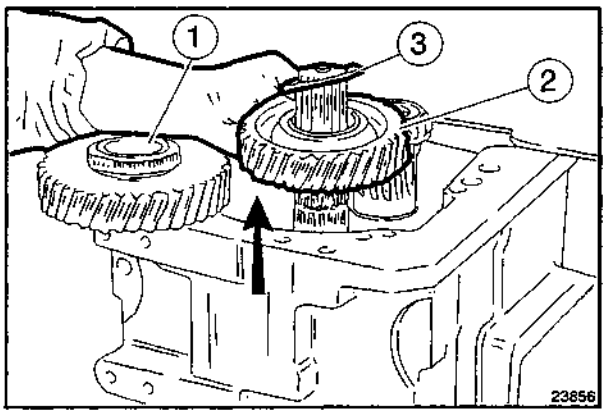


Figure 4-5-93

11. Remove synchronizer (1) (if fitted) or the engagement sleeve along with the control fork and output shaft (2).

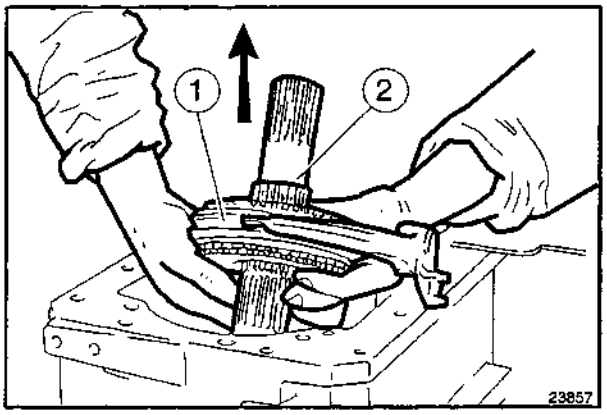


Figure 4-5-94

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12. Remove the range input shaft (1).

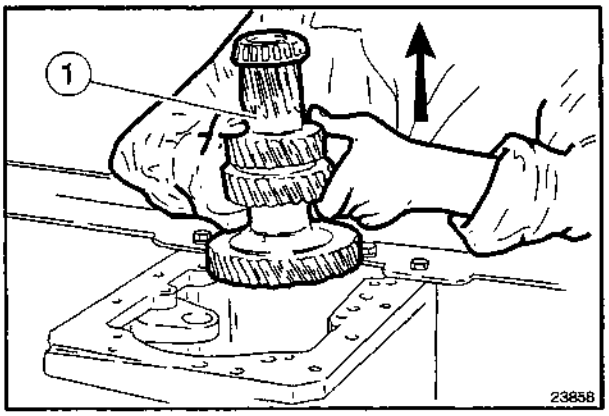


Figure 4-5-95

13. Assemble tool no. **293805** (1) using two 20 mm shims (2) to support the transmission input shaft.

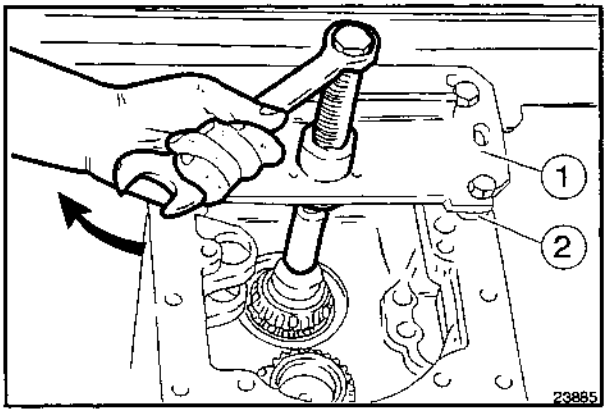


Figure 4-5-96

14. Withdraw the bearing spring retainer (1) (on both sides).

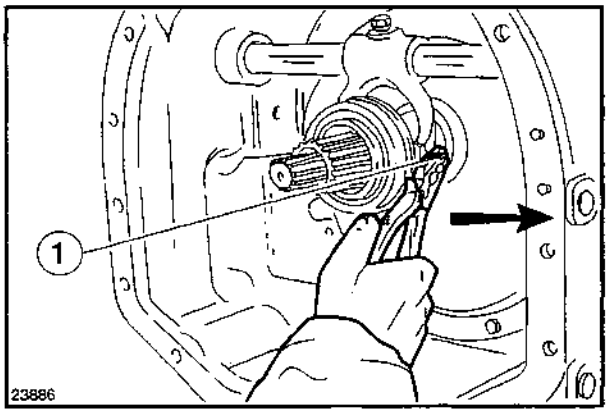


Figure 4-5-97

15. Retrieve clutch engagement bearing (1).

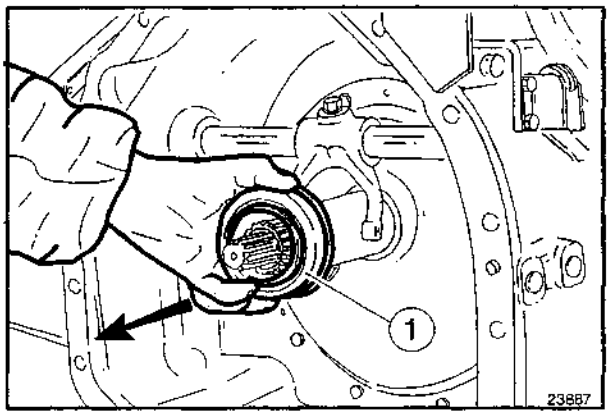


Figure 4-5-98

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16. Loosen the screw (1) attaching the fork to the lever.

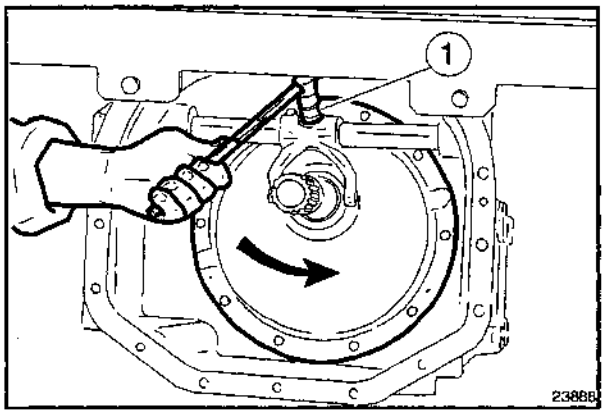


Figure 4-5-99

17. Withdraw the control lever (2) and retrieve the fork (1).

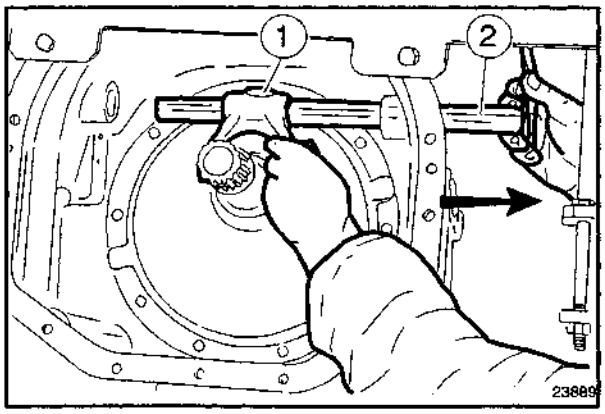


Figure 4-5-100

18. Loosen all cover (1) retaining bolts (2).

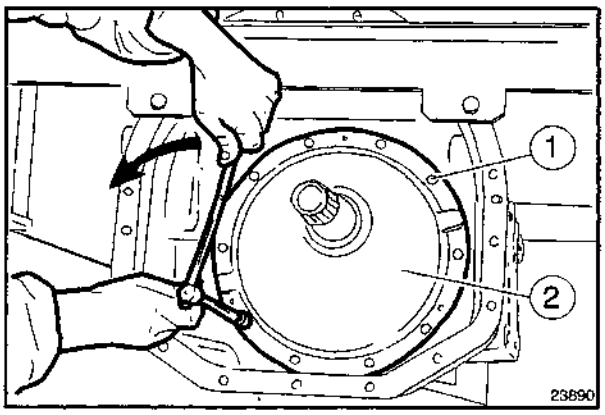


Figure 4-5-101

19. Screw in three of the screws (1, Figure 4-5-101) into the specially designed holes to separate the cover (1) from the transmission housing.

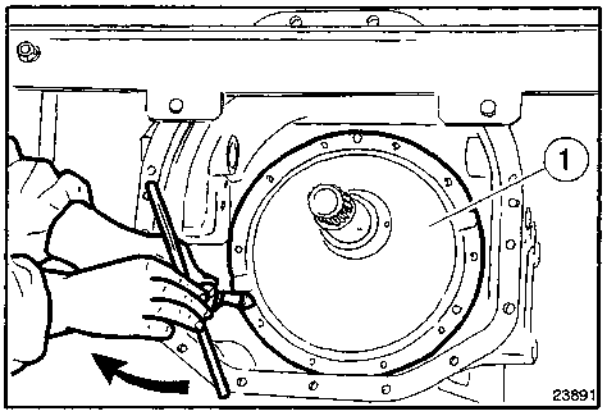


Figure 4-5-102

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20. Loosen the plug (7) and retrieve springs and actuating pawl.

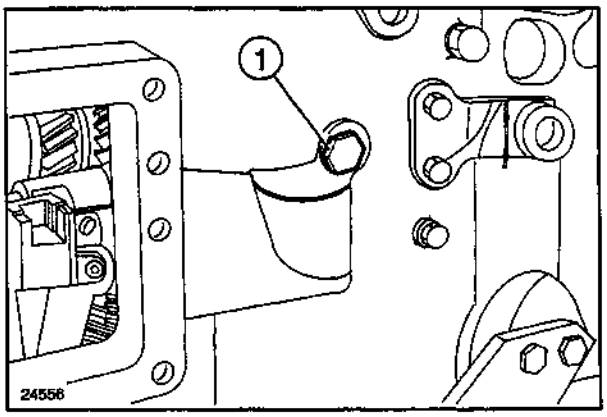


Figure 4-5-103

21. Partially slide out the spring pin until releasing the control lever (3) from the fork (1). Remove control lever and fork.

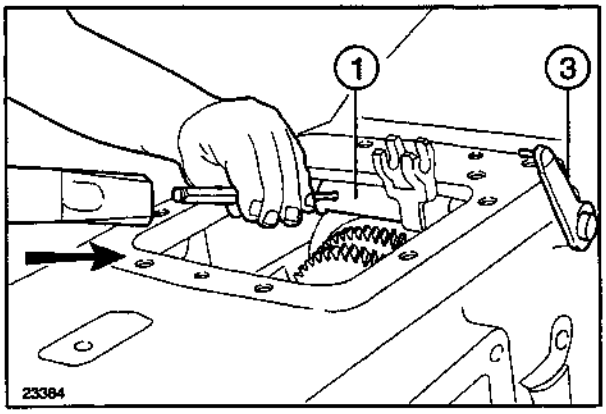


Figure 4-5-104

22. Using a puller withdraw the bearing (1) from the shuttle input shaft.

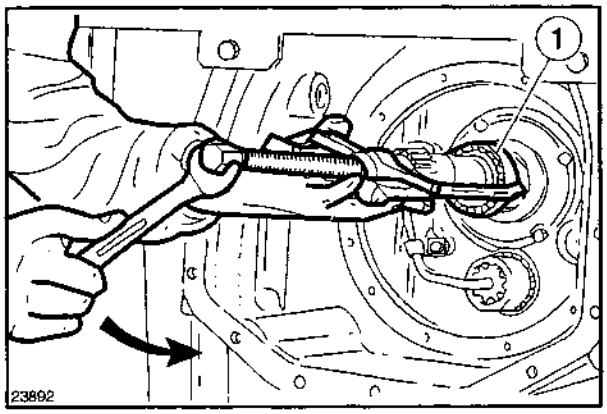


Figure 4-5-105

23. Loosen retaining screws and remove cover (1). Slide out circlip, seals and locating dowel from the shaft.

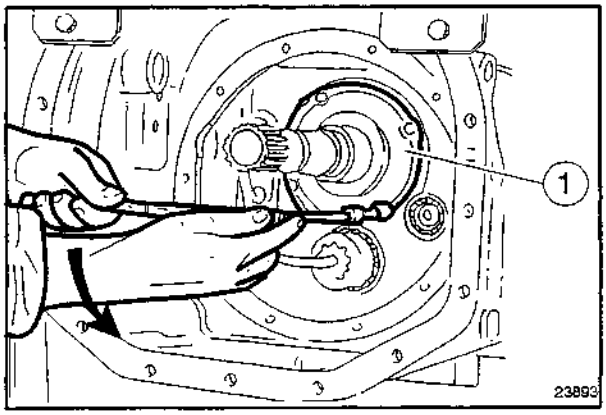


Figure 4-5-106

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24. Slide out circlip (1), seals and locating dowel.

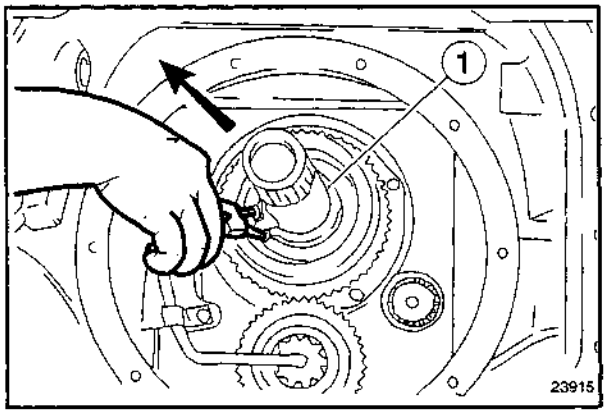


Figure 4-5-107

25. Remove the circlip and using adapter tool no. **292313** (1) and slide hammer tool no. **292927** remove the reverse idler gear pin. Leave gear in place.

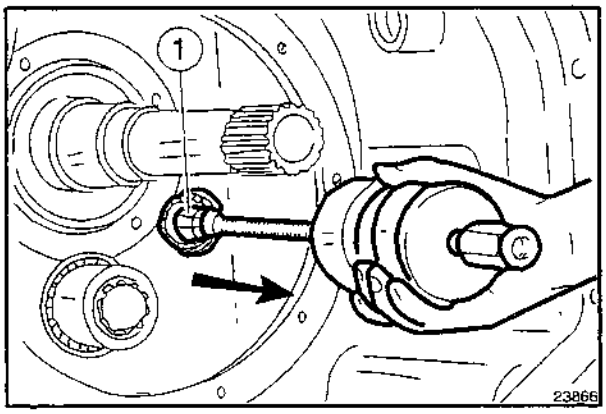


Figure 4-5-108

26. Using a brass punch, push on the rear of reverse control gear.

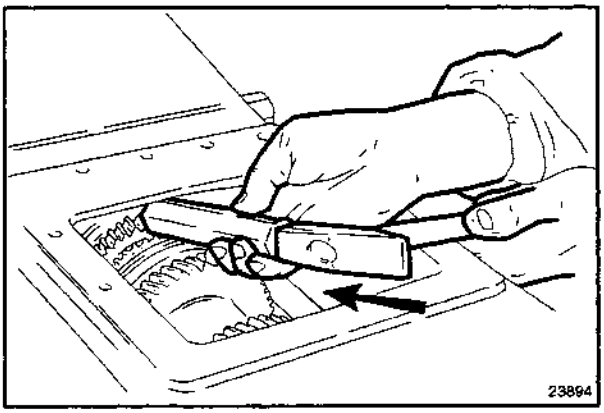


Figure 4-5-109

27. Withdraw the input shaft (1) along with the reverse gear and shuttle synchronizer from the front side.

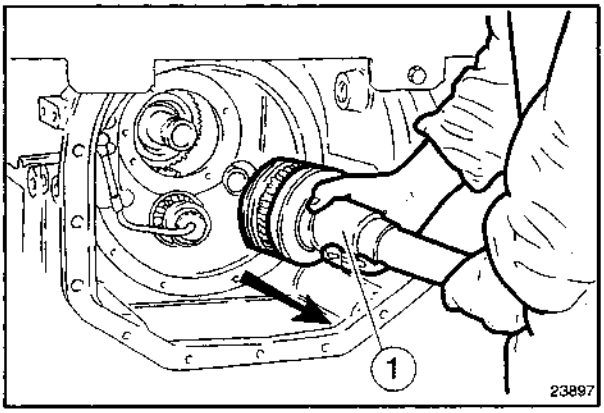


Figure 4-5-110

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28. Remove circlip (1) from the transmission input shaft.

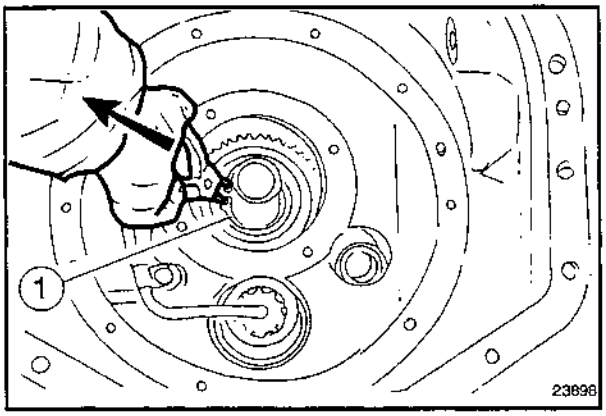


Figure 4-5-111

29. Remove tool no. **293805** from rear side, set the housing upright and withdraw the input shaft (1). Retrieve the gear (2), reverse idler gear and bearing.

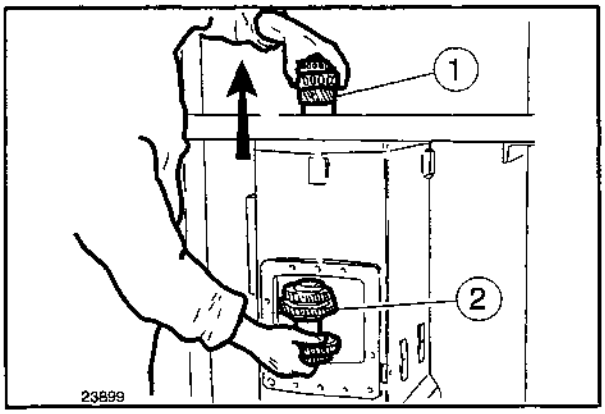


Figure 4-5-112

30. Remove tool no. **293805** from rear side, set the housing upright and withdraw the input shaft (1). Retrieve the gear (2), reverse idler gear and bearing.

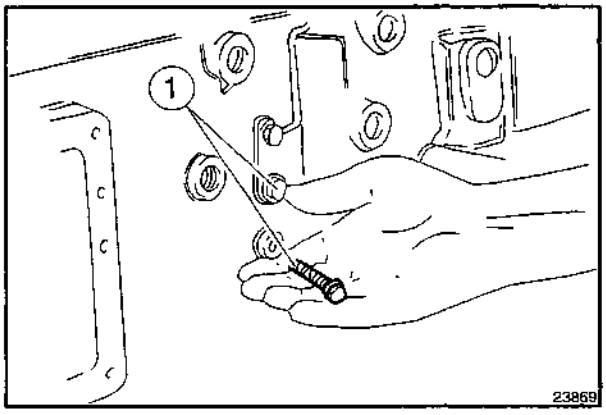


Figure 4-5-113

31. Loosen the stop plugs (5), slide out both selector dog (6) spring pins and the fork internal retaining spring pin.

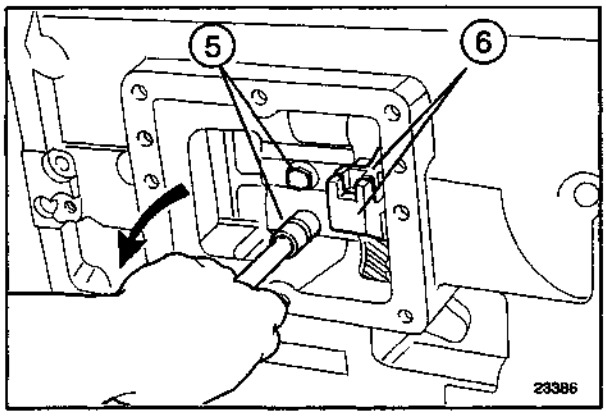


Figure 4-5-114

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32. Slide out the rails from rear side and retrieve forks and selector dog.

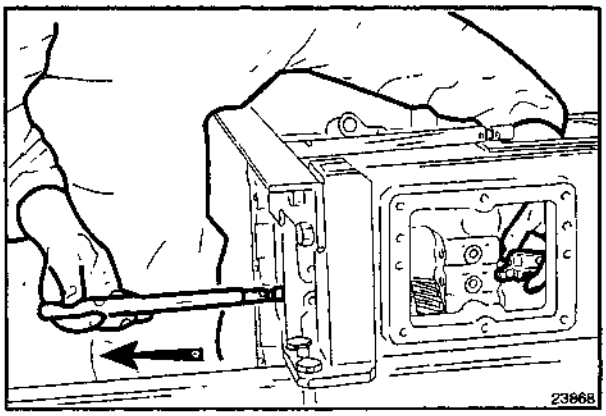


Figure 4-5-115

33. Remove the safety pawl (1).

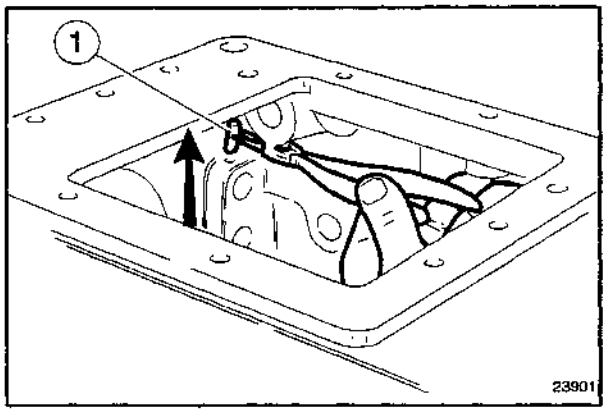


Figure 4-5-116

34. Loosen the fitting and retaining screw, remove the output shaft lubrication tube (1).

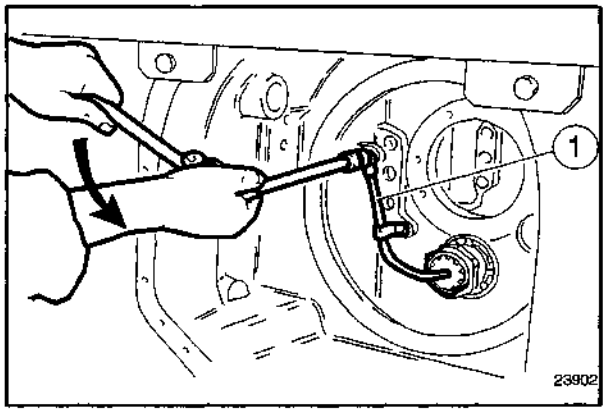


Figure 4-5-117

35. Install tool no. **293808** (1) on transmission output shaft and insert a wrench (2) to hold the shaft in place.

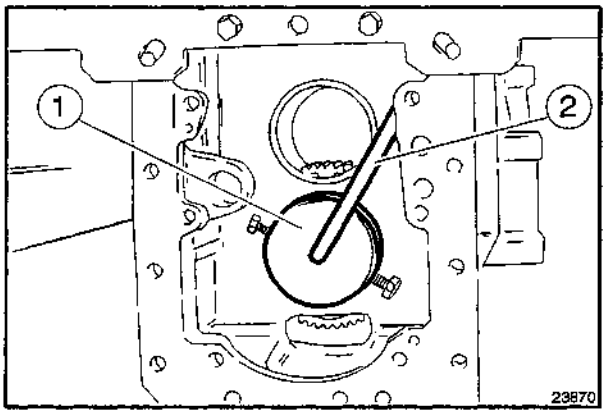


Figure 4-5-118

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36. Straighten the transmission output shaft locknut (1).

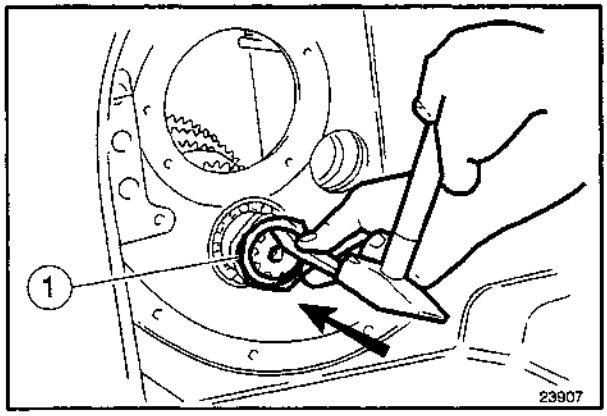


Figure 4-5-119

37. Loosen the transmission output shaft locknut and retrieve the bushing.

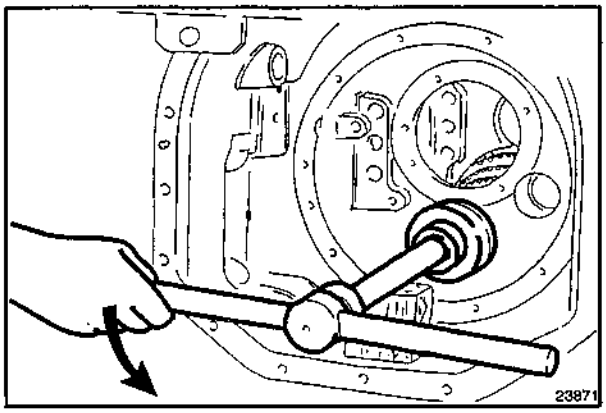


Figure 4-5-120

38. Using an aluminum punch from the front side, release shaft from bearing.

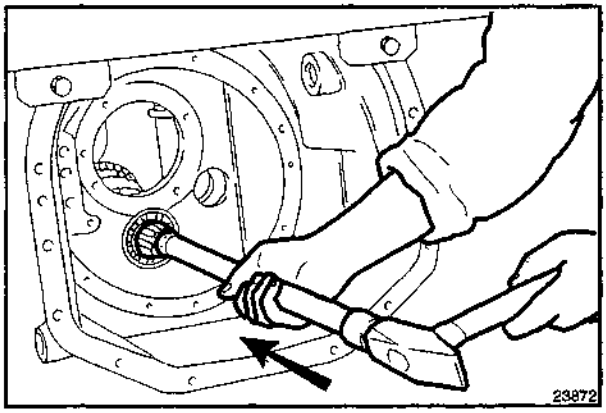


Figure 4-5-121

39. Set the transmission housing upright, withdraw the output shaft (1) and retrieve the group of gears.

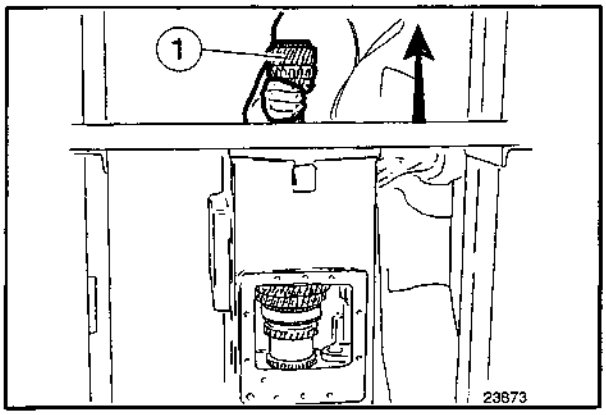


Figure 4-5-122

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40. Reinstall the mechanical speed and range gears into the transmission housing observing the following:

- Reinstallation follows the removal procedure in reverse, from step 39 back to step **1**.
- Refer to figures on pages 4-5-9 to 4-5-12 for correct orientation of the different parts.
- Ensure the housing is thoroughly cleaned (especially inner compartments).
- Check seals and replace if damaged.
- Before reassembling housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant following the pattern shown in the figure on page 4-5-46.
- Tighten to correct torque as detailed on page 4-5-4.
- Consider the following operations and perform adjustments as detailed on pages 4-5-47 to 4-5-50.

41. After removing the circlip and thrust washer, disassemble the transmission input shaft bearings using tools nos. **293805** (1) and. **50062** (2) (see on page 4-5-7). Heat the bearings, reinstall them and settle using a brass punch.

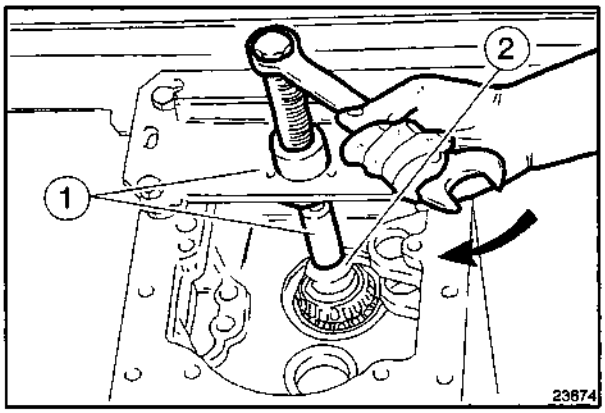


Figure 4-5-123

42. Mount retaining tool no. **293808** (1) on the transmission output shaft and insert a wrench (3) to hold it in place. Support tool (1) using tool no. **293805** (2) attached to the housing.

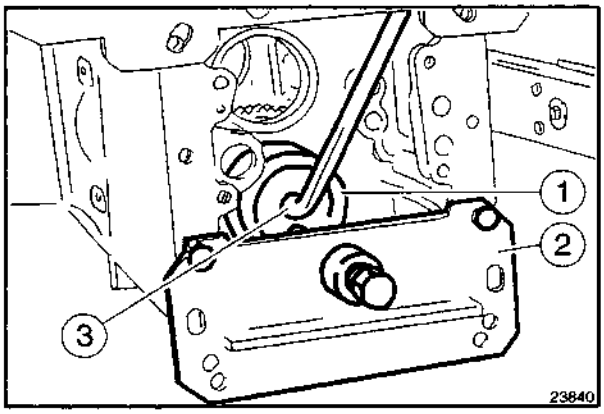


Figure 4-5-124

43. Press–fit front bearing (2) on to the transmission output shaft using tool no. **293869** (1).

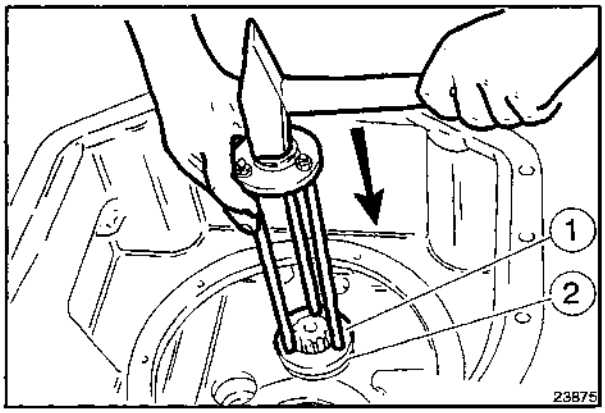


Figure 4-5-125

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44. Withdraw the PTO shaft seal using puller tool no. **294000** (2) and slide hammer (1).

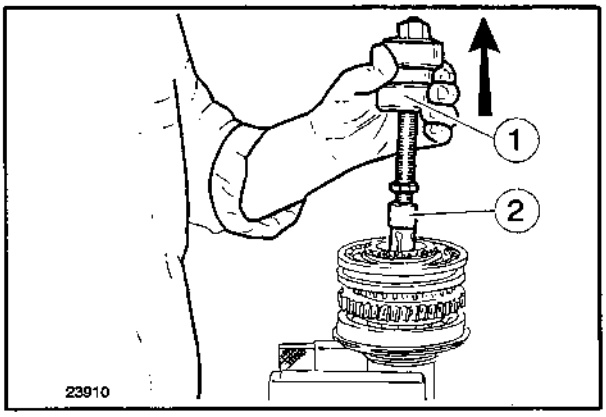


Figure 4-5-126

45. Press–fit the seal using tool no. **293993** (3) and handle tool no. **293800** (1).

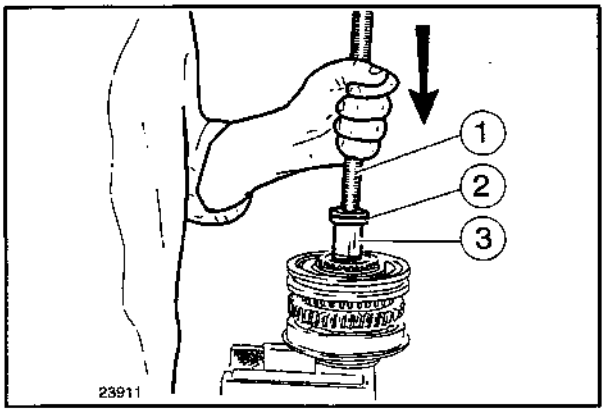


Figure 4-5-127

46. Withdraw the bushing (3) as per step 44. Press–fit the bushing (3) using tool no. **293992** (2) and handle tool no. **293800** (1).

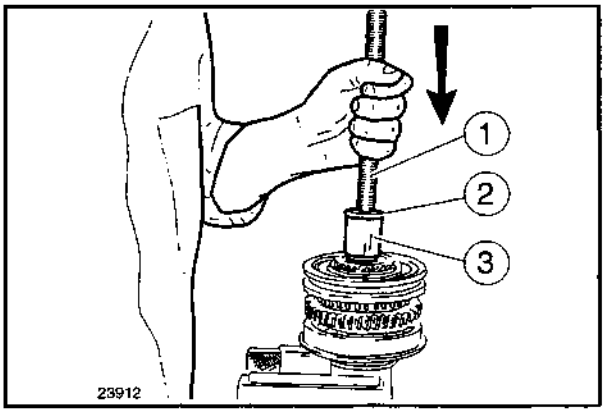


Figure 4-5-128

47. Remove the range input shaft bearing (2) using two suitable pullers and an insert (1).

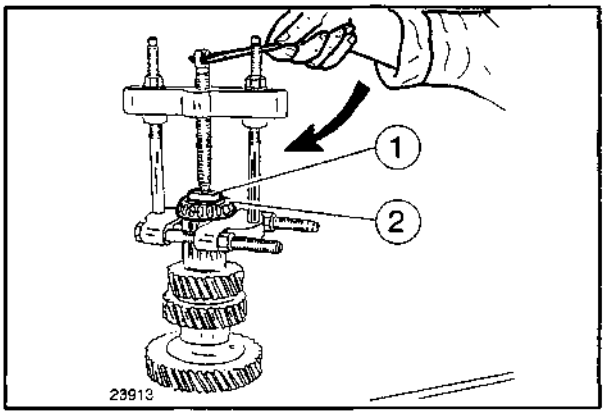


Figure 4-5-129

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48. Heat and press–fit the bearing (3) on to the input shaft using tool no. **50060** (2) shown on page 4-5-7. Using tool no. **50013** (1) (see on page 4-5-8), keep the bearing properly seated during cooling.

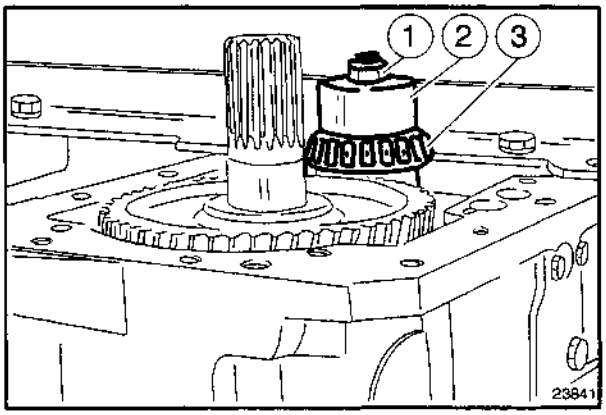


Figure 4-5-130

49. Heat and press–fit the bearing (1) on to the output shaft using tool no. **50061** (2) shown on page 4-5-7. Using tool no. **50018** (3) (see on page 4-5-6) keep the bearing properly seated on the gear during cooling.

Note: Remove tools nos. **50060** (2, Figure 4-5-130) and **50061** (2, Figure 4-5-131) when bearings (1 and 3) have completely cooled down.

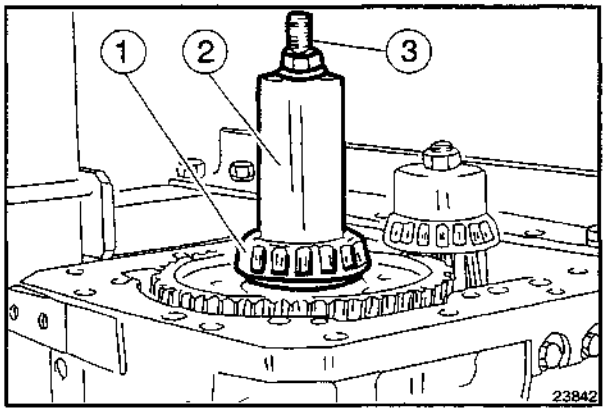


Figure 4-5-131

Pattern for application of sealant during installation of control rail support (1), upper cover (2) and front cover (3) to the transmission housing.

Sealants to be used are listed on page 1-1-16, Section 1.

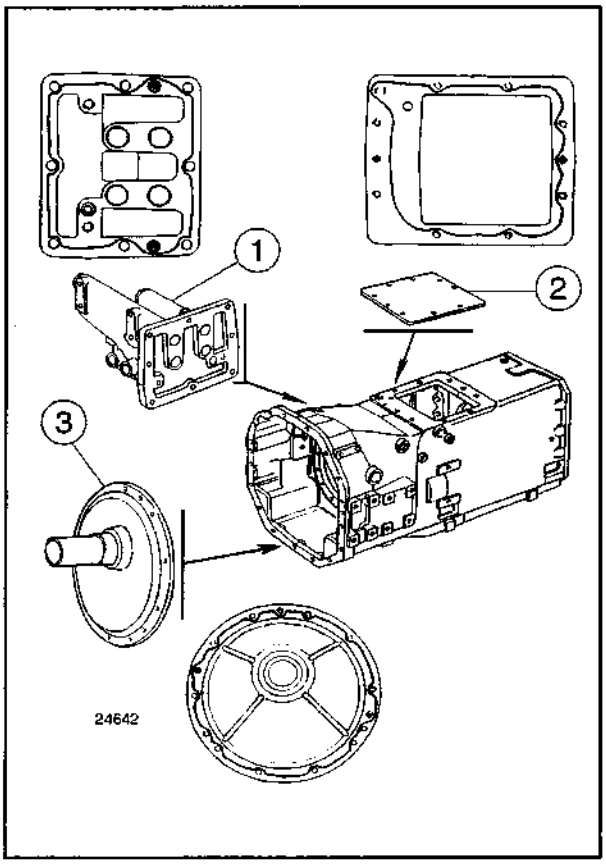


Figure 4-5-132

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SPEED CLUTCH/ MECHANICAL TRANSMISSION HOUSING

Shuttle Gear Bearing Adjustment

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

50. Remove the circlip (5) and slide out adjust shim (4), front bearing (3), spacer (2) and rear bearing (1).

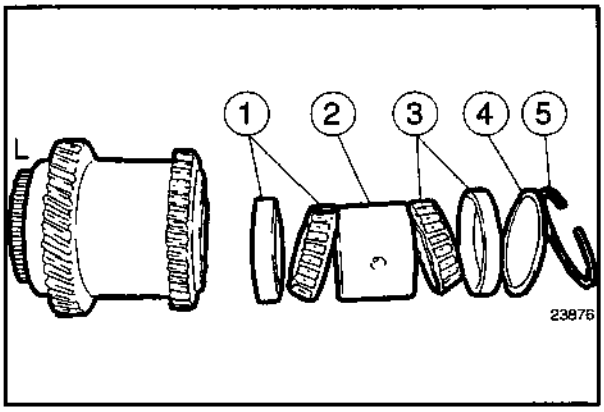


Figure 4-5-133

51. Reassemble all parts without the adjust shim. Ensure the assembly is bottoming. Measure distance (L1) from the top of gear (2) to the bearing outer race (1).

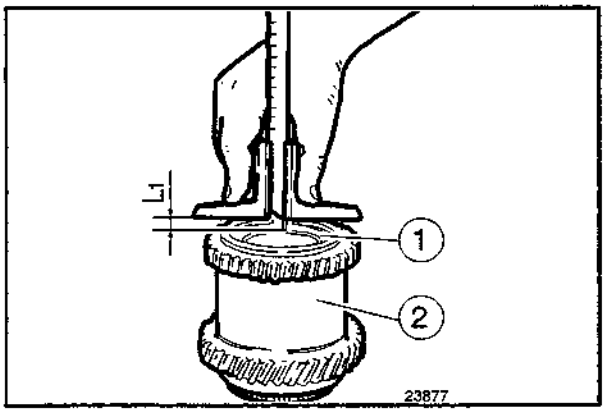


Figure 4-5-134

52. Place the gear on a suitable bushing (1) to have the inner assembly top up. Ensure also the circlip is topping up.

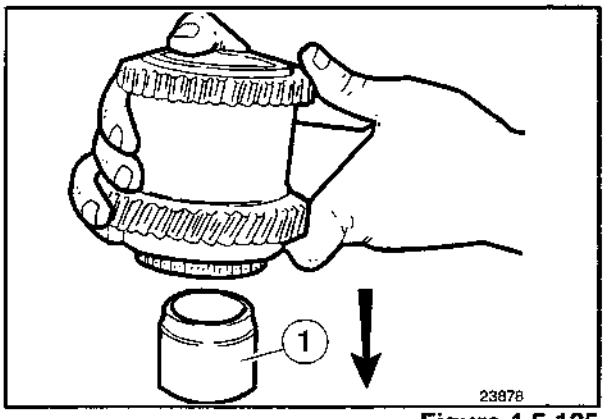


Figure 4-5-135

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53. Measure distance (L2) from the top of gear (2) to the bearing (1) outer race. Adjust shim (3, Figure 4-5-137) to be added is given by:

$S = L_1 - L_2 - 0.05$ mm

where:
S = Adjust shim(2).
L_1 e L_2 = Readings on the gear
0.05 mm = Decrease necessary to compensate for bearing increased load deriving from tightening of the transmission output shaft locknut
If necessary, round off the value (S) to the previous 0.05 mm.

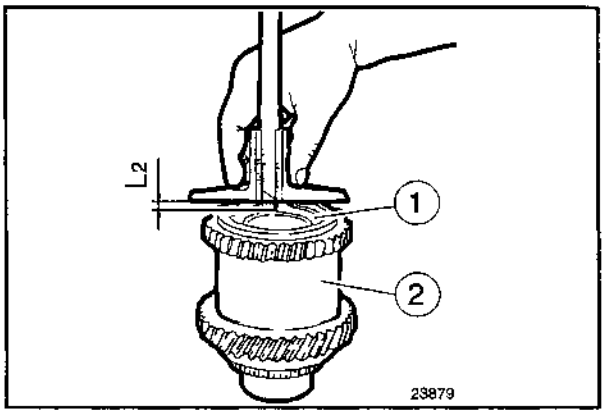


Figure 4-5-136

Example:
Reading L_1 = 10.25 mm.
Reading L_2 = 7.33 mm.
Adjust shim:
S = 10.25 – 7.33 – 0.05 = 2.87 mm.
Adjust shim to be assembled is 2.85 mm.

Note: Available adjust shims for the shuttle driven gear are listed on page 4-5-4.

54. Remove circlip (1), assemble adjust shim (2) as previously found and lock the assembly reinstalling circlip (1).

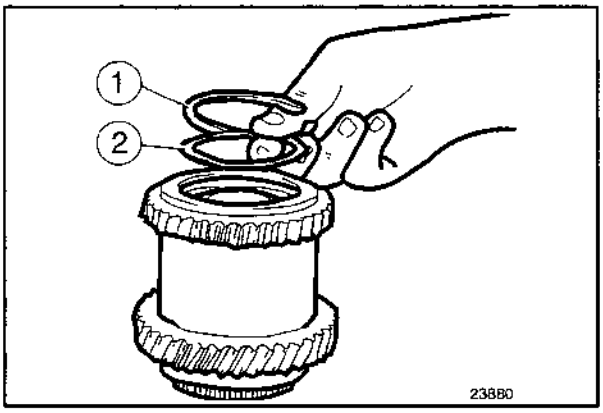


Figure 4-5-137

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SPEED CLUTCH/MECHANICAL TRANSMISSION HOUSING

Range Input and Output Shaft Taper Bearing Adjustment

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

55. Install cover (2) without the adjust shim. Install tool no. **50013** (1) (see page 4-5-8) on to the input shaft.

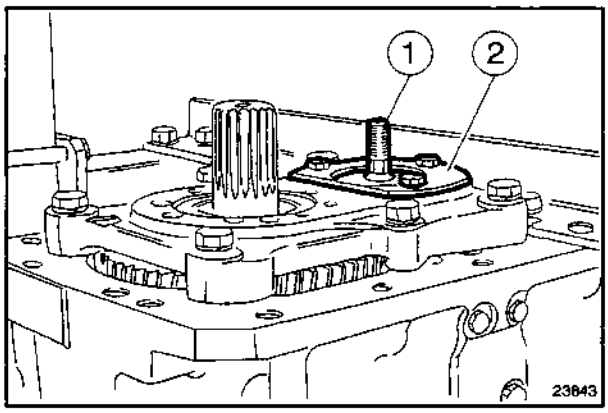


Figure 4-5-138

56. Screw installer tool no. **292176** (2) on tool no. **50013** (3). Place a dial indicator (1) with the stylus touching the bearing inner race. Turn the shafts to settle the bearing rollers, reset gauge to zero ensuring that the assembly is bottoming.
Through the lever of installer tool no. **292176** (2), bring the assembly to touch the cover (4) and read the travel (L) on the dial indicator.
Adjust shim to be added is given by:

S = L– (0 to 0.06 mm)

where:
S = Adjust shim.
L = Travel reading.
0 to 0.06 mm = input shaft bearing end play.

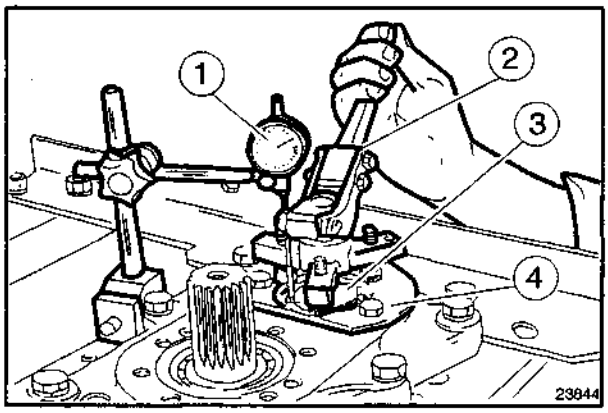


Figure 4-5-139

Note: Available adjust shims for the range input shaft bearings are listed on page 4-5-3.

57. Dismantle tools (2 and 3), remove cover (4), assemble the shim as previously found, reinstall cover (4) and tools (2 and 3). Repeat step 56 to check end play is to specification, 0 to 0.06 mm. Remove tools (2 and 3).

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58. Install disc (1) with a test shim (Sp). Remove output shaft lubrication plug.Assemble tool no. **50018** (4) (see on page 4-5-6), installer tool no. **292176** (3) and dial indicator (2). Ensure the indicator stylus is located on the bearing inner race.
Turn the shafts to settle the bearing rollers and reset gauge to zero ensuring that the assembly is bottoming.
Using the lever of installer tool no. **292176** (3) bring assembly to touch the disc (1) and read travel (H) on the dial indicator.
Shim to be added is given by:

S_1 = H + Sp – (0 to 0.06 mm)

where:

S_1 = Adjust shim.
Sp = Test shim.
H = Travel reading.
0 to 0.06 mm =Output shaft bearing end play.

Note: Available adjust shims for the range output shaft bearings are listed on page 4-5-3.

59. Dismantle tools (3 and 4), remove disc (1), replace test shim (Sp) with adjust shim (S_1), reinstall disc (1) and tools (3 and 4). Repeat step 58 to check end play is to specification, 0 to 0.06 mm. Remove tools (3 and 4) and screw in the output shaft lubrication plug.

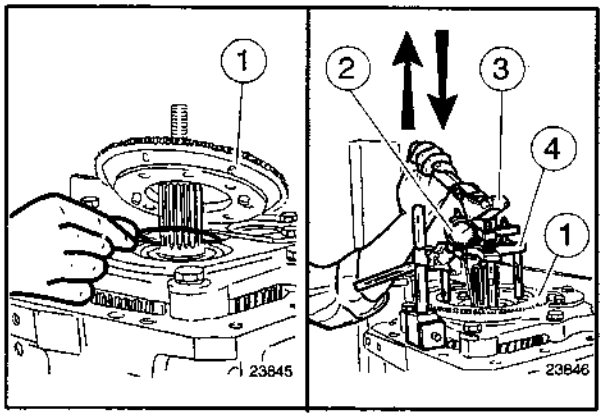


Figure 4-5-140

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SPEED CLUTCH/MECHANICAL TRANSMISSION HOUSING

Removal–Installation of 5th Speed Gears (Op. 21 140 14)

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

To overhaul the 5th speed gears, it is necessary to remove the transmission housing following the procedure detailed on pages 4-5-14 to 4-5-27. Then proceed as follows:

1. Fix the transmission housing on the rotary stand tool no. **290090** using front and rear brackets, tools nos. **293971** (1) and **293972** (2), respectively.

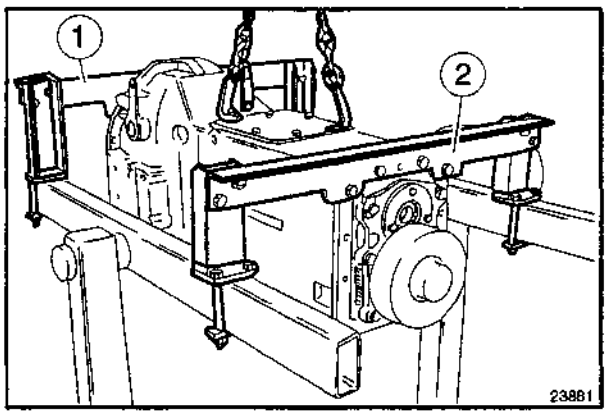


Figure 4-5-141

2. Loosen the retaining bolts and remove the upper cover (1).

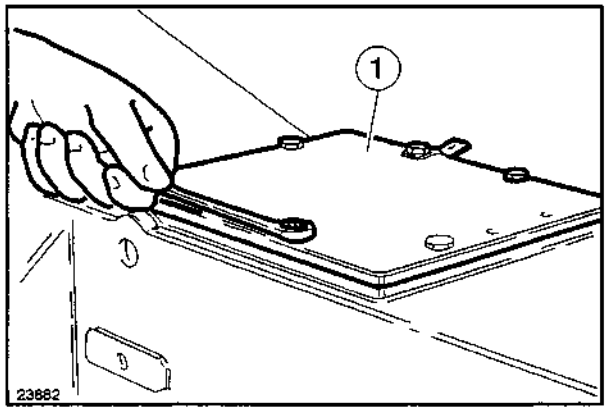


Figure 4-5-142

3. Slide out the bearing spring retainer (1) (on both sides)

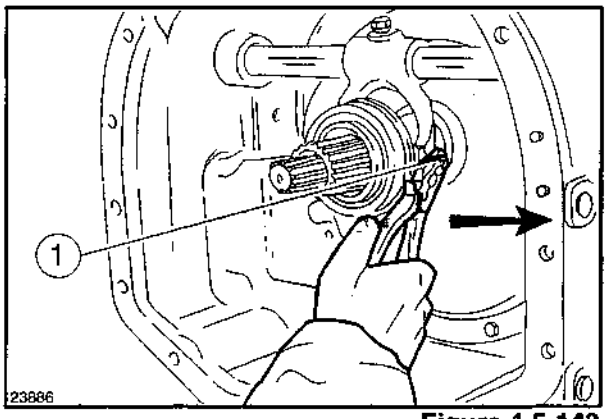


Figure 4-5-143

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4. Retrieve the clutch engagement bearing (1).

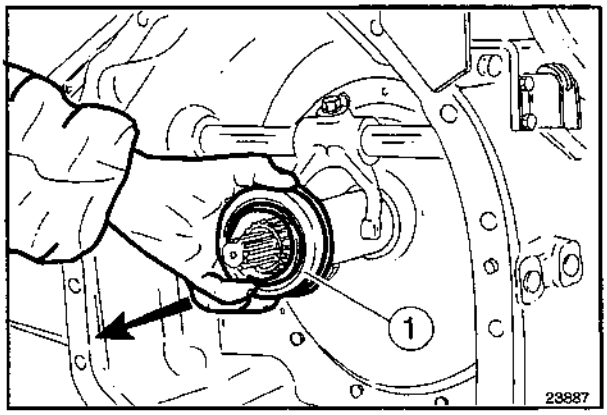


Figure 4-5-144

5. Loosen the screw (1) attaching the fork to the clutch control lever.

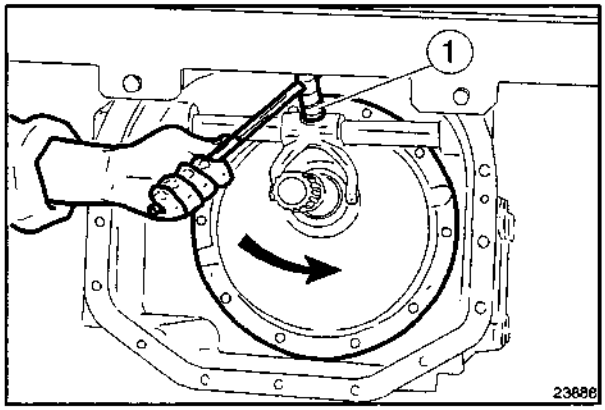


Figure 4-5-145

6. Withdraw the control lever (2) and retrieve the fork (1).

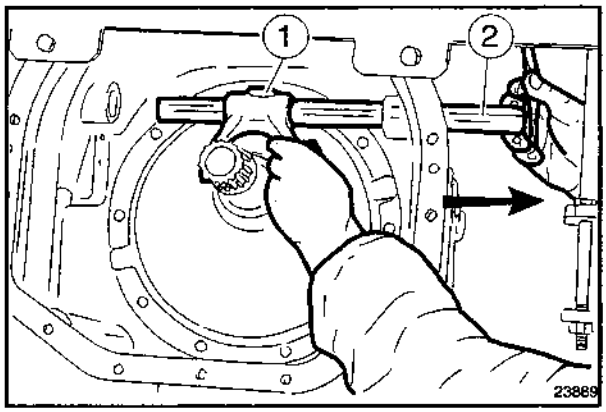


Figure 4-5-146

7. Loosen all cover (1) retaining bolts (2).

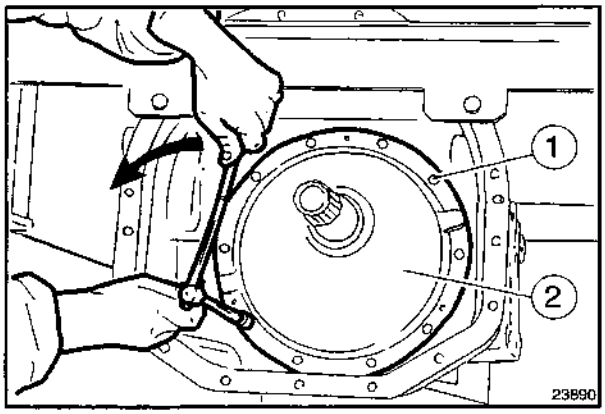


Figure 4-5-147

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8. Screw in three of the screws (1, Figure 4-5-147) into the specially designed holes to separate the cover (1) from the transmission housing.

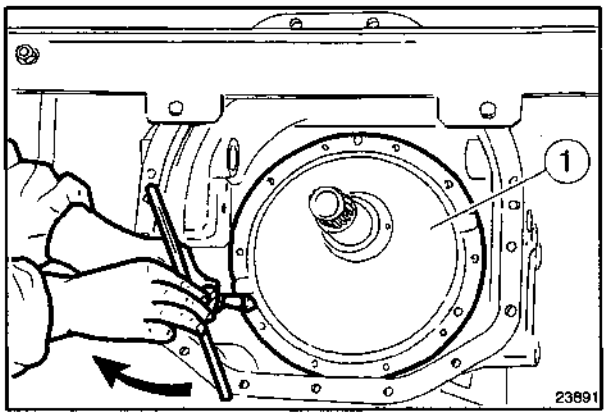


Figure 4-5-148

9. Loosen the screw (1) and retrieve spring and actuating ball.

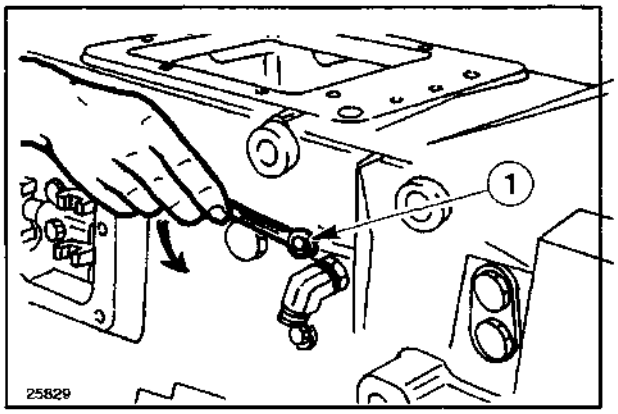


Figure 4-5-149

10. Withdraw the bearing (1) from the shuttle input shaft using a puller.
11. Remove the control and safety selector dog spring pins from the 5th speed rail. Withdraw the control fork along with the rail from the front side. Retrieve selector dogs.

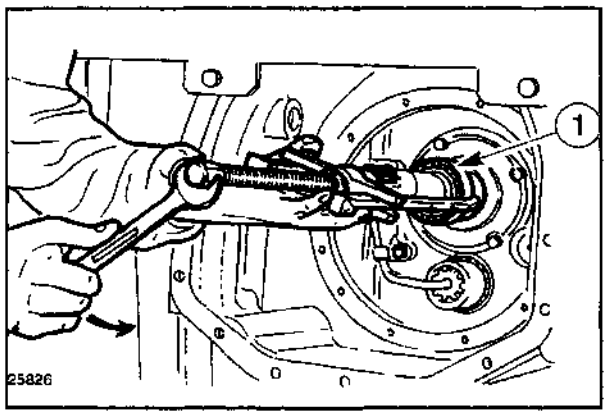


Figure 4-5-150

12. Remove circlip (1).

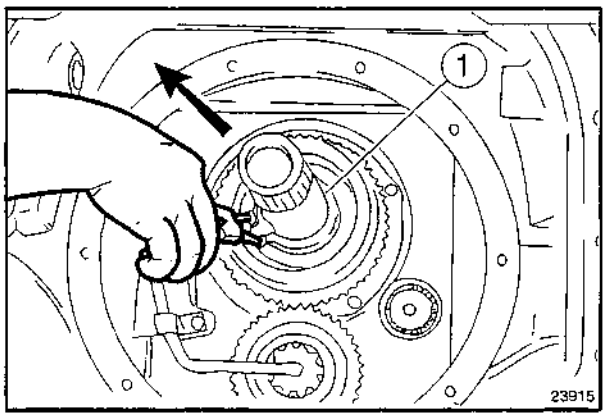


Figure 4-5-151

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13. Retrieve the synchronizer assembly (1), the 5th speed drive gear along with thrust washer and seal.

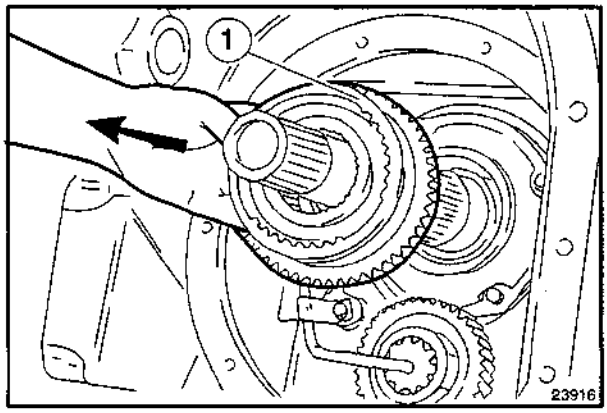


Figure 4-5-152

14. Loosen the fitting and retaining screw, remove the output shaft lubrication tube (1).

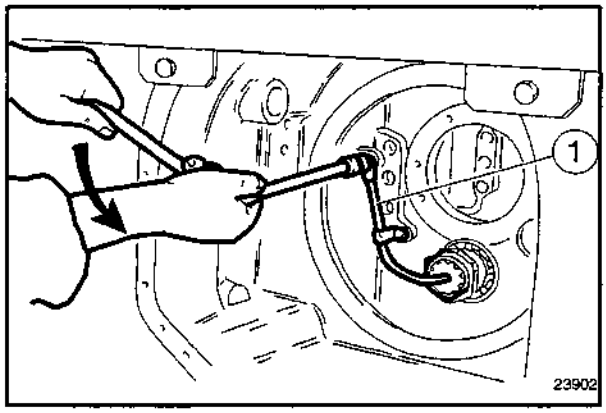


Figure 4-5-153

15. Install tool no. **293808** (1) on to the transmission output shaft and insert a wrench (2) to hold the shaft in place.

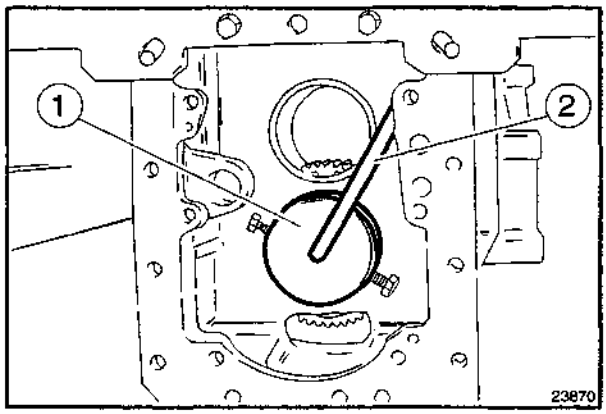


Figure 4-5-154

16. Straighten the transmission output shaft locknut(1)

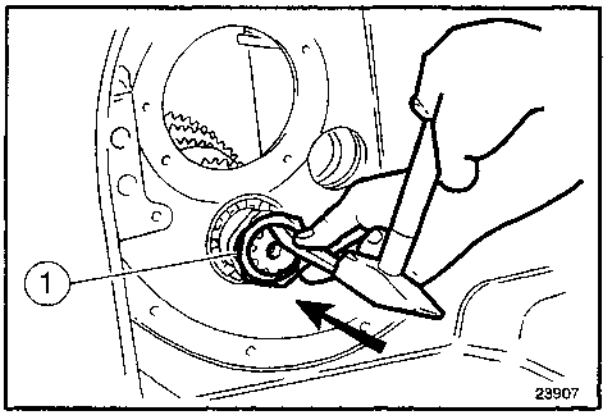


Figure 4-5-155

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17. Loosen the transmission output shaft locknut and retrieve the 5th speed driven gear.

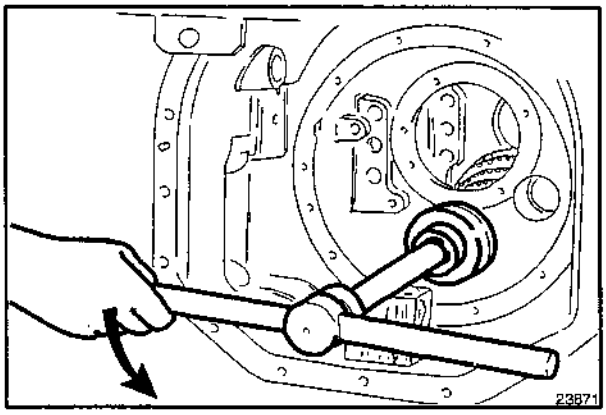


Figure 4-5-156

Note: If it is necessary to disassemble the entire transmission and range gears, perform also previous steps from 9 to 13 during the disassembly procedure detailed from page 4-5-34 to page 4-5-46.

---

18. Reinstall the 5th speed gear assembly into the housing observing the following:

- Reinstallation follows the removal procedure in reverse, from step 17 back to step 1.
- Refer to figures on pages 4-5-9 to 4-5-12 for correct orientation of the different parts.
- Ensure the housing is thoroughly cleaned (especially inner compartments).
- Check seals and replace if damaged.
- Before reassembling the 5th speed gear assembly, thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant following the pattern shown in the figure on page 4-5-46.
- Tighten to correct torques as detailed on page 4-5-4.

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SPEED AND RANGE CONTROL RAIL ASSEMBLY

Removal – Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Remove the mechanical speed and range control rail assembly as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

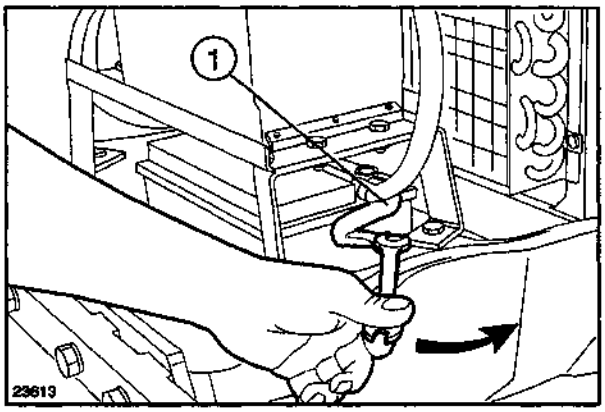


Figure 4-5-157

3. Raise rear tractor, place a stationary stand (1) under the RH final drive case and remove RH wheel.

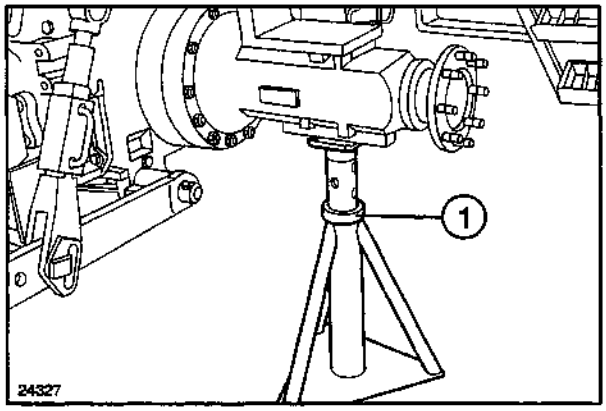


Figure 4-5-158

4. Disconnect speed and range control cables (1) from rails (2) and supports (3).

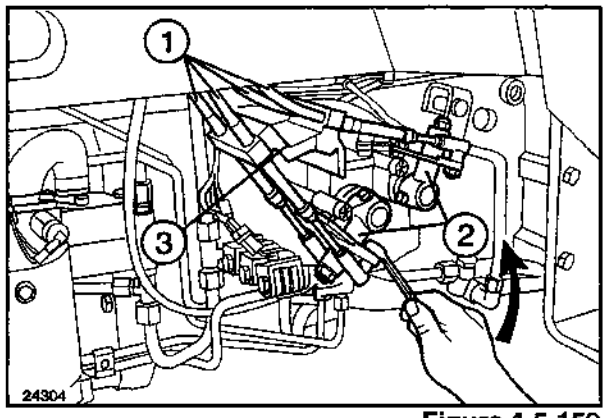


Figure 4-5-159

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5. Detach all electrical connectors (1) from solenoid valves and sensors.

Note: Before detaching connectors from the control assembly, mark each connector and respective solenoid valve as well as each connector and respective sensor to assist reassembly and avoid reversal of connections.

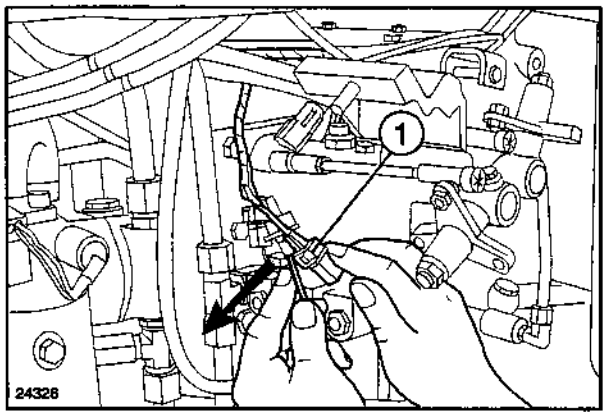


Figure 4-5-160

6. Loosen all lines (1) from the speed and range control rail assembly.

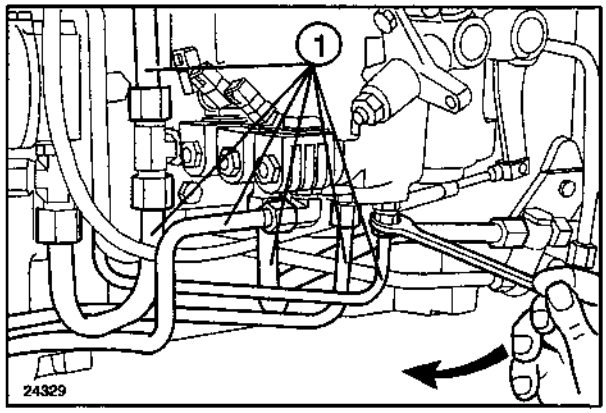


Figure 4-5-161

7. Loosen two retaining screws and insert two alignment pins (1) into the holes. Loosen all retaining screws and remove control assembly.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

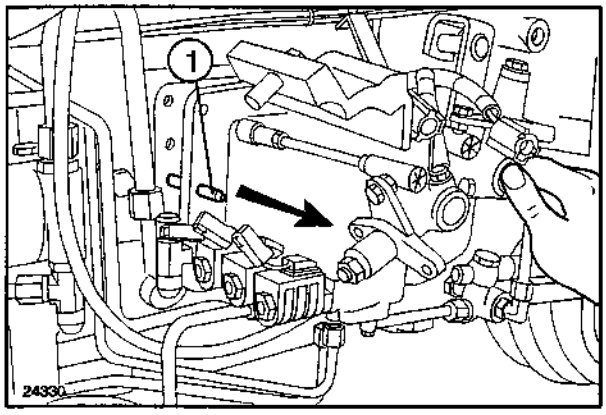


Figure 4-5-162

8. Reinstall the mechanical speed and range control rail assembly to the transmission housing observing the following:
   - Reinstallation follows the removal procedure in reverse, from step 7 back to step 1.
   - Before reassembling the speed and range control rail assembly thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant following the pattern shown in the figure on page 4-5-46.
   - Tighten to correct torques as detailed on page 4-5-4.

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CREEPER GEARS

Removal – Installation

WARNING

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

1. To overhaul the creeper gear assembly it is necessary to remove the transmission housing following the procedure detailed on pages 4-5-14 to 4-5-27.

2. Fix the transmission housing on a suitable stand.

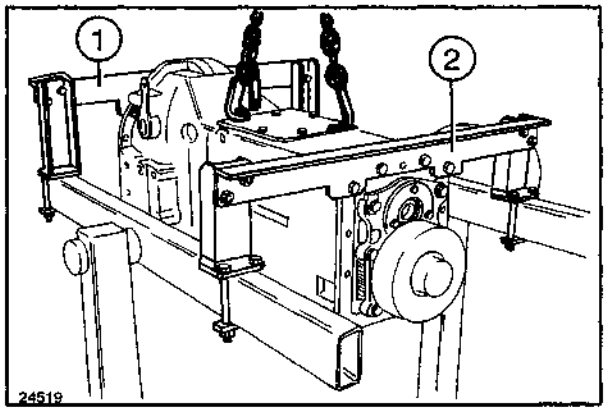


Figure 4-5-163

3. Remove the circlip (1).

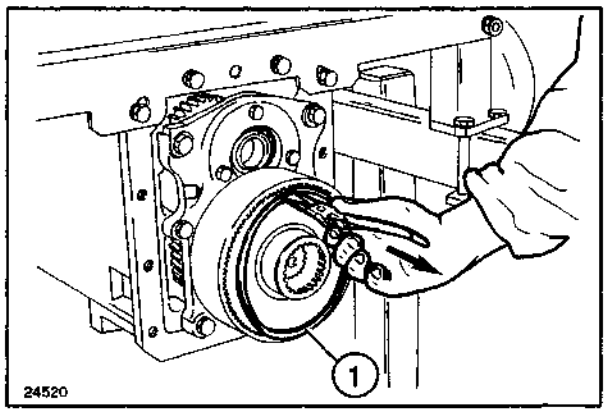


Figure 4-5-164

4. Retrieve the driven gear and friction plate assembly (1)

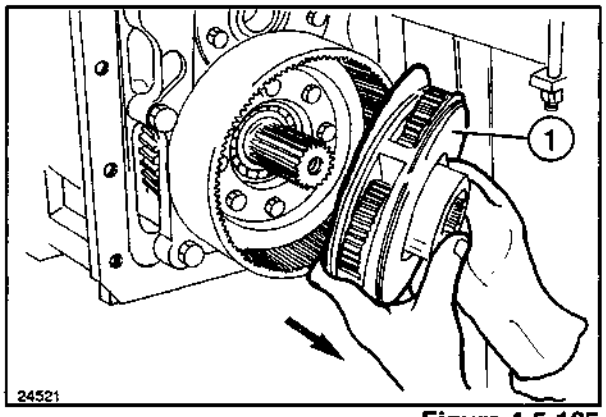


Figure 4-5-165

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5. Loosen retaining screws and remove the creeper gear housing (1).

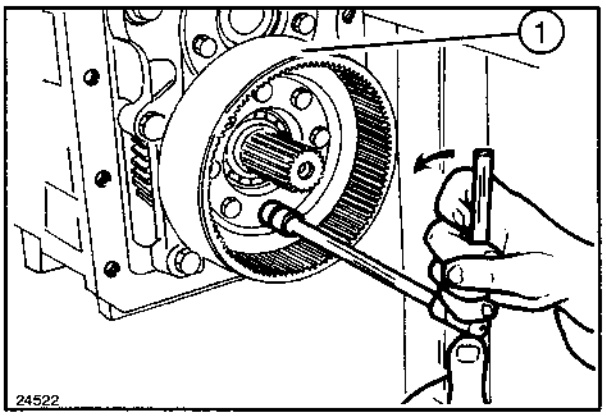


Figure 4-5-166

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

6. Reassemble the creeper gear assembly observing the following:

   – Reassembly follows the disassembly procedure in reverse, from step 5 back to step 1.

   – Refer to figures on page 4-5-9 to 4-5-12 for correct orientation of different components.

   – Tighten to correct torques as detailed on page 4-5-4.

   – Ensure the creeper housing (1, Figure 4-5-166) does not disturb the input shaft bearing cover.

   – After reassembling the transmission housing to the rear axle housing, but before installing the fuel main tank, carry out the following adjustment:

CREEPER GEAR ASSEMBLY

Creeper External Control Lever Travel Adjustment

7. Prior to this adjustment, it is necessary to reinstall the transmission housing to the rear axle housing, but the fuel main tank should not be installed. Then proceed as follows:

8. Loosen the locknut (1) and loosen the bolt (2) almost completely. Move the external lever (3) backwards to end of travel.

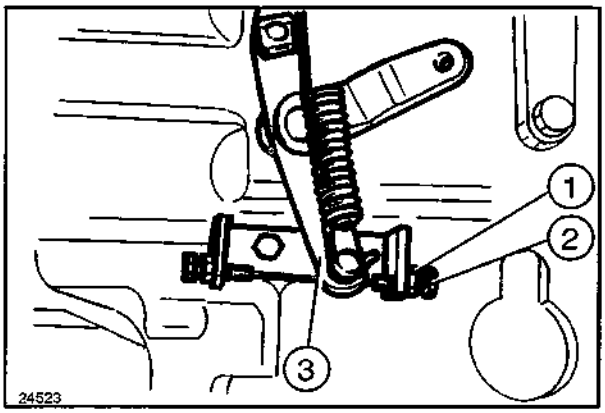


Figure 4-5-167

9. Tighten the screw (3) until touching the external lever (1). Then, screw it in a further 1 1/2 turn and lock using the locknut (2).
   Loosen the locknut (4) and screw in the screw (5) until obtaining a distance (L) = 2.24 in (57 mm) between this screw and screw (3). Tighten the locknut (4).

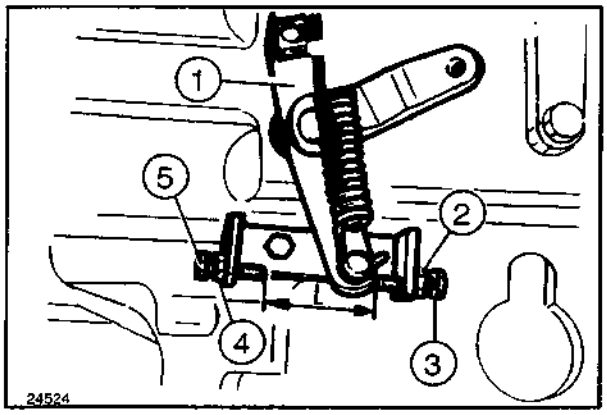


Figure 4-5-168

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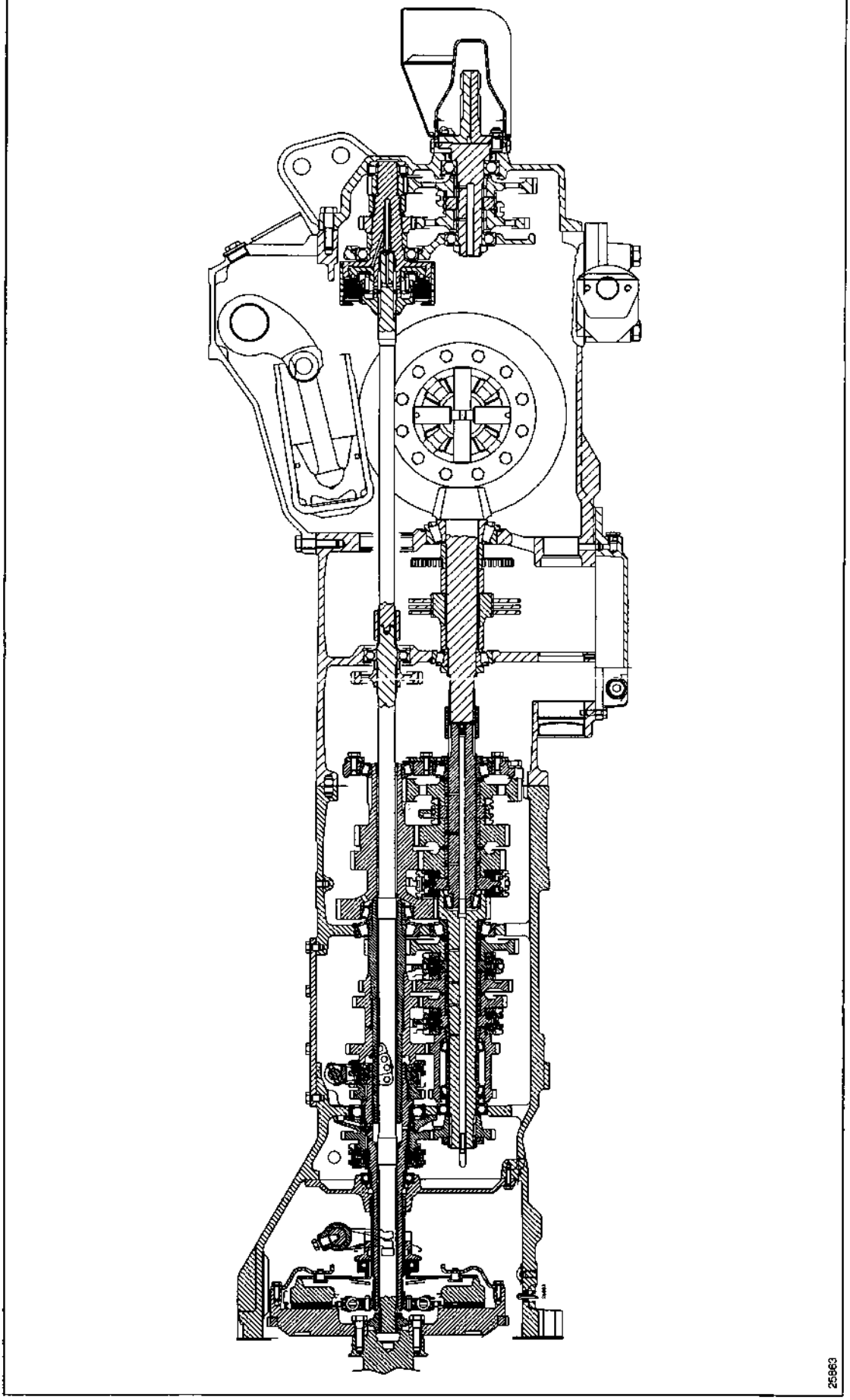


Figure 4-5-160
Drive Line Longitudinal View
4-5-60
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SECTION 8 - HYDRAULIC SYSTEM
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SECTION 10 - CAB

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SECTION 5

MECHANICAL REAR WHEEL DRIVE

CHAPTER 1

MECHANICAL REAR WHEEL DRIVE

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27 000 –SPECIFICATIONS – TIGHTENING TORQUE – TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

PINION, CROWN WHEEL AND DIFFERENTIAL – SPECIFICATIONS

Pinion and crown wheel ratio		10/43 = 1:4. 3
Pinion to crown wheel backlash	in (mm)	0.008 to 0.011 (0.20 to 0.28)
Differential		4–pinion
Differential lock control		
– Models 8160, 8260 and 8360 less cab		Acting through front–meshing, hydraulically operated gears
– Models 8360 with cab and 8560	mm	Acting through a hydraulically controlled multi–pack clutch in oil bath
Number of clutch discs:		
– Driven discs		7
– Drive discs		7
– Driven disc thickness (each)	in (mm)	0.112 to 0.116 (2.85 to 2.95)
– Drive disc thickness (each)	in (mm)	0.069 to 0.073 (1.75 to 1.85)
Differential pinion bore dia. (5, Figures 5-1-7 and 5-1-8)	in (mm)	0.104 to 0.105 (28. 04 to 28. 061)
Differential pinion journal dia. (6)	in (mm)	0.100 to 0.001 (27. 939 to 27. 960)
Differential pinion running clearance	in (mm)	0.003 to 0.005 (0. 080 to 0. 122)
Side gear hub seat in differential		
Casing dia. (4, Figures 5-1-7 and 5-1-8)	in (mm)	2.56 (65.0)
Side gear hub dia. (3)	in (mm)	2.47 to 2.48 (62.8 to 63.0)
Pinion position adjustment		See pages 5-1-47 to 5-1-51
Pinion position shimming (5, Figure 5-1-6):		
– Models 8160 and 8260 w/and L/cab and 8360 L/cab	mm	1. 40–1. 45–1. 50–1. 55–1. 60–1. 65–1. 70–1. 75–1. 80–1. 85–1. 90–1. 95–2. 00–2. 05–2. 10–2. 15–2. 20–2. 25–2. 30–2. 35–2. 40–2. 45–2. 50–3. 0–3. 1–3. 3–3. 4–3. 5–3. 6–3. 7–3. 8–3. 9–4. 0
– Model 8360 w/cab and 8560	mm	
Pinion bearing adjustment		See pages 5-1-49 and 5-1-52
Pinion bearing shimming (3, Figure 5-1-6)	mm	4. 40–4. 50–4. 60–4. 70–4. 80–4. 85–4. 90–4. 95–5. 00–5. 05–5. 10–5. 15–5. 20–5. 25–5. 30–5. 35–5. 40–5. 45–5. 50–5. 55–5. 60–5. 65–5. 70–5. 75–5. 80–5. 85–5. 90–5. 95–6. 00–6. 05–6. 10–6. 15–6. 20–6. 30–6. 40–6. 50–6. 60

(to be continued)

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PINION TO CROWN WHEEL AND DIFFERENTIAL – SPECIFICATIONS

(continued)

Crown wheel bearing and backlash ..... shimming (21, Figure 5-1-7 and 25, Figure 5-1-8) ..... mm	See pages 5-1-53 to 5-1-56 0. 15–0. 20–0. 50
Differential gear and pinion backlash ..... in (mm) Differential gear thrust washer thickness (20, Figure 5-1-7 and 24, Figure 5-1-8) ..... in (mm) Differential gear end play (each) ..... in (mm) Differential gear end play adjustment	0.008 (0.20) (2. 80–2. 85–2. 90–2. 95–3. 00–3. 053. 10–3. 15–3. 20–3. 25–3. 30) 0.012 (0.30) see pages 5-1-61 and 5-1-62

FINAL DRIVES – SPECIFICATIONS

Type ..... Reduction ratios: – Models 8160 and 8260 ..... – Model 8360 ..... – Model 8560	Epicyclic, with three planetary spur gears 14:(14+70)=1:6 12:(12+63)=1:6.25 14:(14+88)=1:7.28
Thickness of planetary gear thrust washers (8 and 10, Figures 5-1-7 and 5-1-8) ..... in (mm) Thickness of planetary gear roller bearing spacer (9) .... in (mm)	(1) 0.193 to 0.195 in (4.90 to 4.95)
Adjustment of drive wheel shaft tapered roller bearings	see page 5-1-72

TIGHTENING TORQUE

DESCRIPTION	Thread size	Torque ft. lbs. (Nm)
Nut, bevel pinion shaft (C_1, Figure 5-1-1)	M45x1. 5	361 (490)
Nut, final drive case (C2)	M14x1. 5	130 (176)
Nut, wheel disc to wheel rim (C_3)	M16x1.5	217 (294)
Nut, steel wheel disc to wheel hub (C_4)	M18x1.5	188 (255)
Capscrew, wheel hub on dual wheel axle shaft (C_5)	M16x1.5	217 (294)
Capscrew, RAIL disc on dual wheel axle shaft (C_7)	M16x1.5	217 (294)
Capscrew, drive wheel shaft (C_8)	M18x1.5	65 (*) (88)
Capscrew, crown wheel and differential caps (C_9)	M10x1.25	40 (54)
Self–locking nut, crown wheel (C_{10})	M12x1.25	101 (137)

(*) see adjustment procedure on page 5-1-72

(to be continued)

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TIGHTENING TORQUE

(continued)

Nut, RAIL disc block (C_6)	M20x2.5	180 (245)
Nut, RAIL disc to wheel hub	M18x1.5	231 (314)
Nut, weight screw to steel wheel disc	M16x1.5	217 (294)
Attaching screws, wheel weights	M16x1.5	156 (211)
Allen screw, wheel weights to cast iron disc	M16x1.5	137 (186)
Capscrew, pump and filter support(C_2 page 5-1-4 Section 8, Chapter 3)	M12x1.5	61 (83)

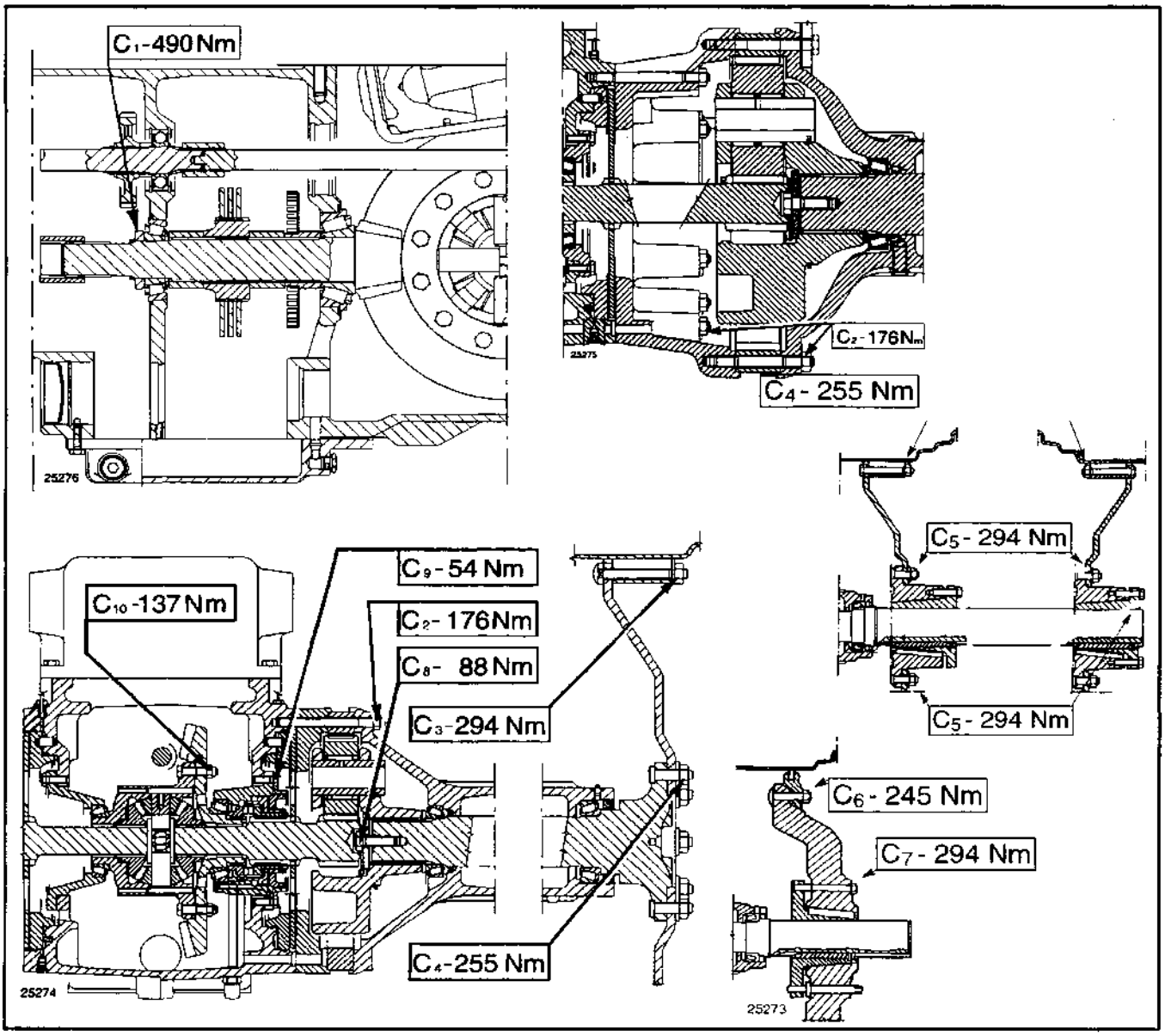


Figure 5-1-1

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SPECIAL TOOLS

Caution – Operations described in this Section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to carry out the different operations described in this Section.

	292320	Tractor separation stand
	293812	Transmission housing to rear axle locating pins
X	**293343**	Nut wrench and for checking pinion rolling torque
X	**293510**	Universal pinion bearing adjustment tool
X	**293975**	Pinion bearing adjustment tool
X	**293977**	Spacer (to be used with **293510** or **293975**)
X	**293976**	Spacer (to be used with **293510** or **293975**)
	293400	Universal pinion installer
X	**293994**	Crown wheel–differential lifting hook
	291525	Differential cap locating pins
	292870	Universal differential lock pressure test kit
X	**293986**	Differential planetary gear adjustment tool
X	**293811**	Reduction gear assembly lifting hook
	291221	Differential overhaul stand.
X	**295026**	Spacer and bushing (to be used with **293975** or **293510**).
	295048	Spacers, two (to be used with **293975**).

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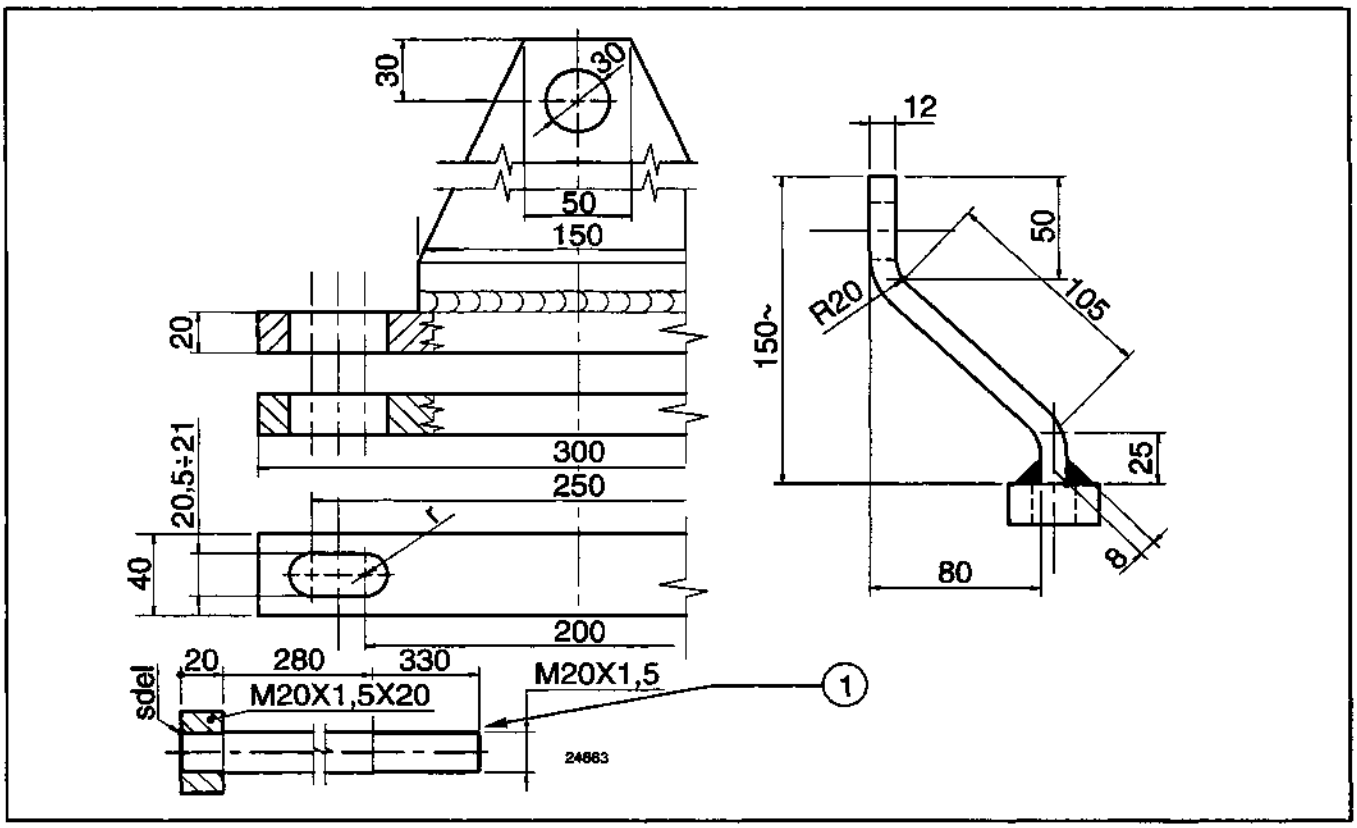


Figure 5-1-2

Tool to be fabricated to disassemble–assemble the final drives (Mark tool with no. 50091 – – Dimensions in mm).

Fabricate tool using Aq 42 D.material

1. Make 2 legs in C 40 H&T material

Tool to be fabricated to disassemble–assemble the final drives (Mark tool with no. 50078 – Dimensions in mm).

Fabricate tool using 38 NCD 4 material.

1. Make from one male eyebolt M12 DIN 580
2. Apply LOCTITE 270

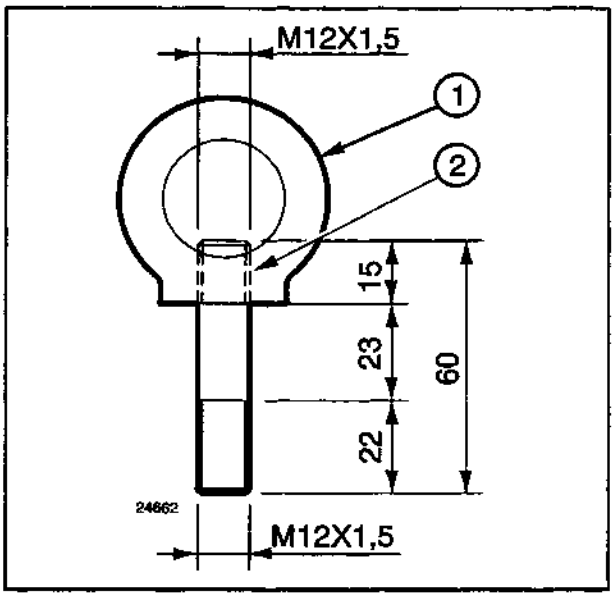


Figure 5-1-3

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Tool to be fabricated to remove the hydraulic pump idler gear pivot pin (Mark tool with no. 50143 – Dimensions in mm)
Note – Fabricate tool using UNI C 40 material.

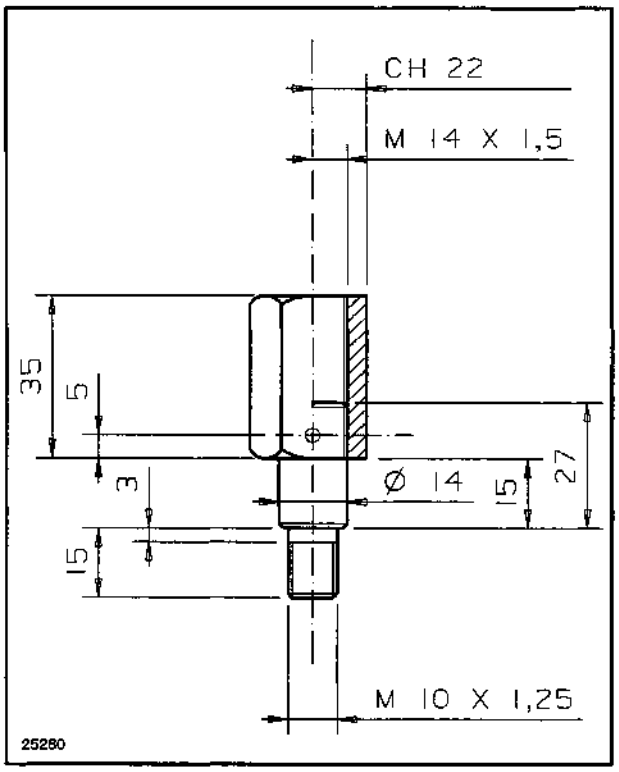


Figure 5-1-4

Tool to be fabricated to remove the hydraulic pump idler gear journal setscrew(Mark tool with no. 50140 – Dimensions in mm)
Note – Fabricate tool using UNI C 40 material.

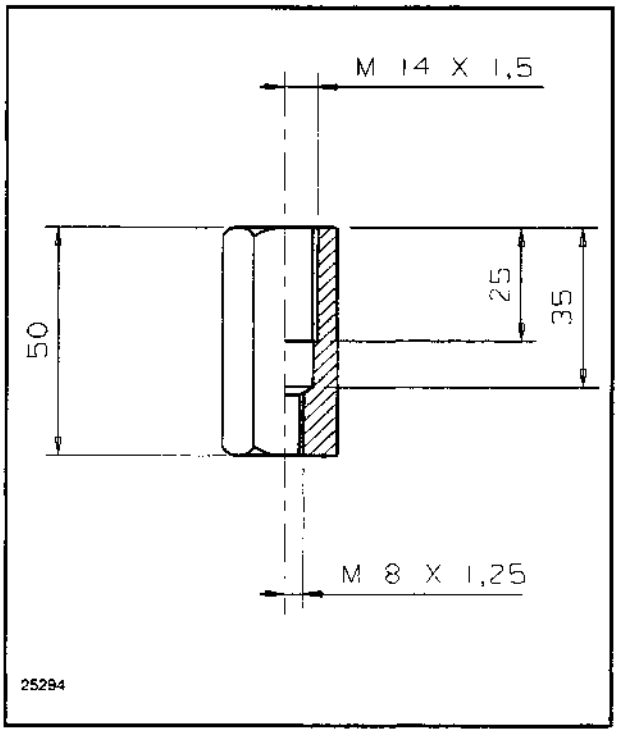


Figure 5-1-5

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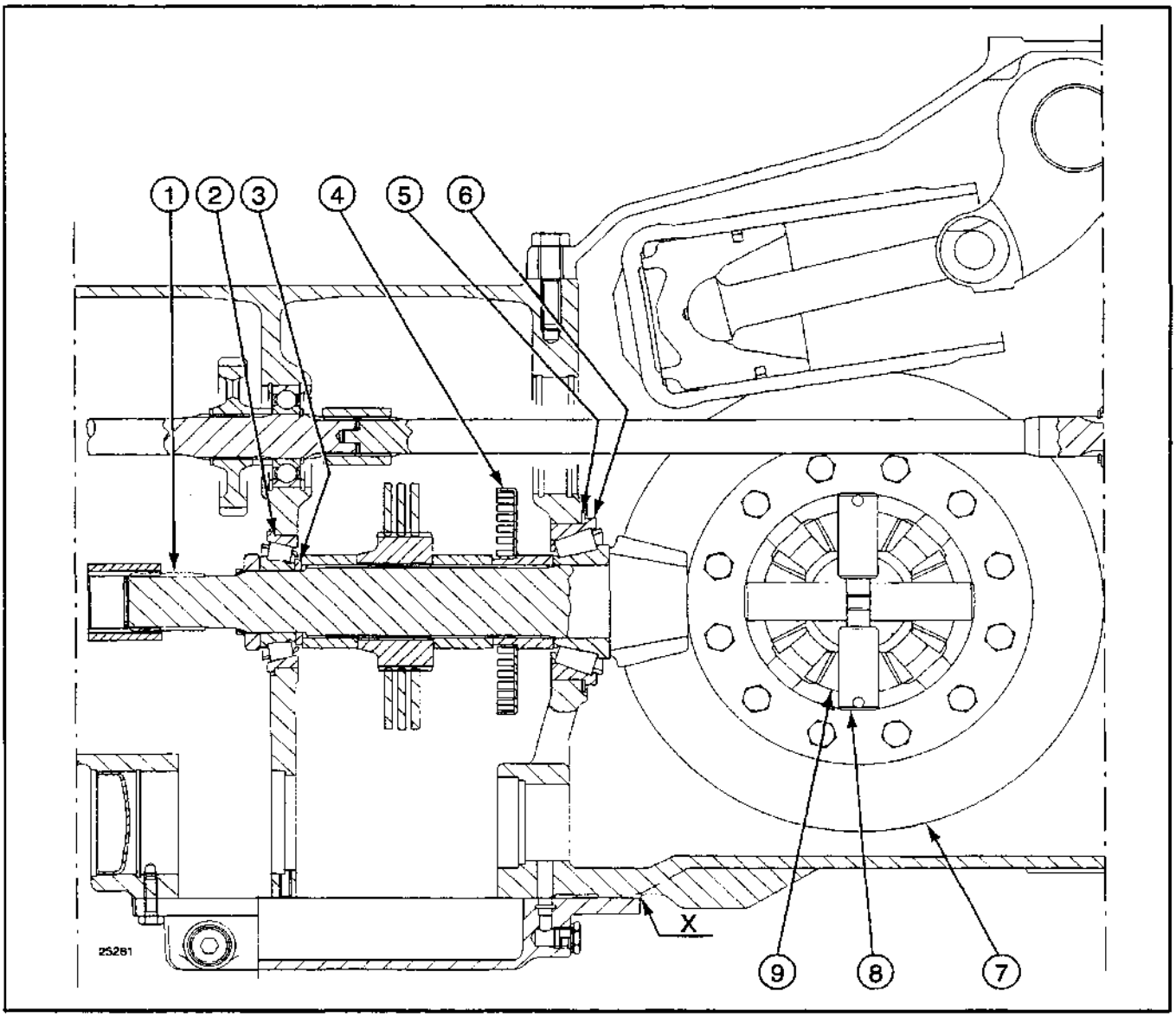


Figure 5-1-6

Rear Axle Longitudinal Sectional View

1. Bevel pinion shaft
2. Tapered roller bearing
3. Bevel pinion bearing adjusting shim
4. Phonic wheel
5. Cone point adjusting shim
6. Tapered roller bearing
7. Crown wheel.
8. Differential gear hub
9. Differential gear

Note – During installation apply liquid gasket on surfaces marked with an **X** as detailed on pages 5-1-35 and 5-1-36.

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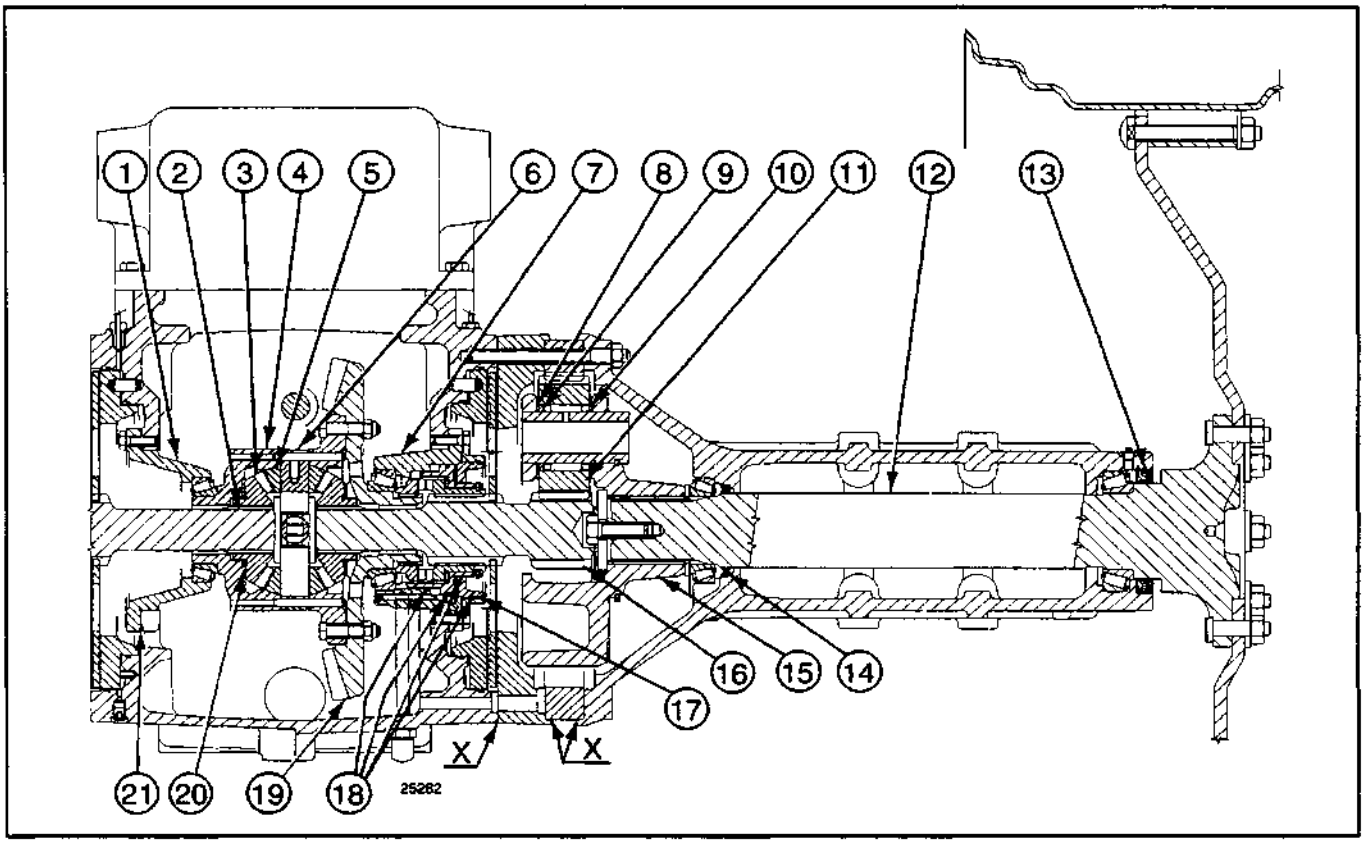


Figure 5-1-7

Rear Axle Cross–Section (Models 8160, 8260 and 8360)

1. Crown wheel bearing cap
2. Differential output half–shaft
3. Side gears
4. Differential casing
5. Differential gears
6. Differential gear hub (5)
7. Crown wheel bearing cap
8. Thrust washer
9. Planetary gear (11) bearing spacer
10. Thrust washer
11. Planetary final reduction gears
12. Wheel axle shaft
13. Seal
14. Seal
15. Planetary carrier
16. Differential output half–shaft
17. Differential lock control piston
18. Seal
19. Crown wheel
20. Side gear end play adjuster rings
21. Pinion to crown wheel backlash and bearing adjuster rings

Note – During installation apply liquid gasket on surfaces marked with an **X** as detailed on pages 5-1-35 and 5-1-36

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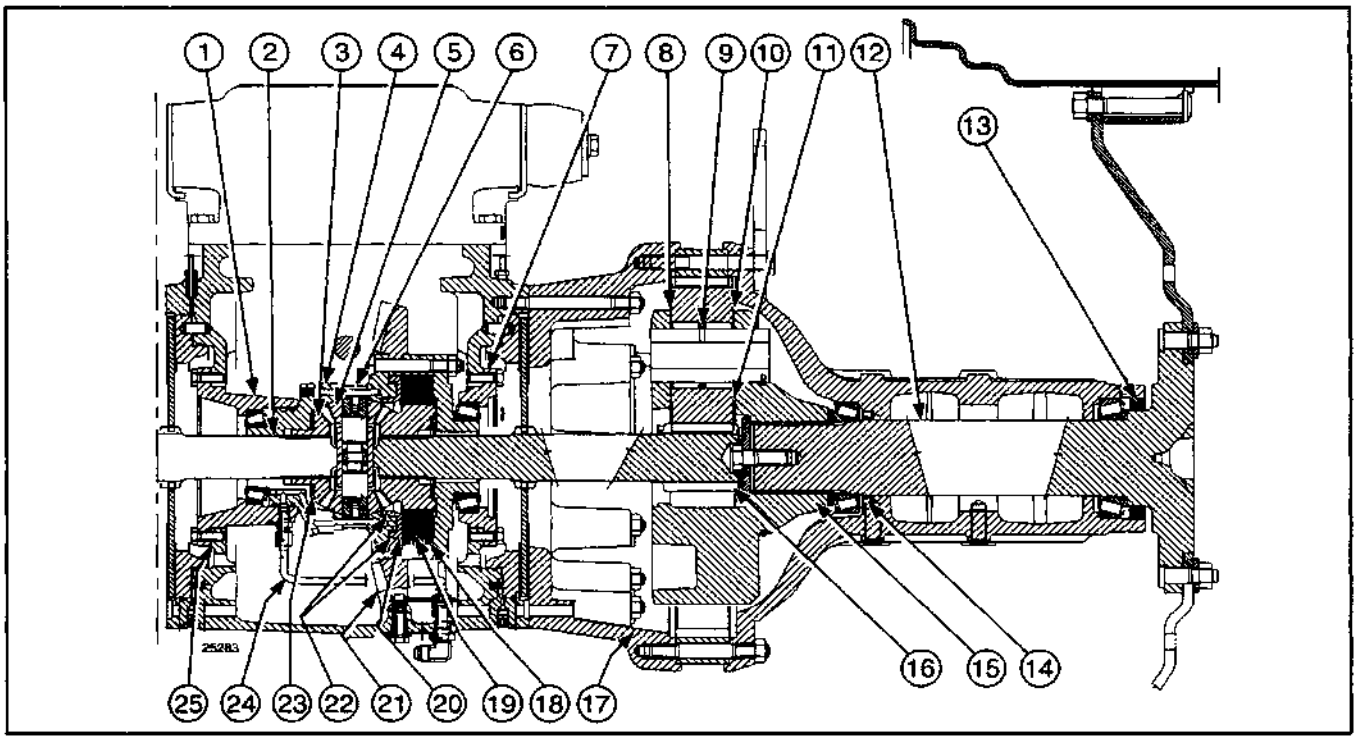


Figure 5-1-8

Rear Axle Cross–Section (Model 8560)

1. Crown wheel bearing cap
2. Differential output half–shaft
3. Side gears
4. Differential casing
5. Differential gear
6. Differential gear hub (5)
7. Crown wheel bearing cap
8. Thrust washer
9. Planetary gear (11) bearing spacer
10. Thrust washer
11. Planetary final reduction gears
12. Wheel axle shaft
13. Seal.
14. Seal.
15. Planetary carrier
16. Differential output half–shaft
17. Final drive case spacer
18. Drive discs
19. Driven discs
20. Differential lock control piston
21. Crown wheel
22. Seal
23. Side gear end play adjuster rings
24. Differential lock control line
25. Pinion to crown wheel backlash and bearing adjuster rings

Note – During installation apply liquid gasket on surfaces marked with an **X** as detailed on pages 5-1-35 and 5-1-36.

DESCRIPTION AND OPERATION

The rear axle assembly transfers drive from the transmission to the epicyclic final drives through a bevel pinion and crown wheel coupling. The bevel gears are spiral type and are supported by tapered roller bearings.
The differential is fitted with four planetary gears and hydraulic differential lock. On Models 8160, 8260 and 8360 (l/cab) tractors the differential lock is operated by hydraulically controlled front spur gears.
On Models 8360 (w/cab) and 8560 tractors the differential lock is operated by a hydraulically controlled multi–pack clutch in oil bath.
Refer to pages 5-1-11 and 5-1-12 for the descriptions of operation of both types of differential lock.
The epicyclic final reduction gear sets are controlled by the bevel pinion and crown wheel output half–shafts, which also control the brakes.

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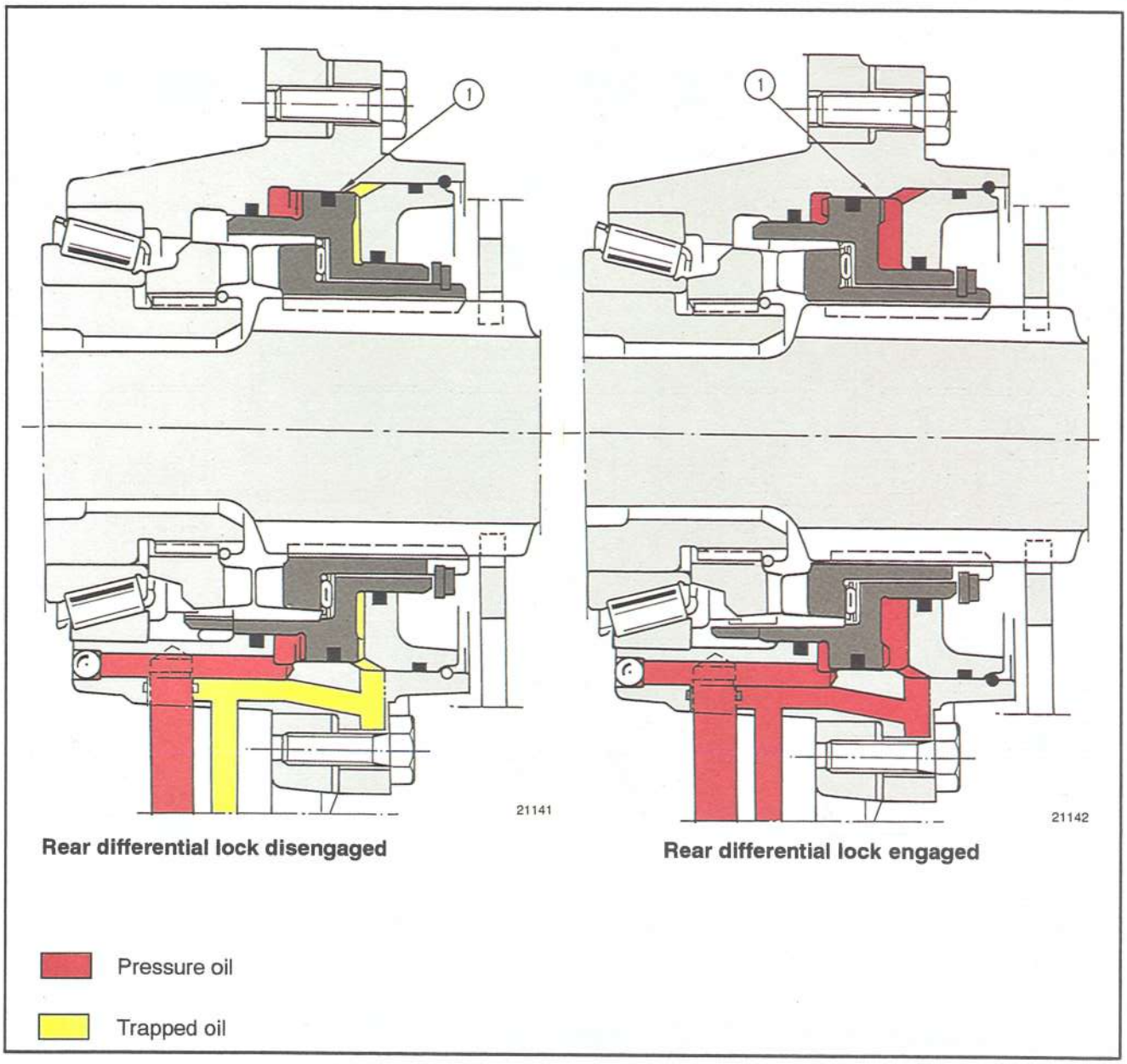


Figure 5-1-9

REAR DIFFERENTIAL LOCK ASSEMBLY (Models 8160, 8260 and 8360 L/cab)

When it is not necessary to lock the differential, the differential lock is kept disengaged by the pressure oil acting on the surface of the control piston smaller annular groove (1).

When the switch on the instrument panel is activated, the solenoid valve opens and directs oil from the pump into the drive piston main annular groove (1).

The pressure applied to the piston (1) larger surface is considerably stronger than the one acting on the smaller surface of same piston (1) and consequently the piston (1) moves, engages the front toothed sleeves and locks the differential.

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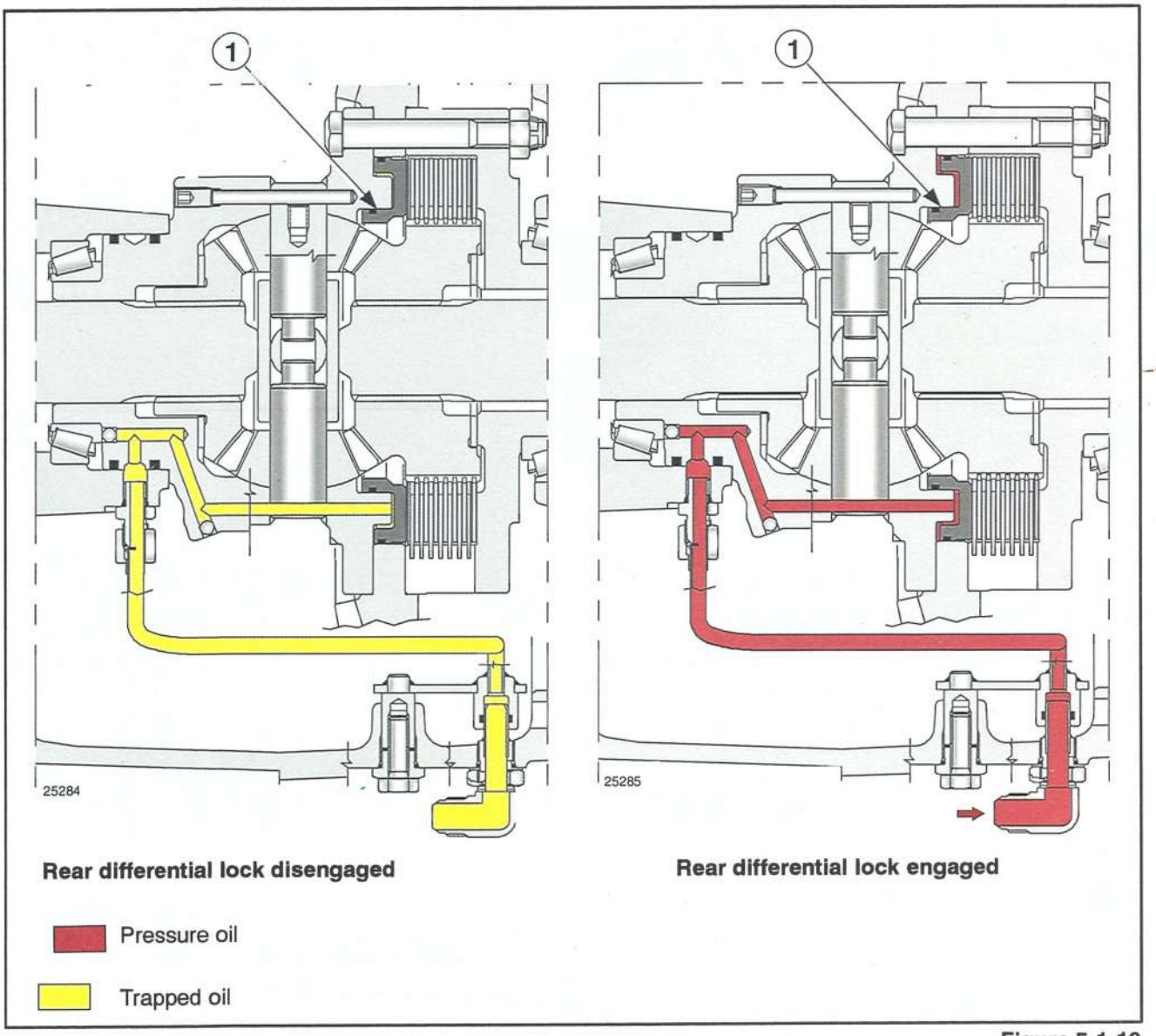


Figure 5-1-10

REAR DIFFERENTIAL LOCK ASSEMBLY (Models 8360 w/cab and 8560)

When the switch on the instrument panel is activated, the solenoid valve opens and directs oil from the pump into the control piston (1) annular groove.

The pressure applied over the piston (1) surface compresses the multi–pack clutch drive and driven discs and locks the differential.

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TROUBLESHOOTING – PINION, CROWN WHEEL AND DIFFERENTIAL

Problem	Possible Cause	Correction
Noisy rear axle when the tractor is moving, and also with transmission in neutral (not originating from final drives)	1. Pinion and/or crown wheel bearing misadjustment	Remove rear axle housing and adjust pinion and crown wheel bearings correctly (page 5-1-47).
	2. Worn or misadjusted side and planetary gears	Remove rear axle housing, replace worn parts and adjust the differential gear backlash (page 5-1-61).
	3. Excess differential side gears to half–shaft spline backlash	Remove rear axle housing and replace damaged parts.
Noisy rear axle with tractor under load and upon release	1. Excess bevel pinion to crown wheel backlash	Remove rear axle housing and adjust bevel pinion and crown wheel bearings correctly (page 5-1-47).
	2. Faulty or defective inner component.	Remove rear axle housing, replace worn parts and adjust differential gear backlash correctly (page 5-1-61).
Noisy rear axle with over–heating	1. Insufficient pinion and/or crown wheel bearing backlash	Remove rear axle housing and adjust bevel pinion and crown wheel bearings correctly (page 5-1-47)
	2. Insufficient bevel pinion to crown wheel tooth backlash	Remove rear axle housing and adjust crown wheel bearings correctly (page 5-1-53).

TROUBLESHOOTING – FINAL DRIVES

Problem	Possible Cause	Correction
Noisy final drives when the tractor is moving and also with transmission in neutral	1. Wheel axle shaft bearing misadjustment.	Remove final drive case and adjust bearings (page 5-1-72).
	2. Faulty or defective inner component.	Remove final drive case and replace damaged parts.
	3. Excess wheel axle shaft to final drive spline backlash	Remove final drive case and replace damaged parts.

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TROUBLESHOOTING – HYDRAULIC DIFFERENTIAL LOCK

Problem	Possible Cause	Correction
Differential lock not engaging.	1. Low rear axle oil level.	Top up to correct level.
	2. Blocked oil filter.	Replace filter.
	3. Faulty hydraulic pump.	Overhaul or replace pump.
	4. Faulty diff lock switch	Replace switch.
	5. Power supply not reaching solenoid valve: detached or damaged connectors, faulty remote switch.	Restore electrical connection and replace faulty parts. Overhaul or replace solenoid valve.
	6. Diff lock control solenoid valve (1, Figure 8-1-43, Section 8, Chapter. 1) stuck on discharge.	Overhaul or replace solenoid valve.
	7. Oil leaks through the seals with consequent pressure drop: cylinder piston oil supply line seals.	Replace faulty seals.
Differential lock not disengaging	1. Faulty diff lock–unlock switch	Replace switch
	2. Power supply not reaching solenoid valve: detached or damaged connectors, faulty remote switch.	Restore electrical connection and replace faulty parts.
	3. Diff lock control solenoid valve stuck on delivery.	Overhaul or replace solenoid valve.
	4. Oil leaks through the seals with consequent pressure drop: cylinder piston or supply line seals.	Replace faulty seals.
With differential lock engaged and control switch on automatic mode, the diff lock does not disengage when raising lift arms using the LIFT–O–MATIC device.	1. Faulty diff lock switch (connected to the LIFT–O–MATIC device).	Replace switch.
With differential lock engaged, the diff lock does not disengage when brake pedals are pressed.	1. Faulty diff lock switch (connected to the brake pump).	Replace switch.

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REAR AXLE HOUSING
Removal – Installation

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.Ensure that units or parts are supported by suitable slings or hooks.Ensure that no–one is in the vicinity of the load to be lifted.

Remove the rear axle housing as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

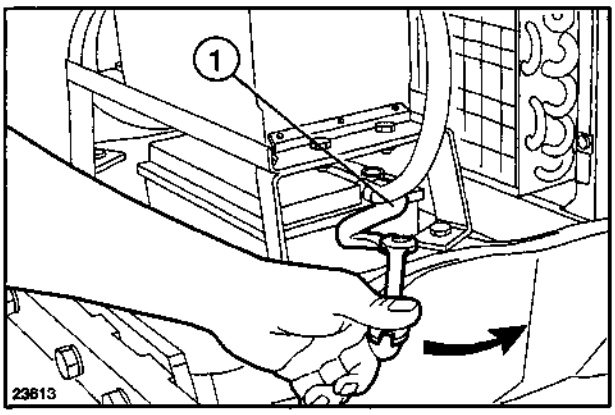


Figure 5-1-11

3. Attach engine hood to a hoist using a nylon cable (1) and disconnect the shock absorbers (2) (one on each side).

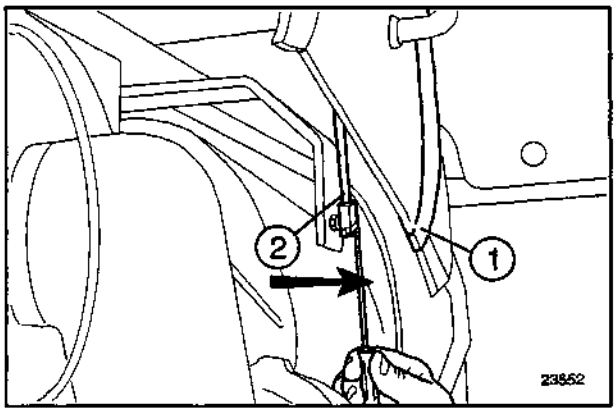


Figure 5-1-12

4. Unscrew hood to engine attaching screws (3), detach electrical connector, C056, to headlights and remove the hood using the hoist. Ensure that there are no obstacles or interference against other components.

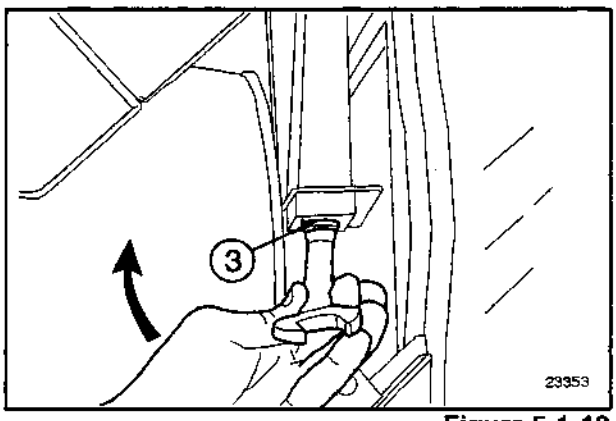


Figure 5-1-13

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5. Unscrew the retaining screws and remove side panels (1) (one on each side).

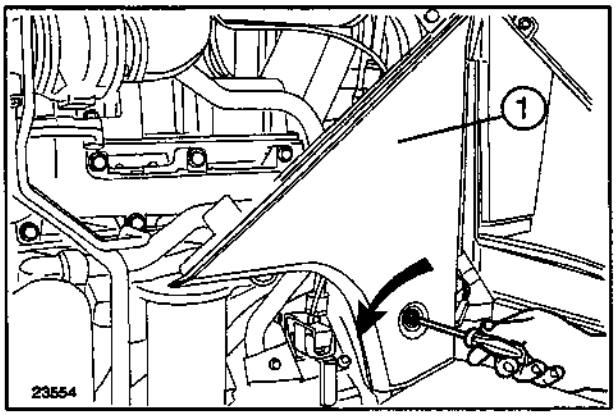


Figure 5-1-14

6. Jack up rear tractor and place two suitable stands (2) under the final drive cases in order that the wheels are off the ground. If necessary, detach the lift rods from the lower links.

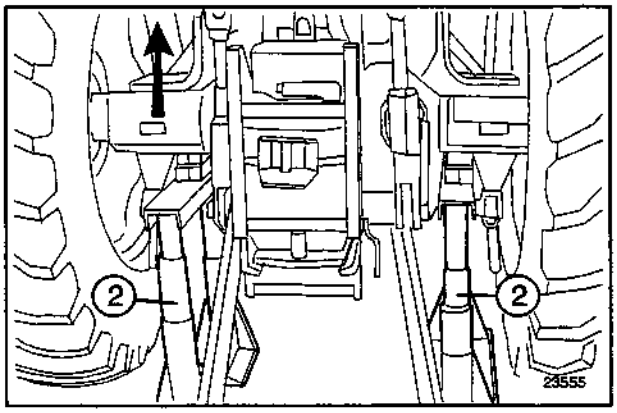


Figure 5-1-15

7. Sling the wheel using a nylon cable (3), unscrew retaining nuts and remove the wheel. Repeat for the left wheel.

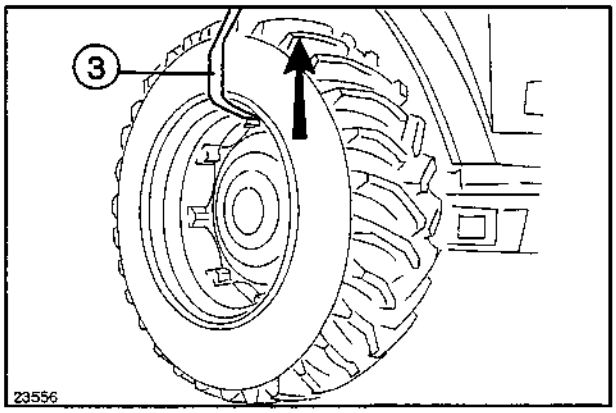


Figure 5-1-16

8. Loosen the two bolts on the cab roof and fix tool no. **FTC213997B** (4) using two appropriate bolts. Connect the tool to a hoist and remove slack in preparation for cab removal.

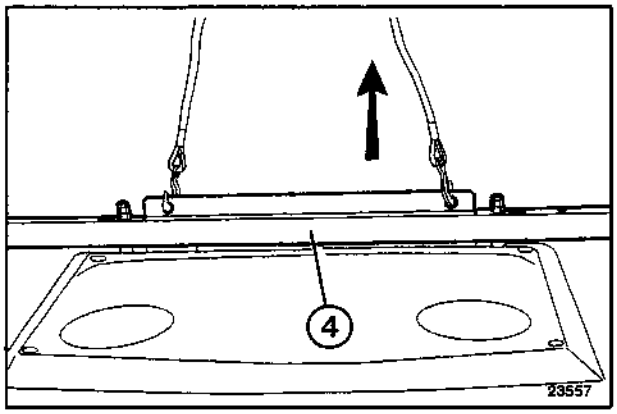


Figure 5-1-17

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9. Detach connectors from the primers. Detach washer bottle (1) lines and remove bottle.

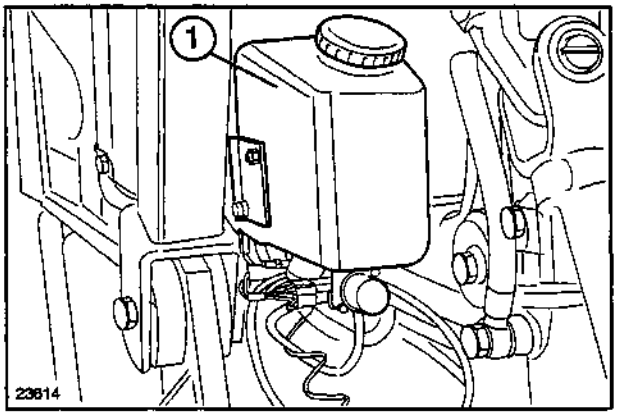


Figure 5-1-18

10. Remove the cotter pin and detach creeper gear control idler lever (2), loosen the screw (3) retaining the parking brake control cable.

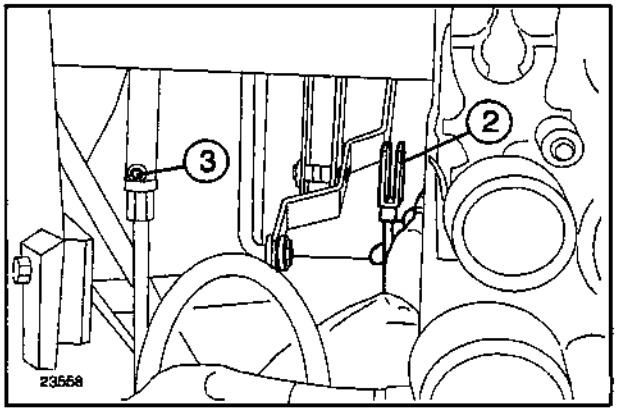


Figure 5-1-19

11. Remove the lockpin and withdraw the pin attaching the fork (4) to the parking brake control lever. Loosen the nut attaching the cable to the fork (4) and release the cable.

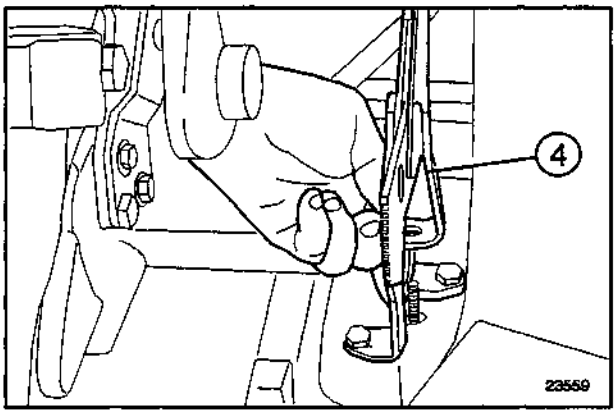


Figure 5-1-20

12. Loosen the retaining nut and detach the ground cable (5) between the cab and the rear axle.

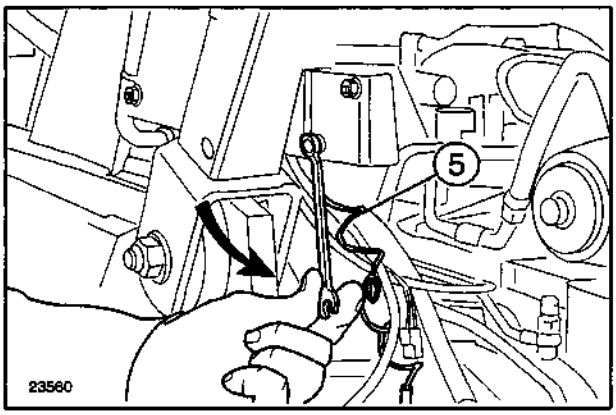


Figure 5-1-21

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13. Unscrew the clamp (1) and detach the bleed line from the main tank.

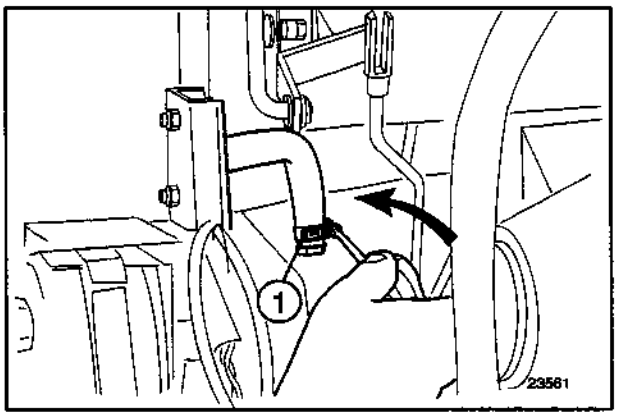


Figure 5-1-22

14. Disconnect the ground synchronized PTO control cable (2) from the rail. (Not used in North America).

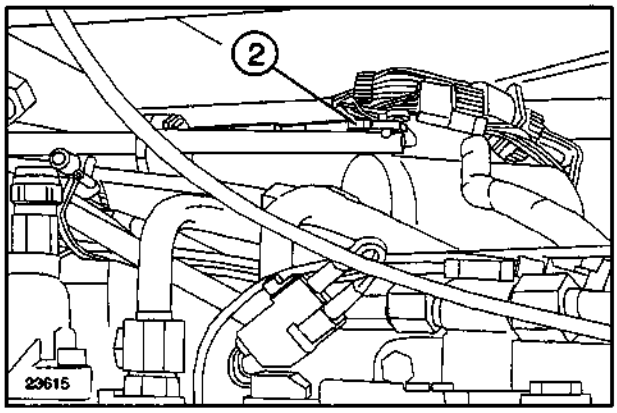


Figure 5-1-23

15. Detach the two connectors (3 and 4) located under the cab floor. Connectors C019 and C020.

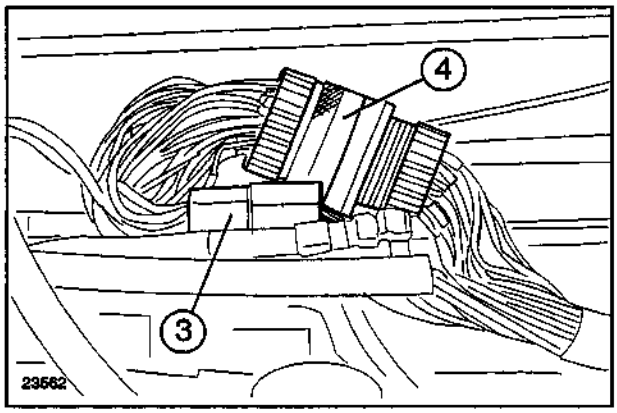


Figure 5-1-24

16. Detach the two connectors (5 and 6) connecting the engine to the cab. Connectors C001 and C002.

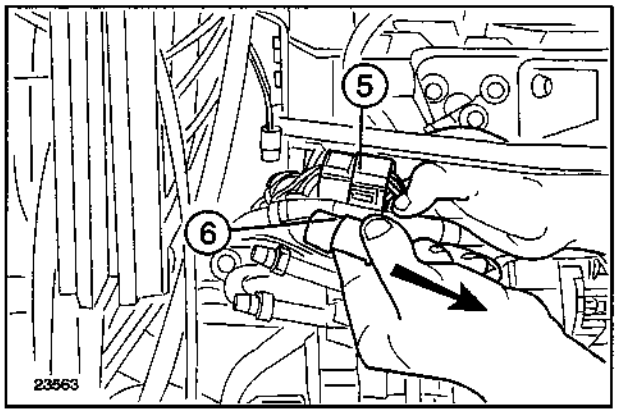


Figure 5-1-25

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17. Detach radar connector (4), fuel filter connector (3), remove protection and detach connectors (1 and 2) from starter motor.

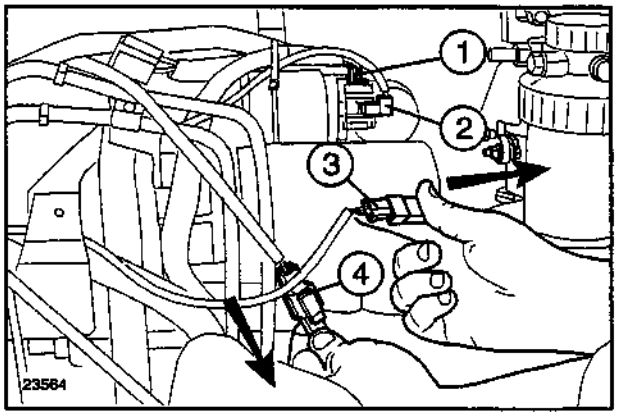


Figure 5-1-26

18. Detach light connector (5) located on the handrail (repeat for both tractor sides).

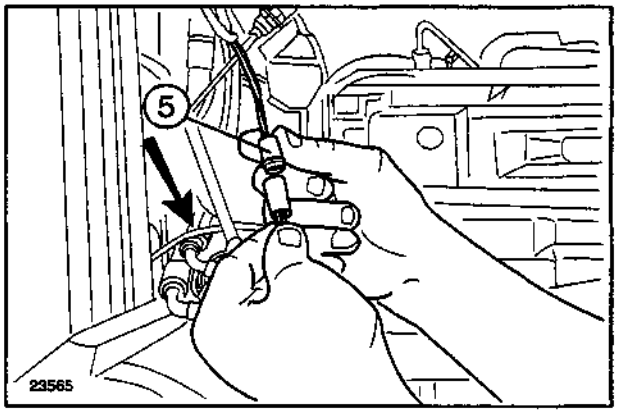


Figure 5-1-27

19. Detach lines (6) connecting heater to the engine, which are located under the front cab right side.

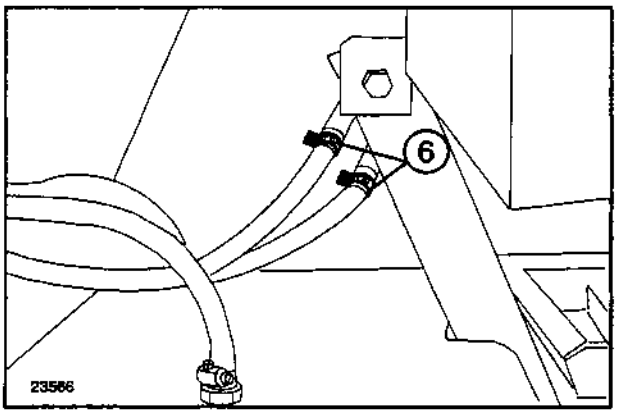


Figure 5-1-28

20. Loosen the retaining nut and detach throttle control cable (7) from injection pump.

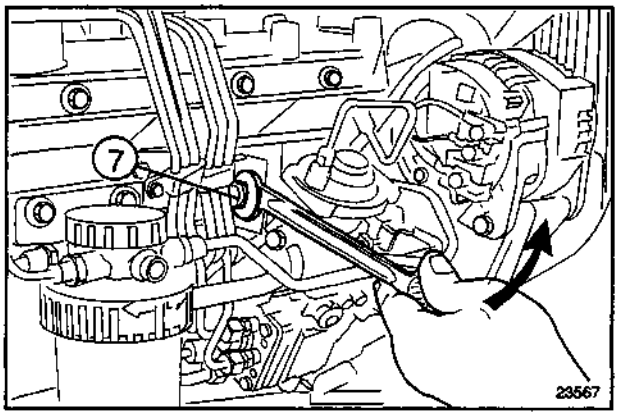


Figure 5-1-29

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21. Detach connectors (1) from brake control pumps and brake fluid tank.

22. Loosen the fittings (2) and detach brake control hoses.

23. Unscrew the hoses connecting the brake control pumps to the tank.

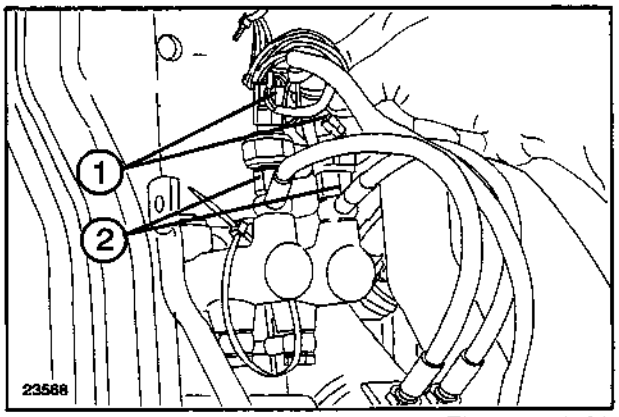


Figure 5-1-30

24. Unscrew the lines (4) connecting the hydrostatic steering valve to control pump.

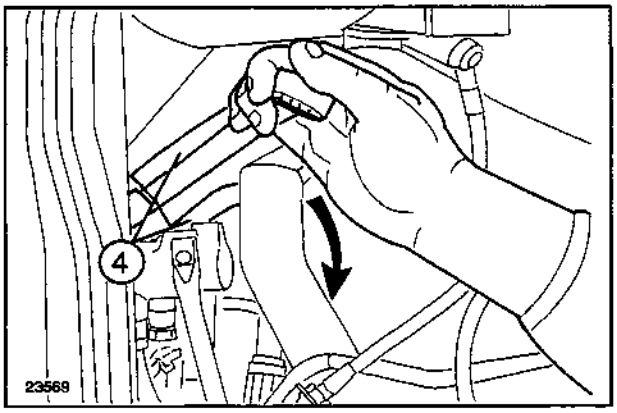


Figure 5-1-31

25. Detach lines (5) connecting the hydrostatic steering valve to the steering control cylinders.

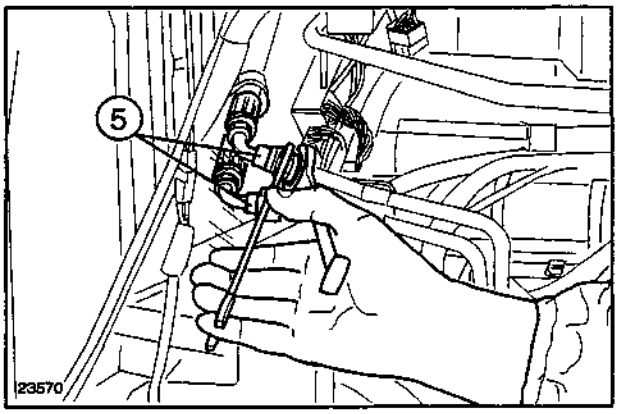


Figure 5-1-32

26. Unscrew the fittings and remove air conditioning lines (6).

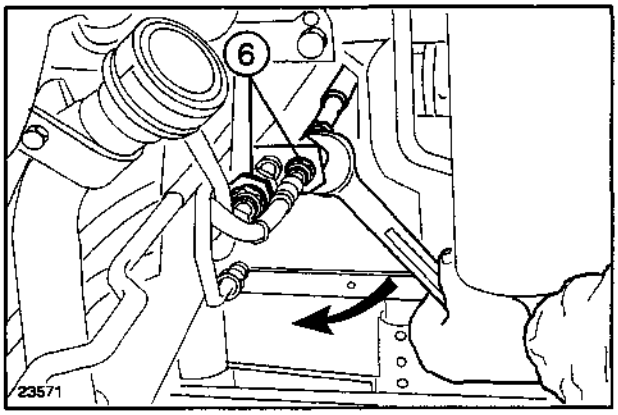


Figure 5-1-33

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27. Loosen the retaining nut, slide out the cotter pin and detach the PTO control cable (1). (Not used in North America).

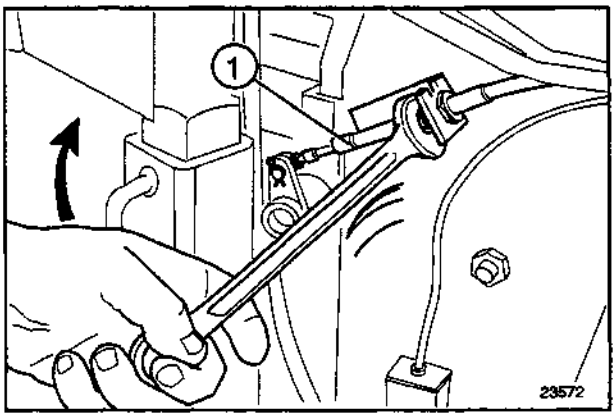


Figure 5-1-34

28. Slide out cotter pins and pins (2), unscrew retaining screws (3) and detach auxiliary valve control cables on right side.

29. If auxiliary valves are fitted also on left side, repeat step 28 for these valves.

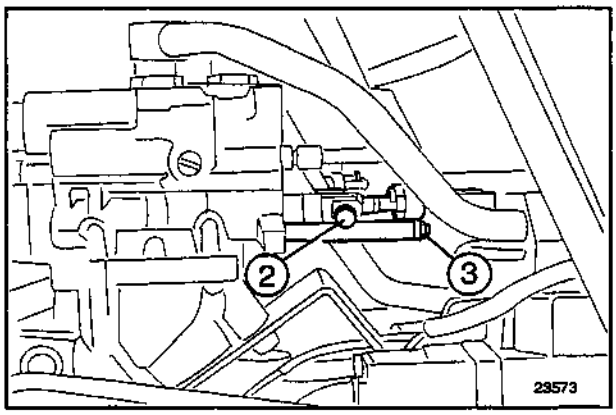


Figure 5-1-35

30. Loosen the screw attaching the steps (6) to the mounting bracket.

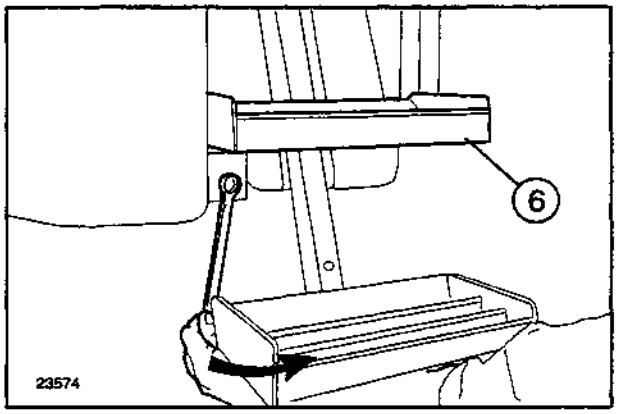


Figure 5-1-36

31. Loosen the screw attaching the steps (1) to the cab floor.

32. Repeat steps 30 and 31 to remove steps on opposite side.

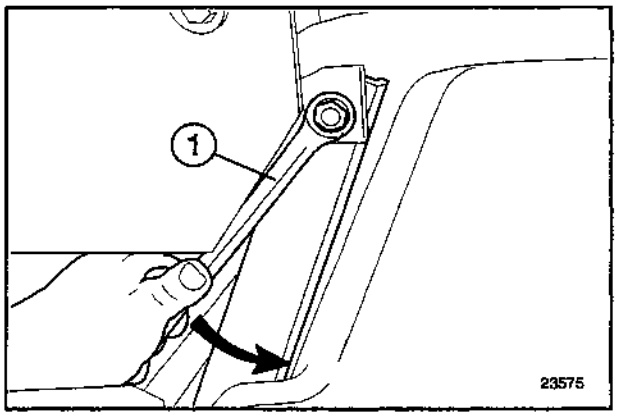


Figure 5-1-37

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33. Raise the floor mat (2) inside the cab and loosen the cab mounting bolt while holding the nut under the cab floor. Recover the bolt and washer. Repeat for both cab sides.

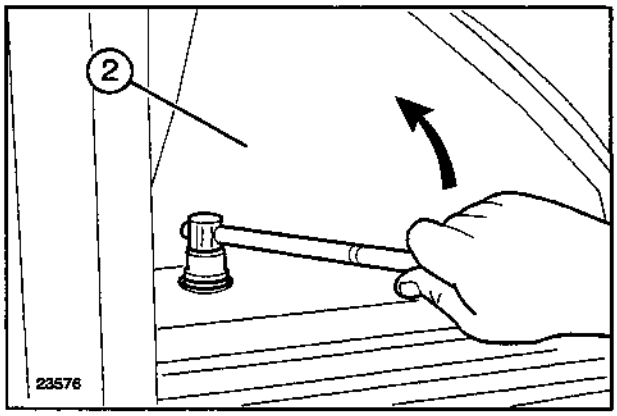


Figure 5-1-38

34. Loosen the rear cab mounting bolts (on both sides).

35. Slowly lift the cab taking care that no components are still connected, hooked or interfering. Remove the cab and lower it onto a suitable base.

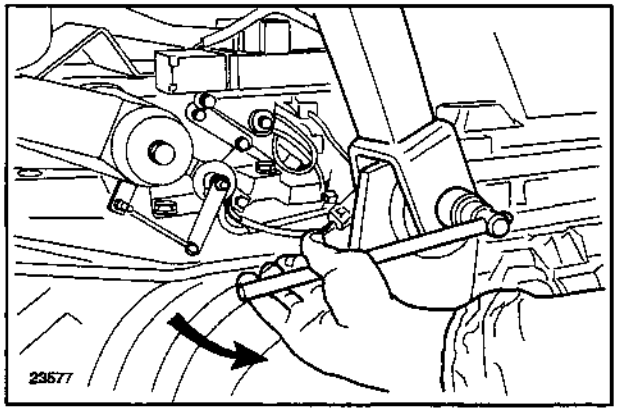


Figure 5-1-39

36. Loosen the plug (3) and drain oil from transmission and rear axle housings into a suitable container (oil capacity is 19.2 gallons on tractors with Dual Command and up to 26.4 gallons on tractors with Range Command).

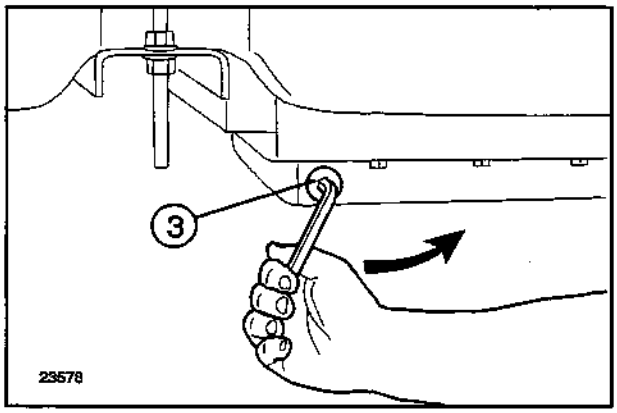


Figure 5-1-40

37. Drain fuel tanks, then loosen the clamp (1) retaining the fuel lines between the main and auxiliary tanks.

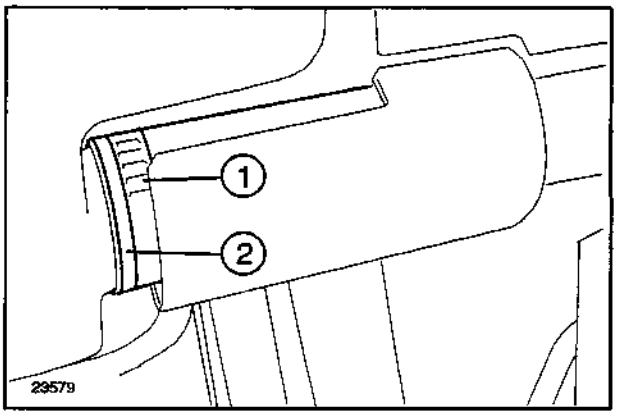


Figure 5-1-41

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38. Loosen the clamp and detach the bleeding line (3) between the main and auxiliary.

39. Detach the fuel return line (2) from the pump to the auxiliary tank. Remove the auxiliary tank.

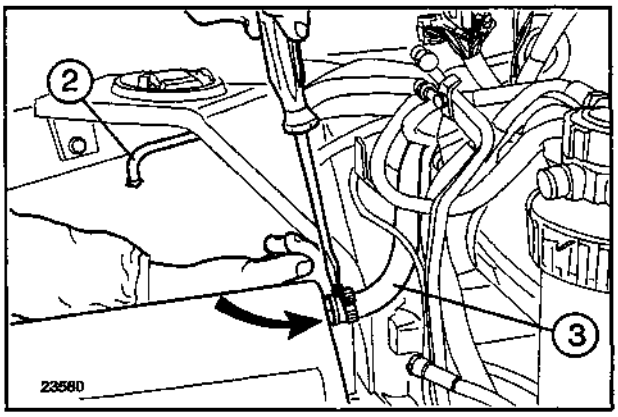


Figure 5-1-42

40. Loosen the clamp and detach the injection pump supply line (5). Detach connectors (4), then unscrew and remove the fuel level sensor assembly.

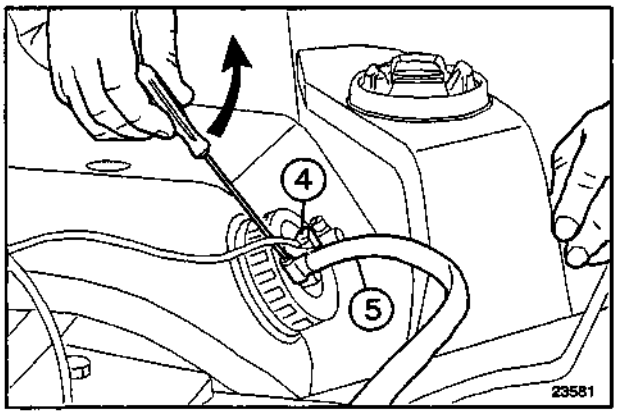


Figure 5-1-43

41. Loosen the nut of the metal strap (6) securing the main tank. Remove the strap and tank.

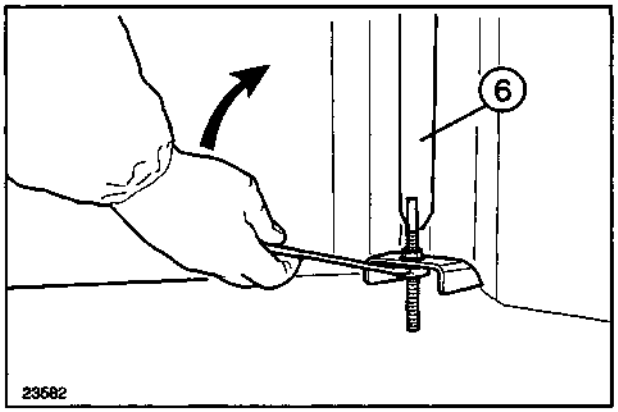


Figure 5-1-44

42. Loosen the retaining screws and remove the cab and fuel tank support bracket (1). (Repeat on both sides of the transmission housing).

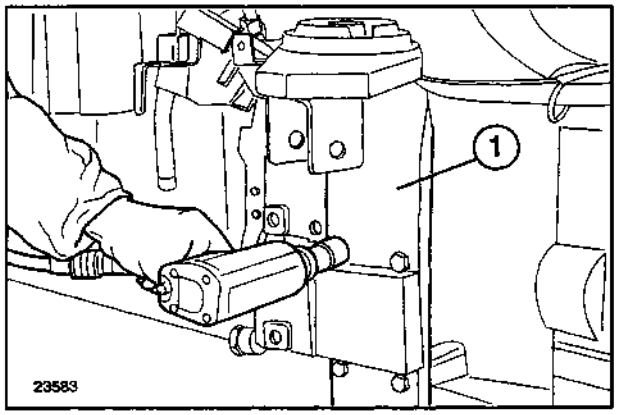


Figure 5-1-45

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43. Loosen the retaining screws and remove the main tank support bracket (2).

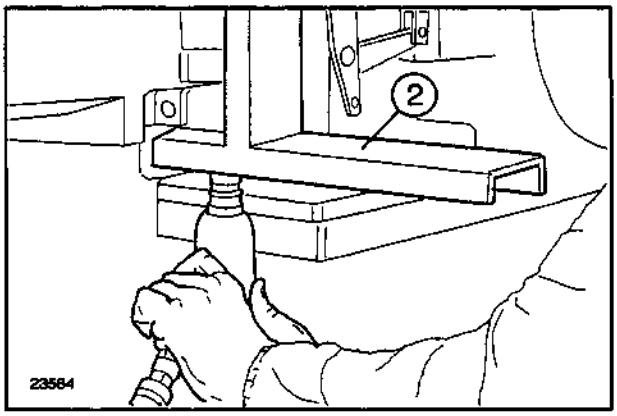


Figure 5-1-46

44. Loosen the attaching screws and remove the guard of the drive shaft to the front axle.

45. Remove the circlip (4) and withdraw the sleeve (5). Repeat for transfer box circlip and sleeve.

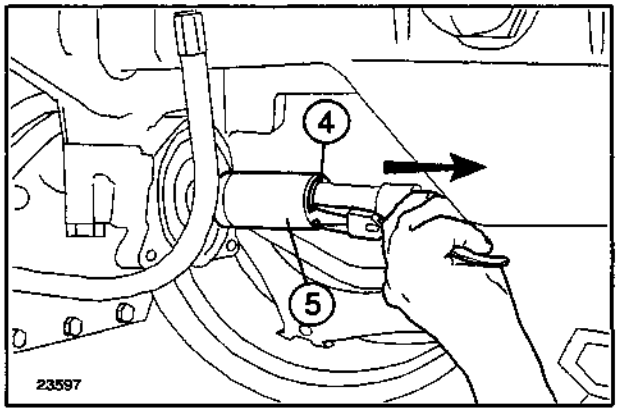


Figure 5-1-47

46. Loosen the screws attaching the support bearing (3) to the transmission housing, detach and remove the front diff lock control line (2).

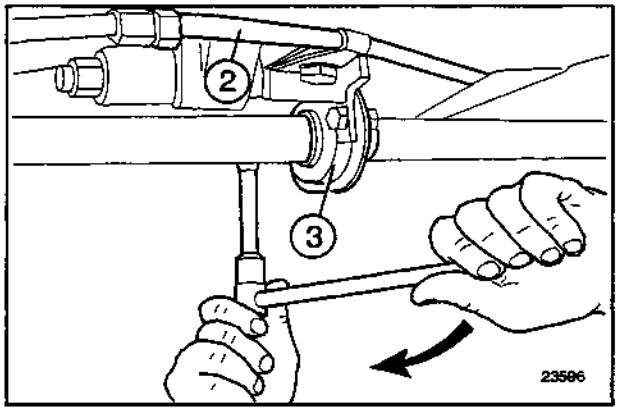


Figure 5-1-48

47. Slide out the hinge pin (1) and remove the top link rod.

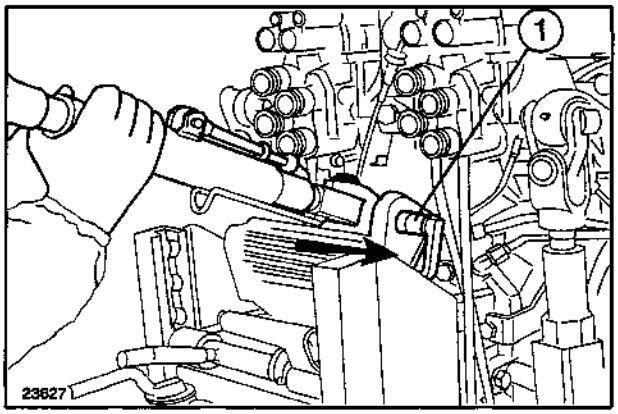


Figure 5-1-49

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48. Hook the tow hitch support (1) to a hoist, loosen the attaching bolts and remove the support.

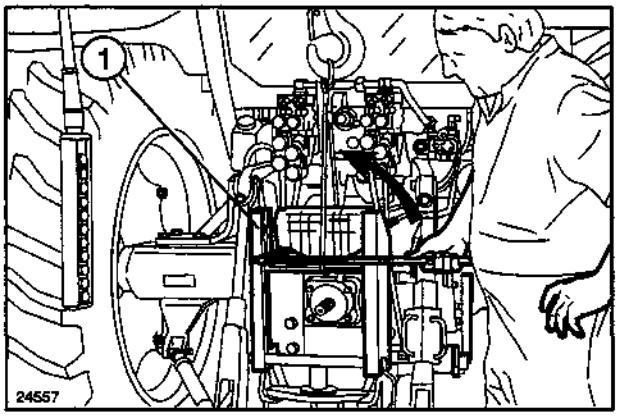


Figure 5-1-50

49. Loosen the retaining screws and remove the cab rear brackets (2) (on both sides). Remove the cab.

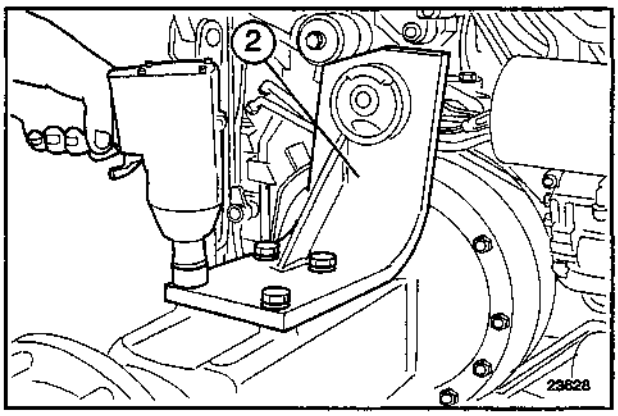


Figure 5-1-51

50. Loosen the retaining screws and remove the telescopic stabilizer hinge brackets (3) (on both sides).

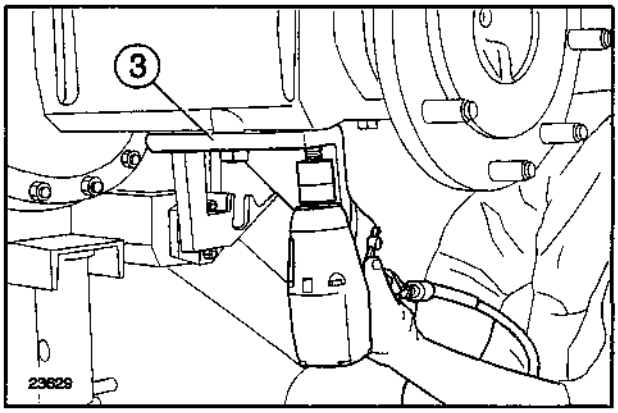


Figure 5-1-52

51. Loosen all line fittings (1) at the auxiliary valves, EDC valve, variable displacement pump, trailer brake valve and remove line.

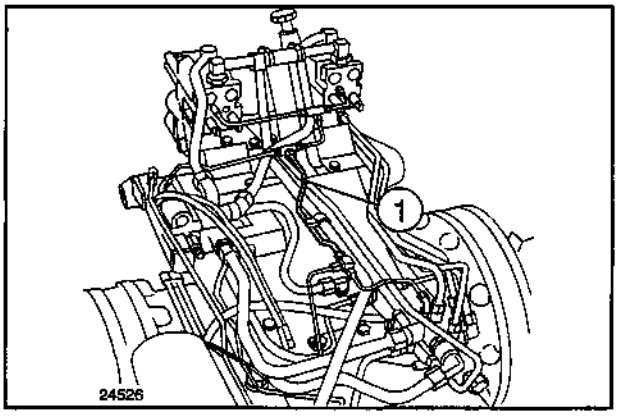


Figure 5-1-53

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52. Loosen and detach fittings (1 and 2) from the EDC valve.

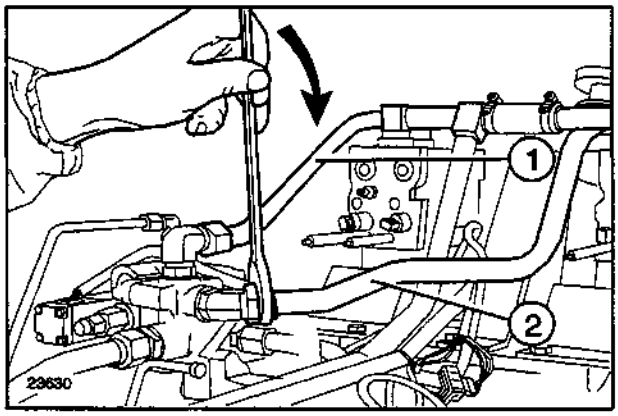


Figure 5-1-54

53. Loosen and remove return line (3) fitting from the variable displacement pump filter.

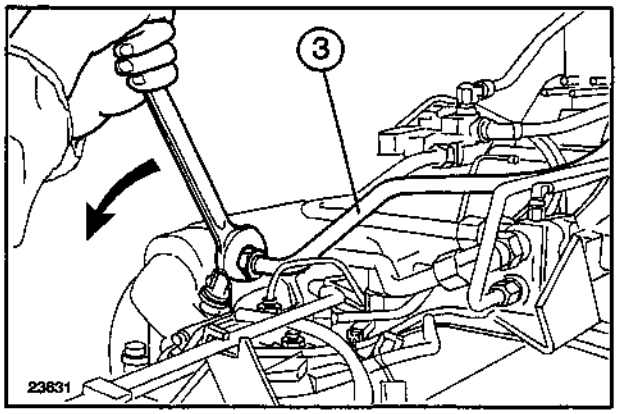


Figure 5-1-55

54. Release clamps and withdraw the sleeve (4) from the outlet line (3).

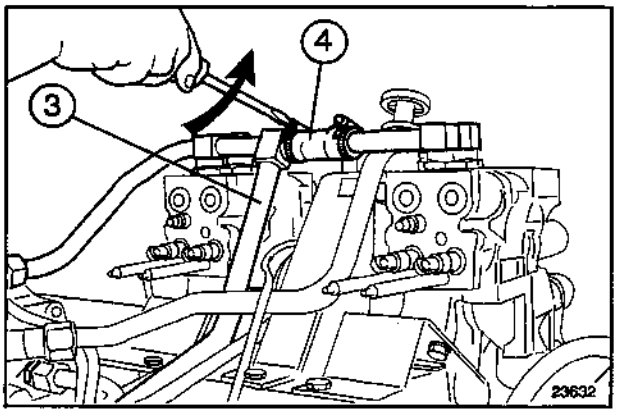


Figure 5-1-56

55. Loosen the retaining screws and remove the two valves (5) together with the line (2) and bracket.

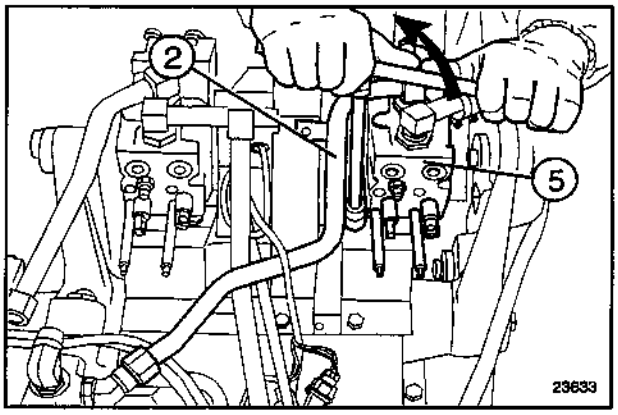


Figure 5-1-57

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56. Detach the multi–pole socket (1) and trailer brake line terminal (2) from the bracket.

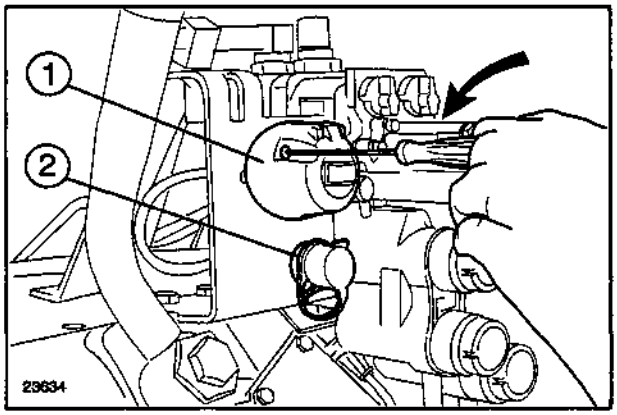


Figure 5-1-58

57. Loosen the retaining screws and remove the multi–pole socket and trailer brake line bracket (3).

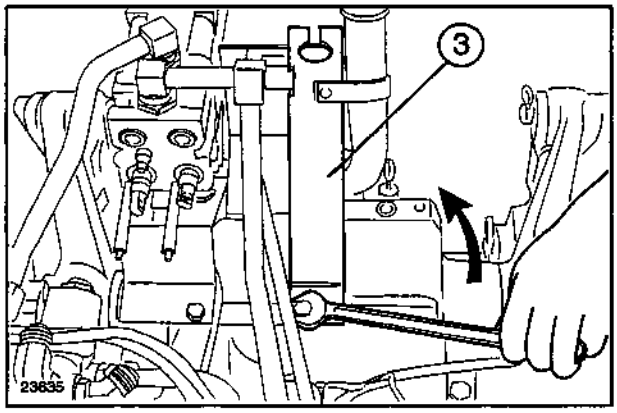


Figure 5-1-59

58. Loosen the retaining nut and remove the oil filler tube (4) to the rear axle housing.

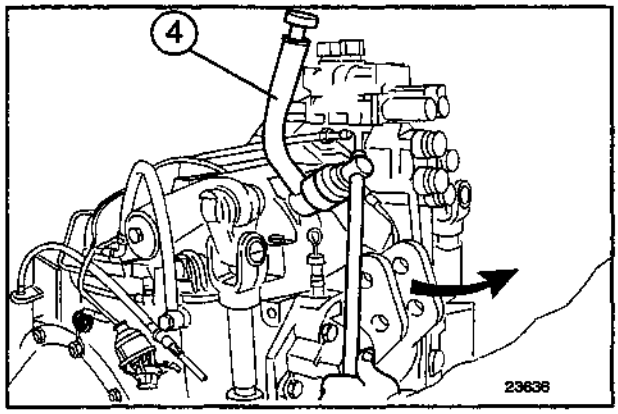


Figure 5-1-60

59. Remove the attaching screws and detach the auxiliary valves (5), inlet and outlet lines and bracket.

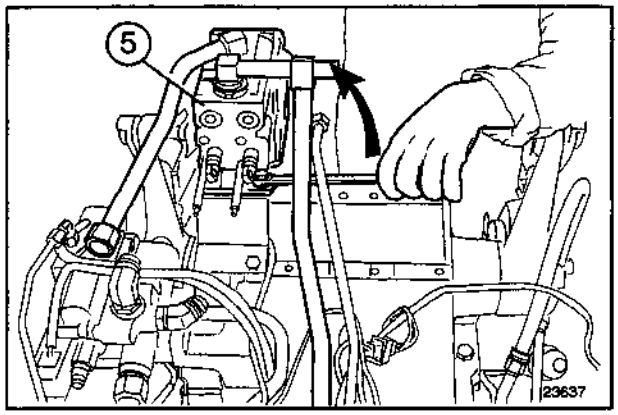


Figure 5-1-61

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60. Detach the EDC valve connector (1).

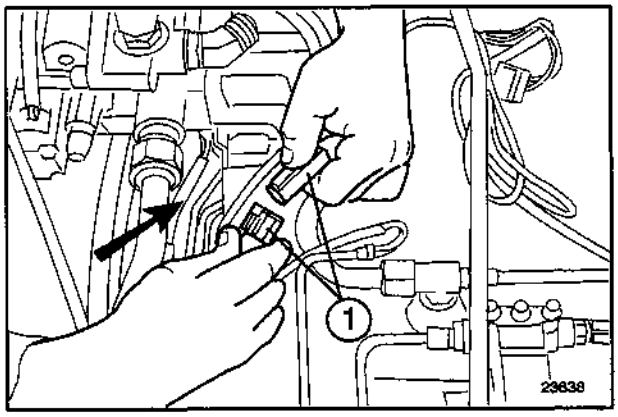


Figure 5-1-62

61. Detach lines (2, 3, and 4) from the hydraulic lift valve, lift housing fitting and trailer brake valve, respectively.

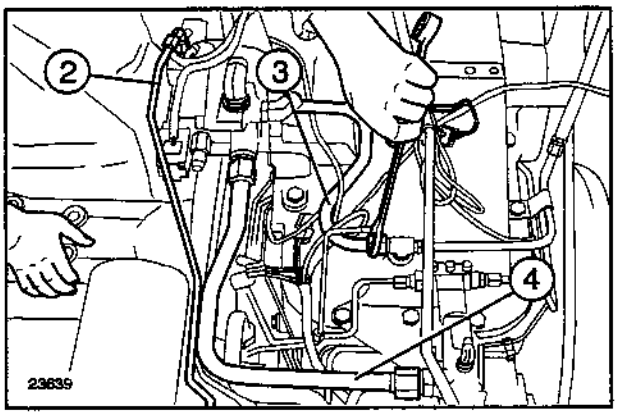


Figure 5-1-63

62. Remove the retaining screws and detach the EDC valve (5).

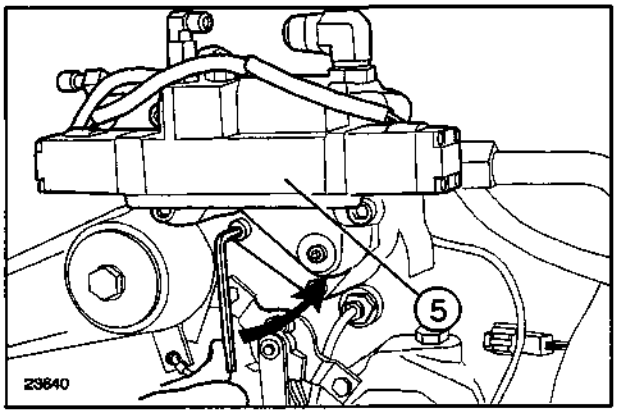


Figure 5-1-64

63. Detach lines (6 and 7) from the variable displacement pump assembly and lines (8) from the rear axle housing.

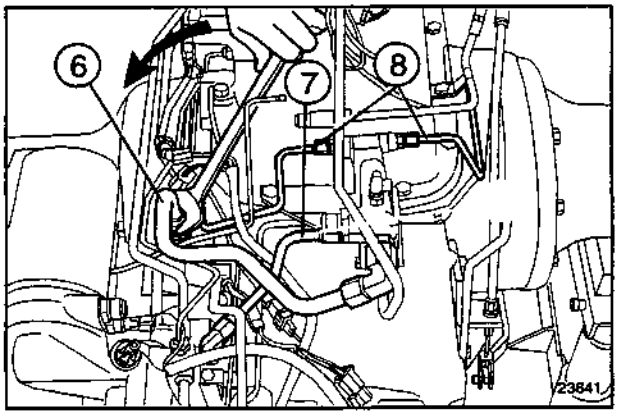


Figure 5-1-65

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64. Loosen the retaining screws and remove the trailer brake valve (1), bracket and lines disconnected at step 63.

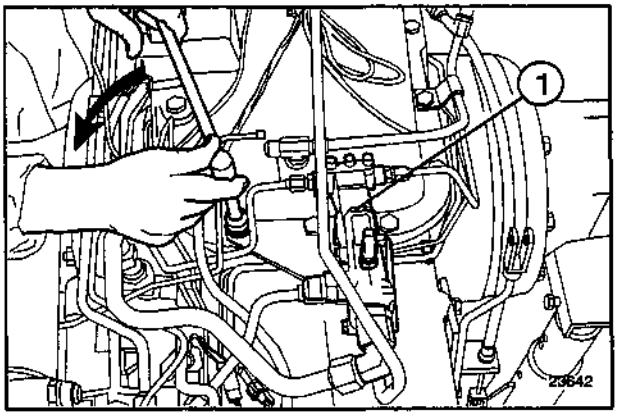


Figure 5-1-66

65. Detach the following connectors: (2) for PTO speed sensor, (3) for draft sensor connection, and (4) for lift arm max. height.

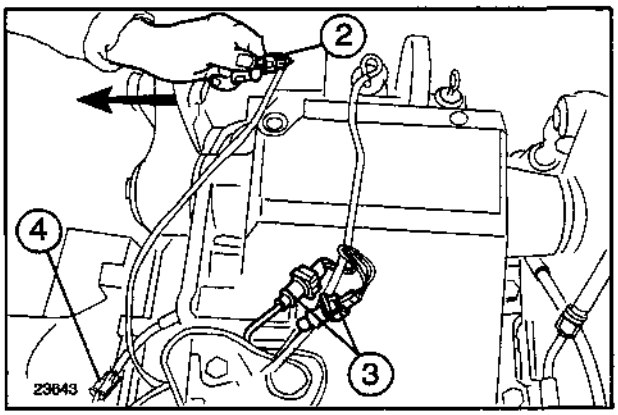


Figure 5-1-67

66. Detach the following connectors: (5) for synchronized PTO speed sensor, (6) for speed sensor, and (7, 8, and 9) from the variable displacement pump assembly. Remove the cotter pin and remove the synchronized PTO drive rail (10).

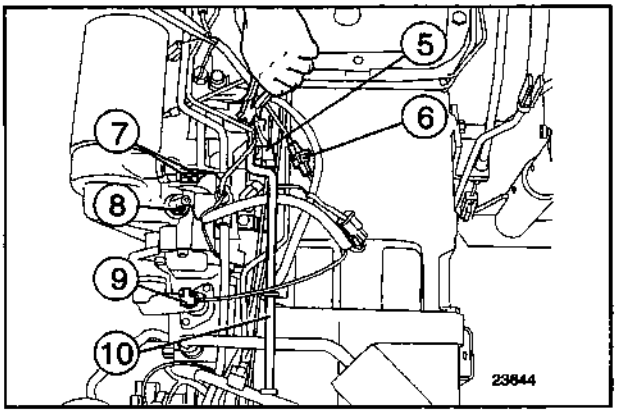


Figure 5-1-68

67. Detach and remove hydraulic lift and PTO lubrication lines (11, 12, and 14). Remove the retaining screw (13) of the brake line bracket.

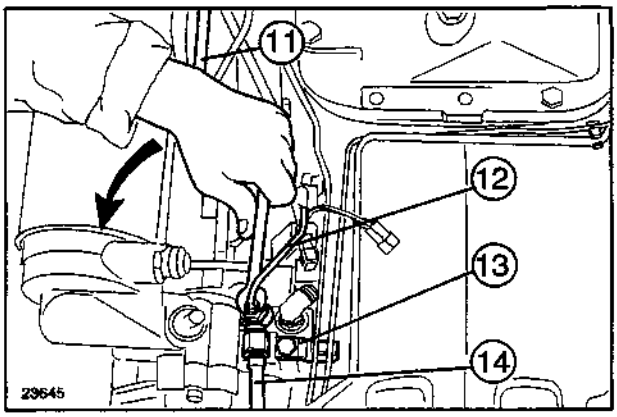


Figure 5-1-69

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68. Loosen and remove the hydrostatic steering supply line (1).

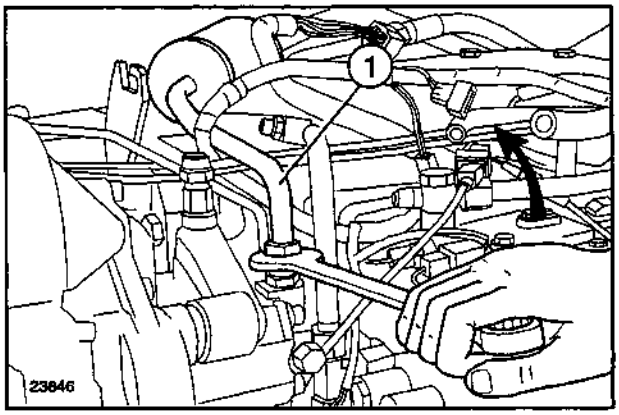


Figure 5-1-70

69. Detach and remove the accumulator (2) to pump connecting line.

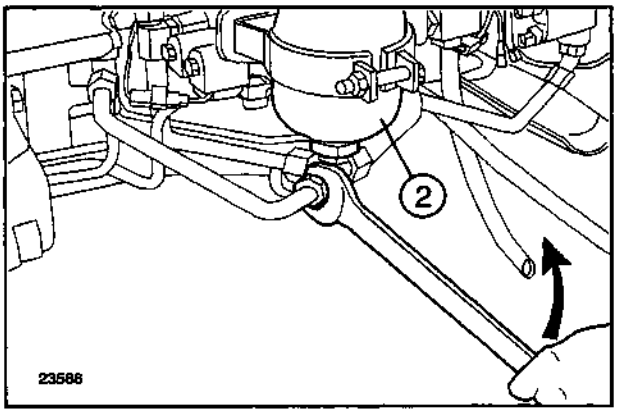


Figure 5-1-71

70. Loosen and remove the differential unlock control line (3).

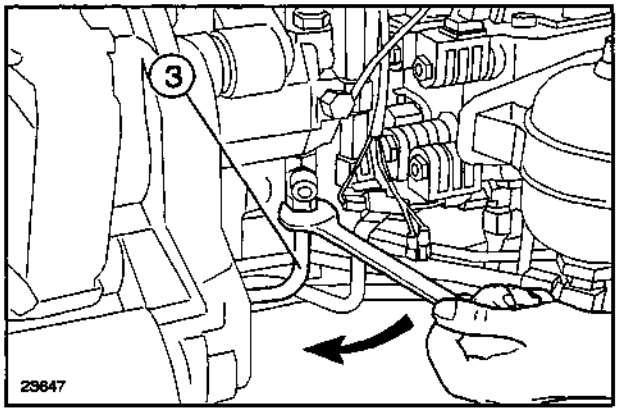


Figure 5-1-72

71. Connect the variable displacement pump assembly to a hoist, loosen the attaching bolts and remove the assembly.

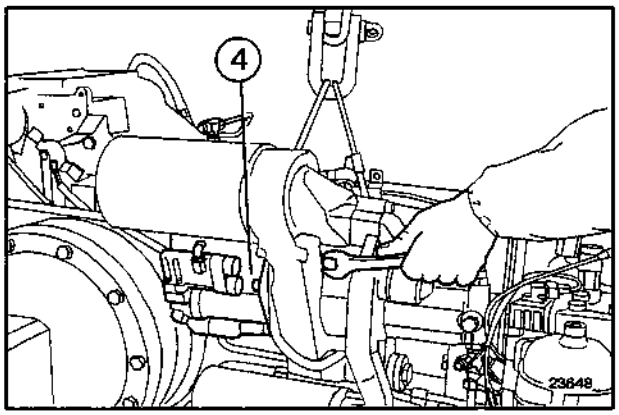


Figure 5-1-73

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72. Slide out the hinge pins and detach the lift rods (1).

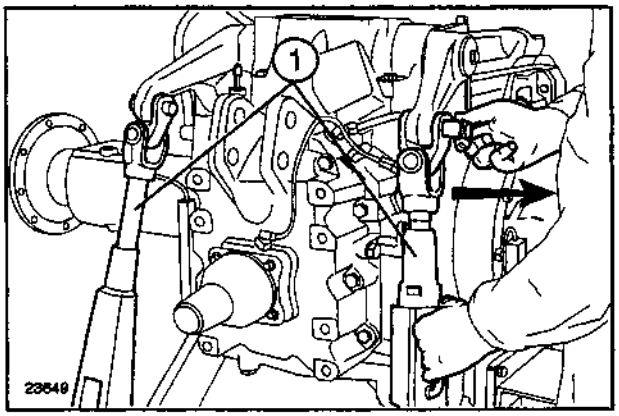


Figure 5-1-74

73. Detach the oil supply line (2), withdraw the pivot pins (3 and 4) and remove the assist ram.

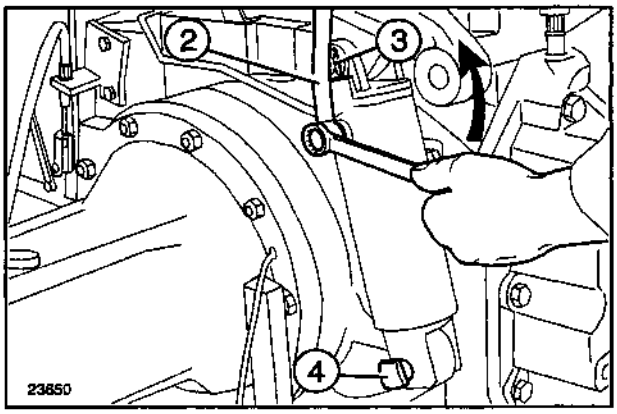


Figure 5-1-75

74. Detach the PTO speed sensor wire tie–strap.

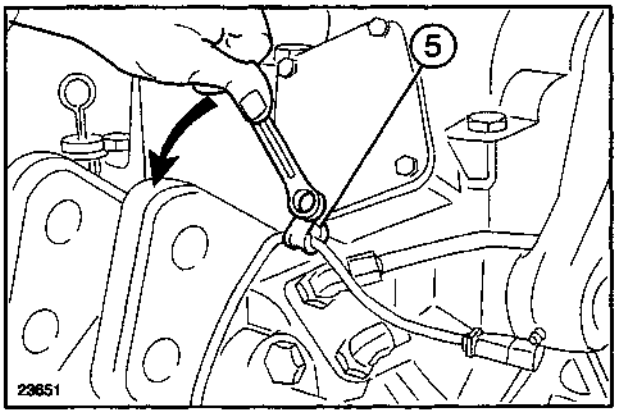


Figure 5-1-76

75. Connect the chain hoist (6) to the lift, unscrew lift attaching bolts and remove lift.

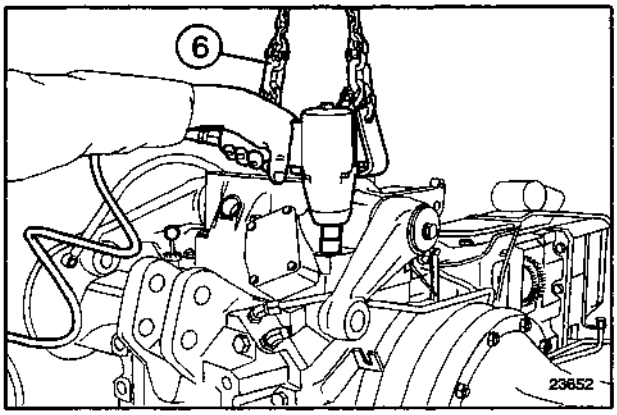


Figure 5-1-77

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76. Loosen the retaining screws and remove the lift arm max. height sensor (1).

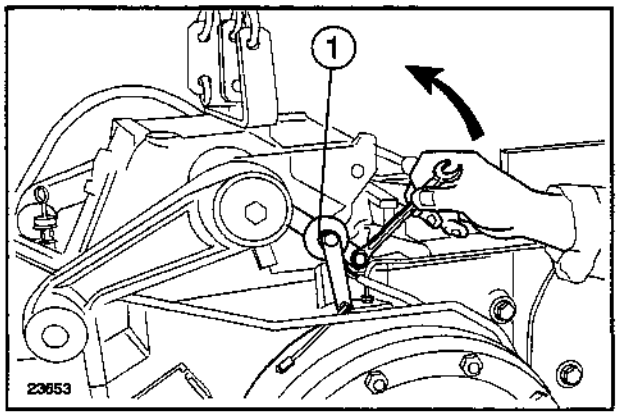


Figure 5-1-78

77. Remove the retaining screws, slide out the draft sensor (2) with its protection (4) and mounting plate (3). Recover the lower link (5). (Repeat for both sides).

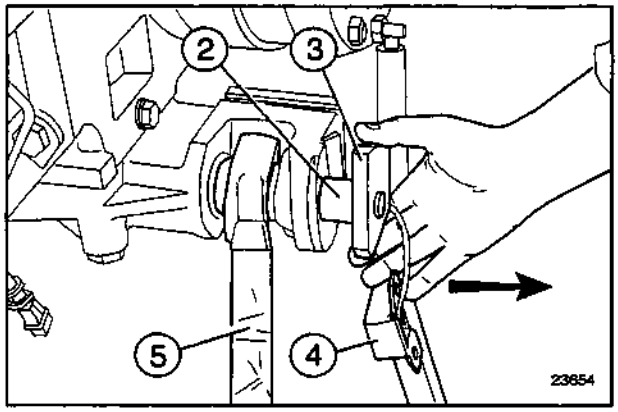


Figure 5-1-79

78. Disconnect the PTO clutch control line (6).

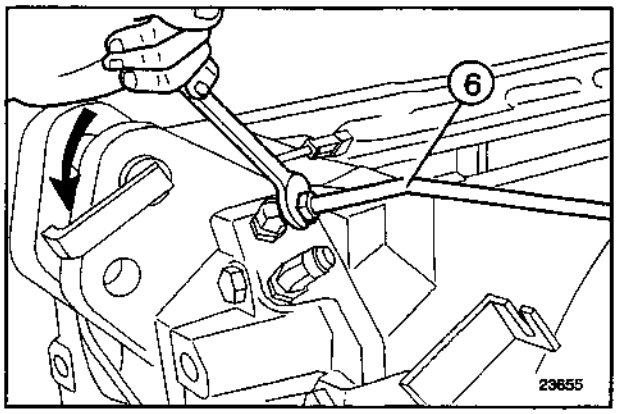


Figure 5-1-80

79. Attach a metal cable to a hoist and PTO assembly (7), loosen the attaching bolts (8) and remove PTO assembly (7).

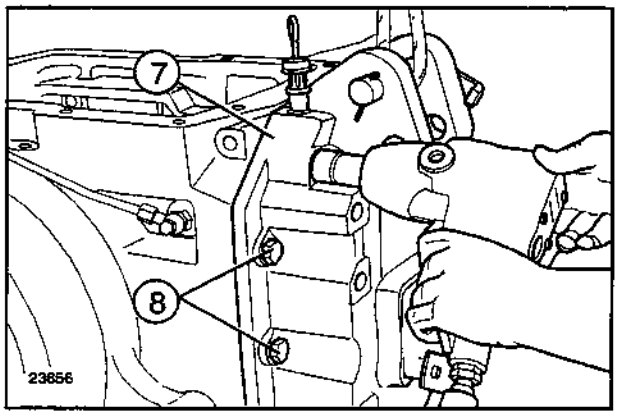


Figure 5-1-81

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80. Using two suitable studs, connect the draft sensor support (1) to a nylon cable. Attach the nylon cable to a hoist, loosen the attaching bolts and remove the support.

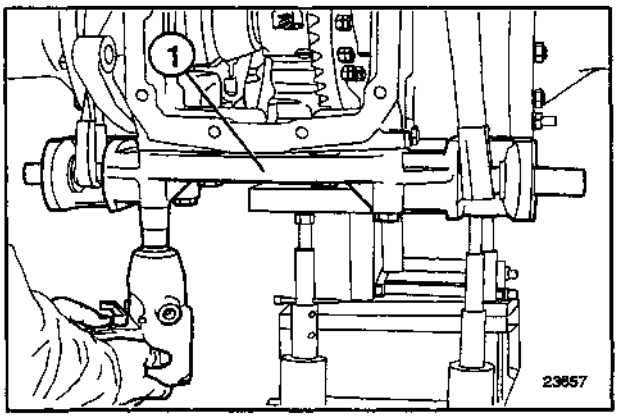


Figure 5-1-82

81. Disconnect and remove the creeper control rail (2) and parking brake control cable (3).

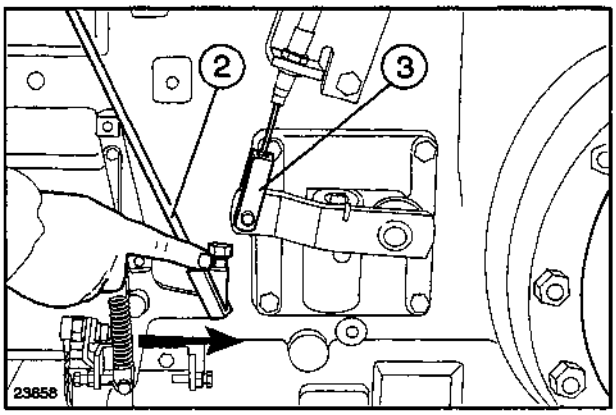


Figure 5-1-83

82. Detach the differential lock, FWD engagement, PTO control, and PTO brake lines from the solenoid support (4) and rear axle housing and remove lines.

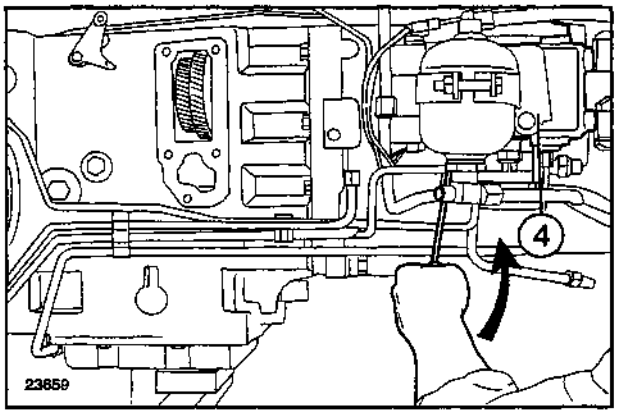


Figure 5-1-84

83. Loosen and detach brake control lines (5) from rear axle housing.

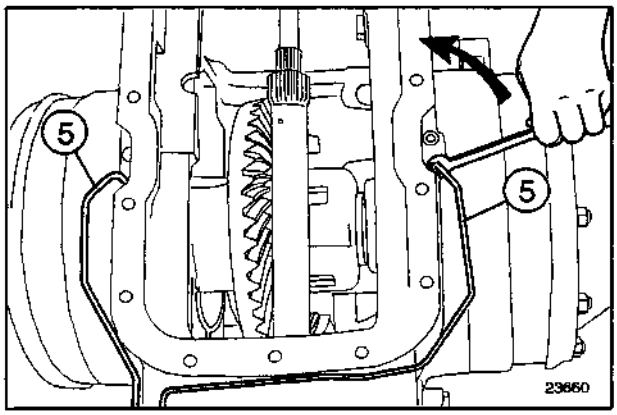


Figure 5-1-85

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84. Properly support the transmission and rear axle housings.

85. Fix tool no. **50091** (1) to the final drive case, connect it to a hoist, loosen attaching bolts and remove the entire final drive complete with the outer ring gear, spacer, brake disc, and brake control piston. (Repeat for the final drive case on the other side).

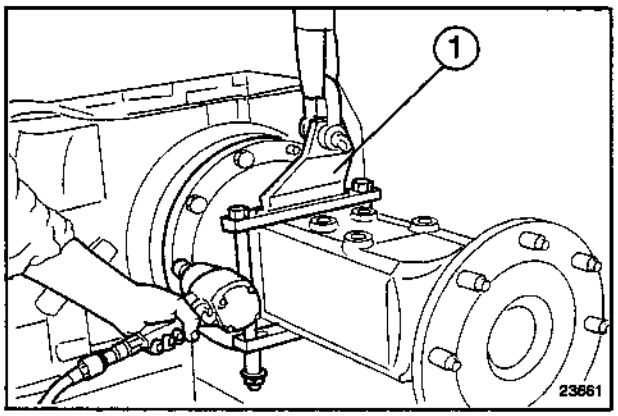


Figure 5-1-86

86. Connect chain (2) to the rear axle housing and hoist, tension the chain, loosen the attaching bolts (3) and detach the rear axle housing from the transmission housing.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

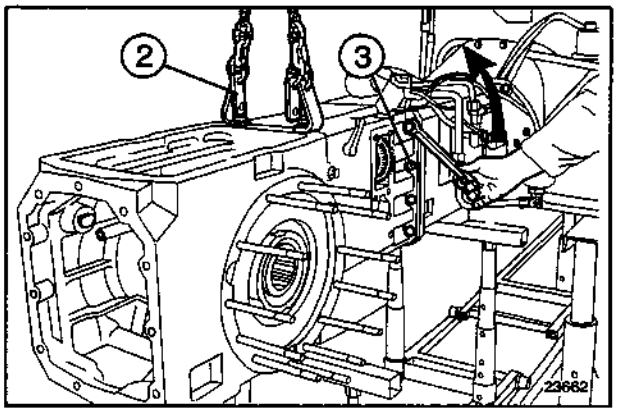


Figure 5-1-87

87. Reinstall the rear axle housing assembly to the transmission housing observing the following:

- Reassembly follows the disassembly procedure in reverse, from step 86 back to step 1.
- Check seals and replace if damaged.
- Before reassembling housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approx. 0.079 in (2 mm) of diameter following the patterns shown in the figures on pages 5-1-35 and 5-1-36.
- Tighten to correct torque as detailed on pages 5-1-3 and 5-1-4.

88. To assist reinstallation of the final drive case, we advise to position the half–shaft (4) into its seat on the differential and brake disc.

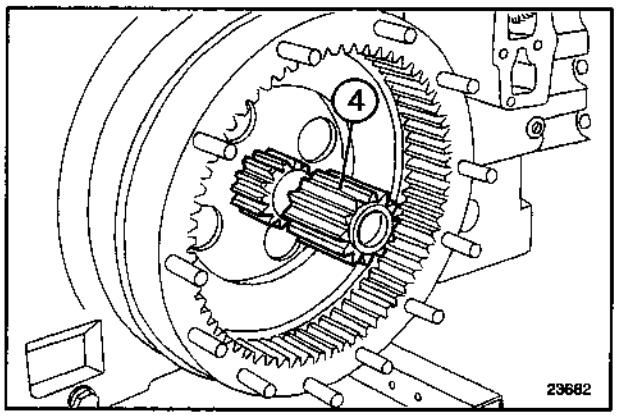


Figure 5-1-88

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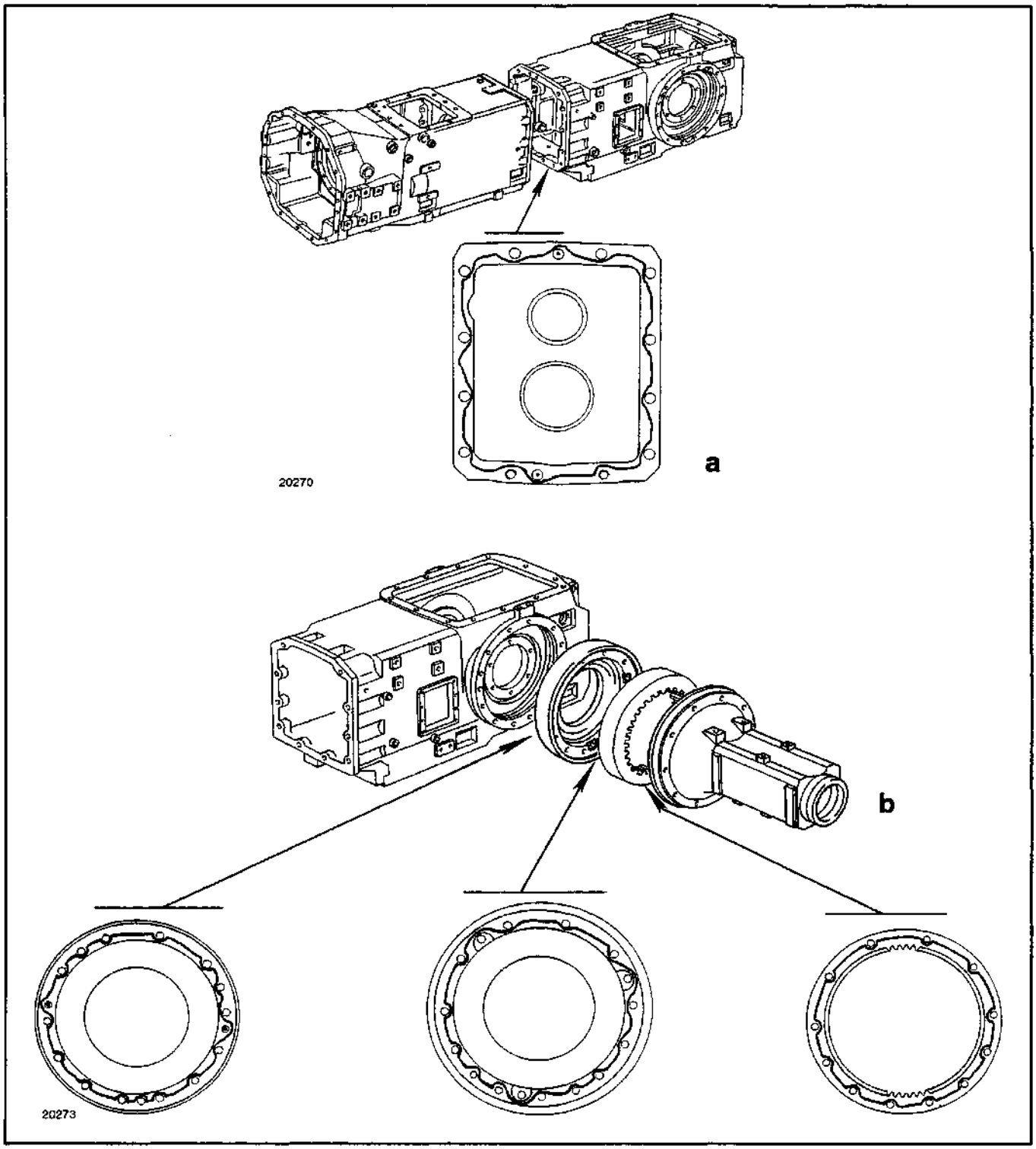


Figure 5-1-89

Patterns for application of liquid gasket during reinstallation of: (a) transmission housing to rear axle housing; (b) final drive cases to rear axle housing.

Sealants to be used are listed on page 0-1-19, Section 00

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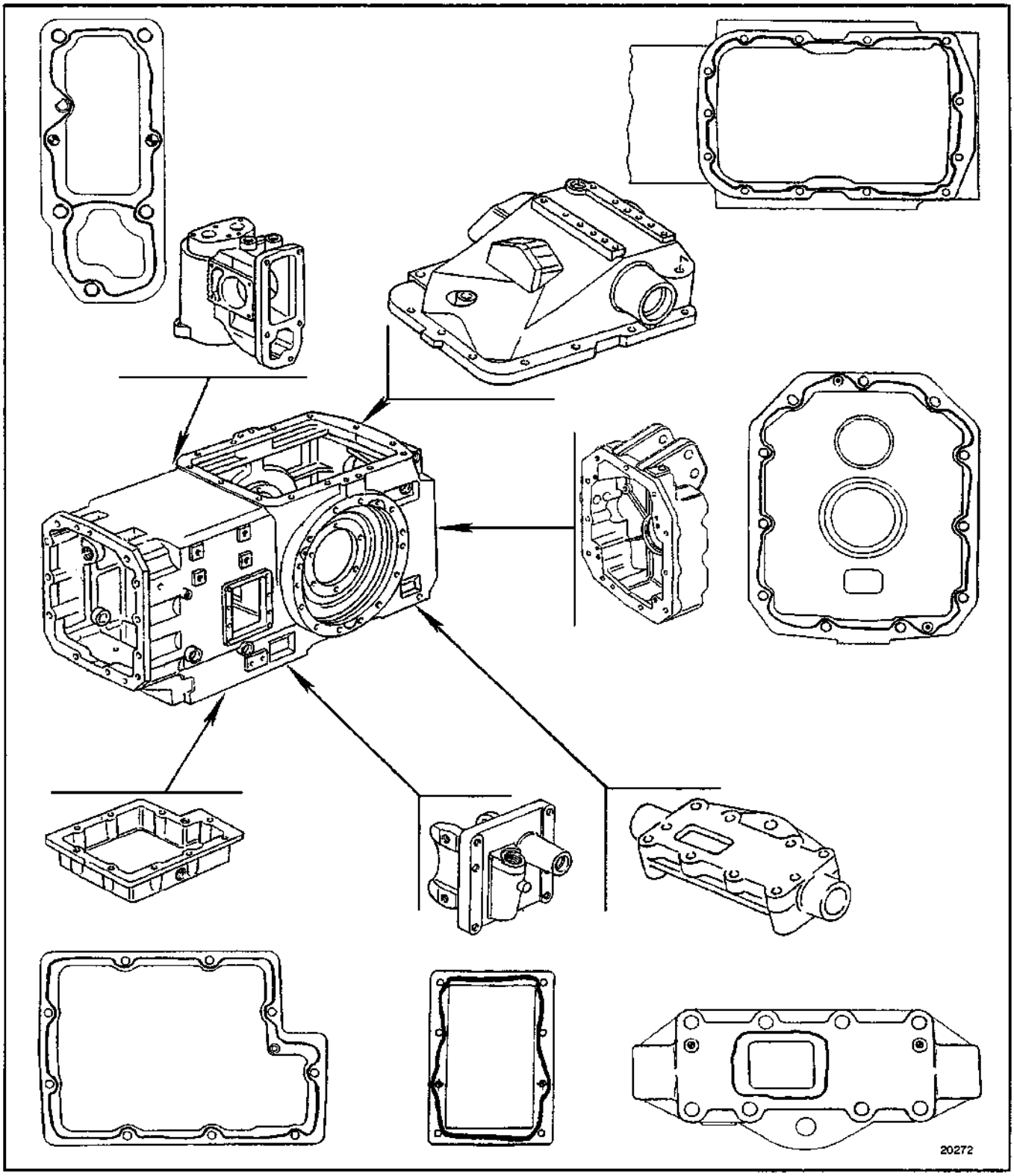


Figure 5-1-90

Patterns for application of liquid gasket during reinstallation of: (a) hydraulic pump mounting plates; (b) hydraulic lift; (c) PTO housing; (d) flex bar support; (e) parking brake bracket; (f) rear axle housing bottom cover.

Sealants to be used are listed on page 0-1-19, Section 00.

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REAR AXLE HOUSING

Replacement

⚠ WARNING ⚠

Handle all components with the greatest care.Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

To replace the rear axle housing it is necessary to detach the rear axle housing from the transmission housing first. Then proceed as follows:

1. Remove the hydraulic pump drive gear locking circlip (1).

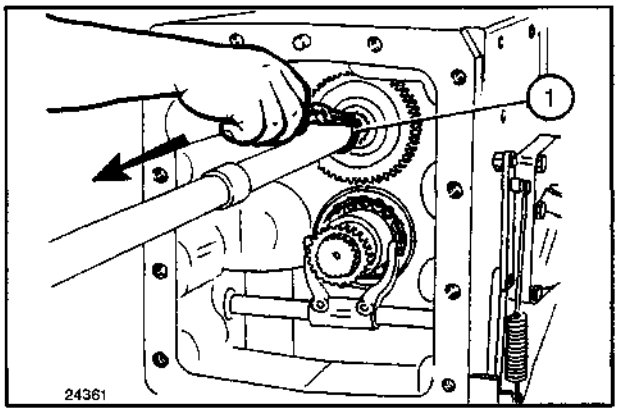


Figure 5-1-91

2. Withdraw the hydraulic pump drive gear (1) and recover the spacer.

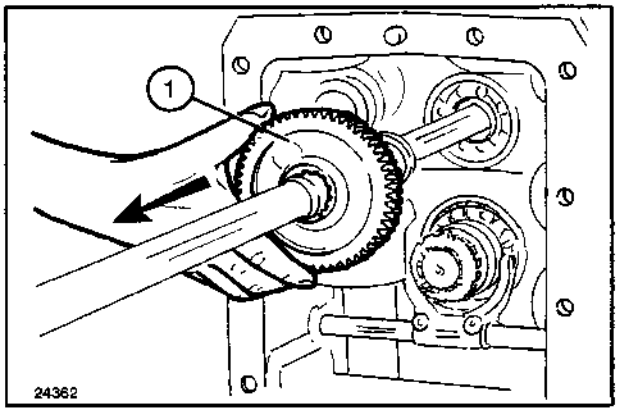


Figure 5-1-92

3. Remove the PTO shaft bearing retaining circlip.

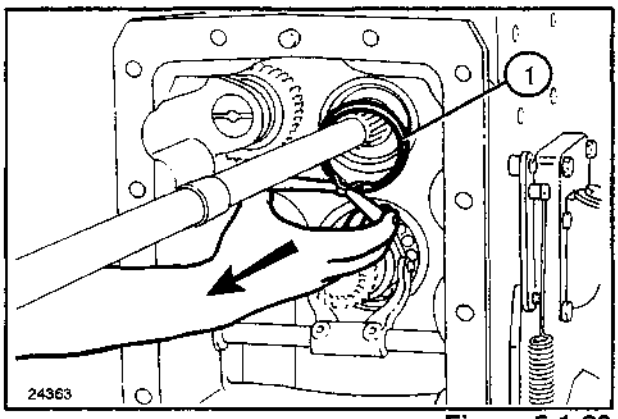


Figure 5-1-93

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4. Withdraw the PTO drive shaft and bearing (1).

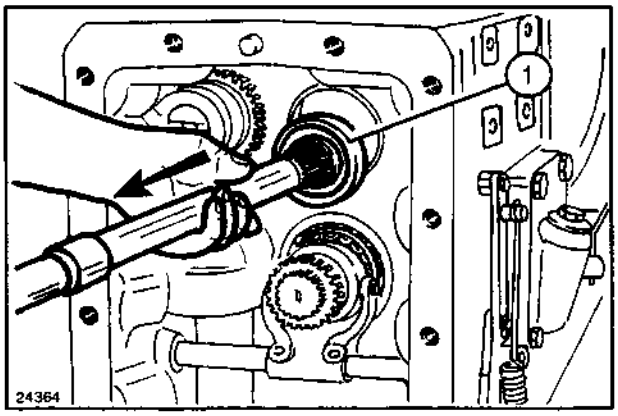


Figure 5-1-94

5. Place the rear axle housing on a suitable stand.

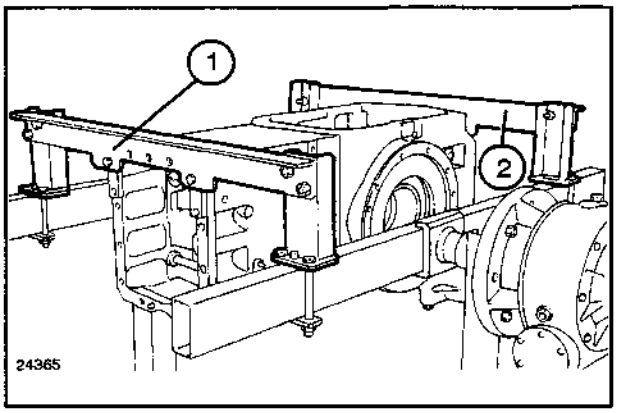


Figure 5-1-95

6. Loosen the attaching bolts and remove the parking brake control assembly (1).

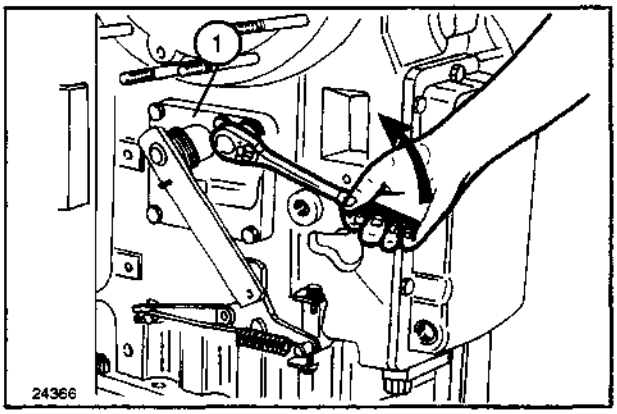


Figure 5-1-96

7. Loosen the differential lock control lines (1).

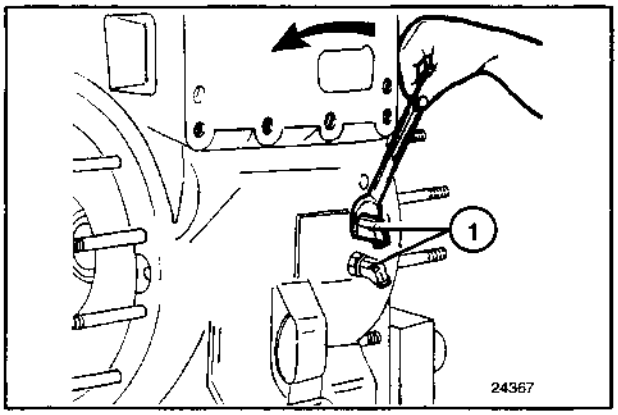


Figure 5-1-97

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8. Withdraw the differential lock control lines (1).

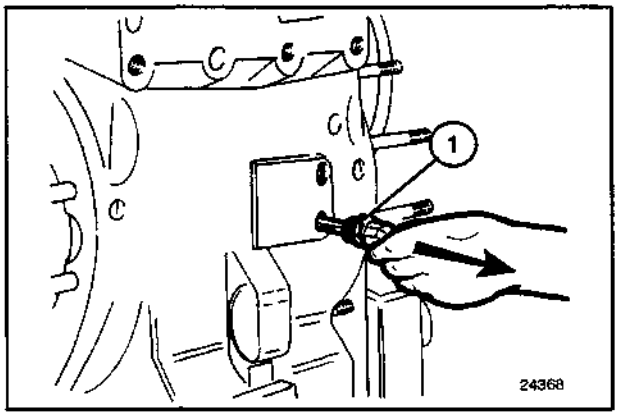


Figure 5-1-98

9. Loosen the retaining screws and recover the transfer box bottom cover.

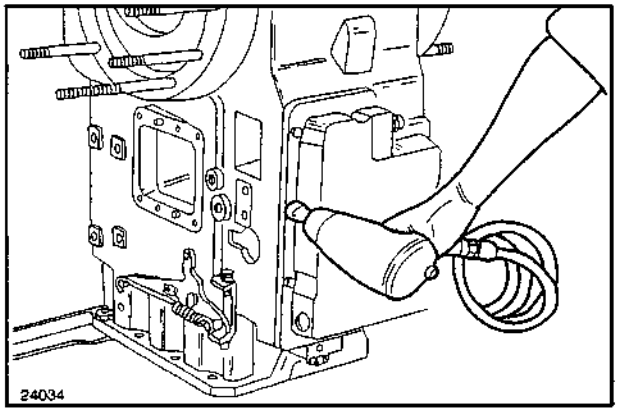


Figure 5-1-99

10. Straighten the locking tabs, unscrew the bolts and remove the transfer box inner guard.

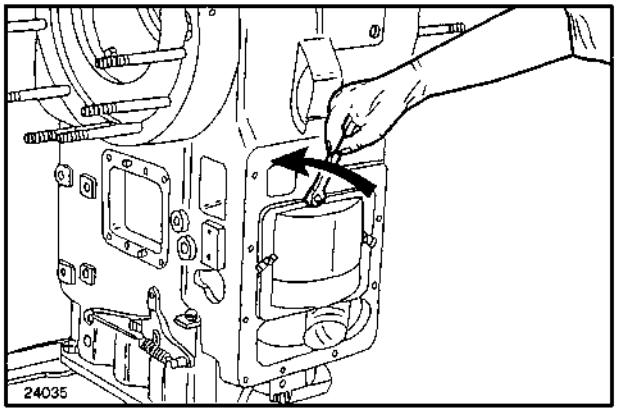


Figure 5-1-100

11. Loosen the hinge pin and withdraw the flex bar draft idler unit (1)

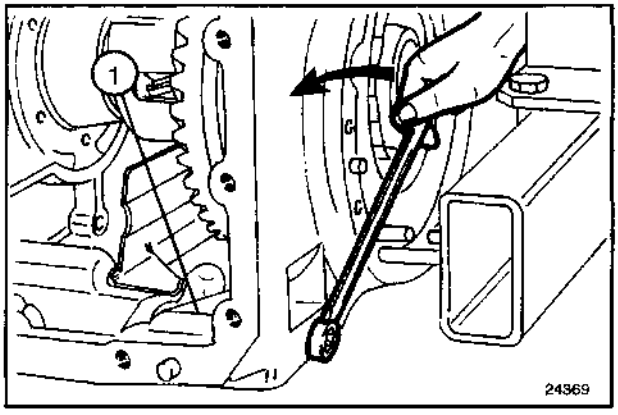


Figure 5-1-101

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12. Remove the ground synchronized PTO drive gear (1) retaining snap ring (2).

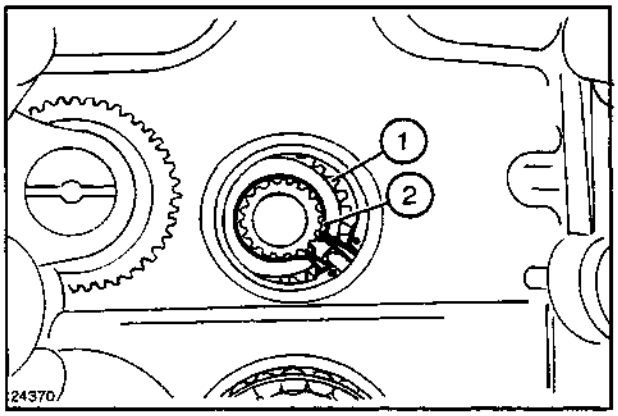


Figure 5-1-102

13. Using a suitable tool, push the lever (1) to the side and release the mentioned gear (2, Figure 5-1-102) from the drive skid. Remove the gear.

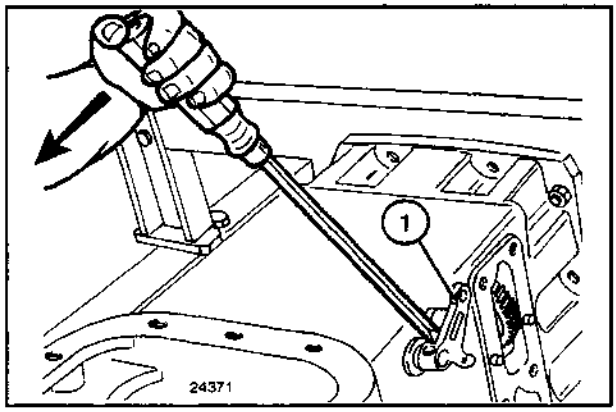


Figure 5-1-103

14. Remove the snap ring (1) and slide out the ground synchronized PTO drive shaft (2) and bearing.

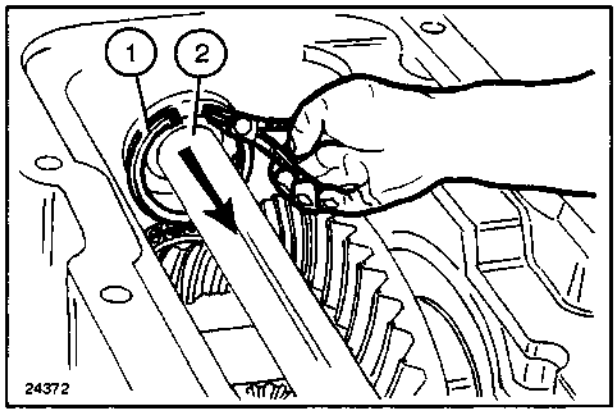


Figure 5-1-104

15. Withdraw the spring pin and remove the ground synchronized PTO control lever (1).

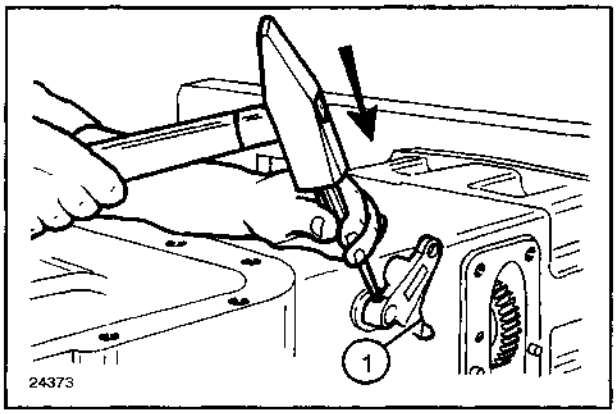


Figure 5-1-105

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16. Loosen the setscrew using adapter tool no. **50140** (1, see on page 5-1-7) and the slide hammer tool.

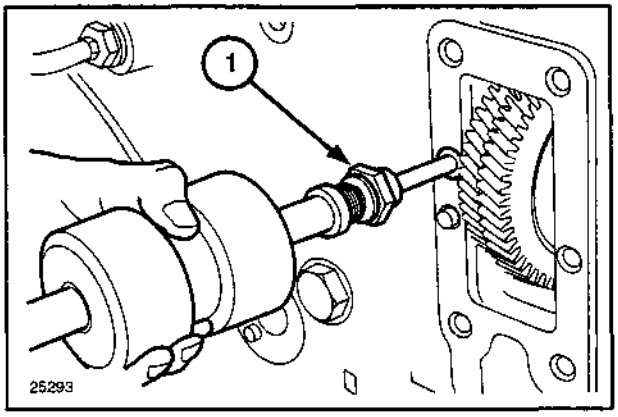


Figure 5-1-106

17. Using adapter tool no. **50143** (1, see on page 5-1-7) and slide hammer, withdraw the pin and recover gear, bearings and adjustment shim.

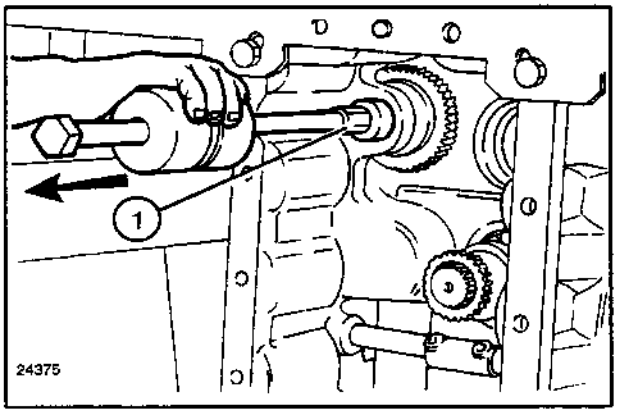


Figure 5-1-107

18. Remove the spring (2) using a suitable hook (1).

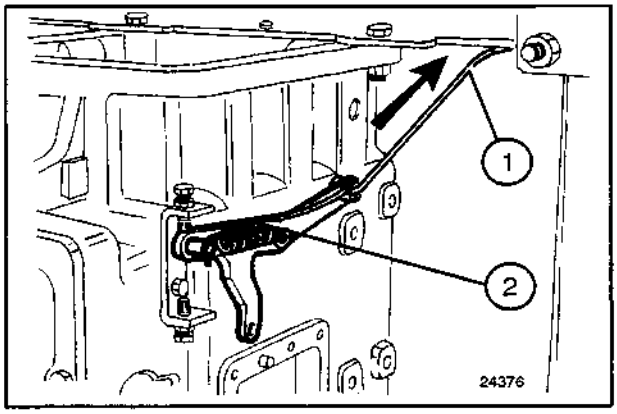


Figure 5-1-108

19. Detach the locking clip (1) .

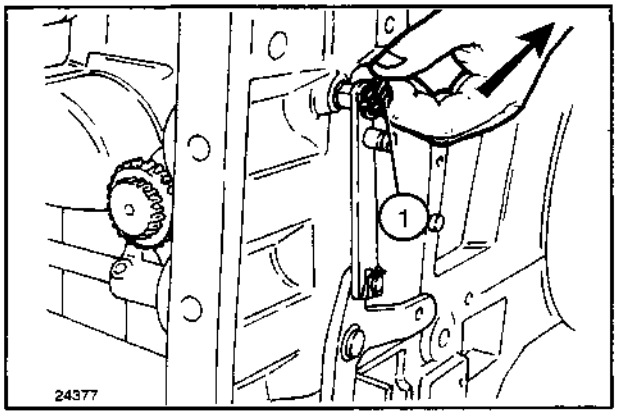


Figure 5-1-109

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20. Remove the spring pins, withdraw the lever (1) and recover the fork.

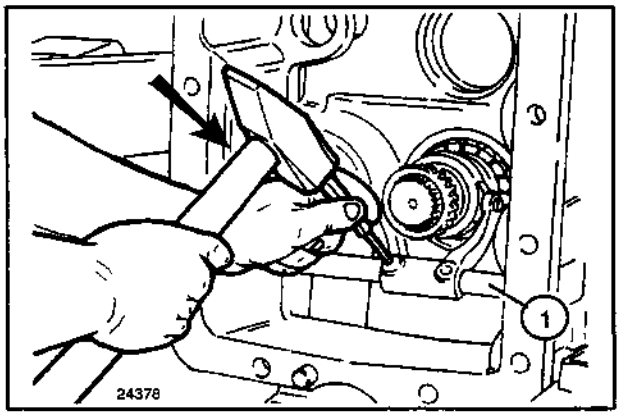


Figure 5-1-110

21. Set the rear axle housing upright, fix tool no. **293994** (1) on the crown wheel and hook it to a suitable lifting equipment.

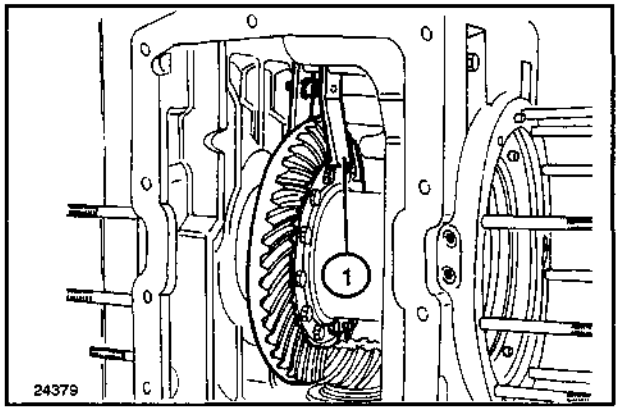


Figure 5-1-111

22. Loosen the attaching bolts, remove the crown wheel/differential support (1) on both sides, recover the crown wheel and remove the inner metal guard.

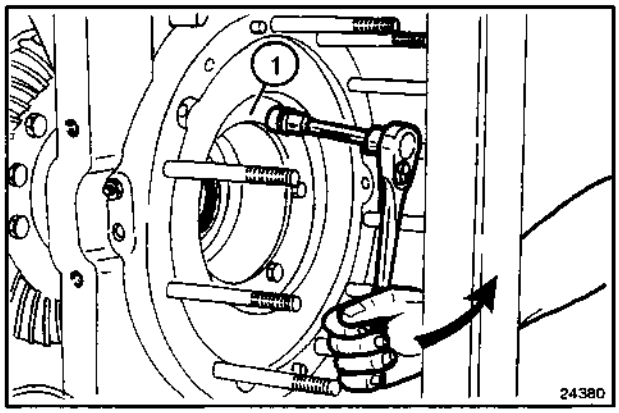


Figure 5-1-112

23. Remove the brake drive piston (1) using compressed air and recover clips on both sides.

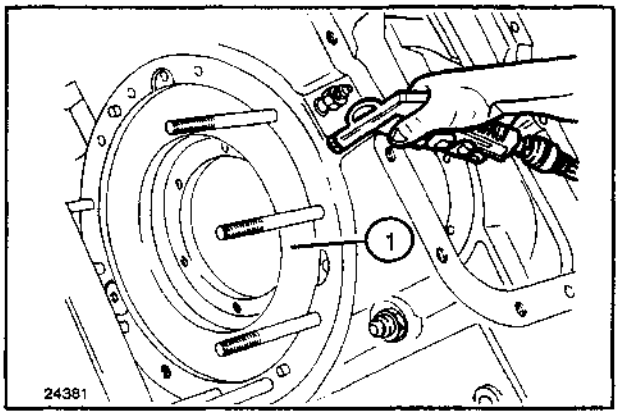


Figure 5-1-113

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24. Disassemble the oil suction tube.

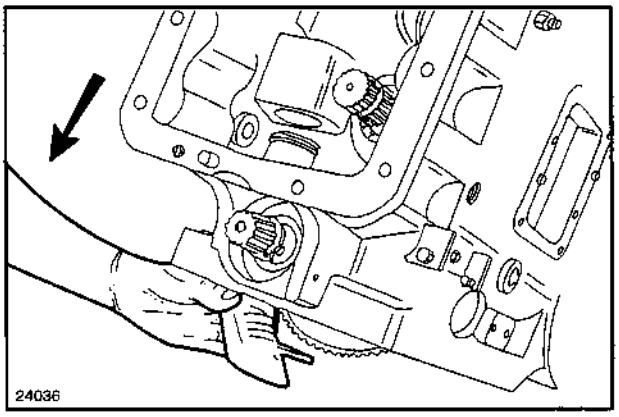


Figure 5-1-114

25. Remove dust ring, seal and transfer box shaft bearing retaining snap ring.

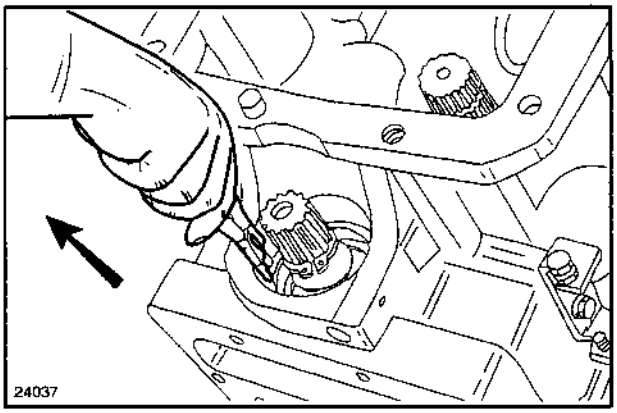


Figure 5-1-115

26. Recover the transfer box shaft bearing adjust ring.

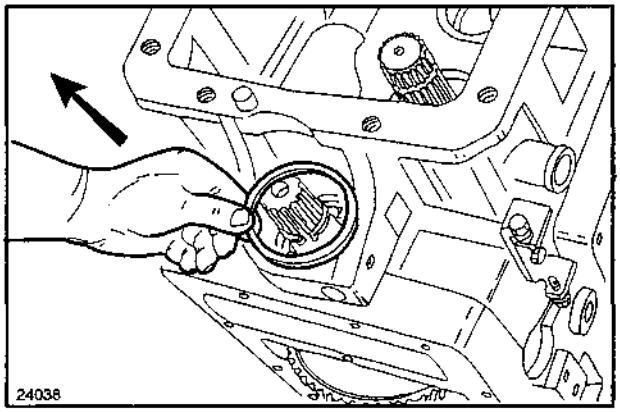


Figure 5-1-116

27. Using a slide hammer (1) and adapter tool no. **293996** (2) partially withdraw the transfer box shaft.

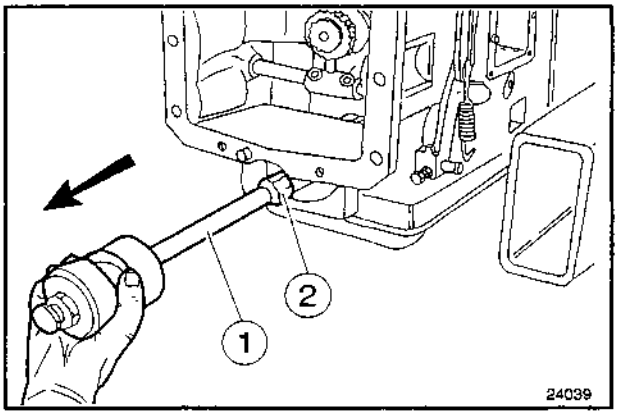


Figure 5-1-117

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28. Remove the transfer box shaft with one hand while holding the FWD engagement clutch with the other.

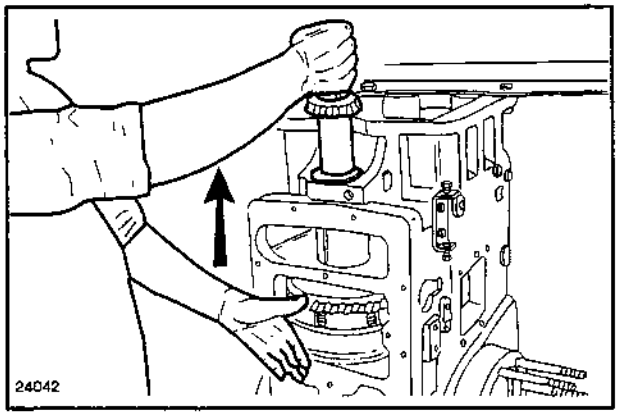


Figure 5-1-118

29. Remove the FWD engagement clutch assembly.

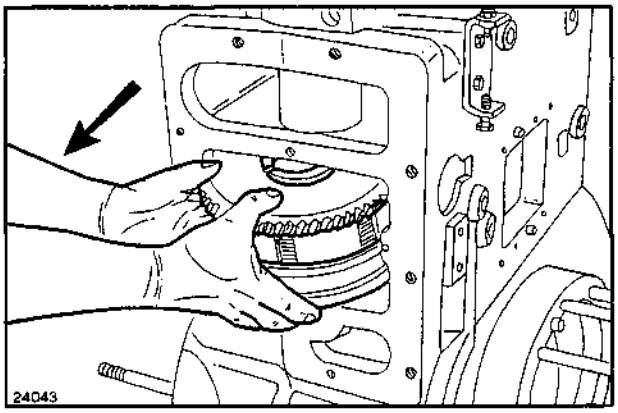


Figure 5-1-119

30. Remove the transfer box drive shaft guard.

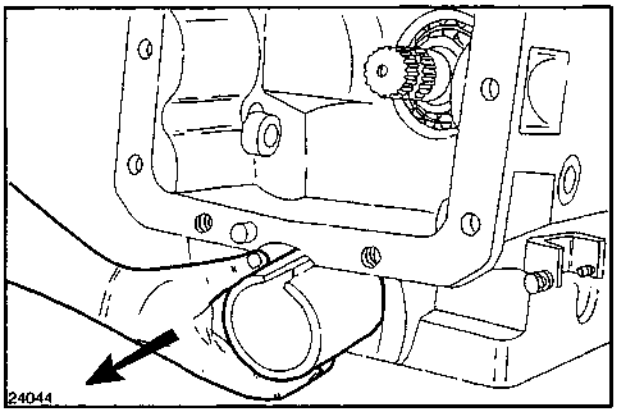


Figure 5-1-120

31. Straighten the crushed nut, hold the pinion steady and loosen the nut using the wrench tool no. **293343** (1).

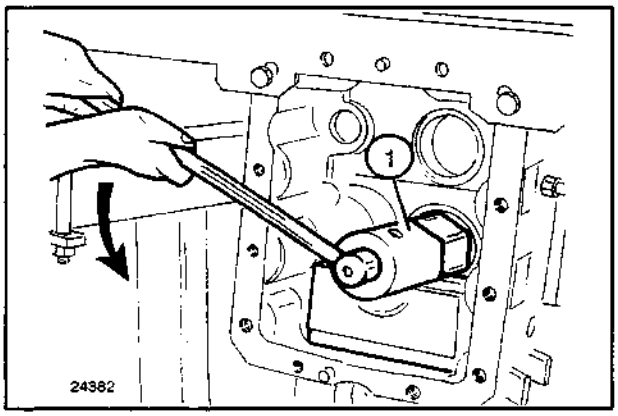


Figure 5-1-121

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32. Using a universal puller (1), partially withdraw the bevel pinion.

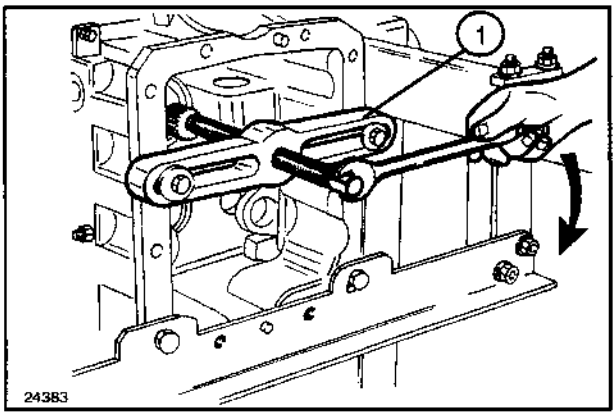


Figure 5-1-122

33. Disassemble the universal puller and remove front bearing (1).

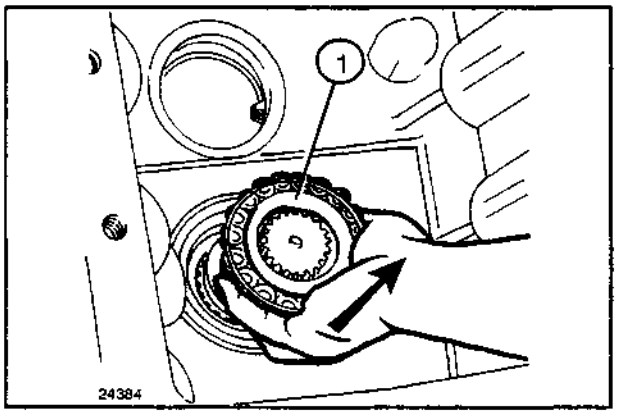


Figure 5-1-123

34. Slide out the pinion and recover the inner parts through the parking brake compartment.

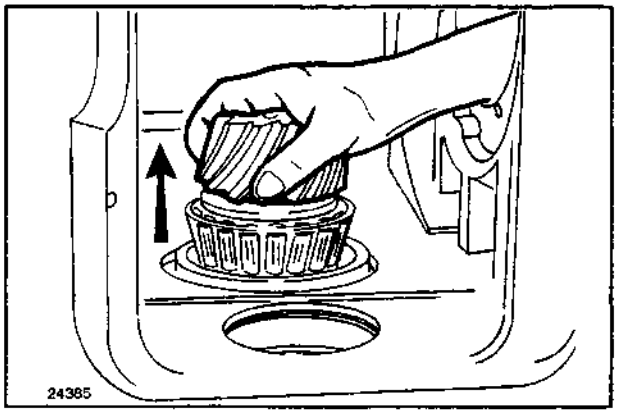


Figure 5-1-124

35. Slide out the bearing (1) from pinion using a drive puller and a hydraulic press.

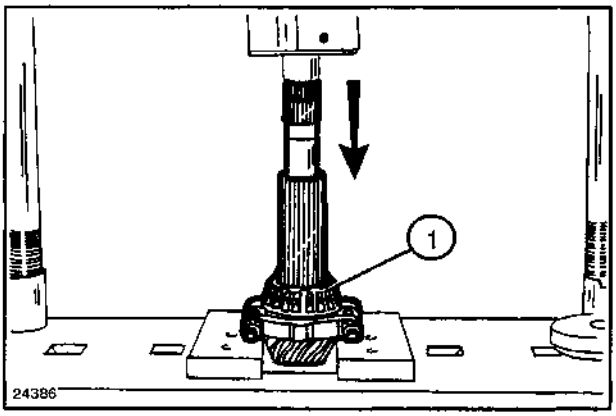


Figure 5-1-125

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36. Remove the pinion rear bearing cup (1) from front end using a driver tool, and recover adjustment shim (S) .

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

37. Reinstall all components into the rear axle housing observing the following:

- Thoroughly clean the housing, especially the inner compartments.
- Reassembly follows the disassembly procedure in reverse, from step 36 back to step 1.
- Refer to figures on pages 5-1-8, 5-1-9, and 5-1-10 for correct positioning and orientation of the different parts.
- Tighten to correct torque as detailed on pages 5-1-3 and 5-1-4.
- Before reassembling housings, supports and covers, thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approx. 0.079 in (2 mm) of diameter following the patterns shown in the figures on pages 5-1-35 and 5-1-36.
- During bevel pinion installation, carry out the adjustments as detailed on pages 5-1-47 to 5-1-52.
- During crown wheel installation, carry out operations described from step 63 on page 5-1-53 to adjust tapered roller bearings and for pinion to crown wheel correct mating.
- During installation of the hydraulic pump drive idler gear assembly, adjust tapered roller bearings as detailed on page 5-1-57.
- Install and adjust transfer box bearings as detailed on pages 9-1-16 to 9-1-18, Section 9, Chapter 1.
- Refer to Section 4, Chapter 1 to adjust the creeper control lever.

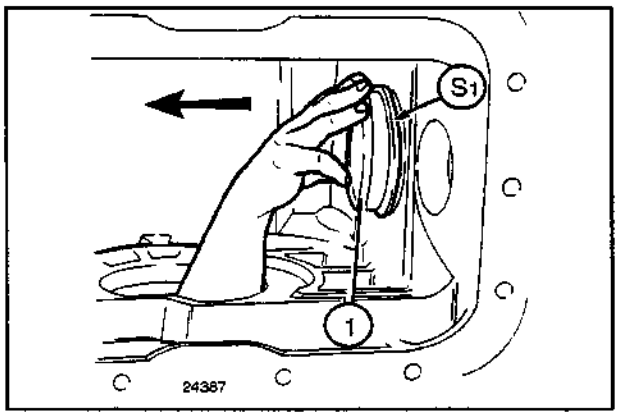


Figure 5-1-126

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PINION AND CROWN WHEEL ADJUSTMENTS

Determining the pinion position shim ring thickness (5, page 5-1-8) using universal tool no. 293510.

Proceed as follows:

38. Assemble tool no. **293976** (1) complete with the pinion rear bearing cup (2) on the rear axle housing

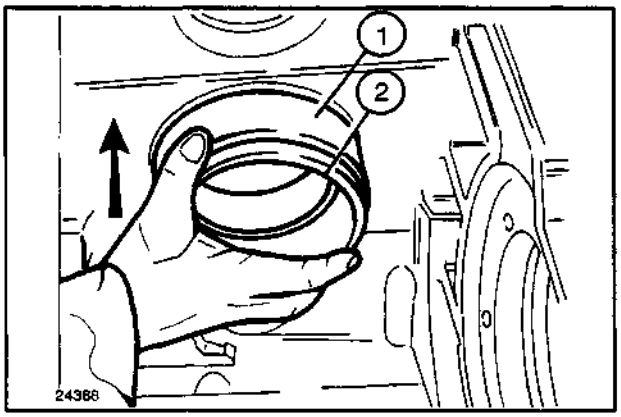


Figure 5-1-127

39. Place the rear bearing complete with the bushing no. **293636** (1) of universal tool no. **293510** (1) on the rear axle housing and insert the end portion (2) of the universal tool.

Note – Place tool spacer no. **295026** on the bearings for tractors fitted with the SEMI–POWERSHIFT transmission.

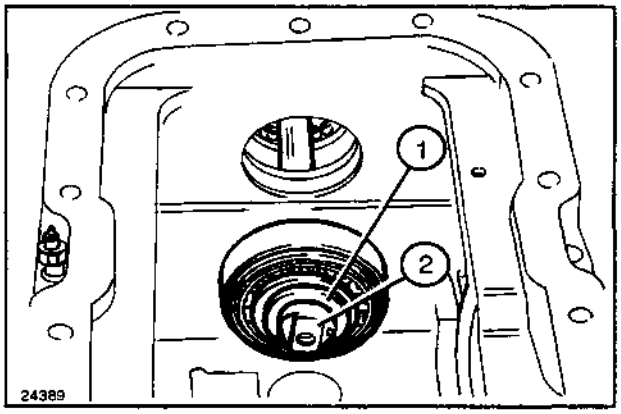


Figure 5-1-128

40. Assemble the universal tool no. **293510** complete with bushing no. **293638** (1), spacers nos. **293619** and **293625** (2) and front bearing.Screw in the handwheel until the pointer indicates 386 lbf (175 kg) while turning the tool to settle the bearings.

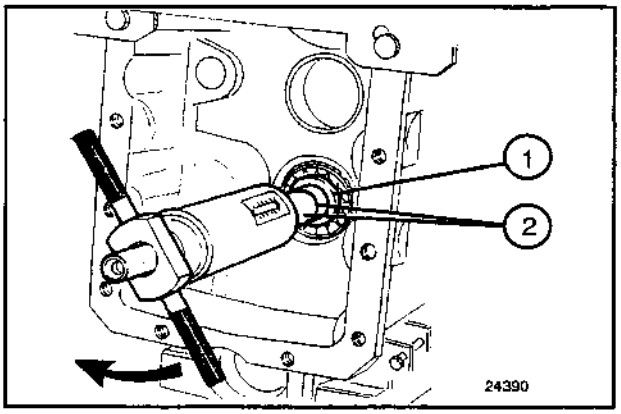


Figure 5-1-129

41. Place universal tool no. **293400** (1) on the crown wheel caps (2) complete with the bearing outer cups.

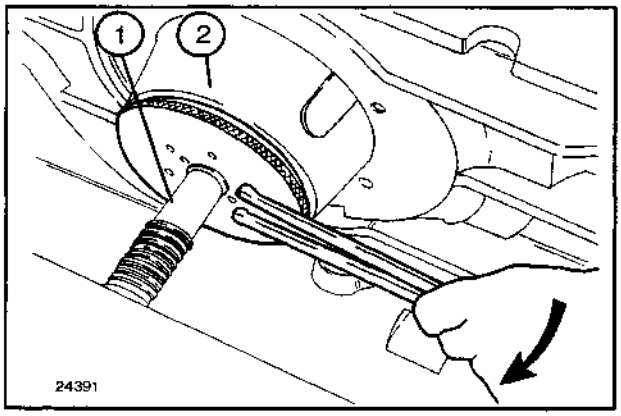


Figure 5-1-130

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42. Bring the tool rod to contact the bearing inner cup. Note the dimension (H_1).

43. Determine the correct nominal dimension (H_2) between the crown wheel centerline and pinion larger base:

$$H_2 = H_3 \pm C$$

where::

H_3 = 7.09 in (180 mm). Nominal dimension between the crown wheel centerline and pinion larger base for tractors fitted with mechanical or DUAL COMMAND transmissions.

H_3 = 7.20 in (183 mm). Nominal dimension between the crown wheel centerline and pinion larger base for tractors fitted with SEMI–POWER-SHIFT transmissions.

C = Correction factor stamped on the pinion, expressed in mm and prefixed by + or – if other than 0, to be added to or subtracted from the nominal dimension (H_3), depending on the sign.

44. Adjuster ring thickness (S_1) is given by:

$$S_1 = H_1 + (1.38 \text{ in}) \ 35 - H_2$$

:where

H_1 = Depth gauge reading

1.38 in (35 mm) =Thickness of bushing no. **293976** (1, Figure 5-1-127).

H_2 =Correct nominal dimension between crown wheel centerline and pinion larger base.

If necessary, round off the value (S_1) to the next 0.002 in (0.05 mm).

Examples:

- Depth gauge reading:: H_1 = 5.78 in (146.9 mm)
- Thickness of bushing no. **293976** (1, Figure 5-1-127) = 1.38 in (35 mm)
- Nominal dimension between crown wheel centerline and pinion larger base: H_3 = 7.09 in (180 mm)
- Correction factor: C = + 0.004 in (0.1 mm)
- Correct nominal dimension: H_2 = 7.09 in (180) + 0.009 in (0.1) = 7.091 in (180.1 mm)
- Adjuster ring thickness
- S_1 = 5.78 in (146.9) + 1.38 in (35) – 7.091 in (180.1) = 0.07 in (1.8 mm)
- Correction factor: C = –0.004 in (–0.1 mm)
- Correct nominal dimension: H_2 = 7.09 in (180) – 0.004 in (0.1 mm) = 7.083 in (179.9 mm)
- Adjuster ring thickness::
- S_1 = 5.78 in (146.9) + 1.38 in (35) – 7.083 in (179.9) = 0.079 in (2.0 mm)
- Correction factor C = 0 in (0 mm)
- Correct nominal dimension: H_2 = H_3 = 7.09 in (180 mm)
- S Adjuster ring thickness:
- S_1 = 5.78 in (146.9) + 1.38 in (35) – 7.09 in (180) = 0.075 in (1.9 mm)

45. Remove universal tool no **293400**.

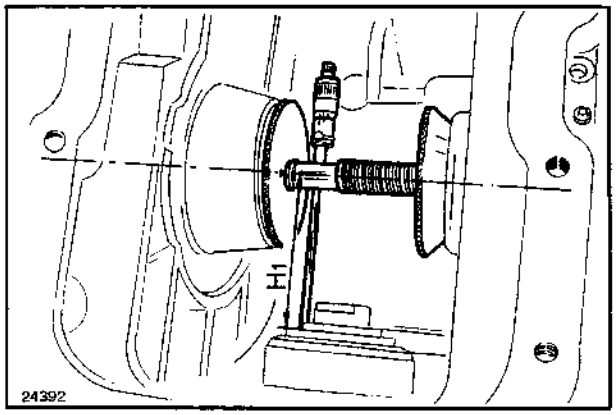


Figure 5-1-131

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PINION AND CROWN WHEEL ADJUSTMENTS

Determining the adjuster ring thickness (3, page 5-1-8) of the pinion shaft tapered roller bearings using universal tool no. 293510.

Proceed as follows:

46. Using a depth gauge, measure dimension (H_4).

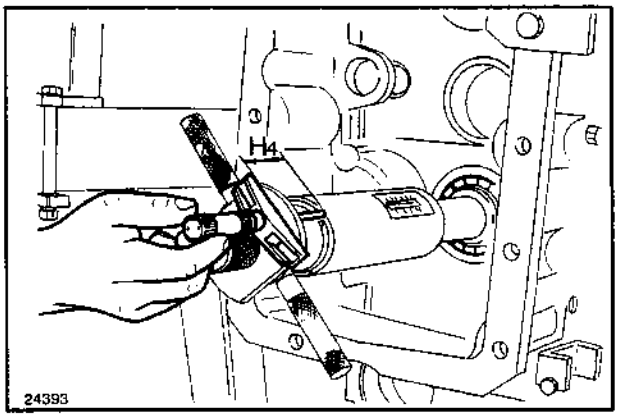


Figure 5-1-132

47. Remove universal tool no. **293510** from rear axle housing and fix it into a vice using part no. **293617** (2).

48. Insert bushings nos. **293636** and **293638**, spacers nos. **293619** and **293625**, bearing inner cups, a test shim (P) to avoid bearing–to–gear interference, spacer no. **293977** (1) and the parts shown in the figure.

49. Bring tool pointer to 386 lbf (175 kg) and measure dimension (H_5) using a depth gauge.

50. Correct adjuster ring thickness (S_2) is given by:

$$S_2 = H_5 + P + S_1 - H_4 + 0.2$$

where:

P = Test shim

S_1 =Cone point adjustment shim, as found in the previous paragraph.

0.008 in (0.2 mm) = Increase necessary to compensate for bearing increased preload deriving from tightening of the pinion shaft locknut

If necessary, round off the value (S_2) to the next 0.002 in (0.05 mm).

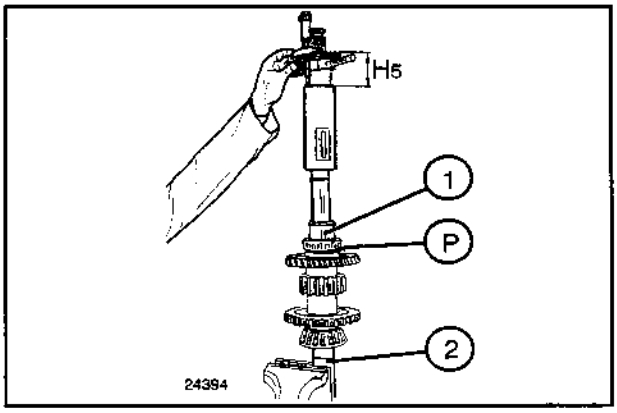


Figure 5-1-133

Examples:

- Cone point adjustment shim, found in the previous paragraph: S_1 = 0.071 in (1.8 mm)
- Depth gauge reading: H_4 = 2.92 in (74.30 mm)
- Test shim: P = 0.079 in (2 mm)
- Depth gauge reading:
  H_5 = 2.98 in (75.80 mm).
- Adjuster ring thickness.
  S_2 = 2.98 in (75.80) + 0.079 in (2) + 0.071 in (1.8) – 2.92 in (74.3) + 0.008 in (0.2) = 0.216 in (5.5 mm)

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PINION AND CROWN WHEEL ADJUSTMENTS

Determining the pinion position shim ring thickness (5, page 5-1-8) using special tool no. 293975.

Proceed as follows:

51. Assemble tool no. **293976** (1) complete with the pinion rear bearing outer cup (2) on the rear axle housing.

52. Assemble special tool no. **293975** (1) complete with the bearings on the rear axle housing. Lock the nut while turning the bearings.

Note – Place tool spacer no. **295026** on the bearings for tractors fitted with the large pinion shaft bearing.

53. Assemble universal tool no. **293400** (2) on crown wheel caps (1) complete with the bearing outer cups.

54. Bring the rod of tool no. **293400** (H) to contact bearing inner cup and measure dimension (H_1).

55. Determine correct nominal dimension (2) between the crown wheel centerline and pinion larger base:

$$H_2 = H_3 \pm C$$

where

H_3 = 7.09 in (180 mm). Nominal dimension between crown wheel centerline and pinion larger base for tractors fitted with mechanical or DUAL COMMAND transmissions.

H_3 = 7.20 in (183 mm). Nominal dimension between crown wheel centerline and pinion larger base for tractors fitted with SEMI–POWER–SHIFT transmissions.

C = Correction factor stamped on the pinion, expressed in mm and prefixed by + or – if other than 0, to be added to or subtracted from the nominal dimension (H_3), depending on the sign.

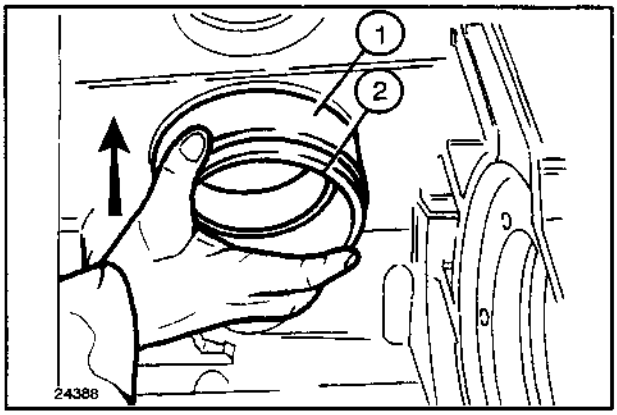


Figure 5-1-134

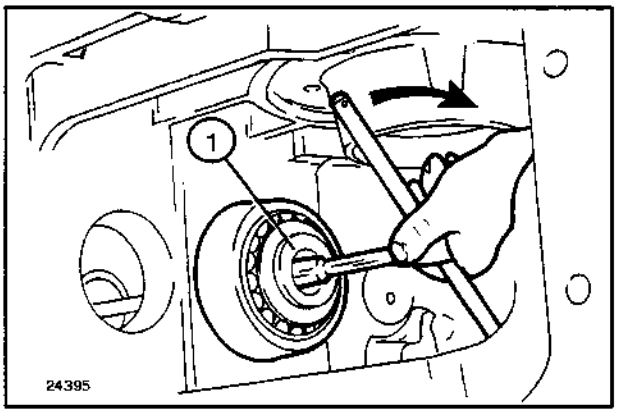


Figure 5-1-135

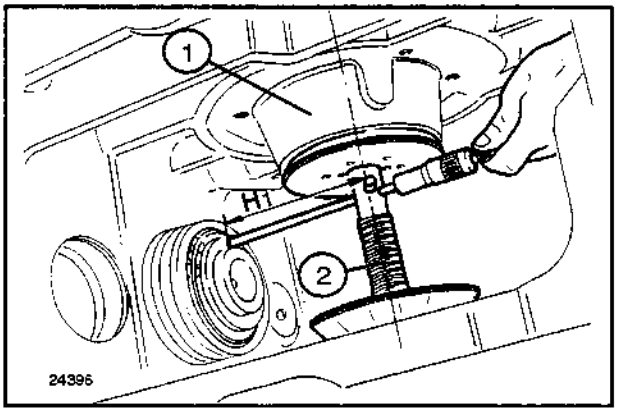


Figure 5-1-136

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56. Adjuster ring thickness (S) is given by:

$$S_1 = H_1 + 1.38 \text{ in } (35) - H_2$$

where

H_1 = Depth gauge reading
1.38 in (35 mm) = Thickness of bushing no **293976** (and **295026**) (1, Figure 5-1-134).
H_2 =Correct nominal dimension between crown wheel centerline and pinion larger base.
If necessary, round off the value (S) to the next 0.002 in (0.05 mm).

Examples:

- Depth gauge reading:: H_1 = 5.78 in (146.9 mm)
- Thickness of bushing no. **293976** (and **295026**) (1, Figure 5-1-134) = 1.38 in (35 mm)
- Nominal dimension between crown wheel centerline and pinion larger base: H_3 = 7.09 in (180 mm)
- Correction factor: C = - 0.004 in (- 0.1 mm)
- Correct nominal dimension: H_2 = 7.09 in (180) + 0.004 in (0.1) = 7.083 in (179.9 mm)
- Adjuster ring thickness
- S_1 = 5.78 in (146.9) + 1.38 in (35) – 7.083 in (179.9) = 0.079 in (2.0 mm)
- Correction factor: C = 0.004 in (+0.1 mm)
- Correct nominal dimension: H_2 = 7.09 in (180) + 0.004 in (0.1 mm) = 7.091 in (180.1 mm)
- Adjuster ring thickness::
- S_1 = 5.78 in (146.9) + 1.38 in (35) – 7.091 in (180.1) = 0.071 in (1.8 mm)
- Correction factor C = 0 in (0 mm)
- Correct nominal dimension: $H_2 = H_3$ = 7.09 in (180 mm)
- Adjuster ring thickness:
- S_1 = 5.78 in (146.9) + 1.38 in (35) – 7.09 in (180) = 0.075 in (1.9 mm)

57. Remove universal tool n **293400**.

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PINION AND CROWN WHEEL ADJUSTMENTS

Determining the adjuster ring thickness (3, page 5-1-8) of the pinion shaft tapered roller bearings using special tool no. 293975.
Proceed as follows:

58. Using a depth gauge, measure dimension (H_6) between the end of tool no. **293975** (1) and the end of the inner screw.

59. Remove tool no. **293975** from rear axle housing.

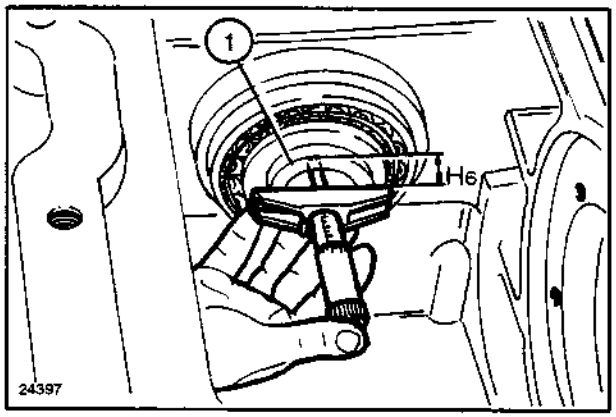


Figure 5-1-137

60. Fix tool no. **293975** into a vice, assemble all parts on it including a test shim (P) and spacer no. **293977** (1).

61. Screw in tool nut to lock the tool and using a depth gauge measure dimension (H_7) between tool end and end of the inner screw.

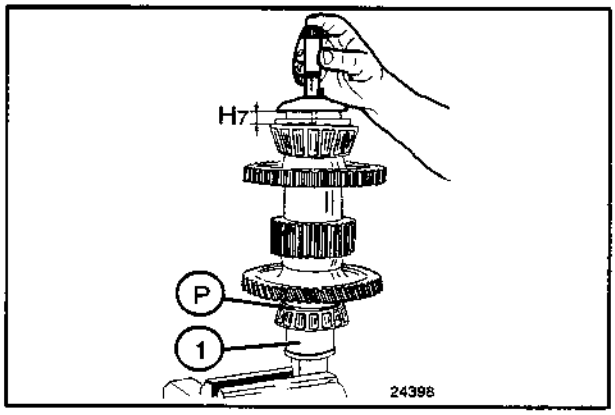


Figure 5-1-138

62. Adjuster ring thickness (S_2) is given by:

$$S_2 = H_6 + P + S_1 - H_7 + 0.008 \text{ in } (0.2)$$

where:
P=Test shim
S_1= Cone point adjustment shim, as found in the previous paragraph.
0.008 in (0.2 mm) = Increase necessary to compensate for bearing increased preload deriving from tightening of the pinion shaft locknut
If necessary, round off the value (S_2) to the next 0.002 in (0.05 mm)

Example

- Cone point adjustment shim, found in the previous paragraph: S_1= 0.071 in (1.8 mm)
- Depth gauge reading: H_6=0.535 in (13.60mm)

Test shim:P=0.079 in (2mm)
Depth gauge reading:H7=0.476 in (12.10 mm)
Adjuster ring thickness.
S_2 =0.535 in (13.60) +0.079 in (2) +0.071 in (1.8) –0.476 in (12.1) + 0.008 in (0.2) = 0.216 in (5.5 mm)

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PINION AND CROWN WHEEL ADJUSTMENTS

Adjustment of crown wheel bearings and crown wheel to pinion backlash.

Proceed as follows:

63. Assemble rear bearing outer cup (1) and adjuster rings (S_1) as found before.

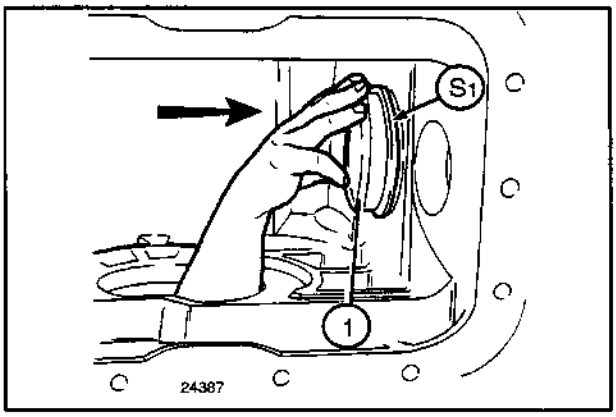


Figure 5-1-139

64. Assemble pinion (1) complete with all components and respective bearing adjuster rings (3, page 5-1-8) as found during previous adjustments. If necessary, hold the pinion in place using a suitable tool.

Note – Pinion position and pinion bearing shims (3 and 5, page 5-1-8) are listed on page 5-1-2.

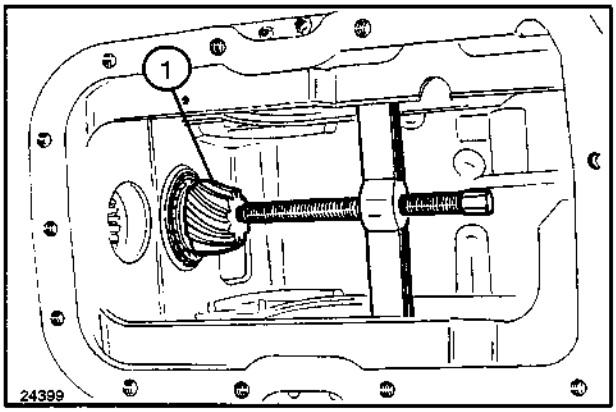


Figure 5-1-140

65. Using the wrench tool no. **293343** tighten the nut (C_1, page 3) to 361 ft. lbs (490 N·m) and while turning the pinion shaft to settle the bearings. Remove pinion tool.

66. Check if the rolling torque necessary to turn the pinion shaft is 0.74 to 1.5 ft. lbs (1.0 to 2.0 N·m) by measuring it at the end of the shaft using the wrench (1) and torque wrench (2). Crush the nut (C_1, page 5-1-4).

Note – Decrease the bearing adjustment shim pack (3, page 5-1-8) if the rolling torque is lower than specified, or increase it if higher.

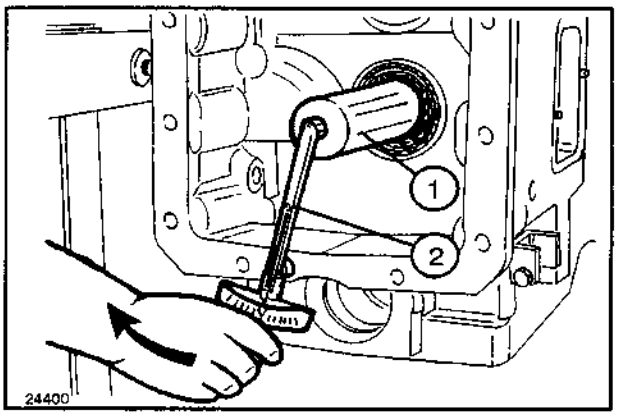


Figure 5-1-141

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67. Assemble the crown wheel – differential assembly to the rear axle housing, insert the RH cap (2) complete with a test shim (1) and fix with three screws. Tighten the screws to 40 ft. lbs (54 N·m).

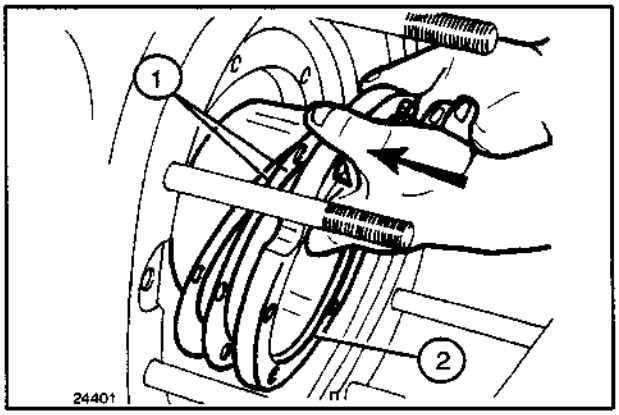


Figure 5-1-142

68. Measure LH cap thickness (D_1).

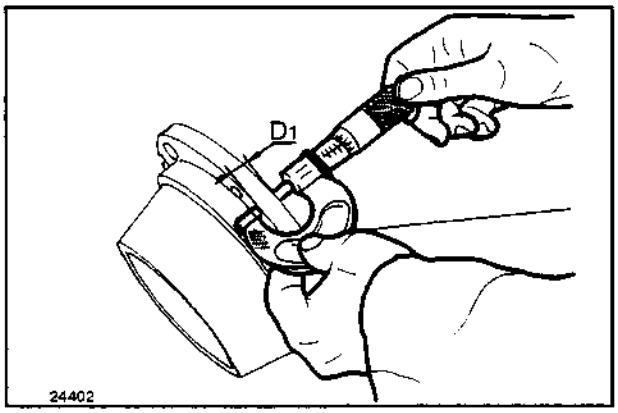


Figure 5-1-143

69. Assemble the LH cap without adjuster rings using three lubricated screws (1) arranged at 120°.

70. Tighten alternatively and gradually the three screws (1) until 4 to 7 ft. lbs (6 to 9 N·m) while turning the crown wheel to settle the bearings

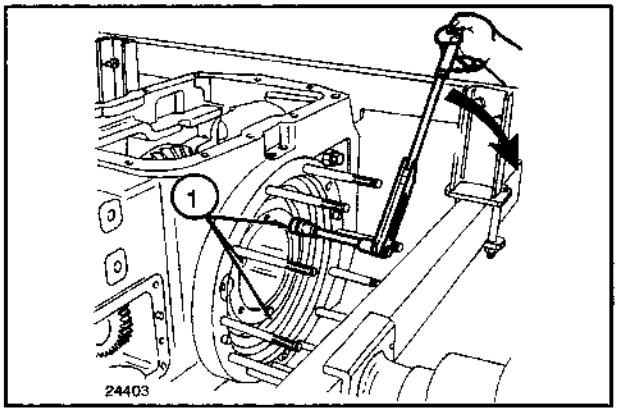


Figure 5-1-144

71. Using a depth gauge, measure dimension (D_2) at the two recesses in the LH cap. Calculate the average of the two readings.

72. The total shim pack (S) to be inserted beneath the RH and LH caps is given by:

$$S = D_2 - D_1 + A + 0.012 \text{ in } (0.3)$$

where:
A = Test shim = 0.059 in (1.5 mm)
D_1 = LH cap thickness, in mm.
D_2 = Dimension measured at step 56, in mm.
0.012 in (0.3 mm) = Increase necessary to diminish the bearing preload deriving from the screws (1).
If necessary, round off the value (S) to the next 0.002 in (0.05 mm).

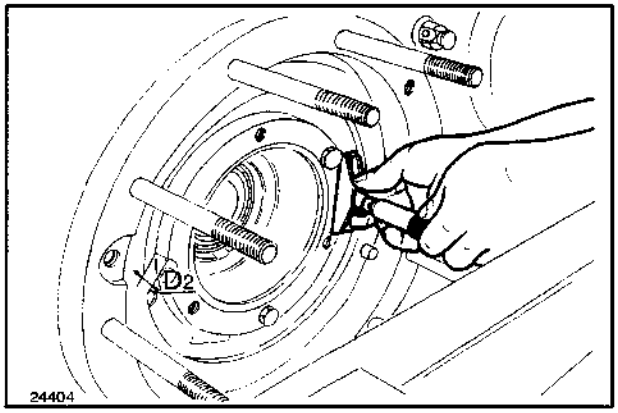


Figure 5-1-145

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73. Using a dial gauge, measure the backlash (G) between the crown wheel and pinion teeth (take three measures at 120° and make the average of the readings).

74. Normal crown wheel to pinion backlash is 0.008 in (0.20) to 0.011 in (0.28 mm), **with an average of 0.009 in (0.24 mm).**

75. To compensate for possible backlash values higher or lower than specified, consider the 1:1.34 ratio existing between normal backlash and corresponding crown wheel end displacement.
Therefore, the end displacement (Z) necessary to restore specified backlash is:

$$Z = (G - 0.009 \text{ in } [0.24]) \times 1.34$$

Adjustment shim packs (Sd and Ss) to be inserted on the RH and LH caps are given by:

$$Sd = A \pm Z$$
$$Ss = S - Sd$$

where:
S = Total shim pack value
Z = Crown wheel end displacement, found above.
A = Test shim = 0.059 in (1.5 mm)

76. Assemble the shim packs determined above on the caps and tighten the screws (1) at the specified torque.

77. Check if the rolling torque necessary to turn the crown wheel and pinion assembly is:
Rp + (0.92 ft. lb [1.25 N·m] to 1.5 ft. lb [2.0 N·m])
by measuring it at the end of the pinion shaft using the wrench tool no. **293343** (1) and torque wrench (2).
where:
Rp =Rolling torque measured for the pinion only (see page 5-1-53).

Example:
- Measure of LH cap thickness (D_1)= 0.551 in (14.00 mm)
- Test shim A = 0.059 in (1.5 mm)
- Measure of clearance of D_2 between LH cap and its seat on the rear axle housing
  0.557 in (14.15 mm); 0.561 in (14.25 mm).
  D_2 =Mean value (0.557 in [14.15] + 0.561 in [14.25]):2 = 0.559 in (14.20 mm)

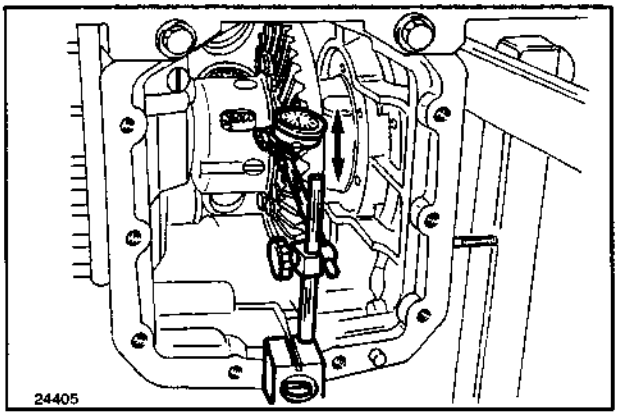


Figure 5-1-146

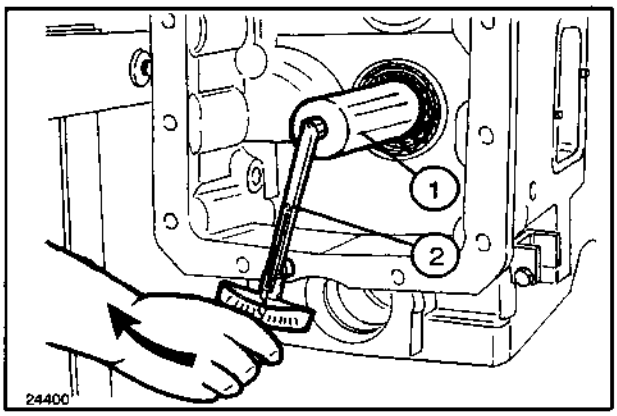


Figure 5-1-147

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- Total adjuster ring thickness
  S = 0.559 in (14.20) – 0.551 in (14.00) + 0.059 in (1.5) + 0.012 in (0.3) = 0.079 in (2.00 mm)
- Measured backlash: 0.005 in (0.13 mm); 0.005 in (0.12 mm); 0.006 in (0.14 mm);
  G = Mean value= (0.005 in [0.13] + 0.005 in [0.12] + 0.006 in [0.14]): 3 = 0.005 in (0.13 mm)
- End displacement (Z) necessary to restore specified backlash.
  Z = (0.005 in [0.13] – 0.009 in [0.24]) x 1.34= – 0.004 in (–0.11) x 1.34 = – 0.006 in (–0.15)
- Adjuster ring thickness to be inserted on the RH cap is:
  Sd = 0.059 in (1.5) – 0.006 in (0.15) = 0.053 in (1.35 mm)
- Adjuster ring thickness to be inserted on LH cap is:
  Ss = 0.079 in (2.00) –5.31 in (135) = 0.026 in (0.65 mm)

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HYDRAULIC PUMP CONTROL IDLER GEAR BEARING ADJUSTMENT

Note: check if the free spring of tool no. **293975** is 2.01 in (51 mm) long. If shorter, add some suitable shims until reaching specified length.

Proceed as follows:

78. Place tool no. **293975** (1) in a vice and slide over the shorter spacer of the dual tool no. **295048** (5), bearing (4), idler gear (3) and bearing (2).

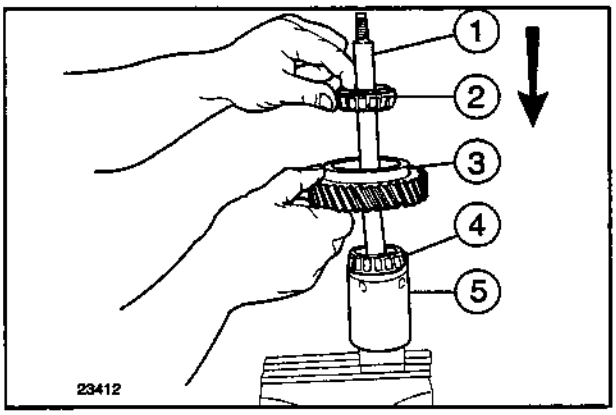


Figure 5-1-148

79. Place longer spacer of the dual tool no. **295048** (6) on tool no. **293975**, lock the nut and turn the idler gear (3) to settle the bearings properly.

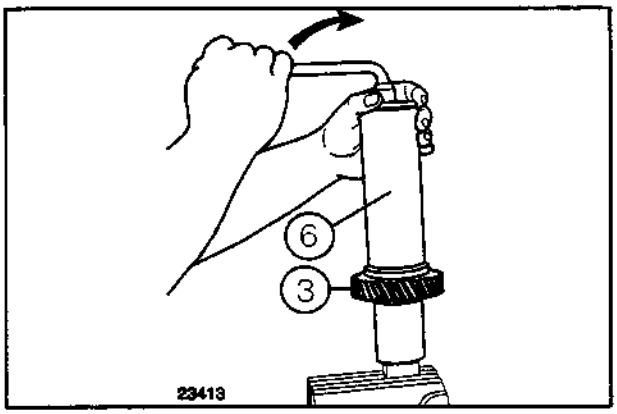


Figure 5-1-149

80. Using a depth gauge, measure the clearance (L) between the end of spacer no. **295048** (6) and the end of the threaded stud of tool no. **293975.**

81. Loosen the nut and remove spacer no. **295048** (6), bearing (2) and idler gear (3).

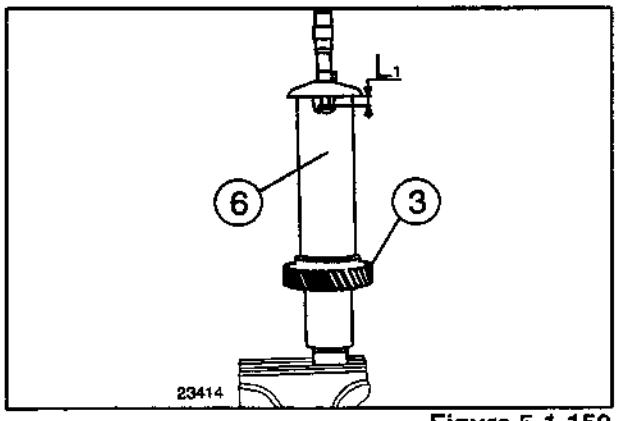


Figure 5-1-150

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82. Place a test shim (3), bearing (2) and spacer no. **295048** (1) on the lower bearing. Screw in the nut and measure clearance (L) between the end of spacer no. **295048** (1) and the end of the threaded stud of tool no. **293975**.
Shim thickness (S) is given by:

$$S = L_2 - L_1 + P$$

where:
L_1 ed L_2 = Measured dimensions
P = Test shim

Example

Measured dimension L_2 = 0.205 in (5.20 mm)
Measured dimension L_1 = 0.197 in (5.00 mm)
Test shim = 0.472 in (12 mm)
S = 0.205 in (5.20) – 0.197 in (5.00) + 0.472 in (12.00) = 0.480 in (12.20 mm)

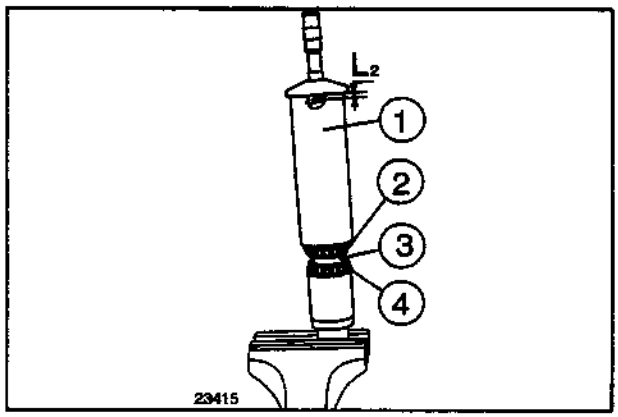


Figure 5-1-151

83. Using a slide hammer, place the pivot pin (5) with the etching horizontal, spacer, bearings, idler gear (6), previously calculated shim (S) and setscrew.

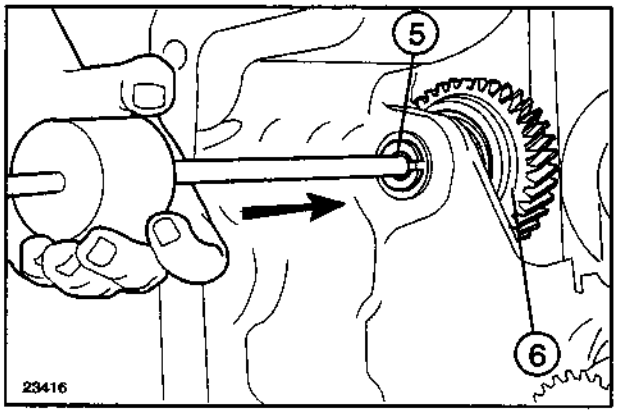


Figure 5-1-152

84. Tighten the retaining screw to 36 ft. lbs (49 N·m) and turn the idler gear to settle the bearings.

85. Loosen the retaining screw and then tighten it again to 21 ft. lbs (29 N·m).

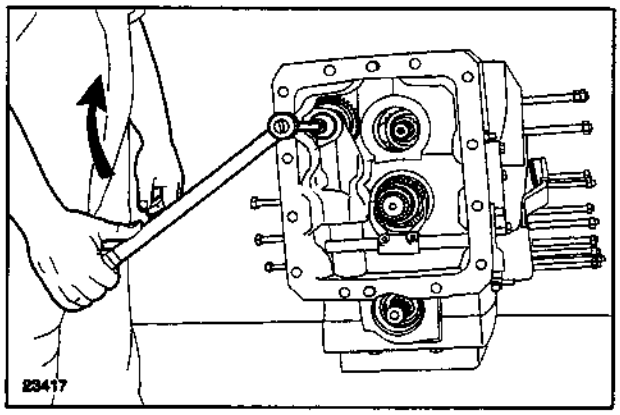


Figure 5-1-153

86. Wind a rope around the idler gear (6) and using a pull scale (7), check if the effort necessary to turn the idler gear is 0.331 to 0.882 lbf (0.150 to 0.400 kg). If this is not the case, repeat steps from 78 to 86.

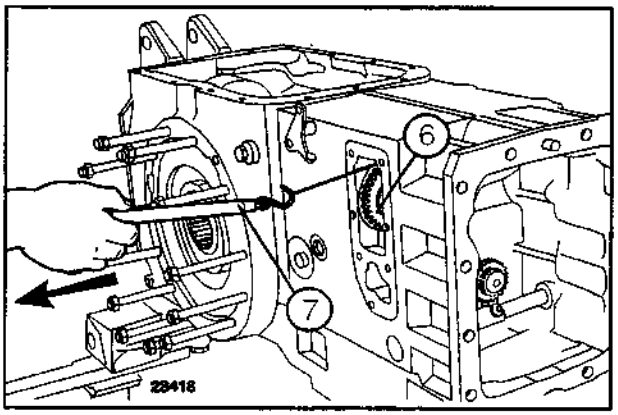


Figure 5-1-154

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HYDRAULIC LOCK DIFFERENTIAL ASSEMBLY

Removal–Installation

With the assembly removed from the rear axle housing, proceed as follows.

⚠ WARNING ⚠

Handle all components with the greatest care
Do not insert hands or fingers between the part.
Wear suitable protection clothing, including goggles, gloves and footwear.

1. Loosen the crown wheel attaching bolts.

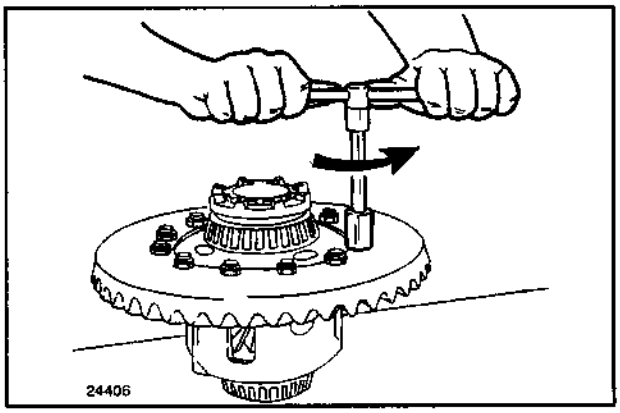


Figure 5-1-155

2. Detach the crown wheel (1) from the differential casing (2).

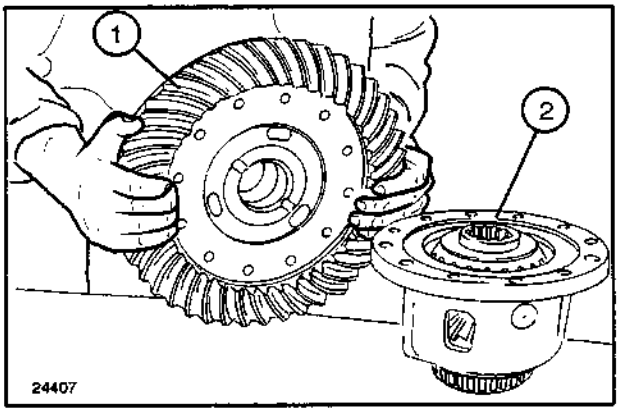


Figure 5-1-156

3. Remove the side gear (1) from the differential casing.

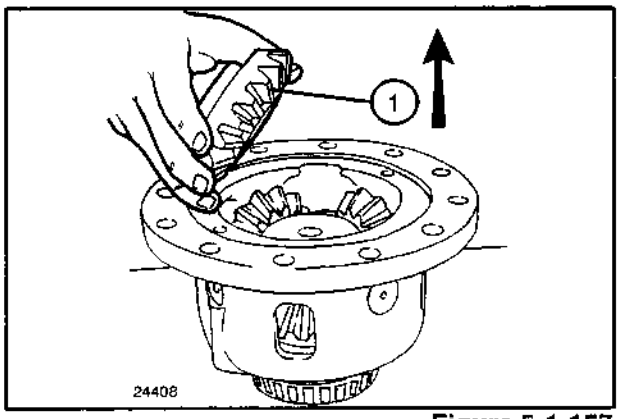


Figure 5-1-157

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4. Remove the locking pins (1) of the differential gear pivot pins.

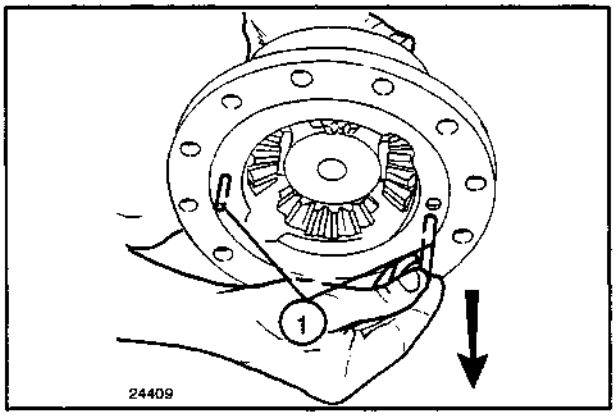


Figure 5-1-158

5. Slide out the pivot pins (2) and recover the differential gears from both sides. We advise to keep the pivot pin and side gear matched as they removed.

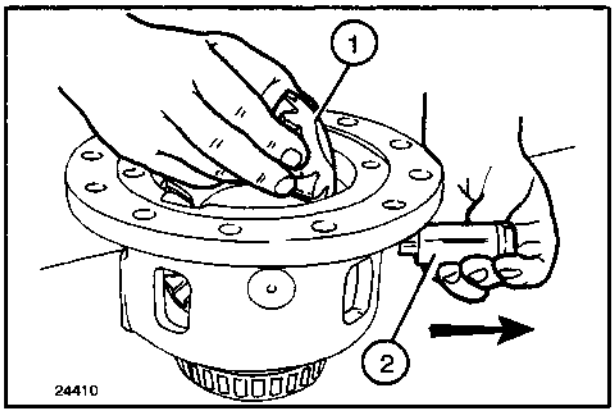


Figure 5-1-159

6. Withdraw the pivot pin (2), recover the pivot pin holder (1) and side gears.

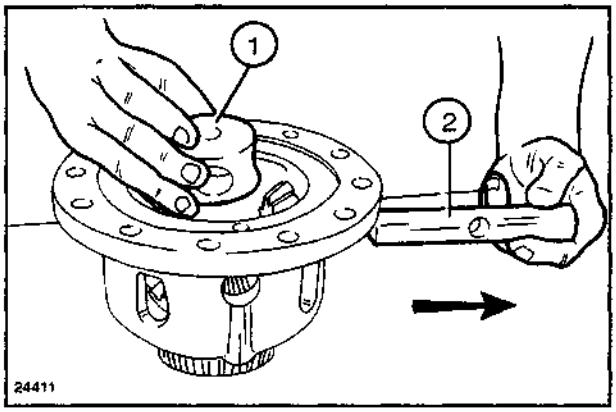


Figure 5-1-160

7. Remove differential lock control gear retaining ring (1).

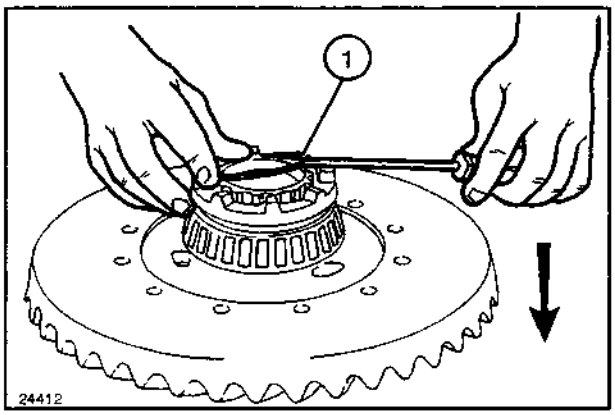


Figure 5-1-161

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8. Using suitable pullers, remove the bearing from the crown wheel.

9. Remove the bearing from the differential casing as indicated at step 8.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

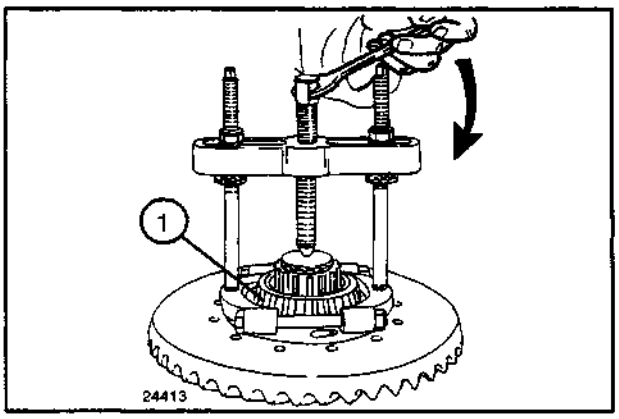


Figure 5-1-162

10. Reinstall all the components of the differential assembly observing the following:
    - Reassembly follows the disassembly procedure in reverse, from step 9 back to step 1.
    - Refer to figures on pages 5-1-9 and 5-1-10 for correct orientation of the different parts.
    - Tighten to correct torque as detailed on pages 5-1-3 and 5-1-4.
    - Consider the following operations and carry out the adjustment detailed below.

11. Assemble the bearing (1) on the crown wheel and differential casing using a suitable hammer.

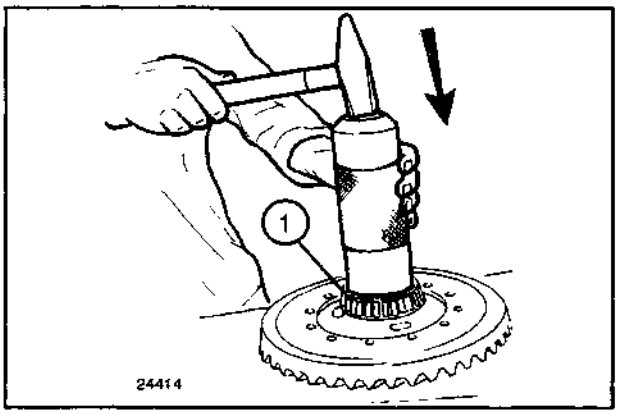


Figure 5-1-163

Side gear end float adjustment

Note: Adjust the LH side carrier end float as indicated for the RH side gear.

12. Assemble side gears, pivot pins and retaining pins.

13. Place the side gear (3) complete with a test shim (2) on tool no. **293986** (1).

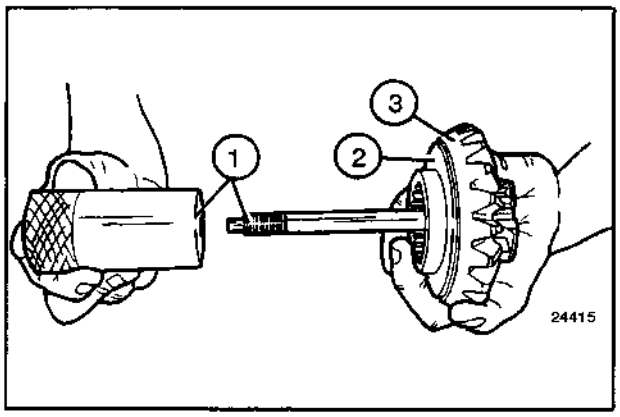


Figure 5-1-164

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14. Assemble the side gear and attached tool no. **293986** on the differential casing, place the crown wheel above it and fix the crown wheel with three bolts (1). Turn the assembly to settle.

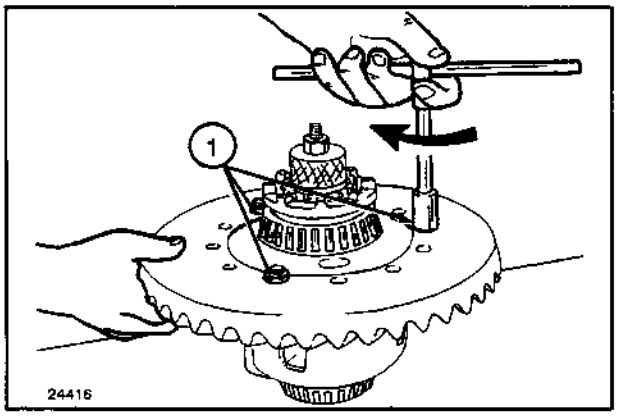


Figure 5-1-165

15. Place a feeler gauge with the feeling end on the tool screw (1), press the tool and set gauge to zero.

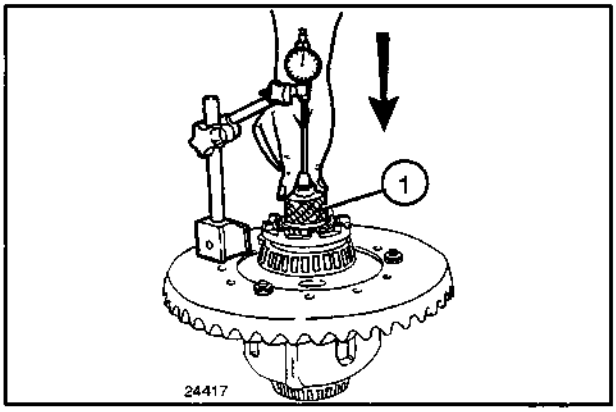


Figure 5-1-166

16. Pull the tool (1) upwards and read the travel (H) on the gauge.

17. Adjuster ring thickness to be inserted on RH side gear is given by:

Rd = (B + H) – 0.002 in (0.05) – 0.012 in (0.30)

where:
Rd = Adjustment shim to be inserted on RH side gear.
B = Test shim = 0.118 in (3.00 mm)
H = Travel measured using the gauge
0.002 in (0.05 mm) = Half end play of differential gears in relation to their pivot pins
0.012 in (0.30 mm) = Specified side gear end play.

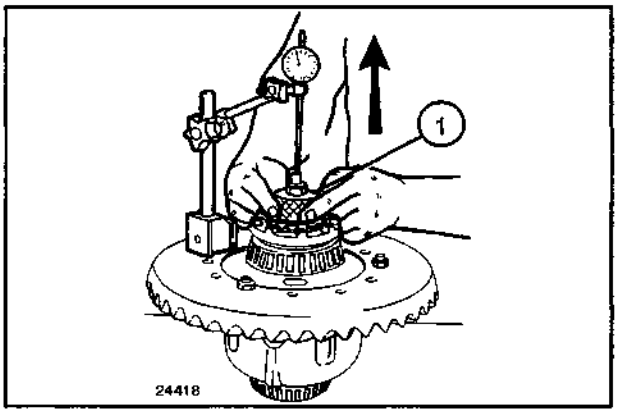


Figure 5-1-167

Example

- Travel measured using the gauge H = 0.020 in (0.50 mm)
- Test shim B = 0.118 in (3.00 mm)
- Thickness of the ring to be inserted on the RH side gear is
  Rd = (0.118 in [3.00] + 0.020 in [0.50]) – 0.002 in (0.05) – 0.012 in (0.30) = 0.124 in (3.15 mm)

18. Once determined the shim packs for LH and RH side gears, reassemble the whole unit and tighten the crown wheel to differential casing attaching bolt nuts at 101 ft. lbs (137 N·m).

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HYDRAULIC DIFFERENTIAL LOCK CONTROL UNIT 8160, 8260 and 8360 (L/cab)

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

1. With the assembly detached from the rear axle housing, proceed as follows. Place the assembly (1) on a clean bench.

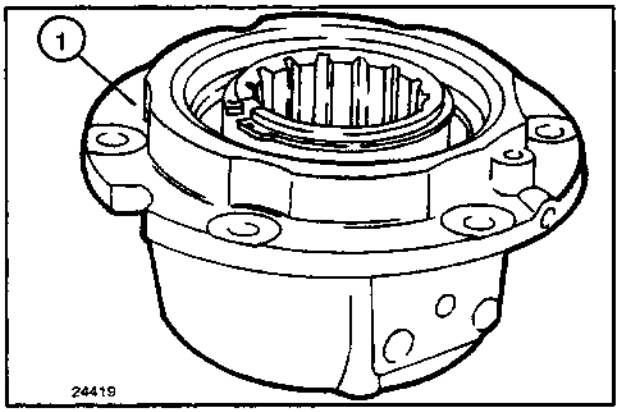


Figure 5-1-168

2. Act on the piston (1) to release the retaining ring.

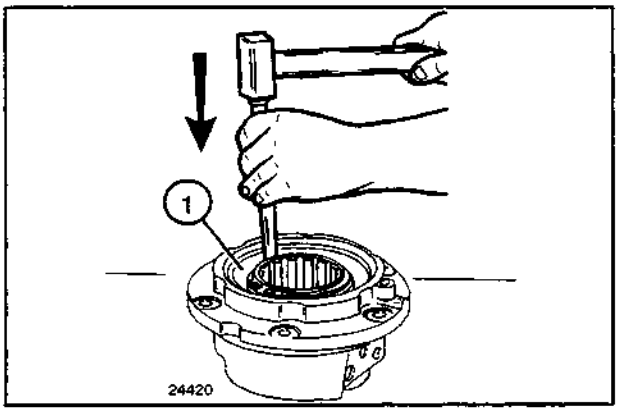


Figure 5-1-169

3. Remove the retaining ring (1).

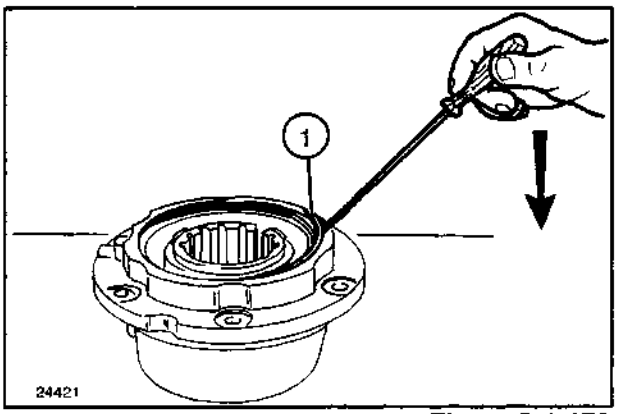


Figure 5-1-170

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4. Withdraw the lock control unit (1) from its case.

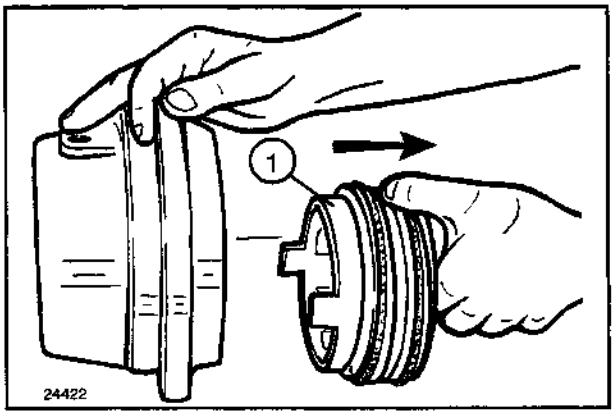


Figure 5-1-171

5. Remove circlip (1).

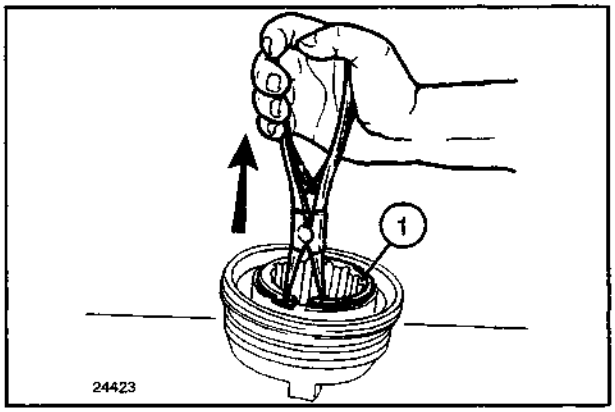


Figure 5-1-172

6. Disassemble the unit, inspect all components and seals, replace worn or damaged parts.

7. Reinstall all the components of the differential lock control unit observing the following
   - Reassembly follows the disassembly procedure in reverse, from step 6 back to step 1.
   - Refer to figures on page 5-1-9 for correct orientation of the different parts.
   - Lubricate all parts with hydraulic oil.

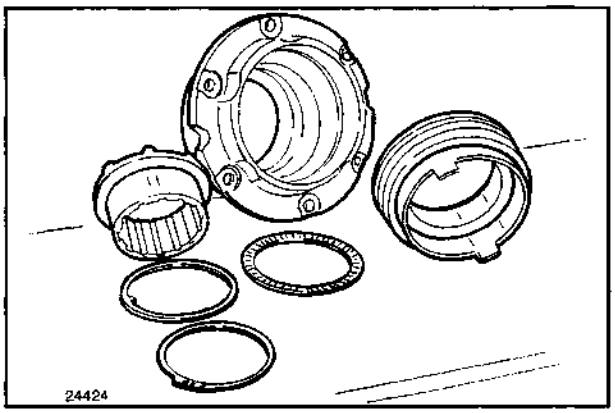


Figure 5-1-173

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HYDRAULIC DIFFERENTIAL LOCK CONTROL UNIT 8360 (w/cab) and 8560

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

With the crown wheel/pinion and differential assembly on the bench, proceed as follows:

1. Loosen the bolts (1) retaining the differential lock (2) and differential casings (3).

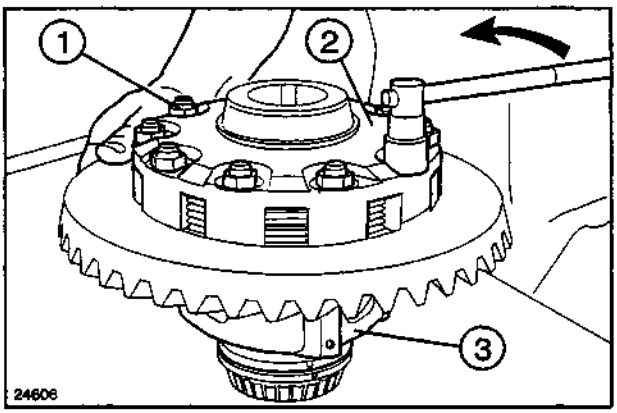


Figure 5-1-174

2. Detach the differential lock case (1) and recover the multi–pack clutch (2).

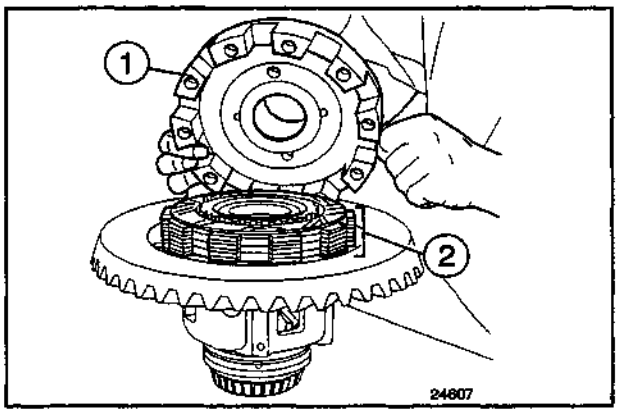


Figure 5-1-175

3. Using a depth gauge, check if the clearance (3) between the differential casing and the multi–pack clutch (2) is 0.053 to 0.122 in (1.35 to 3.1 mm). If this is not the case, replace clutch discs.

4. Reinstall all the components of the differential lock control unit observing the following:
   - Reassembly follows the disassembly procedure in reverse, from step 3 back to step 1.
   - Refer to figures on page 5-1-10 for correct orientation of the different parts.
   - Lubricate all parts with hydraulic oil.

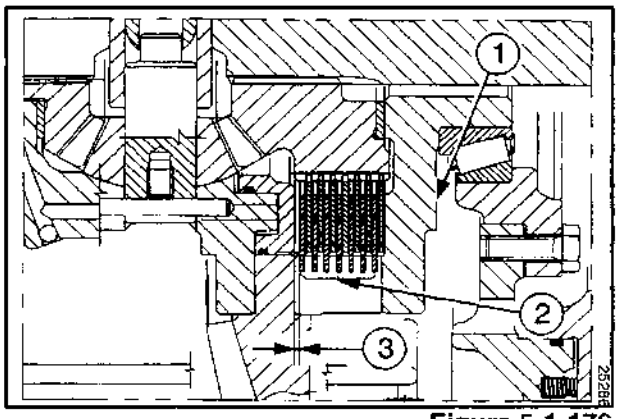


Figure 5-1-176

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FINAL DRIVE CASE (LEFT OR RIGHT HAND)

Removal–Installation

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks.
Ensure that no–one is in the vicinity of the load to be lifted.

Remove the final drive case as follows:

1. Open and raise engine hood.

2. Disconnect negative cable (1) from battery and insulate.

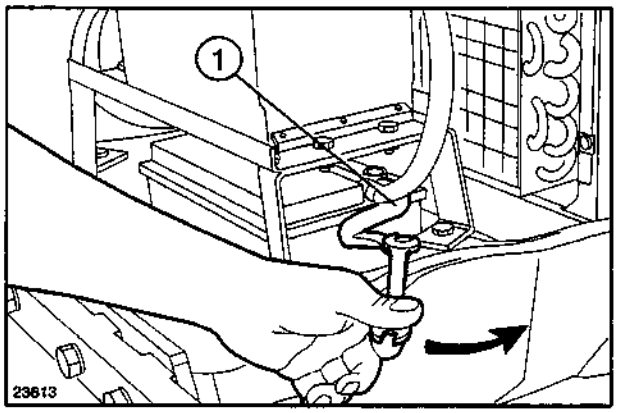


Figure 5-1-177

3. Loosen the plug (3) and drain oil from rear axle and speed clutch/transmission housings into a suitable container (oil capacity is 19.2 gallons on tractors equipped with Dual Command and up to 26.4 gallons on tractors equipped with Range Command).

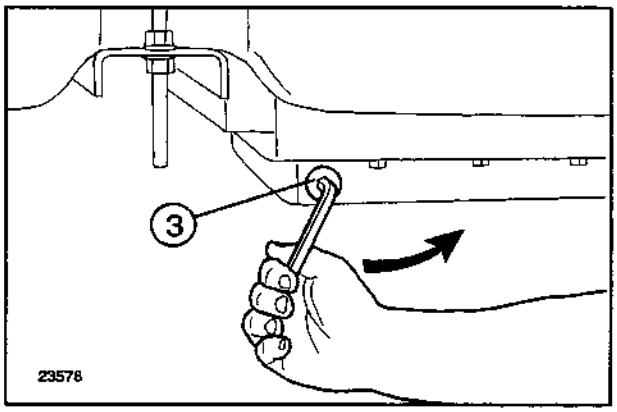


Figure 5-1-178

4. Jack up rear tractor and place a stationary stand under the rear axle housing and a stationary pillar under the LH steps to the cab.

5. Sling the wheel using a nylon cable (3), loosen retaining nuts and remove the wheel. Repeat for left wheel.

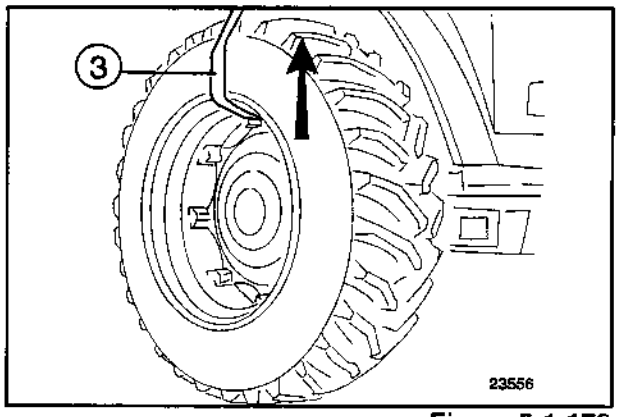


Figure 5-1-179

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6. Loosen the two screws on the cab roof and fix tool no. **FTC213997B** (4) using two appropriate bolts. Connect the tool to a hoist and remove slack to support cab.

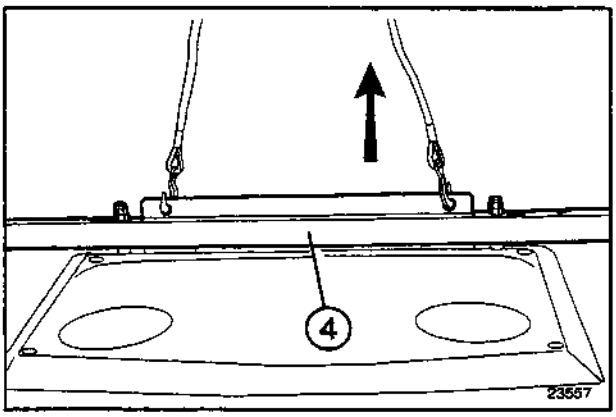


Figure 5-1-180

7. Loosen and remove the bolts attaching the cab to rear brackets (on both rear mounts).

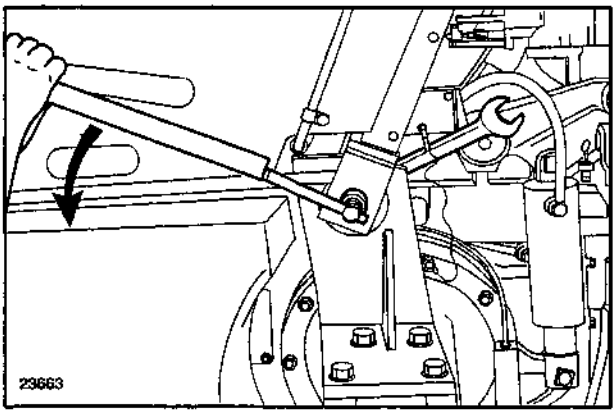


Figure 5-1-181

8. Detach the telescopic stabilizer, loosen the attaching bolts and remove cab bracket (2) and telescopic stabilizer bracket (3).

9. Reinstall bolt and nut on the rear RH mount.

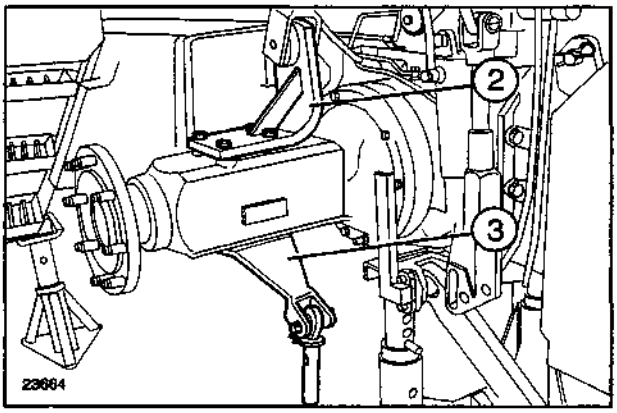


Figure 5-1-182

10. Loosen the mounting screws and remove the draft sensor wire protection (5).

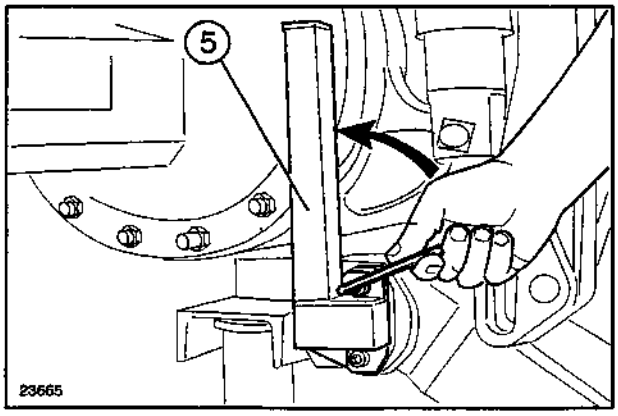


Figure 5-1-183

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11. Place tool no. **50091** (1) and connect it to a hoist using a rope. Loosen the final drive case to rear axle housing retaining nuts.

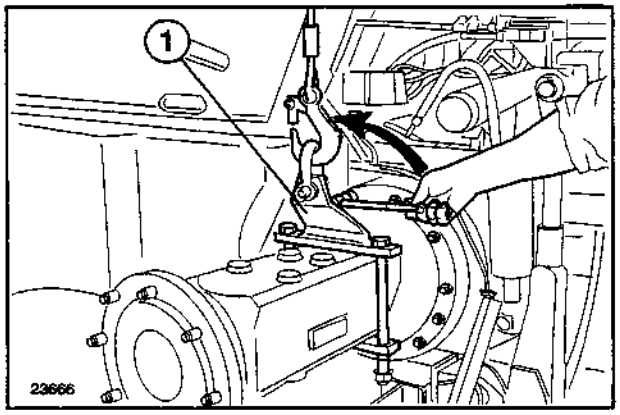


Figure 5-1-184

12. Remove the final drive assembly (2) from the rear axle housing together with the half–shaft (3)

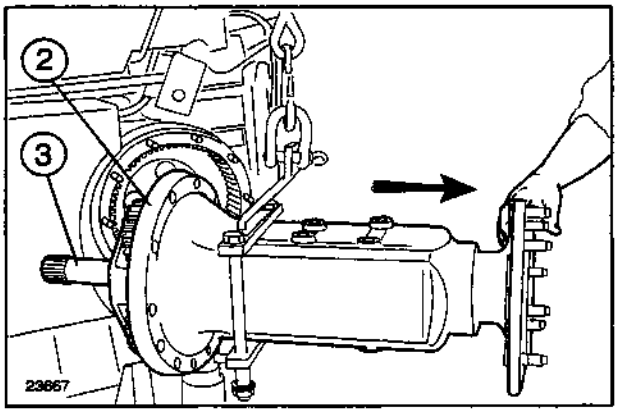


Figure 5-1-185

13. Detach the assist ram from the spacer (5), recover outer ring gear (4), spacer and friction plate (6).

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

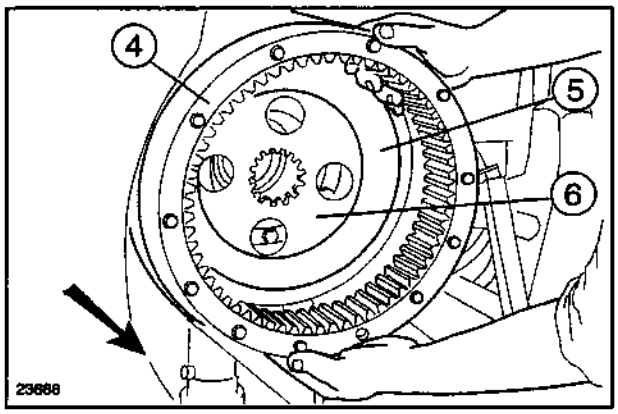


Figure 5-1-186

14. Reinstall the final drive assembly to the rear axle housing observing the following:
   - Reassembly follows the disassembly procedure in reverse, from step 13 back to step 1.
   - Refer to figures on pages 5-1-9 and 5-1-10 for correct orientation of the different components.
   - Before reassembling the final drive case, thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approx. 0.079 in (2 mm) of diameter following the patterns shown in the figures on page 5-1-35.
   - Tighten to correct torque as detailed on pages 5-1-3 and 5-1-4.
   - To assist final drive case reinstallation, locate the half–shaft (4, Figure 5-1-187) into its seat on the differential and brake disc.

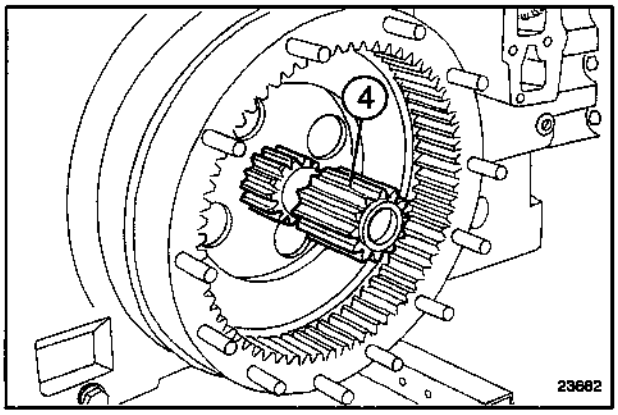


Figure 5-1-187

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DRIVE WHEEL SHAFT

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

With the final drive case removed from the rear axle housing, proceed as follows:

1. Position the final drive case (1) on a rotary stand.

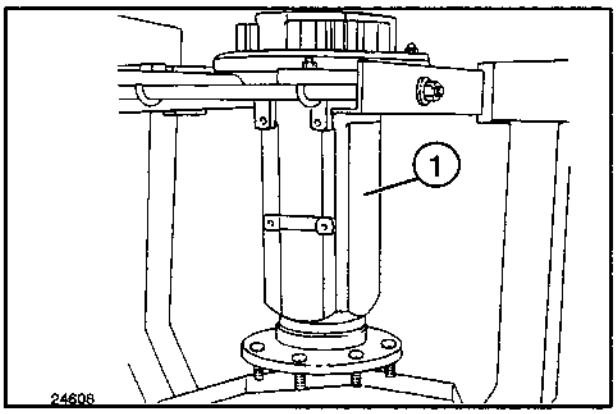


Figure 5-1-188

2. If necessary, remove the locking plate (1) by slightly turning it

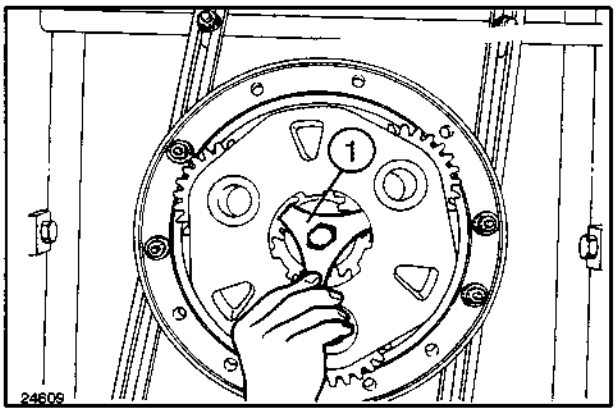


Figure 5-1-189

3. Loosen the screw attaching the planetary carrier (1) to the drive wheel shaft.

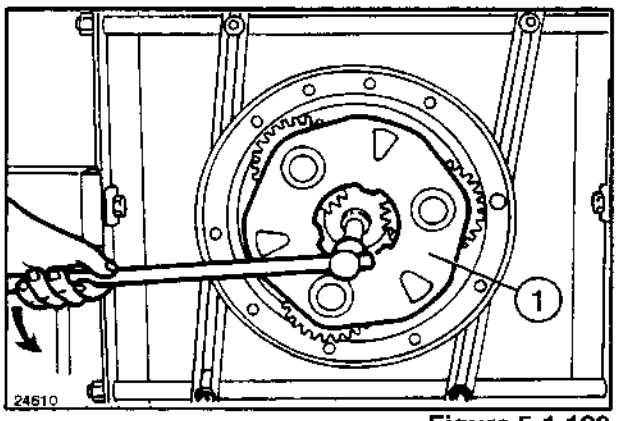


Figure 5-1-190

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4. Slide out the planetary carrier (1).

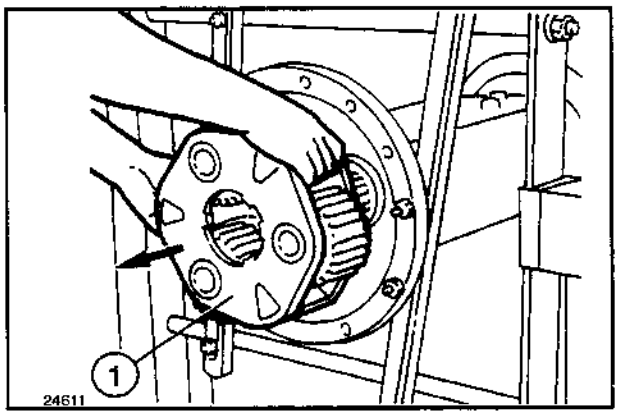


Figure 5-1-191

5. Recover the thrust washer (1).

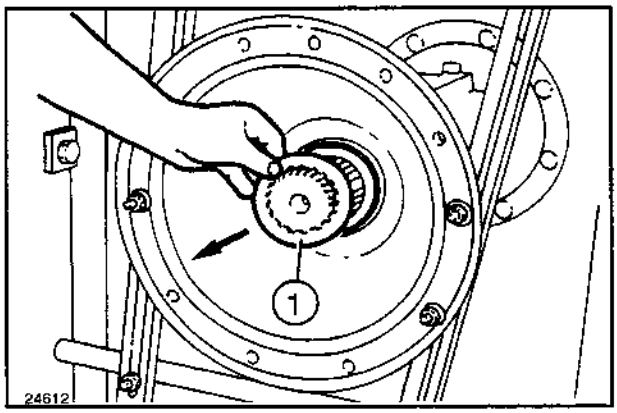


Figure 5-1-192

6. Using a suitable puller, remove the drive wheel shaft (1).

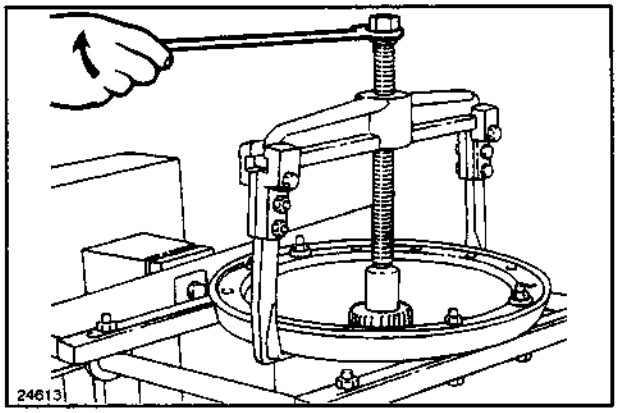


Figure 5-1-193

7. Remove the seal (1) and recover the bearing inner cup from the wheel side.

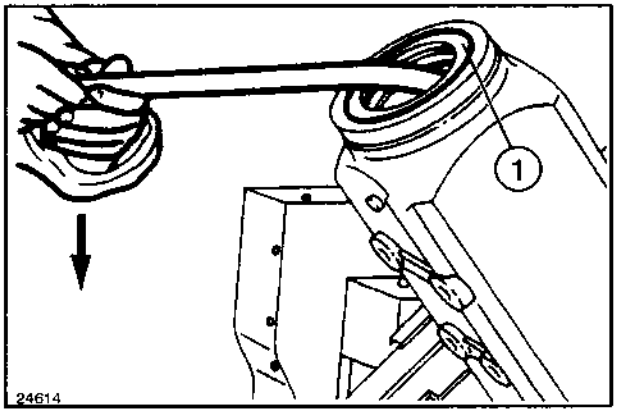


Figure 5-1-194

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8. Using an expansion puller and a slide hammer, remove the bearing outer cup from the wheel side.

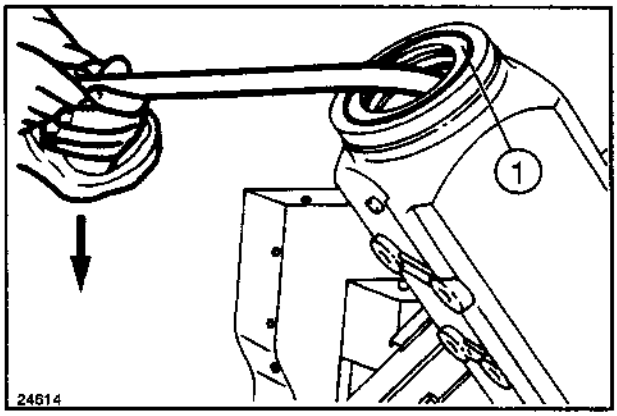


Figure 5-1-195

9. Using an expansion puller and a slide hammer, remove the bearing outer cup (1) from the final drive side.

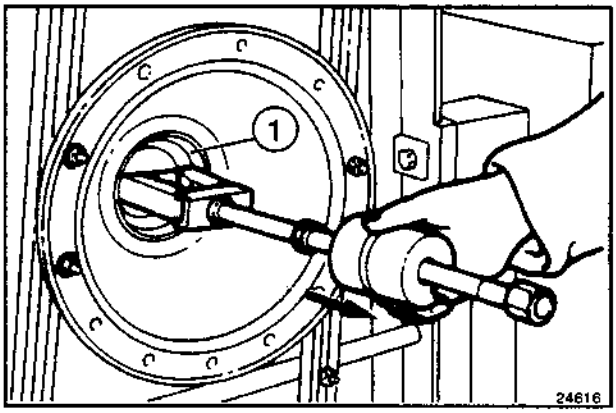


Figure 5-1-196

10. Remove the seal (1).

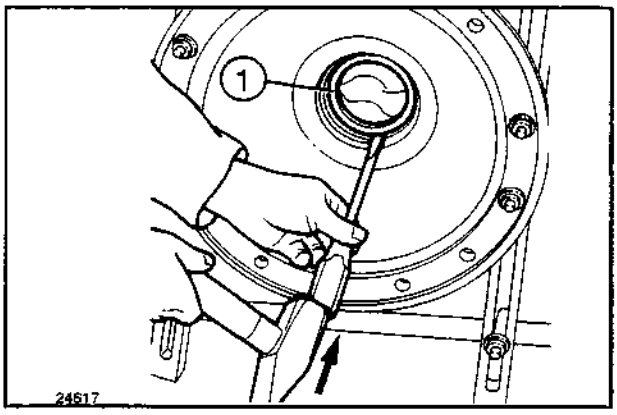


Figure 5-1-197

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

11. Reinstall all the components of the drive wheel shaft assembly observing the following:
    - Reassembly follows the disassembly procedure in reverse, from step 10 back to step 1.
    - Refer to figures on pages 5-1-9 and 5-1-10 for correct orientation of the different parts.

12. Install the outer bearing cups and seals on the housing using suitable drifts.

13. After installing all components on the final drive case, adjust the drive wheel taper bearings.

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Drive wheel taper bearing adjustment

14. Tighten the screw (C_3, page 5-1-3) to 114 ft. lbs (196 N·m) while turning the shaft to settle the assembly.

15. Loosen the screw (C_3, page 5-1-3) then tighten it again to 65 ft. lbs (88 N·m) while turning the shaft to settle the bearings properly.

16. Insert the safety plate and lock it screwing in or out the screw (C_3) until reaching the next notch

Note: Screw in or out to a max. angular variation of 15°.

17. Turn the shaft by hand and check if it turns freely, with no end float, nor excess resistance

18. Using the grease nipple, fill the inner recess with grease.

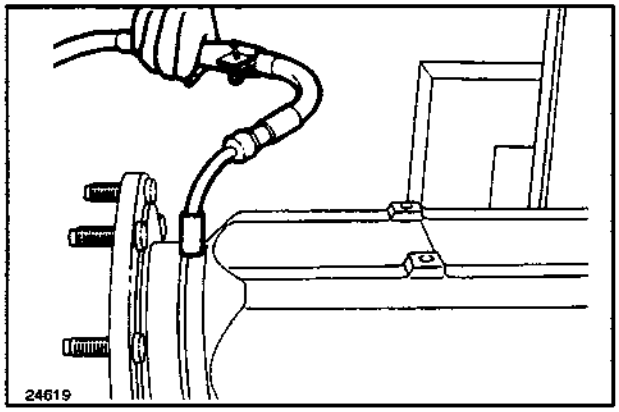


Figure 5-1-198

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PLANETARY GEAR SET

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

With the assembly removed from the case, proceed as follows:

1. Remove retaining ring (1).

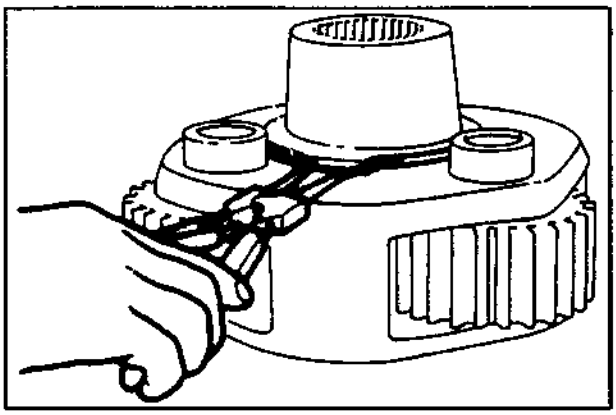


Figure 5-1-199

2. Slide out the pivot pins and recover the gears complete with the needle bearings. Remove the thrust washer (1).

3. Reinstall all components of the planetary gear set observing the following:
   - –Reassembly follows the disassembly procedure in reverse, from step 2 back to step 1.
   - –Insert the thrust washer (1) first on the driven gear holder.

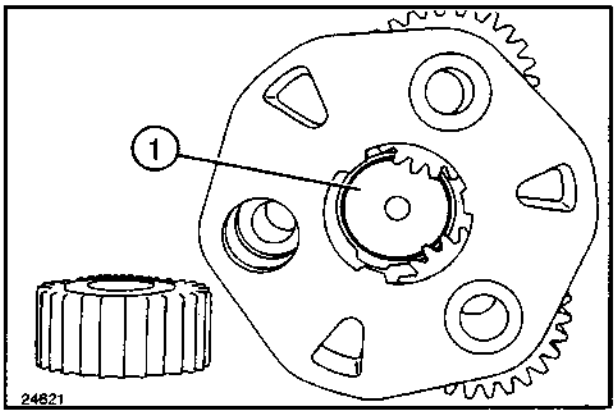


Figure 5-1-200

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8160, 8260, 8360, 8560 TRACTOR REPAIR MANUAL CONTENTS

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SECTION 2 – ELECTRICAL SYSTEM
SECTION 3 – CLUTCH
SECTION 4 – TRANSMISSIONS
SECTION 5 – MECHANICAL REAR WHEEL DRIVE



SECTION 6 – BRAKES

SECTION 7 – POWER TAKE-OFF
SECTION 8 – HYDRAULIC SYSTEM
SECTION 9 – DRIVE LINES - FWD
SECTION 10 – CAB

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SECTION 6

BRAKES

CHAPTER 1

BRAKES

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33 000 – SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

SPECIFICATIONS

Type: - Service Brakes - Parking Brake	 wet disc acting on differential axle shafts three wet discs acting on pinion gear shaft
Controls: – Service Brakes – Parking Brake	 hydraulic, independent pedals (or latched for joint operation) mechanical through a hand lever
Service Brake Disc Material Parking Brake Disc Material Parking Brake Lining Material	sintered steel sintered or organic conglomerate
Disc Thickness: - Service Brakes in (mm) Permissible Wear in (mm) - Parking Brake in (mm)	 0.394 (10) 0.338 (8.6) 0.236 (6)

(to be continued)

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SPECIFICATIONS

(cont'd)

Parking Brake Lining Thickness: - Side ..... in (mm) - Intermediate ..... in (mm)	 0.122 to 0.135 (3.1 to 3.4 mm) 0.165 to 0.177 (4.2 to 4.5)
Hydraulic Drive Unit Hydraulic Pump ..... Operating Pressure ..... lbf/in^2 (bar)	 2 master cylinders independently operated through the brake pedals 255 (17.6 bar)
Control Pedal Adjustment ..... Brake Hydraulic System Bleeding	see page 6-1-13 see page 6-1-14

TIGHTENING TORQUE

DESCRIPTION	Thread Size	Tightening Torque ft. lbs. N·m
Final drive to rear axle housing attaching nuts (C_1 page 6-1-4)	M 14 x 1.5	130 (176)
Parking brake pad guide screws (C_2)	M 14 x 1.5	18 (24)
Brake assembly to rear axle housing attaching screws (C_3)	M 10 x 1.25	36 (49)

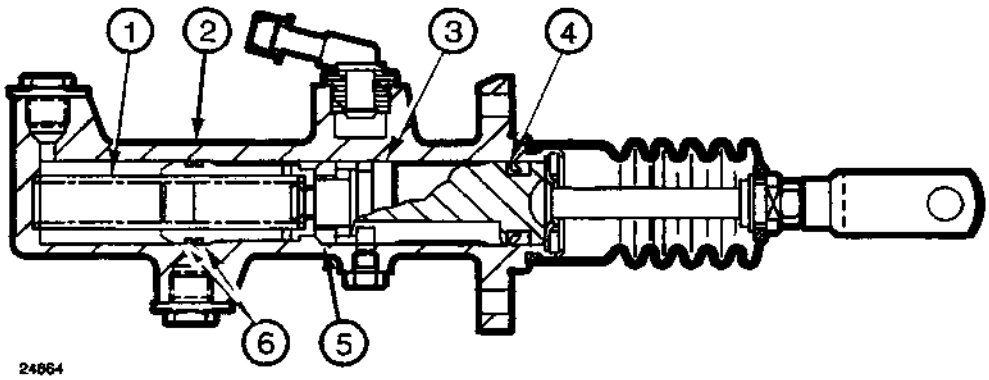


Figure 6-1-1

SERVICE BRAKE CONTROL PUMP SECTIONAL VIEW

1. Spring
2. Pump body
3. Control piston
4. Rear seal
5. Center seal
6. Front seals

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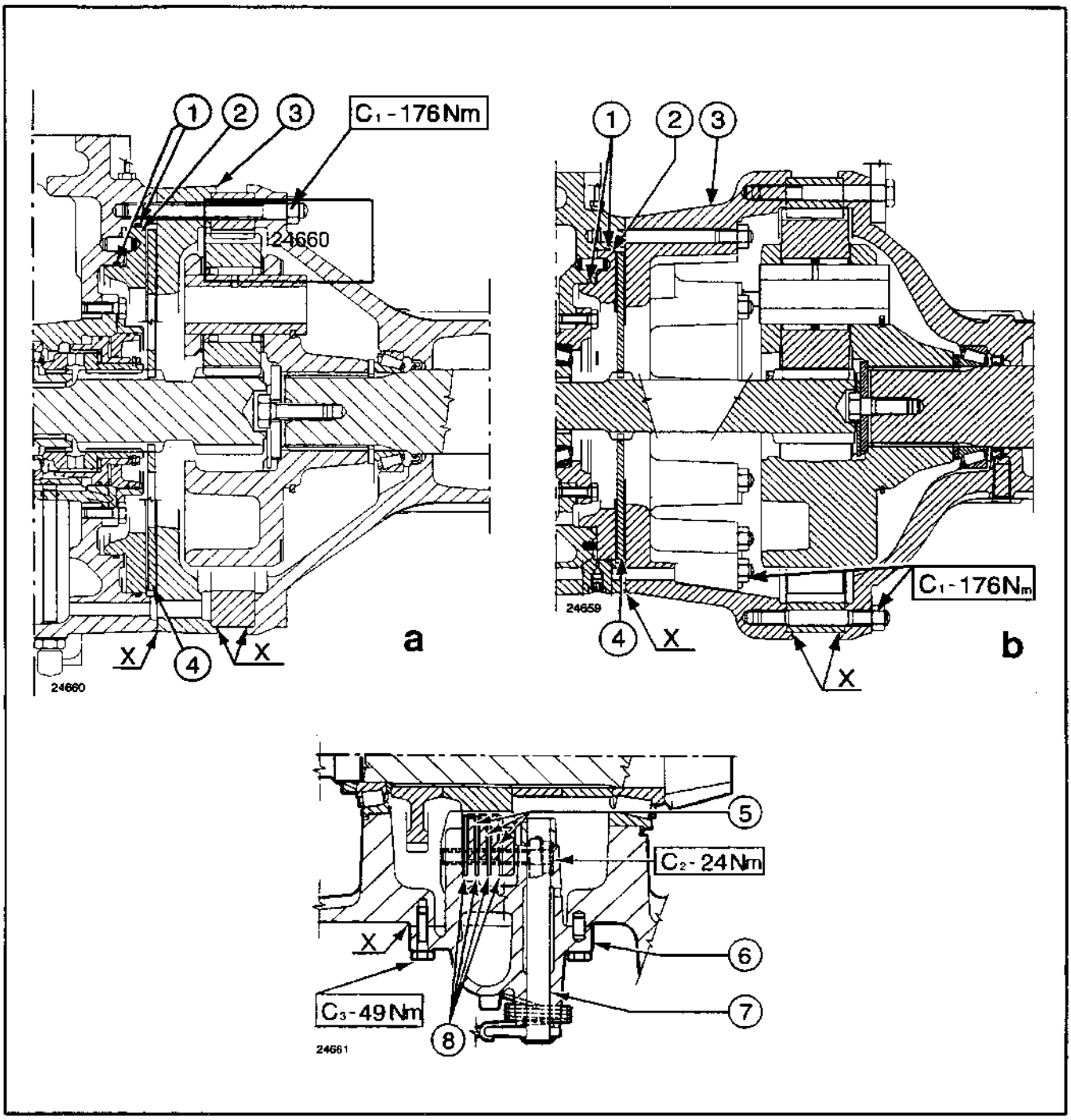


Figure 6-1-2

PARKING AND SERVICE BRAKE SECTIONAL VIEWS

a. Models 8160, 8260 and 8360
b. Model 8560
C_1. Final drive to rear axle housing attaching nuts
C_2. Parking brake pad guide screws
C_3. Parking brake assembly to rear axle housing attaching screws
1. Seal
2. Brake control piston
3. Final drive case spacer
4. Service brake disc
5. Parking brake discs
6. Friction pad assembly
7. Parking brake control lever
8. Pads

Note: During installation apply liquid gasket on surfaces marked with an X as detailed on pages 6-1-11 and 6-1-21.

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SPECIAL TOOLS

Caution – Operations described in this section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to perform service operations covered by this section of the Manual:

X 295016 Parking brake alignment tool.

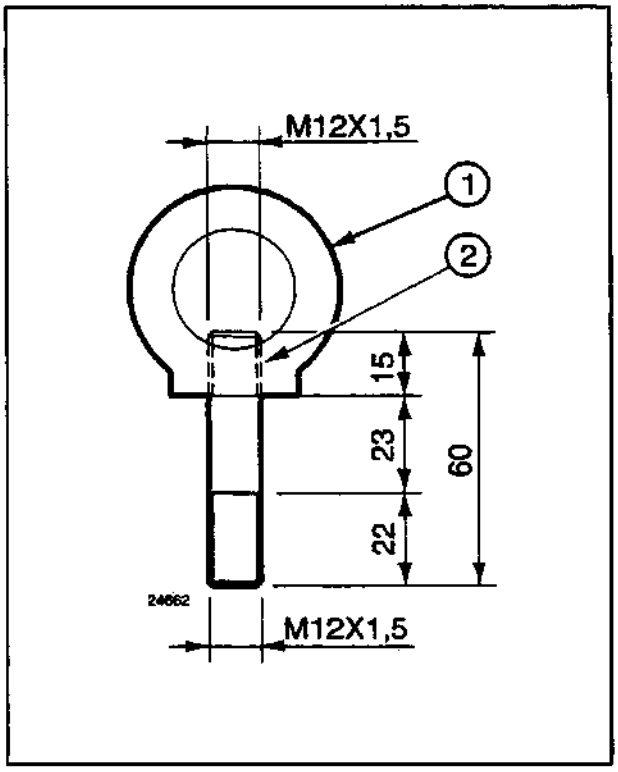


Figure 6-1-3

Tool to be fabricated to disassemble and reassemble the final drives (Mark tool with no. 50078. Dimensions in mm.)

Note: Fabricate tool using 38 NCD 4 material.

1. Fabricate from a male eyebolt M12 DIN 580
2. Apply LOCTITE 270

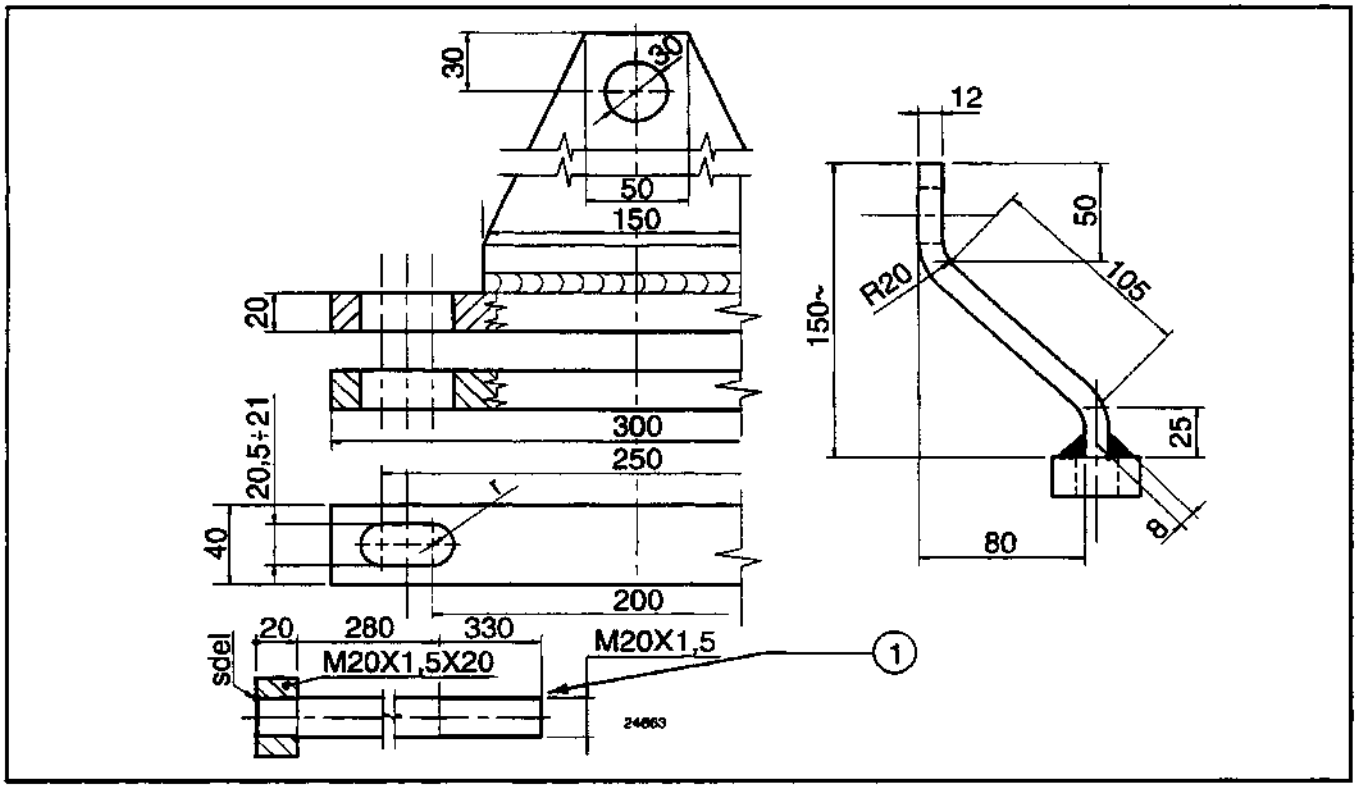


Figure 6-1-4

Tool to be fabricated to disassemble and reassemble the final drives (Mark tool with no. 50091. Dimensions in mm.)

Note: Fabricate tool using Aq 42 D material.

1. Make 2 tie–rods in C 40 H&T material

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DESCRIPTION AND OPERATION

SERVICE BRAKES

Service brakes are wet disc, hydraulically controlled type.

The two control pumps, one for each pedal, are located at cab front and connected to the respective pedals by means of tie–rods.

The pumps can be operated individually or together when the pedals are latched together by the spin.

The pumps are connected by a bridge pipe. This provides balanced braking even if the brake discs are worn out to a different extent.

The control pumps are fed from a single reservoir located under the hood and mounted on the engine by means of a bracket.

Brake discs (one for each rear wheel) are located between the rear axle housing and final drive cases and are splined to the differential output axle shafts.

PARKING BRAKE

The parking brake is controlled mechanically. It acts on the rear pinion gear shaft and is controlled through a hand lever located at the left of the driver's seat.

When the parking brake control lever is raised, the tensioning cable acts on the actuator forcing the pads against the three brake discs splined to the tractor rear pinion gear.

TROUBLESHOOTING

Problem	Possible Causes	Correction
Pedals are hard to operate	1. Seizure of the hydraulic master cylinder involved.	Replace the control pump.
	2. Blocked or flattened brake control lines.	Clean or replace pressure lines.
Brakes remain applied when pedals are released.	1. Stuck control pump pistons.	Free piston and replace pumps if necessary.
	2. Seized master cylinders.	Replace brake control pumps.
Brake noise.	1. Worn brake disc lining.	Replace brake discs.
Excessive pedal travel	1. Air inside the brake hydraulic circuit.	Bleed air from brake hydraulic circuit.
	2. Worn brake control pumps.	Replace brake control pumps.
	3. Oil leakage from pressure lines.	Repair leakage.

(to be continued)

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TROUBLESHOOTING

(cont'd)

Unbalanced braking	1. Wrong tire pressure.	Inflate tires to correct pressure
	2. Worn brake control pumps.	Replace brake control pumps
	3. Blocked or flattened pump bridge pipe.	Repair or replace bridge pipe
	4. Blocked or flattened brake control lines.	Repair or replace pressure lines
	5. Worn or broken pump control piston seals.	Replace pumps
	6. Worn lining on one brake disc (4, page 6-1-4).	Replace disc
Poor braking action	1. Worn brake disc linings (4, page 6-1-4).	Replace brake discs
	2. Worn brake control pumps.	Replace brake control pumps
	3. Air in the brake hydraulic circuit.	Bleed air from brake hydraulic system
	4. Oil leakage from brake control lines.	Repair leakage
	5. Worn or broken hydraulic pump drive piston seals.	Replace pumps
Inefficient parking brake	1. Brake control misadjustment.	Adjust correctly
	2. Worn braking pads (8, page 6-1-4).	Replace pads
Tractor remains braked upon releasing the parking brake control lever	1. Hindered control lever return travel.	Repair as necessary
	2. Seized pads on brake discs	Repair and replace damaged parts

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BRAKE, RIGHT OR LEFT
Removal – Installation

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks.
Ensure that no–one is in the vicinity of the load to be lifted.

Separate and remove final drive case as follows:

1. Open and raise the hood.
2. Detach the negative cable (1) from the battery and insulate.

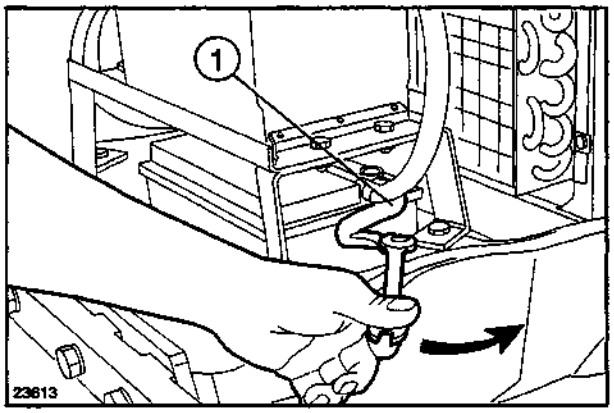


Figure 6-1-5

3. Unscrew the plug (3) and drain oil from transmission and rear axle housings. Collect oil into a suitable container. Loosen the plug (3) and drain oil from rear axle and speed clutch/transmission housings into a suitable container (oil capacity is 19.2 gallons on tractors equipped with Dual Command and up to 26.4 gallons on tractors equipped with Range Command).

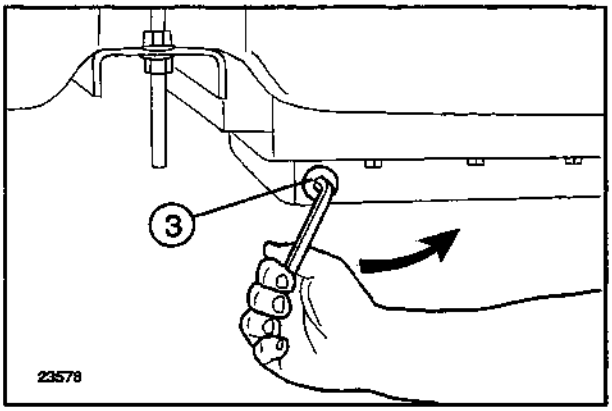


Figure 6-1-6

4. Jack up the tractor and place a stationary stand under the rear axle housing and a stationary support under the left–hand steps to the cab.
5. Sling the wheel using a nylon cable (3), unscrew the attaching nuts and remove the wheel. Repeat for the left wheel.

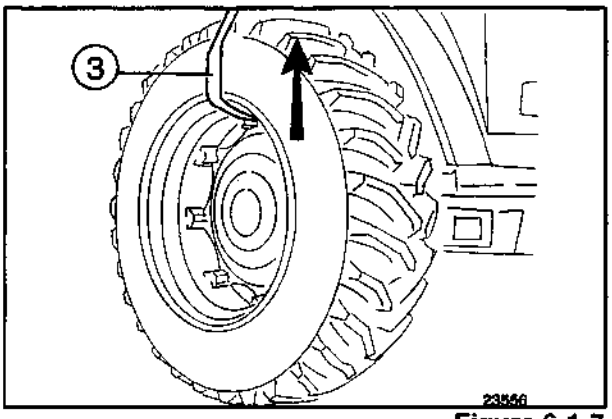


Figure 6-1-7

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6. Loosen the two screws on the cab roof and fix tool **FTC213997B** (4) using two appropriate bolts. Connect tool to a hoist and remove slack to support cab.

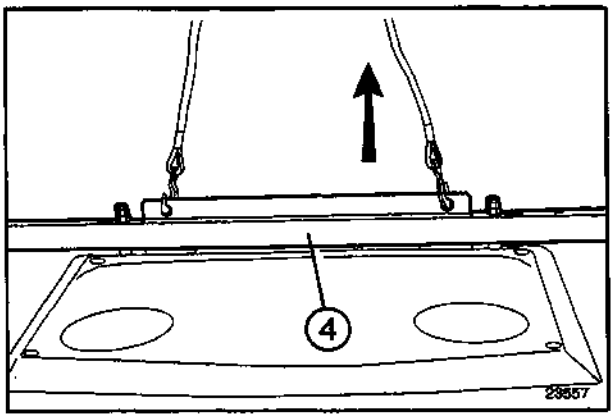


Figure 6-1-8

7. Unscrew and remove the rear screws attaching the cab to the supporting brackets (repeat for both rear mounts).

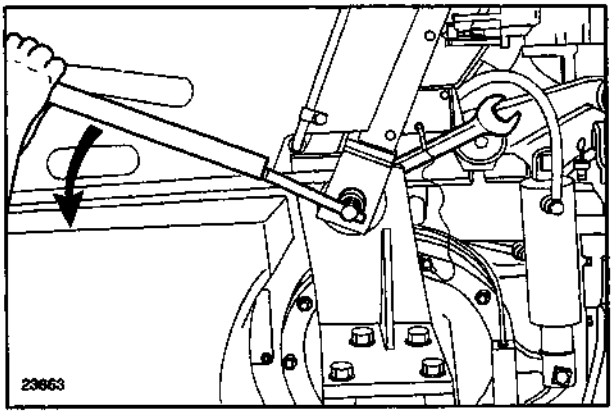


Figure 6-1-9

8. Remove the telescopic stabilizer, loosen the attaching screws and remove the bracket (2) supporting the cab and the bracket (3) supporting the telescopic stabilizer.

9. Reinstall the screw and nut on the rear RH mount.

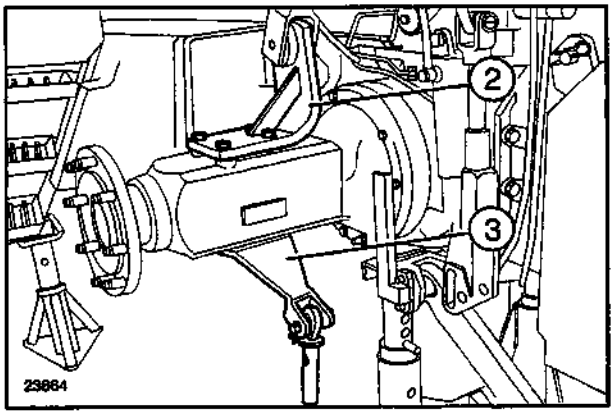


Figure 6-1-10

10. Loosen the attaching screws and remove the draft control sensor cable guard.

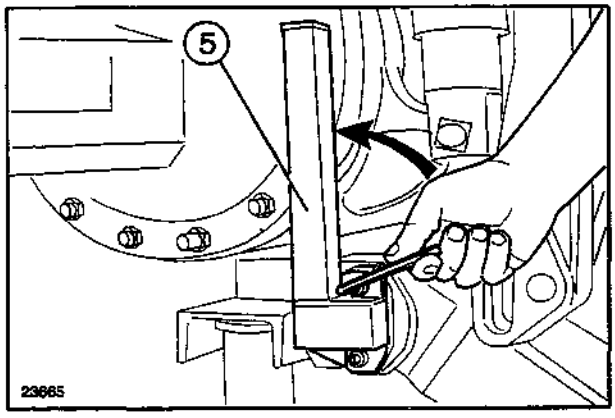


Figure 6-1-11

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11. Locate the tool no. **50091** (1), connect it to a hoist using a cable and unscrew the nuts attaching the final drive case to the rear axle housing.

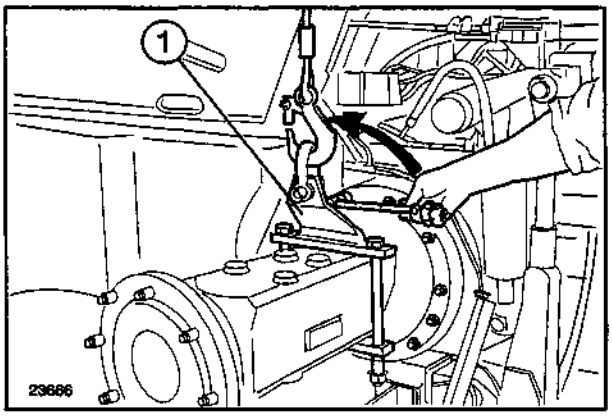


Figure 6-1-12

12. Detach the final drive assembly (2) from the rear axle housing together with the axle shaft (3).

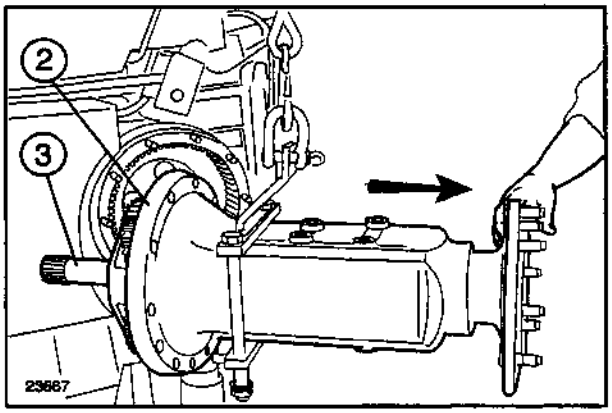


Figure 6-1-13

13. Detach the assist ram from the spacer (5), recover the outer ring gear (4), spacer and friction plate (6).

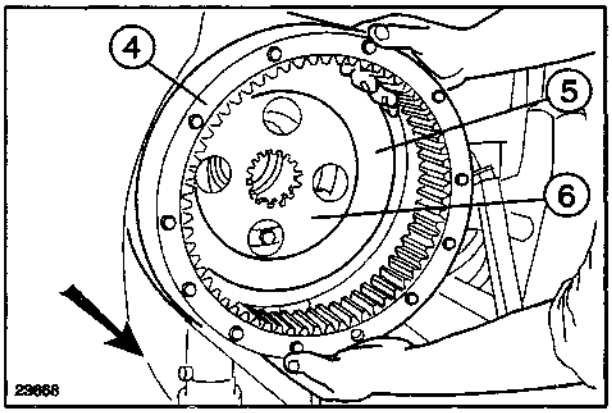


Figure 6-1-14

14. Remove piston (7) from the service brake. Press the control pedal to withdraw the piston from its seat, if necessary.

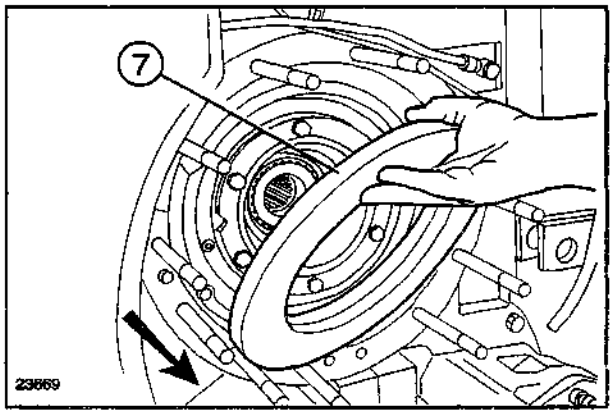


Figure 6-1-15

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⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

15. Reinstall the final drive case to the rear axle housing taking the following into consideration:

    – Rassembly follows the disassembly procedure in reverse, from step 14 back to step 1.

    – Refer to figures on page 6-1-4 to orient the different parts.

    – Before reinstalling the final drive case to the rear axle housing, thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approx. 0.079 in (2 mm) of diameter following patterns shown in the figure below.

    – Check seals for wear or damages and replace if damaged.

    – Tighten to correct torque as detailed on page 6-1-3.

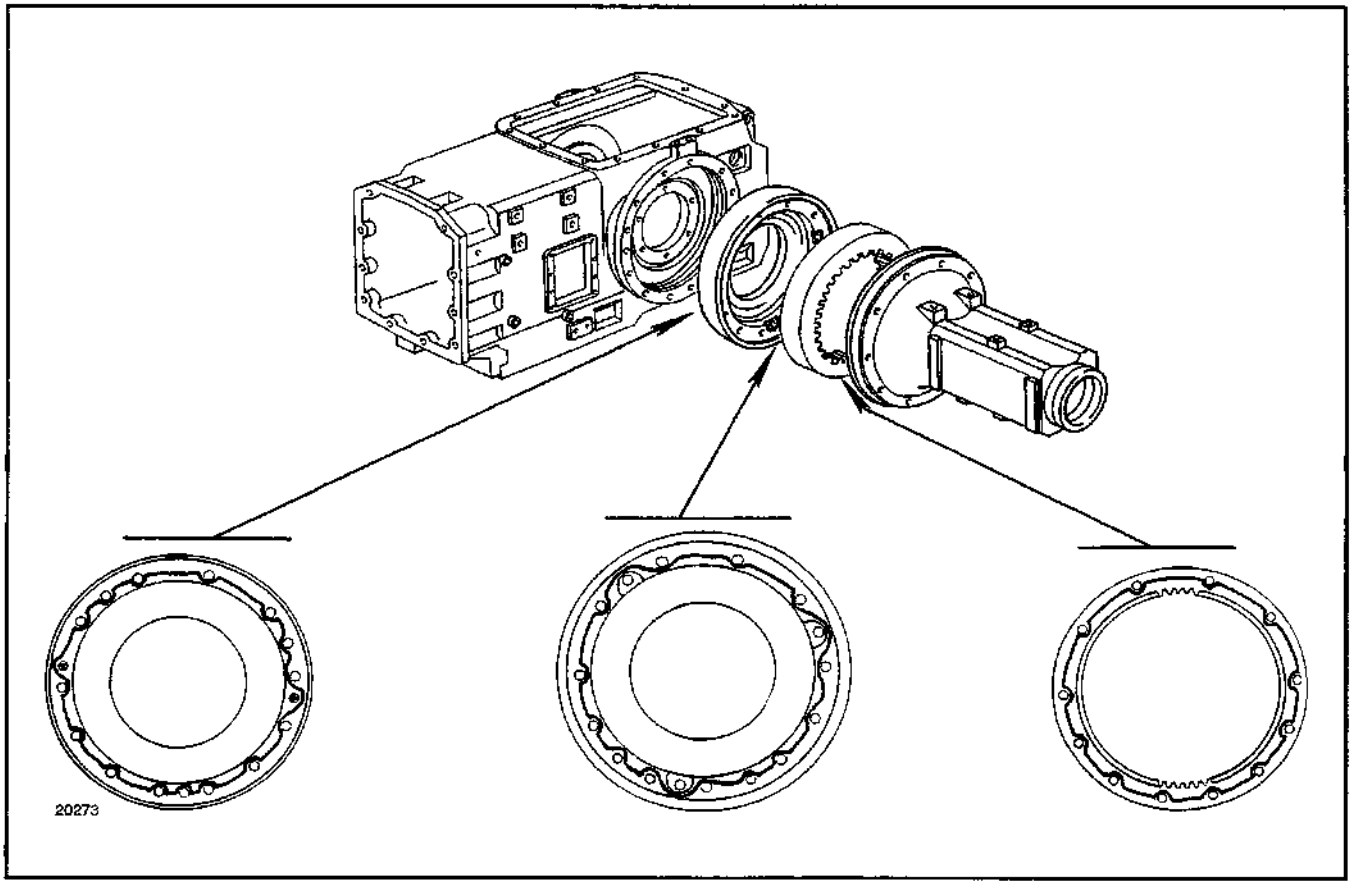


Figure 6-1-16

Pattern for application of liquid gasket between the final drive case and rear axle housing.

Sealants to be used are listed on page 0-1-19, Sec. 00.

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HYDRAULIC BRAKE CONTROL PUMP
Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Remove the hydraulic brake control pump as follows:

1. Open and raise the hood.
2. Detach the negative cable (1) from the battery and insulate.

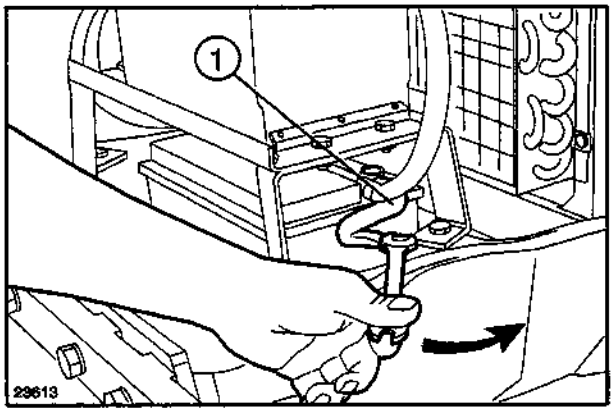


Figure 6-1-17

3. Loosen retaining screws and remove the side panel (1).

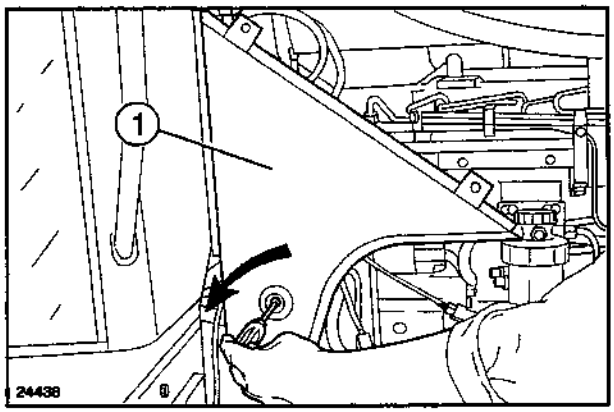


Figure 6-1-18

4. Remove retaining screws (1) and remove protection from right side.

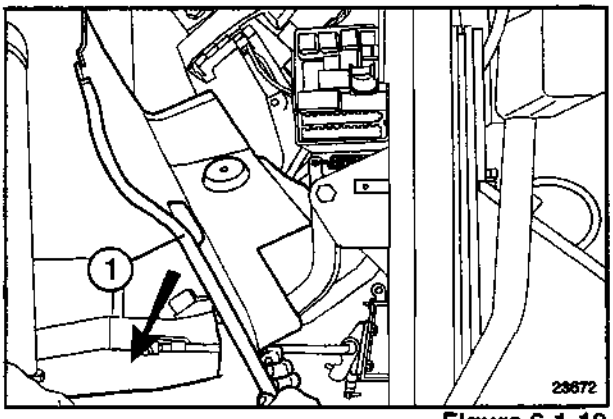


Figure 6-1-19

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5. Detach connectors (1) from brake control pumps.

6. Loosen fittings (2) and detach brake control lines.

7. Loosen lines connecting the brake control pumps to the reservoir.

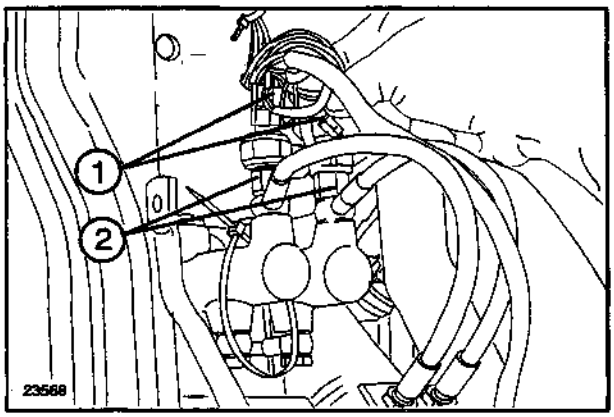


Figure 6-1-20

8. Remove cotter pins and slide out the pins (1) hinging the brake pump drive forks.

9. Loosen the screws (2) retaining the brake control pumps to the cab and withdraw pumps from tractor on the engine side.

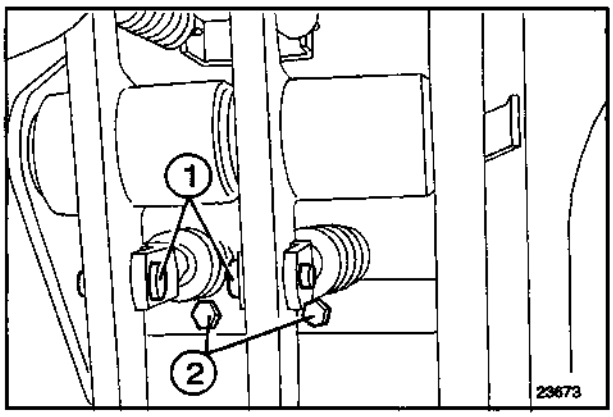


Figure 6-1-21

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

10. Reinstall the hydraulic brake control pumps taking the following into consideration:
    - Reassembly follows the disassembly procedure in reverse, from step 9 back to step 1.
    - Carry out adjustment detailed below and bleed air from the brake hydraulic circuit following the instructions given on page 6-1-14.

Service Brake Pedal Height Adjustment

11. With the brake pedals connected to their forks and the latching pin removed, check the distance (H) from pedal center to the floor mat. It should be approximately 7.28 in (185 mm).

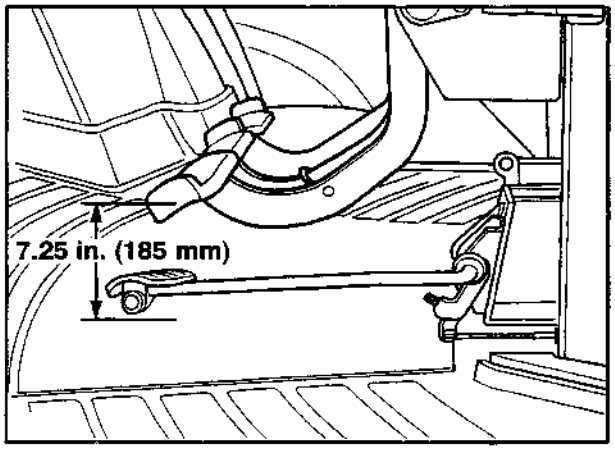


Figure 6-1-22

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12. If this is not the case, release the locknuts (2) and screw in or out the adjust screw (1) to obtain the specified distance. Tighten the locknuts.

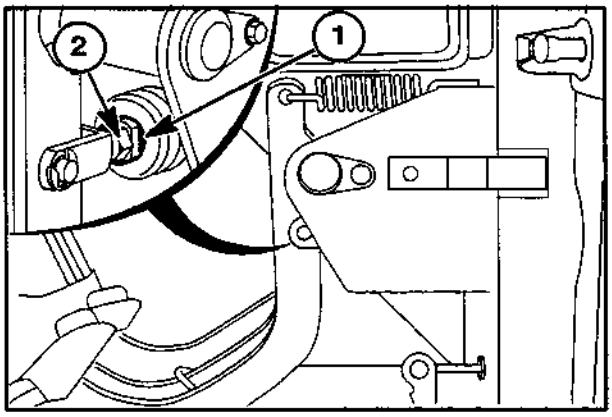


Figure 6-1-23

HYDRAULIC BRAKE SYSTEM

Air Bleeding

Air bleeding should be carried out any time the brake hydraulic system has been serviced or repaired.

Proceed as follows:

1. Thoroughly clean the exterior of the assembly around the bleed screw (1, Figure 6-1-25) and hydraulic oil reservoir cover (1, Figure 6-1-24).

2. Ensure that the reservoir (1) is being filled before and during bleeding.

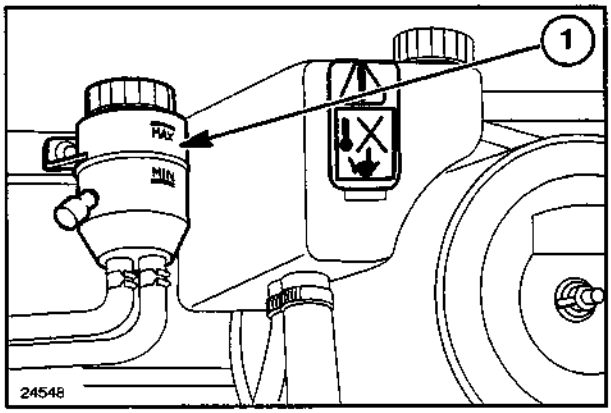


Figure 6-1-24

Note: Filter drained oil accurately before reuse.

3. Press the LH brake pedal **slowly and along all its travel** to pressurize oil.

4. Hold the brake pedal down and unscrew the bleeding screw (1) by half a turn. Let oil drain with air bubbles.
5. Screw in the screw (1) and repeat the above steps until oil free of air comes out.
6. Press again the LH brake pedal to pressurize the circuit. This condition exists when pedal operation is felt normal again.
7. Repeat the above steps for the RH brake pedal.
8. Upon completion of bleeding, top up oil in the reservoir to correct level (1, Figure 6-1-24).

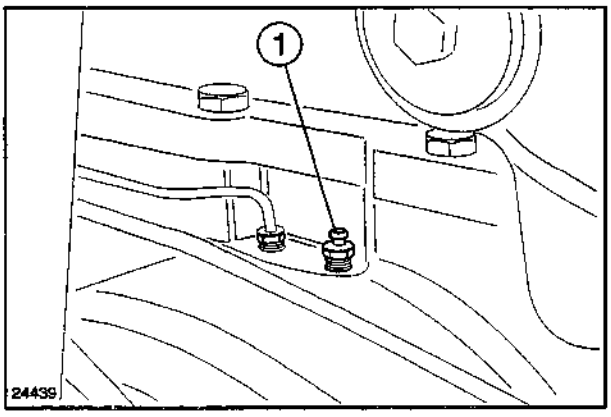


Figure 6-1-25

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9. If the tractor is fitted with a hydraulic trailer brake valve using Kontak auxiliary valves, perform air bleeding as described above and then bleed air from bleed screw (1) following the same procedure as for bleed screw (1, Figure 6-1-25).

10. Upon completion of bleeding, top up oil in the reservoir to correct level (1).

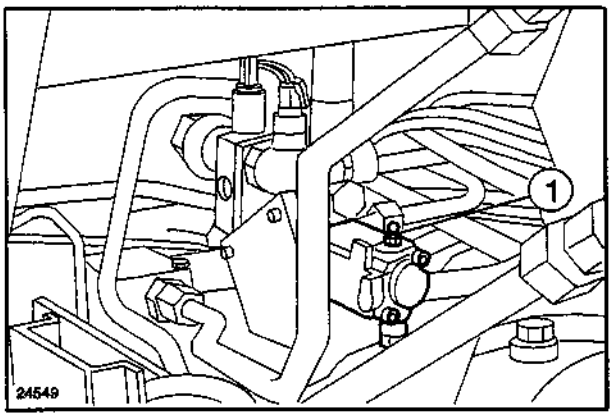


Figure 6-1-26

11. If the tractor is fitted with a hydraulic trailer brake valve using Rexroth auxiliary valves, perform air bleeding as described above and then bleed air from bleed screws (1, 2, and 3) following the same procedure as for bleed screw (1, Figure 6-1-25).

12. Upon completion of bleeding, top up oil in the reservoir to correct level (1).

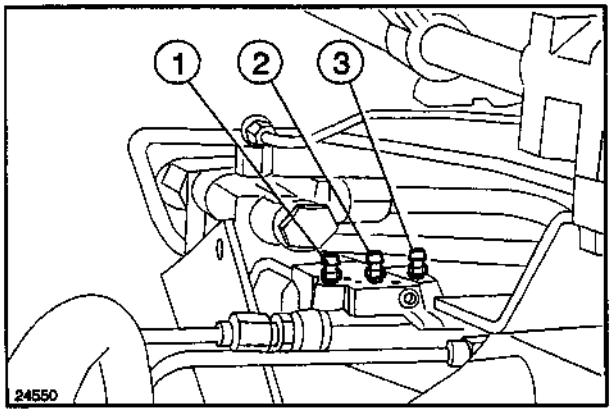


Figure 6-1-27

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PARKING BRAKE ASSEMBLY
Removal – Installation

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.
Ensure that units or parts are supported by suitable slings or hooks.
Ensure that no–one is in the vicinity of the load to be lifted.

Remove the parking brake assembly as follows:

1. Open and raise the hood.
2. Detach the negative cable (1) from the battery and insulate.

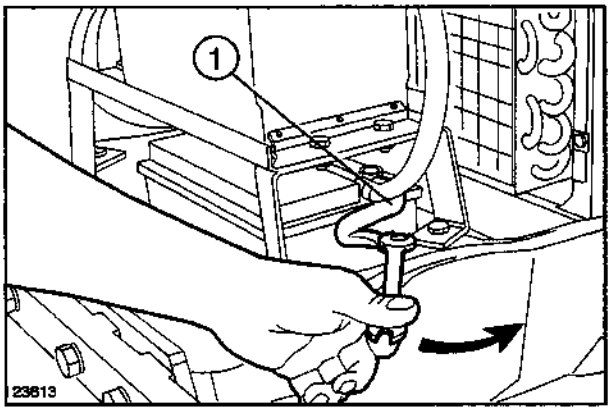


Figure 6-1-28

3. Jack up the tractor rear end and place two suitable stationary stands under the final drive cases. Rear wheels should be off the ground. Detach vertical links from the lower lift arms if necessary.

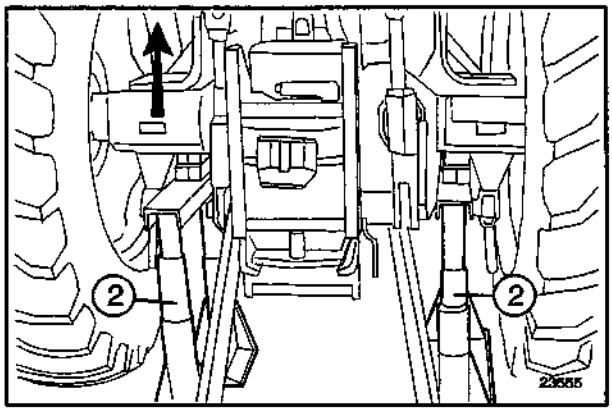


Figure 6-1-29

4. Sling the wheel using a nylon cable (3), unscrew the attaching nuts and remove the wheel. Repeat for the LH wheel.

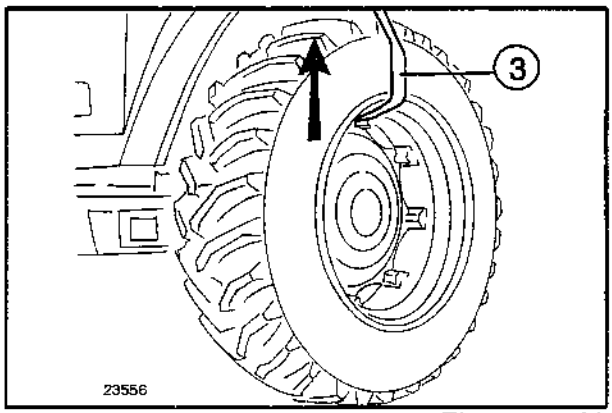


Figure 6-1-30

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5. Loosen the screw retaining the steps (6) to the support bracket.

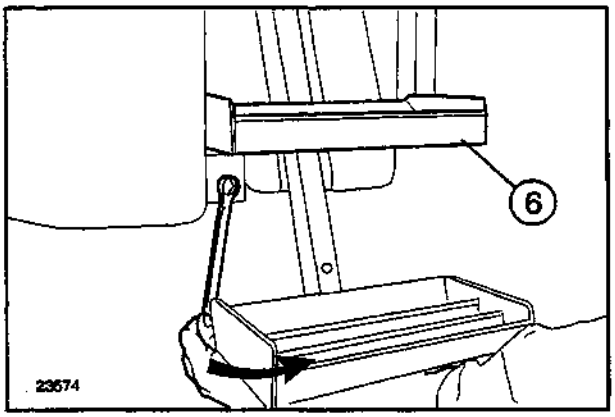


Figure 6-1-31

6. Loosen the screw retaining the steps (1) to the cab floor.

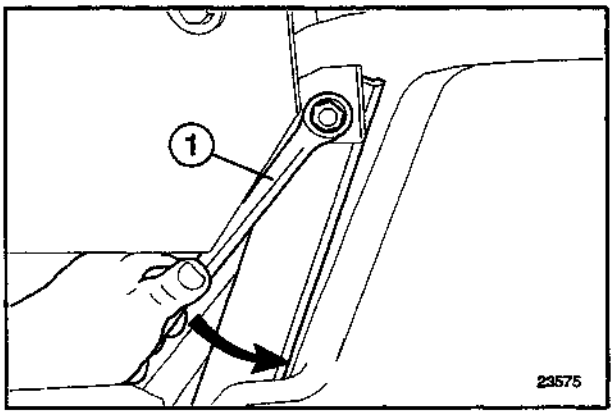


Figure 6-1-32

7. Empty fuel tanks and remove the clamp (1) on the line connecting the main tank to the auxiliary tank.

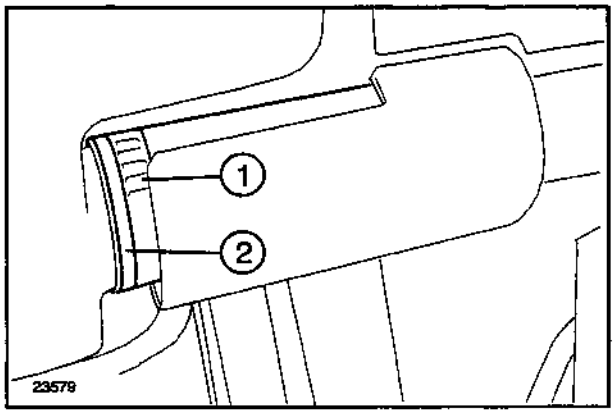


Figure 6-1-33

8. Remove the clamp and detach bleed line (3) between the main tank to the auxiliary tank.

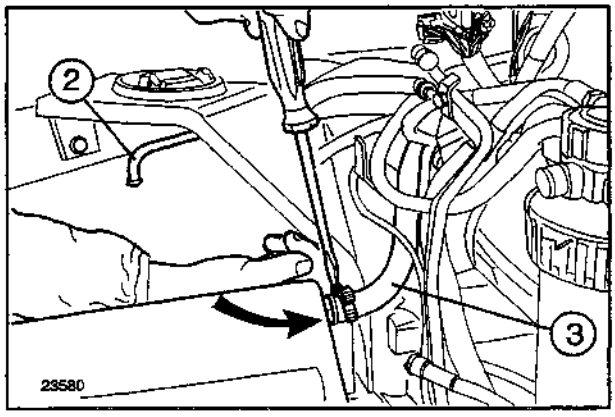


Figure 6-1-34

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9. Loosen the clamp and detach the injection pump supply line (5), detach connectors (4), loosen and remove the fuel level sensing unit.

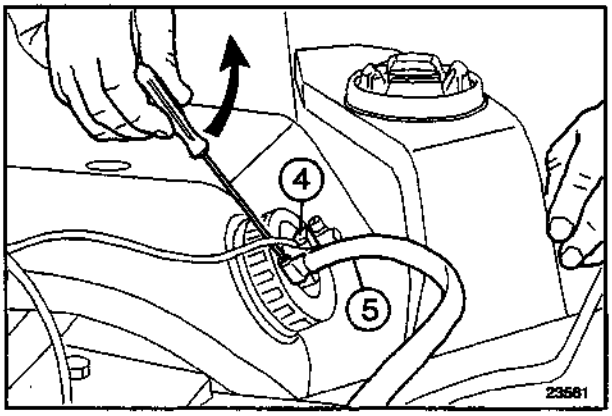


Figure 6-1-35

10. Loosen the nut of the main tank metal lock–plate (6), remove plate and remove the tank. Tilt tank to ease it out from between the cab and mounting bracket.

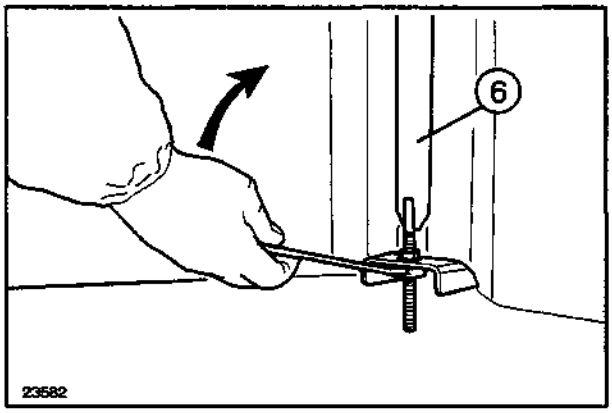


Figure 6-1-36

11. Detach the cable from the parking brake control lever.

12. Loosen the retaining screws and remove the parking brake control assembly.

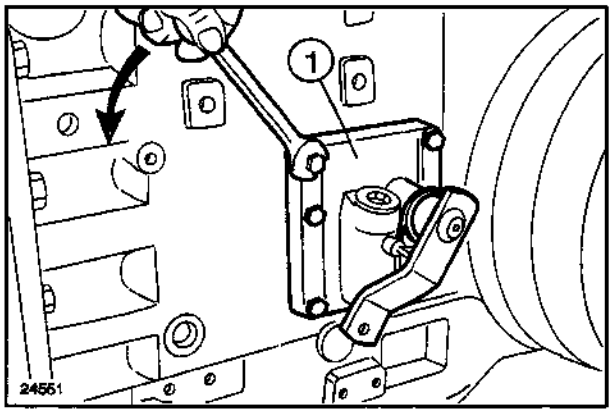


Figure 6-1-37

13. Straighten the locking tabs (1).

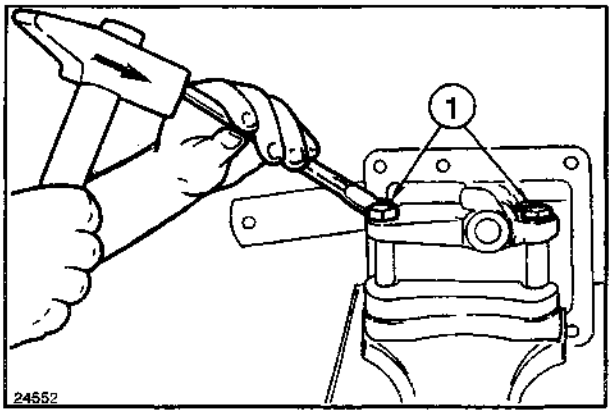


Figure 6-1-38

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14. Loosen the guide screws (C3) and collect the pads.

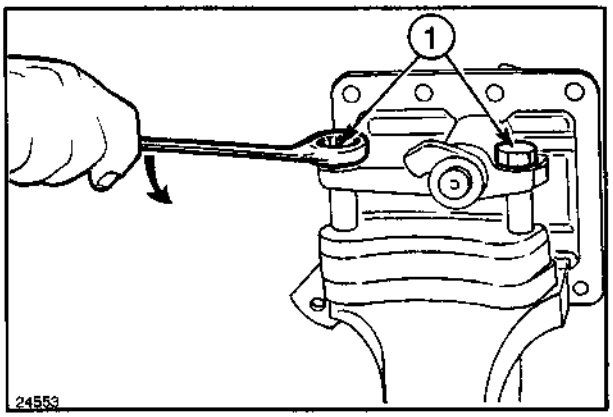


Figure 6-1-39

15. Remove the circlip (2).

Note: Arrows indicate the reference marks to be matched during reassembly.

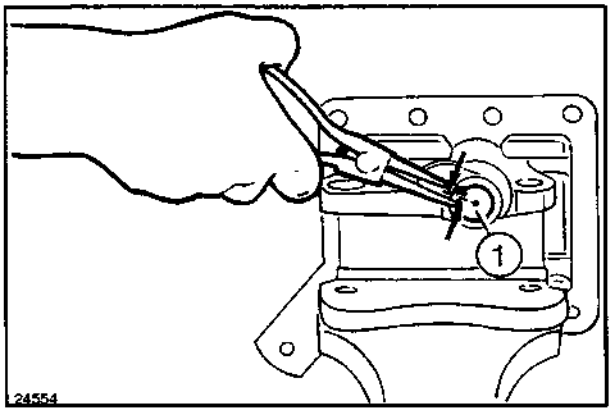


Figure 6-1-40

16. Slide out the control lever and collect inner lever (3).

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

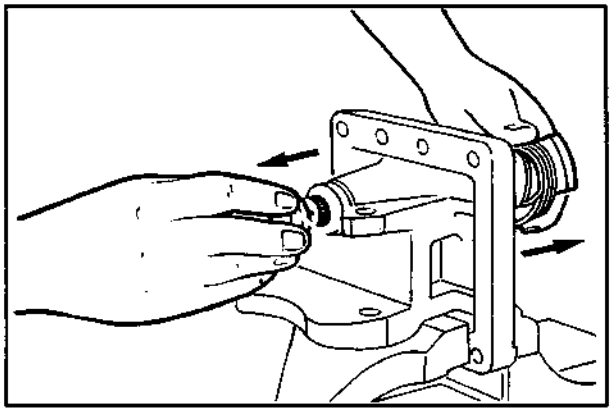


Figure 6-1-41

17. Reinstall the parking brake assembly taking the following into consideration:

- Reassembly follows the disassembly procedure in reverse, from step 16 back to step 1.
- Refer to figures on page 6-1-4 to orient the different parts.
- Take into account steps 17, 18, and 19.
- Before reinstalling the parking brake support unit to the rear axle housing, thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approx. 0.079 in (2 mm) of diameter following pattern shown on page 6-1-21.
- Tighten to correct torque as detailed on page 6-1-3.

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18. To aid reassembly of the parking brake control assembly, use the tool no. **FNH00529** (2) to install the discs (1) on the pinion gear.

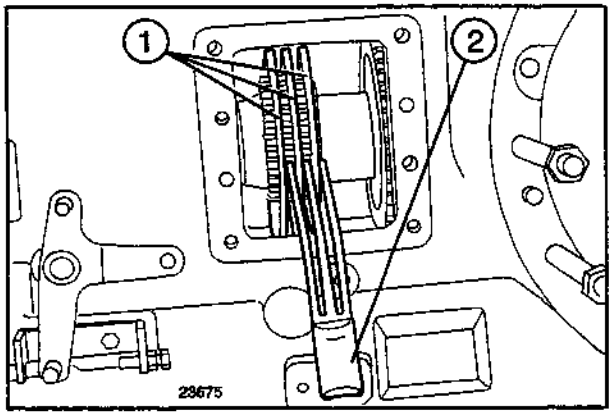


Figure 6-1-42

19. Insert tool no. **FNH00529** (2) between the parking braking pads (3).

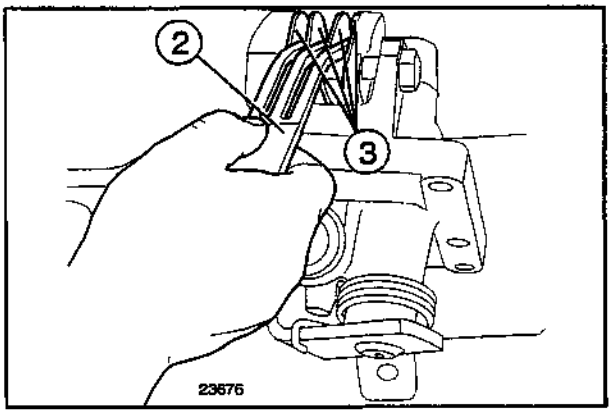


Figure 6-1-43

20. Position the parking brake assembly complete with tool no. **FNH00529** (2) on the discs, getting as near as possible to the rear axle housing. Withdraw tool no. **FNH00529** (2), bring the unit to contact the rear axle housing and lock it in place by tightening the retaining screws to the specified torque (see page 6-1-3).

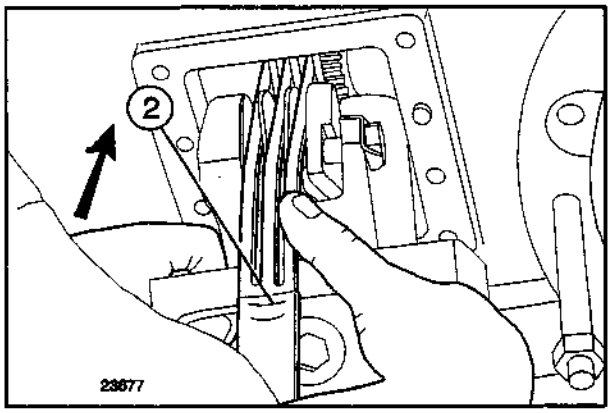


Figure 6-1-44

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Pattern for application of liquid gasket between the parking brake case and rear axle housing.

Sealants to be used are listed on page 0-1-19, Sec. 00.

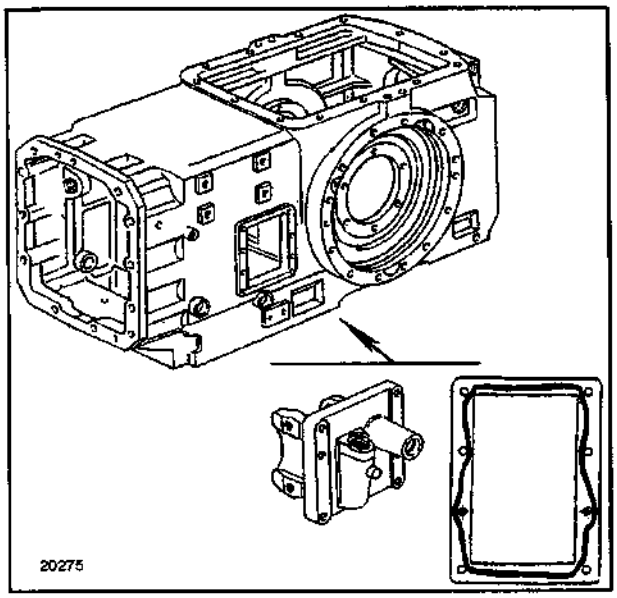


Figure 6-1-45

BRAKE HAND CONTROL

Travel Adjustment

Adjustment of the parking brake control lever travel should be performed each time the parking brake is serviced or repaired and when the idle travel of the lever is excessive.

Proceed as follows:

1. Block front wheels using suitable means.
2. Jack up the tractor rear end using a suitable means until the wheels are slightly off the ground.
3. Raise the parking brake control lever to the fourth notch on the quadrant.
4. Release the locknut (2) and screw in the adjust screw (1) until blocking the wheels.
5. Lower the parking brake control lever and ensure that the wheels can rotate freely.
6. Apply the parking brake several times to check that the assembly does not get blocked or operate abnormally.
7. Tighten the locknut (2) and lower the tractor.

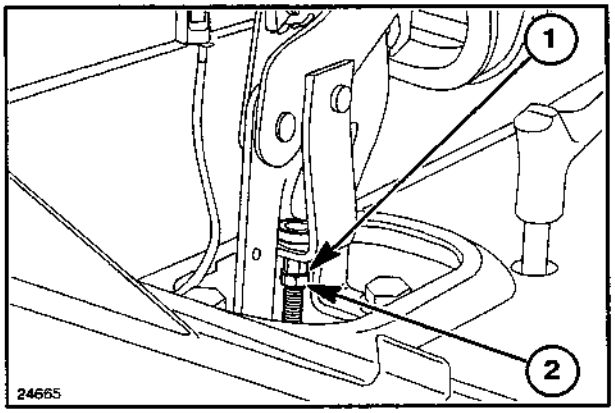


Figure 6-1-46

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SECTION 6

BRAKES

CHAPTER 2

AIR TRAILER BRAKES

(NOTE: NOT USED IN NORTH AMERICA)

CONTENTS

SPECIFICATIONS 6-2-2
TIGHTENING TORQUE 6-2-3
DESCRIPTION AND OPERATION 6-2-4
FAULT FINDING 6-2-9
REMOVAL AND INSTALLATION 6-2-10
OVERHAUL 6-2-14
INDEX 6-2-24

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33 000 SPECIFICATIONS

Air Compressor:

Location	Right hand side of engine, above fuel injection pump
Drive	Belt driven via crankshaft/water pump
Type	Single cylinder air cooled
Speed	3,000 rev/min. Maximum
Lubrication	Pressure fed from engine
Bore / Stroke	2.95 x 1.42 in (75mm x 36mm)
Displacement	9.70 in^3 (159 cm^3)
Operating Pressure	261 $lbf.in^2$ (18 bar) Maximum
Drive belt tension	0.16in. (4 mm) deflection with a force of 9.0 ft. lbs. (40N)

System Operating Pressure — 116 $lbf.in^2$ (8 bar)

Unload (relief) Valve Setting — 160 $lbf.in^2$ (11 bar)

Low Pressure Warning Switch Operates at, — 65 $lbf.in^2$ (4.5 bar)

Pressure Sender

Pressure (lbf/in^2) (bars)	0 (0)	30 (2)	90 (6)	150 (10)
Ohms	10	52	124	184

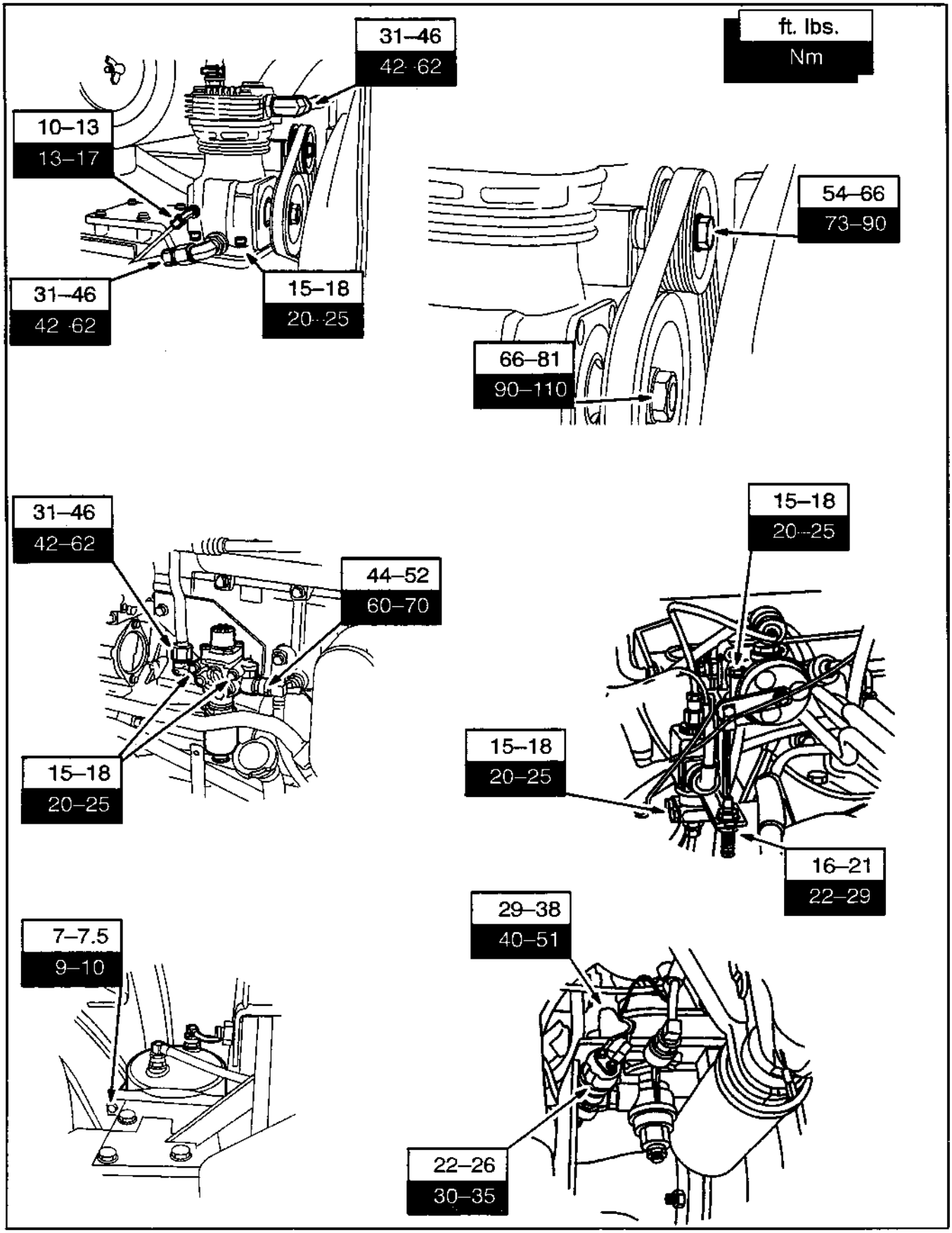
Maintenance

Drain Reservoir Tanks	Daily
Compressor Drive Belt Tension	Every 300 hours

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33 000 TIGHTENING TORQUE



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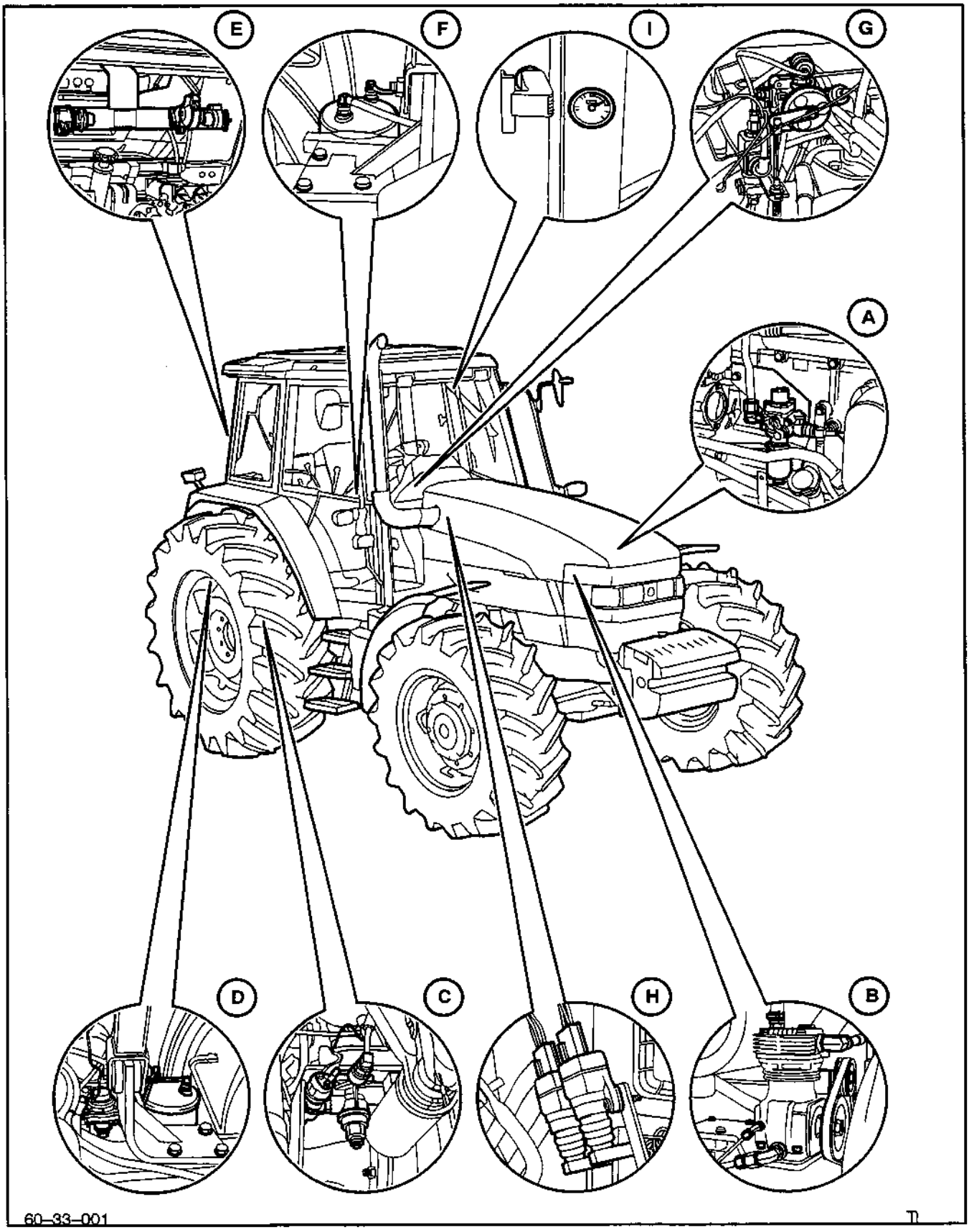


Figure 6-2-1

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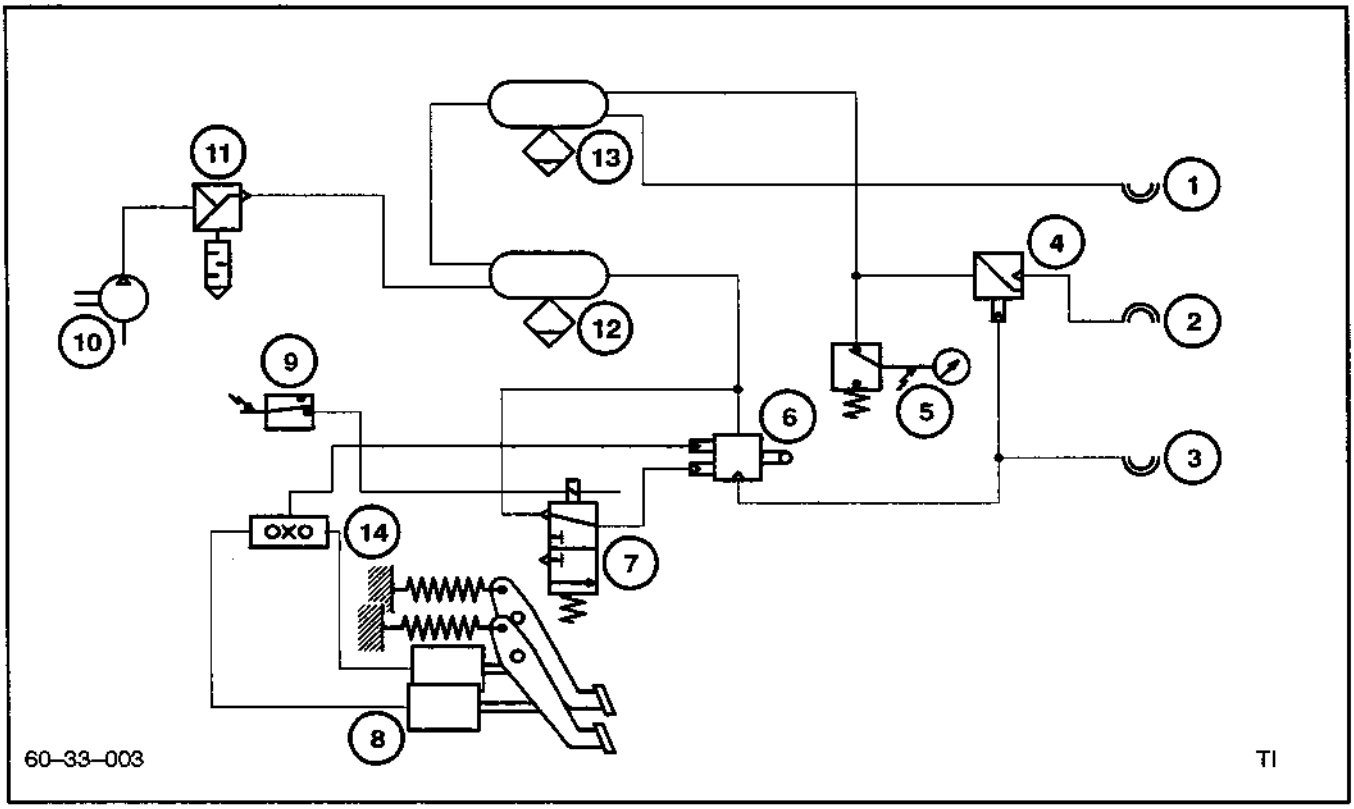


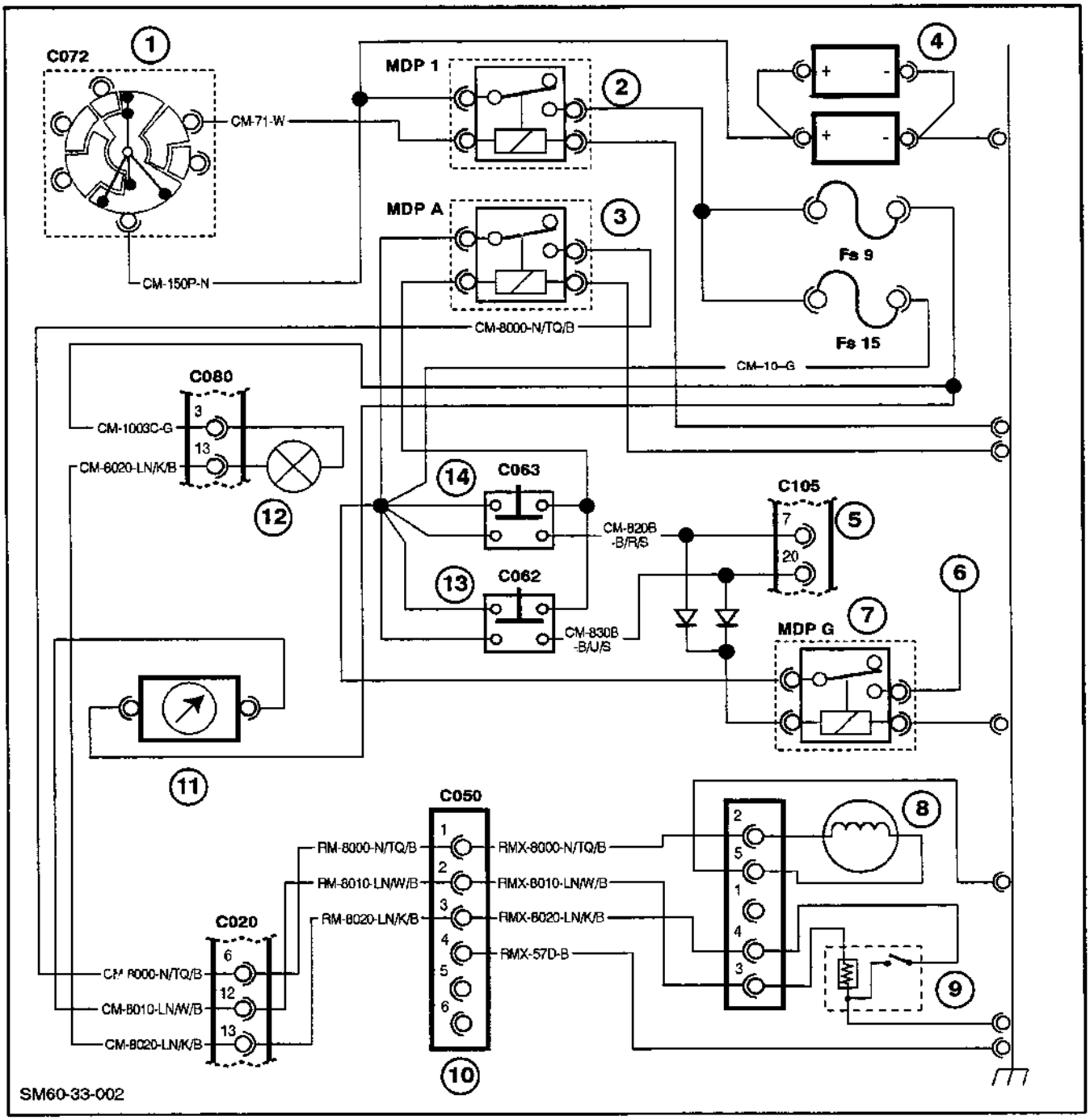
Figure 6-2-2

Air Brake Schematic

1. Dual Line Red (supply) Coupler
2. Single Line Black Coupler
3. Dual Line Yellow (control) Coupler
4. Single Line Control Valve
5. Pressure switch/sender and Gauge
6. Dual Line Control Valve
7. Dual Line Solenoid Valve
8. Brake Master Cylinders
9. Brake Pedal Operated Switches
10. Compressor
11. Unload Valve
12. Left Hand Reservoir Tank
13. Right Hand Reservoir Tank
14. Pilot Valve

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Air Brake Electrical System

Figure 6-2-3

1. Ignition Switch
2. Ignition Relay (Normally Open)
3. Relay 'A' (Normally Closed)
4. Battery
5. Electronic Management Unit
6. Feed to Stoplamps
7. Relay G
8. Dual Line Solenoid Valve Assembly
9. Pressure/Sender Switch
10. Air Brake Extension Harness Connector (C050)
11. Pressure Gauge
12. Instrument Lamp Warning Lamp
13. Right Hand Brake Pedal Switch
14. Left Hand Brake Pedal Switch

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Description	Fig/Ref	Function
Compressor	6-2-1/B	Belt driven via the crankshaft. Takes filtered air and compresses it to supply the two reservoir tanks with pressurized air. The compressor is lubricated from the engine lube system.
Unload (relief) Valve	6-2-1/A	Controls the operating pressure within the system to prevent system damage from excess pressure. Also removes any contamination from the system during unloading.
Reservoir Tanks	6-2-1/D & F	Provides storage for the compressed air generated by the compressor.
Brake Pedal Switch	6-2-1/H	When both brake pedal switches are operated, (both brake pedals depressed), relay 'A' becomes de–energized, this cuts the voltage to the dual line control valve solenoid.
Dual Line Control Valve Solenoid	6-2-1/G	Operated via the brake pedal switch, supplies air pressure to the dual line control valve to establish the trailer brake pressure before the tractor brakes become effective, thereby preventing any delay in operation.
Dual Line Control Valve	6-2-1/G	Provides control of the two line braking system in conjunction with the hydraulic pressure supplied from the brake master cylinder. A mechanical connection to the handbrake provides full trailer braking when the handbrake is applied.

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Description	Fig/Ref	Function
Single Line Control Valve	6-2-1/C	Controls the single line trailer brake system in conjunction with the dual line control valve and brake master cylinder pressure.
Pressure Switch/sender Assembly	6-2-1/C	Connected directly in line with the right hand reservoir, provides an electrical signal to the cab pressure gauge. When the pressure drops to 65 lbf.in^2 (4.5 bar) or lower the switch closes and completes the circuit to illuminate the warning lamp on the instrument cluster.
Pressure Gauge	6-2-1/I	Electrically operated gauge by a signal received from the pressure switch/sender assembly.
Couplers	6-2-1/E	Red and yellow couplers for dual line systems. Red is the supply coupler with full pressure available all the time. The yellow coupler is the control line. Air pressure at the coupler is increased as the brake pedal is depressed. The black coupler is for single line systems. Pressure is available at the coupler with the brake pedal released, pressure decreases as the pedal is depressed.
Control Valve Remote Pilot Head	6-2-11	Ensures that trailer braking only occurs when both brake pedals are depressed simultaneously. Hydraulic pressure from both brake master cylinders act on a ball and plunger arrangement which then allows pressure oil out to act on the control valve.

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33 000 FAULT FINDING

Description	Causes	Remedy
Instrument cluster light illuminates when system is running.	1. System pressure below 65 lbf/in^2 (4.5 bar).	1. Compressor drive belt broken 2. Check system for leaks 3. Unload valve failed, stuck open 4. Compressor fault 5. Reservoir drain tap faulty
	2. Faulty switch or switch wiring	1. Disconnect wiring to switch. If light extinguishes replace switch. If light remains illuminated check wiring for short to ground.
Trailer brakes not functioning (system air pressure okay)	1. Air in braking system	1. Bleed brakes
	2. Faulty pilot valve	1. Disconnect supply line to control valve from pilot valve assembly. Operate the brakes, if oil is expelled, pilot valve is okay. If no oil expelled remove and inspect pilot valve.
	3. Control valve faulty	1. Repair/replace as required
Delay in trailer brake operation	1. Dual line solenoid failed closed or permanently energized.	1. Disconnect wiring to solenoid. If brakes operate normally inspect wiring for short to +12v. If still a delay in operation after wire disconnection replace solenoid assembly. 2. Faulty brake switch
System pressure too high (exceeds 160 lbf/in^2) (11 bar)	1. Faulty unload valve	1. Remove valve clean/replace.

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COMPONENT REMOVAL AND INSTALLATION
Group 33.000

⚠ WARNING ⚠

Before removing any air system component ensure that there is no air pressure in the system. This can be achieved by depressing and releasing the brake pedal several times with the engine off. Also ensure that the wheels of the tractor/trailer are chocked.

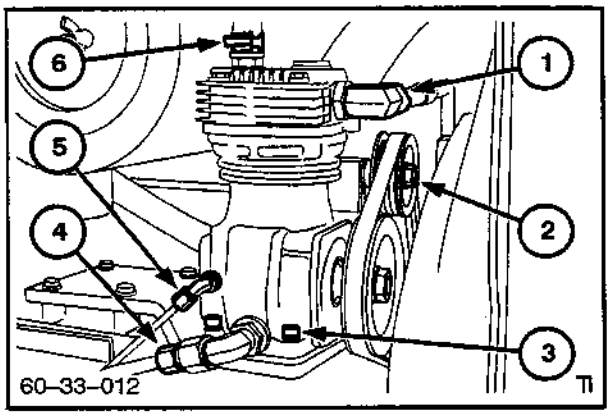


Figure 6-2-4

Compressor – Figure 6-2-4

1. Remove the drive belt (2).
2. Disconnect air inlet hose (6).
3. Disconnect air outlet tube (1).
4. Remove oil feed tube (5).
5. Remove the oil drain tube (4).
6. Remove the four compressor mounting bolts and lift compressor away from tractor (3).
7. Reassembly is the reversal of removal, noting the following point:

a) Adjust the drive belt to provide 0.158 in (4 mm) deflection with a force of 9 ft. lbs. (40N) at the center of the belt run between tensioner and water pump. The belt is tensioned by moving the pulley (1) within the slot of the pulley bracket. Figure 6-2-5.

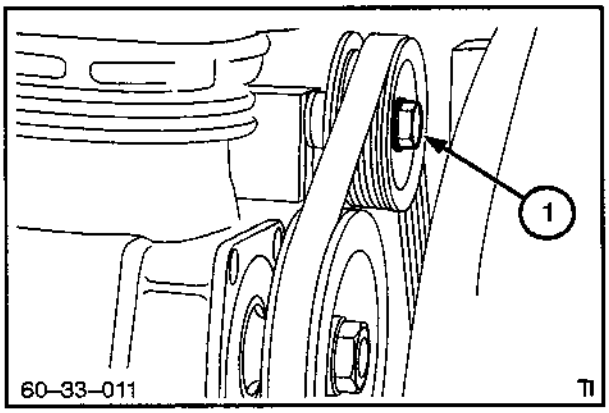


Figure 6-2-5

Unload Valve – Figure 6-2-6

1. Disconnect pressure feed tube from compressor (1).
2. Disconnect outlet hose to left hand reservoir (2).
3. Remove the two retaining bolts (3) and withdraw valve from tractor.
4. Reassembly is the reversal of removal.

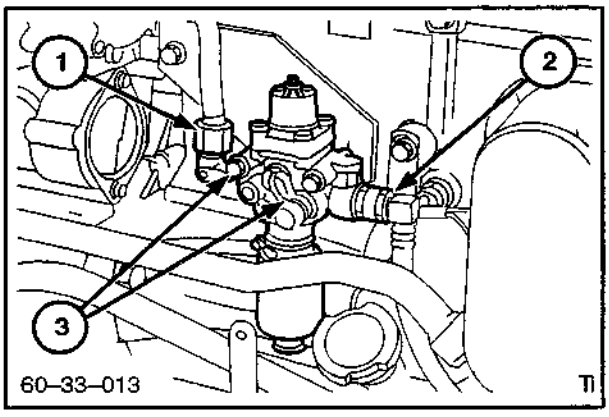


Figure 6-2-6

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Reservoir Tanks – Figure 6-2-7

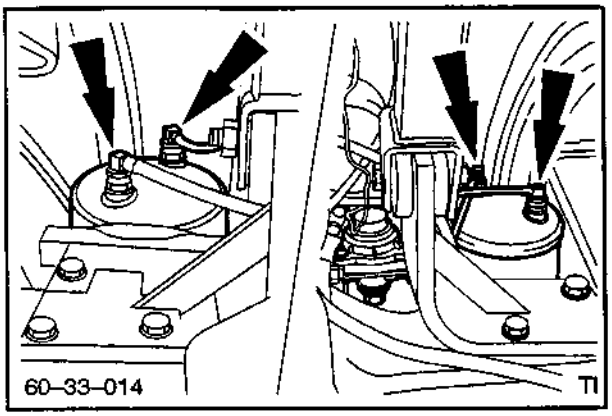


Figure 6-2-7

NOTE: *Removal of the wheel will aid removal of the reservoir tanks, but is not essential.*

1. Remove all the tubes and hoses connected to the tank, noting their location.
2. Loosen the strap retaining nuts and lift out the tank.
3. Reassembly is the reversal of removal.

Dual Line Solenoid – Figure 6-2-8.

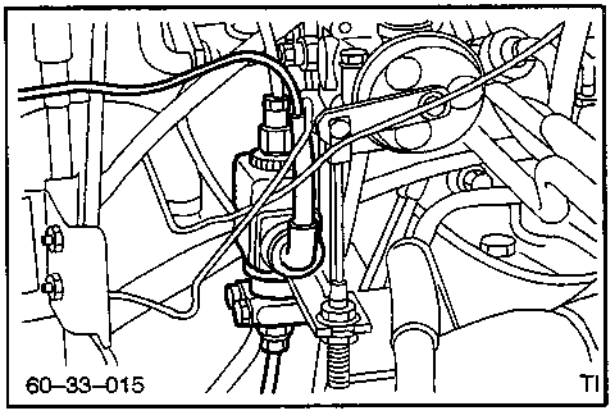


Figure 6-2-8

1. Disconnect the electrical connector.
2. Disconnect the two air lines.
3. Remove the two retaining bolts and lift away from the tractor.
4. Reassembly is the reversal of removal.

Dual Line Control Valve – Figure 6-2-9.

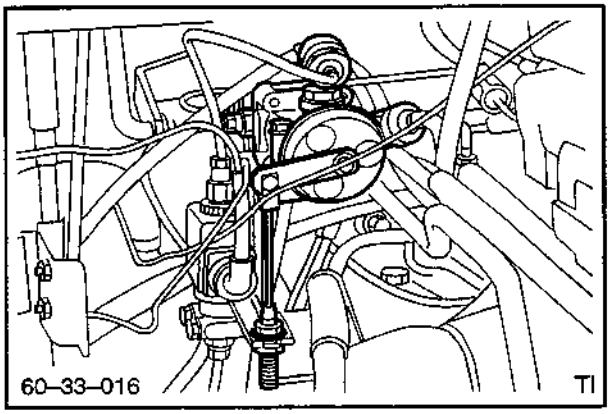


Figure 6-2-9

1. Disconnect the handbrake cable connection.
2. Disconnect hydraulic connection from Pilot valve assembly, cap the end of the tube to prevent contamination and excessive loss of brake oil.
3. Disconnect all air lines, noting locations for reassembly.
4. Remove the two retaining bolts and lift the control valve from the tractor.

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5. Reassembly is the reversal of removal, noting the following points:–

a) When the tube is reconnected it will be necessary to bleed the braking system. Bleed each side of the pilot head assembly, items (1) and (3) Figure 6-2-10, first then at the bleed screw located in the control valve, item (2) Figure 6-2-10.

b) Ensure the handbrake cable is adjusted correctly after assembly:
Assemble the cable and adjust the cable until the operating arm just begins to move, then back off adjuster 1/2 turn to provide some cable slack. Operate handbrake and ensure full travel of the arm is achieved.

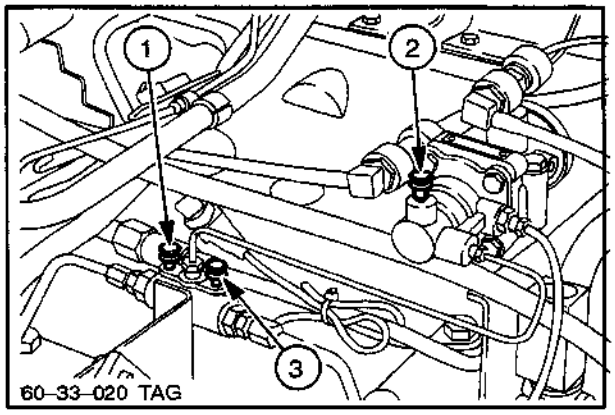


Figure 6-2-10

Pilot Head Valve Assembly – Figure 6-2-11

1. Disconnect the two tubes from the braking system and the outlet tube to the dual line control valve. Cap the ends of the tubes to prevent dirt ingress.

2. Remove the single retaining bolt (1), Figure 6-2-11 and lift away from the tractor.

3. Reassembly is the reversal of removal, noting the following point:

a) Bleed the braking system of air as described previously.

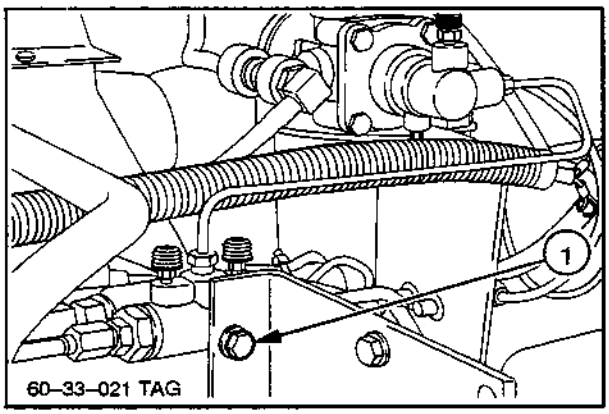


Figure 6-2-11

Pressure Switch/Sender Assembly – Figure 6-2-12.

1. Disconnect wiring to switch.

2. Remove the switch/sender assembly from the tee connector into the single line control valve.

3. Reassembly is the reversal of removal.

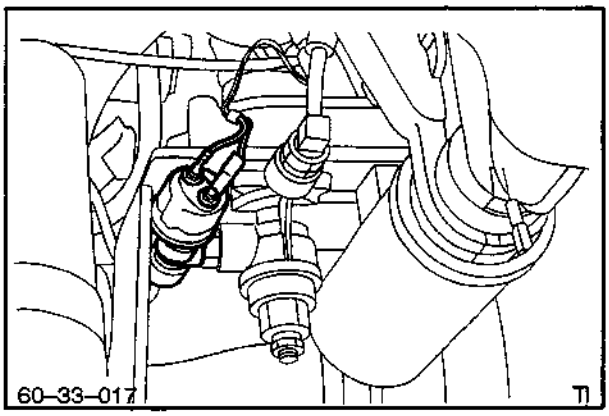


Figure 6-2-12

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Single Line Control Valve – Figure 6-2-13

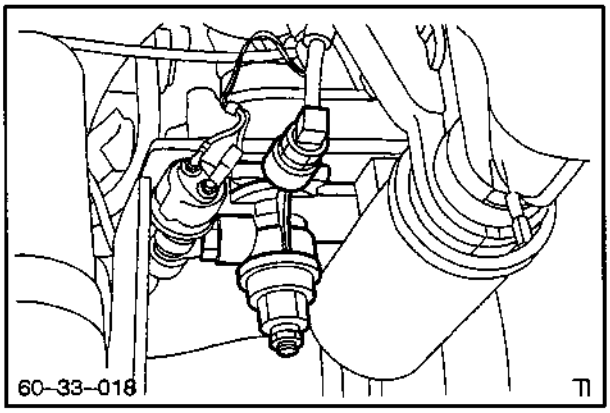


Figure 6-2-13

1. Disconnect the three air lines to the single line control valve assembly.
2. Remove the valve to support bracket retaining bolts and lift away from tractor.
3. Reassembly is the reversal of removal.

Coupler – Figure 6-2-14

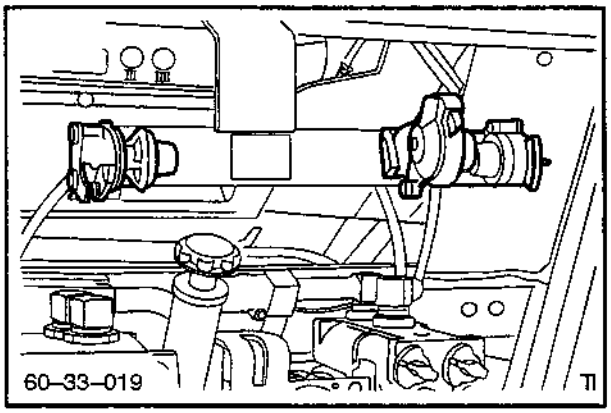


Figure 6-2-14

1. Remove the tube from the rear of the coupler
2. Unscrew the coupler assembly from the bracket.
3. Reassembly is the reversal of removal.

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COMPONENT OVERHAUL – COUPLERS

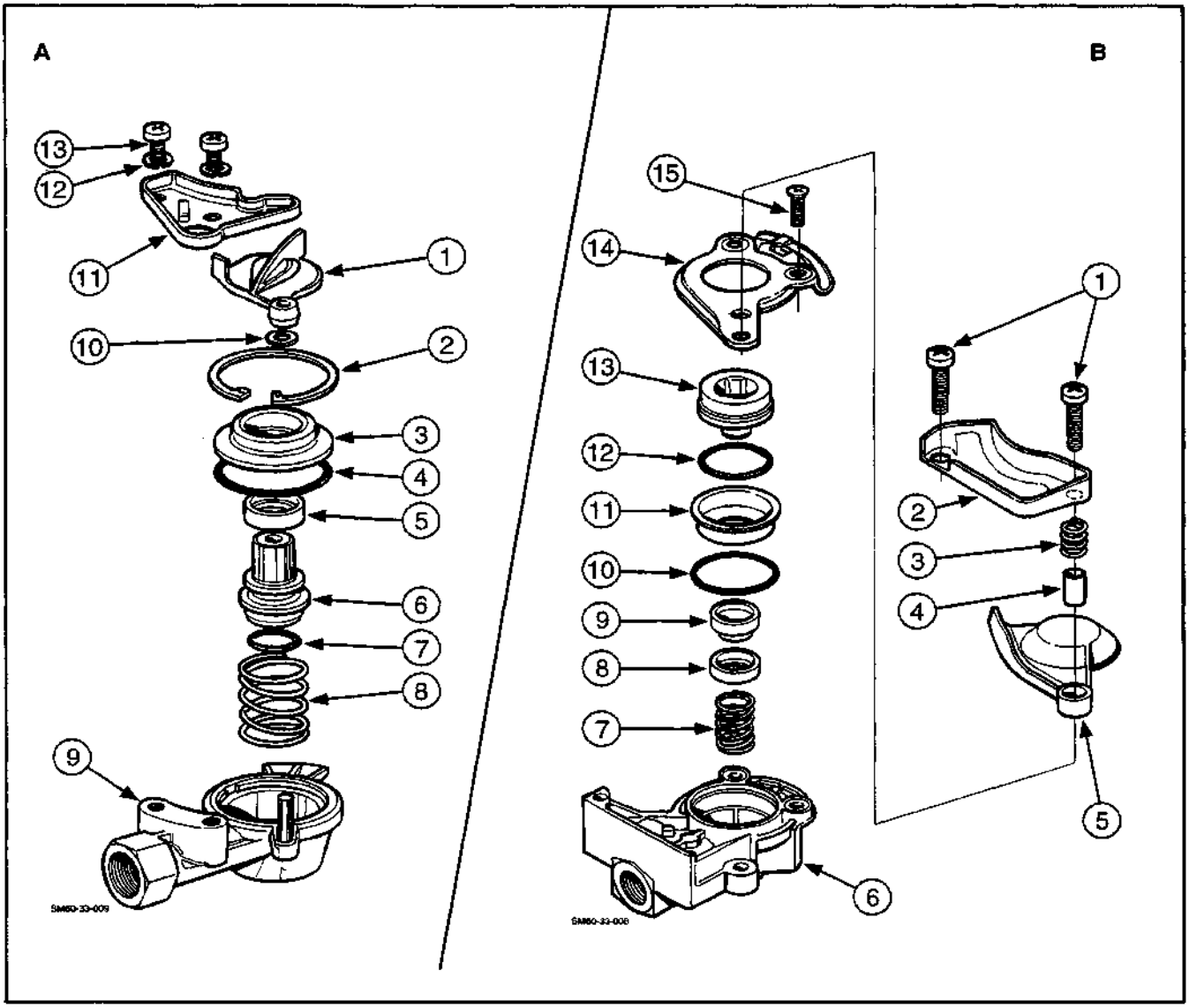


Figure 6-2-15

COUPLERS

Key to Components – Figure 6-2-15

A – Single Line Coupler

1. Cover
2. Circlip
3. Bushing
4. 'O' Ring
5. Valve Ring
6. Valve Body
7. 'O' Ring
8. Spring
9. Housing
10. Washer
11. Guide Piece
12. Washer
13. Screw

B – Supply and Control Line Couplers

1. Screw
2. Guide Piece
3. Spring
4. Tube
5. Cover
6. Housing
7. Spring
8. Cap
9. Valve
10. 'O' Ring
11. Cap
12. 'O' Ring
13. Thrust Piece
14. Guide
15. Screw

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COMPONENT OVERHAUL – COMPRESSOR

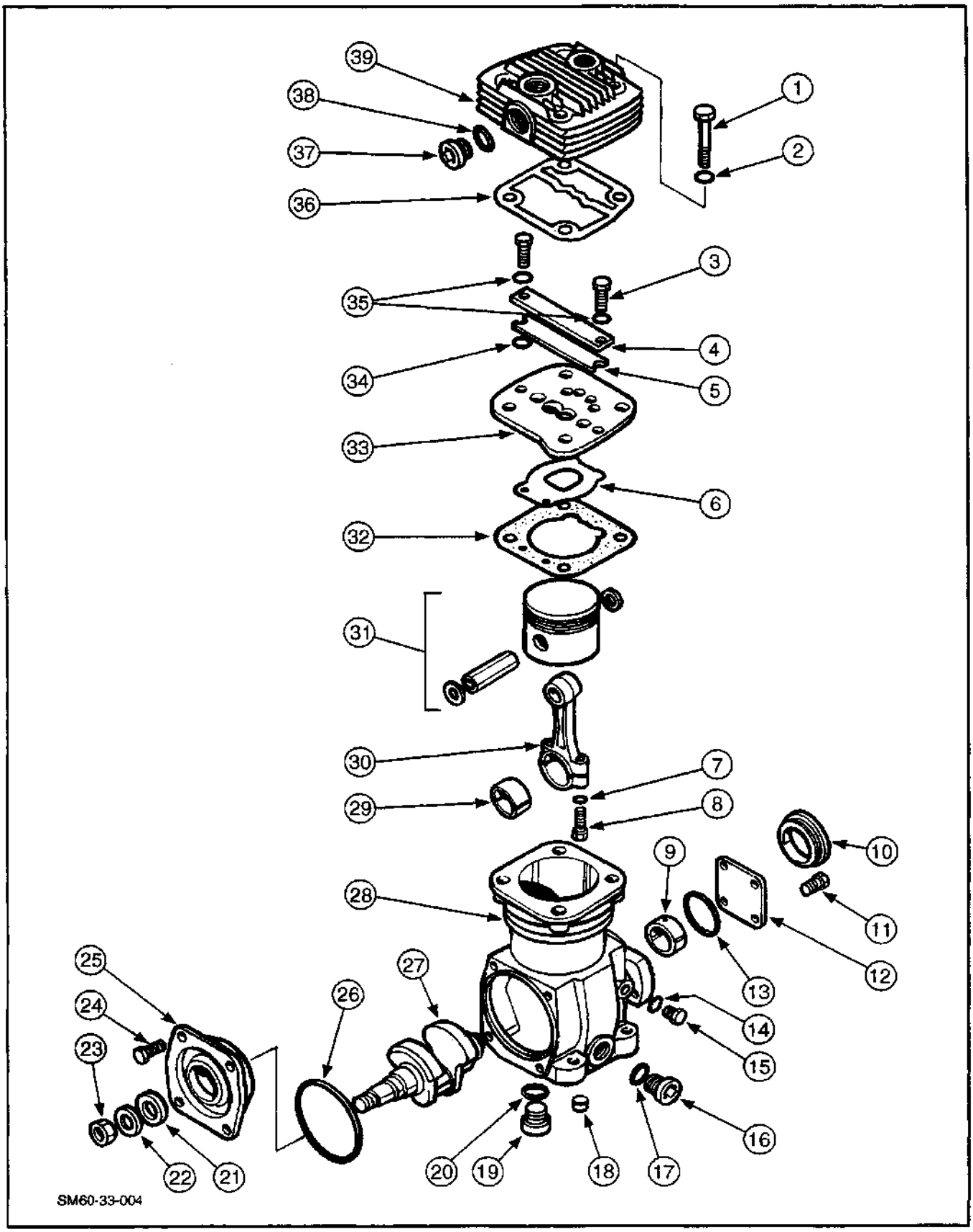


Figure 6-2-16

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COMPRESSOR

Key to Components – Figure 6-2-16

1. Bolt
2. Sealing Ring
3. Bolt
4. Pressure Valve Support
5. Pressure Valve Plate
6. Suction Valve Plate
7. Washer
8. Bolt
9. Bushing
10. Alternate End Housing
11. Screw
12. Cover
13. 'O' Ring
14. Sealing Washer
15. Locking Screw
16. Plug
17. Sealing Ring
18. Cap
19. Bolt
20. Washer
21. Seal
22. Washer
23. Nut
24. Screw
25. Bearing and Cover Assembly
26. 'O' Ring
27. Crankshaft
28. Crankcase
29. Connecting Rod Bearing
30. Connecting Rod
31. Piston Assembly
32. Gasket
33. Valve Assembly (complete)
34. Washer
35. Bushing
36. Gasket
37. Plug
38. Washer
39. Cylinder Head

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COMPONENT OVERHAUL – UNLOADER VALVE

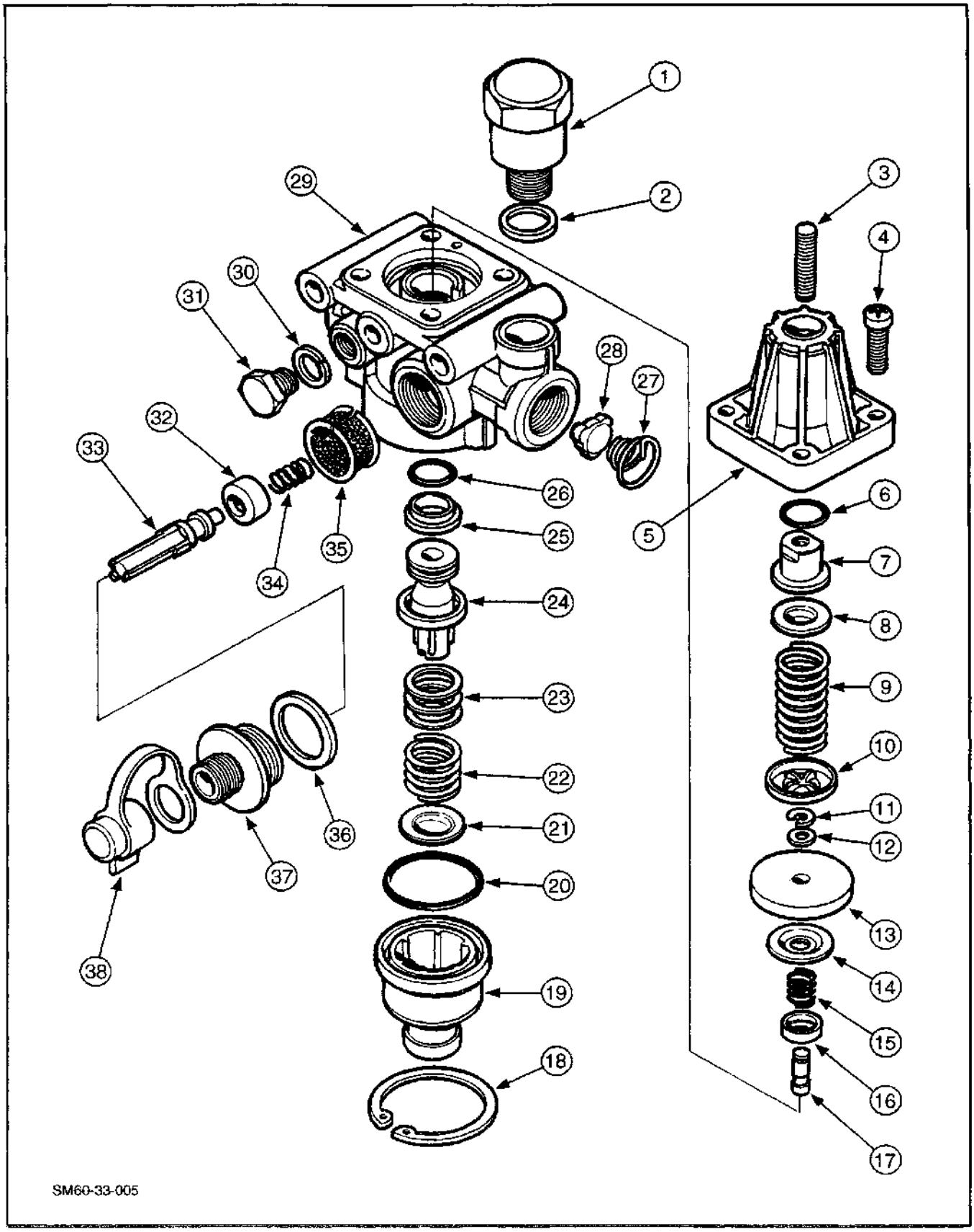


Figure 6-2-17

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UNLOADER VALVE

Key to Components – Figure 6-2-17

1. Relief Valve
2. Sealing Ring
3. Adjuster Screw
4. Screw
5. Housing
6. 'O' Ring
7. Adjuster Block
8. Seat
9. Spring
10. Seat
11. 'C' Clip
12. Washer
13. Plate
14. spring Seat
15. Spring
16. Washer
17. Bolt
18. Circlip
19. Cover
20. Seal
21. Spring Seat
22. Spring
23. Shims
24. Valve
25. Seal
26. 'O' Ring
27. Tapered Spring
28. Valve
29. Housing
30. Sealing Ring
31. Bolt
32. Bushing
33. Valve
34. Spring
35. Filter
36. Seal
37. Adaptor
38. Protective Cap

NOTE: *After reassembly of the unloader valve it will be necessary to adjust the pressure at which the valve unloads. Start at a low setting , i.e, the adjuster screw (3), unscrewed several turns. Observe the pressure gauge within the cab and gradually increase the pressure, by rotating the adjuster clockwise, until xx bar is indicated.*

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COMPONENT OVERHAUL – SINGLE LINE CONTROL VALVE

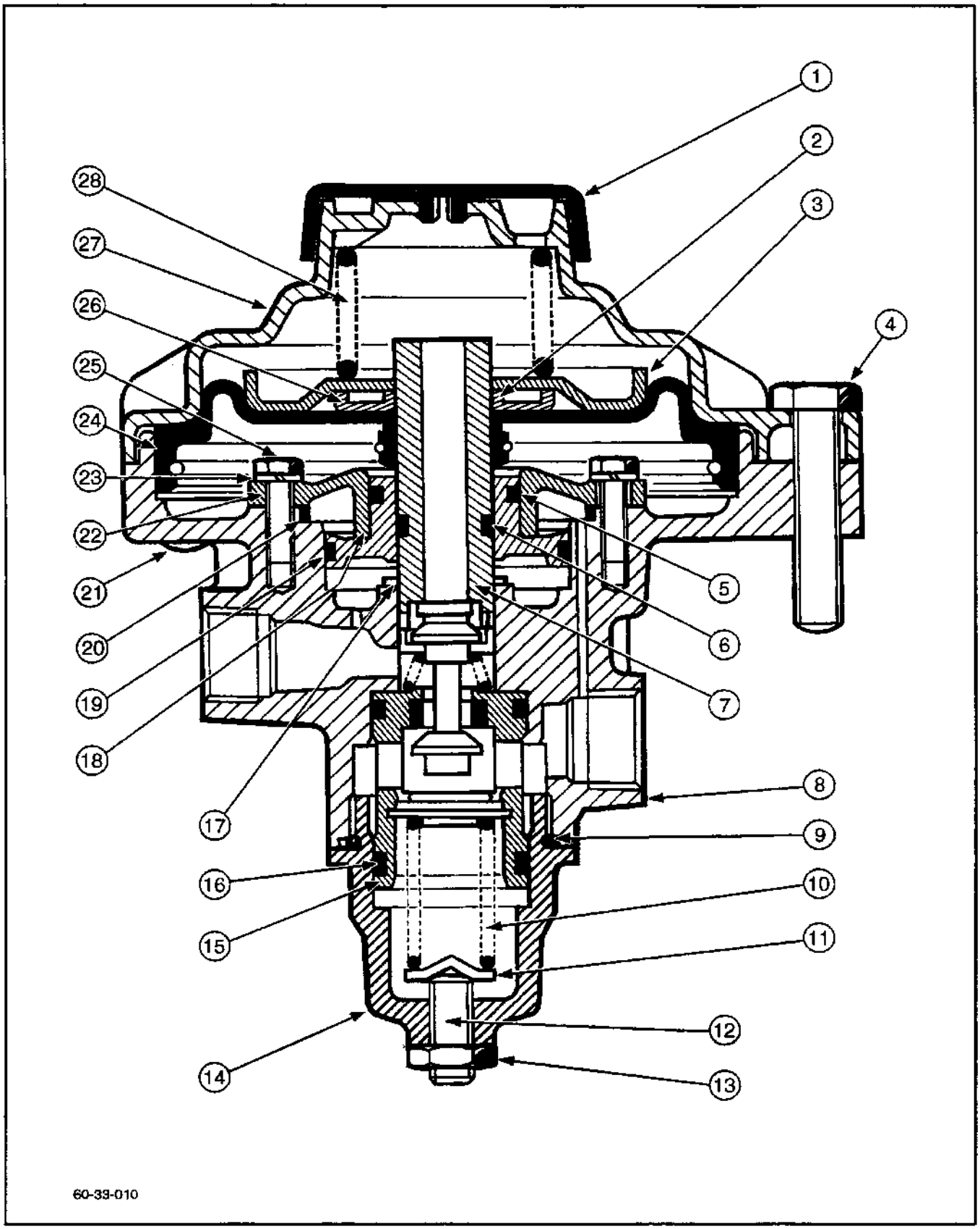


Figure 6-2-18

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SINGLE LINE CONTROL VALVE

Key to Components – Figure 6-2-18

1. Cap
2. Lockring
3. Diaphragm Disk
4. Bolt
5. 'O' Ring
6. 'O' Ring
7. Valve Tappet
8. Housing
9. 'O' Ring
10. Compression Spring
11. Spring Plate
12. Adjuster Screw
13. Locknut
14. End Cap
15. Valve
16. 'O' Ring
17. Lockring
18. Piston
19. 'O' Ring
20. Bolt
21. 'O' Ring
22. Support
23. Spring Washer
24. Diaphragm
25. Bolt
26. Cup Seal
27. Cover
28. Spring

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COMPONENT OVERHAUL – DUAL LINE CONTROL VALVE

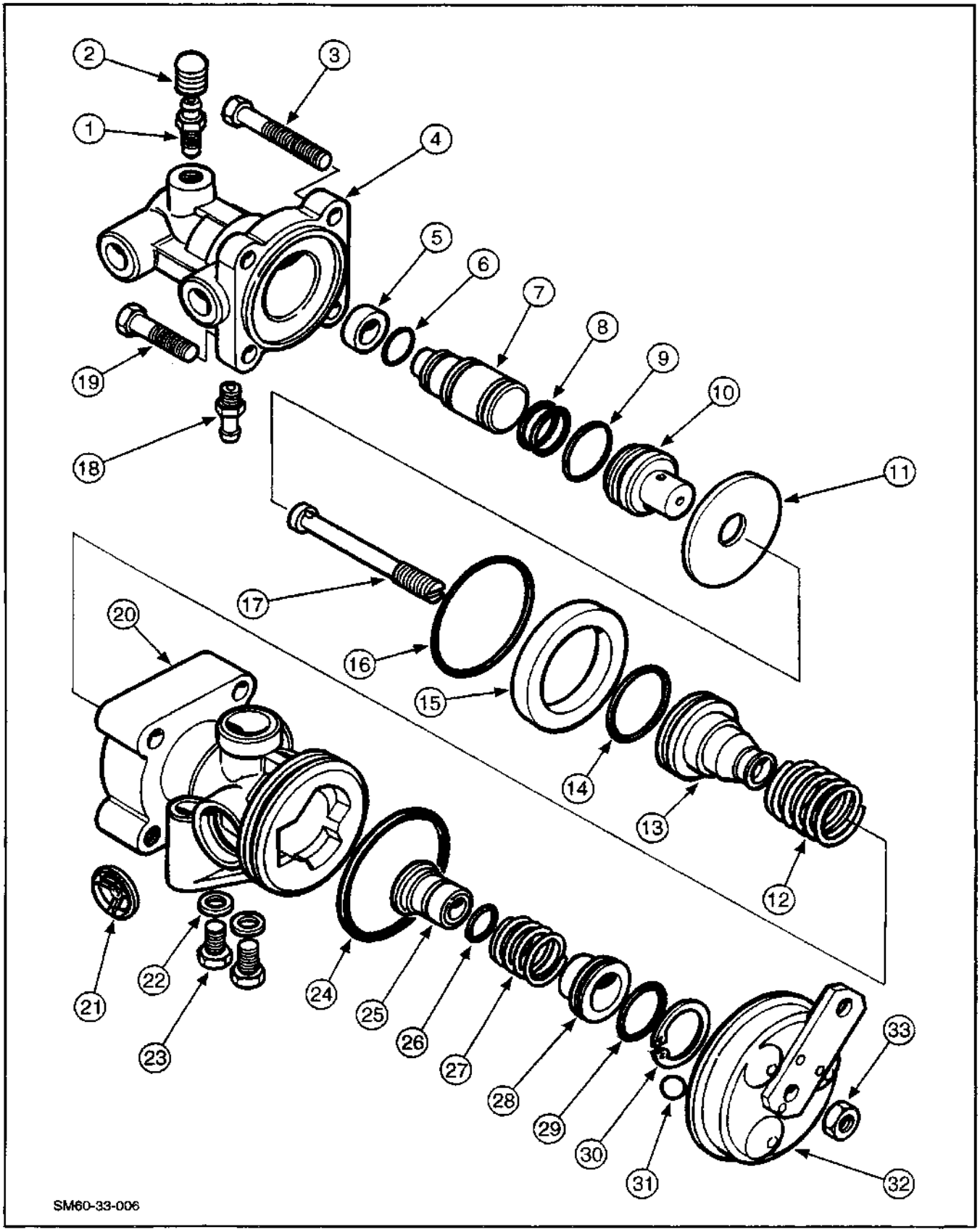


Figure 6-2-19

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DUAL LINE CONTROL VALVE

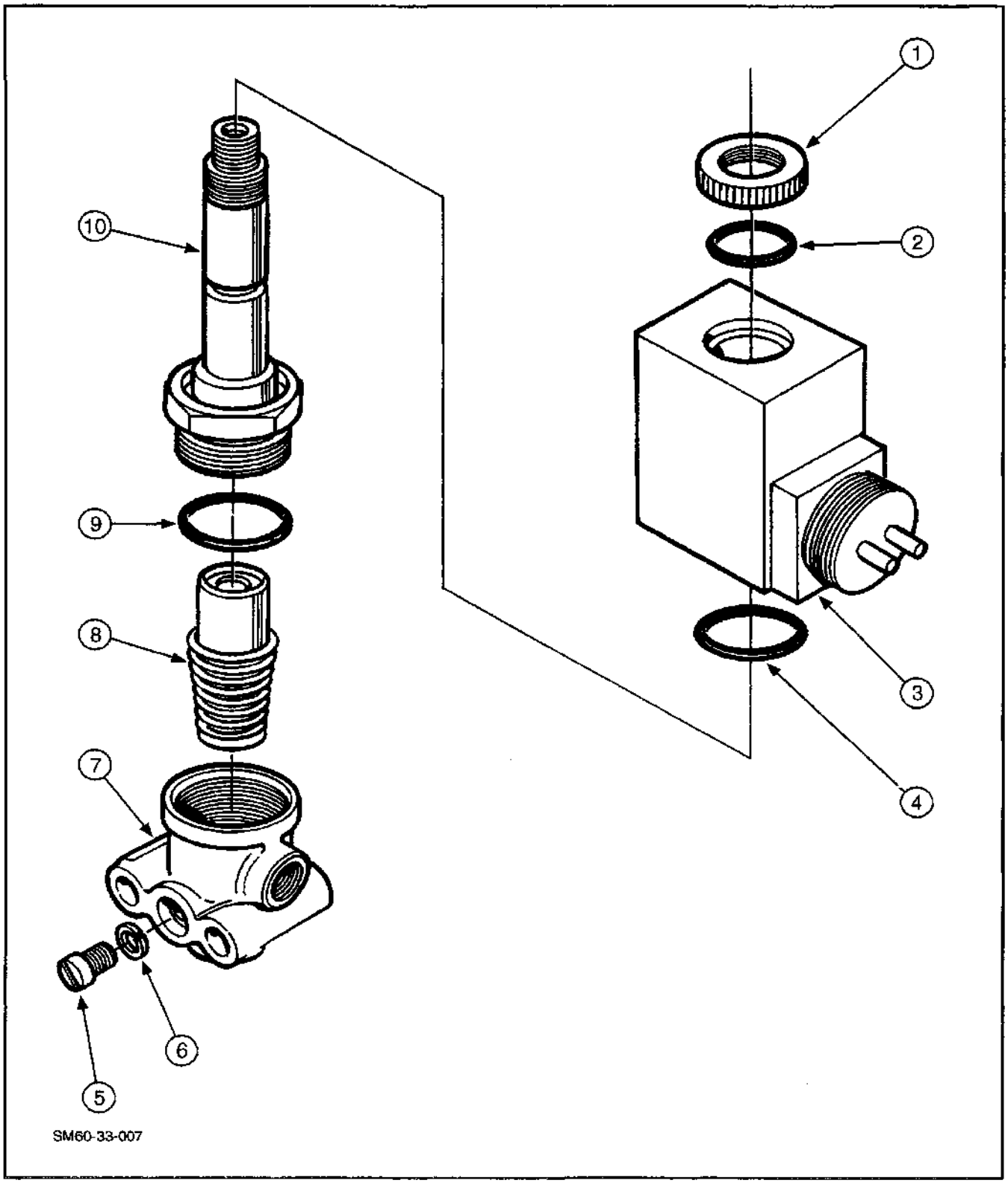
Key to Components – Figure 6-2-19

1. Vent Screw
2. Protective Cap
3. Bolt
4. Housing
5. Lip Seal
6. 'O' Ring
7. Tappet
8. 'O' Ring
9. 'O' Ring
10. Tappet
11. Washer
12. Spring
13. Piston
14. 'O' Ring
15. Guide Ring
16. 'O' Ring
17. Rod
18. Vent Screw
19. Bolt
20. Housing
21. Valve with Lockring
22. Sealing Ring
23. Bolt
24. 'O' Ring
25. Valve
26. 'O' Ring
27. Spring
28. Guide
29. 'O' Ring
30. Circlip
31. Ball
32. Cap
33. Bolt

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COMPONENT OVERHAUL – SOLENOID VALVE



SOLENOID VALVE **Figure 6-2-20**

Key to Components – Figure 6-2-20

1. Housing
2. Sealing Ring
3. Cylinder Screw
4. 'O' Ring
5. Flange
6. Spool
7. 'O' Ring
8. Armature
9. 'O' Ring
10. Knurled Nut

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8160, 8260, 8360, 8560 TRACTOR REPAIR MANUAL CONTENTS

SECTION 1 - ENGINES
SECTION 2 - ELECTRICAL SYSTEM
SECTION 3 - CLUTCH
SECTION 4 - TRANSMISSIONS
SECTION 5 - MECHANICAL REAR WHEEL DRIVE
SECTION 6 - BRAKES



SECTION 7 - POWER TAKE-OFF

SECTION 8 - HYDRAULIC SYSTEM
SECTION 9 - DRIVE LINES - FWD
SECTION 10 - CAB

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SECTION 7

POWER TAKE-OFF

CHAPTER 1

POWER TAKE-OFF

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31 000 – SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

SPECIFICATIONS

	8160, 8260, 8360	8560
540/1000 rpm PTO:		
Type	fully independent	
Engagement and Control	through an electro–hydraulic clutch pack in oil bath	
Rotation (looking from tractor rear end)	clockwise	
Speed Selection	by hand lever located at the operator's RH side	
Engine Speed at 540 rpm PTO Speed rpm	1970	
Engine Speed at 1000 rpm PTO Speed rpm	2120	
PTO Speed at Engine Max. Power Rating:		
– 540 rpm rpm	603	631
– 1000 rpm rpm	1038	1085
Splined Output Shaft Diameter:		
– 540 rpm	$1\frac{3}{8}$" (34.9 mm) (6 splines)	
– 1000 rpm	$1\frac{3}{4}$" (44.4 mm)(20 splines) (optional) $1\frac{3}{8}$" (34.9 mm) (21 splines or)	
Driven Gear Bushing OD (9, pages 7-1-5 and 7-1-6) in (mm)	2.162 to 2.163 (54.910 to 54.940)	
Driven Gear ID (8) in (mm)	2.168 to 2.170 (55.060 to 55.106)	
Gears to Bushings Free Play in (mm)	0.005 to 0.008 (0.120 to 0.196)	
Driven Shaft Diameter. (11, pages 7-1-5 and 7-1-6) in (mm)	1.747 to 1.748 (44.366 to 44.391)	
Bushing ID (9) in (mm)	1.748 to 1.749 (44.400 to 44.425)	
Shaft to Bushings Free Play in (mm)	0.0003 to 0.002 (0.009 to 0.059)	

(to be continued)

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SPECIFICATIONS

(cont'd)

	8160, 8260, 8360	8560
PTO Engagement Clutch		
Type	hydraulically actuated clutch pack in oil bath	
Number of Clutch Discs:		
– Drive Discs	7	9
Drive Disc Thickness in (mm)	0.057 to 0.061 (1.45 to 1.55)	0.057 to 0.061 (1.45 to 1.55)
– Driven Discs	6	8
Driven Disc Thickness in (mm)	0.092 to 0.094 (2.35 to 2.40)	0.092 to 0.094 (2.35 to 2.40)
Number of Clutch Engagement Springs	1	1
Brake	hydraulically controlled shoe–brake acting on the clutch bell housing	
Control Oil Pump	same as for the power steering circuit	
Oil Filter	paper cartridge type	
Oil Filter Location	at pump inlet	

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TIGHTENING TORQUE

		Tightening Torque ft. lbs. N·m
PTO case mounting bolts (C_1, page 7-1-5)	M 16 x 1.5	156 (211)
PTO output shaft retaining self–locking nut (C_2)	M 12 x 1.25	101 (137)
PTO shaft retaining nut (C_3)	M 32 x 1.5	217 (294)
PTO clutch brake connecting plug (C_4)	M 35 x 1.5	61 (83)
Spring retaining plug (C_5)	M 16 x 1.5	36 (49)
Support bearing retaining screws (C_6)	M 12 x 1.25	65 (88)
Solenoid valve retaining screw	–	4 to 6 (5.4 to 8.1)
Solenoid valve pin retaining screws	–	35 to 40 (47 to 54)

SPECIAL TOOLS

Caution – Operations described in this section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to perform service operations covered by this section of the Manual:

	292870	Hydraulic clutch pressure test kit.
X	**293997**	Clutch drive shaft roller bearing installer (with tool no. **293800**)
X	**293836**	Clutch drive shaft seal protection
X	**293993**	Clutch drive shaft seal installer (with tool no. **293800**)
X	**290785**	Clutch drum seal mounting protection
X	**294000**	Cup and shaft bushing removal pliers
	293812	PTO guide pins
	293800	Attachment (for tools nos. **293993** and **293997**)
	293998	Clutch shaft cup installer
	293999	Clutch brake plunger puller adapter
	50063	Clutch spring cup tool (use with tools no. **292651** and **292654**) to be fabricated on site, see Figure 7-1-1.

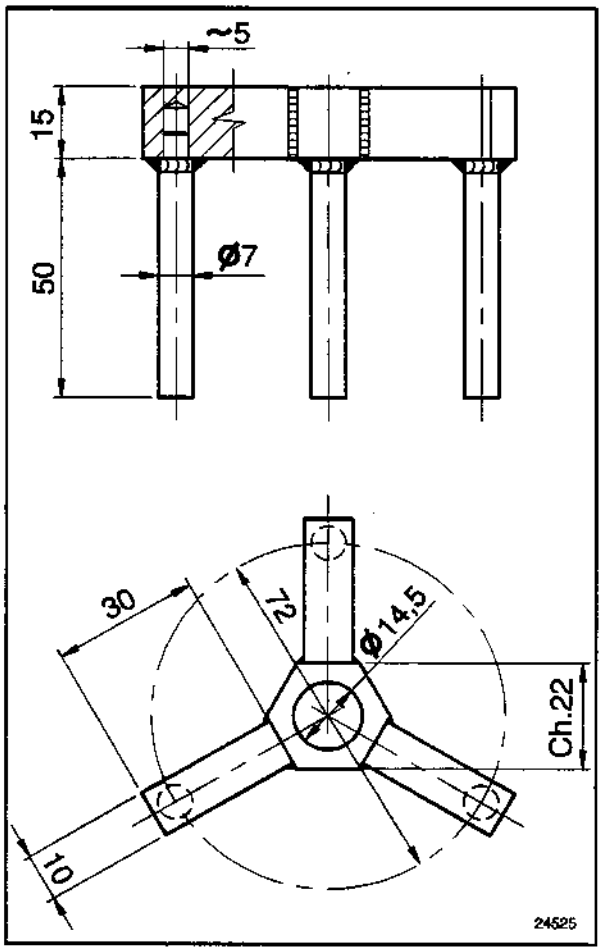


Figure 7-1-1

PTO hydraulic clutch spring cup tool (Mark tool with no. 50063. Dimensions in mm.)

Fabricate tool using Fe42C material.

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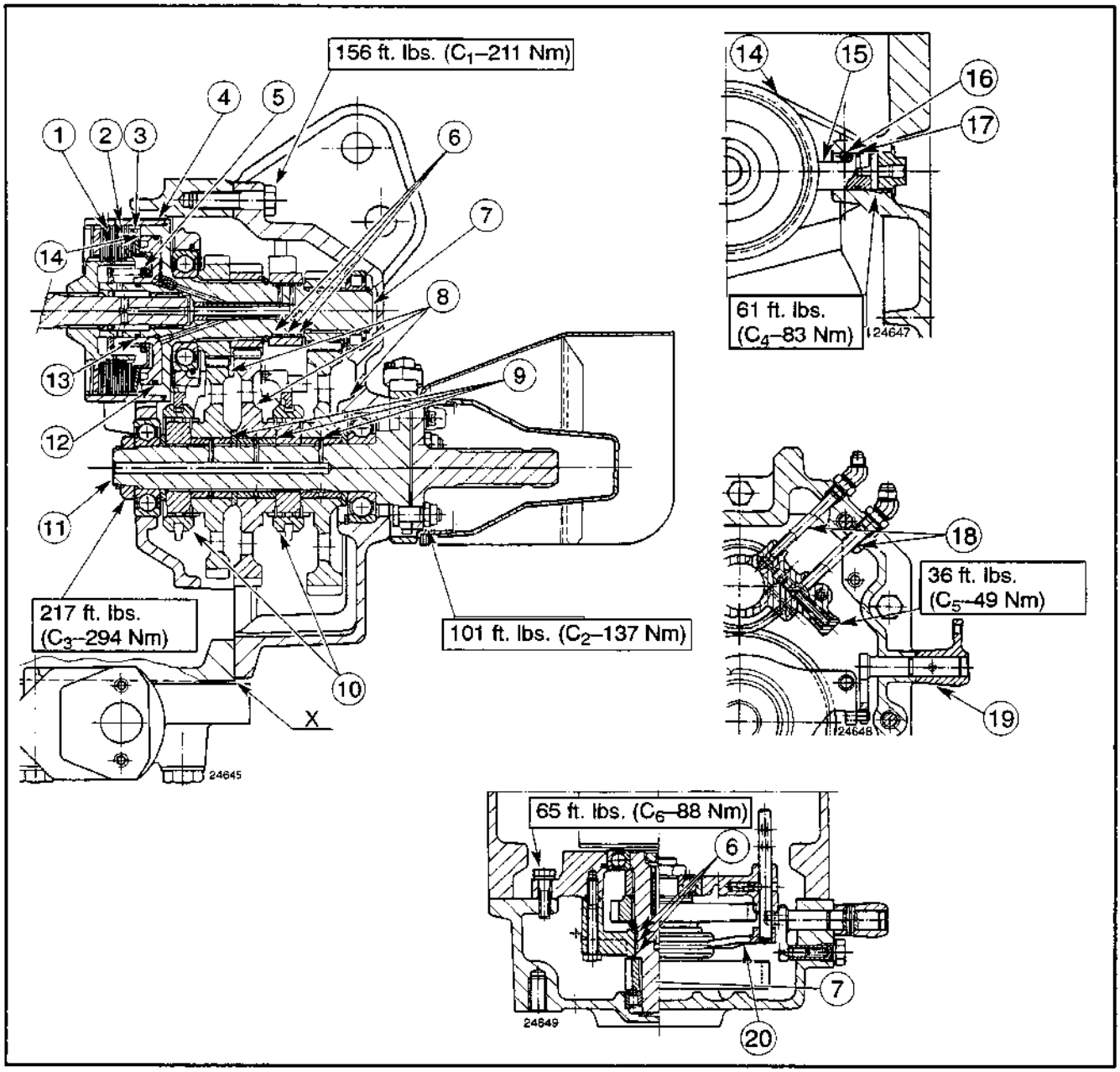


Figure 7-1-2

(540 – 750 – 1000 rpm) PTO Sectional Views
(Not Used in North America)

C_1. PTO case retaining screws
C_2. PTO output shaft retaining nut
C_3. PTO shaft retaining nut
C_4. PTO clutch brake plug
C_5. Spring retaining plug
C_6. Support bearing retaining screws
1. Drive discs
2. Driven discs
3. Clutch engagement spring
4. Drive piston
5. Return spring
6. Metal seal rings
7. Drive gear
8. Driven gears
9. Driven gear support bushings
10. Engagement sleeves
11. Driven shaft
12. Seal
13. Seal
14. Clutch body
15. Brake
16. Stop spring pin
17. Seal
18. Clutch control lines
19. PTO speed selector lever
20. Speed selector fork

Note: During installation apply liquid gasket on surfaces marked with an **X** as detailed on page 0-1-19, Section 00.

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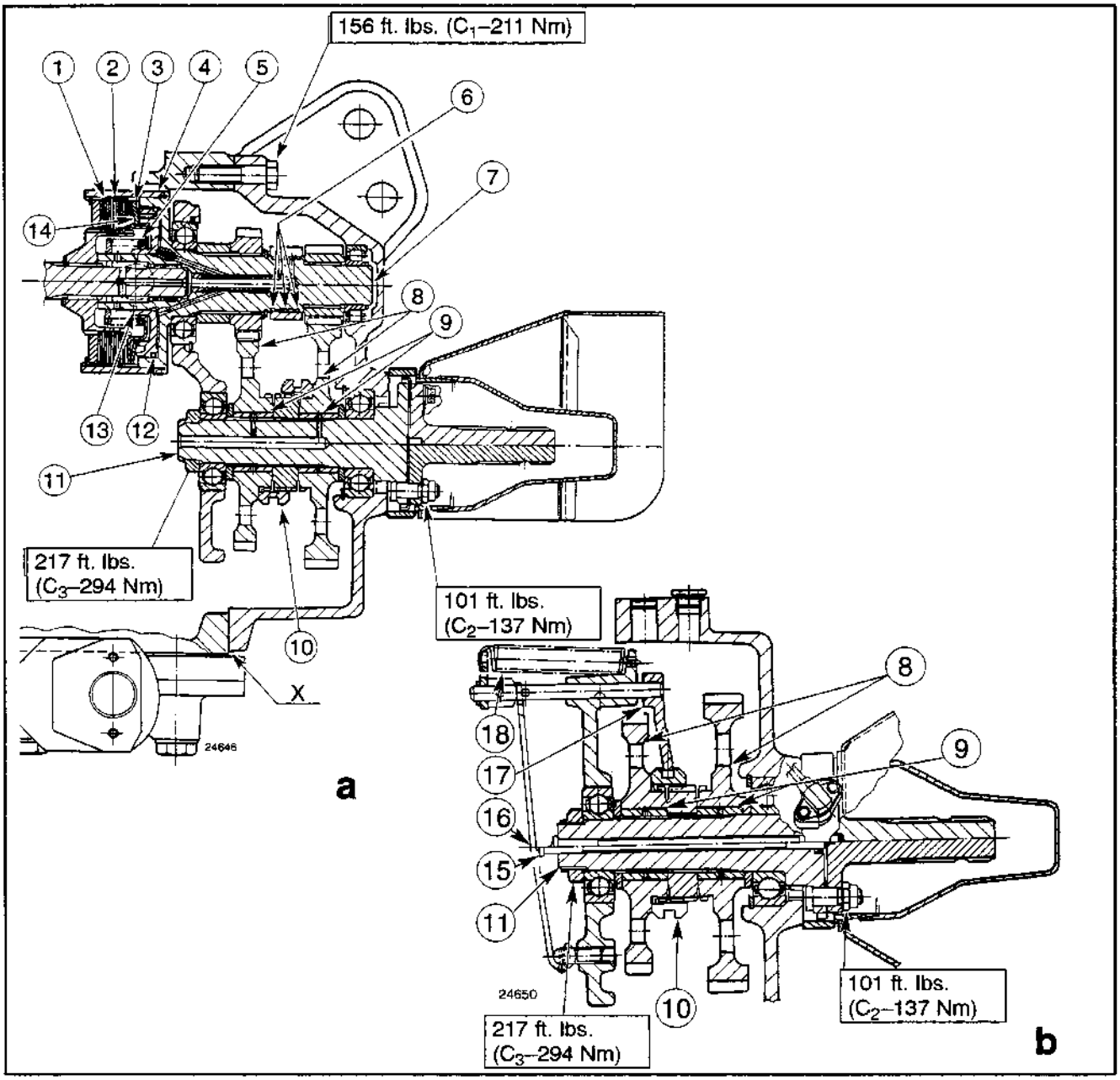


Figure 7-1-3

PTO Sectional Views

a. Two–speed PTO sectional view (540–1000 rpm)
b. Two–speed PTO sectional view (540–1000 rpm) with speed selection by replacement of the splined output shaft
C_1. PTO case retaining screws
C_2. PTO output shaft retaining nut
C_3. PTO shaft retaining nut
1. Drive discs
2. Driven discs
3. Clutch engagement spring
4. Drive piston
5. Return spring
6. Metal seal rings
7. Drive gear
8. Driven gears
9. Driven gear support bushings
10. Engagement sleeves
11. Driven shaft
12. Seal
13. Seal
14. Clutch body
15. Speed selector pin
16. Speed selector lever
17. Speed selector fork
18. Return spring

Note: During installation apply liquid gasket on surfaces marked with an **X** as detailed on page 0-1-19, Section 00.

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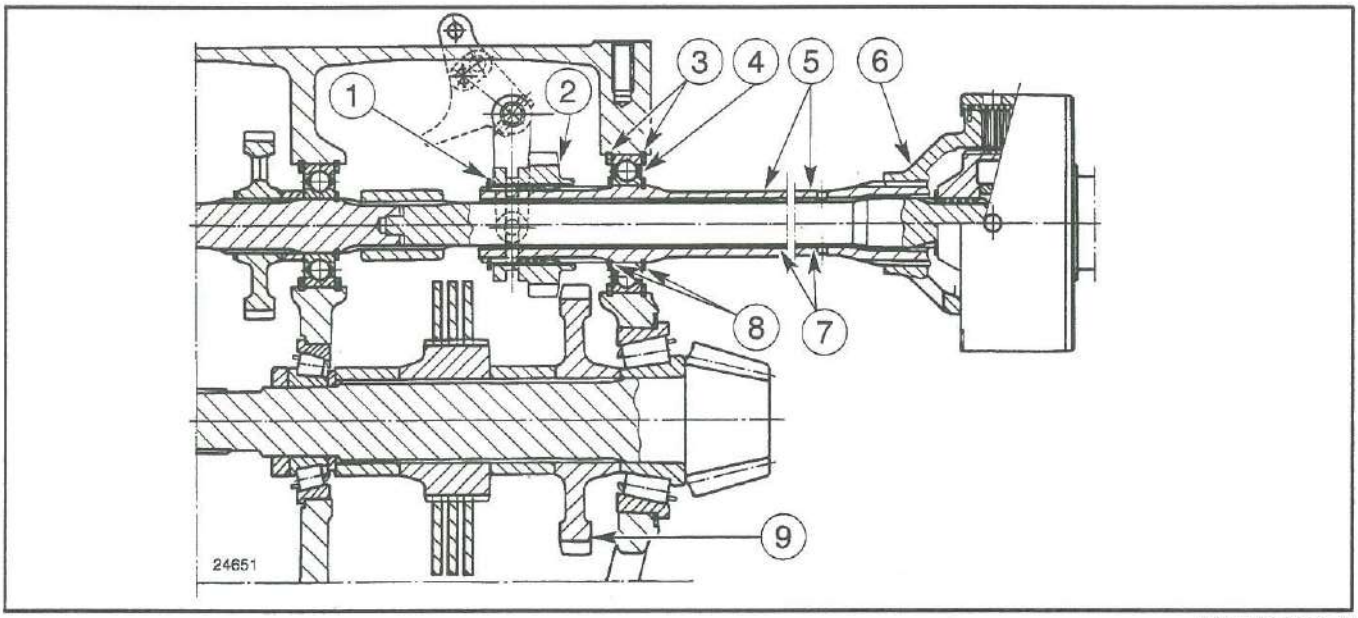


Figure 7-1-4

Transmission Synchronized PTO Sectional View
(Not Used in North America)

1. Snap ring
2. Engagement sleeve
3. Snap rings
4. Drive shaft support bearing
5. Trans. synchronized PTO drive shaft
6. Control gear
7. Engine–controlled PTO drive shaft
8. Snap rings
9. Idle gear

DESCRIPTION AND OPERATION

The PTO transfers the power directly from the engine to the implement through a splined output shaft located at tractor rear end.

The PTO drive shaft runs through the transmission upper shafts. The PTO drive shaft front end is directly splined to the engine flywheel, the rear end is connected to the PTO control clutch.

When the PTO is engaged, the hydraulically controlled clutch pack is compressed and transfers the motion (power) from the engine flywheel to the PTO splined drive shaft.

The PTO has two or three speeds or is synchronized with the tractor speed.

The PTO operating speed is selected either by means of the control lever located at the right side of the driver's seat or by replacing the splined shaft.

Transmission synchronized operation is obtained by actuating the lever located near the PTO speed selector lever.

See on pages 7-1-8, 7-1-9, and 7-1-10 for the description of the PTO control clutch and brake operation.

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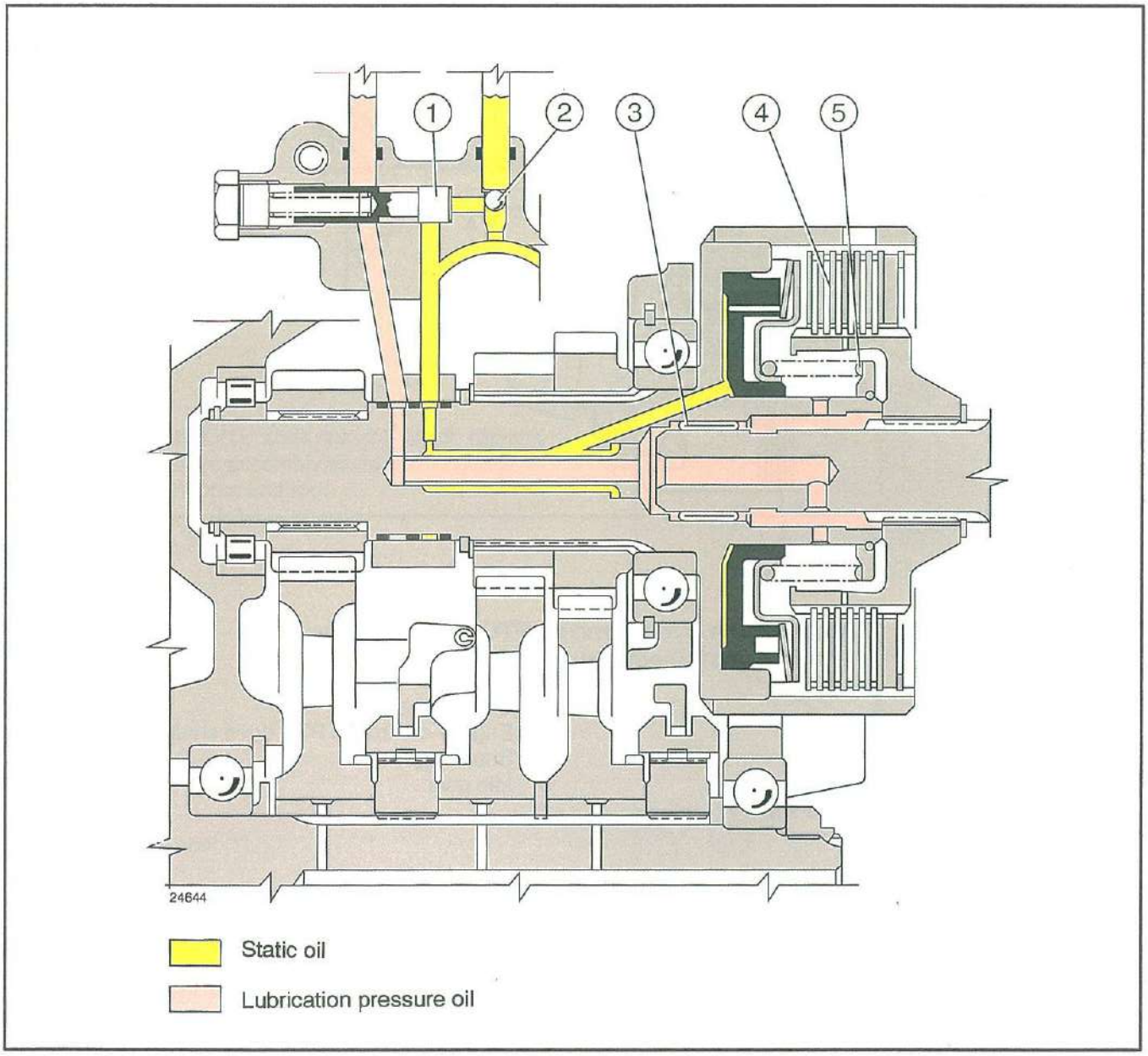


Figure 7-1-5

PTO CONTROL CLUTCH DISENGAGED

When the PTO is not in use, the oil is static and without pressure as the solenoid valve is in the discharge position (de–energized).

Under these conditions, the spiral spring (5) keeps the control clutch (4) disengaged.

An annular groove on the lubrication control valve (1) guarantees the passage of enough oil to lubricate the PTO drive shaft roller bearing (3).

When the clutch is being disengaged, the ball (2) moves and allows control oil to flow inside the bore of the clutch discharging plunger.

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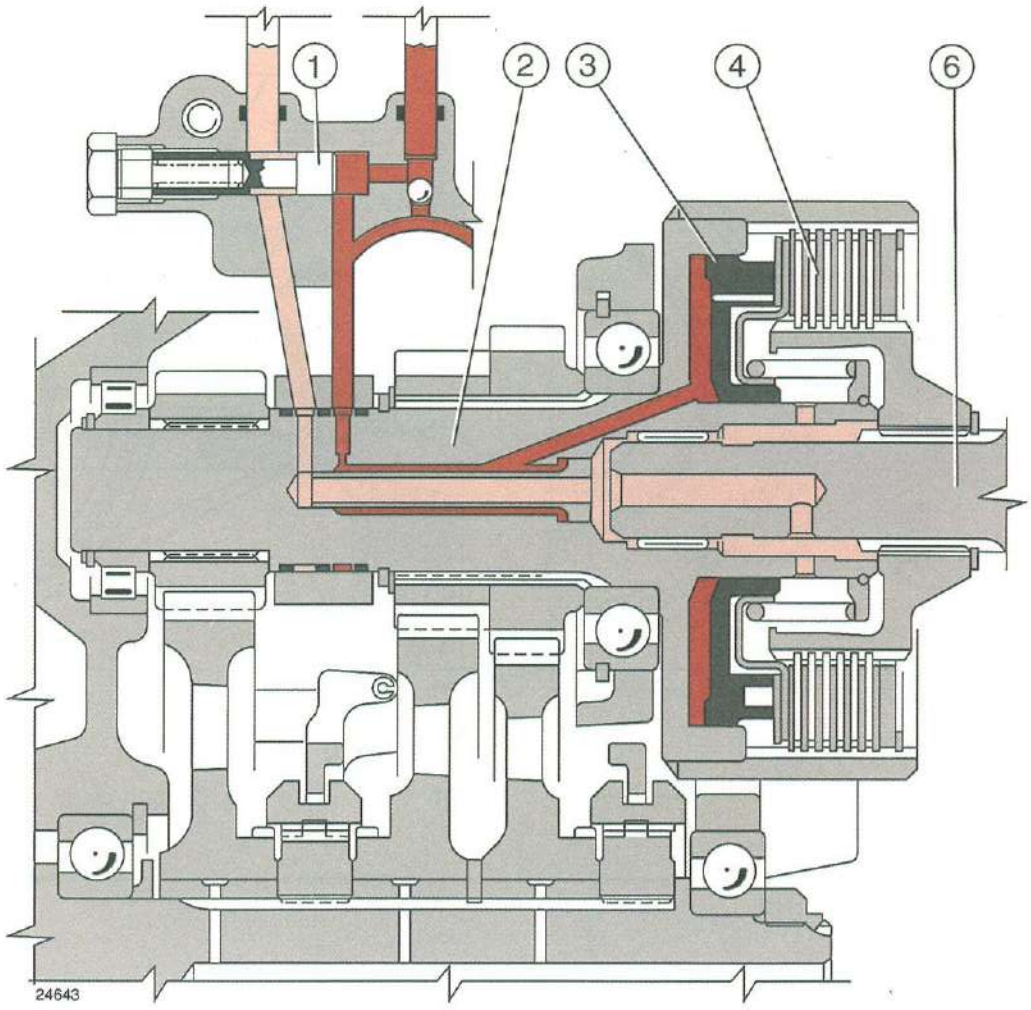


Figure 7-1-6

PTO CONTROL CLUTCH ENGAGED

When the switch on the right hand console is pressed, the solenoid valve opens and deviates oil from the pump into the piston (3) annular groove, where it overcomes the spring action (5) and compresses the control clutch pack.

In this way, drive is transferred from the PTO drive shaft (2) to the PTO driven shaft (6).

Furthermore, pressurized oil moves the lubrication control valve (1) and allows passing oil to lubricate and wash the entire clutch assembly.

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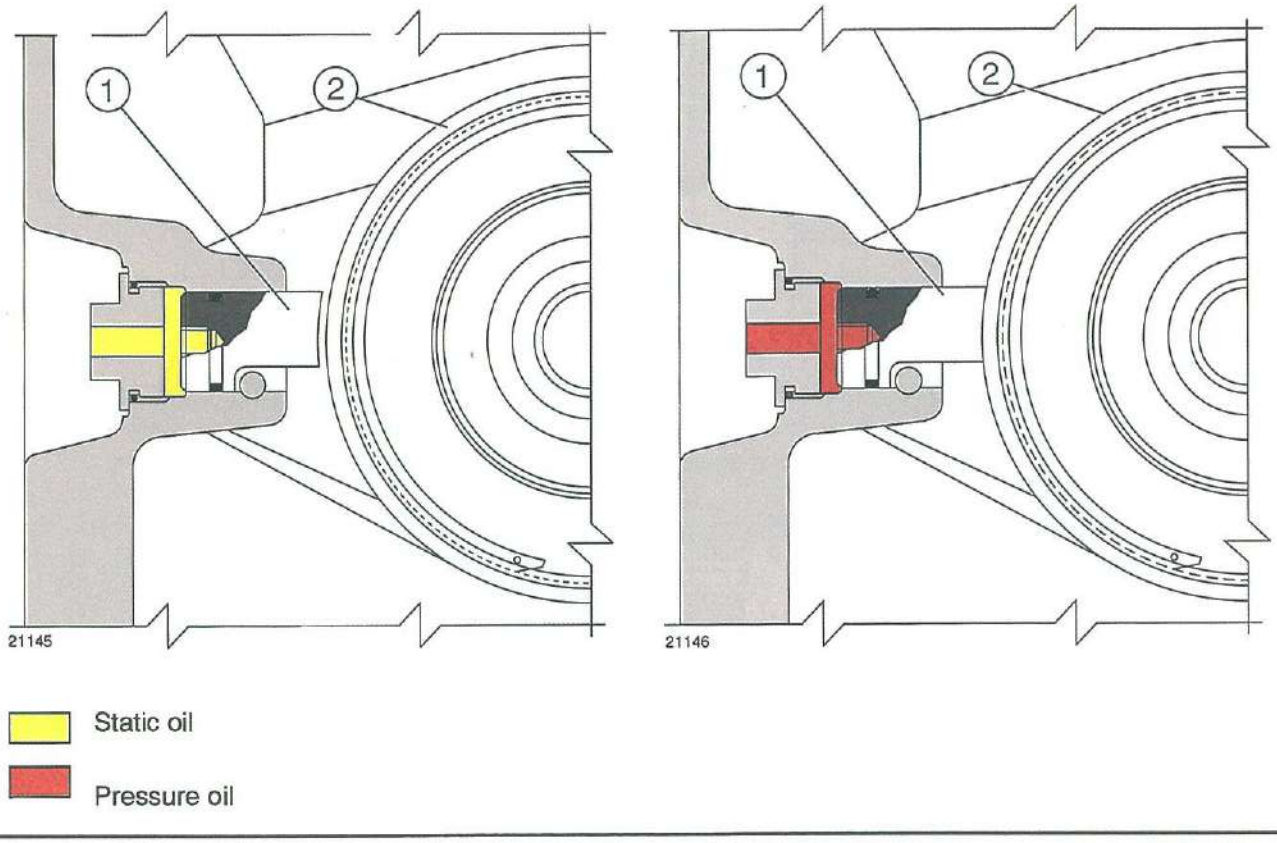


Figure 7-1-7

PTO CLUTCH BRAKE

The clutch brake operates automatically. It applies when the PTO clutch is being disengaged (braking start) and stops braking when the clutch is completely engaged.

When working with highly inertial implements it is possible to keep the brake disengaged by pressing the switch located on the right hand console near the PTO control handle. When the PTO clutch is engaged, the brake control oil is static and without pressure as the solenoid valve in the discharge position (de–energized) and consequently there is no contact between the piston (1) and the clutch case (2).

When the PTO control clutch is being disengaged, the solenoid valve is energized and opens deviating oil from the pump onto the plunger (1). The piston contacts the clutch case (2) and stops rotation.

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TROUBLESHOOTING

Problem	Possible Causes	Correction
The PTO does not operate	1. Low transmission oil level.	Reset correct level.
	2. Blocked oil filter.	Replace filter.
	3. Faulty hydraulic pump.	Repair or replace pump.
	4. Faulty PTO engagement switch	Replace switch.
	5. Lack of power supply to the solenoid valve: detached or damaged connectors, faulty remote switch.	Reset electrical connections and replace faulty parts.
	6. PTO control solenoid valve (2, page 8-1-28, Section 8, Chapter 1) stuck open.	Repair or replace solenoid valve.
	7. Oil leakage through the seals with consequent pressure drop: manifold or control plunger seals	Replace damaged seals.
The PTO remains engaged.	1. Faulty PTO engagement switch.	Replace switch.
	2. Lack of power supply to the solenoid valve: detached or damaged connectors or faulty remote switch.	Reset electrical connections and replace faulty parts.
	3. PTO control valve (2, page 8-1-28, Section 8, Chapter 1) stuck open	Repair or replace solenoid valve.
The PTO control clutch drags.	1. Faulty brake engagement switch	Replace switch.
	2. Lack of power supply to the solenoid valve: detached or damaged connectors or faulty remote switch.	Reset electrical connections and replace faulty parts.
	3. Brake control valve (3, page 8-1-28, Section 8, Chapter 1) stuck closed.	Repair or replace solenoid valve.
	4. Worn PTO brake (15, page 7-1-5)	Replace brake.

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POWER TAKE OFF (PTO)
Removal – Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Remove the PTO and hydraulic clutch as follows:

1. Open and raise the hood.
2. Detach the negative cable (4) from the battery and insulate.

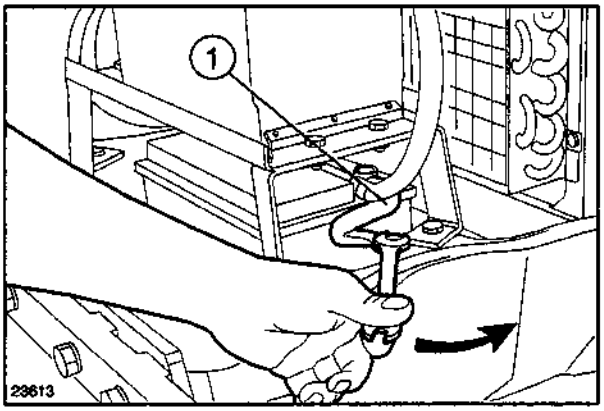


Figure 7-1-8

3. Unscrew plug (3) and drain oil from transmission and rear axle housings. Collect oil in a suitable container. Loosen the plug (3) and drain oil from rear axle and speed clutch/transmission housings into a suitable container (oil capacity is 19.2 gallons on tractors equipped with Dual Command and up to 26.4 gallons on tractors equipped with Range Command).

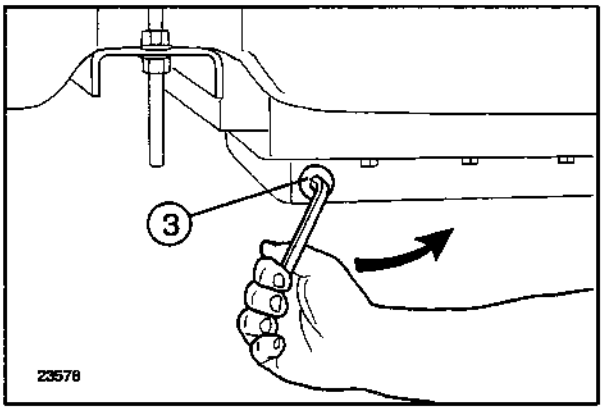


Figure 7-1-9

4. Loosen retaining screws and remove the PTO guard (1).
5. Loosen retaining screws and detach the hitch pin.
6. Remove the adjust tie–rod from the top link.

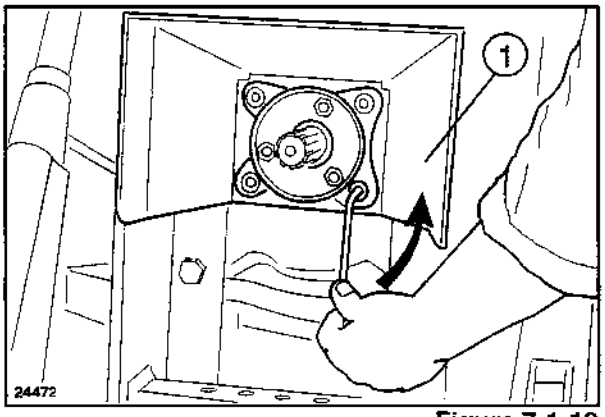


Figure 7-1-10

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7. Loosen the screws retaining the speed sensor (2), detach connector (1) and recover the speed sensor. Withdraw support (3).

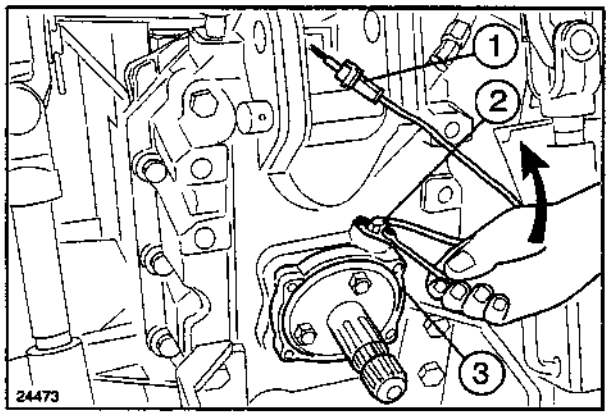


Figure 7-1-11

8. Detach clutch control lines (1) and PTO rotation speed selector lever (2).

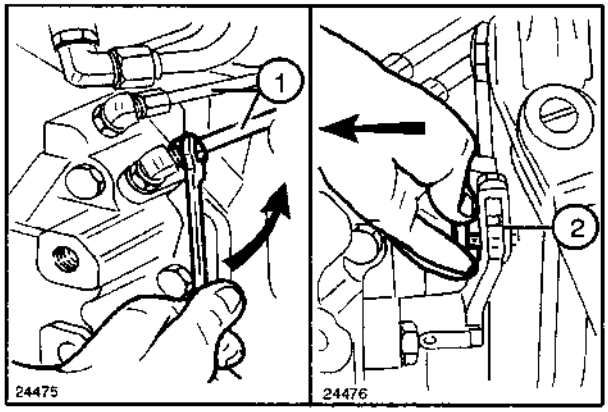


Figure 7-1-12

9. Loosen the PTO assembly retaining screws (1). Install two locally manufactured dowels to assist in removing/installing the PTO assembly, (M16 × 1.5 thread).

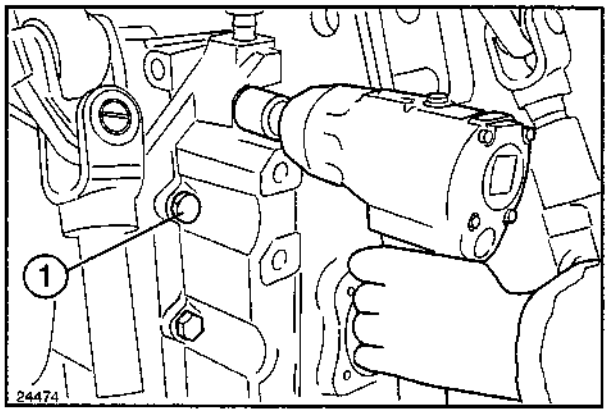


Figure 7-1-13

10. Using a hoist and a suitable hook detach the PTO assembly (1) from the rear axle housing.

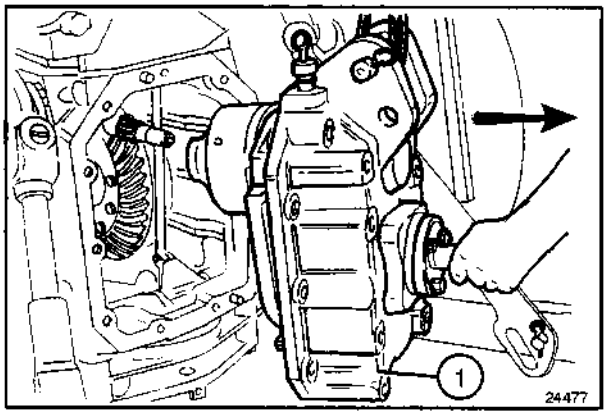


Figure 7-1-14

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⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

11. Reinstall the PTO case to the rear axle housing taking the following into consideration:

- Reassembly follows the disassembly procedure in reverse, from step 10 back to step 1.
- Before reinstalling the PTO case, thoroughly clean and degrease mating surfaces and apply a bead of liquid gasket of approx. 0.079 in (2 mm) of diameter following pattern shown in the figure below.
- Tighten to correct torque as detailed on page 7-1-4.

Pattern for application of liquid gasket between the PTO case and rear axle housing.

Sealants to be used are listed on page 0-1-19, Section 00.

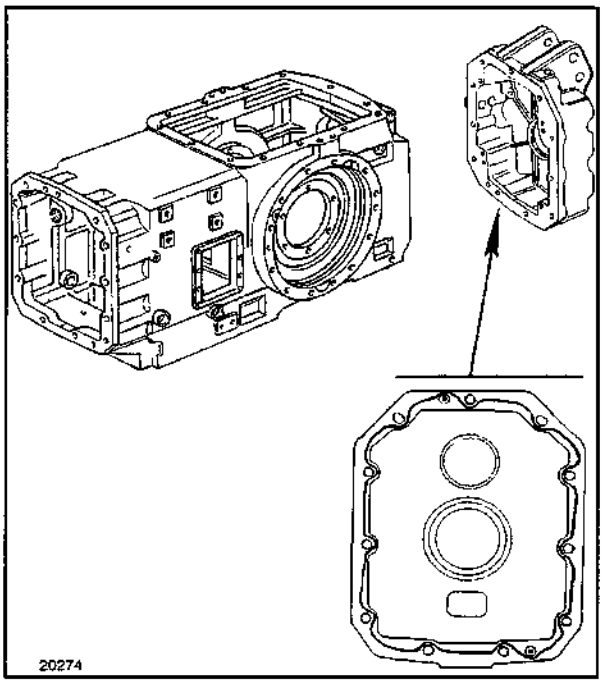


Figure 7-1-15

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POWER TAKE OFF

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

Proceed as follows:

1. Place the PTO assembly (1) on a rotary stand.

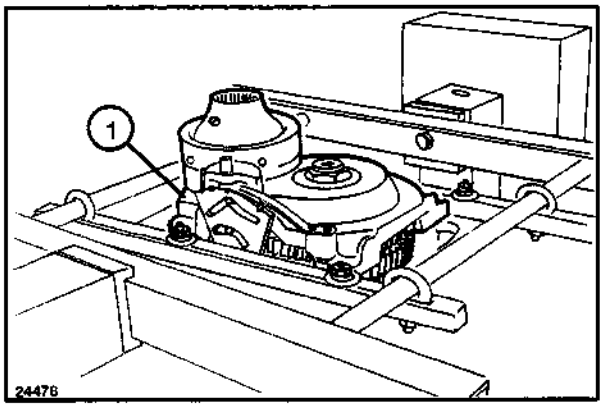


Figure 7-1-16

2. Remove the snap ring (2) and recover the drive gear (1).

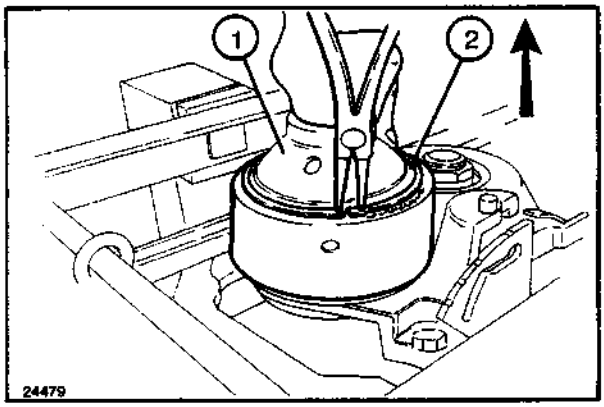


Figure 7-1-17

3. Remove the driven and drive disc assembly (1) together with the inner gear (2).

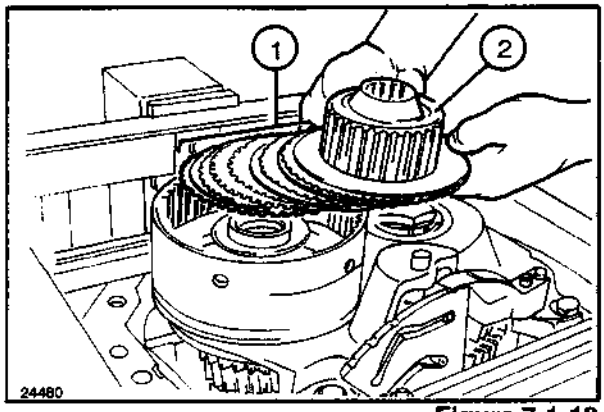


Figure 7-1-18

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4. Reinstall the snap ring (2) using a puller (1) and special tool **50063** (4, page 7-1-4). Screw in the puller until releasing and removing the retaining ring (3). Remove the snap ring (1).

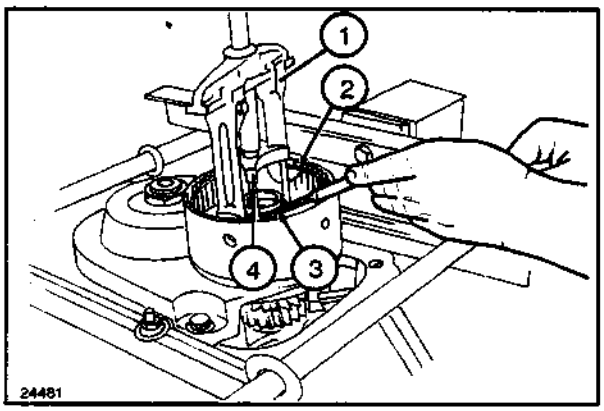


Figure 7-1-19

5. Recover the washer (1), spring (2), lower washer (3), and Belleville spring (4).

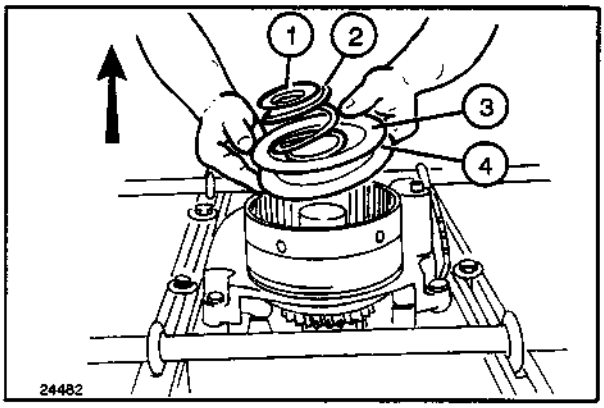


Figure 7-1-20

6. Using the special tool no. **29400** (1) and slide puller remove the cup (2) and inner bearing (3).

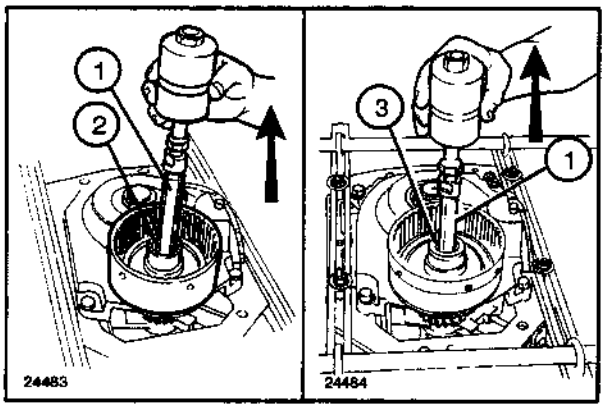


Figure 7-1-21

7. Using compressed air, remove clutch control plunger (1).

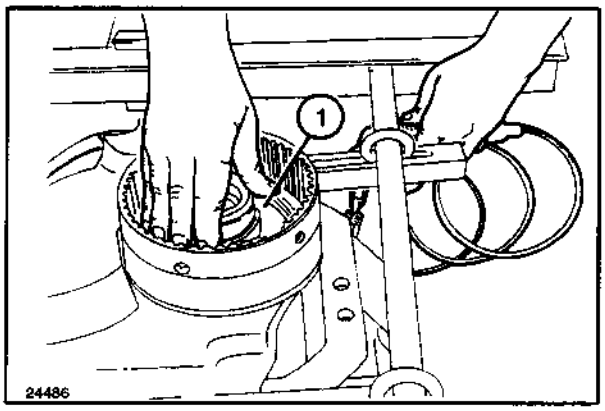


Figure 7-1-22

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8. Loosen the clutch control lines (1) and remove.

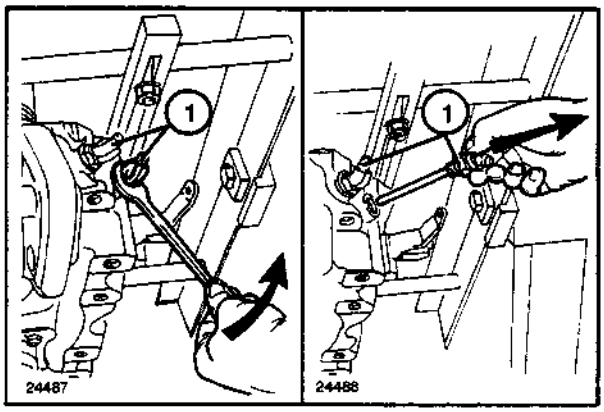


Figure 7-1-23

9. Loosen the driven shaft retaining nut (1).

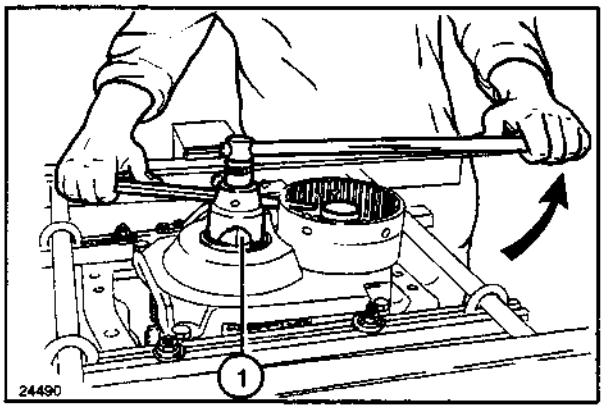


Figure 7-1-24

10. Unscrew the screws (2) retaining the drive shaft support plate (1).

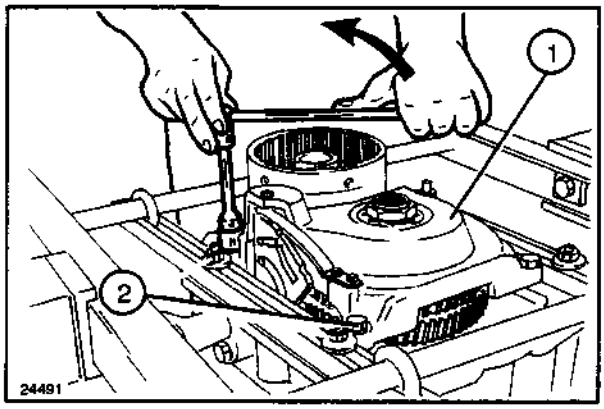


Figure 7-1-25

11. Remove the support plate (1) together with the drive shaft.

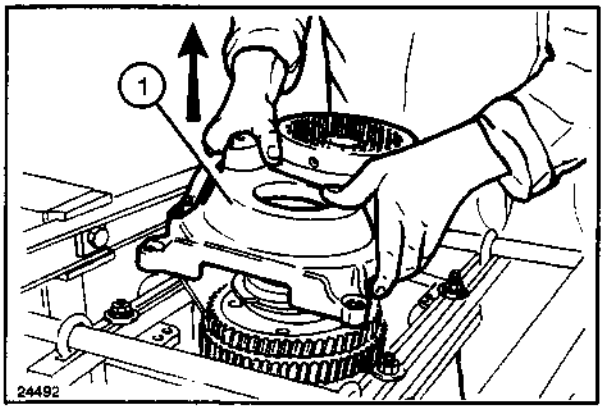


Figure 7-1-26

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12. Remove the pawl retaining pin (1) and recover the pawl (2).

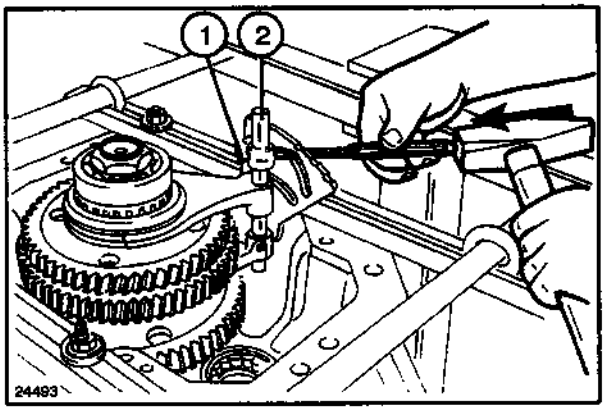


Figure 7-1-27

13. Loosen the nut (1), slide out the shaft (3) and remove the entire assembly of the driven gears (2) complete with forks and rod.

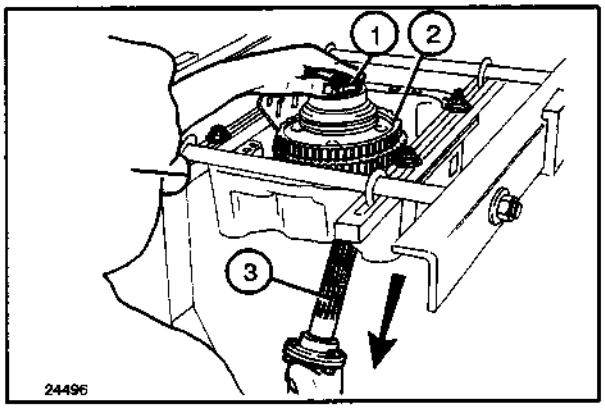


Figure 7-1-28

14. Remove the seal (1).

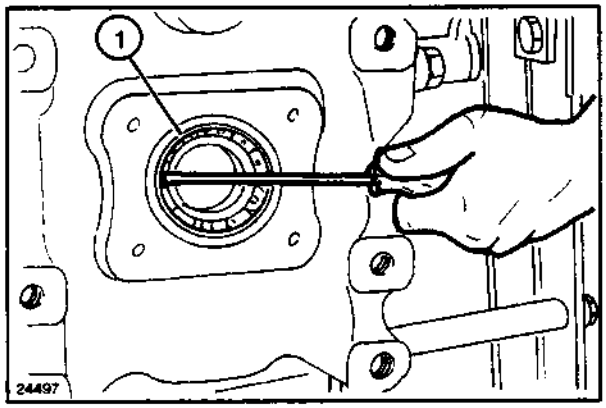


Figure 7-1-29

15. Remove the snap ring (2) and recover the bearing (1).

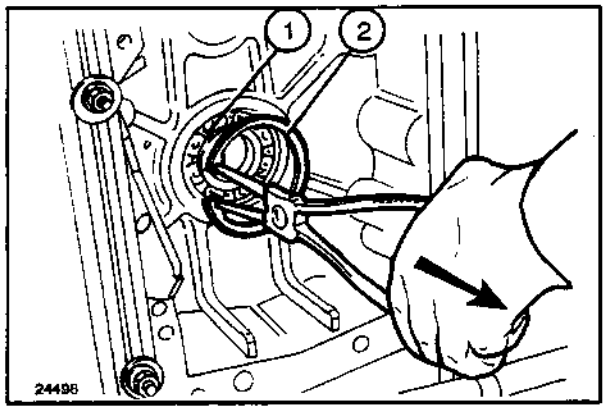


Figure 7-1-30

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16. Withdraw the upper bearing (1) using a slide puller equipped with a ring expander.

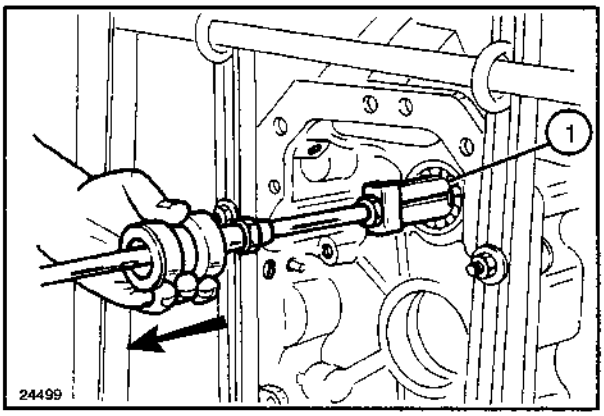


Figure 7-1-31

17. Withdraw the spring pin (1) and remove the lever complete with the selector control.

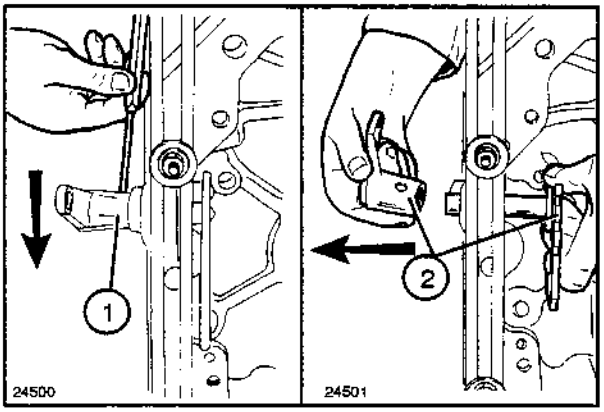


Figure 7-1-32

18. Remove the snap ring (1).

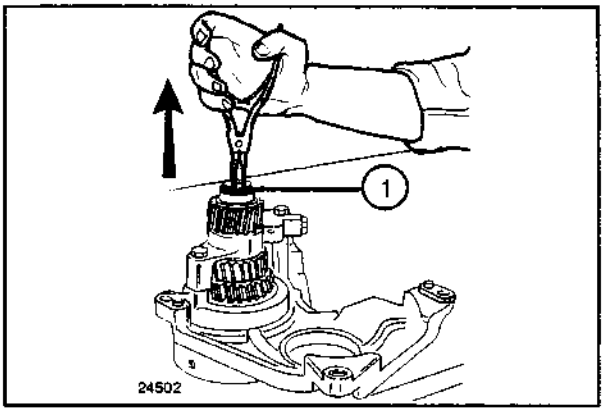


Figure 7-1-33

19. Loosen the screws (1) which retain the hydraulic clutch control manifold (2).

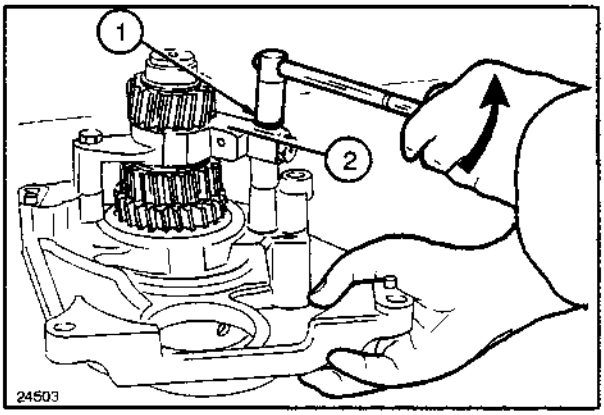


Figure 7-1-34

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20. Withdraw the thrust washer (1), bearing inner race (2), gear (4), manifold (3) with particular care to the metal seal rings (1, Figure 7-1-36).

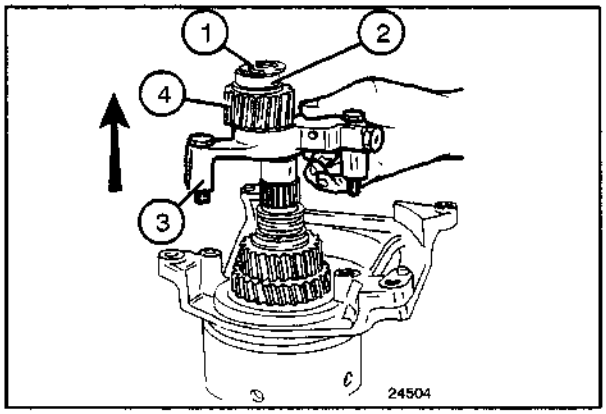


Figure 7-1-35

21. Unhook and remove the metal rings (1).

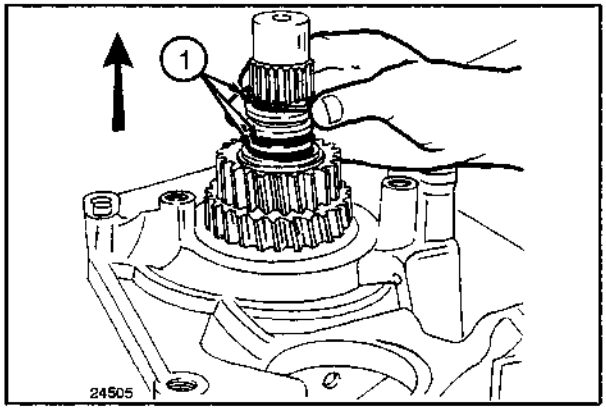


Figure 7-1-36

22. Remove the snap ring (1) and slide out the gears (2) and thrust washer (3).

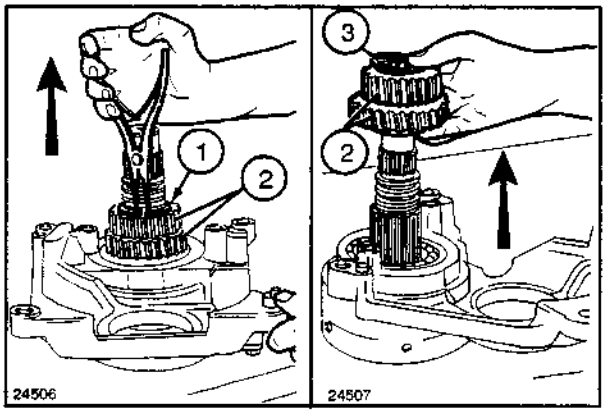


Figure 7-1-37

23. Place the support plate (2) on two wooden blocks and drive out the shaft (1) using a brass drift and a hammer.

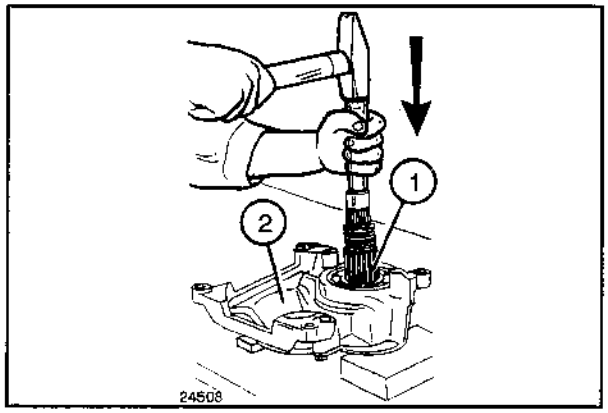


Figure 7-1-38

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24. Open the snap ring (2) and remove bearing (1).

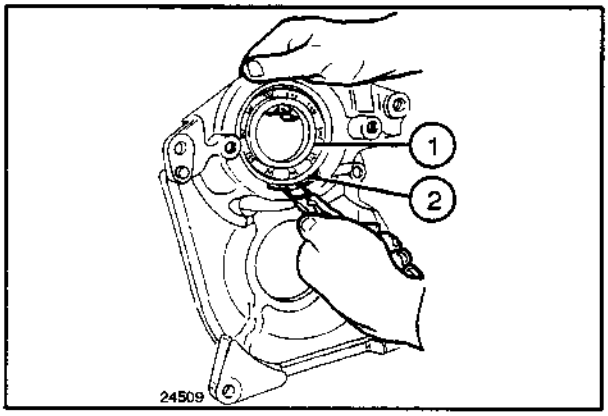


Figure 7-1-39

25. Reassemble all details into the PTO case taking the following into consideration:

- Reassembly follows the disassembly procedure in reverse, from step 24 back to step 1.
- Check all seals and replace if necessary.
- Tighten to correct torque as detailed on page 7-1-4.
- Refer to figures on pages 7-1-5 and 7-1-6 to orient the components.
- Consider the following steps.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

26. Install the upper bearing (1) using a suitable installer.

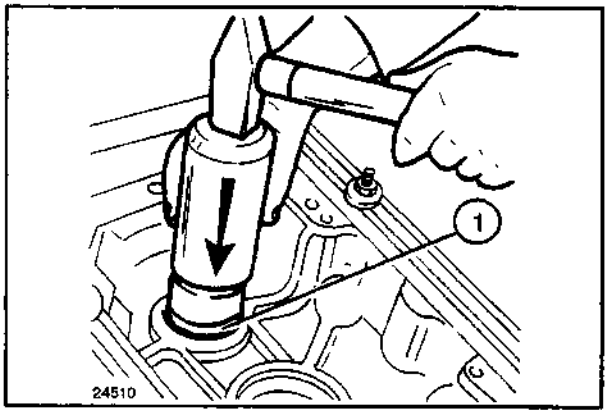


Figure 7-1-40

27. Install the seal (1).

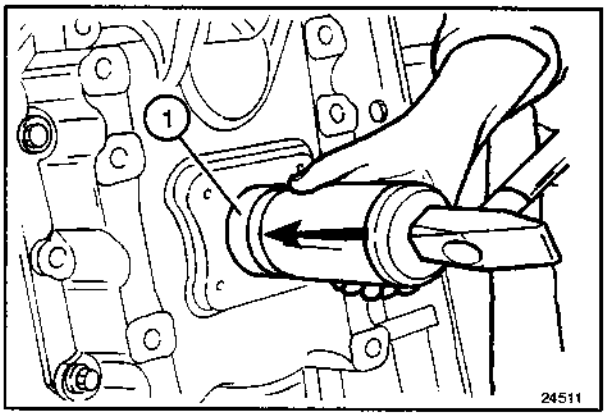


Figure 7-1-41

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28. Install the bearing (2) on the PTO drive shaft (1).

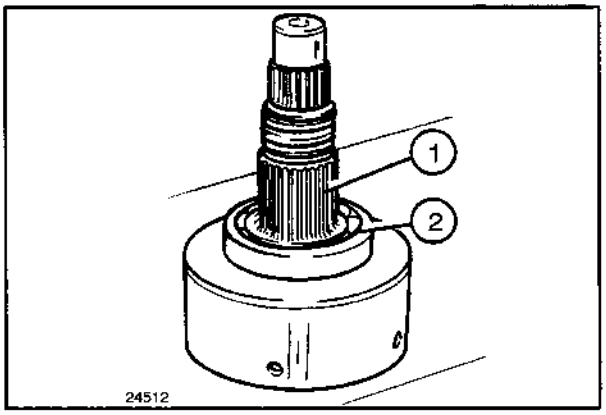


Figure 7-1-42

29. Position the drive shaft (1) complete with its bearing on the support plate (3) and lock it in place using the snap ring (2).

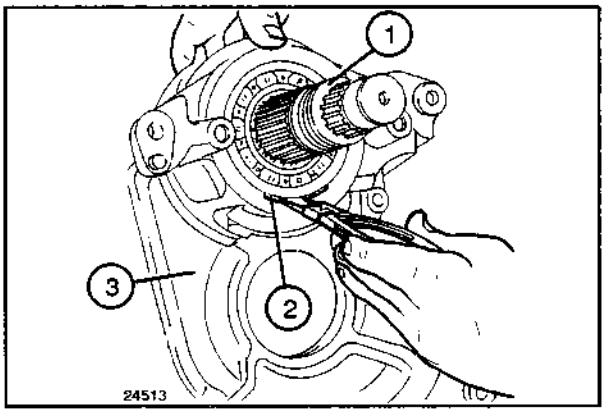


Figure 7-1-43

30. Insert the driving shaft (2) into the clutch case (1) and keep it in place using a suitable support until complete mounting.

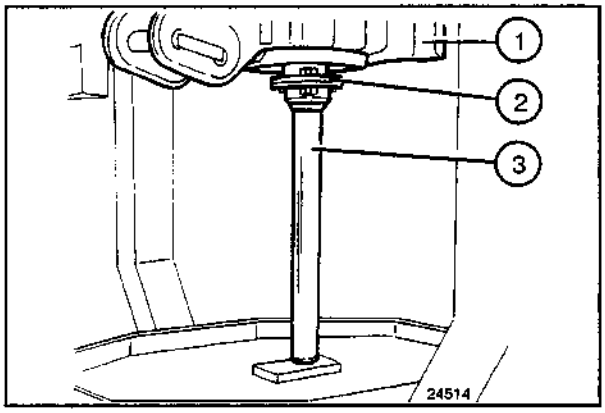


Figure 7-1-44

31. Install the seal (2) using the protection tool no. **290785** (1).

NOTE: Wait at least 15 minutes before mounting the plunger (3).

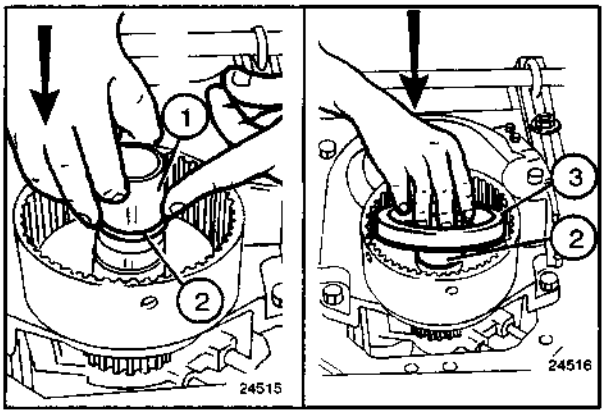


Figure 7-1-45

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32. Install the bearing (1) using the special tool no. **293997** (2) and attachment tool no. **293800**.

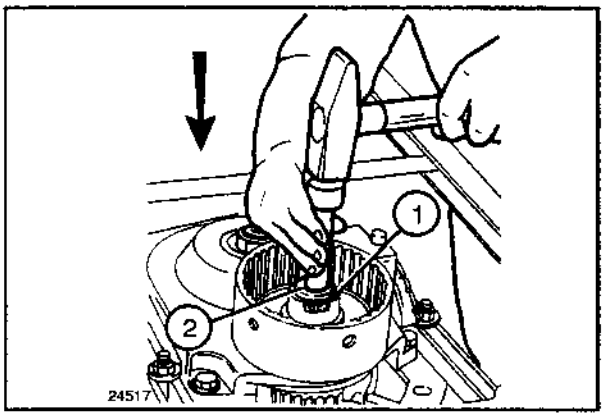


Figure 7-1-46

33. Position the cup (2) using the special tool no. **293998** (1) complete with an hex head bolt M14x1.5 of suitable length.

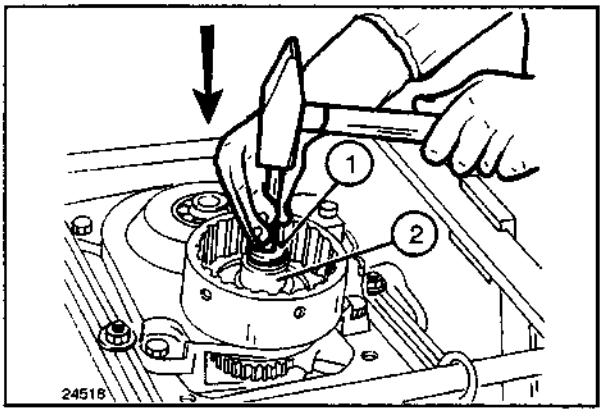


Figure 7-1-47

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8160, 8260, 8360, 8560 TRACTOR REPAIR MANUAL CONTENTS

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SECTION 2 – ELECTRICAL SYSTEM
SECTION 3 – CLUTCH
SECTION 4 – TRANSMISSIONS
SECTION 5 – MECHANICAL REAR WHEEL DRIVE
SECTION 6 – BRAKES
SECTION 7 – POWER TAKE-OFF
SECTION 8 – HYDRAULIC SYSTEM
SECTION 9 – DRIVE LINES - FWD
SECTION 10 – CAB

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SECTION 8

HYDRAULIC SYSTEM

CHAPTER 1

HYDRAULIC CIRCUITS

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INTRODUCTION AND CIRCUIT IDENTIFICATION

The hydraulic system on the 8160–8560 range of tractors are separated into the following circuits:–

High Pressure Circuit

Hydraulic Lift Assembly,
Remote Control Valves
Trailer Brake (Where Fitted)

Steering Circuit

Steering Motor and Cylinders

Low Pressure Circuit

Independent Power Take Off (PTO)
Differential Lock
Front Wheel Drive engagement
Hi/Lo Transmission Synchronizer and Clutch Application
Semi Powershift Transmission Clutch Application and Range Synchronizer Engagement

Lubrication Circuit

PTO Clutch Plates
Transmission Clutch Plates
Transmission Shaft Pressure Lube
Pump Drive Gear Bearing

The high pressure circuit is 'Closed Center Load Sensing' design.

The steering, low pressure and lubrication circuits are always of the the 'Open Center' design.

TRACTOR BUILD OPTIONS				
Transmission	**High Pressure Hydraulic System**	**Hydraulic Pump**	**Hydraulic Lift**	**Remote Control Valves**
Hi/Lo	Closed Center	Variable Flow CCLS	Electronic Draft Control	Closed Center
Semi Powershift	Closed Center	Variable Flow CCLS	Electronic Draft Control	Closed Center

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To identify the tractor build options observe the following components

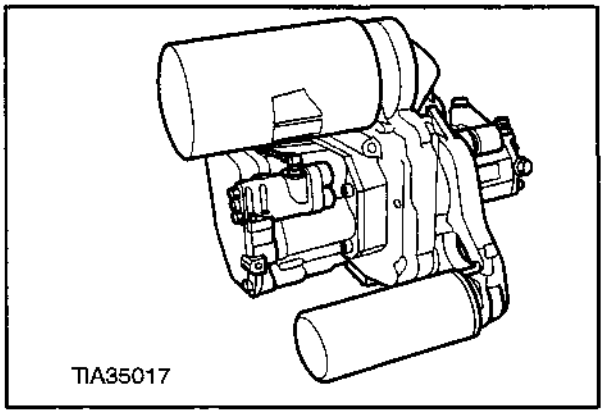


Figure 8-1-1

Closed center high pressure hydraulic systems use:–

Closed center load sensing variable displacement piston pump

Closed center remote valves.

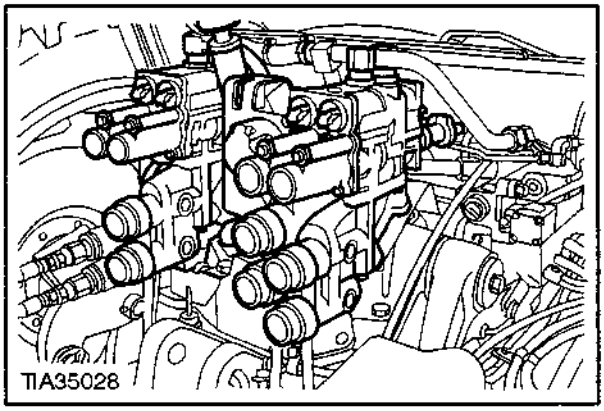


Figure 8-1-2

Open center high pressure hydraulic systems use:–

Open center gear pump. (Not used in North America)

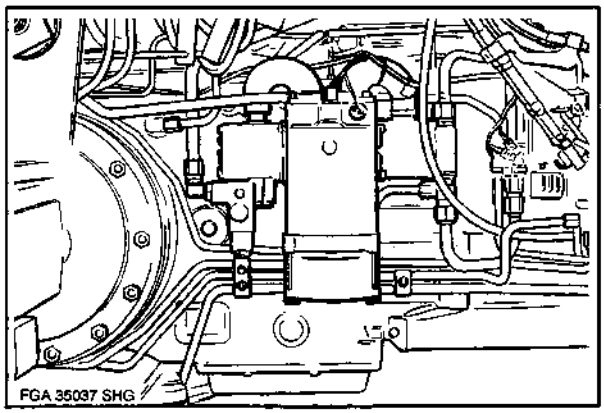


Figure 8-1-3

Open center remote control valves (Not used in North America)

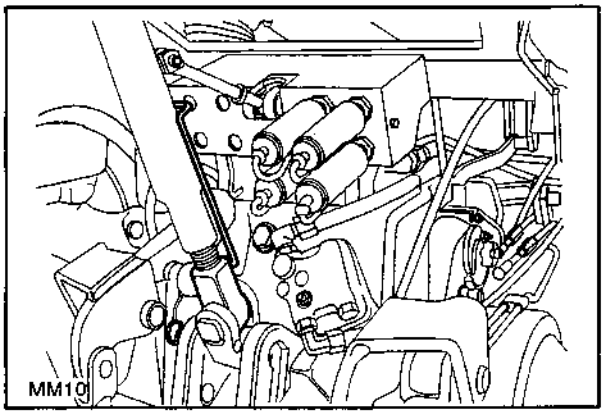


Figure 8-1-4

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Tractors installed with the electronic draft control hydraulic lift assembly use a unique operator control panel as shown.

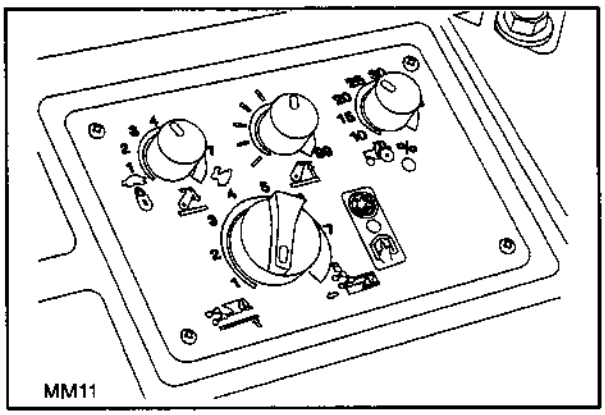


Figure 8-1-5

Electronic draft control is available on both 'Closed' and 'Open' center hydraulic system.

To identify the type of transmission installed, inspect the transmission control lever.

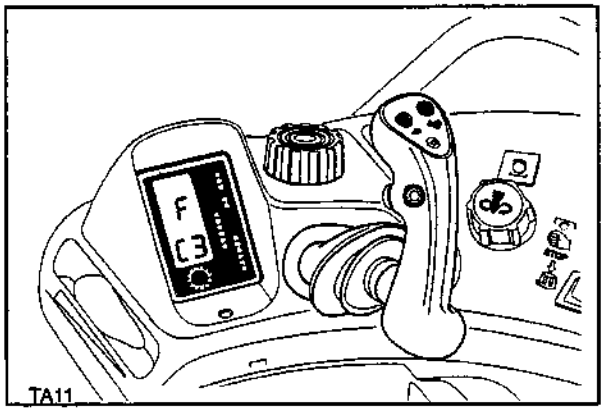


Figure 8-1-6

Tractors installed with semi powershift transmission have a single control lever.

Tractors installed with Hi/Lo transmission uses two control levers.

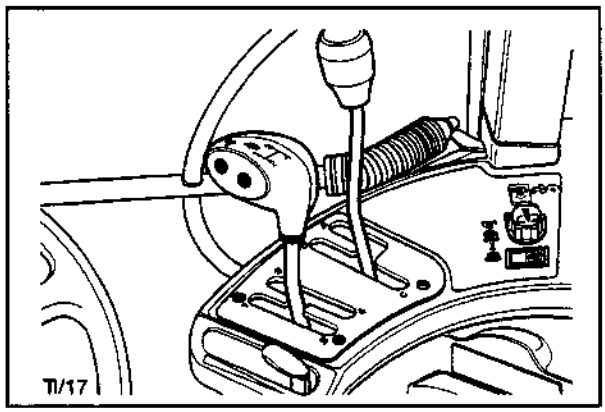


Figure 8-1-7

Tractors installed with mechanical 16x6 and 20x16 transmissions use three control levers. (Not used in North America)

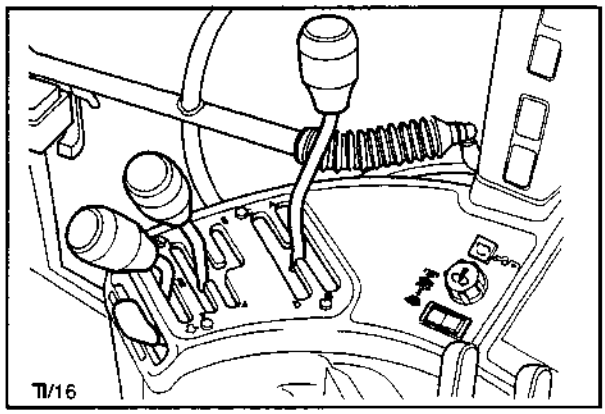


Figure 8-1-8

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Hydraulic Circuit Schematics

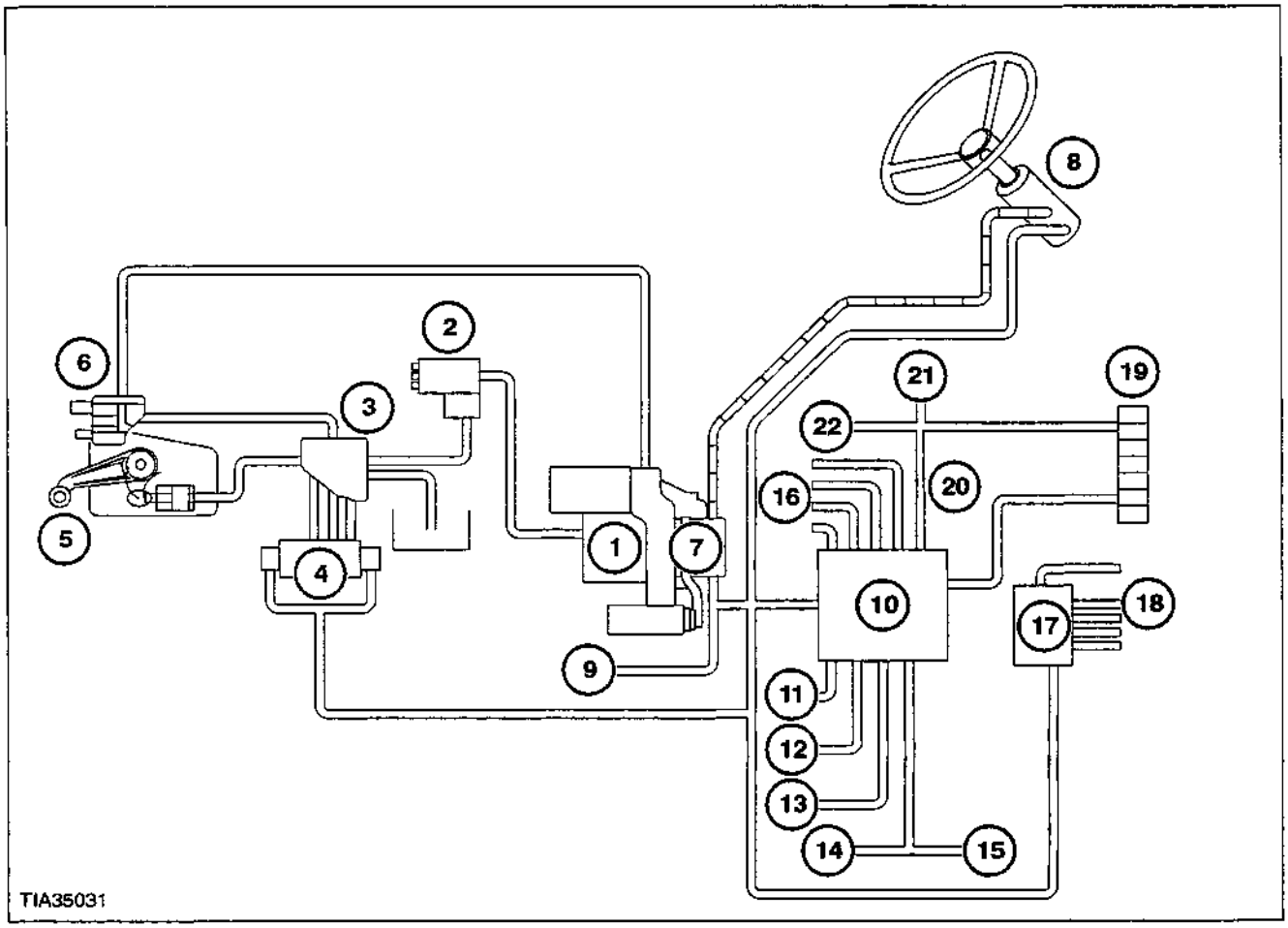


Figure 8-1-9

Hydraulic Schematic
Tractors with Closed Center Load Sensing Hydraulic Pump and Semi Powershift Transmission

High Pressure Circuit

Steering Circuit

Low Pressure Circuit

Lubrication Circuit

Return to Sump

1. Variable Flow Piston Pump
2. Trailer Brake Valve
3. Manifold and Lift Cylinder Safety Valve
4. Hydraulic Lift Electronic Draft Control Valve
5. Hydraulic Lift
6. Remote Control Valves
7. Steering/Low Pressure Circuit Pump
8. Steering Motor
9. To Rear Axle Differential Lock – Disengage
10. Transmission Side Cover and Pressure Regulating Valve
11. To Power Take Off Brake
12. To Power Take Off Clutch
13. To Front Wheel Drive
14. To Rear Axle Differential Engagement
15. To Front Axle Differential Engagement
16. To Range Synchronizer Fork Actuators
17. Clutch Oil Distribution Cover
18. To Transmission Clutches
19. Oil Cooler
20. Oil Cooler By–Pass Valve
21. To Transmission Lubrication
22. To Pump Drive Gear, PTO and Lift Cross Shaft Lubrication
23. Lubrication Circuit Relief Valve

Figures 8-1-9 to Figure 8-1-13 show in basic format the high pressure, steering, low pressure and lubrication circuits for each type of hydraulic pump and transmission assembly option available on the tractor.

A detailed explanation on the operation of each high and low pressure circuit and the location of components within the circuit starts on Page 8-1-10.

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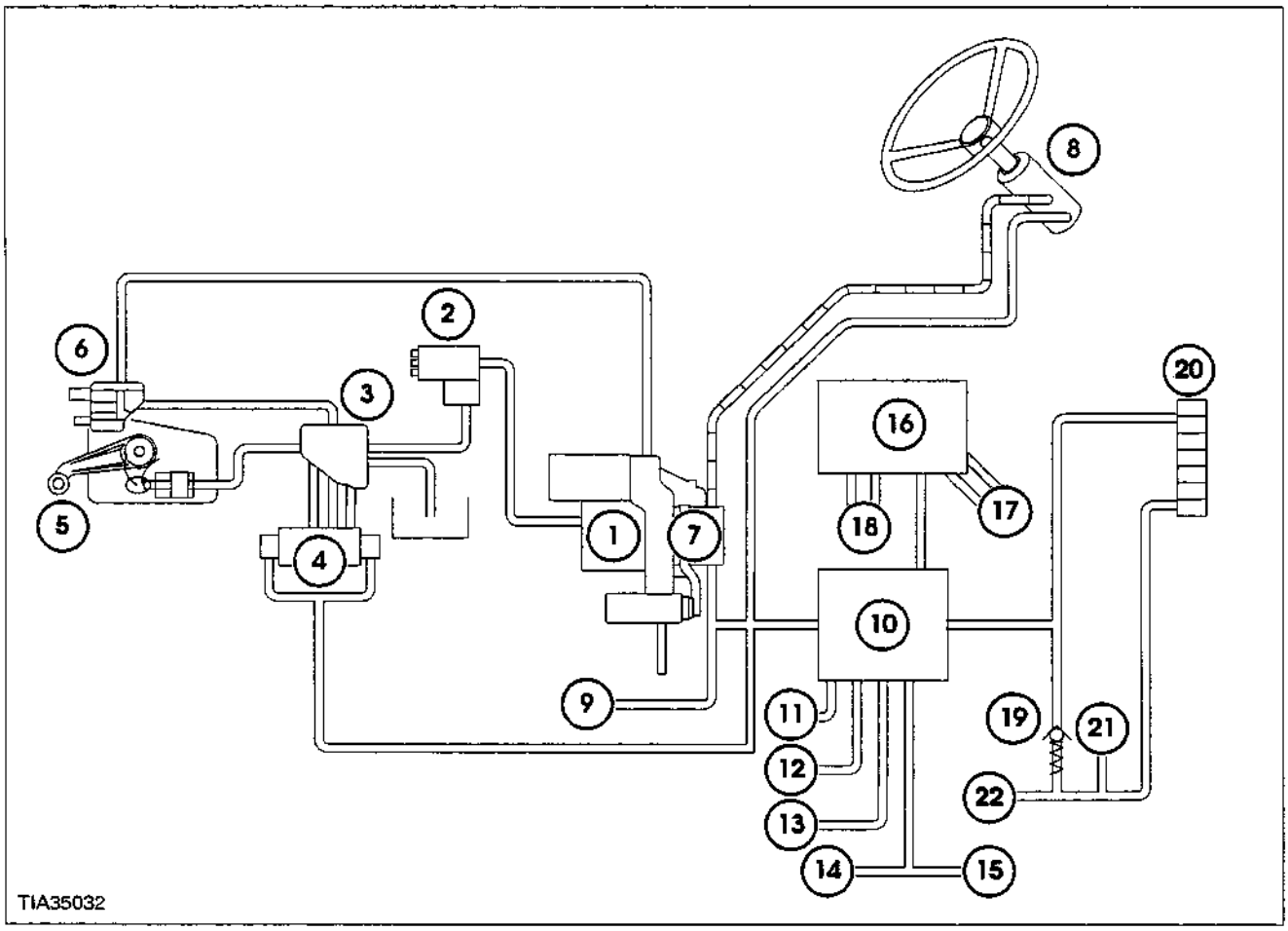


Figure 8-1-10

Hydraulic Schematic
Tractors with Closed Center Load Sensing Hydraulic Pump and Hi/Lo Transmission

High Pressure Circuit

Steering Circuit

Low Pressure Circuit

Lubrication Circuit

Return to Sump

1. Variable Flow Piston Pump
2. Trailer Brake Valve
3. Manifold and Lift Cylinder Safety Valve
4. Hydraulic Lift Electronic Draft Control Valve
5. Hydraulic Lift
6. Remote Control Valves
7. Steering/Low Pressure Circuit Pump
8. Steering Motor
9. To Rear Axle Differential Lock – Disengage
10. Transmission Side Cover and Pressure Regulating Valve
11. To Power Take Off Brake
12. To Power Take Off Clutch
13. To Front Wheel Drive
14. To Rear Axle Differential Engagement
15. To Front Axle Differential Engagement
16. Transmission Top Cover
17. To Transmission Clutches A and B
18. To Forward and Reverse Synchronizers
19. Oil Cooler
20. Oil Cooler By–pass Valve
21. To Pump Drive Gear, PTO and Lift Cross Shaft Lubrication
22. To Transmission Lubrication
23. Lubrication Circuit Relief Valve

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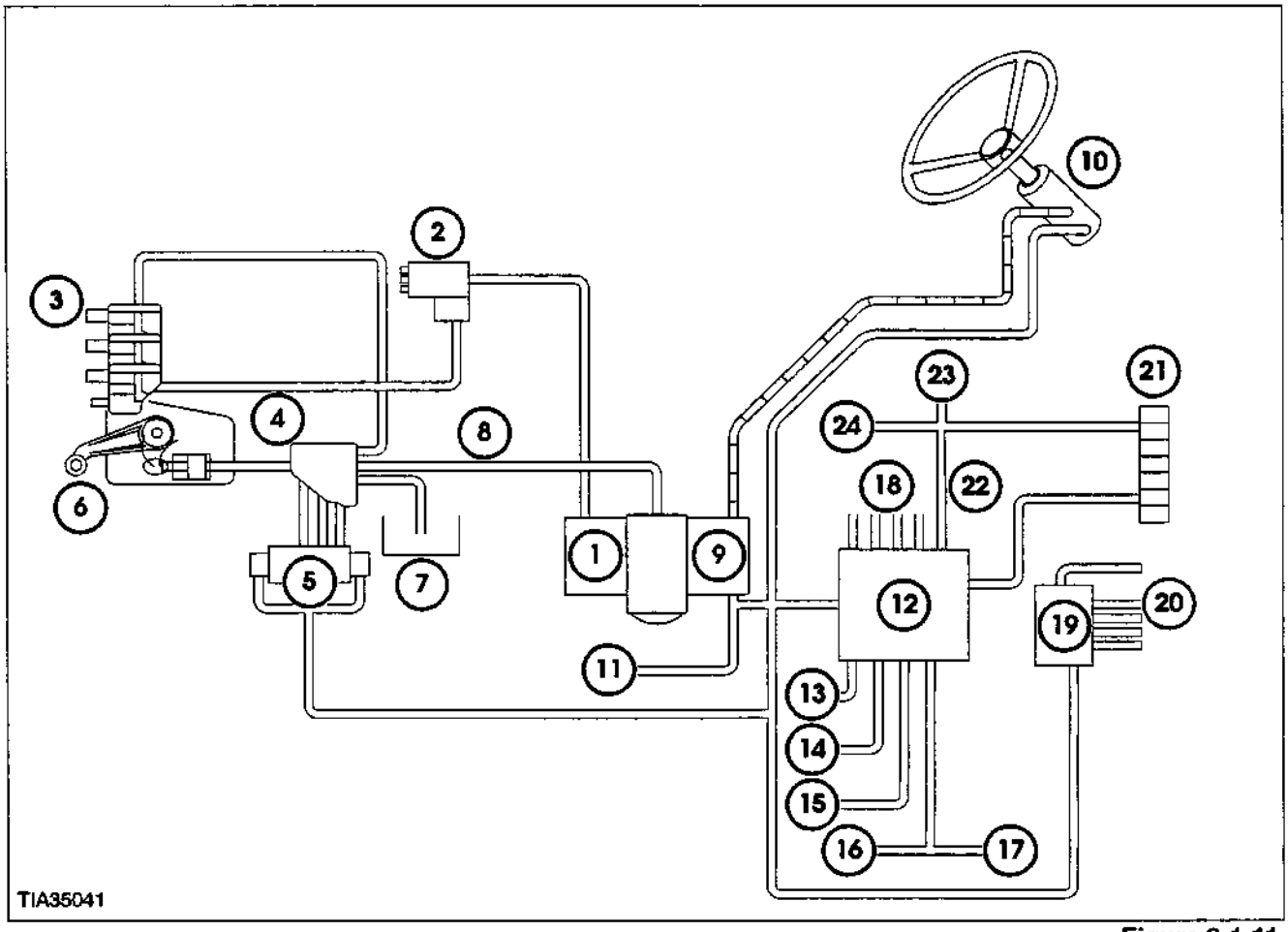


Figure 8-1-11

Hydraulic Schematic
Tractors with Open Center Gear Pump, Semi Powershift Transmission and Electronic Draft Control Hydraulic Lift
(Not Used in North America)

High Pressure Circuit

Steering Circuit

Low Pressure Circuit

Lubrication Circuit

Return To Sump

1. High Pressure Circuit Gear Pump
2. Trailer Brake Valve
3. Open Center Remote Control Valves
4. Manifold, Unload and Lift Cylinder Safety Valve
5. Hydraulic Lift Electronic Draft Control Valve
6. Hydraulic Lift
7. Return To Sump from Hydraulic Lift
8. Return To Sump from Unload Valve
9. Steering/Low Pressure Circuit Pump
10. Steering Motor
11. Rear Axle Differential Lock – Disengage
12. Transmission Side Cover and Pressure Regulating Valve
13. To Power Take Off Brake
14. To Power Take Off Clutch
15. To Front Wheel Drive
16. To Rear Axle Differential Engagement
17. To Front Axle Differential Engagement
18. Range Synchronizer Fork Actuators
19. Clutch Oil Distribution Cover
20. To Transmission Clutches
21. Oil Cooler
22. Oil Cooler By–Pass Valve
23. To Pump Drive Gear, PTO and Lift Cross Shaft Lubrication
24. To Transmission Lubrication
25. Lubrication Circuit Relief Valve

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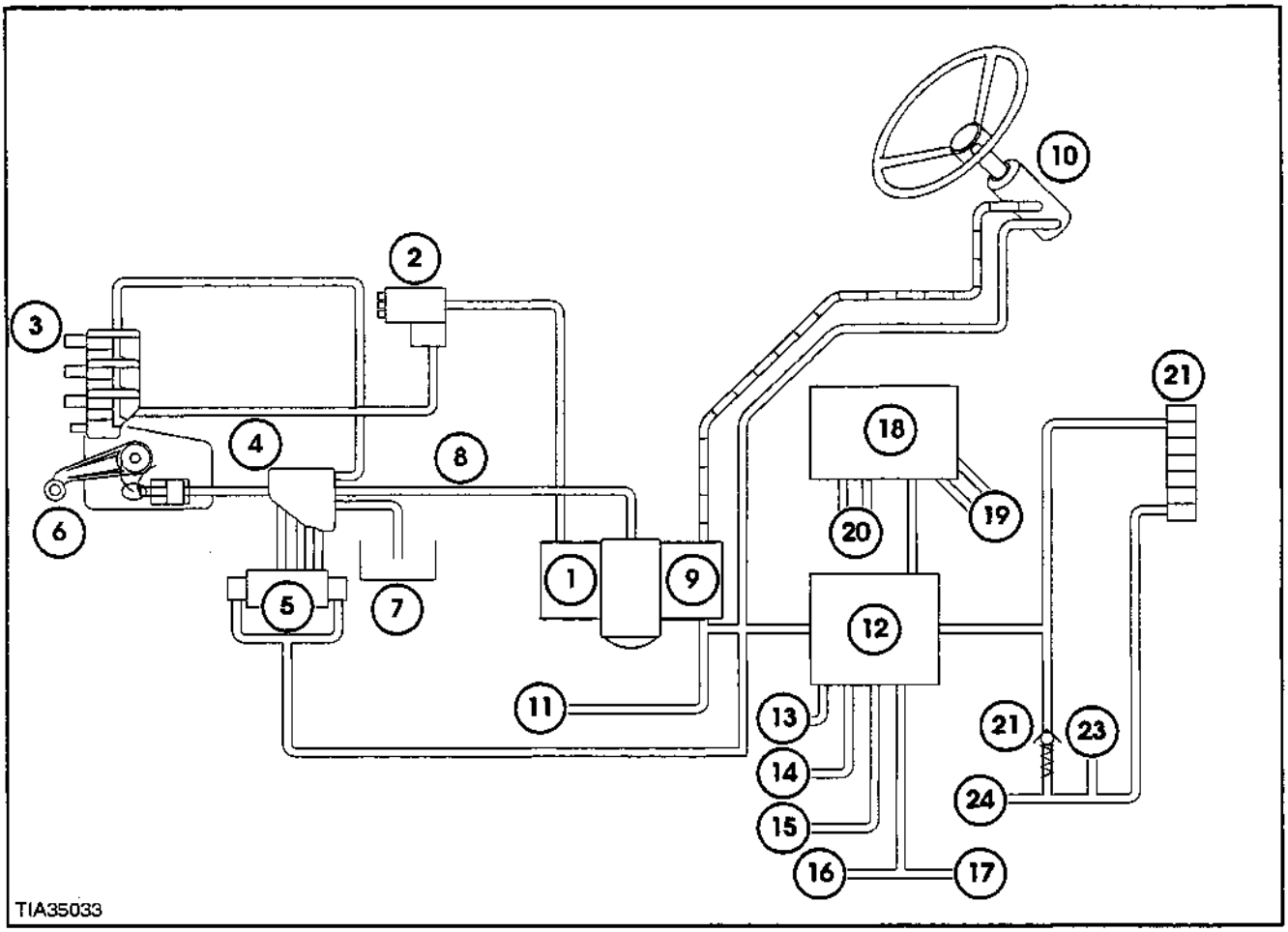


Figure 8-1-12

Hydraulic Schematic
Tractors with Open Center Gear Pump and Hi/Lo Transmission
(Not Used in North America)

High Pressure Circuit

Steering Circuit

Low Pressure Circuit

Lubrication Circuit

Return To Sump

1. High Pressure Circuit Gear Pump
2. Trailer Brake Valve
3. Open Center Remote Control Valves
4. Manifold, Unload and Lift Cylinder Safety Valve
5. Hydraulic Lift Electronic Draft Control Valve
6. Hydraulic Lift
7. Return To Sump From Hydraulic Lift
8. Return To Sump from Unload Valve
9. Steering/Low Pressure Circuit Pump
10. Steering Motor
11. To Rear Axle Differential Lock – Disengage
12. Transmission Side Cover and Pressure Regulating Valve
13. To Power Take Off Brake
14. To Power Take Off Clutch
15. To Front Wheel Drive
16. To Rear Axle Differential Engagement
17. To Front Axle Differential Engagement
18. Transmission Top Cover
19. To Transmission Clutches A and B
20. To Forward and Reverse Synchronizers
21. Oil Cooler
22. Oil Cooler By–pass Valve
23. To Pump Drive Gear, PTO and Lift Cross Shaft Lubrication
24. To Transmission Lubrication
25. Lubrication Circuit Relief Valve

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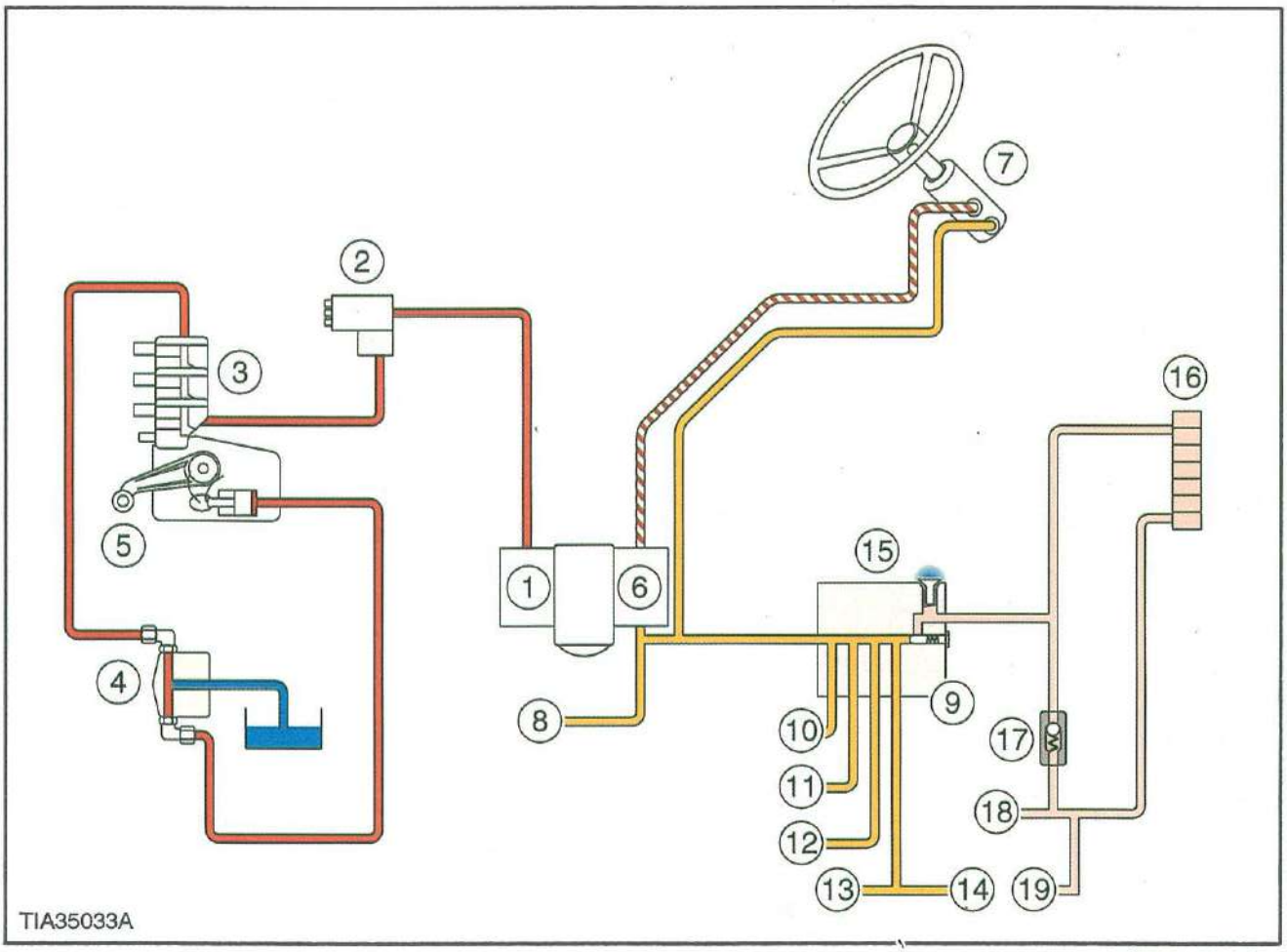


Figure 8-1-13

Hydraulic Schematic
Tractors with Open Center Gear Pump and Mechanical Transmission
(Not Used in North America)

High Pressure Circuit

Low Pressure Circuit

Return To Sump

Steering Circuit

Lubrication Circuit

1. High Pressure Circuit Gear Pump
2. Trailer Brake Valve
3. Open Center Remote Control Valves
4. Hydraulic Lift Control Valve and Lift Cylinder Safety Valve
5. Hydraulic Lift
6. Steering/Low Pressure Circuit Pump
7. Steering Motor
8. To Rear Axle Differential Lock – Disengage
9. Transmission Side Cover and Pressure Regulating Valve
10. To Power Take Off Brake
11. To Power Take Off Clutch
12. To Front Wheel Drive
13. To Rear Axle Differential Engagement
14. To Front Axle Differential Engagement
15. Lubrication Circuit Relief Valve
16. Oil Cooler
17. Oil Cooler By–pass Valve
18. To Pump Drive Gear, Lift Cross Shaft and PTO Lubrication
19. To Transmission Lubrication

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Closed Center High Pressure Hydraulic Circuit (Tractors with Closed Center Load Sensing Variable Flow Piston Pump)

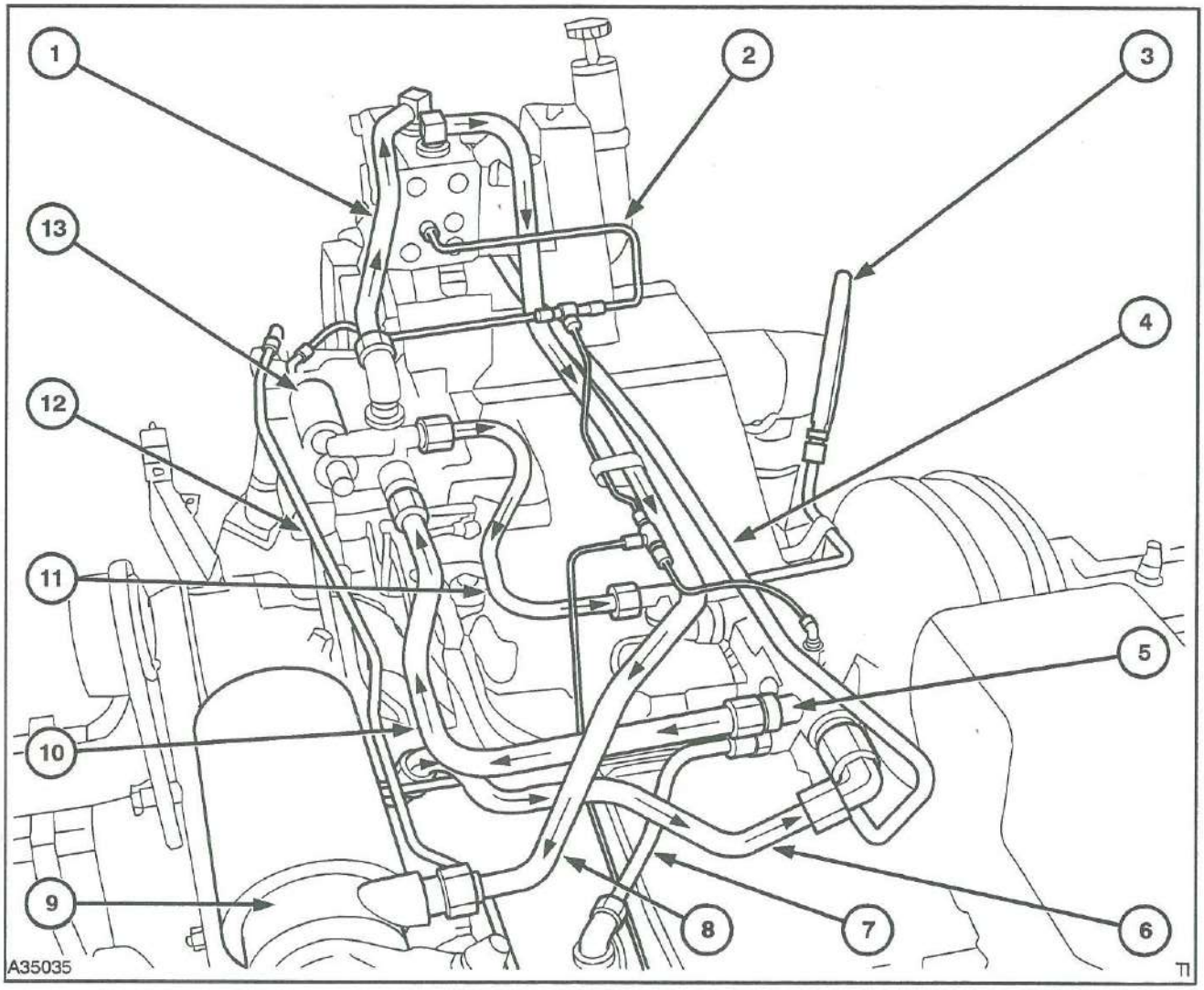


Figure 8-1-14

High Pressure Circuit Components and Pipework
Tractors with Variable Flow Piston Pump

1. To Remote Control Valves
2. Load Sense Lines To Hydraulic Pump
3. To Assist Rams (Where Fitted)
4. To Trailer Brake Connector
5. Trailer Brake Valve (Where Fitted)
6. Pump supply to Trailer Brake
7. Trailer Brake Return To Sump
8. Return From Remote Valves To Pump Intake Filter
9. Variable Flow Hydraulic Pump
10. To Remotes and Hydraulic Lift Control Valve
11. To Hydraulic Lift and Assist Ram (Where Fitted)
12. Pilot Pressure To Hydraulic Lift Control Valve
13. Hydraulic Lift Electronic Draft Control Valve

The principal of operation of the closed center load sensing high pressure hydraulic circuit with variable flow piston pump is to supply oil flow on demand and enable simultaneous operation of the trailer brakes hydraulic lift and remote control valve assemblies.

The load sensing variable flow piston pump offers significant benefits in reducing the engine power loss that occurs in open center systems where a high volume of oil, often far in excess of demand, is continuously pumped round the hydraulic circuit even when the the circuits are not being operated.

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The high pressure circuit is illustrated in Figure 8-1-21 and identifies The following components.

Hydraulic pump assembly (1) and load sensing valve (2) located on the right hand side of the transmission. The load sensing valve contains a pressure and flow compensating valve which controls pump output in accordance with circuit demand.

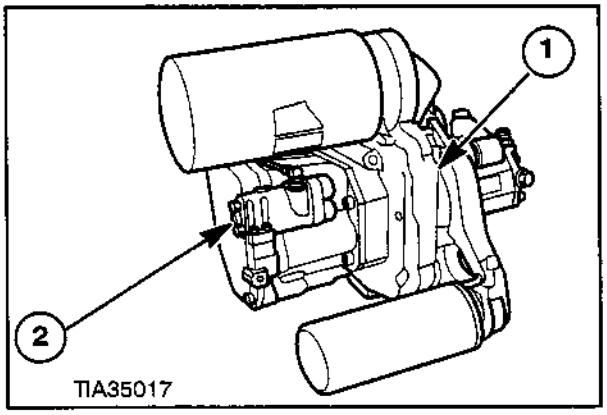


Figure 8-1-15

Trailer brake valve which is located beneath the cab just in front of the hydraulic lift cover. The valve diverts oil pressure to the trailer brakes whenever both tractor brake pedals are depressed.

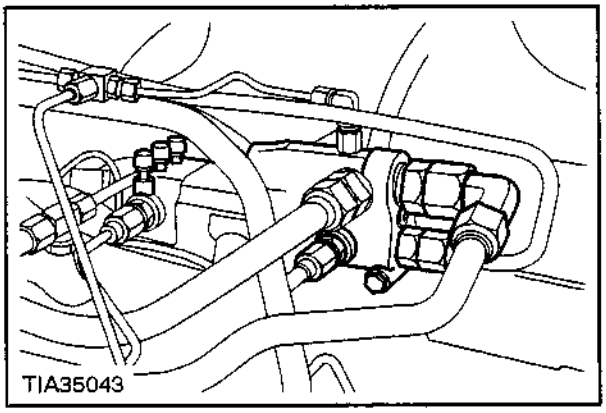


Figure 8-1-16

The lift cylinder safety valve (1) and electronic draft control valve (2) are located beneath the right hand rear corner of the cab.

The hydraulic lift control valve is a proportional solenoid operated valve controlled by a microprocessor to raise and lower the hydraulic lift.

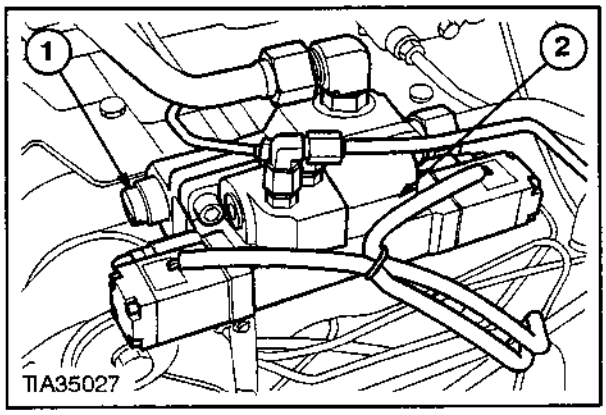


Figure 8-1-17

The lift cylinder safety valve protects the lift cylinder from shock loadings and limits the pressure in the cylinder to 3050–3100 lbf/in^2 (210–215 bar)

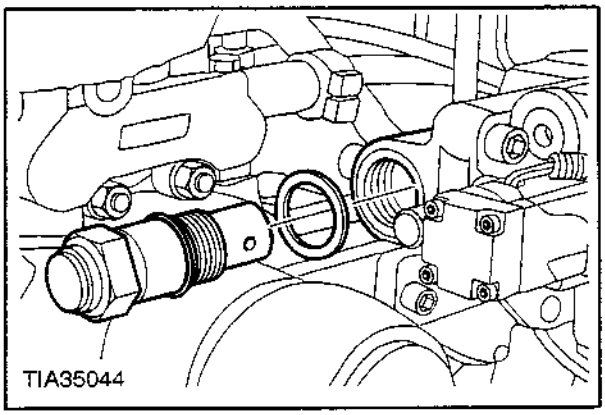


Figure 8-1-18

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The pressure regulating valve for all types of transmission is located in the transmission side cover and regulates the pressure in the low pressure circuit to 232–261 lbf/in^2 (16–18 bar).

On tractors installed with electronic draft control the low pressure circuit is used also to operate the electronic draft control valve spool.

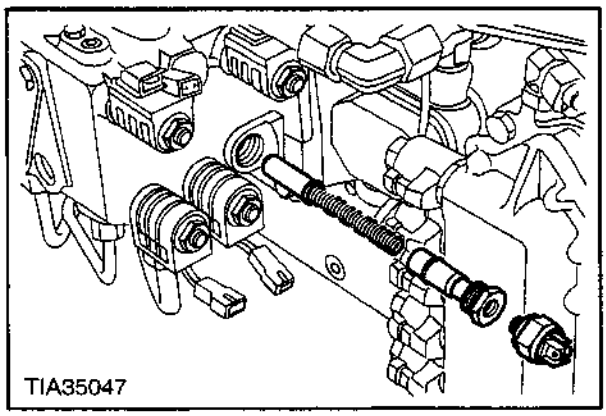


Figure 8-1-19

The closed center load sensing remote control valves are available as two or four valves per tractor.

For further details on the operation of the trailer brake valve, remote control valves and electronic draft control system refer to the appropriate Chapters in this section of the Repair Manual.

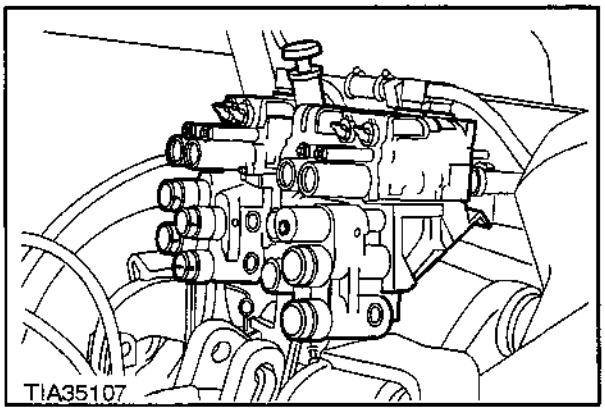


Figure 8-1-20

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With Reference to Figure 8-1-21

Operation of the closed center high pressure hydraulic circuit is as follows:–

The components in the high pressure hydraulic circuit are connected by their load sensing lines to the hydraulic load sensing valve which controls the output of the hydraulic pump.

When the trailer brakes, remote control valves or hydraulic lift is operated the load sensing valve on variable flow piston pump compares the pressure in the component load sense line with the output pressure of the hydraulic pump.

If pump output pressure is less than the combined pressure of the load sense line and spring in the flow control valve then pump output continues to increase. When circuit demand is satisfied pump pressure overcomes the combined pressure of the load sense line and flow compensating valve spring. This moves the spool in the flow compensating valve to the right allowing control pressure oil to be directed to the variable flow swash plate servo piston which de–strokes the pump to adjust output to circuit demand.

For a detailed explanation on the load sensing operating principle of the variable flow piston pump refer to Chapter 2 in this section of the Repair Manual.

Figure 8-1-21

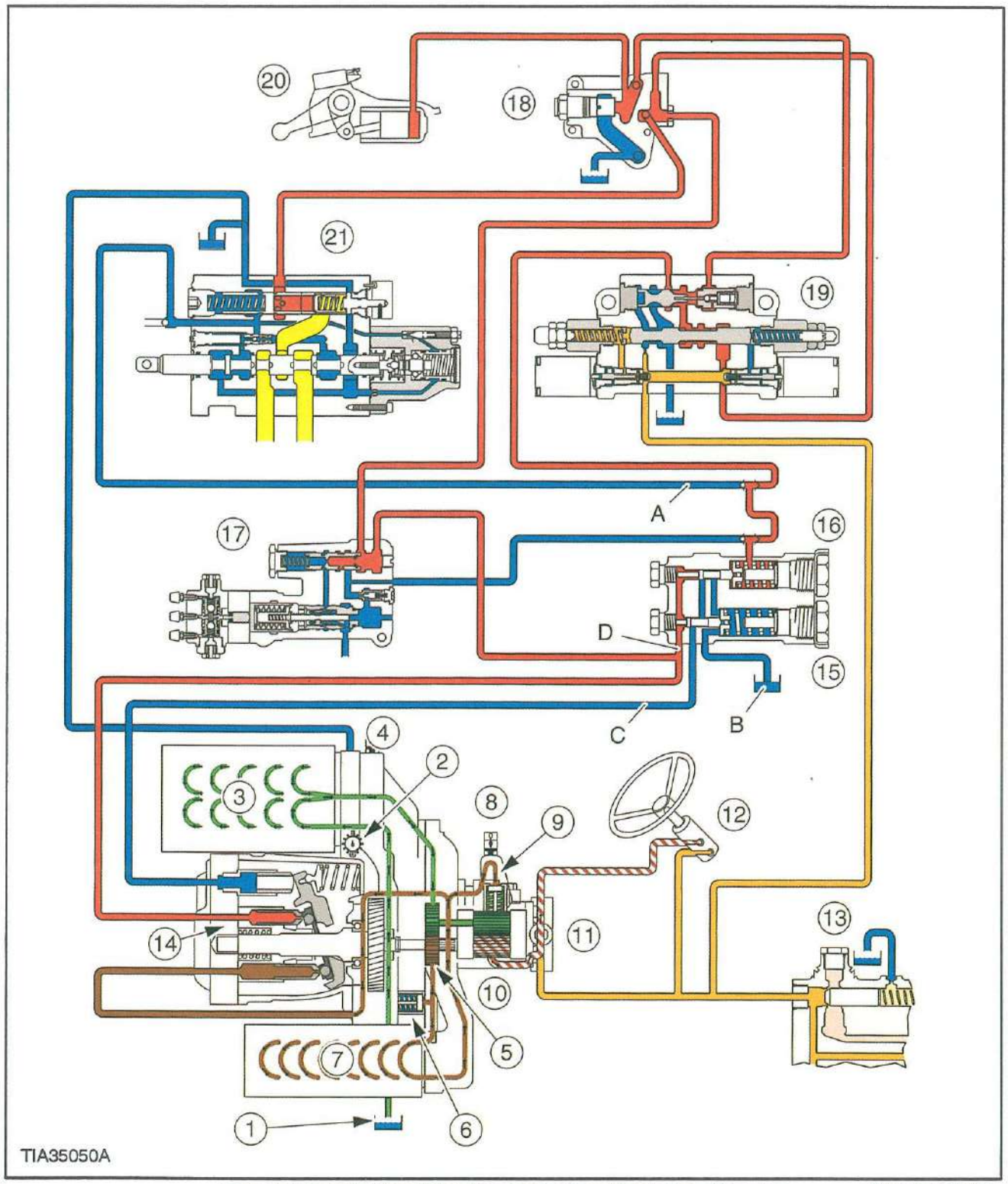
Control of Variable Flow Piston Pump with CCLS
when High Pressure Hydraulic Circuits are Operated (High Demand)

1. Pump Intake
2. Intake Filter Filter Low Temperature Switch
   (Prevents Intake Filter restriction Light Operating when Oil Temperature Below 104°F, 40°C)
3. Intake Filter
4. Intake Filter Restriction Switch
5. Charge Pump
6. Charge Pressure Filter Dump Valve
7. Charge Pressure Filter
8. Low Charge Pressure Switch
9. Charge Pressure By–Pass Valve
10. Steering and Low Pressure Circuit Pump
11. Steering Flow Control Valve
12. Steering Motor
13. Pressure Regulating Valve (Located In Transmission Side Cover)
14. Variable Flow Piston Pump
15. Pressure Compensating Valve
16. Flow Compensating Valve
17. Trailer Brake Valve (Where Fitted)
18. Manifold and Lift Cylinder Safety Valve
19. Electronic Draft Control Valve
20. Hydraulic Lift
21. Closed Center Remote Control Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves

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Control of Variable Flow Piston Pump with Closed Center Load Sensing When High Pressure Hydraulic Circuits are Operated (High Demand)

Figure 8-1-21

- Steering System Oil
- System Pressure Oil
- Low Pressure Circuit Oil 232–261 lbf/in^2 (16–18 bar)
- Charge Pressure Oil 23–50 lbf/in^2 (1.6–3.4 bar)
- Return to Reservoir Oil
- Trapped Oil
- Suction Oil
- Lubrication Circuit

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Open Center High Pressure Hydraulic Circuits
NOTE: NOT USED IN NORTH AMERICA

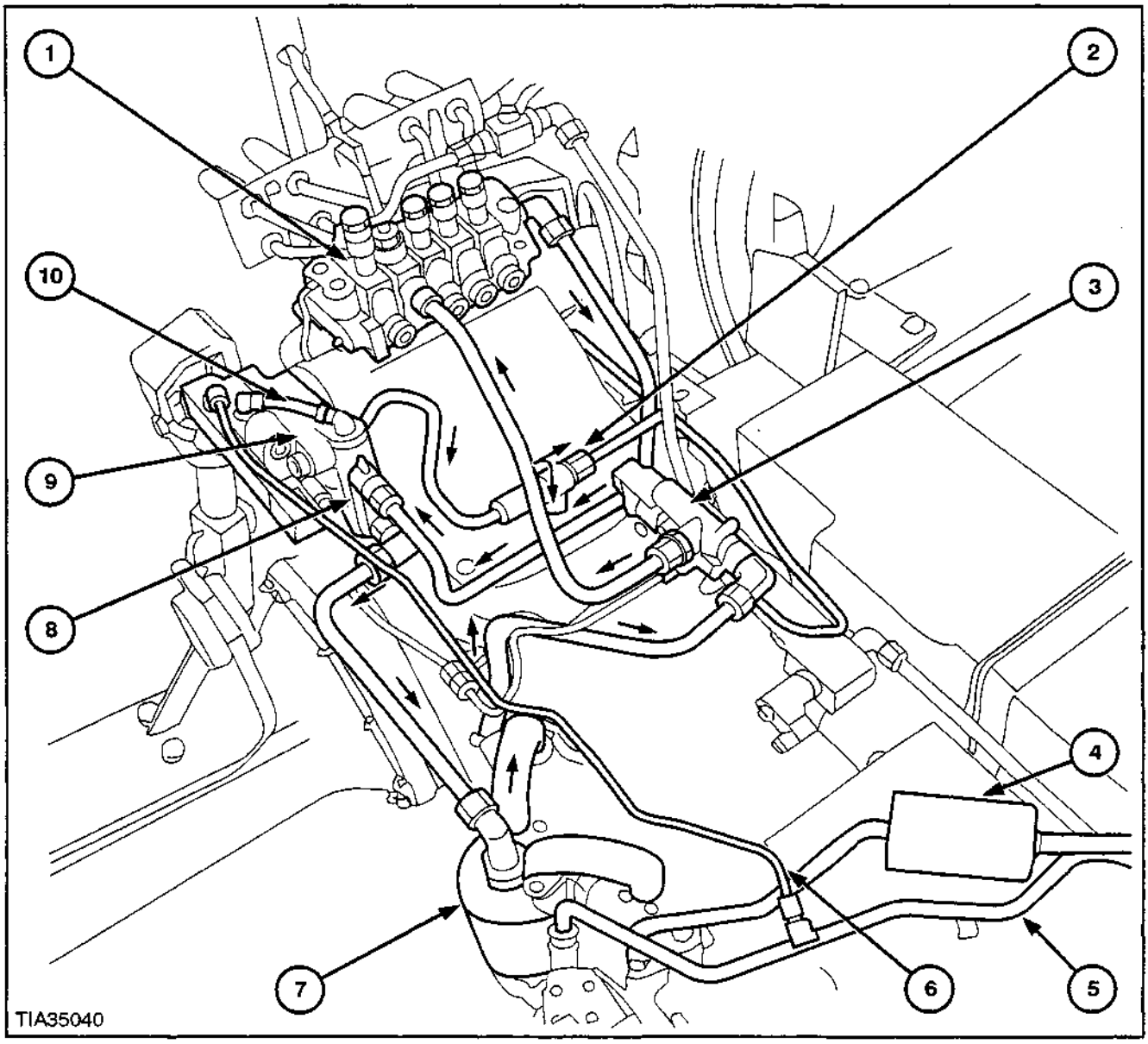


Figure 8-1-22

High Pressure Circuit Components and Pipework
Tractors with Electronic Draft Control and Open Center Gear Type Hydraulic Pump

1. Open Center Remote Control Valves with Flow Divider
2. To Hydraulic Lift and Assist Ram (Where Fitted)
3. Trailer Brake Valve
4. To Steering Motor (Steering Circuit)
5. Steering Motor Return (Low Pressure Circuit)
6. Pilot Pressure To Hydraulic Lift Control Valve
7. Open Center Gear Type Hydraulic Pump
8. Unload Valve
9. Hydraulic Lift Electronic Draft Control Valve
10. Load Sense Line To Unload Valve

The open center high pressure hydraulic system is available with either the electronic draft control or mechanically controlled hydraulic lift assembly.

On open center high pressure hydraulic systems all components are connected in series and pump flow is continually circulated through the hydraulic system even when the circuits are not being operated.

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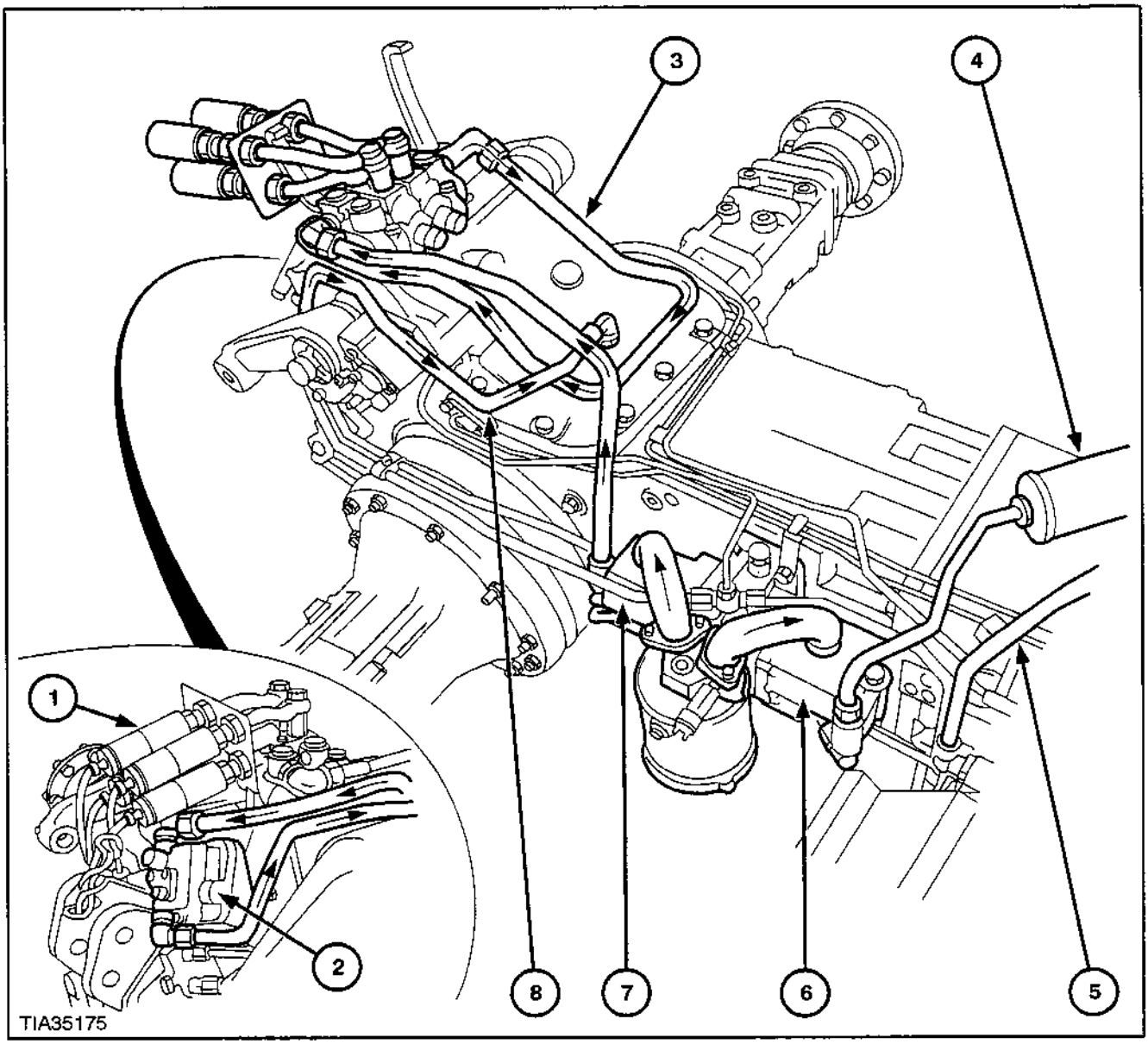


Figure 8-1-23

High Pressure Circuit Components and Pipework
Tractors with Mechanical Hydraulic Lift and Open Center Gear Type Hydraulic Pump
(Not Used in North America)

1. Open Center Remote Control Valves
2. Unload Valve
3. From Remotes to Unload Valve
4. To Steering Motor (Steering Circuit)
5. Steering Motor Return to Low Pressure Circuit
6. Steering and Low Pressure Circuit Pump
7. High Pressure Circuit Gear Pump
8. To Hydraulic Lift and Assist Ram (Where Fitted)

The priority of operation is given to the order of components in the circuits, that is trailer brakes, remote valves then hydraulic lift. This means for example when fully operating a remote valve the hydraulic lift will not operate at the same time.

The exception to this is when open center remotes are installed with a flow divider, refer to Figure 8-1-22 and Figure 8-1-32, in which case 8.4–37 qt (8–35 liter) of oil flow can be diverted to remote valve number one with the remaining flow available for operation of another remote valve or hydraulic lift.

The open center high pressure hydraulic circuits for tractors installed with either the electronic draft control or mechanically controlled hydraulic lift are shown in Figures 8-1-32 and 8-1-33 and include the components shown on the following pages.

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Open center hydraulic pump assembly comprising of the high pressure gear pump (1) and low pressure gear pump (2).

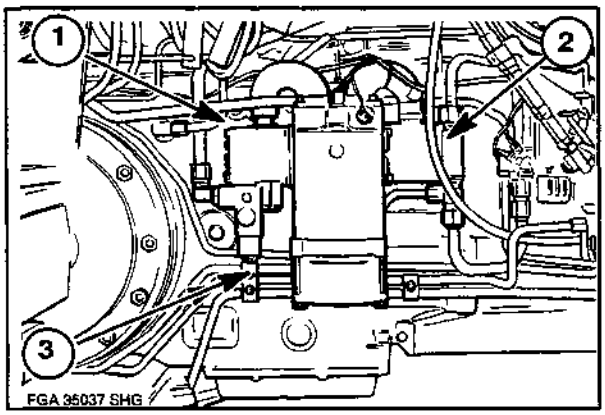


Figure 8-1-24

High pressure circuit relief valve (3) located at the base of the pump diverts pump flow to sump if the system pressure reaches 2760 lbf/in^2 (190 bar).

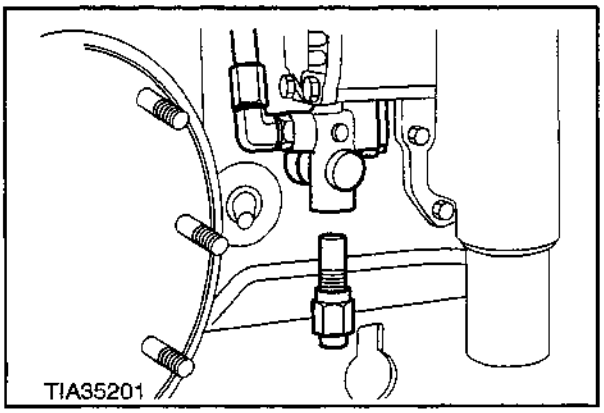


Figure 8-1-25

The trailer brake valve is located beneath the cab on the left hand side of the tractor. The valve diverts oil pressure to the trailer brakes whenever the right hand tractor brake pedals is depressed. This is unlike the valve installed on the closed center system where both pedals have to be depressed in order for the valve to operate.

The trailer brake has absolute priority over other services in the circuit.

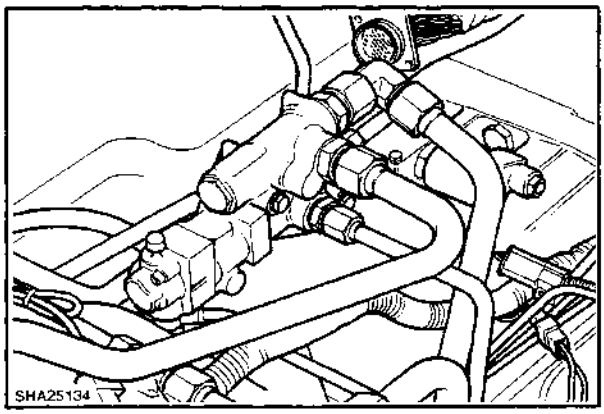


Figure 8-1-26

The open center remote valves are available as two three or four valves per tractor.

The valves can be double–acting with float and kick out.

Double acting convertible to single–acting with float.

Double acting convertible to single–acting.

When four remote valves are installed the optional flow divider valve (1) is available enabling simultaneous operation of remote valve No 1 with another remote valve or hydraulic lift.

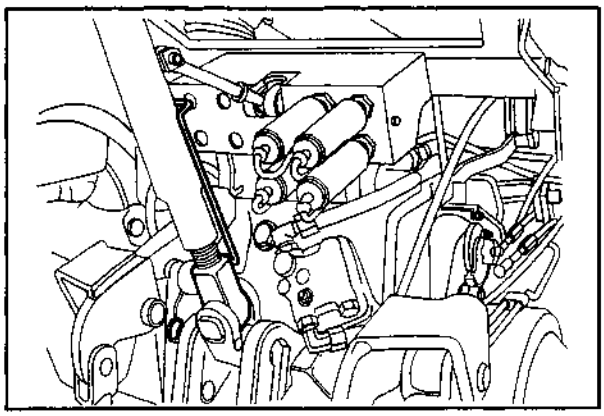


Figure 8-1-27

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The hydraulic lift control valve (1) used on tractors with electronic draft control system is located beneath the right hand rear corner of the cab. The unload valve (2) is located in the manifold onto which the electronic draft control valve is located.

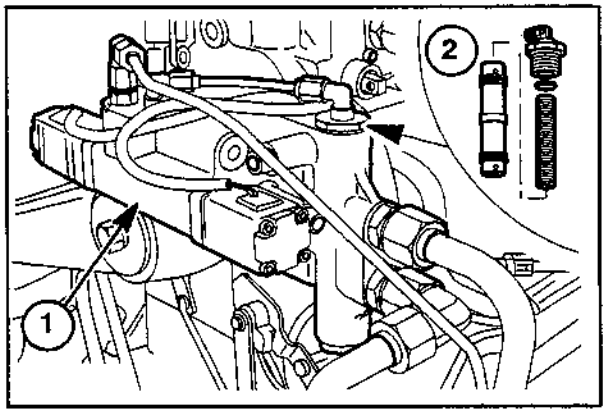


Figure 8-1-28

On tractors installed with the gear type pump the electronic draft control valve is a 'Closed Center' load sensing valve operating in an 'Open Center' system and the unload valve is required to return pump flow to sump when flow exceeds hydraulic circuit demand.

On tractors with electronic draft control the lift cylinder safety valve is located in the manifold at the rear electronic draft control valve. This safety valve protects the lift cylinder from shock loadings and limits pressure in the cylinder to 3050–3100 lbf/in^2 (210–215 bar)

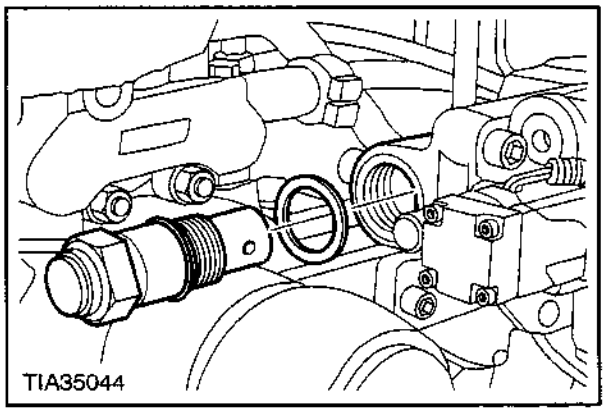


Figure 8-1-29

On tractors with mechanical hydraulic lift the lift cylinder control valve assembly is located at the rear of the hydraulic lift assembly. The lift cylinder safety valve is mounted on the rear face of the control valve which must be removed to obtain access.

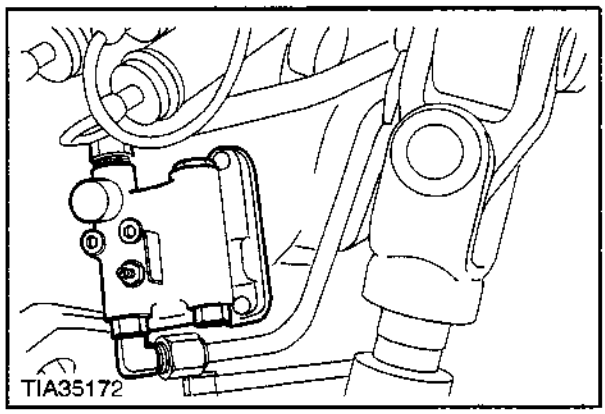


Figure 8-1-30

The pressure regulating valve is located in the transmission side cover and regulates the pressure in the low pressure circuit to 232–261 lbf/in^2 (16–18 bar).

On tractors with electronic draft control the low pressure circuit is used to supply hydraulic pressure for operating the control valve spool.

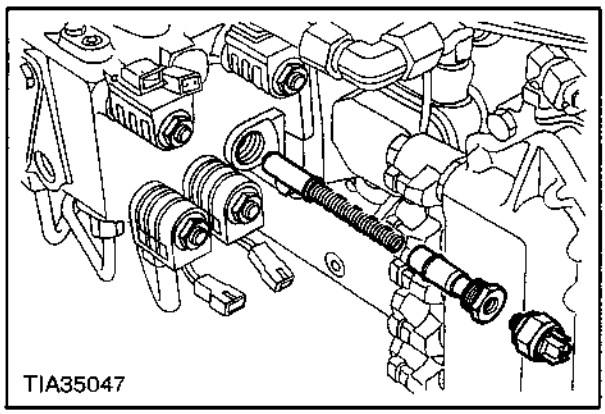


Figure 8-1-31

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High Pressure Hydraulic Circuit for Tractors with Open Center Hydraulics and Electronic Draft Control Hydraulic Lift (Not Used in North America)

With reference to Figure 8-1-32

Both the high and low pressure pumps are driven by a 'live' drive gear train directly connected to the PTO clutch input drive shaft and driven by the engine flywheel.

Oil is drawn through a common intake port and filter to the high and steering/low pressure pump assemblies.

The high pressure pump supplies constant oil flow, according to engine speed, through the trailer brake and open center remote valves and returns to the hydraulic lift unload valve.

If the hydraulic lift is not operating the unload valve diverts the return flow oil to the inlet filter at the hydraulic pump.

When the hydraulic lift is operated a load sense signal from the electronic draft control valve is applied to the end of the unload valve. The load sense pressure and internal spring pressure of the unload valve causes the valve spool to move and restrict the flow of oil returning to the pump inlet filter. The flow of oil is now diverted to the electronic draft control valve allowing operation of the hydraulic lift.

The pilot pressure for operation of the electronic draft control valve spool is provided at 232–261 lbf/in^2 (16–18 bar) from the low pressure hydraulic circuit.

Should the pressure in the high pressure circuit exceed 2760 lbf/in^2 (190 bar) the pressure relief valve located at the pump outlet port operates allowing oil to bleed to sump (rear axle) controlling the maximum pressure in the system.

The lift cylinder safety relief valve protects the lift cylinder and seals from excessive peaks of pressure during operation. If the pressure in the lift cylinder exceeds 3050–3100 lbf/in^2 (210–215 bar) the valve opens and 'bleeds' oil in the cylinder to sump.

For details on the operation of the trailer brake valve , remote control valve and electronic draft control hydraulic lift assembly refer to the appropriate Chapters in Section 8 of of this manual which covers the operation and overhaul of these components.

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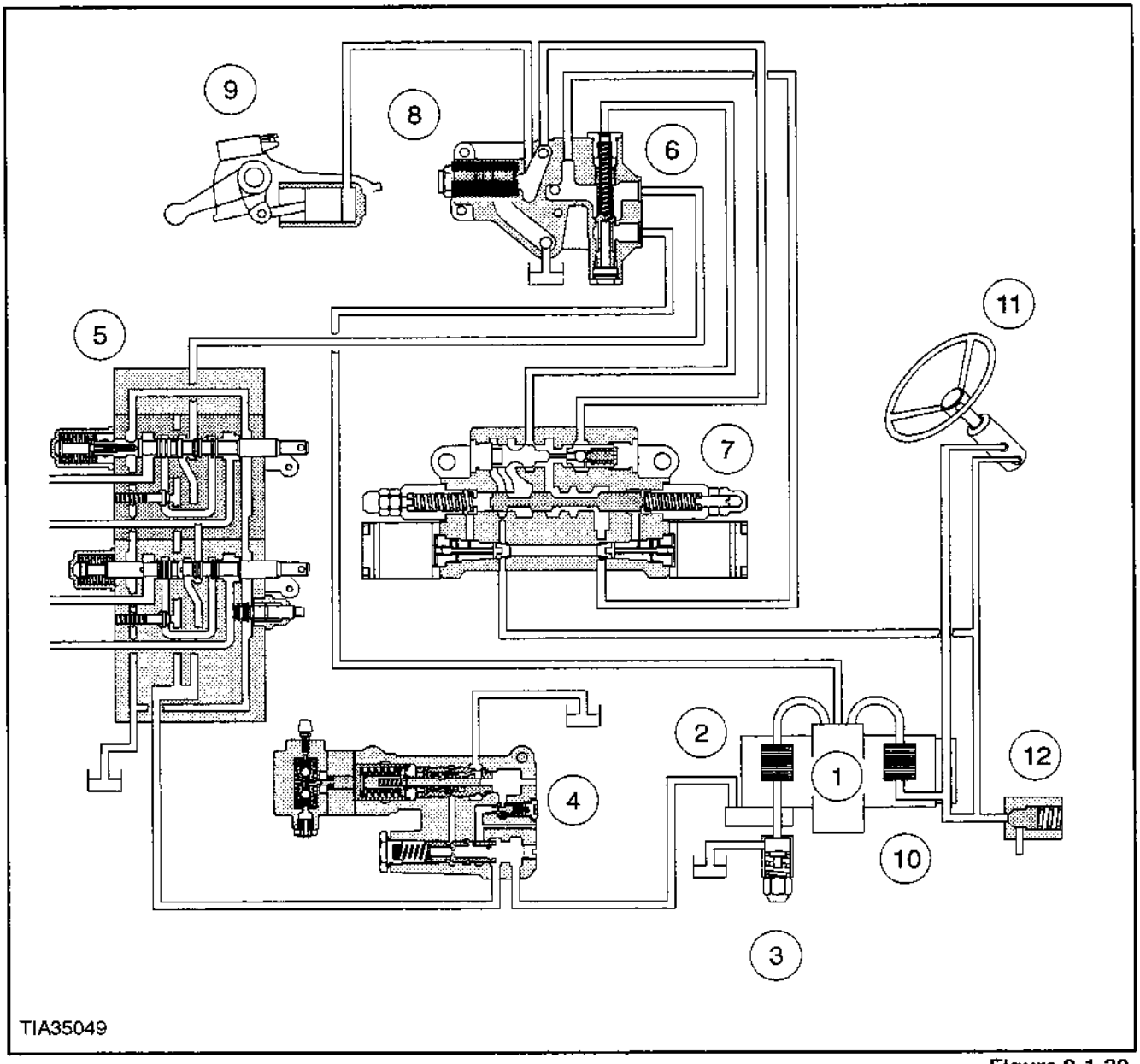


Figure 8-1-32

Open Center High Pressure Hydraulic Circuit Operation
Tractors With Electronic Draft Control Hydraulic Lift
Hydraulic Lift Operating
(Not Used in North America)

Steering System Oil	System Pressure Oil	Trapped Oil
Low Pressure Circuit Oil 230–261 lbf/in^2 (16–18 bar)	Return to Reservoir Oil	Lubrication Oil
Suction Oil		

1. Intake Filter
2. High Pressure Circuit Gear Pump
3. Pressure Relief Valve
4. Trailer Brake Valve
5. Open Center Remote Valves with Flow Divider
6. Unload Vale
7. Electronic Draft Control Valve
8. Lift Cylinder Safety Valve
9. Hydraulic Lift
10. Steering and Low Pressure Circuit Gear Pump
11. Steering Motor
12. Low Pressure Circuit Pressure Regulating Valve

NOTE: Flow divider is available with 4 remote valves only. Diagram only shows two remote valves for clarity.

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High Pressure Circuit for Tractors with Open Center Hydraulics and Mechanical Hydraulic Lift (Not Used in North America)

With Reference to Figure 8-1-33.

The gear type pumps installed on tractors with the mechanical hydraulic lift assembly is the same as that installed on open center systems and electronic draft control hydraulic lift.

Oil is drawn through the common intake port and filter to both the high and steering/low pressure pump assemblies.

The high pressure pump supplies constant oil flow according to engine speed, through the trailer brake and open center remotes.

Oil after passing through the remotes, enters the hydraulic lift control valve located at the rear of the lift assembly which controls the raising and lowering of the lift.

Also located within the assembly is the lift cylinder safety valve which protect the lift cylinder and seals from excessive peaks of pressure during operation.

Unlike tractors with the open center pump and electronic draft control, the system does not contain a pilot operated unload valve to divert pump flow in excess of hydraulic circuit demand back to the inlet filter of the pump. On this system excess oil flow is returned direct to the rear axle through the control valve spool located in the hydraulic lift control valve assembly.

For further details on operation of the mechanical hydraulic lift assembly, trailer brake valve and open center remotes refer to the appropriate Chapters in this Section of the Repair Manual.

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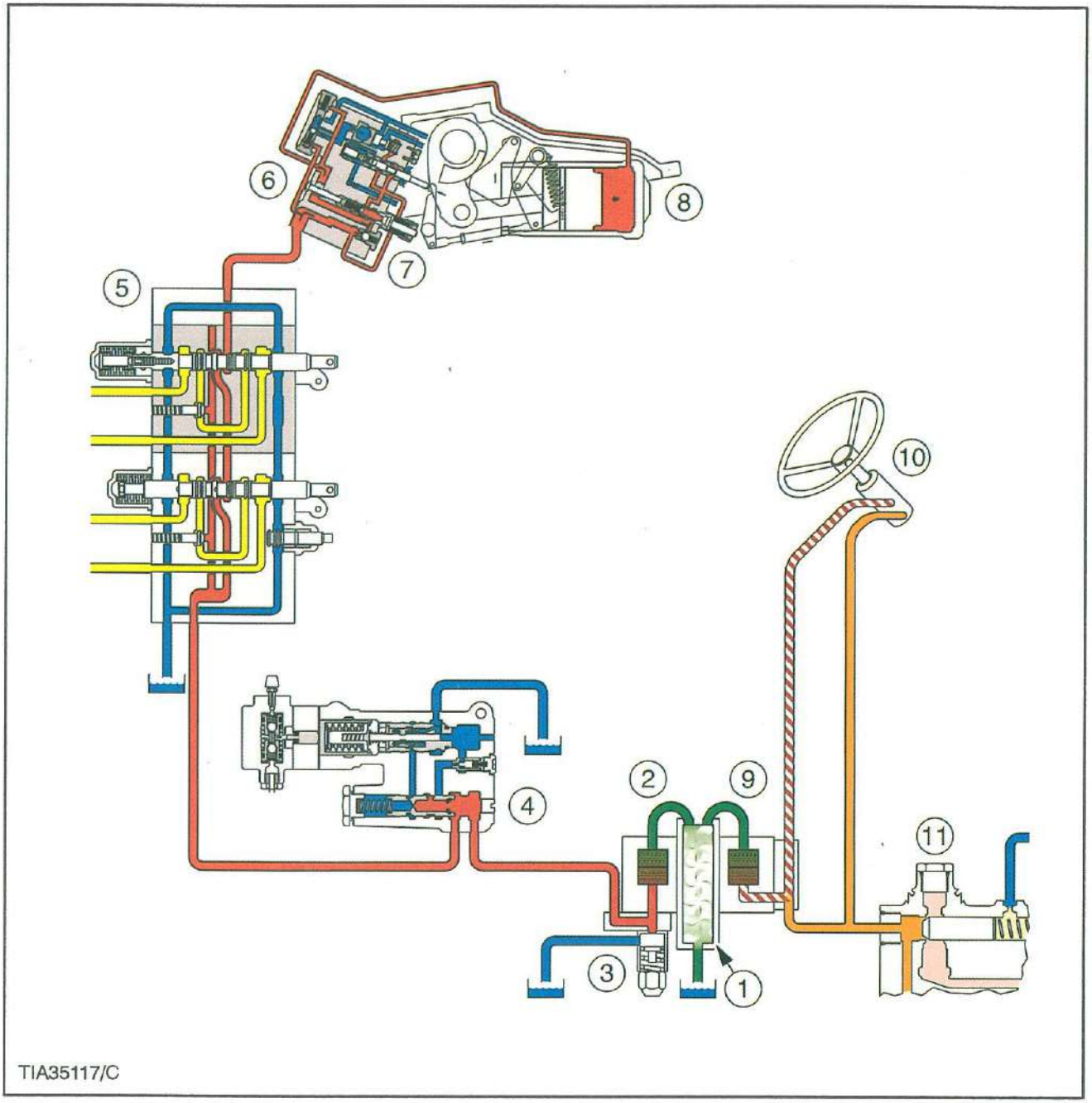


Figure 8-1-33

Open Center High Pressure Hydraulic Circuit Operation
Tractors With Mechanical Hydraulic Lift
Hydraulic Lift Operating
(Not Used in North America)

- Steering System Oil
- System Pressure Oil
- Trapped Oil
- Low Pressure Circuit Oil 230–261 lbf/in^2 (16–18 bar)
- Return to Reservoir Oil
- Lubrication Oil
- Suction Oil

1. Intake Filter
2. High Pressure Circuit Gear Pump
3. Pressure Relief Valve
4. Trailer Brake Valve
5. Open Center Remote Control Valves
6. Lift Control Valve
7. Lift Cylinder Safety Valve
8. Mechanical Hydraulic Lift Assembly
9. Steering and Low Pressure Circuit Gear Pump
10. Steering Motor
11. Low Pressure Circuit Pressure Regulating Valve

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Low Pressure Circuit Operation
Tractors with Semi Powershift Transmission

Oil is drawn through the steering and low pressure circuit pump (1) to the steering flow control valve (2) which ensures 6.6 US. Galls/min (5.5 imp Galls, 25 Ltrs/min) is constantly supplied to the steering motor before returning to merge with the remaining flow from the steering and low pressure circuit pump.

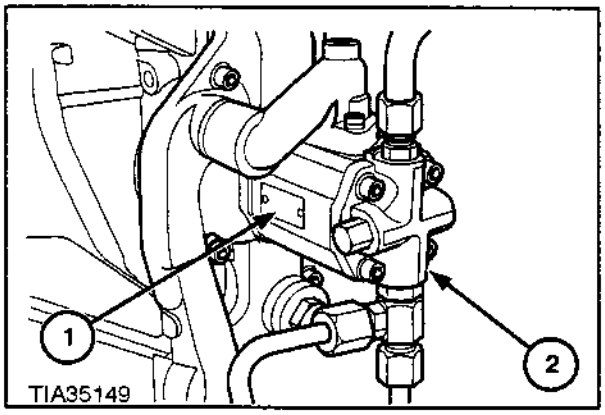


Figure 8-1-34

The low pressure regulating valve in the transmission side cover limits the pressure in this circuit to 230–261 lbf/in^2 (16–18 bar) and the excess flow passes into to the lubrication circuit.

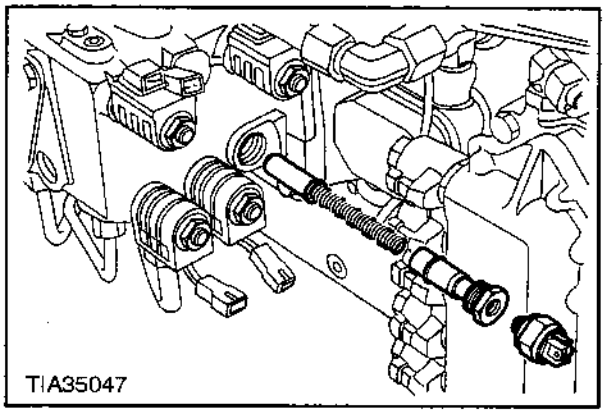


Figure 8-1-35

The transmission side cover contains solenoids for engagement of the transmission range synchronizers, operation of the differential lock, PTO clutch and brake and disengagement of the front wheel drive.

NOTE: The front wheel drive is spring applied and the solenoid is energized whenever disengagement of the drive is required.

Solenoid Function

1. Reverse Synchronizer
2. High Range Synchronizer
3. PTO Engagement
4. Differential Lock
5. Low Range Synchronizer
6. Medium Range Synchronizer
7. Front Wheel Drive
8. PTO Brake

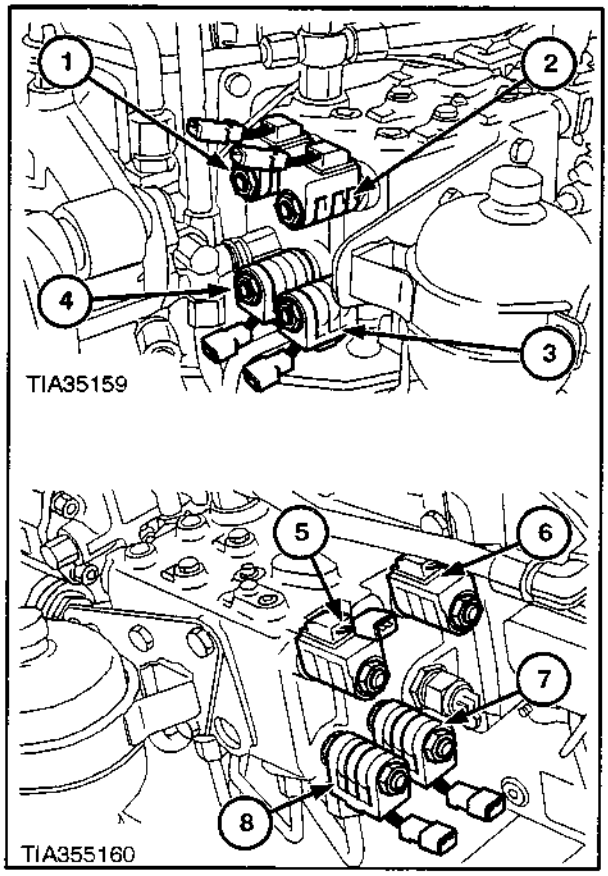


Figure 8-1-36

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The pulse width modulated (PWM) solenoid valves in the clutch oil distribution cover bolted onto the side of the transmission are used to progressively engage/disengage the transmission clutches.

PWM Solenoid Valve Function

1. A Clutch
2. B Clutch
3. C Clutch
4. D Clutch
5. E Clutch

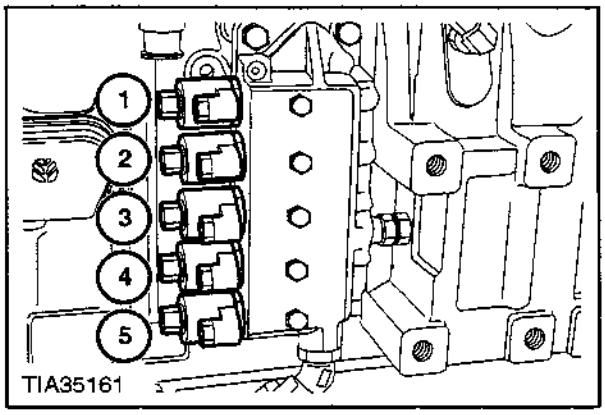


Figure 8-1-37

Low pressure circuit oil is directed through the oil cooler at the front of the tractor and is limited to a maximum pressure of 100 lbf/in^2 (7 bar) by the lubrication valve located in the front of the transmission. Components lubricated by this oil are transmission shafts and clutches, hydraulic pump drive gear, hydraulic lift cross shaft and PTO clutch lubrication.

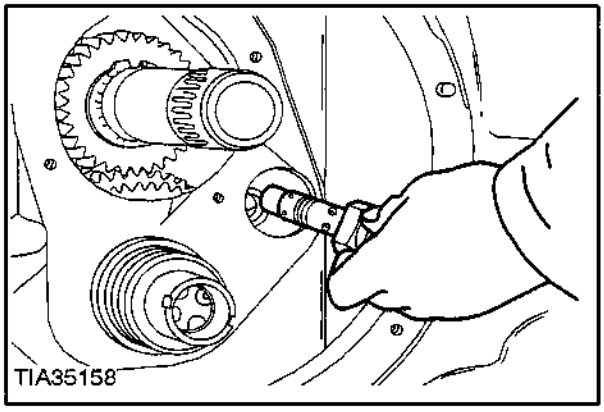


Figure 8-1-38

When the oil is cold and pressure differential across the oil cooler is higher than 50 lbf/in^2 (3.5 bar) the cooler by–pass valve located in the side cover will operate to ensure that adequate flow to the lubrication circuit is maintained. This feature of diverting oil from the cooler assists in aiding a rapid warm up of oil in cold weather conditions.

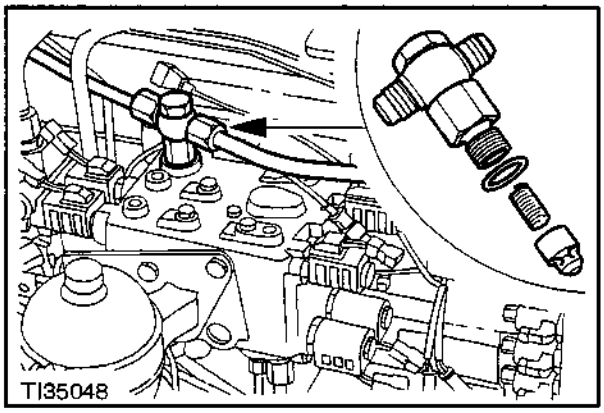


Figure 8-1-39

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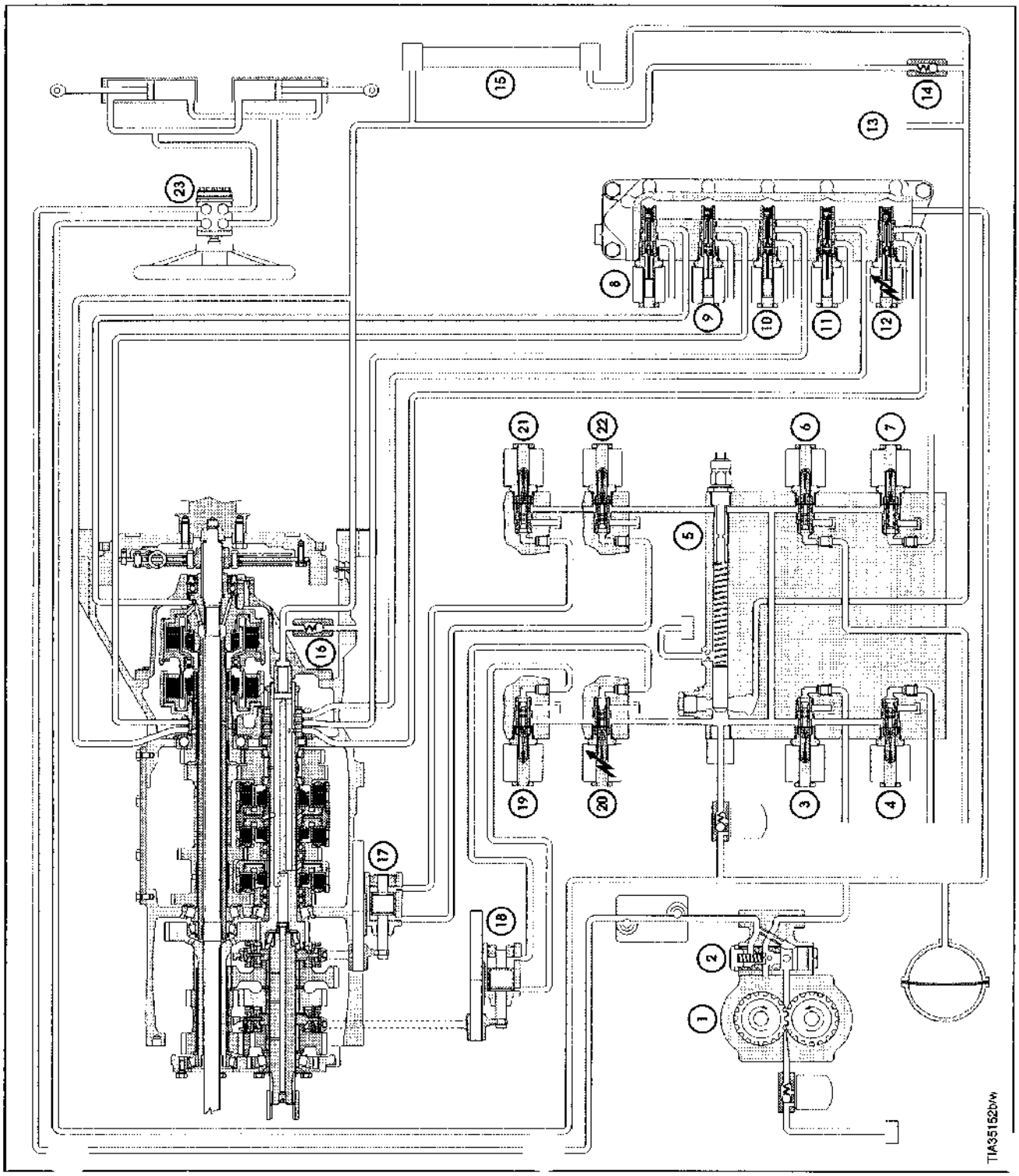


Figure 8-1-40

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Steering, Low Pressure and Lubrication Circuit
Tractors with Semi Powershift Transmission

Steering System Oil

Lubrication Circuit Oil

Low Pressure Circuit Oil
@ 16–18 bar (230–261 lbf/in^2)

Return to Reservoir Oil

Suction Oil

1. Steering and Low Pressure Circuit Pump
2. Steering Flow Control Valve
3. Differential Lock
4. PTO Engagement Solenoid
5. Low Pressure Regulating Valve
6. Differential Lock Solenoid
7. Front Wheel Drive Solenoid
8. A Clutch PWM Valve
9. B Clutch PWM Valve
10. C Clutch PWM Valve
11. D Clutch PWM Valve
12. E Clutch PWM Valve
13. Oil Cooler By–Pass Valve
14. Oil Cooler
15. Lubrication To Pump Drive Gear, PTO and Lift Cross Shaft
16. Lubrication Circuit Relief Valve
17. Actuator–Low and High Range Synchronizer
18. Actuator–Medium and Reverse Range Synchronizer
19. Reverse Range Solenoid Valve
20. Medium Range Solenoid Valve
21. Low Range Solenoid Valve
22. High Range Solenoid Valve
23. Steering Motor

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Low Pressure Circuit Operation
Tractors with HI/LO Transmission

Oil is drawn through the steering and low pressure circuit pump (1) to the steering flow control valve (2) which ensures 6.6 US. Galls/min (5.5 imp Galls, 25 Ltrs/min) is constantly supplied to the steering motor.

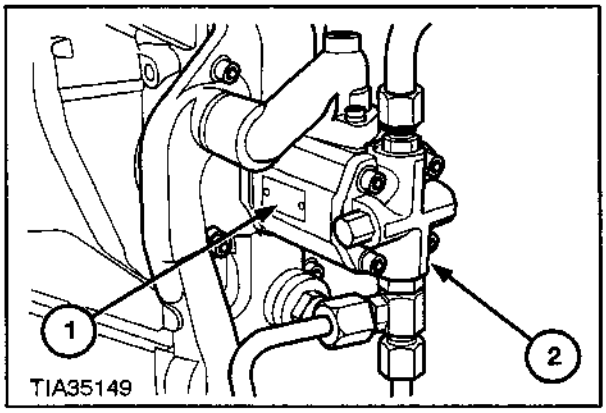


Figure 8-1-41

Oil returning from the steering motor joins with the pump flow from the non priority side of the flow control valve and is supplied to the transmission low pressure and lubrication circuit.

The low pressure regulating valve in the transmission side cover limits the pressure in this circuit to 230–261 lbf/in^2 (16–18 bar) and the excess flow passes into the lubrication circuit.

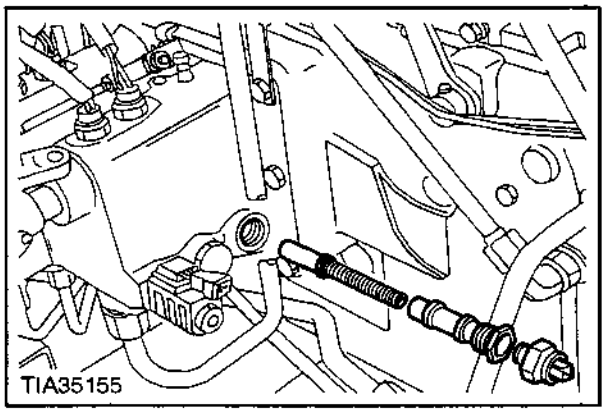


Figure 8-1-42

The solenoids in the side cover with, the exception of the dump solenoid, are energized to divert flow and engage the differential lock, PTO clutch and brake and disengage front wheel drive.

NOTE: The front wheel drive is spring applied and the solenoid is energized whenever disengagement of the drive is required.

Solenoid Function

1. Differential Lock
2. PTO Clutch
3. PTO Brake
4. Front Wheel Drive
5. Transmission Clutch Dump Solenoid

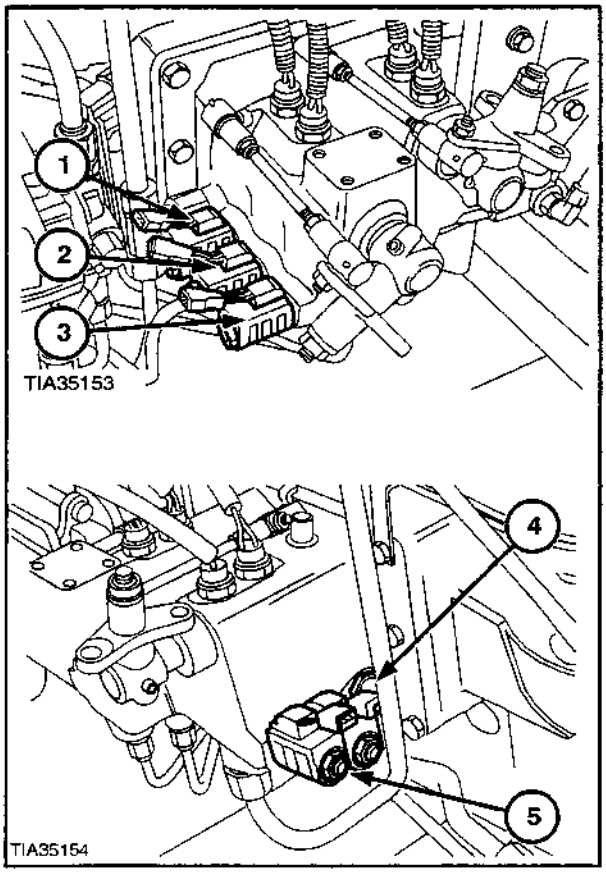


Figure 8-1-43

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The pulse width modulated solenoids in the transmission top cover are used to progressively engage/disengage the transmission forward/ reverse synchronizer and A and B clutches.

Solenoid Function

1. Reverse Synchronizer
2. Forward Synchronizer
3. 'A' Clutch
4. 'B' Clutch

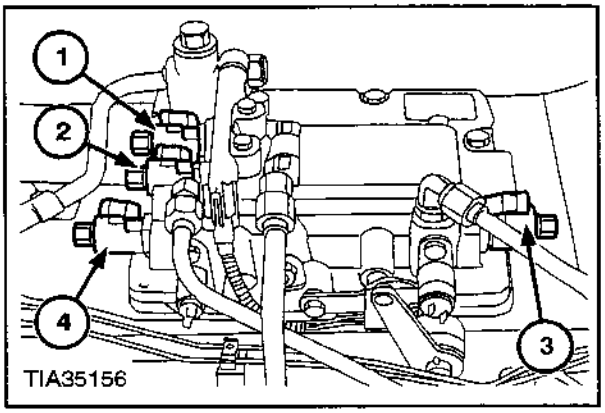


Figure 8-1-44

The dump solenoid in the transmission side cover is a safety solenoid controlled by the pressure switches in the A and B clutch circuits. In the unlikely event that both these clutches are pressurized at the same time the dump solenoid is energized allowing pressure in the circuit to be diverted to sump preventing 'lock up' of the transmission.

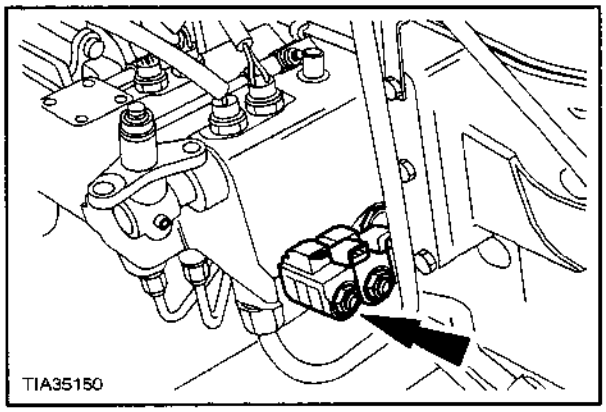


Figure 8-1-45

Low pressure circuit oil is directed through the oil cooler at the front of the tractor and limited to a maximum pressure of 100 lbf/in^2 (7 bar) by the lubrication valve located in the front of the transmission. Components lubricated by this oil are transmission clutches and shafts, hydraulic pump drive gear, hydraulic lift cross shaft and PTO clutch lubrication.

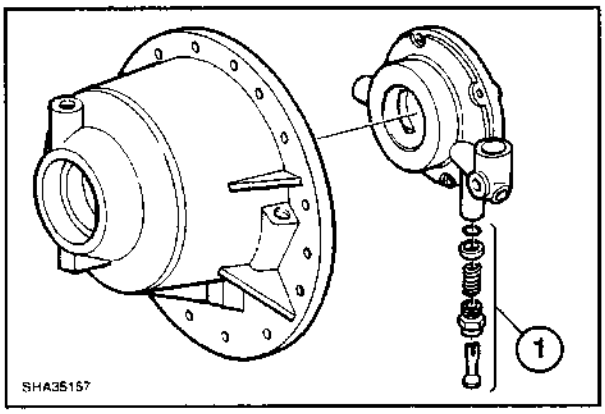


Figure 8-1-46

When the oil is cold and pressure differential across the oil cooler is higher than 50 lbf/in^2 (3.5 bar) the cooler by–pass valve located in the pipework running along the side of the transmission will operate to ensure that an adequate oil flow to the lubrication circuit is maintained. This feature of diverting oil from the cooler assists in aiding a rapid warm up of oil in cold weather conditions.

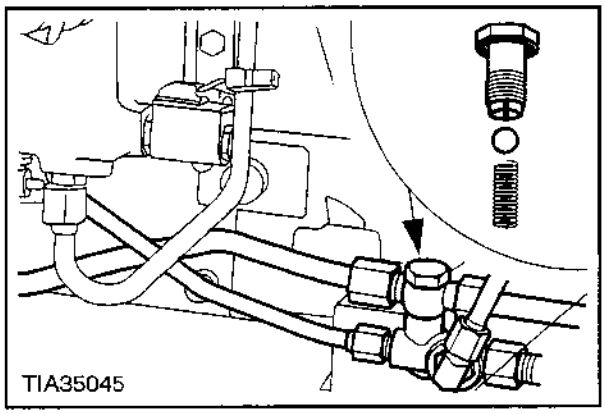


Figure 8-1-47

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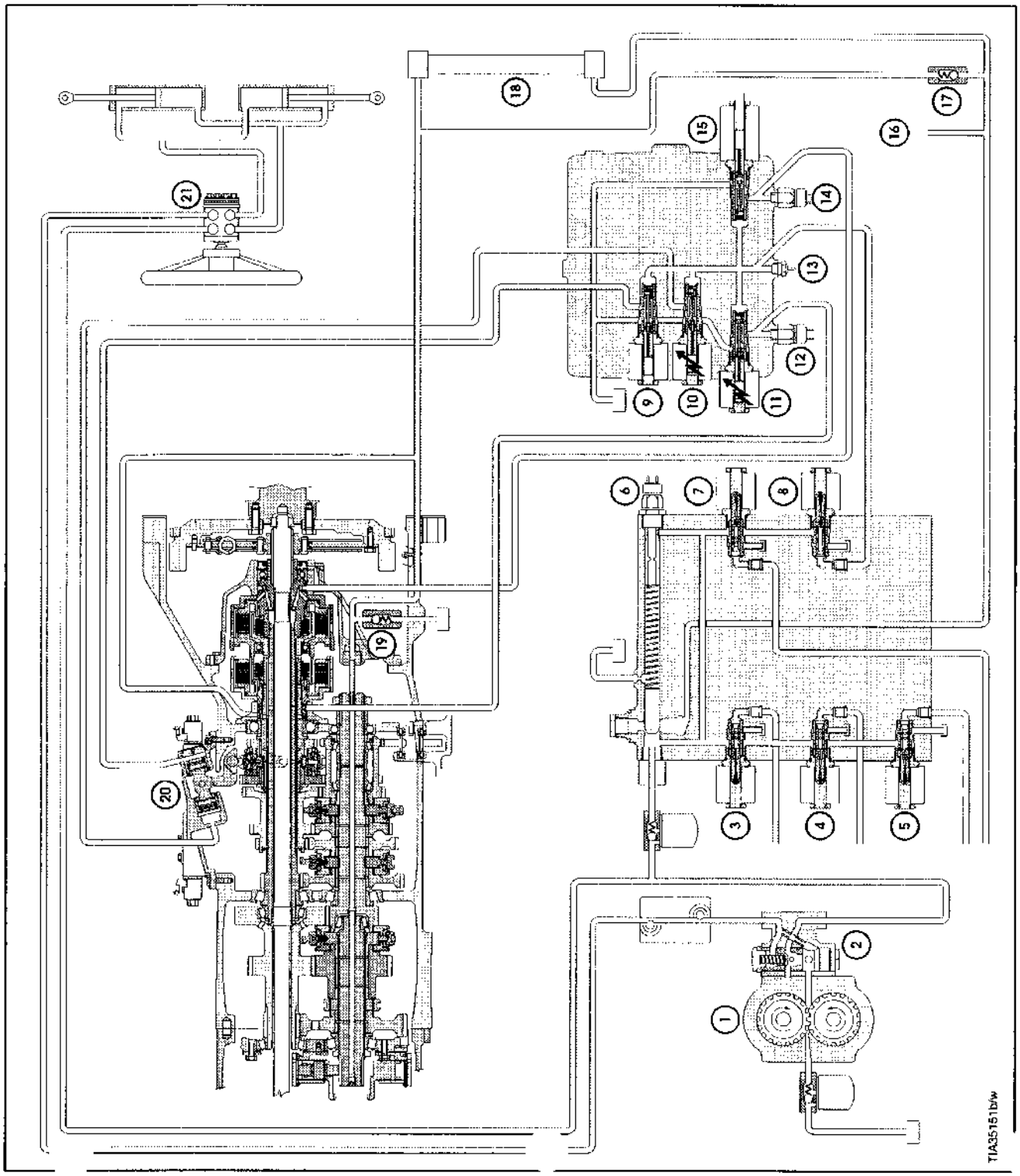


Figure 8-1-48

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Steering, Low Pressure and Lubrication Circuit
Tractors with Hi/Lo Transmission

Steering System Oil

Lubrication Circuit Oil

Low Pressure Circuit Oil
@ 16–18 bar (230–261 lbf/in^2)

Return to Reservoir Oil

Suction Oil

1. Steering and Low Pressure Circuit Pump
2. Steering Flow Control Valve
3. Differential Lock
4. PTO Engagement Solenoid
5. PTO Brake
6. Low Pressure Regulating Valve
7. Front Wheel Drive Solenoid
8. Transmission Clutch Dump Solenoid
9. Reverse Clutch PWM Valve
10. Forward Clutch PWM Valve
11. B Clutch PWM Valve
12. B Clutch Pressure Switch
13. Transmission Low Temperature Switch
14. A Clutch Pressure Switch
15. A Clutch PWM Valve
16. Oil Cooler By–Pass Valve
17. Oil Cooler
18. Lubrication To Pump Drive Gear, PTO and Lift Cross Shaft
19. Lubrication Circuit Relief Valve
20. Actuator–Forward and Reverse Synchronizer
21. Steering Motor

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Low Pressure Circuit Operation
Tractors with Mechanical Transmission
NOTE: NOT USED IN NORTH AMERICA

With Reference to Figure 8-1-54.

Oil is drawn through the steering and low pressure circuit pump (1) to the steering flow control valve (2) which ensures 6.6 US. Galls/min (5.5 imp Galls, 25 Ltrs/min) is constantly supplied to the steering motor.

Oil returning from the steering motor joins with the pump flow through the non priority side of the flow control valve and is supplied to the transmission low pressure and lubrication circuit.

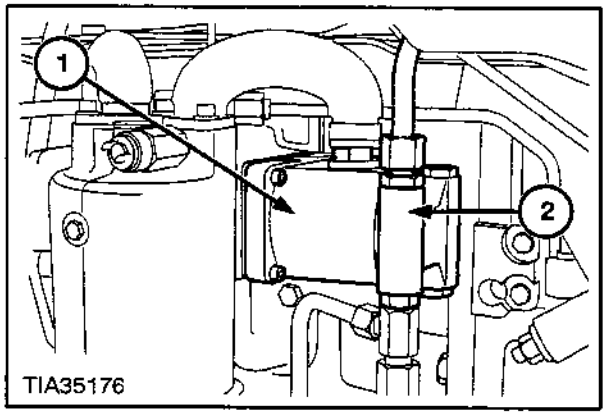


Figure 8-1-49

The low pressure regulating valve in the transmission side cover limits the pressure in this circuit to 230–261 lbf/in^2 (16–18 bar) and the excess flow passes into the lubrication circuit.

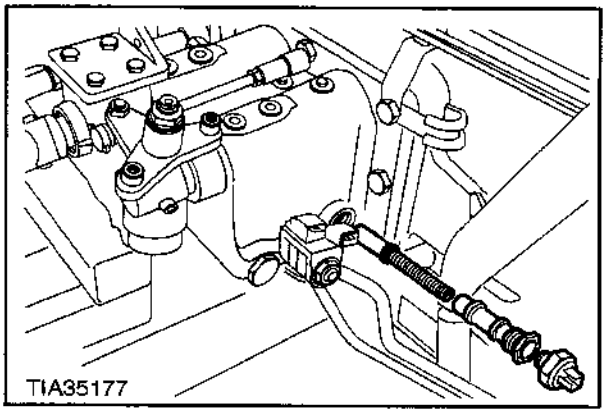


Figure 8-1-50

The solenoids in the side cover are energized to divert flow and engage the differential lock, PTO clutch and brake and disengage front wheel drive.

NOTE: The front wheel drive is spring applied and the solenoid is energized whenever disengagement of the drive is required.

Solenoid Function

1. Differential Lock
2. PTO Clutch
3. PTO Brake
4. Front Wheel Drive

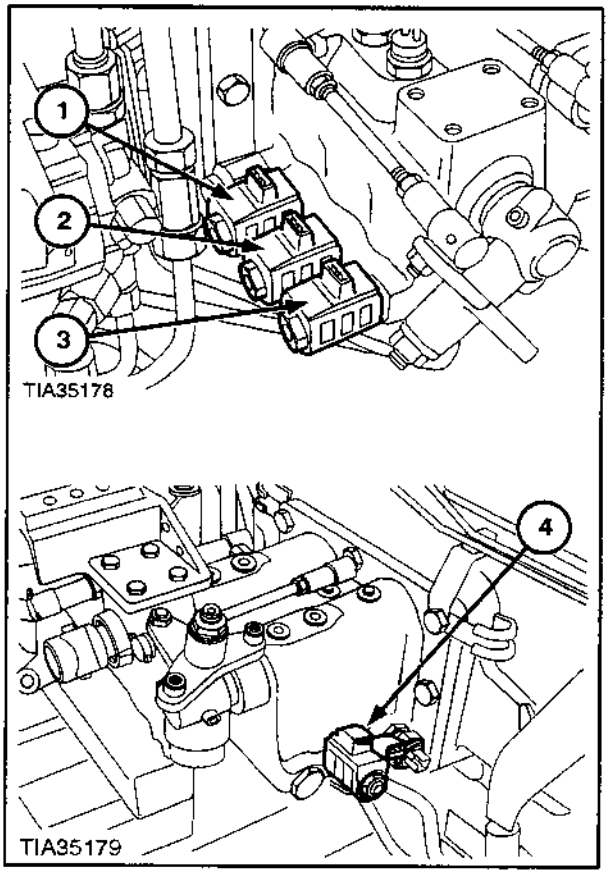


Figure 8-1-51

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Low pressure circuit oil is directed through the oil cooler at the front of the tractor and limited to a maximum pressure of 100 lbf/in^2 (7 bar) by the lubrication valve (1) located in the mating face of the transmission side cover. Components lubricated by this oil are transmission lower shaft, hydraulic pump drive gear, hydraulic lift cross shaft and PTO clutch lubrication.

The check valve (2) also located next to the lubrication valve is called the steering make up valve and is located below the oil level in the transmission. In the event of hydraulic circuit failure the check valve allows the steering motor to draw oil from the transmission and up to the steering motor to ensure safe operation of the steering system is maintained.

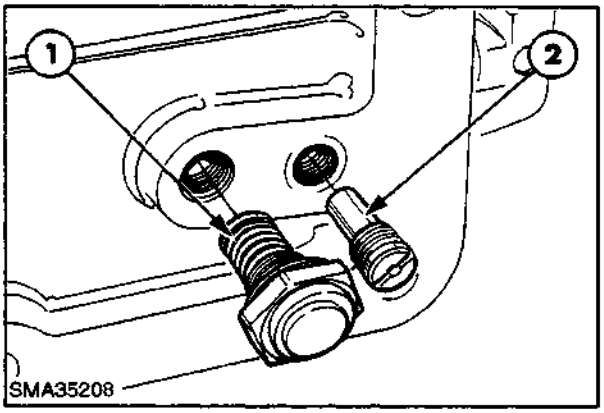


Figure 8-1-52

When the oil is cold and pressure differential across the oil cooler is higher than 50 lbf/in^2 (3.5 bar) the cooler by–pass valve located in the pipework running along the side of the transmission will operate to ensure that an adequate oil flow to the lubrication circuit is maintained. This feature of diverting oil from the cooler assists in aiding a rapid warm up of oil in cold weather conditions.

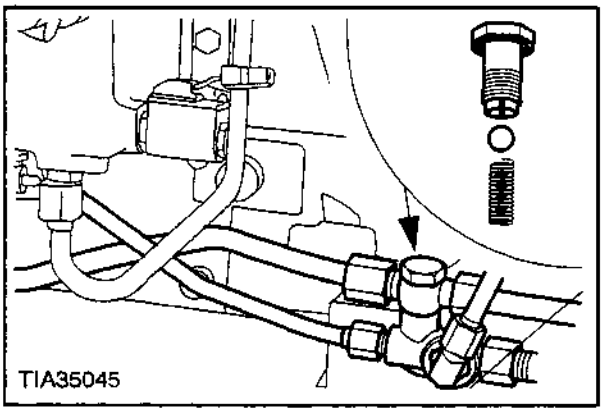
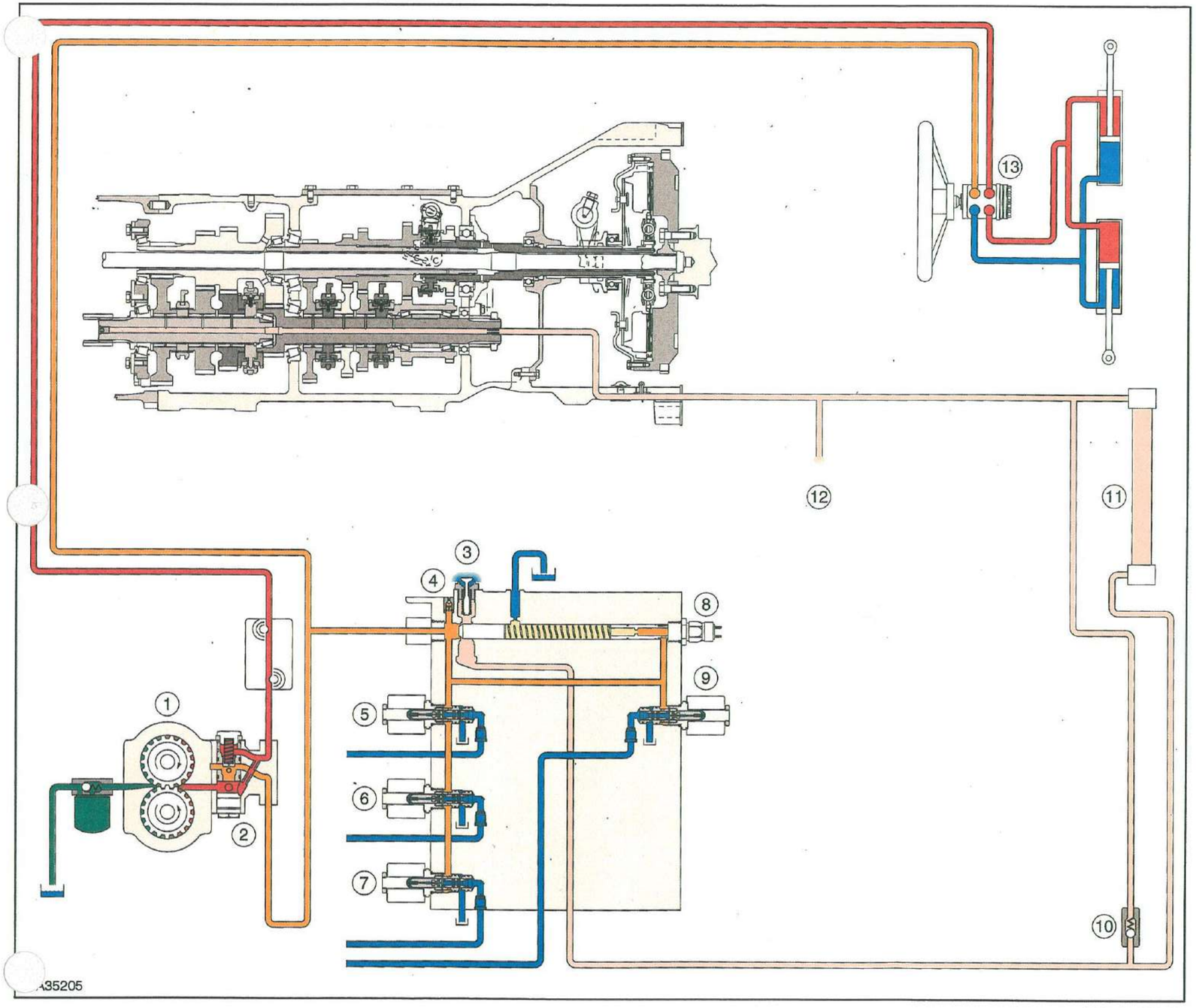


Figure 8-1-53

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Steering, Low Pressure and Lubrication Circuit
Tractors with Mechanical Transmission

- Steering System Oil
- Lubrication Circuit Oil
- Low Pressure Circuit Oil @ 16 – 18 bar (230 – 261 lbf/in²)
- Return to Reservoir Oil
- Suction Oil

1. Steering and Low Pressure Circuit Pump
2. Steering Flow Control Valve
3. Lubrication Circuit Relief Valve
4. Steering Make-Up Valve
5. Differential Lock
6. PTO Engagement Solenoid
7. PTO Brake
8. Low Pressure Regulating Valve
9. Front Wheel Drive Solenoid
10. Oil Cooler By-Pass Valve
11. Oil Cooler
12. Lubrication To Pump Drive Gear, PTO and Lift Cross Shaft
13. Steering Motor

Figure 8-1-54

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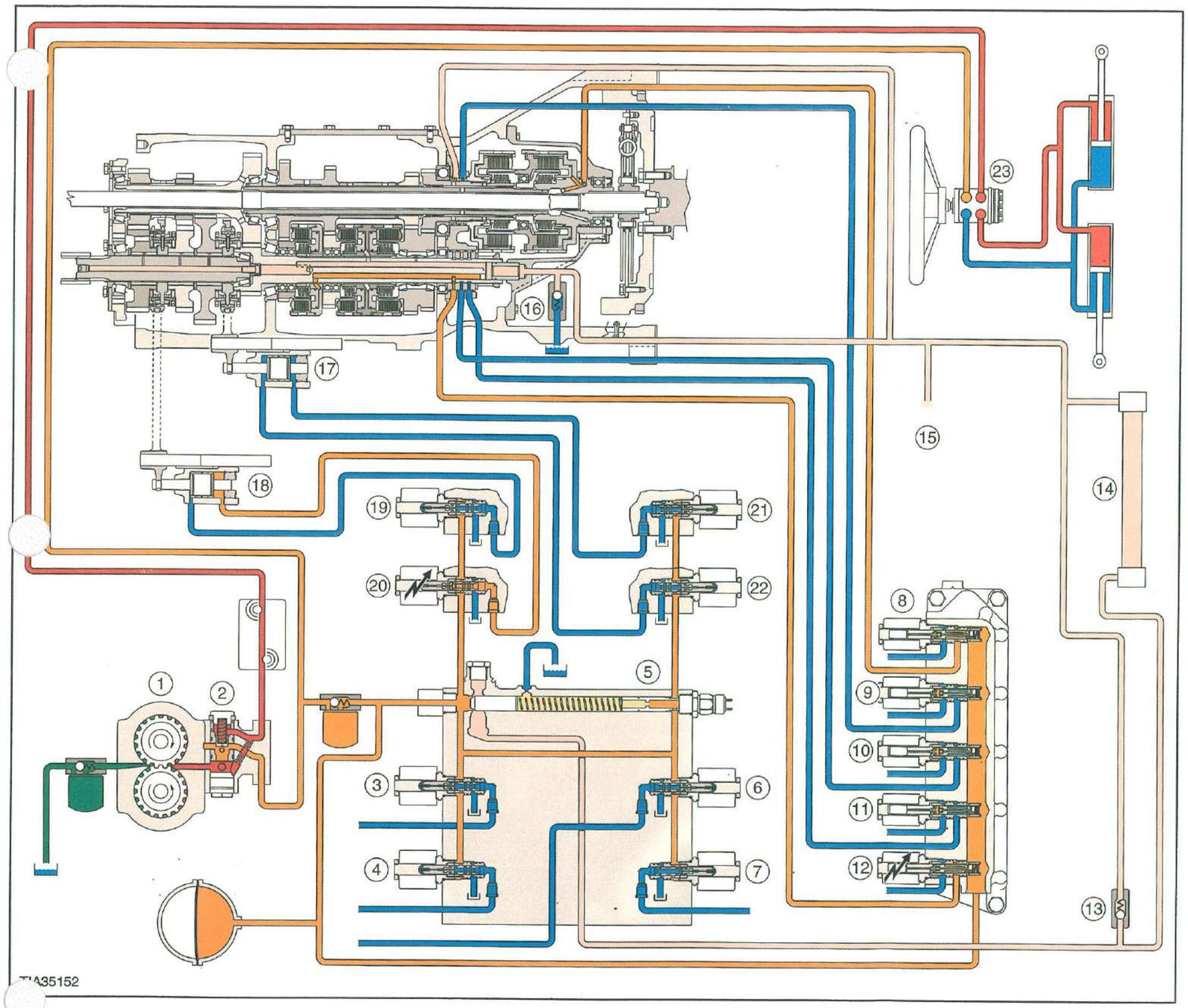
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Steering, Low Pressure and Lubrication Circuit
Tractors with Semi Powershift Transmission

- Steering System Oil
- Lubrication Circuit Oil
- Low Pressure Circuit Oil @ 16 – 18 bar (230 – 261 lbf/in^2)
- Return to Reservoir Oil
- Suction Oil

1. Steering and Low Pressure Circuit Pump
2. Steering Flow Control Valve
3. Differential Lock
4. PTO Engagement Solenoid
5. Low Pressure Regulating Valve
6. Differential Lock Solenoid
7. Four Wheel Drive Solenoid
8. A Clutch PWM Valve
9. B Clutch PWM Valve
10. C Clutch PWM Valve
11. D Clutch PWM Valve
12. E Clutch PWM Valve
13. Oil Cooler By-Pass Valve
14. Oil Cooler
15. Lubrication to Pump Drive Gear, PTO and Lift Cross Shaft
16. Lubrication Circuit Relief Valve
17. Actuator – Low and High Range Synchronizer
18. Actuator – Medium and Reverse Range Synchronizer
19. Reverse Range Solenoid Valve
20. Medium Range Solenoid Valve
21. Low Range Solenoid Valve
22. High Range Solenoid Valve
23. Steering Motor

Figure 8-1-55

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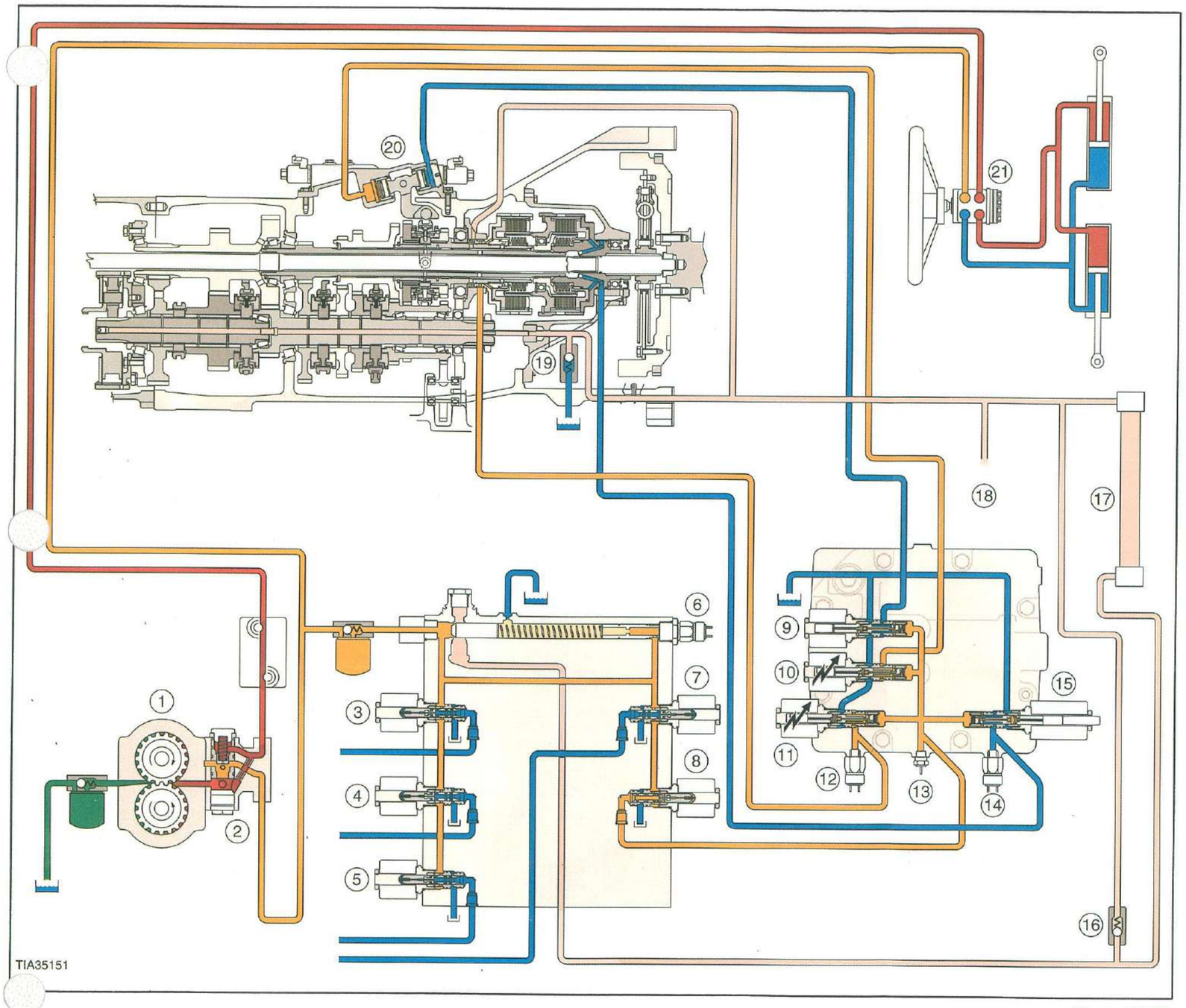


Figure 8-1-56

Steering, Low Pressure and Lubrication Circuit
Tractors with Hi/Lo Transmission

- Steering System Oil
- Lubrication Circuit Oil
- Low Pressure Circuit Oil @ 16 – 18 bar (230 – 261 lbf/in²)
- Return to Reservoir Oil
- Suction Oil

1. Steering and Low Pressure Circuit Pump
2. Steering Flow Control Valve
3. Differential Lock
4. PTO Engagement Solenoid
5. PTO Brake
6. Low Pressure Regulating Valve
7. Four Wheel Drive Solenoid
8. Transmission Clutch Dump Valve
9. Reverse Clutch PWM Valve
10. Forward Clutch PWM Valve
11. B Clutch PWM Valve
12. B Clutch Pressure Switch
13. Transmission Low Temperature Switch
14. A Clutch Pressure Switch
15. A Clutch PWM Valve
16. Oil Cooler By-Pass Valve
17. Oil Cooler
18. Lubrication To Pump Drive Gear, PTO and Lift Cross Shaft
19. Lubrication Circuit Relief Valve
20. Actuator – Forward and Reverse Synchronizer
21. Steering Motor

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SECTION 8

HYDRAULIC SYSTEM

CHAPTER 2

VARIABLE FLOW HYDRAULIC PUMP ASSEMBLY

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SPECIAL TOOLS

	NEW HOLLAND PART No	V. L. CHURCHILL PART No
Pump Removal Bracket	295046	NH 35100
Pump Drive Shaft Retainer	295033	NH 35101
By–Pass and Dump Valve Extractor	295025	4FT. 857
Pressure Gauge 0–100 lbf/in^2 (0–6.6 bar)		FT. 4096
Pressure Gauge 0–6000 lbf/in^2 (0–414 bar)		FT. 8503A
Adaptor Charge Pressure Test	295024	NH 35102
Hydraulic Pressure Test Kit	292870	
Adaptor Pump Drive Gear Shaft Pin Removal	50140*	
Adaptor Pump Drive Gear Shaft Removal	290793	
Alignment Dowel	Local Manufacture	
Plug	(Modify adaptor New Holland Part No 83928452)	

*Dealer Made (Reference page 5-1-7)

SEALANT

Flexible Gasket Sealant

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SPECIFICATIONS

Charge Pump

Type	Gear Type Pump
Charge pump output @ 2200 erpm (New Pump)	29 US Galls/min 24 Imp Galls/min 110 Ltr/min
Charge Pressure Filter Dump Valve	Crack open @ 100 lbf/in^2 (6.9 bar) Fully Open @ 180 lbf/in^2 (12.4 bar)
Charge Pressure	Minimum 23–50 lbf/in^2 (1.6–3.4 bar) @ 2100 rev/min and variable flow piston pump 'On Load'
Charge Pressure Switch	Close @ 8–12 lbf/in^2 (0.55–0.82 bar) Making charge pressure warning light flash

Variable Flow Closed Center Load Sensing Piston Pump

Type	Variable Flow Piston Pump (Swash Plate Controlled)
Minimum Output @ 2200 erpm	25 US Galls/min 21 Imp Galls/min 95 Ltr/min
Standby Pressure (Low Pressure Standby)	310–350 lbf/in^2 (21–24 bar)
Maximum System Pressure (High Pressure Standby)	2750 lbf/in^2 (190 bar)

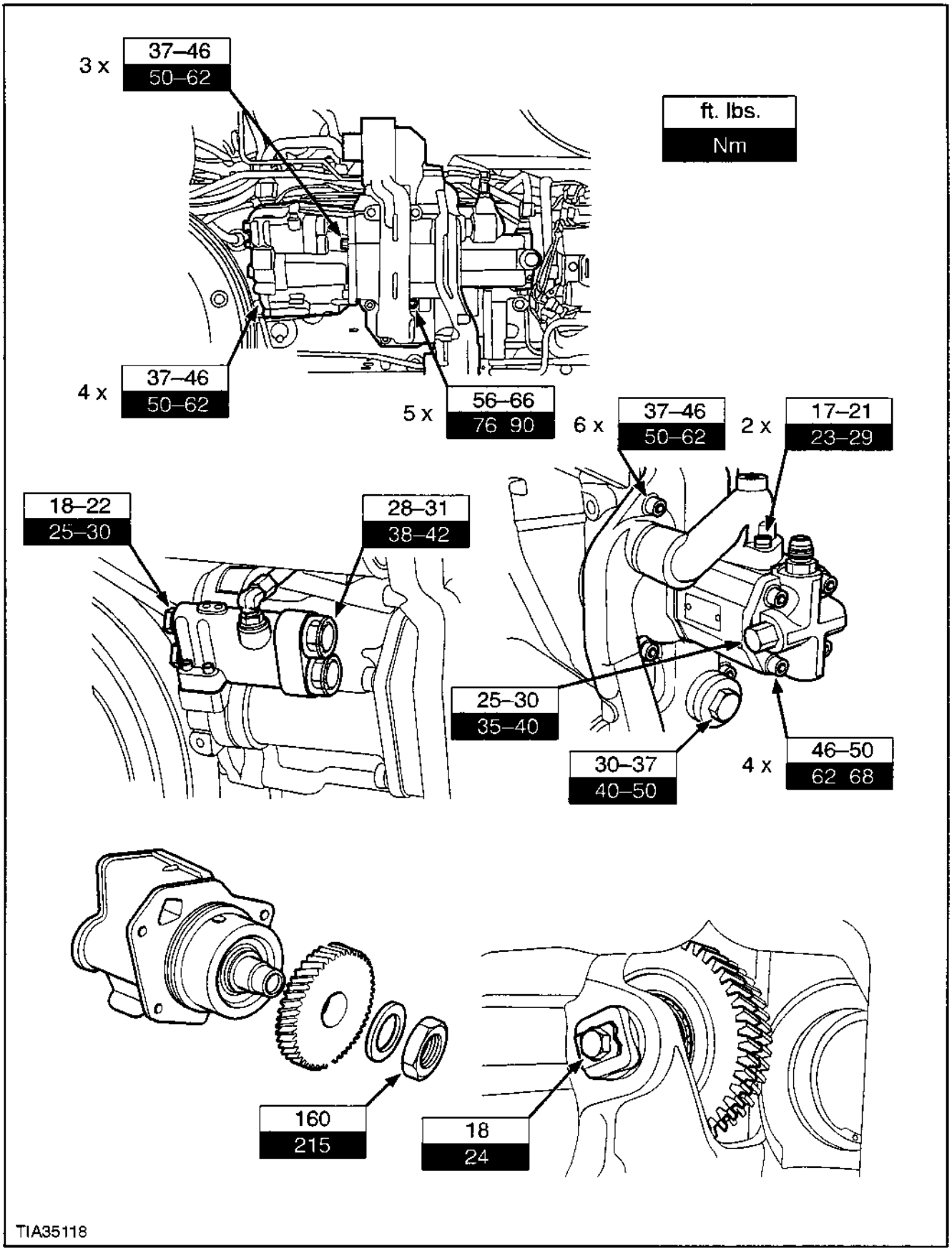
Steering/Low Pressure Circuit Pump

Type	Gear Type Pump
Minimum Output @ 2200 erpm	16 US Galls/min 13 Imp Galls/min 60 Ltr/min
Flow to Steering Motor	5.8–7.4 US Galls/min 4.8–6.2 Imp Galls/min 22–28ltr/min

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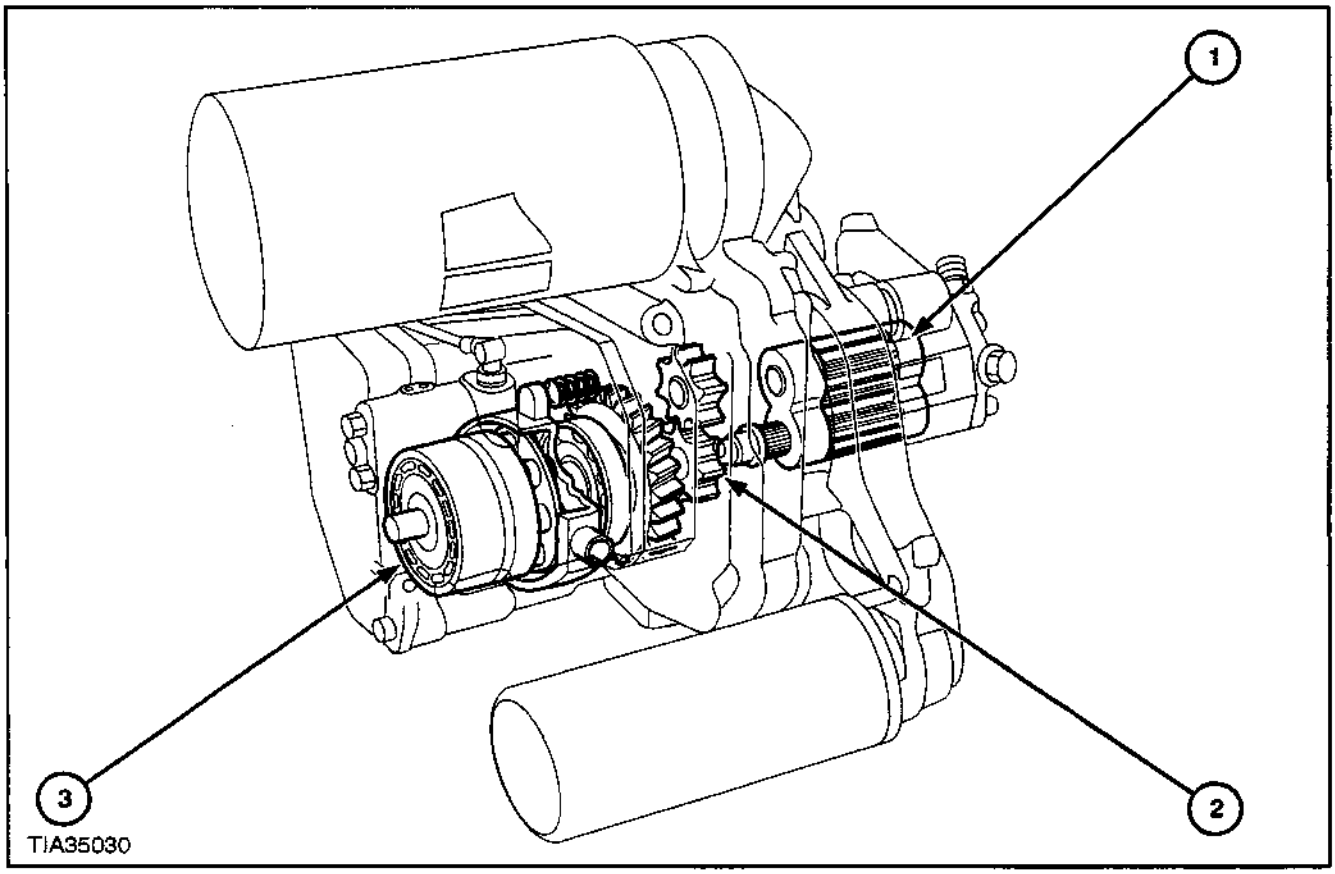
TORQUE



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DESCRIPTION AND OPERATION



Hydraulic Pump Assembly With Variable Displacement Closed Center Load Sensing **Figure 8-2-1**

1. Steering, Low Pressure and Lubrication Circuit Gear Type Pump
2. Gear Type Charge Pump
3. Variable Flow Piston Pump

The variable flow closed center load sensing hydraulic pump assembly is mounted on the right hand side of the rear axle center housing and contains within its body three hydraulic pumps.

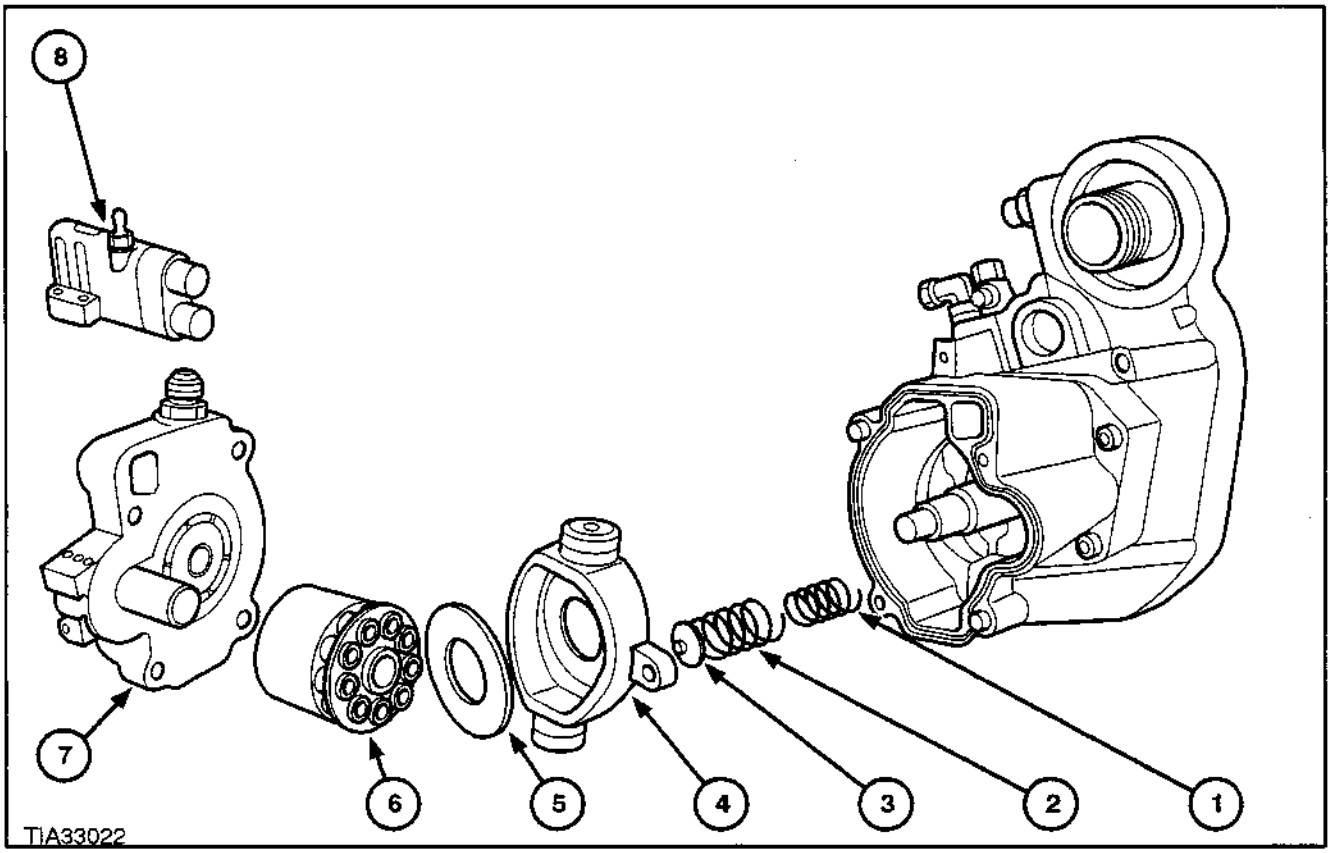
- A charge pump of the gear type to supply oil at a charge pressure of 23–50 lbf/in^2 (1.6–3.4 bar) to a variable flow closed center load sensing hydraulic piston pump.
  Charge pump output @ 2200 erpm
  29 US Galls/min
  24 Imp Galls/min
  110 Ltr/min

- A variable flow closed center load sensing piston type hydraulic pump supplying oil to the high pressure circuits for operation of:–
  Trailer Brake
  Hydraulic Lift Assembly
  Remote Control Valves
  Variable Flow Piston Pump Output on Full Stroke @ 2200 erpm
  25 US Galls/min
  21 Imp Galls/min
  95 Ltr/min

- A fixed displacement gear type pump, referred to as the Steering and Low Pressure Circuit pump, supplying oil for operation of:
  Steering System
  Independent Power Take Off
  Differential Lock
  Front Wheel Drive Axle
  Transmission Clutches
  Lubrication Circuit
  Steering and Low Pressure Pump Output @ 2200 erpm
  16 US Galls/min
  13 Imp Galls/min
  60 Ltr/min

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Variable Flow Piston Pump Pump Components **Figure 8-2-2**

1. Spring
2. Spring
3. Seat
4. Swash Plate
5. Thrust plate
6. Nine Element Pumping Head
7. End Plate and Servo Piston Assembly
8. Load Sensing Valve

Principal of Operation

All three pumping elements are driven by a 'live' drive gear train directly connected to the PTO clutch input drive shaft and driven by the engine flywheel.

The operating principal of the fixed displacement gear pumps is to provide a constant oil flow directly related to the rotation speed of the pump.

The operating principal of a variable flow piston pump however is to provide oil flow on demand. This principle of operation minimizes the engine power absorbed in driving the hydraulic pump when the hydraulic circuits do not require maximum pump flow.

The economic use of the variable flow piston pump in hydraulic systems can therefore have distinct power loss advantages over fixed displacement gear type pumps, which continually provide oil flow and absorb engine power even when the hydraulic circuits do not require the total pump output.

Variable Displacement Piston Pump

The major components of the variable flow piston pump with closed center load sensing are:–

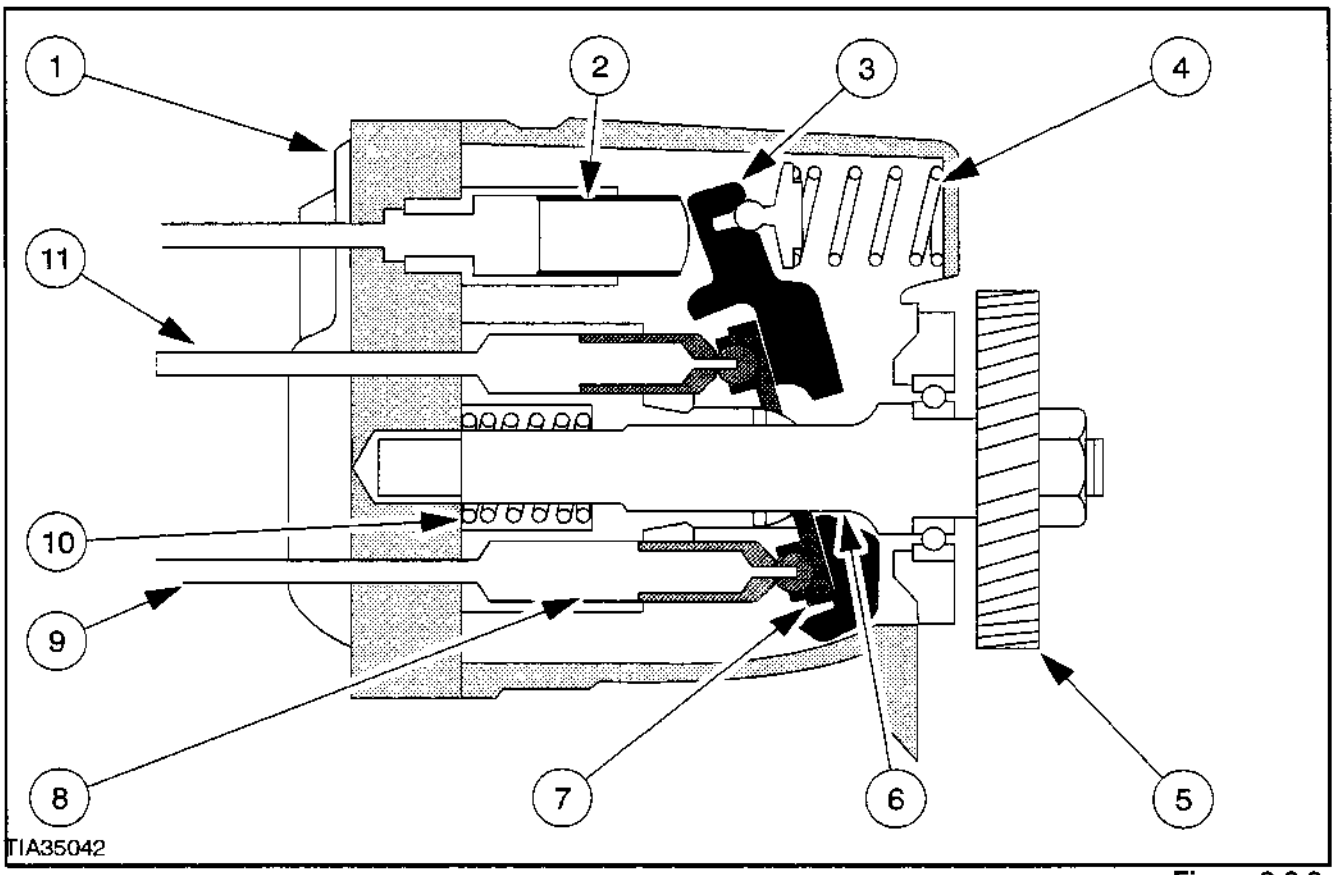
1. A nine element pumping head.

2 A plate mechanism (swash plate) to adjust piston stroke and corresponding pump output.

3 A load sensing valve which monitors the requirements of the hydraulic circuits and signals the pump to increase or decrease hydraulic oil flow accordingly.

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Variable Displacement Piston Pump–Sectional Drawing

Figure 8-2-3

1. Pump End Plate
2. Swash Plate Servo Piston
3. Swash Plate
4. Swash Plate Return Spring
5. Driveshaft Gear
6. Driveshaft
7. Slipper (9 of)
8. Piston and Barrel
9. Inlet Port
10. Pumping Head Pre–load Spring
11. Outlet Port

The nine element pumping head is cylindrical in shape and has nine barrels, into each of which, is installed a piston. On the end of each piston is pressed a slipper which always remains in contact with the face of the swash plate located at the front of the pumping head.

The drive shaft, which is driven by the pump drive gear, rotates the pumping head. As the pumping head rotates, the pistons move in and out of their barrels, following the contour of the swash plate. For every revolution of the drive shaft each piston completes one pumping cycle.

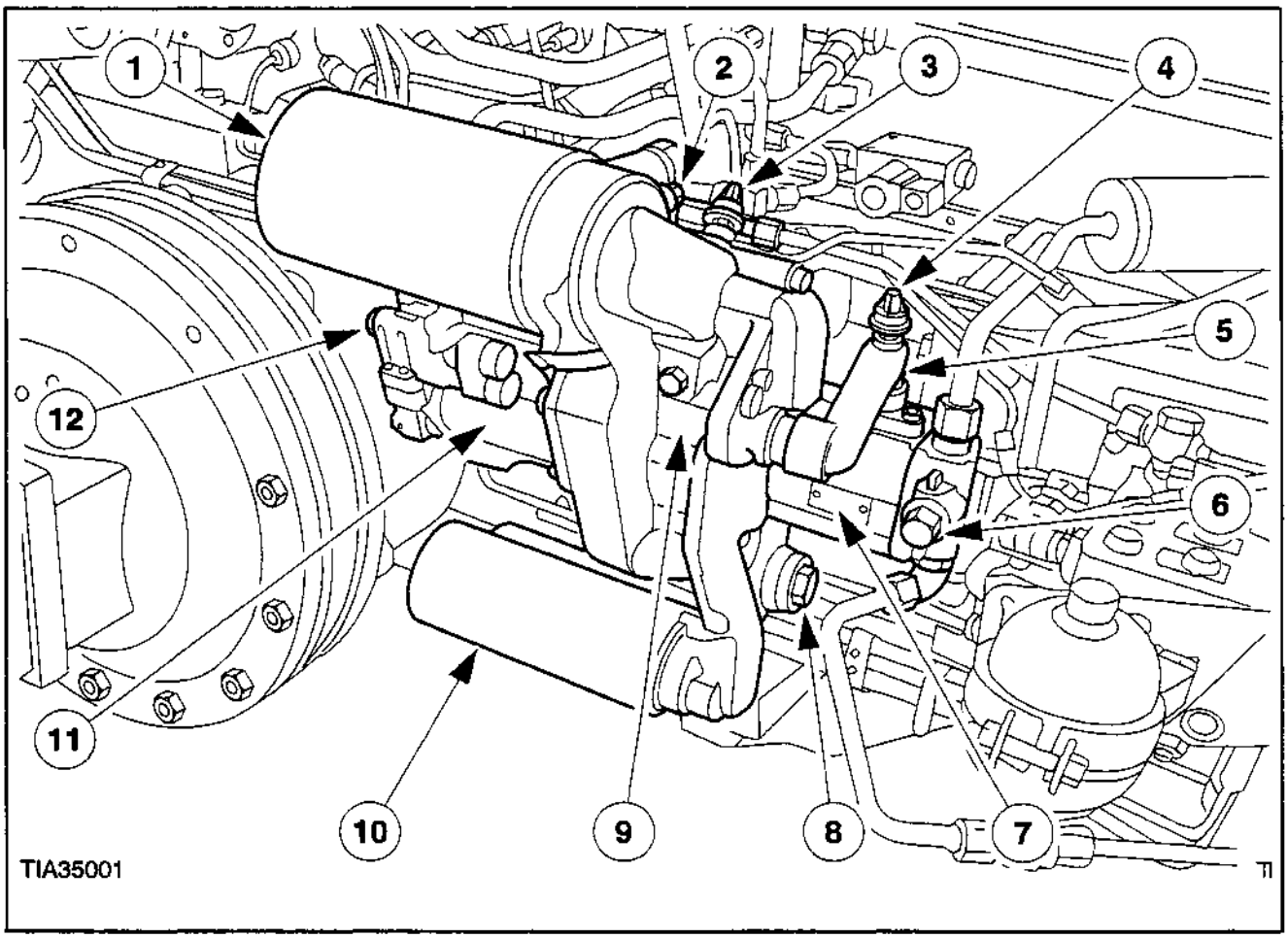
The swash plate, which does not rotate but pivots about the front of the pumping head, is the control mechanism that limits the stroke of each piston and works in conjunction with the pressure and flow compensating valves in the load sensing line.

As the pumping head rotates each barrel passes over the inlet and then the outlet ports of the pump. During the inlet cycle for each piston and barrel, oil is pumped into the barrel pushing the piston forward so that it always remains in contact with the swash plate. The stroke of each piston and volume of oil charged into its barrel is therefore dependent on the angle of the swash plate.

After a piston and barrel has completed the inlet stroke, further rotation of the head aligns the barrel with the outlet port. Oil within the barrel is then forcibly ejected by the piston through the exhaust port to the hydraulic circuits.

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CCLS Hydraulic Pump Installation

Figure 8-2-4

1. Intake Filter
2. Oil Low Temperature Switch
3. Intake Filter Restriction Switch
4. Low Charge Pressure Switch
5. Charge Pressure By–Pass Valve
6. Steering Flow Control Valve
7. Steering and Low Pressure Circuit Pump
8. Charge Pressure Filter Dump Valve
9. Charge Pump
10. Charge Pressure Filter
11. Variable Flow Piston Pump
12. Load Sensing Valve
    (Flow and Pressure Compensating Valves)

The location of the principal components in the hydraulic pump assembly are identified above. These items are shown on the hydraulic circuit diagrams which describe the operating modes of the pump. The principal function of the valves and switches is as follows:–

Intake Filter and Restriction Switch

Oil for both the charge and steering pump is drawn from the rear axle center housing via the intake filter. The filter incorporates a by–pass valve, which is an integral part of the replaceable filter and it is therefore essential that the correct filter is installed at every filter change.

When the filter is blocked the oil filter restriction vacuum switch is activated and illuminates the oil filter restriction warning light on the instrument panel.

Because oil is more viscous (thicker) when cold and can falsely indicate that the filter requires servicing a low temperature oil switch is also used in the filter restriction circuit. This switch ensures that the warning light will not operate if the oil temperature is less than 104°F (40°C).

Low Charge Pressure Switch

The low charge pressure switch will cause a light to 'Flash' on the instrument cluster whenever the charge pressure is less than 11 lbf/in^2 (0.75 bar)

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Charge Pressure Filter Dump Valve

The charge pressure filter dump valve is a safety relief valve for relieving excess pressure on the charge pump should the filter be restricted. This valve will start to operate if the charge pressure exceeds 100–150 lbf/in^2 (6.9–10.3 bar).

It should be noted that the charge pressure filter does not incorporate a by–pass valve thus preventing dirty oil entering the variable flow pump circuits.

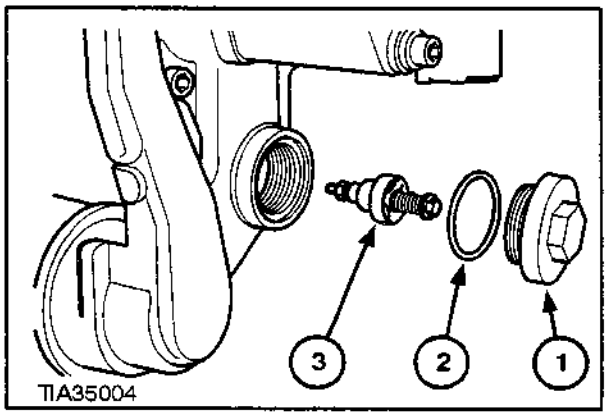


Figure 8-2-5

Charge Pressure Valve

The charge pressure valve diverts excess oil supplied by the charge pump and not required by the variable flow piston pump to the inlet port of the steering and low pressure circuit pump.

This valve starts to operate at a pressure of 23 lbf/in^2 (1.6 bar) and when fully open limits the charge pressure circuit oil to 50 lbf/in^2 (3.4 bar) .

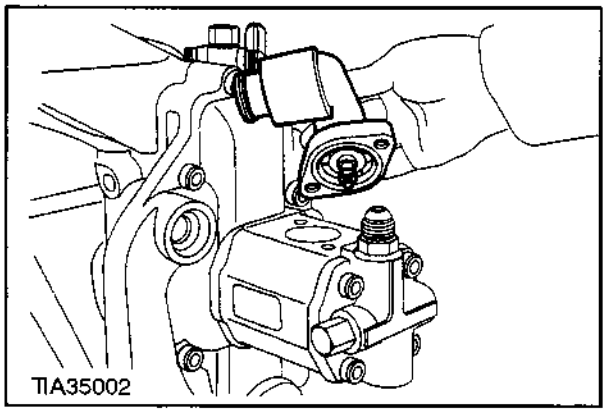


Figure 8-2-6

Steering Flow Control Valve

The steering flow control valve ensures that 6.6 U.S. Galls/min (5.5 Imp Galls, 25 ltr/min) of oil is constantly supplied to the steering motor from the steering and low pressure circuit pump. All additional flow from the pump passes directly into the low pressure circuit.

Refer to Section 8 Chapter 1 for a Description and Operation of the steering and low pressure hydraulic circuits.

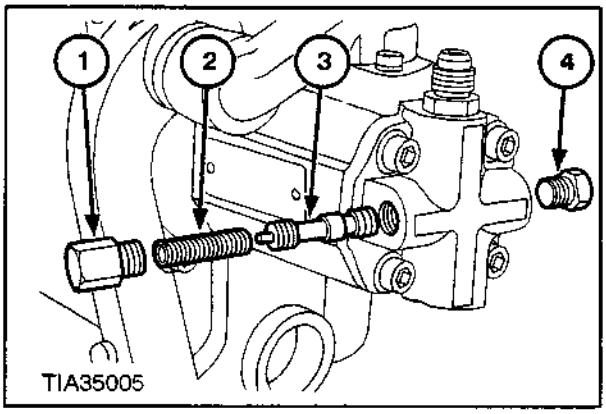
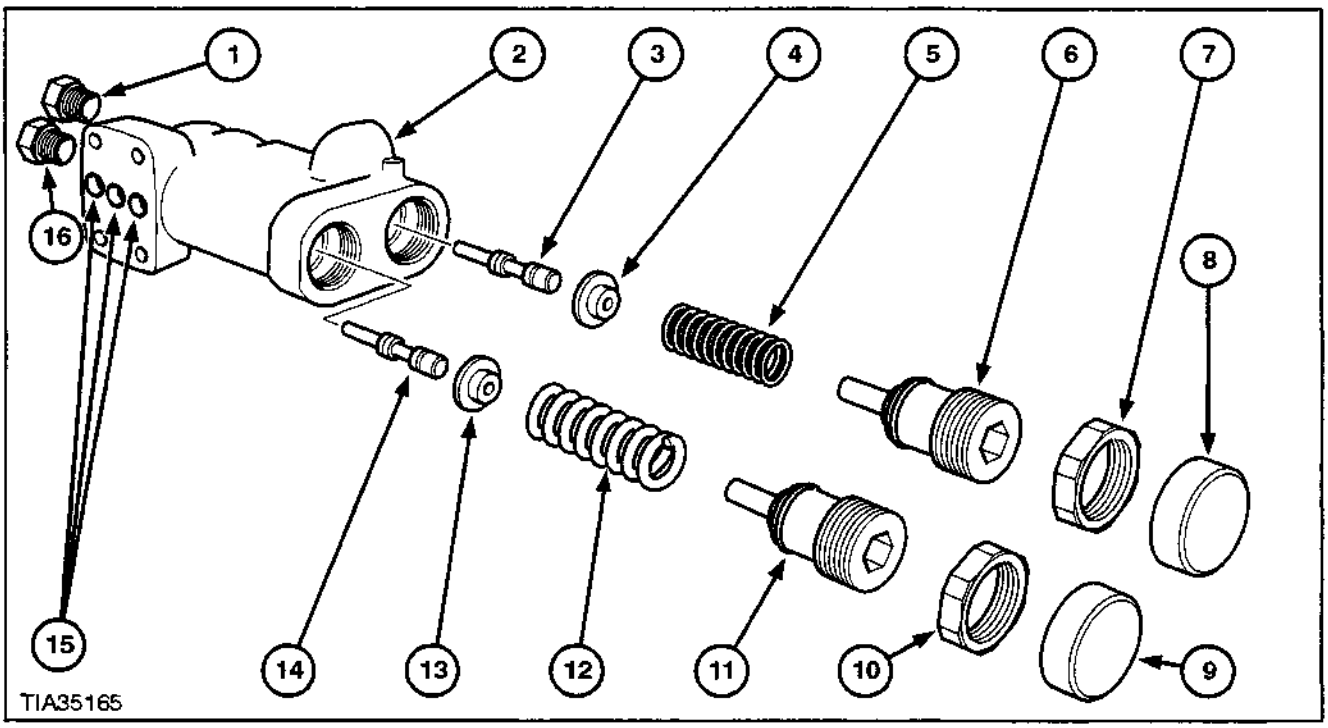


Figure 8-2-7

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Flow and Pressure Compensating Valves

Figure 8-2-8

1. Plug and 'O' Ring
2. Housing
3. Flow Compensating Spool
4. Seat
5. Spring
6. Adjuster and 'O' Ring Seal
7. Locknut
8. Tamperproof Cap
9. Tamperproof Cap
10. Locknut
11. Adjuster and 'O' Ring Seal
12. Spring
13. Seat
14. Pressure Compensator Spool
15. 'O' Ring Seals
16. Plug and 'O' Ring

Flow and Pressure Compensating Valves (CCLS Pump Load Sensing Valve)

Output from the variable flow piston pump is determined by adjusting the angle of the swash plate in the pump. The flow compensating valves senses the circuit operating pressure and adjusts the swash plate angle to control pump output.

If pump output and circuit pressure rises to 2755 lbf/in^2 (190 bar) the pressure compensating valve overrides the flow compensating valve and adjusts the swash plate angle to limit maximum system pressure.

HYDRAULIC CIRCUIT OPERATION

With reference to Figures 8-2-9–8-2-12

The charge pressure pump draws oil through the charge pump inlet filter. A gallery in the inlet side of the charge pump allows oil to flow to and from the inlet side of the steering and lubrication circuit pump.

Oil on passing through the charge pump flows through the charge pressure filter and on to the variable flow piston pump. Oil flow from the charge pump will always exceed demand of the piston pump and the excess flow passes through the charge pressure valve into the inlet port of the steering pump. If the flow through the charge pressure valve exceeds the demand of the steering pump the surplus oil is returned to the inlet side of the charge pump.

The variable flow closed center load sensing hydraulic pump operates progressively in a variety of modes which for clarity can be separated into four catergories as follows:–

Low Pressure Standby

High Pressure Circuit Maximum Demand

High Pressure Circuit Low Demand

Maximum System Pressure
(High Pressure Standby)

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Low Pressure Standby

Low pressure standby is the system pressure 310–350 lbf/in^2 (21–24 bar) maintained by the hydraulic pump when high pressure hydraulic circuits are not being operated.

During engine start up, standby pressure has not been generated and both the flow and pressure compensating valves are held to the left by spring pressure.

While the spools are held to the left oil pressure generated by the pump cannot be applied to the swash plate servo piston. The swash plate consequently remains in the maximum flow position until the pump has developed the low standby pressure.

As system pressure increases to 310–350 lbf/in^2 (21–24 bar), the pressure is sensed in gallery **D** and applied to the end of the flow compensating spool. The spool gradually moves against the spring allowing oil flow from gallery **D** to gallery **C**.

The controlled pressure rise in gallery **C** operates the swash plate servo piston, changing the angle of the swash plate in relation to the pumping head. The change in angle reduces the operating stroke of the pistons and output of the pump.

As pump output decreases and the pressure in gallery **D** reduces to less than 350 lbf/in^2 (24 bar), the spring in the flow compensating valve gradually moves the spool to the left opening gallery **C** to sump through gallery **B**, via the spring cavity of the pressure compensating valve. This reduces the pressure applied to the servo piston, allowing the servo piston to retract at a controlled rate under pressure from the swash plate return spring, which re–adjusts the angle of the swash plate to increase pump output.

This process where the flow compensating valve spool moves back and forth to control the pressure applied to the servo piston, continues until there is a demand by the hydraulic system to increase output to operate the hydraulic lift, remote control valves or trailer brakes (where fitted).

Figure 8-2-9

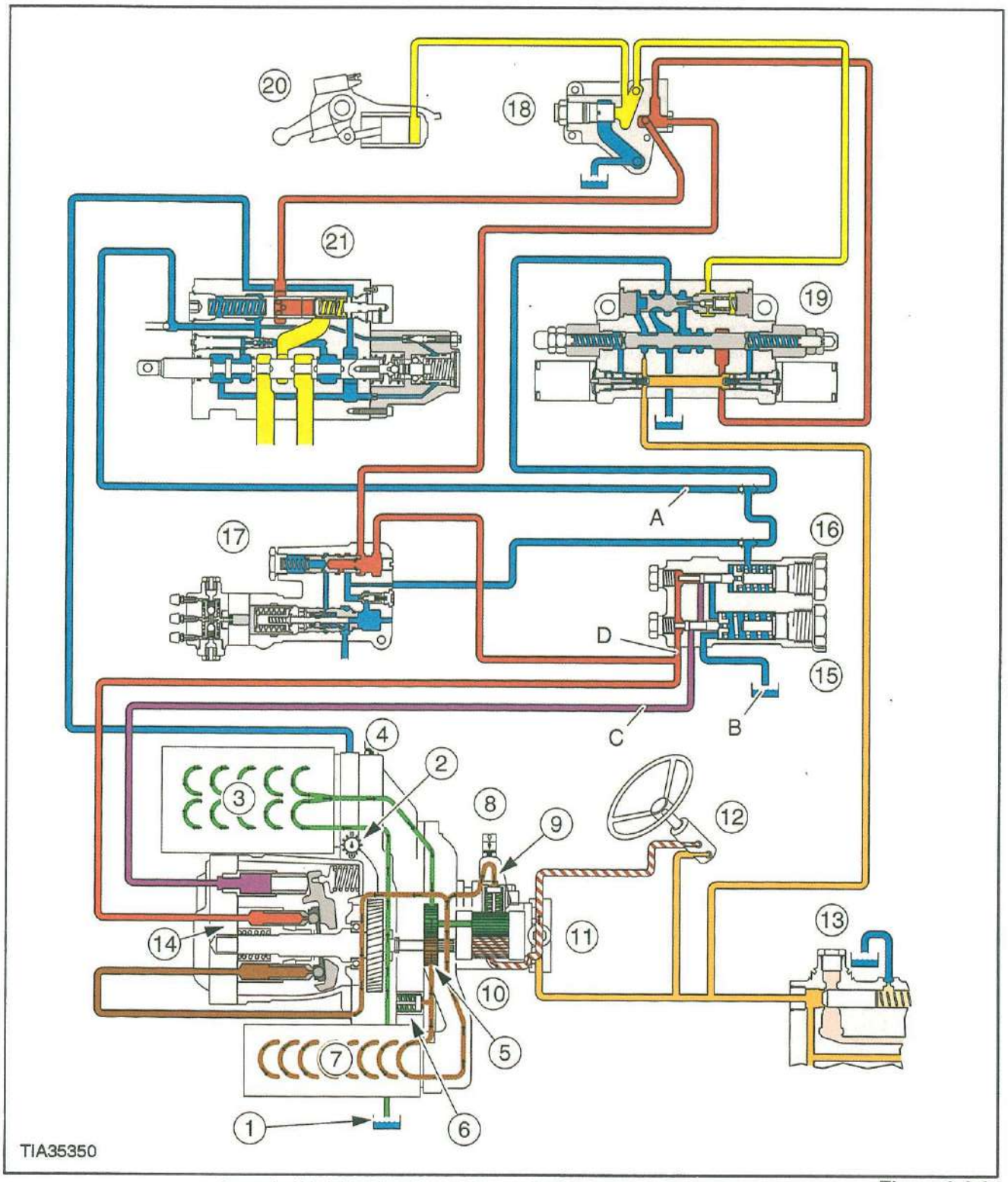
Control of Variable Flow Piston Pump with Closed Center Load Sensing When Regulating Standby Pressure (Low Pressure Standby)

1. Pump Intake
2. Intake Filter Filter Low Temperature Switch (Prevents Intake Filter restriction Light Operating when Oil Temperature Below 104°F, 40°C)
3. Intake Filter
4. Intake Filter Restriction Switch
5. Charge Pump
6. Charge Pressure Filter Dump Valve
7. Charge Pressure Filter
8. Low Charge Pressure Switch
9. Charge Pressure By–Pass Valve
10. Steering and Low Pressure Circuit Pump
11. Steering Flow Control Valve
12. Steering Motor
13. Pressure Regulating Valve (Located In Transmission Side Cover)
14. Variable Flow Piston Pump
15. Pressure Compensating Valve
16. Flow Compensating Valve
17. Trailer Brake Valve
18. Manifold and Lift Cylinder Safety Valve
19. Electronic Draft Control Valve
20. Hydraulic Lift
21. Closed Center Remote Control Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves

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Control of Variable Flow Piston Pump with Closed Center Load Sensing When Regulating Standby Pressure (Low Pressure Standby)

Figure 8-2-9

- Steering System Oil
- Standby Pressure Oil 310–350 lbf/in^2 (21–24 bar)
- Low Pressure Circuit Oil 232–261 lbf/in^2 (16–18 bar)
- Charge Pressure Oil 23–50 lbf/in^2 (1.6–3.4 bar)
- Return to Reservoir Oil
- Control Pressure Oil
- Suction Oil
- Lubrication Circuit
- Trapped Oil

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Variable Flow Piston Pump Operation
High Pressure Circuit High Demand

When the electronic draft control hydraulic lift, remote control valves or trailer braking system are operated the pressure rise in the hydraulic circuit being operated is sensed by the load sensing line **A**. The pressure in the sensing line is now applied to the spring loaded end of the flow compensating valve.

The combined pressure from the pilot line and flow compensating valve return spring causes the flow compensating spool to move against the standby pressure in gallery **D**, preventing the flow of oil to the swash plate servo piston through gallery **C**.

The movement of the spool opens gallery **C** to the return to sump gallery **B**, allowing the servo piston to retract under pressure from the swash plate return spring and adjust the angle of the swash plate to increase pump output,.

Figure 8-2-10

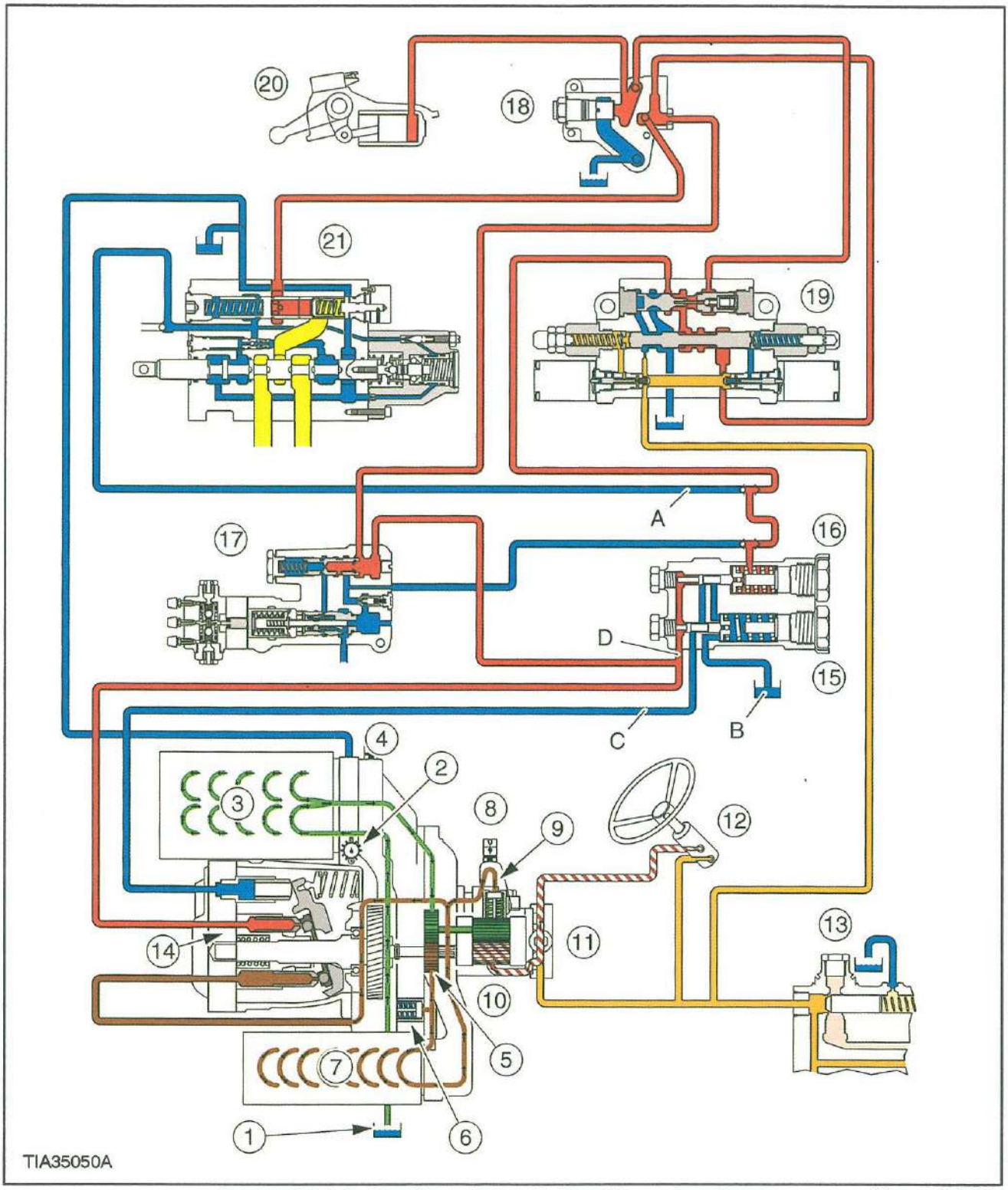
Control of Variable Flow Piston Pump with Closed Center Load Sensing
When High Pressure Hydraulic Circuits are Operated (High Demand)

1. Pump Intake
2. Intake Filter Filter Low Temperature Switch
   (Prevents Intake Filter restriction Light Operating when Oil Temperature Below 104°F, 40°C)
3. Intake Filter
4. Intake Filter Restriction Switch
5. Charge Pump
6. Charge Pressure Filter Dump Valve
7. Charge Pressure Filter
8. Low Charge Pressure Switch
9. Charge Pressure By–Pass Valve
10. Steering and Low Pressure Circuit Pump
11. Steering Flow Control Valve
12. Steering Motor
13. Pressure Regulating Valve (Located In Transmission Side Cover)
14. Variable Flow Piston Pump
15. Pressure Compensating Valve
16. Flow Compensating Valve
17. Trailer Brake Valve
18. Manifold and Lift Cylinder Safety Valve
19. Electronic Draft Control Valve
20. Hydraulic Lift
21. Closed Center Remote Control Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves

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Control of Variable Flow Piston Pump with Closed Center Load Sensing When High Pressure Hydraulic Circuits are Operated (High Demand)

Figure 8-2-10

- Steering System Oil
- System Pressure Oil
- Low Pressure Circuit Oil 232–261 lbf/in² (16–18 bar)
- Charge Pressure Oil 23–50 lbf/in² (1.6–3.4 bar)
- Return to Reservoir Oil
- Trapped Oil
- Suction Oil
- Lubrication Circuit

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Variable Flow Piston Pump Operation
High Pressure Circuit Low Demand

When the demand of the hydraulic circuit being operated has been satisfied and operating cycle nears completion, eg. the hydraulic lift is raised out of the ground and the main spool in the electronic draft control valve gradually returns to the neutral position, the pressure in the load sensing line begins to decrease.

The difference in pressure between the system and load sensing pressures will now rise toward 300 lbf/in^2 (21 bar) and cause the flow compensator spool to move back against the spring to open gallery **D** to gallery **C**. The controlled pressure rise in gallery **C** now operates the swash plate servo piston and changes the swash plate angle to reduce pump output and the speed of lift.

It can now be seen that the basic principle of pump control, when operating the high pressure hydraulic circuits, is similar to that for operation of the pump at low pressure standby. The only difference is that when the hydraulic circuit is operating, the system pressure required to overcome the flow compensating valve and reduce pump output is 300–350 lbf/in^2 (21–24 bar) greater than the pressure sensed in the load sensing gallery **A.**

When the system is at low pressure standby the load sensing galleries are vented to reservoir, hence the pressure in the system is maintained at 300–350 lbf/in^2 (21–24 bar).

Figure 8-2-11

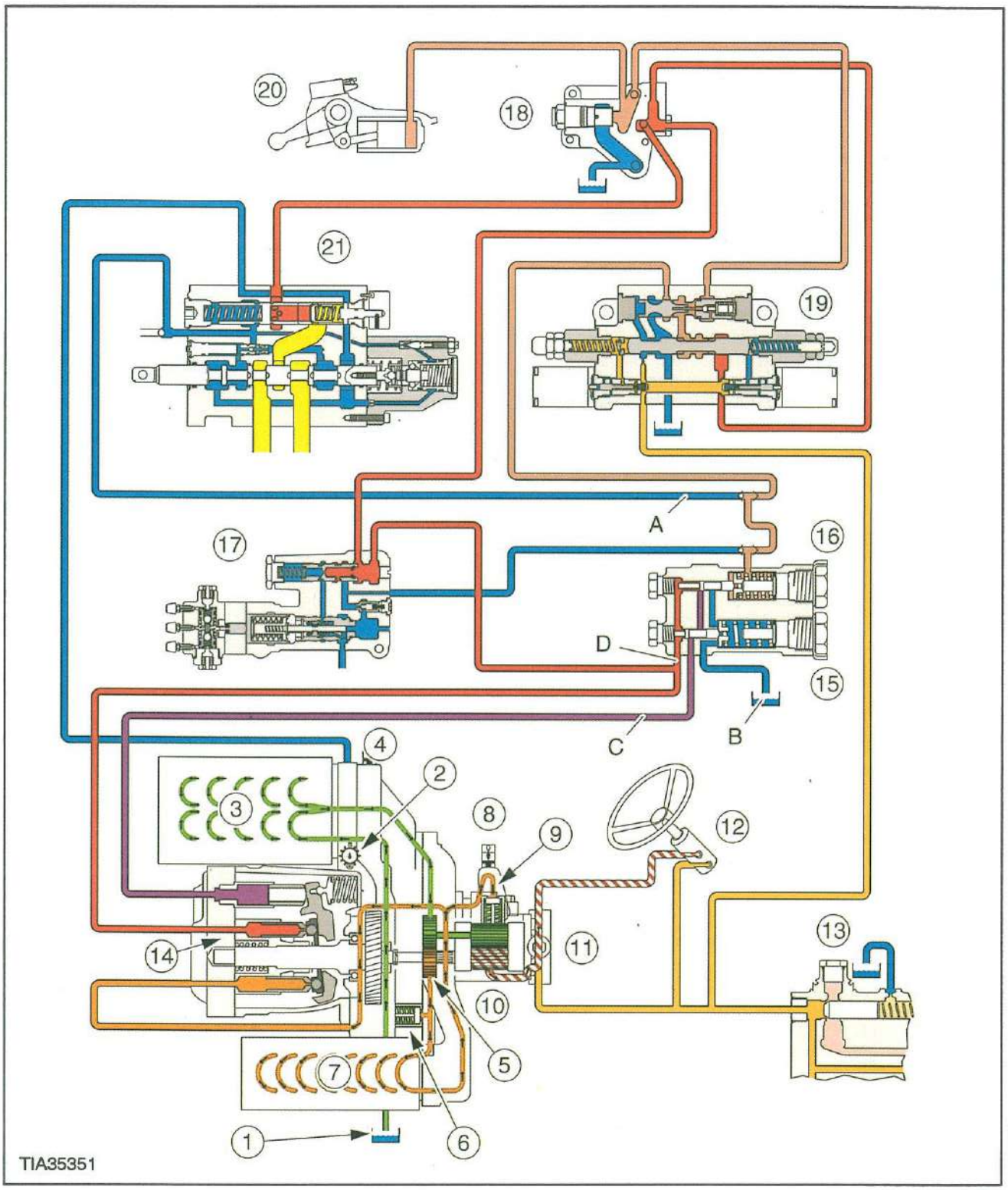
Control of Variable Flow Piston Pump with Closed Center Load Sensing When High Pressure Hydraulic Circuits are Operated (Low Demand)

1. Pump Intake
2. Intake Filter Filter Low Temperature Switch (Prevents Intake Filter restriction Light Operating when Oil Temperature Below 104°F, 40°C)
3. Intake Filter
4. Intake Filter Restriction Switch
5. Charge Pump
6. Charge Pressure Filter Dump Valve
7. Charge Pressure Filter
8. Low Charge Pressure Switch
9. Charge Pressure By–Pass Valve
10. Steering and Low Pressure Circuit Pump
11. Steering Flow Control Valve
12. Steering Motor
13. Pressure Regulating Valve (Located In Transmission Side Cover)
14. Variable Flow Piston Pump
15. Pressure Compensating Valve
16. Flow Compensating Valve
17. Trailer Brake Valve
18. Manifold and Lift Cylinder Safety Valve
19. Electronic Draft Control Valve
20. Hydraulic Lift
21. Closed Center Remote Control Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves

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Control of Variable Flow Piston Pump with Closed Center Load Sensing When High Pressure Hydraulic Circuits are Operated (Low Demand)

Figure 8-2-11

- Steering System Oil
- System Pressure Oil
- Control Pressure Oil
- Charge Pressure Oil 23–50 lbf/in^2 (1.6–3.4 bar)
- Return to Reservoir Oil
- Low Pressure Circuit Oil 232–261 lbf/in^2 (16–18 bar)
- Suction Oil
- Lubrication Circuit
- Trapped Oil

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Limiting Maximum System Pressure of Variable Displacement Piston Pump

To limit the maximum output pressure of the piston pump and prevent consequential damage that may occur due to excessive pressures, a pressure compensating valve, located adjacent to the flow compensator valve, is incorporated in the swash plate control circuit. This valve limits the pressure to 2750 lbf/in^2 (190 bar) and operates as follows:–

As the pressure in gallery **D** increases to 2800 lbf/in^2 (193 bar) the pressure compensator valve spool moves against the valve return spring and opens gallery **D** to gallery **C**. The pressure in gallery **D** is now applied to the servo piston which changes the swash plate angle to reduce pump output to minimum flow. This operating mode is referred to as high pressure standby.

Figure 8-2-12

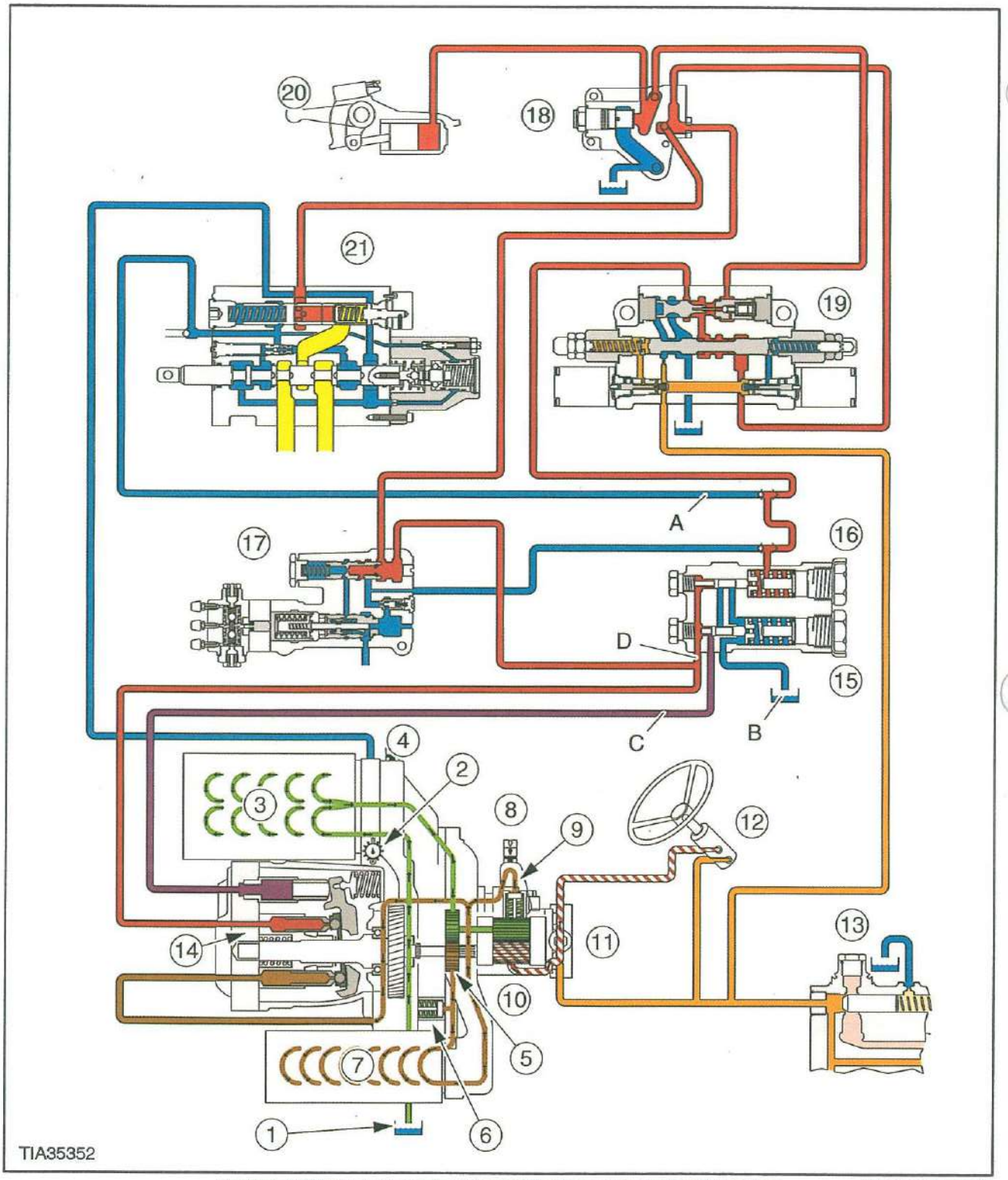
Control of Variable Flow Piston Pump with Closed Center Load Sensing When Limiting Maximum System Pressure (High Pressure Standby)

1. Pump Intake
2. Intake Filter Filter Low Temperature Switch (Prevents Intake Filter restriction Light Operating when Oil Temperature Below 104°F, 40°C)
3. Intake Filter
4. Intake Filter Restriction Switch
5. Charge Pump
6. Charge Pressure Filter Dump Valve
7. Charge Pressure Filter
8. Low Charge Pressure Switch
9. Charge Pressure By–Pass Valve
10. Steering and Low Pressure Circuit Pump
11. Steering Flow Control Valve
12. Steering Motor
13. Pressure Regulating Valve (Located In Transmission Side Cover)
14. Variable Flow Piston Pump
15. Pressure Compensating Valve
16. Flow Compensating Valve
17. Trailer Brake Valve
18. Manifold and Lift Cylinder Safety Valve
19. Electronic Draft Control Valve
20. Hydraulic Lift
21. Closed Center Remote Control Valve

A Load Sensing Line from Hydraulic Lift, Trailer Brake and Remote Control Valve Circuits
B Return to Sump Gallery from Flow and Pressure Compensating Valves
C Gallery to Swash Plate Servo Piston from Flow and Pressure Compensating Valves
D System Pressure Sensing Gallery to Flow and Pressure Compensating Valves

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Control of Variable Flow Piston Pump with Closed Center Load Sensing When Limiting Maximum System Pressure (High Pressure Standby)

Figure 8-2-12

- Steering System Oil
- System Pressure Oil @ 2750 lbf/in^2 (190 bar)
- Control Pressure Oil
- Charge Pressure Oil 23–50 lbf/in^2 (1.6–3.4 bar)
- Return to Reservoir Oil
- Low Pressure Circuit Oil @ 232–261 lbf/in^2 (16–18 bar)
- Suction Oil
- Lubrication Circuit
- Trapped Oil

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FAULT FINDING

If the hydraulic system is not operating correctly and an error code is not displayed on the instrument panel refer to the following fault finding charts.

Initial Fault Finding Check

Charge Pressure Light Flashing

Hydraulic Lift not Working Correctly

Transmission Low Pressure Warning Light 'On'

Power Steering not Working or Working Incorrectly

Trailer Brakes not Working

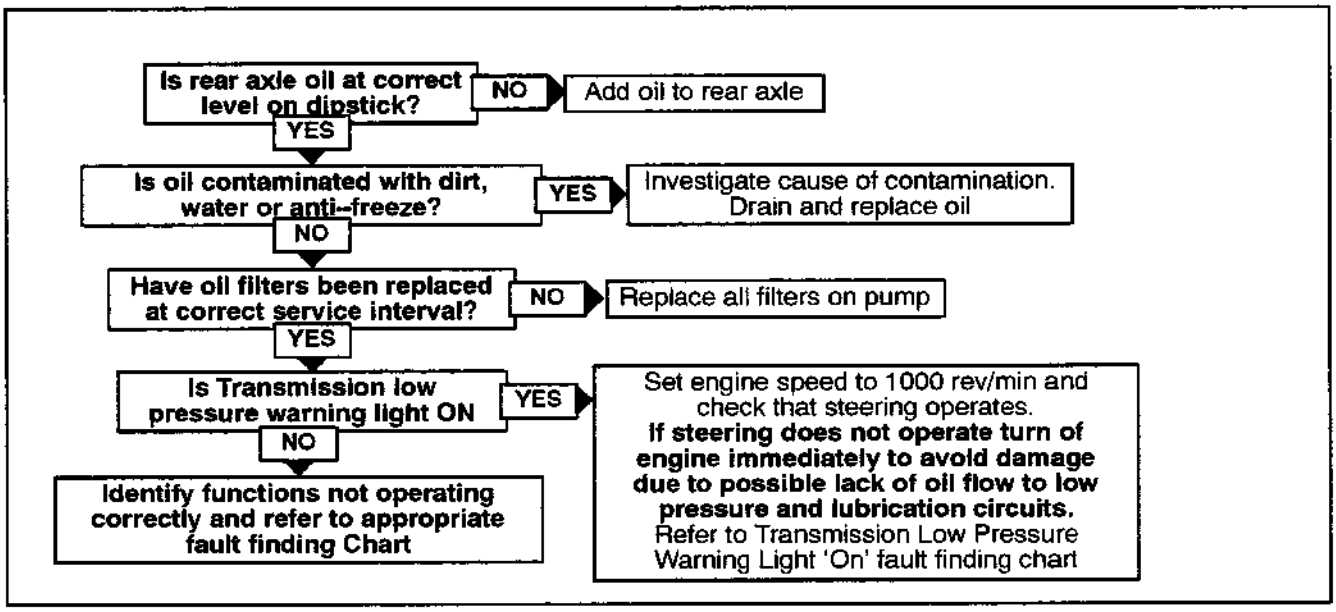
Remote Control Valves not Working

For hydraulic concerns identified by an error code on the instrument cluster, refer to the appropriate fault finding chart in Section 8 Chapter 4, Hydraulic Lift Assembly with Electronic Draft Control.

Before commencing an in depth fault finding procedure it is recommended that reference is made to the initial check fault finding chart which may identify an obvious cause for the concern and prevent unnecessary component disassembly.

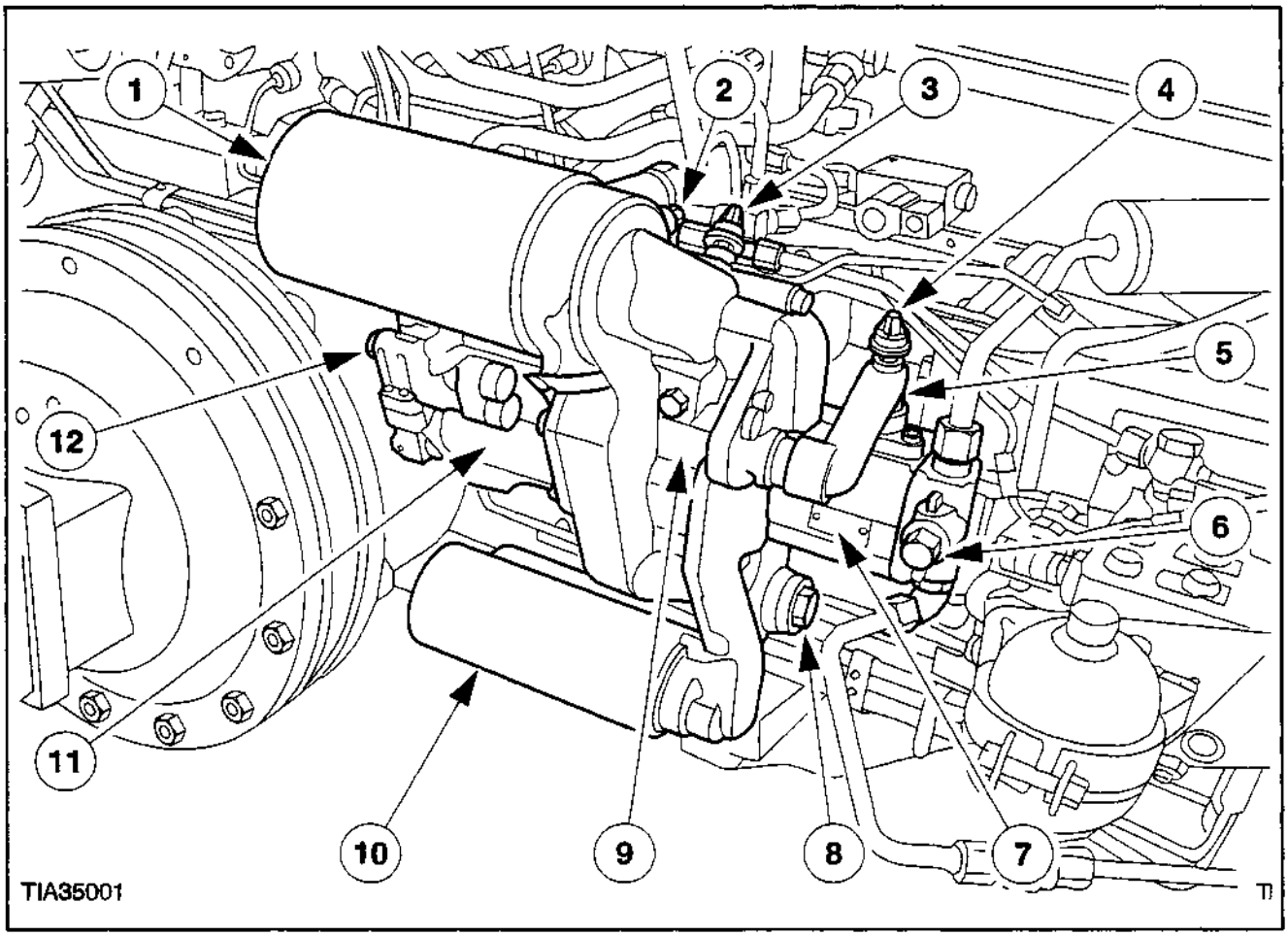
IMPORTANT: *If the steering is inoperative, there will be no lubrication to the transmission or PTO clutch and the tractor must not be run for more than 5 minutes at a maximum engine speed of 1000 rev/min.*

Initial Fault Finding Checks
To be Performed Before Proceeding to General Diagnostic Procedure



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CCLS Hydraulic Pump Installation

Figure 8-2-13

1. Intake Filter
2. Oil Low Temperature Switch
3. Intake Filter Restriction Switch
4. Low Charge Pressure Switch
5. Charge Pressure By–Pass Valve
6. Steering Flow Control Valve
7. Steering and Low Pressure Circuit Pump
8. Charge Pressure Filter Dump Valve
9. Charge Pump
10. Charge Pressure Filter
11. Variable Flow Piston Pump
12. Load Sensing Valve
    (Flow and Pressure Compensating Valves)

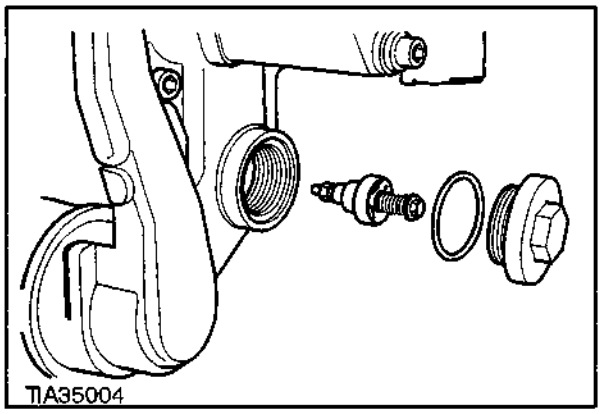


Figure 8-2-14
Charge Pressure Filter Dump Valve

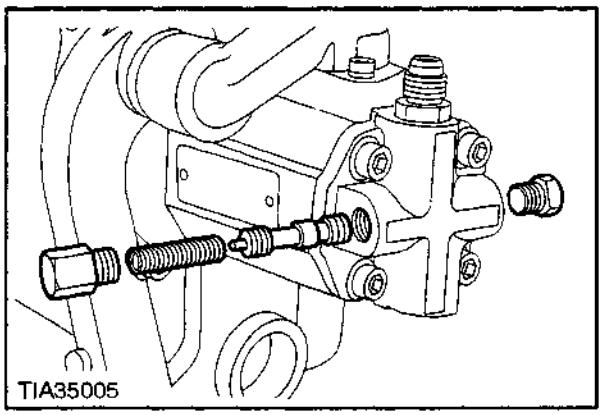
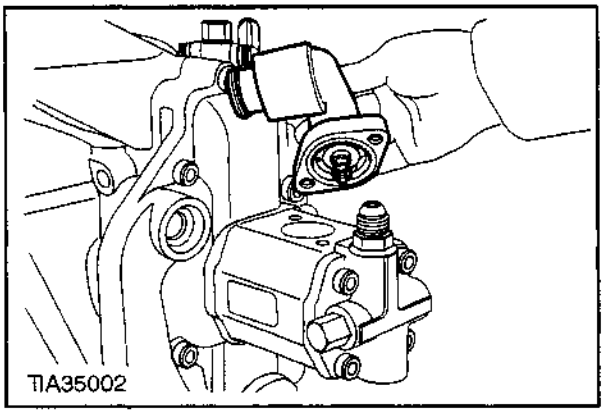


Figure 8-2-15
Steering Flow Control Valve

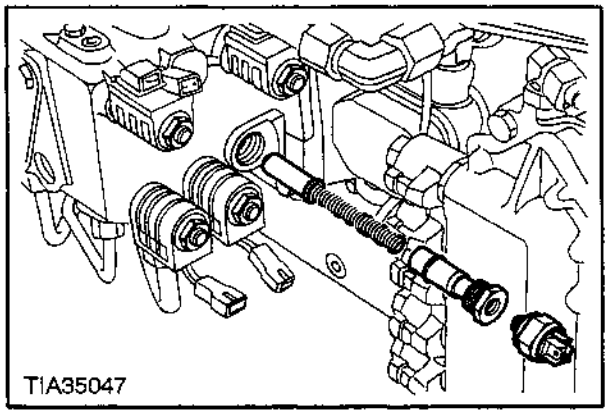
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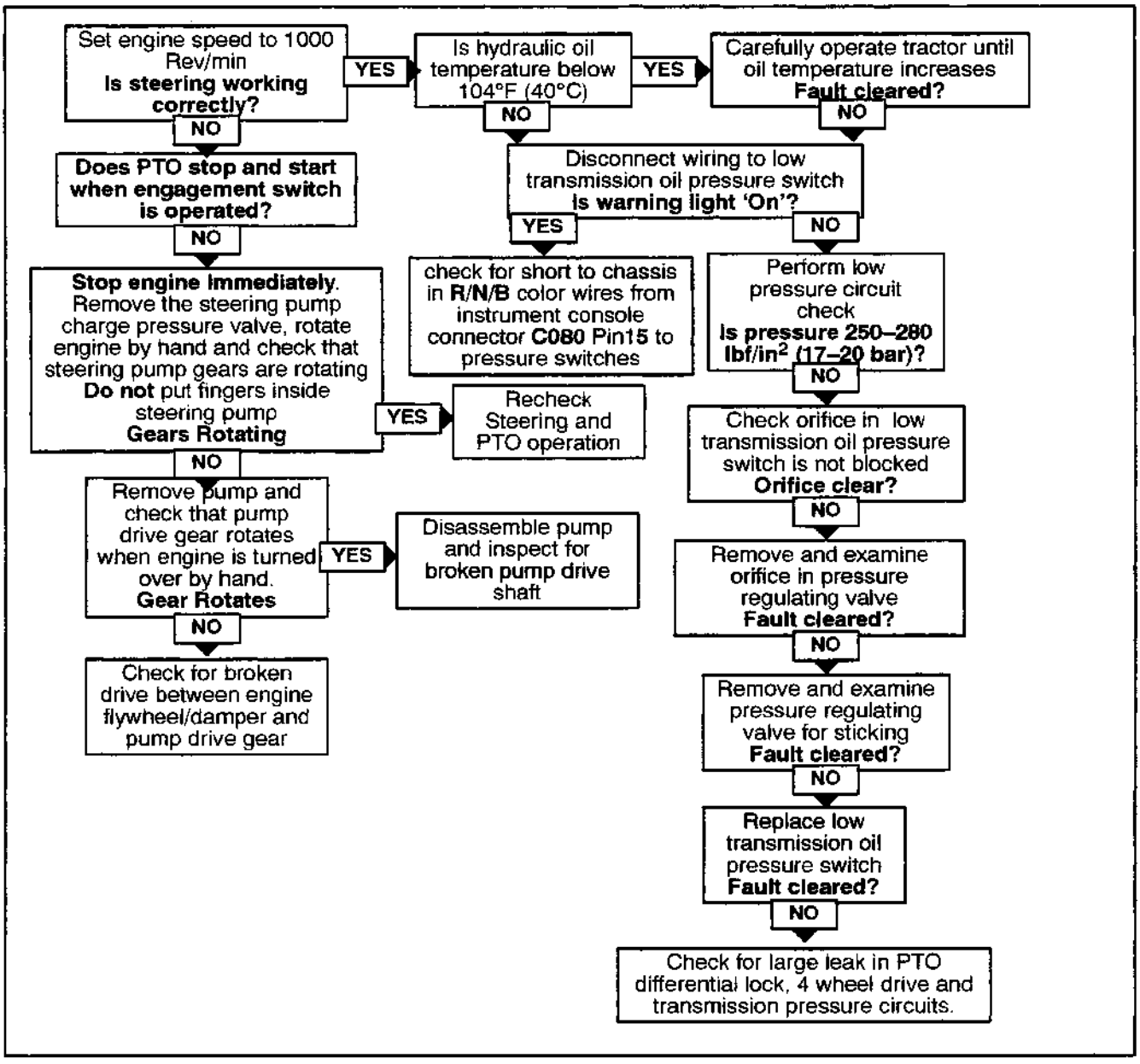
Transmission Low Pressure Warning Light 'ON'



Steering Pump Charge Pressure Valve Removal



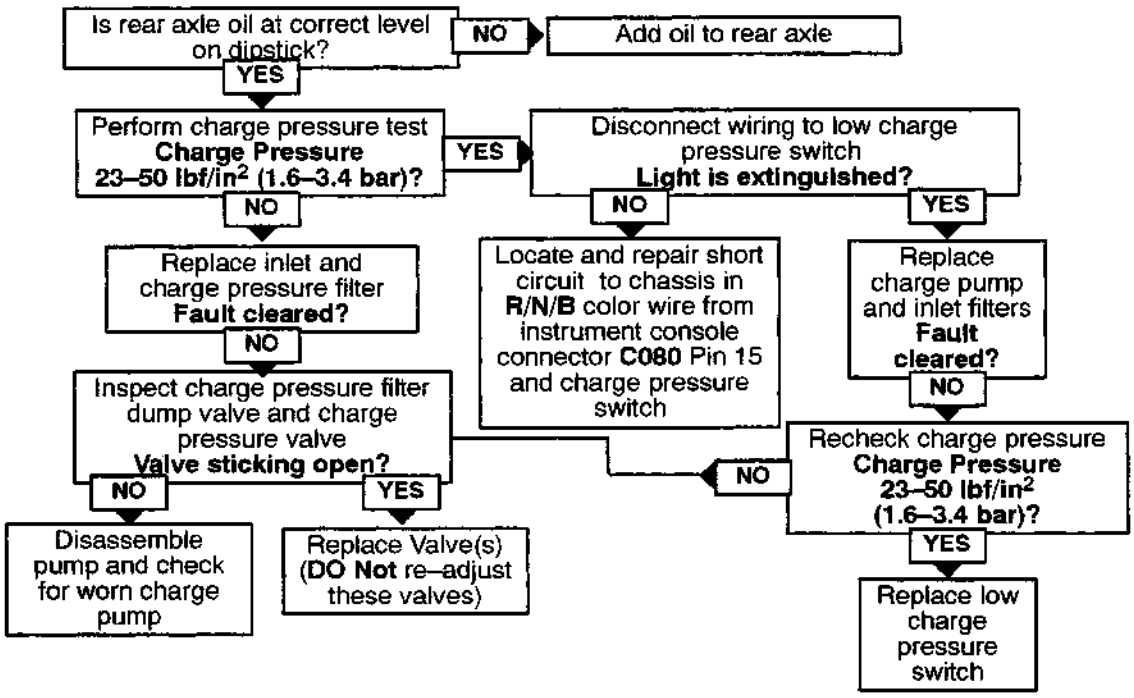
Low Pressure Regulating Valve and Low Transmission Oil Pressure Switch



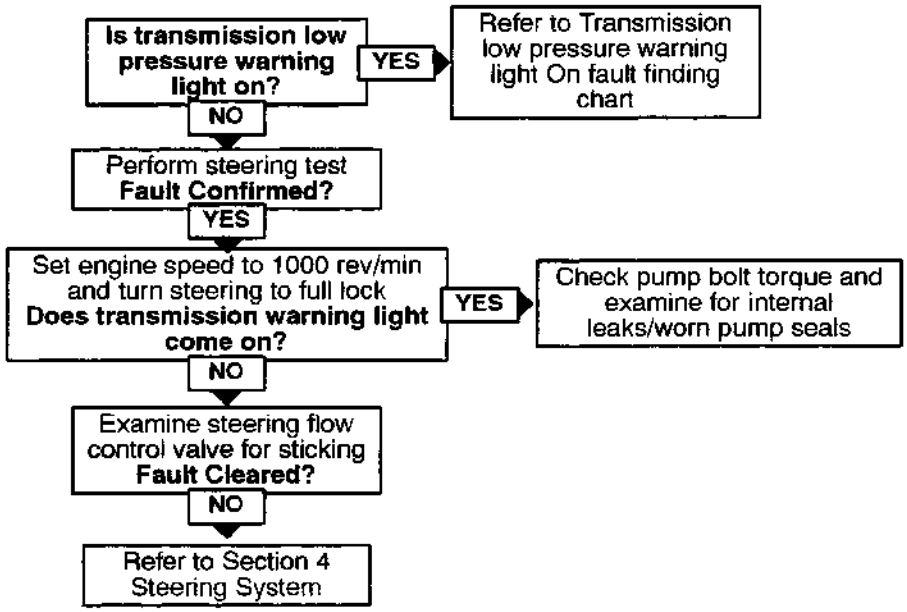
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Charge Pressure Light Flashing



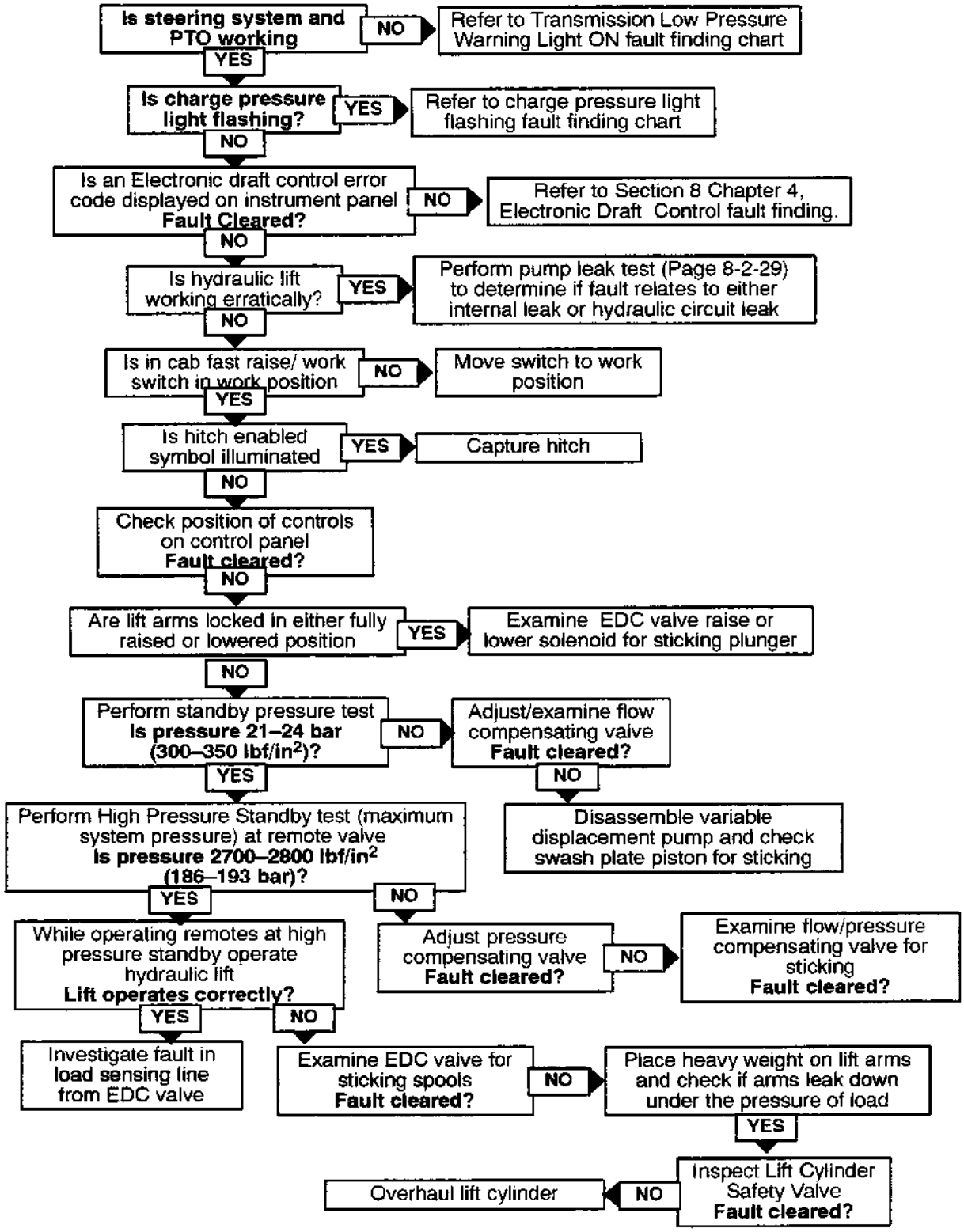
Power Steering Not Working or Working Incorrectly



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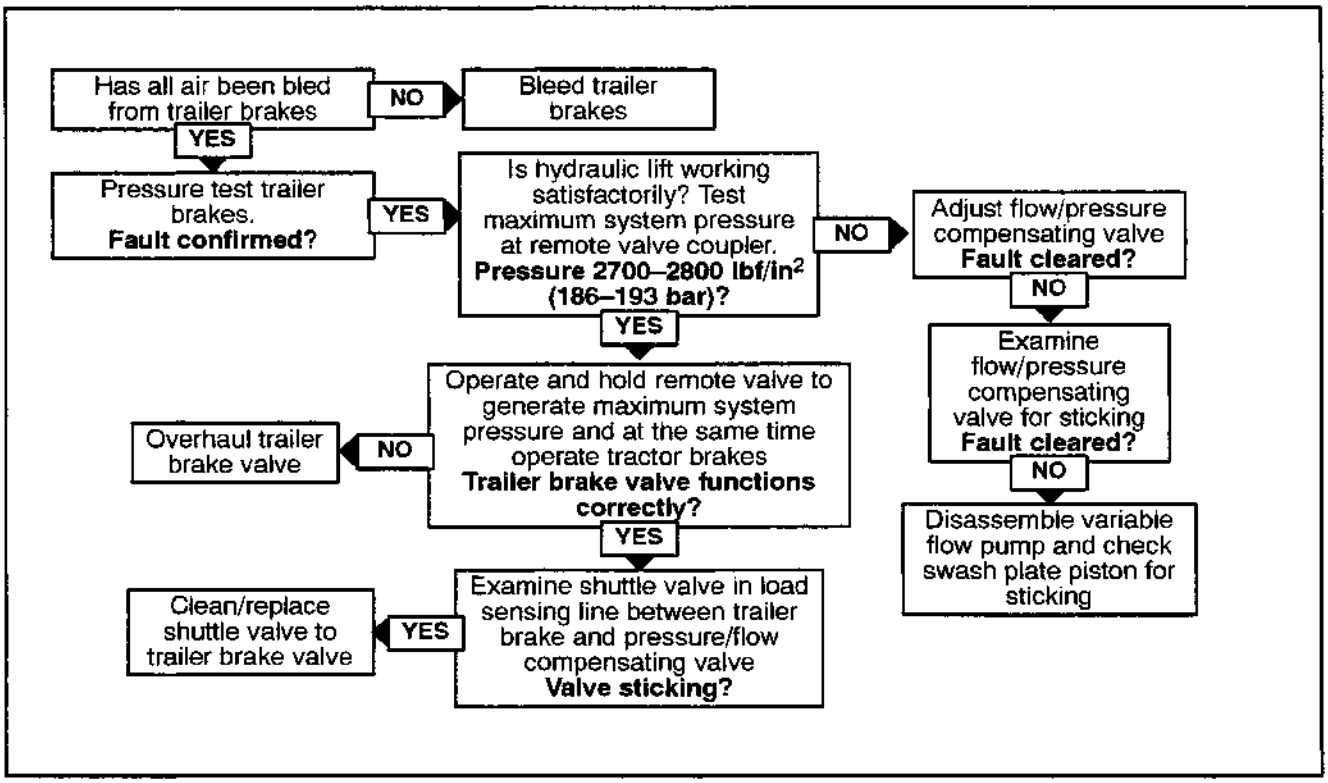
Hydraulic Lift Not Working Correctly



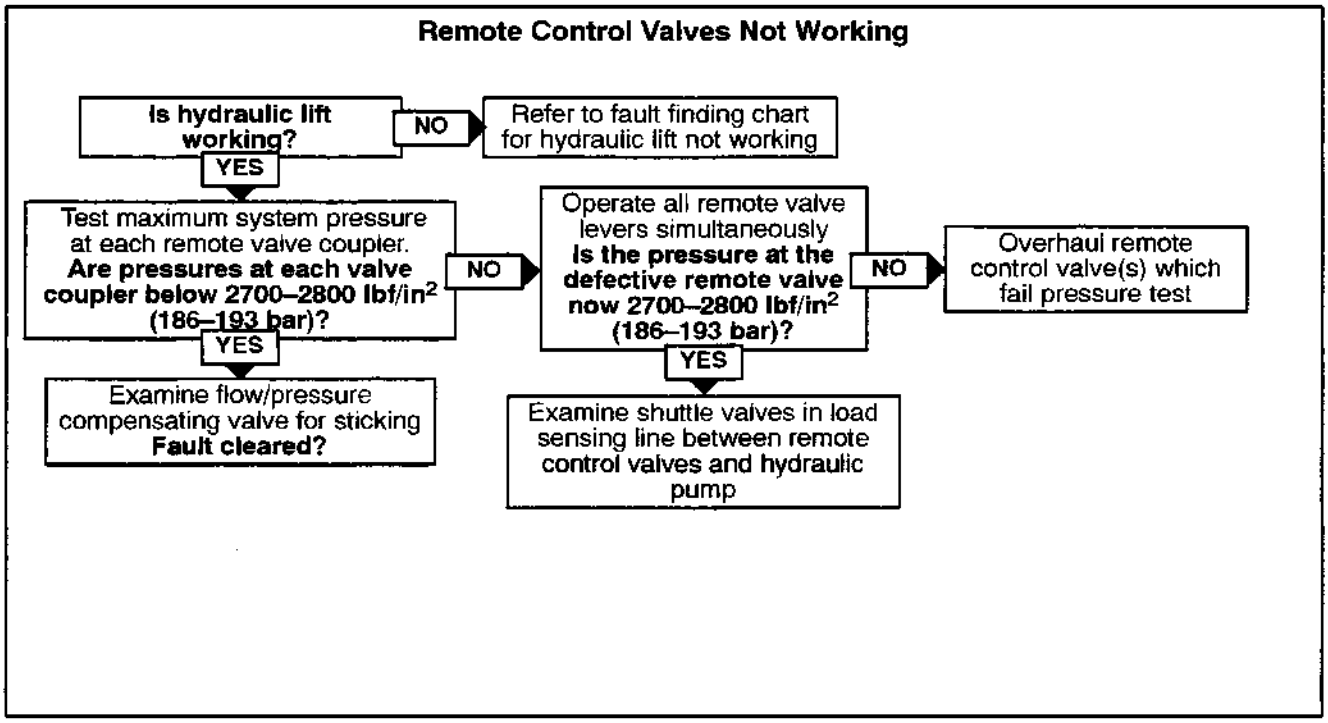
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Trailer Brakes Not Working
NOTE: NOT USED IN NORTH AMERICA



Remote Control Valves Not Working



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PUMP PRESSURE and FLOW TESTING

IMPORTANT: *Before performing any pressure or flow testing operate the tractor until the oil in the rear axle is at normal operating temperature.* 170°F (*75°C*)

LOAD SENSING CIRCUIT TESTS

This test will check operation of the hydraulic circuits and load sensing lines to the trailer brake valve, hydraulic lift and remote control valves.

1. Disconnect load sense line (1) to remote valve number 1. Remove connector (3) from rear of remote valve and install a $^{7}/_{16}$ inch SAE threaded plug (2) into load sense port. Cap open line (1).

Low Pressure Standby

2. Install 0–600 lbf/in^2 (0–42 bar) pressure gauge or if available 0–6000 lbf/in^2 (0–420 bar) Quad gauge (multi range pressure gauge) into lift port of remote valve number 1.

3. Pull and hold remote valve control lever No 1 in the 'extend' position.

4. Vary engine speed between1000–2100 rev/min

5. The pressure reading should be 310–350 lbf/in^2 (21–24 bar) and is the 'Low Pressure Standby. If the tractor is installed with Italian trailer brakes the pressure reading should be 450–500 lbf/in^2 (31–35 bar)

   IMPORTANT: *If a 0–600 lbf/in^2 (0–42 bar) pressure gauge is used* **Do Not** *operate the other remote valves or tractor brakes while remote valve No 1 lever is in operating position, otherwise the system pressure will increase to maximum pressure of 2760* lbf/in^2 *(190 bar) resulting in damage to the pressure gauge.*

   If pressure reading is marginally away from Specification adjust flow compensating valve.

   If reading is high examine flow compensating valve spool for sticking.

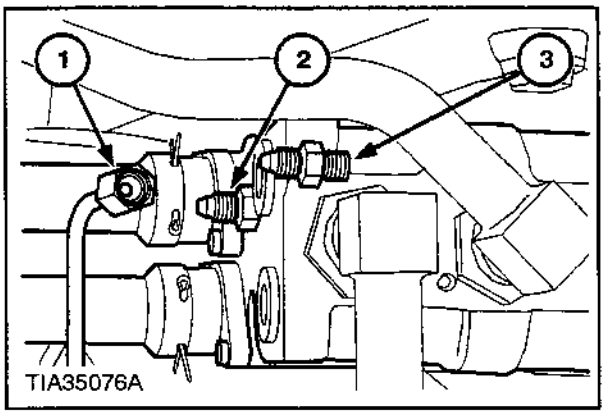


Figure 8-2-16

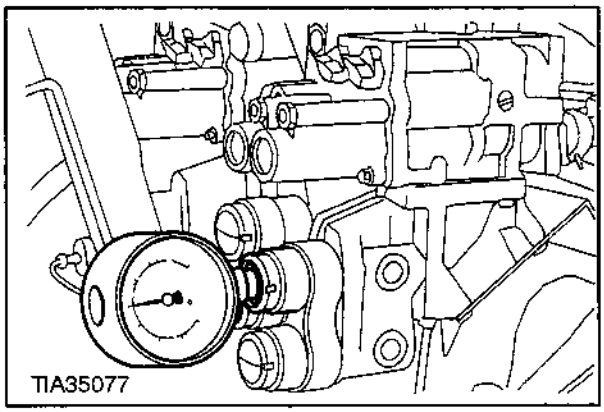


Figure 8-2-17

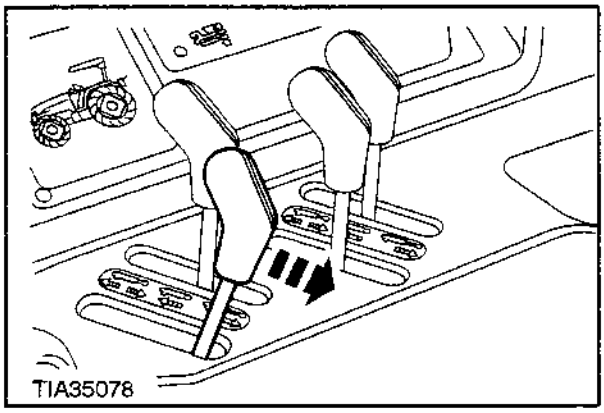


Figure 8-2-18

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Load Sensing Circuit Test

1. Install either a *0–6000* lbf/in^2 *(0–420 bar)* pressure gauge or multi range pressure gauge in the extend port of remote valve No1.

2. Set engine speed to 1500 rev/min.

3. Pull and hold remote valve control lever No 1 in the 'extend' position.

4. While holding remote valve lever No 1 in extend position operate in turn remote valves No 3 and 4, and tractor brakes. As each remote valve is operated the pressure reading should increase from low pressure standby to 2750 lbf/in^2 (190 bar). This is called 'High Pressure Standby'.

   When operating the trailer brake the pressure will rise to a maximum of 2175 lbf/in^2 (150 bar).

   To test the load sensing circuit for remote valves 1 and 2, use remote valve No 3 to install pressure gauge and disconnect load sensing line.

   If pressure readings when operating remote control valves are marginally away from Specification adjust pressure compensating valve.

   If the gauge pressure does not rise when only operating a specific function examine the shuttle valves in the circuit which is not functioning correctly.

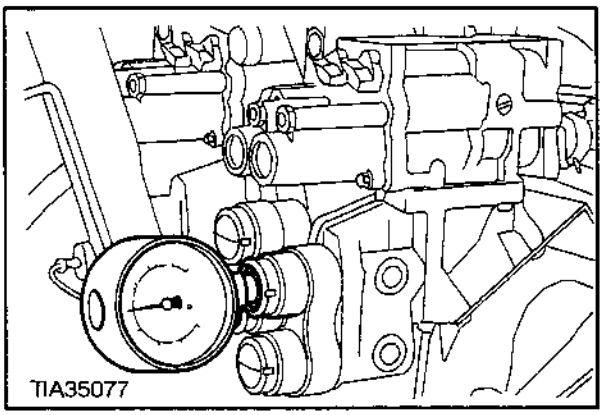


Figure 8-2-19

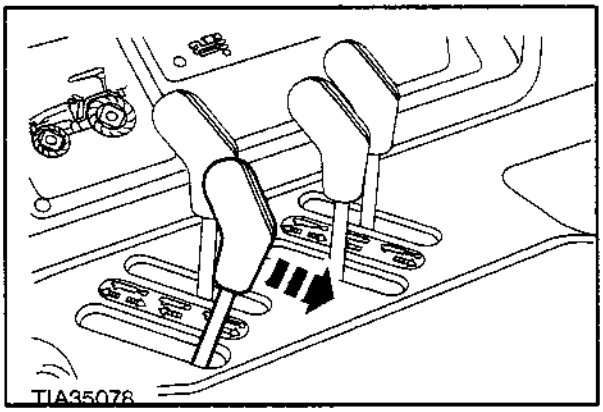


Figure 8-2-20

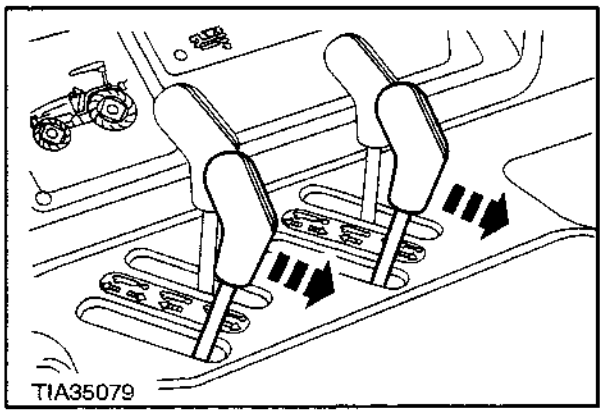


Figure 8-2-21

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Charge Pressure Test

1. Remove charge pressure switch

2. Install 0–100 lbf/in^2 (0–10 bar) pressure gauge (1) using New Holland adaptor 295024 or V.L. Churchill adaptor NH 35 102 (2).

NOTE: *The thread size of the charge pressure switch port is M10 x 1 DIN specification.*

3. Install flow meter between remote valves 1 and 2. Ensure inlet hose of flowmeter is installed into extend port of valve No1.

4. Fully open load valve on flow meter.

5. Set remote valve No 2 in 'Float' position.

6. Set remote valve No 1 in 'Extend' position.

7. Set remote valve flow knobs to maximum flow.

8. Start tractor and set engine speed to 1500 rev/min.

9. Move control lever for remote valve No 1 between extend and neutral position. The charge pressure readings should not vary outside 23–50 lbf/in^2 (1.6–3.4 bar).

If pressure readings below 23 lbf/in^2 (1.6 bar) are recorded replace hydraulic filters and re test.

If after retest charge pressure is still below specification examine both the charge pressure filter dump valve and charge pressure valve before disassembling pump to inspect for wear.

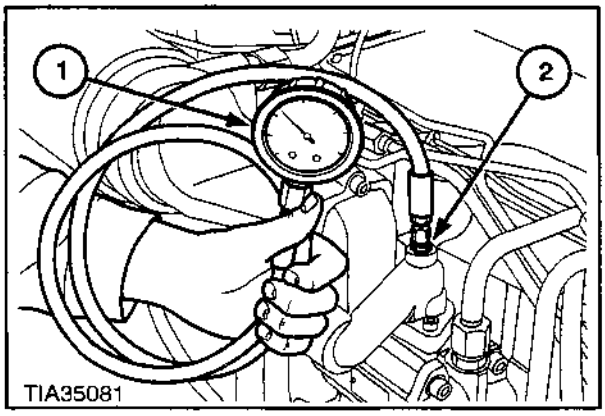


Figure 8-2-22

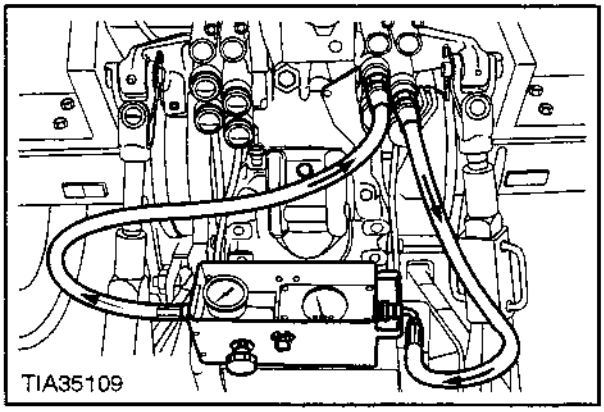


Figure 8-2-23

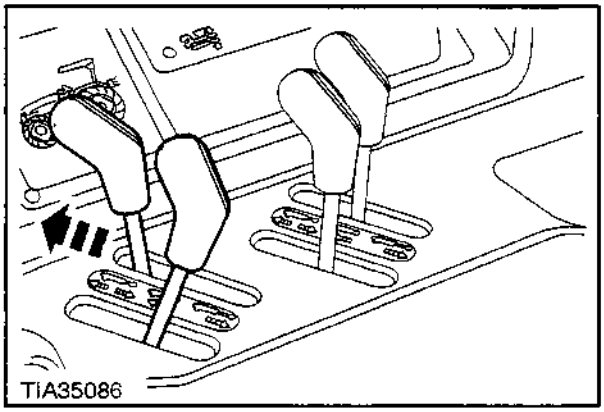


Figure 8-2-24

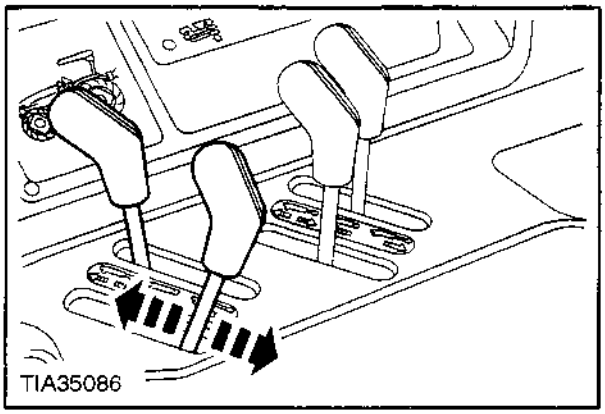


Figure 8-2-25

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Variable Flow Piston Pump Flow Test

To flow test the variable flow piston pump it is recommended that the output is checked at the remote valves.

1. Install flow meter between inlet ports of remote valves 1 and 2.

2. Set flow control knobs to maximum flow.

3. Ensure load valve on flow meter is fully 'Open'.

4. Set tractor engine speed to 1100 rev/min.

5. Set remote valve No 2 in 'Float' position and remote valve No 1 in 'Extend' position.

6. Adjust load on flow meter until the pressure and flow gauges start to fluctuate and the remote valve lever returns to neutral, approximately 2140–2350 lbf/in^2 (148–162 bar).

7. Open flowmeter load valve sufficiently to enable remote lever to remain in extend position and record flow.

8. If the reading recorded is 12 gal/min (45 Ltr/min) at 2000 lbf/in^2 (13.8 bar) then pump flow is to specification.

NOTE: *This test is performed at half maximum rated speed and assumes that pump flow at rated speed is twice that measured in the test.*

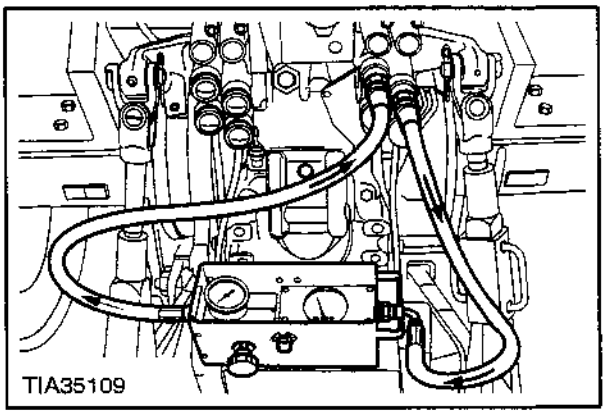


Figure 8-2-26

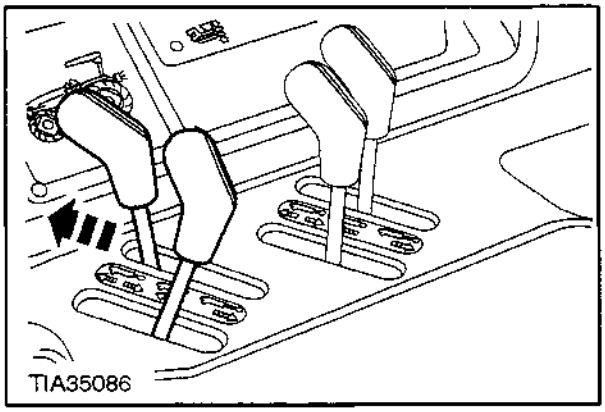


Figure 8-2-27

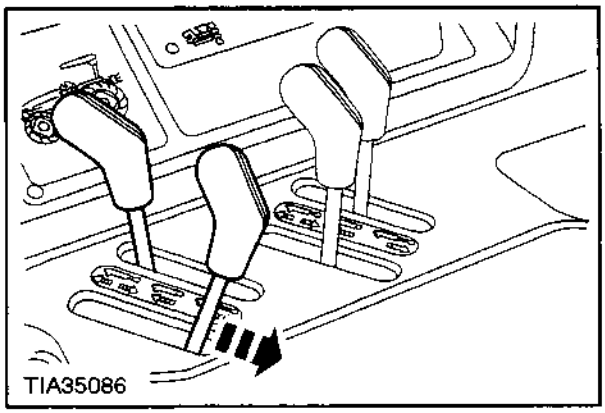


Figure 8-2-28

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Steering Pump/Low Pressure Pump Test

There is no relief valve in the steering/low pressure circuit pump. The following practical test will determine if steering pump output is sufficient to allow satisfactory operation of the steering system.

Steering Test

1. Set engine speed to 1100 rev/min.

2. Turn steering quickly from lock to lock.

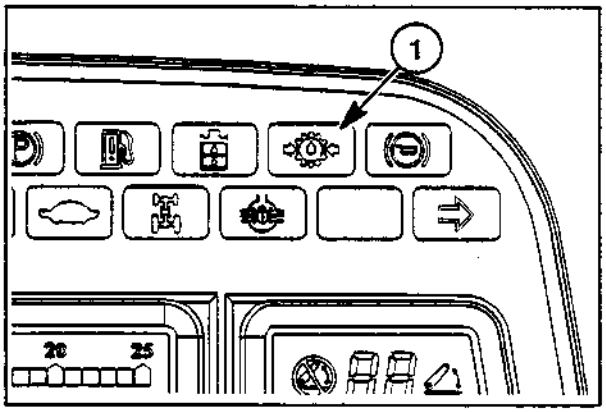


Figure 8-2-29

If steering is operating correctly the reaction should be immediate with no time delay between turning the steering wheel and movement of the wheels. At full lock the relief valve in the steering motor should be heard to blow and the engine speed drop to approximately 970 rev/min.

If transmission low pressure warning light comes on when the steering is held on full lock this is an indication that the pump has developed an internal leak. Check torque of pump mounting bolts and if tight examine pump for leaking seals or wear.

Hydraulic Pump Leak Test

The hydraulic pump leak test should be performed whenever operation of the hydraulic system is erratic or the pump is extremely noisy.

The purpose of the test is to, ascertain if the malfunction of the system is due to an internal pump leak or alternatively the ingress of air due to a leak through a component in the system.

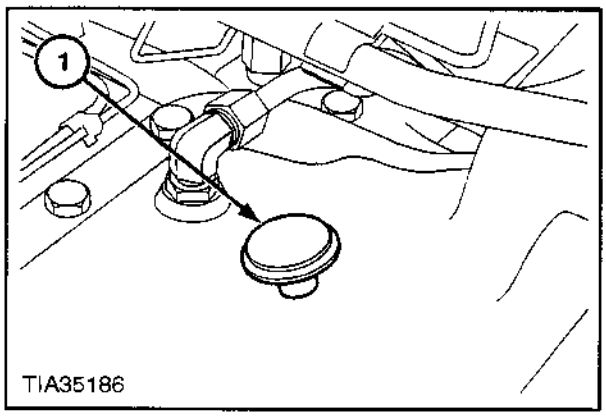


Figure 8-2-30

1. Remove the breather (1) from the top of the hydraulic lift cover and using suitable locally manufactured adaptor attach approximately 4.9 ft ($1^1/_2$ meters) of clear plastic tubing.

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2. Position the tubing so that it forms a 'U' (Similar to a manometer) and fill the tube with sufficient oil to prevent the ingress of air through the tube.

3. Set tractor engine speed to 1000 rev/min and pull and hold remote valve lever

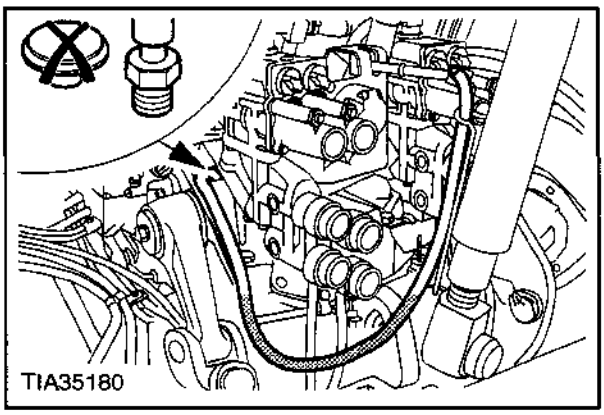


Figure 8-2-31

If the hydraulic pump has an internal leak bubbles will appear in the oil trapped in the plastic tube.

If the hydraulic circuit has an external leak the oil in the 'U' of the plastic tube will be pushed towards the open end of the tube by the air being drawn into the transmission casing through the pump.

⚠ WARNING ⚠

If the leak is excessively large it is possible for the oil to be projected out of the tube. Take care to position the tube so not to cause injury or project oil into the work area.

If an external leak is diagnosed use an 'oil can' to selectively apply a film of oil around the joints of the circuit. For example remote valve tubing joints. When the oil is applied to the leaking joint the noise in the pump will cease.

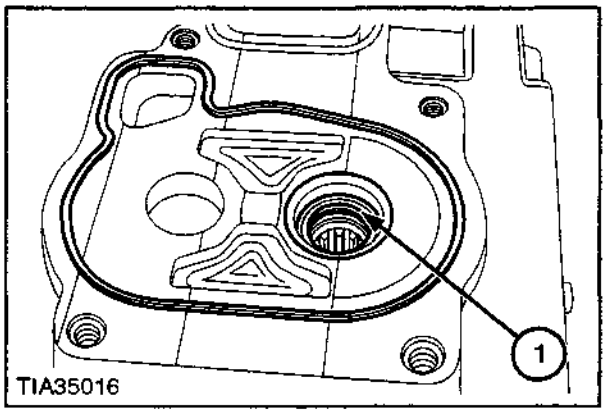


Figure 8-2-32

If an internal leak is identified inspect mounting face at pump intake port, Pump drive shaft seal assembly, Figure 8-2-32 or intake tube in transmission for missing or damaged 'O' ring, Figure 8-2-33.

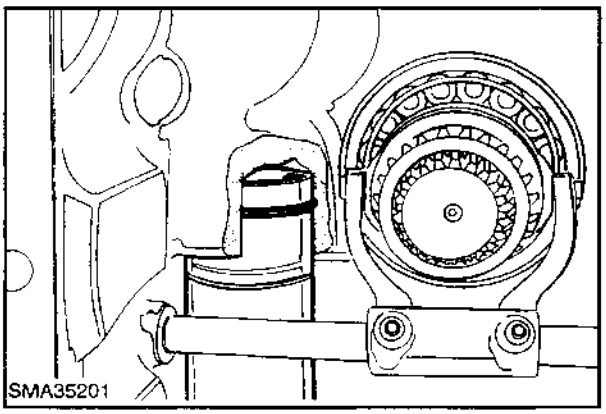


Figure 8-2-33

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A. OVERHAUL

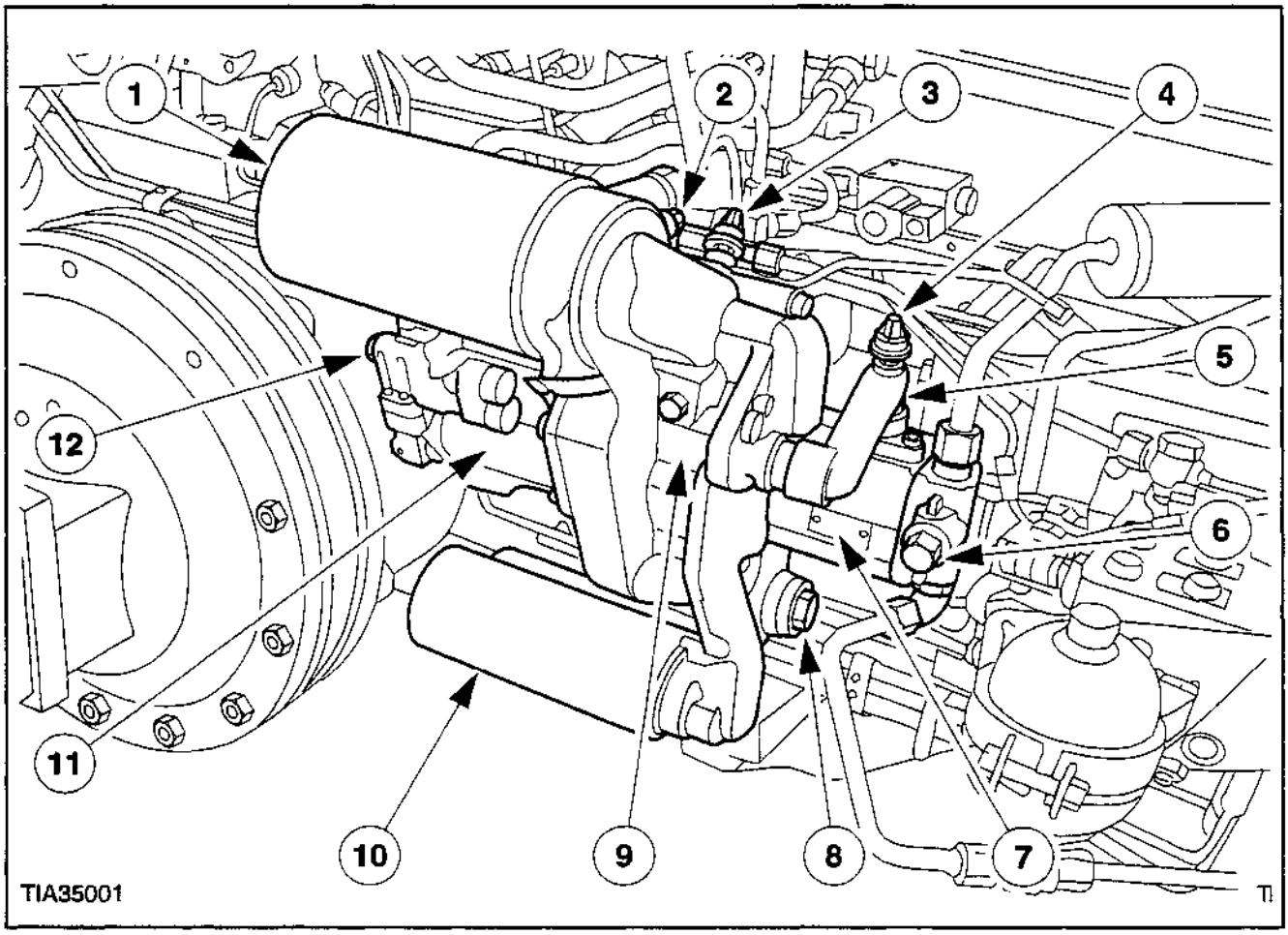


Figure 8-2-34

CCLS Hydraulic Pump Installation

1. Intake Filter
2. Oil Low Temperature Switch
3. Intake Filter Restriction Switch
4. Low Charge Pressure Switch
5. Charge Pressure By–Pass Valve
6. Steering Flow Control Valve
7. Steering and Low Pressure Circuit Pump
8. Charge Pressure Filter Dump Valve
9. Charge Pump
10. Charge Pressure Filter
11. Variable Flow Piston Pump
12. Load Sensing Valve (Flow and Pressure Compensating Valves)

This procedure describes the overhaul of the complete pump assembly when removed from the tractor. The following items however can be serviced with the pump installed on the tractor.

- Charge Pressure Valve
- Charge Pressure Filter Dump Valve
- Low Charge Pressure Switch
- Steering Flow Control Valve
- Pressure and Flow Compensating Valves
- Steering Pump Assembly

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Charge Pressure Valve

1. Remove charge pressure valve manifold from steering pump.

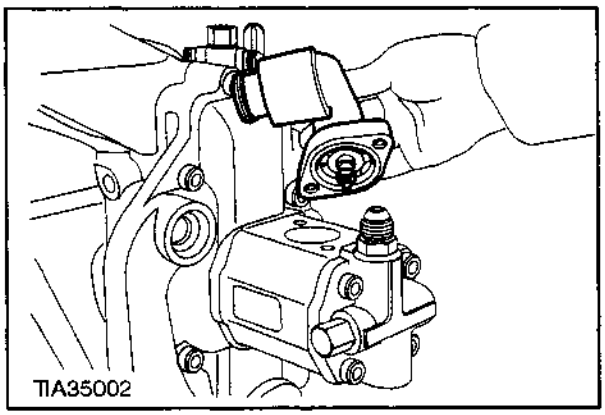


Figure 8-2-35

2. Remove circlip (2) and using New Holland Tool No 295025 or V. L. Churchill Tool No 4FT 857 unscrew valve (3) from manifold (1).

NOTE: *If during pressure testing the charge pressure reading is away from specified value of 23–50 lbf/in^2 (1.6–3.4 bar) both the charge pressure valve and charge pressure filter dump valve must be examined for faulty operation.* ***Do Not*** *attempt to adjust the valves which is supplied as a pre–set assemblies and should not be adjusted.*

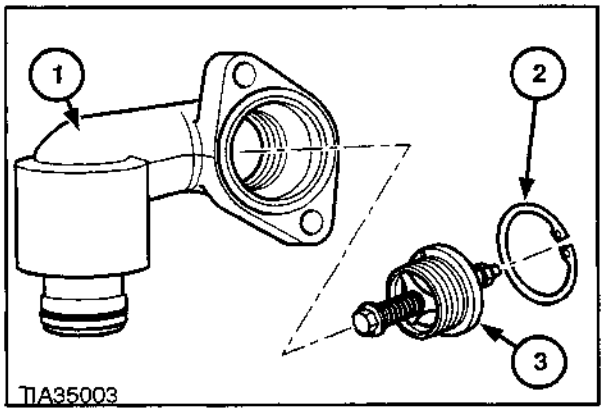


Figure 8-2-36

Charge Pressure Filter Dump Valve

1. Remove Plug (1) and O ring (2).

2. Using Tool New Holland Tool No 295025 or V. L. Churchill Tool No 4FT. 857 unscrew valve (3) from pump body.

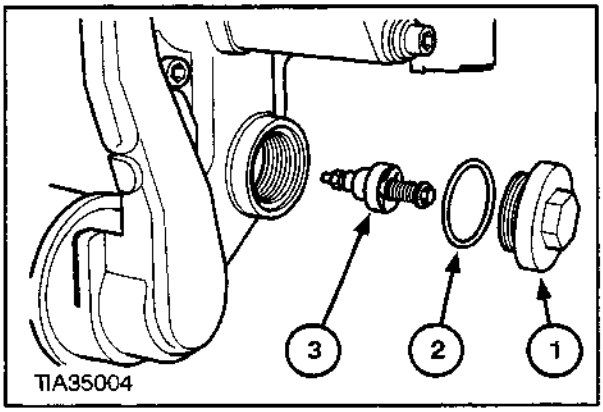


Figure 8-2-37

Steering Flow Control Valve

1. Unscrew plugs (1) and (4) and remove spring (3) and spool (2).

2. Inspect spool for wear or damage. If damaged it is necessary to replace both spool and steering pump end plate.

3. Lubricate spool with clean hydraulic oil prior to re–assembly.

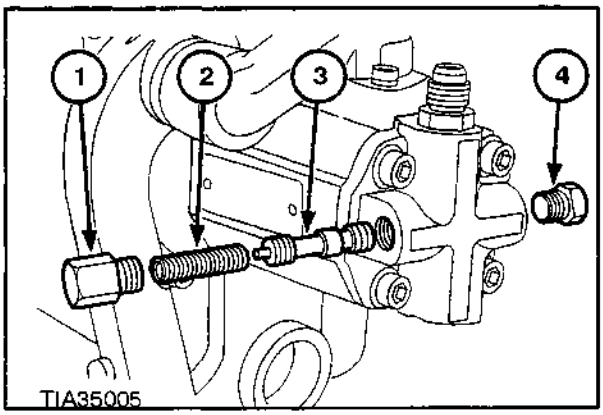


Figure 8-2-38

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Pressure and Flow Compensator Valve

1. Disconnect load sense line connection (1) and remove pressure and flow compensating valve assembly (2).

2. Remove the tamper proof caps, carefully unscrew each adjuster and remove the component parts.

3. To ensure correct re–assembly keep the component parts for each valve separate.

NOTE: *The stem on the flow compensating spool is longer than that on the pressure compensating spool.*

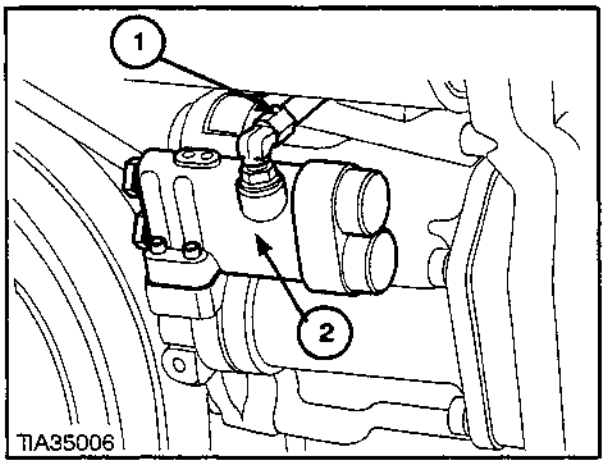


Figure 8-2-39

IMPORTANT: *Due to extreme spring pressure within valves DO NOT remove rear plugs until the adjusters have been removed.*

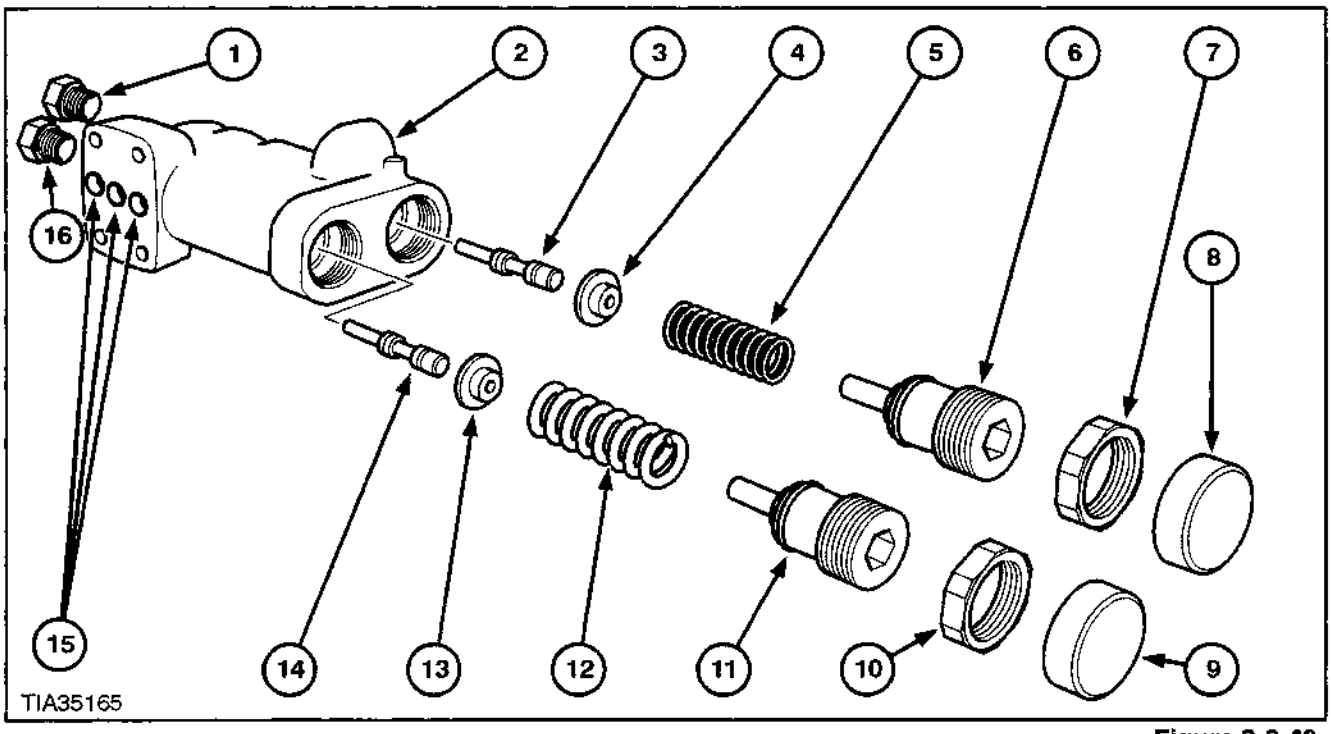


Figure 8-2-40

Flow and Pressure Compensating Valves

1. Plug and 'O' Ring
2. Housing
3. Flow Compensating Spool
4. Seat
5. Spring
6. Adjuster and 'O' Ring Seal
7. Locknut
8. Tamperproof Cap
9. Tamperproof Cap
10. Locknut
11. Adjuster and 'O' Ring Seal
12. Spring
13. Seat
14. Pressure Compensator Spool
15. 'O' Ring Seals
16. Plug and 'O' Ring

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Re–assembly of the valves follows the removal procedure in reverse. On re–assembly observe the following:–

- Wash all components in a suitable solvent.
- Examine all components for wear or damage. If the spools are damaged it is necessary to replace the complete valve assembly.
- Lubricate all parts with clean hydraulic oil.
- To aid re–assembly of pressure and flow compensating valves, the spools should be inserted into the rear of the housing.

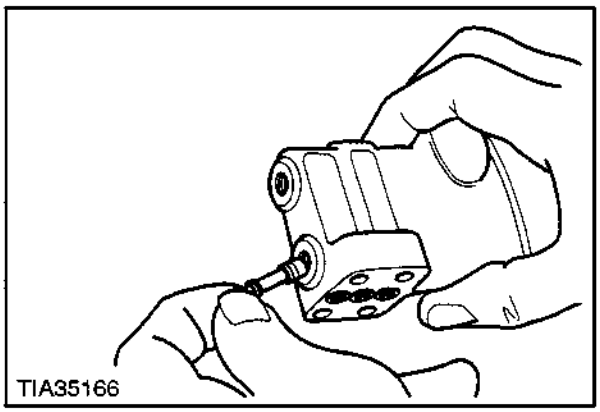


Figure 8-2-41

- Tighten all plugs and locknuts to the correct torque as detailed in Specifications.
- When installing valve on pump ensure all 'O' ring seals are correctly installed.
- Pressure test the pump and adjust the pressure and flow compensating valves to the correct specification as detailed in Pressure Testing Section of this Chapter.

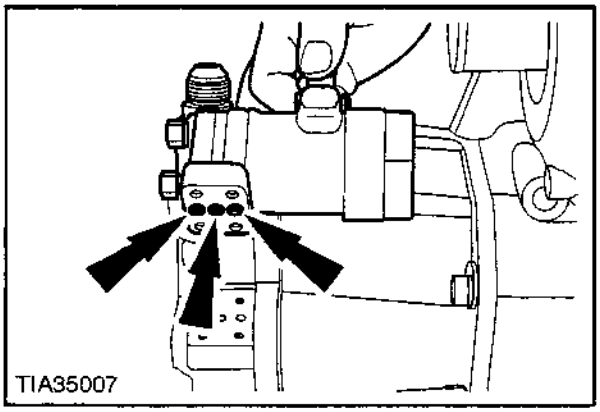


Figure 8-2-42

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PUMP REMOVAL

1. Securely support the tractor on suitable axle stands and remove the right hand rear wheel.

2. Remove oil filters.

NOTE: *To prevent excessive loss of oil loosen intake filter by approximately one turn and leave for one minute to allow oil in filter to drain into sump.*

3. Disconnect all electrical and hydraulic connections to pump.

4. Ensure lubrication pipe banjo connector (1) and brake line retaining bracket (2) are disconnected from pump body.

5. If ground speed PTO is fitted remove interlock safety switch and bracket from pump mounting boss.

6. Manufacture from M12 x 1.25 bolts two alignment dowels to assist in removing/ installing pump on tractor. Cut a screwdriver slot across the end face of each dowel.

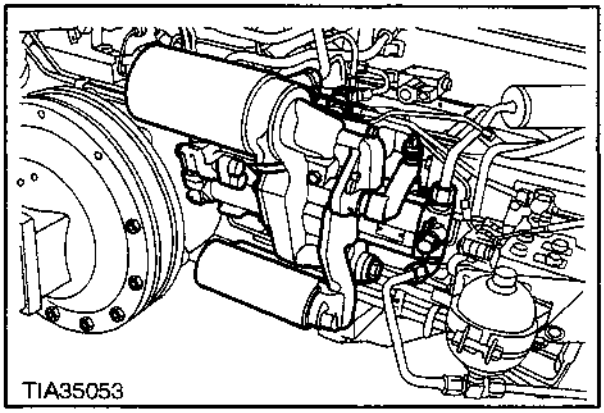


Figure 8-2-43

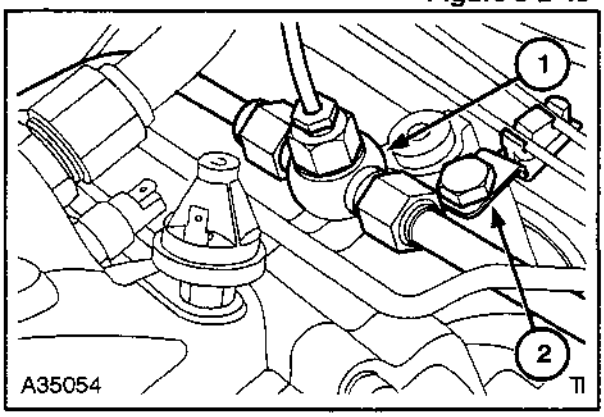


Figure 8-2-44

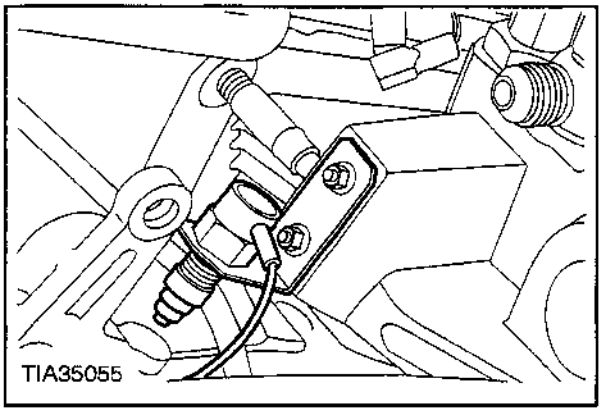


Figure 8-2-45

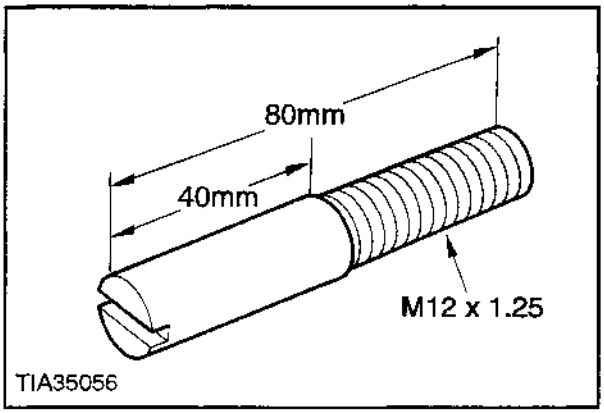


Figure 8-2-46

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7. Remove upper pump retaining bolts and install the two locally manufactured alignment dowels.

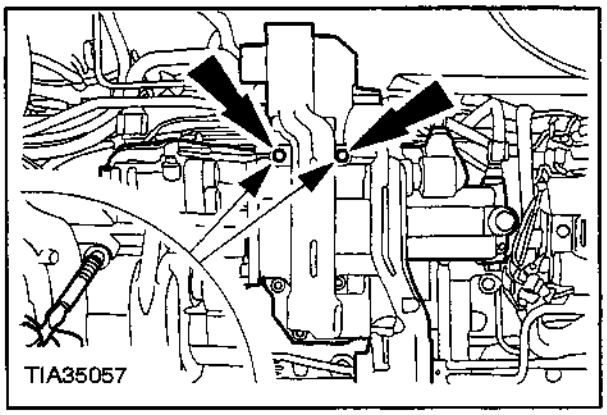


Figure 8-2-47

8. Remove three lower retaining bolts.

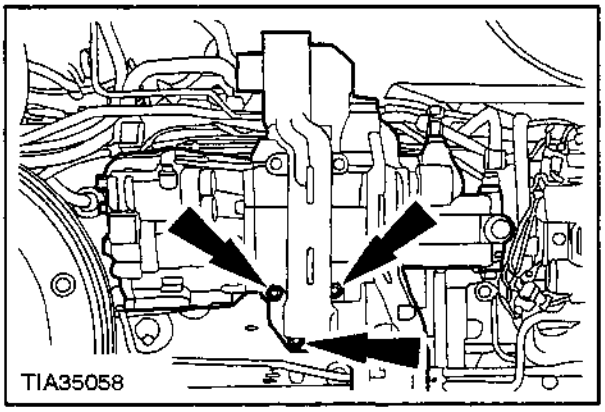


Figure 8-2-48

9. Remove pump from tractor.

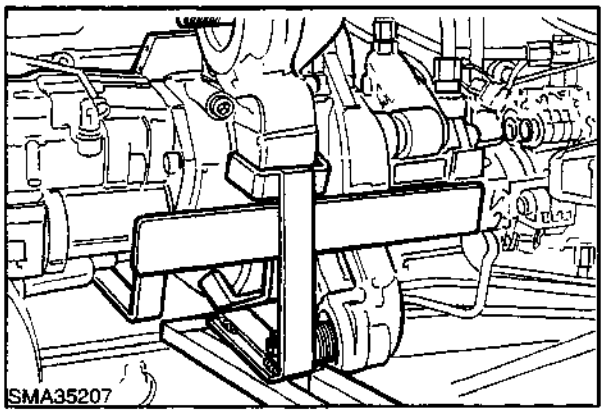


Figure 8-2-49

Alternatively use a locally manufactured support tool (1) and use suitable trolley jack to remove pump, Figure 8-2-50.

⚠ WARNING ⚠

The hydraulic pump is a heavy component and weighs 90 ft. lbs. (40 kgf). It is important that it is securely supported when being removed from the tractor.

NOTE: *Use a drip tray to collect the small volume of oil that may be lost from the transmission during removal of the pump.*

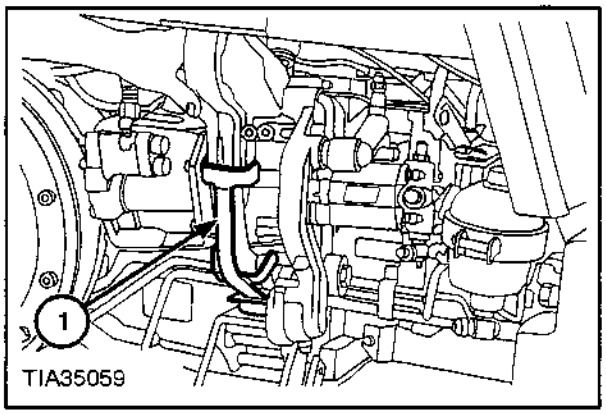


Figure 8-2-50

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INSTALLATION

1. Ensure 'O' ring (1) is correctly positioned around drive gear retaining pin and pump alignment dowels are not damaged.

   Two different types of dowel installation are used, either solid dowels as shown or ring dowels located around top and bottom pump mounting bolts. If dowels are damaged always replace with the same type as originally installed on the tractor.

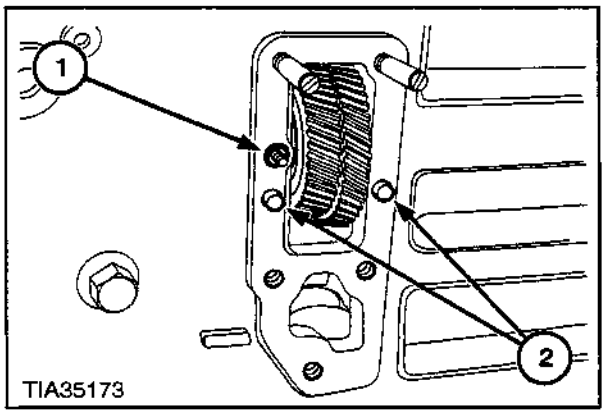


Figure 8-2-51

2. Clean mating face of pump and transmission and apply sealer to transmission face.

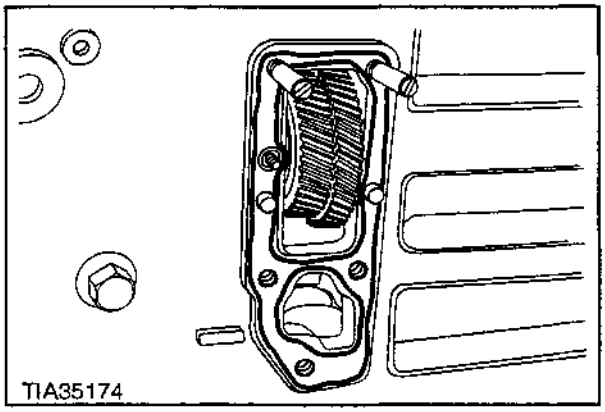


Figure 8-2-52

3. Ensure alignment dowels are installed. The use of the alignment dowels is an important requirement when positioning the pump onto the transmission housing.

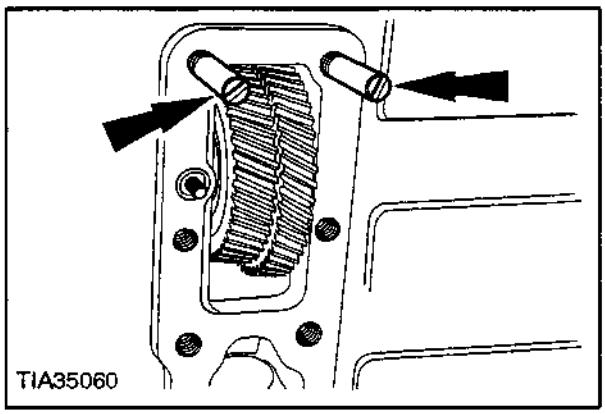


Figure 8-2-53

4. Install pump using the removal procedure in reverse.

5. After installation ensure pump retaining bolts are tightened to a torque of 56–66 ft. lbs. (76–90Nm).

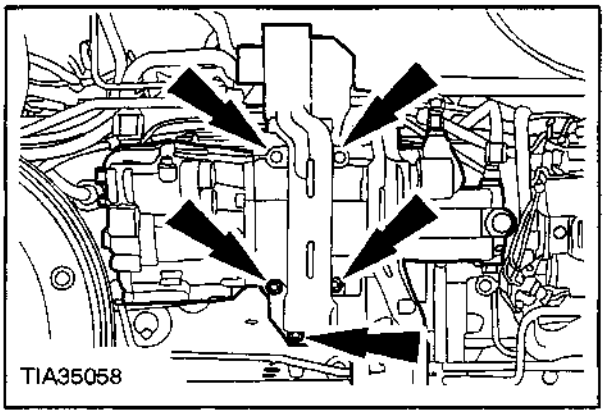


Figure 8-2-54

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Steering Pump Overhaul

The steering pump (2) if required can be serviced with the Variable Flow CCLS hydraulic pump assembly installed on the tractor. Access to remove the pump is however restricted and it is recommended that wherever possible the steering pump is serviced when the complete pump assembly is removed.

For overhaul of the steering flow control valve (1) refer to Page 8-2-32.

1. Remove end plate. Observe installation of end plate and bearing block to ensure correct re–assembly.

2. Pull steering pump from housing and observe position of seals in bearing block.

   NOTE: During removal of end plate and pump housing take care not to loose alignment dowels.

3. Disassemble pump as shown in Figure 8-2-58.

4. Wash all components in a degreasant and dry thoroughly.

5. Examine each bearing block for wear. Light score marking should be removed by placing a sheet of '0' grade emery paper, lubricated with paraffin, on a truly flat surface, then polish the bearing face using a light rotary motion. Bushings within the bearing blocks may show a bronze color but are worn beyond acceptable limits if the bronze color can be seen over the full length of the bushing.

6. Inspect pump bodies for wear and damage. It is normal for gears to cut a light track on the inlet side of the body bore and providing the depth of the track does not exceed 0.004 in (0.10 mm), the body is re–usable.

NOTE: *If pump gears or bearing blocks are worn and require replacement the complete pumping element must be replaced as an assembly.*

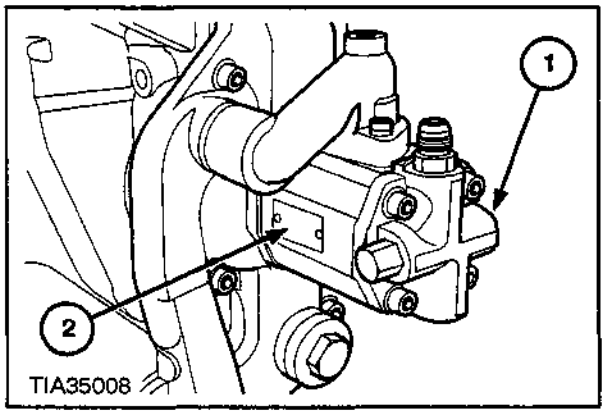


Figure 8-2-55

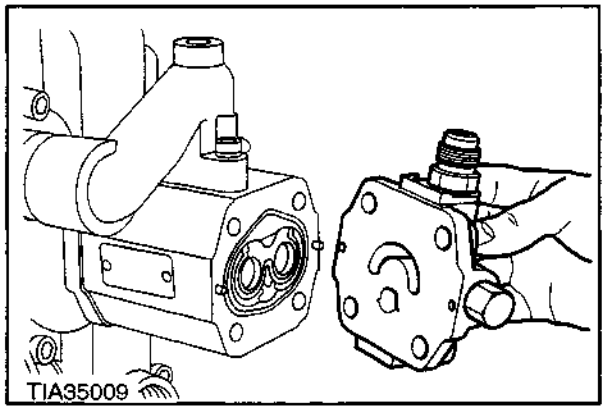


Figure 8-2-56

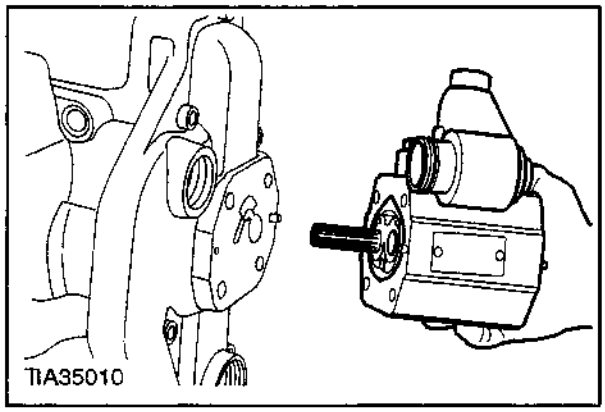


Figure 8-2-57

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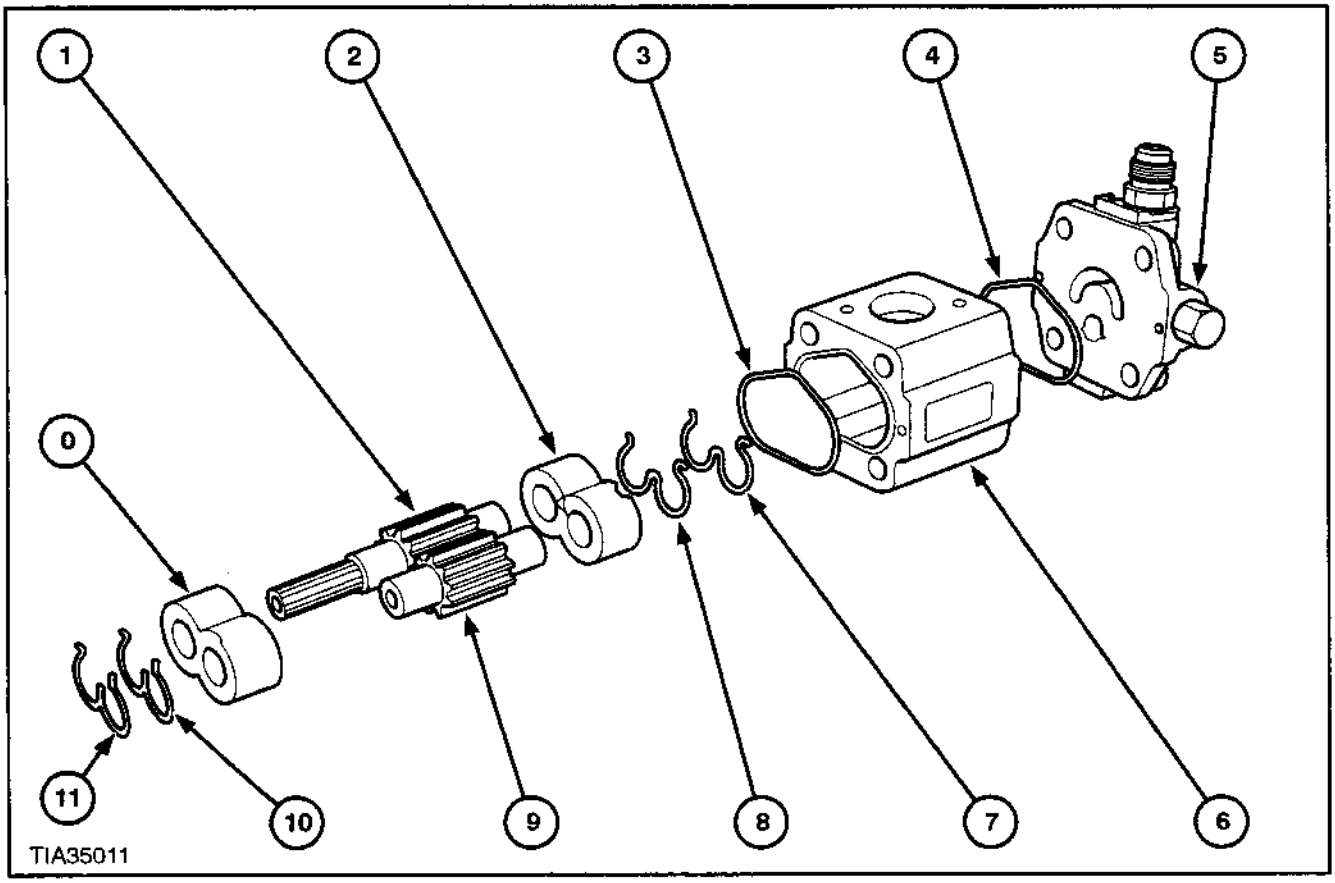


Figure 8-2-58

Steering Pump Assembly Exploded View

1. Drive Gear
2. Bearing Block
3. Seal
4. Seal
5. End Plate
6. Pump Housing
7. Plastic Back–up Seal
8. Seal
9. Driven Gear
10. Seal
11. Plastic back–up Seal
12. Bearing Block

IMPORTANT: *When servicing the pump gears, particular attention must be paid to the following points:*

- *The width of each gear set must be within 0.0002 in. (0.005 mm) of each other to ensure satisfactory pump efficiency.*
- *Journals must be within 0.0005 in. (0.013 mm) of each other.*
- *Gear faces must be flat. This feature may be checked by blueing a bearing face and rotating against the gear. This check will also reveal any sharp edges on the teeth.*

7. Install new seals and 'O' rings. When installing seals in the bearing block ensure that the plastic back–up seal (1) is correctly positioned in the rubber seal (2).

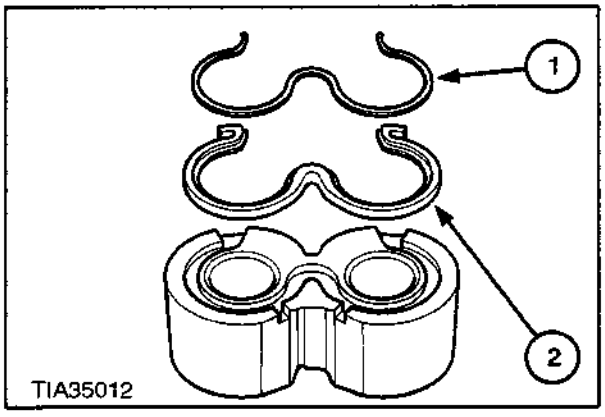


Figure 8-2-59

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Charge Pump Overhaul

1. Remove hydraulic pump assembly from tractor as described on Page 8-2-35

2. Remove 6 bolts securing charge pump housing.

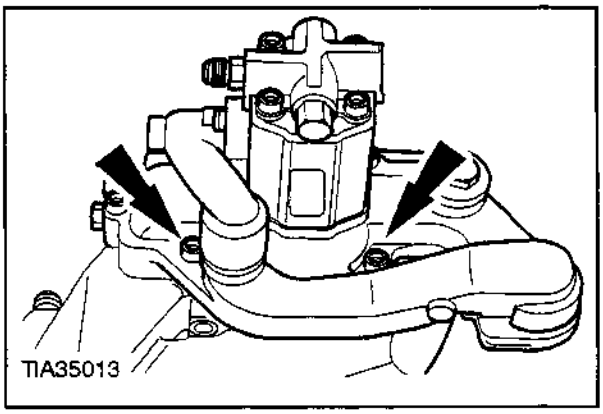


Figure 8-2-60

3. Carefully separate housing.

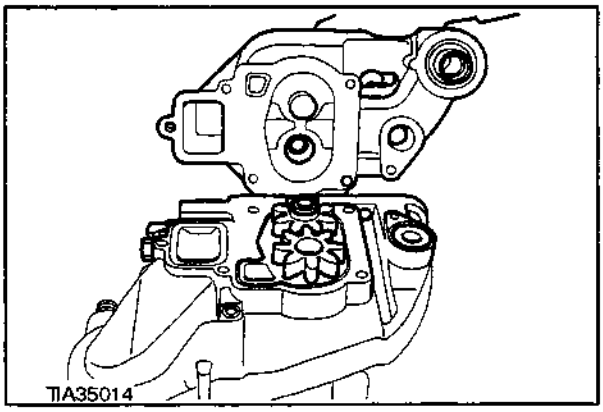


Figure 8-2-61

4. Remove drive link and pump gears.

5. Inspect pump gears and spigots for wear or damage.

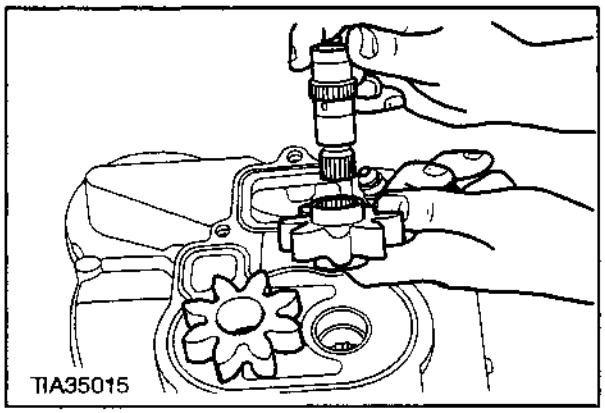


Figure 8-2-62

6. Inspect drive link oil seal (1) and bushing (2) and replace if worn or damaged.

7. Lubricate all components with hydraulic oil.

8. Re–assemble using disassembly procedure in reverse. During re–assembly take care not to damage charge pressure filter dump valve. Where necessary the valve may be removed to assist re–assembly.

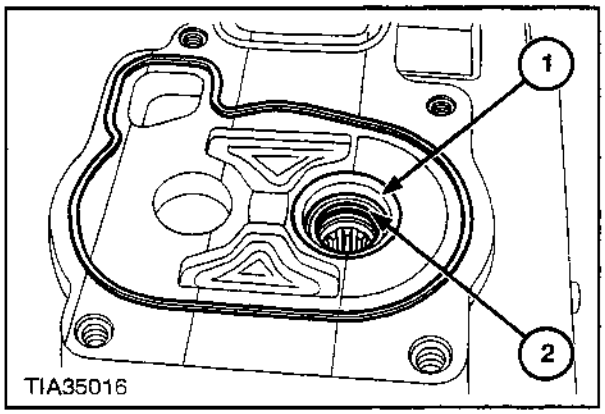


Figure 8-2-63

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Variable Flow Piston Pump Overhaul

1. Remove hydraulic pump assembly from tractor as described on Page 8-2-35.

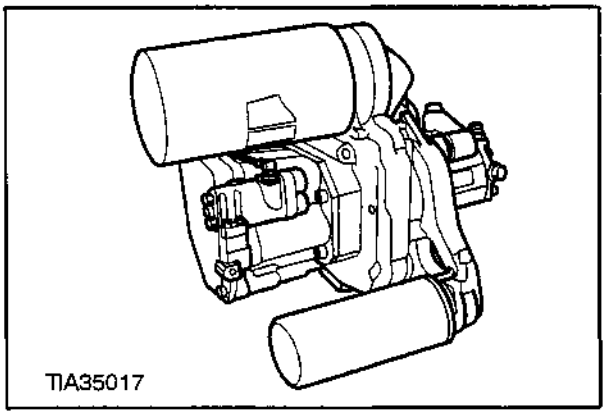


Figure 8-2-64

2. Remove pressure and flow compensating valves.

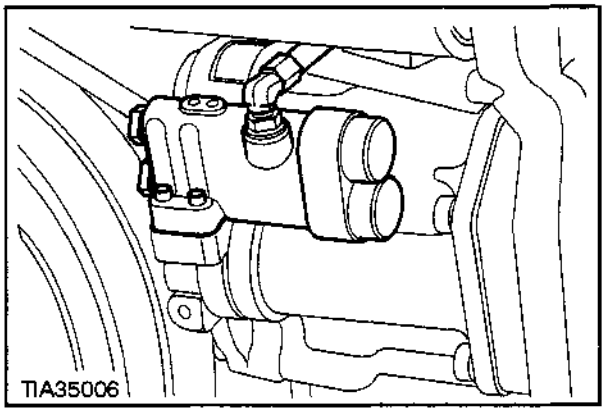


Figure 8-2-65

3. Remove end plate.

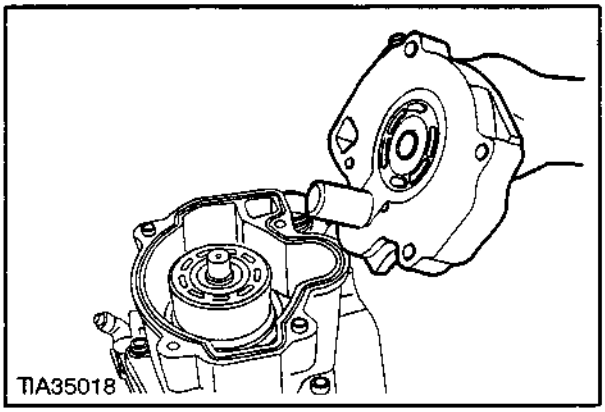


Figure 8-2-66

4. Examine servo piston (1) and port plate (2) for wear or damage. Do Not remove port plate unless replacement is required.

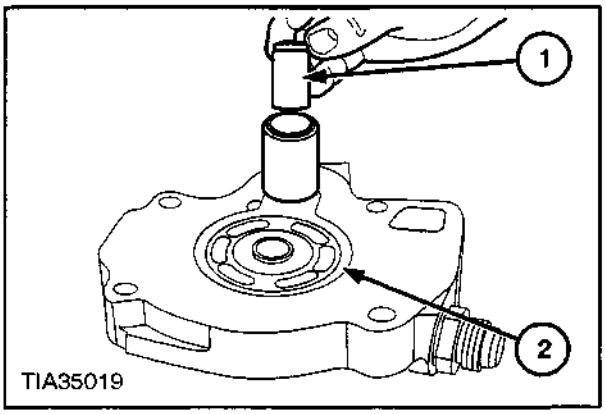


Figure 8-2-67

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5. Remove pumping head assembly.

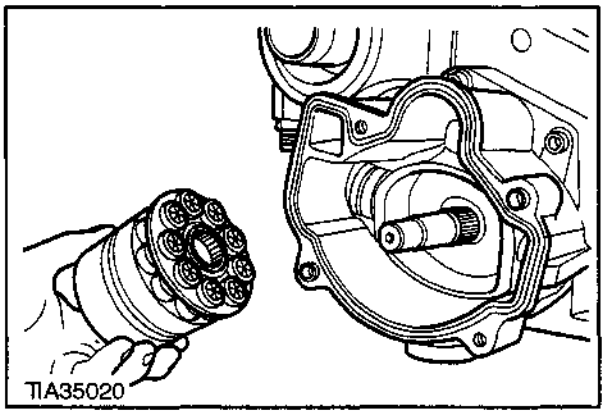


Figure 8-2-68

6. Using a suitable marker identify each piston and slipper to their corresponding barrel in the pumping head.

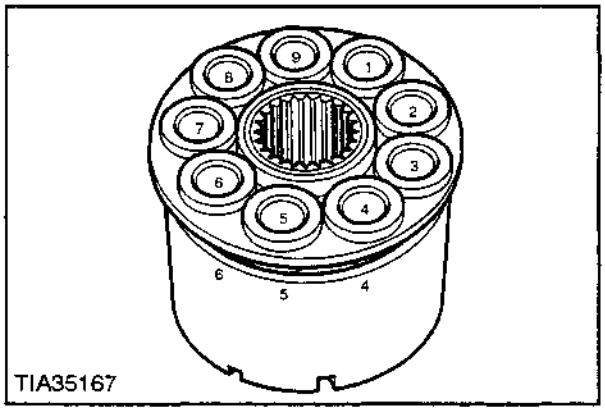


Figure 8-2-69

7. Separate pumping head and slipper assembly and inspect for damage. Where damage is identified the pumping element must be replaced.

Pumping Head and Slipper Assembly

1. Pistons and Slippers
2. Cone
3. Washer
4. Pumping Head
5. Pins (3 off)

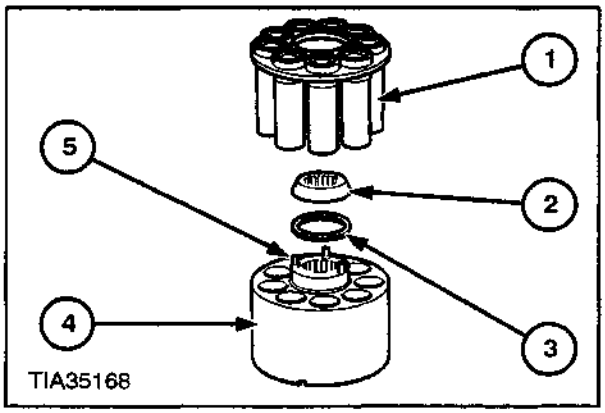


Figure 8-2-70

8. If necessary disassemble pumping head spring assembly by compressing the collar against the spring.

IMPORTANT: *Due to high spring pressure take care when removing retaining ring.*

Pumping Head Spring Assembly

1. Pumping Head
2. Washer
3. Spring
4. Collar
5. Retaining Ring

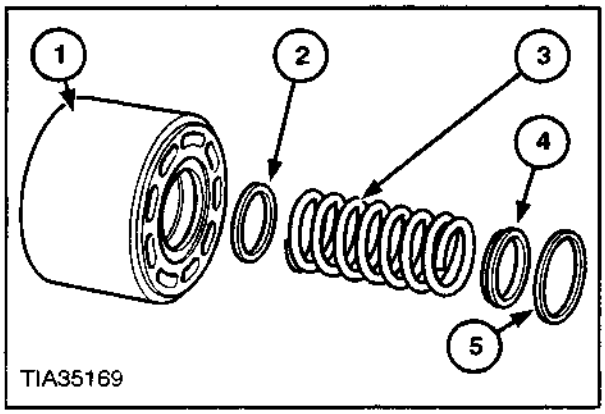


Figure 8-2-71

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9. Remove swash plate assembly by turning pump housing upside down and striking pump driveshaft against a solid block of wood.

10. Inspect components for wear and replace if damaged.

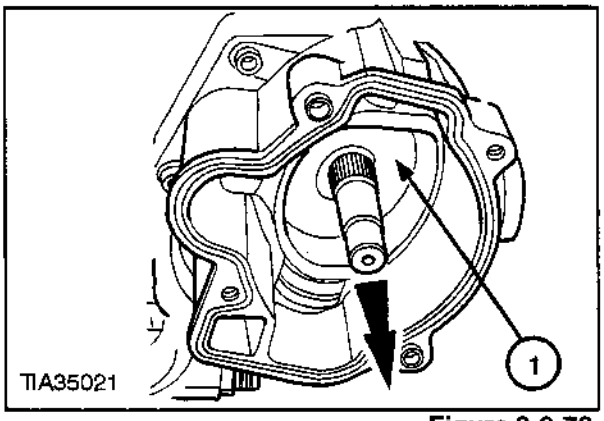


Figure 8-2-72

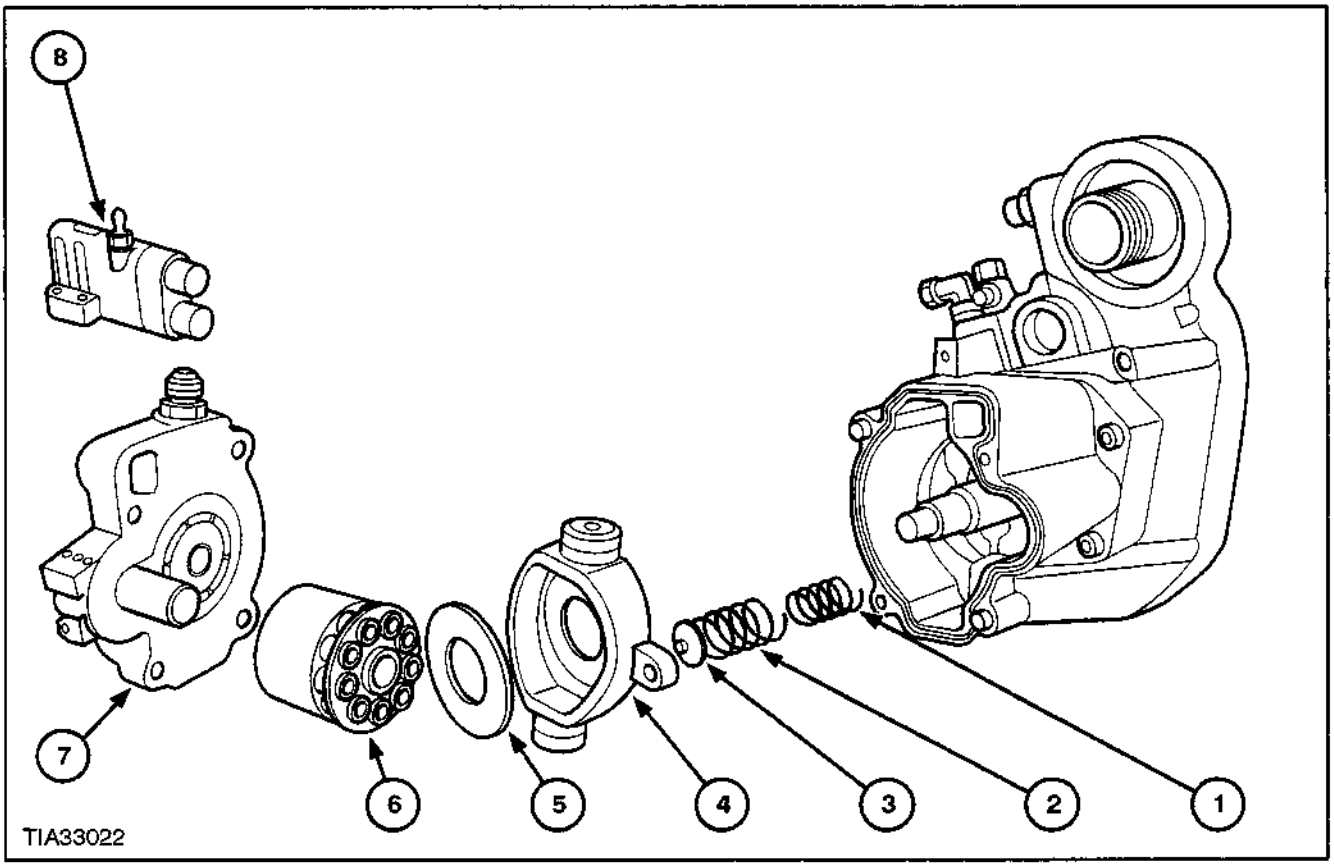


Figure 8-2-73

Variable Flow Piston Pump and Swash Plate Assembly

1. Spring
2. Spring
3. Spring Seat
4. Swash Plate
5. Thrust Plate
6. Pumping Head Assembly
7. End Plate and Servo Piston Assembly
8. Pressure and Flow Compensating Valves

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11. Separate housing and examine driveshaft, drive gear and bearing for wear.

12. If driveshaft overhaul is required use tool No NH 35101 to hold drive shaft splines while removing drive gear nut. **Do Not** clamp drive gear in a vice.

13. Remove drive gear.

14. Remove drive shaft and bearing.

15. Inspect and replace components as necessary. Refer to specifications for tightening torque.

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SECTION 8
HYDRAULIC SYSTEM
CHAPTER 3
FIXED DISPLACEMENT GEAR PUMPS
(NOTE: NOT USED IN NORTH AMERICA)

CONTENTS

SPECIFICATIONS 8-3-2
TIGHTENING TORQUE 8-3-4
SPECIAL TOOLS 8-3-5
SECTIONAL VIEWS – DESCRIPTION AND OPERATION 8-3-6
TROUBLESHOOTING ..... SEE CHAPTER 5
REMOVAL – INSTALLATION – OVERHAUL 8-3-7
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35 000 – SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION

SPECIFICATIONS – REAR LIFT HYDRAULIC PUMP (100, 115, and 135 Hp)

Filter	
Type	full–flow, replaceable paper cartridge
Location	pump intake, on the R.H. side of axle housing
PUMP	
Type	gear type, drawing oil from housing
Location	on the R.H. side of the axle housing
Model	C42
Make	FIAT
Control	actuated by PTO shaft
Rotation (from drive end)	clockwise
Engine/pump rpm ratio	1 : 1.264
Max. speed (with engine running at max. power rated speed) ..... giri/min	2780
Corresponding nominal flow rate ..... gal/min (l/min) (dm^3/min)	14 (53)
Test bench flow rate at 1450 rpm and 2220 lbf/in^2 (156 kg/cm) (153 bar):	
– New or reconditioned pump ..... gal/min (l/min) (dm^3/min)	6.8 (25.8)
– Used pump ..... gal/min (l/min) (dm^3/min)	4.7 (18)
– Test oil temperature ..... °F (°C)	131 to 149 (55 to 65)
– Test oil viscosity	SAE 20
Drive/driven gear shaft diameter ..... in (mm)	0.685 to 0.686 (17.400 to 17.418)
Bearing seat I.D. ..... in (mm)	0.687 to 0.688 (17.450 to 17.475)
Gear shaft/seat running clearance ..... in (mm)	0.001 to 0.003 (0.032 to 0.075)
– Permissible wear limit ..... in (mm)	0.004 (0.1)
Gear radial clearance in pump body ..... in (mm)	0.0008 to 0.002 (0.020 to 0.064)
Max. permissible wear on pump body, suction side, gear location ... in (mm)	0.004 (0.1)
Gear width ..... in (mm)	1.212 to 1.213 (30.800 to 30.815)
Bearing width ..... in (mm)	0.964 to 0.965 (24.490 to 24.510)
Gear and bearing housing width in pump body ..... in (mm)	3.147 to 3.148 (79. 935 to 79.960)
Gear/bearing end float in pump body (on reconditioned pumps also) ..... in (mm)	0.004 to 0.007 (0.100 to 0.180)

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SPECIFICATIONS – HYDROSTATIC STEERING HYDRAULIC PUMP A 31xRP 2 (100, 115 AND 135 Hp)

Type	Gear type, with integral flow regulator, drawing oil from rear axle housing
Location	on the R.H. side of axle housing
Model	A 31 XRP 2
Make	FIAT
Control	actuated by PTO shaft
Rotation (from drive end)	counterclockwise
Engine/pump rpm ratio	1 : 1.264
Max. speed (with engine running at max. power rated speed) giri/min	2780
Corresponding nominal flow rate gal/min (l/min) (dm^3/min)	11 (41)
Nominal flow rate at 1000 rpm gal/min (l/min) (dm^3/min)	3.91 (14.8)
Controlled flow rate starting speed giri/min)	1216
Controlled delivery flow rate gal/min (l/min) (dm^3/min)	4.7 to 5.8 (18 to 22)
Drive/driven gear shaft diameter in (mm)	0.685 to 0.686 (17.400 to 17.418)
Bearing seat I.D in (mm)	0.687 to 0.688 (17.450 to 17.470)
Gear shaft/seat running clearance in (mm)	0.001 to 0.003 (0.032 to 0.070)
– Permissible wear limit in (mm)	0.004 (0.1)
Gear radial clearance in pump body in (mm)	0.0008 to 0.002 (0.020 to 0.064)
Max. permissible wear on pump body, suction side, gear location in (mm)	0.004 (0.1)
Gear width (1) in (mm)	0.945 to 0.945 (24.000 to 24.015)
Bearing width (2) in (mm)	0.964 to 0.965 (24.490 to 24.510)
Gear and bearing housing (3) width in pump body	2.879 to 2.880 (73.135 to 73.160)
Gear/bearing end float in pump body (on reconditioned pumps also) in (mm)	0.004 to 0.007 (0.100 to 0.180)

SPECIFICATIONS – HYDROSTATIC STEERING HYDRAULIC PUMP A 42 XRP 2

Type	gear type, with integral flow regulator, drawing oil from rear axle housing
Location	on the R.H. of rear axle housing
Model	A 42 XRP 2
Make	FIAT
Control	actuated by PTO shaft
Rotation (from drive end)	counterclockwise
Engine/pump rpm ratio	1 : 1.264
Max. speed (with engine running at max. power rated speed giri/min	2780
Corresponding nominal flow rate gal/min (l/min) (dm^3/min)	14 (53)
Nominal flow rate at 1000 rpm gal/min (l/min) (dm^3/min)	5.05 (19.1)
Controlled flow rate starting speed giri/min)	1216
Controlled delivery flow rate gal/min (l/min) (dm^3/min)	6.1 to 7.1 (23 to 27)

(continued)

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SPECIFICATIONS – HYDROSTATIC STEERING HYDRAULIC PUMP A 42 XRP 2 (100, 115 AND 135 Hp)

Drive/driven gear shaft diameter ..... in (mm)	0.685 to 0.686 (17.400 to 17.418)
Bearing seat I.D ..... in (mm)	0.687 to 0.688 (17.450 to 17.475)
Gear shaft/seat running clearance ..... in (mm)	0.001 to 0.003 (0.032 to 0.075)
– Permissible wear limit ..... in (mm)	0.004 (0.1)
Gear radial clearance in pump body ..... in (mm)	0.0008 to 0.002 (0.020 to 0.64)
Max. permissible wear on pump body, suction side, gear location ... in (mm)	0.004 (0.1)
Gear width ..... in (mm)	1.212 to 1.213 (30.800 to 30.815)
Bearing width ..... in (mm)	0.964 to 0.965 (24.490 to 24.510)
Gear and bearing housing width in pump body ..... in (mm)	3.147 to 3.148 (79. 935 to 79.960)
Gear/bearing end float in pump body (on reconditioned pumps also) ..... in (mm)	0.004 to 0.007 (0.100 to 0.180)

TIGHTENING TORQUE

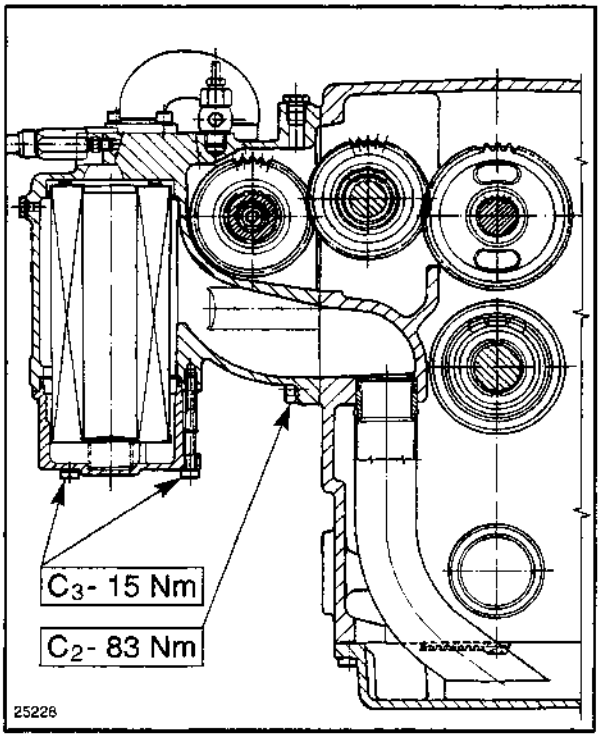


Figure 8-3-1

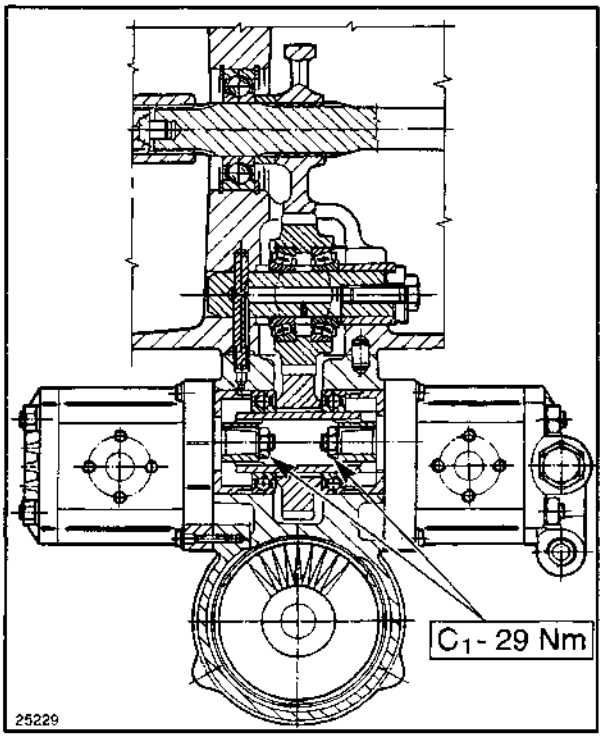


Figure 8-3-2

DESCRIPTION	Thread Size	Torque	
		ft. lbs. (Nm)	ft. lbs. (kgm)
Nut, pump drive coupling hub (C)	20 UNC–2B	21 (29)	21 (3)
Screws, filter and pump support (C_2)	M12 x 1.5	61 (83)	61 (8.5)
Screws, filter cover (C_3)	M8 x 1.25	11 (15)	11 (1.5)

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SPECIAL TOOLS HYDRAULIC LIFT

Caution – Operations described in this Section of the Manual must be performed using the following ESSENTIAL tools marked with the identification code (X).
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to carry out the different operations described in this Section.

Support to remove hydraulic pumps assembly (stamp nr. 50130 on the tool – Dimensions in mm).

Manufacture the tool with Fe 42C material.

(*) Dimension to be defined according to hole sizes on the hydraulic jack.

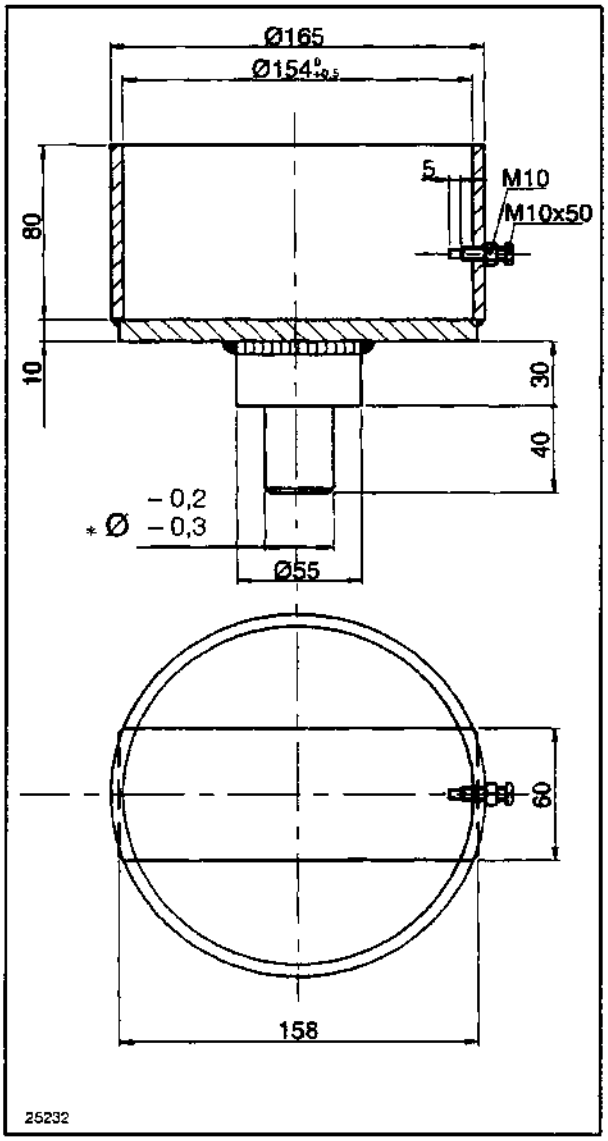


Figure 8-3-3

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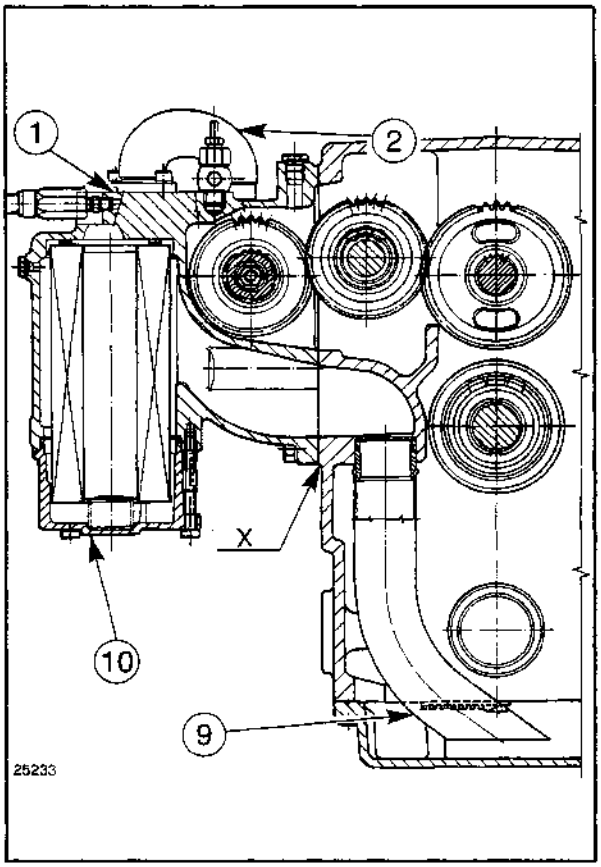


Figure 8-3-4

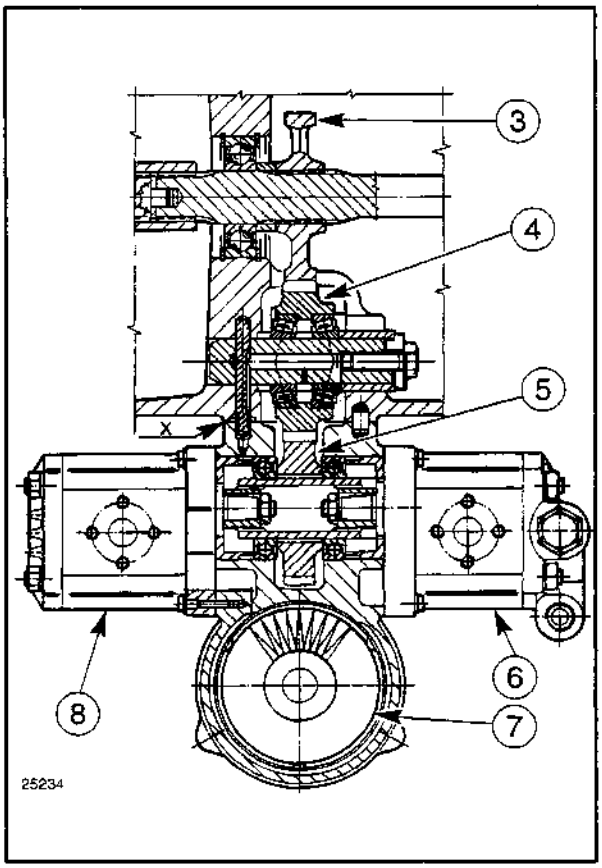


Figure 8-3-5

Filter and hydraulic pumps support sections

1. Support body
2. Pump supply tube (8).
3. Drive gear on PTO shaft
4. Idler gear
5. Pump control gear
6. Accessories and hydrostatic steering control pump
7. Filtering element
8. Hydraulic lift control pump
9. Filter supply tube
10. Filter cover

Note – During assembly apply sealing on X surfaces according to what has been established on page 8-3-11.

DESCRIPTION AND OPERATION

Hydraulic pumps are spur gear and fixed displacement according to erpm.
They are mounted on filter support which, in turn, is fixed to the rear axle housing.
They are driven by a gear splined directly to the PTO drive shaft.Oil is drawn from the rear axle housing by the pumps via common filter.
The front hydraulic pump controls hydrostatic steering and other units such as front and rear differential locks, PTO and PTO brake, FWD engagement, DUAL COMMAND or SEMI–POWERSHIFT transmissions. The front hydraulic pump is fitted with a flow regulator to reduce oil quantity delivered at high speeds. The rear hydraulic pump supplies oil for the hydraulic lift, trailer brake valve and auxiliary valves.

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HYDRAULIC LIFT SYSTEM OIL PUMP

Removal–Installation (Op. 35 104 10)

Proceed as follows

WARNING

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

1. Open and raise engine hood..
2. Detach negative cable (1) from battery and insulate.

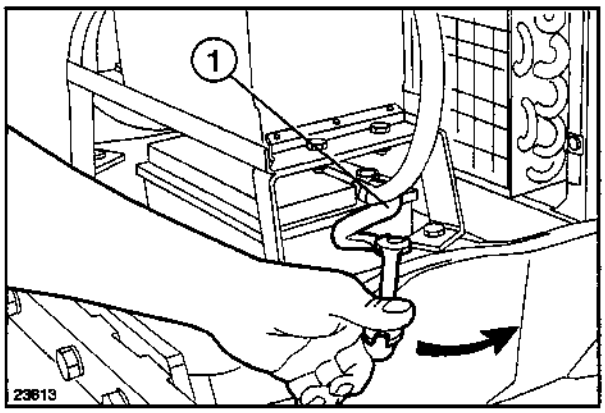


Figure 8-3-6

3. Jack up rear tractor, place a stationary stand under the right–hand final drive and remove right–hand rear wheel.

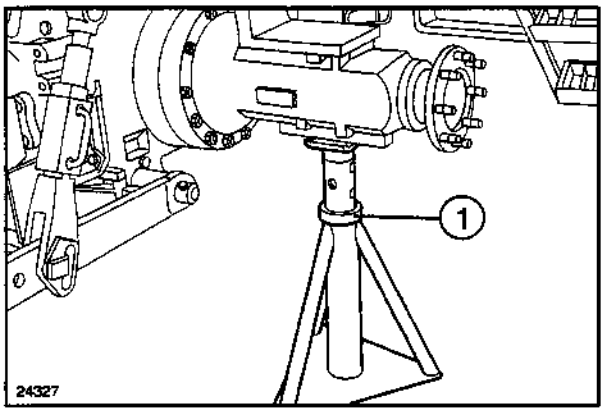


Figure 8-3-7

4. Unscrew the plug (1) to release oil pressure inside the filter.

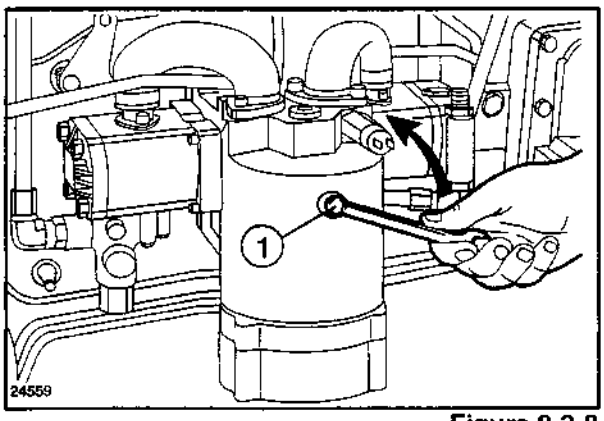


Figure 8-3-8

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5. Loosen fastening screws and remove the supply tube (1) between pump and filter.
6. Remove pump fastening screws (2), loosen the connector (1) on the hydraulic lift system pressure regulating valve and retrieve the pump.

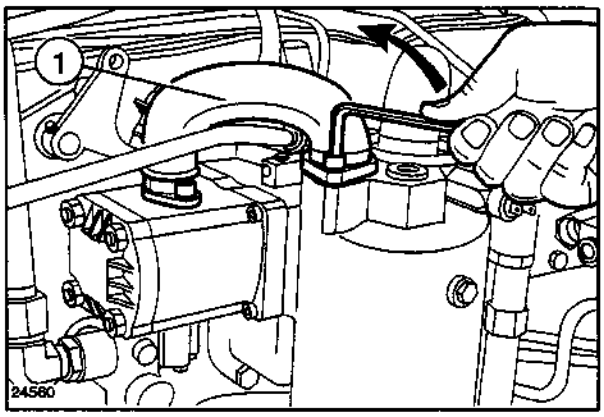


Figure 8-3-9

7. Reinstall the hydraulic lift system oil pump following the removal procedure in reverse.

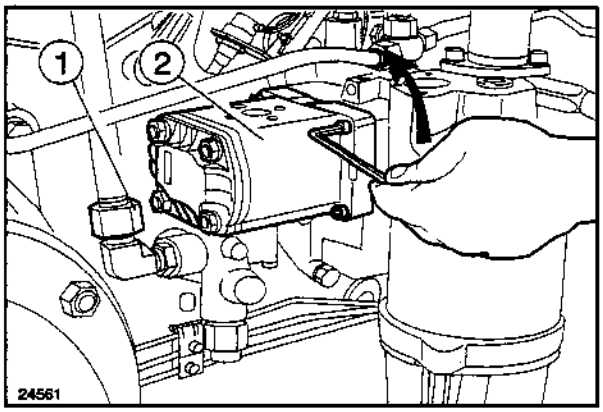


Figure 8-3-10

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HYDROSTATIC STEERING AND HYDRAULIC LIFT PUMP CONTROL ASSEMBLY

Removal–Installation (Op. 27 170 30)

Proceed as follows:

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

1. Open and raise engine hood.
2. Detach the negative cable (1) from battery and insulate.

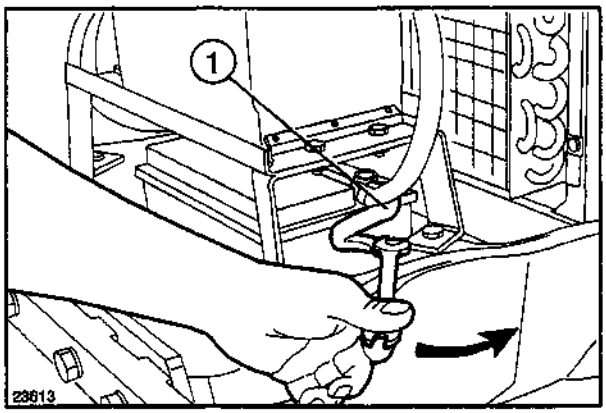


Figure 8-3-11

3. Jack up rear tractor, place a stationary stand under the right–hand final drive and remove right–hand rear wheel.

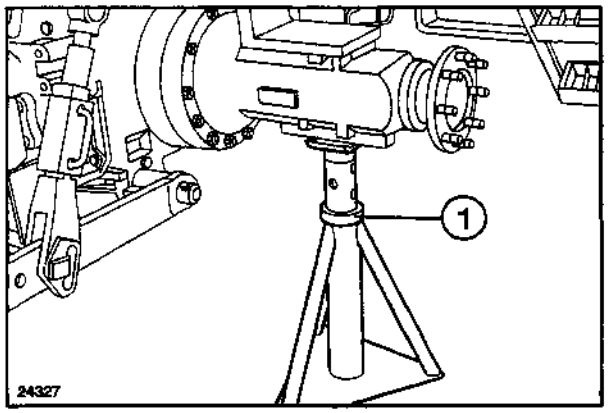


Figure 8-3-12

4. Unscrew the plug (1) to release oil pressure inside the filter.

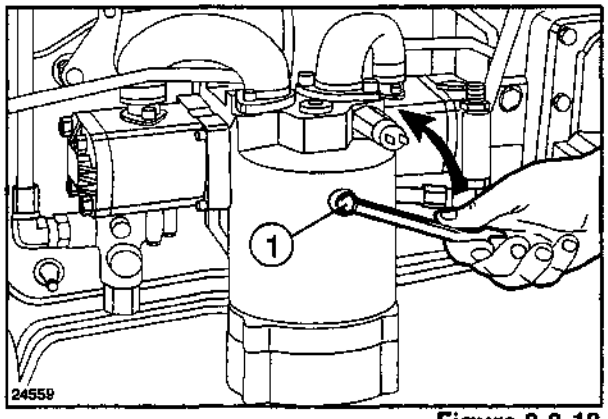


Figure 8-3-13

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5. Disconnect oil supply line (1) to hydraulic lift and detach electrical connection (2).

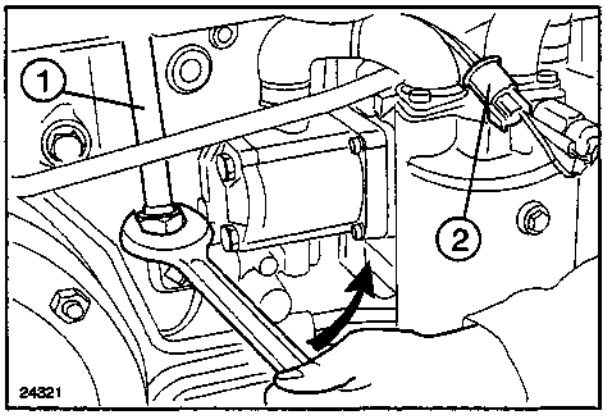


Figure 8-3-14

6. Detach and remove accessory control valve assembly supply line (3). Detach the differential unlock control line (4), power steering supply line (2), and lift lubrication line (1).

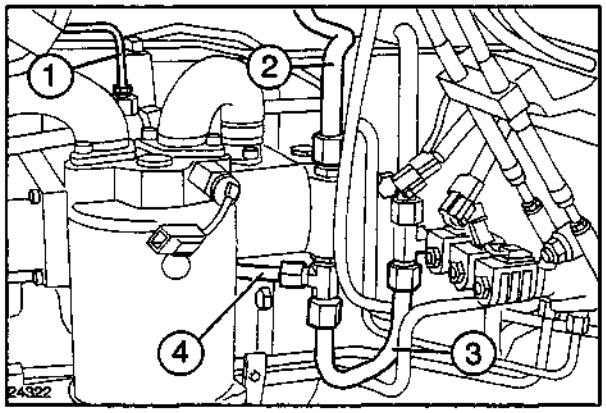


Figure 8-3-15

7. Disconnect PTO lubrication line (1) and oil cooler return line (2).

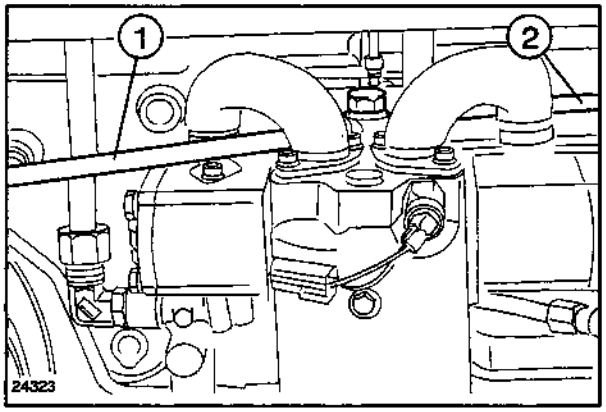


Figure 8-3-16

8. Unscrew hydraulic pump assembly fastening screws along with pump support and filter.

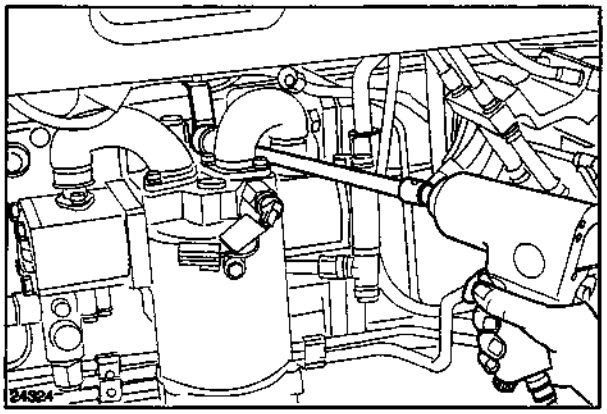


Figure 8-3-17

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9. Remove pump assembly using a hydraulic jack and tool no. 50130 (1) (see page 8-3-5).

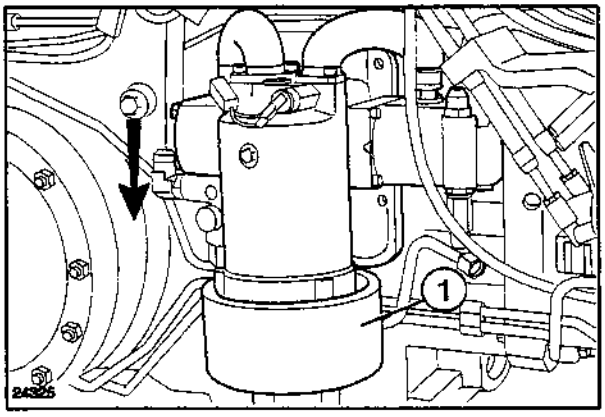


Figure 8-3-18

10. With the assembly on a bench, unscrew supply line fastening screws (1) between pump and filter.

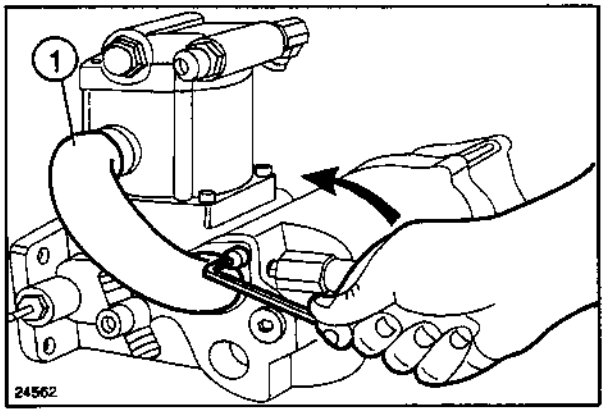


Figure 8-3-19

11. Remove pump fastening screws (1 and 2) from support and retrieve pumps.

12. Reinstall the hydrostatic steering and hydraulic lift pump control assembly observing the following:

- Reinstallation follows the removal procedure in reverse, from step 11 back to step 1.
- Refer to figures on page 8-3-6 for correct orientation of the different parts.
- Before reassembling the hydraulic pump control assembly thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant following the pattern shown in the figure.
- Tighten to correct tightening torque as detailed on page 8-3-4.

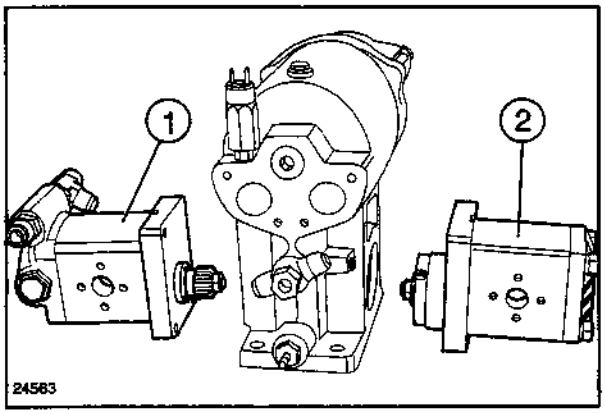


Figure 8-3-20

Pattern for application of sealant during installation of the hydraulic pump control assembly to rear axle housing.

Sealants to be used are listed on page 0-1-19, Section 00

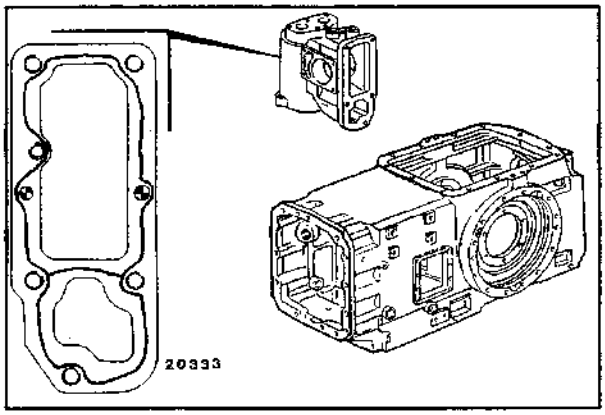


Figure 8-3-21

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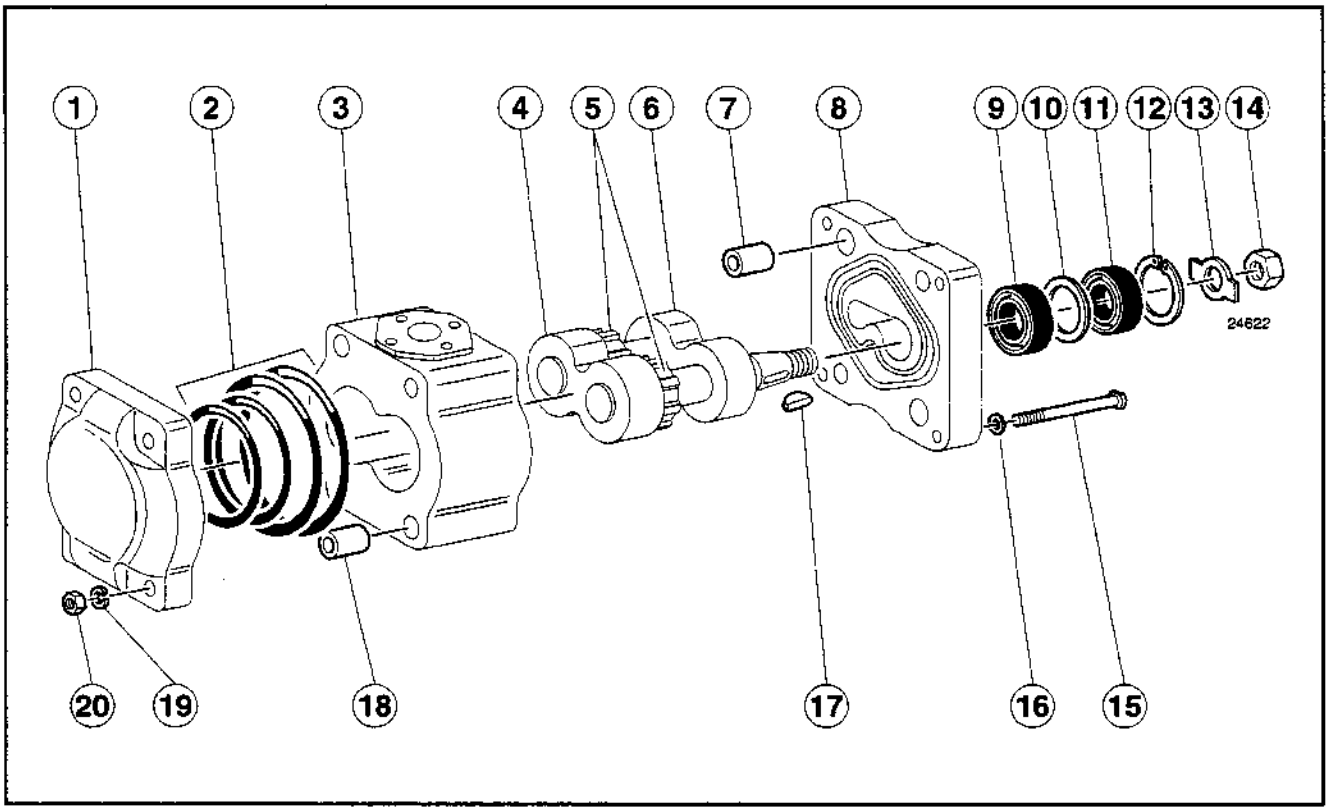


Figure 8-3-22

Hydraulic lift control pump components.

1. Front cover
2. Cover seals
3. Pump body
4. Gear support
5. Drive and driven gear shafts
6. Gear support
7. Bushing
8. Drive end cover
9. Drive shaft seals
10. Spacer
11. Drive shaft seal
12. Circlip
13. Lockwasher
14. Nut
15. Screw
16. Washer
17. Tab
18. Bushing
19. Lockwasher
20. Nut

HYDRAULIC LIFT CONTROL OIL PUMP

Disassembly– Assembly with the pump removed (Op. 35 104 30)

Proceed as follows:

1. Remove cover fastening nuts (20), screws (15) and lockwashers.
2. Remove sleeve fastening nut (14) to pump drive shaft along with lockwasher.
3. Remove rear cover (8), retaining ring (12) and seals (9 and 11).
4. Mark details (3, 4, 5 and 6) to reassemble them in the same position, if fit for reuse.
5. Remove supports (4 and 6) and gears (5) from rear cover (8) and pump body (3).
6. Retrieve seals (2) and back–up rings.

Proceed as follows with disassembled components:

7. Check flatness and squareness of the gear thrust surfaces relative to bearings by placing a thin layer of lampblack between them. Light roughness may be eliminated with very fine grain abrasive paper properly lubricated.

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8. Check that end float of the gear–bearing assembly is, in the pump body, by 0.004 to 0.007 in (0.100 to 0.180 mm). Dimension (2) must be lower than dimension (1) by 0.004 to 0.007 in (0.100 to 0.180 mm).

If necessary, rectify flat surfaces by removing minimum quantities of material with lubricated abrasive paper.

9. Thoroughly clean all details.
10. Remove seals (2, 9 and 11).
11. Lubricate details with the same oil as used in the system. Reassemble the pump referring to Figure 8-3-22, and observing the following:
12. Assembly follows the disassembly procedure in reverse, from step 6 back to step 1;
    - Always work in very clean conditions, to prevent entering of foreign matters which could damage the pump;
    - Match the details (3, 4, 5 and 6, Figure 8-3-22) previously marked, see op.4, page 8-3-5, to reassemble them in the original position;
    - Manually assemble the gear supports (4 and 6 Figure 8-3-22) into the pump body. Turn them towards the connectors on the external circumference corresponding to the outlet tube and set front faces with the lubrication grooves against the gears;
    - Install plastic back–up rings over the seals (2, Figure 8-3-22);
    - Assemble seals (9 and 11, Figure 8-3-22) and spacers (10) on drive end cover (8). Note that the gap between the sealing lips should be opposite to the spacer. Fill the gap with **AMBRA GR 75 MD** grease.

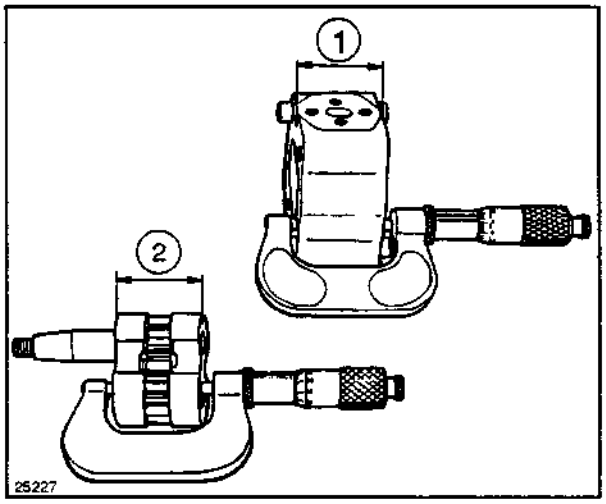


Figure 8-3-23

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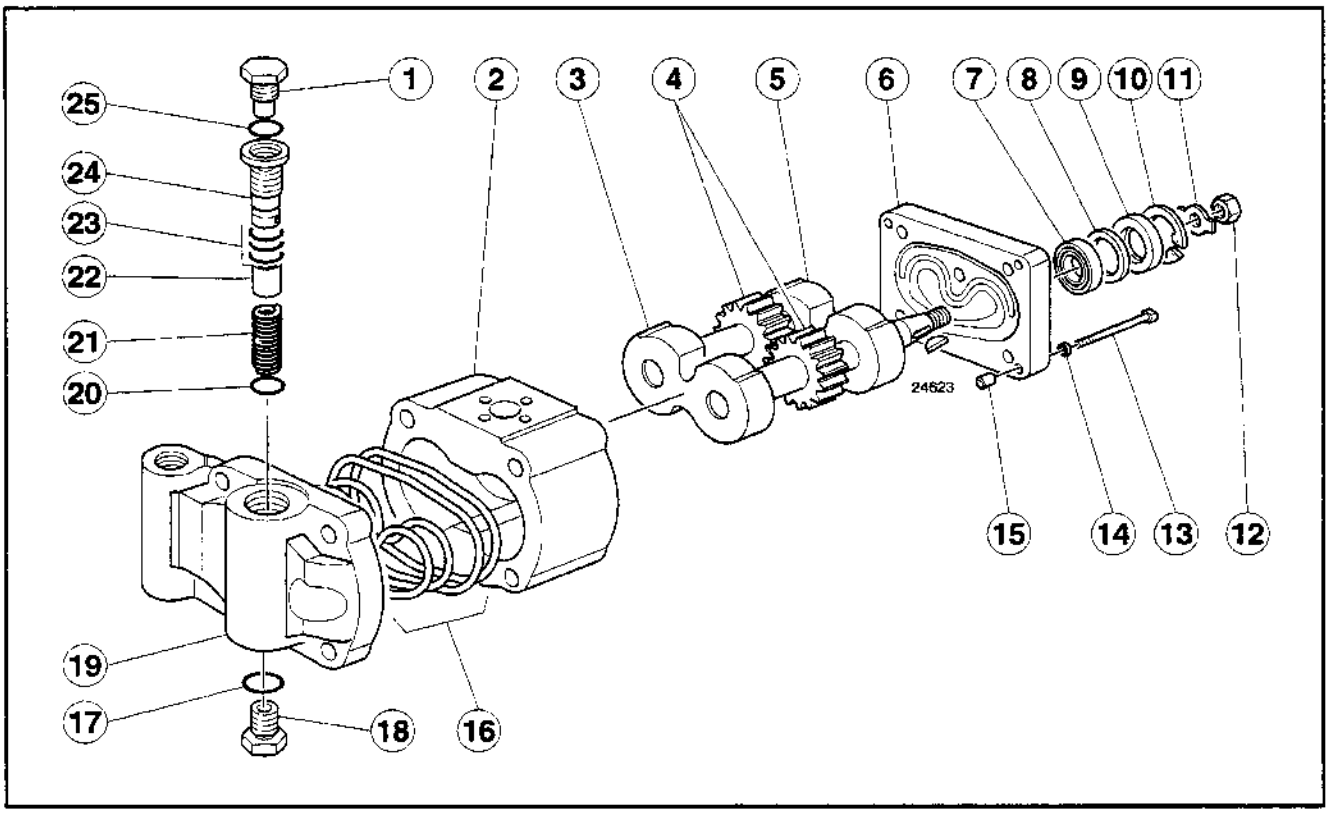


Figure 8-3-24

Accessory control pump components

1. Plug
2. Pump body
3. Gear support
4. Drive and driven gear shafts
5. Gear support
6. Drive end cover
7. Drive shaft seals
8. Spacer
9. Drive shaft seals
10. Circlip
11. Lockwasher
12. Nut
13. Screw
14. Washer
15. Bushing
16. Seals on covers
17. Seal
18. Plug
19. Flow regulator unit
20. Lockring
21. Spring
22. Cursor
23. Seals
24. Cursor seat (22)
25. Seal

ACCESSORIES AND HYDROSTATIC STEERING OIL PUMP

Disassembly–Assembly with the pump detached (Op. 41 206 20)

Proceed as follows:

1. Remove screws (13) and lockwashers (14).
2. Remove sleeve fastening nut (12) to pump drive shaft along with lockwasher (11).
3. Remove drive end cover (6), circlip (10) and seals (7 and 9).
4. Mark details (2, 3, 4 and 5) to reassemble them in the same position, if fit for reuse.
5. Remove bearings (3 and 5), gears (4) from drive end cover (6) and pump body (2).
6. Retrieve seals (16) and back–up rings.
7. Remove plugs (1 and 18) along with seals, disassemble the flow regulator components, i.e.: cursor seat (24), cursor (22), spring (21), from the body (19).

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Proceed as follows, with disassembled components:

8. Check flatness and squareness of the gears thrust surfaces relative to bearings by placing a thin layer of lampblack between them. Light roughness may be eliminated with very fine grain abrasive paper properly lubricated.

9. Check that end float of the bearing–gear assembly is, in the pump body, by 0.004 to 0.007 in (0.100 to 0.180 mm). Dimension (2) must be lower than dimension (1) by 0.004 to 0.007 in (0.100 to 0.180 mm).

If necessary, rectify flat surfaces by removing minimum quantities of material with lubricated abrasive paper.

10. Thoroughly clean all details.

11. Remove seals (2, 9 and 11, Figure 8-3-24).

12. Lubricate details with the same oil as used in the system. Reassemble pump referring to Figure 8-3-24 and observing the following:

- Assembly follows the disassembly procedures in reverse, from step 7 back to step 1;
- Always work in very clean conditions, to prevent entering of foreign matters which could damage the pump;
- Match the details (2, 3, 4 and 5, Figure 8-3-24) previously marked, see op. 4, page 8-3-14, to reassemble them in the original position;
- Manually assemble the gear supports (3 and 5, Figure 8-3-24) into the pump body. Turn them towards the connectors on the external circumference corresponding to the outlet tube and set front faces with the lubrication grooves against the gears;
- Install plastic back–up rings over the seals (16, Figure 7, page 6);
- Assemble seals (9 and 11, Figure 8-3-24) and spacers (8) on drive end cover (6). Note that the gap between the sealing lips should be opposite to the spacer. Fill the gap with **AMBRA GR 75 MD** grease.

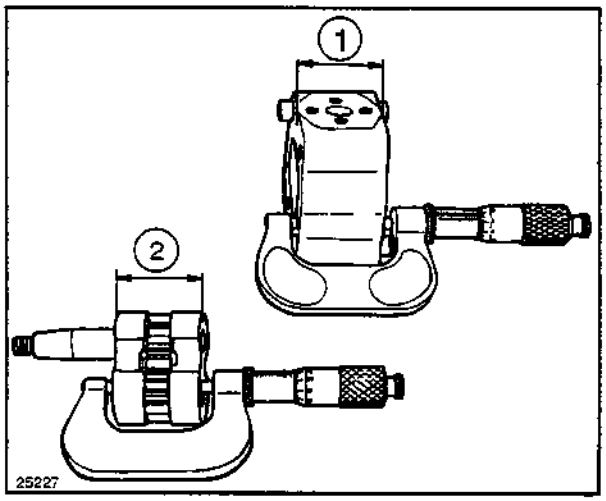


Figure 8-3-25

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SECTION 8
HYDRAULIC SYSTEM
CHAPTER 4
HYDRAULIC LIFT ASSEMBLY WITH ELECTRONIC DRAFT CONTROL

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CAUTION: *Observe the following precautions when arc welding on tractors installed with electronic draft control*

- Where possible, disconnect the part or implement to be arc welded from the tractor.
- Disconnect both battery cables from the battery. Isolate the cable ends to avoid contact with each other and the tractor.
- Position the welder ground clamp as close to the welding area as possible.
- If welding is to be carried out in close proximity of the tractor microprocessors then they should be removed from the tractor.
- Never allow welding cables to lay on, near or across any electrical wiring or electronic component while welding is in progress.

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335 000 SPECIFICATIONS

MAXIMUM LIFT CAPACITY

Test results to OECD criteria–links horizontal, maximum hydraulic pressure:

All Models

Lift Capacity

Without Assist Ram

24 in. (610 mm) to rear of ball ends	10604 ft. lbs. 4810 kg

With Assist Ram

24 in. (610 mm) to rear of ball ends	14837 ft. lbs. 6730 kgf

VALVE SETTINGS

Lift Cylinder Relief Valve	2850–3050 lbf/in^2 (197–210 bar)

HYDRAULIC LIFT COVER

Hydraulic Lift Cylinder Bore Diameter	4.528 – 4.530 in	(115.036 – 115.071 mm)
Hydraulic Lift Cylinder Piston Diameter	4.526 – 4.527 in	(114.978 –115.000 mm)
Hydraulic Lift Cylinder to Piston Clearance	0.0014 – 0.0037 in	(0.036 – 0.093 mm)
Hydraulic Lift Cross Shaft End Float (with lift arms installed)	0.0079 – 0.0551 in	(0.2 – 1.4 mm)

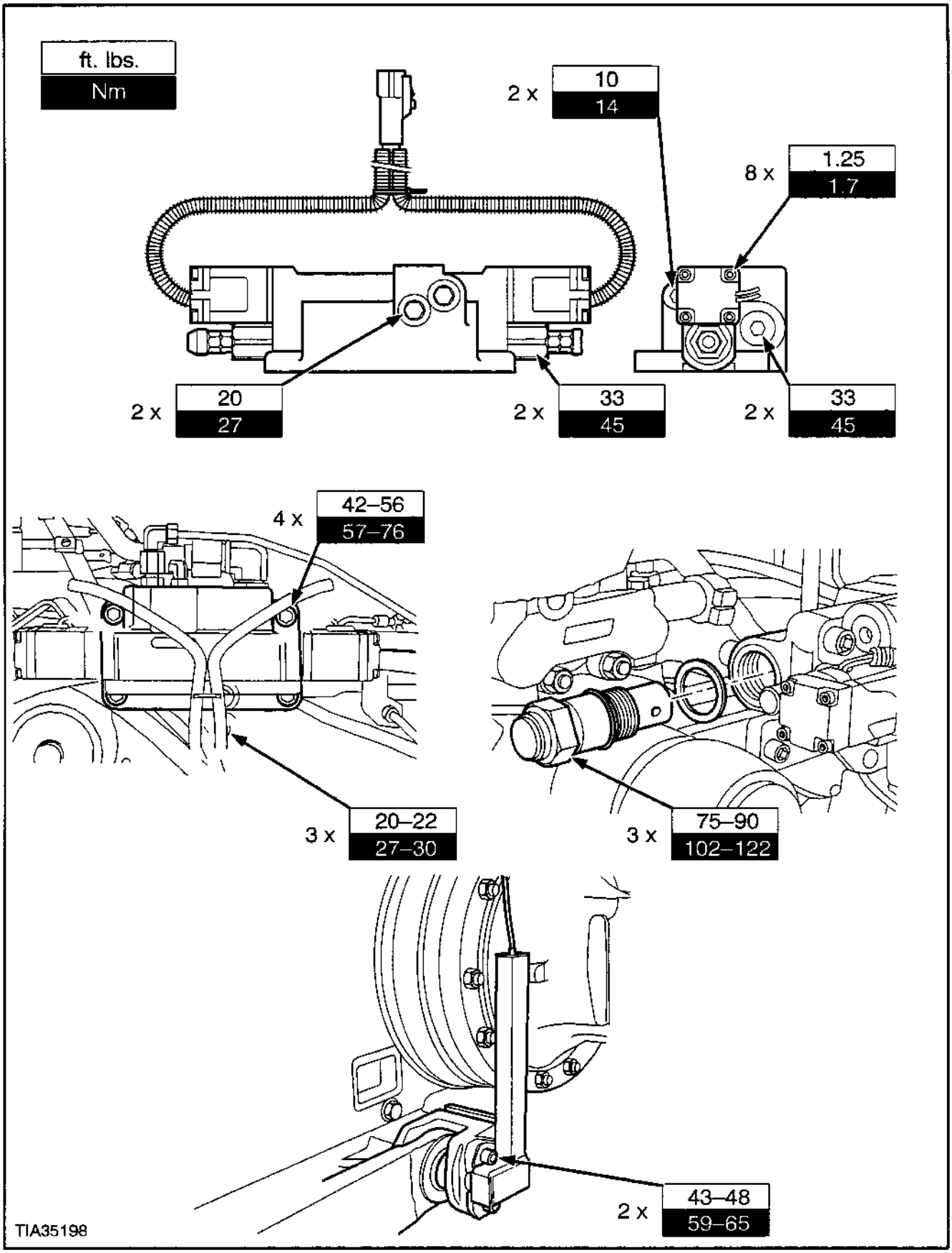
GASKET SEALER

Flexible Gasket Sealant

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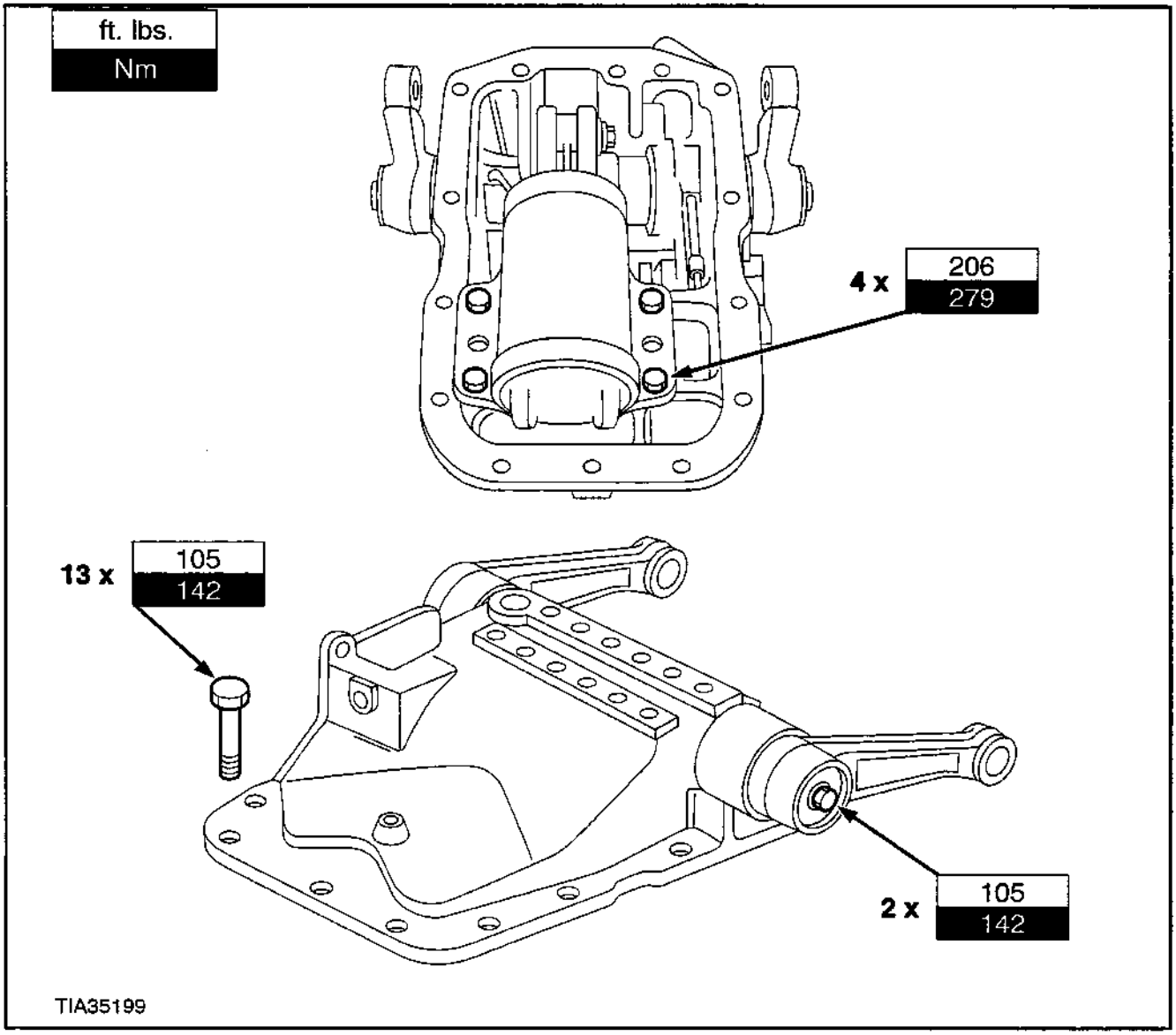
TORQUE SPECIFICATIONS



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TORQUE SPECIFICATIONS CONTINUED



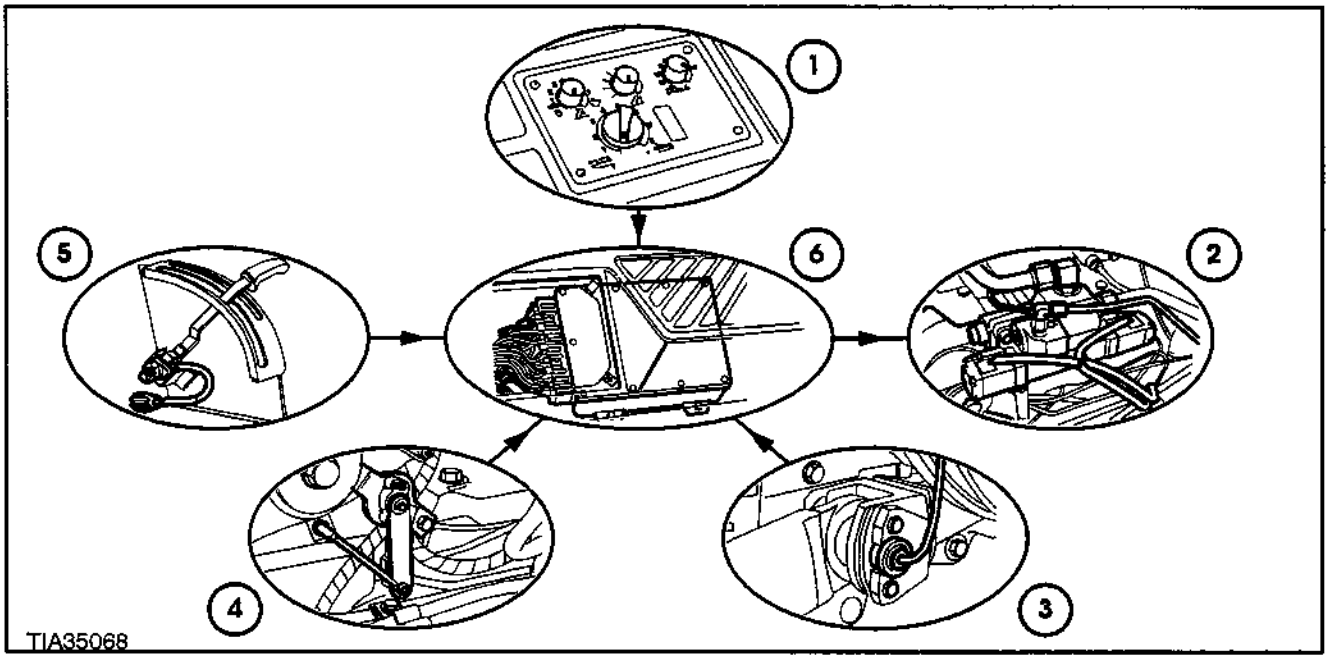
SPECIAL TOOLS

	NEW HOLLAND PART No
Hydraulic Lift Bracket	293983
Hydraulic Lift Lifting Hook	291359/2
Lift Piston Installation Ring (optional)	293813
Lift Cross Shaft Seal Installer	293985
Hand Pump	290284
Lift Cyinder Safety Valve Test Adaptor (Use with 290284)	290824
Safety Valve Adjusting Wrench	291863

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HYDRAULIC LIFT ASSEMBLY WITH ELECTRONIC DRAFT CONTROL –DESCRIPTION AND OPERATION



Position/Draft Control Schematic **Figure 8-4-1**

1. Position/Draft Sensitivity Mix Control on Operator Control Panel
2. Solenoid Operated Hydraulic Control Valve
3. Implement Draft Feedback Signal from Load Sensing Pins
4. Hydraulic Lift Arm Position Feedback Signal from Lift Arm Position Sensing Potentiometer
5. Lift Control Lever
6. Microprocessor (Computes Input Signal to Solenoid Operated Hydraulic Control Valve)

One method of providing a more constant depth control is to take advantage of the fact that draft loading increases with implement depth. If a fixed implement draft is maintained a fixed implement depth will result, providing the tractor speed and type of soil being worked remain constant.

Control of implement draft can be achieved by either mechanical or electrical means. This Chapter describes the operation of both position and draft control when controlled electronically.

The hydraulic lift electronic draft control system provides a means of accurately controlling implement draft and soil penetration depth of a fully or semi mounted implement.

The principle of electronic draft control, is to sense variations in implement draft using a load sensing pin at each lower link mounting point. A microprocessor then translates these variations into electrical signals which operate a control valve to raise and lower the hydraulic links and maintain a constant draft loading.

The smoothness and accuracy provided during operation gives this system a clear advantage over conventional mechanical systems.

Electronic signals to the microprocessor for raising and lowering the hydraulic lift assembly in accordance with position and draft control requirements, are received from four main sources. These are the lift control lever, lift arm position sensing potentiometer, the two load sensing draft control pins in the lower links and the draft/position sensitivity controls on the hydraulic control panel.

Additional signals from the drop rate and maximum lift height controls and wheel slip control (where fitted) also contribute towards the computation of the input signal.

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When the lift control lever is moved to raise or lower, the resistance of the potentiometer at the base of the lever changes and is sensed by the microprocessor. The processor transmits a signal to the hydraulic lift control valve, which raises or lowers the hydraulic lift accordingly.

As the position of the lift arms changes a feedback signal is received by the microprocessor from the lift arm position sensing potentiometer.

When the lift arms have moved to the required position the control signal from the microprocessor to the control valve is turned 'Off' and the lift arms are held in position.

When draft control is selected the implement working depth is also controlled by the draft forces imposed by the implement through the lower links and sensed by the two special load sensing pins.

The average of the draft load signals sensed by each pin is calculated by the microprocessor and compared with the lift control lever position and draft control setting selected using the position/draft sensitivity control on the operator control panel.

If the implement draft begins to increase beyond the range selected by the operator, the microprocessor transmits a revised pulse width modulated signal to the control valve which adjusts the implement depth and maintains the specified draft loading.

When a tractor is operated in draft control and under poor traction conditions, the situation can arise where as the tires slip, the ground speed and draft forces on the load sensing pins reduce. In this situation the reduction in draft forces would signal the microprocessor to continue increasing implement depth to such an extent that it may ultimately stop the tractor from moving forward.

The 'limited slip' option prevents this situation from occurring and uses the microprocessor to calculate the percentage of wheel slip by comparing the tractor ground speed and axle speed.

When wheel slip exceeds the value set by the operator the control valve raises the lift arms, irrespective of draft loading, until the maximum accepted wheel slip is restored.

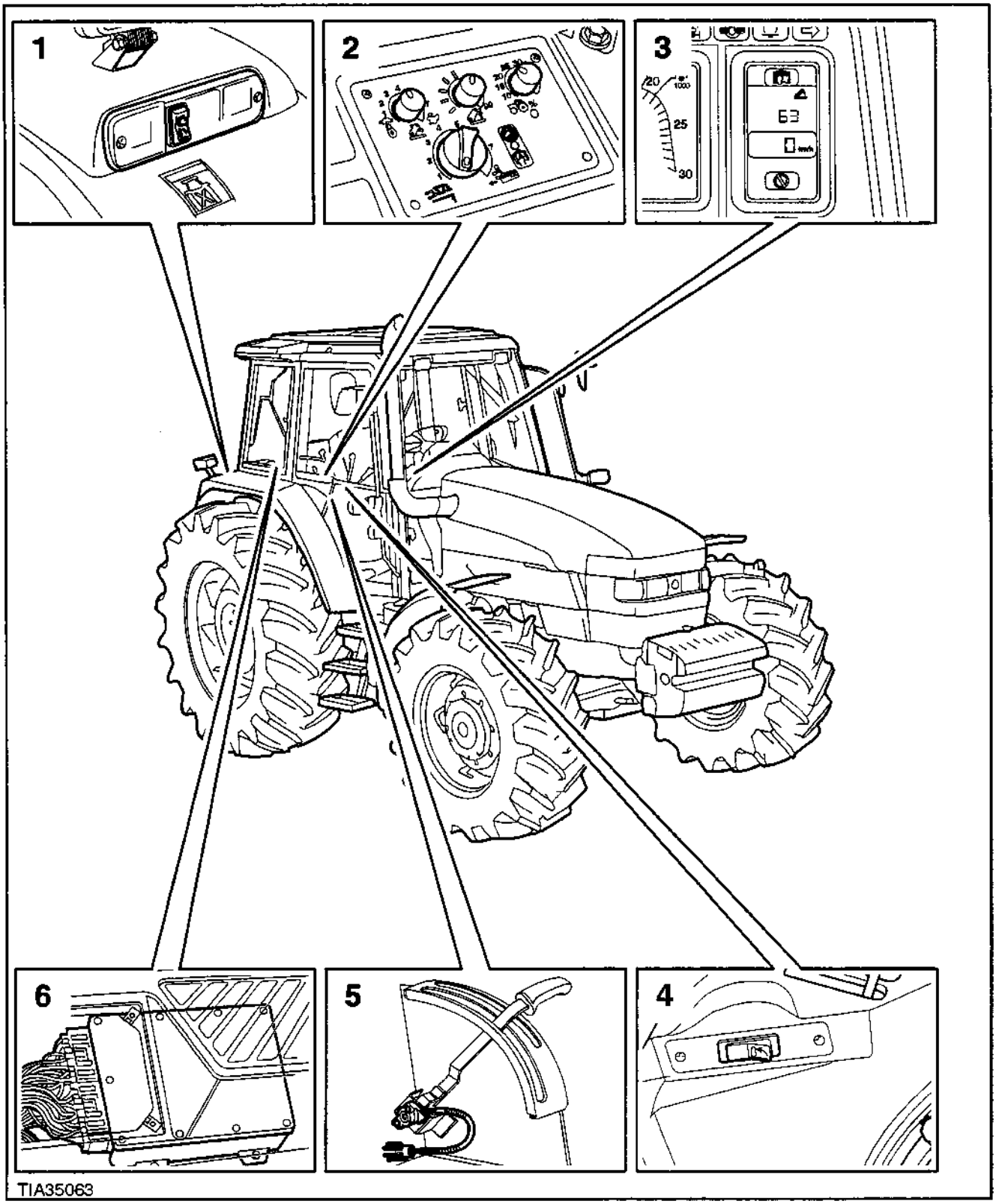
Electronic draft control can be installed on tractors with either closed center load sensing circuit using a variable flow hydraulic pump or an open center circuit using a gear type hydraulic pump.

The principal components of the electronic draft control system are similar for both open and closed center load sensing circuits. The notable difference is the requirement of an unload valve and larger metering lands on the main spool of the EDC valve when the system is used with the open center type circuit .

The location and further details on the operation of all components associated with the electronic draft control hydraulic lift assembly are shown on the following pages.

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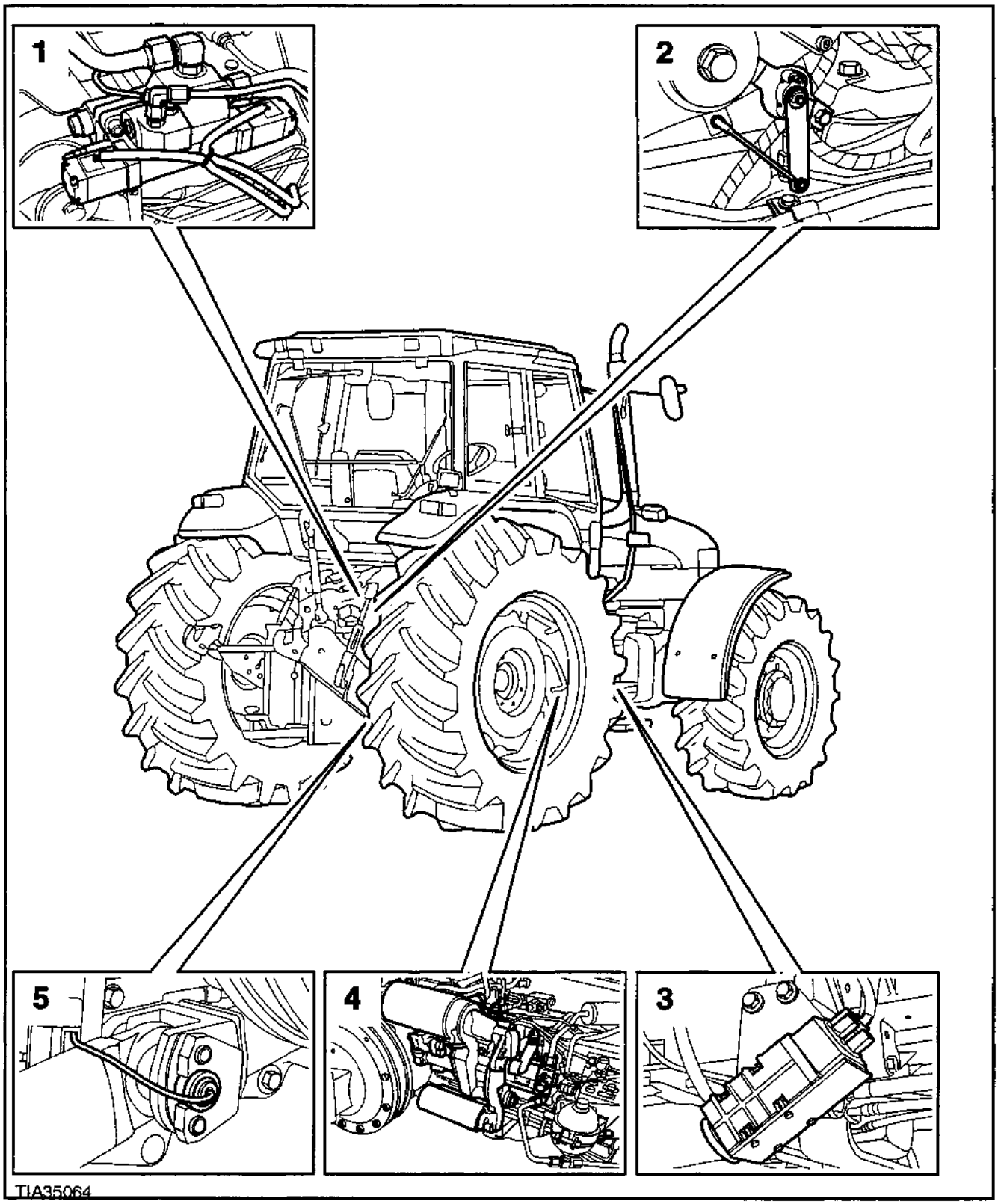


Electronic Draft Control Component Layout
(All Tractors)

1. Rear Fender External Lift/Lower Switch
2. Operator Control Console
3. Instrument Cluster
4. In Cab Fast Raise/Work Switch
5. Lift Control Lever Potentiometer
6. EDC Microprocessor

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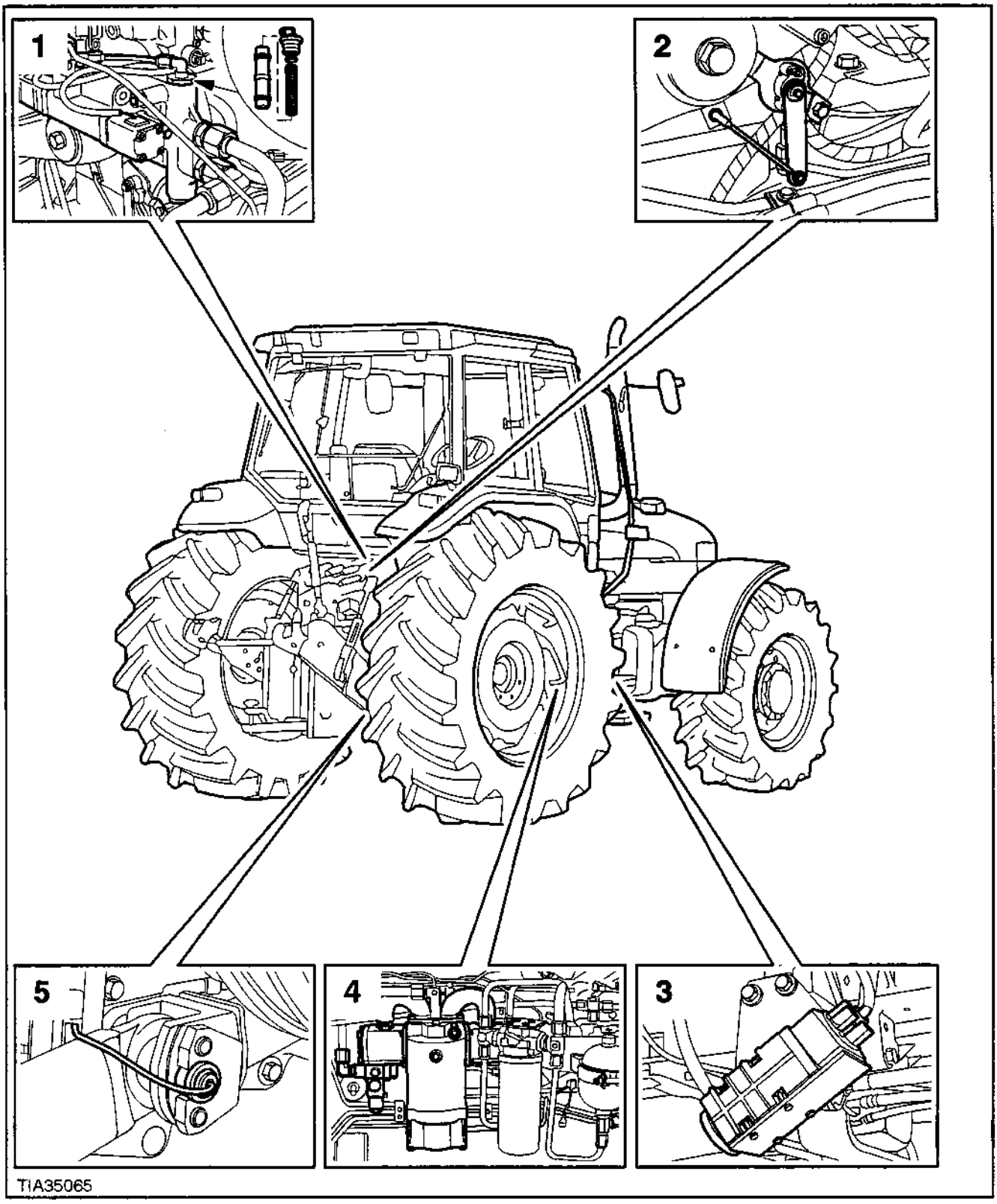


Electronic Draft Control Component Layout – Continued
(Tractors With Closed Center Load Sensing Hydraulic Circuit and Variable Flow Pump)

1. Electronic Draft Control Valve
2. Lift Arm Position Sensing Potentiometer
3. Performance Monitor Radar
4. CCLS Variable Flow Hydraulic Pump
5. Load Sensing Pin

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Electronic Draft Control Component Layout – Continued
(Tractors With Open Center Hydraulic Circuit Using A Gear Type Pump)

1. Electronic Draft Control Valve and Unload Valve
2. Lift Arm Position Sensing Potentiometer
3. Performance Monitor Radar
4. Gear Type Hydraulic Pump
5. Load Sensing Pin

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COMPONENT DESCRIPTION

Hydraulic Pump

Either the variable flow closed center load sensing piston pump, Figure 8-4-2, or gear type hydraulic pump, Figure 8-4-3, can be installed on tractors with electronic draft control.

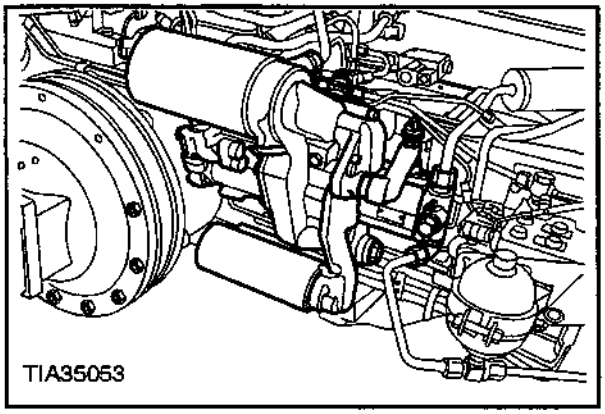


Figure 8-4-2

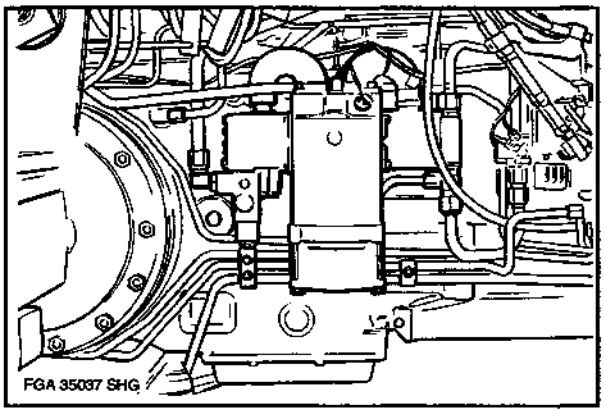


Figure 8-4-3

Hydraulic Lift Assembly

The hydraulic lift top cover assembly used on tractors with electronic draft control and incorporating either the closed center open center circuits are the same.

The top cover incorporates an integral lift cylinder. An optional external assist ram can also be installed if required.

Oil flow to raise the hydraulic lift is directed from the hydraulic pump to the lift cylinder by the hydraulic lift control valve.

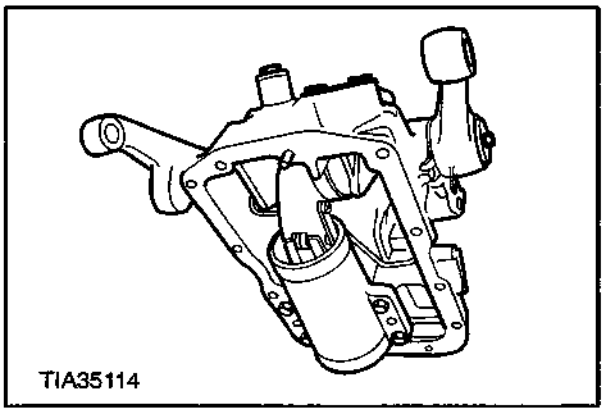


Figure 8-4-4

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Electronic Draft Control (EDC) Microprocessor

The EDC microprocessor is housed in a protective casing in the control console and connects to the electrical harness via two multi–pin connectors. The processor contains no serviceable parts and requires direct replacement when faulty.

The microprocessor manages the operation of the hydraulic lift assembly by receiving and interpreting signals from the other components in the system which it then converts to an input signal to the hydraulic lift control valve.

The microprocessor also contains software for controlling the direct drive and underdrive clutches of the Dual Command transmission, where fitted.

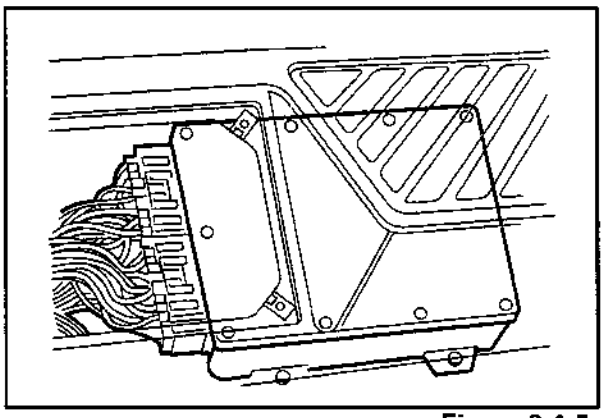


Figure 8-4-5

Load Sensing Pins

The load sensing pins sense draft variations applied by an implement on the lower links.

Each load sensing pin consists of a hollow metal tube (1) containing a circuit board (4) and load sensing core (2). Within the core material are three wire coils (3) supported by metal rods. The coils are energized by the 8.5 volt supply and create a stable pattern of magnetic flux within the core.

The outer casing of the pin is made from a metal with unique electromagnetic properties. When the metal is subjected to a shear force, which is centered on the waisted section (5) of the pin, the natural magnetism of the pin casing changes, which distorts the magnetic flux pattern of the core and is transformed into an electrical output signal. This signal which is proportional to the draft load acting on the implement is then received by the microprocessor.

To ensure that the load sensing pins only sense draft forces and not forces due to the weight of the implement, they are designed to only react to shear forces in the horizontal plane. It is, therefore, essential that the pin cannot be incorrectly fitted and this is achieved by using a special clamp which ensures correct installation.

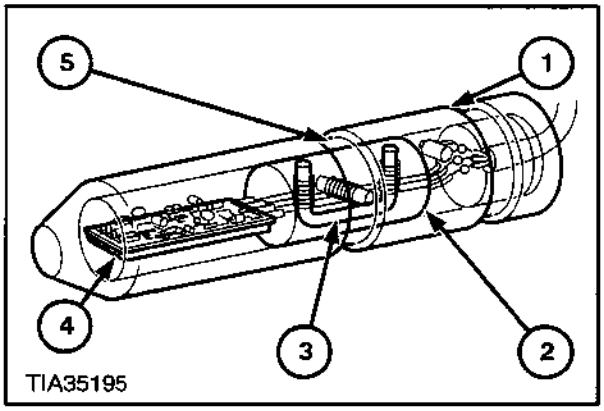


Figure 8-4-6

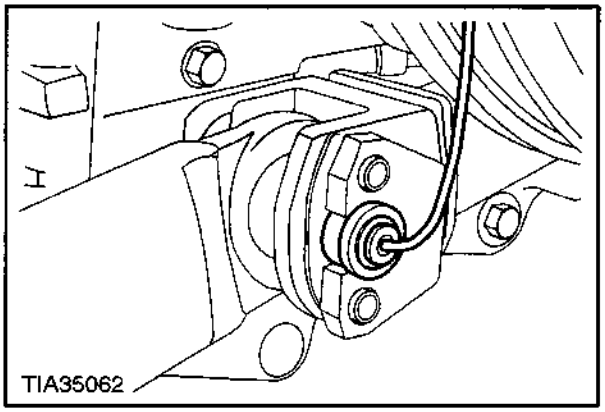


Figure 8-4-7

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Hydraulic Lift Assembly Control Valve

The hydraulic lift electronic draft control valve (EDC valve) is a proportional solenoid operated valve located adjacent to the hydraulic lift assembly. The valve responds to pulse width modulated signals from the microprocessor to direct pump pressure oil to and from the hydraulic lift cylinder in direct proportion to the degree of lift required.

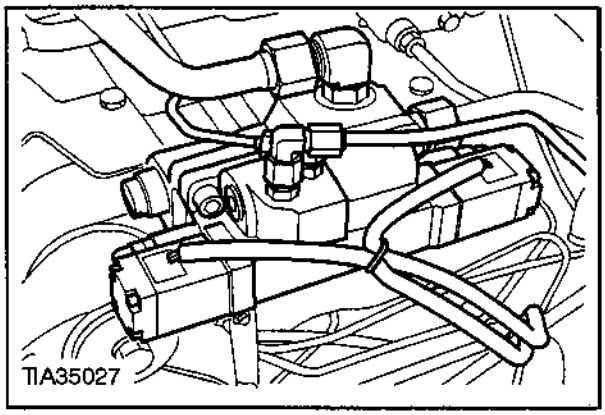


Figure 8-4-8

Unload Valve
(Tractors with Gear type pump only)
(Not used in North America)

The unload valve must be installed on tractors fitted with the gear type hydraulic pump and is located adjacent to the hydraulic lift control valve.

The unload valve directs pump oil flow to either the hydraulic lift control valve or return to sump circuit when the hydraulic lift is not being operated.

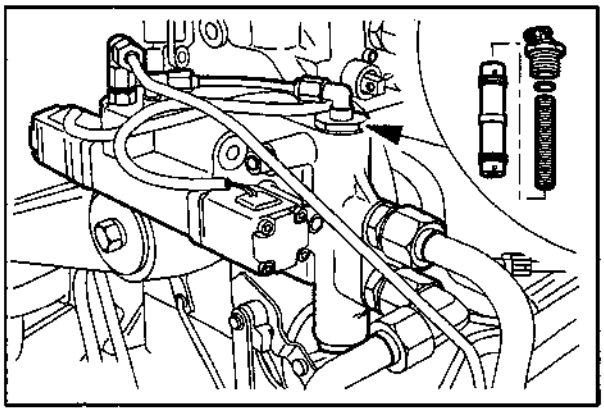


Figure 8-4-9

Lift Control Lever Potentiometer

When the lift control lever is moved the resistance value of the potentiometer changes and indicates to the microprocessor the position to which the lift arms are to be raised.

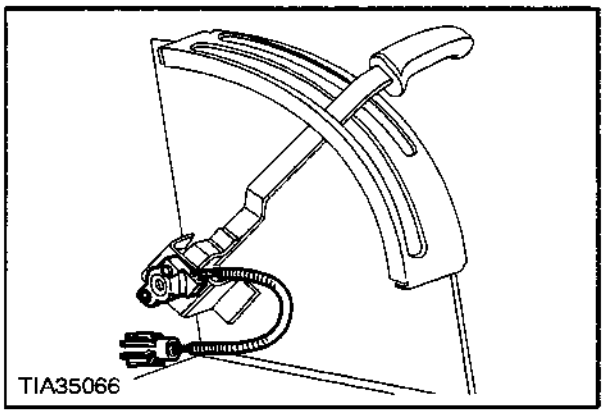


Figure 8-4-10

Lift Arm Position Sensing Potentiometer

The lift arm position sensing potentiometer is mounted on the right hand lift arm and indicates at all times to the EDC microprocessor the exact position of the hydraulic lift arms.

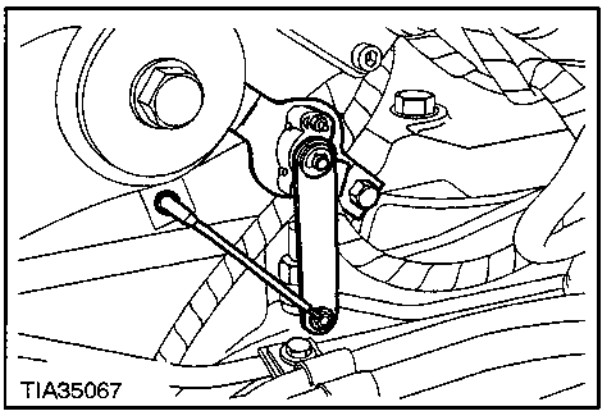
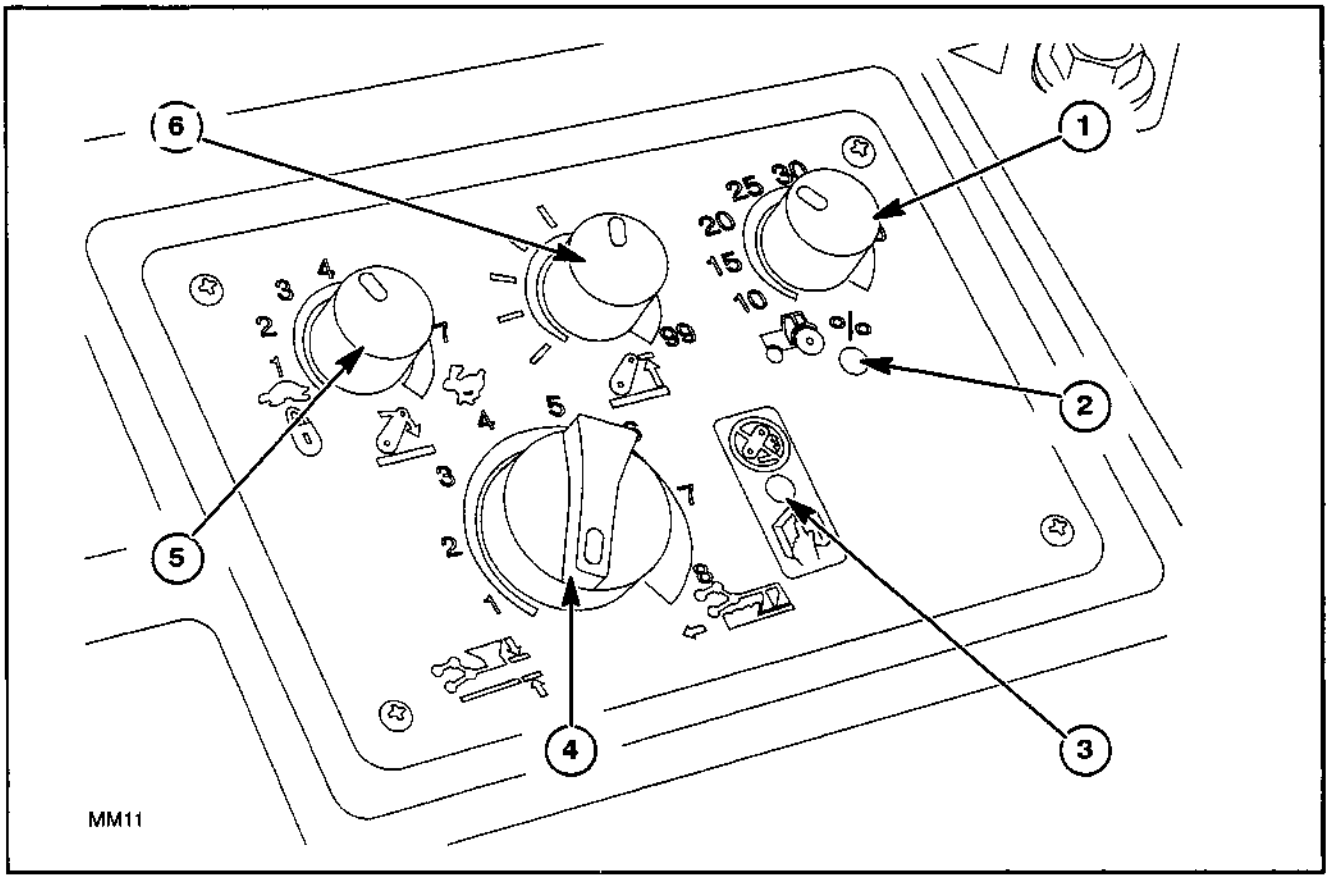


Figure 8-4-11

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Hydraulic Controls



The electronic draft and position control system is operated from a console to the right of the operator's seat. Each of the variably adjustable controls is directly attached to a potentiometer whose change in resistance, when operated, is sensed by the microprocessor and contributes to the input signal which operates the hydraulic control valve.

The position/draft sensitivity knob (4) selects full position control, maximum draft control or a mixture of the two allowing selectable sensitivity in draft control according to operating needs.

The drop rate control (5) is provided to limit the rate of drop of the hitch and functions whenever the implement is raised out of the ground.

A transport lock position (control turned counter-clockwise provides for transporting equipment on the three point linkage and prevents the equipment from accidentally lowering and damaging the road surface. When transport lock is selected, the hitch is fully raised using the in cab fast raise/work switch and the vehicle speed is above 5 mph (8 kmh) the EDC system will automatically sense any bounce oscillations of the implement through the load sensing pins and automatically make small raise and lower adjustments to minimize their effect on the ride and steering control of the tractor.

The height limit control (6) restricts the maximum height the lift arms can be raised, to prevent large implements from striking the rear of the cab or platform. This control restricts the lift height when either the lift control lever or external lift/lower switches are used.

The status indicator (3) flashes whenever a malfunction is identified by the microprocessor. The status indicator is continuously illuminated when the hitch is disabled.

The slip limit control (1),where fitted, works in conjunction with the performance monitor radar and limits the amount of wheel slip by reducing the working depth of the lift arms when slip exceeds a pre determined percentage. The indicator light (2) is illuminated when the lift arms are responding to an excessive slip condition.

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The raising and lowering of the lift arms is controlled by a lever (2) in the right hand console.

The three position in cab raise/work rocker switch (1) allows the operator to rapidly raise and lower the implement without moving the position of the lever. When the switch is in the raised position, the maximum height of the hydraulic lift links is controlled by the height limit control. When the switch is in the work position the links will lower to a position preset by the lift control lever.

NOTE: *The raise/work switch will not lower the implement if the tractor speed is greater than 15 MPH (24 km/h).*

The center position is required to select operation of the external fender switches as described below.

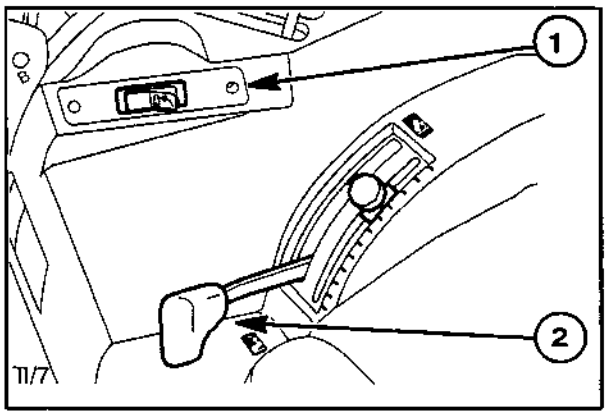


Figure 8-4-12

Rear Fender Lift Lower Switches

These externally operated switches (1) allow the hydraulic linkage to be raised and lowered by the operator while standing beside the tractor, so aiding attachment and detachment of implements.

The fender switches are activated by positioning the in cab raise/ work switch in the central position.

To return to normal hydraulic lift operation select 'Raise' using the in cab fast raise/work switch and move the lift control lever until it corresponds to the position of the hydraulic lift links and the lift disabled symbol is extinguished. This operation is known as capturing the lift.

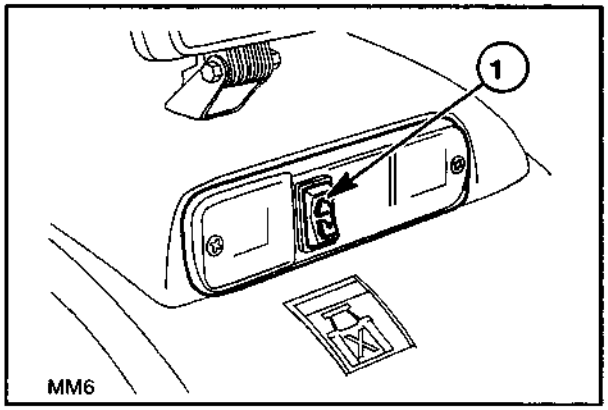


Figure 8-4-13

When raising or lowering an implement using the external switches the speed of lift/lowering is non adjustable and automatically controlled by the microprocessor, to compensate for variations in implement weight, battery voltage and hydraulic pressure.

Never operate the external switches while standing:

- *Directly behind the tractor or tires*
- *Between the lower links*
- *On or near the implement*

Never extend arms, legs, any other part of the body or any object into the area near the 3–point linkage or implement while operating the external switch.

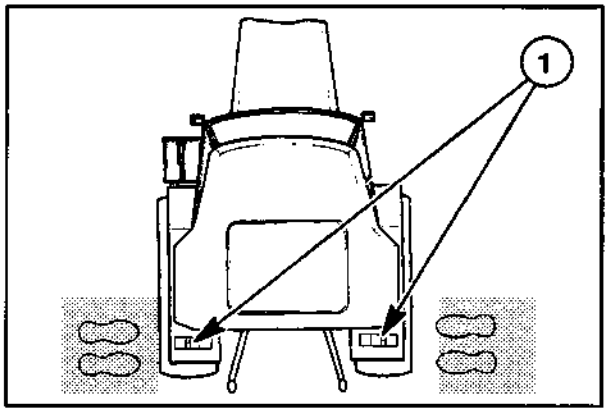


Figure 8-4-14

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Instrument Panel

Either an electronic or analog electronic instrument panel may be fitted to the tractor and incorporate the following functions to advise on the status of the hydraulic lift.

- Implement Position Display
- Hitch Enabled Symbol (Electronic Instrument Panel Only)
- Hitch Disabled Symbol
- Read Your Manual Symbol
- Diagnostic Error Code

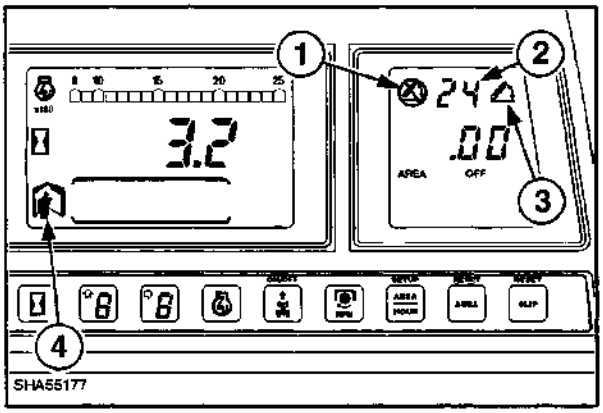


Figure 8-4-15

Electronic Instrument Panel

1. Hitch Disabled Symbol
2. Implement Position/Diagnostic Repair Code
3. Hitch Enabled Symbol
4. 'Read Your Manual' Symbol

Implement Position Display

The digital display indicates the position of the lift arms on the scale of 0 (fully lowered) to 99 (fully raised).

Hitch Enabled Symbol (Electronic Instrument Panel Only)

The hitch enabled symbol illuminates when the position of the lift arms is in phase to the position of the lift control lever.

Hitch Disabled Symbol

The hitch disabled symbol is illuminated if the lift arms and lift control lever are out of phase.

This will occur if:–

(1) The lift control lever has been inadvertently moved while the engine is stopped.

(1) The in cab fast/raise work switch has been put in center position to transfer control of the hydraulic lift to the external switches.

Diagnostic Repair Code

These tractors have a self diagnostic fault finding capability. If a malfunction occurs in the system, a 'flashing' two digit diagnostic repair code and flashing 'Read your Manual' symbol are displayed.

System Pointer
Analog Electronic Instrument Panel Only

The instrument panel can also display PTO and transmission data. The pointer indicates if the display is referring to PTO, Transmission or EDC data.

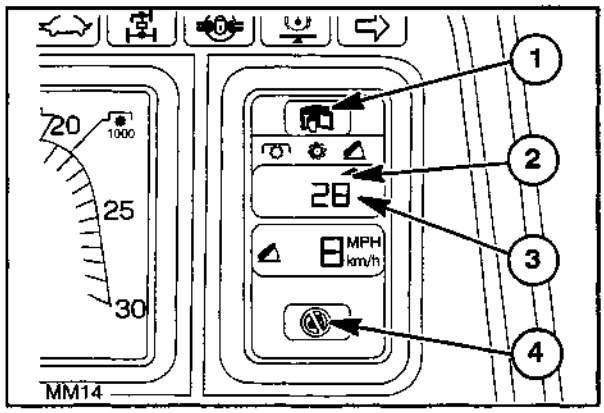


Figure 8-4-16

Analog Electronic Instrument Panel

1. 'Read Your Manual' Symbol
2. System Pointer
3. Implement Position/Diagnostic Repair Code
4. Hitch Disabled Warning Symbol

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Operation of Hydraulic Lift Control Valve

Operation of the hydraulic lift control valve for tractors installed with either the closed center load sensing variable flow or open center gear type hydraulic pump is the same. An unload valve is however incorporated into the output circuit of the open center gear type hydraulic pump to divert excess pump flow back to sump whenever the hydraulic lift is not operating or pump output exceeds demand of the hydraulic lift.

The hydraulic circuits for tractors with either variable flow or fixed displacement gear type pumps are shown in Section 8 Chapter 1. The following diagrams illustrate the specific operation of the hydraulic lift control valve and also include the open center gear type pump unload valve.

Hydraulic Lift in Neutral

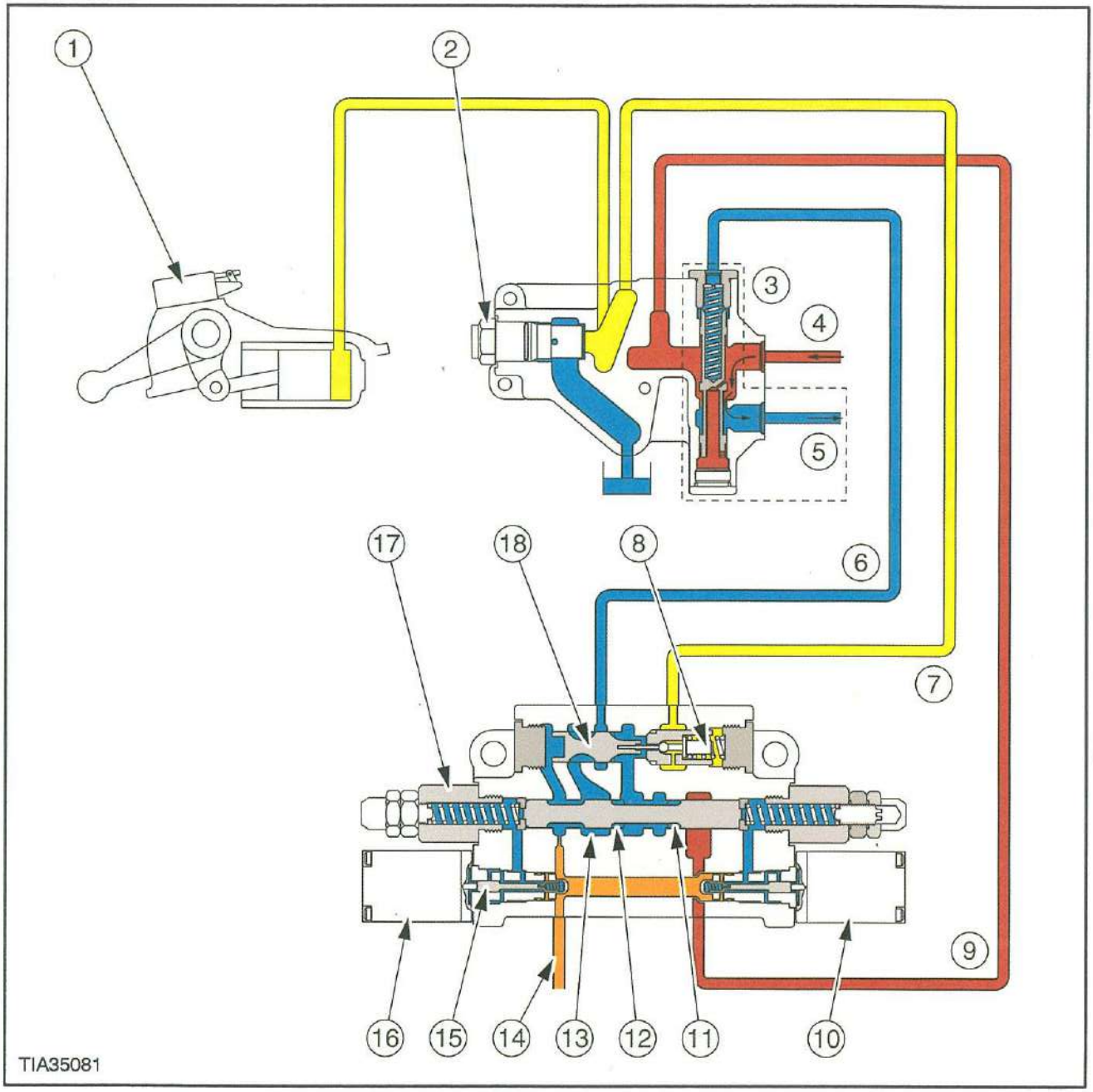
In the 'Neutral' condition the EDC microprocessor is not sending raise or lower signals to the control valve solenoids and the spring force applied to each end of the main spool holds the spool in a central 'Neutral' position, preventing oil flow from the pump to the hydraulic lift.

When the main spool is in neutral, the right hand end of the load sensing valve and hence the load sensing line are open to sump. In this condition the hydraulic lift load check valve remains seated and oil in the hydraulic lift cylinder is trapped maintaining the lift arms in a stationary position.

When the tractor is installed with the open center gear pump and the hydraulic lift is in neutral, system pressure oil flow from the pump flows through the orifice in the spool of the unload valve moving the valve against the spring to divert pump flow to sump.

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Electronic Draft Control Operation–Neutral

1. Hydraulic Lift
2. Lift Cylinder Safety Valve
3. Unload Valve*
4. Flow From Hydraulic Pump
5. Return To Sump*
6. Load Sensing Line *
7. To Hydraulic lift
8. Load Check Valve
9. Pump Flow to Electronic Draft Control Valve
10. Solenoid (Lower)
11. Main Spool Inlet Metering Land
12. Main Spool Return to Reservoir Metering Land
13. Return to Reservoir Port
14. Pilot Pressure From Low Pressure Circuit
15. Pilot Spool
16. Solenoid (Raise)
17. Spool Centering Spring
18. Load Sensing Valve

* Tractors With Open Center Circuit Only
* Connects to either Unload Valve or Variable Flow Hydraulic Pump as fitted

Pump System Pressure Oil
Pilot Pressure Oil 265 lbf/in^2 (18 bar)
Return to Reservoir Oil
Trapped Oil

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Raising

When the lift control lever is moved to raise the hydraulic lift the microprocessor identifies the change in resistance of the lift control lever potentiometer and transmits a signal to the raise solenoid of the control valve. The armature in the solenoid reacts to the signal and the pilot spool is moved to the right, allowing pilot pressure from the low pressure hydraulic circuit to be applied to the left hand end of the main spool.

The main spool moves to the right allowing pump system standby pressure oil to flow past the main spool inlet metering land to the load check and load sensing valves. The load sensing valve moves to the right allowing a sensing pressure to be applied to the unload valve or variable flow piston pump as fitted.

On tractors installed with the 'Open Center' circuit the combined load sense pressure and spring pressure of the unload valve moves the valve against pump pressure restricting pump flow from returning to sump and increasing flow and pressure to the hydraulic lift control valve.

When the tractor is installed with the 'Closed Center' load sensing variable flow piston pump, the load sensing pressure is applied to the pump flow compensating spool which signals the pump to increase output. Refer to Section 8 Chapter 2 for further details on description and operation of variable flow piston pump.

The resulting rise in pump pressure applied to the end of the load check valve lifts the valve of its seat allowing metered system pressure oil to flow into the lift cylinder and raise the arms of the hydraulic lift to the desired position.

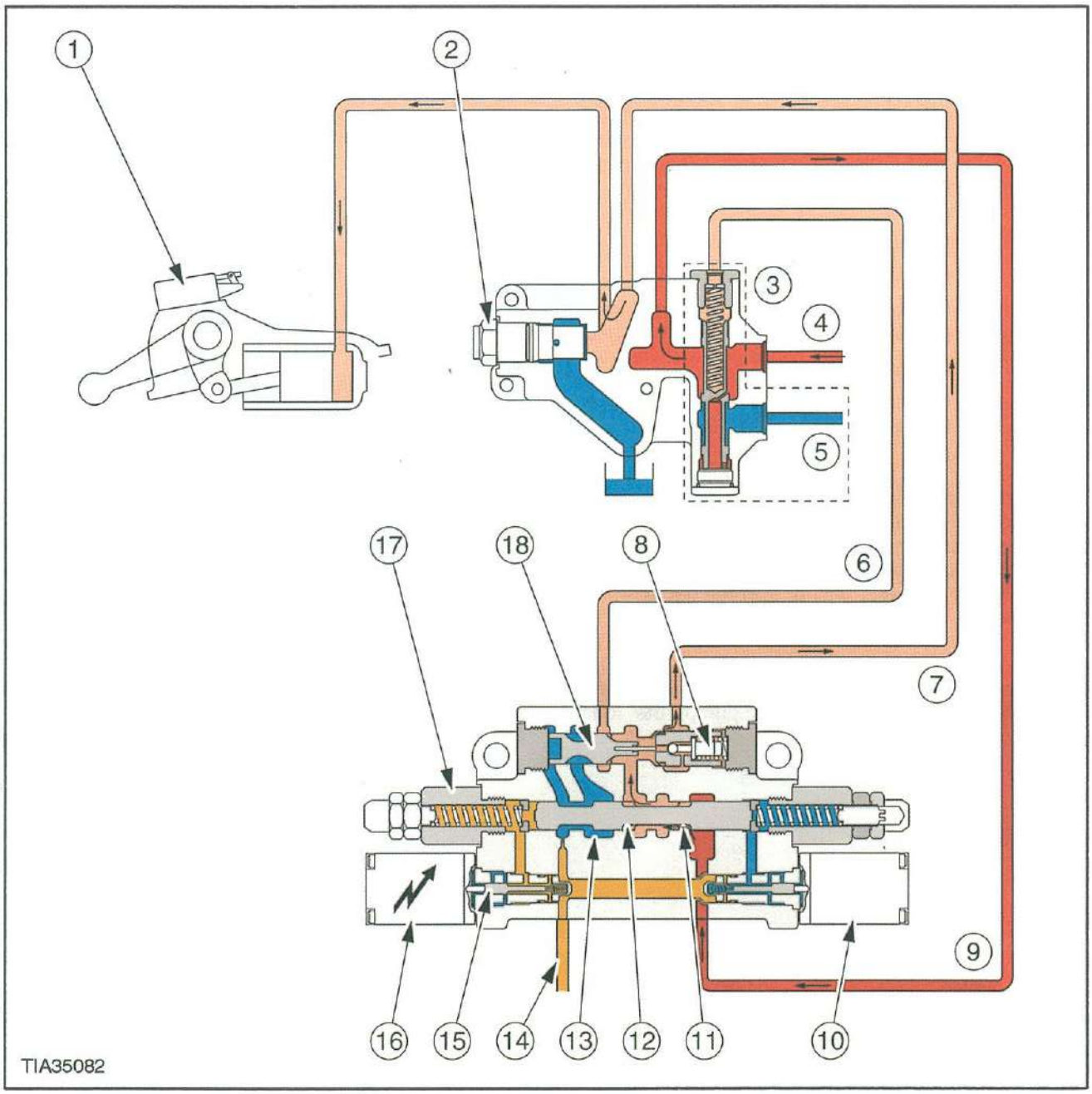
The rate of lift is controlled by the modulated signal to the raise solenoid which by opening and closing the pilot valve allows the main spool to continually adjust the volume of metered oil to the lift cylinder.

When the lift arms have moved to the desired position the resistance of the the lift arm position sensing potentiometer matches the value of the lift control lever potentiometer and the microprocessor switches of the signal to the raise solenoid.

The main spool returns to neutral position and the load check valve closes, trapping the oil in the lift cylinder.

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Electronic Draft Control Operation–Raising

1. Hydraulic Lift
2. Lift Cylinder Safety Valve
3. Unload Valve*
4. Flow From Hydraulic Pump
5. Return To Sump*
6. Load Sensing Line *
7. To Hydraulic lift
8. Load Check Valve
9. Pump Flow to Electronic Draft Control Valve
10. Solenoid (Lower)
11. Main Spool Inlet Metering Land
12. Main Spool Return to Reservoir Metering Land
13. Return to Reservoir Port
14. Pilot Pressure From Low Pressure Circuit
15. Pilot Spool
16. Solenoid (Raise)
17. Spool Centering Spring
18. Load Sensing Valve

* Tractors With Open Center Circuit Only
* Connects to either Unload Valve or Variable Flow Hydraulic Pump as fitted

Pump System Pressure Oil

Pilot Pressure Oil 265 lbf/in^2 (18 bar)

Return to Reservoir Oil

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Lowering

When the lift control lever is moved to lower the hydraulic lift the microprocessor identifies the change in resistance of the lift control lever potentiometer and transmits a signal to the lower solenoid of the control valve. The armature in the solenoid reacts to the signal and the pilot spool is moved to the left, allowing pilot pressure from the low pressure hydraulic circuit to be applied to the right hand end of the main spool.

The main spool moves to the left blocking the flow through the orifice from the pilot circuit. Pressure builds up which moves the load sensing valve to the right and the pin on the end of the valve unseats the ball in the end of the load check valve.

With the ball unseated, oil behind the load check valve vents to sump enabling the load sensing valve to continue moving to the right and unseat the load check valve poppet.

The pressurized oil in the lift cylinder can now return to sump across the return to sump metering land of the main spool, allowing the arms to lower at a controlled speed.

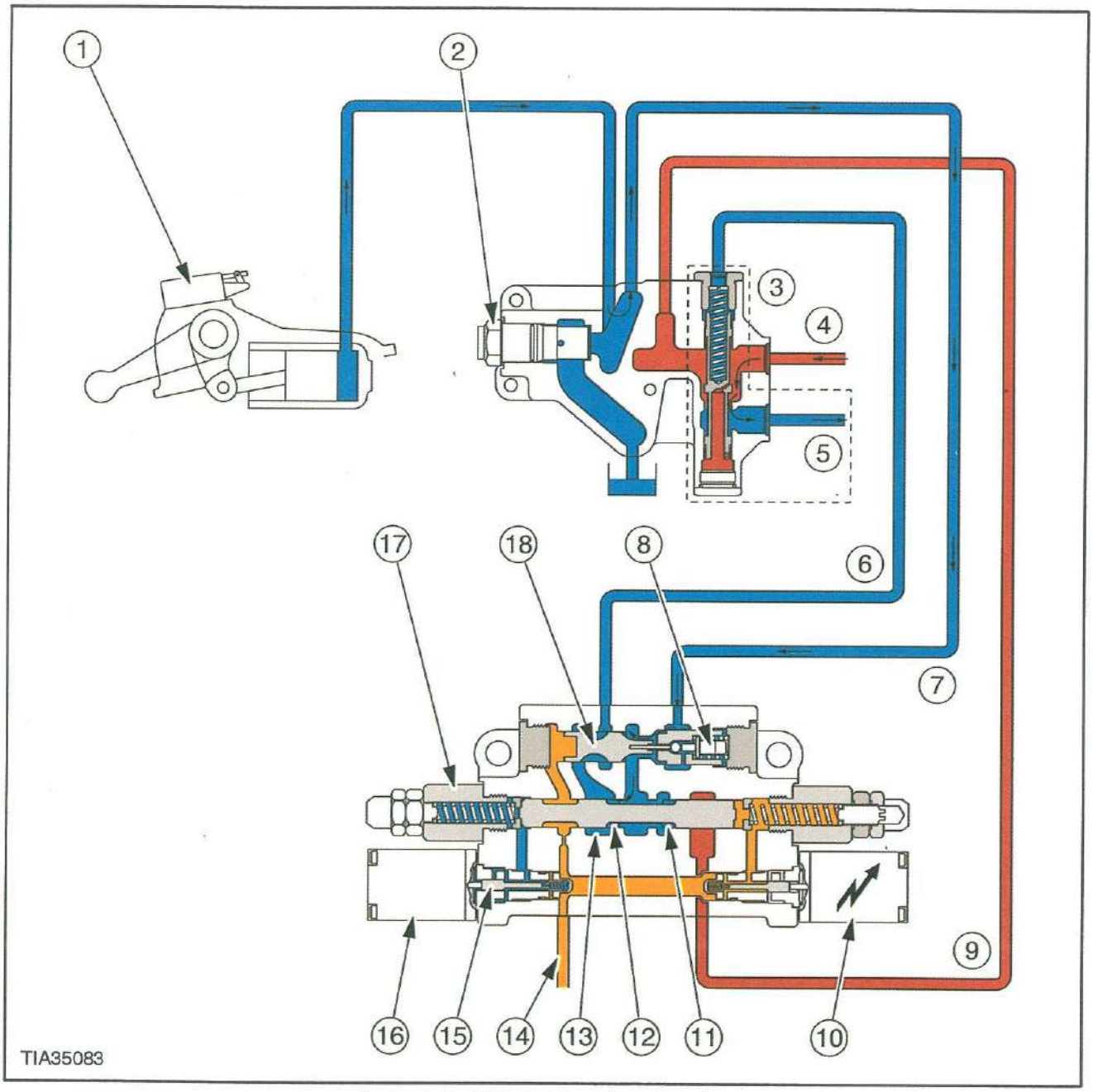
The rate of lowering is controlled by the modulated signal to the lower solenoid which by opening and closing the pilot valve allows the main spool to continually adjust the volume of metered oil returning to sump from the lift cylinder.

When the tractor is operating in draft control the microprocessor lowers the hydraulic lift but also senses through the load sensing pins in the lower links the draft forces imposed by the soil on the implement .

If the draft on the implement starts to exceed that set by the operator using the position/draft sensitivity control the microprocessor sends a signals to the raise solenoid and gradually raises the implement until the required draft forces are restored. If after raising the implement the draft forces decrease below that required the microprocessor sends a similar signal to increase the working depth of the implement.

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Electronic Draft Control Operation–Lowering

1. Hydraulic Lift
2. Lift Cylinder Safety Valve
3. Unload Valve*
4. Flow From Hydraulic Pump
5. Return To Sump*
6. Load Sensing Line *
7. To Hydraulic lift
8. Load Check Valve
9. Pump Flow to Electronic Draft Control Valve
10. Solenoid (Lower)
11. Main Spool Inlet Metering Land
12. Main Spool Return to Reservoir Metering Land
13. Return to Reservoir Port
14. Pilot Pressure From Low Pressure Circuit
15. Pilot Spool
16. Solenoid (Raise)
17. Spool Centering Spring
18. Load Sensing Valve

* Tractors With Open Center Circuit Only
* Connects to either Unload Valve or Variable Flow Hydraulic Pump as fitted

Pump System Pressure Oil

Return to Reservoir Oil

Pilot Pressure Oil 265 lbf/in^2 (18 bar)

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FAULT FINDING AND REPAIR

Tractors installed with electronic draft control are equipped with two separate systems to assist in the detection and correction of faults in the system.

These are:–

- Self Diagnostic Error Code Display
- Service Diagnostic Test Routines

Fault diagnostic error codes as mentioned previously in this Chapter are displayed on the instrument panel as a two digit flashing error code.

On tractors installed with the electronic instrument cluster the error codes are displayed in the instrument panel as shown Figure 8-4-17.

On tractors installed with the analog electronic instrument cluster the electronic management unit, transmission and electronic draft control hydraulic lift fault codes are all displayed in the same instrument cluster window.

To differentiate between each type of code the following logic applies.

Error codes relating to the Electronic management unit are preceded by the letter **P**, Figure 8-4-18.

Error codes relating to the transmission are preceded by the letter **E**, Figure 8-4-19.

Error codes relating to the Electronic draft control hydraulic lift assembly **do not** have any preceding letter, Figure 8-4-20.

The pointer above the code moves to either the PTO, transmission or hydraulic lift symbol to also indicate the type of fault displayed,

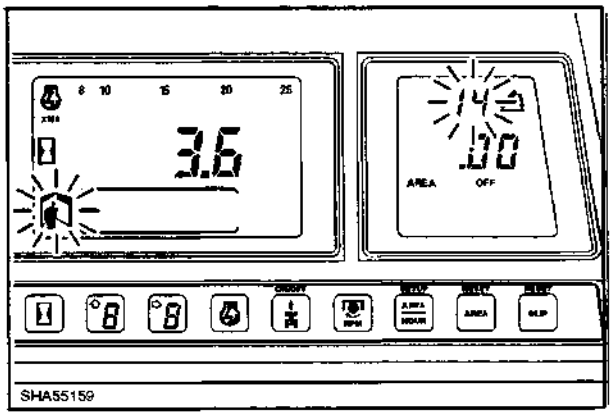


Figure 8-4-17

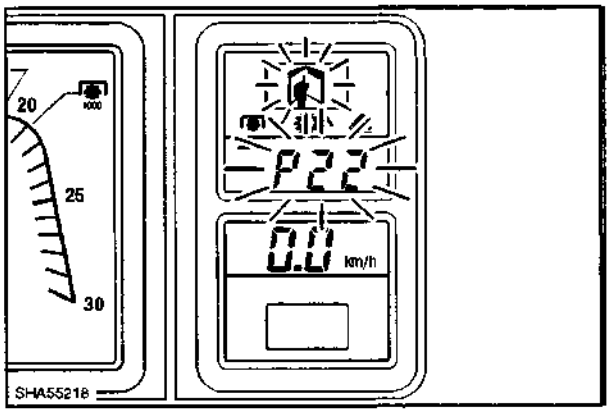


Figure 8-4-18

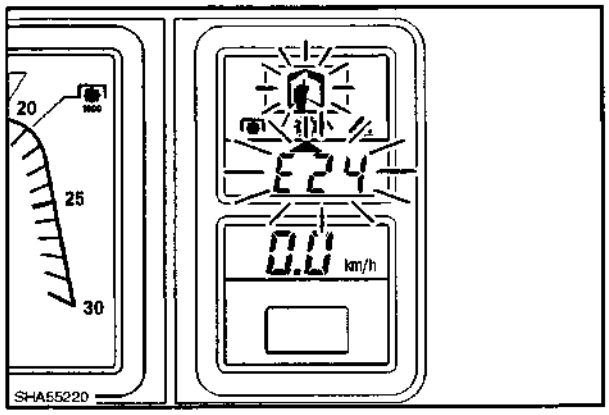


Figure 8-4-19

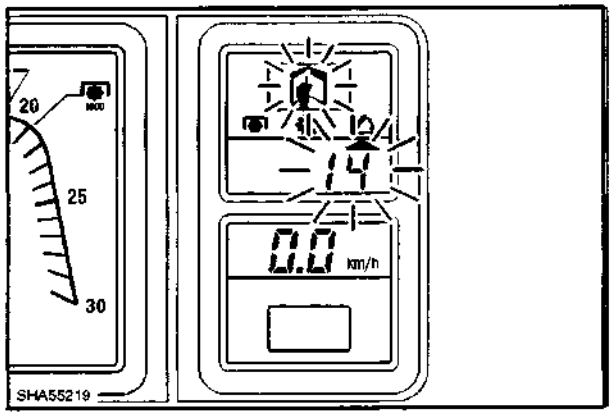


Figure 8-4-20

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When an error code is displayed refer to the error code listing on Page 8-4-32. This gives a brief description of the fault and identifies the page in this Section where a comprehensive fault finding chart for the error can be found.

Should more than one error occur simultaneously on the tractor, the most important error is displayed until repaired. Outstanding faults will then be displayed in an order of priority until all faults are cleared.

An essential piece of equipment for checking electronic systems is a good quality multimeter with an input impedance of at least 20,000 ohms which can measure voltage, current and resistance.

NOTE: *Upon completion of each repair it is necessary to turn the key–start switch 'On' and 'Off' to clear the code from the digital display and confirm that the repair was successful.*

Error Code Recovery

The electronic instrument panel has a feature which stores and recalls the last ten error codes and the operating hours at which they occurred. This feature is useful in establishing a record of the last time that a particular error occurred on the tractor. Full details on the recovery of error codes on tractors with electronic instrument cluster are described in Section 2 of this Repair Manual.

SERVICE DIAGNOSTIC TEST ROUTINES

The service diagnostic test routines listed below supplement the automatic diagnostic error codes previously described. Access to these test routines is via the service diagnostic connector, located adjacent to the EDC Microprocessor and enables the following menu system to be displayed on the instrument panel in order to perform specific tests on the tractor. Practical examples on the use of these routines are shown on Page 8-4-26.

'H9' allows access to a further very comprehensive menu as shown on the following page and enables diagnostic test routines to be performed on potentiometers and voltage supplies.

SERVICE DIAGNOSTIC TEST ROUTINES

Display	Hydraulic Lift Status	Electronic Draft Control Test Routine
HH	Disabled	–
H1	Enabled	EDC Valve Calibration Mode
H2	Disabled	Not Used
H3	Disabled	EDC Valve Calibration Values
H4	Disabled	Software Revision Display
H5	Disabled	Switch Diagnostic Mode
H6	Enabled	Not Used
H7	Enabled	Not Used
H8	Disabled	Microprocessor Non–volatile Memory Reset
H9	Enabled	Vehicle Sensor Operation and Voltage Tests
HA	Enabled	Not Used
HB	Enabled	Not Used

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H9 Diagnostic Test Routine Menu

Channel Number	Description	Typical Approximate Values
1	Transmission Oil Temperature	75 @ 104°F (40°C)
2	CCLS Pump Low Temperature Switch	96>104°F (40°C) 2<104°F (40°C) Note:This channel available on HI/Lo transmissions only
3	Fuse 12 Sense	96
4	Programming voltage Vpp	22
5	5 Volt Reference	49
6	12 Volt Vf input to Microprocessor	42
7	12 Volt Vd input to Microprocessor	3
8	12 Volt Vh input to Microprocessor	41
9	8 Volt reference to EDC Load Sensing Pins	79
10	Not Used	–
18	EDC Valve Raise Solenoid Current	0–66
19	EDC Valve Lower Solenoid Current	0–66
20	Ground Speed Signal	64
25	Implement Status Lamp Sense	7 when illuminated
26	Wheel Slip Lamp Sense	7 When Illuminated
28	Lift Arm Position Sensing Potentiometer	15 lift Lowered 79 Lift raised
29	Lift Control Lever Potentiometer	25 Fully Lowered 74 Fully Raised
30	Drop Rate Control Potentiometer	84 Turned Fully Clockwise 14 Turned Fully Counter Clockwise
31	Height Limit Control Potentiometer	84 Turned Fully Clockwise 14 Turned Fully Counter Clockwise
32	Position/Draft SensitivityPotentiometer	84 Turned Fully Clockwise 14 Turned Fully Counter Clockwise
33	Slip Limit Control Potentiometer	84 Turned Fully Clockwise 14 Turned Fully Counter Clockwise
34	Right Hand Load Sensing Pin	48 When Implement Not Being Used
35	Left Hand Load Sensing Pin	48 When Implement Not Being Used

The H9 Diagnostic test routine menu has 37 channels which are applicable to either the Electronic Draft Control system or Transmission systems. Only those channels applicable to Electronic Draft control are listed above. Refer to Section 4 Transmission Systems and Section 2 Electrical Systems for further details on the use of Menu H9.

The Electronic draft control test routines, which are operated through the menu, should be used in conjunction with the fault finding procedures described later in this section.

When a test routine is performed for a particular channel the data is displayed on the instrument panel and must be compared with the typical approximate values shown in the table above.

Where the data displayed differs by more than 5% from those typical values shown it is an indication that the component/circuit being tested is the cause of the malfunction.

Examples on the procedure to enter and use the diagnostic test routines are described on the following pages.

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Entering Diagnostic Test Routine

1. Connect diagnostic switch special tool FNH00874 into the black diagnostic socket.

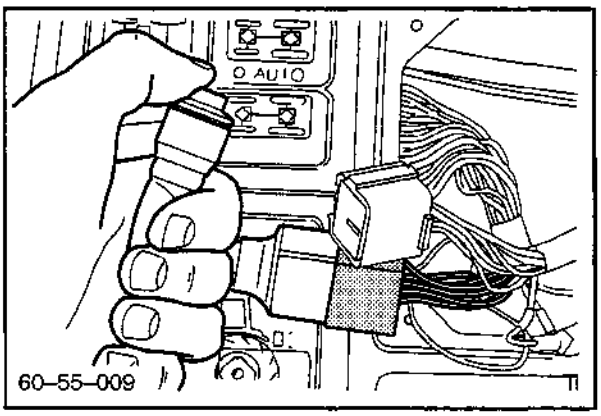


Figure 8-4-21

2. Turn key–start switch 'On', the display on instrument panel will show 'HH'.

Electronic instrument cluster display.

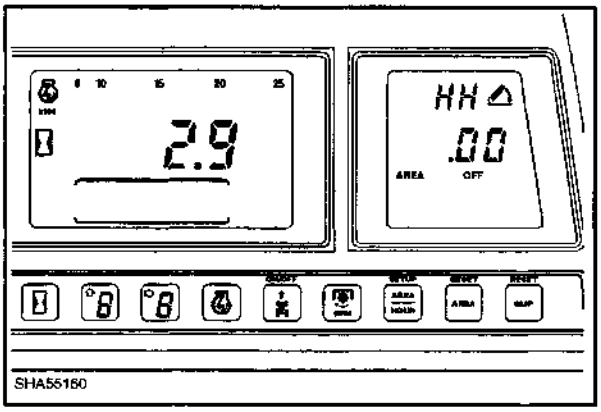


Figure 8-4-22

Analog electronic instrument cluster display.

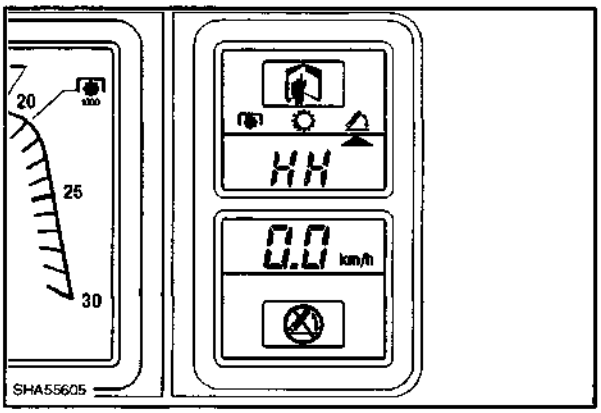


Figure 8-4-23

3. Repeatedly depress the button on the diagnostic switch until the display on the instrument panel changes to the required menu.

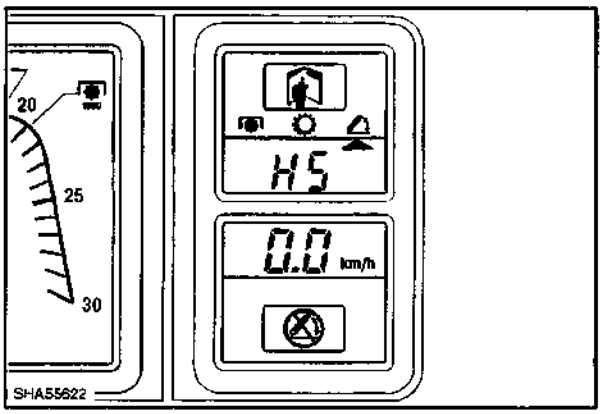


Figure 8-4-24

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Examples On Using Diagnostic Menus

For examples on using H1 and H3 menus refer to calibration of EDC valve on Page 8-4-50

H5–Switch Diagnostic Mode

(Electronic Instrument Cluster Shown)

The switch diagnostic mode allows a simple method of checking the continuity of switches on both the electronic draft control hydraulic system and transmission.

A full list is shown in Section 2.

The switches on the EDC hydraulic system which can be checked using H5 diagnostic mode are:–

In cab fast raise/work switch

External lift/lower fender switches

To use diagnostic routine H5 proceed as follows:–

1. Enter the diagnostic routine and depress the button on the diagnostic switch 'five times' until the display on the instrument panel changes to 'H5.

2. After a maximum period of 4 seconds the display will again change to 'd0'. This is the switch diagnostic mode.

3. Depressing either the in cab fast raise/work switch or external fender switches will cause the numbers on the display to change as follows indicating that the switch being tested is operating correctly.

Switch Code	Switch Description
d1	Fender switch operating correctly in lower position.
d2	Fender switch operating correctly in raise position.
d3	In cab fast raise/work switch operating correctly from raise to lower.
d4	In cab fast raise/work switch operating correctly from lower to raise.

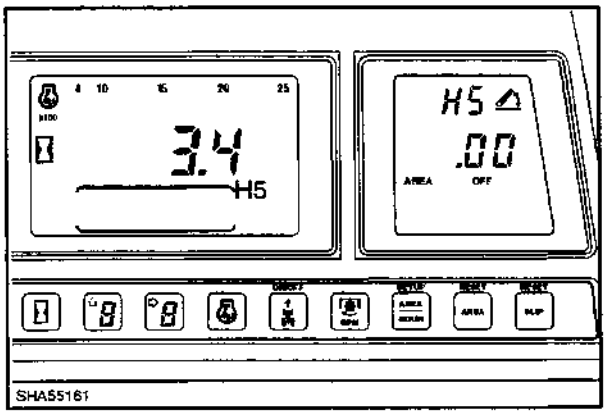


Figure 8-4-25

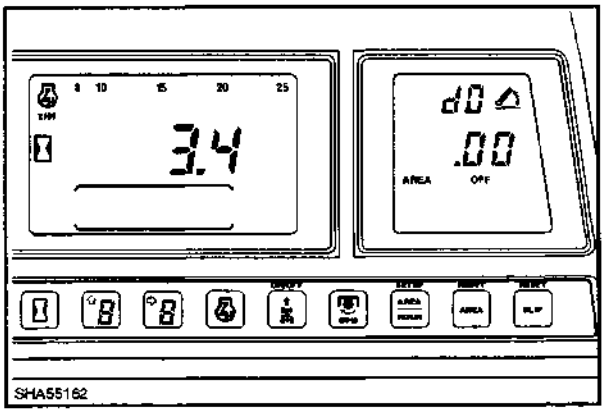


Figure 8-4-26

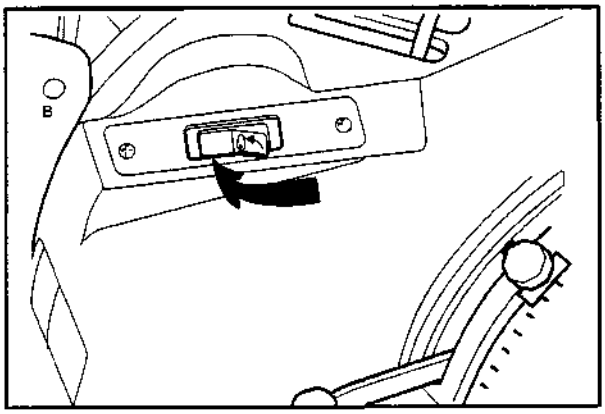


Figure 8-4-27

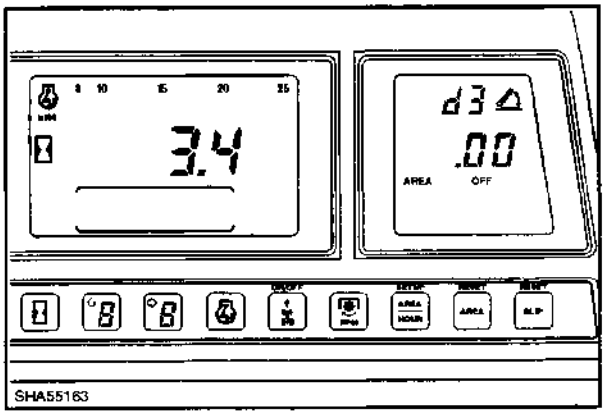


Figure 8-4-28

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H8–Microprocessor Memory Reset Procedure

Whenever the fault finding procedure specifies that it is necessary to replace or reset the microprocessor, the following 'Memory reset' procedure must be followed.

If the 'Memory Reset' procedure is not performed the operator may experience that the hydraulic lift arms will not raise or lower to the maximum limits of travel, or contact the internal mechanical stop before the lift control lever has been moved through its range to the fully raised position.

To reset the memory proceed as follows:–

1. Enter the diagnostic routine and depress the button on the diagnostic switch 'eight' times until the instrument panel changes to H8.

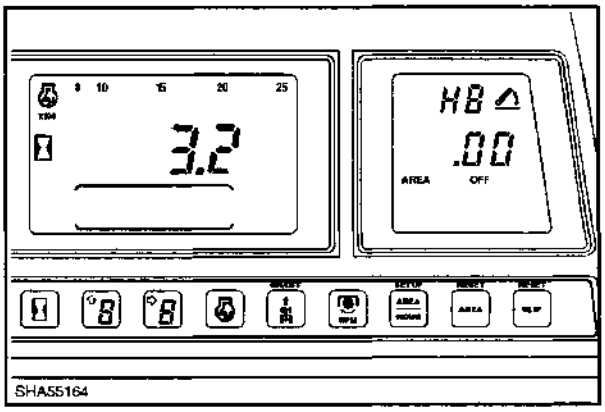


Figure 8-4-29

2. Wait for approximately 4 seconds for the microprocessor to select the memory erase routine. The instrument panel display will change from 'H8' to 'EE' and back to 'HH' indicating memory in processor has been reset.

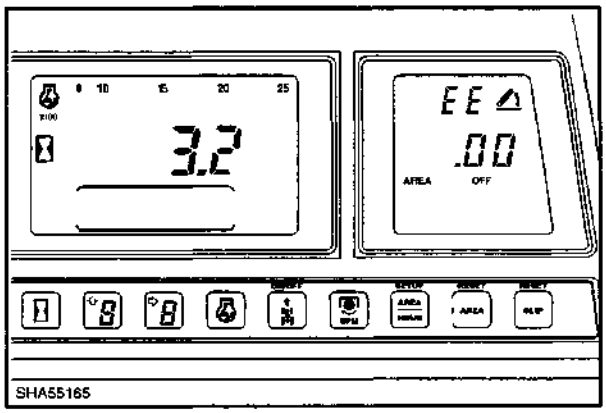


Figure 8-4-30

3. Turn keystart switch 'Off', wait 2 seconds and then turn keystart switch 'On'. The display will change to code 24 indicating that the hydraulic lift requires calibration.

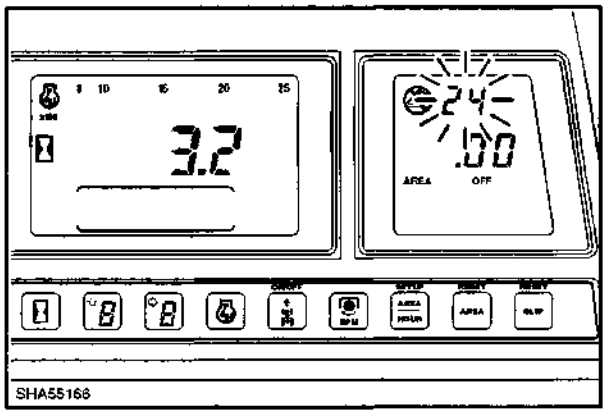


Figure 8-4-31

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On tractors installed with the hi/lo transmission, resetting the memory using H8 will also erase the transmission calibration figures.

If these tractors are also installed with the analog electronic instrument cluster the display will initially display H8.

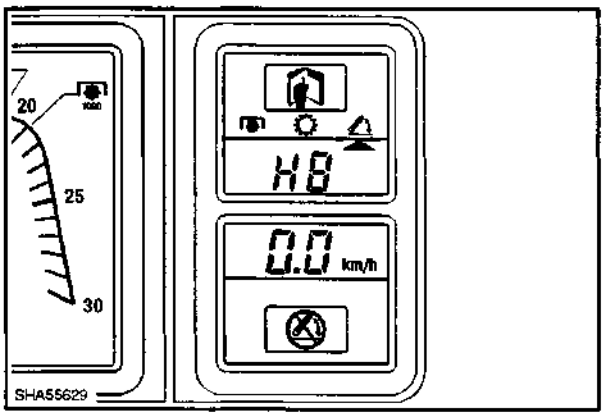


Figure 8-4-32

After approximately 4 seconds the display will change to EE and back to 'HH' indicating memory in processor has been reset.

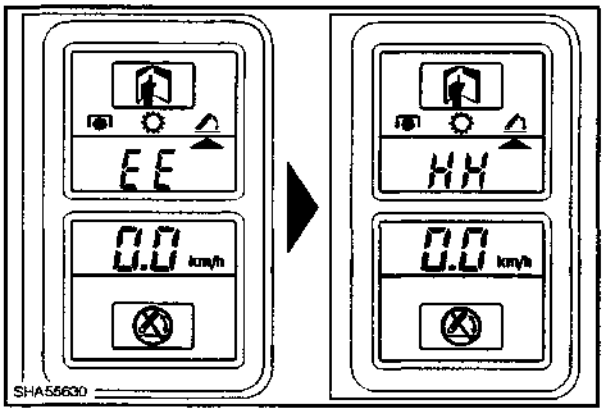


Figure 8-4-33

The transmission error code E24 will then be displayed and remain illuminated until the transmission has been recalibrated.

Refer to transmission Section of this manual for further details on transmission calibration.

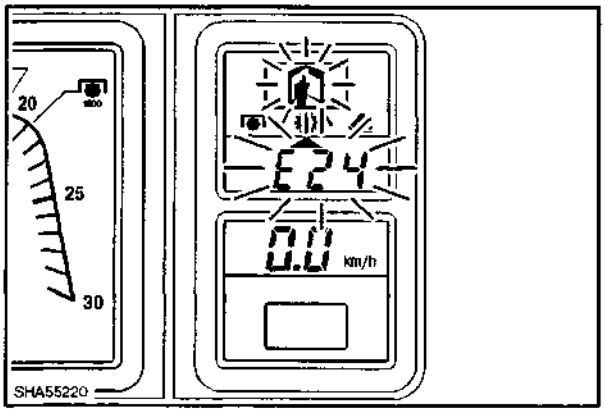


Figure 8-4-34

Hydraulic lift error code 24 will flash and be displayed until the hydraulic lift has been calibrated as described on Page 8-4-48.

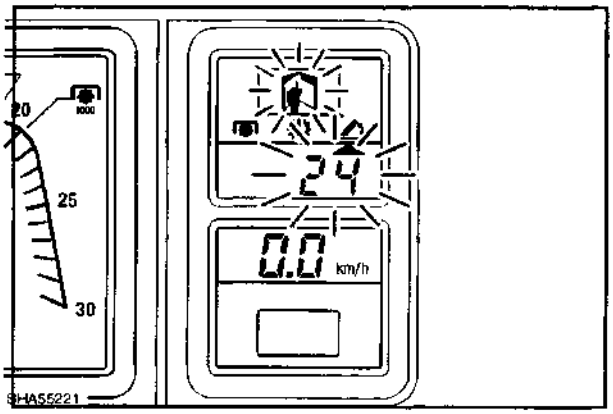


Figure 8-4-35

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H9–Vehicle Sensor and Voltage Tests

This mode allows service personnel to verify the operation of various potentiometers and voltage supplies on the electronic draft control and transmission.

To use diagnostic routine H9 proceed as follows:–

1. Enter the diagnostic routine and depress the button on the diagnostic switch 'nine times' until the display on the instrument panel changes to 'H9.

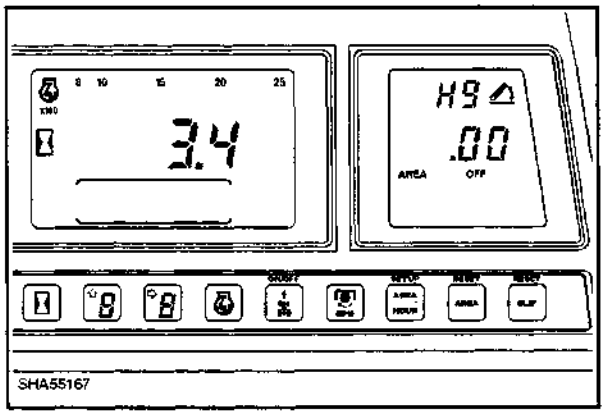


Figure 8-4-36

2. After approximately 4 seconds the display will change to '0'.

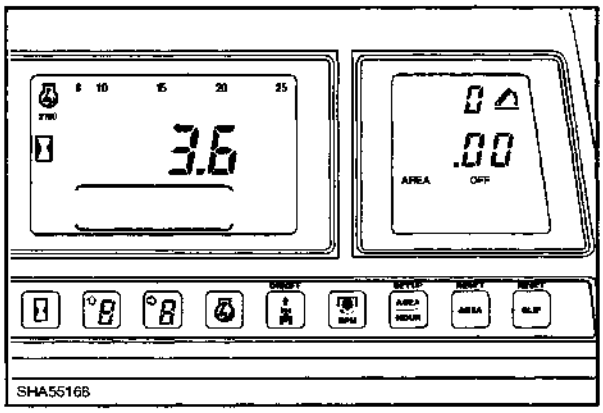


Figure 8-4-37

3. If the tractor is installed with a Hi/Lo transmission this number will then change automatically to approximately 91 which represents the value for correct operation of the clutch pedal potentiometer when the pedal is released. If the tractor is installed with a semi powershift transmission the display will remain at zero and the clutch pedal value will be displayed in the transmission gear display on the operator control console.

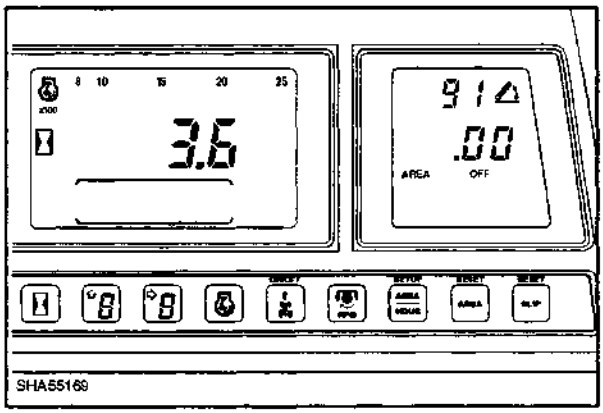


Figure 8-4-38

Figure 8-4-39

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4. By repeatedly depressing the in cab fast raise/work switch the channel number can be increased or decreased until the desired channel has been selected. If the tractor is installed with the Hi/Lo transmission the channel number can also be selected by depressing both transmission upshift and downshift switches.

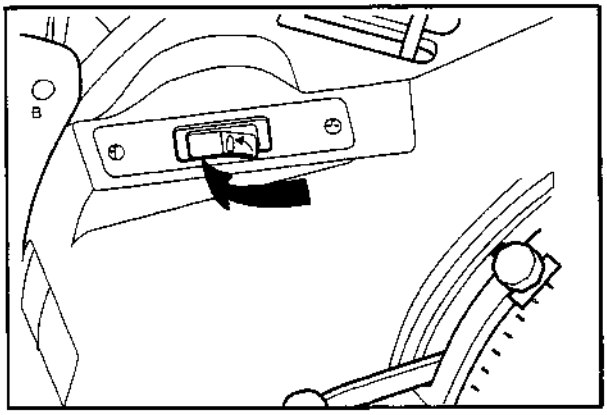


Figure 8-4-40

5. In Figure 8-4-41, Channel 31 has been selected which checks operation of the height limit control potentiometer.

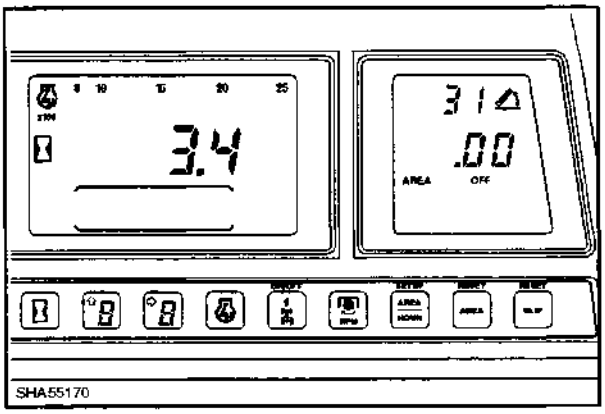


Figure 8-4-41

6. The channel number selected will then change and on turning the height limit control from minimum to maximum should display values of approximately 14 to 84.

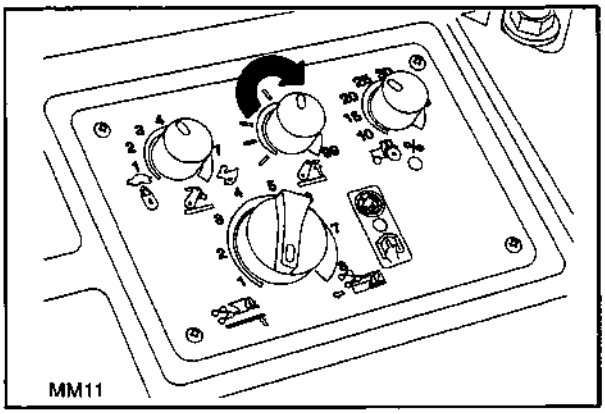


Figure 8-4-42

7. This values displayed must be compared with the typical value in the H9 Channel chart on Page 8-4-25 and if different by greater than 5% indicates that there is a concern in either the potentiometer or circuit being tested.

8. If the values are away from specification it is likely that the potentiometer is defective. Checks on the harnesses should however be made before replacing the potentiometer.

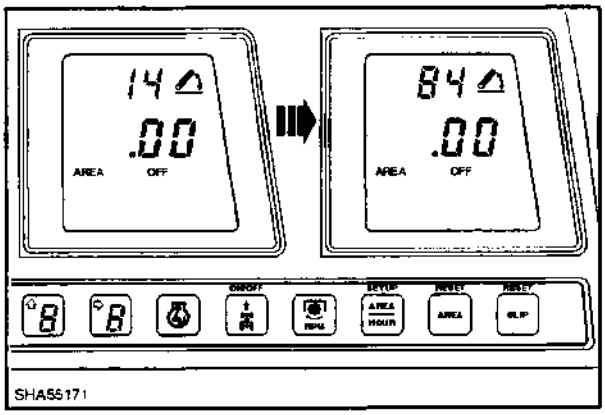


Figure 8-4-43

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ELECTRONIC DRAFT CONTROL ERROR CODES

The following listing details the Electronic Draft Control error codes that can be displayed on the instrument panel whenever a fault is detected in the system.

Should an error occur, reference should be made to the appropriate page of the fault finding procedure. Where the procedure specifies a wiring check refer to the wiring diagram at the end of this fault finding Section.

When using the wiring diagram, each connector and pin is identified using an alpha numeric code.

For example the wiring from the microprocessor to the EDC valve raise solenoid is identified as C127–20 to C051–2 color K/U. This indicates the wiring runs from the microprocessor connector C127 pin number 20 to the EDC valve raise solenoid connector C051 pin number 2 and is a pink wire with a blue tracer.

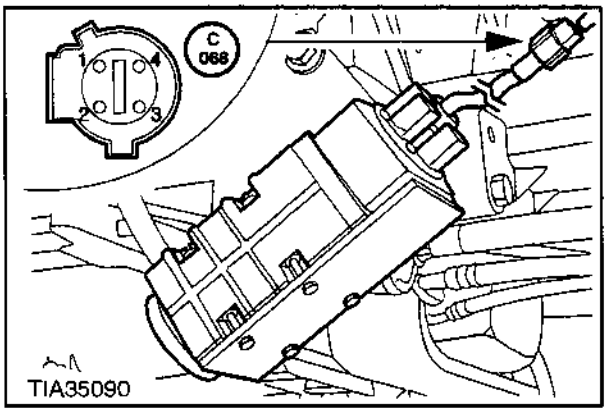
Refer to illustrations in fault finding procedures for connector reference numbers and pin layout.

Error Code	Error Description	Page
Code 2	Tractor Performance Monitor Radar Disconnected	8-4-33
Codes 3, 4 and 5	Speed Sensor Errors	8-4-34
Codes 6 and 7	Slip Control Potentiometer or Circuit Failed	8-4-35
Code 8	Raise/Work Switch Failure	8-4-36
Code 9	Both External Lift/Lower Fender Switches are being Operated Simultaneously	8-4-39
Codes 10 and 11	Height Limit Control Potentiometer Failed	8-4-40
Codes 12 and 13	Drop Rate Potentiometer Failed	8-4-41
Codes 14 and 15	Right Hand Load Sensing Pin or Circuit Failed	8-4-42
Codes 16 and 17	Left Hand Load Sensing Pin or Circuit Failed	8-4-43
Code 18	Both Load Sensing Pins Disconnected	8-4-44
Codes 19 and 20	Incorrect Load Sensing Pin Reference Voltage	8-4-45
Codes 21 and 22	Position/Draft Sensitivity Control Potentiometer or Circuit Failed	8-4-46
Code 23	Control Panel Disconnected	8-4-47
Code 24	Perform Hydraulic Lift Autocalibration	8-4-48
Code HL	Height Limit Incorrectly Set to Perform Autocalibration	8-4-48
Codes 25 and 26	Lift Control Lever Potentiometer Disconnected or Circuit Failed	8-4-53
Codes 27 and 28	Lift Arm Position Sensing Potentiometer Disconnected or Circuit Failed	8-4-54
Code 29	Hydraulic Control Valve Disconnected	8-4-55
Code 30	Ground Signal to Microprocessor Open Circuit	8-4-56
Code 31	Chassis Harness Disconnected	8-4-57
Code 49	Wheel Speed Sensor Open/Short Circuit	8-4-58
Code 53	Microprocessor 5 volt Reference Shorted to 12 volts	8-4-59
Code 54	Microprocessor 5 volt Reference Shorted to Ground	8-4-60
Code 57	EDC Microprocessor Failure	8-4-61
Code 59	Microprocessor 5 volt Reference Voltage Open Circuit	8-4-62
Code 63 and 65	EDC Hydraulic Valve Lower Solenoid Open/Short Circuit	8-4-63
Code 64 and 66	EDC Hydraulic Valve Raise Solenoid Open/Short Circuit	8-4-64
Code 67	EDC Hydraulic Valve Supply Voltage to Low	8-4-65
No Error Code	Miscellaneous Hydraulic Lift Concerns	8-4-66

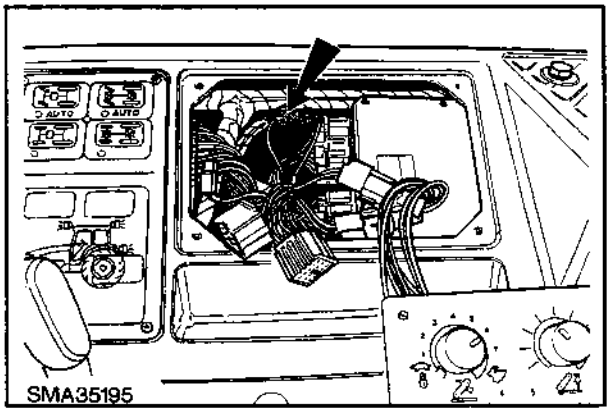
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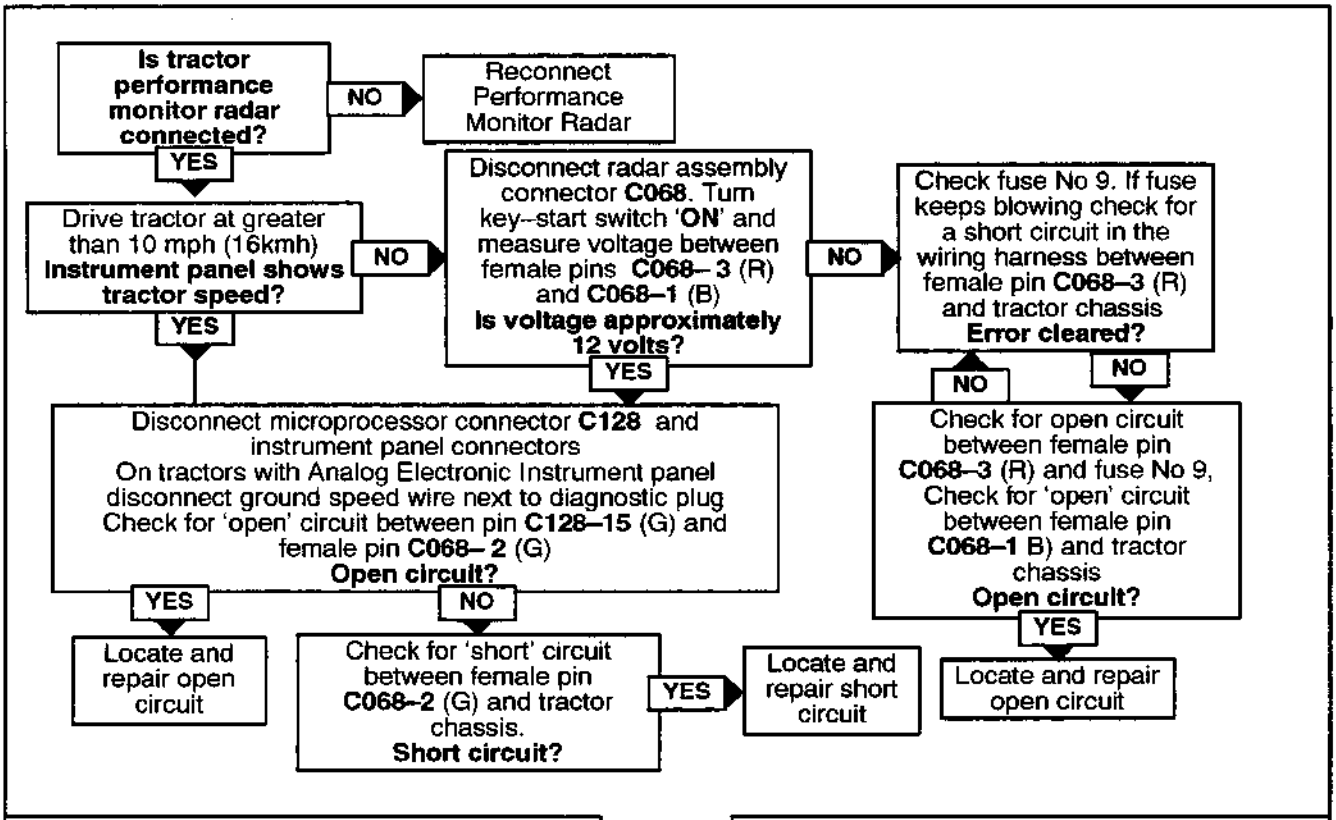
Error Code 2 Poor or No Signal From Tractor Performance Monitor Radar

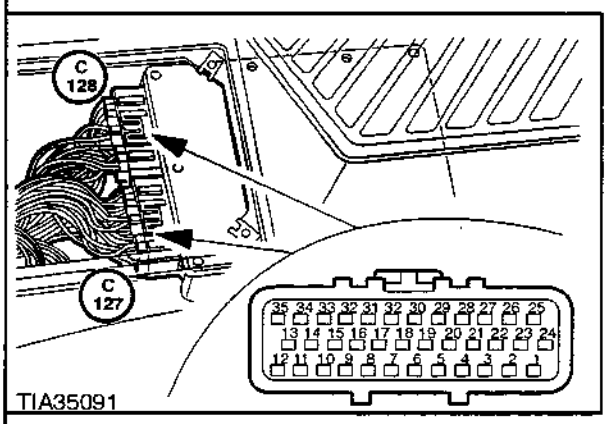


Performance Monitor Radar Connector

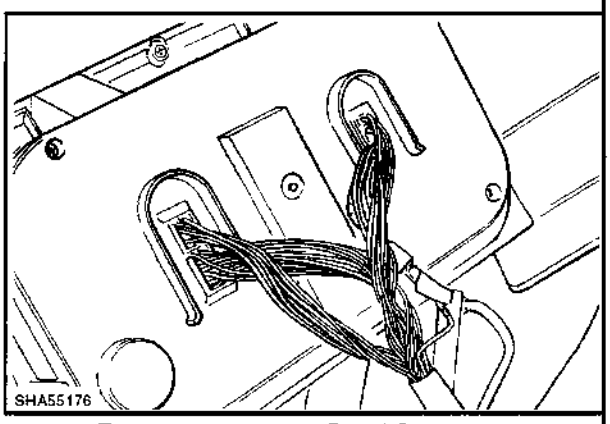


AEIC Ground Speed Wire





Microprocessor Connectors

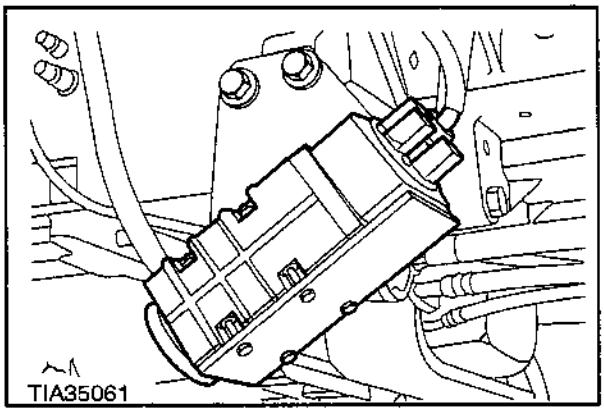


Electronic Instrument Panel Connectors

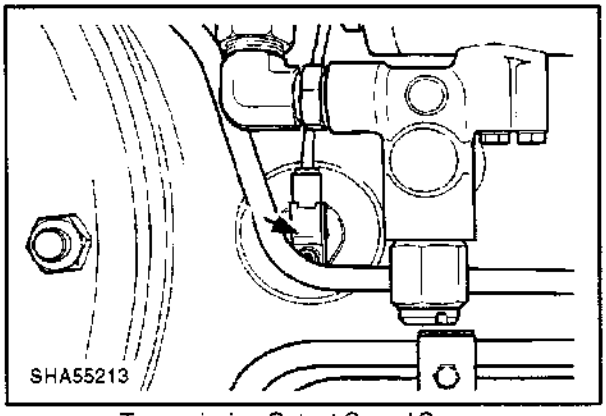
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Error Codes 3, 4 and 5 Speed Sensor Errors

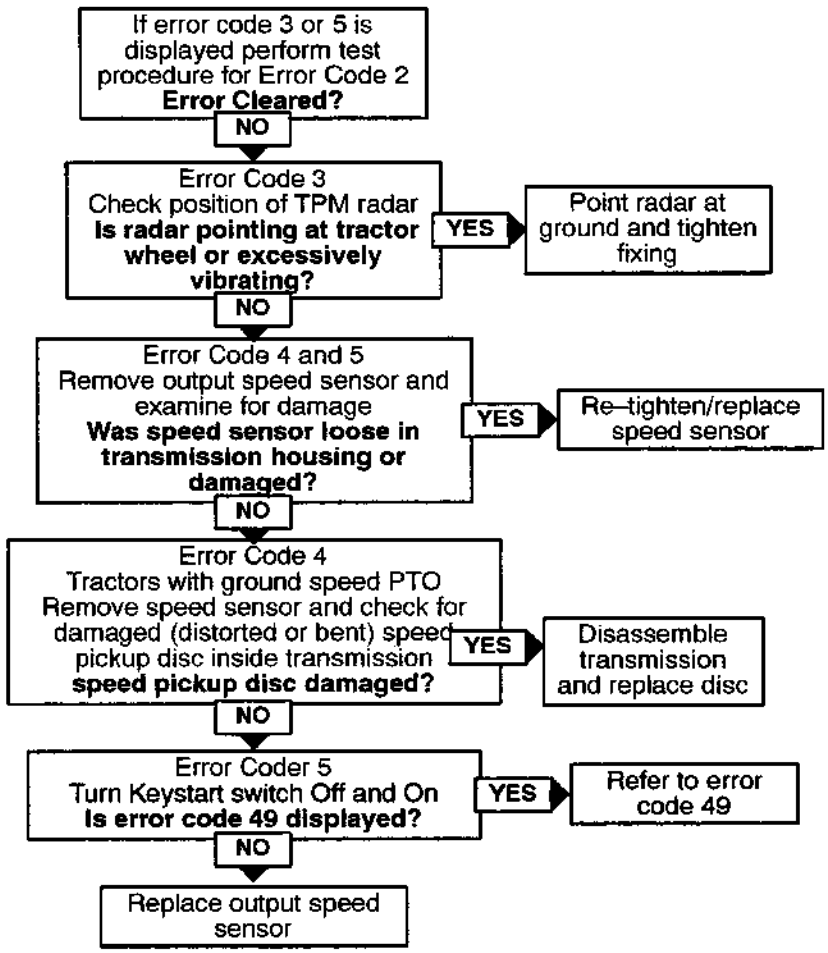


Performance Monitor Radar



Transmission Output Speed Sensor (Right Hand Side of Tractor)

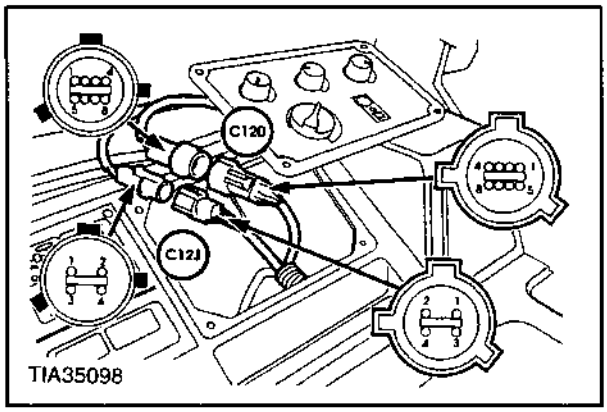
Error Code 3 Radar (Ground speed) greater than wheel speed
Error Code 4 Wheel speed greater than maximum speed of tractor
Error Code 5 Wheel speed zero when radar is indicating ground speed



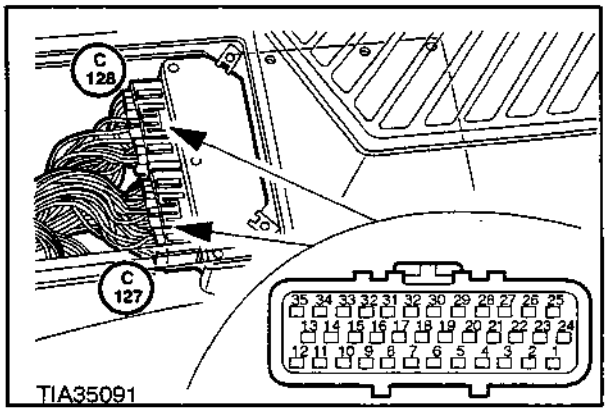
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Error Codes 6 and 7 Slip Control Potentiometer or Circuit Failed



EDC Control Panel Connectors



Microprocessor Connectors

Error Code 6 Slip control voltage low (short or open circuit)
Error Code 7 Slip control voltage high (damaged potentiometer or short to +12 volts)

Enter diagnostic mode H9 Channel 33 (Refer to Page 8-4-30) and turn slip control knob fully clockwise and then fully counter clockwise
Do the values range from 84 to14

YES → While in H9 Channel 33 wiggle wiring comnnectors to check for intermittent circuit. Channel 33 values will change if intermittent circuit detected.

NO

Remove EDC control panel and disconnect connectors **C120** and **C121**.
While turning slip limit control, measure resistance across male pins **C120–1** (TQ/R) and **C121–4** (B) of console
Does resistance vary between 80–600 Ω?

NO → Replace control panel

YES

While turning slip limit control, measure resistance across male pins **C120–1** (TQ/R) and **C121–1** (LN)
Does resistance vary between 80–600 Ω?

NO → Replace control panel

YES

Turn key start switch **'ON'** and measure voltage across female pins **C121–1** (LN) and **C121–4** (B) of harness
Is voltage approximately 5 volts?

NO → Disconnect microprocessor connector **C127**. Check for open circuit between female pins **C121–1** (LN) and **C127–5** (LN), then **C121–4** (B) and **C127–1** (B)
Open circuit?

YES

NO → Check for short circuit between female pins **C121–1** (LN) and **C121–4** (B) or a short circuit to chassis between each of these pins
Short circuit?

YES → Locate and repair short circuit

NO → Replace microprocessor

YES → Locate and repair open circuit

Disconnect microprocessor connector **C128**. Check for open circuit between female pins **C120–1** (TQ/R) and **C128–16** (TQ/R)
Open circuit?

YES → Locate and repair open circuit

NO → Check for short circuit between female pins **C120–1** (TQ/R) and **C121–4** (B). Repeat check between **C120–1** (TQ/R) and **C121–1** (LN)
Short circuit?

YES → Locate and repair short circuit

NO → Check for short circuit between **C120–1** (TQ/R) and chassis
Short circuit?

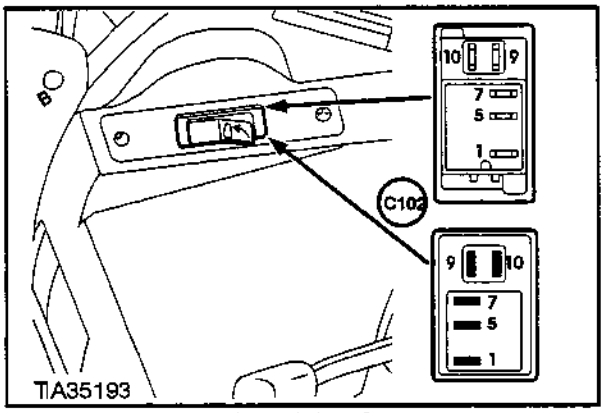
YES → Locate and repair short circuit

NO → Replace microprocessor

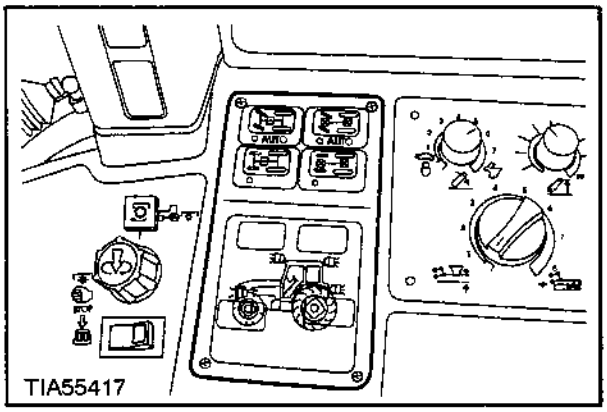
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Error Code 8 Raise/Work Switch Failure



Fast Raise/Work Switch



Electronic Management Unit (EMU)

Enter switch diagnostics mode H5. Refer to Page 8-4-27. **Do Not** start the engine. The display will show **d0**

YES

Move the fast raise/work switch between raise and work positions, several times **Does the display change between:**

NO → **Go to continuation of Error Code 8 On Next Page**

0, d3 and d4 YES → System O.K.

d3 and d0 YES → Disconnect EMU Does display change from 0, d3 and d4 YES → Replace EMU

NO

d4 and d0 YES

Disconnect raise/work switch connector **C102**. With the switch in the raise position, check for open circuit between switch contacts **1 and 3** **Open circuit?**

YES → Replace switch

NO

Disconnect raise/work switch connector **C102**. With the switch in the work position, check for open circuit between switch contacts **3** and **7** **Open circuit?**

YES → Replace switch

NO

Disconnect microprocessor connector **C128**. Check for open circuit between **C102—7** (TQ/P) and **C128–29** (TQ/P) **Open circuit?**

YES → Locate and repair open circuit

YES

Disconnect microprocessor connector C128. Check for open circuit in harness between switch connector **C102–1** TQ/W) and microprocessor connector **C128–26** TQ/W) **Open circuit?**

NO

Check harness for short circuit between switch connector **C102–1** (TQ/W) and **C102–3** (R/LG/B) or tractor chassis **Short circuit?**

YES → Locate and repair short circuit

NO

Check for short circuit **between C102–3** (R/LG/B) and **C102–7** (TQ/P) or tractor chassis **Short circuit?**

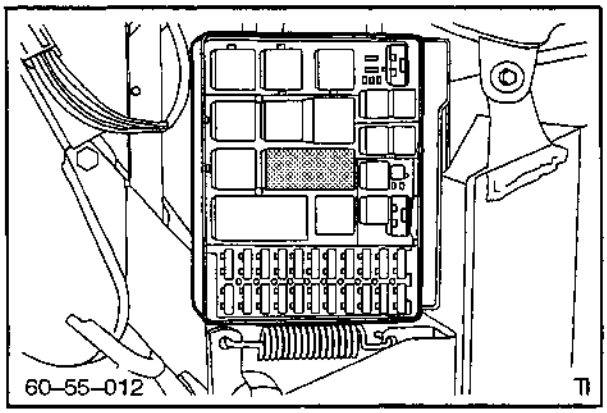
YES → Locate and repair short circuit

NO → Replace microprocessor

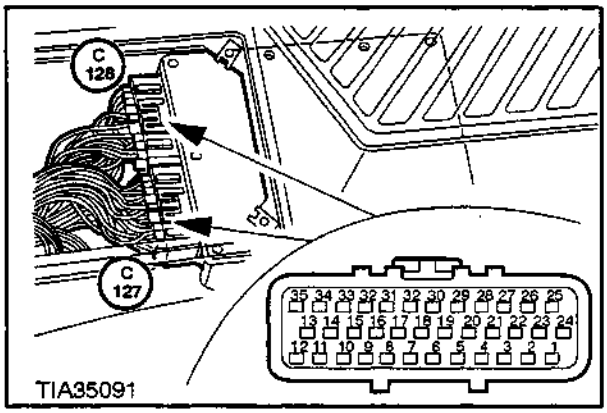
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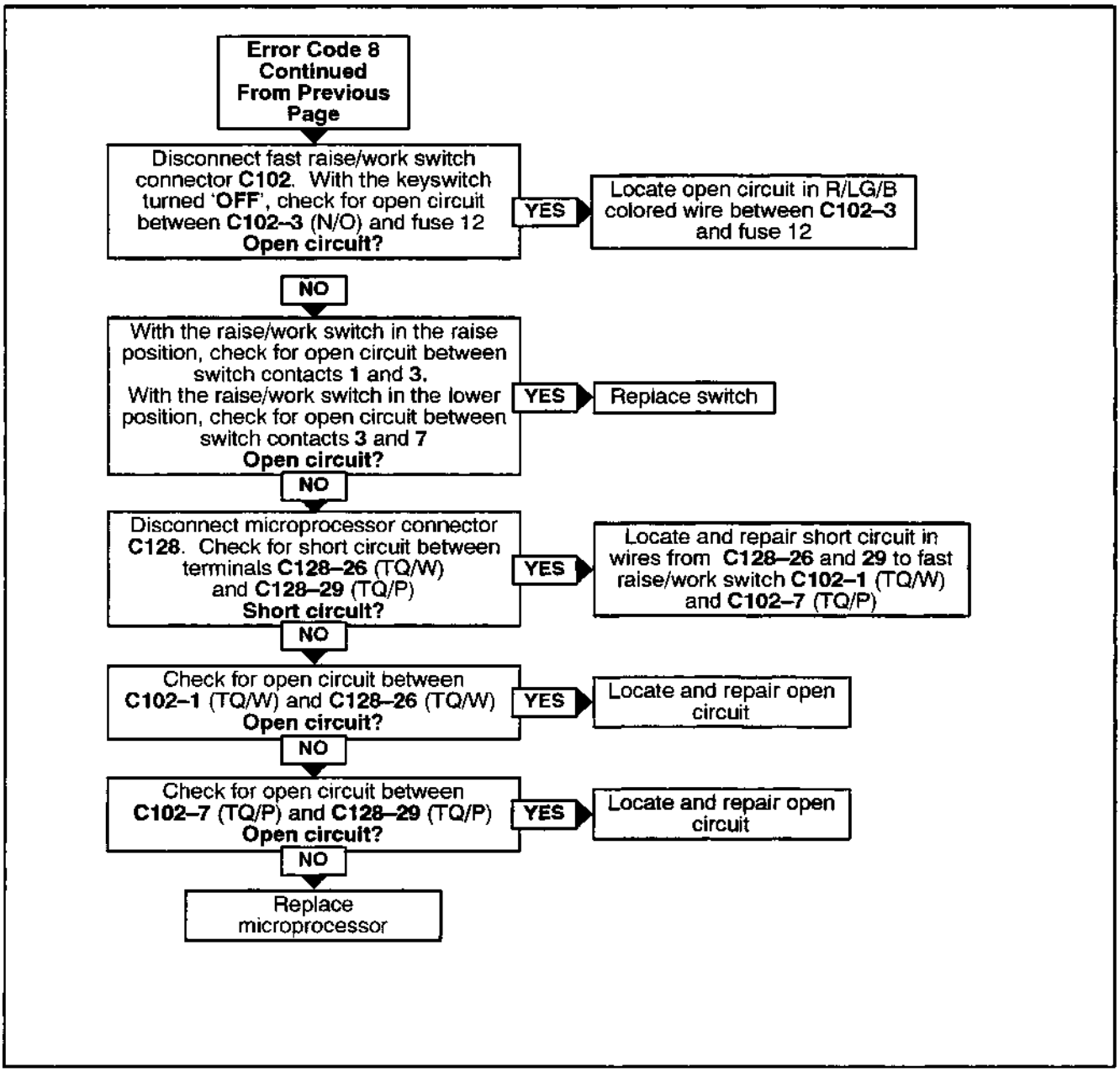
Error Code 8 Raise/Work Switch Failure



Fuse Panel



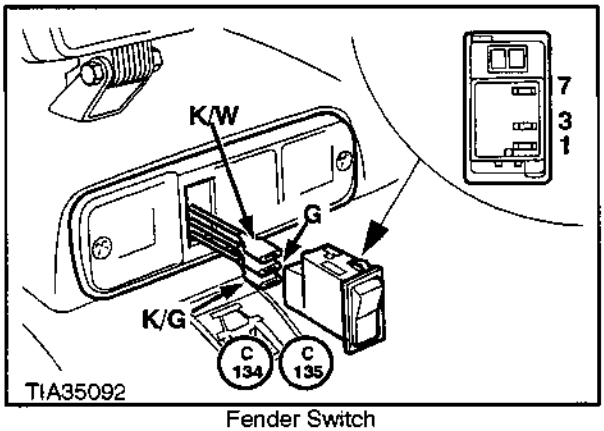
Microprocessor Connectors



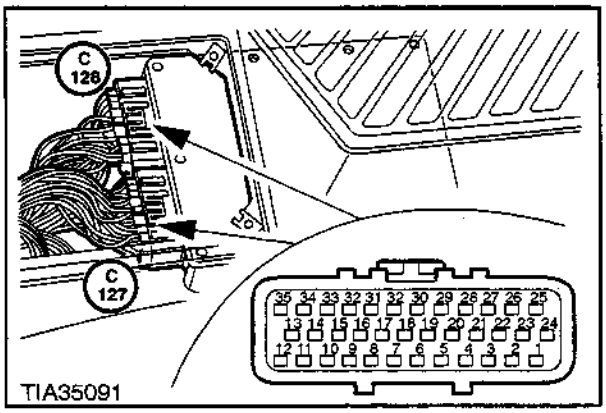
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Error Code 9 Both External Lift/Lower Fender Switches Are Being Operated Simultaneously



Fender Switch



Visibly verify fender switches are not sticking in the raise or lower position **Switch sticking?**
YES → Clean, fix or replace fender switch
NO

Has fuse No 9 blown?
YES → Replace fuse
NO

Enter switch diagnostics mode menu H5. Refer to page 8-4-27. The display will show **d0**
YES

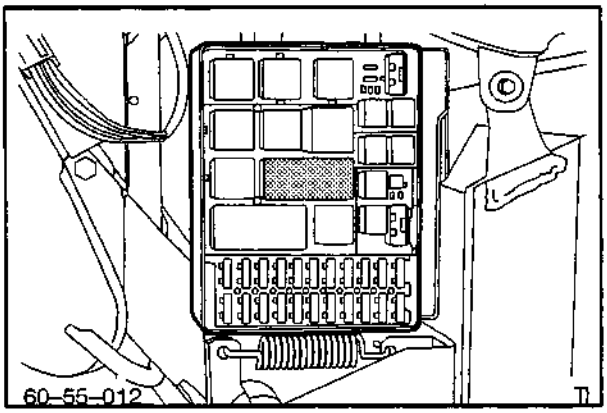
In turn, depress and hold each fender switch in the raise position **Does the display change from d0 to d2?**
YES → **Go to continuation of Error Code 9 On Next Page**
NO

Disconnect fender switch which does not change the display. With the keyswitch in the '**ON**' position, check voltage between **Green** wire and tractor chassis **Is voltage 12 volts?**
YES → With switch in raise position check for open circuit between switch contacts **3** and **7** **Open circuit?**
NO → Disconnect microprocessor connector **C128**. Check for open circuit between terminals **C128–21** and **K/W** colored wire at fender switch **Open circuit?**
YES → Locate and repair open circuit
NO → Check for short circuit between **G** and **K/W** wires at fender switch **Short circuit?**
NO → Replace microprocessor
YES → Locate and repair short circuit
YES → Replace switch
NO → Locate and repair open circuit in green wire between fender switch and fuse No 9

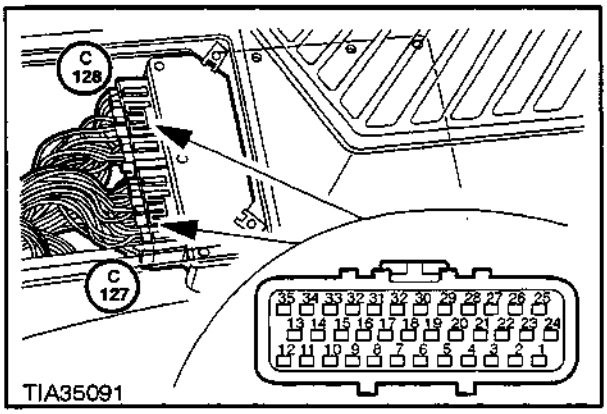
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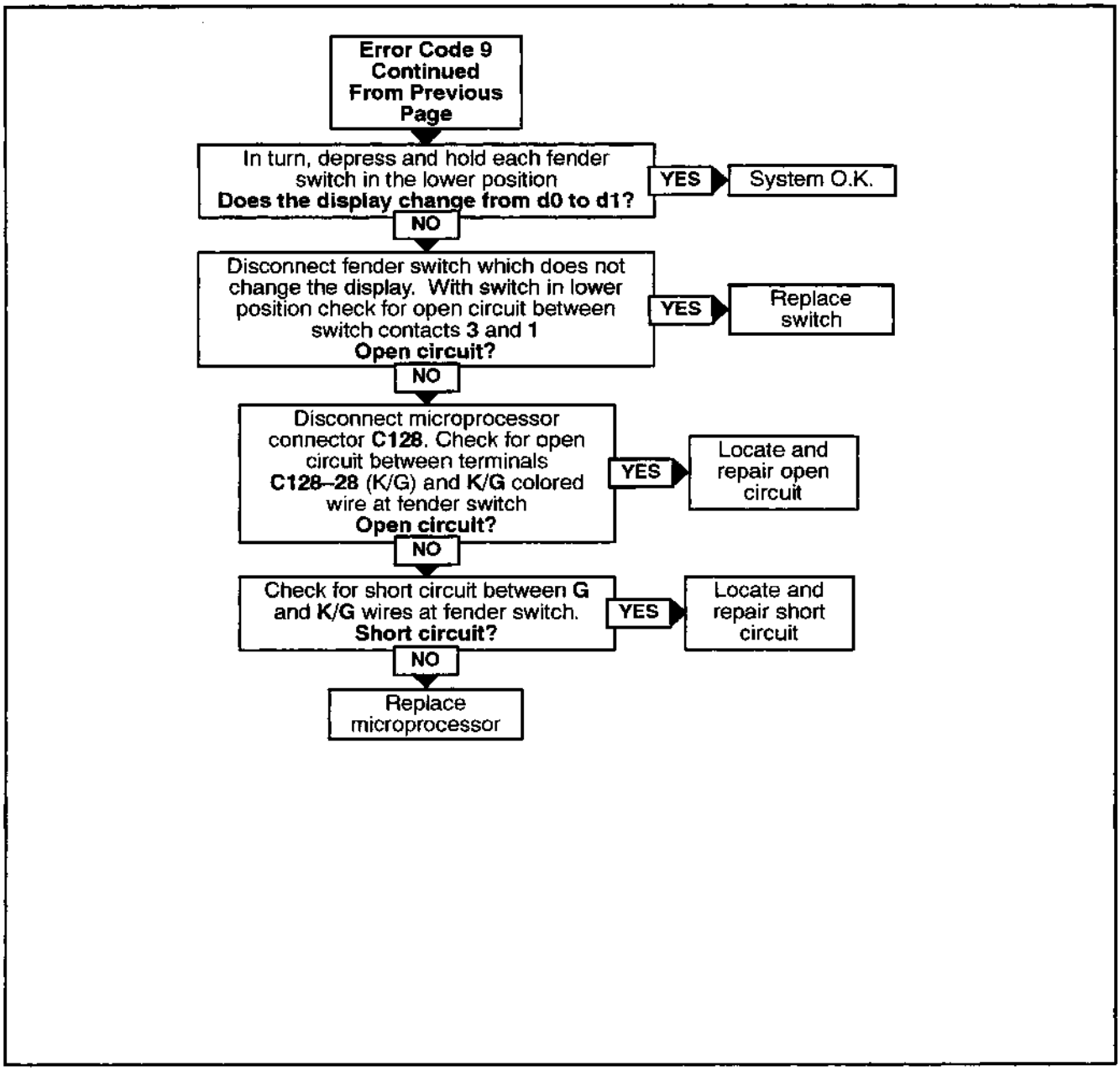
Error Code 9 Both External Lift/Lower Fender Switches Are Being Operated Simultaneously



Fuse Panel



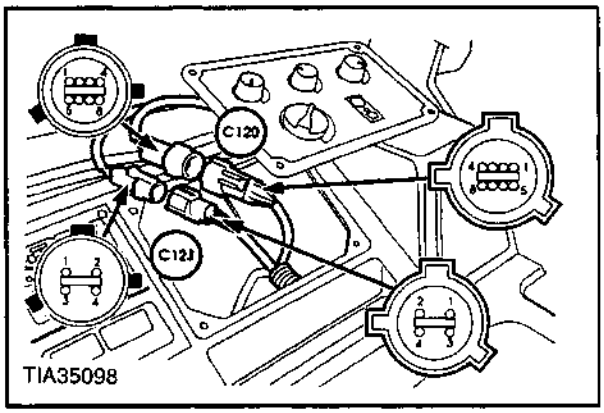
Microprocessor Connectors



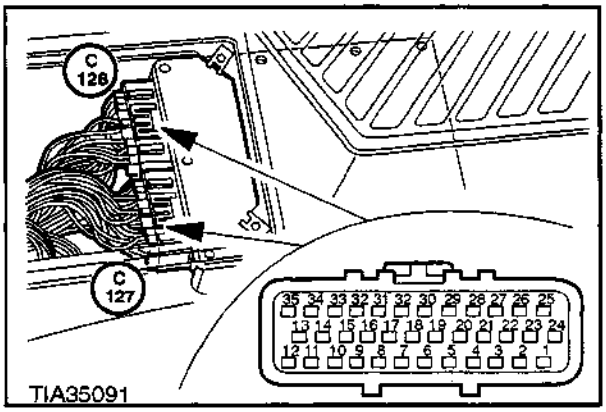
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Error Codes 10 and 11 Height Limit Control Potentiometer or Circuit Failed



EDC Control Panel Connectors



Microprocessor Connectors

Error Code 10 Height limit control voltage low (short or open circuit)
Error Code 11 Height limit control voltage high (damaged potentiometer or short to +12 volts)

Enter diagnostic mode H9 Channel 31 (Refer to Page 8-4-30) and turn height limit control knob fully clockwise and then fully counter clockwise **Do the values range from 84 to14**
- YES → While in H9 Channel 31 wiggle wiring comnnectors to check for intermittent circuit. Channel 31 values will change if intermittent circuit detected.
- YES ↓

Remove EDC control panel and disconnect connectors **C120** and **C121**. While turning height limit control, measure resistance across male pins **C121–4** (N) and **C121–7** (Y/G) of console **Does resistance vary between 80–600 Ω ?**
- NO → Replace control panel
- YES ↓

While turning height limit control, measure resistance across male pins **C121–1** (G) and **C121–7** (Y/G) of console **Does resistance vary between 80–600 Ω ?**
- NO → Replace control panel
- YES ↓

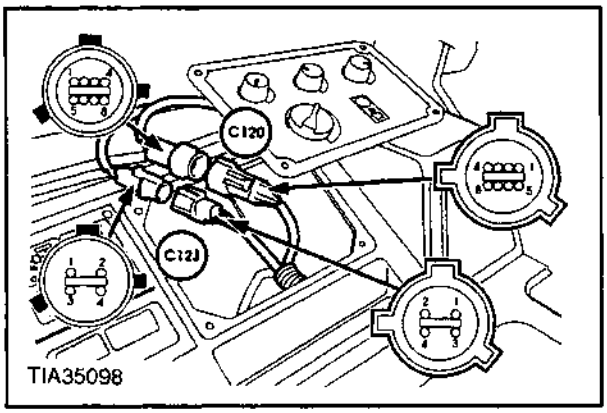
Turn key start switch **'On'** and measure voltage across female pins **C121–1** (LN) and **C121–4** (B) of harness **Is voltage approximately 5 volts?**
- NO → Disconnect microprocessor connector **C127**. Check for open circuit between female pins **C121–1** (LN) and **C127–5** (LN). Repeat check between **C121–4** (B) and **C127–1** (B) **Open circuit?**
  - NO → Check for short circuit between female pins **C121–1** (LN) and **C121–4** (B) or a short circuit to chassis between each of these pins **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor
  - YES → Locate and repair open circuit
- YES ↓

Disconnect microprocessor connector **C128** Check for open circuit between female pins **C121–7** (K/O) and **C128–31** (K/O) **Open circuit?**
- YES → Locate and repair open circuit
- NO → Check for short circuit between **C121–7** (K/O) and **C121–4** (B). Repeat check between **C121–7** (K/O) and **C121–1** (LN). **Short circuit?**
  - YES → Locate and repair short
  - NO → Check for short circuit between **C121–7** (K/O) and chassis **Short circuit?**
    - NO → Replace microprocessor
    - YES → Locate and repair short

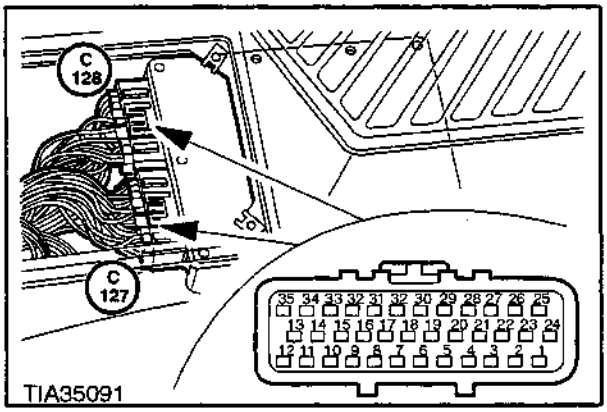
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Error Codes 12 and 13 Drop Rate Control Potentiometer Failed



EDC Control Panel Connectors



Microprocessor Connectors

Error Code 11 Drop rate control voltage low (short or open circuit)
Error Code 12 Drop rate control voltage high (damaged potentiometer or short to +12 volts)

Enter diagnostic mode H9 Channel 30 (Refer to Page 8-4-30) and turn height limit control knob fully clockwise and then fully counter clockwise **Do the values range from 84 to14**

YES → While in H9 Channel 30 wiggle wiring comnnectors to check for intermittent circuit. Channel 30 values will change if intermittent circuit detected.

NO → Remove EDC control panel and disconnect connectors **C120** and **C121**. While turning drop rate control, measure resistance across male pins **C121–2** (Y) and **C121–4** (N) **Does resistance vary between 80–600 Ω ?**

NO → Replace control panel

YES → While turning drop rate control, measure resistance across male pins **C121–2** (Y) and **C121–1** (G) **Does resistance vary between 80–600 Ω ?**

NO → Replace control panel

YES → Turn key start switch **'On'** and measure voltage across female pins **C121–1** (LN) and **C121–4** (B) **Is voltage approximately 5 volts?**

NO → Disconnect microprocessor connector **C127**. Check for open circuit between female pins **C121–1** (LN) and **C127–5** (LN). Repeat check between **C121–4** (B) and **C127–1** (B) **Open circuit?**

YES → Disconnect microprocessor connector **C128**. Check for open circuit between female pins **C121–2** (LN/Y) and **C128–9** (LN/Y) **Open circuit?**

NO → Check for short circuit between female pins **C121–1** (LN) and **C121–4** (B) or a short circuit to chassis between each of these pins **Short circuit?**

YES → Locate and repair open circuit

YES → Locate and repair short circuit

NO → Check for short circuit between **C121–2** (LN/Y) and **C121–4** (B). Repeat check between **C121–1** (LN) and **C121–2** (LN/Y) **Short circuit?**

YES → Locate and repair short circuit

NO → Check for short circuit between **C121–2** (LN/Y) and chassis **Short circuit?**

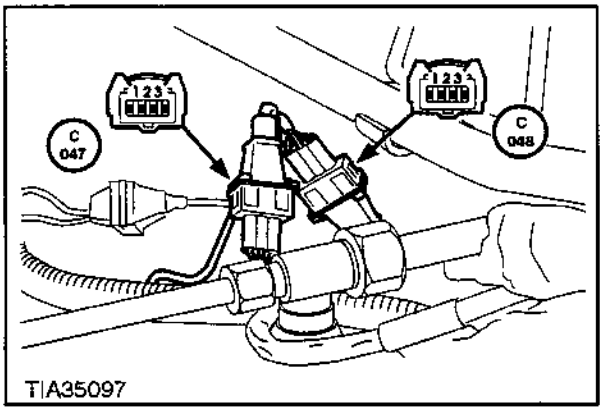
YES → Locate and repair short circuit

NO → Replace microprocessor

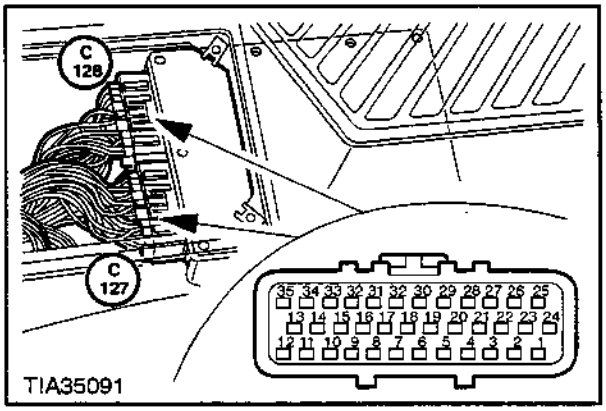
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Error Codes 14 and 15 Right Hand Load Sensing Pin or Circuit Failed



Load Sensing Pin Connectors



Microprocessor Connector

Error Code 14 Open circuit connection to pin, short circuit to ground or failed pin
Error Code 15 Pin short circuit to +12 volts, failed or corroded pin

Is right hand load sensing pin connected?
NO → Reconnect pin
YES

Where possible remove implement to ensure load sensing pins are not being subjected to any draft loading Enter diagnostic mode H9 Channel 34
Is the value approximately 48?.
YES → Turn keystart switch off and On **Error cleared?**
NO → Replace microprocessor
YES → Check for intermittent circuit in wiring to pin
NO

Turn key–start switch **'OFF'** Install new pin and turn–key start switch **'ON'** (if new pin not available interchange left and right hand pins) **Error cleared?**
YES → Install new pin
NO

Disconnect microprocessor connectors and 'both' load sensing pins, connectors **C048** and **C047**
Check for open circuit between male pins
C048–1 (LN/G) and **C127–1** (LN/G)
C048–2 (LN/P) and **C128–11** (LN/P)
C048–3 (K) and **C127–25** (K)
Open circuit?
YES → Locate and repair open circuit
NO

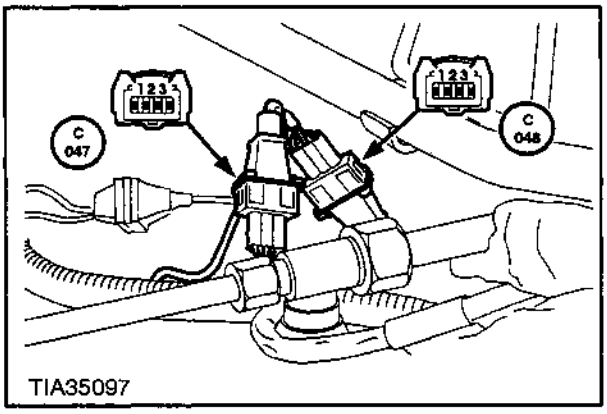
Check for short circuit between male pins **C048–1**, **C048–2** and **C048–3** or a short circuit to chassis between each of these pins
Short circuit?
YES → Locate and repair short circuit
NO

With microprocessor connectors disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pins **C048–2** (LN/P) Repeat check between **C048–3** (K) and tractor chassis
Is voltage approximately 0 Volts?
YES → Replace microprocessor

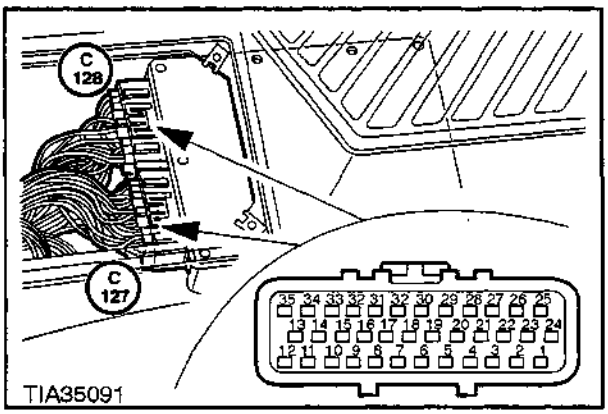
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Error Codes 16 and 17 Left Hand Load Sensing Pin or Circuit Failed



Load Sensing Pin Connectors



Microprocessor Connectors

Error Code 16 Open circuit connection to pin, short circuit to ground or failed pin
Error Code 17 Pin short circuit to +12 volts, failed or corroded pin

Is left hand load sensing pin connected?
NO → Reconnect pin
YES

Where possible remove implement to ensure load sensing pins are not being subjected to any draft loading Enter diagnostic mode H9 Channel 35 **Is the value approximately 48?**.
YES → Turn keystart switch off and On **Error cleared?**
NO → Replace microprocessor
YES → Check for intermittent circuit in wiring to pin
NO

Turn key–start switch **'OFF'** Install new pin and turn–key start switch **'ON'** (if new pin not available interchange left and right hand pins) **Error cleared?**
YES → Install new pin
NO

Disconnect microprocessor connectors and 'both' load sensing pins, connectors **C048** and **C047** Check for open circuit between male pins **C047–1** (LN/G) and **C127–1** (LN/G) **C047–2** (LN/P) and **C128–33** (LN/P) **C047–3** (K) and **C127–25** (K) **Open circuit?**
YES → Locate and repair open circuit
NO

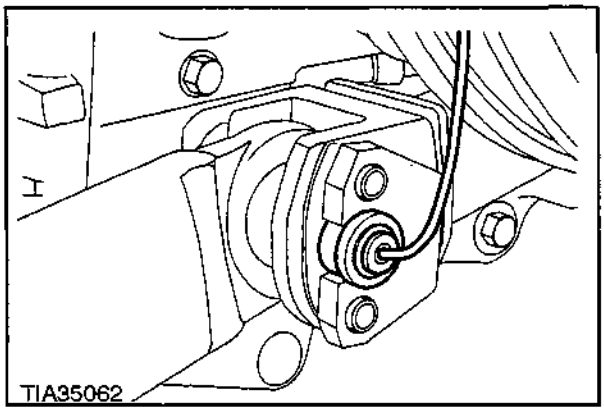
Check for short circuit between male pins **C047–1, C047–2** and **C047–3** or a short circuit to chassis between each of these pins **Short circuit?**
YES → Locate and repair short circuit
NO

With microprocessor connectors disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pins **C047–2** (LN/P) Repeat check between **C047–3** (K) and tractor chassis **Is voltage approximately 0 Volts?**
YES → Replace microprocessor

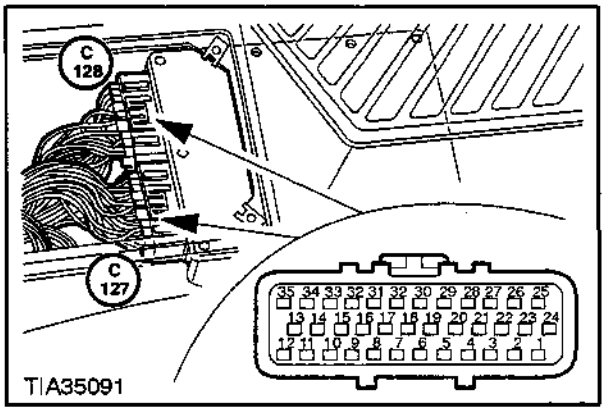
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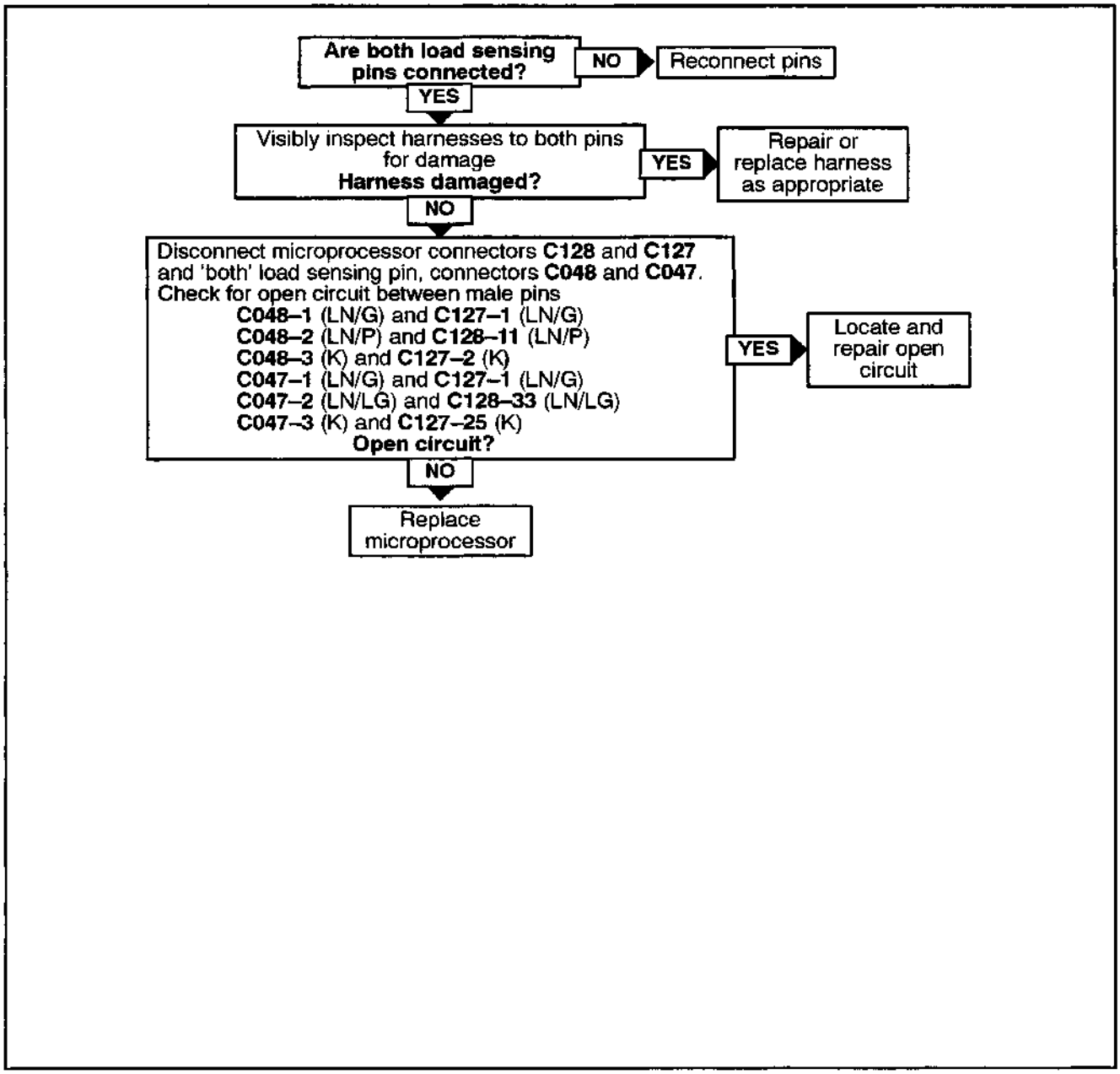
Error Code 18 Both Load Sensing Pins Disconnected



Load Sensing Pin



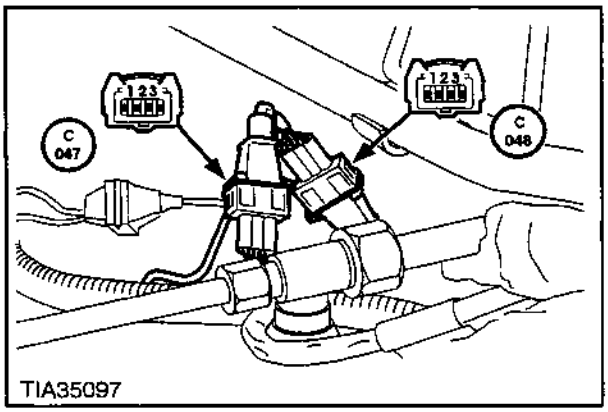
Microprocessor Connectors



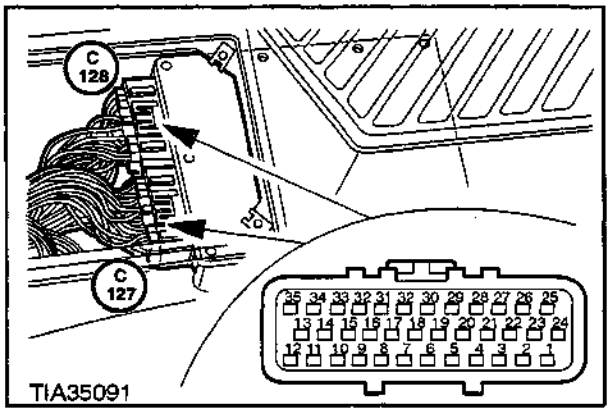
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Error Codes 19 and 20 Incorrect Load Sensing Pin Reference Voltage



Load Sensing Pin Connectors



Microprocessor Connectors

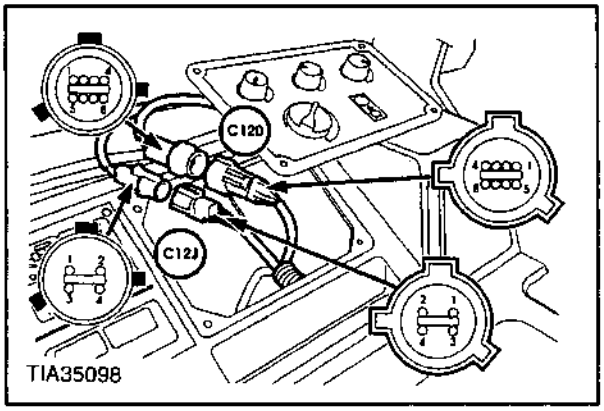
Error Code 19 Pin reference voltage less than 8 volts (short or open circuit)
Error Code 20 Pin reference voltage greater than 8 volts (short to +12 volts)

Enter diagnostic mode H9 Channel 9 (Refer to Page 8-4-30) **Is the value approximately 79?**
- YES → Turn keystart switch Off and On **Error Cleared?**
  - NO → Replace Microprocessor
  - YES → Check for intermittent circuit on wiring to pins
- YES → Disconnect both load sensing pins. Turn keystart switch On and measure voltage between **C048–3 and C048–1**, **C047–3 and C047–1** **Is voltage approximately 8 volts?**
  - YES → Replace Microprocessor
  - NO → Disconnect microprocessor connectors. Check for open circuit between **C047–3 and C127–25**, **C048–3 and C127–25** **Open circuit?**
    - NO → Turn key start switch **'OFF'**. Install new load sensing pin(s) from another tractor if available. Turn key–start switch **'ON'** **Error cleared?**
      - YES → Install new pin(s)
      - NO → Disconnect microprocessor connectors and 'both' load sensing pin connectors **C048** and **C047**. Check for short circuit between tractor chassis and male pins **C048–3** (K) and **C047–3** (K) **Short circuit?**
        - YES → Locate and repair short circuit
        - NO → With microprocessor connectors disconnected, turn key–start switch **'ON'** and measure the voltage between tractor chassis and male pin **C048–3** (K). Repeat check between male pin **C047–3** (K) and tractor chassis **Is voltage approximately 0 Volts?**
          - NO → Examine harness for damage resulting in voltage supply direct from battery
          - YES → Replace microprocessor

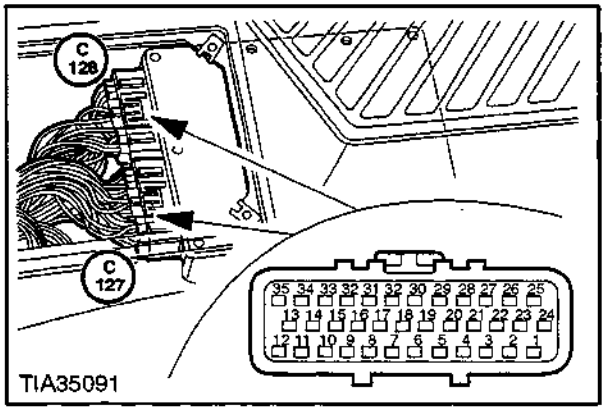
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Error Codes 21 and 22 Position/Draft Sensitivity Control Potentiometer or Circuit Failed



EDC Control Panel Connectors



Microprocessor Connectors

Error Code 21 Position/draft control voltage low (short or open circuit)
Error Code 22 Position/draft control voltage high (damaged potentiometer or short to +12 volts)

Enter diagnostic mode H9 Channel 32. Turn position/draft sensitivity control knob fully clockwise and then fully counter clockwise **Do the values range from 84 to14**
- YES → Refer to wiring diagram and check for intermittent circuit on wiring to control panel
- NO →

Remove EDC control panel and disconnect connectors **C120** and **C121**. While turning position/draft sensitivity control, measure resistance across male pins **C121–3** (W) and **C121–4** (N) **Does resistance vary between 80–600 Ω ?**
- NO → Replace control panel
- YES →

While turning position/draft sensitivity control, measure resistance across male pins **C121–3** (W) and **C121–1** (G) **Does resistance vary between 80–600 Ω ?**
- NO → Replace control panel
- YES →

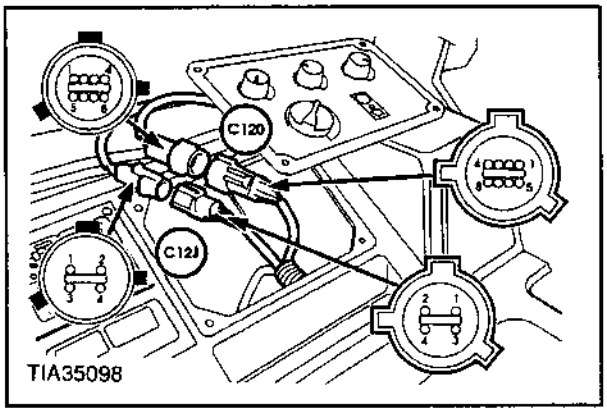
Turn key start switch **'On'** and measure voltage across female pins **C121–1** (G) and **C121–4** (B) **Is voltage approximately 5 volts?**
- NO → Disconnect microprocessor connector **C127**. Check for open circuit between female pins **C121–1** (LN) and **C127–5** (LN). Repeat check between **C121–4** (B) and **C127–1** (B) **Open circuit?**
  - YES → Locate and repair open circuit
  - NO → Check for short circuit between female pins **C121–1** (LN) and **C121–4** (B) or a short circuit to chassis between each of these pins **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor
- YES →

Disconnect microprocessor connector **C128**. Check for open circuit between female pins **C121–3** (LN/W) and **C128–10** (LN/W) **Open circuit?**
- YES → Locate and repair open circuit
- NO → Check for short circuit between **C121–3** (LN/W) and **C121–4** (B). Repeat check between **C121–1** (LN) and **C121–3** (LN/W) **Short circuit?**
  - YES → Locate and repair short circuit
  - NO → Check for short circuit between **C121–3** (LN/W) and chassis **Short circuit?**
    - YES → Locate and repair short circuit
    - NO → Replace microprocessor

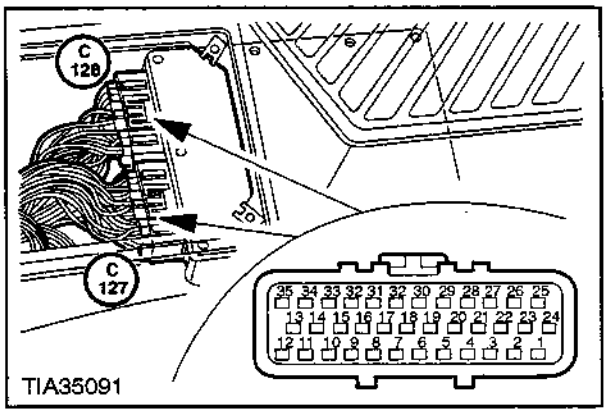
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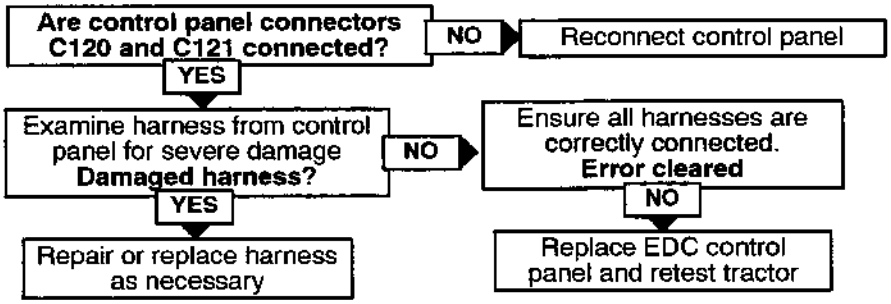
Error Code 23 Control Panel Disconnected



EDC Control Panel Connectors



Microprocessor Connectors



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Error Code 24
Perform Hydraulic Lift Calibration

Calibration of Position Sensors

This procedure is required whenever:–

- The lift arm or lift control lever position sensing potentiometers or EDC valve have been replaced.
- The microprocessor has been replaced or its memory has been reset using Diagnostic Menu **H8**.

1. Lower lift arms and disconnect vertical rods from hanger on automatic pick–up hitch (where fitted). **This will allow the lift arms to raise to their maximum position.**

   NOTE: *It is not necessary to lower the pick up hitch.*

2. Position in cab raise/work switch to work position.

3. Turn all the EDC operator controls fully clockwise.

NOTE: *If the height limit control has not been turned fully clockwise to the maximum height position, the* ***Error Code HL*** *will be displayed.*

4. Start engine and set speed to 1100 rpm.

5. Move lift control lever forward and fully lower the lift.

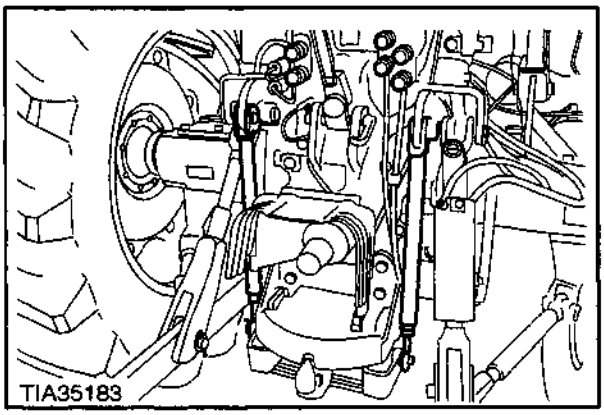


Figure 8-4-44

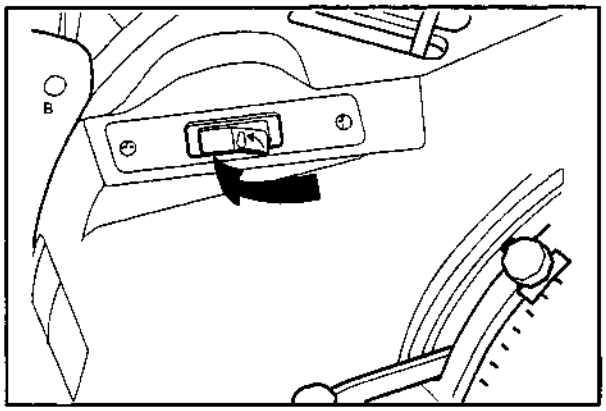


Figure 8-4-45

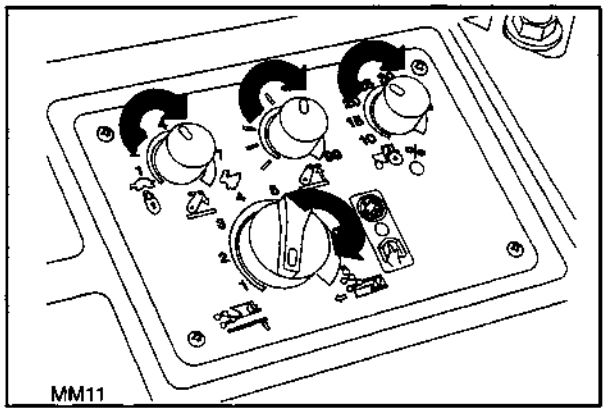


Figure 8-4-46

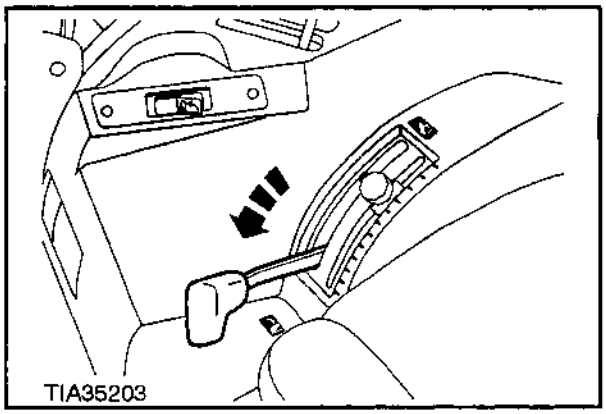


Figure 8-4-47

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6. Fully raise the hydraulic lift and ensure pick–up hitch rods do not catch or jam on lift linkage.

NOTE: *When raising the lift ensure the pick–up hitch rods do not catch or jam on the lift linkage.*

When the lift arms reach the fully raised position the pump will momentarily reach high pressure standby.

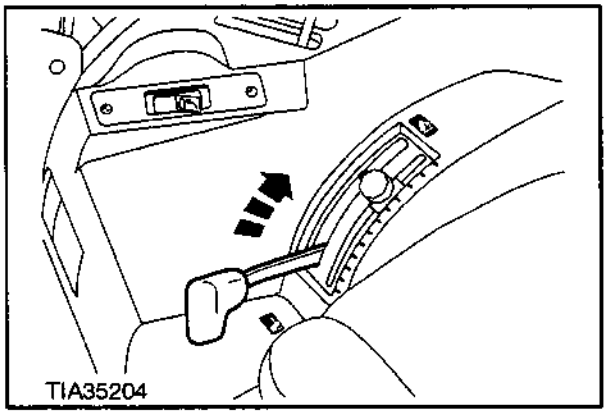


Figure 8-4-48

7. Check that the lift arm position display increases to 99.

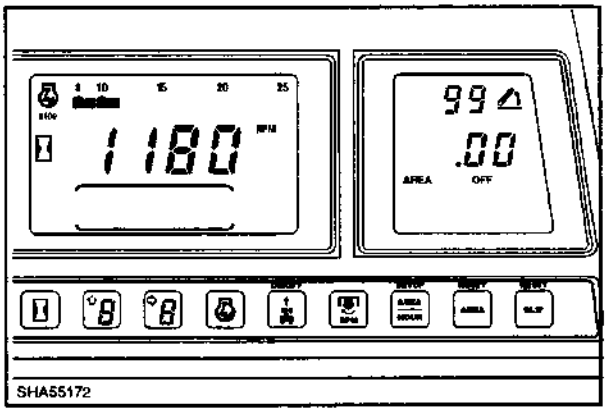


Figure 8-4-49

8. Reconnect and adjust the rod on the automatic pick–up hitch as follows:–

Move the lift control lever forward sufficiently to to allow the lift arms to lower slightly.

Set the in cab raise work switch in the central position (Fender switches enabled).

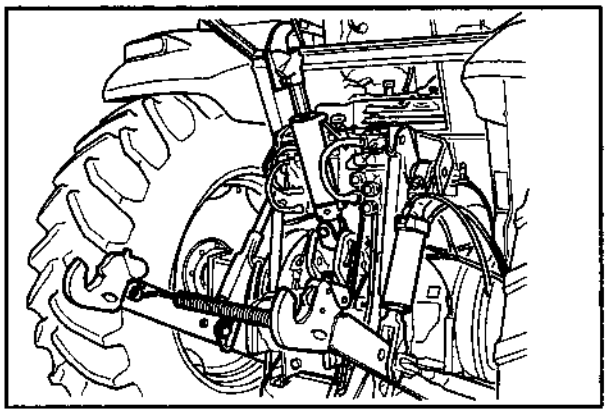


Figure 8-4-50

Reconnect the pick–up hitch lift rods.

Adjust the length of the lift rods so that when the hydraulic lift is fully raised using the external fender switches, the lift rods are slightly loose.

Check that the automatic pick–up hitch operates correctly.

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CALIBRATION OF THE EDC VALVE

This calibration is required if either the EDC valve or the microprocessor has been replaced or its memory has been reset using Diagnostic Menu **H8**.

NOTE: *If the microprocessor memory has been reset using Diagnostic Menu H8 it is also necessary to reset the processor for the type of hydraulic system installed on the tractor, ie 'Open' or 'Closed Center' Hydraulics. This procedure is described on Page 8-4-52 under valve calibration review, H3 diagnostic routine and must be performed before proceeding with the calibration.*

Perform the calibration with warm hydraulic oil and a suitable implement or weight mounted on the hydraulic lift. The weight of the implement should be sufficient to overcome any friction in the hydraulic lift assembly and enable the lift arms to lower without binding.

1. Enter H1 mode, using the diagnostic tool. Refer to Page 8-4-26.

2. Capture the hitch. Lower the lift below mid range and then raise the lift to the top.

3. Leave the hitch in this position while it does a series of three raise/lower cycles.

   Each time the hitch makes a correction the display will progressively change from 0 to 1 to 2 and then 3.

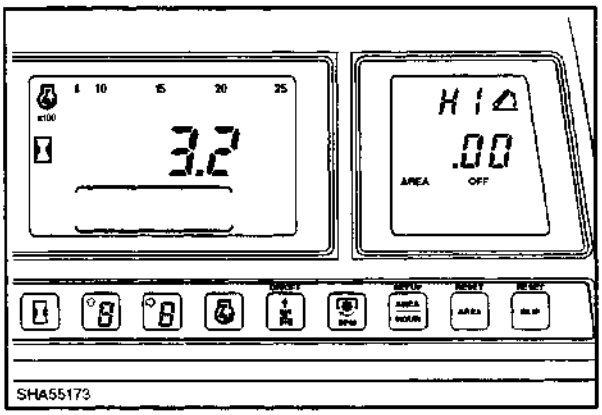


Figure 8-4-51

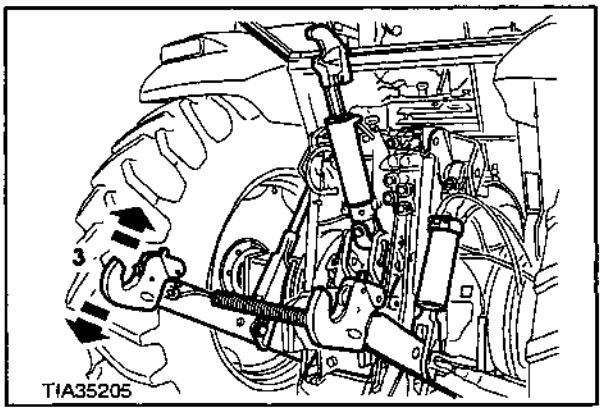


Figure 8-4-52

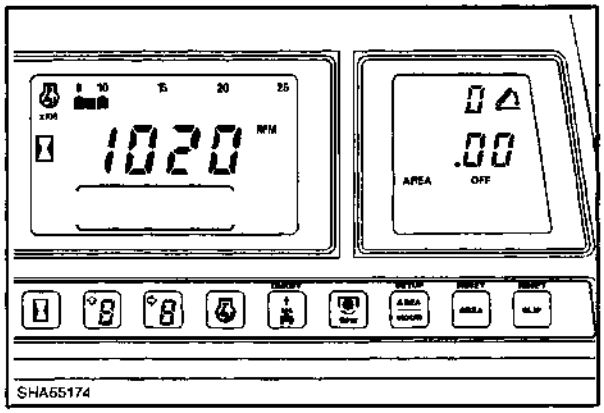


Figure 8-4-53

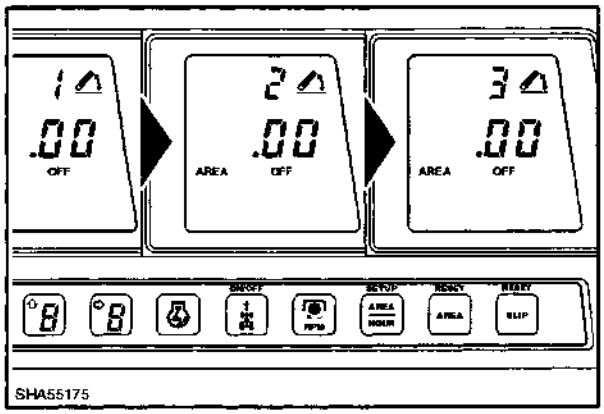


Figure 8-4-54

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NOTE: *When the tractor is installed with both an analog electronic instrument cluster and HI/Lo transmission the display does not progressively change from 0 to 1 to 2 and then 3 but changes from H1 and then constantly shows the word cal.*

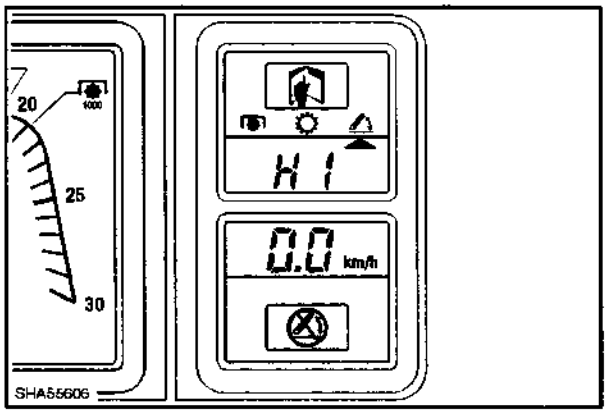


Figure 8-4-55

Under these circumstances it is necessary to observe the hydraulic lift arms performing the three raise and lower movements to determine when the calibration procedure is completed. It should be understood that the lift arm movement during these raise/lower cycles are very small and careful observation is required.

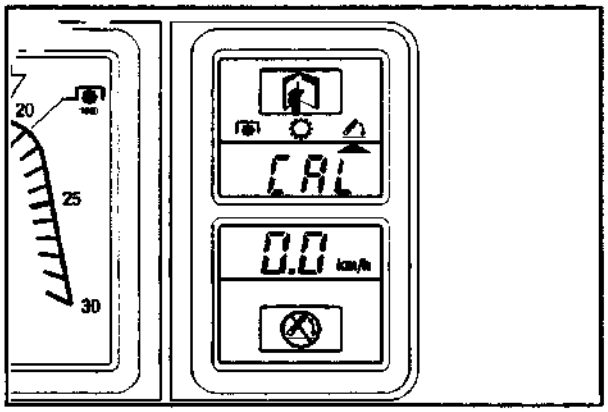


Figure 8-4-56

4. Key off the tractor to store the calibrations.

NOTE: *Steps 2 & 3 can be performed several times to provide a better average of the valve thresholds. The thresholds (the current required to start the EDC valve raise and lower solenoids to operate) may be viewed in mode H3 and are displayed in amps x 100, i.e, 0.530 amps will be displayed as 53. The raise threshold is displayed first followed by the lower.*

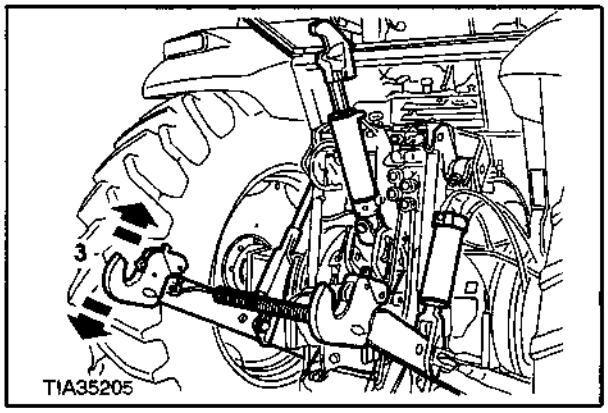


Figure 8-4-57

It is recommended that the after the EDC valve has been calibrated the threshold values are reviewed as explained on the following page and compared to the typical values shown.

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Valve Calibration Review
(H3 Diagnostic Routine)

(Analog Electronic Instrument Cluster Shown)

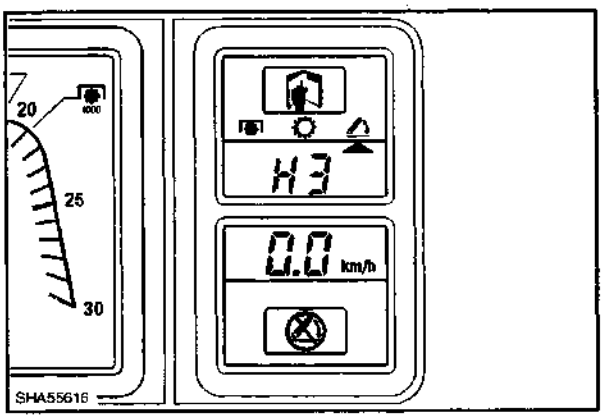


Figure 8-4-58

1. Enter the diagnostic routine and depress the button on the diagnostic switch 'three times' until the display on the instrument panel changes to 'H3'.

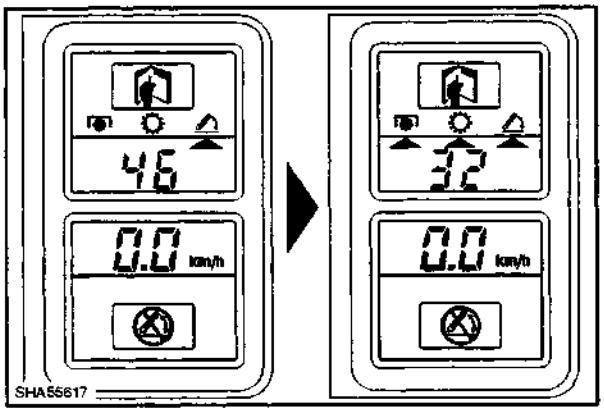


Figure 8-4-59

2. After approximately 4 seconds the display will change to show the EDC valve solenoid raise and lower thresholds.

   The threshold values will differ for each tractor with a nominal value of approximately 50.

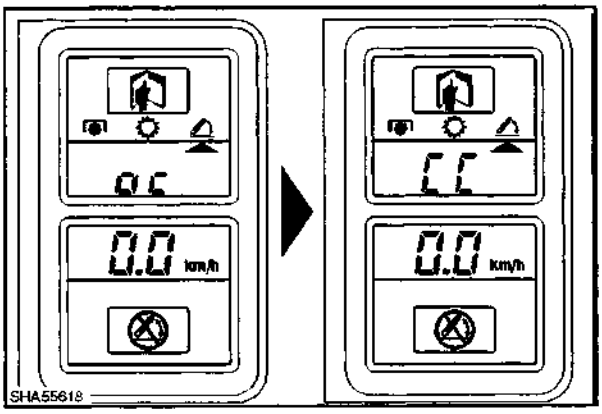


Figure 8-4-60

3. The display will then change to show either 'OC' or 'CC'. This is the type of hydraulic system used on the tractor that the EDC microprocessor has been programmed for.

   OC = Open Center Hydraulics
   CC = Closed Center Hydraulics.

   It is important that the microprocessor is set for the correct type of hydraulics. If this is incorrect the hydraulic lift may hesitate during operation.

   If the type of hydraulic system programmed into the microprocessor is incorrect depress the in cab fast raise/work switch to cycle between 'Open' and 'Closed' center systems.

   If it is necessary to replace the EDC microprocessor always perform this operation before calibrating the hydraulics.

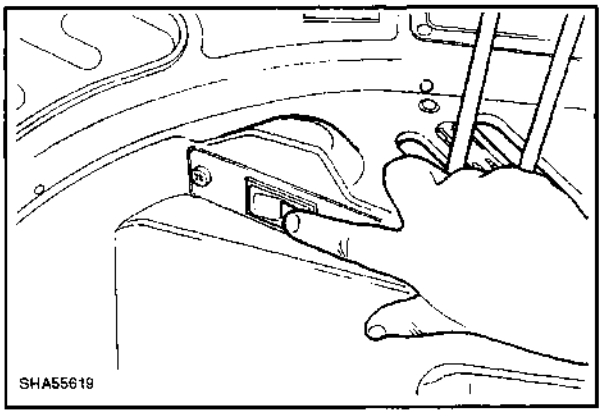
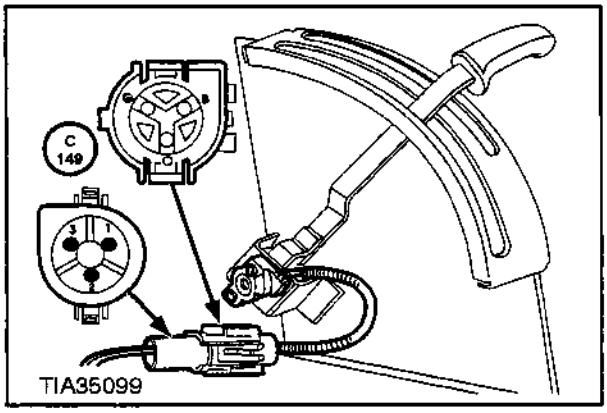


Figure 8-4-61

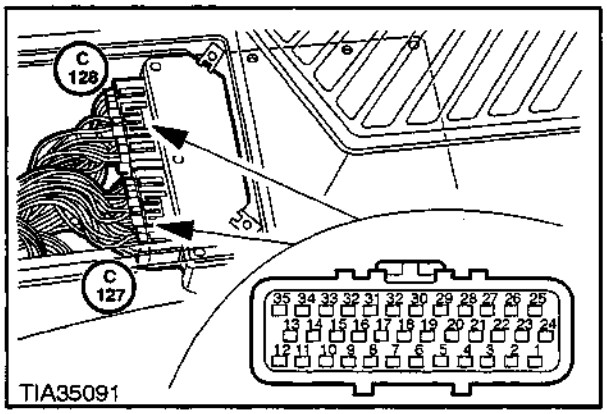
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Error Codes 25 and 26 Lift Control Lever Potentiometer Disconnected or Circuit Failed



Lift Control Lever Potentiometer



Microprocessor Connectors

Error Code 25 Lift lever potentiometer control voltage low (short or open circuit)
Error Code 26 Lift lever potentiometer control voltage high (damaged potentiometer or short to +12 volts)

Is lift control lever potentiometer or linkage damaged?
YES → Repair/replace potentiometer
NO ↓

Enter diagnostic mode H9 Channel 29 (Refer to Page 8-4-30). Fully lower and then raise the lift control lever **Do the values range from 25 to 74**
YES → Refer to wiring diagram and check for intermittent circuit on wiring to lift control lever potentiometer
NO ↓

Disconnect potentiometer connector **C149** and measure resistance between green and orange wires from potentiometer. Repeat test between green and black wires **Does resistance vary between 100–4000Ω as lever is moved in both directions?**
NO → Replace potentiometer
YES ↓

Turn key start switch **'ON'** and measure voltage across male pins **C149–2** (K/B) and **C149–3** (LN/G) **Is voltage approximately 5 volts?**
YES → Disconnect microprocessor connector **C128** and check for open circuit between male pins **C149–1** (LN/B) and **C128–30** (LN/B) **Open circuit?**
NO ↓

Disconnect microprocessor connector **C127** Check for open circuit between male pins **C149–2** (K/B) and **C127–5** (LN). Repeat check between **C149–3** (LN/G) and **C127–1** (B) **Open circuit?**
YES → Locate and repair open circuit
NO ↓

Check for short circuit between male pins **C149–2** (K/B) and **C149–3** (LN/G) or a short circuit to chassis between each of these pins **Short circuit?**
YES → Locate and repair short circuit
NO ↓

Replace microprocessor

Open circuit?
YES → Locate and repair open circuit
NO ↓

Check for short circuit between male pins **C149–1** (LN/B) and **C149–2** (K/B). Repeat check between **C149–1** (LN/B) and **C149–3** (LN/G) **Short circuit?**
YES → Locate and repair short circuit
NO ↓

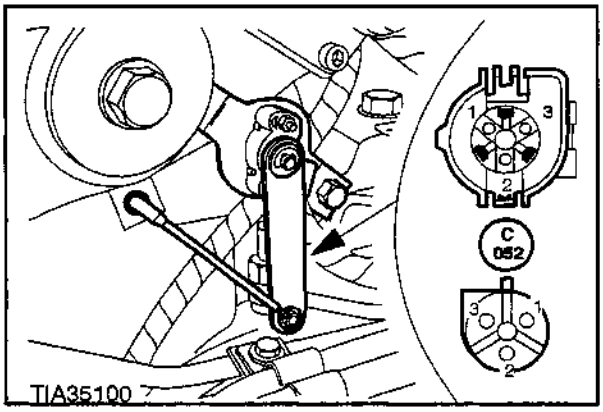
Check for short circuit between **C149–1** (LN/B) and tractor chassis **Short circuit?**
YES → Locate and repair short circuit
NO ↓

Replace microprocessor

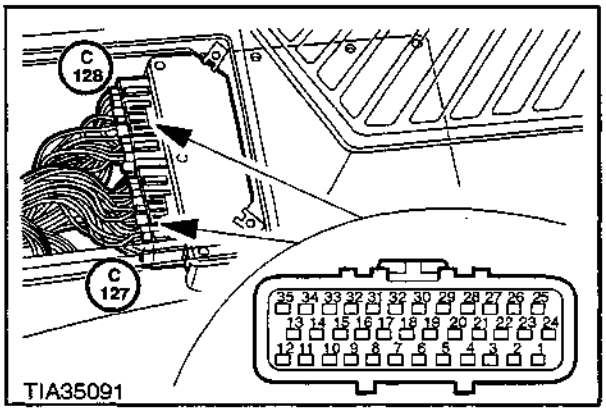
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Error Codes 27 and 28 Lift Arm Position Sensing Potentiometer Disconnected or Circuit Failed



Lift Arm Position Sensing Potentiometer



Microprocessor Connectors

Error Code 27 Lift arm position sensing control voltage low (short or open circuit)
Error Code 28 Lift arm position sensing control voltage high (damaged potentiometer or short to +12 volts)

Is lift arm position sensing potentiometer or linkage damaged?
- YES → Repair/replace potentiometer
- NO ↓

Enter diagnostic mode H9 Channel 28. Fully lower and then raise the hydraulic lift arms. (Ensure auto pickup hitch lift rods do not restrict maximum movement of arms when fully raising lift)
Do the values range from 15 to 79
- YES → Refer to wiring diagram and check for intermittent circuit on wiring to lift control lever potentiometer
- NO ↓

Disconnect potentiometer linkage and connector **C052** and measure resistance between green and orange wires from potentiometer. Repeat test between green and black wires.
Does resistance vary between 100–4000Ω as lever is moved in both directions?
- NO → Replace potentiometer
- YES ↓

Turn key–start switch **'ON'** and measure voltage across female pins **C052–2** (K/Y) and **C052–3** (LN/G)
Is voltage approximately 5 volts?
- YES → Disconnect microprocessor connector **C128** and check for open circuit between female pins **C052–1** (K/N) and **C128–8** (K/N)
  Open circuit?
  - YES → Locate and repair open circuit
  - NO → Check for short circuit between female pins **C052–1** (K/N) and **C052–2** (K/Y). Repeat check between **C052–1** (K/N) and **C052–3** (LN/G)
    Short circuit?
    - YES → Locate and repair short circuit
    - NO → Check for short circuit between **C052–1** (K/N) and tractor chassis
      Short circuit?
      - YES → Locate and repair short circuit
      - NO → Replace microprocessor
- NO ↓

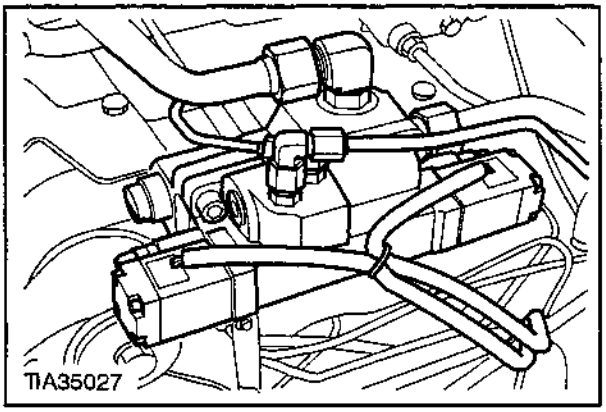
Disconnect microprocessor connector **C127**. Check for open circuit between female pins **C052–2** (K/B) and **C127–5** (LN). Repeat check between **C052–3** (LN/G) and **C127–1** (B)
Open circuit?
- YES → Locate and repair open circuit
- NO ↓

Check for short circuit between female pins **C052–2** (K/Y) and **C052–3** (LN/G) or a short circuit to chassis between each of these pins
Short circuit?
- YES → Locate and repair short circuit
- NO → Replace microprocessor

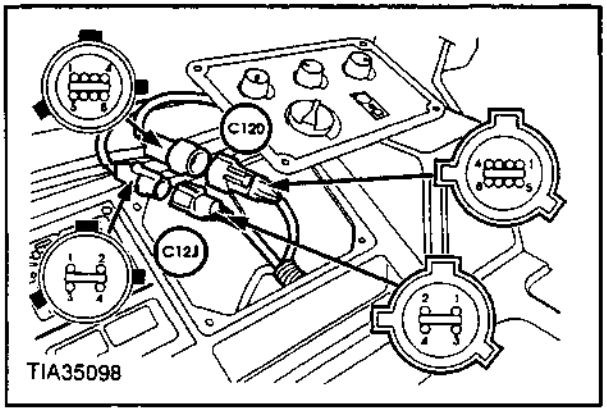
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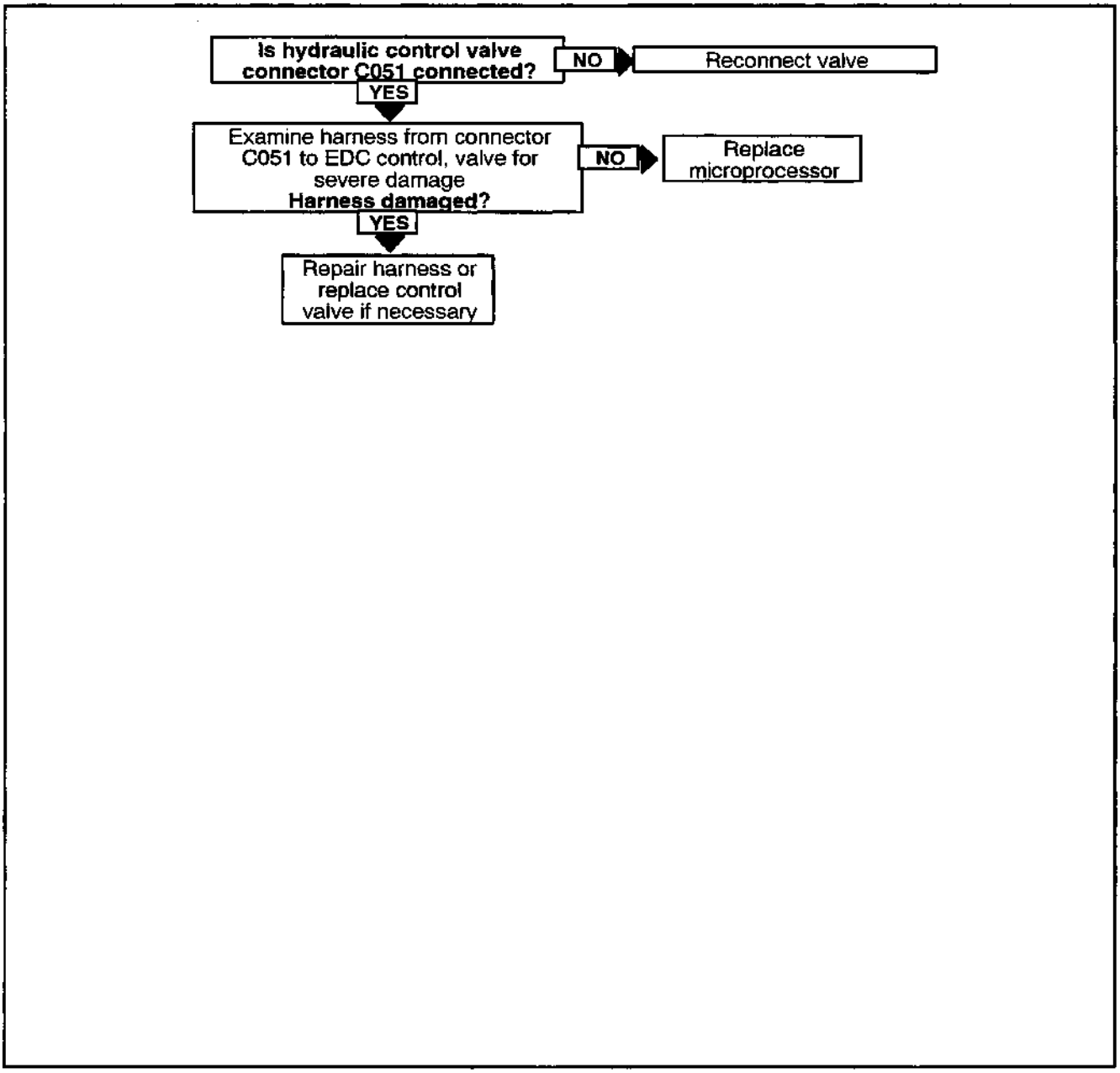
Error Code 29 Hydraulic Control Valve Disconnected



Hydraulic Control Valve



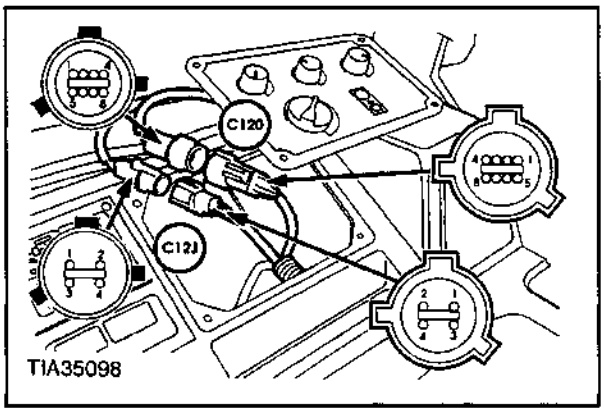
EDC Control Panel Connectors



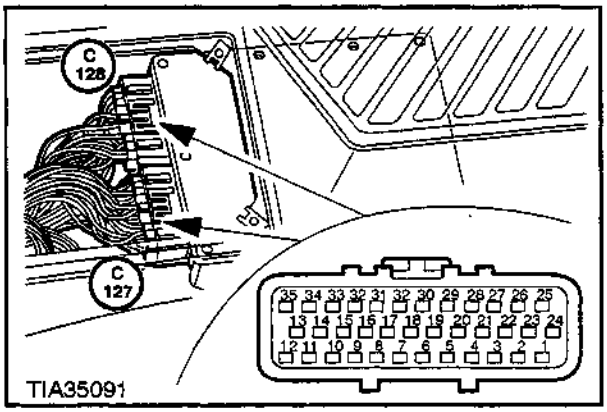
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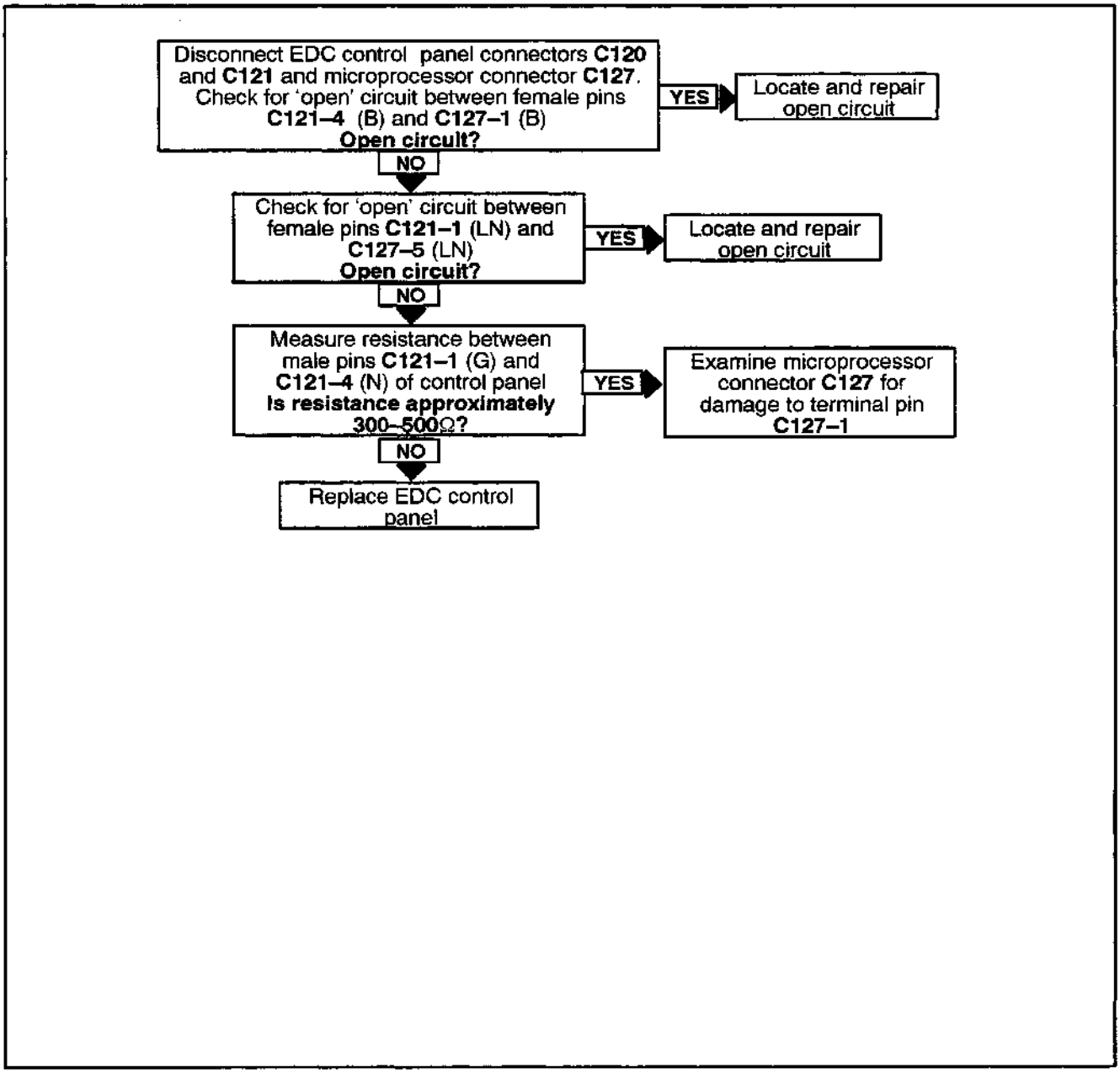
Error Code 30 Signal Ground Open Circuit



EDC Control Panel Connectors



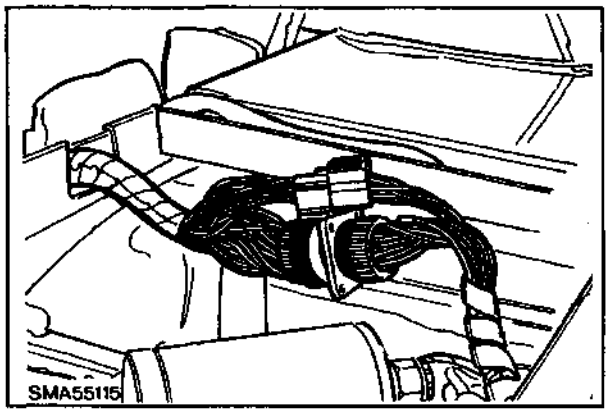
Microprocessor Connectors



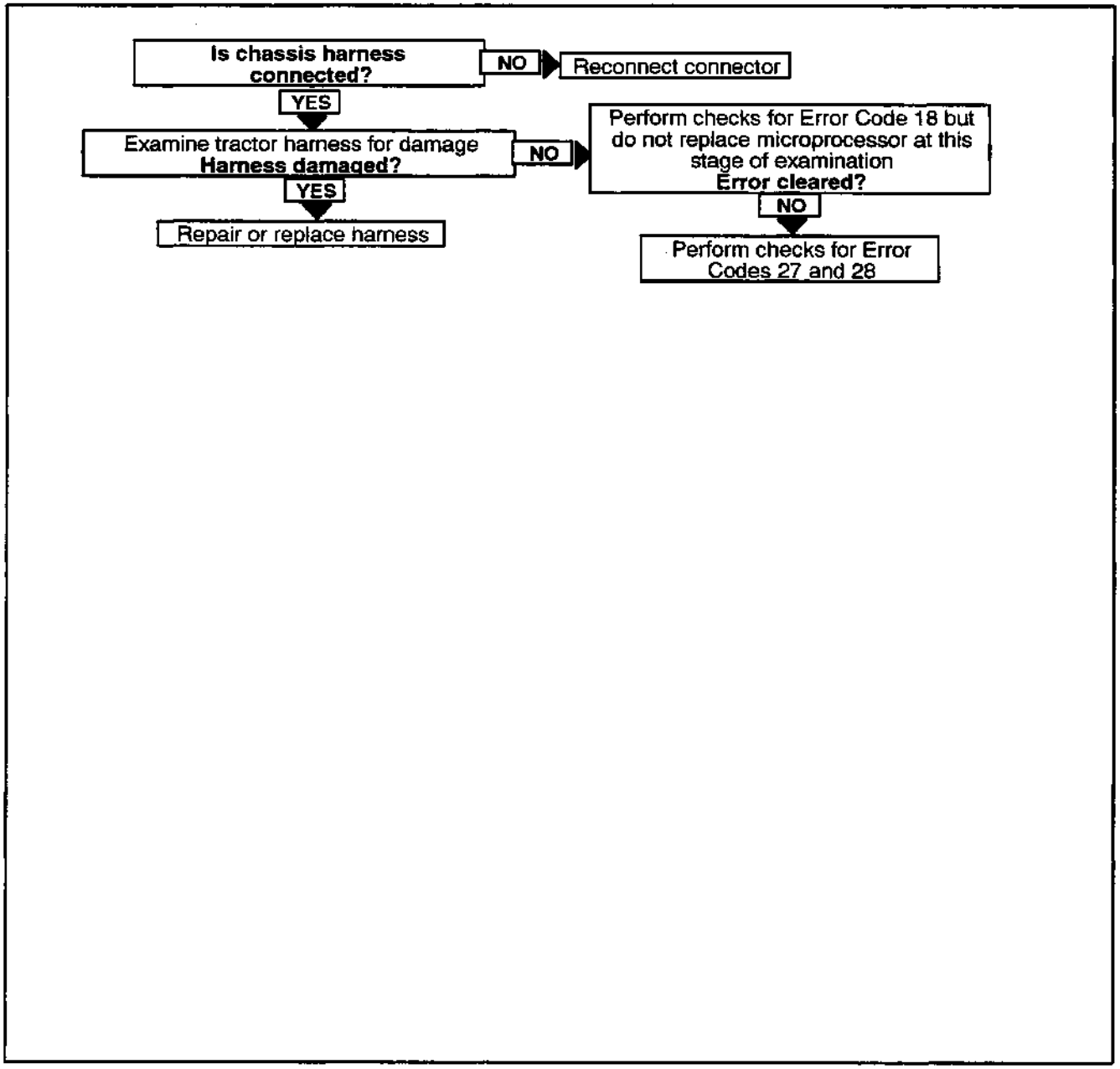
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Error Code 31 Chassis Harness Disconnected



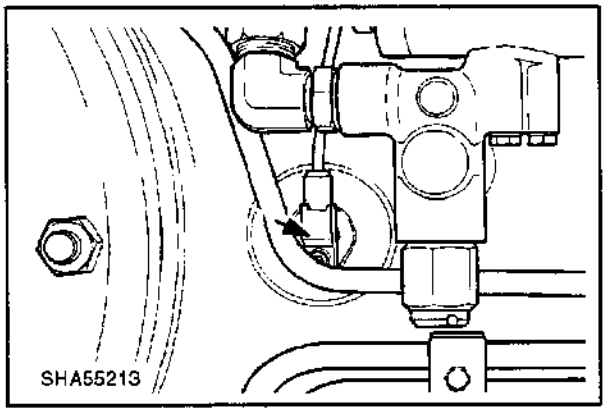
Chassis Harness Connectors



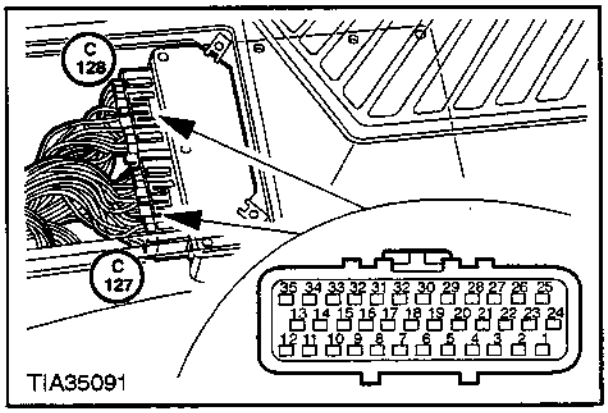
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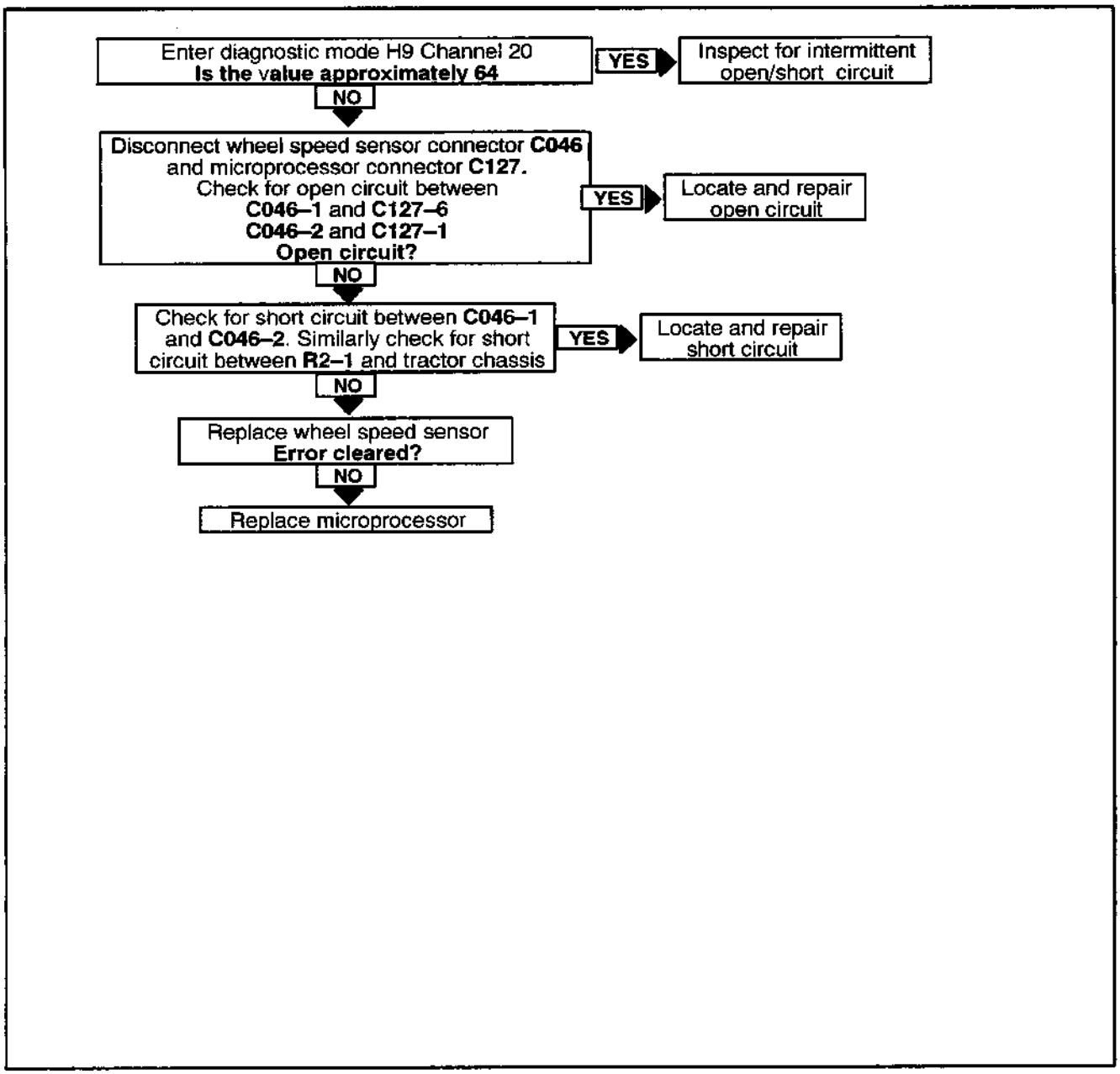
Error Code 49 Wheel Speed Sensor Open or Short Circuit



Wheel Speed Sensor



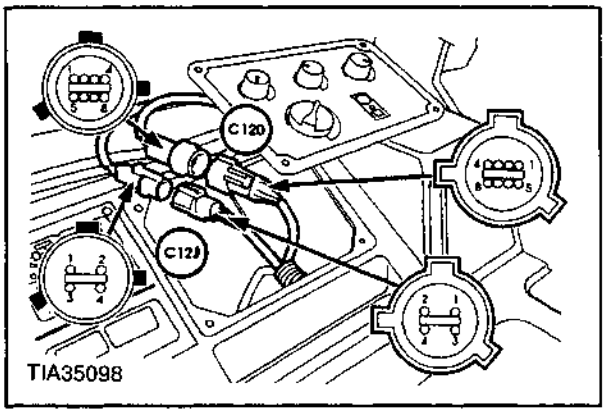
Microprocessor Connectors



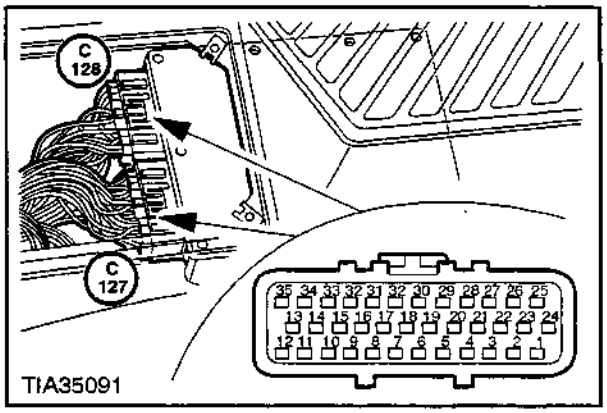
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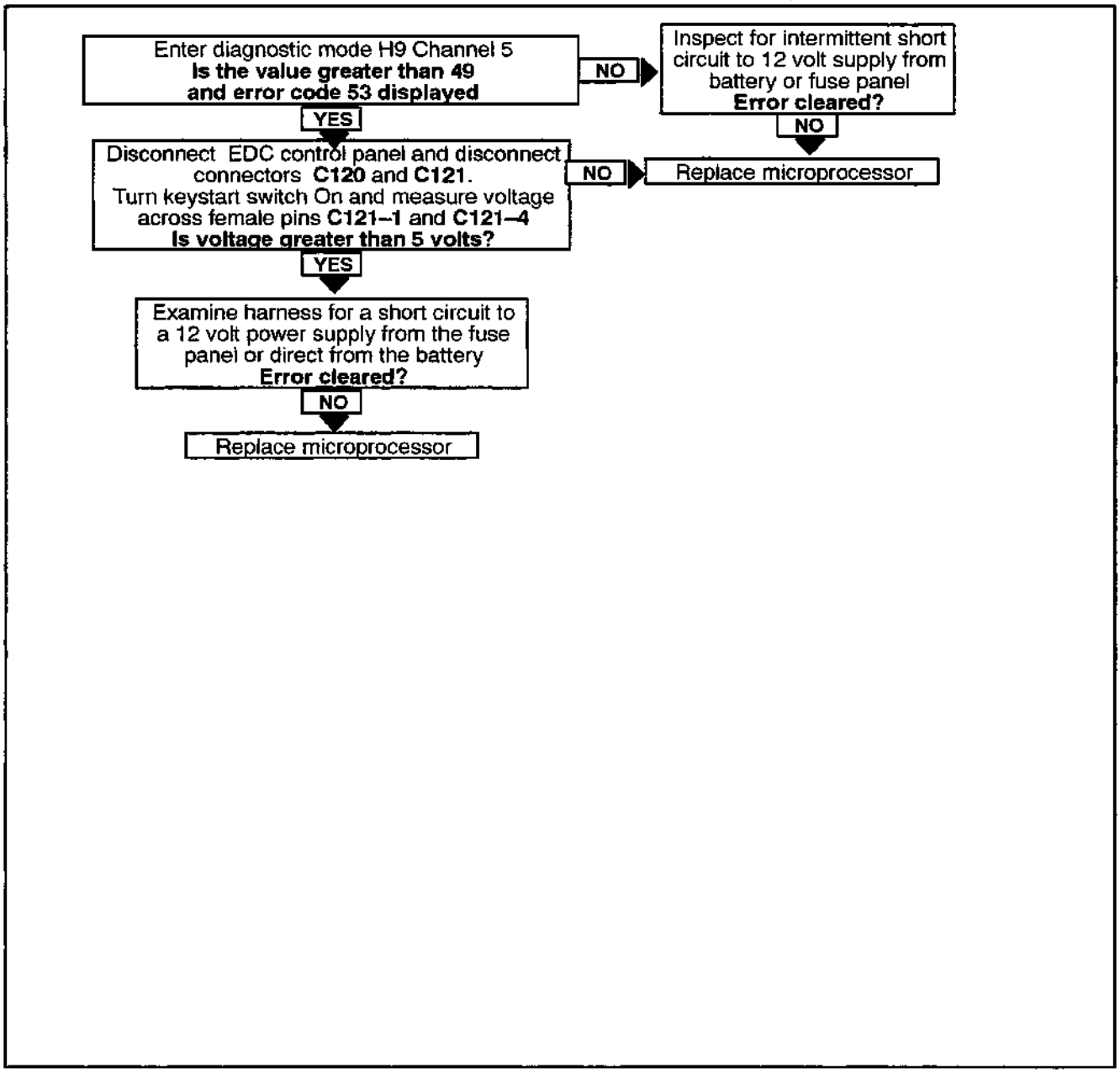
Error Code 53 Microprocessor 5 volt reference Shorted to 12 volts



EDC Control Panel Connectors



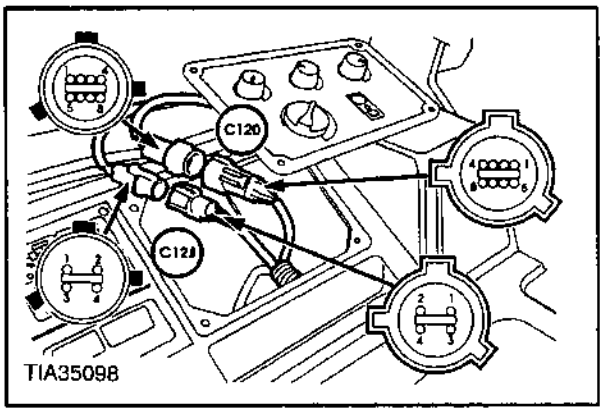
Microprocessor Connectors



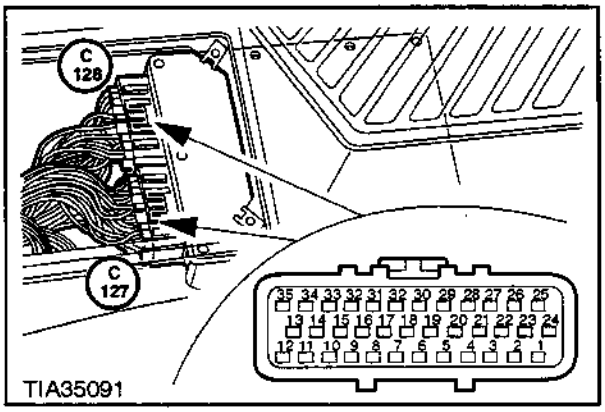
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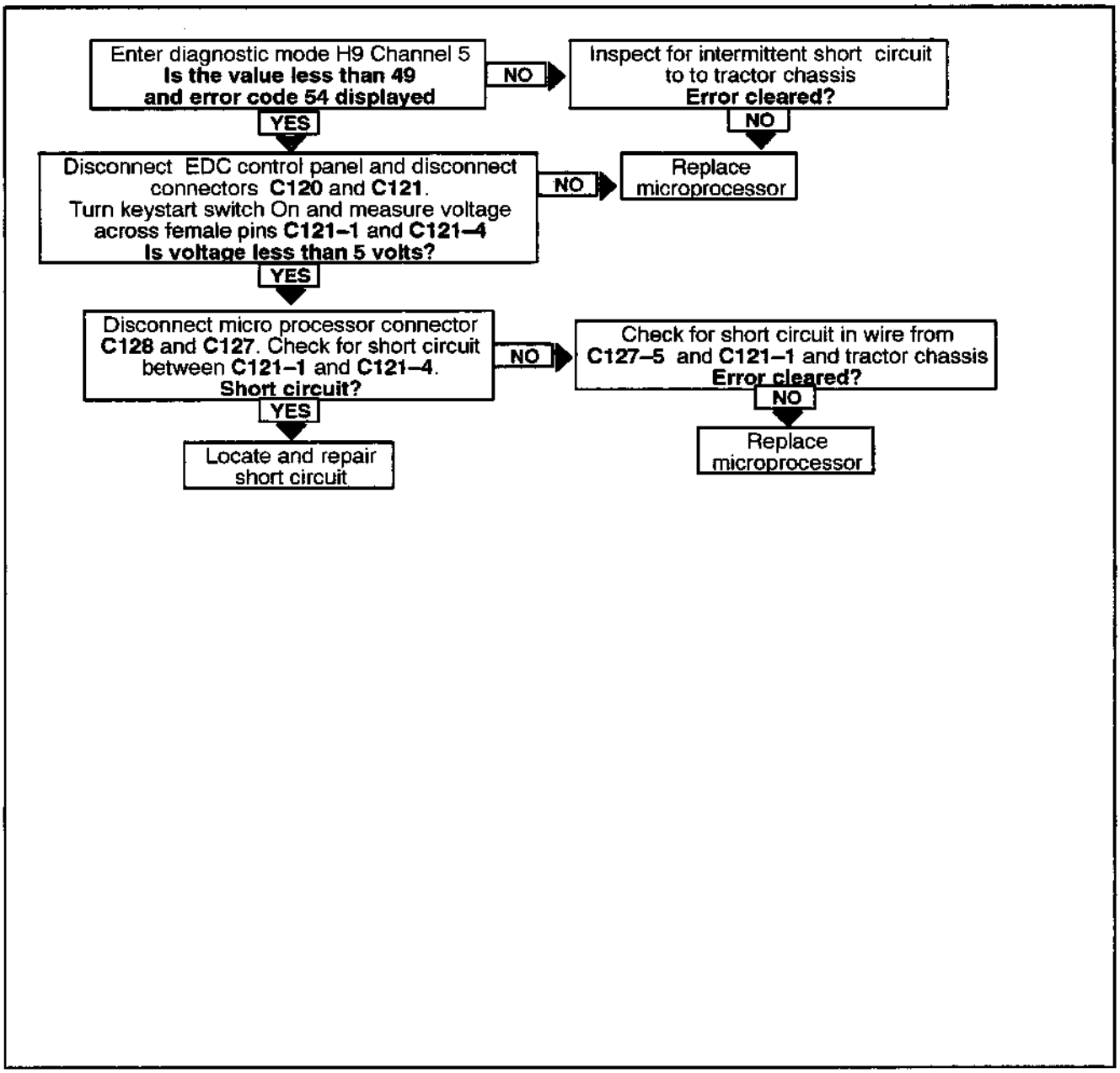
Error Code 54 Microprocessor 5 volt reference Shorted to Ground



EDC Control Panel Connectors



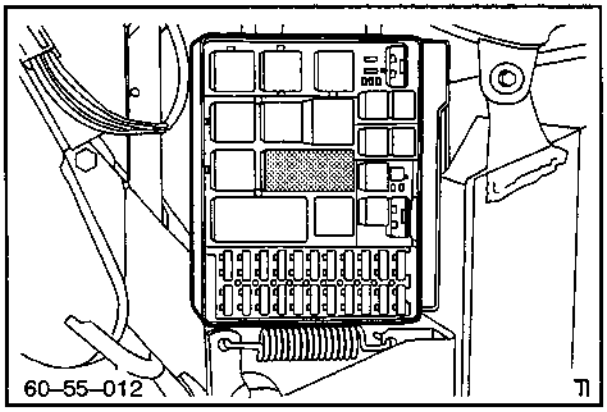
Microprocessor Connectors



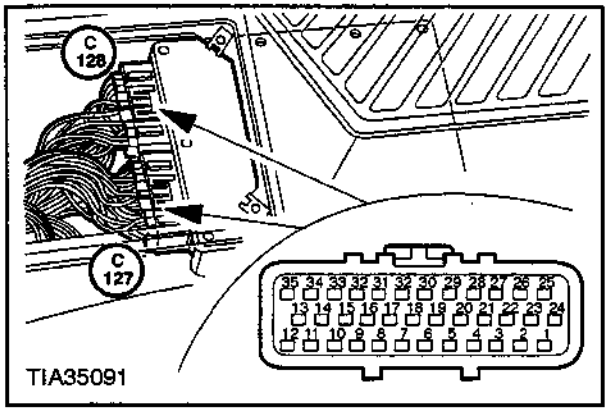
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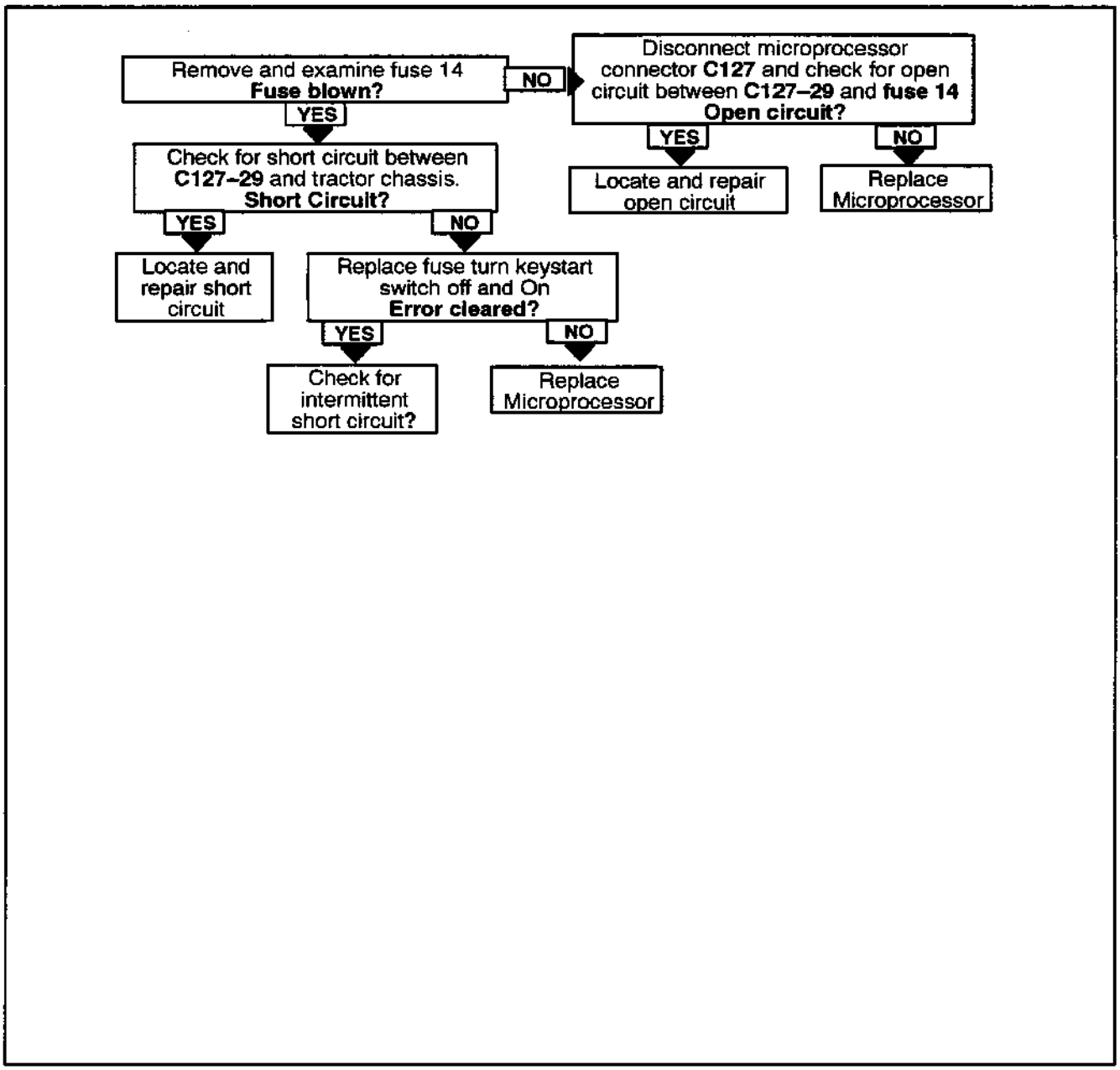
Error Code 57 EDC Microprocessor Failure



Fuse Panel



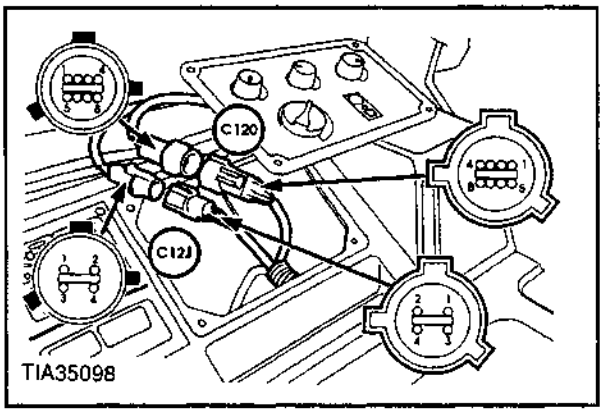
Microprocessor



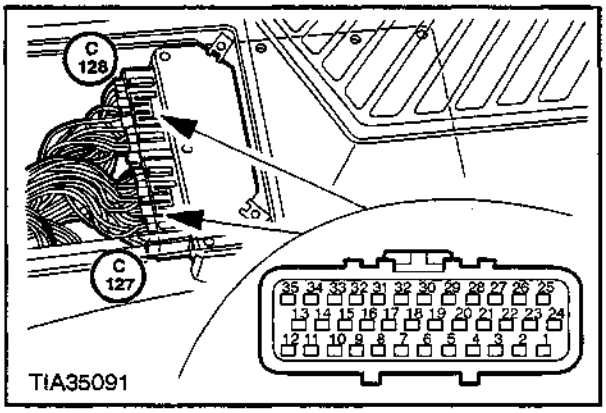
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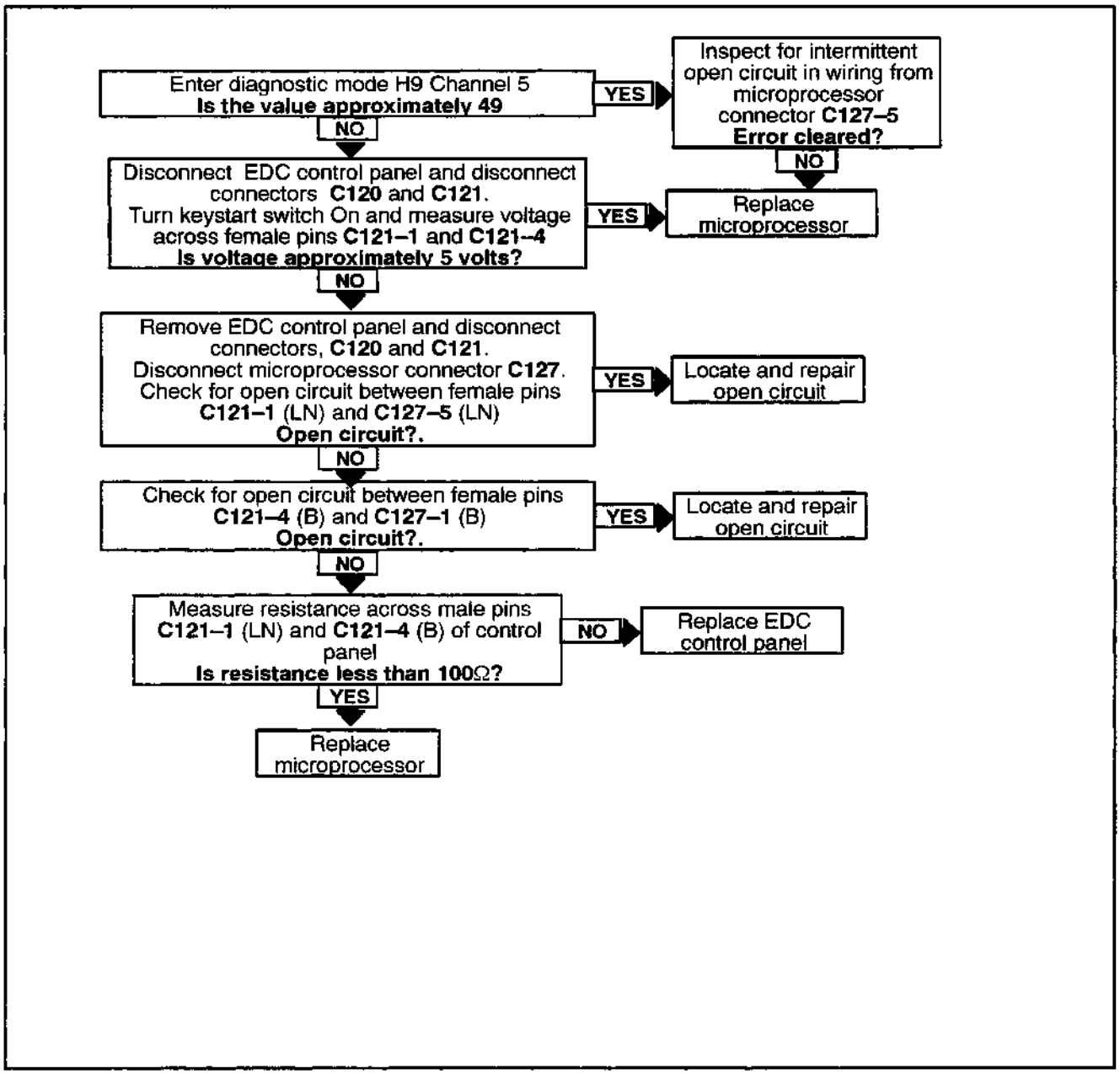
Error Code 59 Micro–processor Reference Voltage Open Circuit



EDC Control Panel Connectors



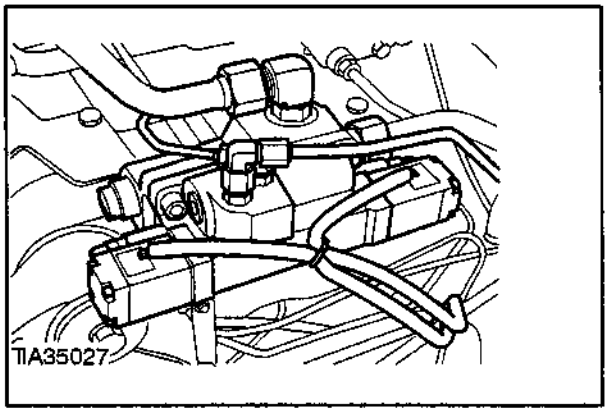
Microprocessor Connectors



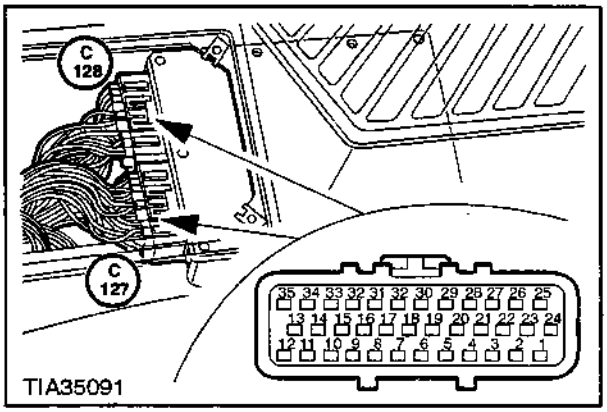
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Error Code 63 EDC Hydraulic Valve Lower Solenoid Open Circuit
Error Code 65 EDC Hydraulic Valve Lower Solenoid Short Circuit

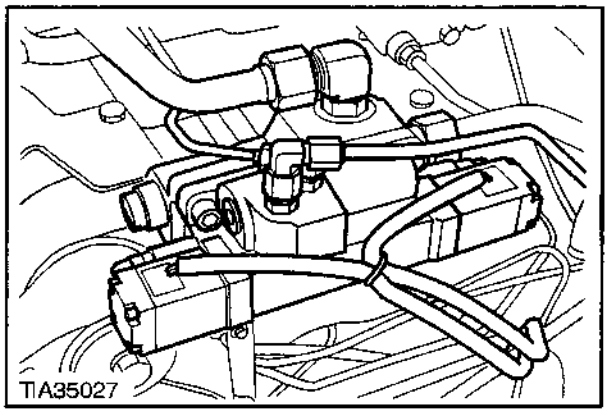


Hydraulic Control Valve



Microprocessor Connectors

Disconnect hydraulic control valve connector **C051**. Measure coil resistance across male pins **C051–3** (K/G/B) and **C051–4** (K/R)
Is resistance approximately 8Ω?
- NO → Replace lower solenoid
- YES → Turn key–start switch **'ON'**. Measure voltage across female pin **C051–4** (K/R) and tractor chassis.
Is voltage approximately 12 volts?
  - NO → Disconnect microprocessor connector **C127** and check for open circuit between **C051–3** (K/G/B) and **C127–27** (K/G/B) **HB–4** (K/R) and **C127–19** (K/R)
Open circuit?
    - YES → Locate and repair open circuit
    - NO → Disconnect microprocessor connector **C127**. Check for short circuit between female pin **C051–4** (K/R) and **C051–3** (K/G/B). Similarly check for short circuit to chassis between each of these pins
Short circuit?
      - YES → Locate and repair short circuit
      - NO → Replace microprocessor



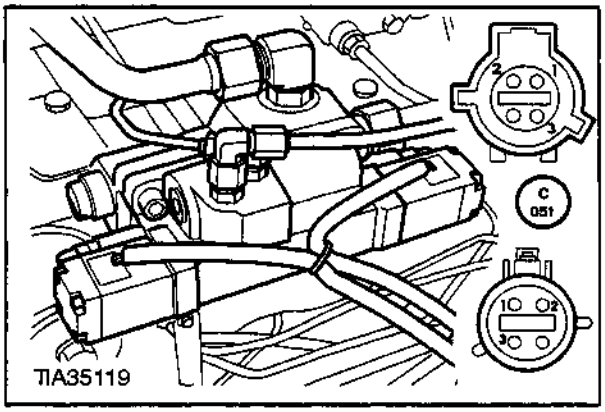
Hydraulic Control Valve Solenoids

1. Lower Solenoid
2. Raise Solenoid

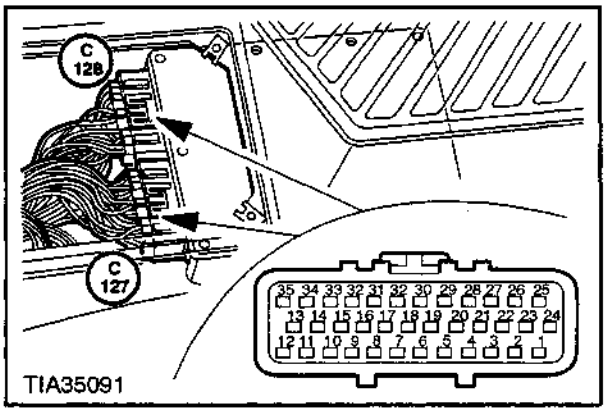
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Error Code 64 EDC Hydraulic Valve Raise Solenoid Failed Open Circuit
Error Code 66 EDC Hydraulic Valve Raise Solenoid Failed Short Circuit



Hydraulic Control Valve



Microprocessor Connectors

Disconnect hydraulic control valve connector **C051**. Measure coil resistance across male pins **C051–1** (K/U/B) and **C051–2** (K/U)
Is resistance approximately 8Ω?

NO → Replace lower solenoid

YES

Turn key–start switch **'ON'**. Measure voltage across female pin **C051–2** (K/U) and tractor chassis.
Is voltage approximately 12 volts?

NO → Disconnect microprocessor connector **C127** and check for open circuit between **C051–1** (K/U/B) and **C127–28** (K/U/B) **C051–2** (K/U) and **C127–20** (K/U)
Open circuit?

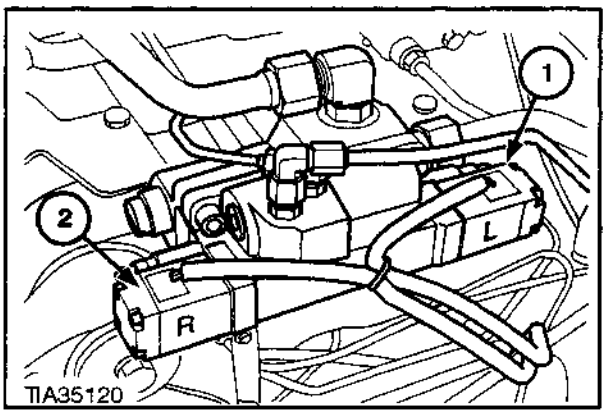
YES → Locate and repair open circuit

YES

Disconnect microprocessor connector **C127**. Check for short circuit between female pin **C051–1** (K/U/B) and **C051–2** (K/U).
Similarly check for short circuit to chassis between each of these pins
Short circuit?

NO → Replace microprocessor

YES → Locate and repair short circuit



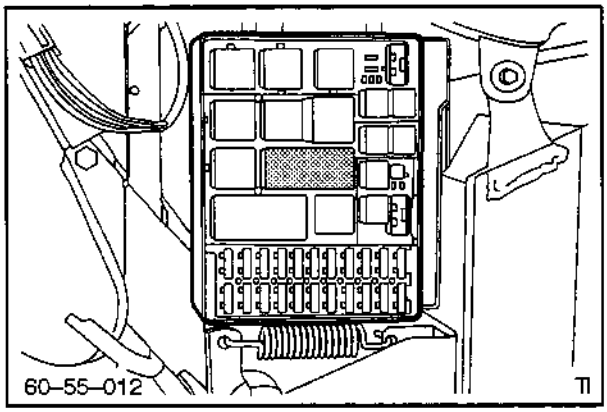
Hydraulic Control Valve Solenoids

1. Lower Solenoid
2. Raise Solenoid

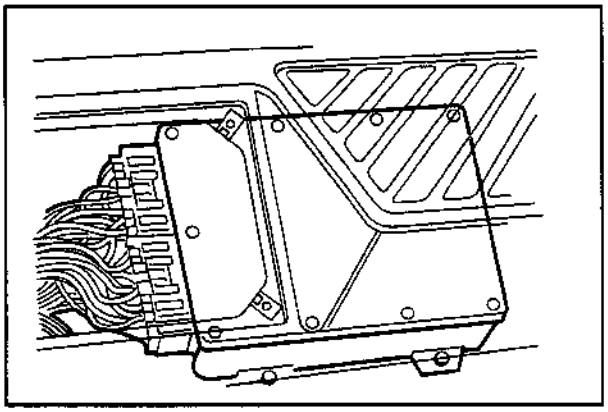
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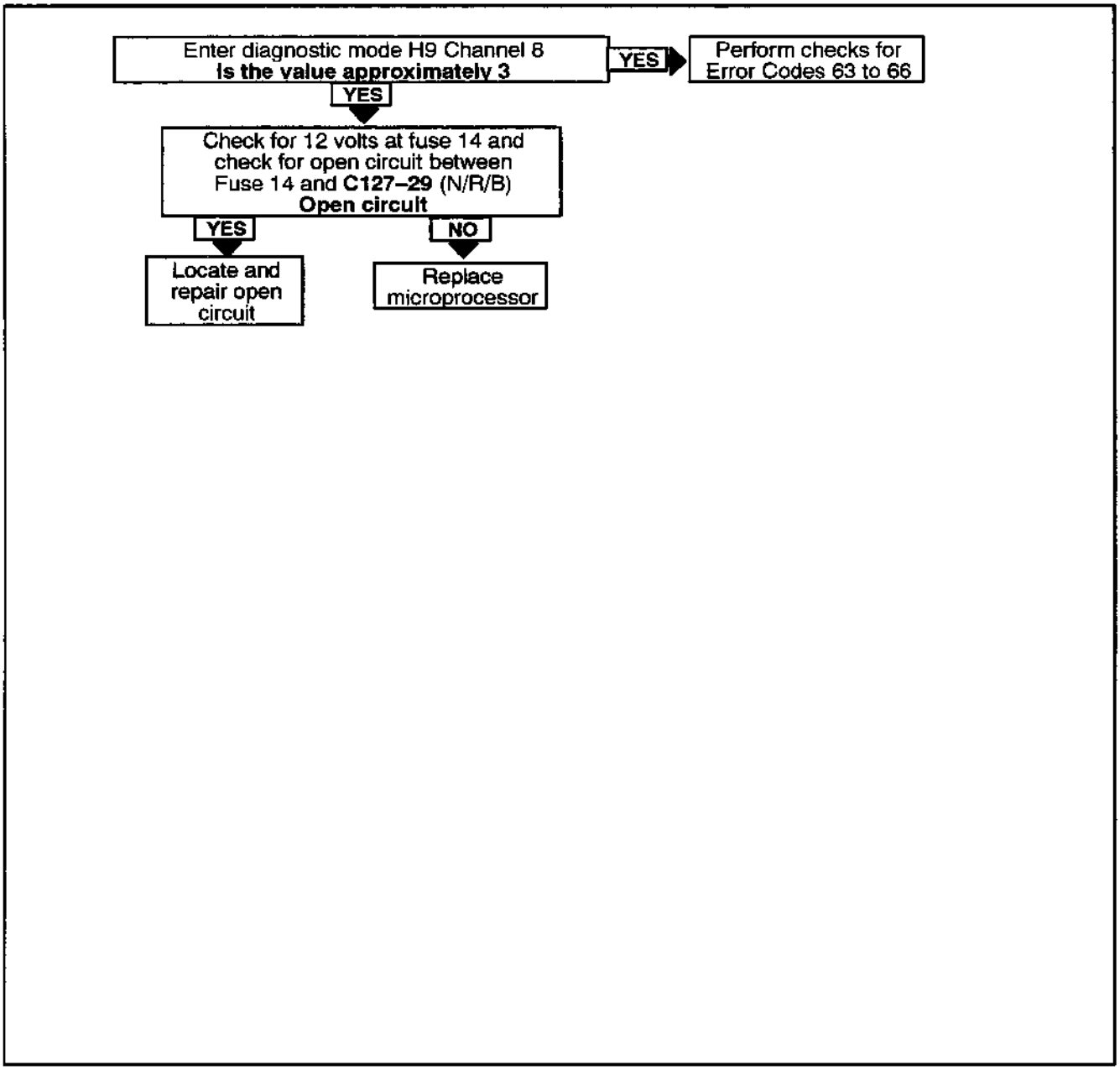
Error Code 67 EDC Hydraulic Valve Supply Voltage to Low



Fuse Panel



Microprocessor



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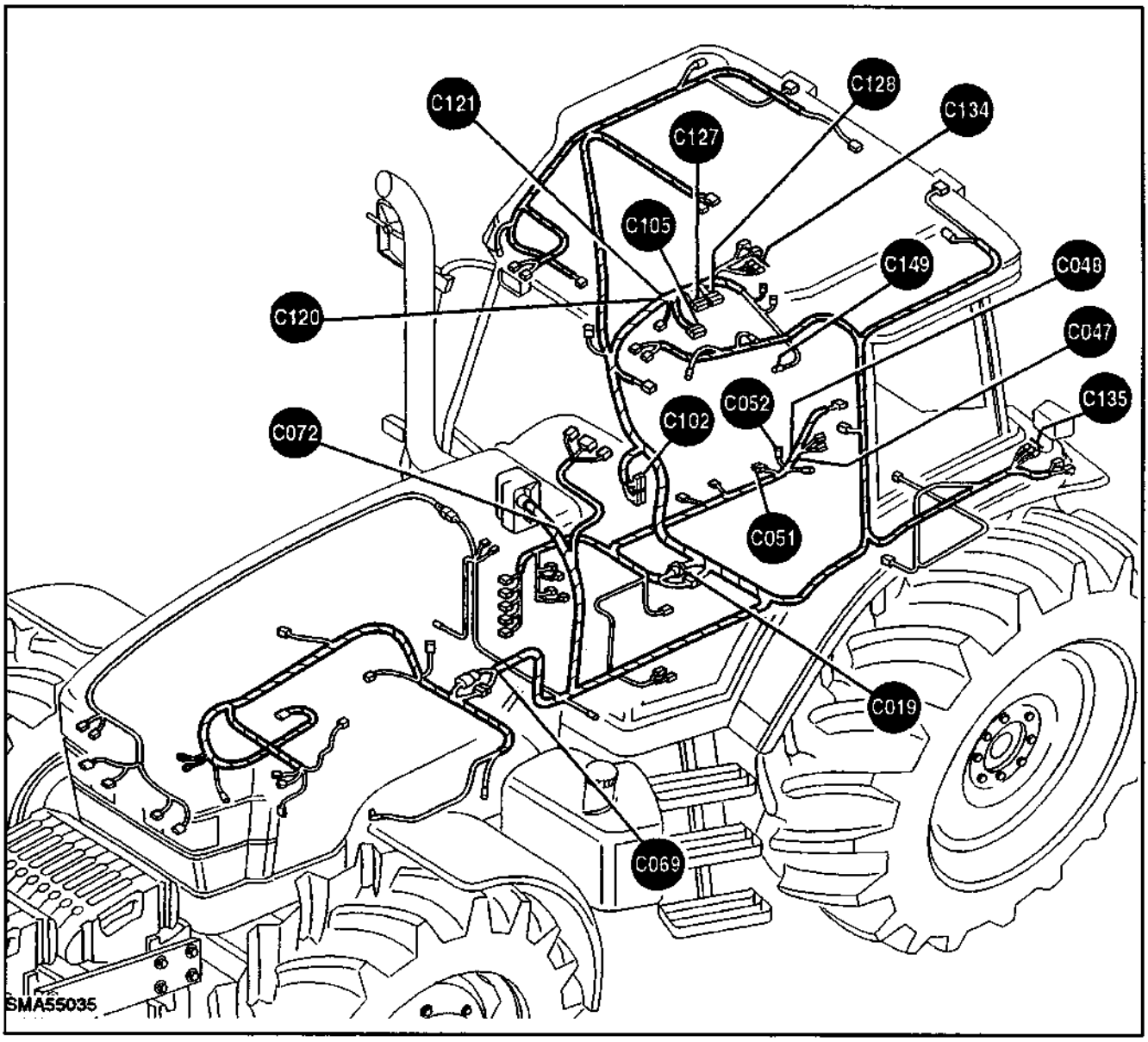
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Fault Diagnostic Chart For Miscellaneous Hydraulic Lift Concerns

SYMPTON	POSSIBLE CAUSE	ACTION
Hydraulic lift will not operate.	No pilot pressure to EDC hydraulic control valve.	Perform low pressure circuit tests. Refer to Section 8 Chapter 2
	No load sensing signal.	Tractors with CCLS Pump Check load sensing valve for sticking. Tractors with Open Center Gear Pump Examine unload valve for sticking
	EDC load check valve sticking,	Examine load check valve.
Hydraulic lift will not lower.	Load check valve piston sticking.	Examine load check piston.
	Control valve spool sticking.	Examine spool.
	Lowering solenoid spool sticking.	Examine solenoid spool and torque of solenoid retaining screws.
	EDC Valve out of adjustment.	Examine spool adjusters for signs of tampering. Check valve calibration values using diagnostic routine H2.
Lift arms erratic, Slow or move when not in operation.	EDC valve receiving electronic signal.	Disconnect EDC valve connector and trace wiring fault if arms remain stationary.
	Pilot or control valve spools sticking.	Examine pilot and control valve spools for sticking or wear.
	EDC valve out of adjustment or incorrect valve fitted.	Examine spool adjusters for signs of tampering. Check valve calibration values using diagnostic routine H3 Check correct EDC valve fitted Refer to Page 8-4-73.
Lift arms slowly drop when held in raised position with engine Off.	Check valve leaking.	Examine check valve poppet ball seat for wear.
	Lift Cylinder safety valve leaking	Examine safety valve
Cannot lift heavy loads.	Pump worn or lift cylinder seals leaking.	Perform hydraulic pump flow and pressure tests. Refer to Section 2 Chapter 2
	Unload valve sticking (Open center hydraulics only)	
Hydraulic lift will not raise or lower to maximum limits of travel.	Microprocessor incorrectly calibrated.	Perform memory reset and autocallbration procedure. See Error Code 24.

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Electronic Draft Control Connector Location and Harness Routing

C019	Extension Harness Connector
C047	Left Hand Draft Pin
C048	Right Hand Draft Pin
C051	EDC Valve Connector
C052	Lift Arm Potentiometer
C102	Fast Raise Lower Switch
C105	Electronic Management Unit Connector
C120	EDC Control Panel Connector 1
C121	EDC control Panel Connector 2
C127	EDC Microprocessor Connector 1
C128	EDC Microprocessor Connector 2
C134	Right Hand External Raise Lower Fender Switch
C135	Left Hand External Raise Lower Fender Switch
C149	Lift Control Lever Potentiometer

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Electronic Draft Control Electrical Circuit

1. Battery
2. Ignition Switch
3. Ignition Relay
4. Instrument Cluster (EIC or AEIC)
5. Performance Monitor Radar
6. Alternator
7. Electronic Management Unit (EMU)
8. EDC Diagnostic Connector
9. Axle Speed Sensor
10. EDC Control Panel
11. Position/Draft Sensitivity Control Potentiometer
12. Drop Rate Control Potentiometer
13. Slip Limit Control Potentiometer
14. Height Limit Control Potentiomeyer
15. Right Hand Load Sensing Pin
16. Left Hand Load Sensing Pin
17. Lift Control Lever Potentiometer
18. Lift Arm Position Sensing Potentiometer
19. Hydraulic Lift Fender Switch (Right Hand)
20. Hydraulic Lift Fender Switch (Left Hand)
21. In Cab Fast Raise/Work Switch
22. Hydraulic Lift Status (Captured) Indicator Light
23. Slip Limit "On" Indicator Light
24. Hydraulic Control Valve Raise Solenoid
25. Hydraulic Control Valve Raise Solenoid
26. EDC Microprocessor


Chassis Ground


Power Ground

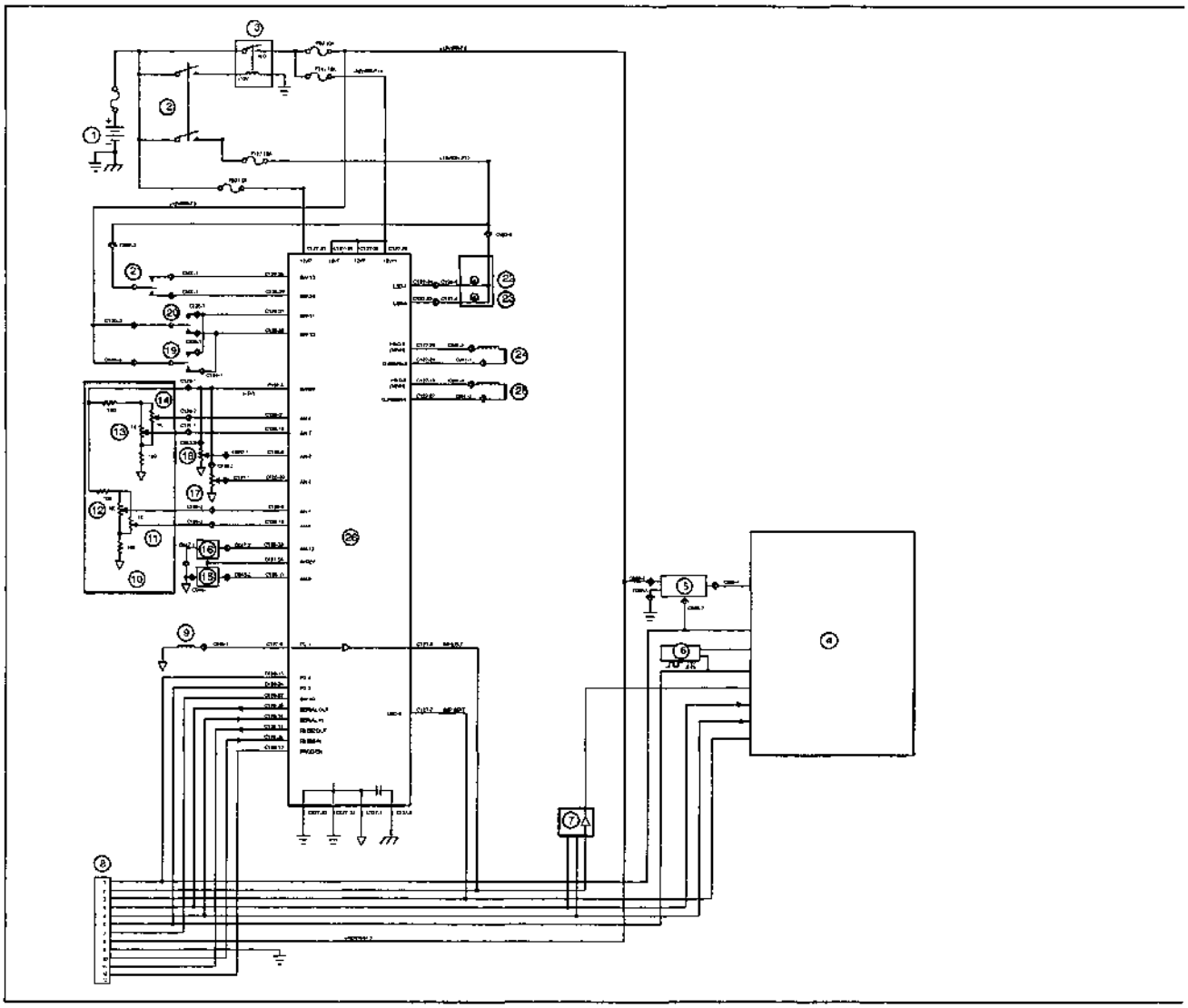

EDC Sensor Signal Ground

Wire Color Codes

B	Black	G	Green
N	Brown	LG	Light Green
LN	Tan	U	Blue
S	Slate	TQ	Turquoise
R	Red	P	Purple
O	Orange	K	Pink
Y	Yellow	W	White

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OVERHAUL

HYDRAULIC CONTROL VALVE– Removal and Installation

1. Lower hydraulic lift arms.

2. Thoroughly clean the area around the valve prior to proceeding with the removal procedure.

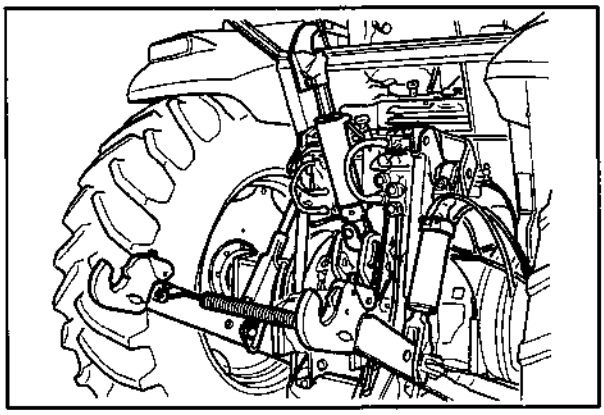


Figure 8-4-62

Tractors with variable displacement CCLS hydraulic pump

3. Disconnect electrical connector, load sensing line (1) and pilot pressure line (2).

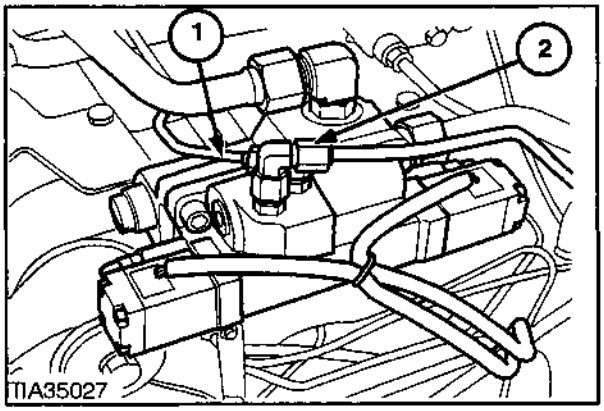


Figure 8-4-63

Tractors with open center gear type pump (Not used in North America)

4. Disconnect electrical connector, pilot pressure line (1) and load sensing line to unload valve (2).

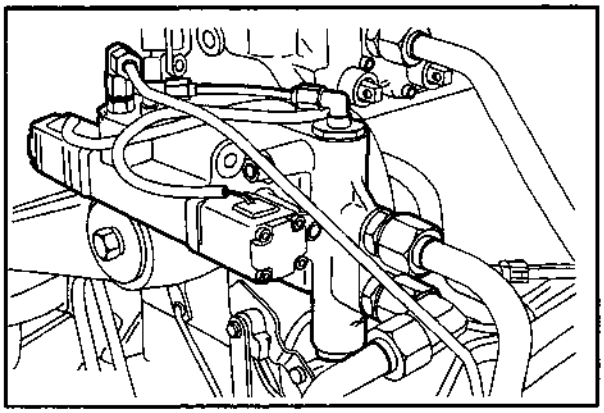


Figure 8-4-64

5. Remove four retaining bolts and lift valve from tractor.

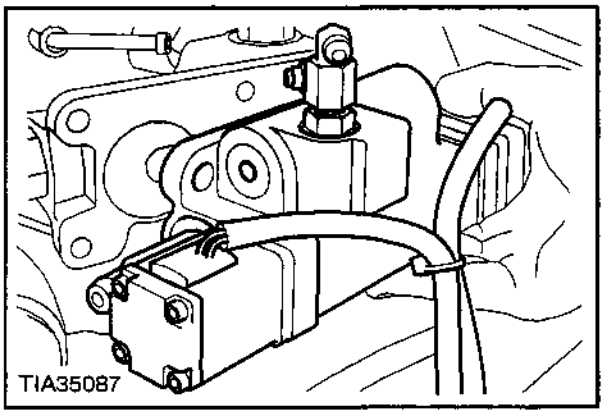


Figure 8-4-65

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INSTALLATION

1. Replace 'O' ring seals (1) and (2) and ensure they are correctly located around oil galleries on mounting face of hydraulic control valve.

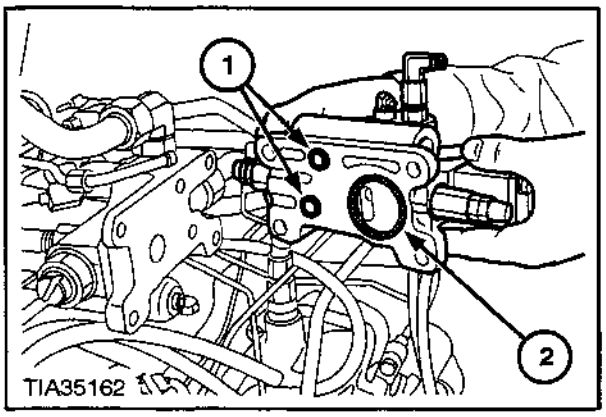


Figure 8-4-66

2. Install valve using removal procedure in reverse and tighten mounting bolts and tube connections to the specified torque

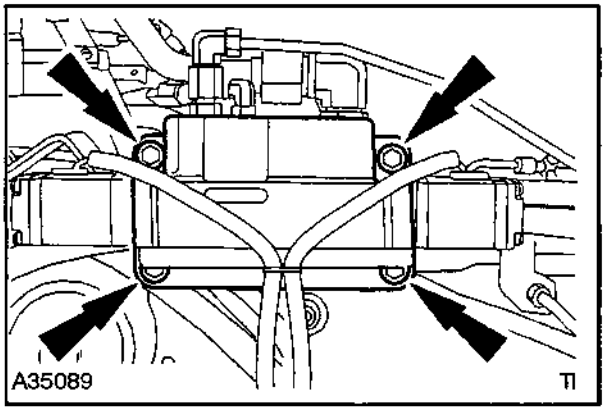


Figure 8-4-67

HYDRAULIC CONTROL VALVE– Disassembly–Assembly

Solenoids and Pilot Spools

1. Identify lower (1) and raise (2) solenoids, to aid re–assembly and remove valve from tractor,

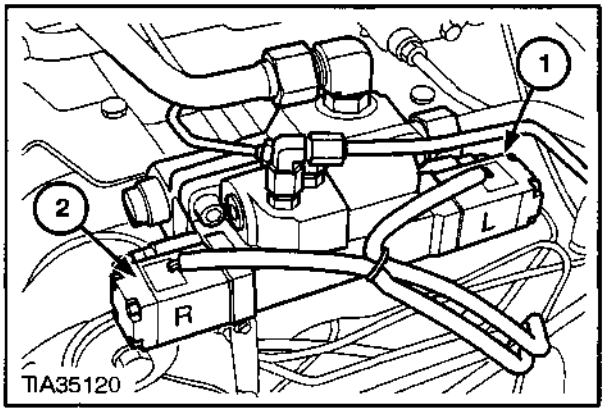


Figure 8-4-68

2. Remove and if necessary disassemble solenoids.

   NOTE: Solenoid is only serviced as a complete assembly.

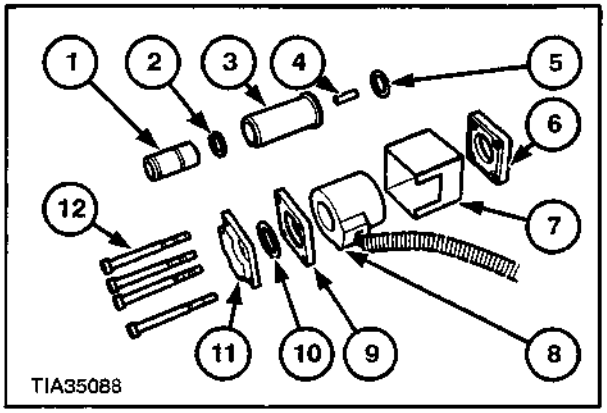


Figure 8-4-69

Solenoid Components–Exploded View

1. Piston
2. 'O' Ring
3. Core
4. Plunger
5. 'O' Ring
6. Plate
7. Cover
8. Field Coil
9. Plate
10. 'O' Ring
11. End Cap
12. Allen Screws

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3. Remove pilot spool (1) and spring (2) from pilot operated valves.
   Ensure spools move freely when pushed in against the spring

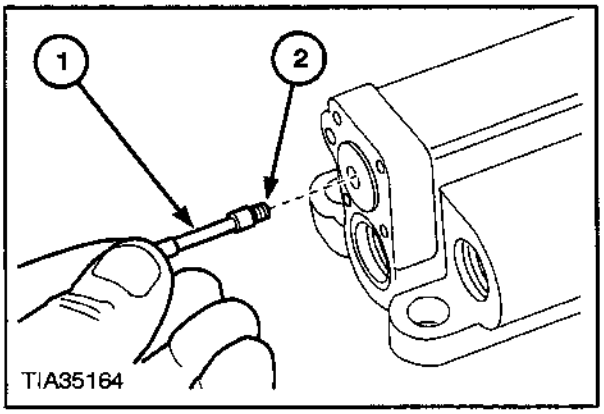


Figure 8-4-70

4. Insert a $^{5}/_{16}$ in UNF bolt into end of pilot spool. Pull pilot spool from housing.

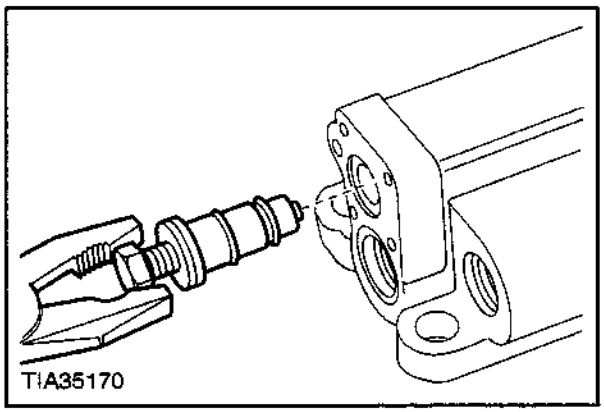


Figure 8-4-71

5. Re–assembly and installation of solenoids follows disassembly procedure in reverse. During installation ensure solenoids are mounted square to valve body and Allen screws are progressively tightened in a cross corner sequence to a torque of 18 in. lbs. (2 Nm).
   Do Not overtighten the screws.

Main Spool

1. Identify left and right hand adjusters in relationship to valve housing body.

NOTE: *It is important that the adjusters are not disassembled*

2. Remove adjuster assemblies and withdraw spool, centering springs and seats.
   Ensure that springs and seats remain matched with each adjuster.

IMPORTANT: *Do not disassemble or reset the adjuster assemblies. The hydraulic control valve adjustment is pre–set at the factory and ensures that the spool is correctly set for the neutral position.*

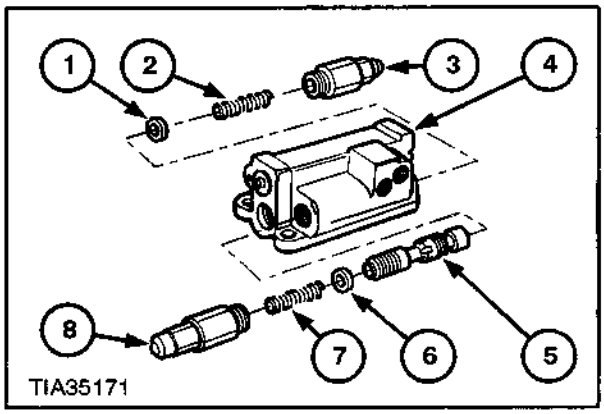


Figure 8-4-72

Main Spool

1. Seat
2. Spring
3. Adjuster Assembly
4. Valve Housing
5. Spool
6. Seat
7. Spring
8. Adjuster Assembly

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NOTE: *There are two designs of spool.*

Spool (1) used on tractors with Close center load sensing circuit has a smaller metering land.

Spool (2) used on tractors with open center circuit has a large metering land on inlet (Raise) land of the spool. (Not used in North America)

The large metering land is necessary to provide a low differential pressure between pump and load sensing pressures which ensures the unload valve does not prematurely return pump flow to sump causing hesitation of the lift.

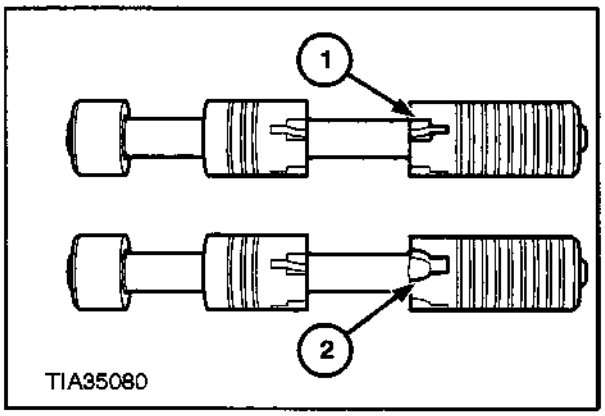
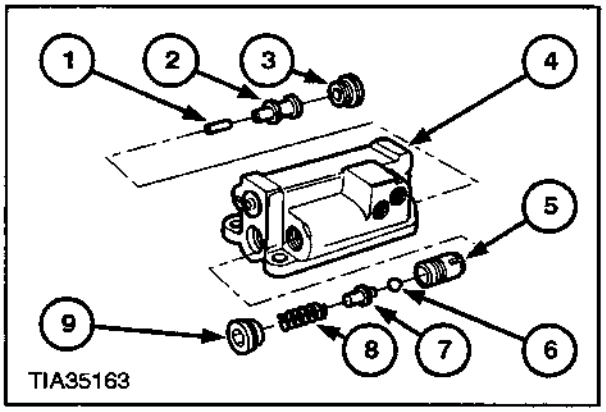


Figure 8-4-73

Load Check Valve

1. Remove the load check valve plugs and withdraw the load check valve components.

NOTE: *The pin, item 7, is rounded on one end. When re–assembling the valve ensure the rounded end of the pin is inserted into the poppet, item 2.*



Load Check Valve **Figure 8-4-74**

1. Pin
2. Piston
3. Plug and 'O' Ring
4. Valve Housing
5. Poppet
6. Ball
7. Guide
8. Spring
9. Plug and 'O' Ring

INSPECTION AND RE–ASSEMBLY

1. Wash all parts, except solenoids, in a suitable solvent and inspect for scoring and distortion.

2. Minor imperfections can be corrected by using fine abrasive emery cloth or fine lapping compound. Exercise extreme care when abrasive materials are used to ensure all particles are removed from the valve housing.

3. If deep scores or serious pitting is observed discard the valve.

4. Re–assembly follows disassembly procedure in reverse

5. Lubricate all components with oil and ensure the spools move freely in their bores.

6. Replace all 'O' ring seals.

7. Tighten all plugs and locknuts to the correct torque. See Specifications.

8. When installing the solenoids ensure solenoids are mounted square to valve body and Allen screws are progressively tightened in a cross corner sequence to a torque of 18 in. lbs. (2 Nm), **Do Not** overtighten the screws.

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Load Sensing Pin Replacement

1. Lower hydraulic lift arms.

2. Disconnect load sensing pin connectors. The connectors are located on top of the hydraulic lift cover and can be accessed from the rear of the tractor.

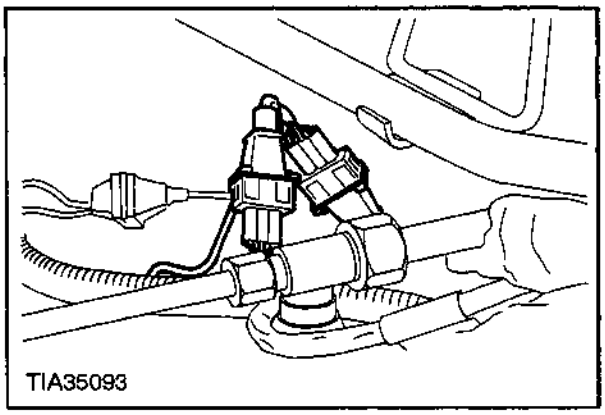


Figure 8-4-75

3. Remove wiring protection guard at pin.

A. 8160, 8260 and 8360
B. 8560 Tractors

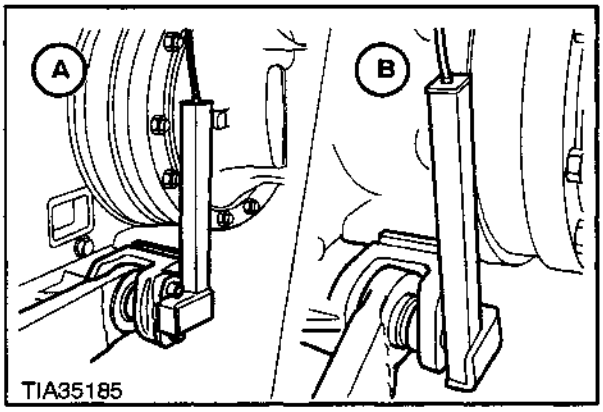


Figure 8-4-76

4. Remove spacers (2) and clamp (1).

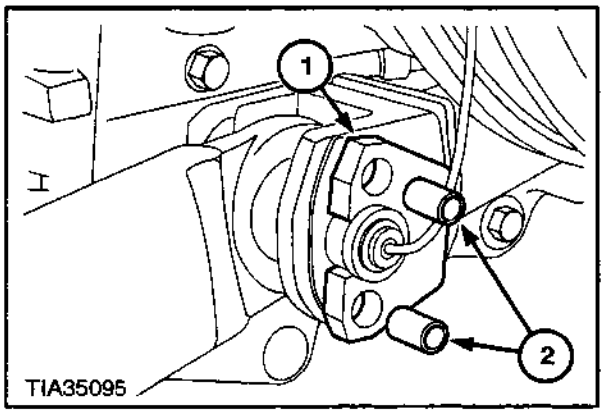


Figure 8-4-77

5. Withdraw Pin.

6. Install pin using procedure in reverse and torque clamp bolts to the specified torque.

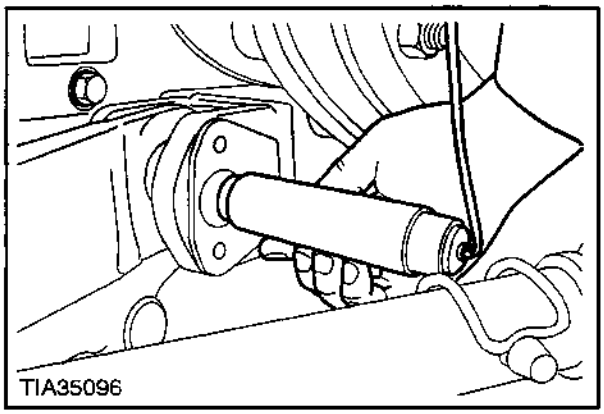


Figure 8-4-78

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HYDRAULIC LIFT COVER–OVERHAUL

1. Lower lift arms

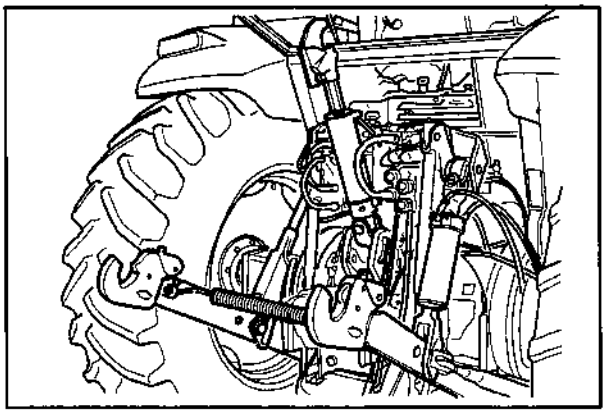


Figure 8-4-79

2. Disconnect lift rods and assist ram (where fitted).

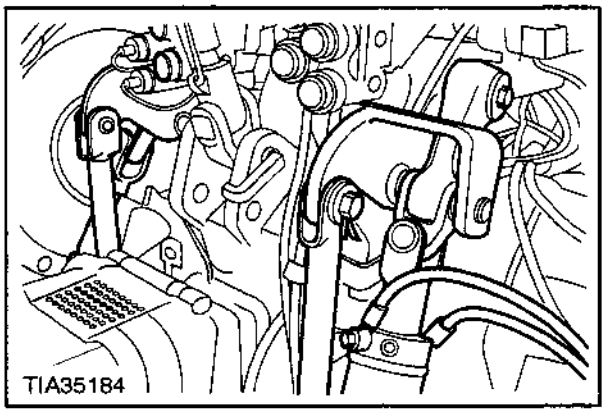


Figure 8-4-80

3. Disconnect and remove lift arm position sensing potentiometer.

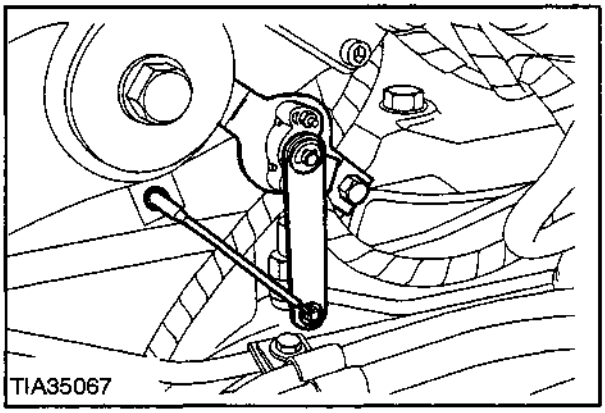


Figure 8-4-81

4. Remove cab rear mounting bolts and raise rear of cab to clear cab mounts on rear axle.

5. Reinstall mounting bolts into cab and lower cab until bolts rest on top of cab mounts on rear axle. This will provide improved access to pipework from pump to components mounted on the lift cover.

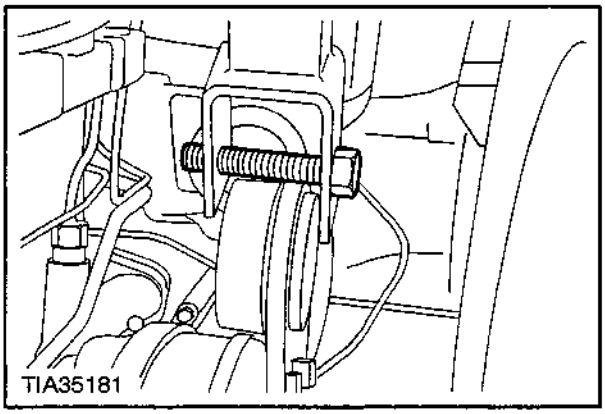
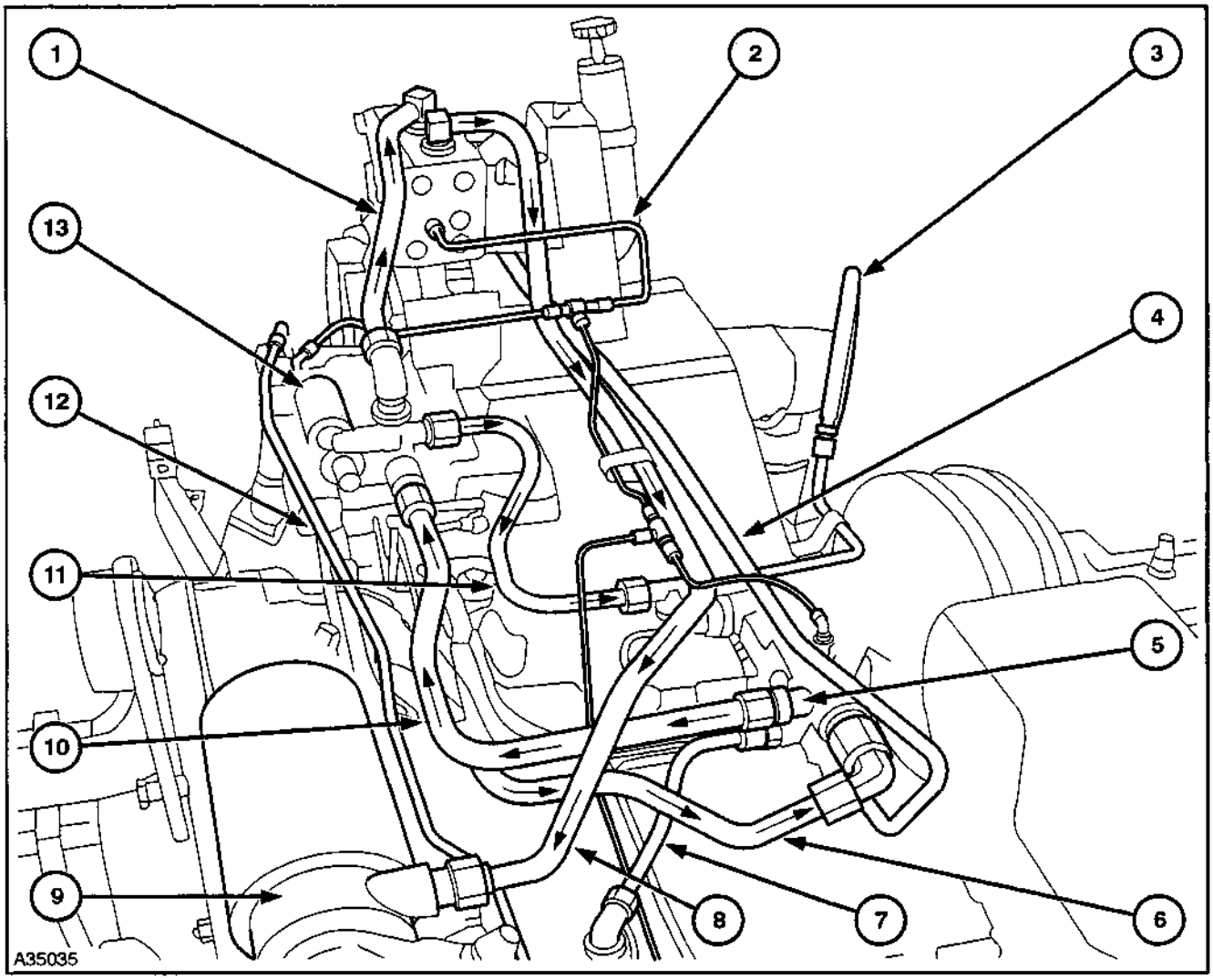


Figure 8-4-82

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High Pressure Circuit Components and Pipework
Tractors with Variable Flow Piston Pump Shown

Figure 8-4-83

1. Remote Control Valve
2. Load Sense Lines To Hydraulic Pump
3. To Assist Ram (Where Fitted)
4. To Trailer Brake Connector
5. Trailer Brake Valve
6. Pump Supply to Trailer Brake
7. Trailer Brake Return To Sump
8. Return From Remote Valves
9. Variable Flow Hydraulic Pump
10. To Remotes and Hydraulic Lift Control Valve
11. To Hydraulic Lift and Assist Ram (Where Fitted)
12. Pilot Pressure To Hydraulic Lift Control Valve
13. Hydraulic Lift Electronic Draft Control Valve

6. With reference to Figure 8-4-83. Disconnect hydraulic connections to components mounted on hydraulic lift cover lift cover.

7. Remove remote control valves

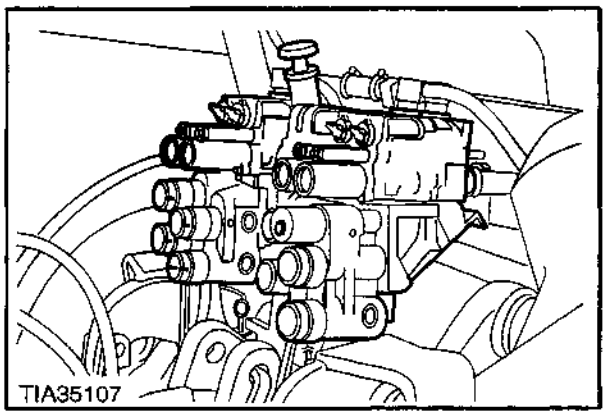


Figure 8-4-84

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8. Remove electronic draft control valve.

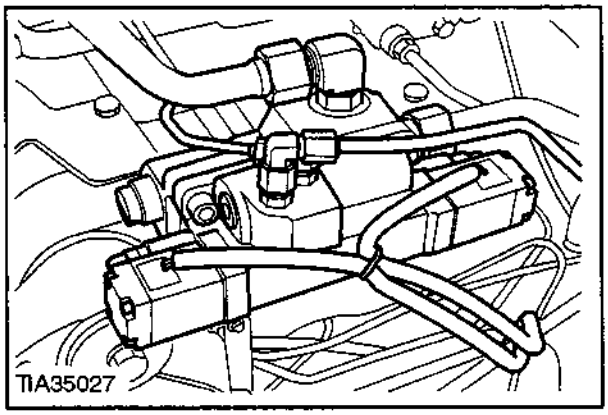


Figure 8-4-85

9. Remove lift cover mounting bolts and fit lifting bracket (1) New Holland Tool No 293983 to top of lift cover.

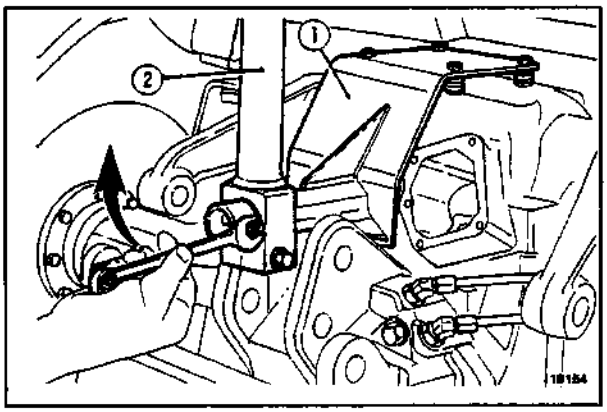


Figure 8-4-86

10. Connect lifting hook (2) New Holland Tool No 291359/2 to bracket and using hoist carefully raise cover sufficiently to enable removal from tractor.

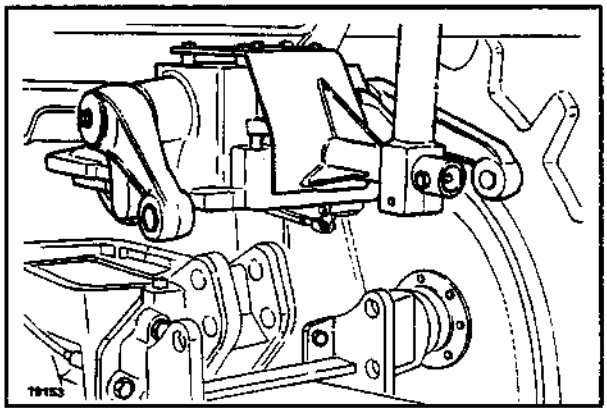


Figure 8-4-87

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Disassembly

1. Remove four bolts securing lift cylinder to cover and remove cylinder.

2. Disassemble Lift cover with reference to Figure 8-4-89

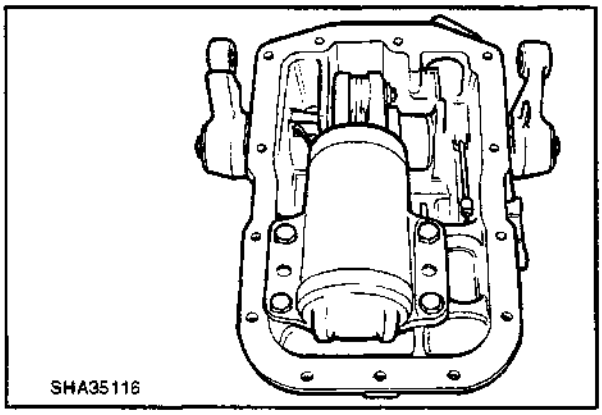
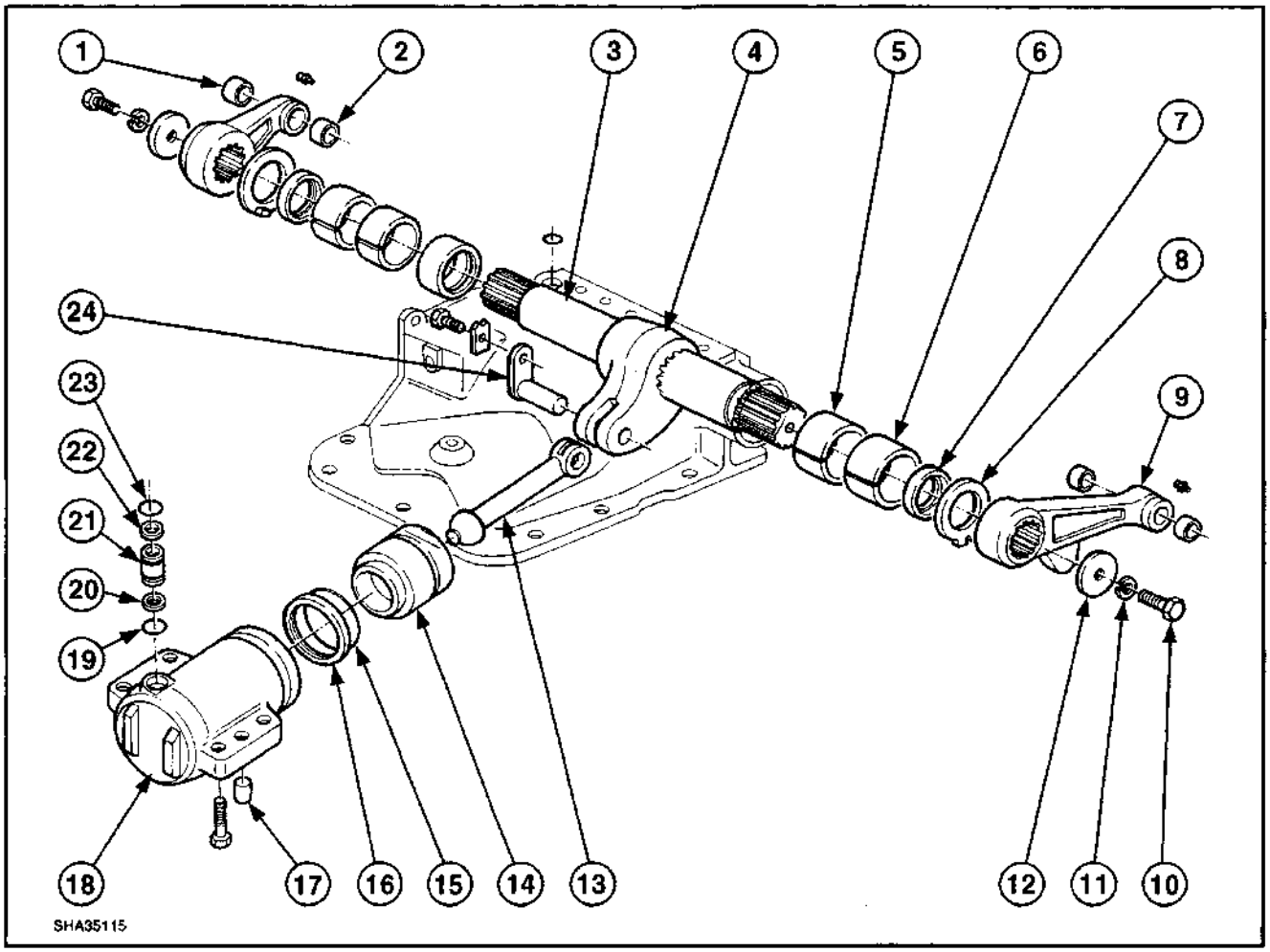


Figure 8-4-88



Hydraulic Lift Cover

Figure 8-4-89

1. Bushing
2. Bushing
3. Cross Shaft
4. Arm
5. Bushing
6. Bushing
7. Seal
8. Spacer
9. Arm
10. Bolt
11. Washer
12. Spacer
13. Rod
14. Piston
15. Back up Ring
16. Seal
17. Dowel (2 off)
18. Cylinder
19. 'O' Ring
20. Seal
21. Connecting Tube
22. Seal
23. 'O' Ring
24. Pin

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3. To remove piston from cylinder insert an airline into the inlet port or alternatively tap the open end of the cylinder onto a piece of wood.

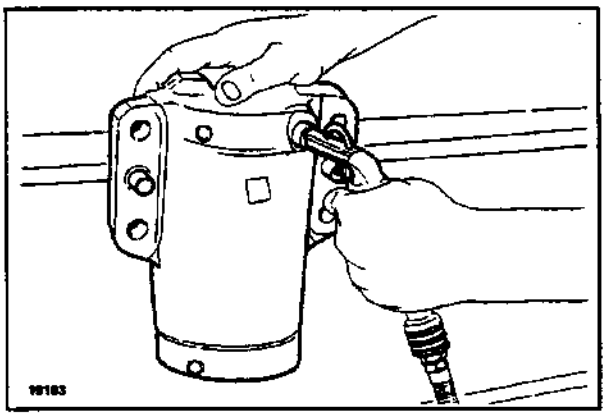


Figure 8-4-90

Re– Assembly and Installation

1. Wash all parts in suitable cleaning fluid.

2. Re–assembly and installation follows the disassembly procedure in reverse while observing the following requirements.

3. When installing the piston apply petroleum jelly to outer surface of seal and carefully insert into cylinder.

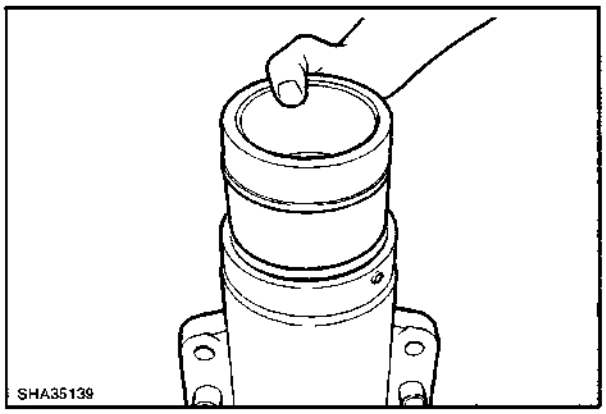


Figure 8-4-91

4. Where available the use of New Holland Special Tool No 293813 (1) will aid assembly without risk of damaging piston seals

5. When installing lift cylinder tighten retaining bolts to a torque of 105 ft. lbs. (142 Nm)

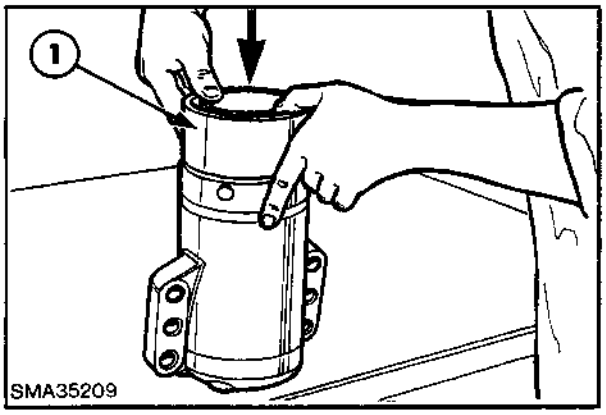


Figure 8-4-92

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6. Use New Holland seal installer 293985 to install new cross shaft seals

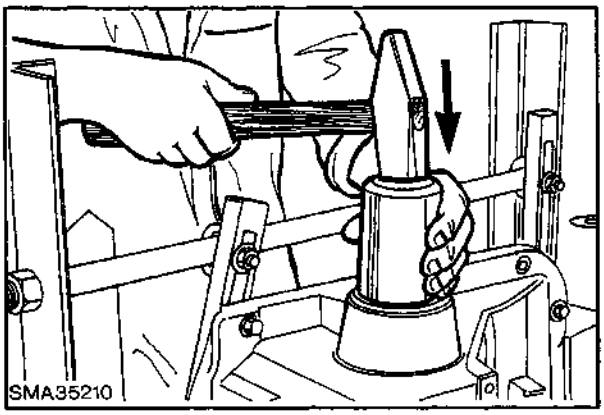


Figure 8-4-93

7. Ensure the positioning mark on the ends of the cross shaft align with the corresponding marks on the lift arms.

8. Tighten lift arm retaining bolts to a torque of 105 ft. lbs. (142 Nm).

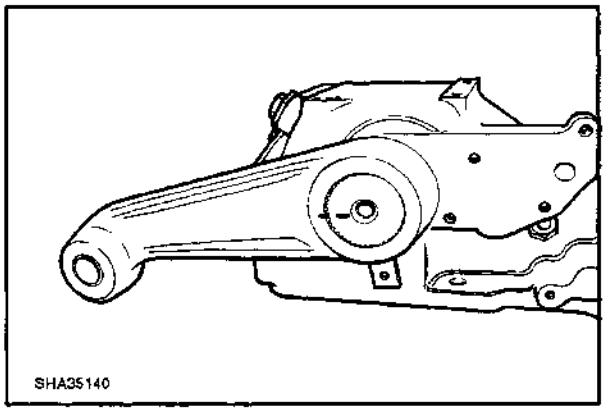


Figure 8-4-94

9. When installing lift cover onto tractor apply a continuous bead of sealant to mating face of cover while ensuring a ring of sealant is also applied around each mounting bolt hole.

10. Install lift cover retaining bolts and tighten to specified torque.

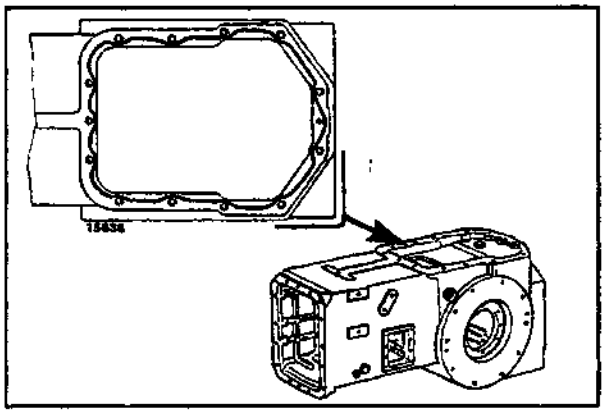


Figure 8-4-95

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Lift Cylinder Safety Valve Adjustment

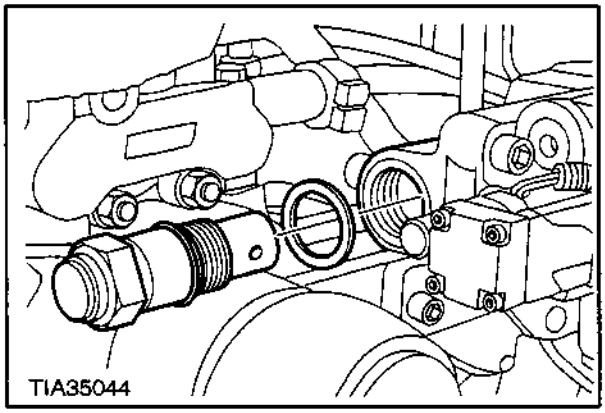


Figure 8-4-96

1. Remove lift cylinder safety valve located immediately behind electronic draft control valve.

2. Using adaptor (3) New Holland Tool No 290824 connect valve (2) to hand pump (1).

3. Operate hand pump and check that safety valve operates at 3104 – 3176 lbf/in^2 (210–215 bar).

4. If the valve setting is incorrect it is advisable to replace the valve. Where necessary it is possible to adjust the valve using New Holland Tool No 291862. Turning the adjustment plug clockwise to increases pressure and counter clockwise reduces pressure setting.

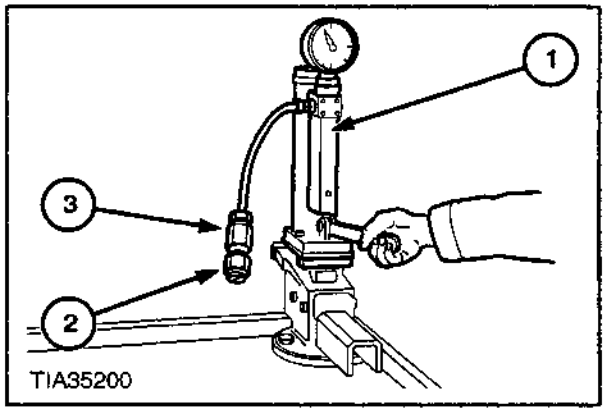


Figure 8-4-97

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SECTION 8

HYDRAULIC SYSTEM

CHAPTER 5

MECHANICAL REAR HYDRAULIC LIFT

(NOTE: NOT USED IN NORTH AMERICA)

CONTENTS

SPECIFICATIONS 8-5-2
TIGHTENING TORQUE 8-5-4
SPECIAL TOOLS 8-5-6
SECTIONAL VIEWS 8-5-7
DESCRIPTION AND OPERATION 8-5-10
TROUBLESHOOTING 8-5-14
REMOVAL – INSTALLATION – OVERHAUL 8-5-16
INDEX 8-9-4

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35 000 – SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

SPECIFICATIONS – REAR HYDRAULIC LIFT

Type	with separate position or draft control plus mixed position/draft control feature
Control	Through two independent levers
Vario–speed sensitivity control	Automatic, through a hydraulic unit located inside the lift control valve
LIFT-O-MATIC	For fast raise/lower through push–buttons, without using the draft or position control levers
Drop rate adjustment	Through a bolt and nut located on the lift control valve
Single–acting cylinder	
– Bore and stroke ... in (mm)	4.53 x 6.26 (115 x 159)
– Displacement ... in^2 (cm^3)	100.7 (1651)
Pressure regulating valve setting ... lbf/in^2 (bar)	2760 to 2830 lbf/in^2 (190 to 195) (194 to 199 kg/cm^2)
Cylinder safety valve setting ... lbf/in^2 (bar)	3040 to 3120 lbf/in^2 (210 to 215) (214 to 219 kg/cm^2)
Piston dia. ... in (mm)	4.527 to 4.528 (114.978 to 115.000)
Cylinder bore dia. ... in (mm)	4.529 to 4.530 (115.036 to 115.071)
Piston to bore clearance ... in (mm)	0.001 to 0.004 (0.036 to 0.093)

(to be continued)

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SPECIFICATIONS – REAR HYDRAULIC LIFT

(continued)

Cross shaft (3, Figure 8-5-3) dia. at the bushings:		
– RH side	in (mm)	2.558 to 2.559 (64.970 to 65.000)
– LH side	in (mm)	2.755 to 2.756 (69.970 to 70.000)
Lift casing press–fit bushing inner dia:		
– RH side (3, Figure 8-5-2)	in (mm)	2.563 to 2.566 (65.100 to 65.184) (1)
– LH side (5)	in (mm)	2.760 to 2.763 (70.100 to 70.184) (1)
Cross shaft to bushings clearance	in (mm)	0.004 to 0.008 (0.100 to 0.214)
Bushings to bushing seats interference	» »	0.002 to 0.007 (0.065 to 0.185)
Shaft end play (with lift arms installed)	» »	0.008 to 0.045 (0.2 to 1.4)
Draft control shaft (4, Figure 8-5-4) outer dia.	in (mm)	0.865 to 0.866 (21.967 to 22.000)
Support seat inner diameter	in (mm)	0.867 to 0.870 (22.020 to 22.072)
Shaft to seat clearance	in (mm)	0.0008 to 0.004 (0.020 to 0.105)
Position control shaft (5, Figure 8-5-4) dia.	in (mm)	0.550 to 0.551 (13.973 to 14.000)
Position control shaft inner dia.	in (mm)	0.552 to 0.554 (14.016 to 14.059)
Draft control shaft to position control shaft clearance	in (mm)	0.0006 to 0.003 (0.016 to 0.086)
Control spool (8, Figure 8-5-5) to seat clearance	in (mm)	0.0003 to 0.0005 (0.008 to 0.012) (2)
Pilot valve (10) to control valve housing seat clearance	in (mm)	0.0003 to 0.0006 (0.008 to 0.014) (2)
Check valve return spring (12, Figure 8-5-5):		
– Free length	in (mm)	1.004 (25.5)
– Compressed length under a load of 12 to 13 ft. lbs. (5.28 to 5.72 kg) (52 to 56 N)	in (mm)	0.689 (17.5)
Control spool return spring (5, Figure 8-5-5)		
– Free length	in (mm)	1.988 (50.5)
– Compressed length under a load of 7.13 to 7.9 ft. lbs. (3.23 to 3.57 kg) (31.7 to 35 N)	in (mm)	1.338 (34)
Pilot valve return spring (9, Figure 8-5-5):		
– Free length	in (mm)	1.732 (44)
– Compressed length under a load of 23.2 to 25.8 ft. lbs. (10.5 to 11.7 kg) (103 to 114.7 N)	in (mm)	1.142 (29)
Drop rate control valve spring (14, Figure 8-5-5):		
– Free length	in (mm)	1.338 (34)
– Compressed length under a load of 15.1 to 16.4 ft. lbs. (6.86 to 7.46 kg) (67 to 73 N)	in (mm)	1.063 (27)
Sensitivity valve spring (4, Figure 8-5-5):		
– Free length	in (mm)	1.890 (48)
– Compressed length under a load of 14.6 to 16 ft. lbs. (6.6 to 7.2 kg) (65 to 71 N)	in (mm)	1.260 (32)
Sensitivity valve spring (1, Figure 8-5-5):		
– Free length	in (mm)	0.827 (21)
– Compressed length under a load of 0.2 to 0.22 ft. lbs. (0.09 to 0.11 kg) (0.9 to 1 N)	in (mm)	0.512 (13)

(1) Final dimension to be obtained without grinding

(2) Upon assembly, control spools and pilot valves are opportunely selected to obtain the required end play

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SPECIFICATIONS – IMPLEMENT LINKAGE

(segue)

Type Category Draft control	3–point hitch 2nd Through lower links and sensing bar
Max. lifting capacity with gravity center at 610 mm (24 in) from lower link ball ends, starting with links in horizontal position (top link connected to top bracket hole): – Without assist ram ft. lbs. (daN) – With assist ram ft. lbs. (daN)	 4717 (10,600 ft. lbs.) (4810 kg) 6600 (14,800 ft. lbs.) (6730 kg)
Max. lower link displacement, with vertical lift rods all out in (mm)	29 (740)
Sensing bar diameter in (mm) Sensing bar end play in (mm)	1.372 to 1.374 (34.861 to 34.900) 0.075 to 0.177 (1.9 to 4.5)

TIGHTENING TORQUE

DESCRIPTION		Tightening Torque	
		Thread size	Torque (ft. lbs.)
Hydraulic lift Bolts, lift to rear axle housing (C_1, page 8-5-5)	M 14x1.5	142	10.7 (14.5)
Bolts, control valve to lift (C_2)	M 8x1.25	32	2.4 (3.3)
Bolts, lift arm plates (C_3)	M 14x1.5	142	10.7 (14.5)
Plug, pilot valve (C_4)	M 20x1.5	54	4.0 (5.5)
Cylinder safety valve (C_5)	M 20x1.5	83	6.3 (8.5)
Plug, check valve (C_6)	M 24x1.5	83	6.3 (8.5)
Nut, position control shaft	M 10x1.25	14.7	1.1 (1.5)
Nuts, lever quadrant bracket retaining studs	M 8x1.25	23	1.8 (2.4)
Bolts, lift cylinder	M 16x1.5	279	21.0 (28.5)
Implement linkage Bolts, sensing bar support	M 18x1.5	304	23 (31)
Bolts, top link support	M 18x1.5	304	23 (31)
Nut, draft control rod	M 10x1.25	36	2.7 (3.7)
Nut, arm back–up ring screw	M 12x1.25	98	7.4 (10)
Remote control valves Bolts, remote control valves	M 10x1.25	127	9.6 (13)

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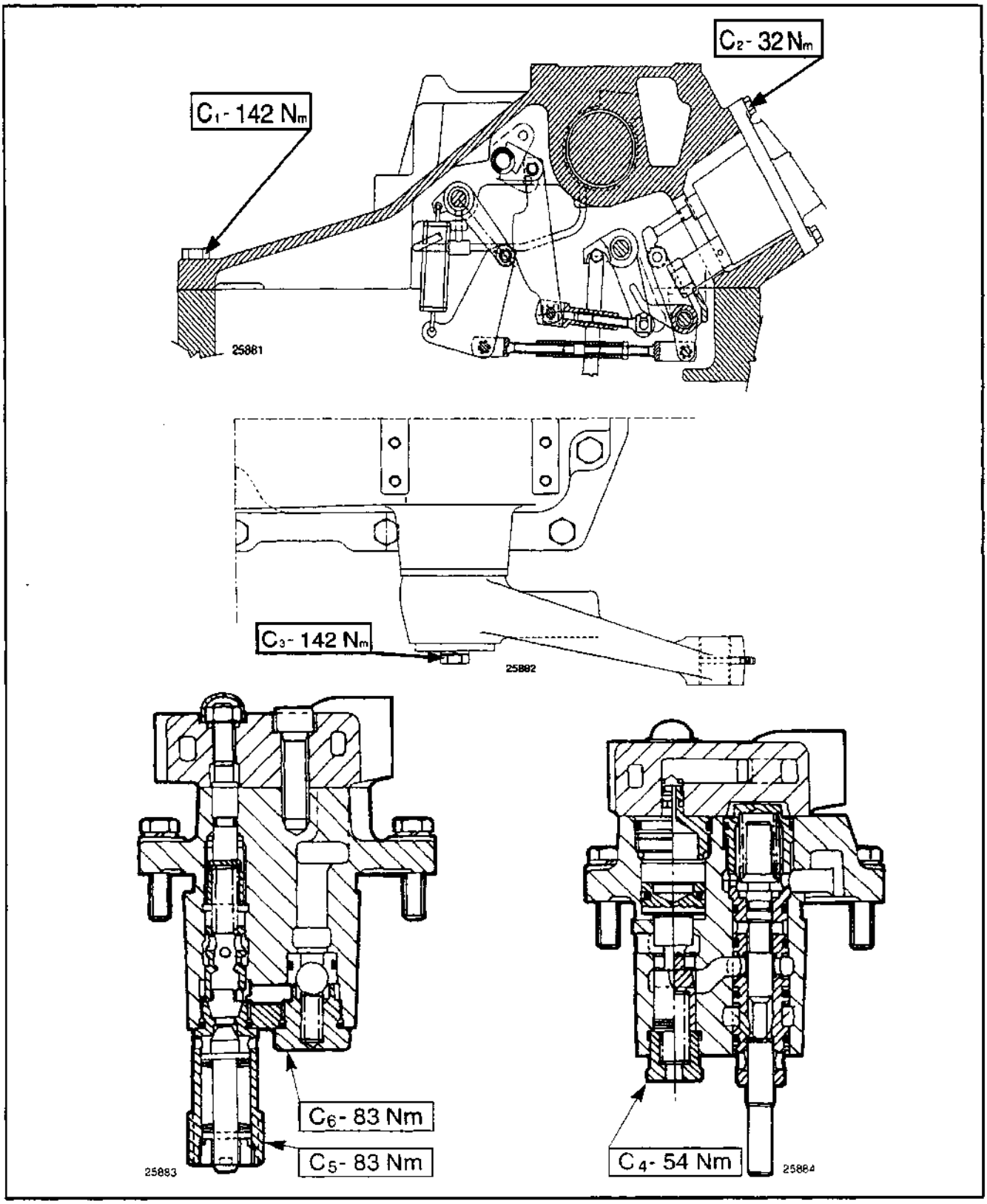


Figure 8-5-1

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SPECIAL TOOLS – HYDRAULIC LIFT

Caution – Operations described in this Section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

	291359	Hydraulic lift lifting hook
X	**293813**	Piston assembly ring (with lift seals)
X	**293985**	Cross shaft seal punch
	291215	Lift linkage spring disassembly/assembly hook
X	**293839**	Punch, roller bearings on control valve lever bushing
X	**293838**	Punch, roller bearings on draft control lower lever
X	**293838**	Punch, roller bearings on draft control upper lever
X	**293838**	Punch, roller bearings on draft actuator arm
X	**293981**	Draft control adjustment alignment pin
X	**291862**	Cylinder safety valve setting ring wrench
X	**291863**	Lift pressure regulating valve setting ring wrench
X	**293865**	Guard, seal assembly on drop rate adjust pin
	292870	Pressure test kit
	290284	Valve setting hand pump
X	**290828**	Cylinder safety valve setting connector
X	**290824**	Lift pressure regulating valve setting connector
X	**293982**	Control spool leak test connector
X	**293978**	Arm raise adjustment wrench
X	**293984**	Pilot valve seal guard
X	**293980**	Draft control adjustment tool
X	**293979**	Draft and position control adjustment tool
	293987	Arm shaft bushing rod
	293988	Nut (use with tool no. **293987**)
	293989	Bushing (use with tool no. **293987**)
	293990	Bushing (use with tool no. **293987**)
	293983	Adapter (use with tool no. **291359**)

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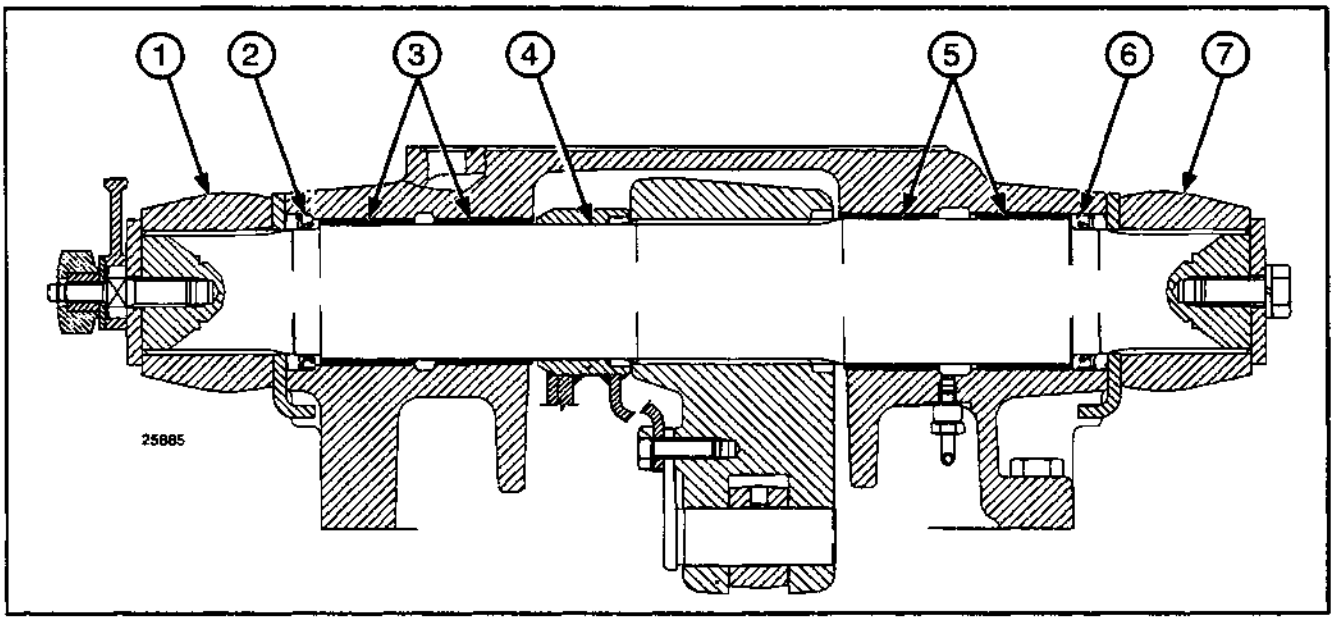


Figure 8-5-2

Lift Arm Control Shaft Sectional View

1. Lift arm, right–hand side
2. Seal
3. Shaft (4) support bushings, right–hand side
4. Lift arm control shaft
5. Shaft (4) support bushings, left–hand side
6. Seal.
7. Lift arm, left–hand side.

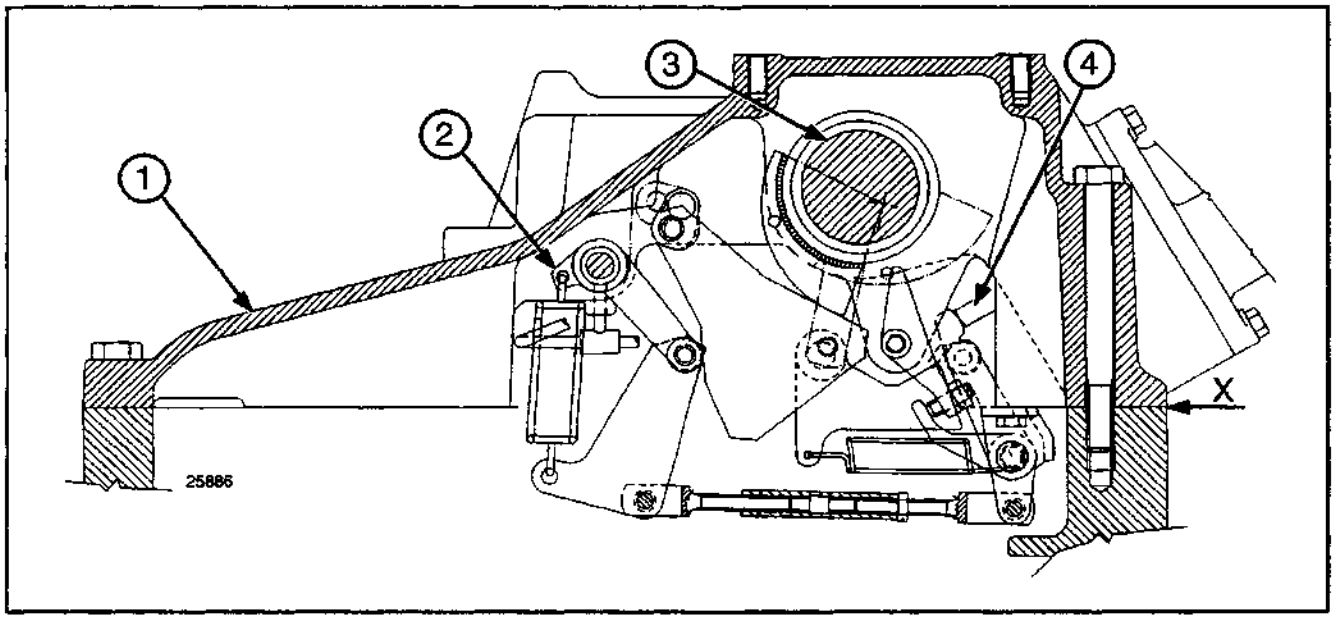


Figure 8-5-3

Lift Longitudinal View (Position Control).

1. Lift casing.
2. Position actuator armage.
3. Lift arm control shaft.
4. Control spool.

Note: During installation apply liquid gasket on surfaces marked with an **X** as detailed on page 8-5-20.

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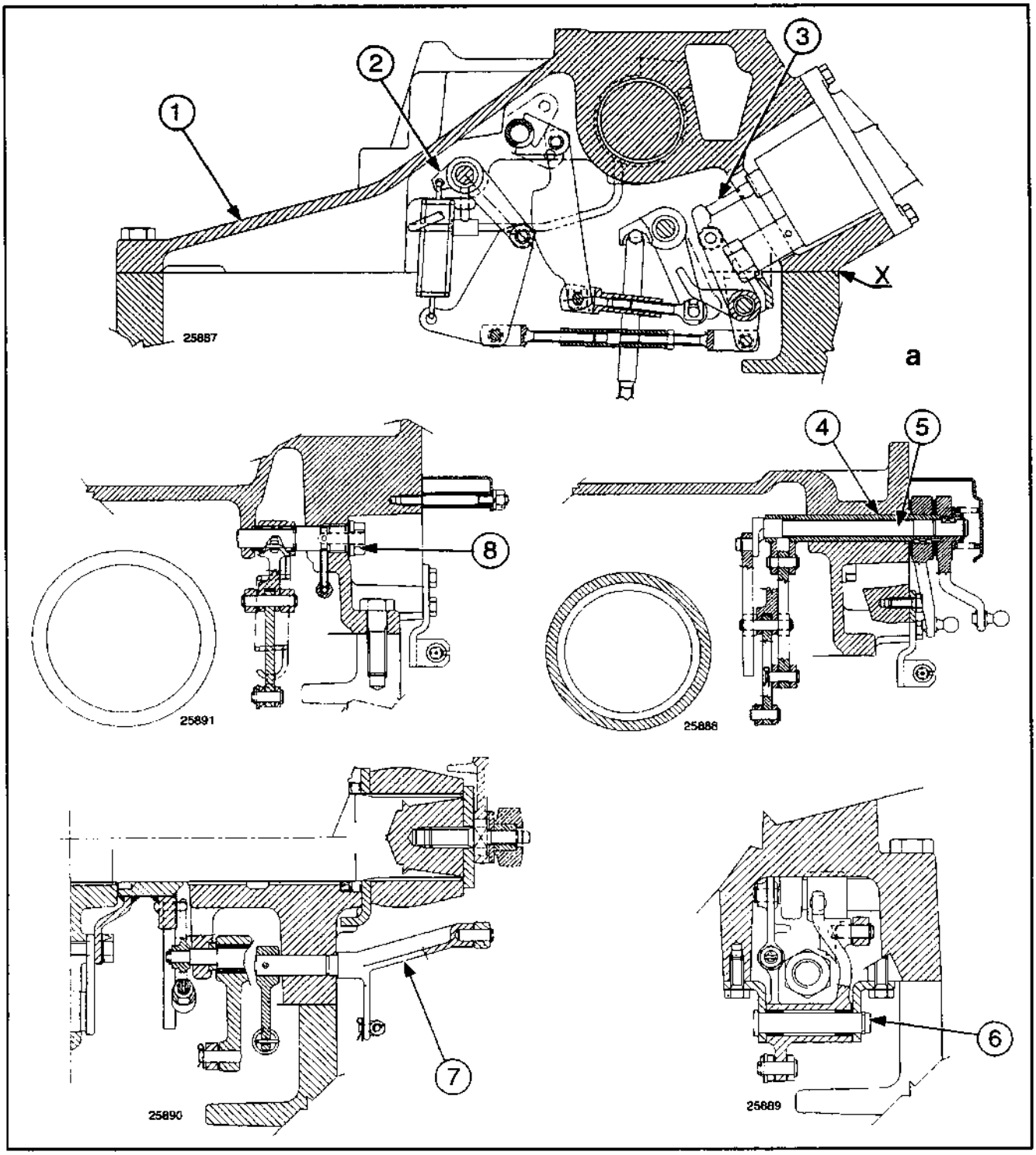


Figure 8-5-4

Lift Longitudinal and Sectional Views

a. Draft actuator armage cross section.
1. Lift casing.
2. Draft actuator armage.
3. Control spool.
4. Draft control shaft.
5. Position control shaft.
6. Control valve spool (3) lever pivot pin.
7. Lift–O–Matic external control lever.
8. Idler linkage pivot pin.

Note: During installation apply liquid gasket on surfaces marked with an **X** as detailed on page 8-5-20.

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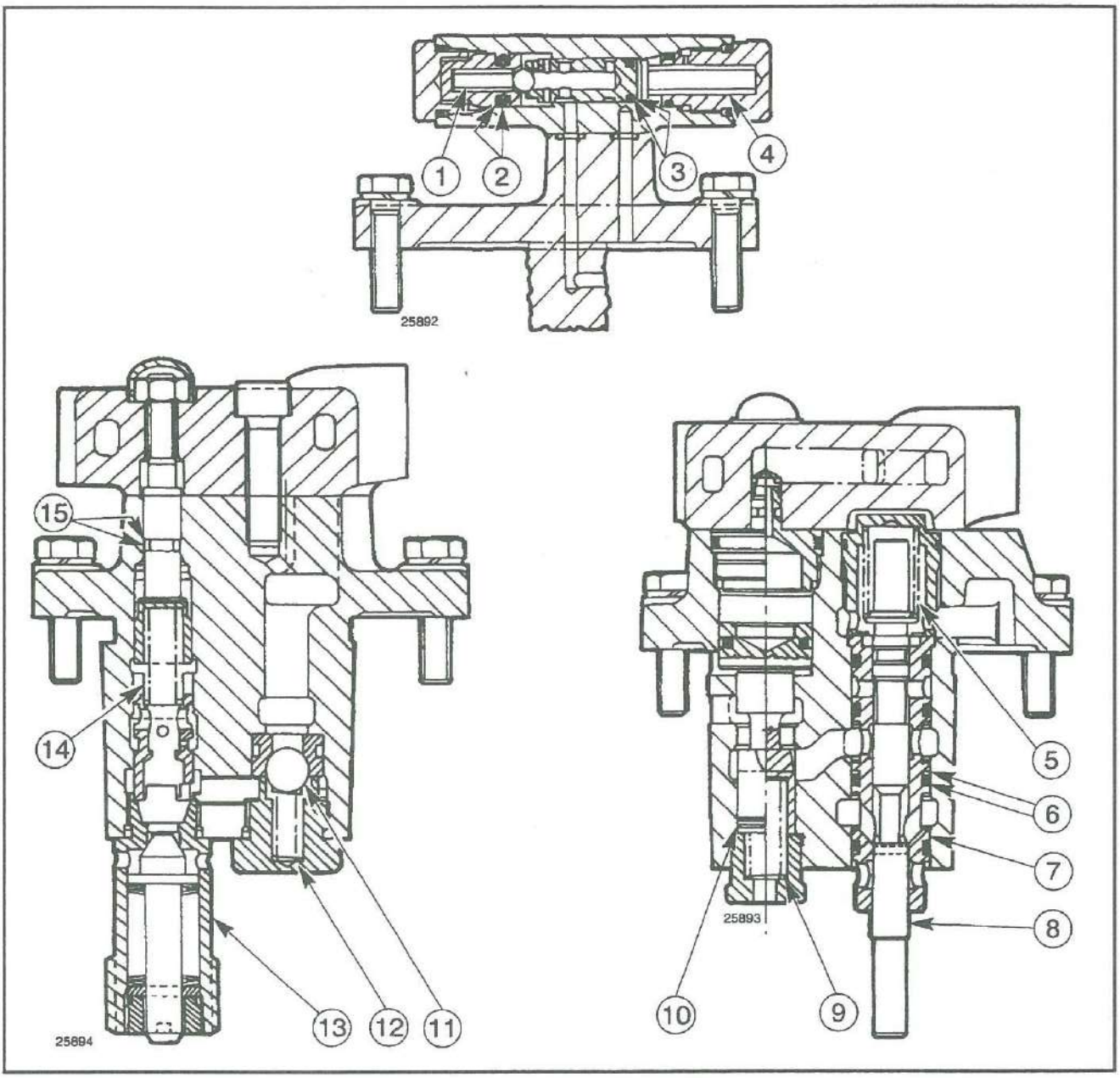


Figure 8-5-5

Lift Hydraulic Control Valve Sectional Views

1. Sensitivity valve spring.
2. Seal and ring.
3. Seal and ring.
4. Sensitivity valve spring.
5. Control spool return spring.
6. Seal and ring.
7. Control spool seat.
8. Control spool.
9. Pilot valve return spring.
10. Pilot valve.
11. Check valve ball.
12. Check valve return spring.
13. Cylinder safety valve.
14. Drop rate control valve spring.
15. Seal and ring.

NOTE - Upon assembly of seals 2, 3, 6 and 15, heat back–up rings in oil at a temperature of approximately 122°F (50°C).
Upon assembly of seal (15) and back–up ring, use guard tool no. **293865**.
Upon assembly of seal (6) and back–up rings, use guard tool no. **293984**. Seals (2 and 3) and back–up rings can be assembled without using guards. Only take due care not to damage them.

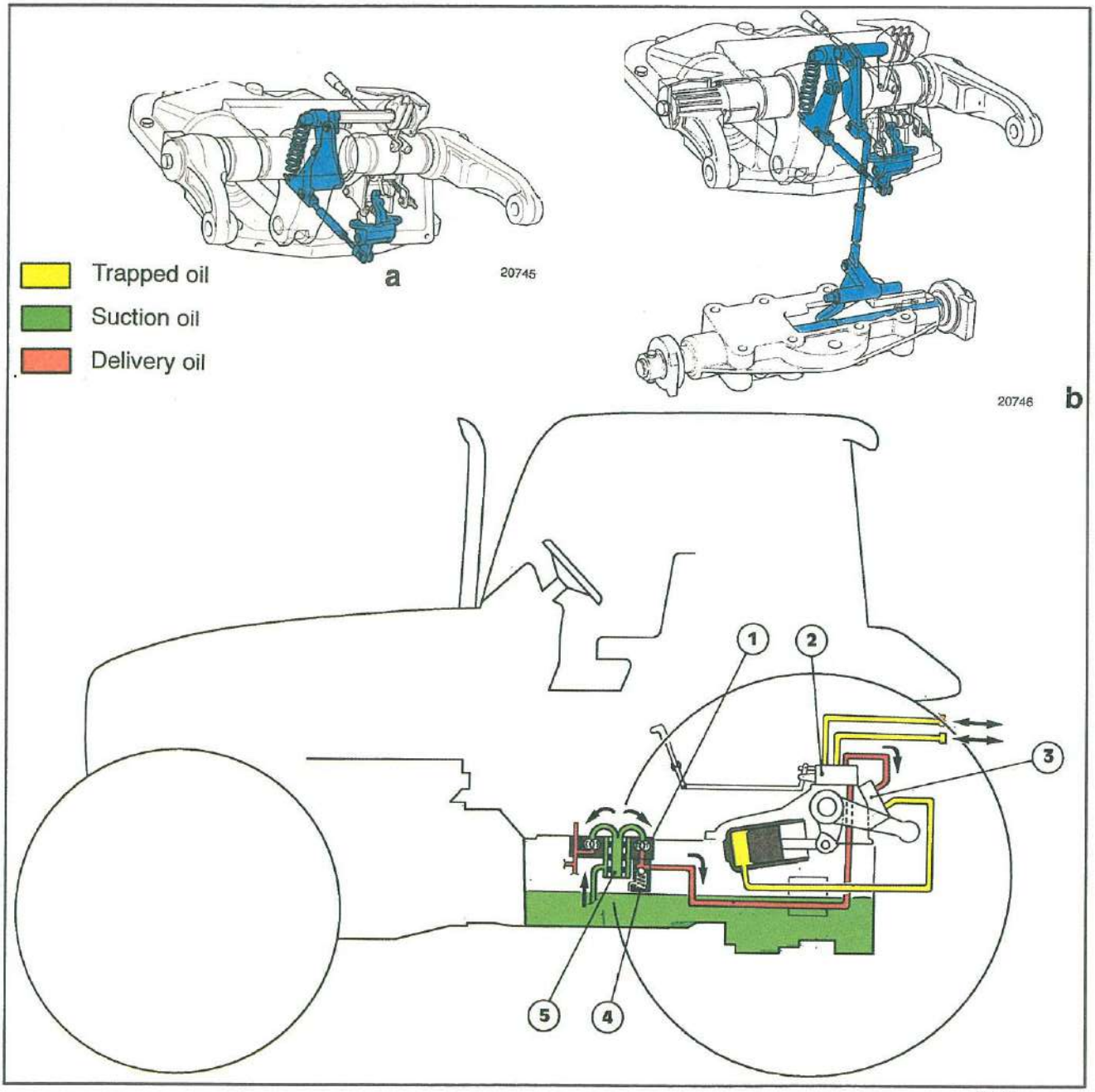
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DESCRIPTION AND OPERATION

The mechanical lift can be operated in either Position or Draft control, or in mixed position/draft control.
The lift is controlled through two dedicated levers located at the operator's right side. It is fitted with the Lift–O–Matic device for fast implement raise and lower without using the position and draft control levers.

Draft control is performed through the sensing bar located in a special case attached under the rear axle housing.
The lift lower links and linkage rods are connected to the sensing bar.



25859
Figure 8-5-6

HYDRAULIC LIFT CIRCUIT

a. Position actuator armage operation.
b. Draft actuator armage operation.
1. Hydraulic pump.
2. Remote control valve.
3. Hydraulic control valve.
4. Pressure regulating valve.
5. Filter.

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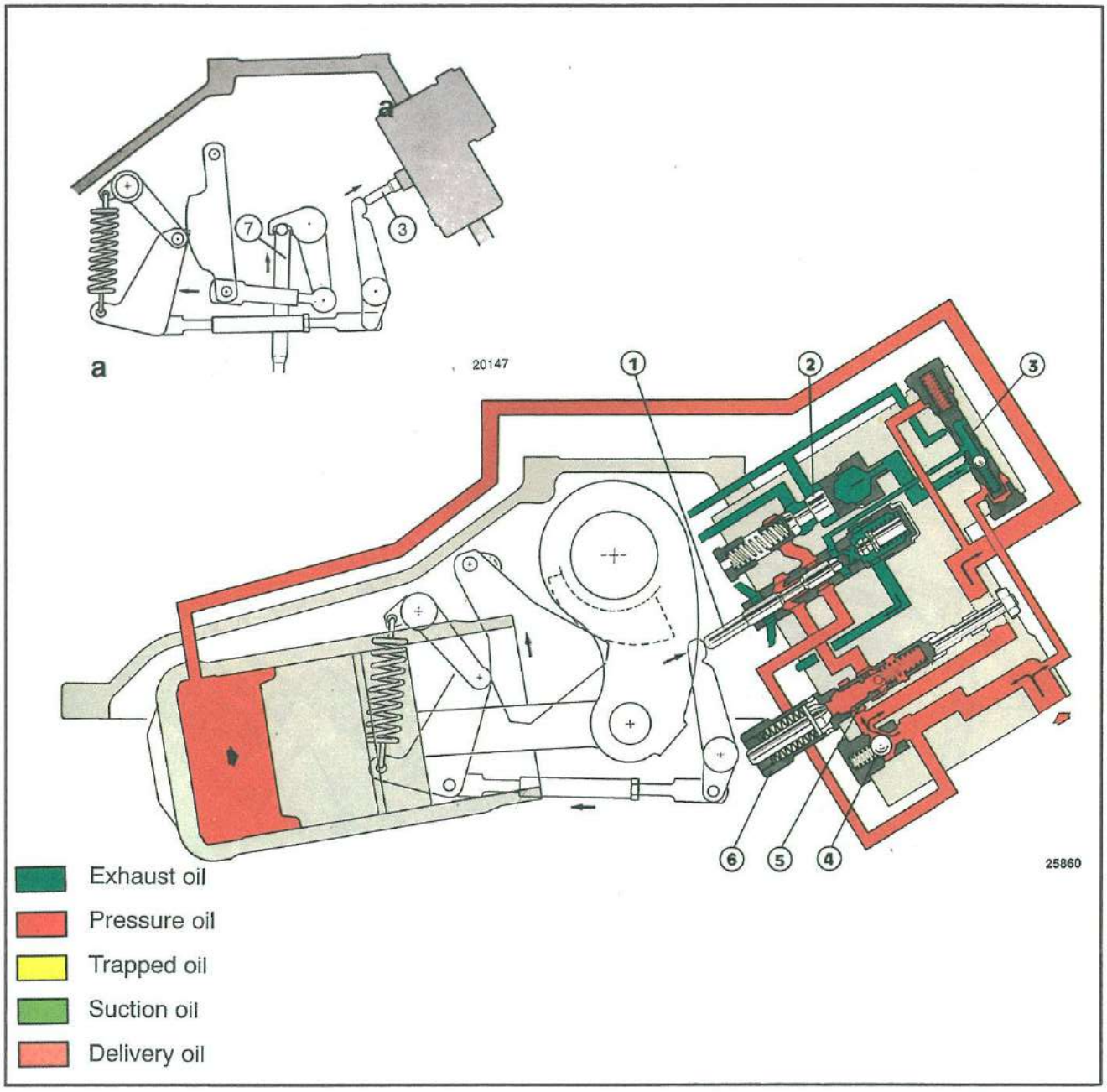


Figure 8-5-7

OIL FLOW IN RAISING

a. Draft control operation (detail).
1. Control spool.
2. Pilot valve.
3. Sensitivity valve.
4. Check valve.
5. Drop rate control valve.
6. Cylinder safety valve.

When lift arms are raised using the position control lever located at the operator's right side, internal links transfer motion to the control spool (1), as shown by the arrows. The control spool (1) moves and cuts off the oil flow to both the pilot valve (2), which moves under the action of the spring, and sensitivity valve (3).Pressure oil opens the check valve (4) and acts on the arm raising piston.

During draft control operation (detail a), raising is achieved through the sensing bar, which transfers motion to the control spool (1) through the linkage rod (7), as shown by the arrows.

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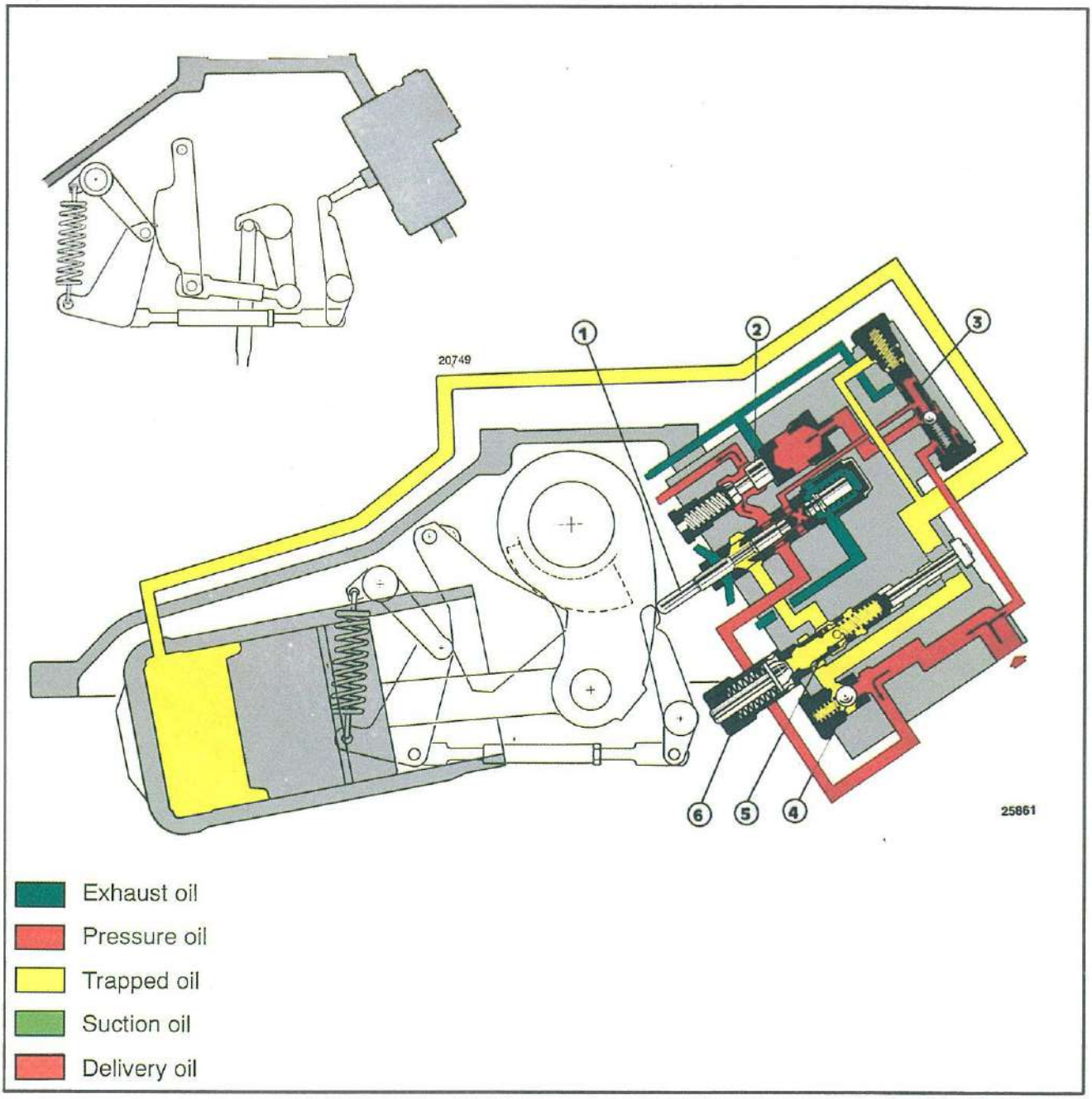


Figure 8-5-8

OIL FLOW IN NEUTRAL

1. Control spool.
2. Pilot valve.
3. Sensitivity valve.
4. Check valve.
5. Drop rate control valve.
6. Cylinder safety valve.

When the lift arms have reached the preset height, the inner linkage stops. With the control spool (1) in this position, oil flows through the sensitivity valve (3) on to the pilot valve (2) piston, which under the action of pressure oil overcomes the spring force, moves the valve and opens a discharge port directing oil into the axle housing instead of the lift cylinder.

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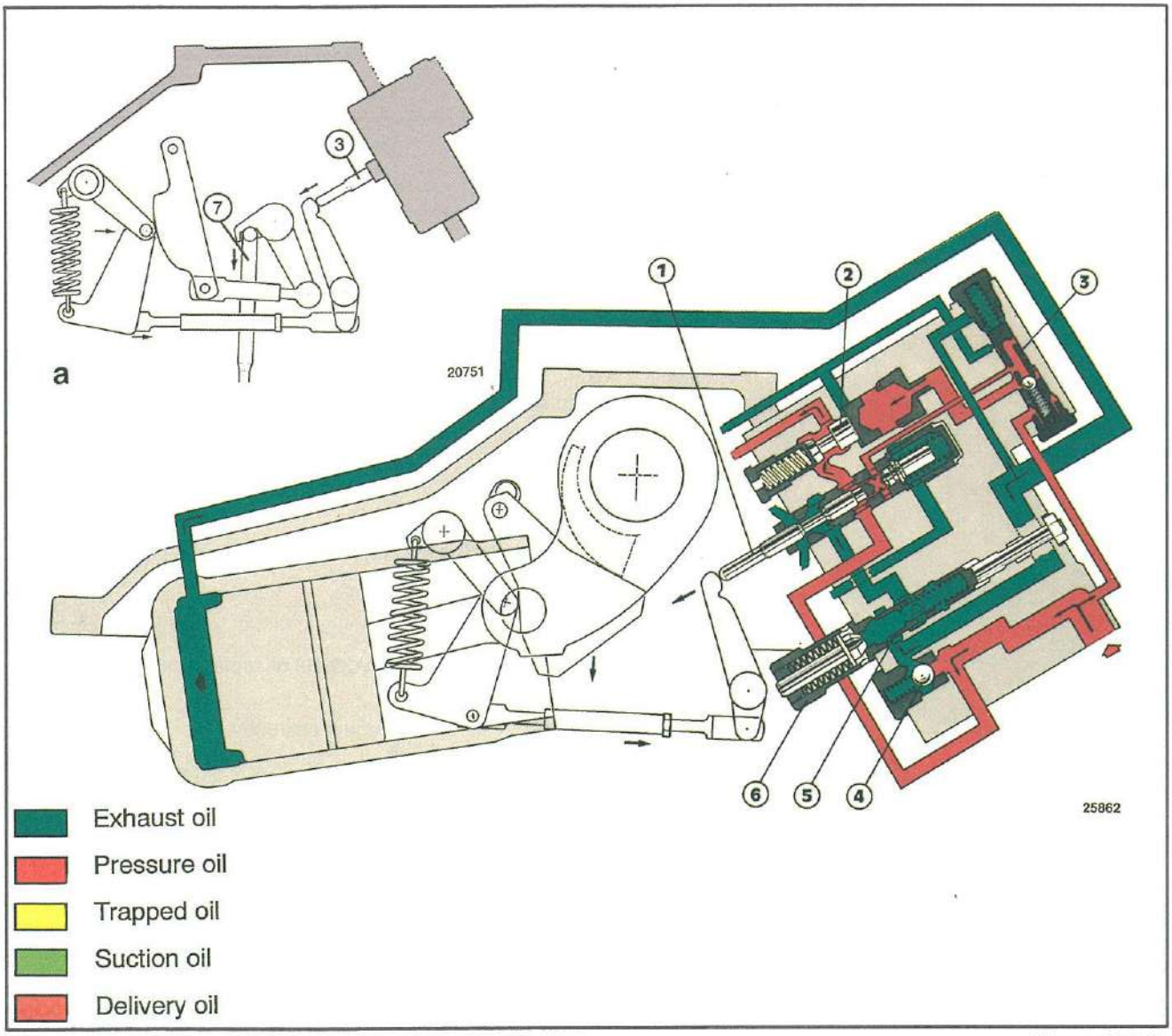


Figure 8-5-9

OIL FLOW IN LOWERING

a. Draft control operation (detail).
1. Control spool.
2. Pilot valve.
3. Sensitivity valve.
4. Check valve.
5. Drop rate control valve.
6. Cylinder safety valve.

When the position control lever, located at the operator's right side, is lowered, the lift arms lower. Internal links transfer motion to the control spool (1), as shown by the arrows, which moves downwards under the action of the spring. Oil in the cylinder is pushed out by the piston towards the discharge through the drop rate control valve and the hole left open by the control spool. Delivery oil, through the valve (5), acts on the pilot valve (2) piston, moves the valves against the force of the spring and opens a discharge port directing oil into the axle housing instead of the lift cylinder.

During draft control operation (detail a), lowering is achieved through the sensing bar which transfers motion to the control spool (1) through the linkage rod (7), as shown by the arrows.

Note: Drop rate of the implement connected to the lift arms depends on the position of the drop rate control valve (5). If the valve (5) adjust screw is unscrewed, the discharge hole between the drop rate valve and control valve housing is reduced and the implement takes a longer time to be lowered. If it is fully screwed in, the discharge hole is larger and the implement is lowered more quickly.

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TROUBLESHOOTING – HYDRAULIC LIFT

Problem	Possible Causes	Correction
Hydraulic lift not raising.	1. Clogged oil filter.	Replace filter.
	2. Pilot valve stuck in discharge.	Repair pilot valve.
	3. Faulty hydraulic pump.	Overhaul or replace pump.
Lift bounces when raising.	1. Clogged oil filter.	Replace filter.
	2. Air leaks on pump suction side	Check fittings and seals for air–tightness.
Lift raising too slowly.	1. Clogged oil filter.	Replace filter.
	2. Oil leaks through seals with consequent pressure drop: piston seals or cylinder inlet fitting.	Replace faulty sealing items.
	3. Faulty hydraulic pump.	Overhaul or replace pump.
Lift lowering too slowly.	1. Drop rate misadjusted.	Adjust correctly.
Lift lowering too quickly.	1. Drop rate misadjusted.	Adjust correctly.
Lift operation too fast.	1. Foreign particles between ball and ball seat on the flow control valve	Disassemble valve, remove foreign particles and inspect oil filter.
	2. Defective flow control valve ball sealing	Replace delivery control valve.
	3. Delivery control valve piston binding	Disassemble valve, remove causes for piston binding.
Lift operation too slow .	1. Blocked delivery control valve holes.	Disassemble valve, remove obstructions and inspect oil filter.
	2. Delivery control valve piston binding.	Disassemble valve, remove causes for piston binding.

(to be continued)

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(cont'd)

Problem	Possible Causes	Correction
Lift fails to keep load raised (with engine running, there is a continuous rhythmic height oscillation; with engine shut off, the load is lowered).	1. Faulty check valve sealing.	Disassemble, inspect, clean and replace interested parts, if necessary.
	2. Oil leaks through the control spool seat seals.	Replace seals.
	3. Poor control spool sealing.	Disassemble and check sealing. Replace control spool and seat, if faulty.
	4. Oil leaks through raise piston seals or cylinder inlet fitting seals.	Replace seals.
	5. Poor cylinder safety valve sealing or valve setting too low.	Replace valve.
Pressure regulating valve operating with lift arms fully raised.	1. Lift arm travel misadjusted.	Adjust correctly.
Poor lifting capacity.	1. Pressure regulating valve misadjusted.	Replace valve.
	2. Cylinder safety valve misadjusted.	Replace valve.
	3. Poor pump yield (generally, accompanied by a considerable increase in lifting time).	Overhaul or replace pump.

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REAR HYDRAULIC LIFT

Removal–Installation (Op. 35 110 30)

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.Ensure that units or parts are supported by suitable slings or hooks.Ensure that no–one is in the vicinity of the load to be lifted.

Remove the hydraulic lift from the rear axle housing as follows:

1. Open and raise engine hood.
2. Detach negative cable (1) from battery and insulate.
3. Remove the top link.

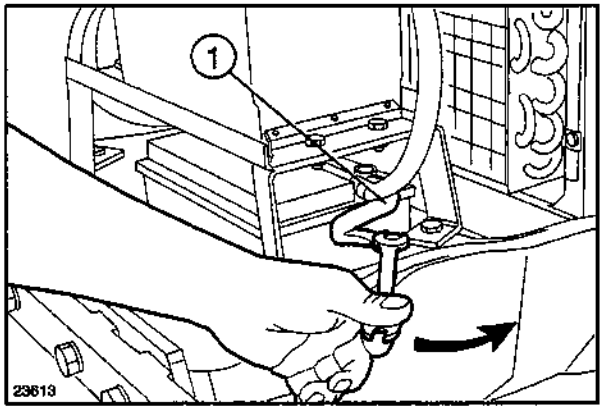


Figure 8-5-10

4. Loosen the retaining screw and remove the flow control adjuster knob (1).

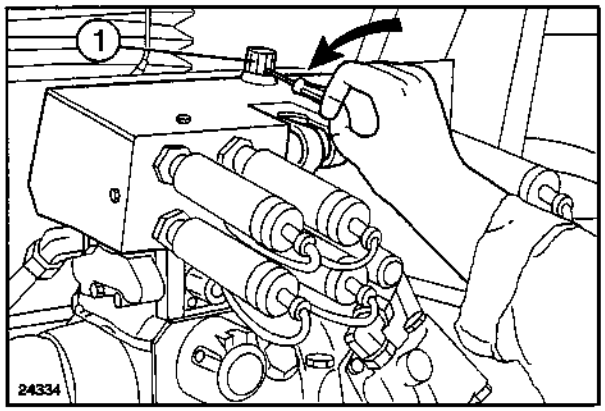


Figure 8-5-11

5. Loosen the retaining screws and retrieve the remote valve protection cover (1).

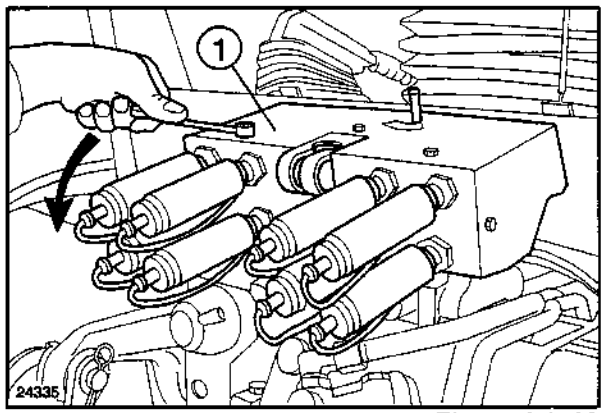


Figure 8-5-12

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6. Detach remote valve supply and exhaust lines (2 and 1).

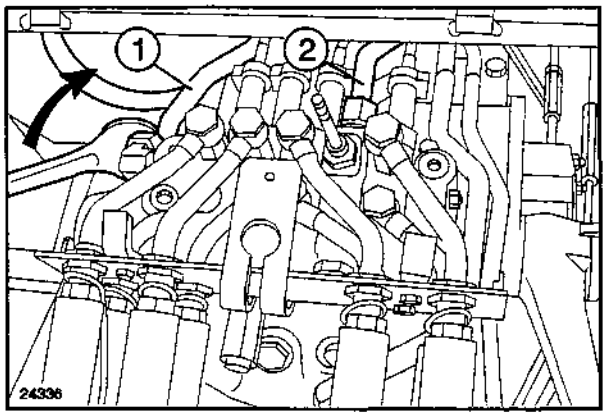


Figure 8-5-13

7. Slide out the cotter pins (1) and detach control cables from remote valves.

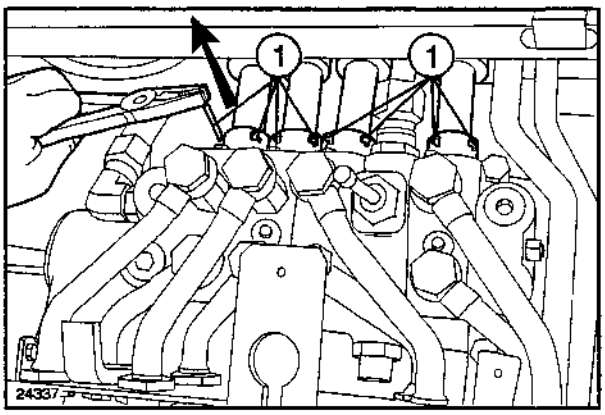


Figure 8-5-14

8. Loosen the retaining screws and remove the remote valve assembly.

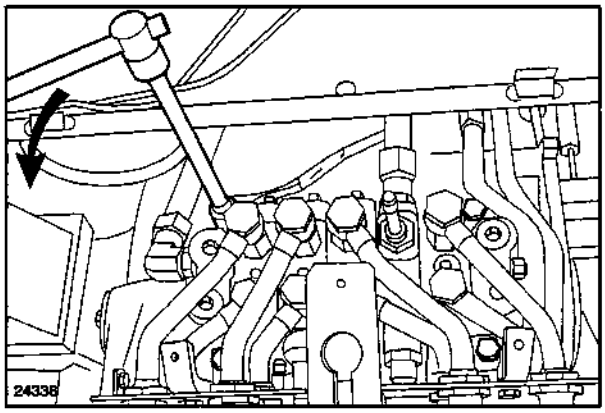


Figure 8-5-15

9. Slide out cotter pins (1), remove hinge pins (2) and detach lift rods (3) from lift arms.

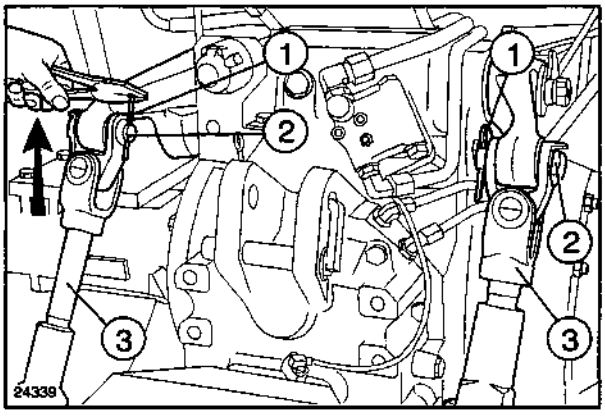


Figure 8-5-16

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10. Detach and remove the hydraulic control valve lines (1 and 2).

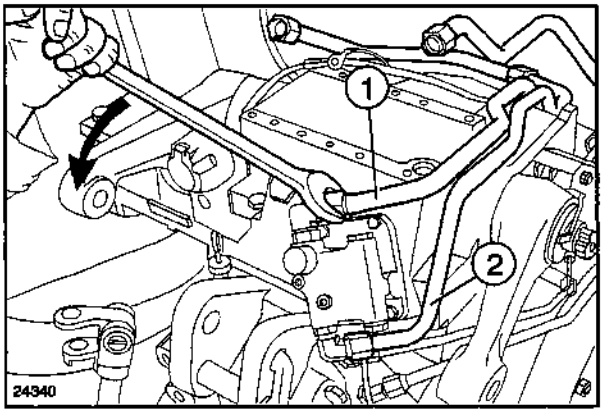


Figure 8-5-17

11. Disconnect the accessory socket (1) and detach it from the support bracket (2).

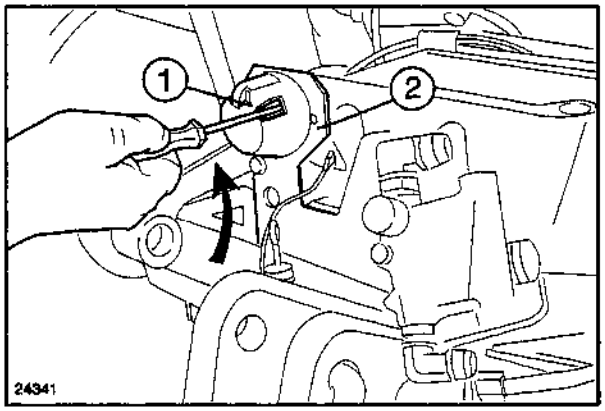


Figure 8-5-18

12. Detach the PTO speed sensor connector (1).

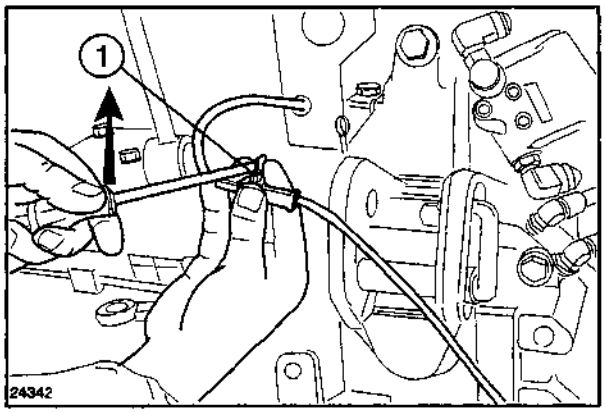


Figure 8-5-19

13. Detach the hydraulic lift control levers (2 and 4) and the Lift–O–Matic control cable (1). Detach the lift lubrication line (3).

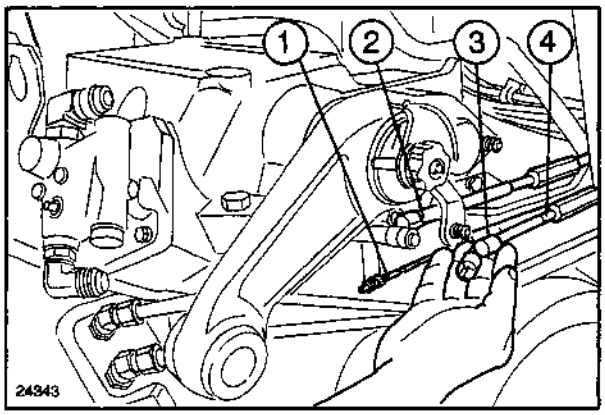


Figure 8-5-20

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14. Loosen retaining screws and lift out the control valve (1) from the lift casing.

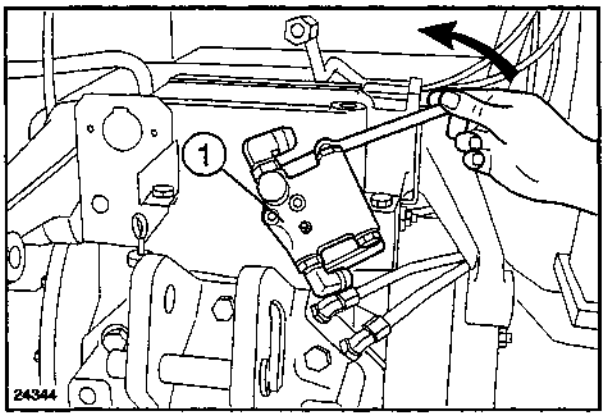


Figure 8-5-21

15. Loosen lift casing to rear axle housing attaching bolts.

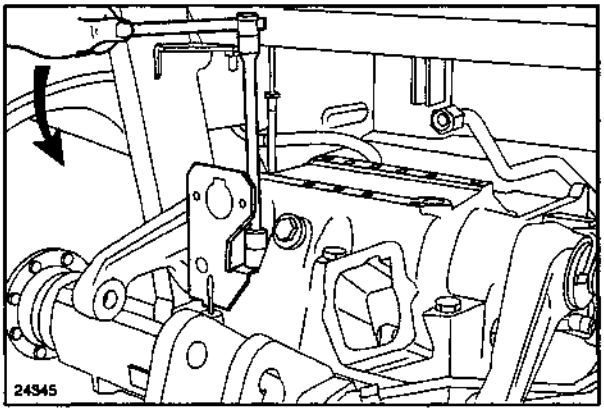


Figure 8-5-22

16. Fix tool no. **293983** (1) to the lift.

Note: When assembling the bracket tool no. **293983**, make sure that the mounting holes on the lift casing are not plugged. If so, remove cork plugs.

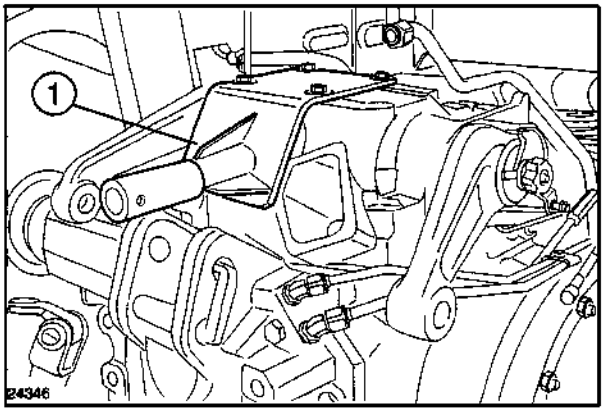


Figure 8-5-23

17. Assemble hook tool no. **291359** (1) on tool no. **293983** (2) and tighten the safety screw. Remove the hydraulic lift using a hoist.

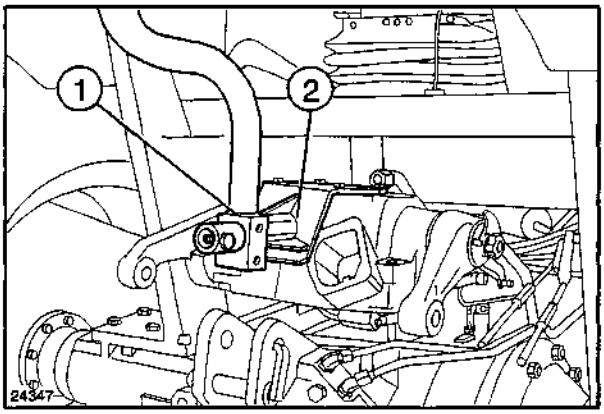


Figure 8-5-24

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18. Reinstall the hydraulic lift to the rear axle housing observing the following:

- Reinstallation follows the removal procedure in reverse. Thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant to the rear axle housing following the pattern shown in the side figure.
- Sealants to be used are listed on page 0-1-19, Section 00.
- Reinstall the control valve to the lift after applying a bead of sealant as shown in figure 8-5-82, page 8-5-39.
- Reassemble the cork plugs on the upper side of the lift casing, if removed to install the bracket tool no. **293983**.

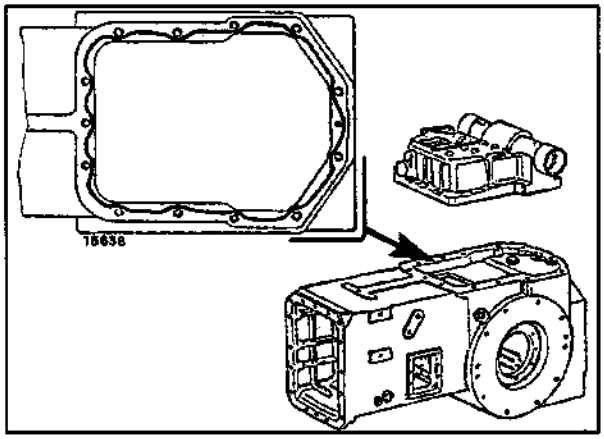


Figure 8-5-25

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REAR LIFT EXTERNAL CONTROLS
Disassembly–Assembly (Op. 35 110 17)

⚠ WARNING ⚠

Handle all components with the greatest care.Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

Lift external controls can be disassembled and reassembled with either the lift on a work bench or still in the tractor.
Proceed as follows:

1. Unscrew the three nuts attaching the guard (1) to the lift casing.

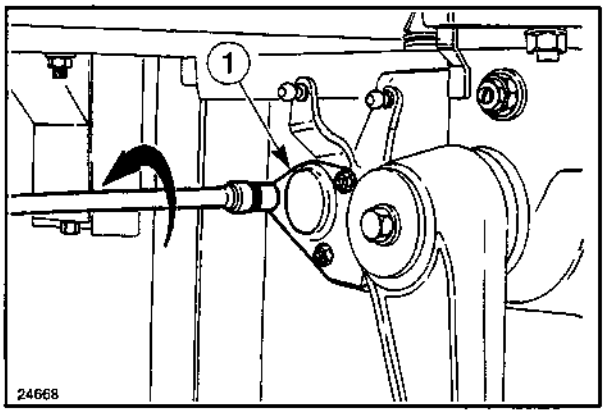


Figure 8-5-26

2. Retrieve guard and springs (2).

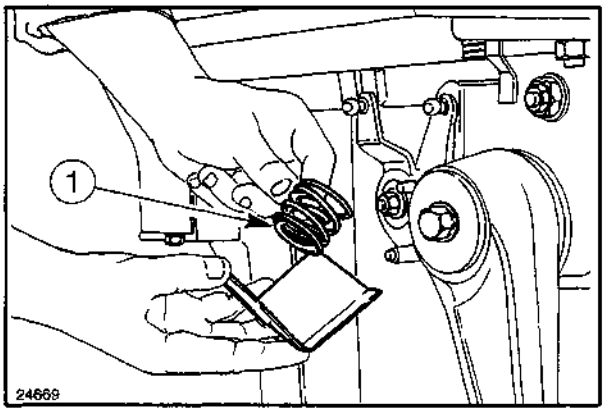


Figure 8-5-27

3. Unscrew the retaining nut and retrieve the position and draft external control levers (1 and 2, respectively) along with friction pads.
4. Reassemble the lift external controls following the disassemble procedure in reverse.

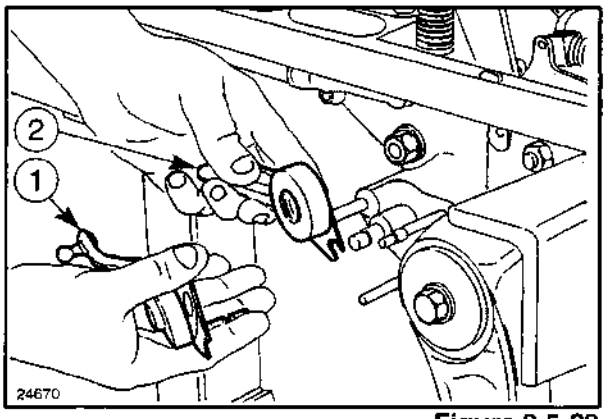


Figure 8-5-28

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REAR LIFT INTERNAL CONTROLS
Disassembly–Reassembly (Op. 35 110 40)

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Proceed as follows:

1. Fix the lift on a rotary stand paying attention to position stand brackets so as to let the last lift to rear axle mounting hole (control valve side) free, as in this hole will be later installed tool no. **293980**.
2. Remove the four retaining screws and disassemble cylinder (1) and piston.

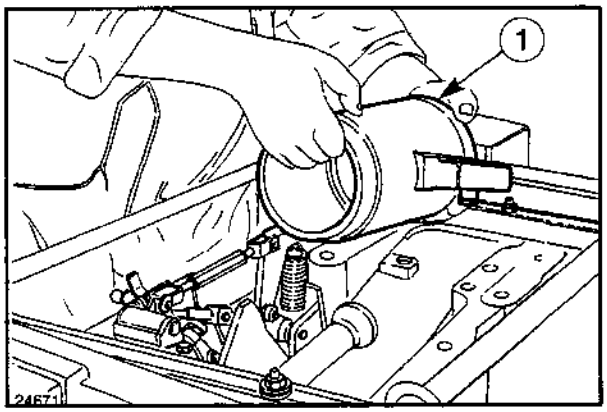


Figure 8-5-29

3. Disassemble lubrication line (1).

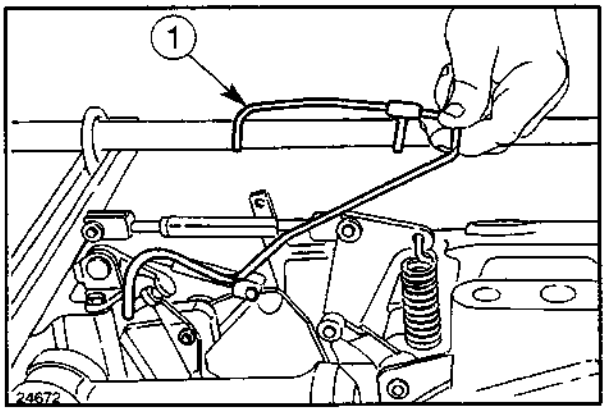


Figure 8-5-30

4. Disassemble the position and draft control internal control levers (2 and 1, respectively) along with the drive shafts.

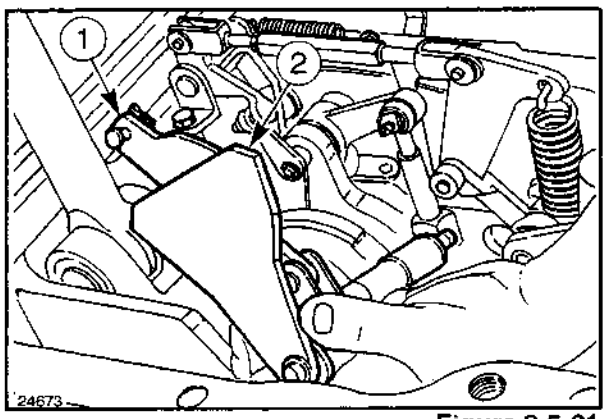


Figure 8-5-31

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5. Loosen the retaining pin (1), disassemble the control valve actuator arm along with lever and spring. Retrieve the thrust washer (2).

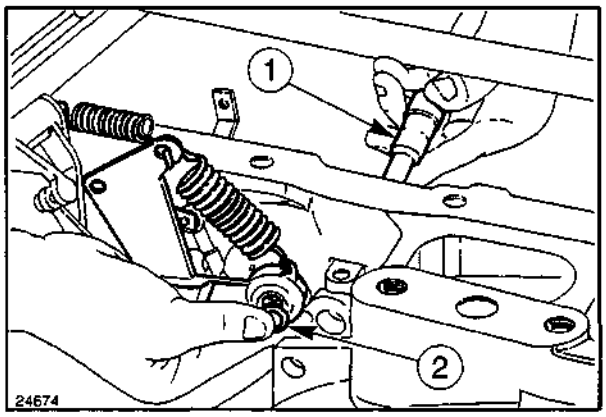


Figure 8-5-32

6. Remove the two retaining screws and disassemble the control valve lever along with the threaded rod (1).

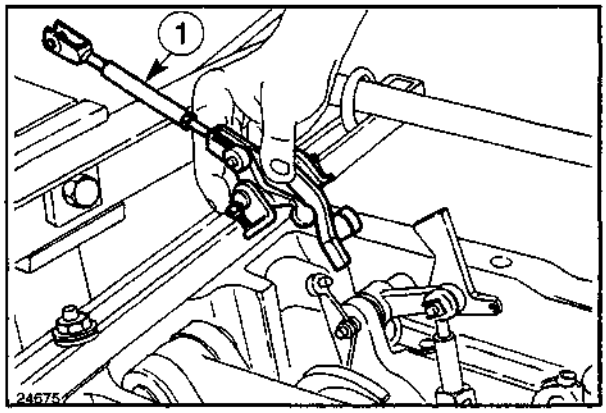


Figure 8-5-33

7. Remove the retaining pin (1) and disassemble the draft control inner lever. Retrieve the thrust washer (2) and the pin retaining ring.

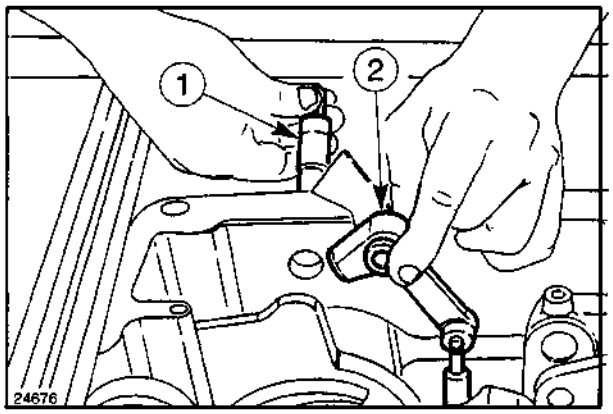


Figure 8-5-34

8. Using punch tool no. **293838** (1), replace the roller bearings on the draft actuator arm.

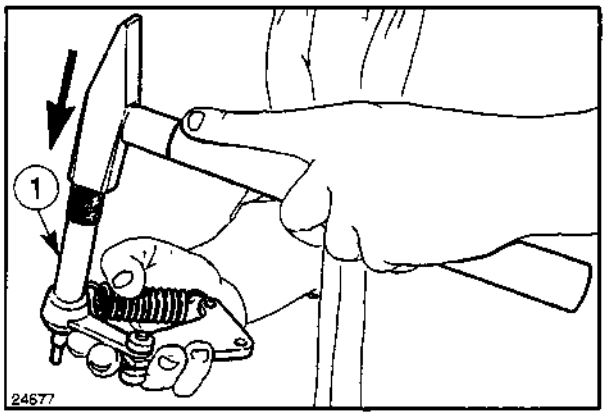


Figure 8-5-35

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9. Using punch tool no. **293838** (1), replace the roller bearings on the draft control internal lever.

10. Using punch tool no. **293839**, replace control valve lever bearings.

11. Reassemble lift levers following the disassembly procedure in reverse. Perform adjustments described in the following pages.

NOTE: Adjustments should be performed in the sequence they are described.

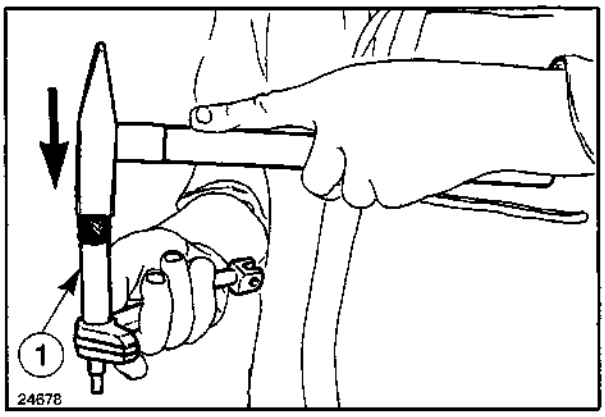


Figure 8-5-36

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Position Control Adjustment

Proceed as follows:

12. Fix tool no. **293980** (1) on a surface plate and screw in or out the end of the rod (3) until the rod upper end is perfectly flat with the tool. Lock the nut (2).

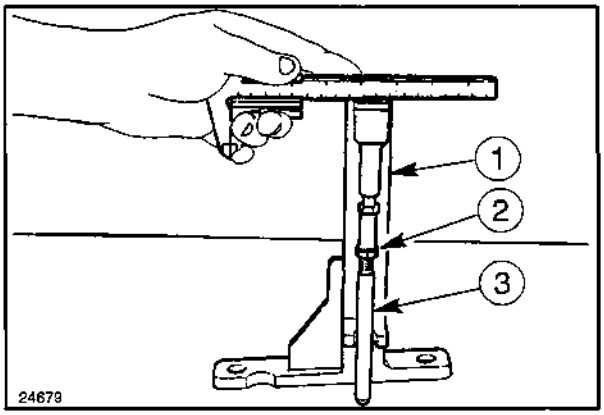


Figure 8-5-37

13. Connect the LIFT–O–MATIC lever to tool no. **293980** (1) using the special pin.

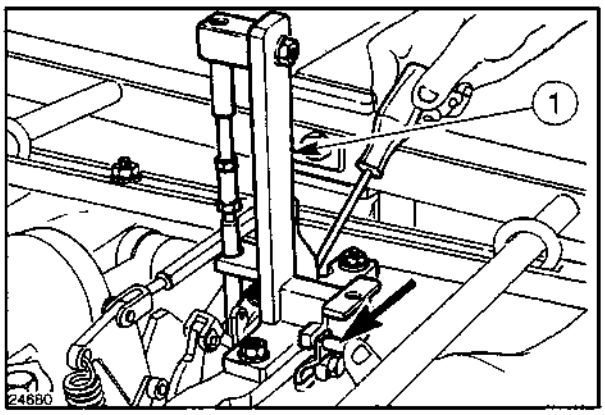


Figure 8-5-38

14. Move the position control external lever (1) fully forward, to touch the quadrant stop.

15. Ensure the inner link is in contact with the lift casing.

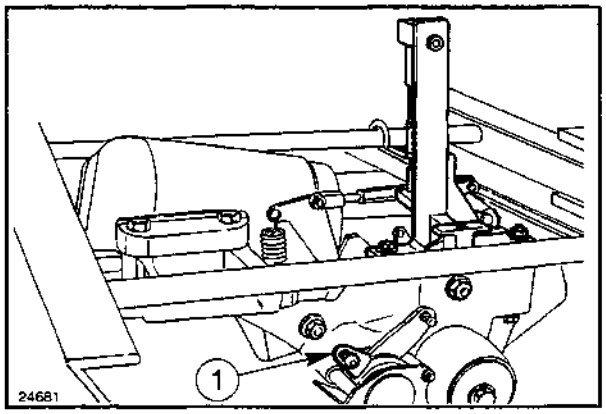


Figure 8-5-39

16. Using a wrench tool no. **293978** (2), unscrew the adjust screw (1) until the screw is no longer touching the lift control levers.

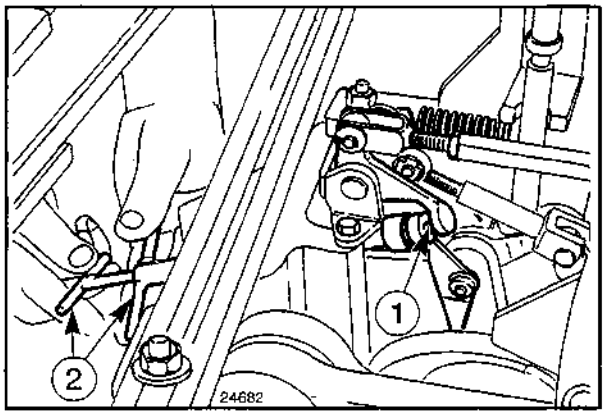


Figure 8-5-40

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17. Assemble tool no. **293979** (1) in place of the control valve and check that the tool end rests on the control valve lever.

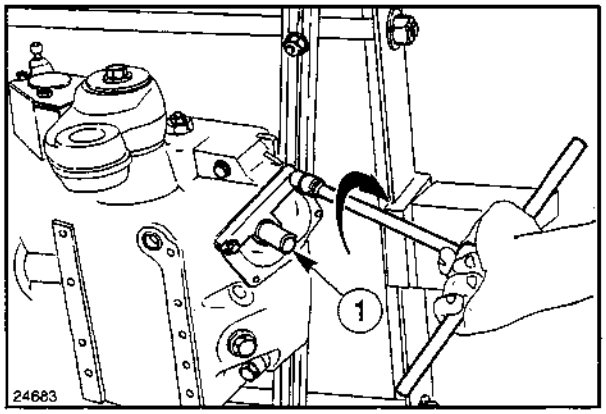


Figure 8-5-41

18. Using two wrenches, undo the locknut (1) and screw in or out the threaded rod.

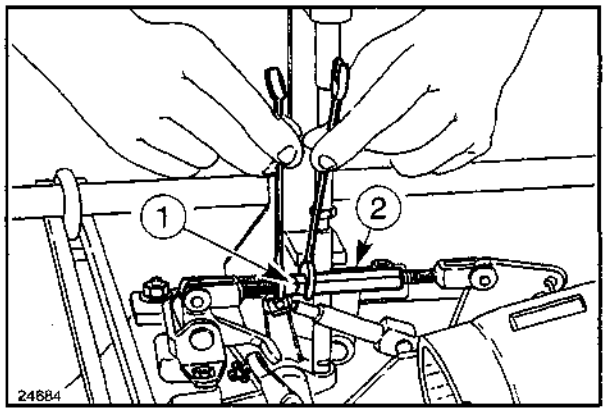


Figure 8-5-42

19. Check that the mobile tip (1) is exactly aligned with the outer reference plane of the tool (2), as shown in the figure. If not, adjust through the threaded rod (2, Figure 8-5-42).

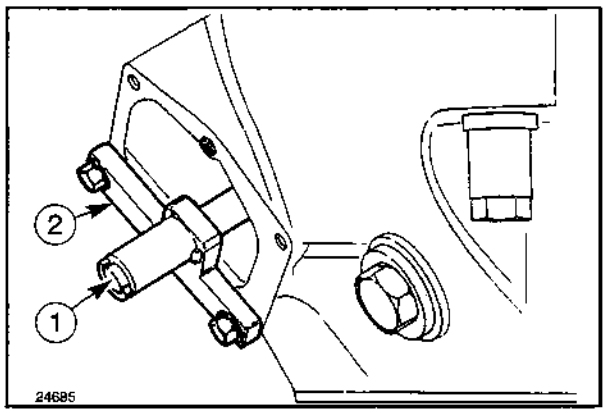


Figure 8-5-43

20. Tighten the threaded rod (2) locknut (1).

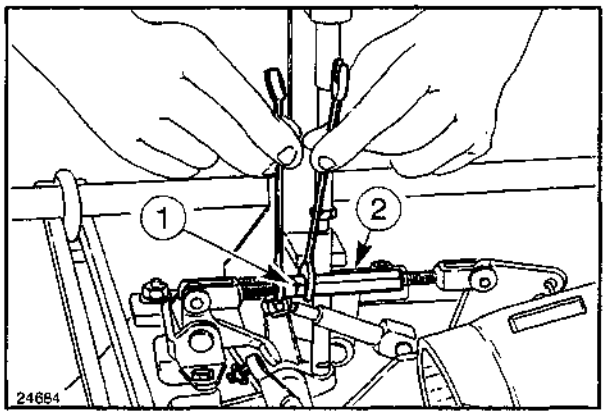


Figure 8-5-44

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21. Move the position control external lever (1) fully backward to touch the quadrant stop and turn the cross shaft as to bring the piston to end of forward stroke.

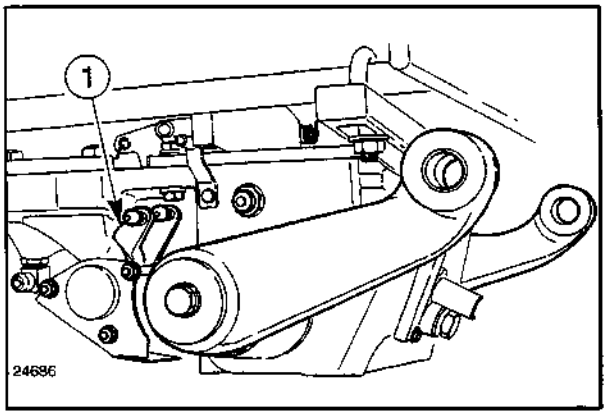


Figure 8-5-45

22. Check that the mobile tip (1) is either level or further recessed with respect to the inner reference plane of the tool (2).

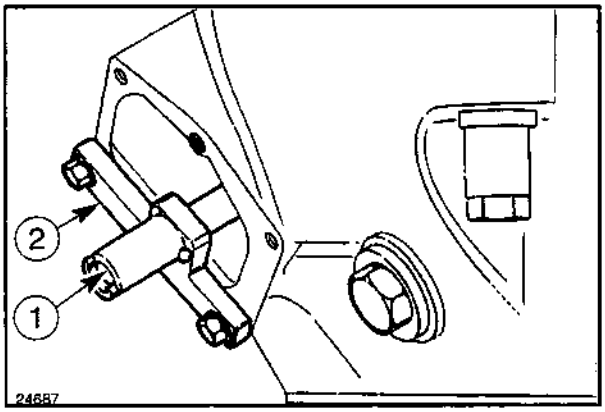


Figure 8-5-46

Draft Control Adjustment

Proceed as follows:

23. Move the position and draft control external levers (2 and 1, respectively) fully backward, to touch the quadrant stop.

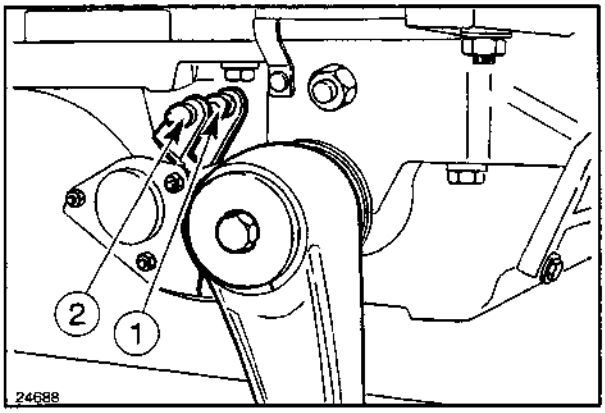


Figure 8-5-47

24. Disassemble the eccentric pin (1, Figure 8-5-34) retaining the draft control internal lever. Insert tool no. **293981** (1) in the pin hole.

Note: Using a lever as shown in the figure, unload the control valve rod spring to assist eccentric pin removal and subsequent installation of service pin (1).

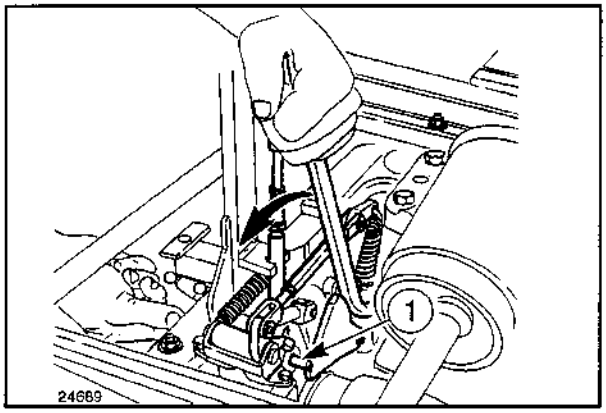


Figure 8-5-48

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25. Tighten the screw (2) of tool no. **293980** (1).

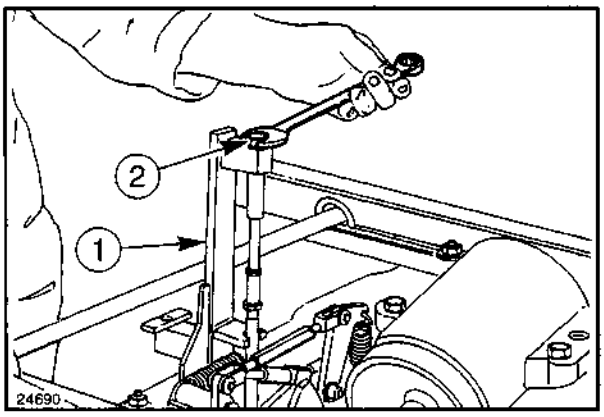


Figure 8-5-49

26. Turn in or out the threaded rod (1) after removing the stop pin and sliding out the retaining pin at the draft control internal lever.

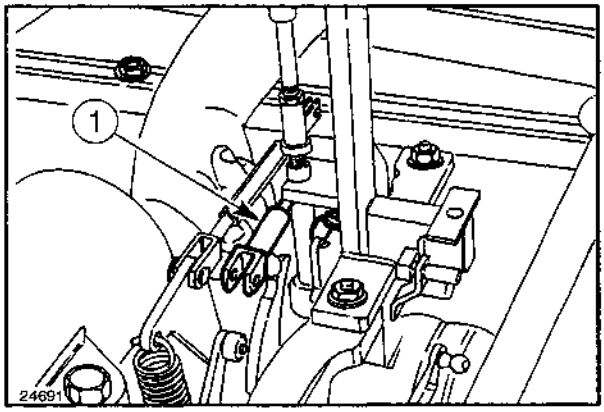


Figure 8-5-50

27. Check that the mobile tip (1) is approximately level with the external reference plane of tool no. **293979** (2), as shown in the figure.

Note : One turn of the threaded rod corresponds to moving the tool pin (1) by approximately 3 mm.

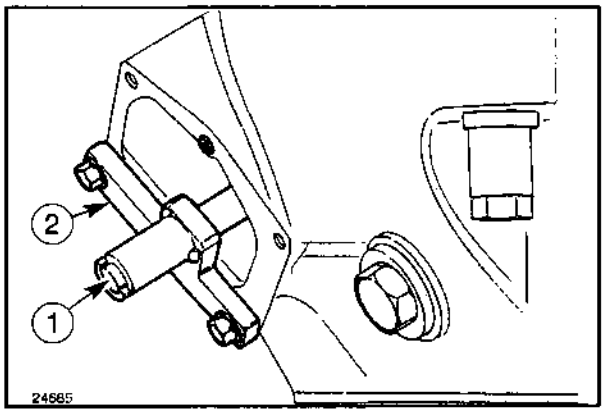


Figure 8-5-51

28. Disassemble pin tool no. **293981** (1, Figure 8-5-48) and reassemble the eccentric pin (1, Figure 8-5-34) taking care that the pin cam is turned towards the front of the tractor. Tighten the retaining ring nut to the lift casing.

29. Turn the eccentric pin until the tip (1) is exactly aligned with the outer reference plane of tool no. **293979** (2).

30. Tighten the eccentric pin locknut.

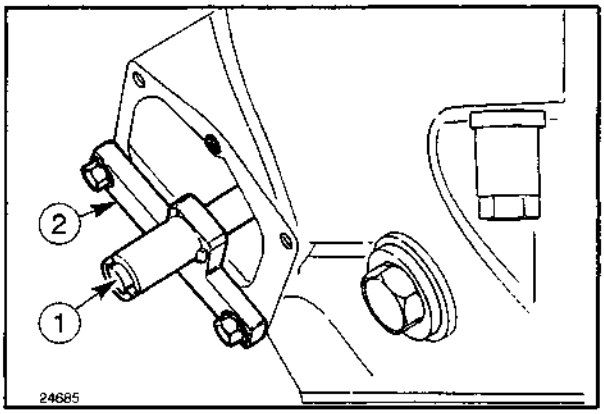


Figure 8-5-52

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Max Lift Height Adjustment

Proceed as follows:

31. Move the position control external lever (1) fully forward, to touch the quadrant stop.

32. Ensure that the inner link is touching the lift casing.

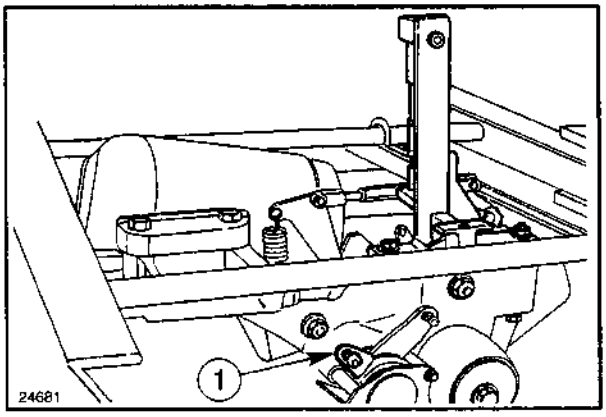


Figure 8-5-53

33. Using a wrench tool no. **293978** (2), screw in the adjust screw (1).

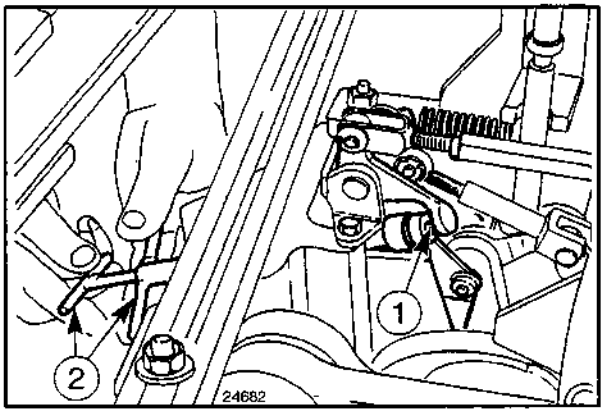


Figure 8-5-54

34. Check that the mobile tip (1) is exactly aligned with the inner reference plane of tool no. **293979** (2), as shown in the figure.

35. Reinstall the lift assembly into the tractor observing the following:

- Reinstallation follows the removal procedure in reverse, from step 18, page 8-5-20, back to step 1.
- Tighten to correct torque as detailed on page 8-5-4.
- Adjust mounting position of the draft control rod as detailed in the following pages.
  Once adjusted, the draft control rod should protrude from the axle housing upper side by 1.240 ± 0.004 in (31.5 ± 0.1 mm).

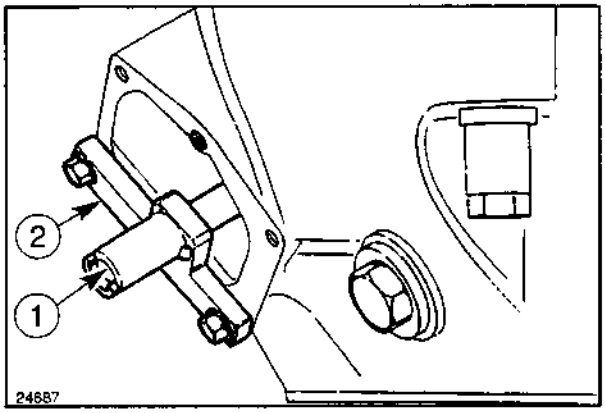


Figure 8-5-55

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Draft Control Rod Mounting Position Adjustment

Proceed as follows:

36. Place tool no. **293980** (1) on a surface plate and using a depth gauge measure the distance (H1) from the tool base on the surface plate to the depth gauge base on the tool. Stamp reading (H1) on the tool

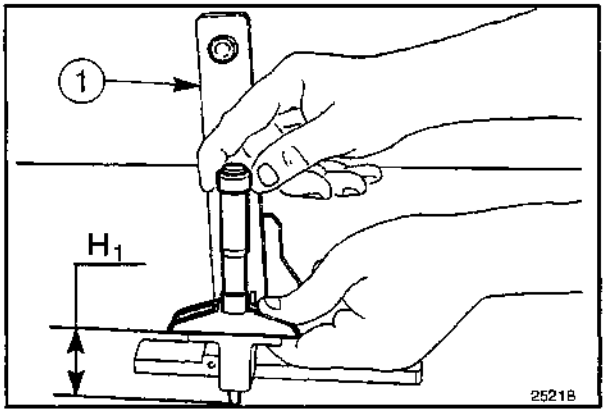


Figure 8-5-56

37. Attach tool no. **293980** (1) to two holes of the axle housing. The draft control rod (2) should enter exactly into the tool hole.

38. Using a depth gauge, read distance (H_2) from the rod (2) upper end and the depth gauge base on the tool.

39. Dimension (H_2) is given by:

$$H_2 = H_1 - 1.240 \text{ in } (31,5 \text{ mm})$$

where:
H_1 =reading on tool no. **293980** when assembled on the surface plate.
1.240 in (31,5 mm) = operating protrusion of the draft control rod from the axle housing upper side.

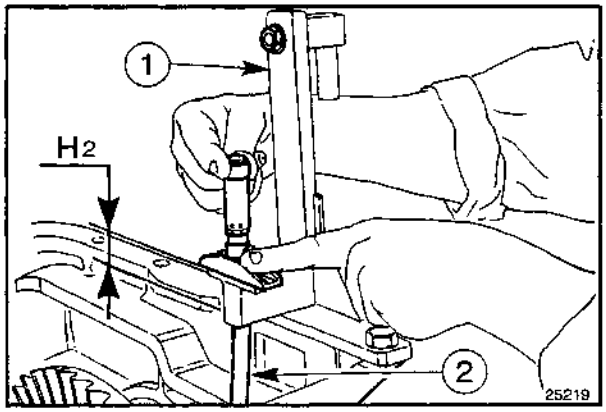


Figure 8-5-57

40. If this is not the case, turn the threaded rod of the draft control rod in to increase dimension (H_2) or out to decrease.

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LINKAGE ADJUSTMENT (Op. 35 110 08)

Position Control Rod Adjustment

Proceed as follows:

1. Move the position control lever (1) to end of travel on the quadrant. Check that distance (L) is 0.591 to 0.787 in (15 to 20 mm).

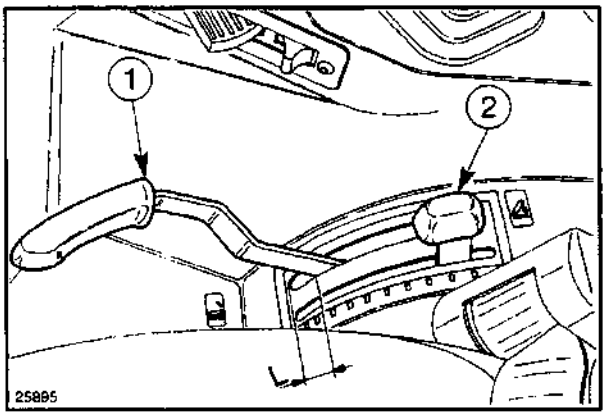


Figure 8-5-58

2. Move the position control external lever (2) fully forward to touch the quadrant stop.
3. Connect the control rod (1) and adjust rod length, if necessary.
4. Lock rod (1) using the locknuts.

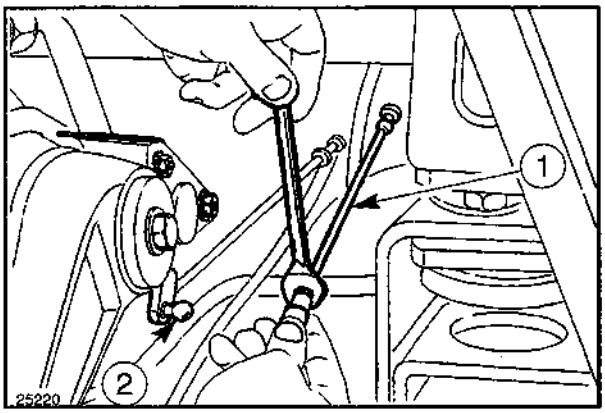


Figure 8-5-59

Draft Control Rod Adjustment

Test conditions:

- Apply a load of 3590 to 4740 ft. lbs. (1630 to 2150 kg) to the lower links ball ends
- Run the engine at medium speed
- Oil temperature of 86 to 104°F (30° to 40° C).

Proceed as follows:

5. Move the position control lever (1) fully forward on the quadrant and the draft control lever (2) at a distance (L1) of 0.591 to 0.787 in (15 to 20 mm) from beginning of the slot.

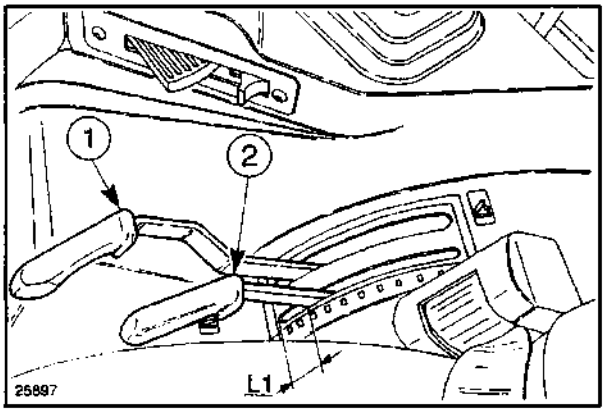


Figure 8-5-60

6. Move the draft control external lever (1) fully backward to touch the quadrant stop.
7. Connect the control rod and adjust rod length, if necessary.

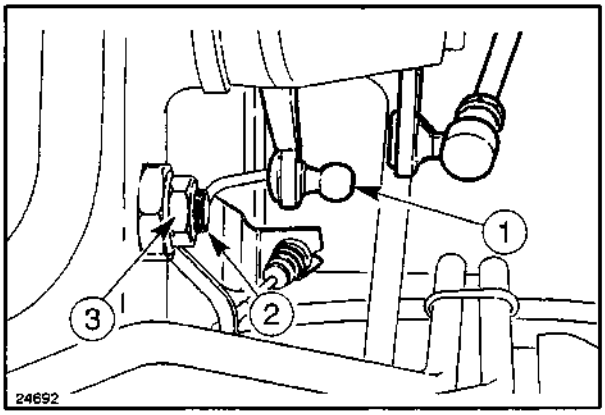


Figure 8-5-61

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8. Move the draft control lever (2) to a distance (L2) of 3.937 to 4.134 in (100 to 105 mm) (or 2/3 of the quadrant travel) from beginning of the slot. Check that in this position the arms start raising.
9. If not, act on the eccentric pin (2, Figure 8-5-61) to reset correct distance.
10. Lock the eccentric pin using the locknut (3, Figure 8-5-61).

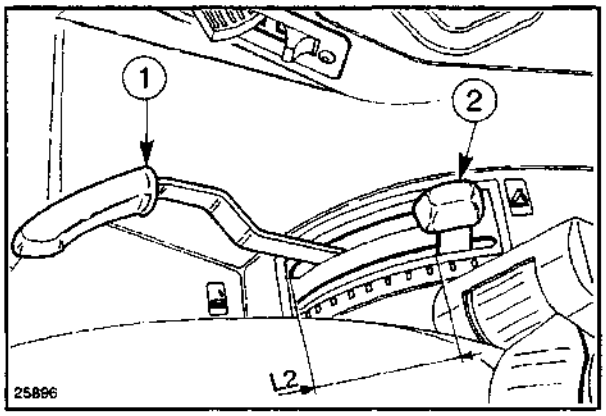


Figure 8-5-62

LIFT–O–MATIC Adjustment

Proceed as follows:

11. Move the draft and position control levers (1 and 2, respectively) fully forward on the quadrant.
12. Raise the arms using the lever (4).

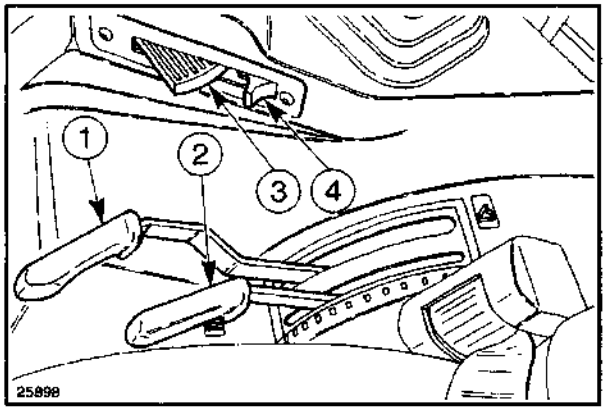


Figure 8-5-63

13. Screw in the nut (1) until lowering the arms.
14. With the lever (4, Figure 8-5-63) still in the same position, loosen the nut (1) until arms start raising.
15. Loosen the nut (1) by a further 1 ⅛ turns.
16. Using levers (3 and 4, Figure 8-5-63), lower and raise arms several times to test LIFT–O–MATIC correct operation.

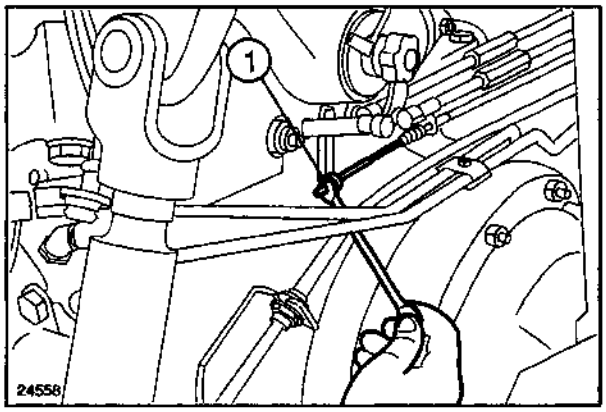


Figure 8-5-64

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LIFT–O–MATIC Height Limit Adjustment

1. Move levers (3 and 4) fully backward until touching the quadrant stop (lift arms fully lowered).

2. Move the mobile sector (2) counterclockwise until it contacts the lift arm. Lock with the knob (1).

Note: This adjustment is done to disable the LIFT–O–MATIC height limit.

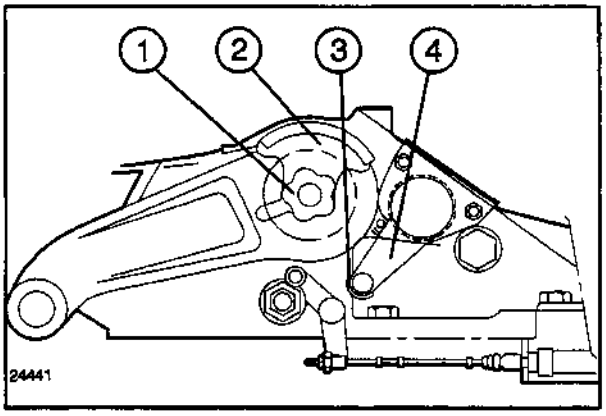


Figure 8-5-65

OPERATIONS TO BE CARRIED OUT TO ADJUST THE LIFT–O–MATIC HEIGHT LIMIT

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

1. Apply a load to the lower link ball ends.

2. Start the engine and run at medium speed

3. Press the button (1) until hitch–on position (arms fully lowered).

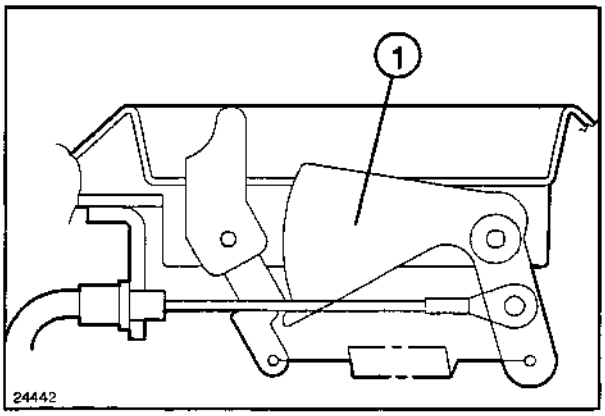


Figure 8-5-66

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4. Move levers (1 and 2) fully forward on the quadrant (arms fully lowered).

5. Using the position control lever (1), raise arms to the desired height.

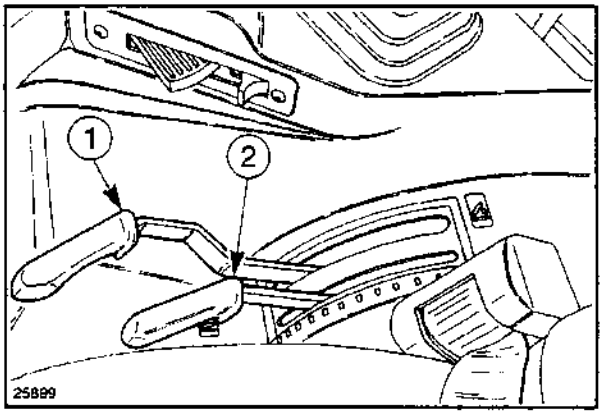


Figure 8-5-67

6. Release the knob (2) and move the mobile sector (3) clockwise until it contacts the roller (1) on the LIFT–O–MATIC control lever (4).

Note: Arm raise height limit acts only on the LIFT–O–MATIC device and leaves the other functions of the lift unchanged. Consequently, it is possible to perform full arm raising using the control levers (1 and 2, Figure 8-5-67).

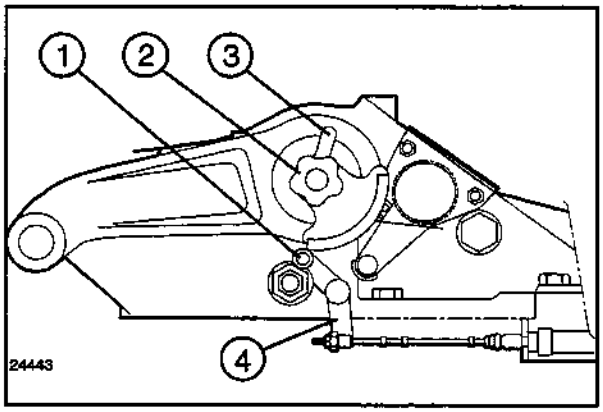


Figure 8-5-68

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LIFTING CYLINDER AND CROSS SHAFT DISASSEMBLY–REASSEMBLY(Op. 35 110 42)

Proceed as follows:

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

1. Fix the lift on a rotary stand.

2. Remove the four retaining screws and disassemble cylinder (1) and piston.

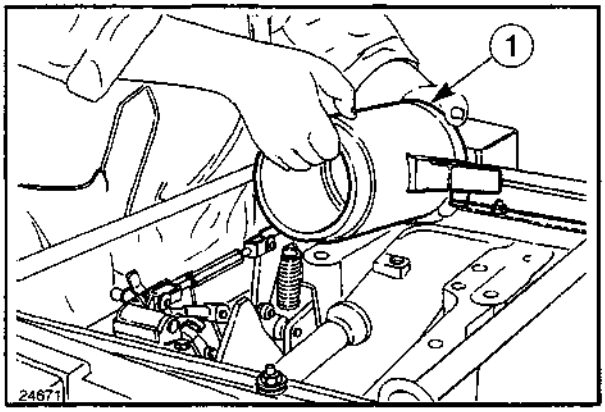


Figure 8-5-69

3. Disassemble lift arms (1). Before disassembly, ensure that there are reference marks on both the lift arms and cross shaft. If not, trace marks as shown.

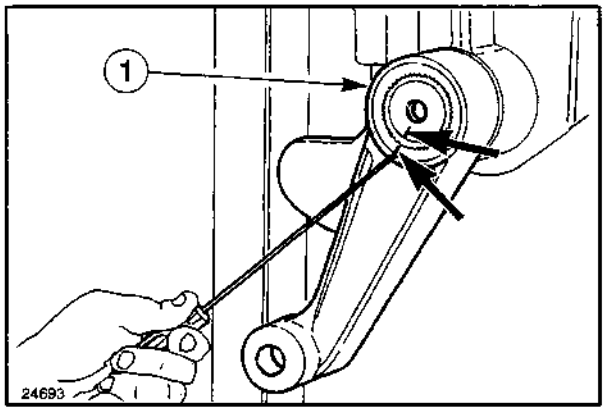


Figure 8-5-70

4. Disassemble the cross shaft (1) and retrieve inner arm (2) from inside the lift casing. Before disassembly, ensure that there are reference marks on both inner arm and cross shaft. If not, trace marks as shown.

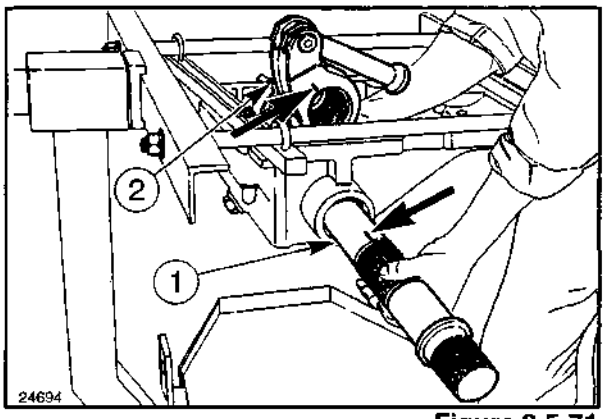


Figure 8-5-71

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5. Check cross shaft seals for wear. Remove if unserviceable.

6. Blow compressed air into the inlet hole and remove piston from the cylinder.

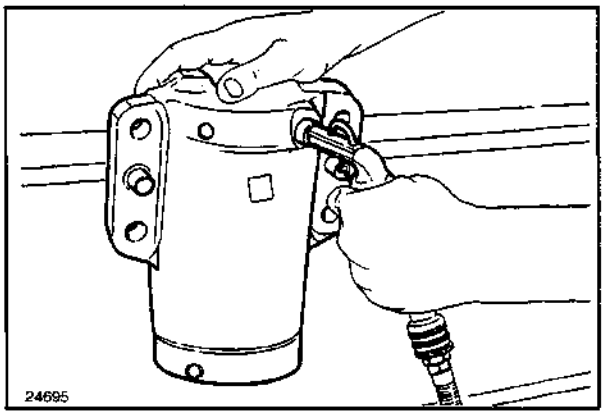


Figure 8-5-72

7. Detach the piston oil inlet fitting (1) and check O rings for wear.

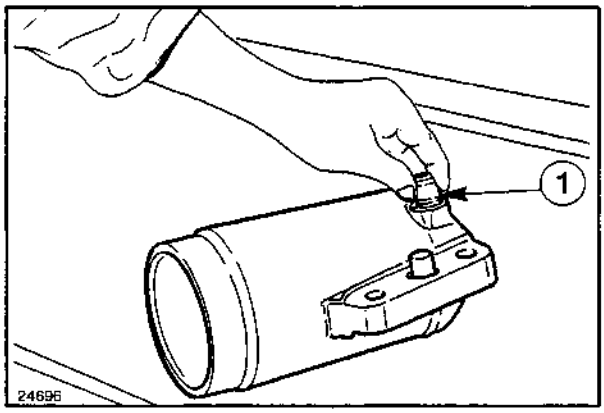


Figure 8-5-73

8. Insert piston into the cylinder bore using drive tool no. **293913** (1) to prevent damages to the seal.

9. Reinstall the cross shaft taking care to match the reference marks on the cross shaft and inner arm.

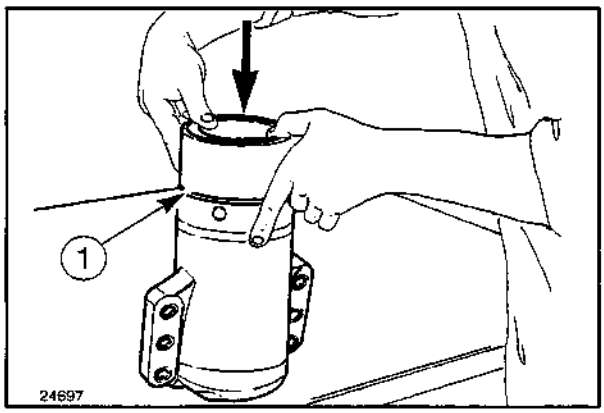


Figure 8-5-74

10. To prevent damages to the seal inner lips, roll up a 7.874 x 3.534 in (200x90 mm) flexible brass sheet (1) with a thickness of 0.002 to 0.004 in (0.05 to 0.1 mm) and insert the seal. Position the assembly on the splines and push the seal into its seat by hand. Slide out the metal plate.

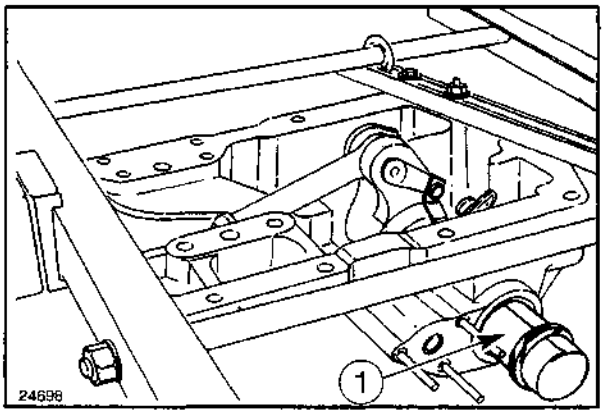


Figure 8-5-75

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11. Using punch tool no. **293985** (1), achieve assembly of the seals onto the cross shaft.

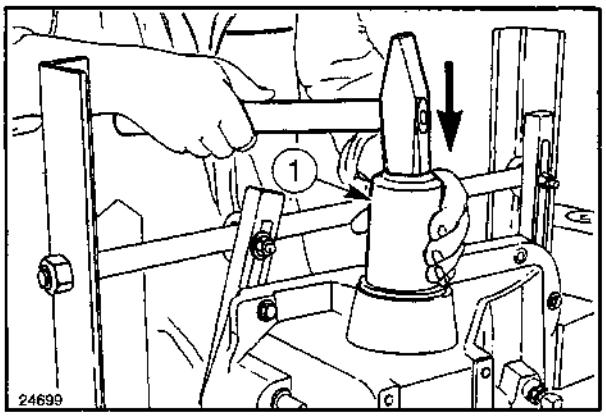


Figure 8-5-76

12. Reassemble the lift arms (1) on to the cross shaft taking care to match reference marks.

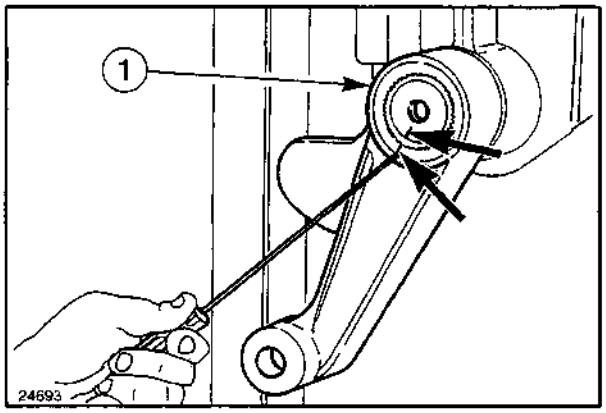


Figure 8-5-77

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LIFT CONTROL VALVE

Removal–Installation (Op. 35 114 10)

Proceed as follows:

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

1. Disconnect the two oil delivery and return tubes (2 and 1, respectively) from the control valve.

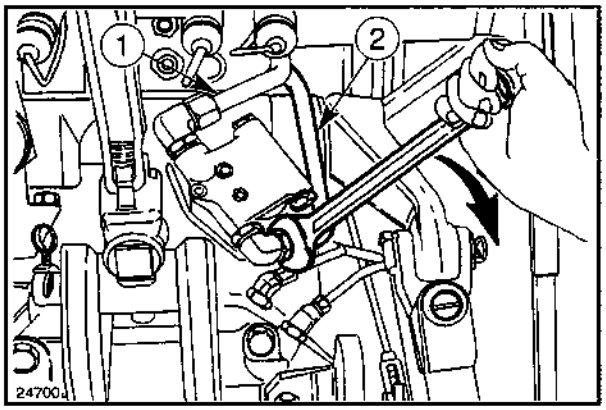


Figure 8-5-78

2. Remove the drop rate valve screw locknut (1).

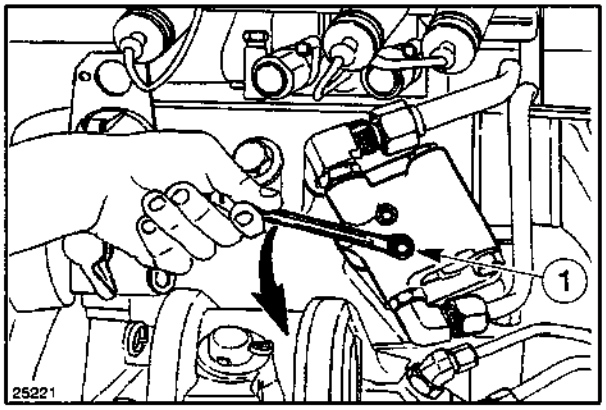


Figure 8-5-79

3. Remove the socket head screws. Remove the control valve cover (1).

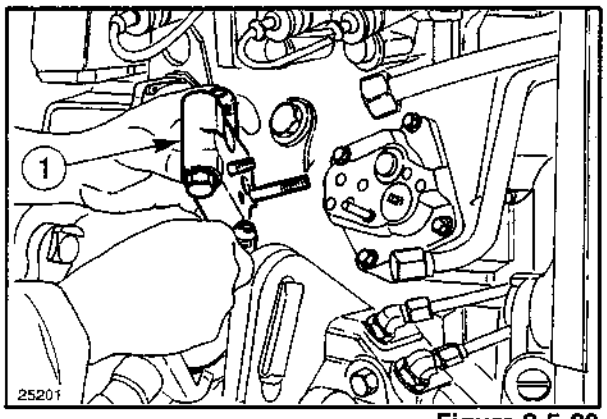


Figure 8-5-80

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4. Remove the four retaining screws and remove the control valve.

5. Reinstall the control valve to the lift casing following the removal procedure in reverse and observing the following precaution.

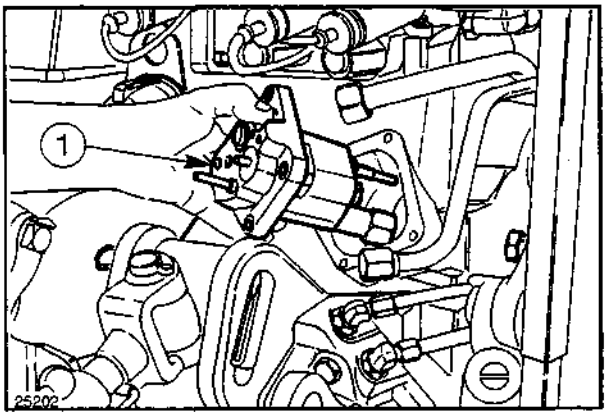


Figure 8-5-81

6. Thoroughly clean mating surfaces and apply a 0.079 in (2 mm) bead of sealant to the lift casing following the pattern shown in the side figure. Sealants to be used are listed on page 0-1-19, Section 00.

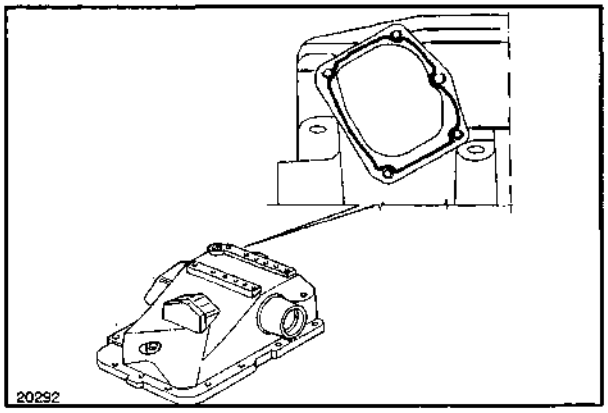


Figure 8-5-82

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LIFT CONTROL VALVE (REMOVED)

Disassembly–Reassembly (Op. 35 114 14)

Proceed as follows:

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

1. Remove the cylinder safety valve (1).

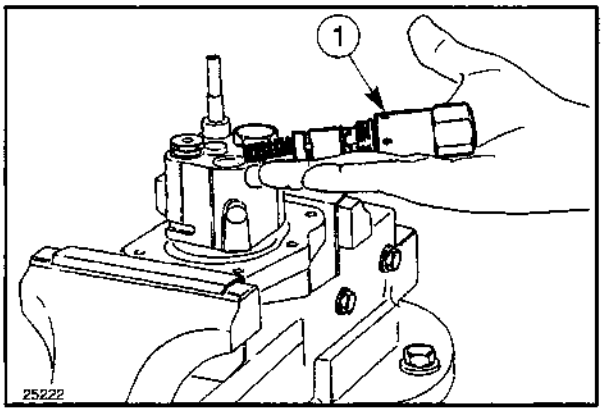


Figure 8-5-83

2. Remove the pilot valve spool (1).

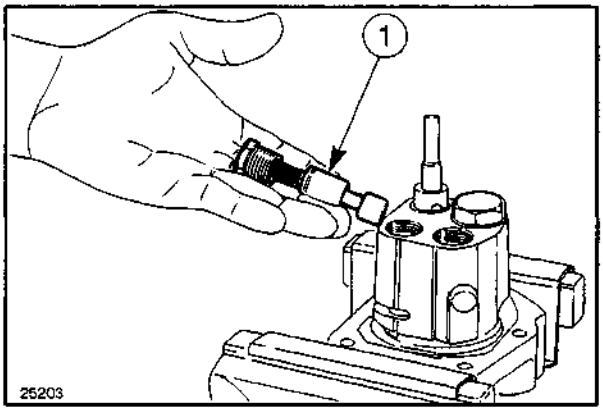


Figure 8-5-84

3. Remove the check valve (1).

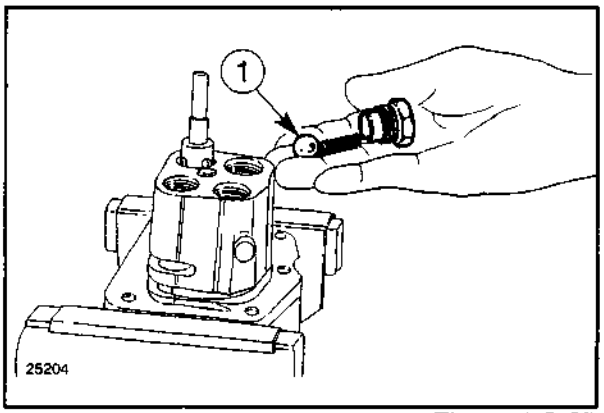


Figure 8-5-85

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4. Remove the control spool (1).

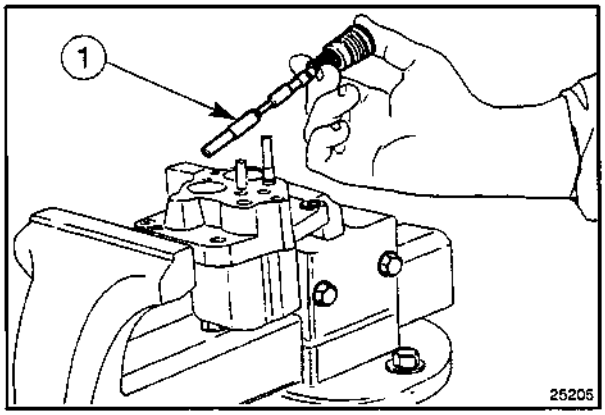


Figure 8-5-86

5. Remove the control spool seat (1).

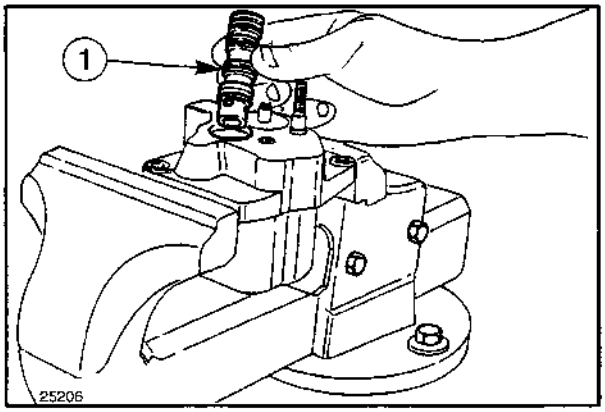


Figure 8-5-87

6. Remove the plug (1) and retrieve the flow control valve spring and pin.

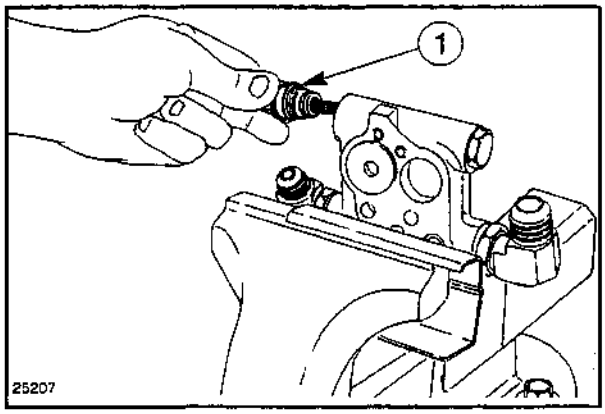


Figure 8-5-88

7. Remove flow control valve piston (1), spring (3) ball (2) and pin (4).

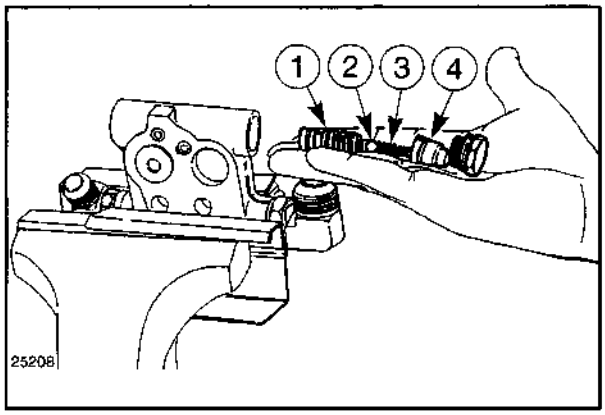


Figure 8-5-89

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8. Check control spool seat seals for wear. Replace if damaged using protection tool no. **293984** (1) and following the advice given on page 8-5-9.

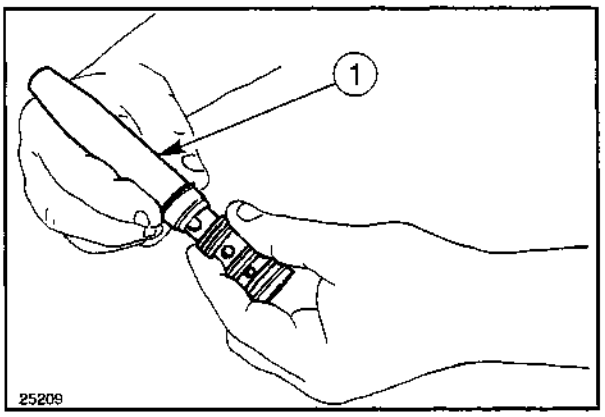


Figure 8-5-90

9. Check control spool operating conditions as follows:

10. Assemble control spool (2) and seat (1) on tool no. **293982** (3).

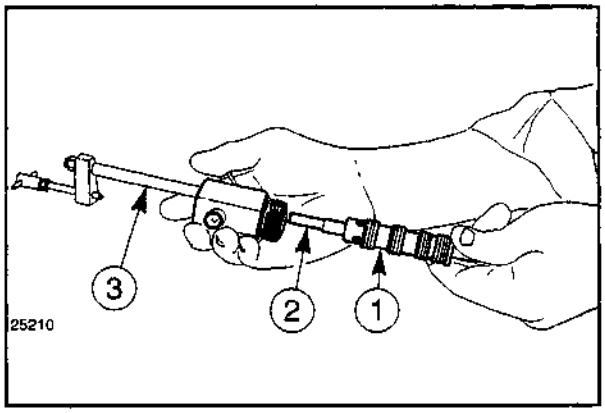


Figure 8-5-91

11. Assemble the control spool spring (2) and plug (3) of tool no. **293982** (1). Screw in until touching and check that the control spool slides freely along its seat.

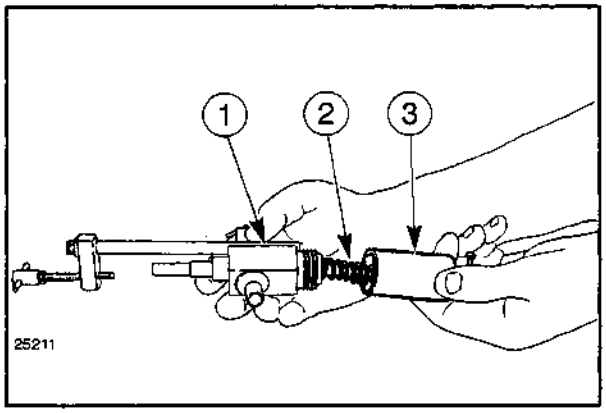


Figure 8-5-92

12. Assemble tool no. **293982** (1) on the hand pump tool no. **290284** (2) filled with oil **HYDROSYSTEM 68**. Connect a dial indicator to the tool and fix using the screw.

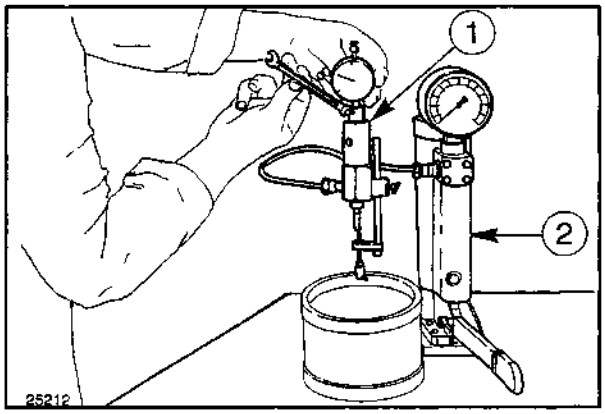


Figure 8-5-93

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13. Prime the hand pump and at the same time screw in the tool screw (1) until oil stops coming out from the control spool seat discharge hole.
14. Reset gauge to zero in this condition.
15. Screw the tool screw (1) further in to move the control spool by 0.071 to 0.079 in (1.8 to 2 mm). Check the distance on the dial indicator.

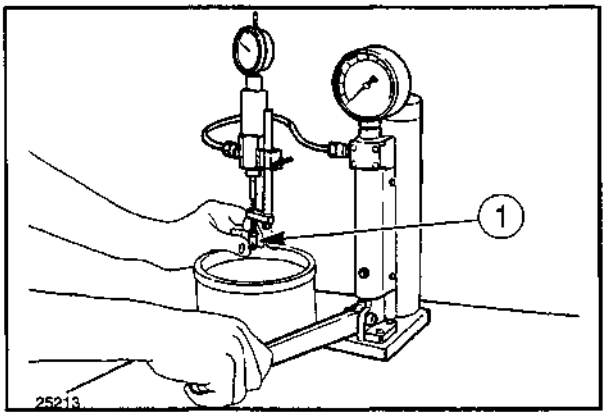


Figure 8-5-94

16. Prime the hand pump to bring system oil to the initial pressure of 3550 lbf/in^2 (250 kg/cm2) (245 bar). Check on the pressure gauge that pressure drops from 2840 lbf/in^2 (200 kg/cm2) (196 bar) to 1420 lbf/in^2 (100 kg/cm2) (98 bar) in more than six seconds. If not, replace the control spool. The control spool and its seat are available in service as a matched set.

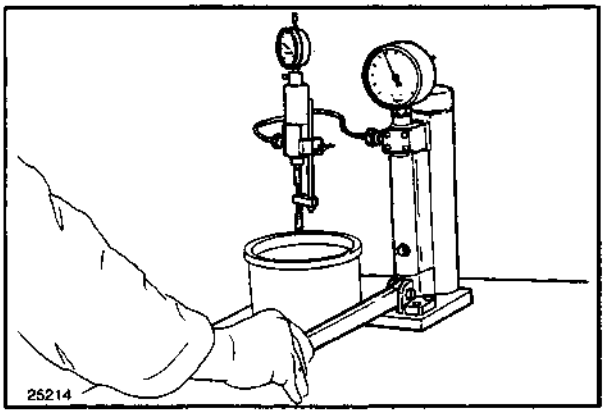


Figure 8-5-95

17. Check control valve cover seals for damages and replace, if necessary.

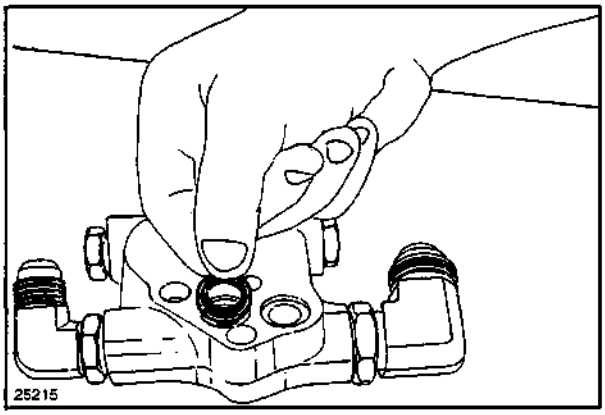


Figure 8-5-96

18. Check control valve cover seals for damages and replace, if necessary.
19. Check the drop rate pin seal for damages. If necessary, replace seal using protection tool no. **293865** and observing the note on page 8-5-9.
20. Check the cylinder safety valve setting as follows:

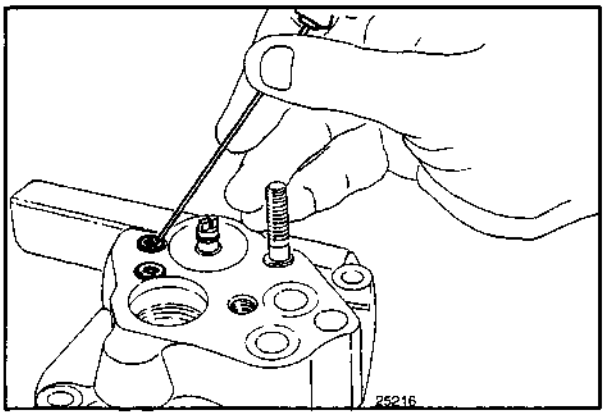


Figure 8-5-97

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21. Assemble the cylinder safety valve (1) on the valve fitting tool no. **290828** (2) and connect fitting to the hand pump tool no. **290284** (3).

22. Prime the hand pump (3) and check that the cylinder safety valve opens at a pressure of 3040 to 3120 lbf/in^2 (214 to 219 kg/cm2) (210 to 215 bar). If valve setting is not to specification, the best thing to do is to replace the valve. In case of need, however, it is possible to adjust valve setting through the threaded plug using the wrench tool no. **291862**. Tighten the fitting to increase the valve setting value, loosen to decrease.

23. Reassemble the control valve observing following:
- Reassembly follows the disassembly procedure in reverse, from step 21 back to step 1.
- Refer to figures on page 8-5-9 for correct orientation of the different parts.
- Tighten to correct torques as detailed on page 8-5-4.

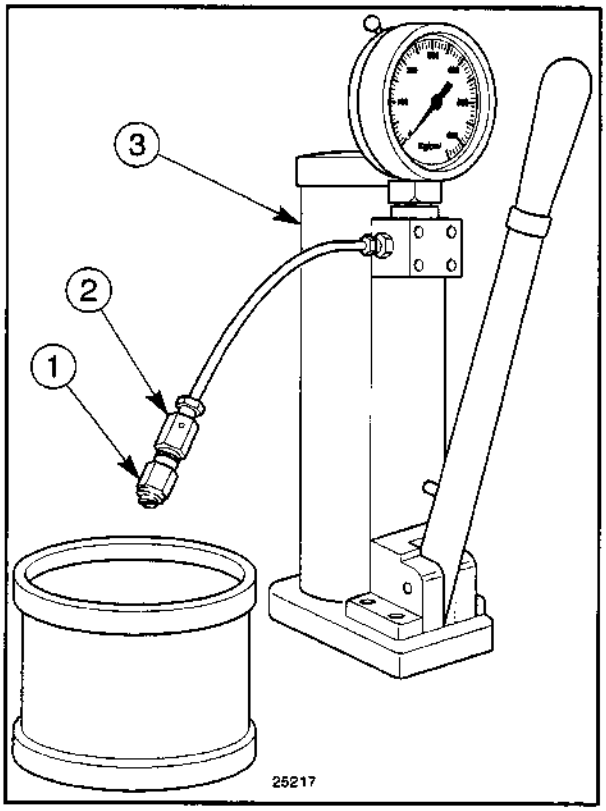


Figure 8-5-98

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MAX HEIGHT ADJUSTMENT (WITH THE LIFT IN THE TRACTOR)

Max height adjustment can be performed with either the lift on a work bench or still in the tractor.
With the lift on a bench, refer to that detailed on page 8-5-29.
With the lift installed in the tractor, proceed as follows:

1. Detach the control valve housing from the lift as detailed on page 8-5-38. Assemble tool no. **293979** at its place.

2. Move the position control lever (1) fully backward on the quadrant.

3. Acting by hand, fully raise lift arms.

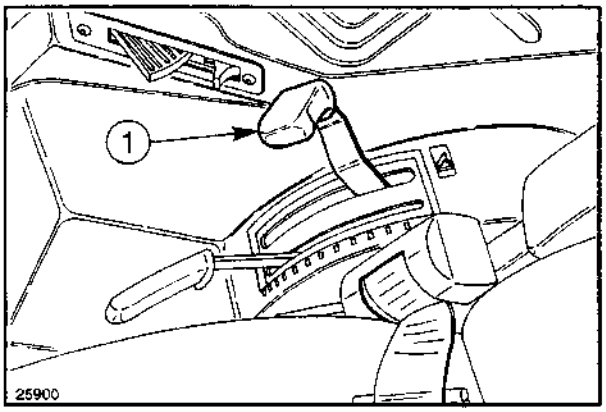


Figure 8-5-99

4. Check that the mobile tip (2) is exactly aligned with the internal reference plane of tool no. **293979** (1). If not, turn the adjust screw using the wrench tool no. **293978** (3).

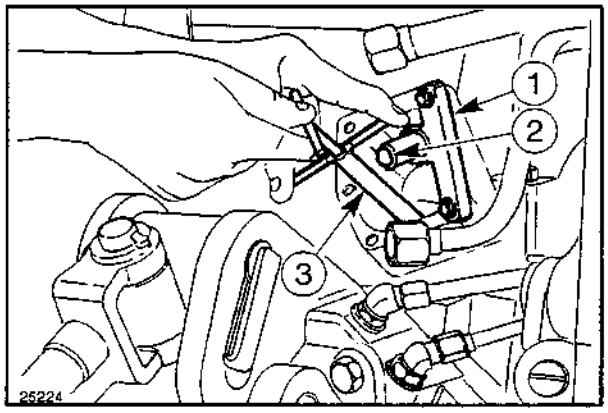


Figure 8-5-100

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DROP RATE ADJUSTMENT

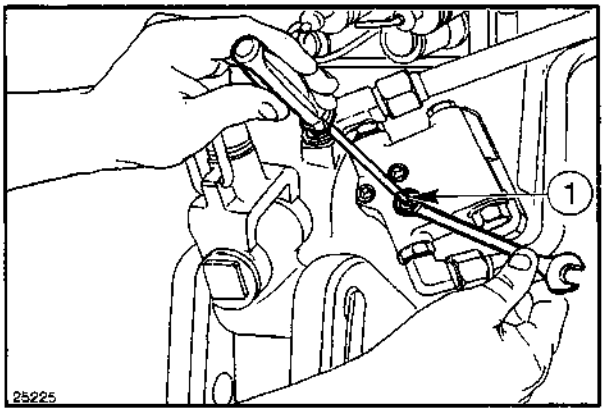


Figure 8-5-101

Proceed as follows:

1. Apply a load of 3590 to 4740 ft. lbs. (1630 to 2150 kg) to the lower link ball ends.
2. Bring system oil to a temperature of 86 to 104°F (30° to 40°C).
3. Remove the protective cap from the control valve housing.
4. Release the locknut and using a screwdriver, turn the adjust pin (1) in to increase the drop rate, or out to decrease.
5. Once obtained the desired drop rate, lock the nut and reassemble the protective cap.

OIL FILTER

Replacement (Op. 35 100 06)

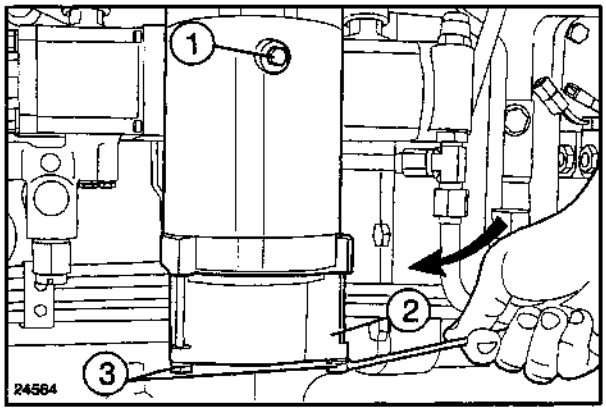


Figure 8-5-102

Proceed as follows:

1. Loosen the screw (1) to allow oil to dump from the oil filter to the axle housing.
2. Loosen the screws (3) and remove cover (2).
3. Slide out the filter paper cartridge located inside the filter body.
4. Insert a new cartridge, install cover (2) and tighten the screws (3 and 1).

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LIFT PRESSURE REGULATING VALVE

Removal–Installation (Op. 35 114 30)

The lift pressure regulating valve is located between the oil supply tube and hydraulic pump.
If faulty, remove and replace the valve.

LIFT PRESSURE REGULATING VALVE

Setting (Op. 35 114 32)

Proceed as follows:

1. Run the engine until oil reaches a temperature of approximately 122°F (50°C).
2. Insert fitting tool no. **293449** (1) in a female quick–coupling and connect to a 0 to 3560 lbf/in^2 (0 to 250 kg/cm2) pressure gauge from test kit no. **292870**.
3. Move the valve lever of the quick–coupling involved until tripping the pressure regulating valve.
4. With the engine running at medium speed, the pressure gauge should read approx. 2700 to 2770 lbf/in^2 (190 to 195 kg/cm2) (186 to 191 bar). If the valve setting is not to specification, the best thing to do is to replace the valve. In case of need, however, it is possible to adjust valve setting through the threaded plug using the wrench tool no. **291863**. Tighten the threaded plug to increase valve setting, loosen to decrease.

Note: The pressure regulating valve setting can also be checked as a bench test, as follows:

5. Mount the pressure regulating valve (1) on the test fitting tool no. **290824** (2) and connect fitting to the hand pump tool no. **290284** (3).
6. Prime the hand pump (3) and check that the pressure regulating valve opens at a pressure of approximately 2700 to 2770 lbf/in^2 (190 to 195 kg/cm^2) (186 to 191 bar).

Notice : The pressure regulating valve is set with oil flow in production. Consequently, the test performed using the hand pump tool no. **290284** should be considered as indicative only. Therefore, we advise to test the pressure regulating valve setting with the valve installed in the tractor, as previously described.

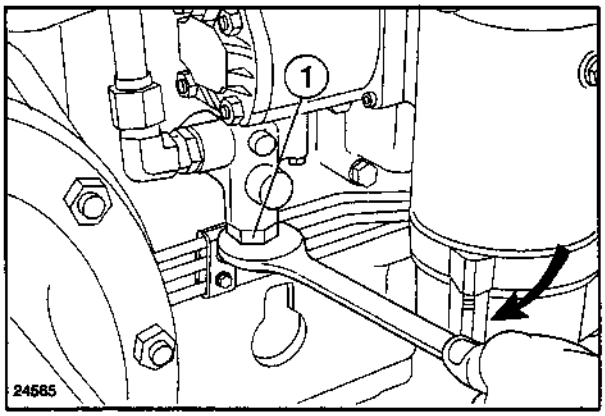


Figure 8-5-103

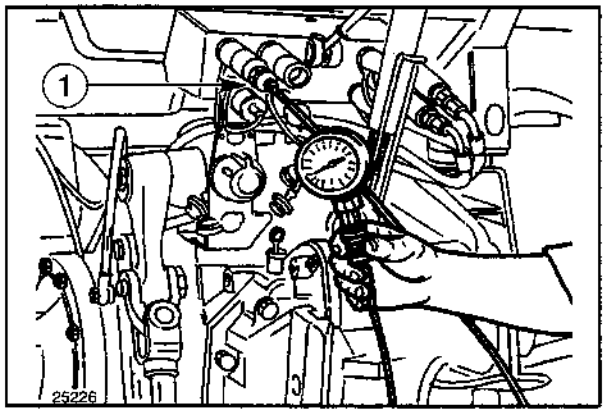


Figure 8-5-104

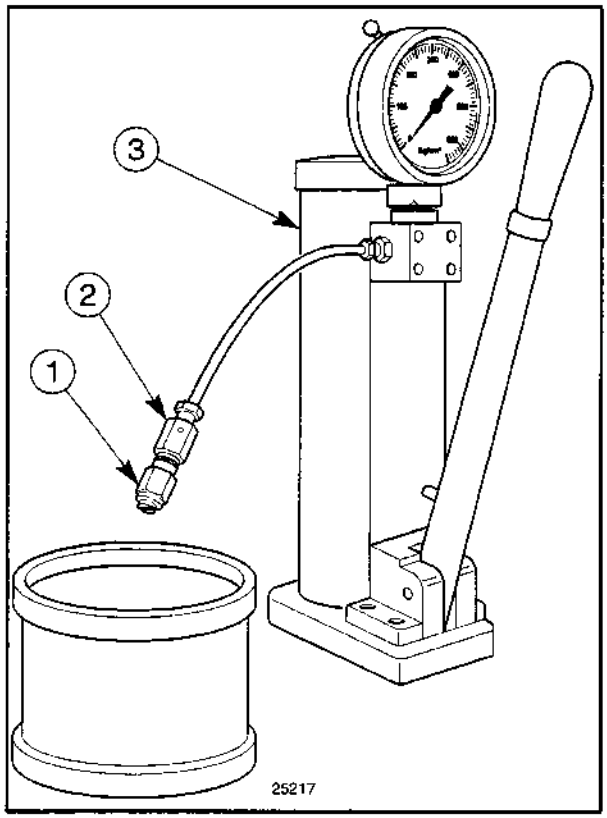


Figure 8-5-105

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SECTION 8

HYDRAULIC SYSTEM

CHAPTER 6

CLOSED CENTER REMOTE CONTROL VALVES

CONTENTS

SPECIFICATIONS 8-6-2
TIGHTENING TORQUE 8-6-2
SPECIAL TOOLS 8-6-2
DESCRIPTION AND OPERATION 8-6-3
PRESSURE TESTING 8-6-19
OVERHAUL 8-6-20
FAULT FINDING ..... SEE CHAPTER 2
INDEX 8-9-4

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SPECIFICATIONS

Remote Valve Output	1–22 U.S. gal/min (0.9–18.7 Imp Gals) (4–85 ltrs/min)
Detent Regulating Valve Pressure	2150–2350 lbf/in^2 (148–162 bar)

TORQUE

Flow Control Valve Plug	20 ft. lbs.	27 Nm
Detent Shaft Pivot Coupling	5 ft. lbs.	7 Nm
Detent Housing Retaining Screws	5 ft. lbs.	7 Nm
Priority Check Valve	5 ft. lbs.	7 Nm
Valve to Coupler Housing Bolts	11–15 ft. lbs.	15–20 Nm
Valve Housing to Mounting Bracket Bolts	20–26 ft. lbs.	27–35 Nm
Remote Valve Coupler to Housing	50–70 ft. lbs.	68–95 Nm
Lock Valve to Coupler Housing	25–30 ft. lbs.	34–40 Nm
Lock Valve Solenoid Nut	12–15 ft. lbs.	16–20 Nm
Lock Solenoid Port Plug	65–75 ft. lbs.	88–102 Nm

THREAD SEALANT

New Holland Part No 82995773

SPECIAL TOOLS

Flowmeter	Suitable for measuring 0–32 gal/min (0–120 ltrs/min)
Flowmeter Hoses	Procure locally to suit Flowmeter used
Coupler Remover	FNH 00095
Slipper Seal Installation Tool	VL Churchill FT 8611

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DESCRIPTION and OPERATION

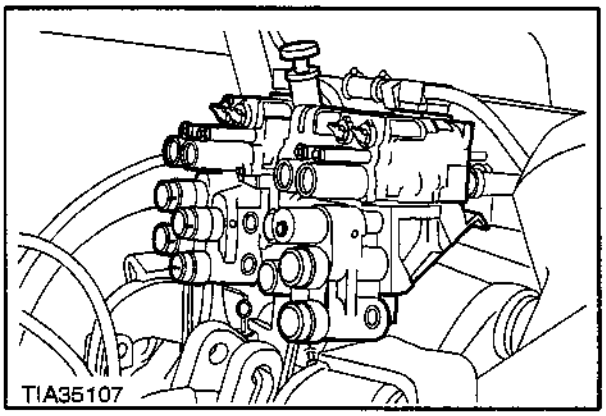


Figure 8-6-1

This chapter describes the operation and overhaul of 'Closed Center' remote valves installed on tractors with the load sensing variable flow piston pump. For details on the 'Open center' remote valves installed on tractors with the gear pump refer to Chapter 7.

Up to four remote control valves may be installed and are located at the rear of the tractor. The valves are mounted directly onto quick release couplers and designed to give unrestricted flow and low back pressure.

The valves are operated by levers located by the side of the drivers seat. The levers and their respective valves are color coded for identification.

Lever Color	Valve Position/No.
Green	Right–hand outer – I
Blue	Right–hand inner – II
Ginger	Left–hand inner – III
Black	Left–hand outer – IIII

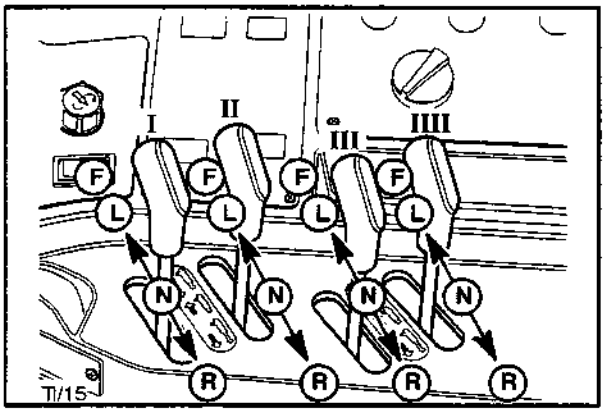


Figure 8-6-2

Each remote valve has four operating positions, as follows:–

Raise (R) – Pull a lever toward you to extend the cylinder to which it is connected.

Neutral (N) – Push the lever away from you from the raise position to select neutral and de-activate the connected cylinder.

Lower (L) – Push the lever forward, past neutral, to retract the cylinder.

Float (F) – Push the lever fully away from you, beyond the 'lower' position, to select 'float'. This will permit the cylinder to extend or retract freely, thereby allowing equipment such as scraper blades to 'float' or follow the ground contour.

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An alternative joystick control (1) may be fitted in place of the levers operating remote control valves I and II. The joystick operates in a cross pattern. As with the conventional levers, the joystick provides four positions: Raise (R), Neutral (N), Lower (L) and Float (F).

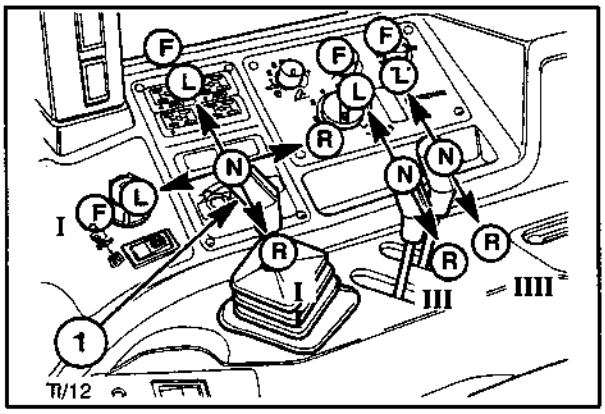


Figure 8-6-3

The joystick has the added advantage of being able to operate two remote control valves simultaneously by moving the lever between the valve No. I and No. II positions. This feature will be found useful when operating, loaders, fertilizer spreaders, etc.

Each remote valve has its own flow control valve (1) which permits individual adjustment of the range of flow when operating two or more valves simultaneously. Turning the flow control knob counterclockwise (hare symbol uppermost) increases the rate of flow and turning the knob clockwise (tortoise symbol uppermost) decreases the rate of flow. The couplers are of a self–sealing/locking design but will allow remote cylinder hoses to pull free if the implement should become disconnected from the tractor.

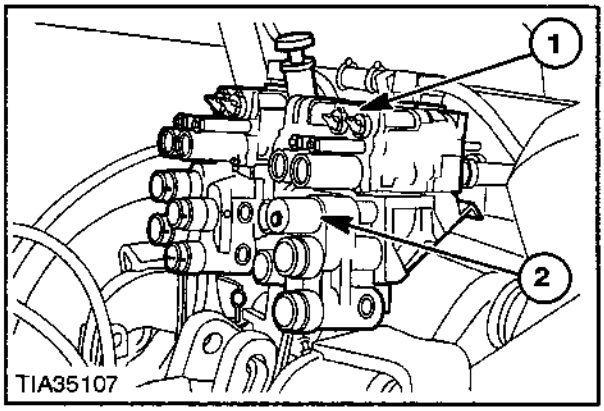


Figure 8-6-4

Remote valves I and III can also be equipped with the optional solenoid operated lock valves (2). These valves lock the oil in the raise coupler, whenever the remote valve lever is in Neutral and are designed specifically for use when using the remote valves to raise and hold equipment during transportation or work.

Lock valves are not available on remote valve number I if the joystick control described above is fitted.

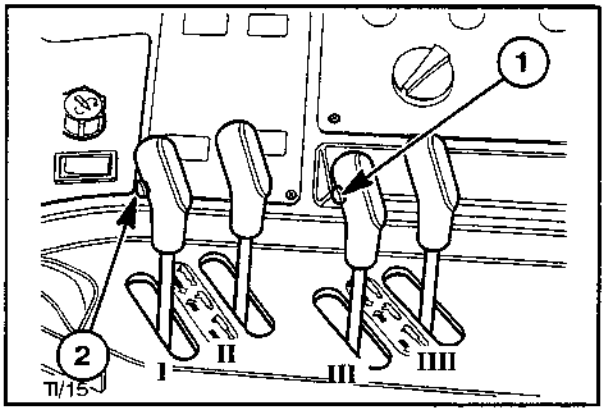


Figure 8-6-5

NOTE: *When operating remotes which incorporate the lock valve it is necessary to depress and hold the button on the side of the control lever when operating the valve in the lower/retract mode.*

*It is **not possible** to operate remotes installed with lock valves, in the **'Float'** position.*

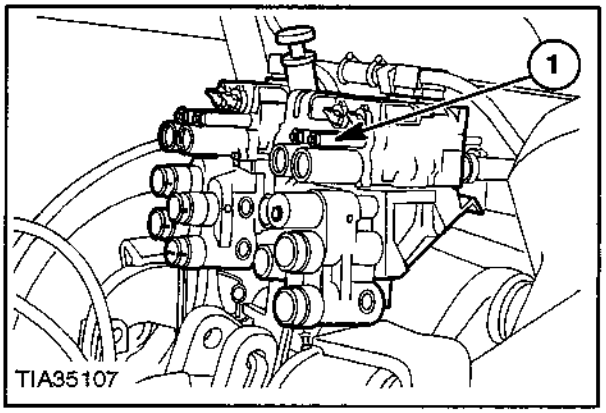


Figure 8-6-6

A detent (1) will hold the lever in the selected extend or retract position until the remote cylinder reaches the end of the stroke when the control lever will automatically return to neutral. Alternatively, the lever may be returned to neutral manually. The lever will not return automatically from the float position or when the detent screw has been fully screwed in. Adjustment of the detent screw varies the system pressure required to return the lever automatically to the neutral position.

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OPERATING EXTERNAL CYLINDERS AND MOTORS

Double Acting Cylinder Operation

Connect the two hoses to the raise and lower couplers, eg. piston end of cylinder to raise coupler and rod end to lower coupler.

To retract cylinder move remote lever to 'lower' (L) position.

To extend cylinder move remote lever to 'raise' (R) position.

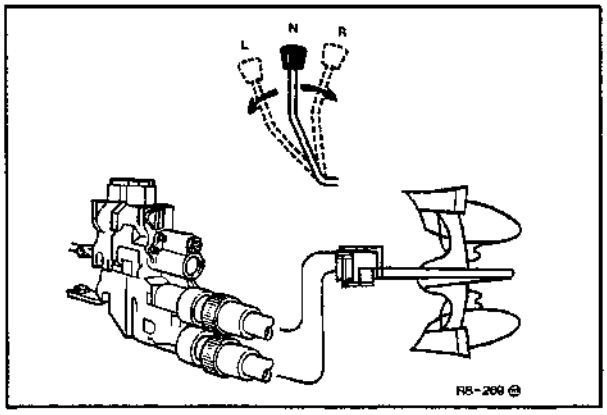


Figure 8-6-7

Single Acting Cylinder Operation

For normal single acting operation, connect hose to the raise coupler.

To raise (extend) cylinder move remote lever to 'raise' (R) position.

To lower (retract) cylinder move remote lever fully forward to 'float' position.

To hold cylinder move remote lever to 'neutral' position.

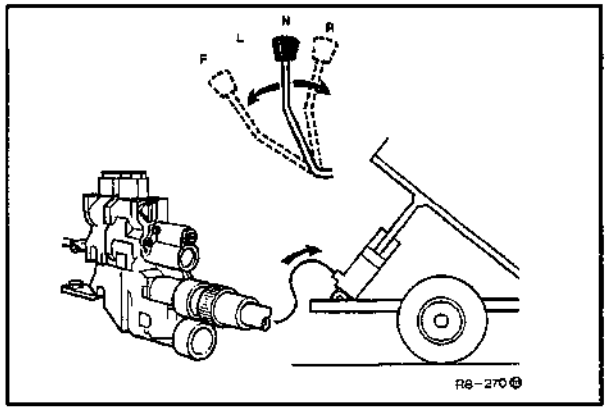


Figure 8-6-8

Hydraulic Motor Operation

The hydraulic motor feed hose must be connected to the lower coupler and the return hose into the raise coupler.

To run the motor, push the remote valve lever to the lower (L) position. To stop the motor, push the remote valve lever fully forward to the 'float' (F) position.

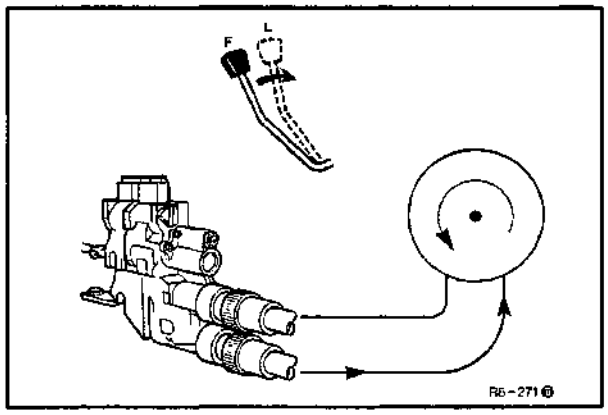


Figure 8-6-9

NOTE: *Neutral (N) position should not be used to stop the motor as the flow of oil will be stopped instantly causing damage to the motor, unless it is fitted with a cross line circuit check valve.*

Some motor manufacturers may recommend that the motor return is directed through the return plug to eliminate any back pressure from the system.

The thread of the plug is $^{3}/_{4}$ inch to British Standard 5380.

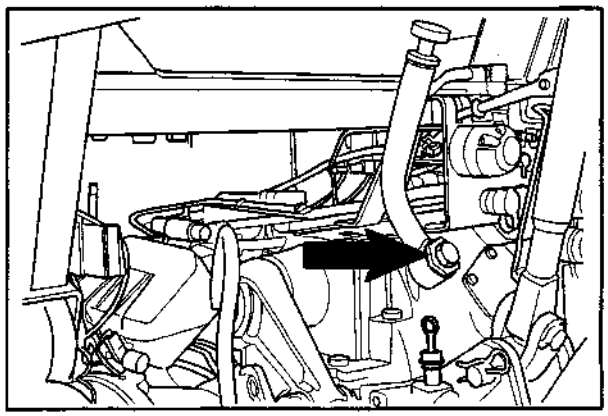
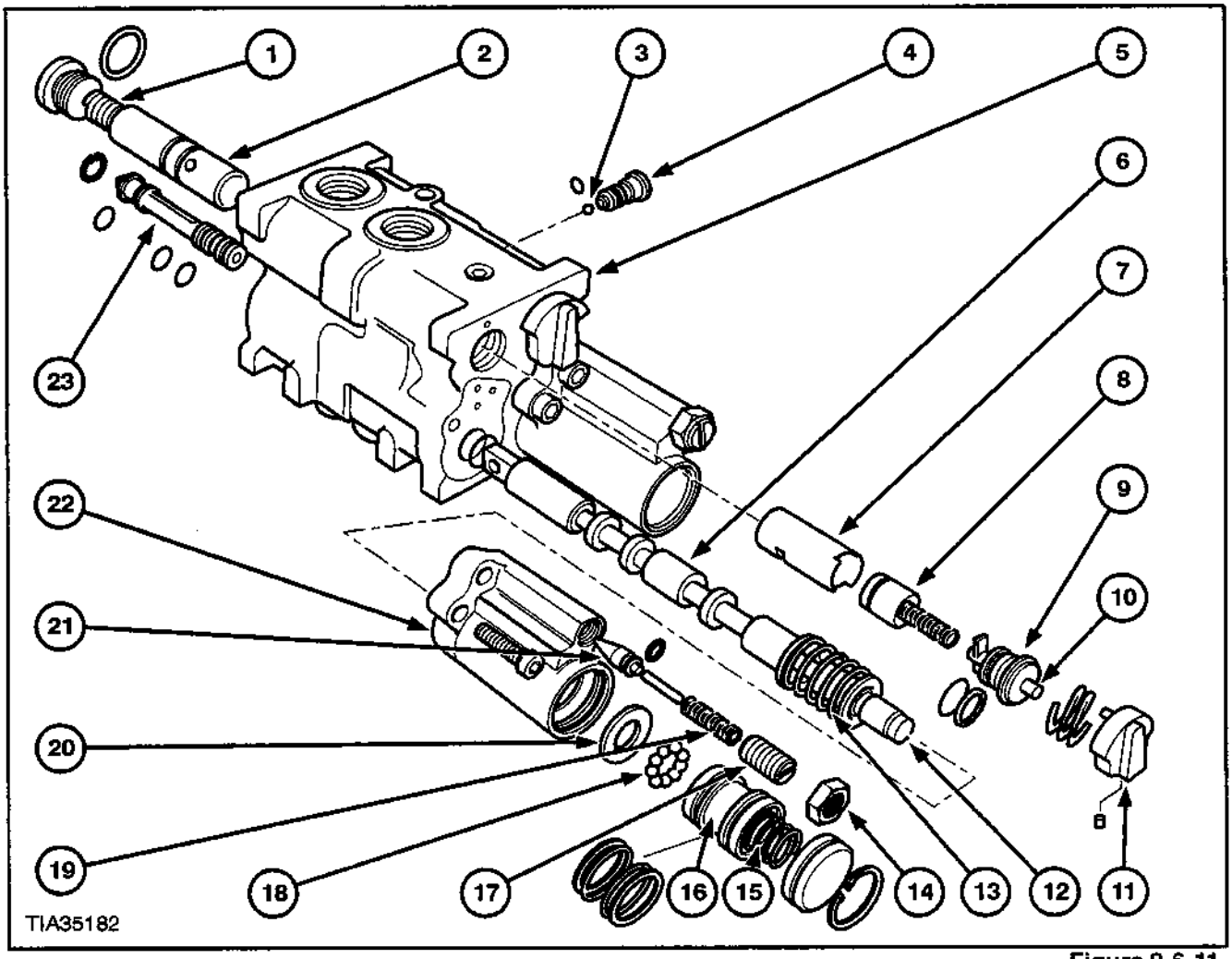


Figure 8-6-10

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Double Spool Remote Control Valve

Figure 8-6-11

1. Flow Control Spring
2. Flow Control Spool
3. Priority Check Valve Ball (double spool only)
4. Priority Check Valve Retainer
5. Valve Body
6. Spool
7. Flow Restrictor*
8. Load Check Valve
9. Flow Restrictor End Plug
10. Flow Restrictor Control Shaft
11. Flow Restrictor Control Knob
12. Detent Shaft
13. Spool Centering Spring
14. Locknut
15. Detent Piston Spring
16. Detent Piston
17. Detent Valve Spring Adjuster
18. Detent Balls (9 off)
19. Detent Regulating Valve Spring
20. Spacer
21. Detent Regulating Valve
22. Detent Housing
23. Shuttle Check Valve

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Oil Flow In Neutral

With reference to Figure 8-6-12.

Figure 8-6-12 is drawn with the lock valve installed. On remote valves not available with this feature gallery 'G' flows directly into the raise coupler. Refer to Figure 8-6-17.

When the remote valves are in neutral the control valve spool is held in the neutral position by the centering spring and passage 'B' is blocked by the center land of the spool.

The control valve spool also isolates lift port 'G' and drop port 'H' from supply passage 'B' and return oil galleries 'E' and 'F'. The oil in both ends of the lift cylinder is, therefore, trapped.

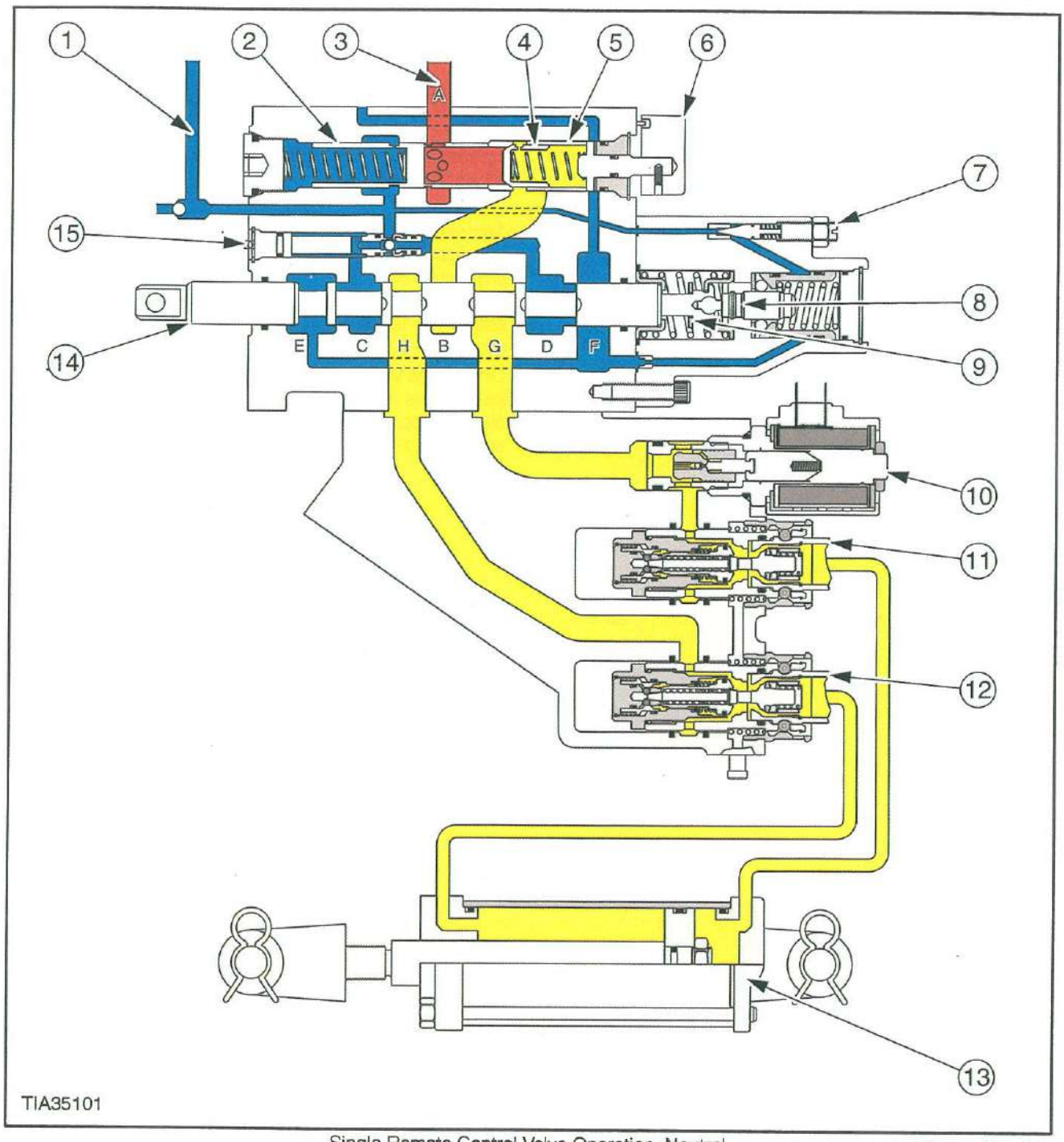
When the valve is in neutral, galleries 'C' and 'D' connect with the return oil galleries 'E' and 'F' allowing pressure in the load sensing lines from the valve to return to sump.

Assuming no other services are being operated the variable flow piston pump maintains an output at low pressure standby. If another service is operated however the pump system pressure would rise to satisfy the demand.

On remote valves installed with the solenoid operated lock valves an implement is held in the raised position by the poppet valve within the valve assembly (item 10) which is sprung loaded in the closed position.

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Single Remote Control Valve Operation–Neutral

Figure 8-6-12

Pump Pressure Oil

Exhaust Oil

Trapped Oil

1. Load Sensing (Pilot) line
2. Flow Control Spool
3. Hydraulic Pump Supply
4. Load Check Valve
5. Flow Control Restrictor
6. Flow Control Knob
7. Detent Regulating Valve
8. Detent Spool Assembly
9. Centering Spring
10. Lock Valve (where fitted)
11. Extend Coupler
12. Retract Coupler
13. External Cylinder
14. Control Valve Spool
15. Shuttle Check Valve

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Oil Flow In Raising

With reference to Figure 8-6-13.

Figure 8-6-13 is drawn with the lock valve installed. On remote valves not available with this feature gallery 'G' flows directly into the raise coupler. Refer to Figure 8-6-17.

When the remote valve lever is moved to the raise position, the control valve spool is moved forward and the spring loaded detent balls engage with the rear groove in the detent plunger.

Passage 'B' is now connected to lift port gallery 'G' and 'D'. The drop port 'H' and gallery 'C' are connected to the return to sump oil gallery E.

When the remote control valve lever is initially moved to the raise position the pressure at gallery 'D' is equivalent to the cylinder pressure or tractor hydraulic back pressure whichever is the greatest.

The pressure oil at gallery 'D' now flows to the shuttle check valve and through the internal drilling to:

Detent Regulating Valve

Flow Control Valve Spool

Load Sensing (Pilot) Line

The load sensing line pressure acts on the flow compensating valve in the variable flow piston pump, which controls the angle of the pump swash plate to increase output to meet demand.

Pump pressure oil flows from Port 'A' to passage 'B' through:–

(i) Flow Control Spool Holes

(iii) Flow Control Restrictor – Manual pre–set.

(ii) Load Check Valve

The volume of oil entering passage 'B' and flowing to the lift Port 'G' is determined by the flow control restrictor setting which is manually pre–set.

When a lock valve is installed, oil flowing through the extend Port 'G' lifts the poppet valve in the lock valve assembly of its seat to allow oil to flow through the coupler to the implement.

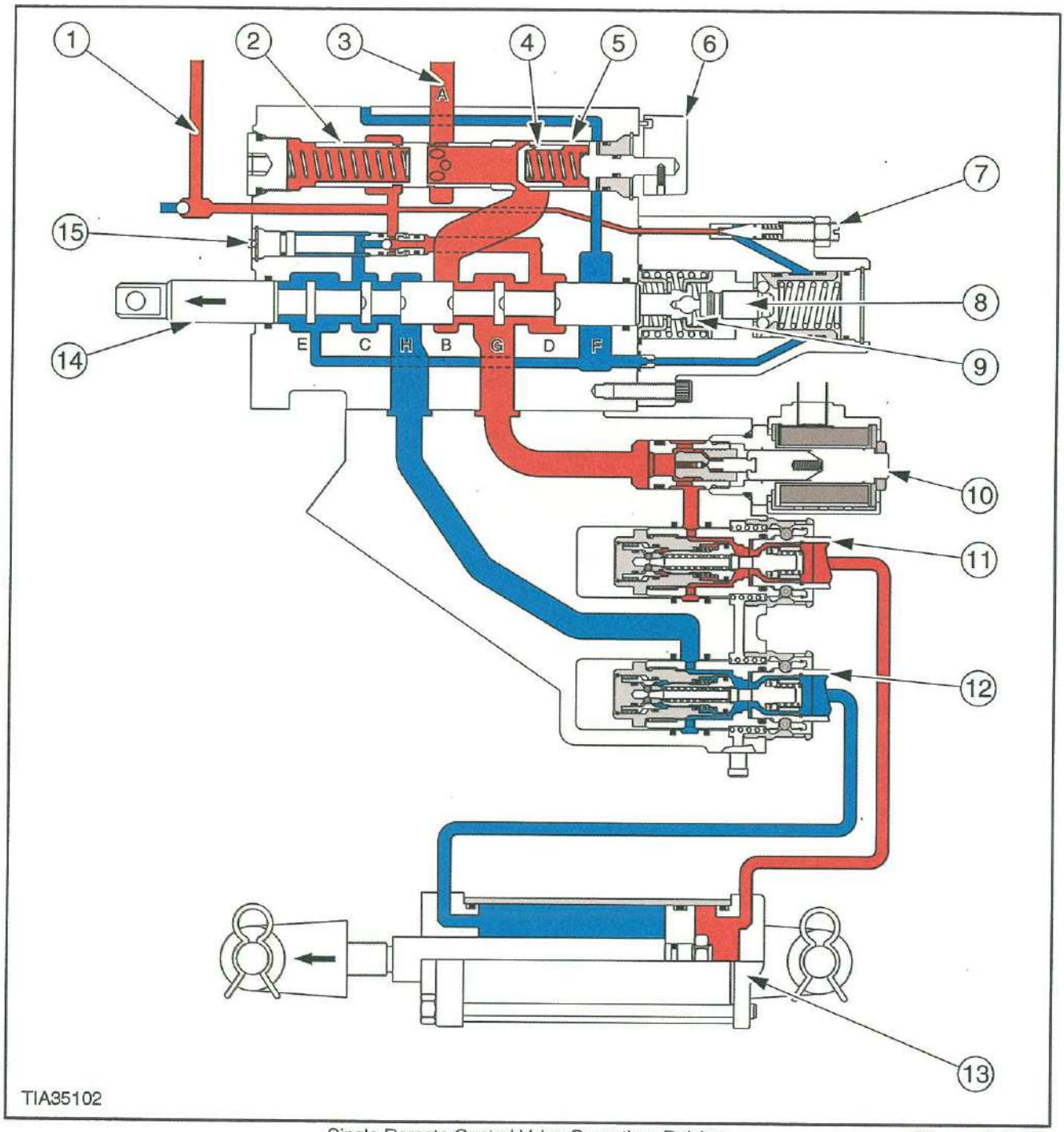
NOTE: *On remotes installed with the lock valve it* ***is not*** *necessary to depress the control button on the remote valve lever in order to operate the valve in the raise (extend) position.*

Exhaust oil from the lift cylinder drop port 'H' now returns to reservoir through oil gallery 'E'.

When the cylinder is fully extended pump supply oil pressure increases until the detent regulating valve opens. Pump pressure oil moves the detent spool against the detent spring and releases the clamping effort of the detent balls on the end of the control valve spool. The centering spring now moves the spool back to the neutral position.

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Single Remote Control Valve Operation–Raising

Figure 8-6-13

Pump Pressure Oil

Exhaust Oil

1. Load Sensing (Pilot) line
2. Flow Control Spool
3. Hydraulic Pump Supply
4. Load Check Valve
5. Flow Control Restrictor
6. Flow Control Knob
7. Detent Regulating Valve
8. Detent Spool Assembly
9. Centering Spring
10. Lock (where fitted)
11. Extend Coupler
12. Retract Coupler
13. External Cylinder
14. Control Valve Spool
15. Shuttle Check Valve

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Oil Flow In Lowering

With reference to Figure 8-6-14.

Figure 8-6-14 is drawn with the lock valve installed. On remote valves not available with this feature gallery 'G' flows directly into the raise coupler. Refer to Figure 8-6-17.

When the remote valve lever is moved to the lowering position the spool moves rearwards allowing the spring loaded detent balls to engage with the front groove in the detent plunger.

In the lowering position, passage 'B' is connected to drop port 'H' and gallery 'C'. Lift port 'G' is connected to gallery 'D' and return oil gallery 'F'. The connections to and from the cylinder are now reversed allowing pump flow to retract the cylinder in a similar manner to that described for raising.

NOTE: *On remote valves installed with the lock valve, oil can not flow from the implement and back through the extend coupler unless the control button on the side of the remote valve lever is* ***held*** *in the depressed position to energize the solenoid and unlock the valve.*

Depressing the button energizes the solenoid which withdraws the plunger in the center of the poppet valve to allow return oil from the implement to push the poppet valve off its seat and flow back into port 'G' and return to sump through Gallery 'F'.

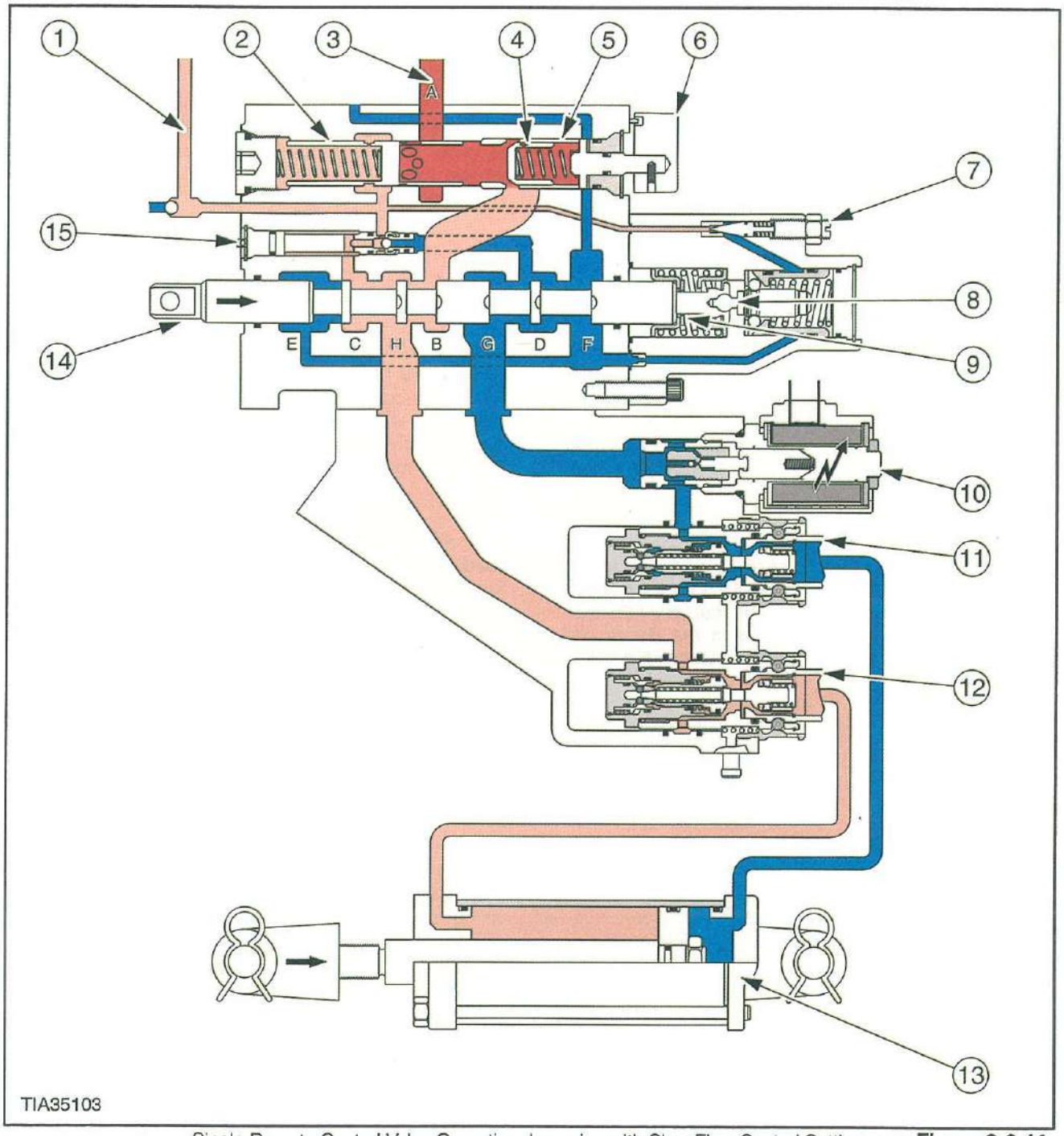
The shuttle check valve allows pressure from gallery 'C' to be sensed in the load sensing line and also operate the detent regulating valve and flow control spool.

As the flow control restrictor is rotated towards slow flow the slot in the restrictor, which aligns with passage 'B', is reduced restricting oil flow to passage 'B'. This restriction will cause a pressure differential between pump supply pressure in gallery 'A' and the load sense pressure sensed from gallery 'H'.

The differential between load sense line pressure feedback from the operational remote and the pump supply pressure, acts on the flow compensating valve in the variable flow piston pump to control the angle of the pump swash plate and adjust output in accordance with demand.

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Single Remote Control Valve Operation–Lowering with Slow Flow Control Setting **Figure 8-6-14**

Pump Pressure Oil | Reduced Oil Flow | Exhaust Oil

1. Load Sensing (Pilot) line
2. Flow Control Spool
3. Hydraulic Pump Supply
4. Load Check Valve
5. Flow Control Restrictor
6. Flow Control Knob
7. Detent Regulating Valve
8. Detent Spool Assembly
9. Centering Spring
10. Lock Valve (where fitted)
11. Extend Coupler
12. Retract Coupler
13. External Cylinder
14. Control Valve Spool
15. Shuttle Check Valve

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Oil Flow With Cylinder Overload

With reference to Figure 8-6-15.

Figure 8-6-15 is drawn with the lock valve installed. On remote valves not available with this feature gallery 'G' flows directly into the raise coupler. Refer to Figure 8-6-17.

Figure 8-6-15 is illustrated in the lowering position and operates as described.

Under normal operating conditions excessive pressures in the remote circuits are protected by the detent regulating valve which returns the control valve spool to neutral when the external cylinder pressure reaches the operating pressure set by screwing the detent regulating valve in or out of the housing.

This can be adjusted to suit the operating pressure requirements of a machine however if the operator screws the detent regulating valve fully clockwise the remote valve will not return to neutral.

This is similar to the situation where the operator overrides the detent by continually holding the remote valve in the operating position and allowing the operating pressure to continually rise.

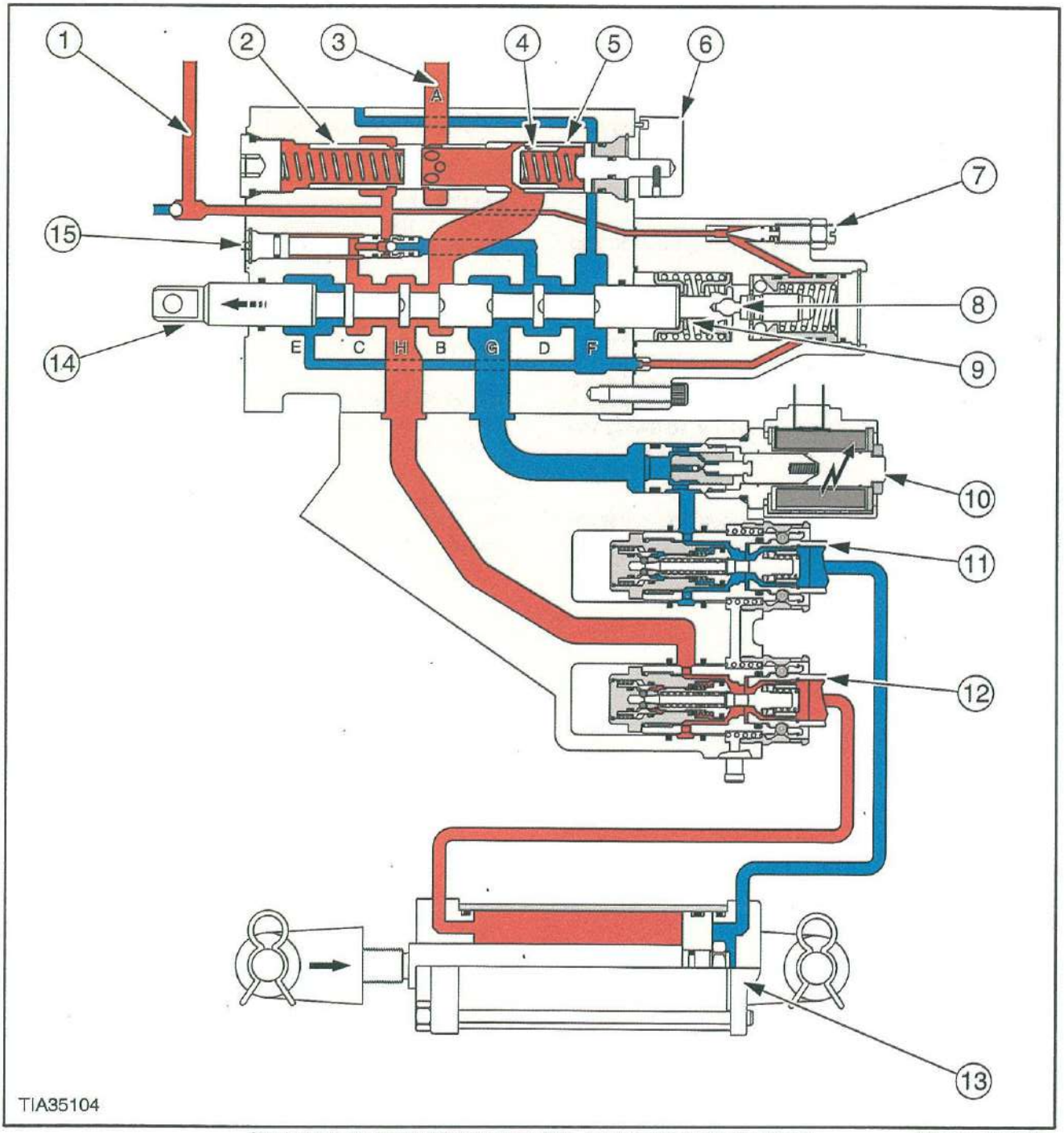
When the pressure in the system reaches 2750 lbf/in^2 (190 bar) the circuit is protected by the pressure compensating valve in the variable flow piston pump.

The 2750 lbf/in^2 (190 bar) pressure generated by the pump causes the pump pressure compensating valve to operate and destroke the pump to minimum flow.

Refer to Chapter 2 in this part of the Repair Manual for the operation of the variable displacement CCLS hydraulic pump.

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Single Remote Control Valve Operation–External Cylinder Overload **Figure 8-6-15**

Pump Pressure Oil

Exhaust Oil

1. Load Sensing (Pilot) line
2. Flow Control Spool
3. Hydraulic Pump Supply
4. Load Check Valve
5. Flow Control Restrictor
6. Flow Control Knob
7. Detent Regulating Valve
8. Detent Spool Assembly
9. Centering Spring
10. Lock Valve (where fitted)
11. Extend Coupler
12. Retract Coupler
13. External Cylinder
14. Control Valve Spool
15. Shuttle Check Valve

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Double Remote Valve Operation

With reference to Figure 8-6-16.

Figure 8-6-16 is drawn with the lock valve installed. On remote valves not available with this feature gallery 'G' flows directly into the raise coupler. Refer to Figure 8-6-17.

Two or more remote valves can be operated simultaneously irrespective of cylinder load.

If two spools are operating a light load circuit and a heavy load circuit simultaneously, all the oil flow from the valve will attempt to flow to the light load circuit. The flow control spool will maintain pre–set flow (manual restrictor setting) to light load circuit.

It should be noted that in this condition the priority check valve ball in the load sense line is pushed firmly towards the low pressure circuit. isolating the sense line from the remote valve operating under the lighter load condition, Figure 8-6-16.

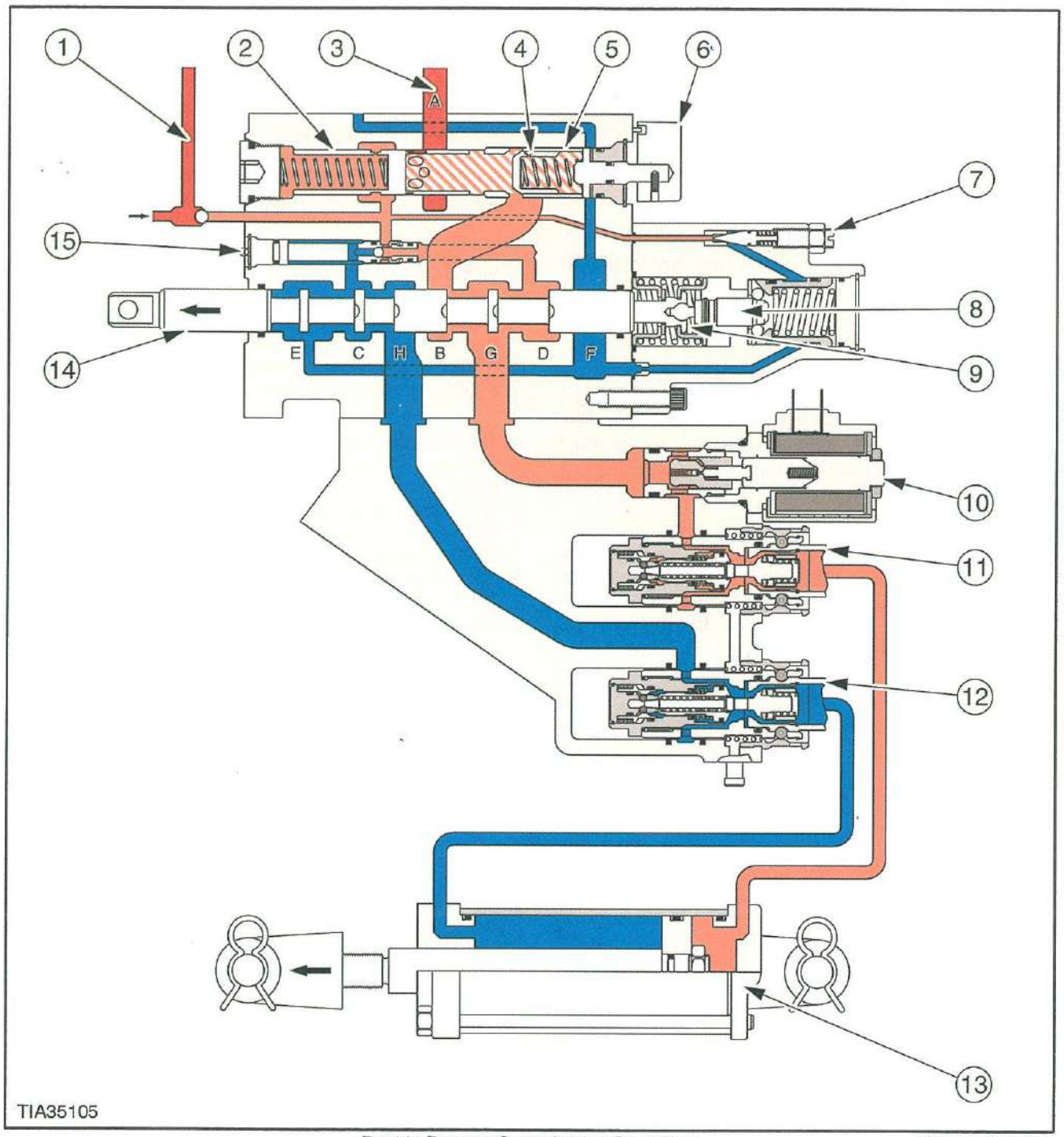
In the double remote valve operation passage 'B' is connected through the shuttle check valve to the spring end of the flow control valve spool. The portion of the spool in port 'A' contains radial holes, through which pump oil must flow to reach passage 'B'.

If there is a large difference in the operating pressures between the two remote valve circuits an excessive amount of oil will attempt to flow from the pump, through the flow control spool and restrictor of the remote circuit operating at the lower pressure. This additional flow results in an increased pressure being generated on the right hand face of the flow control spool.

The increased pressure acting on the right hand face of the flow control spool moves the spool to the left, against both the spring and lower pressure acting on the opposite face of the spool. As the spool moves to the left, the flow control spool radial holes are progressively covered restricting and controlling oil flow from passage 'A' to the load check valve. Excessive oil flow to the light load circuit is therefore prevented while maintaining a high supply line pressure from the heavy load circuit.

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Double Remote Control Valve Operation

Figure 8-6-16

Pump Pressure Oil
Controlled Oil Flow
Reduced Oil Flow
Exhaust Oil

1. Load Sensing (Pilot) line
2. Flow Control Spool
3. Hydraulic Pump Supply
4. Load Check Valve
5. Flow Control Restrictor
6. Flow Control Knob
7. Detent Regulating Valve
8. Detent Spool Assembly
9. Centering Spring
10. Anti–Leak Down Valve (where fitted)
11. Extend Coupler
12. Retract Coupler
13. External Cylinder
14. Control Valve Spool
15. Shuttle Check Valve

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Oil Flow In Float

The float position allows operation of single acting cylinders when lowering under light load conditions.

When the remote valve lever is pushed fully forward to the float position, the spool is moved fully rearward past lowering to allow the detent balls to engage with the float detent plunger groove.

The spool can only be returned to neutral manually by the operator as no pressure can be generated at the shuttle check valve to release the detent mechanism.

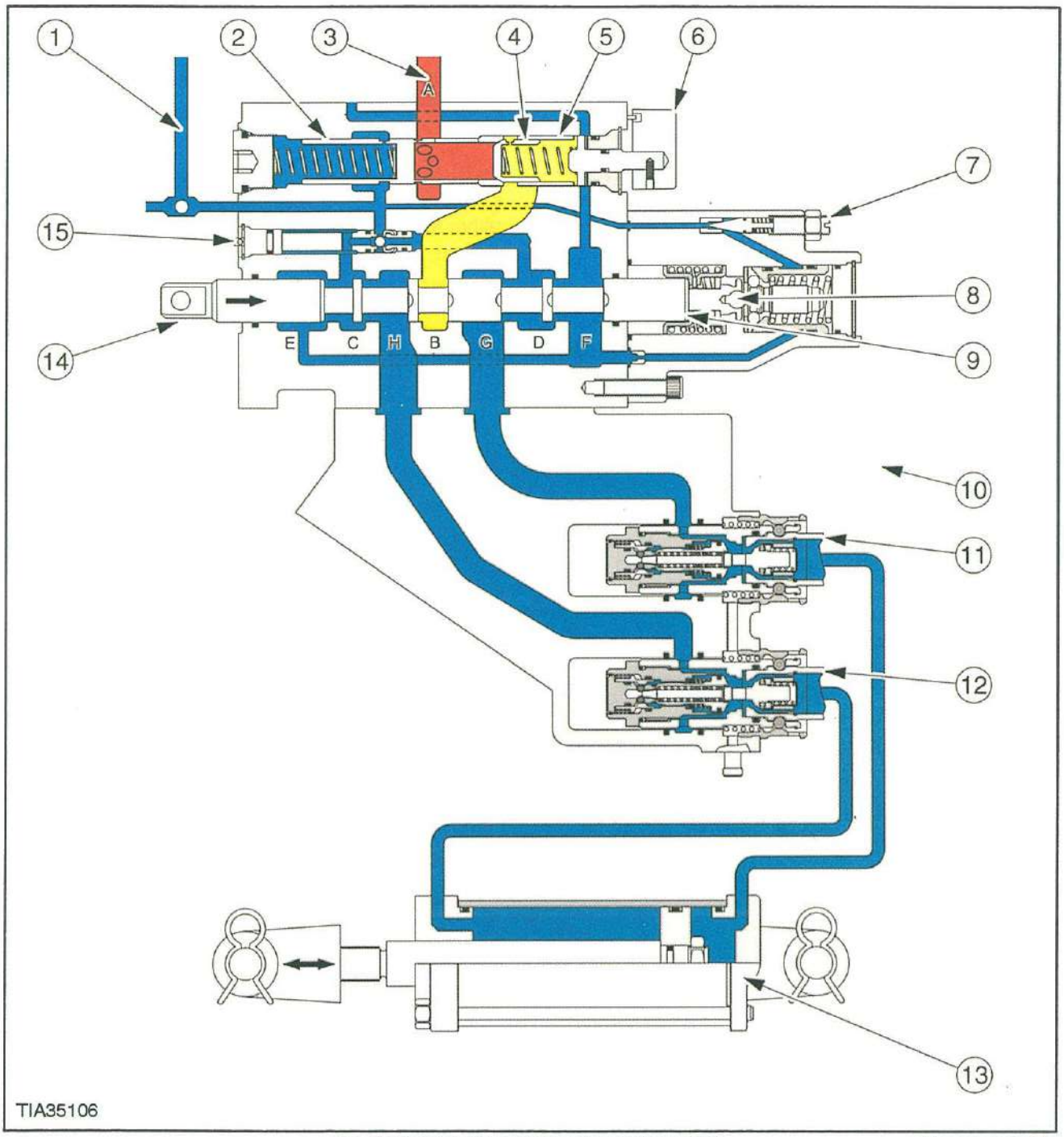
Lift port 'G' and drop port 'H' are connected to return galleries 'F' and 'E' allowing the remote cylinder to float and assume any position.

Galleries 'C' and 'D' are also connected to the return oil galleries 'E' and 'F', allowing only low back pressure to either side of the shuttle check valve.

The load sensing line is not pressurized allowing the variable displacement piston pump to remain in low pressure standby, until hydraulic demands are made on the pump by other hydraulic circuits.

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Single Remote Control Valve Operation–Float **Figure 8-6-17**

Pump Pressure Oil | Exhaust Oil | Trapped Oil

1. Load Sensing (Pilot) line
2. Flow Control Spool
3. Hydraulic Pump Supply
4. Load Check Valve
5. Flow Control Restrictor
6. Flow Control Knob
7. Detent Regulating Valve
8. Detent Spool Assembly
9. Centering Spring
10. Extend Coupler
11. Retract Coupler
12. External Cylinder
13. Control Valve Spool
14. Shuttle Check Valve

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PRESSURE TESTING

After servicing and if the control levers and spool are returning to neutral prematurely, the detent regulating valve should be tested as follows:–

In the illustrations shown in the following example the detent regulating valve (1) for remote valve No 1 is being checked.

1. Install inlet hose of a flowmeter into **extend** (raise) coupler of valve to be tested and set flow control knob to maximum flow.

2. Install return hose from flow meter into **extend** (raise) coupler of another remote valve on tractor.

   Do Not install return hose of flow meter into extend port of either remote valve I or II that are installed with lock valves because this type of remote valve cannot be operated in 'Float', unless the control button on the remote valve lever is manually held in the depressed position.

3. Ensure load valve (1) on flow meter is fully open.

4. Push lever for remote valve receiving the return oil from the flowmeter fully forward into **float**.

5. Start tractor and set engine speed to 1500 rev/min.

6. Pull lever of remote control valve to be tested, fully rearwards, to the extend position.

7. Slowly close flowmeter load valve and the lever should return to neutral at 2150–2350 lbf/in^2 (148–162 bar).

8. Adjust detent regulating valve if required. Half a turn of screw is equivalent to approximately 450 lbf/in^2 (32 bar).

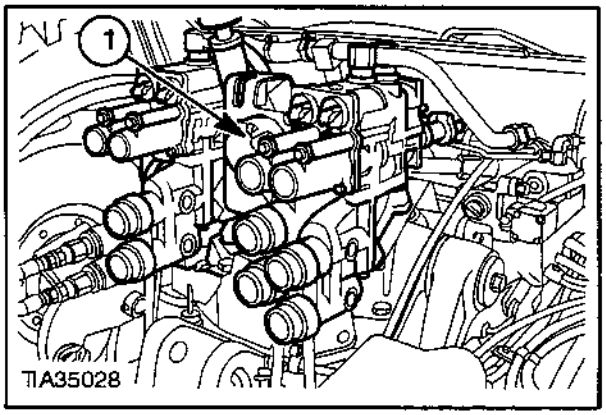


Figure 8-6-18

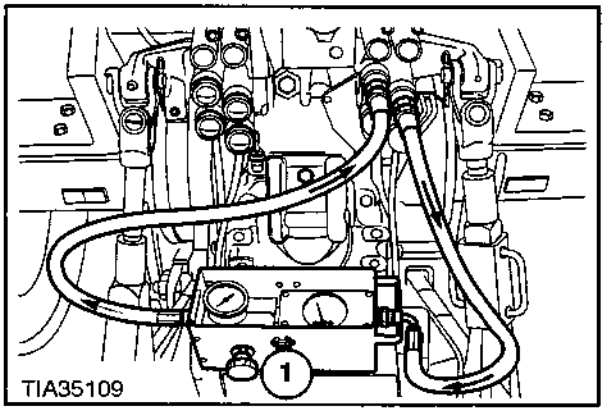


Figure 8-6-19

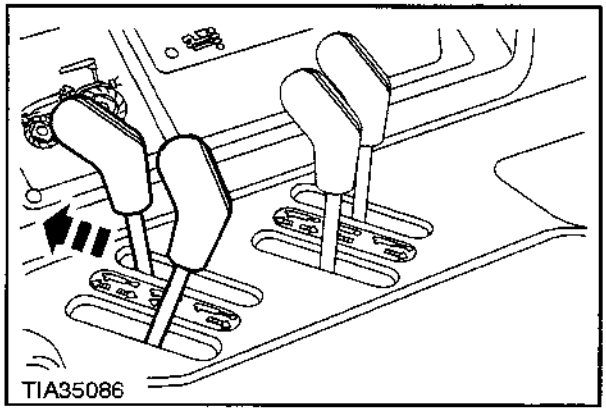


Figure 8-6-20

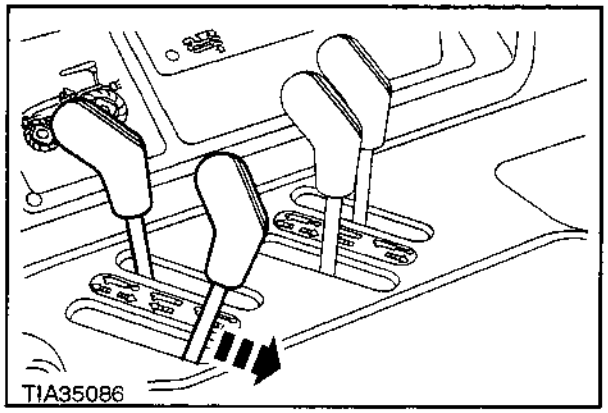


Figure 8-6-21

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OVERHAUL

Lock Valve

Servicing of the lock valve assembly (1) is restricted to the following:–

Replacement of the coil and connector

Replacement of 'O' Ring seals

Replacement of solenoid valve assembly

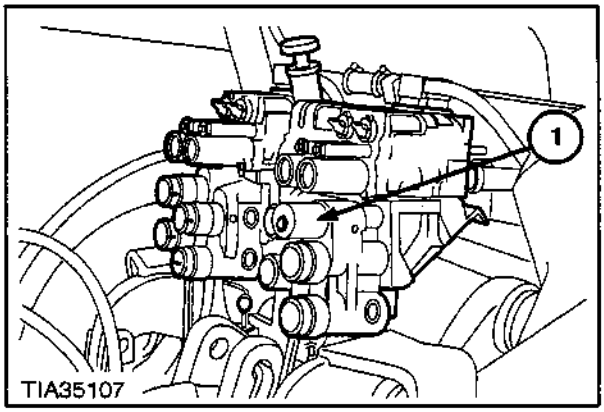
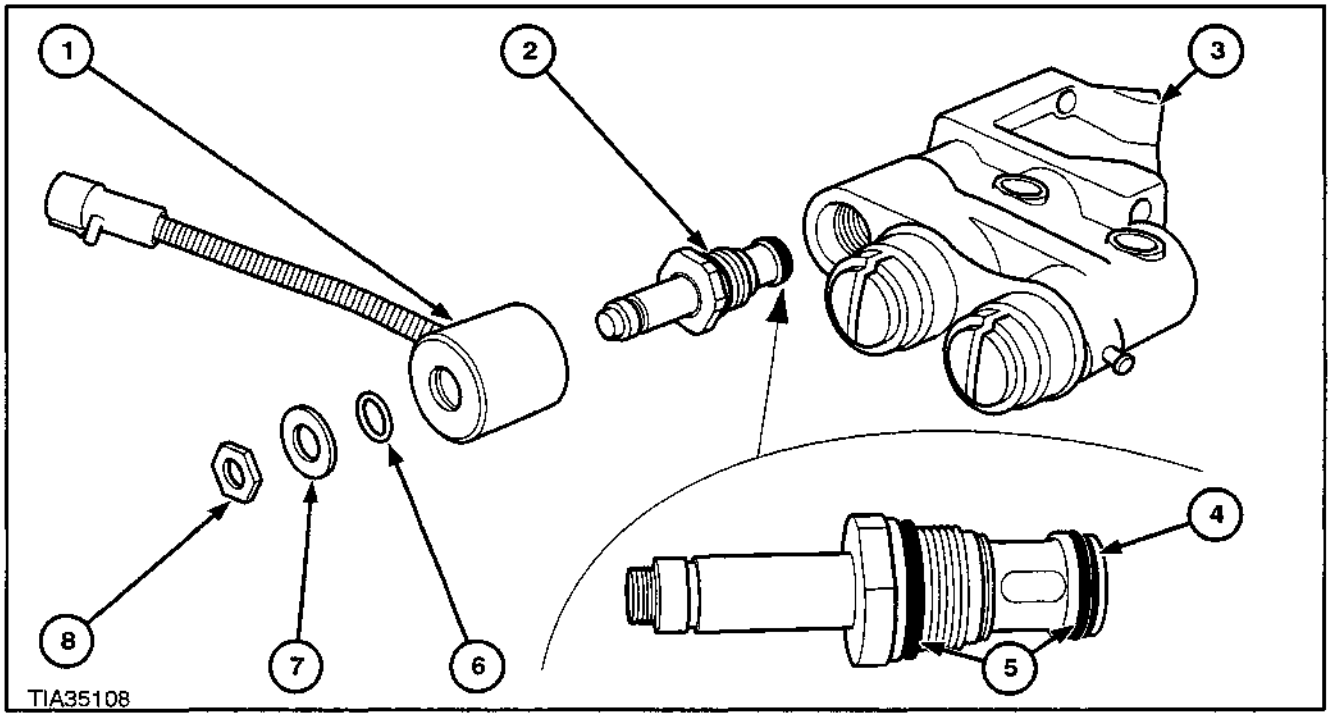


Figure 8-6-22



Anti Leak– Down Valve Assembly

1. Solenoid
2. Anti Leak– Down Valve
3. Coupler Housing
4. Back–Up Ring
5. 'O' Rings
6. 'O" Ring
7. Washer
8. Nut

1. Remove solenoid (1) and lock valve (2)
2. Examine valve and replace 'O' ring and back up ring if required.
3. Screw valve into housing and tighten to a torque of 33–37 ft. lbs. (45–50 Nm).
4. Install solenoid and tighten retaining nut to a torque of 12–15 ft. lbs. (16–20 Nm).

NOTE: *If a lock valve is not installed a plug is screwed into the coupler housing and tightened to a torque of 65–75 ft. lbs. (88–102 Nm).*

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Remote Valve Coupler
Removal and Replacement

NOTE: *It is not necessary to remove coupler housing (1) from tractor to perform this operation*

1. Use either Tool FNH00095 or a locally manufactured tool as shown below to unscrew coupling (1) from housing.

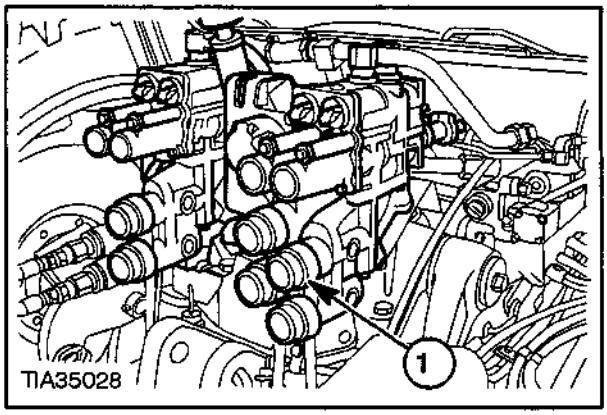


Figure 8-6-23

Coupler Removal Tool – Local Manufacture

1. 30 mm Socket (welded inside item 2)
2. Sleeve
3. Hardened Locking Screw (3 off) made from 0.250 in (6 mm) Bolts

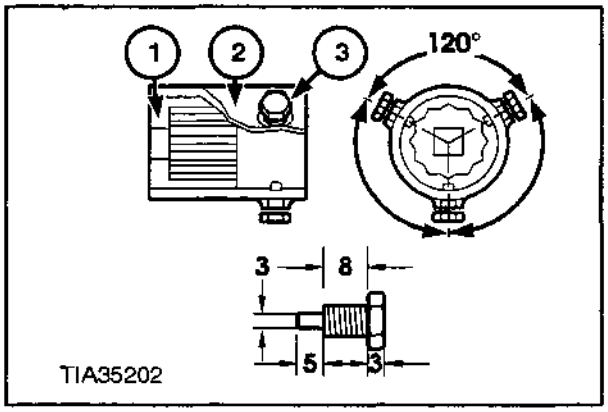


Figure 8-6-24

2. Unscrew coupler (1) from housing and if disassembly is required refer to Figure 8-6-30.

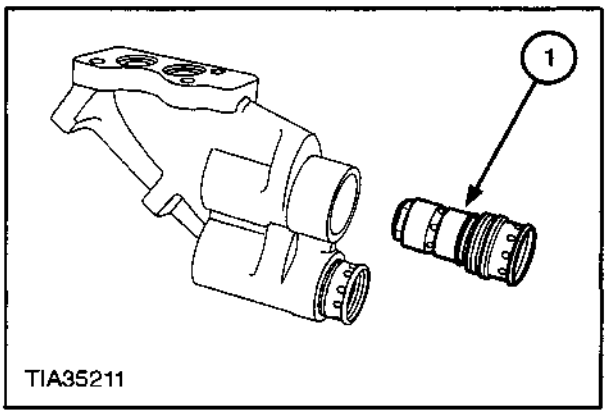


Figure 8-6-25

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3. Remove the two 'O' rings (1) and slipper seals (2) from the coupler housing.

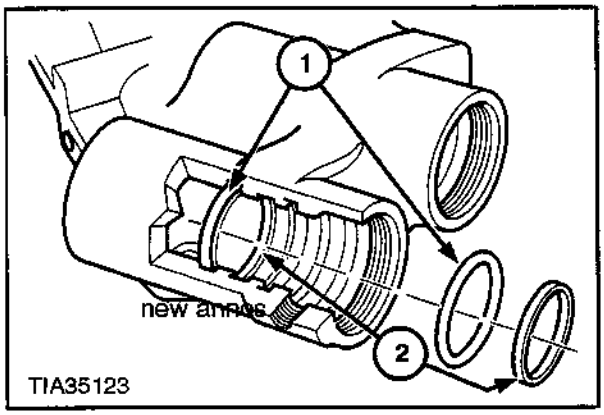


Figure 8-6-26

4. Lightly oil two new 'O' ring seals prior to installation and install into the coupler housing grooves.

5. Shape the new slipper seals as shown and locate inside 'O' ring seals. Use a clean finger to smooth the seals into position.

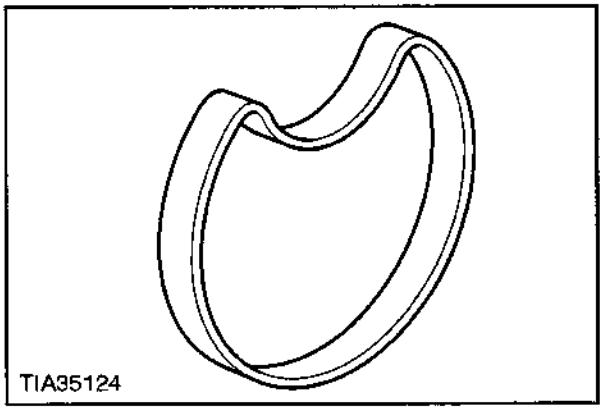


Figure 8-6-27

6. Insert slipper seal tool No FT 8611 (1) into the housing (2) and rotate back and forth. This operation slightly stretches and seats the seals in order that the coupling can be installed.

NOTE: *It is important that this stretching operation is performed before the coupler is installed. failure to use the special tool could result in damage to the slipper seals.*

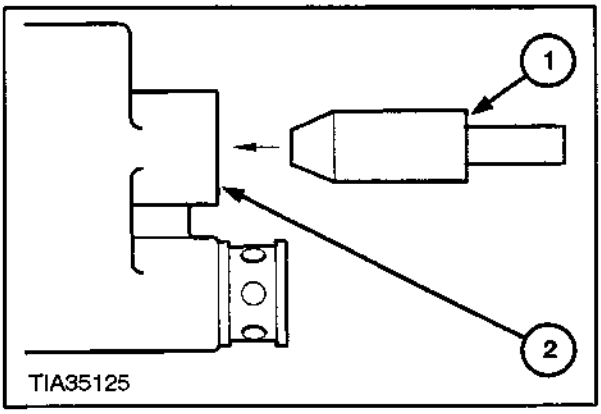


Figure 8-6-28

7. Lightly oil coupler and carefully install into the housing.

8. Install and tighten sleeve to a torque of 60 ft. lbs. (82 Nm)

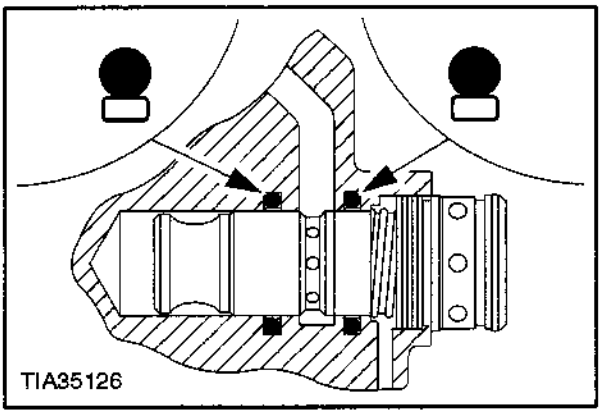
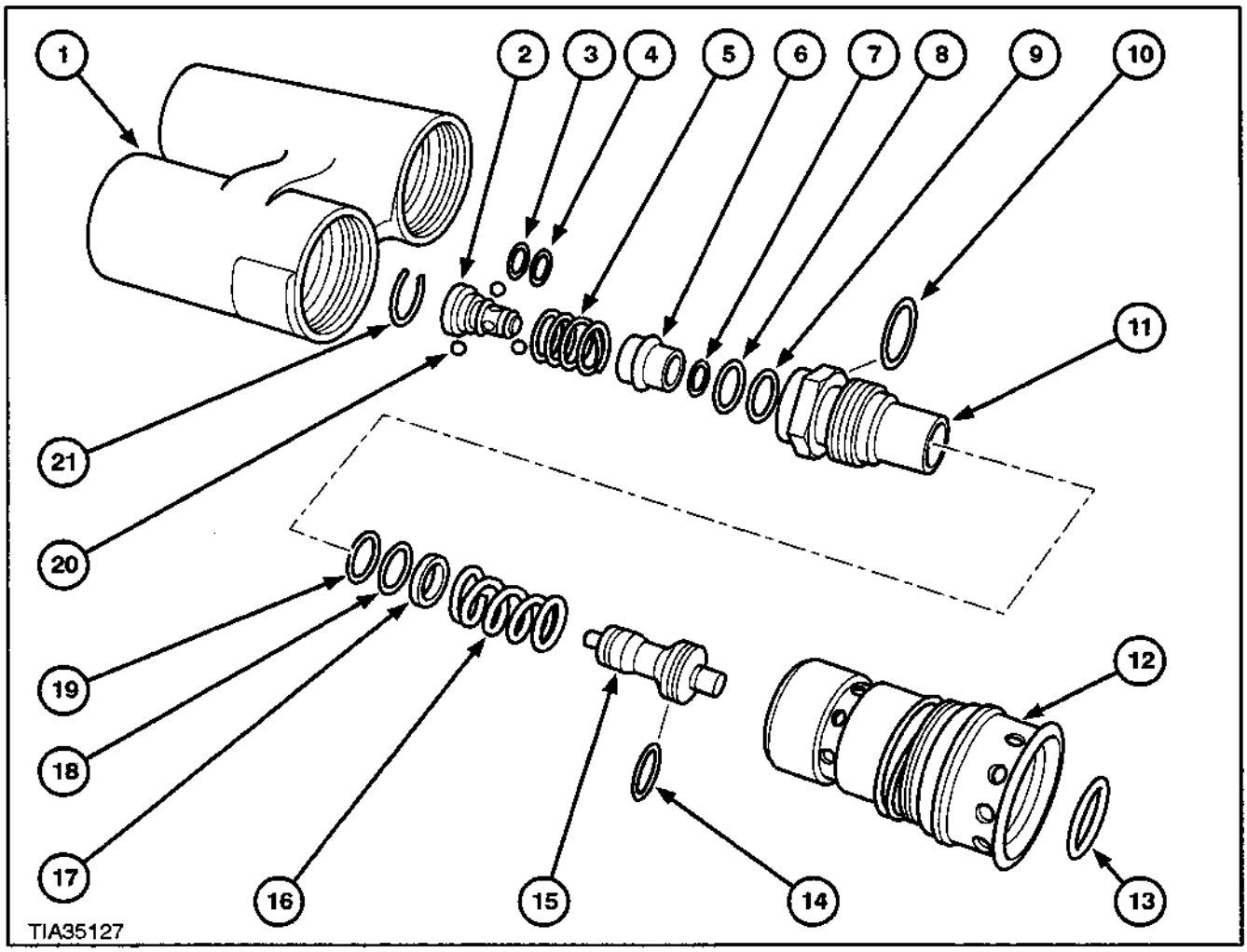


Figure 8-6-29

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Remote Valve Coupler

Figure 8-6-30

1. Coupler Housing
2. Locking Body
3. Back–up Ring
4. 'O' Ring
5. Spring
6. Locking Sleeve
7. Retaining Ring
8. Back–up Ring
9. 'O' Ring
10. 'O' Ring
11. Adaptor
12. Sleeve Assembly
13. Front Sealing Ring
14. 'O' Ring
15. Probe Assembly
16. Spring
17. Washer
18. 'O' Ring
19. Back–up Ring
20. Locking Balls
21. Retaining Ring

Remote Valve Coupler – Disassembly

9. Replacement couplers are provided as pre assembled cartridges.

If it is necessary to disassemble a cartidge refer to illustration shown above

10. Re–assemble the coupler using the disassembly procedure in reverse.

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Control Valve Housing–Overhaul

1. Disconnect supply line (1), return line (2), Load sensing line (3) and control linkage (4).

2. Unbolt and remove valve and coupler housing from rear of tractor.

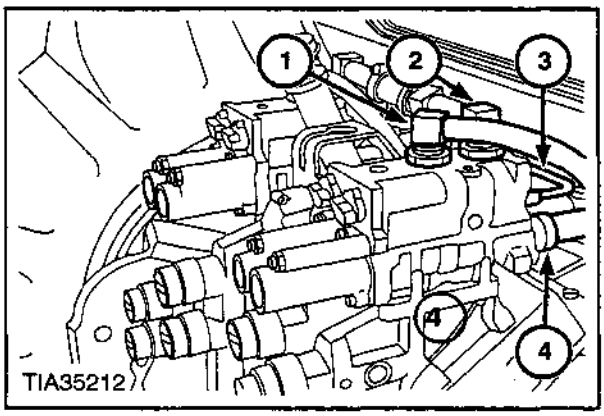


Figure 8-6-31

3. Separate control valve housing (1) from coupling housing (2).

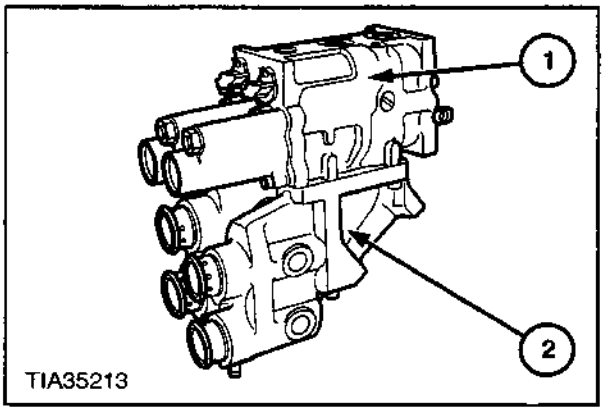


Figure 8-6-32

4. Remove plug (3) and withdraw spring (2) and flow control spool (1) from rear of housing.

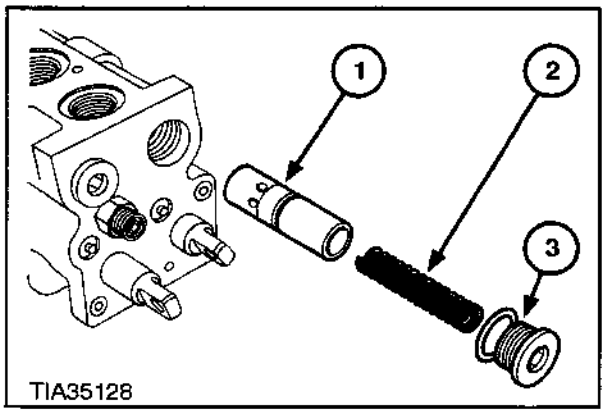


Figure 8-6-33

5. Remove flow control knob (3), push plug (1) as far as possible into housing and remove spiral circlip (2).

NOTE: *The plug can only be pushed into the housing by approximately 0.040 in (1 mm) and is just sufficient to allow removal of the spiral circlip.*

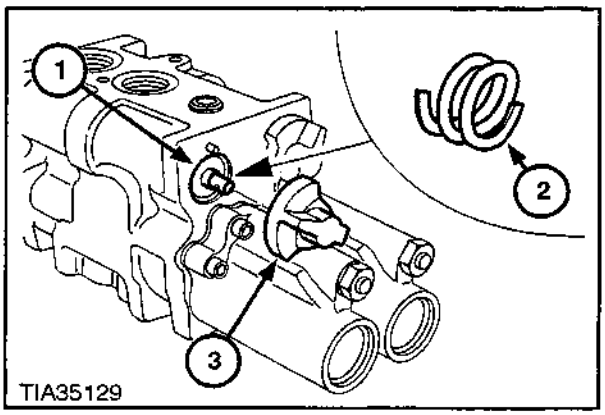
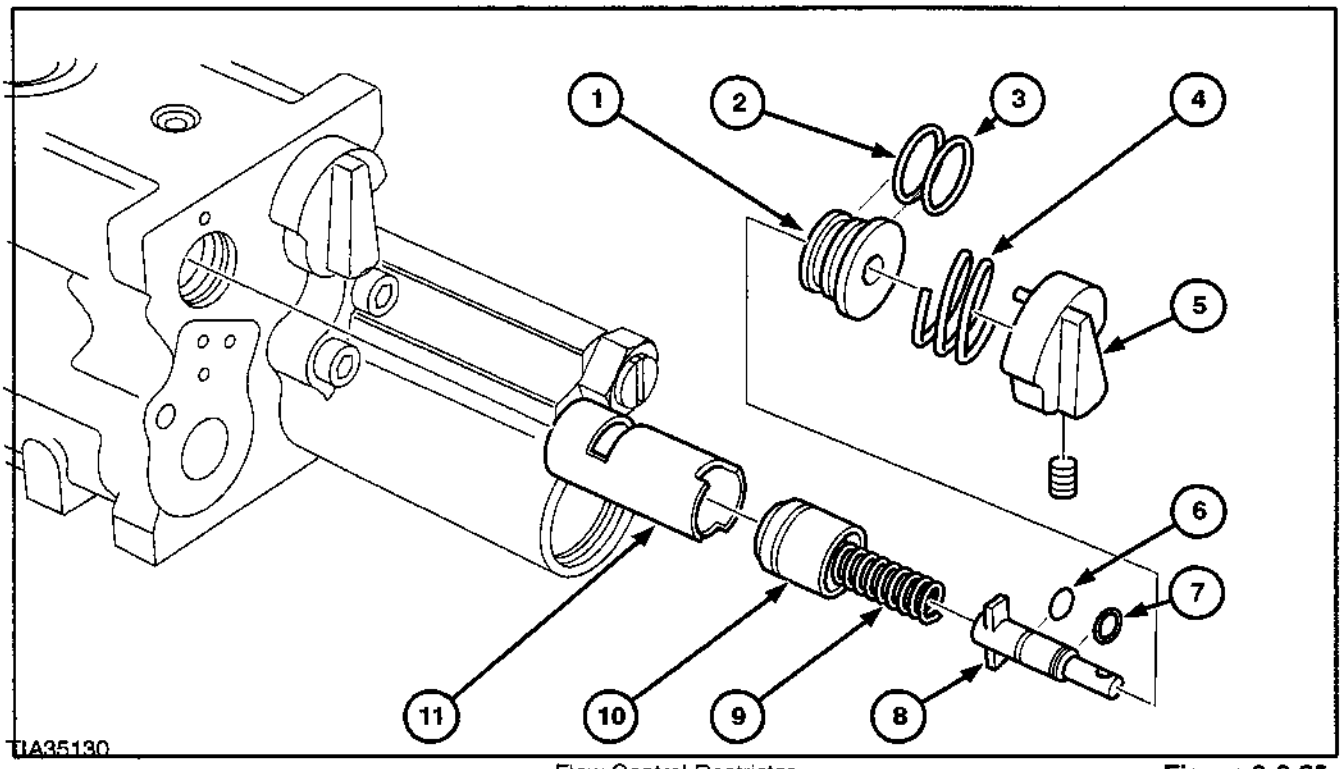


Figure 8-6-34

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Flow Control Restrictor

Figure 8-6-35

1. Restrictor End Plug
2. 'O' Ring
3. Back–up Ring
4. Spiral Circlip
5. Knob
6. 'O' Ring
7. Back–up Ring
8. Shaft
9. Spring
10. Load Check Valve
11. Flow Restrictor

6. Disassemble flow control restrictor.

7. Remove fixing screws and pull detent assembly (1) with a sharp jerk from the end of the control spool centering assembly (3). Collect 'O' ring (2).

8. Disassemble detent assembly with reference to Figure 8-6-38. Use a press to push end cap into detent housing to enable removal of snap ring. Carefully release press and allow the spring within the detent housing to eject the plug.

9. Remove centering spring assembly (3) with reference to Figure 8-6-39.

10. Remove spool.

NOTE: *To prevent spool damage due to presence of any paint on linkage end of spool, remove spool from opposite end of housing to that which the centering spring was fitted*

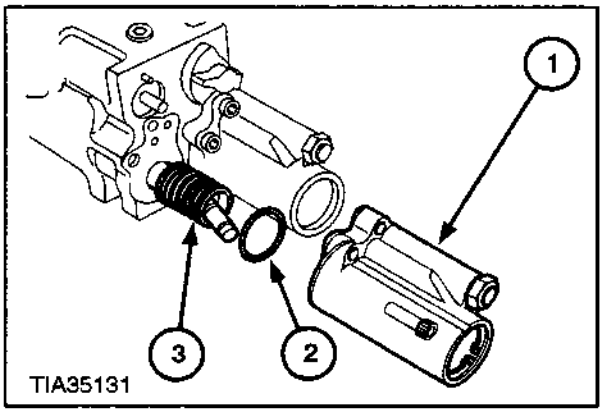


Figure 8-6-36

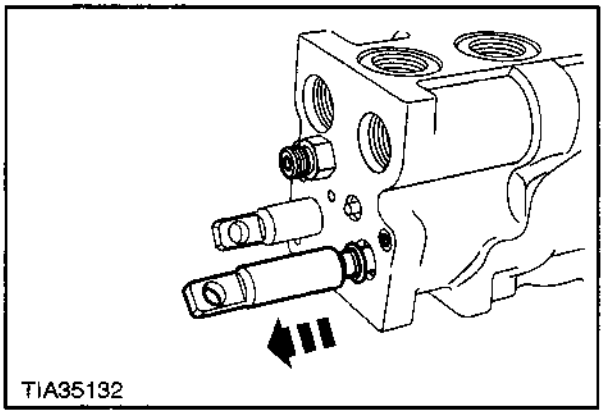
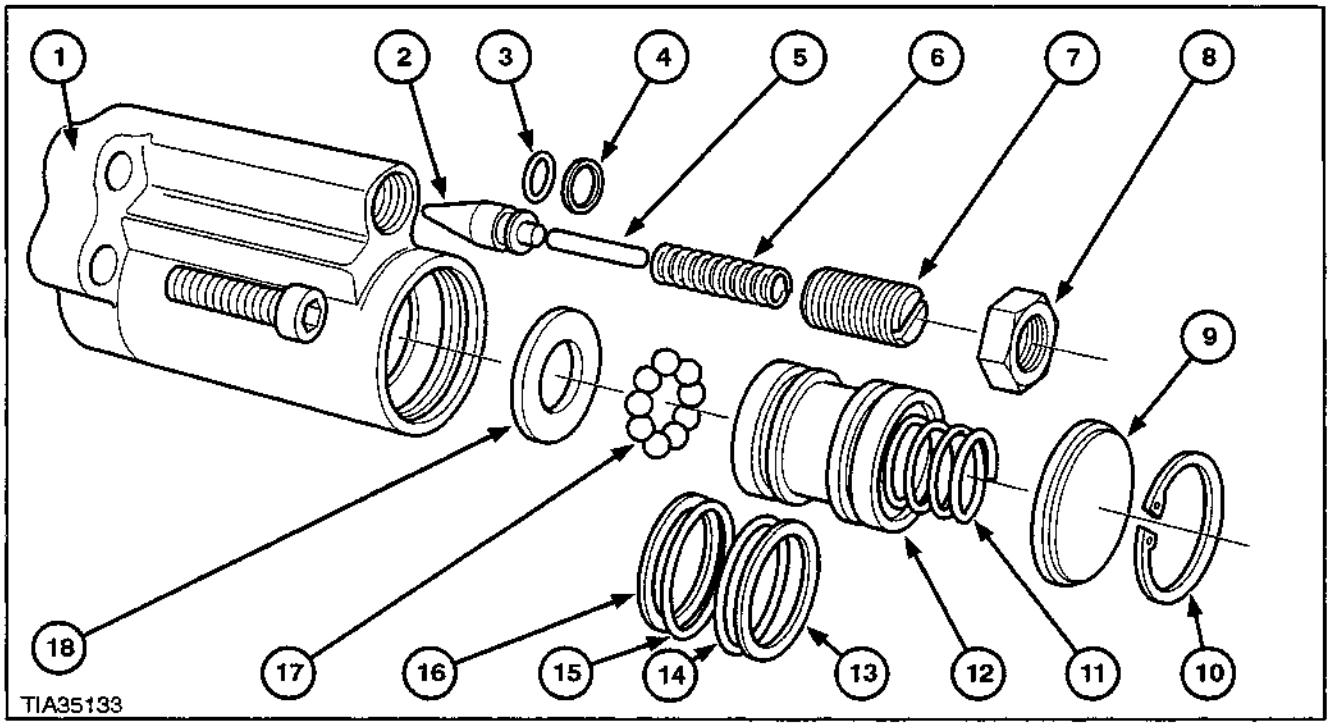


Figure 8-6-37

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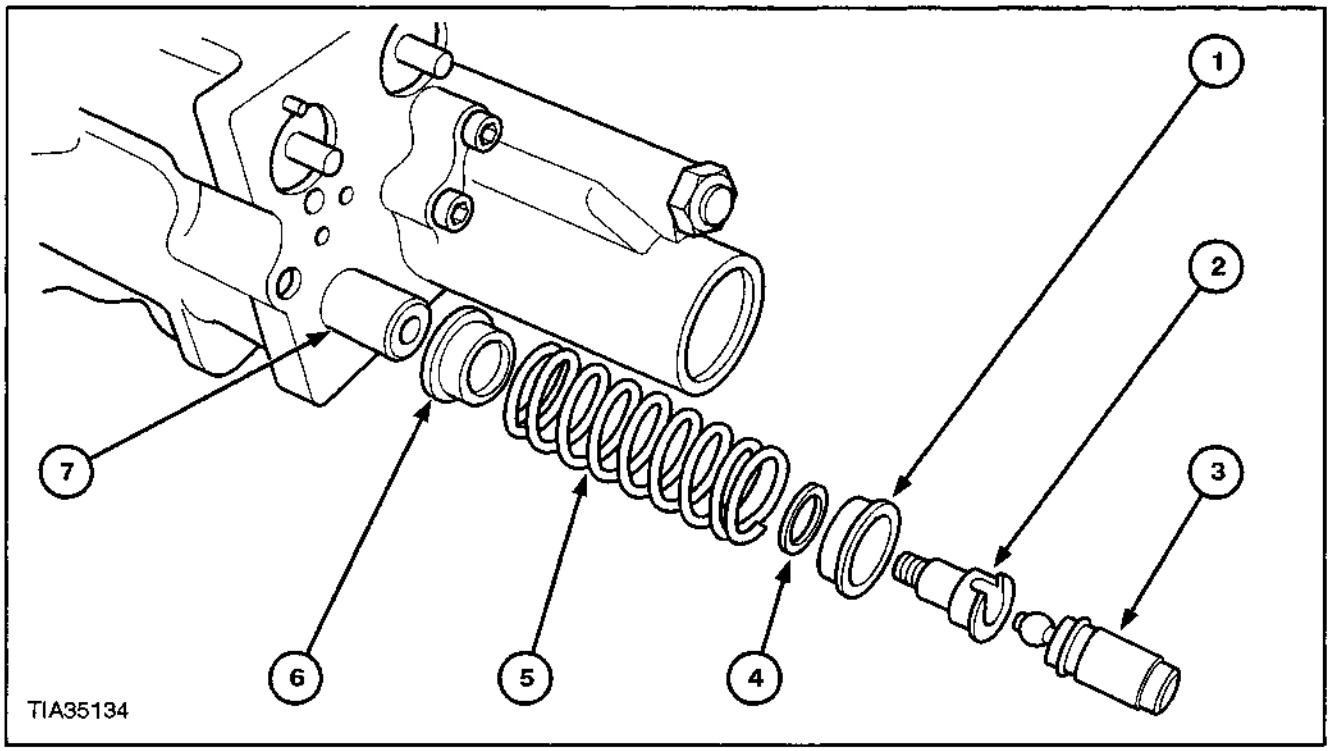
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Detent Mechanism

Figure 8-6-38

1. Detent Housing
2. Valve
3. O' Ring
4. Back–up Ring
5. Rod
6. Spring
7. Adjuster
8. Lock Nut
9. End Cap
10. Snap Ring
11. Spring
12. Detent Spool
13. Back–up Ring
14. 'O' Ring
15. 'O' Ring
16. Back–up Ring
17. Detent Balls
18. Washer



Centering Spring Assembly

Figure 8-6-39

1. Retainer
2. Shaft
3. Detent Plunger
4. Washer
5. Spring
6. Retainer
7. Main Spool

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11. Remove spiral circlip and using a small rod withdraw shuttle check valve.

1. Shuttle Check Valve
2. 'O' Ring
3. Back–up Ring
4. Rod (to assist removal of valve)
5. 'O' Rings

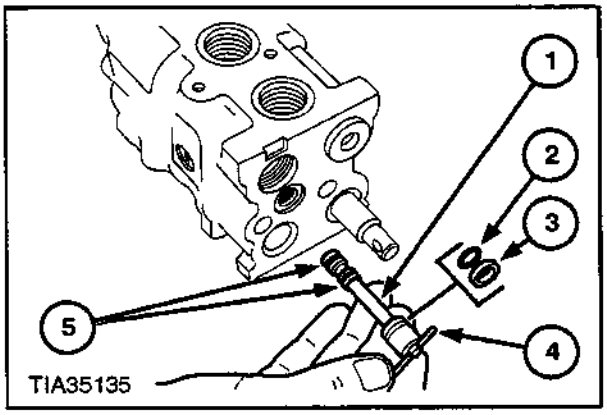


Figure 8-6-40

12. Remove priority check valve.

1. Ball
2. Seat
3. 'O' Rings

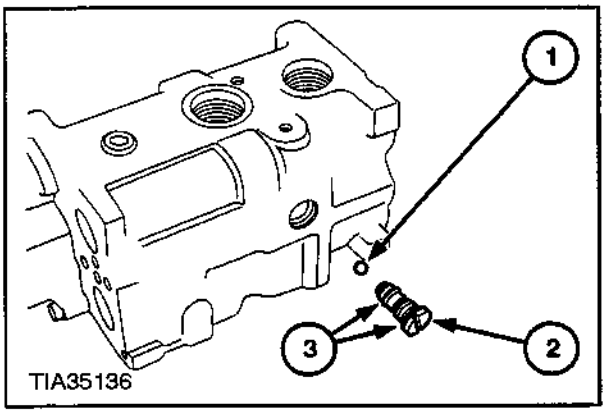


Figure 8-6-41

INSPECTION AND RE–ASSEMBLY

1. Inspect all components for wear or damage. The main spool, flow control spool and restrictor assembly are matched to the valve body and are not available separately.

2. Replace all 'O' rings and back–up rings.

3. Re–assemble with reference to Figure 8-6-44 and install main spool 'O' ring seals as described below.

   Position the 'O' ring (1) into the detent end of the housing.

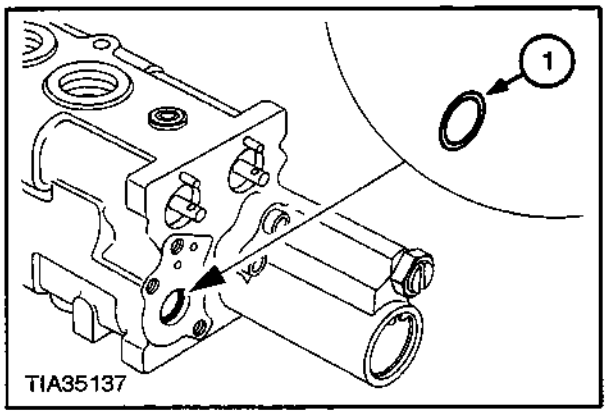


Figure 8-6-42

   Insert the spool (1) from the opposite end of the housing to position shown, then install remaining 'O ring (2).

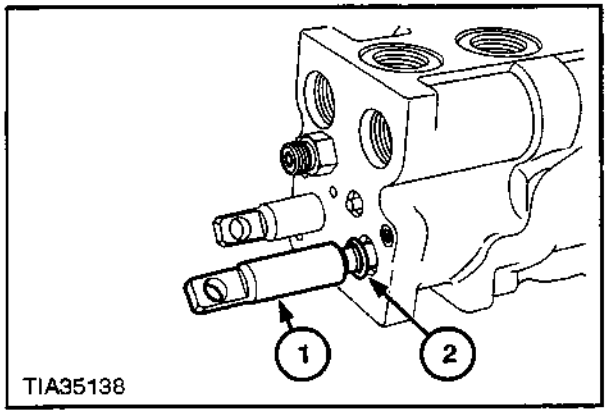
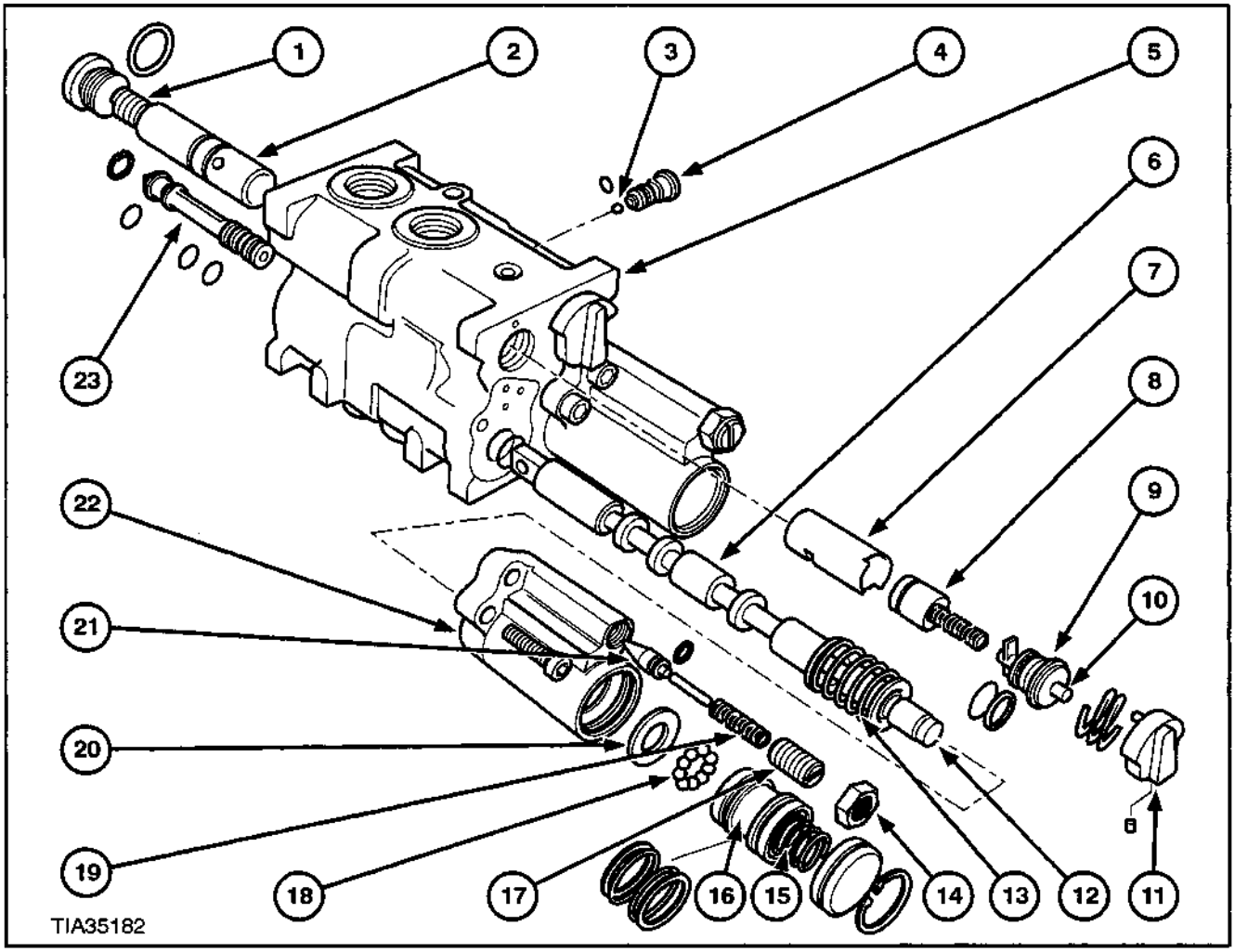


Figure 8-6-43

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Double Spool Remote Control Valve

Figure 8-6-44

1. Flow Control Spring
2. Flow Control Spool
3. Priority Check Valve Ball (double spool only)
4. Priority Check Valve Retainer
5. Valve Body
6. Spool
7. Flow Restrictor**
8. Load Check Valve
9. Flow Restrictor End Plug
10. Flow Restrictor Control Shaft
11. Flow Restrictor Control Knob
12. Detent Shaft
13. Spool Centering Spring
14. Locknut
15. Detent Piston Spring
16. Detent Piston
17. Detent Valve Spring Adjuster
18. Detent Balls (9 off)
19. Detent Regulating Valve Spring
20. Spacer
21. Detent Regulating Valve
22. Detent Housing
23. Shuttle Check Valve

** The flow restrictor **must** be installed with the large slot facing downwards

4. Apply thread sealant to the thread of the detent shaft. Assemble centering spring and screw shaft onto main spool, tightening to a maximum torque of 5 ft. lbs. (6.7 Nm).

5. Re–connect the valve housing to the coupler assembly, ensuring that the 'O' ring seals between the coupler and valve have not been omitted. Tighten the bolts to a torque of 11–15 ft. lbs. (15–20 Nm).

6. Assemble the valve and coupler to the tractor tightening the bolts to a torque of 20–26 ft. lbs. (27–35 Nm).

7. Reconnect the pipework and control lever cables.

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CABLE ADJUSTMENT

1. Move control valve spool (1) to 'Neutral' position and connect cable to spool.

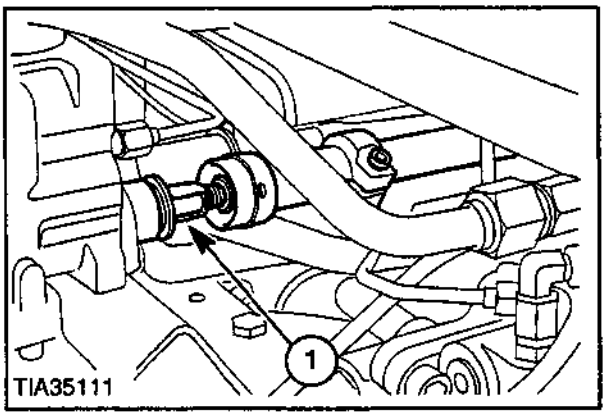


Figure 8-6-45

2. Slide cable outer sleeve (1) onto rear of control valve housing and fix in position using two split pins.

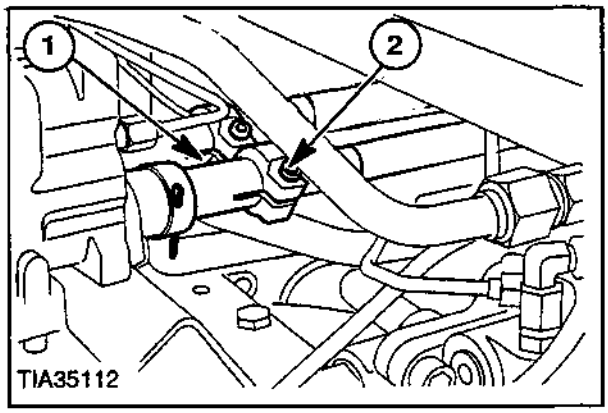


Figure 8-6-46

3. Using an assistant hold control lever in Neutral position.

4. Tighten outer sleeve clamp retaining bolt (2) and check for correct operation of the valve in 'Raise' Neutral' 'Lower' and 'Float' positions.

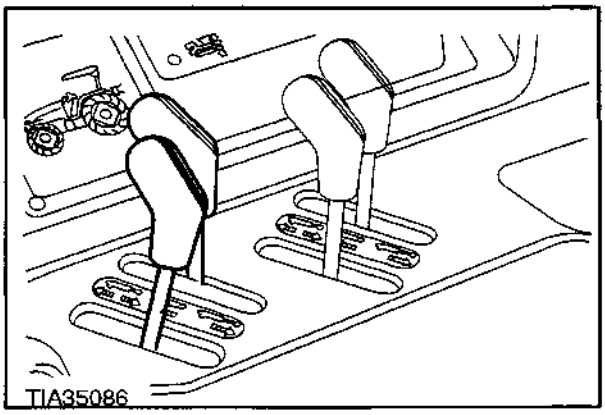


Figure 8-6-47

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SECTION 8

HYDRAULIC SYSTEM

CHAPTER 7

OPEN CENTER REMOTE CONTROL VALVES

(NOTE: NOT USED IN NORTH AMERICA)

CONTENTS

SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS 8-7-2
SECTIONAL VIEWS 8-7-3
DESCRIPTION AND OPERATION 8-7-5
REMOVAL – INSTALLATION – OVERHAUL 8-7-9
INDEX 8-9-4

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35 000 – SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION

SPECIFICATIONS

Filter	Full–flow, paper cartridge (same filter as for the hydraulic lift circuit)
Pump	Gear–type (same pump feeding the hydraulic lift circuit, see Chapter 3)
Remote Control Valves	
Arrangement	Modular pack (4 valves max.) secured to the lift upper side
Control	By hand levers
Pressure regulating valve adjustment lbf/in^2 (bar)	2760 to 2830 lbf/in^2 (194 to199 kg/cm^2) (190 to195)
Type	Convertible single to double acting, convertible single to double acting with automatic release, double acting with float and automatic release

TIGHTENING TORQUES

Remote control valves			
Screws, remote control valves	M10 x 1.25	127	9.6 ft. lbs. (13)

SPECIAL TOOLS

Caution – Operations described in this Section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to carry out the different operations described in this Section.

292870	Pressure test kit
294039 (X)	Flow control adjuster adjustment tool
293195	Kontak one–way valve seal protection

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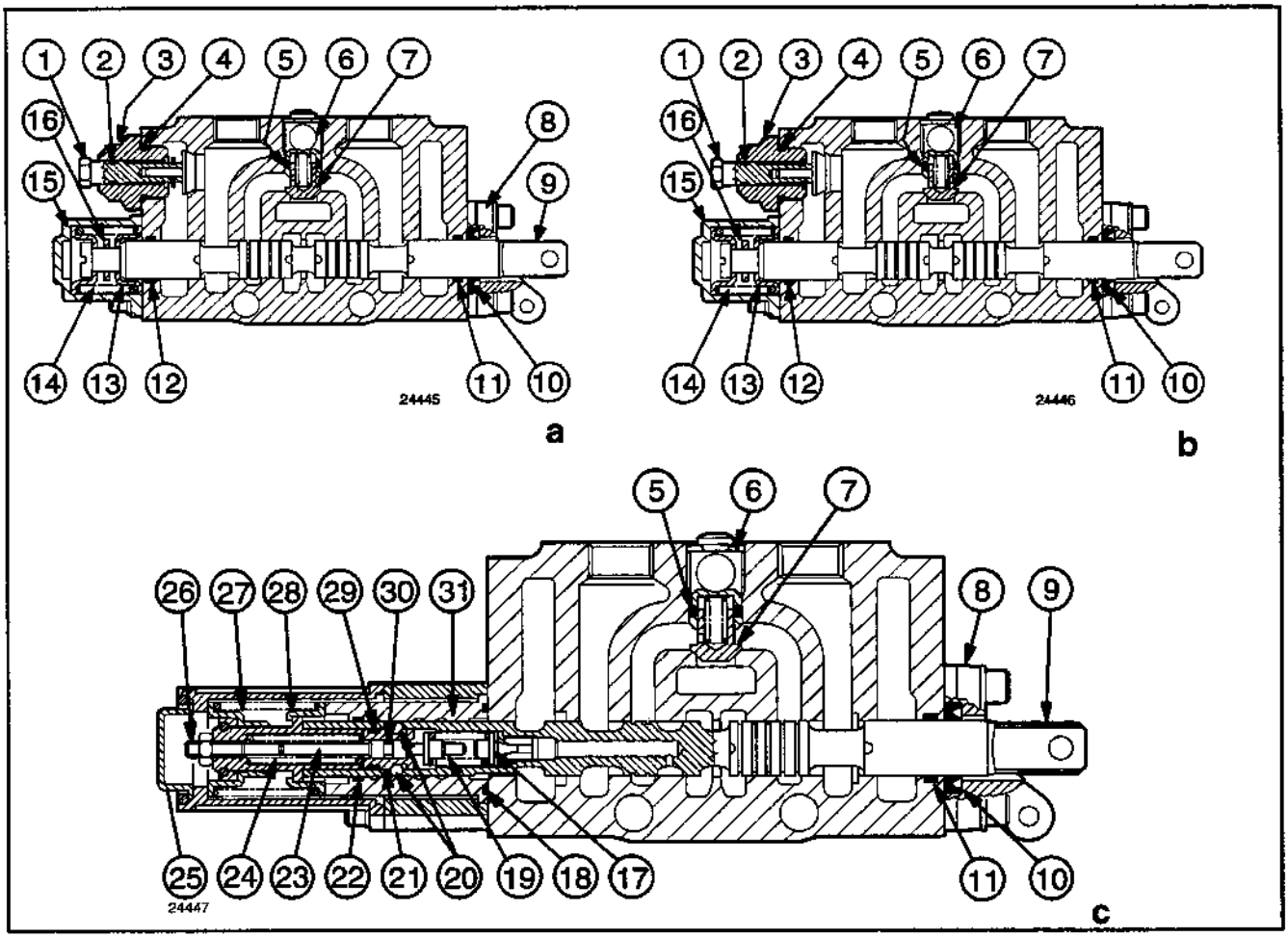


Figure 8-7-1

Sectional Views – Remote Control Valve

a. Remote control valve for double–acting cylinder
b. Remote control valve for single–acting cylinder
c. Double–acting remote control valve with float and automatic release
1. Single to double acting switching valve
2. Seal
3. Valve retaining cap
4. Seal
5. Seal
6. Check valve seat
7. Check valve
8. Control support
9. Valve control spool
10. Seal
11. Seal
12. Seal
13. Retainer
14. Valve spool return spring
15. Cover
16. Spacer
17. Taper pin
18. Seal
19. Spring
20. Detent balls
21. Ball support
22. Seal
23. Inner pin
24. Spring
25. Cover
26. Release pressure adjust screw
27. Valve spool return spring
28. Retainer
29. Seal
30. Seal
31. Ball seat body

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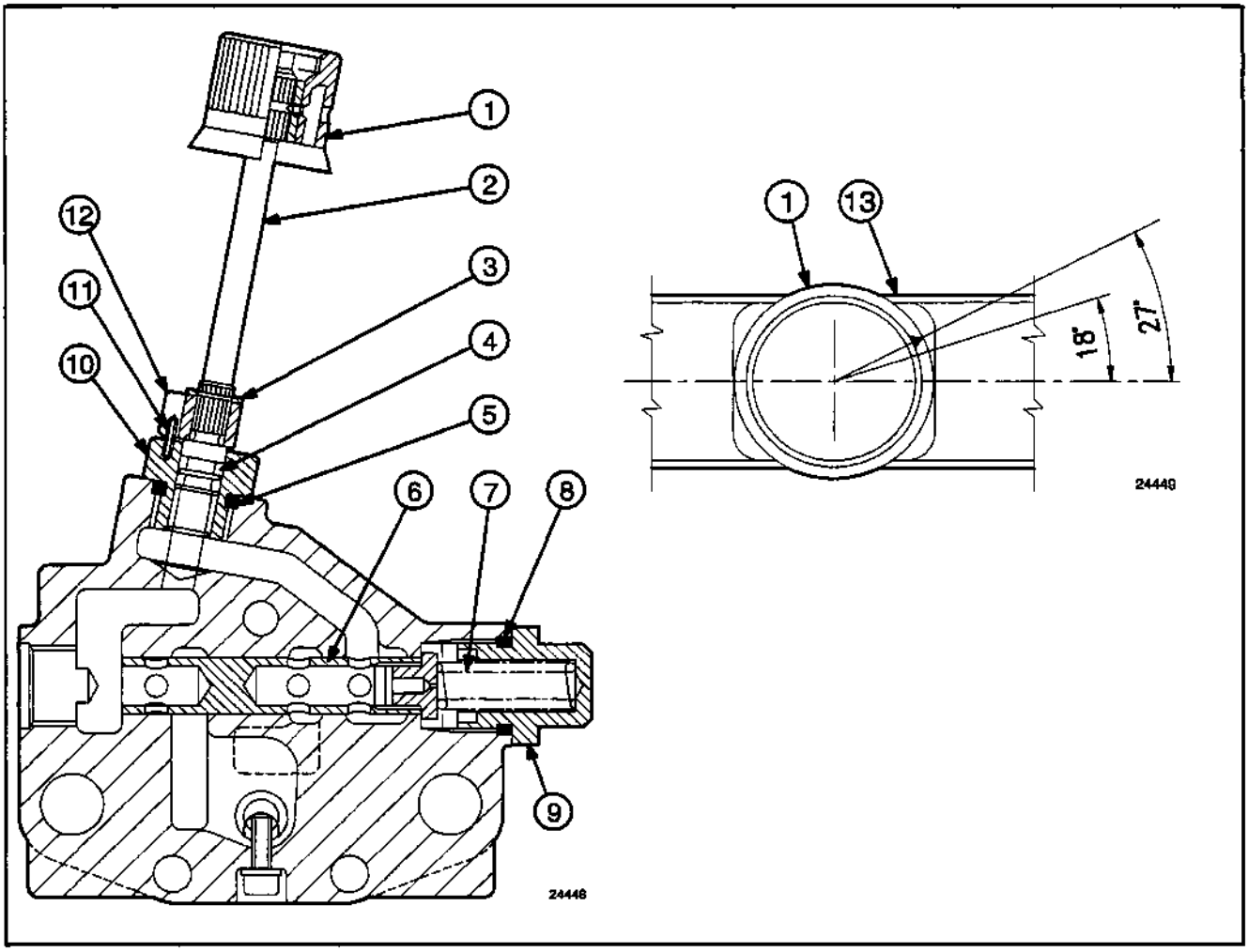


Figure 8-7-2

Sectional View – Flow Control Adjuster

1. Control pin knob
2. Control pin
3. Snap ring
4. Seal
5. Seal
6. Flow control valve
7. Spring
8. Seal
9. Plug
10. Control pin support plug
11. Spring pin
12. Detent fin bushing
13. Flow control adjuster body

Sectional View – Trailer Brake Release Pressure Regulating Valve

1. Inlet
2. Valve
3. Valve body
4. Seal
5. Spring
6. Outlet

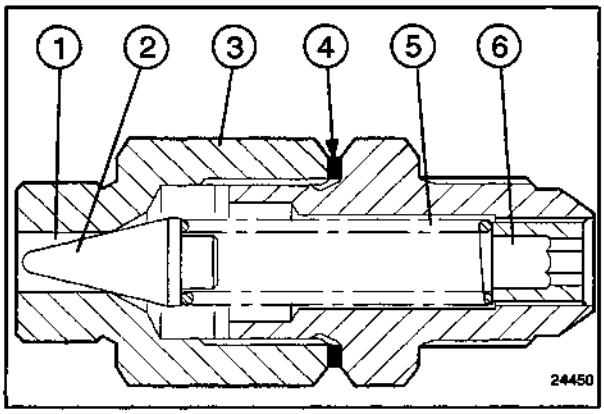


Figure 8-7-3

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DESCRIPTION AND OPERATION

The remote control valves are used to control external hydraulic implements connected to the tractor.

Tractors may be equipped with up to 4 remote control valves, which are secured to the upper side of the lift housing.

The remote valves are operated by means of control levers located at the operator's right side.

Each lever and corresponding valve are color coded, as follows:

Lever Color	Valve Location and No.	
Green	external, RH	-I
Blue	internal, RH	-II
Brown	internal, LH	-III
Black	external, LH	-III

Each remote valve control lever has three or four positions, as required by the type of valve controlled.

1. Raise – Pulling the lever towards the operator will extend the cylinder and raise the implement.

2. Neutral – Pushing the lever from the operator and away from the raise position will select the neutral position and deactivate the cylinder connected.

3. Lower – Pushing the lever farther from the operator, beyond the neutral position, will retract the cylinder and lower the implement.

4. Float (valves I and III only) – Pushing the lever still farther from the operator and beyond the lower position will select the float position. The cylinder extends or retracts freely, allowing implements such as loaders to adapt to the ground profile.

If four remote control valves are fitted, it is possible to install an alternative joy–stick control replacing control levers for remote valves I and II. Raise, Neutral, Lower and, only for valve I, Float.

Moving the joystick rearward or forward will raise or lower the implement connected to remote control valve I. If the joystick is pushed still forward, beyond the lower position, the valve reaches the floating position.

Moving the joystick towards the left or right will raise or lower the implement connected to remote control valve II. The floating position is not available for remote control valve II.

The joystick control has the advantage of activating two remote control valves at the same time by toggling the lever through positions for remote control valves I and II.

Tractors fitted with 4 remote control valves are equipped with a flow control adjuster which is located between valve I and valve II.

The flow control adjuster varies the oil flow to cylinder I. The control knob should be turned anticlockwise to reduce the flow, clockwise to increase it.

If the oil flow to valve I is increased, the amount of oil available for remaining valves and the hydraulic lift will be reduced.

Refer to pages 8-7-6 to 8-7-8 for detailed operation of the hydraulic remote valves.

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SCHEMATICS – OPERATING PHASES OF A REMOTE CONTROL VALVE CONTROLLING A DOUBLE – OR SINGLE–ACTING CYLINDER (FIGURES 4 & 5 AND 6 &7, RESPECTIVELY)

4. RAISE – When the cab control lever is pulled, the valve spool (2) moves and allows the oil to flow from the supply passage (E) to the cylinder lower chamber through the check valve (3) and passage (G) and from the cylinder upper chamber to the exhaust passage (L) through the passage (H), deviating the oil supply directed to the hydraulic lift valve. If the lever is kept pulled, full raise is achieved when the cylinder has reached the end of its stroke. Once released, the lever automatically moves back to the neutral position under the action of the return spring and all the oil flow from the pump is sent to the lift valve through the passages (M).

5. LOWER – To lower the implement, it is necessary to push the cab control lever. The valve spool (2) moves to the position shown in Figure 8-7-5 and allows oil trapped into the cylinder lower chamber to dump into the exhaust passage (L) through the passage (G) while upper chamber opens to the supply passage (E) through the passage (H) and check valve (3).

6. RAISE – When the cab control lever is pulled, the valve spool (2) moves and allows oil to flow from the supply passage (E) to the cylinder through the check valve (3) and passage (G). Passage (H), which is in use when controlling double–acting cylinders, is left unused now and remains permanently connected to the exhaust passage (L) through the switching valve (1) opening.

7. LOWER – When the cab control lever is pushed, the valve spool (2) moves to the position shown in figure 8-7-7. Oil trapped in the cylinder, under the weight of the implement raised, flows to the exhaust passage (L) through the passage (G) while all oil flowing from the pump is sent to the exhaust passage (L) through the check valve (3) and passage (H).

Pressure oil

Suction, delivery or exhaust oil

Trapped oil

Note: Fully tighten screw (1) to control a double–acting cylinder; unscrew to control a single–acting cylinder.

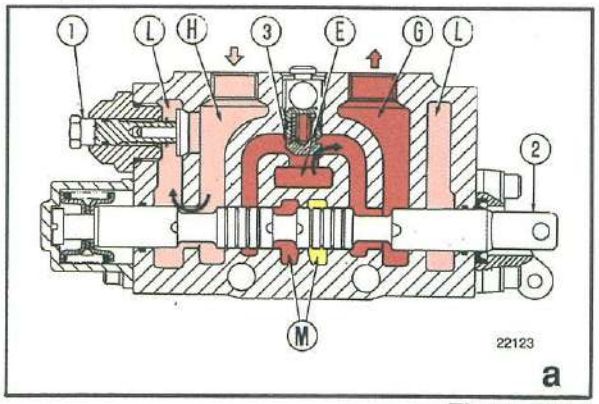


Figure 8-7-4

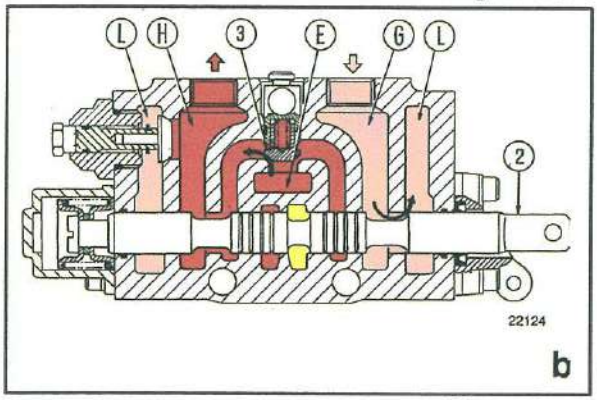


Figure 8-7-5

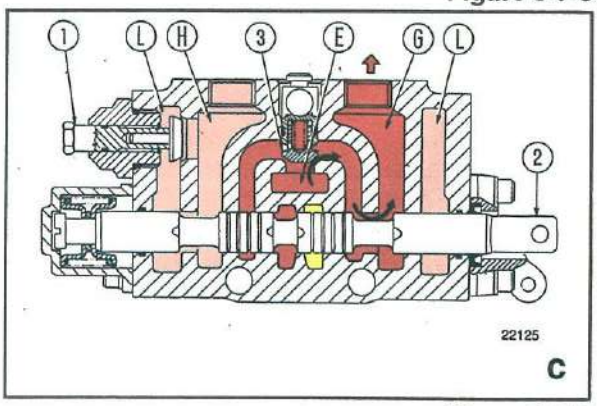


Figure 8-7-6

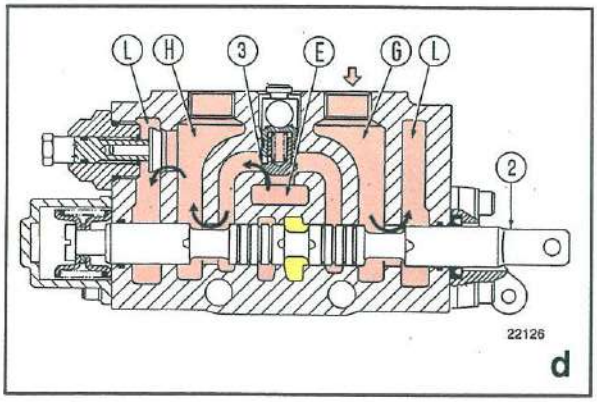


Figure 8-7-7

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SCHEMATICS – OPERATING PHASES OF A REMOTE CONTROL VALVE CONTROLLING A DOUBLE–ACTING CYLINDER WITH AUTOMATIC RELEASE

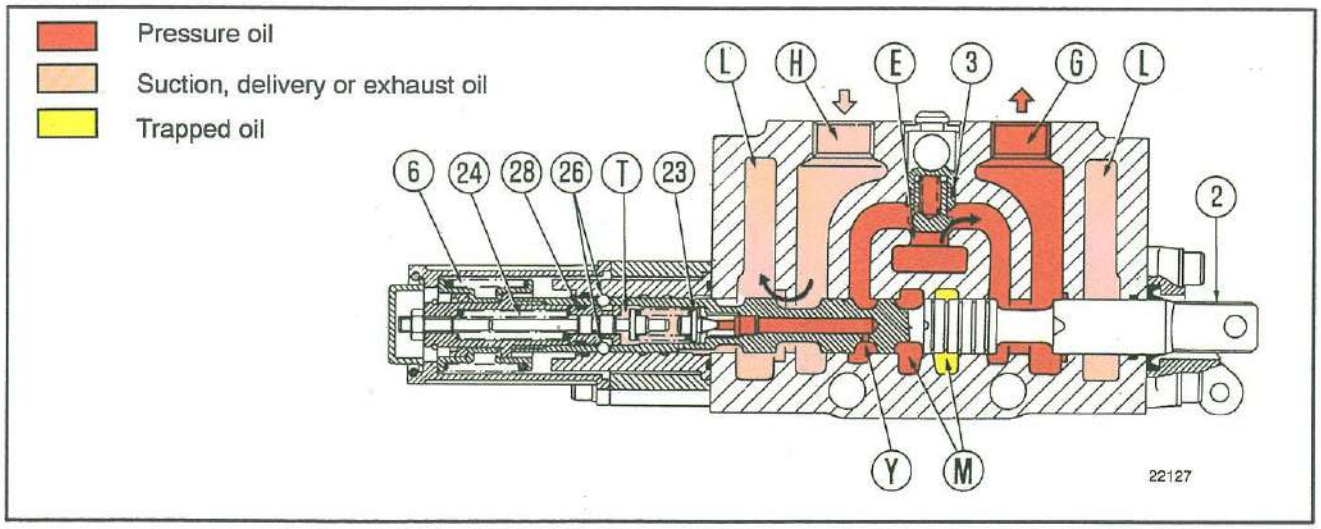


Figure 8-7-8

RAISE

When the cab control lever is pulled, the valve spool (2) moves and the balls (26) enter the left–hand seat where they remain trapped by the support (28) and spring (24). Spool (2) movement allows oil to flow from the supply passage (E) to the cylinder lower chamber through the check valve (3) and passage (G) and from the cylinder upper chamber to the exhaust passage (L) through the passage (H), deviating the oil supply directed to the hydraulic lift valve. Upon full raise, oil pressure increases reaching 2460 to 2540 lbf/in^2 (173 to 178 kg/cm^2) (170 to 175 bar) and through the drilling (V) overcomes the action of the tapered pin spring (23). Within the chamber (T), oil pressure against the support (28) increases until it overcomes the spring force and moves the support (28) back . As a consequence, the two balls (26) fall on the support (38) releasing the spool (2), that, under the action of the spring (6), returns to the neutral position. Consequently, all oil flowing from the pump is sent to the lift valve through the passages (M).

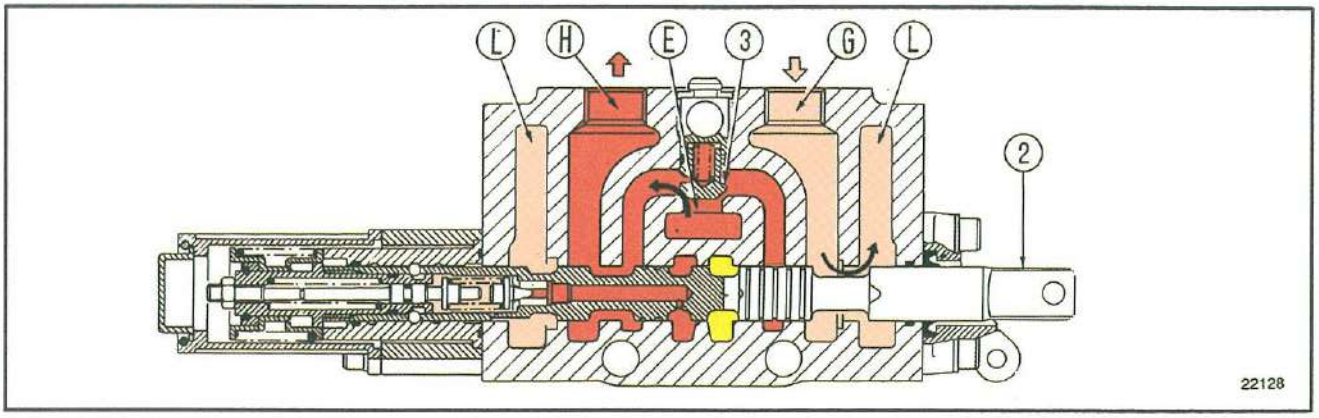


Figure 8-7-9

LOWER

To lower the implement, it is necessary to move the cab control lever forward. The valve spool (2) moves and the balls (26) enter the central seat where they remain trapped by the support (28) and spring (24). This condition allows oil trapped into the cylinder lower chamber to dump to the exhaust passage (L) through the passage (G) while the upper chamber opens to the supply passage (E) through the passage (H) and the check valve (3). When the implement is fully lowered , automatic release will take place, as previously described.

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SCHEMATICS – OPERATING PHASES OF A REMOTE CONTROL VALVE CONTROLLING A DOUBLE ACTING CYLINDER WITH AUTOMATIC RELEASE AND FLOAT

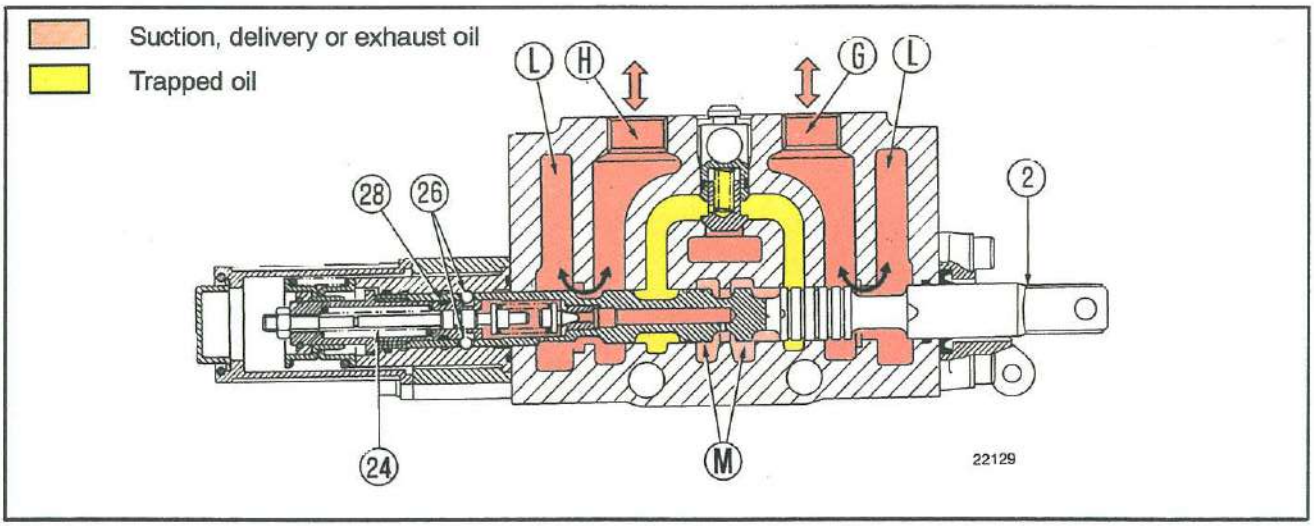


Figure 8-7-10

FLOAT

To obtain floating of the valve, the cab control lever should be pushed fully forward. The valve spool (2) moves and the balls (26) enter the right–hand seat where they remain trapped by the support and spring (24). With the spool (2) in this position, the way is open between the two passages (M) which send all oil flowing from the pump to the lift valve and between the two exhaust passages (L) and the cylinder upper and lower chambers, respectively, through the passages (H and G). Under these conditions, the implement connected rests on the ground with its weight and can adapt to the ground profile allowing use of the hydraulic lift. When floating, the automatic release cannot take place as there is no pressure inside the remote control valve.

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REMOTE CONTROL VALVE ASSEMBLY

Removal – Installation (Op. 35 204 40)

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Remove the remote control valves from the hydraulic lift as follows:

1. Open and raise engine hood.
2. Detach negative cable (1) from battery and insulate.
3. Remove the top link rod.

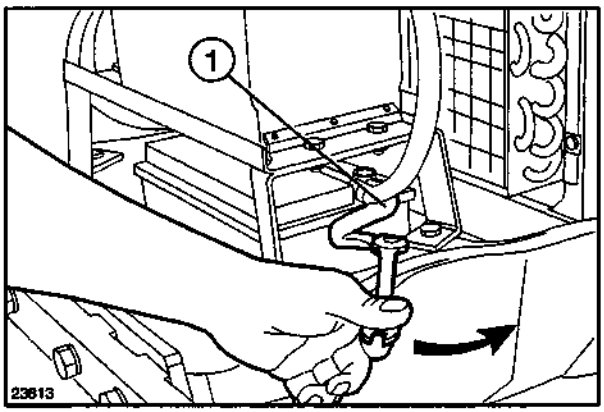


Figure 8-7-11

4. Loosen the retaining screw and remove the flow adjuster control knob (1).

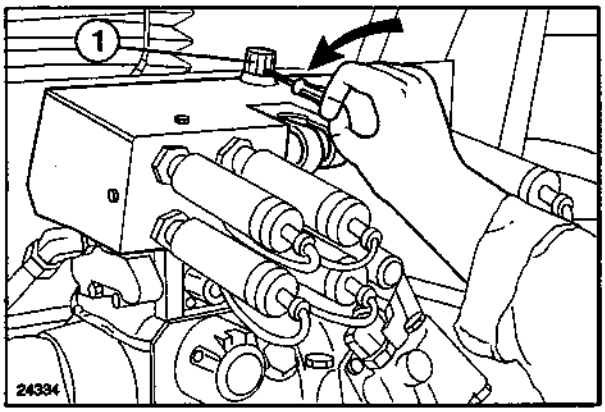


Figure 8-7-12

5. Loosen the retaining screws and retrieve the remote valve protection cover (1).

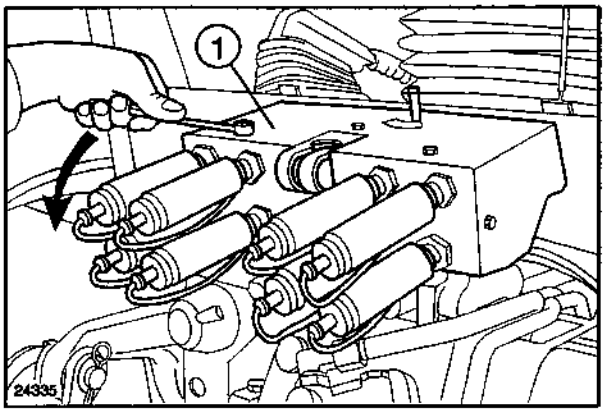


Figure 8-7-13

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6. Detach remote valve supply and exhaust lines (2 and 1).

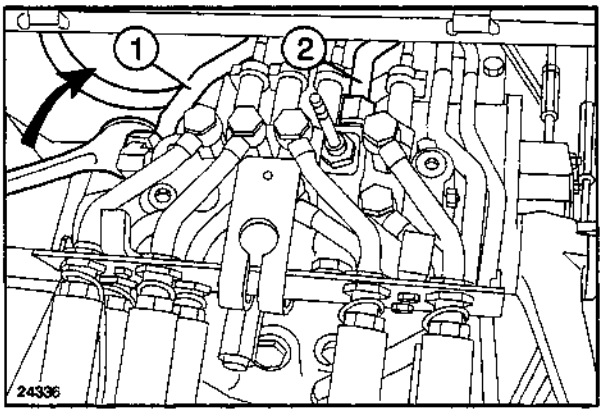


Figure 8-7-14

7. Slide out the cotter pins (1) and detach control cables from respective remote valves.

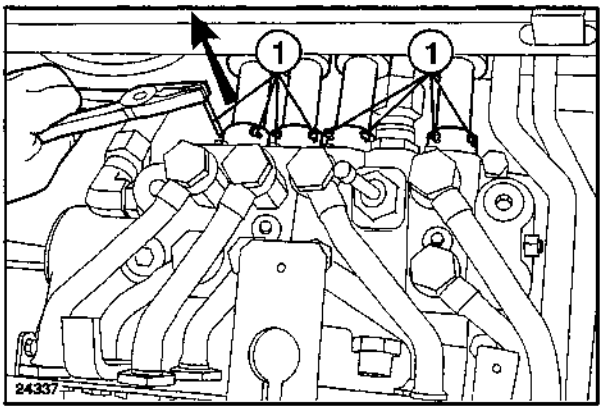


Figure 8-7-15

8. Loosen the retaining screws and remove the remote control valve assembly.
9. Reinstallation of the remote control valves follows the removal procedure in reverse

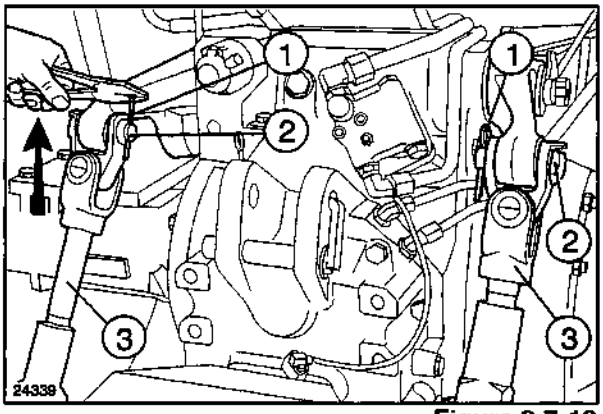


Figure 8-7-16

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REMOTE CONTROL VALVE ASSEMBLY (removed)

Disassembly–Assembly (Op. 35 204 46)

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Convertible single to double acting remote control valve

Disassemble the different components of the remote control valve making reference to sectional views on page 8-7-3 and observe the following:

1. Detach cover (5), retrieve spring (4) and retainer.
2. Slide out the valve spool (3).
3. Detach the control lever support (1) and retrieve seal (2).
4. Loosen the plug (6) and retrieve the single to double acting switching valve (7).
5. Withdraw the valve seat (8) and retrieve the check valve and spring.
6. Check seals for damages before reassembly.

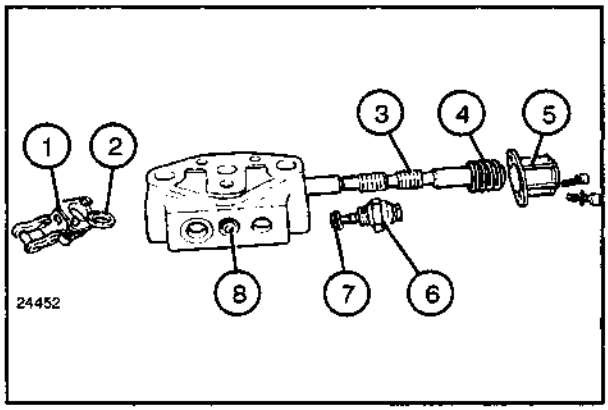


Figure 8-7-17

Double–acting remote control valve with float and automatic release

Disassemble the different components of the remote control valve making reference to sectional views on page 8-7-3 and observe the following:

1. Loosen retaining screws, retrieve cover (4) and spacer (3).
2. Loosen retaining screws and retrieve the control lever support (1) and seal (2).

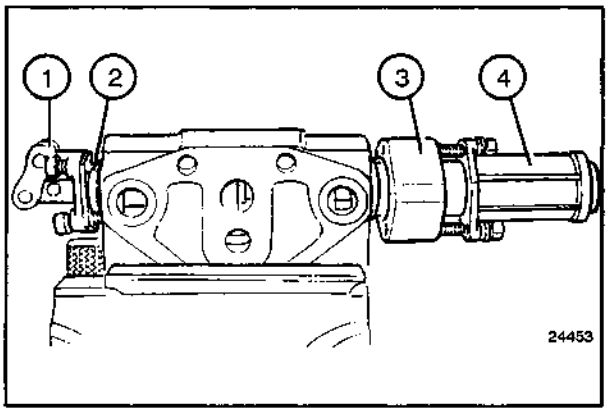


Figure 8-7-18

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3. Slide out valve spool (1).
4. Withdraw the valve seat and retrieve the check valve and spring.
5. Check seals for damages before reassembly.

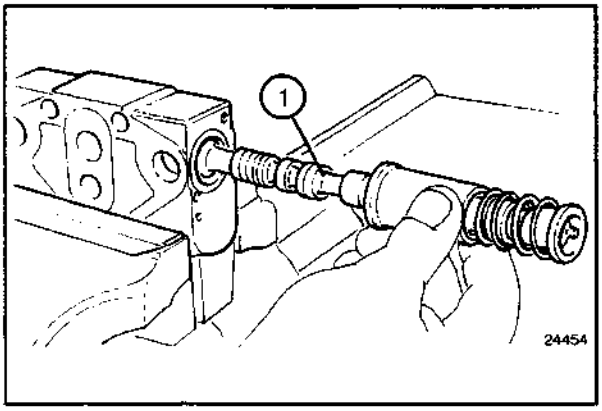


Figure 8-7-19

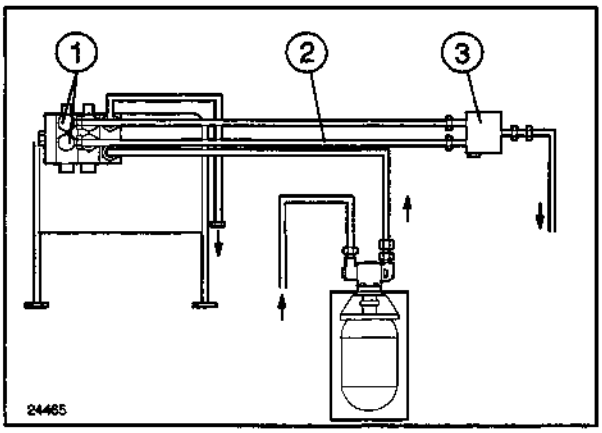


Figure 8-7-20

Valve Control Spool Sticking Test (Figures 8-7-19 and 8-7-20)

Note: Using a test equipment filled with oil **HYDRO-SYSTEM 66**, following tests should be performed with a temperature of approximately 140°F (60°C) and a flow of 3.30 gal/min (12.5 L/min), which can be obtained by turning the electrical motor to the highest speed (1450 rpm).

Install the remote control valve assembly to be tested and testing equipment as shown (Figures 8-7-19 and 8-7-20) observing the following:

- Double–acting valves (Fig. 8-7-19): the two holes for oil supply to the implement cylinder should be connected to the ball connector (3) using respective lines (2) and banjo fittings (1).
- Single–acting valves (Fig. 8-7-20): the return passage (2) should be connected to the hole for cylinder oil supply of the remote valve being tested through the banjo fitting (1) (the hole is located on the opposite side to the switching valve).

After connecting the items as shown in the schematics, test the remote control valve as follows:

- Start the hydraulic pump and move the valve spool hand control lever (in both directions for double–acting valves).
- Gradually increase pressure by turning the flow test equipment handwheel. Check that pressure is 2490 lbf/in^2 (175 kg/cm^2) (172 bar) on the test equipment pressure gauge. Under these conditions, the control spool of the valve being tested should slide normally and return freely to the neutral position as the control lever is released.

Schematic for the installation of testing equipment and accessories for control spool sticking test on double–acting (Fig. 8-7-19) and single–acting (5) valves.

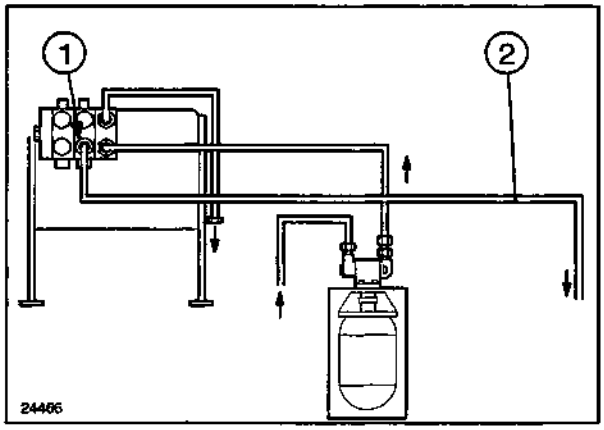


Figure 8-7-21

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– Repeat the test on all remaining valves after carrying out connections as required.

Schematics for installation of testing equipment and accessories for valve spool leak test

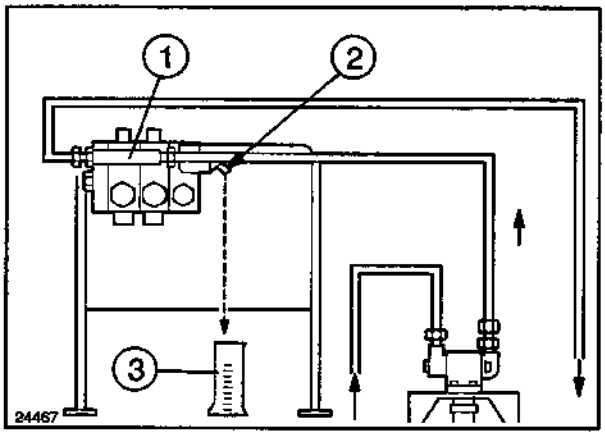


Figure 8-7-22

Remote Control Valve Leak Test

Install the remote control valve assembly to be tested and testing equipment as shown in the schematics (Figure 8-7-22). Consider that the T fitting (1) should be connected to single– or double–acting valves using adequate reductions.

After connecting items as shown in the schematics, perform the test as follows:

– Start the hydraulic pump and gradually increase pressure by turning the flow test equipment handwheel and check on the test equipment pressure gauge that pressure is 2130 lbf/in^2 (150 kg/cm^2) (147 bar).

– Collect leak oil coming out from fitting (2) into the graded bottle for one minute exactly. It should not exceed 1.5 in^3/min (25 cm^3/min) for a new valve or 3.7 in^3/min (60 cm^3/min) for a worn valve.

Repeat on all valves, testing alternatively either supply passage to the respective implement cylinder.

AUTOMATIC RELEASE PRESSURE ADJUSTMENT

Connect the remote valve to the test equipment.

Start the hydraulic pump and tighten the release pressure adjust screw (26, page 8-7-3) until obtaining a pressure of 2460 to 2540 lbf/in^2 (173 to 178 kg/cm^2) (170 to 175 bar) before the taper pin.

Lock the screw (26) by tightening the locknut.

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FLOW CONTROL ADJUSTER

Disassembly – Assembly (Op. 35 204 46)

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Proceed as follows:

1. Remove the snap ring, raise the finned bushing (2), loosen the control pin (1) and remove the pin (1) seat (3).

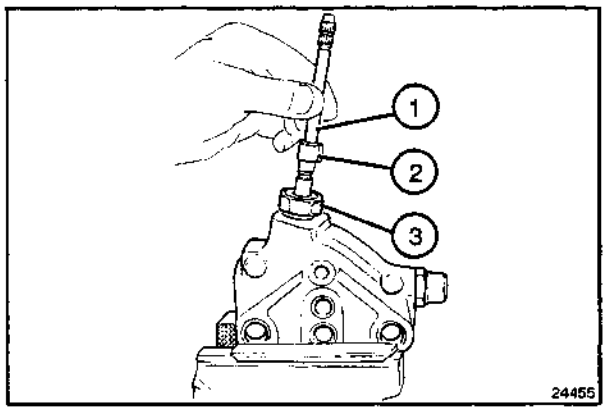


Figure 8-7-23

2. Loosen the plug (3) and retrieve the spring (2) and valve (1).

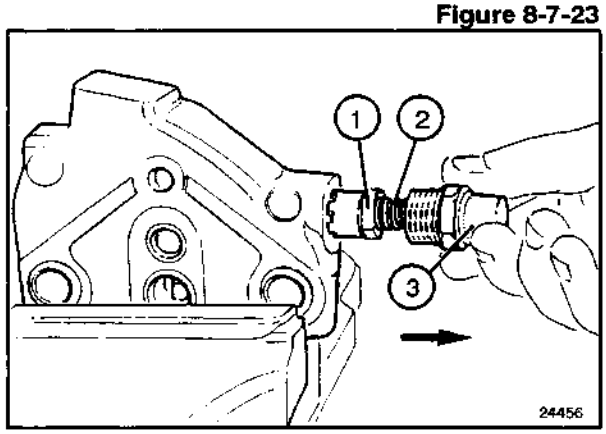


Figure 8-7-24

3. Check seals (1, 2 and 3) for damages before reassembly.

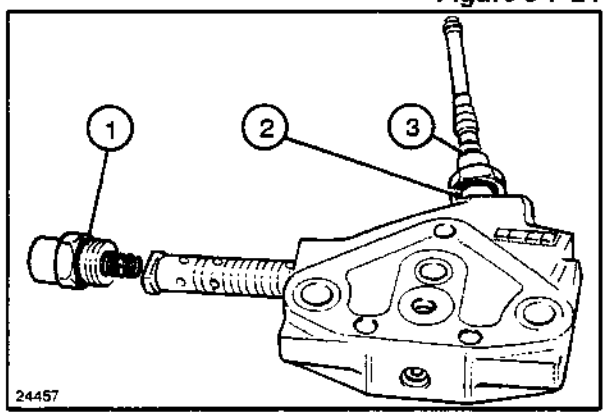


Figure 8-7-25

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FLOW CONTROL ADJUSTER

Flow–rate Adjustment (on the tractor)

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

Adjustment should be carried out with the engine shut off.

Proceed as follows:

1. Loosen the retaining screw and retrieve the flow adjuster control knob (1).

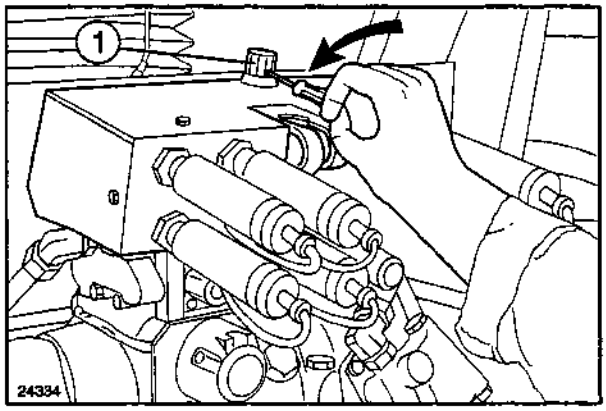


Figure 8-7-26

2. Loosen the retaining screws and remove the remote valve protection cover (1).

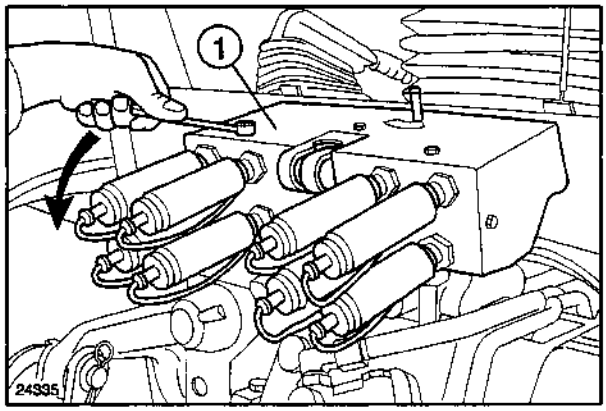


Figure 8-7-27

3. Drive out the snap ring (1).

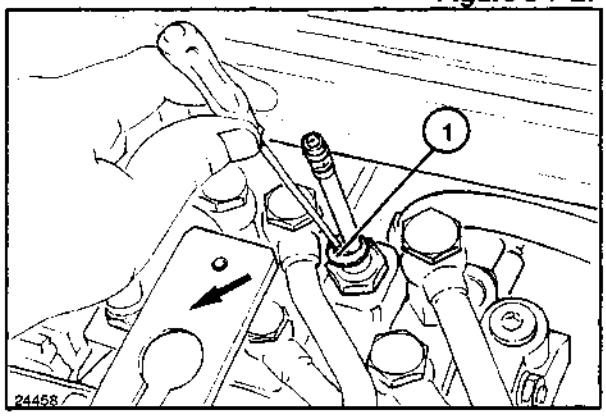


Figure 8-7-28

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4. Slide out the finned bushing (3). Screw in the control pin until in contact. Do not force. Install the bushing with the fin touching the stop pin (2). If not possible, slightly unscrew the pin (1) to obtain contact.

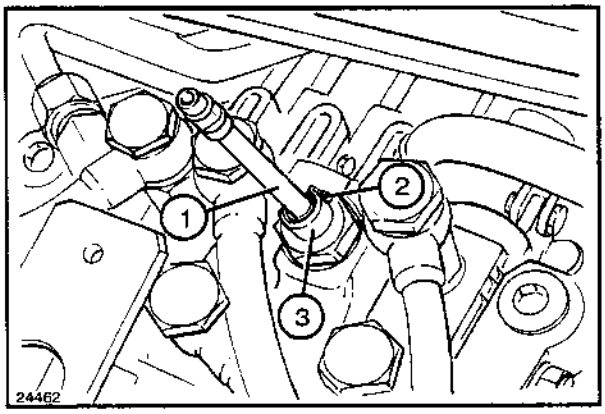


Figure 8-7-29

5. Locate tool no. **294039** (2) to touch the stop pin (1) opposite to the bushing fin (3, Fig. 8-7-29).

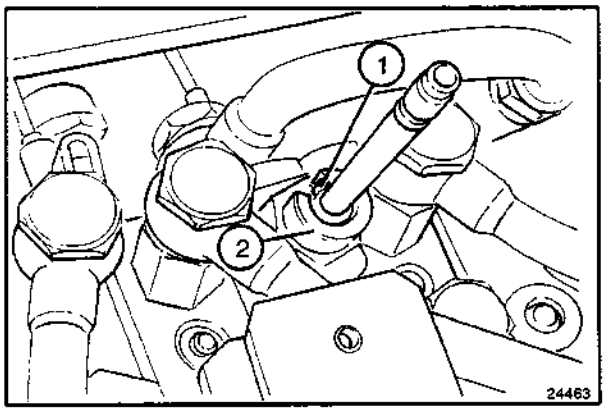


Figure 8-7-30

6. Loosen the control pin (1) until bringing the bushing fin (3, Fig. 8-7-29) to contact tool no. **294039** (2).

7. While holding the control pin (1) perfectly still, withdraw tool no. **294039** (2) and the finned bushing (3, Fig. 8-7-29). Place the latter, always with the control pin (1) still, with the fin touching the stop pin (1, Fig. 8-7-30). If not possible, slightly unscrew the pin (1) to make obtain contact.

8. Lock the bushing (3, Fig. 8-7-29) or the ring nut using the snap ring (1, page 24, Fig. 3).

9. Install the protection cover (1, page 24, Fig. 2) and tighten retaining screws.

10. Position the knob as to have the pointer into the "max." section (on the protection) with pin (1) fully unscrewed and into the "min" section with the pin (1) fully screwed in. (Check that, when in this position, the pointer is between the two angles 18° to 27° indicated on page 8-7-4). Lock using the setscrew.

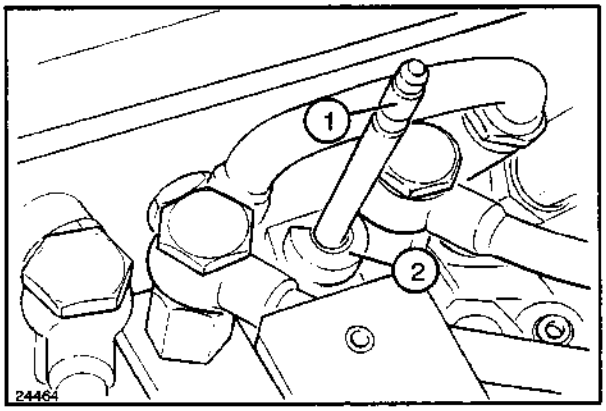


Figure 8-7-31

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Note: The above adjustment should be considered as indicative only. For perfect adjustment, it is necessary to perform bench hydraulic setting considering the following:
Test oil **AMBRA MULTI G** at a temperature of 122°F (50°C). Connect the flow control adjuster to the pump, screw in the control pin until it bottoms.. Do not force. Unscrew the control pin until obtaining a flow corresponding to data in the table coming out from the right–hand side outlet (looking at the flow control adjuster from the plug (9, page 8-7-4) side).

Flow from pump to flow control adjuster l/min dm^3/min (gal/min)	Flow to be obtained at the flow control adjuster outlet l/min dm^3/min (gal/min)
6.6 (25)	1.8 to 2.1 (7 to 8)
7.9 (30)	1.9 to 2.2 (7,2 to 8,2)
9.2 (35)	1.9 to 2.2 (7,3 to 8,3)
10 (40)	2.0 to 2.2 (7,4 to 8,4)
12 (45)	2.0 to 2.3 (7,6 to 8,6)
13 (50)	2.1 to 2.3 (7,8 to 8,8)
14 (55)	2.1 to 2.4 (8 to 9)

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SECTION 8

HYDRAULIC SYSTEM

CHAPTER 8

TRAILER BRAKE AUXILIARY VALVE

(NOTE: NOT USED IN NORTH AMERICA)

CONTENTS

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Trailer Brake Auxiliary Valve Sectional View.
(Open center circuit) .

1. Check valve
2. Flow regulator
3. Pilot valve and body
4. Pilot valve piston
5. Pressure relief valve
6. Body piston

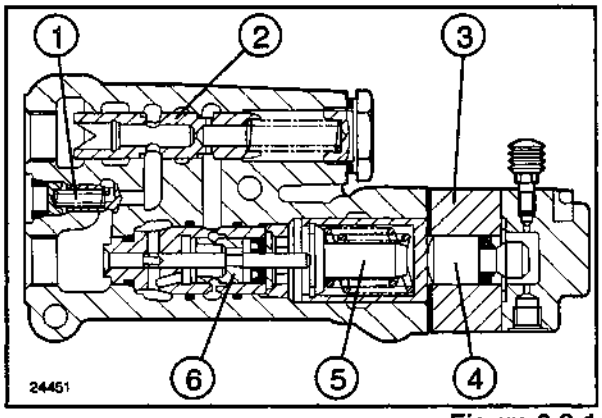


Figure 8-8-1

Pilot Valve (Closed Center Circuit). Details which Change with Respect to Sectional View Fig. 8-8-1.

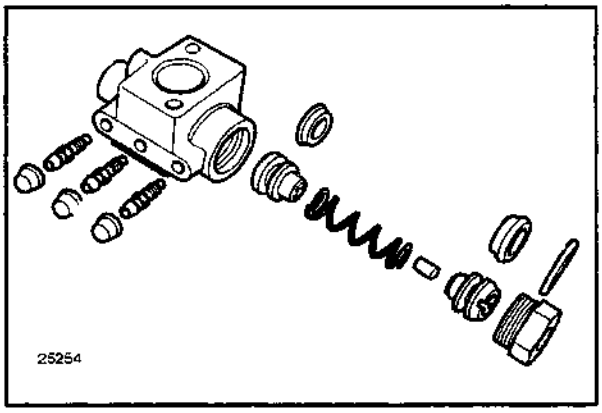


Figure 8-8-2

DESCRIPTION AND OPERATION

Trailer brake valve is located on the rear axle housing in front of the hydraulic lift and controlled by the lift control pump.
Trailer brake valve has the priority both on auxiliary valves and hydraulic lift.
Trailer brake valves assembled on the open center or closed center circuits are similar, as they only differ for the pilot valve. Hydraulic operation is described on pages 8-8-4, 8-8-5 and 8-8-6.
For ITALY only, the trailer brake valve has the capability to keep the trailer braked even when engine is not running and in case of pump failure or low oil flow. Operation is described on pages 8-8-7, 8-8-8, 8-8-9 and 8-8-10.

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TRAILER BRAKE AUXILIARY VALVE

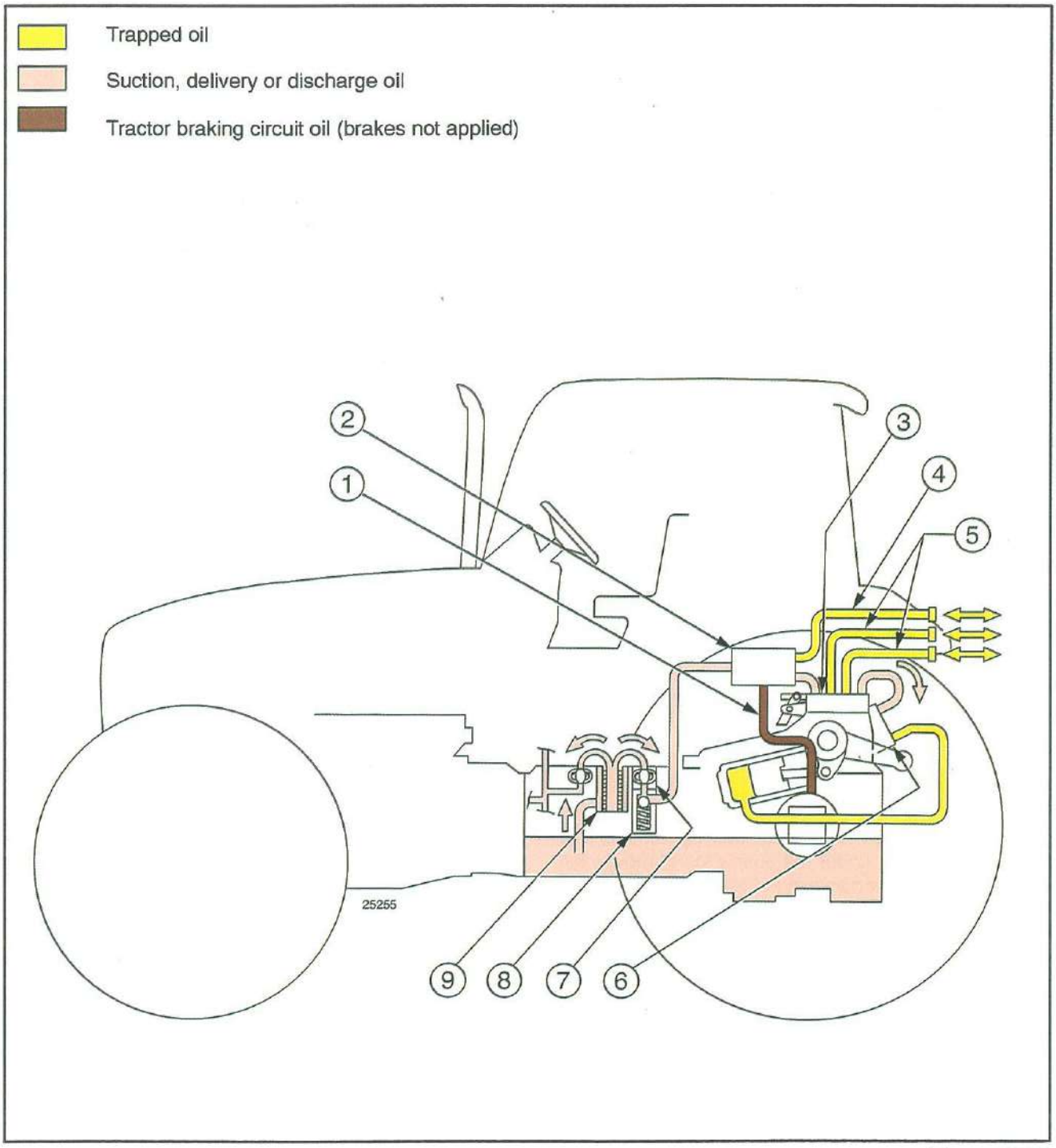


Figure 8-8-3

Trailer Brake Auxiliary Valve Circuit Schematic

1. Trailer brake valve to tractor braking system line.
2. Trailer brake auxiliary valve.
3. Auxiliary valve.
4. Oil supply line to trailer brake.
5. Oil supply line to implements.
6. Lift valve.
7. Hydraulic pump.
8. Overpressure valve.
9. Filter.

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TRAILER BRAKES NOT APPLIED When tractor brakes are not applied, oil from the hydraulic circuit linked to the valve through the fitting (Y) is not under pressure. Therefore the piston (5) of the pilot valve (6) and the body piston (7) are not applied as shown in Figure 8-8-4.

Oil from hydraulic pump (1, Figure 8-8-3) through the fitting (P_1), passes through diaphragm (1) and waisted section (3), undergoes a pressure drop and consequently drives the flow regulator (2) rightwards.

Most of the flow is directed to auxiliary valves through the fitting (N). Remaining part of the flow reaches the hydraulic lift through the passage (4), body piston (7) and fitting (R).



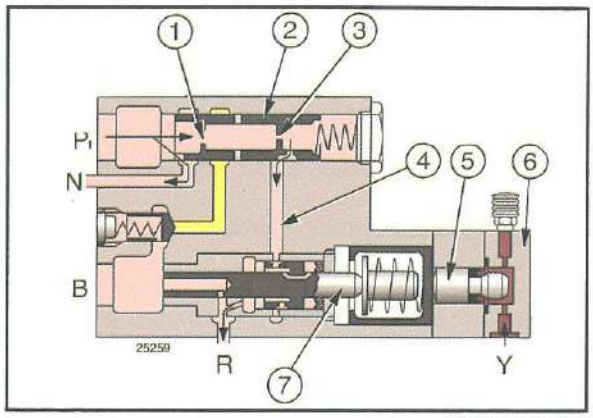


Figure 8-8-4

Trailer Brakes Not Applied.

N. To auxiliary valves.
P_1. From lift circuit hydraulic pump.
R. Discharge oil to lift.
Y. From tractor brakes.

BRAKING START When tractor brake pedals are pressed, hydraulic circuit oil in the fitting (Y) is pressurized and moves the piston (7), pressure relief valve (6) and body piston (8) leftwards. The body piston stops the flow between the oil discharge fitting (R) and both trailer braking fitting (B) and passage (5).

Oil pressure inside the flow regulator (4) remains even and the regulator, under the spring force, moves leftwards to the position shown in Figure 8-8-5.

Part of the oil from the hydraulic pump flows through the fitting (P_1) and reaches the auxiliary valves through the fitting (N). Remaining flow arrives at trailer braking device through the diaphragm (2), passage (3), check valve (1) and fitting (B).

Increased oil pressure in the trailer brake fitting (B) acts on the active surface (9) of the body piston (8) against the pressure applied to the piston (7) by the tractor braking circuit oil.

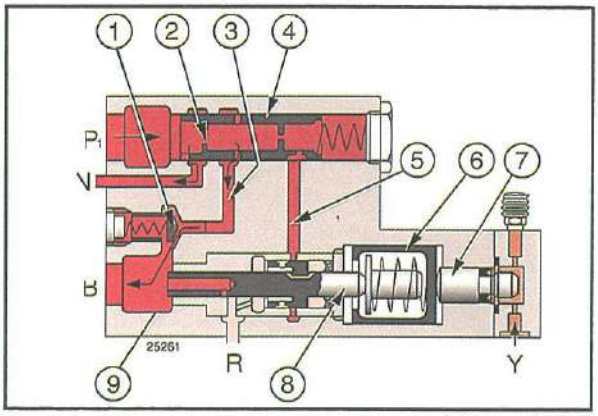


Figure 8-8-5

Braking start

B. To trailer brake.
N. To auxiliary valves.
P_1. From lift circuit hydraulic pump.
R. Discharge oil to lift.
Y. From tractor brakes.

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BRAKING – If tractor brake pedals are kept pressed, oil pressure in the trailer brake fitting (B) increases and, acting on the active surface (10) of the body piston (9), moves the piston rightwards against the pressure relief valve (8) spring (7) force.

When oil pressure in the trailer braking system is equal to the spring pressure (7), the body piston (9) remains in the position shown in Figure 8-8-6 and allows oil from the hydraulic pump to discharge into the lift circuit through the fitting (P_1), diaphragm (2), waisted section (5), passage (6) and fitting (R).

Because of the diaphragm (2) and waisted section (5) oil pressure in the flow regulator drops (4) causing the flow regulator to move rightwards. Consequently, passage (3) and check valve (1) close.

Further pressure on tractor brake pedals moves the piston (7, Figure 8-8-5), pressure relief valve (8) and body piston (2) to the left, thus provoking an oil pressure increase in the trailer braking system and repeating the phases described in **BRAKING START.**

If owing to external actions the trailer braking circuit pressure increases, the body piston (9) quickly opens and restores communication between the trailer brake fitting (B) and oil discharge fitting in the lift circuit (R) perfectly balancing oil pressure within the braking system and pressure relief valve springs (7).

When tractor brake pedals are released, oil pressure in the fitting (Y) decreases and conditions illustrated in Figure 8-8-4 are re–established.

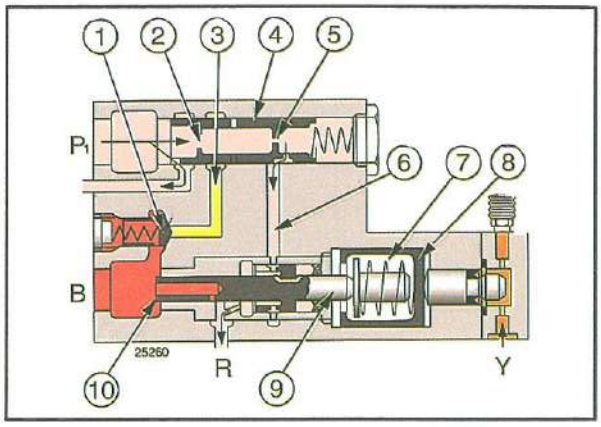


Figure 8-8-6

Braking.

B. To trailer brake.

P_1. From lift circuit hydraulic pump.

R. Discharge oil to lift.

Y. From tractor brakes.

- Pressure oil
- Suction, delivery or discharge oil
- Trapped oil
- Tractor braking circuit oil (under pressure)

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Closed Center Circuit Pilot Valve Operation

1. Piston.
2. Bleed screw.
3. Piston.
4. Ball.
5. Pilot piston.
6. Piston.
7. Ball.

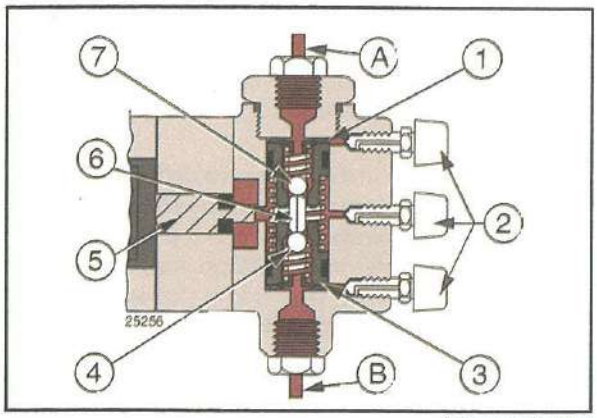


Figure 8-8-7

Brakes Not Applied.
When tractor brakes are not applied, passages (A and B) are not under pressure.

One–Pedal Braking.

When only one brake pedal is pressed, pressure flows to the trailer brake valve pilot valve. Brake control oil pressure through the passage (B) moves the ball (4) against the piston (3) and the ball against the piston. As no pressure oil comes from passage (A), the ball (4) moves the piston (6) and the ball (7). Oil pressure keeps the ball (4) against the piston (3) closing the passage. Therefore oil can't act on pilot piston (5) and consequently trailer brake valve is not actuated.

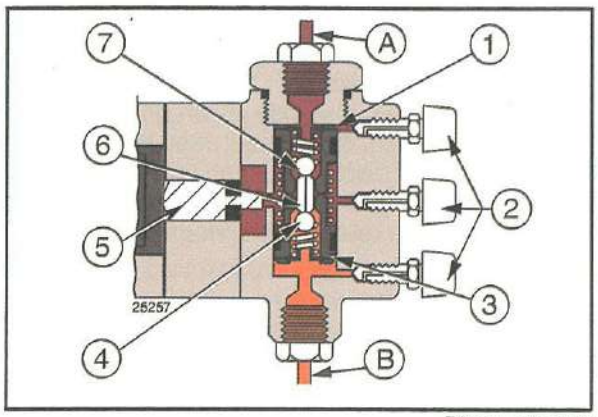


Figure 8-8-8

Tractor braking circuit oil (brakes not applied)
Tractor braking circuit oil (under pressure)

Two–Pedal Braking.

Acting on both brake pedals, pressure oil enters the pilot valve from both passages (A and B).
Oil pressure moves the two pistons (1 and 3) one against the other while the piston (6) keeps the two balls (4 and 7) off the holes located on the two pistons (1 and 3).
In this situation pressure oil contacts the pilot piston (5) operating the trailer brake valve.

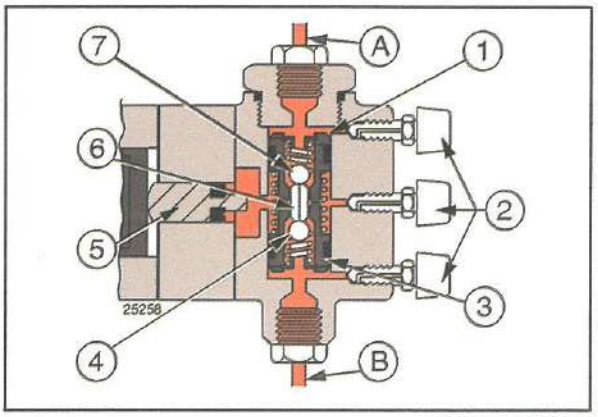


Figure 8-8-9

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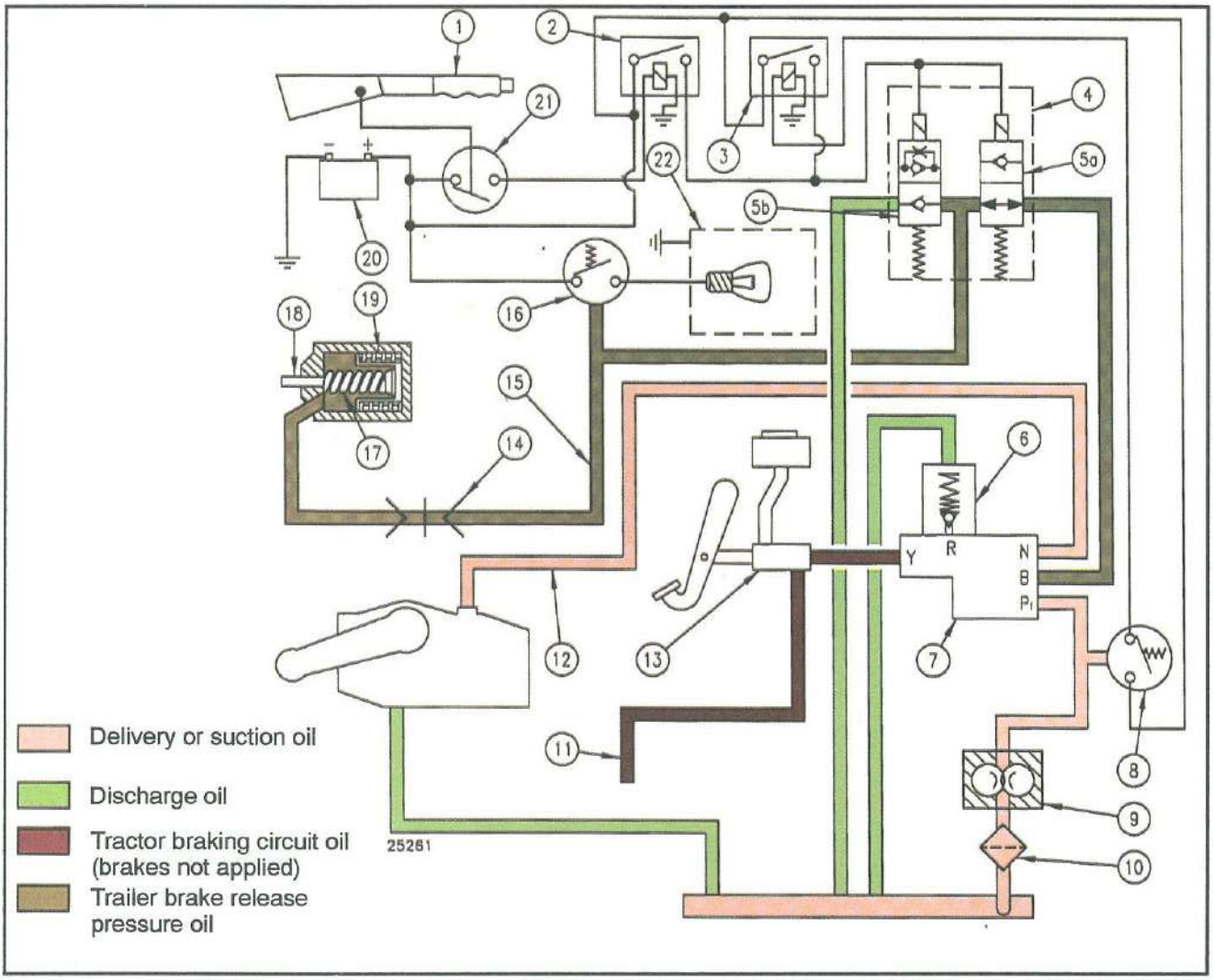


Figure 8-8-10

TRAILER BRAKE VALVE ELECTRO–HYDRAULIC OPERATION DIAGRAM (ITALY ONLY)

Engine running, brakes not applied.

1. Parking brake control lever – 2. Parking brake indicator circuit relay – 3. Trailer brake circuit relay – 4. Trailer braking control solenoid valves – 5a. Delivery solenoid valve (normally open) – 5b. Discharge solenoid valve (normally closed) – 6. Trailer brake disengagement pressure regulating valve – 7. Trailer braking valve (see pages 8-8-4 and 8-8-5) – 8. Trailer brake circuit safety switch – 9. Hydraulic pump – 10. Filter – 11. Brake control line – 12. Hydraulic lift and auxiliary valve supply line – 13. Brake pump – 14. Trailer–tractor coupler – 15. Trailer brake control line – 16. Trailer brake engaged indicator switch 17– 19. Springs – 18. Trailer brake control pin – 20. Battery – 21. Parking brake engaged switch – 22. Trailer brake engaged light indicator.

Oil from hydraulic pump (9) flows to the trailer braking valve (7). From this valve the greatest part of the oil is sent to auxiliary valves and hydraulic lift through the passage (12). A small part of the oil flows to the oil discharge valve (6) which adjusts pressure 160 to 170 lbf/in^2 (11.2 to 12.2 kg/cm^2) (11 to 12 bar). Pressure oil at 160 to 170 lbf/in^2 (11.2 to 12.2 kg/cm^2) (11 to 12 bar) from the trailer brake valve flows to the trailer brake through the solenoid valve (5a), line (15) and coupler (14). This pressure is necessary to overcome the spring force (19) and remove the retainer, while the spring (17) moves the pin (18) eliminating the braking action on the trailer.

Notice – At engine start–up, reduce time necessary to reach the trailer brake release pressure by pressing the brake pedals (linked together) with the parking brake control lever lowered. The light indicator (22) will go off when the trailer brake is released.

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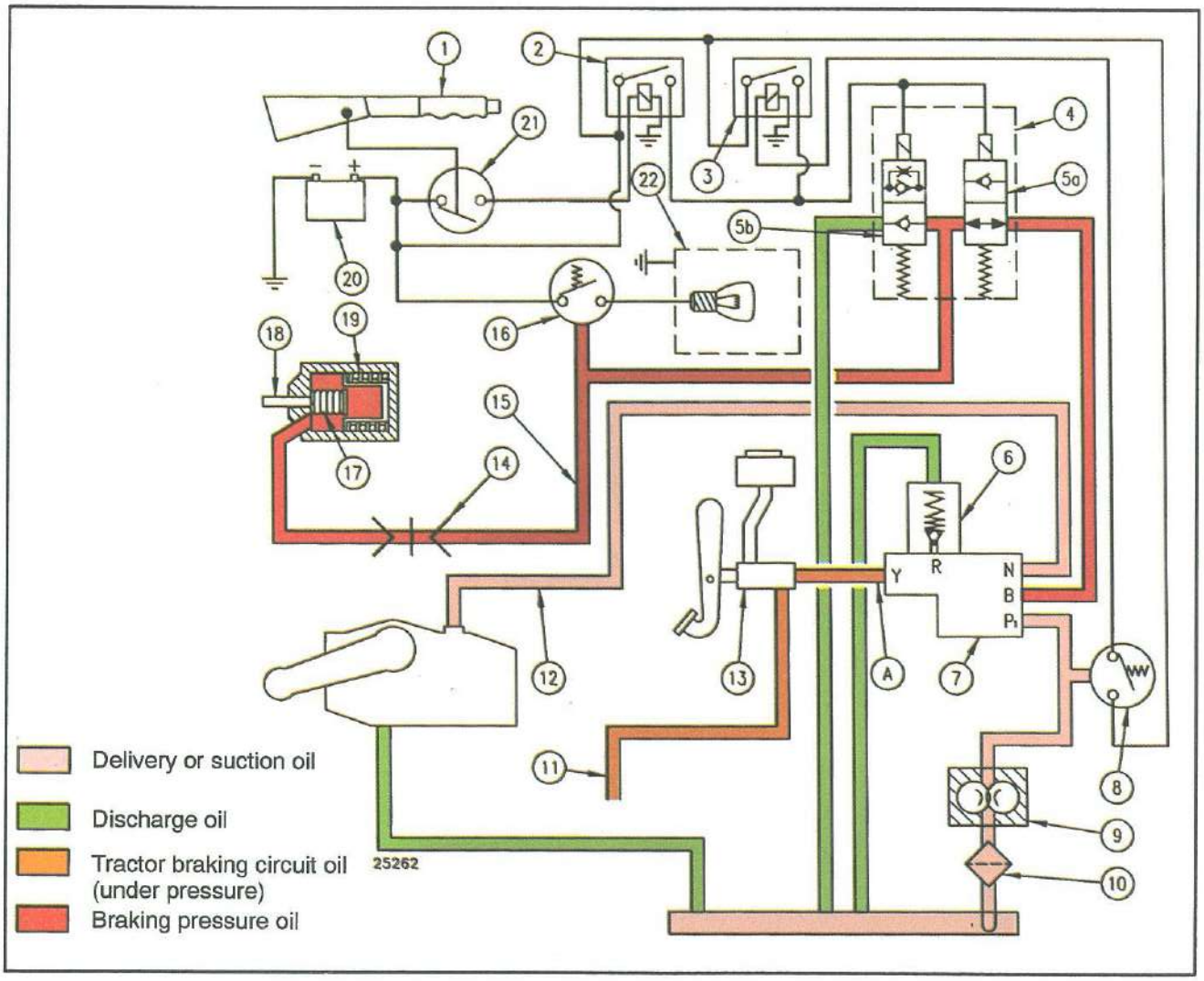


Figure 8-8-11

TRAILER BRAKE VALVE ELECTRO–HYDRAULIC OPERATION DIAGRAM (ITALY ONLY)

Engine running, brakes applied.

A. Brake pump (13) to brake trailer valve (7) connecting line – 1. Parking brake control lever – 2. Parking brake indicator circuit relay – 3. Trailer brake circuit relay – 4. Trailer braking control solenoid valves – 5a. Delivery solenoid valve (normally open) – 5b. Discharge solenoid valve (normally closed) – 6. Trailer brake disengagement pressure regulating valve – 7. Trailer braking valve (see pages 8-8-4 and 8-8-5) – 8. Trailer brake circuit safety switch – 9. Hydraulic pump – 10. Filter – 11. Brake control line – 12. Hydraulic lift and auxiliary valve supply line – 13. Brake pump – 14. Trailer–tractor coupler – 15. Trailer brake control line – 16. Trailer brake engaged indicator switch 17–19. Springs – 18. Trailer brake control pin – 20. Battery – 21. Parking brake engaged switch – 22. Trailer brake engaged light indicator.

Pressure oil deriving from action on brake pedals flows through the passage (A), closes the outlet (R) which is open to discharge through the valve (6). Consequently oil pressure from the hydraulic pump (9) increases. Pressure oil (170 to 2180 lbf/in^2) (12 to 150 bar – 12.2 to 153 kg/cm^2) goes out from the trailer brake valve (7) through the passage (B),flows to the solenoid valve (5a) which is open and reaches the trailer brake through the line (15). Here it overcomes the spring force (17 and 19) and moves the pin (18) which brakes the trailer.

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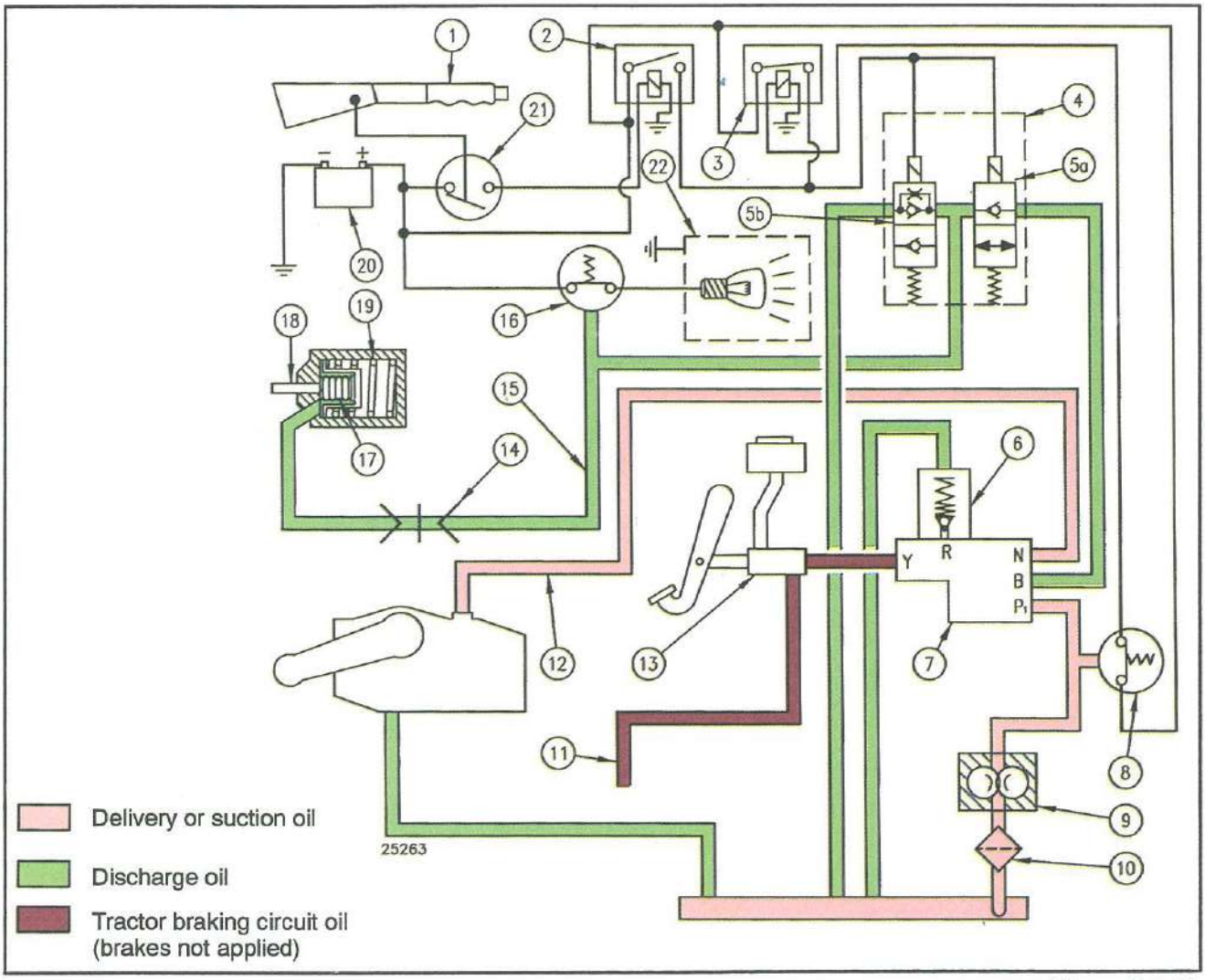


Figure 8-8-12

TRAILER BRAKE VALVE ELECTRO–HYDRAULIC OPERATION DIAGRAM (ITALY ONLY)

Engine stopped or running but with low hydraulic pump flow.

1. Parking brake control lever – 2. Parking brake indicator circuit relay – 3. Trailer brake circuit relay – 4. Trailer braking control solenoid valves – 5a. Delivery solenoid valve (normally open) – 5b. Discharge solenoid valve (normally closed) – 6. Trailer brake disengagement pressure regulating valve – 7. Trailer braking valve (see pages 8-8-4 and 8-8-5) – 8. Trailer brake circuit safety switch – 9. Hydraulic pump – 10. Filter – 11. Brake control line – 12. Hydraulic lift and auxiliary valve supply line – 13. Brake pump – 14. Trailer–tractor coupler – 15. Trailer brake control line – 16. Trailer brake engaged indicator switch 17– 19. Springs – 18. Trailer brake control pin – 20. Battery – 21. Parking brake engaged switch – 22. Trailer brake engaged light indicator.

With the engine running or stopped, in case of low hydraulic pump flow (9) there is no or very low oil pressure reaching the trailer brake valve (7). Consequently the switch (8) closes. With the switch (8) closed current energizes the relay (3). The relay closes and current reaches and energizes solenoid valves (5a and 5b) closing the former and opening the latter. In this condition line and trailer brake oil (15), subject to the spring force (19), can reach the discharge through the solenoid valve (5b), in this condition braking action is performed mechanically following the spring (19) pressure on the pin (18). Oil discharge provokes a pressure drop which closes the switch (16), and current, passing through the switch (16), reaches the instrument panel light indicator (22), which lights up.

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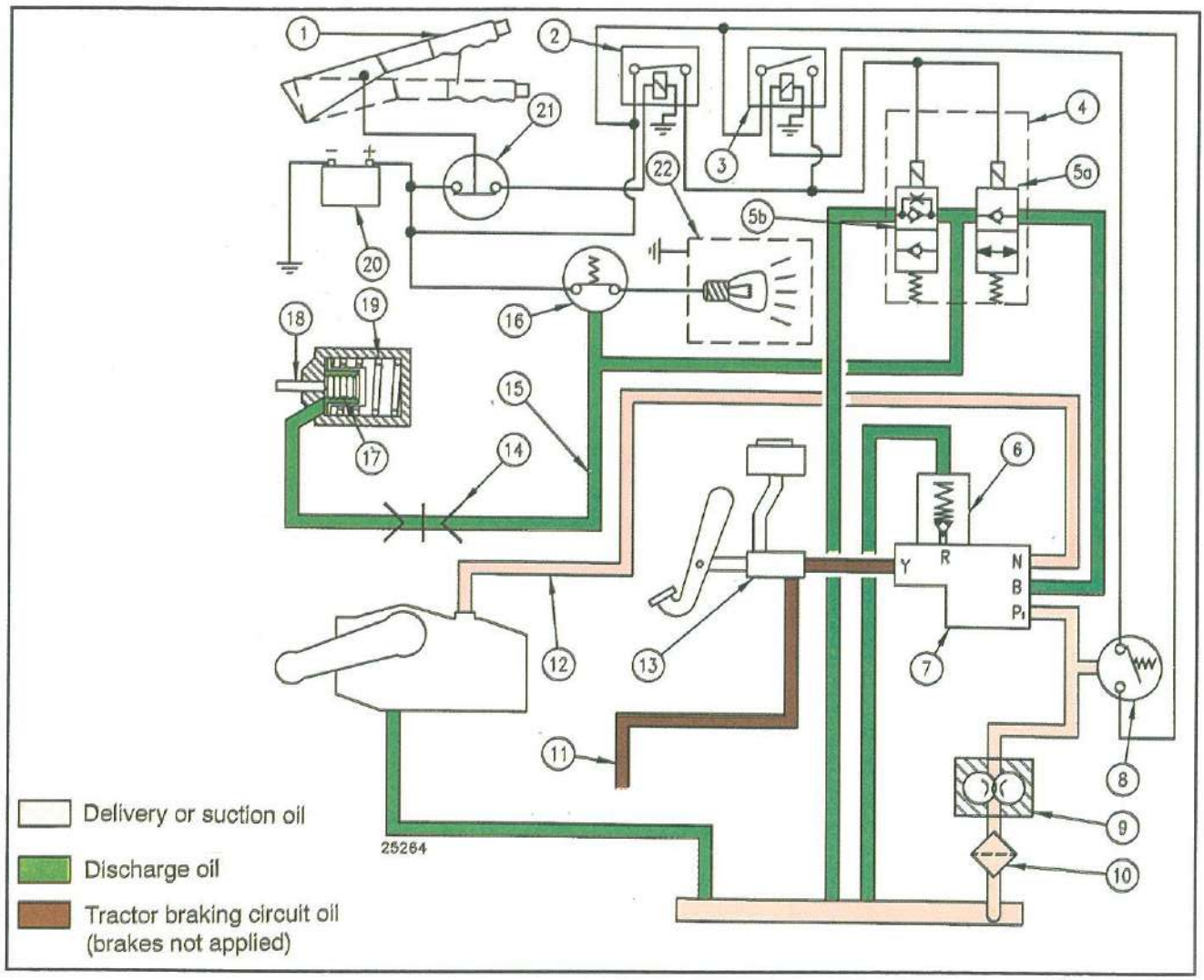


Figure 8-8-13

TRAILER BRAKE VALVE ELECTRO–HYDRAULIC OPERATION DIAGRAM (ITALY ONLY)

Engine running, parking brake engagement.

1. Parking brake control lever – 2. Parking brake indicator circuit relay – 3. Trailer brake circuit relay – 4. Trailer braking control solenoid valves – 5a. Delivery solenoid valve (normally open) – 5b. Discharge solenoid valve (normally closed) – 6. Trailer brake disengagement pressure regulating valve – 7. Trailer braking valve (see pages 8-8-4 and 8-8-5) – 8. Trailer brake circuit safety switch – 9. Hydraulic pump – 10. Filter – 11. Brake control line – 12. Hydraulic lift and auxiliary valve supply line – 13. Brake pump – 14. Trailer–tractor coupler – 15. Trailer brake control line – 16. Trailer brake engaged indicator switch 17– 19. Springs – 18. Trailer brake control pin – 20. Battery – 21. Parking brake engaged switch – 22. Trailer brake engaged light indicator.

Parking brake (1) engagement makes the switch (21) close. Therefore current is allowed to reach and excite the relay (2),and through the closed relay contact (2) it excites the solenoid valves (5a and 5b) closing the former and opening the latter. In this condition line and trailer brake oil (15), subject to the spring (19) force can reach the discharge through the solenoid valve (5b). Braking action is performed mechanically following the spring (19) pressure on the pin (18). Oil discharge provokes a pressure drop which closes the switch (16), and current, passing through the switch (16), reaches the instrument panel light indicator (22), which lights up.

Notice – After parking brake engagement, wait approx. 10 seconds before stopping the engine to permit complete oil discharge from trailer brake cylinder and obtain optimal braking action.

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TRAILER BRAKE VALVE OPERATION TESTS AND TROUBLESHOOTING – ITALY ONLY

Test conditions.

Oil temperature 104 to 122°F (40° to 50° C).
Engine speed 1000 rpm.
Electrical system powered.
Parking brake disengaged.

Trailer brake disengagement pressure test.

Proceed as follows:

1. Insert fitting no. **293190** (1) into the trailer brake coupler and connect it to a 0 to 570 lbf/in^2 (0 to 40 kg/cm^2) pressure gauge from kit no. **292870.**
2. With engine and oil as detailed above, pressure should be 160 to 170 lbf/in^2 (11.2 to 12.2 kg/cm^2) (11 to 12 bar).
3. Make sure that light indicator (22, Figure 8-8-13) is off.
4. Engage parking brake, disconnect pressure gauge and fitting no. **293190 (1).**

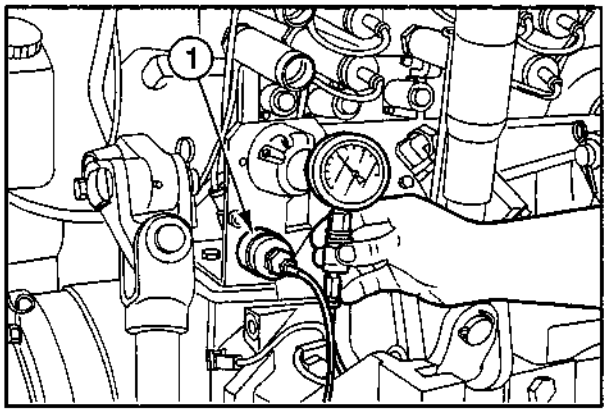


Figure 8-8-14

Troubleshooting.

Problem	Possible cause	Correction
Trailer brake disengagement pressure = 0 lbf/in^2 (0 bar) (light indicator on 22, Figure 8-8-13).	1. Parking brake (1, Figure 8-8-13) engaged.	Disengage parking brake.
	2. Trailer brake disengagement pressure valve misadjusted (6)	Replace valve.
	3. Faulty trailer brake circuit safety switch (8).	Replace switch.
	4. Faulty hydraulic pump (9).	Overhaul or replace pump.
	5. Delivery solenoid valve (5a) stuck closed.	Repair or replace solenoid valve.
	6. Discharge solenoid valve (5b) stuck open.	Repair or replace solenoid valve.
Trailer brake disengagement pressure = 0 to 160 lbf/in^2 (0 to 11.2 kg/cm^2) (0 to 11 bar).	1. Trailer brake disengagement pressure valve misadjusted (6).	Replace valve.
Correct trailer brake disengagement pressure but light indicator (22) is on.	1. Faulty trailer brake engaged indicator switch (16).	Replace switch.
Trailer brake disengagement pressure not correct but light indicator (22) is off.	1. Faulty indicator lamp (22).	Replace lamp.
	2. Faulty trailer brake engaged indicator switch (16).	Replace switch.

Note – The switch (8) can be recognized by the red paint point existing between the two switch blades.

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Trailer Braking System Pressure Regulating Valve Adjustment Testing (Incorporated into the Trailer Brake Auxiliary Valve).

Proceed as follows:

1. Insert fitting no. **293190** (1) in trailer brake coupler and connect it to a 0 to 3560 lbf/in^2 (0 to 250 kg/cm^2) pressure gauge from kit no. **292870.**
2. With engine and oil in the conditions described at the beginning of this chapter and applying a force of 418 to 488 lbf/in^2 (29.4 to 34.3 kg/cm^2) (30 to 35 daN) on the brake pedals, pressure should be 1960 to 2100 lbf/in^2 (138 to 148 kg/cm^2) (135 to 145 bar).
3. Engage parking brake, disconnect pressure gauge and fitting no. **293190 (1).**

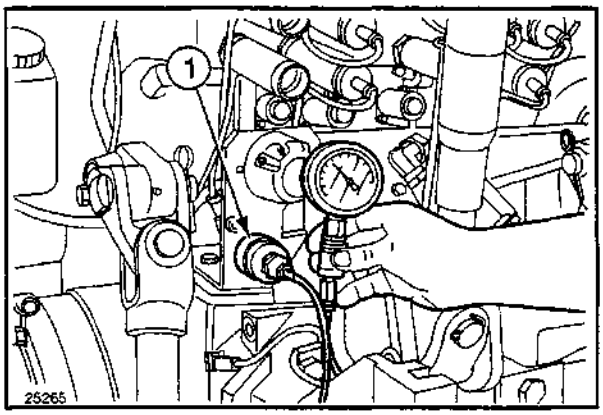


Figure 8-8-15

Troubleshooting.

Problem	Possible cause	Correction
Pressure higher or lower than specified.	1. Faulty trailer braking auxiliary valve pressure regulating valve (3, Figure 8-8-13).	Replace trailer braking auxiliary valve.
	2. Faulty hydraulic pump (9).	Replace pump.

Hydraulic System Leak Testing

Proceed as follows:

1. Insert fitting no. **293190** (1) in trailer brake coupler and connect it to a 0 to 3560 lbf/in^2 (0 to 250 kg/cm^2) pressure gauge from kit no. **292870.**
2. With engine an oil in the conditions described at the beginning of this chapter and applying a force of 418 to 488 lbf/in^2 (29.4 to 34.3 kg/cm^2) (30 to 35 daN) on the brake pedals, pressure should be 1960 to 2100 lbf/in^2 (138 to 148 kg/cm^2) (135 to 145 bar).
3. Engage parking brake, disconnect pressure gauge and fitting no. 293190 (1).

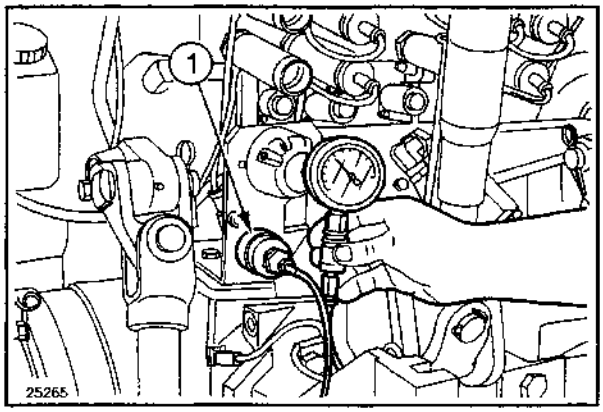


Figure 8-8-16

Troubleshooting.

Problem	Possible cause	Correction
Excess pressure peaks are observed when applying the specified force on the brake pedals for 10 seconds.	1. Oil leaks from hydraulic system.	Locate leaks and repair.
	2. Anomalous solenoid valve leak (5b, Figure 8-8-13).	Replace solenoid valve.
	3. Anomalous trailer brake auxiliary valve (7) leaks.	Replace trailer brake auxiliary valve.

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Disengagement Pressure Zeroing upon Parking Brake Engagement Test.

Proceed as follows:

1. Insert fitting no. **293190** (1) in trailer brake coupler and connect it to a 0 to 570 lbf/in^2 (0 to 40 kg/cm^2) pressure gauge from kit no. **292870.**
2. With engine and oil in the conditions described at the beginning of this chapter, fully raise parking brake control lever (1, Figure 8-8-13).
3. Check if pressure is 0 lbf/in^2 (0 bar) and light indicator (22, Figure 8-8-13) is on.
4. With parking brake engaged disconnect pressure gauge and fitting no. **293190** (1).

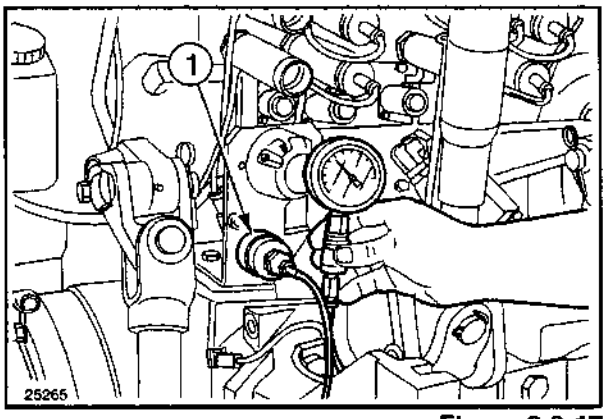


Figure 8-8-17

Troubleshooting.

Problem	Possible cause	Correction
Trailer brake disengagement pressure does not zero when parking brake is applied.	1. Faulty parking brake engaged switch (21, Figure 8-8-13).	Replace switch.
	2. Faulty parking brake indicator circuit relay (2).	Replace relay.
	3. Discharge solenoid valve (5b)faulty or stuck closed.	Repair or replace solenoid valve.

Injector Calibration Test (8 and 16, Figure 8-8-13).

Proceed as follows:

1. Insert fitting no. **293190** in trailer brake coupler and connect it to a 0 to 570 lbf/in^2 (0 to 40 kg/cm^2) pressure gauge from kit no. **292870**.
2. With parking brake and tractor brakes not applied, actuate an auxiliary valve control lever (till the intervention of the relative overpressure valve), keep this position for a few seconds and quickly release the control lever.
3. Check if parking brake disengagement pressure remains at the specified value: 160 to 170 lbf/in^2 (11.2 to 12.2 kg/cm^2) (11 to 12 bar).
4. Engage parking brake, disconnect pressure gauge and fitting no. **293190** (1).

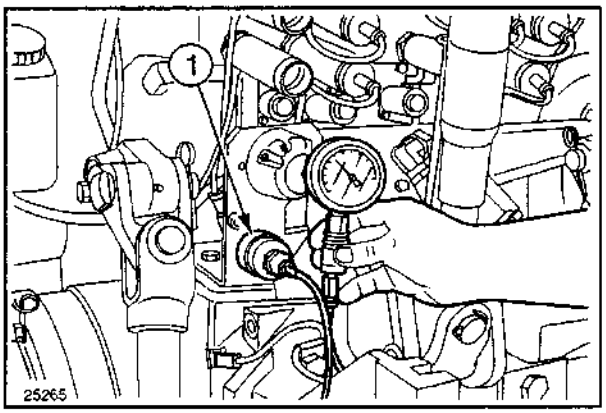


Figure 8-8-18

Troubleshooting.

Problem	Possible cause	Correction
Trailer brake disengagement pressure is permanently zeroed when operating the lever s described above.	1. Trailer brake circuit safety switch (8, Figure 8-8-13) adjustment exceeding rated value (3 ± 0.5 bar).	Replace switch.
	2. Switches (8 and 16) reversed in the specified positions or with exchanged power supply cables.	Move switches to correct positions or reverse power supply cables.

Note – The switch (8) can be recognized by the red paint point existing between the two switch blades.

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SECTION 8

HYDRAULIC SYSTEM

CHAPTER 9

ASSIST RAM

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SPECIFICATIONS

Type Quantity	Single–acting1
Pin diameter in (mm) Stroke in (mm)	2.95 (75) 5.90 (150)

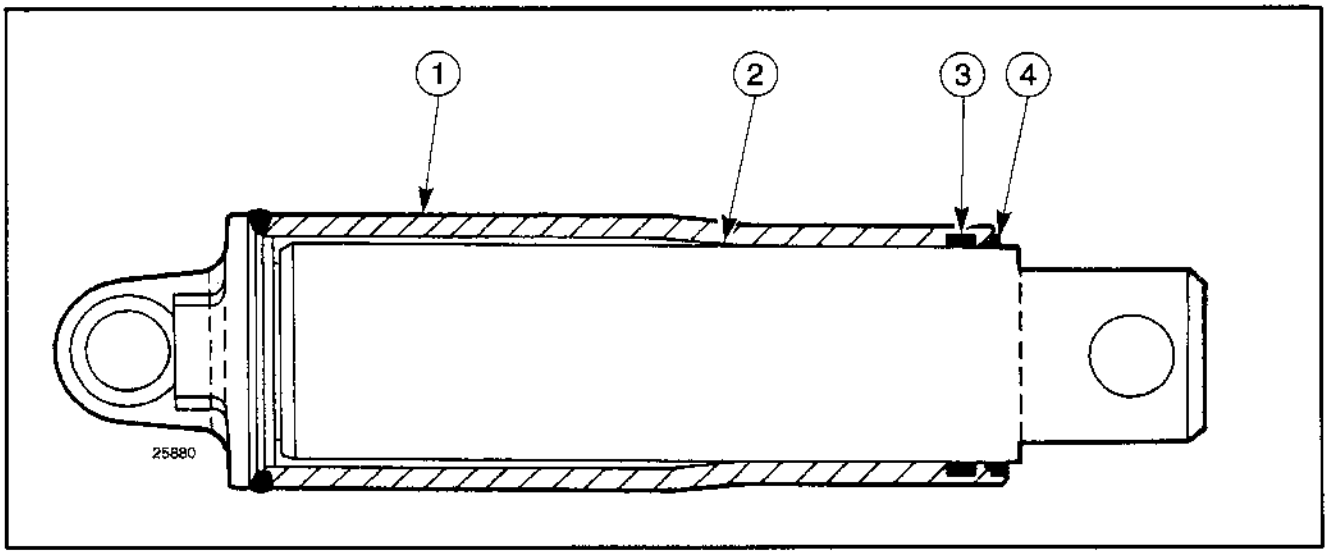


Figure 8-9-1

Assist Ram Sectional View

1. Assist ram body
2. Pin
3. Seal
4. Dust seal

DESCRIPTION AND OPERATION

An assist ram can be installed to increase hydraulic lift power.
The assist ram is connected to the lift left arm and is hinged on the final drive case spacer.

The assist ram is single–acting type and controlled by the oil flow from the lift control valve, which also drives the lift internal cylinder.

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ASSIST RAM
Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Remove the assist ram as follows:

1. Open and raise engine hood.
2. Detach negative cable (1) from battery and insulate.
3. Fully lower lift arms .

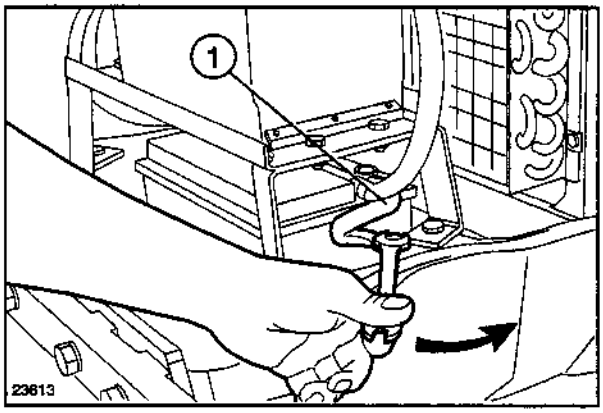


Figure 8-9-2

4. Detach the oil supply line (2), slide out pins (3 and 4) and remove the assist ram.
5. Reinstallation of the assist ram follows the removal procedure in reverse.

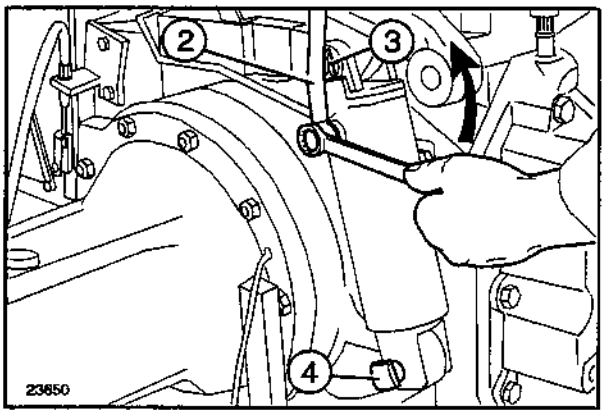


Figure 8-9-3

ASSIST RAM
Disassembly – Reassembly

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Disassemble the assist ram as follows:

1. Withdraw the pin (2, Fig. 8-9-1) from the assist ram cylinder and check for distortion or roughness.
2. Check seal (3, Fig. 8-9-1) and dust seal (4). Replace if necessary.
3. Grease the three above components with specified oil and insert the pin (2).

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SECTION 9

DRIVE LINES – FWD

CHAPTER 1

DRIVE LINES

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SPECIFICATIONS – TIGHTENING TORQUE – SPECIAL TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

FWD ELECTRO–HYDRAULIC CLUTCH SPECIFICATIONS

FWD Shaft Bearing Adjust Ring Shims (5, page 9-1-5) ..... mm	1.00–1.05–1.10–1.15–1.20–1.251.30–1.35–1.40–1.45–1.50–1.551.60–1.65–1.70–1.75–1.80–1.851.90–1.95–2.00–2.05–2.10–2.15–2.20
Clutch Reaction Disc Thickness (9) ..... in (mm)	0.280–0.287–0.295–0.303 (7.1–7.3–7.5–7.7) 0.311–0.319–0.327-0.335 (7.9–8.1–8.3–8.5) 0.342–0.350–0.358–0.366 (8.7–8.9–9.1–9.3) 0.374–0.382–0.390–0.398 (9.5–9.7–9.9–10.1)
Clutch Driven Discs	9
Clutch Drive Discs	8
Clutch Driven Disc Thickness ..... in (mm)	0.067–0.071 (1.7+1.8)
Clutch Drive Disc Thickness ..... in (mm)	0.057–0.061 and 0.065–0.069 (1.45+1.55) and (1.65+1.75)
Free Belleville Spring Height (one) ..... in (mm)	0.388–0.398 (9.85+10.10)
Free Belleville Spring Height under a 1972 kg (4350 lbf) load ..... in (mm)	0.305 (7.75)

DRIVE SHAFT SPECIFICATIONS

Front Sleeve Positioning Adjust Ring Shims (2, page 9-1-4) ..... mm	1–1.2–1.5–1.8–2–2.2–2.5–3–3.33.7–4–4.3
Front Sleeve End–Play (L) ..... in (mm)	0.047–0.067 (1.2+1.7)

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TIGHTENING TORQUE

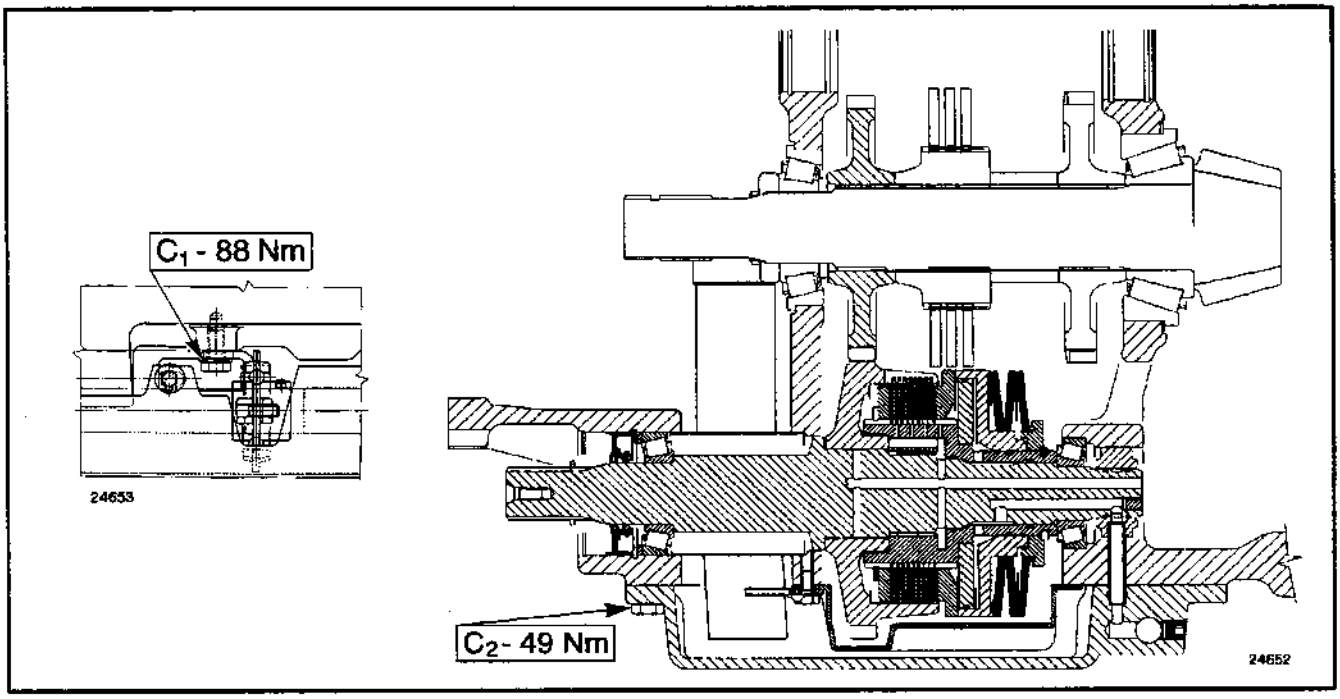


Figure 9-1-1

DESCRIPTION	Thread Size	Tightening Torque ft. lbs. (Nm)
Drive Shaft Main Bearing Attaching Screw (C_1)	M12 x 1,5	65 (88)
Transfer Box Attaching Screw (C_2)	M10 x 1,25	36 (49)

SPECIAL TOOLS

Caution – Operations described in this section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

	293996	Transfer box drive shaft puller (M8x1.25) adapter (to be used with tool no. **292927**)
X	**293995**	Transfer box drive shaft end–play checking bracket

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Tool to be fabricated to remove the electro–hydraulic transfer box rear cup. (Mark tool with no. 50067. Dimensions in mm.)

Note: Fabricate tool using F42 material.

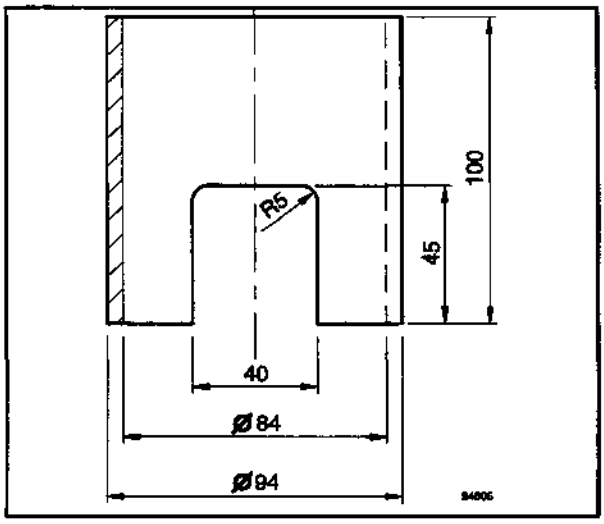


Figure 9-1-2

Tool to be fabricated to remove the electro–hydraulic transfer box reaction disc (Mark tool with no. 50068. Dimensions in mm.)

Note: Fabricate tool using F42 material.

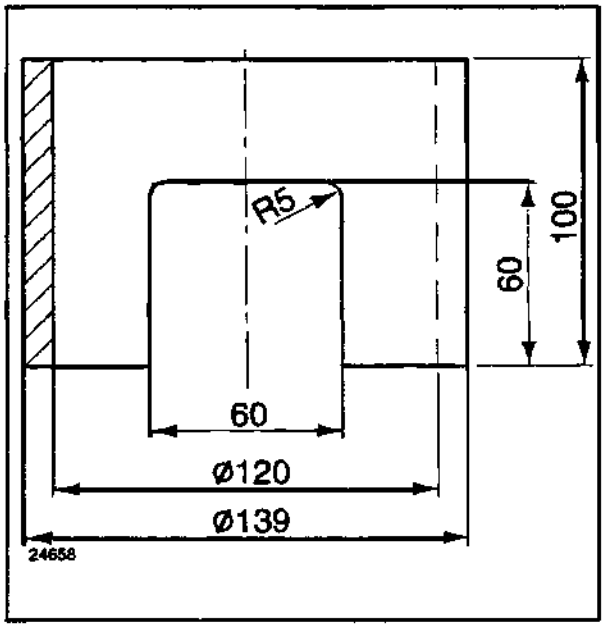


Figure 9-1-3

Tool to be fabricated to remove the electro–hydraulic transfer box clutch assembly. (Mark tool with no. 50069. Dimensions in mm.)

Note: Fabricate tool using F42 material.

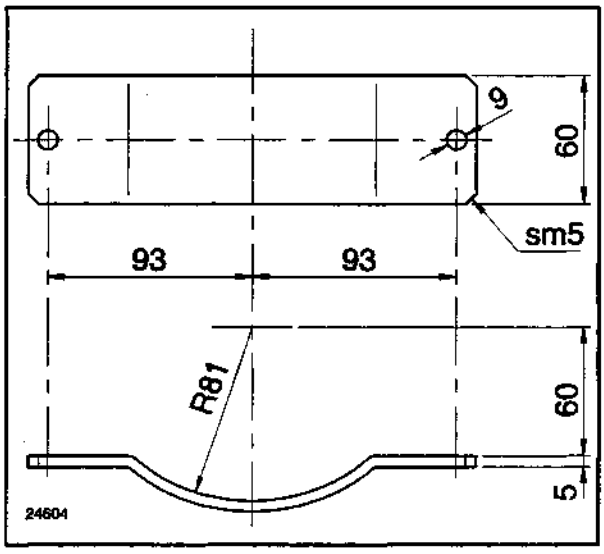


Figure 9-1-4

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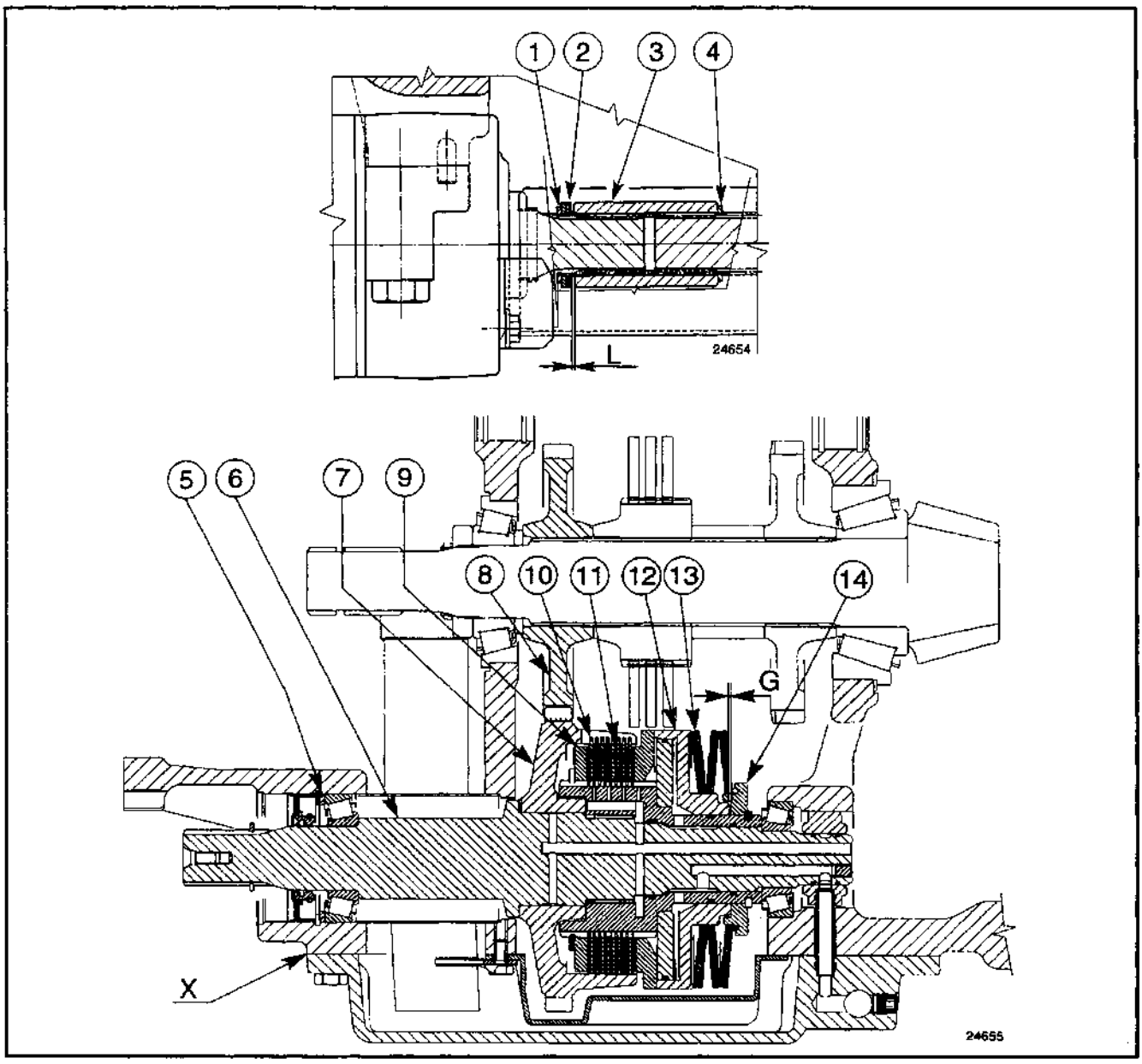


Figure 9-1-5

FWD Electro--Hydraulic Clutch Sectional Views

G= 0.039 to 0.047 in (1 to 1.2 mm). Release travel.
L= 0.047 to 0.067 in (1.2 to 1.7 mm). Sleeve (3) end–play.

1. Circlip
2. Sleeve (3) positioning adjust ring.
3. Front sleeve
4. Circlip
5. FWD shaft bearing adjust shims.
6. FWD shaft
7. Driven gear
8. Drive gear
9. Clutch reaction disc
10. Drive discs
11. Driven discs
12. Control piston
13. Belleville spring
14. Belleville spring reaction disc

Note: During installation apply sealer on surfaces marked with an X as detailed on page 9-1-19.

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TROUBLESHOOTING

Problem	Possible Causes	Correction
FWD does not engage	1. Faulty FWD engagement switch.	Replace switch.
	2. The electromagnet is not energized: damaged or detached connectors, faulty remote switch.	Reset electrical connections and replace faulty parts.
	3. FWD control solenoid valve (4, page 8-1-28, Sec. 8, Chap. 1) stuck open.	Repair or replace solenoid valve.
	4. Worn clutch discs .	Replace clutch discs.
	5. Bent Belleville springs.	Repair clutch assembly.
FWD does not disengage	1. Low transmission oil.	Reset oil level.
	2. Blocked oil filter.	Replace filter.
	3. Faulty water pump.	Overhaul or replace pump.
	4. Faulty FWD engagement switch.	Replace switch.
	5. The electro–magnet is not energized: damaged or detached connectors, faulty remote switch.	Reset electrical connections and replace faulty parts.
	6. FWD control solenoid valve stuck open.	Repair or replace solenoid valve.
	7. Oil leaks through the seals with consequent pressure drop: hub, piston, inlet fitting, and transfer box shaft seals	Replace faulty oil seals.
With the FWD electro–hydraulic clutch disengaged, the FWD does not engage when the brake pedals are pressed.	1. Faulty pump pressure switch.	Replace pressure switch.

DESCRIPTION AND OPERATION

The transfer box is located under the rear transmission housing and connects the rear transmission to the front axle by means of a shaft running along the central axis of the tractor.

The transfer box is controlled by a control gear located on a bevel spur gear. This gear acts on the clutch and moves a gear splined to the FWD shaft.

Refer to pages 9-1-7 and 9-1-8 for the description of the transfer box clutch operation.

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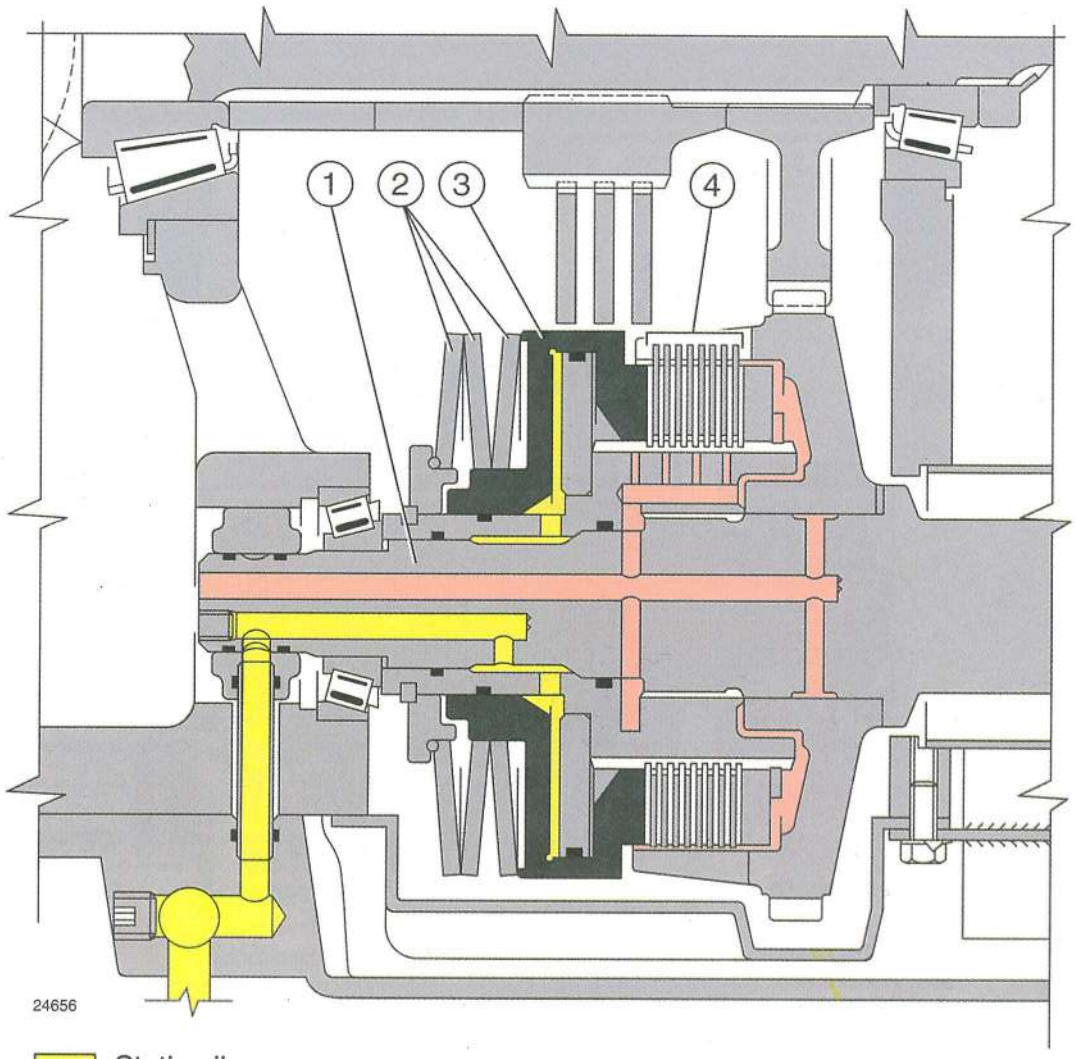


Figure 9-1-6

FWD ELECTRO–HYDRAULIC CLUTCH (FWD ENGAGED)

When the FWD is engaged by means of the switch located on the EIC panel, the oil within the control piston (3) annular groove is static and without pressure. The solenoid valve is in the discharge position (de–energized).

FWD engagement takes place through the Belleville springs (2) which keep pressed the multi–pack clutch (4) which transfers the drive reaching the front axle through the drive shaft (1).

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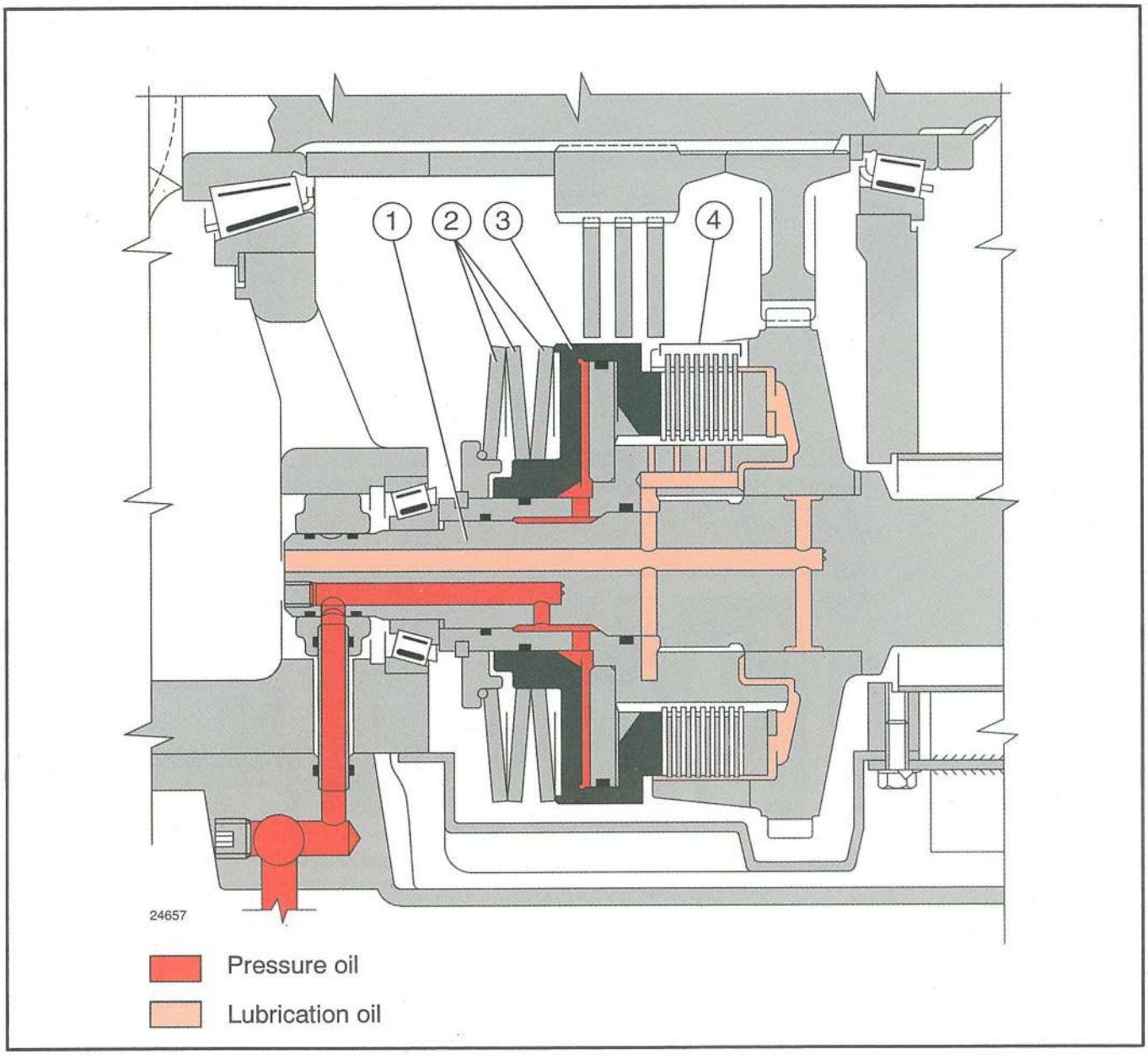


Figure 9-1-7

FWD ELECTRO–HYDRAULIC CLUTCH (FWD ENGAGED)

When the switch located on the EIC panel is pressed, the solenoid valve opens and let the oil flow from the pump into the control piston (3) annular groove.

Pressure oil works against the action of the Belleville springs (2) and moves the piston (3).

Under these conditions, the control clutch (4) is not compressed and the drive shaft (4) reaching the front axle can rotate freely as it is no longer integral to the assembly.

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DRIVE SHAFT AND BEARING

Removal – Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Proceed as follows:

1. Open and raise the hood.
2. Detach the negative cable (4) from the battery and insulate.

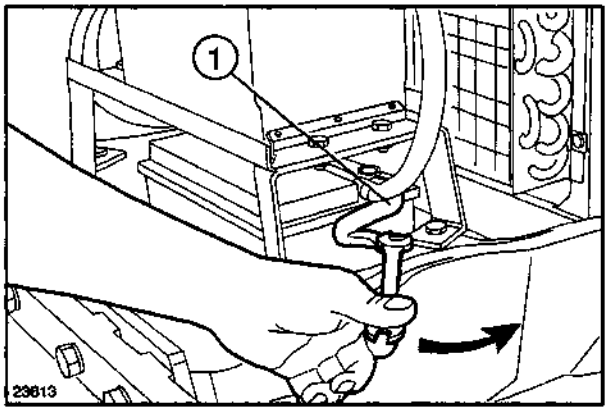


Figure 9-1-8

3. Loosen the retaining screws and remove the drive shaft protection.
4. Remove circlip (4) and withdraw the sleeve (5). Repeat for transfer box circlip and sleeve.

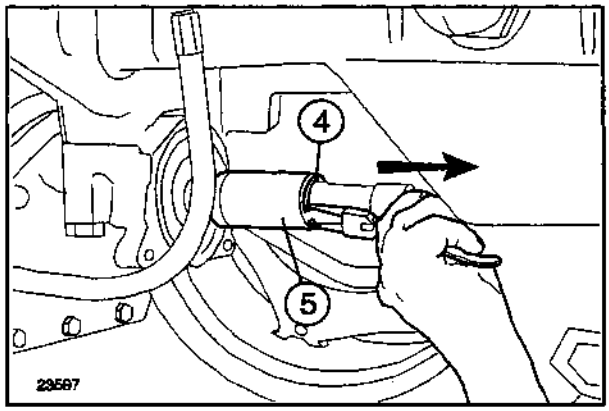


Figure 9-1-9

5. Loosen the screws retaining the bearing (3) to the transmission and speed clutch housing and recover the bearing as well as the drive shafts.
6. Reinstallation of the drive shaft follows the removal procedure in reverse.

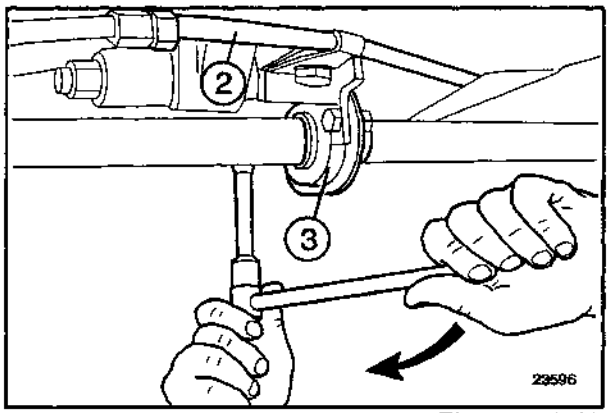


Figure 9-1-10

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TRANSFER BOX SHAFT OIL SEAL

Replacement with the transfer box shaft removed from the tractor.

The transfer box shaft oil seal can be replaced with the transmission housing on a bench or installed into the tractor(both in the mechanical and electro–hydraulic clutch versions).

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

Proceed as follows:

1. Open and raise the hood.
2. Detach the negative cable (4) from the battery and insulate.
3. If the transmission housing is installed on the engine, drain oil from the rear transmission and speed clutch housings and remove the drive shaft reaching the front axle (see page 9-1-9).
4. Using a screw–driver or punch, remove dust ring and oil seal to be replaced.

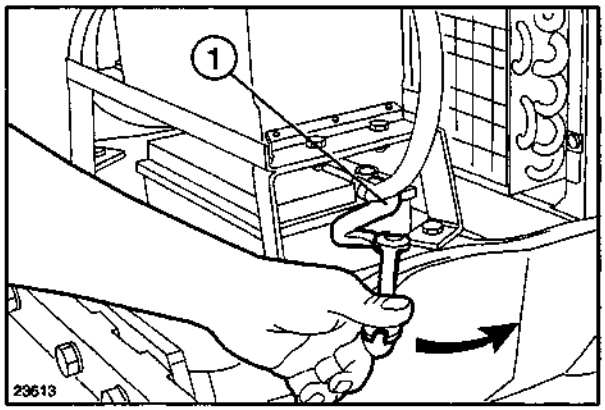


Figure 9-1-11

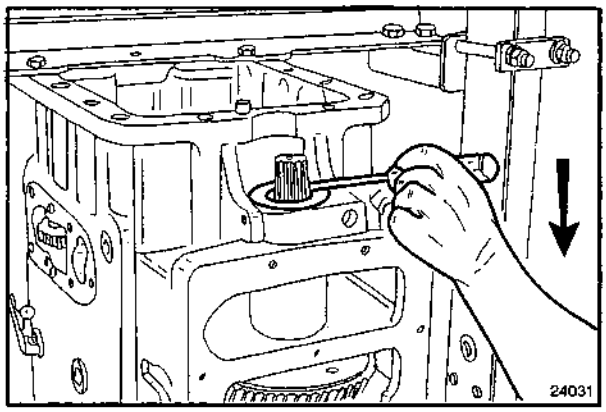


Figure 9-1-12

5. Install a new seal and settle it correctly into its seat using the drift tool no. **293475** (1).
6. Install a new dust seal.
7. Assemble the drive shaft reaching the front axle, fill transmission with specified oil, and connect the negative cable to the battery.

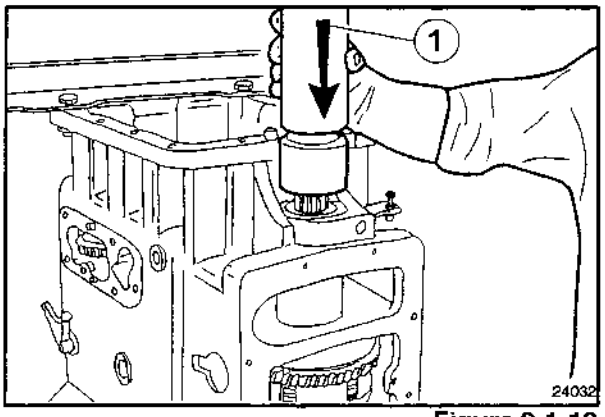


Figure 9-1-13

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ELECTRO–HYDRAULIC CLUTCH TRANSFER BOX

Removal – Installation

Removal and installation of the electro–hydraulic clutch transfer box can be carried out with the transmission housing on a bench or installed in the tractor.

⚠ WARNING ⚠

Handle all components with the greatest care.
Do not insert hands or fingers between the parts.
Wear suitable protection clothing, including goggles, gloves and footwear.

Proceed as follows:

1. Open and raise the hood.
2. Detach the negative cable (4) from the battery and insulate.
3. If the transmission housing is installed on the engine, drain oil from the rear transmission and speed clutch housings and remove the drive shaft reaching the front axle (see page 9-1-9).

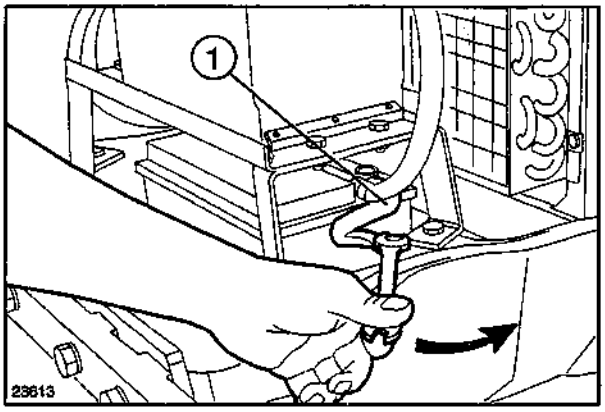


Figure 9-1-14

4. Detach the supply line from the transfer box bottom cover.

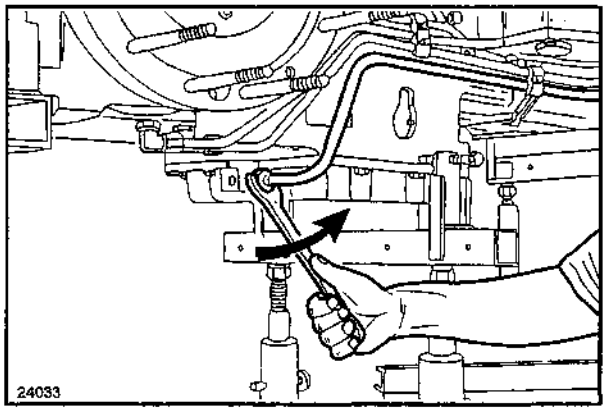


Figure 9-1-15

5. Remove the transfer box bottom cover.

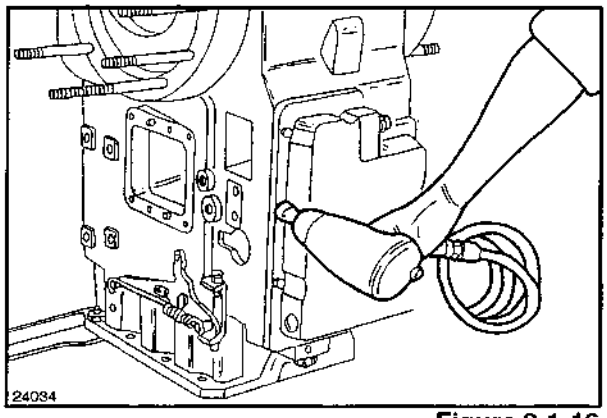


Figure 9-1-16

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6. Remove the inner transfer box guard.

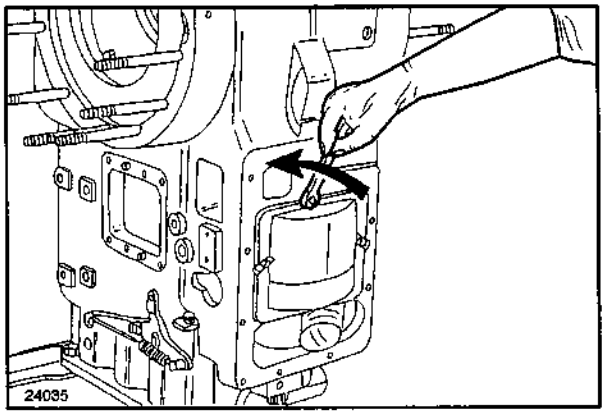


Figure 9-1-17

7. Remove the oil suction line.

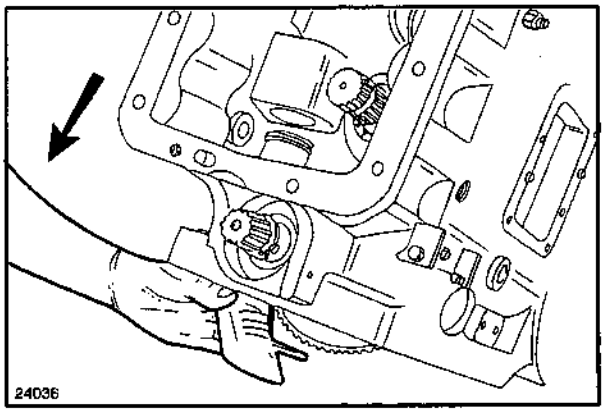


Figure 9-1-18

8. Remove the dust ring, oil seal and circlip retaining the transfer box shaft bearings.

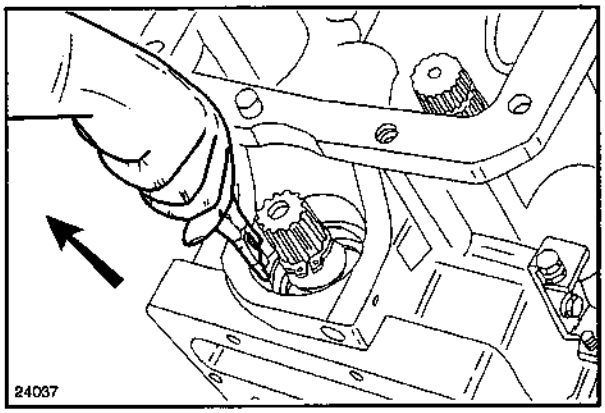


Figure 9-1-19

9. Recover the transfer box shaft bearing adjust ring.
10. Fabricate on site the bracket tool no. **50069** following the instructions given in the drawing on page 9-1-4.
11. Install the bracket tool no. **50069** on the transmission housing to lock the FWD clutch.

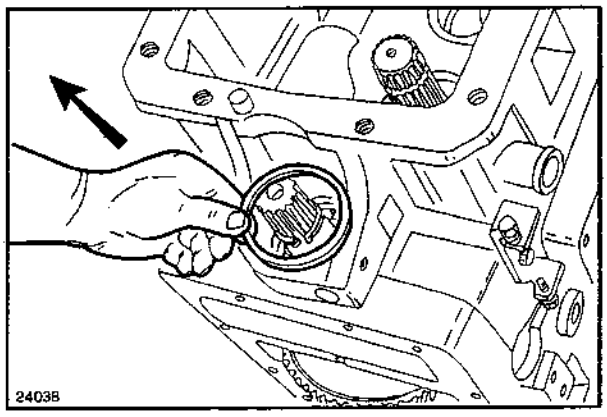


Figure 9-1-20

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12. Using a puller tool (1) and adapter tool no. **293996** (2) partially withdraw the transfer box shaft.

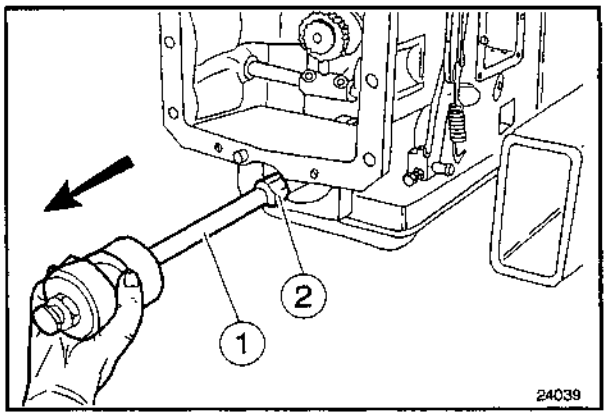


Figure 9-1-21

13. Complete transfer box shaft removal by hand and ensure that the clutch is held in place by the bracket tool no. **50069** (3).

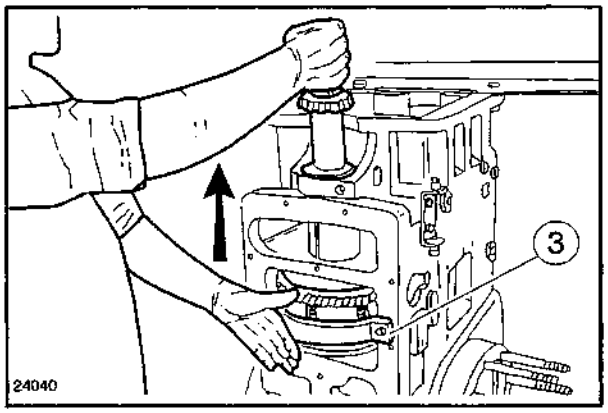


Figure 9-1-22

14. Remove the bracket tool no. **50069** and withdraw the clutch complete with the FWD engagement control device.

Note: The bracket tool no. **50069** is necessary to remove the electro–hydraulic clutch transfer box when the transmission housing is installed into the tractor. If the transmission housing is placed on a bench proceed as follows:

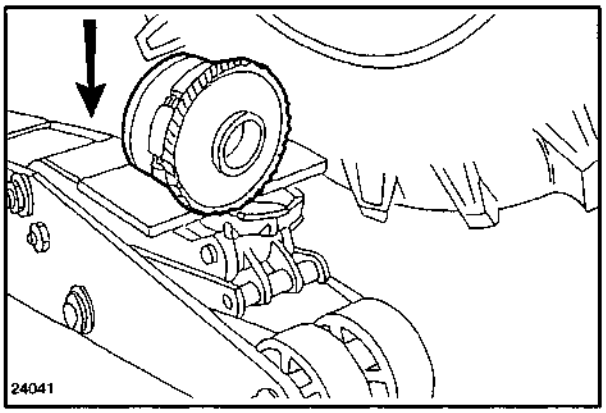


Figure 9-1-23

15. Using a puller tool (1) and adapter tool no. **293996** (2) and partially withdraw the transfer box shaft.

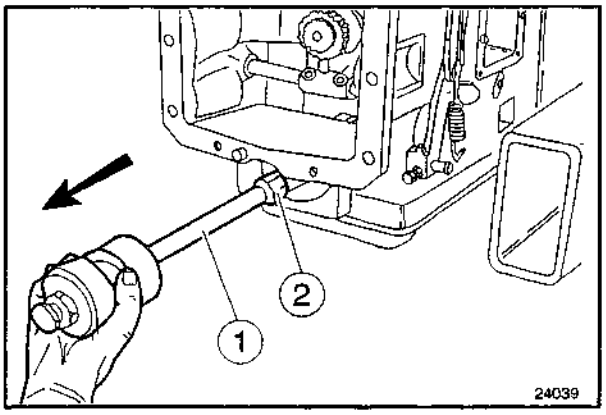


Figure 9-1-24

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16. With the housing in the upright position, complete transfer box removal with one hand and hold the FWD clutch in place with the other.

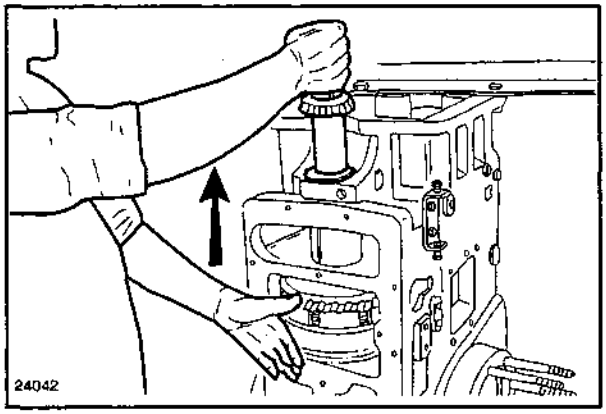


Figure 9-1-25

17. Remove the clutch complete with the FWD engagement control device.

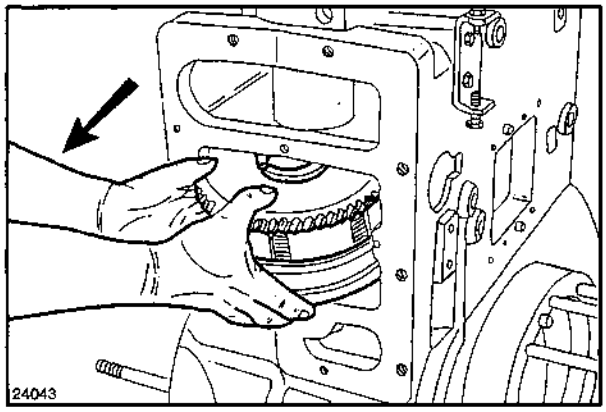


Figure 9-1-26

18. Remove the pipe section protecting the transfer box shaft.
19. Overhaul the FWD electro–hydraulic clutch on the bench as follows:
20. Fabricate on site the tools nos. **50067** and **50068** following the instructions given in the drawings on page 9-1-4.
21. Place the clutch on a hydraulic press with the clutch discs turned upwards.
22. Install the tool no. **50068**, previously fabricated on site, on the clutch.

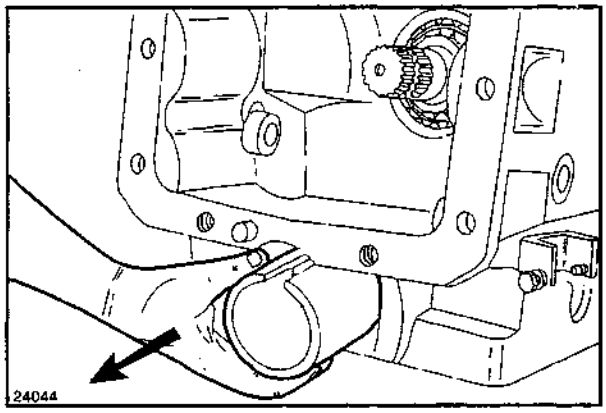


Figure 9-1-27

23. Overcome the clutch spring resistance with the press and remove the circlip retaining the clutch discs.

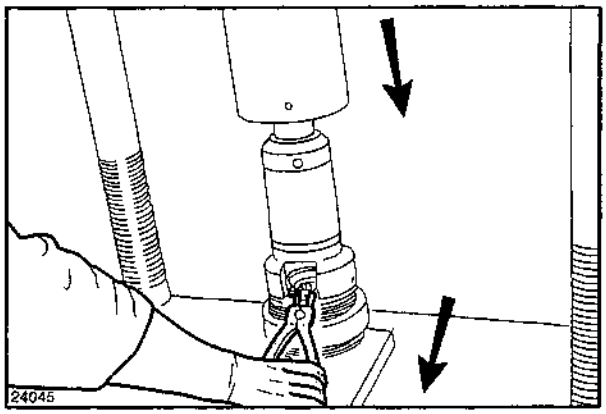


Figure 9-1-28

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24. Release the hydraulic press and recover the clutch discs together with the circlip, reaction and clutch release discs.

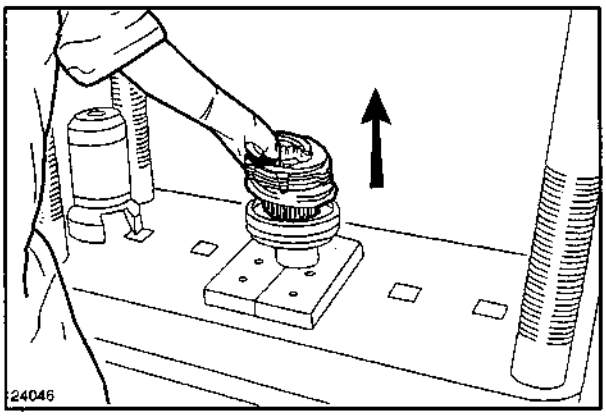


Figure 9-1-29

25. Place the clutch assembly with the springs turned upwards and install the tool no. **50067** on the clutch. Overcome the spring action using the hydraulic press and remove the two saddle rings which retain the springs.

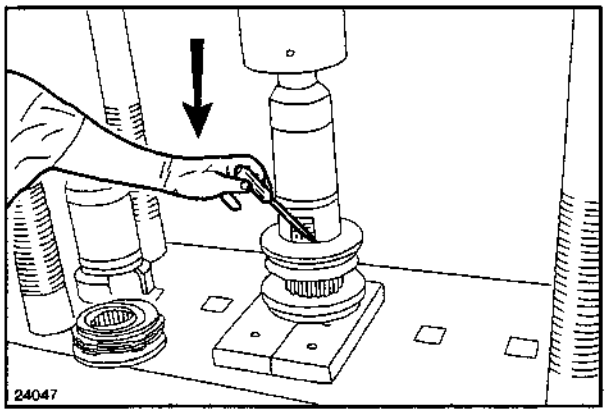


Figure 9-1-30

26. Release the hydraulic press and recover the springs complete with the reaction disc.

27. Check the O rings for wear and replace if damaged.

28. Reinstallation of the clutch follows the removal procedure in reverse.

29. Place the clutch complete with all details on the press with the discs turned upwards.

30. Install the tool no. **50068**, previously fabricated on site, on the clutch.

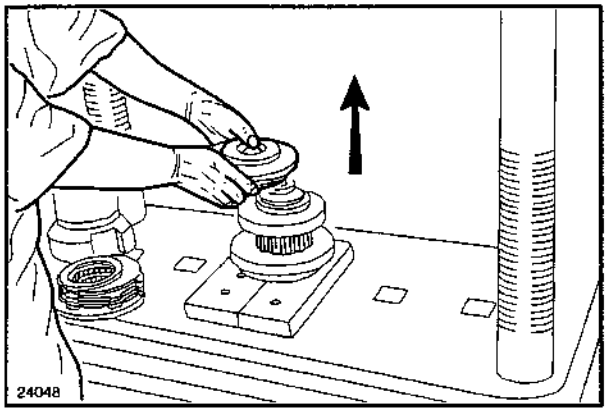


Figure 9-1-31

31. Overcome the clutch spring action with the press and using a feeler gauge measure the clearance between the circlip and reaction disc. The clearance should be 0.039 to 0.047 in (1 to 1.2 mm). If this is not the case, replace the clutch reaction disc (9, page 9-1-5). With a new reaction disc installed, use the press again to check that the clearance between the circlip and reaction disc is 0.039 to 0.047 in (1 to 1.2 mm).

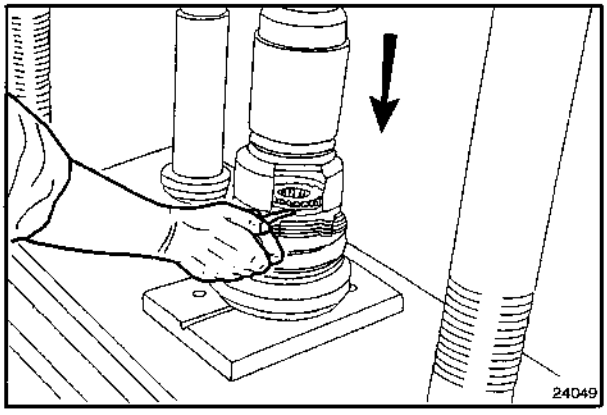


Figure 9-1-32

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32. Install the pipe section protecting the transfer box shaft ensuring that the split is turned upwards.

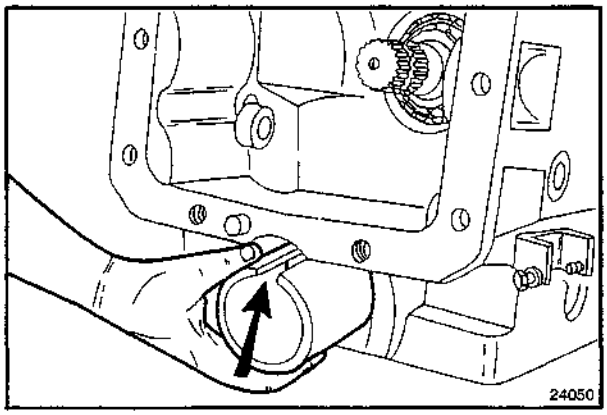


Figure 9-1-33

33. Install the clutch on the transmission housing and, if the transmission housing is assembled on the tractor, lock the clutch using the bracket tool no. **50069** (3). Install the transfer box shaft.

34. Remove the bracket tool no. **50069** and insert the outer race of the transfer box shaft bearing in its seat keeping it in contact with the rollers.

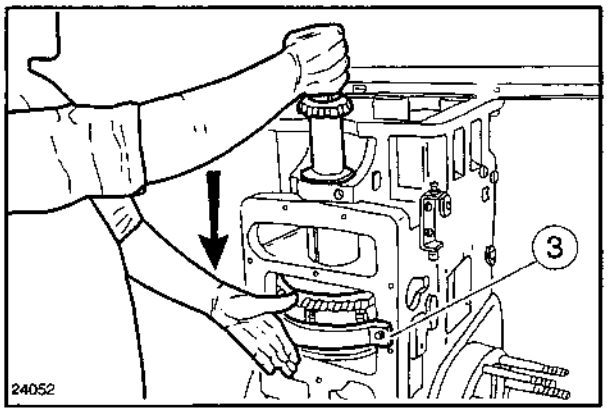


Figure 9-1-34

35. Install the circlip retaining the transfer box shaft bearings.

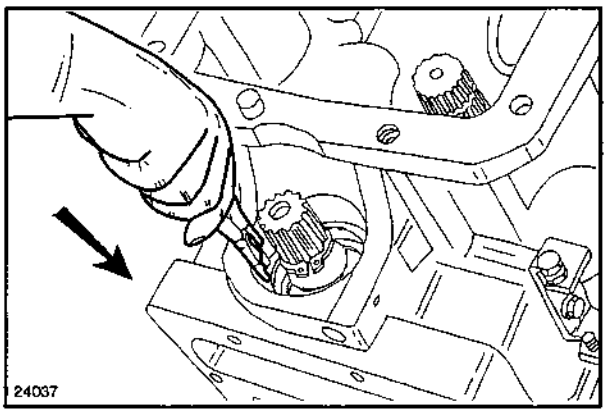


Figure 9-1-35

36. Fix the screw of the tool no. **293995** (1) to the transfer box shaft.

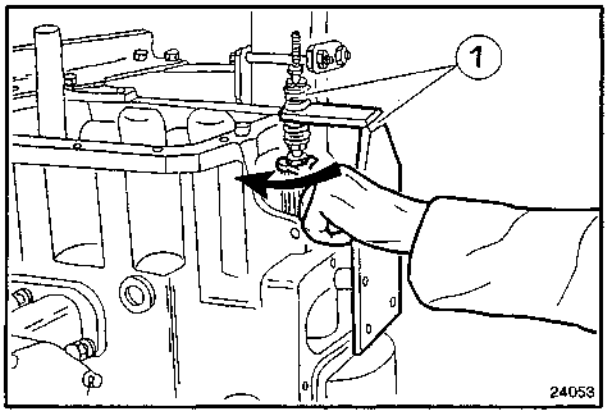


Figure 9-1-36

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37. Fix the tool no. **293995** (1) to the transmission housing. (If necessary, loosen the threaded pin nuts on the tool to align the transmission housing holes.)

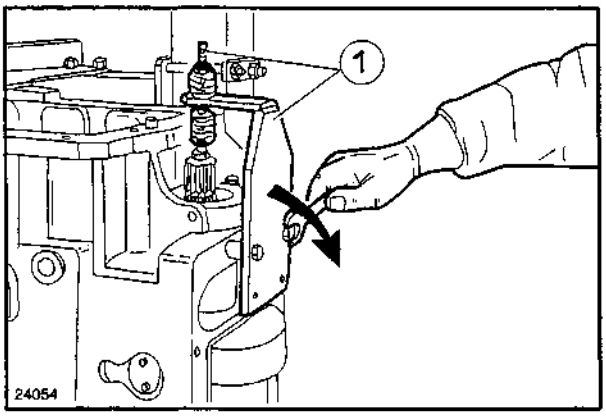


Figure 9-1-37

38. Install a lever gauge and fix it using to the transmission housing (not to the tool) its magnetic base. Position the gauge tip on the transfer box shaft top.

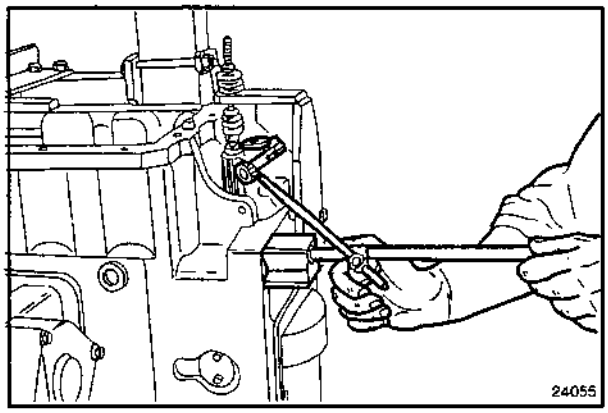


Figure 9-1-38

39. With the lower nut completely loose, screw in manually the upper nut of the tool no. **293995** until it touches the upper spring cup. Then screw it in a further 1 ½ turn. When in this condition, reset gauge to zero.

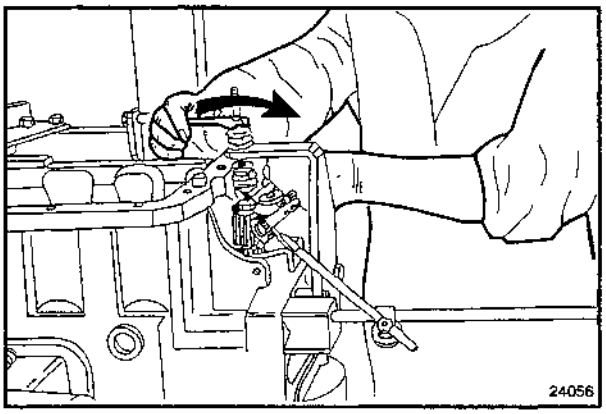


Figure 9-1-39

40. Loosen the upper nut of the tool no. **293995** completely and screw in by hand the lower nut until it touches the lower spring cup. Then screw it in a further 1-1/2 turn.

41. Read the transfer box shaft axial displacement (L) on the lever gauge. The shim pack (5, page 9-1-5) to be inserted between the circlip and bearing race will be as follows:

$$S_1 = L - 0.002 \text{ in } (0,05)$$

where:
L = transfer box axial displacement read on the gauge

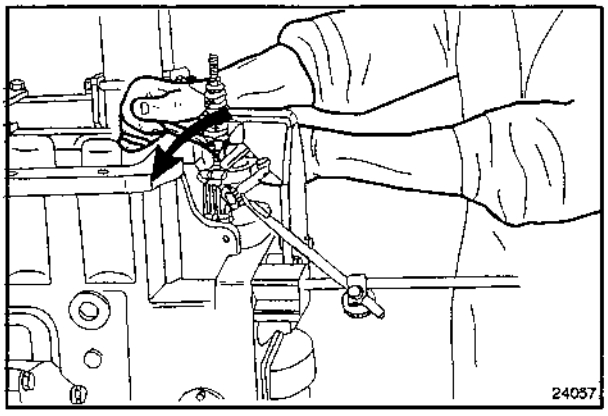


Figure 9-1-40

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0.002 in (0,05) = necessary reduction to avoid bearing pre–load.
Round off the value obtained to the lower value within 0.002 in (0.05 mm).

42. Remove tool no. **293995** from the transmission housing.

43. Remove the circlip retaining the transfer box shaft bearings.

44. Insert shims (1) as previously computed.

45. Install the circlip retaining the transfer box shaft bearings.

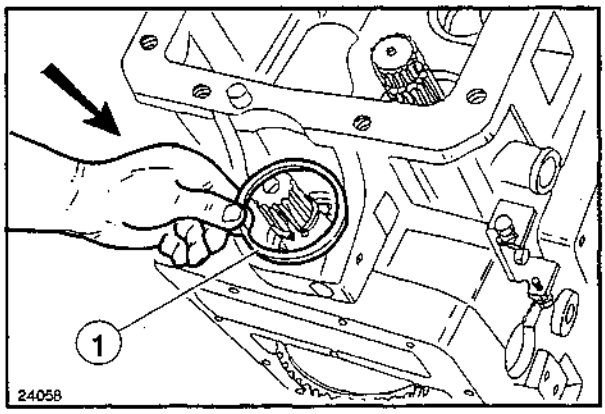


Figure 9-1-41

46. Install the oil seal and settle it down correctly using a positioner tool no. **293475** (1). Last, install the dust ring.

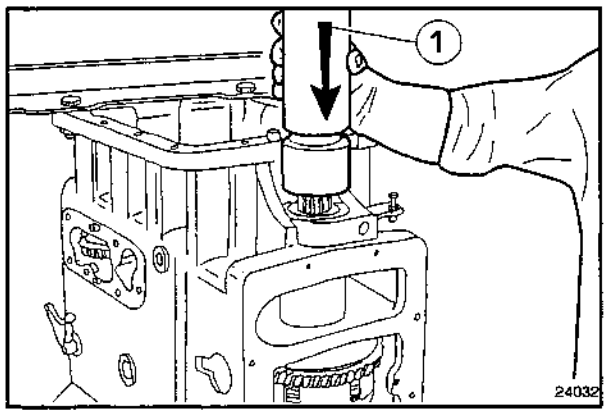


Figure 9-1-42

47. Install the oil suction line.

48. Install the inner transfer box protection.

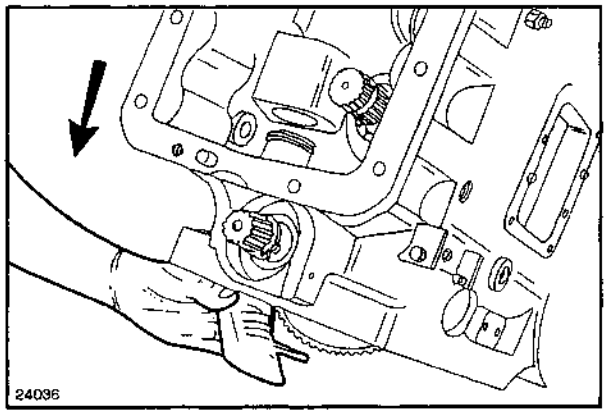


Figure 9-1-43

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49. Thoroughly clean and degrease the transmission housing and transfer box bottom cover mating surfaces. Apply one of the specified sealants listed on page 0-1-19, Sec. 00, following the pattern shown in the figure.

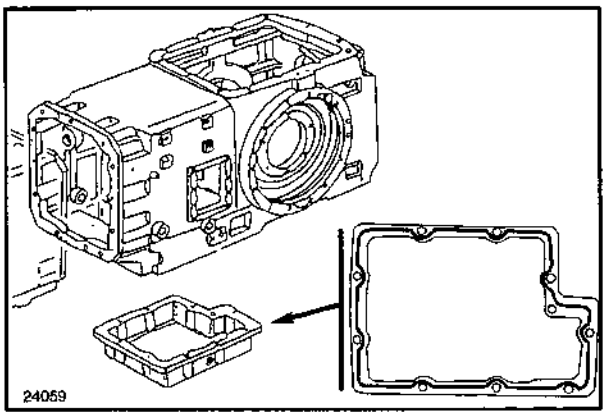


Figure 9-1-44

50. Install the transfer box bottom cover and connect the supply line to the cover.

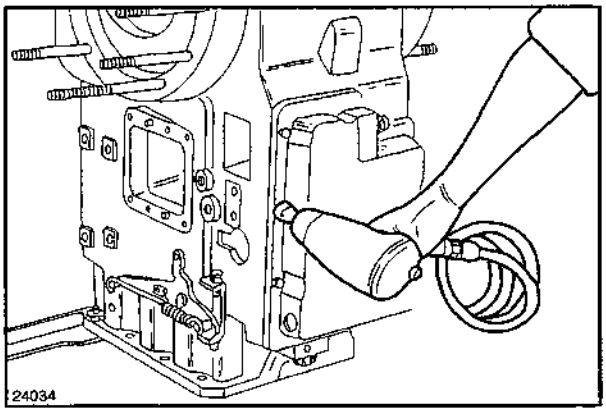


Figure 9-1-45

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SECTION 9

DRIVE LINES – FWD

CHAPTER 2

FRONT AXLE AND WHEELS (STANDARD)

CONTENTS

SPECIFICATIONS 9-2-2
TIGHTENING TORQUE 9-2-3
SPECIAL TOOLS 9-2-4
DESCRIPTION AND OPERATION 9-2-4
TROUBLESHOOTING 9-2-4
SECTIONAL VIEWS 9-2-5
REMOVAL – INSTALLATION – OVERHAUL 9-2-6
FRONT WHEEL SETTING TESTS 9-2-15
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SPECIFICATIONS – TIGHTENING TORQUE – TOOLS – SECTIONAL VIEWS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

SPECIFICATIONS

Type	Reversed U–shaped, telescopic, centrally pivoted
Track settings (7 of) ... in (mm)	60.8–64.8–68.7–72.6 (1545–1645–1745–1845) 76.6–80.5–84.4 (1945–2045–2145)
Wheel camber	2°, corresponding to approx. 0.59 in (15 mm) with 16" rims
Wheel toe–in ... in (mm)	0 to 5 (0 to 0.197)
Swivel Pin Assembly	
Swivel pin (3, Fig. 9-2-2) diameter at the bushings ... in (mm)	1.967 to 1.969 (49.961 to 50.000)
Press–fit bushing (4) inner diameter ... in (mm)	1.970 to 1.974 (50.050 to 0.140 (1))
Swivel pin to bushing clearance ... in (mm)	0.002 to 0.007 (0.050 to 0.179)
Axle Pivot Pin Assembly	
Pivot pin (9, Fig. 9-2-2) diameter ... in (mm)	1.494 to 1.496 (37.961 to 38.000)
Press–fit bushing (8) inner diameter ... in (mm)	1.498 to 1.502 (38.050 to 38.140 (1))
Pivot pin to bushing clearance ... in (mm)	0.002 to 0.007 (0.050 to 0.179)

(1) final dimension without grinding

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TIGHTENING TORQUE

DESCRIPTION	Thread size	Torque ft. lbs. (Nm)
Front axle Screws or nuts, front axle carrier to housing (C_1)	3/4"–10UNC	245 to 275 (333 to 373)
Nut, track control rod clamp (C_2)	M 10x1.25	36 (49)
Locknut, steering rod (C_3)	M 20x1	130 (176)
Nut, RH and LH levers to swivel pins retaining screw (C_4)	M 16x1.5	217 (294)
Nut, axle outer section (C_5)	M 16x1.5	156 (211)
Screw, front wheel to hub (C_6)	M 18x1.5	231 (314)
Screw, axle pivot pin (C_7)	M 10x1.25	36 (49)

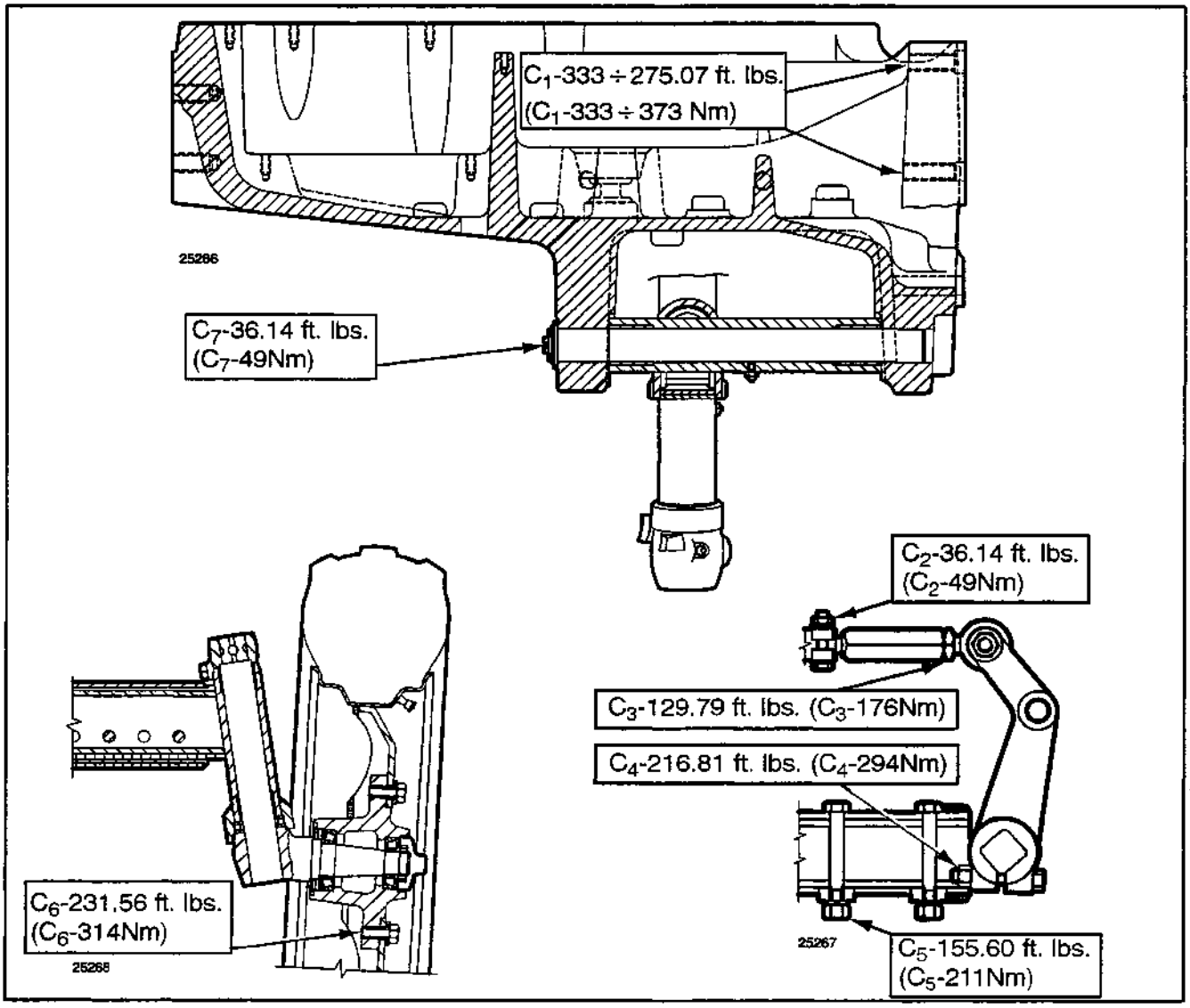


Figure 9-2-1

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SPECIAL TOOLS

Caution – Operations described in this Section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to carry out the different operations described in this Section.

X 293521 Swivel pin ring nut wrench.

X 290793 Axle pivot pin adapter (M 12x1.25) (use with **292927**).

TROUBLESHOOTING

Problem	Possible Cause	Correction
Premature tire wear	1. Wrong inflation pressure.	Inflate tires to correct pressure, refer to values suggested in the Operator's Manual. Always comply with values specified by the tire manufacturer.
	2. Wrong front wheel toe–in.	Adjust toe–in (see page 9-2-15).
Poor tractor stability	1. Wrong inflation pressure.	Inflate tires to correct pressure considering above recommendations.

DESCRIPTION AND OPERATION

The front axle for two wheel drive tractors is composed of a reversed U type center beam with telescopic axle outer sections.
The center beam is attached to the front axle carrier by means of a single pivot which allows oscillation on both sides.
The front axle is controlled by the power steering system through a cylinder attached to the axle housing and the swivel pin control lever. The two swivel pins are connected by an adjustable track control rod for toe–in adjustment, if required.
Axle center beam and telescopic outer sections are drilled as to obtain 7 possible track settings.

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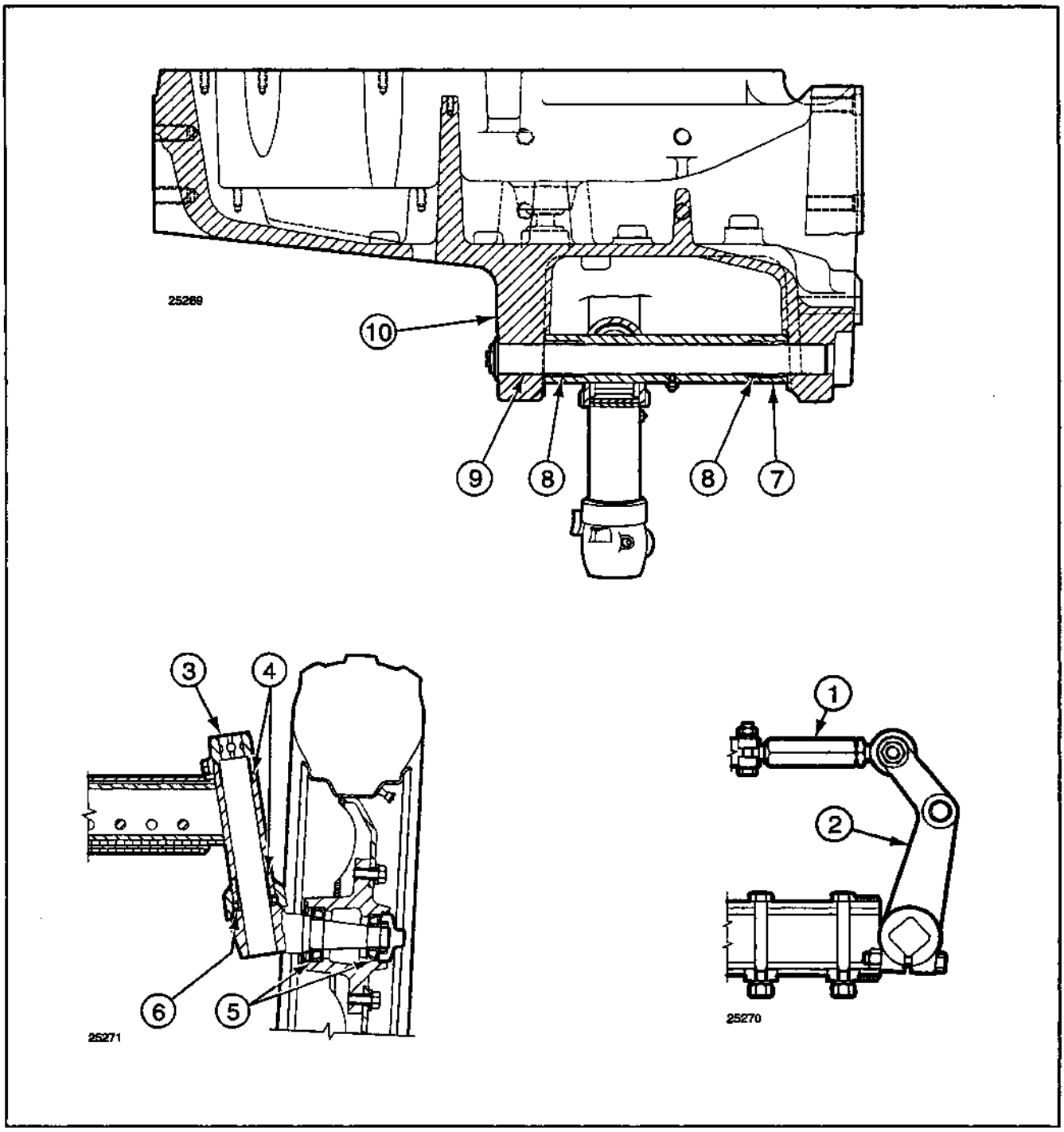


Figure 9-2-2

Front Axle and Carrier – Sectional View

1. Adjustable track control rod
2. Swivel pin control lever
3. Swivel pin
4. Swivel pin bushings
5. Wheel hub tapered roller bearing.
6. Swivel pin thrust bearing
7. Axle center beam
8. Axle pivot pin bushings
9. Axle pivot pin
10. Front axle carrier.

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FRONT AXLE
Removal – Installation

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity. Ensure that units or parts are supported by suitable slings or hooks. Ensure that no–one is in the vicinity of the load to be lifted.

Remove the front axle assembly from the tractor as follows:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.
3. Safely block rear wheels.
4. Remove front ballast and ballast support, if present.

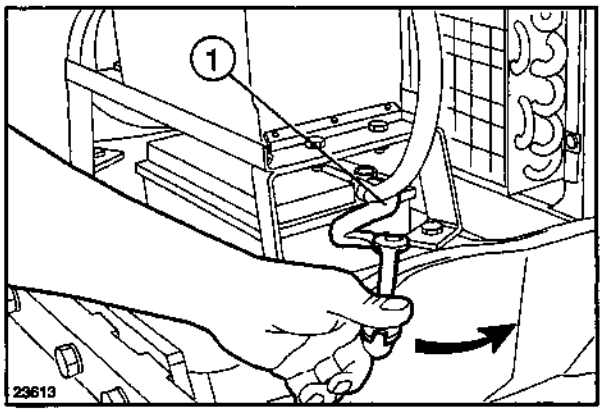


Figure 9-2-3

5. Jack up front tractor and place a stationary stand (1) under the sump.

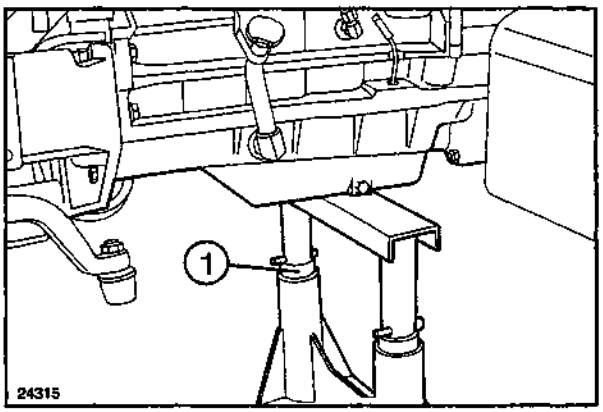


Figure 9-2-4

6. Loosen retaining screws and remove front wheels.

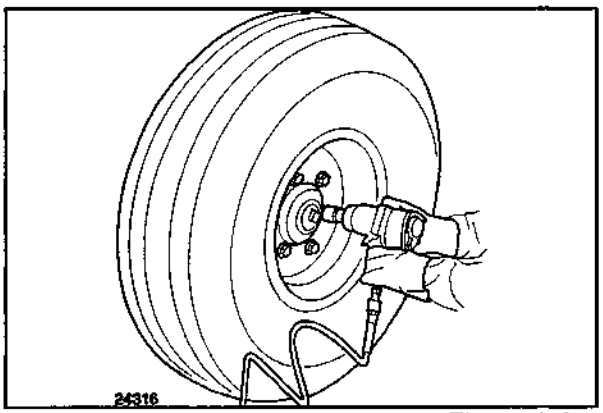


Figure 9-2-5

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7. Connect axle to a hoist using two nylon cables (2) (one on each side). Disconnect steering cylinder control lines (1).

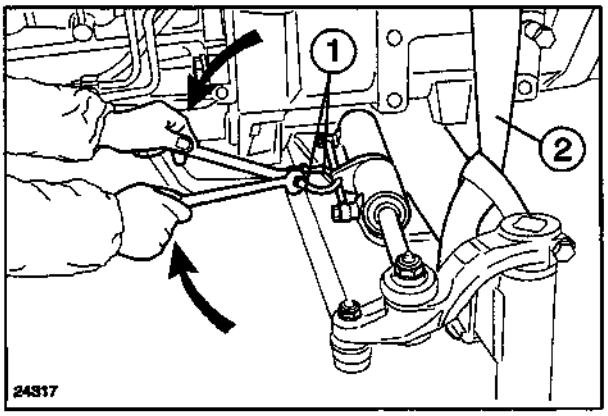


Figure 9-2-6

8. Loosen the axle pivot pin locking bolt (1).

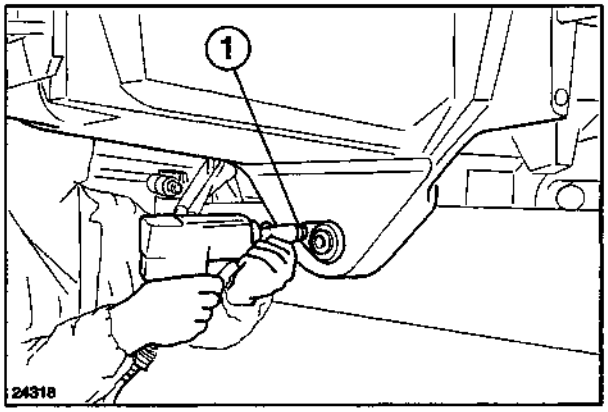


Figure 9-2-7

9. Assemble a slide puller (1) on the pivot pin (2) and withdraw the pivot pin.

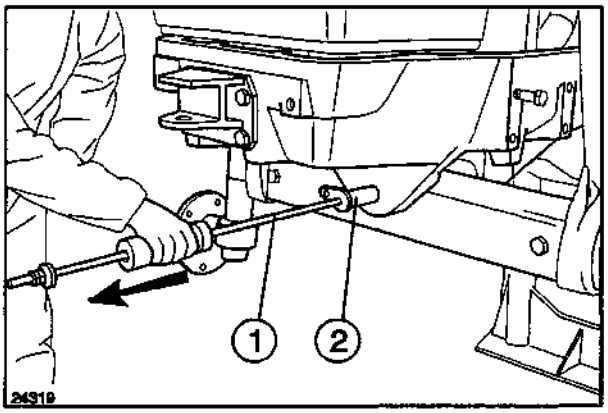


Figure 9-2-8

10. Remove front axle using a hoist.

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

11. Reinstall the front axle assembly to carrier observing the following:
    - Reassembly follows the disassembly procedure in reverse, from step 10 back to step 1.
    - Tighten to correct torque as detailed on page 9-2-3.

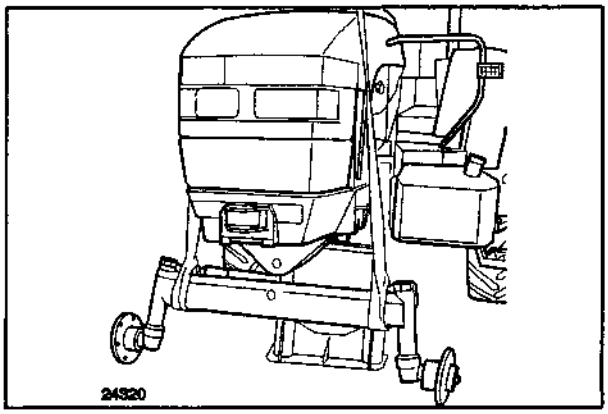


Figure 9-2-9

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FRONT WHEEL HUB
Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Wheel hubs can be removed with the front axle on the tractor. Proceed as follows for each hub:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.
3. Safely block rear wheels.
4. Remove front ballast and ballast support, if present.

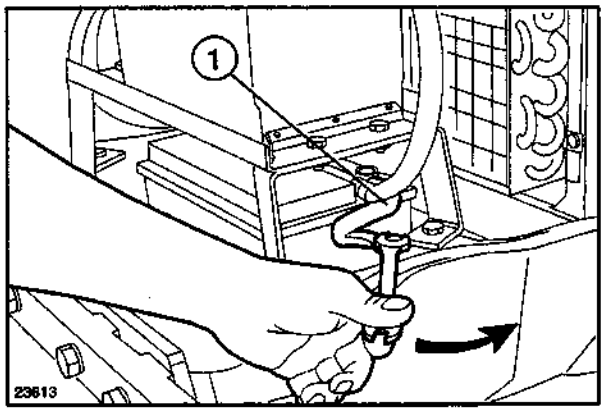


Figure 9-2-10

5. Jack up front tractor and place a stationary stand (1) under the sump.

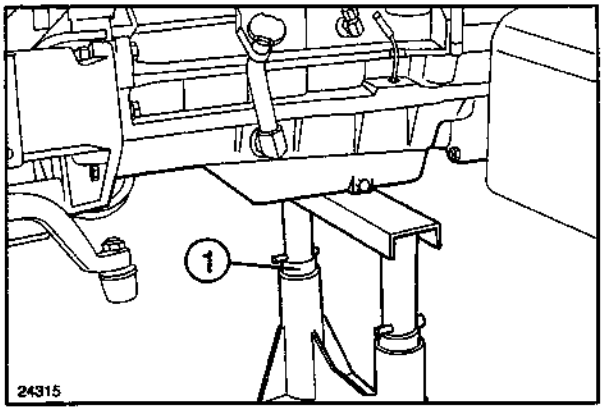


Figure 9-2-11

6. Loosen retaining screws and remove front wheels.

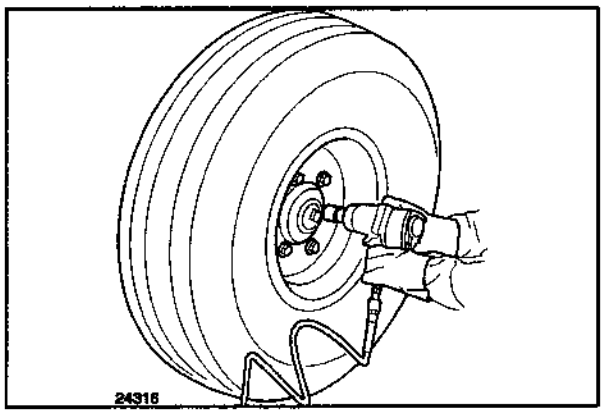


Figure 9-2-12

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7. Remove the wheel hub bearing grease cup (1)

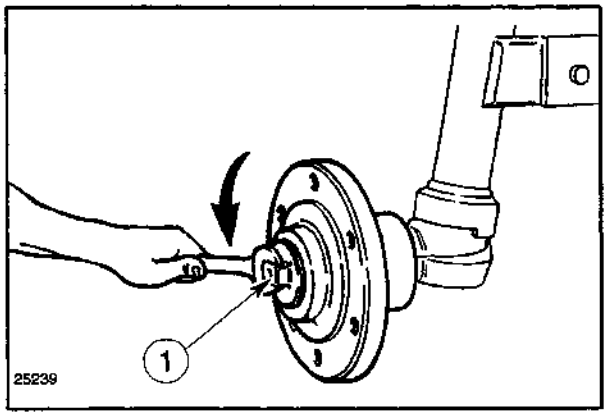


Figure 9-2-13

8. Straighten the wheel hub bearing adjust ring nut (1).

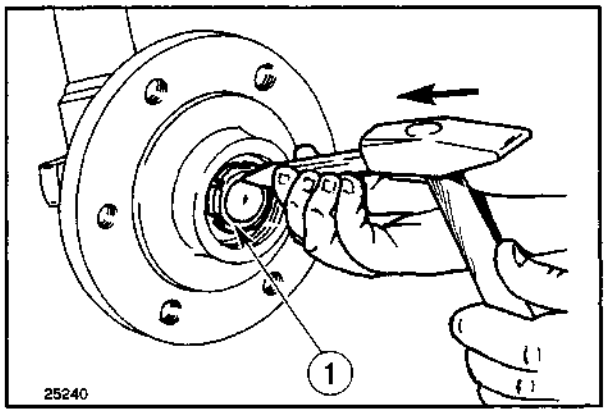


Figure 9-2-14

9. Using the socket wrench tool no. **293521** (1), loosen the wheel hub bearing adjust ring nut.

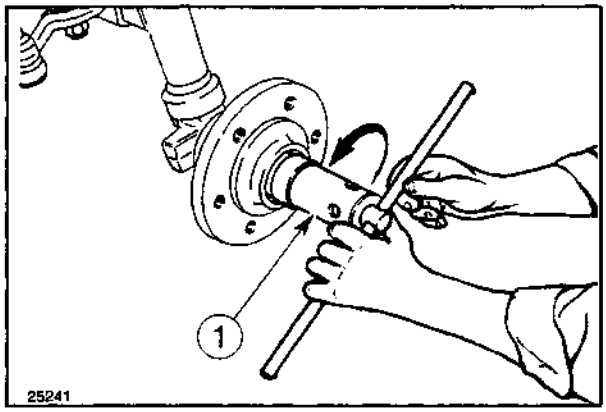


Figure 9-2-15

10. Remove the wheel hub (2) and recover bearings (1 and 3).

11. Replace faulty seals and worn bearings using suitable pullers and drifts.

12. Fill the wheel hub with grease.

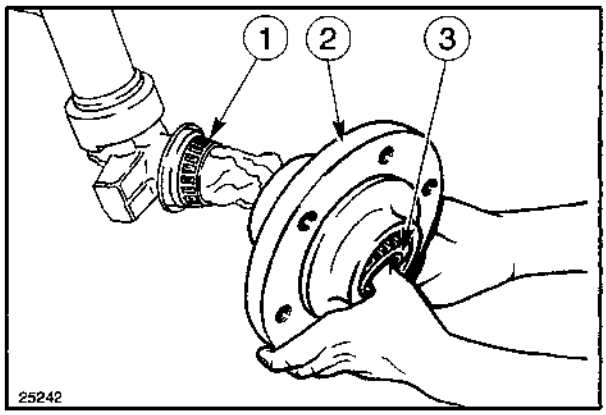


Figure 9-2-16

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13. Reassemble the wheel hub (2) complete with the bearings (1 and 3).

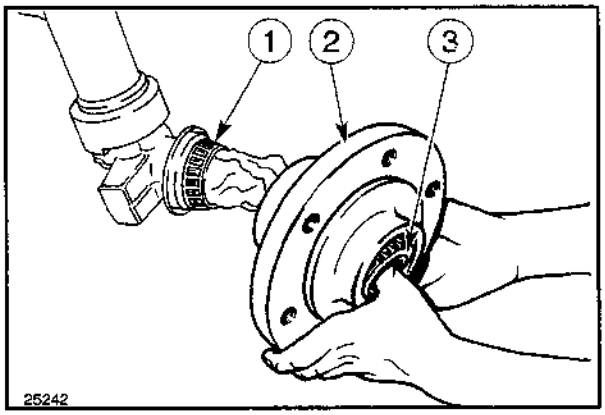


Figure 9-2-17

14. Using a torque wrench and socket wrench tool no. **293521** (2), torque the ring nut to 145 ft. lbs. (196 Nm) while turning the wheel hub to settle the bearings.

15. Loosen the ring nut and torque it again to 18 to 21 ft. lbs. (24 to 29 Nm) continuing to turn the wheel hub.

Note: The ring nut should be replaced at each reassembly.

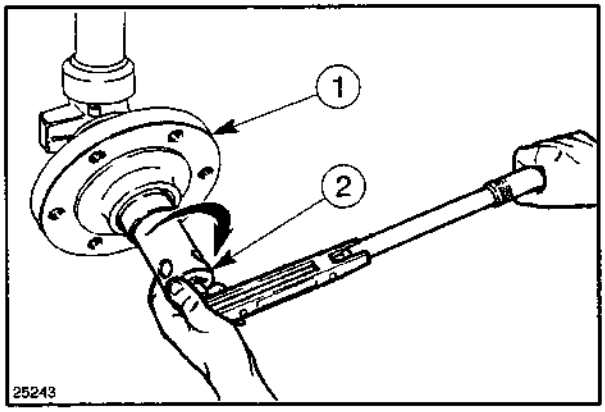


Figure 9-2-18

16. Crush the ring nut (1) locked.

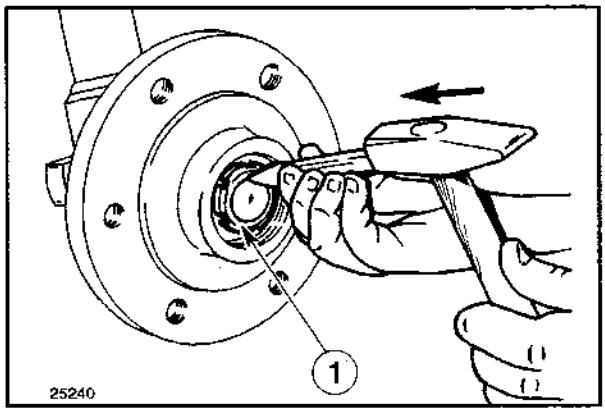


Figure 9-2-19

17. Reassemble the wheel hub bearing grease cup (1).

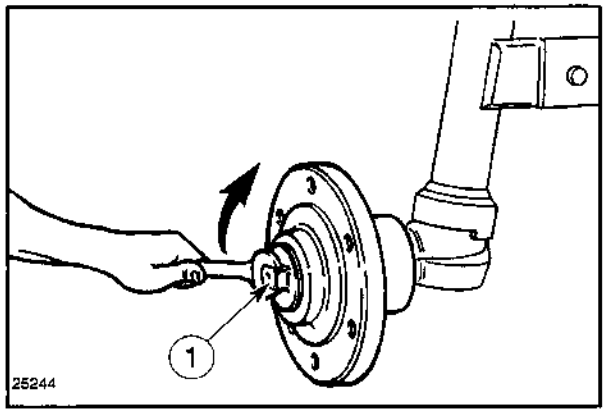


Figure 9-2-20

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SWIVEL PIN ASSEMBLY
Overhaul

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts. Wear suitable protection clothing, including goggles, gloves and footwear.

Swivel pins can be overhauled with the front axle on the tractor. Proceed as follows for each wheel:

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.
3. Safely block rear wheels.
4. Remove front ballast and ballast support, if present.

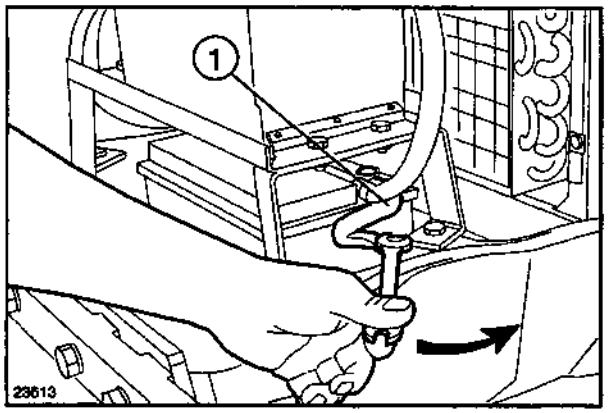


Figure 9-2-21

5. Jack up front tractor and place a stationary stand (1) under the sump.

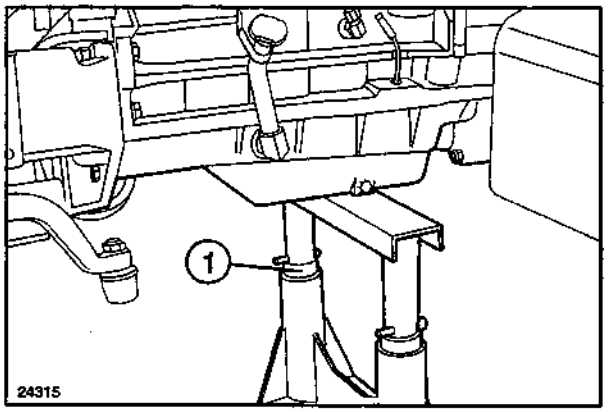


Figure 9-2-22

6. Loosen retaining screws and remove front wheels.

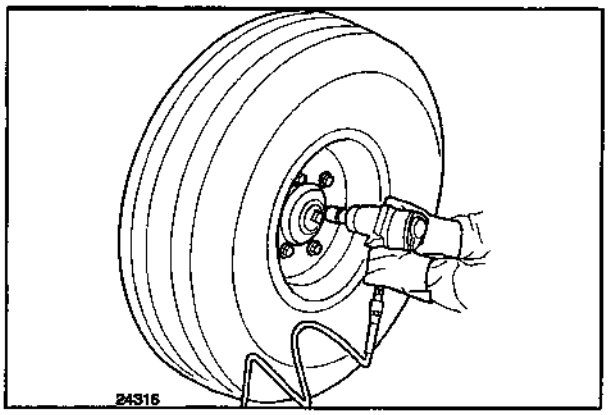


Figure 9-2-23

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7. Place an hydraulic jack under the swivel pin assembly and loosen the swivel pin control lever (1) retaining screw.

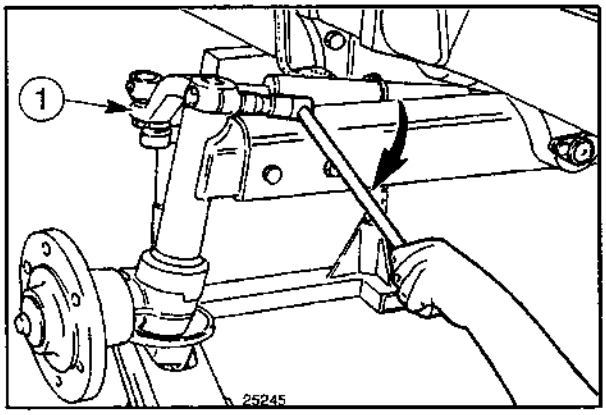


Figure 9-2-24

8. Slide out the control lever (1) from the swivel pin assembly.

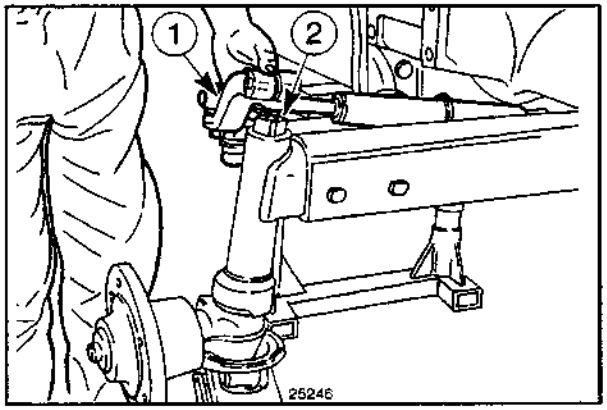


Figure 9-2-25

9. Lower the hydraulic jack and recover the swivel pin (1).

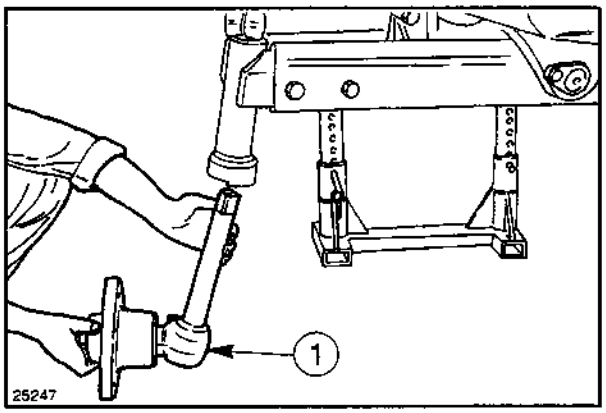


Figure 9-2-26

10. Loosen the axle outer section (1) attaching bolts.

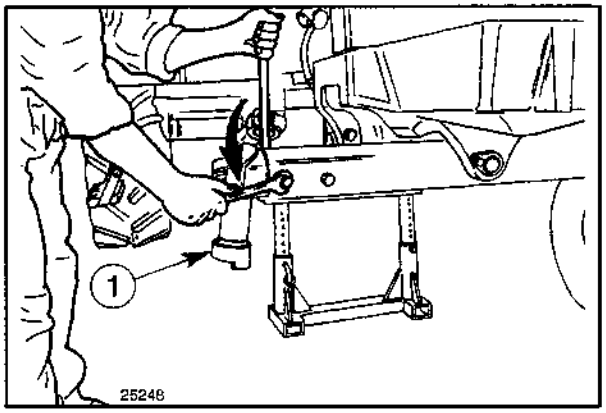


Figure 9-2-27

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11. Remove the axle outer section (1).

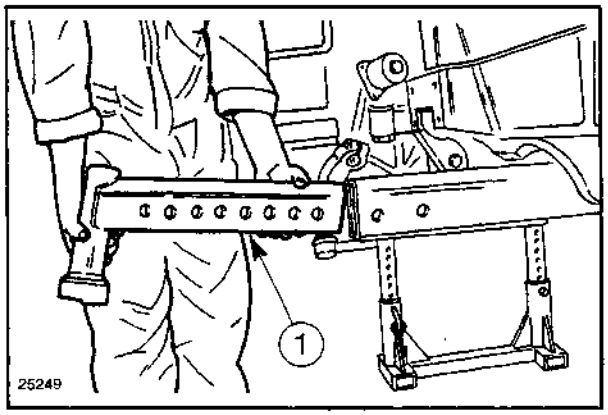


Figure 9-2-28

12. Fix the axle outer section in a vise and using a slide puller remove the swivel bearing bushings (1).

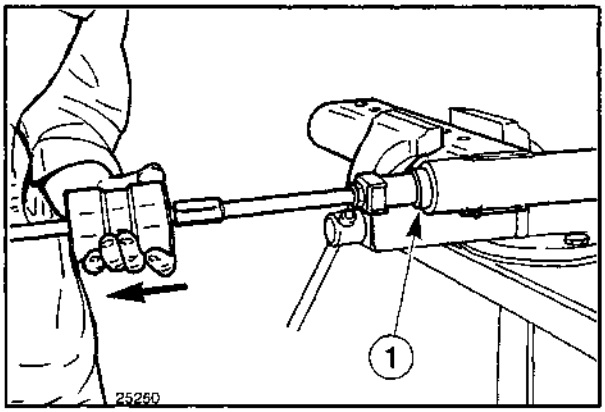


Figure 9-2-29

13. Reinstall the swivel pin assembly to the front axle following the disassembly procedure in reverse and using a suitable drift to install new bushings (1) on the axle outer section.

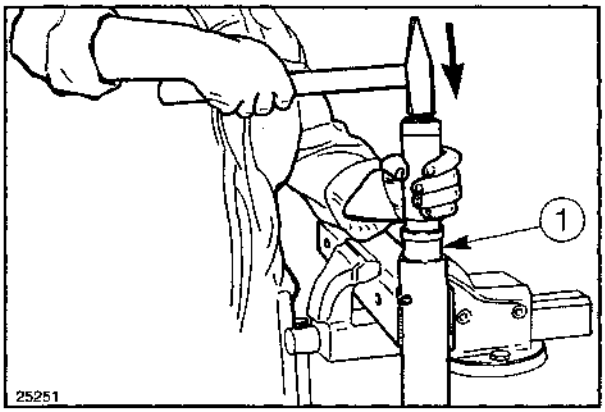


Figure 9-2-30

14. Reinstall axle outer section (1).

15. Reinstall the swivel pin assembly to the axle outer section.

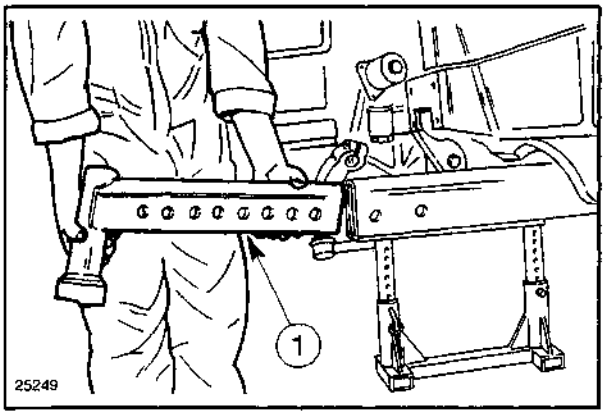


Figure 9-2-31

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16. Place the control lever (1) on the swivel pin assembly (2) and torque retaining screw.

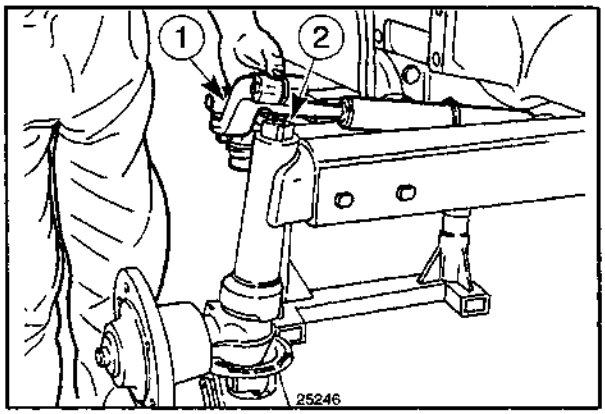


Figure 9-2-32

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FRONT WHEEL SETTING TESTS

Wheel camber test

Check the front wheel camber considering that, when the tractor moves along a straight line, wheels should be tilted by 2° relative to the ground, corresponding to a difference (X) of approximately 0.590 in (15 mm) between the rim edges (with 16" [406 mm] rims).

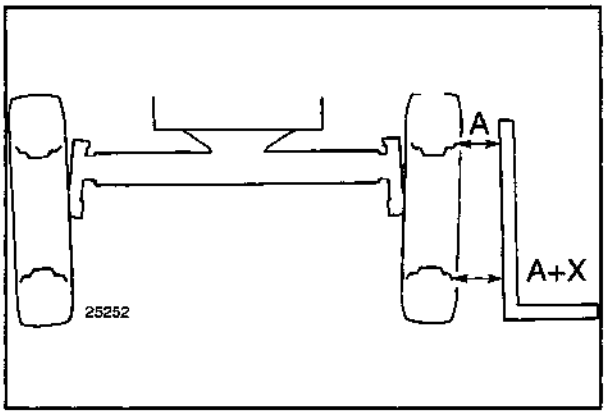


Figure 9-2-33

Front wheel toe–in test

When the tractor moves along a straight line, wheels should be parallel to the tractor centerline or slightly toe–in until a max. of 2.16 in (55 mm), measured between the rim edges.

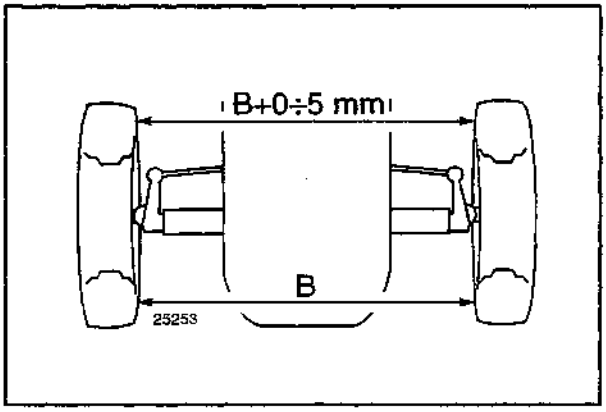


Figure 9-2-34

Check correct toe–in as follows:

1. Inflate front tires at a pressure of 36 lbf/in^2 (2.5 bar).
2. Place the steering wheel at mid–travel, with one spoke along the tractor centerline.
3. Check if wheels are parallel to the tractor centerline.
4. Measure the distance (B) between the wheel inner rims at hub height at the **front** of the wheels.
5. Measure the distance between the wheel inner rims at hub height at the **rear** of the wheels. The measurement taken should be the same as (B) or greater by up to 0.197 in max (5 mm).
6. Should it be necessary to adjust the front wheel toe–in, proceed as follows:
   – Remove the locknuts (1) on both end of the track control rod.
   – Turn the track control rod hex end (2) in or out to shorten or lengthen the track control rod until reaching specified toe–in value.
   – Torque the locknuts (1) to the specified torque (see on page 9-2-3).

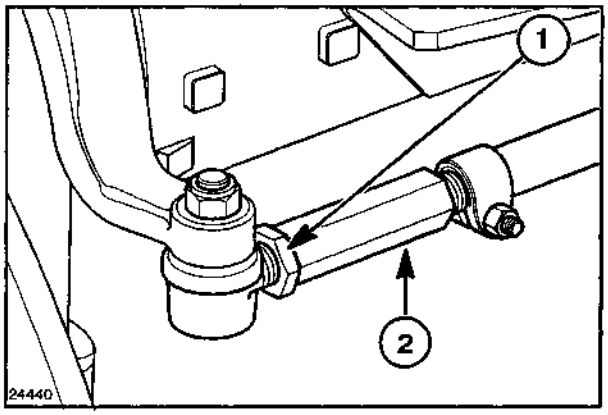


Figure 9-2-35

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SECTION 9

DRIVE LINES – FWD

CHAPTER 3

MECHANICAL FRONT AXLE (FWD)

CONTENTS

SPECIFICATIONS 9-3-2
TIGHTENING TORQUE 9-3-4
SPECIAL TOOLS 9-3-5
SECTIONAL VIEWS 9-3-6
DESCRIPTION AND OPERATION 9-3-7
TROUBLESHOOTING 9-3-10
REMOVAL – INSTALLATION – OVERHAUL 9-3-11
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SPECIFICATIONS – TIGHTENING TORQUE – SECTIONAL VIEWS – SPECIAL TOOLS – DESCRIPTION AND OPERATION – TROUBLESHOOTING

SPECIFICATIONS

Type	steering, stress-supporting, centrally pivoted
Pinion and Crown Wheel – Differential	
Pinion to crown wheel reduction ratio	10/34 = 1:3.4
Pinion to crown wheel backlash in (mm)	0.007 to 0.009 (0.18 to 0.23)
Pinion Position adjustment shims (8, page 9-3-6) mm	2.3 – 2.4 – 2.5 – 2.6– 2.7 – 2.8 – 2.9 – 3.0– 3.1 – 3.2 – 3.3 – 3.4 – 3.5
Pinion bearing adjustment shims (12) mm	2.2–2.25–2.3–2.35–2.4–2.45– 2.5–2.55–2.6–2.65–2.7–2.75– 2.8–2.85–2.9–2.95–3.00–3.05– 3.10–3.15–3.20–3.25–3.3– 3.35–3.4–3.45
Crown wheel point adjustment shims (2) mm	1 – 1.1 – 1.2 – 1.3 – 1.4 – 1.5– 1.6 – 1.7 – 1.8 – 1.9 – 2
Side gear to differential gear backlash in (mm)	0.007 (0.18)
Differential gear thrust washer (5) thickness in (mm)	0.058 to 0.060 (1.470 to 1.530)
Side gear thrust washer (3) thickness in (mm)	0.055–0.059–0.063–0.067–0.071 (1.4–1.5–1.6–1.7–1.8)
Differential gear pin (6) diameter in (mm)	0.982 to 0.983 (24.939 to 24.960)
Pin bore diameter on differential gears (7) in (mm)	0.986 to 0.987 (25.040 to 25.061)
Pins to seats mounting clearance in (mm)	0.003 to 0.005 (0.080 to 0.122)
Side gear hub (4) diameter in (mm)	2.006 to 2.008 (50.954 to 51.000)
Hub bore diameter on differential casing in (mm)	2.012 to 2.014 (51.100 to 51.146)
Side gears to seats mounting clearance in (mm)	0.004 to 0.008 (0.100 to 0.192)

(to be continued)

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SPECIFICATIONS

(continued)

Differential Lock Assembly (8160, 8260 and 8360 [L/cab]) (Class 3))	
Free spring length (1, page 9-3-6) ..... in (mm)	approx. 3.42 (87)
Compressed spring length, under a load of 425 to 458 ft. lbs. (192.5 to 207.5 kg) ..... in (mm)	approx. 1.89 (48)
Differential Lock Assembly (8360 w/cab and 8560) (Class 4N)	
Drive discs (9) ..... in (mm)	0.069 to 0.073 (1.75 to 1.855)
Drive discs (9) ..... quantity	5
Driven discs (10) ..... in (mm)	0.092 to 0.096 (2.35 to 2.45)
Driven discs (10) ..... quantity	6
Axle–Shafts and Swivel Assemblies	
Outer axle–shaft (7, page 9-3-7) dia. at the bushings (8) ..... in (mm)	1.771 to 1.772 (44.975 to 45.000)
Press–fit bushing (8) inner diameter ..... in (mm)	1.776 to 1.778 (45.100 to 45.175 (1))
Axle–shafts to bushings mounting clearance ..... in (mm)	0.004 to 0.008 (0.100 to 0.200)
Bushings to seats fitting interference ..... in (mm)	0.002 to 0.005 (0.064 to 0.129)
Swivel pin bearing adjust shims (10)	0.10–0.15–0.20–0.25–0.30
Planetary Reduction Hubs	
Reduction ratio	16:(16+68) = 1:5.25
Planet gear thrust washer (9) thickness ..... in (mm)	0.030 to 0.032 (0.77 to 0.83)
Front Axle Support Pillars	
Axle housing to support pillars end play ..... in (mm)	0.012 to 0.043 (0.3 to 1.1)
Max. wear end play ..... in (mm)	0.079 (2)
Front support pillar (1) diameter ..... in (mm)	2.469 to 2.470 (62.720 to 62.740)
Press–fit front bushing (2) inner diameter ..... in (mm)	2.472 to 2.476 (62.80 to 62.884 (1))
Pillar (1) to bushing (2) mounting clearance ..... in (mm)	0.002 to 0.006 (0.060 to 0.164)
Rear bushing (4) outer diameter (press–fit into pinion support) ... in (mm)	4.548 to 4.550 (115.527 to 115.585)
Rear bushing (5) inner diameter (press–fit into support pillar) .... in (mm)	4.552 to 4.556 (115.636 to115.711 (1))
Bushing to bushing mounting clearance ..... in (mm)	0.002 to 0.007 (0.051 to 0.184)
Axle front and rear thrust washer (3 and 6) thickness ..... in (mm)	0.193 to 0.197 (4.90 to 5.00)

(1) final dimension without grinding

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TIGHTENING TORQUE

DESCRIPTION	Thread size	Torque ft. lbs. (Nm)
Front Axle		
Bolt, crown wheel to differential casing (C_1);	M12 x 1.25	83.2 (113)
Ring nut, pinion shaft (C_2);	M40 x 1.5	see page 9-3-34
Bolt, crown wheel/differential carrier to center housing (C_3);	M12 x 1.25	83.2 (113)
Bolt, swivel pins (C_4);	M14 x 1.5	see page 9-3-19 – 9-3-20
Ring nut, wheel hub bearings (C_5);	M90 x 2	see page 9-3-16
Bolt, planetary carrier (C_6);	M12 x 1.25	83.2 (113)
Bolt, front and rear support pillars (C_1, page 9-3-5);	M12 x 1.25	83.2 (113)
Bolt, differential casing caps (C_2, page 9-3-5);	M14 x 1.5	127 (176)
Bolt or nuts, front axle to engine (C_3, page 9-3-5);	3/4 10 UNC	245 to 275 (333 to 373)
Bolt, multi–pack clutch and differential lock assembly (C_4, page 9-3-5);	M8	14.4 (19.6)
Nut, rim to disc attaching screw	M16 x 1.5	180 (245)

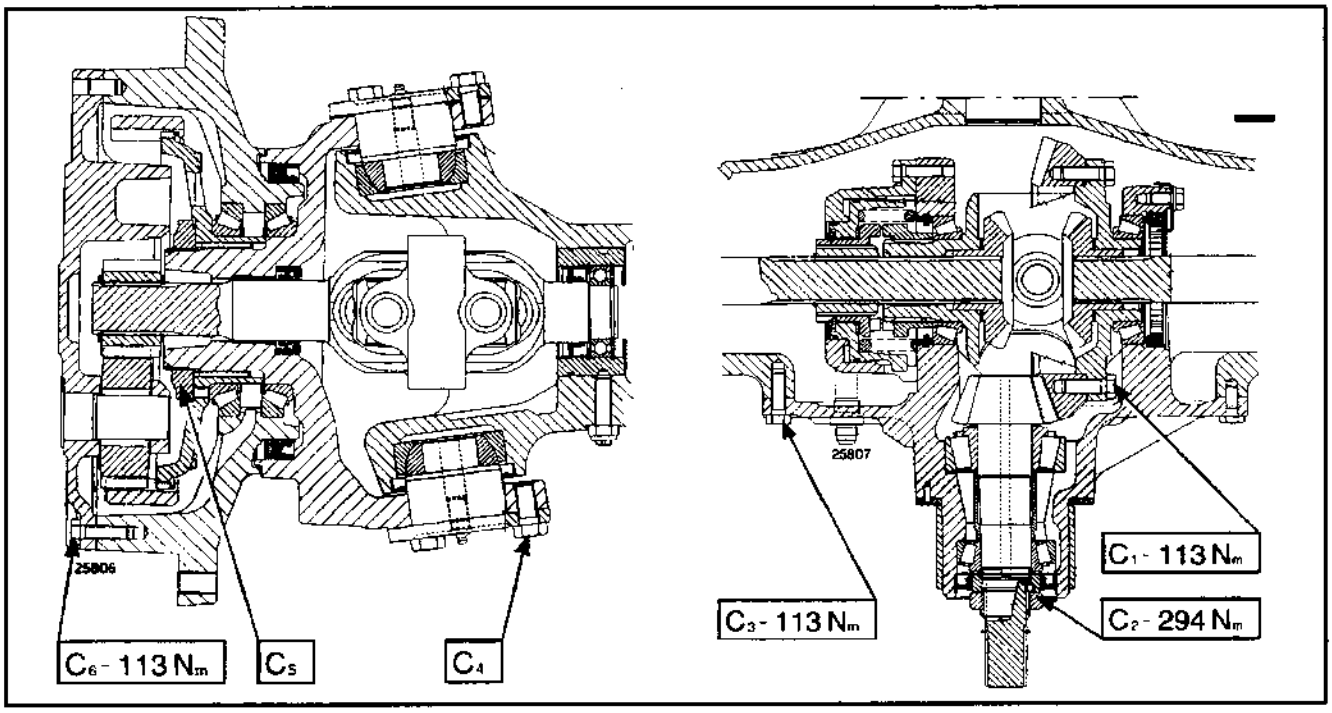


Figure 9-3-1

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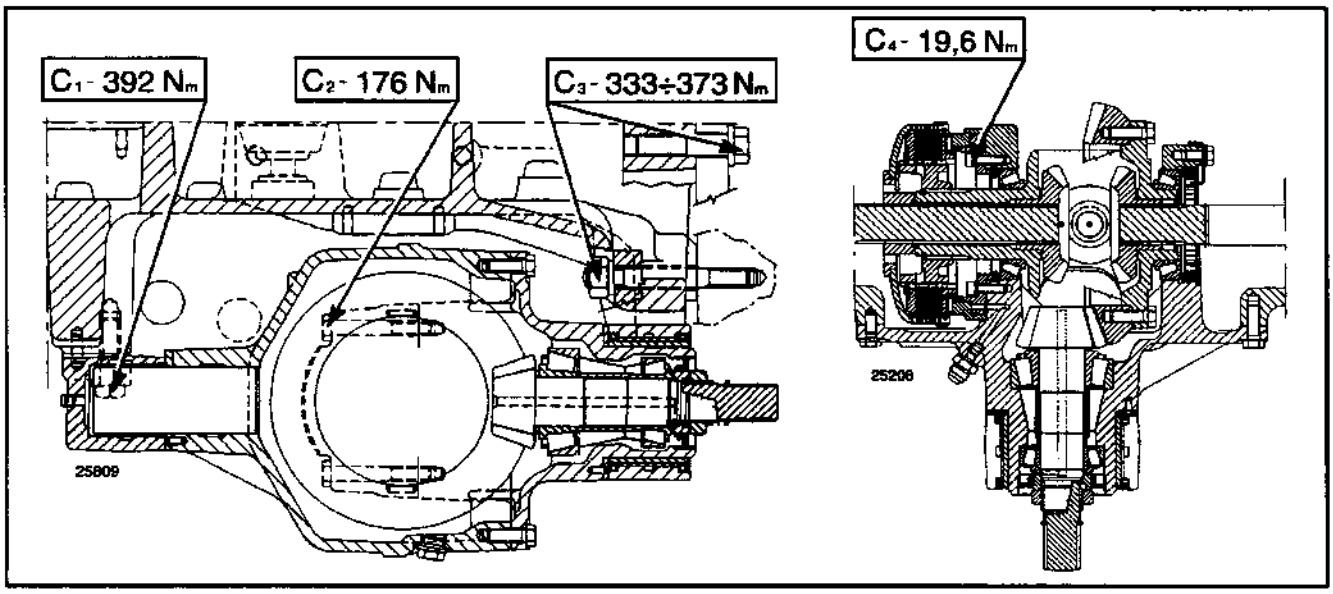


Figure 9-3-2

SPECIAL TOOLS

Caution – Operations described in this Section of the Manual must be performed using the following **ESSENTIAL** tools marked with the identification code **(X)**.
To work safely and achieve the best technical results with additional savings of time and effort, these mandatory tools should be used in conjunction with the suggested special tools listed below and integrated with the self–made ones for which you will find the necessary construction drawings and specifications directly on this Manual.

List of special tools necessary to carry out the different operations described in this Section.

	293743	Front axle differential casing overhaul fixture
X	**293878**	Front axle drive pinion nut wrench (Class 3 axle)
X	**293879**	Front axle drive pinion nut wrench (Class 4N axle)
X	**293438**	Drive pinion bearing adjustment tool
X	**293510**	Drive pinion bearing adjustment gauge.
X	**292903**	Pulling pliers
X	**293876**	Front axle drive pinion retaining tool (Class 3 axle)
X	**293877**	Front axle drive pinion retaining tool (Class 4N axle)
	293400	Front axle drive pinion position adjustment gauge
X	**293665**	Front axle differential casing bearing adjustment ring nut wrench (Class 3 axle)
X	**293798**	Front axle differential casing bearing adjustment ring nut wrench (Class 4N axle)
X	**293880**	Front wheel hub bearing ring nut wrench (Class 3 axle)
X	**293881**	Front wheel hub bearing ring nut wrench (Class 4N axle)
X	**293882**	Front axle hub bearing pulling aids (two)
	292888	Front axle planetary reduction hub alignment pins (M12x1.25)
	293812	Front wheel removal/installation pins (M16x1.25)
X	**293857**	Front axle swivel pin puller
X	**292161**	Front axle swivel pin bearing outer race puller
X	**292220**	Front axle bearing rolling torque test tool
	293889	Front axle–shaft to swivel housing mounting guide (Class 3 axle)
	293888	Front axle–shaft to swivel housing mounting guide (Class 4N axle)
	292870	**Front axle differential engagement oil pressure test kit**

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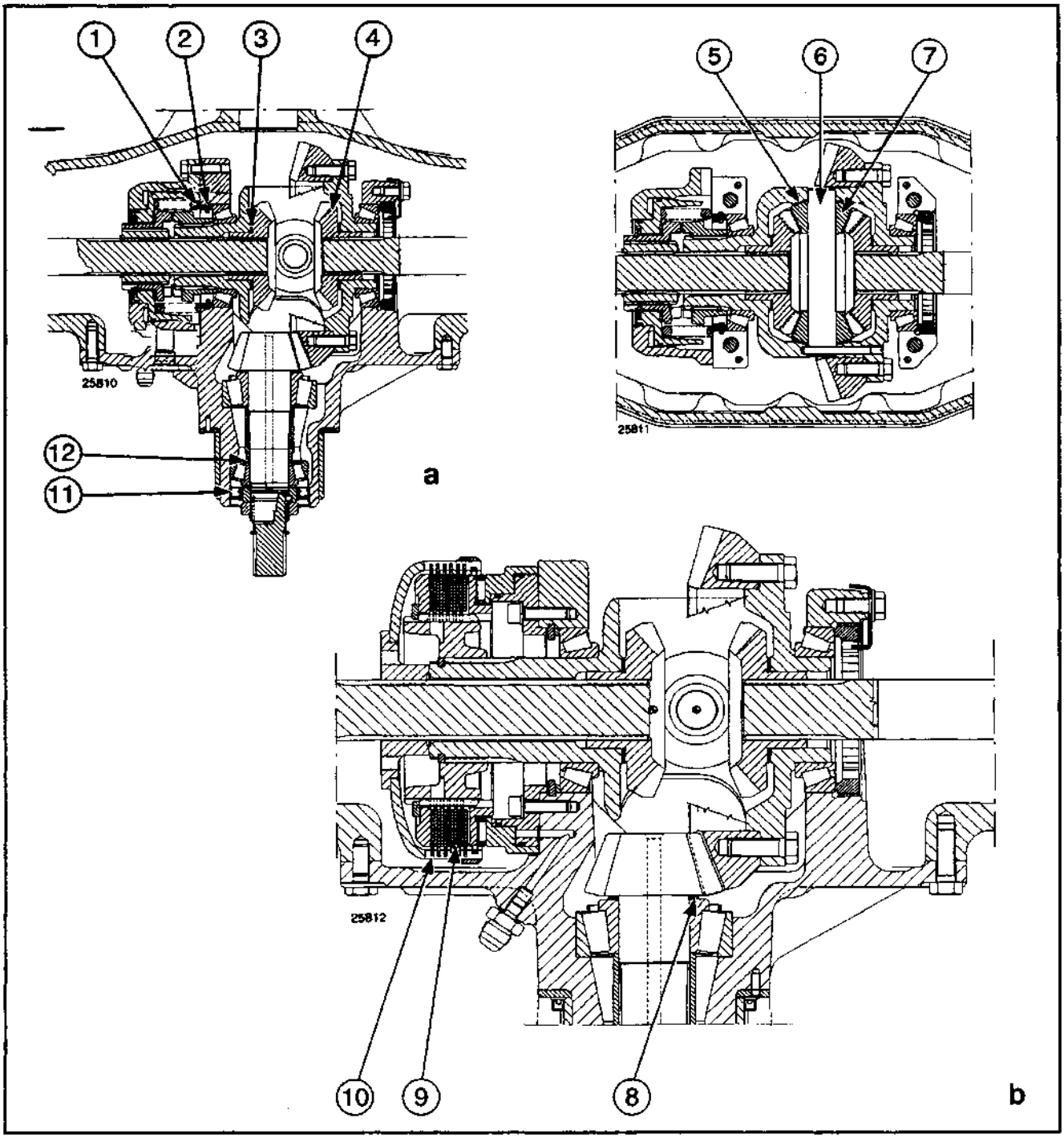


Figure 9-3-3

Front Axle Cross–Sections

a. 8160, 8260 and 8360 (L/cab) Class 3
b. 8360 (w/cab) 8560 Class 4N
1. Spring
2. Crown wheel bearing adjustment shims
3. Side gear thrust washer shims
4. Side gears
5. Differential gear thrust washer shims
6. Differential gear pin
7. Differential gears
8. Pinion position adjustment shims
9. Clutch drive discs
10. Clutch driven discs
11. Seal
12. Pinion bearing adjustment shims

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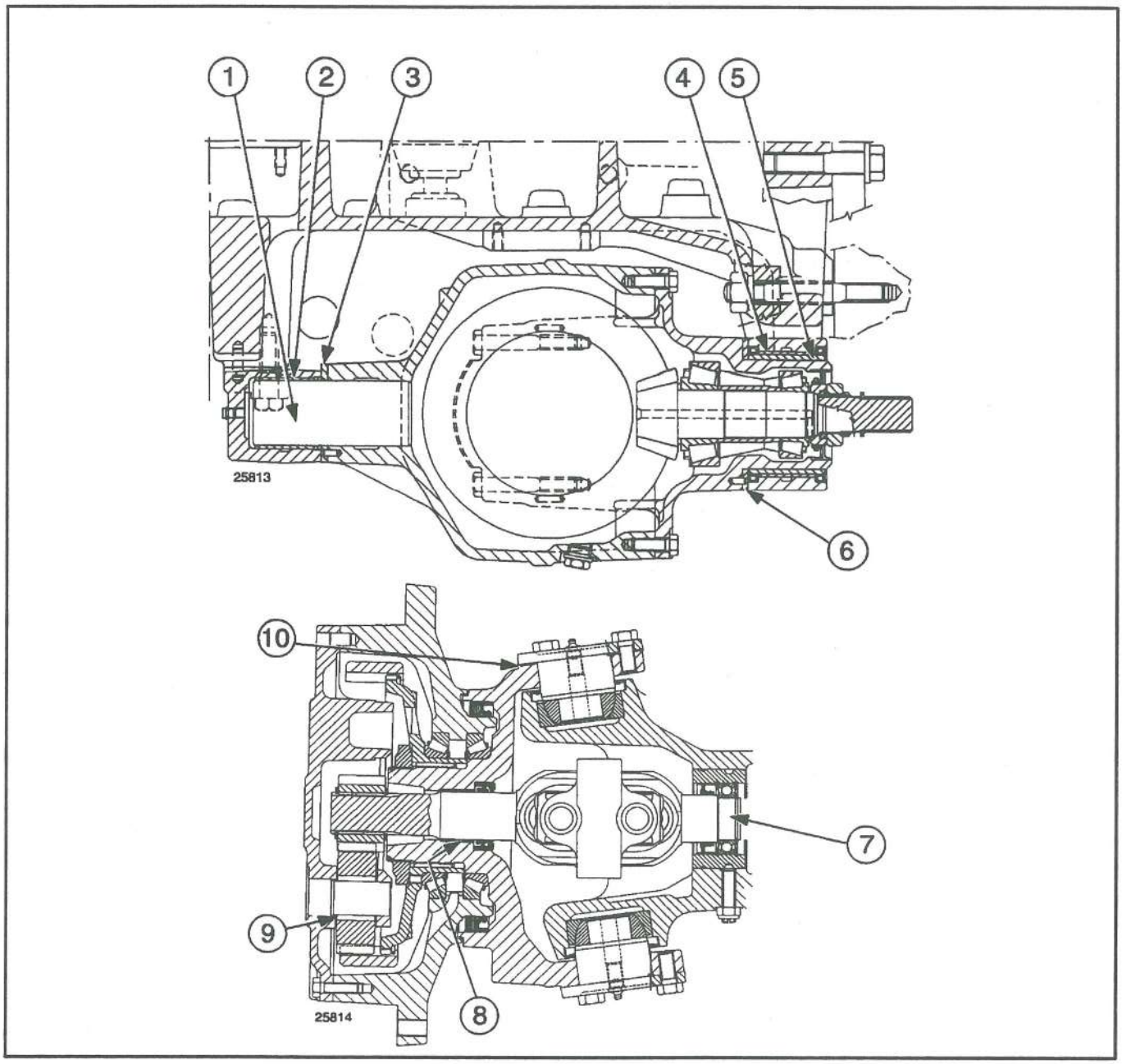


Figure 9-3-4

Support Pillars and Planetary Reduction Hub Cross–Sections

1. Front support pillar
2. Front support pillar bushing
3. Front thrust washer
4. Rear bushing (press–fit into support pillar)
5. Rear bushing (press–fit into pinion support)
6. Rear thrust washer
7. Outer axle–shafts
8. Bushings
9. Driven gear thrust washers
10. Swivel pin adjustment shims

DESCRIPTION AND OPERATION

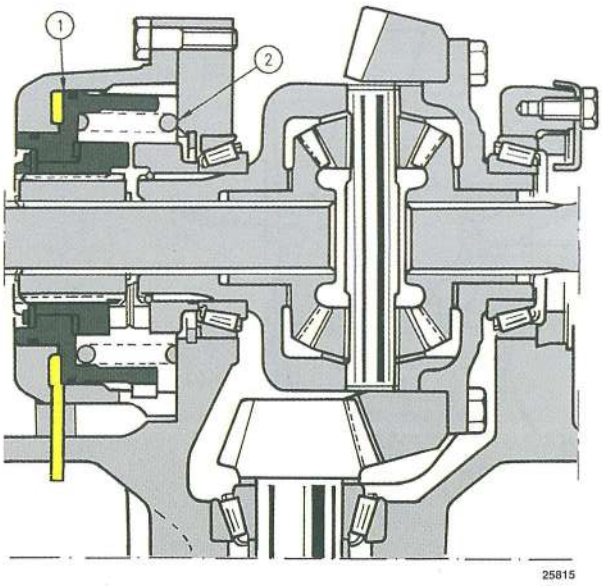
8160, 8260, 8360 and 8560 tractors are fitted with a centrally pivoted front axle with support pillars and propshaft parallel to the tractor centerline. The propshaft has no universal joints.

The differential assembly includes two planet gears. Drive is transferred to the epicyclic reduction gear hubs by means of maintenance–free universal joints.Refer to page 9-3-8 for the spur–gear hydraulically controlled differential lock assembly fitted to the 8160, 8260 and 8360 (L/cab) tractor Class 3 front axles.

Refer to page 9-3-9 for the multi–pack wet clutch differential lock assembly fitted to the 8360 (w/cab) and 8560 tractor Class 4N front axles.

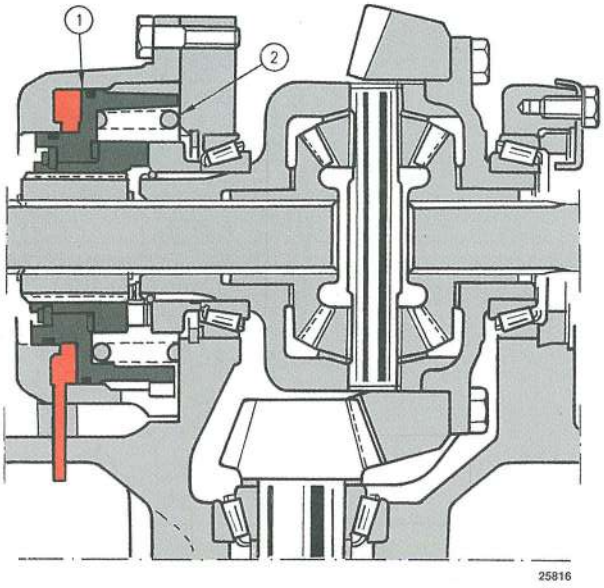
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Front differential lock disengaged

Front differential lock engaged



Pressure-free oil

Pressure oil

Figure 9-3-5

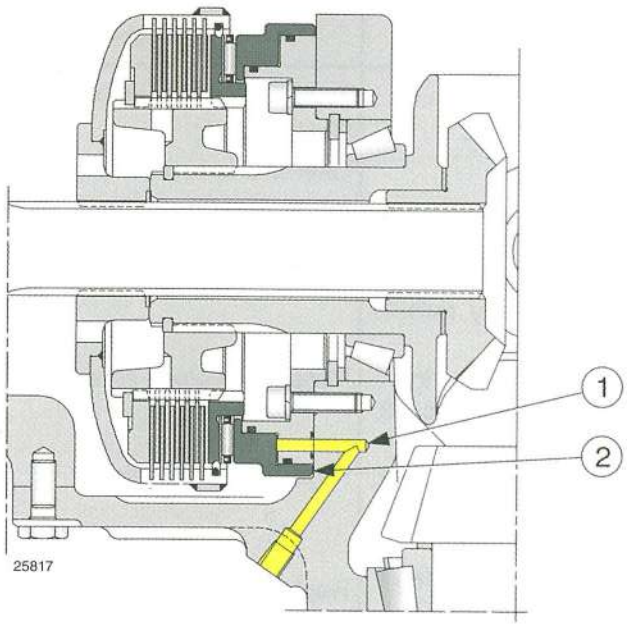
FRONT DIFFERENTIAL LOCK ASSEMBLY CLASS 3

When the diff lock is not engaged, the solenoid valve is on the discharge position (not energized) and therefore pressure–free oil is trapped within the piston (1) annular groove.
Under these conditions, the helix spring (2) keeps the diff lock control toothed sleeves apart.

When the switch on the instrument panel is activated, the solenoid valve opens and directs oil from the pump into the drive piston (1) annular groove, where it overcomes the spring (2) force and moves the piston locking the differential.

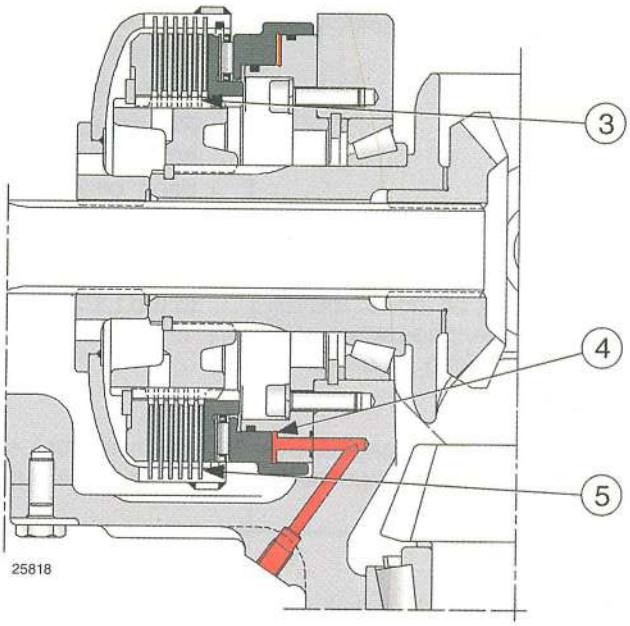
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Front differential lock disengaged

Pressure-free oil



Front differential lock engaged

Pressure oil

Figure 9-3-6

FRONT DIFFERENTIAL LOCK ASSEMBLY CLASS 4N

When the diff lock is not engaged, the solenoid valve is in the discharge position (not energized) and therefore pressure–free oil is trapped within the passage (1) to the piston (2) annular groove.
Under these conditions, the clutch drive and driven discs (3 and 5, respectively) remain separate and the differential lock is disengaged.

When the switch on the instrument panel is activated, the solenoid valve opens and directs oil from the pump into the drive piston (2) annular groove (4).
Pressure oil within the annular groove (4) moves the piston (2) locking the differential.

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TROUBLESHOOTING – HYDRAULIC DIFFERENTIAL LOCK

Problem	Possible Cause	Correction
Differential lock not engaging.	1. Front axle oil low	Top up to correct level.
	2. Blocked oil filter.	Replace filter.
	3. Faulty hydraulic pump.	Overhaul or replace pump.
	4. Faulty diff lock switch	Replace switch.
	5. Power supply not reaching the solenoid valve: detached or damaged connectors, faulty remote switch.	Restore electrical connections and replace faulty parts.
	6. Diff lock solenoid valve (1, Figure 8-1-43, page 8-1-28, Sec. 8, Chap. 1) stuck on discharge.	Repair or replace solenoid valve.
	7. Oil leaks through the seals with consequent pressure drop (piston or supply line seals).	Replace faulty seals.
	8. Worn friction plates (Class 4N)	Replace friction plates.
Differential lock not disengaging	1. Diff lock solenoid valve (5) stuck on delivery	Repair or replace solenoid valve.
	2. Diff unlock spring broken.	Replace spring.
	3. Power supply not reaching the solenoid valve: detached or damaged connectors, faulty remote switch.	Restore electrical connections and replace faulty parts.
With differential lock engaged and control button set on no. 3, the diff lock does not disengage when raising lift arms using the LIFT–O–MATIC device.	1. Faulty diff lock switch (connected to the LIFT–O–MATIC device).	Replace switch.
With differential lock engaged, the diff lock does not disengage when brake pedals are pressed.	1. Faulty diff lock switch (connected to the brake pump).	Replace switch.

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FRONT AXLE ASSEMBLY
Removal – Installation

⚠ DANGER ⚠

Lift and handle all heavy components using lifting equipment of appropriate capacity.Ensure that units or parts are supported by suitable slings or hooks.Ensure that no–one is in the vicinity of the load to be lifted.

Proceed as follows:

Note – The front axle assembly can be separated from the tractor with either the propshaft removed from or installed in the tractor. The following operations detail how to remove the front axle assembly with the propshaft still in the tractor. To remove the propshaft, refer to that described on page 9-1-9, Section 9, Chapter 1.

1. Open and raise engine hood.
2. Detach the negative cable (1) from the battery and insulate.

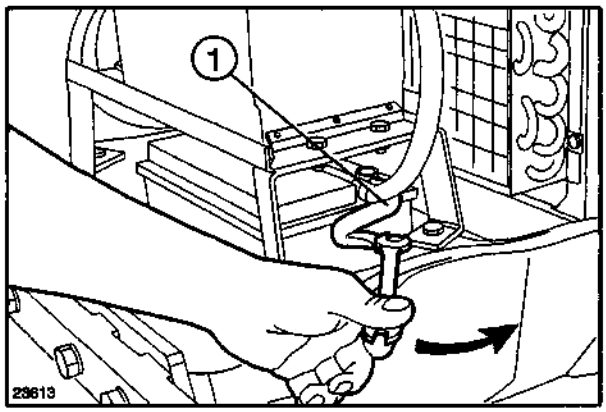


Figure 9-3-7

3. If front ballast is fitted, thread a nylon cable (1) through the first row of ballast, unscrew support plate (2) retaining screws and remove ballast using a hoist.
4. Unscrew retaining screws of the second row of ballast and slide them out, one at a time.

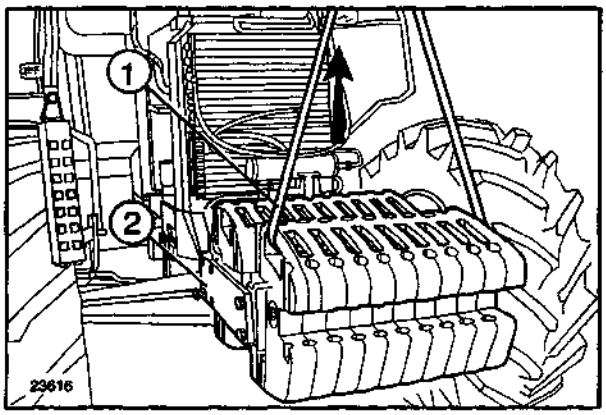


Figure 9-3-8

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5. Loosen the retaining screws and remove the propshaft guard.
6. Remove the circlip (4) and slide out the sleeve (5).

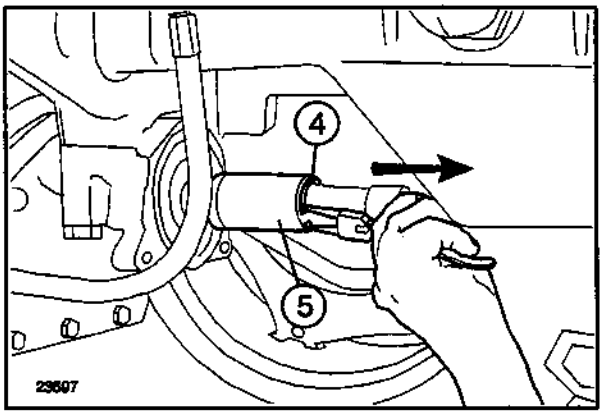


Figure 9-3-9

7. Slightly raise tractor using a hoist and a nylon cable (1) and place a stationary stand under the sump.

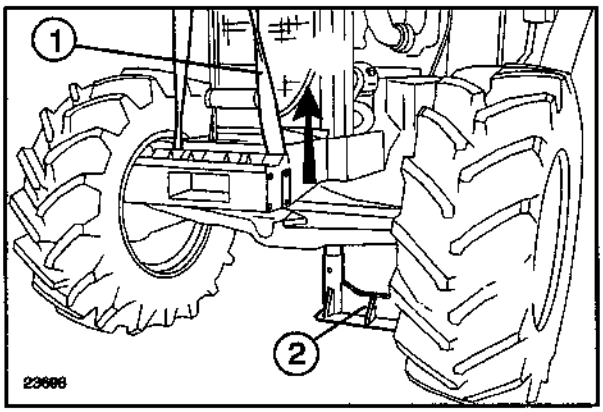


Figure 9-3-10

8. Lock the front axle relative to the engine using wooden wedges. Loosen the attaching bolts and remove the front wheels.

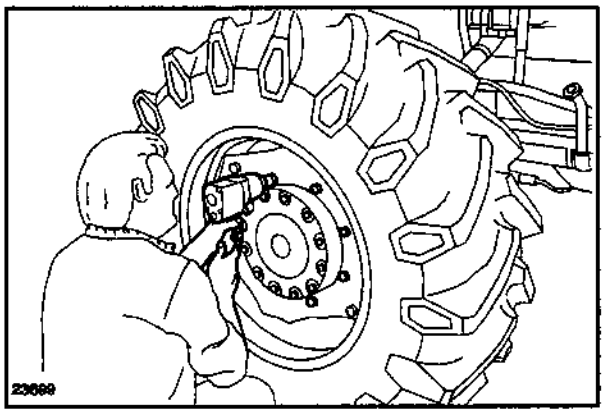


Figure 9-3-11

9. Detach the steering control cylinder lines (3). Mark the lines and respective fittings to assist reassembly.

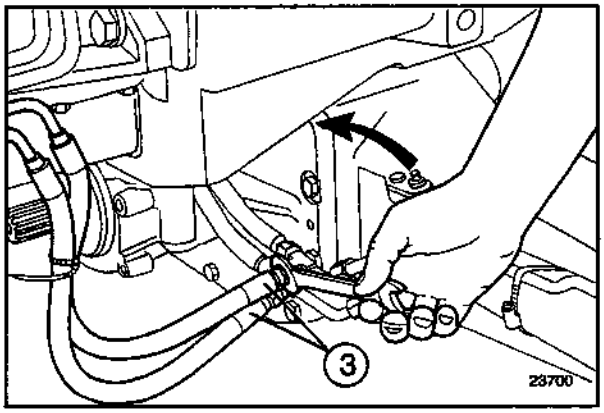


Figure 9-3-12

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10. Detach the differential lock control line (1).

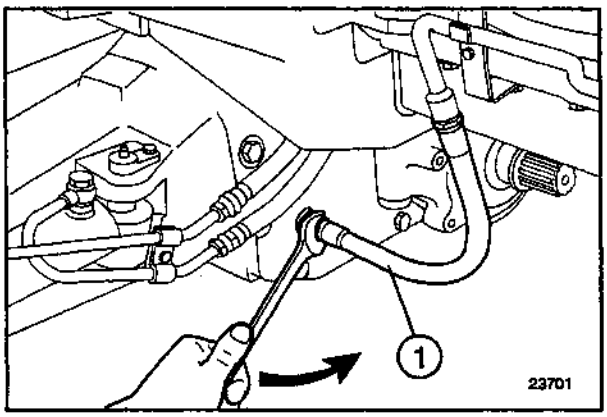


Figure 9-3-13

11. Loosen the front (3) and rear support pillar attaching bolts and remove the front axle using a hoist and two nylon cables (2) (one on each side).

⚠ WARNING ⚠

Always use suitable tools to align holes. DO NOT USE HANDS OR FINGERS.

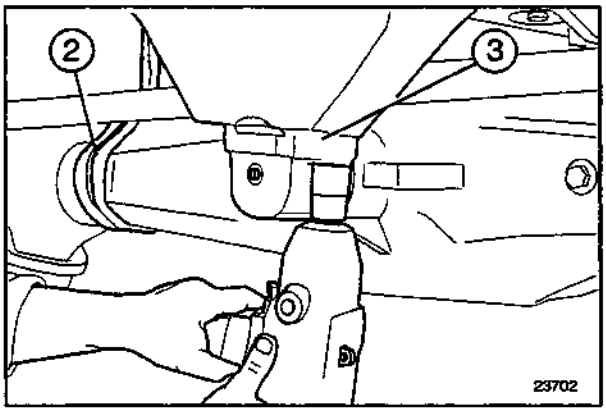


Figure 9-3-14

12. Reinstall the front axle assembly observing the following:

- Reassembly follows the disassembly procedure in reverse, from step 11 back to step 1.
- Tighten to correct torque as detailed on page 9-3-4.

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PLANETARY GEAR ASSEMBLY

Removal – Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

Removal and installation of the planetary gear assembly can be performed with either the axle removed from the vehicle and placed on the stand, or with the axle still in the tractor. In this case, place a support stand under the engine sump.
Remove the power steering cylinders prior to placing the axle on the stand.

1. Drain oil from planetary hubs.
2. Remove the planetary carrier attaching bolts.

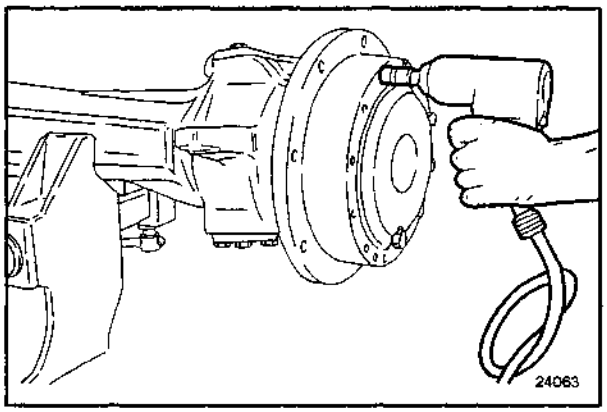


Figure 9-3-15

3. Insert a slide puller into the drain plug hole and detach the planetary carrier.

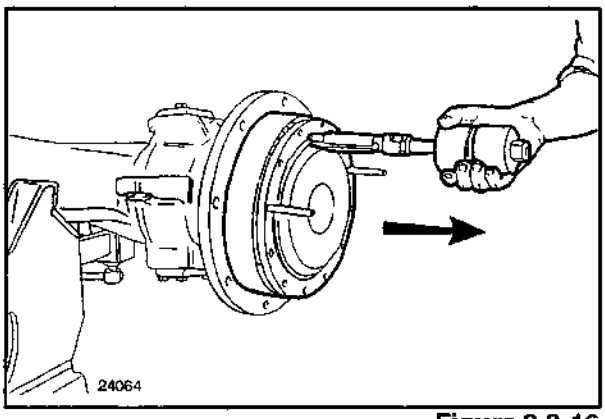


Figure 9-3-16

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4. Remove the planetary carrier and gears.

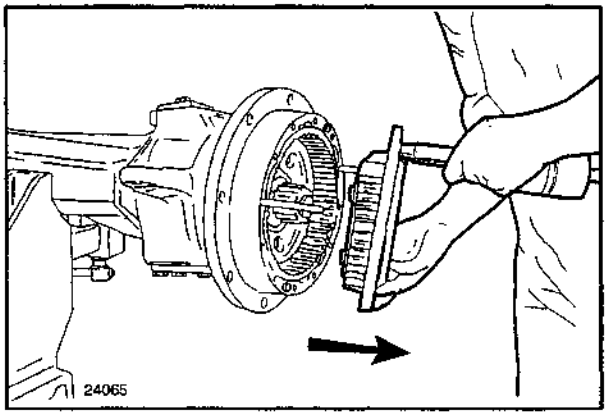


Figure 9-3-17

5. Remove the sun gear retaining ring.

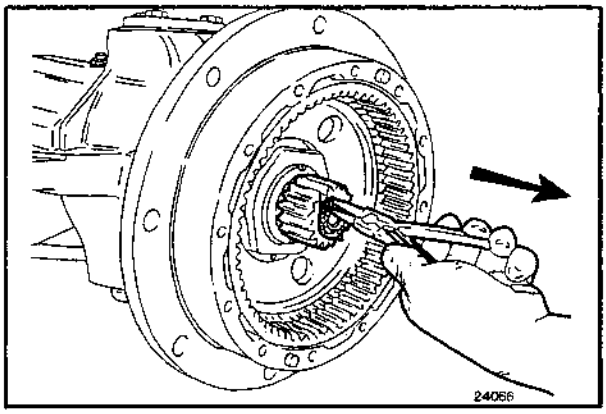


Figure 9-3-18

6. Remove sun gear.

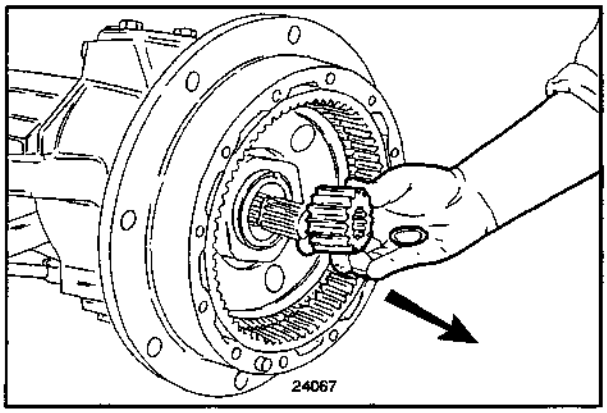


Figure 9-3-19

7. Remove the rear sun gear retaining ring.

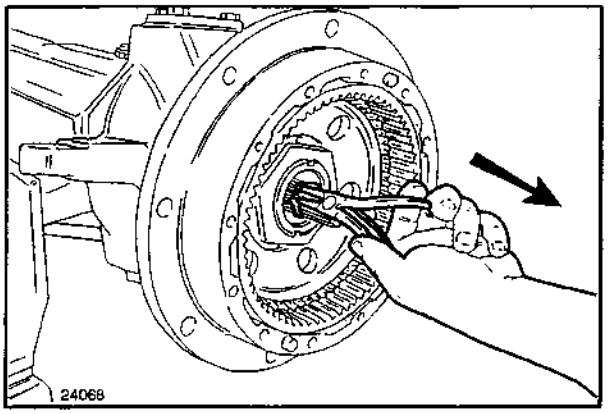


Figure 9-3-20

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8. Straighten the hub bearing lock ring nut.

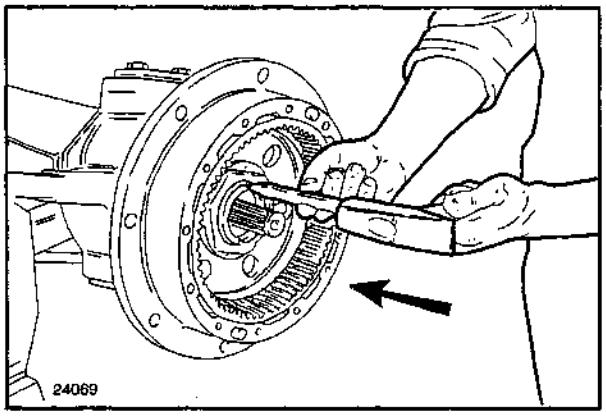


Figure 9-3-21

9. Remove the hub bearing lock ring nut using wrench (1) tool no. **293880** for Class 3 axles and tool no. **293881** for Class 4N axles.

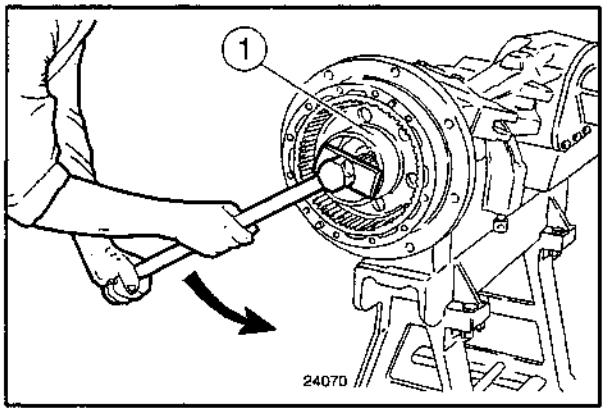


Figure 9-3-22

10. Remove ring gear.
11. Reassemble the planetary gear assembly following the disassembly procedure in reverse.
12. Reinstall the ring gear and hub bearing lock ring nut.

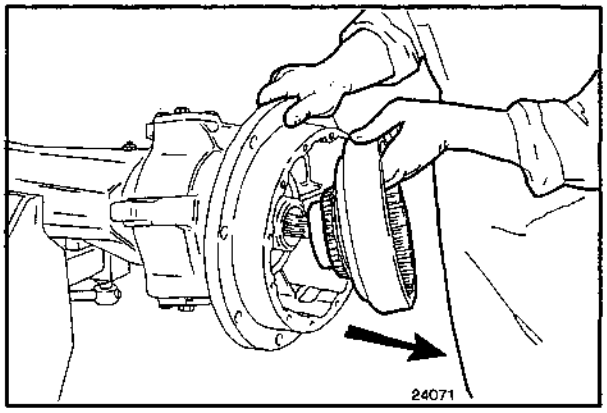


Figure 9-3-23

13. Using a torque wrench and wrench (1) tool no. **283880** for Class 3 axles and no. **293881** for Class 4N axles, gradually torque the ring nut (C_5, page 9-3-4) to 289 ft. lbs. (392 Nm) for Class 3 axles and to 361 ft. lbs. (490 Nm) for Class 4N axles. While tightening the nut, continue turning the wheel hub to ensure that the bearings are correctly seated.

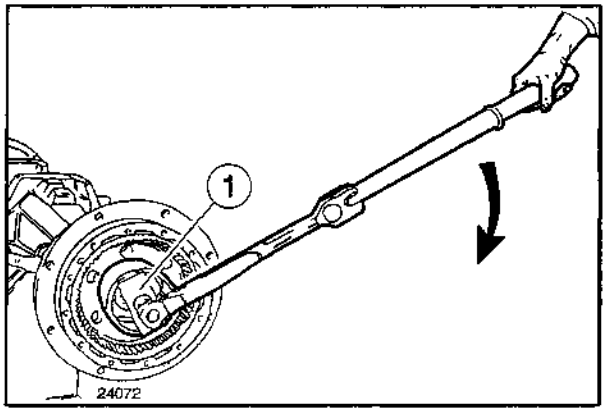


Figure 9-3-24

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14. Deform the ring nut. Turn the hub by hand and check it turns without binding, nor play.

15. Install sun gear, circlips and planetary carrier.

16. Prior to installation of the planetary carrier, thoroughly clean and degrease the mating surfaces and apply a 0.079 in (2 mm) bead of flexible sealant. See sealant application pattern on page 9-3-37.

17. Tighten to correct torque as listed on page 9-3-4.

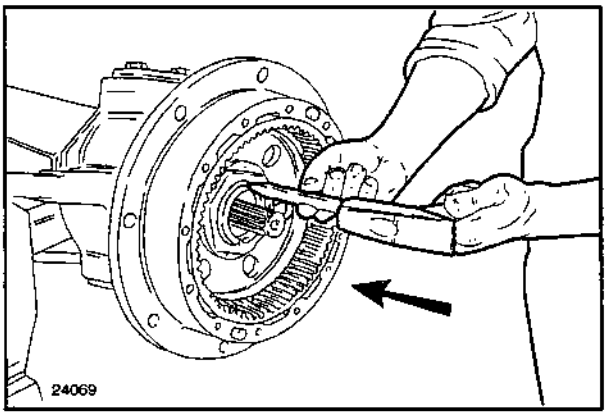


Figure 9-3-25

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WHEEL HUB AND SWIVEL ASSEMBLY

Removal–Installation

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

The wheel hub can be disassembled only after removing the planetary reduction gear assembly as detailed on page 9-3-14. Proceed as follows:

1. Remove the wheel hub.
2. Remove the steering tie rod, as detailed on page 9-3-21.

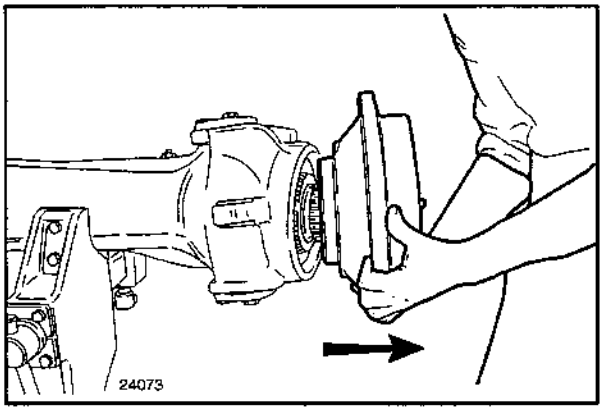


Figure 9-3-26

3. Remove the swivel pin greaser and retaining bolts. Assemble a slide puller into the greaser hole and remove the swivel pins.

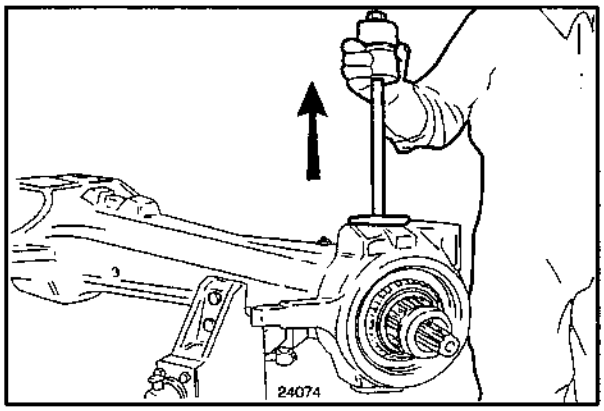


Figure 9-3-27

4. Remove the swivel pin and housing taking care not to damage the inner seal.
5. Reassemble the wheel hub and swivel assembly following the disassemble procedure in reverse. Adjust swivel pin bearings as described below.

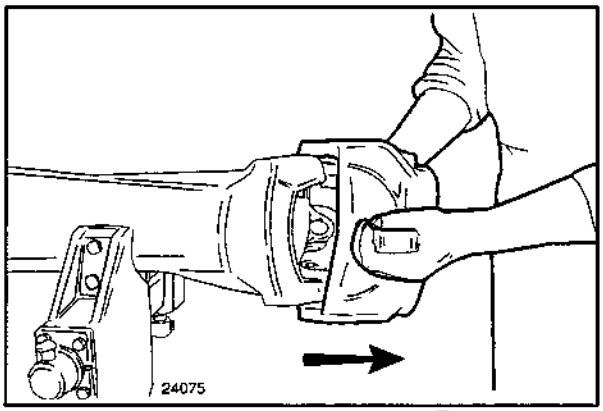


Figure 9-3-28

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6. Coat the bearing outer races with grease and assemble the upper cover, without shims but complete with tool no. **292220** (2). Tighten retaining bolts (C_4, page 9-3-4) to 83.3 ft. lbs. (113 Nm) for Class 3 axles and to 130 ft. lbs. (176 Nm) for Class 4N axles.

Note – To assist swivel pin assembly, mount the guide (1) tool no. **293889** for Class 3 axles and tool no. **293888** for Class 4N axles on to the axle shaft.

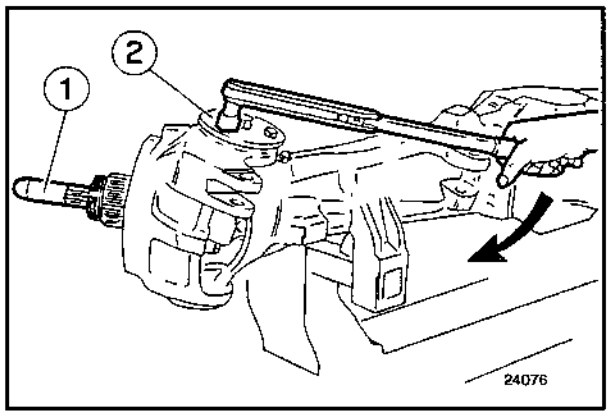


Figure 9-3-29

7. Assemble the lower cover without adjusting shims using the three retaining bolts previously lubricated with engine oil.

8. Tighten the three lower cover bolts alternately and progressively, while swinging the housing to expel excess grease.

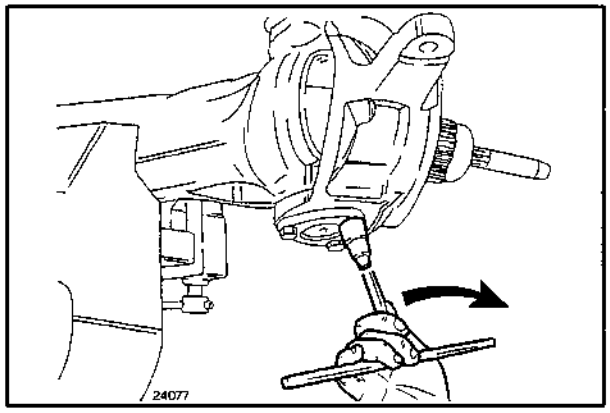


Figure 9-3-30

9. Using a torque meter and tool no. **292220** (1) check torque required to swing the swivel housing is 15 to 11 to 18 ft. lbs. (25 Nm), excluding breakaway value. If different, screw in or out the lower cover bolts.

10. Measure the distance (H) between the lower cover and housing, at the three retaining bolts.

11. Average the three values. The adjustment shim pack (10, page 9-3-7) to be installed under the lower cover is given by:
S_3= H – 0.008 in (0.20 mm) (Class 3 axle)
S_3= H – 0.016 in (0.40 mm) (Class 4N axle).
Round off the value obtained to the next 0.002 in (0.05 mm) if necessary.

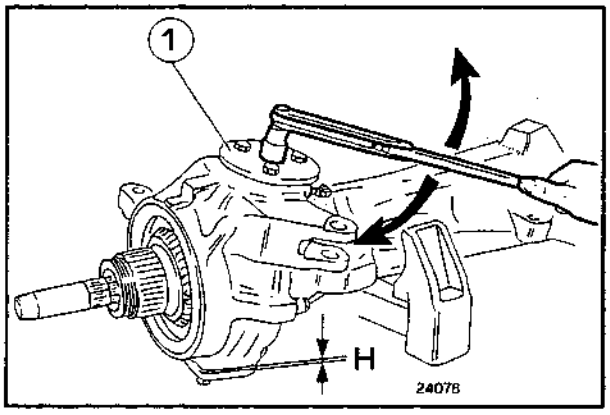


Figure 9-3-31

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12. Partially undo the lower cover bolts, insert shims (10, page 9-3-7) and tighten the bolts (C_4, page 9-3-4) to 83.3 ft. lbs. (113 Nm) for Class 3 axles and to 130 ft. lbs. (176 Nm) for Class 4N axles.

13. Check the torque required for swinging the housing, after some initial rocking movement to settle the assembly, is 90.0 to 108 ft. lbs. (118 to 147 Nm) for Class 3 axles and 166 to 203 ft. lbs. (225 to 275 Nm) for Class 4N axles, without considering the breakaway torque.

14. If the torque is higher than specification, increase shims; reduce shims if lower.

15. Mount greasers to upper and lower covers and achieve greasing.

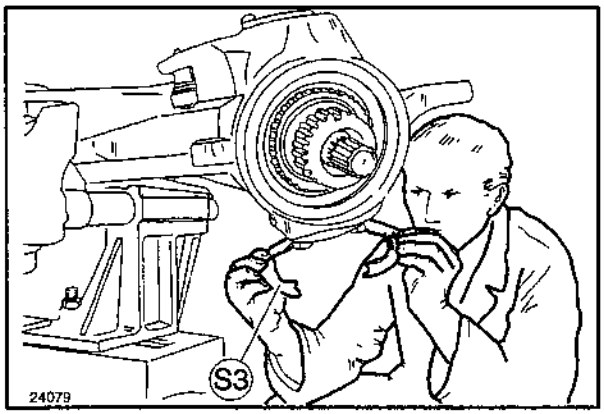


Figure 9-3-32

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CROWN WHEEL/ DIFFERENTIAL CARRIER

Installation – Removal

WARNING

Handle all components with the greatest care. Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

Place the front axle on the stand and proceed as follows:

1. Drain oil from planetary hubs and axle housing.

2. Remove the steering tie–rod pin nuts and using a puller withdraw pins from their seats in the swivel housings. Retrieve steering tie–rod.

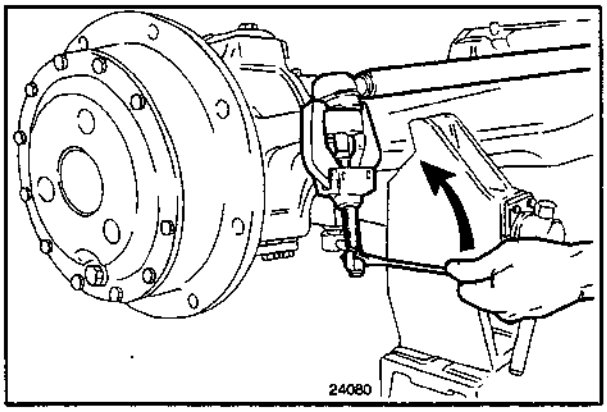


Figure 9-3-33

3. Remove the planetary carrier retaining bolts.

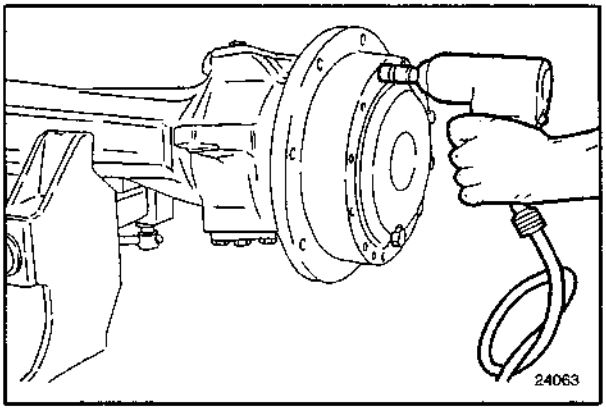


Figure 9-3-34

4. Using a slide puller screwed into the drain plug hole detach the planetary carrier.

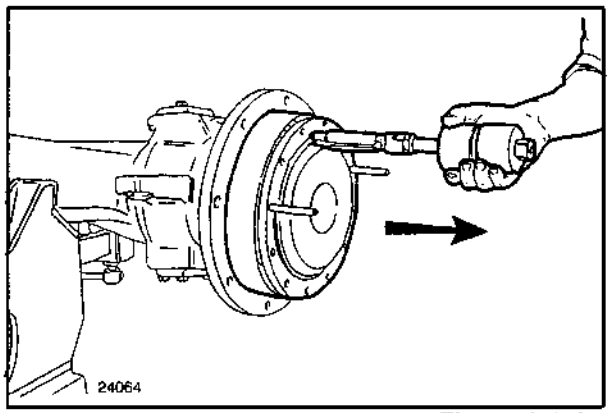


Figure 9-3-35

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5. Remove the planetary carrier.

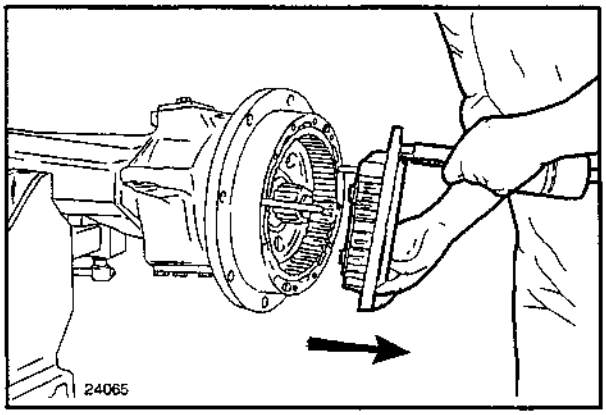


Figure 9-3-36

6. Remove the sun gear retaining ring.

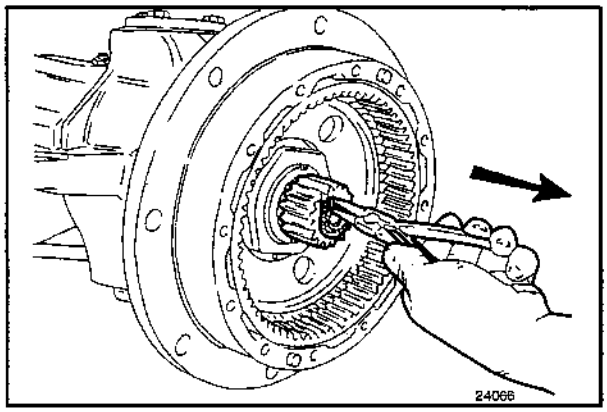


Figure 9-3-37

7. Remove sun gear.

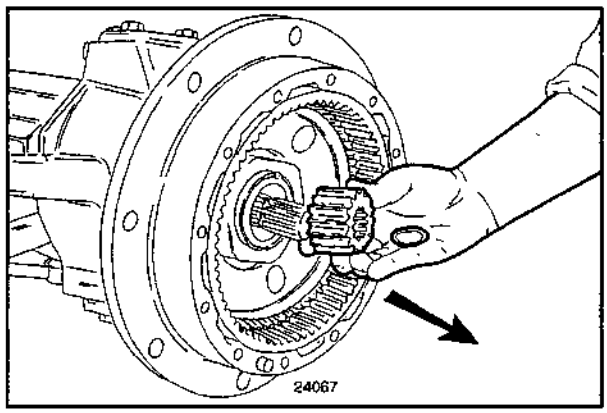


Figure 9-3-38

8. Remove the rear sun gear retaining ring.
9. Connect the wheel hub and swivel housing to a hoist and remove the swivel pins as detailed on 9-3-18.

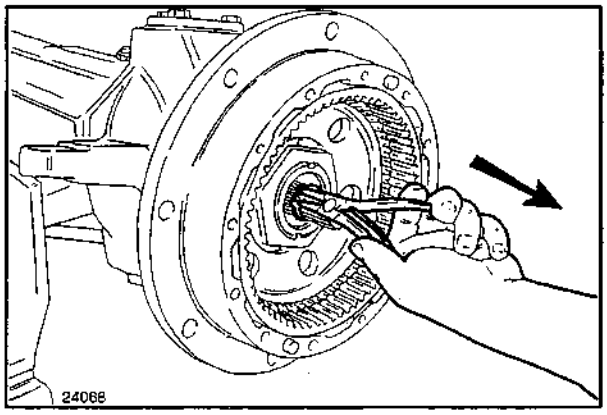


Figure 9-3-39

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10. Remove the wheel hub and swivel housing taking care not to damage inner seal.

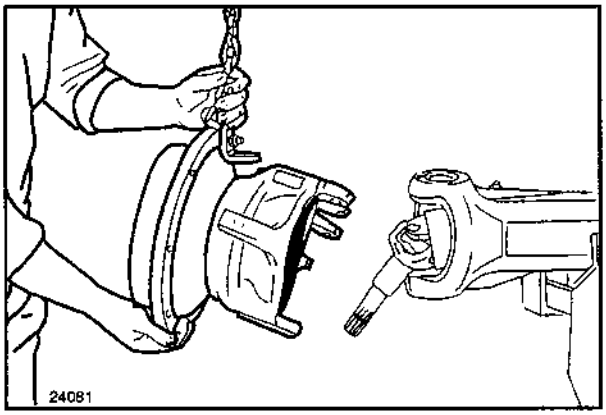


Figure 9-3-40

11. Remove the half–shaft retaining screw.

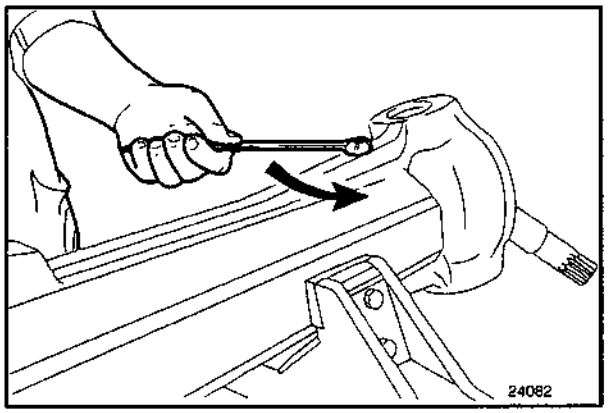


Figure 9-3-41

12. Remove the half–shaft along with the universal joint and bearing bushing.

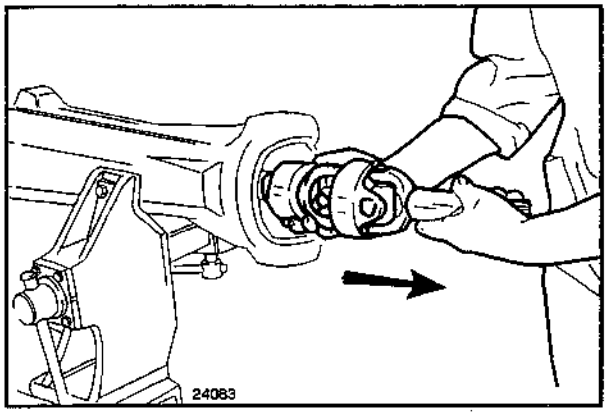


Figure 9-3-42

13. Remove the two bolts attaching the crown wheel/ differential carrier to the axle housing and screw two alignment pins (1) into the holes. Remove remaining bolts ensuring the crown wheel/differential carrier is firmly supported by the alignment pins (1).

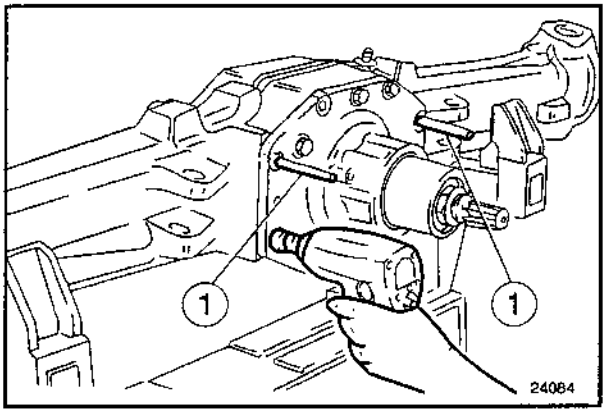


Figure 9-3-43

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14. Connect the crown wheel/differential carrier to a hoist and detach it from axle housing.

15. Reassemble the crown wheel/differential carrier following the disassembly procedure in reverse and observe the following:

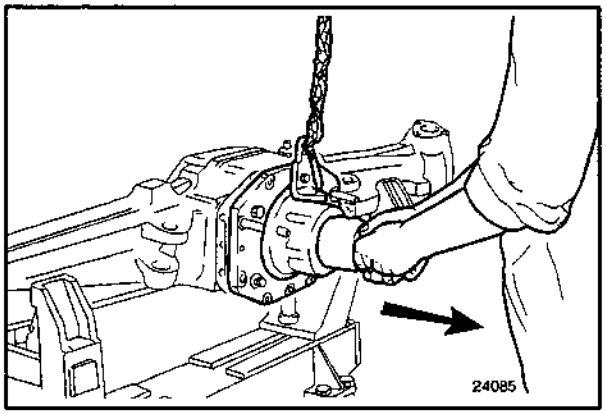


Figure 9-3-44

16. To assist the wheel hub and swivel housing reassembly, mount the guide (1) tool no. **293889** for Class 3 axles and no. **293888** for Class 4N axles on to the axle–shaft.

17. Adjust the swivel pin bearings as detailed on page 9-3-19, steps 6 to 15.

18. Install the sun gear complete with retaining rings.

19. Install the planetary carrier.

20. Install the steering tie–rod.

21. Refill planetary hubs and axle housing with oil in the specified quantity.

22. Before reassembling the crown wheel/differential carrier, thoroughly clean and degrease mating surfaces and apply a 0.079 in (2 mm) bead of sealant. See sealant application patterns on page 9-3-37.

23. Tighten to correct torque, as specified on page 9-3-4.

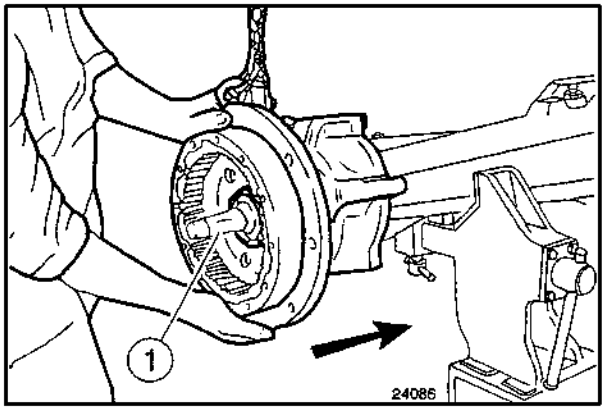


Figure 9-3-45

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FRONT DIFFERENTIAL LOCK CLUTCH
(Class 3 Axle)

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

Support the crown wheel/differential carrier. Proceed as follows:

1. Detach the oil supply fitting to the differential lock.

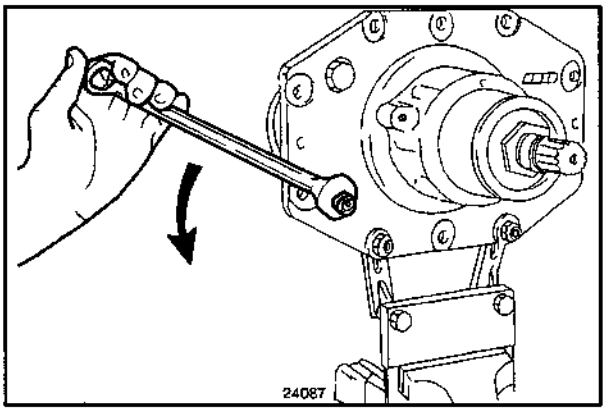


Figure 9-3-46

2. Remove the upper and lower attaching bolts from the diff lock outer bell housing and install two 2.76 in (70 mm) minimum long bolts into the holes. Gradually loosen the four remaining diff lock outer bell housing bolts to allow gradual release of the diff unlock spring. These retaining bolts must be used as the housing captures the spring.

Note – It is essential that replacement bolts are 2.76 in (70 mm) long minimum as common bell housing attaching bolts do not allow complete release of the diff unlock spring. These retaining bolts must be used as this housing captures the spring.

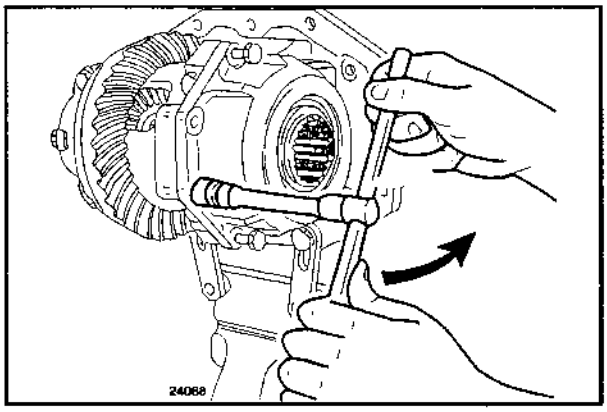


Figure 9-3-47

3. Loosen the 2.76 in (70 mm) long bolts last.

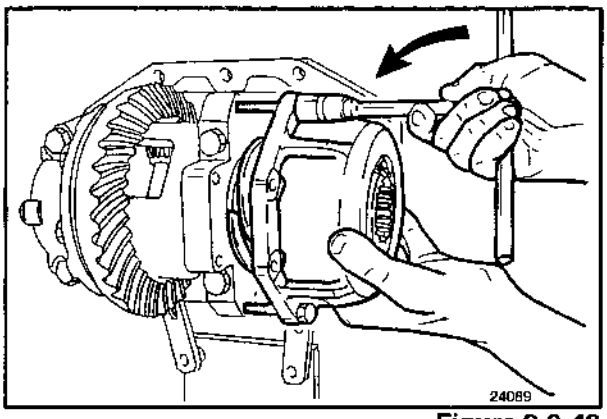


Figure 9-3-48

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4. Remove the clutch bell housing complete with diff unlock spring and diff lock control piston.

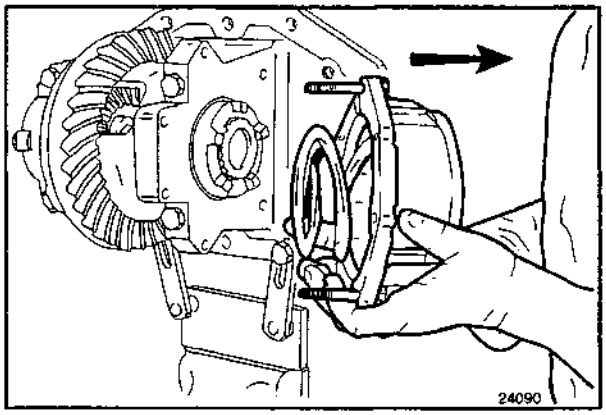


Figure 9-3-49

5. Remove the diff lock sleeve retaining wire.

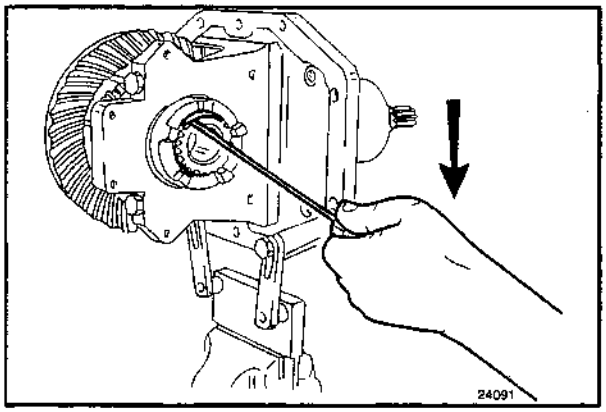


Figure 9-3-50

6. Remove the diff lock sleeve.

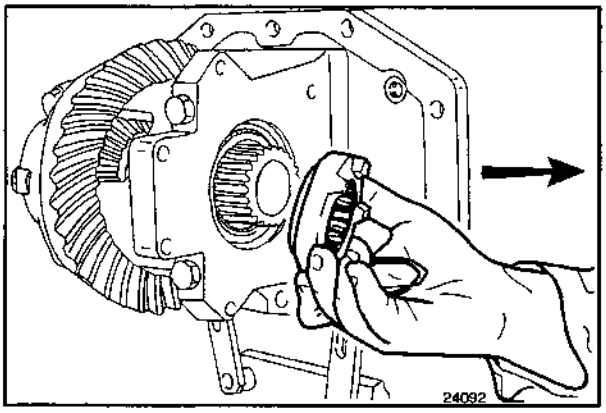


Figure 9-3-51

7. Remove the diff lock control piston retaining ring and retrieve the sliding sleeve with the two thrust washers.

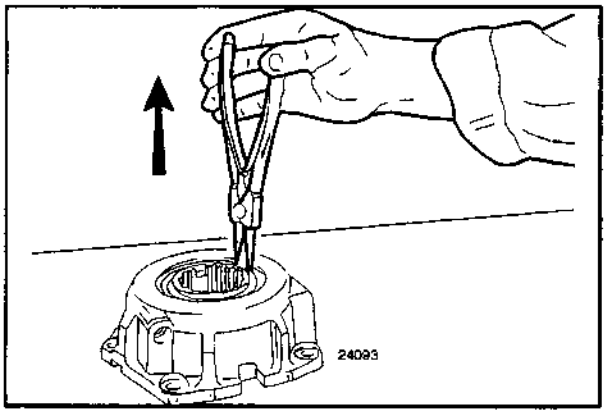


Figure 9-3-52

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8. **Gently** tap on the piston to expel it out from the clutch bell housing.

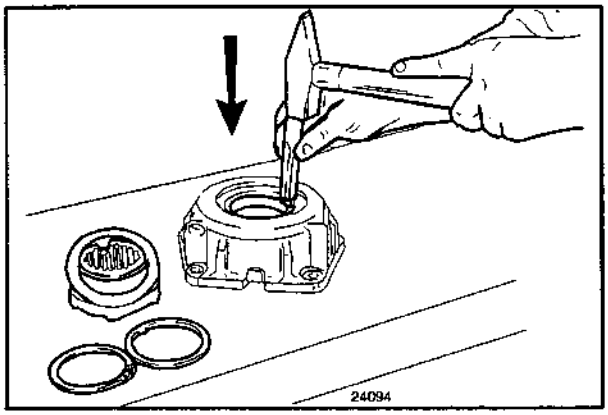


Figure 9-3-53

9. Disassemble the diff lock control piston.
10. Reassemble the diff lock clutch components following the disassemble procedure in reverse and observe the following:
11. Carefully check that two piston O–rings are in good condition.

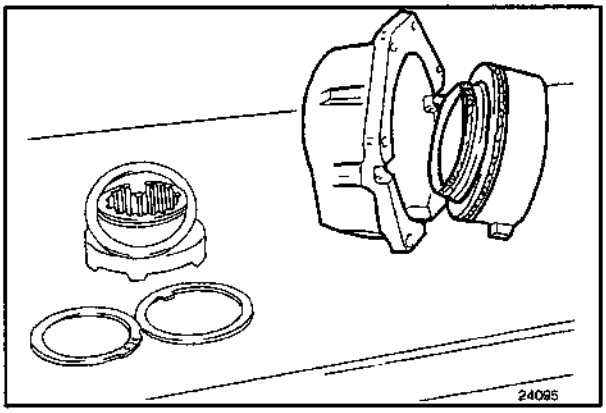


Figure 9-3-54

12. Assemble the clutch bell housing complete with the unlock spring and piston to the differential carrier using the two 2.76 in (70 mm) minimum long bolts. Screw them in gradually to compress the spring.

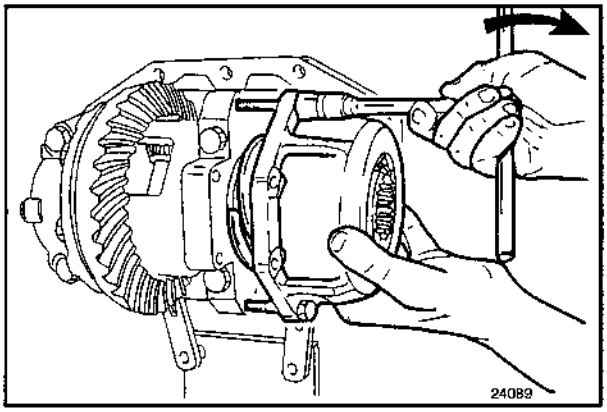


Figure 9-3-55

13. Install the four clutch bolts, remove the 2.76 in (70 mm) bolts and install the last two clutch bolts at respective locations.

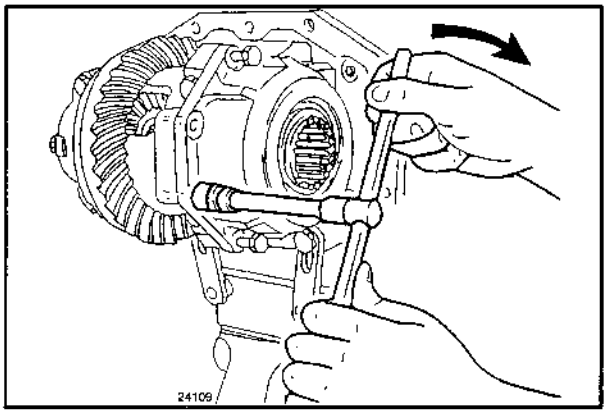


Figure 9-3-56

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FRONT AXLE PINION AND CROWN WHEEL

Overhaul

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

1. Remove the crown wheel nut retainer.
2. Loosen the crown wheel bearing adjustment ring nut using the wrench(1) tool no. **293665** for Class 3 units and no. **293798** for Class 4N units.

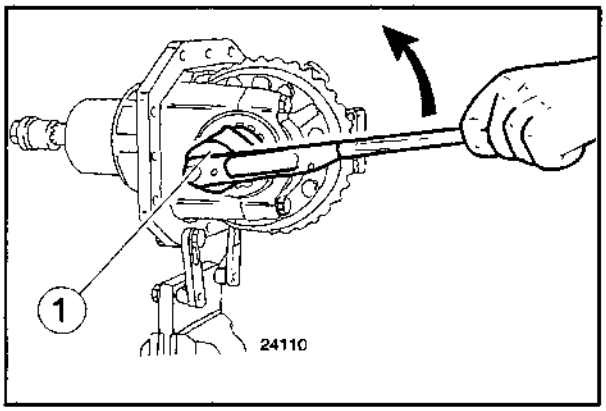


Figure 9-3-57

3. Remove the crown wheel/differential carrier cap attaching bolts.

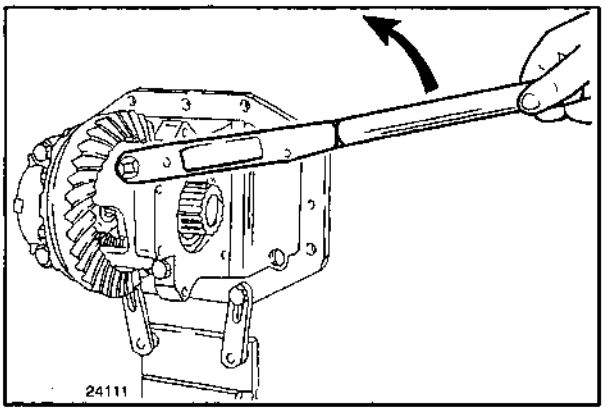


Figure 9-3-58

4. Remove the crown wheel and retrieve the adjustment shims located opposite to the adjust ring nut.

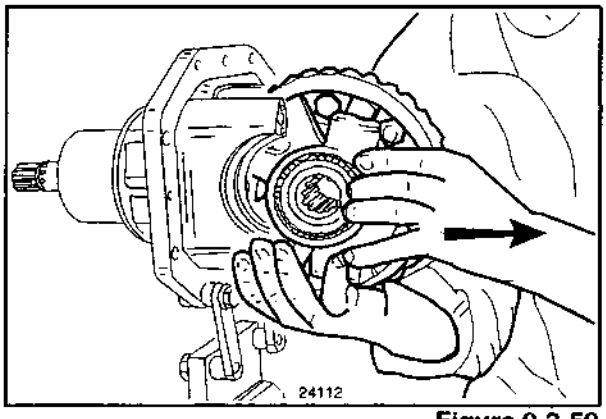


Figure 9-3-59

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5. Remove the circlip from the pinion shaft.

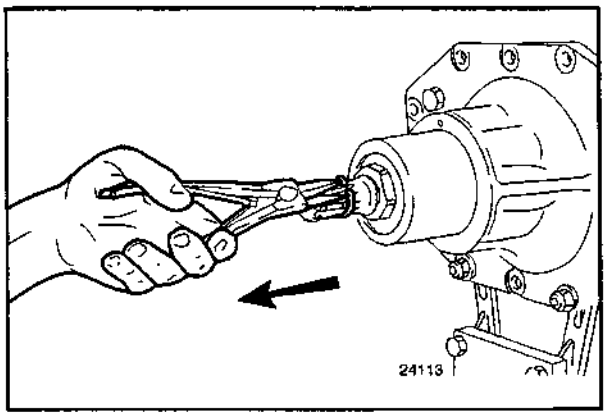


Figure 9-3-60

6. Straighten the pinion shaft locknut.

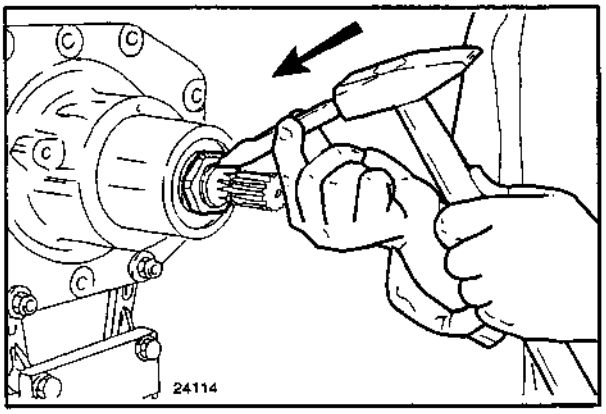


Figure 9-3-61

7. Loosen the pinion locknut using the socket wrench tool no. **293878** (2) and pinion tool no. **293876** (1) for Class 3 axles or tool no. **293879** (2) and pinion tool no. **293877** (1) for Class 4N axles.

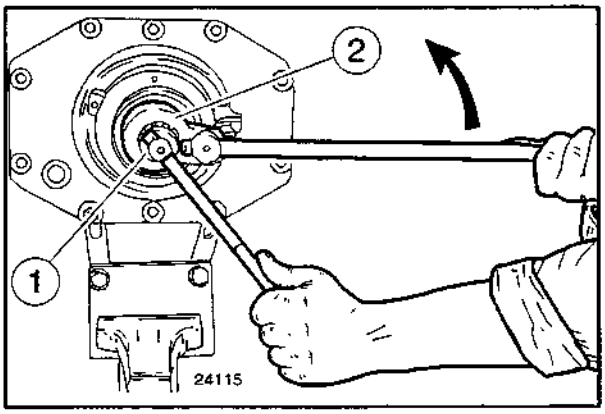


Figure 9-3-62

8. Retrieve the detent ball (3).

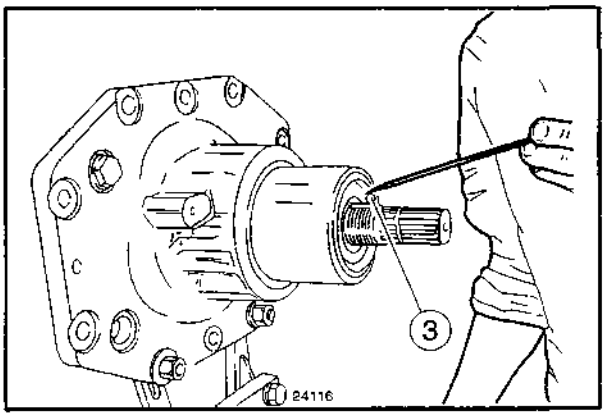


Figure 9-3-63

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9. Withdraw the pinion shaft by gently tapping on pinion shaft rear end.
10. Remove oil and dust seals and retrieve rear bearing and spacer.
11. Reinstall the pinion and crown wheel assembly observing the following:
    - Reassembly follows the disassembly procedure in reverse, from step 10 back to step 1.
    - Refer to figures on page 9-3-6 for correct orientation of the different parts.
    - Tighten to correct torque as detailed on page 9-3-4.
    - Carry out adjustments following procedures described on page 9-3-31 to 9-3-37.

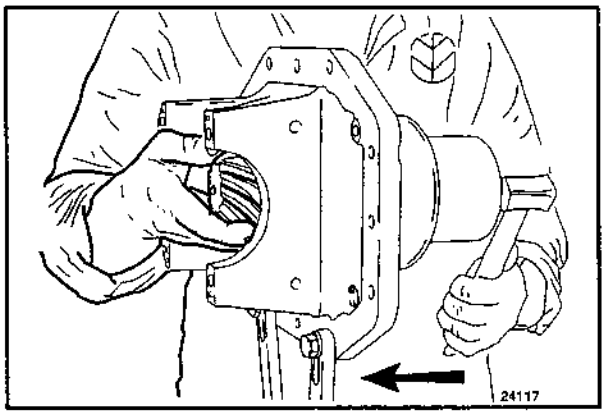


Figure 9-3-64

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PINION AND CROWN WHEEL ADJUSTMENTS

Determining the pinion shaft (12, page 9-3-6) bearing pre–load.

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

Proceed as follows:

12. Fix tool no. **293438** (1) in a vise, install the bearing inner races (2 and 4) and spacer (3) and fully tighten the tool nut.

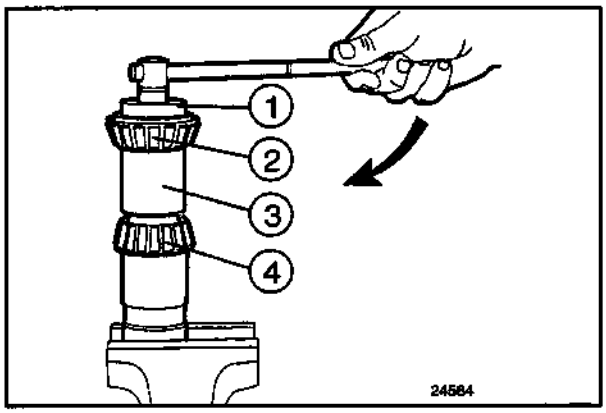


Figure 9-3-65

13. Using a depth gauge, measure dimension (H_1) between top level and end of pivot of tool no. **293438** (1).

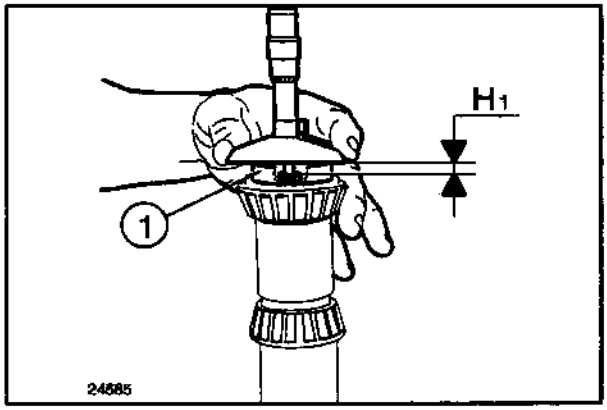


Figure 9-3-66

14. Dismantle the previous shim pack, lubricate bearings with engine oil and reassemble all pack details, except spacer (3, Figure 9-3-65), on the crown wheel/differential carrier complete with bearing outer races and already fixed in a vise using tool no. **293743**.

15. Fully tighten nut of the tool no. **293438** (1) while turning the tool to correctly seat the bearings.

16. Using a depth gauge, measure dimension (H_2) in the tool under this condition.

17. Thickness of adjuster ring (12) to be installed is given by:

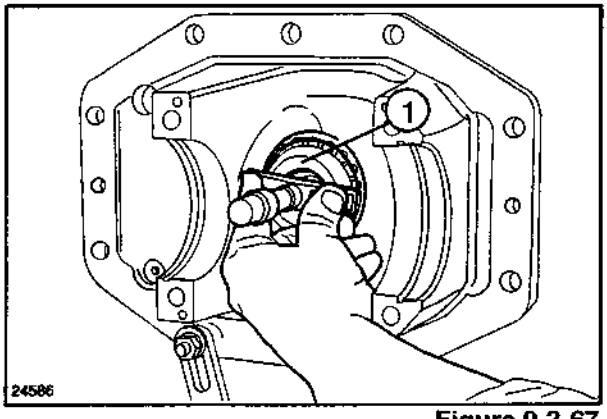


Figure 9-3-67

$$S = H_2 - H_1 + 0.05 \text{ mm } (0.002 \text{ in})$$

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Round off the adjuster ring value obtained (12) to the next 0.05 mm (0.002 in) if necessary

Note – upon completion of adjustment, do not disassemble the tool from the crown wheel/differential assembly for subsequent pinion position adjustment.

PINION AND CROWN WHEEL ADJUSTMENTS

Determining the pinion position (8, page 9-3-6) adjustment shim thickness.

Proceed as follows:

18. Assemble tool no. **293400** (1) to the crown wheel/differential carrier complete with the bearing outer races, crown wheel bearing adjuster nut, crown wheel bearing adjust shim, circlip and differential casing caps.

19. Screw in or out cones (3) of tool no. **293400** (1) to orient the depth gauge tip towards the bearing inner race (2) and remove all end play between the cones and the crown wheel bearing outer races.

20. Bring the depth gauge tip to contact the bearing inner race (2) and measure dimensions obtained (H_3).

21. Determine correct nominal dimension (H_5) between the crown wheel center line and the pinion larger base:

$$H_5 = H_4 \pm C$$

where:

H_4 = 4.53 in (115 mm) (Class 3) and 4.82 in (122.5 mm) (Class 4N). Nominal dimension between the crown wheel center line and pinion larger base.

C = Correction factor stamped on the pinion, prefixed by + or – if other than 0, to be added to or subtracted from the nominal dimension (H_4), depending on the sign.

22. Adjuster ring (8, page 9-3-6) thickness is given by:

$$S = H_3 - H_5$$

where:

H_3 = Depth gauge reading

H_5 = Correct nominal dimension between crown wheel center line and pinion larger base.

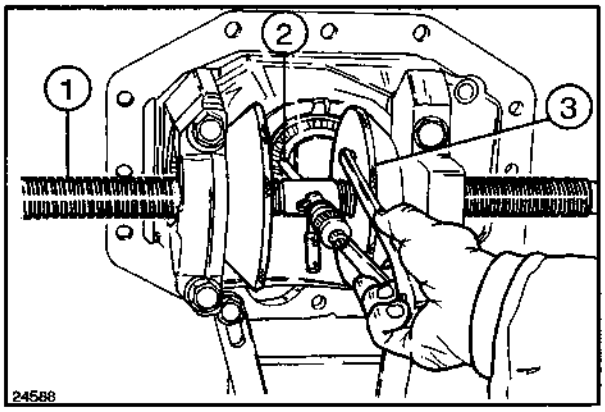


Figure 9-3-68

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Examples (Class 3 axle):

- Depth gauge reading: H_5 = 4.65 in (118 mm).
- Nominal dimension between crown wheel center line and pinion larger base: H_4 = 4.53 in (115 mm).
- Correction factor: C = + 0.008 in (0.2 mm).
- Correct nominal dimension: H_5 = 4.53 + 0.008 = 4.54 in (115 + 0.2 = 115.2 mm)
- Adjuster ring thickness:
  S = 4.65 – 4.54 = 0.11 in (118 – 115.2 = 2.8 mm).
- Correction factor: C = – 0.008 in (0.2 mm).
- Correct nominal dimension: H_5 = 4.53 – 0.008 = 4.52 in (115 – 0.2 = 114.8 mm).
- Adjuster ring thickness:
  S = 4.65 – 4.52 = 0.13 in (118 – 114.8 = 3.2 mm).
- Correction factor: C = 0 in (0 mm).
- Correct nominal dimension: H_5 = H_4 = 4.53 in (115 mm).
- Adjuster ring thickness:
  S = 4.65 – 4.53 = 0.12 in (118 – 115 = 3 mm).

23. Remove universal tools no. **293438** and **293400** from the pinion and crown wheel carrier.

24. Assemble the pinion with the bearing inner races, spacer and adjuster rings as previously found.

25. Assemble the O–ring (1) on the pinion shaft.

26. Slide the spacer and detent ball over the pinion, after carefully lubricating the ball outer surface.

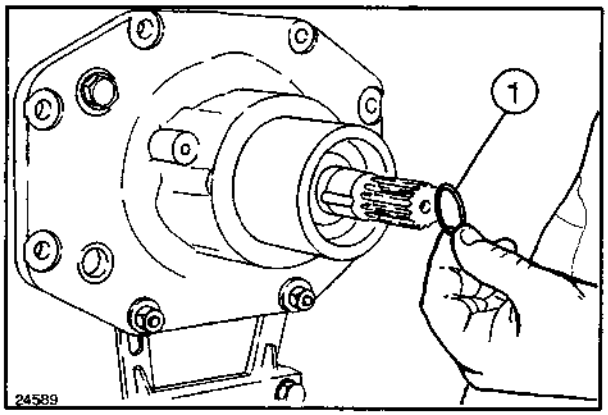


Figure 9-3-69

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27. Assemble the pinion tool (2) no. **293876** for Class 3 units and no. **293877** for Class 4N units.

28. Insert the wrench (1) tool no. **293878** for Class 3 units and no. **293879** for Class 4N units on the adjuster nut.

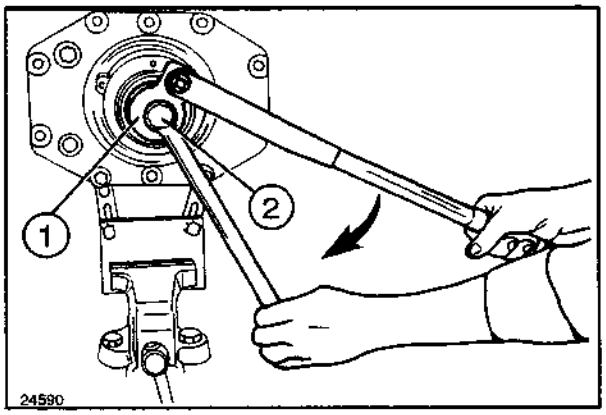


Figure 9-3-70

29. Using a wrench assembled to the pinion tool (2) hold the pinion and a torque meter placed on the nut wrench (1) exactly as shown in the figure, tighten the nut (C_2, page 9-3-4) to 217 ft. lbs. (294 Nm) while turning the pinion shaft to seat the bearings correctly.

30. Using a torque meter (1) assembled to the pinion tool (2) no. **293876** for Class 3 units or no. **293877** for Class 4N units, check pinion rolling torque is 0.5 to 0.4 to 0.7 ft. lbs. (1 Nm) without both the oil seal (11, page 9-3-6) and dust seal. If the rolling torque is lower than specification, reduce adjust shims (12, page 9-3-6); increase if higher.

31. Loosen the nut and assemble the oil seal (11, page 9-3-6) and dust seal. Tighten the nut to 217 ft. lbs. (294 Nm) while turning the pinion shaft to seat the bearings properly.

32. Using a torque meter (1) assembled to the pinion tool (2) no. **293876** for Class 3 units or no. **293877** for Class 4N units, check pinion rolling torque is 0.55 ft. lbs. (0.75 Nm) with both the oil seal (11, page 9-3-6) and dust seal installed. Deform the nut and install the circlip on the pinion shaft.

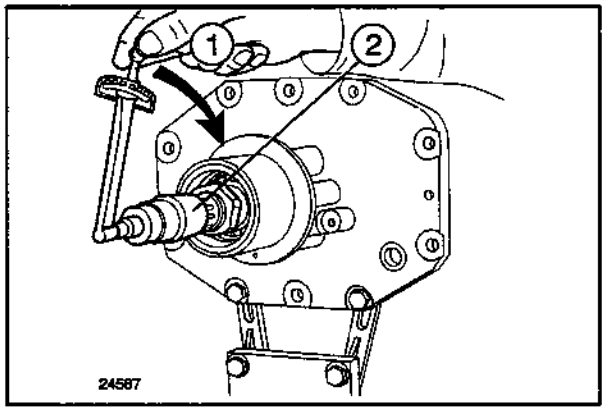


Figure 9-3-71

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PINION AND CROWN WHEEL ADJUSTMENTS

Adjustment of crown wheel bearings and crown wheel to pinion backlash.

Proceed as follows:

33. Assemble the differential assembly complete with the crown wheel and crown wheel bearing inner races to the crown wheel/differential carrier.

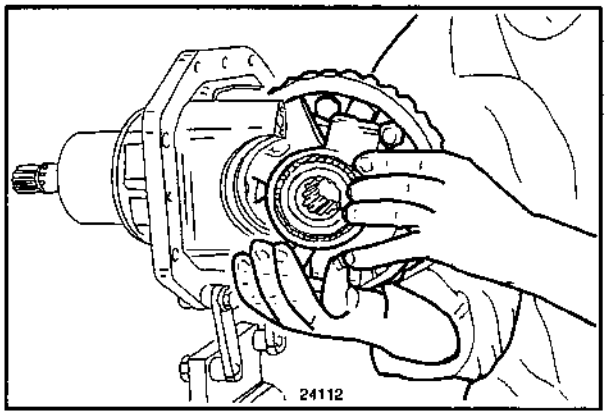


Figure 9-3-72

34. Insert the outer races into the crown wheel/differential carrier, assemble the differential casing caps and tighten bolts to 43 ft. lbs. (59 Nm). Loosen the bolts and tighten them again to 15 ft. lbs. (20 Nm).

35. Assemble the adjust shim (2, page 9-3-6) removed during axle overhaul and retaining ring.

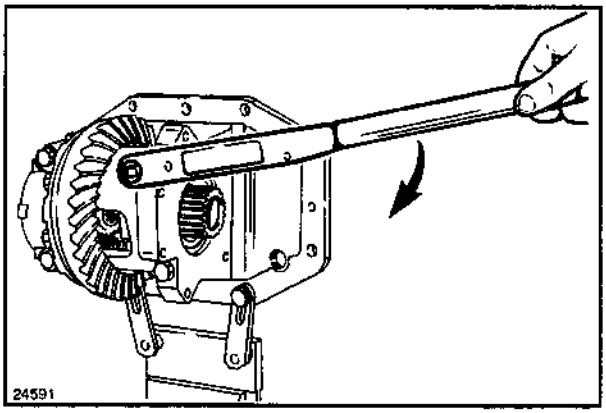


Figure 9-3-73

36. With the bearings perfectly lubricated, turn the crown wheel and at the same time using the wrench (1) tool no. **293665** for Class 3 units and no. **293798** for Class 4N units tighten the nut to 29 to 43 ft. lbs. (39 to 59 Nm) to guarantee that the end play between the components is re–established.

37. Place a dial indicator at right angles to the outside one of the crown wheel teeth (1) and measure pinion to crown wheel backlash.

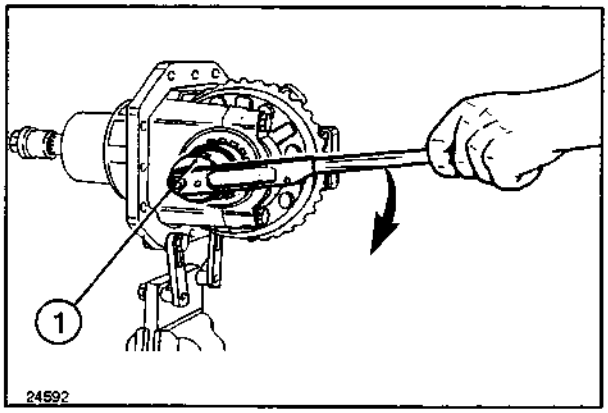


Figure 9-3-74

38. Repeat measurement in two more places at 120° from one another and compare the average (Gm) of the three readings with the specified backlash of 0.007 to 0.009 in (0.18 to 0.23 mm), with an **average of 0.008 in (0.20 mm).**
If backlash determined is higher than specification, reduce the final shim pack (2, page 9-3-6) to be assembled.
Final shim pack (2, page 9-3-6) to be assembled to the crown wheel/differential carrier is given by:

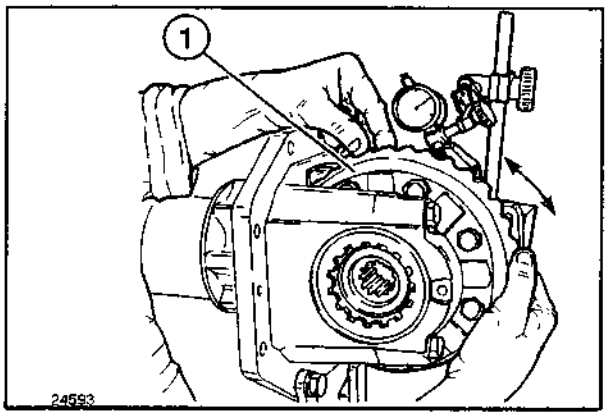


Figure 9-3-75

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S = Sp – {(Gm – 0.20 [0.008 in]) x 1.35}

where:

Sp = Test shim assembled to the crown wheel/differential carrier

Gm = Average pinion to crown wheel backlash

If the backlash value is lower than specification, increase the shim pack (2, page 9-3-6) to be assembled, calculating value as follows:

S = Sp + {(0.20 [0.008 in] – Gm) x 1.35}

where:

Sp = Test shim assembled to the crown wheel/differential carrier

Gm = Average pinion to crown wheel backlash

39. Assemble the shim (2, page 9-3-2) determined and using a centesimal dial indicator placed at right angles to the outside one of the crown wheel teeth, check pinion to crown wheel backlash is within the admissible range of 0.007 to 0.009 in (0.18 to 0.23 mm).

40. Tighten the cap screws (C_2, page 9-3-5) to a torque value of 130 ft. lbs. (176 Nm).

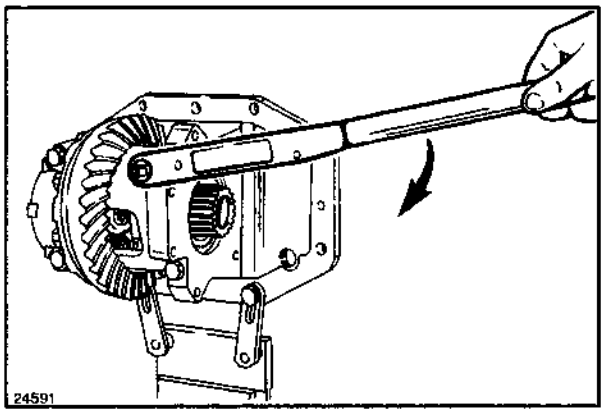


Figure 9-3-76

41. Using a wrench (1) tool no. **293665** for Class 3 units and no. **293798** for Class 4N units, turn the adjuster nut and using a torque meter (1), tighten the ring nut to 19.3–36.3 ft. lbs. (26–49 Nm).

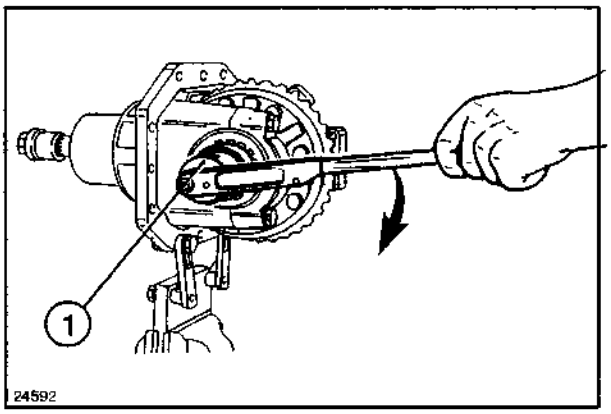


Figure 9-3-77

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check if pinion and crown wheel bearing rolling torque, measured under the same conditions as when checking the pinion only rolling torque, is:

$A_2 = A_1 + 0.7–1.1$ ft. lbs. (1 + 1.5 Nm)

where:

A_2 = Pinion and crown wheel rolling torque

A_1 = Pinion only rolling torque previously found

0.7–1.1 ft. lbs. (0.1 to 1.5 Nm) = Crown wheel only rolling torque measured at the end of the pinion using the wrench tool no. **293876** for Class 3 units and no. **293877** for Class 4N units and torque meter.

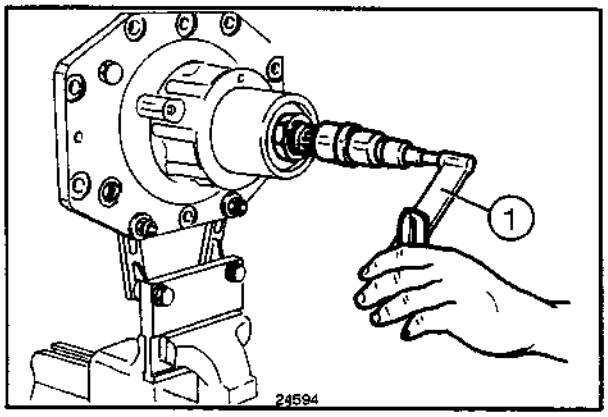


Figure 9-3-78

42. Install the locking tab and screw in or out the adjuster nut till the nearest notch.

43. Fix the crown wheel/differential carrier to the axle housing after thoroughly cleaning and degreasing the mating surfaces and applying a 0.079 in (2 mm) bead of sealant as shown in the figure below.

Sealant applications pattern for crown wheel carrier and planetary carrier.

Sealants to be used are listed on page 0-1-19, Section 00

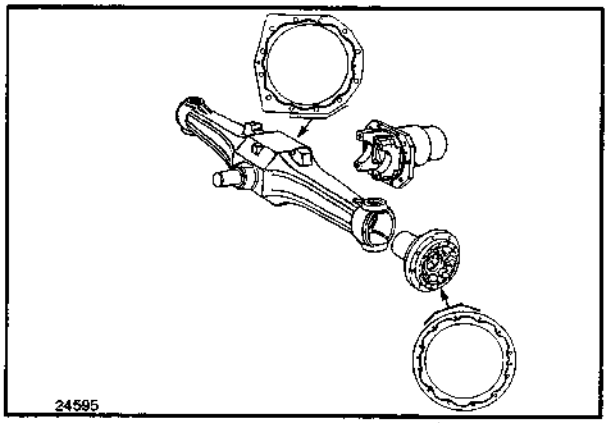


Figure 9-3-79

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FRONT AXLE DIFFERENTIAL ASSEMBLY

Overhaul

If the differential assembly has been overhauled, the differential planet gears to side gears backlash should be adjusted.
Proceed as follows:

1. Thoroughly wash all differential components to remove oil traces which could affect backlash testing.

2. Assemble the two side gears to the differential casing, without thrust washers.

3. Insert planet gears complete with thrust washers and pins. Turn the pin attaching screws by some turns to prevent pins from falling out.

4. Place a dial indicator on the differential casing.

5. Bring the left hand side gear to fully contact the planet gear and then push it to contact the differential casing. Read left hand side gear end play (Gs) on the gauge.

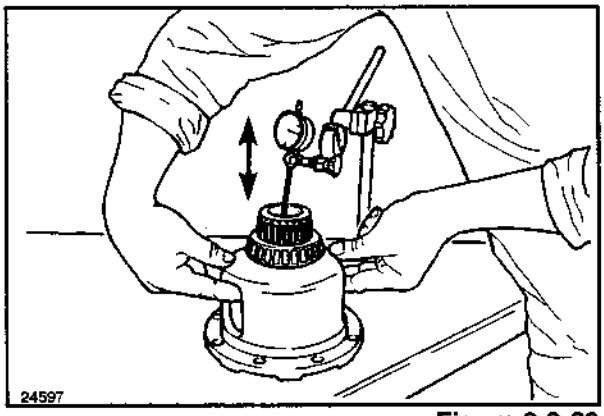


Figure 9-3-80

6. Repeat for right hand side gear and measure right hand side gear end play (Gd).

   Specified end play should be **0.010 in (0.25 mm)** for Class 3 units and **0.012 in (0.30 mm)** for Class 4N units.
   Therefore, adjust shims to be assembled to the differential casing are given by:

   $S_s = G_s - 0.010$ in (0.25 mm) LH side gear, Class 3 units

   $S_d = G_d - 0.010$ in (0.25 mm) RH side gear, Class 3 units

   $S_s = G_s - 0.012$ in (0.30 mm) LH side gear, Class 4N units

   $S_d = G_d - 0.012$ in (0.30 mm) RH side gear, Class 4N units

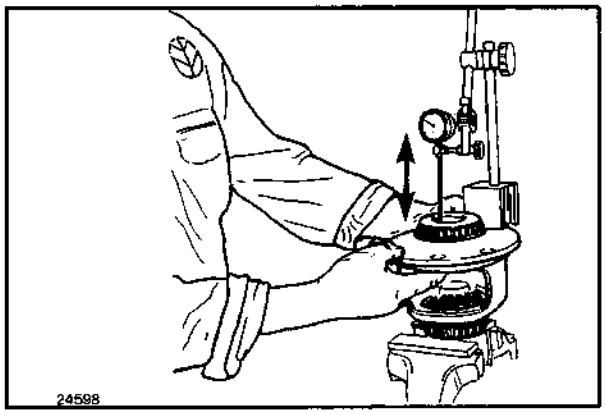


Figure 9-3-81

7. Assemble thrust washers nearest to the value obtained. Using a dial indicator and following the above procedure, check RH and LH side gear end play is near to 0.010 in (0.25 mm) for Class 3 units and to 0.012 (0.30 mm) for Class 4N units.

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SWIVEL PINS AND BEARINGS

Replacement

If the swivel pins are difficult to be disassembled, proceed as follows:

1. Remove greasers and swivel pin retaining bolts.
2. Install screws (1) of tool no. **293857**.
3. Install tool plate (2) and fix to the screws using nuts (5).
4. Install tie–rod (4) and screw it in completely into the greaser hole on the pin (6).
5. Tighten the nut (3) until withdrawing the pin.

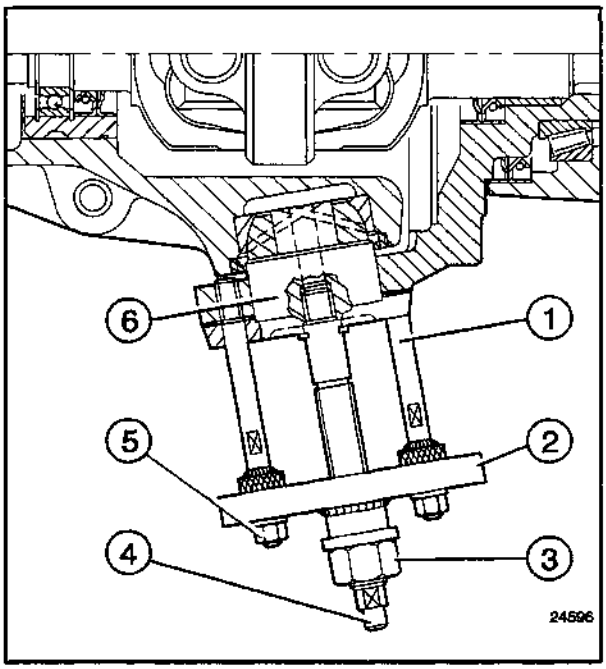


Figure 9-3-82

6. Using a puller tool no. **292161** (1) remove the swivel bearings.
7. Reassemble the swivel bearings using a suitable installer.

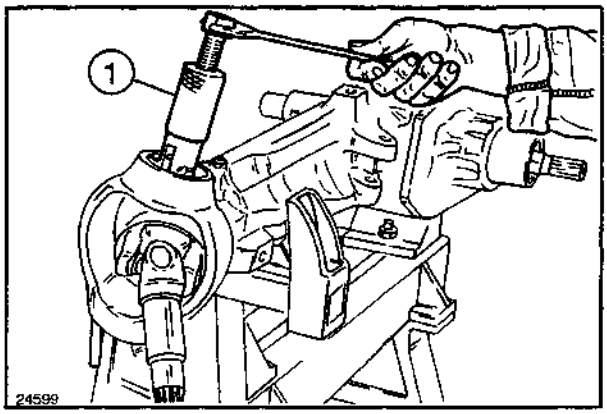


Figure 9-3-83

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FRONT WHEEL TOE–IN TEST

When the tractor moves along a straight line, FWD tractor wheels should be parallel to the tractor center line. A slight front toe–in until a max. of 0.236 in (6 mm), measured between the rim edges, is also admitted.

Check correct FWD tractor toe–in as follows:

1. Inflate front tires to the specified pressure.
2. Place the steering wheel at mid–travel, with one spoke along the tractor center line.
3. Check wheels are parallel to the tractor center line.
4. Measure the distance (1) between the wheel inner rims at hub height at the **front** of the wheels.
5. Rotate both front wheels 180° and check the distance (2) again, at hub height, this time at the **rear** of the wheels. The measurement taken should be the same as (1) or greater by up to 0.236 in (6 mm) max. 180° wheel rotation is necessary to eliminate rim run–out errors.

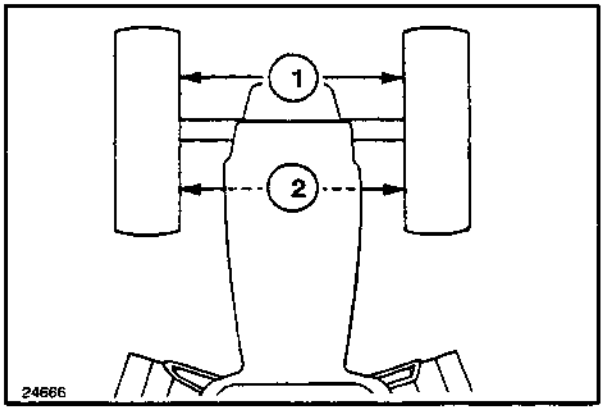


Figure 9-3-84

6. Should it be necessary to adjust the front wheel toe–in, proceed as follows:
   Remove the nut (2) and slide out the rod end (1) from its seat.
   Loosen the locknut (3) and screw in or out the rod end (1) to reduce or increase the distance (2, Figure 9-3-1).
   Insert the rod end (1) into its seat and check the toe–in as detailed in steps 4 and 5.
   When the toe–in is to specification, tighten the locknut (3) to 133 ft. lbs. (180 Nm) and the nut (2) to 74 ft. lbs. (100 Nm).

Note – The self–locking nut (2) should be replaced every time it is disassembled or loosened.

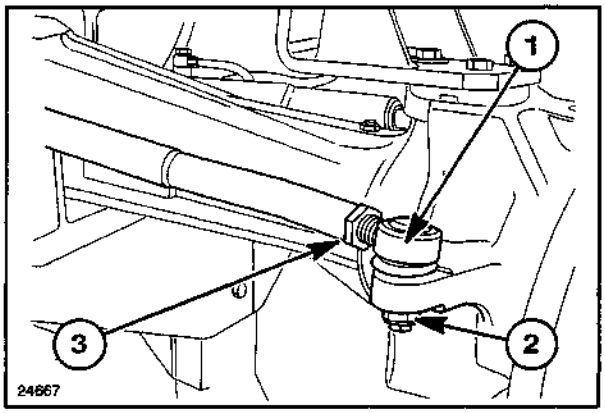


Figure 9-3-85

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FRONT DIFFERENTIAL LOCK CLUTCH
Overhaul

⚠ WARNING ⚠

Handle all components with the greatest care. Do not insert hands or fingers between the parts.Wear suitable protection clothing, including goggles, gloves and footwear.

With the pinion and crown wheel carrier placed on fixture tool no. **293743**.

Proceed as follows:

1. Remove the retaining ring (3), bell housing (2), clutch disc (4) hub retaining ring (1).

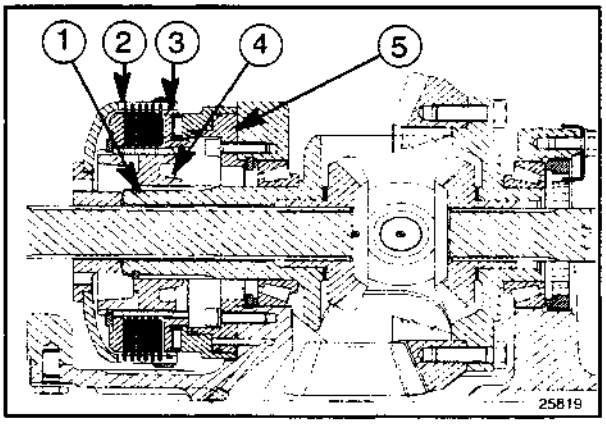


Figure 9-3-86

2. Remove the circlip (1), disassemble the reaction ring (2) along with the clutch discs (3) and clutch disc hub (4).

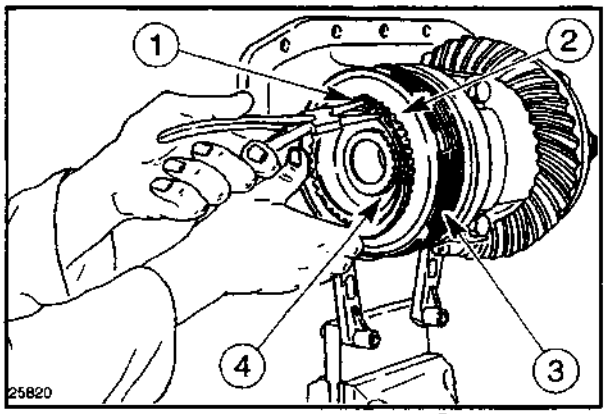


Figure 9-3-87

3. Remove the thrust washer (1), washer (2) and release bearing (3).

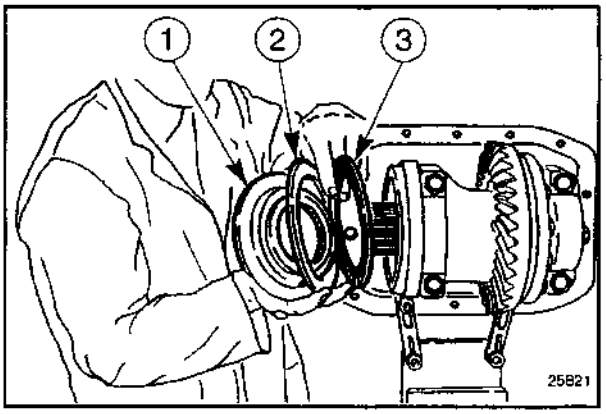


Figure 9-3-88

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4. Blow compressed air into the oil inlet fitting and drive out the diff clutch lock piston (1).

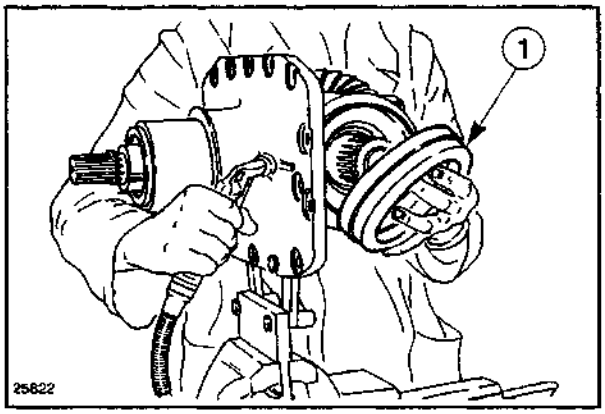


Figure 9-3-89

5. Remove the attaching bolts (1) and diff lock support plate (2). Retrieve oil seal (5, page 9-3-41).
6. Check all hydraulic cylinder sliding surfaces are free from scuffs and in perfectly good condition.
7. Check clutch discs for abnormal wear or imperfections. Replace if damaged.
8. Reinstall the differential lock assembly observing the following:

– Reassembly follows the disassembly procedure in reverse, from step 5 back to step 1.
– Refer to figures on page 9-3-6 for correct orientation of the different parts.
– Check seals and replace if damaged.
– Tighten to correct torque as detailed on page 9-3-4.

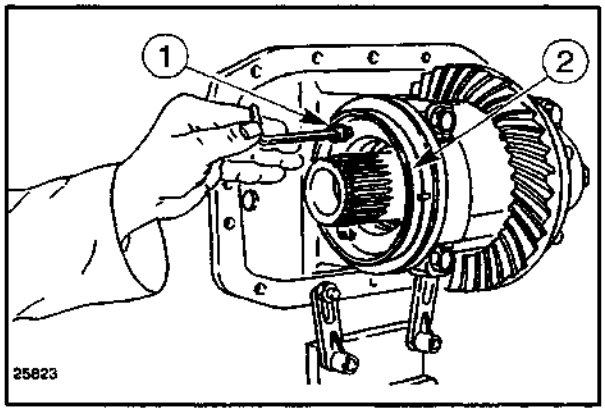


Figure 9-3-90

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SECTION 9

DRIVE LINES – FWD

CHAPTER 4

HYDROSTATIC STEERING SYSTEM

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SPECIFICATIONS

HYDROSTATIC SYSTEM

Pump specifications	**2WD**	**FWD**
Minimum Pump Output		
Liters/min.	39.1	50.4
Imp.Galls/min.	8.57	11.05
U.S. Galls/min.	10.34	13.33
Steering Motor Displacement	125cc/revolution	160cc/revolution
Relief Valve Maximum Differential Pressure Setting	170 Bar 2465 lbf/in^2	170 Bar 2465 lbf/in^2
Absolute Gauge Pressure	186 Bar 2700 lbf/in^2	186 Bar 2700 lbf/in^2

TWO WHEEL DRIVE AXLE

Standard Tire (Front)	11.00 x 16
Maximum Steering angle	55°
Steering Wheel Turns (Lock to Lock)	Left to Right 3.98 Right to Left 5.03
Cylinder	Double Acting Unbalanced
Turning Radius with Brakes	13 ft (3.9m)
Turning Radius less Brakes	14 ft (4.3m)
Toe–out	0–0.51 in (0–13 mm)

FRONT WHEEL DRIVE AXLE

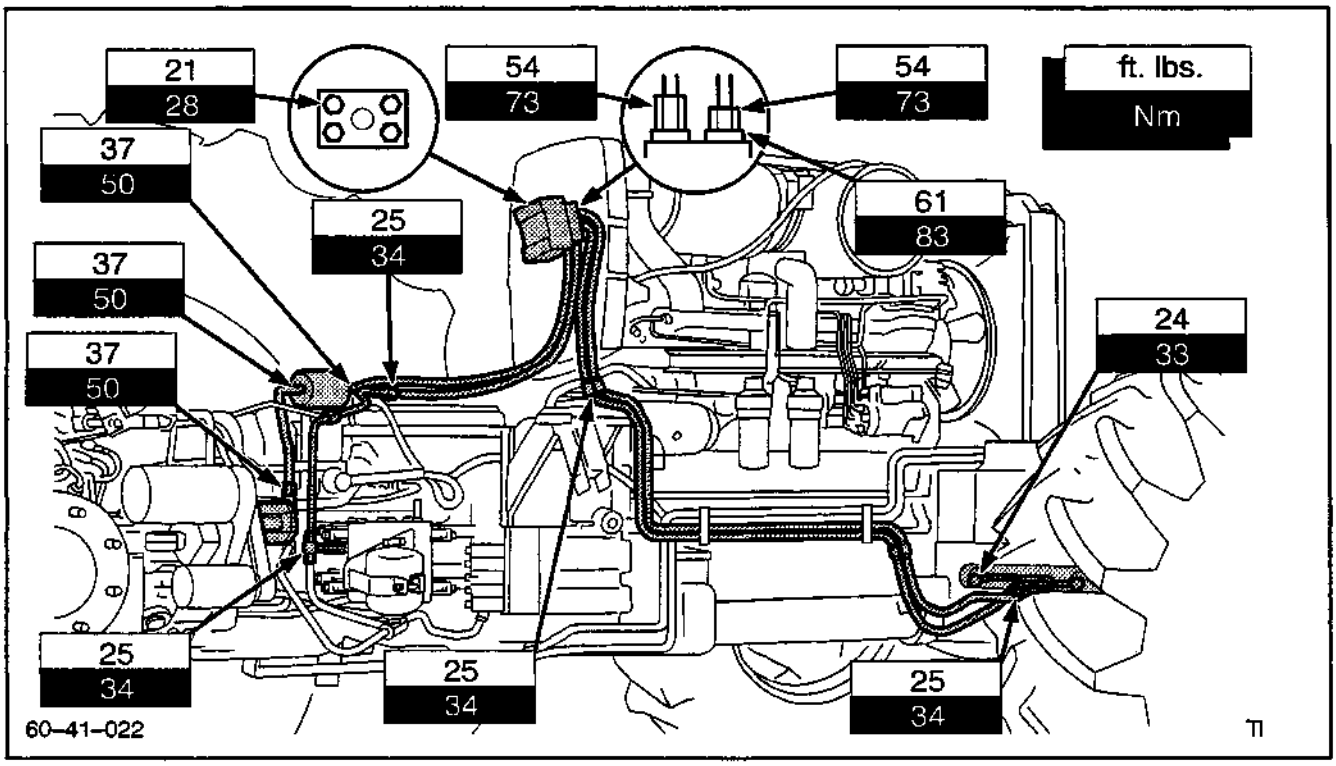
Standard Tire (Front)	
Class 3	380–70R28
Class 4N	16.9 x R28
Maximum Steering angle	55°
Steering Wheel Turns (Lock to Lock)	
Class 3 Axle	4.3
Class 4 Axle	4.8
Cylinder	2 of Double acting Unbalanced

	8160	**8260**	**8360**	**8560**
Turning Radius with Brakes (FWD disengaged)	13.6 ft (4.15m)	13.6 ft (4.15m)	13 ft (4.0m)	13 ft (4.0m)
Turning Radius less Brakes (FWD disengaged)	15 ft (4.6m)	15 ft (4.6m)	15.2 ft (4.65m)	15.2 ft (4.65m)
Toe–In	0.51 in (13mm)			

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41 000 TIGHTENING TORQUE



Steering General

	ft. lbs.	Nm
Steering Wheel Retaining Nut	17.0	23.0
Front Wheel Nut 2WD	230.0	314.0
Front Wheel Nut FWD	156.0	211.0
Motor End Cover	17.0	23.0
Cylinder, Rod End Nut (2WD)		
Cylinder, Tube End Nut (2WD)		
Cylinder, Tube End Pin Retaining Bolt (FWD)		
Cylinder End Cap (FWD)		
Column to Frame Bolt	17.0	23.0

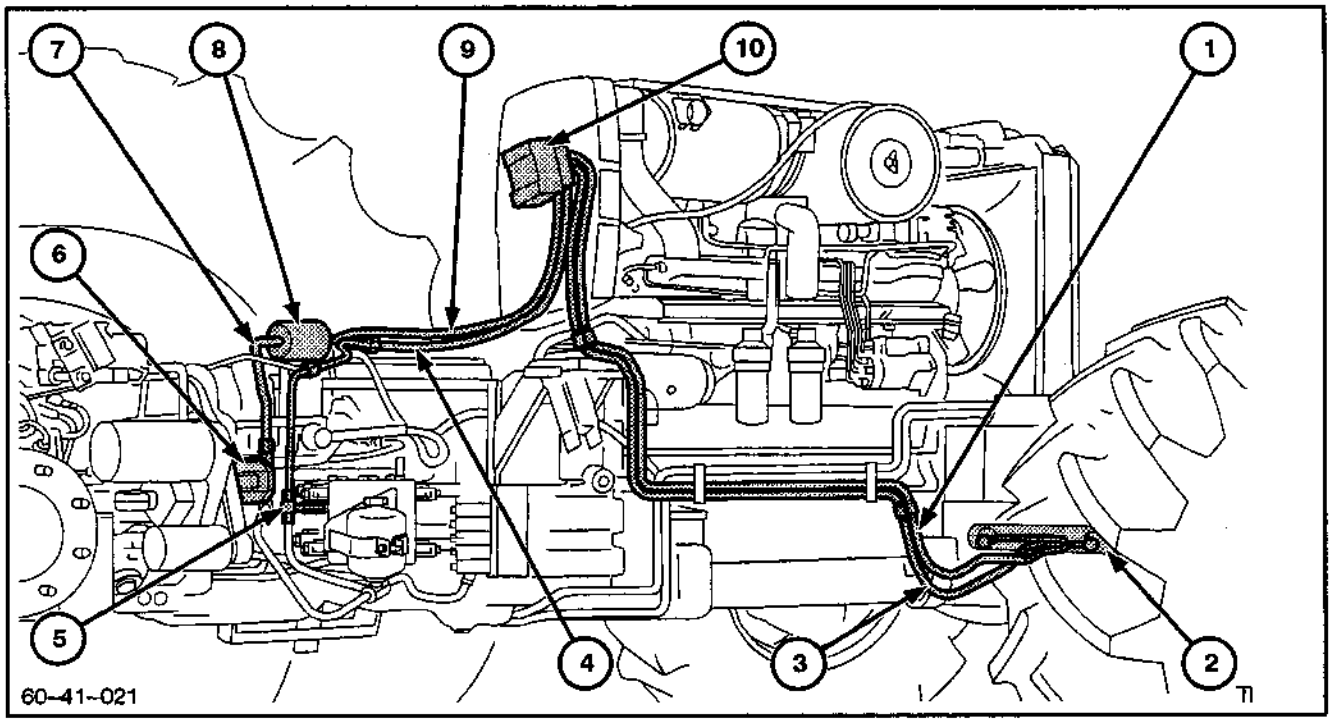
SPECIAL TOOLS

DESCRIPTION	V.L.CHURCHILL TOOL No.	DANFOSS TOOL No.
Pressure Gauge (0–6000 lb/in^2)	FT8503A	
Seal Installer	–	Danfoss No. SJ.150N4014–1
Adaptor (Gauge to Hose)	FT8503–8	
Test Hose E1NN F493 AA (Finis Code 3936707)		
Adaptor (Test hose to tractor tube) 7/16 JIC Male x 9/16 JIC Male		

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41 000 – DESCRIPTION AND OPERATION



Hydrostatic Steering System Component Layout **Figure 9-4-1**

1. Left Hand Turn Hose
2. Steering Cylinder
3. Right Hand Turn Hose
4. Steering Return / Lubrication Line
5. Inlet to Pressure Regulating Valve
6. Steering Pump
7. Pump Output Line
8. Resonator (System Silencer)
9. Resonator to Steering Motor Line
10. Steering Motor

All models have fitted as standard, hydrostatic steering systems that are powered when the engine is running by hydraulic pumps mounted on the rear axle.

There are two types of steering pump used depending on whether the hydraulic system has a closed center or open center system.

Both open and closed center hydraulic systems incorporate a steering pump as part of the hydraulic pump assemblies and both types share the main intake filter of that system.

The pumps, driven by a gear straight from the P.T.O. shaft, pressurize the steering column operated steering motor. The pressurized oil from the steering motor drives the axle mounted double acting steering cylinder (2WD), or twin cylinders (FWD).

The steering motor is similar across the vehicle range and is bolted to a bracket within the steering console and connected to the steering column by a splined shaft.

The steering column is adjustable for varying angles of tilt on all models.

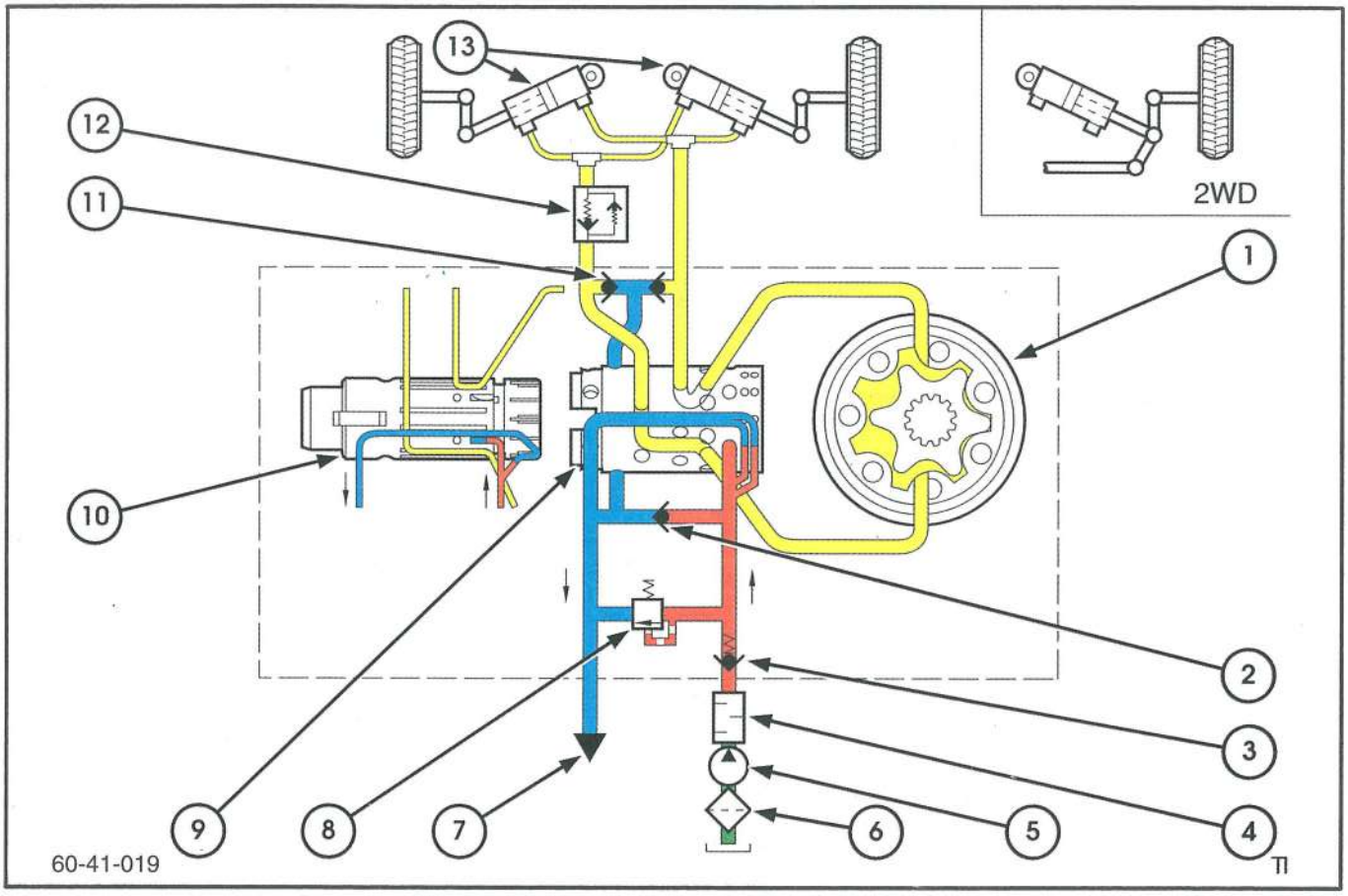
On two wheel drive units the steering cylinder is fixed at one end to the front axle beam and at the other to an eye on the spindle steering arm.

On front wheel drive units two steering cylinders are used, one for each wheel. The cylinders are fixed at one end to the axle casing and the piston end to steering arms from the swivel housings.

The pressure relief valve for the system is contained within the steering motor itself.

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Steering Operation Schematic – Neutral Position **Figure 9-4-2**

1. Metering Unit
2. Check Valve
3. Non Return Valve
4. Resonance Damper Filter
5. Pump
6. Filter
7. Return via Cooling and Lubrication
8. Pressure Relief Valve
9. Control Valve Sleeve
10. Control Valve Spool
11. Suction Valves (2WD Only)
12. Bias Valve (2WD Only)
13. Steering Cylinder/s

Suction oil

Trapped oil

Return oil
(Restricted by cooling and lubrication)

Pump oil

OPERATION

Oil is drawn from the rear axle and into the pump through a filter, pressurized by the rotation of the gears, and expelled through the pump outlet port to the steering motor, via a resonance damper filter which reduces the noise from the system and smooths the output from the pump. The pressurized oil when received at the steering motor is directed to the steering actuating cylinder when the steering wheel is turned.

The steering motor incorporates a metering unit which regulates the volume of oil supplied to the cylinder so that it is proportional to the angular movement of the steering wheel. The metering unit in combination with the check valve also allows the steering to be operated **MANUALLY** without pressurized oil being supplied from the pump.

Suction valves, item 10 Figure 9-4-2, only used on two wheel drive models, prevent cavitation in the steering cylinder as oil is transferred from a small area to a large area when the steering motor is in the neutral position.

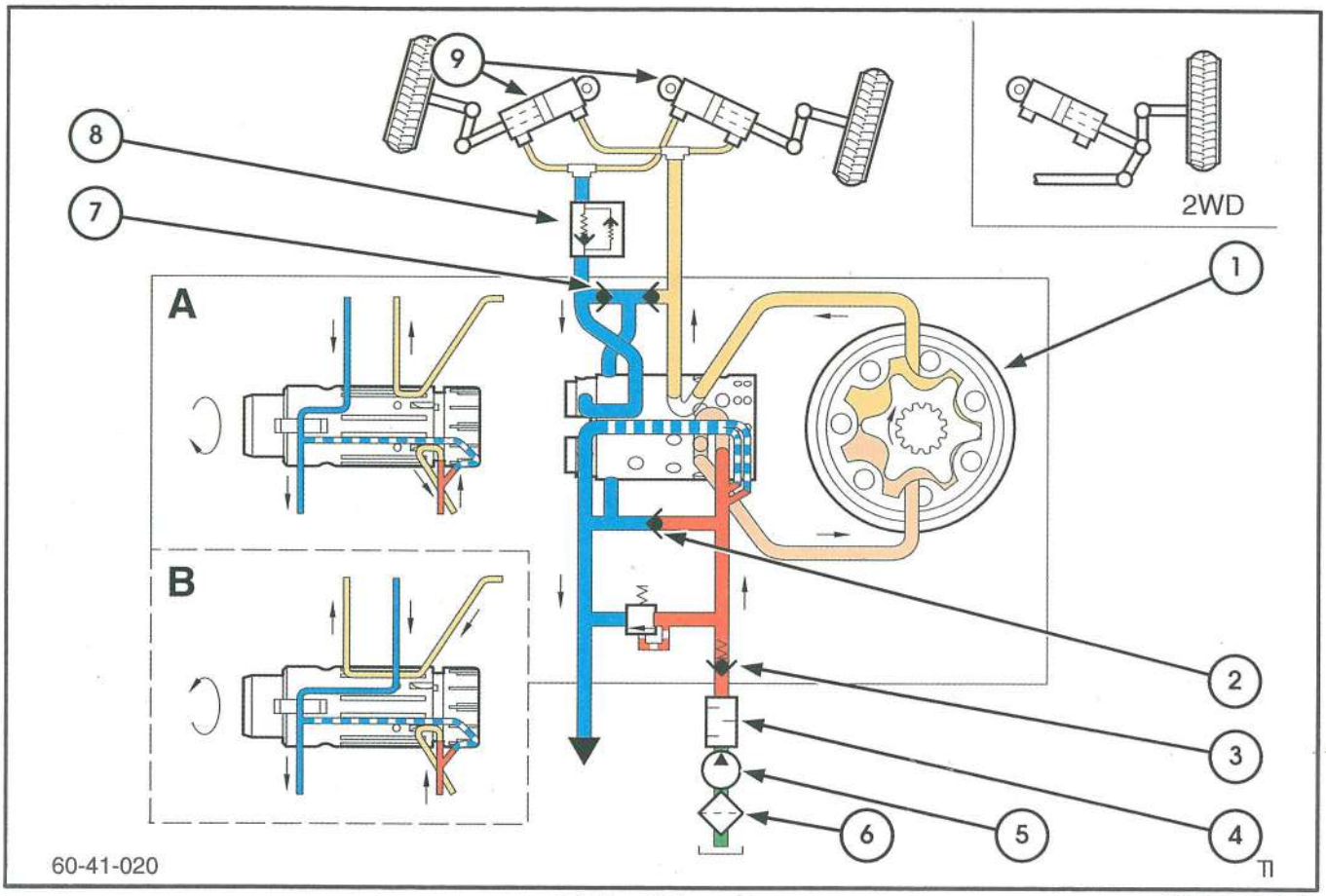
The system is fully hydrostatic and as such there is no mechanical connection between the steering column and the steering wheels.

Neutral Position

With the steering wheel held still, the leaf springs in the steering motor return and hold the spool and sleeve in the neutral position. This ensures no more oil is supplied to the steering cylinder, Figure 9-4-2. The trapped oil is, however, allowed to transfer between the left and right turn sides of the cylinder/s, allowing the wheels to react to the ground to provide feedback for the driver.

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Oil Flow Schematic **Figure 9-4-3**

A– Right Hand Turn B– Left Hand Turn

- Suction oil
- Metering unit supply
- Return oil (Restricted by cooling and lubrication)
- Pressure supply
- Metered oil to steering cylinder

Right Hand Turn

When the steering wheel is turned the movement of the control valve spool in its sleeve forms a series of passages. During right turns the oil flows through the sleeve along a groove in the valve spool and into a passage in the steering motor housing which leads to the metering unit, Figure 9-4-3.

The metering unit is turned by the drive shaft and directs oil along another set of passages in the spool and sleeve and into the steering cylinder. Return oil from the other side of the cylinder is directed through the valve spool and sleeve to a return passage in the housing.

Left Hand Turn

When turning the wheel to the left oil flows along the sleeve and operates in a similar manner as described in right hand turn, Figure 9-4-3.

Manual Right Turn

In the event of a power steering pump failure or loss of oil pressure, the power steering system can be operated manually. Turning the steering wheel rotates the metering unit rotor and forces oil into the rod side of the power steering cylinder.

On the suction side of the metering unit, return oil flows from the cylinder and is drawn through the check valve to feed the metering unit.

Manual Left Turn

Turning the steering wheel rotates the metering unit rotor which forces oil into the piston side of the power steering cylinder.

When additional oil supply is required, as in making a left turn, additional oil is drawn from the power steering reservoir through the check valve to the metering unit.

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FAULT FINDING

IMPORTANT: *When effecting a repair the cause must be corrected to avoid a repeat failure.*

PROBLEM	POSSIBLE CAUSE	REMEDY
No steering or excessive effort to steer	1. Air in system	1. Check for loose connections or damaged tubing. Purge system of air.
	2. Steering system relief valve sticking/faulty	2. Check system pressure.
	3. Worn pump	3. Inspect and repair.
	4. Leaking steering cylinder	4. Inspect and repair.
	5. Broken or damaged steering column coupling	5. Inspect and replace as required.
	6. Damaged or worn metering unit	6. Inspect and replace as required.
Steering wanders	1. Excessive play in steering linkage joints	1. Inspect and replace as required.
	2. Leaking steering cylinder	2. Inspect and repair.
	3. Damaged or worn metering unit	3. Inspect and replace as required.
Drift to Left, Two Wheel Drive only	1. Bias valve faulty	1. Replace or repair
Front wheels surge when steering	1. Leaking steering cylinder	1. Inspect and repair.
	2. Damaged or worn metering unit	2. Inspect and replace as required

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SYSTEM TESTING

When the hydrostatic steering system is in operation, the pressure of oil supplied by the steering pump, item 3, Figure 9-4-4, to the steering motor, can rise towards the maximum setting of the steering motor relief valve, which is 2465 lbf/in^2 (170 bar) depending on tractor model.

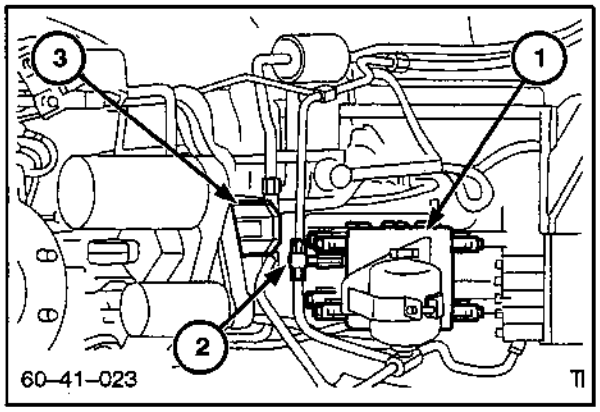


Figure 9-4-4

The pressure oil leaving the steering motor returns to the transmission side cover, item 1, Figure 9-4-4, and the regulating valve, item 2, Figure 9-4-4. The return oil then becomes the low pressure oil supply for components such as, front and rear differential locks, P.T.O. clutch and brake and front wheel drive systems, where fitted.

Steering Pump

There is no relief valve in the steering/low pressure pump. The following practical test will determine if steering pump output is sufficient to allow satisfactory operation of the steering system.

Steering Test

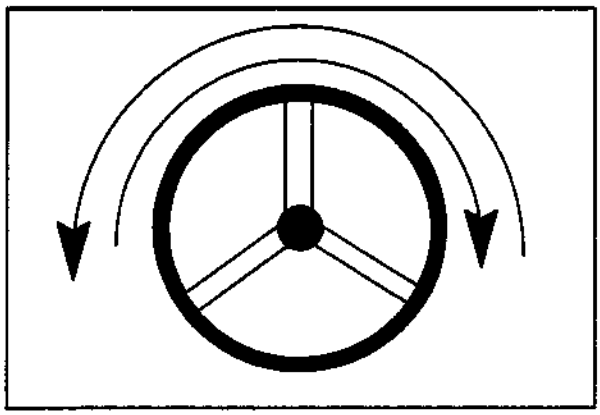


Figure 9-4-5

1. Set engine speed to 1000 rev/min.

2. Turn steering quickly from lock to lock. If steering is operating correctly the reaction of the steering should be immediate with no time delay between turning the steering wheel and movement of the wheels. At full lock the relief valve in the steering motor should be heard to blow and the engine speed should drop to approximately 970 rev/min.

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Steering Relief Valve Pressure Test

IMPORTANT: *There is no relief valve in the steering/low pressure pump and the following pressure test must only be performed as specified below. Failure to observe this precaution may result in severe damage to the hydraulic pump.*

1. Turn steering onto full left hand lock.

2. Disconnect left hand turn feed hose at steering cylinder.

3. Install a 0–6000 lbf/in^2 (0–410 bar) pressure gauge, item 1, Figure 9-4-6, using adaptor FT8503–8, item 2, Figure 9-4-6 and a locally procured 7/16 JIC male x 9/16 JIC male adaptor, item 3, Figure 9-4-6.

4. Start tractor and set engine speed to 1450 rev/min. Turn steering wheel to the left with a pull of approximately 5 ft. lbs. (22 N) and observe the pressure reading.

NOTE: *The use of a force greater than 5 ft. lbs. (22 N) at the rim of the steering wheel may lead to slightly inaccurate readings due to the pumping action of the hydrostatic steering motor.*

If the steering test was satisfactory but the pressure readings are away from specification the relief valve in the steering motor must be adjusted.

The pressure reading should be:–

2700 lbf/in^2 (186 bar) for all models.

5. If the system pressure is not to specification proceed to Relief Valve Adjustment.

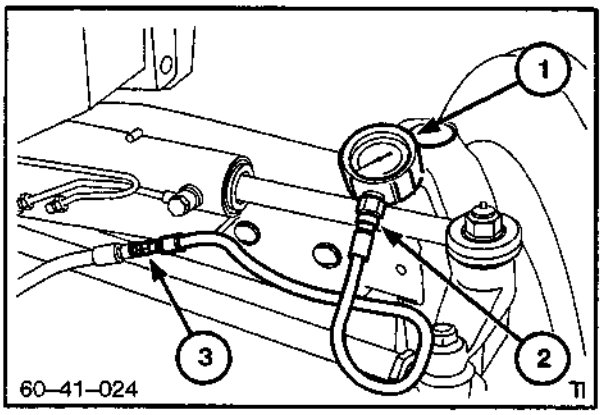


Figure 9-4-6

Differential Pressure

Differential pressure is the difference in pressure between the supply and sump ports on the steering motor. Measured (gauge) pressure is equal to the relief valve setting plus system back pressure.

System back pressure should be 1232 lbf/in^2 (6 bar) for all models.

The flow of oil on leaving the steering motor returns to the pump body for distribution to the low pressure and lubrication circuits. The pressure of oil returning from the steering motor is regulated at a pressure of 232.0 lbf/in^2 (16.0 bar), by the low pressure regulating valve at 2100 revs/min. As the pressure is regulated, excess oil in the low pressure circuit flows through the regulating valve, into an adjacent lubrication circuit relief valve which limits the pressure of oil in the lubrication circuit to 100 lbf/in^2 (7 bar).

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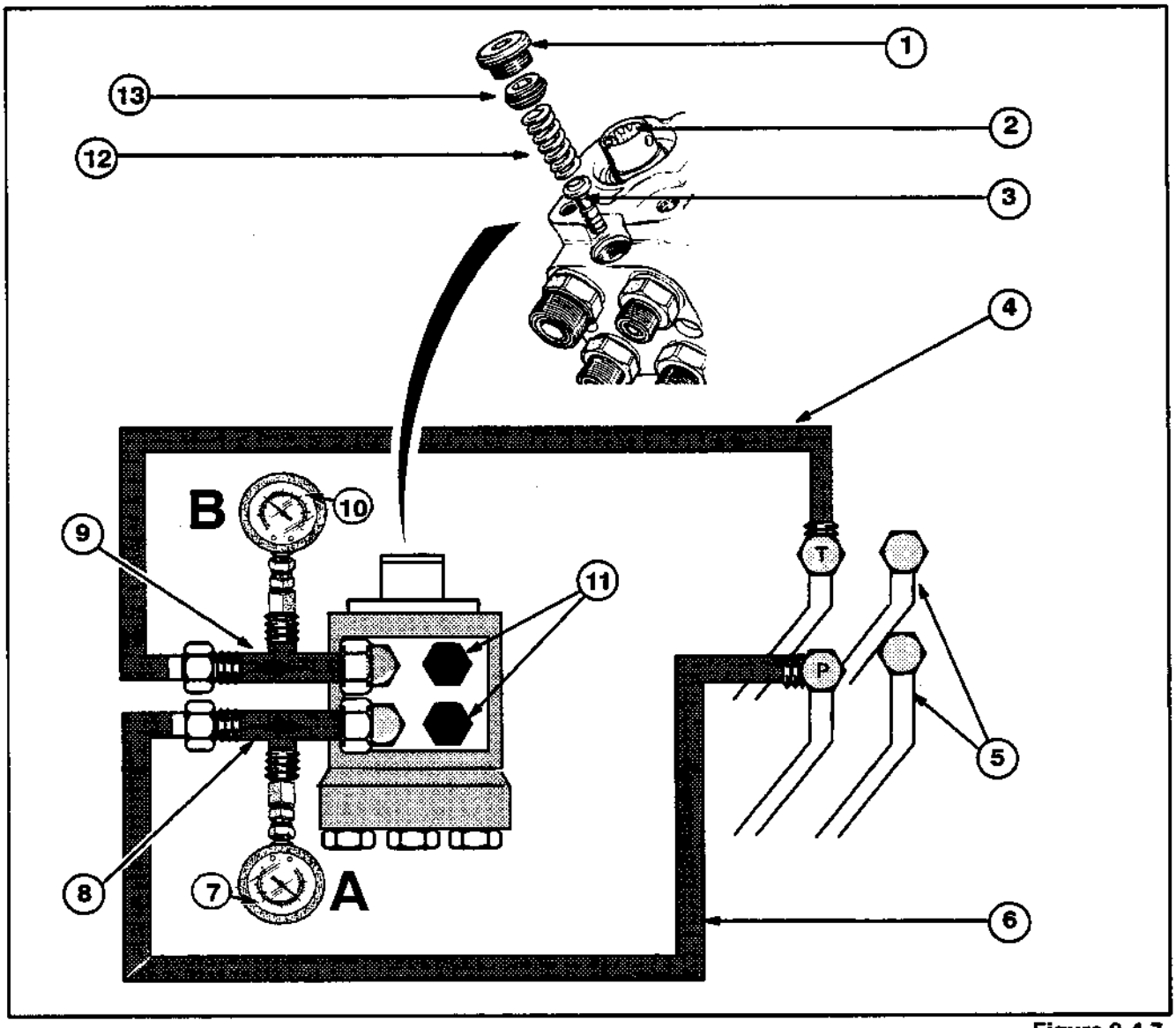


Figure 9-4-7

Steering Motor Relief Valve Adjustment

1. Plug
2. Steering Shaft
3. Relief Valve
4. Fabricated Steering Motor Output Hose
5. Tractor Tubes to Steering Cylinder
6. Fabricated Hose for Pump Supply to Steering Motor
7. Pressure Gauge 0–5000lbf/in^2 (0–340 bar)
8. Size 8 ORS Swivel Running Tee
9. Size 10 ORS Swivel Running Tee
10. Pressure Gauge 0–500lbf/in^2 (0–34 bar)
11. Size 6 ORS Blanking Cap
12. Spring
13. Adjuster

Relief Valve Adjustment – All Models

With reference to Figure 9-4-7.

NOTE: *To adjust the steering system relief valve it is necessary to remove the steering motor from the steering bracket, to gain access to the hexagon headed adjusting screw.*

1. Disconnect the steering motor from the steering bracket, as detailed later in this Chapter, and remove from the tractor.

2. Fabricate suitable test hoses to connect from the tractor pressure and return tubes. Connect the hoses into locally procured tee pieces and install pressure gauges. Start the engine and idle between 1450 and 1500 rev/min. Run the tractor until the transmission oil reaches normal working temperature of approximately 155°F (68°C).

3. With the engine running, turn the steering motor shaft to obtain full lock. The pressure gauge reading at point 'A' should read 2700 lbf/in^2 (186 bar). The gauge pressure at point 'B' should be in the region of 235 lbf/in^2 (16 bar).

4. To establish actual (differential) pressure subtract gauge 'B' reading from the gauge 'A' reading. The differential pressure should be to the specification of:

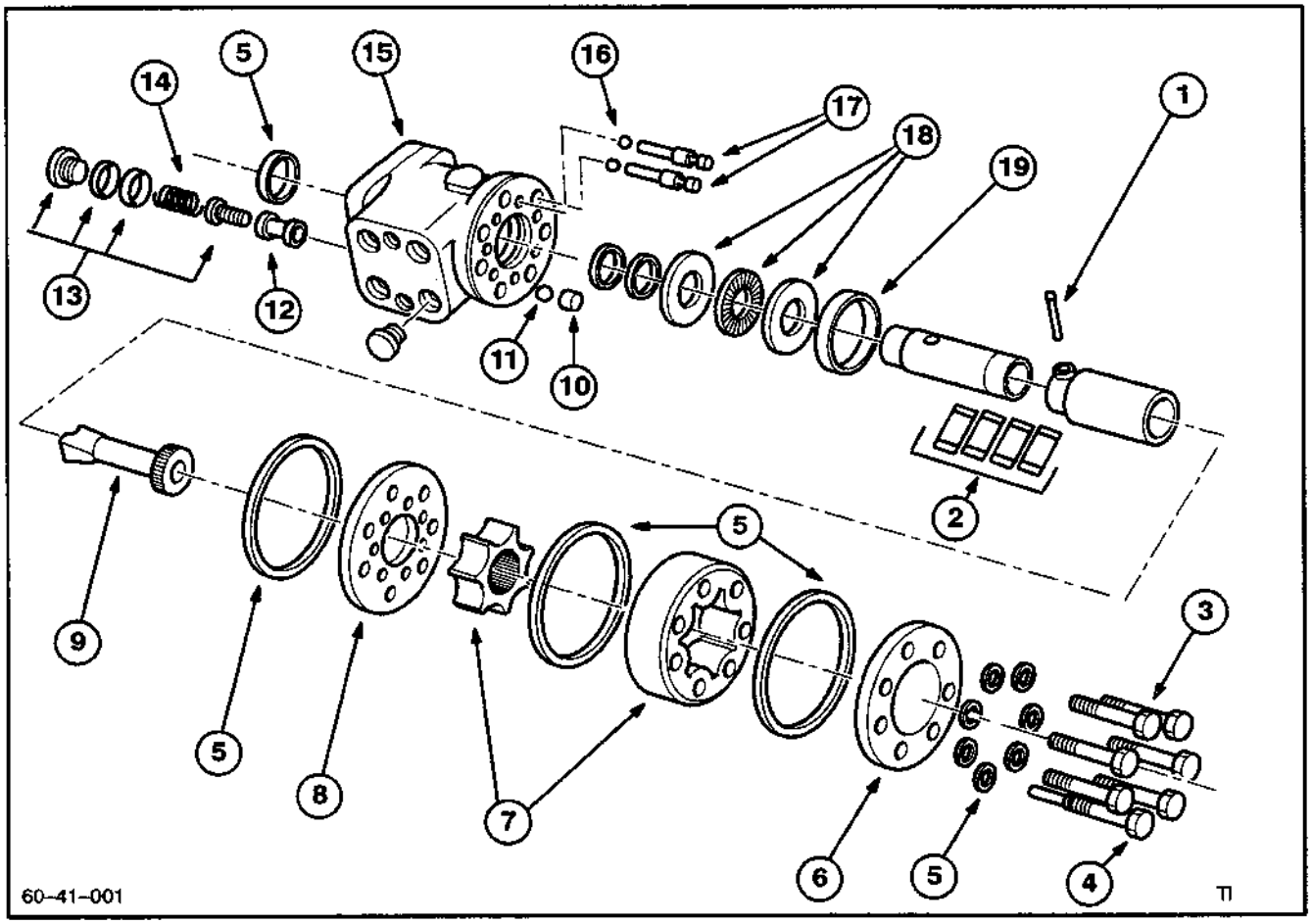
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Gauge 'A' 2700 lbf/in^2 (186 bar) minus Gauge 'B 235 lbf/in^2 (16 bar) =
2465 lbf/in^2 (170 bar) on all models

5. If the pressure readings are not correct, reset the adjuster (item 13), 9-4-7, using an 0.315 in (8mm) hexagon key. Half a turn on the adjuster equates to approximately 200 lbf/in^2 (13.8 bar).

STEERING MOTOR - OVERHAUL



Steering Motor

Figure 9-4-8

1. Pin
2. Centering Springs
3. Retaining Bolts
4. Dowel Pin Bolt
5. 'O' Ring Seal (Kit)
6. End Plate
7. Rotor and Stator Assembly
8. Manifold Plate
9. Drive Shaft
10. Retainer
11. Ball
12. Relief Valve Seat
13. Relief Valve (Kit items)
14. Spring
15. Complete Assembly
16. Ball
17. Pin
18. Thrust Bearing and Washers
19. Spacer

NOTE: *Parts/Motors are common between the two steering pumps, with the exception of items 7,10,12 and 13, Figure 9-4-8.*

Removal

1. Position the tractor on a hard level surface and apply the parking brake.

2. To gain access to the steering motor :–

   Raise the engine hood
   Remove the left hand steering column console
   Remove left hand engine side cover

3. Disconnect the four supply/return tubes and 'O' ring seals from the steering motor and cap the ends of the tubes.

4. Remove the roll pin from the drive collar to separate the steering shaft, Figure 9-4-9.

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5. Remove the four bolts at the base of the steering column and slide the steering motor from the upper section of the steering column, Figure 9-4-9.

6. Remove the steering motor from the front of the cab through the engine compartment.

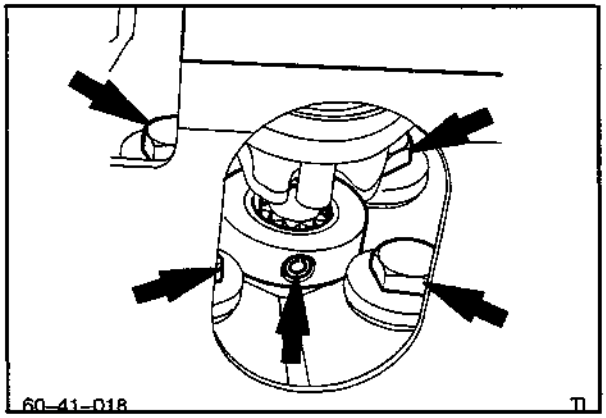


Figure 9-4-9

Disassembly

1. With the steering motor connectors removed note position of the non return valve.

2. Hold the steering motor securely in a vise using a tube connector as shown in, Figure 9-4-10.

NOTE: *The position of the pin bolt must remain the same on re–assembly.*

3. Remove the end plate bolts, end plate and 'O' ring, Figure 9-4-10.

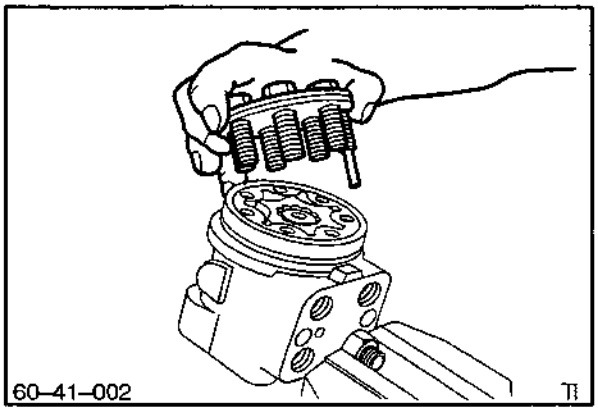


Figure 9-4-10

4. Remove metering unit, valve plate and 'O' ring seals, note mating surfaces for correct re–assembly, Figure 9-4-11.

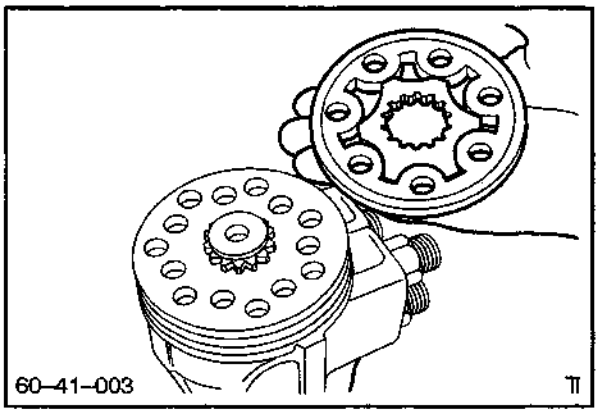


Figure 9-4-11

5. Lift out rotor drive-shaft, Figure 9-4-12.

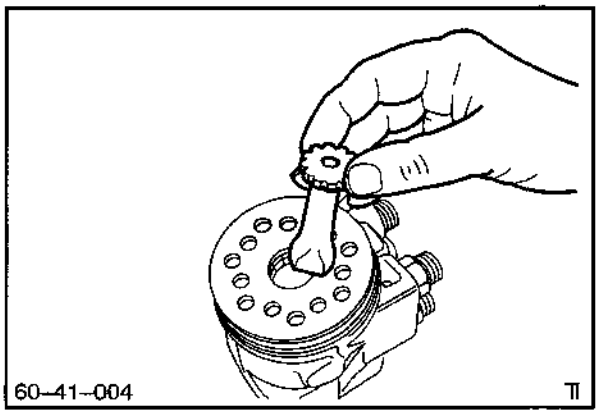


Figure 9-4-12

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6. Unscrew the check valve retainer, Figure 9-4-13 and shake out the check and suction valves.

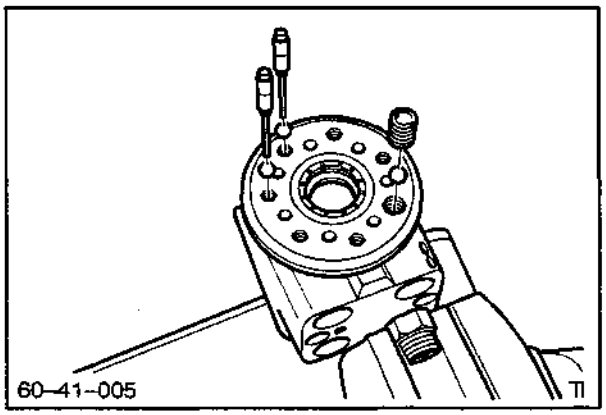


Figure 9-4-13

7. Remove the relief valve assembly, Figure 9-4-14.

IMPORTANT: *The relief valve must be set to the correct pressure setting on re–assembly. Follow the correct procedure as detailed under the heading 'Pressure relief valve setting', of this Chapter.*

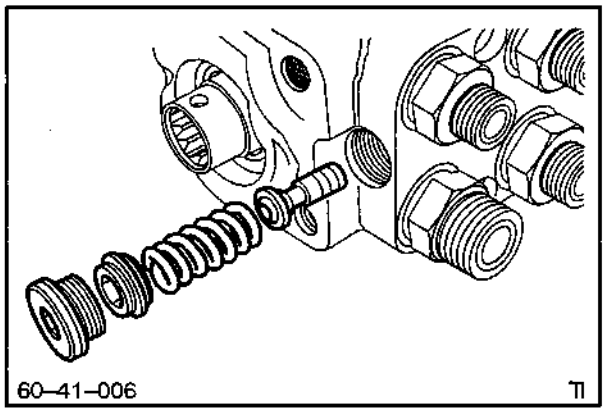


Figure 9-4-14

8. Remove the inner and outer valve sleeves, bearings and thrust washer, Figure 9-4-15.

NOTE: *When removing spool and sleeve ensure drive pin is in a horizontal position so that it cannot fall into an internal gallery and make removal difficult.*

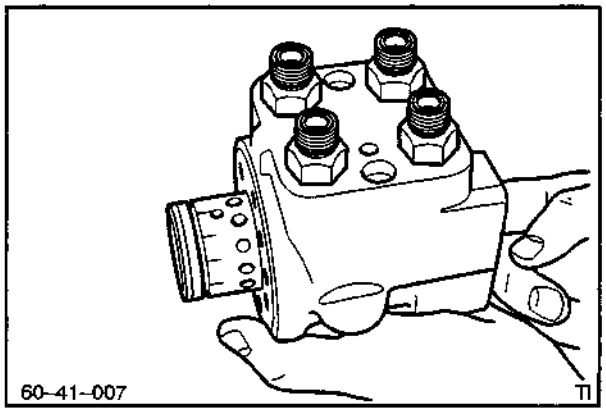


Figure 9-4-15

9. Once spool is disassembled from the body ensure oil seal is removed, Figure 9-4-16.

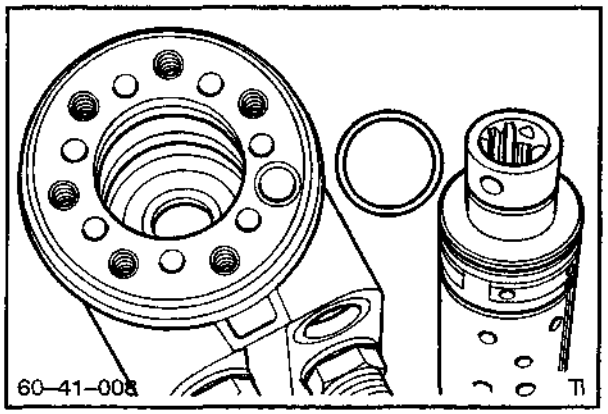


Figure 9-4-16

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IMPORTANT: *Upon re–assembly ensure washer, item 1, Figure 9-4-17 is installed with chamfer towards the valve sleeve.*

10. Remove the control valve spool and sleeve, Figure 9-4-17.

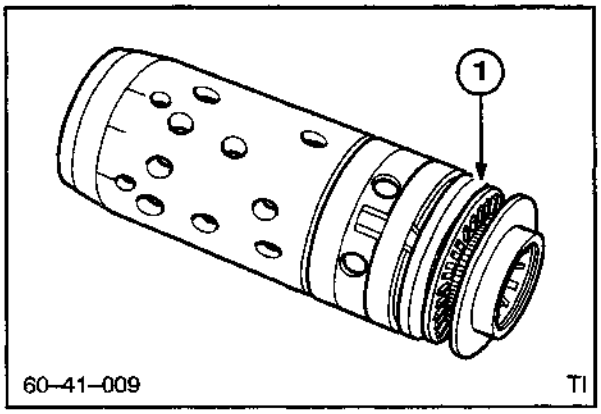


Figure 9-4-17

11. Remove centering springs, Figure 9-4-18.

NOTE: *Arrangement of the leaves must remain the same upon re–assembly.*

12. Remove drive pin, Figure 9-4-18.

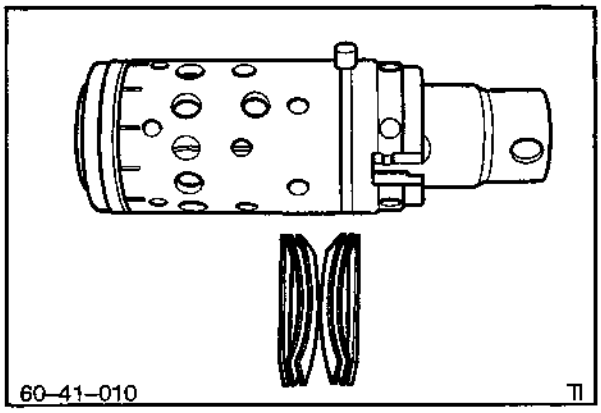


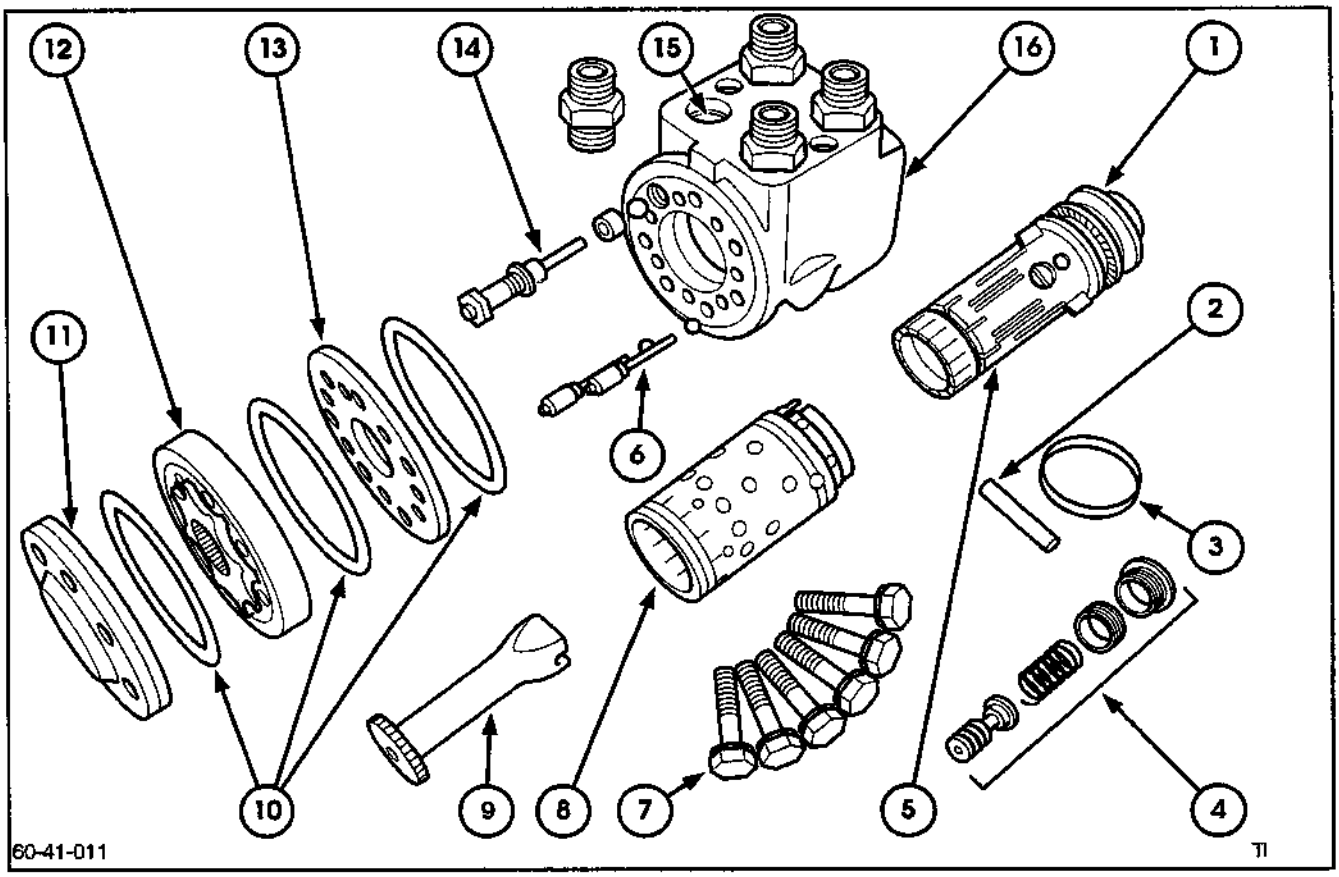
Figure 9-4-18

13. Push inner sleeve from outer sleeve.

14. Remove 'O' ring and back-up ring.

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Hydrostatic Steering Components **Figure 9-4-19**

1. Thrust Washers and Bearing
2. Drive Pin
3. Retaining Ring
4. Relief Valve
5. Control Valve Spool
6. Suction Valves
7. Bolts
8. Control Valve
9. Drive Link
10. 'O' Ring
11. End Plate
12. Metering Unit
13. Distributor Plate
14. Check Valve Bolt
15. Non Return Valve
16. Housing

Inspection

1. Wash all parts in a suitable solvent to remove any foreign particles and dry with a clean lint free cloth or compressed air.

2. Inspect valve sleeves for, damage or wear. Minor burrs or scratches can be removed with a fine abrasive. Ensure all parts are thoroughly cleaned prior to re-assembly.

3. Check leaf springs for damage. Replace if necessary.

4. Discard all 'O' ring seals and replace with new seals on re-assembly.

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Re-Assembly

1. Assemble inner and outer sleeves so that the leaf spring slots align.

2. Install the drive pin, Figure 9-4-20.

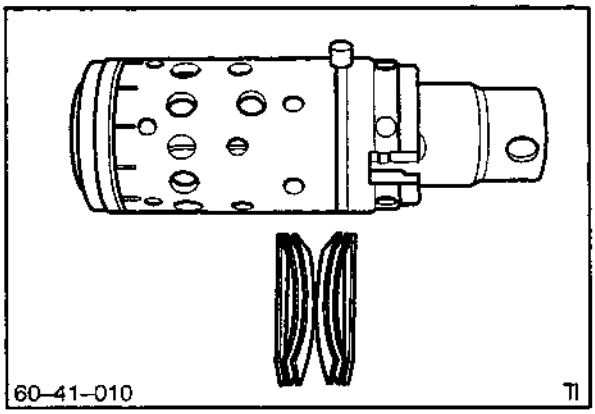


Figure 9-4-20

3. Install the leaf springs and push fully into position, Figure 9-4-21.

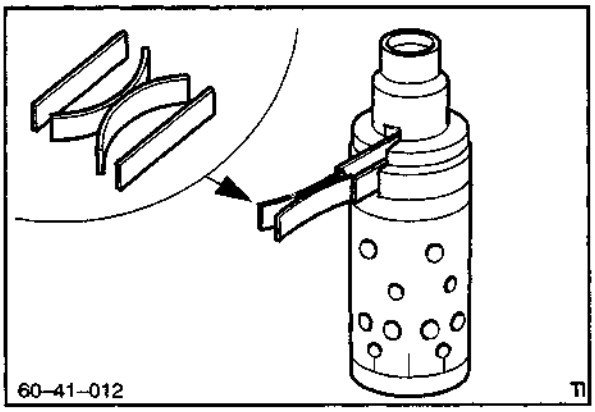


Figure 9-4-21

4. Install leaf spring retainer, and bearing, Figure 9-4-22.

NOTE: *The inner bearing race must be positioned with the chamfer side facing the spool, 9-4-17.*

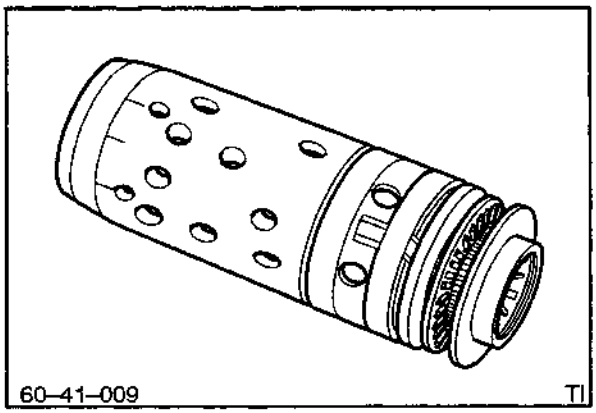


Figure 9-4-22

5. Apply a light coating of hydraulic oil onto the sleeve item 2 and insert into the steering motor body, item 3, Figure 9-4-23.

6. Coat the 'O' ring and back-up ring, item 4, Figure 9-4-23, with hydraulic fluid and position them onto the seal installer guide.

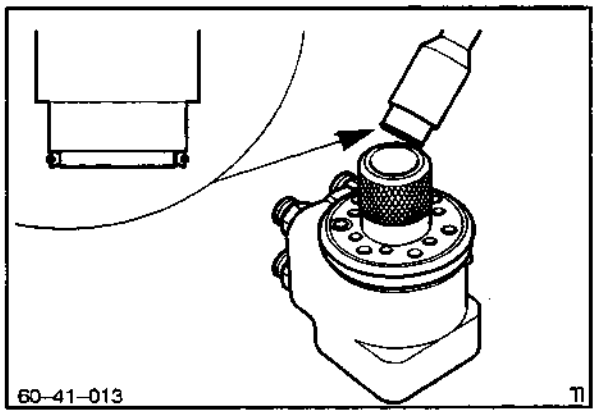


Figure 9-4-23

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7. Position the seal guide tool into the sleeve and push down with a twisting action, Figure 9-4-24.

8. Remove tools once the seal has seated.

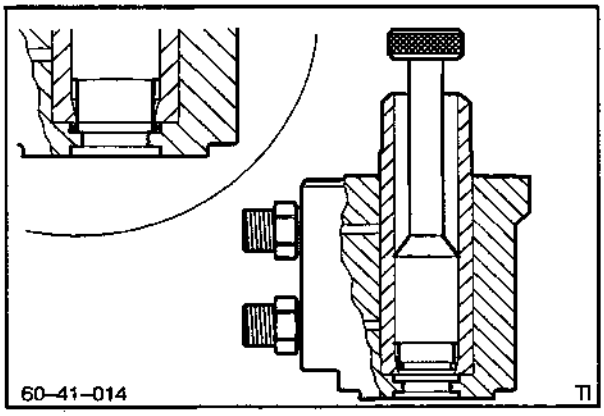


Figure 9-4-24

9. With the seal installed in the motor body refit control valve, Figure 9-4-25.

NOTE: *Ensure that the Drive is in a horizontal position to aid re–assembly.*

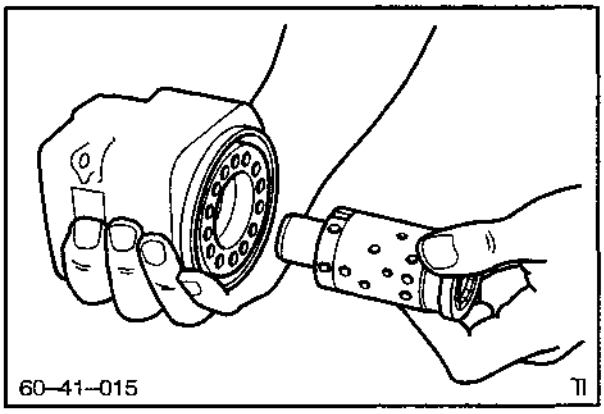


Figure 9-4-25

10. Once the control valve is seated correctly refit the check and suction valves, Figure 9-4-26.

11. Screw the check valve down to just below the surface of the housing.

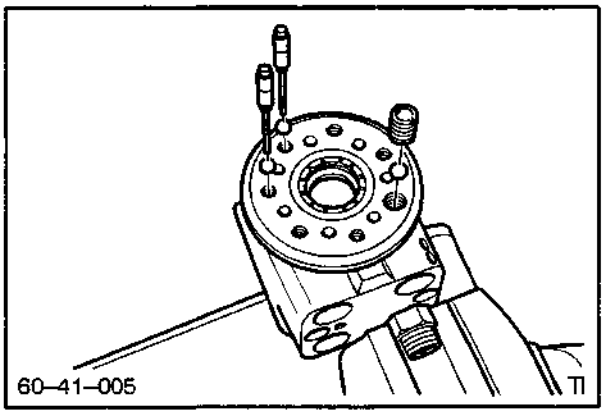


Figure 9-4-26

12. Refit the 'O' Ring and place the end plate in position.

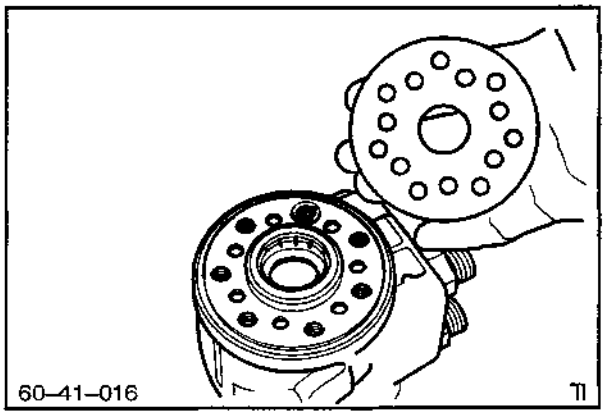


Figure 9-4-27

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Metering Unit Reassembly

1. To aid reassembly install the control valve into the housing so that the drive pin is perpendicular to the front face of the housing.

2. Install drive link into the steering motor body, Figure 9-4-28, ensuring that the link engages correctly over the drive pin.

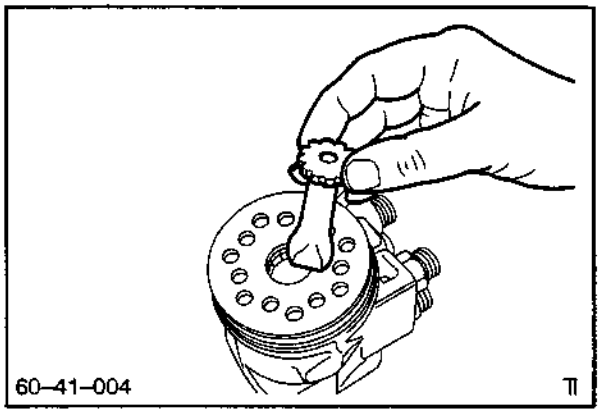


Figure 9-4-28

3. Assemble the metering unit rotor and stator and install new lightly greased 'O' rings to either side of the stator, Figure 9-4-29.

4. Assemble the rotor and stator onto the drive link.

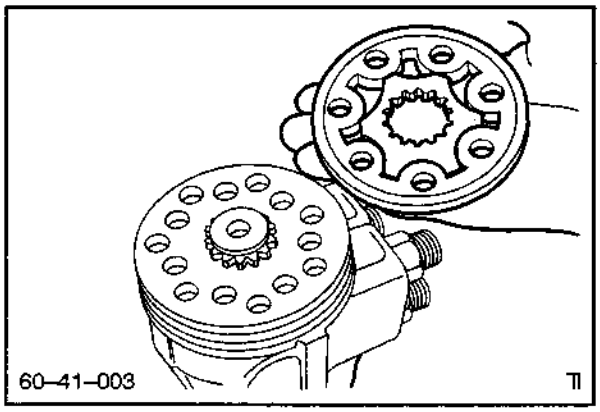


Figure 9-4-29

5. Install the end plate and bolts, ensure the pin bolt(1) is fitted in position '7'. Tighten the bolts in two steps, first to 8 ft. lbs. (10.8 Nm) and then to 21 ft. lbs. (28.4 Nm) in sequence as shown, Figure 9-4-30.

6. Install the relief valve assembly, items 1, 2 and 3 Figure 9-4-31., leaving the plug, item 4 out until after the relief valve has been adjusted.

7. Check to ensure the motor turns freely without binding.

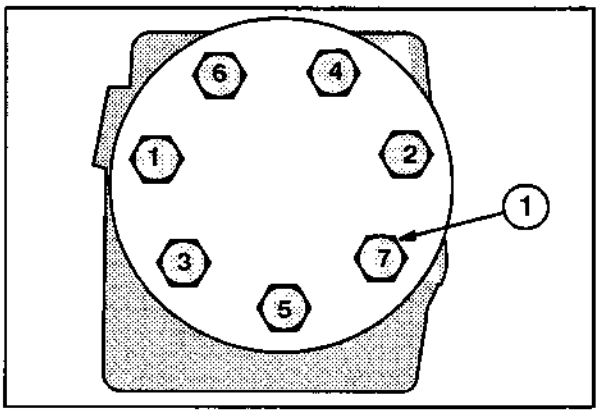


Figure 9-4-30

IMPORTANT: *The relief valve must be set to the correct pressure setting after the motor has been re-assembled. Follow the correct procedure as detailed under 'Pressure relief valve setting', of this Chapter.*

8. After the relief valve has been correctly set re–install the steering motor onto the mounting bracket and tighten the securing bolts to a torque value of 10–15 ft. lbs. (13–20Nm).

9. Reconnect the steering hoses, tighten to a torque value of 10–15 ft. lbs. (13–20Nm).

10. Purge the air from the system by operating the steering system from lock to lock until the system functions correctly.

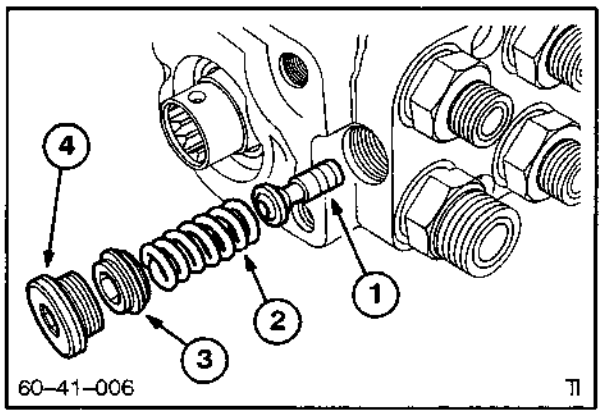


Figure 9-4-31

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STEERING COLUMN REMOVAL and INSTALLATION

NOTE: *The component parts of the steering column as listed are serviced separately.*

Removal

1. Remove the steering wheel, if required.
2. Remove the lower steering column cover complete with multi–function switches.
3. Remove the upper steering column cover on mechanical transmission models. Prior to removing the upper cover on Hi–Lo and semi–powershift models remove the shuttle lever from steering column.
4. Remove the instrument console side panels.
5. Remove the four securing bolts securing the column to the frame, Figure 9-4-32.
6. Lift the column clear of the steering shaft and clear of the instrument console, Figure 9-4-33.
7. Remove the pin from the spacer at the bottom of the column and remove the steering shaft and spacer, Figure 9-4-34.

Inspection

1. Inspect the steering shaft universal joint and lower rubber coupling. Replace if any free play is evident.
2. Inspect the column assembly, if damaged or the bushings are worn a new assembly will be required.

Installation

1. Place spacer and steering shaft onto the steering motor and install pin.
2. Carefully place the steering column through the instrument console and over the steering shaft, ensuring flat sides are aligned.
3. Replace the securing bolts at the top of the column. Tighten to 17 ft. lbs. (23 Nm).
4. Refit the upper and lower column covers and shuttle switch if fitted.
5. Refit the instrument console panels.
6. Refit the steering wheel.

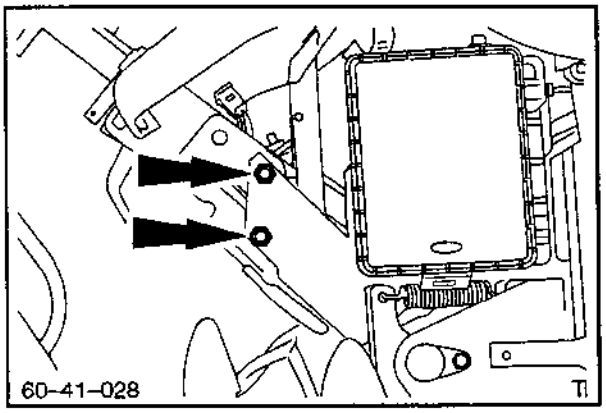


Figure 9-4-32

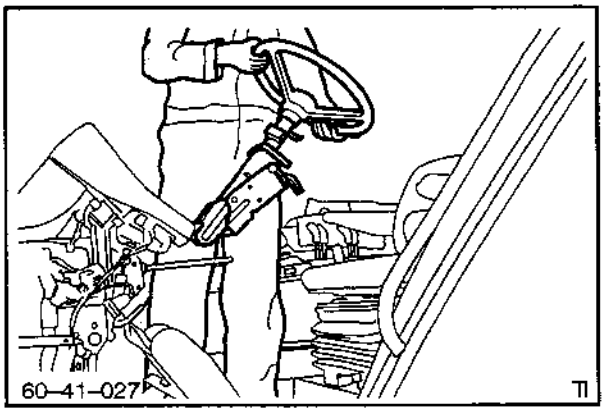


Figure 9-4-33

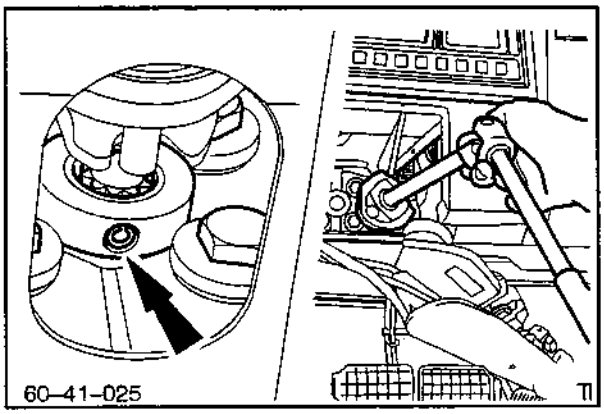


Figure 9-4-34

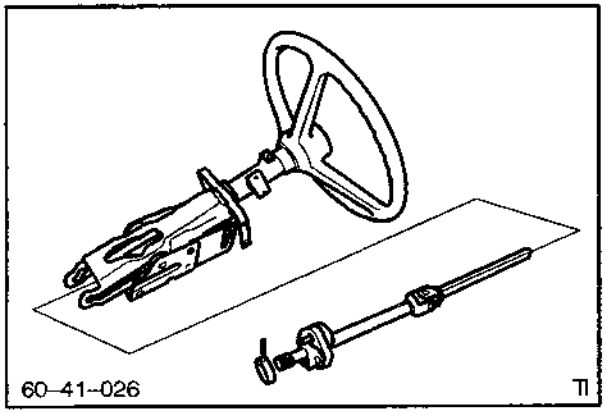
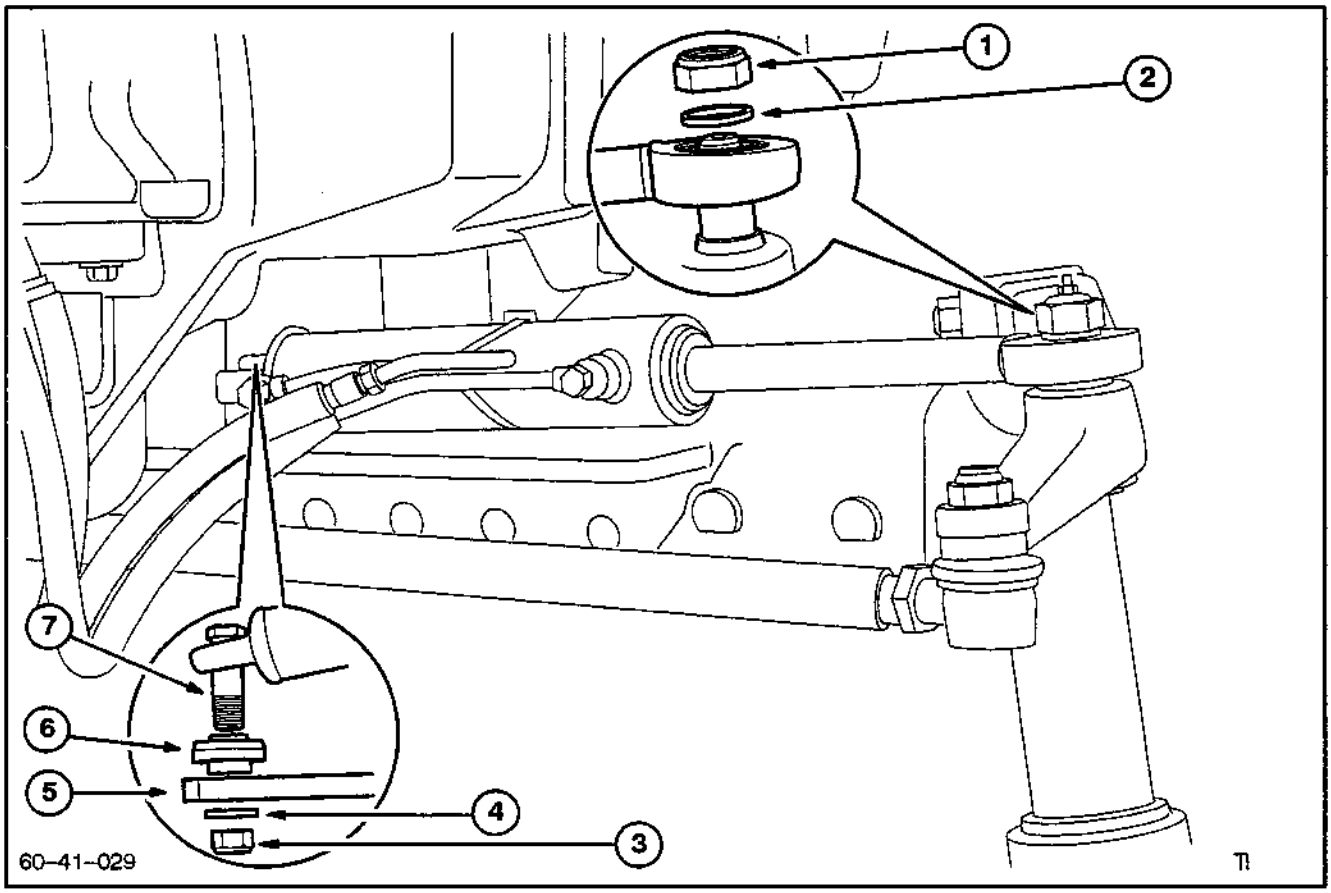


Figure 9-4-35

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TWO WHEEL DRIVE STEERING CYLINDER – REMOVAL AND INSTALLATION (Op. 41 216)



Steering Cylinder Installation – Two Wheel Drive

Figure 9-4-36

1. Nut
2. Washer
3. Nut
4. Washer
5. Cylinder Mounting Bracket
6. Spacer
7. Bolt

Removal

1. Stand the unit on a hard level surface and position the front wheel in the straight ahead position.

2. Disconnect flexible pipes, cap the open pipe ends and remove hose clamps.

NOTE: *Position of flexible pipes and orientation of connectors must be the same upon re–assembly.*

3. Remove the nut securing the cylinder rod ball joint to the steering arm and separate the joint, Figure 9-4-36.

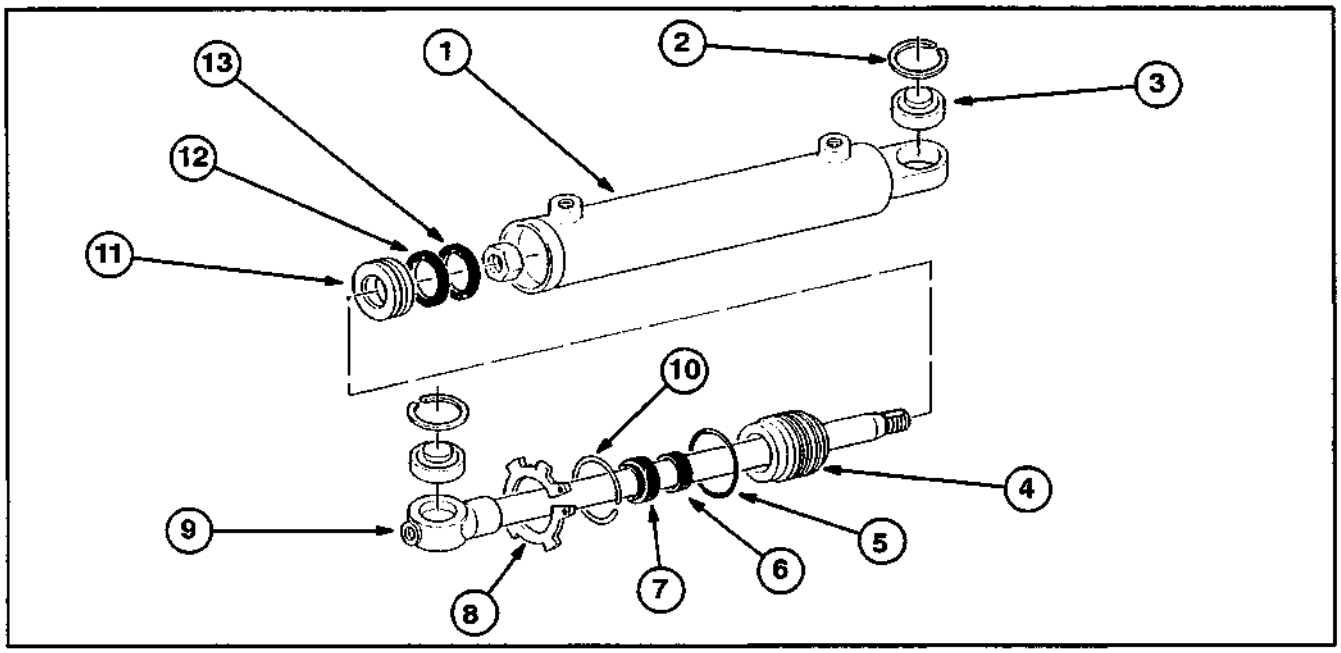
4. Remove the steering cylinder to axle pivot pin and remove the steering cylinder from the vehicle.

5. Installation is the reversal of the removal procedure.

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Steering Cylinder Overhaul – Two Wheel Drive



Steering Cylinder Assembly – Two Wheel Drive **Figure 9-4-37**

1. Cylinder
2. Lockring
3. Bearing
4. Gland
5. 'O' Ring
6. Seal
7. Wiper Seal
8. Gland Lockring
9. Cylinder Rod
10. Retaining Ring
11. Piston
12. Seal
13. Seal

1. Using appropriate circlip pliers, remove the gland lockring.

2. Using a punch, push the steering cylinder gland into the cylinder and remove the wire locking ring.

3. Pull the rod and gland assembly from the cylinder.

4. Remove the nut from the cylinder rod and disassemble to replace seals.

5. Inspect the bore of the cylinder and replace if scored.

6. Reassemble the cylinder in the reverse to disassembly, lubricating all components as assembled. Replace all seals supplied in the service seal kit.

NOTE: *The seal located in the center of the gland is replaceable.*

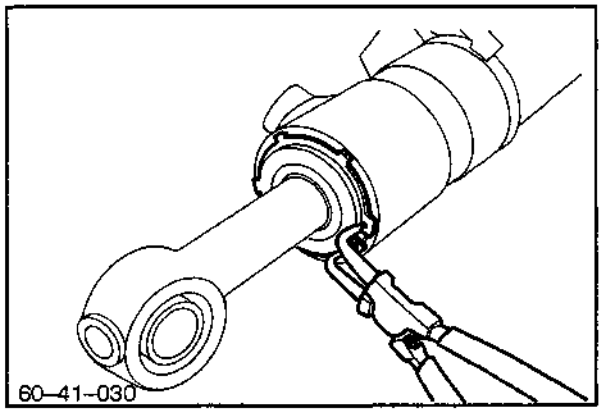


Figure 9-4-38

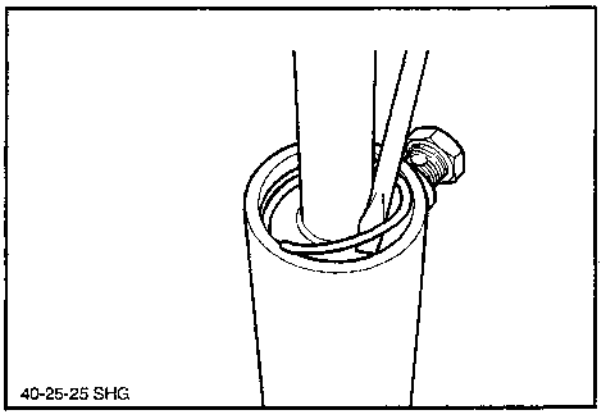
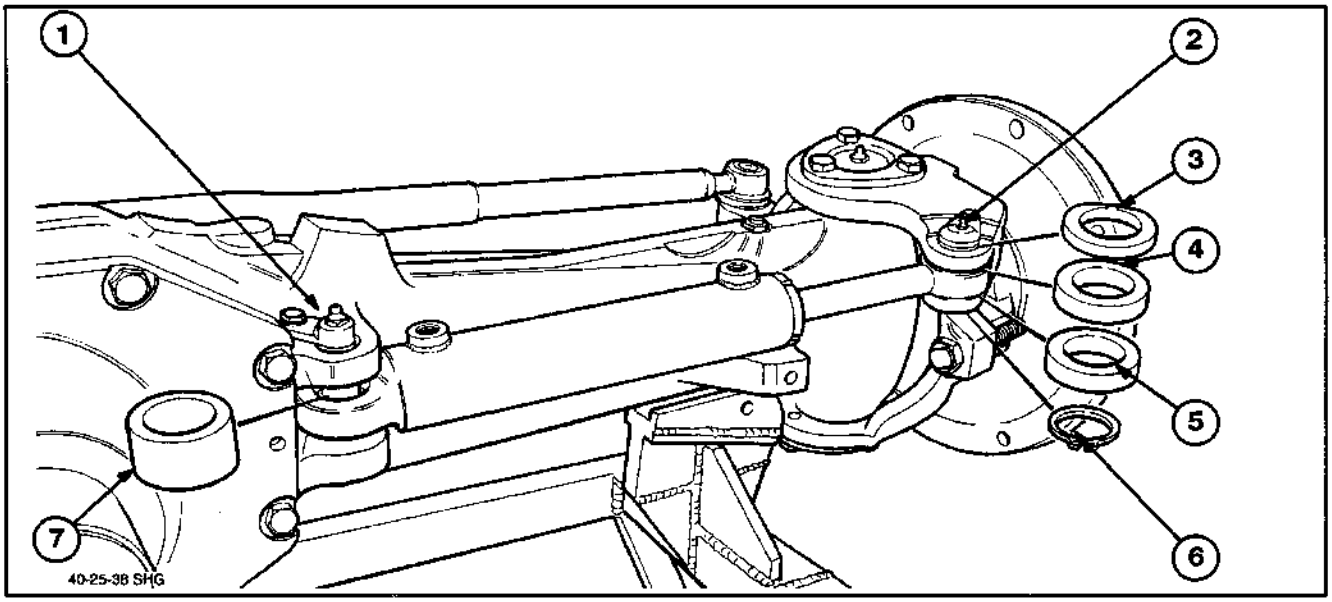


Figure 9-4-39

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FRONT WHEEL DRIVE STEERING CYLINDERS – REMOVAL AND INSTALLATION



Steering Cylinder Installation – Front Wheel Drive **Figure 9-4-40**

1. Pivot Pin
2. Pivot Pin
3. D Shaped Washer
4. Spacer
5. Circlip
6. Spacer
7. Spacer

1. Stand the unit on a hard level surface and position the front wheel in the straight ahead position.

2. Disconnect flexible pipes, cap the open pipe ends and remove hose clamps.

NOTE: *Position of flexible pipes and orientation of connectors must be the same upon re–assembly.*

3. Remove the snap ring retaining the steering arm to the cylinder piston pivot pin, item 6, Figure 9-4-40 and remove the pivot pin.

4. Remove the steering cylinder fixed end pivot pin retaining bolt and withdraw the pivot pin, item 1, Figure 9-4-40 . Remove the cylinder from the vehicle.

5. Installation is the reversal of the removal procedure.

Steering Stop Adjustment

1. Turn the wheels to full lock and adjust steering stop to ensure tires or mudguards do not touch the side of the tractor and that the steering cylinders have not reached the end of their travel.

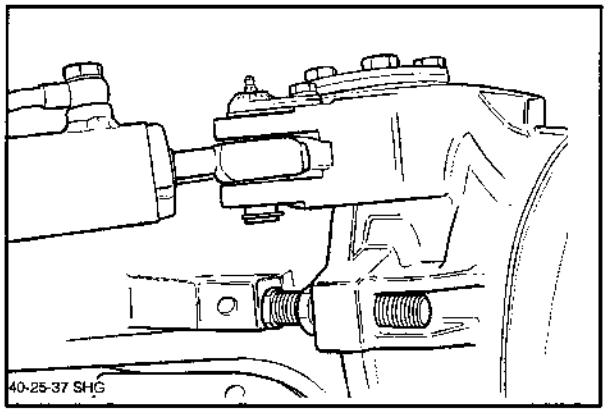
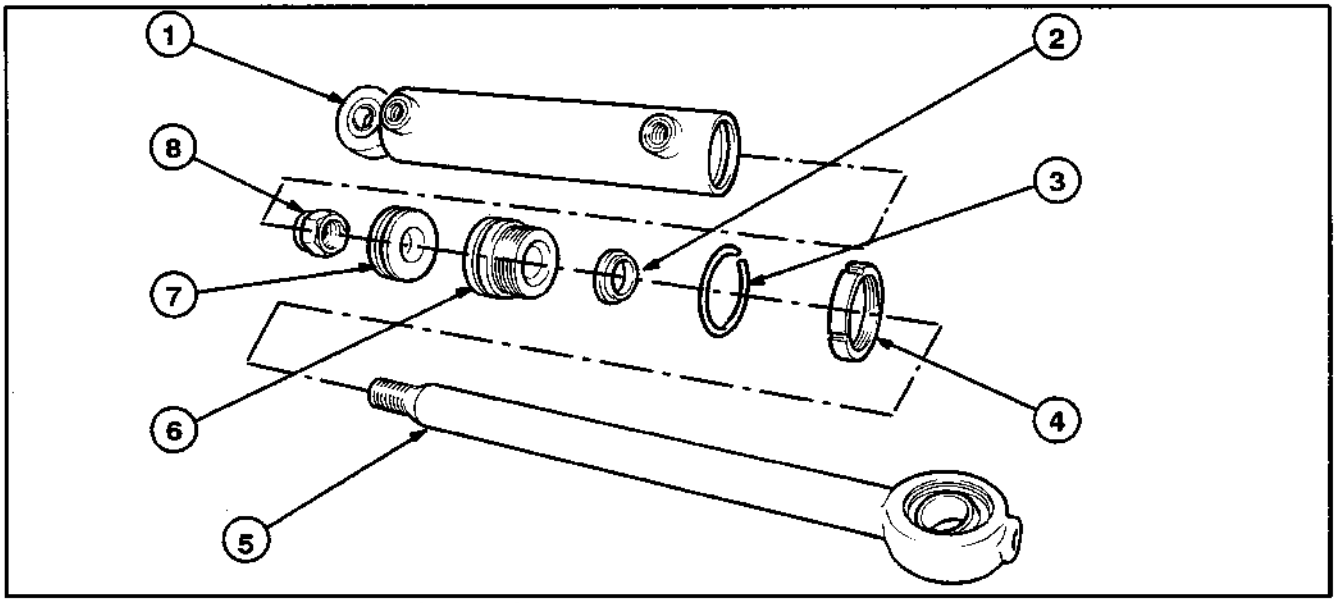


Figure 9-4-41

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Steering Cylinder Overhaul – Front Wheel Drive



Steering Cylinder Assembly – Front Wheel Drive **Figure 9-4-42**

1. Cylinder
2. Wiper Seal
3. Retaining Ring
4. Gland Nut
5. Cylinder Rod
6. Gland and Seal Assembly
7. Piston
8. Nut

1. Using appropriate 'C' wrench, unscrew and remove the gland nut.

2. Using a punch, push the steering cylinder gland into the cylinder and remove the wire locking ring.

3. Pull the rod and gland assembly from the cylinder.

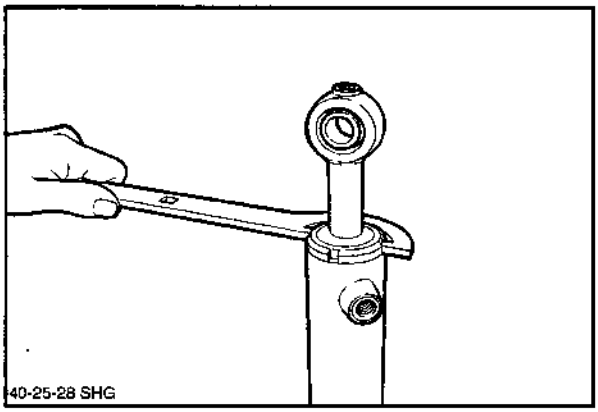


Figure 9-4-43

4. Remove the nut from the cylinder rod and disassemble to replace seals.

5. Inspect the bore of the cylinder and replace if scored.

6. Reassemble the cylinder in the reverse to disassembly, lubricating all components as assembled. Replace all seals supplied in the service seal kit.

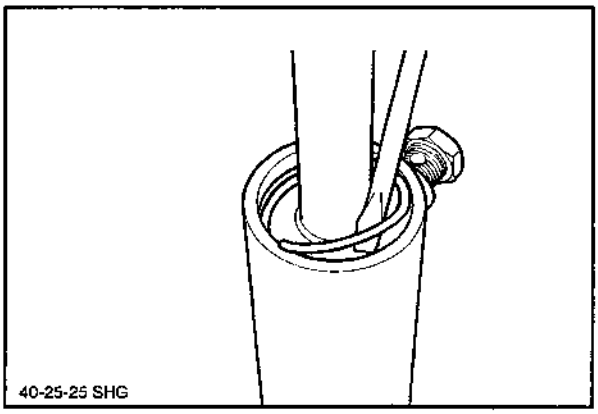


Figure 9-4-44

NOTE: *The seal located in the center of the gland is replaceable.*

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SECTION 10

CAB

CHAPTER 1

GLASS REPLACEMENT

CONTENTS

CAB, BONDED GLASS REMOVAL AND REPLACEMENT 10-1-2
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The following instructions detail the procedure for the replacement of any direct glazed (bonded) glass on New Holland tractor cabs.

The bonding kit, Figure 10-1-5, available from the Parts Depot should be used when replacing any direct glazed glass. If the bonding kit is not available use only a reputable auto glazing company to perform repairs.

REMOVAL – GLASS INTACT

⚠ WARNING ⚠

Always wear gloves and eye protectors to avoid injury from small fragments of glass.

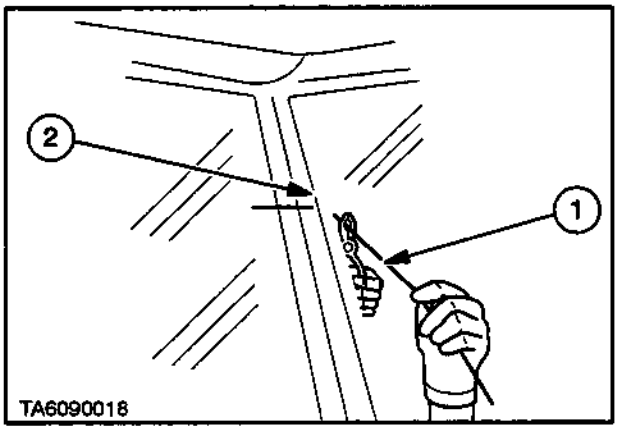


Figure 10-1-1

1. Remove exterior trim moldings – as required.

2. Remove interior trim moldings – as required.

3. Where possible remove glass support blocks as they can restrict the action of the cutting wire. Insert the cutting wire into the inner end of the tool and secure.

4. From inside the cab use a pair of pliers to push the wire (1) through the adhesive (2) between glass and frame, Figure 10-1-1.

5. Secure cutting wire (1) in external handle (2), see Figure 10-1-2.

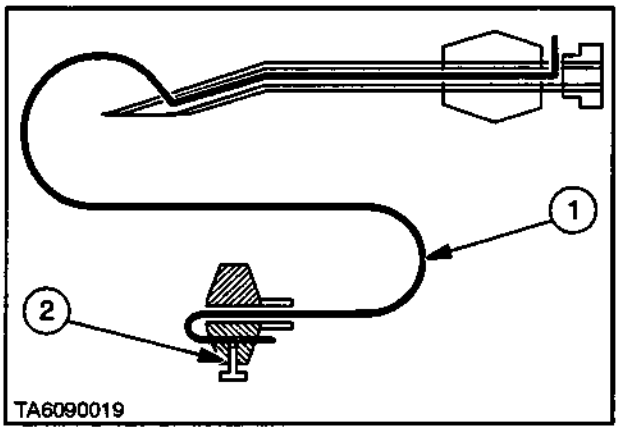


Figure 10-1-2

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6. Anchor end of tool in adhesive and pull handle, see Figure 10-1-3 (A), guiding wire close to glass edge. Pull end of tool (1) from the adhesive bead (2) and reposition further along the bead, Figure 10-1-3 (B). Use long cutting strokes on straight edges to reduce risk of wire breakage and short cutting strokes at corners to avoid breaking glass (two man operation).

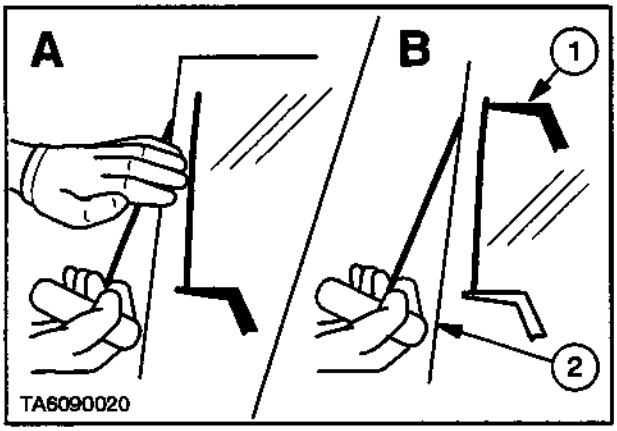


Figure 10-1-3

7. Using suction cups, lift out glass. Place outer surface of glass face down on a protected surface.

8. Taking care not to damage the frame, cut away adhesive (1) to leave a smooth bevel of approximately 0.079 in (2.0 mm), see Figure 10-1-4.

NOTE: *It is not necessary to remove all residual material from the frame.*

9. Repeat Number 8, above, for glass clean up procedure.

REMOVAL – GLASS BROKEN

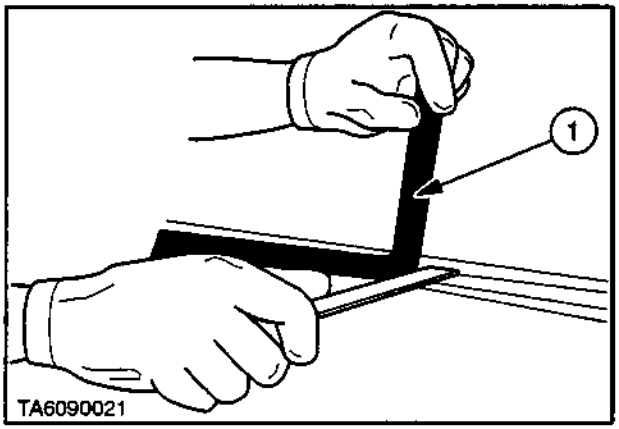


Figure 10-1-4

1. Remove exterior trim moldings – as required.

2. Remove interior trim moldings – as required.

3. Where possible remove glass support blocks as they can restrict the action of the cutting knife.

4. Taking care not to damage frame cut away adhesive to leave a smooth bevel of approximately 0.079 in (2.0 mm), see Figure 10-1-4.

NOTE: *It is not necessary to remove all residual material from the frame.*

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REPLACEMENT – NEW GLASS

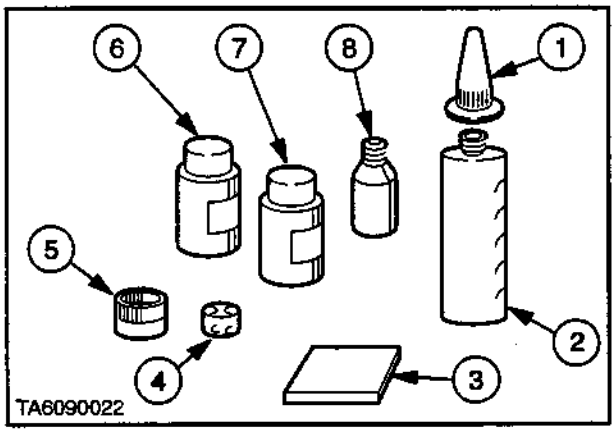


Figure 10-1-5

Kit Contents (Figure 10-1-5)

1. Applicator Nozle
2. Adhesive
3. Tissue
4. Felt Pad
5. Applicator
6. Activator
7. Primer
8. Applicator Bottle

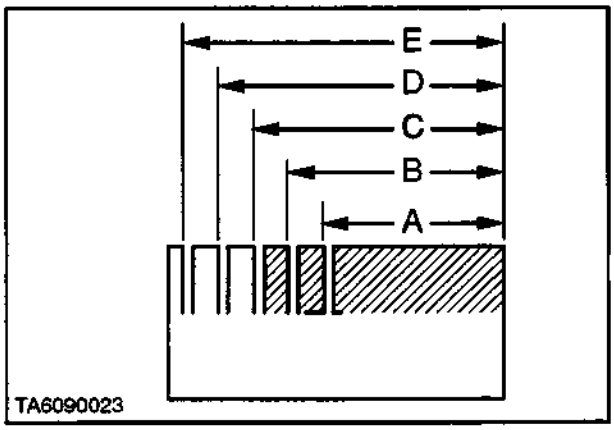


Figure 10-1-6

1. Apply the activator to the edge of the glass (adhesive contact area) with the clean tissue provided. Allow to dry.

2. Shake the bottle of glass primer for 60 seconds. Pour into applicator bottle.

3. Trim the applicator to dimension 'C' in Figure 10-1-6, and insert the felt pad.

4. Screw the applicator to the applicator bottle.

5. Apply the primer (2) to the previously prepared area of glass (1), Figure 10-1-7.

6. Allow 15 mins to dry.

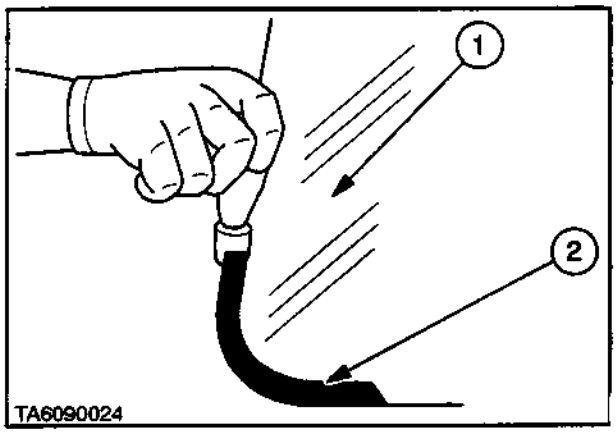


Figure 10-1-7

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7. Using a sharp knife, cut off the end of the adhesive applicator (1) and cut a 'V' (2) in the end of the nozzle, as shown in Figure 10-1-8. All dimensions shown in millimeters.

8. Apply a smooth continuous bead of adhesive to the glass (or Frame)

   NOTE: *It is difficult to fill in spaces to the correct profile. Ensure that joints are formed correctly to avoid water leaks.*

9. Fit glass support blocks in position.

10. Lift glass into position with suction cups.

11. Fit lower glass support blocks.

12. Press glass into frame to ensure good contact of adhesive bead.

13. Replace exterior trim moldings – as required.

14. Replace interior trim moldings – as required.

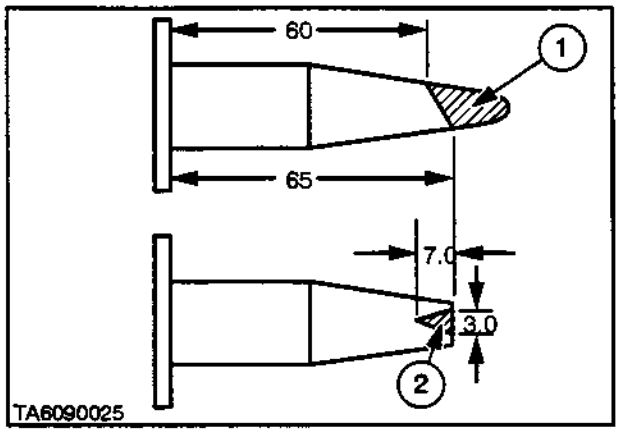


Figure 10-1-8

REPLACEMENT – EXISTING GLASS

1. Using a sharp knife, cut off the end of the adhesive applicator (1) and cut a 'V' (2) in the end of the nozzle, as shown in Figure 10-1-8. All dimensions shown in millimeters.

2. Apply a smooth, continuous bead of adhesive to glass (or frame).

   NOTE: *It is difficult to fill in spaces to the correct profile. Ensure that joints are formed correctly to avoid water leaks.*

3. Fit glass support blocks in position.

4. Lift glass into position with suction cups.

5. Fit lower glass support blocks.

6. Press glass into frame to ensure good contact of adhesive bead.

7. Replace exterior trim moldings – as required.

8. Replace interior trim moldings – as required.

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SECTION 10

CAB

CHAPTER 2

CAB INTERIOR COMPONENTS

CONTENTS

CAB TRIM REMOVAL AND INSTALLATION 10-2-2
HEATER BLOWER MOTOR REMOVAL AND INSTALLATION 10-2-5
WIPER MOTORS REMOVAL AND INSTALLATION 10-2-6
INDEX 10-3-54

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Steering Column side Covers – Figure 10-2-1

1. To remove, unscrew the two knobs items 1 and 2 and lift out the panel.

2. Replacement is the reversal of removal.

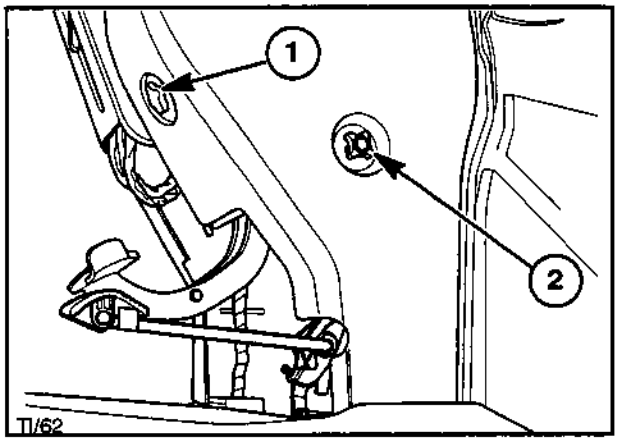


Figure 10-2-1

Floor Pan Removal and Installation – Figure 10-2-2

1. Lift and remove the rubber mat.

2. Remove the thirteen retaining bolts and lift the floor panel out.

3. Replacement is the reversal of removal.

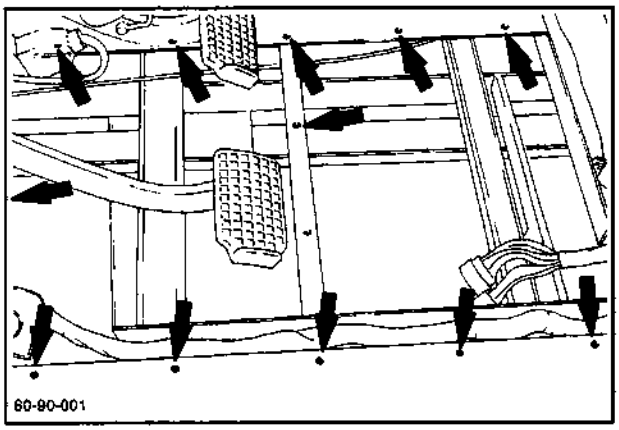


Figure 10-2-2

Pillar Trim Removal – Figure 10-2-3

1. Carefully pry the trim near each retaining clip and lift away from pillar.

NOTE: *If trailer air brakes are fitted disconnect wiring to pressure gauge when removing the left hand trim.*

2. Replacement is the reversal of removal.

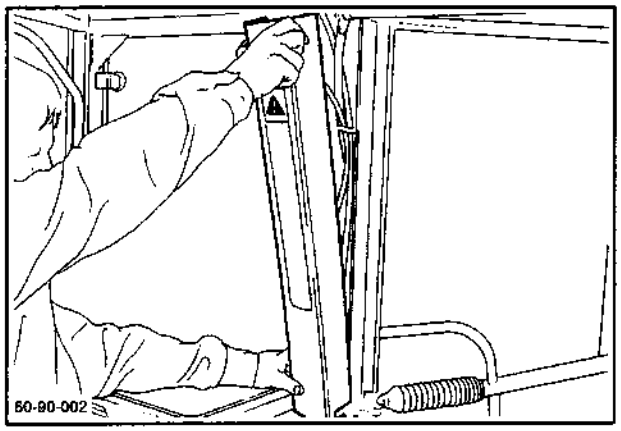


Figure 10-2-3

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Heater Control Panel – Figure 10-2-4

1. Carefully pry the trim near each retaining clip, lower the panel slightly and disconnect wiring to switches and heater control rod.

2. Replacement is the reversal of removal.

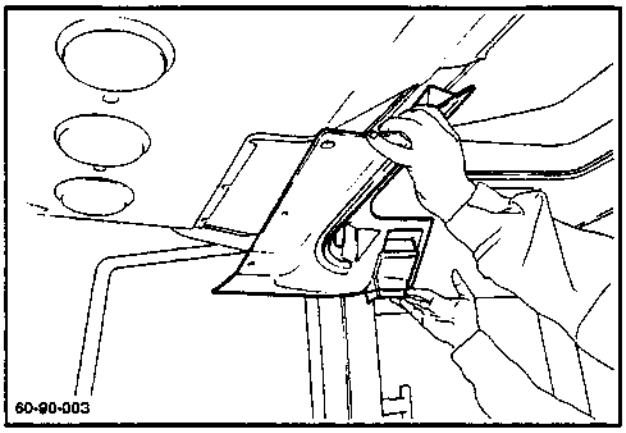


Figure 10-2-4

Cab Roof Trim – Figure 10-2-5

1. Remove the interior light.

2. Carefully pry the trim near the retaining clips, with the trim slightly lowered, disconnect wiring from radio speakers.

3. Replacement is the reversal of removal.

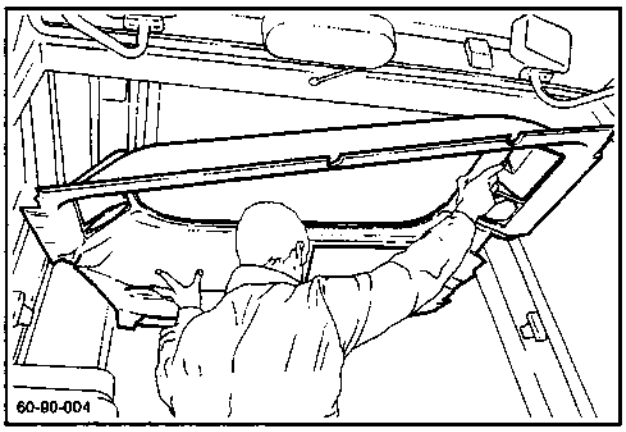


Figure 10-2-5

Left Hand Trim :–

1. Remove passenger seat, Figure 10-2-6.

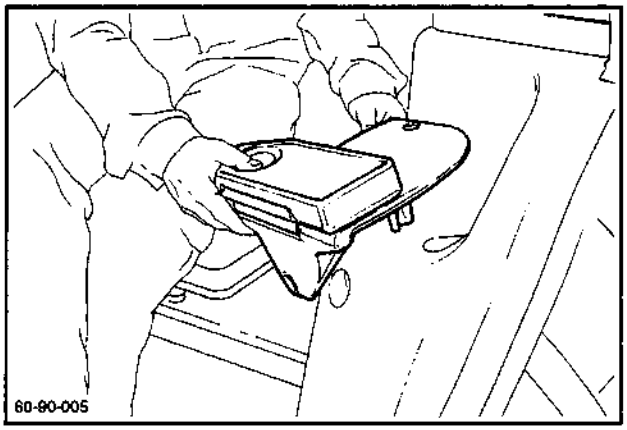


Figure 10-2-6

2. Remove storage box, Figure 10-2-7.

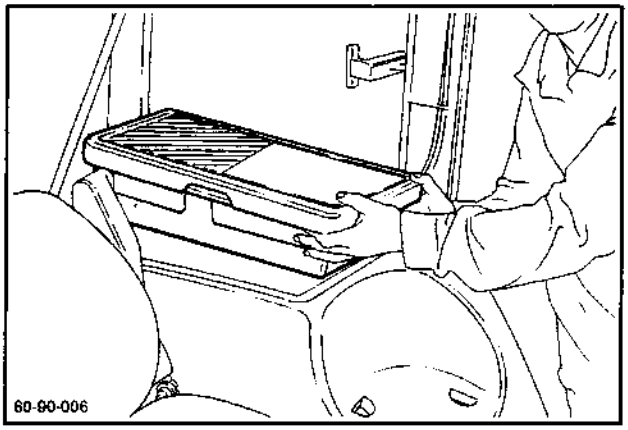


Figure 10-2-7

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3. Carefully unclip the foam from the cab frame and remove the left hand trim panel, Figure 10-2-8.

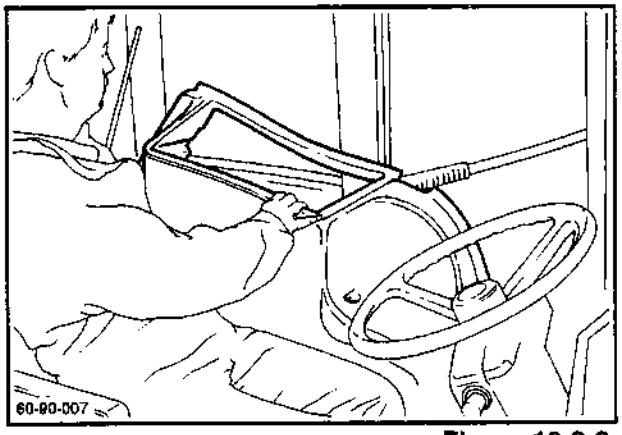


Figure 10-2-8

Right Hand Trim:–

1. Remove control knobs from:
   - Remote valves
   - P.T.O. range lever
   - Hand throttle
   - Hydraulic lift levers

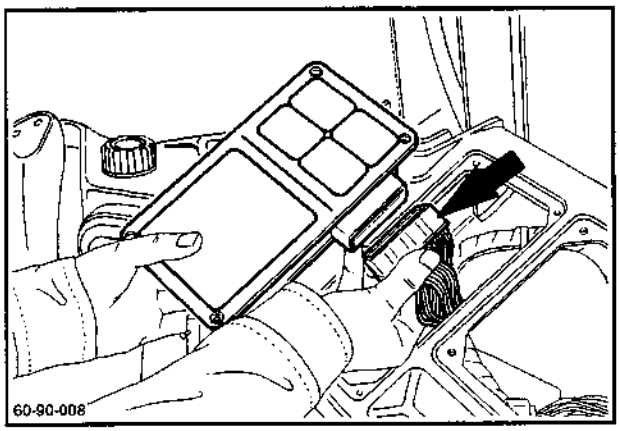


Figure 10-2-9

2. Remove the electronic management unit and electronic draft control panels, Figure 10-2-9 and Figure 10-2-10.

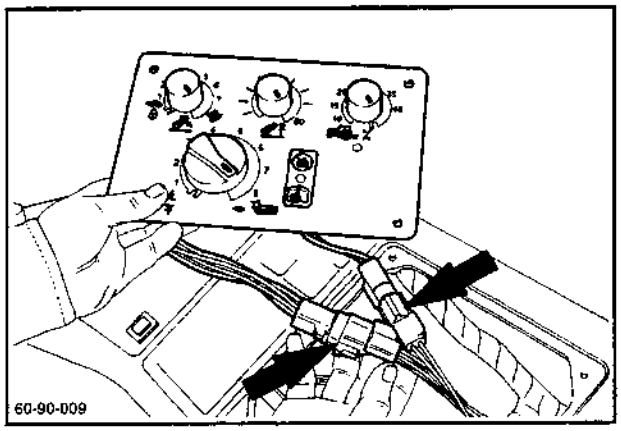


Figure 10-2-10

3. Remove the two bolts, located in the top right hand corner of the console, securing the console to the cab. Remove the transmission display and control handle if the semi–powershift transmission is fitted.

Carefully lift the panel away, disconnecting and noting wire connections, Figure 10-2-11.

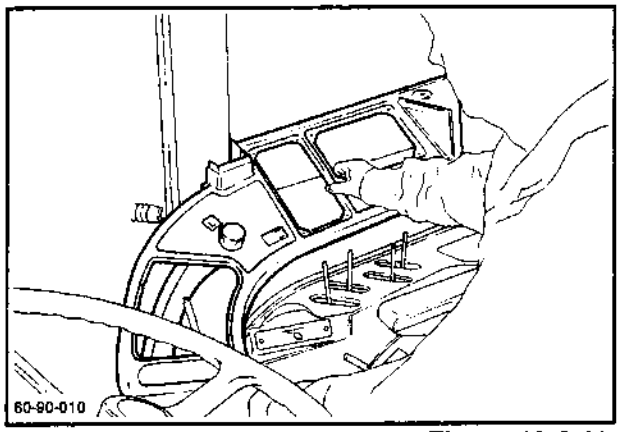


Figure 10-2-11

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4. Remove the front right hand trim panel, secured in position by two floor screws, Figure 10-2-12.

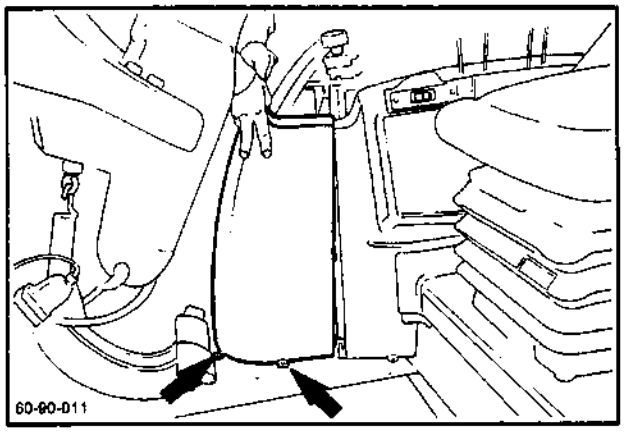


Figure 10-2-12

5. Remove the right hand rear lower panel, lifting over hydraulic lift lever, Figure 10-2-13.

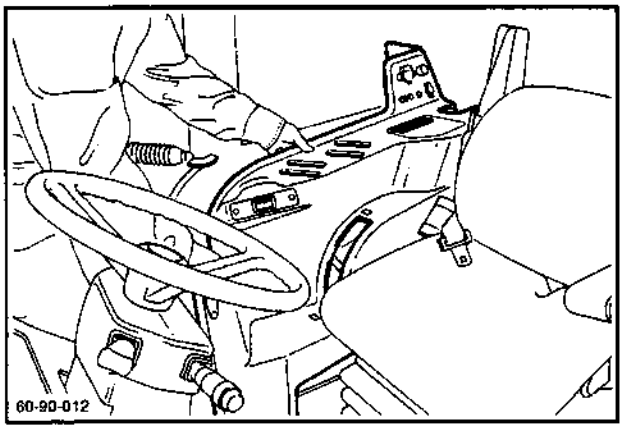


Figure 10-2-13

6. Carefully unclip the right hand foam panel and remove, Figure 10-2-14.

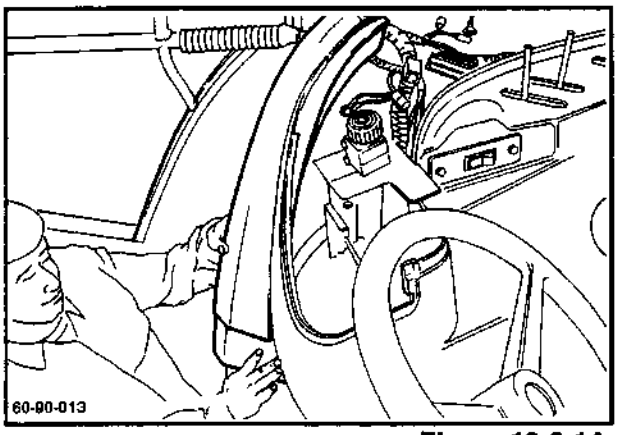


Figure 10-2-14

Heater Blower Motor Removal and Installation

1. Remove the front outer roof panel.

2. Disconnect wiring connector, remove the four motor retaining bolts and withdraw the motor from the top of the roof, Figure 10-2-15.

3. Reassembly is the reverse of removal.

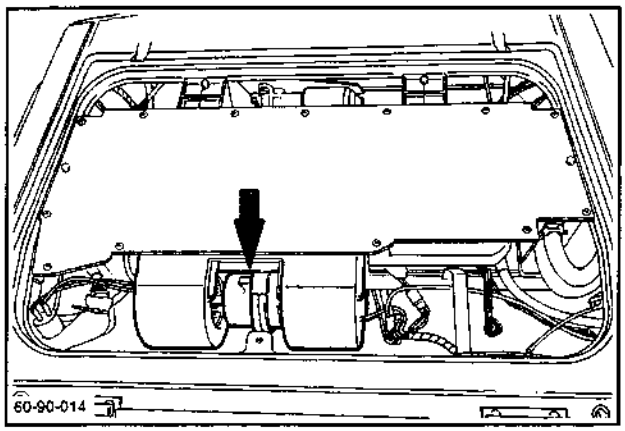


Figure 10-2-15

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Front Wiper Motor – Removal & Installation

NOTE: *The motor is serviced as an assembly only. A fault within the motor will require a complete motor replacement.*

1. Remove the front outer roof panel.
2. Disconnect the wiring connector to the motor.
3. Remove the wiper blade and remove the nut securing the motor drive shaft to the windscreen/bracket.
4. Remove the three bolts from inside the cab roof securing the motor to the bracket and withdraw the motor.
5. Reassembly is the reverse of removal.

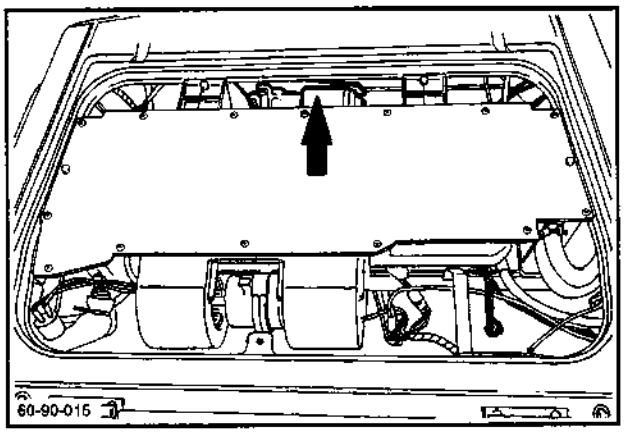


Figure 10-2-16

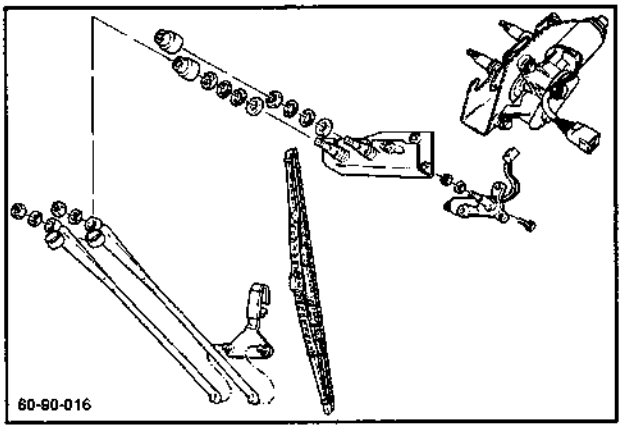


Figure 10-2-17

Rear Wiper Motor – Removal & Installation

NOTE: *The motor is serviced as an assembly only. A fault within the motor will require a complete motor replacement.*

1. Remove plastic shroud from motor assembly.
2. Carefully pull/pry down rubber grommet in cab frame and extract wire from roof and disconnect.
3. Remove wiper blade.
4. Remove nut from wiper motor drive shaft (1) and nut securing wiper motor assembly to glass, (3) Figure 10-2-18, withdraw assembly from tractor.
5. Remove the two bolts retaining the motor to the bracket, (2) Figure 10-2-18.
6. Reassembly is the reverse of removal.

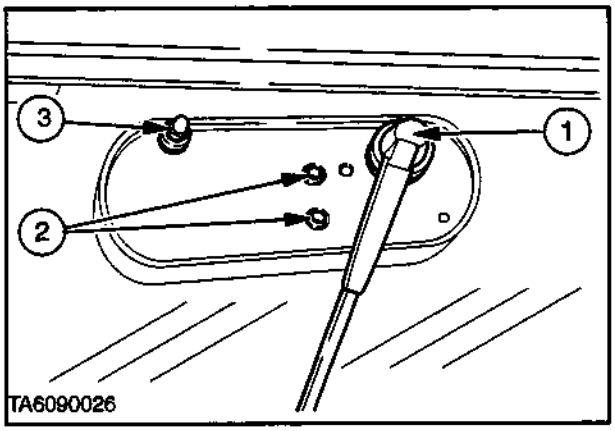


Figure 10-2-18

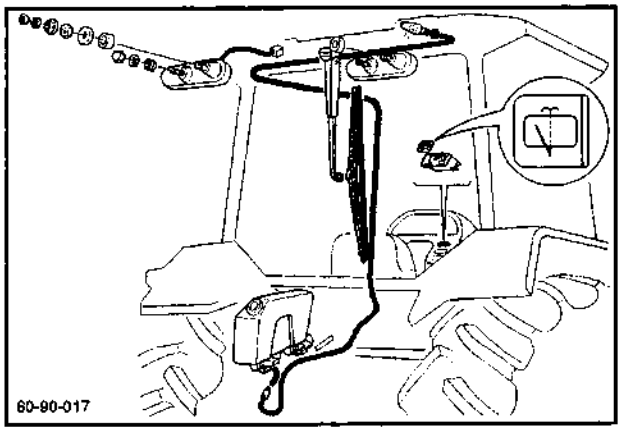


Figure 10-2-19

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SECTION 10

CAB

CHAPTER 3

AIR CONDITIONING

CONTENTS

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SPECIAL TOOLS 10-3-3
SAFETY PRECAUTIONS 10-3-3
DESCRIPTION AND OPERATION 10-3-4
FAULT FINDING AND SYSTEM TESTING 10-3-15
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SPECIFICATIONS

Refrigerant Specification	R134a
Refrigerant Charge	3.1 lbs (1.4 kg)
Compressor Oil Specifications	PAG Type (ISO 100 Viscosity) Sanden SP20
Refrigerant Oil Capacity (Compressor and system)	11.3in^3–13.9 in^3 (6.3 oz–7.7 oz) 186 cc–228 cc

Cooling capacity @ 75° F – 120°F (22° C – 49° C) ambient. 4.5 kW Typical
(Actual capacity dependent on system control operator settings)

Combined High/Low Pressure Switch (Mounted Adjacent to Compressor)

Low Pressure Switch	
On	29.9 lbf/in^2 (2.06 bar)
Off	28.4 lbf/in^2 (1.96 bar)
High pressure switch	
On	299 lbf/in^2 (21 bar)
Off	384 lbf/in^2 (26 bar)

Low Pressure Cut Out Switch (Mounted in Cab Roof)

On	34 lbf/in^2 (2.3 bar)
Off	10 lbf/in^2 (0.7 bar)

Temperature Cycling Control Switch

Switch Setting	On	Off
Minimum Cooling	70°F (21° C)	64°F (18° C)
Maximum Cooling	40°F (5° C)	36°F (2° C)

COMPRESSOR

Manufacturer and Type	Sanden SD7H15 (model 7890)
Compressor Clutch and Pulley Air Gap	0.016 and 0.031" (0.4–0.8 mm)
Drive Belt Tension	Automatic Belt Tensioner

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TORQUE

Compressor Cylinder Head Bolts		18–19.5 ft. lbs. (24.5–26.5 Nm)
Compressor Clutch Front Plate retaining Bolt		8–10 ft. lbs. (11.0–14.0 Nm)
Self–sealing Couplings	small	29–40 ft. lbs. (40–54 Nm)
	large	40–50 ft. lbs. (54–68 Nm)
Compressor Mounting Bolts		15–19 ft. lbs. (20.5–25.5 Nm)

SPECIAL TOOLS

Certified Refrigerant Recover,Recycling and Recharge Equipment suitable for the type of refrigerant gas used on tractor are required when servicing air conditioning systems.

This special equipment is available through recognized suppliers of air conditioning equipment. Refer to the Tool supplier for details on the latest equipment available for servicing the air conditioning system.

Vacuum/charge Portable system	
Recovey/recharge Portable system	
Evaporator and condenser cleaner	
Expansion valve tape	
Electronic Gas Leak Detector	
Manifold Gauge Set (Where required)	FNH00172
Quick Release Coupling Tool	FNH00890
COMPRESSOR TOOLS:	
Sanden SDH715 Klt	FNH02343B

SAFETY PRECAUTIONS

WARNING

Before overhauling an air conditioning system read and observe the following Safety PrecautionsIf a repair or replacement becomes necessary, ensure that only certified Air Conditioning technicians are employed, using approved equipment to effect repairs. Do ***not*** *attempt to disassemble the air conditioning system, It is possible to be* ***severely frostbitten or injured*** *by escaping refrigerant.*

IMPORTANT: *Do* ***not*** *allow refrigerant to escape into the atmosphere.*

Refrigerant must be handled with care in order to AVOID HAZARDS.

Undue direct contact with liquid refrigerant can produce freezing of skin and eyes.

Keep the refrigerant container and air conditioning system away from flame or heat sources, the resulting pressure increase can cause the container or system to explode.

If in direct contact with open flames or heated metal surfaces, the refrigerant will decompose and produce products that are toxic and acidic.

Make sure to comply with the following indications and simple precautions to avoid any risk of injury:

- Never discharge refrigerant into the atmosphere. When servicing air conditioning units a certified refrigerant recovery unit operated by a certified technician must be used.
- When discharging the refrigerant in the system make sure you are operating in well–ventilated premises with good air circulation and far away from open flames.
- When charging and discharging the system always wear goggles and take suitable precautions to protect the face in general and the eyes in particular, from accidental spillage of the refrigerant fluid.
- The oil and refrigerant mixture inside the air conditioning system is pressurized. Consequently, never loosen fittings or tamper with lines unless the system has been properly discharged.
- Before loosening any connection, cover the fitting in question with a cloth and wear gloves and goggles in order to prevent refrigerant from reaching the skin or eyes.
- In the event of an accident, proceed as follows:–

  If the refrigerant has reached the eyes, wash them immediately with copious amounts of sterilized water or mains pressure tap water and transfer to hospital for immediate medical help.

  If the refrigerant has touched the skin, wash with cold water and transfer to hospital for immediate medical help.

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PRINCIPALS OF AIR CONDITIONING

The function of the air conditioning system is to improve the operator's comfort by cooling the air temperature inside the cab and reducing the humidity level.

This temperature control is achieved by absorbing the heat within the cab into a refrigerant and then allowing the heat absorbed by the refrigerant to be transferred to the outside air

In order to achieve this heat transfer the following principals of heat generation and transfer are applied within the air conditioning system.

1. When two bodies of different temperature come together heat is transferred from one to another. On air conditioning systems an evaporator is used to hold the low temperature refrigerant which absorbs the heat from the air within the cab.

2. When a gas is pressurized the temperature of the gas will rise. In air conditioning systems the increase in pressure is achieved using a compressor.

3. When a gas is cooled it will condense into a liquid. In the air conditioning system a condenser is used to cool the gas and the resulting liquid is stored in a receiver dryer.

4. When a liquid is atomized through an orifice, the temperature of the resultant vapor will drop. The low temperature of the atomized liquid will then absorb heat from its surroundings. On air conditioning systems the refrigerant is atomized using an expansion valve.

It can now be seen that the principal components of an air conditioning system are:–

- Refrigerant
- Evaporator
- Compressor
- Condenser
- Receiver Dryer
- Expansion Valve

Figure 10-3-5, uses the examples above to illustrate the air conditioning cycle.

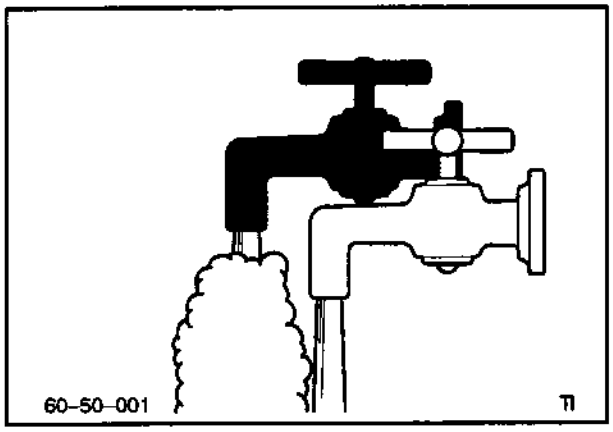


Figure 10-3-1

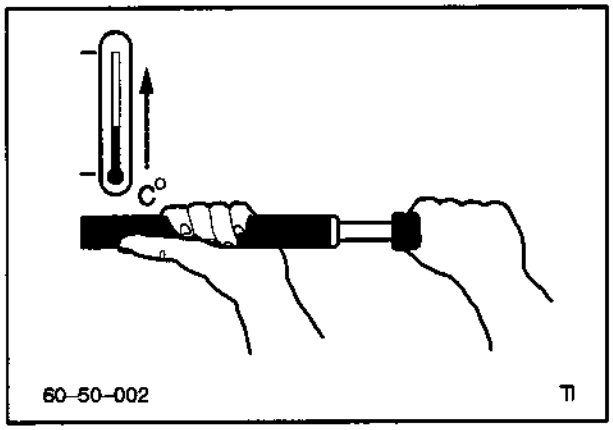


Figure 10-3-2

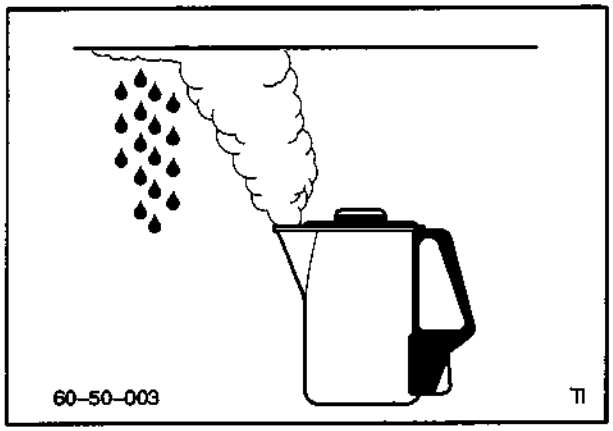


Figure 10-3-3

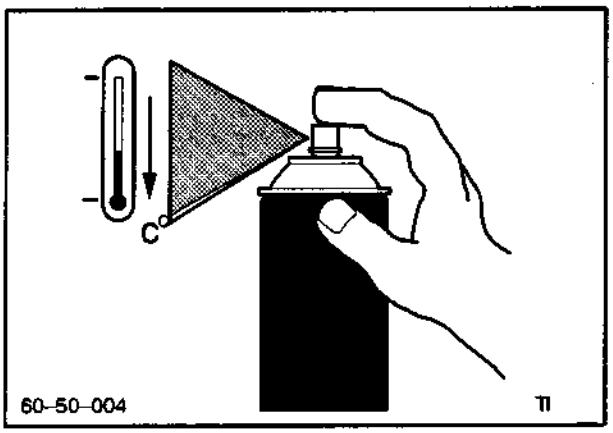
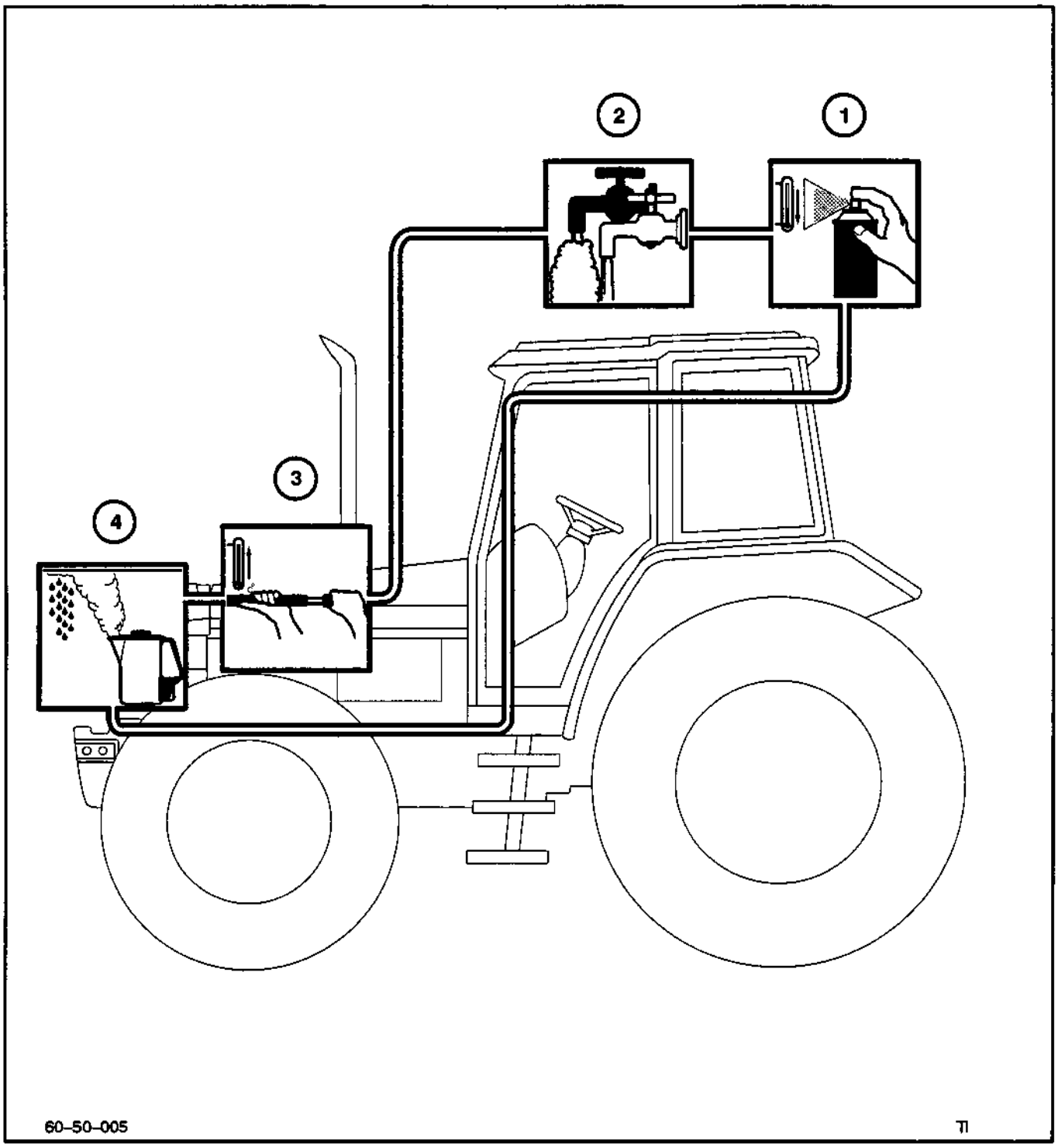


Figure 10-3-4

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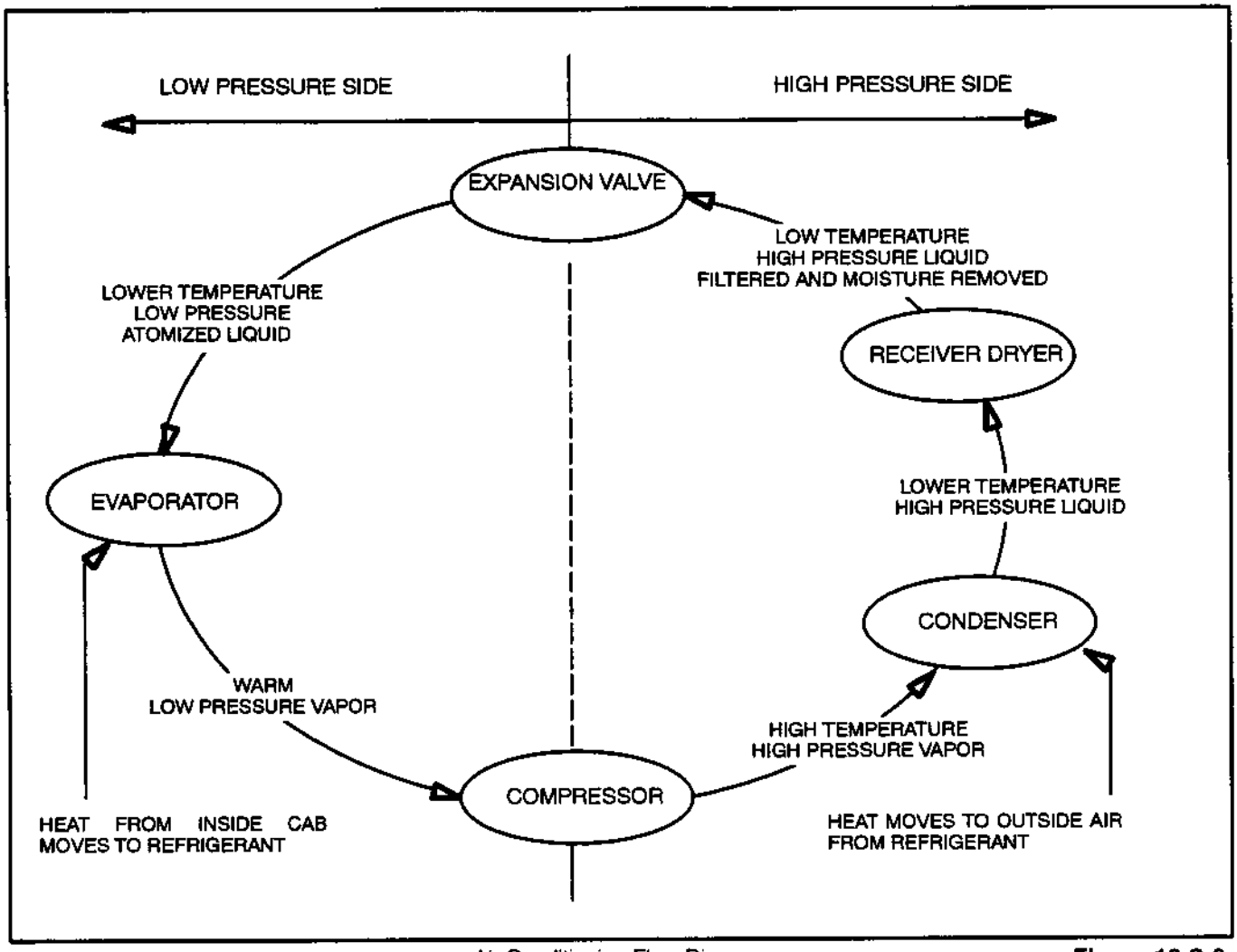
Air Conditioning Principal of Operation

Figure 10-3-5

1. Expansion Valve – Atomizes Liquid Refrigerant Before Passing to Evaporator
2. Evaporator– Absorbs Heat From Air In Cab
3. Compressor – Compresses and Raises Temperature Of Refrigerant Gas
4. Condenser, Evaporator and Dryer – Converts Refrigerant from Gas to a Liquid

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Air Conditioning Flow Diagram **Figure 10-3-6**

Figure 10-3-6, shows in schematic form the flow of refrigerant through the five major components of an air conditioning system. Refer to, Figure 10-3-7, for the location of these components on the tractor.

Refrigerant is drawn into the compressor as a cool, low pressure vapor which is compressed and then pumped out as a hot, high pressure vapor to the condenser.

As the hot, high pressure vapor passes through the condenser core it gives off heat to the cooler outside air, being drawn past the fins by the engine cooling fan.

By giving off heat to the outside air, the vapor is condensed to a liquid which moves under high pressure to the receiver dryer where it is stored until released to the evaporator by the temperature sensing expansion valve.

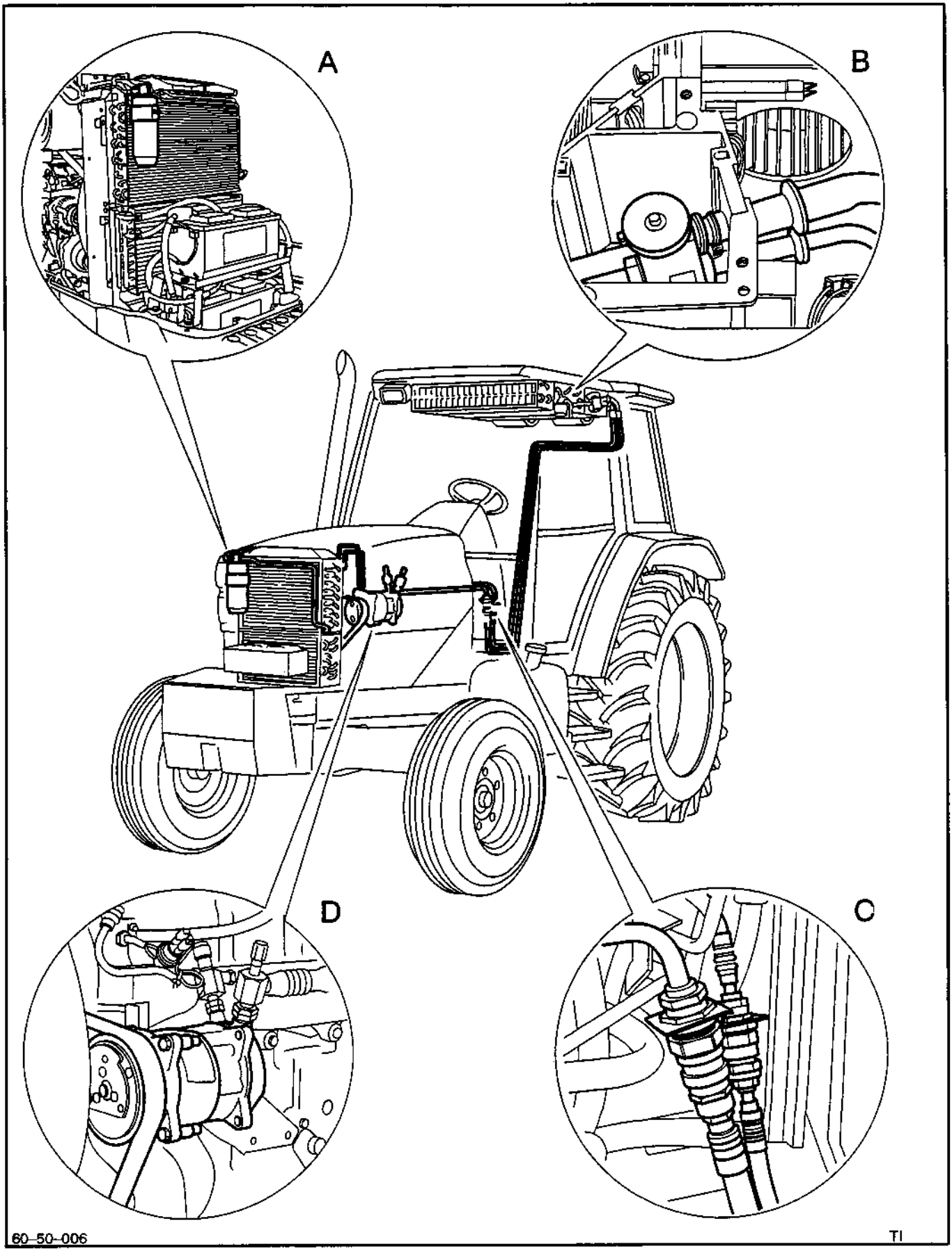
As liquid refrigerant passes through the metered orifice in the expansion valve the refrigerant changes from a high pressure liquid to a low pressure atomized liquid with a lower temperature.

This low pressure, low temperature, atomized liquid enters the evaporator coils and absorbs heat from the cab warm air blown across the coils and fins by the cab blower motor. The refrigerant now changes from a cold low pressure atomized liquid to a warm low pressure vapor and leaves the evaporator outlet, moving to the suction (low pressure) side of the compressor to repeat the cycle.

As this heat loss is taking place, moisture (humidity) in the cab air will condense on the outside of the evaporator and drain off as water through the drain hoses attached to the evaporator drain pan, thereby reducing the humidity level of the cab.

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Air Conditioning Component Layout

Figure 10-3-7

A. Condenser, Receiver Dryer
B. Expansion Valve, Evaporator
C. Quick Release Self Sealing Couplers
D. Compressor

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SYSTEM COMPONENTS – DESCRIPTION AND OPERATION

Refrigerant

To achieve the absorption and the release of heat which is, in essence, the function of an air conditioning system, requires the use of a suitable "refrigerant" - a liquid that has a relatively low temperature boiling point, plus certain desirable safety and stability features.

The refrigerant used in the air conditioning system is refrigerant R-134a.

NOTE: *To help protect the environment legislation has been introduced in most territories banning the release into the atmosphere of refrigerants,including R134a. All service procedures contained in this manual can be carried out without the need to release refrigerant into the atmosphere.*

In order to prevent the incorrect type of refrigerant being charged to the system the service valves fitted to the tractor and necessary to connect up refrigerant recovery, evacuation and recycling/recharging equipment will be of two different sizes as recognized and specified by the air conditioning industry.

⚠ WARNING ⚠

*R–134a refrigerant is **not compatible** with R–12 refrigerant. **Do not** attempt to replace R134a refrigerant with R–12 refrigerant or test the system using gauges or equipment previously used with R12 as damage to the system will result.*

R-134a refrigerant is stable at all operating temperatures and able to absorb great quantities of heat.

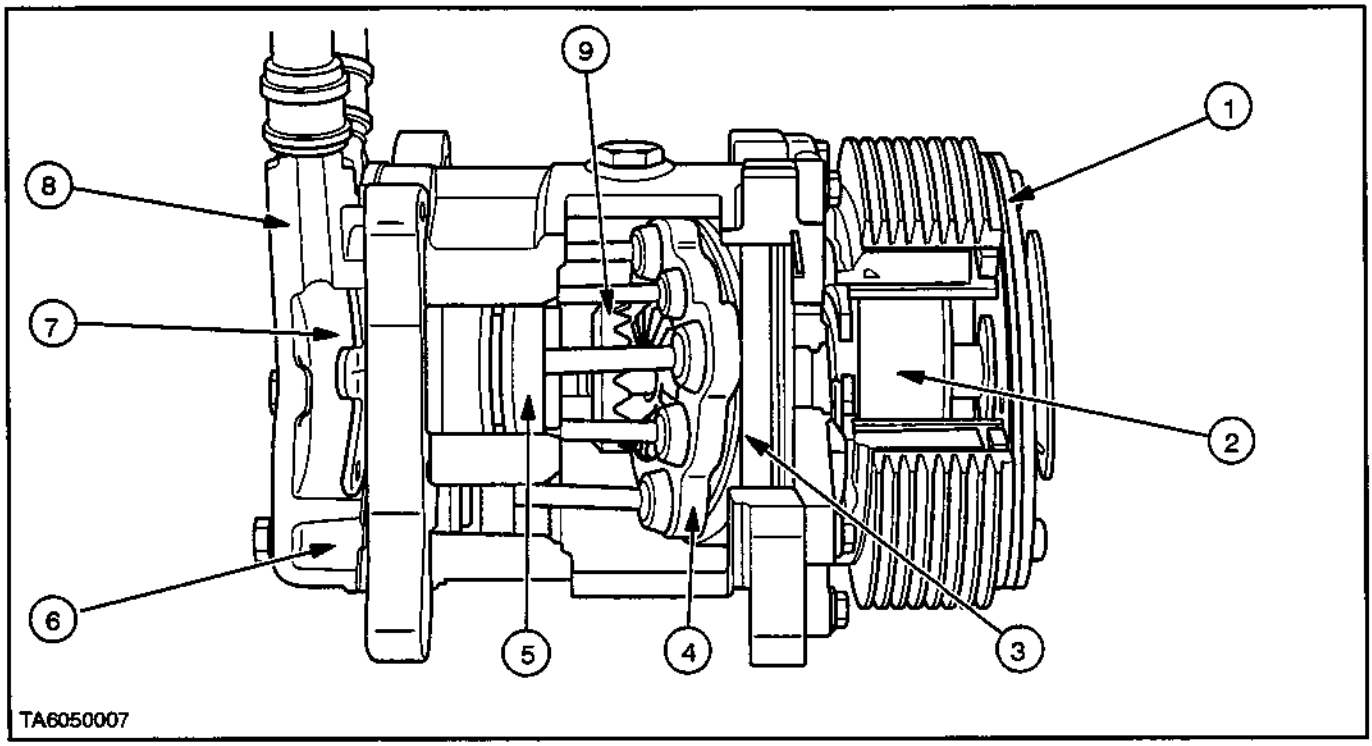
The boiling point of R-134a is -15° F (-22° C) at atmospheric pressure.

If the pressure is increased, R-134a will readily vaporize to absorb heat at temperatures between 11° F (-11.7° C) at 27.5 lbf/in^2 (1.9 bar) and 32° F (0°C) at 42 lbf/in^2 (2.9 bar) in the evaporator.

At higher pressures, R-134a will condense and give off heat at temperatures between 118° F (48° C) at 180 lbf/in^2 (12.4 bar) and 136° F (58° C) at 230 lbf/in^2 (15.85 bar) in the condenser.

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Air Conditioning Refrigerant Compressor

Figure 10-3-8

1. Electro–magnetic Clutch
2. Clutch Bearing
3. Cam Rotor
4. Wobble Plate
5. Piston
6. Suction Chamber
7. Discharge Chamber
8. Cylinder Head
9. Static Gear

Compressor Pump

The tractor air conditioning unit compressor pump is mounted on the left hand side of the engine and is belt driven by the crankshaft pulley, Figure 10-3-7.

The compressor separates the low and high pressure sides of the system and is basically a pump which has two functions:

(1) To raise the refrigerant temperature by compression to a higher degree of temperature than the ambient (outside air) temperature.

(2) To circulate the required volume of refrigerant through the system.

The refrigerant compressor is a seven cylinder wobble plate unit housed in a die cast aluminum housing.

Drive to the wobble plate is from the pulley, through the electro magnetic clutch to the main driveshaft. Attached to the driveshaft is a cam rotor which oscillates the wobble plate. The wobble plate is prevented from rotating by a static gear engaging with teeth formed in the face of the plate. The seven pistons are connected to the wobble plate by rods located in ball sockets.

Refrigerant is drawn in on the downward stroke of a piston through the reed valves located either end of the cylinder assembly. Refrigerant enters the cylinder assembly through a gallery in the outer circumference of the cylinder assembly.

The upwards stroke of the piston compresses the refrigerant and expels it through another reed valve into an inner gallery in the cylinder assembly and out into the refrigerant circuit.

The compressor is lubricated with a Polyalklene Glycol (PAG) oil. This oil is totally miscible with the refrigerant and is carried around the refrigerant circuit.

The compressor is activated by an electro-magnetic clutch which functions to engage or disengage the compressor as required in the operation of the air conditioning system.

The clutch is primarily activated by the:–

- Temperature cycling control switch
- Combined high/low pressure cut–out switch
- Low pressure cut–out switch

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Air Conditioner Temperature Cycling Control Switch

The air conditioner temperature cycling control switch is mounted on the left hand side of the evaporator housing and close to the expansion valve, Figure 10-3-9.

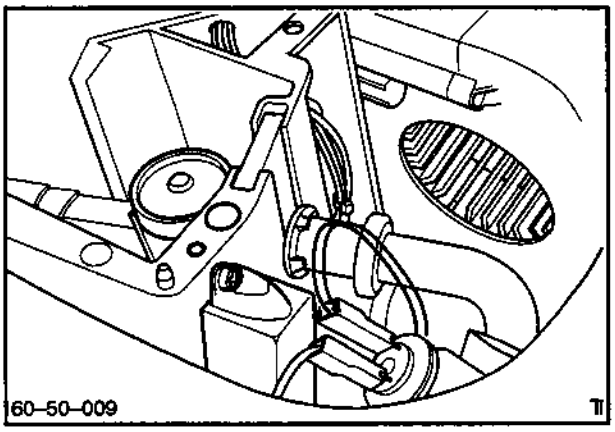


Figure 10-3-9

The switch is a device which turns the compressor clutch on and off to maintain a constant average evaporator temperature and senses the evaporator temperature using a thermistor positioned within the evaporator fins, Figure 10-3-10.

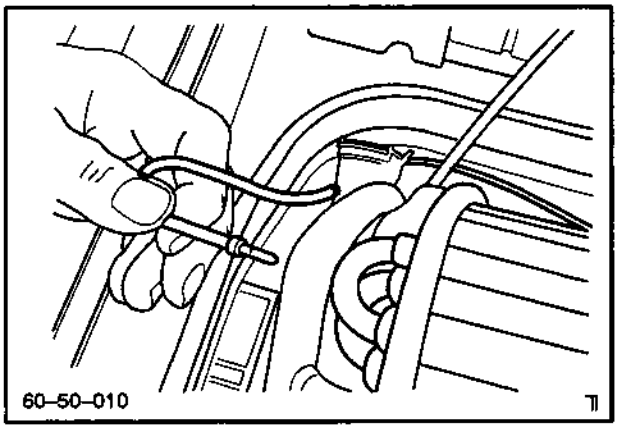


Figure 10-3-10

The temperature cycling control switch compares the voltage of the thermistor, which is dependent on the temperature of the evaporator, with the voltage across the potentiometer of the 'in cab' temperature control switch.

The switch upon comparing the two voltages determines whether the compressor clutch should be switched 'on' or 'off' in order to maintain the desired in cab temperature control.

Low Pressure Cut-out Switch

The low pressure switch, Figure 10-3-11, is in the evaporator outlet line and located in the cab roof next to the evaporator and temperature cycling control switch.

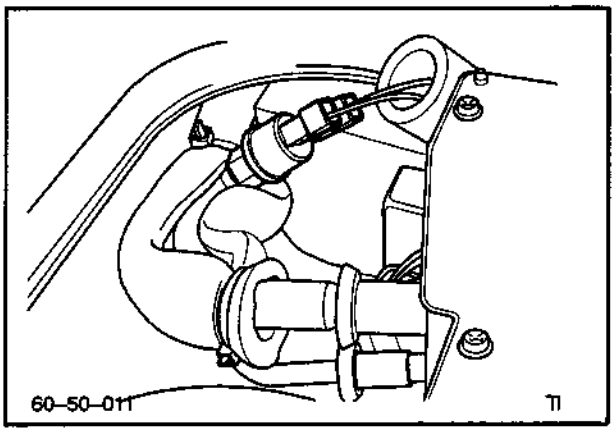


Figure 10-3-11

The purpose of the switch is to shut off the compressor pump in the event of low pressure in the refrigerant system.

Low refrigerant pressure may occur due to a faulty expansion valve, icing up of the expansion valve orifice or refrigerant loss. Low refrigerant pressure may result in damage to the compressor pump.

The low pressure switch is factory set and cannot be adjusted.

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Combined High/Low Pressure Cut–out Switch

The combined high/low pressure switch, (1) Figure 10-3-12, is located in the condenser inlet line from the compressor. The switch shuts off the compressor pump in the event of a restriction in the high pressure line or excessively low pressure due to lack of refrigerant in the system.

Loss of refrigerant in the system will result in insufficient cooling and lubrication and continuous operation will cause damage to the compressor pump.

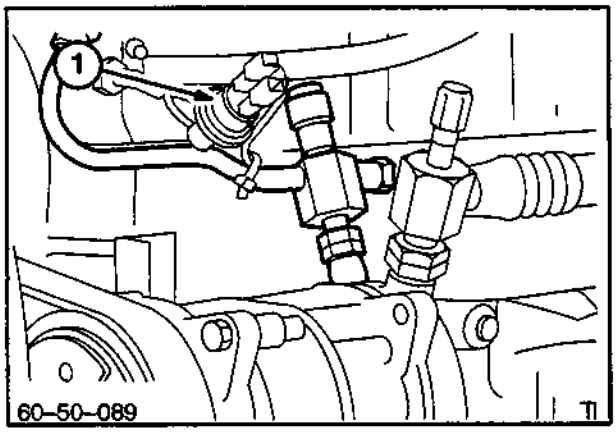


Figure 10-3-12

System Pressure Relief Valve

A relief valve is located at the discharge port on the compressor, (1) Figure 10-3-13. This allows the system refrigerant to be discharged into the engine bay (atmosphere) instead of in the cab, if the system pressure became such that a hose might fail in the cab and cause injury to the operator. This secondary safety feature will only operate in extreme conditions, for example, if the high pressure cut out switch were to fail, or in the event of an engine fire.

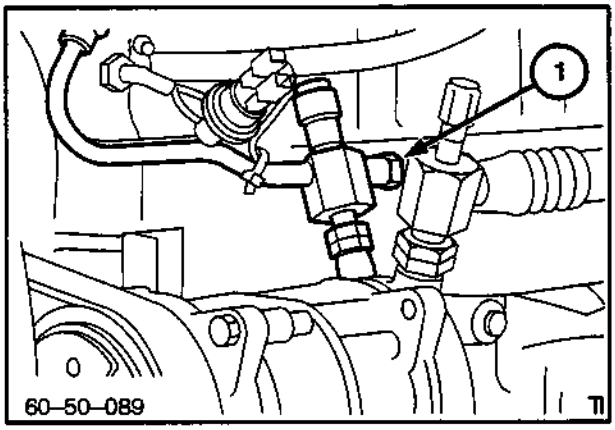


Figure 10-3-13

Condenser And Receiver Dryer

The condenser, (1) located at the front of the tractor, Figure 10-3-14, consists of a number of turns of continuous coil mounted in a series of thin cooling fins to provide a maximum of heat transfer in a minimum amount of space.

The condenser receives the hot, high pressure refrigerant vapor from the compressor. The hot vapor passes through the condenser coils and outside air is pushed through the condenser by the engine cooling fan.

Heat moves from the hot refrigerant vapor into the cooler outside air flowing across the condenser coils and fins.

When the refrigerant vapor reaches the pressure and temperature that will induce a change of state, a large quantity of heat is transferred to the outside air and the refrigerant changes to a high pressure warm liquid.

The warm liquid refrigerant continues onto the receiver/drier where it is filtered and desiccated, to remove any moisture, before passing through an outlet line to the thermostatic expansion valve.

The receiver/dryer(2) stores the liquid refrigerant to be sure a steady flow to the thermostatic expansion valve is maintained under widely different operating conditions.

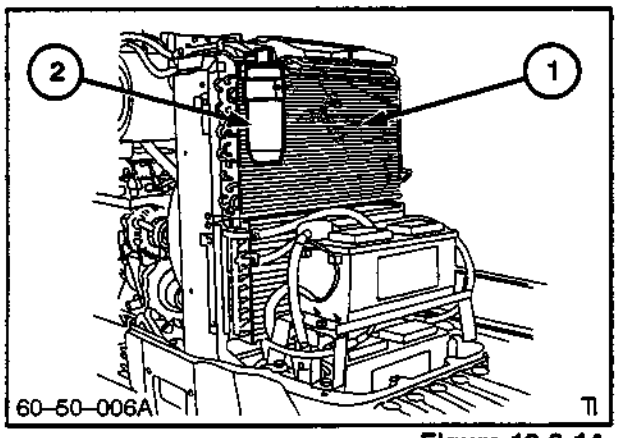


Figure 10-3-14

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The drier section contains a desiccant (Molecular sieve) to absorb any moisture within the system and a filter prevents the entry of foreign particles.

NOTE: *Any moisture in the air conditioning system is extremely harmful. Moisture not absorbed by the dehydrator will circulate with the refrigerant and droplets may collect and freeze in the thermostatic expansion valve orifice. This action will block the refrigerant flow and stop the cooling action. Moisture will also react with refrigerant R-134a and the lubricant to form a corrosive acid.*

The desiccant can only absorb a limited amount of moisture before reaching saturation point. Because of this, after any system component replacement or repairs requiring entry into the system, the receiver/dryer should be replaced.

Expansion Valve

The expansion valve, Figure 10-3-15, is located next to the evaporator, in the pressure line leading from the receiver/dryer and performs the following functions:

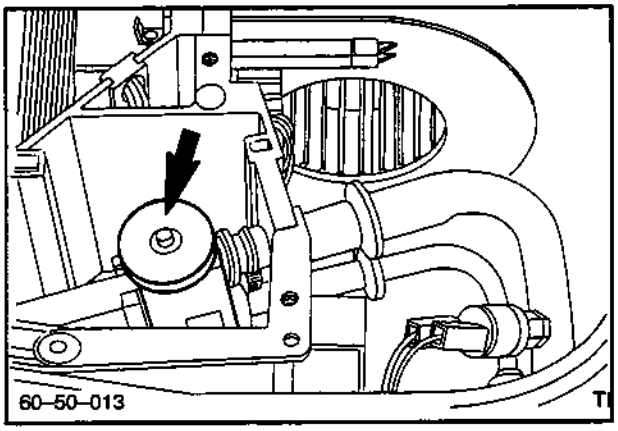


Figure 10-3-15

1. METERING ACTION -
   A metered orifice changes the liquid refrigerant from a high pressure low temperature liquid to a low pressure, lower temperature atomized liquid.

2. MODULATING ACTION -
   A thermostatically controlled valve within the expansion valve body controls the volume of liquid refrigerant passing through the orifice and makes sure the refrigerant is fully vaporized within the evaporator. Liquid refrigerant would damage the compressor reed valves or freeze the pistons.

3. CONTROLLING ACTION -
   The valve responds to changes in the cooling requirements. When increased cooling is required, the valve opens to increase the refrigerant flow and when less cooling is required the valve closes and decreases the refrigerant flow.

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Expansion Valve - Operation

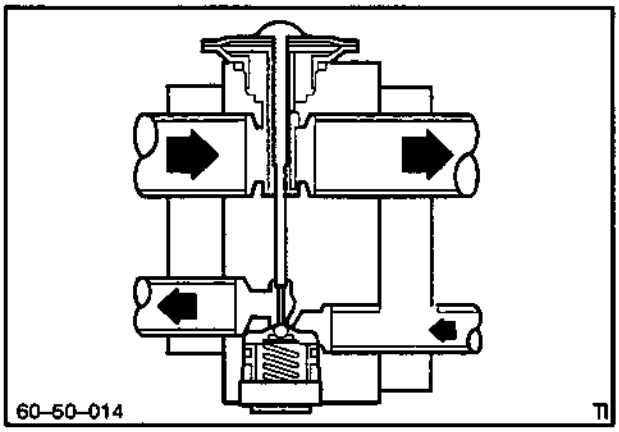


Figure 10-3-16

All of the needed temperature sensing and pressure sensing functions are consolidated into this basic unit and no external tubes are required for these purposes.

The refrigerant from the condenser and receiver dryer enters the thermostatic expansion valve as a high pressure warm liquid. Upon passing through the ball and spring controlled metering orifice, the pressure and temperature of the refrigerant is reduced and the refrigerant leaves the thermostatic expansion valve as a low pressure, lower temperature atomized liquid.

The atomized liquid now passes through the evaporator where it absorbs heat before returning via the expansion valve to the compressor as a warm Low pressure vapor.

There are two refrigerant passages in the valve. One passage is in the refrigerant line from the condenser to the evaporator and contains the ball and spring type orifice valve. The other passage is in the refrigerant line from the evaporator to the compressor and contains the valve's temperature sensing element.

Liquid refrigerant flow from the condenser and receiver dryer is controlled by a push-rod forcing the orifice valve ball off its seat and the spring exerting pressure on the ball to keep it on its seat.

During stabilized (vehicle shutdown) conditions, the pressure on the bottom of the expansion valve diaphragm rises above the pressure on the top of the diaphragm allowing the valve spring to close the orifice.

When the system is started, the pressure on the bottom of the diaphragm drops rapidly, allowing the orifice to open and meter atomized liquid refrigerant to the evaporator where it begins to vaporize.

Suction from the compressor draws the vaporized refrigerant out of the evaporator and back through a gallery in the top of the valve which passes the temperature sensor.

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The temperature sensor reacts to variations in refrigerant gas pressure returning from the evaporator. When heat from the passenger compartment is absorbed by the refrigerant the pressure of the gas increases causing a differential pressure above and below the temperature sensor diaphragm. The diaphragm reacts to this pressure differential and a push rod forces the ball in the expansion valve orifice further off its seat. This reaction allows an increase in the atomized refrigerant to flow through the valve, to the evaporator, so that more heat can be absorbed by the air conditioning system.

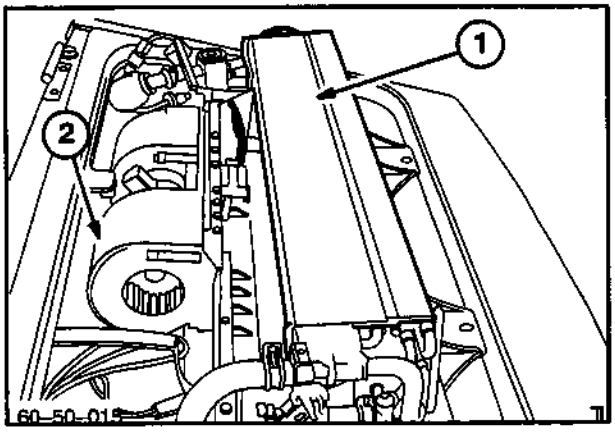


Figure 10-3-17

Similarly when the temperature of the gas returning from the evaporator decreases the pressure of the gas decreases. This causes the diaphragm to react accordingly and allow the ball in the orifice to move closer towards its seat thus reducing the flow of refrigerant through the valve to the evaporator.

Evaporator

The evaporator, (1) Figure 10-3-17, is located in the cab roof and consists of a number of turns of continuous coils mounted in a series of thin cooling fins to provide a maximum of heat transfer in a minimum amount of space.

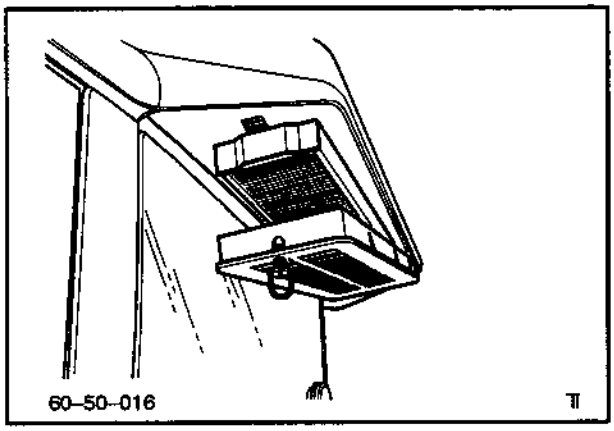


Figure 10-3-18

Low temperature refrigerant in the evaporator absorbs heat from the hotter air in the operator's compartment, thereby cooling the air.

Blower Fan

The blower fan, (2) Figure10-3-17, draws warm air from outside the cab through the intake filters, Figure 10-3-18 and forces it across the evaporator before entering the cab through louvered vents.

The blower motor is controlled by a three-speed switch, 10-3-19. The switch uses a variable resistor to change the fan speed.

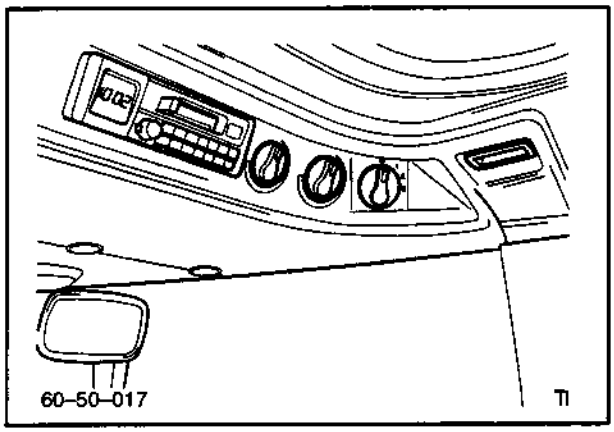


Figure 10-3-19

High blower speed provides the greatest volume of circulated air, however, a slower speed will allow the air to contact the cooling fins and coils of the evaporator for a longer period resulting in the warm air giving up more heat to the cooler refrigerant.Therefore, the coldest air temperature is obtained when the blower fan is operated at the lowest speed.

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FAULT FINDING AND TESTING THE AIR CONDITIONING SYSTEM

General

Overhaul of the air conditioning system should only be undertaken by a certified specialist refrigeration engineer using a comprehensive air conditioning test kit, including a gas leak detector, suitable for R134a refrigerant gas.

⚠ WARNING ⚠

Before dismantling an air conditioning system for repair the gas within the system must be discharged and recovered using a ***certified recovery unit*** *designed for the type of refrigerant gas used in the system.*

NEVER release refrigerant gas into the atmosphere.

ALWAYS wear safety goggles and gloves when servicing any part of the air conditioning system.

To prevent the entry of any foreign material, observe the following points:

- Ensure all tools, gauges, hoses and replacement parts are kept clean and dry and are suitable for the type of refrigerant gas used in the system.
- Clean all hoses and fittings before disconnecting. Cap or plug all openings when disconnected.
- When adding lubricating oil to the system always uncap and re-cap the oil container immediately before and after use. Always ensure the oil remains free of moisture.

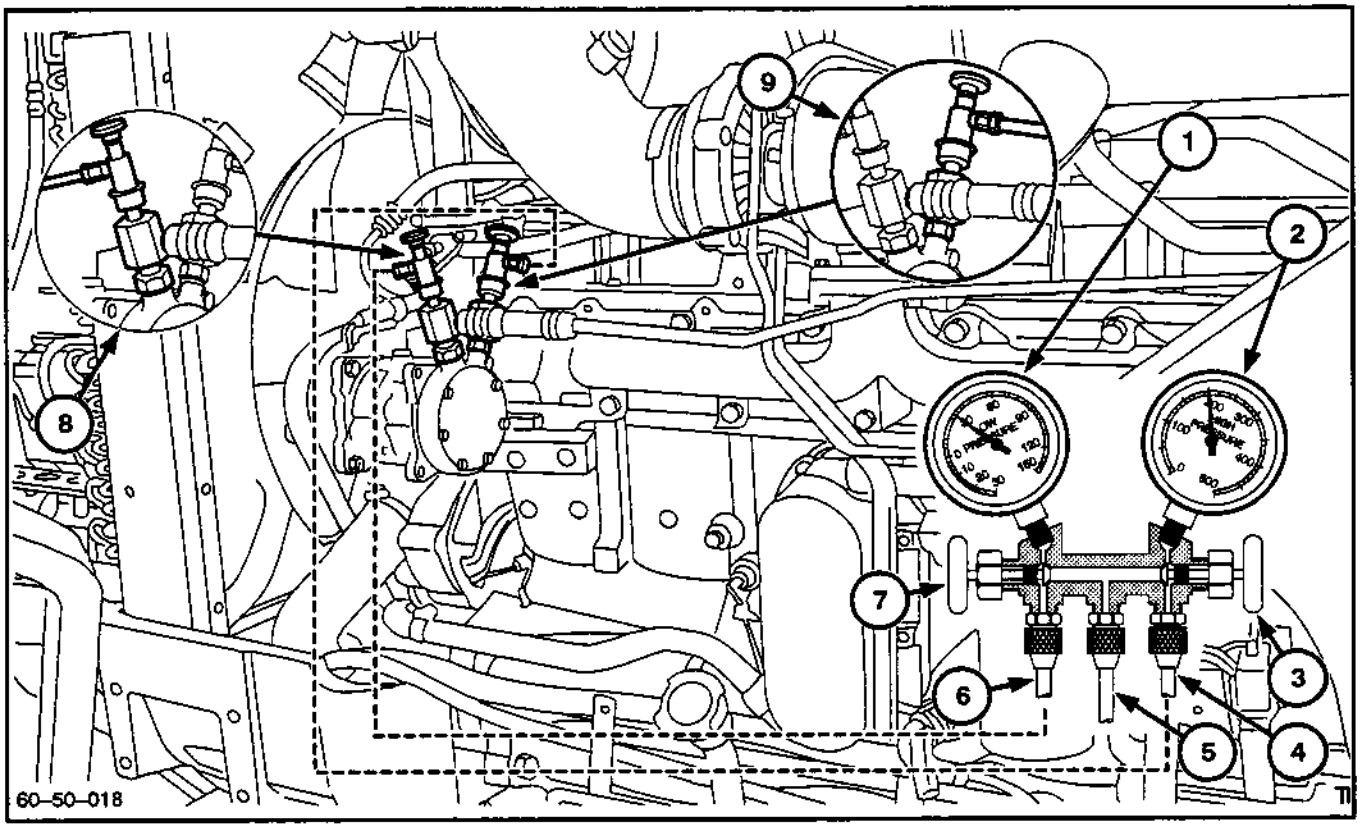
Preliminary Fault Finding

Always conduct the preliminary fault finding checks before performance testing the system.

1. Run the engine at 1000-1200 rev/min for 10 minutes with the air conditioner set at maximum cooling and the blower on high speed.
2. Check that the heater temperature control is switched OFF.
3. Close the heater shut–off valve on the rear of the inlet manifold.
4. Check that the blower fan is operating at all speeds.
5. Check that the compressor clutch engages when the temperature control switch is turned from "OFF" to "ON" position. A clicking sound indicates the clutch is engaging. If the clutch fails to operate it may indicate an electrical problem in the high low pressure cut out switches or malfunction of the electric drive clutch on the compressor.
6. Check the engine cooling fan is drawing cool air through the condenser
7. Check the compressor drive belt tension.
8. Check the condenser core and grid is clean and free of obstruction.
9. Check the cab air filters are clean and free of obstruction.
10. Check the evaporator fins are not plugged or excessively dirty.

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Attaching Manifold Gauge Set to the Tractor **Figure 10-3-20**

1. Low Side Gauge
2. High Side Gauge
3. Shut-off Valve
4. Test Hose to High Side Service Connector
5. Center Hose (Not Used)
6. Test Hose to Low Side Service Connector
7. Shut-off Valve
8. Low Pressure Side Service Valve
9. High Pressure Side Service Valve

Performance Testing The Air Conditioning System

The manifold gauge set is the most important tool used in testing and servicing the air conditioning system.

It should be noted however that for those dealers who posses the latest design level of refrigerant recovery, recycling and recharging station these gauges are an integral part of the machine.

The following instructions for performance testing the air conditioning system is based on the use of the gauge set shown in Figure 10-3-20. The principal of operation is however similar when testing the system using a recovery and recharging station with integral gauges.

When using this type of equipment **always** consult the manufacturers operating instructions.

Operating Precautions

IMPORTANT: Always ensure the shut–off valves are **closed** (turn clockwise until seated) during all test operations.

In the closed position, refrigerant circulates around the valve stems to the gauges. Therefore, when the manifold gauge set is connected into a system, pressure is registered on both gauges.

- **NEVER** open the HIGH SIDE shut off valve when the system is operating.

- **ALWAYS** open the LOW SIDE shutoff valve when adding refrigerant.

Attaching The Gauge Set To The Tractor

WARNING

To avoid personal injury, stop the tractor engine during connection of the manifold gauge set.

1. Check that the gauge set shut off valves are closed (turned fully clockwise).

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2. Connect the high side gauge hose (normally red) to the high pressure side service valve and the low side gauge hose (normally blue) to the low pressure side service valve on the tractor, Figure 10-3-20. Ensure the hose connections are fully tightened.

IMPORTANT: *Prior to connection of the manifold gauge set, identify the suction (low pressure) and discharge (high pressure) service gauge ports. The high pressure service valve is always in the line from the compressor to the condenser.*

The high and low pressure service valves on the tractor are spring loaded valve and will be automatically opened when the test hose is connected.

NOTE: *The test hose must incorporate a valve depressor to actuate this type of valve.*

The service valves have a protective cap. This cap must be removed for test gauge connections and replaced when service operations are completed.

Test Procedure

After the manifold gauge set has been connected and before pressure tests can be made, the system must be stabilized as follows:

1. Re–check that both the high and low side shut off valves on the manifold gauge set are fully **closed.**

2. Apply the parking brake, check the gear shift levers are in neutral and close the cab windows and doors.

3. Run the engine at 1000-1200 rev/min.

4. Turn the heater temperature control 'off'

5. Operate the system at maximum cooling, with the blower fan at high speed for 10 minutes to stabilize all components.

6. Check the manifold low pressure gauge reading is within the specified range of approximately 4-36 lbf/in^2 (0.28-2.48 bar).

7. Check the manifold high pressure gauge reading and compare the reading to the pressure indicated on the pressure temperature chart below.

8. Measure and compare the temperature of conditioned air entering the cab through the louvered air vents with the ambient air at the air intake filters on the outside of the cab.

   If the system is operating correctly the conditioned air entering the cab should be 10–15° F (6–9° C) cooler than the ambient temperature of the outside air.

9. If it is confirmed that the system is not operating correctly refer to the fault diagnostic charts and performance test gauge reading examples on the following pages for possible corrective action.

⚠ WARNING ⚠

A significant amount of refrigerant vapor may have condensed to a liquid at the service fitting at the high side of the compressor. Use a cloth or other protective material when disconnecting the manifold hose from this fitting to prevent personal injury to hands and face.

APPROXIMATE HIGH PRESSURE GAUGE READINGS

Ambient Air Temperature		High Pressure Gauge Reading	
Degrees F	Degrees C	lbf/in^2	bar
80	27	147/168	10.0/11.6
85	29	162/184	11.2/12.7
90	32	179/200	12.3/13.8
95	35	194/221	13.3/15.2
100	38	210/242	14.5/16.7
105	41	231/265	16.0/18.3
110	43	252/289	17.3/20.0

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PERFORMANCE TEST DIAGNOSIS

Gauge Readings:– **Low Pressure - Low**
High Pressure - Low

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air not cold (Refer to Example 1)	Low refrigerant charge.	Perform leak tests and repair Evacuate system Charge system, re–test system
Evaporator air warm	Extremely low refrigerant charge.	Perform leak tests and repair Evacuate system Charge system, re–test system
Evaporator air cool but not sufficiently cold . Low pressure switch cutting out Expansion valve to evaporator tube shows considerable condensation or frost. Too cold to touch	Expansion valve not permitting sufficient flow. Stuck valve	Check expansion valve as follows: Set a max. cooling Low pressure gauge should drop slowly If expansion valve is defective: Discharge system Replace expansion valve Evacuate system Charge system Re–test

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PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - High
High Pressure - High

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air warm Liquid line hot (condenser outlet to expansion valve tube) High pressure switch cutting out	Improper operation of condenser Overcharged with refrigerant Air in system	Inspect for dirty condenser restricting air flow and cooling Check operation of condenser cooling fans. Repair or replace as needed. Check for overcharge as follows: Stop the engine. Recover and recycle the charge using correct recovery equipment. Recharge the the system with the correct quantity of refrigerant, replacing any lost lubricant. Recheck performance of air conditioning system.
Evaporator air not cold	Expansion valve allowing too much refrigerant to flow through the evaporator	Check expansion valve as follows: Set for Maximum cooling. Low pressure gauge should drop slowly If expansion valve is defective: Discharge System Replace Expansion Valve Evacuate System Charge System Re–test

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PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - Low
High Pressure - High

PROBLEM	POSSIBLE CAUSES	CORRECTION
Insufficient cooling	Restriction in liquid line	Discharge the system Replace the receiver/drier Inspect all lines and tubing from compressor outlet to expansion valve. Replace if needed. Evacuate the system Charge the system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - High
High Pressure - Low

PROBLEM	POSSIBLE CAUSES	CORRECTION
Evaporator air not cold	Internal leak in compressor. (reed valves, gasket, worn or scored piston rings or cylinder)	Discharge the system Replace the compressor Evacuate the system Charge the system Re–test

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PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - Normal
High Pressure - Normal

PROBLEM	POSSIBLE CAUSES	CORRECTION
Insufficient cooling Low pressure reading does not fluctuate with changes in temperature control switch (pressure should drop until compressor cycles) Evaporator air not cold.	System low on charge Air or moisture present in system	Perform leak test Discharge system Repair leaks Replace receiver/drier Check oil level Evacuate system Charge the system Re–test

PERFORMANCE TEST DIAGNOSIS CHART

Gauge Readings:– Low Pressure - High
High Pressure - Normal

PROBLEM	POSSIBLE CAUSES	CORRECTION
Compressor cycles "on" and "off" too frequently	Defective temperature control (thermostatic) switch	Stop engine and shut off A/C Replace temperature control switch Re–test system and check compressor cycling

EXAMPLES OF MANIFOLD GAUGE READINGS AND INTERPRETATIONS

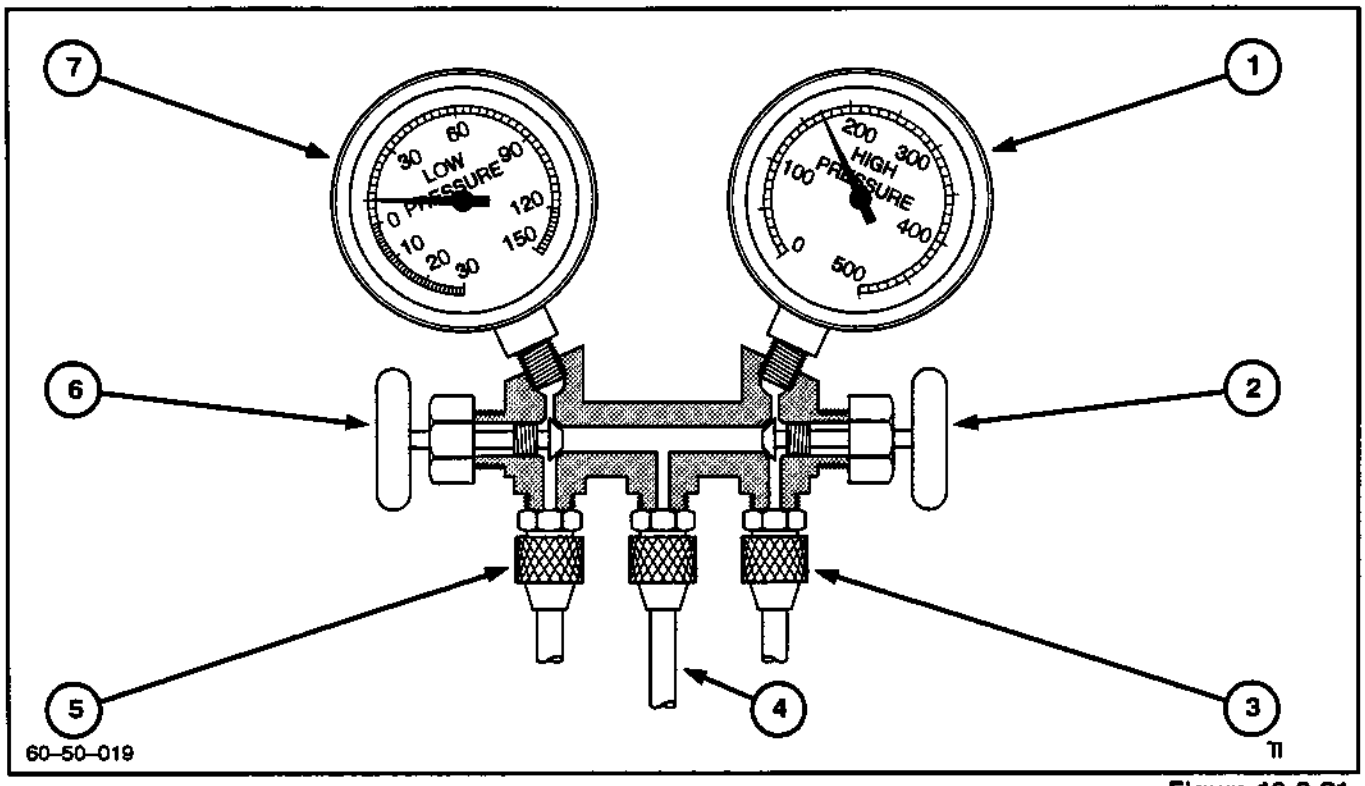
The following examples show typical low and high pressure gauge readings obtained when performance testing the air conditioning system with an ambient temperature of 95° F (35° C).

The recommended corrective action is based on a similar fault as identified in the performance test diagnosis charts.

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PERFORMANCE TEST EXAMPLE 1



Performance Test Example 1

Figure 10-3-21

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Little or no cooling.

CAUSE:

Refrigerant slightly low.

CONDITIONS*

Low side pressure too low.
Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too low.
Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

Evaporator air not cold.

CORRECTIVE PROCEDURES

1. Leak test the system.
2. Repair leaks. (Discharge and recover the refrigerant from the system; replace lines or components).
3. Check compressor oil to ensure no loss.
4. Evacuate the system.
5. Charge the system.
6. Performance test the system.

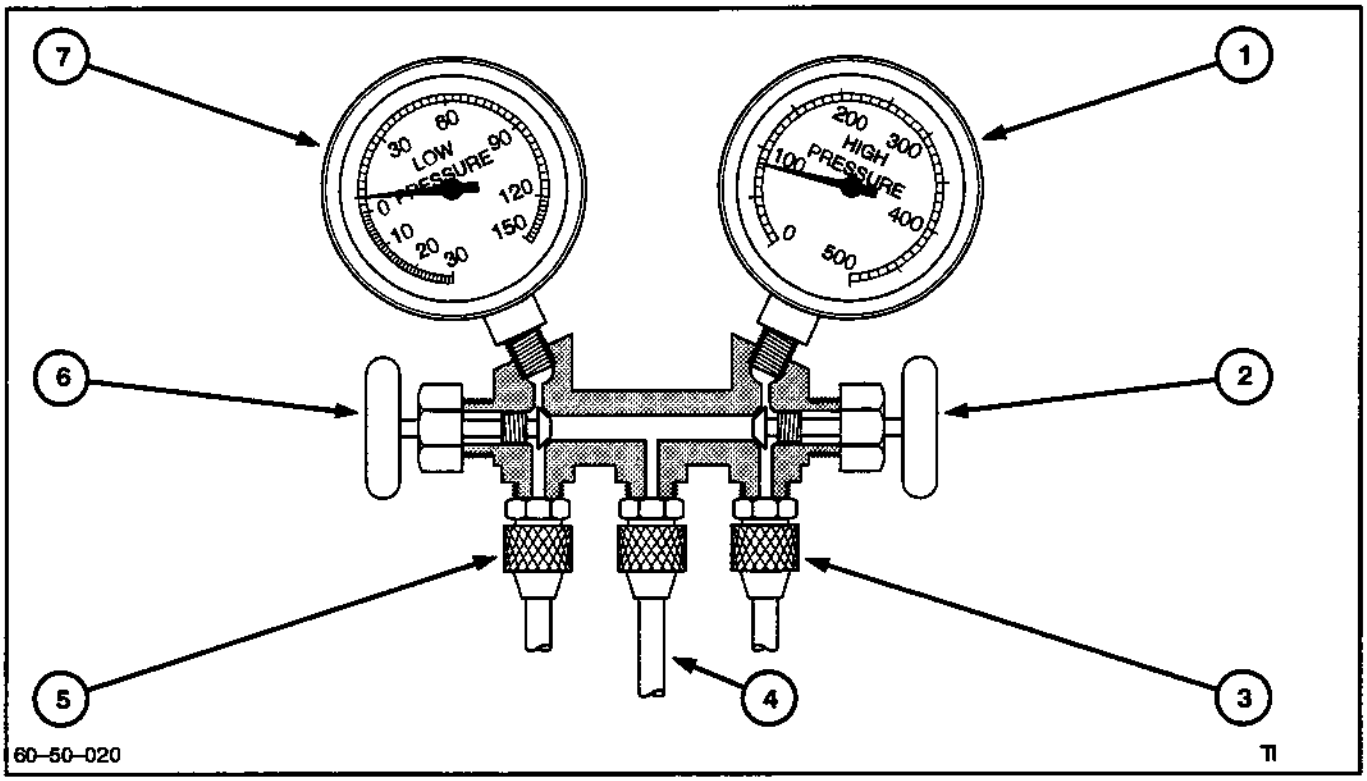
DIAGNOSIS: *System refrigerant is low. May be caused by a small leak.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 2



Performance Test Example 2 **Figure 10-3-22**

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected t Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Refrigerant excessively low.

CONDITIONS*

Low side pressure very low.
Gauge should read 15-30 lbf/in^2 (1–2 bar)

High side pressure too low.
Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

Evaporator air warm.

Low pressure switch cutting out

CORRECTIVE PROCEDURES

1. Leak test the system.
2. Discharge and recover the refrigerant from the system.
3. Repair leaks.
4. Check compressor oil to ensure no loss.
5. Evacuate the system.
6. Charge the system.
7. Performance test the system.

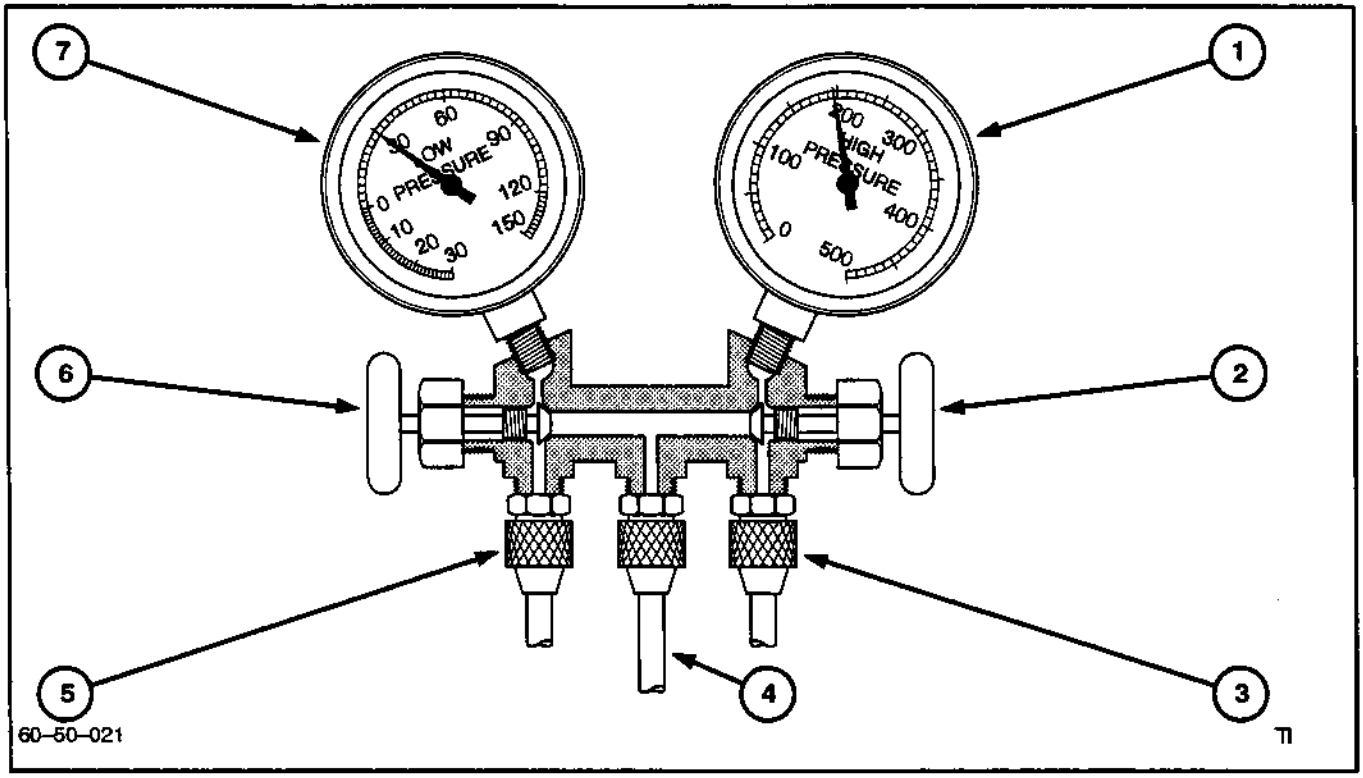
DIAGNOSIS: *System refrigerant is extremely low. A serious leak is indicated.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 3



Performance Test Example 3

Figure 10-3-23

1. High Side Normal
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Air in system.

CONDITIONS*

Low side pressure reading does not change when compressor cycles "on" and "off".

High side pressure slightly high or slightly low. Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

Evaporator air not cold.

CORRECTIVE PROCEDURES

1. Leak test the system. Give special attention to the compressor seal area.
2. Discharge and recover the refrigerant from the system.
3. Repair leaks.
4. Replace the receiver/dryer.
5. Check compressor oil to ensure no loss.
6. Evacuate the system.
7. Charge the system.
8. Performance test the system.

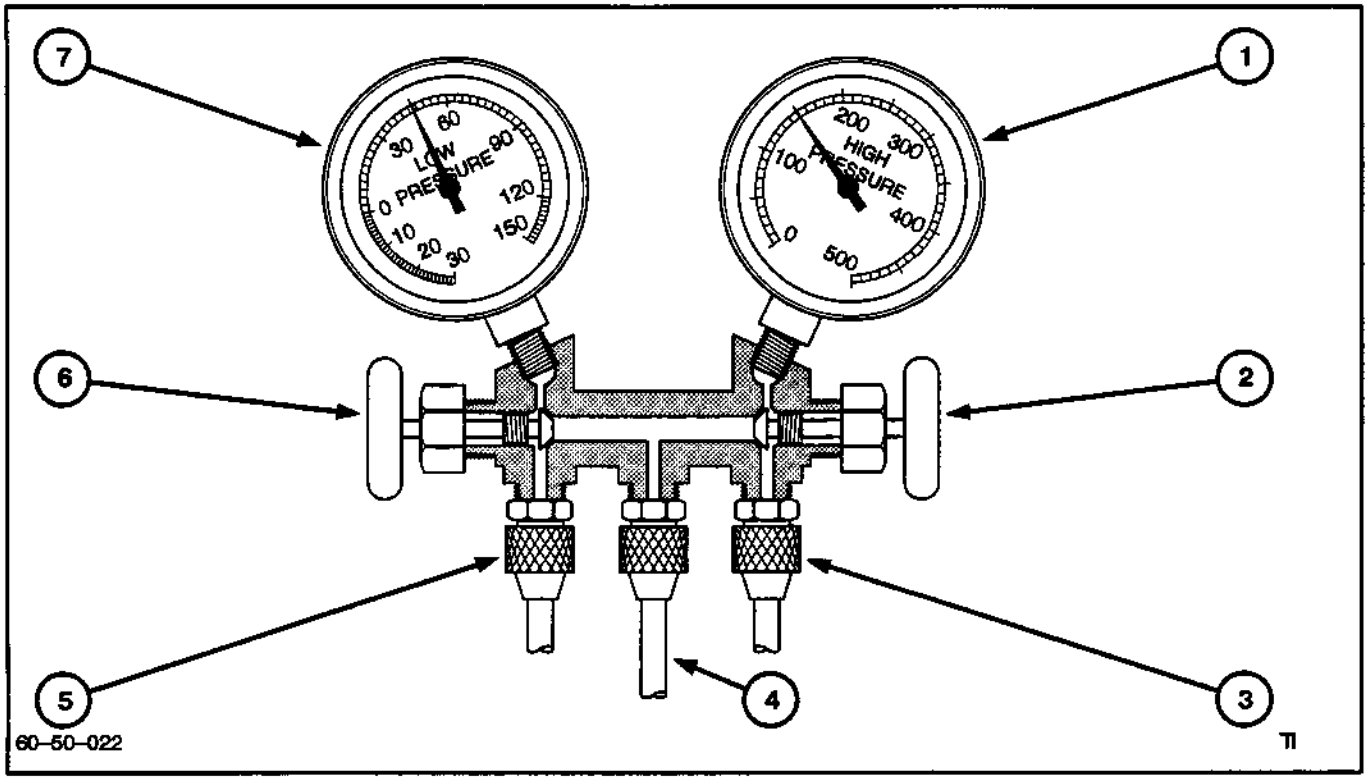
DIAGNOSIS: *Air or moisture in system. System not fully charged.*

***NOTE:** Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 4



Performance Test Example 4 **Figure 10-3-24**

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side High

PROBLEM:

Insufficient cooling.

CAUSE:

Compressor malfunction.

CONDITIONS*

Low side pressure too high. Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too low. Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

Evaporator air not cold.

CORRECTIVE PROCEDURES

1. Replace the compressor.

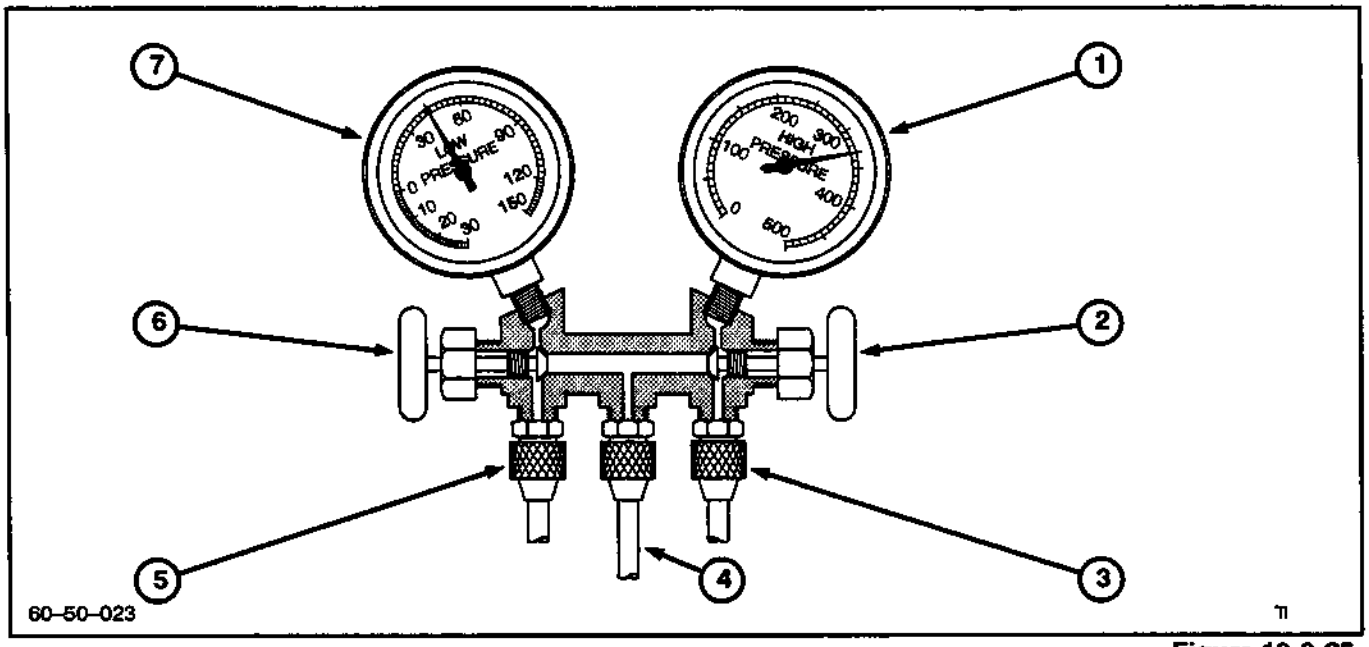
DIAGNOSIS: *Internal leak in compressor caused by worn or scored pistons, rings, or cylinders.*

***NOTE:** Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 5



Performance Test Example 5

Figure 10-3-25

1. High Side High
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side High

PROBLEM:

Insufficient or no cooling. Engine overheats in some cases.

CAUSE:

Condenser not functioning properly.

CONDITIONS*

Low side pressure too high. Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too high. Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

Liquid line hot.

Evaporator air warm.

High pressure switch cutting out.

CORRECTIVE PROCEDURES

1. Check belt. Loose or worn drive belts could cause excessive pressures in the compressor head.
2. Look for clogged passages between the condenser fins and coil, or other obstructions that could reduce condenser airflow.
3. If engine is overheating replace engine thermostat and radiator pressure cap.

At this point, operate the system and check its performance. If still unsatisfactory, proceed as follows:–

4. Discharge and recover the refrigerant from the system.
5. Remove the condenser and clean and flush it to ensure a free flow of refrigerant. Or, if the condenser appears to be unduly dirty or plugged, replace it.
6. Replace the receiver/dryer.
7. Evacuate the system, and recharge it with the correct quantity of refrigerant.
8. Performance test the system.

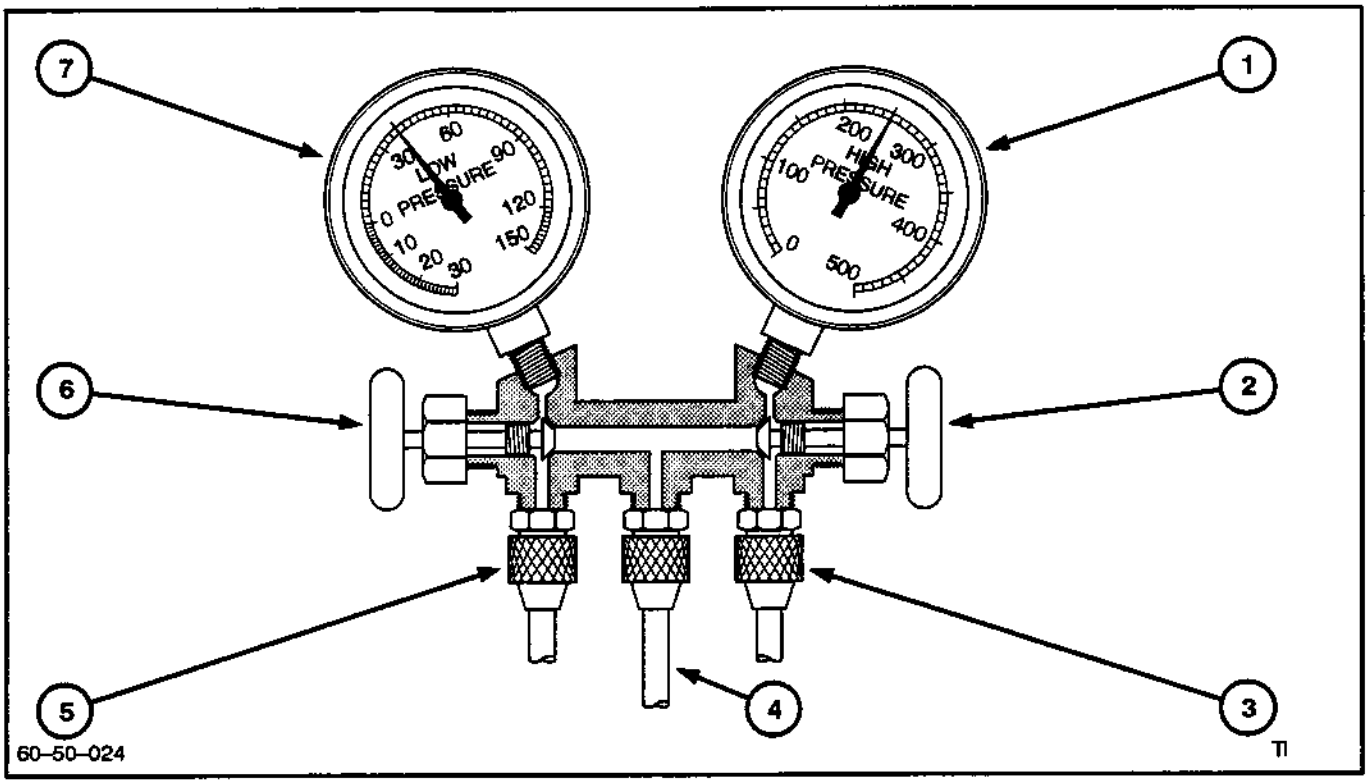
DIAGNOSIS: *Lack of cooling caused by pressure that is too high on the high side, resulting from improper operation of condenser. (Refrigerant charge may be normal or excessive).*

***NOTE:** Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 6



Performance Test Example 6

Figure 10-3-26

1. High Side Normal
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Normal

PROBLEM:

Insufficient or no cooling.

CAUSE:

Large amount of air in system.

CONDITIONS*

Low side pressure too high. Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too high. Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

Evaporator air not cool.

CORRECTIVE PROCEDURES

1. Discharge and recover the refrigerant from the system.
2. Replace the receiver/dryer.
3. Evacuate the system.
4. Charge the system.
5. Performance test the system.

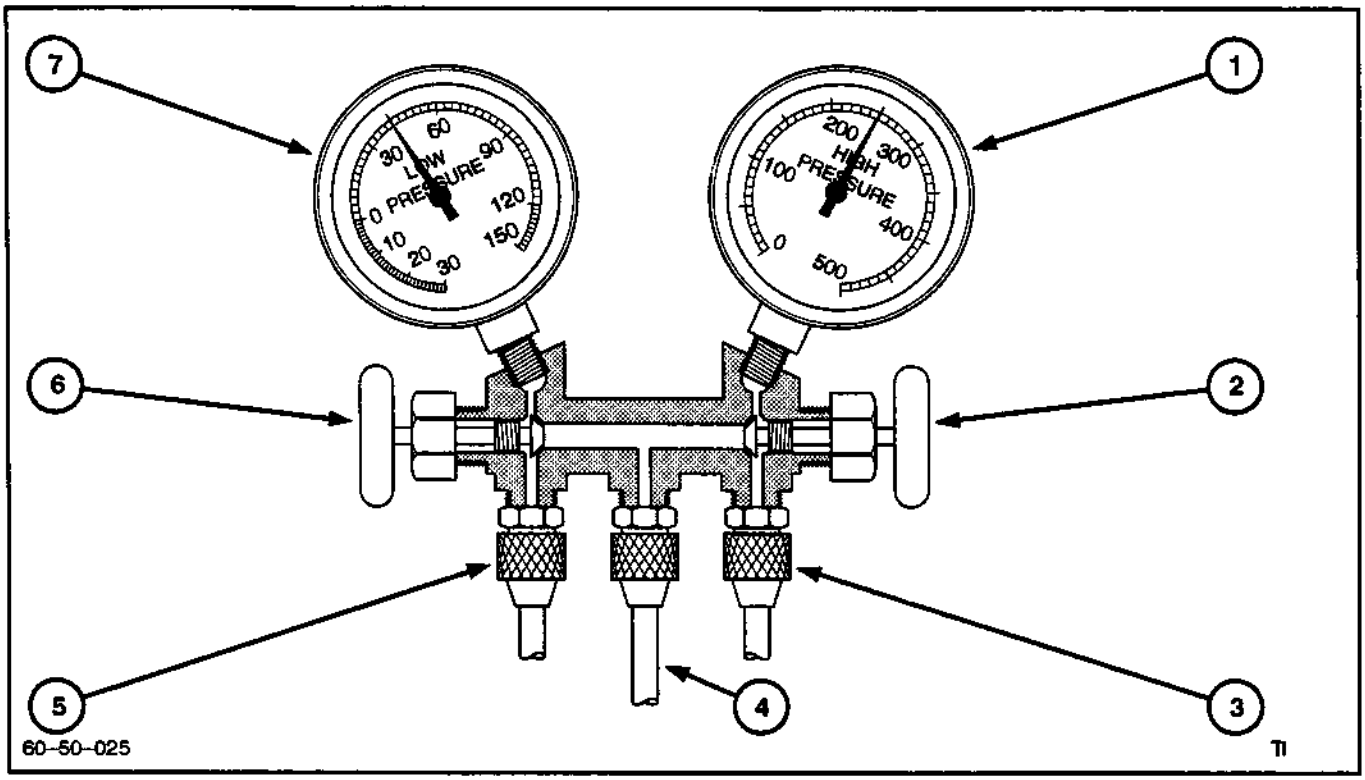
DIAGNOSIS: *Air in system. This, and the moisture in the air, is contaminating the refrigerant, causing the system to operate improperly.*

***NOTE:** Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 7



Performance Test Example 7 **Figure 10-3-27**

1. High Side High
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Hide

PROBLEM:

Insufficient or no cooling.

CAUSE:

Improper operation of thermostatic expansion valve (stuck open)

CONDITIONS*

Low side pressure too high. gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too high. Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

Evaporator air warm.

Evaporator and suction hose (to compressor) surfaces show considerable moisture.

CORRECTIVE PROCEDURES

1. Check for sticking expansion valve as follows:–

   Operate the system at maximum cooling.

   Check the low side gauge. The pressure should drop slowly.

2. If the test indicates that the expansion valve is defective, proceed as follows:

   Discharge and recover the refrigerant from the system.

   Replace the expansion valve.

   Evacuate the system.

   Charge the system.

   Performance test the system.

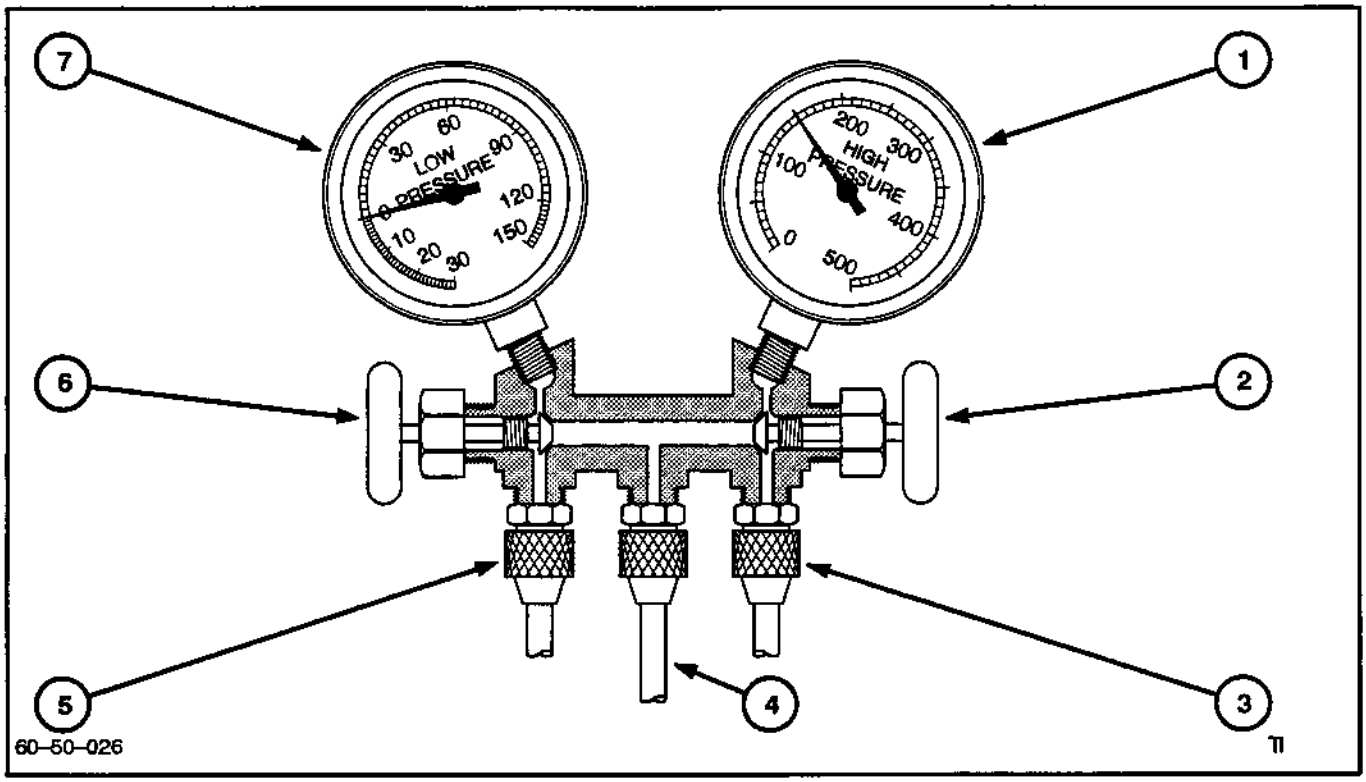
DIAGNOSIS: *Thermostatic expansion valve is allowing too much refrigerant to flow through the evaporator coils. Valve may be stuck open.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 8



Performance Test Example 8

Figure 10-3-28

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM: Insufficient cooling.

CAUSE: Improper operation of thermostatic expansion valve (stuck closed).

CONDITIONS*

Low side pressure too low (zero or vacuum). Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure low. Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

Evaporator air cool, but not sufficiently cold.

Evaporator inlet pipe surface shows considerable moisture or frost.

Low pressure switch cutting out.

CORRECTIVE PROCEDURES

1. Place finger on expansion valve to evaporator tube. If too cold to touch, proceed as follows:

   Operate the system at maximum cooling.

   Check the low side gauge. The pressure should drop slowly.

2. If the procedure outlined in Step 1 shows that the expansion valve is defective, proceed as follows:

   Discharge system

   Replace expansion valve

   Evacuate the system.

   Charge the system.

   Performance test the system.

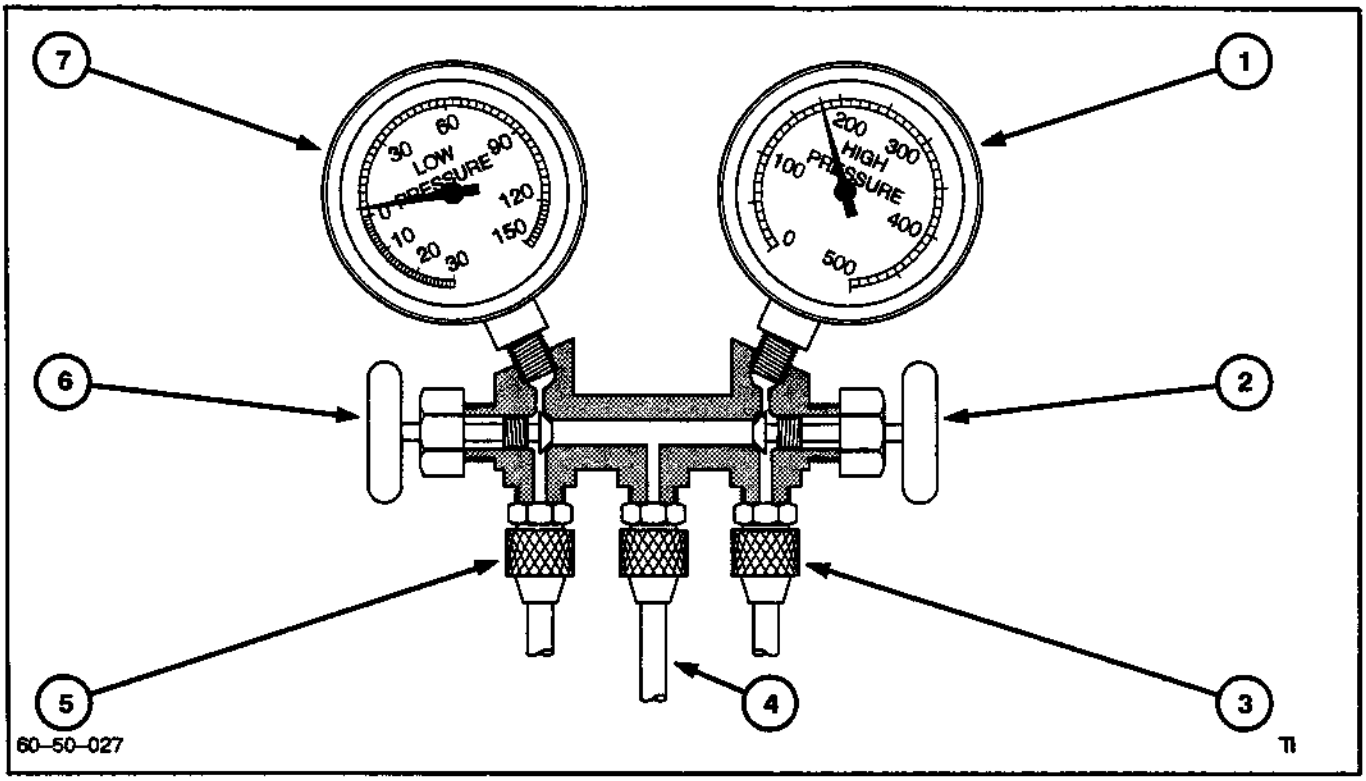
DIAGNOSIS: *Expansion valve is not permitting a sufficient flow of refrigerant. May be caused by valve stuck in restricted or closed position.*

***NOTE:** Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 9



Performance Test Example 9

Figure 10-3-29

1. High Side Low
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Low

PROBLEM:

Insufficient cooling.

CAUSE:

Restriction in high side of system.

CONDITIONS*

Low side pressure too low. Gauge should read 15-30 lbf/in^2 (1–2 bar).

High side pressure too low. Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

NOTE: *A normal or high reading of the high side pressure gauge under these conditions indicates the system is overcharged or the condenser or receiver/dryer is too small.*

Evaporator only slightly cool.

Liquid line and receiver/dryer are cool to touch and show frost or considerable moisture.

CORRECTIVE PROCEDURES

1. Discharge and recover the refrigerant from the system.
2. Replace the liquid lines, receiver/dryer, or other obstructed components.
3. Evacuate the system.
4. Charge the system.
5. Performance test the system.

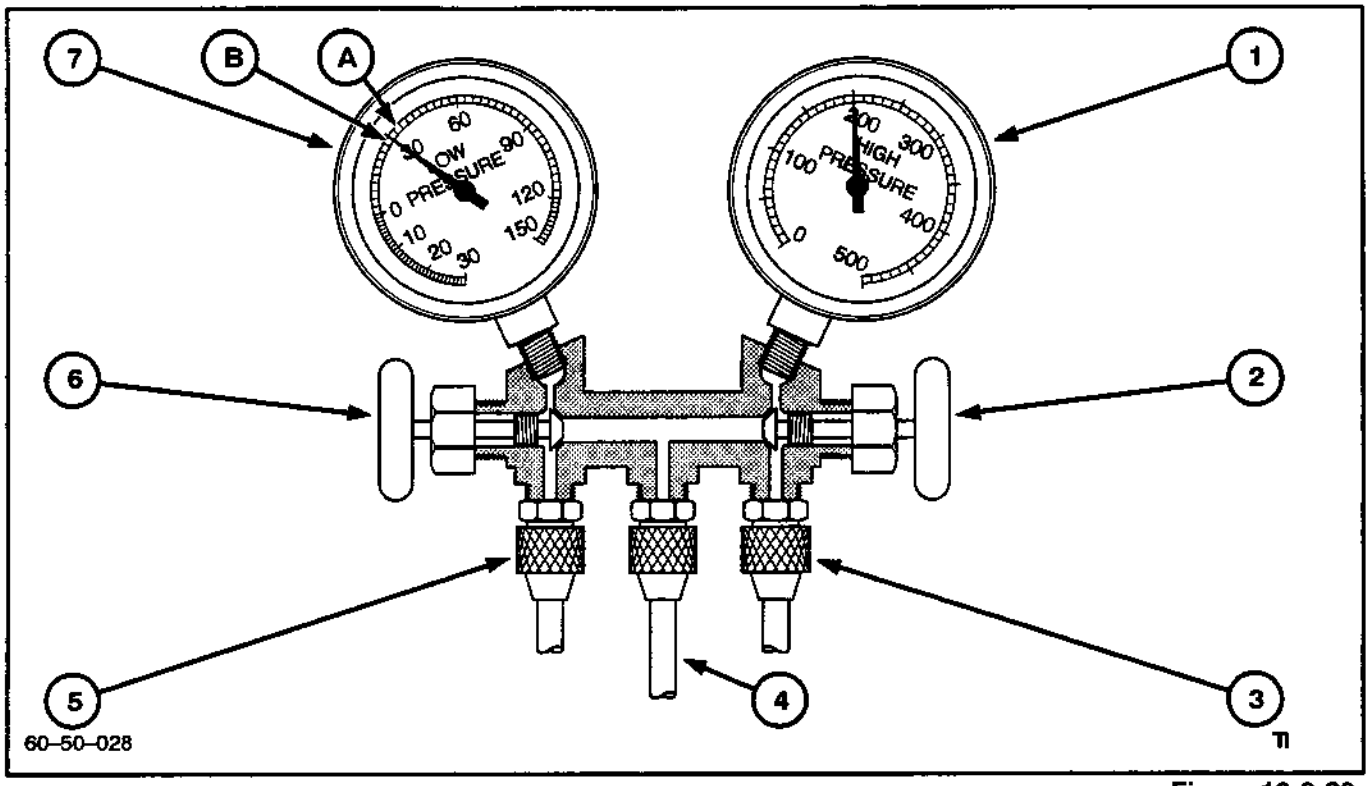
DIAGNOSIS: *Restriction in the liquid line and/or receiver/dryer resulting in a "starved" evaporator (compressor moving refrigerant from the evaporator faster than it can enter).*

***NOTE:** Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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PERFORMANCE TEST EXAMPLE 10



Performance Test Example 10

Figure 10-3-30

1. High Side Normal
2. High Side Hand Valve Closed
3. High Side Hose Connected to High Side Service Connector
4. Not Used
5. Low Side Hose Connected to Low Side Service Connector
6. Low Side Hand Valve Closed
7. Low Side Gauge
   Compressor Cycles on at 34 lbf/in^2 (2.3 bar)
   Compressor Cycles off at 28 lbf/in^2 (1.9 bar)

PROBLEM:

Compressor cycles (cuts in and out) too rapidly.

CAUSE:

Thermostatic switch defective.

CONDITIONS*

Low side pressure readings too high during both "on" and "off" compressor cycles and between cycles. Readings should be:

12-15 lbf/in^2 (0.8–1.0 bar) - cycle "off"

36-39 lbf/in^2 (2.5–2.7 bar) - cycle "on"

24-27 lbf/in^2 (1.7–1.9 bar) - between cycles

High side pressure normal. Gauge should read 194–215 lbf/in^2 (13.3–14.8 bar).

CORRECTIVE PROCEDURES

1. Stop the engine and shut off A/C system.
2. Replace thermostatic switch with switch of same type.
3. Make sure the switch's temperature sensor is installed in the same position and depth (in evaporator core) as previous.
4. Performance test the system.

DIAGNOSIS: *Defective thermostatic switch.*

***NOTE:** *Test procedure based upon ambient temperature of 95° F (35°C). For proper high side gauge reading for other ambient temperatures, refer to the pressure temperature chart.*

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LEAK TESTING, DISCHARGING and CHARGING THE AIR CONDITIONING SYSTEM

Leak Testing

To perform a leak test if refrigerant leakage is suspected, use an electronic leak detector, Figure 10-3-31 following manufacturer's instructions.

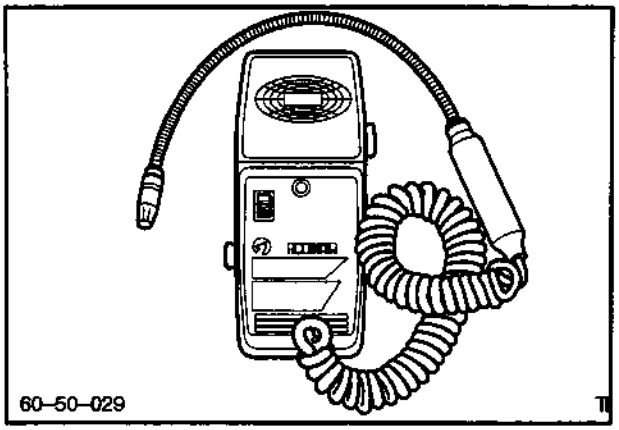


Figure 10-3-31

Electronic leak detectors use flashing lights or sound to alert the operator to a leak. If the leak detector's sensitivity is adjustable, be sure you calibrate the detector according to the manufacturer's instructions before use.

When using a leak detector, keep in mind that a very slight amount of leakage in the compressor pulley area is normal and does not necessarily indicate a repair is required.

When a leak is located, follow these steps.

- Discharge the system using a certified freon recovery system.
- Repair the leak.
- Evacuate the system.
- Partially charge system with 14 ozs (400 grams) of refrigerant.
- Check system for leaks.
- Fully charge the system.

Always check the system for leaks as a final test after evacuating and before recharging. Refer to Evacuating the system.

Discharging The System

Legislation has been introduced banning the release of refrigerant into the atmosphere.

Whenever overhauling the air conditioning system or performing other tasks which require the air conditioning system to be dismantled it is necessary to discharge the refrigerant gas before commencing repair.

Before you can dismantle an air conditioning system for repairs, you must discharge and recover the refrigerant using a **certified** recovery unit in accordance with the manufacturers instructions.

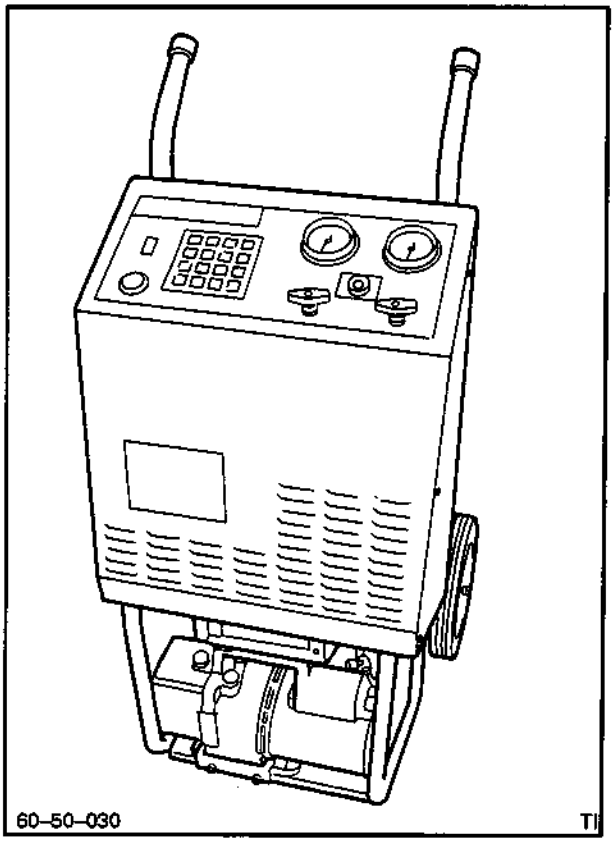
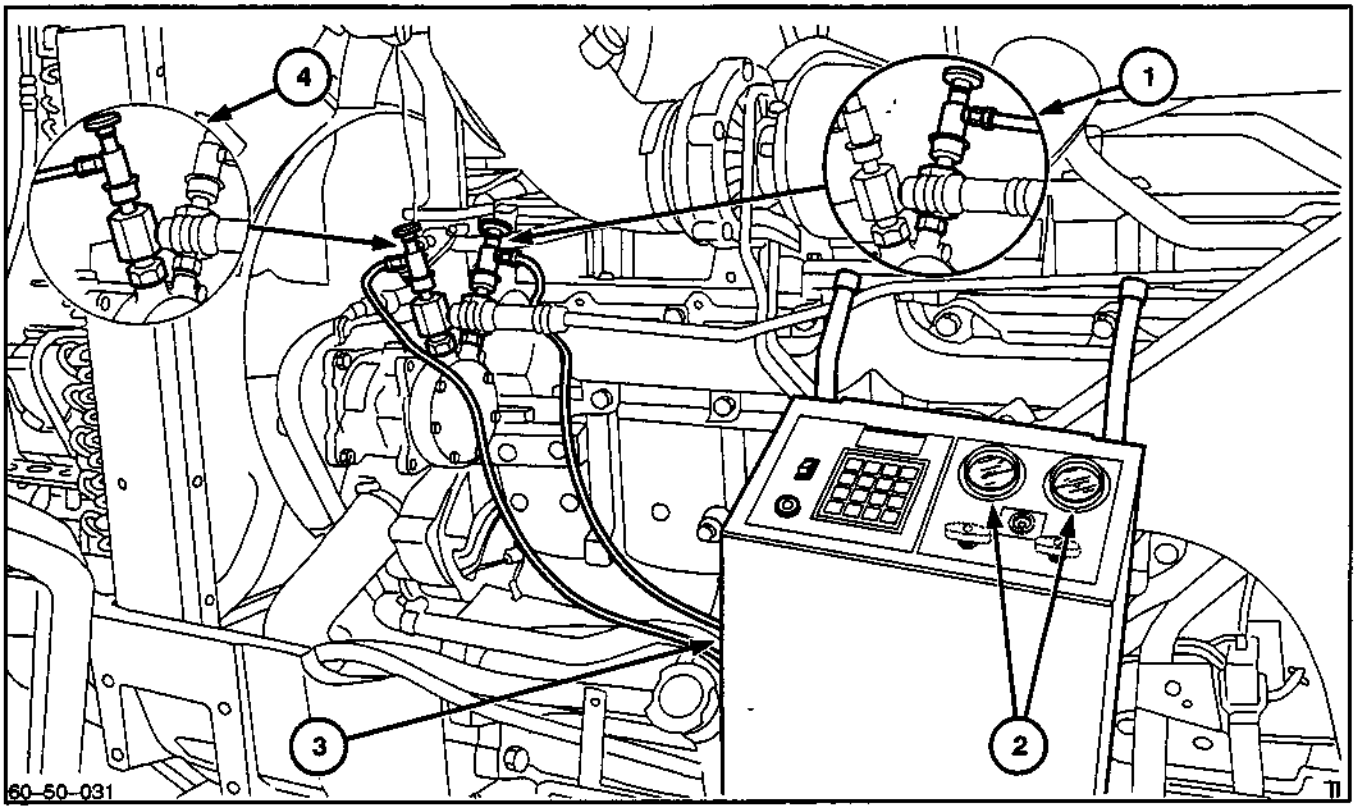


Figure 10-3-32

Figure 10-3-32 shows a combined refrigerant recovery, evacuation and recycling/charging station. This equipment removes R–134a refrigerant from the air conditioning system, recycles and recharges all in one hook up. The unit is designed to be used with the manifold gauge set built into the control panel.

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Connecting Recovery Evacuation and recycling/Charging Station to the Tractor **Figure 10-3-33**

1. High Side Service Valve (Red Hose)
2. Built In Manifold Gauge Set
3. Recovery/Recharging Unit
4. Low Side Service Valve (Blue Hose)

Other recovery systems are available where the manifold gauges are not an integral part of the machine. When this type of equipment is used a separate manifold gauge set must be used.

The following is a summary of the steps for discharging the system using a recovery/recycling unit

WARNING

Never *discharge refrigerant gas into the atmosphere. Always where safety goggles and gloves when working with refrigerant. Only use authorized refrigerant tanks.*

IMPORTANT: *Always follow the manufactures instructions when operating recovery equipment.*

1. Run the vehicle's air conditioning system for a few minutes.
2. Set up the recovery unit following manufacturer's instructions. Ensure that the units red (high side) hose is connected to the high side fitting and the blue (low side) hose to the low side fitting, Figure 10-3-33.

NOTE: *If a unit requiring the manifold gauge set is being used, the low and high sides of the manifold set are connected to the low and high sides of the tractor air conditioning system. The hose from the recovery unit is then connected to the manifold center port. Refer to Figure 10-3-34.*

3. To recover refrigerant, open both high and low side valves on the control panel or the valves on the manifold gauge set if being used, Figure 10-3-34.
4. Open the valves labeled "gas" and "liquid" on the recovery unit refrigerant tank, Figure 10-3-35.
5. Plug in the units power cord
6. Operate the recovery system in accordance with the manufacturers instructions.

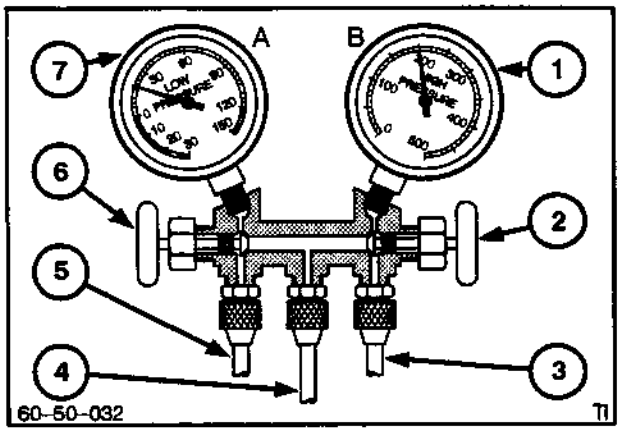
The compressor will shut off automatically when the recovery is complete.

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FLUSHING THE SYSTEM

Air conditioning systems may occasionally become contaminated with solid particles. This contamination may be the result of allowing dirt to enter the system while it was open, from aluminum corrosion or sludge, or from disintegrated compressor reed plates. Contamination of this nature can result in plugged evaporators, condensers and expansion valves.



Manifold Gauge Set

Figure 10-3-34

1. High Side Gauge
2. High Side Shut–off Valve
3. High Side Hose
4. Center Service Hose
5. Low Side Hose
6. Low Side Shut–off Valve
7. Low Side Gauge

Contaminated systems must be flushed with a special flushing solvent to remove the unwanted material. Prior to flushing, the system must be discharged as described in "Discharging the System".

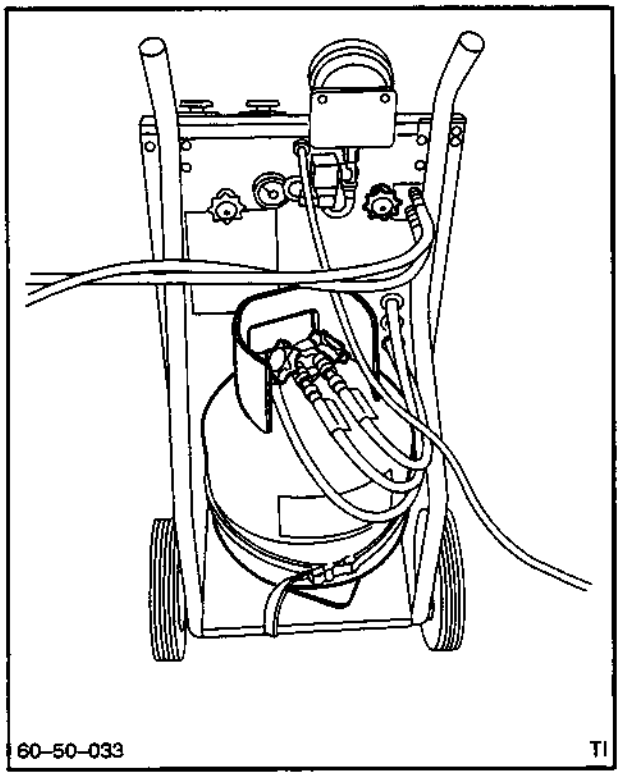


Figure 10-3-35

Each individual component must be flushed after disconnecting every hose fitting.

The compressor and expansion valve can not be flushed, therefore, the compressor should be disassembled and cleaned or replaced and the expansion valve should be replaced. When flushing the system always replace the receiver/drier.

NOTE: *Never use any solvent for flushing an air conditioning system other than a special flush solvent made specifically for air conditioning systems. Always follow the manufacturer's recommendations and directions for using the flushing equipment and solvent.*

Re–assemble and evacuate the system to remove air and moisture as described in "Evacuating the System".

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EVACUATING THE SYSTEM

IMPORTANT: *A system in which the refrigerant has been recovered to facilitate repairs, must be evacuated before new refrigerant is installed.*

Air and moisture are removed by evacuating the system using a vacuum pump.

The automatic recycling, recharge and evacuation stations or evacuating and charging stations available throughout the air conditioning industry incorporate a vacuum pump within the assembly. If this type of equipment is not available a separate vacuum pump and manifold gauge set must be used.

As the system is evacuated the boiling point of any moisture within the system is similarly lowered. As the vacuum increases the boiling reduces to below that of the ambient temperate and the moisture is subsequently boiled away.

The relationship of system vacuum to the boiling temperature at which the water vapor is removed from the system is as follows:

System Vacuum		Temperature	
In Mercury	Cm. of Mercury	° F	° C
28.0	71.0	100	38
28.9	73.4	80	27
29.4	74.6	60	16
29.7	75.4	40	5
29.8	75.7	20	-7
29.9	75.9	0	-18

NOTE: *For every 1000 feet (305 m) above sea level, the vacuum gauge reading must be corrected by adding 1" (2.54 cm) of mercury to compensate for the change in atmospheric pressure.*

IMPORTANT: *Be sure the system is completely discharged as refrigerant will damage the vacuum pump.*

1. If the manifold gauge set FNH00172 is being used connect the low and high sides of the manifold to the low and high sides of the tractor air conditioning system as described for discharging the system.

   Connect the manifold center hose to the vacuum pump suction port as per the manufacturers instructions.

   Fully open both the low and high side gauge shutoff valves.

2. If a combined recovery/evacuation unit is to be used attach the unit to the air conditioning system in accordance with the manufacturers instructions. Be sure to read all installation and operating instructions carefully before starting the unit.

3. After starting the evacuation cycle, note the low side gauge to be sure the system pulls down into a vacuum.

4. Time the evacuation for a minimum of 20 minutes from the point when lowest vacuum is attained.

5. When the low side gauge attains the lowest steady vacuum, stop the evacuation process.

NOTE: *The vacuum pump achieves ultimate vacuum with the vented exhaust valve closed.*

6. Check the system by closing the gauge shut–off valves, turning the vacuum pump off and noting the low side gauge reading. A loss of more than 2" (5 cm) of vacuum in 5 minutes indicates either a leak or moisture in the system.

7. If the gauge needle remains stationary and the vacuum is maintained for 3-5 minutes, close both the high and low side manifold hand valves, turn off and disconnect the center hose from the pump. The system is now ready for charging.

8. If a leak is detected, charge the system with approximately 14 ozs (400 g) of refrigerant, see charging the system and identify leak using a leak detector.

9. Once the leak is located discharge and recover the refrigerant in the system, repair the leak, then repeat the evacuation procedure.

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CHARGING THE SYSTEM

IMPORTANT: *Be sure there are no leaks in the system and the system has been fully evacuated.*
Observe all safety recommendations when handling refrigerant R-134a, see "Precautions when Handling Refrigerant R-134a" in this Section.

1. Ensure the charging unit is correctly connected to the tractor air conditioning system in accordance with the manufacturers instructions.

2. If a charging unit, in conjunction with the manifold gauge set is used, open the high and low side hand valves on the manifold.

3. Charge the system with 3.1lbs (1.4kg) of refrigerant as per the manufacturers instructions.

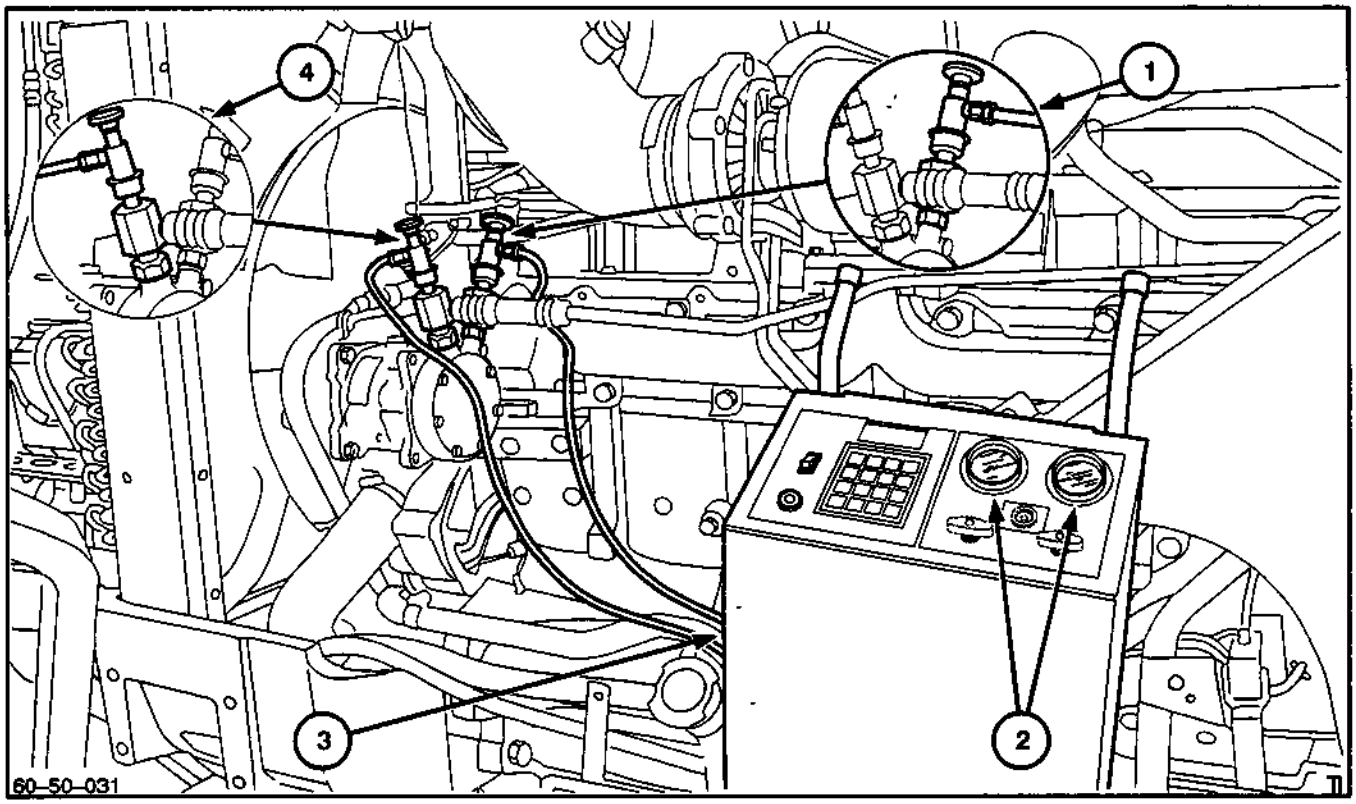
4. If the charging rate becomes very slow close the high side valve, start the tractor and set engine speed to idle. Turn 'ON' the air conditioning so that the compressor can pull the remainder of the refrigerant into the system.

5. If the refrigerant charge will not completely transfer to the air conditioning system, recover and recharge the system.

6. Close the high and low side valves on the units control panel, or manifold gauge set if being used and test the air conditioning as detailed in Performance Testing The Air Conditioning System on Page 10-3-16.

NOTE: *After charging a system use the following start up procedure to ensure the lubricating oil is properly dispersed around the system:*

- Ensure air conditioning is switched OFF.
- Start the engine and bring speed down to idle.
- Turn the air conditioning ON and allow system to operate for at least one minute before increasing engine speed.



Connecting Recovery Evacuation and Recycling/Charging Station to the Tractor **Figure 10-3-36**

1. High Side Service Valve (Red Hose)
2. Built In Manifold Gauge Set
3. Recovery/Recharging Unit
4. Low Side Service Valve (Blue Hose)

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COMPONENT OVERHAUL (EXCLUDING COMPRESSOR)

GENERAL

⚠ WARNING ⚠

Before disconnecting components in the air conditioning system the refrigerant gas must be discharged and recovered using a certified recovery system. Refer to Discharging the system on Page 10-3-32. ***Do Not*** *discharge the gas into the atmosphere.*

If an air conditioning component is to be replaced during a system overhaul it is necessary to drain any refrigerant oil that has collected in the component being replaced into a clean calibrated container.

A volume of clean refrigerant oil equivalent to that removed from the replaced component must then be added to the new item before being installed onto the tractor.

Upon completion of the repair evacuate, recharge, leak test and performance test the system to ensure correct operation.

Disconnection and Reconnection Of Air Conditioning Spring Lock Couplings

1. The spring lock couplings, Figure 10-3-37(A), can be separated using Special Tools reference FNH00890, which are available for $^{3}/_{8}$, $^{1}/_{2}$, $^{5}/_{8}$, $^{3}/_{4}$ inch diameter air conditioning tubes.

2. To separate the connection position the tool around the connector and slide the tool into the coupling, Figure 10-3-37(B), The sleeve on the tool will then release the retaining spring in the connector.

3. Pull the connector tubes to separate the coupling Figure 10-3-37(C).

4. Prior to reconnecting the connections examine the 'O' ring seals for damage and replace as necessary.

5. Coat the 'O' rings with compressor oil.

6. To reconnect the connector install the plastic ring, (1), (not part of the tool but supplied with the tractor) into the bulbous section of the coupling, (2), Figure 10-3-38.

7. Push couplings firmly together until they 'lock' at which time the plastic ring will be ejected from the bulbous section of the tube.

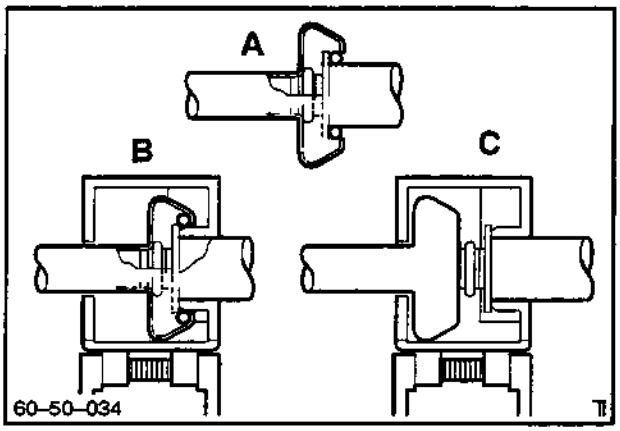


Figure 10-3-37

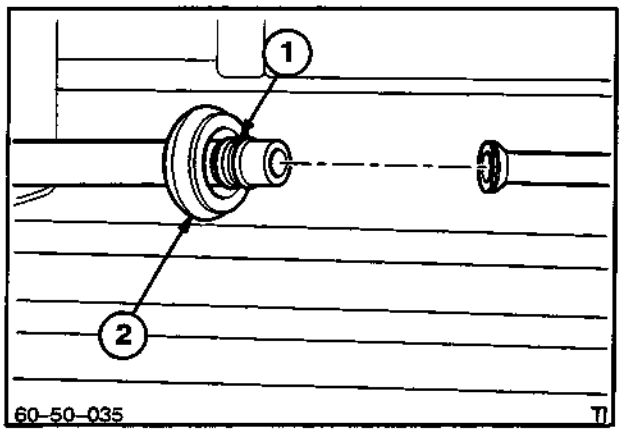


Figure 10-3-38

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EXPANSION VALVE

The expansion valve is not a serviceable item and must be replaced if defective.

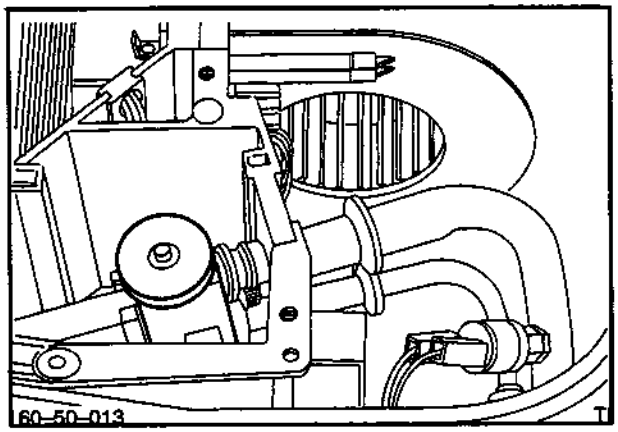


Figure 10-3-39

1. Fully discharge the air conditioning system.

2. Remove roof access hatch and evaporator cover plate to gain access to the valve, Figure 10-3-39.

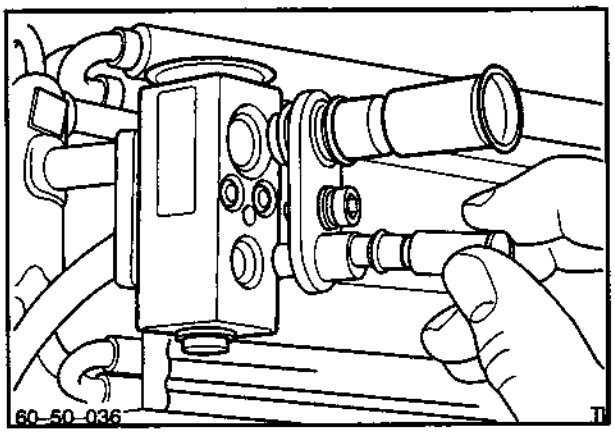


Figure 10-3-40

3. To gain access to the expansion valve spring lock couplings partially lift the evaporator core from its position in the cab roof.

4. Disconnect the two spring lock couplings to the expansion valve.

5. Remove Allen screw securing the inlet and outlet connections to the valve, Figure 10-3-40 and pull valve from tubing.

6. Replace the 'O' ring seals and lubricate with refrigerant oil prior to installing the valve using disassembly procedure in reverse, Figure 10-3-41.

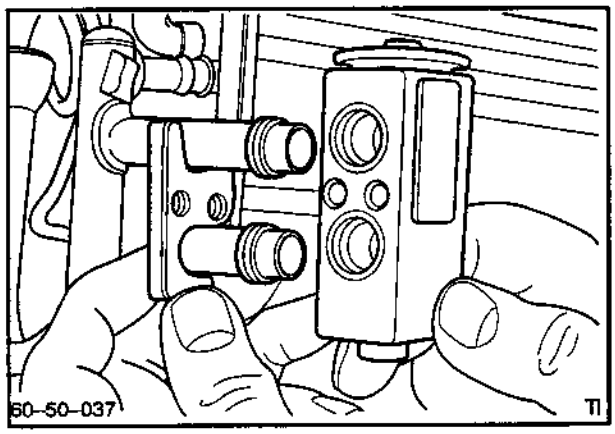


Figure 10-3-41

7. Evacuate, leak test and recharge the system.

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EVAPORATOR

1. Close the heater shut–off valve on the rear of the inlet manifold, Figure 10-3-42.

2. Turn the cab heater temperature control to maximum heat.

3. Apply a clamp to the heater return hose at the left side of the engine. Disconnect the hose and drain the heater system of coolant, Figure 10-3-43.

4. Discharge and reclaim refrigerant gas using certified recovery systems.

5. Remove the black cover plate to reveal evaporator assembly.

6. Partially lift evaporator and heater core from plastic housing to improve access to hoses, Figure 10-3-44.

7. Remove temperature cycling control thermocouple, Refer to Figure 10-3-45.

8. Disconnect tubing to expansion valve.

9. Disconnect heater hoses and remove evaporator and heater core assembly.

10. Check the evaporator assembly fins for damage. Straighten fins if necessary.

11. Clean the evaporator core of all foreign material to be sure it is free of obstructions.

12. Check the evaporator assembly for indications of refrigerant leakage. If damage or leaks are evident, replace the evaporator core.

13. If a new evaporator is to be installed drain the refrigerant oil in the evaporator into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the replacement evaporator core.

14. Install evaporator using disassembly procedure in reverse.

15. Evacuate, leak test and recharge the system.

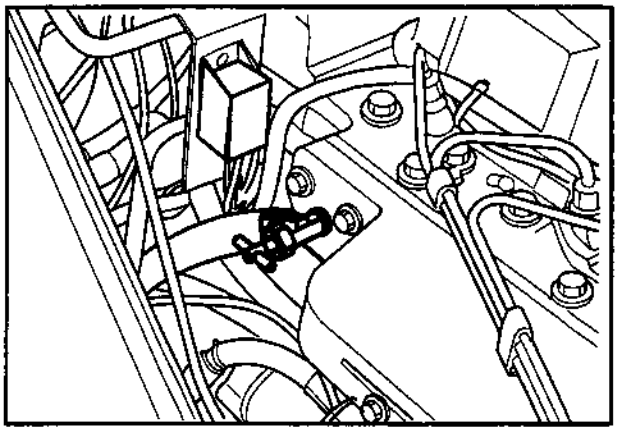


Figure 10-3-42

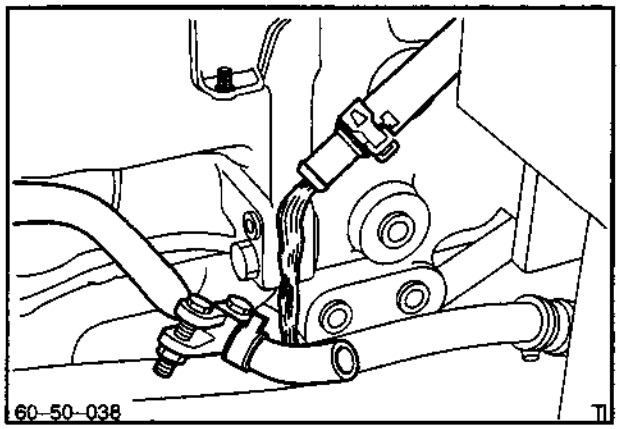


Figure 10-3-43

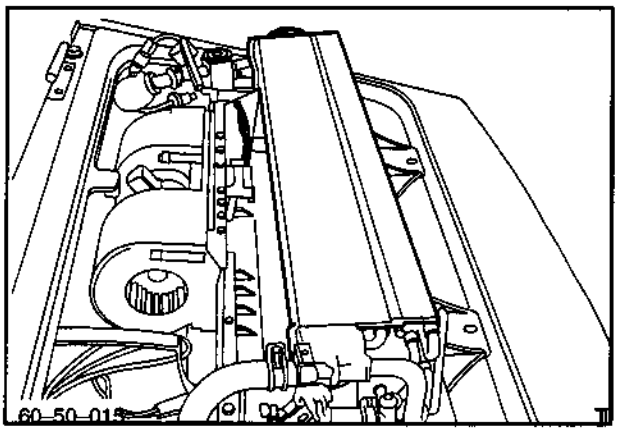


Figure 10-3-44

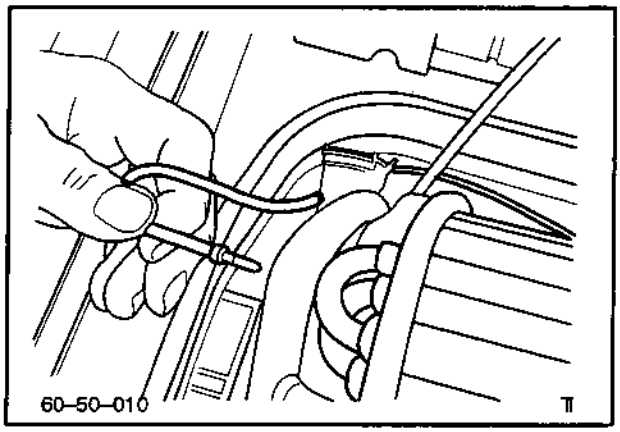


Figure 10-3-45

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AIR CONDITIONER TEMPERATURE CYCLING CONTROL SWITCH

1. Remove the black evaporator cover plate.

2. Partially lift evaporator and heater core and remove temperature cycling control switch thermistor from left hand end of evaporator, Figure 10-3-46.

3. Carefully pull and disconnect the switch wiring connector from beneath the plastic housing which holds the evaporator and blower motor assembly. Refer to Figure 10-3-52.

4. Remove temperature cycling control switch, Figure 10-3-47.

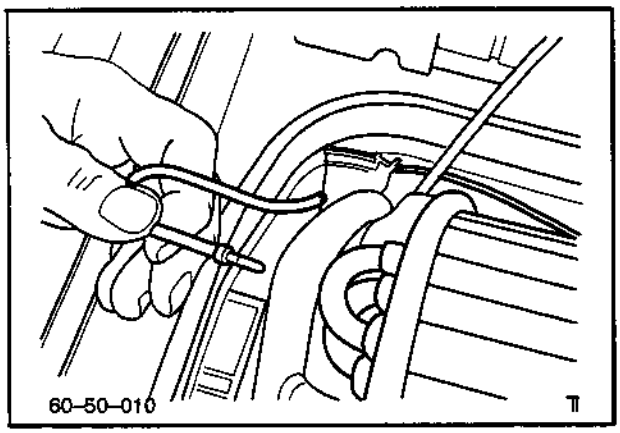


Figure 10-3-46

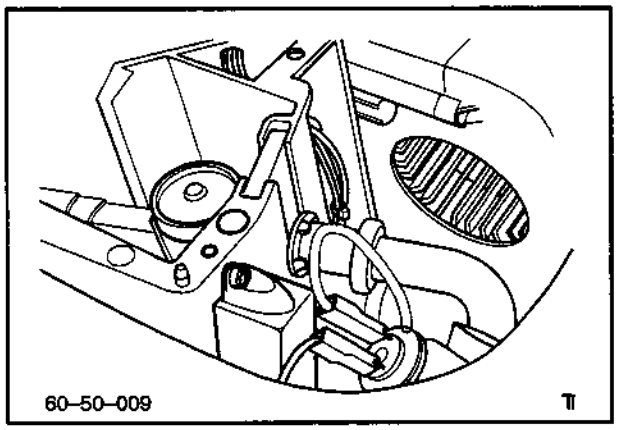


Figure 10-3-47

LOW PRESSURE CUT–OUT SWITCH

1. With the engine 'Off' check continuity across the switch contacts, Figure 6-2-12. If the switch shows 'Open Circuit' replace as detailed below.

NOTE: *The switch can be replaced without discharging the system.*

2. Remove switch, Figure 6-2-12, by unscrewing from self sealing schrader valve.

3. Replace with new switch and connect to harness.

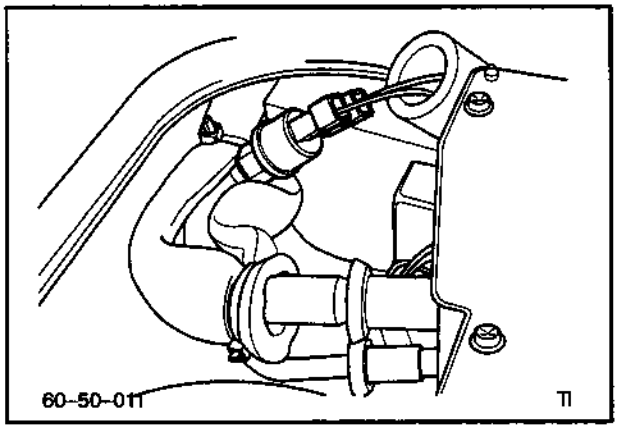


Figure 10-3-48

BLOWER MOTOR and FAN ASSEMBLY

The blower motor can if required be removed without discharging the system as follows:–

1. Remove the cab heater temperature control knob, Figure 10-3-49 and then unscrew the control shaft retaining nut.

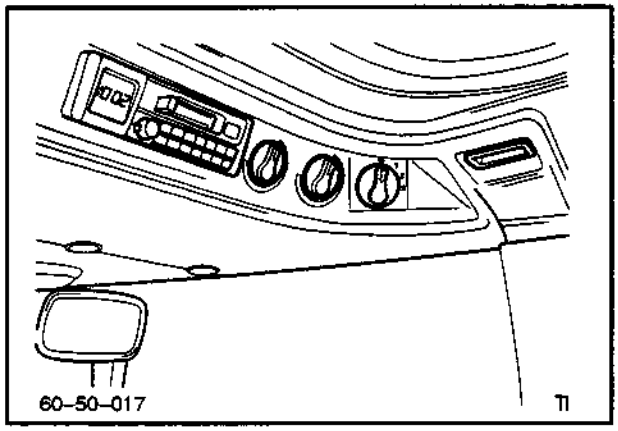


Figure 10-3-49

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2. Remove the 3 head lining studs situated close to the air louvre vents inside the front of the cab.

3. Raise the cab roof and withdraw the heater control mechanism, Figure 10-3-50, from the control panel.

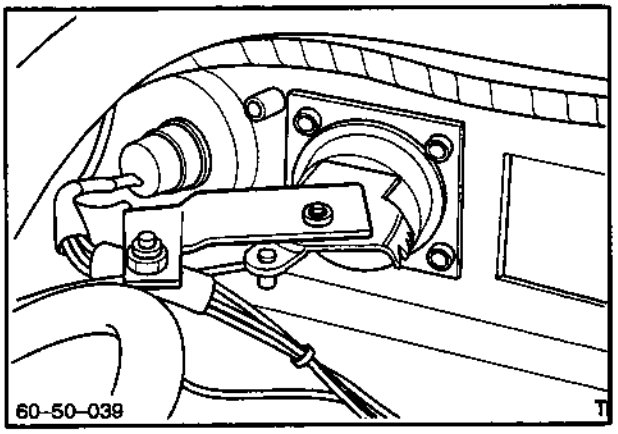


Figure 10-3-50

4. Remove the visible screws which attach the motor to the plastic air conditioning housing in the cab roof.

5. Remove the 2 retaining bolts from the plate which covers the evaporator and then remove the 2 bolts securing the plastic evaporator housing to the cab roof.

6. Carefully lift the front of the plastic evaporator housing and turn the complete assembly over towards the rear of the cab Refer to Figure 10-3-51 and Figure 10-3-52.

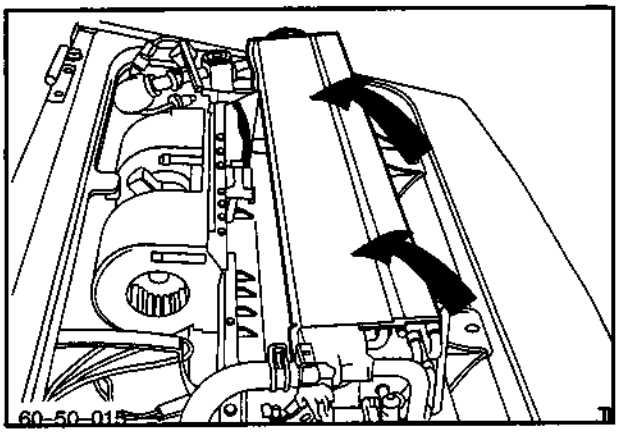


Figure 10-3-51

NOTE: *Take care not to damage hoses during this operation or spill any water onto the cab roof.*
If the cab heater hoses restrict movement of the housing drain the heater assembly and disconnect the hoses.

7. Disconnect the motor wiring connector block.

8. Remove the remaining motor securing screws and withdraw motor.

9. Re–assembly follows the disassembly procedure in reverse. During re–assembly ensure the 4 drain hoses are reconnected to the plastic air conditioning housing, Figure 10-3-52.

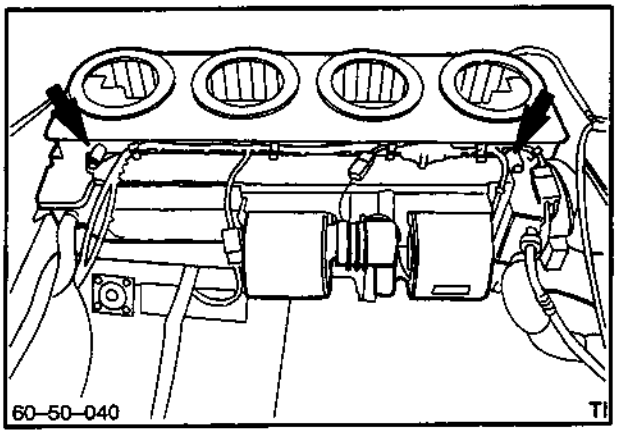


Figure 10-3-52

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RECEIVER DRYER and CONDENSER

The receiver/dryer, (2) Figure 10-3-53, cannot be overhauled and must be replaced as an assembly. The receiver/dryer assembly should be replaced if it is suspected that moisture is in the system.

The receiver dryer must also be replaced if the system has been discharged and the air conditioning joints disconnected.

1. Discharge and reclaim refrigerant gas using certified recovery systems.
2. Slide condenser, (1) Figure 10-3-53, to side of tractor.
3. Separate the air conditioning tube spring lock couplings to the receiver dryer.
4. Remove the dryer from the tractor.
5. Disconnect the connections to the condenser.
6. Cap and plug all fittings to prevent any dirt entering the system.
7. Remove condenser from tractor.
8. Inspect the condenser assembly fins for damage and be sure they are not plugged.
9. Check the condenser for signs of leakage. If the condenser is damaged or leaking, install a new condenser assembly.
10. Drain the refrigerant oil from the receiver dryer into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the new item.
11. If the condenser is to be replaced, drain the refrigerant oil from the condenser into a clean calibrated container. Measure the quantity of oil obtained and add the same quantity of new refrigerant oil directly into the new condenser.
12. Soak new tubing connector 'O' rings in clean refrigerant lubrication oil and install onto tubing
13. Install condenser and a new receiver dryer.
14. Evacuate, leak test and recharge the system.

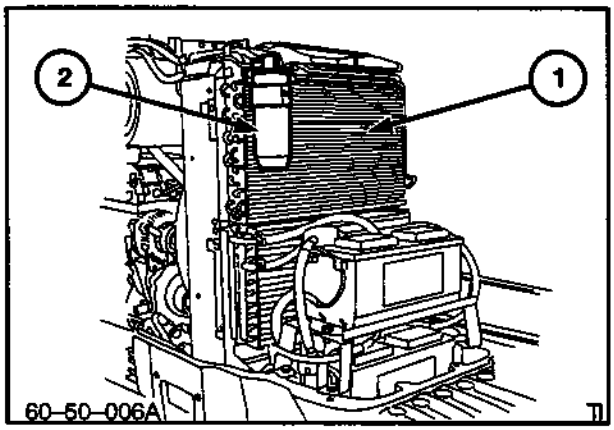


Figure 10-3-53

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COMPRESSOR HIGH LOW CUT–OUT SWITCH

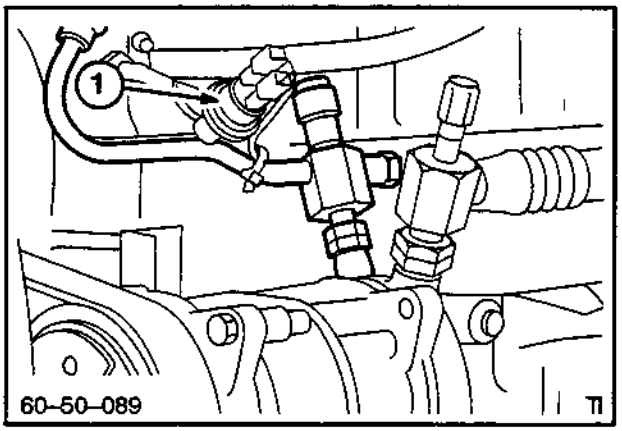


Figure 10-3-54

1. With the engine 'Off' check continuity across the switch contacts, (1), Figure 10-3-54. If the switch shows 'Open Circuit' replace as detailed below.

NOTE: *The switch can be replaced without discharging the system.*

2. Remove switch by unscrewing from self sealing schrader valve.

3. Replace with new switch and connect the harness.

CAB AIR FILTERS

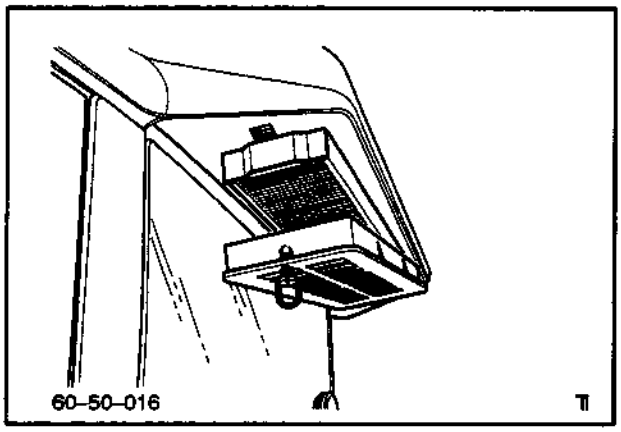


Figure 10-3-55

1. Before servicing the filters, switch off the blower and close the roof hatch, all windows and one door. Slam the final door closed and the resulting back pressure will dislodge most of the loose dirt from the underside of the filters.

2. Remove filter element(s), Figure 10-3-55 and clean by blowing with compressed air not exceeding 30 lbf/in^2 (2 bar).

   Blow the dust from the upper surface through the element to the underside. Hold the nozzle at least 12 in (300 mm) from the element to prevent damage to the paper pleats.

3. Clean both filter chambers with a damp, lint free cloth.

4. Replace the filter elements with the rubber seal uppermost and re–install the covers.

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COMPRESSOR – OVERHAUL

Compressor Removal

1. Discharge and reclaim refrigerant gas using certified recovery systems. Record the amount of oil discharged as (X).

2. Disconnect tubing to compressor.

3. Disconnect wiring connector to compressor clutch.

4. Disconnect drive belt, remove the four mounting bolts and remove compressor from tractor.

5. Drain the refrigerant oil from the old compressor into a clean calibrated container. Measure and record the quantity of oil as (Y). This information is required during installation of the new or overhauled unit.

NOTE: *It is necessary to rotate the compressor drive shaft several times to completely expel all the oil.*

Compressor Installation

1. Installation is the reversal of the removal but the following points should be noted:–

- Torque the mounting bolts to 29–38 ft. lbs. (40–51Nm).

NOTE: It is recommended that a new receiver / drier assembly is installed after any system component replacement or any repair that requires entry into the system.

- Drain the oil from the new compressor to be fitted into a clean container, or if the old compressor is to be refitted, obtain a new can of refrigerant oil.

- Calculate the amount of oil to be installed as, **(x)+(y)**. Add this quantity of the new oil into the fill port on top of the compressor.

NOTE: *Refer to the following page regarding **Oil Level Measurement** to determine if the system oil quantity is correct.*

After charging a system use the following start up procedure to ensure the lubricating oil is properly dispersed around the system:

- Ensure air conditioning is switched OFF.
- Start the engine and bring speed down to idle.
- Turn the air conditioning ON and allow system to operate for at least five minutes before increasing engine speed.

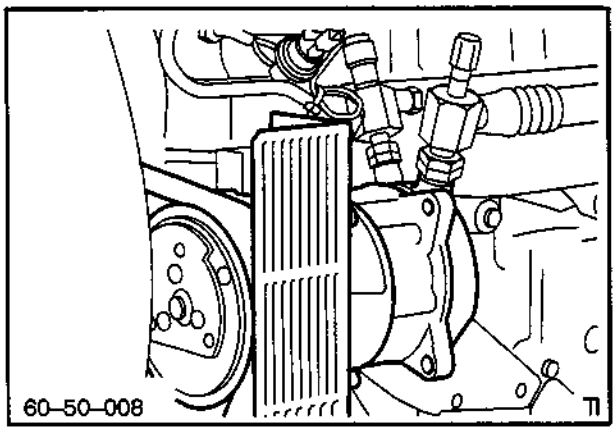


Figure 10-3-56

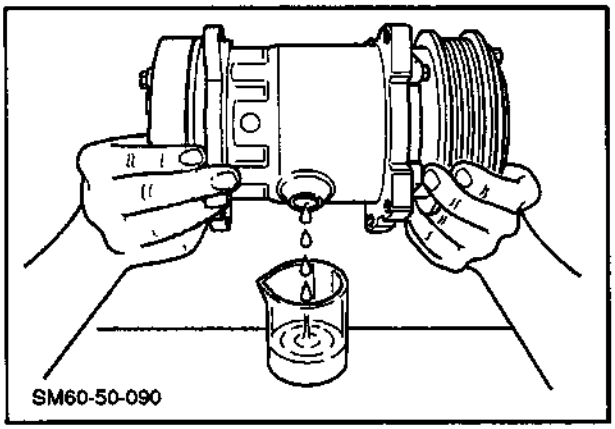


Figure 10-3-57

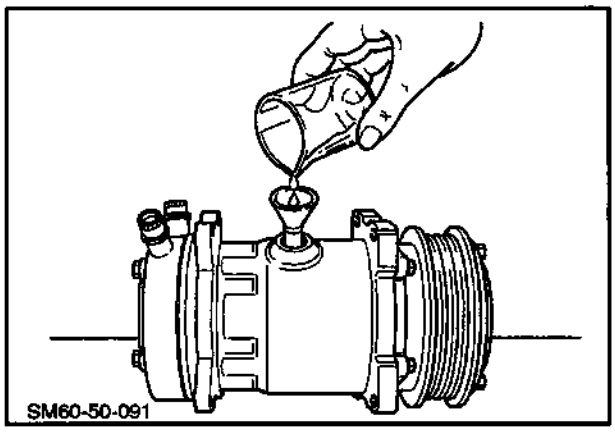


Figure 10-3-58

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Oil Level measurement (on vehicle)

Oil level in the compressor should be checked when a system component is removed or replaced or when an oil leak is suspected.

Use the following procedure to determine if the oil quantity is correct.

1. Start the engine and allow to idle. Switch on air conditioning and run the compressor for 10 minutes.

2. Recover the refrigerant from the system, very slowly so as not to lose any oil.

3. Carefully remove the oil filler plug. Turn the armature retaining nut to allow full insertion of the oil dipstick (1) Figure 10-3-59, supplied with kit NH.50–100.

4. Remove the dipstick and count the notches covered by the oil. An acceptable level of oil is when 5–7 notches are covered.

5. Add or subtract oil through the filler plug to obtain the correct level.

6. Ensure the filler hole seat and filler plug seal are clean and not damaged and Install the oil plug. Tighten to 11–18 ft. lbs. (15–25Nm).

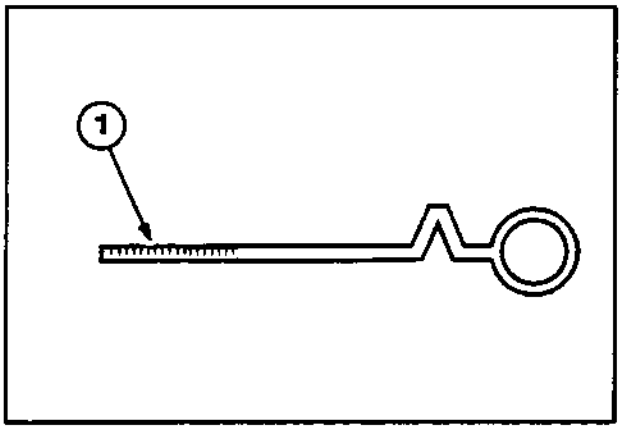


Figure 10-3-59

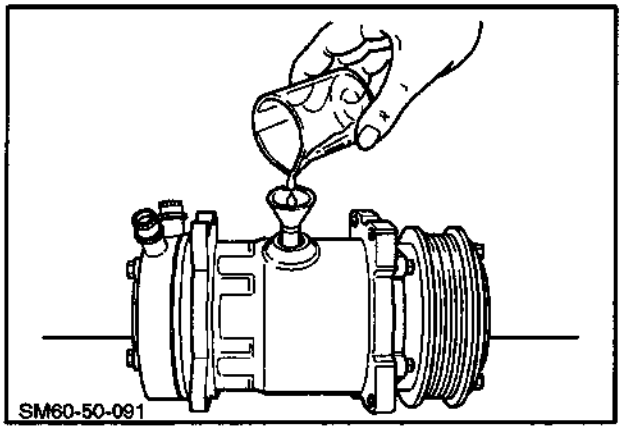


Figure 10-3-60

Oil Retained in System Components

After replacement of individual system components it will be necessary to add some oil to the system to make up the amount lost in the removed component. The table, on the right, shows some typical volumes for the components. It is, however, still recommended that the on vehicle oil level measurement procedure, described above, is carried out after a new component has been installed to establish correct oil quantity.

Component	Typical oil amount	
	fl.oz.	cc
Evaporator	2.0	60
Condenser	1.0	30
Receiver / drier	0.5	15
Hoses	0.3	10

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Preliminary Inspection

1. Rotate the compressor shaft. Use a suitable socket on the hub center bolt or by hand using the rubber dampers.

   If severe roughness is felt while rotating the hub, the compressor should be disassembled.

2. Using a 12 volt battery check current drawn by the field coil which should be between 3.6– 4.2 Amps.

   Very high current readings indicate a short circuit in the field coil and no current reading indicate an open circuit. Replace coil with either fault. Resistance of the coil using an ohmmeter should be approximately 3.0Ω at 68°F (20°C).

   A poor ground connection of the field coil will result in a low voltage.

3. Ensure clutch is disengaged and rotate pulley by hand. If roughness in the bearing is felt, it will be necessary to replace the pulley and bearing as an assembly.

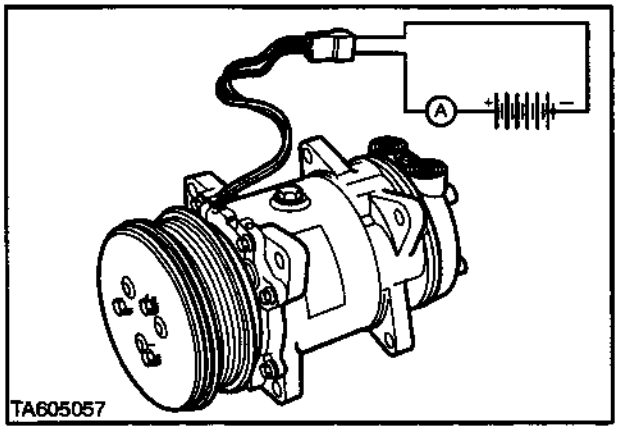


Figure 10-3-61

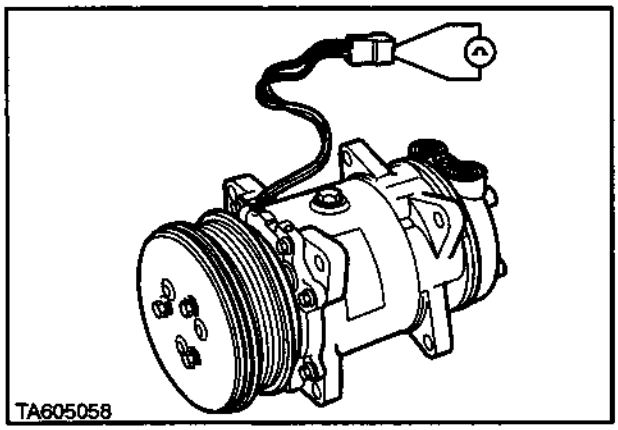


Figure 10-3-62

Clutch Disassembly

Removal

All clutch servicing should be done with the compressor removed from the vehicle:

1. Support the compressor. If using a vise, do not hold on to the housing.

2. Remove the cover on the front of the clutch plate.

3. Using the front plate tool hold the clutch plate stationary and remove the retaining nut from the end of the shaft. Figure 10-3-63.

4. Place a thread protector over the end of the driveshaft and using a puller remove the clutch front plate, Figure 10-3-64.

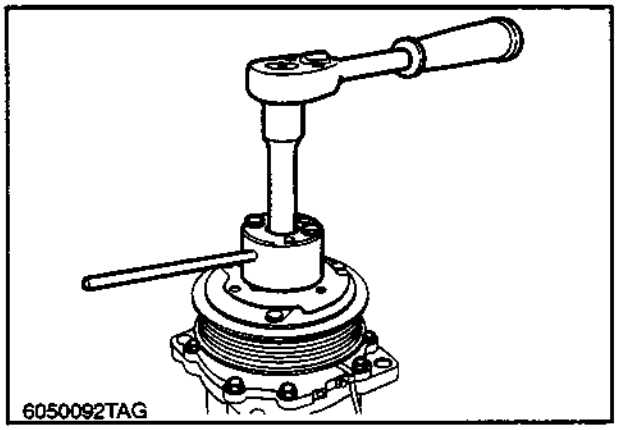


Figure 10-3-63

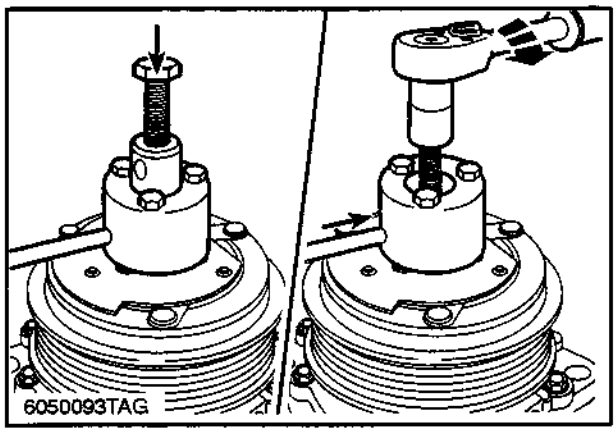


Figure 10-3-64

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5. Carefully remove the bearing dust cover, if fitted.

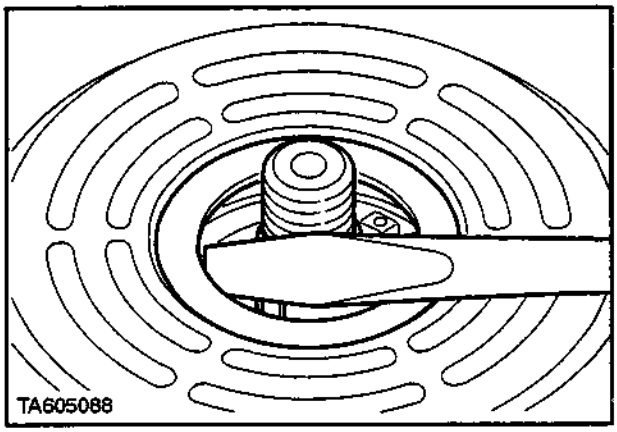


Figure 10-3-65

6. Remove the clutch shims

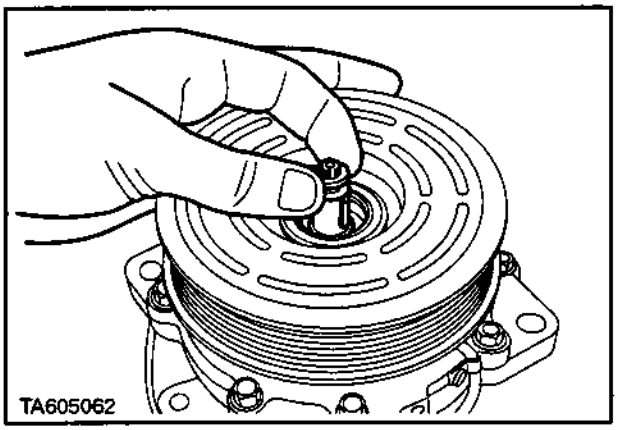


Figure 10-3-66

7. Remove the shaft key

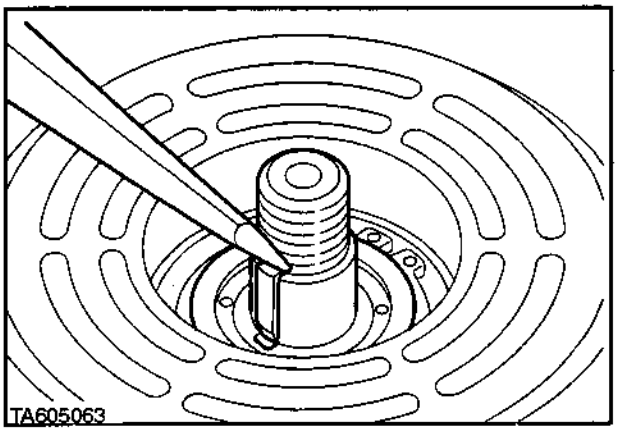


Figure 10-3-67

8. Remove the pulley bearing external snap ring

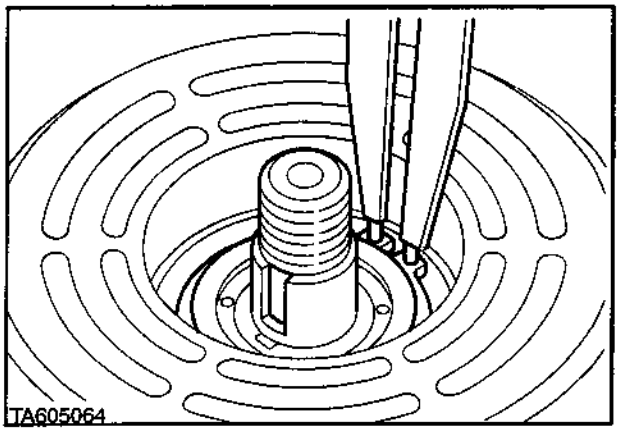


Figure 10-3-68

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9. With a shaft protector over the exposed shaft, use a suitable puller to remove the clutch pulley.

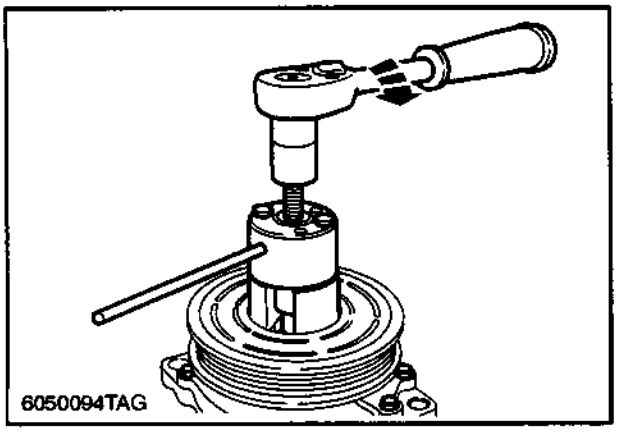


Figure 10-3-69

10. Inspect the pulley bearing for wear and replace where necessary.

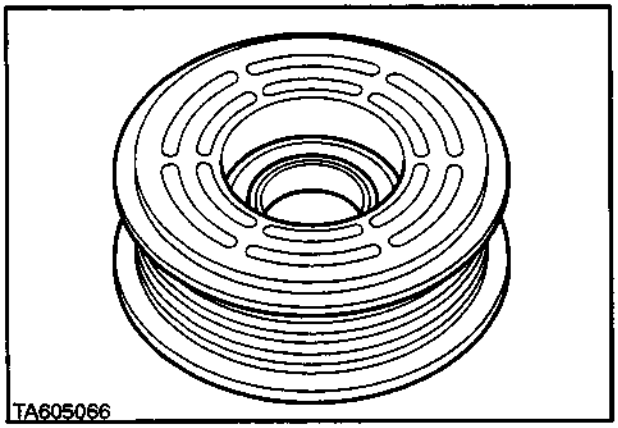


Figure 10-3-70

11. Remove the field coil wire retaining clip.

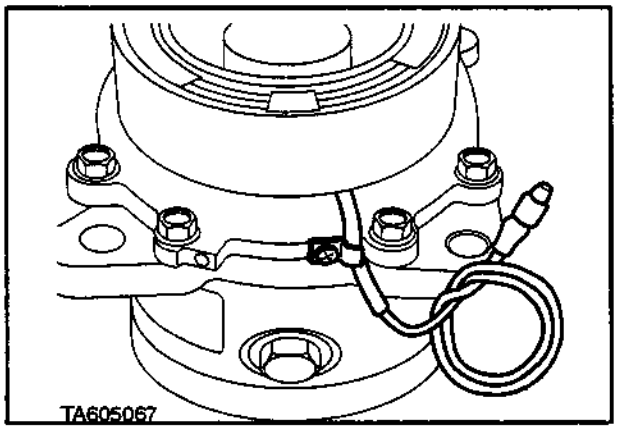


Figure 10-3-71

12. Remove the field coil retaining snap ring and lift the coil from the housing.

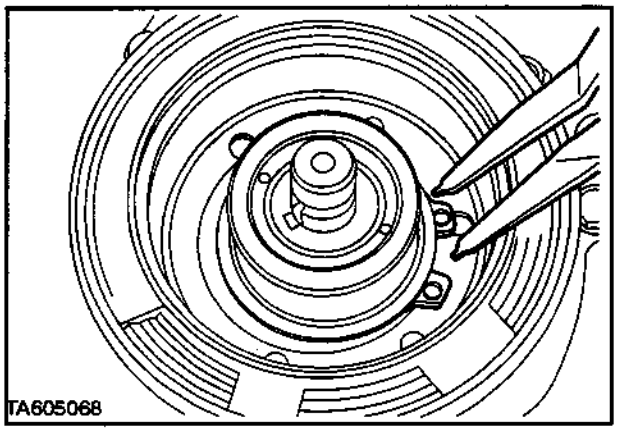


Figure 10-3-72

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Clutch Reassembly

1. Install the field coil, ensuring that the lug on the compressor housing locates in the cut out on the back of the coil housing, secure with the snap ring.

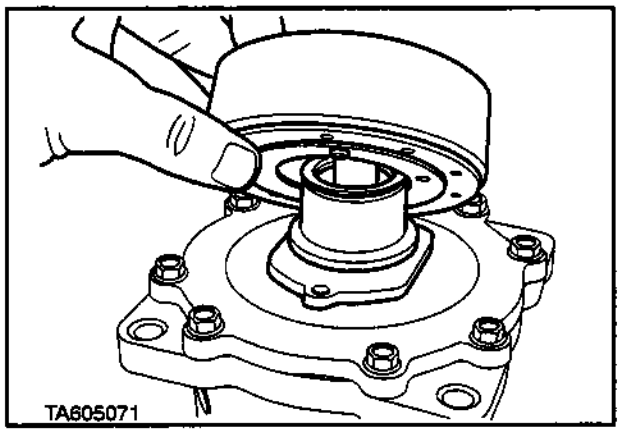


Figure 10-3-73

2. Position the pulley on the housing hub.

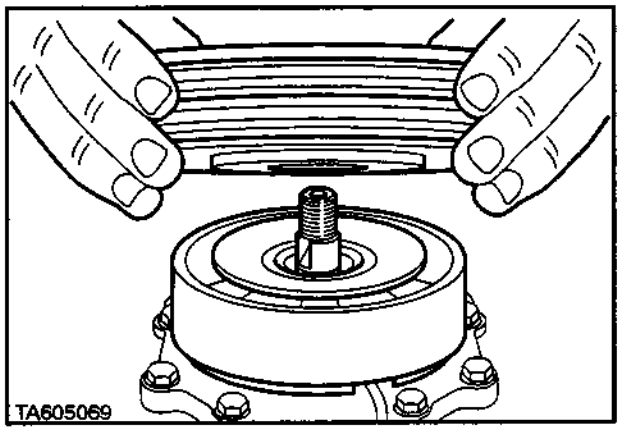


Figure 10-3-74

3. Using a suitable adaptor that rests firmly on the inner race of the pulley bearing, tap the pulley onto the front hub of the compressor.

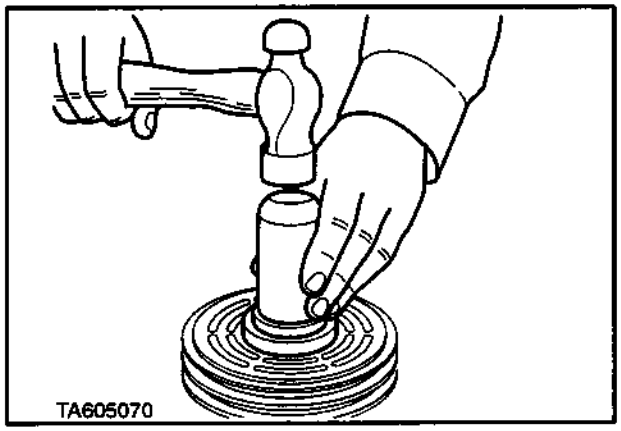


Figure 10-3-75

4. Install the bearing snap ring.
5. Replace the original shims, key and a new bearing dust cover.

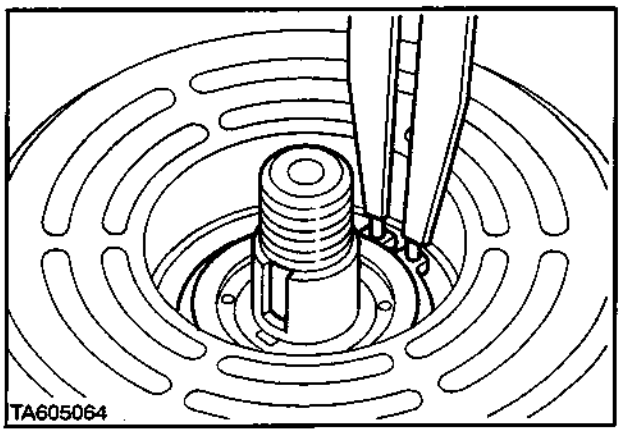


Figure 10-3-76

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6. Install the clutch front plate and using a suitable adaptor, tap into position.

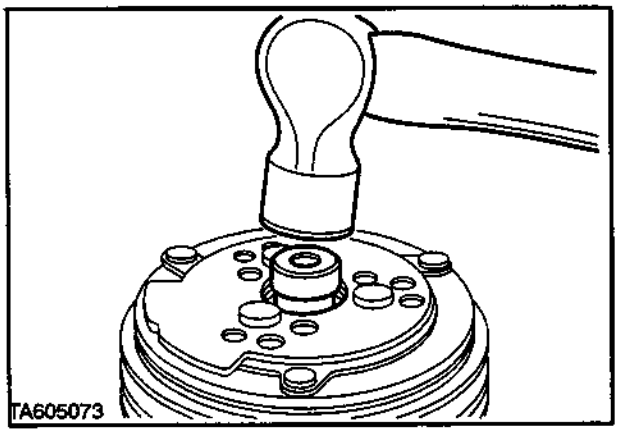


Figure 10-3-77

7. Replace the retaining nut and tighten to a torque of 13 ft. lbs. (18Nm).

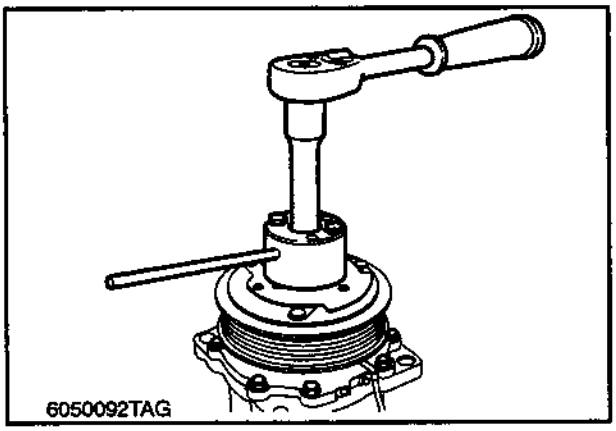


Figure 10-3-78

8. Check the clearance between the clutch front plate and pulley. This should be consistent around the circumference and be between 0.016–0.031in. (0.4–0.8mm)
9. If the air gap is not consistent, lightly pry up on the counter weighted front plate at the low spots or lightly tap down at the high spots.

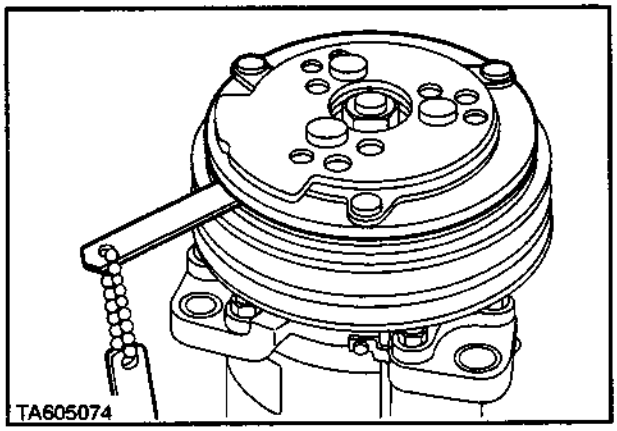


Figure 10-3-79

10. If the clearance is not within specification the shims under the front plate, Figure 10-3-80, should be added to or subtracted from until the correct clearance is obtained.

NOTE: *New shims are available in sizes 0.040, 0.020 and 0.005 in., (1.00, 0.50 and 0.13 mm).*

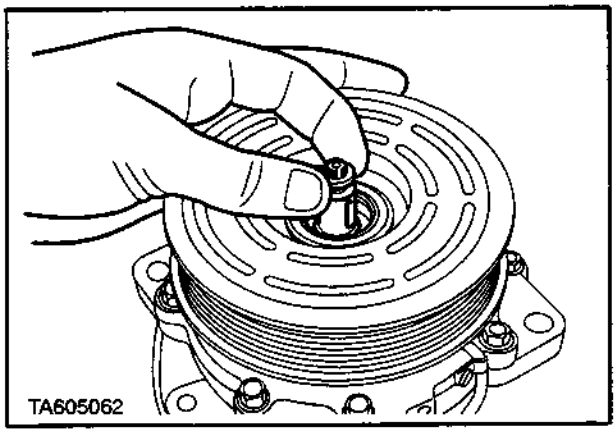


Figure 10-3-80

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Shaft Seal Replacement

The refrigerant must be discharged from the system and the compressor removed from the vehicle prior to replacing the shaft seal.

Removal

1. Remove the clutch front plate, as detailed in steps 1 to 7 of clutch disassembly.
2. Using a suitable lever or pair of snap ring pliers, remove the felt ring.

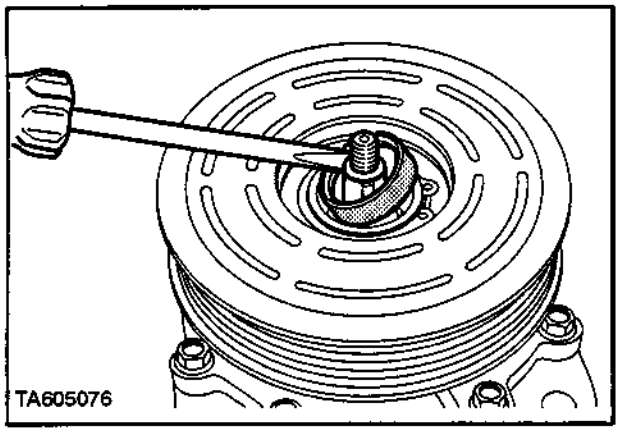


Figure 10-3-81

3. Remove the shaft seal retaining snap ring.

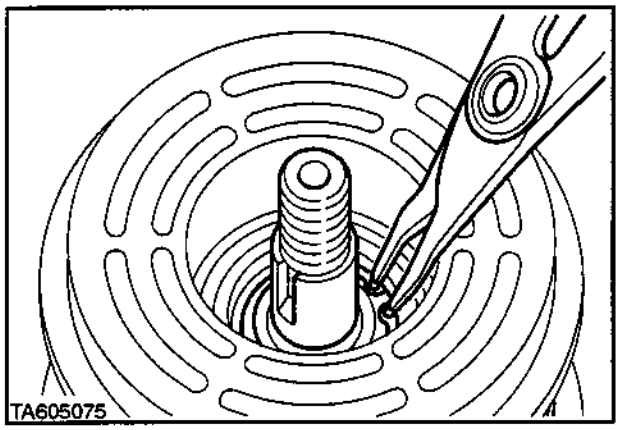


Figure 10-3-82

4. Insert the seal remover/installer tool. Twist the tool to engage the slots in the seal. Pull up to remove. Discard the seal.

NOTE: *If seal remover tool is not available, insert a suitable piece of hooked wire into the seal slot and pull out seal.*

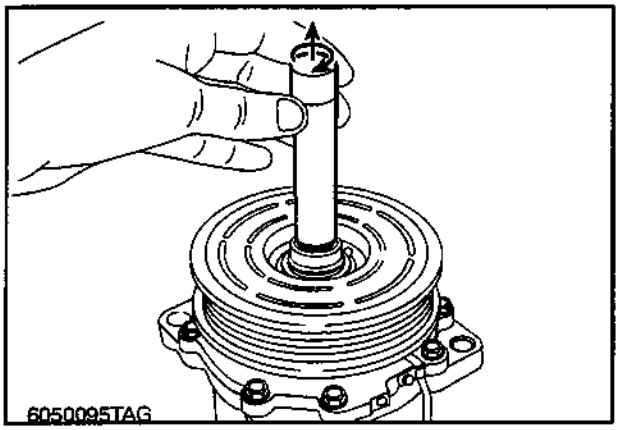


Figure 10-3-83

Installation

1. Thoroughly clean the seal cavity in the hub. Use 'lint free' cloth only.
2. Position the seal protector over the driveshaft.

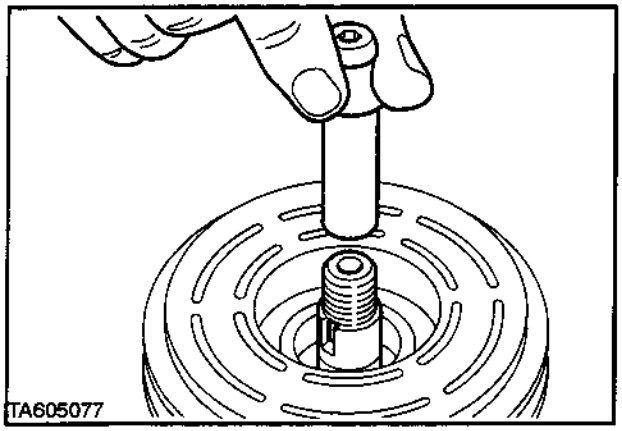


Figure 10-3-84

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3. Ensure the shaft seal 'O' ring is installed onto the seal assembly.

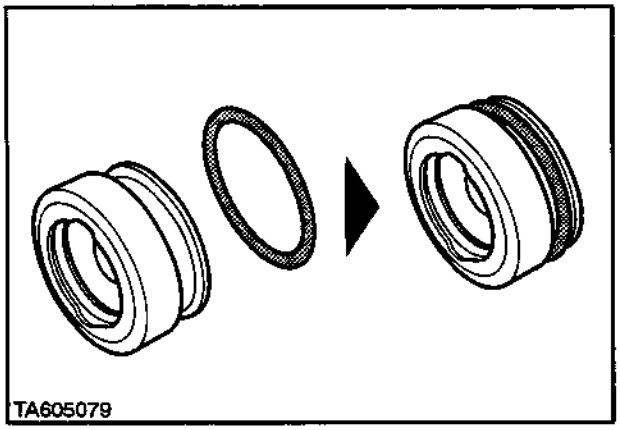


Figure 10-3-85

4. Dip the new seal assembly in clean refrigerant oil and attach to the seal remover/installer tool.
5. Insert the new seal fully into the hub.

NOTE: *If remover/installer tool is not available, position the seal squarely in the hub and tap gently until fully seated.*

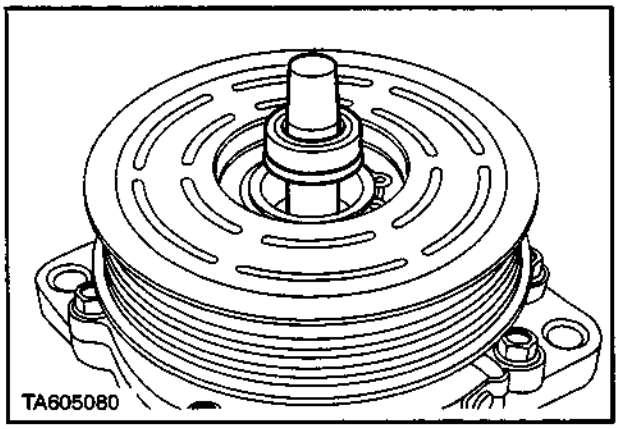


Figure 10-3-86

6. Install the seal snap ring. If the snap ring has a beveled edge this should face outwards.

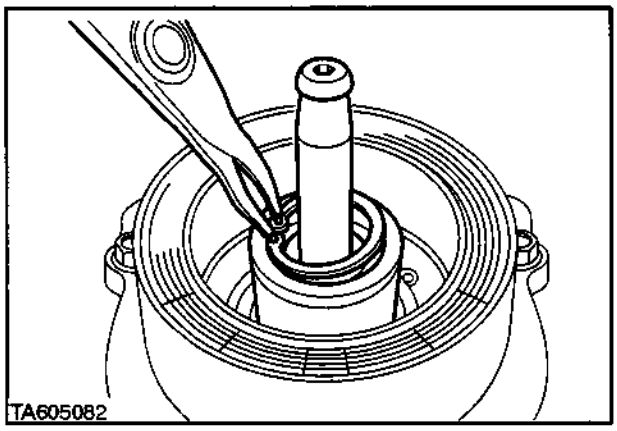


Figure 10-3-87

7. Install a new felt seal and gently tap into position.
8. Remove the shaft protector and position the shims over the shaft.
9. Reinstall the clutch front plate as described in clutch reassembly.

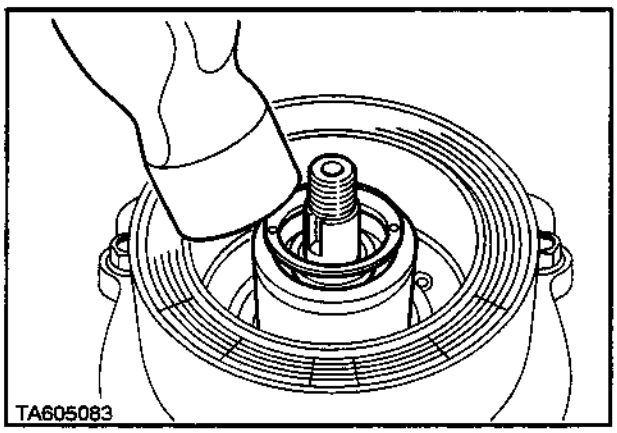


Figure 10-3-88

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CYLINDER HEAD SERVICING

Disassembly

1. Drain the refrigerant oil from the compressor into a clean calibrated container. Measure and record the quantity of oil obtained. This information is required during installation of the new or overhauled unit.

2. Remove the six cylinder head bolts and using a hide mallet, gently tap the cylinder head free. The use of a gasket scraper may also be required to free cylinder the cylinder head from the compressor body.

3. If the valve plate and/or cylinder head are to be reused, carefully remove the gasket using a suitable scraper.

4. Gently pry the valve plate free from the cylinder block and remove the gasket.

5. Inspect the valve plate for damage.

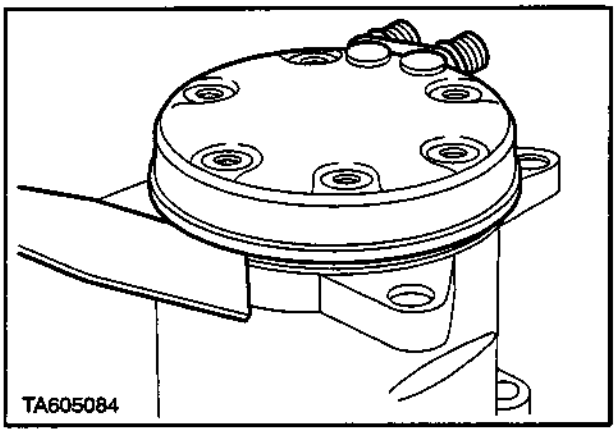


Figure 10-3-89

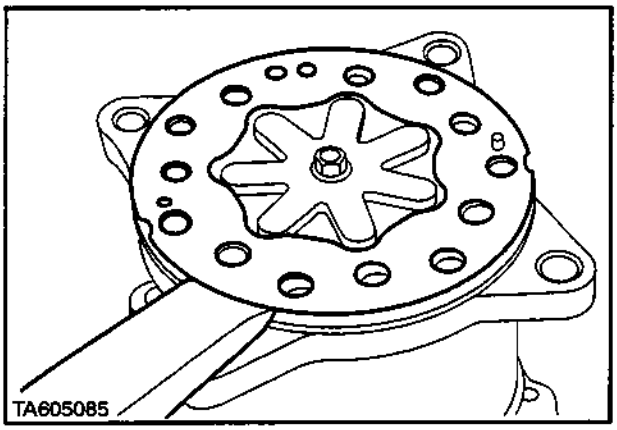


Figure 10-3-90

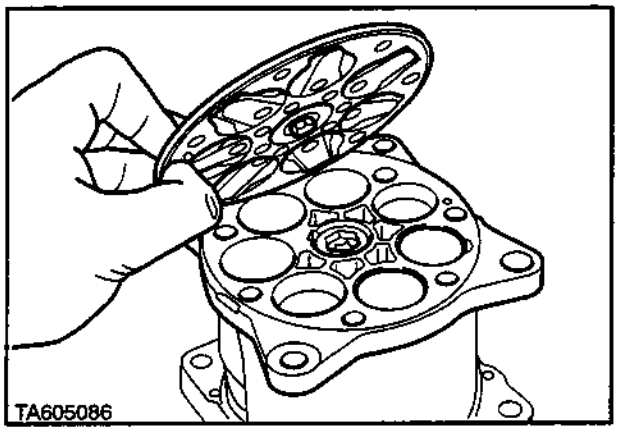


Figure 10-3-91

Reassembly

1. Coat the top of the valve plate with clean refrigerant oil and reassemble the cylinder head using the reverse of the disassembly procedure.

2. When installing the gaskets and valve plate ensure they are correctly positioned over the locating pins in the cylinder block.

3. Install the cylinder head bolts and tighten using the sequence shown in Figure 10-3-92. Torque initially to 14 ft. lbs. (20Nm) then finally to 24 ft. lbs. (32Nm).

4. When the overhaul is complete add to the compressor a volume of oil equivalent to that drained prior to disassembly.

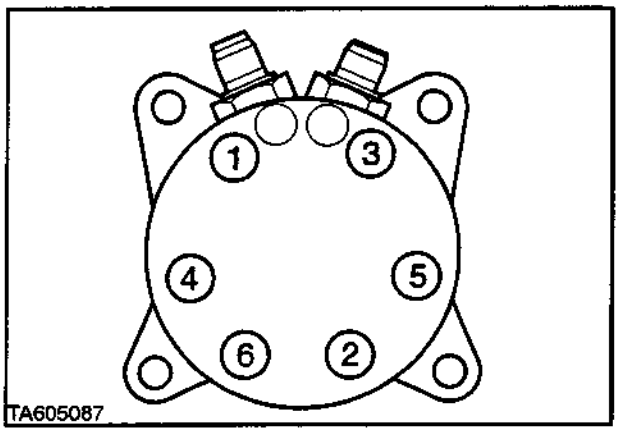


Figure 10-3-92

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