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WORKSHOP MANUAL

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INTRODUCTION

The purpose of this workshop manual is to provide instruction for repair technicians and a practical guide to improving the quality of repairs.

This manual enables repair technicians to acquire a thorough knowledge of the machine, indicating the correct methods for fault diagnosis, for working in safety and for accurate dimensional checks and visual inspections. The instructions also indicate the products to use, the tightening torques and the adjustment data.

The technical material contained in this manual is reserved to Authorised Dealers and Service Centres who will be duly informed of any technical changes to the machines in question through the issue of documents regarding modifications, updates and supplements for optional equipment.

All technicians and their colleagues are expressly forbidden from reproducing any part of this manual in any form or from communicating the contents to third parties without the express written permission of the Manufacturer, who remains the sole owner of this document with all rights reserved in accordance with applicable laws.

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SAFETY NOTES

To ensure that machines entrusted to Authorised Service Centres for repair or overhaul continue to function correctly, it is very important that all repair work is carried out in the prescribed manner.

The procedures for checks and repairs indicated in this manual are safe and effective.

Some of the operations described require the use of special tools and equipment: these tools have been designed for a specific purpose and may ordered directly from the Manufacturers.

DO NOT USE MAKESHIFT TOOLS; not only is there is risk of personal injury, but such tools are rarely suited to the purpose for which they are used.

To prevent injury to operators, the symbols ⚠ and ✱ are used in this manual to indicate the safety precautions required. The warnings accompanying these symbols must always be adhered to carefully.

In potentially hazardous situations, always give priority to personal safety and take the necessary actions to eliminate the danger.

GENERAL SAFETY RULES

1 - Even if you have a thorough knowledge of the machine as regards its components, operation and controls, always take particular care when carrying out the following operations. Remember that the machine you are working on is in need of repair or overhaul and consequently may not always behave as expected.

2 - Before starting work, clean the machine thoroughly to remove all mud, dust and road dirt.
Also clean the cab to remove all traces of oil, snow and ice from the access steps and grab rails.

3 - When climbing up to or down from the cab, always ensure you maintain three points of contact at a time (foot or handholds) in order to keep your balance and prevent accidental falls.

4 - Always take special care when carrying out fault diagnosis operations; these operations often require two persons, who must never stand in front of the wheels when the engine is running.

5 - When carrying out checks and repairs, wear close-fitting clothing, safety goggles and protective gloves that are suitable for the task (cleaning, draining fluids, repairs).
When working near moving parts, long hair should be gathered up and secured safely under a cap to prevent the risk of entanglement and sever injury.

6 - Do not allow anyone who is not directly involved in the work to come near the machine; ensure that they remain at a safe distance.

7 - Keep well clear of moving parts; when the engine is running, some moving parts are not easily visible and therefore present a risk of entanglement, even if protected by safety guards.

8 - Ensure that the area is well ventilated before starting the engine in order to avoid the formation of dangerous concentrations of toxic gases; always connect suitable fume extraction equipment to the exhaust pipe.

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9 - Under no circumstances start the engine with the safety guards removed; all repair and adjustment operations must be carried out with the engine stopped.

10 - Do not top up fuel, oil or coolant levels when the engine is running.

11 - Never smoke and ensure there are no naked flames nearby when topping up fuel or oil.
Always remove the battery from the machine before recharging.

12 - Before checking or removing the battery, stop the engine and remove the key from the starter switch.

13 - Remove the battery and recharge in a well-ventilated area where the temperature exceeds 0°C.

14 - When checking or recharging the battery, do not smoke or allow naked flames in the vicinity as the hydrogen gas given off by the battery is highly explosive.

15 - The liquid (electrolyte) contained in the battery is very harmful if it comes into contact with the skin and the eyes; for this reason, always wear gloves and safety goggles with side shields when checking or topping up the battery.
Should any electrolyte accidentally come into contact with your skin, wash the affected parts immediately with copious amounts of water. If electrolyte comes into contact with your clothing, this should be removed as soon as possible.
In case of accidental ingestion of electrolyte, drink copious amounts of water, milk or vegetable oil and take antacids such as magnesium, bicarbonate, etc.. and seek medical attention immediately.

16 - Before working on the electrical systems, always disconnect the battery terminals.

⚠ IMPORTANT!
Always disconnect the negative terminal (–) first and then the positive terminal (+); when re-connecting the battery on completion of the work, first connect the positive terminal (+) and then the negative (–).

17 - Before carrying out any arc welding, on the tractor, always disconnect the battery terminals and unplug all the connectors of the electronic control units and the alternator.

18 - When topping up lubricants, always wear suitable protective gloves.

19 - Do not wear clothing contaminated by engine or hydraulic oil; prolonged contact with the skin can be harmful and may cause allergic reactions.

20 - Used engine oil and hydraulic oil must be disposed of in a proper manner; recover used lubricants and dispose of them in accordance with the applicable regulations.

21 - Before carrying out any work on the hydraulic or pneumatic systems, discharge all residual pressure from the circuits.

22 - Before carrying out any work on the hydraulic system or engine, allow the oil and engine coolant to cool down.

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23 - When removing and refitting certain assemblies, it will be necessary to support the machine; use stands, jacks or blocks capable of supporting the weight and arrange them in a triangular pattern to prevent the machine from overturning.

24 - To lift heavy components, use a hoist or crane.
Check that wire ropes, chains or fibre slings are not worn and that hooks are not damaged.

25 - Always use lifting equipment of suitable capacity for the weight of the components to be removed. Ensure lifting equipment is attached correctly.

26 - When lifting or supporting an assembly or component, manoeuvre the parts slowly and carefully to avoid oscillation or collision with other components.

27 - Never work on components suspended from a hoist or crane.

28 - When removing the retaining bolts of a component that could fall, always leave two opposing bolts in place for safety; these bolts should only be removed when the component has been securely attached to a hoist or when supporting blocks have been put in position.

29 - Any oil or fuel spilled during removal or dismantling operations should be cleaned up as soon as possible to prevent the risk of slipping and fire.

30 - When refitting electrical wiring looms and wires, ensure that they are properly secured with their original retaining straps or brackets to prevent the possibility of damage caused by vibration.

31 - Never insert your fingers or hands to check the alignment between fixing holes in components; always use a suitable dowel of soft material.

32 - When refitting assemblies or components, always use the specified tightening torques; the tightening torques indicated in the paragraphs regarding assembly/refitting operations have been determined through experimentation and must be scrupulously adhered to.

33 - When refitting parts that are subject to vibration or that rotate at high speed, take particular care when carrying final installation checks.

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SAFETY PRECAUTIONS FOR REMOVAL AND REFITTING OPERATIONS

★ When removing or refitting parts, always take the following safety precautions.

1. PRECAUTIONS FOR REMOVAL OPERATIONS

- Unless otherwise indicated, lower the working equipment until it rests on the ground.
- After disconnecting hydraulic and fuel system pipes, always fit plugs to the open ends of the pipes to prevent ingress of impurities.
- Before removing a cylinder, fully retract the piston and secure it in this position using a retaining strap.
- Use containers of sufficient capacity when draining oil, coolant or fuel.
- Before removing a part from the machine, check for alignment markings indicating the correct assembly position. If necessary, make new markings to ensure correct assembly.
- When unplugging electrical connectors, always grip the connectors firmly to avoid pulling on the wires.
- Where necessary, label wires and pipes before removal to avoid confusion when reconnecting.
- Check the number and thickness of any shims removed and keep them together in a safe place.
- To lift the machine or any of its main components, use lifting equipment of suitable capacity.
- When using eyebolts for lifting tractor components, first check that they are not deformed or damaged, screw them fully home and then turn the bolt so that the eye is aligned with the lifting hook.
- Before removing a part, clean the surrounding area and, after removing the part, cover it to prevent the ingress of dirt and dust.

2. PRECAUTIONS FOR REFITTING OPERATIONS

- Tighten nuts and bolts to the specified tightening torques.
- When refitting flexible pipes and wires, take care not to twist or tangle them.
- Always fit new seals, O-rings, cotter pins and safety stop rings on reassembly; make sure that the ends of the cotter pins are separated and bent back so that the pin cannot be withdrawn from the hole.
- Ensure that circlips are correctly installed in their seatings.
- Always fit new seals, O-rings, cotter pins and safety stop rings; ensure that cotter pins are bent over so that they cannot work loose.
- When applying sealant, first clean the surface removing all traces of oil and grease and check for dirt or indentations, then apply the sealant evenly making sure that it forms a continuous film around any fixing holes.
- Clean all parts, removing dirt, oxidisation, carbon deposits, burrs and indentations.

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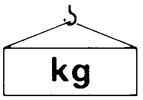
- Coat all moving parts with a thin film of engine oil.
- When reconnecting electrical connectors, first remove all traces of oil, dust and water from the inside of the connector and then push the two halves together firmly; only apply the force necessary to clip the two halves together.
- Bolt down flanged fittings evenly, tightening the bolts gradually in a crosswise pattern.

3. PRECAUTIONS TO BE TAKEN ON COMPLETION OF REMOVAL/REFITTING OPERATIONS

- If coolant has been drained from the engine, refit the drain plug and add new coolant to the correct level. Start the engine to circulate the coolant and then check the level again and top up.
- After removing hydraulic components, top up the hydraulic oil to the specified level. Start the engine to circulate the oil in the hydraulic circuits and then recheck the level and top up as necessary.
- After having removed a variable displacement pump, connect the drain pipe and fill the pump casing with oil through the filler hole provided.
- Grease stub axle housings, cylinder pivot mountings and drive shafts thoroughly after assembly.

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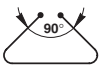
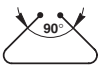
LIFTING INSTRUCTIONS



⚠ Components weighing over 25 kg or of significant size must be supported and removed using suitable lifting equipment with wire rope or polyester slings.
In the paragraphs regarding removal and refitting operations, the weight of the component or assembly to be lifted is indicated with the symbol 

WIRE ROPES - SLINGS

- Use wire ropes or polyester slings of suitable capacity for the parts to be lifted, referring to the following tables:

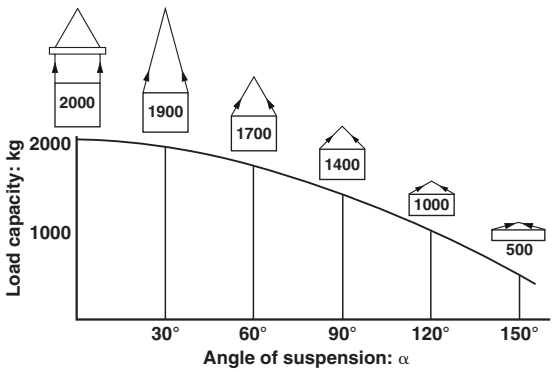
WIRE ROPES (standard twisted «S» or «Z» type)				POLYESTER SLINGS (eye-and-eye - simple loop)				
Ø rope mm	Capacity (kg)			Width (mm)	Capacity (kg)			
								
8	650	620	500	25	500	400	860	700
10	1000	1740	1420	50	1000	800	1730	1410
12	1450	2500	2050	62	1250	1000	2160	1760
14	2000	3460	2820	75	1400	1120	2420	1980
16	2600	4500	3670	100	2000	1600	3460	2820
18	3300	5710	4660	150	2500	2000	4330	3530

NOTE. Lifting capacities are calculated with a safety coefficient.

- The lifting hook should be attached to the central part of the rope or sling; if the hook is attached near the ends of the rope/sling, this could cause the load to slip during lifting.
- Never lift a heavy load using a single rope; always use two or more symmetrically arranged ropes.

⚠ Suspension of a load from a single rope could cause the load to start rotating and consequently cause the rope strands to untwist or the load to slip; this could lead to serious injury.

- Never lift a heavy load when the two branches of the ropes form a wide angle.
The permitted load (kg) decreases in inverse proportion to the angle of suspension; the table below indicates how the permitted load varies according to the angle of suspension for two Ø 10 mm ropes each with a load capacity of 1000 kg.



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HOW THE MANUAL IS STRUCTURED

Section 00 Contains the general safety rules, information on how to use and update the manual, the symbols used, the products required, the standard tightening torques and a conversion table for units of measurement.

Section 10 Contains technical descriptions and information regarding the mechanical and hydraulic operation of machine components, the designations of the various components, hydraulic diagrams and general technical data.

Section 30 Contains the methods, checks and adjustments regarding the external components; the operations dealt with in this section do not require removal of the various assemblies that form the tractor frame and cab.

Section 40 Contains information and diagrams regarding the machine's electrical and electronic systems.

Section 50 This section contains the procedures regarding the removal and overhaul of the engine .

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HOW TO CONSULT THE MANUAL

1. Removal and refitting of assembled units

(1) For the removal or refitting of assembled units, the sequence of operations and the methods to be applied are described in the removal procedure; if the refitting sequence of operations is the exact reverse of the removal procedure, it is not described.

(2) All special techniques that apply only to the refitting procedure are indicated by the symbol ※ 1 ; this same symbol appears at the end of each major step in the removal procedure to indicate the parts for which special techniques are to be applied during refitting.

E.g.: **REMOVAL OF UNIT** : ..... Operation heading

⚠ : ..... Safety rules to be observed when carrying out the procedure described

1 - Remove part (1):..... Step of the procedure

★: ..... Technique or important information regarding the removal operation.

2 - Disconnect (2) ..... ※ 1 : .....Indicates the existence of special information regarding refitting of the component in question.

..... ℓ: ..... Recover oil, liquid or fuel and the quantity to be recovered

E.g.: **REFITTING UNIT:** ..... Operation heading

- Refitting is the reverse of removal

※ 1 :.....Technique to be applied during refitting

★: ..... Technique or important information regarding the refitting operation

- ..... ℓ: ..... Filling with oil or liquid with quantity

2. During removal and refitting operations, in addition to the general safety rules, you must also apply the specific «SAFETY PRECAUTIONS FOR REMOVAL AND REFITTING OPERATIONS».
Always adhere to these precautions.

3. List of special tools

(1) For details regarding the type, code numbers and quantity of all the tools (T1, T2, etc.) specified in the operating procedures, see the heading «SPECIAL TOOLS».

4. Tightening torques

1 - In the operating procedures, the symbol Nm denotes a specific tightening torque that has been determined experimentally and that must be adhered to.

2 - If the symbol does not appear, the torque values to be used are those indicated in the table in Section 00 of this manual.

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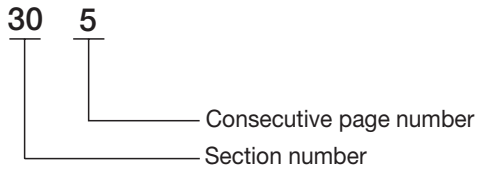
HOW TO USE AND UPDATE THE MANUAL

1. UPDATING THE MANUAL

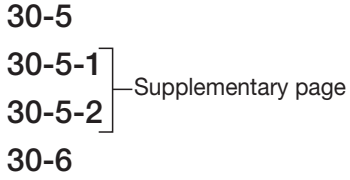
All additions, corrections or amendments to the manual will be sent to the Authorised Service Centres.
Before starting any repair or overhaul operations, check that you have the most recent updates as these may contain supplementary data not present in previous issues.

2. INSERTING UPDATES

1- **Check the** number of the page and insert it in the appropriate section of the manual following the consecutive order of the page numbers. Example:

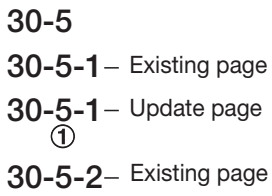


2 - **Supplementary pages:** indicated with a hyphen (-) and consecutive number after the page number. Example:



NOTE. The contents of supplementary pages are structured so that there is no overlap with existing pages.

3 - **Updated pages:** indicated by a consecutive number in a circle; this symbol appears below the page number. Example:

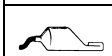


NOTE. All supplementary and updated pages are indicated in the manual page list; a revised page list is sent with each update and supersedes the previous list.

3. SYMBOLS USED IN THE MANUAL

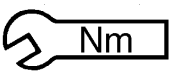
For greater clarity, important information pertaining to operator safety and to critical stages in the working procedures is highlighted by the symbols shown in the following table.

Symbol	Meaning	Notes
	Safety	Safety rules to be applied during operation.
		Operation requiring special safety measures due to internal pressure.
	Warning	Operations requiring special technical or other precautionsto ensure compliance with standard values.
	Weight	Weight of main assemblies. Choose lifting ropes/slings carefully; supports required, etc.

Symbol	Meaning	Notes
	Coating	Parts must be coated with adhesive, lubricant, etc.
	Oil, water	Points at which oil, water or fuel must be added and quantity required.
	Drain	Points from which oil, water or fuel must be drained with quantity.
	Tightening torques	Parts requiring special tightening torque during refitting or assembly.

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STANDARD TIGHTENING TORQUES FOR NUTS AND BOLTS



⚠ The tightening torques for certain specific components and special tightening methods are indicated in the relative assembly paragraphs.

★ The tightening torques indicated below refer to bolts and nuts assembled without lubrication and, where applicable, with anaerobic threadlocking compound.
The values apply to tightening on steel or cast iron components; for soft materials such as aluminium, copper, plastic, sheet metal or panels, the indicated tightening torques must be reduced by 50%.

BOLT SIZE		BOLT CLASS					
		8.8		10.9		12.9	
		Nm	lb.ft.	Nm	lb.ft.	Nm	lb.ft.
COARSE THREAD	M6x1	8.0–8.8	5.9–6.5	11.8 – 13.0	8.7–9.6	13.8 – 15.2	10.2–11.2
	M8x1.25	19.4–21.4	14.3–15.8	28.5 – 31.5	21.0 – 23.2	33.3 – 36.9	24.5 – 27.2
	M10x1.5	38.4 – 42.4	28.3 – 31.2	56.4 – 62.4	41.6 – 46.0	67.4 – 74.4	49.7 – 54.8
	M12x1.75	66.5 – 73.5	49.0 – 54.2	96.9 – 107	71.4 – 78.9	115 – 128	84.8 – 94.3
	M14x2	106 – 117	78.1 – 86.2	156 – 172	115.0 – 126.8	184 – 204	135.6 – 150.3
	M16x2	164 – 182	120.9 – 134.1	241 – 267	117.6 – 196.8	282 – 312	207.8 – 229.9
	M18x2.5	228 – 252	168.0 – 185.7	334 – 370	246.2 – 272.7	391 – 432	288.2 – 318.4
	M20x2.5	321 – 355	236.6 – 261.6	472 – 522	347.9 – 384.7	553 – 611	407.6 – 450.3
	M22x2.5	441 – 487	325.0 – 358.9	647 – 715	476.8 – 527.0	751 – 830	553.5 – 611.7
	M24x3	553 – 611	407.6 – 450.3	812 – 898	598.4 – 661.8	950 – 1050	700.2 – 773.9
	M27x3	816 – 902	601.4 – 664.8	1198 – 1324	882.9 – 975.8	1419 – 1569	1045.8–1156.4
FINE THREAD	M8x1	20.8 – 23.0	15.3 – 17.0	30.6 – 33.8	22.6 – 24.9	35.8 – 39.6	26.4 – 29.2
	M10x1.25	40.6 – 44.8	29.9 – 33.0	59.7 – 65.9	44.0 – 48.6	71.2 – 78.6	52.5 – 57.9
	M12x1.25	72.2 – 79.8	53.2 – 58.8	106 – 118	78.1 – 87.0	126 – 140	92.9 – 103.2
	M12x1.5	69.4 – 76.7	51.1 – 56.5	102 – 112	75.2 – 82.5	121 – 134	89.2 – 98.8
	M14x1.5	114 – 126	84.0 – 92.9	168 – 186	123.8 – 137.1	199 – 220	146.7 – 162.1
	M16x1.5	175 – 194	129 – 143	257 – 285	189.4 – 210.0	301 – 333	221.8 – 245.4
	M18x1.5	256 – 282	188.7 – 207.8	375 – 415	276.4 – 305.9	439 – 485	323.5 – 357.4
	M20x1.5	355 – 393	261.6 – 289.6	523 – 578	385.5 – 426.0	611 – 676	450.3 – 498.2
	M22x1.5	482 – 532	355.2 – 392.1	708 – 782	521.8 – 576.3	821 – 908	605.1 – 669.2
	M24x2	602 – 666	443.7 – 490.8	884 – 978	651.5 – 720.8	1035 – 1143	762.8 – 842.4

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THREADLOCKERS, ADHESIVES, SEALANTS AND LUBRICANTS



FUNCTION	DESIGNATION	DESCRIPTION
THREADLOCKER	**Loctite 222** Colour: opaque fluorescent purple	Anaerobic product suitable or low-strength locking of retaining, adjustment and precision fasteners. All traces of lubricant must first be removed using the specific activator.
	Loctite 242 Colour: fluorescent blue	Anaerobic product that prevents loosening of all types of nut and bolt; used in place of conventional mechanical locking systems. Used for medium-strength locking. All traces of lubricant must first be removed using the specific activator.
	Loctite 243 Colour: opaque fluorescent blue	Alternative product to 242; oil tolerant and so can used on lightly lubricated surfaces without prior use of activator.
	Loctite 270 Colour: fluorescent green	Anaerobic product for high-strength locking of bolts and studs that do not normally require disassembly. Parts must be heated to approximately 80°C for removal. All traces of lubricant must first be removed using the specific activator.
DEGREASERS AND ACTIVATORS	**Loctite 703**	Product used for degreasing and cleaning parts prior to application of Loctite anaerobic products; after drying, promotes uniform curing of threadlockers.
	Loctite 747	Product used for specifically for treatment of passive metals prior to use of slow-cure anaerobic threadlockers(series 5 and 6). Can also be used to increase cure speed at low temperatures or in applications where there is large gaps between the parts.
SEALANTS (for faces and flanges)	**Loctite 510** Colour: red	Super-rapid anaerobic sealant for sealing between rigid metal faces; can eliminate the need for conventional gaskets as it can fill gaps up to 0.4 mm. Does not shrink and therefore fasteners do not need re-tightening to specified torque values after curing.
	Loctite 542 Colour: brown	Anaerobic product used a liquid sealant for threaded fittings up to 3/4” gas; rapid curing and parts may be disassembled with ordinary tools.
	Loctite 554 Colour: red	Anaerobic sealant and locking compound used for sealing cooling and industrial fluid circuits. Slow curing, also suitable for use on non-ferrous alloys.
	Loctite 572 Colour: white	Anaerobic sealant and locking compound used for sealing pipes and threaded fittings up to 2" in diameter. Very slow curing on most metal surfaces.
	Loctite 573 Colour: green	Thixotropic anaerobic product used for sealing joints between metal faces. Ensures total contact between surfaces with maximum tolerance of 0.10 mm, filling micro-voids caused by flatness errors. Very slow curing on most metal surfaces and requires prior application of an activator.
	Loctite 576 Colour: brown	Anaerobic product used a liquid thread sealant for large diameter threaded fittings (up to 2"). Very slow curing; also suitable for non-ferrous alloys and parts requiring subsequent removal.

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FUNCTION	DESIGNATION	DESCRIPTION
INSTANT ADHESIVES	**Loctite 401** Colour: colourless	Cyanoacrylate instant adhesive suitable for bonding a wide range of acidic and porous materials including, ceramics, wood, rubber and plastic (excluding polyolefin). Curing takes place in a few seconds as an effect of the condensed humidity present on the surfaces to be bonded, and is independent of environmental conditions.
	Loctite 495 Colour: colourless	Cyanoacrylate instant adhesive suitable for bonding a rubber, plastics and metal in any combination.
SILICONE SEALANTS	**Silastic 738 (Dow Corning)** Colour: milky white	One-part silicone adhesive/sealant, ready for use. Cures on exposure to air to form a rubbery solid and obviates the need for conventional seals on flexible joints, filling gaps greater than 1 mm.
	Dirko Transparent Colour: transparent	One-part silicone adhesive/sealant, shrinking, ready for use. Cures rapidly when exposed to humidity in the air to form a rubbery solid; resistant to high temperatures.
POLYURETHANE SEALANTS	**Betaseal HV3 (Gurit Essex)** Colour: black	Polyurethane prepolymer based adhesive/sealant, high viscosity, suitable for permanent, high-strength flexible bonding. Slow curing, used for bonding glass to frames, wire mesh, metal plates, etc. surfaces must be degreased with primer.
RETAINING COMPOUNDS	**Loctite 601** Colour: fluorescent green	Anaerobic, fast-curing, high-strength adhesive. Suitable for sealing and retaining cylindrical assemblies with gap clearances of up to 0.10 mm; used for retaining rotors, gears, bearings, pulleys, bushes etc. on shafts.
	Loctite 638 Colour: fluorescent green	Anaerobic structural adhesive, quick-curing, very high strength; suitable for bonding cylindrical parts in non-ferrous alloys.
	Loctite 648 Colour: fluorescent green	Anaerobic structural adhesive, quick-curing, high-strength; suitable for bonding cylindrical parts, permanent retention of threaded parts, sealing of refrigeration systems, retention of bearings, etc. Alternative to Loctite 601 in high-temperature applications.
	Loctite 986/AVX Colour: fluorescent red	Anaerobic sealant/retaining compound for metal cylindrical parts. Slow-curing, high-strength, heat-resistant and resistant to chemical pressure. Parts must be first treated with an activator.
LUBRICANTS	**Grease** (NLGI 2 EP ASTM D217: 265/295)	Multi-purpose Lithium grease used for lubrication of seals, to prevent oxidization and to facilitate assembly operations.
	Molikote (Dow Corning)	Anti-wear compound, contains Molybdenum bisulphate, use neat or diluted with engine oil for assembly of main engine bearings.
	Vaseline	Neutral pH compound used to protect battery terminals against oxidization and corrosion.
	Engine oil 10W - 30	Used to dilute Molikote anti-wear lubricant during assembly of main engine bearings.

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CONVERSION FACTORS

CONVERSION FROM BRITISH TO METRIC UNITS

inch x 25,40	**= mm**
foot x 0,305	**= m**
yard x 0,914	
Eng.miles x 1,609	**= km**
Sq.in. x 6,452	**= cm^2**
Sq.ft. x 0,093	**= m^2**
Sq.yard x 0,835	
Cu.in. x 16,39	**= cm^3**
Cu.ft. x 28,36	**= m^3**
Cu.yard x 0,763	
Imp.gall. x 4,547	**= litres**
US gall. x 3,785	
pint x 0,568	
quart x 1,137	
US.gpm x 3,785	**= ℓ/min**
oz. x 0,028	**= kg**
lb. x 0,454	
lb.ft. x 0,139	**= kgm**
lb.in. x 17,87	**= kg/m**
psi x 0,070	**= kg/cm^2**
lb./Imp.gall x 0,100	**= kg/ℓ**
lb./US.gall x 0,120	
lb./cu.ft. x 16,21	**= kg/m^3**
lb.ft. x 1,356	**= Nm**
psi x 1,379	**= bar**

CONVERSION FROM METRIC TO BRITISH UNITS

mm x 0,0394	**= inch**
m x 3,281	**= foot**
m x 1,094	**= yard**
km x 0,622	**= Eng.miles**
cm^2 x 0,155	**= Sq.in.**
m^2 x 10,77	**= Sq.ft.**
m^2 x 1,197	**= Sq.yard**
cm^3 x 0,061	**= Cu.in.**
m^3 x 0,035	**= Cu.ft**
m^3 x 1,311	**= Cu.yard**
litres x 0,220	**= Imp.gall.**
litres x 0,264	**= US gall.**
litres x 1,762	**= pint**
litres x 0,880	**= quart**
ℓ/min x 0,2642	**= US.gpm**
kg x 35,25	**= oz.**
kg x 2,203	**= lb.**
kgm x 7,233	**= lb.ft.**
kg/m x 0,056	**= lb.in.**
kg/cm^2 x 14,22	**= psi**
kg/ℓ x 10,00	**= lb./Imp.gal.**
kg/ℓ x 8,333	**= lb./US.gal.**
kg/m^3 x 0,062	**= lb./cu.ft.**
Nm x 0,737	**= lb.ft.**
bar x 14,503	**= psi**

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SECTION 10

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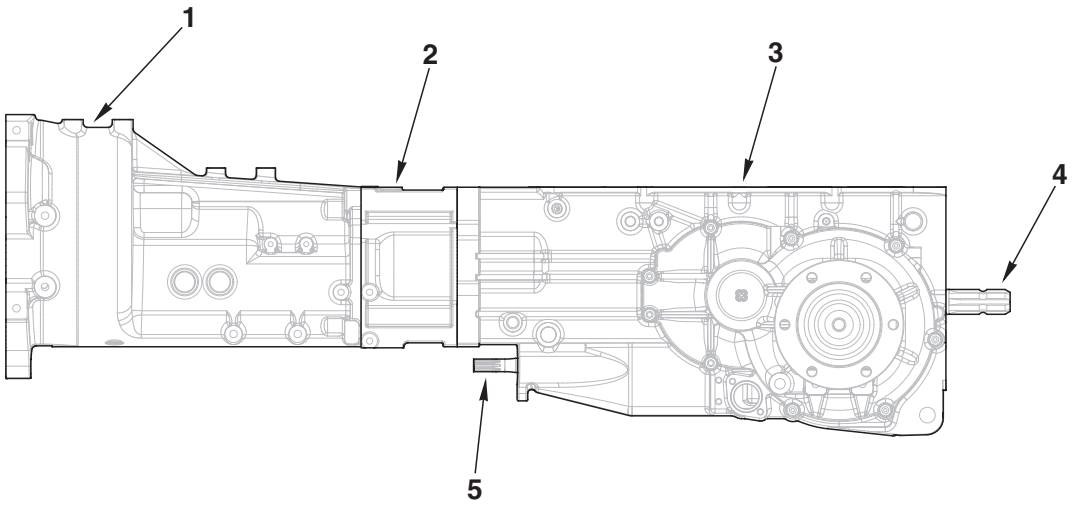
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1. TRANSMISSION

1.1 INTRODUCTION

- The tractors in this series are equipped with a 4-speed transmission with forward/reverse shuttle and three speed ranges.
  The main gearbox and the forward/reverse shuttle are synchronised, while the 3-speed range gearbox is not synchronised.
- The rear transmission casing also houses the drive train for the rear PTO, which is supplied in a single version (540-1000-groundspeed).
  The rear PTO is of the mechanical type with non-synchronised gears.
  The PTO can also be supplied with a mid-mounted output shaft that is only enabled when the 1000 rpm PTO speed is selected.



D0018450

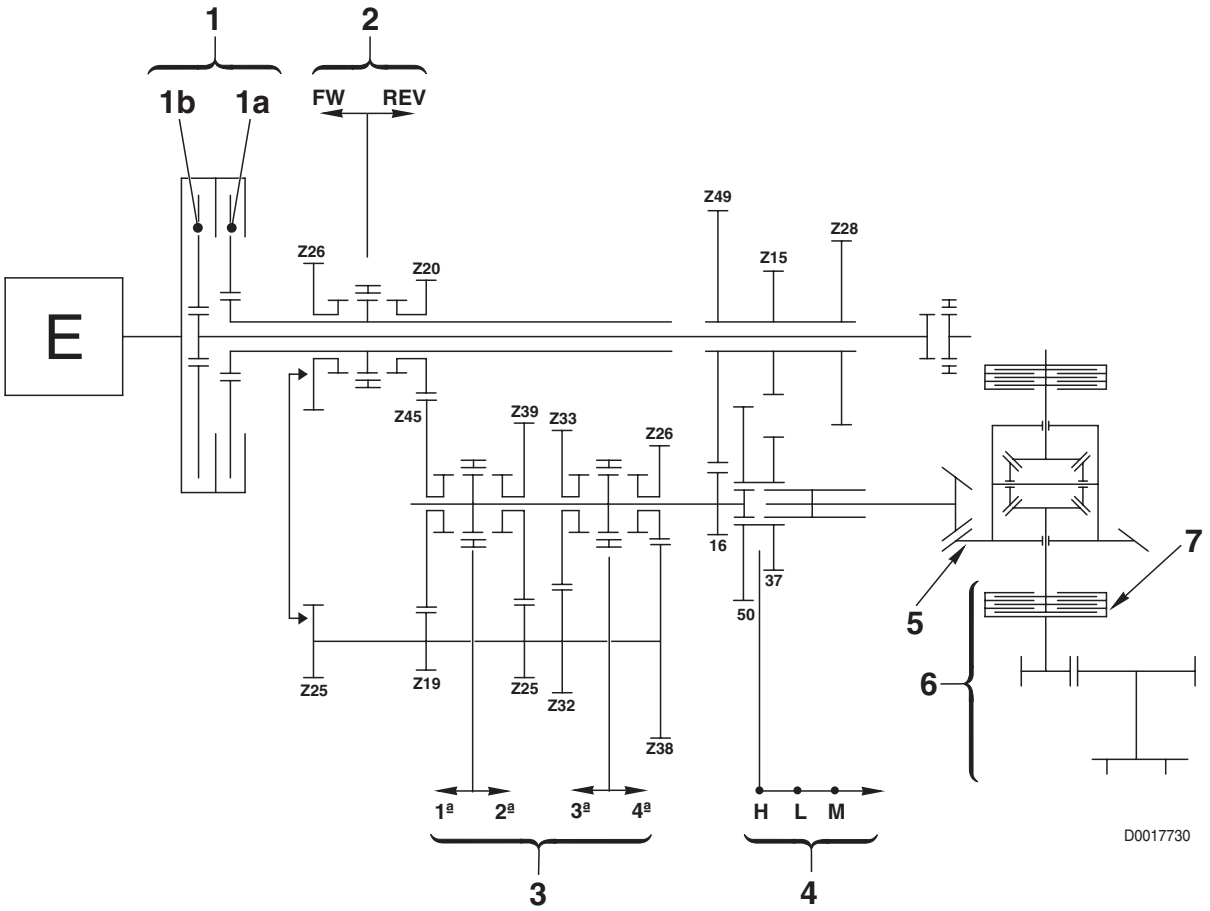
MAIN ASEMBLIES

1 - Clutch housing
2 - Shuttle gearbox assembly
3 - Range gearbox and differential assembly
4 - Rear PTO
5 - Mid PTO

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1.2 DESCRIPTION

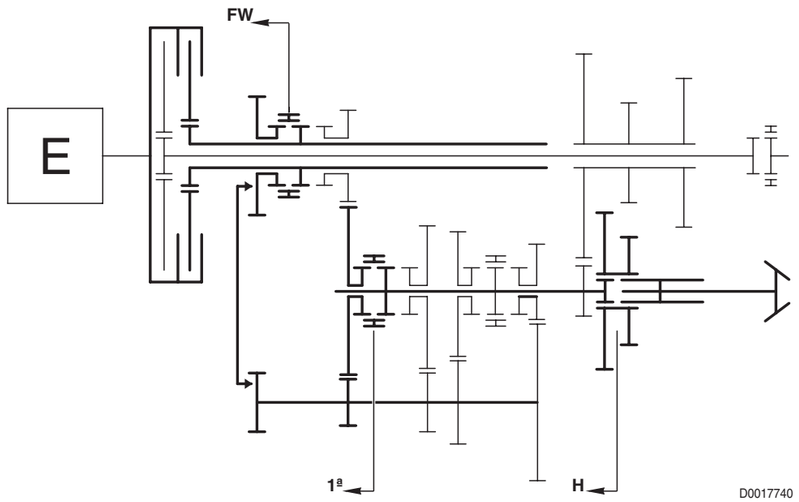
- The transmission receives drive from the engine and transmits it through the dual clutch assembly (1) (main drive clutch (1a) and rear PTO clutch (1b), the main gearbox (3), the shuttle (2) and the range gearbox (4) to the bevel drive gears (5).
  Drive is then transmitted to the final drive units (6) which mount the brake assemblies providing both service brake and parking brake functions.



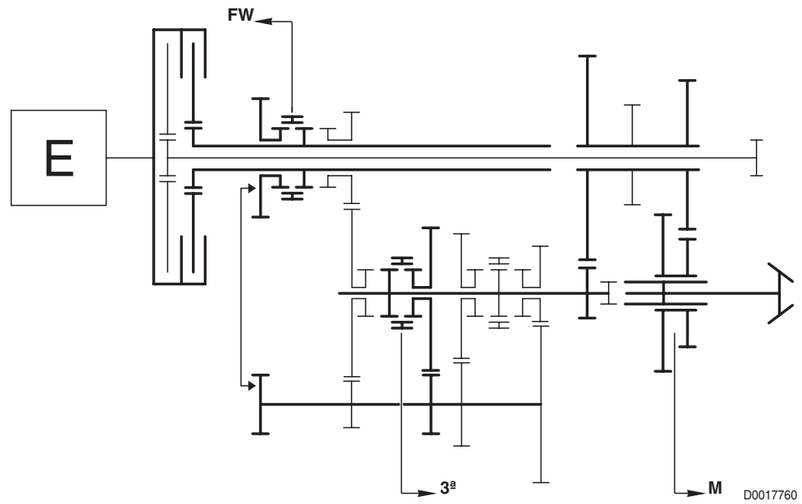
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1.2.1 DRIVE TRANSMISSION

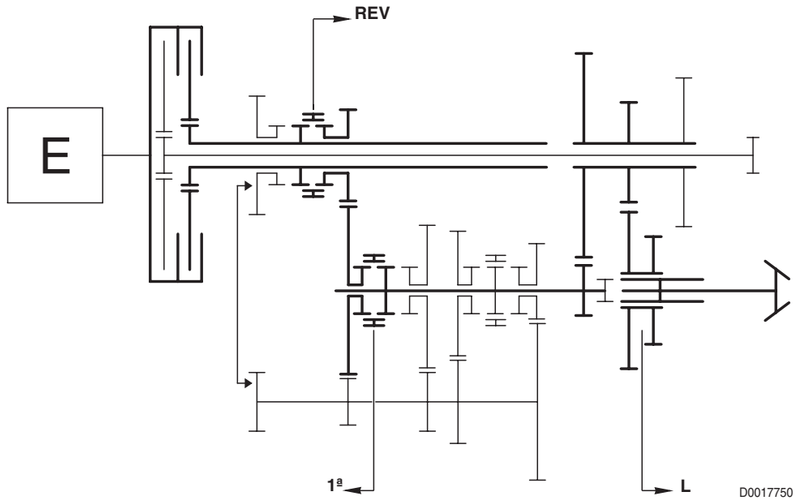
1st gear, forward drive and high range (H) selected



3rd gear, forward drive and medium range (M) selected

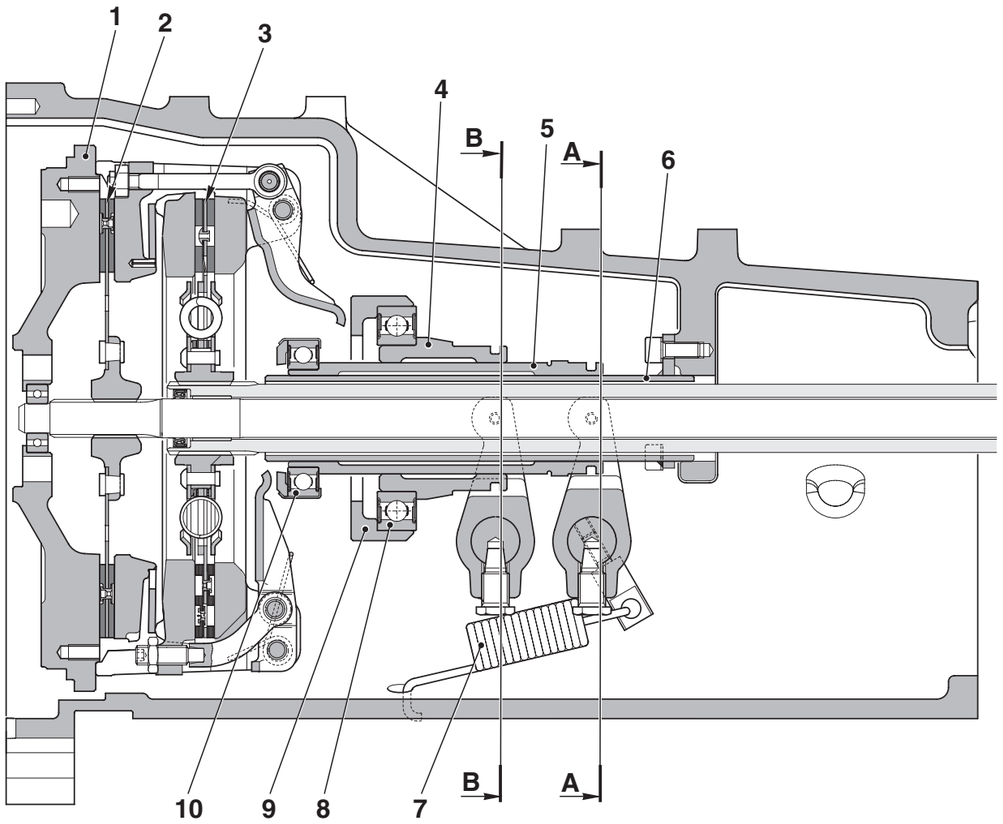


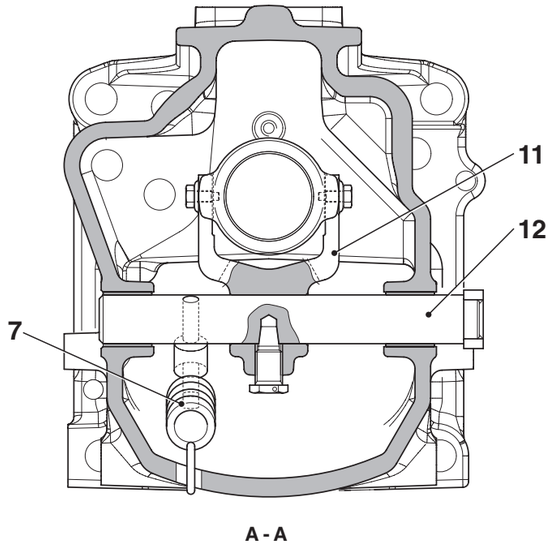
1st gear, reverse drive and low range (L) selected



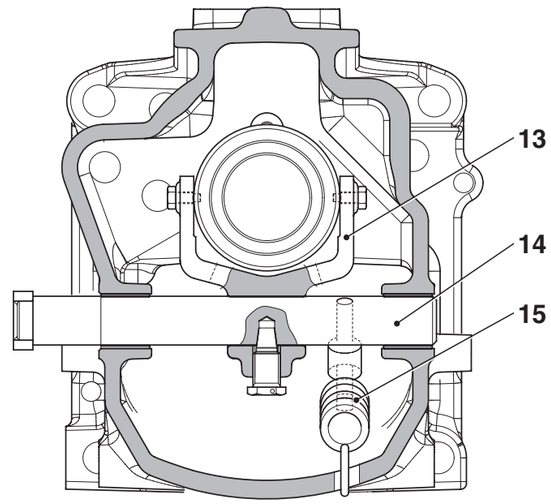
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1.3 CLUTCH HOUSING





A - A



B - B

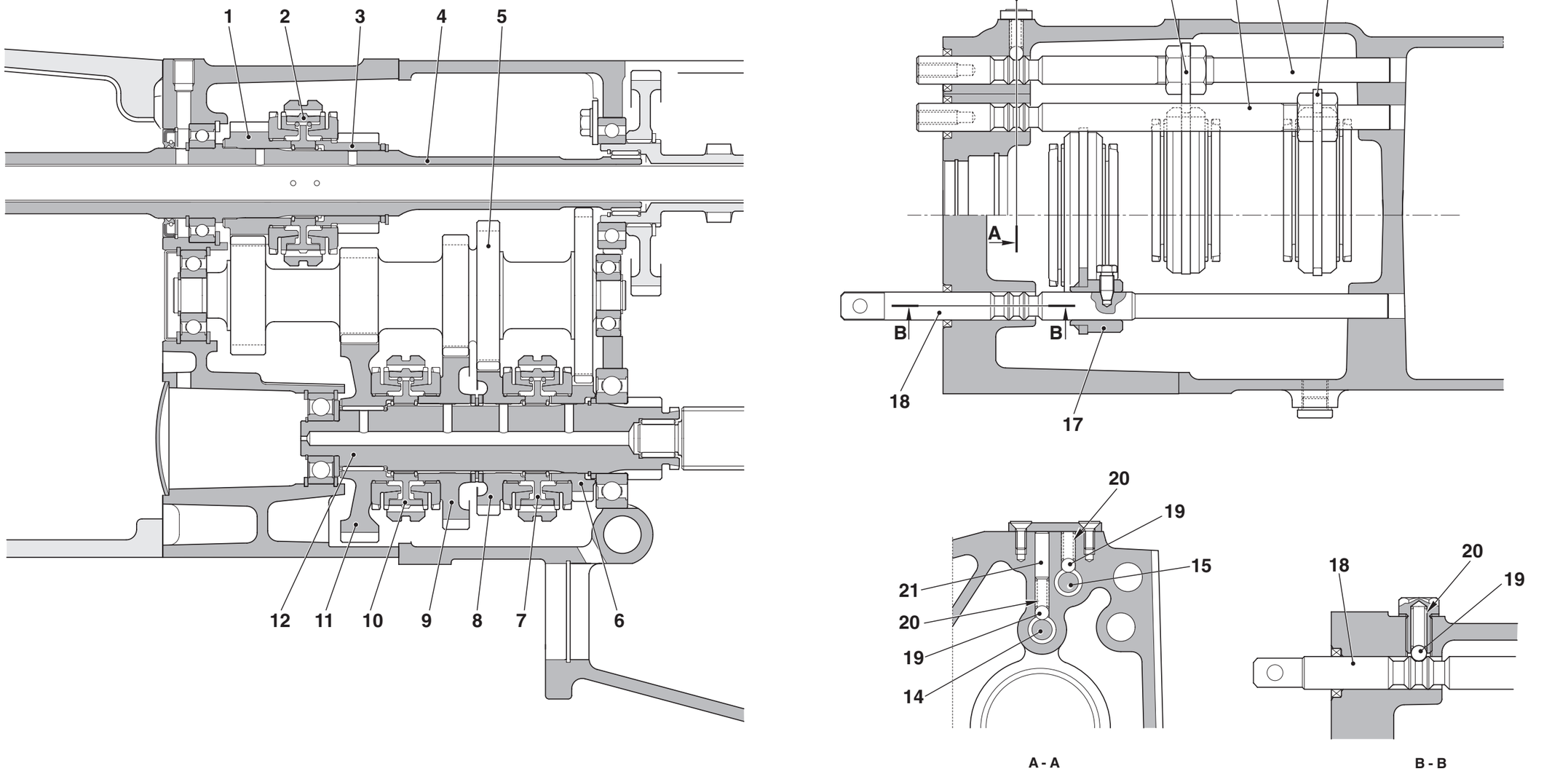
D0017770

COMPONENTS

1 - Flywheel
2 - Rear PTO clutch plate
3 - Main clutch plate
4 - Rear PTO clutch sleeve
5 - Main clutch sleeve
6 - Sleeve support
7 - Main clutch release fork return spring
8 - PTO clutch release bearing
9 - PTO clutch thrust plate
10 - Main clutch release bearing
11 - Main clutch release fork
12 - Main clutch control shaft
13 - PTO clutch release fork
14 - PTO clutch control shaft
15 - PTO clutch release forks return spring

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1.4 GEARBOX AND SHUTTLE ASSEMBLY

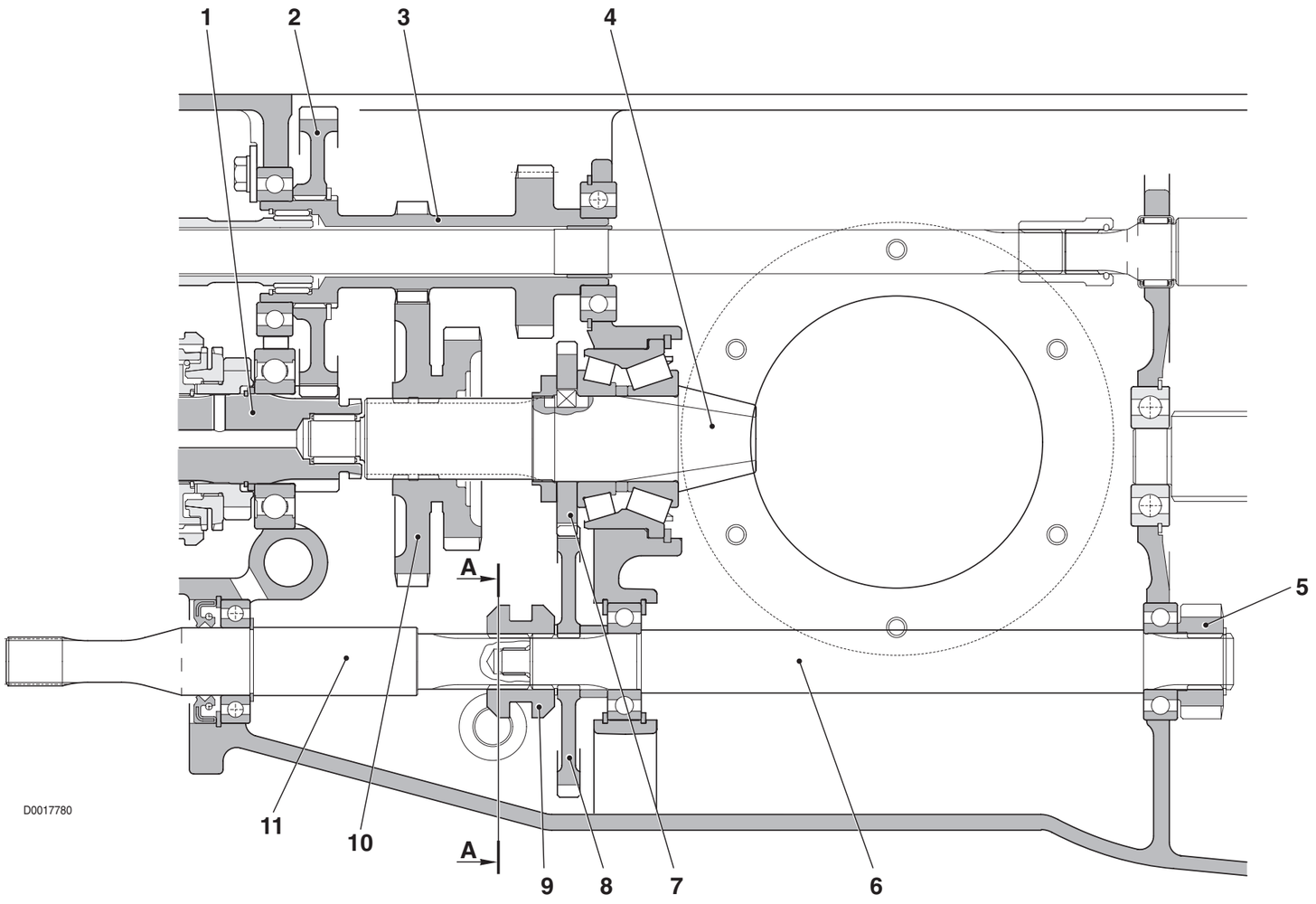


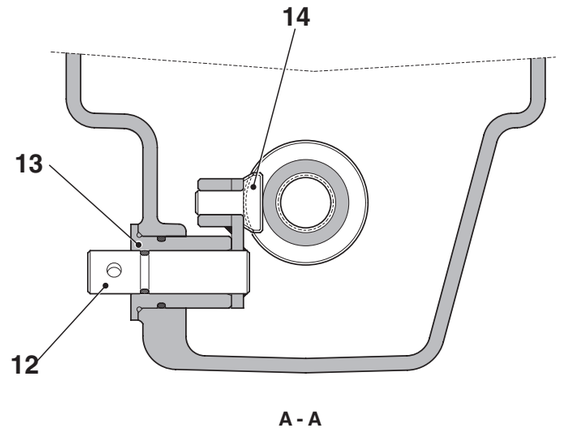
COMPONENTS

1 - Forward travel driving gear
2 - Forward/reverse gear synchroniser
3 - Reverse travel driving gear
4 - Input shaft
5 - Primary shaft
6 - 4th speed driven gear
7 - 3rd - 4th gear synchroniser
8 - 3rd gear
9 - 2nd gear
10 - 1st - 2nd gear synchroniser
11 - 1st speed driven gear
12 - Secondary shaft
13 - 1st - 2nd gear selector fork
14 - 3rd - 4th gear selector rod
15 - 1st - 2nd gear selector rod
16 - 3rd - 4th gear selector rod
17 - Forward/reverse gear selector fork
18 - Forward/reverse gear selector rod
19 - Ball
20 - Spring
21 - Spacer

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1.5 4WD RANGE GEARS ASSEMBLY



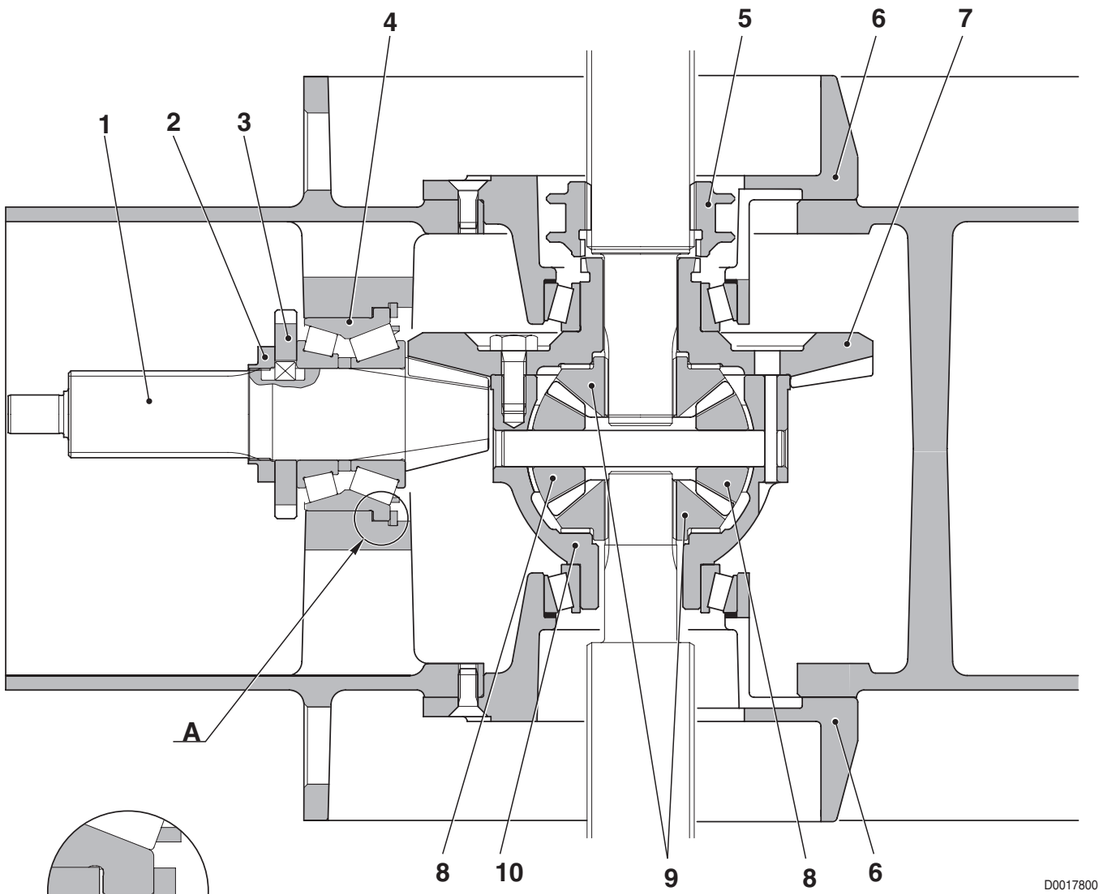


COMPONENTS

1 - Primary shaft
2 - Driven gear
3 - L and M range driving gear
4 - Pinion
5 - Driving gear for groundspeed PTO
6 - Groundspeed PTO drive shaft
7 - 4WD driving gear
8 - 4WD driven gear
9 - 4WD engagement sleeve
10 - L and M ranges driven gear
11 - 4WD output shaft
12 - 4WD engagement control shaft
13 - Bush
14 - Shoe

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1.6 PINION AND DIFFERENTIAL ASSEMBLY



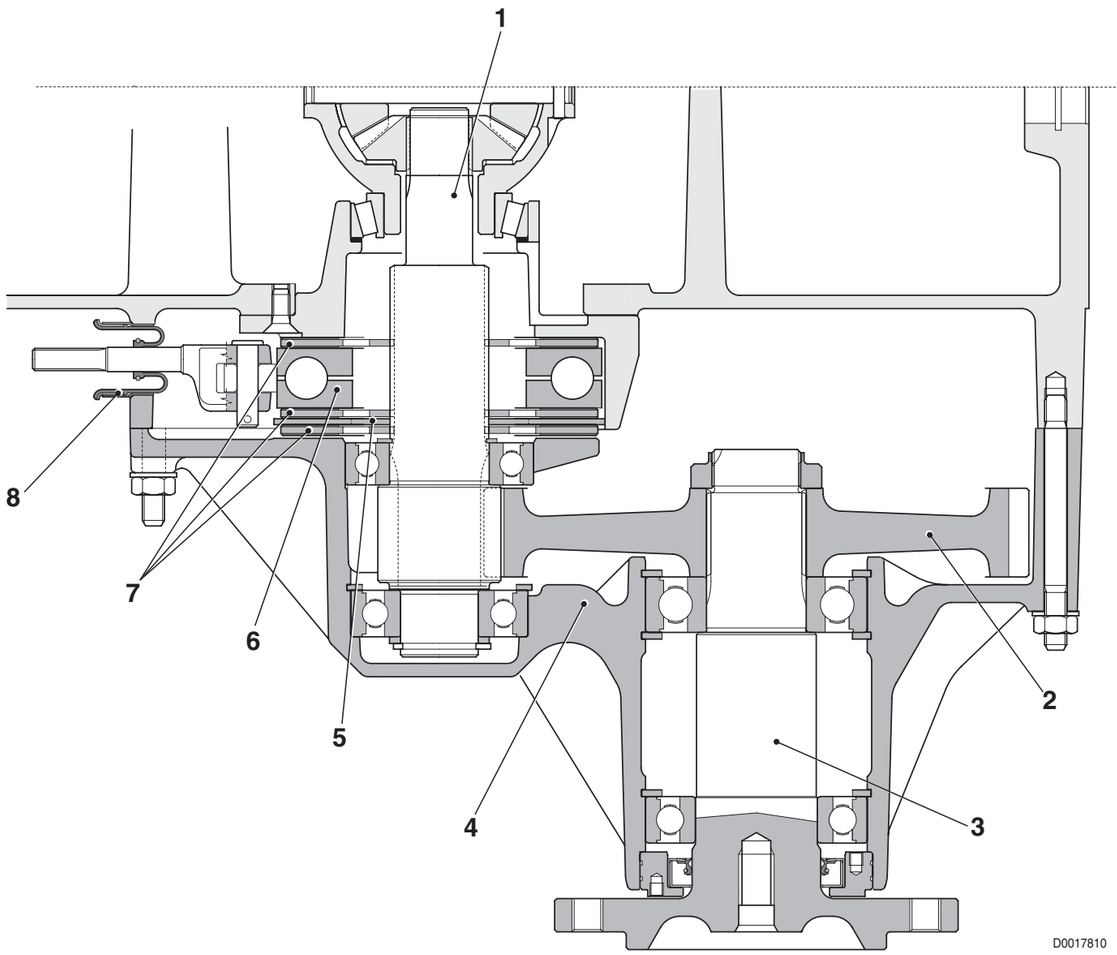
Detail A

COMPONENTS

1 - Pinion
2 - Ringnut
3 - 4WD driving gear
4 - PInion bearing
5 - Differential lock sleeve
6 - Differential support
7 - Crown wheel
8 - Planet pinion
9 - Sun gear
10 - Differential cage

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1.7 BRAKES AND REAR AXLE ASSEMBLY



COMPONENTS

1 - Drive shaft
2 - Driven gear
3 - Half-shaft
4 - Final drive housing
5 - Plane steel disc
6 - Brake
7 - Friction disc
8 - Hood

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1.8 REAR PTO AND MID PTO

1.8.1 COMPONENTS

The rear power take-off allows drive to be transmitted to an implement at a predetermined rotation speed.
The rotary drive is taken directly from the engine and the operator controls engagement of the PTO output shaft via a lever.

The rear power take-off is supplied in a single version offering three rotation speeds:

540 rpm PTO (with engine at 2655 rpm)

1000 rpm PTO (with engine at 2736 rpm)

Groundspeed PTO

The Groundspeed PTO rotates at a speed that is directly proportional to the rotation speed of the rear wheels: 7.1036 revolutions of the PTO shaft for each revolution of the rear wheel.

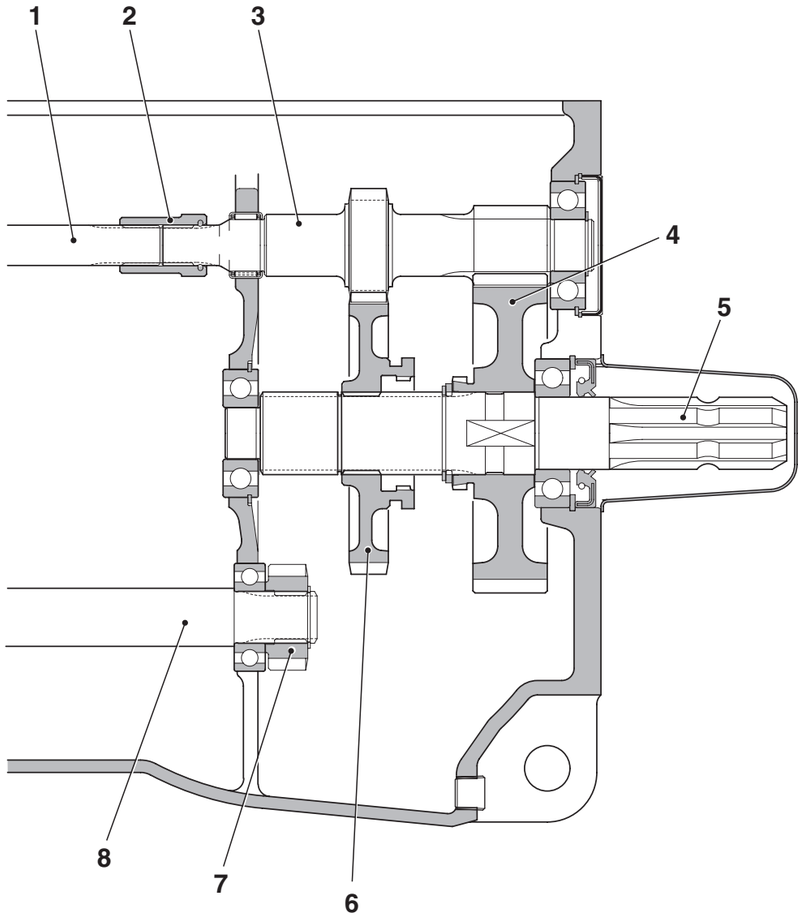
This series of tractors is equipped with a mid PTO with two speeds:

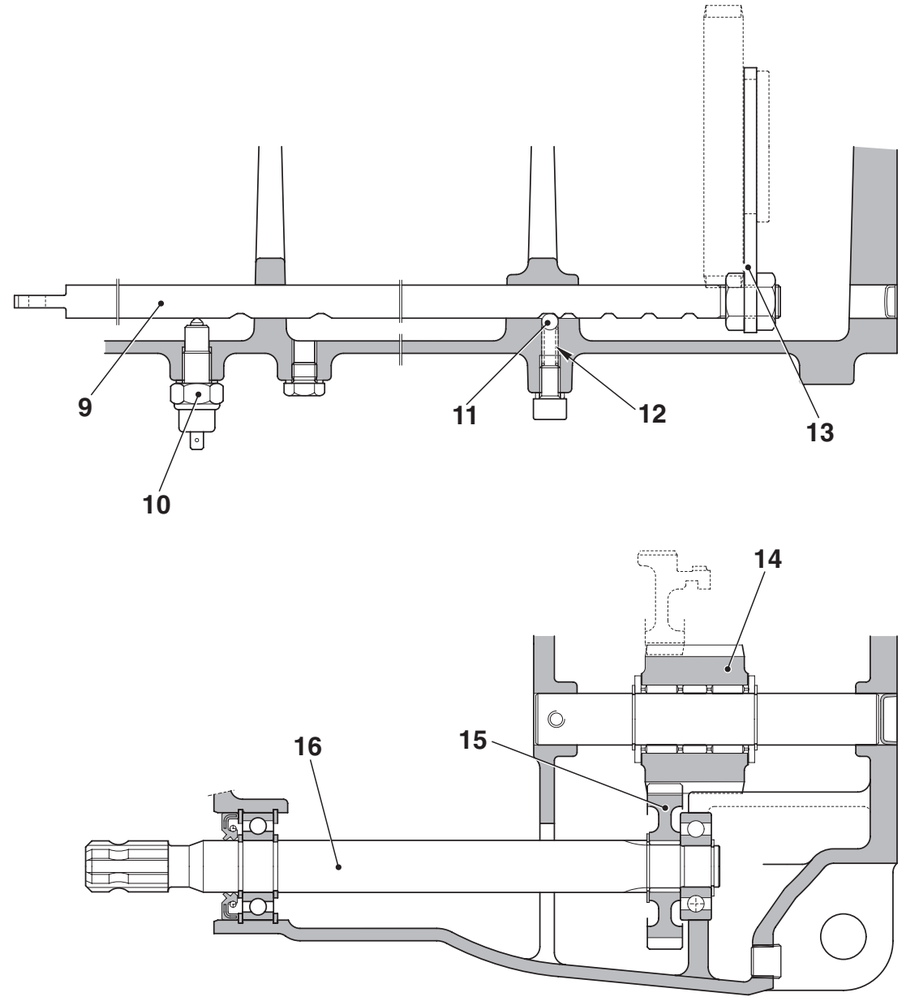
1000 rpm (with engine at 2733 rpm)
2000 rpm (with engine at 3052 rpm)

The mid PTO rotation speed is selected via the rear PTO speed selection lever and the drive is taken directly from the rear PTO driven gear.

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1.8.2 MAIN COMPONENTS



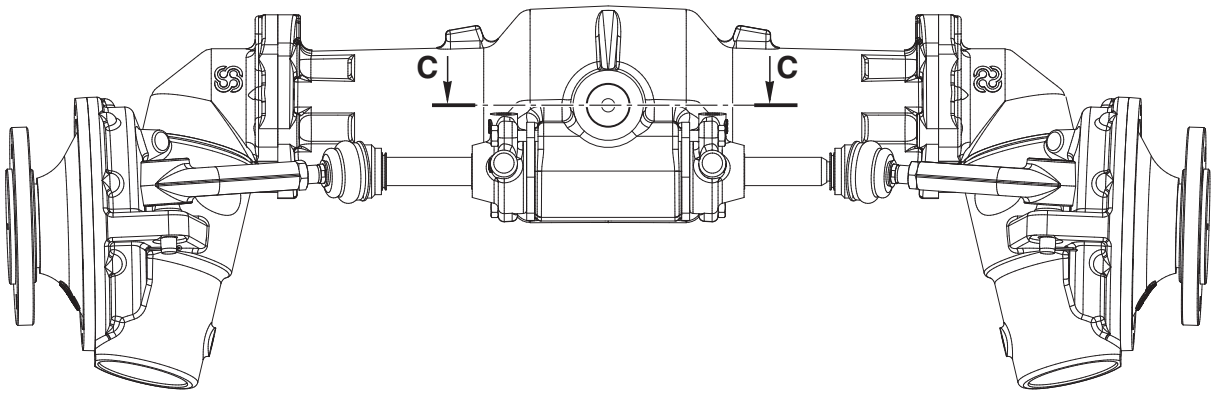


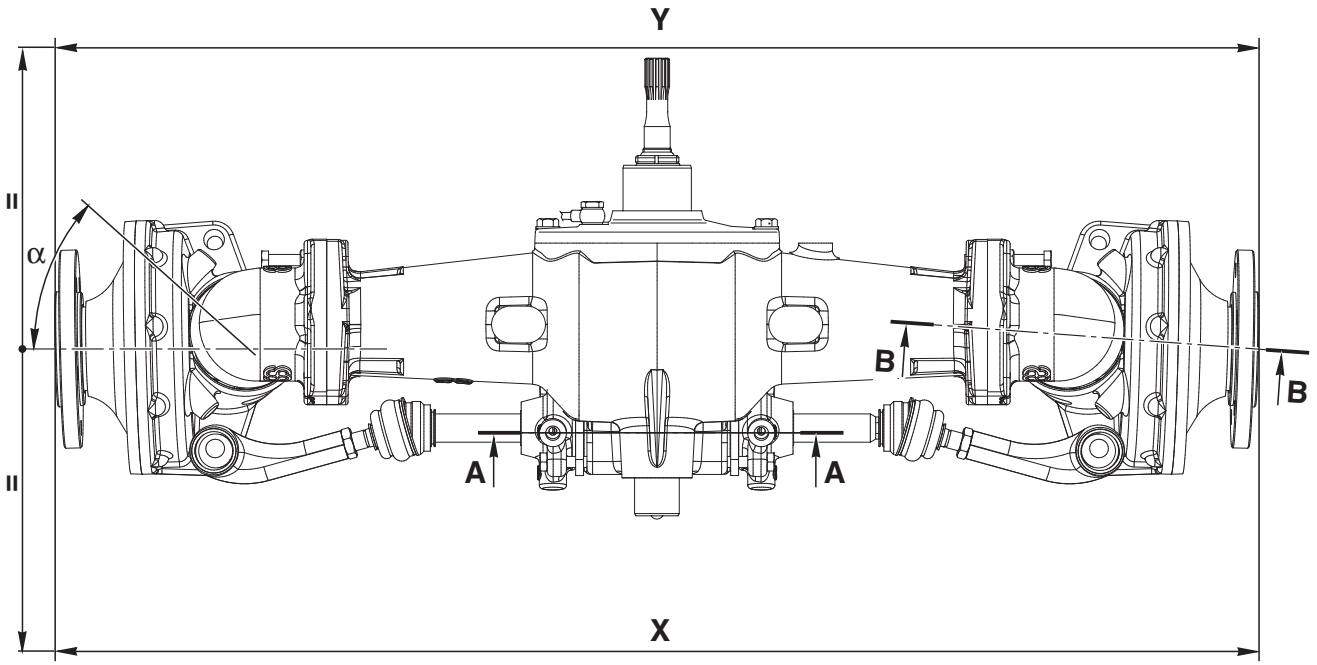
D0017820

1 - PTO control shaft
2 - Sleeve
3 - PTO drive shaft
4 - 540 PTO driven gear
5 - PTO output shaft
6 - 1000 PTO and Groundspeed driven gear
7 - Groundspeed PTO driving gear
8 - Groundspeed PTO drive shaft
9 - PTO speed selector rod
10 - PTO engagement sensor
11 - Ball
12 - Spring
13 - PTO fork
14 - Mid PTO intermediate gear
15 - Mid PTO driven gear
16 - Mid PTO output shaft

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2. FRONT AXLE



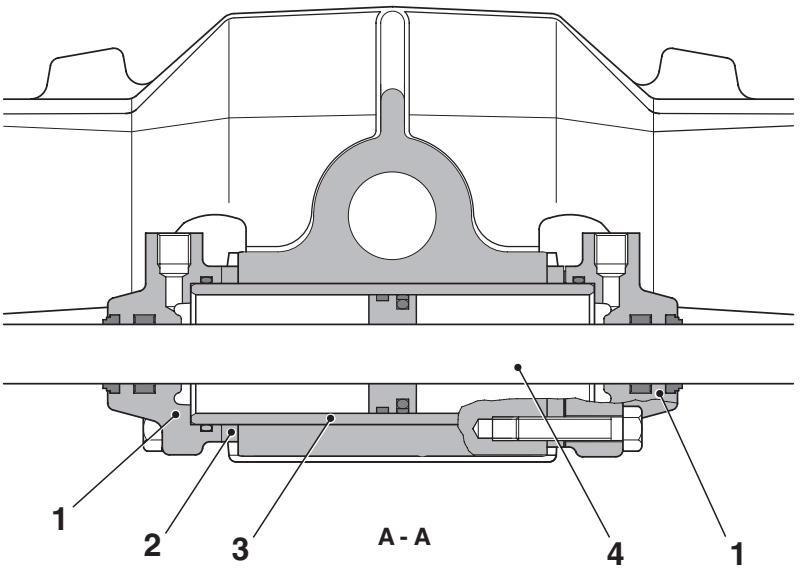


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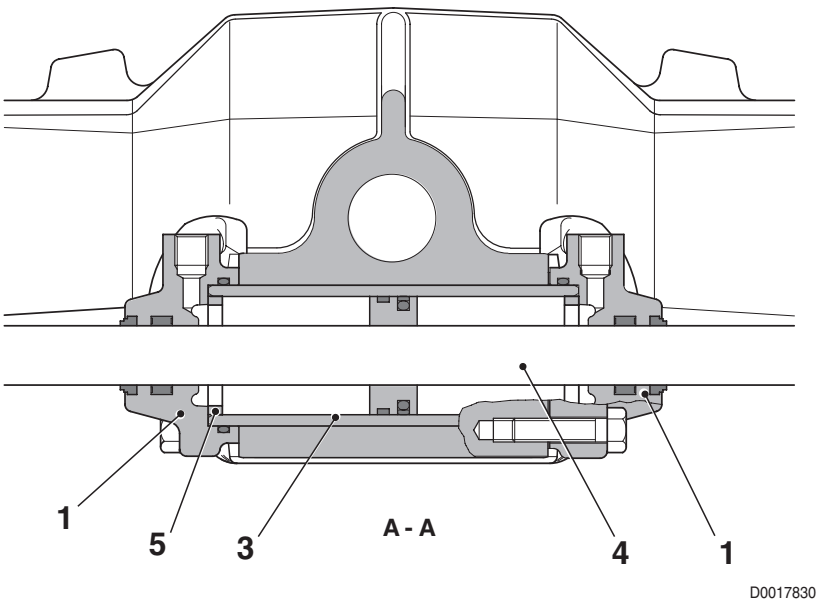
Tractor	Version	Track (X)	Toe-in (X – Y)	Steering angle maximum (α)
50 CV	Standard	1200	+ 0 – 2	max. 57°
40 CV	Standard	1050	+ 0 – 2	max. 57°
30 CV	Standard	1050	+ 0 – 2	max. 57°
	Narrow	916	+ 0 – 2	max. 50°

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2.1 STEERING CYLINDER



Standard version

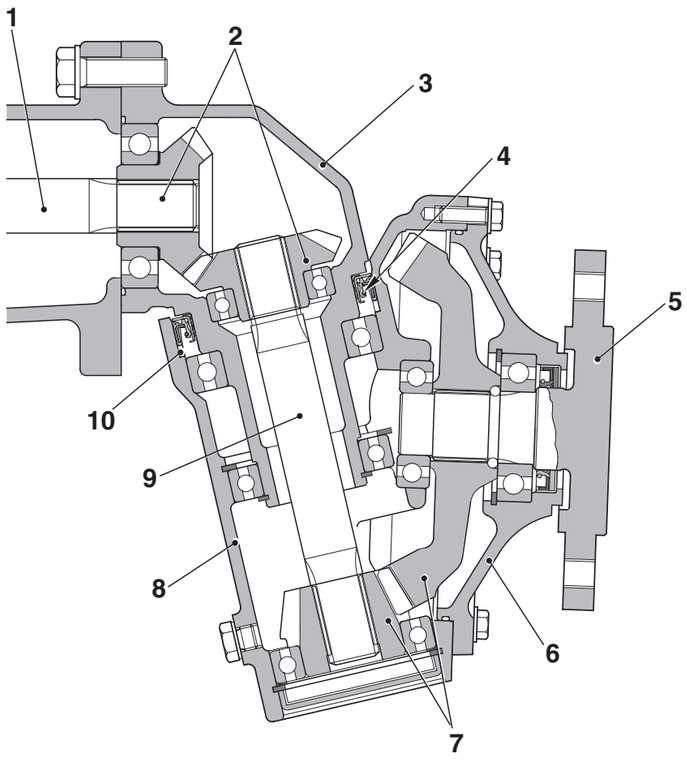


Narrow version

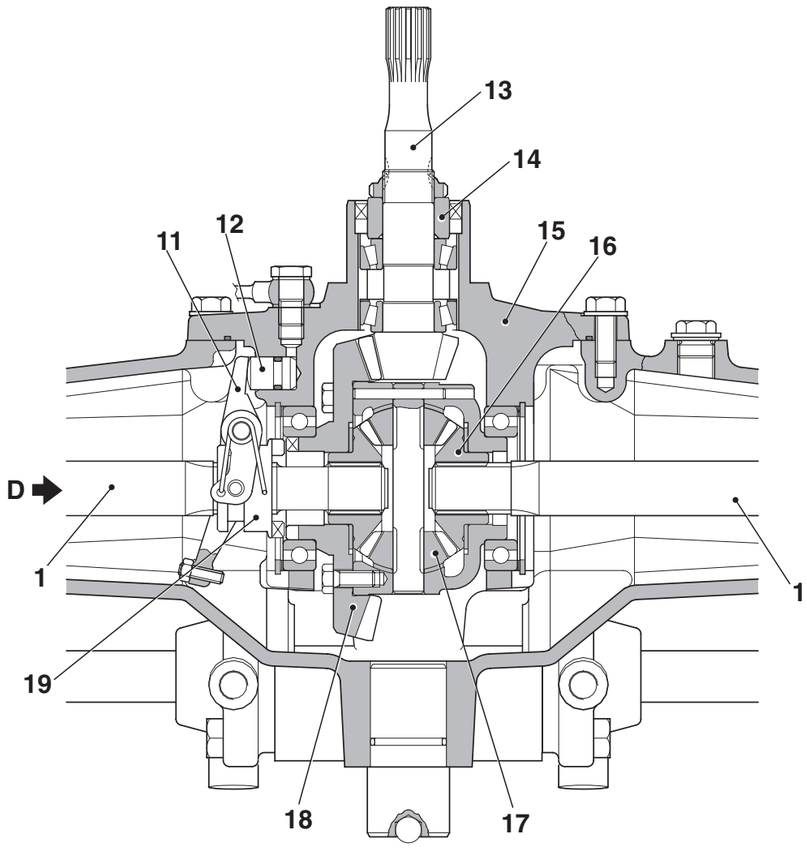
1 - End cap
2 - Spacer (standard version)
3 - Cylinder
4 - Piston
5 - Spacer (narrow version)

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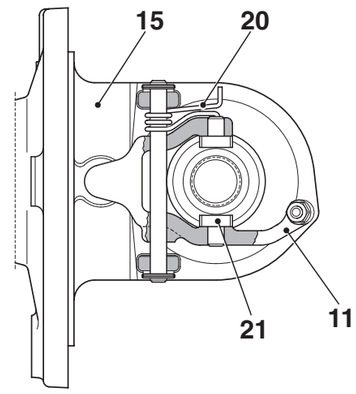
2.2 DIFFERENTIAL- PINION - FINAL DRIVE UNIT



B - B



C - C



View D

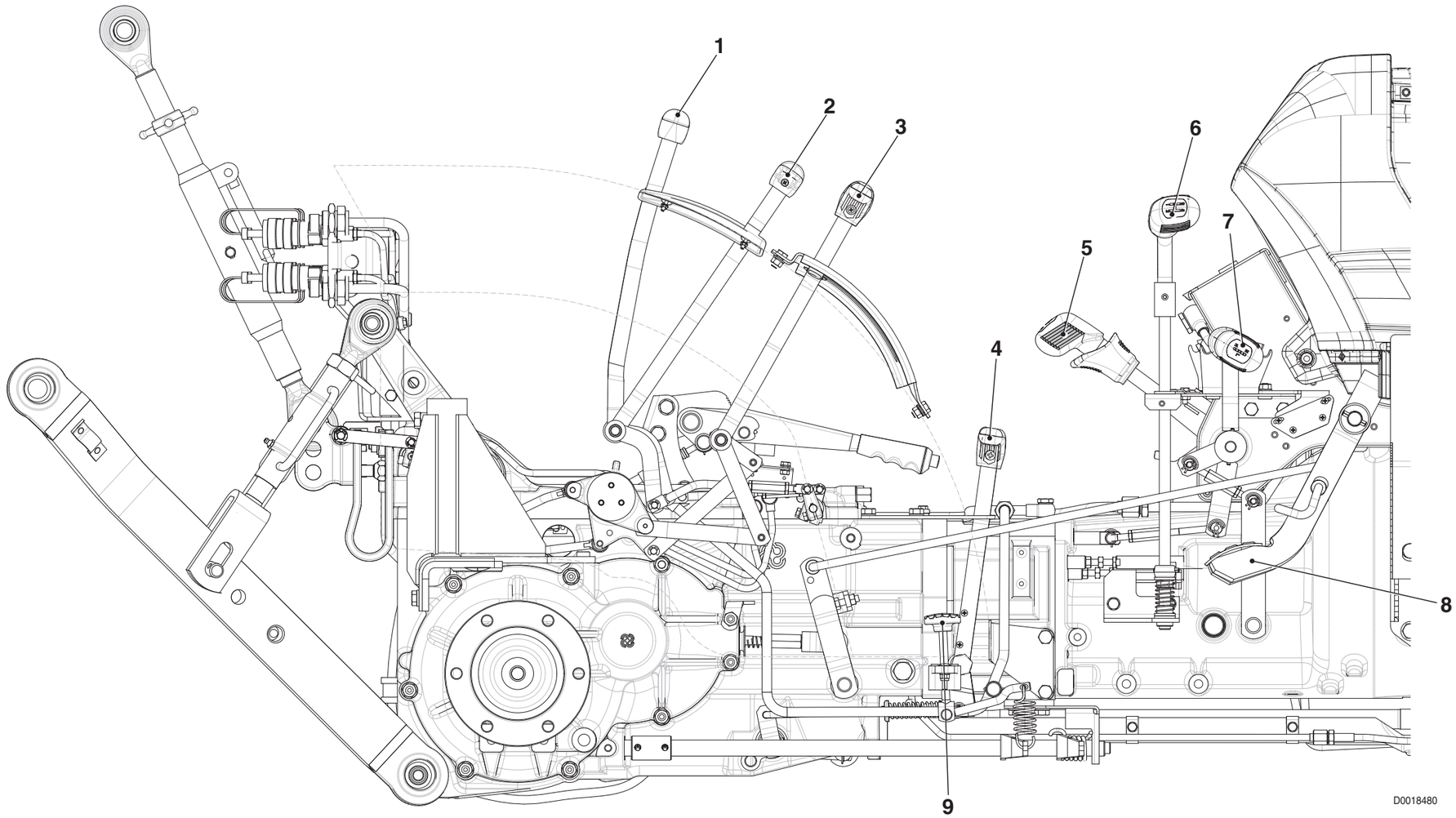
D0017880

1 - Half-shaft
2 - Input bevel gear pair
3 - Hub support
4 - Oil seal
5 - Axle housing
6 - Flange
7 - Output bevel gear pair
8 - Hub carrier
9 - Shaft
10 - Spacer
11 - Differential lock engagement fork
12 - Differential lock engagement piston
13 - Pinion
14 - Spacer
15 - Differential support
16 - Sun gear
17 - Planet pinion
18 - Crown wheel
19 - Differential lock engagement sleeve
20 - Lever return spring
21 - Shoe

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3. CONTROLS

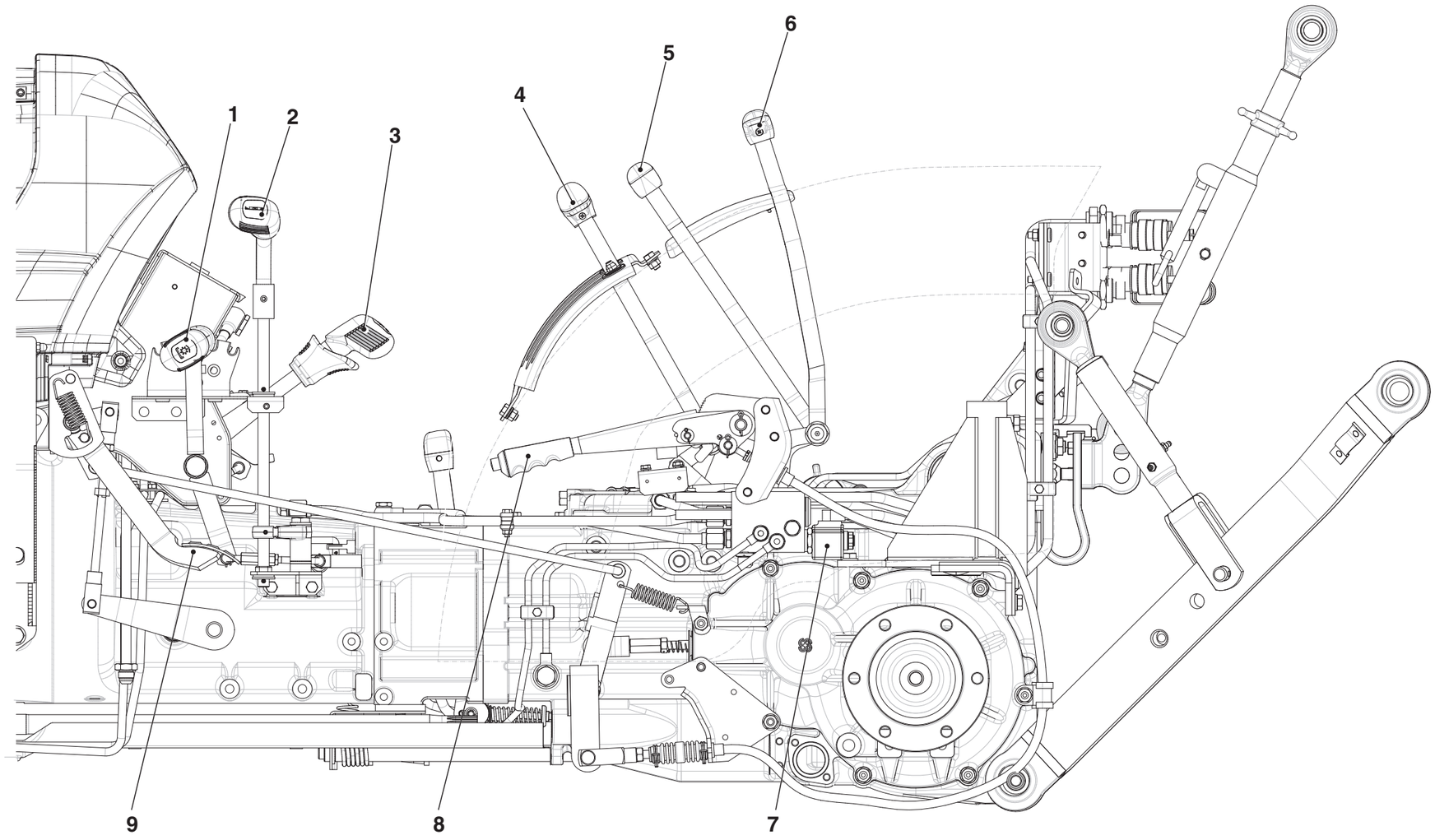
3.1 RIGHT-HAND SIDE VIEW



1 - Auxiliary service control valve (No. 1) control lever
2 - Auxiliary service control valve (No. 2) control lever
3 - Position control lever (yellow)
4 - DT control lever
5 - Rear PTO control lever
6 - Gear control lever
7 - Range control lever
8 - Right brake pedal
9 - Rear differential locking control pedal

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3.2 LEFT-HAND SIDE VIEW

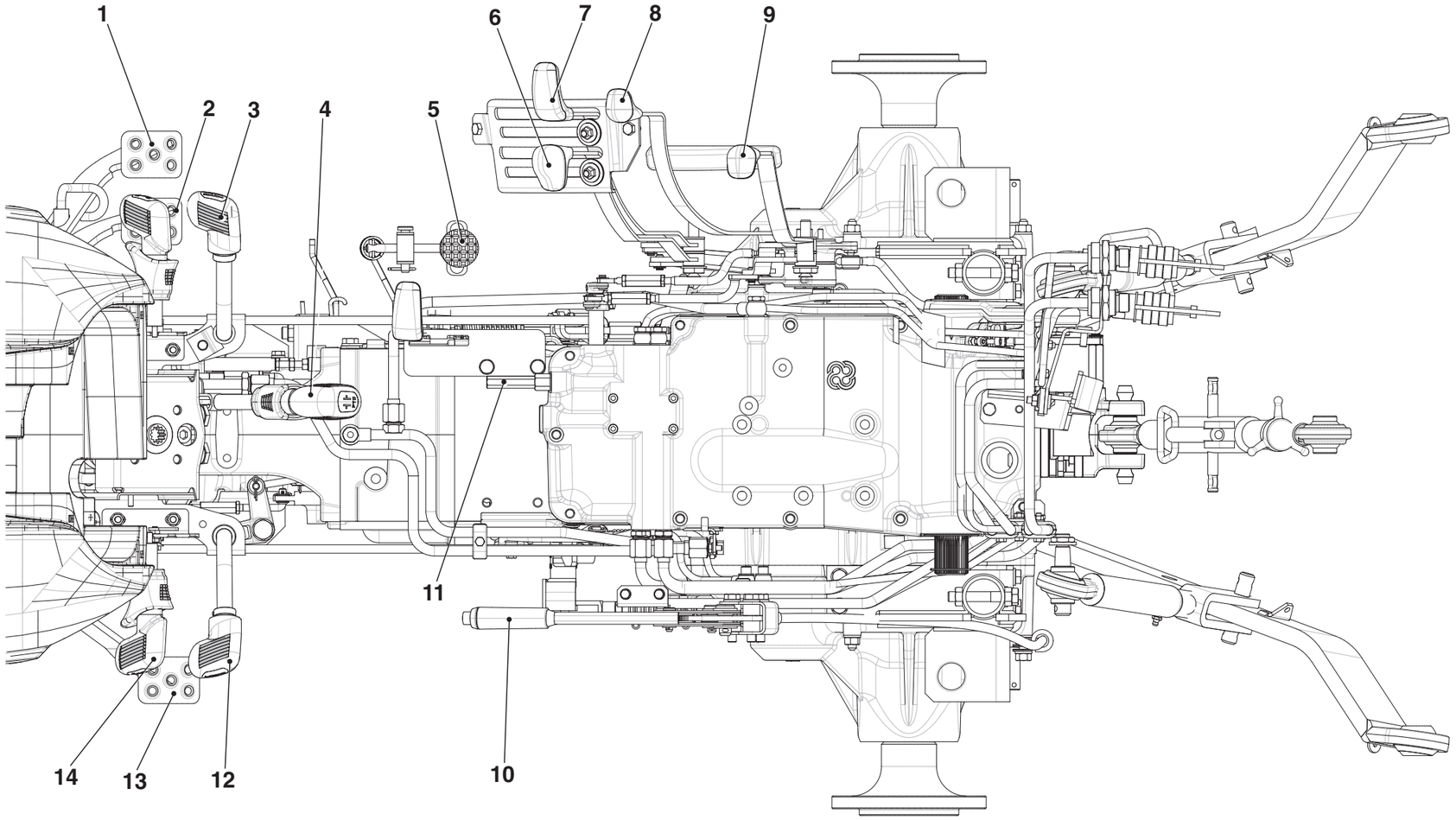


D0018500

1 - PTO selection speed control lever
2 - Shuttle control lever
3 - Rear PTO control lever
4 - Controlled stress lever (green)
5 - Auxiliary service control valve (No. 2) control lever
6 - Auxiliary service control valve (No. 1) control lever
7 - Solenoid controlling engagement of front diff lock
8 - Parking brake control lever
9 - Transmission clutch pedal

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3.3 TOP VIEW



D0018490

1 - Right brake pedal
2 - Left brake pedal
3 - Gear control lever
4 - PTO control lever
5 - Rear differential locking control pedal
6 - Controlled stress lever (green)
7 - Position control lever (yellow)
8 - Auxiliary service control valve (No. 2) control lever
9 - Auxiliary service control valve (No. 1) control lever
10 - Parking brake control lever
11 - Double/ single acting converter
12 - Shuttle control lever
13 - Transmission clutch pedal
14 - PTO selection speed lever

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4. HYDRAULIC SYSTEM

4.1 DESCRIPTION

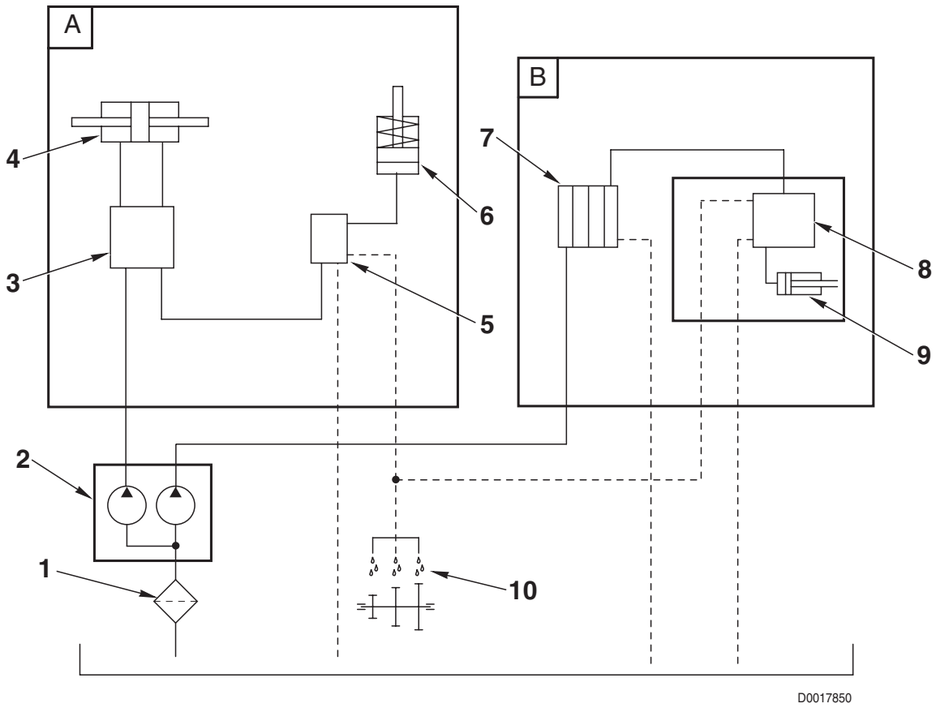
The tractors in this series are equipped with a hydraulic system that comprises two main circuits.

A - Steering circuit

B - Auxiliary hydraulic services circuit

These circuits are supplied with oil by a tandem gear pump that converts the energy delivered by the engine into hydraulic energy.

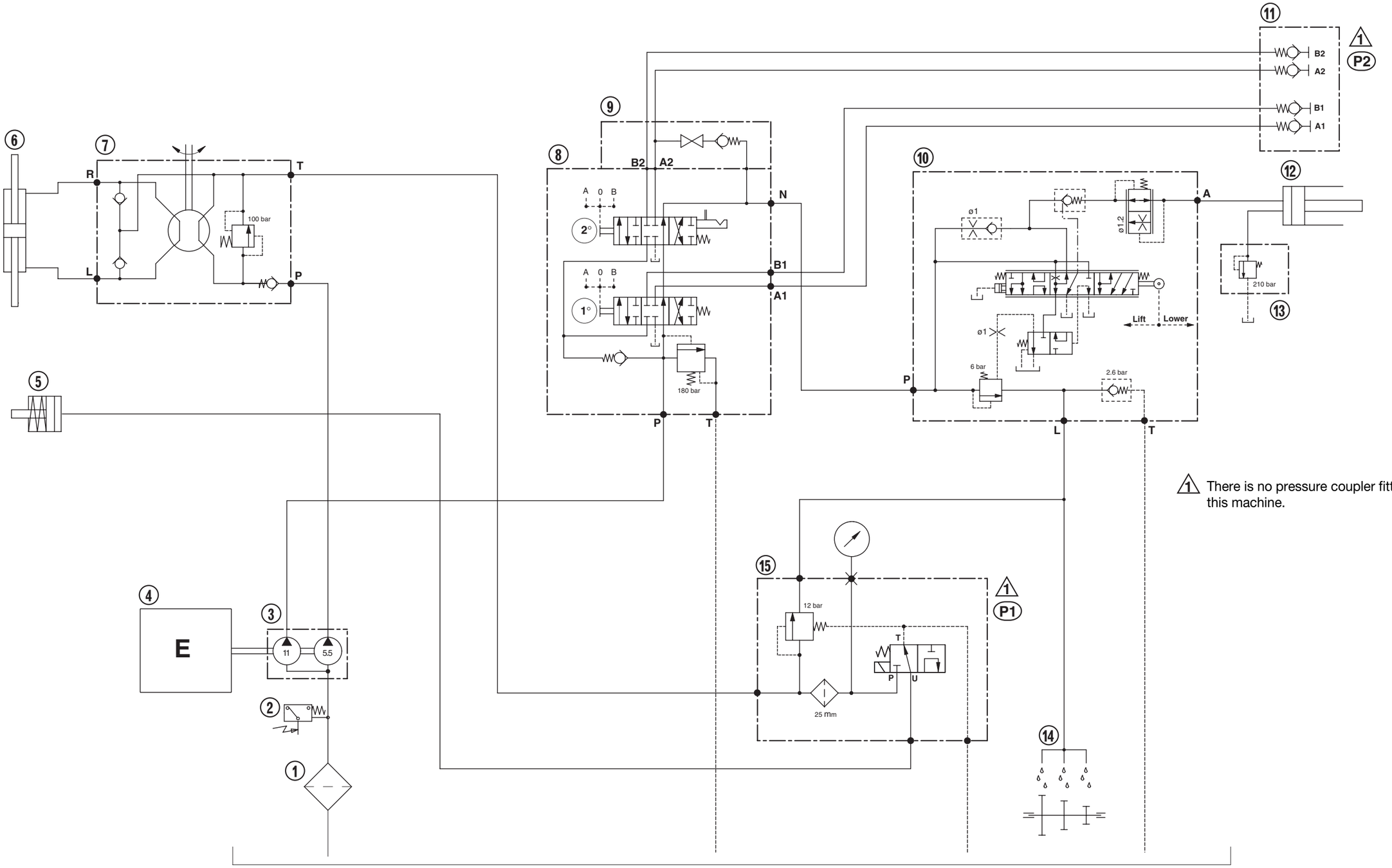
The main oil flow from the pump is sent to the devices that control and direct oil pressure to the actuators.
The actuators convert hydraulic energy into mechanical energy.



1 - Suction line filter
2 - Tandem gear pump
3 - Power steering
4 - Steering cylinder
5 - Differential lock control assembly
6 - Front differential lock control piston
7 - Auxiliary services control valve (2 ways)
8 - Lift control valve
9 - Lift control cylinder
10 - Gearbox and shuttle lubrication

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4.2 HYDRAULIC DIAGRAM



⚠1 There is no pressure coupler fitted to this machine.

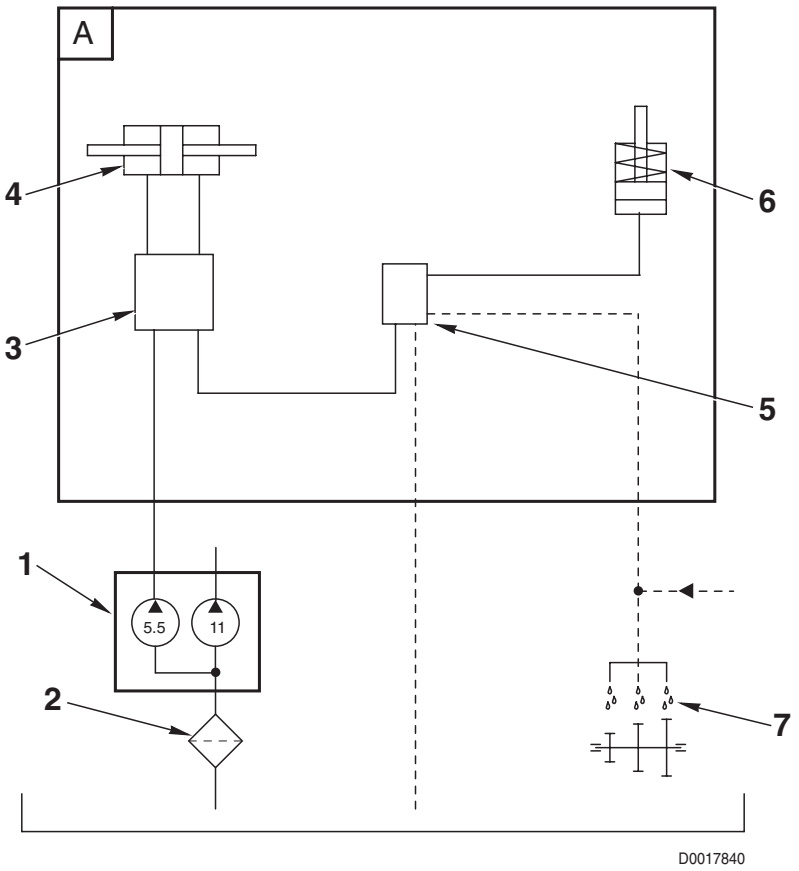
1 - Suction line filter (25 µm)
2- Clogged filter sensor (normally open contact; commutation pressure 0.5 bar)
3 - Tandem gear pump (11+5.5 cc/rev)
4 - Engine
5 - Front differential lock control piston
6 - Steering cylinder
7 - Power steering
8 - Auxiliary services control valve (2 ways)
9 - Double/ single acting converter
10 - Lift control valve
11 - Rear quick-action couplers
12 - Lift control cylinder
13 - Lift relief valve
14 - Gearbox and shuttle assembly lubrication
15 - Differential lock control assembly

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4.3 STEERING CIRCUIT

4.3.1 FUNCTION

The steering circuit sends oil to the power steering, which in turn, according to the request from the operator, sends oil pressure to the steering circuit.



4.3.2 OPERATION

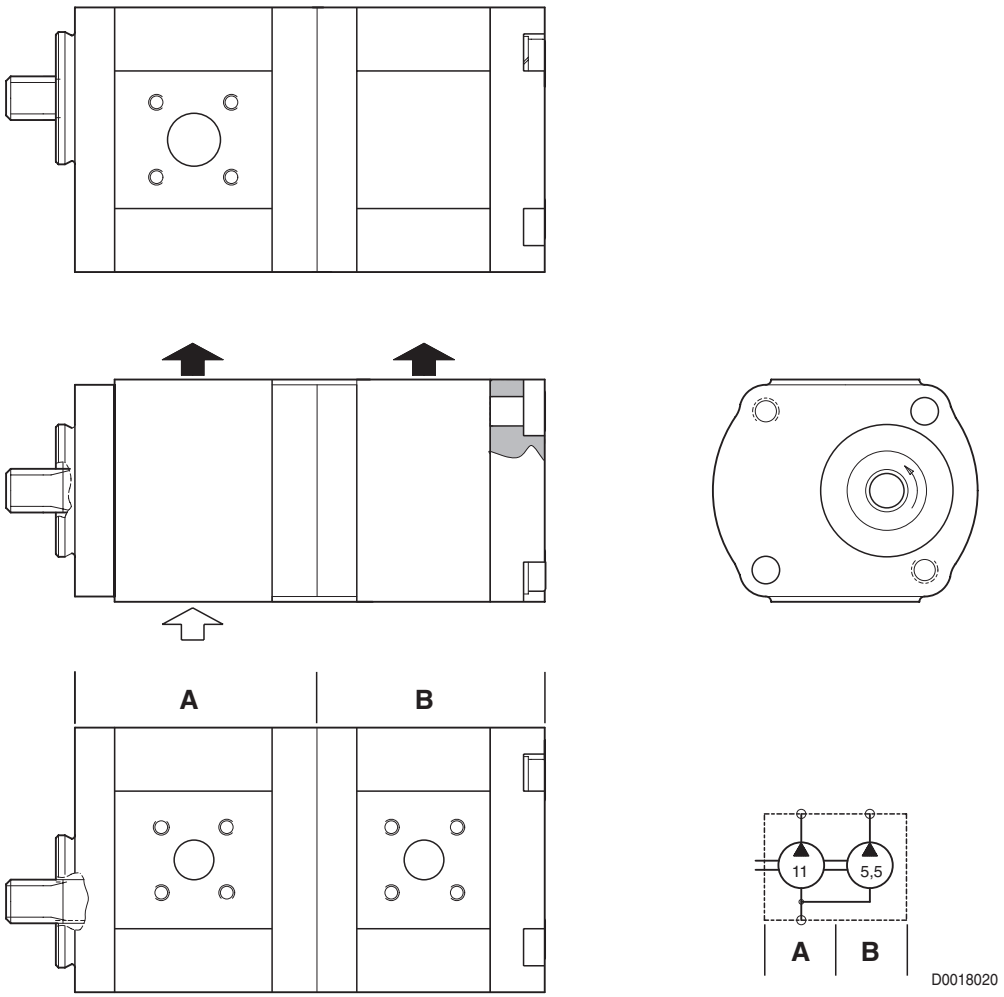
The gear pump (1) draws in oil (through filter (2)) from the transmission casing and sends it to the power steering (3).

The excess oil not used by the power steering (3) is sent to the differential lock control (5) and used to operate the front axle differential piston (6) and for lubrication of the gearbox and shuttle assembly (7).

When the operator turns the steering wheel, part of the oil supplied from the pump (1) is sent to the steering cylinder (4) which steers the tractor.

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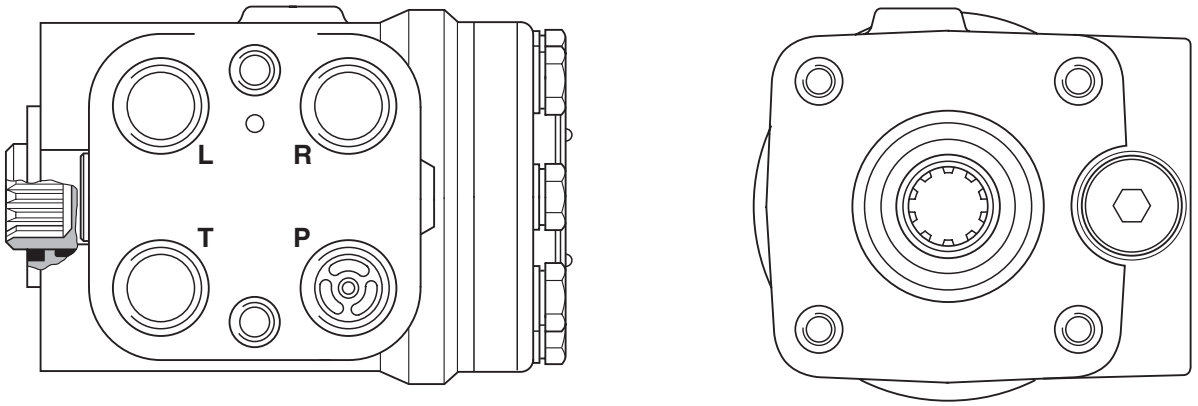
4.3.3 GEAR PUMP



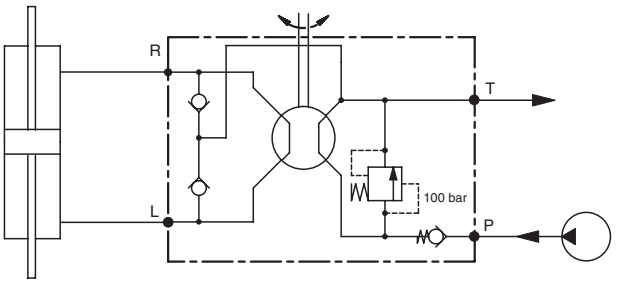
CHARACTERISTICS	PUMP A	PUMP B	NOTES
Displacement	11 cc/rev	5,5 cc/rev	
Maximum operating pressure	180 bar	100 bar	
Maximum capacity	33.0 ℓ/min.	16,5 ℓ/min	at an engine speed of 3000 rpm

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4.3.4 POWER STEERING



HYDRAULIC DIAGRAM



D0018010

OPERATION

- The power steering system consists of a control valve with a rotary spool; the operation of these units is hydrostatic.
- When the steering wheel is turned, the rotary spool control valve sends the oil from the pump to one side or the other of the steering cylinder.
  The rotary spool ensures that that the volume of oil delivered to the cylinder is proportional to the angle through which the steering wheel is turned.
- In the event of a malfunction of the power steering pump, the rotary spool valve automatically functions as a manual pump to ensure emergency steering.

CHARACTERISTICS

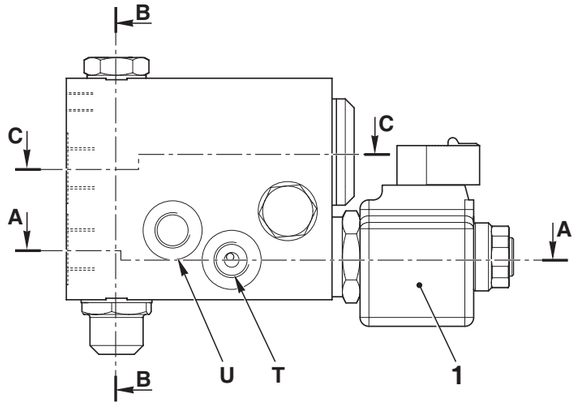
- Pressure relief valve setting: 100÷105 bar
- Displacement: 80 cc/rev

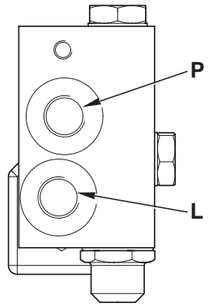
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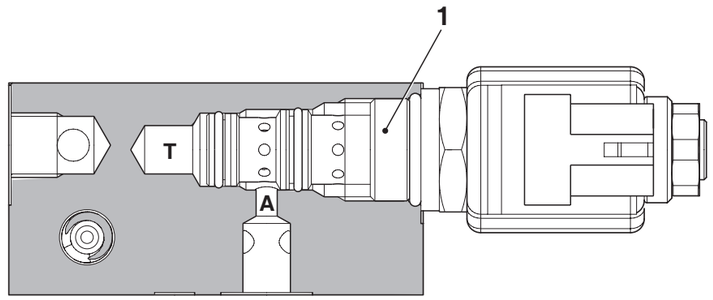
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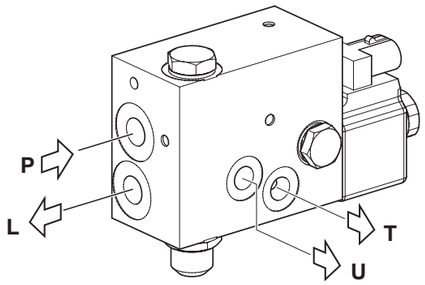
4.3.5 DIFFERENTIAL LOCK CONTROL ASSEMBLY

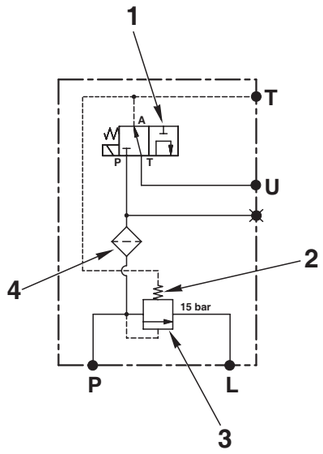


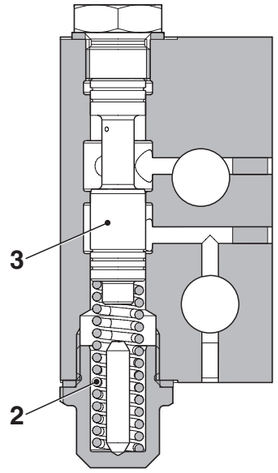




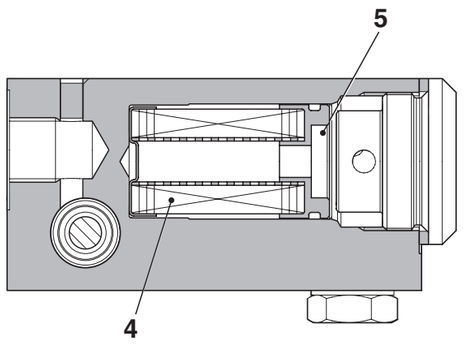
A - A







B - B



C - C

D0017900

PORT CONNECTIONS

- P - Supply to assembly
- L - Lubrication of gearbox/shuttle assembly
- U - Differential lock control
- T - Return to transmission housing

COMPONENTS

- 1 - Differential lock control solenoid valve (Connector X41)
- 2 - Pressure reducing valve spring
- 3 - Pressure reducing valve spool
- 4 - Filter (25 µm)
- 5 - Plug

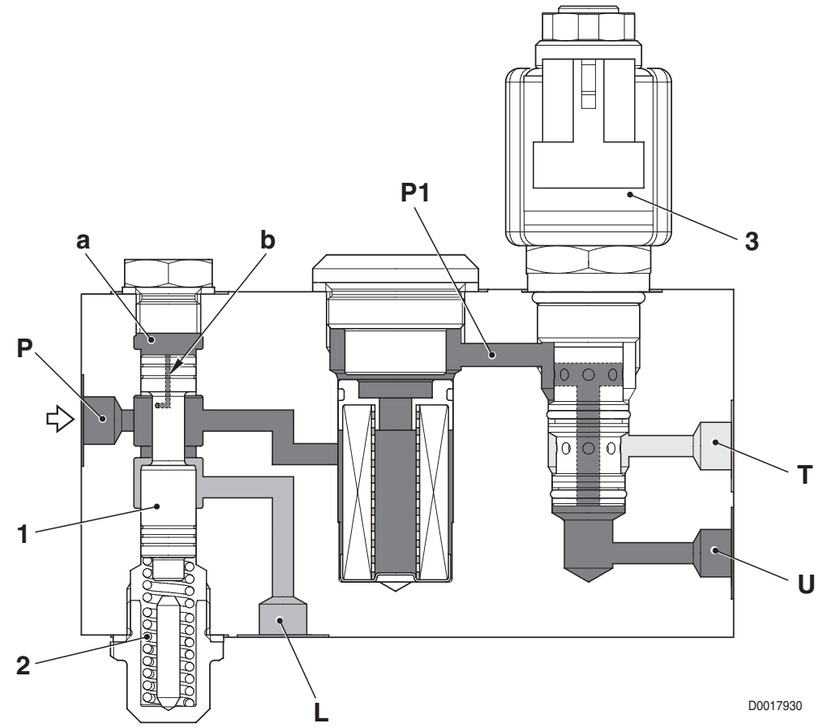
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FUNCTION

The differential lock control serves to direct the oil pressure from the power steering to the front differential control piston.

In order to limit the oil pressure sent to the differential lock piston, the control assembly incorporates a pressure relief valve set to 2 bar.

The excess oil not used by the solenoid valve is used for lubrication of the gearbox/shuttle assembly.

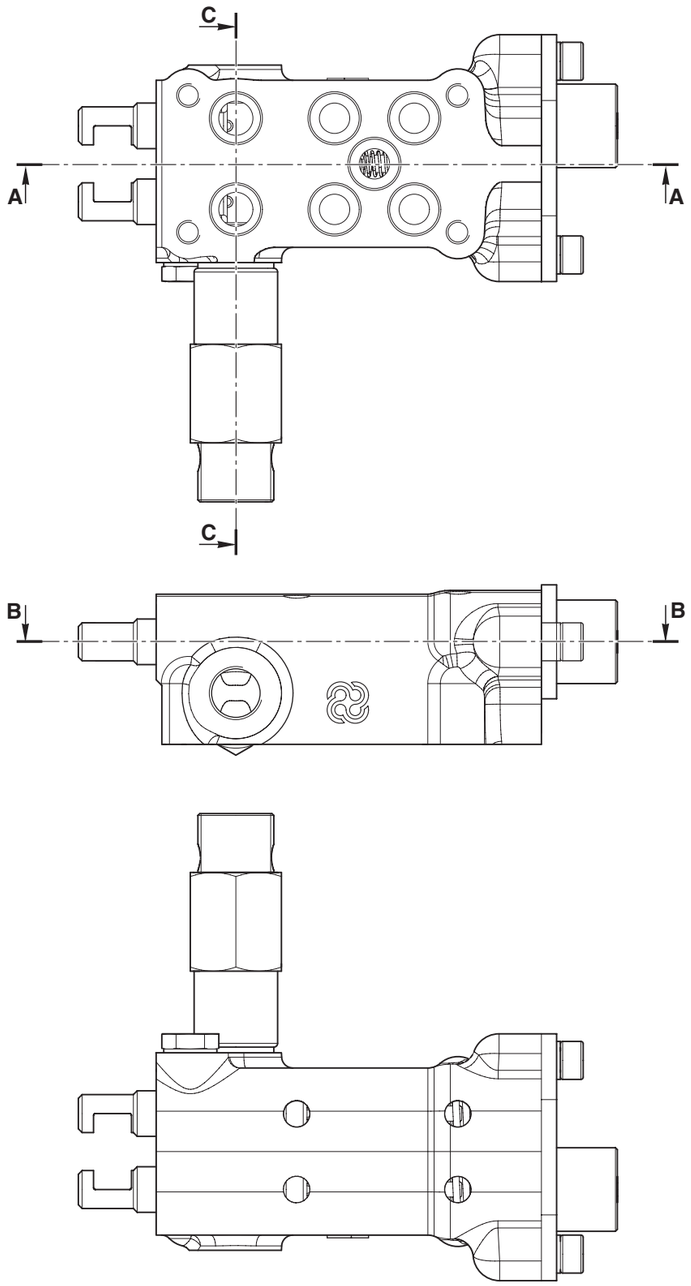


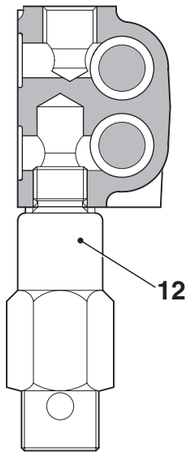
OPERATION

- The pressurised oil from the power steering reaches chamber **P** and chamber **a** through passage **b**.
  If there is no demand from the actuators, the oil stays in chamber **P** where the pressure starts to increase.
  When the force exerted on the spool (1) by the oil pressure in chamber **a** exceeds the force of the spring (2), the spool shifts downwards, thereby connecting chamber **P** with chamber **L** and regulating the pressure in chamber **P1** to 12 bar.
  Surplus oil is thus directed through chamber **L** to the gearbox/shuttle assembly where it is used for lubrication.
- If the solenoid valve (3) is not energised, the oil stops in chamber **P1** and chamber **U** is connected to chamber**T** and the oil is returned to the tank.
- If the solenoid valve (3) is energised, (as shown in the drawing), chamber **P1** is connected to chamber **U** and oil is sent to the control piston of the front differential lock.

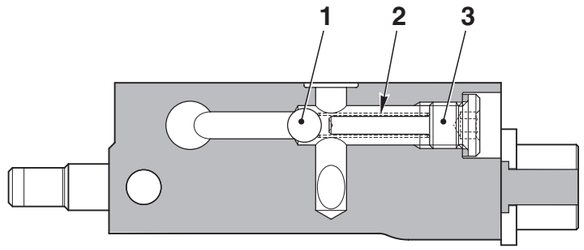
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4.3.6 AUXILIARY SERVICES CONTROL VALVE (4 WAYS)

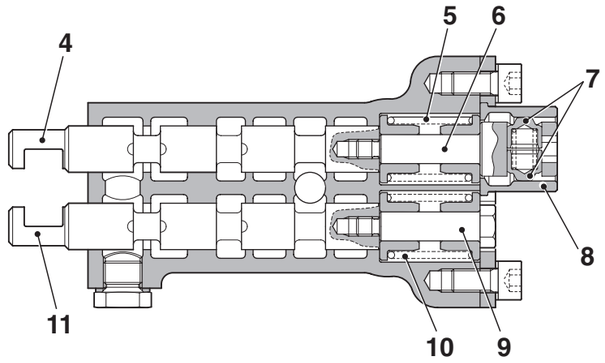




C - C



A - A



B - B

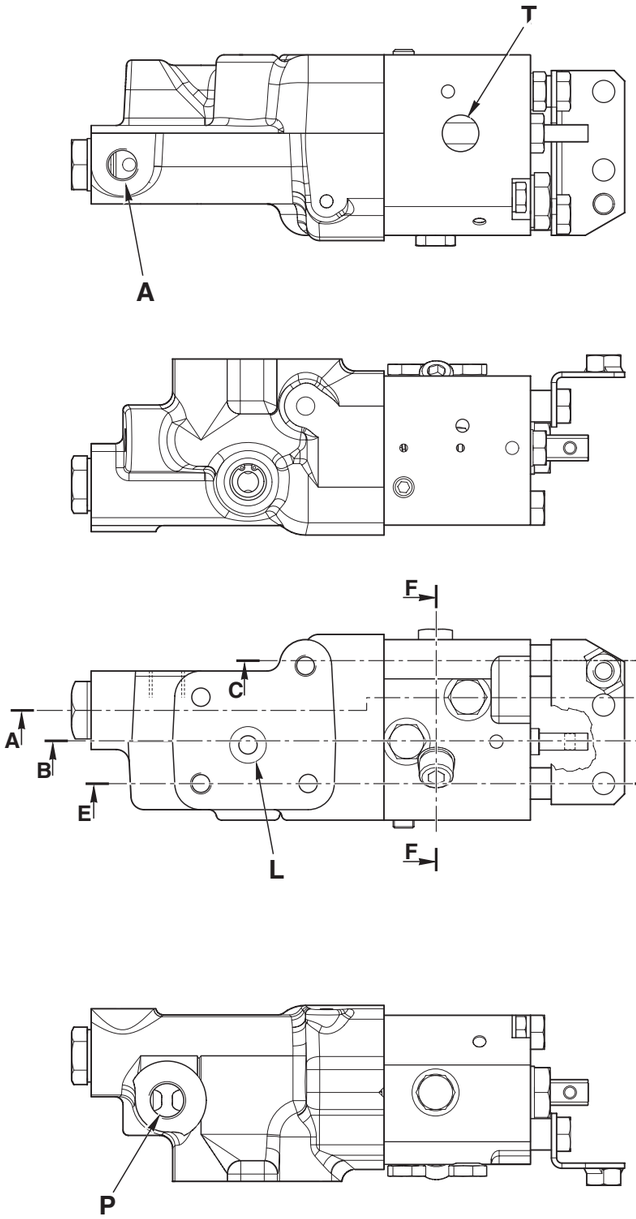
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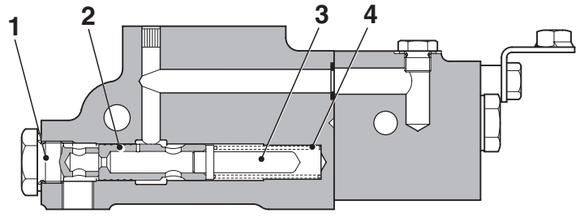
COMPONENTS

1 - Ball
2 - Spring
3 - Plug
4 - Control valve spool n° 2
5 - Spool return spring
6 - Pin
7 - Detent
8 - Bush
9 - Screw
10 - Spool return spring
11 - Control valve spool n° 1
12 - Pressure relief valve (180 bar)

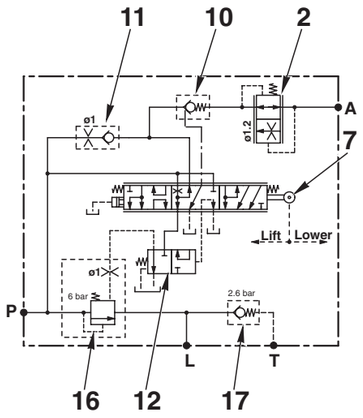
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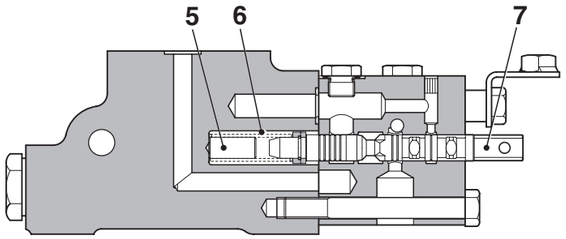
4.3.7 POWER LIFT CONTROL VALVE



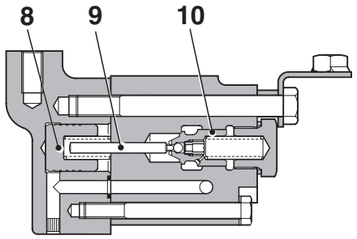


A-A

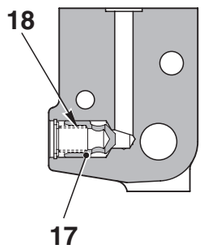




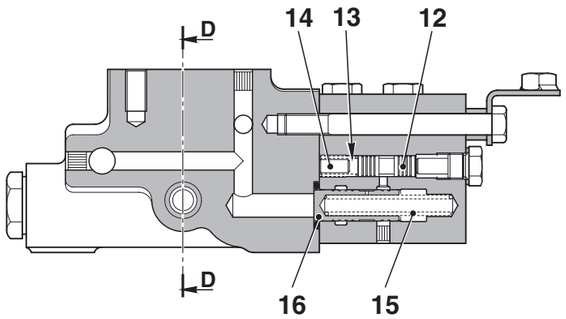
B-B



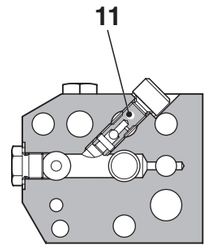
C-C



D-D



E-E



F-F

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PORT CONNECTIONS

- **P** - Supply line
- **T** - Exhaust
- **L** - Gearbox/shuttle lubrication
- **A** - LIft control

COMPONENTS

1 - Plug
2 - Rate of drop control valve spool (Valvematic)
3 - Plunger
4 - Rate of drop control valve spring
5 - Spacer
6 - Lift control valve spool return spring
7 - Lift control valve spool
8 - Control piston check valve
9 - Valve stem
10 - One-way valve
11 - Inlet valve
12 - Pilot/enabling valve
13 - Pilot/enabling valve spring
14 - Spacer
15 - Enabling valve spring
16 - Enabling valve
17 - Lubrication pressure control valve
18 - Lubrication pressure control valve spring

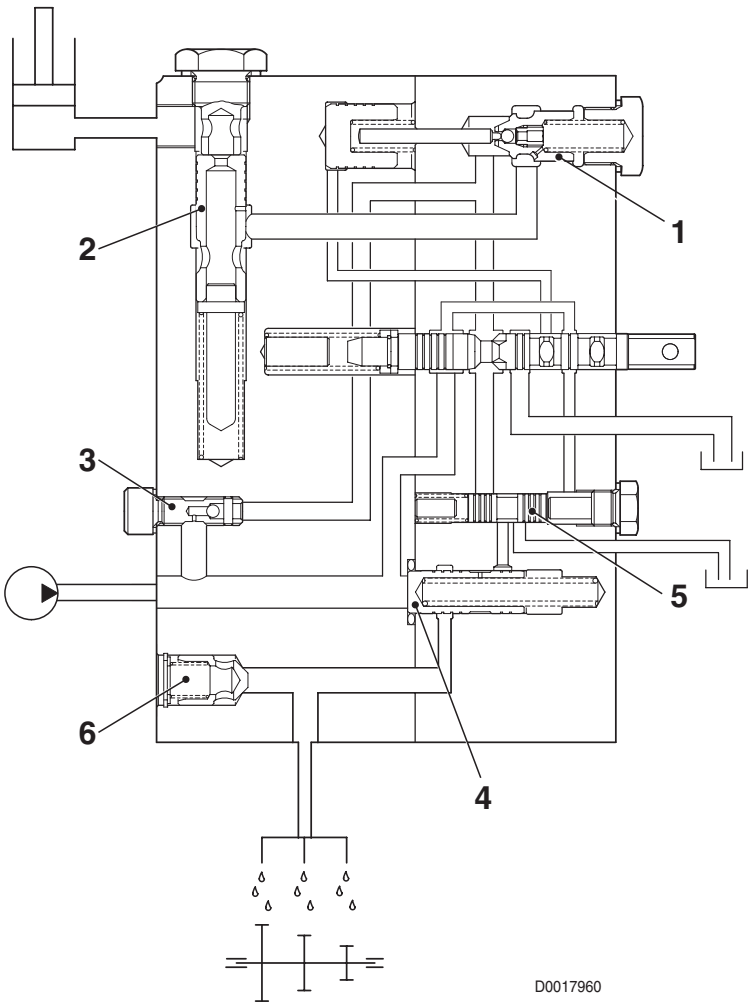
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FUNCTION

The function of the lift control valve is to direct oil pressure to the lifting cylinder, thereby allowing the linkage to be raised and lowered.

It incorporates the following valves:

- One-way valve (1)
- Rate of drop control valve (Valvematic) (2)
- Inlet valve (3)
- Enabling valve (4)
- Pilot/enabling valve (5)
- Lubrication pressure control valve (6))

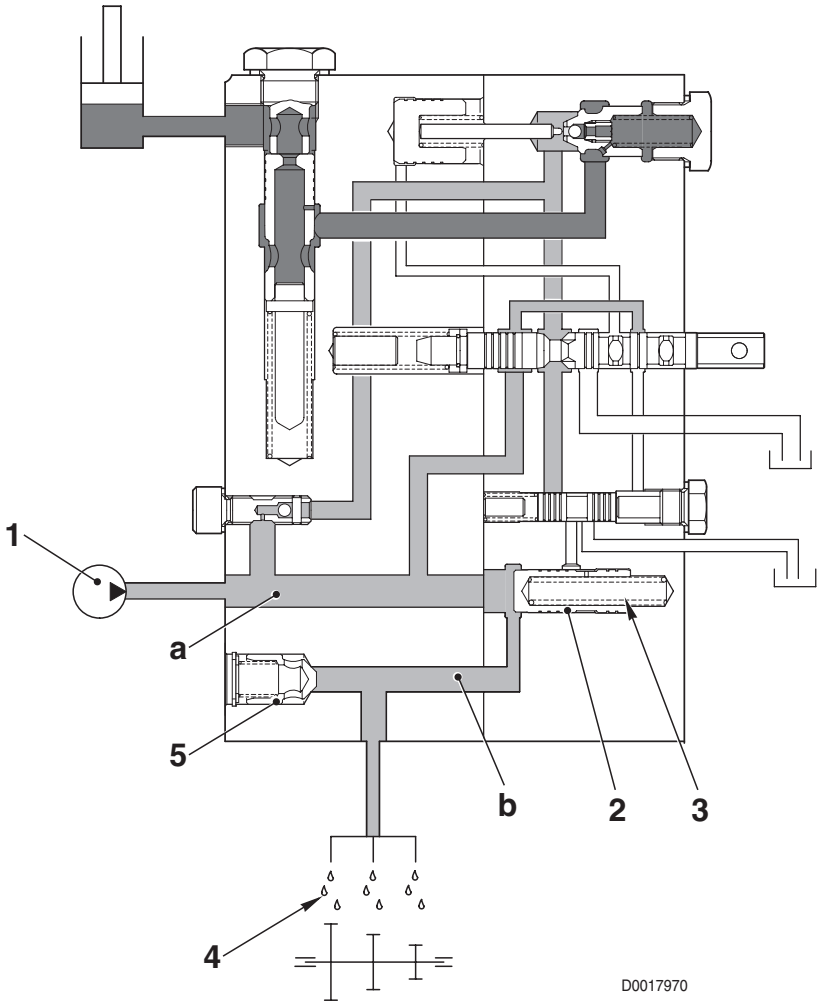


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OPERATION

1. When the lift control is in neutral position

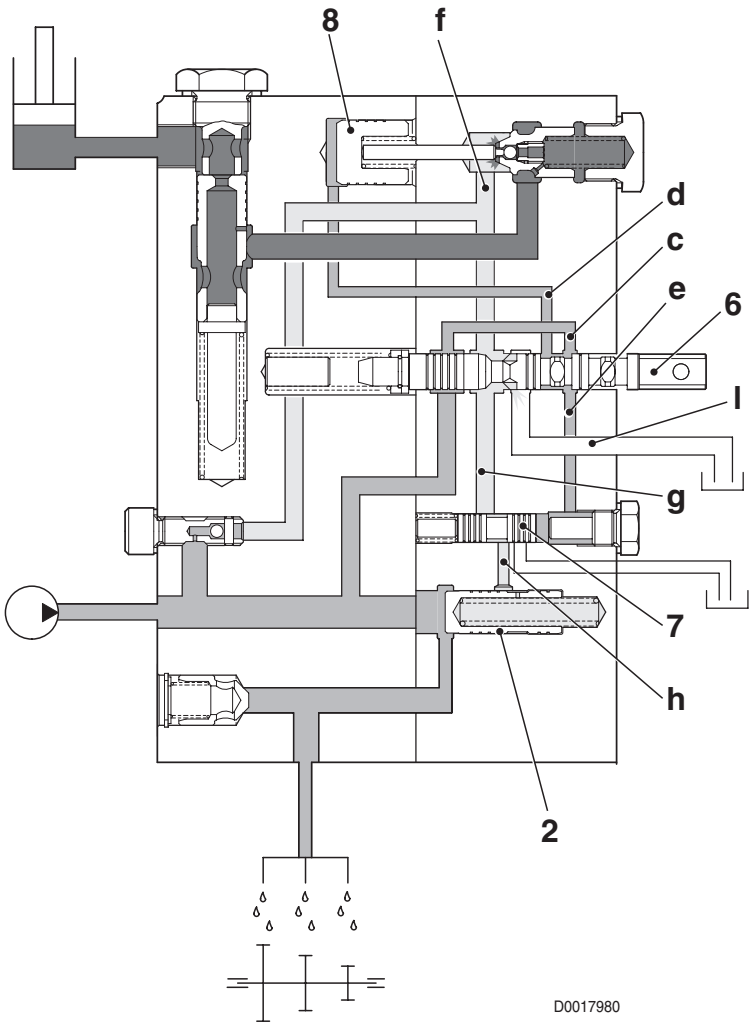
- The pressurised oil from the pump (1) flows to line **a**.
  As all the passages are closed, the pressure increases and when the force exerted on the enabling valve (2) overcomes that of the spring (3), the valve (2) shifts to the right to allow oil to flow in line **b** and on to the gearbox/ shuttle assembly where it is used for lubrication (4).
  To prevent sudden changes in pressure, a pressure control valve (5) is installed on line **b**, to limit the lubrication oil pressure.



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2. When the lift is lowered

- When the spool (6) is shifted to the left, lift lowering begins; this can be divided into two stages:
  - **STAGE 1**
    When the spool (6) is shifted to the right, this connects:
    - line **c** with line **d**, thereby allowing the piston (8) to move to the right.
    - line **f** to drain line **l**, thereby allowing the pressure in line **f** to fall.



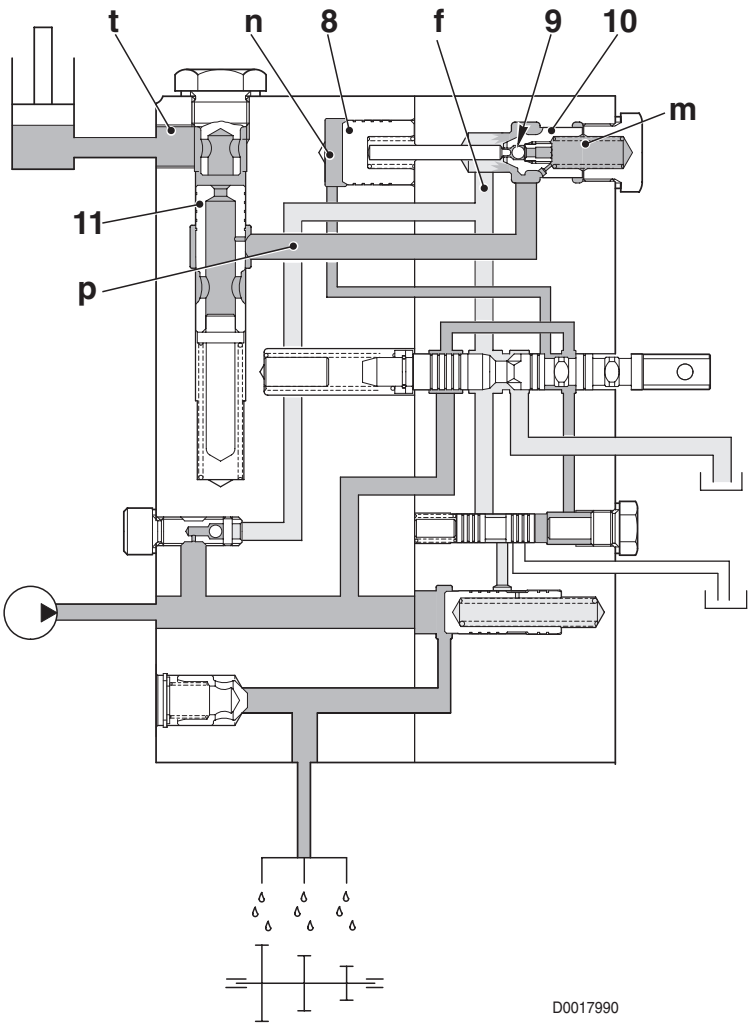
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- **STAGE 2**

  When the piston (8) moves to the right, the ball (9) is also moved to the right to connect chamber **m** of the check valve (10) with line **f**.

  Consequently the pressure in chamber **m** is decreased and the force exerted on the piston (8) by the pressure in chamber **n** pushes the valve (10) to right thereby connecting line **p** with line **f** and allowing the oil to flow and the lift to be lowered.

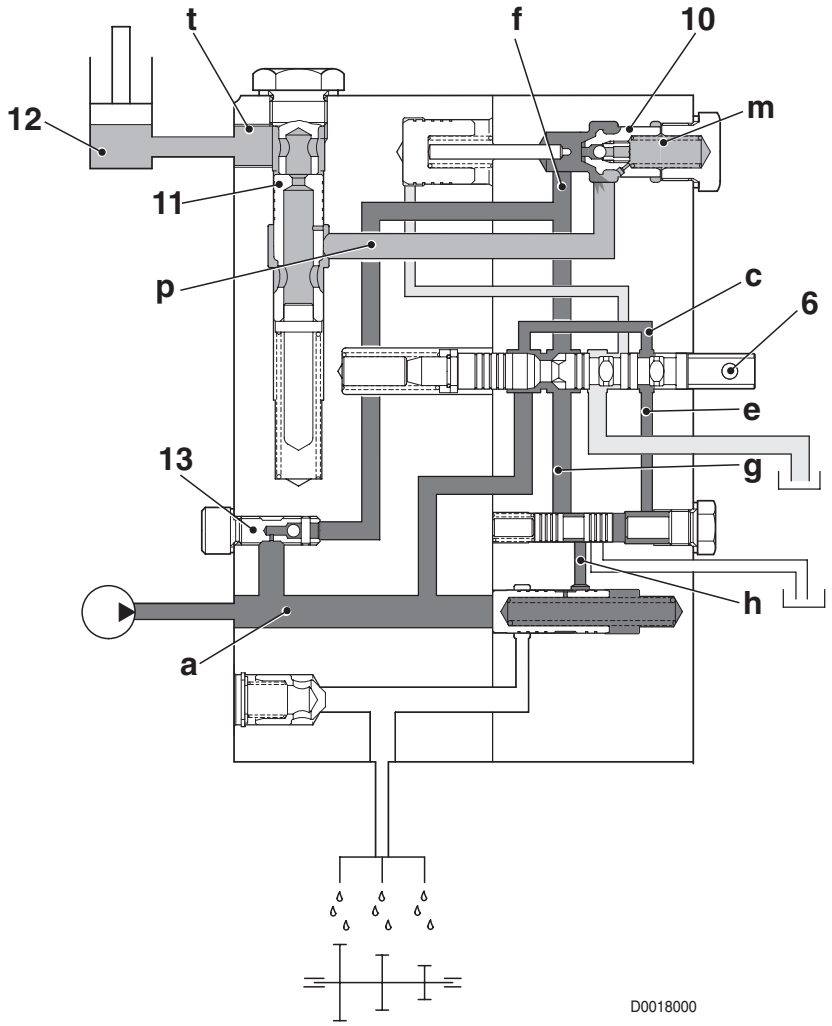
  The valve (11) is used to regulate the rate of drop; when moved downwards, it limits the flow of oil between port **t** and line **p**.



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3. When the lift is raised

- When the spool (6) is shifted to the left, this opens the connecting passages between lines **c** and **e, g** and **h, a** and **f**.
  When the forces exerted by the pressure in line **f** overcomes the force exerted by the pressure in chamber **m**, the valve (10) is shifted to the right and oil can flow into line **p** and from there, through the valve (11), to port **t** and the lifting cylinder (12).
  To increase the lifting speed i.e. the flow of oil to the lifting cylinder (12), a one-way valve (13) is installed in parallel with the spool (6); this ensures that oil is only supplied during the lifting stage.



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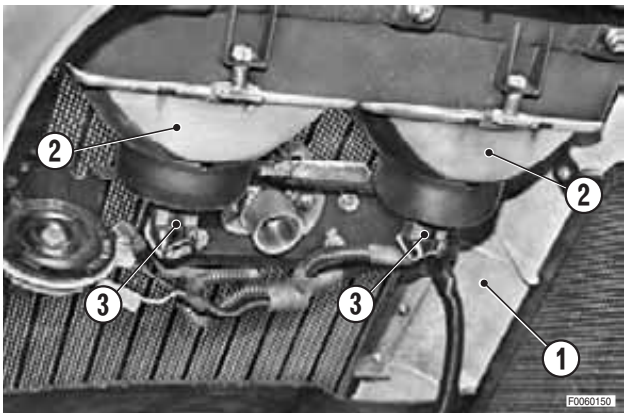
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ENGINE HOOD

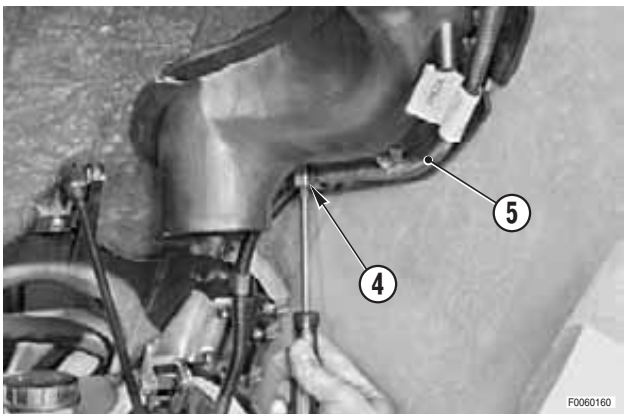
Removal

Remove the key from the ignition and apply the parking brake.

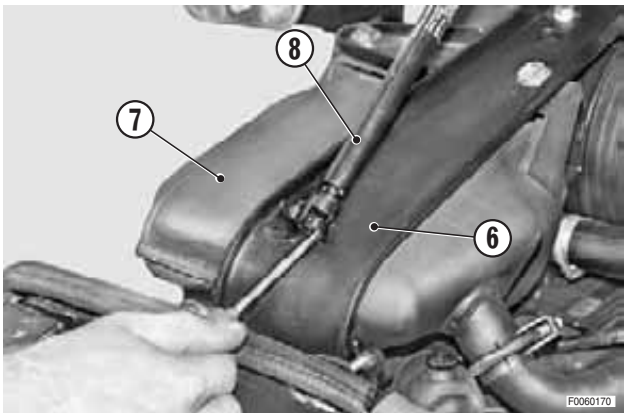
1 - Raise the hood (1) and unplug the connectors (3) from the lights (2).



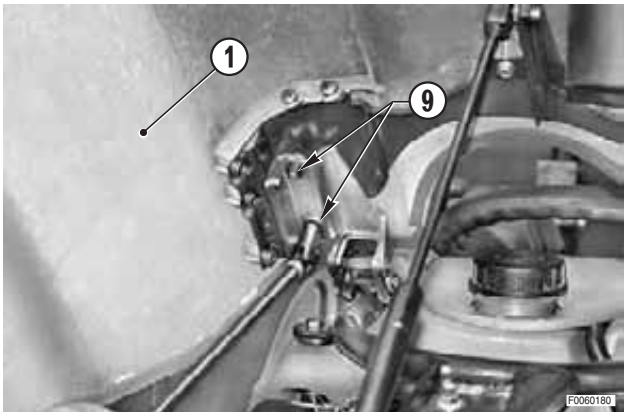
2 - Remove the screws (4) and release the wiring (5) from the hood.



3 - Disconnect the hood piston (8) from the frame (6) supporting the silencer (7).



4 - Remove the nuts (9) (2 per side) and remove the hood (1).



Refitting

- Refitting is the reverse of removal.

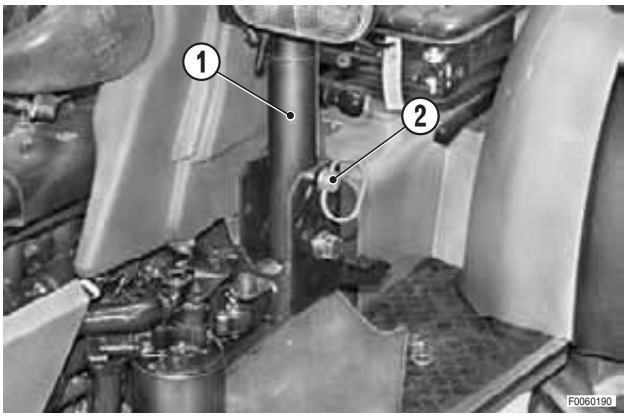
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SAFETY ROLL BAR

Removal

⚠ Remove the key from the ignition and apply the parking brake.

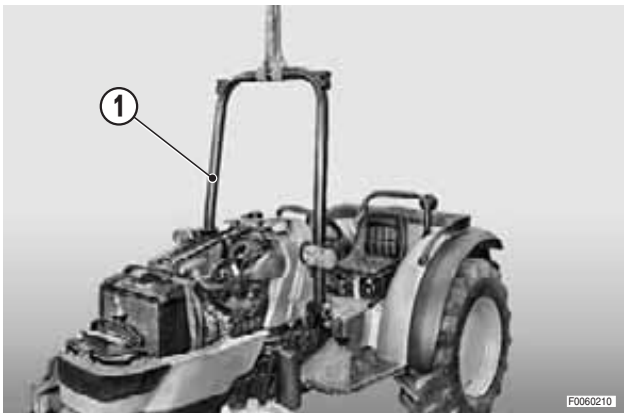
1 - Position the roll-over safety bar (1) in the upright position and secure it with the pins (2).



2 - Disconnect the light connectors (3) (1 per side).

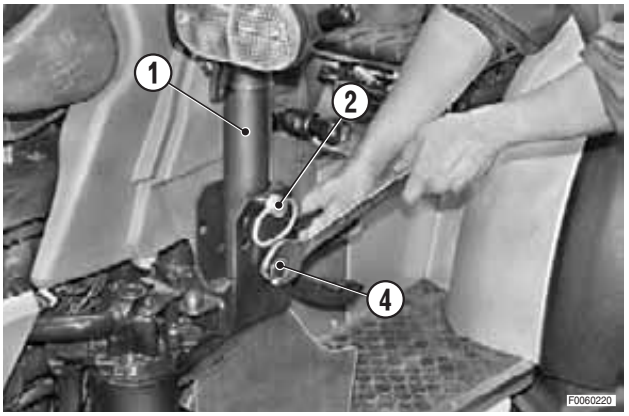


3 - Sling the roll bar (1) to a hoist and take up the slack.



4 - Unscrew and remove the screws (4).

5 - Remove the pins (2) and remove the roll bar (1).



Refitting

- Refitting is the reverse of removal.

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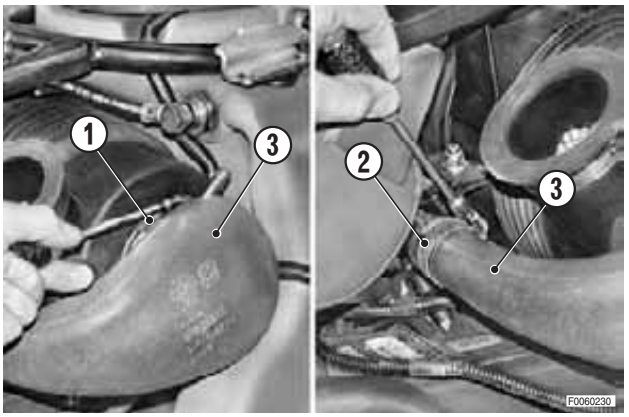
SILENCER

Removal

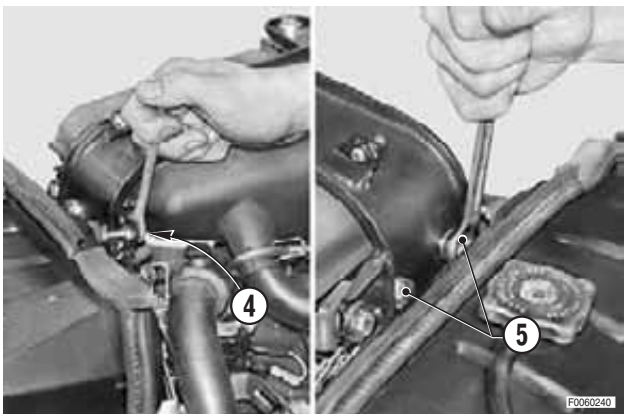
⚠ Remove the key from the ignition and apply the parking brake.

1 - Remove the hood.
(For details see «ENGINE HOOD»).

2 - Loosen the clips (1) and (2) and remove the inlet manifold (3).
★ Disconnect the air filter wires

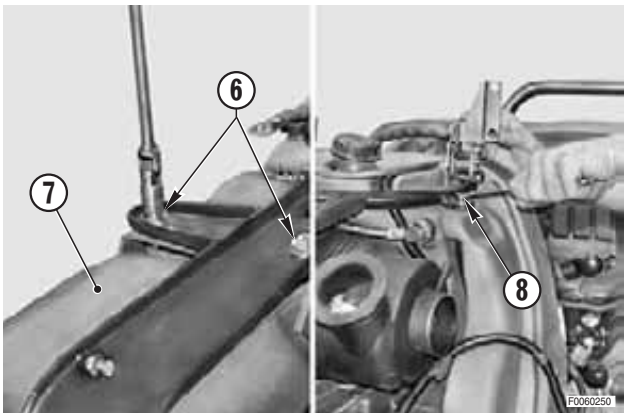


3 - Remove the nut (4) and the bolts (5).

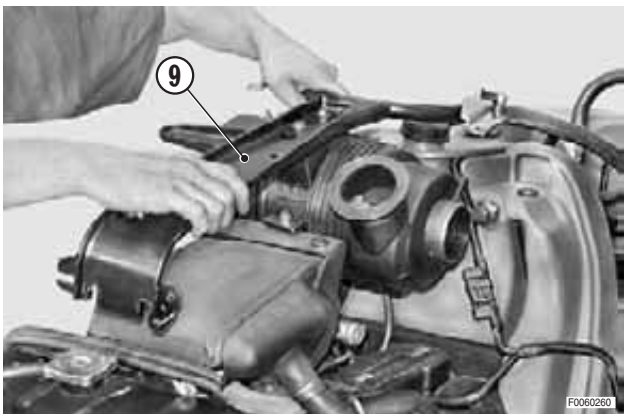


4 - Remove the bolts (6) securing the silencer (7).

5 - Remove the bolts (8).



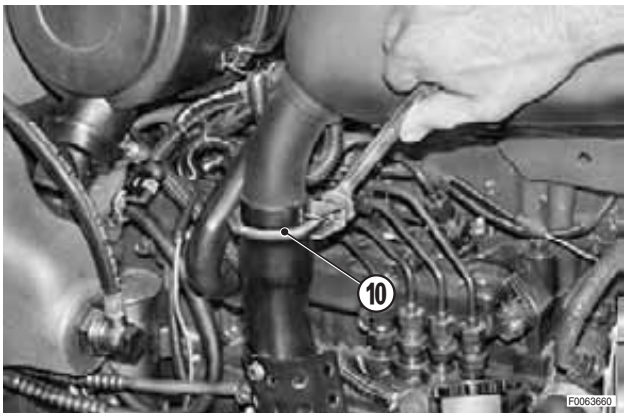
6 - Remove the support (9) complete with air filter.



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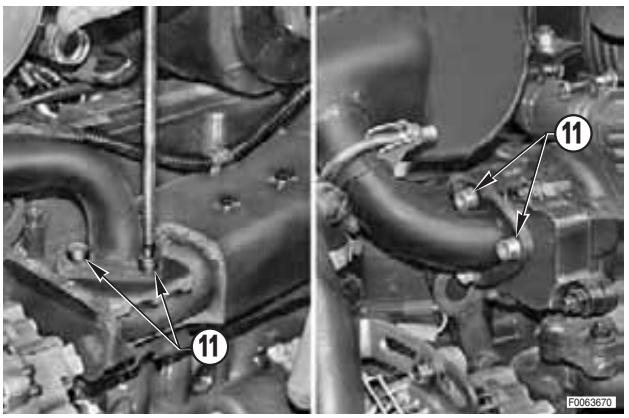
30 CV version

7 - Loosen the clip (10).

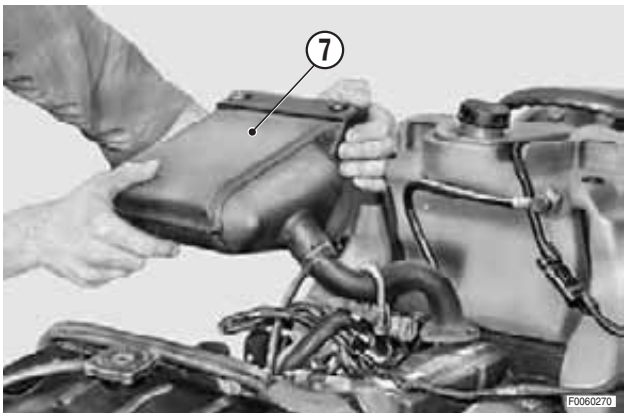


40-50 CV Version

8 - Remove the screws (11). ※ 1



9 - Remove the silencer (7).



Refitting

- Refitting is the reverse of removal.

※ 1

★ Renew the gasket every time the pump is removed.

Nm Screws:
40 CV: 17.5–21.5 Nm (13–15.8 lb.ft.)
50 CV: 18.8–23 Nm (14–17 lb.ft.)

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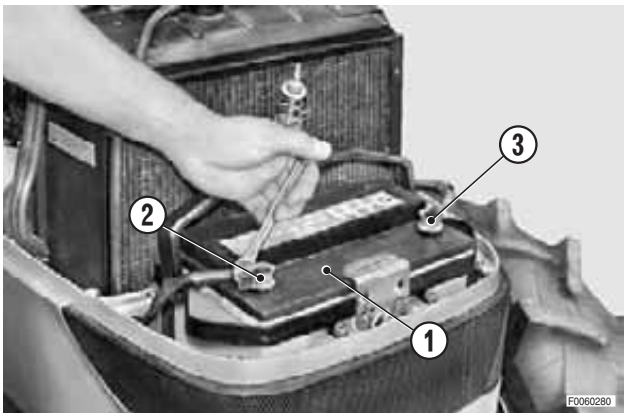
RADIATOR

Removal

Remove the key from the ignition and apply the parking brake.

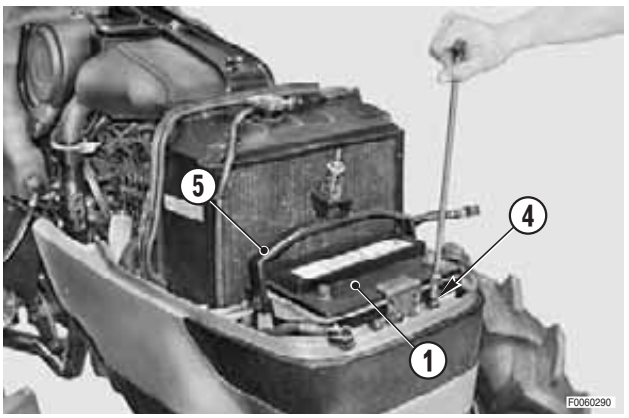
1 - Remove the hood.
(For details see «ENGINE HOOD»).

2 - Disconnect the leads from the terminals of the battery (1). Always disconnect the negative lead (2) first and then the positive lead (3).



3 - Remove the six screws (4) and remove the frame (5).

4 - Remove the battery (1).



5 - Remove the lower hose clip (6).

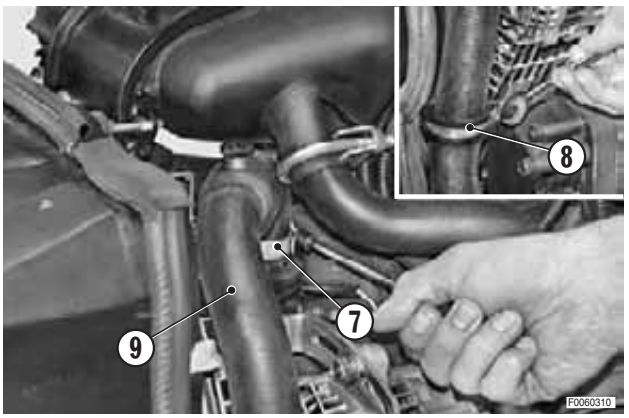
6 - Drain off all the engine coolant.

Coolant: max 5 ℓ (1.3 US.gall.)

7- Remove the silencer.
(For details see «SILENCER»).

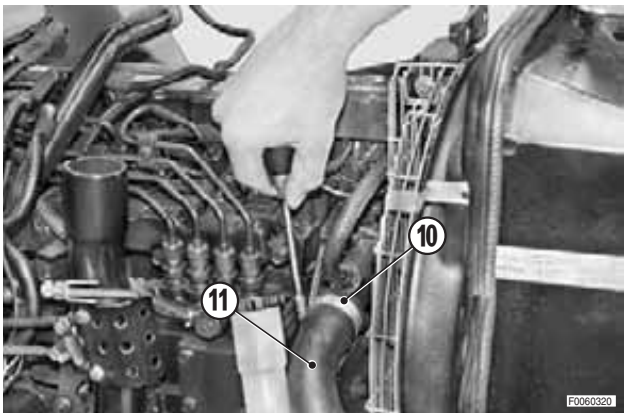


8 - Loosen the hose clips (7) and (8) and disconnect the hose (9).

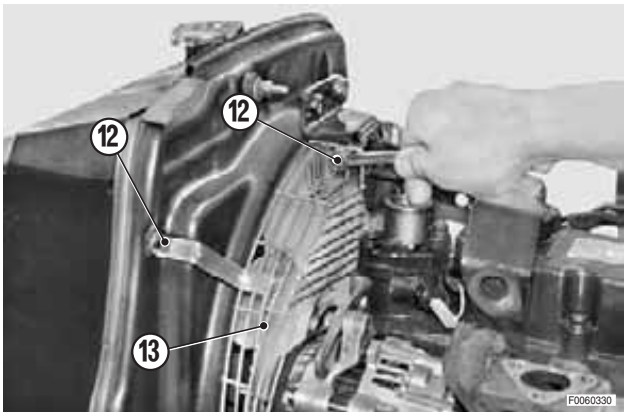


https://truckmanualshub.com/

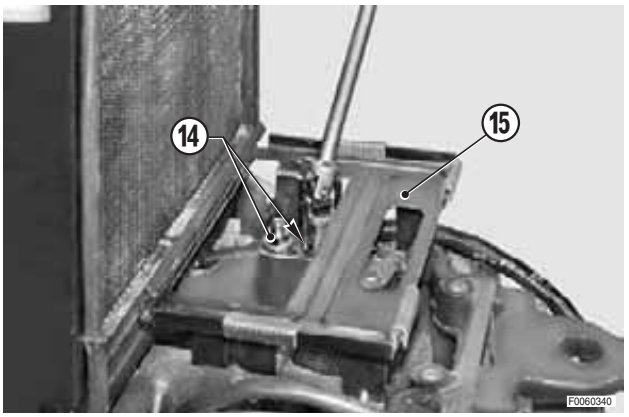
9 - Loosen the hose clip (10) and disconnect the hose (11).



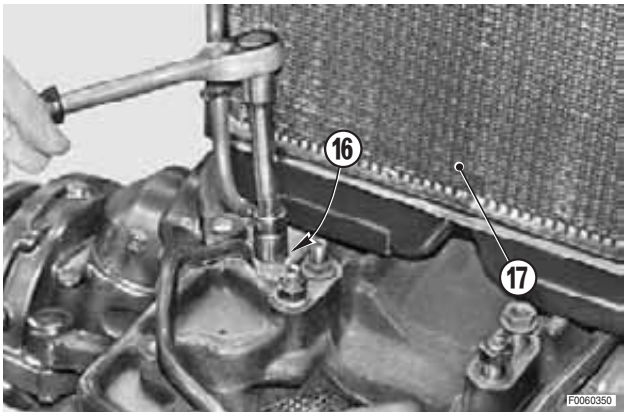
10 - Remove the five screws (12) and remove the left and right grilles.



11 - Remove the bolts (14) and remove the battery support (15).



12 - Remove the four screws (16) and remove the radiator (17).



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Refitting

- Refitting is the reverse of removal.

1 - Fill the engine cooling system.



Coolant:
max 5 ℓ (1.3 US.gall.)

2 - Start the engine and run for a few minutes to allow the coolant to circulate and then check the seals for leaks.

3 - Stop the engine and top up the coolant level.

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FRONT SUPPORT

Removal

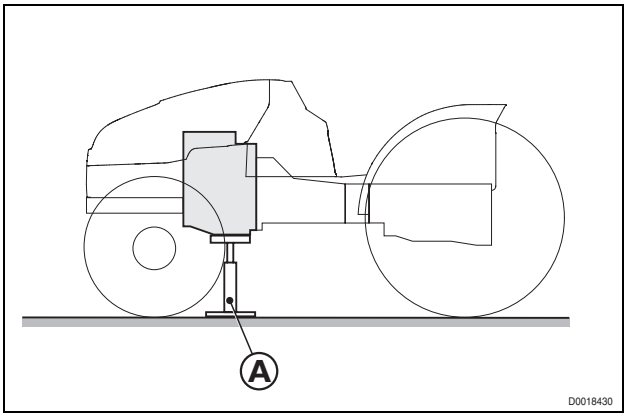
1 - Remove the hood.
(For details see «ENGINE HOOD»).

2 - Remove the silencer.
(For details see «SILENCER»).

3 - Remove the radiator.
(For details see «RADIATOR»).

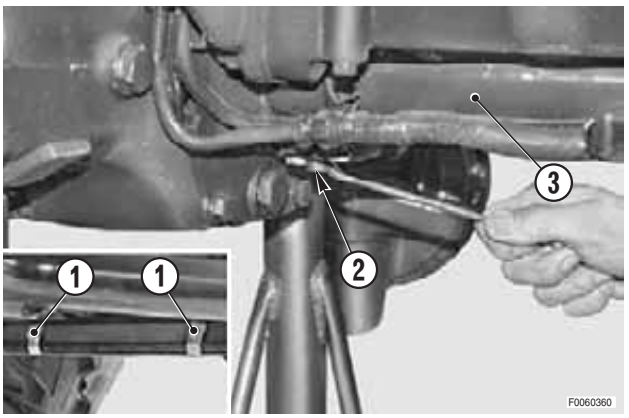
4 - Position a stand "**A**" under the engine crankcase.

5 - Remove the front tyres.
(For details see «TYRES»)

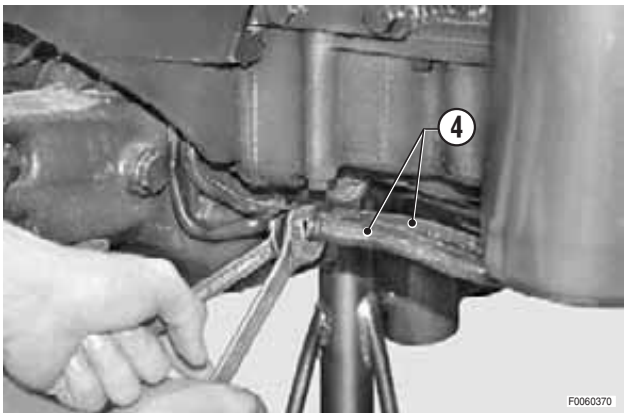


6 - Remove the screws (1) securing the clips.

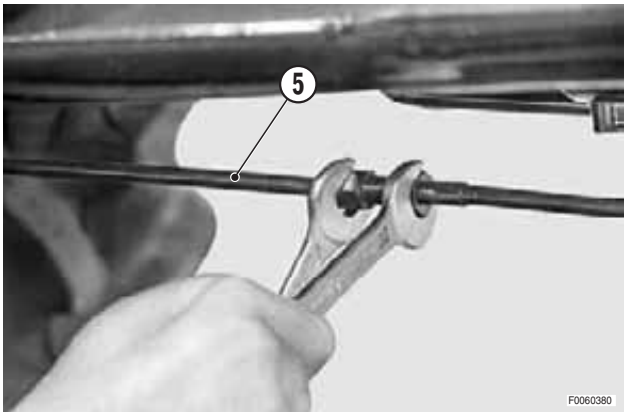
7 - Remove the five screws (2) and remove the four-wheel drive shaft guard (3).



8 - Disconnect the steering pipes (4).
★ Plug the pipes to prevent the entry of impurities.

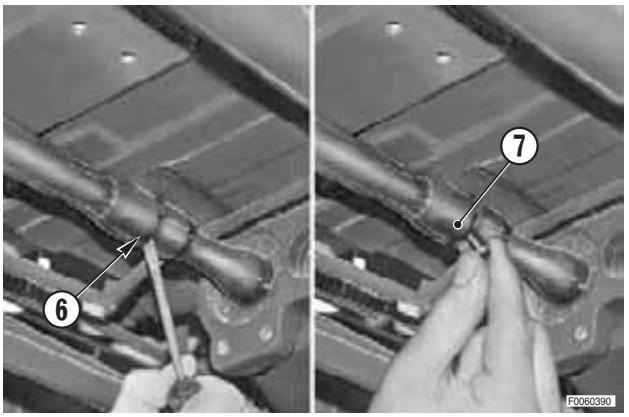


9 - Disconnect the front differential lock pipe.
★ Plug the pipe to prevent the entry of impurities.



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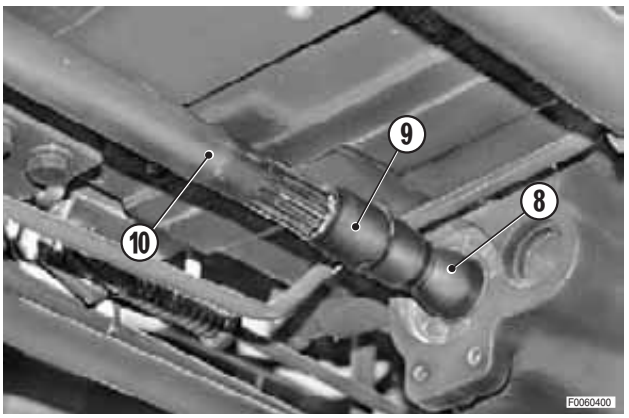
10 - Remove the circlip (6) from its seating and withdraw the pin (7).



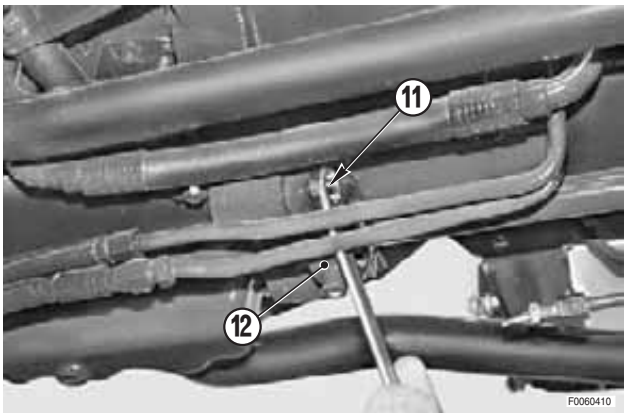
11 - Move the sleeve (9) towards the pinion (8) so as to release the 4WD shaft (10).

★ Take care not to get the sleeve stuck on the pinion teeth.

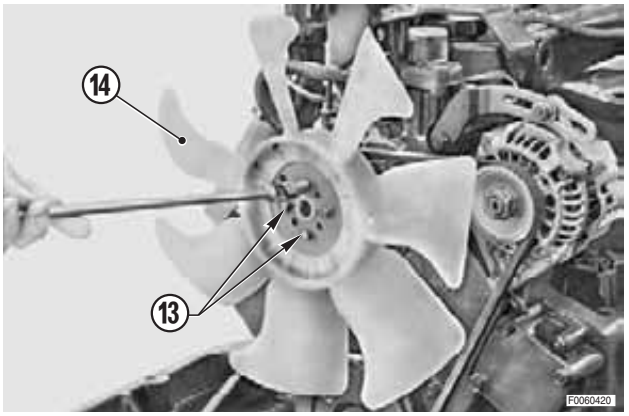
12 - Repeat the procedure described in points 10 and 11 for the front sleeve.



13 - Remove the screws (11) and remove the 4WD shaft complete with the central support (12).

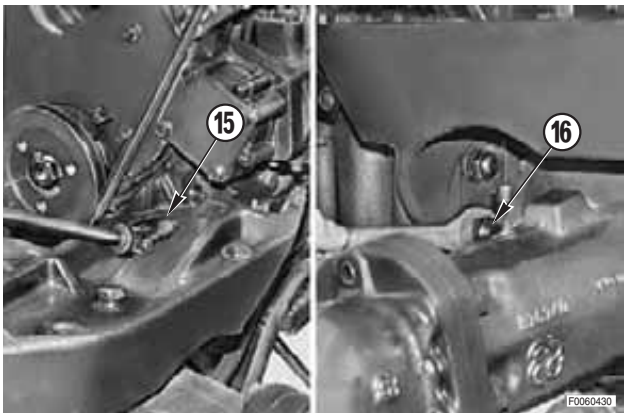


14 - Remove the screws (13) and remove the cooling fan (14).

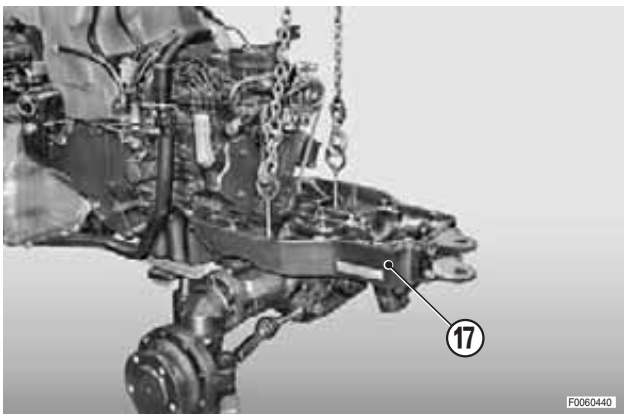


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15 - Remove the two bolts (15) and the four nuts (16).
★ Note that the lower left nut must not be removed.

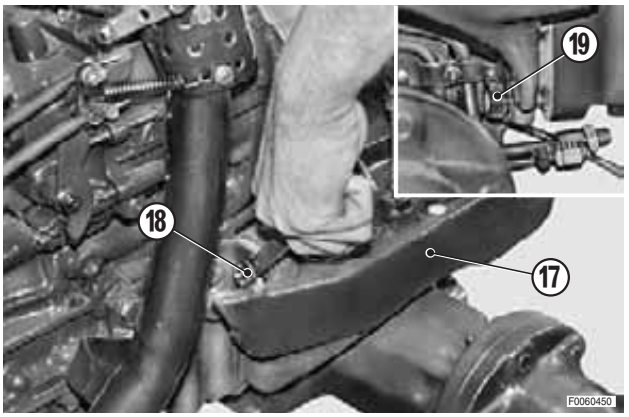


16 - Attach the front support (17) to a hoist and take up the slack in the lifting ropes or slings.



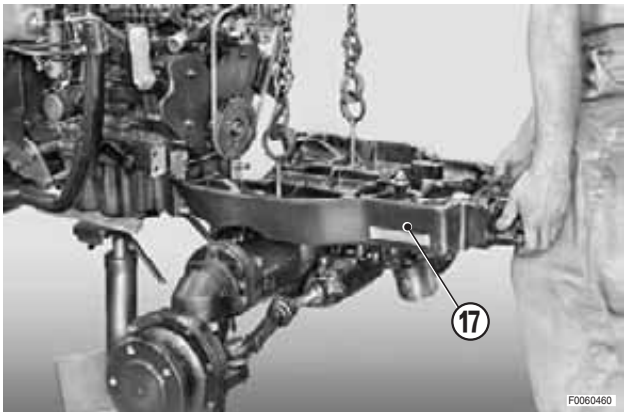
17 - Remove the four bolts (18) and move the front support (17) slightly away from the engine.

18 - Remove the front left nut (19).



19 - Remove the front support (17) complete with the axle.

kg Front support: approx. 200 kg (441 lb.)



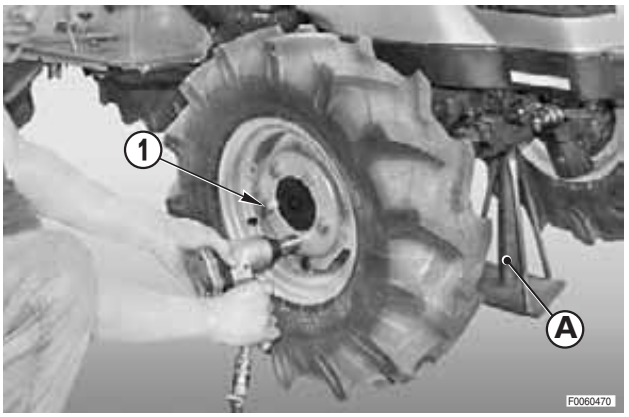
Refitting

- Refitting is the reverse of removal.

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WHEELS

FRONT WHEELS



Removal

⚠ Remove the key from the ignition and apply the parking brake.

1 - Raise the tractor and position two stands “**A**” under the front axle.
  ★ Drive safety wedges between the axle and the front axle support.

2 - Unscrew all the bolts (1), but leave them in position for safety. ※ 1

3 - Remove the wheel.

4 - Repeat the above operations for the other wheel.

Refitting

- Refitting is the reverse of removal.

※ 1

Nm Wheel bolts: 169 Nm (124.5 lb.ft.)

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REAR WHEELS

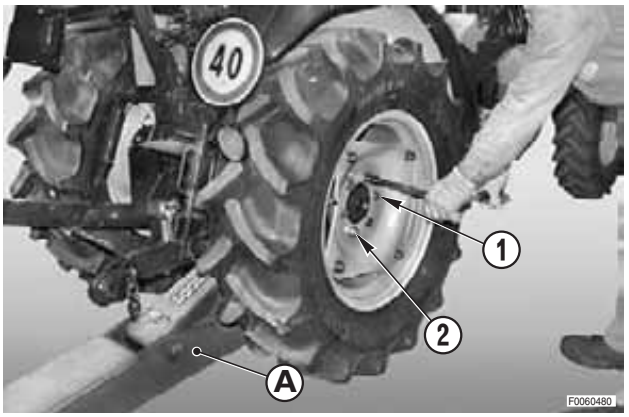
Removal

1 - Position a jack "**A**" under the rear gearbox casing.
★ Position the jack "**A**" so that it is nearer to the wheel to be removed.

2 - Raise the tractor sufficiently to eliminate the flexure of the tyre wall.

3 - Remove all the bolts (1) and the nuts (2). ※ 1

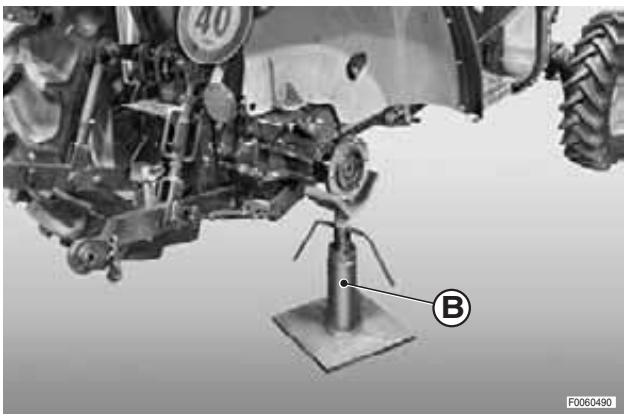
4 - Remove the wheel.



5 - Position a stand "**B**" with lateral retaining wings under the rear axle housing and lower the jack so that the axle rests on the stand.

6 - Check that the stand is correctly positioned before removing the jack.

7 - Repeat the above operations to remove the other wheel.



Refitting

- Refitting is the reverse of removal.

※ 1

Nm Nuts: 169 Nm (124.5 lb.ft.)

Nm Bolts: 169 Nm (124.5 lb.ft.)

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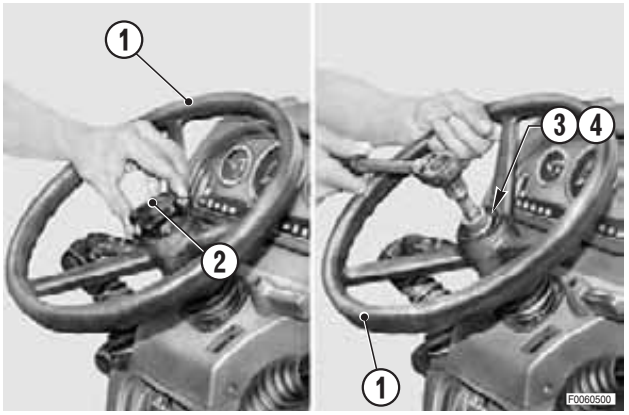
INSTRUMENT PANEL

Removal

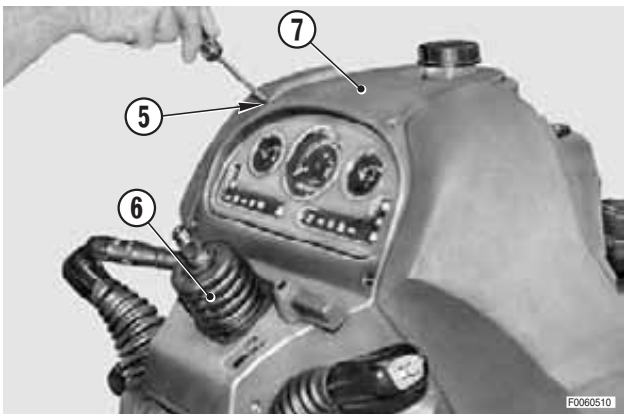
⚠ Disconnect the lead from the negative (–) terminal of the battery.

1 - Remove the centre cover (2) from the steering wheel (1).

2 - Remove the nut (3), the toothed washer (4) and remove the steering wheel (1).

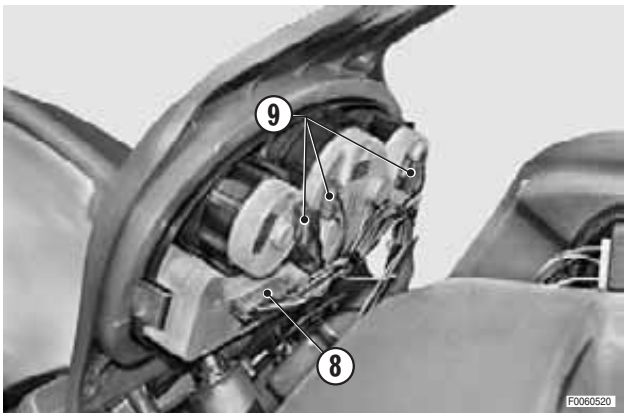


3 - Remove the seven screws (5) and the shroud (6) and tilt the housing (7) towards the rear of the tractor.

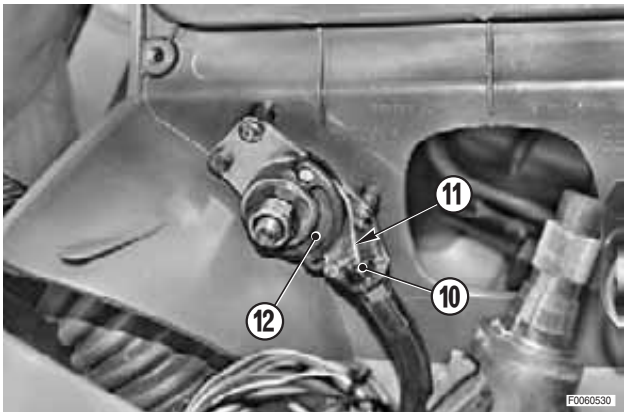


4 - Unplug connectors (8) and (9) from the instrument panel.

★ Label the connectors to avoid confusion on refitting.

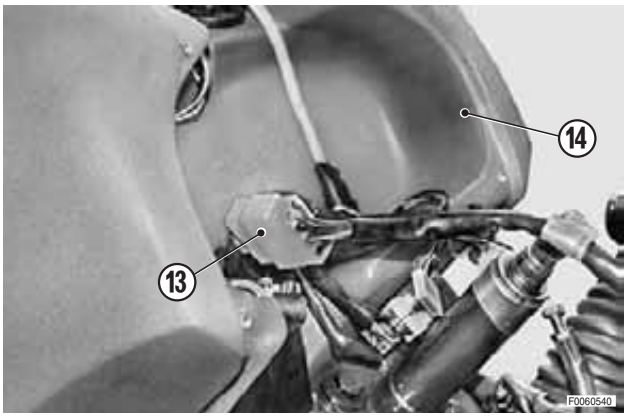


5 - Loosen off nut (10) fully and disconnect the accelerator control cable (11) from the lever (12).



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6 - Disconnect the connector (13) of the lights switch and remove the instrument panel (14) complete with shroud.



Refitting

- Refitting is the reverse of removal.

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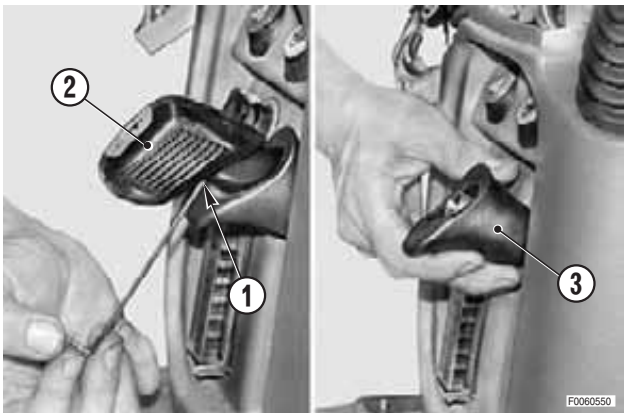
CONSOLE SHROUDS

Removal

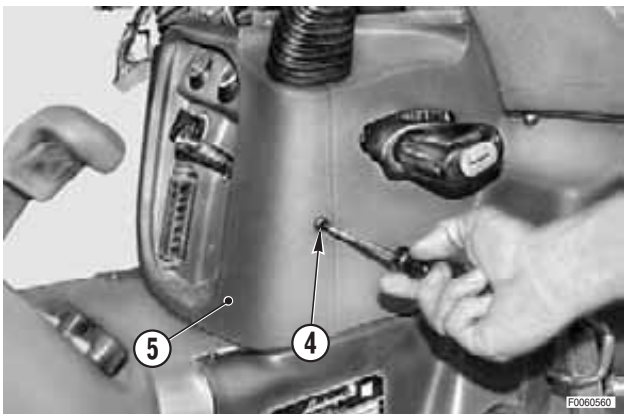
Disconnect the lead from the negative (–) terminal of the battery.

1 - Remove the instrument panel.
(For details see «INSTRUMENT PANEL»).

2 - Remove the grub screw (1) and remove the knob (2) of the rear PTO control and lever (3).
★ Remove the lever (3) by turning it clockwise.



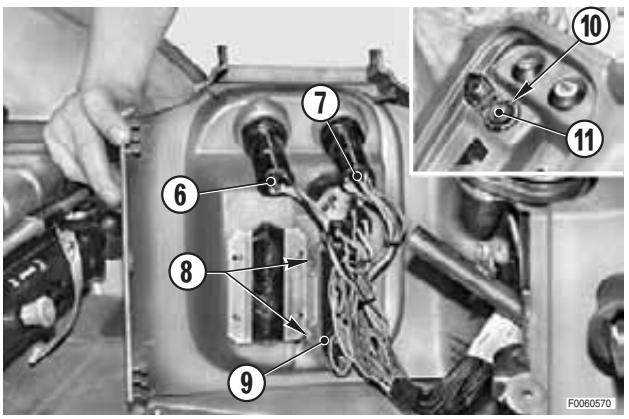
3 - Remove the two screws (4) and move the shroud (5) towards the rear of the tractor.



4 - Unplug the connectors (6) and (7).
★ Label the connectors to avoid confusion on refitting.

5 - Remove the screws (8) and remove the complete fuse box (9).

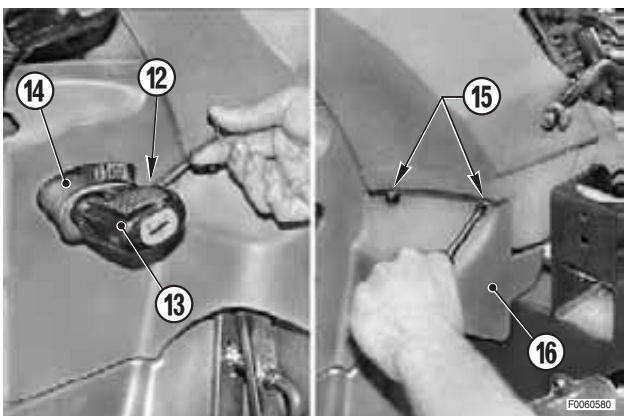
6 - Remove the ringnut (10) and remove the starter switch assembly (11).



7 - Remove the grub screw (12) and remove the range control knob (13) and the lever (14).
★ Remove the lever (14) by turning it anticlockwise.

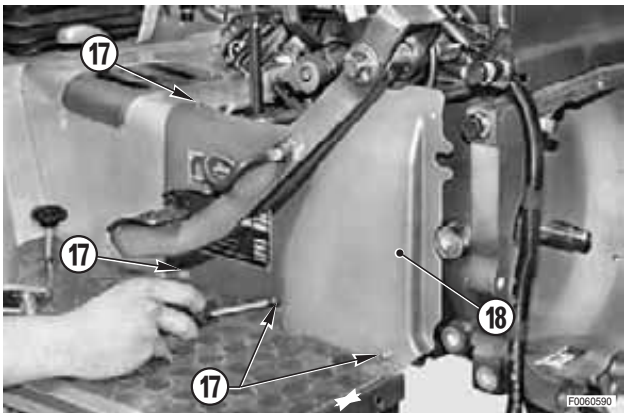
8 - Remove the screws (15) and remove the cover (16).

9 - Remove the rear PTO speed selector and the relative shroud using the procedure indicated in points 7 and 8.



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10 - Remove the screws (17) (four per side) and remove the console shrouds (18) on both sides.



Refitting

- Refitting is the reverse of removal.

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POWER STEERING

Removal

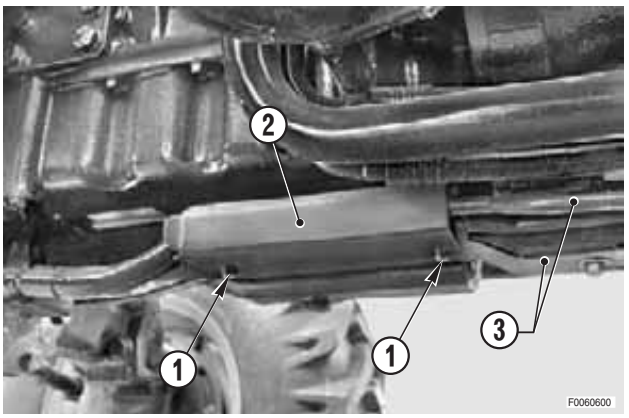
Disconnect the negative battery lead (–) and apply the parking brake.

1 - Remove the instrument panel.
(For details see «INSTRUMENT PANEL»).

2 - Remove the front console shrouds.
(For details see «FRONT CONSOLE SHROUDS»).

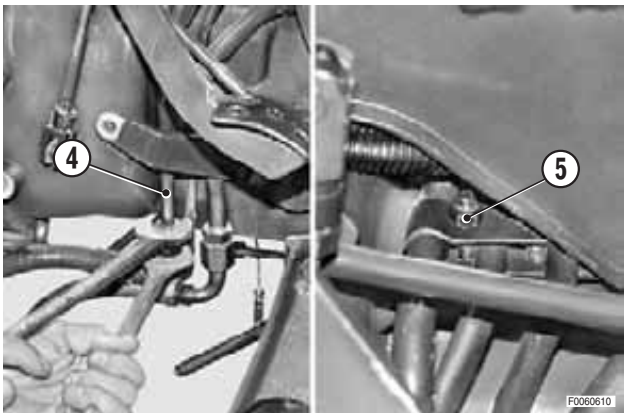
3 - Remove the screws (1) and remove the cover (2).

4 - Disconnect the steering pipes (3).
★ Plug the pipes to prevent the entry of impurities.



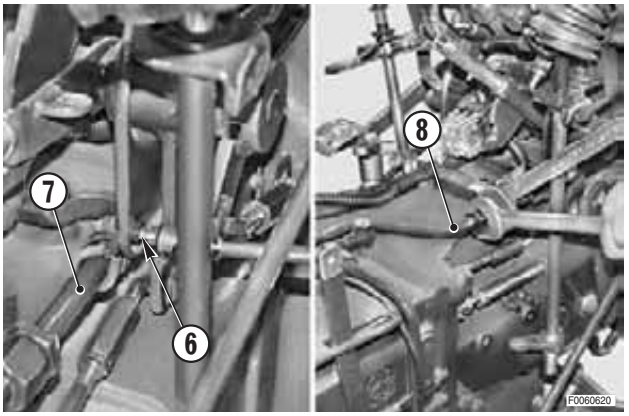
5 - Disconnect the supply line (4) to the power steering.

6 - Fully loosen the nut (5) but do not remove it.



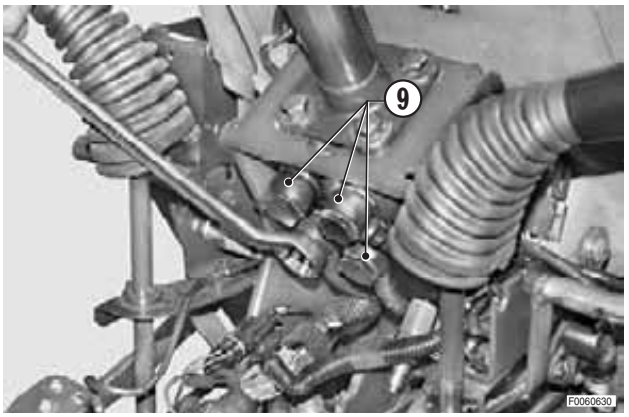
7 - Remove the screw (6) to release the pipe (7) from the support.

8 - Disconnect the return line (8).

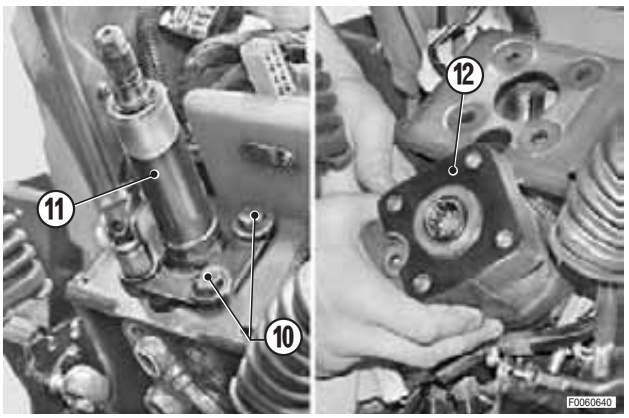


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9 - Remove the unions (9).
★ Renew the copper washers on reassembly.



10 - Remove the screws (10), remove the steering tube (11) and remove the power steering unit (12).



Refitting

- Refitting is the reverse of removal.

1 - After refitting all the components, start the engine and bleed the air from the steering circuit.

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FUEL TANK

Removal

1 - Do not smoke or allow naked flames in the vicinity during the removal, refitting and filling of the fuel tank.

2 - Wipe up any spilt fuel immediately before someone slips on it.

3 - Disconnect the negative lead (–) from the battery and apply the parking brake.

1 - Remove the instrument panel.
For details see «INSTRUMENT PANEL»).

2 - Remove the front console shrouds.
(For details see «FRONT CONSOLE SHROUDS»).

3 - Remove the engine hood.
(For details see «ENGINE HOOD»).

4 - Remove the silencer support.
(For details see «SILENCER»).

5 - Using a suitable pump, draw off all the fuel from the fuel tank.

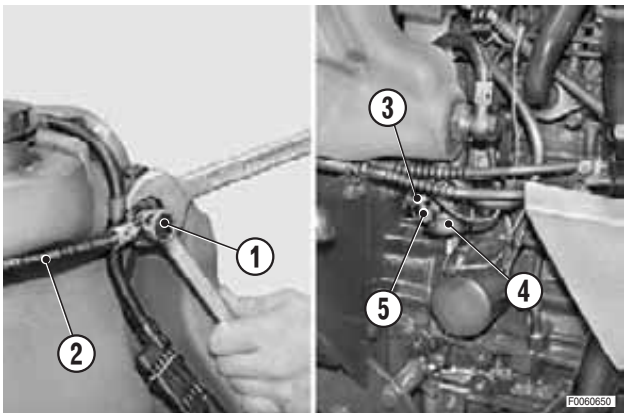
Fuel: 35 ℓ (9.24 US.gall.)

6 - Remove the union (1) of the fuel return pipe (2).

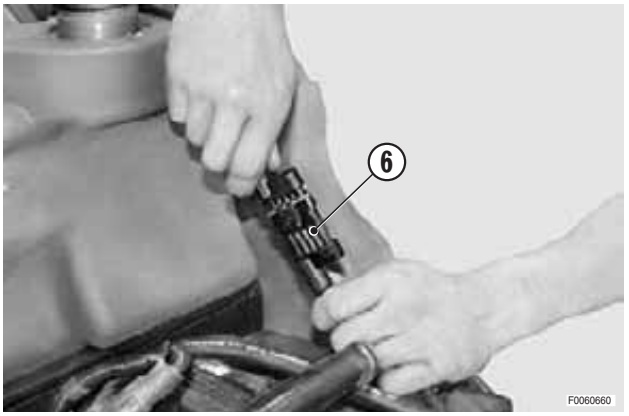
1

7 - Loosen the clip (3) and disconnect the suction pipe (5) from the fuel pump (4).

★ Plug the pipe to prevent fuel spillage.

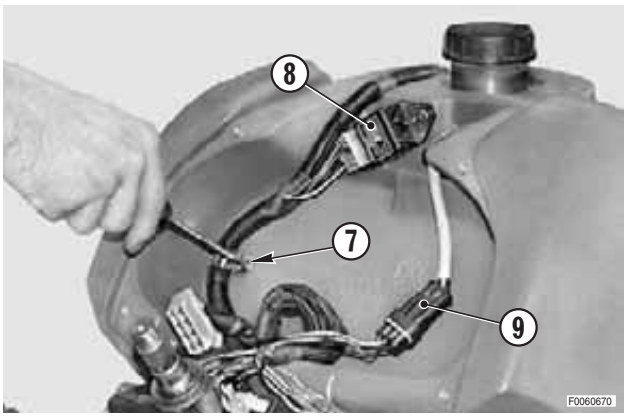


8 - Unplug the connectors (6).

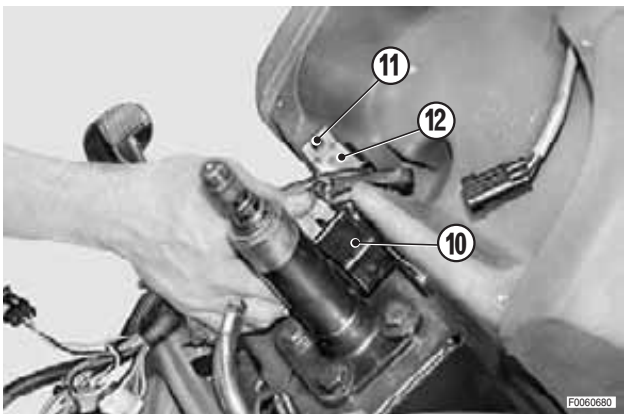


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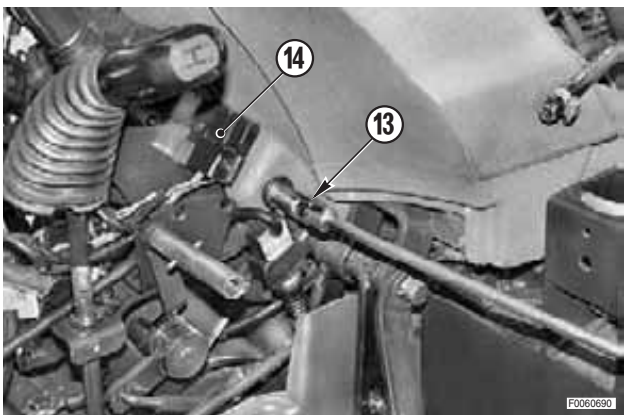
9 - Remove the screws (7), remove the preheating control unit (8) and unplug the connector (9) of the fuel level sensor.



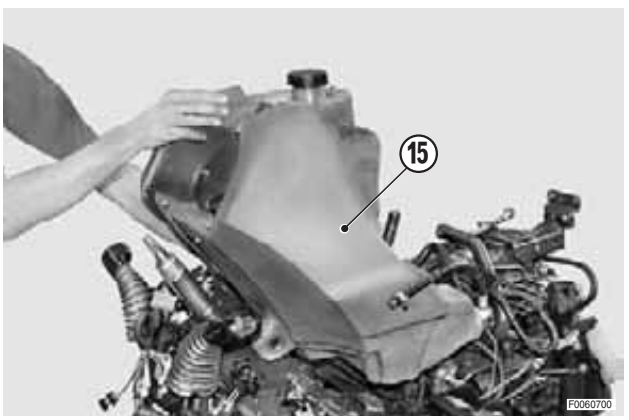
10 - Withdraw the relay (10), remove the screw (11) and disconnect the flasher control unit (12).



11 - Remove the screws (13) (1 per side) and fully disconnect the relay (14) from the control support.



12 - Remove the tank (15) by lifting it upwards.



Refitting

- Refitting is the reverse of removal.

1

Nm Union: 28.5–31.5 Nm (21.0 – 23.21 lb.ft.)

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PLATFORM

Removal

Disconnect the lead from the negative (–) terminal of the battery.

1 - Remove the rear wheels.
(For details see «WHEELS»).

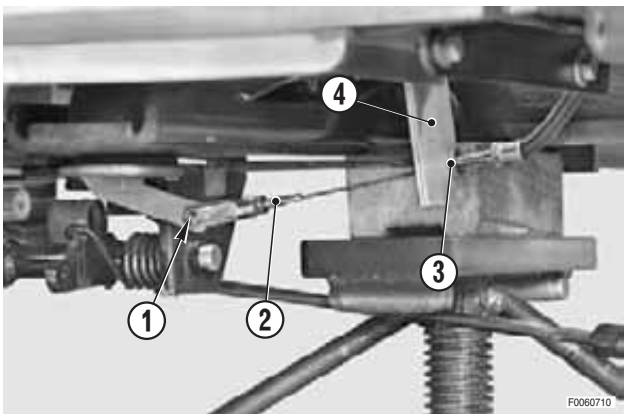
2 - Remove the instrument panel.
(For details see «INSTRUMENT PANEL»).

3 - Remove the front console shrouds.
(For details see «FRONT CONSOLE SHROUDS»).

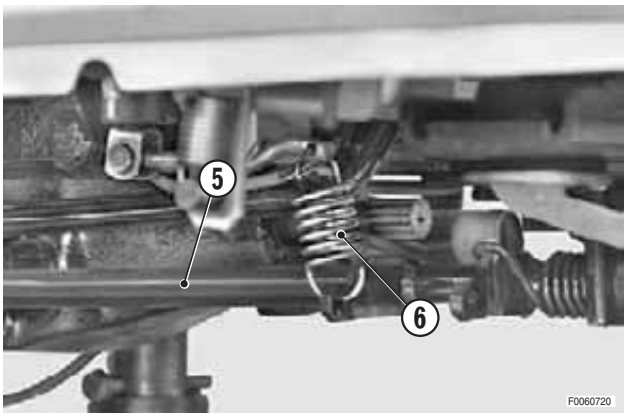
4 - Remove the rear roll bar.
(For details see «ROLL BAR»).

5 - Remove the pin (1) and disconnect the accelerator pedal control cable (2) from the lever.

6 - Loosen the nut (3) and disconnect the cable (2) from the platform (4).

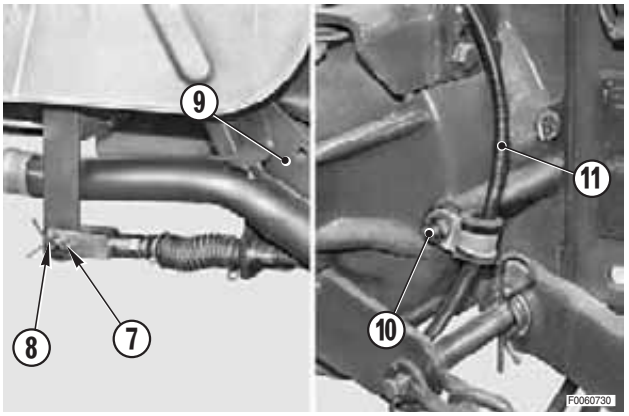


7 - Disconnect the spring (6) from the differential control rod (5).



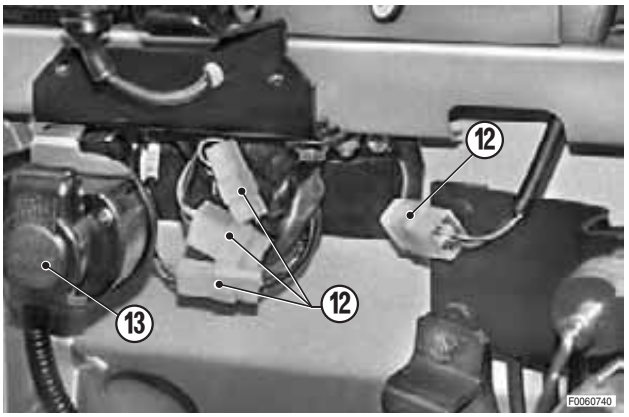
8 - Remove the cotter pin (7), remove the pin (8) and disconnect the parking brake cable from the support (9).

9 - Remove the screw (10) and withdraw the cable (11) towards the rear.

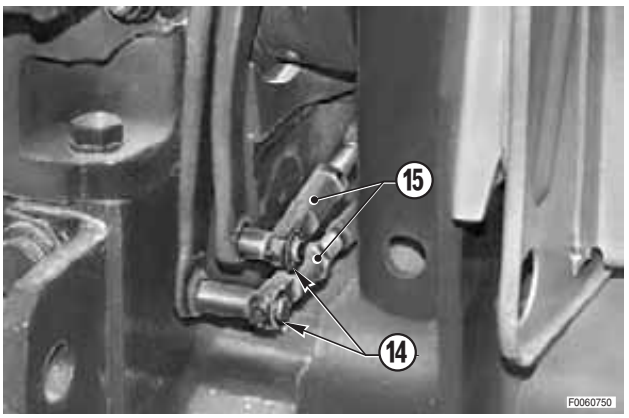


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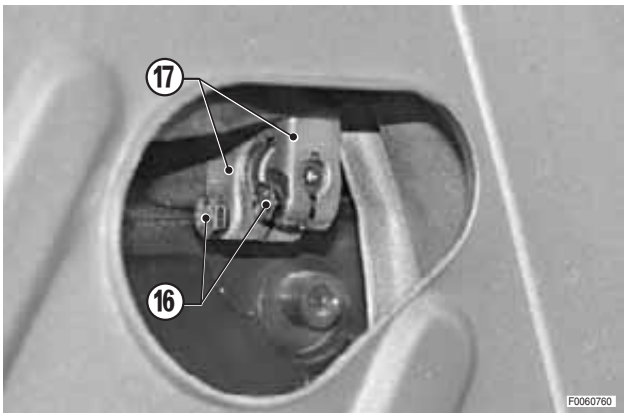
10 - Unplug the connectors (12) and remove the trailer socket (13).
★ Label the connectors to avoid confusion on refitting.



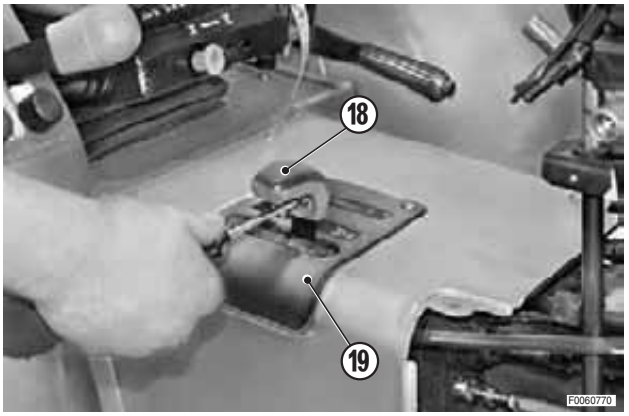
11 - Remove the spring clips (14) and disconnect the lift control rods (15).



12 - Remove the screws (16) and disconnect the auxiliary control valve levers (17).

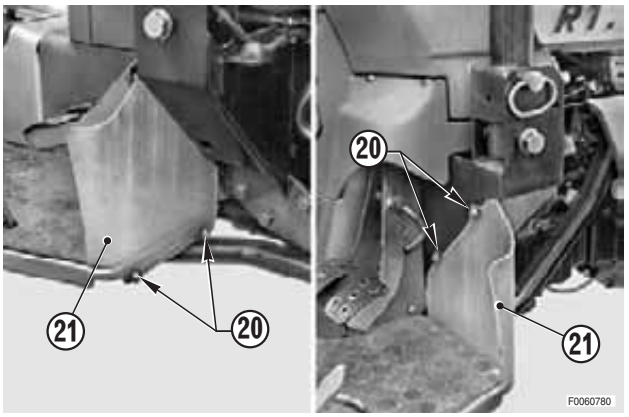


13 - Remove the knob (18) and remove the panel (19).

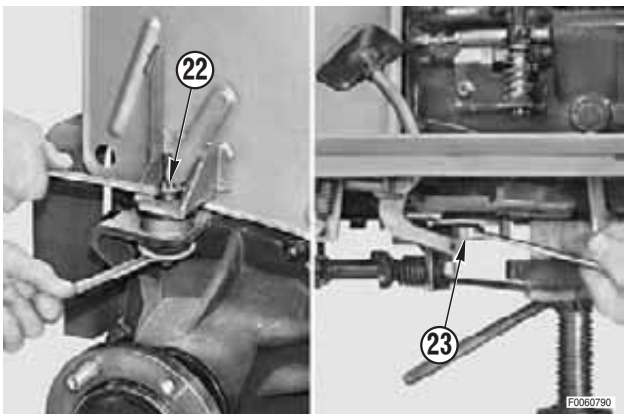


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14 - Remove the screws (20) and remove the covers (21) on both sides.

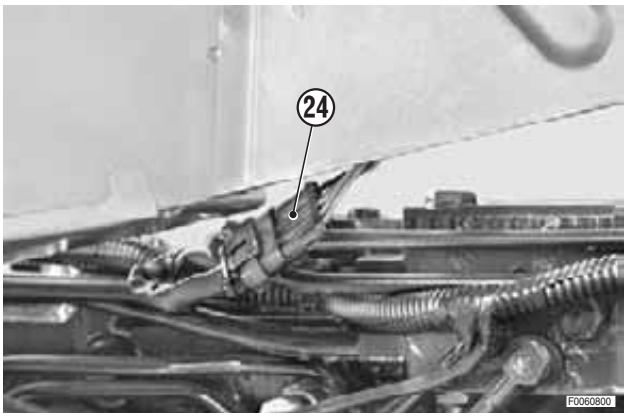


15 - Remove the screws (22) and (23) on both sides.

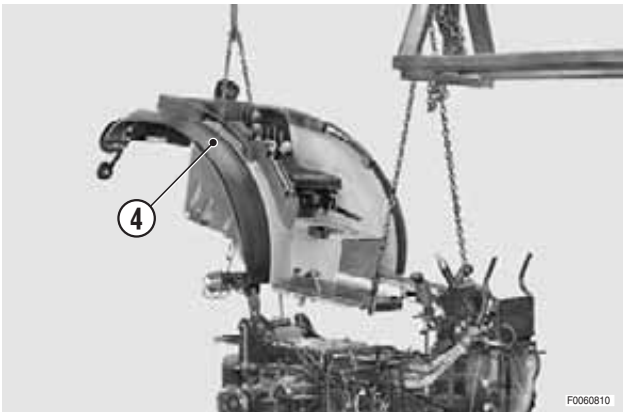


16 - Attach the platform to a hoist via lifting slings or ropes and raise it slightly.

17 - Disconnect the handbrake sensor connector (24).



18 - Remove platform (4).



Refitting

- Refitting is the reverse of removal.

1 - Check that the handbrake is properly adjusted. (For details see «ADJUSTMENT OF CONTROL LEVER AND PEDALS»).

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STARTER MOTOR

Removal

Disconnect the negative battery lead (–) and apply the parking brake.

1 - Remove the fuel tank.
(For details see «FUEL TANK»).

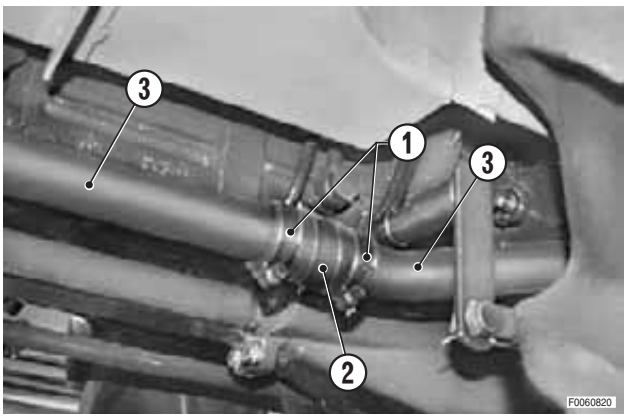
2 - Remove the front roll bar.
(For details see «ROLL BAR»).

3 - Drain off all the oil from the transmission.

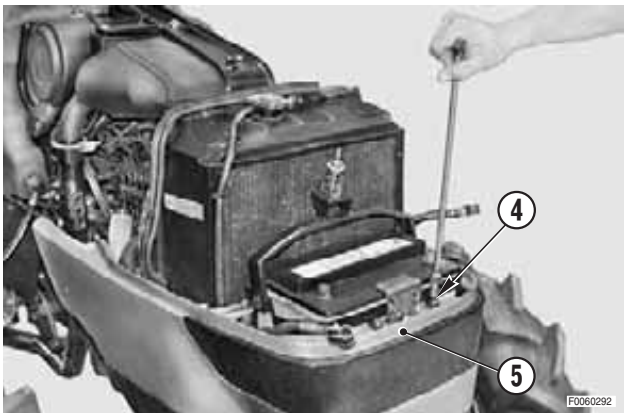
※ 1

Oil: max. 21 ℓ (5.5 US.gall.)

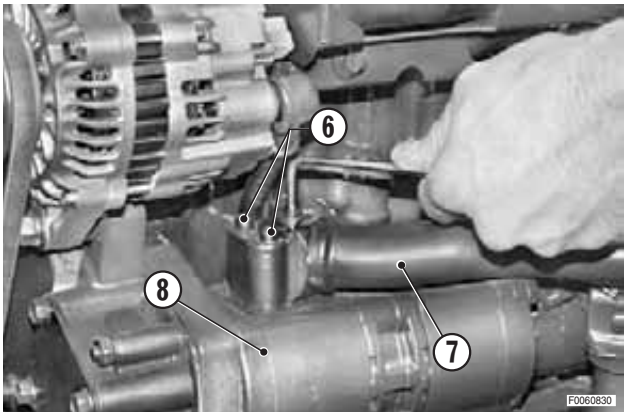
4 - Loosen the clips (1) and disconnect the sleeve (2) from one of the pipes (3).



5 - Remove the 6 screws (4) and remove the lower fascia (5).

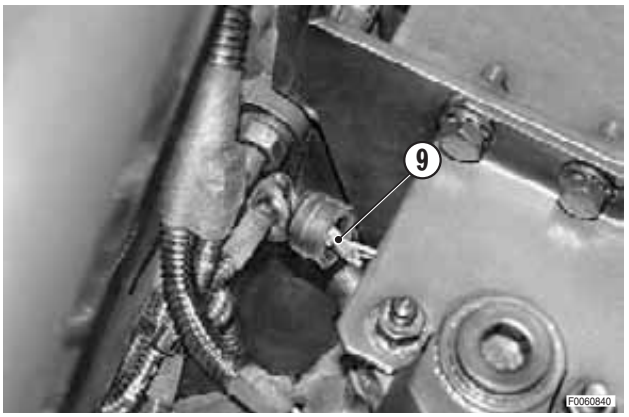


6 - Remove the three screws (6) and disconnect the suction pipe (7) from the pump (8).
★ Recover the O-ring.



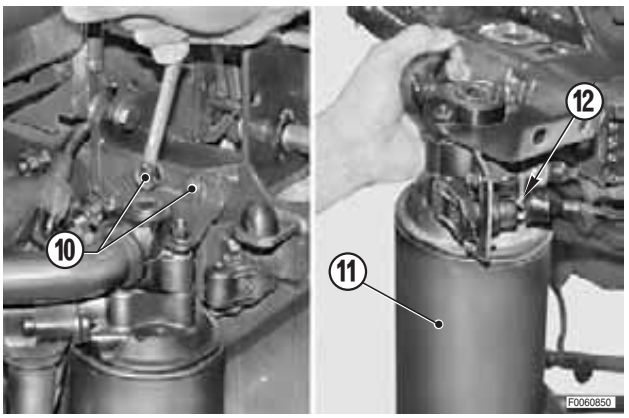
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7 - Disconnect the connector (9) of the hydraulic oil filter clogging sensor.



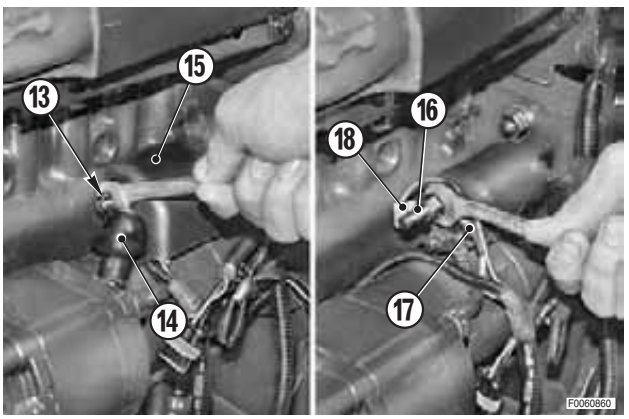
8 - Remove the screws (10) and remove the complete filter assembly (11).

9 - Disconnect the connectors (12) of the auxiliary power socket.

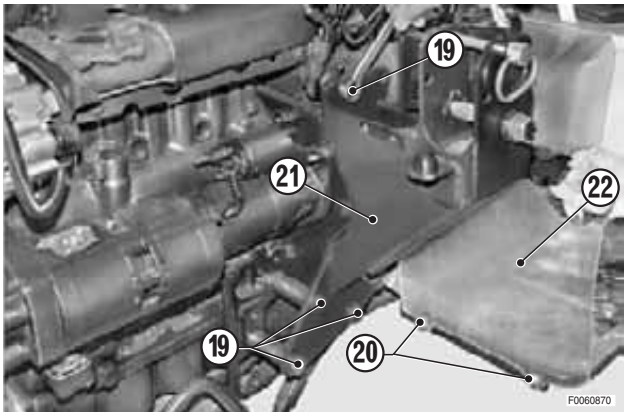


10 - Remove the nut (13), disconnect the cable (14) and remove the cover (15). ※ 2

11 - Remove the extension (16) and disconnect the cable (17) and the connector (18). ※ 3

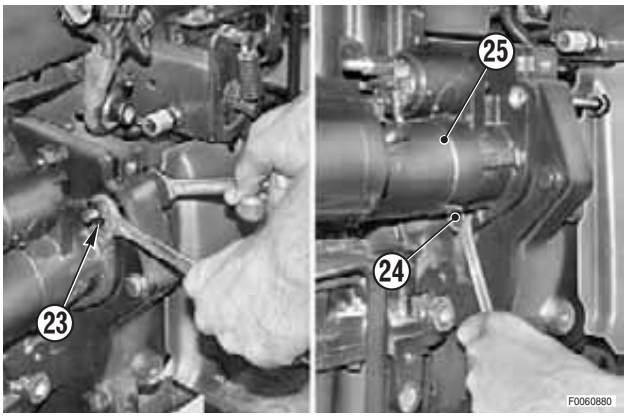


12 - Remove the screws (19) and (20) and remove the roll bar support (21) complete with cover (22).



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13 - Remove the nut (23) and bolt (24) and remove the starter motor (25).



Refitting

- Refitting is the reverse of removal.

※1

★ Fill the transmission with the required quantity of oil.

Transmission oil: max. 21 ℓ (5.5 US.gall.)

※2

Nm Nut: 10.7–16.0 Nm (7.89–11.79 lb.ft.)

※3

Nm Extension: 10.7–16.0 Nm (7.89–11.79 lb.ft.)

1 - Fill all the systems with the appropriate fluids. Start the engine and run for a few minutes to allow the fluids to circulate, then check for leaks.

2 - Expel the air from the hydraulic circuits by repeatedly raising and lowering the linkage and by turning the steering wheel back and forth.
Check all the fittings and circuits for leaks.

3 - Stop the engine, check all the fluid levels and top up if necessary.

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HYDRAULIC PUMP

Removal

Disconnect the negative battery lead (–) and apply the parking brake.

1 - Remove the fuel tank.
(For details see «FUEL TANK»).

2 - Remove the front roll bar.
(For details see «ROLL BAR»).

3 - Drain off all the oil from the transmission.

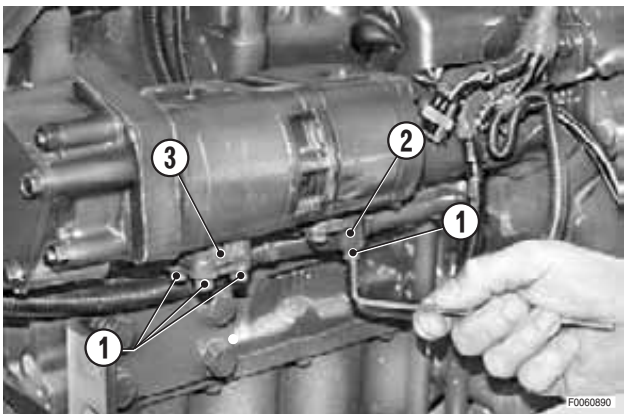
※ 1

Transmission oil: max. 21 ℓ (5.5 US.gall.)

4 - Remove the starter motor.
(For details see «STARTER MOTOR»).

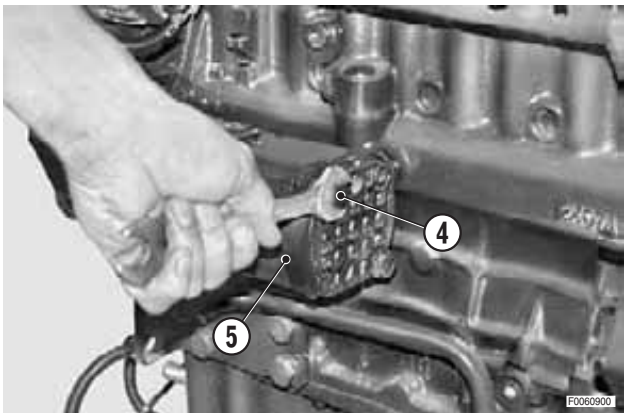
5 - Remove the seven screws (1) and disconnect the supply pipes to the power steering (2) and to the lift (3).

★ Recover the O-rings.



6 - Fully loosen all the screws (4) and remove the hydraulic pump (5).

★ Renew the gasket every time the pump is removed.



Refitting

- Refitting is the reverse of removal.

※ 1

★ Fill the transmission with the required quantity of oil.

Transmission oil: max. 21 ℓ (5.5 US.gall.)

1 - Fill all the systems with the appropriate fluids. Start the engine and run for a few minutes to allow the fluids to circulate, then check for leaks.

2 - Expel the air from the hydraulic circuits by repeatedly raising and lowering the linkage and by turning the steering wheel back and forth; then check the pipe fittings and circuits for leaks.

3 - Stop the engine, check all the fluid levels and top up if necessary.

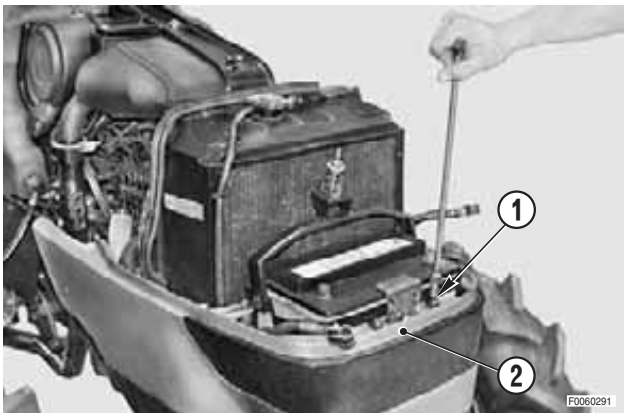
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ALTERNATOR

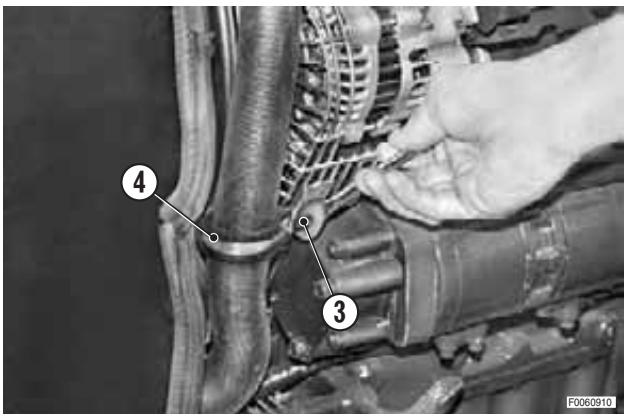
Removal

⚠ Disconnect the negative battery lead (–) and apply the parking brake.

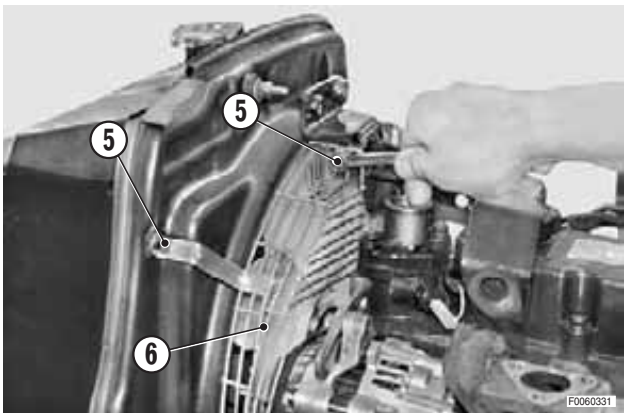
1 - Remove the six screws (1) and remove the lower fascia (2).



2 - Remove the screw (3) and detach the clip (4).

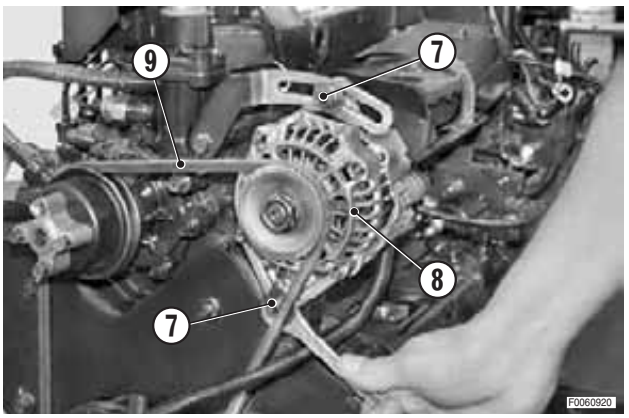


3 - Remove the screws (5) and remove the fan cover (6).



4 - Loosen the bolts (7) and move the alternator (8) nearer to the engine.

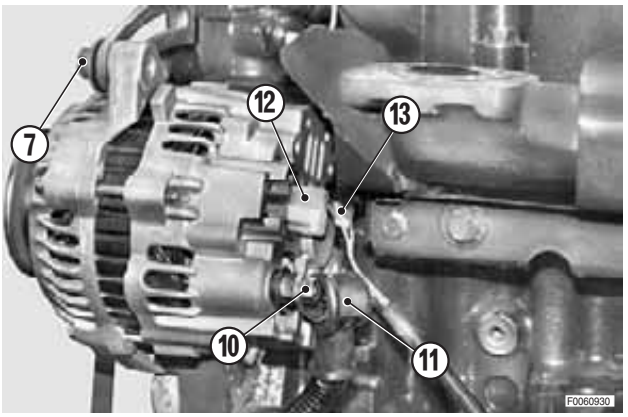
5 - Release the alternator from the drivebelt (9) and tilt it outwards.



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6 - Remove the nut (10) and disconnect the cable (11) and the connectors (12) and (13). [1]

7 - Remove the bolts (7) and remove the alternator.



Refitting

- Refitting is the reverse of removal.

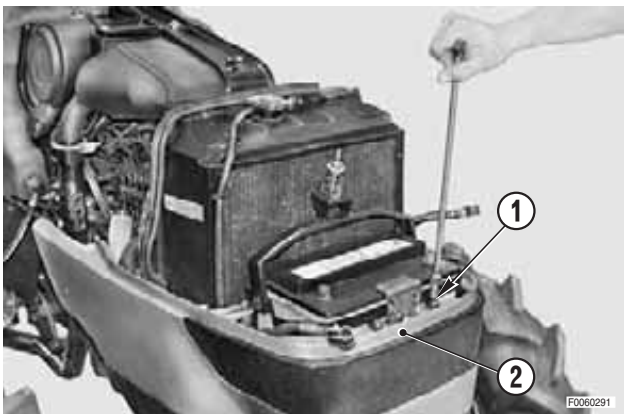
[1]

Nm Nut: 4.2–6.0 Nm (3.09–4.42 lb.ft.)

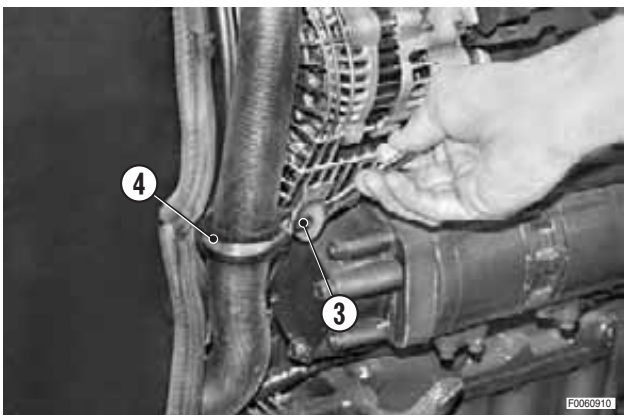
Tensioning the drivebelt

★ Before tensioning the drivebelt, check the condition carefully.
If the drivebelt shows any signs of fraying, cracks or cuts, it must be renewed.

1 - Remove the six screws (1) and remove the lower fascia (2).

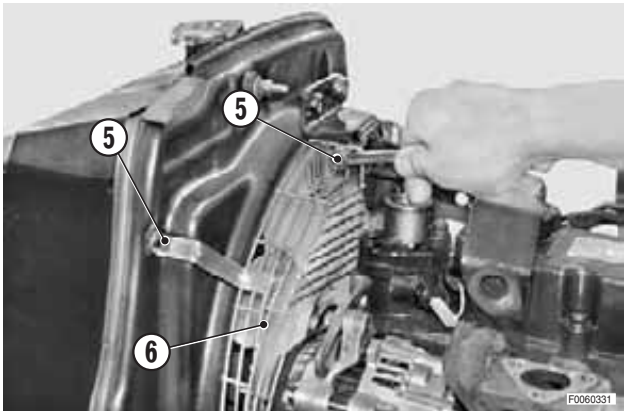


2 - Remove the screw (3) and detach the clip (4).

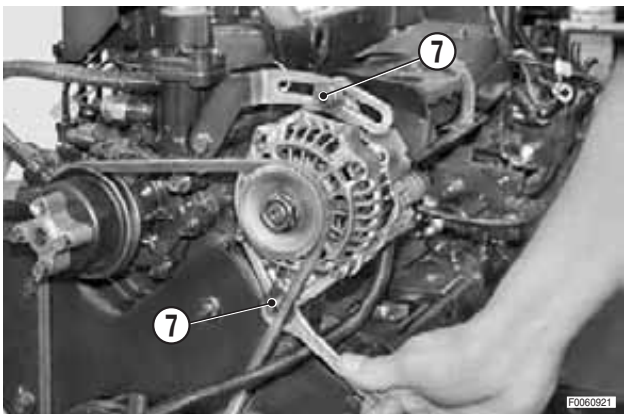


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3 - Remove the screws (5) and remove the fan cover (6).



4 - Loosen the alternator bolts (7).

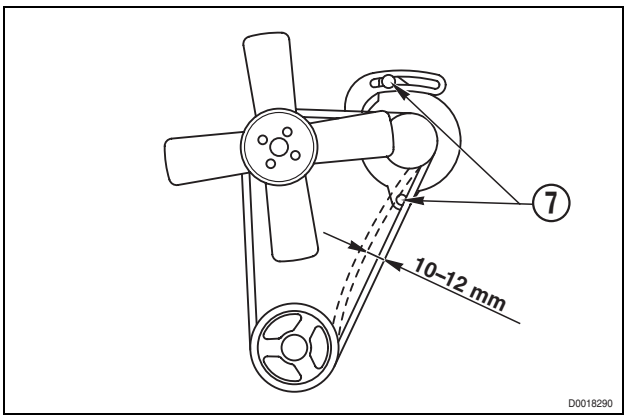


5 - Using a lever, force the alternator outwards to tension the drivebelt. When correctly tensioned, the drivebelt will deflect through 10–12 mm when a force of about 10 kg is applied at the mid point of the belt run between the crankshaft pulley and the alternator.

6 - Tighten the bolts (7) to secure the alternator in position.

7 - Refit all the removed components by following the removal procedure reverse order.

★ After fitting a new drivebelt, recheck the tension after about 50 operating hours.



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ENGINE

Separating the engine from the transmission

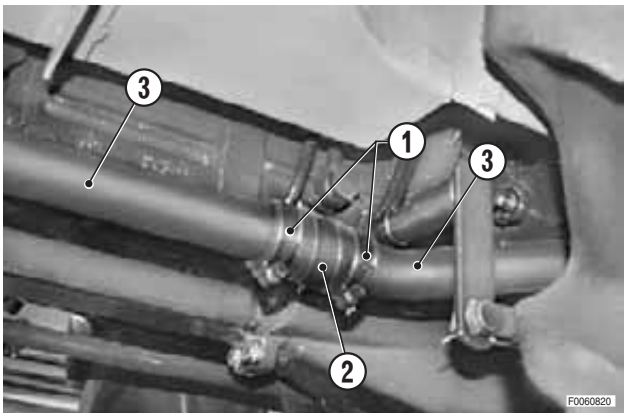
Disconnect the negative battery lead (–) and apply the parking brake.

1 - Drain off all the oil contained in the transmission.

※1

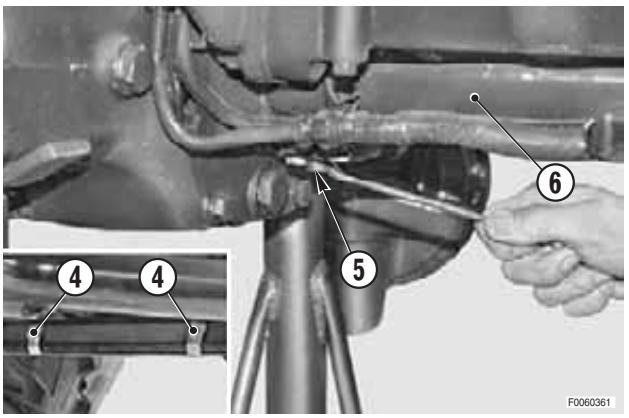
Transmission oil: max. 21 ℓ (5.5 US.gall.)

2 - Loosen the hose clips (1) and disconnect the hose (2) from one of the pipes (3).



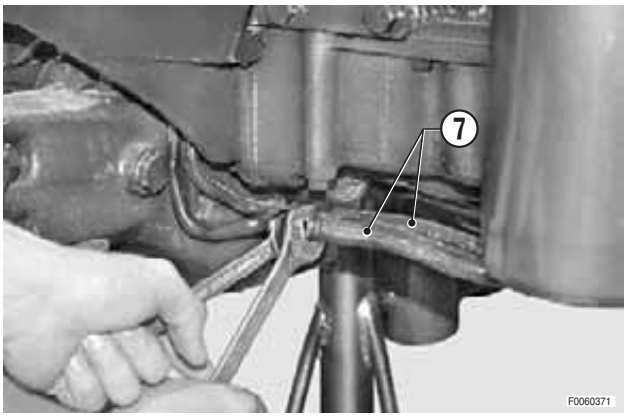
3 - Remove the screws (4) of the hose clips.

4 - Remove the five screws (5) and remove the cover (6) of the 4WD shaft.



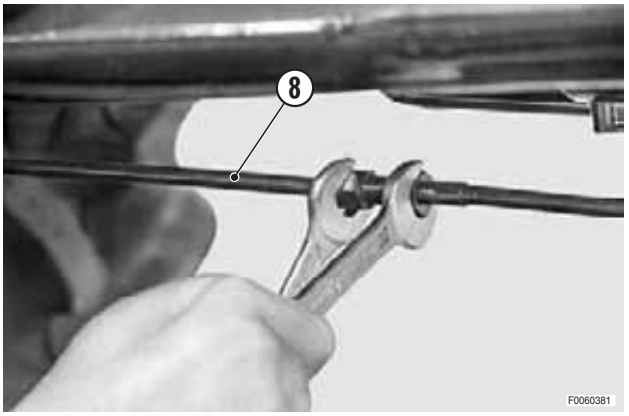
5 - Disconnect the steering control pipes (7).

★ Plug the pipes to prevent the entry of impurities.



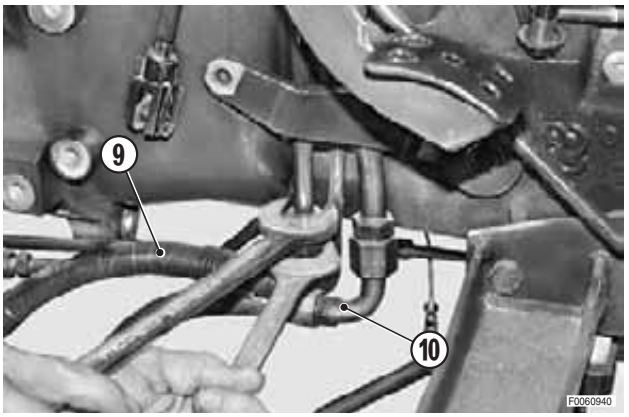
6 - Disconnect the front differential lock control pipe (8).

★ Plug the pipe to prevent impurities getting in.

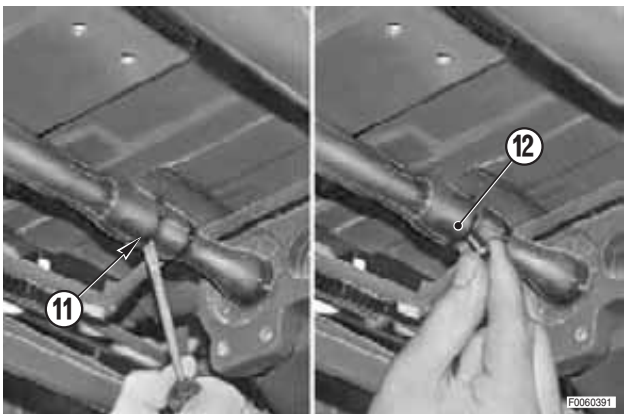


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7 - Disconnect the supply pipes (9) and (10) to the power steering and the lift.
★ Plug the pipes to prevent the entry of impurities.

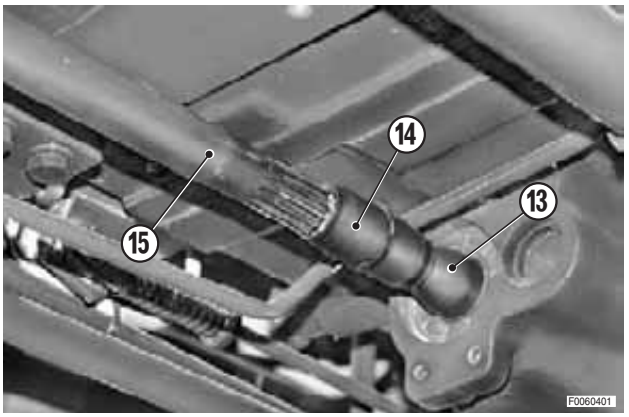


8 - Move the circlip (11) from its seating and withdraw the pin (12).



9 - Move the coupling sleeve (14) in the direction of the pinion (13) so as to release the 4WD shaft (15).
★ Take care not to get the sleeve stuck on the pinion teeth.

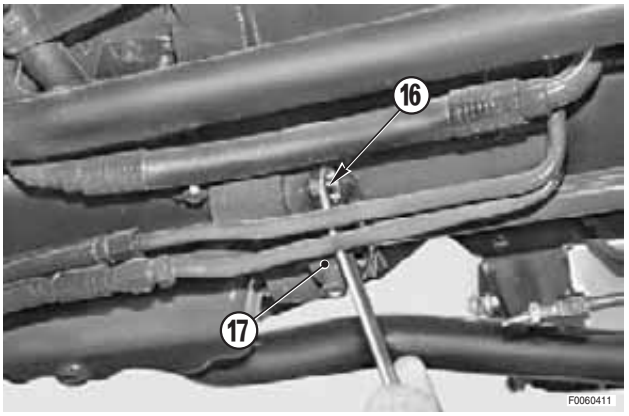
10 - Repeat the procedure described at points 8 and 9 for the front coupling sleeve.



11 - Remove the screws (16) and remove the 4WD shaft (15) complete with the central support (17).

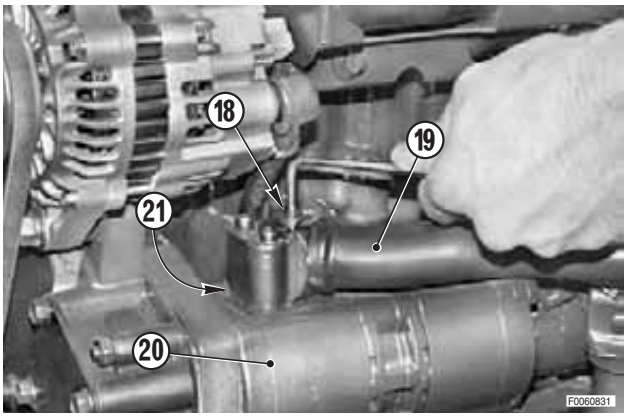
12 - Remove the roll bar.
(For details see «ROLL BAR»).

13 - Remove the fuel tank.
(For details see «FUEL TANK»).

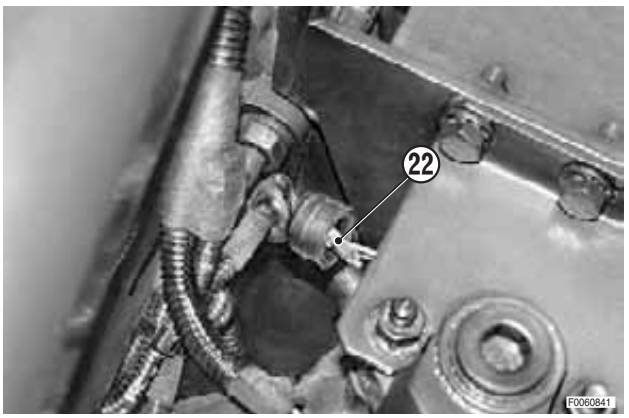


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14 - Remove the three screws (18) and disconnect the suction pipe (19) from the pump (20).
★ Recover the O-ring (21).

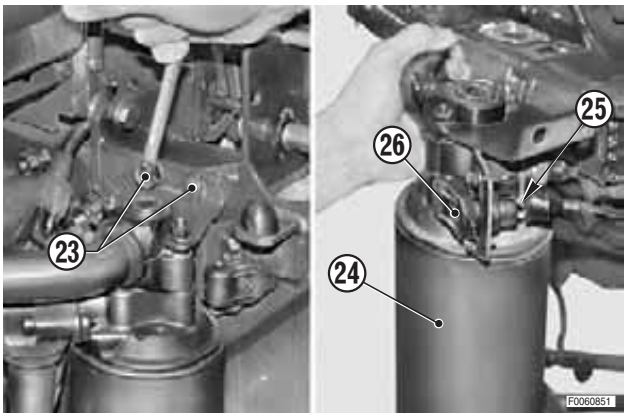


15 - Unplug the connector (22) of the hydraulic oil filter clogging sensor.



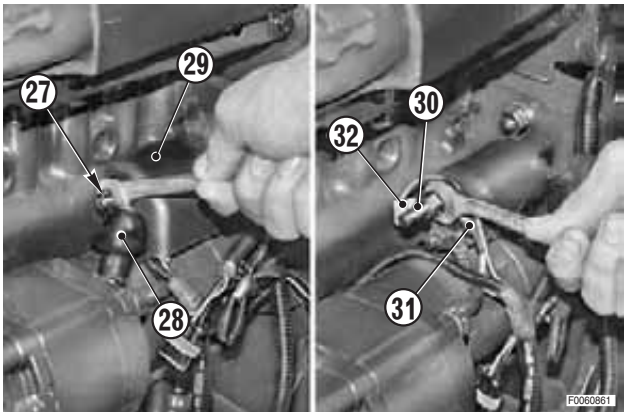
16 - Remove the screws (23) and remove the complete filter assembly (24).

17 - Disconnect the connectors (25) from the auxiliary power socket (26).



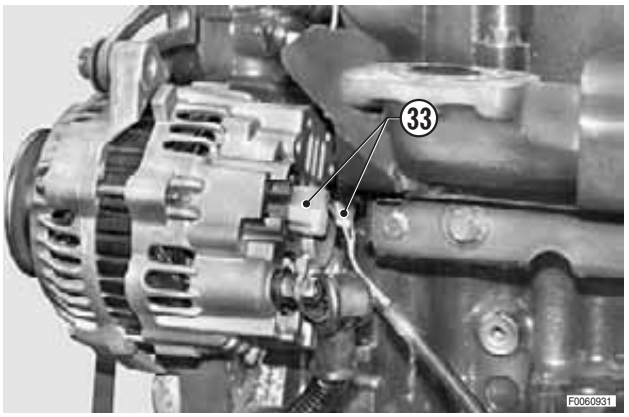
18 - Remove the nut (27), disconnect the cable (28) and remove the cover (29). ※ 2

19 - Remove the extension (30) and disconnect the cable (31) and the connector (32). ※ 3

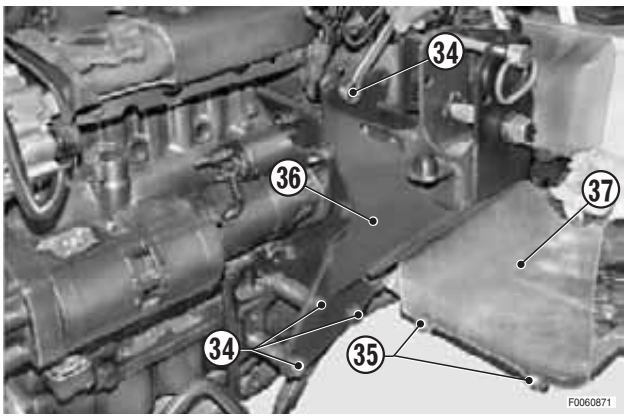


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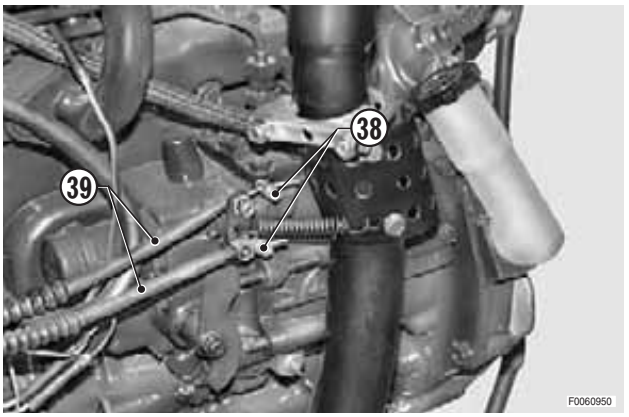
20 - Disconnect the connectors from the alternator (33). (For details see «ALTERNATOR»). ⁂ 4



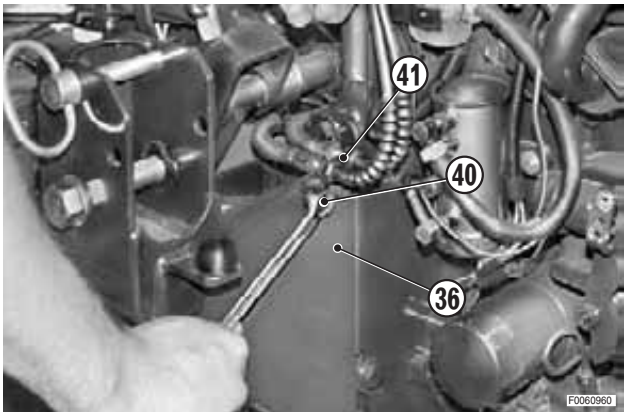
21 - Remove the bolts (34) and (35) and remove the roll bar support (36) complete with the cover (37).



22 - Remove the nuts (38) and disconnect the accelerator control cables (39).

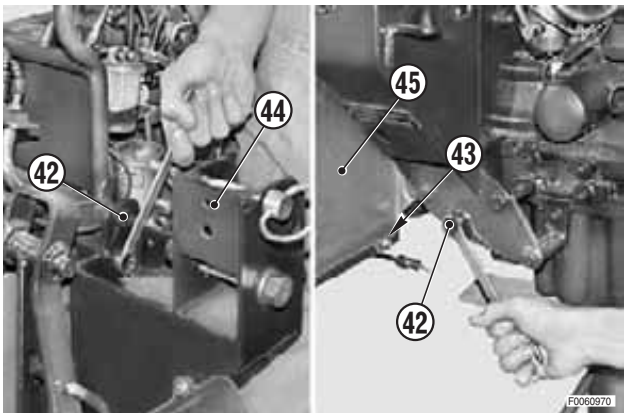


23 - Remove the bolts (40) and detach the support (41) from the roll bar support (36).



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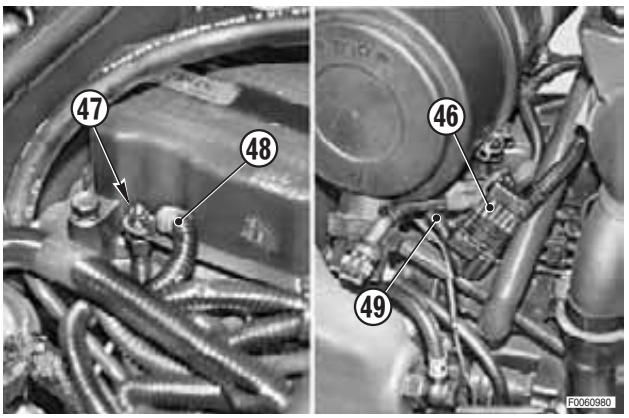
24 - Remove the screws (42) and (43) and remove the roll bar support (44) complete with cover (45).



25 - Disconnect the connector (46).

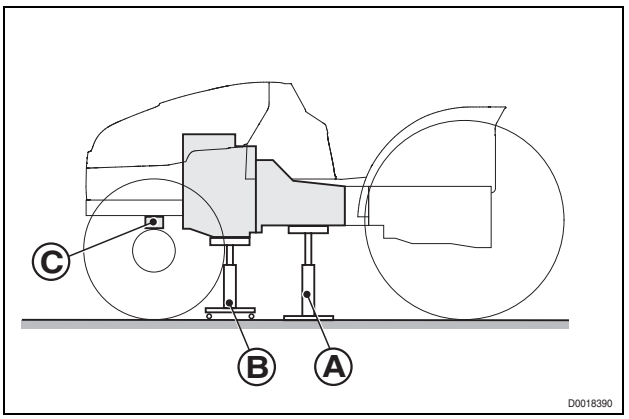
26 - Remove the nut (47) and disconnect the eyelet (48) of the glowplug feed wire.

27 - Withdraw the wiring loom (49) towards the rear of the tractor.

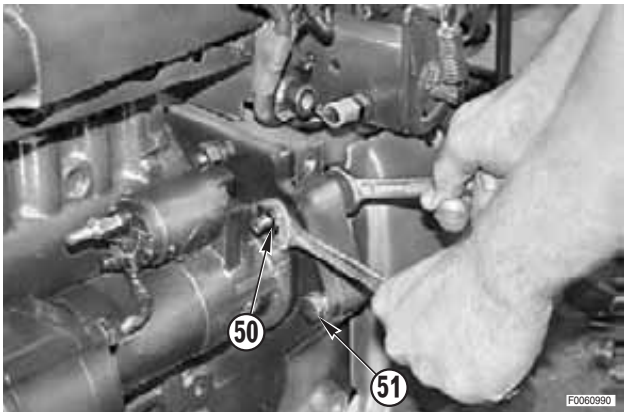


28 - Position a stand "**A**" under the transmission and a trolley-mounted screw jack "**B**" under the engine sump.

29 - Drive two wedges "**C**" between the front axle support and the front axle to prevent the engine from dropping when it is moved.



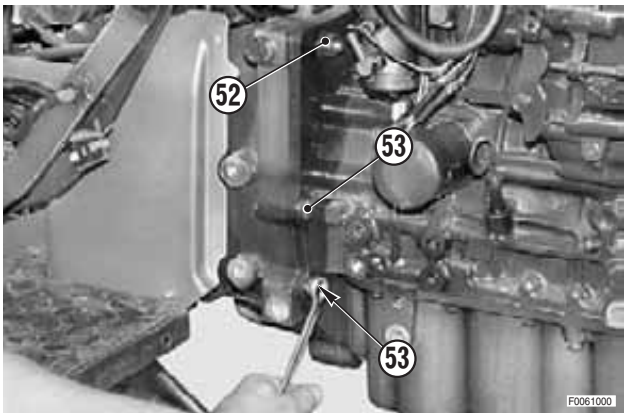
30 - Remove the nuts (50), leaving the relative bolts in position, and remove the screws (51).



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31 - Remove the nut (52) and the bolts (53).

32 - Apply force to both front wheels to move the engine assembly away from the transmission. ※ 5 ※ 6



Reconnecting the engine to the transmission

- Reverse the steps for separating the engine and transmission.

※ 1

★ Fill the transmission with oil.

Transmission oil: max. 21 ℓ (5.5 US.gall.)

※ 2

Nut: 10.7–16.0 Nm (7.88–11.79 lb.ft.)

※ 3

Extension: 10.7–16.0 Nm (7.88–11.79 lb.ft.)

※ 4

★ Tension the drivebelt.
(For details see «ALTERNATOR»).

※ 5

★ Adjust the height of the jacks to bring the mating surfaces parallel to each other.

★ Apply a film of lubricant to the locating dowels and mating surfaces.

Surfaces and dowels: Oil

※ 6

★ Before inserting the transmission input shaft in the clutch assembly, insert the rear PTO control shaft and make sure that it is correctly engaged in the clutch plate.

1 - Fill all the systems with the appropriate fluids. Start the engine and run for a few minutes to allow the fluids to circulate, then check for leaks.

2 - Expel the air from the hydraulic circuits by repeatedly raising and lowering the linkage and by turning the steering wheel back and forth; then check the pipe fittings and circuits for leaks.

3 - Stop the engine, check all the fluid levels and top them up if necessary.

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Removal

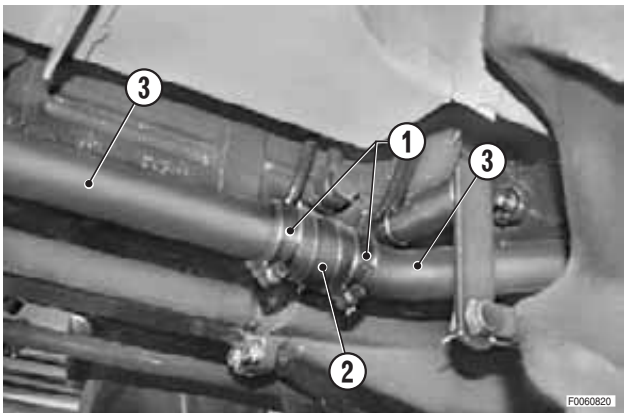
Disconnect the negative battery lead (–) and apply the parking brake.

1 - Drain off all the oil contained in the transmission and all the coolant. ⁂ 1

Transmission oil: max. 21 ℓ (5.5 US.gall.)

Coolant:
max. 5 ℓ (1.3 US.gall.)

2 - Loosen the hose clips (1) and disconnect the hose (2) from one of the pipes (3).



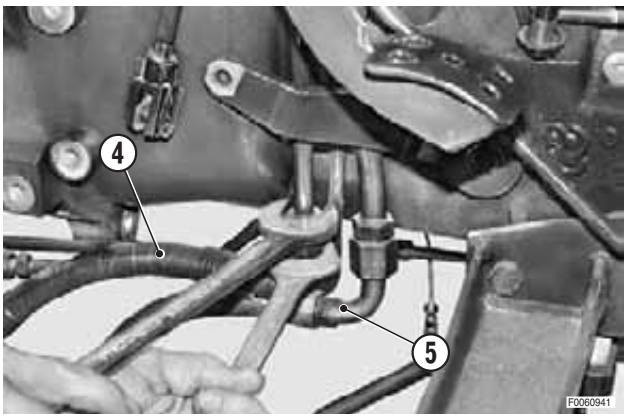
3 - Remove the front axle support.
(For details see «FRONT AXLE SUPPORT»).

4 - Disconnect the supply pipes (4) and (5) to the power steering and the lift.

★ Plug the pipes to prevent the entry of impurities.

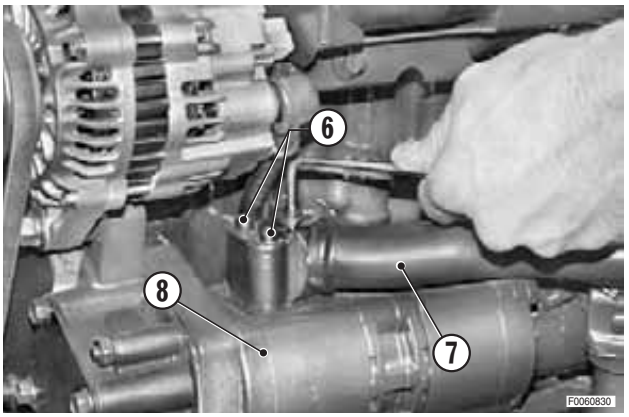
5 - Remove the front roll bar.
(For details see «ROLL BAR»).

6 - Remove the fuel tank.
(For details see «FUEL TANK»).

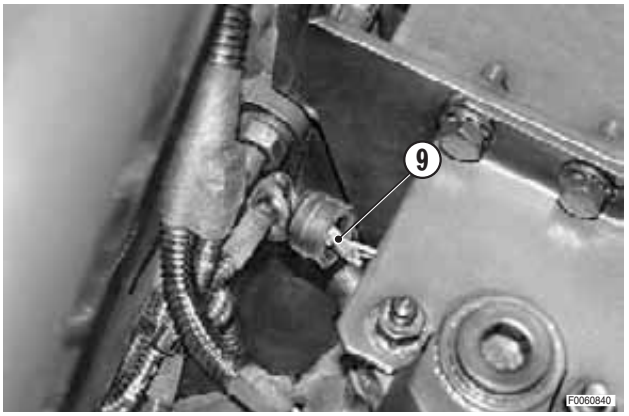


7 - Remove the 3 screws (6) and disconnect the suction pipe (7) from the pump (8).

★ Recover the O-ring.



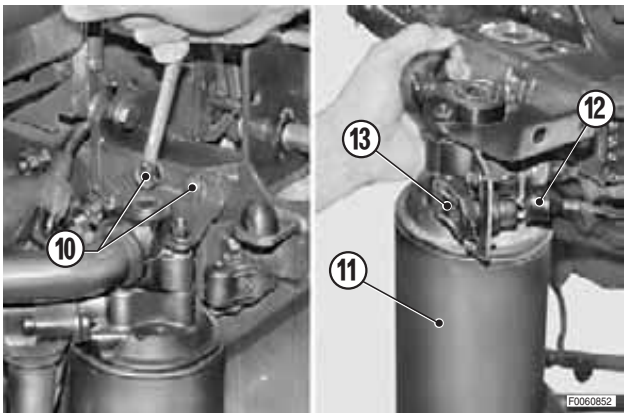
8 - Unplug the connector (9) of the filter clogging sensor.



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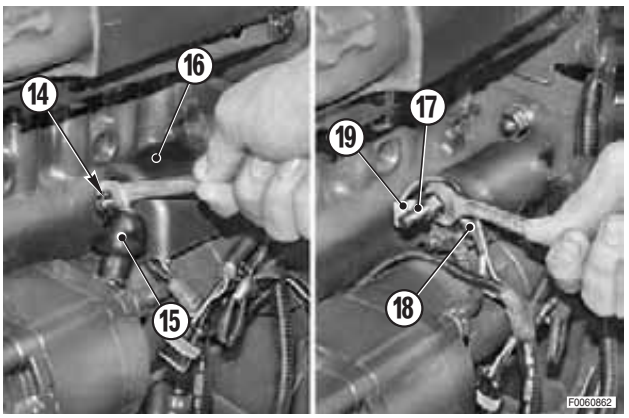
9 - Remove the screws (10) and remove the complete filter assembly (11).

10 - Disconnect the connector (12) of the auxiliary power socket (13).

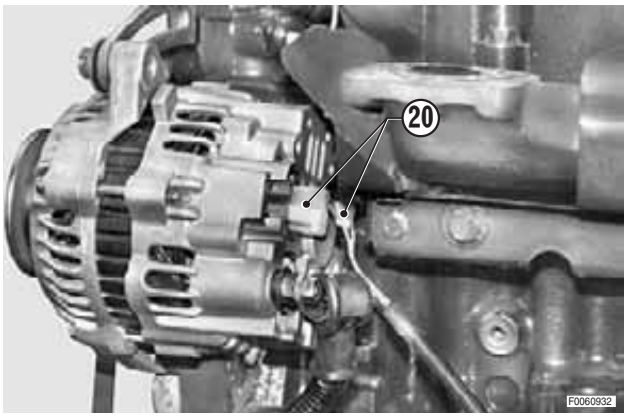


11 - Remove the nut (14), disconnect the cable (15) and remove the cover (16). ※ 2

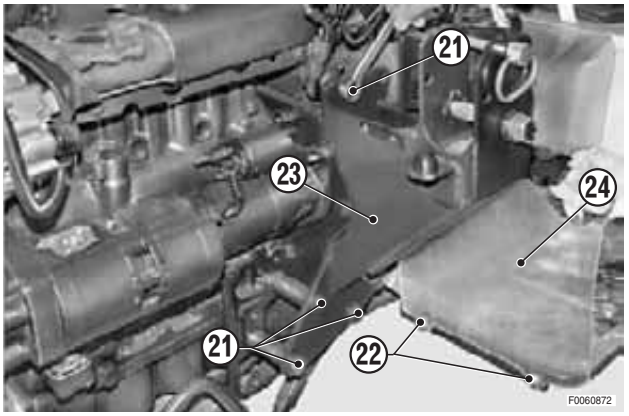
12 - Remove the extension (17) and disconnect the cable (18) and the connector (19). ※ 3



13 - Disconnect the connectors (20) from alternator. (For details see «ALTERNATOR»). ※ 4

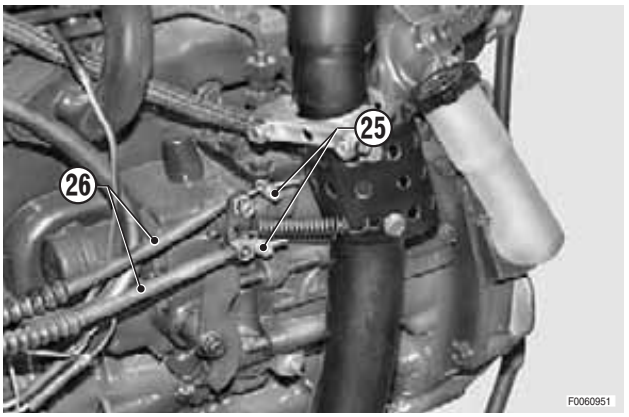


14 - Remove the bolts (21) and (22) and remove the roll bar support (23) complete with the cover (24).

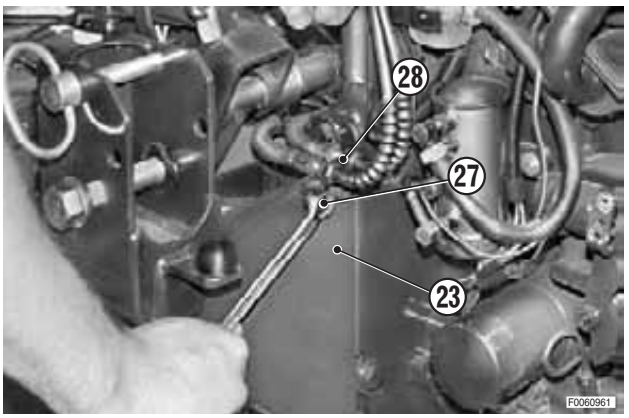


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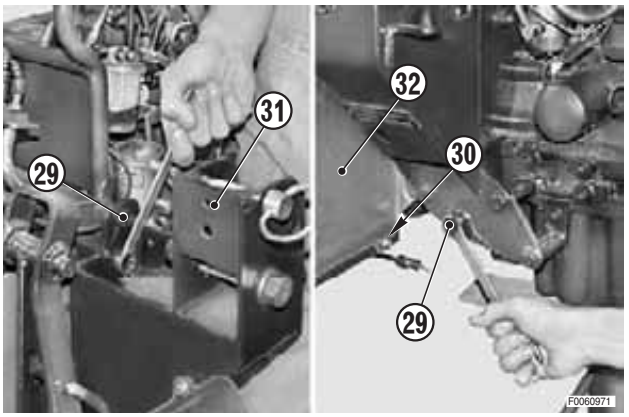
15 - Remove the nuts (25) and disconnect the accelerator control cables (26).



16 - Remove the bolts (27) and disconnect the support (28) from the roll bar support (23).



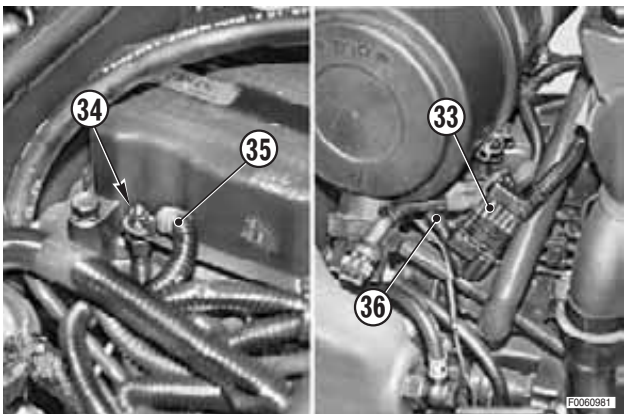
17 - Remove the bolts (29) and (30) and remove the roll bar support (31) complete with the cover (32).



18 - Disconnect the connector (33).

19 - Remove the nut (34) and disconnect the eyelet (35) of the glowplug feed wire.

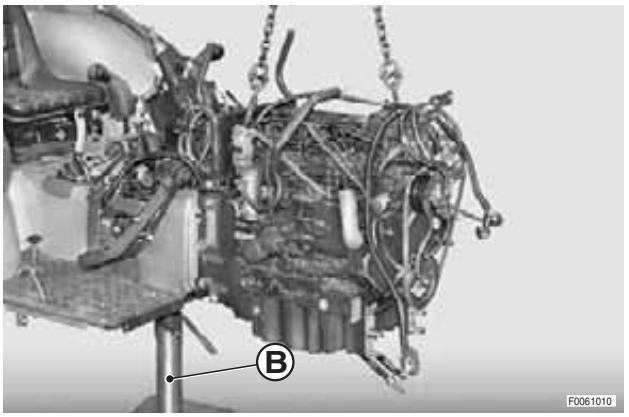
20 - Withdraw the wiring loom (36) towards the rear of the tractor.



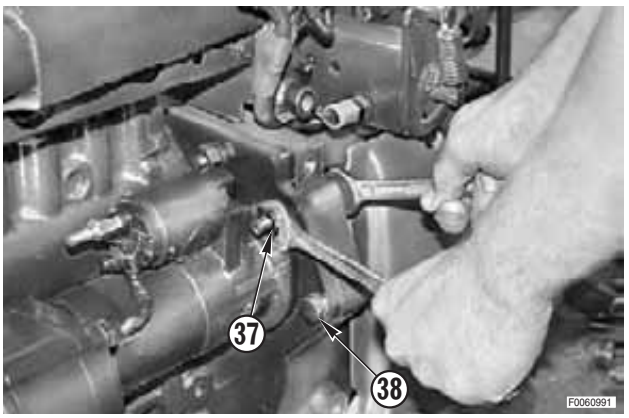
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21 - Attach the engine to a hoist using a lifting sling or ropes and take up the slack.

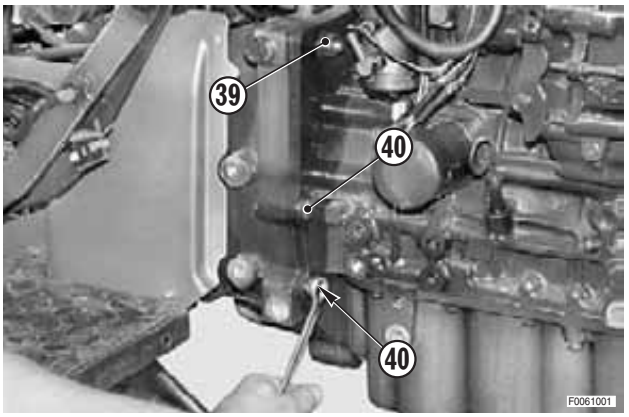
22 - Position a screw type stand "**B**" under the clutch housing.



23 - Remove the nuts (37), leaving the relative bolts in position, and remove the screws (38).



24 - Remove the nut (39) and the bolts (40) and remove the complete engine assembly. ※5 ※6



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Refitting

- Refitting is the reverse of removal.

1

★ Fill the transmission system with oil and the cooling system with coolant.

Transmission oil: max. 21 ℓ (5.5 US.gall.)

Coolant:
max. 5 ℓ (1.3 US.gall.)

2

Nut: 10.7–16.0 Nm (7.88–11.79 lb.ft.)

3

Extension: 10.7–16.0 Nm (7.88–11.79 lb.ft.)

4

★ Tension the drivebelt.
(For details see «ALTERNATOR»).

5

★ Adjust the height of the jacks to bring the mating surfaces parallel to each other.

★ Apply a film of lubricant to the locating dowels and mating surfaces.

Surfaces and dowels: oil

6

★ Before inserting the transmission input shaft in the clutch assembly, insert the rear PTO control shaft and make sure that it is correctly engaged in the clutch plate.

1 - Fill all the systems with the appropriate fluids. Start the engine and run for a few minutes to allow the fluids to circulate, then check for leaks.

2 - Expel the air from the hydraulic circuits by repeatedly raising and lowering the linkage and by turning the steering wheel back and forth; then check the pipe fittings and circuits for leaks.

3 - Stop the engine, bleed the air from the cooling circuits, check all the fluid levels and top them up if necessary.

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CLUTCH ASSEMBLY

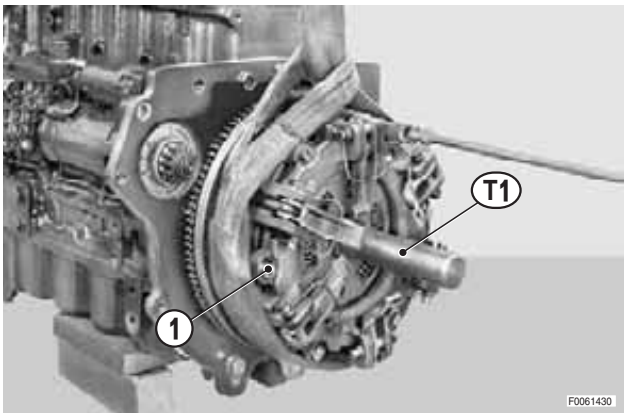
PTO CLUTCH

Removal and renewal of the PTO clutch plate

⚠ Disconnect the negative battery lead (–) and apply the parking brake.

1 - Separate the engine from the transmission. (For details see «ENGINE»).

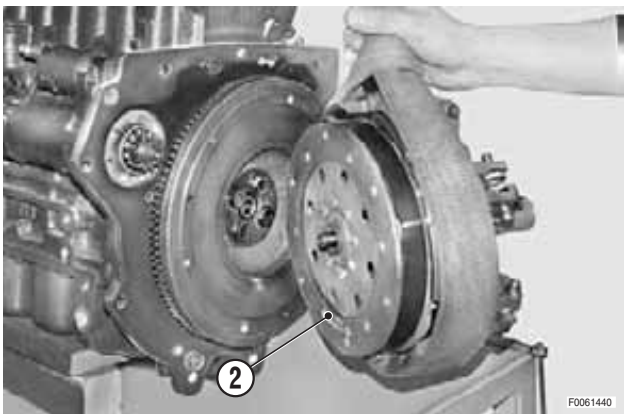
2 - Insert the dowel **T1** (code 5.9030.961.0) into the centre hole of the clutch assembly.



3 - Attach the clutch assembly to a hoist using a lifting sling or ropes and take up the slack.

4 - Remove the bolts (1) and remove the complete clutch assembly.
★ Loosen the bolts (1) gradually in a crosswise pattern.

5 - Remove the PTO clutch plate (2).



Check PTO clutch plate wear

1 - Check that the thickness of the clutch plate is within the prescribed tolerance limits and there is no sign of burning.
★ Clutch plate thickness:
- standard measurement: 7.5±0.3 mm
- limit: 6.4 mm

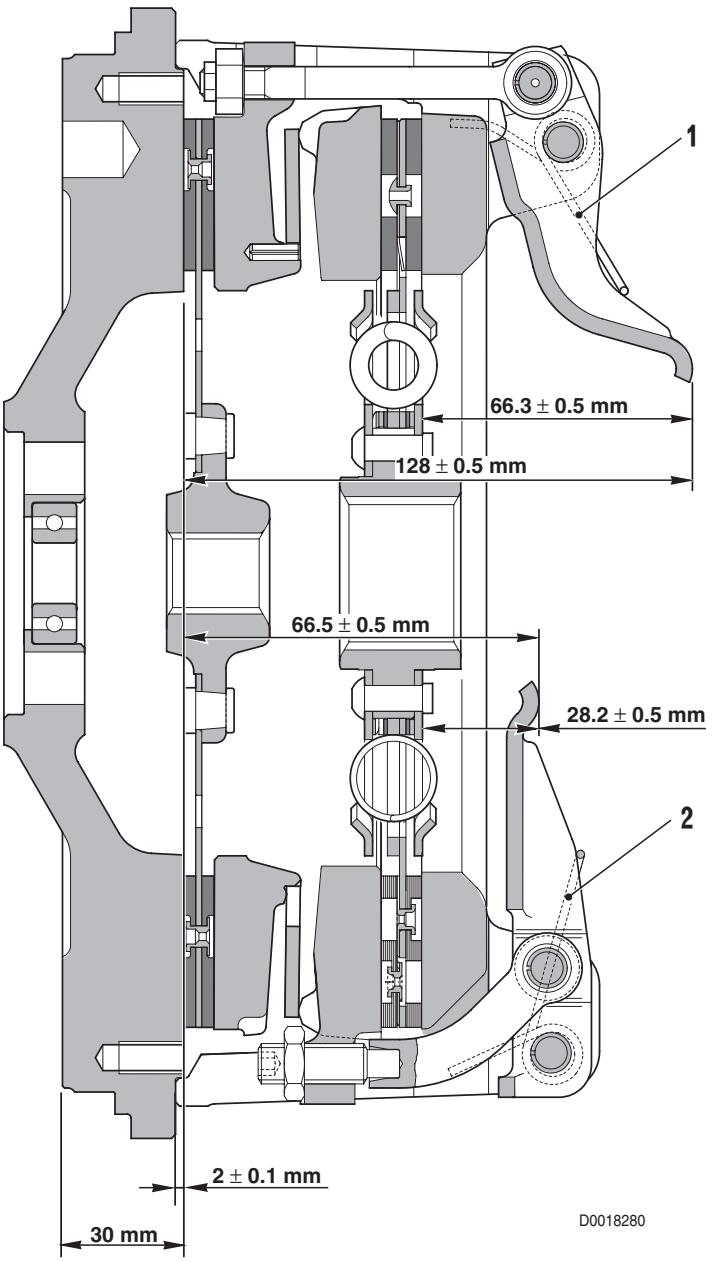
Refitting the PTO clutch plate

• Refitting is the reverse of removal.

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Adjustment of the clutch levers

1 - With the clutch assembly installed on the flywheel, adjust the height of the PTO clutch lever (1) and the main clutch levers (2) to the specified values.
★ Maximum difference between the heights of control levers of the same clutch: 0.7 mm (0.0276 in.).



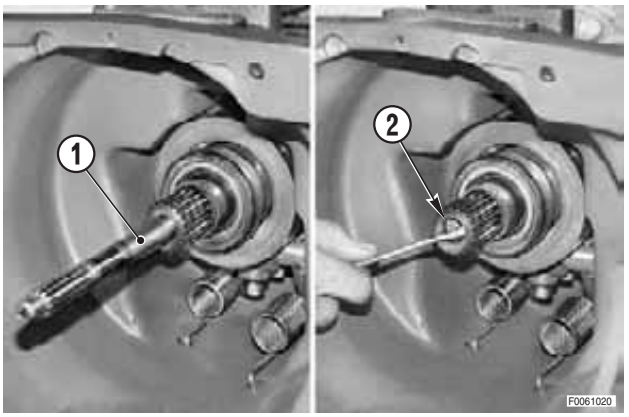
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PTO DRIVE SHAFT OIL SEAL

Renewal

1 - Withdraw the PTO drive shaft (1) from the transmission.

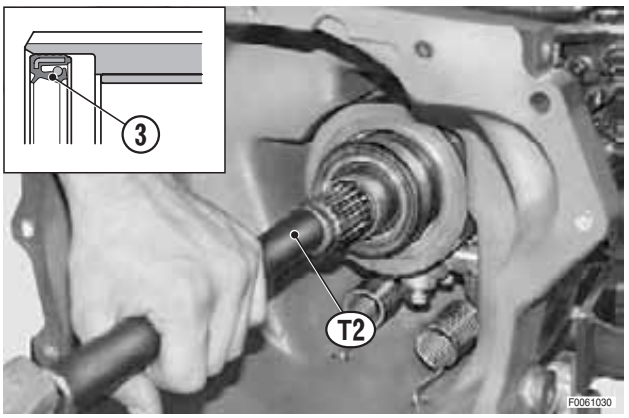
2 - Remove the oil seal (2).



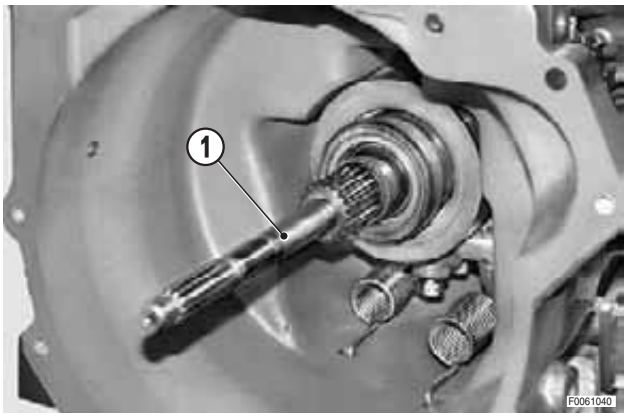
3 - Using the tool **T2** (code 5.9030.962.0) install the new oil seal (3).

★ Take care to install the oil seal the right way round

★ Lubricate the lips of the seal with grease.



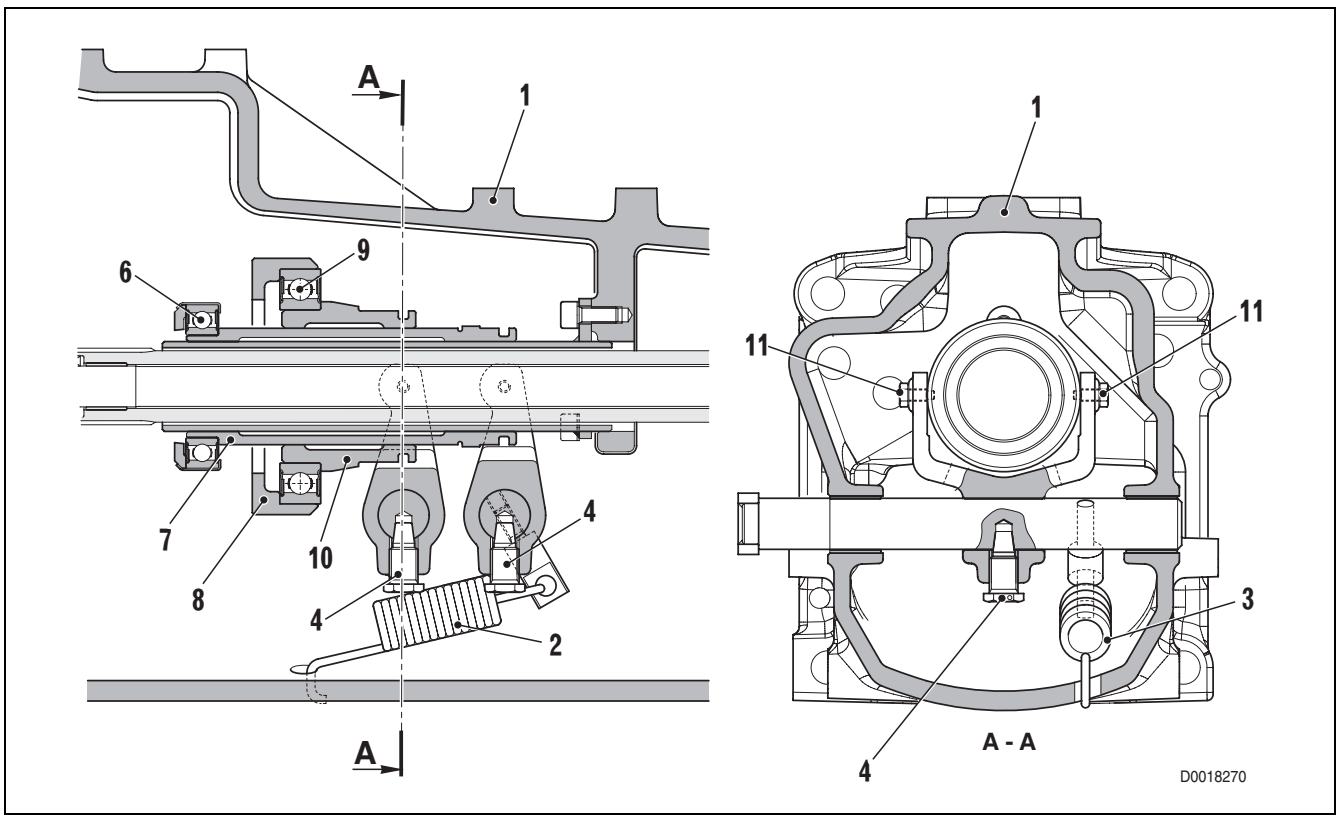
4 - Insert the PTO drive shaft (1) in the transmission, taking care not damage the lips of the oil seal.



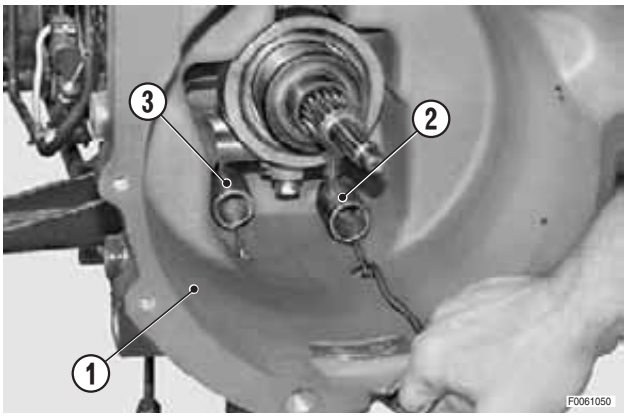
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CLUTCH RELEASE BEARINGS

Removal

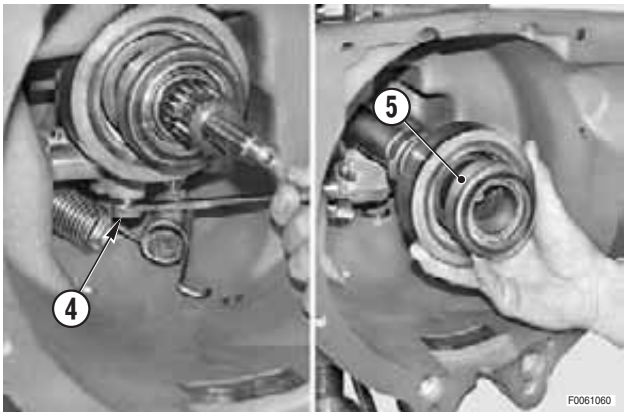


1 - Detach the springs (2) and (3) from the clutch housing (1).



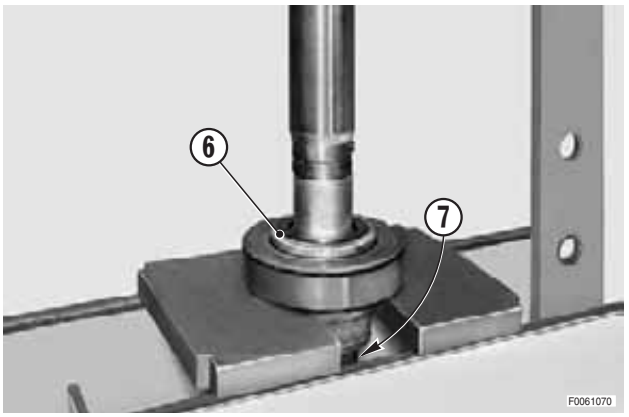
2 - Remove the screws (4) securing the clutch release forks. ※ 1

3 - Withdraw the complete release bearing assembly (5). ※ 2

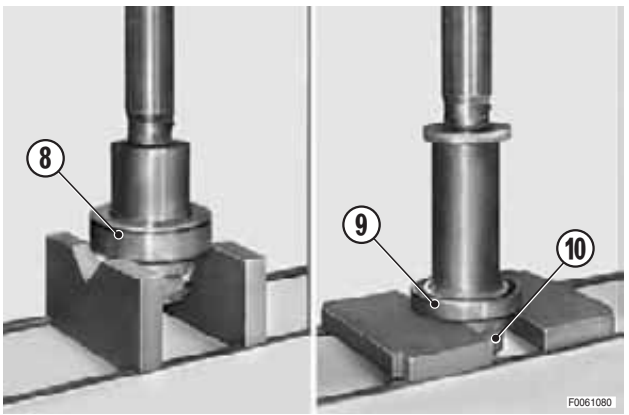


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4 - Position the release bearing assembly under a press and, using a suitable tool, separate the main clutch release bearing (6) from the sleeve (7). ⁘ 3

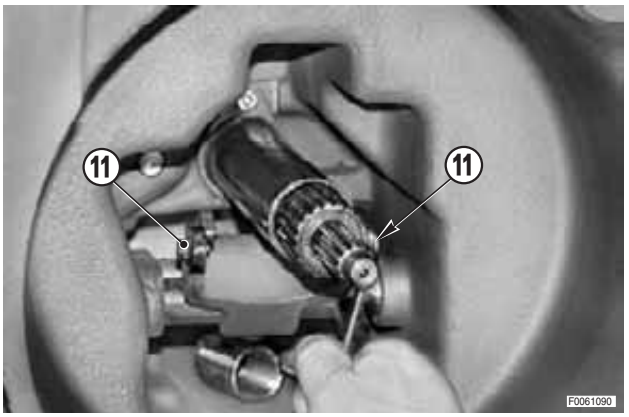


5 - Using a suitable tool, remove the ring (8) from the bearing (9), and bearing (9) from the sleeve (10).



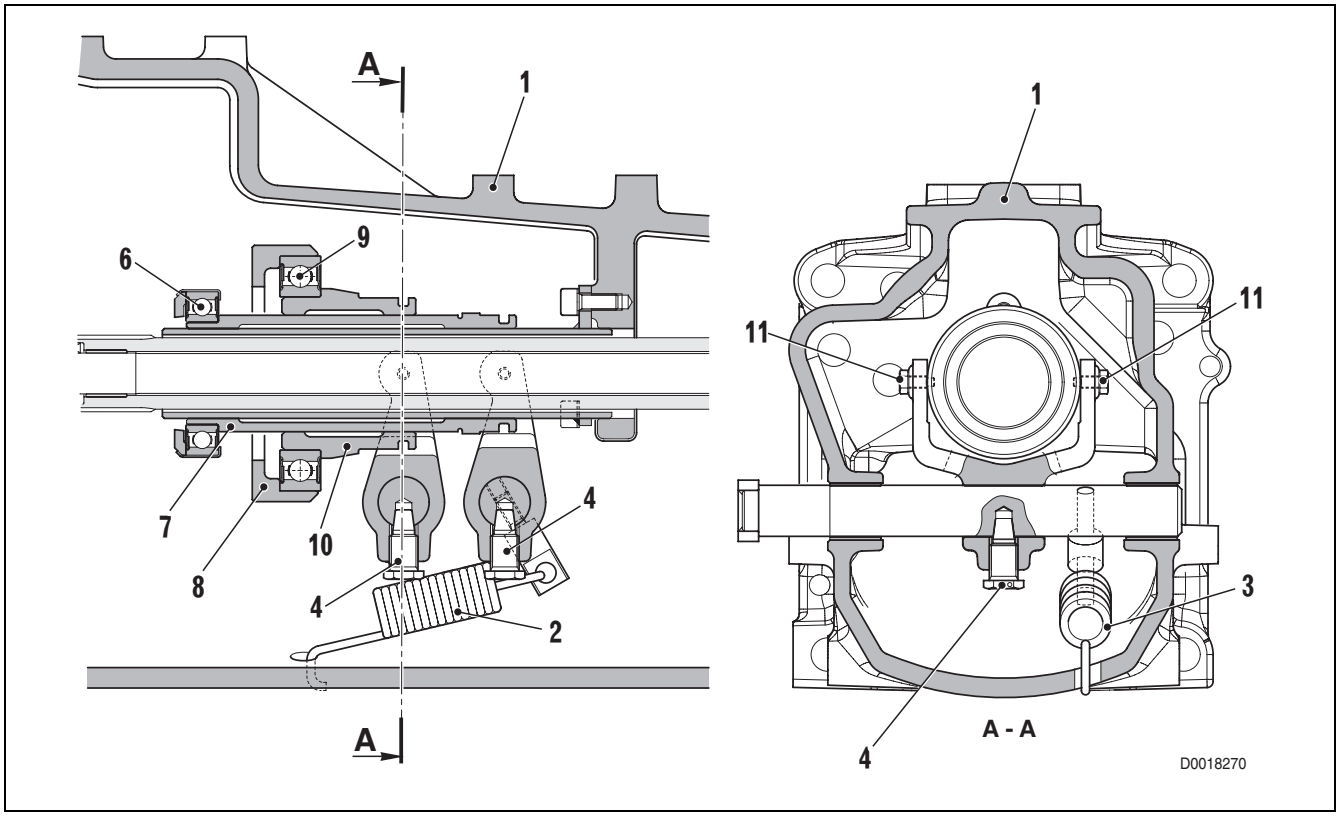
6 - Remove the fork control pins (11) (2 per fork).

★ Check that the pins are not excessively worn or deformed and renew them if necessary.



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Refitting



- Refitting is the reverse of removal.

※ 1

Bolts: Loctite 242

※ 2

★ Grease the sleeve support.

Support: Molikote

1 - Fit the release bearing assembly (5) and centre the fork control pins (11) in their respective housings on the sleeves.

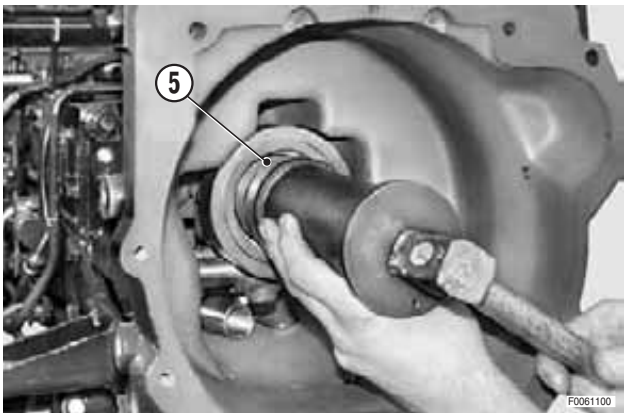
2 - Push the sleeves (7) and (10) as far as they will go towards the transmission, then, using a suitable installation tool, fit the release bearing (9).

※ 3

★ Grease the sleeves (7) and (10).

Sleeve: Molikote

★ Do not install the clutch release bearing (6) at this point.



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LIFT

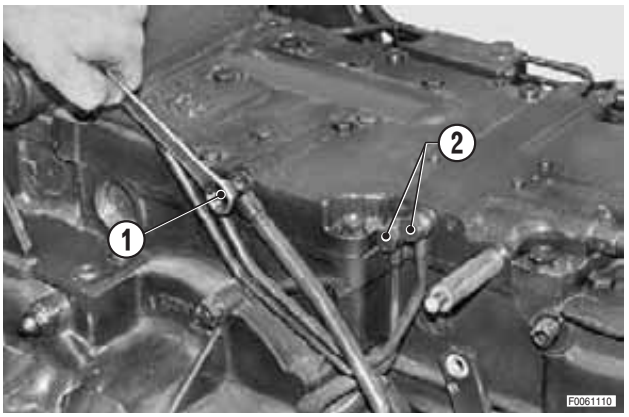
COMPLETE ASSEMBLY

Removal

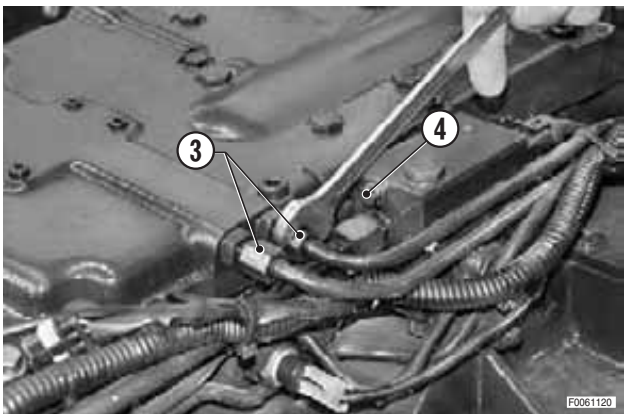
⚠ Disconnect the lead from the negative (–) terminal of the battery.

1 - Remove the platform.
(For details see «PLATFORM»).

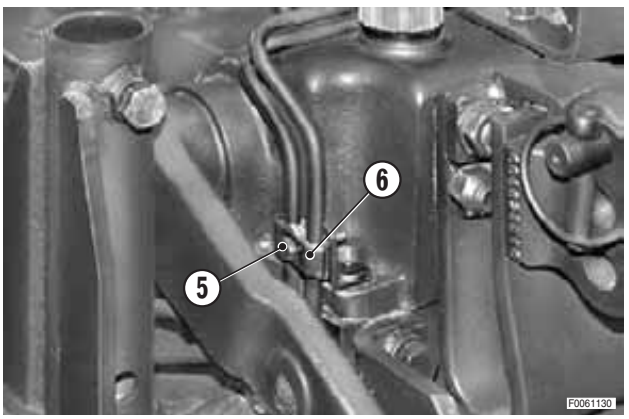
2 - Remove the unions (1) and (2).
★ Renew the spring washers on reassembly.



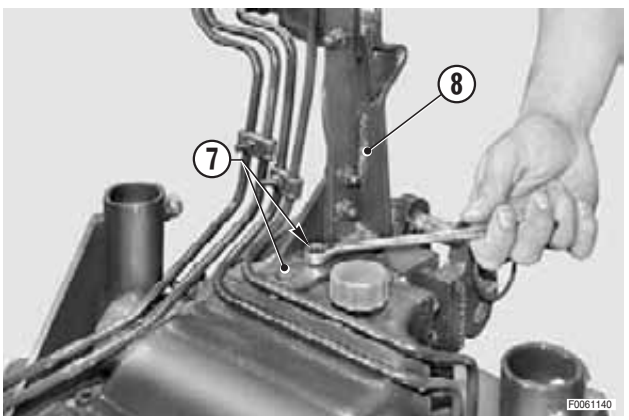
3 - Fully loosen off the pipes (3) and remove the screw (4).



4 - Remove the screw (5) and remove the hose clip (6).

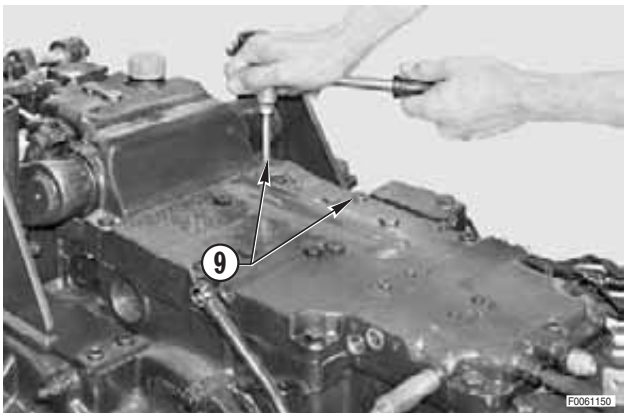


5 - Remove the screws (7) and remove the quick-action coupler support (8) complete with the pipes.



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6 - Remove the eleven screws (9).

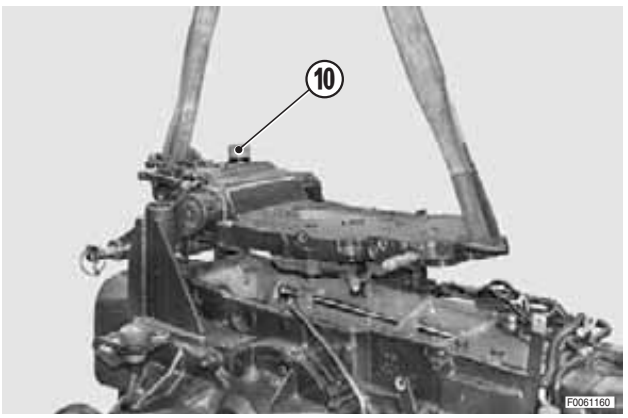


7 - Attach a hoist to the lift cover and remove it.

kg Lift: 55 kg (121 lb.)

8 - If you need to remove any components mounted on the lift cover, remove the oil filler/breather screw (10).

9 - Clean the mating surfaces of the transmission and the lift cover thoroughly. ※ 1

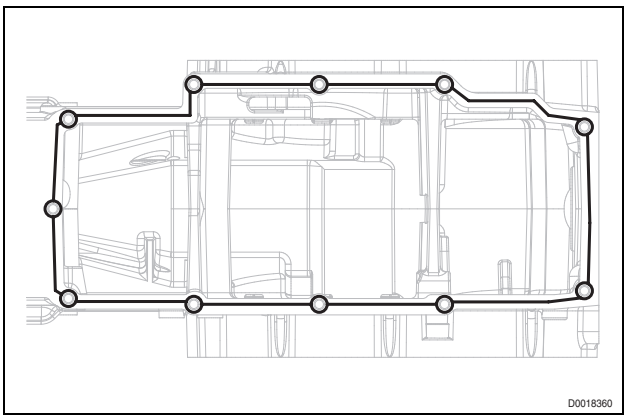


Refitting

- Refitting is the reverse of removal.

※ 1

Mating surfaces: Loctite 510

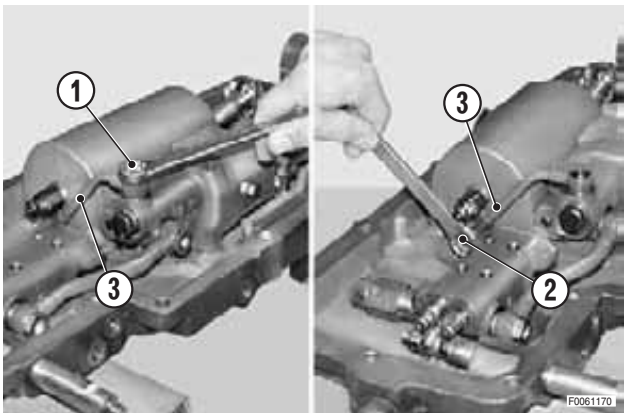


https://truckmanualshub.com/

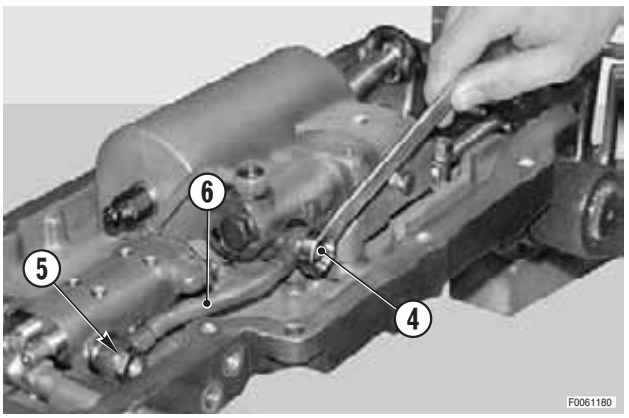
POWER LIFT CONTROL VALVE

Removal

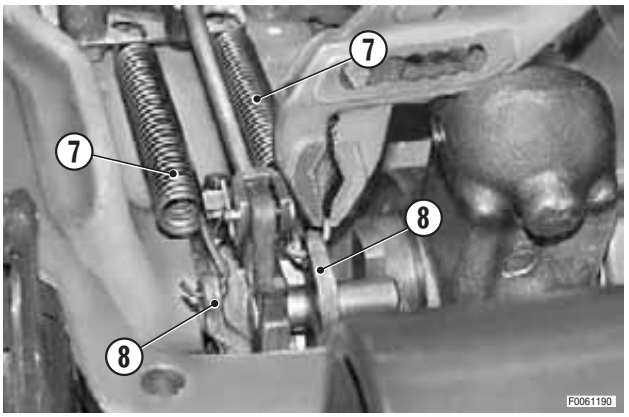
1 - Remove the unions (1) and (2) and remove the pipe (3).
★ Renew the copper washers on reassembly.



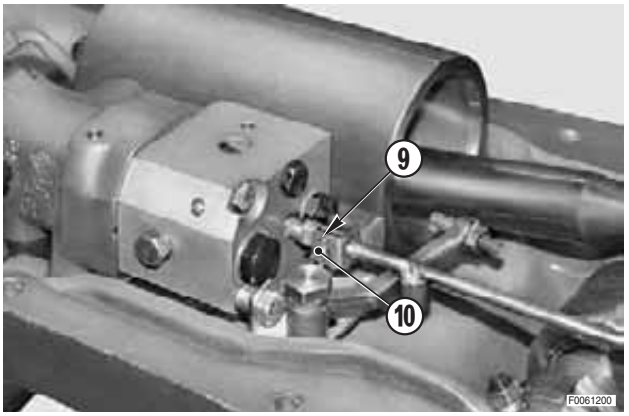
2 - Remove the unions (4) and (5) and remove the pipe (6).



3 - Detach the springs (7) from the levers (8).

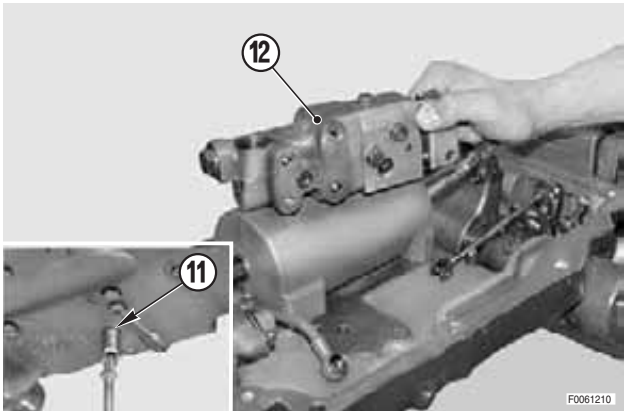


4 - Remove the cotter pin (9) and remove the pivot pin (10).
★ Renew the cotter pin on reassembly.



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5 - Remove the screws (11) and remove the complete control valve assembly (12). ※ 1
★ Check the condition of the O-rings and renew them if necessary.



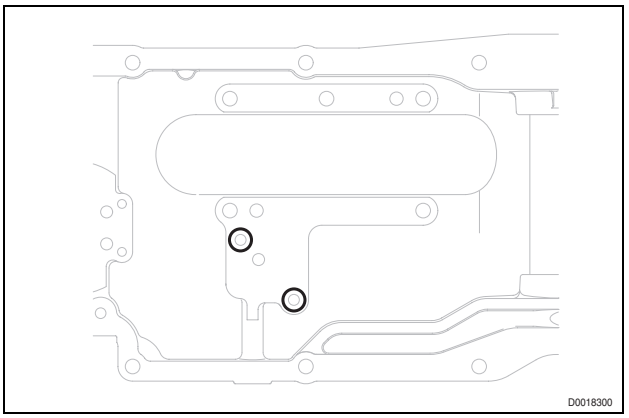
Refitting

- Refitting is the reverse of removal.

※ 1
★ Apply a bead of sealant around the holes for the control valve fixing screws.

Sealant: Loctite 510

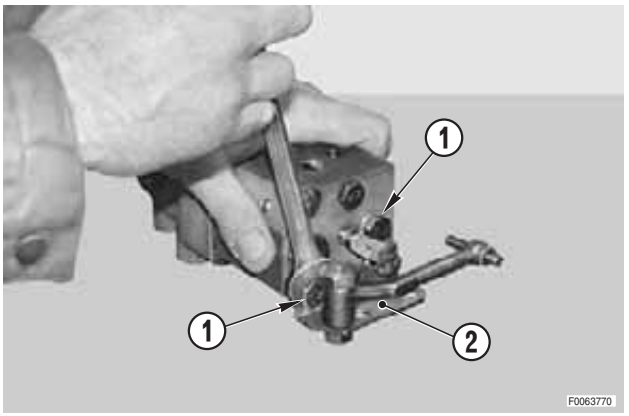
1 - Check that the hydraulic limit control lever is correctly adjusted.
(For details see «HYDRAULIC LIMIT LEVER» in this chapter).



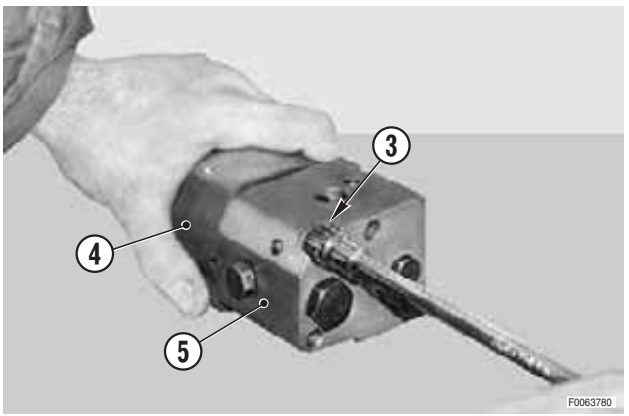
https://truckmanualshub.com/

Disassembly

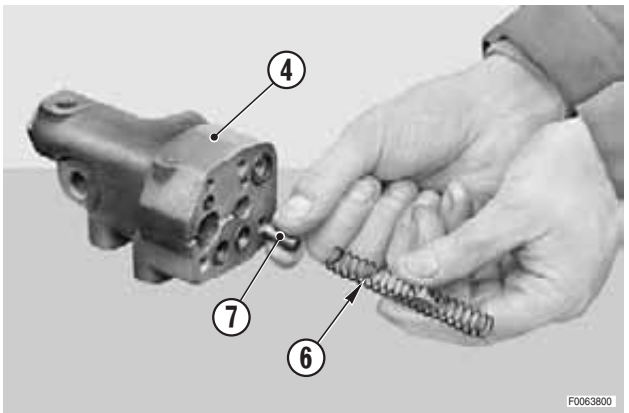
1 - Remove the screws (1) and remove the complete bracket (2).



2 - Remove the screw (3) and separate the two control valve housings (4) and (5).



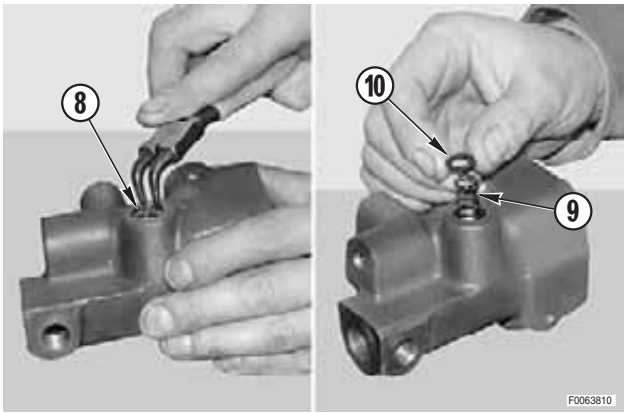
3 - Remove the spring (6) and the spacer (7) from the housing (4).



4 - Remove the circlip (8).

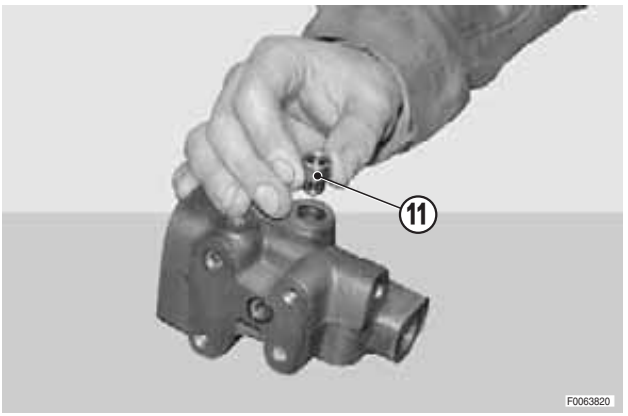
★ Gradually relieve the load exerted by the spring (9).

5 - Remove the washer (10) and the spring (9).

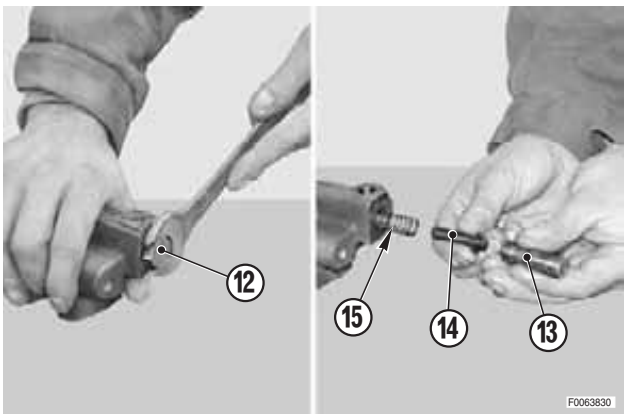


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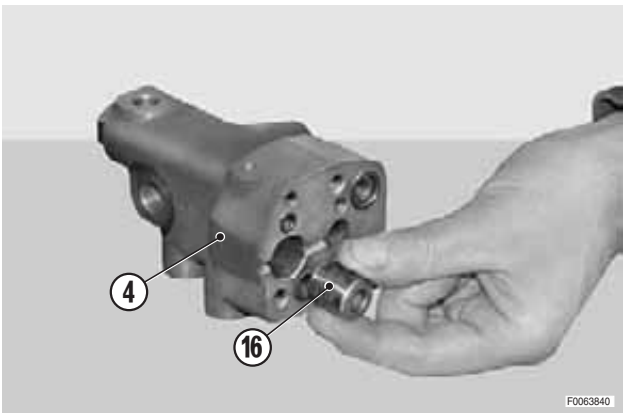
6 - Withdraw the valve (11).



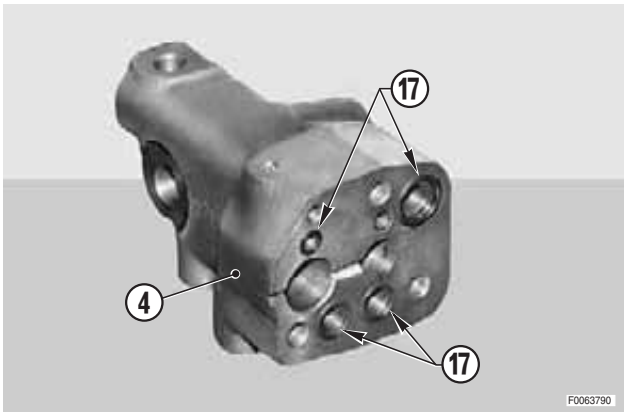
7 - Remove the plug (12) and remove the valve (13), the pin (14) and the spring (15). ※ 1
★ Renew the copper washers on reassembly.



8 - Withdraw the piston (16) from the valve body (4). ※ 2

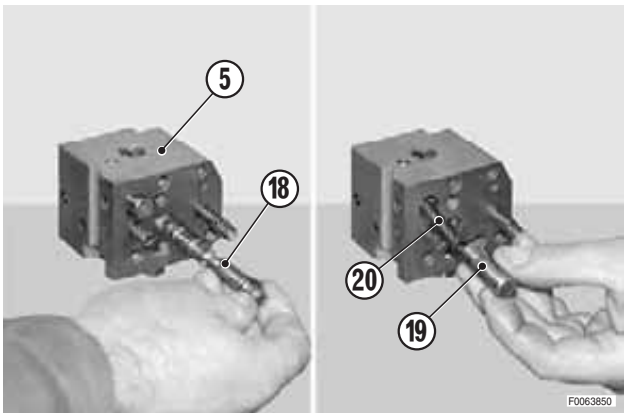


9 - Remove the four O-rings (17) from the valve body (4).

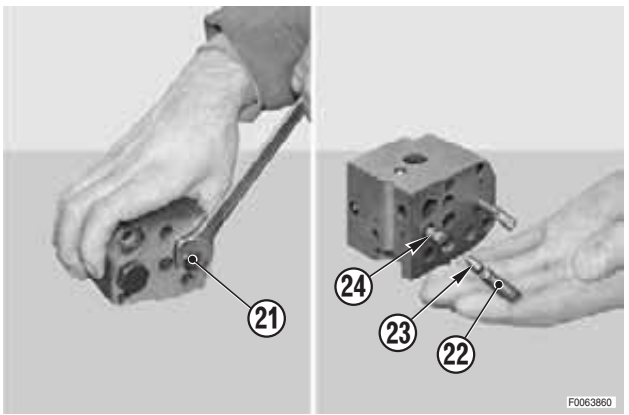


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10 - Withdraw the spool (18) from the valve body (5) and remove the piston (19) and the spring (20). ※ 3



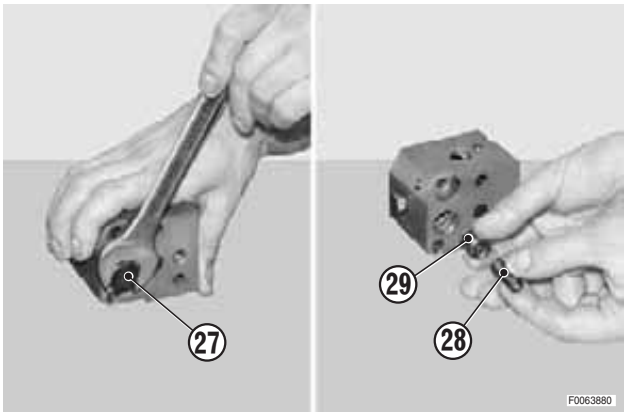
11 - Remove the plug (21) and withdraw the spring (22), the spacer (23) and the valve (24). ※ 4
★ Renew the copper washer on reassembly.



12 - Remove the spring (25) and the rod (26). ※ 5

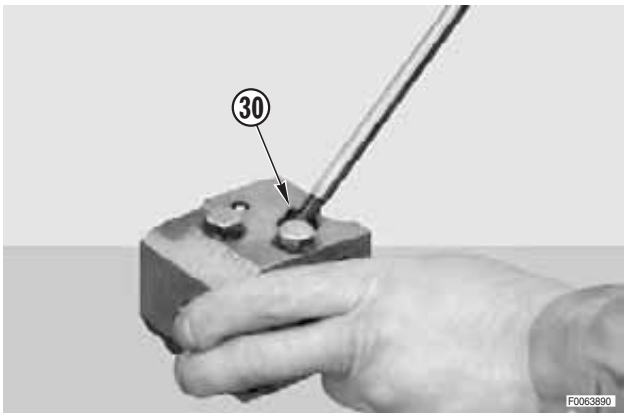


13 - Remove the plug (27) and remove the spring (28) and the valve (29). ※ 6
★ Renew the copper washer on reassembly.



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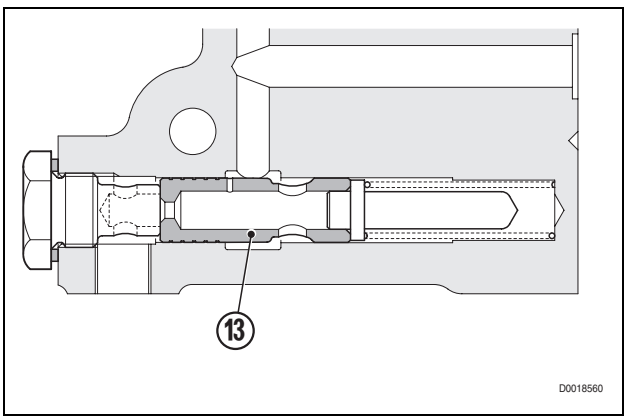
14 - Remove the valve (30).
★ Renew the copper washer on reassembly.



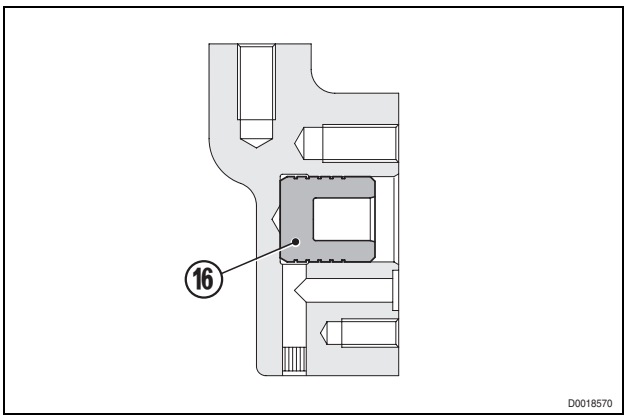
Assembly

- Assembly is the reverse of disassembly.

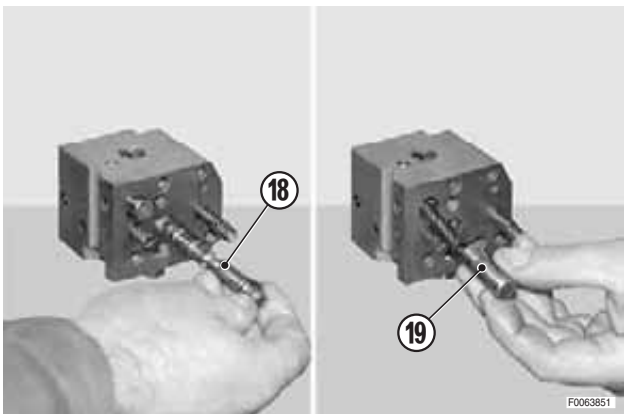
※ 1
★ Check that the valve (13) slides freely in its seat.
★ Make sure that valve (13) is positioned the right way round.



※ 2
★ Check that the piston (16) is installed the right way round.



※ 3
★ Check that the spool (18) slides freely without sticking.
★ Check that the piston (19) slides freely in its seat.

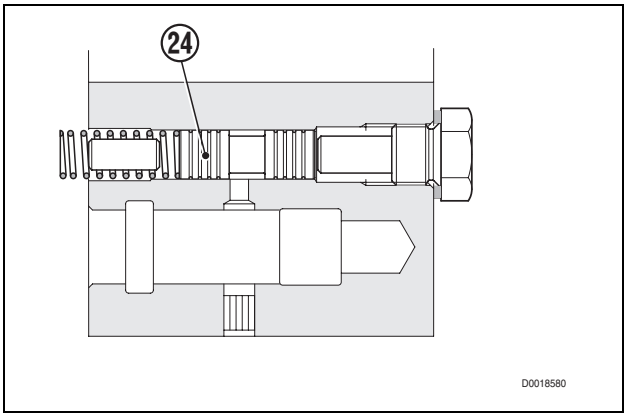


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※ 4

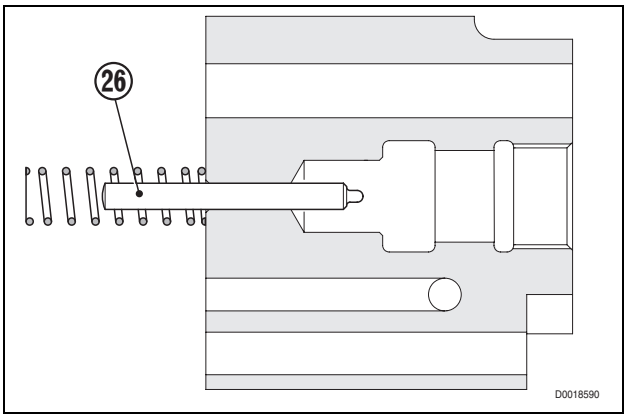
★ Check that the valve (24) slides freely.

★ Make sure that the assembly sequence is correct.



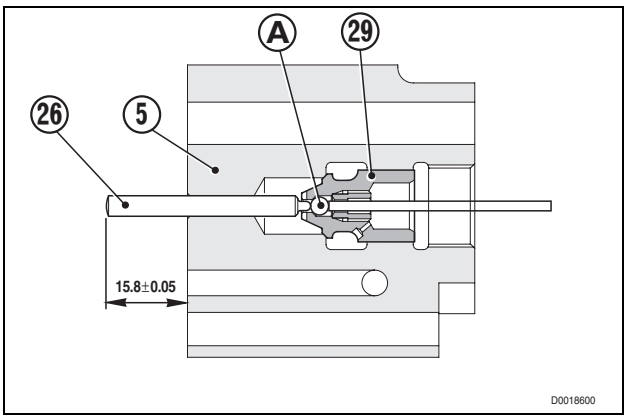
※ 5

★ Check that the rod (26) is installed the right way round.



※ 6

★ While holding the ball "**A**" in valve (29) tight up against the rod (26), ensure that the standout of the rod (26) relative to the face of the valve body (5) is within the prescribed tolerance limits (15.8±0.05 mm).

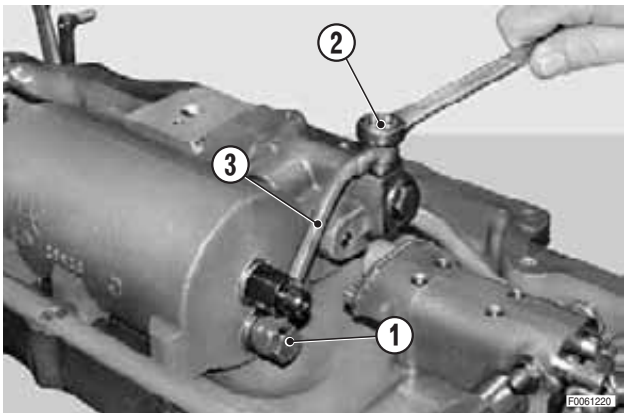


https://truckmanualshub.com/

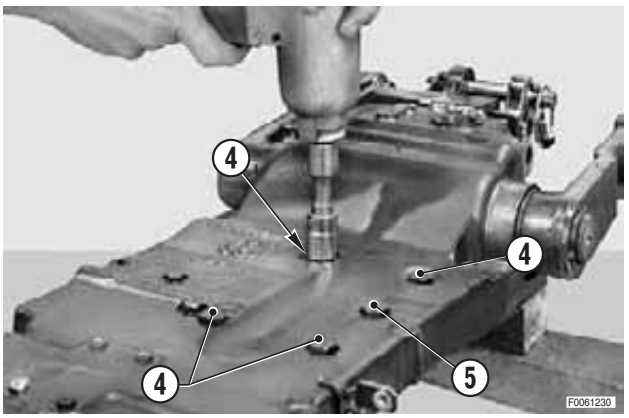
CYLINDER

Disassembly

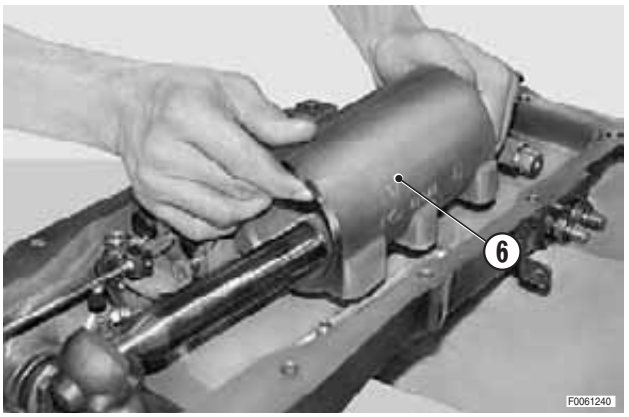
1 - Remove the unions (1) and (2) and remove the pipe (3).
★ Renew the copper washers on reassembly.



2 - Turn the lift over, remove the screws (4) and loosen the screw (5).

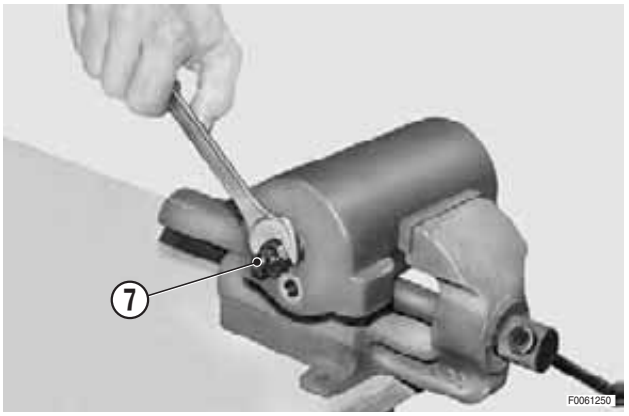


3 - Turn the lift over again, remove the screw (5) that was previously left in position and remove the complete cylinder assembly (6). ※1



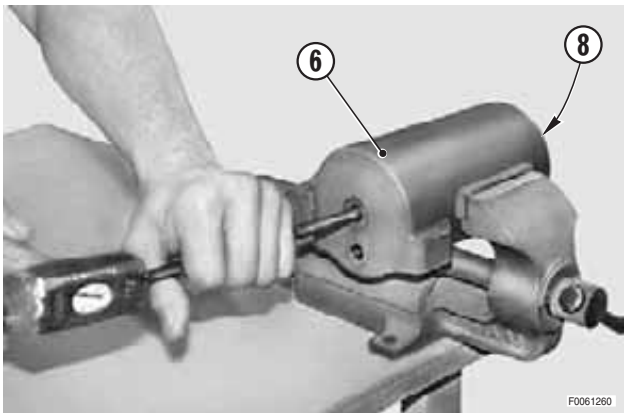
Only if necessary

4 - Remove the lift safety valve (7).
★ Renew the copper washer on reassembly.



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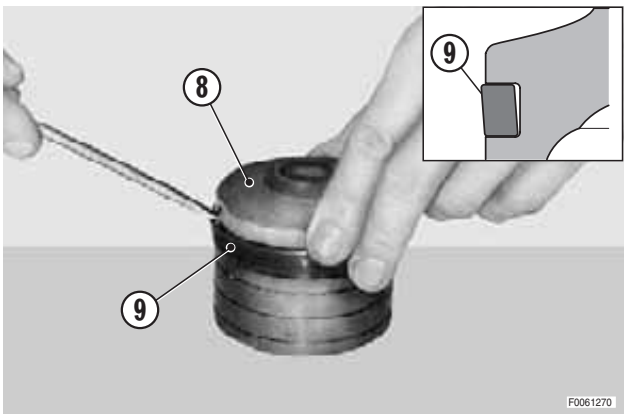
5 - Using a bar made of soft material, withdraw the piston (8) from the cylinder (6).



6 - Remove the seal (9) from the piston (8)

※ 2

★ Note which way round the seal is installed (8).



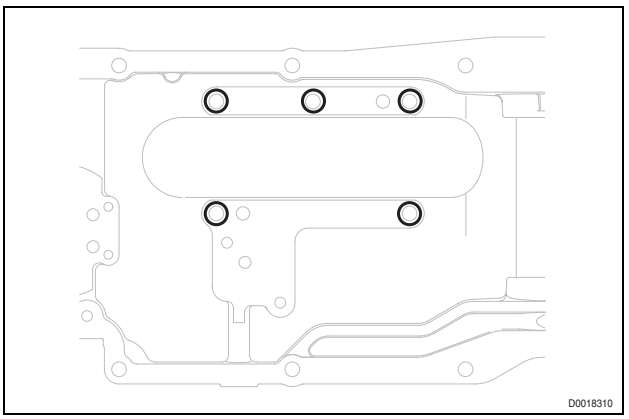
Assembly

- Assembly is the reverse of disassembly.

※ 1

1 - Apply a bead of sealant around the cylinder fixing holes.

Sealant: Loctite 510

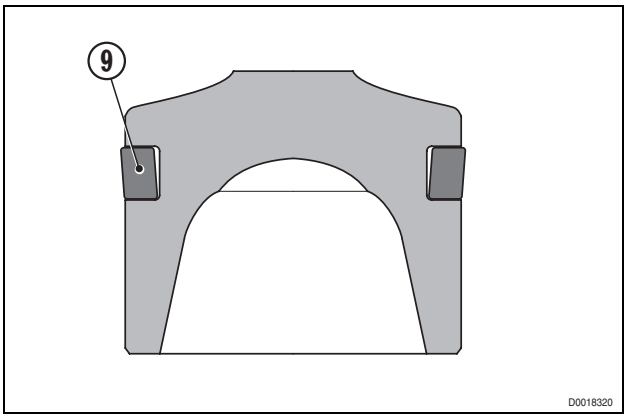


※ 2

1 - Check that the seal is installed the right way round (9).

2 - Lubricate the seal and the cylinder.

Seal and cylinder: transmission oil.

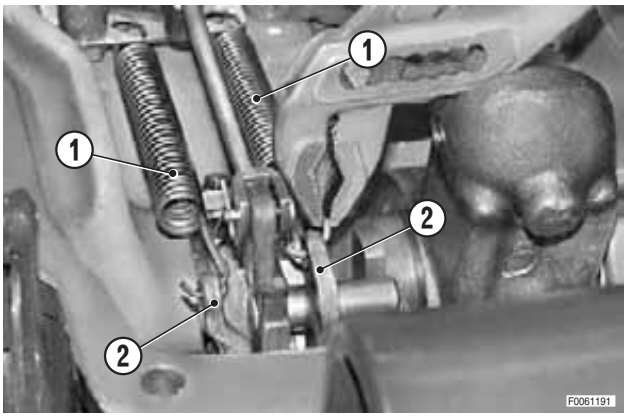


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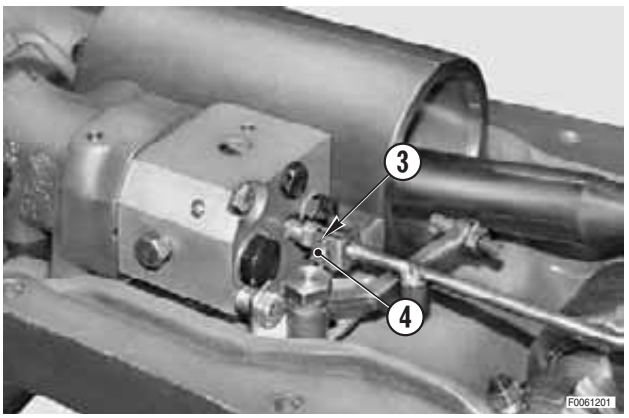
LIFT ARM OIL SEAL

Removal

1 - Detach the springs (1) from the levers (2).



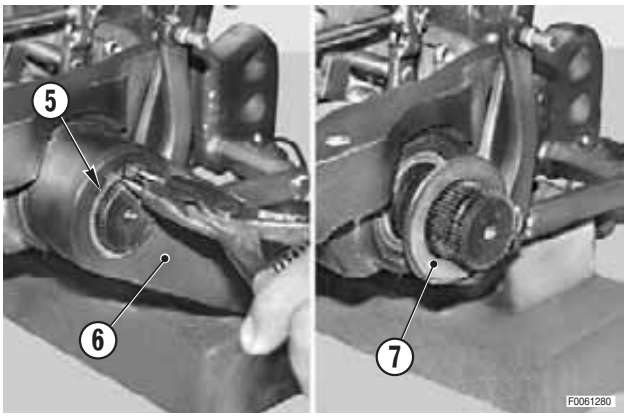
2 - Remove the cotter pin (3) and remove the pin (4).
★ Renew the cotter pin on reassembly.



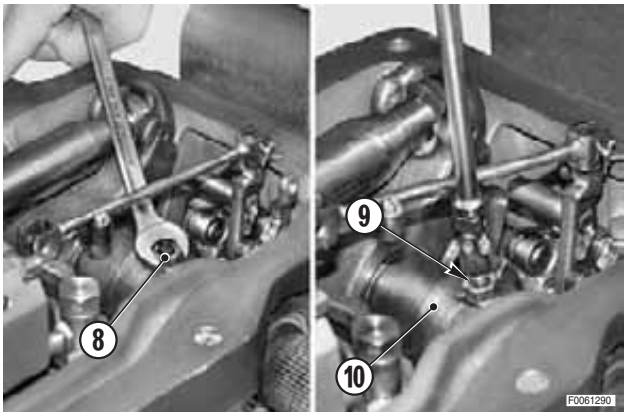
3 - Unseat the circlip (5) and remove the lift arm (6).

4 - Remove the thrust washer (7).

5 - Remove also the other lift arm and the relative thrust washer.

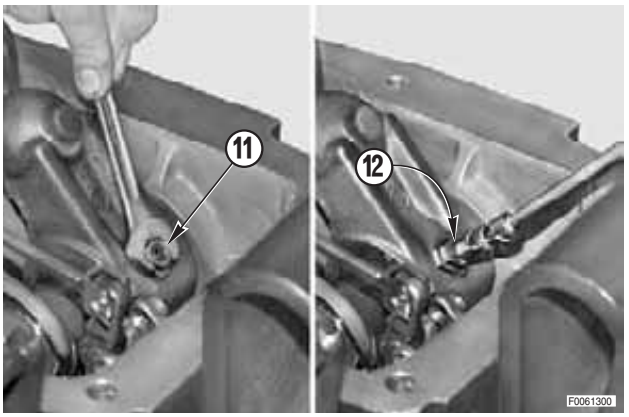


6 - Loosen the nut (8) and remove the grub screw (9). ⁘ 1
★ Note the position of the cam (10).

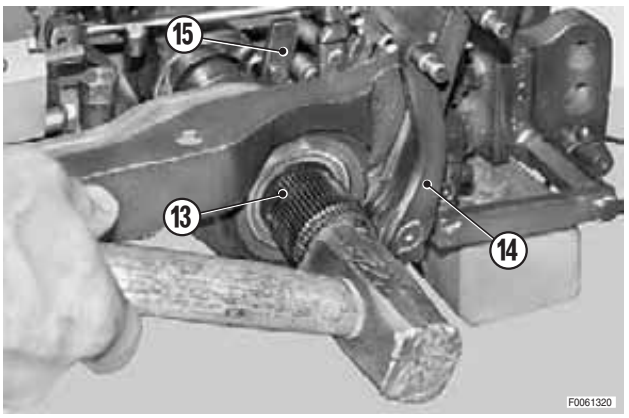


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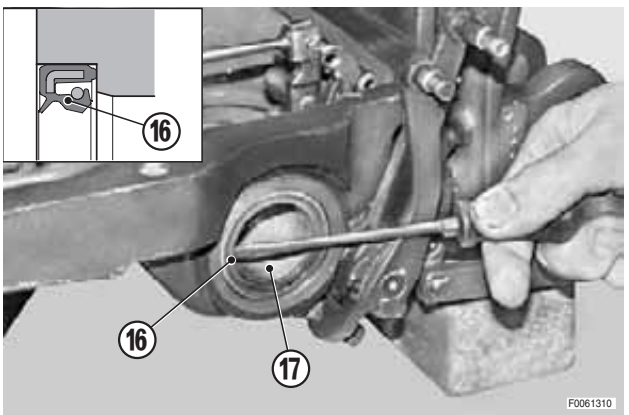
7 - Loosen the nut (11) and remove the grub screw (12).
※ 2



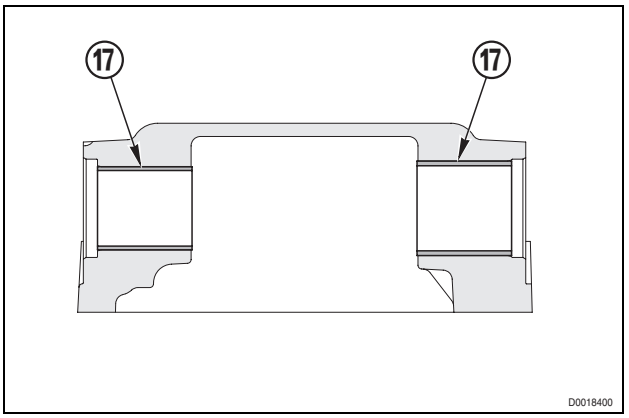
8 - Withdraw the shaft (13) towards the side opposite the controls (14).
※ 3
★ Use a soft-faced mallet.
★ Renew the oil seal on the opposite side to the controls on reassembly.
★ Note which way round the oil seal is installed.
★ Note that the widest part of plate (15) faces upwards.



9 - Remove the oil seal (16) from the controls side.
※ 3
★ Note which way round the oil seal is installed.



10 - Check that the bushes (17) are not worn out-of-round and renew them if necessary.
(For details see «BUSHES»).
※ 3



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Refitting

- Refitting is the reverse of removal.

★ Check that all components are installed the right way round.

※ 1

Grub screw: Loctite 242

★ Screw in fully and then, while holding it in position, secure with the nut.

※ 2

Grub screw: Loctite 242

★ Screw fully into its seating on the shaft and then unscrew it by half a turn.
Hold in position and secure with the nut.

※ 3

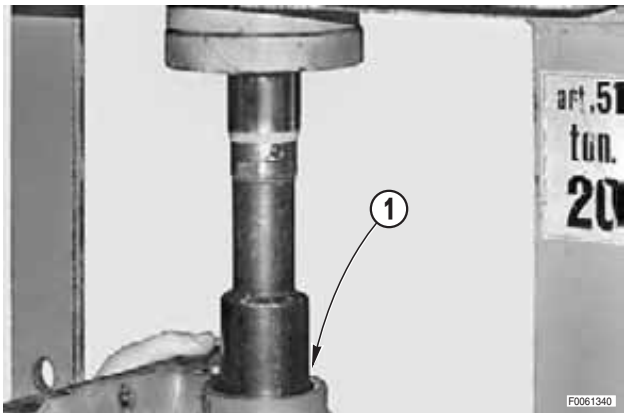
★ Grease the shaft, the bushes and the oil seal.

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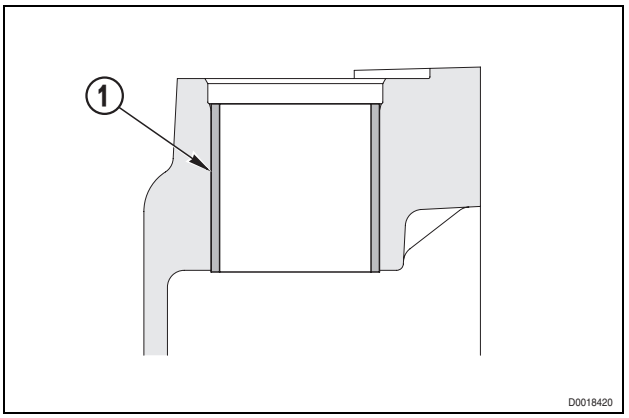
BUSHES

Renewal

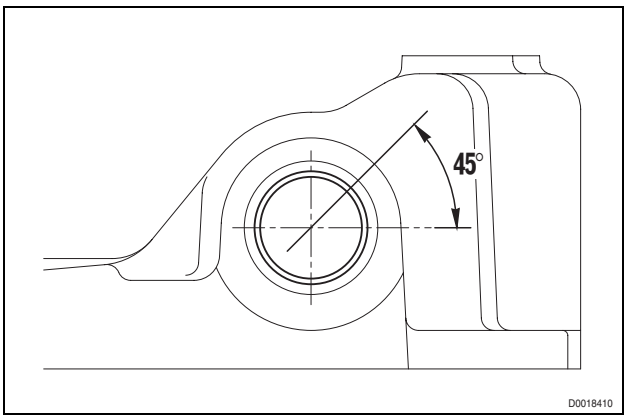
1 - Position the lift cover under a press and, using a suitable tool, remove the bushes (1).



2 - Fit the new bushes in the lift cover taking care to align them with the hole.



★ Fit the bushes with the split rotated 45° towards the rear of the lift cover.



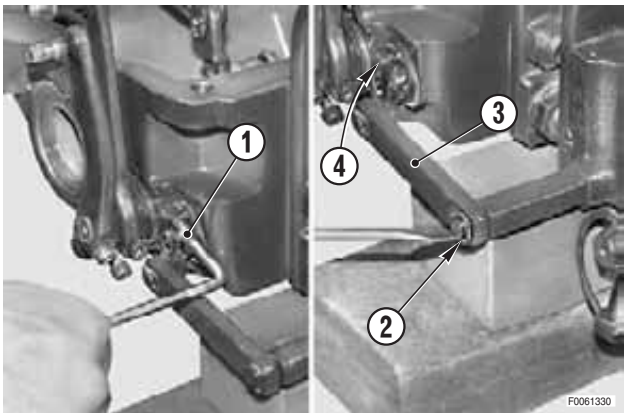
https://truckmanualshub.com/

INTERNAL LINKAGE

Removal

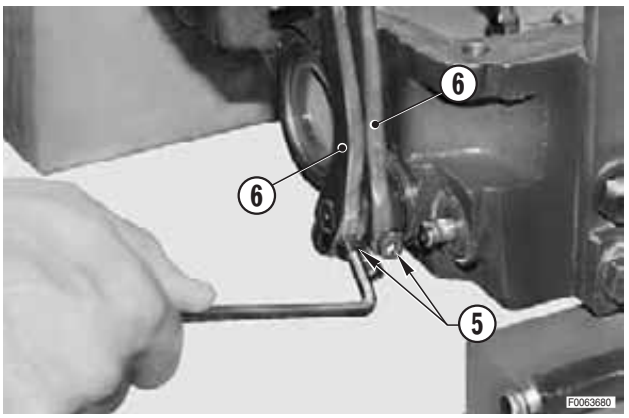
1 - Remove the shaft.
(For details see «LIFT ARM OIL SEAL» in this chapter).

2 - Remove the screw (1), the circlip (2) and remove the tie-rod (3) complete with the lever and key (4).



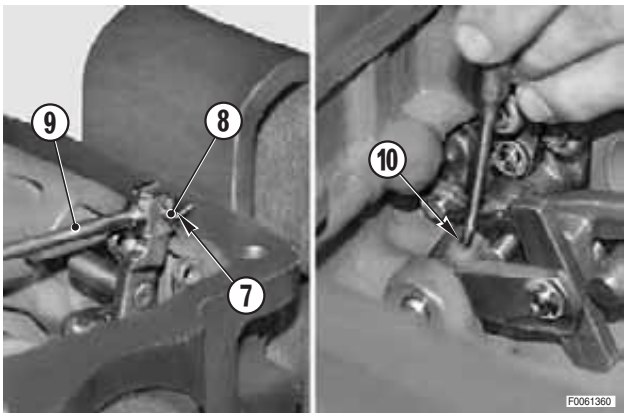
3 - Remove the screws (5) and remove the levers with their respective keys.

★ Note the positions of the keys relative to the lift cover.



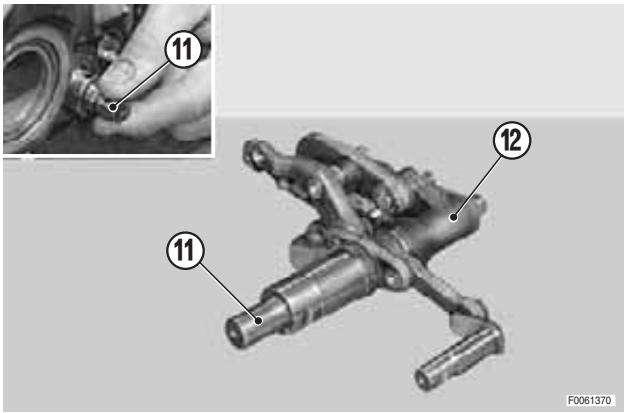
4 - Remove the cotter pin (7), remove the pin (8) and the tie-rod (9).

5 - Drive out the spring pin (10). ⁘ 1



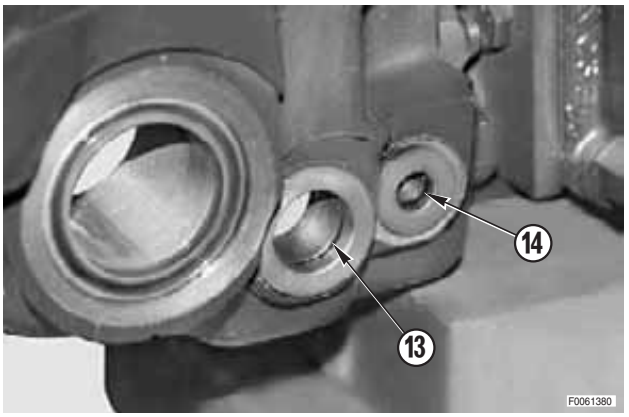
6 - Withdraw the shaft (11) and remove the linkage (12). ⁘ 2

★ Carefully note the relative positions of the cams and the levers to avoid errors on reassembly.



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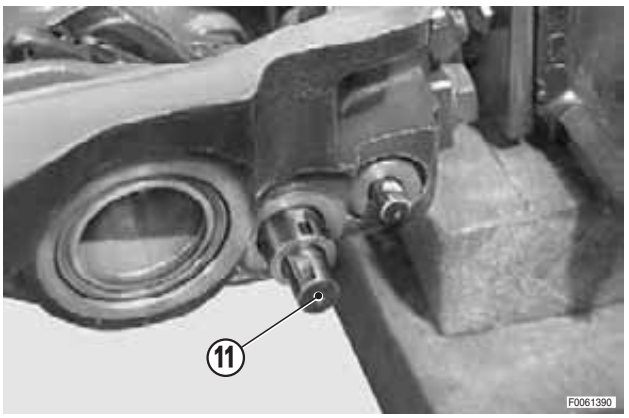
7 - Remove the O-rings (13) and (14).
★ Renew the O-rings on reassembly.



Refitting

- Refitting is the reverse of removal.

※1
★ Position the shaft (11) so that the seat of the key is facing upwards.



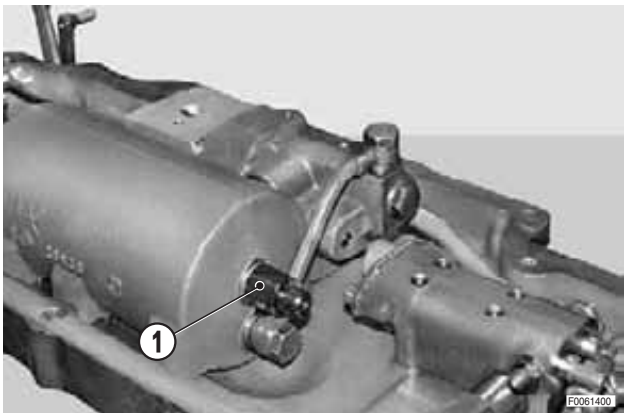
※2
★ Grease the bushes and the shafts.
★ Take care not to damage the O-rings.

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HYDRAULIC LEVER LIMIT

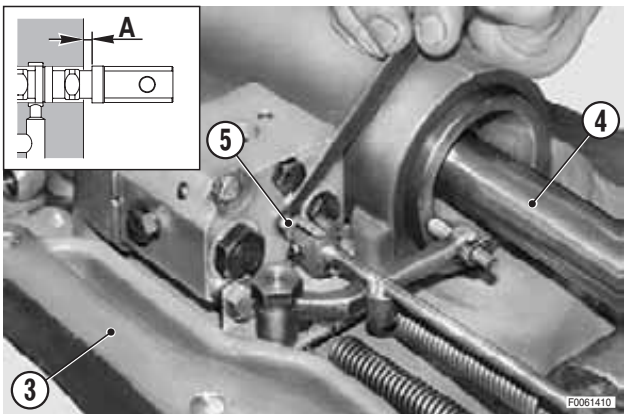
Adjustment

1 - Remove the lift safety valve (1).
★ Renew the copper washer on reassembly.

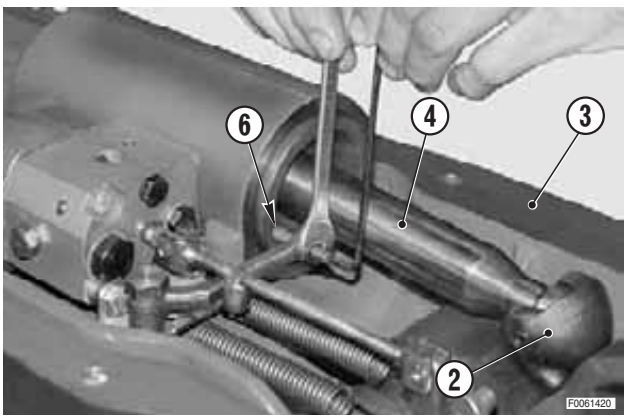


2 - Rotate the lift arms to bring the lever (2) up against the lift cover (3) and, using a bar of soft material, push the piston up against the connecting rod (4).

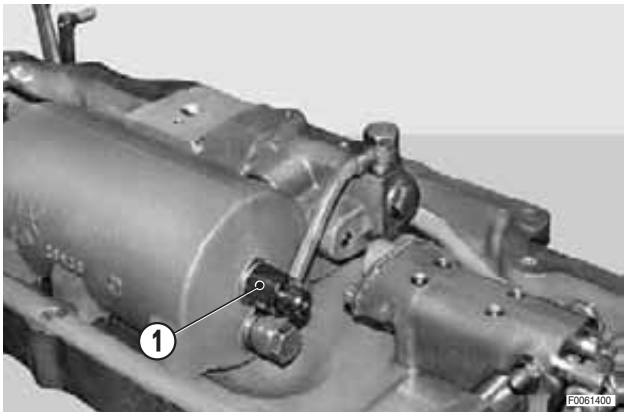
3 - Check dimension "**A**" of the spool slot standout (5) relative to the control valve.



4 - Adjust dimension "**A**" by screwing the grub screw (6) in or out to obtain the prescribed value
★ Dimension **A**: 2±0.5 mm (0.07–0.02 in.)



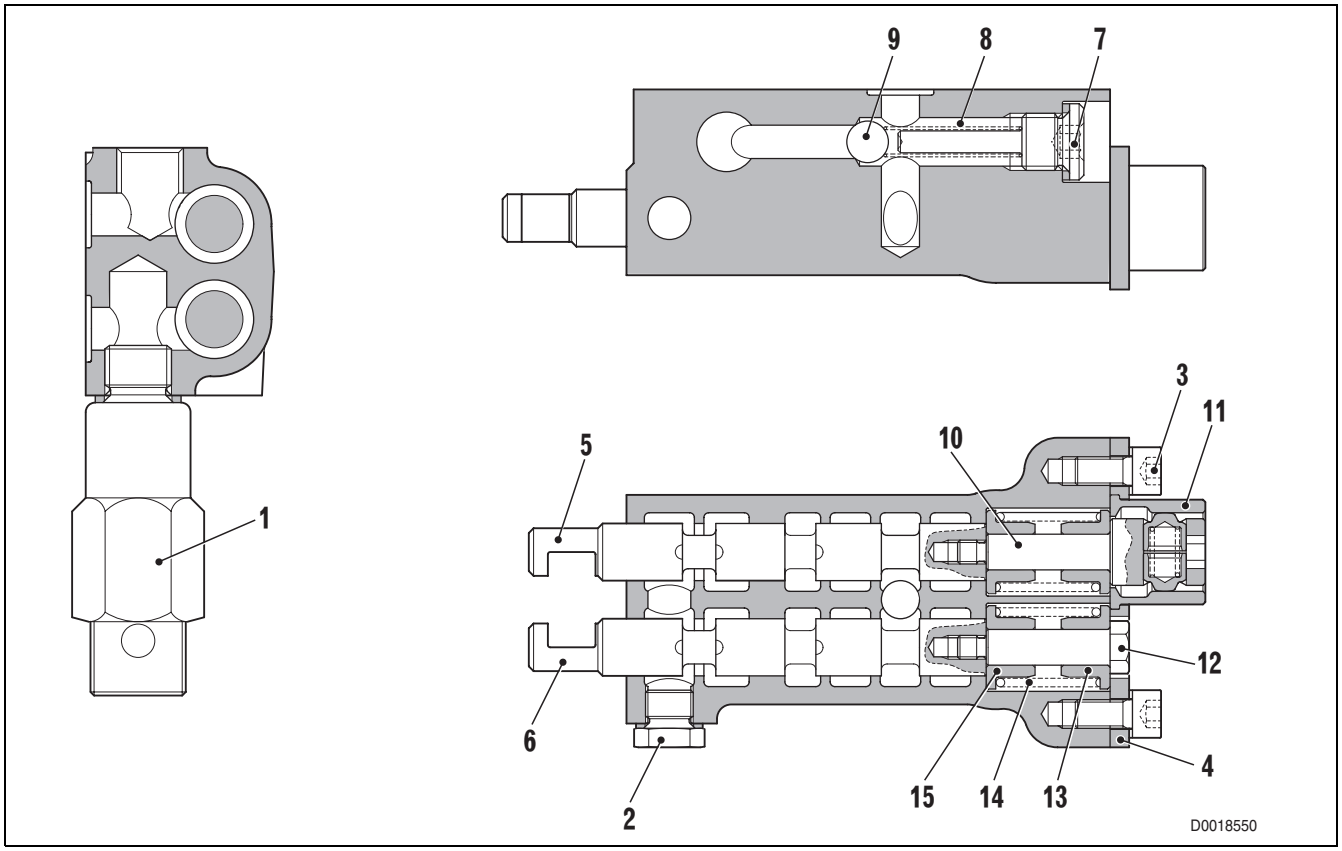
5 - Install the lift safety valve (1).



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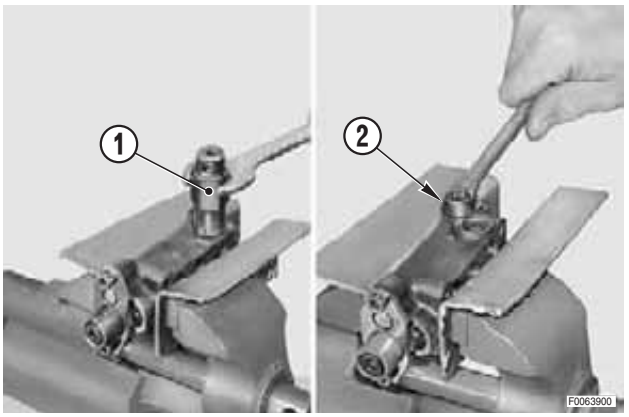
LIFT CONTROL VALVE

Disassembly

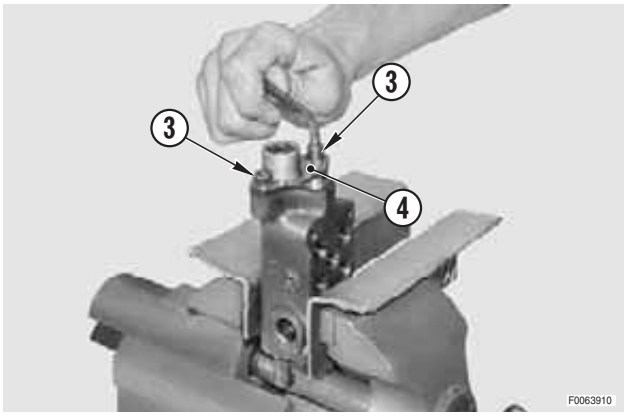


1 - Remove the pressure relief valve (1).
★ Renew the copper washer on reassembly.

2 - Remove the plug (2).
★ Renew the copper washer on reassembly.

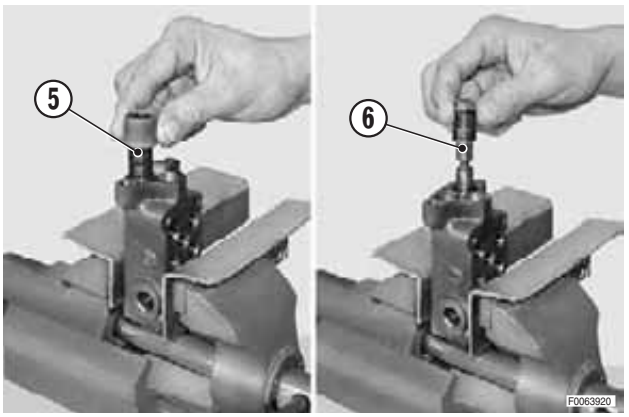


3 - Remove the screws (3) and remove the plate (4).

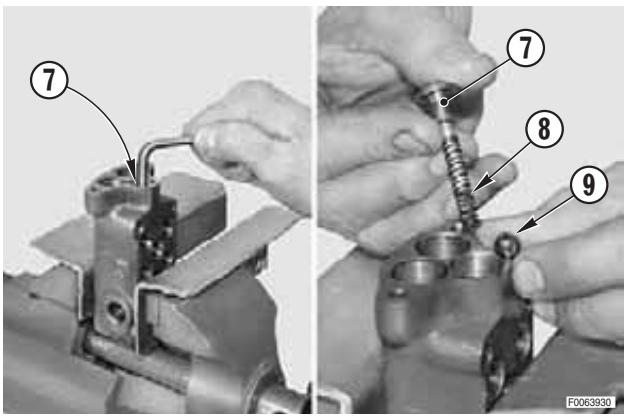


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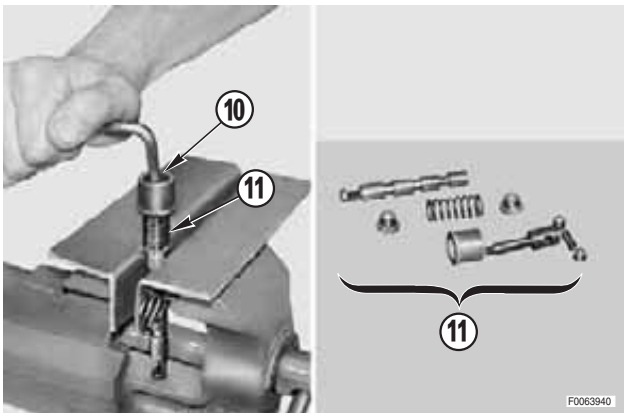
4 - Remove the spool (5) of control valve n° 1 and spool (6) of control valve n° 2.



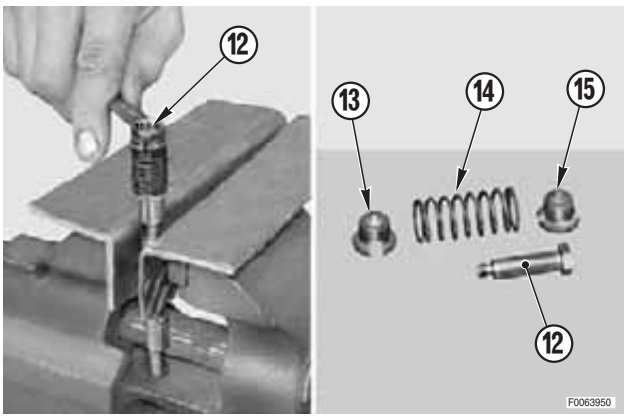
5 - Remove the plug (7) and remove the spring (8) and the ball (9).



6 - Remove the screw (10) and disassemble the spool return device (11).



7 - Remove the screw (12) and remove the disc (13), the spring (14) and the disc (15).



Assembly

- Assembly is the reverse of disassembly.

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AUXILIARY SERVICES CONTROL VALVE (4 WAYS)

AUXILIARY SERVICES CONTROL VALVE

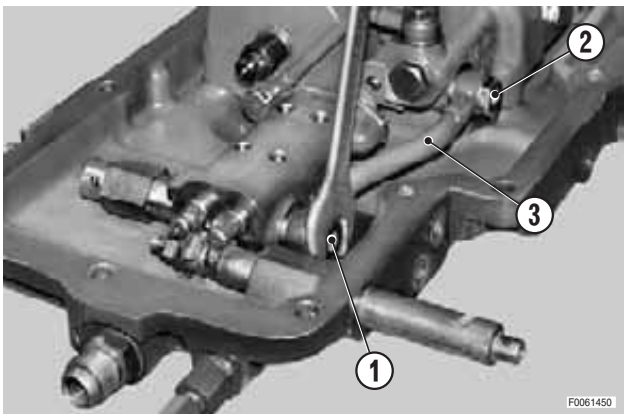
Removal

⚠ Disconnect the lead from the negative (–) terminal of the battery.

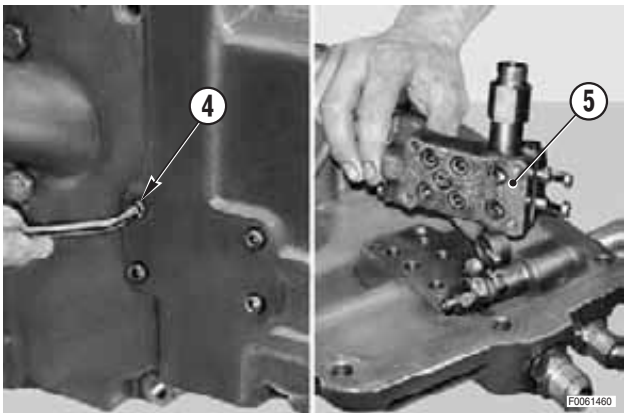
1 - Remove the platform.
(For details see «PLATFORM»).

2 - Remove the complete lift assembly.
(For details see «LIFT»).

3 - Remove the unions (1) and (2) and remove the pipe (3).
★ Renew the copper washers on reassembly.



4 - Remove the screws (4) and remove the complete control valve assembly (5). ※ 1
★ Check the condition of the O-rings and renew them if necessary ※ 2



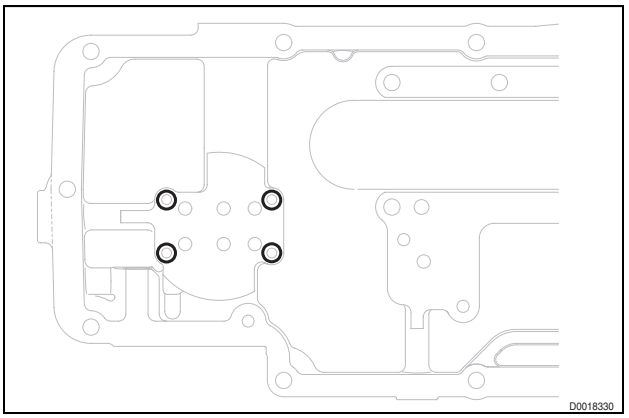
Refitting

- Refitting is the reverse of removal.

※ 1
★ Apply a bead of sealant around the control valve fixing holes.

Sealant: Loctite 510

※ 2
★ Apply grease to the O-rings to hold them in position.



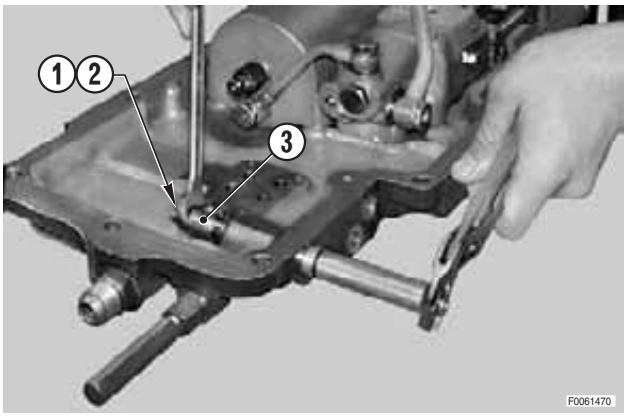
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CONTROL RODS

Disassembly

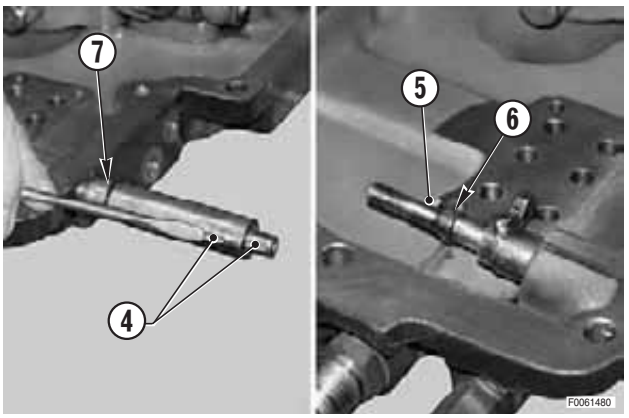
1 - Remove the control valve.
(For details see «AUXILIARY SERVICE CONTROL VALVE» in this chapter).

2 - Remove the nut (1) and the washer (2) and remove the lever (3).

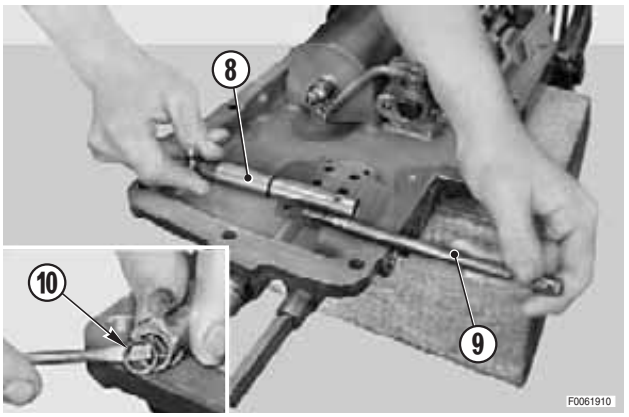


3 - Remove both the keys (4).

4 - Remove the key (5), the ring (6) and the O-ring (7).



5 - Withdraw the shafts (8) and (9) and remove the O-rings (10). ※ 1



Assembly

- Assembly is the reverse of disassembly.

※ 1

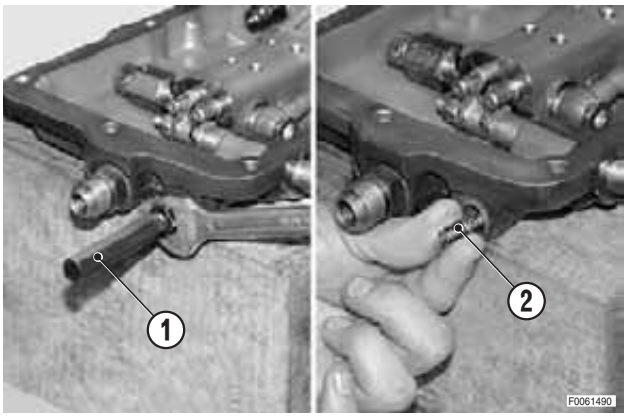
★ Grease the shafts and the O-rings.

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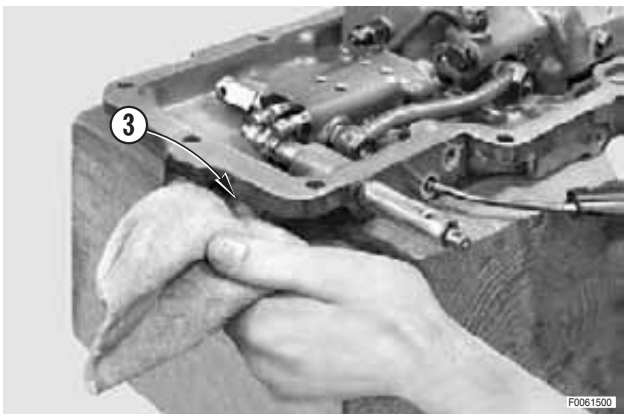
DOUBLE/ SINGLE ACTING CONVERTER

Overhaul

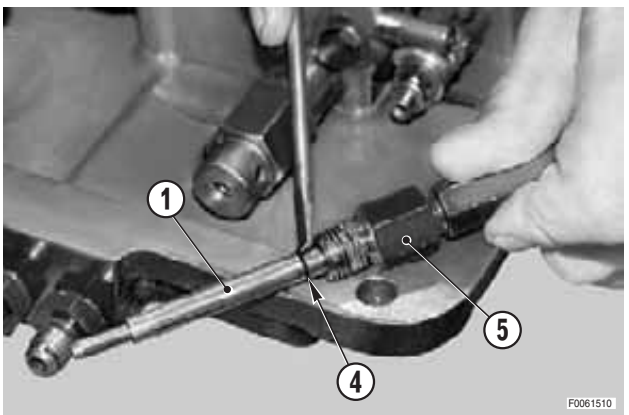
1 - Remove the complete device (1) and remove the spring (2).
★ Renew the copper washer on reassembly.



2 - Drive out the ball (3) using a low pressure compressed air jet.

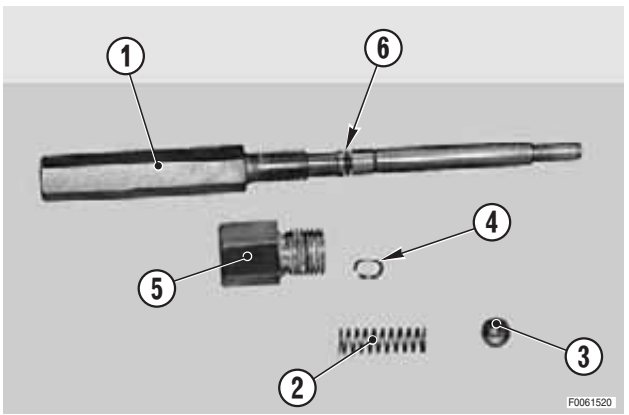


3 - Remove the spring clip (4) and separate the nut (5) from the pin (1).



4 - Remove the O-ring seal (6) and replace it with a new one.

5 - Assemble the device by reversing the disassembly procedure.



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CLUTCH HOUSING

Separation from the transmission

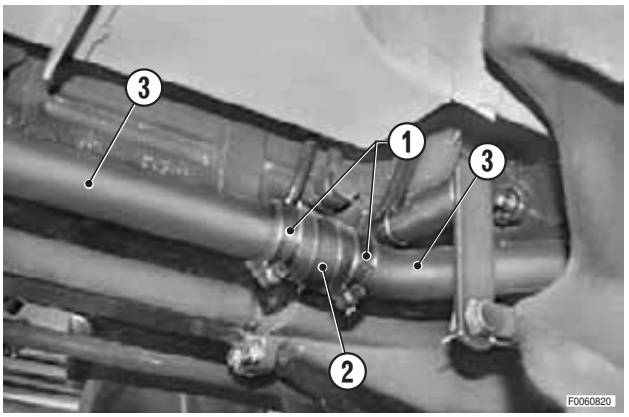
Disconnect the lead from the negative (–) terminal of the battery.

1 - Drain off all the oil contained in the transmission.

※1

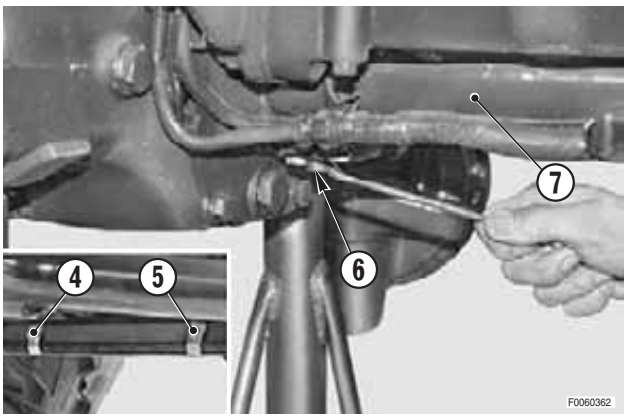
Transmission oil: max. 21 ℓ (5.5 US.gall.)

2 - Loosen the hose clips (1) and disconnect the hose (2) from one of the pipes (3).

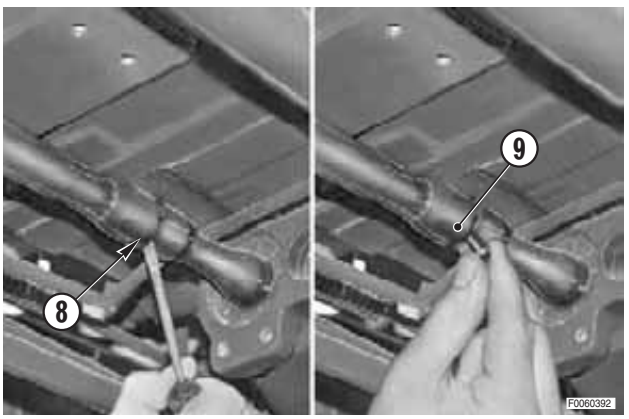


3 - Remove the screws (4) securing the hose clips (5).

4 - Remove the six screws (6) and remove the 4WD shaft cover (7).



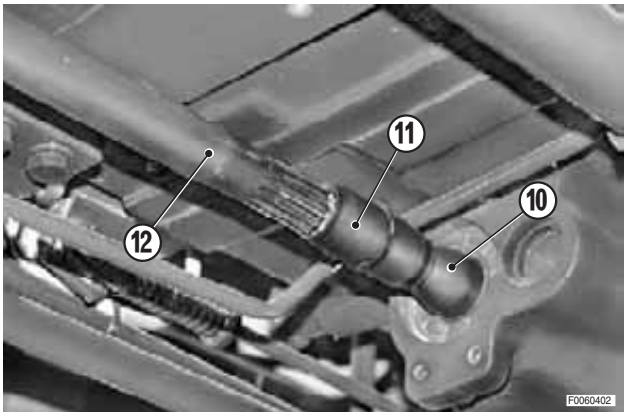
5 - Unseat the circlip (8) and withdraw the spring pin (9).



6 - Move the sleeve (11) towards the pinion (10) in order to release the 4WD shaft (12).

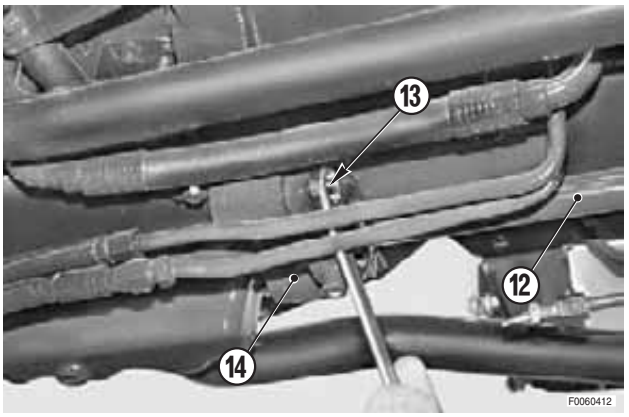
★ Take care not to get the sleeve (11) stuck on the pinion teeth.

7 - Repeat the procedure described at points 5 and 6 for the front sleeve.



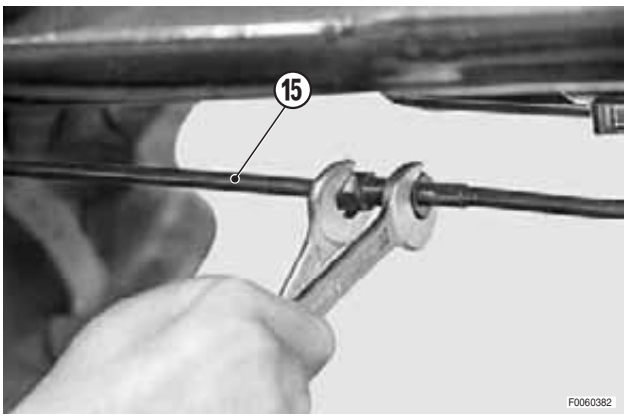
https://truckmanualshub.com/

8 - Remove the bolts (13) and remove the 4WD shaft (12) complete with the central support (14).

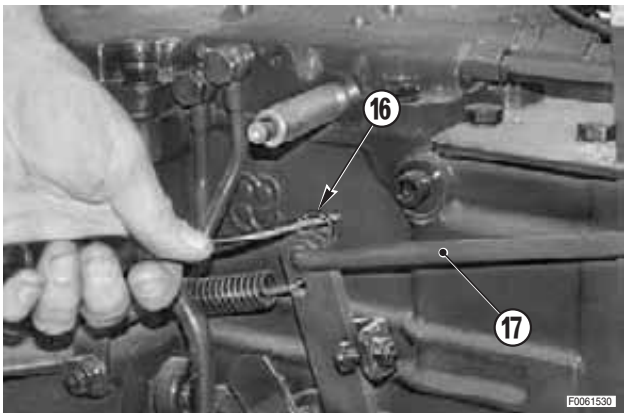


9 - Disconnect the front differential lock control pipe (15).
★ Plug the pipes to prevent the entry of impurities.

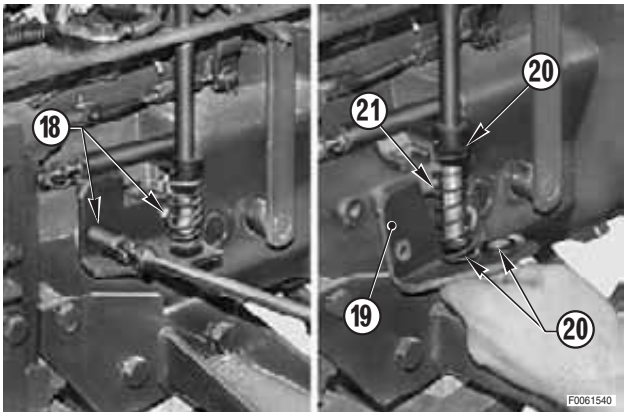
10 - Remove the platform.
(For details see «PLATFORM»).



11 - Remove the lock pins (16) and disconnect the tie-rods (17) of the right and left brakes.

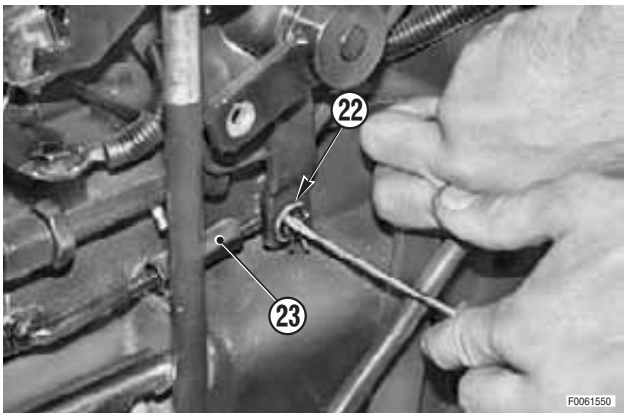


12 - Remove the screws (18) and remove the support (19), the spring seats (20) and the spring (21) of the gear lever.

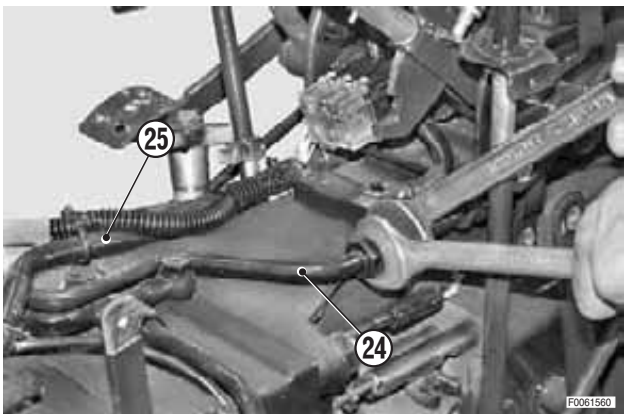


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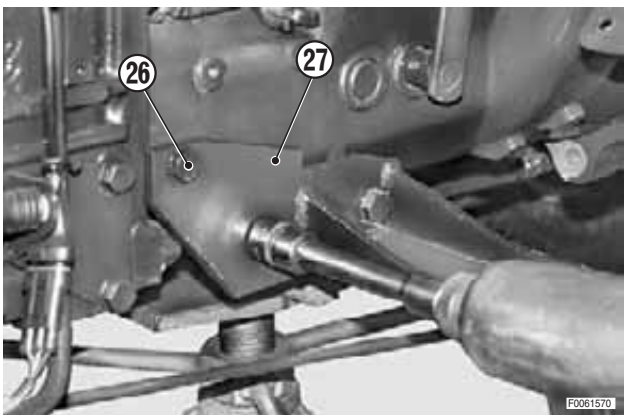
13 - Remove the lock pin (22) and disconnect the rod (23) of the range gear selector.



14 - Disconnect the lift return and supply pipes (24) and (25).

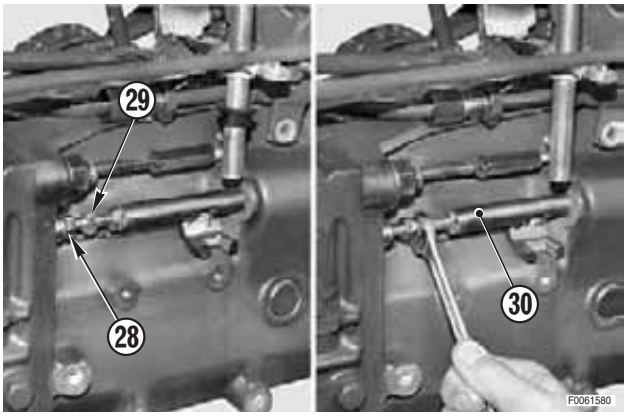


15 - Remove the screws (26) (3 per side) and remove the platform supports (27).



16 - Fully unscrew the nuts (28) and remove the gear selector adjuster screw (29).

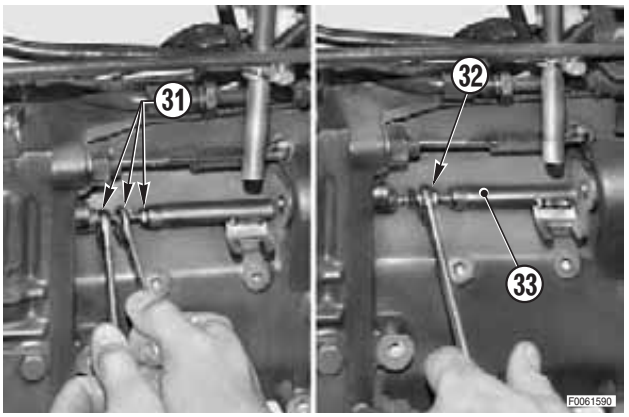
17 - Remove the extension (30) of the gear control rod.



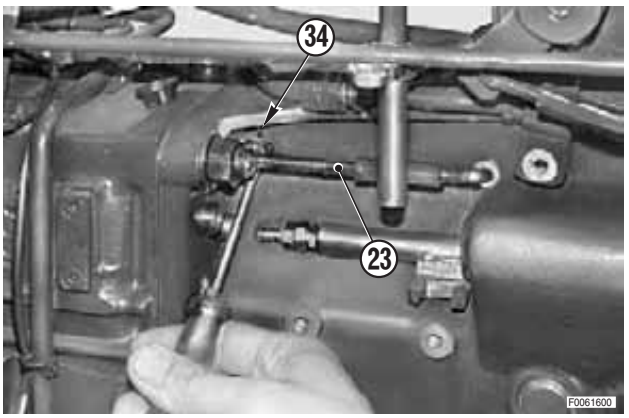
https://truckmanualshub.com/

18 - Fully unscrew the nuts (31) and fully loosen the adjuster screw (32) to release it from the gear selector rod.

19 - Then screw the screw (32) into the selector rod extension (33).



20 - Remove the lock pin (34) and remove the range gear selector tie-rod (23).

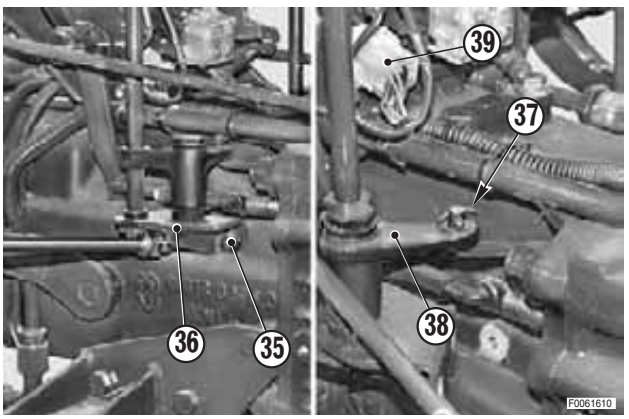


21 - Remove the screws (35) and disconnect the support (36) of the forward/reverse shuttle levers.

22 - Remove the cotter pin (37) and disconnect the shuttle control rod (38).

★ Renew the cotter pin on reassembly.

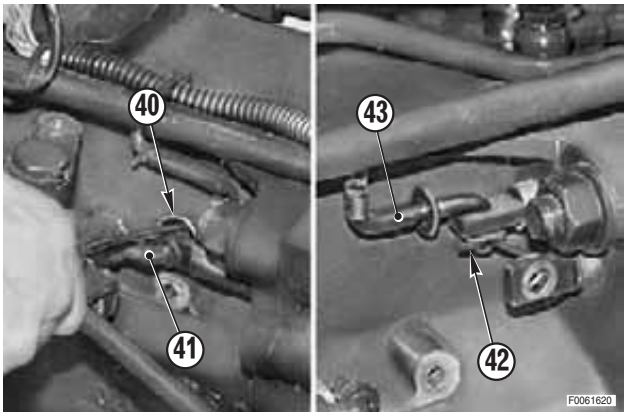
23 - Disconnect the connector (39).



24 - Remove the lock pin (40) and disconnect the PTO speed selection rod (41).

25 - Remove the cotter pin (42) and remove the shuttle control rod (43).

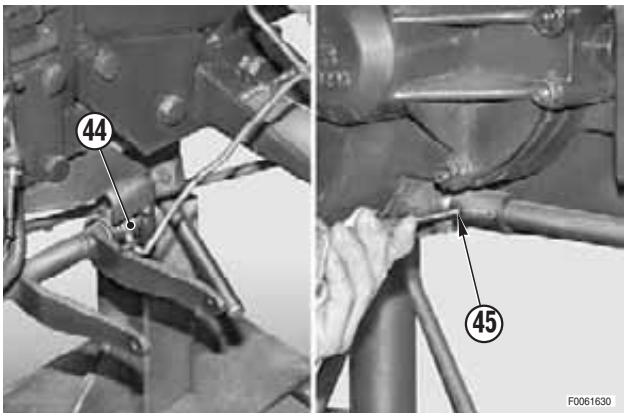
★ Renew the cotter pin on reassembly.



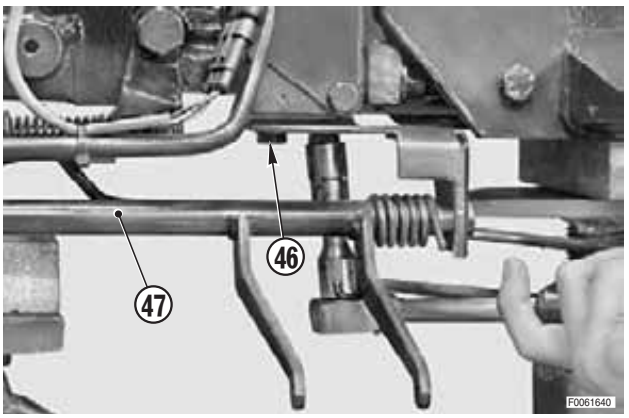
https://truckmanualshub.com/

26 - Disconnect the differential lock disengagement spring (44).

27 - Drive out the spring pin (45).

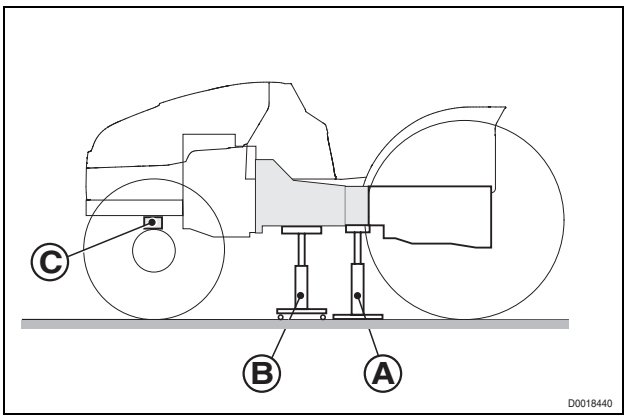


28 - Remove the screws (46) and remove the differential lock control rod (47).



29 - Position a screw-type stand "**A**" under the transmission and a trolley-mounted screw-type stand "**B**" under the clutch housing.
Drive two wedges "**C**" between the front axle support and the axle to prevent the engine dropping when it is moved.

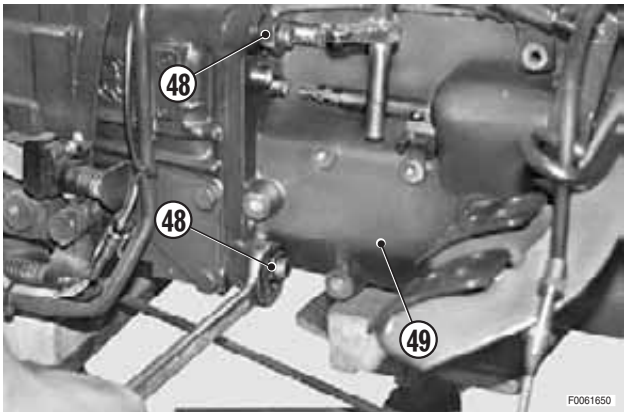
★ Make sure that the transmission is perfectly level to facilitate the subsequent reassembly.



30 - Drive two wedges between the front axle support and the axle to prevent the engine dropping when it is moved.

31 - Remove the four nuts (48) and push both front wheels to separate the clutch housing (49) from the transmission. ※ 2

★ Before removing the nuts, make sure that the rear PTO control lever is in the "PTO engaged" position (lever in high position).



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Reconnection to the transmission

- Reverse the steps for separating the clutch housing and transmission.

※ 1

1 - Adjust the brake pedals, the gear lever, PTO speed selection lever, and range gear lever.
(For details see «ADJUSTMENT OF PEDALS AND LEVERS»).

2 - Fill the transmission with oil of the specified type and quantity.

Transmission oil: max. 21 ℓ (5.5 US.gall.)

※ 2

Nuts (48): 175–194 (129–143 lb.ft.)

★ Before installing the transmission input shaft in the clutch housing, install the rear PTO drive shaft and check that it is correctly inserted in the clutch plate.

1 - Fill all the systems with the appropriate fluids. Start the engine and run for a few minutes to allow the fluids to circulate, then check for leaks.

2 - Expel the air from the hydraulic circuits by repeatedly raising and lowering the lift and by turning the steering wheel back and forth; then check the pipe fittings and circuits for leaks.

3 - Stop the engine, check all the fluid levels and top up if necessary.

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GEARBOX AND SHUTTLE ASSEMBLY

COMPLETE ASSEMBLY

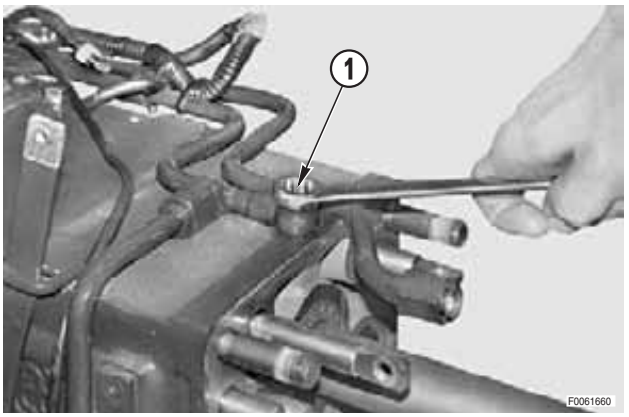
Removal

⚠ Disconnect the lead from the negative (–) terminal of the battery.

1 - Separate the clutch housing from the transmission. (For details see «CLUTCH HOUSING»).

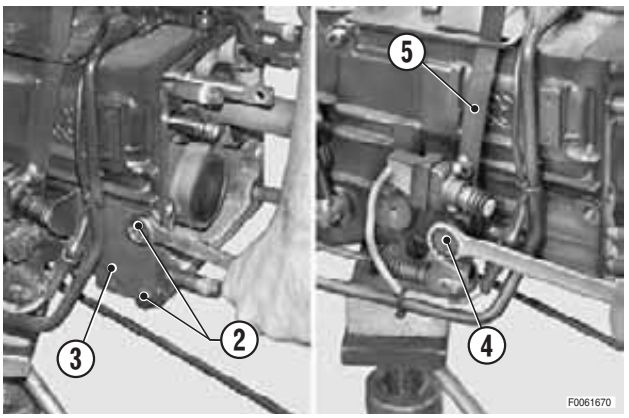
2 - Remove the union (1).

★ Renew the copper washer on reassembly.



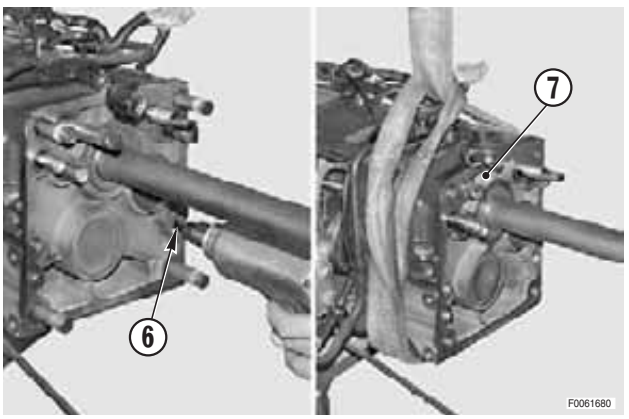
3 - Remove the screws (2) and remove the bracket (3).

4 - Remove the pin (4) and turn over the 4WD control lever (5).



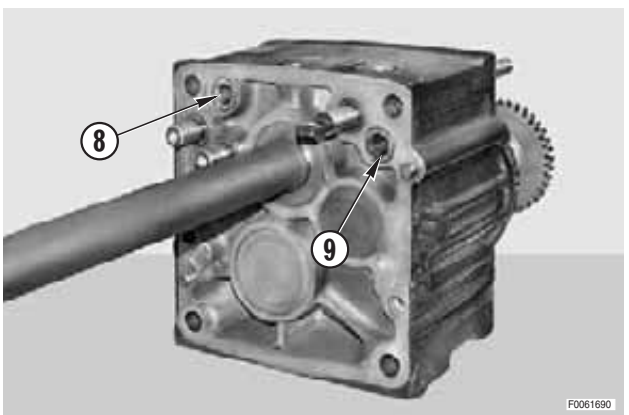
5 - Remove the screws (6), attach the gearbox/shuttle assembly (7) to a hoist and remove it.

※1



6 - Remove the seals (8) and (9) of the range gear selector rod and the PTO speed selector rod.

★ Remove all traces of paint from the rods to prevent damage to the seals during reassembly.



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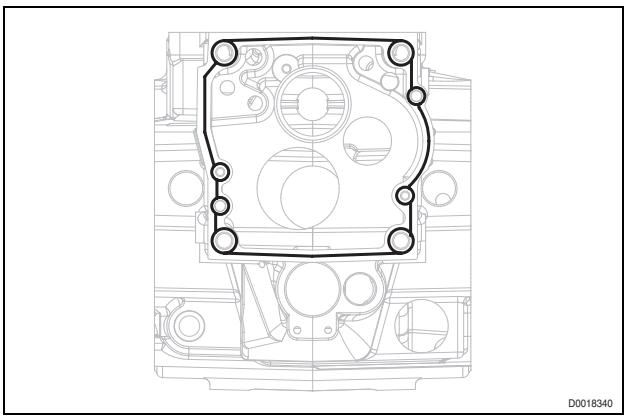
Refitting

- Refitting is the reverse of removal.

1

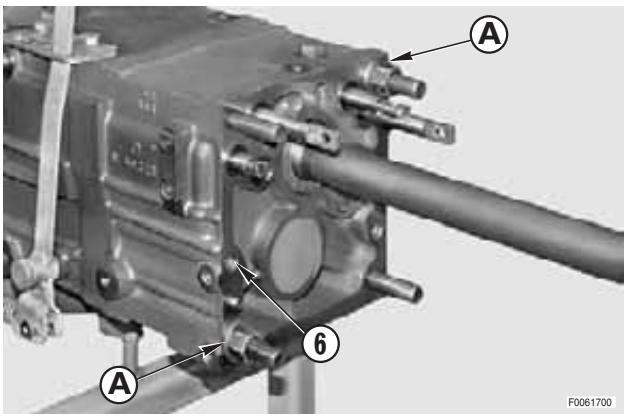
1 - Apply a continuous bead of sealant to the contact surfaces of the transmission casing and the gearbox/shuttle assembly

Surfaces: Loctite 510

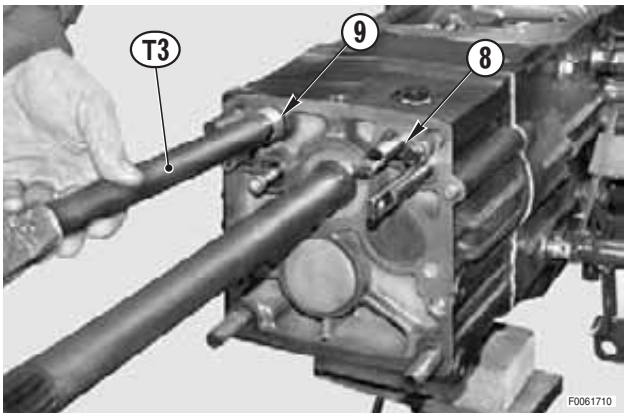


2 - Install the gearbox/shuttle assembly and secure it with the screws (6).

★ If the clutch housing is not to be installed immediately, fit the spacers "**A**" on the clutch housing studs and secure them in position with nuts to ensure perfect adhesion between the mating surfaces.



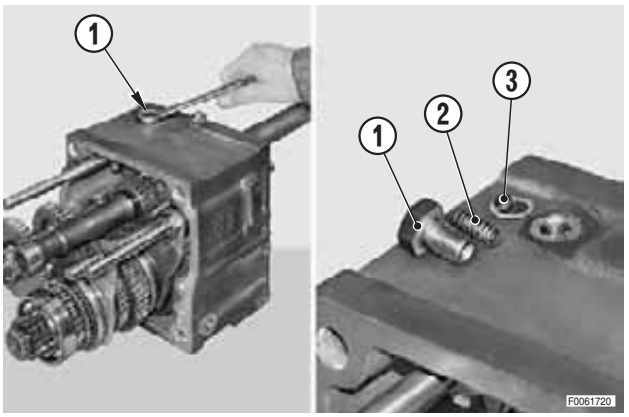
3 - Using the installer **T3** (code 5.9030.963.0), fit the previously removed oil seals (8) and (9).



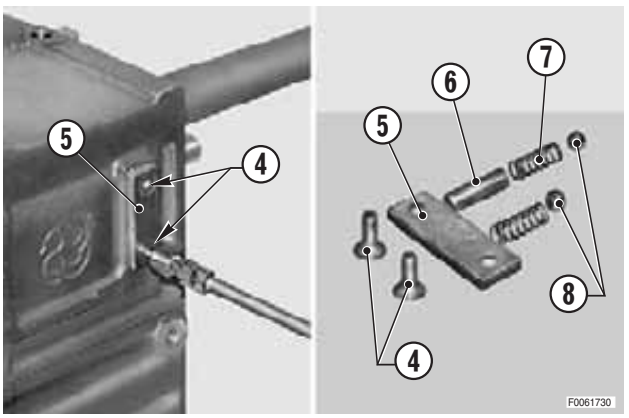
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Disassembly

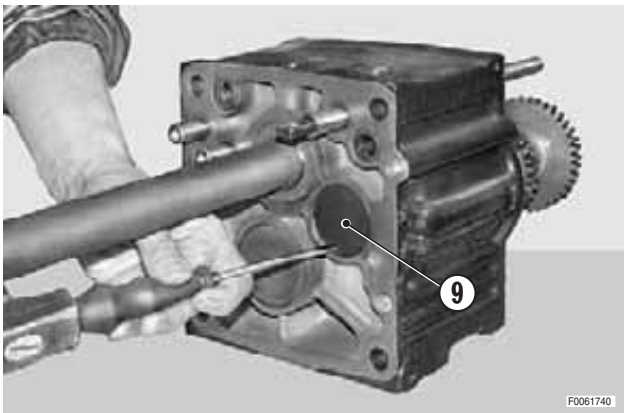
1 - Remove the plug (1) and remove the spring (2) and the ball (3).
★ Renew the copper washer on reassembly.



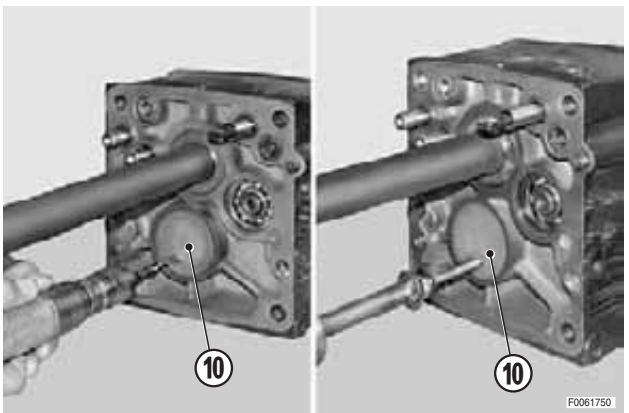
2 - Remove the screws (4) and the plate (5) and remove the pin (6), the springs (7) and the balls (8).
※ 1 ※ 2



3 - Remove the cover (9).

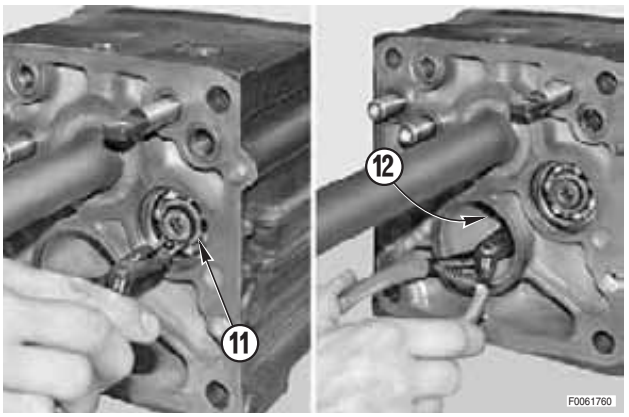


4 - Drill the cover (10) and, using a slide hammer puller, remove it. ※ 3
★ Clean all traces of old sealant from the cover seating.
★ Renew the cover on reassembly.

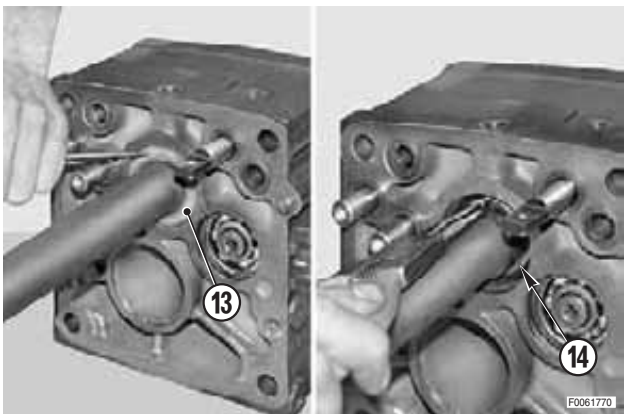


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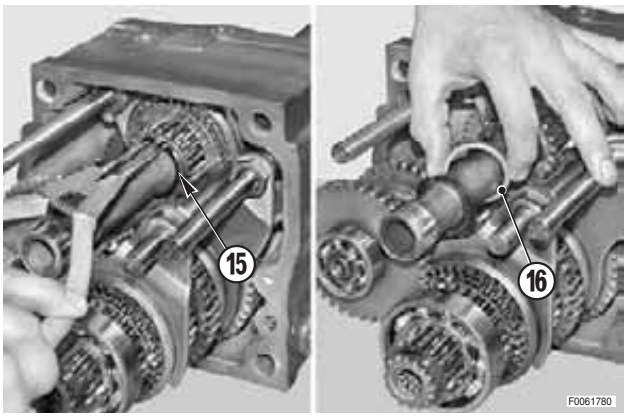
5 - Remove the circlips (11) and (12) securing the primary and secondary shafts.



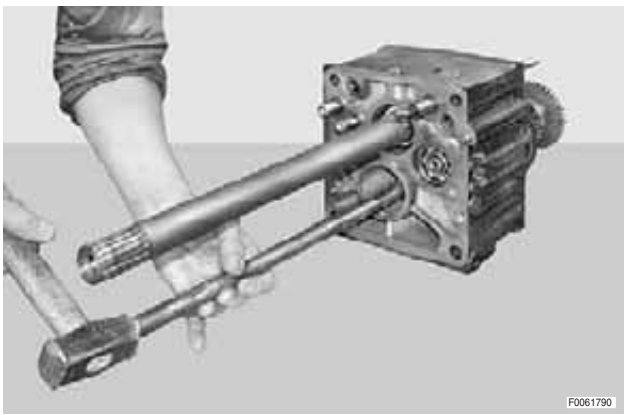
6 - Remove the oil seal (13) and remove the circlip (14).



7 - Remove the circlip (15) and the spacer (16).

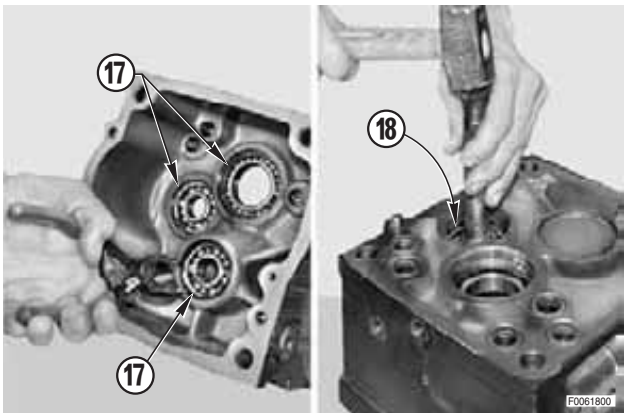


8 - Using a copper bar and a soft-faced mallet, simultaneously drive out the input, primary and secondary shafts, tapping each in turn alternately. ⁘ 4



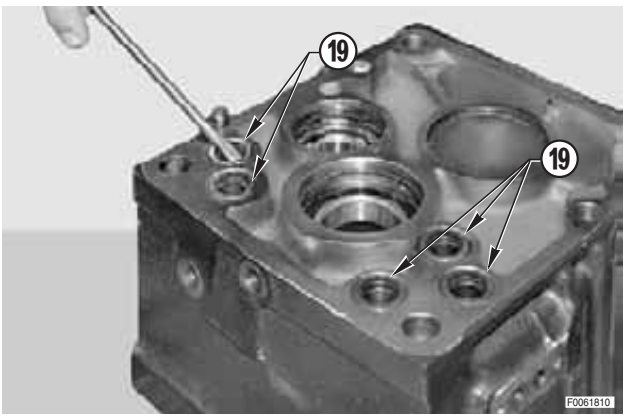
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9 - Remove the three circlips (17) and withdraw the bearings (18).



10 - Remove the five seals (19). ※ 5

★ Carefully inspect the selector forks for signs of wear or distortion and renew them if necessary. (For details see «GEAR SELECTOR FORKS»).



Assembly

- Assembly is the reverse of disassembly.

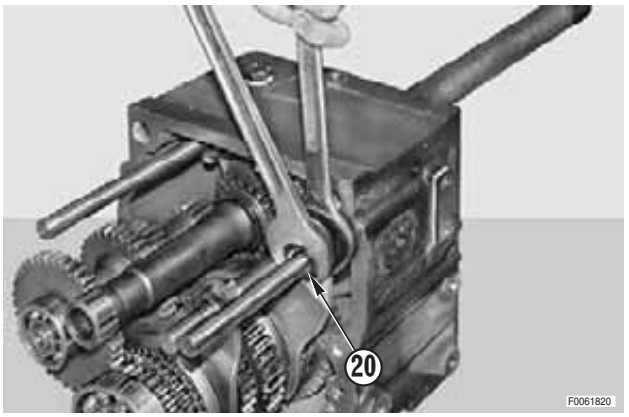
※ 1

1 - Adjust the position of the gear selector forks so that they are positioned centrally relative to the synchronizer ring and secure them by tightening the nuts (20).

Nuts: Loctite 270

Nuts: 90–105 Nm (66–77lb.ft.)

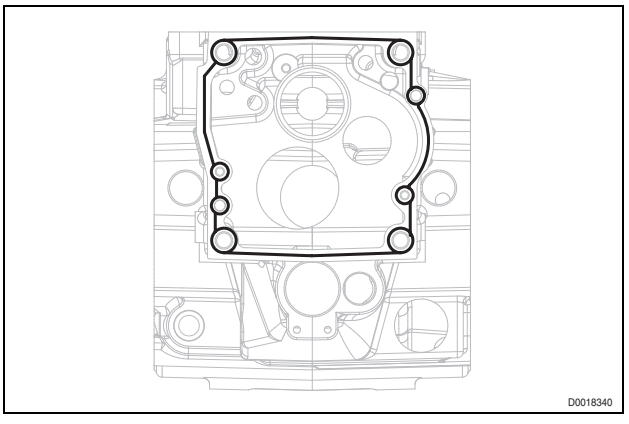
★ Fit the nuts so that the flat sides face the forks.



※ 2

★ Apply a bead of sealant to the transmission casing.

Transmission casing: Loctite 510



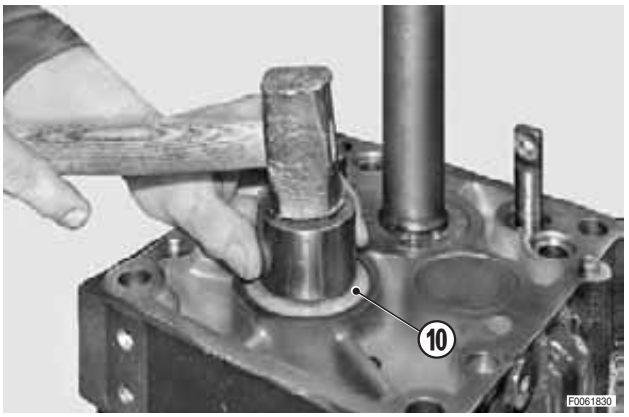
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※ 3

1 - Apply a bead of sealant to the seating of the cover (10).

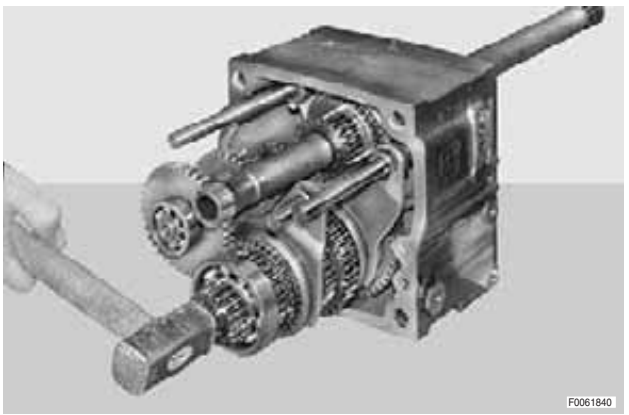
Cover: Loctite 601

2 - Locate the cover and secure in position by tapping it in the centre.



※ 4

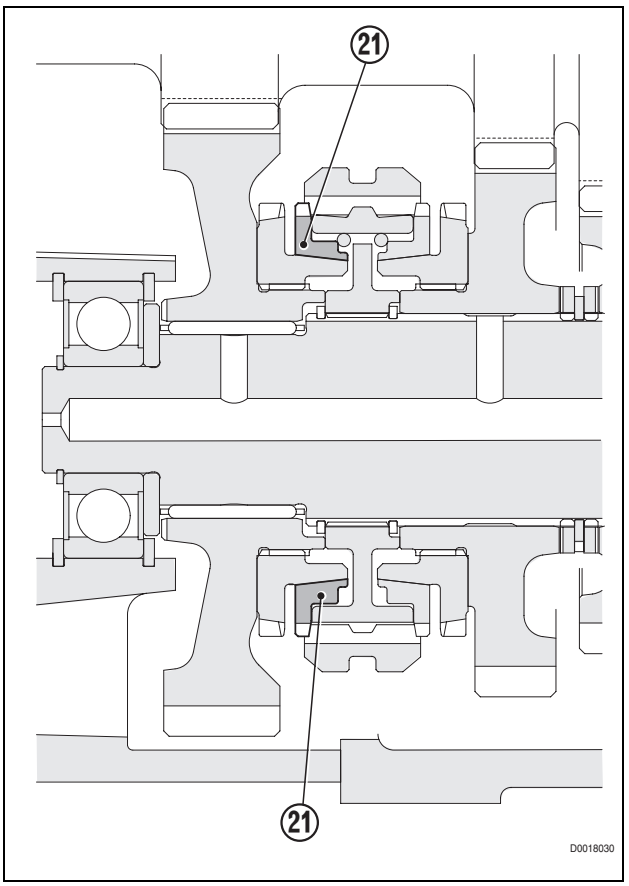
★ Insert all the shafts and forks simultaneously and, using a soft-faced mallet, tap each shaft in succession to gradually drive them up against the bearings in the gearbox casing.



★ Take care that the friction ring (21) of the 1st gear synchronizer does not move out of position.

※ 5

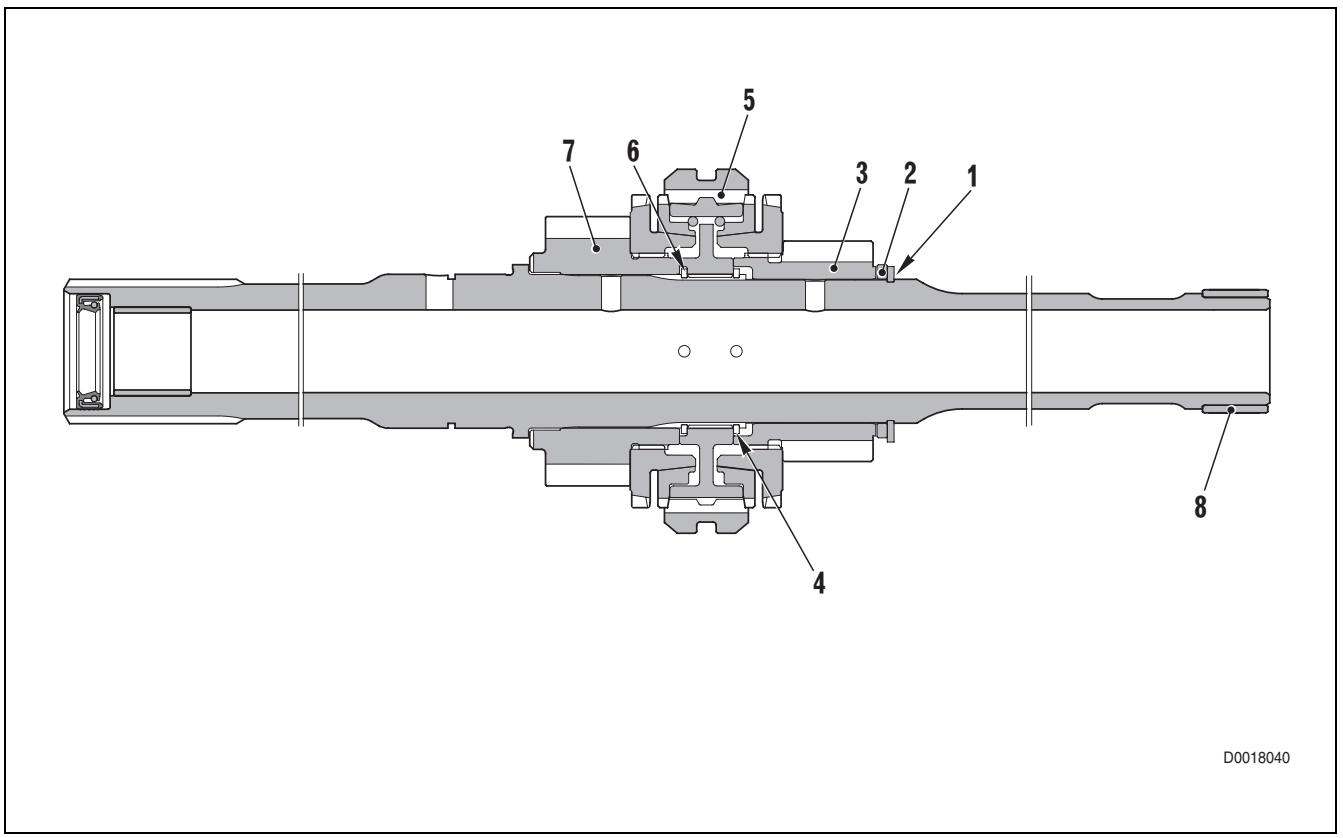
★ Do not install the oil seals at this stage.



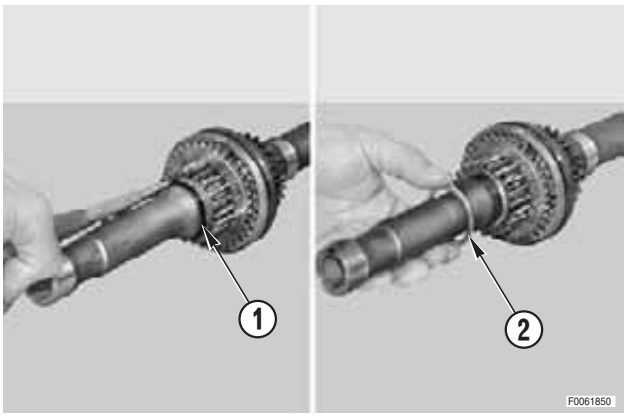
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INPUT SHAFT

Disassembly

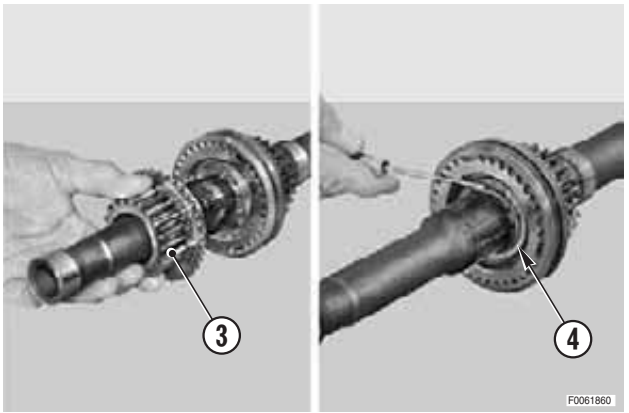


1 - Remove the circlip (1) and the spacer (2).



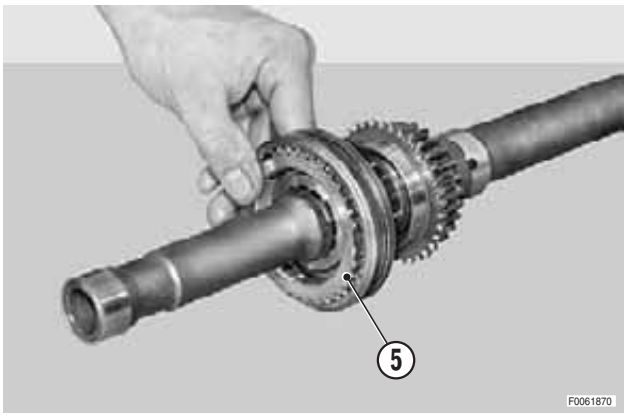
2 - Remove the driving gear (3) of the forward drive.

3 - Remove the circlip (4).

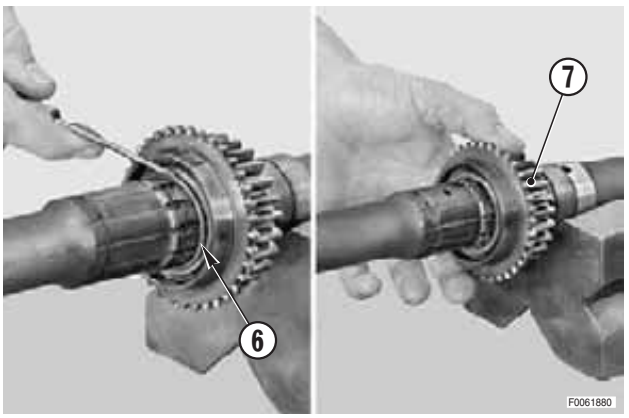


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4 - Remove the complete synchronizer assembly (5).



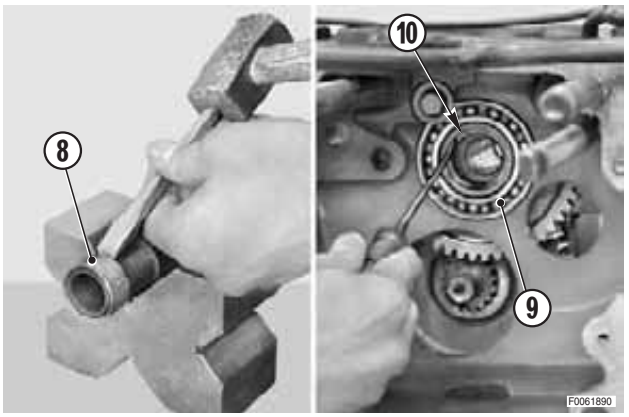
5 - Remove the circlip (6) and the reverse drive driving gear (7).



Only if necessary

6 - Remove the inner ring (8) of the roller cage (9).

7 - Remove the circlip (10) and withdraw the roller cage (9).



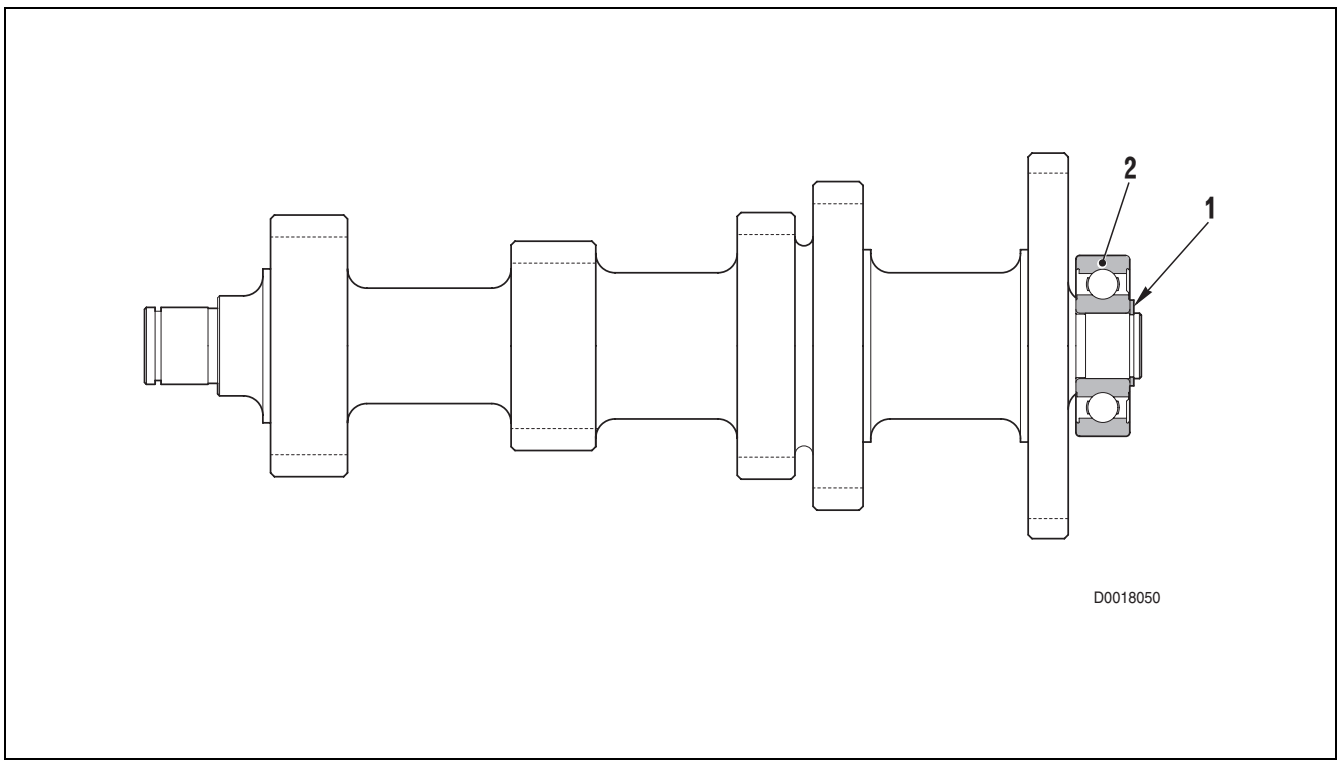
Assembly

- Assembly is the reverse of disassembly.

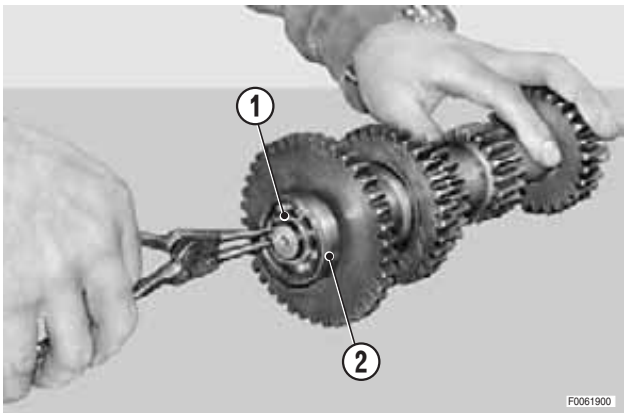
https://truckmanualshub.com/

PRIMARY SHAFT

Disassembly



1 - Remove the circlip (1) and, using a suitable puller, remove the bearing (2).



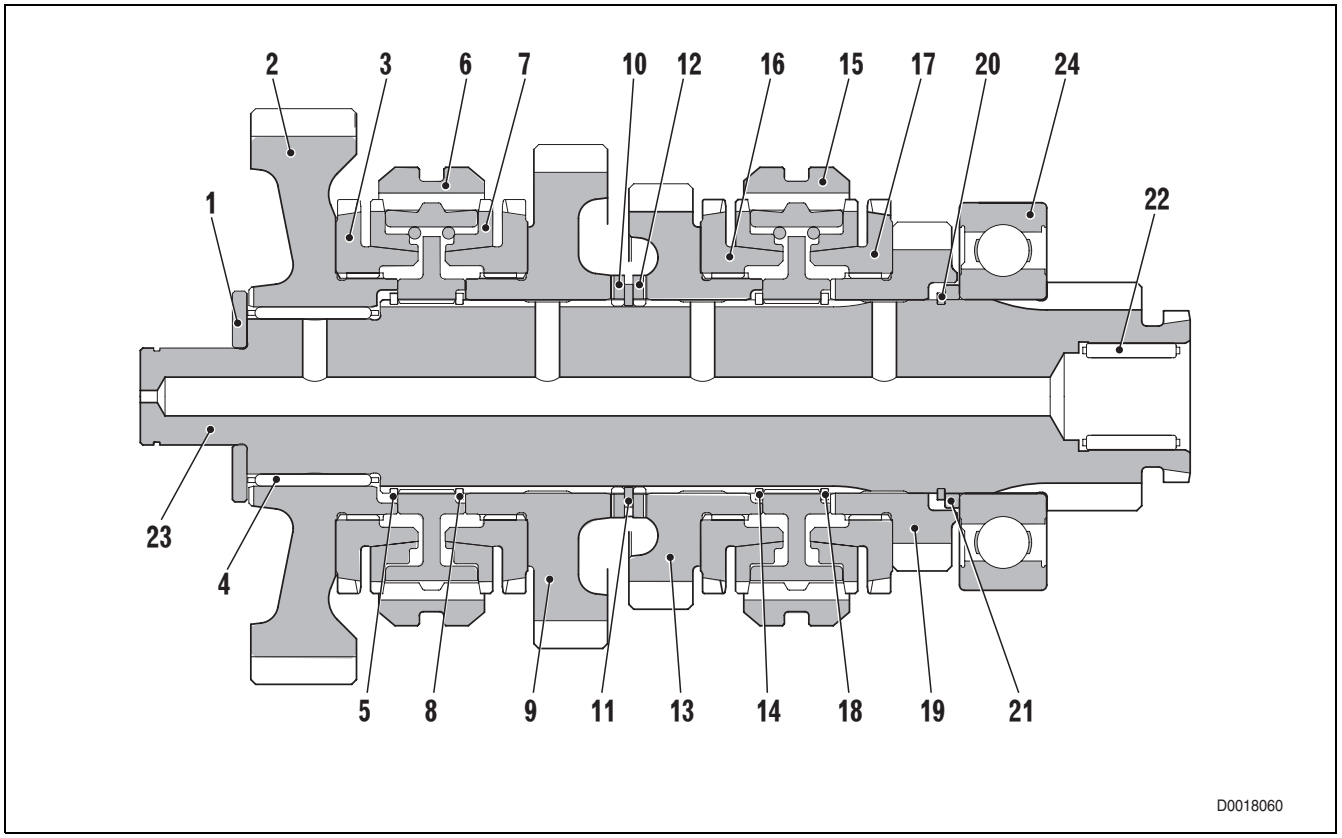
Assembly

- Assembly is the reverse of disassembly

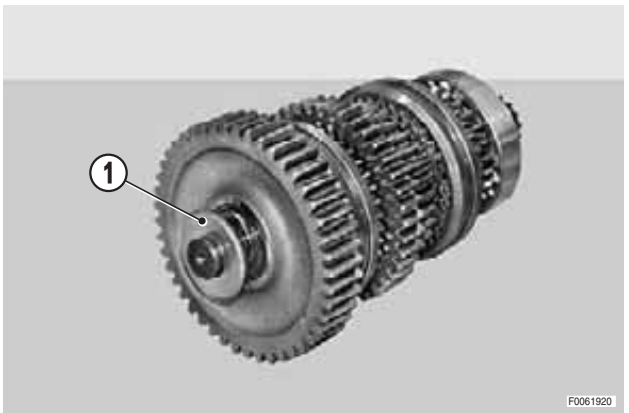
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SECONDARY SHAFT

Disassembly

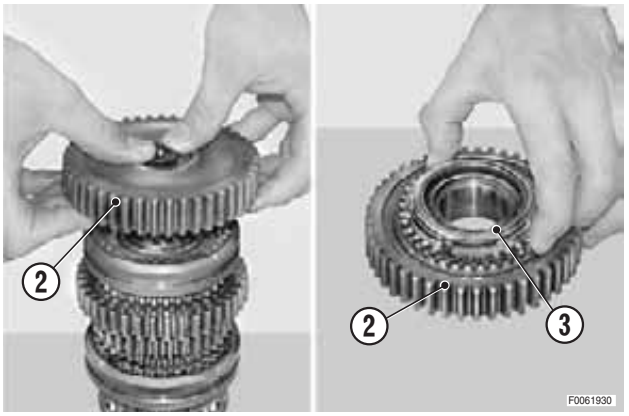


1 - Remove the spacer (1).



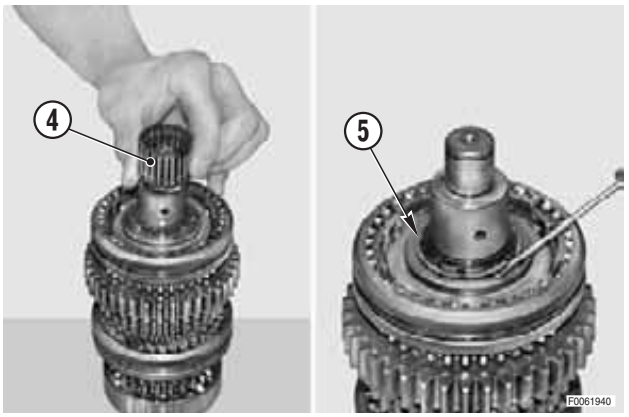
2 - Remove the 1st speed driven gear (2).

3 - Remove the driving disc (3) from the gear (2).

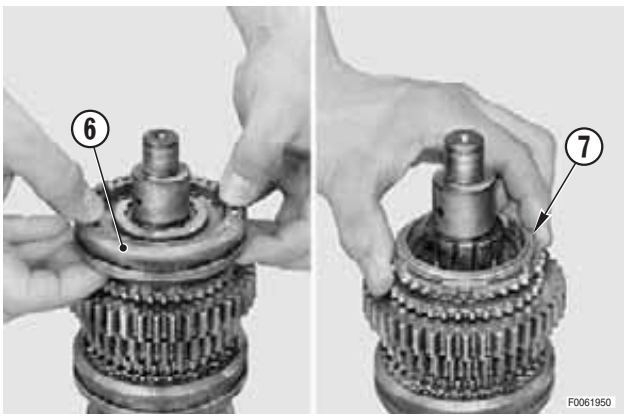


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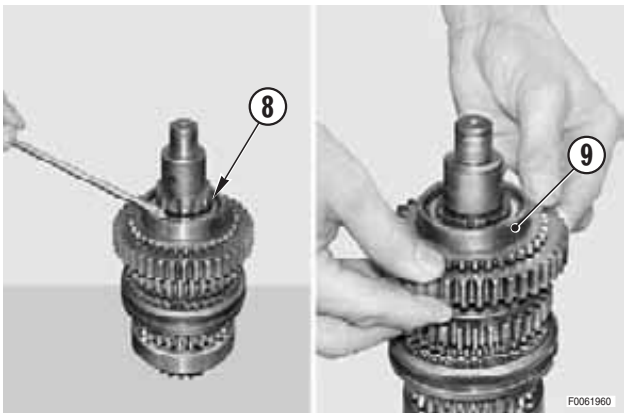
4 - Remove the roller cage (4) and remove the circlip (5).



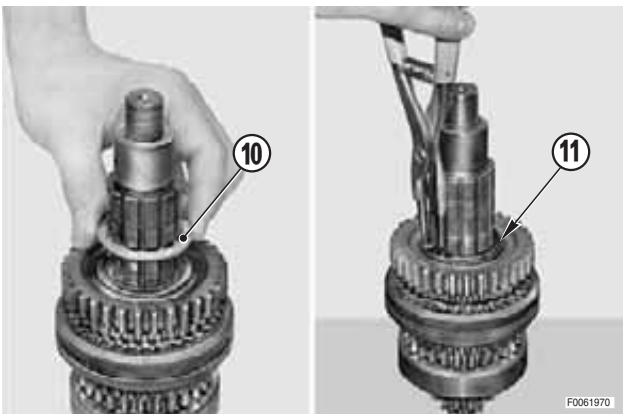
5 - Remove the synchronizer (6) and the friction ring (7).



6 - Remove the circlip (8) and the 2nd speed driven gear (9).

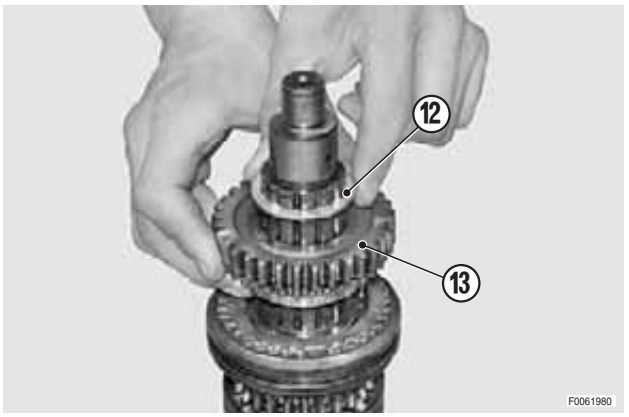


7 - Remove the thrust plate (10) and remove the circlip (11).
★ Note which way round the thrust plate (10) is installed.

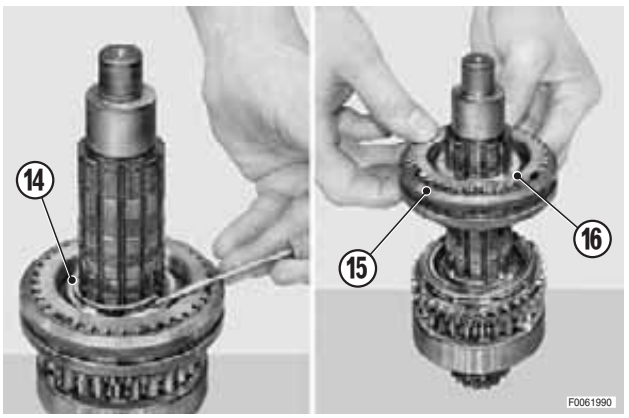


https://truckmanualshub.com/

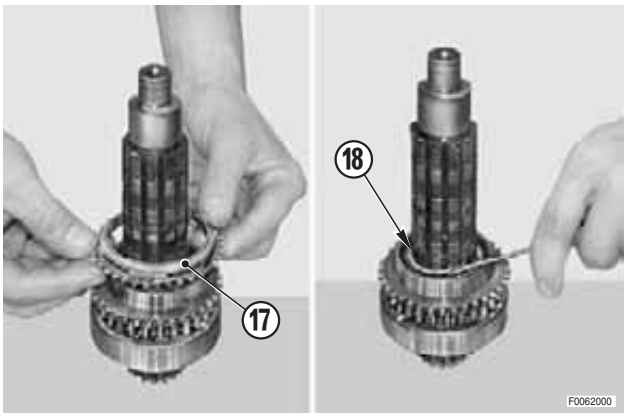
8 - Remove the thrust plate (12) and the 3rd speed driven gear(13).
★ Note which way round the thrust plate (12) is installed.



9 - Remove the circlip (14) and remove the synchronizer (15) complete with the friction ring (16).



10 - Remove the friction ring (17) and remove the circlip (18).



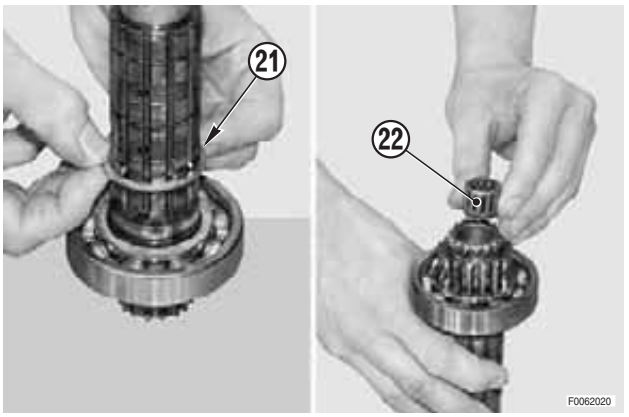
11 - Remove the 4th speed driven gear (19) and remove the circlip (20).



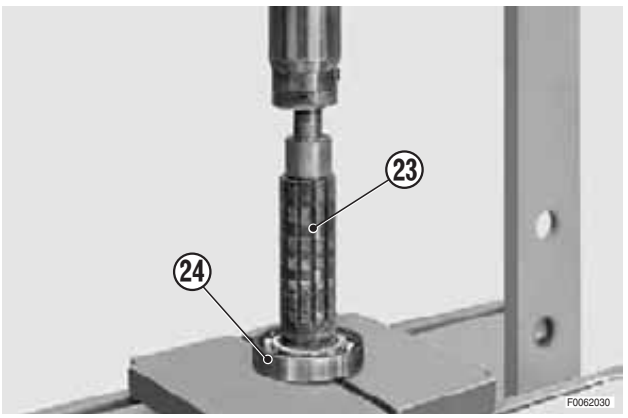
https://truckmanualshub.com/

12 - Remove the spacer (21).

13 - Remove the roller cage (22).



14 - Position the output shaft (23) under a press and withdraw the bearing (24).



Assembly

- Assembly is the reverse of disassembly.

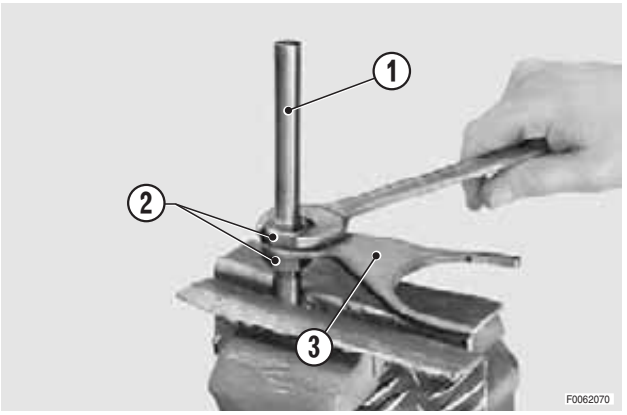
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GEAR SELECTOR FORKS

Check flatness

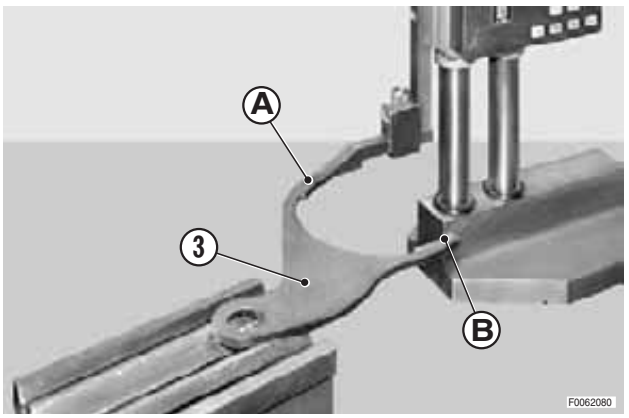
1 - Place the rod (1) in a vice with jaws faced in soft material and remove the nuts (2) and the fork (3).

2 - Recut the threads of the nuts with a tap to facilitate the subsequent adjustment.



3 - Position the fork on a magnetic stand.

4 - Using a fixed reference, check that the difference between the heights of the surfaces “**A**” and “**B**” is less than 0.15 mm (0.006 in.).



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REAR AXLE AND BRAKES

REAR AXLE

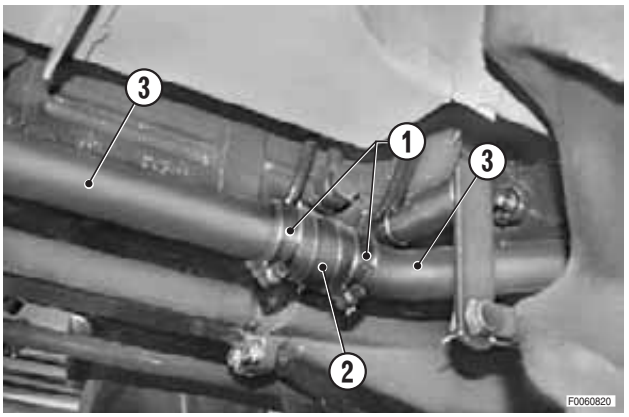
Removal

⚠ Disconnect the lead from the negative (–) terminal of the battery.

1 - Drain off all the oil from the transmission. ※ 1

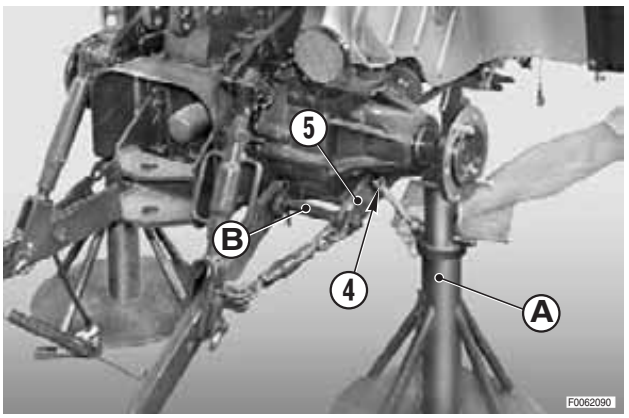
Transmission oil: max. 21 ℓ (5.5 US.gall.)

2 - Loosen the hose clips (1) and disconnect the hose (2) from one of the pipes (3).



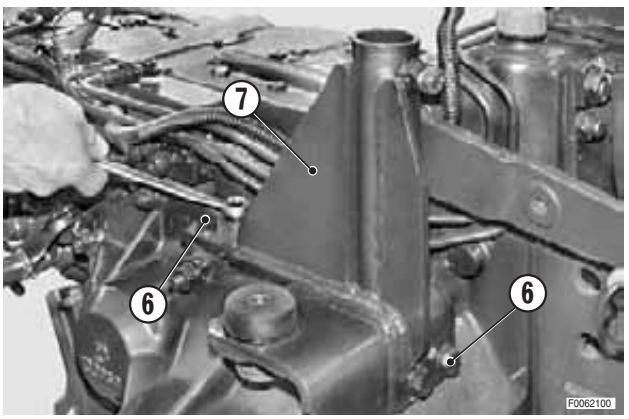
3 - Remove the nuts (4) and disconnect the plate (5) from the transmission.

4 - Move the stand "**A**" positioned under the rear axle under the bar "**B**".



5 - Remove the platform.
(For details see «PLATFORM»).

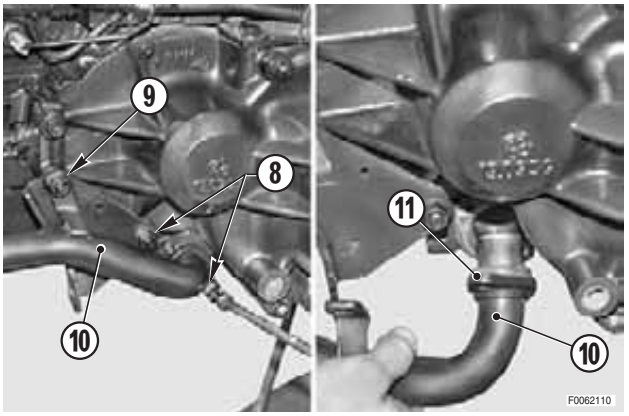
6 - Remove the screws (6) (4 per side) and remove the supports (7) for the platform and the rear roll bar.



For left rear axle only

7 - Remove the bolts (8) and the nut (9) and remove the oil suction pipe (10).

★ Recover the gasket (11).

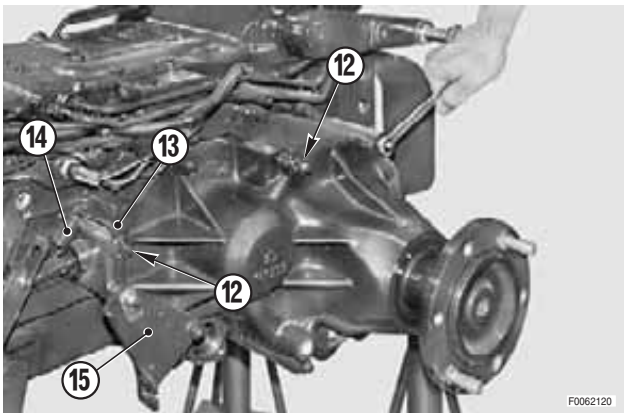


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8 - Remove all the nuts (12), remove the bracket (13) and the spring (14). ※ 2

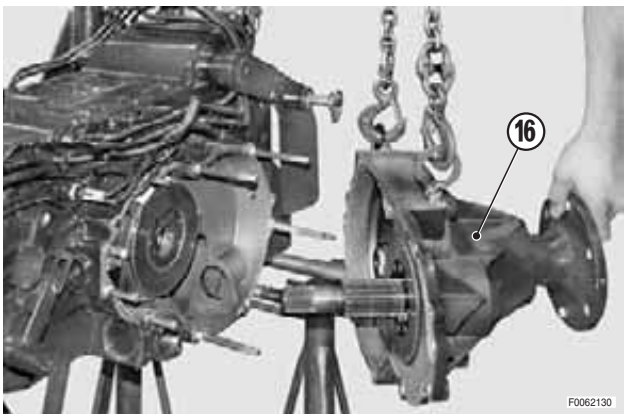
For left rear axle only

9 - Remove the plate (15) securing the parking brake cable.



10 - Attach the rear axle (16) to a hoist and take up the slack in the lifting slings/ropes.

11 - Remove the complete axle assembly (16). ※ 3



Refitting

- Refitting is the reverse of removal.

※ 1

1 - Adjust the brake pedals and the parking brake lever. (For details see «ADJUSTMENT OF PEDALS AND BRAKES»).

2 - Fill the transmission with oil of the specified type and quantity.

Transmission oil: max. 21 ℓ (5.5 US.gall.)

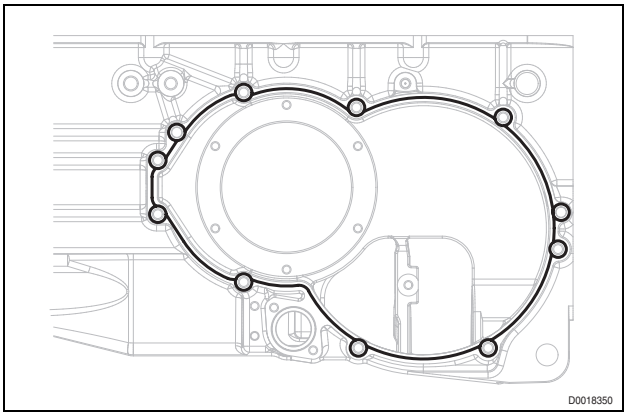
※ 2

Nuts: 40.5–44.8 (30–33 lb.ft.)

※ 3

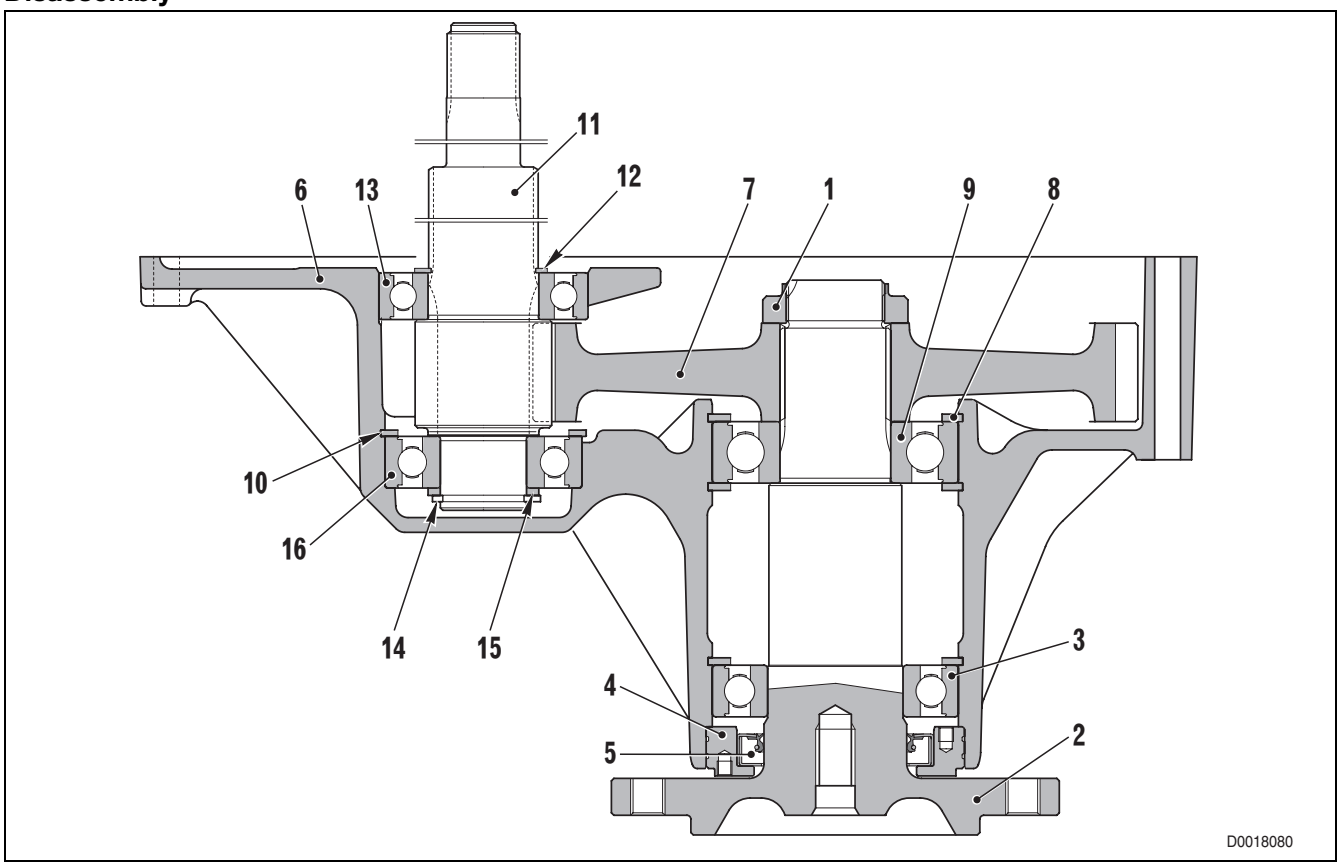
★ Apply a bead of sealant to the contact surface between the transmission casing and the rear axle housing.

Surface: Loctite 510

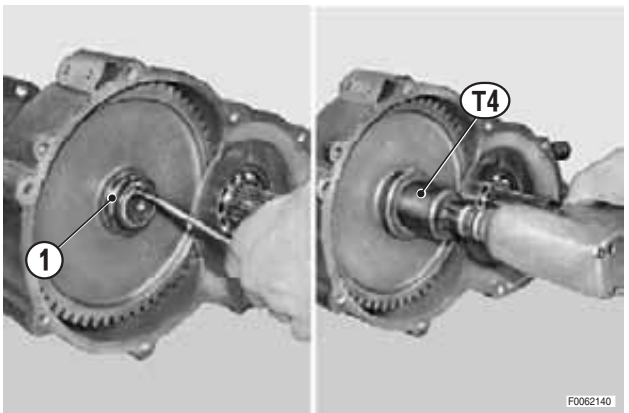


https://truckmanualshub.com/

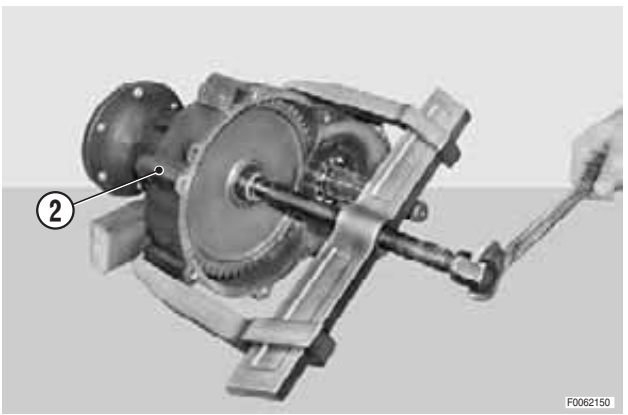
Disassembly



1 - Relieve the staking and remove the ringnut (1) using the special wrench **T4** (code 5.9030.601.0).
★ Renew the ringnut on reassembly.

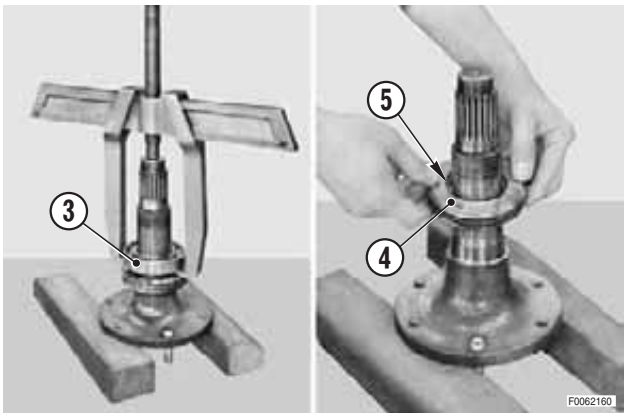


2 - Remove the hub (2) using a puller.

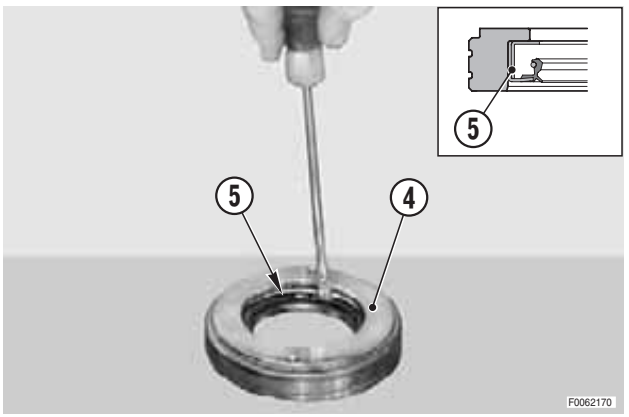


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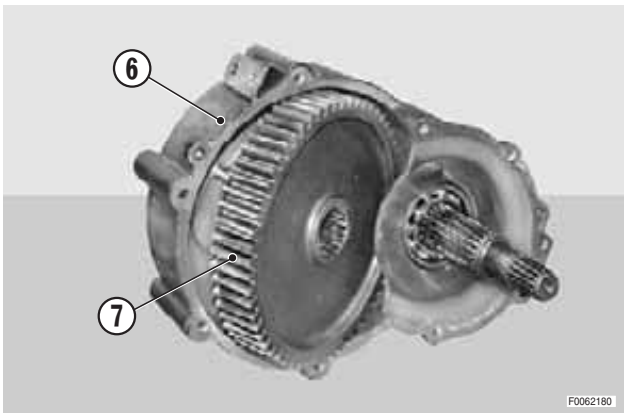
3 - Remove the bearing (3) and the ring (4) complete with the oil seal (5).



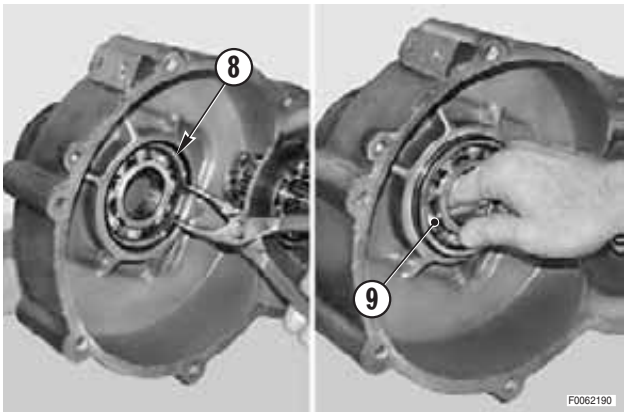
4 - Remove the oil seal (5) from the ring (4).
- ★ Renew the oil seal (5) on reassembly.
- ★ Note which way round the oil seal (5) is installed.



5 - Withdraw the gear (7) from the axle housing (6).

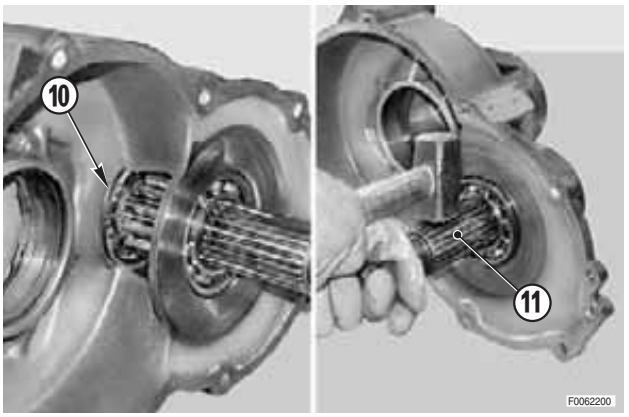


6 - Remove the circlip (8) and withdraw the bearing (9).

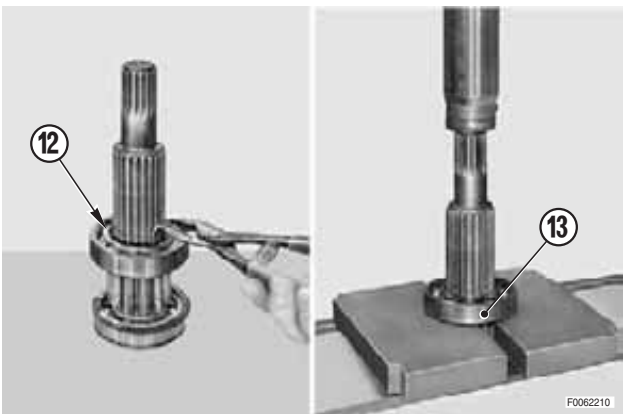


https://truckmanualshub.com/

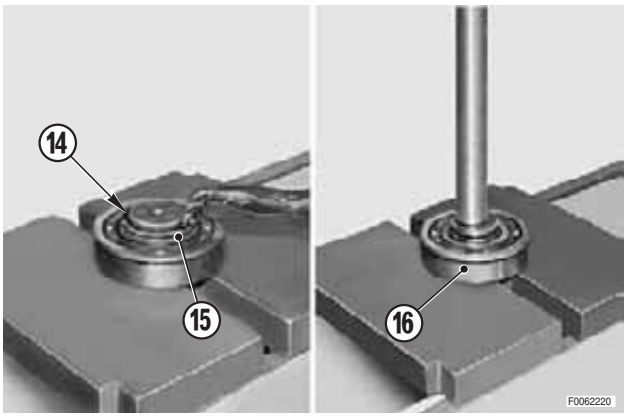
7 - Remove the circlip (10) and withdraw the complete shaft (11).
★ To withdraw the shaft, pull it towards you while tapping it with a soft-faced mallet.



8 - Remove the circlip (12) and withdraw the bearing (13).



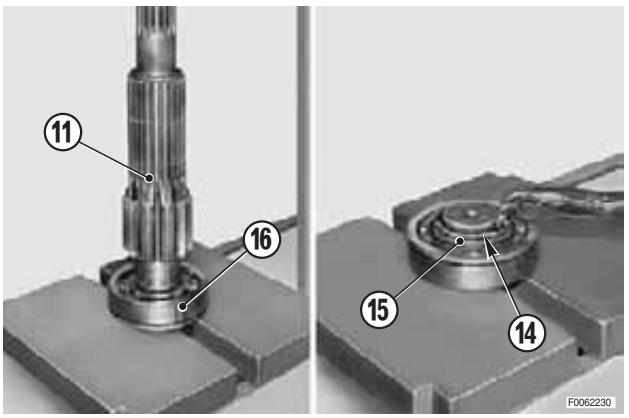
9 - Remove the circlip (14), the spacer (15) and remove the bearing (16).



Assembly

1 - Using a press, install the bearing (16) on the shaft (11).

2 - Fit the spacer (15) and secure it in position with the circlip (14).

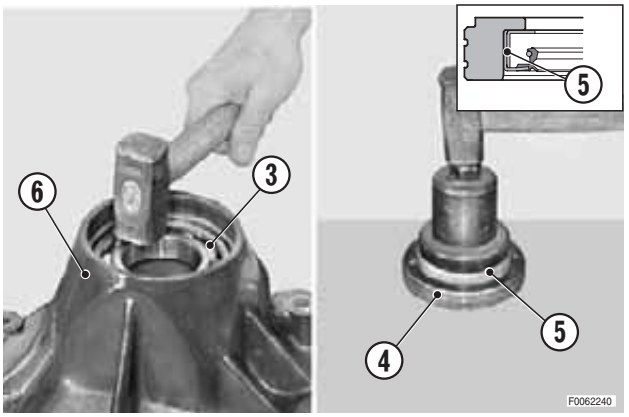


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3 - Fit the bearing (3) in the axle housing (6).

4 - Fit the oil seal (5) in the ring (4).

★ Take care to install the oil seal the right way round.



5 - Position the complete ring assembly (4) on the axle housing and, using a suitable tool, drive it into its seating.

★ Fill the grooves in the ring (4) with sealant.

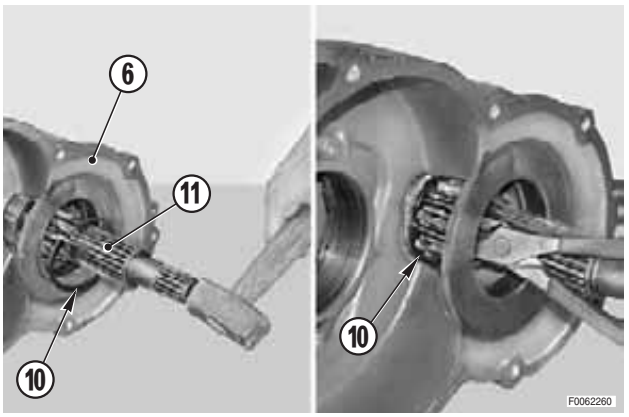
Ring grooves: Silastic

★ Lubricate the lips of the oil seal.

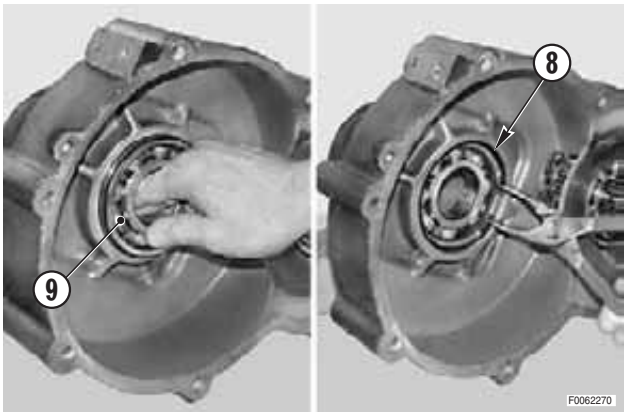
Oil seal: Olio



6 - Fit the shaft (11) in the axle housing (6) and secure it in position with the circlip (10).

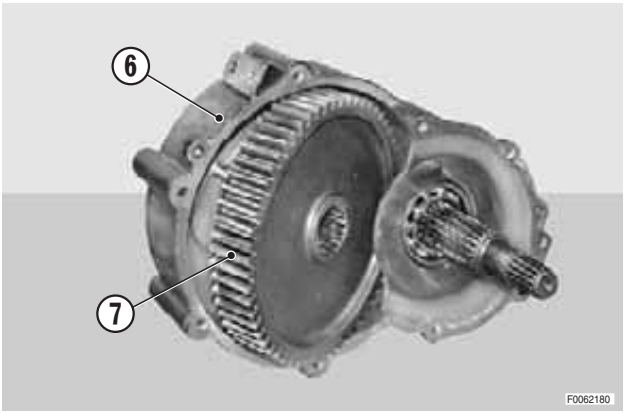


7 - Fit the bearing (9) and secure it in position with the circlip (8).



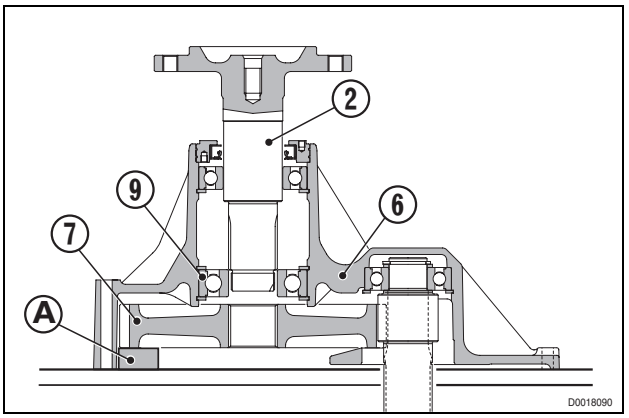
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8 - Install the gear (7) in the axle housing (6).

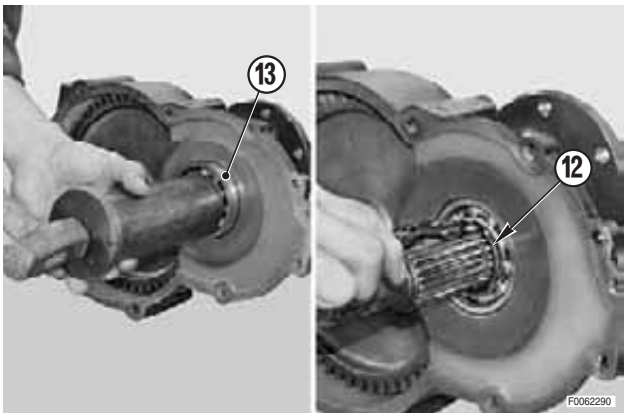


9 - Position the axle housing (6) under a press and install the hub (2), driving it up against the bearing (9).

★ To facilitate installation, place spacers "**A**" to a thickness of 20 mm between the surface of the press and the gear (7) to prevent the hub (6) getting stuck in the gear.



10 - Using a suitable tool, install the bearing (13) and secure it in position with the circlip (12).

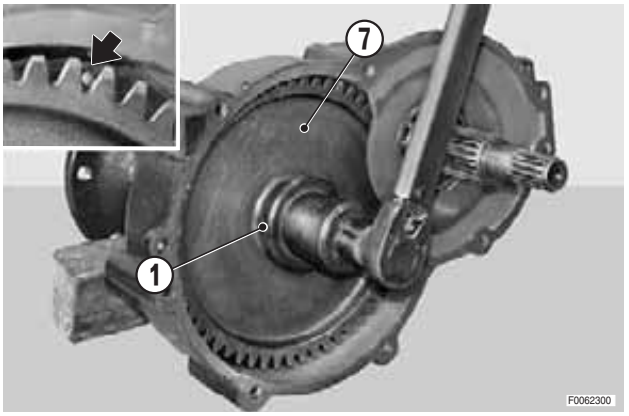


11 - Tighten the ringnut (1).

Nm Ringnut: 340–420 Nm (250.5–309.5 lb.ft.)

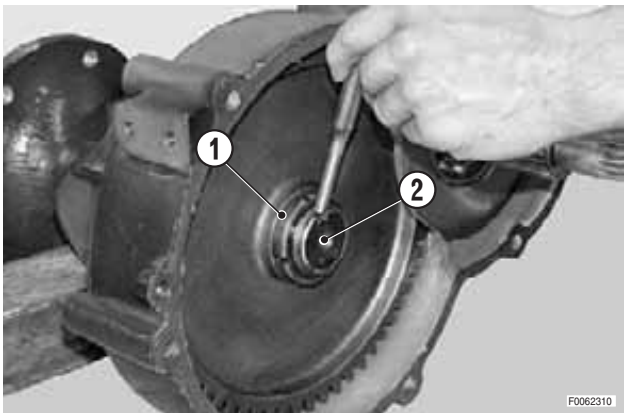
★ To facilitate tightening of the ringnut, insert a spring pin in the teeth of gear (7) and rotate the input shaft until it locks up.

12 - Remove the spring pin.



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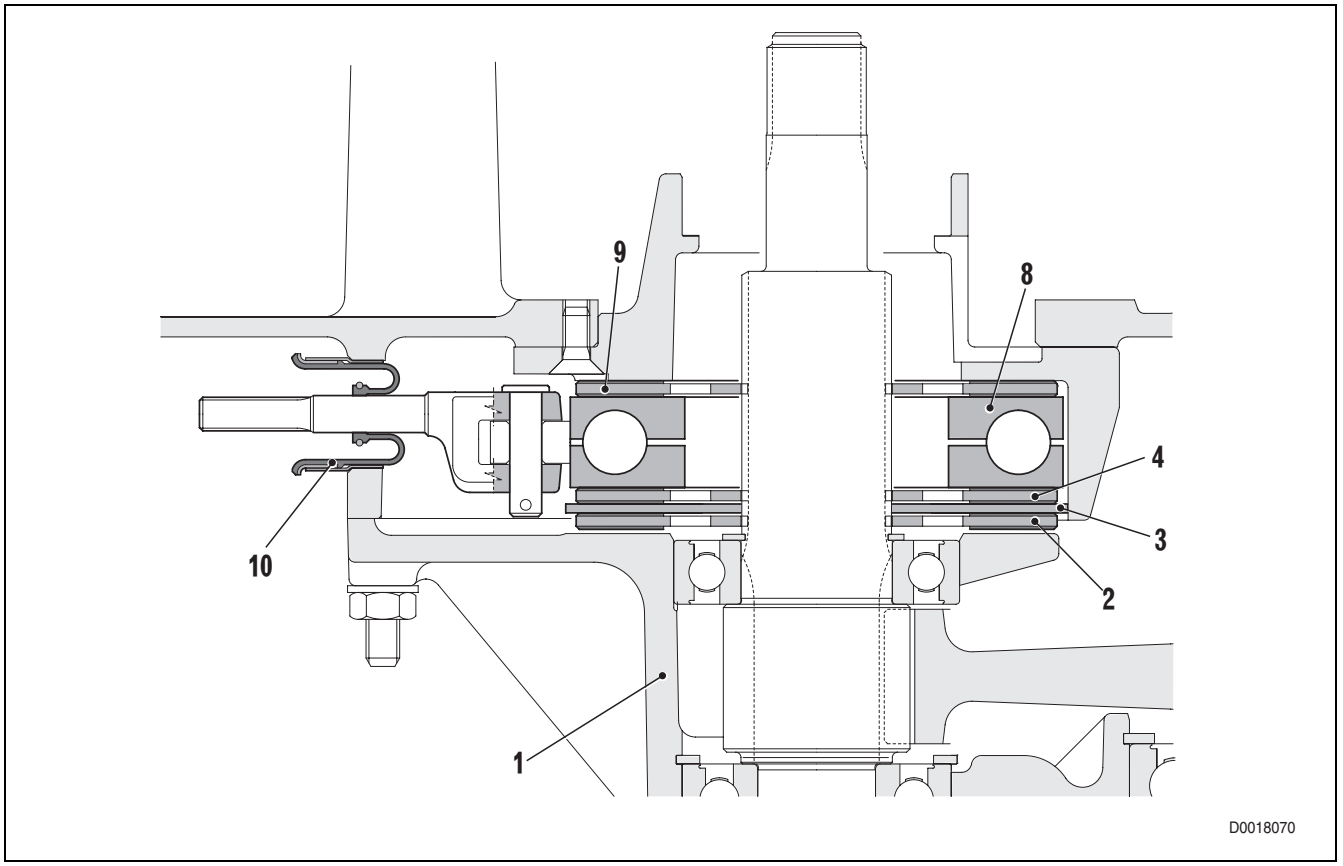
13 - Stake the ringnut (1) in correspondence with the slot in the hub (2).



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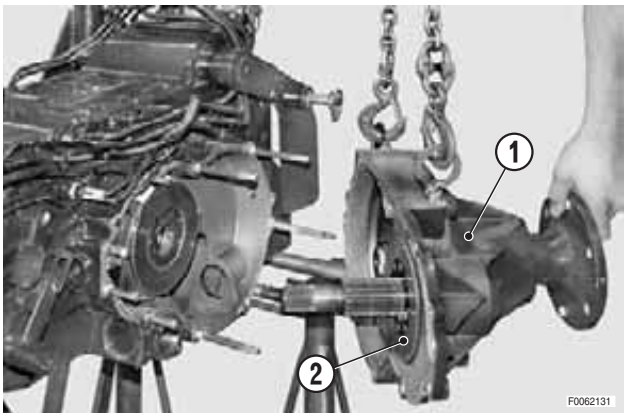
BRAKE

Renewal of the braking discs



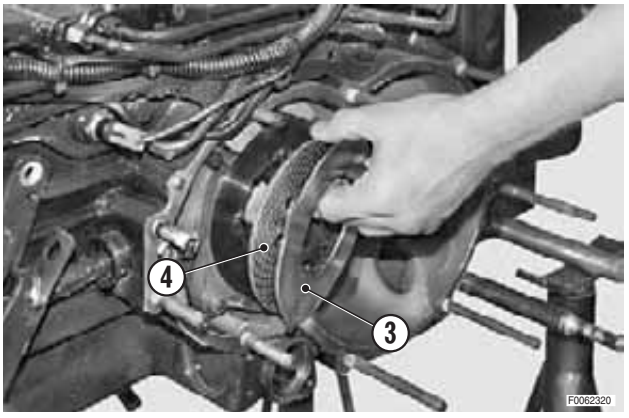
1 - Remove the rear axle in question.
(For details see «REAR AXLE»).

2 - Remove the friction disc (2) from the axle (1).



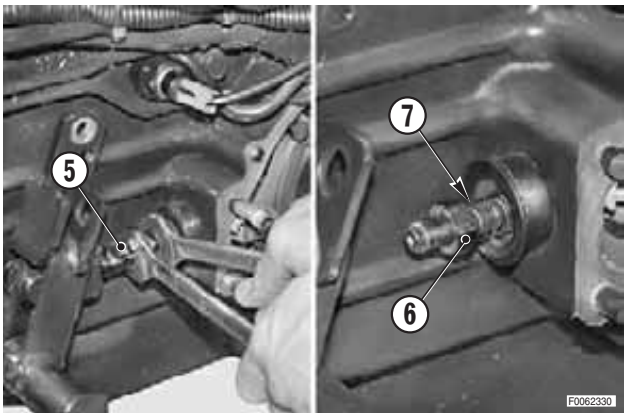
3 - Remove the plain steel disc (3) and the friction disc (4).

★ Note which way round the plain steel disc (3) is installed.

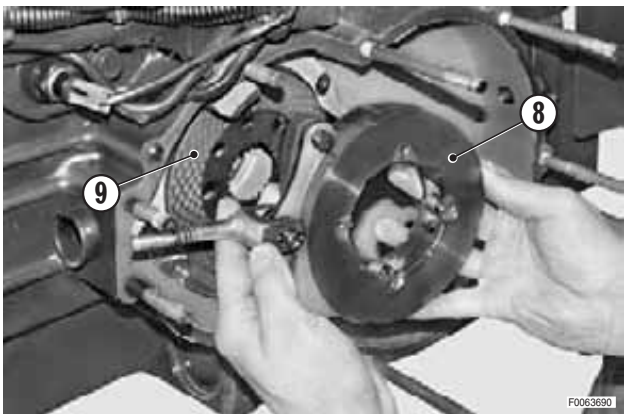


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4 - Loosen off fully the brake operating rod (5) and remove the nut (6) and the spring (7).



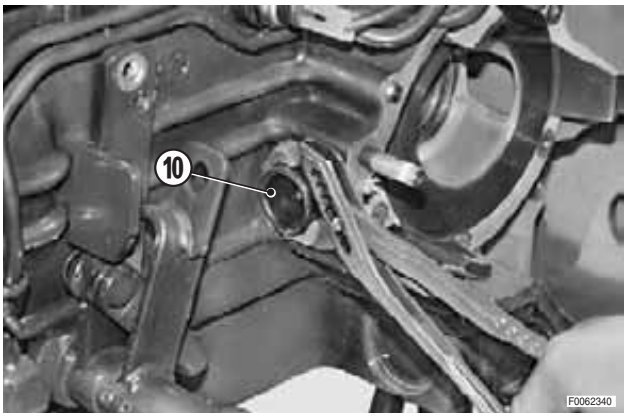
5 - Remove the braking device (8) and the last friction disc (9).



Only if necessary

6 - Remove the boot (10) and replace it with a new one.

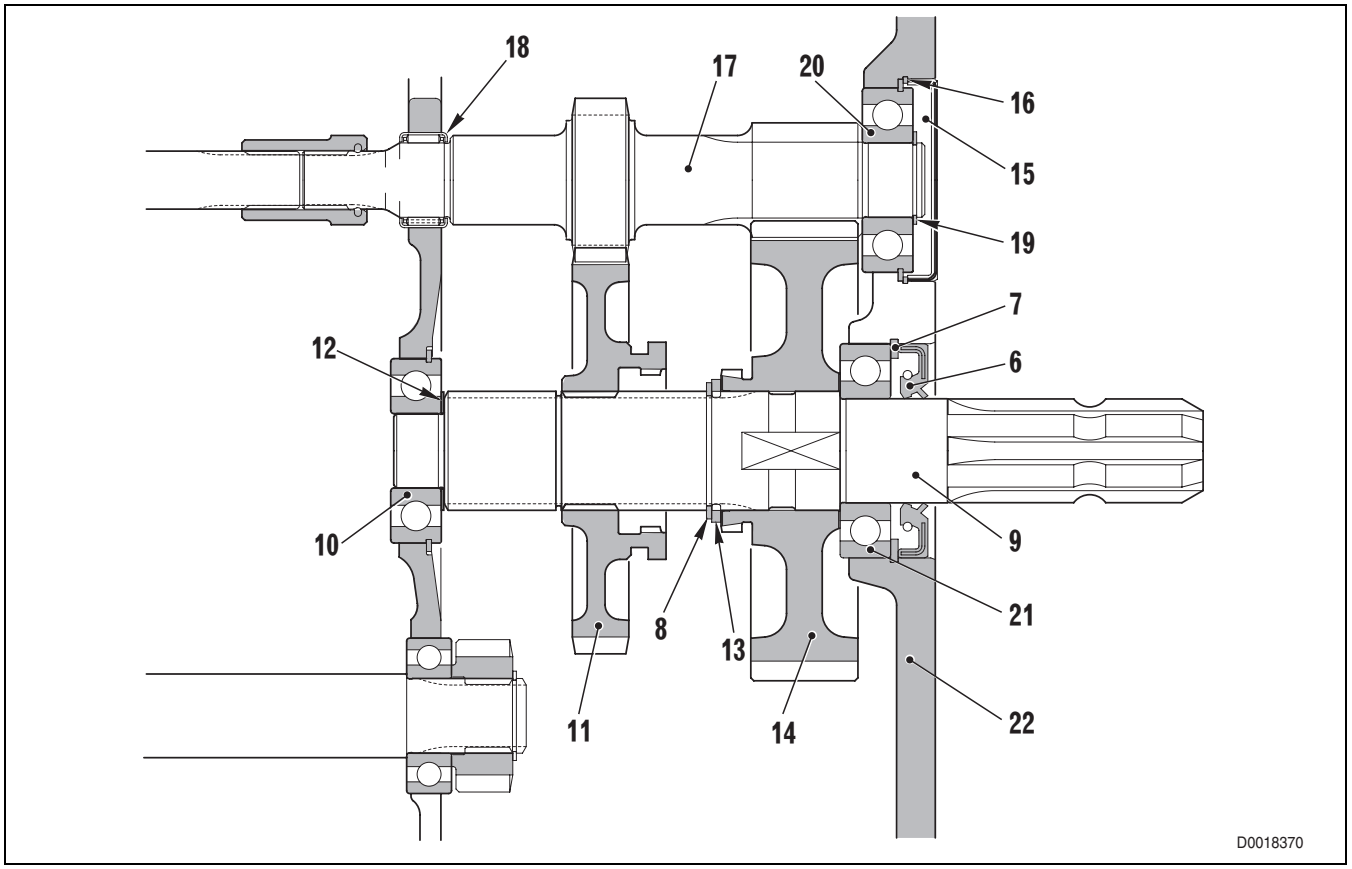
7- Assemble the components by reversing the disassembly procedure and, on completion, adjust the travel of the brake pedals.
(For details see «ADJUSTMENT OF LEVERS AND PEDALS»).



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REAR PTO

Disassembly



Disconnect the lead from the negative (–) terminal of the battery.

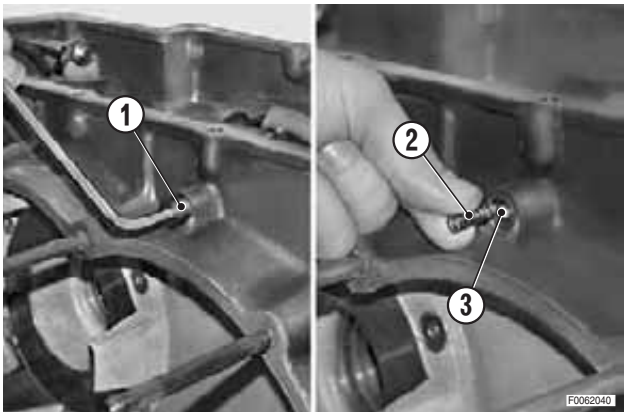
1 - Remove the platform.
(For details see «PLATFORM»).

2 - Remove the complete lift assembly.
(For details see «LIFT»).

3 - Drain off all the oil contained in the transmission.

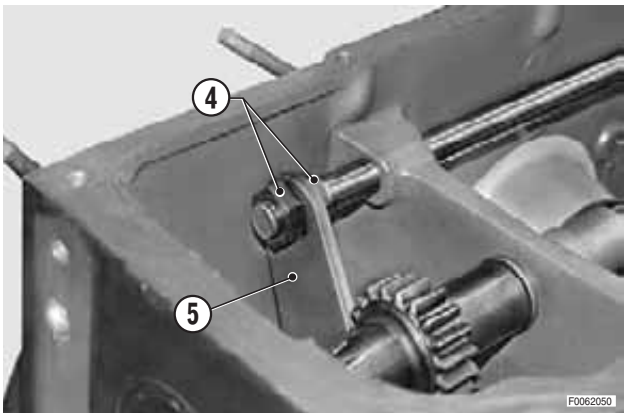
Transmission oil: max. 21 ℓ (5.5 US.gall.)

4 - Remove the screw (1) and remove the spring (2) and the ball (3). ※1

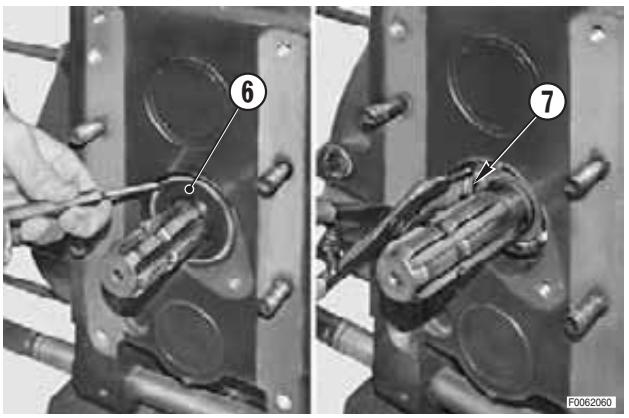


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5 - Remove the nuts (4) and remove the fork (5).

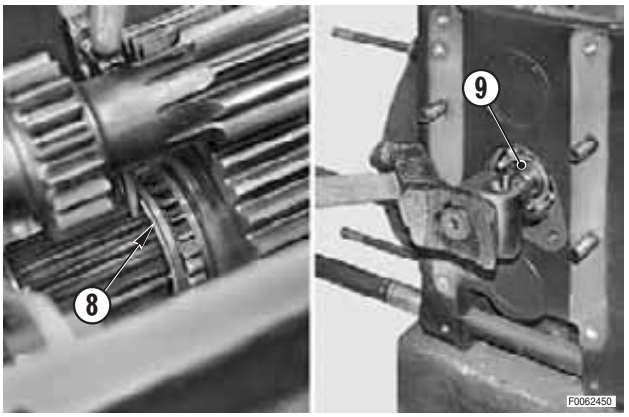


6 - Remove the oil seal (6) and remove the circlip (7).



7 - Move the circlip (8) towards the front of the transmission.

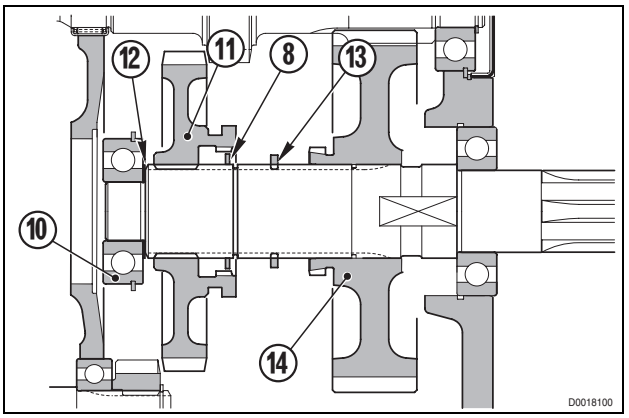
8 - Using a suitable tool, partially withdraw the PTO shaft (9).



9 - Finally remove the circlip (8) and remove the PTO shaft (9).

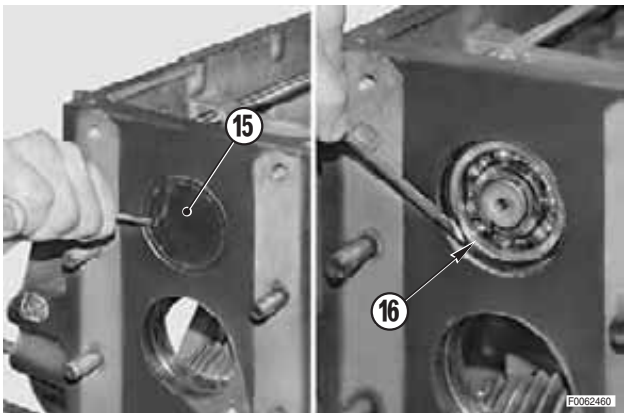
★ In some cases the bearing (10) may remain on the shaft (9).
Remove it using the gear (11).

★ Recover the shims (12), the spacer (13) and the gear (14).

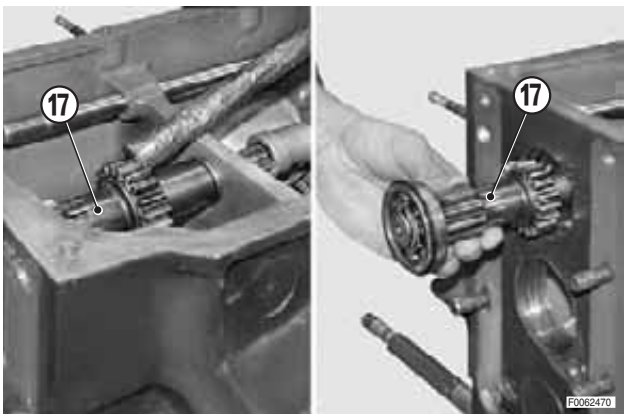


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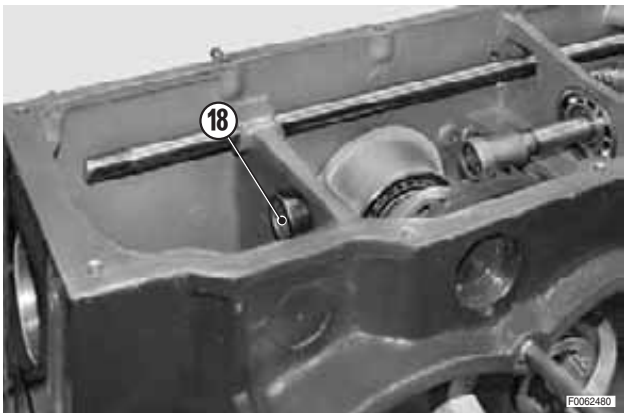
10 - Remove the cover (15) and remove the circlip (16).



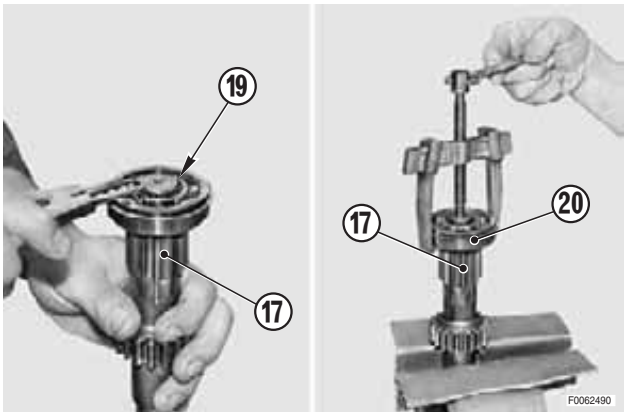
11 - Use a drift to drive out the shaft (17).



12 - Remove the roller cage (18).

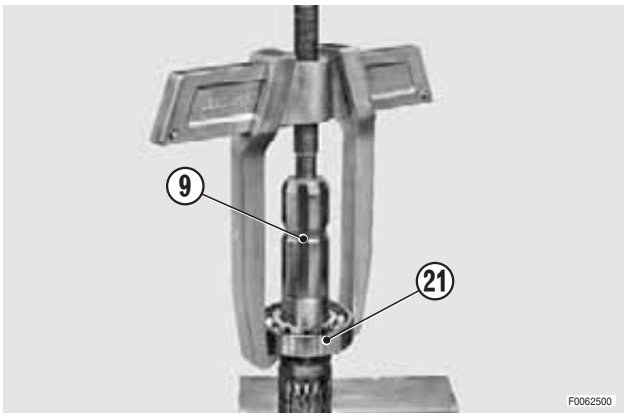


13 - Remove the circlip (19) from the shaft (17) and remove the bearing (20).



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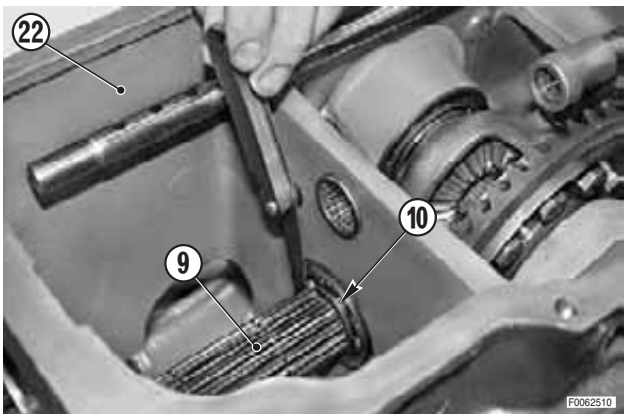
14 - Remove the bearing (21) from the PTO shaft (4).



Assembly

- To assemble, follow the disassembly steps in reverse order.

★ If the PTO shaft (9), the bearings (10) and (21) or the transmission casing (22) are to be renewed, form a shim pack to be installed between the PTO shaft (9) and the front bearing (10) to achieve play of 0.05–0.15 mm.



1

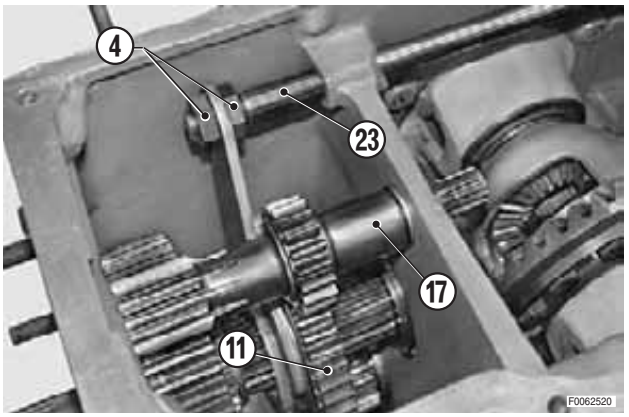
1 - Adjust the position of the PTO speed selector fork so that, when the rod (23) is in the 1000 rpm position, the selector gear (11) is positioned centrally relative to the gear (17).

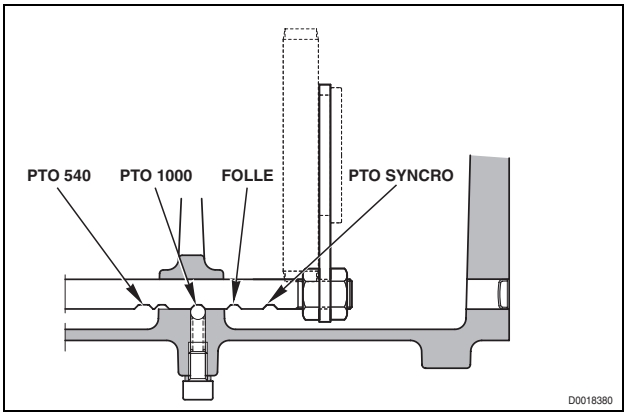
2 - Secure in position by tightening the nuts (4).

Nuts: Loctite 270

Nm Nuts: 90–105 Nm (66–77 lb.ft.)

★ Fit the nuts so that their flat surfaces face the fork.



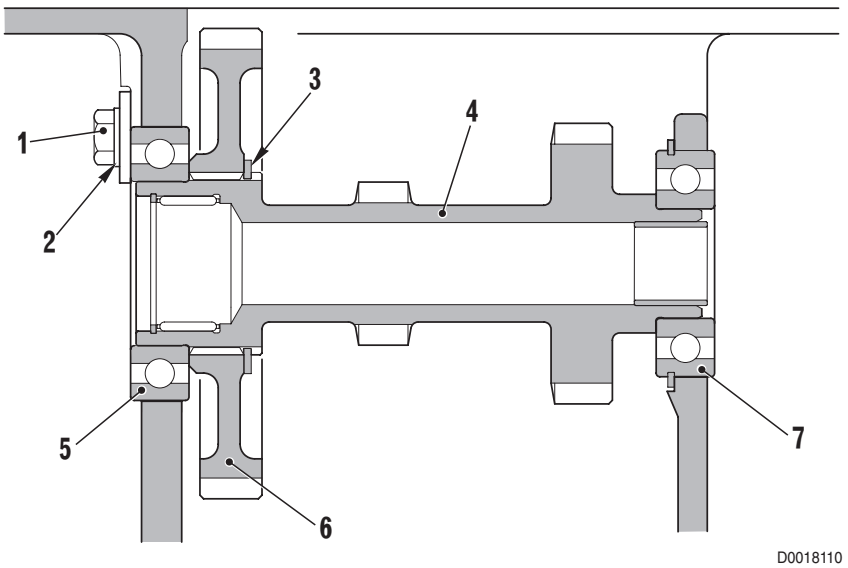


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RANGE GEARBOX AND REAR DIFFERENTIAL ASSEMBLY

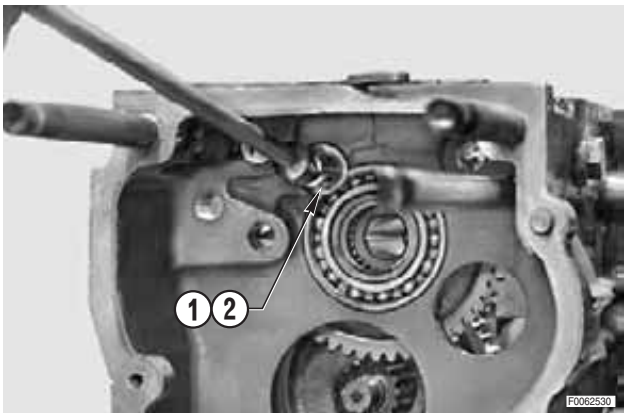
RANGE GEARBOX INPUT SHAFT

Disassembly

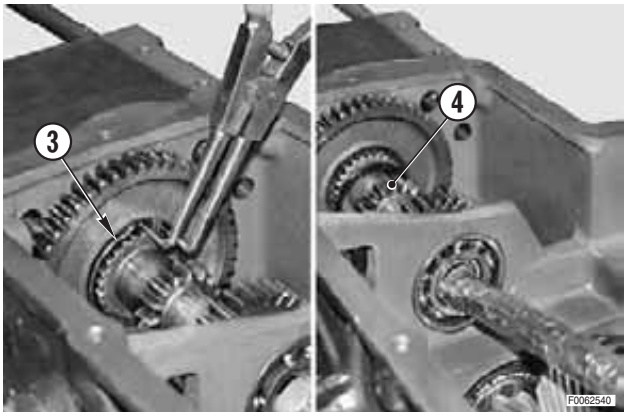


1 - Remove the gearbox and shuttle assembly. (For details see «GEARBOX AND SHUTTLE ASSEMBLY»).

2 - Remove the screw (1) and remove the washer (2). ※1

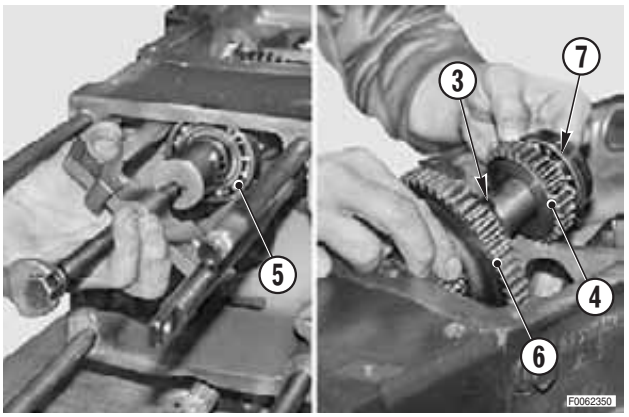


3 - Move the circlip (3) towards the rear of the transmission and drive the shaft (4) towards the front using a copper punch.

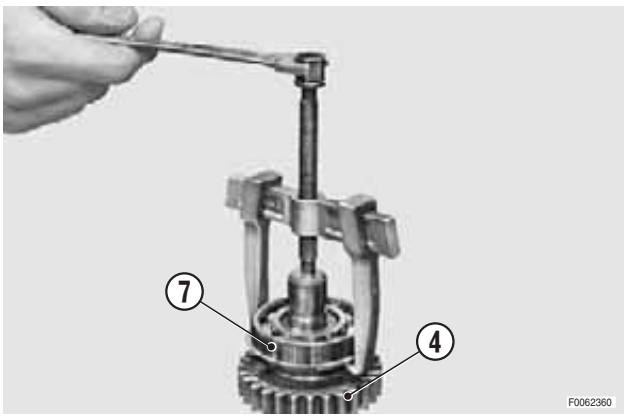


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4 - Remove the bearing (5) and remove the shaft (4) complete with gear (6), circlip (3) and bearing (7).
★ Note the way in which the gear (6) is installed.



5 - Remove the bearing (7) from the shaft (4).



Assembly

- To assemble, follow the disassembly steps in reverse order.

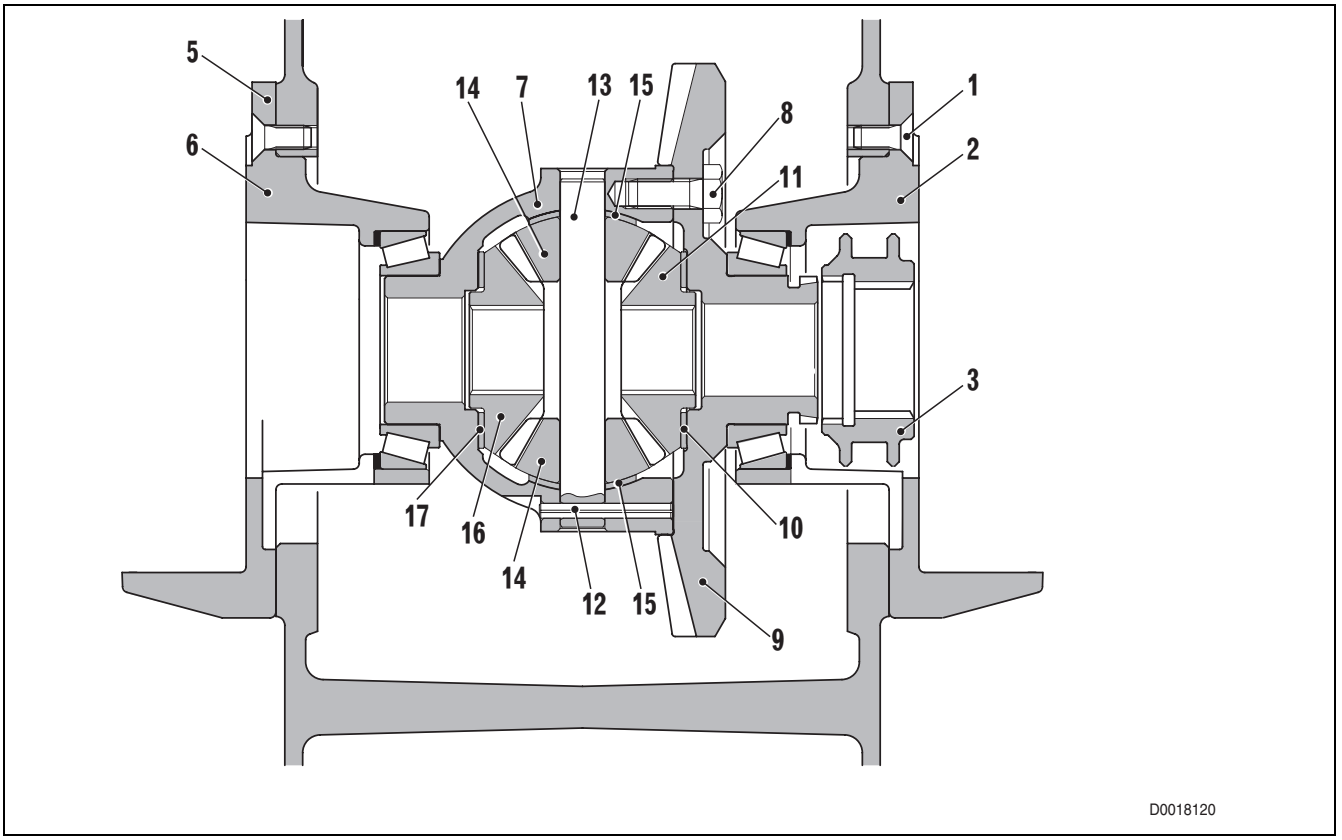
1

Screw: Loctite 242

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DIFFERENTIAL

Removal



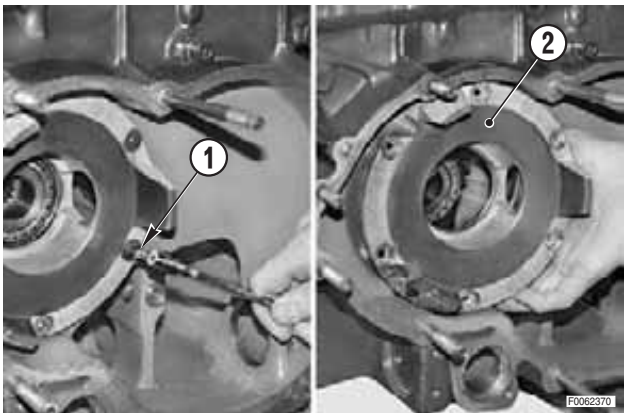
1 - Remove the rear axles and braking devices.
(For details see «REAR AXLE AND BRAKES»).

2 - Remove the complete lift assembly.
(For details see «LIFT»).

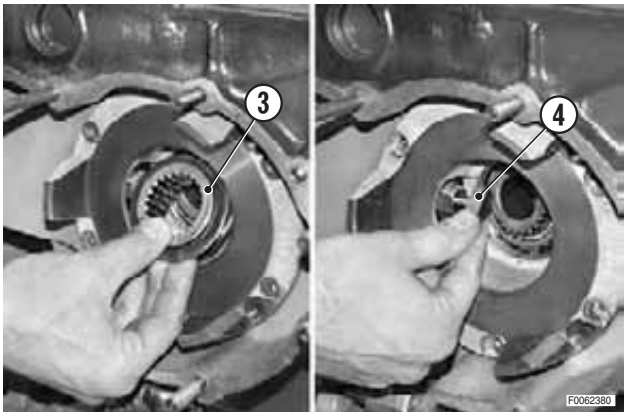
3 - Remove the screws (1) and remove the left differential support (2). 1

★ Do not use automatic screwdrivers as this could damage the hex heads of the screws.

★ Support the differential during removal of the support.



4 - Remove the differential lock engagement sleeve (3) and the shoe (4).



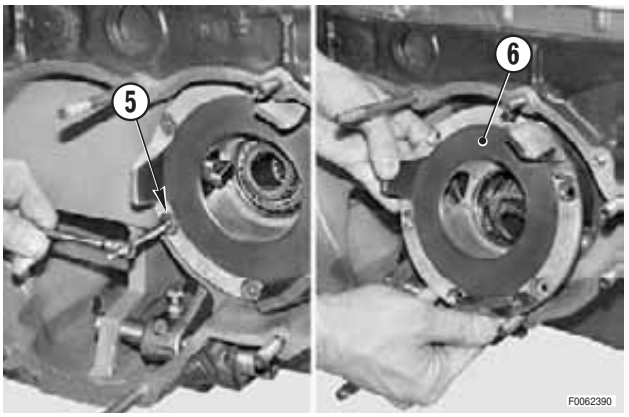
https://truckmanualshub.com/

5 - Remove the screws (5) and remove the right differential support (6). ⁘ 2

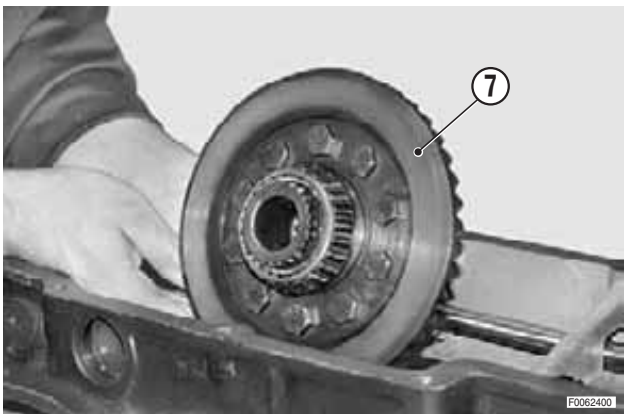
★ Do not use automatic screwdrivers as this could damage the hex heads of the screws.

★ Support the differential during removal of the support.

★ Mark the right support to avoid confusion on reassembly.



6 - Remove the complete differential assembly (7).



Refitting

- Refitting is the reverse of removal.

⁘ 1

Nm Screws: 21±1 Nm (15.5±0.7 lb.ft.)

Screws: Loctite 242

⁘ 2

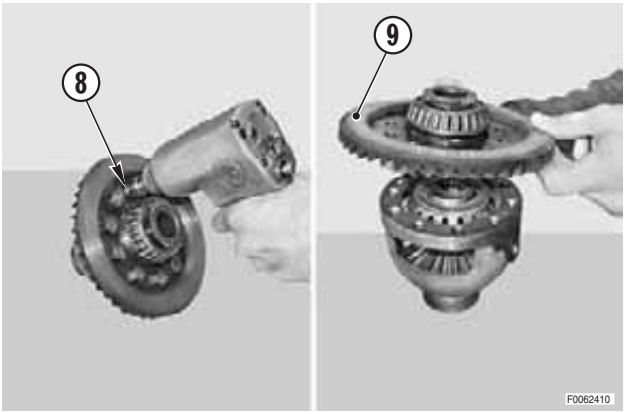
Nm Screws: 21±1 Nm (15.5±0.7 lb.ft.)

Screws: Loctite 242

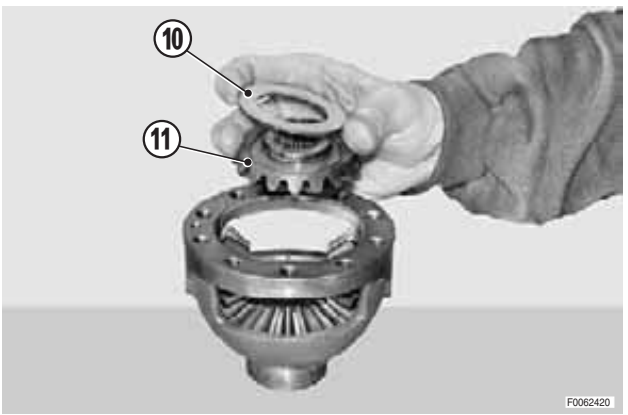
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Disassembly

1 - Remove the screws (8) and remove the differential crown wheel (9). ※ 1



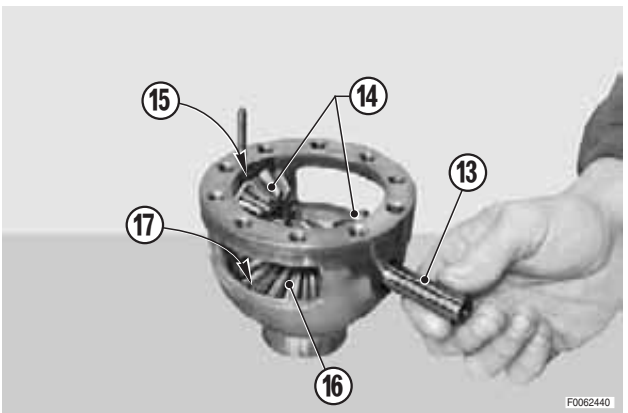
2 - Remove the thrust washer (10) and the sun gear (11). ※ 2



3 - Withdraw the spring pin (12). ※ 3



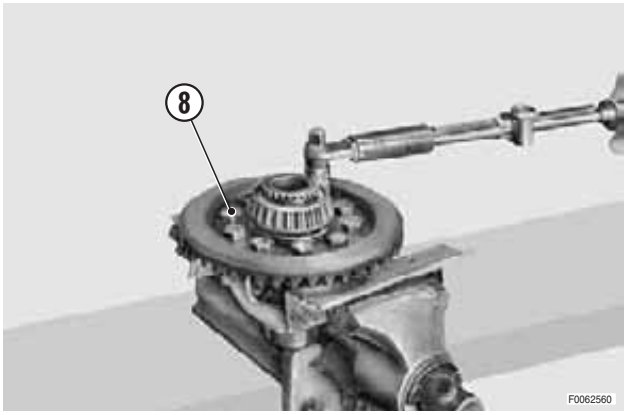
4 - Withdraw the cross pin (13), the planet pinions (14), the thrust washers (15) and the second sun gear (16) with the relative thrust washer (17). ※ 4



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Assembly

- To assemble, follow the disassembly steps in reverse order.



※ 1

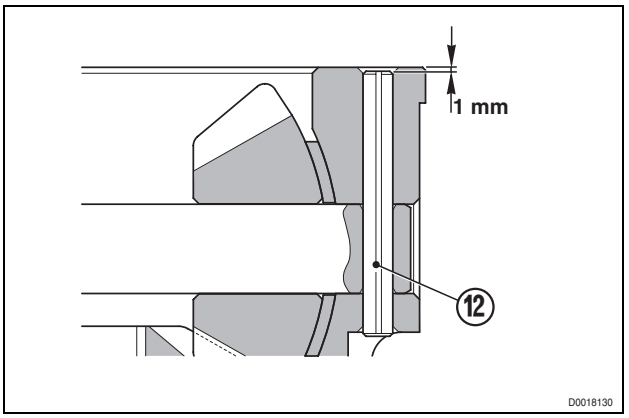
Nm Screws: 75±4 Nm (55±3 lb.ft.)

※ 2

Thrust washers: transmission oil.

※ 3

★ Insert the spring pin (12) so that the end lies approx. 1 mm below the face of the differential housing to which the crown wheel is mounted.



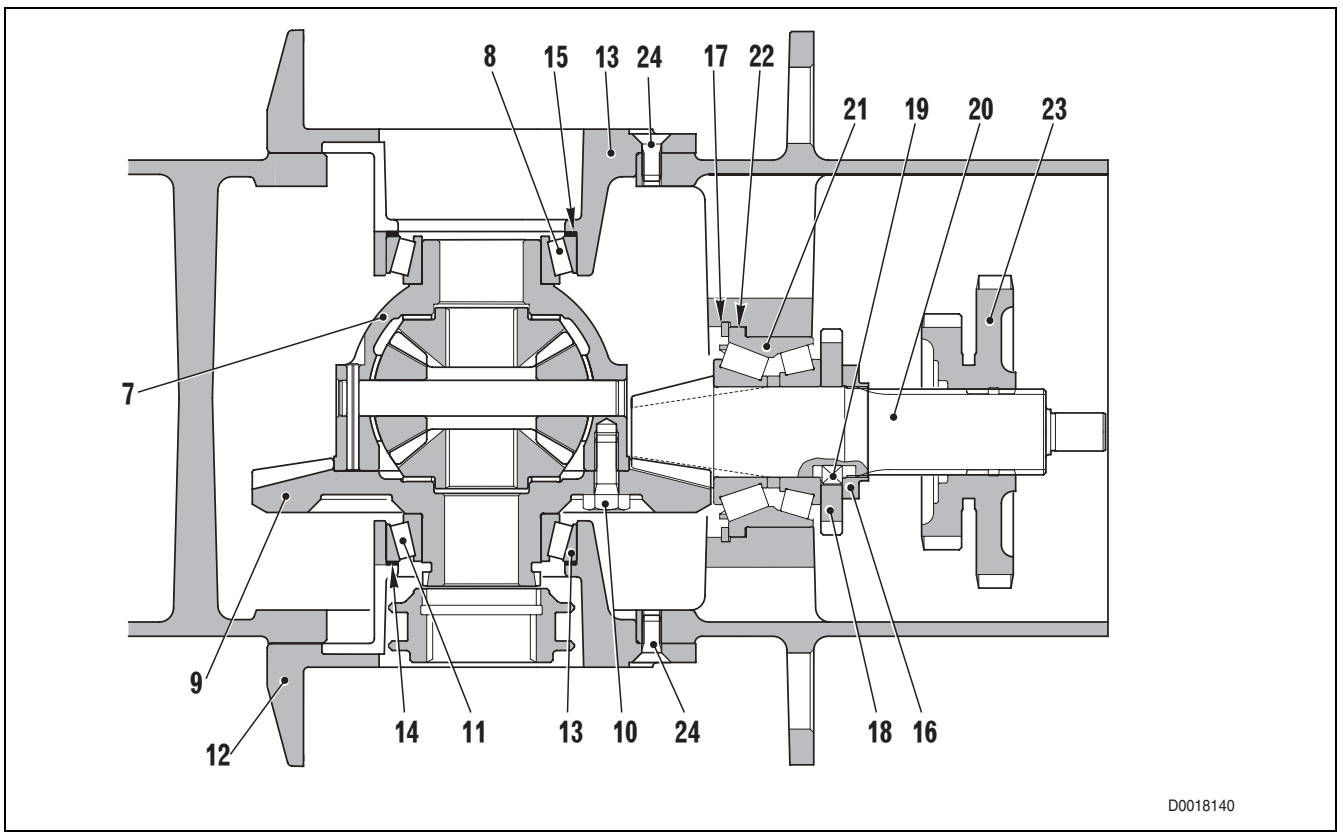
※ 4

Thrust washers: transmission oil

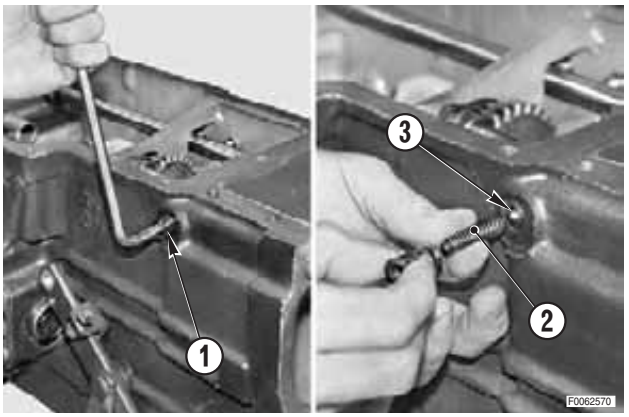
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BEVEL GEAR PAIR

Disassembly



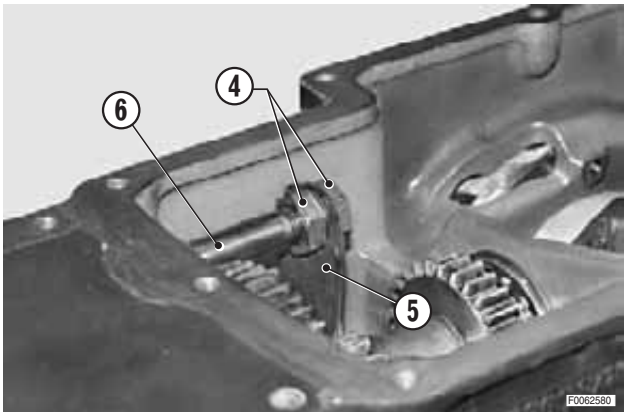
1 - Remove the screw (1) and remove the spring (2) and the ball (3).



2 - Remove the nuts (4), remove the fork (5) and the rod (6).

3 - Remove the range gearbox input shaft.
(For details see «RANGE GEARBOX INPUT SHAFT»).

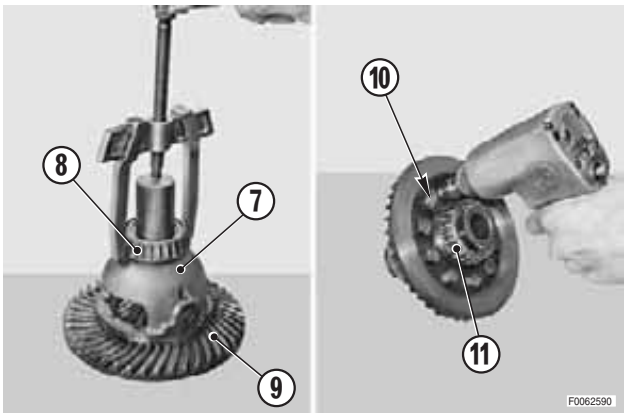
4 - Remove the differential.
(For details see «DIFFERENTIAL»).



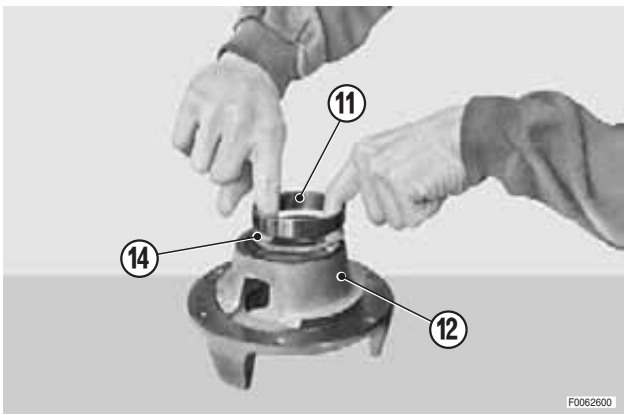
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5 - Remove the bearing (8) on the opposite side to the crown wheel (9) from the differential housing (7).

6 - Remove the screws (10) and remove the crown wheel (9) complete with bearing (11).

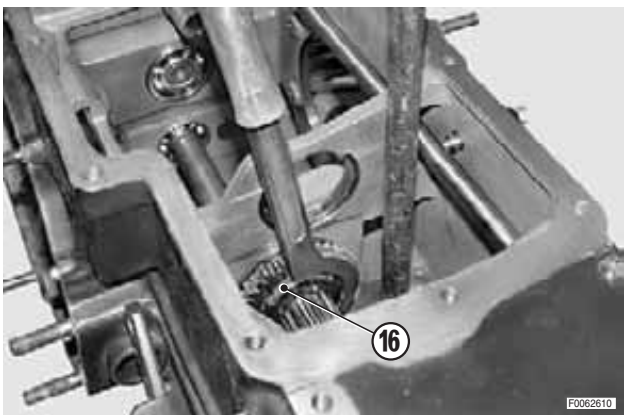


7 - Remove the outer races of the bearings (8) and (11) from the differential supports (12) and (13), while leaving in position the relative shims (14) and (15).



8 - Using a C spanner and a soft metal bar inserted between the driven gear and the transmission casing, fully loosen the ringnut (16).

★ Renew the ringnut (16) on reassembly.



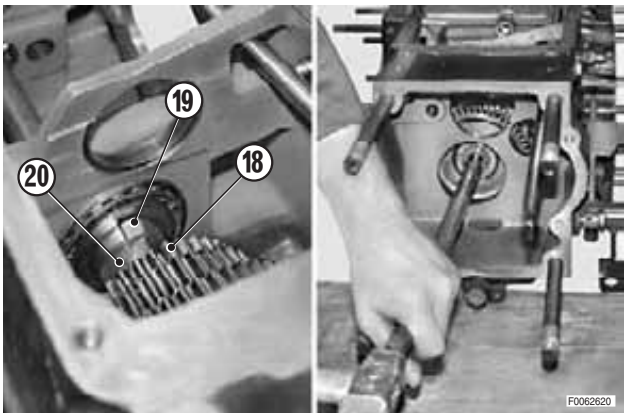
9 - Remove the circlip (17).



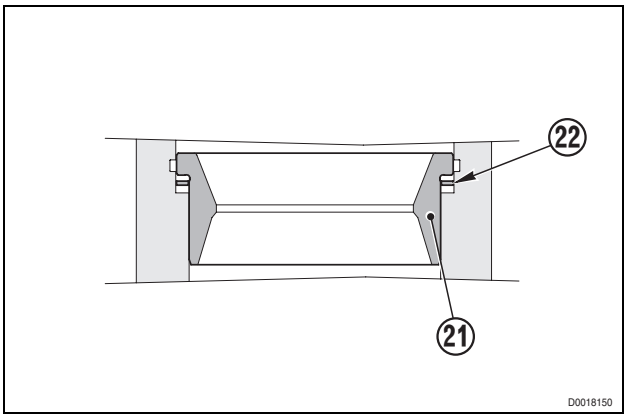
https://truckmanualshub.com/

10 - Move the 4WD driving gear (18) towards the front of the transmission and remove the locking key (19).

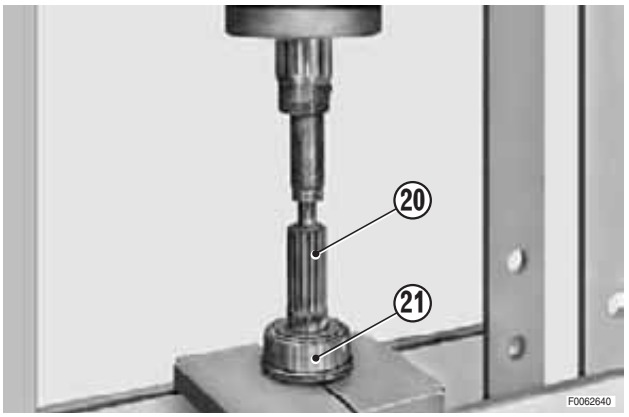
11 - Remove the pinion (20).



12 - Remove the outer ring of the pinion bearing (21) and the spacers (22) from the transmission casing.
★ Recover the spacers.



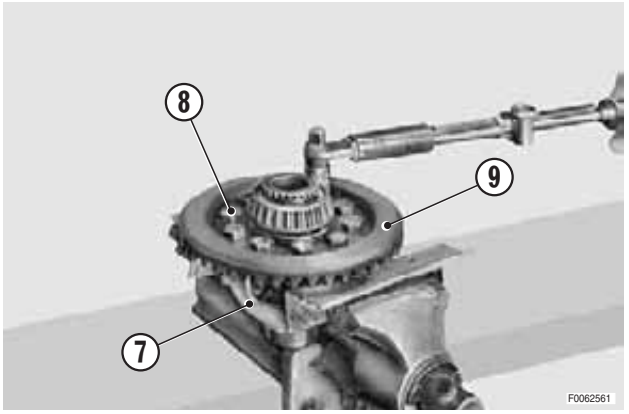
13 - Using a press, remove the remaining components of the bearing (21) from the pinion (20).



Preparation for installation

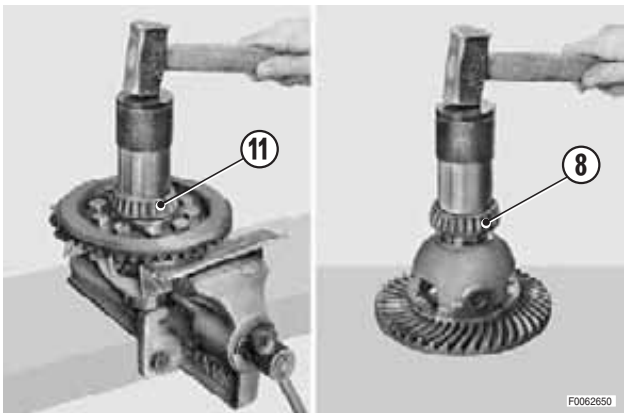
1 - Mount the new crown wheel (9) on the differential housing (7) and secure it with the screws (10).

Nm Screws: 75±4 Nm (55±3 lb.ft.)



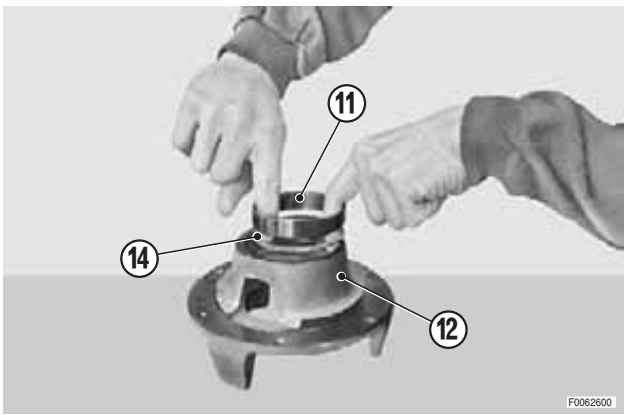
https://truckmanualshub.com/

2 - Using a suitable tool, install the inner rings of the bearings (8) and (11).



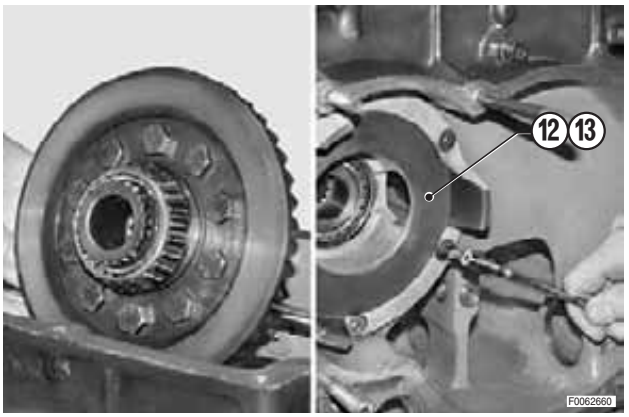
3 - Remove shims to the value of 0.2 mm from each of the two shim packs (14) and (15) of the differential supports (12) and (13) and refit them in their respective supports along with the outer rings of the bearings (11) and (8).

★ If it is not possible to determine the shim packs of the two sides, form two shim packs: one1.3 mm thick for the crown wheel side and the other 1.8 mm thick for the opposite side.

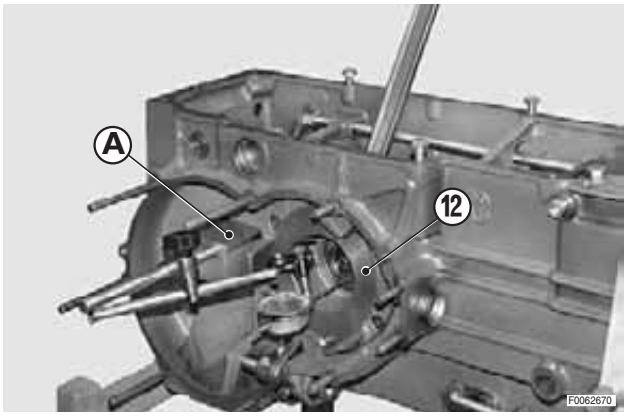


Adjustment of the differential preload

1 - Install the complete differential assembly and the supports (12) and (13).



2 - Position a dial gauge with magnetic stand "**A**" on the differential support (12) of the crown wheel side and set it to zero on the head of the differential while using a lever to force the differential towards the opposite side to the crown wheel.

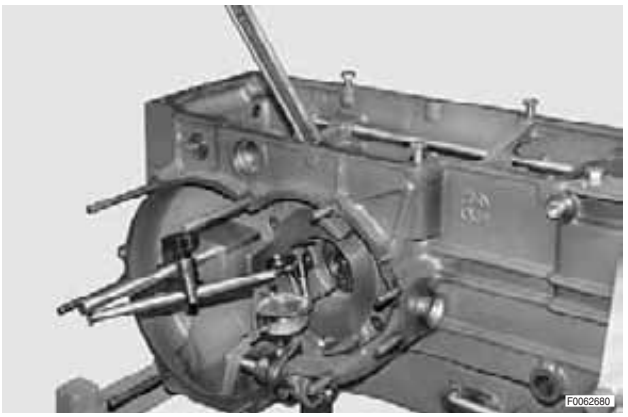


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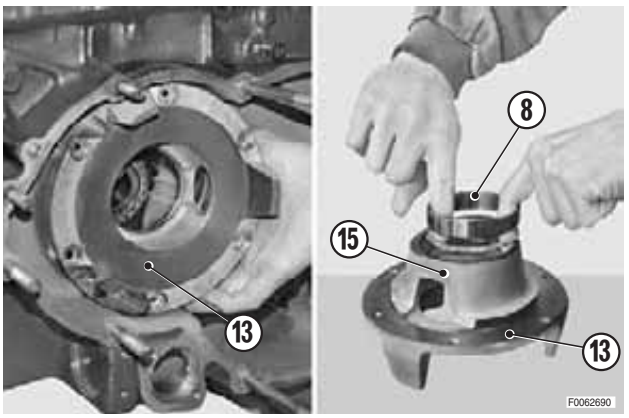
3 - Force the differential towards the crown wheel side and measure the end float.

4 - Add 0.1 mm to the measured end float to determine the thickness of the shims to be installed under the bearing (8) on the opposite side to the crown wheel.

★ Repeat the measurement procedure a number of times.

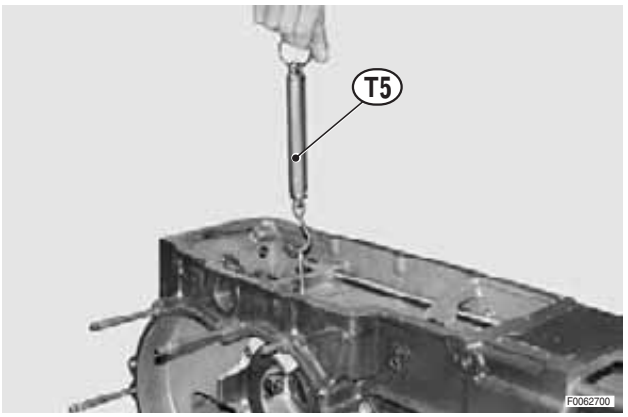


5 - Remove the flange (13) of the opposite side to the crown wheel and install a shim pack (15) of the thickness calculated in the previous step.
Refit the differential support (13) to the transmission support.



6 - Wind a cord around the 122 mm Ø section of the differential housing and, using a spring dynamometer **T5** (code 5.9030.529.0), measure the rolling resistance torque of the differential (7) to check the correct preloading of the bearings (8) and (11).

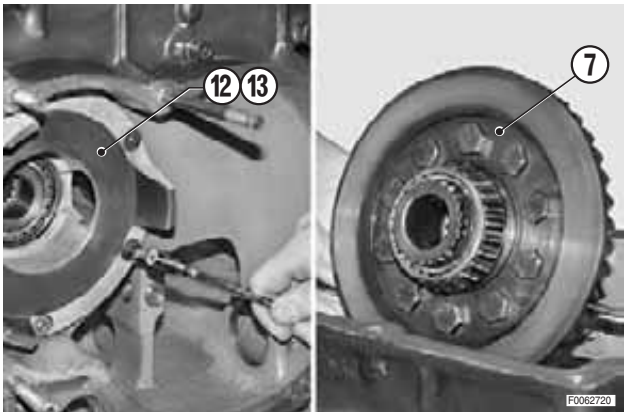
★ Force required to maintain steady rotation: 2.5–4.0 kg.



Adjustment of the pinion position

1 - Remove the differential supports (12) and (13) and the differential (7).

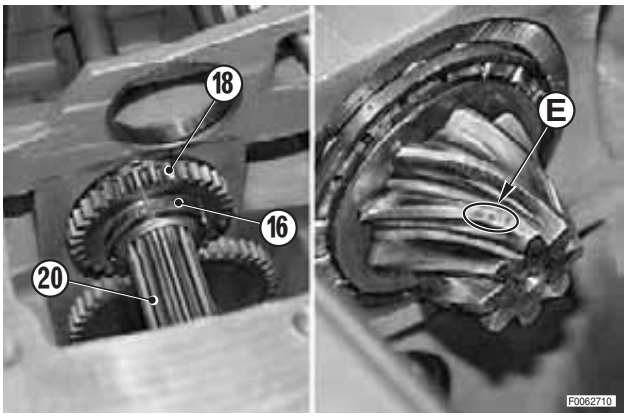
★ Take care not to confuse the right and left differential supports.



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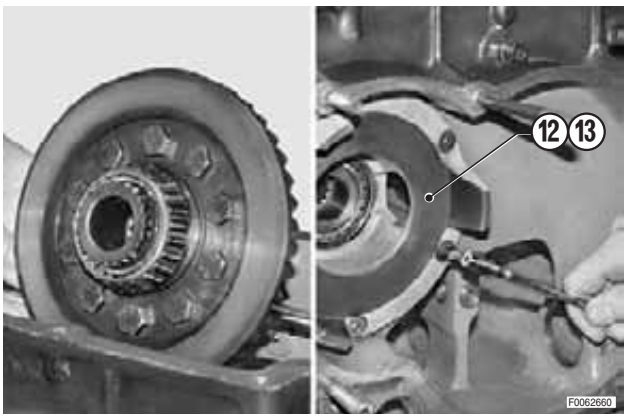
2 - Install the pinion (20) complete with the bearing (21) in the transmission casing and drive it into its seating.
★ Make a note of the value "**E**" stamped on a tooth of the pinion (20) (in this example + 0.3 mm).

3 - Temporarily fit the 4WD gear (18) and the ringnut (16).
★ Tighten the ringnut to eliminate the bearing play.



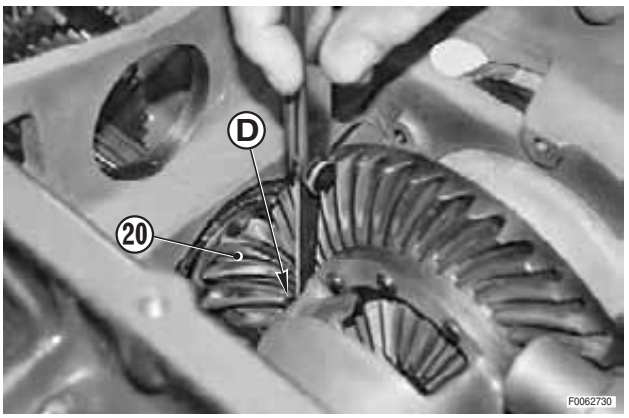
4 - Fit the complete differential and the supports (12) and (13).

5 - Fix the supports (12) and (13).
★ While tightening the screws, check that there is clearance between the differential and the pinion (20).
If the differential is tight up against the pinion, adjust the two shim packs by reducing the shim thickness on the crown wheel side while increasing the thickness on the opposite side.



6 - Use a feeler gauge to measure the distance "D" between the end face of the pinion (20) and the 122 mm Ø section of the differential housing (in this example 2.95 mm).

7 - Calculate the value "**R**" by adding the distance "**E**" stamped on the tooth of the pinion (20) to the theoretical value of 2.00 mm.
★ If "**E**" is positive, as in the example shown in the figures, add it to the theoretical value of 2.00 mm.
R = 2.00 + **E**
i.e.
R = 2.00 + 0.30 = **2.30**
★ If "**E**" is negative, subtract it from the theoretical value of 2.00 mm.
R = 2.00 – **E**
i.e.
R = 2.00 – 0.30 = **1.70**



8 - If the measured value "**D**" differs from the calculated value "**R**", calculate the difference between "**D**" and "**R**".
The resulting value "**S**" is the shim thickness to be installed under the bearing (21) of the pinion (20).
★ Formula:

S = D – R

which in our example gives:

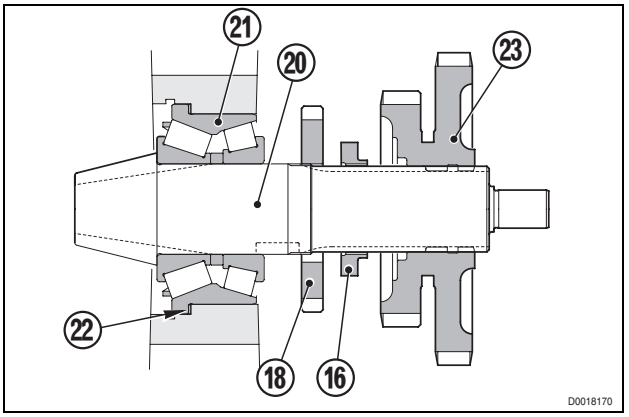
S = 2.95 – 2.30 = 0.65 mm

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9 - Remove the differential (11) and the pinion (20) complete with bearing.

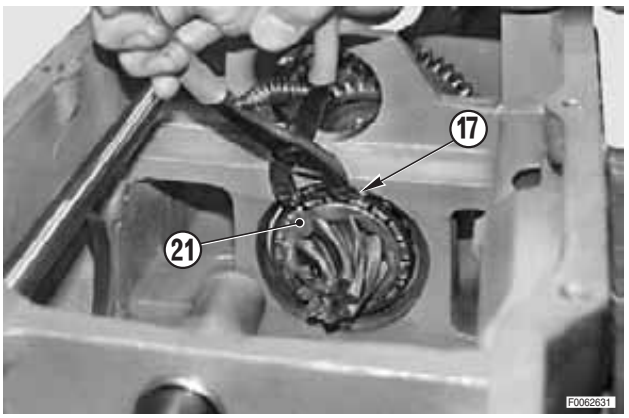
10 - Fit the shim pack "**S**" (22) thus calculated on the bearing (21) and install in the transmission casing.

★ Fit the 4WD driving gear (18), the ringnut (16) and the driven range gear (23) to the pinion shaft (20).



11 - Secure the bearing (21) in position with a suitable circlip (17) selected from the available sizes.

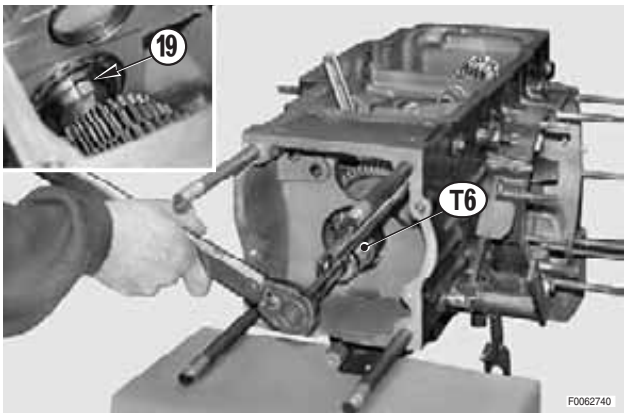
★ Select the circlip by applying the following formula:
Circlip thickness = "**A**":
Fixed dimension = "**R**"
Shim thickness = "**S**"
A = R – S
which in our example gives:
A = 3.50 – 0.65 = 2.85 mm
A 2.80 mm thick circlip is therefore required.



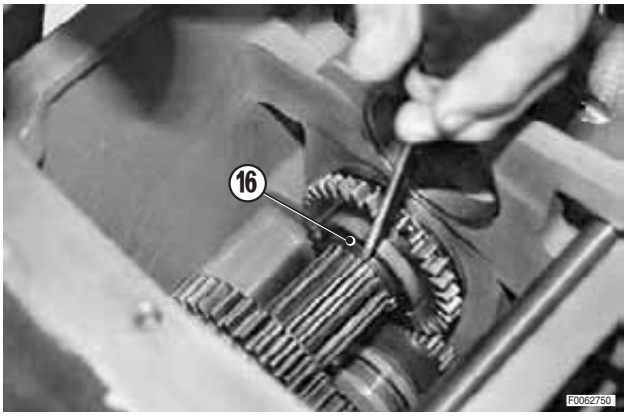
12 - Insert the key (19) and, using the wrench **T6** (code 5.9030.964.0), tighten the ringnut (16).

Nm Ringnut: 140±20 Nm (103±14.7 lb.ft.)

Ringnut: Loctite 270



13 - Stake the ringnut (16) at three points.



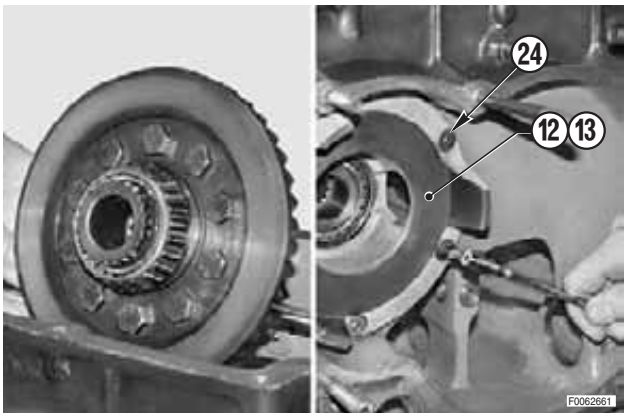
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Adjustment of the pinion and crown wheel

1 - Fit the complete differential assembly and the supports (12) and (13).

2 - Fix the supports (12) and (13) by tightening the screws (24).

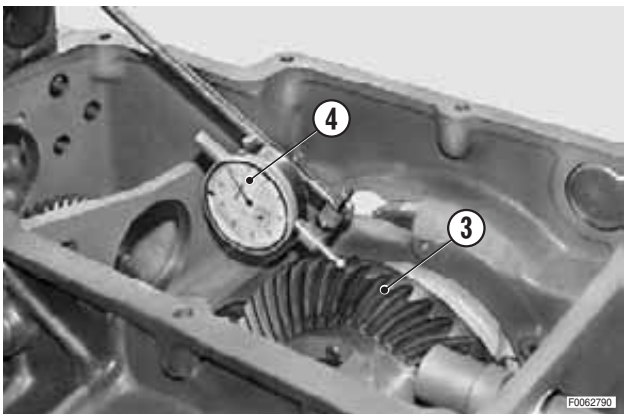
★ While tightening the nut, rotate the pinion in both directions and lightly tap the differential housing to help seat the bearings.



3 - Position a dial gauge "**A**" on a magnetic stand with the contact point perpendicular to the side of a tooth on the external diameter of the crown wheel.
Preload the gauge by approx. 3 mm and measure the backlash "**Z**" between the pinion and crown wheel by turning the crown wheel (9) in both directions.

★ Normal backlash: 0.10–0.15 mm

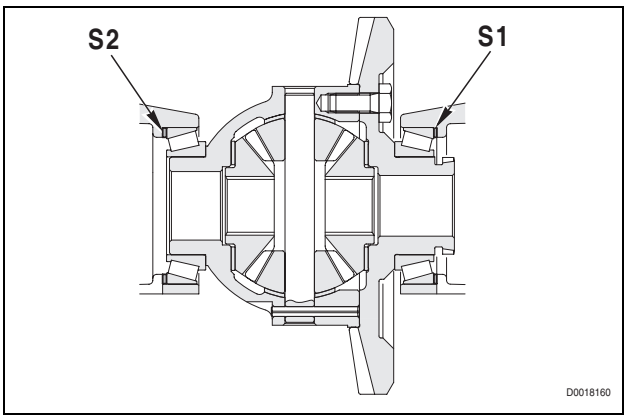
★ Take four measurements 90° apart and calculate the average.



4 - If the backlash "**Z**" is less than 0.10 mm, transfer shims from the pack "**S1**" (crown wheel side) to the pack "**S2**" (opposite side to the crown wheel).
If the backlash "**Z**" is greater than 0.15 mm, add shims to the "**S1**" shim pack (crown wheel side) and transfer the same shims from the pack "**S2**" (opposite side to crown wheel).

★ The sum total thickness of the shim packs"**S1**" and "**S2**" should not be altered from the value determined by testing the rolling resistance of the differential.

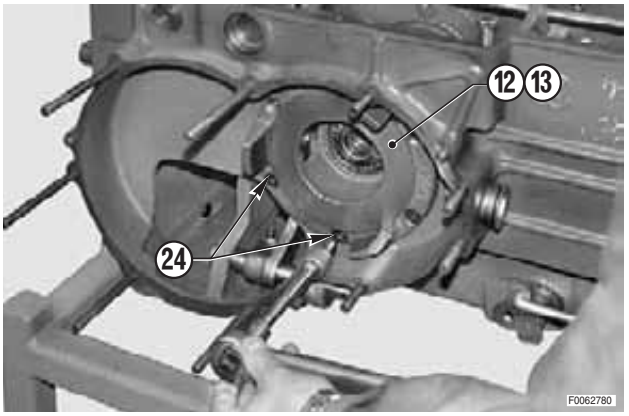
5 - Check again the backlash "**Z**" and move the shims to obtain the correct backlash.



6 - Finally tighten down the screws (24) securing the differential supports (12) and (13).

Nm Screws: 21±1 Nm (15.5±0.7 lb.ft.)

Screws: Loctite 242

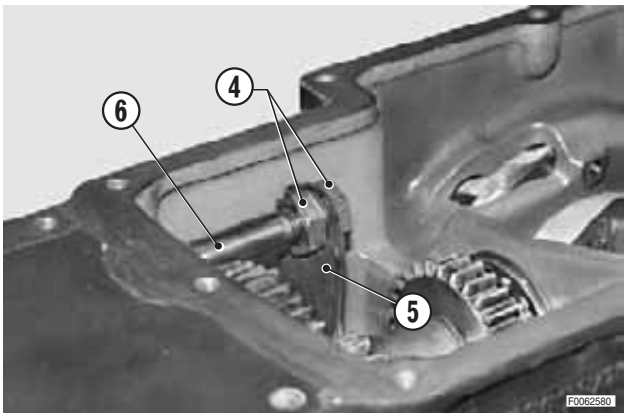


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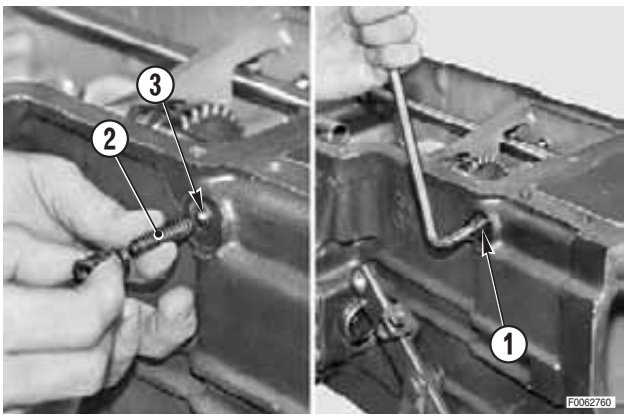
Final assembly

1 - Fit the range gearbox input shaft.
(For details see «RANGE GEARBOX INPUT SHAFT»).

2 - Insert the selector rod (6) in the transmission casing and fit the selector fork (5) and the nuts (4).



3 - Insert the ball (3), the spring (2) and tighten the screw (1).
★ Renew the copper washers.

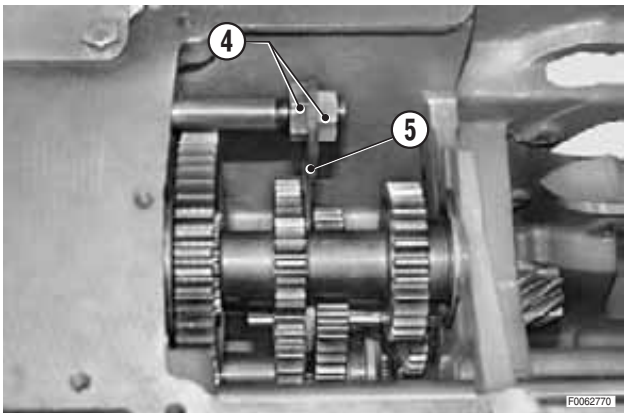


4 - Adjust the position of the fork (5) so that the selector gear is positioned centrally relative to the corresponding gear when the selector rod is in the L range position.

5 - Tighten the nuts (4) to secure in position.

Nm Nuts 50–105 Nm (37–77.4 lb.ft.)

Nuts: Loctite 270



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4WD AND GROUND SPEED PTO OUTPUT SHAFT

Disassembly

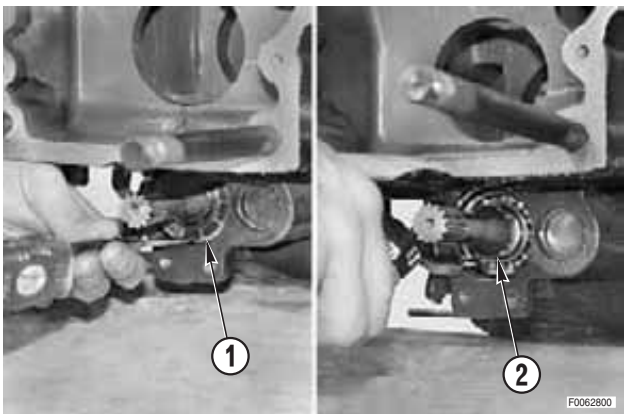
1 - Remove the range gearbox input shaft, the differential and the pinion.
(For details see «RANGE GEARBOX INPUT SHAFT» and «BEVEL GEAR PAIR»). ⁘ 1

★ When removing the differential, mark the crown wheel side support to avoid confusion on reassembly.

★ If the bevel gear pair is to be renewed, do not remove the shims from the differential support.

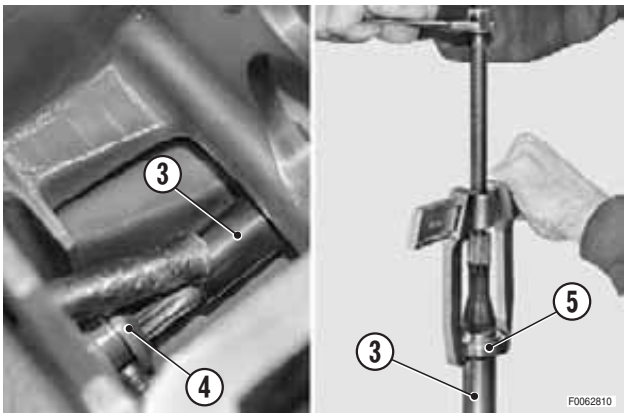
2 - Remove the oil seal (1) and remove the circlip (2). ⁘ 2

★ Renew the oil seal (1) on reassembly.

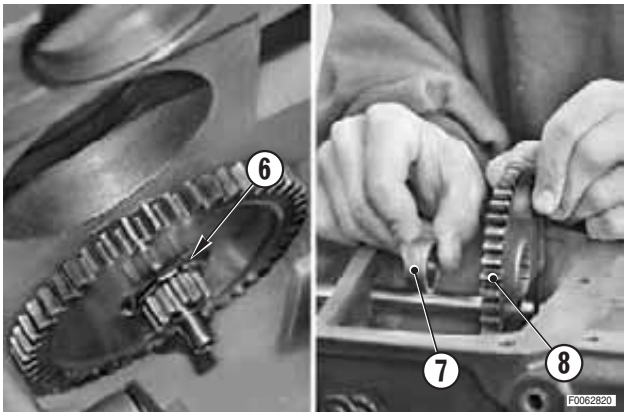


3 - Using a soft metal bar as a punch, drive out the shaft (3) complete with the bearing and remove the sleeve from the transmission casing (4).

4 - Remove the bearing (5) from the shaft (3).



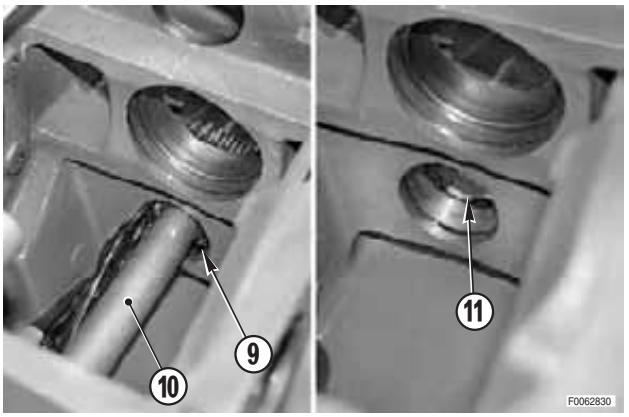
5 - Remove the circlip (6) and remove the 4WD driven gear (8) and the spacer (7).



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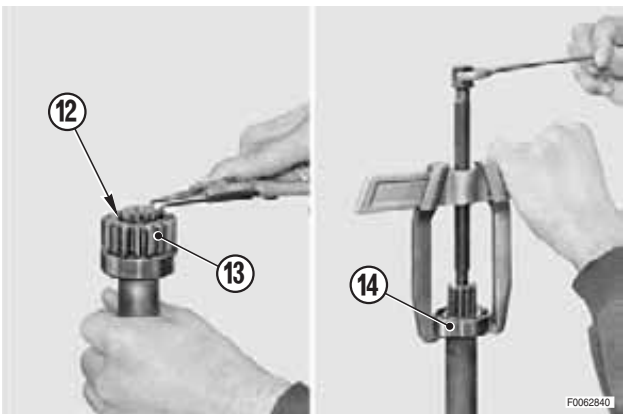
6 - Remove the circlip (9) and move the shaft (10) towards the rear of the transmission casing.

7 - Remove the circlip (11) and withdraw the complete shaft assembly (10) towards the front of the transmission.

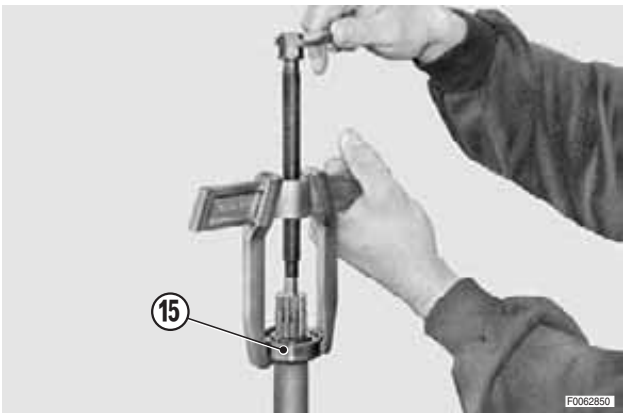


8 - Remove the circlip (12) and the gear (13).

9 - Remove the bearing (14).



10 - Remove the bearing (15).



Assembly

- To assemble, follow the disassembly steps in reverse order.

※ 1

1 - Install the pinion and the differential, skipping the adjustment operations.

2 - Tighten the pinion ringnut.

Ringnut: Loctite 270

Ringnut 140±20 Nm (103±14.7 lb.ft.)

★ Renew the ringnut on reassembly.

※ 2

★ Lubricate the lips of the seal.

Oil seal: transmission oil

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PEDALS AND CONTROL LEVERS

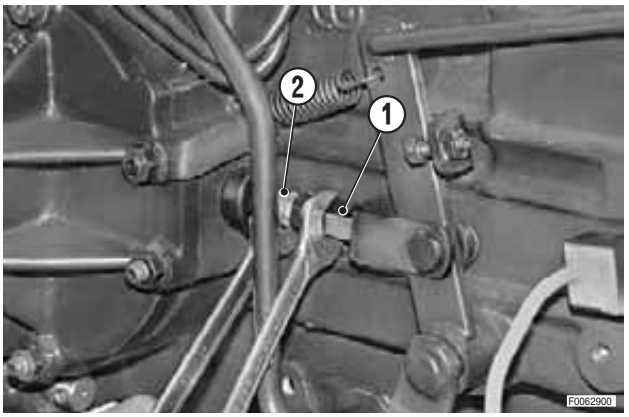
BRAKE PEDALS

Adjustment

★ Before carrying out the adjustment, press both pedals hard several times to bed in the brake discs.

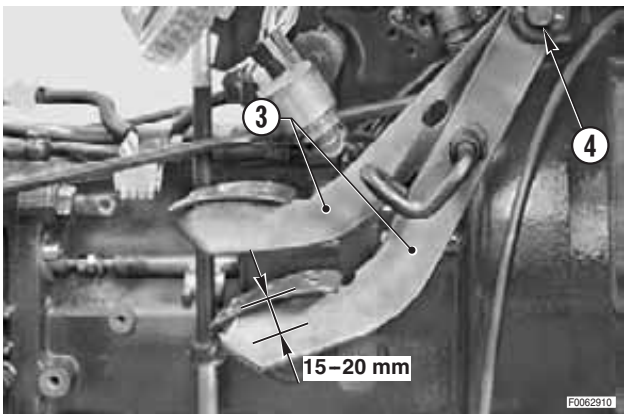
1 - Screw the adjuster (1) of the right pedal in or out to obtain a free travel of 15–20 mm and tighten the nut (2).

2 - Latch the two pedals (3) together with the pin (4) and press them simultaneously.



3 - Screw the adjuster of the left pedal in or out to obtain the same free travel as the right pedal and tighten the lock nut.

4 - Remove the connecting pin and check that the free travel is the same on both pedals.

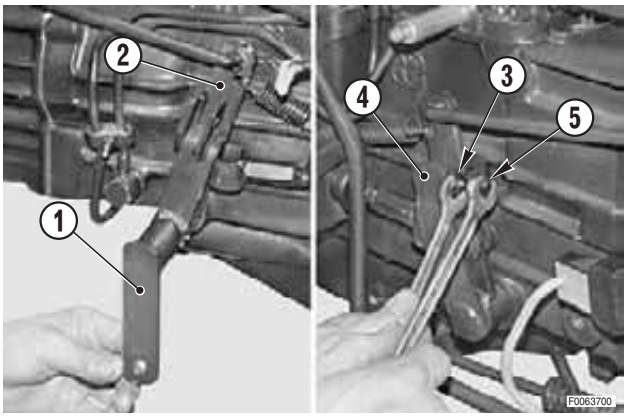


PARKING BRAKE LEVER

Adjustment

★ Before proceeding with adjustment of the parking brake, adjust the travel of the brake pedals.

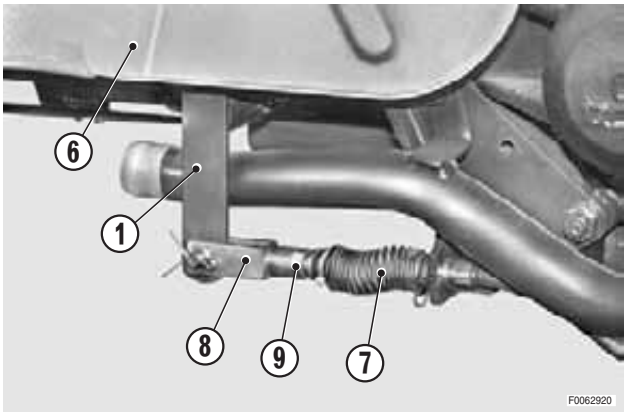
1 - While keeping the lever (1) in contact with lever (2), screw the adjuster screw (3) in or out to bring it up against the lever (4) and secure in position with the lock nut (5).



2 - Fit the platform (6) and fit the parking brake cable (7).

3 - Fully lower the parking brake lever and screw the fork (8) in or out so that it engages without moving the lever (1).

4 - Secure the fork (8) with the nut (9).

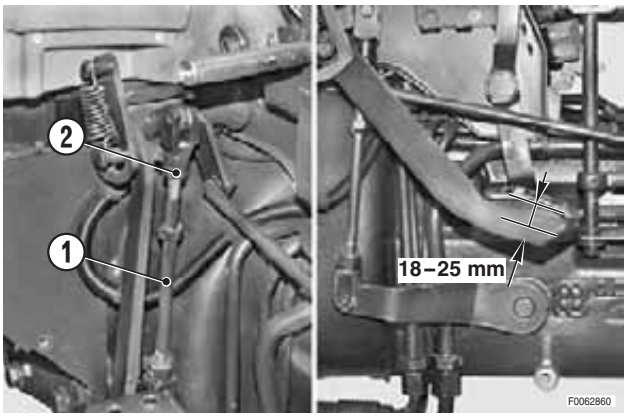


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CLUTCH PEDAL

Adjustment

1 - Adjust the tie rod (1) by screwing in or out to obtain clutch pedal free travel of 18–25 mm and then tighten the nut (2).

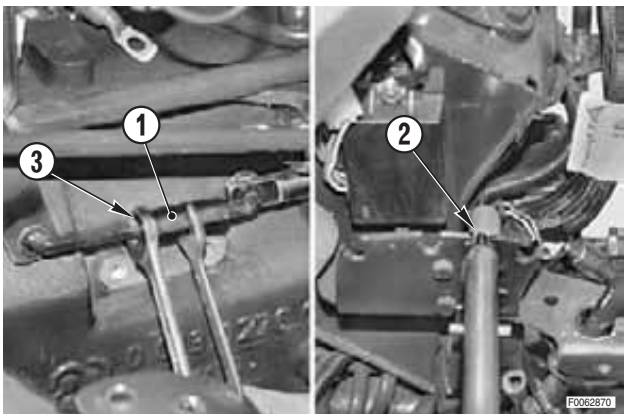


PTO SPEED SELECTOR LEVER

Adjustment

1 - Screw the tie rod (1) in or out so that the lever lock pin (2) is positioned centrally in the slot and then tighten the nut (3).

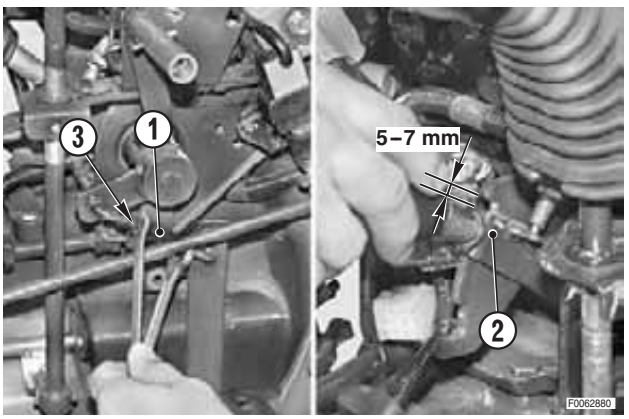
2 - Check that the pin enters the slots in the other lever positions.



PTO ENGAGEMENT LEVER

Adjustment

1 - Screw the tie rod (1) in or out to obtain free travel of the lever (2) of 5–7 mm and tighten the nut (3).

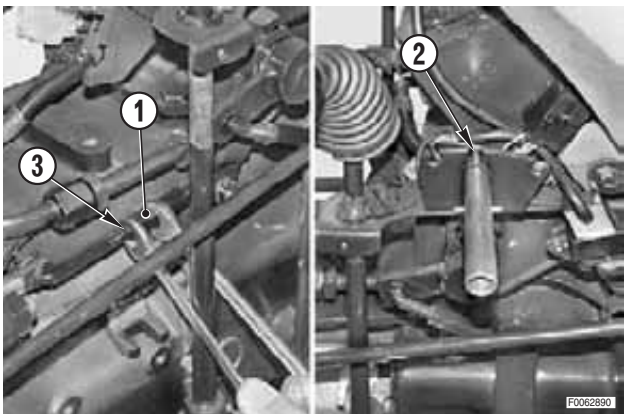


RANGE GEAR LEVER

Adjustment

1 - Screw the tie rod (1) in or out so that the lever lock pin (2) is positioned centrally in the slot and then tighten the nut (3).

2 - Check that the pin (2) enters the slots in the other lever positions.



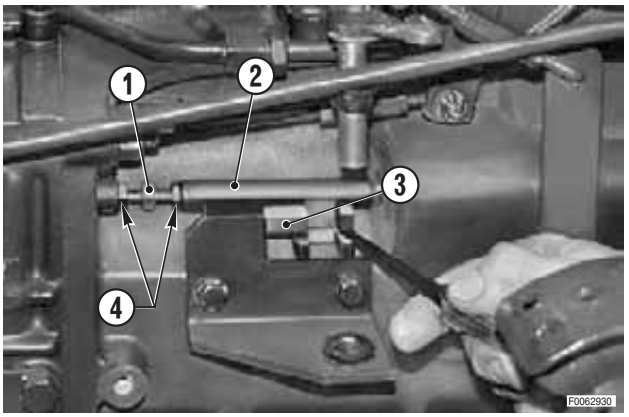
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MAIN GEAR LEVER

Adjustment

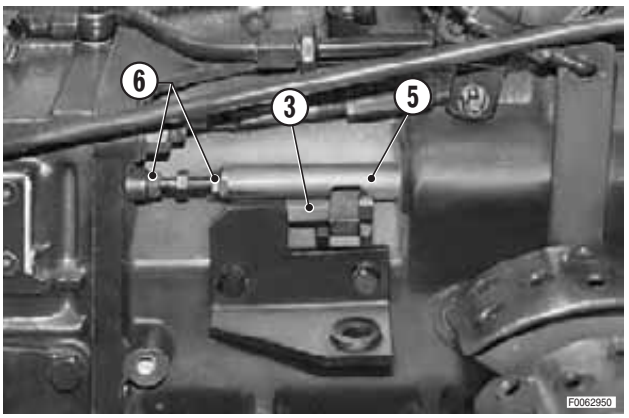
1 - Screw the adjuster screw (1) in or out to align the movable fork (2) with the fixed fork (3).

2 - Insert a 0.5 mm shim between the movable fork (2) and the fixed fork (3) and tighten the nuts (4) to secure in position.



3 - Insert the extension (5) in the clutch housing and adjust the position of the slot relative to the fixed fork (3).

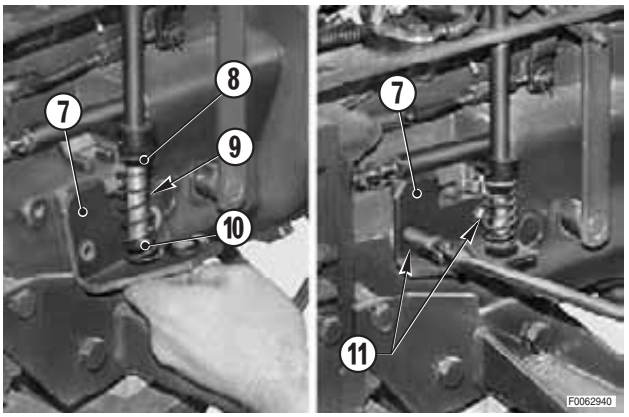
4 - Make sure that the bottom of the slot is level and tighten the nuts (6) to secure in position.



5 - Remove the support (7), and fit the spacer (8), the spring (9) and the spacer (10) on the control rod.

6 - Fix the support (7) by tightening the screws (11).

★ Grease the spring and contact surfaces of the spacers.



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FRONT AXLE

COMPLETE AXLE ASSEMBLY

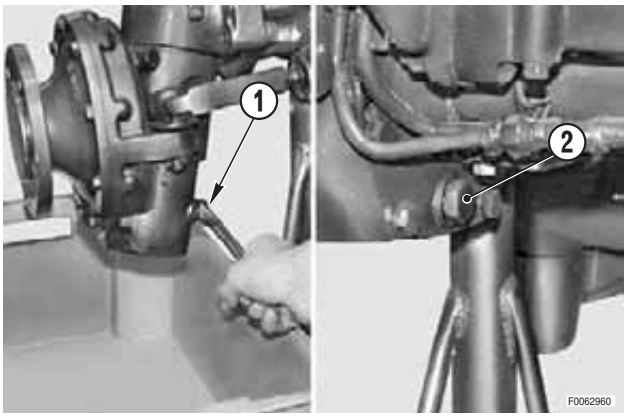
Removal

⚠ Remove the key from the ignition and apply the parking brake.

★ If the front axle is to be overhauled, remove the plugs (1) and (2) and drain off all the oil. ※1

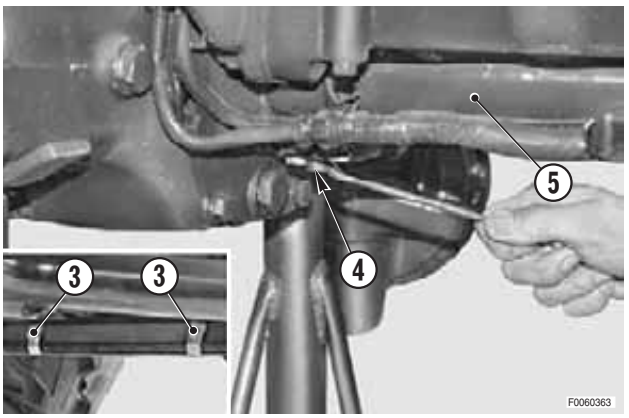
Front axle: max. 4.8 ℓ (1.3 US.gall.)

★ Renew the spring washers on reassembly.

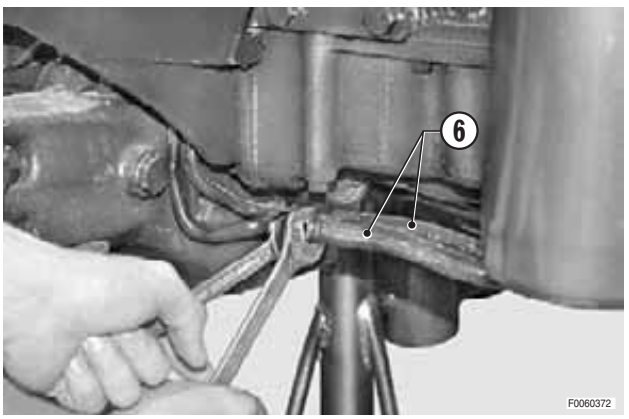


1 - Remove the screws (3) securing the hose clips.

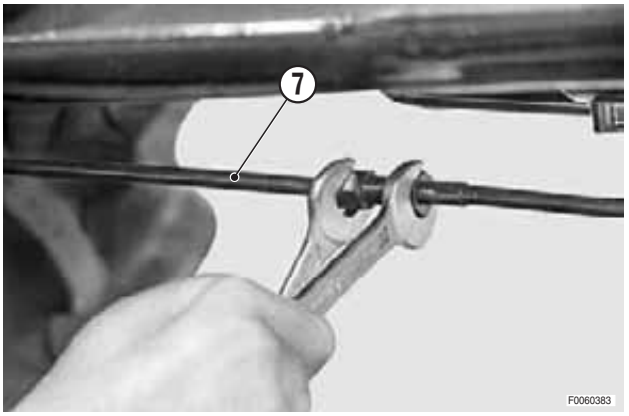
2 - Remove the five screws (4) and remove the 4WD shaft cover (5).



3 - Disconnect the steering control pipes (6).
★ Plug the pipes to prevent the entry of impurities.

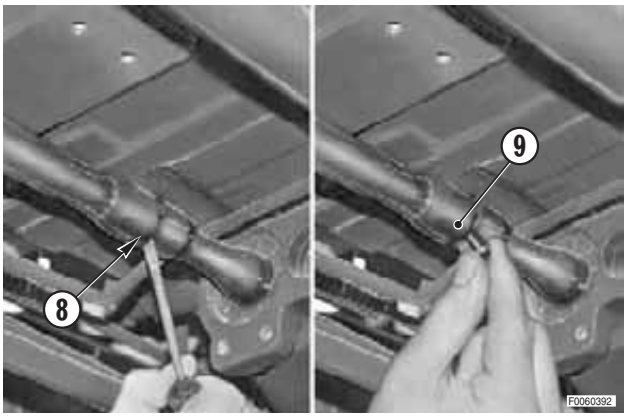


4 - Disconnect the front differential lock pipe (7).
★ Plug the pipe to prevent impurities getting in.



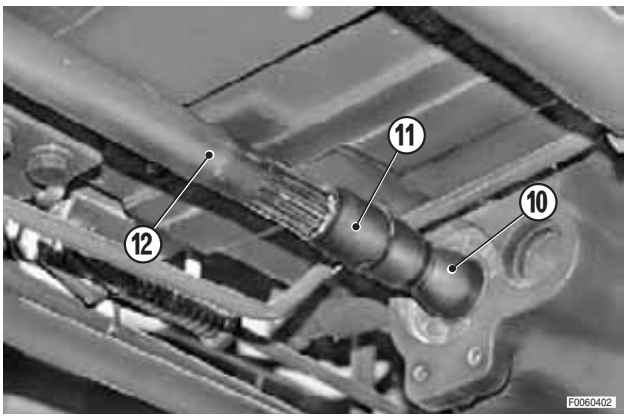
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5 - Unseat the circlip (8) and drive out the spring pin (9).

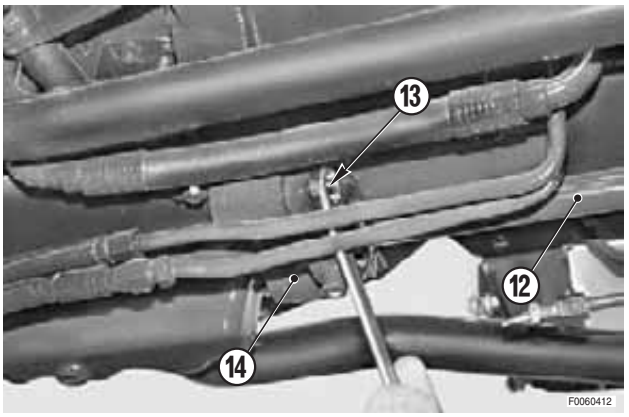


6 - Move the sleeve (11) towards the pinion (10) so as to release the 4WD shaft (12).
★ Take care not to get the sleeve stuck on the pinion teeth.

7 - Repeat steps 5 and 6 for the front sleeve.

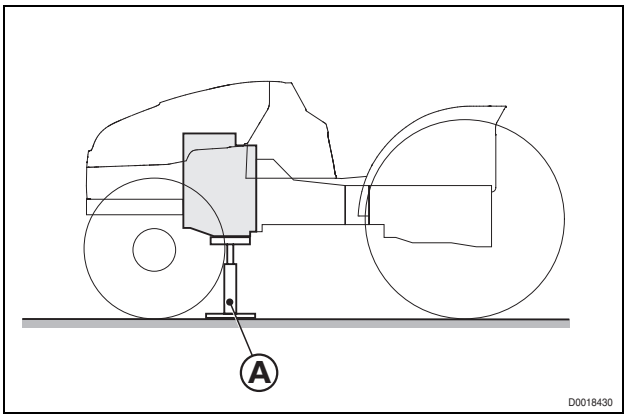


8 - Remove the bolts (13) and remove the 4WD shaft (12) complete with the central support (14).



9 - Raise the front end of the tractor and position a screw type stand “A” under the sump.

10 - Remove the front wheels.
(For details see «WHEELS»).

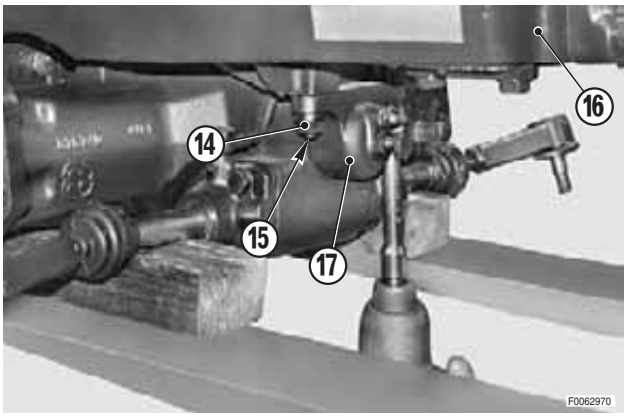


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11 - Position a jack under the front axle and remove the nuts (14) and the washers (15) (2 for each nut).

12 - Apply a lever between the front support (16) and the front and rear axle supports (17) and remove the complete axle. ※ 2

kg Front axle: max. 90 kg (198 lb.)



Refitting

- Refitting is the reverse of removal.

※ 1

1 - Fill the front axle with oil of the specified type and quantity.

Front axle: max. 4.8 ℓ (1.3 US.gall.)

2 - Start the engine and turn the steering wheel repeatedly to full lock in both directions in order to expel air from the steering system.

※ 2

★ Grease the front axle supports

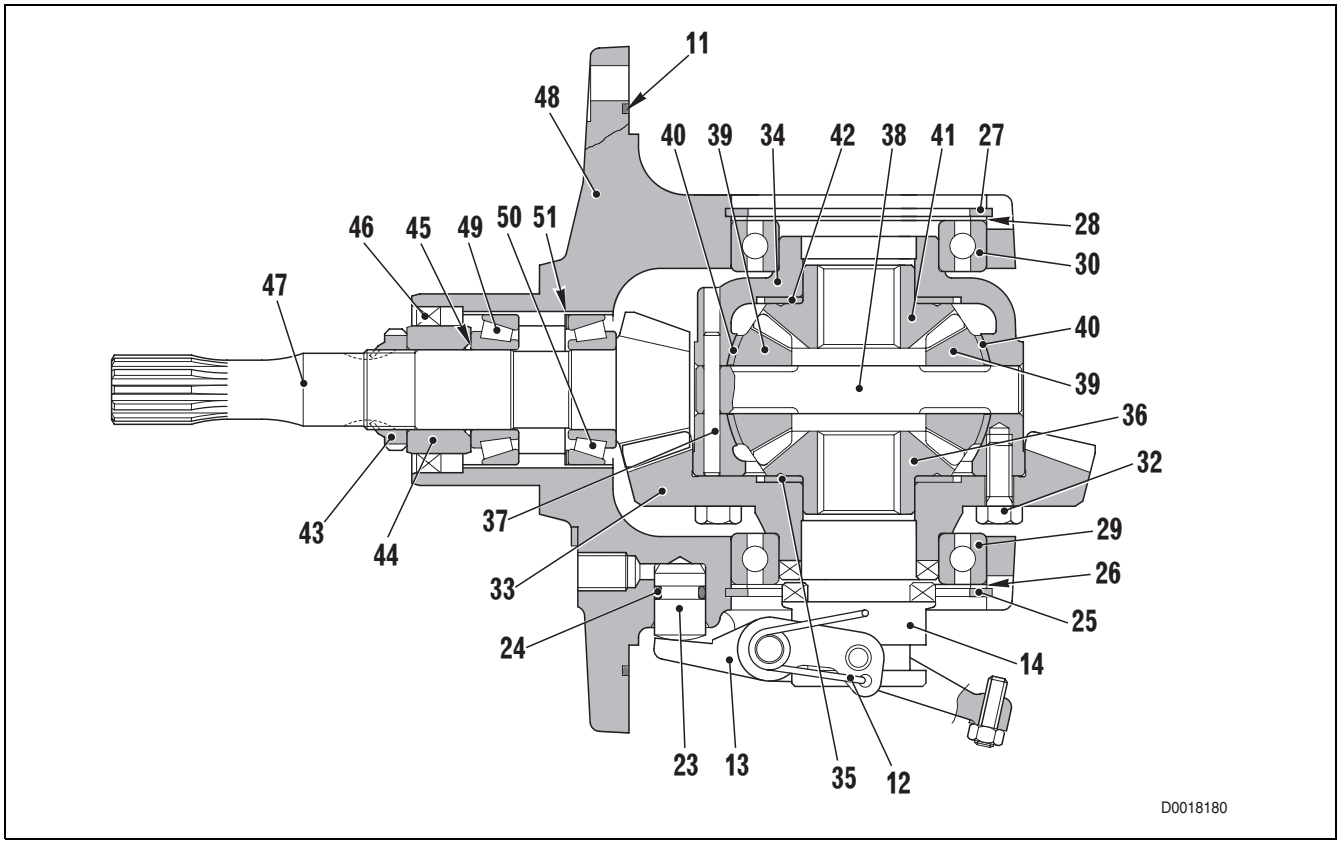
Supports: Grease

Nm Nuts: 112±5.6 Nm (82.5±4.1 lb.ft.)

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BEVEL GEAR PAIR

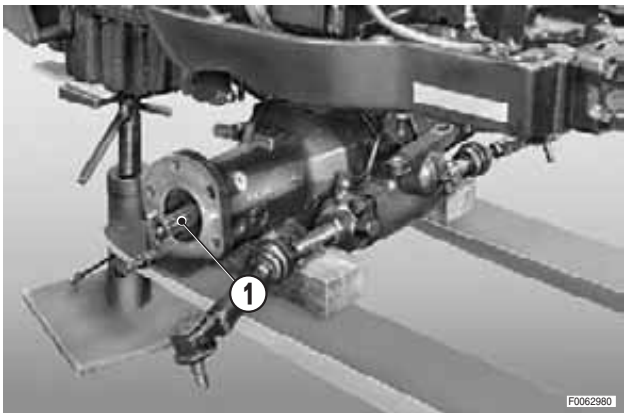
Disassembly



1 - Remove the final drive reduction units.
(For details see «FINAL DRIVE REDUCTION UNITS»).

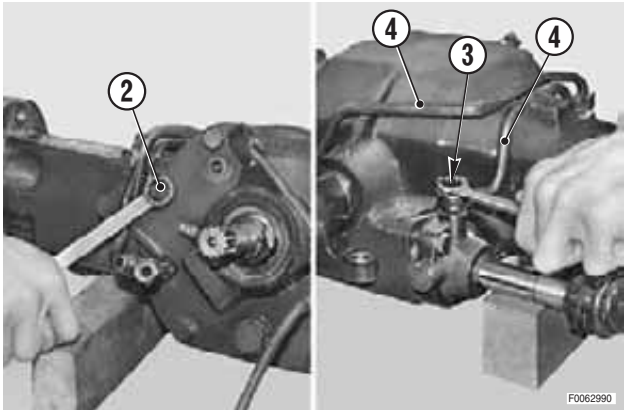
2 - Remove the axle.
(For details see «COMPLETE AXLE ASSEMBLY»).

3 - Remove the halfshafts (1).



4 - Remove the screw (2) and the unions (3) and remove the steering control pipes (4).

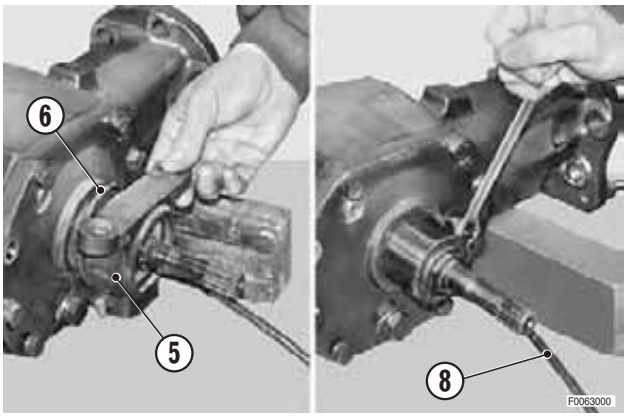
★ Renew the copper washers on reassembly.



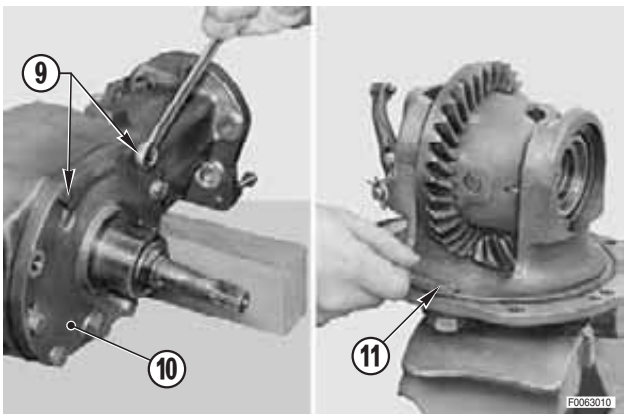
https://truckmanualshub.com/

5 - Remove the rear support (5) and the spacer (6).

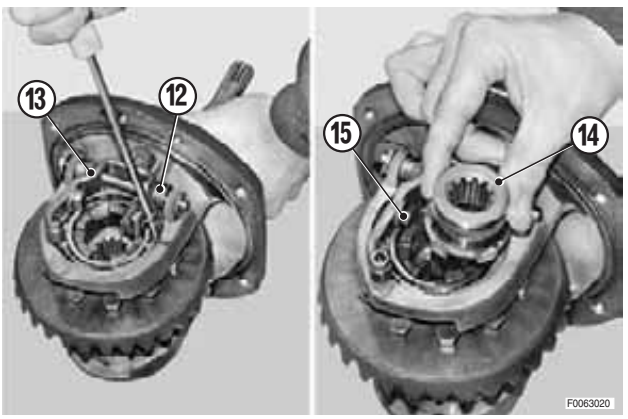
6 - Remove the union (7) and remove the differential lock control pipe (8).
★ Renew the copper washers on reassembly.



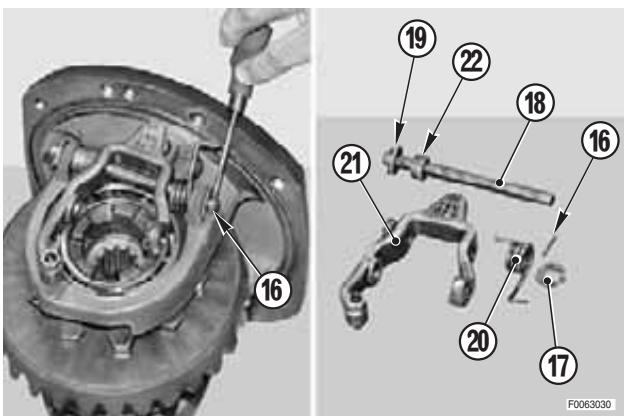
7 - Remove the screws (9) and remove the complete differential assembly (10).
★ Check the condition of the O-ring (11). Renew it if distorted or damaged.



8 - Detach the spring (12) from the fork (13) and remove the sleeve (14) and the shoes (15).



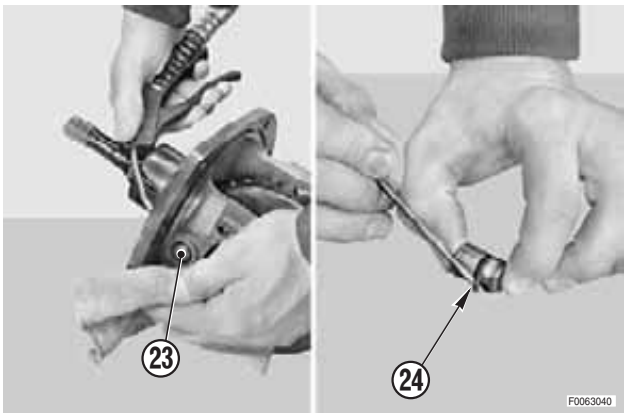
9 - Drive out the spring pin (16) and remove, in order, the washer (17), the pin (18) complete with washer (19), the spring (20), the fork (21) and the spacer (22).
★ Note which way round the spring (20) is positioned.



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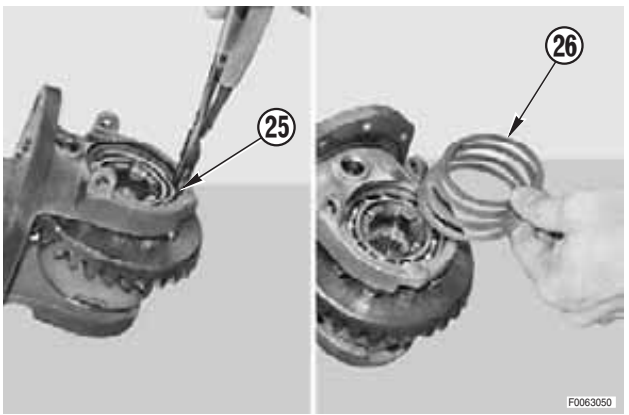
10 - Force the differential lock piston (23) with a low pressure compressed air jet.

★ Carefully check the condition of the O-ring (24); renew it if distorted or damaged.



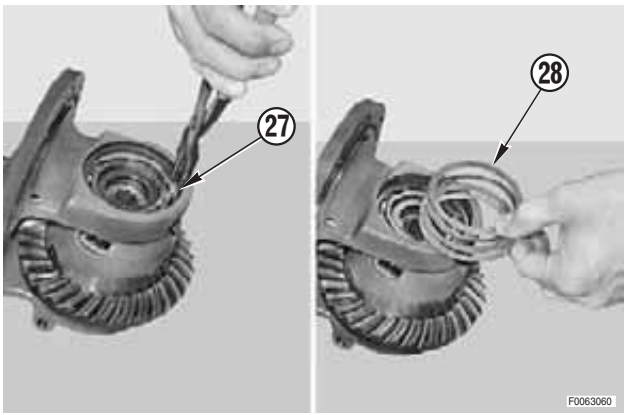
11 - Remove the circlip (25) on the crown wheel side and recover the shims (26).

★ Make a note of the total thickness of the shim pack (26).

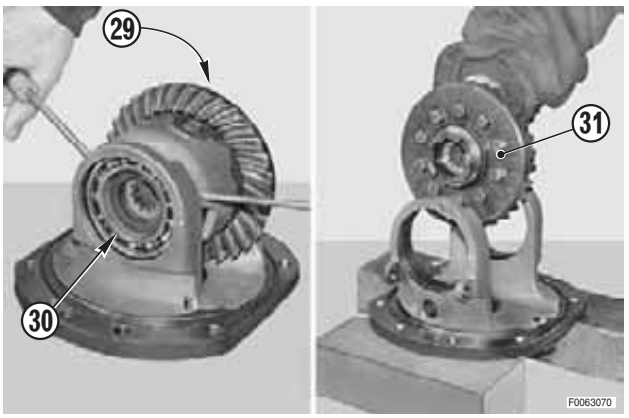


12 - Remove the circlip (27) from the opposite side to the crown wheel and recover the shims (28).

★ Make a note of the total thickness of the shim pack (28).

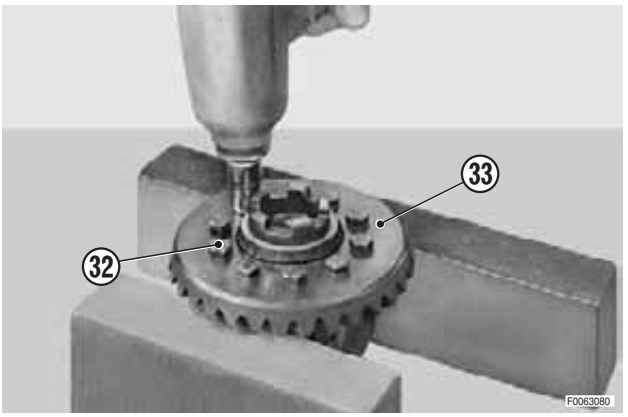


13 - Withdraw the bearings (29) and (30) and remove the complete differential assembly (31).

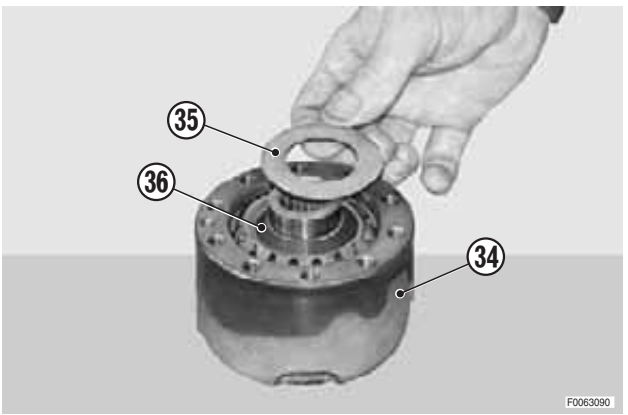


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14 - Remove the screws (32) and remove the crown wheel (33).

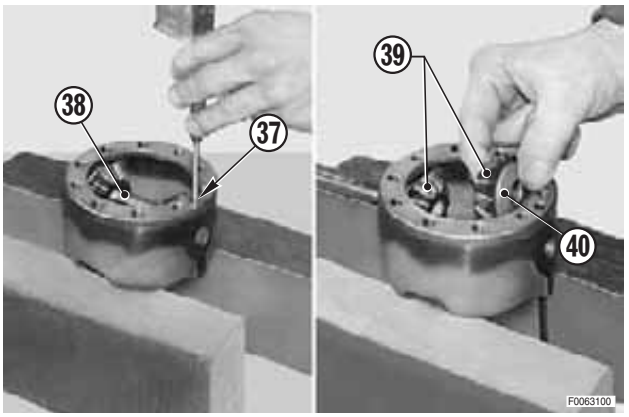


15 - Remove the thrust washer (35) and the sun wheel (36) from the differential housing (34).

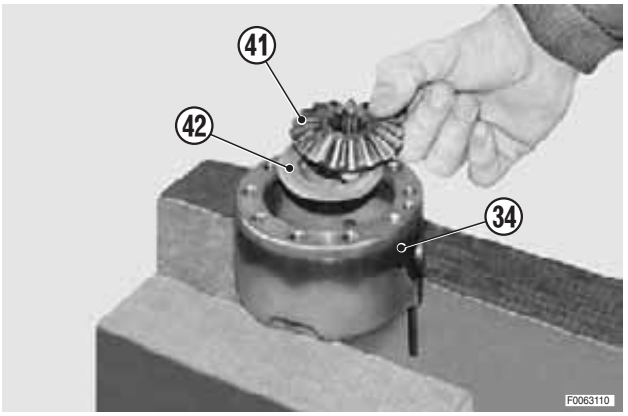


16 - Drive out the spring pin (37) sufficiently to release pin (38) and withdraw the pin (38).

17 - Withdraw the planet pinions (39) and the relative washers (40).



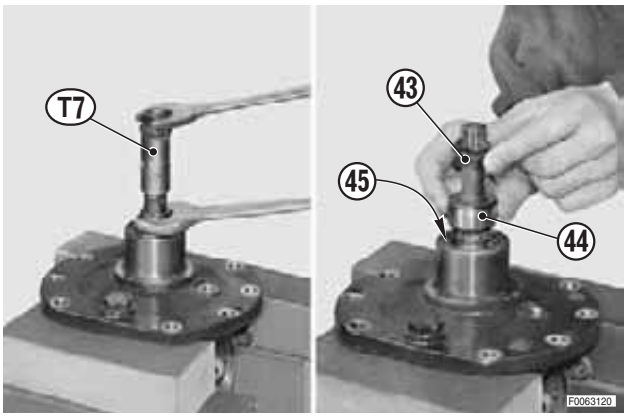
18 - Remove the sun gear (41) and the thrust washer (42) from the differential housing (34).



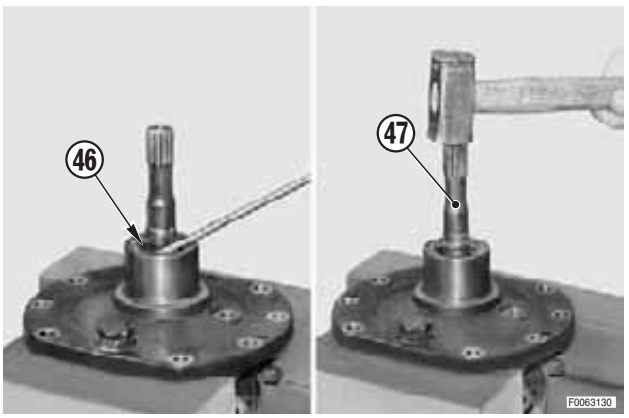
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19 - Using the wrench **T7** (code 5.9030.965.0), remove the ringnut (43).
★ Renew the ringnut on reassembly.

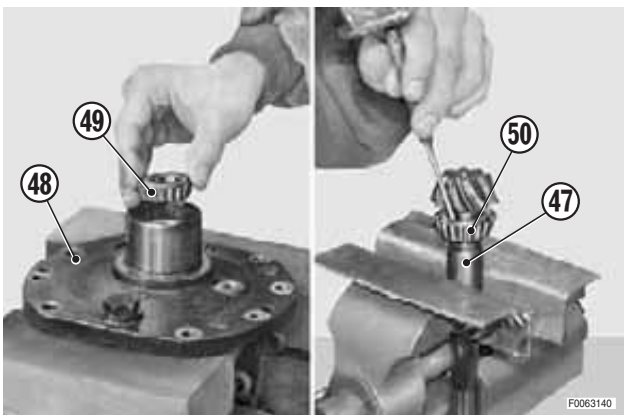
20 - Remove the spacer (44).
★ Recover the O-ring (45).



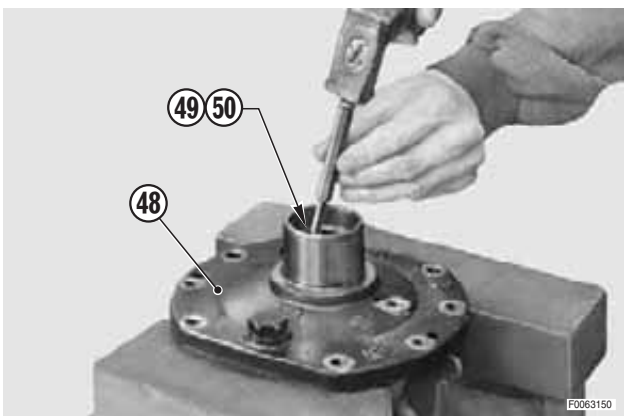
21 - Remove the oil seal (46) and withdraw the pinion (47).
★ Renew the oil seal on reassembly.



22 - Remove the inner ring of the bearing (49) from the differential support (48) and withdraw the inner ring of the bearing (50) from the pinion.



23 - Withdraw the outer rings of the bearings (49) and (50) from the differential support (48).
★ Recover the shims (51) installed under the outer ring of the bearing (50).

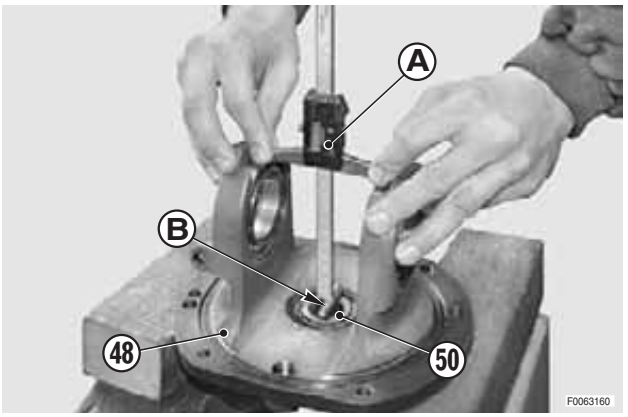


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Assembly

1 - Install the bearing (50) without the shims (51) in the differential support (48), and use a depth gauge "**A**" to measure the dimension "**X**".

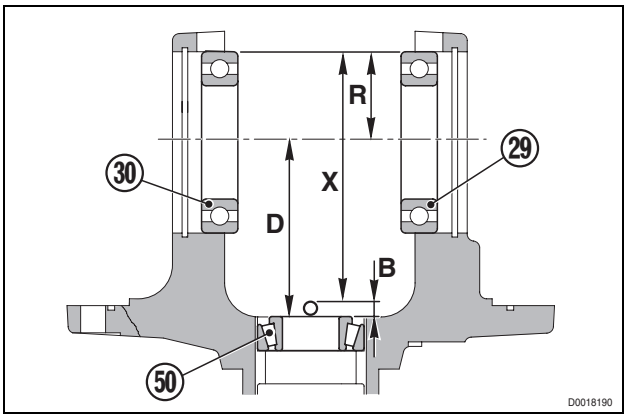
★ To facilitate the measurement, use a pin "**B**" or a calibrated plate.



2 - Calculate the distance "D" of the axis of rotation of the differential from the face of the bearing (50) with the following formula:
D = X + B – radius of crown wheel bearing (R)

★ Example:
- dimension "**X**" = 128.9 mm
- pin diameter "**B**" = 8.00
- radius of crown wheel bearing = 40.0 mm

D = 128.9 + 8.00 – 40.0 = 76.9 mm

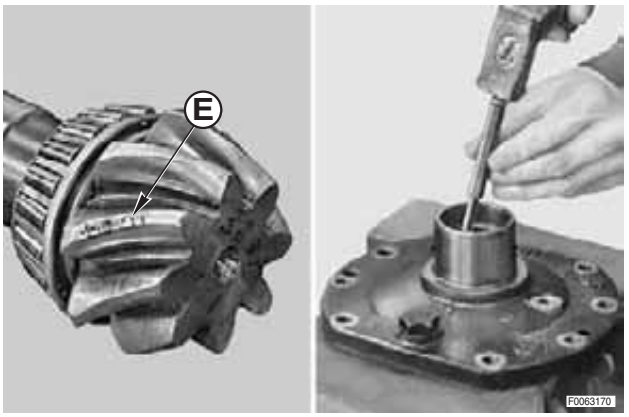


3 - Note the dimension "**E**" stamped on the tooth tip.

4 - Remove the outer ring of the bearing (50) and the bearings (29) and (30) of the differential support and form a shim pack "**S**" by applying the following formula:
S = D – theoretical value – E
Where:
S = shim pack
D = distance calculated in point 2.
theoretical value = 76.00
E = value stamped on tooth

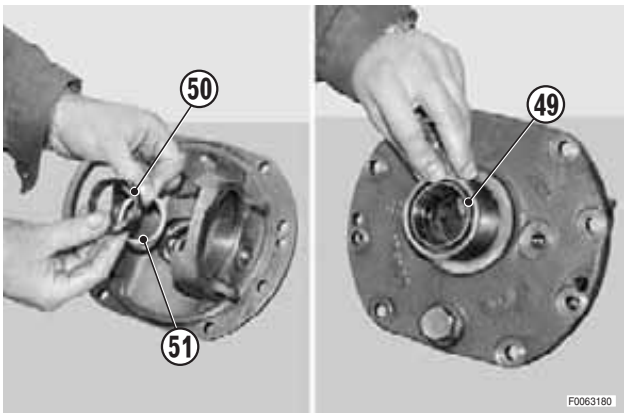
★ Example 1 (positive "**E**" value):
D = 76.90 mm
E = 0.30 mm
theoretical value = 76.00
S = 76.90 – 76.00 – 0.30 = 0.60 mm

★ Example 2 (negative "**E**" value):
D = 76.90 mm
E = – 0.30 mm
theoretical value = 76.00
S = 76.90 – 76.00 + 0.30 = 1.20 mm

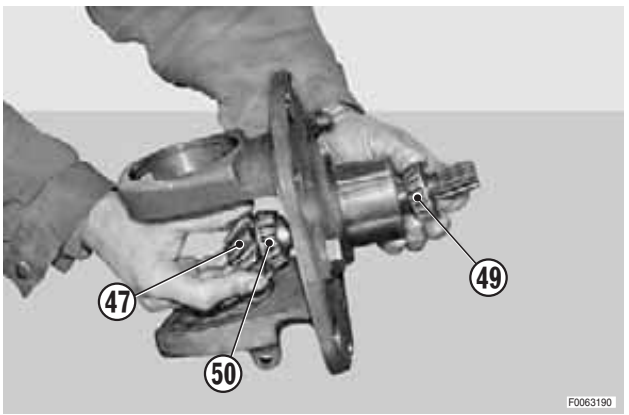


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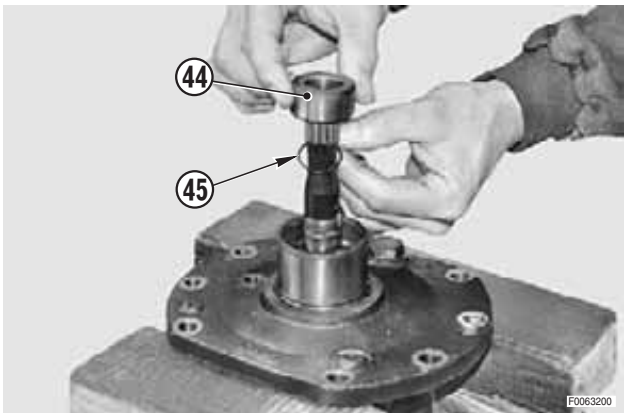
5 - Install in the differential support (48) the shim pack (51), the outer ring of the bearing (50) and the outer ring of the bearing (49).



6 - Insert the pinion (47) complete with the inner rings of the bearing (50) and the bearing (49).



7 - Fit the O-ring (45) and the spacer (44).

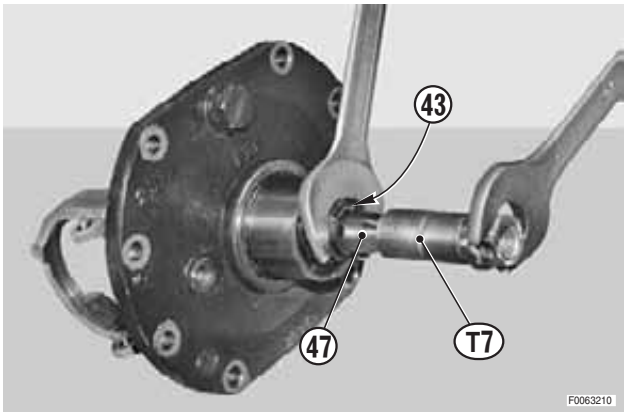


8 - Using the tool **T7** (code 5.9030.965.0), screw in the ringnut (43) to seat the bearings, then back off by about 1/4 turn.

Ringnut: Loctite 270

9 - While tightening the nut, rotate the pinion (47) in both directions and lightly tap it to help seat the bearings.

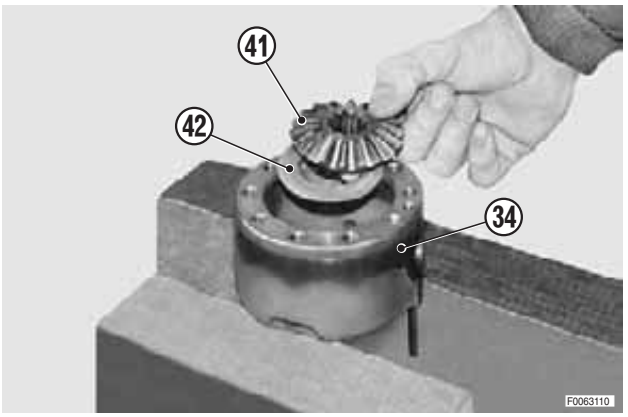
10 - Tighten the nut (10) gradually until all pinion end float is eliminated, but without preloading the bearings.



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11 - Position the thrust washer (42) and the sun gear (41) in the differential housing.

Thrust washer: transmission oil

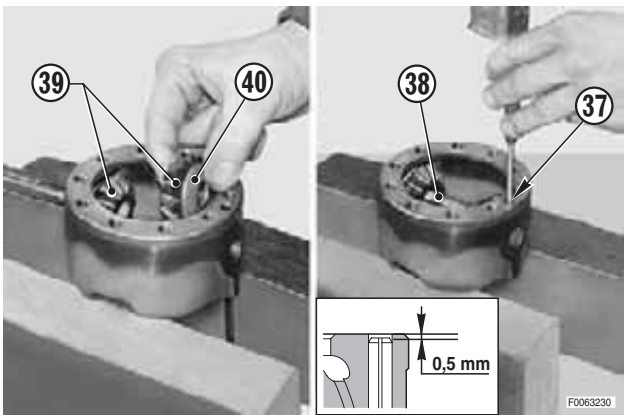


12 - Position the planet pinions (39) with their thrust washers (40).

Thrust washers: transmission oil

13 - Insert the pin (38) and secure it in position with the spring pin (37).

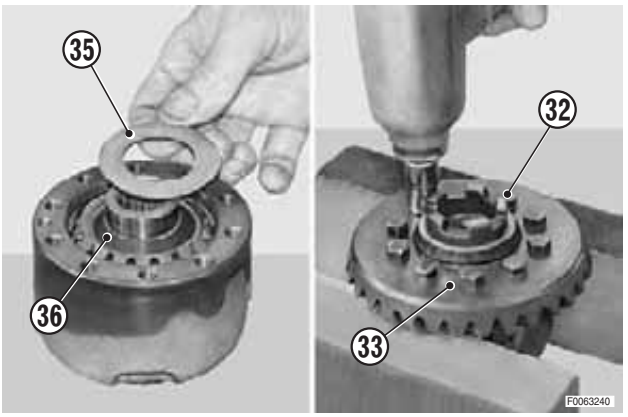
★ Insert the spring pin so that the end lies approx. 0.5 mm below the face of the differential housing to which the crown wheel is mounted.



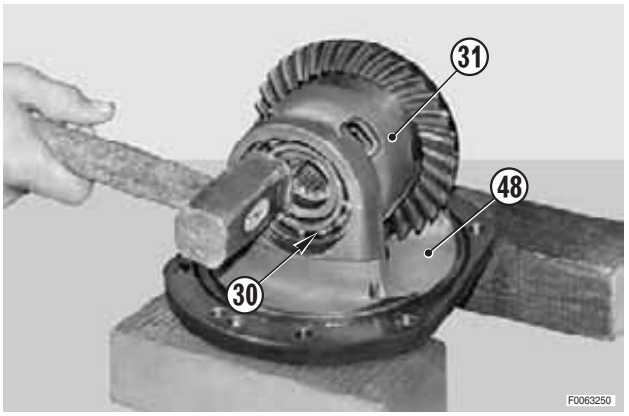
14 - Position the sun gear (36) and its thrust washer (35).

Thrust washer: transmission oil

15 - Fit the crown wheel (33) and tighten the screws (32).



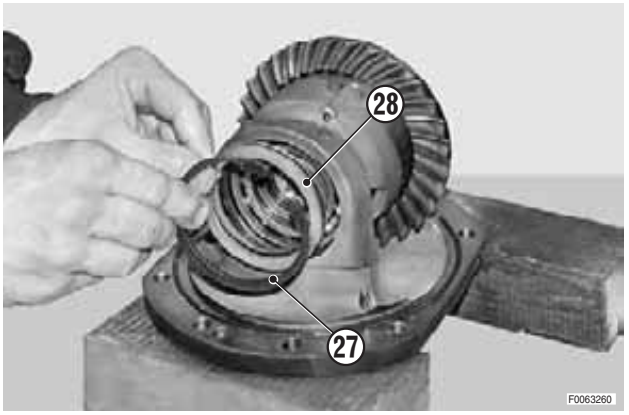
16 - Position the complete differential assembly (31) in the support (48) and fit the bearing (30) on the opposite side to the crown wheel.



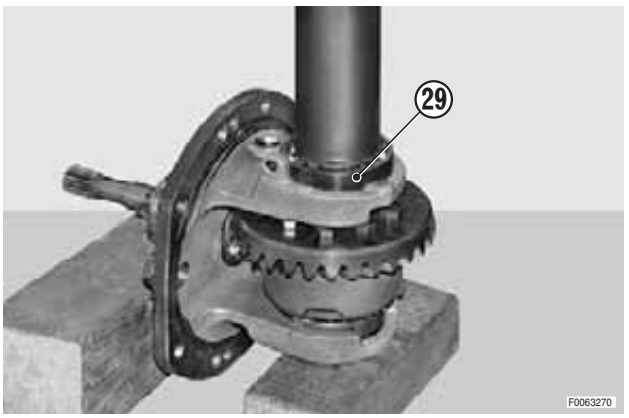
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17 - Form the shim pack (28) on the opposite side to the crown wheel by adding 0.2 mm to the thickness measured during disassembly.
★ Example:
measured thickness = 1.5 mm
new shim pack = 1.7 mm

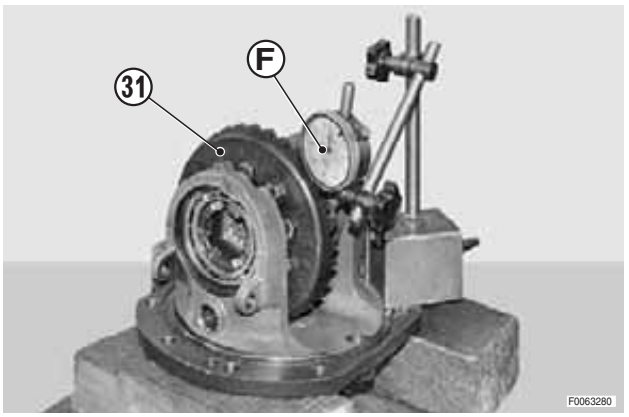
18 - Fit the new shim pack (28) and secure with the circlip (27).



19 - Fit the crown wheel side bearing (29) in its seat in the differential housing.
★ Check that both bearings are fully seated in the differential housing.

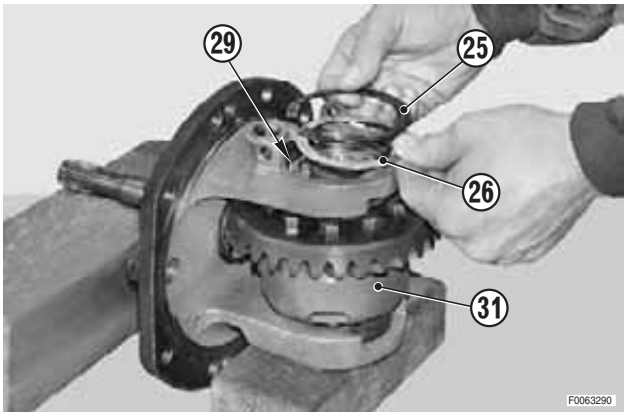


20 - Position a dial gauge "**F**" on a magnetic stand as shown with the contact point perpendicular to the outer side of a tooth on the crown wheel.
Preload the gauge by approx. 2 mm and measure the backlash "**Z**" between the pinion and crown wheel by turning the differential (31) back and forth in both directions.
★ Check that the bearing (30) on the opposite side to the crown wheel is tight up against the circlip.
★ Backlash "Z" normal: 0.14–0.19 mm
★ Take four measurements 90° apart and calculate the average.



21 - Temporarily fit the circlip (25) and, with a feeler gauge, measure the clearance between the circlip (25) and the bearing (29) to determine the thickness of the shim pack (26) to be installed under the circlip on the crown wheel side.
★ The shim pack (26) should be thick enough to eliminate the end float of the differential (31).

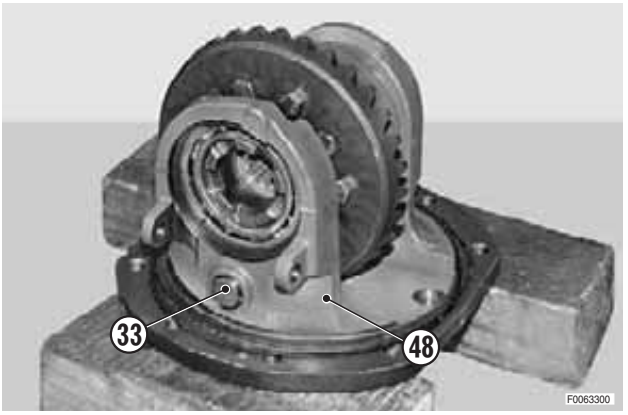
22 - Fit the shim pack (26) and secure it with the circlip (25).



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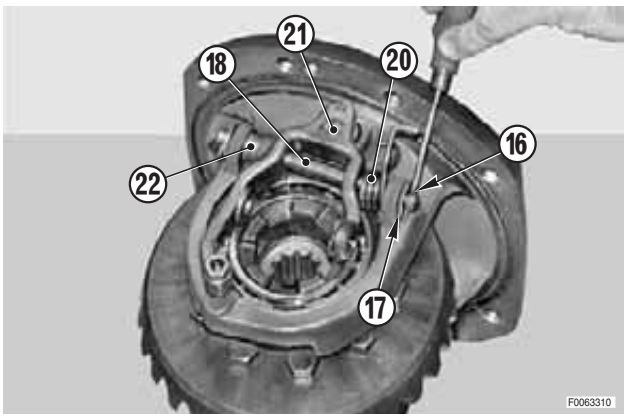
23 - Insert the differential lock piston (33) in the differential support (48).

O-ring seal: transmission oil



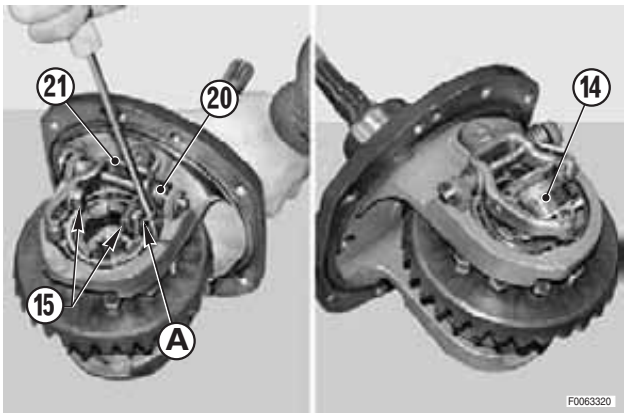
24 - Install the following components in the differential support in the order given: the spacer (22), the fork (21), the spring (20), the pin (18), the washer (17) and secure with the spring pin (16).

★ Take care to install the spring (20) the right way round.



25 - Insert the shoes (15) in the fork (21) and insert the end of the spring (20) in the hole "**A**".

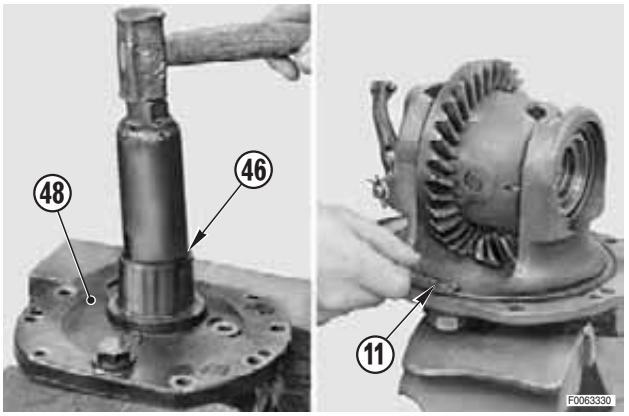
26 - Fit the sleeve (14).



27 - Using a suitable tool, fit the oil seal (46) on the differential support (48).

28 - Fit the O-ring (11).

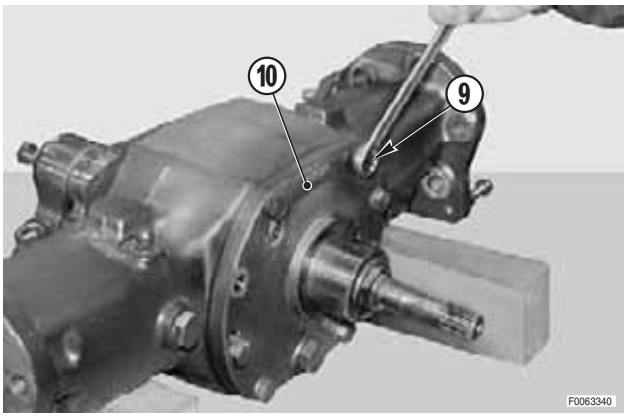
O-ring: grease



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29 - Install the complete differential assembly (10) in the axle housing and tighten the bolts (9).

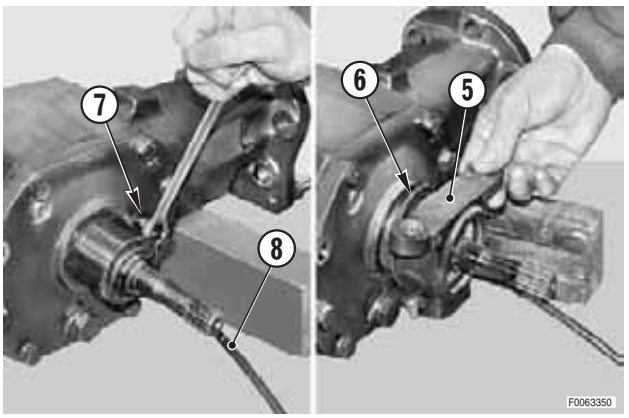
★ Make sure that the differential lock sleeve stays in position.



30 - Fit the pipe (8) and tighten the union (7).

★ Renew the copper washers on reassembly

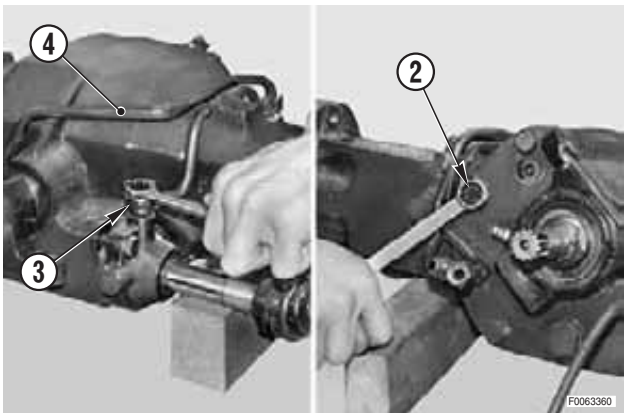
31 - Fit the spacer (6) and the rear axle housing (5).



32 - Fit the pipes (4) and tighten the unions (3).

★ Renew the copper washers on reassembly.

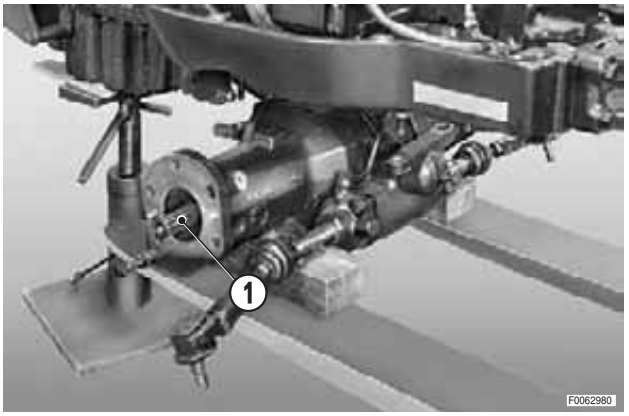
33 - Tighten the bolt (2).



34 - Fit the halfshafts (1).

35 - Fit the axle.
(For details see «COMPLETE AXLE ASSEMBLY»).

36 - Fit the final drive reduction units.
(For details see «FINAL DRIVE REDUCTION UNITS»).



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FINAL DRIVE REDUCTION UNITS

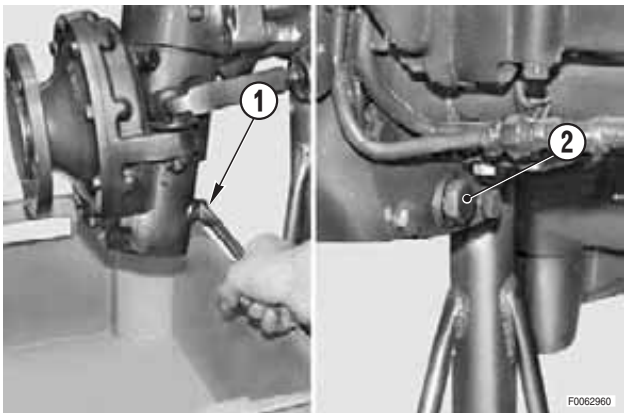
Removal

1 - Remove the front wheels.
(For details see «WHEELS»).

2 - Remove the left and right plugs (1) and (2) and drain off all the oil. ※ 1

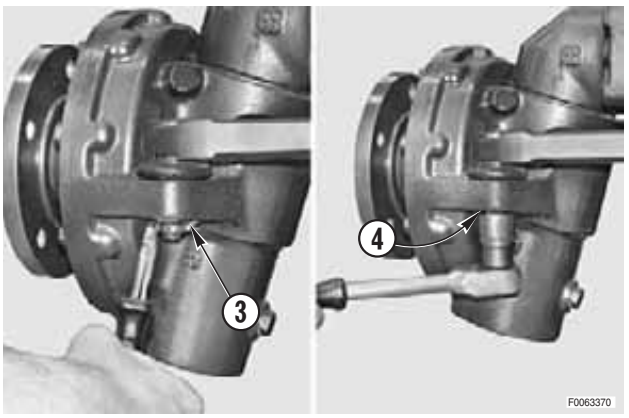
Front axle: max. 4.8 ℓ (1.3 US.gall.)

★ Renew the copper washers on reassembly.



3 - Remove the cotter pin (3) and loosen the nut (4).

★ Fit new cotter pins on reassembly.

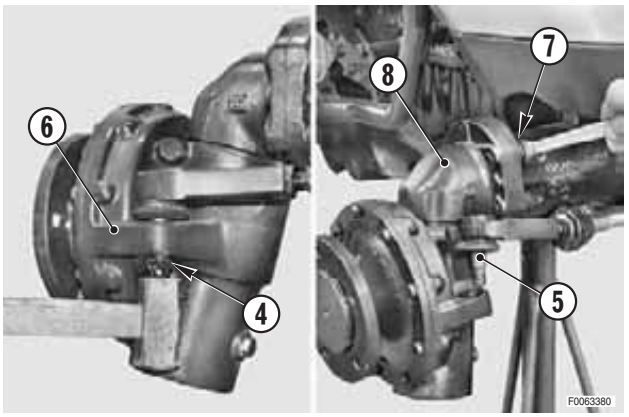


4 - Using a soft faced mallet and the nut (4) as a punch, detach the pin (5) from the stub axle housing (6).

※ 2

5 - Remove the nut (4) and remove the pin (5) from the stub axle housing.

6 - Remove the bolts (7) and remove the complete reduction unit assembly (8).



Refitting

- Refitting is the reverse of removal.

※ 1

1 - Fill the front axle with oil of the specified type and quantity.

Front axle: max. 4.8 ℓ (1.3 US.gall)

2 - Start the engine and turn the steering wheel repeatedly to full lock in both directions in order to expel air from the steering system.

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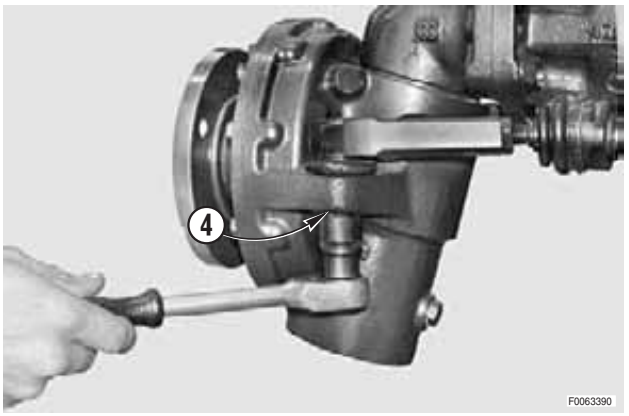
2

1 - Tighten the nut (4) to the specified torque.

Nm Nut: 25 Nm (18.4 lb.ft.)

2 - Tighten the nut (4) further to align the slot in the nut with the hole in the pin.

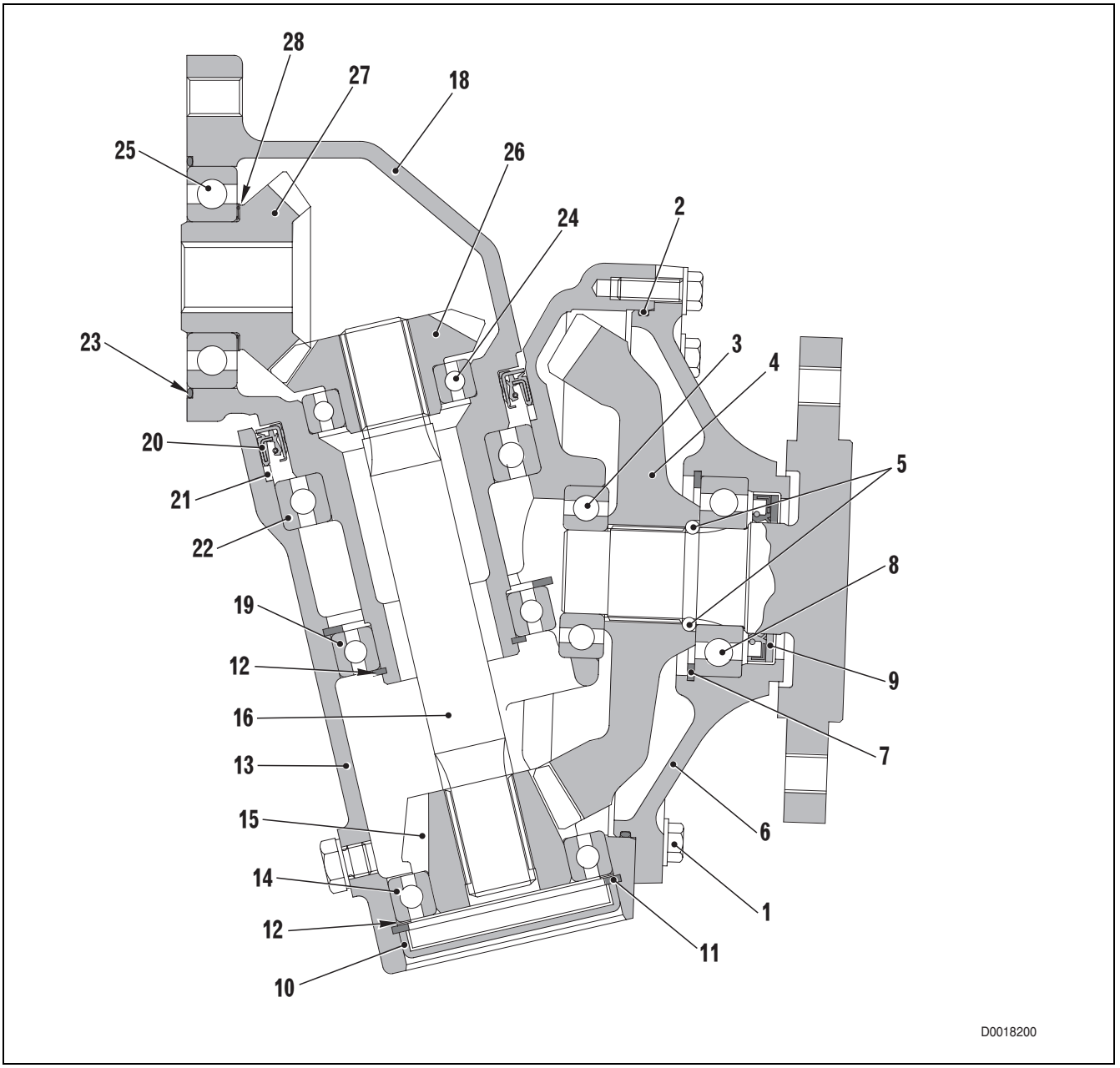
3 - Secure in position with a new cotter pin.



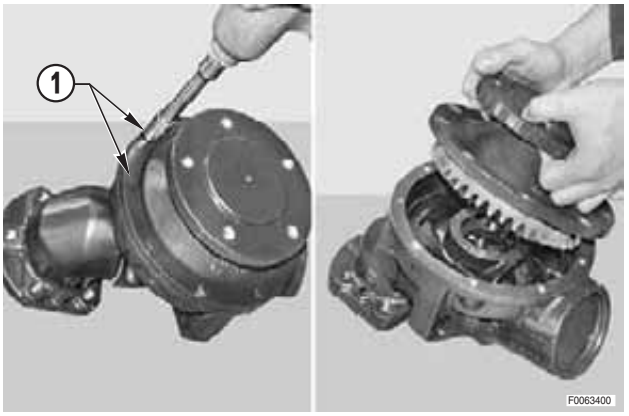
https://truckmanualshub.com/

OUTPUT FLANGE

Disassembly



1 - Remove the bolts (1) and remove the complete flange assembly.

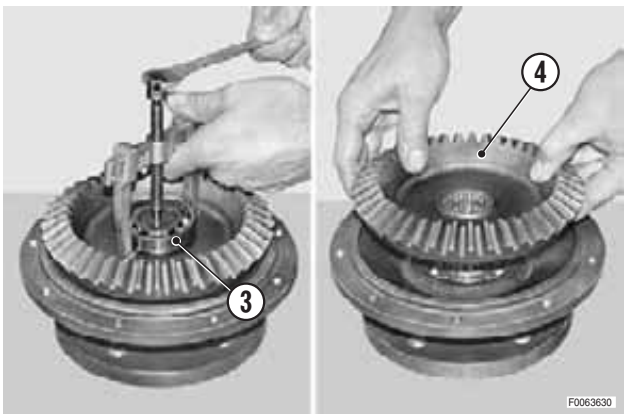


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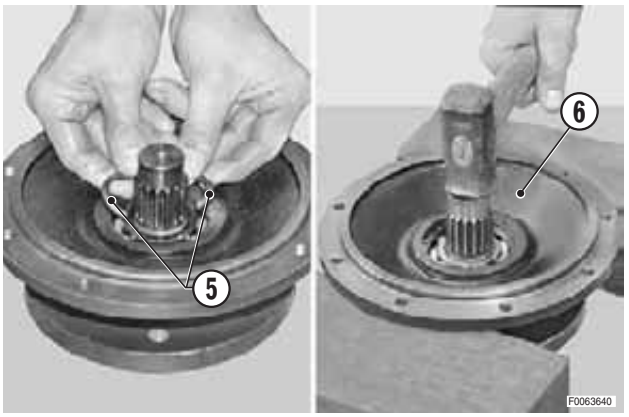
2 - Check the condition of the O-ring (2) and renew it if necessary. ⁘ 1



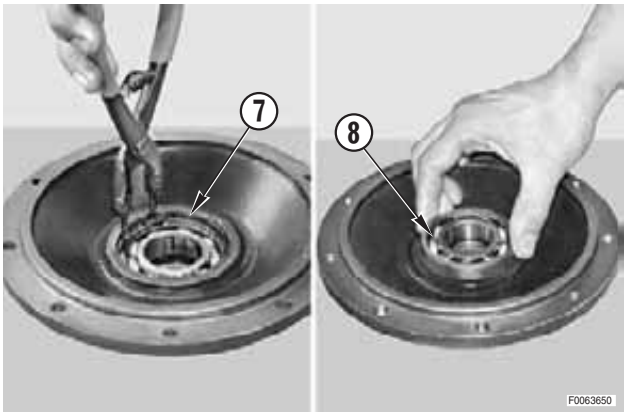
3 - Remove the bearing (3) and remove the crown wheel (4).



4 - Remove the ring halves (5) and remove the flange (6).

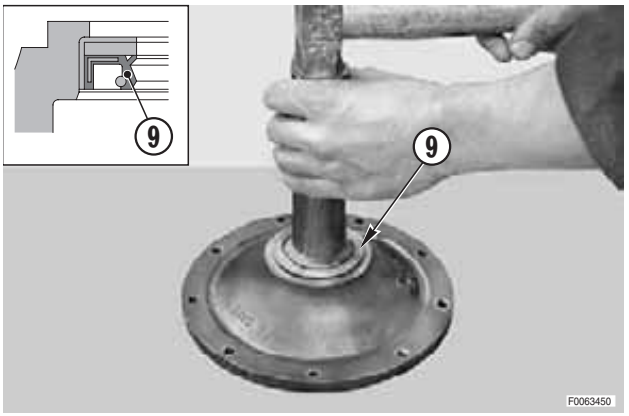


5 - Remove the circlip (7) and remove the bearing (8).



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6 - Remove the oil seal (9). ※ 2
★ Note which way round the oil seal is installed.



Assembly

- To assemble, follow the disassembly steps in reverse order.

※ 1
★ Lubricate the O-ring seal.

O-ring seal: Grease

※ 2
★ Lubricate the lips of the oil seal.

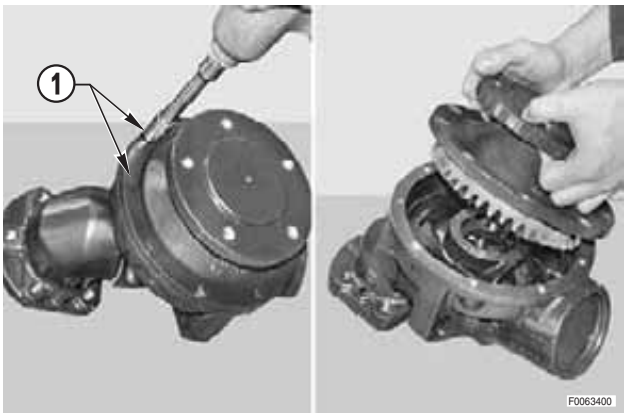
Oil seal: Grease

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STEERING JOINT

Disassembly

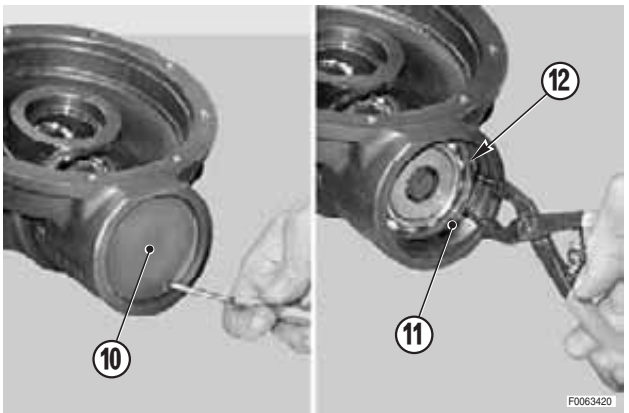
1 - Remove the bolts (1) and remove the complete flange assembly.



2 - Check the condition of the O-ring (2) and renew it if necessary. ※ 1

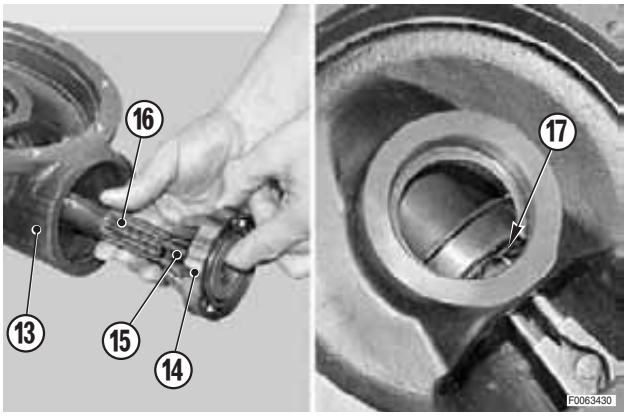


3 - Remove the cover (10), remove the circlip (11) and the spacer (12).



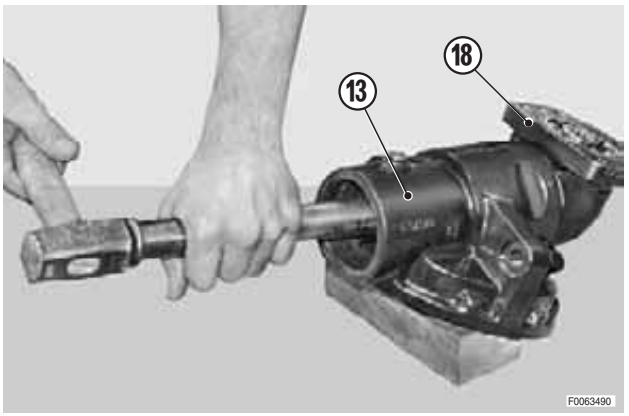
4 - Remove from the stub axle housing (13) the bearing (14) complete with gear (15) and shaft (16).
   ★ Mark the gear (15) to avoid confusion on reassembly.

5 - Remove the circlip (17).

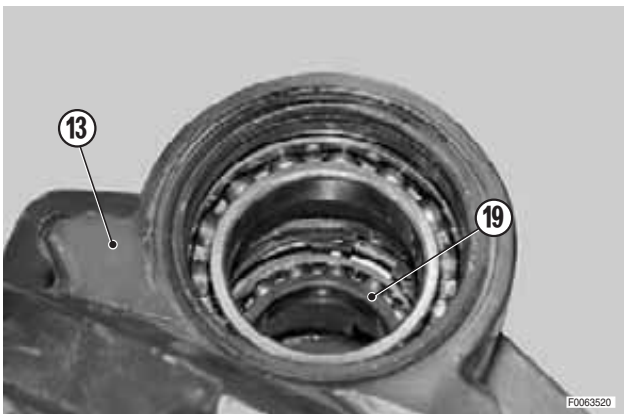


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6 - Using a soft metal punch and a mallet, drive the steering joint support (18) from the stub axle housing (13).
※ 2

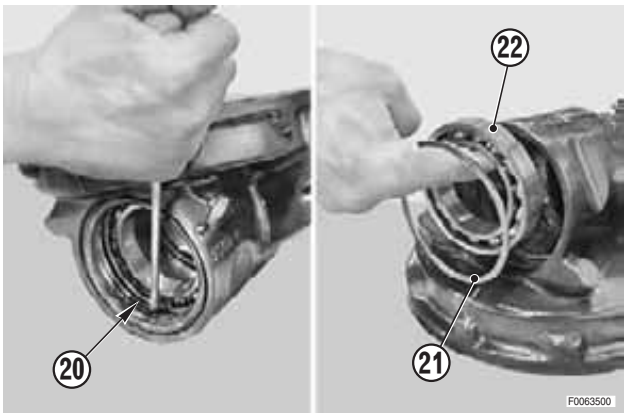


7 - Using a soft metal punch and a mallet, drive the bearing (19) from the stub axle housing (13).



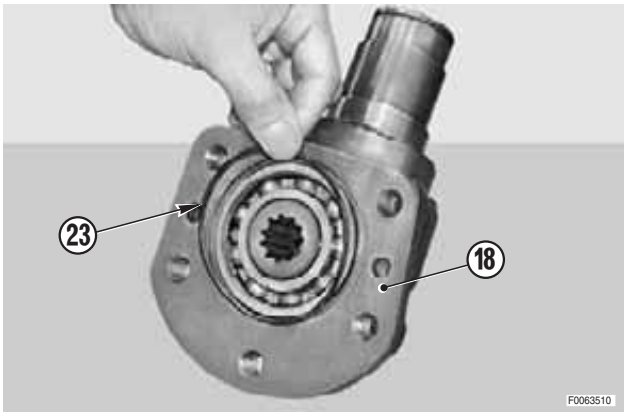
8 - Using a lever, remove the oil seal (20).

9 - Remove the spacer (21) and the bearing (22).



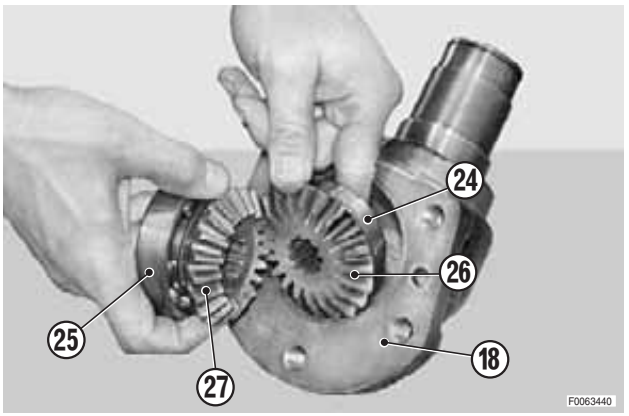
10 - Remove the O-ring (23) from the steering joint support (18).
※ 3

★ Check the condition of the O-ring and renew it if distorted or damaged.



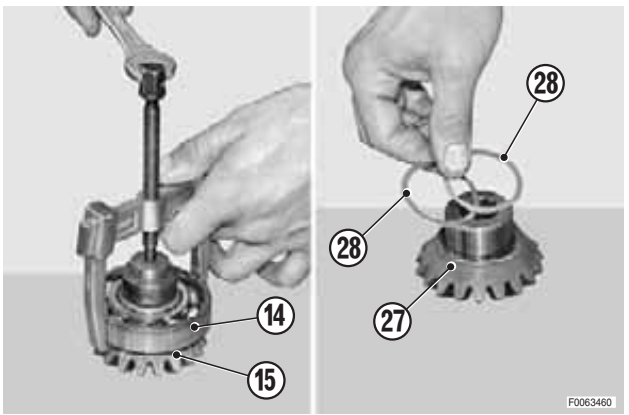
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11 - Remove from the steering joint support (18) the bearings (24) and (25) complete with gears (26) and (27).



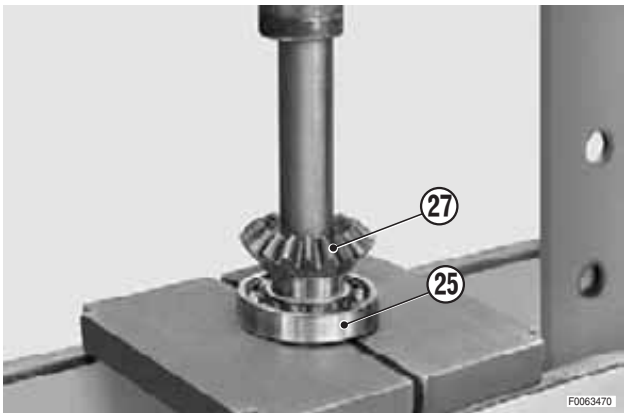
12 - Remove the bearings (14), (24) and (25) from the corresponding gears (15), (26) and (27).

13 - Recover the spacers (28) from the gear (27).



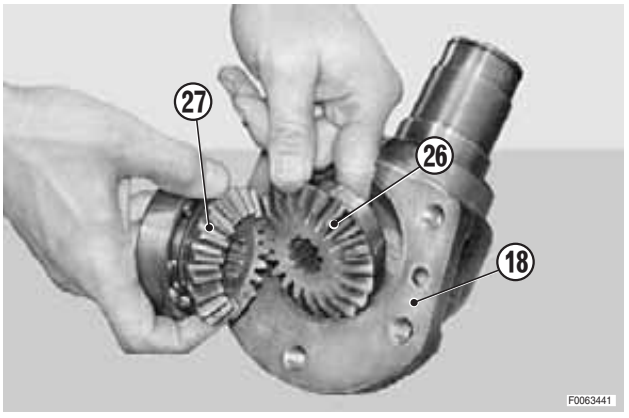
Preparation For Assembly

1 - Fit the gear (27) without shims (28) on the bearing (25) and fit the gears (15) and (26) on the corresponding bearings (14 and (24).



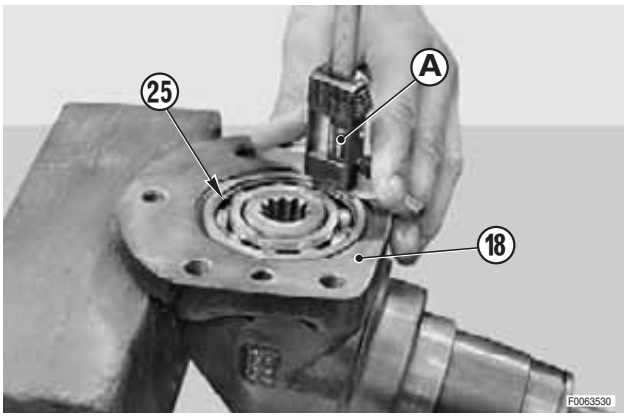
2 - Fit the complete gear assembly (26) and carefully drive it into its seating in the steering joint support (18).

3 - Fit the gear (27) previously assembled without shims and force it up against the gear (26).



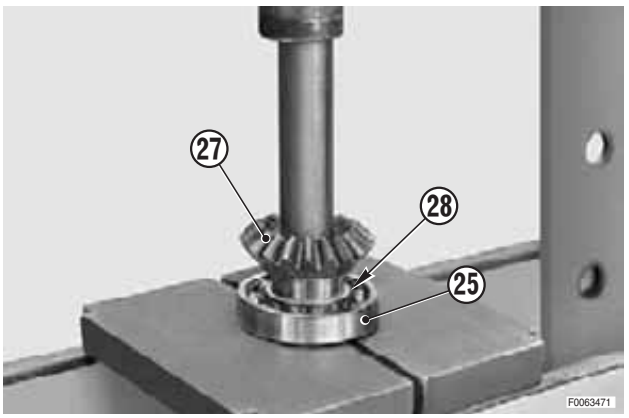
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4 - Using a depth gauge “A”, measure the distance “B” between the face of the steering joint support (18) and the outer ring of the bearing (25).
Calculate the thickness of the spacers “S” to be inserted by applying the following formula:
S = B – 0.3 mm

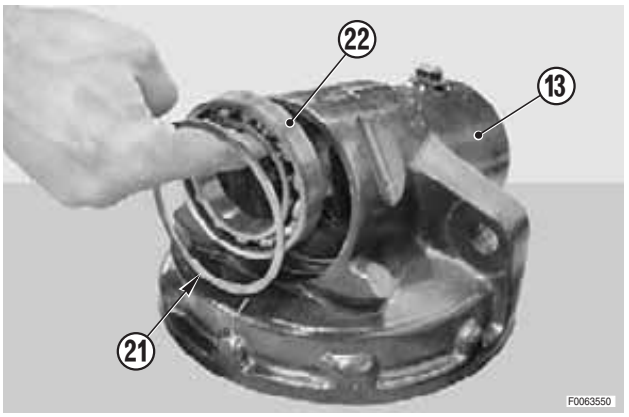


5 - Form a shim pack (28) with thickness equal to the calculated value “S” ± 0.04 mm.

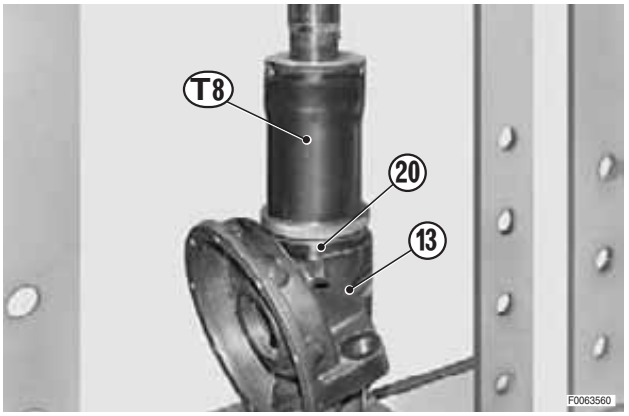
6 - Fit shims (28) of the calculated thickness under the gear (27).



7 - Fit the bearing (22) and the spacer (21) in the stub axle housing (13).



8 - Using the special tool **T8** (code 5.9030.966.0), fit the oil seal (20) in the stub axle housing (13).
★ Before installing the oil seal, carefully clean and degrease the seatings of the seal in the stub axle housing and on the steering joint support.
★ Do not lubricate the oil seal seatings.



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Final assembly

- To assemble, follow the disassembly steps in reverse order.

※ 1

★ Lubricate the O-ring seal (2).

O-ring: grease

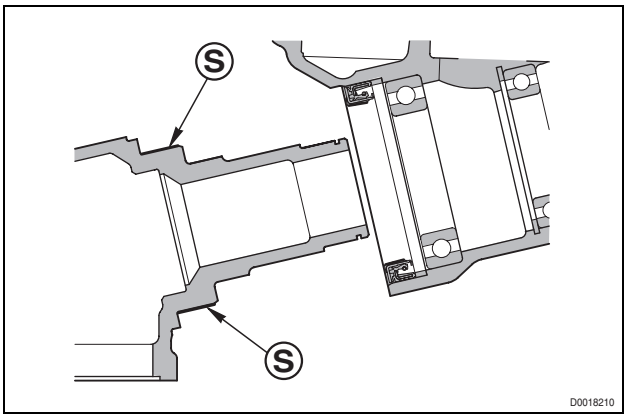
※ 2

★ Moisten the surfaces “S” of the steering joint support with ethyl alcohol to facilitate installation of the oil seal.

※ 3

★ Lubricate the O-ring (23).

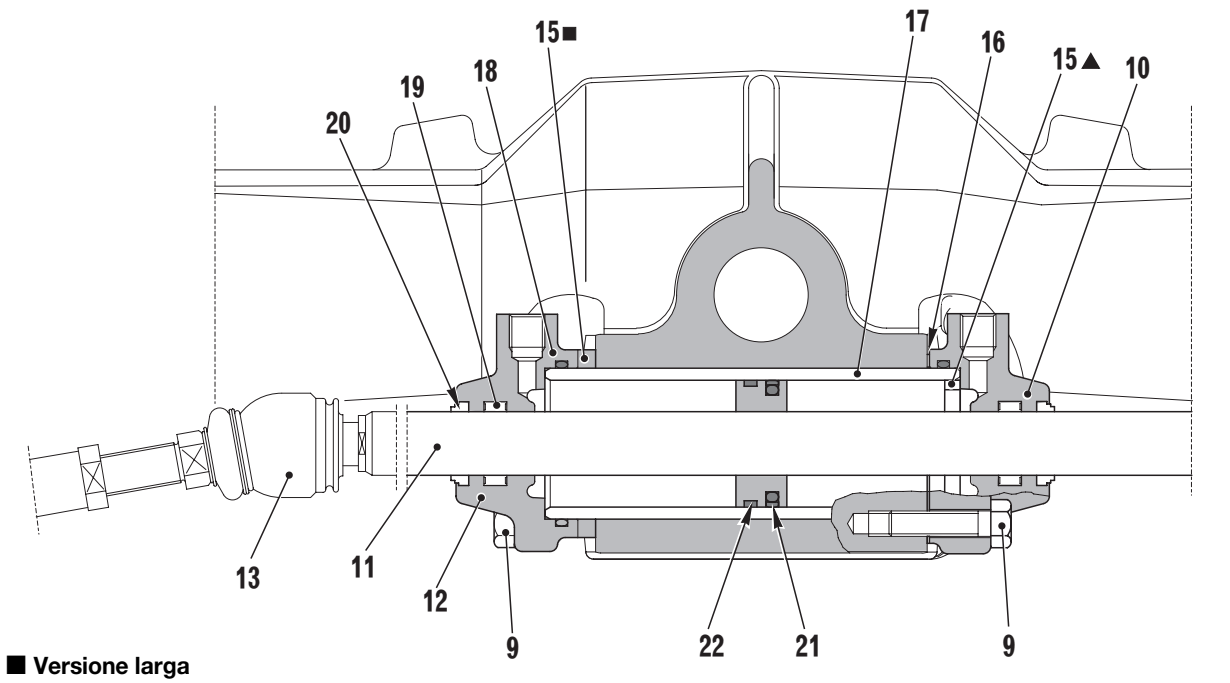
O-ring: grease



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STEERING CYLINDER

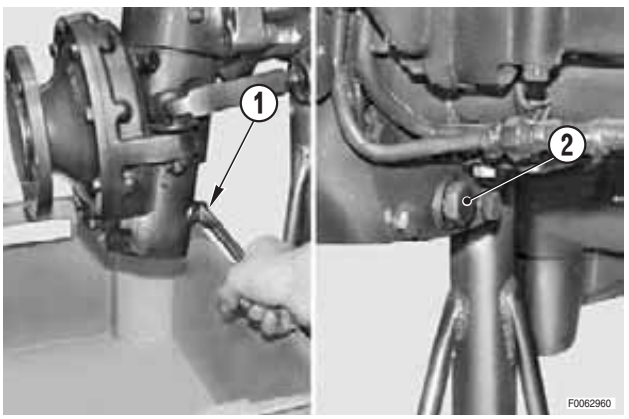
Disassembly



1 - Remover the right and left plugs (1) and the plug (2) and drain off all the oil. ※ 1

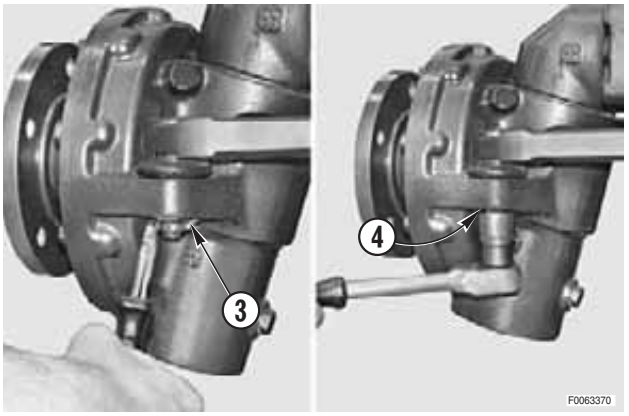
Front axle: max: max. 4.8 ℓ (1.3 US.gall.)

★ Renew the copper washers on reassembly.



2 - Remove the cotter pin (3) and loosen the nut (4).

★ Fit new cotter pins on reassembly.

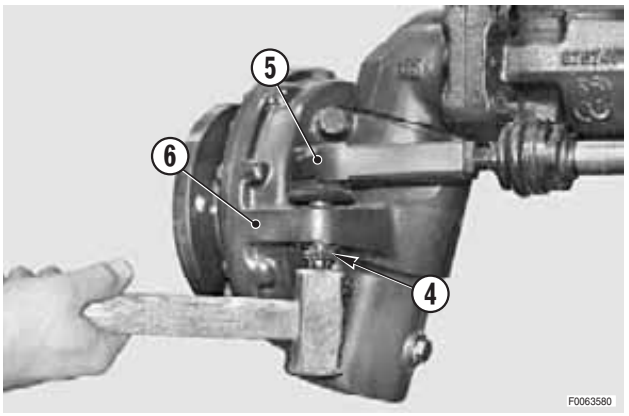


https://truckmanualshub.com/

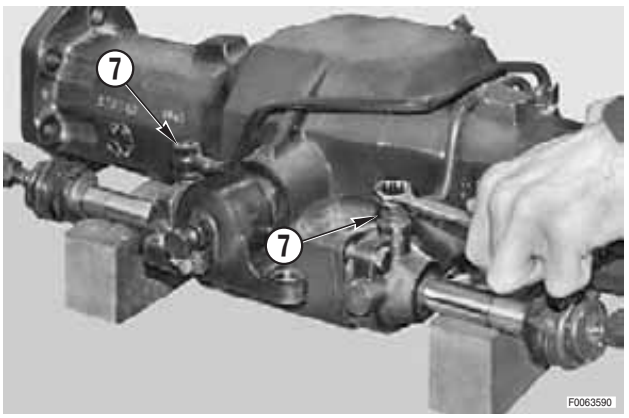
3 - Use a soft faced mallet and the nut (4) as a drift, detach the pin (5) from the stub axle housing (6). ※ 2

4 - Remove the nut (4) and withdraw the pin (5) from the stub axle housing..

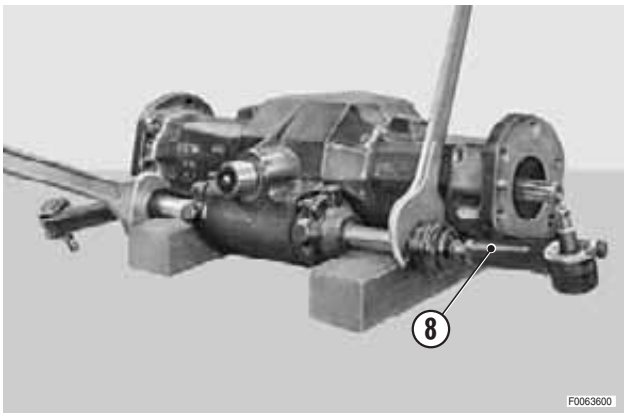
5 - Repeat steps 2, 3 and 4 for the pinion on the opposite side.



6 - Remove the unions (7).
★ Renew the copper washers on reassembly.

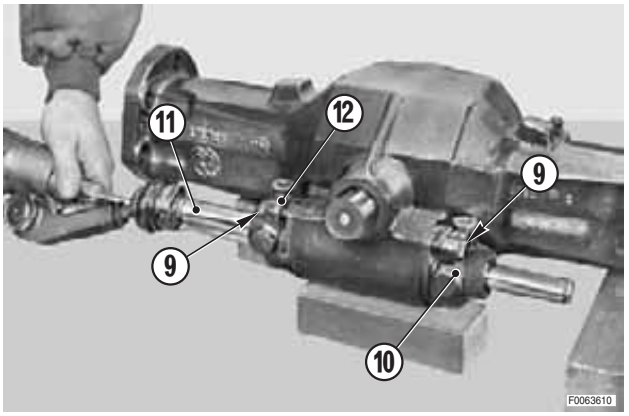


7 - Using a hot air generator, heat one side of the piston to approx. 65 °C and removethe steering arm (8). ※ 3



8 - Remove the screws (9) (2 per side) and remove the end cap (10). ※ 4

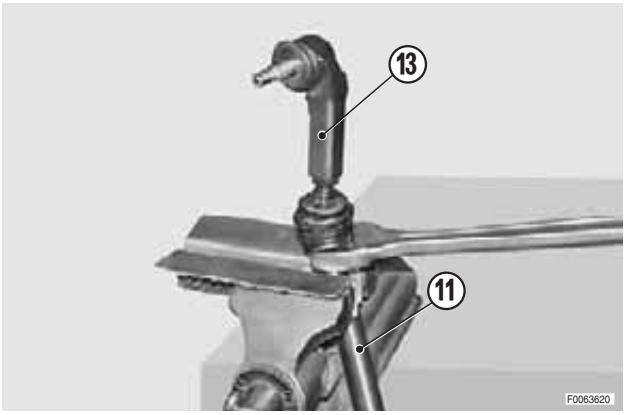
9 - Withdraw the piston (11) complete with the end cap (12).



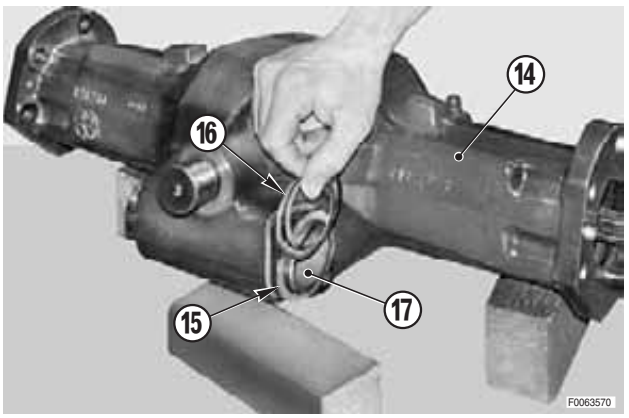
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10 - Grip the piston (11) in a vice (with soft-faced jaws) and using a hot air generator, heat the end to approx. 65°C and remove the steering arm (13). ⁘ 5

11 - Remove the end cap.



12 - Remove the spacers (15), the shims (16) and the steering cylinder (17) from the axle housing (14). ⁘ 6

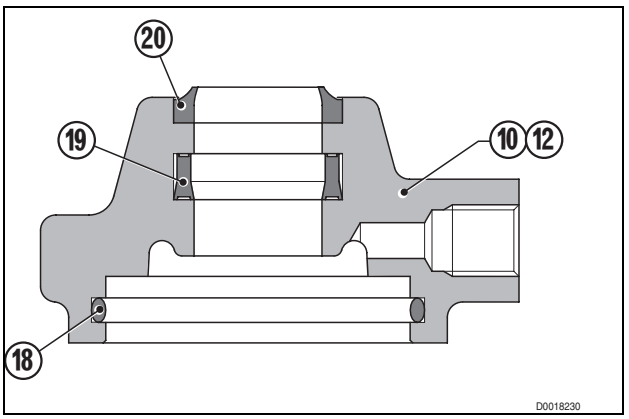


13 - Remove the O-ring (18), the gasket (19) and the dust seal (20) from the end caps (10) and (12).

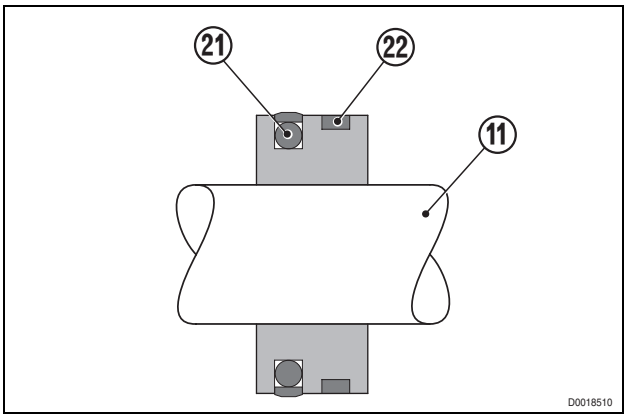
★ Check the condition of the O-ring (18) and renew it if necessary.

★ Note which way round the gasket (19) is installed.

★ Renew the gasket (19) and the dust seal (20) on reassembly.



14 - Remove the seal (21) and guide ring (22) from the piston (11).



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Assembly

- To assemble, follow the disassembly steps in reverse order.

※ 1

1 - Fill the front axle with oil of the specified type and quantity.

Front axle: max. 4.8 ℓ (1.3 US.gall)

2 - Start the engine and turn the steering wheel repeatedly to full lock in both directions in order to expel air from the steering system.

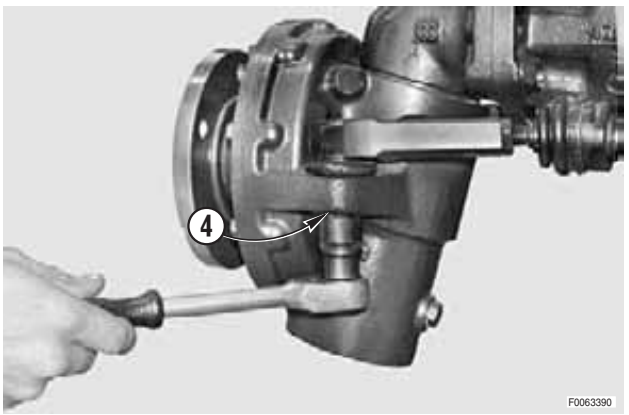
※ 2

1 - Tighten the nut (4) to the specified torque.

Nm Nut: 25 Nm (18.4 lb.ft.)

2 - Tighten the nut (4) further to align the slot in the nut with the hole in the pin.

3 - Secure in position with a new cotter pin.



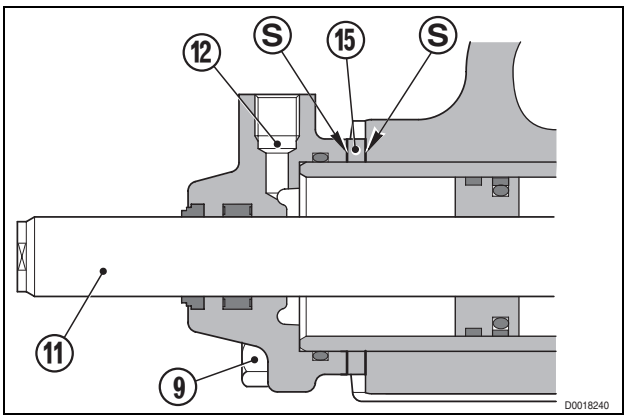
※ 3

1 - Fit and tighten the two steering arms (8) and (13) simultaneously.

Nm Steering arms: 131–145 Nm (96.5–107 lb.ft.)

Steering arms: Loctite 242

Wide version

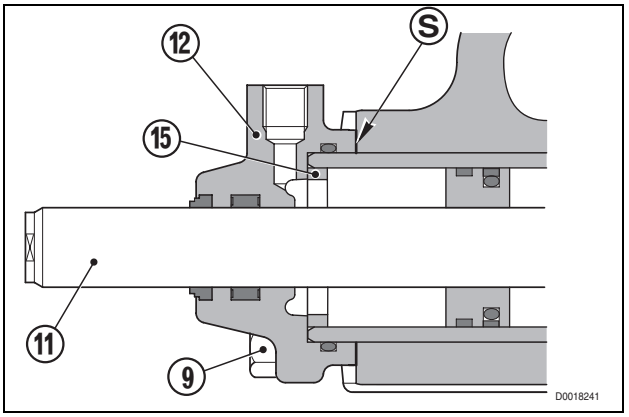


※ 4

1 - Fit the piston (11), the spacer (15) and the right end cap (12) in the steering cylinder and tighten the screws (9).

Mating surfaces "**S**": Silastic

Narrow version

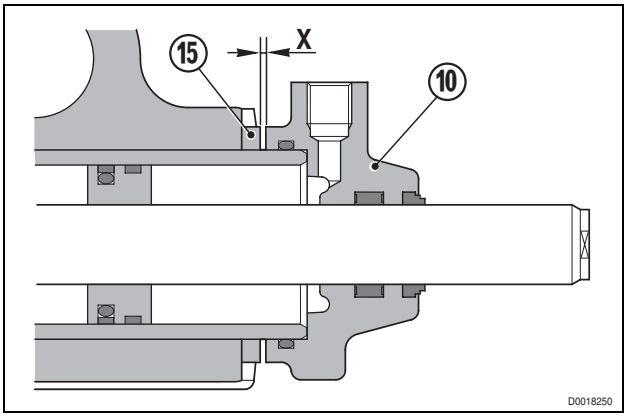


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2 - Temporarily fit the left end cap (10) without shims and measure the dimension “X”.

★ For wide versions, fit also the spacer (15).

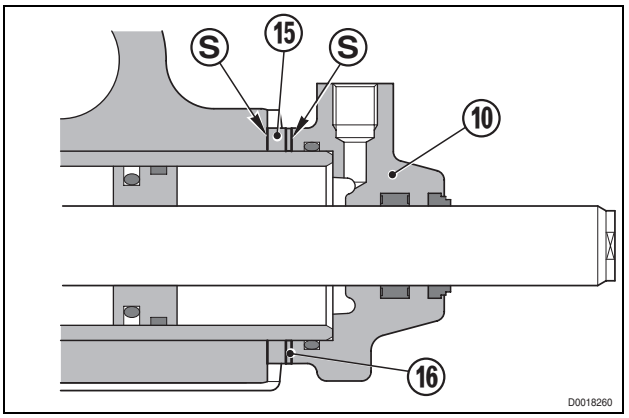
3 - Form a shim pack of the measured thickness “**X**” plus 0.05–0.10 mm.



Wide Version

4 - Insert the shim pack (16) between the left end cap (10) and the spacer (15) and tighten the screws.

Mating surfaces “**S**”: Silastic



Narrow version

5 - Insert the spacer (15) in the cylinder, fit the shim pack (16), the left end cap (10) and tighten the screws.

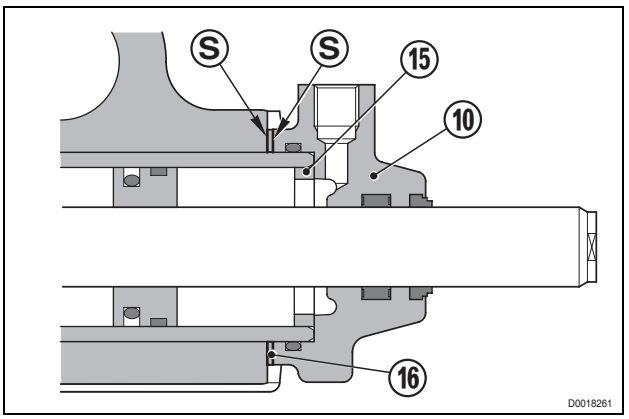
Mating surfaces “**S**”: Silastic

5

★ Do not fit the steering arm at this stage.

6

★ Do not fit the spacers (15) and the shims (16) at this stage.



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SECTION 40

CONTENTS

THE STRUCTURE OF THE UNIT 1

HOW TO CONSULT THE UNIT 2

1. INTRODUCTION 3
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- 1.2 DEFINITION OF COMPONENTS AND SYMBOLS 3
- 1.3 GENERAL RULES 4
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THE STRUCTURE OF THE UNIT

For easier consultation, this unit has been divided into the following chapters:

1. Introduction

Contains a brief description of the terminology used, the procedures to follow for troubleshooting and repairs, and the instruments required for troubleshooting.

2. Indices

Contains the indices arranged by connector name, by component code and by component description.

3. Components

Contains the layouts of the connectors used in the electrical system, descriptions of the components installed on the tractor,the technical data necessary for functional testing and the pinouts of the electronic control units.

4. Systems

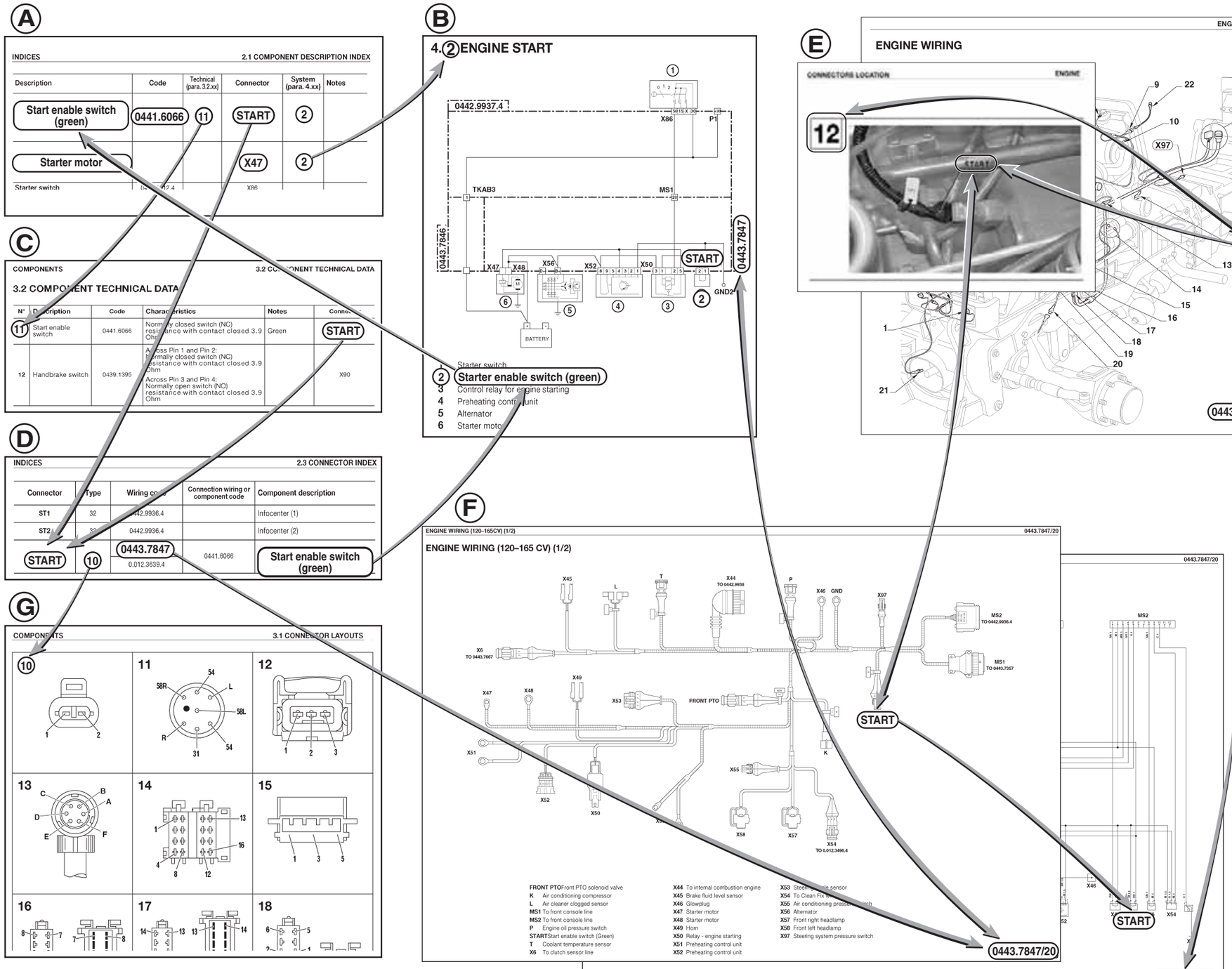
Contains the electrical diagrams of the tractor's systems.

5. Wiring harnesses

Contains the layouts, the wiring diagrams and the positioning of connectors on the tractor.

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HOW TO CONSULT THE UNIT



How to consult the table

The quickest way to determine the cause of a malfunction of a component (e.g. the starter motor) is to check all the components in the system in which the component is incorporated.
In this example, the problem is a malfunction of the starter motor, which fails to start the engine.

1 - Look in paragraph "**2.1. Component description index**" for the starter motor and identify the system in which it is incorporated.
The system is indicated in the column "**System (para 4.xx)**" and in this case is "**2**" (figure A).

2 - Consult paragraph "**4.2 Starting**" (figure B), in which the electrical diagram indicates all the components in the system; these components are accompanied by numbers that correspond to the key on the same page.

3 - Check all the components in the system, starting, for example, with the switch "**2**".

4 - Look in paragraph "**2.1. Component description index**" (figure A) for "**Starting enabling switch (Green)**" and check in the column "**Technical (para 3.2.xx)**" if there is a technical description of the component (in this case it is given at n° 11 of the paragraph "**3.2 Component technical data**") (figure C).
Note down also the name of the connector to which the component is connected (in this case "**START**").

Only if the position of the component is not known

5 - Look in paragraph "**2.3 Connector index**" (figure D) for the name of the connector to which the component is connected (in this case "**START**") and note down the wiring harness in which it is incorporated (in this case "**0443.7847**" or "0.012.3639.4") and the type of connector (in this case "**10**").

6 - Look for the wiring harness in chapter "**5. Layouts, electrical wiring diagrams, connector positions**" using the index at the beginning of the chapter.

7 - Look for the name of the connector in the photos attached to the electrical diagrams and determine its position on the tractor from the drawing (figure E).
NOTE.
In the electrical diagrams (figure F) are indicated the names of the connectors and the descriptions that are used in all the tables of chapter 2.

8 - Using the data contained in the paragraph "**3.2 Component technical data**" (figure C) in position n° **11**, check the operation of the switch.

⚠ If the pinout of the connector is not known, look in paragraph "**3.1 Connector layouts**" (figure G) for the number found in the column "**Type**" of paragraph "**2.3 Connector index**".

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1. INTRODUCTION

This section of the workshop manual is intended as a practical guide to troubleshooting the tractor's electrical and electronic systems.

The following pages provide the technician with all the necessary information regarding the tractor's systems and components.

Due to the possible time difference between the introduction of technical modifications (in line with our policy of continuous product improvement) and the corresponding amendment of our printed documentation, we are obliged to state that the data contained in this document are subject to modification and as such are not binding.

1.1 LIST OF WIRING LOOMS

DESCRIPTION	CODE	PAGE
Front wiring	0.012.6951.4/50	23
Central wiring	0.012.6948.4/60	31
Rear wiring	0.013.1452.4	43

1.2 DEFINITION OF COMPONENTS AND SYMBOLS

To prevent any misunderstanding or ambiguity, listed below are definitions for some of the key terms used in this unit.

TERM	DESCRIPTION
Connector	Element used to connect two components (e.g. wiring-switch. wiring-wiring)
Temperature sensor	Electrical component that converts the temperature of a medium (air, water, oil, etc.) into a voltage or resistance
Pressure sensor	Electrical component that converts the pressure of a medium (air, water, etc.) into a voltage or resistance
Position sensor	Electrical component that converts the angular or linear position of an object into a voltage
Pressure switch	Switch that changes state (opens or closes a contact) according to the operating pressure in the circuit in which it is installed
Thermostat	Switch that changes state (opens or closes a contact) according to the temperature of the medium in which it is immersed.
Switch	Mechanical component that opens or closes one or more electrical contacts.
Solenoid valve	Valve operated by applying electrical current to a coil (or solenoid)

Chapter “3.2 Description of components” shows the wiring diagrams for certain switches and buttons.

The following symbols are used for ease of identification:

SYMBOL	DESCRIPTION
	Contact between CLOSED pins (stable position of switch)
	Contact between CLOSED pins (non-stable position of switch)
	Indicator LED
	Indicator lamp
	Diode

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1.3 GENERAL RULES

The inspection, maintenance, troubleshooting and repair operations are essential to ensure that the tractor continues to operate correctly over time and to prevent malfunctions and breakdowns.

The scope of this paragraph is to describe repair procedures and to help improve the quality of repairs.

1.3.1 MODIFICATION OF THE TRACTOR'S ELECTRICAL/ELECTRONIC CIRCUITS

The manufacturer prohibits any modification or alteration of the electrical wiring for the connection of any non-approved electrical applicances or components.

In particular, if it is discovered that the electrical system or a component has been modified without authorisation, the manufacturer will accept no liability for any damage to the vehicle and the vehicle warranty will be invalidated.

1.3.2 MAIN WIRING FAULTS

a. Poor contact between connectors

The main causes of poor contact between connectors are incorrect insertion of the male into the female connector, deformation of one or both connectors, and corrosion or oxidisation of the pin contact surfaces.

b. Defective pin welding or crimping

The pins of the male and female connectors make good contact in the crimped or welded area, but the wires are subjected to excessive tension, leading to breakage of the insulation or the wire itself and a poor connection.

c. Disconnecting wiring

If components are disconnected by pulling on the wires, or if components are removed with the wires still connected, or if the wiring is subject to a heavy impact this could damage the connections at the pins, breaking strands of wire.

d. Penetration of water in connectors

The connectors are designed to prevent penetration of liquids (water, oil etc.); however, it is possible that when the tractor is cleaned using high-pressure water or steam, water could penetrate or condense in the connectors.

As the connectors are designed to prevent liquid penetration, any water that does get in will not be able to drain out, and thus may cause shortcircuits across the pins.

For this reason it is good practice to dry the connectors with a low pressure jet of compressed air after washing the tractor.

e. Oil or dirt on connectors

Oil or grease on the connectors or pins can create a poor contact (oil and grease are non-conductors) .

Clean the connectors thoroughly using a dry cloth or a low pressure jet of compressed air and use specific products (deoxidising sprays, etc.) to degrease the contacts.

★ Take care not to bend the pins when cleaning them.

★ Use dehydrated not lubricated compressed air.

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1.3.3 REMOVAL, REFITTING AND DRYING OF CONNECTORS AND WIRING

a. Disconnection of connectors

When disconnecting wiring, pull on the connectors rather than on the wires themselves. For connectors that are held in position with screws or levers, fully loosen the screws, then pull on the connector.
For connectors that are clipped togther, fully depress the clip then pull the connector apart.
After disconnecting connectors, cover them in a waterproof material to prevent dirt or moisture getting into the contacts.

b. Connecting the connectors

Check the condition of the connectors:

- Make sure the pin contact surfaces are free of water, dirt or oil.
- Check that the connectors are not deformed and that the pins are not corroded.
- Check that the connector casings are not damaged or split.

★ If a connector is contaminated with oil or grease, or if moisture has penetrated the casing, clean it as described in paragraph 1.3.2.

★ If a connector is damaged, deformed or broken, replace it with a new one.

When connecting connectors, make sure they are properly aligned before applying any force.
For connectors with clips, insert the two halves until they clip together.

c. Cleaning and drying wiring

When wiring is dirty or contaminated with oil or grease, clean it with a dry cloth, or, if necessary, with water or steam.
If the wiring has to be cleaned with water, avoid directing the water or steam jet on the connectorsi; if water penetrates the connector, proceed as described in paragraph 1.3.2.

★ Check that the connector is not short circuited by water by testing the continuity across the pins.

★ After checking the connector is in good condition, degrease the contacts using a deoxidising product.

d. Renewal of damaged electrical components.

- When replacing electrical components (fuses, relays, etc.), use only original parts supplied by the manufacturer.
- When replacing fuses, check that the new fuse conforms to DIN 72581 standards and in particular:

  - bayonet fuse (F2, F3, etc.) DIN 72581/3C

  The fitting of replacement fuses that do not comply with these standards will invalidate the warranty with immediate effect and release the manufacturer from any liability.
- When replacing relays, make sure that the new relay conforms to the standards marked on the original relay.

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1.4 DIAGNOSTIC INSTRUMENTS

For the correct diagnosis of any faults in tne tractor's electrical system, the following instruments are required:

1 - **Digital multimeter** with the following minimum characteristics:
AC VOLT 0-600
DC VOLT..... 0-600
OHM..... 0-32M
AC AMP 0-10
DC AMP 0-10

1.5 WIRE COLOUR CODES

COLOUR CODES	
A	Light blue
B	White
C	Orange
G	Yellow
H	Grey
L	Dark blue

COLOUR CODES	
M	Brown
N	Black
R	Red
S	Pink
V	Green
Z	Purple

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2. INDICES

2.1 INDEX BY PART DESCRIPTION

Component description	Part Code	Technical. descr'n (Chap. 3.2.xx)	Connector	System (Chap. 4.xx)
4WD engagement lamp switch	2.7659.096.0/10	11	X36	5
Air cleaner clogged sensor			X10	5
Alternator	0.010.2734.10		B+ D+ W	2-5
Auxiliary power socket	2.6032.011.0		X1	5
Brake switch	2.7659.202.0	3	X9	4
Clutch pedal switch to enable starting	2.7659.247.0	1	X6	2
Engine coolant temperature sensor	2.7099.640.0/10	5	X32	5
Engine coolant temperature sensor for warning lamp	0.010.2748.1		X31	5
Engine oil pressure switch	0.010.2749.1		X34	5
Engine stop control unit	0.011.0647.4		X21-X22	2
Engine stop solenoid	0.009.4771.4		X35	2
Flasher control unit	2.8639.007.0		X20	4
Front diff lock control switch	0.007.5944.0/20	14	X4	3
Fuel level sensor	2.7059.811.0	7	X17	5
Fuel lift pump	0.008.6957.4		X33	5
Glowplug	0.010.2731.2		X24	2
Handbrake switch	2.7659.202.0	8	X37	4
Hazard warning lights switch	2.7659.110.0	15	X5	4
Horn	2.8419.006.0		X29	4
Hydraulic oil filter clogging sensor	2.7099.180.0/10	10	X27	5
Instrument panel	2.8339.230.0/30		X12-X13-X14-X15-X16	2-4-5
Left headlamp			X28	4
Left tail light			X40	4
LH light			X2	4
Lights selector switch	0.013.3337.3/01	12	X19	4
Number plate light	2.8029.240.0/10		X44	4
Preheating glow plugs relay	2.8519.022.0	6	X18	2
Preheating relay control unit	2.8519.021.0		X11	2
PTO clutch engaged lamp switch	2.7659.246.0	2	X8	5
PTO speed selector lamp switch	2.7659.087.0	9	X42	5
PTO switch to enable starting	2.7659.247.0	1	X7	2

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Component description	Part Code	Technical. descr'n (Chap. 3.2.xx)	Connector	System (Chap. 4.xx)
RH light			X23	4
Right headlamp			X30	4
Right tail light			X38	4
Solenoid controlling engagement of front diff lock	0.010.2831.1	4	X41	3
Starter motor			+30A +50	2-3-4-5
Starter relay			RL1	2
Starter switch	2.7659.127.0	13	X3	2-3-4-5
Trailer socket			X39	4
Worklight	2.8029.300.0		X43	4

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2.2 INDEX BY PART CODE

Code	Description	Technical descr'n (Chap. 3.2.xx)	Connector	System (para. 4.xx)
0.007.5944.0/20	Front diff lock control switch	14	X4	3
0.008.6957.4	Fuel lift pump		X33	5
0.009.4771.4	Engine stop solenoid		X35	2
0.010.2731.2	Glowplug		X24	2
0.010.2734.10	Alternator		B+ D+ W	2-5
0.010.2748.1	Engine coolant temperature sensor for warning lamp		X31	5
0.010.2749.1	Engine oil pressure switch		X34	5
0.010.2831.1	Solenoid controlling engagement of front diff lock	4	X41	3
0.011.0647.4	Engine stop control unit		X21	2
0.011.0647.4	Engine stop control unit		X22	2
0.013.3337.3/01	Lights selector switch	12	X19	4
2.6032.011.0	Auxiliary power socket		X1	5
2.7059.811.0	Fuel level sensor	7	X17	5
2.7099.180.0/10	Hydraulic oil filter clogging sensor	10	X27	5
2.7099.640.0/10	Engine coolant temperature sensor	5	X32	5
2.7659.087.0	PTO speed selector lamp switch	9	X42	5
2.7659.096.0/10	4WD engagement lamp switch	11	X36	5
2.7659.110.0	Hazard warning lights switch	15	X5	4
2.7659.127.0	Starter switch	13	X3	2-3-4-5
2.7659.202.0	Brake switch	3	X9	4
2.7659.202.0	Handbrake switch	8	X37	4
2.7659.246.0	PTO clutch engaged lamp switch	2	X8	5
2.7659.247.0	Clutch pedal switch to enable starting	1	X6	2
2.7659.247.0	PTO switch to enable starting	1	X7	2
2.8029.240.0/10	Number plate light		X44	4
2.8029.300.0	Worklight		X43	4
2.8339.230.0/30	Instrument panel		X12-X13-X14-X15-X16	2-4-5
2.8419.006.0	Horn		X29	4
2.8519.021.0	Preheating relay control unit		X11	2

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Code	Description	Technical descr'n (Chap. 3.2.xx)	Connector	System (para. 4.xx)
2.8519.022.0	Preheating glow plugs relay	6	X18	2
2.8639.007.0	Flasher control unit		X20	4

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2.3 INDEX BY CONNECTOR

Connector	Wiring code	Connection wiring or component code	Component description
+30A	0.012.6948.4/60		Starter motor
	0.012.6951.4/40		
+30	0.012.6951.4/40		Battery
+50	0.012.6948.4/60		Starter motor
B+	0.012.6951.4/40	0.010.2734.10	Alternator (B+)
D+	0.012.6948.4/60	0.010.2734.10	Alternator (D+)
G1	0.012.6948.4/60	0.012.6951.4/40	
G2	0.012.6948.4/60	0.012.6951.4/40	
G3	0.012.6948.4/60	0.012.6951.4/40	
G4	0.012.6948.4/60	0.013.1452.4	
RL1	0.012.6948.4/60		Starter relay
W	0.012.6948.4/60	0.010.2734.10	Alternator (W)
X1	0.012.6948.4/60	2.6032.011.0	Auxiliary power socket
X2	0.012.6948.4/60		Left light (on roll bar)
X3	0.012.6948.4/60	2.7659.127.0	Starter switch
X4	0.012.6948.4/60	0.007.5944.0/20	Front diff lock control switch
X5	0.012.6948.4/60	2.7659.110.0	Hazard warning lights switch
X6	0.012.6948.4/60	2.7659.247.0	Clutch pedal switch to enable starting
X7	0.012.6948.4/60	2.7659.247.0	PTO switch to enable starting
X8	0.012.6948.4/60	2.7659.246.0	PTO clutch engaged lamp switch
X9	0.012.6948.4/60	2.7659.202.0	Brake switch
X10	0.012.6951.4/40		Air cleaner clogged sensor
X11	0.012.6948.4/60	2.8519.021.0	Preheating relay control unit
X12	0.012.6948.4/60	2.8339.230.0/30	Instrument panel
X13	0.012.6948.4/60	2.8339.230.0/30	Instrument panel (coolant temperature gauge)
X14	0.012.6948.4/60	2.8339.230.0/30	Instrument panel
X15	0.012.6948.4/60	2.8339.230.0/30	Instrument panel (engine rpm indicator)
X16	0.012.6948.4/60	2.8339.230.0/30	Instrument panel (fuel gauge)
X17	0.012.6948.4/60	2.7059.811.0	Fuel level sensor
X18	0.012.6948.4/60	2.8519.022.0	Preheating glow plugs relay
X19	0.012.6948.4/60	0.013.3337.3/01	Lights selector switch
X20	0.012.6948.4/60	2.8639.007.0	Flasher control unit
X21	0.012.6948.4/60	0.011.0647.4	Engine stop control unit
X22	0.012.6948.4/60	0.011.0647.4	Engine stop control unit

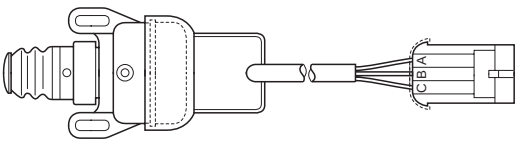
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Connector	Wiring code	Connection wiring or component code	Component description
X23	0.012.6948.4/60		Right light (on roll bar)
X24	0.012.6948.4/60	0.010.2731.2	Glowplug
X27	0.012.6948.4/60	2.7099.180.0/10	Hydraulic oil filter clogging sensor
X28	0.012.6951.4/40		Left headlamp
X29	0.012.6951.4/40	2.8419.006.0	Horn
X30	0.012.6951.4/40		Right headlamp
X31	0.012.6951.4/40	0.010.2748.1	Engine coolant temperature sensor for warning lamp
X32	0.012.6951.4/40	2.7099.640.0/10	Engine coolant temperature sensor
X33	0.012.6951.4/40	0.008.6957.4	Fuel lift pump
X34	0.012.6951.4/40	0.010.2749.1	Engine oil pressure switch
X35	0.012.6951.4/40	0.009.4771.4	Engine stop solenoid
X36	0.013.1452.4	2.7659.096.0/10	4WD engagement lamp switch
X37	0.013.1452.4	2.7659.202.0	Handbrake switch
X38	0.013.1452.4		Right tail light
X39	0.013.1452.4		Trailer socket
X40	0.013.1452.4		Left tail light
X41	0.013.1452.4	0.010.2831.1	Solenoid controlling engagement of front diff lock
X42	0.013.1452.4	2.7659.087.0	PTO speed selector lamp switch
X43	0.013.1452.4	2.8029.300.0	Worklight
X44	0.013.1452.4	2.8029.240.0/10	Number plate light

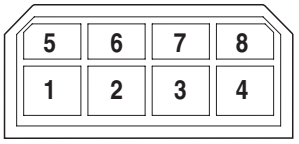
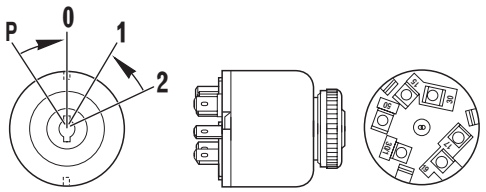
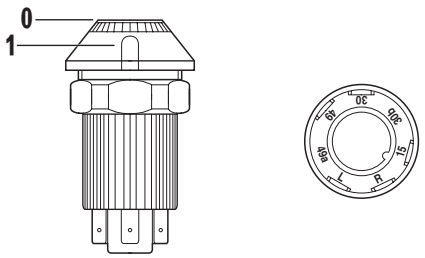
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3. COMPONENTS

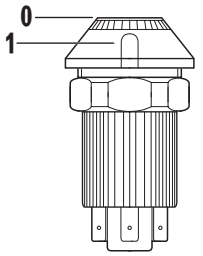
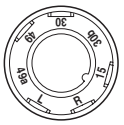
3.1 COMPONENT TECHNICAL DATA

N°	Description	Code	Characteristics	Connector
1	Clutch pedal switch to enable starting	2.7659.247.0	Normally open contact (NO)	X6-X7
2	PTO switch to enable starting	2.7659.246.0	Normally open contact (NO)	X8
3	Brake switch	2.7659.202.0	Between pin 2 and pin 3: normally closed contact (NC) Between pin 1 and pin 4: normally open contact (NO) With switch free of levers	X9
4	Solenoid controlling engagement of front diff lock	0.010.2831.1	Pin 1 = earth Pin 2 = power Resistance between pin1 and pin 2: ~ 8 Ohm (at 20 °C)	X41
5	Engine coolant temperature sensor	2.7099.640.0/10	Resistance between the pin and the sensor body: at 20°C ~2000 Ohm at 60°C 470 ÷ 499Ohm ± 3% at 80°C 238 ÷ 247Ohm ± 2% at 100°C 129 ÷ 131Ohm ± 1%	X32
6	Preheating glow plugs control relay	2.8519.022.0	Resistance between pin 3 and pin 4: 13 Ohm	X18
7	Fuel level sensor	2.7059.811.0	Resistance between pin 2 and pin 3: with tank full: 5 ± 1.2 Ohm with tank half full:120 ± 7 Ohm with tank empty: 332 ± 17.6 Ohm	X17
8	Handbrake switch	2.7659.202.0	Between pin 2 and pin 3:normally closed contact (NC) Between pin 1 and pin 4:normally open contact (NO) With switch free of levers	X37
9	PTO engaged lamp switch	2.7659.087.0	Normally open contact (NO)	X42
10	Hydraulic oil filter clogging sensor	2.7099.180.0/10	Normally open contact Calibration pressure: 0.5÷0.4 bar absolute pressure	X27
11	4WD engagement lamp switch	2.7659.096.0/10	 Between pin 1 and pin 2: normally closed contact (NC) Between pin 2 and pin 3: normally open contact (NO)	X36

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N°	Description	Code	Characteristics	Connector
12	Lights selector switch	0.013.3337.3	 Pin / Pos: 1 2 3 4 5 6 7 8 FR SX: ● ● (6–8) FR DX: ● ● (6–7) CLAX: ○ ○ (1–5) LAMP: ○ ○ (1–4) POS: ● ● (1–2) ANA: ● ● ● (1–3) ABB: ● ● ● (1–4)	X19
13	Starter switch	2.7659.127.0	 Pin / Pos: 15 30/1 50 19 30 17 P: ○ ○ (19–30) 0: 1: ● ● (15–30/1) 2: ○ ○ ○ ○ ○ ○ (30/1–50–19–30–17)	X3
14	Front diff lock control switch	0.007.5944.0/20	 Pin / Pos: 15 30 49 49a L R 0: ● ● (15–49) 1: ● ● ⊗ ● ● ● (15–30–49–49a–L–R)	X4

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N°	Description	Code	Characteristics	Connector
15	Hazard warning lights switch	2.7659.110.0	 	X5

Pos \ Pin	15	30	49	49a	L	R
0	●		●			
1	●		●	⊗	●	●

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3.2 PREHEATING SYSTEM

The preheating system has been designed to ensure that the engine functions correctly in all climatic conditions.

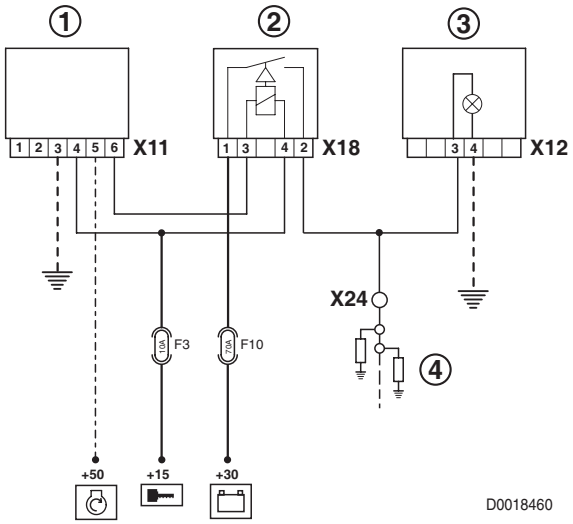
The system comprises four main components:

1 - Preheating control unit (X11)
2 - Glowplugs power relay (X18)
3 - Glowplugs (X24)
4 - Preheating indicator lamp on the instrument panel (X12)

The system controls the duration of the power feed to the glowplugs in accordance with the input signals received by the preheating control unit.

When the operator turns the key to "**I**" (ON), a current signal reaches the preheating control unit (X11 - pin 4); the control unit (X11) powers the relay (X18) that switches on the glowplugs (X24) and the preheating indicator lamp (X12) on the instrument panel.

The glowplugs remain on for a maximum duration of 6±0.7 seconds.



3.3 ENGINE STOP SYSTEM

The engine stop system is designed to stop the engine when the operator turns the key to position "**O**" (OFF).

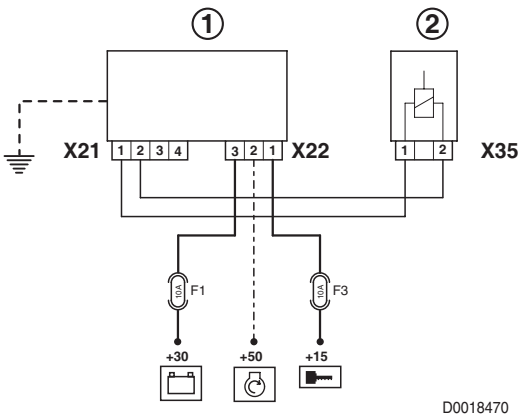
The system comprises two main components:

1 - Engine Stop control unit (X21 - X22)
2 - Engine Stop solenoid (X35)

The engine is stopped when the solenoid (X35) is activated.

To do this, the engine stop control unit (X21 - X22) energises the solenoid for a brief period (5-6 sec.) when the starter key is turned to position "**O**" (OFF).

To prevent the engine stopping as result of voltage drops during starting, the engine starting signal is also sent to the engine stop control unit.

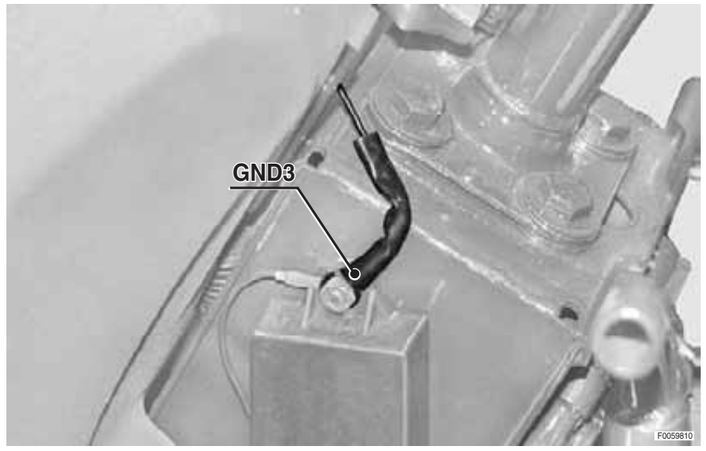


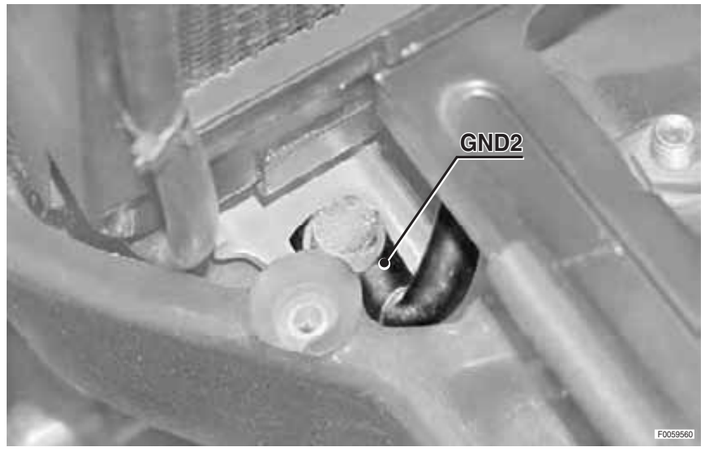
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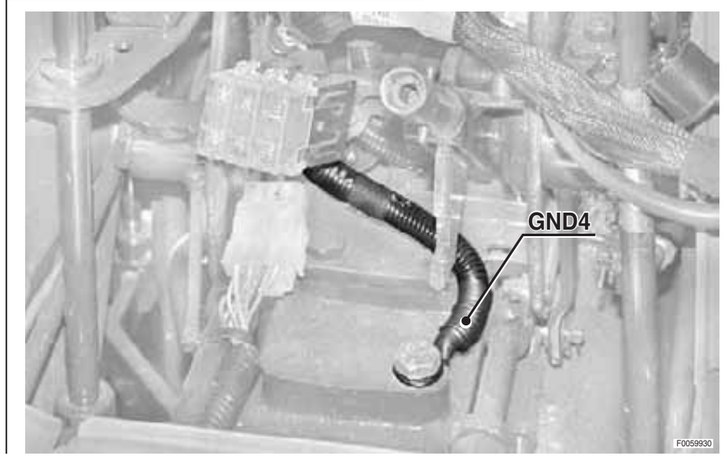
4. SYSTEMS
4.1 EARTHING POINTS







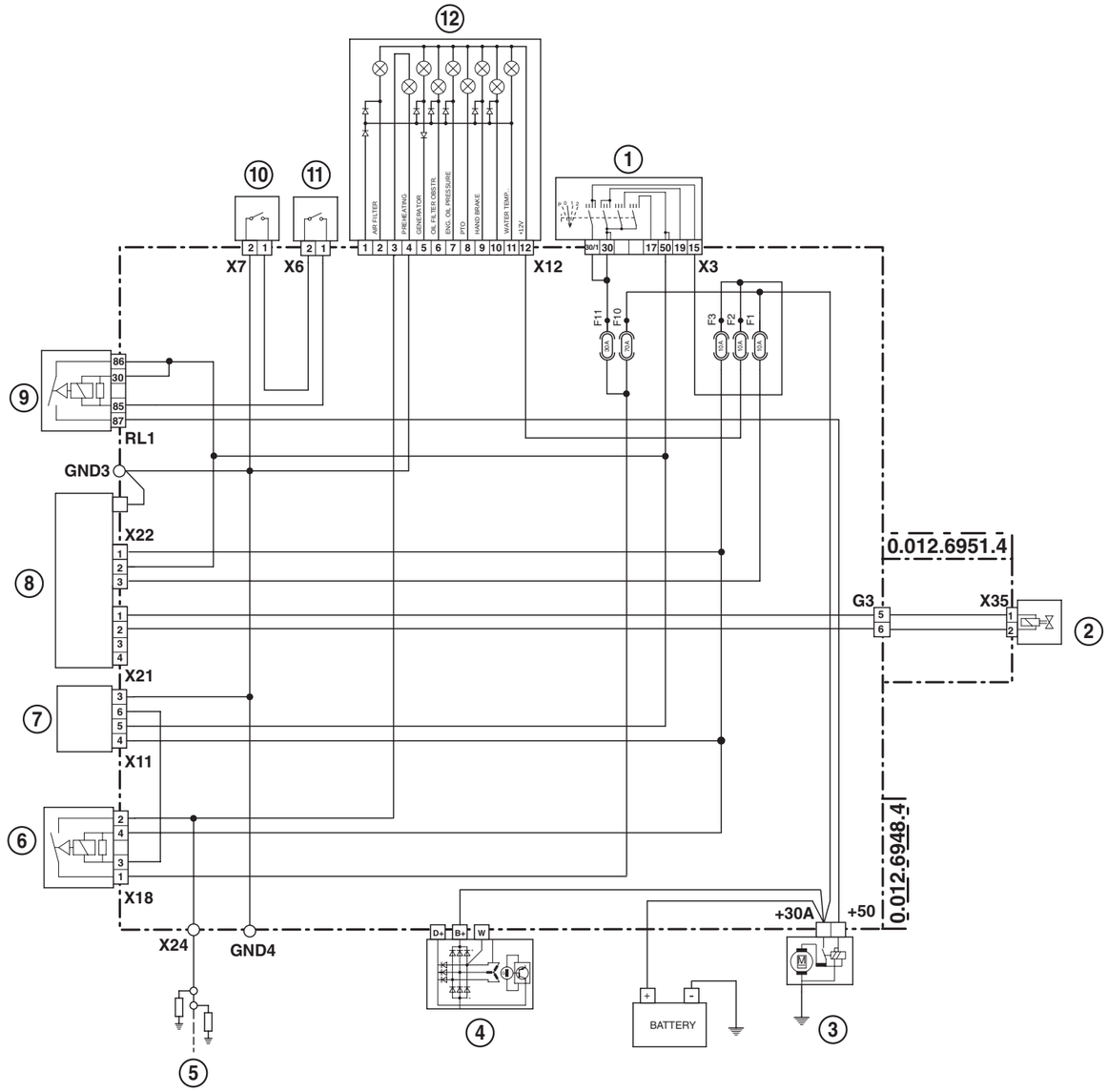






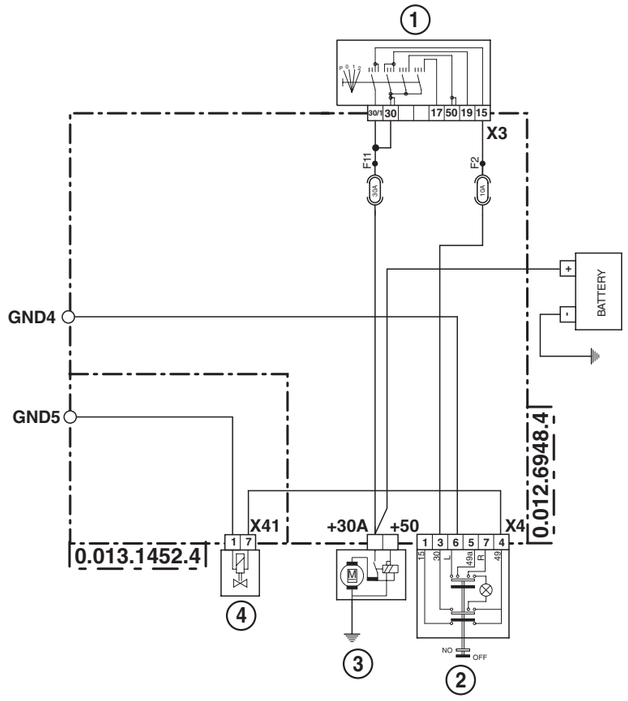
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4.2 STARTING



1 Starter switch
2 Engine stop solenoid
3 Starter motor
4 Alternator
5 Glowplug
6 Preheating glow plugs relay
7 Preheating relay control unit
8 Engine stop control unit
9 Starter relay
10 PTO switch to enable starting
11 Clutch pedal switch to enable starting
12 Instrument panel

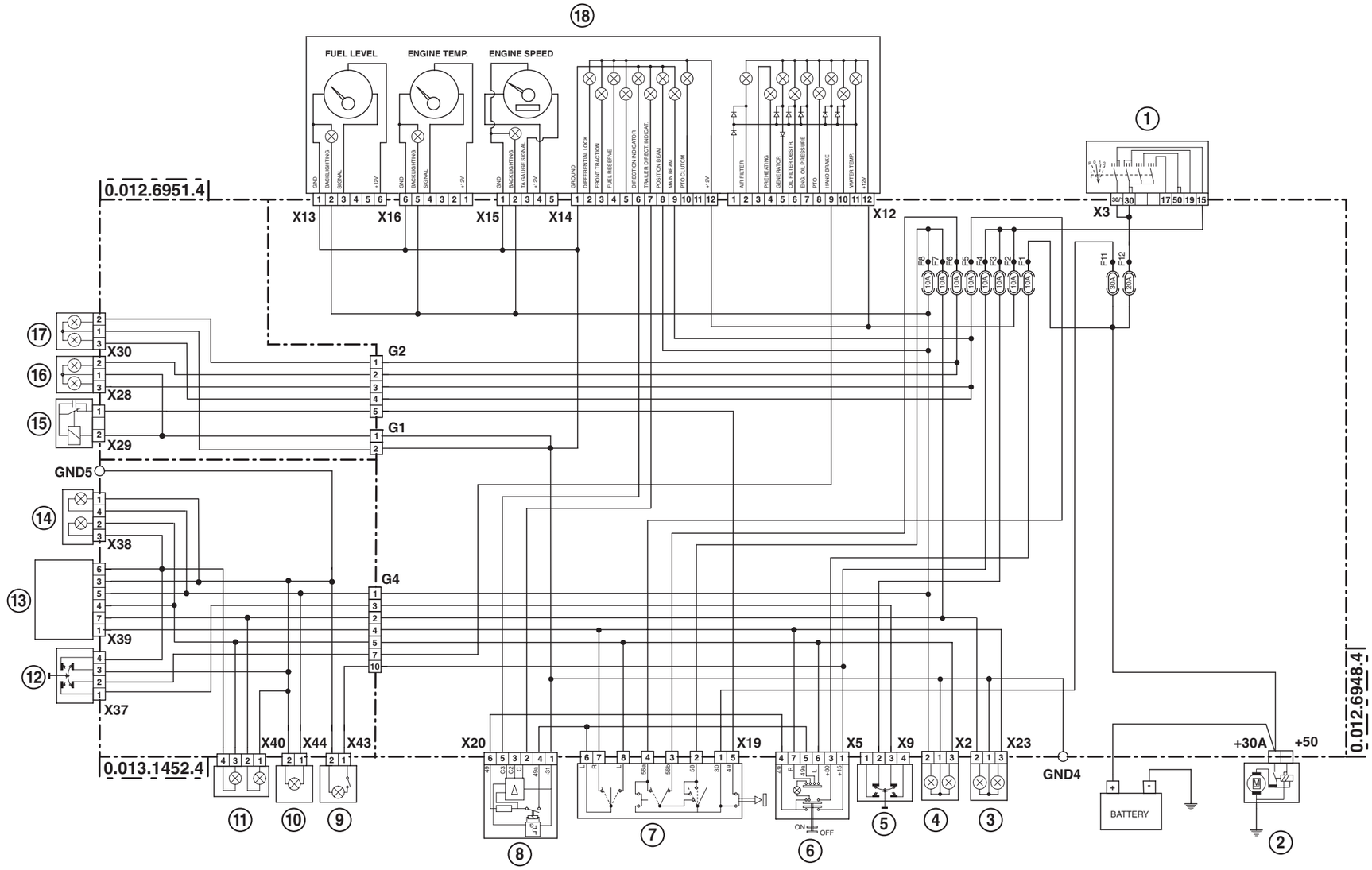
4.3 FRONT AXLE DIFFERENTIAL LOCK



1 Starter switch
2 Front diff lock control switch
3 Starter motor
4 Solenoid controlling engagement of front diff lock

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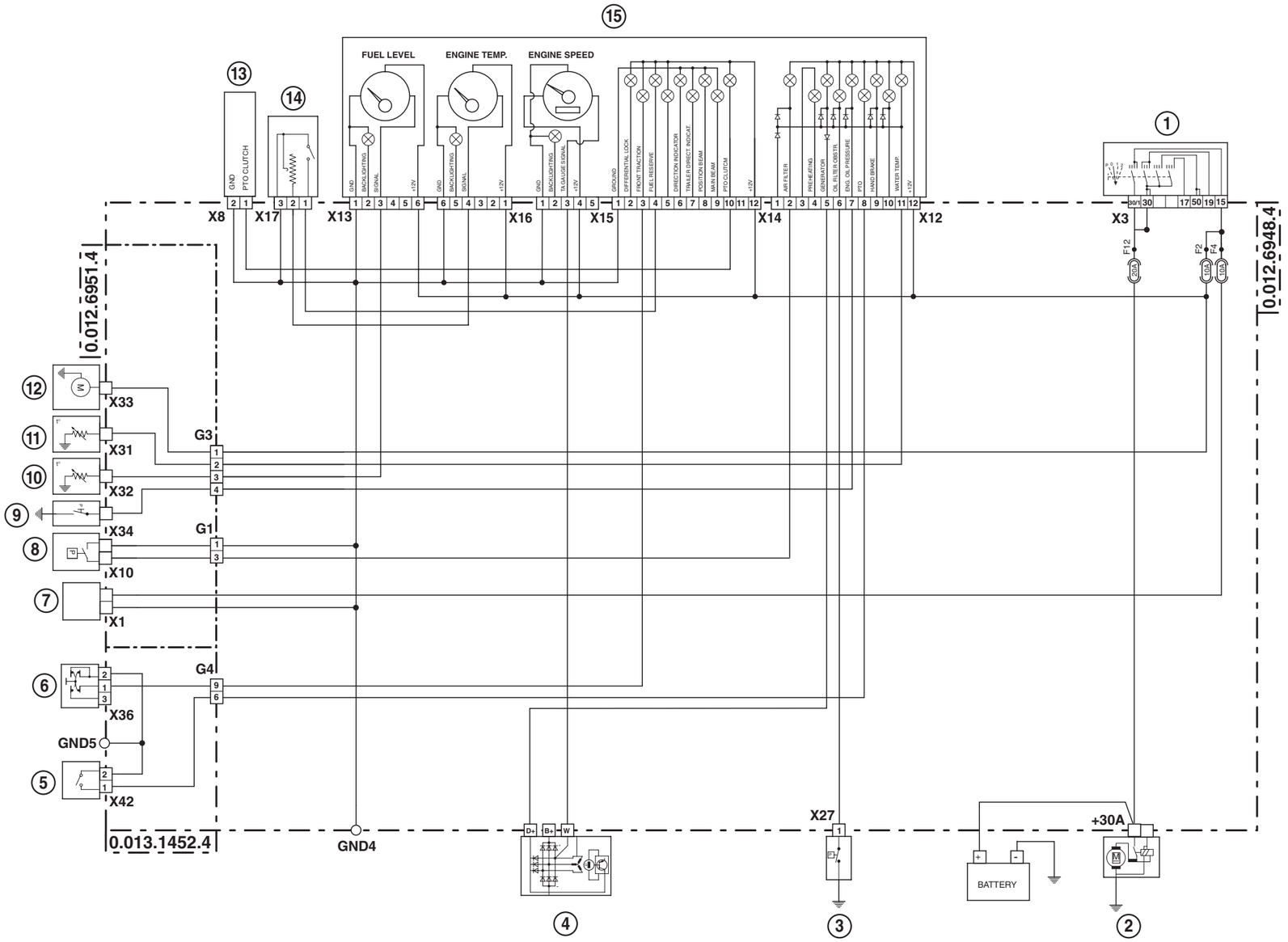
4.4 LIGHTS-SWITCH UNIT-BRAKES



1	Starter switch	**10**	Number plate light
2	Starter motor	**11**	Left tail light
3	RH light	**12**	Handbrake switch
4	LH light	**13**	Trailer socket
5	Brake switch	**14**	Right tail light
6	Hazard warning lights switch	**15**	Horn
7	Lights selector switch	**16**	Left headlamp
8	Flasher control unit	**17**	Right headlamp
9	Worklight	**18**	Instrument panel

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4.5 INSTRUMENT PANEL



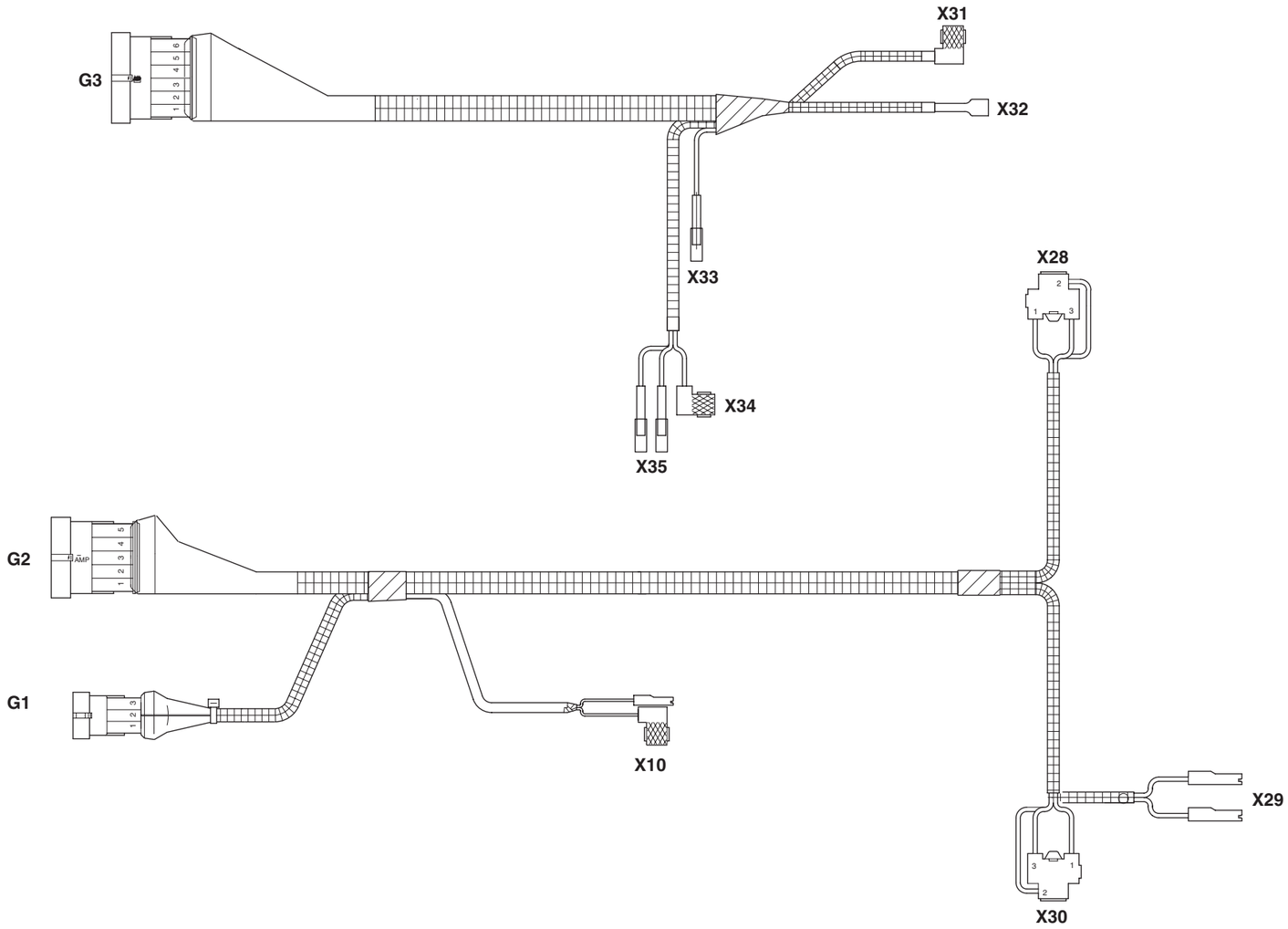
1 Starter switch
2 Starter motor
3 Hydraulic oil filter clogging sensor
4 Alternator
5 PTO speed selector lamp switch
6 4WD engagement lamp switch
7 Auxiliary power socket
8 Air cleaner clogged sensor
9 Engine oil pressure switch
10 Engine coolant temperature sensor
11 Engine coolant temperature sensor for warning lamp
12 Fuel lift pump
13 PTO clutch engaged lamp switch
14 Fuel level sensor
15 Instrument panel

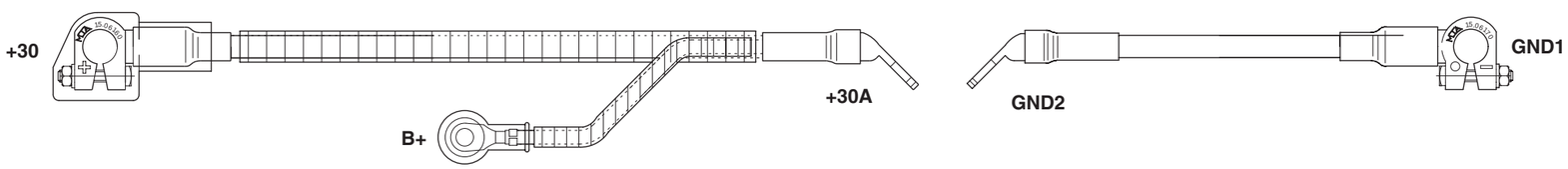
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5. LAYOUTS, ELECTRICAL WIRING DIAGRAMS, CONNECTOR POSITIONS
FRONT WIRING (1/2)





+30A Starter motor
+30 Battery
B+ Alternator (B+)
G1 To central wiring
G2 To central wiring
G3 To central wiring
X10 Air cleaner clogged sensor
X28 Left headlamp
X29 Horn
X30 Right headlamp
X31 Engine coolant temperature sensor for warning lamp
X32 Engine coolant temperature sensor
X33 Fuel lift pump
X34 Engine oil pressure switch
X35 Engine stop solenoid

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FRONT WIRING (2/2)

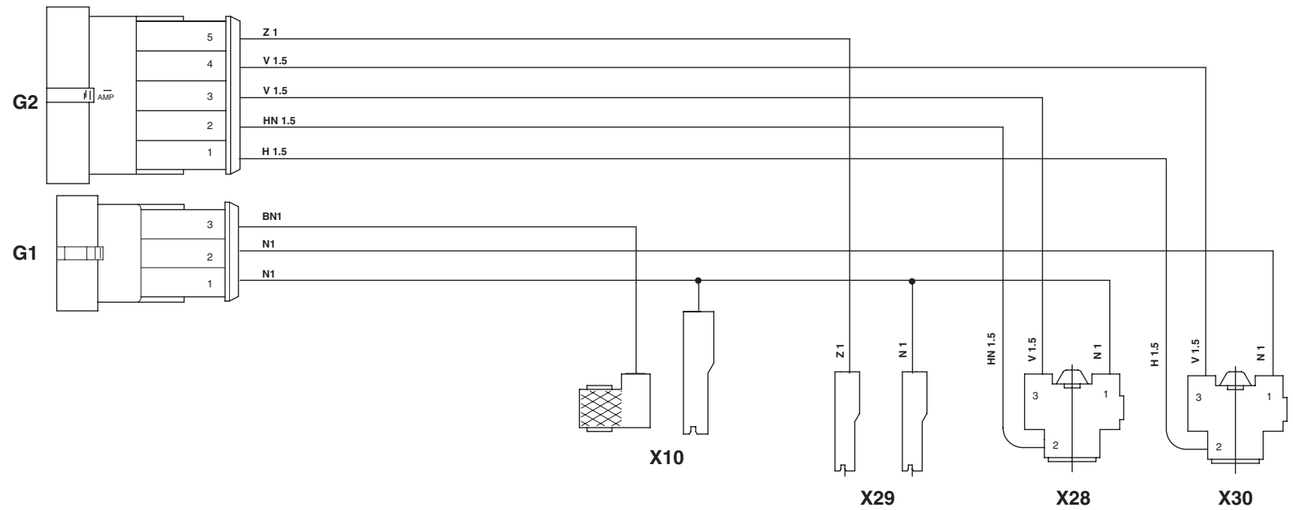
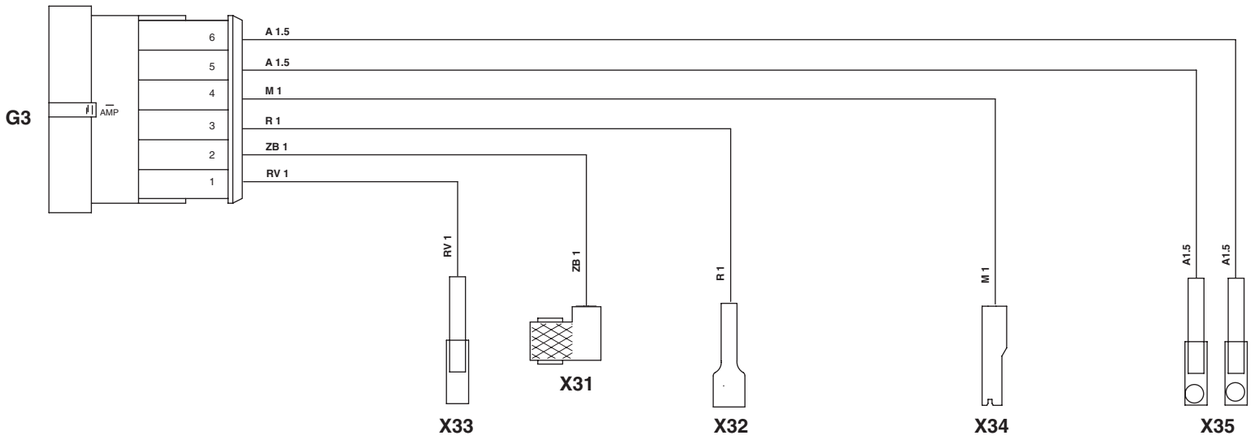
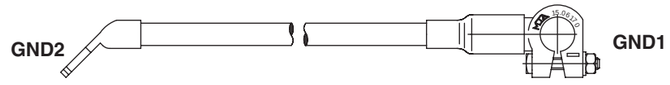
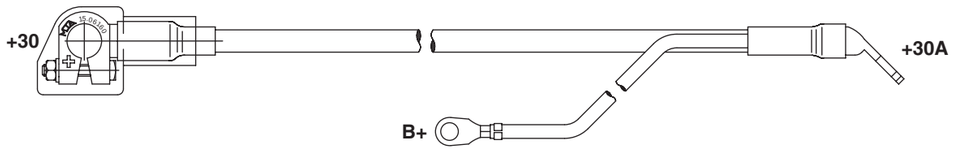


TABELLA COLORI / COLOURS TABLE			
M	Marrone/Brown	C	Arancio/Orange
V	Verde/Green	A	Azzurro/Blue
Z	Viola/Violet	B	Bianco/White
N	Nero/Black	L	Blu/Dark Blue
S	Rosa/Pink	G	Giallo/Yellow
R	Rosso/Red	H	Grigio/Gray



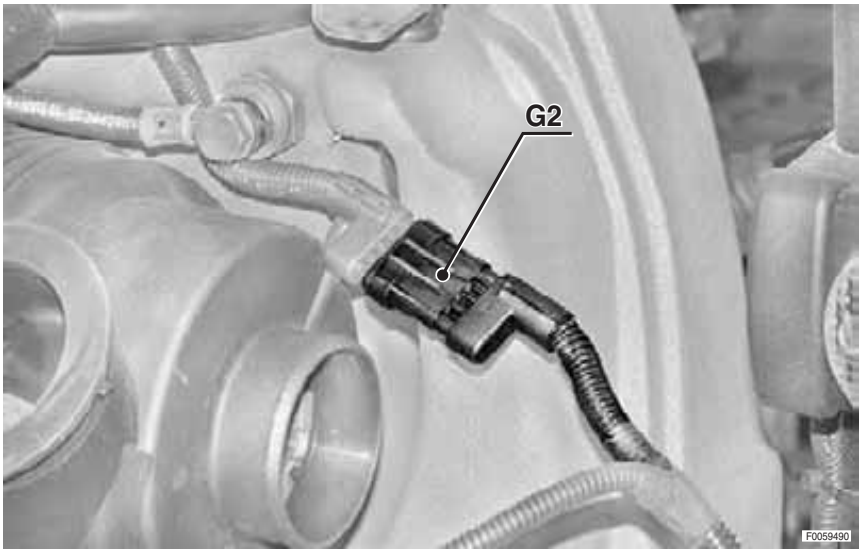




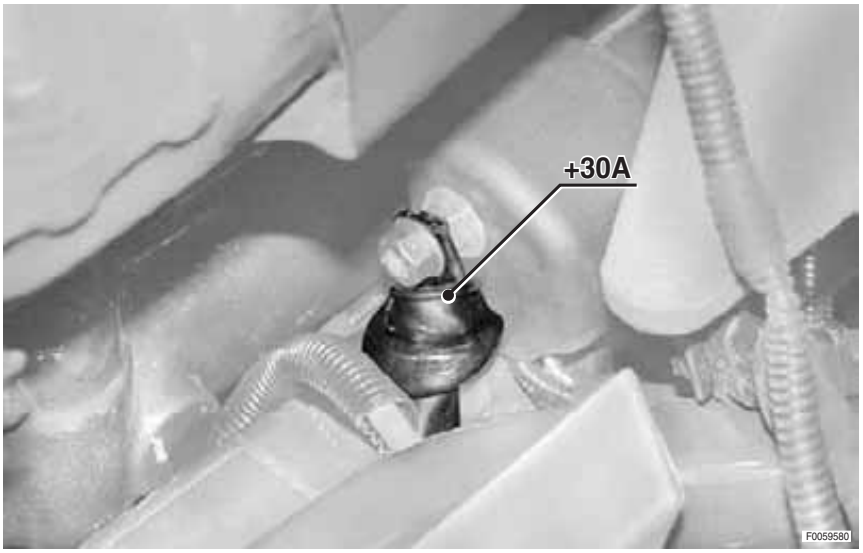
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CONNECTORS LOCATION

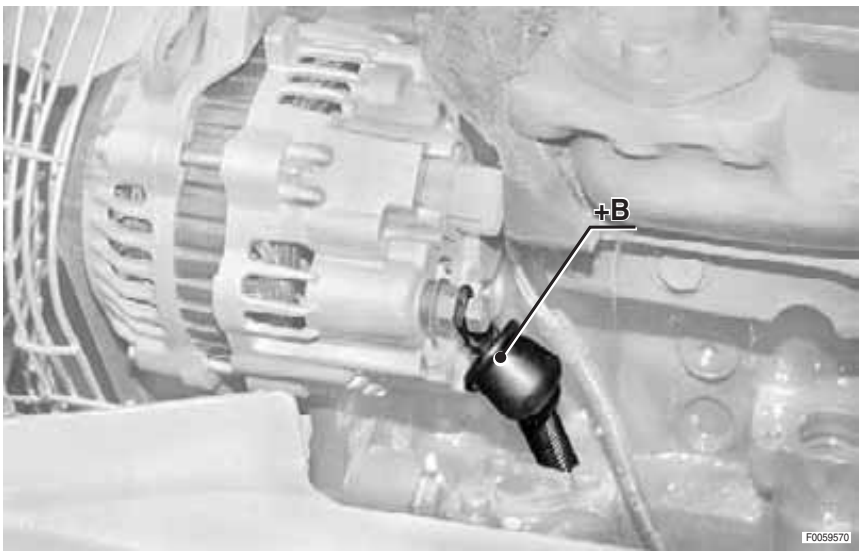
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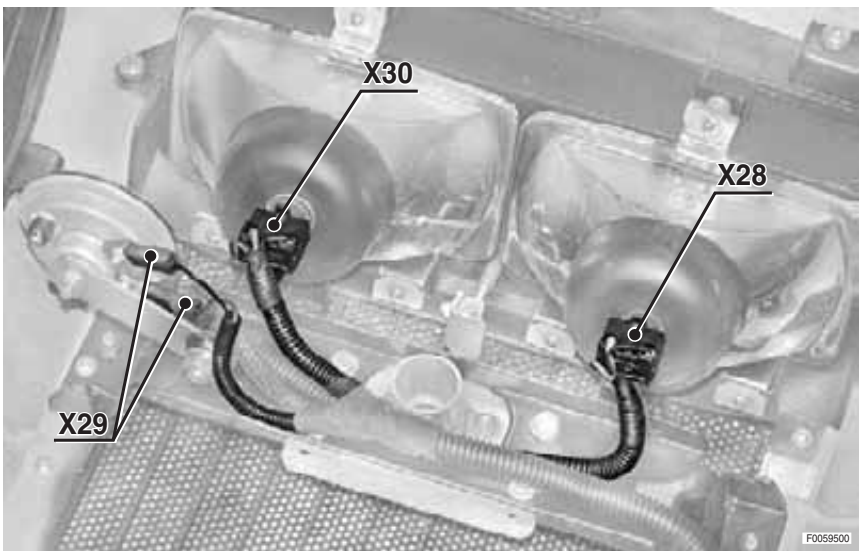
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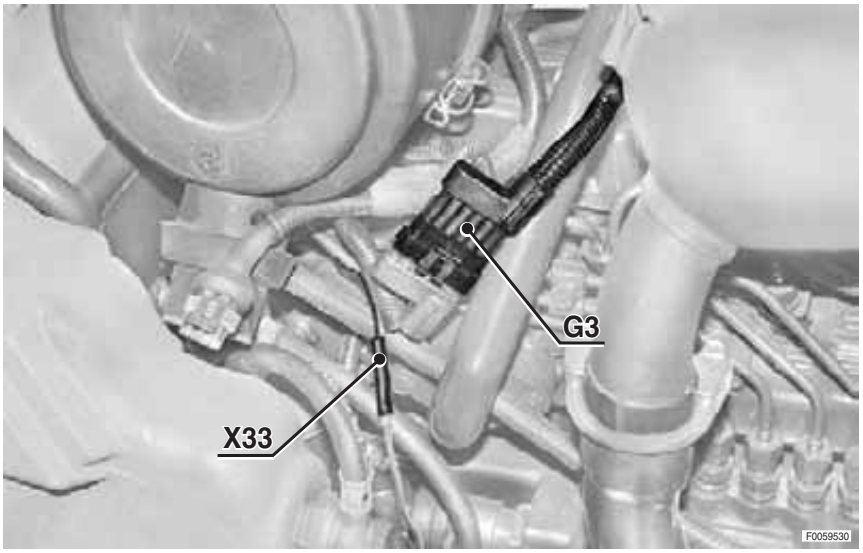


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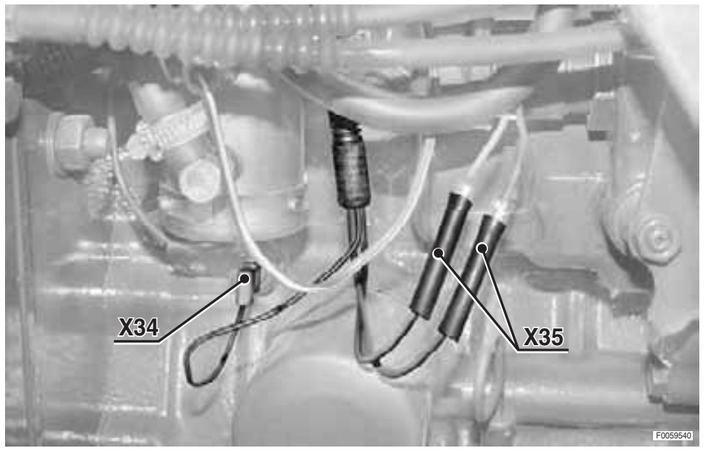
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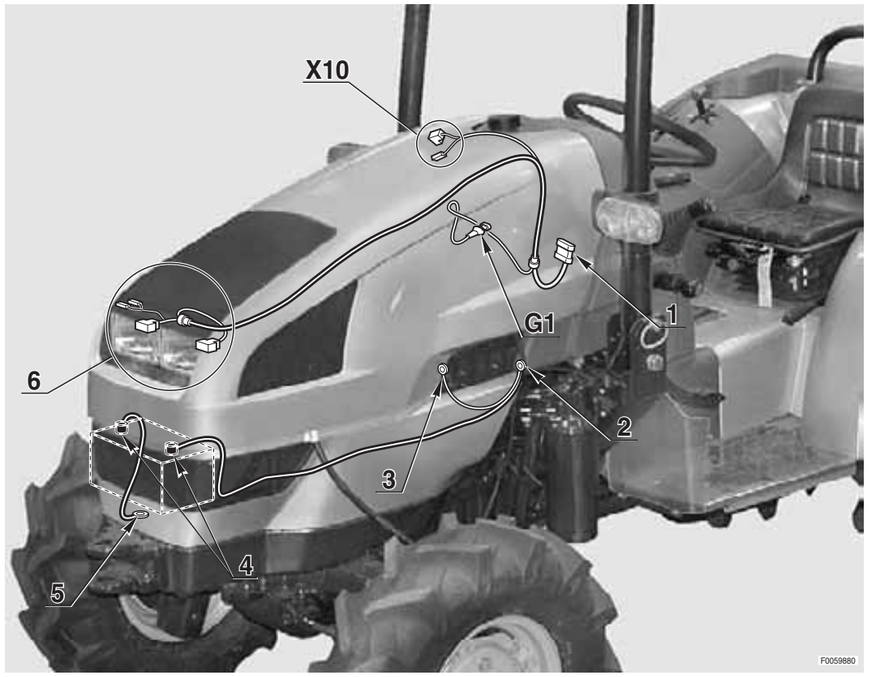
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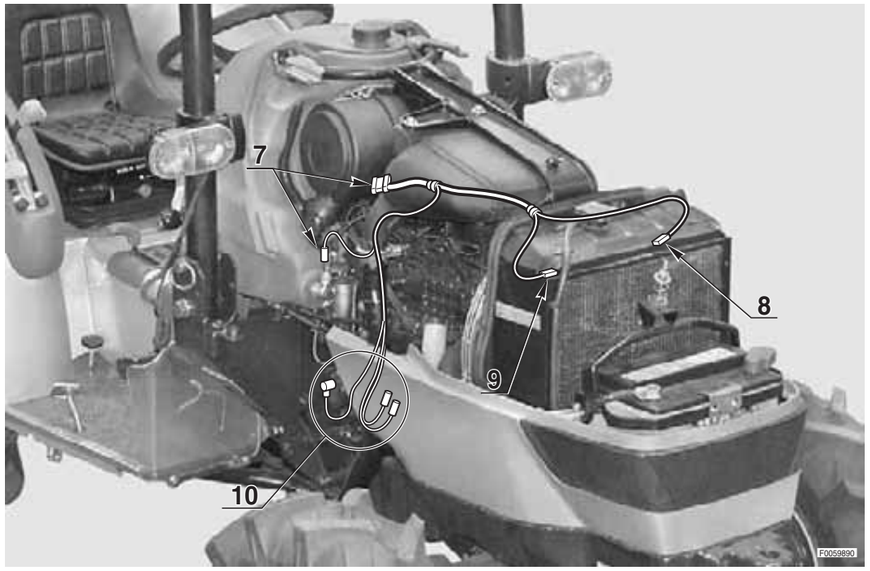
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FRONT LINE

10





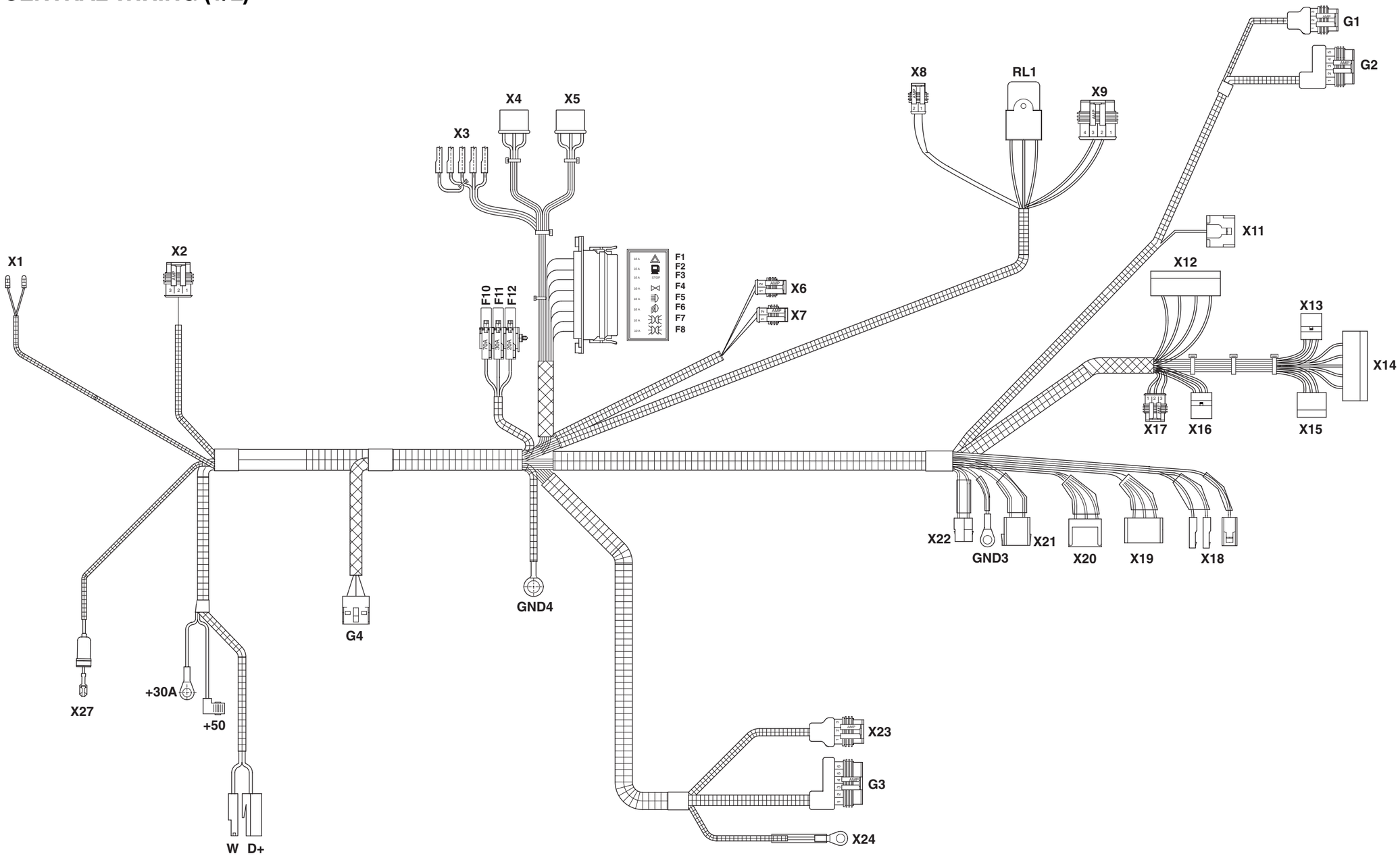


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CENTRAL WIRING (1/2)



+30A Starter motor
+50 Starter motor
D+ Alternator (D+)
G1 To front wiring
G2 To front wiring
G3 To front wiring
G4 To rear wiring
RL1 Starter relay
W Alternator (W)

X1 Auxiliary power socket
X2 Left light (on roll bar)
X3 Starter switch
X4 Front diff lock control switch
X5 Hazard warning lights switch
X6 Clutch pedal switch to enable starting
X7 PTO switch to enable starting
X8 PTO clutch engaged lamp switch
X9 Brake switch

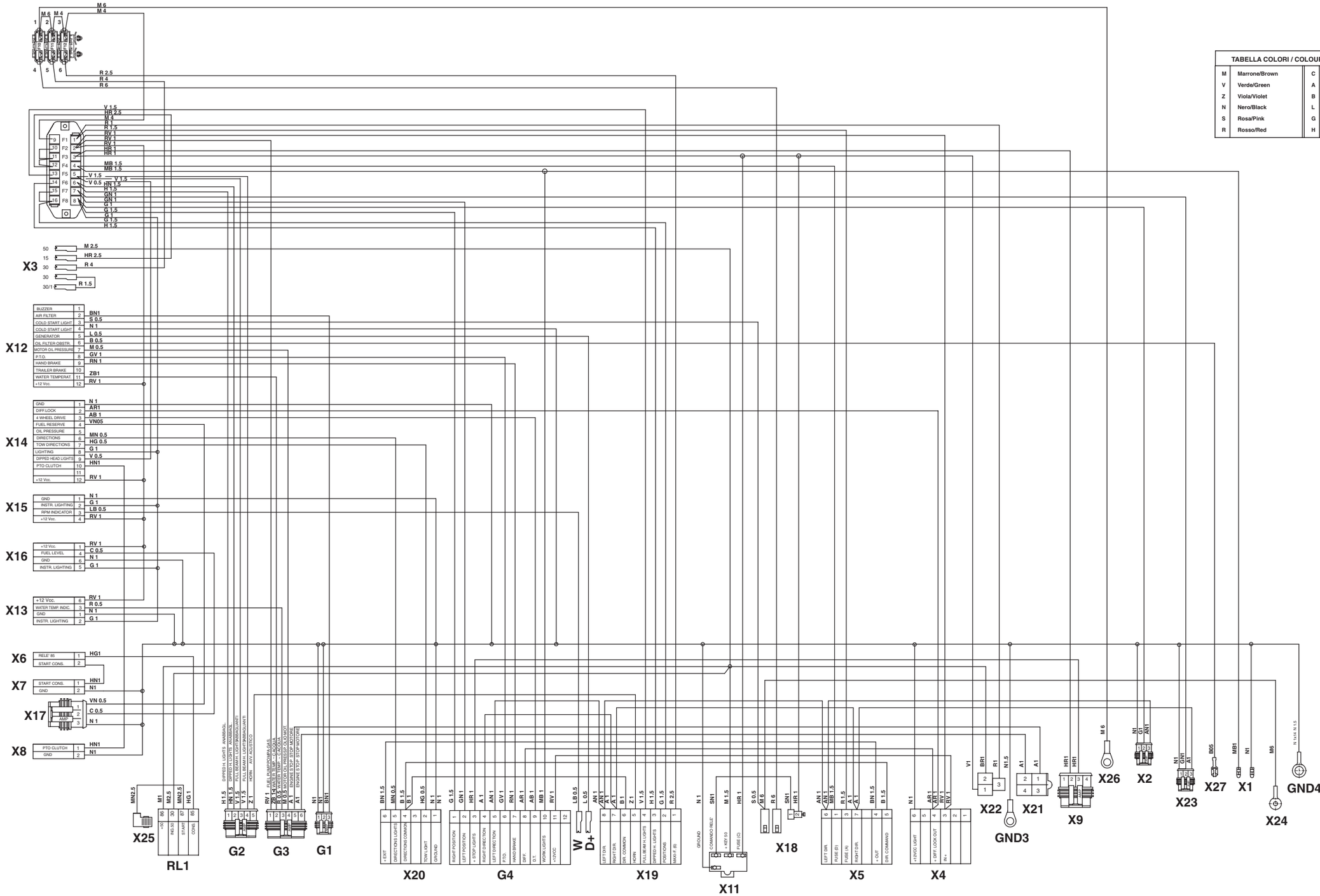
X11 Preheating relay control unit
X12 Instrument panel
X13 Instrument panel (coolant temperature gauge)
X14 Instrument panel
X15 Instrument panel (engine rpm indicator)
X16 Instrument panel (fuel gauge)
X17 Fuel level sensor
X18 Preheating glow plugs relay
X19 Lights selector switch

X20 Flasher control unit
X21 Engine stop control unit
X22 Engine stop control unit
X23 Right light (on roll bar)
X24 Glowplug
X27 Hydraulic oil filter clogging sensor

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CENTRAL WIRING (2/2)

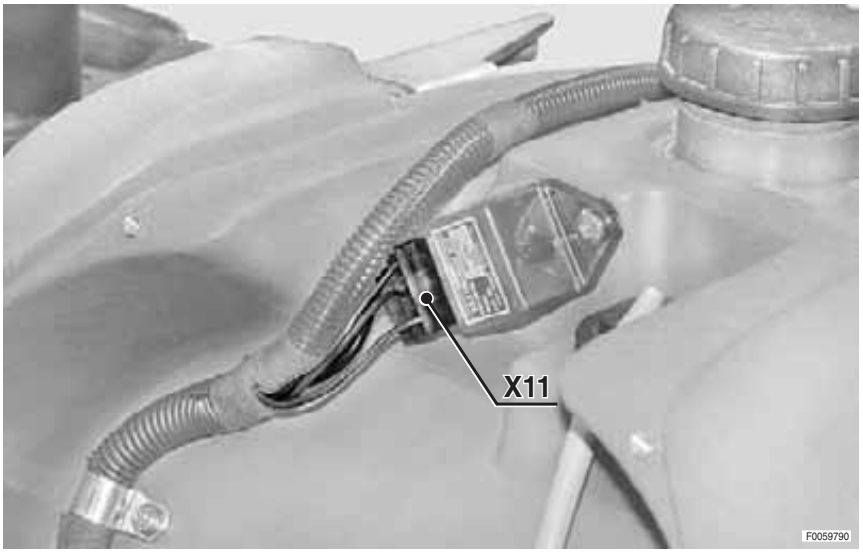


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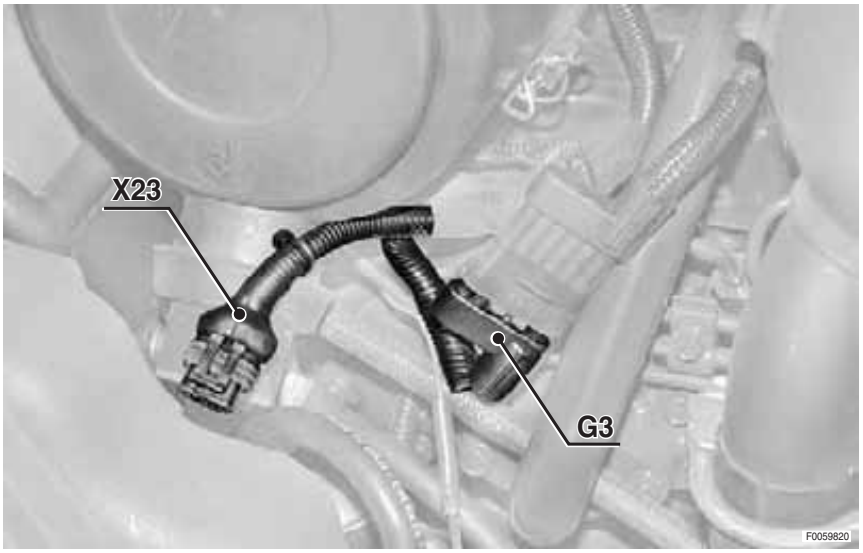
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CONNECTORS LOCATION

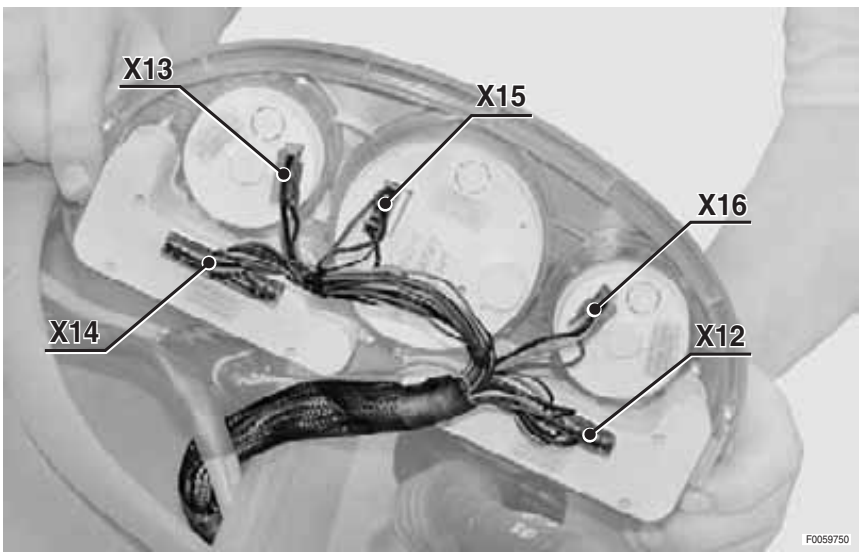
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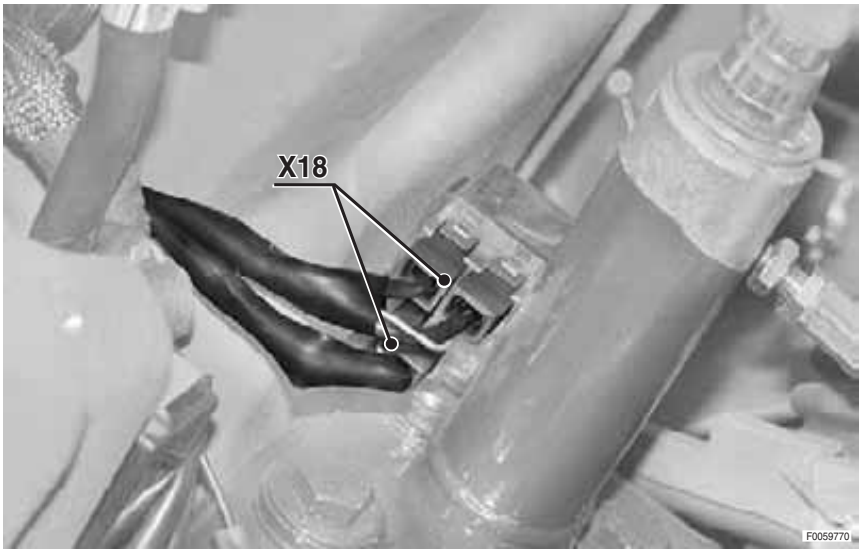


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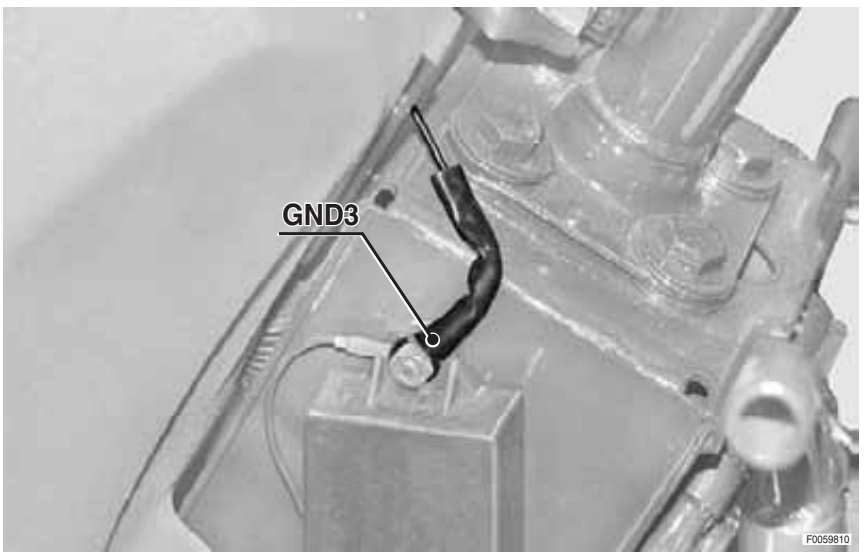


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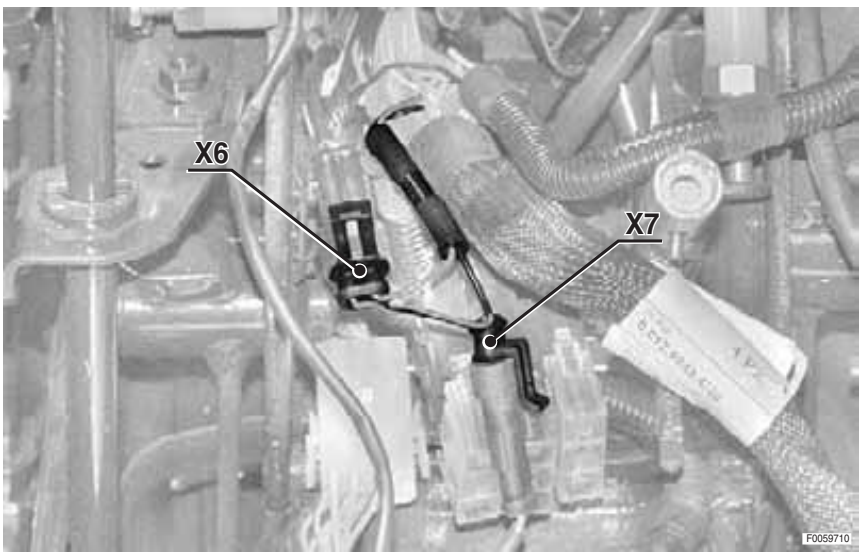
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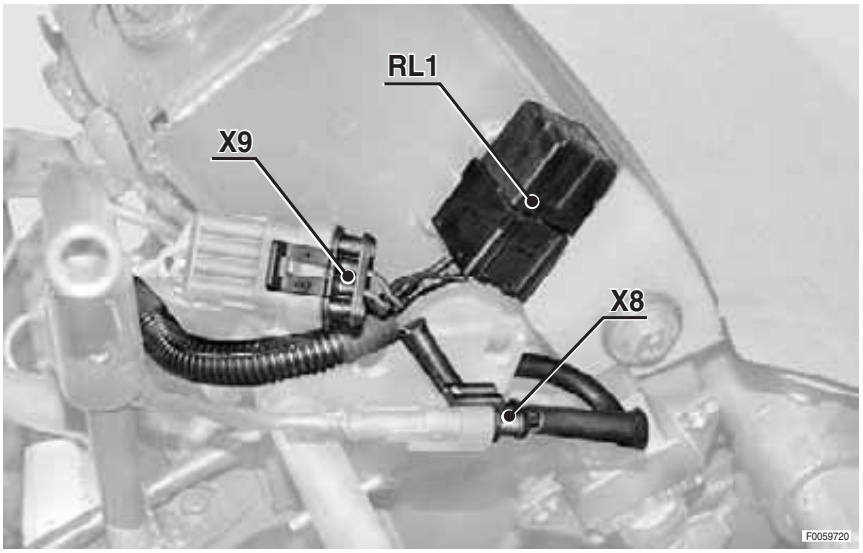


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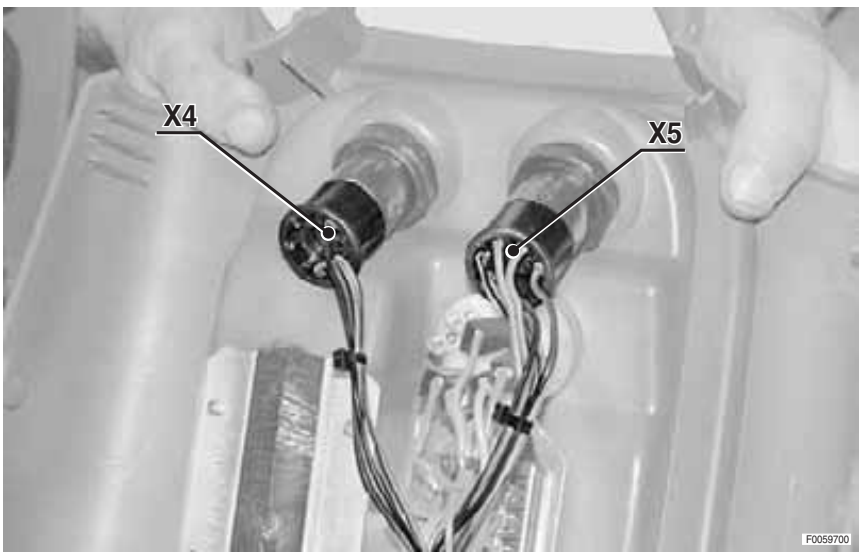


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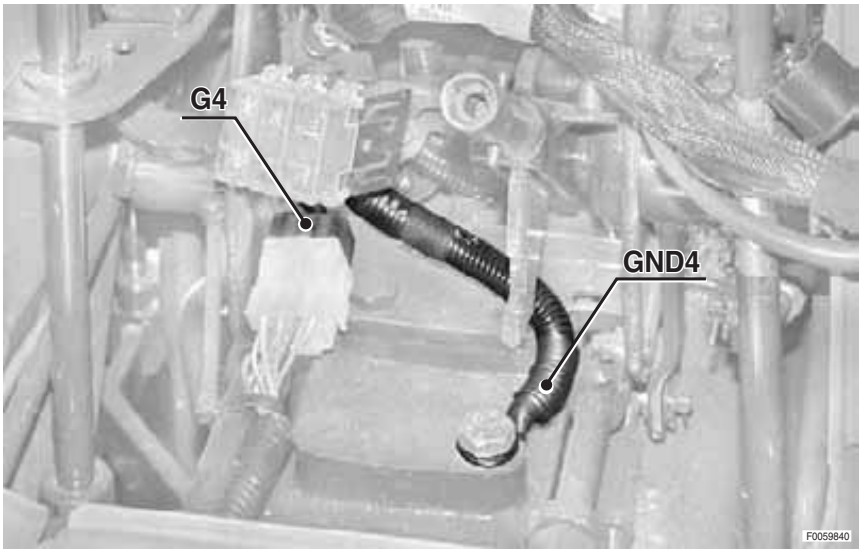


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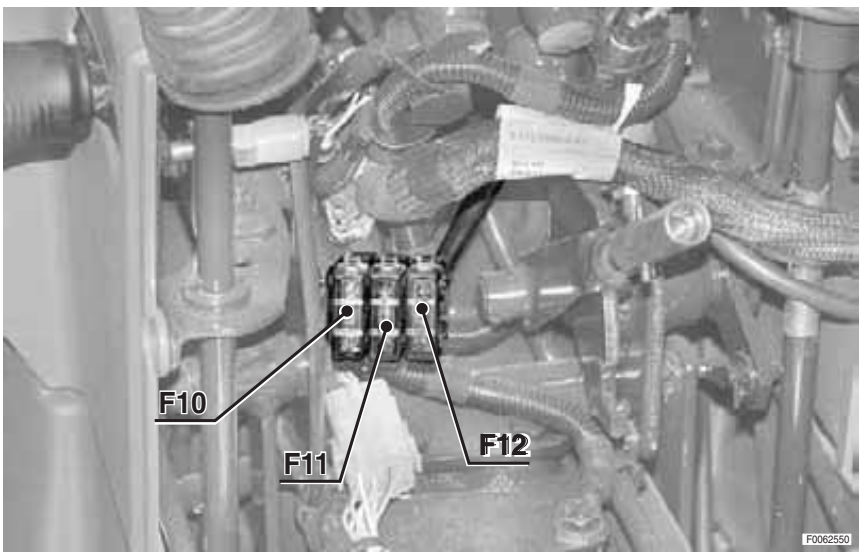


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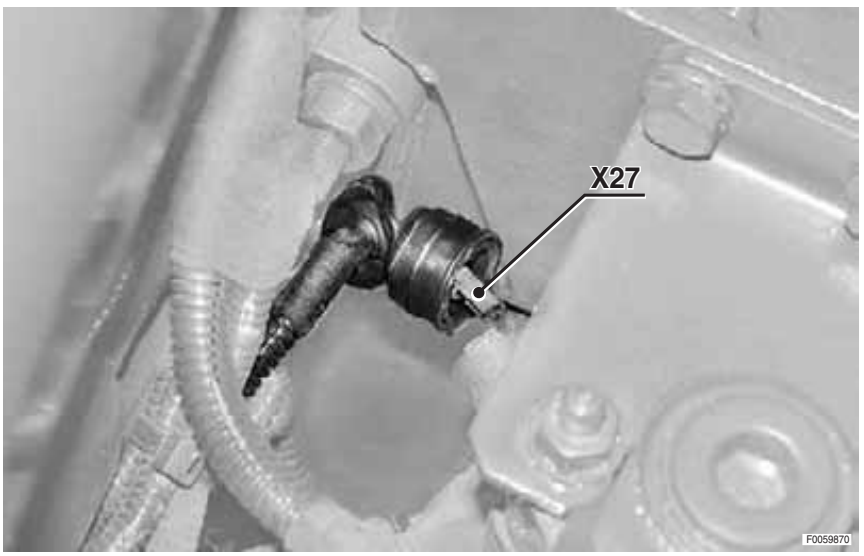
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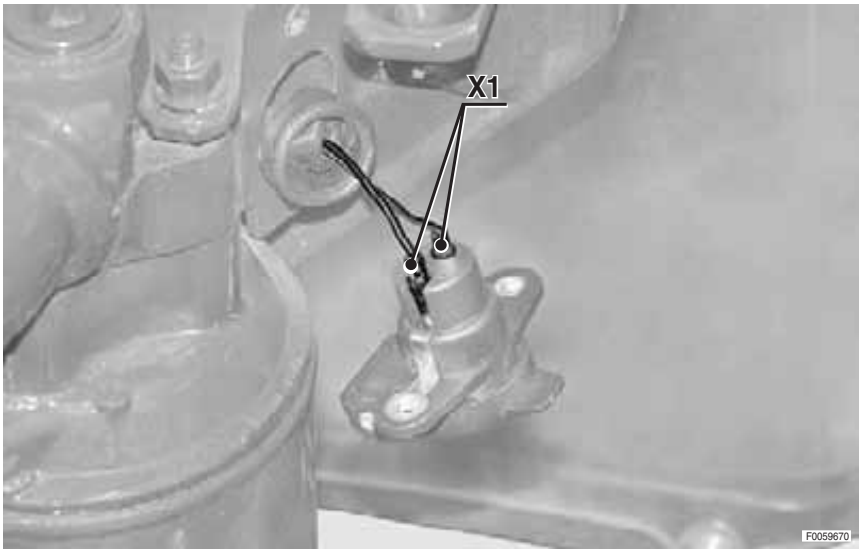


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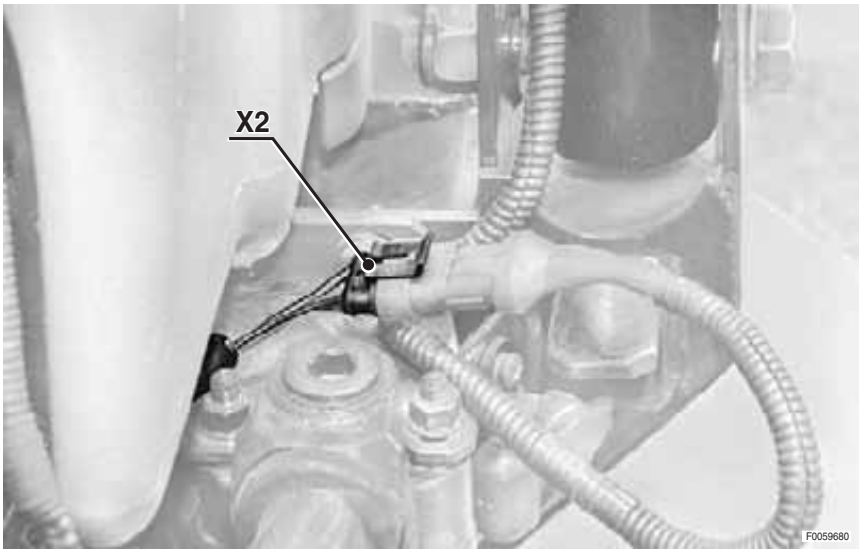


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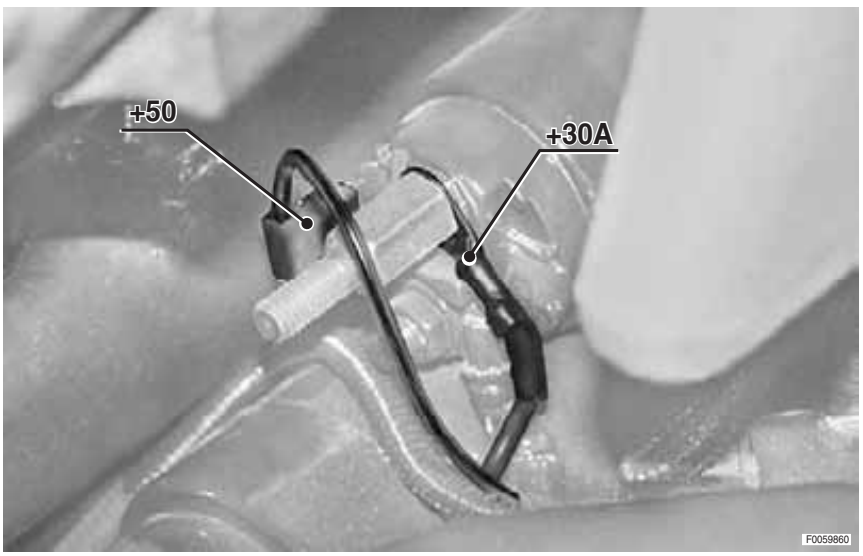
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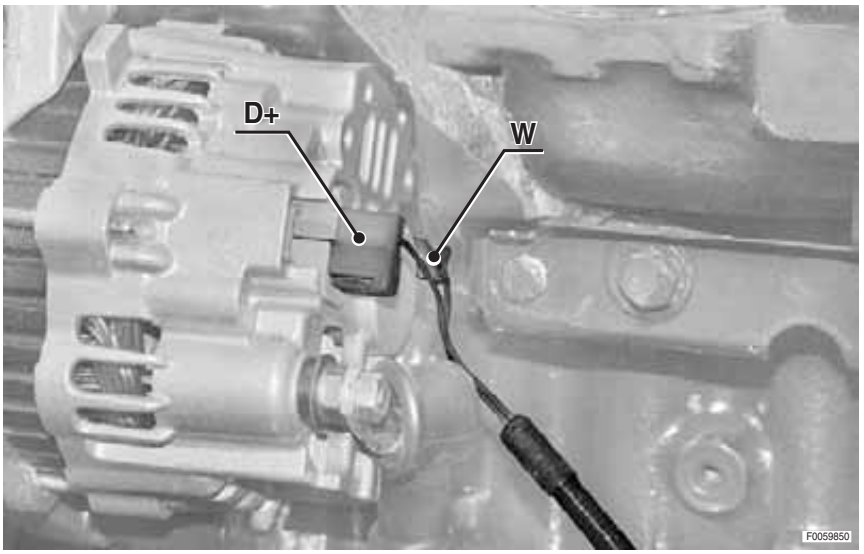


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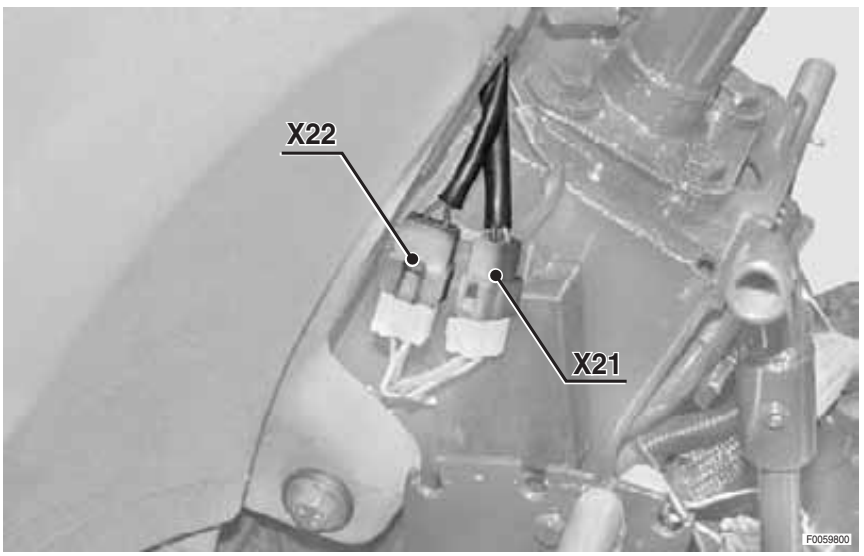


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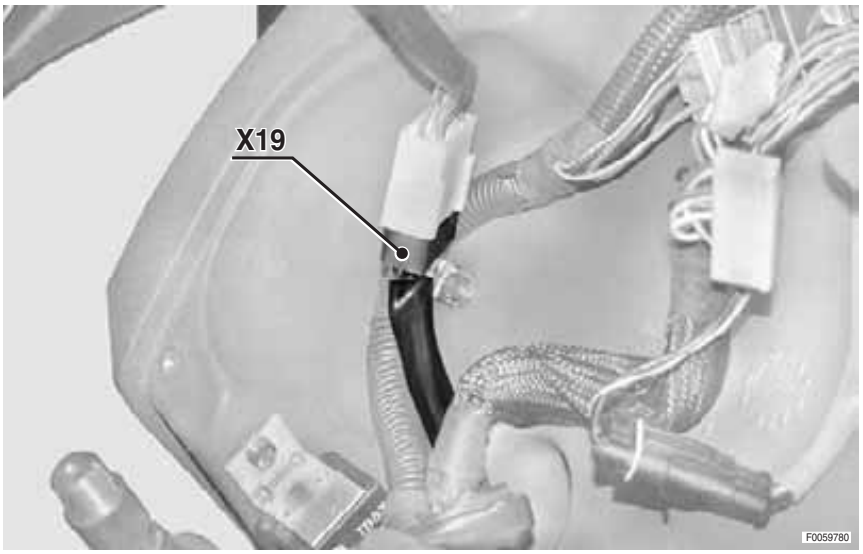


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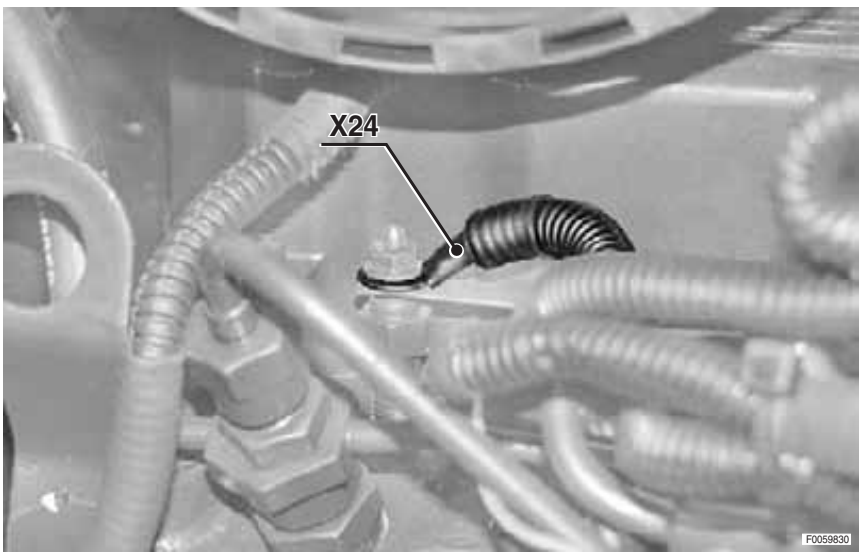


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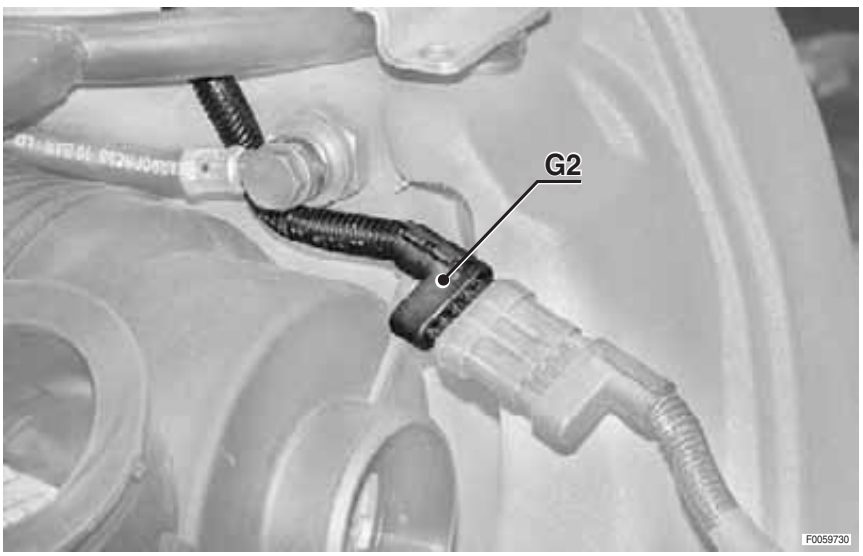
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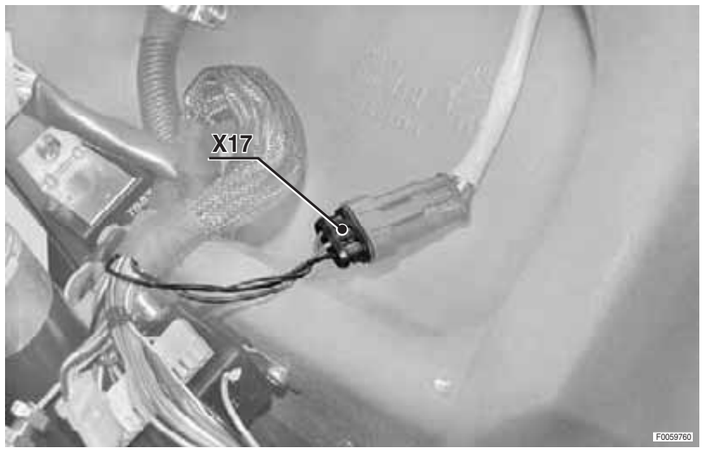
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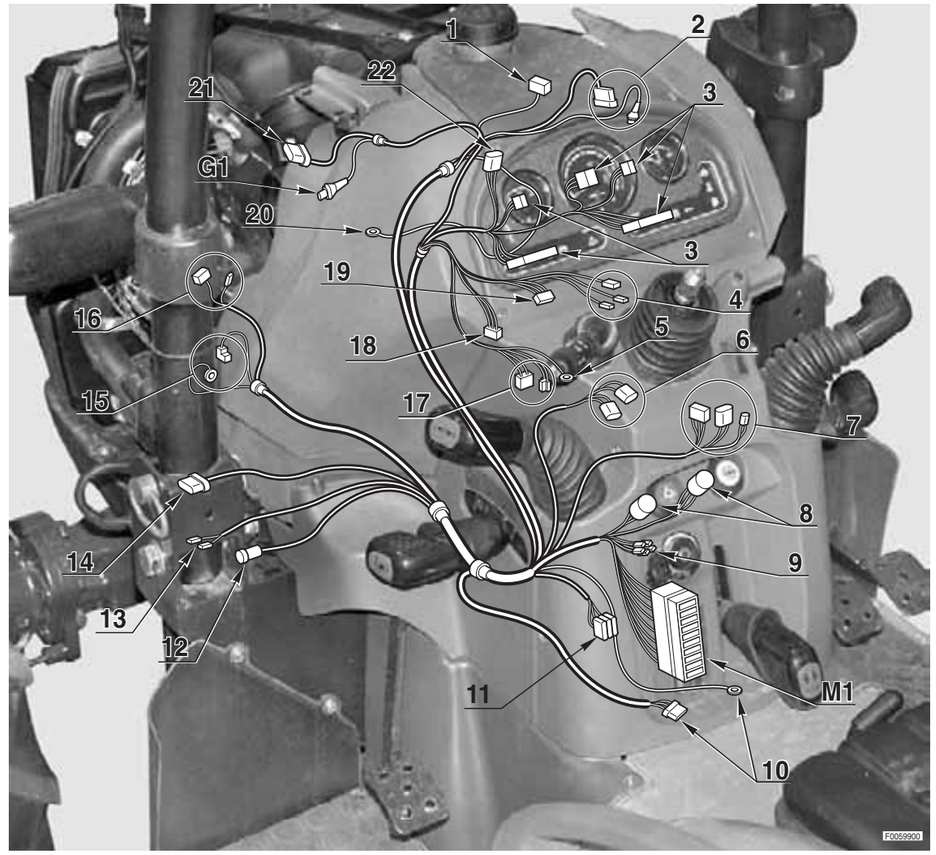
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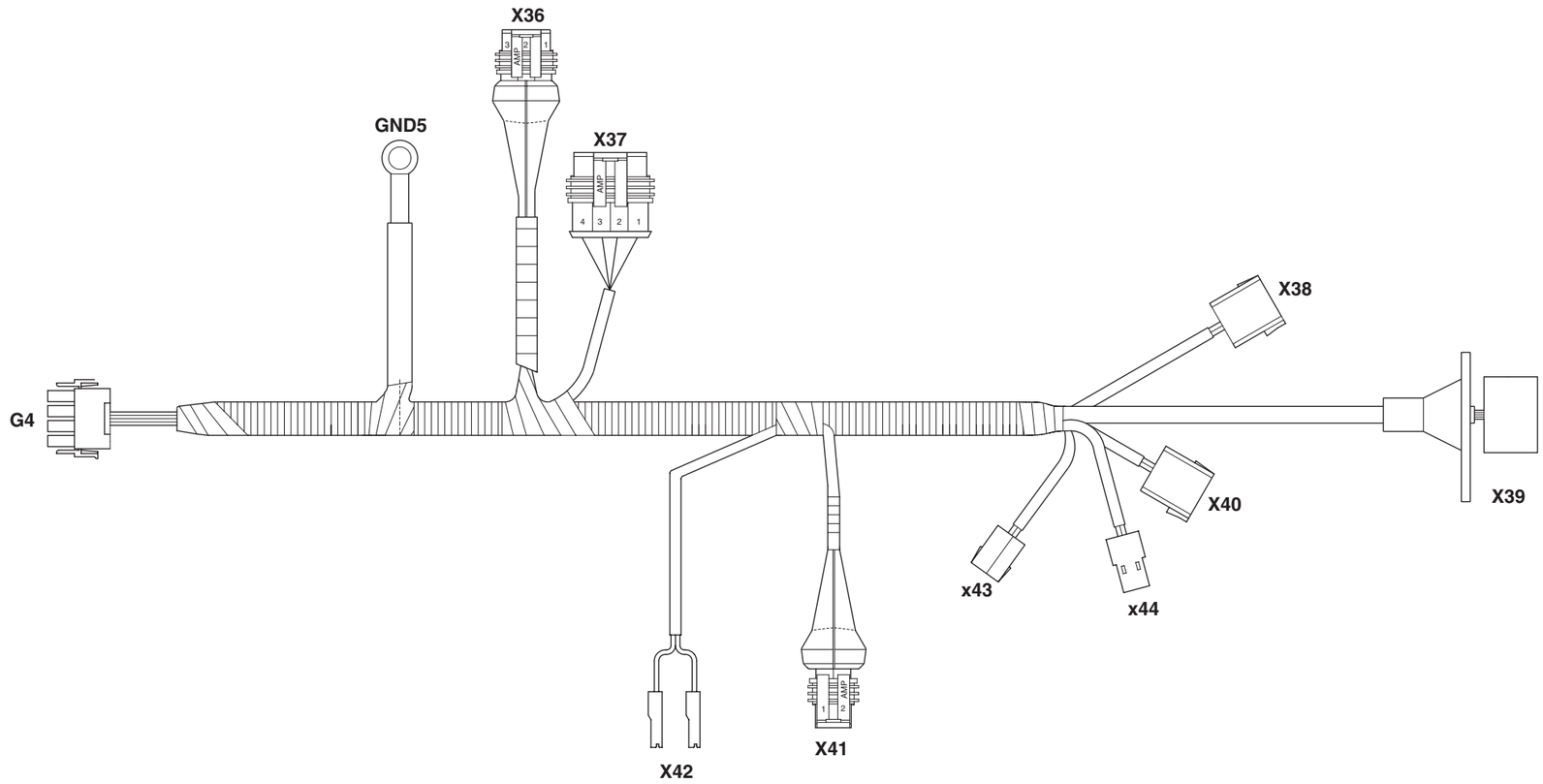


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REAR WIRING (1/2)



G4 To central wiring
X36 4WD engagement lamp switch
X37 Handbrake switch
X38 Right tail light
X39 Trailer socket
X40 Left tail light
X41 Solenoid controlling engagement of front diff lock
X42 PTO speed selector lamp switch
X43 Worklight
X44 Number plate light

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REAR WIRING (2/2)

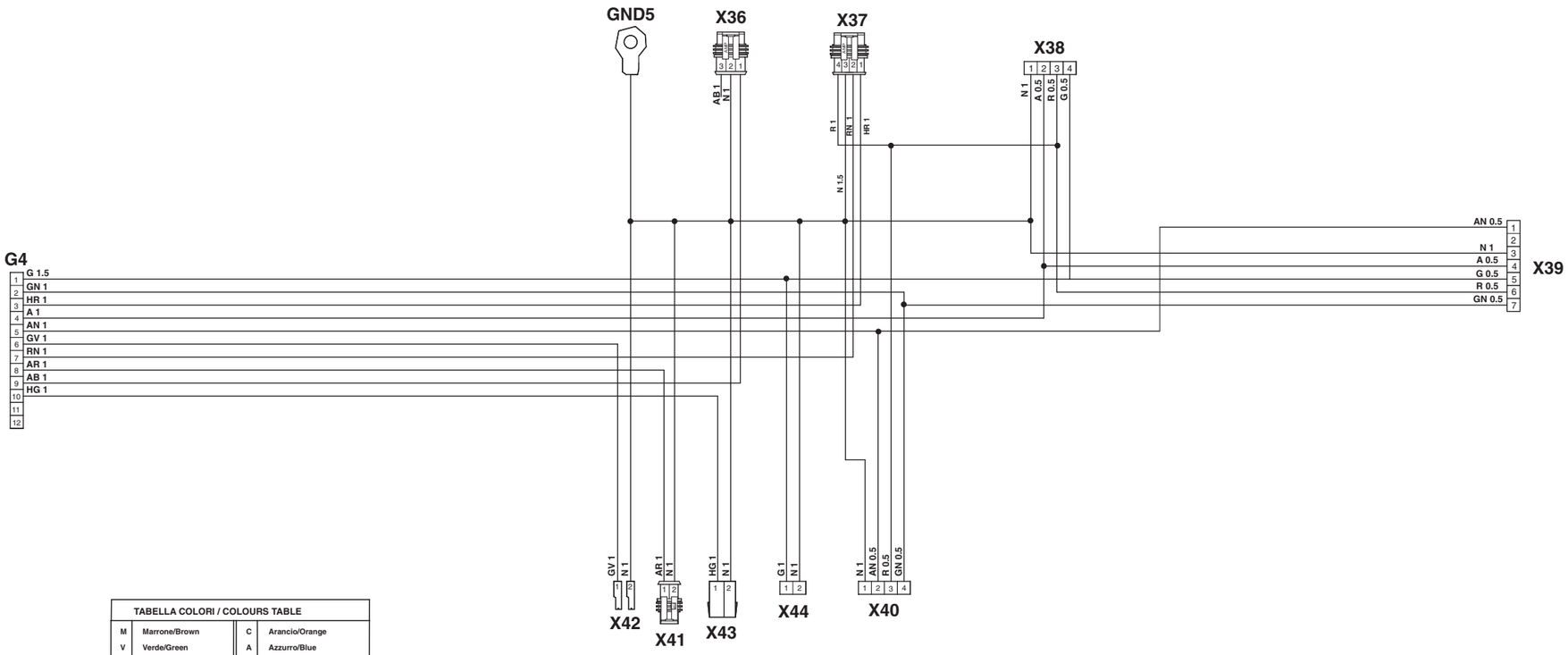
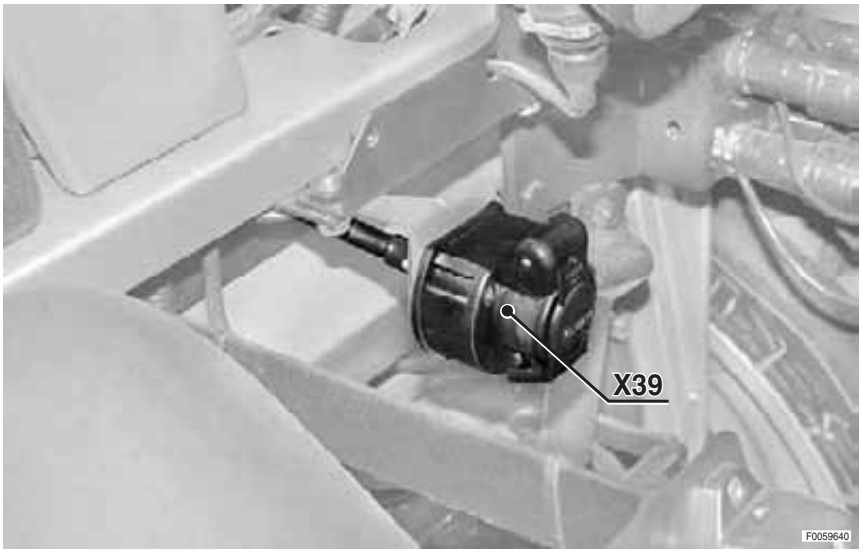


TABELLA COLORI / COLOURS TABLE			
M	Marrone/Brown	C	Arancio/Orange
V	Verde/Green	A	Azzurro/Blue
Z	Viola/Violet	B	Bianco/White
N	Nero/Black	L	Blu/Dark Blue
S	Rosa/Pink	G	Giallo/Yellow
R	Rosso/Red	H	Grigio/Gray

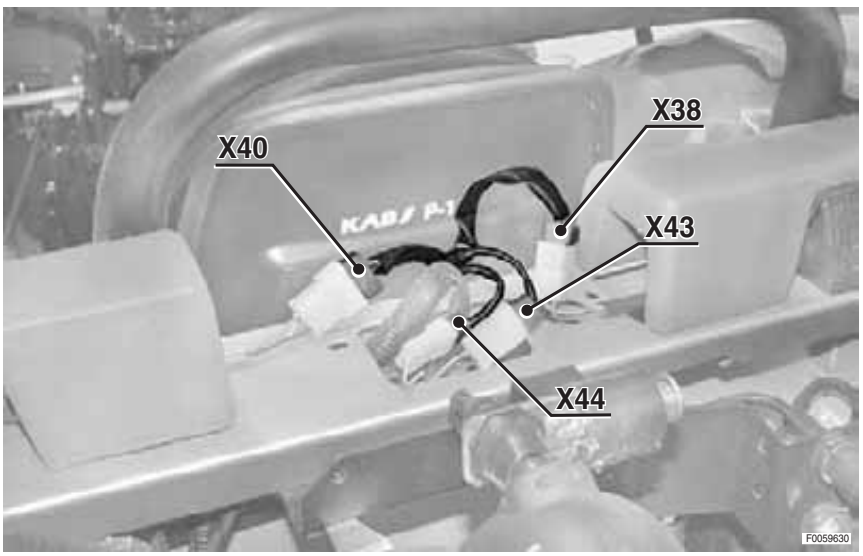
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CONNECTORS LOCATION

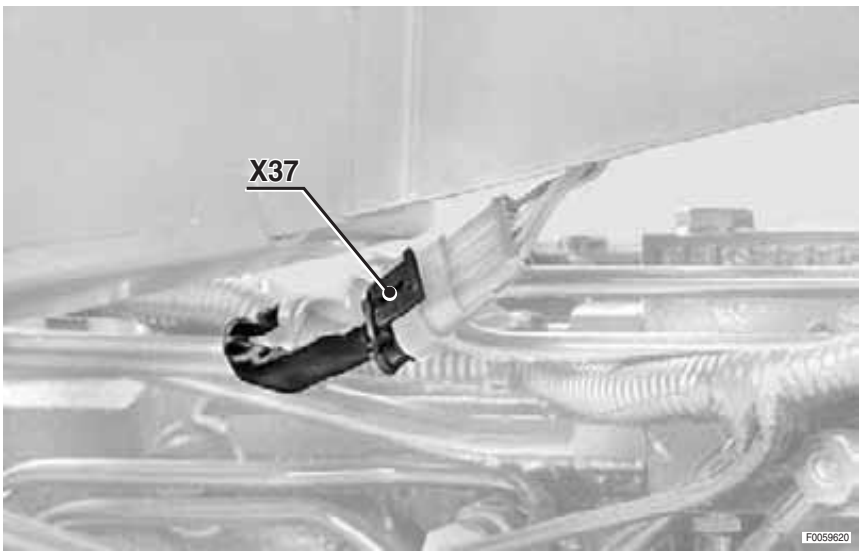
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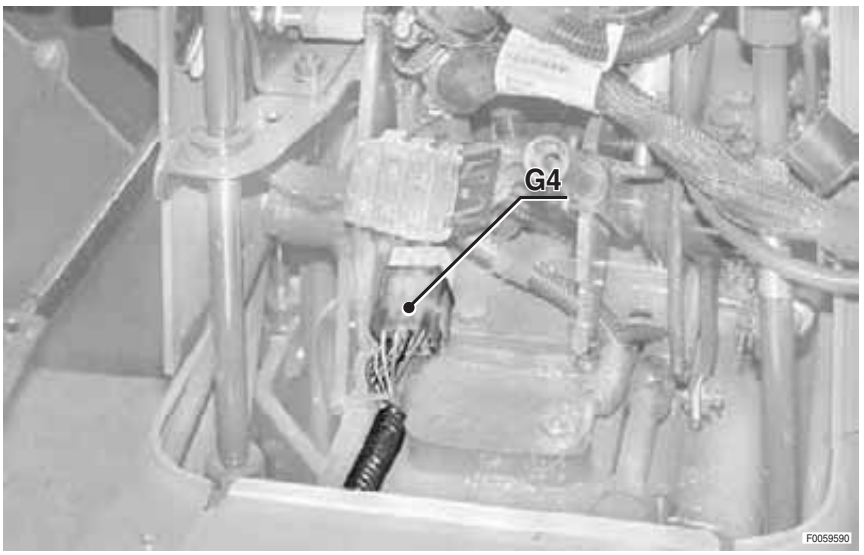


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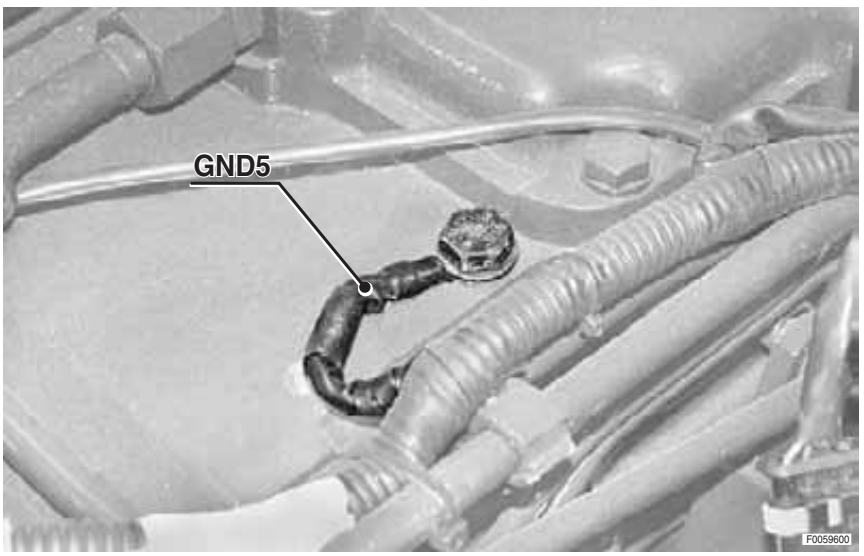


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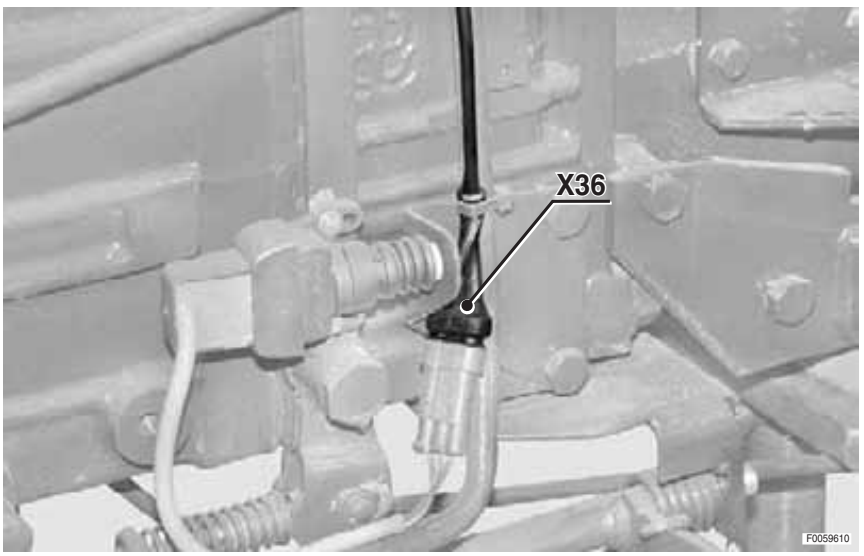
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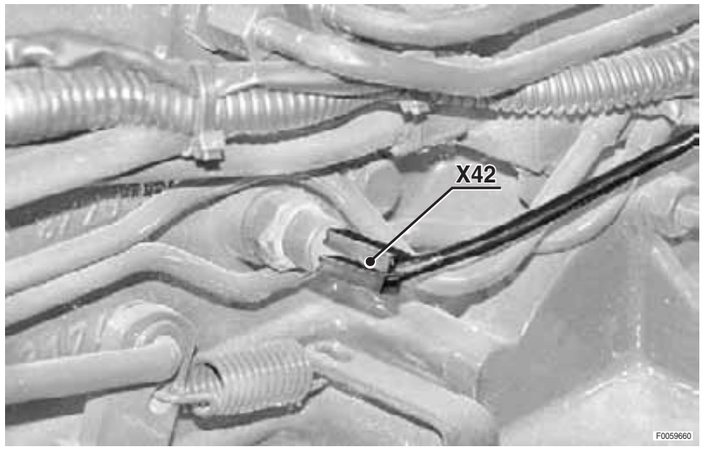
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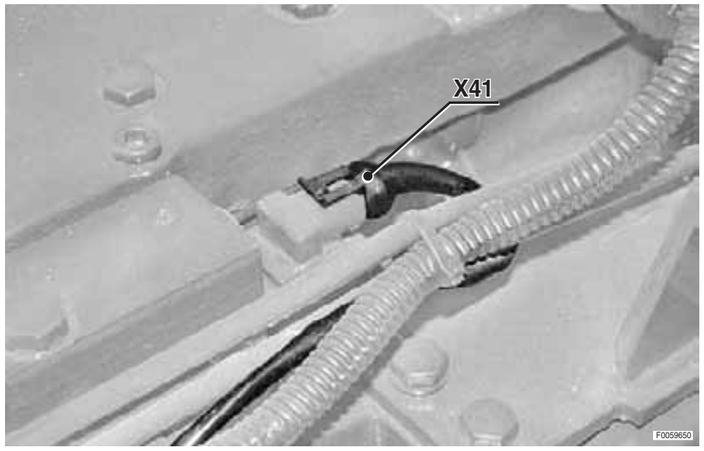
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REAR LINE

7



8





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SECTION 50

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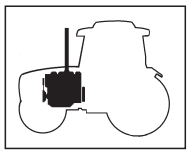
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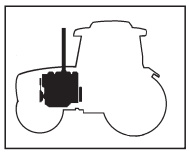
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This service manual has instructions and procedures for the subject on the front cover.
The information, specifications and illustrations in this manual are on the basis of the information that was current at the time this issue was written.
Correct servicing, test and repair procedures will give the engine a long service life. Before starting a test, repair or rebuild job, the serviceman must read the respective sections of this manual to know all the components he will work on.
Continuing improvement of product design may have caused changes to your engine which are not included in this manual.
Whenever a question arises regarding your engine, or this manual, consult your dealer for the latest available information.

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1 Mitsubishi engine

Introduction

HOW TO USE THIS MANUAL

1. Exploded views

In the exploded views, the component parts are separated but so arranged to show their relationship to the whole. Index numbering is used to identify the parts and to indicate a sequence in which the parts are to be removed for disassembly, or they are to be installed for assembly.

2. Symbols

The following symbols are used in this manual to emphasize important and critical instructions:

NOTE ..... Indicates a condition that is essential to highlight.



CAUTION ..... Indicates a condition that can cause engine damage.



WARNING ..... Indicates a condition that can cause personal injury or death.

3. Definition of locational terms

The fan end is ”front” and the flywheel end is ”rear.” The words ”left” and ”right” are as these directions would appear from the flywheel end.

4. Dimensional or specification terms

Nominal size.....Is the named size which has no specified limits of accuracy.

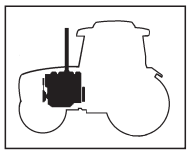
Standard .....Is the dimension of a part to be attained at the time of assembly, or the standard performance.

Limit ....Is the maximum or minimum permissible limit beyond which a part must be repaired or replaced.

5. Tightening torques

Tighten bolts, nuts, etc. in a wet condition (apply oil to threads) when specified as [WET]. Tighten them in a dry condition unless so specified. Use the general torques unless otherwise specified.

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Section	Content	No.
General information	Model identification and serial number location; component location; specifications	1
Overhaul instructions	Determining when to overhaul the engine; compression pressure measurement; troubleshooting; basic precautions for disassembly and assembly	2
Disassembly	Preparation for disassembly; electrical system; cooling system; fuel system; lubrication system; air inlet system and exhaust system; cylinder head and valve mechanism timing gears and flywheel; cylinder block, crankshaft, pistons and oil pan	3
Inspection	Cylinder head and valve mechanism; timing gears and flywheel; cylinder block, crankshaft, pistons and oil pan	4
Assembly	Cylinder block, crankshaft, pistons and oil pan; timing gears and flywheel; cylinder head and valve mechanism air inlet system and exhaust system; fuel system; lubrication system; cooling system; electrical system	5
Electrical system	General; starter; alternator; key shutoff system; automatic glow timer system	6
Cooling system	General; inspection (water pump; thermostat; thermoswitch; thermounit)	7
Lubrication system	General; inspection (oil pump; oil pressure switch; pressure relief valve)	8
Fuel system	General; fuel injection nozzle; fuel injection pump; governor fuel pump; fuel filter	9
Air inlet system and exhaust system	General; Inspection	10
Maintenance	Lubrication and maintenance chart; engine oil and oil filter; valve clearance; fuel injection timing; fuel filter; fuel system priming; idle rpm setting; fuel injection nozzle; fan belt	11
Service data	Specifications; tightening torques; sealants; special tools	12

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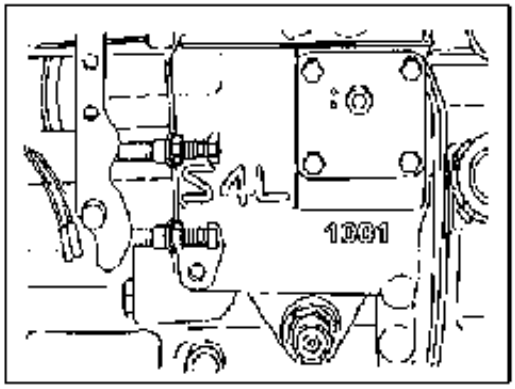
MODEL IDENTIFICATION AND SERIAL NUMBER LOCATION

1. Model identification location

(A) The model identification is embossed on the right side of the cylinder block, near the fuel injection pump mount.

(B) The model identifications and displacements of the engines in current production are as listed below:

	Displacement
S3L - 61A	1.125 liters (68.7 cu in.)
S3L2 - 61A	1.318 liters (80.4 cu in.)
S4L - 61A	1.500 liters (91.5 cu in.)
S4L2 - 61A	1.758 liters (107.3 cu in.)



1 - Model identification location

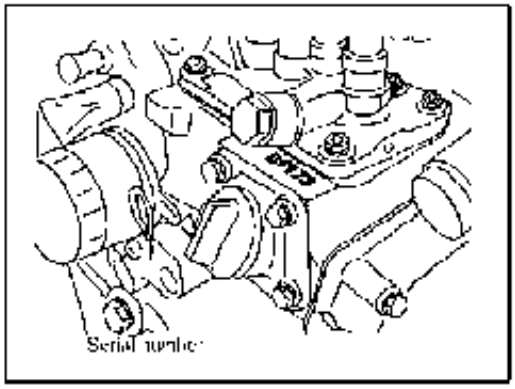
(C) A scheme of coding used for identifying the engines in current production is as follows.

Example: Coded designation:

S	Identification of "Sagamihara Machinery Works"
4	Number-of-cylinders code ["4" stands for four cylinders]
L	Series code [Bore: 78 mm (3.07 in.)]
(2)	Stroke code (No code: 78.5 mm (3.09 in.), 2: 92 mm (3.62 in.)
61	Export code
A	Specification code

2. Serial Number Location

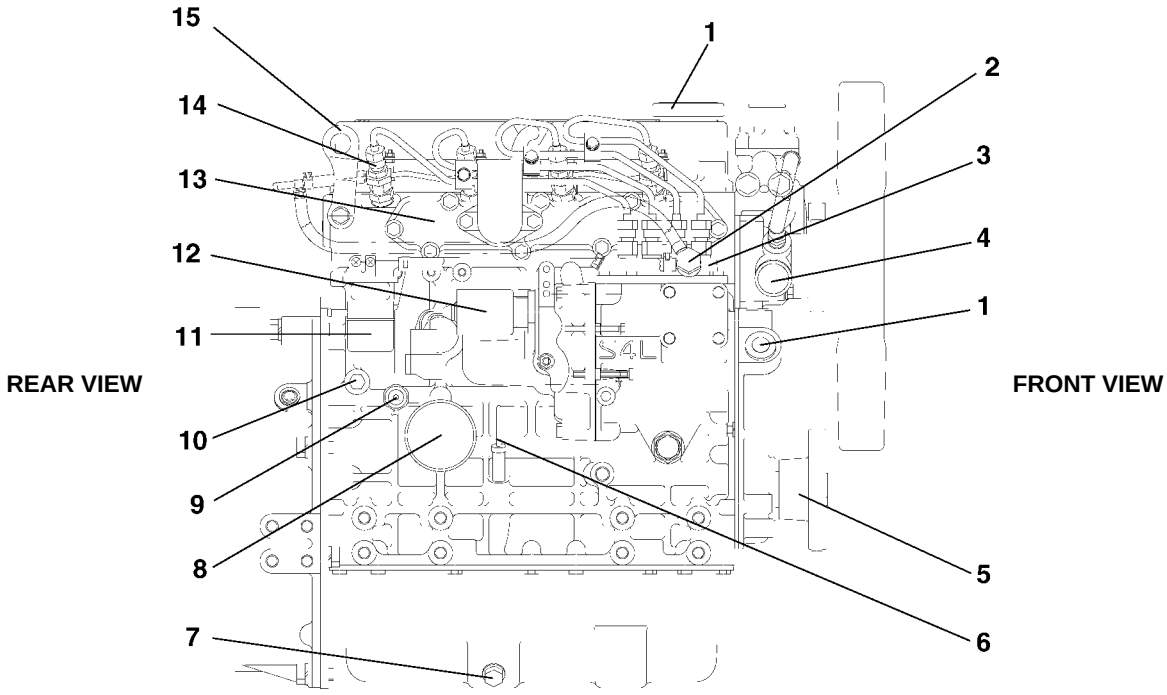
The serial number is punched on the cylinder block, near the fuel injection pump mount



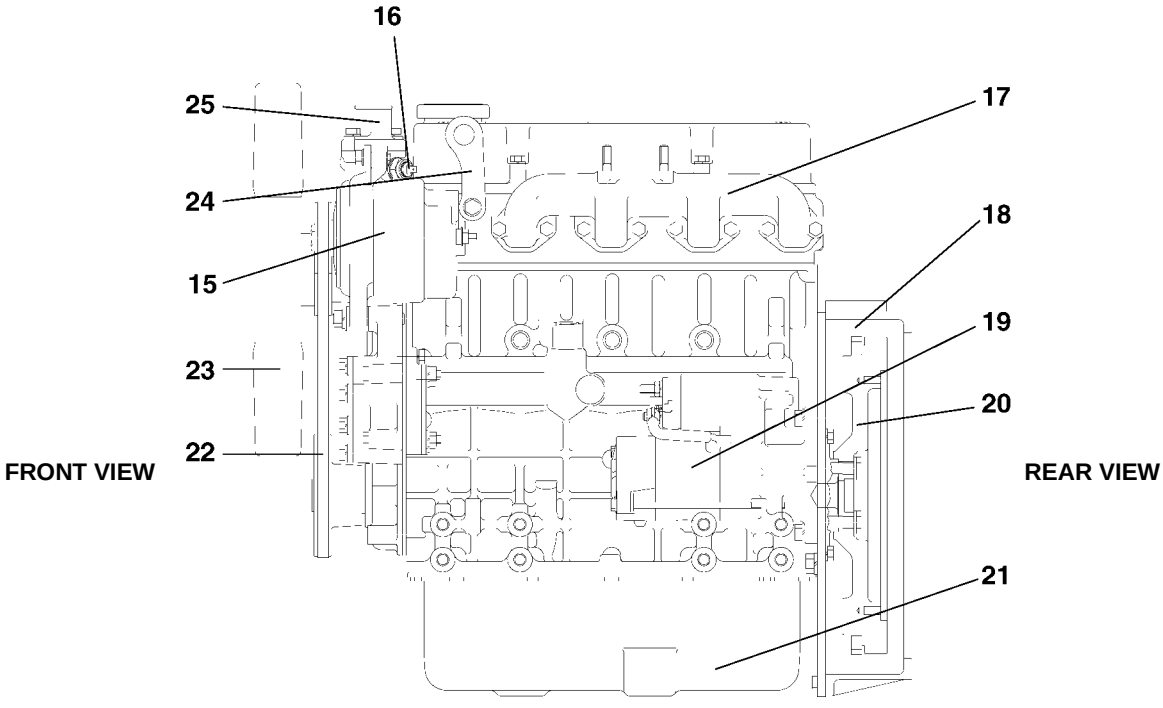
1 - Serial number location

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COMPONENT POSITIONS - NATURALLY ASPIRATED ENGINE (S4L/S4L2)



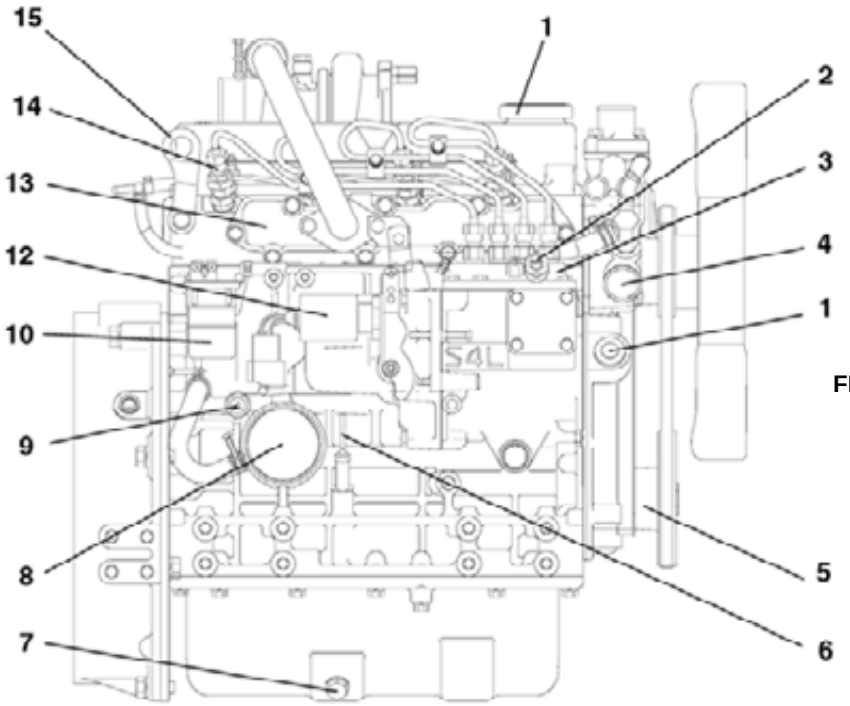
RIGHT SIDE VIEW



LEFT SIDE VIEW

1 - Oil filler
2 - Air bleed screw
3 - Injection pump
4 - Coolant pump
5 - Crankshaft pulley
6 - Oil level dipstick
7 - Oil drain plug
8 - Oil filter
9 - Engine oil pressure switch
10 - Engine coolant drain plug
11 - Fuel filter
12 - Engine Stop solenoid
13 - Air inlet cover
14 - Injector nozzle
15 - Bracket
16 - Thermostat
17 - Exhaust manifold
18 - Flywheel housing
19 - Starter motor
20 - Flywheel

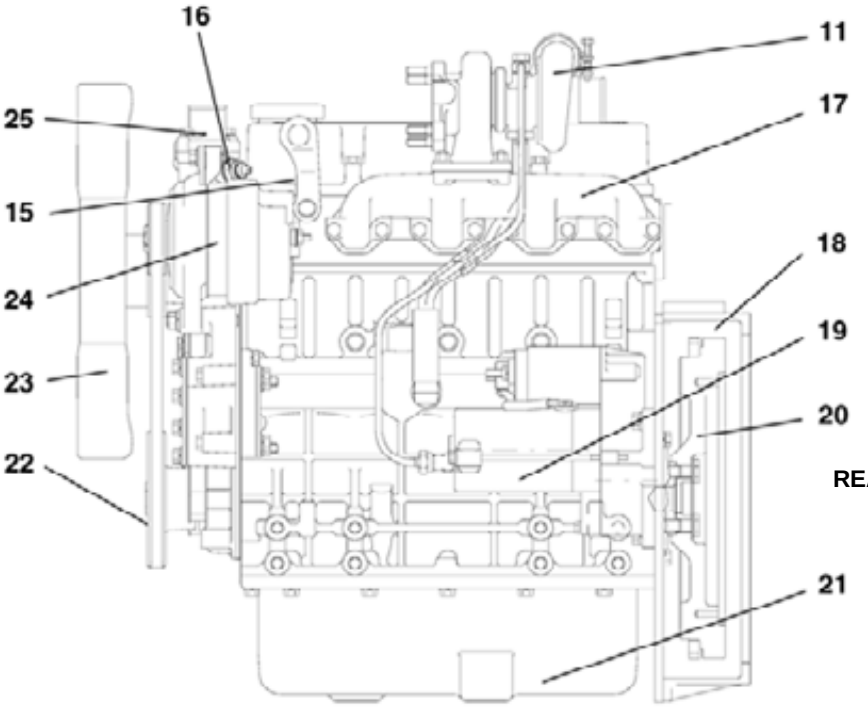
COMPONENT POSITIONS - TURBO ENGINE (S4L-T/S4L2-T)



REAR VIEW

FRONT VIEW

RIGHT SIDE VIEW



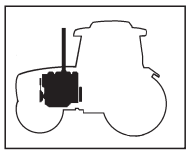
FRONT VIEW

REAR VIEW

LEFT SIDE VIEW

1 - Oil filler
2 - Air bleed screw
3 - Injection pump
4 - Coolant pump
5 - Crankshaft pulley
6 - Oil level dipstick
7 - Oil drain plug
8 - Oil filter
9 - Engine oil pressure switch
10 - Fuel filter
11 - Turbocharger
12 - Engine Stop solenoid
13 - Air inlet cover
14 - Injector nozzle
15 - Bracket
16 - Thermostat
17 - Exhaust manifold
18 - Flywheel housing
19 - Starter motor
20 - Flywheel

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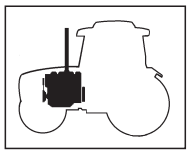
1 Mitsubishi engine

General information

SPECIFICATIONS

Model		S3L - 61A	S3L2 - 61A	S4L - 61A	S4L2 - 61A
Type		Water-cooled, 4-stroke cycle, in-line diesel engine			
Firing order (injection sequence)		1 - 3 - 2		1 - 3 - 4 - 2	
Compression ratio		22			
Combustion chamber, type		Swirl			
Weight, kg (lb)		125 (276)		150 (331)	
No. of cylinders		3		4	
Bore x Stroke, mm (in.)		78 x 78.5 (3.07 x 3.09)	78x92 (3.07 x 3.62)	78 x 78.5 (3.07 x 3.09)	78x92 (3.07 x 3.62)
Displacement, liter (cu in.)		1.125 (68.7)	1.318 (80,4)	1.500 (91.5)	1.758 (107.3)
Fuel system	Injection pump, type	Bosch M			
	Injection nozzle, type	Throttle			
	Governor, type	Centrifugal flyweight			
	Fuel	ASTM no. 2-D			
Lubrication system	Type	Force feed (by trochoid pump)			
	Engine oil	API Service Classification CC			
	Oil filter	Paper-element (full-flow)			
	Capacity (high level excl. 0.5 liter (0.13 U.S. gal) of oil in oil filter), liter (U.S. gal)	5.7 (1.5) (with deep oil pan) 3.7 (1.0) (with standard oil pan)		7.7 (2.0) (with deep oil pan) 5.4 (1.4) (with standard oil pan)	
Cooling system	Type	Forced cooling			
	Capacity (approximate), liter (U.S. gal)	1.8 (0.5)		2.5 (0.7)	
Starter, V - kW		12 - 1.6		12 – 2.0	
Alternator, V – A		12 – 50			

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DETERMINING WHEN TO OVERHAUL THE ENGINE

Generally, when to overhaul the engine is to be determined by taking into account a drop in compression pressure as well as an increase in lube oil consumption and excessive blowby gases.

Lower power or loss of power, an increase in fuel consumption, a drop in lube oil pressure, hard starting and excessive abnormal noise are also troubles.
These troubles, however, are not always the result of low compression pressure and give no valid reason for overhauling the engine.

The engine develops troubles of widely different varieties when the compression pressure drops in it. Following are the typical troubles caused by the compression pressure failure:

(1) Low power or loss of power
(2) Increase in fuel consumption
(3) Increase in lube oil consumption
(4) Excessive blowby through breather due to worn cylinders, pistons, etc.
(5) Excessive blowby due to poor seating of worn inlet and exhaust valves
(6) Hard starting or failure to start
(7) Excessive engine noise

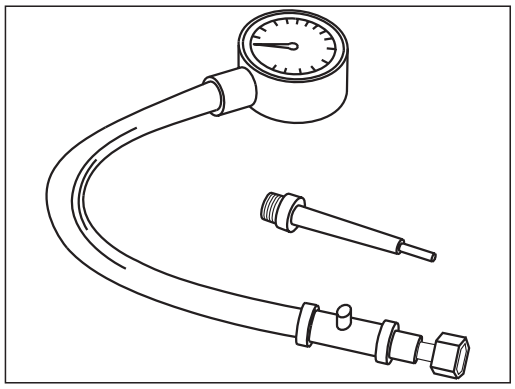
In most cases, these troubles occur concur- rently. Some of them are directly caused by low compression pressure, but others are not.

Among the troubles listed above, (2) and (6) are caused by a fuel injection pump improperly adjusted with respect to injection quantity or injection timing, worn injection pump plungers, faulty injection nozzles, or poor care of the battery, starter and alternator.

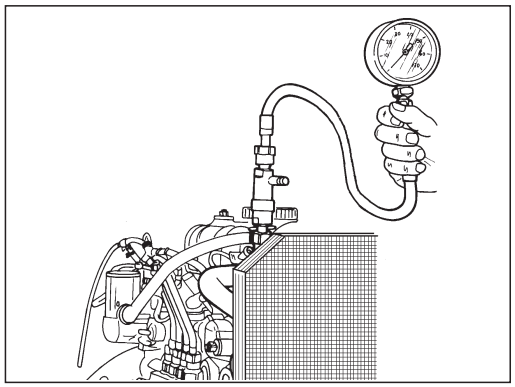
The trouble to be taken into account as the most valid reason for overhauling the engine is (4): in actually determining when to overhaul the engine, it is reasonable to take this trouble into account in conjunction with the other ones.

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COMPRESSION PRESSURE MEASUREMENT



Compression gauge and adaptor



Measuring compression pressure

CAUTION:
a) It is important to measure the compression pressure at regular intervals to obtain the data on the gradual change of the compression pressure.
b) The compression pressure would be slightly higher than the standard in a new or overhauled engine owing to breaking-in of the piston rings, valve seats, etc. It drops as the engine components wear down.

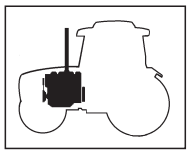
1. Inspection
Check to make sure –
(1) The crankcase oil level is correct, and the air cleaner, starter and battery are all in normal condition.
(2) The engine is at the normal operating temperature.

2. Measurement
(1) Move the control lever to a position for shutting off fuel supply.
(2) Remove all glow plugs from the engine. Install the compression gauge and adaptor (ST332270) combination to a cylinder on which the compression pressure is to be measured.
(3) Turn the engine with the starter and read the gauge pressure at the instant the gauge pointer comes to stop.
(4) If the gauge reading is below the limit, overhaul the engine.

CAUTION:
a) Be sure to measure the compression pressure on all cylinders.
b) The compression pressure varies with change of engine rpm. This makes it necessary to check engine rpm at the time of measuring the compression pressure.

Item	Standard		Limit
Engine speed, rpm	290		-
Compression pressure, kg/cm2 (psi) [kPa]	SL	30 (427) [2 942]	27 (327) [2 256]
	SL2	32 (455) [3 138]	25 (356) [2 452]
Maximum permissible difference between average compression pressure of all cylinders in one engine, kgf/cm'(psi) [kPa]	3 (42.7) [294]		-

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TROUBLESHOOTING

1. General

The diagnosis of troubles, especially those caused by a faulty fuel injection pump or injection nozzles, or low compression pressure, can be difficult. It requires a careful inspection to determine not which item is the cause, but how may causes are contributing to the trouble, someone of which is the primary cause.

Several causes may be contributing to a single trouble.

On the following pages, there are trouble- shooting charts on which engine troubles can be traced to their causes. Each chart has items to be verified ahead and suggested inspection procedure.

Diesel engines exhibit some marked characteristics during operation. Knowing these characteristics will help minimize time lost in tracing engine troubles to their source.

Following are the characteristics of diesel engines you should know about for diagnosis:

Combustion knock (diesel knock)

Some black exhaust smoke (when the engine picks up load)

Vibration (due to high compression pressure and high torque)

Hunting (when the engine speed is quickly decreased)

Some white exhaust smoke (when the engine is cold, or shortly after the engine has been started)

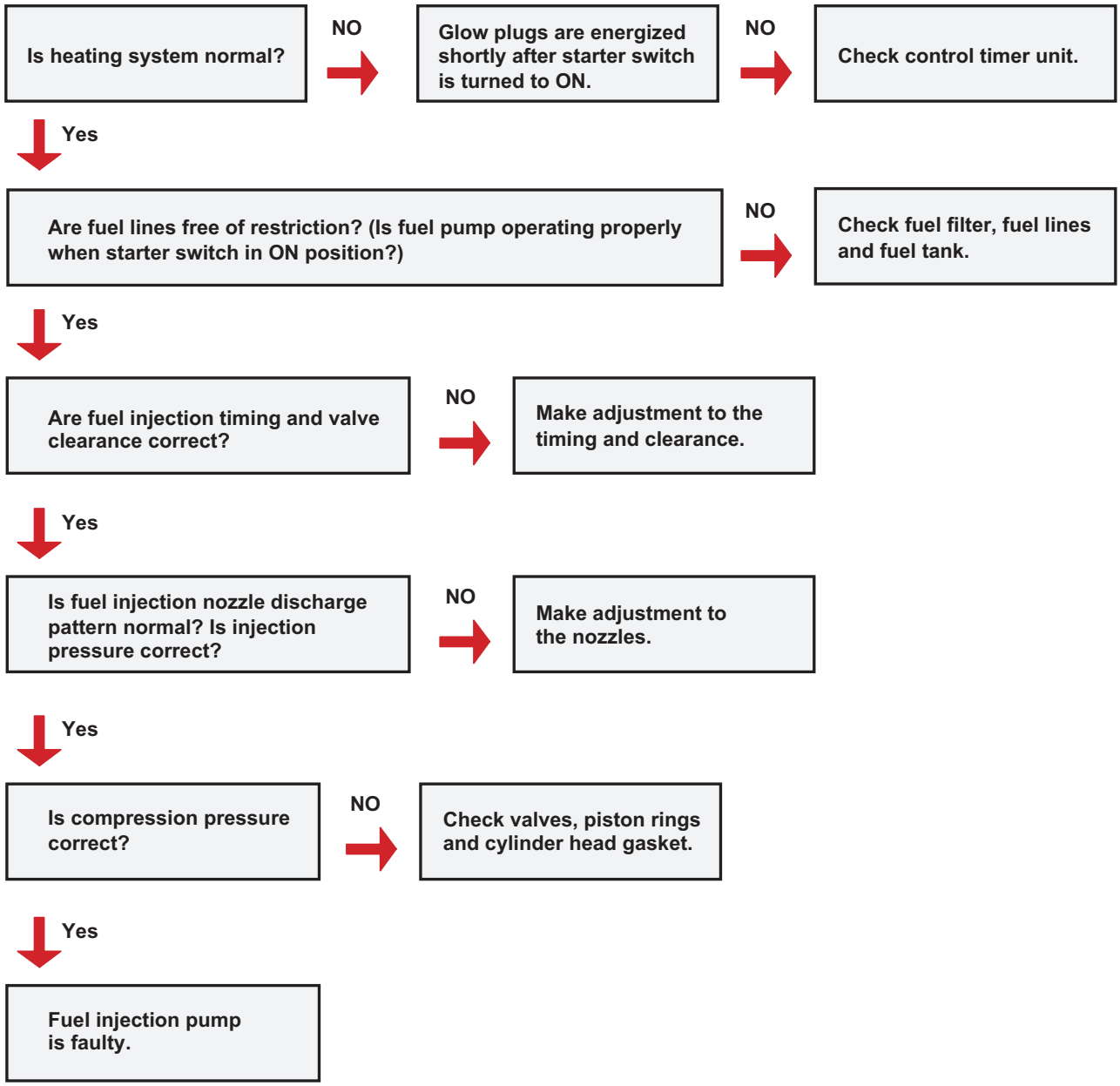
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2. Engine troubleshooting

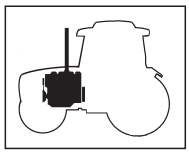
Problem 1: Hard starting

(1) Items to be checked for ahead
Clogged air cleaner
Wrong oil grade for weather conditions
Poor quality fuel
Low cranking speed

(2) Inspection procedure



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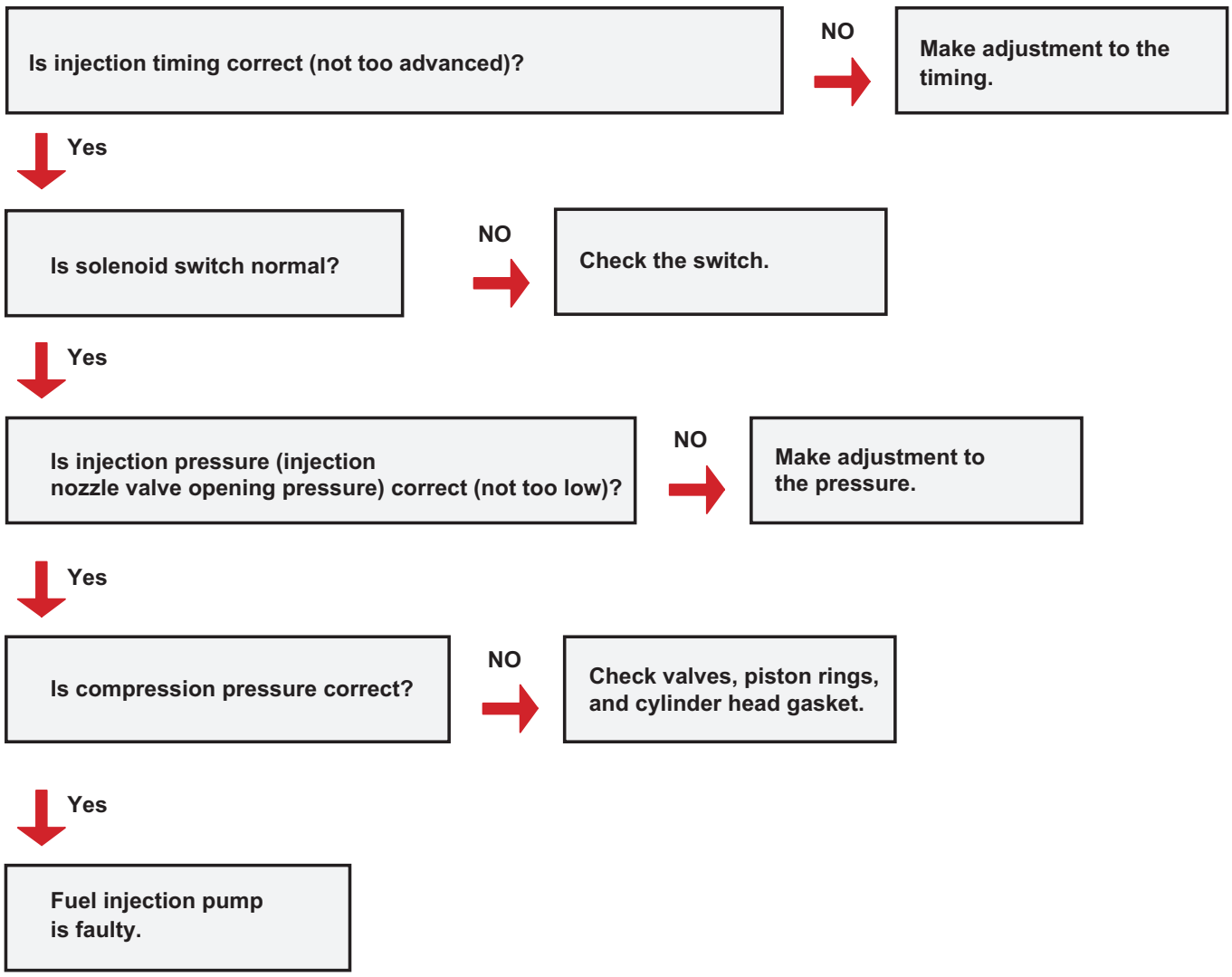
Problem 2: Fuel knock

More or less fuel knock occurs in diesel engines. This may be caused either by an excessively large delay period or by a too fast rate of fuel injection.

(1) Items to be checked for ahead

Clogged air cleaner
Poor quality fuel

(2) Inspection procedure



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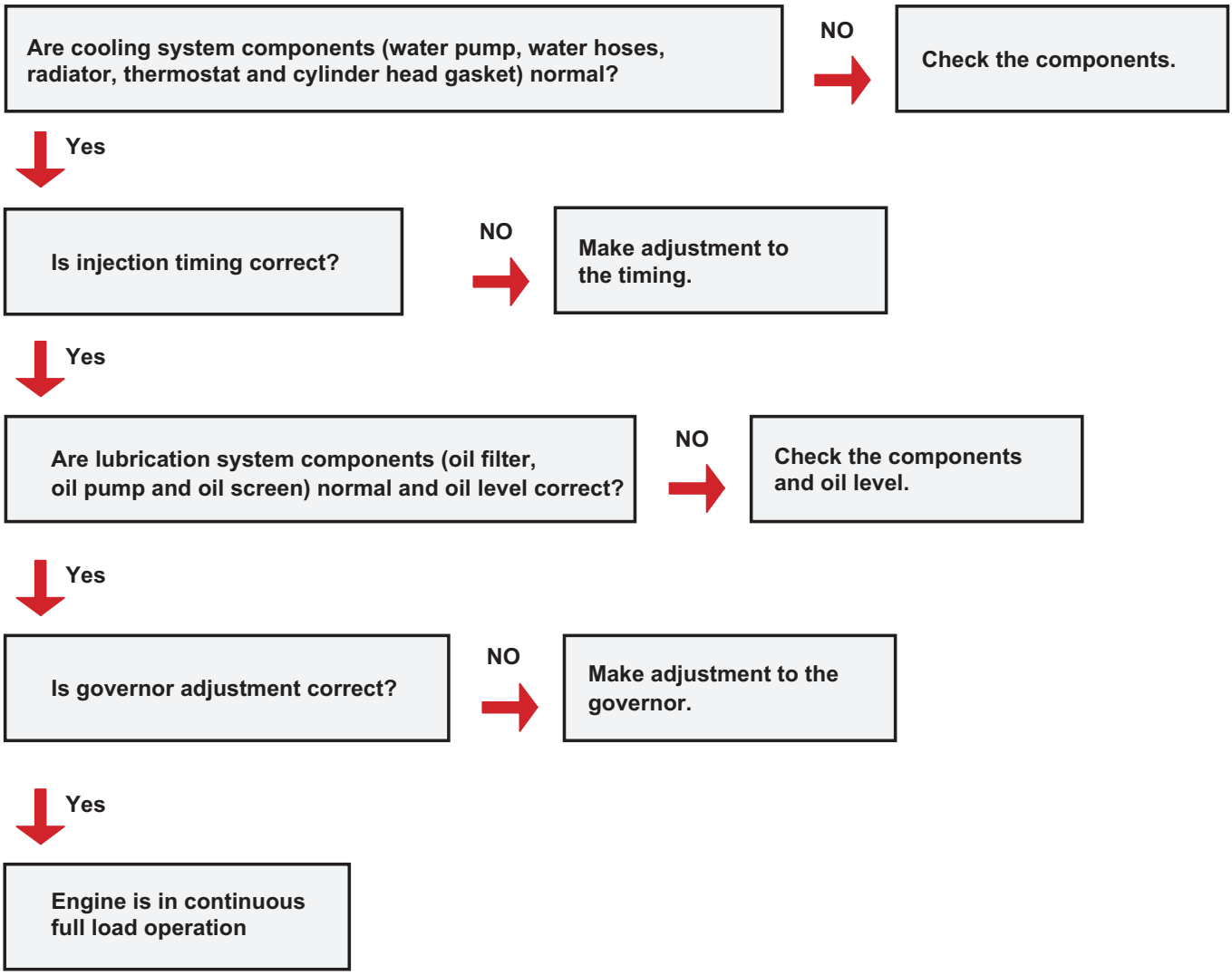
Problem 3: Overheating

(1) Items to be checked for ahead

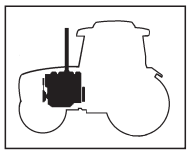
Overheating might also be caused by abnormal operating conditions. If the engine is overheating but its cooling system is not contributing to this trouble, it is necessary to check the difference between the ambient temperature and coolant temperature when the engine is in normal operation (with the thermostat fully open). If the ambient temperature is higher than the normal coolant temperature by more than 60°C (108°F), investigate other items than those related to the engine cooling system.

Insufficient coolant and exterior coolant leaks
Loose fan belt
Radiator core openings plugged with dirt

(2) Inspection procedure



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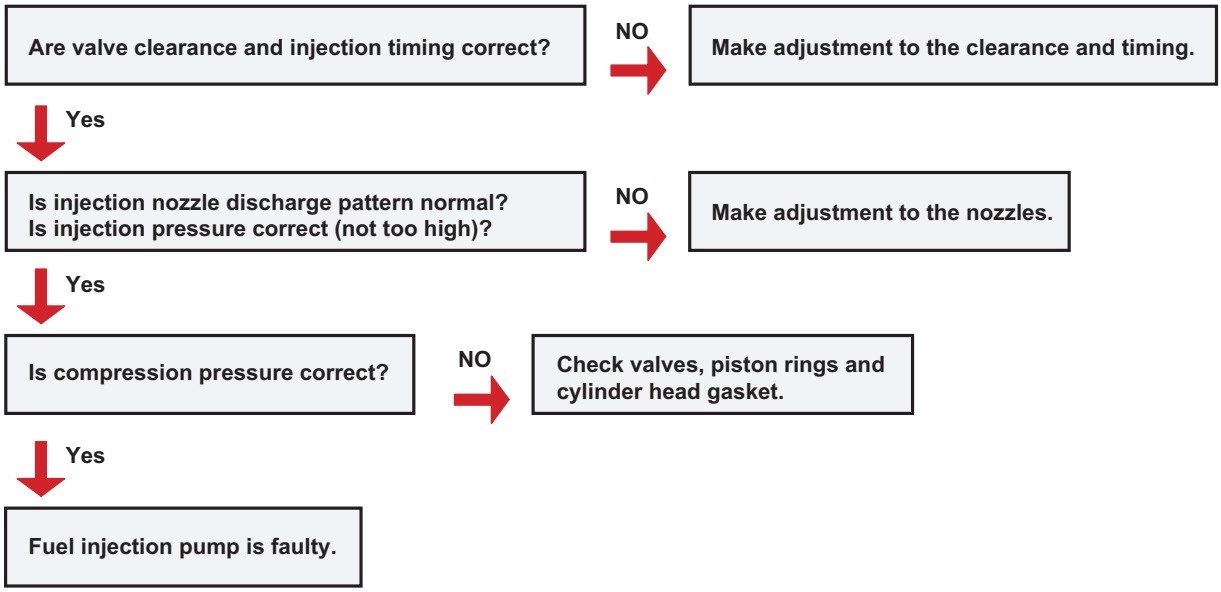


Problem 4: Black exhaust smoke

(1) Items to be checked for ahead

Clogged air cleaner
Poor quality fuel

(2) Inspection procedure

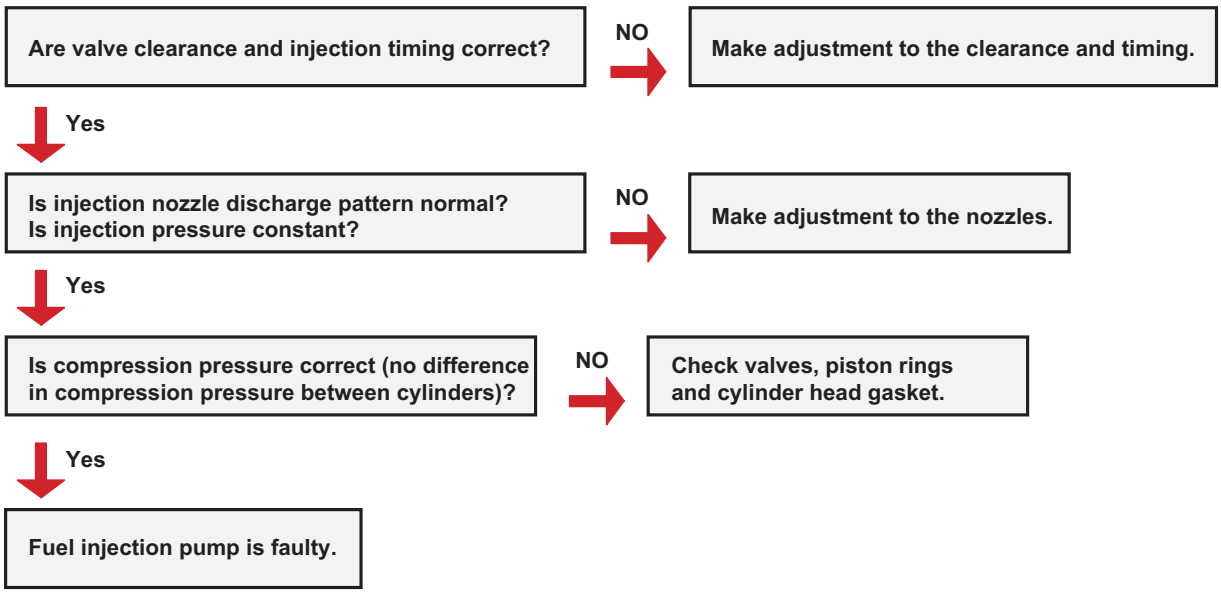


Problem 5: Erratic idle speeds

(1) Items to be checked for ahead

Maladjusted engine control
Wrong oil grade for weather conditions
Poor quality fuel

(2) Inspection procedure



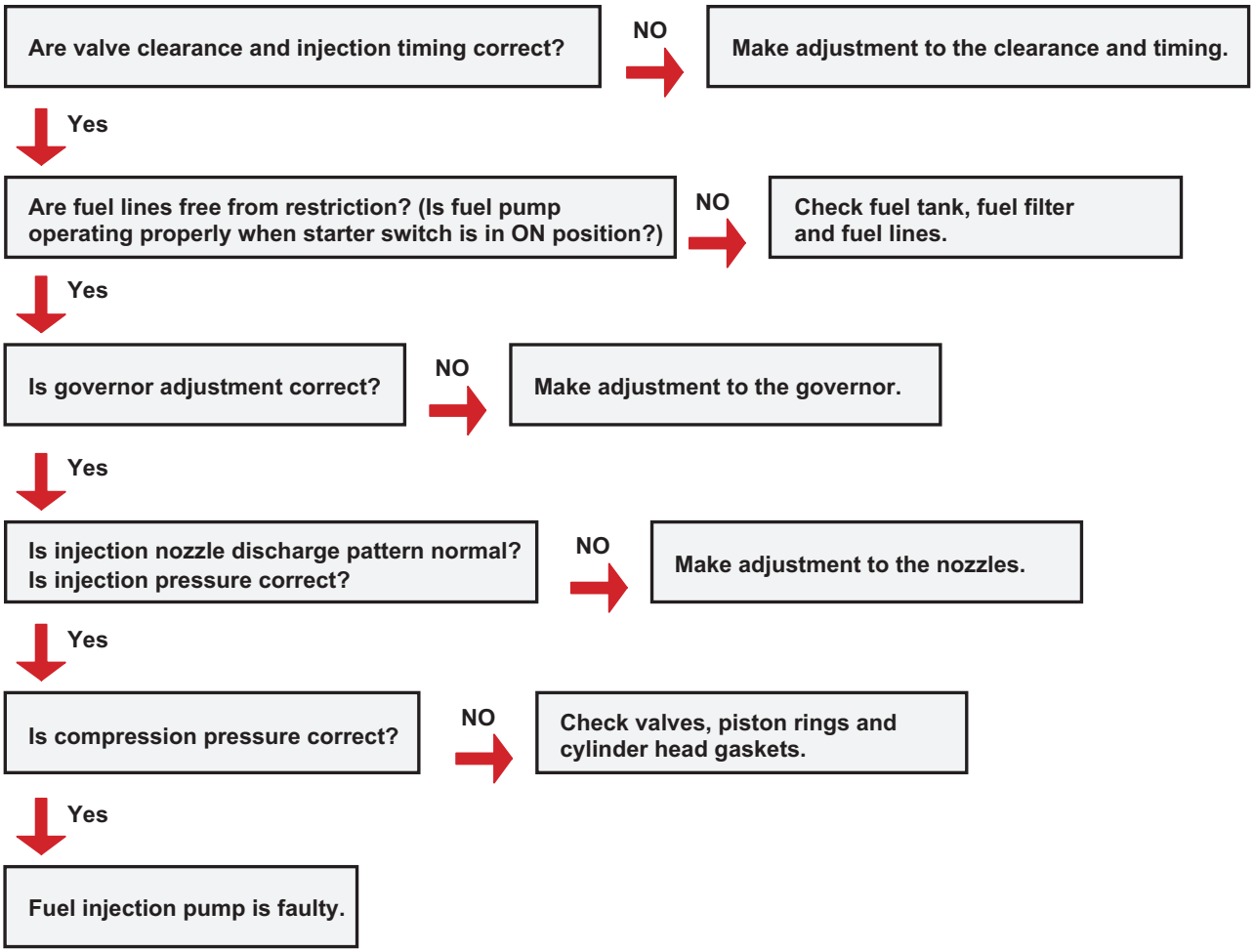
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Problem 6: Low power or loss of power

(1) Items to be checked for ahead

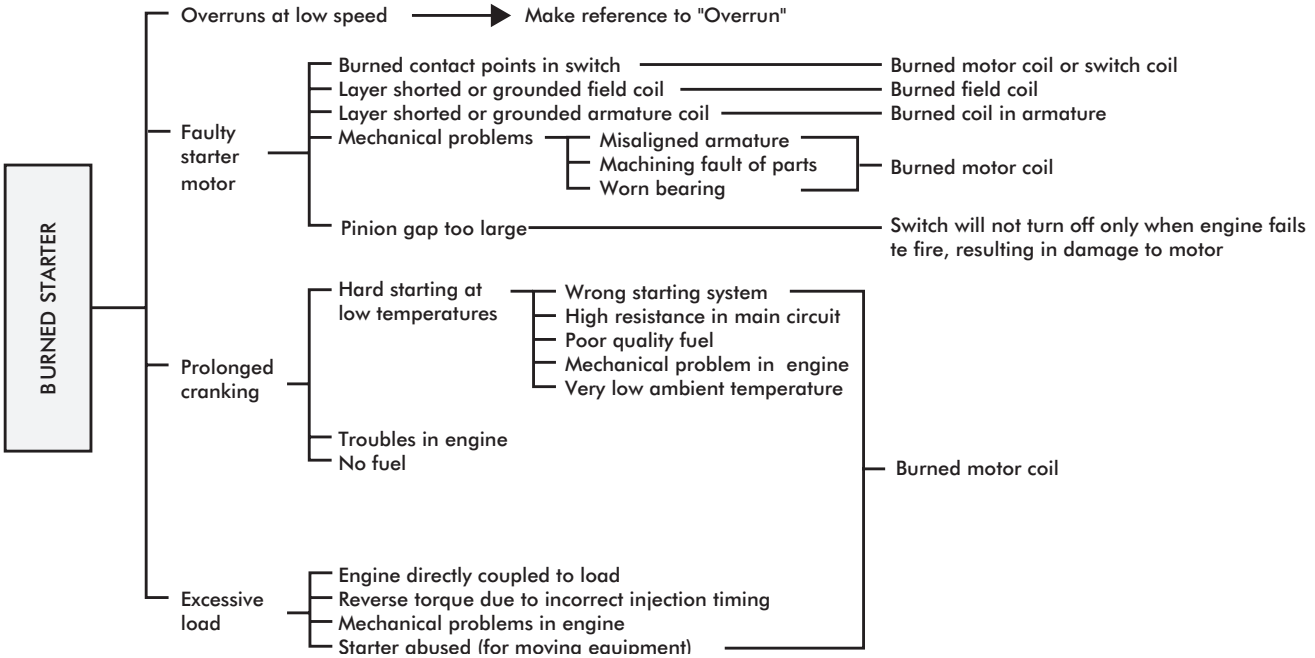
Stuck running parts
Wrong oil grade for weather conditions
Poor quality fuel
Clogged air cleaner
Restricted exhaust line
Faulty power take-off

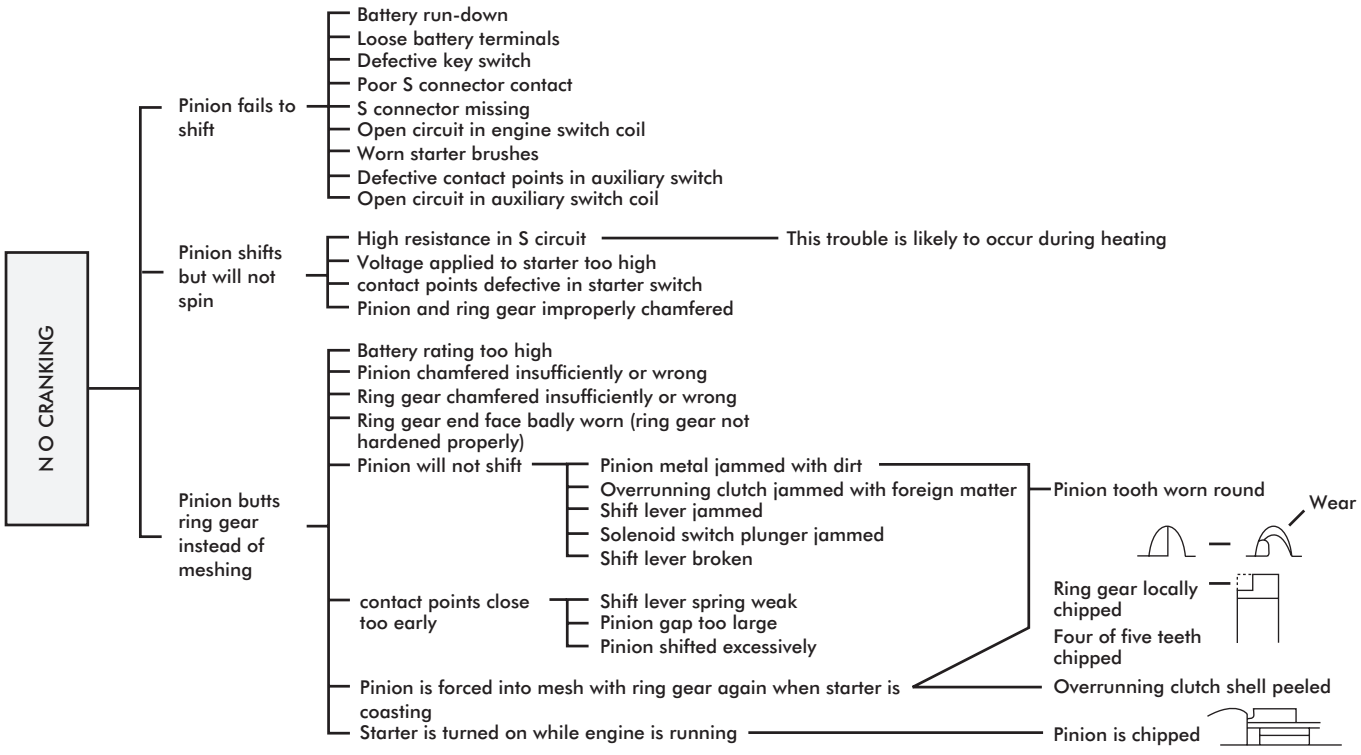
(2) Inspection procedure



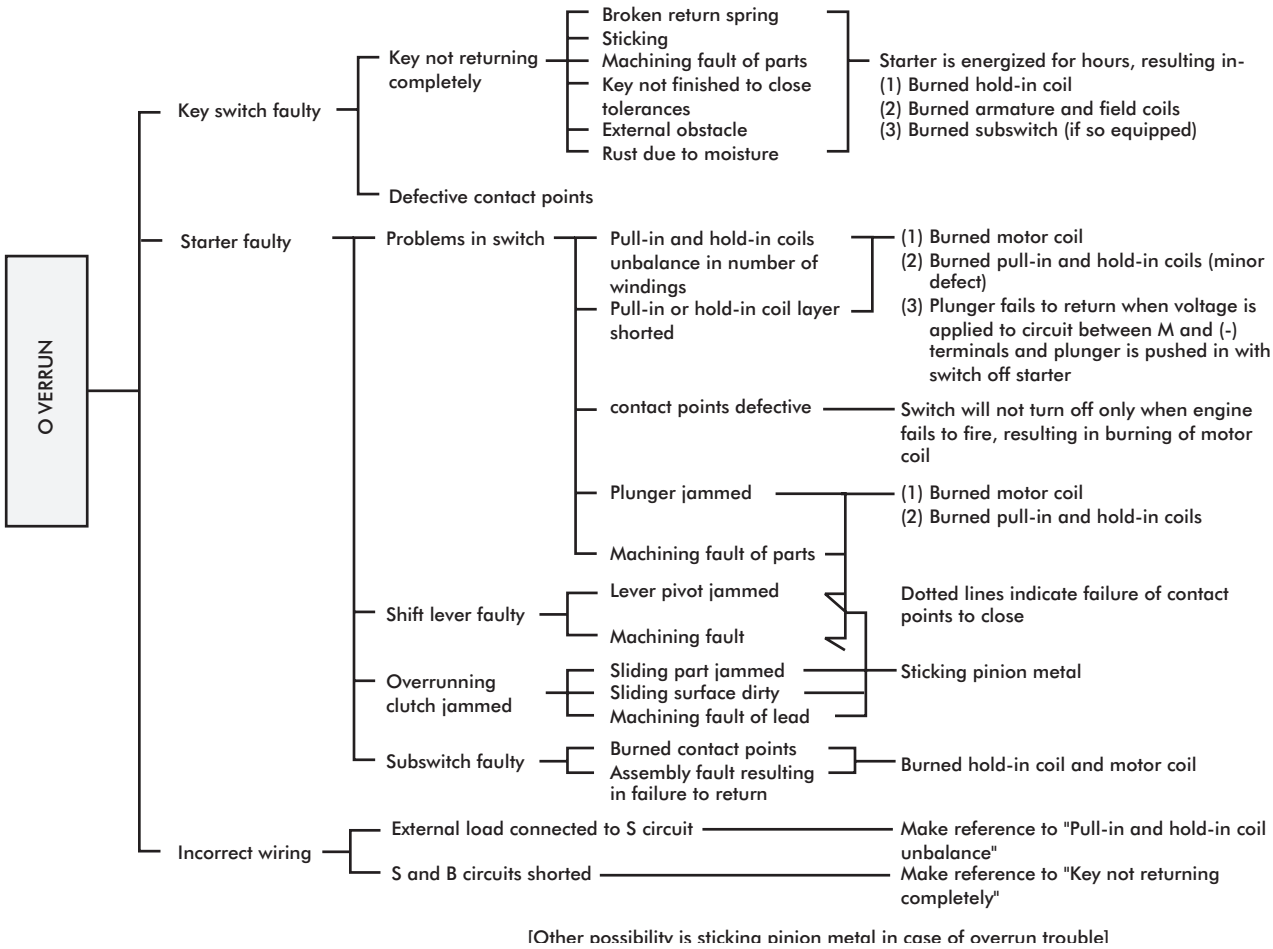
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3. Starting system troubleshooting



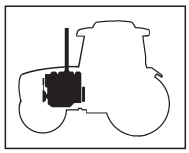


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[Other possibility is sticking pinion metal in case of overrun trouble]

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BASIC PRECAUTIONS FOR DISASSEMBLY AND ASSEMBLY

This section outlines basic precautions recommended by Mitsubishi that should always be observed.

1. Disassembly

(**1**) Always use tools that are in good condition and be sure you understand how to use them before performing any job.

(**2**) Use an overhaul stand or a work bench, if necessary. Also, use bins to keep engine parts in order of removal.

(**3**) Parts must be restored to their respective components from which they were removed at disassembly. This means that all parts must be set aside separately in groups, each marked for its component, so that the same combination or set can be reproduced at assembly.

(**4**) Pay attention to marks on assemblies, components and parts for their positions or directions. Put on marks, if necessary, to aid assembly.

(**5**) Carefully check each part or component for any sign of faulty condition during removal or cleaning. The part will tell you how it acted or what was abnormal about it more accurately during removal or cleaning.

(**6**) When lifting or carrying a part too heavy or too awkward for one person to handle, get another person's help and, if necessary, use a jack or a hoist.

2. Assembly

(**1**) Wash all parts, except for oil seals, O-rings, rubber sheets, etc., with cleaning solvent and dry them with pressure air.

(**2**) Always use tools that are in good condition and be sure you understand how to use them before performing any job.

(**3**) Use only good-quality lubricants. Be sure to apply a coat of oil, grease or sealant to parts as specified.

(**4**) Be sure to use a torque wrench to tighten parts for which torques are specified.

(**5**) Any time the engine is assembled, new gaskets and 0-rings must be installed.

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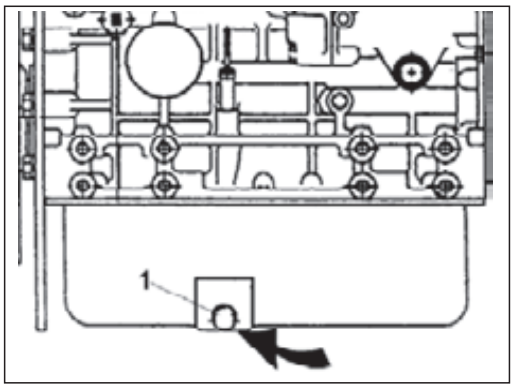
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PREPARATION FOR DISASSEMBLY

1. Engine oil draining

Remove the drain plug from the bottom of the oil pan and allow the oil to drain.

Refill capacities (high level excl. 0,5 liter (0.13 U.S. gal) of oil in oil filter, liter (U.S. gal)	S3L/S3L2: 5.7 (1.5) (with deep oil pan) 3.7 (1.0) (with standard oil pan) S4L/S4L2: 7.7 (2.0) (with deep oil pan) 5.4 (1.4) (with standard oil pan)



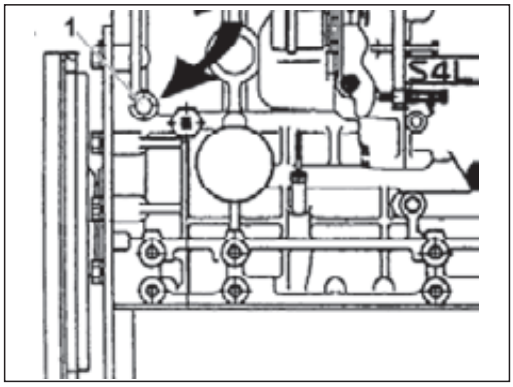
Draining engine oil
1 - Engine oil drain plug

WARNING: Hot oil and components can cause personal injury. Do not allow hot oil or components to contact skin.

2. Coolant draining

Loose the drain plug on the right side of the cylinder block and allow the coolant to drain.

Refill capacities, liter (U.S. Gal)	S3L/S3L2: 1.8 (0.5) S4L/S4L2: 2.5 (0.7)



Draining coolant
1 - Coolant drain plug

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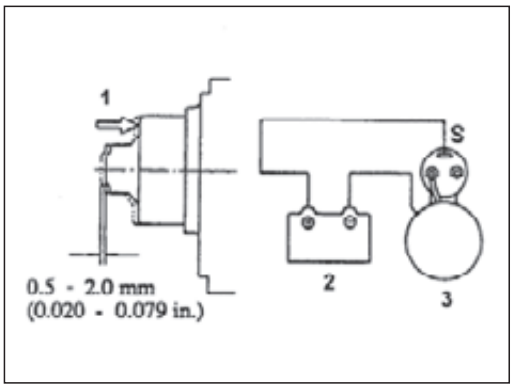
ELECTRICAL SYSTEM

1.Starter

1.1. Testing before disassembly

(1) Clearance between pinion and housing (pinion clearance)

(a) Connect the starter to a 12 volt battery as shown in the illustration to cause the pinion to shift into cranking position and remain there.



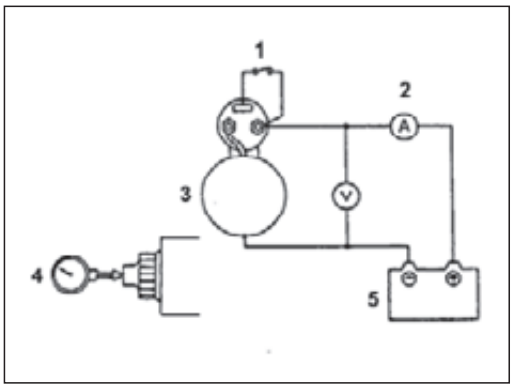
Connections for measuring pinion clearance

1 - Push in pinion
2 - Battery (12 volts)
3 - Starter

CAUTION: Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.

(b) Push the pinion toward the commutator end by hand to measure its free movement (pinion clearance).

(c) The pinion clearance must be 0.5 to 2.0 mm (0.020 to 0.079 in.). If the clearance is out of this range, make an adjustment to it by adding or removing the packings on the magnetic switch. Adding the packings will decrease the clearance.



Connections for testing no-load characteristics

1 - Switch
2 - Ammeter
3 - Starter
4 - Tachometer
5 - Battery (12 volts)

(2) No-load characteristics

(a) Connect the starter to a 12 volt battery with an ammeter capable of indicating several hundred amperes as shown in the illustration.

(b) Close the switch to make sure the pinion shifts into cranking position properly and the starter runs at speeds higher than is specified. If the current draw and/or operating speed is out of the standard, disassemble the starter for inspection and repairs.

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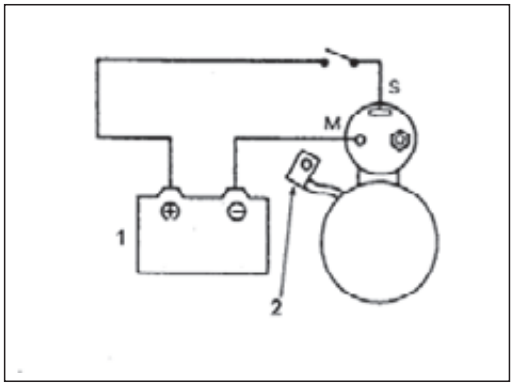
CAUTION:
a) The size of wires used for this test must be as large as possible. Tighten the terminals securely.
b) This starter has a reduction gear. Do not confuse gear noise with some abnormal noise else.
c) When measuring the starter speed at the end of the pinion, be ready for accidental shifting of the pinion.

Item		Standard	
Model		M2T56272	M2T50381
Nominal output, V - kW		12 - 2,0	12 - 1,6
No load characteristics	Terminal Voltage, V	11	11,5
	Current draw, A	130 maximum	100 maximum
	Speed, rpm	3850 minimum	3000 minimum

(3) Magnetic switch

(a) Disconnect the connector from the M terminal of the magnetic switch.

(b) Connect the magnetic switch to a 12 volt battery with a switch as shown in the illustration to test the pull-in coil. Close the switch to see if the pinion shifts. If the piston fails to shift, the magnetic switch is faulty.

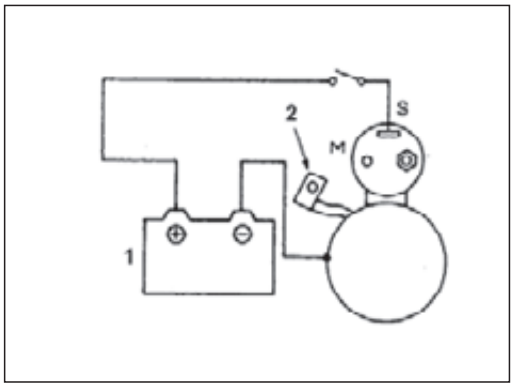


Connections for testing pull-in coil

1 - Battery (12 volt)
2 - Connector disconnected

CAUTION: Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.

(c) Connect the magnetic switch to a 12 volt battery with a switch as shown in the illustration to test the hold-in coil. Close the switch and pull the pinion away from the commutator end by hand. Release the pinion to see if it remains there. If the pinion returns, the magnetic switch is faulty.

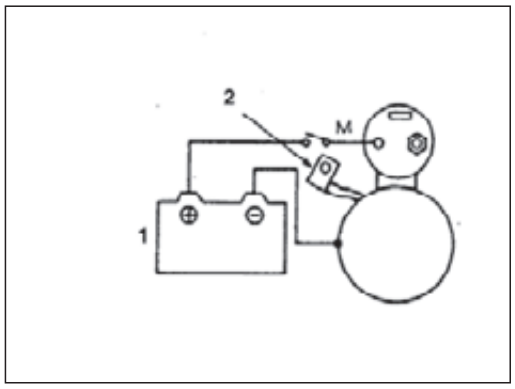


Connections for testing hold-in coil

1 - Battery (12 volt)
2 - Connector disconnected

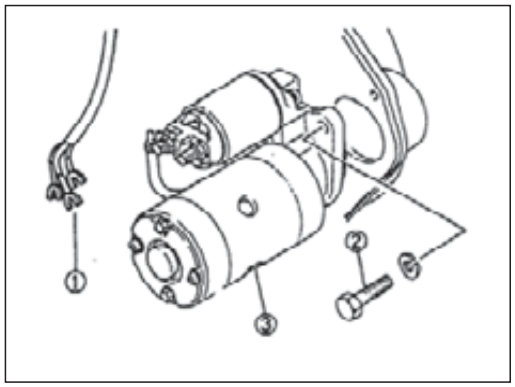
CAUTION: Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.

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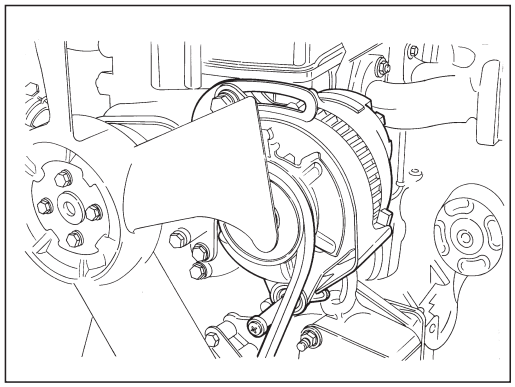


Connections for pinion return test

1 - Battery (12 volt)
2 - Connector disconnected



Removing starter



Alternator on engine

(d) Connect the magnetic switch to a 12 volt battery with a switch as shown in the illustration to make a pinion return test. Close the switch and pull the pinion away from the commutator end by hand. Release the pinion to see if it returns immediately when released. If the pinion fails to so return, the magnetic switch is faulty.

CAUTION:Due to the amount of current being passed through the solenoid series winding, this test must be made within 10 seconds.

1.2. Removal

(1) Disconnect the battery wires. Disconnect the negative (–) wire first.

(2) Disconnect wire (1) from the starter.

(3) Loosen bolts (2) (two) holding starter (3) in position and remove the starter.

2. Alternator

2.1. Inspection before removal

The correct diagnosis of the charging system requires a careful inspection with the alternator on the engine to determine whether or not it is necessary to remove the alternator from the engine for further inspection.
The following chart, in which two troubles are listed with four possible causes of each, will help locate the cause of the trouble:

Alternator charge too high	Voltage regulator setting too high
	Ground return circuit defective
	Wiring incorrect
	Series resistor or winding open-circuited
Alternator gives no charge	Alternator drive belt loose
	Voltage regulator setting too low
	Alternator output low
	Brushes worn

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2.2. Precautions for removal

Following is a list of basic precautions that should always be observed for removal:

(1) When installing the battery, care must be used to make sure the negative (–) terminal is grounded.

(2) Do not use a megger (an instrument for high resistance of electrical materials).

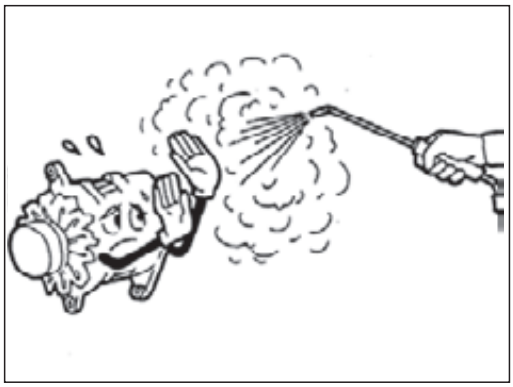
(3) Disconnect the battery cables before charging the battery.

(4) Do not attempt to disconnect the lead from the B terminal of the alternator when the engine is running.

(5) Battery voltage is being applied to the B terminal of the alternator. Do not ground it.

(6) Do not short or ground the L terminal of the alternator with a built-in IC regulator.

(7) Do not blow a spray from the steam cleaner nozzle at the alternator.



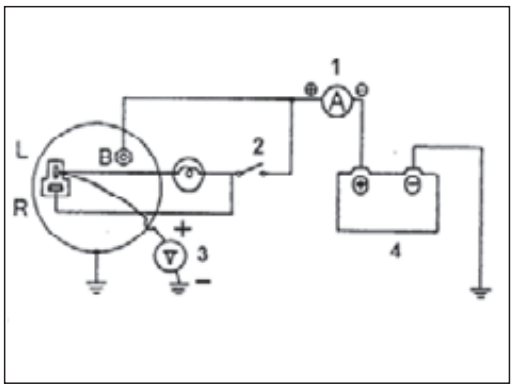
2.3. Testing voltage setting

(1) Connect the alternator to a 12 volt battery with an ammeter, a voltmeter and a switch as shown in the illustration.

(2) The voltmeter reading must be zero (0) when the starter switch is in OFF position. It must be lower than the battery voltage when the switch is in ON position (the engine will not start).

(3) With one ammeter lead short-circuited, start the engine.

(4) Read the voltmeter when the ammeter reading is below five amperes and the engine is running at 1800 rpm and also at 2500 rpm with all electrical loads turned off. The voltage setting varies with alternator temperature. Generally, the higher the alternator temperature, the lower the voltage setting.

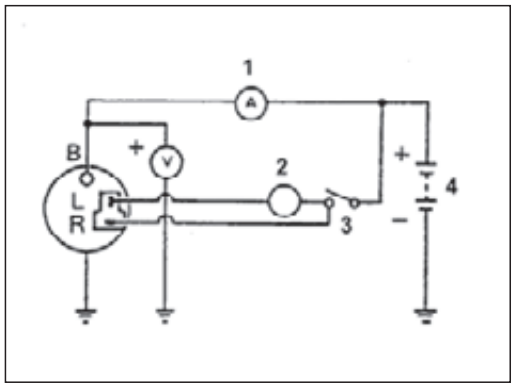


Connections for testing voltage setting

1 - Ammeter
2 - Switch
3 - Voltmeter
4 - Battery (12 volts)

Item	Standard
Voltage setting [at 20°C (68°F)]	14.7 ± 0.3 V

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Connections for testing output characteristics (alternator with built-in regulator)

1 - Ammeter
2 - Alternator indicator light
3 - Switch
4 - Battery

Item	Model	Standards	
		Terminal voltage /current	Speed
Output characteristics (at normal temperature)	A7T02071	13.5 V 33 A	2500 rpm maximum
		13.5 V 47 A	5000 rpm maximum

2.4. Testing output characteristics

(1) Disconnect the battery ground (negative) cable.

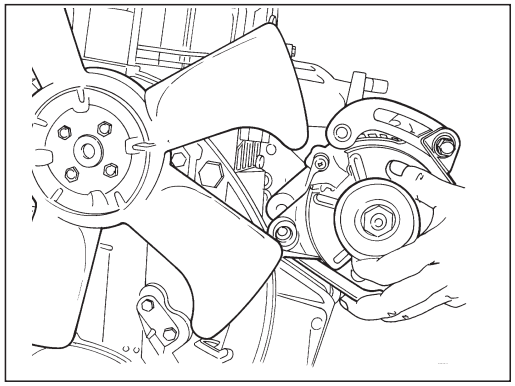
(2) Connect one ammeter lead to the B terminal of the alternator and the other lead to the positive terminal of the battery. Connect one voltmeter lead to the B terminal and the other lead to the ground.

(3) Connect the battery ground cable.

(4) Start the engine.

(5) Turn on all electrical loads.

(6) Increase the engine speed. Measure the maximum output current at the specified alternator speed when the voltmeter reading is 13.5 volts.



Removing alternator

2.5. Removal

(1) Disconnect the battery cables.

(2) Disconnect the lead from the B terminal of the alternator.

(3) Disconnect the connector from the alternator.

(4) Loosen the brace and support bolts. Move the alternator toward the engine and remove the drive belt.

(5) Remove the alternator.

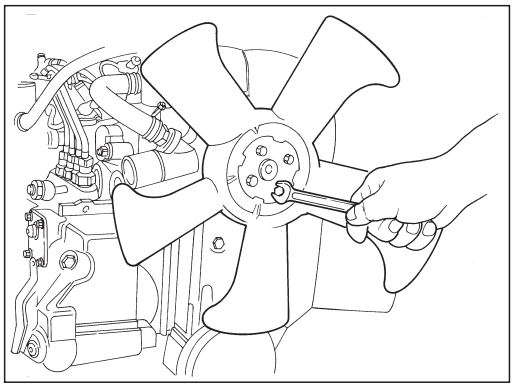
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COOLING SYSTEM

1. Cooling fan removal

Hold the fan by one hand and remove the four bolts that hold the fan in position. Remove the fan and spacers.

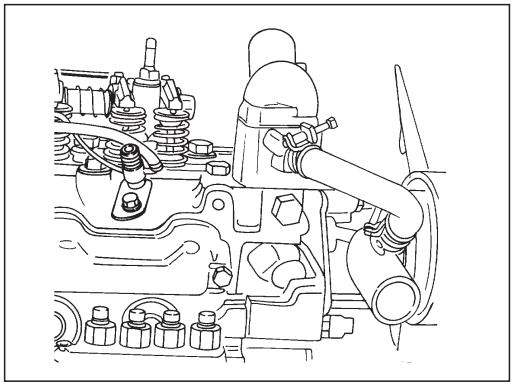
NOTE: Keep the spacers with the fan for installation.



Removing cooling fan

2. Thermostat case removal

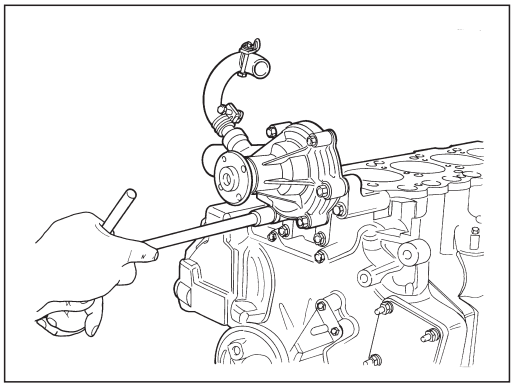
Remove the thermostat case assembly containing thermostat.



Removing thermostat assembly

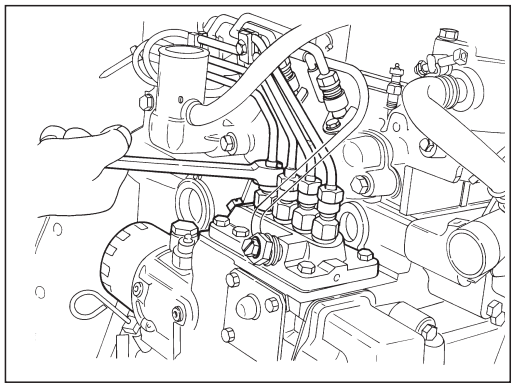
3. Water pump assembly removal

Remove the water pump assembly.



Removing water pump assembly

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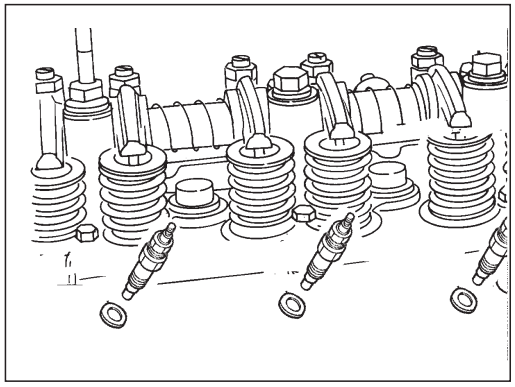
Removing fuel injection pipes

FUEL SYSTEM

1. Fuel injection pipe removal

Disconnect the fuel injection pipes and fuel leak-off pipe from the fuel injection pump and nozzles.

NOTE: Put plugs or caps on the openings of the injection pump and nozzle connectors.

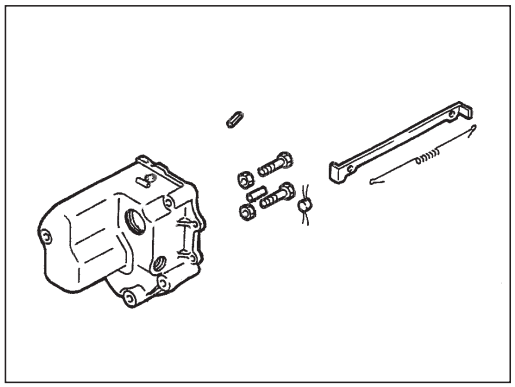


Removing fuel injection nozzles

2. Fuel injection nozzle removal

Loosen the fuel injection nozzles with a wrench. Remove the nozzles and gaskets from the cylinder head.

NOTE: Remove the gaskets from the cylinder head with a screwdriver or the like. Discard defective gaskets.



Removing governor assembly

3. Governor assembly removal

(1) Remove the tie rod cover.

(2) Remove the spring from the tie rod with a pliers to disconnect the tie rod from the fuel injection pump.

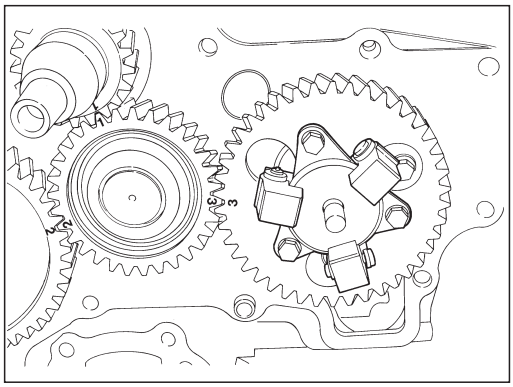
(3) Remove the governor assembly.

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4. Governor weight removal

(1) Remove the sliding sleeve.

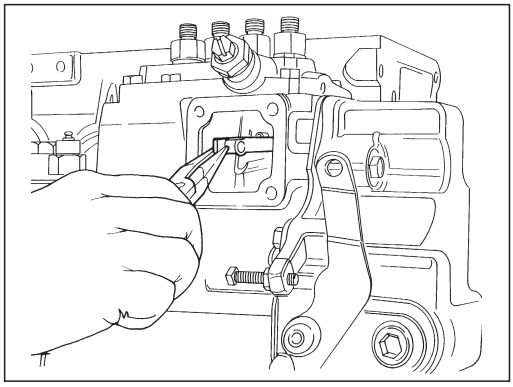
(2) Remove the sliding sleeve shaft and governor weights.



Removing governor weights

5. Fuel injection pump removal

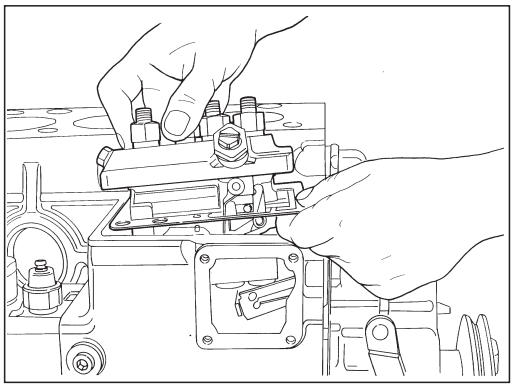
(1) Remove the tie rod cover.
(2) Remove the spring from the tie rod with a pliers to disconnect the tie rod from the fuel injection pump.



Removing tie rod

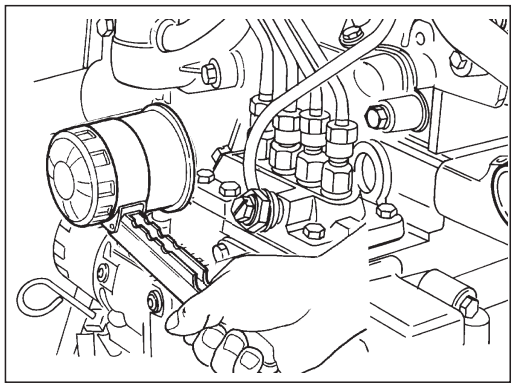
(3) Remove the fuel injection pump.

NOTE: Keep a record of the thickness of shims for installation.



Removing fuel injection pump

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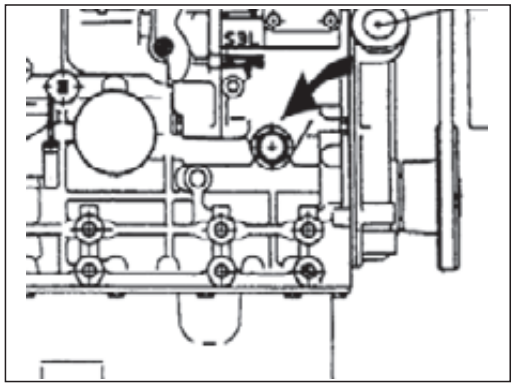
Removing oil filter

LUBRICATION SYSTEM

1. Oil filter removal

(1) Put a container under the oil filter to catch the oil.

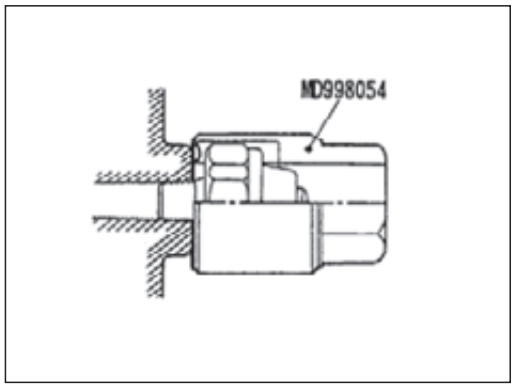
(2) Remove the oil filter from the cylinder block with a filter wrench.



Removing pressure relief valve

2. Pressure relief valve removal

Remove the pressure relief valve from the cylinder block.



Removing oil pressure switch

3. Oil pressure switch removal

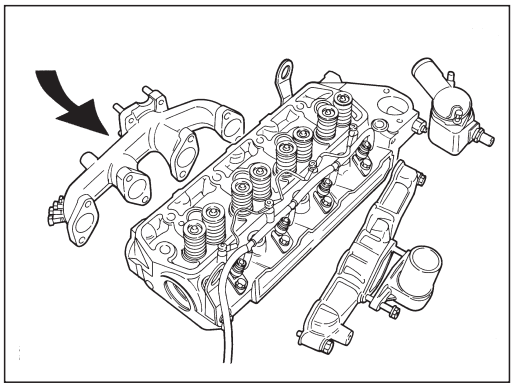
Remove the oil pressure switch with Oil Pressure Switch Socket Wrench (MD998054) (special tool).

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AIR INLET SYSTEM AND EXHAUST SYSTEM

1. Exhaust manifold removal

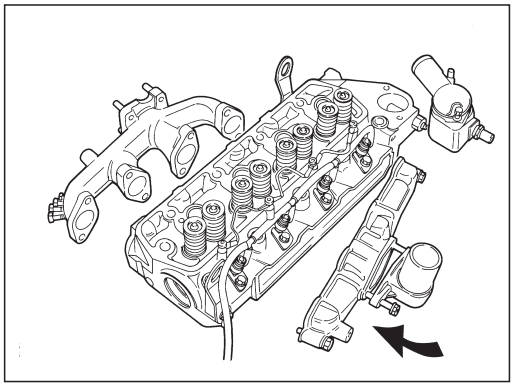
Remove the exhaust manifold from the cylinder head.



Removing exhaust manifold

2. Air inlet cover removal

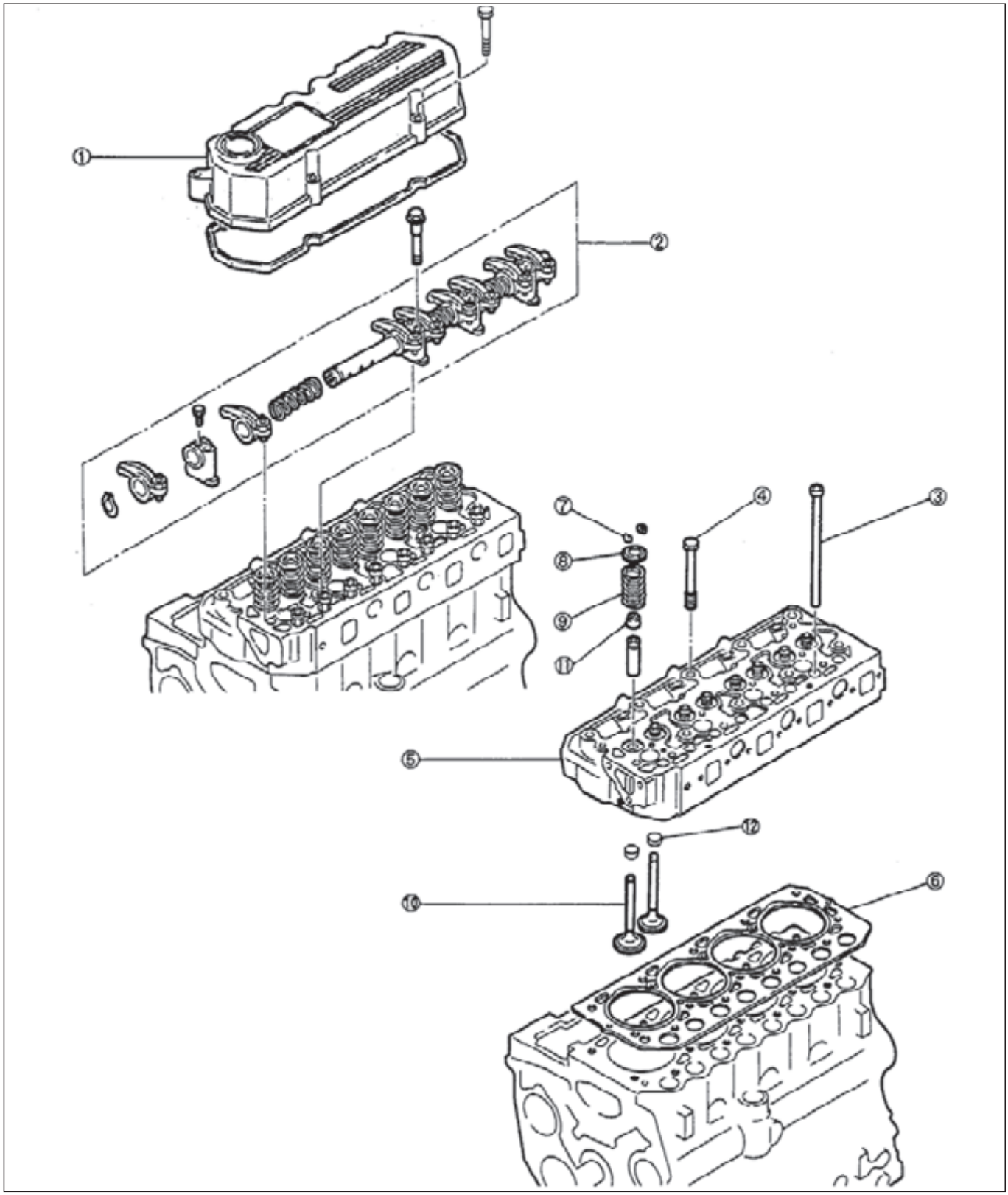
Remove the air inlet cover from the cylinder head.



Removing air inlet cover

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CYLINDER HEAD AND VALVE MECHANISM



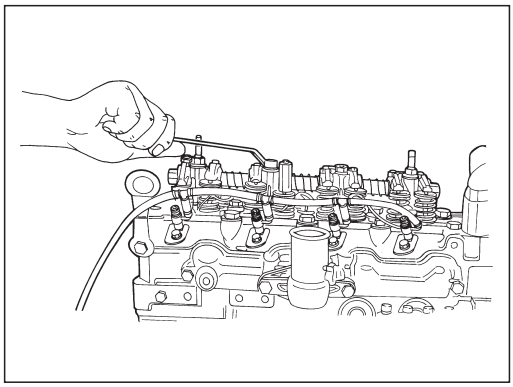
1 - Rocker cover
2 - Rocker shaft assembly
3 - Valve push rod
4 - Cylinder head bolt
5 - Cylinder head
6 - Cylinder head gasket
7 - Valve lock
8 - Valve retainer
9 - Valve spring
10 - Valve
11 - Valve stem seal
12 - Valve cap

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1. Rocker shaft assembly removal

(1) Remove the bolts that hold the rocker stays in position and remove the rocker shaft assembly.

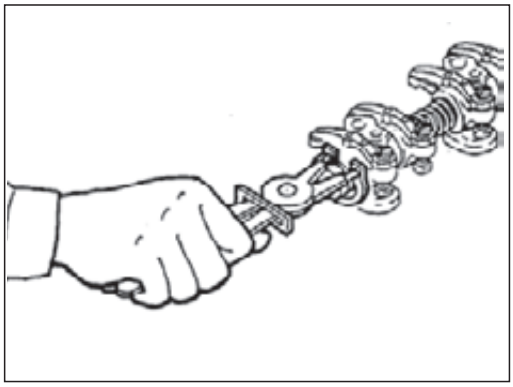
(2) Remove the valve caps.



Removing rocker shaft assemblies

2. Rocker shaft disassembly

Put identification on each rocker arm as to its location on the rocker shaft.

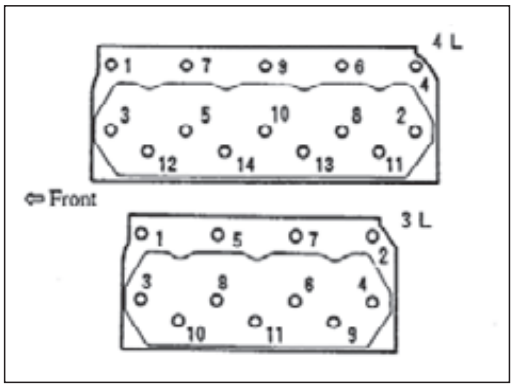


Disassembling rocker shaft assembly

3. Cylinder head bolt removal

Loosen the cylinder head bolts in two or three steps in the sequence shown.

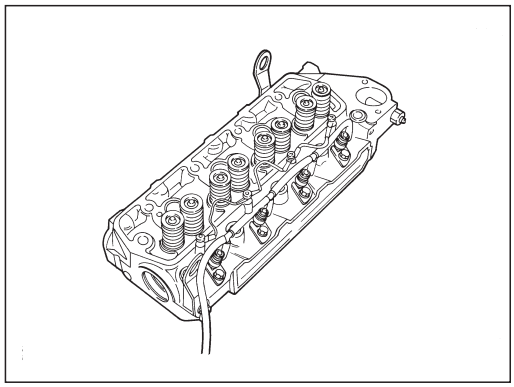
NOTE: If any parts on the cylinder head are faulty, check the cylinder head bolts for tightness with a torque wrench before loosening them.



Cylinder head bolt loosening sequence

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Disassembly

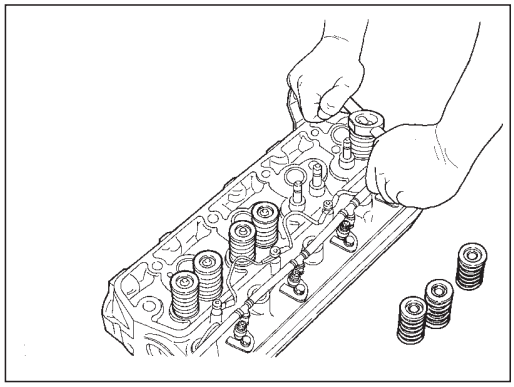


Removing cylinder head assembly

4. Cylinder head assembly removal

Lift the cylinder head straight up with a hoist.

NOTE:If the gasket is seized and the cylinder head cannot be separated from the cylinder block, tap around the thick side portion of the cylinder head with a plastic hammer.



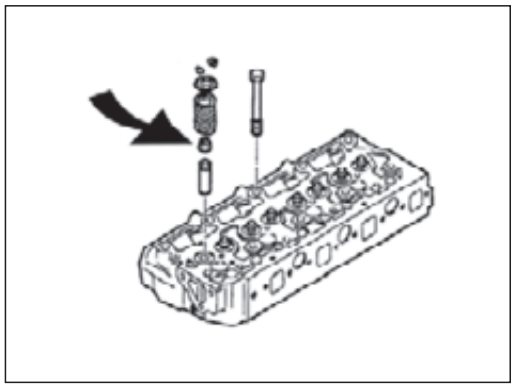
Removing valve springs

5. Valve and valve spring removal

(1) Compress the valve spring with a valve lifter and remove the valve lock.

(2) Remove the retainer, spring and valve.

NOTE:The valves, retainers, springs and valve locks must be set aside separately in groups, each tagged for cylinder number, for correct installation.



Removing valve stem seals

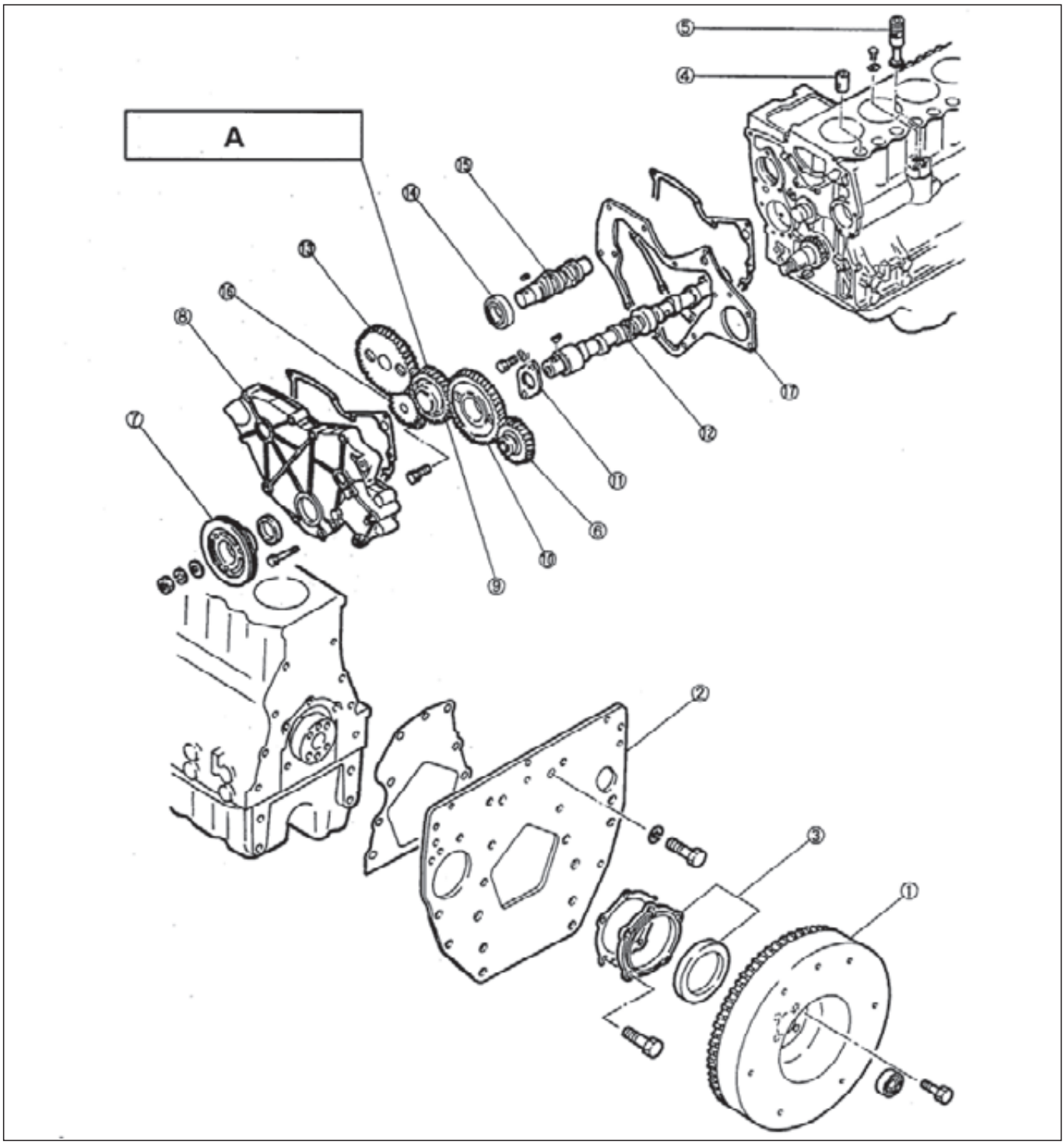
6. Valve stem seal removal

Remove the valve stem seals with a pliers.

NOTE: Do not reuse the valve stem seals.

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TIMING GEARS AND FLYWHEEL

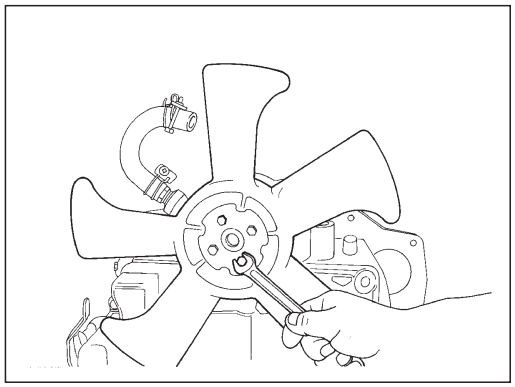


1 - Flywheel
2 - Rear plate
3 - Oil seal case; oil seal
4 - Tappet
5 - Speedometer driven gear
6 - P.T.O. Gear
7 - Crankshaft pulley
8 - Timing gear case
9 Idler gear
(Remove 10 thru 12 as an assembly)
10 - Camshaft gear
11 - Thrust plate
12 - Camshaft
(Remove13 thru 15 as an assembly)
13 - Fuel injection pump camshaft gear
14 - Bearing
15 - Fuel injection pump camshaft
16 - Oil pump
15 - Front plate

A - Measure the backlash before removing the gears.

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Disassembly



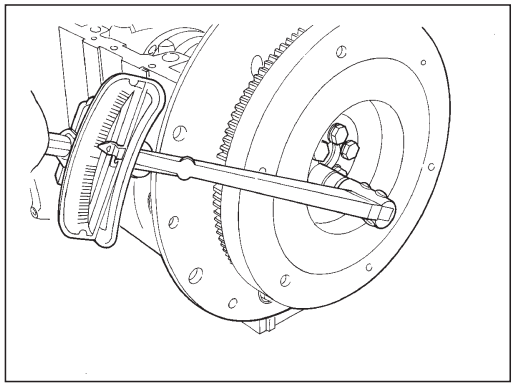
Holding flywheel

1. Flywheel removal

(1) Have someone hold the crankshaft pulley with a wrench to prevent the flywheel from rotating.

(2) Remove one of the bolts that hold the flywheel in position.

WARNING: Always signal each other to prevent possible personal injury.

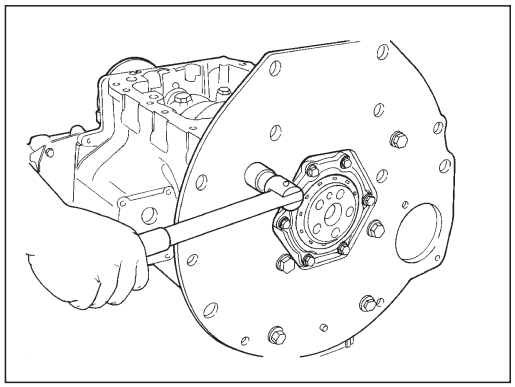


Removing flywheel

(3) Install a safety bar (M12 x 1.25) into the threaded hole in the flywheel from which the bolt was removed in Step (2). Remove the remaining bolts.

(4) Hold the flywheel by hands and withdraw it from the crankshaft. Joggling the flywheel back and forth will facilitate removal.

WARNING: When removing the flywheel, wear heavy gloves to avoid hand injury.



Removing rear plate

2. Rear plate removal

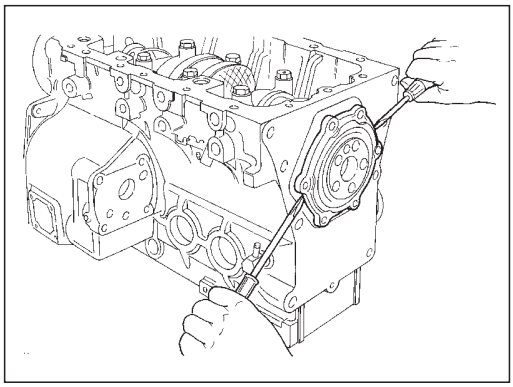
The rear plate is doweled in position. Pull the plate as straight as possible when removing it.

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3. Oil seal case removal

Remove the bolts that hold the oil seal case in position. Remove the case from the cylinder block with a screwdriver or the like.

CAUTION: Do not cause damage to the oil seal.

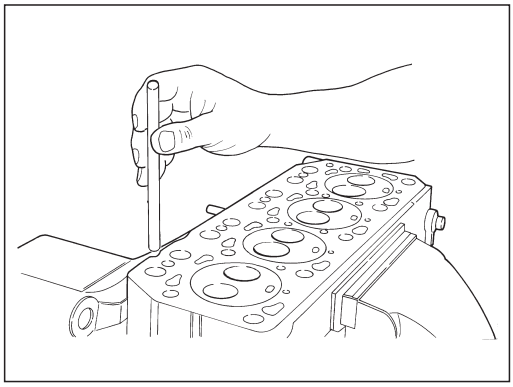


Removing oil seal case

4. Tappet removal

Remove the tappets from the cylinder block with a valve push rod.

NOTE: The tappers will fall into the oil pan if the camshaft is removed before the tappets are removed.

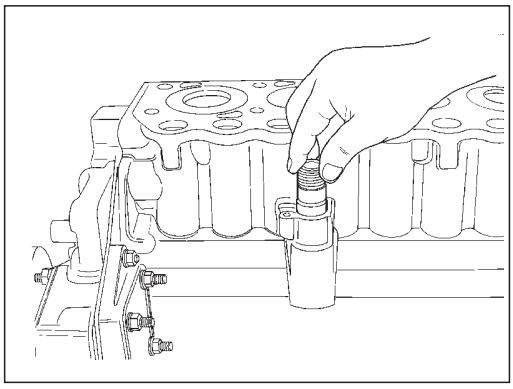


Removing tappets

5. Speedometer driven gear removal

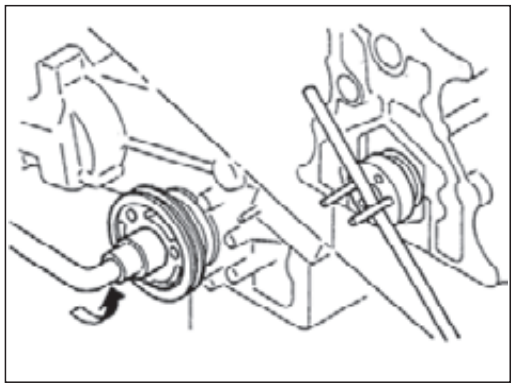
Remove the lock plate and speedometer driven gear in that order.

NOTE: Unless the speedometer driven gear is removed, the camshaft cannot be removed.



Removing speedometer driven gear

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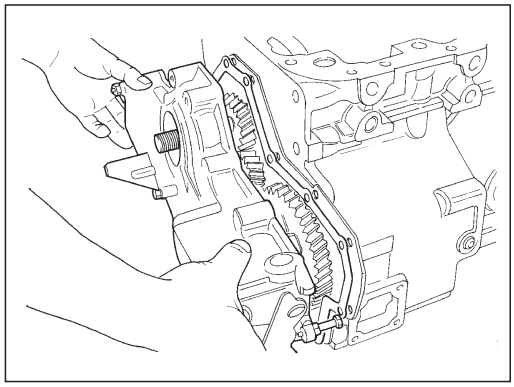
Removing the crankshaft pulley

6. Crankshaft pulley removal

(1) Install two safety bars (M12 x 1.25) into the threaded holes in the rear end of the crankshaft. Put a bar between the safety bars to hold the crankshaft to prevent it from rotating.

(2) Remove the crankshaft pulley.

WARNING: When removing the crankshaft pulley, be prepared to stop the job in case the bar slips off the crankshaft to prevent injury.

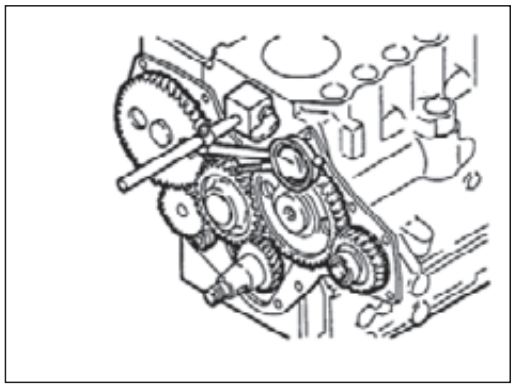


Front plate attaching bolts

7. Timing gear case removal

Remove the bolts.that hold the timing gear case in position and remove the case.

CAUTION: The front plate is bolted inside the timing gear case. Do not attempt to remove this plate along with the timing gear case by tapping.



Measuring timing gear backlash

8. Timing gear backlash measurement

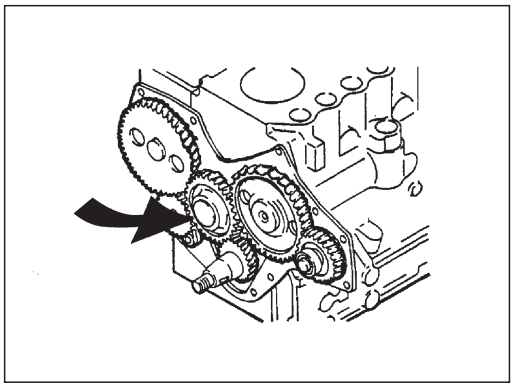
Measure the backlash of each gear and keep a record of it for correct installation. Replace the gears if the backlash exceeds the limit.

Item		Standard	Limit
Timing gear backlash	Crankshaft gear and idler gear	0.04 to 0.12 (0.001 6 to 0.004 7)	0.30 (0.011 8)
	Idler gear and camshaft gear		
	Idler gear and fuel injection pump camshaft gear		
	Camshaft gear and P.T.O. gear	0.08 to 0.19 (0.003 1 to0.0075)	
	Fuel injection pump camshaft gear and oil pump gear	0.07 to 0.20 (0.0028 to 0.0079)	

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9. Idler gear removal

To remove the idler gear, rotate the gear in a direction of the helix of the teeth to pull it out of mesh.



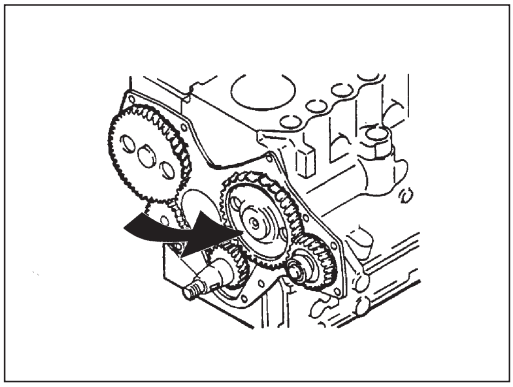
Removing idler gear

10. Camshaft removal

(1) Remove the bolts that hold the thrust plate

(2) Pull the camshaft out of the cylinder block

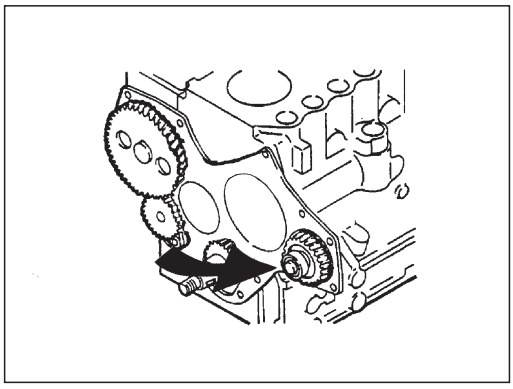
CAUTION: Do not cause damage to the lobes or bearing journals when removing the camshaft



Removing camshaft

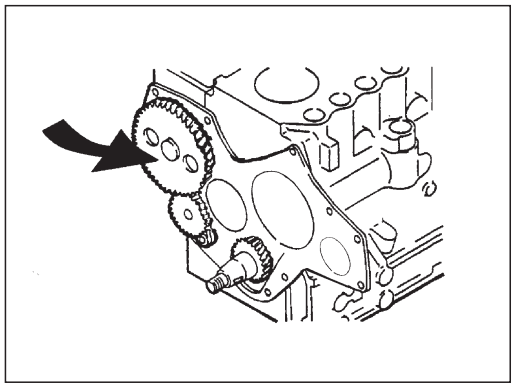
11. Fuel injection pump camshaft removal

(1) Remove the stopper bolt.



Removing camshaft stopper bolt

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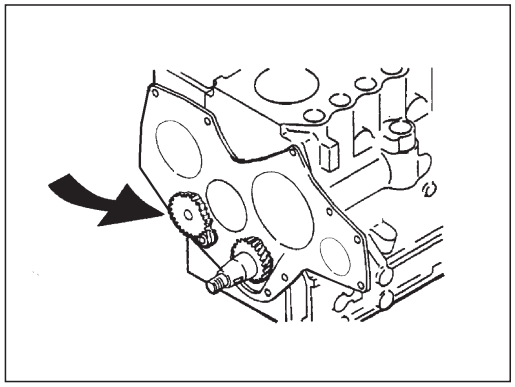


Removing fuel injection pump camshaft

(2) Tap the rear end of the camshaft with a copper bar to push it out of the front side of the cylinder block.

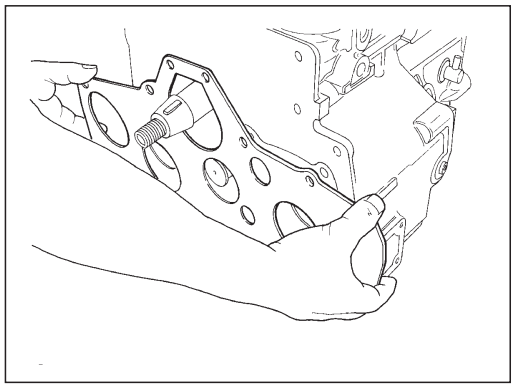
12. Gear removal (when required)

To remove the gears from the camshaft and fuel injection pump camshaft, use an arbor press.



Removing oil pump

13. Oil pump removal
Remove the bolts that hold the oil pump to the cylinder block and remove the pump.



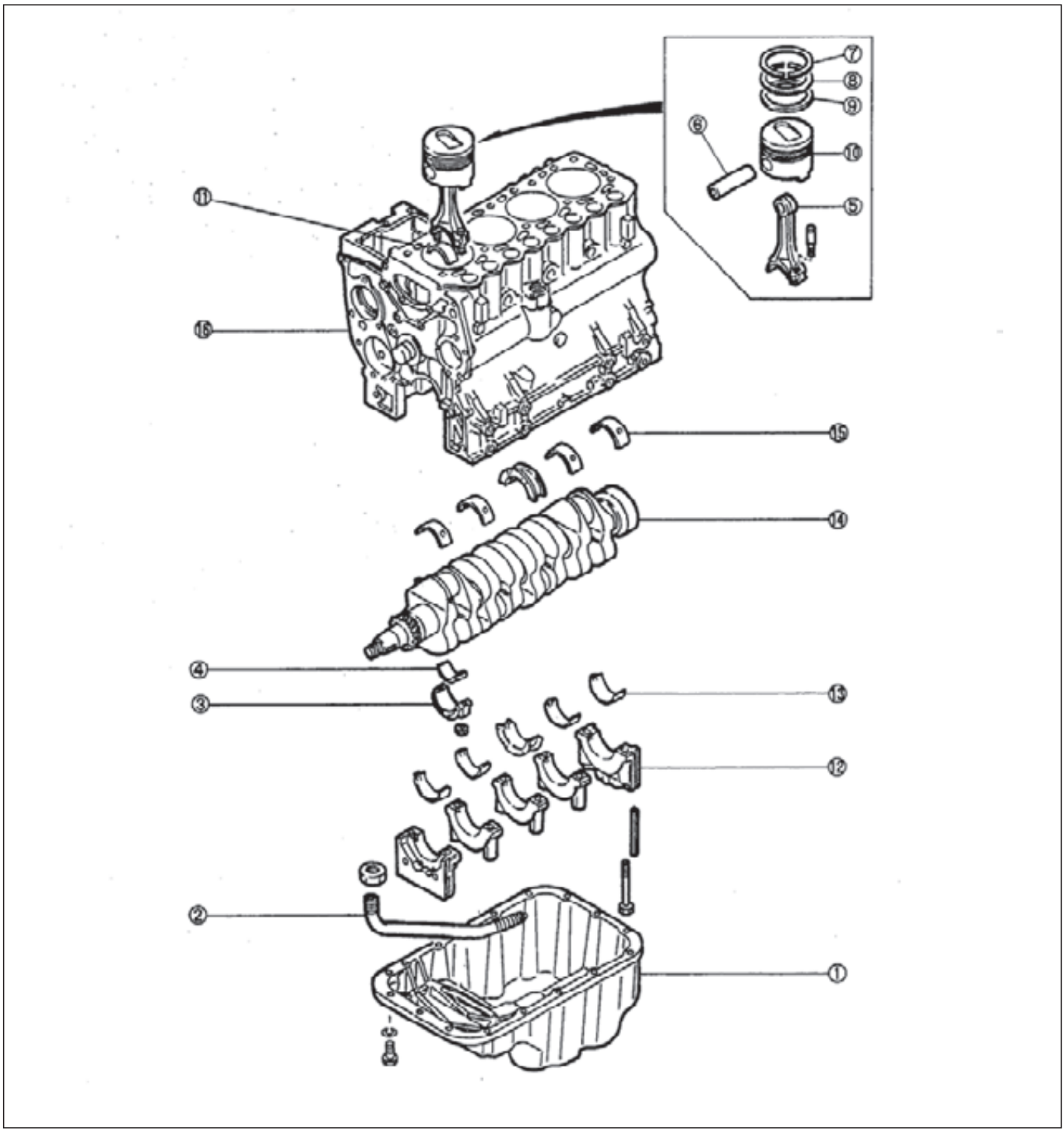
Removing front plate

14. Front plate removal
Remove four bolts that hold the front plate in position.

Tap the plate lightly with a plastic hammer to separate the gasket.

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CYLINDER BLOCK, CRANKSHAFT, PISTONS AND OIL PAN



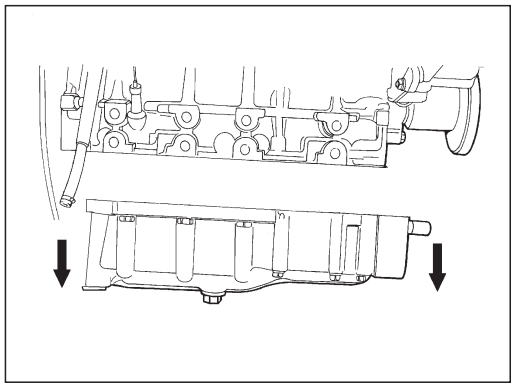
1 - Oil pan
2 - Oil screen
3 - Connecting rod cap
4 - Connecting rod bearing (lower half)
(Remove 5 thru 10 as an assembly)
5 - Connecting rod
6 - Piston pin
7 - No. 1 ring
8 - No. 2 ring
9 - Oil ring
10 - Piston
11 - Oil Connecting rod bearing (upper half)
12 - Main bearing cap
13 - Main bearing (lower half)
14 - Crankshaft
15 - Main bearing (upper half)
16 - Cylinder block

NOTE: When the cylinder block is to be discarded, remove the components (pressure relief valve, etc) from the block for reuse.

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Mitsubishi engine

Disassembly



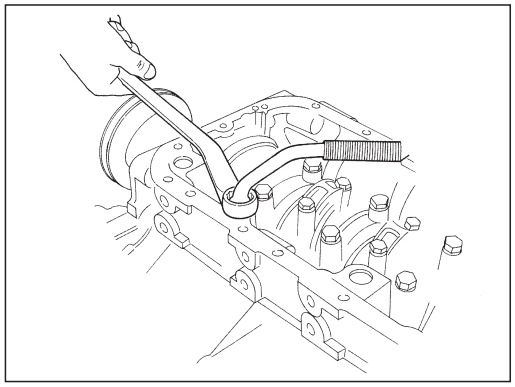
Removing oil pan

1. Oil pan removal

(1) Turn the engine upside down.

(2) Tap the bottom corners of the oil pan with a plastic hammer to remove the oil pan.

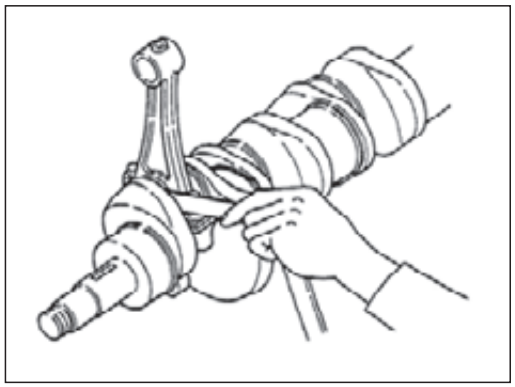
CAUTION: Do not attempt to pry off the oil pan by inserting a screwdriver or a chisel between the oil pan and cylinder block. Damage to the oil pan can be the result.



Removing oil screen

2. Oil screen removal

Loosen the nut that holds the oil screen in position and remove the screen.



Measuring thrust clearance for connecting rod big end

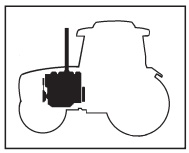
3. Thrust clearance measurement for connecting rod big end

Install the connecting rod to its cranking and tighten the cap nuts to the specified torque. Measure the thrust clearance with a feeler gauge. If the clearance exceeds the limit, replace the connecting rod.

Unit: mm (in.)

Item	Standard	Limit
Thrust clearance for connecting rod big end	0.10 to 0.35 (0.0039 to 0.0138)	0.50 (0.0197)

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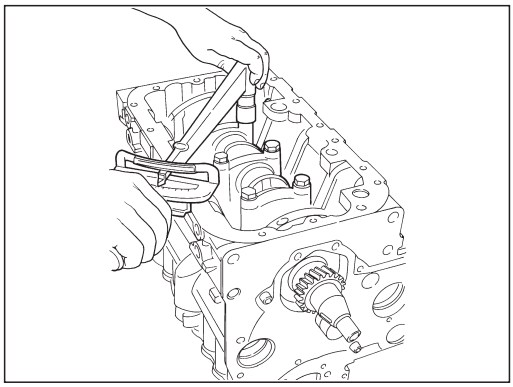


4. Connecting rod cap removal

(1) Lay the cylinder block on its side.

(2) Put identification on each connecting rod and cap combination as to its location in the engine.

(3) Remove the caps.

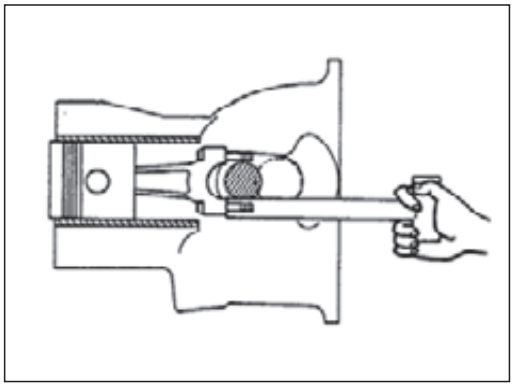


Removing connecting rod caps

5. Piston removal

(1) Turn the crankshaft until the piston is at top center.

(2) Push the piston and connecting rod away from the crankshaft with the handle of a hammer or the like until the piston rings are above the cylinder. Remove the piston and connecting rod. Do Steps (1) and (2) for the removal of the other pistons.



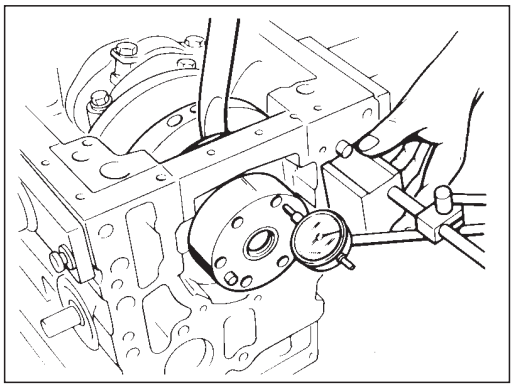
Removing piston

6. End play measurement for crankshaft

Set a dial indicator so that it will touch the end of the crankshaft and measure the end play. If the end play exceeds the limit, replace No. 3 flanged bearing.

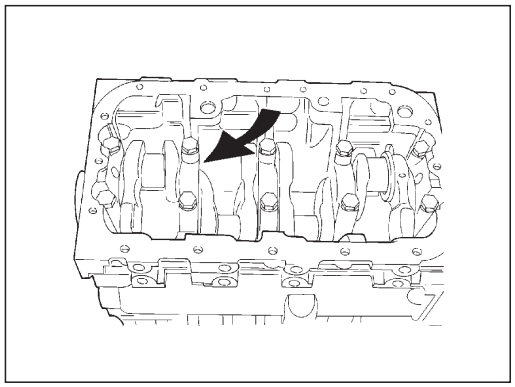
Unit: mm (in.)

Item	Standard	Limit
End play for crankshaft end play	0.050 to 0.175 (0.00197 to 0.00689)	0.50 (0.0197)



Measuring end play for crankshaft

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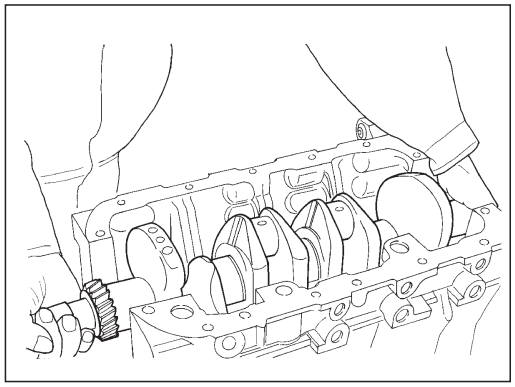
Removing main bearing caps

7. Main bearing cap removal

(1) Lay the cylinder block with its bottom (oil pan) side up.

(2) Remove the bolts that hold the main bearing caps in position. Remove the caps.

(3) Remove the front and rear bearing caps with a sliding hammer.



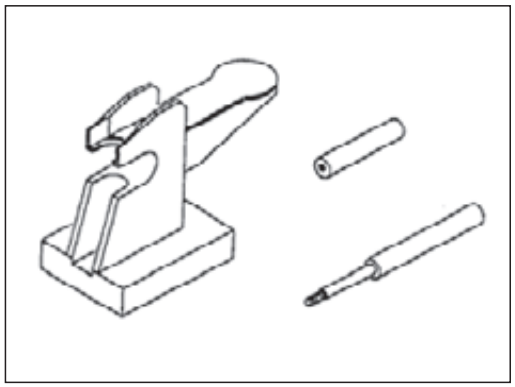
Removing crankshaft

8. Crankshaft removal

Remove the crankshaft

CAUTION: Do not cause damage to the bearings.

NOTE: Put identification on each main bearing as to its location in the engine.



Piston pin setting tool

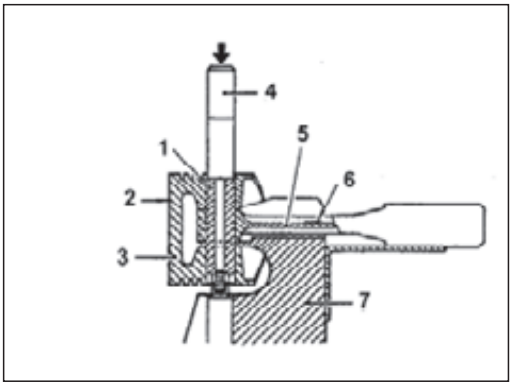
9. Piston separation from connecting rod

(1) Use Piston Pin Setting Tool (31A91- 00100) (special tool) to separate the piston from the connecting rod.

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(2) Insert the push rod of the tool into the bore in the piston for the piston pin and, using an arbor press, remove the piston pin.

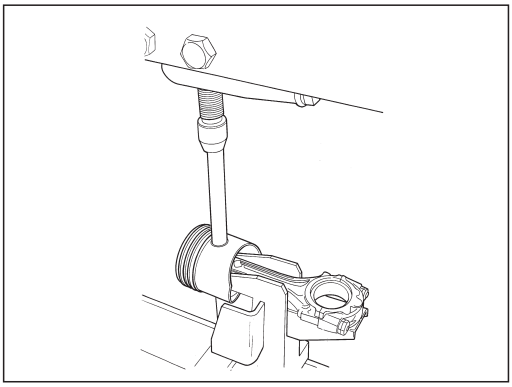
(3) Use this Piston Pin Setting Tool to install the connecting rod to the piston.



Removing piston pin (1)

1 - Piston pin
2 - Arrow mark
3 - Piston
4 - Push rod (tool)
5 - Connecting rod
6 - Identification mark
7 - Tool body

CAUTION: Do not attempt to remove the piston pin by tapping. Replace a piston pin which needs a greater force for removal.



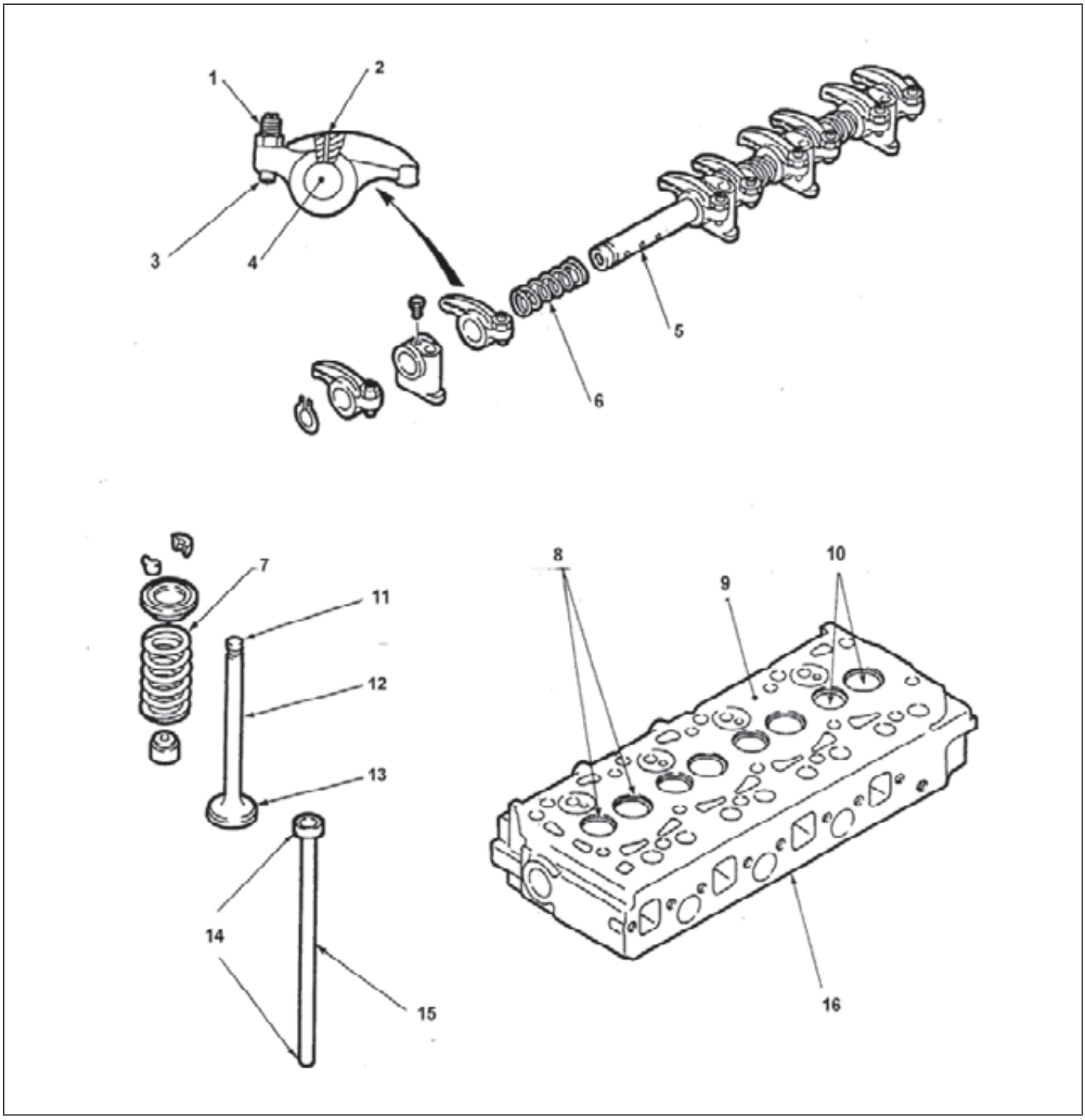
Removing piston pin (2)

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CYLINDER HEAD AND VALVE MECHANISM

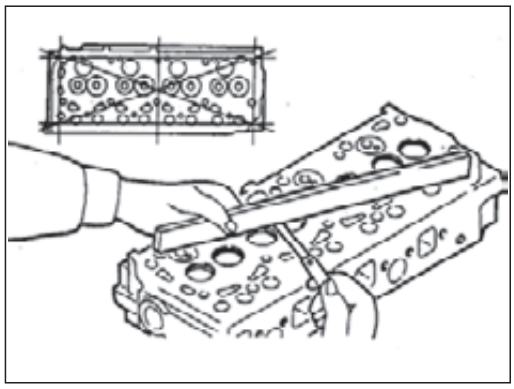


Inspection points

1 - Check threads for stripping
2 - Check oil hole for clogging
3 - Check end for wear
4 - Check bore for wear
5 - Check for wear or clogged oil holes
6 - Test
7 - Check for damage and test
8 - Check valve seats for improper contact or wear
9 - Check for warpage
10 - Check valve guides for wear or damage
11 - Check for galling of wear
12 - Check for ridges or damage
13 - Check for wear or improper contact
14 - Check ends. for wear or damage
15 - Check for bend
16 - Check for cracks, oil or coolant leaks
Remove gasket, scale and carbon deposits.

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Inspection



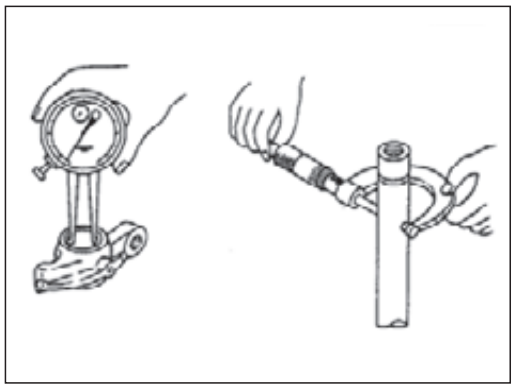
Checking cylinder head bottom face for warpage

1. Cylinder head

Using a heavy accurate straight edge and a feeler gauge, check the bottom face for warpage in three positions lengthwise, two crosswise and two widthwise as shown in the illustration. If warpage exceeds the limit, reface the bottom face with a surface grinder.

Unit: mm (in)

Item	Standard	Limit
Warpage of cylinder head bottom face maximum	0.05 (0.0020) maximum	0.10 (0,0039)



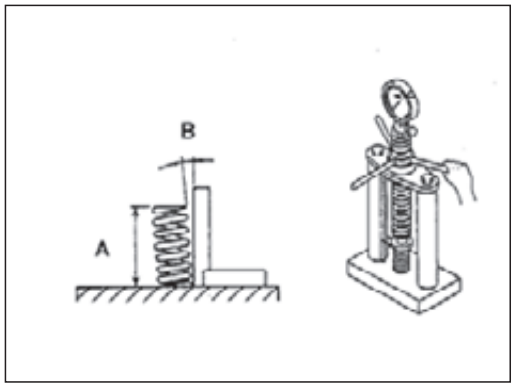
Measuring rocker arm and rocker shaft

2. Rocker arms and rocker shaft

Measure the bore in the rocker arm for the rocker shaft and the diameter of the rocker shaft to find the clearance between the arm and shaft. If the clearance has reached the limit, replace the rocker arm. If it exceeds the limit, replace both arm and shaft.

Unit: mm (in)

Item	Nominal size	Standard	Limit
Bore in rocker arm for shaft	18.9 (0,744)	18.910 to 18.930 (0.74449 to 0.74527)	-
Diameter of shaft for arm	18.9 (0,744)	18.880 to 18.898 (0.74331 to 0.74401)	-
Clearance between rocker arm and shaft	-	0.012 to 0.050 (0.00047 to 0.00197)	0.200 (0.00787)



Testing valve spring

3. Valve springs

Check the squareness and free length. If the squareness and/or free length exceeds the limit, replace the spring.

Unit: mm (in)

Item		Standard	Limit
Free length (A)		47 (1.85)	46 (1.81)
Squareness (B)		1.5° maximum	
Test force Kgf (lbf) [N]	Lenght under test force: 39.1 (1.54)	13.9 ± 0.7 (30.6 ± 1.5) [136 ± 7]	-15%
	Lenght under test force: 30.5 (1.20)	29 ± 2 (64 ± 4.4) [284 ± 20]	

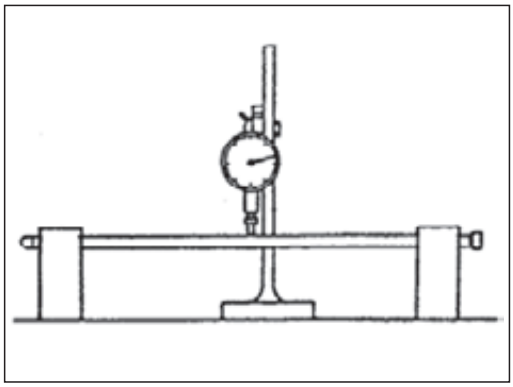
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4. Valve push rods

Using V-blocks and a dial indicator, check for bend. If the bend exceeds the limit, replace the push rod.

Unit: mm (in)

Item	Limit
Bend (dial indicator reading) of valve push rod	0.3 (0.012) maximum



Checking bend of valve push rod

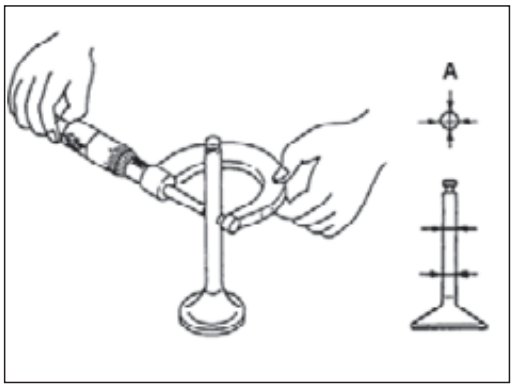
5. Valves, valve guides and valve seats

(1) Diameter of valve stem

Measure the diameter of the valve stem as shown in the illustration. If the stem is worn beyond the limit, or if it is abnormally worn, replace the valve.

Unit: mm (in)

Item		Nominal size	Standard	Limit
Diameter of valve stem	Intel valve	6.6 (0.260)	6.565 to 6.580 (0.25846 to 0.25905)	6.500 (0.25591)
	Exhaust valve	6.6 (0.260)	6.530 to 6.550 (0.25709 to 0.25787)	

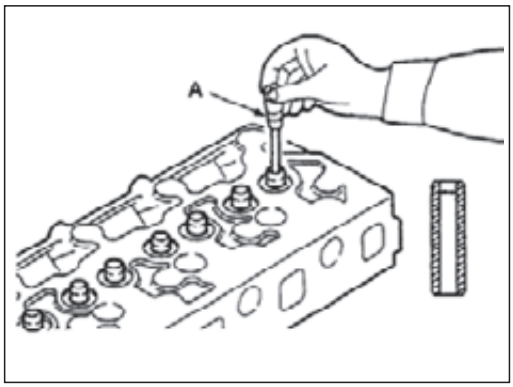


Measuring valve stem

A - Measuring diagram

(2) Clearance between valve stem and valve guide

The valve guide wears more rapidly at its both ends than at any other parts. Measure the bore in the guide for the stem at its ends with an inside micrometer caliper to find the clearance between the stem and guide. If the clearance exceeds the limit, replace the guide or valve whichever is badly worn.



Measuring valve guide

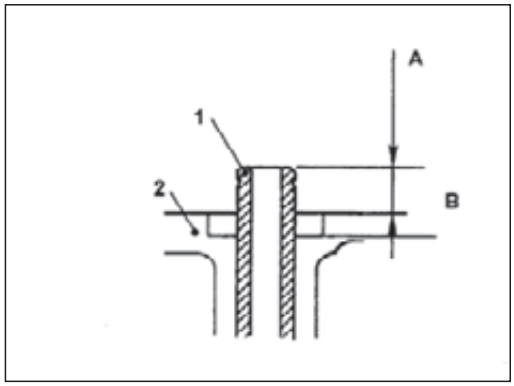
A - Inside micrometer caliper

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Inspection

Unit: mm (in)

Item		Nominal size	Standard	Limit
Clearance between valve stem and valve guide	Inlet valve	-	0.02 to 0.05 (0.0008 to 0.0020)	0.10 (0.0039)
	Exhaust valve	-	0.05 to 0.085 (0.0020 to 0.00335)	0.15 (0.0059)
Height to top of valve guide		10 (0,39)	9.5 to 10.5 (0.374 to 0.413)	-



Height to top of valve guide

1 - Valve guide
2 - Cylinder head
A - 10 ± 0.5 mm (0.93 ± 0.020 in)
B - 15 mm (0.59 in)

NOTE: Before measuring the valve guides, clear the guides of lacquer and carbon.

(3) Valve guide replacement

(a) Remove the guide from the cylinder head by pushing it with a tool and an arbor press from the bottom side of the head.

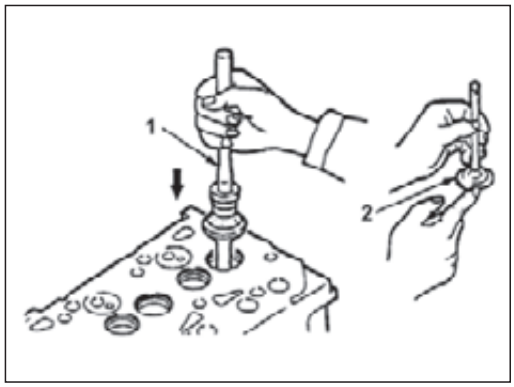
(b) Install a new guide into the cylinder head by pushing it with an arbor press from the upper side of the head until the specified height to the top of the guide is obtained.

(c) Insert a new valve into the guide and make sure the valve slides in the guide freely.

(d) After the valve guide has been replaced, check the valve contact with its seat.

(4) Valves

(a) Put a small amount of Prussian blue or read lead on the valve face. Hold the valve with a valve lapping tool (commercially available) and press it against the seat to check its contact.

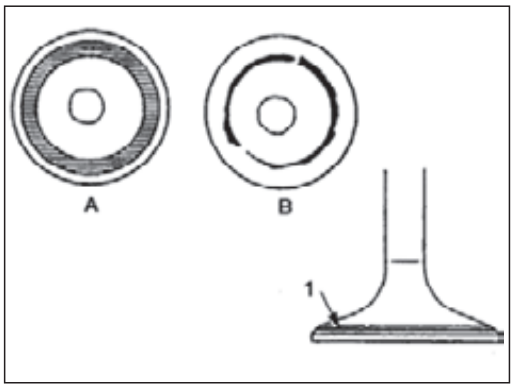


Checking valve contact with seat

1 - Valve lapping tool
2 - Prussian blue

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(b) The width of contact must be uniform all the way around both seat and valve. If the contact is bad, reface the valve and seat.



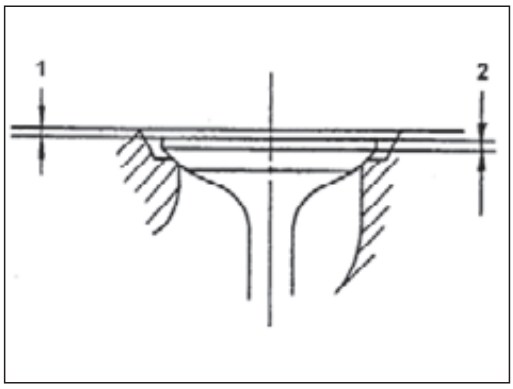
Valve and valve seat contact

A - Good
B - Bad
1 - Contact must be uniform around the complete circumference.

(c) If the valve margin (valve lip thickness) exceeds the limit, replace the valve.

Unit: mm (in)

Item	Standard	Limit
Valve margin (lip thickness)	1.0 (0.039)	0.5 (0.020)



Valve margin and sinkage

1 - Valve sinkage
2 - Valve margin

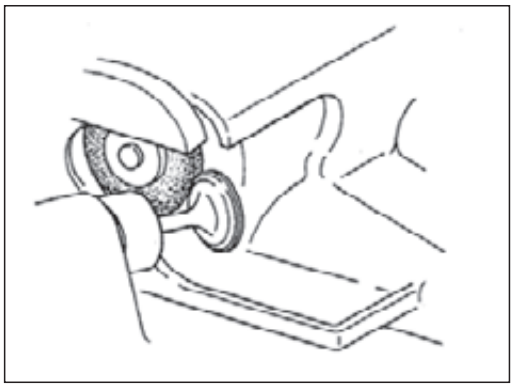
(d) If the valve linkage (the dimension from the top of a closed valve to the face of cylinder head) exceeds the limit, recondition the valve seat or replace the cylinder head assembly.

Unit: mm (in)

Item	Standard	Limit
Valve sinkage (dimension from top of closed valve to face of head)	0.5 ± 0.25 (0.020 ± 0.0098	1.5 (0.059)

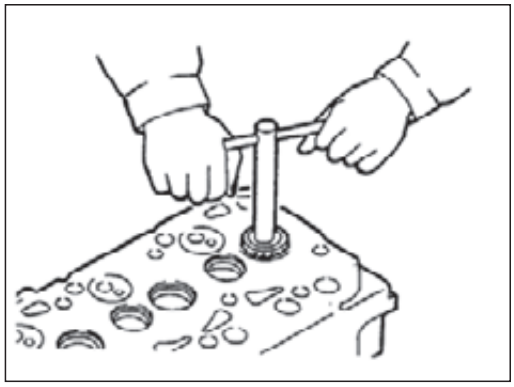
(5) Valve refacing
(a) Set the valve refacer at an angle of 45’ and grind the valve.

(b) The valve margin must be not less than the limit. If the margin seems to be less than the limit when the valve is refaced, replace the valve.



Refacing valve face

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Refacing valve seat

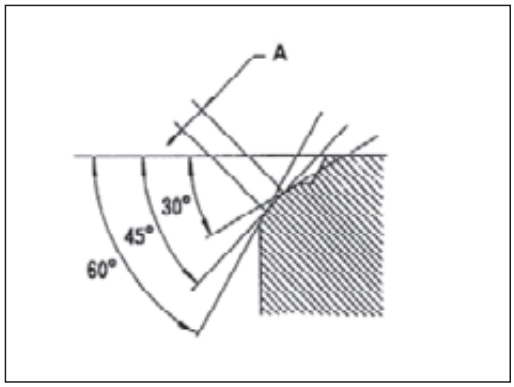
(6) Valve seat refacing

(a) Before refacing the valve seat, check the clearance between the valve and guide, and replace the guide if necessary.

(b) Cut the valve seat with a valve seat cutter (commercially available), or grind it with a valve seat grinder, and finish the width of valve seat and the angle of seat face to the correct values.

Unit: mm (in)

Item	Standard	Limit
Angle of seat face	45°	-
Width of valve seat	1.3 to 1.8 (0.051 to 0.071)	2.5 (0.098)



Valve seat width and valve face angle

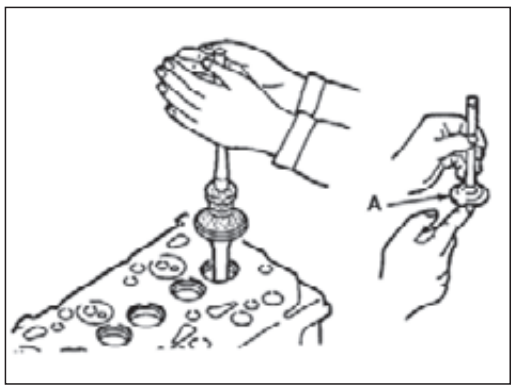
A - Width of valve seat 1.3 to 1.8 mm (0.051 to 0.071 in.)

(c) After refacing the valve seat, put lapping compound on the valve face and lap the valve in the valve seat.

(7) Valve lapping

Be sure to lap the valves in the seats after refacing or replacing the valves or valve seats.

(a) Put a small amount of lapping compound on the valve face.



Lapping valve in seat

A - Compound

NOTE:
a) Do not put lapping compound on the valve stem.
b) Use a lapping compound of 120 to 150 mesh for initial lapping and a compound of finer than 200 mesh for finish lapping.
c) Mixing the compound with a small amount of engine oil will help put the compound on the valve face uniformly.

(b) Using a lapping tool, hold the valve against the seat and rotate it only a part of a turn, then raise the valve off its seal,

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rotating it to a new position. Press the valve against the seal for another part of a turn. Repeat this operation until the compound wears and loses its cutting property.

(c) Wash the valve and valve seat with dry cleaning solvent.

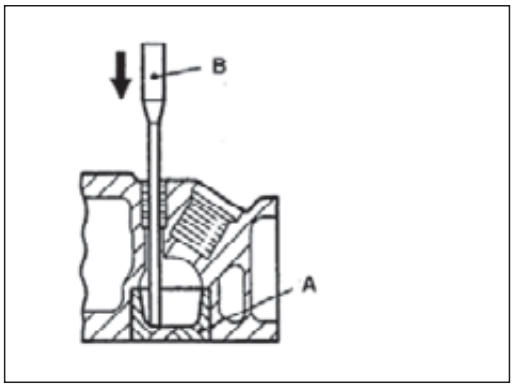
(d) Apply engine oil to the valve and lap it in the seat.

(e) Check the valve face for contact.

6. Combustion jet replacement

Replace the combustion jets only when they are cracked or defective.

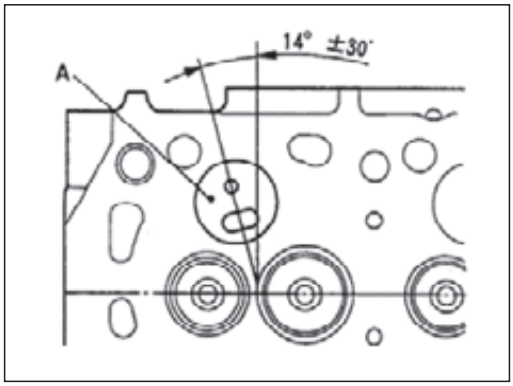
(1) To remove the jet, insert a 6 mm (0.24 in.) diameter round bar through the bore in the cylinder head for the glow plug and tap around the jet.



Removing combustion jet

A - Combustion jet
B - Round bar

(2) To install a new jet, put the jet in position in the head with its tangential orifice in alignment with the center of the main chamber and tap it with a plastic hammer.

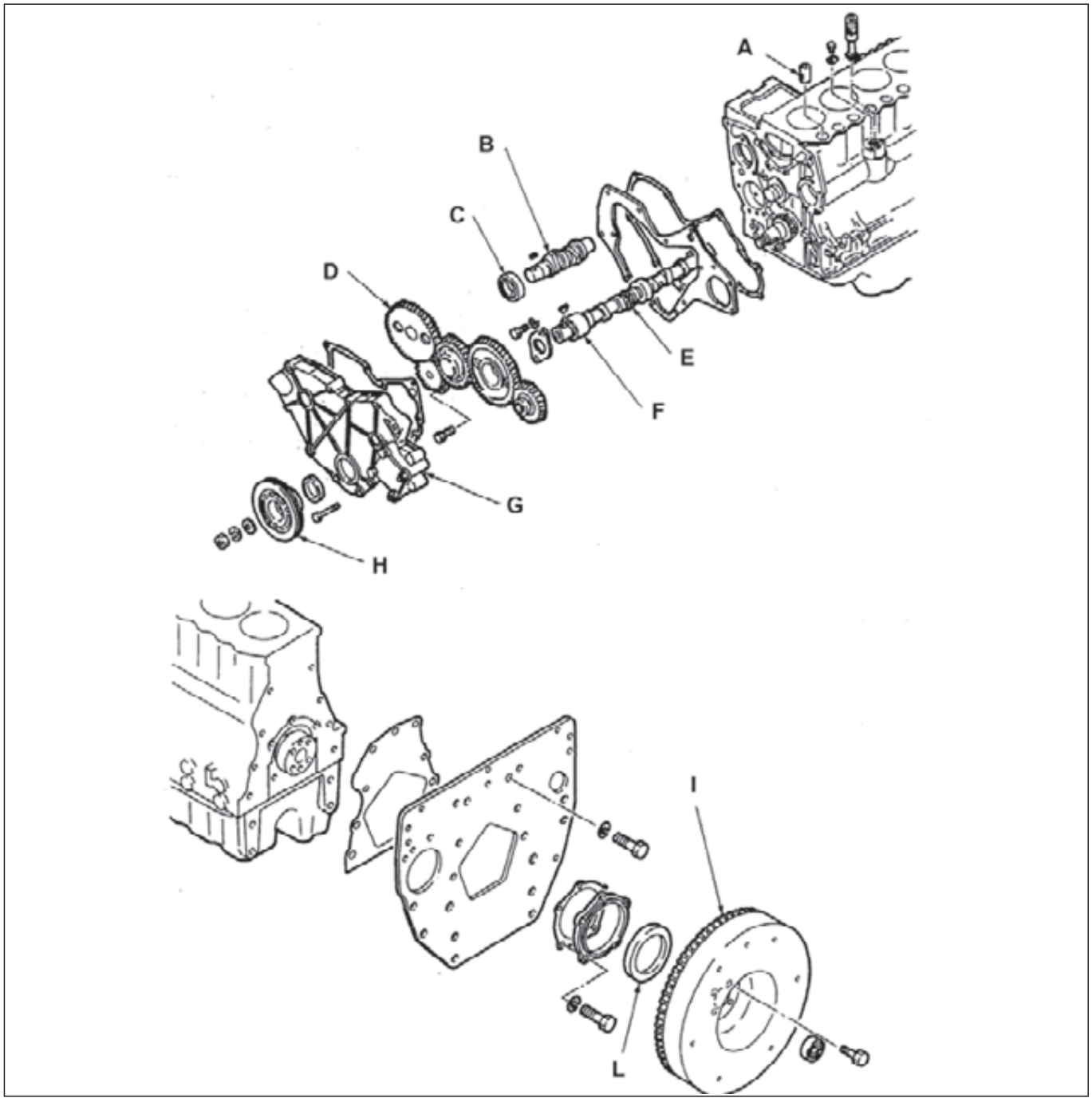


Installing combustion jet

A - Combustion jet

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TIMING GEARS AND FLYWHEEL



Inspection points

A - Check for wear.
B - Check for damage to lobes and bearing journals.
C - Check for wear or abnormal noise (when spun).
D - Check teeth for wear, nicks, buns or chips.
E - Check speedometer driven gear for damage.
F - Check for bend or damage to lobes.
G - Check for cracks or distortion.
H - Check belt groove for wear.
I - Check clutch contact face for scores or ridges Check ring gears for damage or wear.
L - Check for wear, damage or aging.

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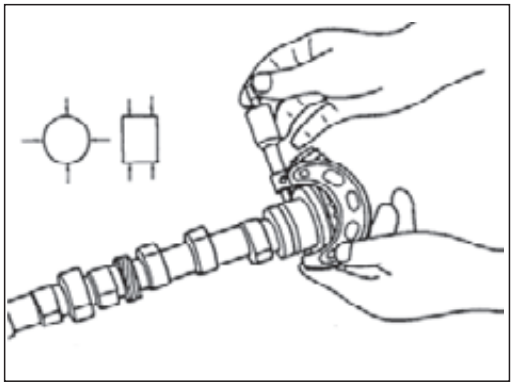
1. Camshaft

(1) Clearance between journal and bushing

Measure the diameter of the journal and the bore in the bushing for the shaft to find the clearance as shown in the illustration. If the clearance exceeds the limit, replace the bushing.

Unit: mm (in)

Item	Standard
Clearance between camshaft journal and bushing	0.15 (0.0059)



Measuring camshaft journal

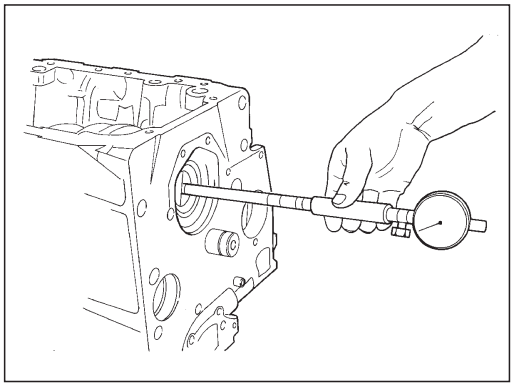
(2) Bushing replacement

Measuring bore in camshaft bushing

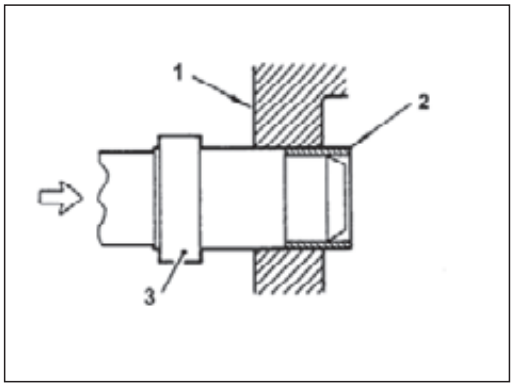
Use Camshaft Bushing Installer (ST332340) (special tool) for camshaft bushing replacement.

(a) Removal

Remove the oil pan. Using a ”remover” end of the Installer, push out the bushing into the cylinder block. Crush and take out the bushing from the block.



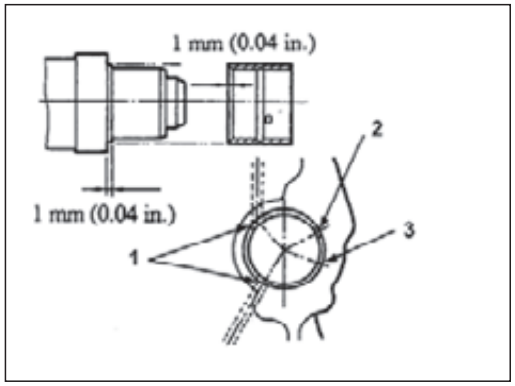
Measuring bore in camshaft bushing



Removing camshaft bushing

1 - Front of cylinder block
2 - Camshaft bushing
3 - Camshft Bushing Installer

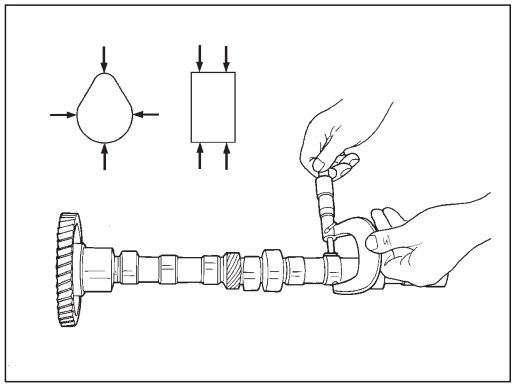
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Installing camshaft bushing

1 - Oil holes
2 - Notch in bushing
3 - Ends of bushing

(b) Installation
Install a new bushing in position with its oil holes in alignment with those of the oil gallery.



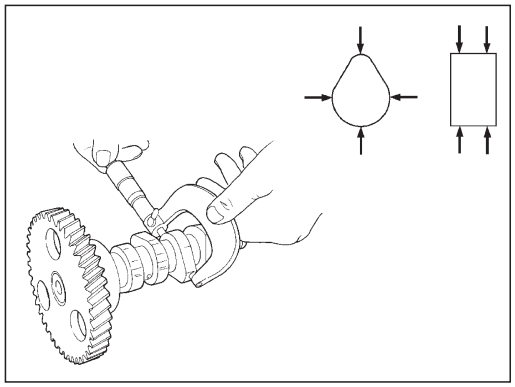
Measuring lobe height of camshaft

(3) Lobe lift

Measure the lobe height and base circle as shown in the illustration. Subtract the base circle from the lobe height to find the lobe life. If the lobe lift exceeds the limit, replace the camshaft.

Unit: mm (in)

Item	Standard	Limit
Lobe height of camshaft	35.72 (1.4063)	34.72 (1.3669)



Measuring lobe height of fuel injection pump camshaft

2. Fuel injection pump camshaft

Measure the lobe height and base circle as shown in the illustration. Subtract the base circle from the lobe height to find the lobe life. If the lobe lift exceeds the limit, replace the camshaft.

Unit: mm (in)

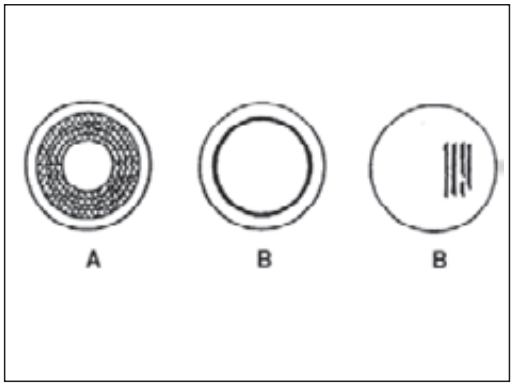
Item	Standard	Limit
Lobe height of fuel injection pump camshaft	44 (1.73)	43 (1.69)

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3. Tappets

(1) Cam contact face

Check the cam contact face of each tappet for abnormal wear. Replace the tappet if the face is defective.



Cam contact face of tappet

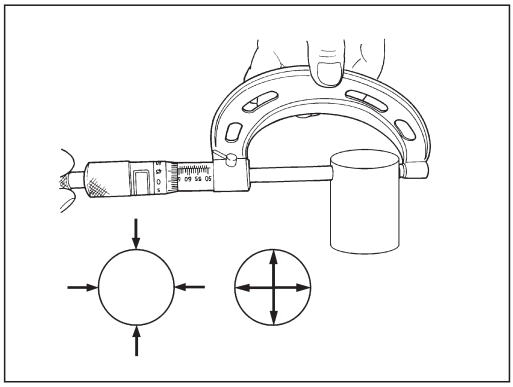
A - Good
B - Bad

(2) Clearance between tappet and cylinder block

Measure the diameter of the tappet and the bore in the cylinder block for the tappet to find the clearance. If the clearance exceeds the limit, replace the tappet.

Unit: mm (in)

Item	Standard
Clearance between tappet and cylinder block	0.15 (0.0059)



Measuring tappet and bore in cylinder

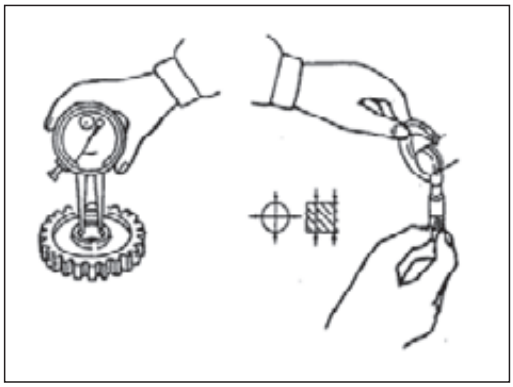
4. Idler gear

(1) Clearance between idler gear and shaft

Measure the bore in the idler gear for the shaft and the diameter of the shaft to find the clearance. If the clearance exceeds the limit, replace the gear or shaft whichever is badly worn.

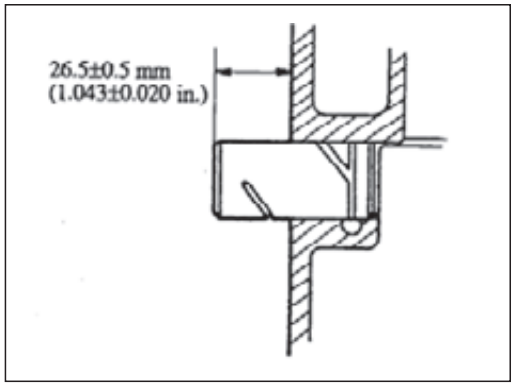
Unit: mm (in)

Item	Standard	Limit
Clearance between idler gear and shaft	0.03 to 0.07 (0.0012 to 0.0028)	0.20 (0.0079)



Measuring idler gear and shaft

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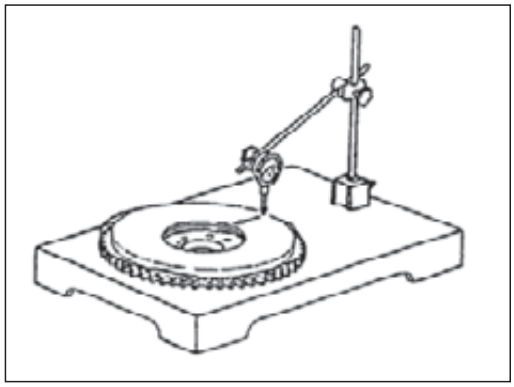
Idler shaft dimension

(2) Idler shaft replacement

Install a new idler shaft to the cylinder block so that its dimension from the face of the block is 26.5 ± 0.5 mm (1.043 ± 0.020 in.).

5. Flywheel and ring gear

(1) Flatness (difference between lower and higher measurements) of flywheel



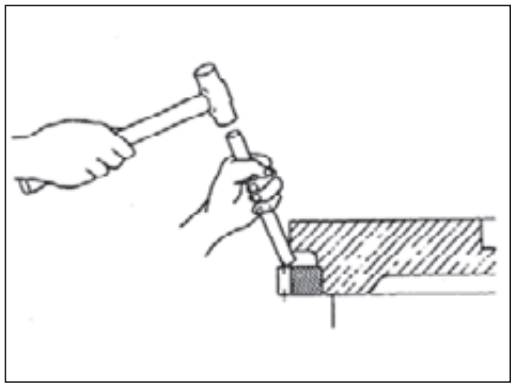
Measuring flywheel flatness

Put the flywheel on the surface plate. Set a dial indicator at one side of the friction (clutch contact) face and move it over to the opposite side of the face as shown in the illustration to find the flatness. If the flatness exceeds the limit, grind the face.

Unit: mm (in)

Item	Standard	Limit
Flatness of flywheel	0.15 (0.0059) maximum	0.50 (0.0197)

(2) Ring gear replacement



Removing ring gear

Check the ring gear and replace it if its teeth are abnormally worn or chipped.

(a) Removal
Heat the ring gear evenly with an acetylene torch. Tap the ring gear all the way around with a bar and a hammer as shown in the illustration to remove it from the flywheel.

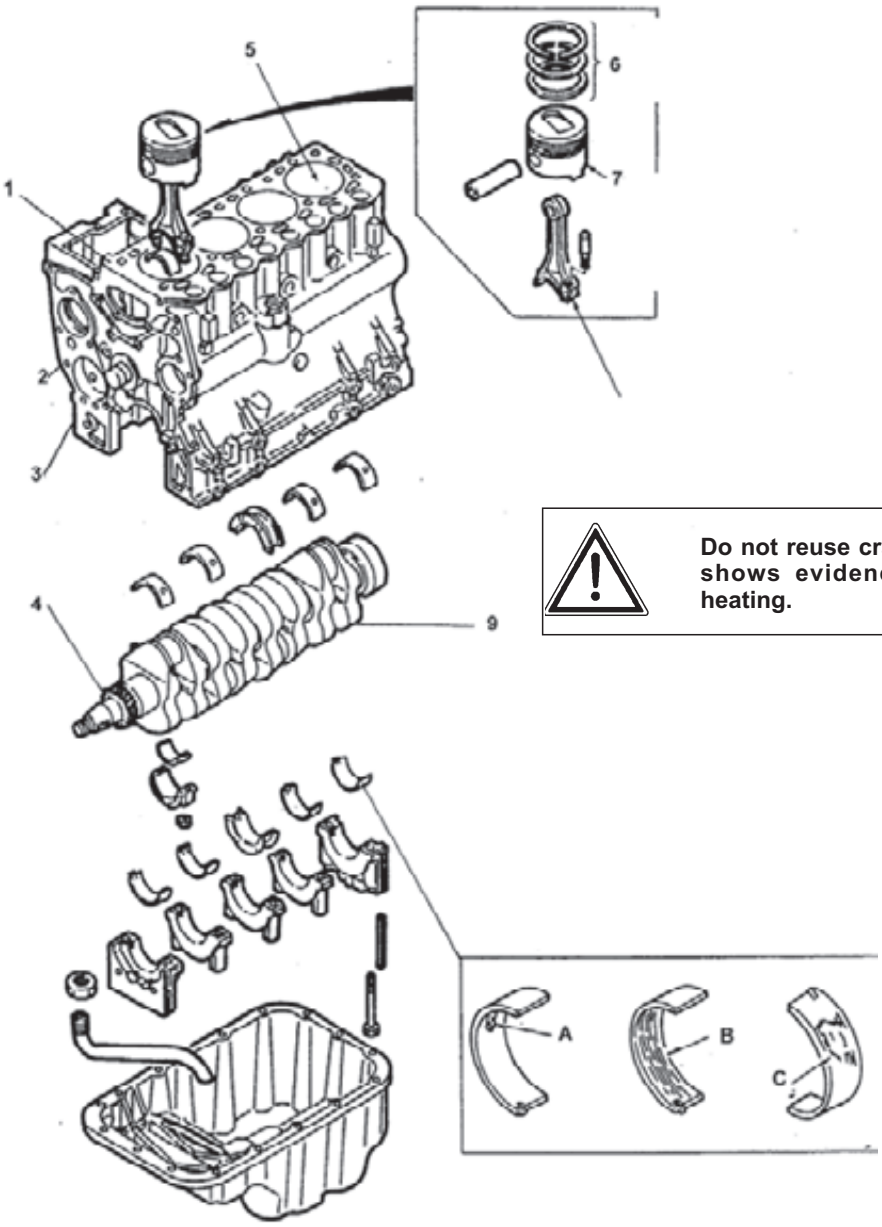
(b) Installation
Heat a new ring gear up to a temperature of 150’C (302’F) with a piston heater and install it to the flywheel with its unchamfered side foremost.

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CYLINDER BLOCK, CRANKSHAFT, PISTONS AND OIL PAN

1 - Check top face for warpage.
2 -Check for damage to plugs or dowels.
3 - Check for plugged oil holes.
4 - Check for damage to gear teeth.
5 - Check for cracks, scores or ridges at top of ring travel.
6 - Check for wear or damage. Check clearance between ends.
7 - Check for wear, scores, cracks, overheating or excessive widened ring grooves.
8 - Check for bend or twist. Check big end thrust clearance.
9 - Check journals and crankpins for abnormal wear, cracks, bend or plugged oil holes.

A - Loss of overlay
B - Scratches
C - Defect due to poor installation

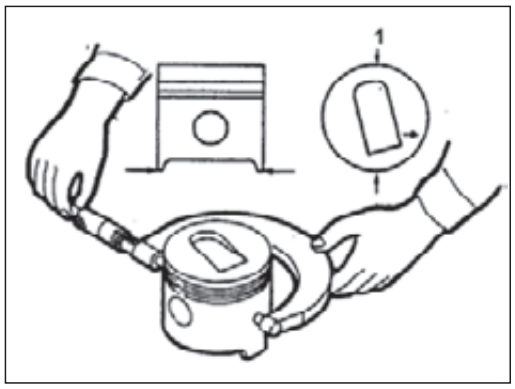


Do not reuse crankshaft if it shows evidence of overheating.

Inspection points

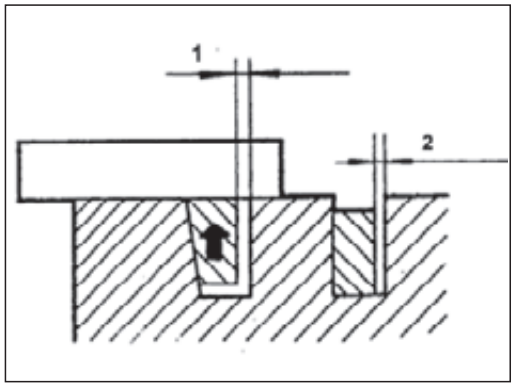
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Inspection



Measuring diameter of piston

1 - Direction traverse to piston pin



Measuring clearance between piston ring and groove

1 - No. 1 compression ring clearance
2 - No. 2 compression ring clearance

1. Pistons, Piston Rings and Piston Pins

(1) Diameter of piston

Measure the diameter of the piston at its skirt in a direction transverse to the piston pin with a micrometer as shown in the illustration. If the diameter exceeds the limit, replace the piston.
Select a new piston so that the difference between average weight of all pistons in one engine does not exceed the standard.

Unit: mm (in)

Item		Nominal size	Standard	Limit
Diameter of piston	Standard	78.00 (3.0709)	77.93 to 77.95 (3.0681 to 3.0689)	77.80 (3.0630)
	0.25 (0.0098) oversize	78.25 (3.0807)	78.18 to 78.20 (3.0779 to 3.0787)	78.05 (3.0728)
	0.50 (0.0197) oversize	78.50 (3.0905)	78.43 to 87.45 (3.0878 to 3.0886)	78.30 (3.0827)
Maximum permissible difference between average weight of all pistons in one engine, g (oz)			5 (0.18)	-

(2) Clearance between piston ring and groove

(a) Measure the clearance between the groove and piston with a straight edge and a feeler gauge as shown in the illustration. If the clearance exceeds the limit, replace the ring.

Unit: mm (in)

Item	Standard	Limit
No. 1 compression ring	0.06 to 0.10 (0.0024 to 0.0039)	0.30 (0.0118)
No. 2 compression ring	0.06 to 0.10 (0.0024 to 0.0039)	0.20 (0.0079)
Oil ring	0.06 to 0.10 (0.0024 to 0.0039)	0.20 (0.0079)

(b) If the clearance still exceeds the limit after new piston rings have been installed, replace the piston.

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(3) Clearance between ends of piston ring

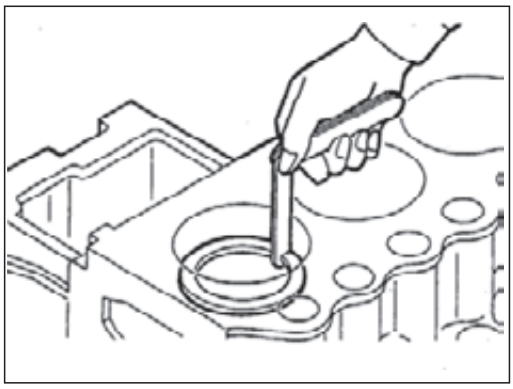
Put the piston ring in a gauge or in the bore in a new cylinder block and measure the clearonce between the ends of the ring with a feeler gauge as shown in the illustration. If the clearance exceeds the limit, replace all the rings.

Inside diameter of gauge

Standard:
$78^{+0.03}_{0}$ mm ($3.07^{+0.0012}_{0}$ in.)

0.25 mm (0.0098 in.) oversize:
$78.25^{+0.03}_{0}$ mm (3.08^{+00012}_{0} in.)

0.50 (0.0197 in.) oversize
$78.50^{+0.03}_{0}$ mm ($3.09^{+0.0012}_{0}$ in.

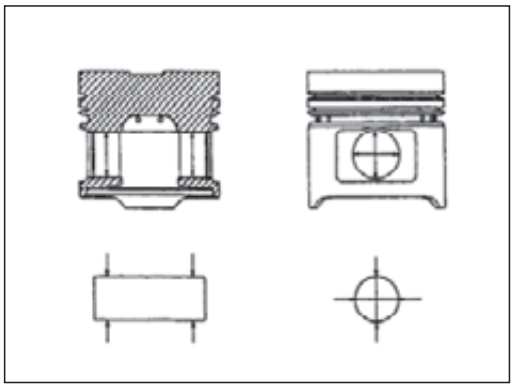


Measuring clearance between ends of piston ring

NOTE: Put the piston ring in the gauge or cylinder squarely with the piston.

Unit: mm (in)

Item		Standard	Limit
Clearance between ends of piston ring	No. 1 compression ring	0.15 to 0.30 (0.0059 to 0.0118)	1.50 (0.0591)
	No. 2 compression ring	0.15 to 0.35 (0.0059 to 0.0138)	
	Oil ring	0.20 to 0.40 (0.0079 to 0.0157)	



Measuring piston pin and bore in piston for pin

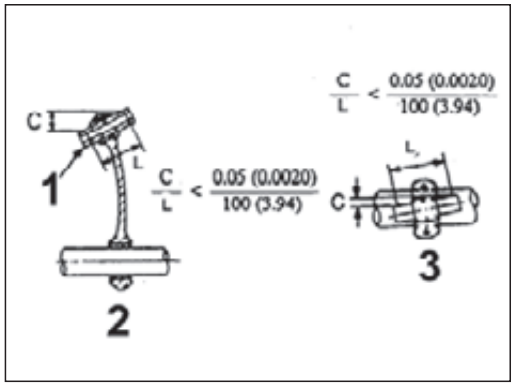
(4) Clearance between piston pin and piston

Measure the diameter of the piston pin and the bore in the piston for the pin as shown in the illustration to find the clearance. If the clearance exceeds the limit, replace the piston or pin whichever is badly worn.

Unit mm (in.)

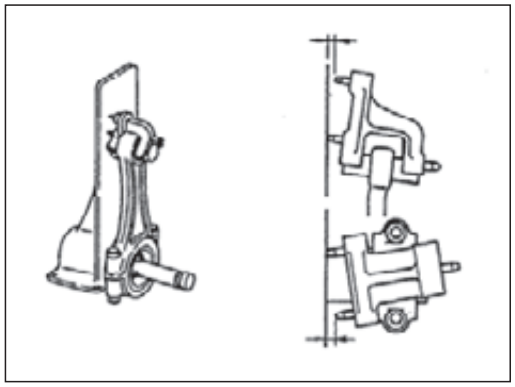
Item	Normal size	Standard	Limit
Diameter of piston pin	23 (0.91)	22.994 to 23.000 (0.90527 to 0.90551)	
Clearance between piston pin and piston	-	0.006 to 0.018 (0.00024 to 0.00071)	0.050 (0.00197)

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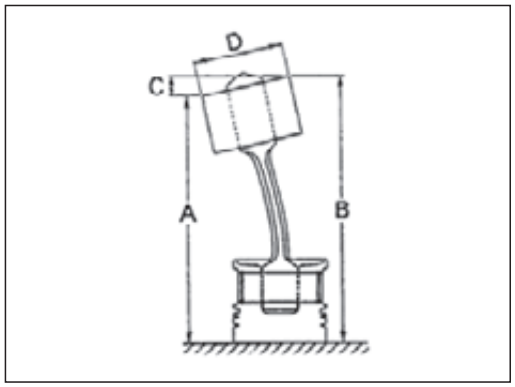


Checking connecting rod for bend or twist

Unit: mm (in.)
1 - Piston pin
2 - Bend
3 - Twist



Check connecting rod on a connecting rod aligner



Checking connecting rod for bend with a dial indicator

2. Connecting rods

Check the connecting rod for bend or twist as follows:

(a) Measure ”C” and ”L” If ”C” exceeds 0.05 mm (0.0020 in.) per 100 mm (3.94 in.) of ”L”, straighten the connecting rod with a press.

Unit: mm (in)

Item	Standard	Limit
Bend or twist of connecting rod	0.05/100 (0.002/3.94) maximum	0.15/100 (0.0059/3.94)

(b) Generally, a connecting rod aligner is used to check the connecting rod for bend or twist.

NOTE: To check the rod for bend, install the cap to the connecting rod and tighten the cap nuts to the specified torque.

(c) To check the connecting rod fitted to the piston for bend, put the connecting rod and piston on the surface plate as shown in the illustration, insert a round bar having a diameter equal to that of the crankpin into the bore in the big end of the rod and measure ”A” and ”B” with a dial indicator. Subtract ”A” from ”B” to find the bend (”C”).

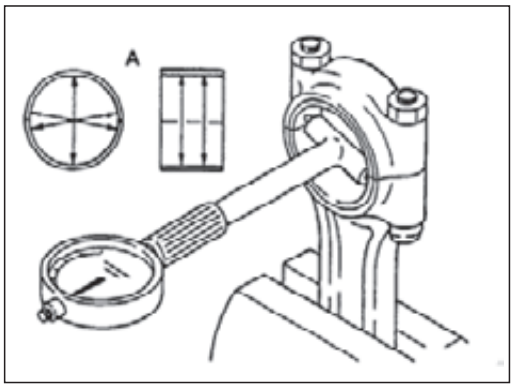
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3. Crankshaft

(1) Clearance between crankpin and connecting rod bearing

(a) Install the bearing (upper and lower halves) and cap to the big end of the connecting rod and tighten the cap nuts to the specified torque. Measure the bore in the bearing for crankpin as shown in the illustration.

Tightening torque	3.55 ± 0.25 kgf x m (25.7 ± 1.8 lbf x ft) [34.8 ± 2.5 N x m]



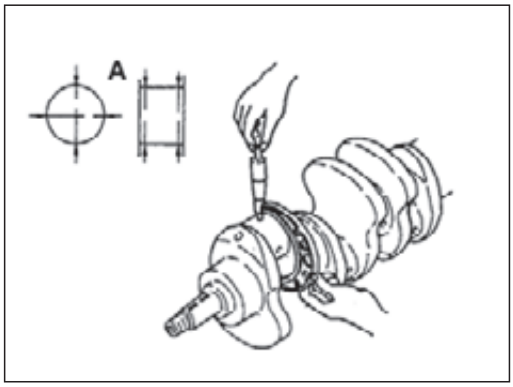
Measuring bore in connecting rod bearing

A - Measuring diagram

(b) Measure the diameter of the crankpin as shown in the illustration to find the clearance between the crankpin and connecting rod bearing.

Unit mm (in.)

Item	Normal size	Standard	Limit
Diameter of crankpin (standard)	48 (1.89)	47.950 to 47.965 (1.88779 to 1.88838)	-
Clearance between crankpin and connecting rod bearing	-	0.025 to 0.072 (0.00098 to 0.00283)	0.150 (0.00591)



Measuring diameter of crankpin

A - Measuring diagram

(c) If the clearance exceeds the limit, install a new bearing and check the clearance again.

(d) If the clearance still exceeds the limit, grind the crankpin to 0.25 mm (0.0098 in.), 0.50 mm (0.0197 in.) or 0.75 mm (0.0295 in.) undersize and use undersize connecting rod bearing.

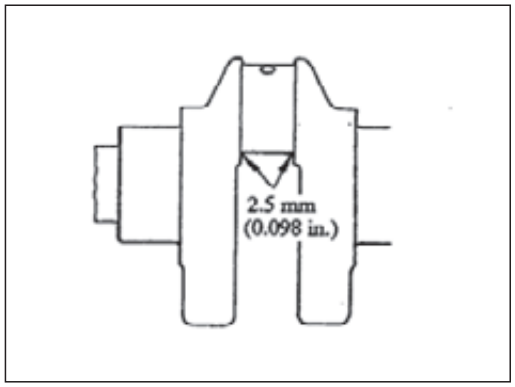
Crankpin undersizes

Unit: mm (in.)

Item	Undersize	Finish
Crankpin	0.25 (0.0098)	$47.75\ ^{-0.035}_{-0.050}$ ($1.8979\ ^{-0.00138}_{-0.00197}$)
	0.50 (0.0197)	$47.50\ ^{-0.035}_{-0.050}$ ($1.8701\ ^{-0.00138}_{-0.00197}$)
	0.75 (0.0295)	$47.25\ ^{-0.035}_{-0.050}$ ($1.8602\ ^{-0.00138}_{-0.00197}$)

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Inspection



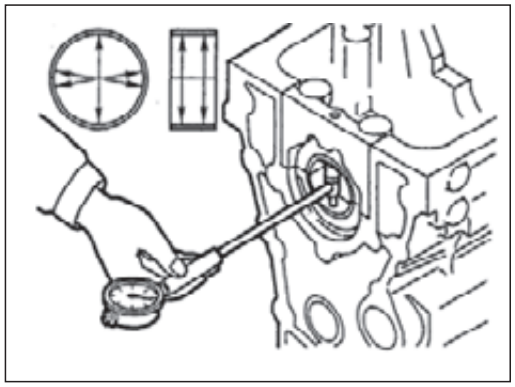
Crankpin fillet radius

CAUTION:
a) Grind all the crankpins of one crankshaft to the same undersize.
b) Finish the crankpin fillets to a radius of 2.5 mm (0.098 in.).

(2) Clearance between journal and main bearing

(a) Install the main bearing (upper and lower halves) and cap to the cylinder block and tighten the cap bolts to the specified torque. Measure the bore in the bearing for the journal as shown in the illustration.

Tightening torque	5.25 ± 0.25 kgf x m (38 ± 1.8 lbf x ft) [51.5 ± 2.5 N x m]

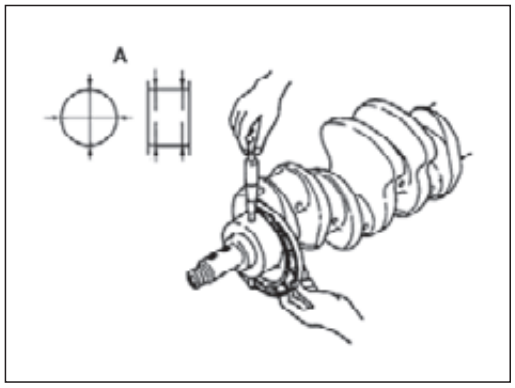


Measuring bore in main bearing

(b) Measure the diameter of the journal as shown in the illustration to find the clearance between the journal and main bearing.

Unit mm (in.)

Item	Normal size	Standard	Limit
Diameter of journal (standard)	52 (2.05)	51.985 to 52.000 (2.04665 to 2.04724)	-
Clearance between journal and main bearing	-	0.030 to 0.077 (0.00118 to 0.0.00303)	0.100 (0.00394)



Measuring diameter of journal

A - Measuring diagram

(c) If the clearance exceeds the limit, install a new bearing and check the clearance again.

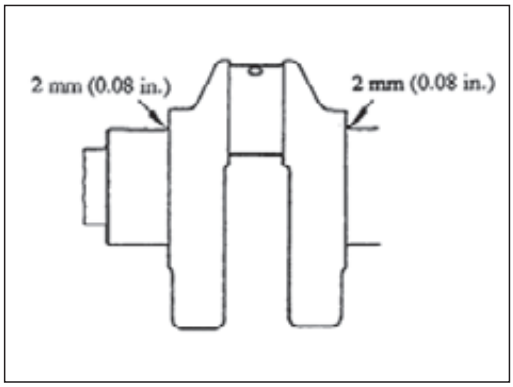
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(d) If the clearance still exceeds the limit, grind the journal to 0.25 mm (0.009 8 in.), 0.50 mm (0.019 7 in.) or 0.75 mm (0.029 5 in.) undersize and use undersize main bearing.

Journal undersizes

Unit: mm (in.)

Item	Undersize	Finish
Journal	0.25 (0.0098)	$51.75\ ^{0}_{-0.015}$ ($2.0374\ ^{0}_{-0.00059}$)
	0.50 (0.0197)	$51.50\ ^{0}_{-0.015}$ ($2.0276\ ^{0}_{-0.00059}$)
	0.75 (0.0295)	$51.25\ ^{0}_{-0.015}$ ($2.0177\ ^{0}_{-0.00059}$)

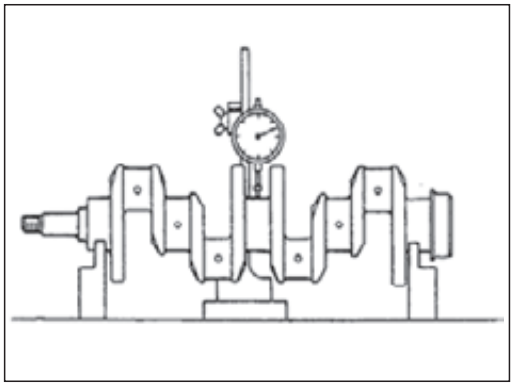


Journal fillet radius

CAUTION:
a) Grind all the journals of one crankshaft to the same undersize.
b) Finish the journal fillets to a radius of 2 mm (0.08 in.).

(3) Runout

Support the crankshaft on its front and rear journals in V-blocks or in a lathe and check runout at the center journal with a dial indicator as shown in the illustration. Depending on the amount of runout, repair the crankshaft by grinding or by straightening with a press. If runout exceeds the limit, replace the crankshaft.


Checking crankshaft runout

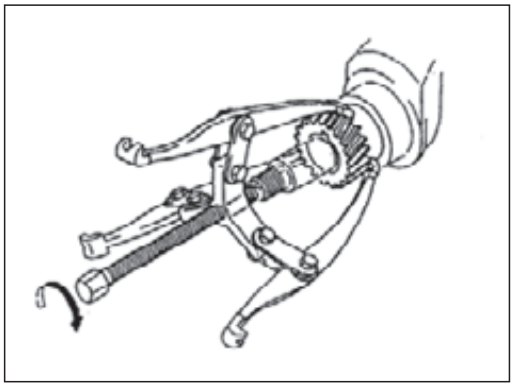
Unit: mm (in)

Item	Standard	Limit
Crankshaft runout	0.025 (0.00098)	0.05 (0.0020)

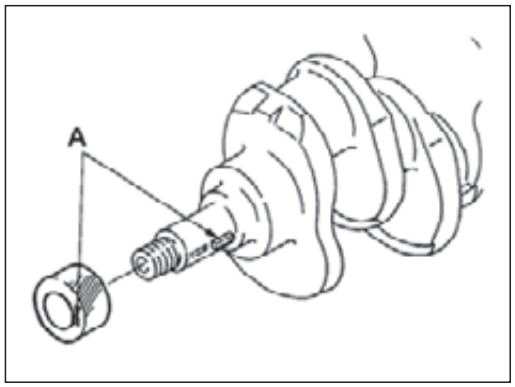
(4) Crankshaft gear removal

Use a gear puller to remove the gear from the crankshaft.

NOTE: Do not remove the gear unless the gear or crankshaft is defective.

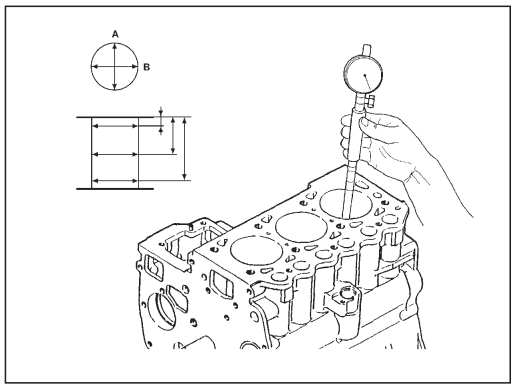

Removing crankshaft gear

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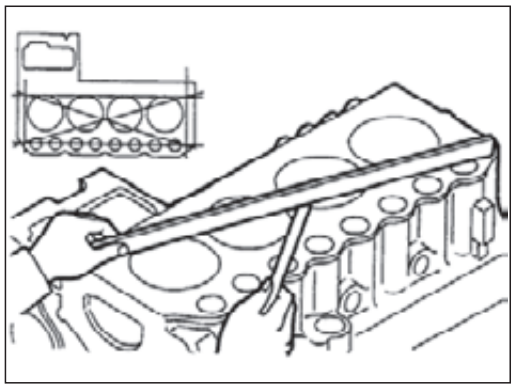


Installing crankshaft gear

A - To be aligned



Measuring bore in cylinder block



Checking cylinder block top face for warpage

Unit: mm (in)

Item	Standard	Limit
Warpage of cylinder block top face	0.05 (0.0020) maximum	0.10 (0.0039)

(5) Crankshaft gear installation

(a) Install the key in position on the crankshaft.
(b) Install the gear in position with its keyway in alignment with the key as shown in the illustration.

4. Cylinder block

(1) Bore

Measure the bore at the top, middle and bottom points on axes A and B with a cylinder bore gauge as shown in the illustration. If any one of the cylinders exceeds the limit, hone out all the bores for oversize pistons.

Piston and piston ring		Bore	
Size	Size code	Standard	Limit
Standard	STD	$78\ ^{+0.03}_{0}$ ($3.07\ ^{+0.0012}_{0}$)	Standard +0.2 (+0.008)
0.25 (0.0098) oversize	25	$78.25\ ^{+0.03}_{0}$ ($3.0807\ ^{+0.0012}_{0}$)	
0.50 (0.0197) oversize	50	$78.50\ ^{+0.03}_{0}$ ($3.0905\ ^{+0.0012}_{0}$	
Taper and out of round		0.01 (0.0004) maximum	-

(2) Warpage of top face
Using a heavy accurate straight edge and a feeler gauge, check the top face for warpage in two positions lengthwise, two crosswise and two widthwise as shown in the illustration. If warpage exceeds the limit, reface the top face with a surface grinder.

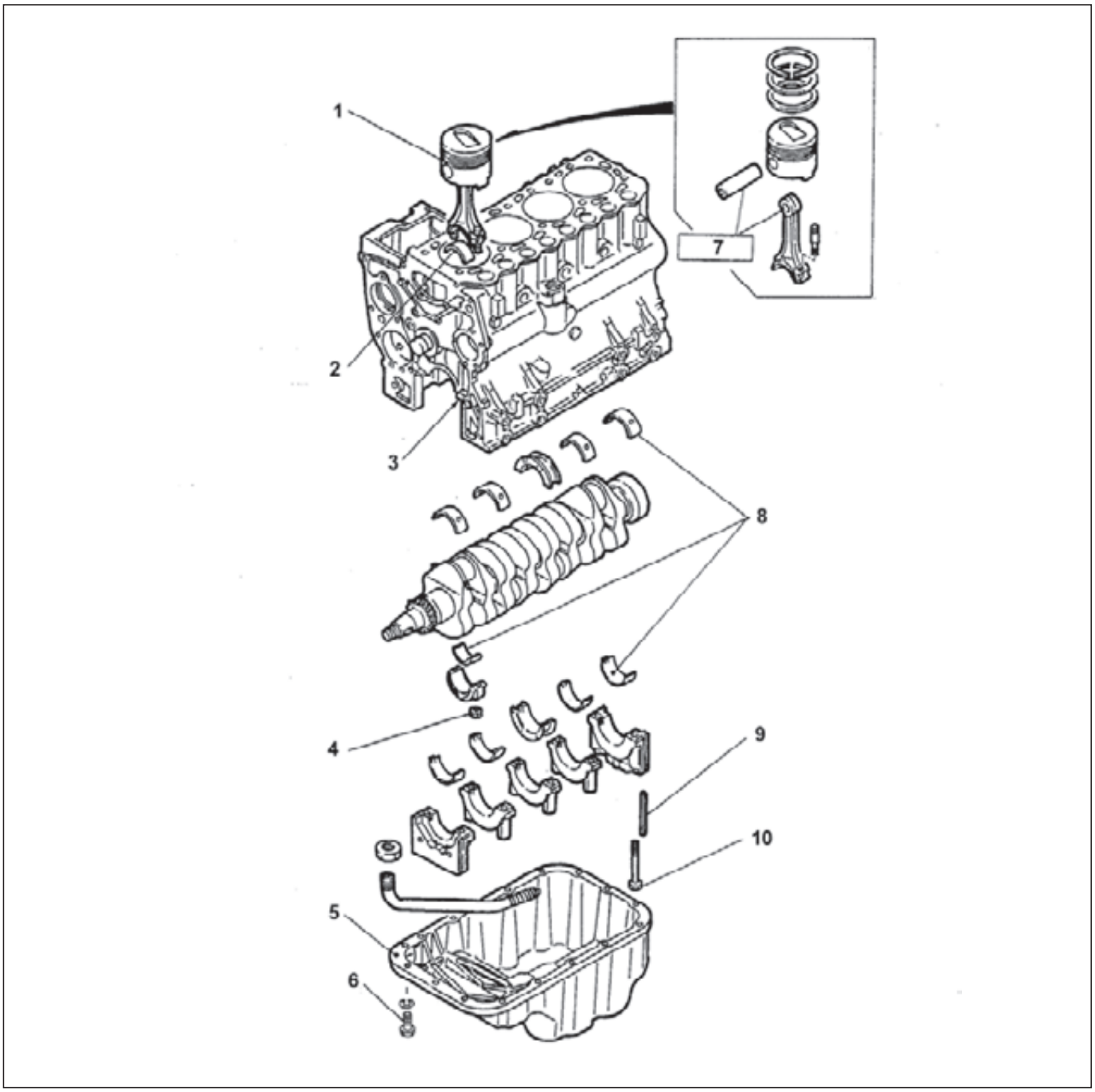
CAUTION: The maximum permissible amount of stock to be removed from the cylinder head and block by grinding is 0.2 mm (0.008 in.) in total.

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CYLINDER BLOCK, CRANKSHAFT PISTONS AND OIL PAN



Inspection points

1 - Lubricate the entire surface with engine oil.
2 - Lubricate the bearing (inside) surface with engine oil.
3 - Coat the front and rear bearing cap contact surfaces with Three Bond 1212.
4 - Tightening torque: 3.55 ± 0.25 kgf x m (25.7 ± 1.8 lbf x ft) [34.8 ± 2.5 N x m].
5 - Coat the entire surface with Three Bond 1207C.
6 - Tightening torque Cast oil pan: 2.8 ± 0.3 kgf x m (20.3 ± 2.2 lbf x ft) [27.5 ± 3 N x m]
Plate oil pan: 1.15 + 0.15 kgf-m (8.3 + 1.1 1bf-ft) [11.3 + 1.5 N m].
7 - Force fit
8 - Lubricate the bearing (inside) surface with engine oil.
9 - Coat with Three Bond 1212.
10 - Tightening torque: 5.25 ± 0.25 kgf x m (38 ± 1.8 lbf x ft) [51.5 ± 2.5 N x m].

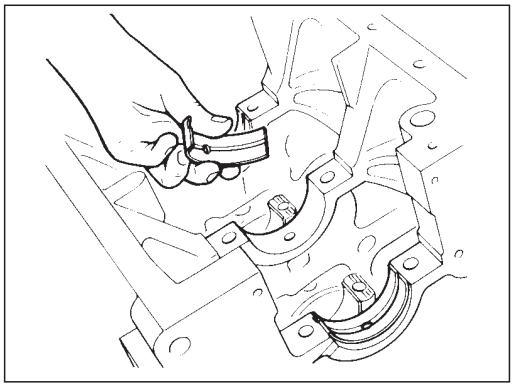
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1. Main bearing installation

(1) Install the upper halves of the main bearings in the cylinder block and the lower halves in the main bearing caps so their tabs fit into the notches in the cylinder block and the main bearing caps.

(2) Install the flanged bearing in the No. 3 journal.

(3) Lightly lubricate the inside surfaces of the bearings with engine oil.



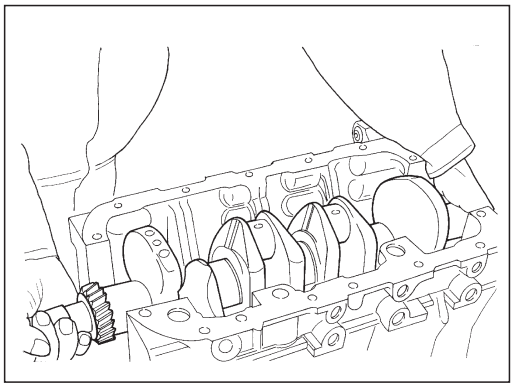
Installing main bearings

2. Crankshaft installation

(1) Clean the crankshaft with cleaning solvent and blow dry with compressed air.

(2) Fasten a hoist to the crankshaft and hold it in horizontal position. Carefully put the crankshaft in position in the cylinder block.

(3) Lightly lubricate the crankshaft journals with engine oil.



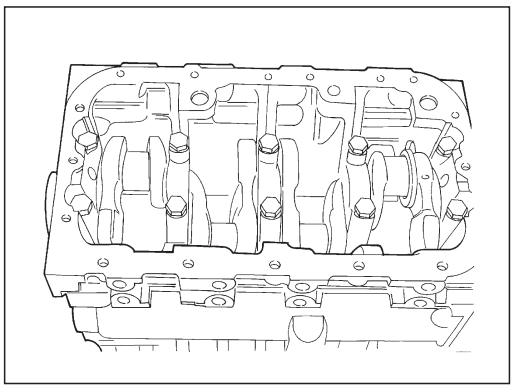
Installing crankshaft

3. Main bearing cap installation

(1) Coat the mating surfaces of the rear bearing cap and cylinder block with Three Bond 1212.

(2) Install the main bearing caps in position. Make sure the number (arrow head) on the main bearing cap is toward the front of the engine.

(3) Tighten the main bearing cap bolts finger tight only.



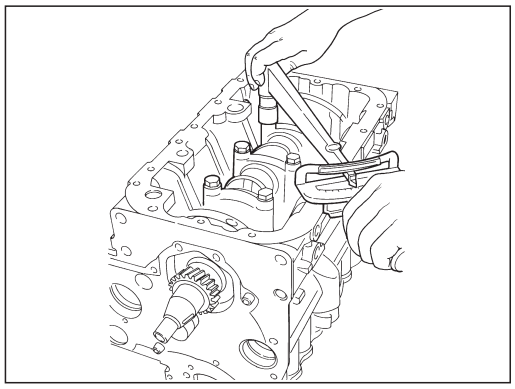
Main bearing caps installed

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CAUTION: Install the front and rear bearing caps in position so their end faces are even with the end faces of the cylinder block.

(4) Tighten the bolts holding the main bearing caps in steps to the specified torque.

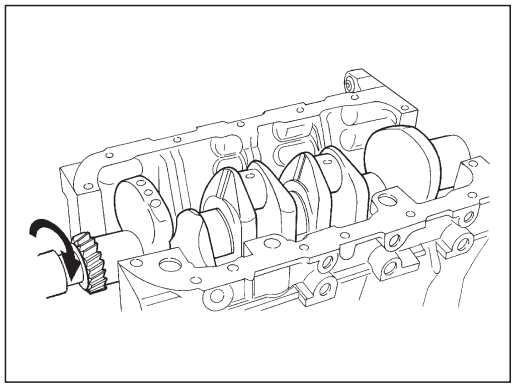
Tightening torque	5.25 ± 0.25 kgf x m (38 ± 2 1bf x ft) [51.5 ± 2.5]



Tightening bolts holding main bearing caps

(5) Make sure the crankshaft rotates freely without binding or catching.

(6) Measure the end play for the crankshaft. Make reference to ”End play measurement for crankshaft” (page 123). If the end play is incorrect, loosen the bolts holding the main bearing caps once and tighten them again.



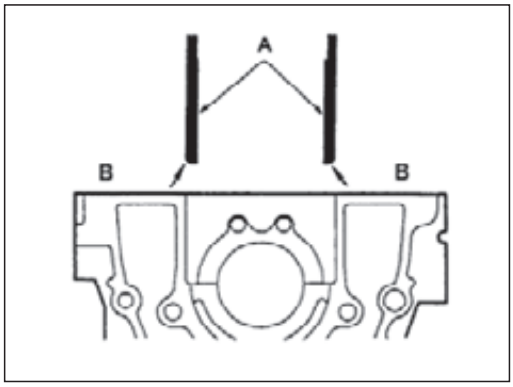
Checking crankshaft for rotation

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4. Side seal installation

(1) Coat the side seals with Three Bond 1212.

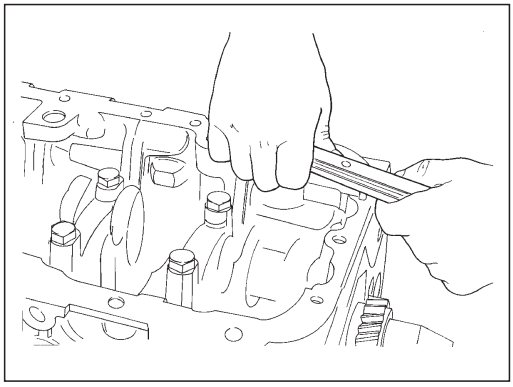
(2) Insert the side seals between the cylinder block and the front and rear caps and push in them by hand as far as possible, with their rounded side toward the outside of the cylinder block.



Side seals

A - Side seals
B - Rounded side

(3) Using a flat plate, push the seals into position, taking care not to bend them.

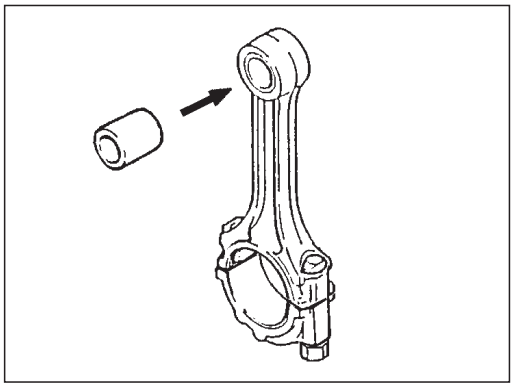


Installing side seals

5. Piston assembling to connecting rod

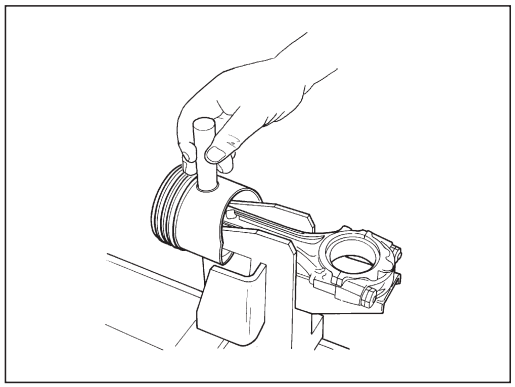
(1) Set Piston Setting Tool (31A91-00100) (special tool) in a hydraulic press.

(2) Put the connecting rod on the Tool and lubricate the bore in the rod for the piston pin with engine oil.



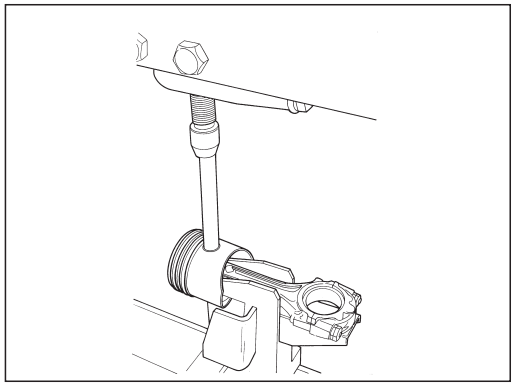
Connecting rod on Piston Setting Tool

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Installing piston pin

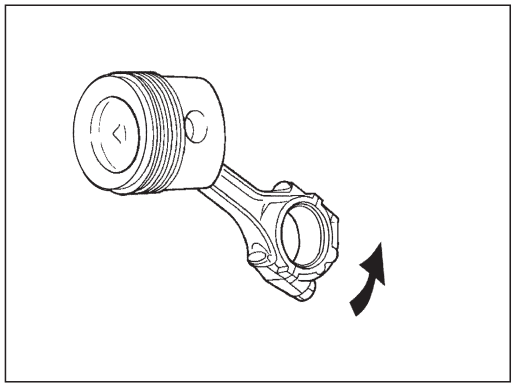
(3) Put the piston in position on the connecting rod, making sure the model identification on the rod is on the same side as the arrow head on the top of the piston. Put the piston pin in position.



Pressing piston pin

(4) Insert the push rod of the Tool into the bore in the piston for the piston pin and press the pin with the press.

CAUTION:Observe the indicator of the press when pressing the piston pin. If the force of the press is ready to exceed 50 kgf (110 1bf) [490 N], stop pressing the pin and check the bores in the piston and connecting rod for alignment.



Checking piston and connecting rod

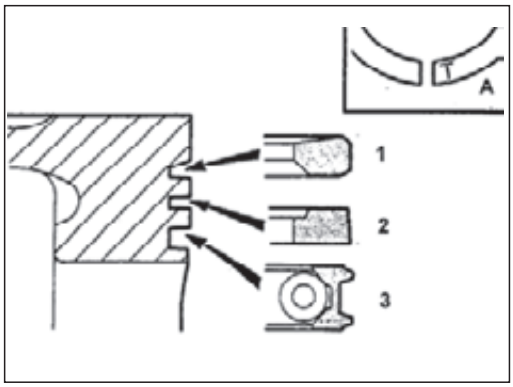
(5) After assembling the piston and connecting rod, make sure the connecting rod moves freely.

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6. Piston ring installation

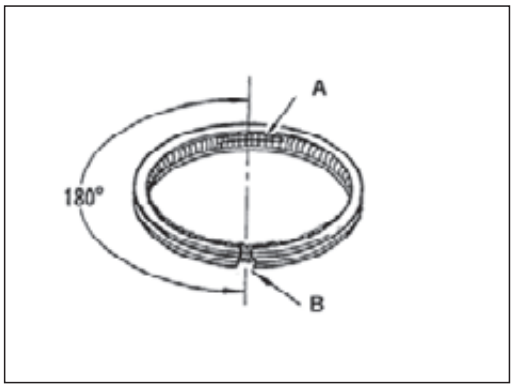
Using a piston ring pliers, install the piston rings on the piston.

NOTE:
a) The piston rings must be installed with the side that has the mark "T" toward the top of the piston.
b) The oil ring must be installed with the ring end gap 180' apart from the coil spring joint.



Piston rings

A - Mark to be up
1 - no. 1 compression ring
2 - no. 2 compression ring
3 - Oil ring



Oil ring

A - Coil spring joint
B - Ring end gap

7. Piston and connecting rod installation

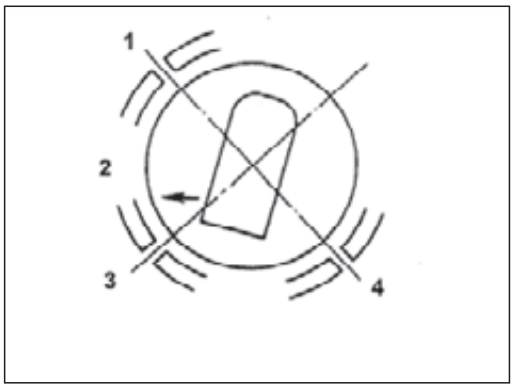
(1) Lubricate the piston and piston rings with engine oil.

(2) Move the piston rings on the piston so that the end gaps are apart from a direction parallel to, or transverse to, the piston pin.

(3) Install the connecting rod bearing (upper half) to the rod, making sure the tab in the back of the bearing is in the notch of the connecting rod.

(4) Turn the crankshaft until the crankpin for the piston and connecting rod to be installed is at the top center.

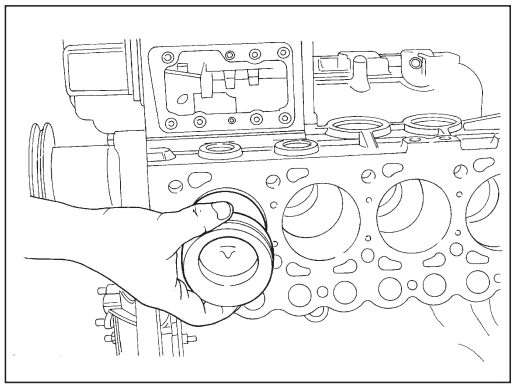
(5) Hold the piston and connecting rod with "FRONT" mark (arrow head) on the top of the piston toward the front (timing gear case side) of the engine.



Relative location of piston ring end gaps

1 - Oil ring
2 - Front of engine
3 - no 1 compression ring
4 - no 2 compression ring and oil ring coil spring joint

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Installing piston and connecting rod

(6) Using a piston guide (commercially available), put the piston and connecting rod into the cylinder from the top of the cylinder block.

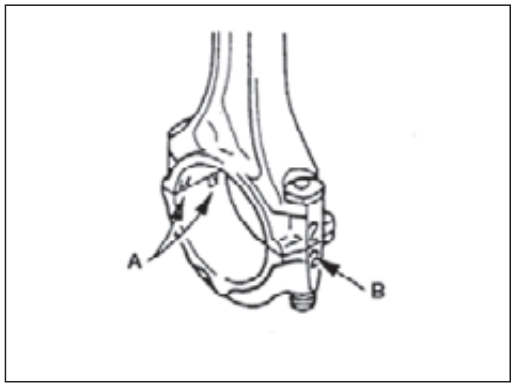
CAUTION:Do not hit the piston with a hammer to install the piston and connecting rod. This will put force on the piston and connecting rod and cause damage to the piston rings and crankpin.

8. Connecting rod cap installation.

(1) Push the piston into position until the big end of the connecting rod is put into position over the crankpin. Then turn the crankshaft 180' while pushing on the top of the piston.

(2) Install the lower half of the connecting rod bearing in the connecting rod cap, making sure the tab in the back of the bearing is in the notch of the cap.

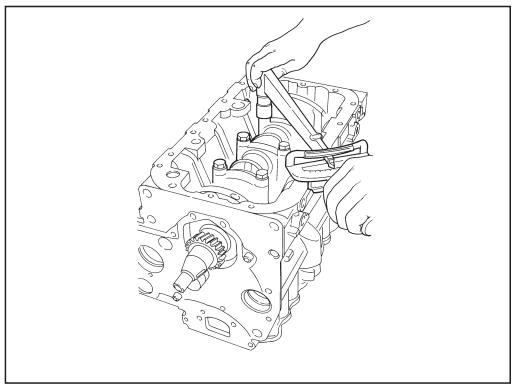
(3) Install the bearing cap to the connecting rod.



Installing connecting rod cap

A - Notches
B - Cylinder number

NOTE:
a) Make sure the number on the cap is the same as the number on the connecting rod.
b) In case of a new connecting rod having no cylinder number, install the cap to the rod with the notches on the same side.



Tightening connecting rod cap nuts

(4) Tighten the connecting rod cap nuts in steps to the specified torque.

Tightening torque	3.55 ± 0.25 kgf x m (25.7 ± 2 lbf x ft) [34.8 ± 2.5 N x m]

(5) Check the thrust clearance for the connecting rod big end.

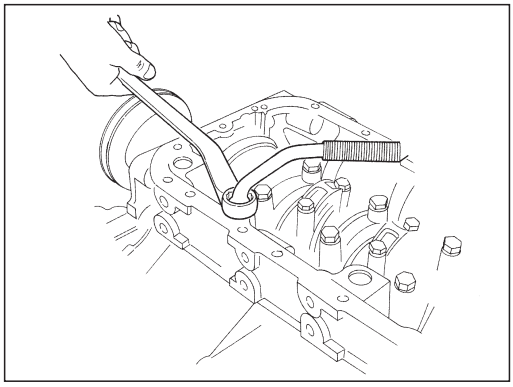
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9. Oil screen installation

(1) Lay the cylinder block with the bottom (oil pan side) up.

(2) Install the oil screen in position.

NOTE: The oil screen must be installed in position so that it is below the oil level line and away from the oil pan.

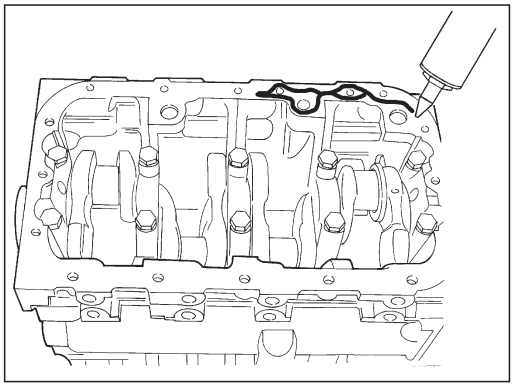


Installing oil screen

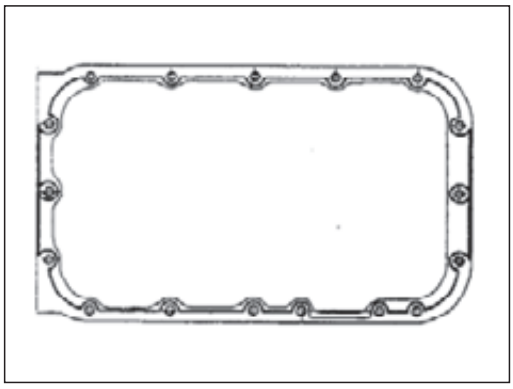
10. Oil pan installation

(1) Clean the mating surfaces of the oil pan and cylinder block and coat them with Three Bond 1207C.

NOTE:Squeeze out a 4 mm (0.2 in.) thick bar of sealing compound (Three Bond) from the tube and put it on the flange of the oil pan as shown.

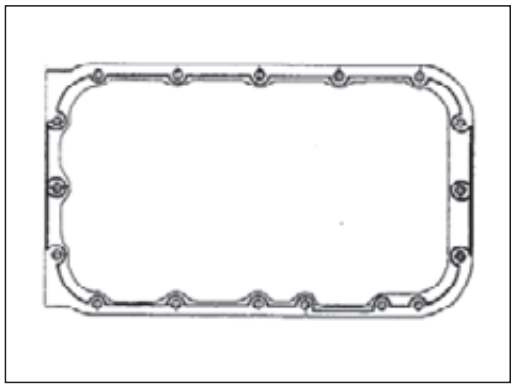


Coating mating surfaces with adhesive

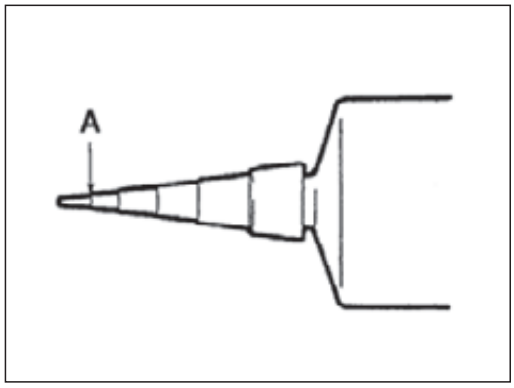


Oil pan for S4L and S4L2 engines

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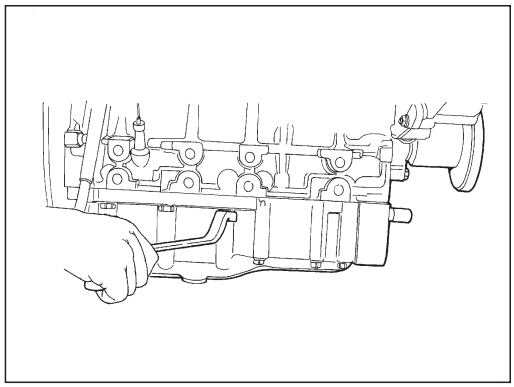
Oil pan for S3L and S3L2 engines



Cutting sealing compound tube nozzle

A - Cut nozzle here.

To squeeze out a 4 mm (0.2 in.) thick bar, cut the nozzle of the tube as shown.



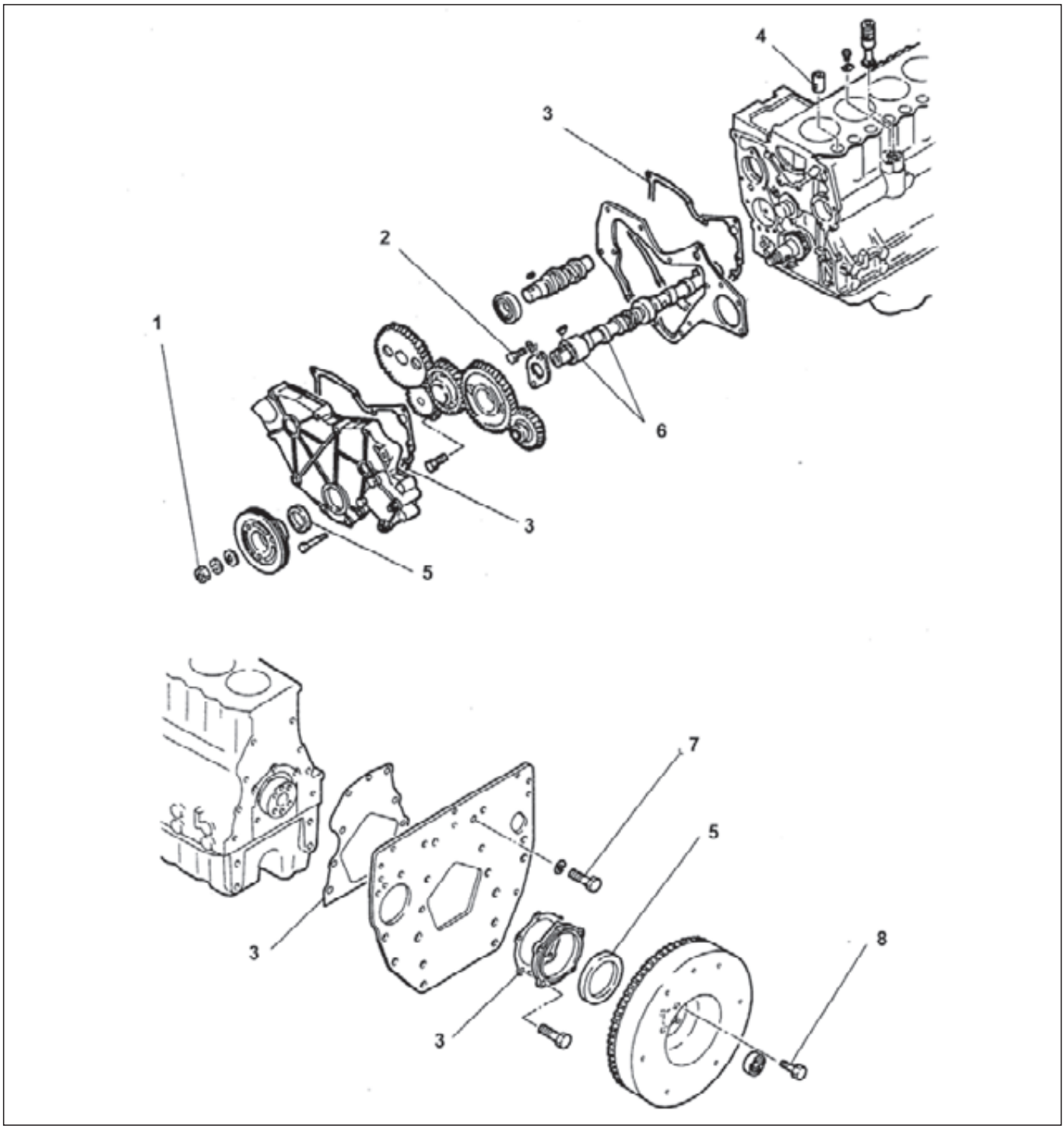
Tightening oil pan bolts

(2) Tighten the bolts that hold the oil pan to the cylinder block in a crisscross pattern to the specified torque.

Tightening torque	Cast oil pan: 2.8 ± 0.3 kgf x m (20.3 ± 2.2 lbf x ft) [27.5 ± 3 N x m] Plate oil pan: 1.15 ± 0.15 kgf x m (8.3 ± 1.1 lbf x ft) [11.3 ± 1.5 N x m]

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TIMING GEARS AND FLYWHEEL

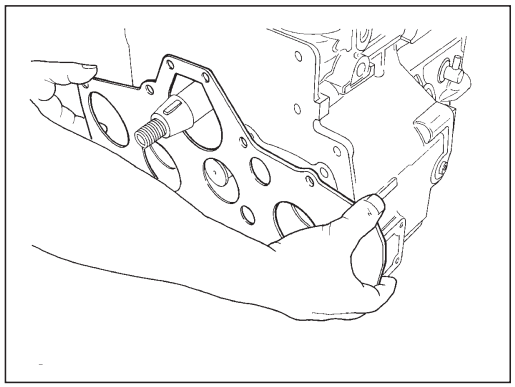


Inspection points

1 - Tightening torque:1.1 ± 0.1 kgf x m (8 ± 0.7 lbf x ft) [10.8 ± 25 N x m]
2 - Tightening torque: 17.5 ± 2.5 kgf x m (127 ± 18 lbf x ft) [172 ± 25 N x m]
3 - Use a new gasket.
4 - Lubricate with engine oil.
5 - Lubricate lip with engine oil.
6 - Lubricate journals and lobes with engine oil.
7 - Tightening torque: 6.5 ± 1 kgf x m (47 ± 7 lbf x ft) [64 ± 10 N x m)
8 - Tightening torque: 13.5 ± 0.5 kgf x m (98 ± 4 lbf x ft) [132 ± 5 N x m]

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Assembly



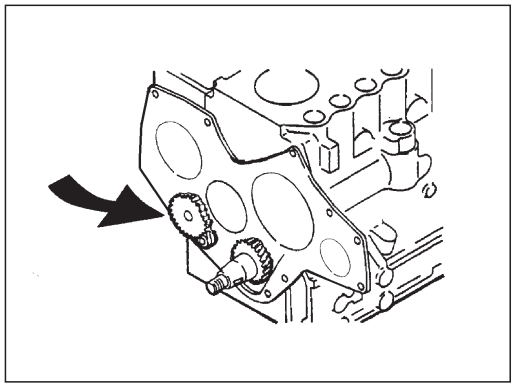
Installing front plate

1. Front plate installation

(1) Scrape the gasket from the cylinder block and front plate.

(2) Coat the gasket contact surface of cylinder block with adhesive and put a new gasket in position, making sure the holes in the gasket are all in alignment with the holes in the cylinder block.

(3) Put the front plate in position. Install four bolts and tighten them.



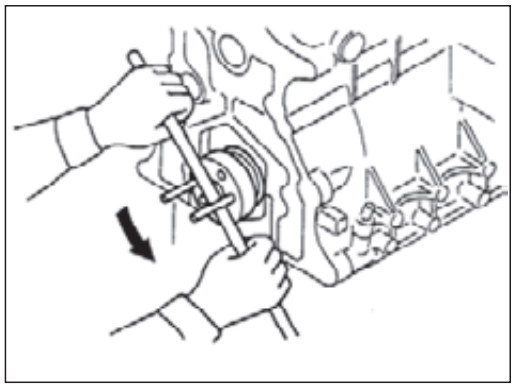
Installing oil pump

2. Oil pump installation

(1) Make sure the packing has been put in position on the oil pump.

(2) Put the oil pump in position on the cylinder block. Install three bolts and tighten them evenly.

(3) Make sure the oil pump gear rotates freely.



Turning engine

3. Engine turning

(1) Install two bolts (M12 x 1.25) in the flywheel bolt holes in the crankshaft.

(2) Put a bar between the bolts and turn the crankshaft to bring No. 1 piston to the top center as shown in the illustration.

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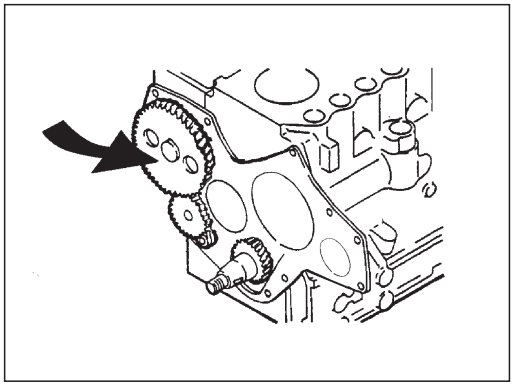
4. Fuel injection pump camshaft installation

(1) Put the camshaft (with bearing and gear) in position in the cylinder block.

(2) Hit the gear with a plastic hammer to fit the bearing in position.

(3) Make sure the camshaft rotates freely.

(4) Tighten the stopper bolt.



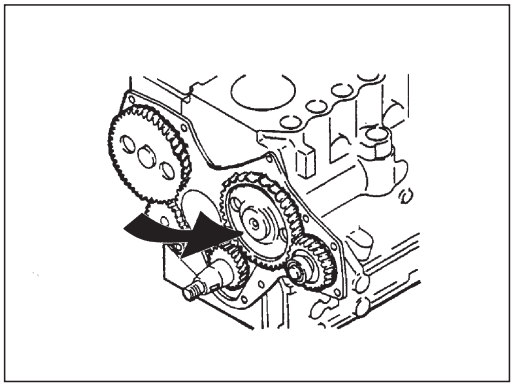
Installing fuel injection pump camshaft

5. Camshaft installation

(1) Lubricate the lobes and journals with engine oil.

(2) Put the camshaft (with gear) in position in the cylinder block.

CAUTION: Do not cause damage to the lobes and journals when the camshaft is installed.



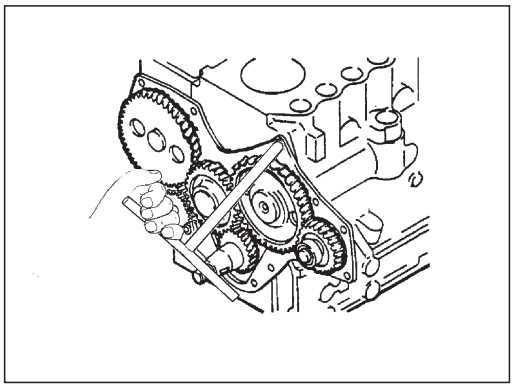
Installing camshaft

A - Lubricate with engine oil.

(3) Tighten the bolts that hold the thrust plate to the specified torque.

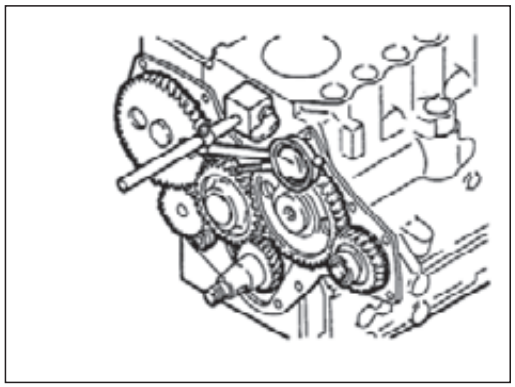
Tightening torque	1.1 ± 0.1 kgf x m (8 ± 0.7 lbf x ft) [10.8 ± 1 N x m]

(4) Make sure the camshaft rotates freely. Check the end play for the camshaft.



Installing thrust plate

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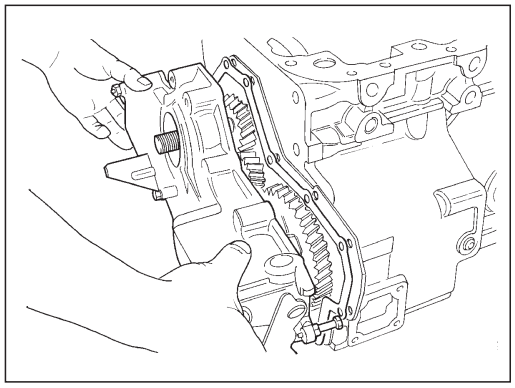
Marks on timing gears

6. Idler gear installation

(1) Lubricate the idler gear with engine oil.

(2) Install the idler, gear in position with its ”3,” ”2” and ”11” marks in alignment with the ”33” mark on the fuel injection pump camshaft gear, the ”22” mark on the camshaft gear and the ”1’ mark on the crankshaft gear respectively.

(3) Check the backlash of the gears. Make reference to ”Timing gear backlash measurement” (page 118).



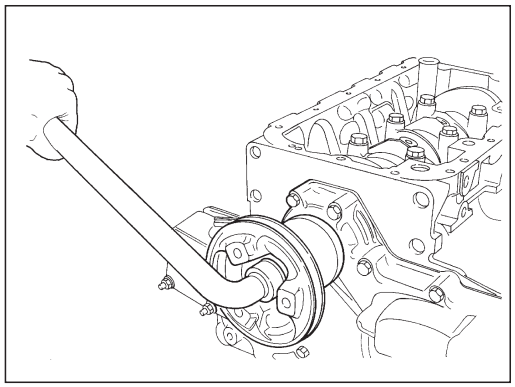
Installing timing gear case

7. Timing gear case installation

(1) Coat the gasket with adhesive and put it in position on the front plate.

(2) Lubricate the oil seal lip with engine oil.

(3) Tighten the bolts that hold the timing gear case.



Tightening crankshaft pulley nut

8. Crankshaft pulley nut tightening

(1) Install two bolts (M12 x 1.25) in the flywheel bolt holes in the crankshaft and hold the crankshaft.

(2) Tighten the crankshaft pulley nut to the specified torque.

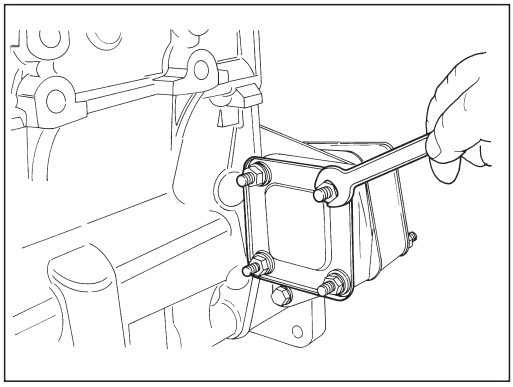
Tightening torque	17.5 ± 2.5 kgf x m (127 ± 18 lbf x ft) [172 ± 25 N x m]

WARNING: Check the strength of the bolts and bar used for holding the crankshaft.

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9. P.T.O gear installation

Install the P.T.O. gear in position in the timing gear case with the side that has no oil hole toward the rear of the engine.

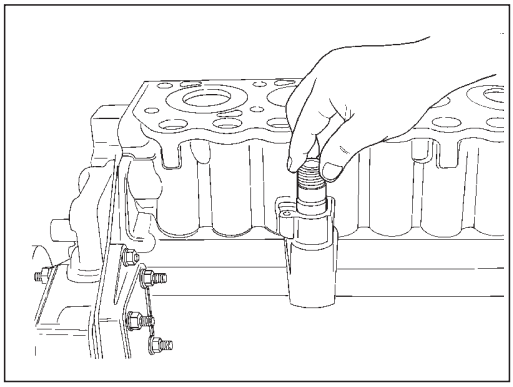


Installing PTO. gear

10. Speedometer driven gear installation

(I) Install the O-ring in the groove in the driven gear sleeve.

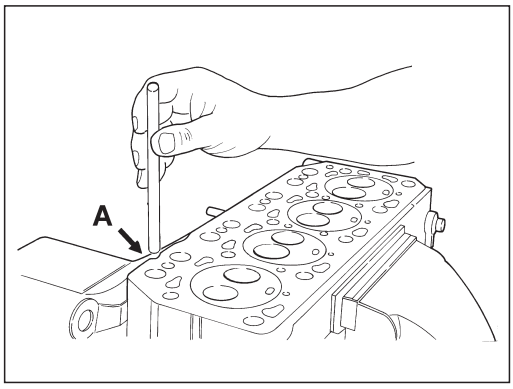
(2) Install the speedometer driven gear in position in the cylinder block while rotating it or the camshaft.



Installing speedometer driven gear

11. Tappet installation

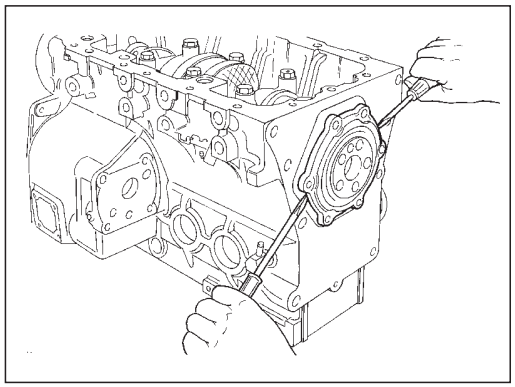
Lubricate the tappets with engine oil and put them in position in the cylinder block.



Installing tappets

A - Lubricate with engine oil

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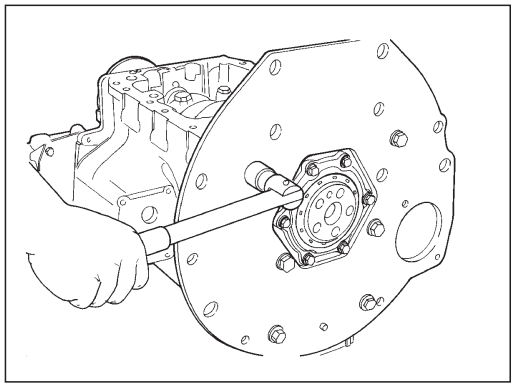


Installing oil seal case

12. Oil seal case installation

(1) Put a new gasket in position on the oil seal case.

(2) Lubricate the oil seal lip with engine oil and install the oil seal in position in the cylinder block.



Installing rear plate

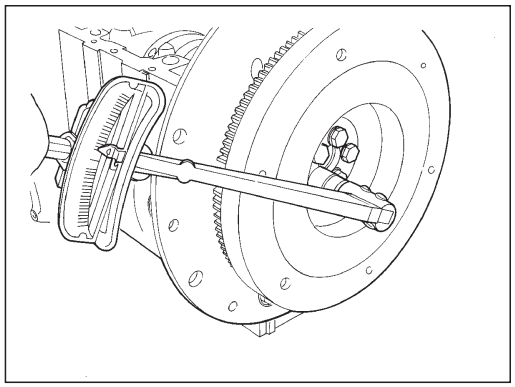
13. Rear plate installation

(1) Put a new gasket in position on the rear plate.

(2) Put the rear plate in position on the cylinder block with its dowel boles in alignment with the dowels. Tighten the bolts that hold the rear plate to the specified torque.

Tightening torque	6.5 ± 1 kgf x m (47 ± 7 lbf x ft) [64 ± 10 N x m]

NOTE: Install the starter to the rear plate before installing the plate to the cylinder block for convenience of rear plate installation.



Safety bar

14. Flywheel installation

(1) Install a safety bar (M12 x 1.25) in the rear end of the crankshaft.

(2) Put the flywheel in position in alignment with the safety bar.

(3) Install three of four bolts in the flywheel and tighten them finger tight only.

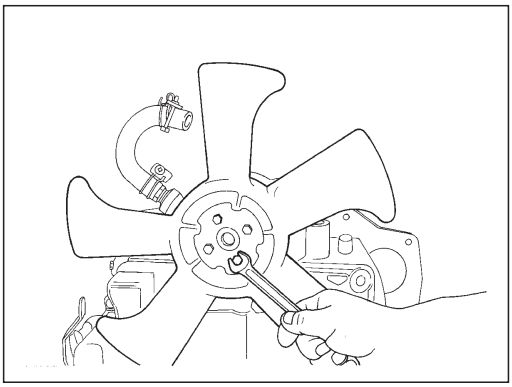
(4) Remove the safety bar. Install the last bolt in the flywheel and tighten it finger tight only.

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(5) Have someone hold the crankshaft pulley with a wrench to prevent the flywheel from rotating.

(6) Tighten the four bolts that hold the flywheel to the specified torque.

Tightening torque	13.5 ± 0.5 kgf x m (98 ± 4 lbf x ft [132 ± 5 N x m]

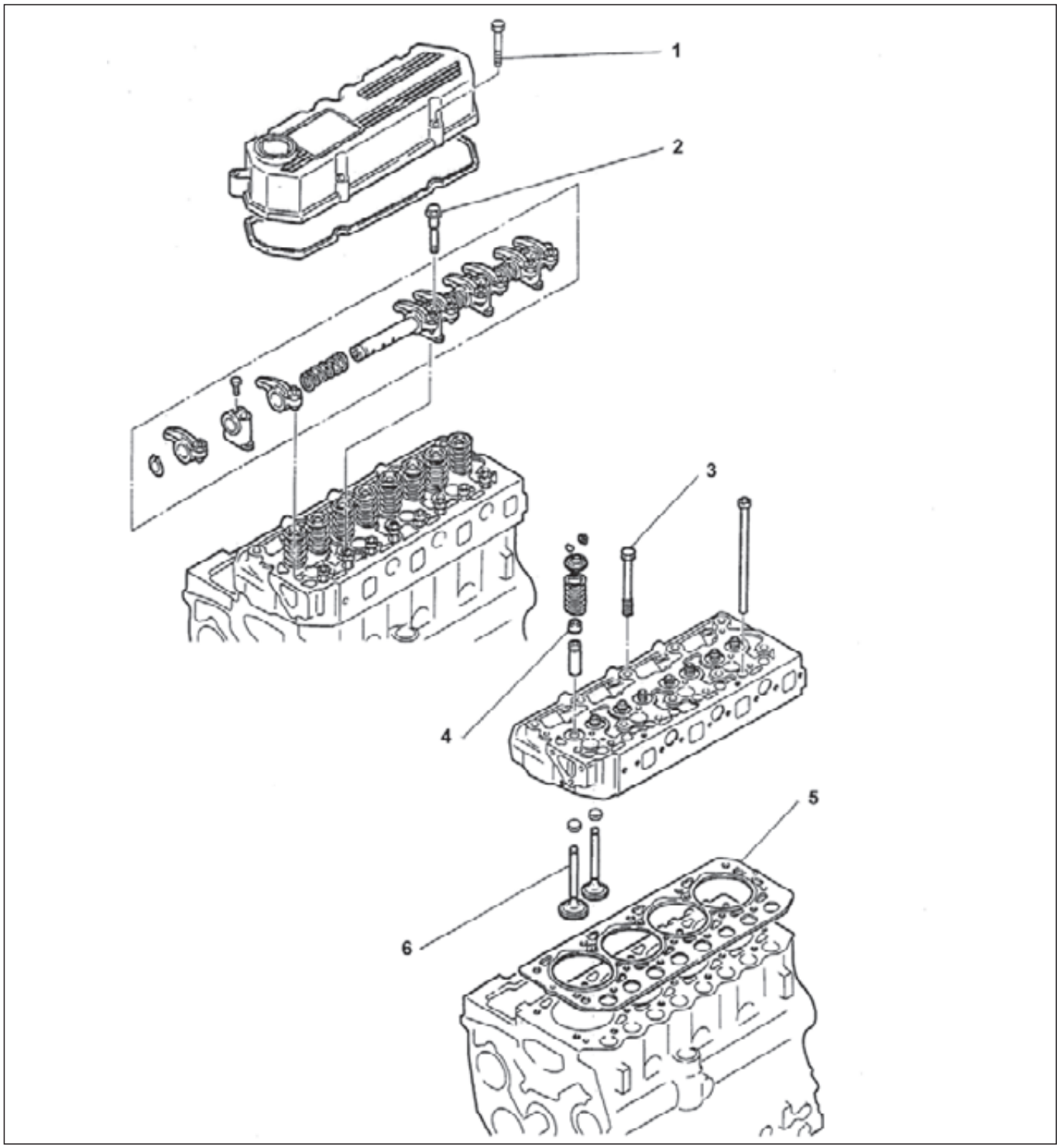


Tightening flywheel bolts

WARNING: Always signal each to prevent possible personal injury

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CYLINDER HEAD AND VALVE MACHANISM



Inspection point

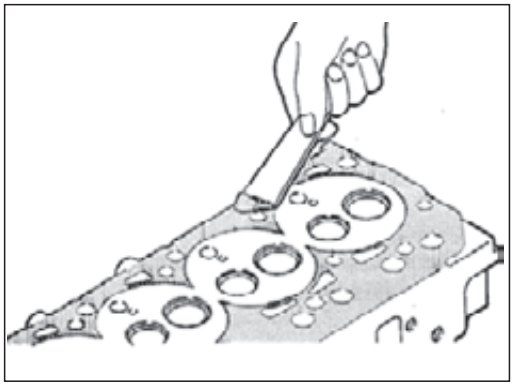
1 - Tightening torque: 1.15 ± 0.15 kgf x m (8.3 ± 1.1 lbf x ft) [11.3 ± 1.5 N x m]
2 - Tightening torque: 1.50 ± 0.50 kgf x m (11 ± 4.0 lbf x ft) [14.7 ± 5.0 N x m]
3 - Tightening torque: 9.50 ± 0.50 kgf x m (65 ± 4 lbf x ft) [88 ± 5 N x m]
4 - Use a new part.
5 - Use a new gasket.
6 - Lubricate stem with engine oil.

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1. Cylinder head bottom face cleaning

Scrape the gasket from the bottom face of the cylinder head.

NOTE: After scraping the gasket, rub off gasket remnants from the face with an oilstone smeared with engine oil and thoroughly clean the face.

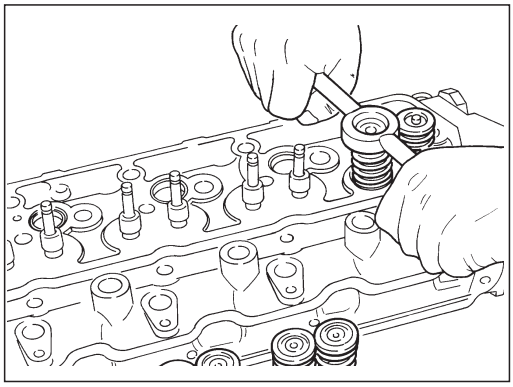


Removing cylinder head gasket

2. Valve stem seal installation

Using Box 12, install the valve stem seal in position in the valve guide. After installation, make sure the seal is in its correct position.

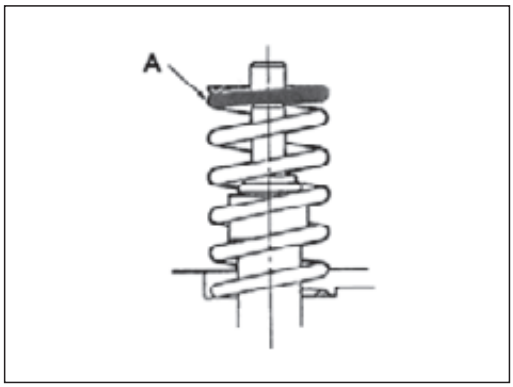
NOTE: Improper stem seal installation can cause a failure to seal against downward flow of oil along the stem.



Installing valve stem seal

3. Valve spring installation

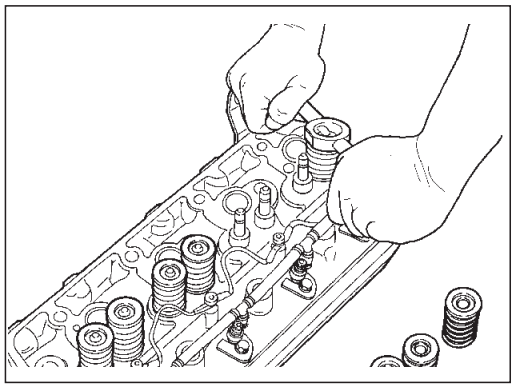
Install the valve spring with the white enameled end up.



Installing valve spring

A - White enameled end

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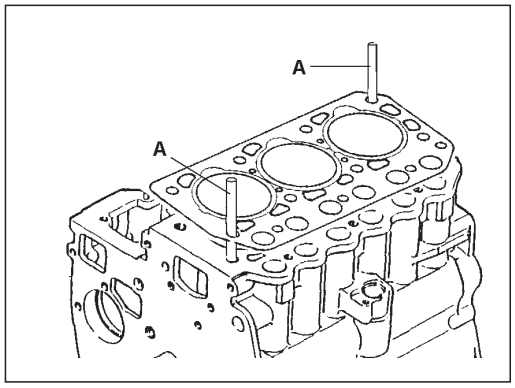


Installing valve block

4 Valve block installation

Put compression on the valve spring with a valve lifter and install the block in position on the valve top.

CAUTION: Do not put excessive compression on the valve spring. This can cause the retainer to hit and damage the stem seal.



Putting cylinder head gasket

A - Guide bolts

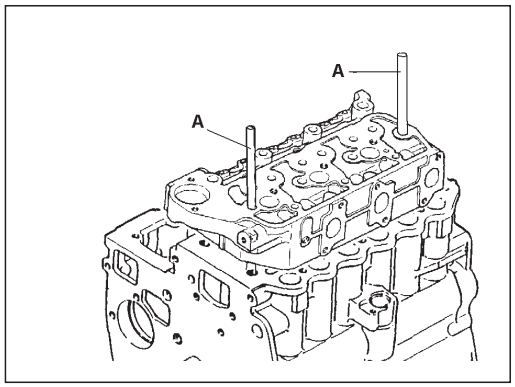
5. Cylinder head gasket installation

(1) Thoroughly clean the top faces of the cylinder block and pistons.

(2) Install two guide bolts (M10 x 1.25) in the bolt holes in the cylinder block.

(3) Put a new cylinder head gasket in position on the cylinder block, making sure the guide bolts are all in alignment with their respective holes in the gasket.

CAUTION: Do not use any gasket adhesive or other substances on the top face of the cylinder block.



Installing cylinder head

A - Guide bolts

6. Cylinder head installation

Put the cylinder head in position on the cylinder block, making sure the guide bolts are all in alignment with their respective bolt holes in the head.

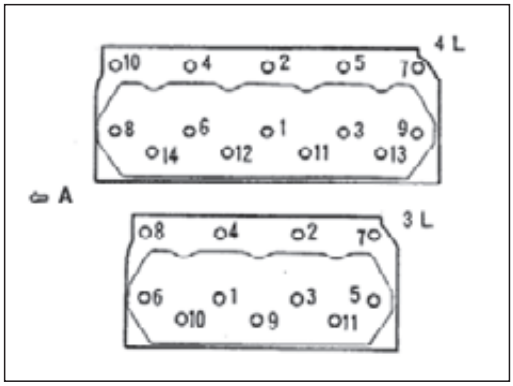
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7. Cylinder head bolt tigheting

(1) Remove the guide bolts and install the bolts that hold the cylinder head to the cylinder block.

(2) Tighten the bolts in number sequence in two or three steps to the specified torque.

Tightening sequence	9 ± 0.5 Kgf x m (65 ± 4 lbf x ft) [88 ± 5 N x m]



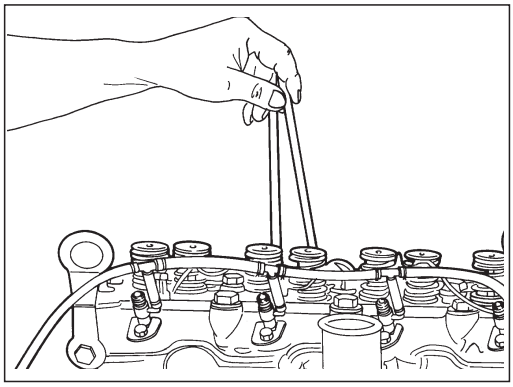
Tightening torque

A - front

8. Valve push rod installation

(1) Put the valve push rod into position through the bore in the cylinder head.

(2) make sure the ball end of the push rod has been put into position over the top of the tappet

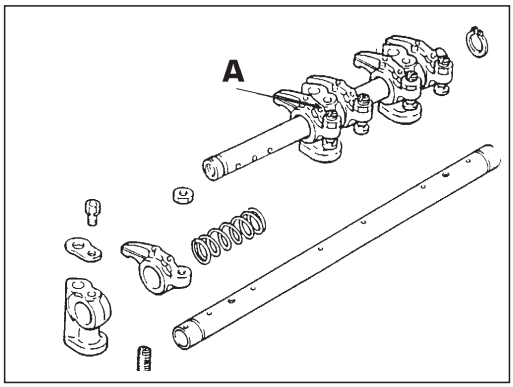


Installing valve push rods

9. Rocker shaft assembling

(1) Install the rocker arms, brackets and springs on the rocker shaft. Secure the brackets to the shaft by tightening the bolts.

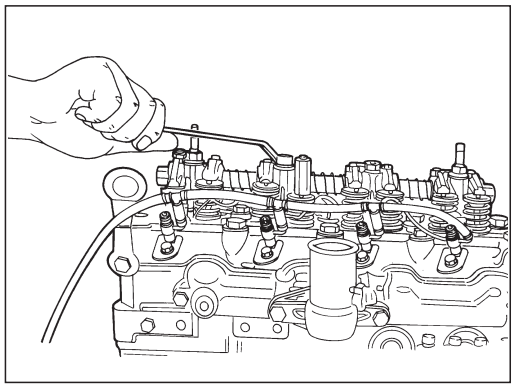
(2) Make sure the rocker arms move freely.



Assembling rocker arms

A - Bolt

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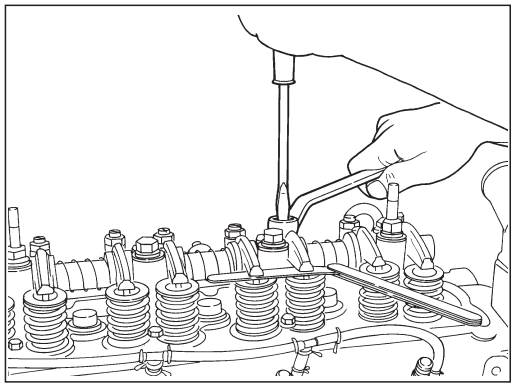
Installing rocker shaft assembly

10. Rocker shaft assembly installation

(1) Install the valve caps in position on the top of the valves.

(2) Put the rocker shaft assembly in position on the cylinder head. Tighten the bolts that hold the rocker shaft assembly to the specified torque.

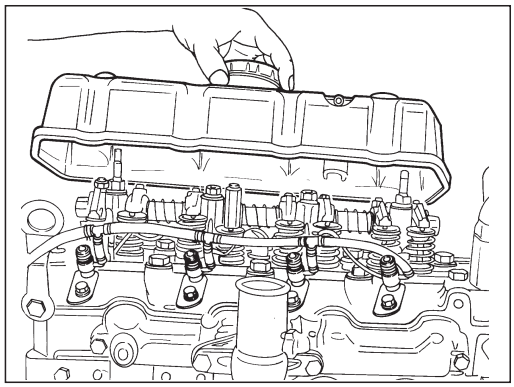
Tightening torque	1.5 ± 0.5 kgf x m (11 ± 4 lbf x ft) [14.7 ± 5 N x m]



Adjusting valve clearance

11. Valve clearance just adjustment

Make reference to ”VALVE CLEARANCE” (page 234).



Installing rocker cover

12. Rocker cover installation

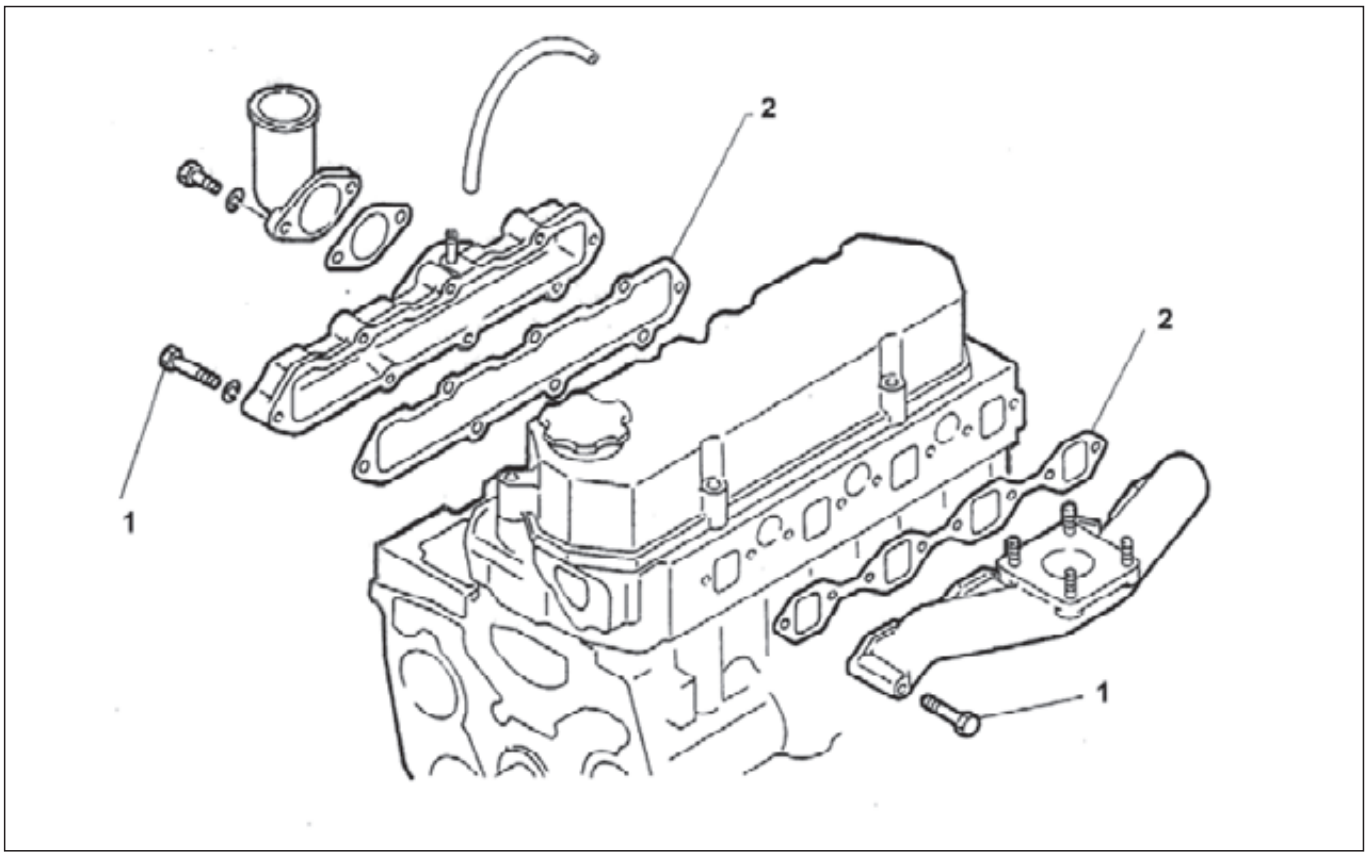
(1) Make sure the gasket is put on the rocker cover.

(2) Tighten the bolts that hold the rocker cover to the specified torque.

Tightening torque	1.15 ± 0.l5 kgf x m (8.3 ± 1.1 lbf x ft) [11.3 ± 1.5 N x m]

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AIR INLET SYSTEM AND EXHAUST SYSTEM



1 - Tightening torque: 1.85 ± 0.35 kgf X m (13.4 ± 2.5 lbf x ft) [18 ± 3.4 N x m]
2 - Use a new gasket

1. Air inlet cover installation

Tighten the bolts that hold the air inlet cover to the specified torque.

Tightening torque	1.85 + 0.35 kgf x m (13.4 ± 2.5 lbf x ft) [18 ± 3.4 N x m]

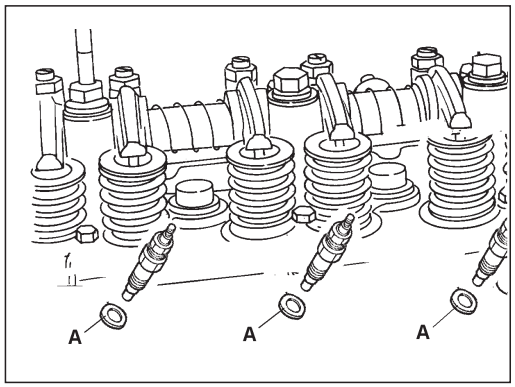
2. Exhaust manifold installation

Tighten the bolts that hold the exhaust manifold to the specified torque.

Tightening torque	1.85 + 0.35 kgf x m (13.4 ± 2.5 lbf x ft) [18 ± 3.4 N x m]

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FUEL SYSTEM



Installing fuel injection nozzle

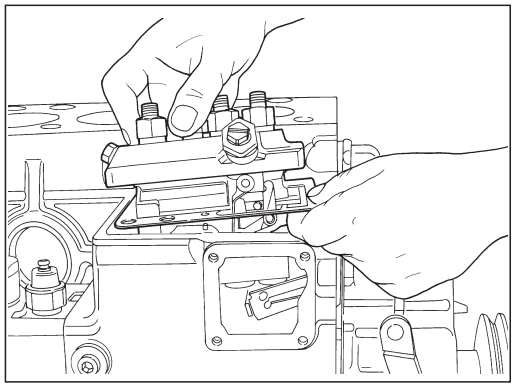
A - Gasket

1. Fuel injection nozzle installation

(1) Put the gasket on the nozzle.

(2) Put the nozzle assembly in position in the cylinder head and tighten it to the specified torque.

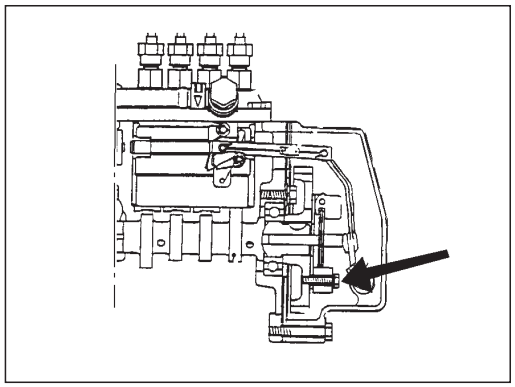
Tightening torque	5.5 ± 0.5 kgf x m (40 ± 4 lbf x ft) [54 ± 5 N x m]



Installing fuel injection pump

2. Fuel injection pump installation

Put the pump in position on the cylinder block and tighten the bolts that hold the pump to the specified torque.



Installing flyweight assembly

3. Flyweight assembly installation

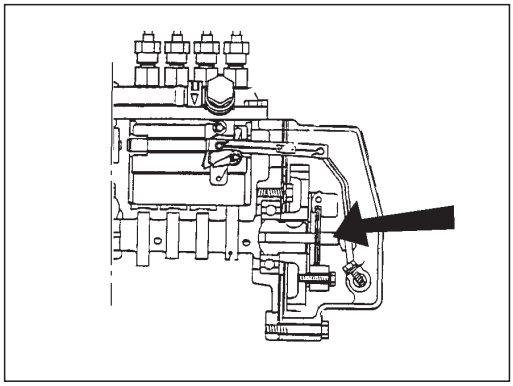
Put the flyweight assembly in position on the rear end of the fuel injection pump camshaft and tighten the sliding sleeve shaft to the specified torque.

Tightening torque	3.6 ± 0.6 kgf x m (26 ± 4.3 lbf x ft) [35 ± 6 N x m]

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4. Sliding sleeve installation

Install the sliding sleeve on the sliding sleeve shaft and make sure the sleeve moves freely,



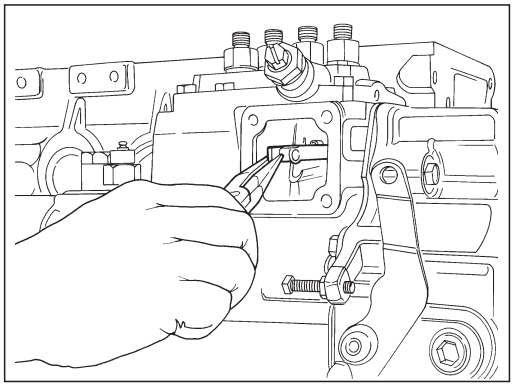
Installing sliding sleeve

5. Governor assembly installation

(1) Install the governor assembly in position while putting the tie rod and spring into position in the injection pump.

(2) Install the tie rod to the pin of the control rack and secure it with the tie rod spring.

(3) Install the tie rod cover in position.

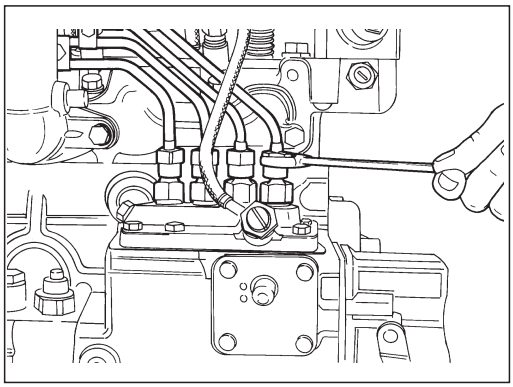


Installing governor assembly

6. Fuel injection line installation

(1) Put the fuel leak-off line in position and connect it to the fuel injection nozzles.

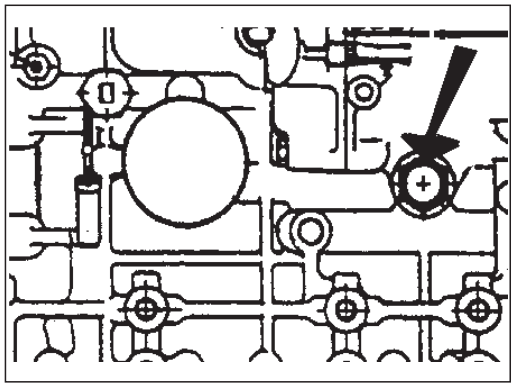
(2) Put the fuel injection lines in position and connect them to the fuel injection pump. Install the clamps.



Installing fuel injection lines

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LUBRICATION SYSTEM

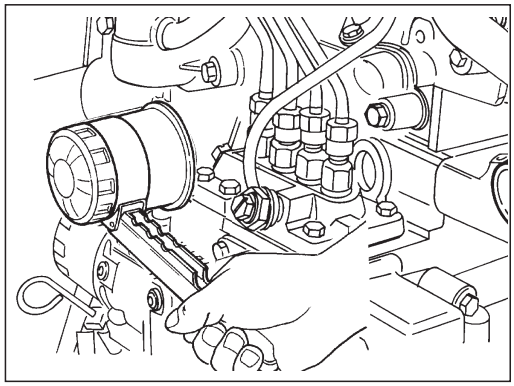


Installing pressure relief valve

1. Pressure relief valve installation

Put the relief valve in position on the cylinder block and tighten it to the specified torque.

Tightening torque	5 ± 0.5 kgf x m (36 ± 4 lbf x ft) [49 ± 5 N x m]

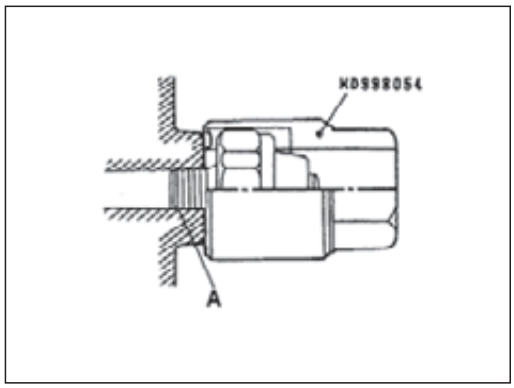


Installing oil filter

2. Oil filter installation

(1) Lightly lubricate the gasket with engine oil.

(2) Install the new filter element by hand. When the gasket contacts the base, tighten one turn more.



Installing oil pressure switch

A - To be coated with thread sealant

3. Oil pressure switch installation

Coat the threads of the switch with thread sealant (Three Bond 1192). Use Gil Pressure Switch Socket Wrench (MD998054) (special too1) to install the oil pressure switch.

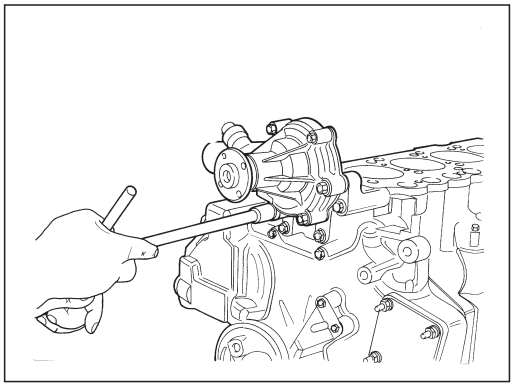
CAUTION:
a) Put the sealant on the threads only.
b) Bo not over-tighten the oil pressure switch when it is installed.

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COOLING SYSTEM

1.Water pump installation

Put a new gasket in position on the water pump flange. Install the water pump in position on the cylinder block.

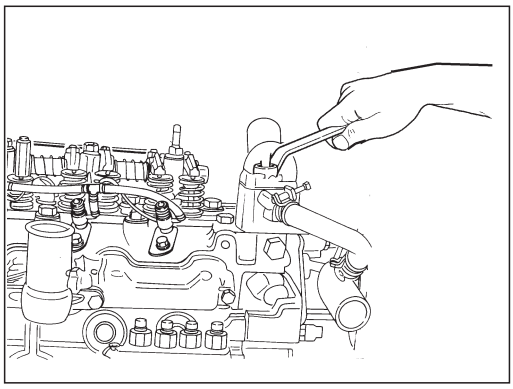


Installing water pump

2. Thermostat installation

(1) Put the thermostat in the thermostat case.

(2) Put a new gasket in position on the thermostat case. Install the thermostat assembly in position on the cylinder head.

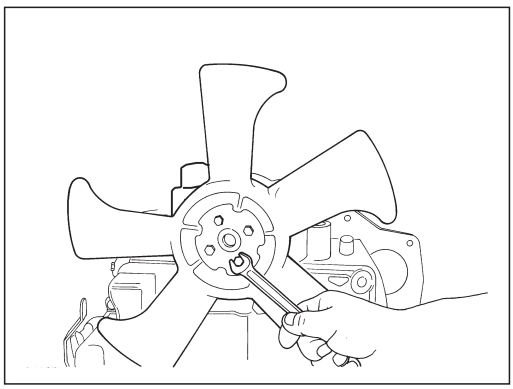


Installing thermostat

3. Cooling fan installation

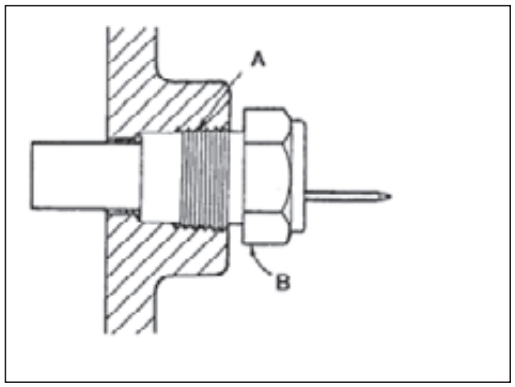
(1) Install the spacers in position in the fan as shown.

(2) Install the pulley in position on the water pump. Install the fan and spacer combination in position on the pulley.



Installing cooling fan

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Installing thermoswitch and thermounit combination

A - To be coated with thread sealant (Three Bond 1104)
B - Tightening torque: 2.3 ± 0.4 kgf x m (16.6 ± 3 lbf x ft) [22.6 ± 4 N x m)

4. Thermoswitch and thermounit combination installation

Coat the threads of the combination with Three Bond 1104. Put the combination in position and tighten it to the specified torque.

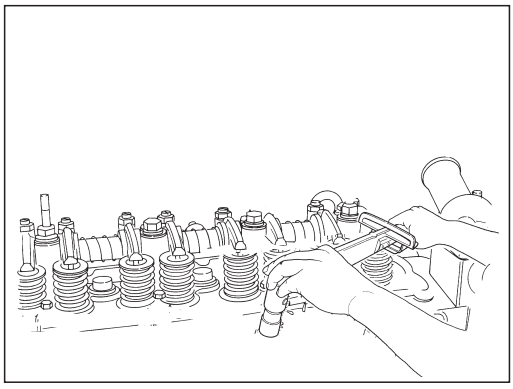
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ELECTRICAL SYSTEM

1. Glow plug installation

Install the glow plug in position in the precombustion chamber and tighten it to the specified torque.

Tightening torque	1.75 ± 0.25 kgf x m (12.7 ± 1.8 lbf x ft) [17.2 ± 2.5 N x m]



Installing glow plugs

2. Alternator installation

(1) Put the alternator in position. Install the adjusting plate bolt in position to hold the alternator in position.

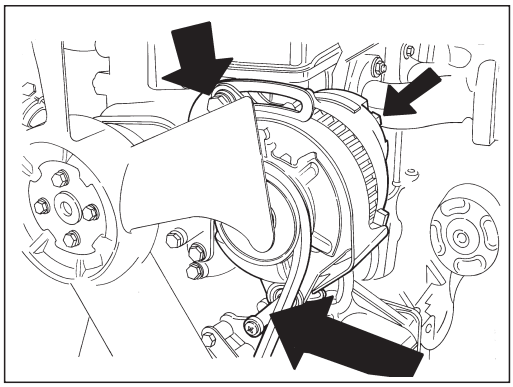
(2) Put the belt in position on the pulley. Move the alternator away from the engine to make an adjustment to the belt.

(3) Tighten the bolts.

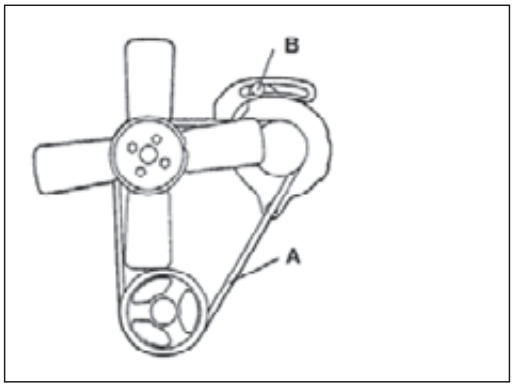
(4) Make sure the deflection (tension) of the belt is correct.

Unit: mm (in.)

Deflection under 10 kgf (22 lbf) [98 N] force	10 to 12 (0.4 to 0.5)



Installing alternator



Adjusting alternator and fan belt

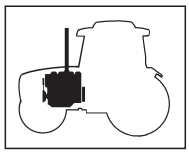
A - Apply 10 kgf (22 1bf) [98 N] force midway between crankshaft pulley and alternator pulley.

B - Adjusting plate bolt.

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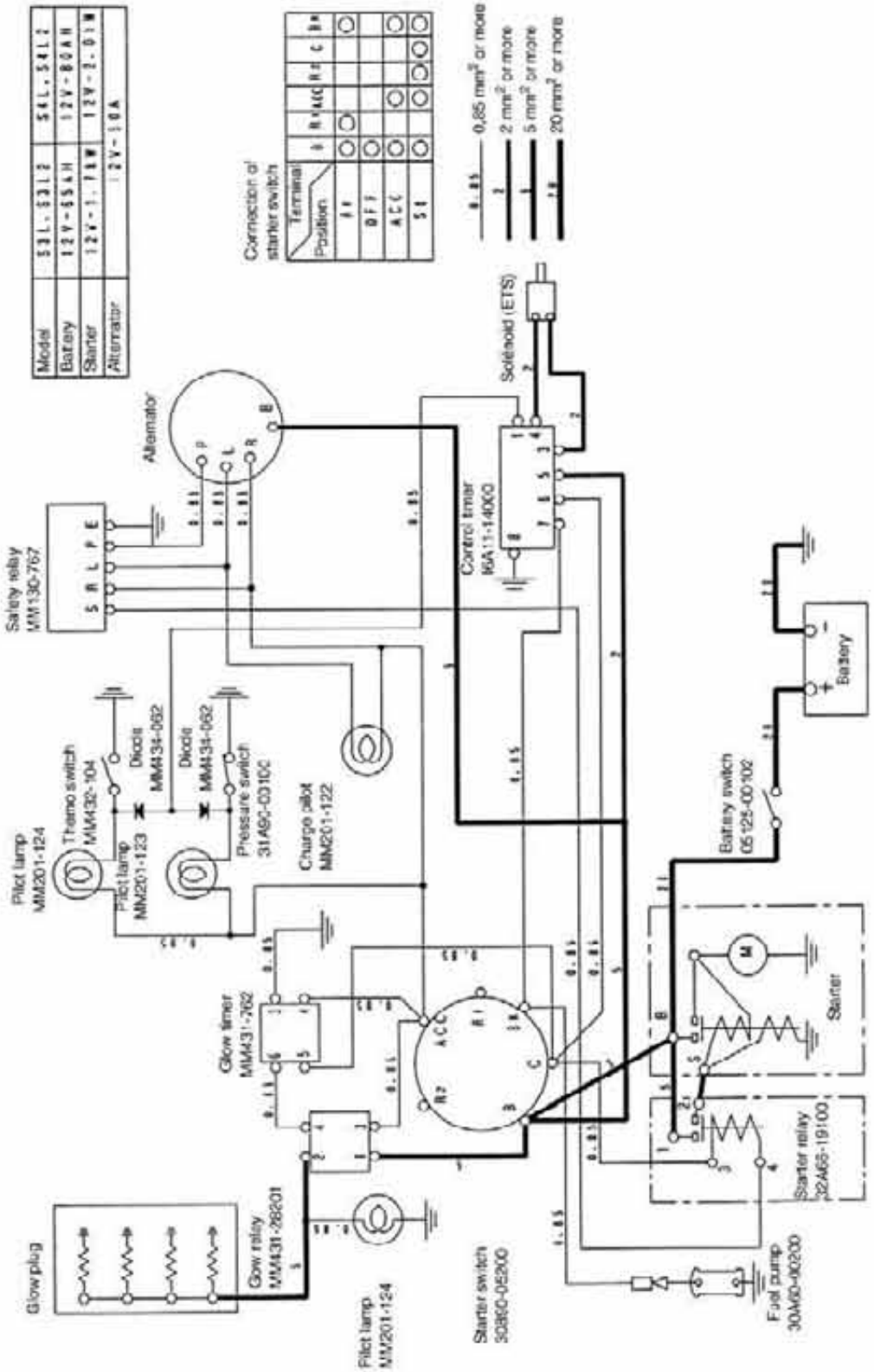
GENERAL

1. Specifications (standard)

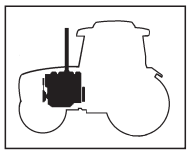
Engine model		S3L / S3L2	S4L / S4L2
Starter	Model	M2T50381	M2T56272
	Type	DC solenoid shifted (with reduction gear)	
	Nominal output, V - kW	12 - 1.6	12 - 2.0
Alternator	Model	A7T02071	
	Regulator, type	IC	
	Nominal output, V - A	12 - 50	
Glow plug	Model	008816 - 4C	
	Type	Sheathed	
	Rated voltage, V	10.5	
	Current draw, A	9.7 ± 1.0 (30 seconds at rated voltage)	
Glow plug relay	Model	G71SP	
	Rated voltage, V	DC 12	
	Continuous rating	1 minute	
	Resistance in coil, Ω	13	
Control timer unit	Model	YM - 1C	
	Input voltage range, V	DC 9 to 15	
	Load	Solenoid (resistance in coil: 1.7 Ω minimum)	
Key shut down solenoid	Model	YMS - 1	
	Type	Solenoid	
	Resistance in coil, Ω	1.8 ± 10% at 20 °C (68 °F)	
	Stroke, mm (in.)	3.5 ± 0.5 (0.53 ± 0.02)	
	Operating voltage, V	DC 10 to 15	
Glow controller	Model	QGS	
	Rated voltage, V	DC 12	
	Operating voltage range, V	7 to 15	
	Operating temperature range, °C (°F)	- 30 to +70 (- 22 to 158)	
	Storage temperature range, °C (°F)	- 40 to +80 (- 70 to 176)	
	Pre-glow time, second	6.2 ± 0.7	

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2. Schematic



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Schematic

(1) Figure indicates a nominal size of automotive low-tension line (JIS C 3406).

(2) This schematic shows the electrical system of the standard engine equipped with a key shut down solenoid and glow plugs.

Remarks:

(1) The components and circuits vary according to the specification and application of the engine.

(2) When installing a battery, do not reverse the terminal connections. This engine has the negative terminal grounded

(3) Don neither disconnect any corrector nor turn off the staring switch when the engine is running

(4) Cord size varies with length of cord

(5) Diode A prevents reverse current from L terminal to G cord of the control timer when the starting switch is turned off. (This diode is not necessary if the circuit between BR and ACC terminals is opened when the starting switch is turned off.)

(6) Diode B prevents oil pressure lamp and water temperature lamp from lighting simultaneously. (This diode is not necessary when these lamps have to light simultaneously.)

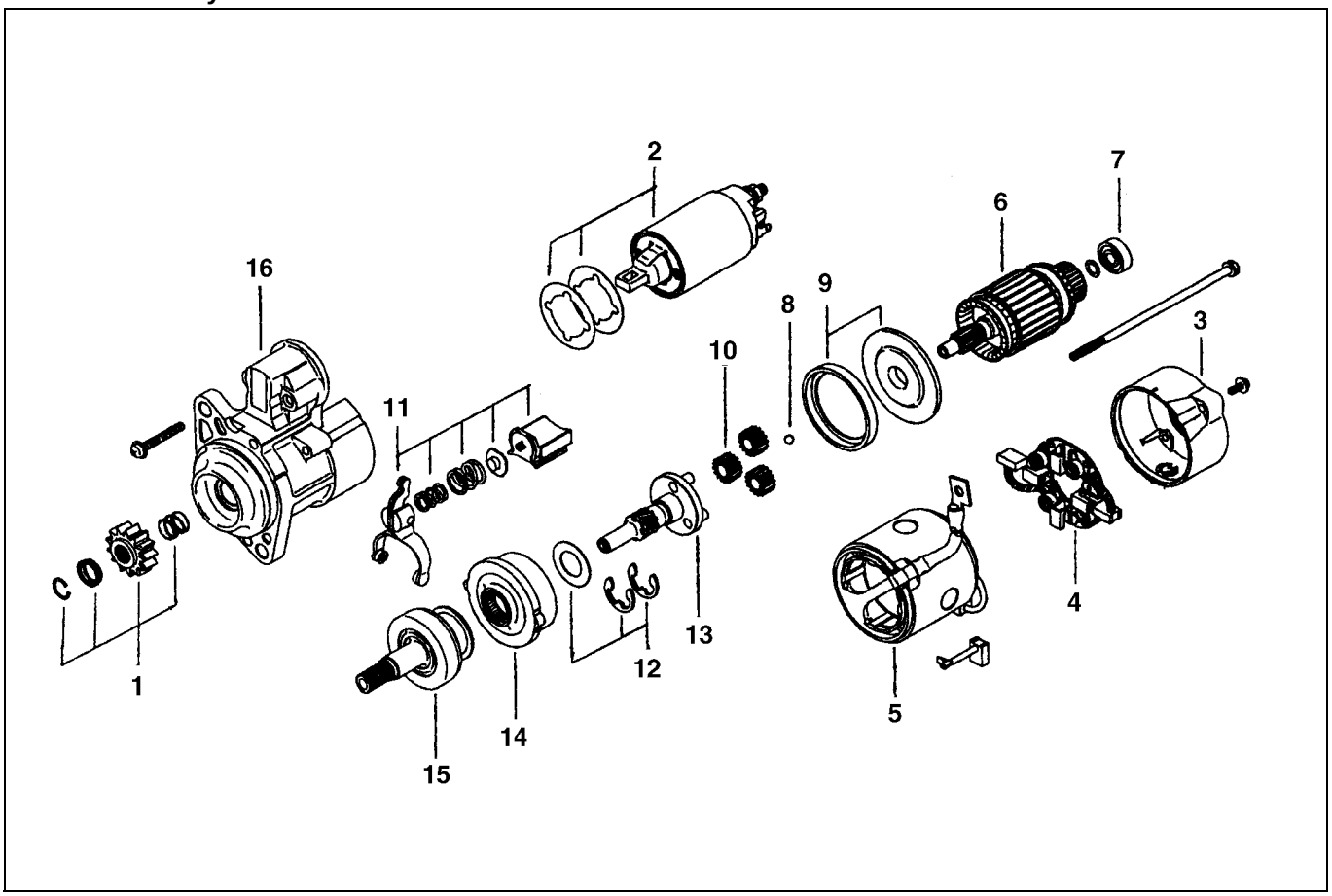
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STARTER MOTOR

1. Disassembly



Disassembly sequence

1 - Pinion assembly
2 - Field magnet
3 - Support bracket
4 - Brush gear
5 - Yoke
6 - Armature
7 - Bearing
8 - Ball
9 - Seal housing
10 - Gear
11 - Lever assembly
12 - Gasket kit
13 - Gear carrier shaft
14 - Internal gear
15 - Overrunning clutch
16 - Front support bracket

PRECAUTION: the pinion must be removed prior to removing or renewing the bracket (16), the gears (10) and the overrunning clutch (15).

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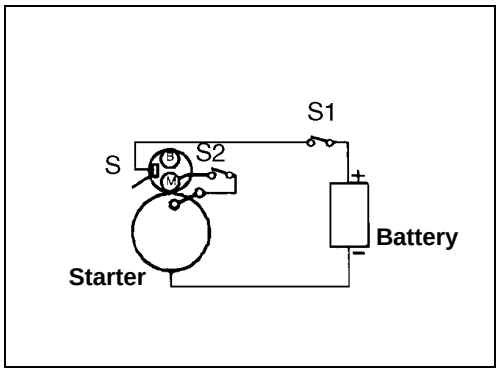
Disassembly procedure

(1) Pinion

It is possible to remove the pinion when in the forward position as a result of excitation of the field magnet.

Disconnect the connector of the M terminal and create a circuit that connects the starter motor and the battery as illustrated in the figure. Close the switches S1 and S2 so that the pinion is moved forward and rotates. Then open the solenoid switch S2. The pinion will stop rotating but remain in the forward position. Apply a pipe-shaped tool to the pinion stop and tap it gently with a mallet to remove the pinion.

If, when tapped, the pinion returns to its back position before the stop is detached, repeat the operation from the beginning.



(2) Ball

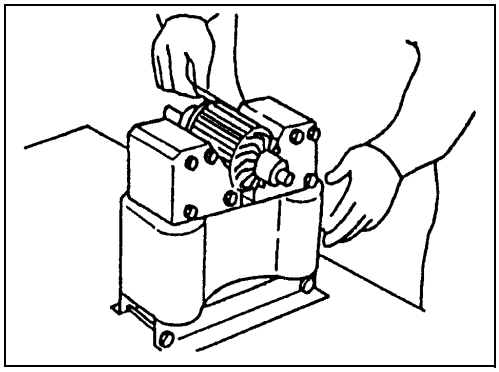
The ball at the end of the armature serves as a thrust bearing. When the armature is removed, the ball may remain attached to the end by grease. Be careful not to lose it.

Control

(1) Armature

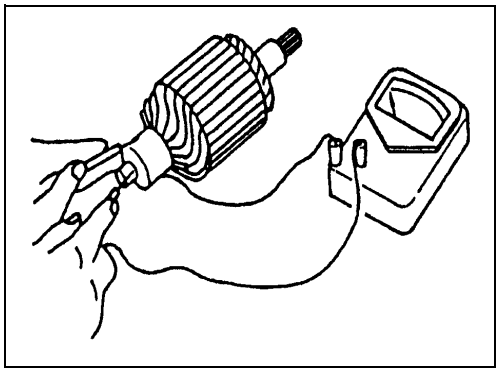
1. Coil shortcircuit test

Position the armature on shortcircuit tester (growler). Hold an iron bar parallel to the armature and slowly turn the latter by hand. If the iron bar vibrates or is attracted towards the armature, this means the armature coil is short circuiting and must be replaced.



2. Coil earth test

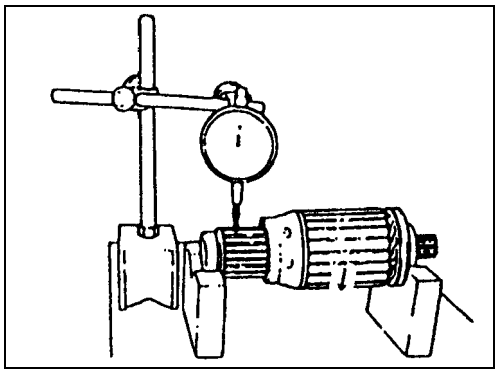
Test for continuity between the commutator and the shaft (or core). If there is continuity, this means that the coil is connected to earth and the armature must be replaced.



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3. Commutator test

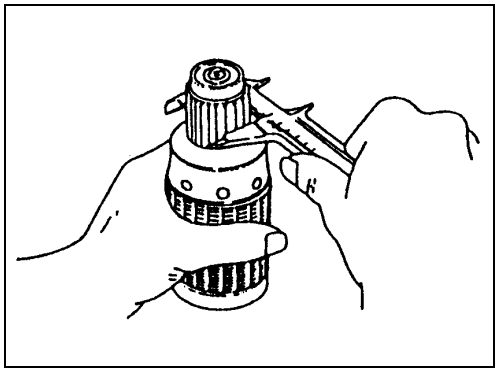
1) Measure the commutator run-out using a dial gauge. If the run-out exceeds the indicated tolerance limit, lightly skim the commutator on a lathe so that the outside diameter is within the specifications. If the surface of the commutator is rough or has "steps" worn into it, smooth using fine grade glasspaper (# 300 – 500).



Unit: mm (in.)

	Limit
Commutator run-out	0.1 (0.004)

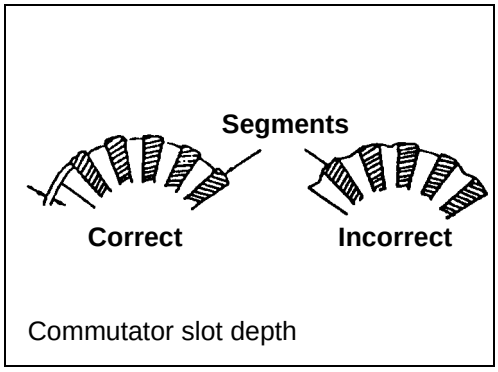
2) Measure the outside diameter of the commutator.
If the diameter is not within the prescribed tolerance limits, replace the armature.



Unit: mm (in.)

	Normal value	Limit
Commutator outside diameter	32.0 (1.26)	31.4 (1.24)

3) Measure the depth of the slots between the commutator segments. If the depth is less than the specified tolerance limit, recut the slots to a depth of 0.4 – 0.6 mm. (0.016-0.024 inches).



Commutator slot depth

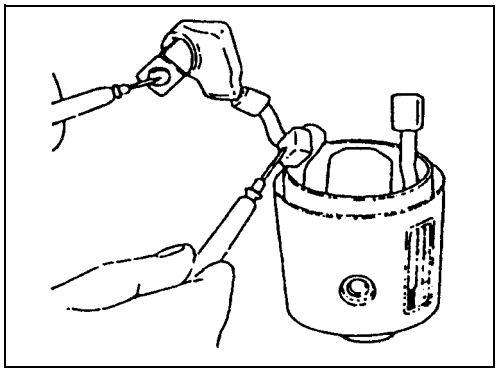
Unit: mm (in.)

	Limit
Commutator run-out	0.1 (0.004)

(2) Field coil

1. Field coil interruption test

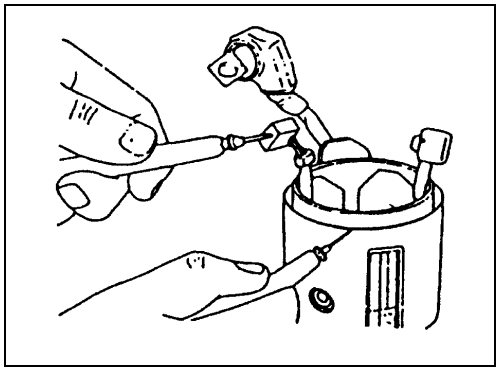
Test for continuity between the terminal conductor and each of the brushes. If there is no continuity, this means the field coil circuit is interrupted. In this case the yoke must be replaced.



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2. Coil earth test

Test for continuity between the yoke and each of the brushes. If there is continuity, this means the coil is connected to earth and must be checked to see if the insulation is defective. Replace the yoke assembly if it cannot be repaired.



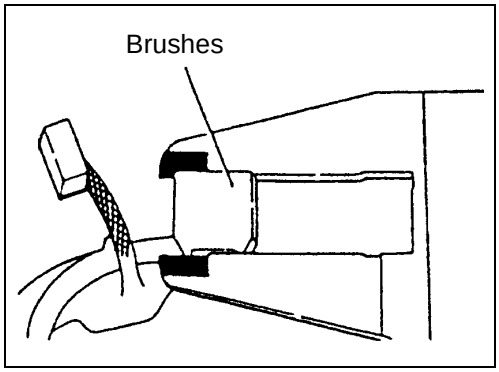
(3) Brushes and brush gear

1. Brush wear

Measure the length of the brushes. If the length is below the specified tolerance limit, renew the brush. If the brush is worn unevenly or has rough contact face, repair using fine grade glasspaper (#300-500).

Unit: mm (in.)

	Normal value	Limit
Brush length	18 (0.71)	11 (0.43)

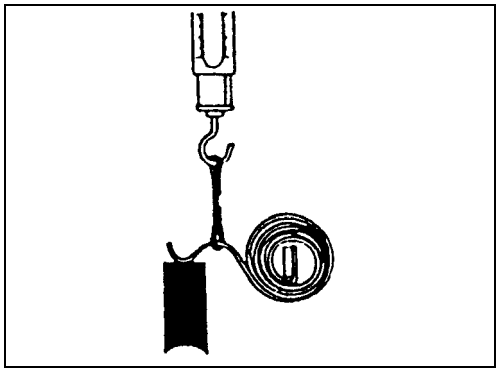


2. Brush spring force

Whenever a new brush is fitted, it is necessary to test the force of the spring. Pull the spring brush with a strain gauge and read the load value at the point where the spring becomes detached from the brush. Renew the spring if the force is less than the specified limit.

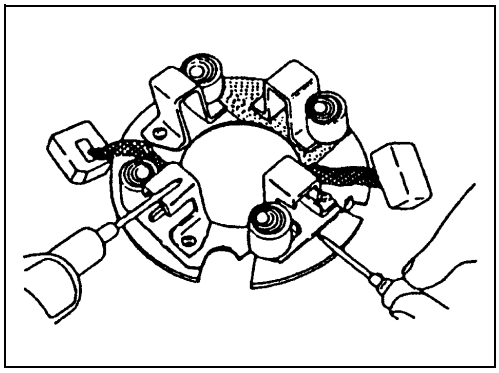
Unit: N (lbf.)

	Normal value	Limit
Brush spring force	26.7–36.1 (60.–8.3)	14.7 (3.3)

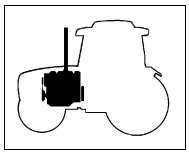


3. Brush gear insulation test

Test for continuity between the brush holder (+) and the brush-holder mounting plate (–). If there is continuity, renew the brush holder gear.

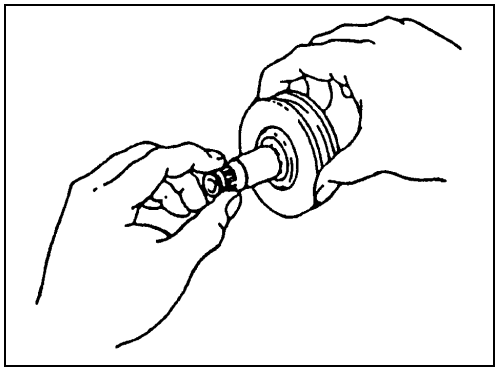


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(4) Overrunning clutch

Check that the pinion shaft runs smoothly when turned clockwise (normal direction of rotation) and that it locks up when turned anti-clockwise. If the pinion shaft does not function correctly, renew the overrunning clutch.



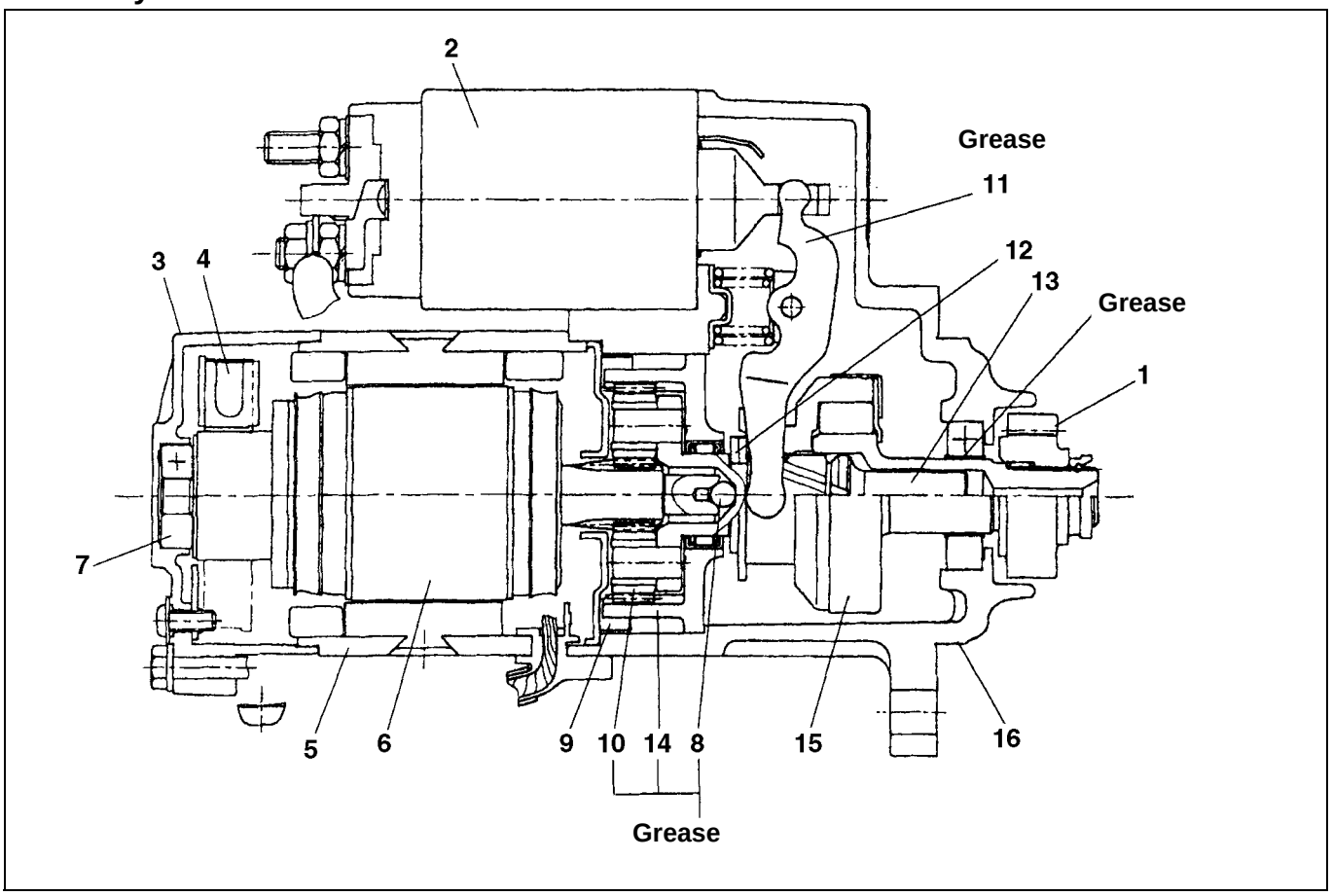
(5) Gear carrier shaft end float

It is not necessary to adjust the end float of the gear carrier shaft.

(6) Armature end float

It is not necessary to adjust the end float of the armature.

Assembly

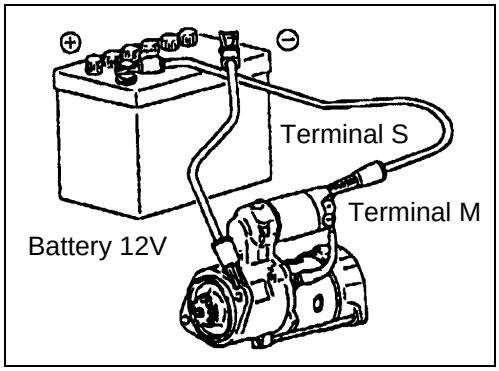


Assembly sequence:
16 –> 12 –> 13 –> 14 –> 15 –> 1 –> 10 –> 11 –> 9 –> 8 –> 5 –> 6 –> 7 –> 4 –> 3 –> 2

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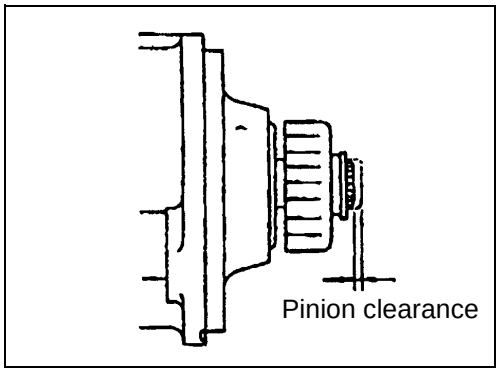
Post-assembly tests and checks

After assembling the starter motor, carry out the following tests and checks:



(1) Checking and adjustment of the pinion clearance

1. Connect the starter motor to the battery as shown in the figure. The pinion will move outwards and rotate slowly. Then remove the connector of terminal M to stop the starter motor.
2. Gently push the pinion shaft towards the armature and measure the axial movement (pinion clearance).
3. If the pinion clearance is not within the prescribed tolerance limits of 0.5-2.0 mm (0.02 – 0.08 in.), adjust by increasing or decreasing the number of gaskets on the field magnet (adding gaskets reduces the pinion clearance). It may be necessary to renew the lever in order to obtain the correct pinion clearance.



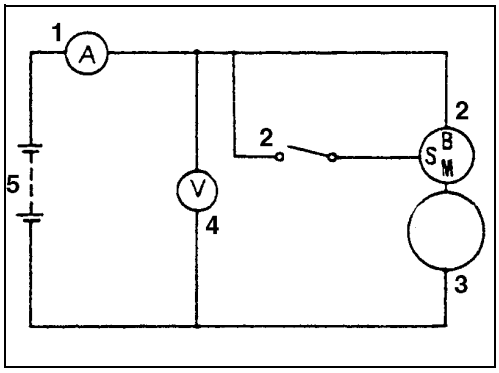
Unit: mm (in.)

	Limit
Pinion clearance	0.5–2.0 (0.02–0.08)

NOTE: do not excite the field magnet for more than 10 seconds to avoid overheating.

(2) No-load test

When the pinion clearance has been correctly adjusted, connect an ammeter and a voltmeter between the starter motor and the battery as shown in the figure, then check the no-load characteristics of the starter motor.



1. Ammeter
2. Solenoid switch
3. Starter motor
4. Voltmeter
5. Battery

PRECAUTION Use the thickest possible cables. Tighten all the terminals securely.

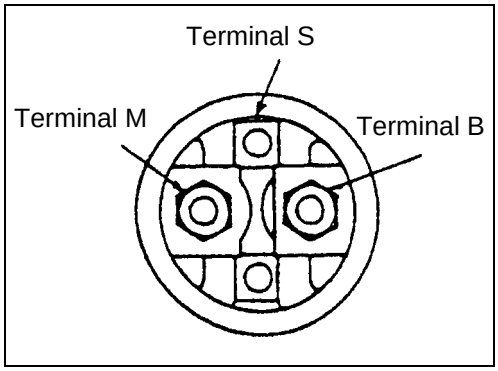
	Voltage (V)	Current (A)	Speed (min^{-1})
No-load characteristics	11	130 maximum	3600 minimum

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(3) Field magnet

Carry out the following continuity tests. If the field magnet does not pass any of these tests, it should be replaced.

1. Check for interruptions in the coil circuit
   There should be continuity between terminals S and M and between terminal S and earth (casing).
2. Check for poor contacts
   There should be not be continuity between terminals B and M.



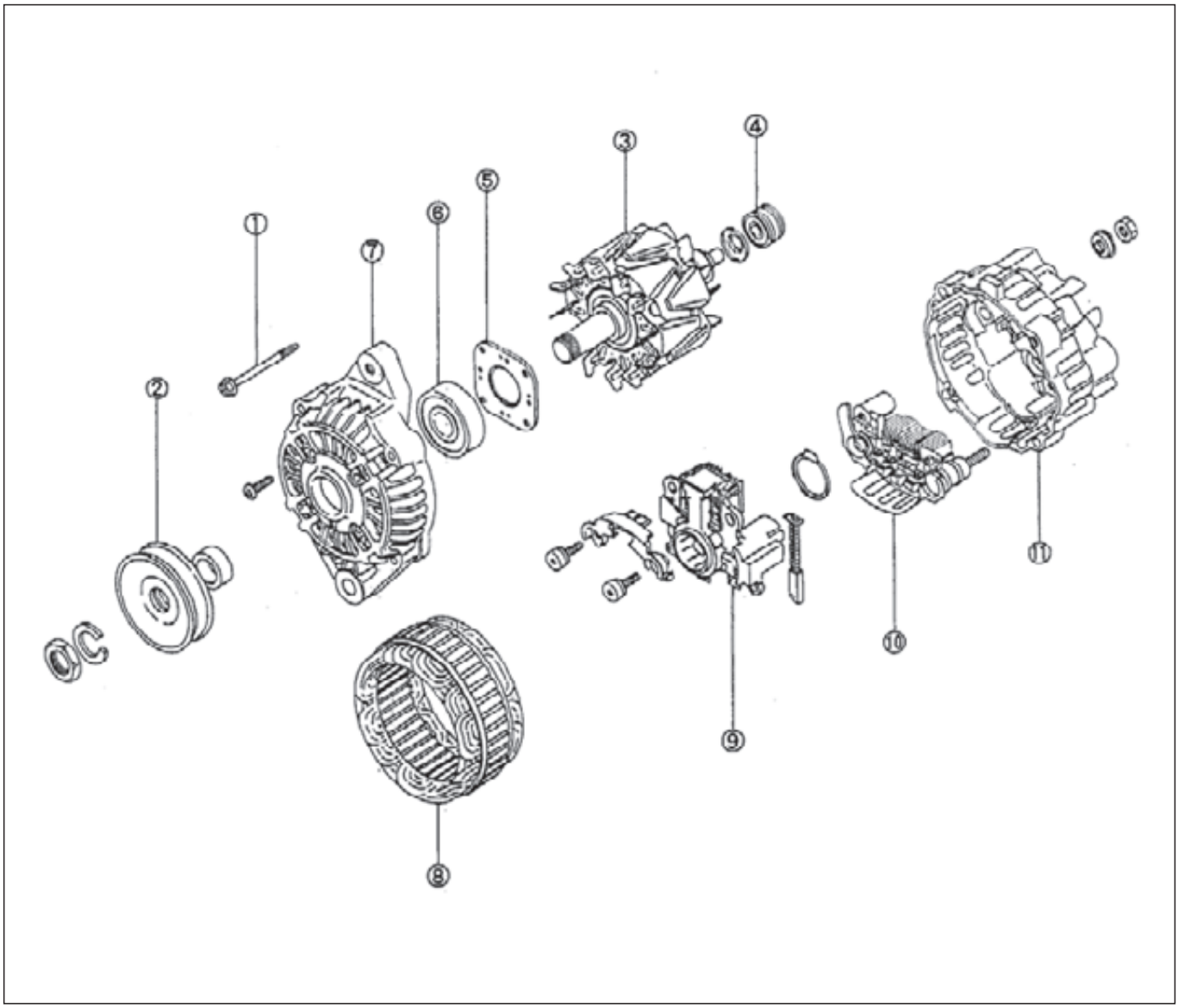
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ALTERNATOR

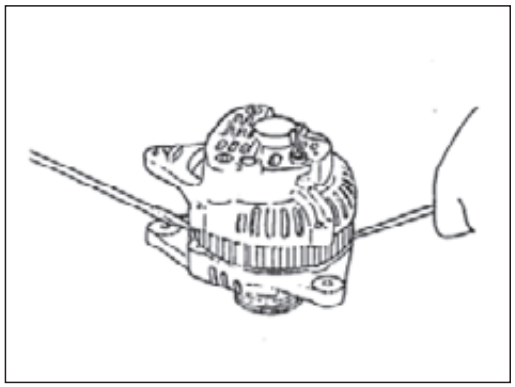
1. Disassembly



Disassembly sequence

1 - Through bolt
2 - Pulley
3 - Rotor
4 - Rear bearing
5 - Bearing retainer
6 - Front bearing
7 - Front bracket
8 - Stator core
9 - Brush holder
10 - Rectifier
11 - Rear bracket

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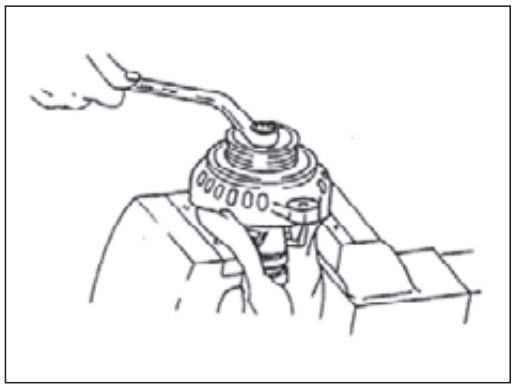
Disassembling alternator

Disassembly procedurere

(1) Stator core separation from front bracket

(A) Pry the stator core off the front bracket with a screwdriver as shown in the illustration.

CAUTION: Be careful not to insert the screwdriver too deep. Damage to the stator core can be the result.

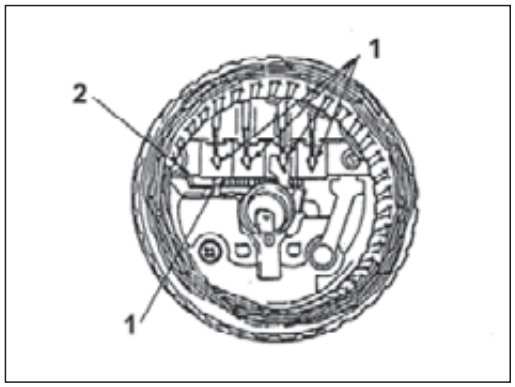


Removing pulley

(2) Pulley removal

(a) Hold the rotor assembly in a vise by using thick cloth as shown in the illustration. Remove the nut that holds the pulley in position, and remove the pulley and spacer.

(b) Remove the rotor assembly from the front bracket.



Removing stator core

1 - Unsolder
2 - Rectifier

(3) Stator core and rectifier removal

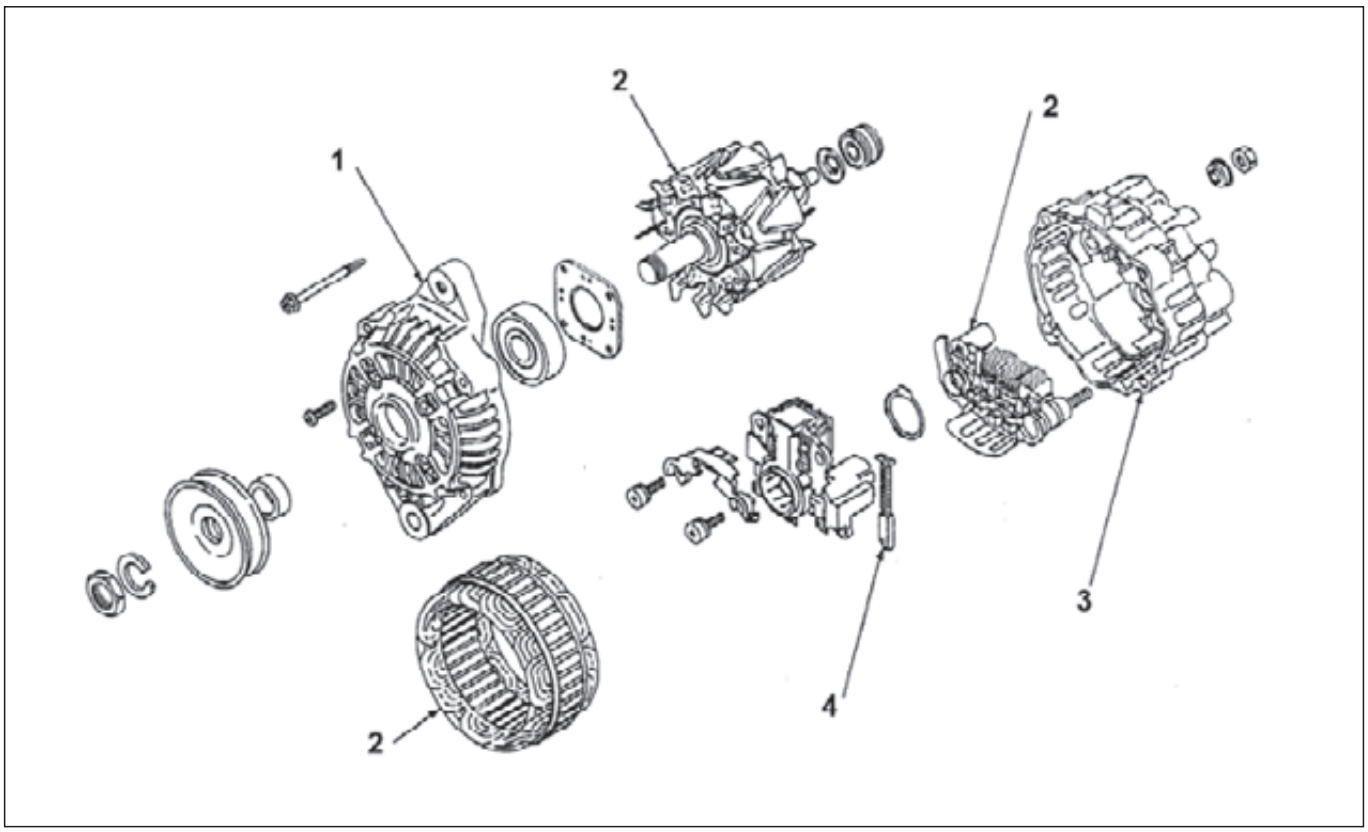
(a) Unsolder the leads from the rectifier and remove the stator core from the rectifier.

Unsolder the leads as quickly as possible to prevent damage to the diodes in the rectifier.

b) Remove the screws that hold the rectifier in position and remove the rectifier.

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2. Inspection



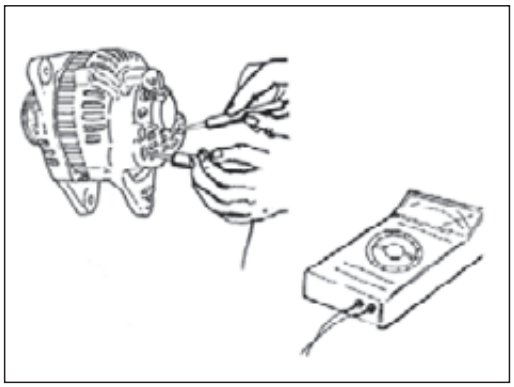
Inspection points

1 - Check for cracks or other defects.
2 - Test for open or short circuit using the procedure that follows.
3 - Check for cracks or other defects.
4 - Check for wear.

Inspection procedure

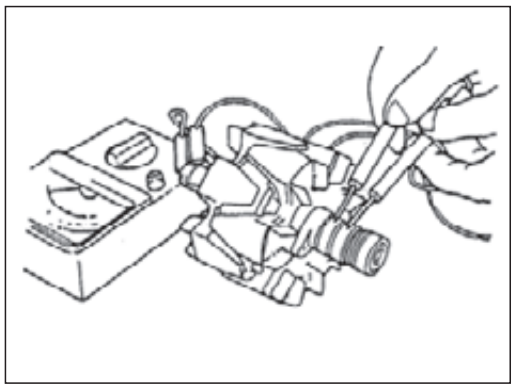
(1) Diodes

(a) Test the resistance between the diode and heat sink. First touch the positive (+) prod of an ohmmeter to the diode, then the negative (–) prod. If the resistance is infinite in both cases, the diode is open. If it is nearly zero in both cases, the diode is shorted. Do the same step for the remainder of the diodes. If any diode is open or shorted, replace the rectifier.



Testing diode

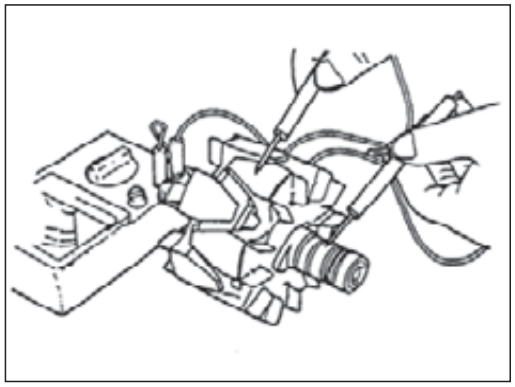
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Testing field coil for open circuit

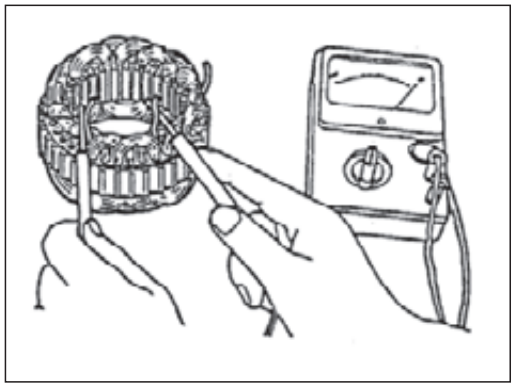
(2) Field coil

(a) Test for continuity between the slip rings as shown in the illustration. No continuity shows there is an open circuit in the field coil. Replace the field coil.



Testing field coil for grounded circuit

(b) Test for no continuity between the slip ring and shaft (or core) as shown in the illustration. Any continuity shows there is a grounded circuit in the field coil. Replace the field coil.



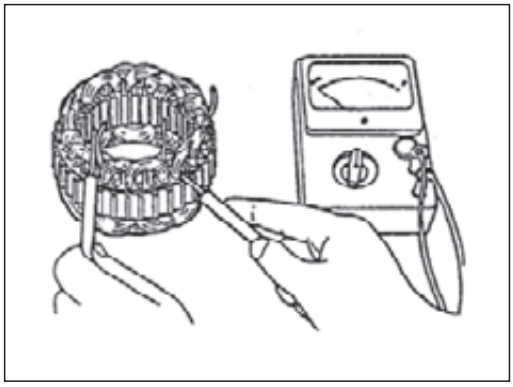
Testing stator core for open circuit

(3) Stator core

(a) Test for continuity between the leads as shown in the illustration. No continuity shows there is an open circuit in the stator core. Replace the stator core.

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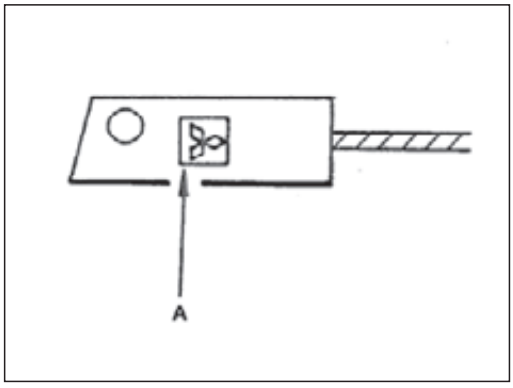
(b) Test for no continuity between each lead and stator core as shown in the illustration. Any continuity shows there is a grounded circuit in the stator core. Replace the stator core.



Testing stator core for grounded circuit

(4) Brushes

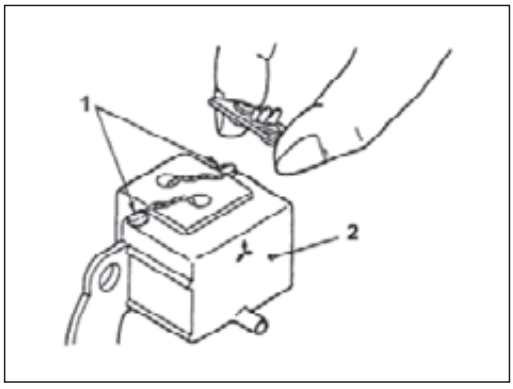
(a) Make replacement of brushes that have been worn down to, or beyond, the wear limit line



Checking brush for wear

A - Wear limit line

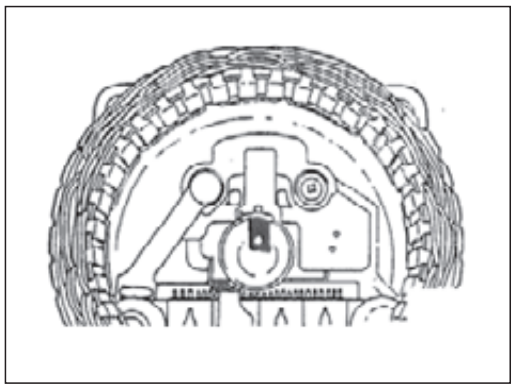
(b) To remove the brushes from the brush holder for replacement, unsolder the leads from the brushes. This will permit removal of the brushes and springs.



Removing brushes for replacement

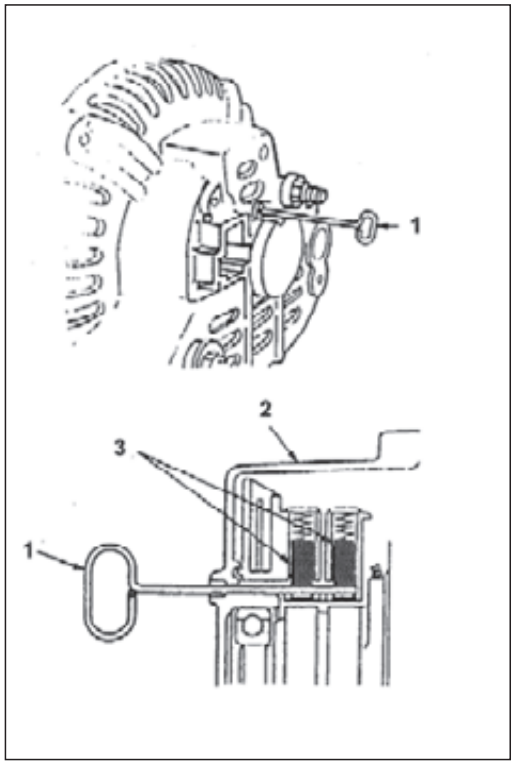
1 - Unsolder
2 - Brush holder

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Installing new brushes

(c) To install the new brushes, put them in position in the brush holder and solder the leads to the brushes.



Assembling alternator

1 - Wire-shaped tooling
2 - Brushes
3 - Rear bracket

3. Assembly

Follow the reverse of disassembly and use the procedure that follows.

(a) The rear bearing has a groove for the snap ring, Install the snap ring in this groove, making sure its tab is in the deep portion of the groove.

(b) When installing the new rear bearing, put it in position with the side that has a groove toward the slip rings of the rotor.

(c) To install the rear bearing in the rear bracket, heat the rear bracket.

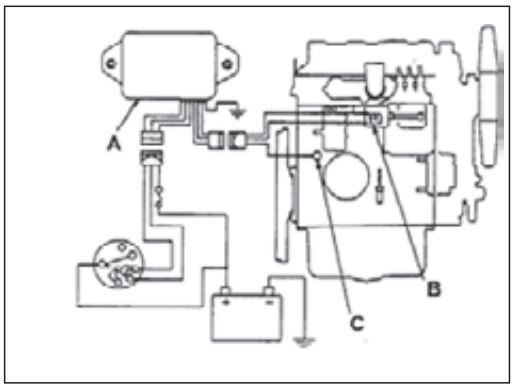
(d) Before installing the rotor in the rear bracket, insert a wire-shaped tooling into the hole in the rear bracket to lift the brushes off the slip rings. Remove the tooling after the rotor has been installed in position.

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KEY SHUTOFF SYSTEM

1. General

This system consisting of a switch, a control timer and a solenoid, permits the operator to shut off the engine by turning the starter switch key to OFF position. Another function of this system is to shut off the engine automatically when the oil pressure is too low, or when coolant temperature is too high.

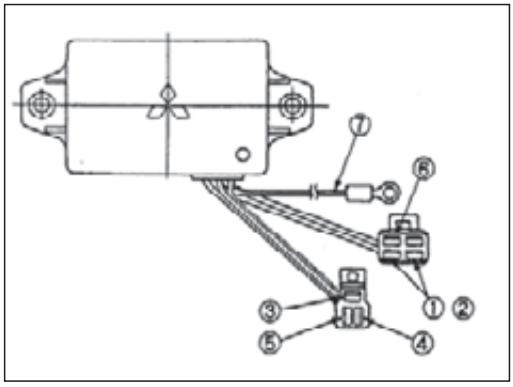


Key shutoff system

A - Control timer
B - Solenoid
C - Oil pressure switch

2. Cord color standard

No.	Cord color	Connected to
1	Blue	Solenoid
2	Blue	Solenoid
3	Red	Battery (starter switch B terminal)
4	Green	Starter switch ON terminal
5	Red/white	Starter (starter switch and starter)
6	Yellow	Oil pressure switch
7	Black	Ground



Control timer connection

3. Shutoff solenoid installation

(a) Remove the tie rod cover.

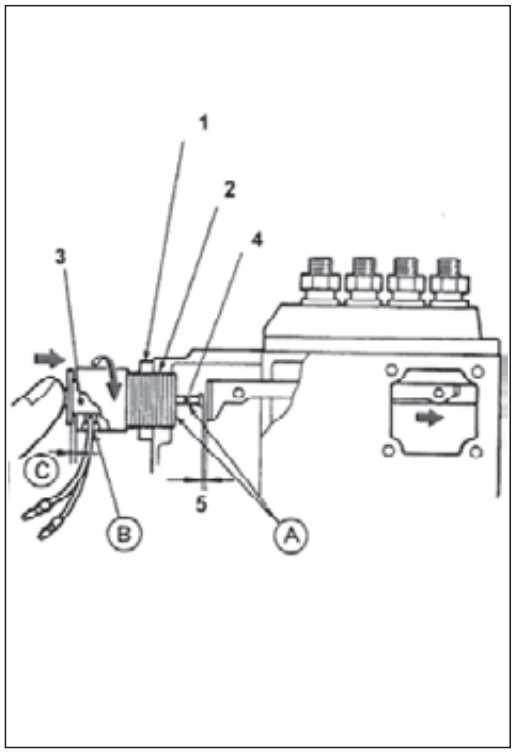
(b) Coat the threads of the stop solenoid with thread sealant (Three Bond 1212).

NOTE: Coat the length of the threads to be turned in the governor case.

(c) Temporarily install the shutoff solenoid and nut in the governor case.

(d) Move the injection pump control rack all the way to the non-injection (shutoff) position.

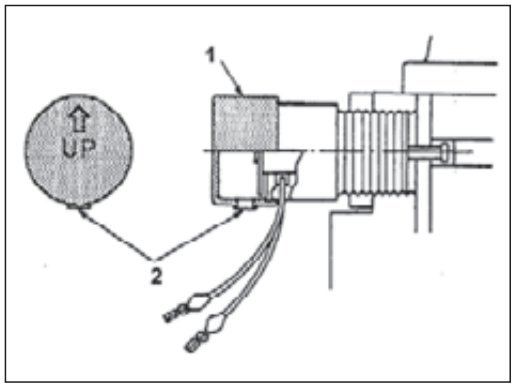
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Installing shutoff solenoid

1 - Tightening torque:
4.5 ± 0.5 kgf x m (32.5 ± 3.6 lbf x ft) [44 ± N x m]
2 - Threads: To be coated with thread sealant
3 - Shaft
4 - Plunger
5 - 0.15 to 0.20 mm (0.0059 to 0.0079 in.)

NOTE: Do not allow thread sealant to contact (A) Do not allow cleaning solvent to enter the solenoid through (B).



Installing rubber cap

1 - Rubber cap
2 - Water drain hole

NOTE: It will take about 5 minutes to restart an engine which was shut down by the key shutoff device.

e) Turn the shutoff solenoid in the governor case while pushing the plunger toward the control rack until the shaft is in touch with the tie rod. At this time, clearance C must be 0 mm. (Under this condition, the plunger will be rotated by the shutoff solenoid being turned in.)

(f) Back off the shutoff solenoid 30' to 45' turn (the clearance between the contro1 rack and plunger will be 0.15 to 0.20 mm (0.6059 to 0.0079 in.)) and tighten the nut to the specified torque.
(g) Start the engine and make sure the engine stops when the plunger is pushed all the way.

(h) Install the rubber cap in position with the arrow head toward up (with the side that has a water drain hole down) as shown in the illustration.

CAUTION: Do not allow cleaning solvent to contact any solenoid parts.

4. Inspection after assembly

(a) For the schematic of the key shutoff system, see page 178.

(b) Start the engine and make sure the engine stops when the starter switch key is turned to OFF position.

(c) Start the engine and make sure the engine stops when the oil pressure switch terminal is shorted to the switch body.

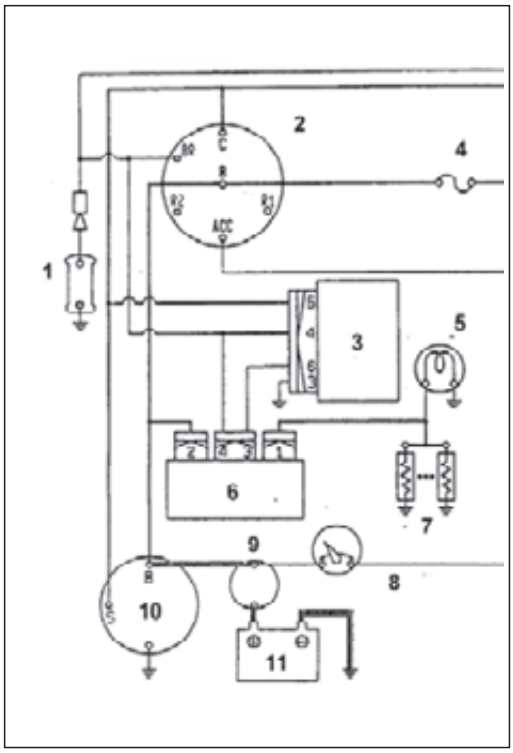
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AUTOMATIC GLOW PLUG SYSTEM

1. General

Turning the starter switch to ON position activates the glow plugs to heat the engine and causes the glow plug indicator to come on.

Heating time	6.2 ± 0.7 seconds



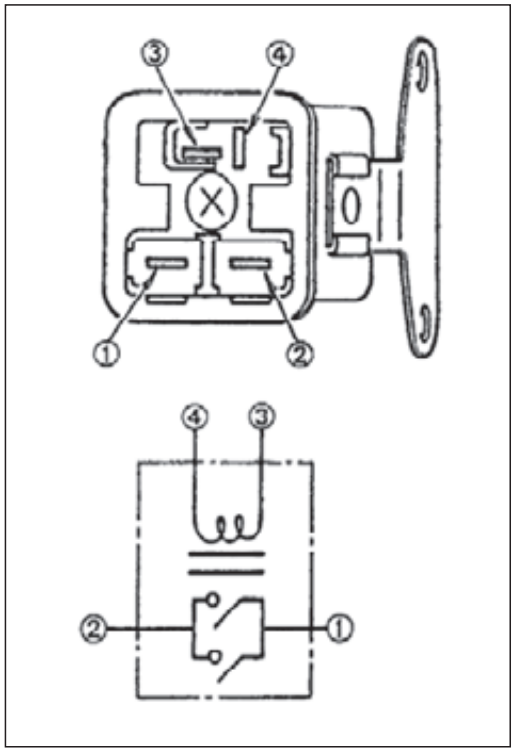
Automatic glow plug system

1 - Fuel pump
2 - Starter switch
3 - Glow plug timer
4 - Fuse
5 - Glow plug indicator
6 - Glow relay
7 - Glow plugs
8 - Ammeter
9 - Battery switch
10 - Starter
11 - Battery

2. Glow plug timer specifications (standard)

Model	QGS
Type	Quick heating
Rated voltage	DC 12 V
Operating voltage range	7 to 15 V
Operating temperature range	- 30 °C to +70 °C (-22 °F to +158 °F)
Storage temperature range	-40 °C to + 80 °C (- 40 °F to + 176 °F)
Glow plug activating time	6.2 ± 0.7 seconds

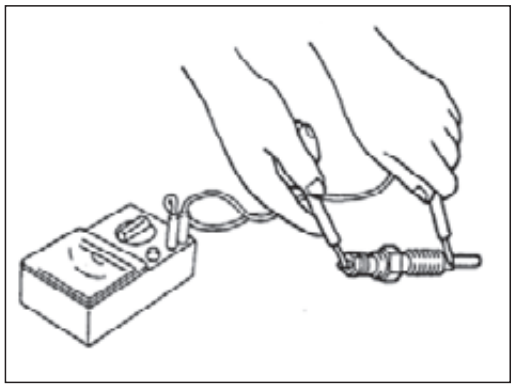
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Glow plug relay

3. Glow plug relay specifications (standard)

Model	G71SP
Rated voltage	DC 12 V
Continuous rating	1 minute
Coil resistance	13 Ω
Inductance	24 mH (at 1 kHz)
Operating temperature range	-40 °C to + 100 °C (-40 °F to + 212° F)



Testing glow plug

4. Glow plug inspection

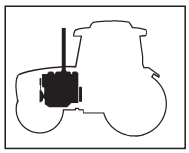
Test for continuity between the terminal and body as shown in the illustration.

Item	Standard
Resistance	0.55 Ω

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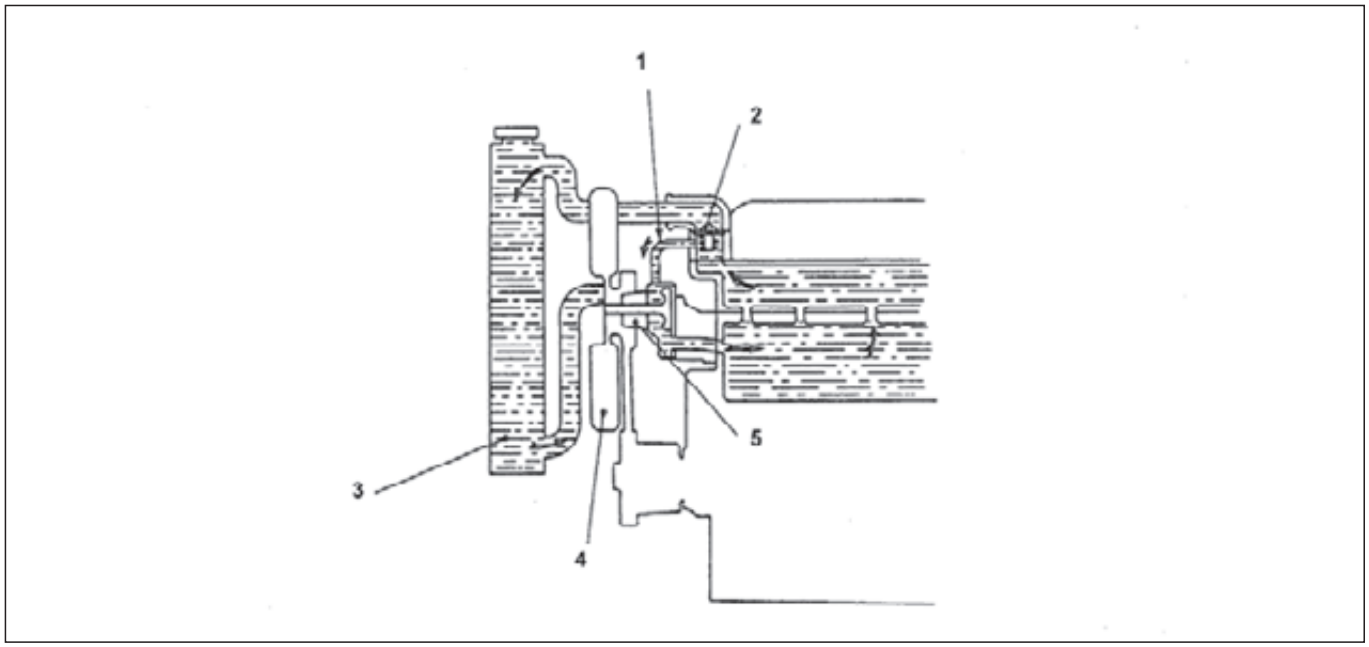


1 Mitsubishi engine

Cooling system

GENERAL

1. Schematic



Schematic

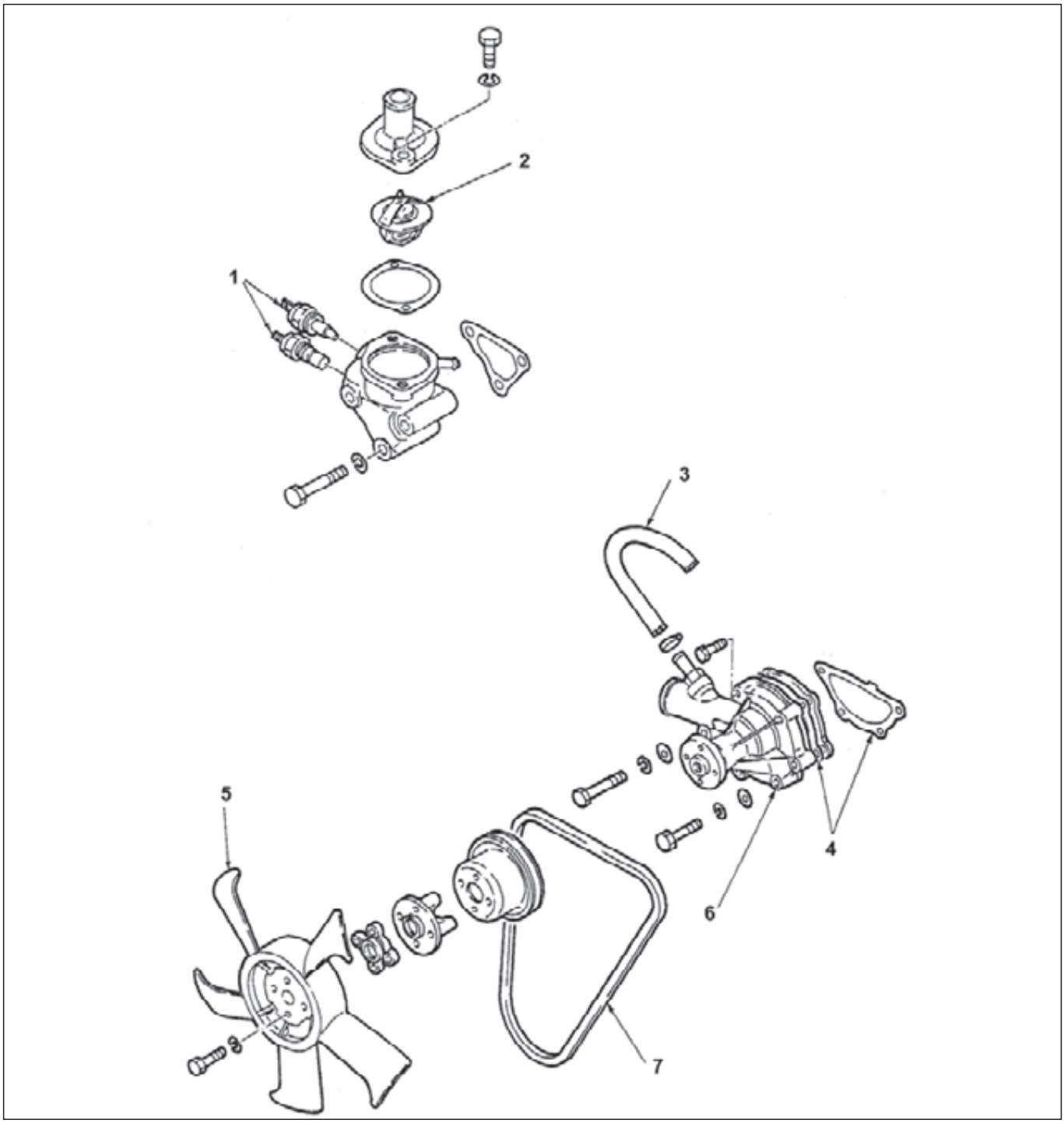
1 - Water bypass hose
2 - Thermostat
3 - Radiator
4 - Cooling fan
5 - Water pump

2 Specifications (standard)

Engine model		S3L / S3L2	S4L / S4L2
Fan belt (for farm or industrial engine)		LL or HM type (width = 10.7 mm (0.42 in.), V angle = 38°, outer circumference = 980 mm (38.6 in.)	
Cooling fan	Suction type	No. of blades = 5, diameter = 320 mm (12.6 in.)	No. of blades = 5, diameter = 360 mm (14.2 in.)
Water pump		Centrifugal type	
Thermostat	Temperature at which valve starts opening	82 ± 1.5 °C (180 ± 2.7 °F)	
	Temperature at which valve lift is 8 mm (0.3 in.)	95 °C (203 °F)	
Thermoswitch	Type	Bimetal	
	Temperature at which switch is turned ON	111 ± 3.5 °C (232 ± 6.3 °F)	
	Temperature difference for ON-OFF control	8 ± 3.5 °C (46.4 ± 6.3 °F)	
Resistance in thermounit		50 °C (122 °F): 80 ± 10 Ω 80 °C (176°F): 29.5 ± 2.5 Ω 120 °C (248 °F): 10 ± 0.3 Ω	

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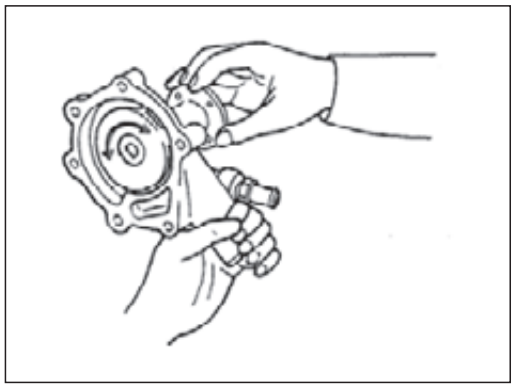
INSPECTION



Inspection points

1 - Test thermoswitch and thermounit using the procedures that follow.
2 - Test thermostat using the procedure that follows.
3 - Check for aging or damage.
4 - Use new gaskets.
5 - Check for cracks or distortion.
6 - Check for cracks or leaks.
7 - Check for elongation, aging or wear..

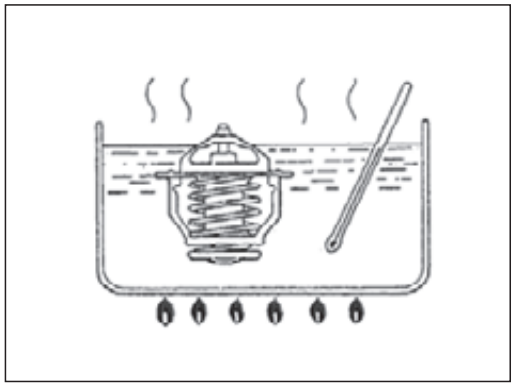
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Checking water pump

1. Water Pump

Check the impeller and shaft for rotation. If they do not rotate freely or have noise, replace the water pump assembly.



Testing thermostat

Stir up the water to keep the temperature uniform.

2. Thermostat standard

Hang the thermostat in the pan of water as shown in the illustration. The thermostat must be below the surface of the water and its must be away from the sides of the pan. Heat the water uniformly in the pan and measure a temperature at which the valve starts opening and a temperature at which the valve lift (distance) is 8 mm (0.3 in.). Replace the thermostat if defective.

Temperature at which valve starts opening	85 ± 1.5 °C (180 ± 2.7 °F)
Temperature at which valve lift is 8 mm (0.3 in.)	95 °C (203 °F)

WARNING: Water in the pan is hot.Any contact can cause severe burns

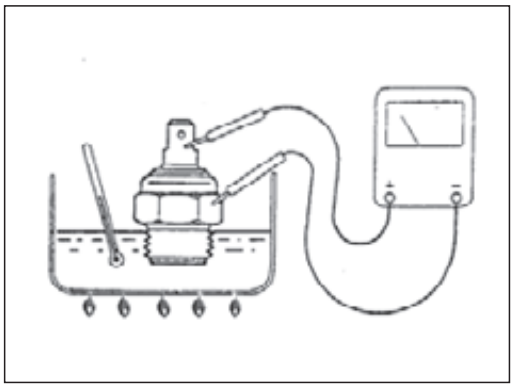
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3.Thermoswitch (standard)

Hang the thermoswitch in the pan of oil with its temperature sensing end below the surface of oil and measure the resistance while heating the oil as shown in the illustration. If the resistance is incorrect, replace the thermoswitch.

Resistance at 120 °C (248°F)	30 m Ω
Temperature at which switch is turned ON	111 ± 3.5 °C (232 ± 6.3 °F)

WARNING: Oil in the pan is hot any contact can cause severev burns



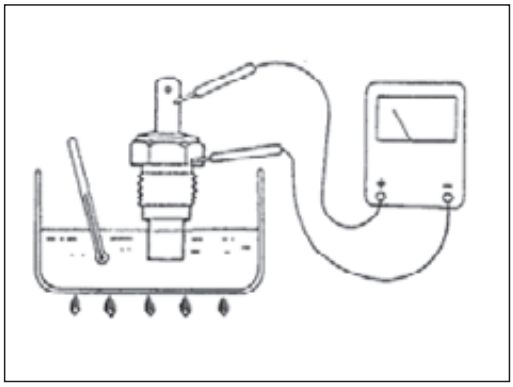
Testing thermoswitch

4. Thermounint (standard)

Hang the thermounit in the pan of antifreeze with its temperature sensing end below the surface of antifreeze and measure the resistance while heating the antifreeze as shown in the illustration. If the resistance is incorrect, replace the thermounit.

Standard	50 °C (122 °F): 80 ± 10 W 80 °C (176 °F): 29.5 ± 2.5 W 120 °C (248 °F): 10 ± 0.3 W

WARNING: Antifreeze in the pan is hot any contact can cause server burns



Testing thermounit

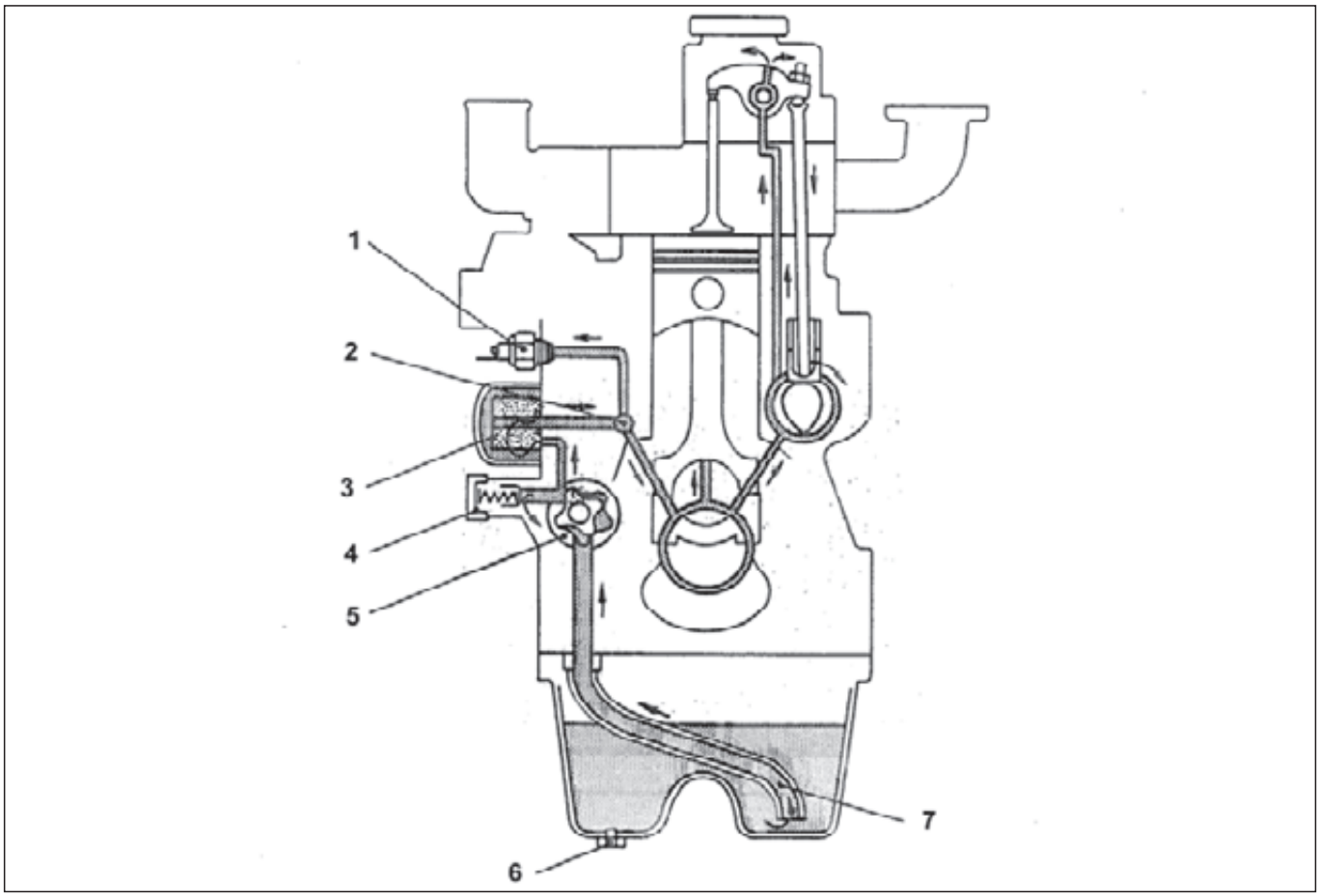
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GENERAL

1. Schematic



Schematic

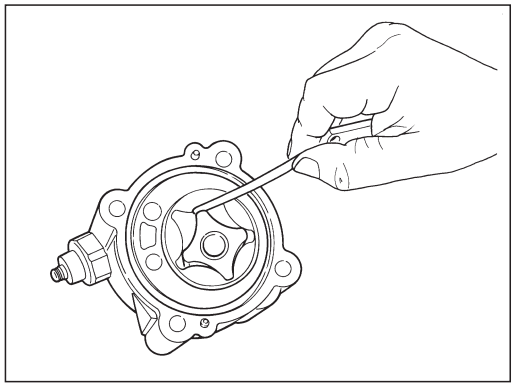
1 - Oil pressure switch
2 - Main oil gallery
3 - Oil filter
4 - Pressure relief valve
5 - Oil pump
6 - Oil drain plug
7 - Oil screen

2. Specifications

Engine model		S3L / S3L2	S4L / S4L2
Type		Force feed	
Oil		AKROS TURBO 15 W 40	
Capacity (high level excl. 0.5 liter (0.13 U.S. gal) of oil in oil filter), liter (U.S. gal)		5.7 (1.5) (with deep oil pan) 3.7 (1.0) (with standard oil pan)	7.7 (2.0) (with deep oil pan) 5.4 (1.4) (with standard oil pan)
Oil pump	Type	Trochoid	
	Driven by	Camshaft gear	
Relief valve opening pressure		3.5 ± 0.5 kgf/cm² (50 ± 7 psi) [343 ± 49 kPa]	
Pressure difference at which oil pressure switch is closed (indicator light comes on)		0.5 ± 0.1 kgf/cm² (7 ± 1.4 psi) [49 ± 10 kPa]	
Oil filter		Paper-element cartridge (full flow) type	

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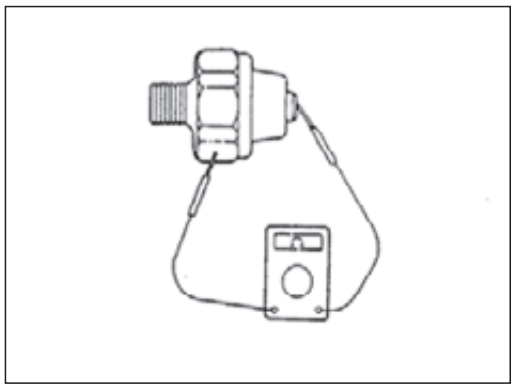
INSPECTION



Checking oil pump

1. Oil pump

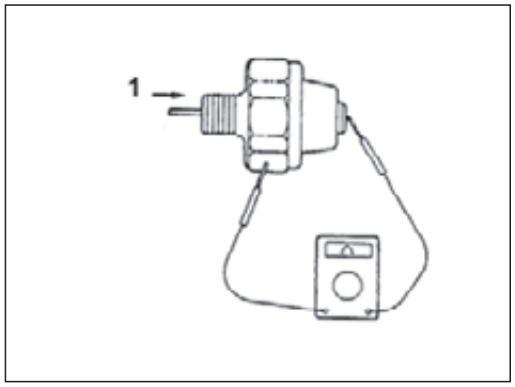
Visually check the pump for rough rotation or other defects. Replace the pump assembly if defective.



Testing oil pressure switch (1)

2. Oil pressure switch

(1) Test for continuity between the terminal and body with an ohmmeter as shown in the illustration. No continuity is the cause for replacing the switch.



Testing oil pressure switch (2)

1 - Small diameter bar

(2) Insert a small diameter bar into the oil hole in the switch and lightly push it in to test for no continuity as shown in the illustration.
Any continuity is the cause for replacing the switch.

(3) Apply a pressure air of 0.5 kgf/cm' (7 psi) [49 kPa] to the switch through the oil hole to test for no continuity. Any continuity is the cause for replacing the switch. Also, check for air leaks. Any air leak is an indication of a ruptured diaphragm. In such a case, replace the switch.

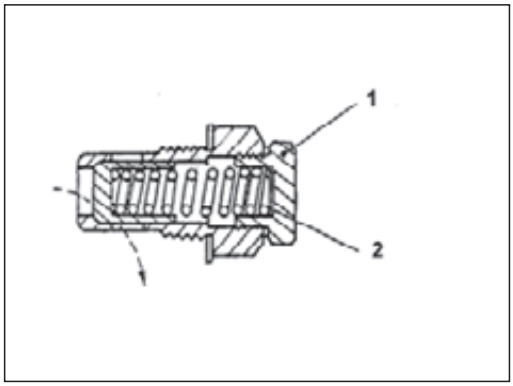
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3. Pressure relief valve

(1) Check the valve seat for contact. Check the spring for damage.

(2) Measure the oil pressure at which the relief valve opens (the oil pressure with engine running at the rated rpm).If the pressure is not correct, remove the cap nut and increase or decrease the ammount of shims.The engine oil pressure tap is located on the right side of engine.

Relief valve opening pressure	3.5 ± 0.5 kgf/cm² (50 ± 7 psi) [343+ 49 kPa]



Checking pressure relief valve

1 - Cap nut
2 - Shims

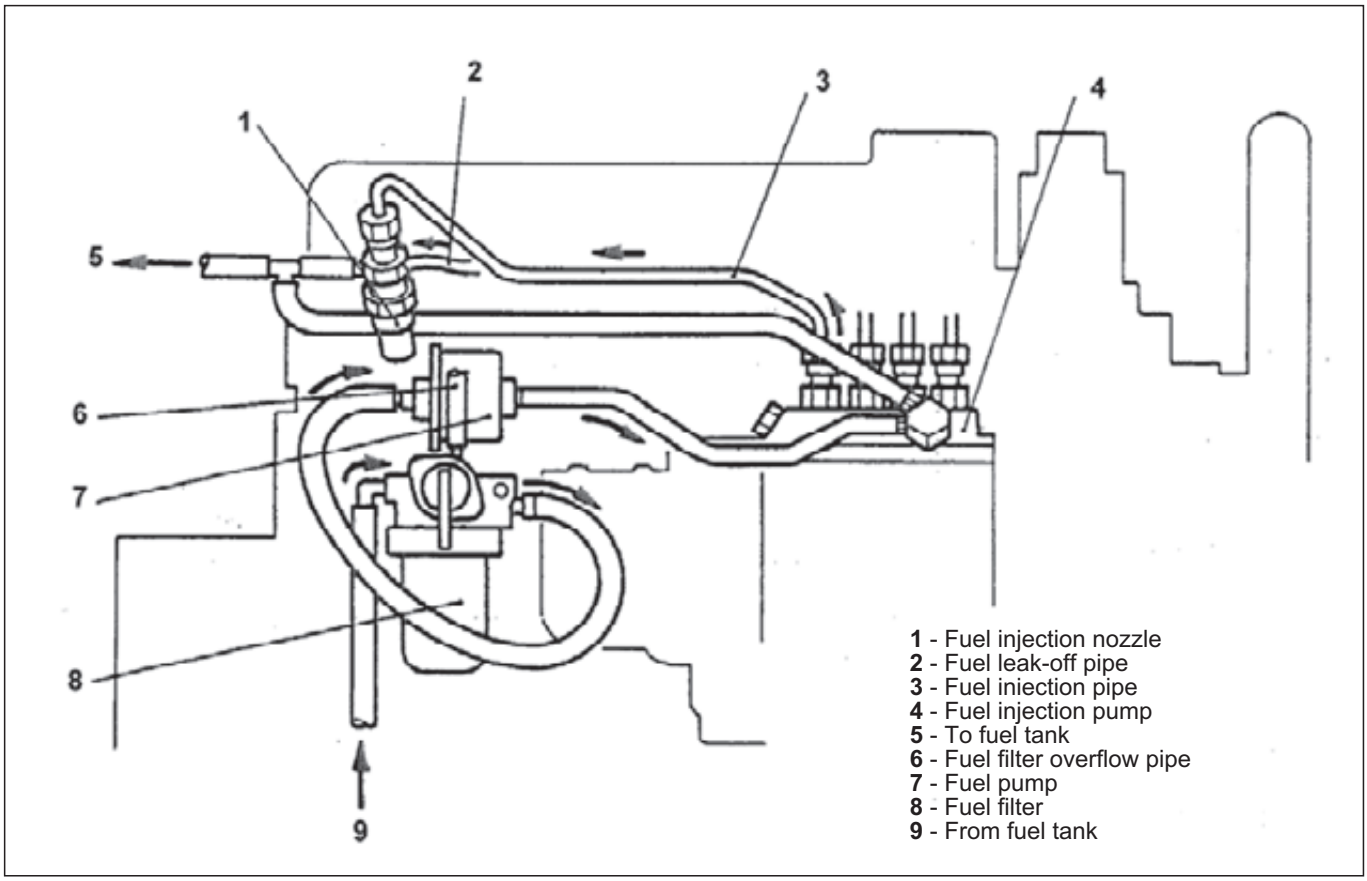
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GENERAL

1. Schematic

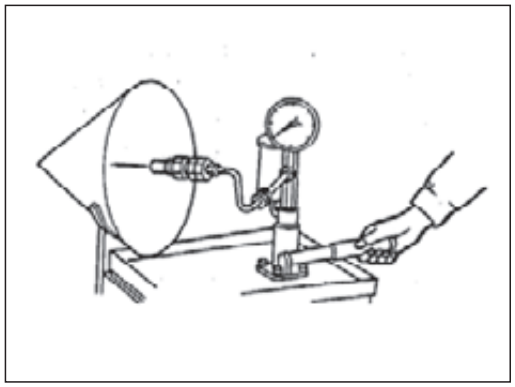


2. Specifications (standard)

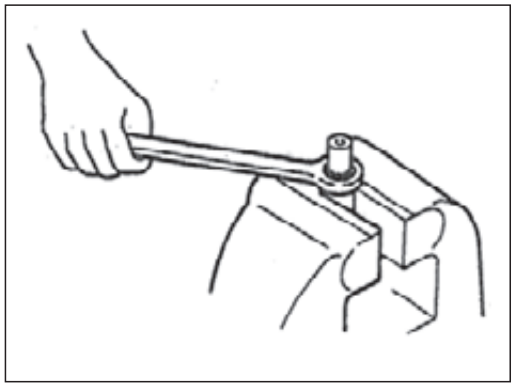
Engine model		S3L / S3L2	S4L / S4L2
Fuel injection pump	Type	Bosch M	
	Model	ND-PFR3M	ND-PFR4M
	Plunger diameter	5.5 mm (0.217 in.)	
	MS retard (crank angle), dag	8	
	Delivery valve, type	Silto or Bosch	
	Air vent screw	Yes	
Fuel injection nozzle	Type	Throttle	
	Model	DN15PD6	
	Injection pressure (valve opening pressure)	140 $^{+5}_{0}$ Kgf/cm² (1991 $^{+71}_{0}$ [13729 $^{+490}_{0}$ kPa]	
Fuel filter (remote)	Type	Paper element	
Fuel pulp (remote)	Type	Electric (diaphragm)	
	Capacity (at terminal voltage of DC 12 V and 20 °C (68 °F))	300 cc (18.3 cu in.)/min minimum or 400 cc (24.4 cu in.)/min minimum	

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FUEL INJECTION NOZZLE



Fuel injection nozzle ready for test.



Removing tip from injection nozzle.

1. Inspection

(1) Injection pressure (valve opening pressure) test

(a) Install the injection nozzle on the tester. Slowly operate the tester handle to bleed (remove) air from the tester.

(b) Operate the tester handle at a speed of one stroke per second to make a slow increase in pressure until the valve in the injection nozzle starts to open. Read the maximum gauge pressure at the instant fluid flows from the tip.

(c) If the injection pressure is incorrect, disassemble the nozzle and change the thickness of the washer.

Injection pressure (valve opening pressure) Standard	$140\ ^{+5}_{0}$ kgf/cm² ($1991\ ^{+71}_{0}$ psi) [$13729\ ^{+490}_{0}$ kPa]

NOTE: An increase or decrease of washer thickness by 0.1 mm (0.004 in.) will vary the injection pressure by 10 kgf/cm' (142 psi) [981 kPa]. 10 kinds of washer are available in thicknesses from 1.25 mm (0.049 2 in.) to 1.70 mm (0.066 9 in.) in increments of 0.05 mm (0.002 0 in.).

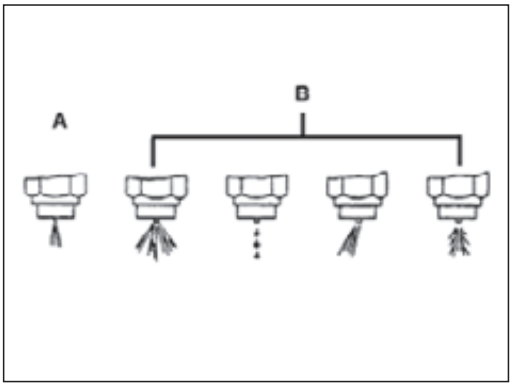
WARNING: When the injection nozzles are tested, be sure to wear eye protection. Fuel comes from the orifices in the nozzle tip with high pressure. The fuel can pierce (go through) the skin an cause serious injury to the operator. Keep the tip of the noozle pointed away from the operator and into the fuel collector.

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(2) Orifice restriction test

(a) Look at the orifice discharge pattern (shape of discharge) when fluid begins to flow through the injection nozzle. The discharge must be straight. Any change is an indication of a bad nozzle.

(b) Operate the tester handle at a speed of one stroke per second to make sure the discharge is straight.



Orifice restriction test

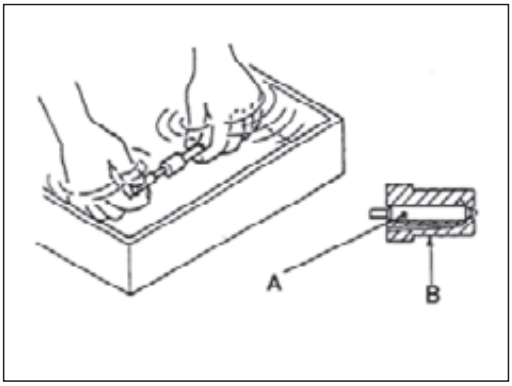
A - Good nozzle (Use again.)
B - Discharge pattern for orifice with a restriction (Recondition or replace.)

(3) Nozzle tip washing and replacement.

(a) Loosen the retaining nut and remove the tip from the injection nozzle. Wash the needle valve and body in clean diesel fuel. After washing, put the needle valve in the body in clean diesel fuel.

CAUTION: Do not hit the tip when removing it from the injection nozzle.

NOTE: Keep the need valves with their respective bodies. Do not use needle valves or bodies with other bodies or needle valves.



Washing nozzle tip

A - Needle valve
B - Body

(b) After cleaning the tip, install it in the nozzle and tighten the retaining nut to the specified torque.

Tightening torque	3.75 ± 0.25 kgf x m (27 ± 1.8 lbf x ft) [36.8 ± 2.5 N x m]

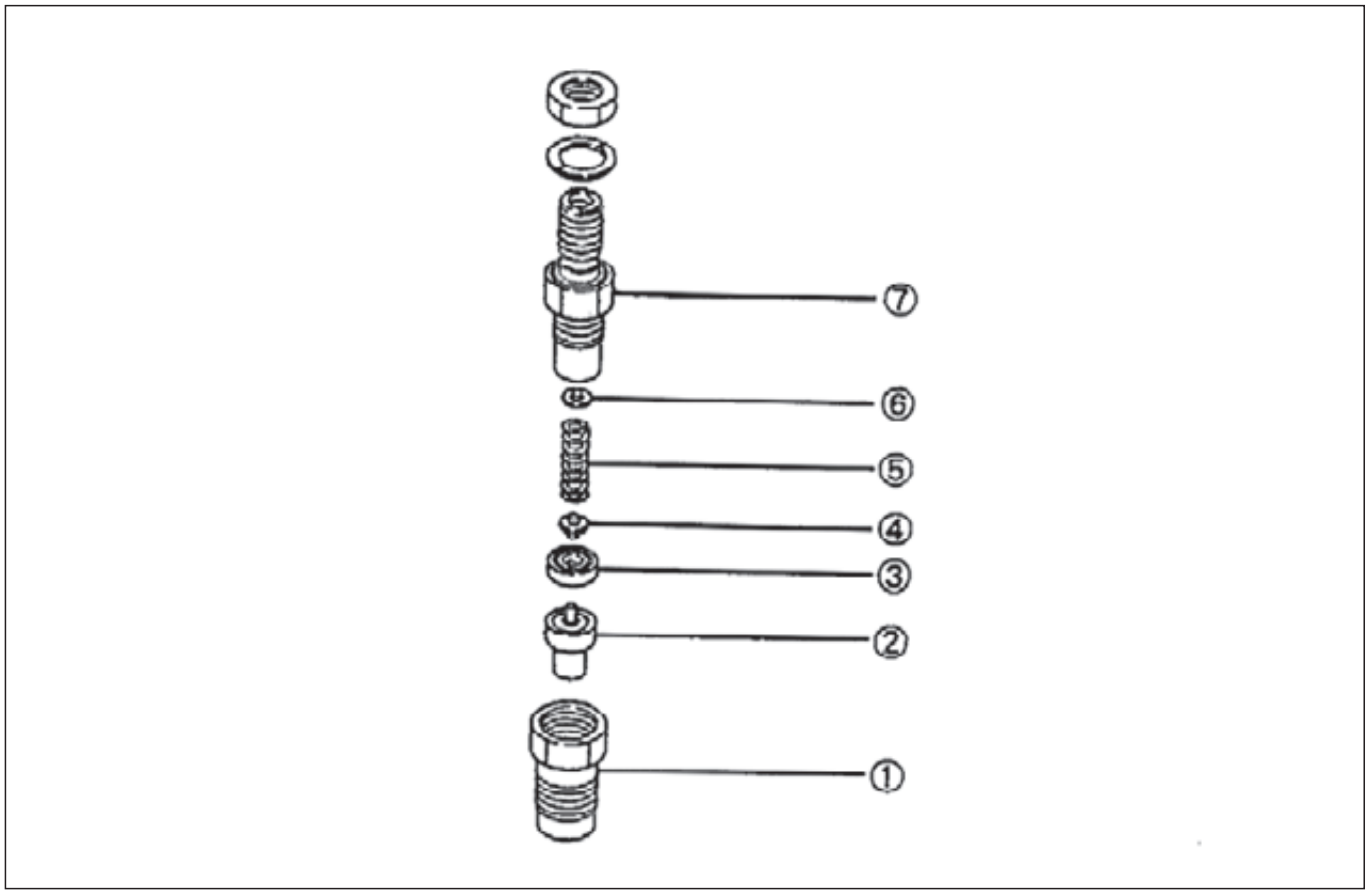
NOTE:
a)Do not touch the sliding surface of the needle valve.

b) When installing the new nozzle tip, remove synthetic resin film from the tip and slide the needle valve in the body in clean diesel fuel to wash off inhibitor completely.

(c) If the injection nozzle is still bad after the tip has been washed, replace the tip.

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2. Disassembly and assembly



Disassembly sequence and inspection points

1 - Retaining nut - Tightening torque: 3.75 ± 0.25 kgf x m (27 ± 1.8lbf x ft) [36.8 ± N x m].
2 - Nozzle tip assembly - Check for too much carbon on tip of nozzle or in nozzle orefice.
3 - Piece.
4 - Pin - Check for wear or damage.
5 - Spring - Check test force and squareness.
6 - Washer - Check for wear.
7 - Body - Tightening torque: 5.5 ± 0.5 kgf x m (40 ± 4 lbf x ft) [54 ± 5 N x m].

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FUEL INJECTION PUMP

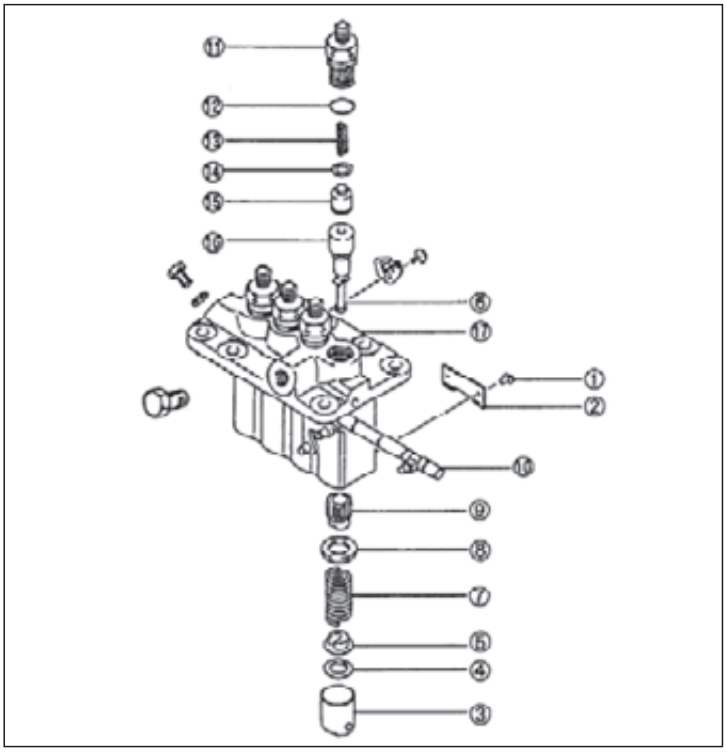
1. Test on engine

Check the injection pump for items listed in the chart below and replace it if defective. Do not attempt to make repairs by disassembling.

Test item	Test method	Criteria
Low idle speed	Use a tachometer.	Standard farm engine: 980^{+30}_{0} rpm
Exhaust smoke	1) Check by quickly increasing engine speed under no-load condition. 2) Check by starting load.	No too much black or gray smoke
Orifice discharge patter	Remove injection nozzle and reinstall it with orifice toward outside of engine. Look at discharge pattern by cranking the engine with starter.	Good discharge pattern

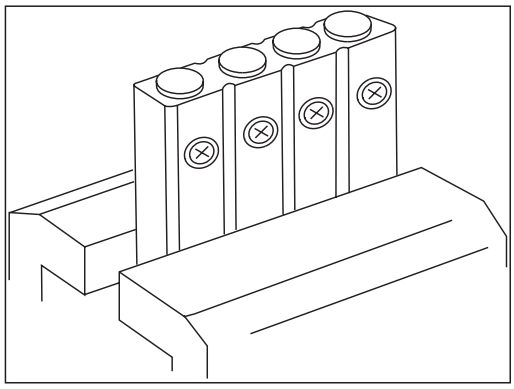
2. Disassembly

1 -Tappet guide pin
2 -Lock plate
3 - Tappet
4 - Tappet adjusting shim
5 - Lower spring seat
6 - Plunger
7 - Plunger spring
8 - Upper spring seat
9 - Control sleeve
10 - Control rack
11 - Delivery valve holder
12 - O-ring
13 - Delivery valve spring
14 - Delivery valve gasket
15 - Delivery valve
16 - Plunger barrel
17 - Pump housing



Disassembly sequence

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Removing tappet guide pins

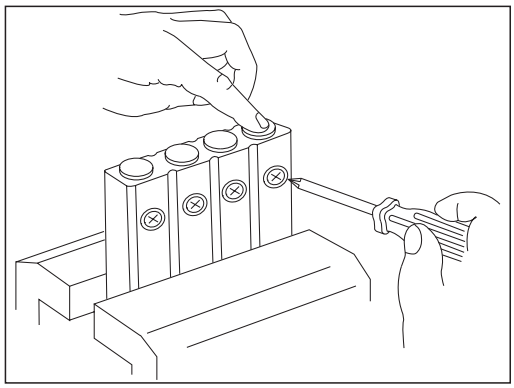
Disassembly procedure

(1) Tappet removal

(a) Hold the injection pump in a vise with the side that has tappets up

(b) Straghten the lock plate away from the tappaet guide pin with a screwdriver.

(c) Rotate the tappet guide pin 180° to unlock it from the housing



Removing tappet

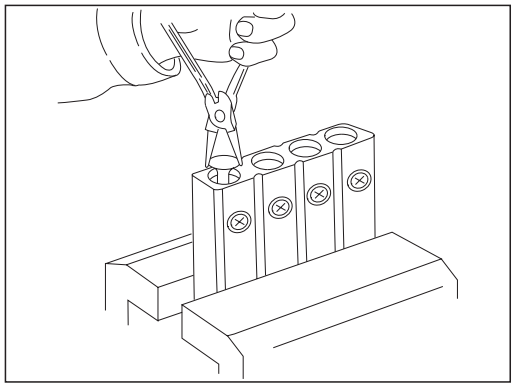
(d) Remove the tappet guide pin with a needle-nose pliers while pushing down on the tappet. Remove the tappet.

(e) Do steps (b) trough (d) again for remainder of the tappets

CAUTION: The tappet can be thrown from the housing when the tappet guide pin is removed. Hold the tappet to prevent it from falling.

(2) Plunger removal

(a) Remove the tappet adjusting shim.



Removing plungers

(b) Remove the lower spring seat and plunger with a tweezers.

(c) Remove the plunger spring.

(d) Remove the upper spring seat and control sleeve.

(e) Do Steps (a) through (d) again for remainder of the plungers.

(f) Remove the control rack.

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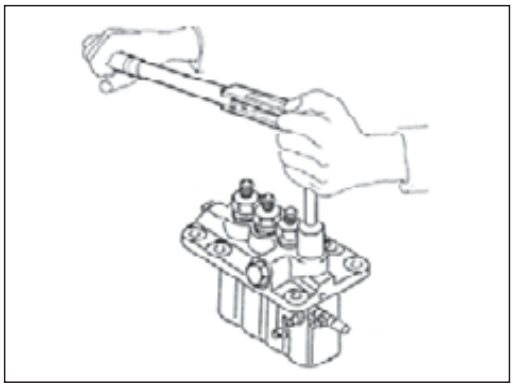
(3) Delivery valve removal

(a) Turn the injection pump upside down and hold it in a vise.

(b) Remove the delivery valve holder.

(c) Remove the delivery valve spring.

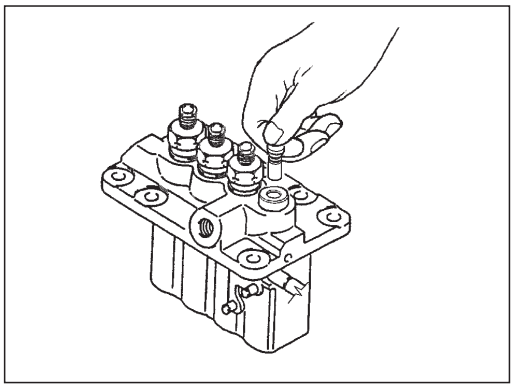
(d) Remove the delivery valve gasket.



Removing delivery valve holders

(e) Remove the delivery valve with a tweezers.

(d) Do Steps (b) through (e) again for remainder of delivery valves.

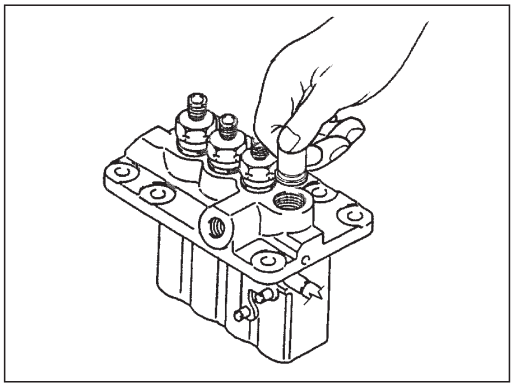


Removing delivery valves

CAUTION: The delivery valves are finely finished parts. Keep them as clean as possible.

(4) Barrel removal

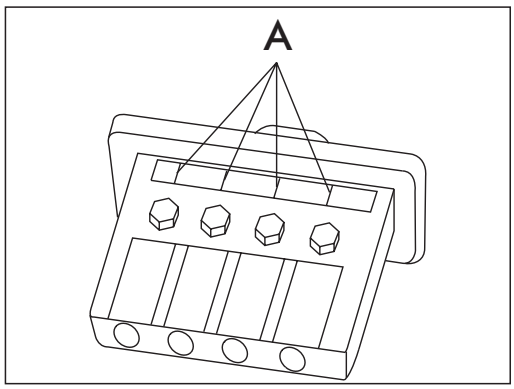
(a) Remove the barrels from the housing.



Removing barrels

CAUTION:
a) The plungers and barrels are finely finished parts. Keep them as clean as possible.
b) Keep the plungers with their respective barrels for installation Do not use plungers or barrels with other barrels or plungers.

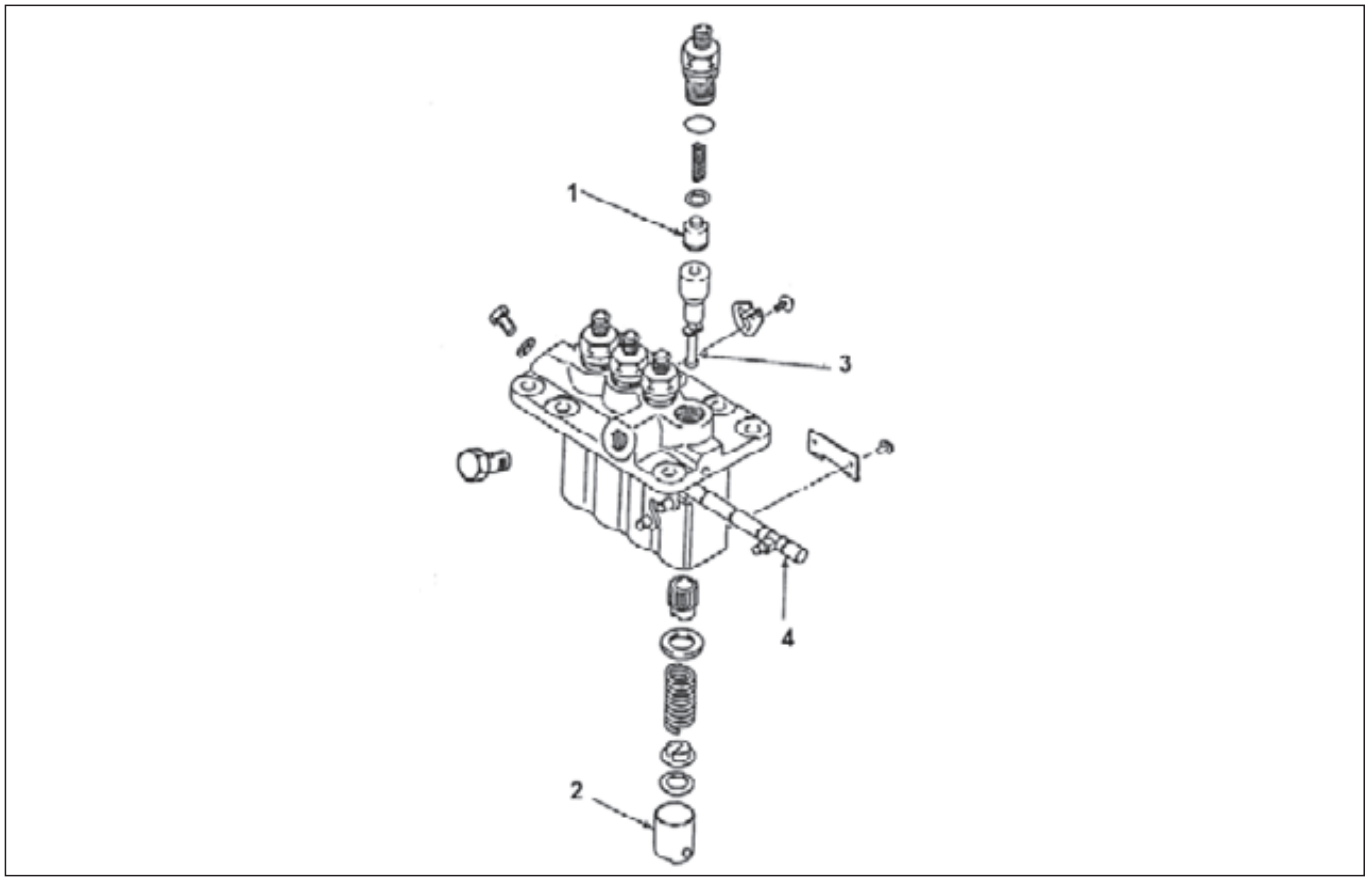
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A - Adjusting plates

NOTE
(a)When replacing the plungers and barrels or delivery valves, do not loosen the adjusting plates between the pumping elements.
b) After these parts have been replaced, the injection quantity must be measured. Pump Tester Cam Box is needed for measurement of injection quantity.
c) Keep the disassembled injection pump parts in clean diesel fuel.

3. Inspection

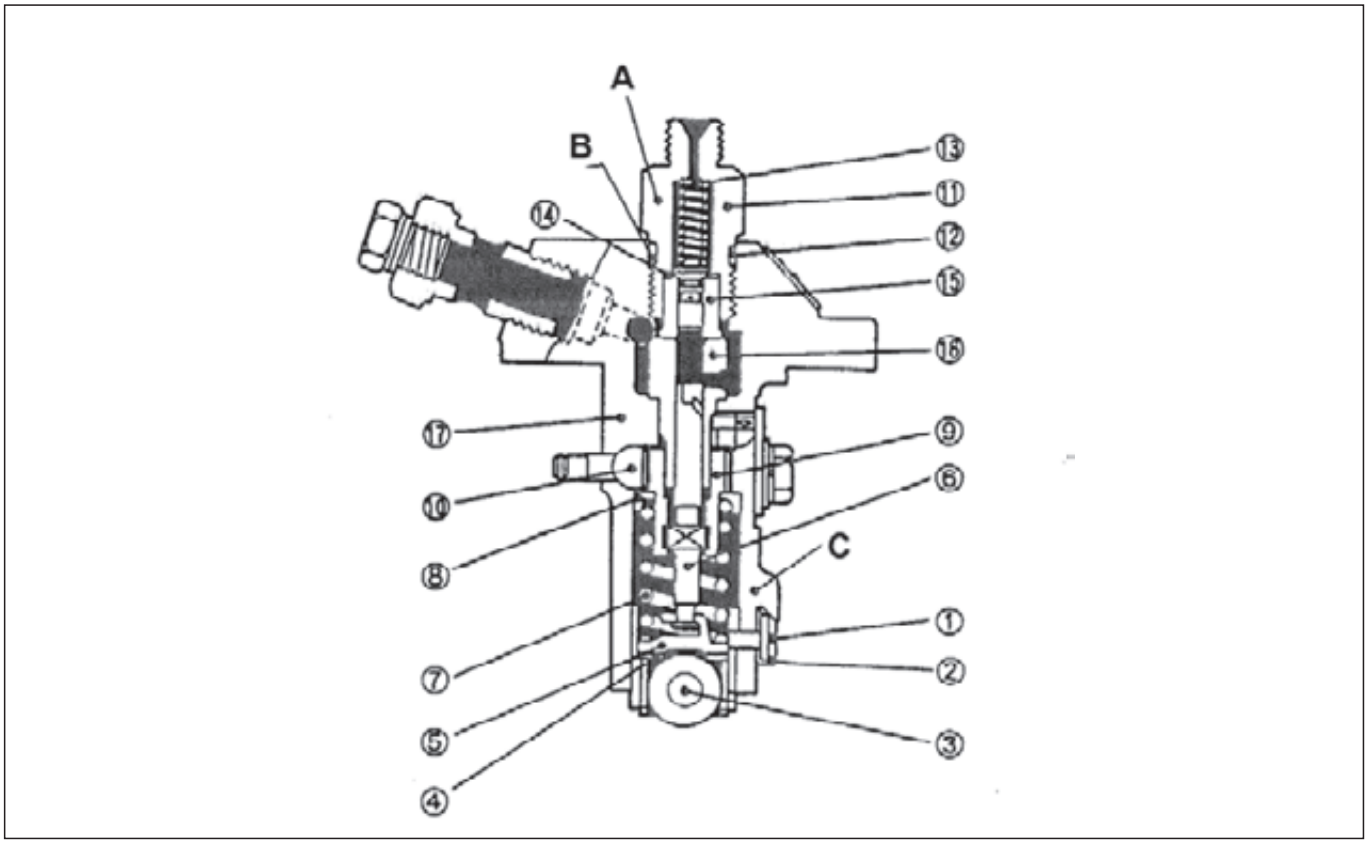


Inspection points

1 - Check delivery valve for wear or damage.
2 - Check tappet for wear.
3 - Check plunger for wear, rusting or scoring.
4 - Check control rack for movement.

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4. Assembly



Assembly sequence

A - Tightening torque:4.5 ± 0.5 kgf x m (32.5 ± 4 lbf x ft) [44 ± 5 N x m]
B - Use a new O-ring.
C - Use new lock plate.

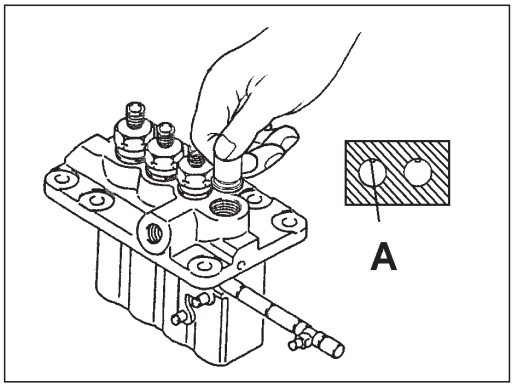
Follow the reverse of disassembly and use the procedure that follows.

Assembly procedure

(1) Barrel installation

Put each barrel in position in the housing with its slot in alignment with the dowel of the housing and put it straight down into the bore.

NOTE: If the slot in the barrel is not aligned with the dowel of the housing, the O -ring will not seat correctly (still visible) after the delivery valve holder has been installed.



Installing barrels

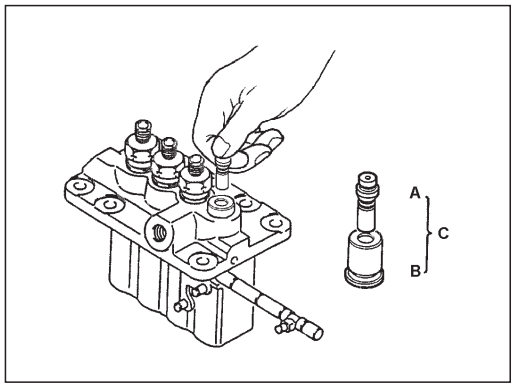
A - Locating dowel

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(2) Delivery valve installation

Install the delivery valve, gasket, spring and O-ring on the barrel and tighten the delivery valve holder finger tight. Do this step for remainder of the delivery valves.

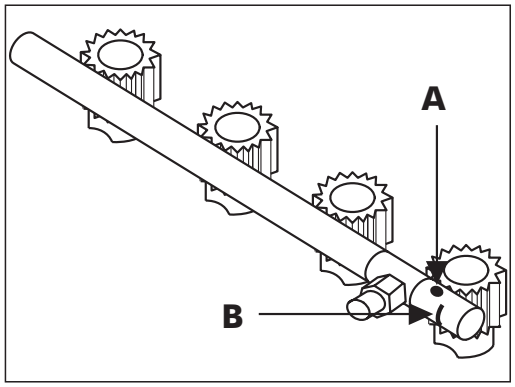
CAUTION:
a) Any time the injection pump is disassembled, a new O-ring must installed.
b) Make sure the threads of the delivery valve holder do not cause damage to the O-rings.



Installing delivery valves

A - Valve
B - Valve seat
C - Delivery valve

(3) Control sleeve installation
(a) Install each control sleeve with the center tooth in alignment with the line mark of the control rack.

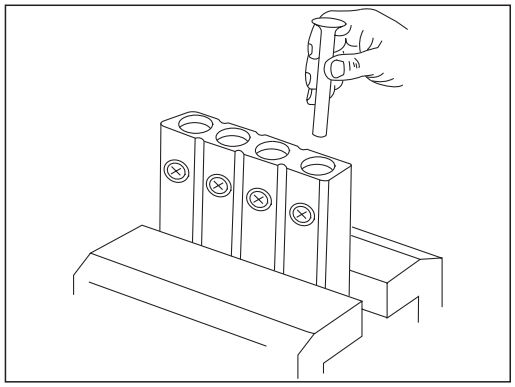


Installing control sleeves

A - Center tooth (visible when seen from the lower side).
B - Line.

(b) Put the plungers in position in the barrels.

CAUTION: Make sure the notch in the plunger is toward the adjusting plate.



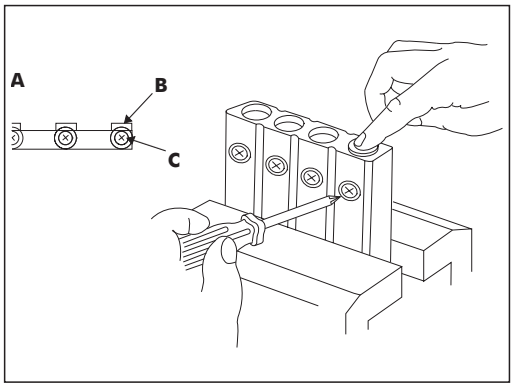
Installing plungers

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(4) Tappet installation

Move the control rack back and forth while pushing down on each tappet to align the slot in the tappet with the hole in the housing for the tappet guide pin. Install the lock plates and tappet guide pins in position.

CAUTION: Any time the injection pump is disassembled, new lock plates must be used.



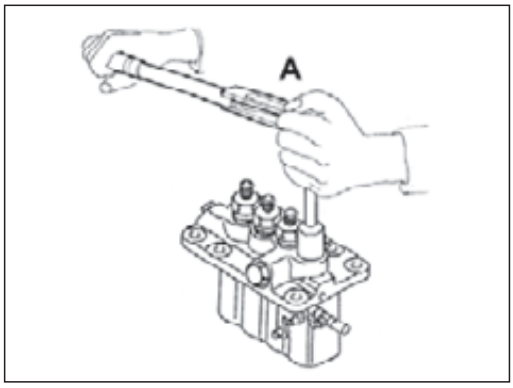
Installing tappets

A - Position tappet guide pins in correct position.
B - Lock plate
C - Tappet guide pin

(5) Delivery valve holder installation

Put the delivery valve holders in position and tighten them to the specified torque.

CAUTION: Do not over tighten the delivery valve holders. This can put end force on the barrels, resulting in a failure of the plungers to move freely. If the holders are not tightened to the specified torque, engine oil would leak in the injection pump.



Tightening delivery valve holders

A - 4.5 ± 0.5 kgf x m (32.5 ± 4 lbf ft) [44 ± 5 N x m]

(6) Inspection after assembly

(a) After the injection pump has been assembled, check to see if the control rack moves freely without any binding or catching.

(b) If the control rack fails to move freely, the possible causes are:

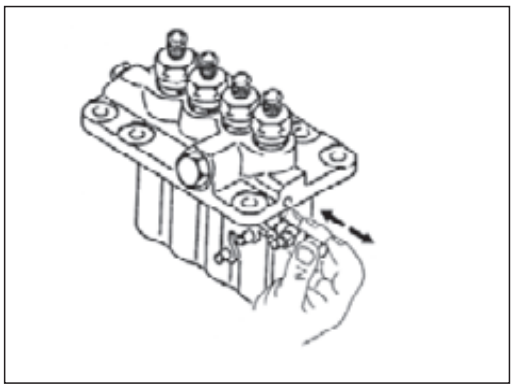
1) Pumping element(s) sticking

2) Foreign particles lodged between control rack and sleeves

3) Over tightening of delivery valve holder(s)

Disassemble and check the injection pump to locate the cause of the trouble.

(c) After the injection pump has been finally assembled, check the injection timing.

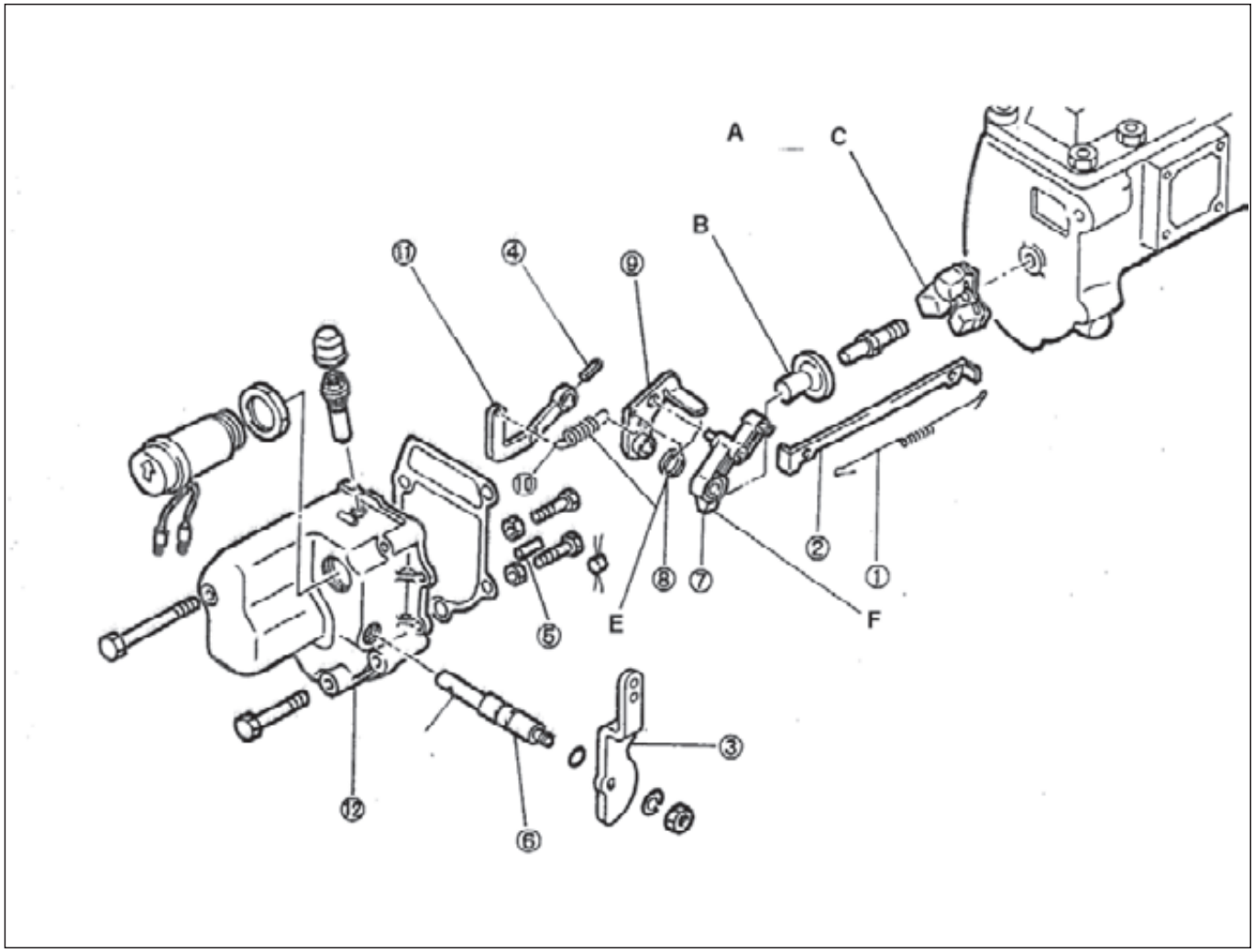


Checking control rack movement

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GOVERNOR

1. Disassembly and inspection



Disassembly sequence and inspection points

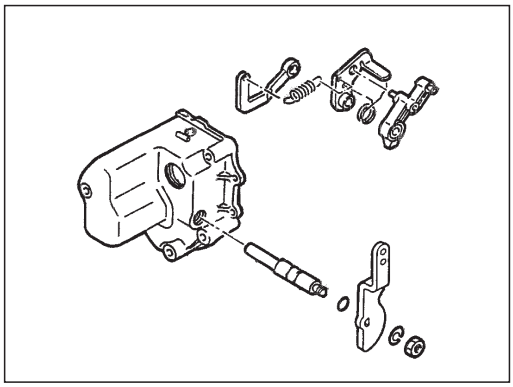
1 - Tie rod spring
2 - Tie rod
3 - Speed control lever
4 - Spring pin
5 - Grooved pin
6 - Governor shaft
(Remove 7 thru 11 as an assembly.)
7 - Governor lever
8 - Start spring
9 - Tension lever
10 - Governor spring
11 - Governor spring lever
12 - Governor case

A - Make sure levers move freely
B - Check sliding sleeve for wear or damage. Make sure it move freely
C - Check weights for wear
D - Check shaft for defects
E - Check spring for damage
F - Check sliding sleeve contact face for wear

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2. Assembly

(1) Install the levers in position.



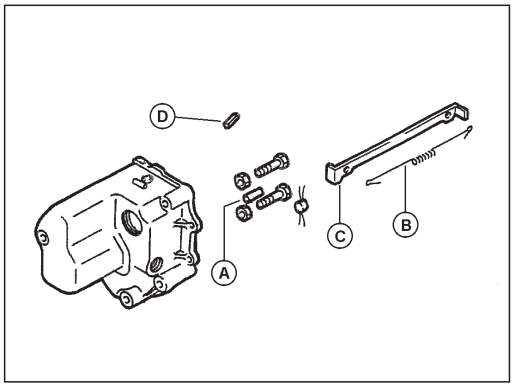
Installing governor levers

(2) Put O-ring on the governor shaft.

(3) Put the governor shaft in position in the governor case and put the levers on the governor shaft.

(4) Install the grooved pin and spring pin in position with a hammer.

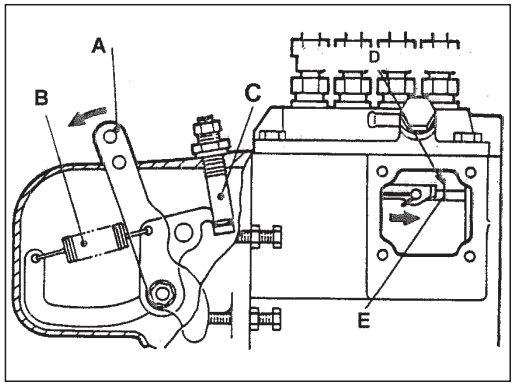
(5) Install the tie rod and tie rod spring in position.



Assembling governor

A - Grooved pin
B - Tie rod spring
C - Tie rod
D - Spring pin

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Installing torque spring set

A - Speed control lever
B - Governor spring
C - Torque spring set
D - Line mark on pump body
E - Line mark on control rack

3. Torque spring set installation

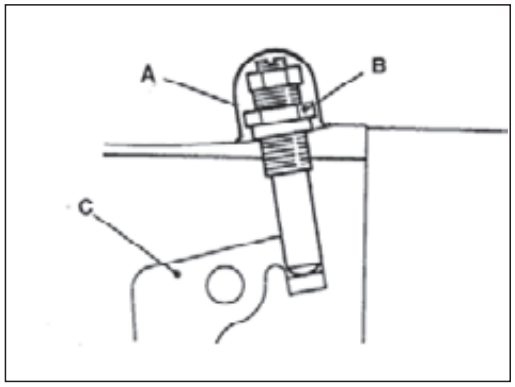
The torque spring set is to be installed and adjusted after an adjustment is made to the low idle speed and high idle speed, with the engine at a standstill.

(1) Remove the tie rod cover.

(2) Move the speed control lever to the high idle position and hold it there.

(3) Pull the tie rod in the direction of arrow head to the point where a slight resistance is encountered.

NOTE: In this position, the tie rod does not pull on the governor spring.



Sealing cap for torque spring set

A - Sealing cap
B - Special nut
C - Governor lever

(4) Turn in the torque spring set while lightly pulling the tie rod until the line mark on the control rack is aligned with the line mark on the pump body.

(5) With these line marks aligned, lock the torque spring set in position by tightening the special nut.

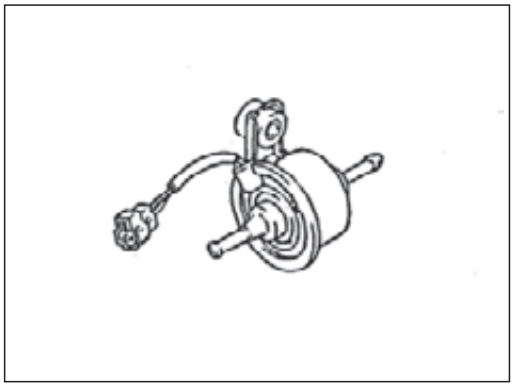
(6) Install the sealing cap over the torque spring set and stake the cap in position.

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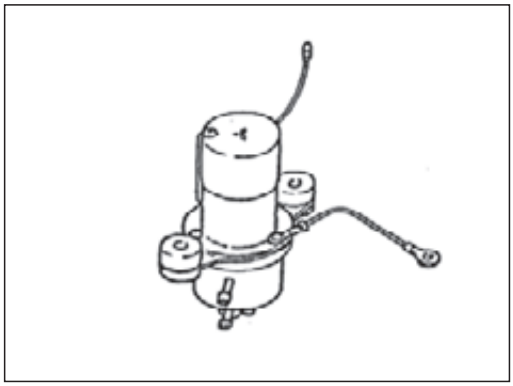
FUEL PUMP

Inspection

Look outside the pump for defects and test its performance. Do not attempt to disassemble the pump.



Fuel pump (plunger type)

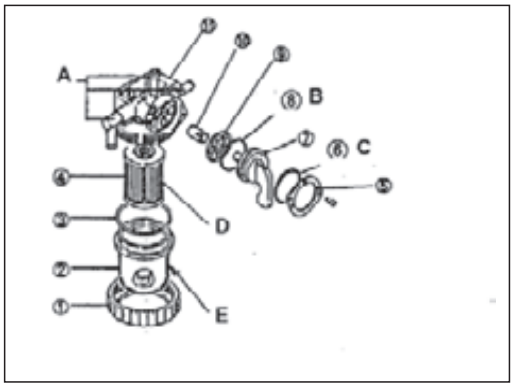


Fuel pump (diaphragm type)

FUEL FILTER

(1) Normally, the fuel filter is not to be disassembled. Only element removal for cleaning or replacement is recommended.

(2) When installing the valve lever after washing, coat the O-ring for the lever with silicone oil and the washer with grease.

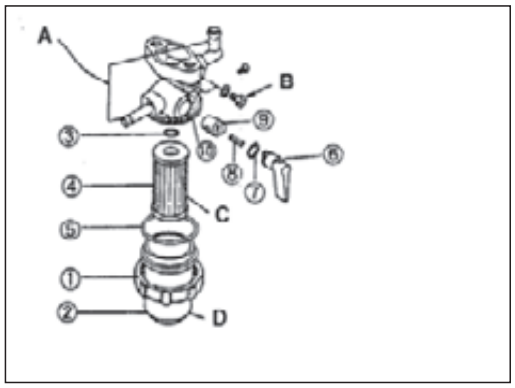


Fuel filter

1 - Ring nut
2 - Cup
3 - O-ring
4 - Element
5 - Lever plate
6 - Wascher
7 - Valve lever
8 - O-ring
9 - Packing
10 - Valve seat
11 - Filter body

A - Do not remove
B - Coat with silicone oil
C - Coat with grease
D - Wash in diesel fuel every 100 service hours. Replace every 500 service hours
E - Check for water and sediment.

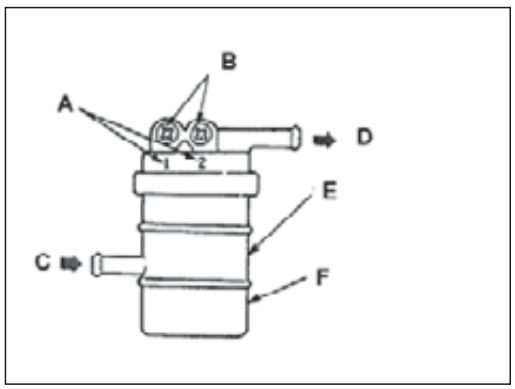
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Fuel filter

1 - Ring nut
2 - Cup
3 - O-ring
4 - Element
5 - O-ring
6 - Valve lever
7 - O-ring
8 - Spring
9 - Valve
10 - Filter body

A - Do not remove.
B - Air vent screw.
C - Wash in diesel fuel every 100 service hours. Replace every 400 service hours.
D - Check for water and sediment accumulation.



Fuel filter (cartridge type)

A - Priming sequence
B - Air vent screws
C - From fuel tank
D - To pump
E - Replace every 400 service hours
F - Check for water and sediment accumulation

Do not attempt to disassemble the cartridge type fuel filter. Check the filter for contamination or damage and replace it as an assembly if necessary.

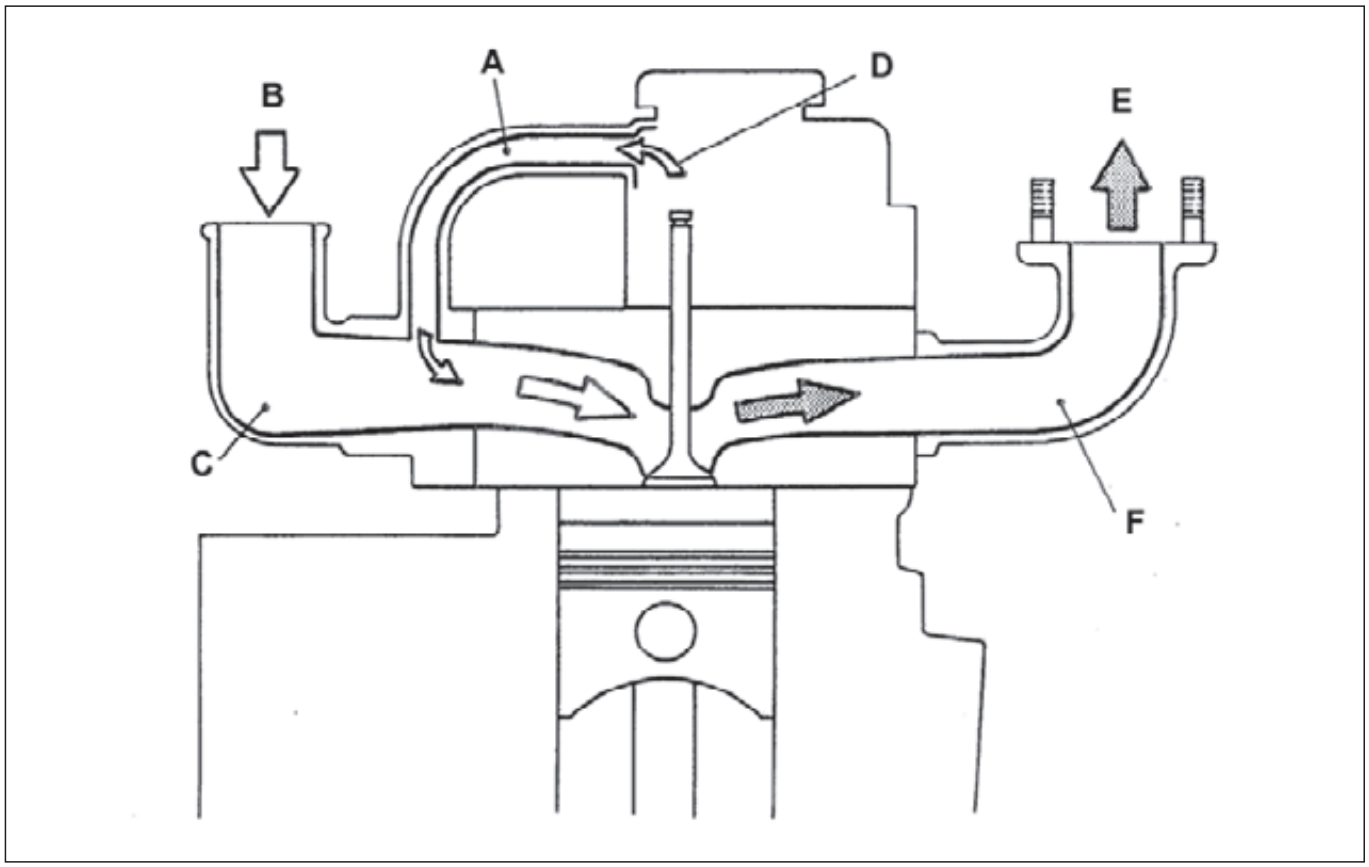
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GENERAL

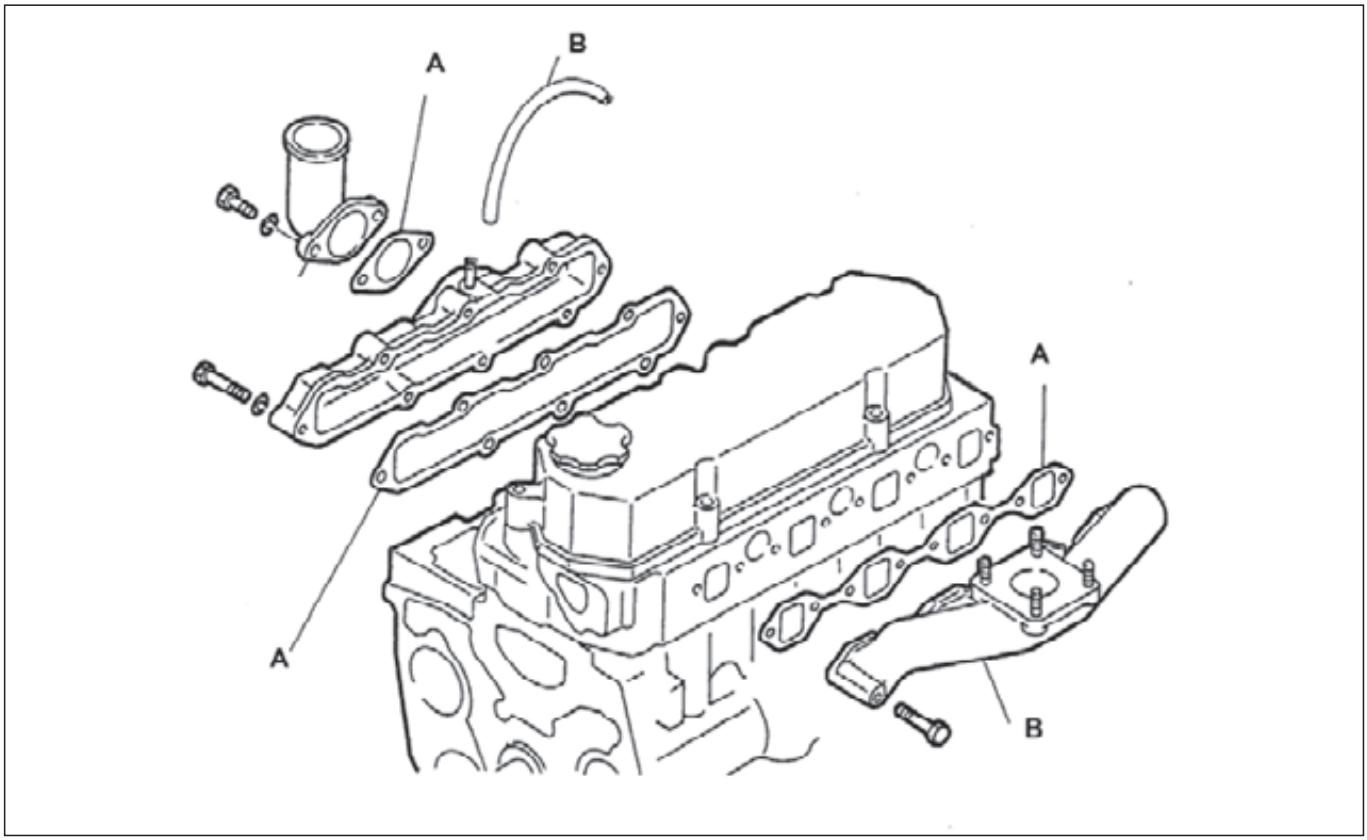
Schematic



A - Air breather pipe (for recirculation of blowby gases)
B - Air (from air cleaner)
C - Air inlet cover
D - Blowby gases
E - To exhaust muffler
F - Exhaust manifold

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INSPECTION



Inspection point

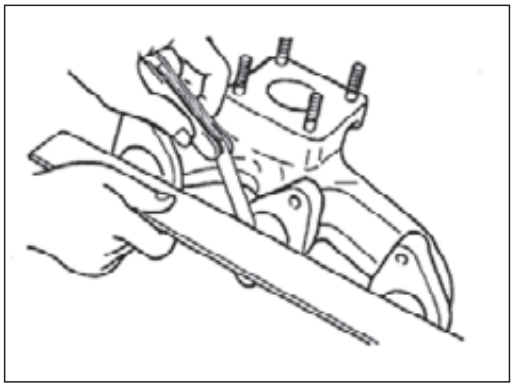
A - Use a new gasket
B - Check for cracks

Inspection procedure

Using a straight edge and a feeler gauge, check the flange faces of the manifold for warpage. If warpage exceeds the limit, recondition or replace the manifold.

Unit: mm (in.)

Item	Standard
Warpage of manifold	0.15 (0.0059)

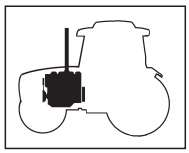


Checking manifold for warpage

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LUBRICATION AND MAINTENANCE CHART

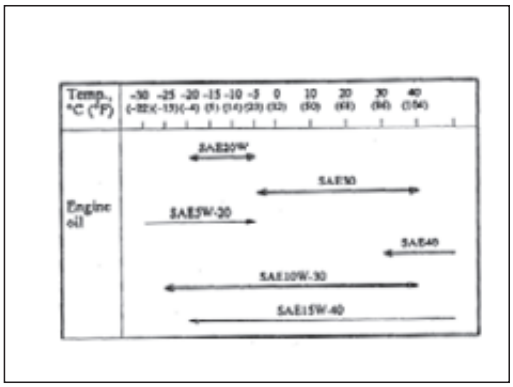
(1) Recommended service should be performed at the specified intervals. Under extremely severe, dusty or wet operating conditions, more frequent lubrication than is specified in this chart may be necessary.

(2) Perform service on items at multiples of the original requirement. For example, at Every 500 Service Hours, also service those items listed under Every 100 Service Hours, Every 50 Service Hours and Every 10 Service Hours.

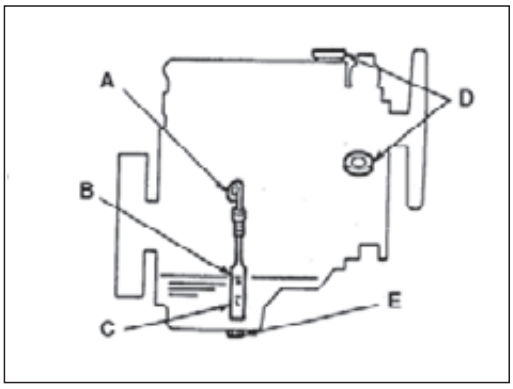
Service intervals	Item	Remarks (service data)
Every 10 service hours	Walk-around inspection Check engine oil level Check the amount of fuel Check coolant level	
Every 50 service hours	Drain water and sediment from fuel tank	
First 50 service hours of a new or reconditioned engine	Change engine oil Change oil filter Retighten bolts and nuts	Capacity: See SPECIFICATIONS
Every 100 service hours	Wash fuel filter Clean radiator fins	After fuel filter has been washed, prime fuel system (page 240)
Every 300 service hours	Change engine oil Change oil filter	Capacity: See SPECIFICATIONS
Every 500 service hours	Check and adjust valve clearance Change fuel filter element Check and adjust fuel injection nozzles Check fan belt Check glow plugs	0.25 mm (0.0098 in.) for inlet and exhaust valves Injection pressure: 140 kgf/cm² (1991 psi) [13729 kPa] Tension (deflection): 10 to 15 mm (0.4 to 0.6 in.)
Every 1000 service hours	Retighten bolts and nuts Check starter Check alternator	
Every 2 years	Change coolant	Capacity: See SPECIFICATIONS
When required	Prime fuel system Clean air cleaner element	

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ENGINE OIL AND OIL FILTER



Reccommended engine oil viscosities



Checking oil level

A - Dipstick
B - ”H” mark
C - ”L” mark
D - Oil fillers
E - Drain plug

Tightening torque	4 ± 0.5 kgf x m (29 ±4 lbf x ft) [39 ± 5 N x m]

1. Engine oil specifications

Use oils AKROS TURBO 15 W 40

2. Oil level check

(1) Check the crankcase oil level with dipstick with the engine kept level.

(2) If the oil level is at or below ”L” (low level) mark on the dipstick, add oil to ”H” (high level) mark on the dipstick.

NOTE:
a) After adding oil, leave the engine standing for one minute and check the oil level.
b) Avoid mixing different brands of oils. In some cases, they are not compatible with each other and deteriorate when mixed. Use the same brand at successive intervals.
c) If the engine has been left standing for a long period of time, check the oil for level and contamination before starting the engine. Start and run the engine for a few minutes. Then stop the engine and check the oil level again.

3. Oil change

(1) Change the oil after the first 50 service hours of operation of a new or reconditioned engine and every 300 service hours thereafter.

(2) Warm up the engine. Remove the drain plug and allow the oil to drain in a container. Install the drain plug, tightening it to the specified torque, and refill the engine with the new oil.

(3) Refill to the ”H” mark on the dipstick. Approximately 0.5 liter (0.5 qt) of oil is required for the oil filter and oil lines.

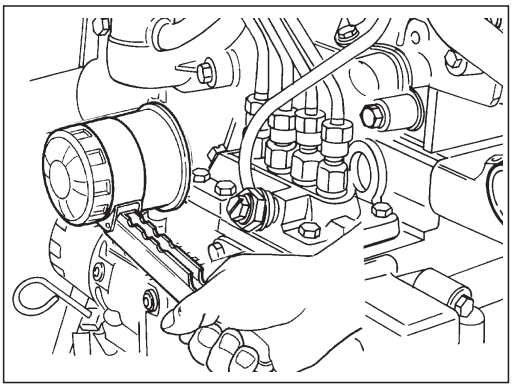
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4. Oil filter change

(1) Change the oil filter every 300 service hours.

(2) Remove the used filter with a filter wrench. Discard the filter.

(3) Remove all of the old filter gasket from the filter base and apply a thin coat of engine oil to the gasket on the new filter. Install the filter by hand until its gasket contacts the base. Tighten 3/4 turn more.



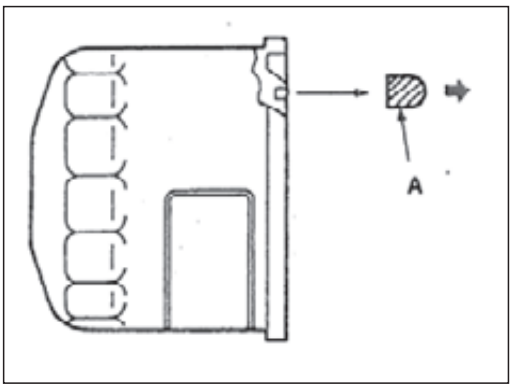
Installing new oil filter

CAUTION: Do not cause damage to the O-ring when installing the filter.

(4) Add 0.5 liter (0.5 qt) of oil.

(5) Start the engine and check for leaks around the filter.

(6) Stop the engine. Check the oil level and add oil if necessary.

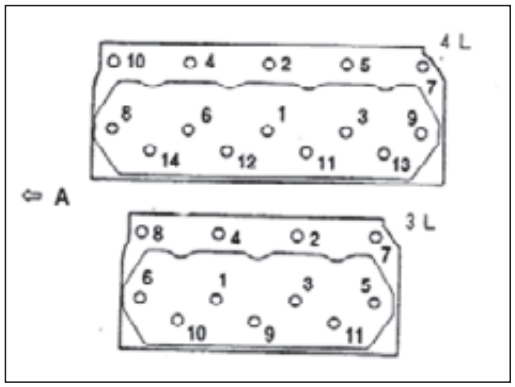


Installing new oil filter

A - Apply oil.

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VALVE CLEARANCE



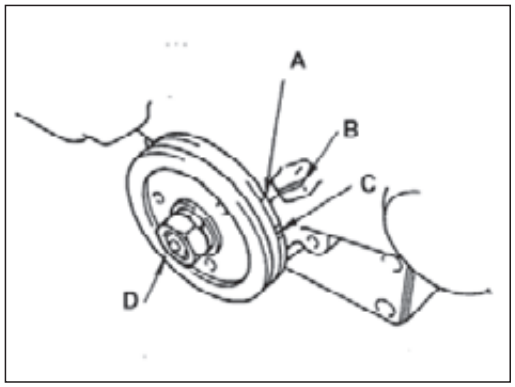
Cylinder head bolt tightening sequence

A - Front of engine

NOTE: Make an adjustment to the valve clearance when the engine is cold.

(1) Slightly loosen the cylinder head bolts and retighten the to the specified torque in number sequence.

Tightening torque	9 ± 0.5 kgf x m (65 ± 4 lbf x ft) [88 ± 5 N x m]



Timing mark

A - TDC (top dead center) mark for No. 1 and No. 4 pistons
B - Mark on timing gear case
C - IT (injection timing) mark
D - TDC mark for No. 2 and No. 3 pistons

(2) Find top dead center compression position for No. 1 piston by using the procedure that follows:

(a) Turn the crankshaft until TDC mark on the crankshaft pulley is aligned with the mark on the timing gear case.

(b) With No. 1 piston at top dead center on the compression stroke, the rocker arms will not be moved when the crankshaft is turned approximately 20’ in both directions.

(c) If the rocker arms move, No. 1 piston is at top dead center on the intake or exhaust stroke. In such a case, turn the crankshaft 360’ in the direction of engine rotation again. No. 1 piston is now at top dead center on the compression stroke.

(3) Loosen the lock nut for the adjusting screw. With a feeler gauge inserted between the rocker arm and valve cap, adjust the valve clearance by turning the adjusting screw.

Unit: mm (in.)

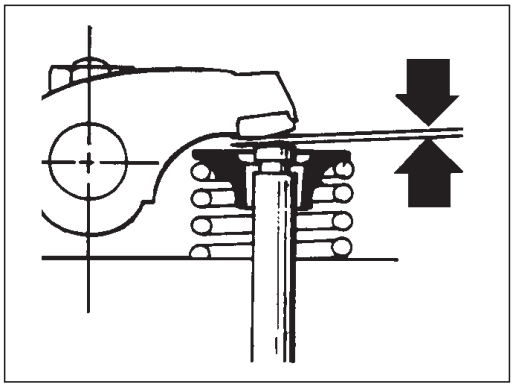
Item	Standard
Valve clearance (both inlet and exhaust valves)	0.25 (0.0098)

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(4) Hold the adjusting screw and tighten the lock nut.

(5) After the valve clearance on the valves for No. 1 cylinder has been adjusted, turn the crankshaft 180’ in the direction of engine rotation and adjust the valve clearance on the valves for the remainder of the cylinders in firing order (injection sequence)

Firing order (injection sequence)		Crankshaft rotation angle
S3L	1 – 3 – 2	240°
S4L	1 – 3 – 4 – 2	180°

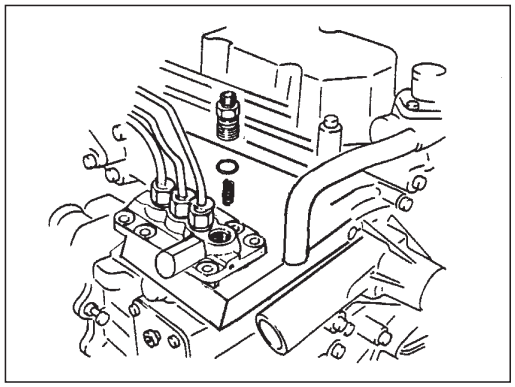


Adjusting valve clearance

CAUTION: After the valve clearance on the valves for all cylinders has been adjusted, turn the crankshaft two or three times and make sure the valve clearance is correct.

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FUEL INJECTION TIMING



Removing delivery valve and spring

1. Preparation

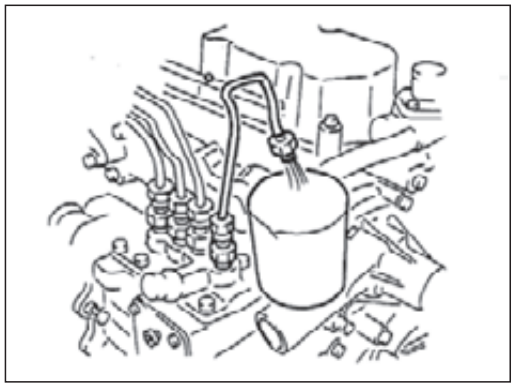
(1) Close the fuel filter valve.

(2) Disconnect the N°. 1 fuel injection pipe from the cylinder head and injection pump

(3) Remove No.1 delivery valve holder from the injection pump. Remove the delivery valve and spring from the holder. Restore the delivery valve holder only to the injection pump.

(4) Connect the fuel injection pipe to the injection pump.

(5) Hold the speed control lever in the low speed position.



Fuel coming from injection pipe

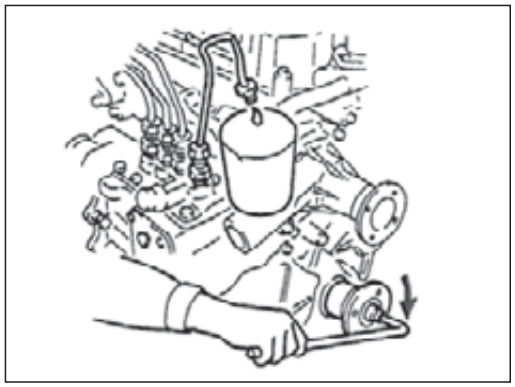
2. Inspection

2.2 Fuel flow method

(1) Open the fuel filter valve. Turn the starter switch key to GN position.

NOTE: Fuel will come from the injection pipe with high pressure when the starter switch key is turned to position if the engine is equipped with an electric fuel pump. Direct fuel flow into the container.

(2) Slowly turn the crankshaft clockwise, looking at the free end of the injection pipe. The instant fuel stops coming out is the fuel injection timing.



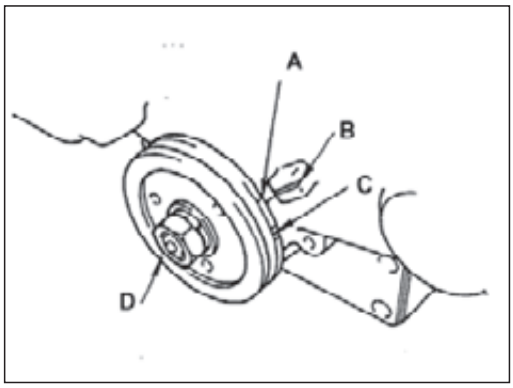
Fuel stops coming from injection pipe

NOTE: Turn the crankshaft in reverse direction just a little and do Step (2) again to verify the injection timing.

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(3) The fuel injection timing is correct if IT mark on the crankshaft pulley is aligned with the mark on the timing gear case when fuel stops fro the injection pipe.

Fuel Injection timing (BTDC)	17° (standard)



Timing mark
A - TDC (top dead center) mark for No. 1 and No. 4 pistons
B - Mark on timing gear case
C - IT (injection timing) mark
D - TDC mark for No. 2 and No. 3 pistons

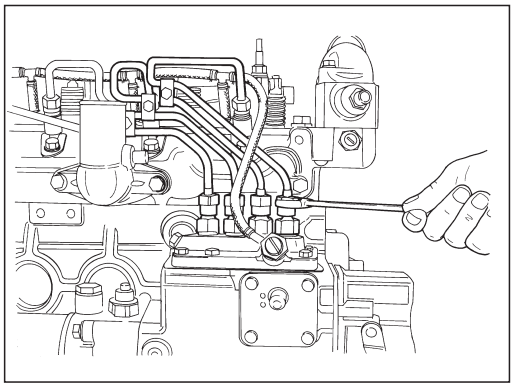
2.2 Alternate method

In the fuel flow method, the delivery valve has to be removed. As a result, there is a good chance for dirt particles to get inside the fuel injection pump. In this alternate method, however, it is not necessary to remove the delivery valve.

(1) Disconnect No. 1 fuel injection pipe at the fuel injection nozzle (cylinder head).

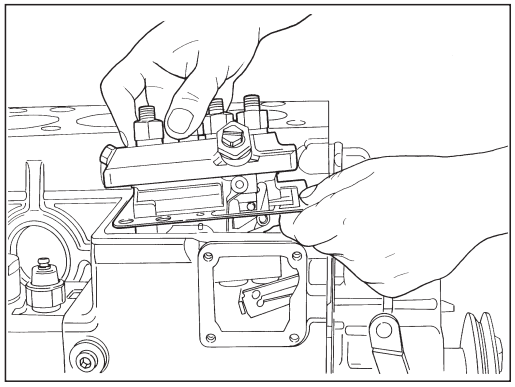
(2) Prime the fuel system.

(3) Slowly turn the crankshaft clockwise until fuel just swells at the free end of the injection pipe and, at that instant, check the position of the IT mark with respect to the mark on the gear case. This timing is approximately 1° retarded. Take this 1° retardation into account when making a shim adjustment.

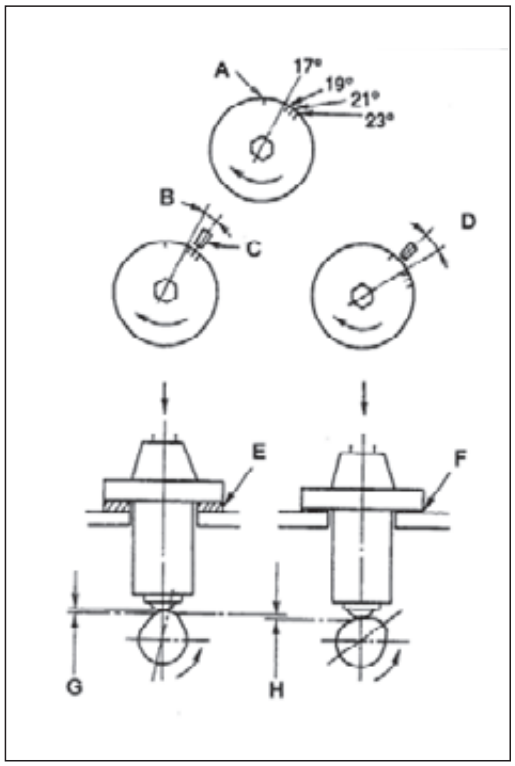


Disconnecting No. 1 fuel injection pipe

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Adjusting fuel injection timing



Adjusting fuel injection timing

A - TDC mark
B - Angle by which fuel injection timing is advanced
C - Mark on timing gear case
D - Angle by which fuel injection timing is retarded
E - Increase shim thickness
F - Decrease shim thickness
G - Retarded
H - Advanced

3. Adjustment

(1) If the fuel injection timing is incorrect, change the thickness of shims under the fuel injection pump. An increase or decrease of the shims by 0.1 mm (0.004 in.) will vary the timing by 1°.

(2) Increase the thickness of the shims to retard the timing or decrease it to advance the timing.

Adjustment range	standard ± 1.5°

Four kinds of shims are available in thicknesses 0.2 mm (0.007 9 in.), 0.3 mm (0.011 8 in.), 0.4 m m (0.015 7 in.) and 0.8 mm (0.031 5 in.). These shims have no identification; measure the thickness of each shim with a calipers before using it.

CAUTION: Apply sealant to both faces of each shim to prevent oil leaks.

(3) After the timing has been adjusted, make sure it is correct.

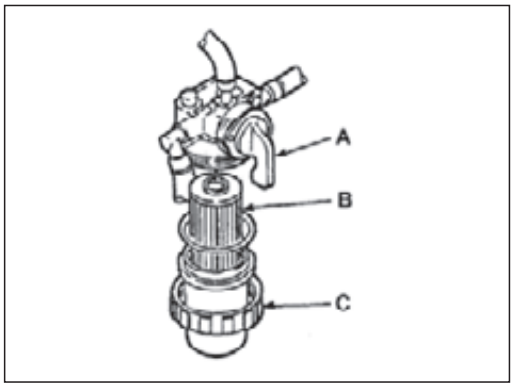
(4) Close the fuel filter valve and restore the delivery valve and injection pipe to the original state.

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FUEL FILTER

Fuel filter with [AIR] valve

Close the fuel filter valve. Loosen the ring nut and take out the element for cleaning or replacement.

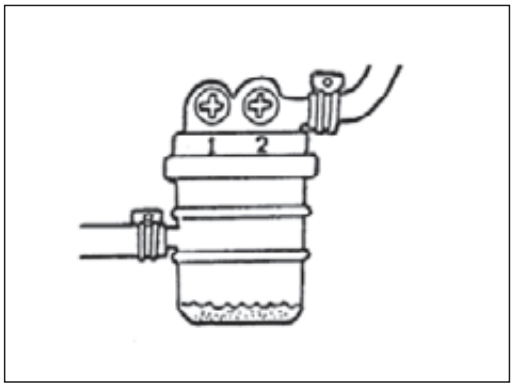


Fuel filter with [AIR] valve

A - Valve lever
B - Element
C - Ring nut

Cartridge (air vent screw) type fuel filter

Replace the filter as an assembly if water and sediment have been accumulated in it.



Cartridge type fuel filter

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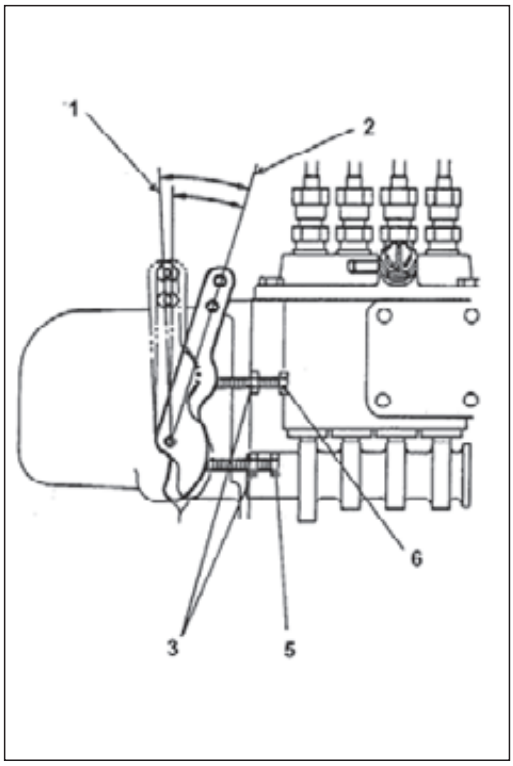
IDLE RPM SETTING

NOTE: Make sure that the valve clearance and injection timing are correct and that the fuel injection nozzles have no defect.

(1) Start and run the engine at low idle until the coolant temperature is above 60 °C (140°F).

(2) To set the low idle rpm loosen the lock nut for the idling set bolt and turn the set bolt to make the engine run at the specified rpm. Tighten the lock nut.

(3) To set the high idle rpm, loosen the lock nut for the high-idle set bolt and turn the set bolt to make the engine run at the specified rpm. Tighten the lock nut.



Idle rpm setting

1 - High idle position
2 - Low idle position
3 - Idling set bolt
4 - Lock nuts
5 - High-idle set bolt

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FUEL INJECTION NOZZLES

1 - Injection pressure (valve opening pressure) test

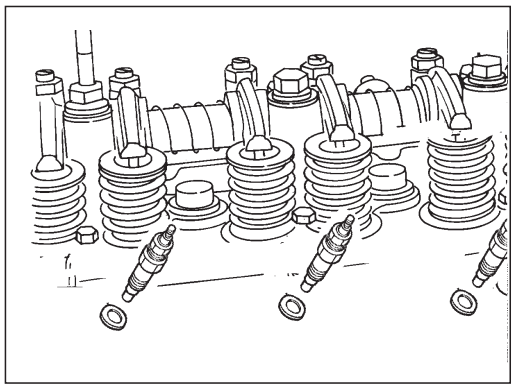
Make reference to FUEL INJECTION NOZZLE (page 212).

2. Orifice restnction test

Make reference to FUEL INJECTION NOZZLE (page 213).

3. Nozzle tip washing and replacement

Make reference to FUEL INJECTION NOZZLE (page 213).



Installing fuel injection nozzles

4. Installation

(1) Put the gasket on the injection nozzle.

(2) Put the nozzle in position in the cylinder head and tighten it to the specified torque.

Tightening torque	5.5 ± 0.5 kgf x m (40 ± 4 lbf x ft) [54 ± 5 N x m]

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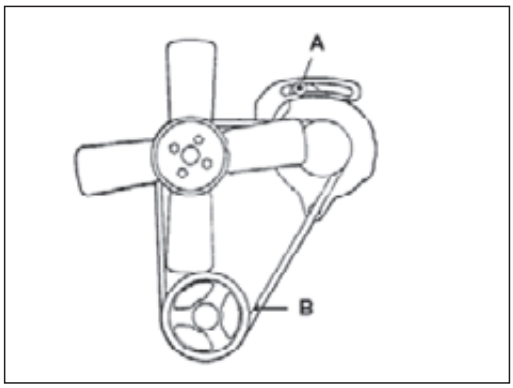
FAN BELT

(1) Measure the deflection of the belt. Apply 10 kgf (22 lbf) [98 N] force midway between the alternator pulley and the crankshaft pulley.

(2)Adjust the belt if the deflection is not correct. Loosen the adjusting bolt and move the alternator to obtain the required belt deflection.

Unit: mm (in.)

Item	Standard
Deflection	10 to 12 (0.4 to 0.5)



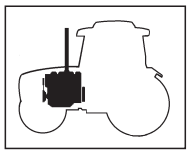
Adjusting fan belt

A - Adjusting bolt
B - Deflection: 10 to 12 mm (0.4 to 0.5 in.) under 10 kgf (22 lbf) [98 N] force

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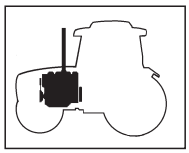


1. Basic engine components

Unit: mm (in.)

Item		Standard		Limit	Correction - Remarks
Compression pressure		30 kgf/cm² (427 psi) [2942 kPa]		27 kgf/cm² (384 psi) [2648 kPa]	Repair or replace
Maximum permissible difference between average compression pressure of all cylinders in one engine		3 kgf/cm² (42.7 psi) [294 kPa]		-	Repair or replace
Fuel injection timing (BTDC)		17°			
Clearance between rocker arm and shaft (oil clearance)		0.012 to 0.050 (0.00047 to 0.00197)		0.200 (0.00787)	Replace rocker arm.
Valve clearance		0.25 (0.0098)			Adjust.
Clearance between valve stem and valve guide	Inlet valve	0.02 to 0.05 (0.0008 to 0.0020)		0.10 (0.0039)	Replace valve and valve guide
	Exhaust valve	0.05 to 0.085 (0.0020 to 0.00335)		0.15 (0.0059)	
Valve margin (valve lip thickness)		1.0 (0.039)		0.5 (0.020)	Replace valve
Valve sinkage		0.5 ± 0.25 (0.020 ± 0.00098)		1.5 (0.059)	Recondition valve seat or replace cylinder head.
Valve seat	Angle	45°		-	Recondition
	Width	1.3 to 1.8 (0.051 to 0.071)		2.5 (0.098)	
Valve spring	Free lenght	47 (1.85)		46 (1.81)	Replace
	Length under test force	39.1 (1.54)	30.5 (1.20)	-	
	Test force, Kgf (lbf) [N]	13.9 ± 0.7 (30.6 ± 1.5) [136 ± 7]	29 ± 2 (64 ± 4.4) [284 ± 20]	-15%	
Warpage of cylinder head bottom face		0.05 (0.0020) maximum		0.10 (0.0039)	Repair
Bend (dial indicator reading of valve push rod		-		0.3 (0.012)	Replace
Timing gear backlash	Crankshaft gear and idler gear	0.04 to 0.12 (0.0016 to 0.0047		0.30 (0.0118)	Replace
	Idle gear and camshaft gear				
	Idler gear and fuel injection pump camshaft gear				
	Camshaft gear and P.T.O. gear	0.08 to 0.19 (0.0031 to 0.0078)			
	Fuel injection pump camshaft gear and oil pump gear	0.07 to 0.20 (0.0028 to 0.0079)			
Lobe height of camshaft		35.72 (1.4063)		34.72 (1.3669)	Replace
Lobe height of fuel injection pump camshaft		44 (1.73)		43 (1.69)	Replace
Flatness of flywheel		0.15 (0.0059) maximum		0.50 (0.0197)	Recondition

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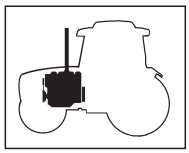
1 Mitsubishi engine

Service data

Unit: mm (in.)

Item		Standard	Limit	Correction - Remarks
Clearance between tappet and cylinder block		-	0.15 (0.005 9)	Replace tappet.
Clearance between camshaft journal and bushing		-	0.15 (O.E)5 9)	Replace bushing.
Clearance between idler gear and shaft		0.03 to 0.07 (0.0012 to 0.0028)	0.20 (0.0079)	Replace idler gear or shaft.
Warpage of cylinder block top face		0.05 (0.0020) maximum	0.10 (0.0939)	Repair.
Bore in cylinder block		$78.0_{0}^{+0.03}$ ($3.07_{0}^{+0.0012}$)	78.2 (3.079)	Hone out re for over-size piston or replace cylinder block.
Taper and out-of-round of cylinder		0.01 (0.0004) maximum	-	
Diameter of piston	Standard	77.93 to 77.95 (3.0681 to 3.0689)	77.80 (3.0630)	
	0.25 (0.0098) oversize	78.18 to 78.20 (3.0779 to 3.0787)	78.05 (3.0728)	
	0.50 (0.0197) oversize	78.43 to 78.45 (3.0878 to 3.0886)	78.30 (3.0827)	
Clearance between piston pin and piston		0.006 to 0.018 (0.00024 to 0.00071)	0.050 (0.00197)	
Clearance between piston ring and groove	No. 1 compression ring	0.06 to 0.10 (0.002 4 to 0.003 9)	0.30 (0.0118)	Replace piston ring.
	No. 2 compression ring	0.05 to 0.09 (0.002 0 to 0.003 5)	0.20 (0.007 9)	
	Oil ring	0.03 to 0.07 (0.001 2 to 0.002 8)	0.20 (0.007 9)	
Clearance between ends of piston ring	No. 1 compression ring	0.15 to 0.30 (0.0059 to 0.0118)	1.50 (0.059)	Replace piston ring.
	No. 2 compression ring	0.15 to 0.35 (0.0059 to 0.0138)		
	Oil ring	0.20 to 0.40 (0.0079 to 0.0157)		
Clearance between piston and cylinder		0.035 to 0.086 (0.00138 to 0.00339)	0.300 (0.01181)	Hone out bore for over-size piston or replace cylinder block.
Clearance between crankpin and connecting rod bearing		0.025 to 0.072 (0.00098 to 0.00283)	0.150 (0.00591)	Replace connecting rod bearing.
Thrust clearance for connecting rod big end		0.10 to 0.35 (0.0039 to 0.0138)	0.50 (0.0197)	Replace connecting rod.
Crankshaft	Diameter of journal	51.985 to 52.000 (2.04665 to 2.04724)	-	
	Diameter of crankpin	47.950 to 47.965 (1.88779 to 1.88838)	-	
	Runout	0.025 (0.00098)	0.05 (0.0020)	Repair or replace.
	Clearance between journal and main bearing	0.030 to 0.077 (0.00118 to 0.00303)	0.100 (0.00394)	Replace main bearing.
	Clearance between crankpin and connecting rod bearing	0.025 to 0.072 (0.00098 to 0.00283)	0.150 (0.00591)	Replace connecting rod bearing.
	End play	0.050 to 0.175 (0.00197 to 0.00689)	0.500 (0.01969)	Replace No. 3 flanged bearing.

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2. Lubrication system

Unit: mm (in.)

Item	Standard	Limit	Correction - Remarks
Pressure relief valve setting	3.5 ± 0.5 kgf/cm^3 (50 ± 7 psi) [343 ± 49 kPa]	-	Replace.
Pressure difference at which oil pressure switch is closed (indicator light comes on)	0.5 ± 0.1 kgf/cm^3 (7 ± 1.4 psi) [49 ± 10 kPa]	-	Replace.

3. Fuel system

Unit: mm (in.)

Item	Standard	Limit	Correction - Remarks
Injection pressure (valve opening pressure)	140_{0}^{+5} kgf/cm^3 (1991_{0}^{+71} psi) [13729_{0}^{+490} kPa]	-	Adjust with washer.

4. Air inlet system and exhaust system

Unit: mm (in.)

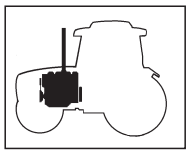
Item	Standard	Limit	Correction - Remarks
Paper-element type air cleaner element	If warning pilot lamp lights up	to replace after three cleanings	
Warpage of mounting faces of manifolds	-	0.15 (0.0059)	Repair or replace.

5. Cooling system (standard)

Unit: mm (in.)

Item		Standard	Limit	Correction - Remarks
Thermostat	Temperature at which valve starts opening	82 ± 1.5° C (180 ± 2.7° F)	-	Replace.
	Temperature at which valve lift is more than 8 mm (0.3 in.)	95° C (203° F)	-	
Thermoswitch	Temperature at which switch is turned ON	111 ± 3.5° C (232 ± 6.3°F)	-	Replace.
	Resistance at oil temperature of 120° C (284° F)	30 mΩ maximum	-	
Resistance in thermounit	At 50° C (122° F)	80 ± 10 Ω	-	Replace.
	At 80° C (176° F)	29.5±+ 2.5 Ω	-	
	At 120° C (248° F)	10 ± 0.3 Ω	-	
Deflection of fan belt under 10 kgf (22 lbf) [98 N] force applied midway between alternator pulley and crankshaft pulley		10 to 12 (0.4 to 0.5)	-	Replace.

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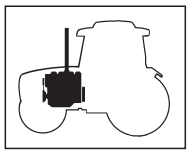


6. Electrical system

Unit: mm (in.)

Item				Standard		Limit	Correction - Remarks
Starter	Pinion clearance			0.5 to 2.0 (0.020 to 0.079)		-	Adjust with packing.
	No-load characteriscteristics			S3L/S3L2	S4L/S4L2		Test.
			Terminal voltage	11.5 V	11 V	-	
			Current draw	100 A maximum	130 A maximum	-	
			Rpm	3000 minimum	3850 minimum	-	
	Brush length			-		Wear limit line	Replace.
	Brush spring tension			3.0 kgf (6.6 lbf) [29.4 N]		1.8 kgf (4.0 lbf) [17.7 N]	Replace.
	Runout of commutator			0.03 (0.0012)		0.10 (0.0039)	Repair or replace.
	Diameter of commutator			32 (1.26)		31 (1.22)	Replace.
	Undercut of mica			0.5 (0.020)		0.2 (0.008)	Repaire.
Alternador	Regulated voltage at 20° C (68° F)			14.7 ± 0.3 V		-	
	Output characteristics (at operating temperature)	Below 2500 rpm	Terminal voltage	13.5 V		-	Test.
			Current	33 A		-	
		Below 5000 rpm	Terminal voltage	13.5 V		-	
			Current	47 A		-	
	Brush length			-		Wear limit line	Replace.
Resistance in glow plug				0.55 Ω		-	Replace.

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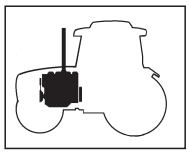


TIGHTENING TORQUES

1. Major bolts and nuts

Bolt or nut	Thread, mm				Torque, kgf-m (lbf-ft) [N-m]
	Diameter	Pitch	Width across flats	Clamp length	
Cylinder head bolt	M10	1.25	14	87	9 ± 0.5 (65 ± 4) [88 ± 5]
Rocker cover bolt	M8	1.25	12	40	1.15 ± 0.15 (8.3 ± 1.1) [11.3 ± 1.5]
Rocker shaft bracket bolt	M8	1.25	12	58	1.5 ± 0.5 (11± 4) [14.7 ± 5]
Thermoswitch	M16	1.5	17	31.5	2.3 ± 0.4 (16.6 ± 3) [22.6 ± 4]
Crankshaft pulley nut	M18	1.5	27	-	17.5 ± 2.5 (127 ± 18) [172 ± 25]
Main bearing cap bolt	M10	1.25	17	81	5.25 ± 0.25 (38 ± 2) [51.5± 2.5]
Connecting rod cap nut	M9	1.0	14	-	3.55 ± 0.25 (25.7 ± 2) [34.8 ± 2.5]
Rear plate bolt (for tractor engine)	M12	1.25	17	28	9.5 ± 1 (69 ± 7) [93 ± 10]
Rear plate bolt (standard)	M12	1.25	17	28	6.5 ± 1 (47 ± 7) [64 ± 10]
Rear plate bolt (stamping)	M8	1.25	12	16	1.15 ± 0.15 (83 ± 1.1) [11.3 ± 1.5]
Flywheel bolt	M12	1.25	19	29	13.5 ± 0.5 (98 ± 4) [132 ± 5]
Oil pan bolt (for tractor engine)	M8	1.25	12	25	2.8 ± 0.3 (20.3 ± 2.2) [27.5 ± 3]
Oil pan drain plug	M14	1.5	22	10	4 ± 0.5 (29 ± 4) [39 ± 5]
Pressure relief valve	M22	1.5	22	33	5 ± 0.5 (36 ± 4) [49 ± 5]
Oil filter	M20	1.5	-	-	1.2 ± 0.1 (8.7± 0.7) [12 ± 1]
Oil pressure switch	PT1/8	-	26	11	1 ± 0.2 (7.2 ± 1.4) [10 ± 2]
Fuel injection pipe nut	M12	1.5	-	-	3 ± 0.5 (22 ± 4) [29 ± 5]
Fuel leak-off pipe nut	M12	1.5	18	-	2.75 ± 0.25 (20 ± 2) [27 ± 2.5]
Delivery valve holder	-	-	19	-	4.5 ± 0.5 (32.5 ± 4) [44 ± 5]
Fuel injection nozzle holder	M20	1.5	21	-	5.5 ± 0.5 (40 ± 4) [54 ± 5]
Retaining nut for delivery valve holder body	M16	0.75	19	-	3.75 ± 0.25 (27 ± 2) [37 ± 2.5]
Sliding sleeve shaft	M10	1.25	14	29.5	3.6 ± 0.6 (26 ± 4) [35 ± 6]
Special nut for torque spring set	M12	1.0	17	-	2 ± 0.5 (14 ± 4) [20 ± 5]
Glow plug	M10	1.25	12	60	1.75 ± 0.25(12.7 ± 2) [17.2 ± 2.5]
Glow plug connection plate	M4	0.7	8	-	0.125 ± 0.025 (0.9 ± 0.2) [1.2 ± 0.2]
Stop solenoid nut	M30	1.5	36	-	4.5 ± 0.5 (32.5 ± 4) [44 ± 5]
Starter B terminal	M8	1.25	12	-	1.1 ± 0.1 (8 ± 0.7) [10.8 ± 1]

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1 Mitsubishi engine

Service data

2. Torques for bolts an nuts with standard threads

Unit: kgf-m (lbf-ft) [N-m]

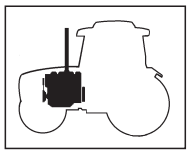
Thread diameter	Identification on head		
	4	7	
M6	0.4 ± 0.1 (3 ± 0.7) [3.9± 1]	0.9 ± 0.1 (6.5 ± 0.7) [8.8 ± 1]	
M8	1.1 ± 0.1 (8 ± 0.7) [10.8 ± 1]	1.85 ± 0.35 (13.4 ± 2.5) [18 ± 3]	
M10	2.15 ± 0.35 (15.6 ± 2.5) [21 ± 3]	3.6 ± 0.6 (26 ± 4.3) [35.3 ± 6]	
M12	3.6 ± 0.6 (26 ± 4.3) [35.3 ± 6]	6.5 ± 1 (47 ± 7) [63.7 ± 10]	
M14	6 ±1 (43 ± 7) [59 ± 10]	9.5 ± 1.5 (69± 11) [93.2± 15]	

3. Torques for plugs with taperlock threads

Unit: kgf-m (lbf-ft) [N-m]

Size	For aluminum materials	For ferrous materials
NPTF1/16	0.65 ± 0.15 (4.7± 1) [6.4± 1]	1 ± 0.2 (7.2 ± 1) [10± 2]
PT1/8	1 ± 0.2 (7.2 ± 1) [10 ± 2]	1.85 ± 0.35 (13.4 ± 2.5) [18 ± 3]
PT1/8, NPTF1/4	2.5 ± 0.5 (18 ± 4) [25 ± 5]	4 ± 0.5 (29 ± 4) [39 ± 5]
PT3/8	-	6.5 ± 1 (47 ± 7) [64 ± 10]

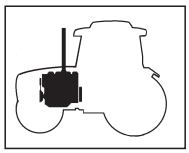
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SEALANTS

Component		Sealant	Mating part	Mating part
Thread parts	Stop solenoid	Three Bond 1212	Governor case	Apply to effective thread part
	Water drain joint	Three Bond 1212	Cylinder block	
	Oil pressure switch			
	Torque spring set	Three Bond 1102	Governor case	
Force-fit parts	Sealing cap	Three Bond 1102	Cylinder block	Apply to holes in cylinder head and cylinder block.
			Cylinder head	
			Cylinder head and cylinder block	
	Expansion plug		Cylinder block	
	Dipstick guide			
Other parts	Side seal	Three Bond 1212	Cylinder block and main bearing caps	Apply to external surface.
	Main bearing caps (front and rear)		Cylinder block	Apply to surfaces that come into contact with cylinder block.
	Oil pan	Three Bond 1207C		Apply to sealing surface.

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SPECIAL TOOLS

NOTE: In the previous pages we have mentioned the ordering codes of special tools, as suggested by the engine maker.

These special tools are serviceable by Mitsubishi only.