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GRADALL®

Technical Manual

Part Number 80404137

XL4100II

(6x4) S/N 4100001 thru 4100145,
0210017431 thru 0210018099
& 4100000146 & After

(6x6) S/N 4160001 thru 4160012,
0210017428 thru 0210018093
& 4160000013 & After

Original Issue
May 6th, 2011

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GRADALL®

XL4100II

Electrical System Manual



ALAMO GROUP

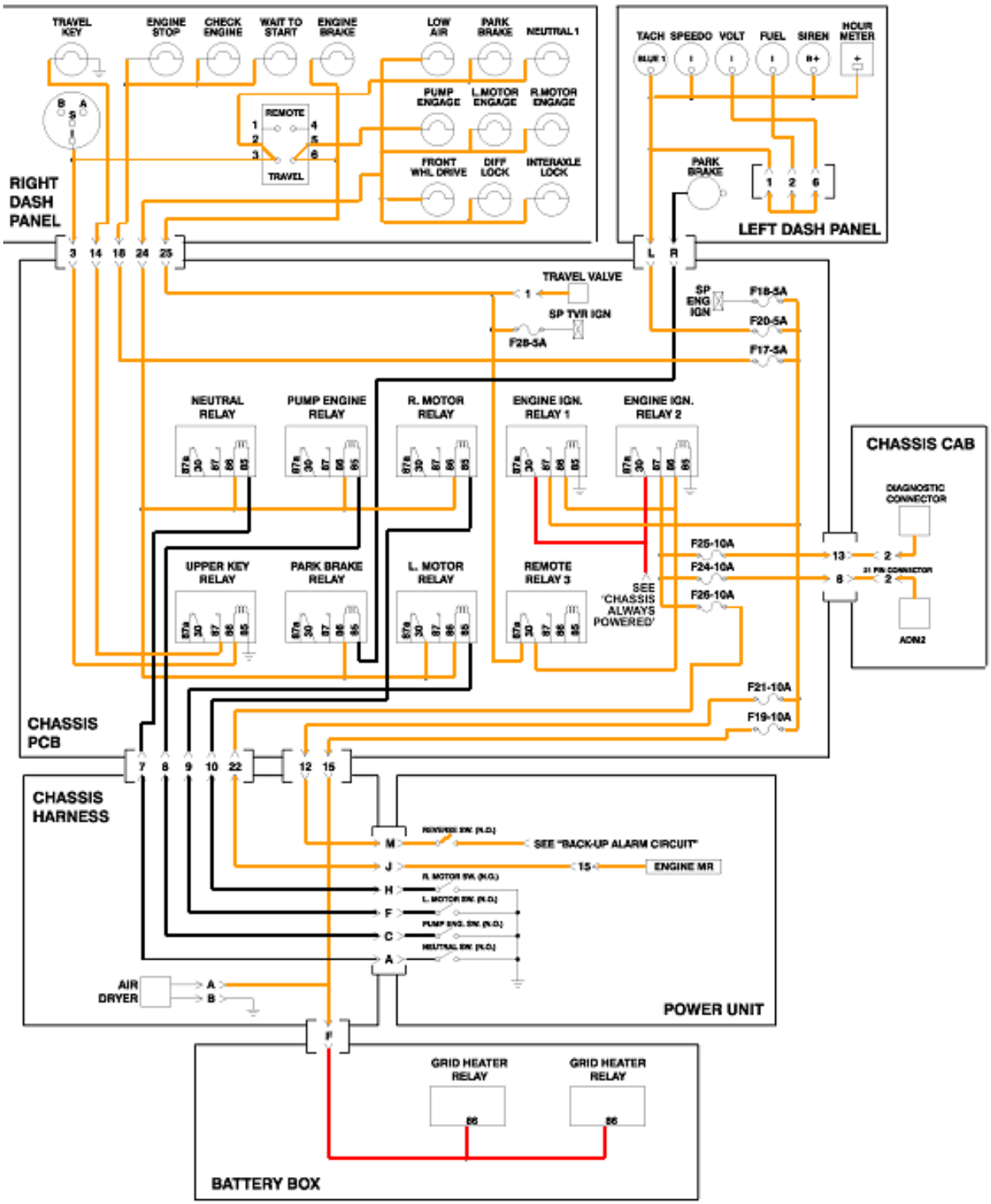
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Introduction

- This manual provides color diagrams of specific circuits. Always have the electrical schematic available while troubleshooting for additional detail
- The machine uses a 12V system.
- When making any weld repairs, battery leads and any processors must be disconnected to prevent damage.
- A digital volt/ohm meter is recommended for accurate testing of circuits.
- Weather resistant connectors are used throughout the electrical system. Use of special terminal removal tools and crimping tools is required for connector repair and replacement.
- Wire designations are provided on the wiring to assist troubleshooting.

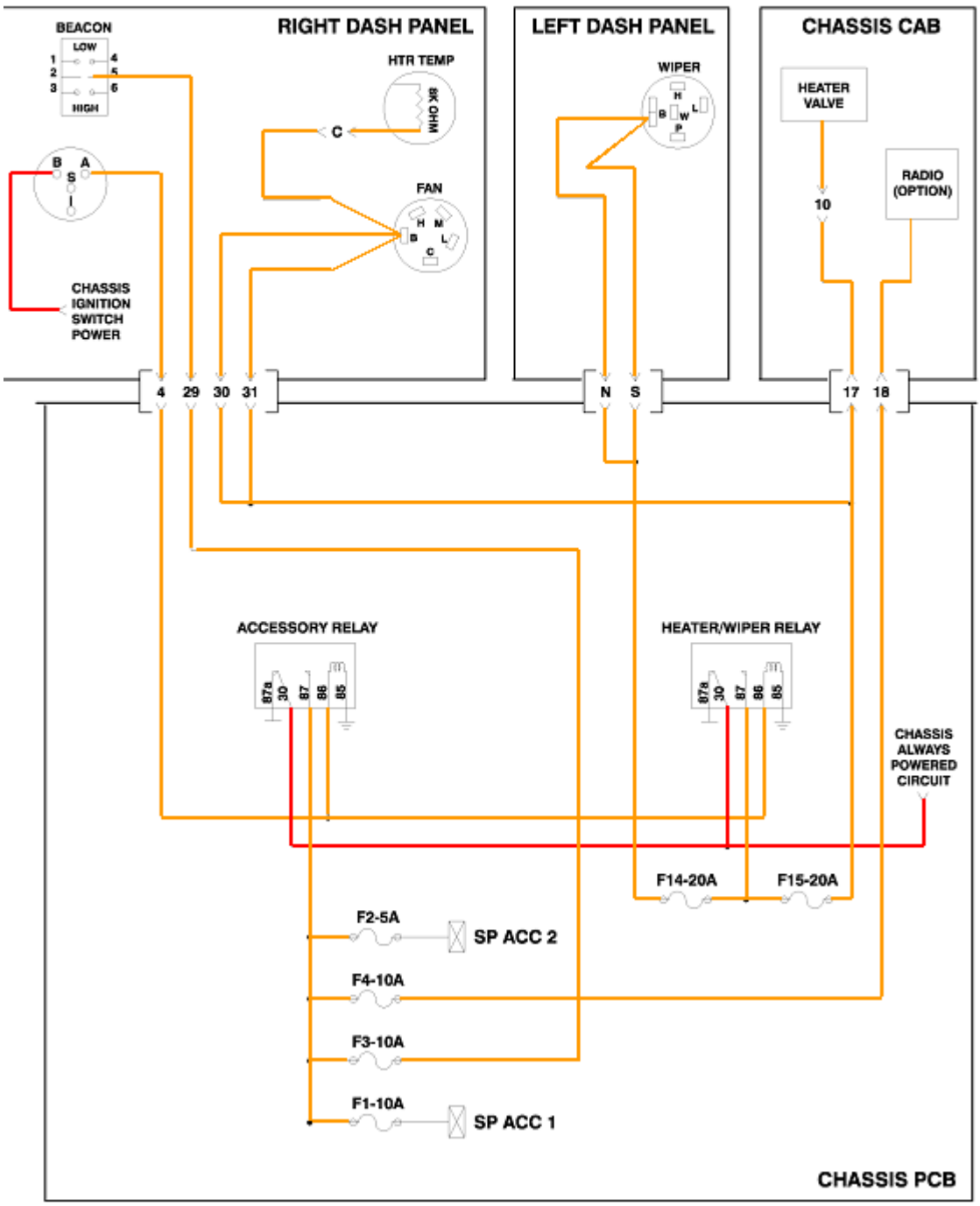
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UN-4 CHASSIS IGNITION CIRCUIT



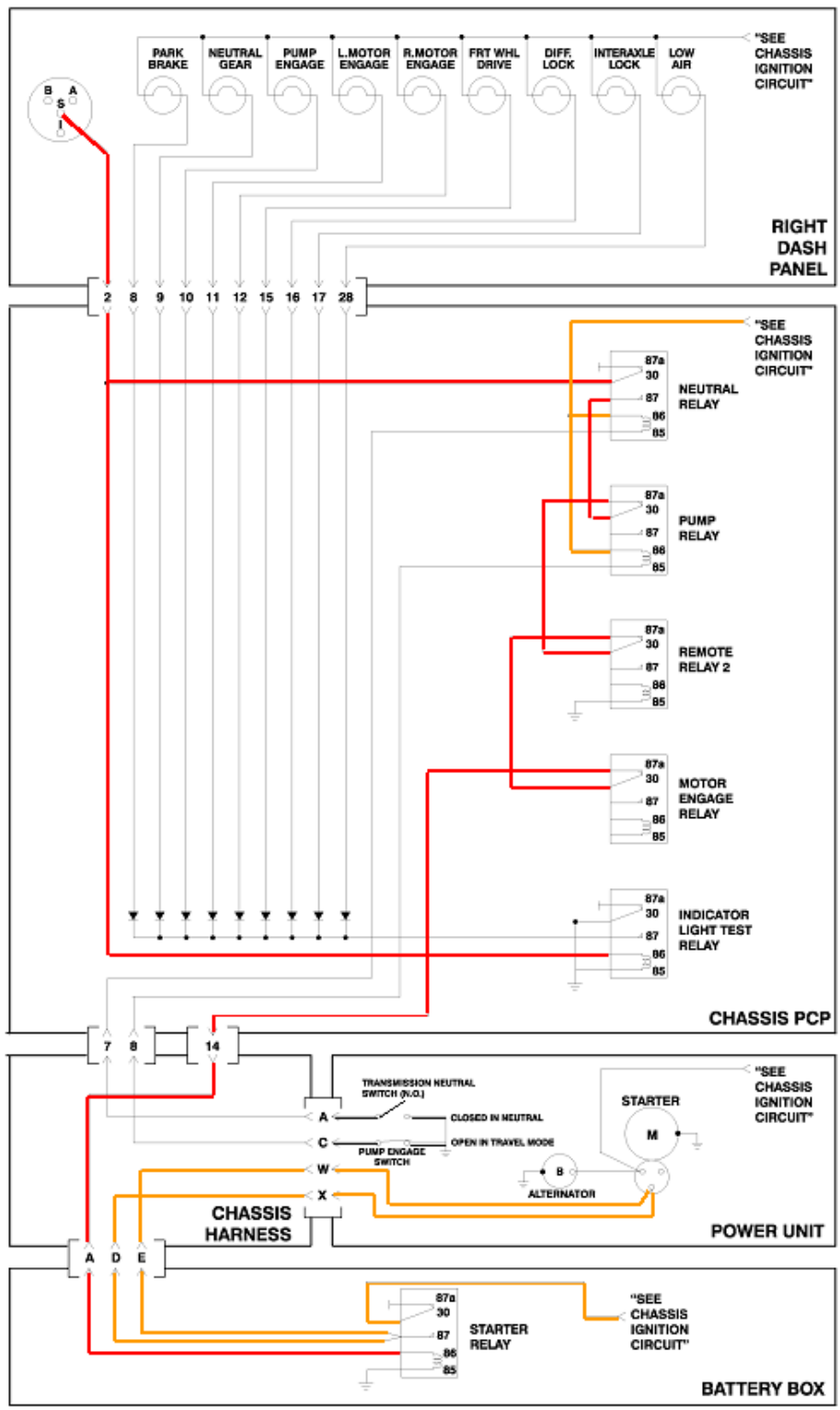
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UN-5 CHASSIS - ACC (ACCESSORIES)



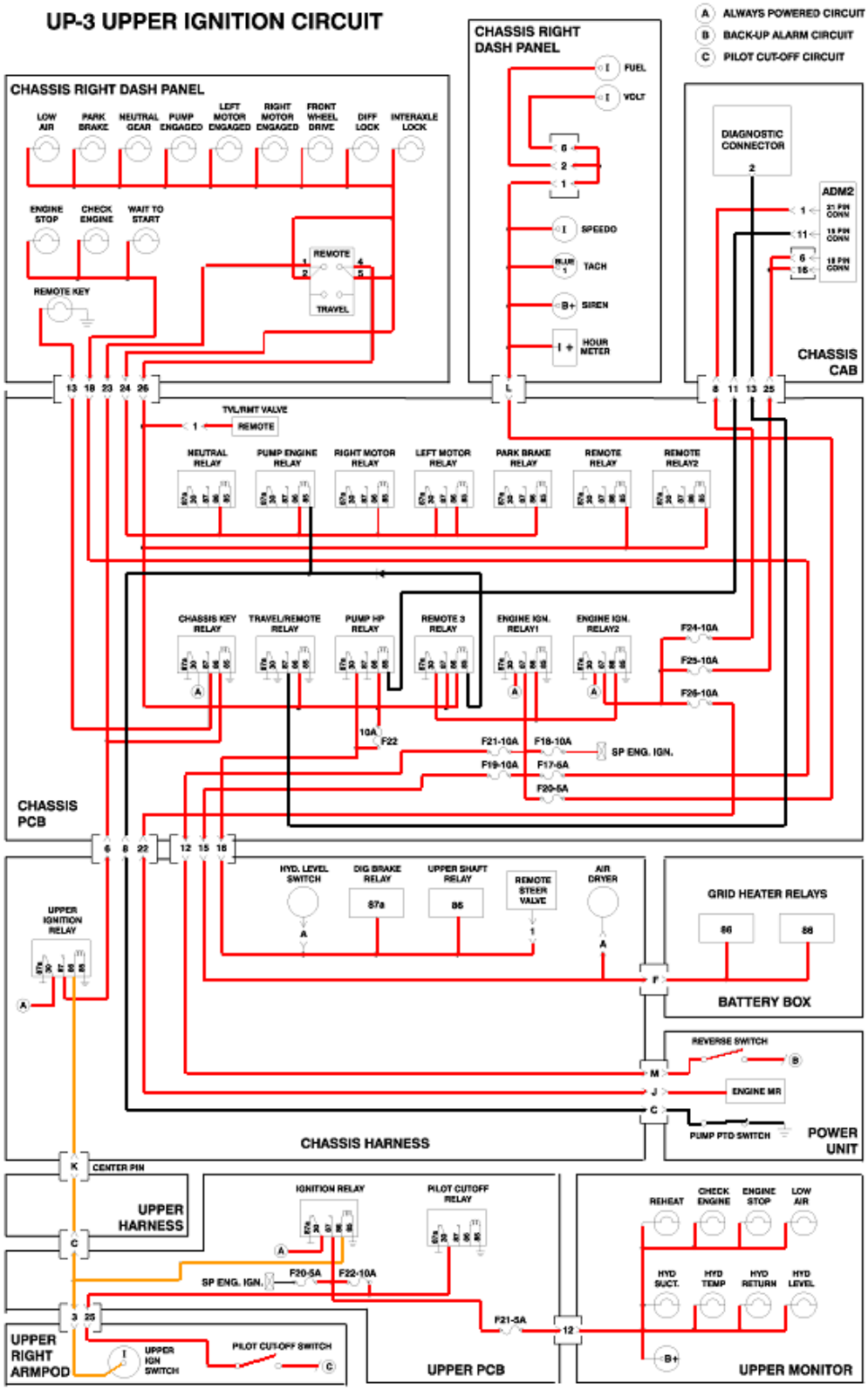
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UN-3 CHASSIS START CIRCUIT



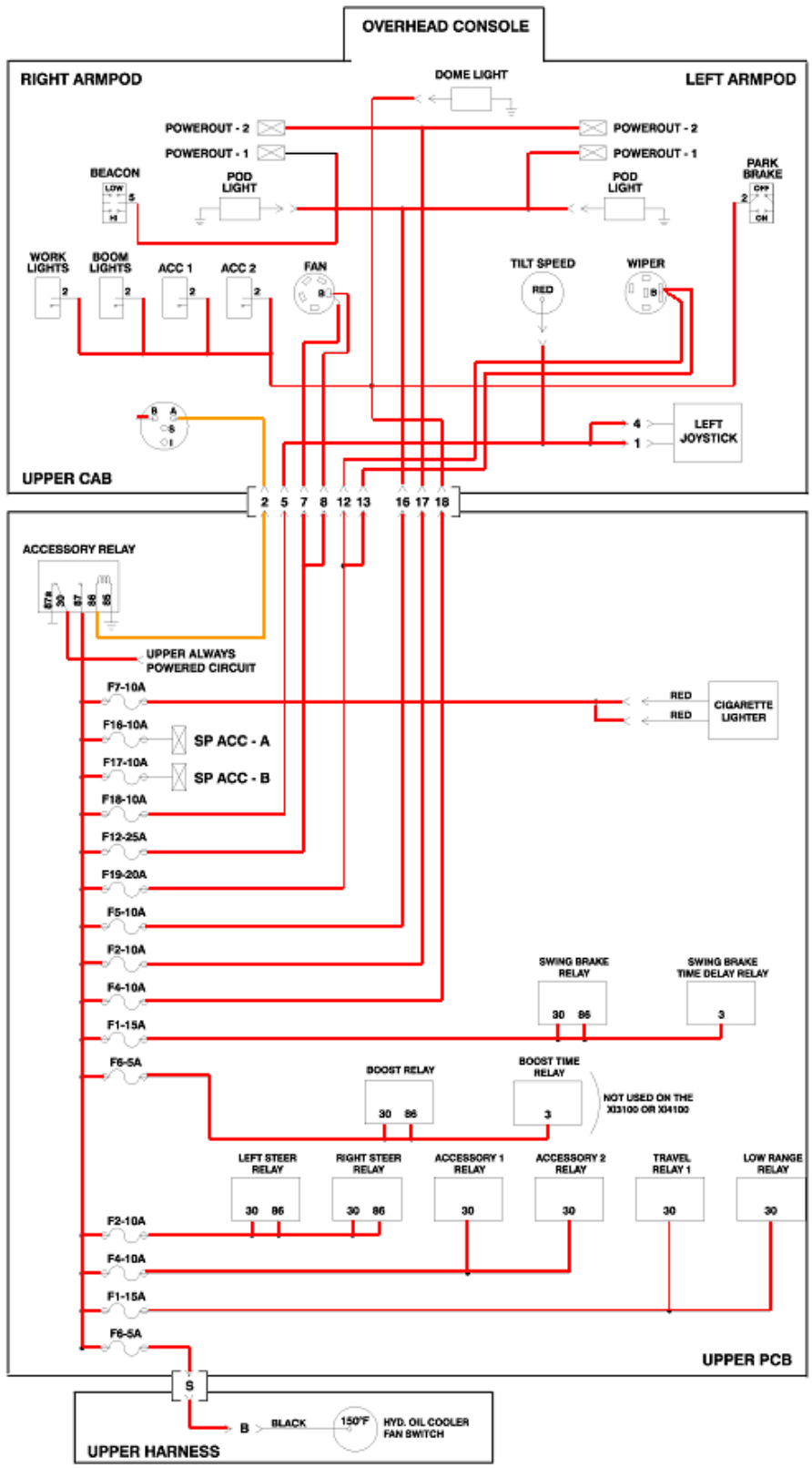
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UP-3 UPPER IGNITION CIRCUIT



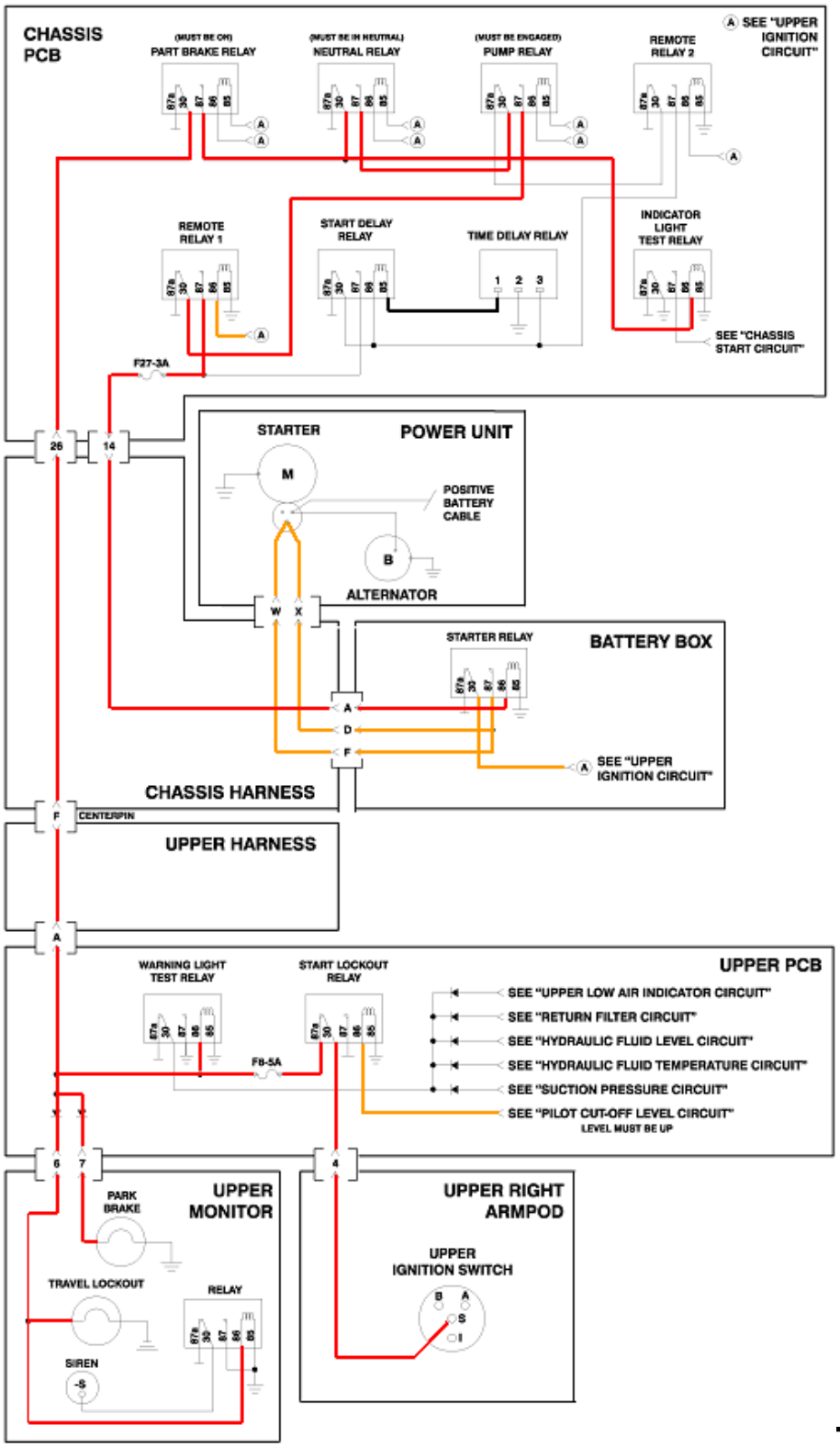
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UP-4 UPPER - ACC (ACCESSORIES)



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UP-2 UPPER START CIRCUIT

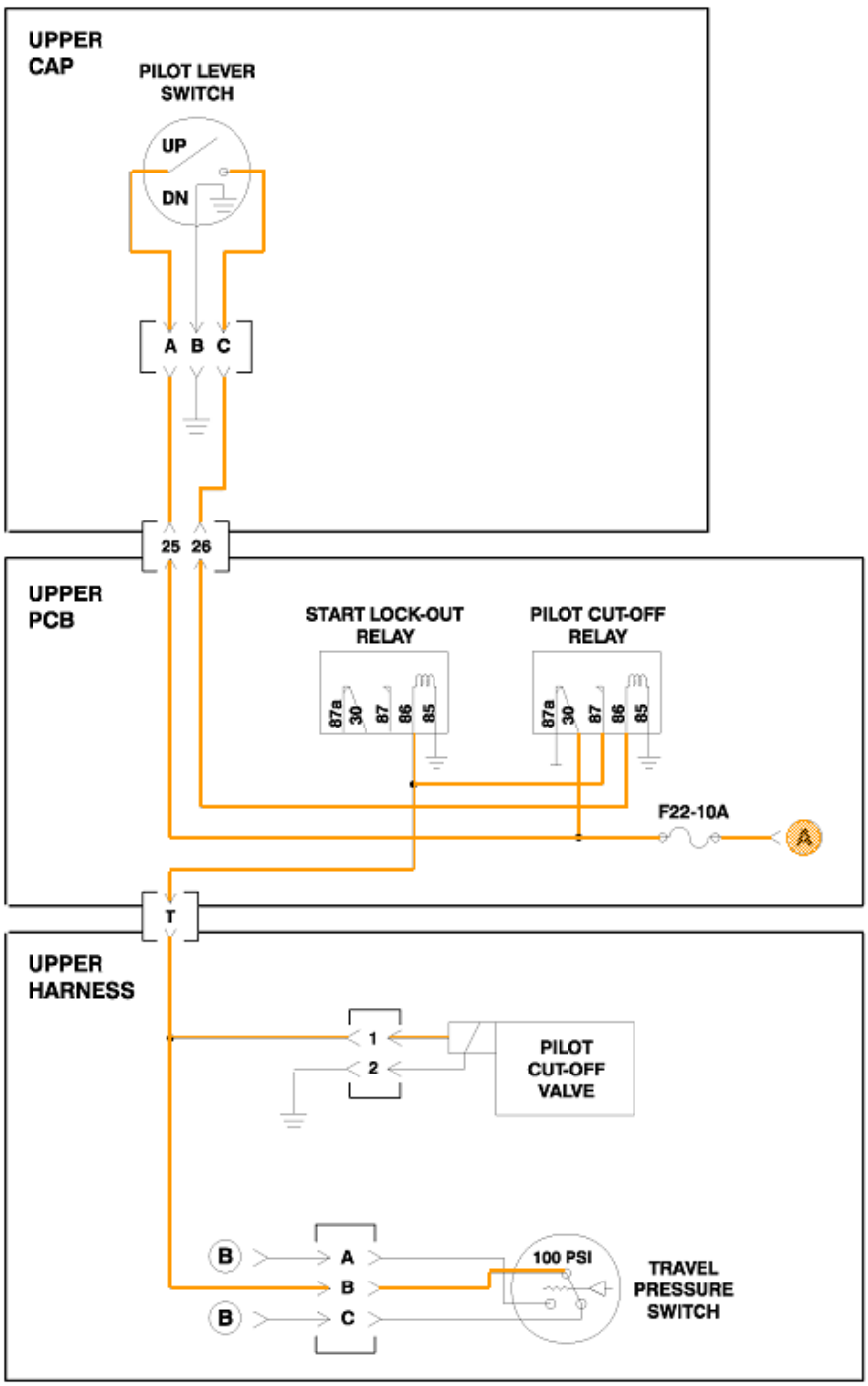


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UP-17 PILOT CUT-OFF

(A) SEE "UPPER IGNITION CIRCUIT"

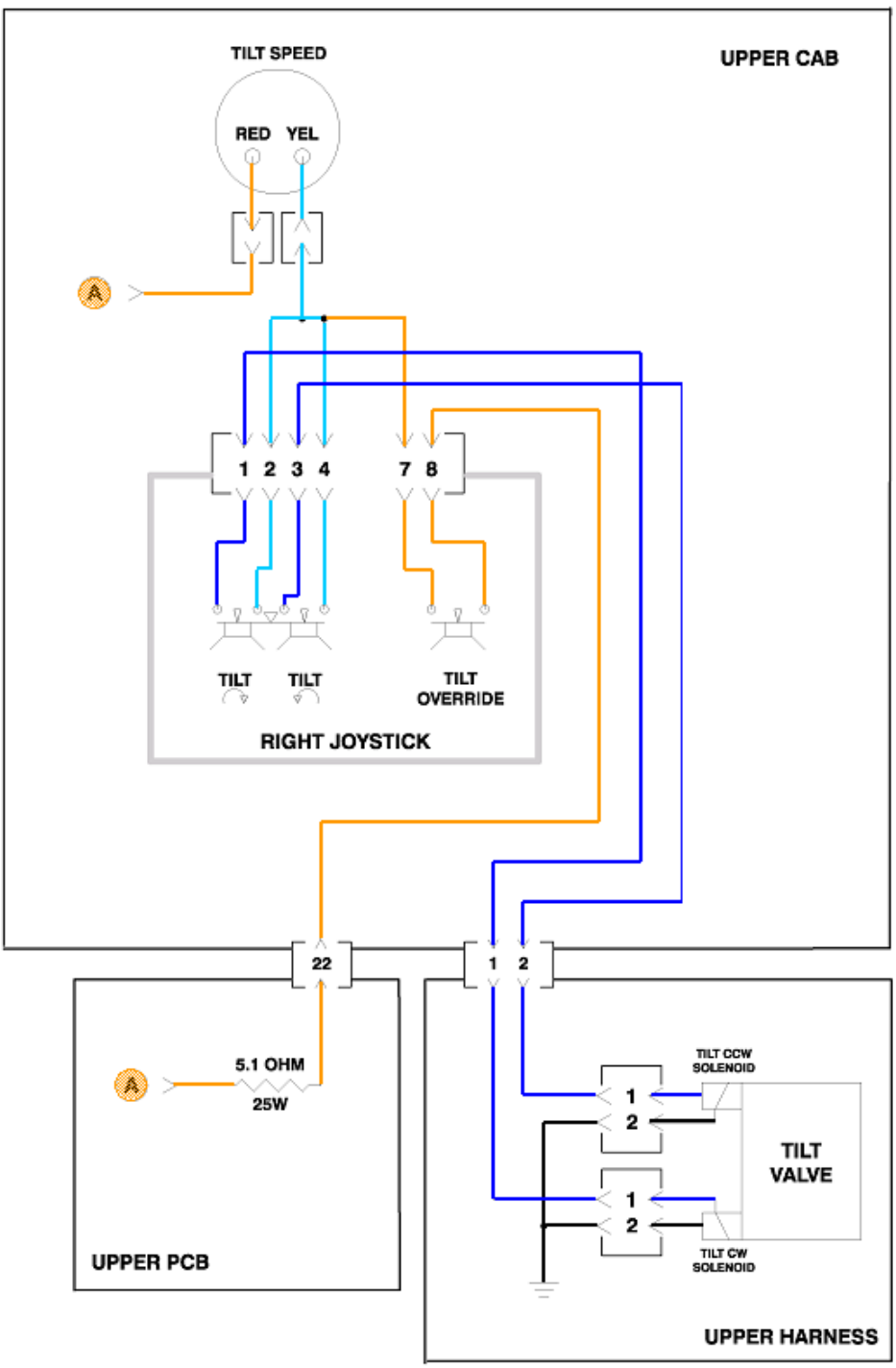
(B) SEE "DIG BRAKE CIRCUIT"



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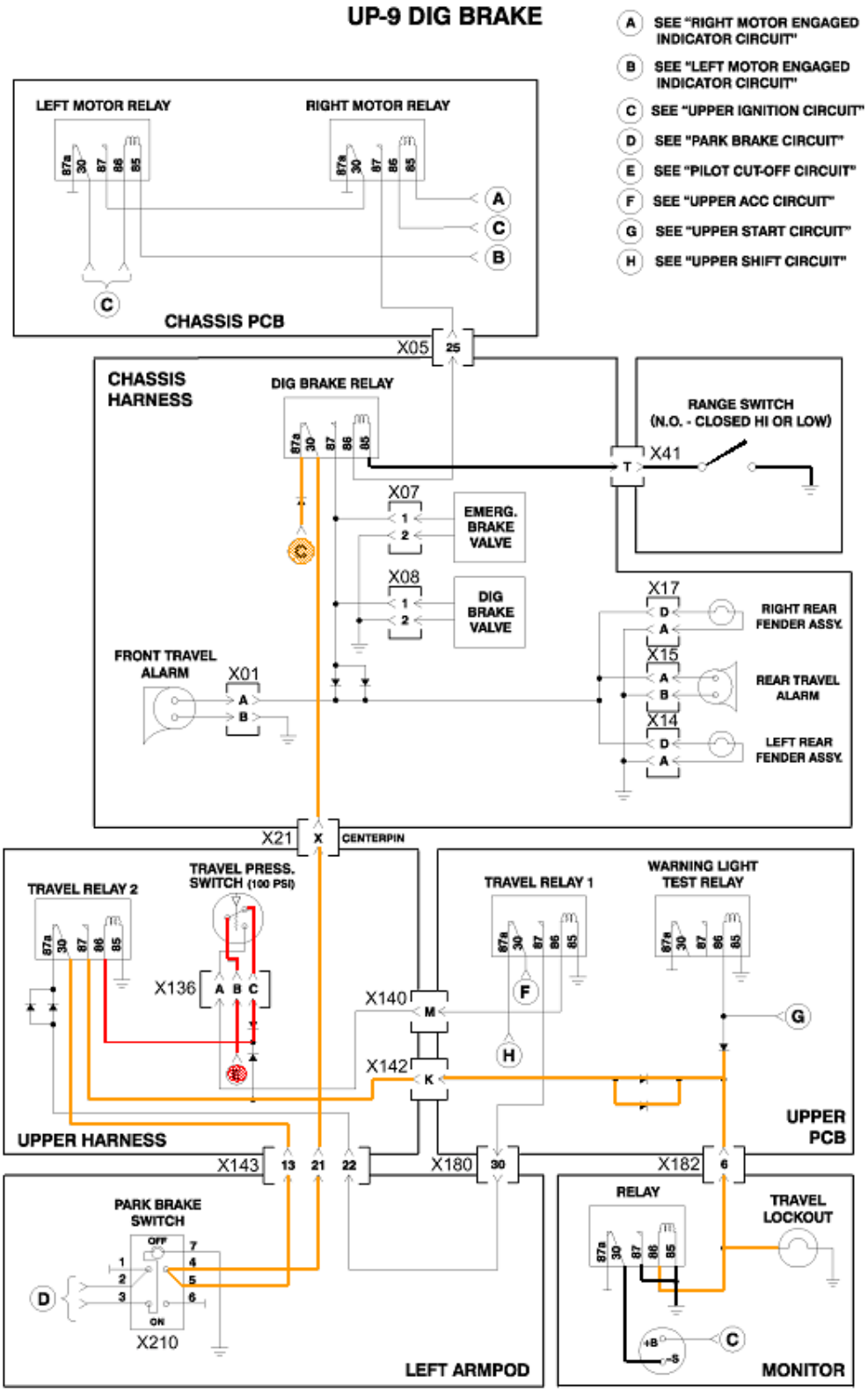
UP-21 TILT

(A) SEE "UPPER ACC CIRCUIT"



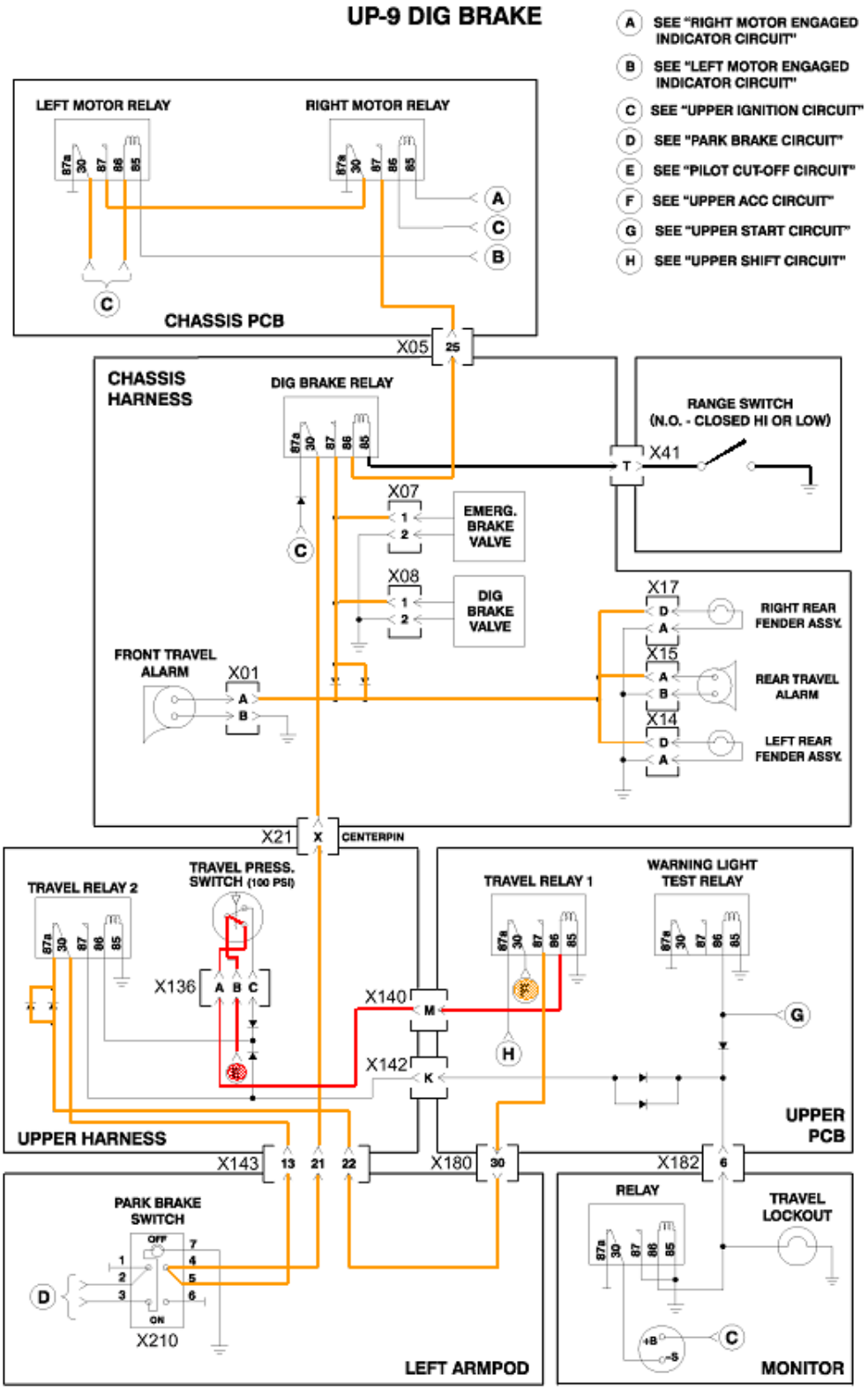
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UP-9 DIG BRAKE



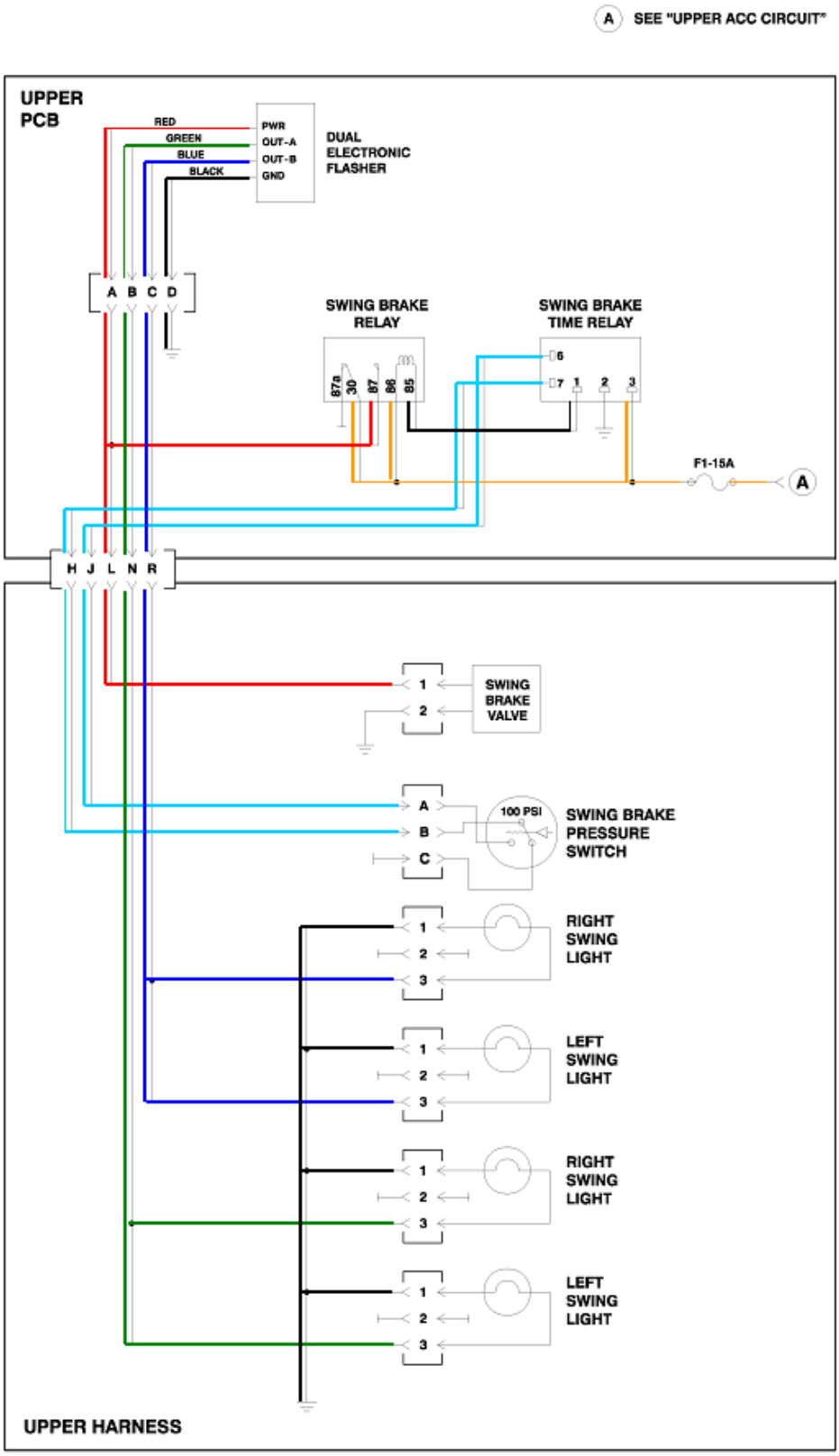
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UP-9 DIG BRAKE



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UP-19 SWING

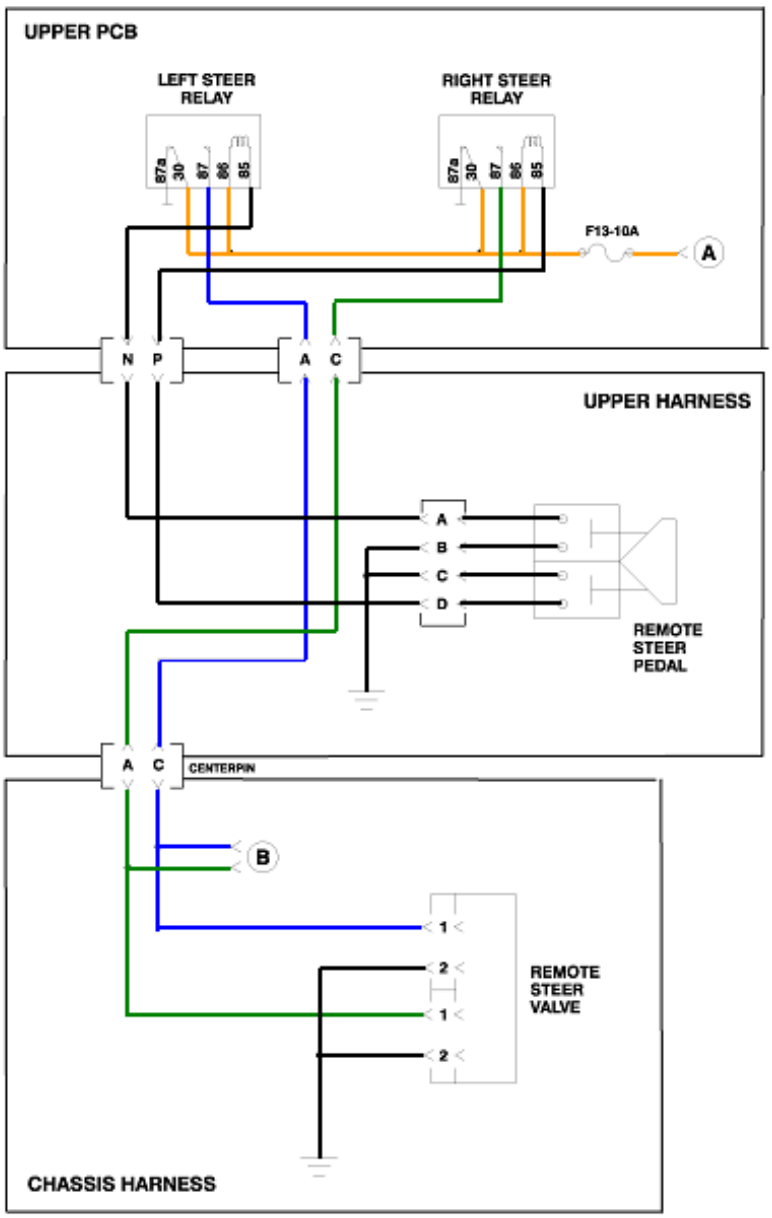


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UP-18 UPPER STEERING

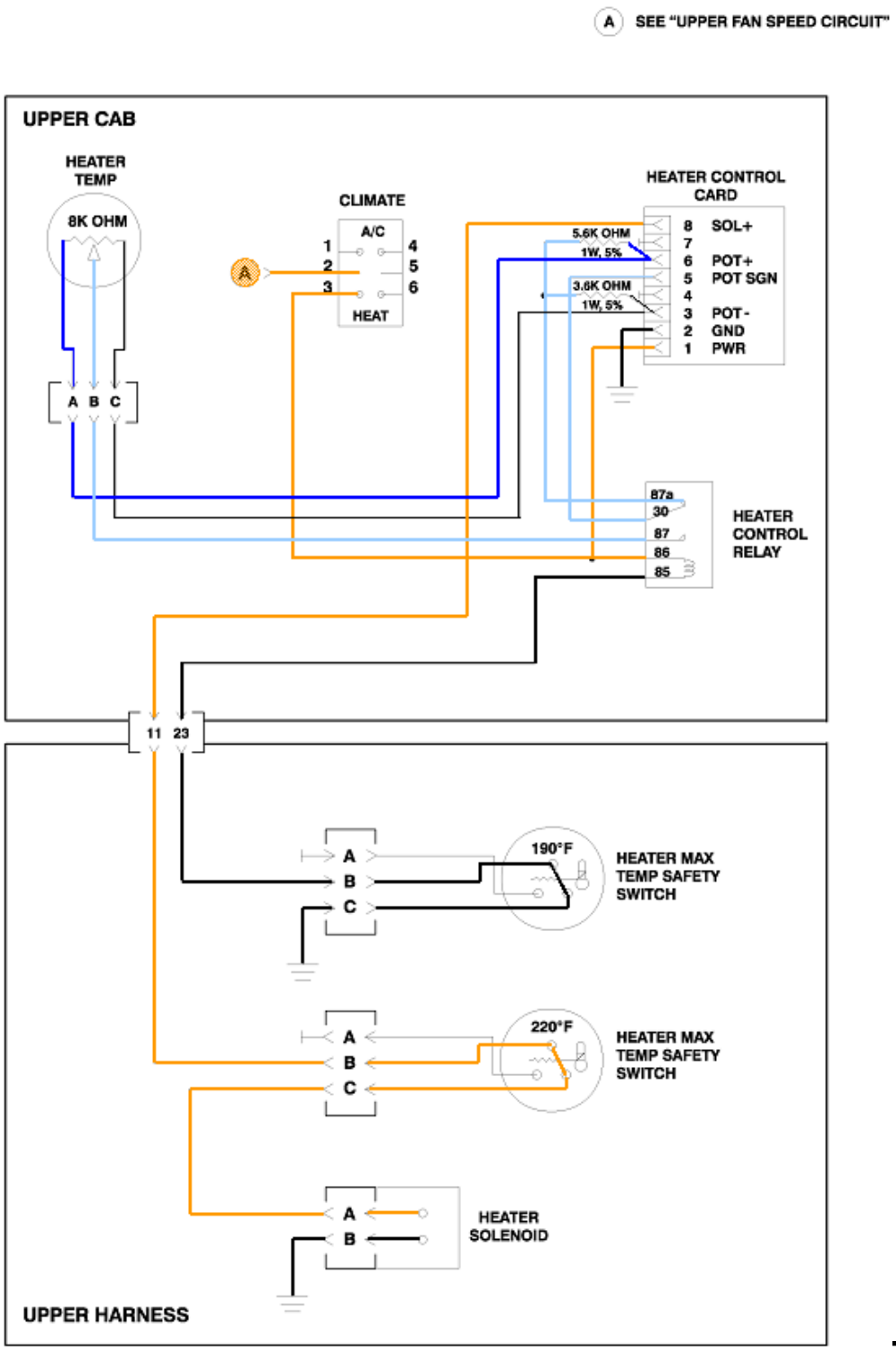
(A) SEE "UPPER ACC CIRCUIT"

(B) SEE "BACK-UP LIGHTS & ALARM CIRCUIT"



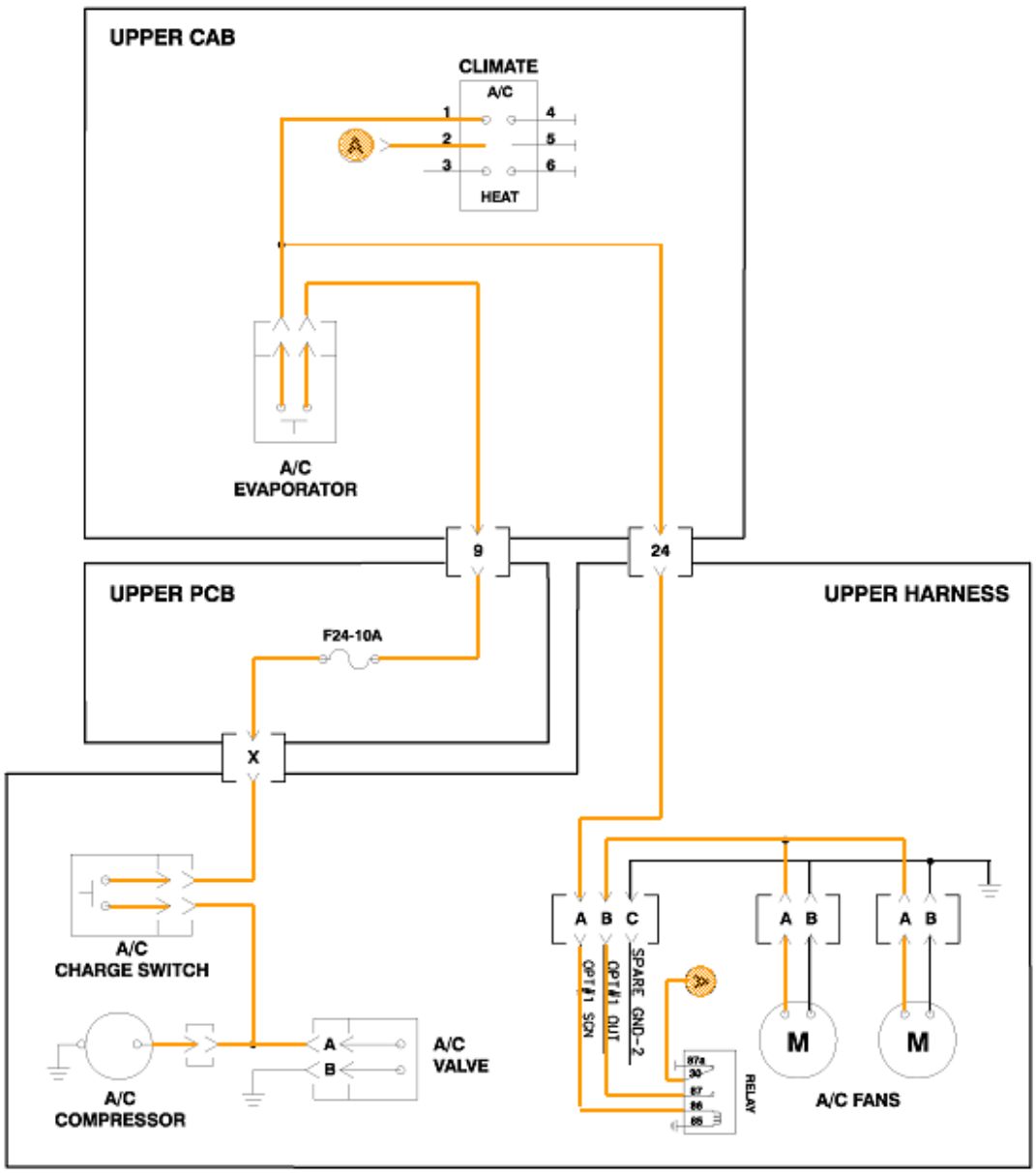
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UP-8 TEMPERATURE CONTROL

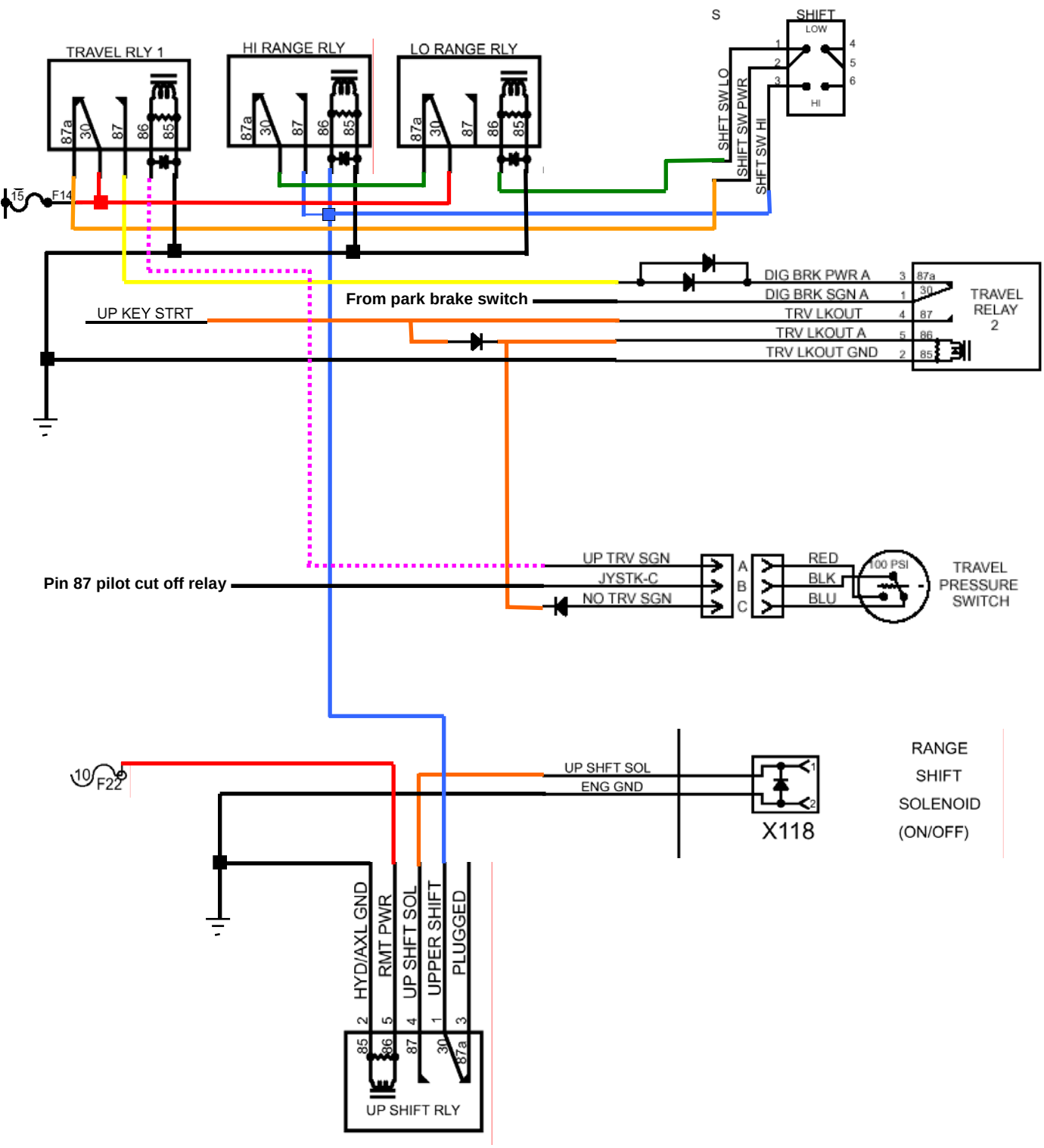


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UP-23 UPPER A/C (OPTIONAL)

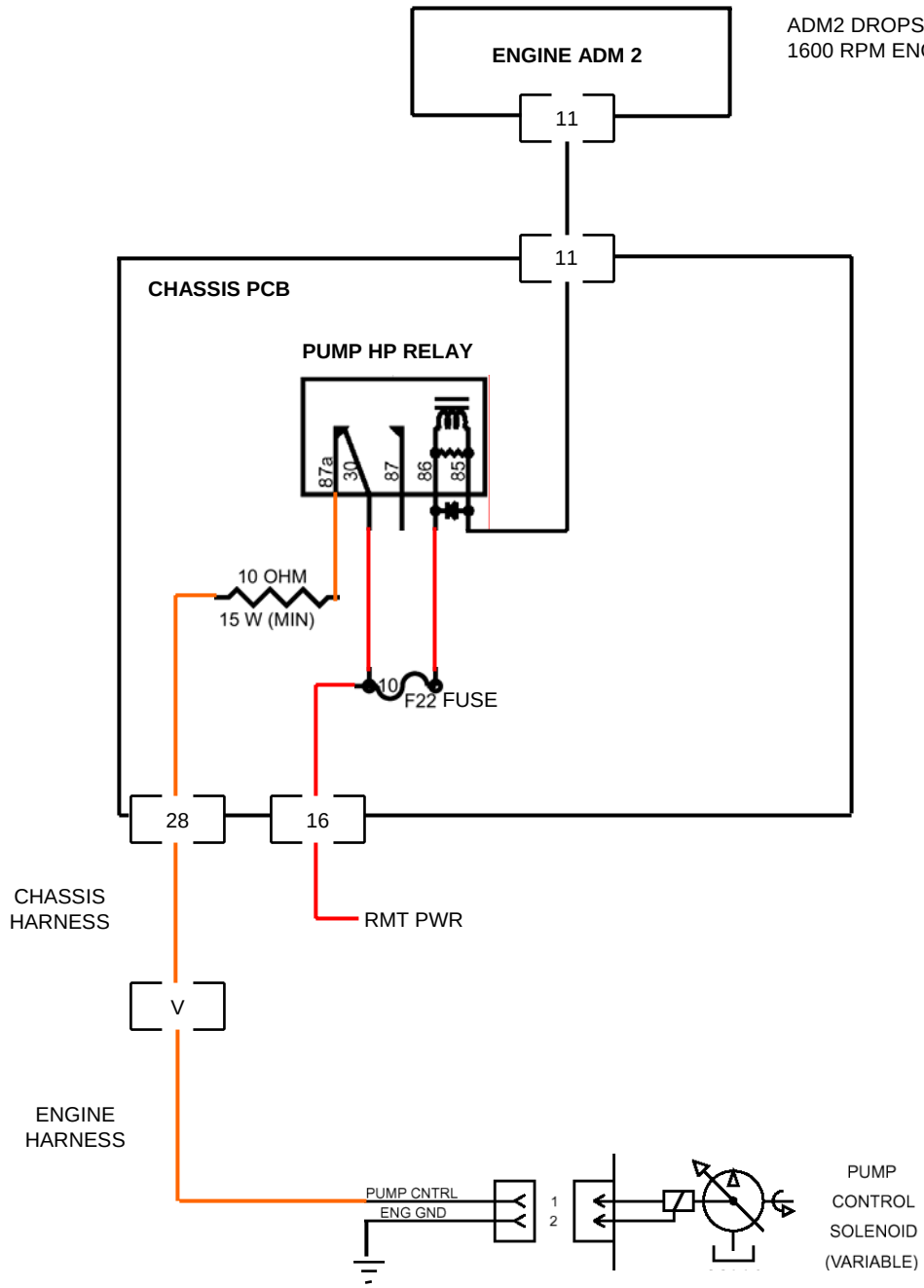


UP-26 HIGH/LOW RANGE SHIFT



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PUMP CONTROLLER



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GRADALL Hydraulic System Operation

Highway speed models
XL3100 Cummins
XL3100-II
XL4100-II



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Hydraulic System Introduction

GRADALL **XL series Highway Speed Excavators machines use hydraulics to power all major machine functions. Hydraulics provide power, speed, control, and flexibility to perform machine operation. The system is a variable flow, load sensing system made up of *components* that work together within the system.**

This training will provide insight into the component operation within the system. Understanding the components makes understanding the system simpler.



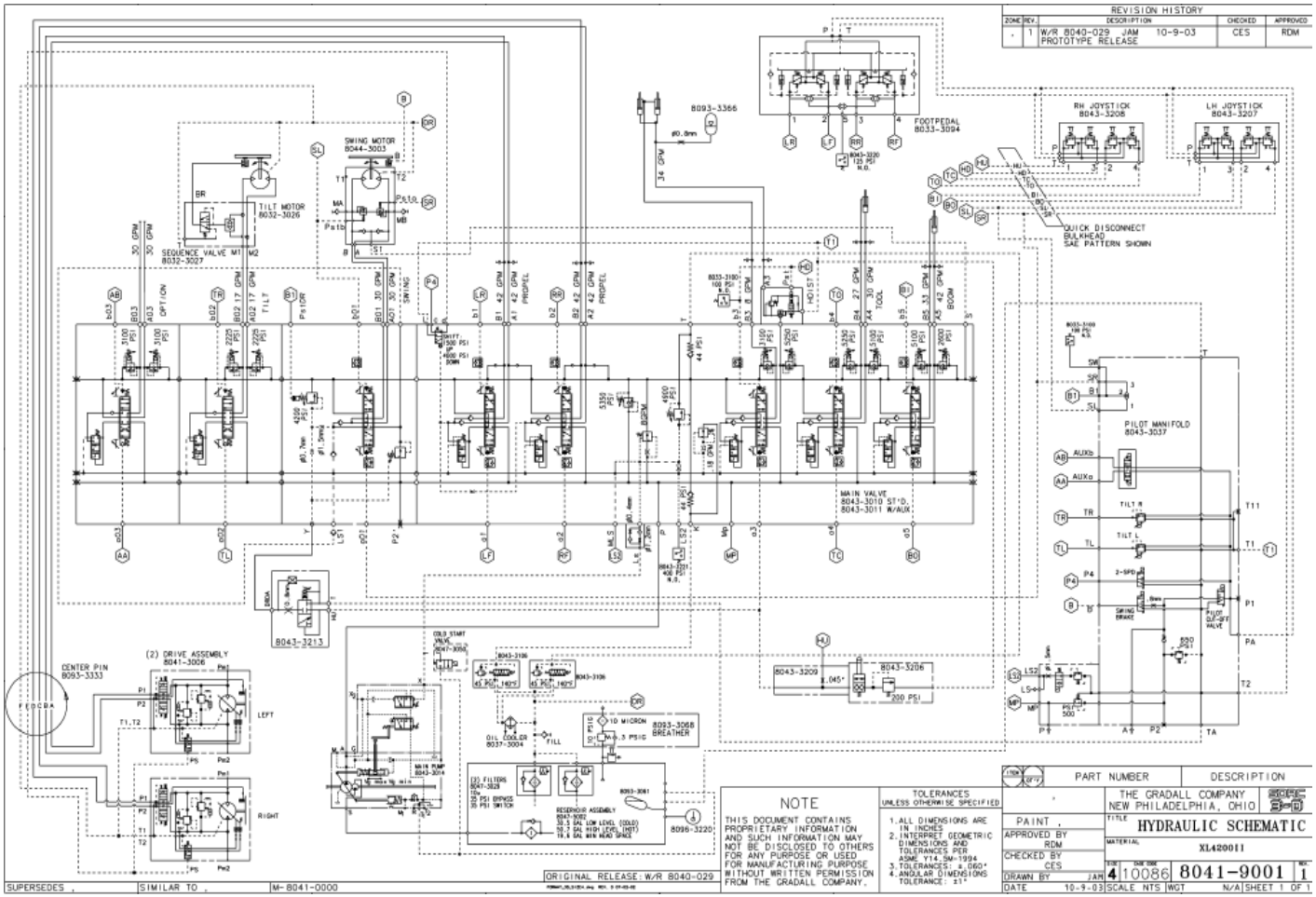




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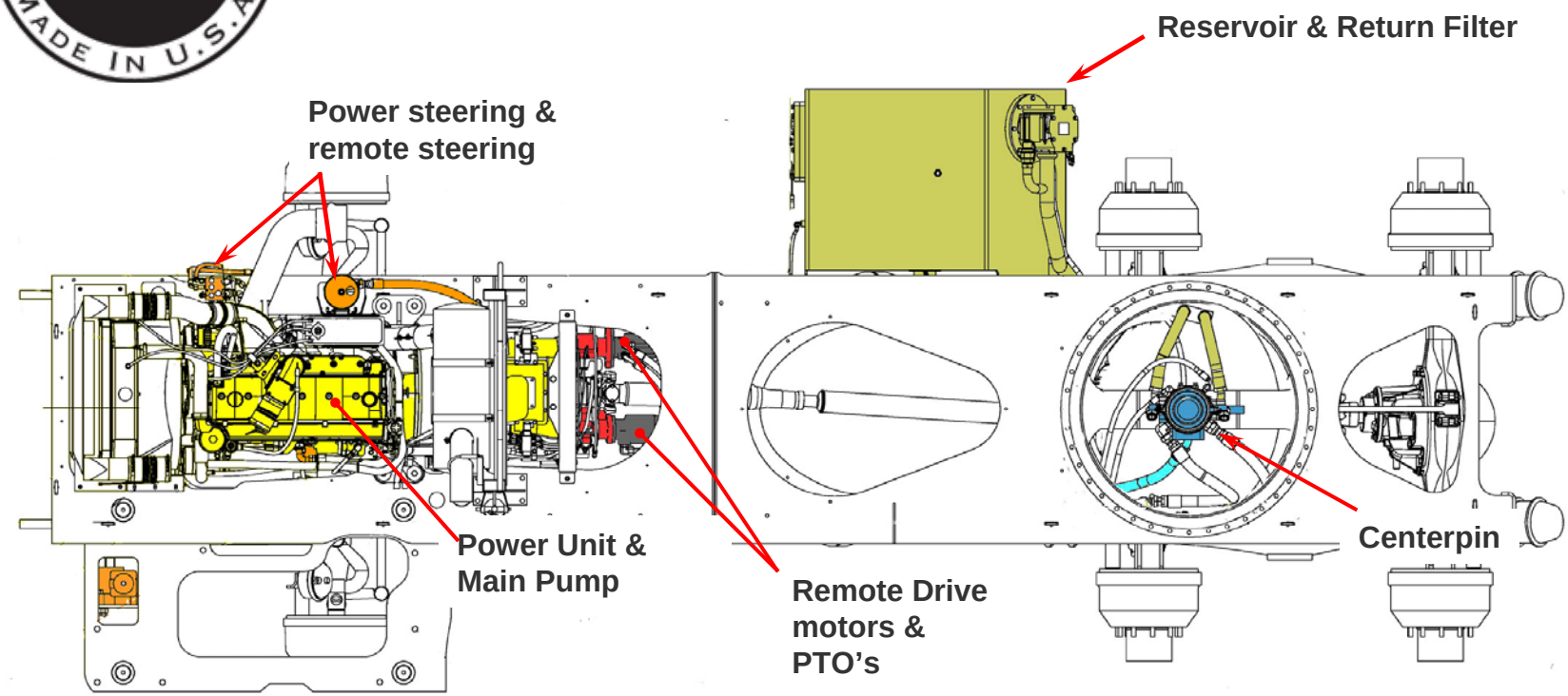
Hydraulic System Overview

The hydraulic system, when viewed as a schematic, appears very complex. Yet the system is merely many simple components and circuits working together. The schematic shows the entire system, today's program will break the complex system into components and circuits within the system.



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Chassis Hydraulic Component Locations

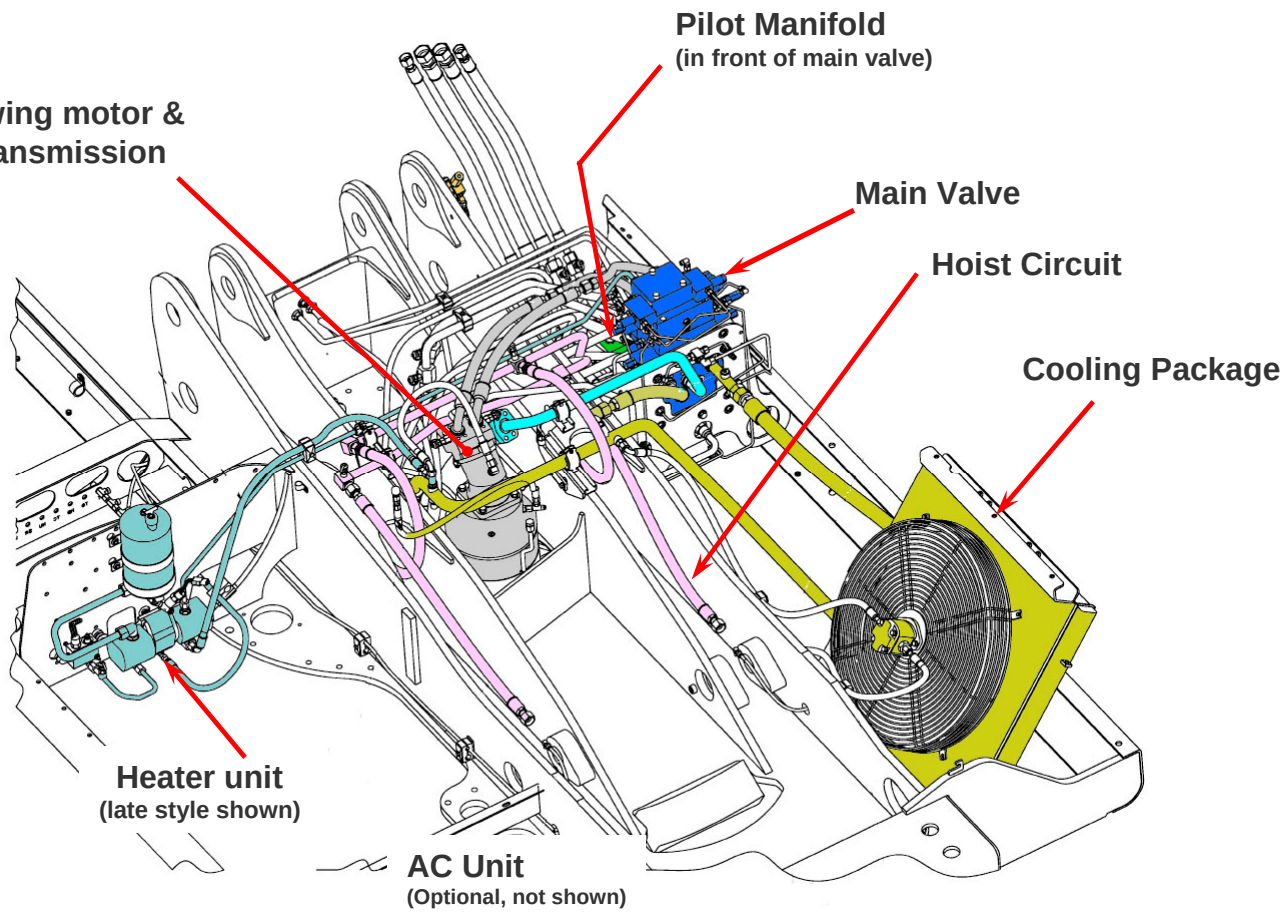


Highway speed machines also have major hydraulic components located on the chassis. As a single engine machine, the chassis power unit not only drives the highway speed carrier but also provides power for the hydraulic pump. Reservoir and filter are mounted on the chassis also. Some other chassis mounted hydraulic components are centerpin, remote drive motors, remote steering, and power steering.

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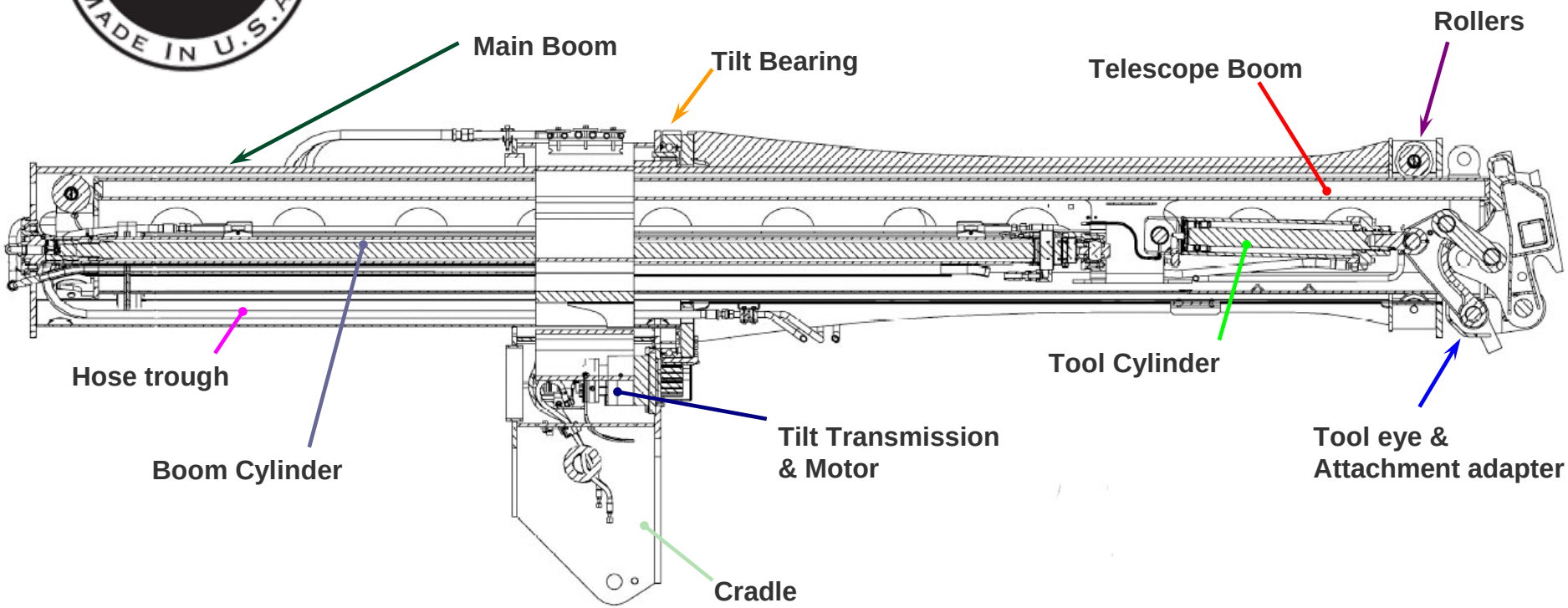
Frame Hydraulic Component Locations

Upper frame provides mounting platform for cab, boom, and other major components. Hydraulic components mounted on the frame include hoist cylinders for boom, main valve, hydraulic heater, air conditioner, cooling package, pilot manifold and controls, and other components.



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Boom Hydraulic Component Location



Boom and cradle consist of 3 major weldments: Cradle which pivots on machine frame, Main boom attached to cradle by tilt bearing, Telescope boom which rides inside of main boom using rollers. A “tool eye” at end of telescope is used to for attachment installation and operation.

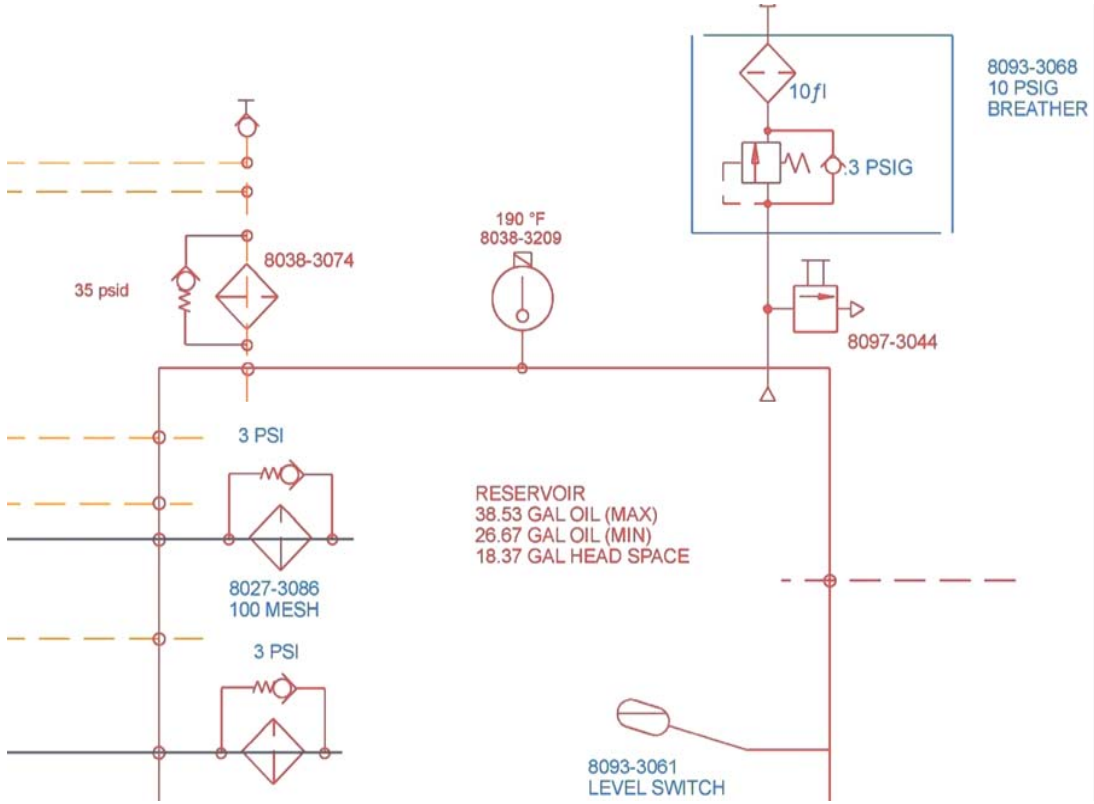
2 cylinders provide boom movement: Boom cylinder moves telescope boom in/out, Tool Cylinder moves the attachment. A tilt transmission and motor works with the tilt bearing to tilt the boom assembly.

A hose trough provides area for the tool hoses to move with the telescope boom.

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Reservoir & filters

The hydraulic reservoir holds 38 gallons of hydraulic oil. A 10 micron in tank filter is provided for return oil. Early machines had 2, 100 mesh Suction Screens. The reservoir breathes through a Breather Assembly that opens at 10 PSI to protect the tank as well as vent as needed.



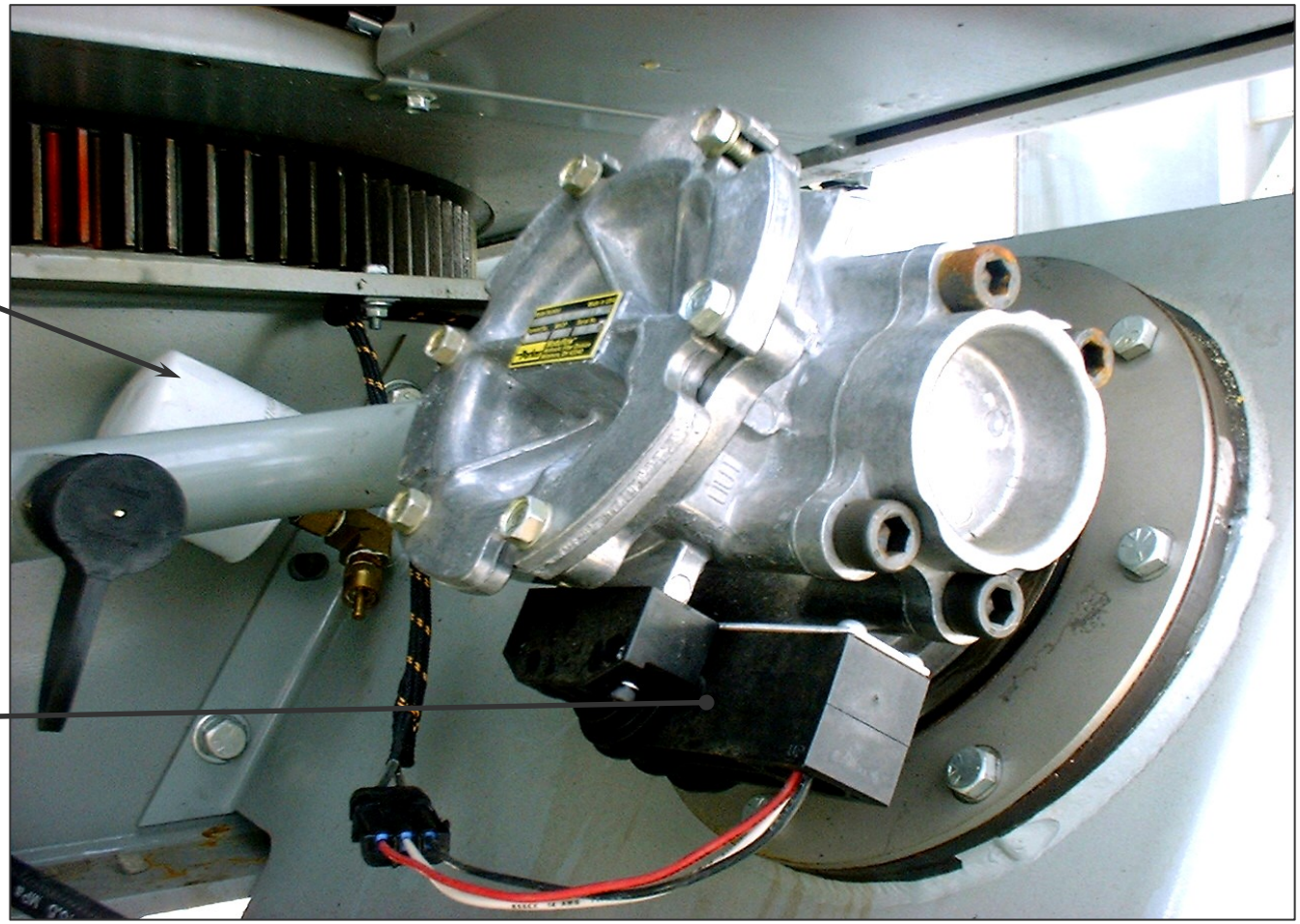
Also in or near the reservoir are 3 switches: Hydraulic Fluid Level, Hydraulic Oil Temperature and Filter Condition Switch.

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Hydraulic filter & breather

Tank breather
Relieves at 10 PSI
Opens at - .3

Return Filter
Switch
Operating Pressure
35 PSI



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Hydraulic Temperature Switch



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Additional Hydraulic Switch Locations

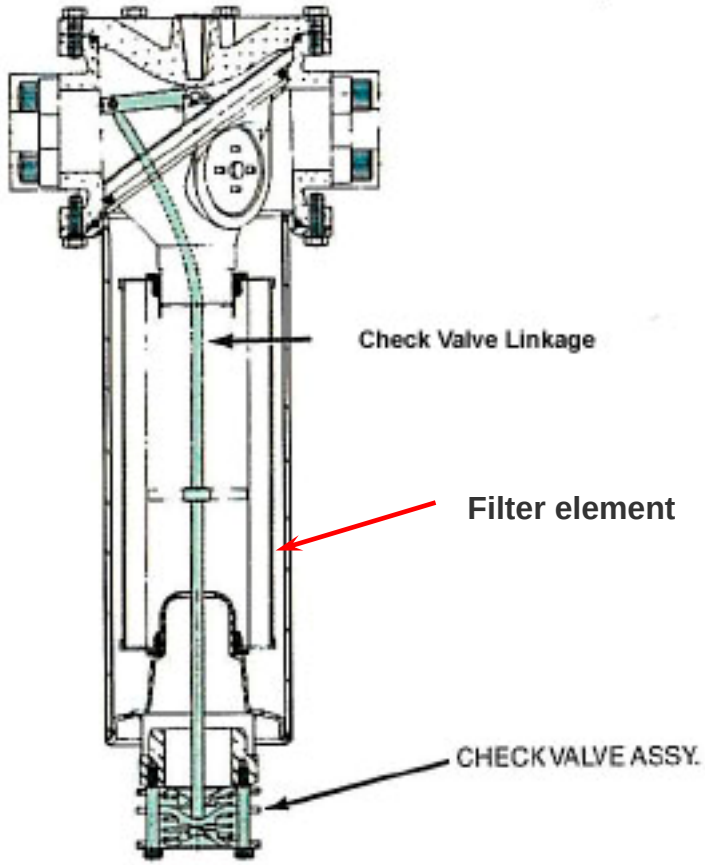


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Hydraulic Return Filter

Filter assembly is installed in the reservoir. Return oil is routed through the filter element. If the element is becoming clogged, a bypass valve opens and allows oil into tank without filtration. A pressure switch on the filter head warns of high filter pressure. Switch turns on at 35 psi.

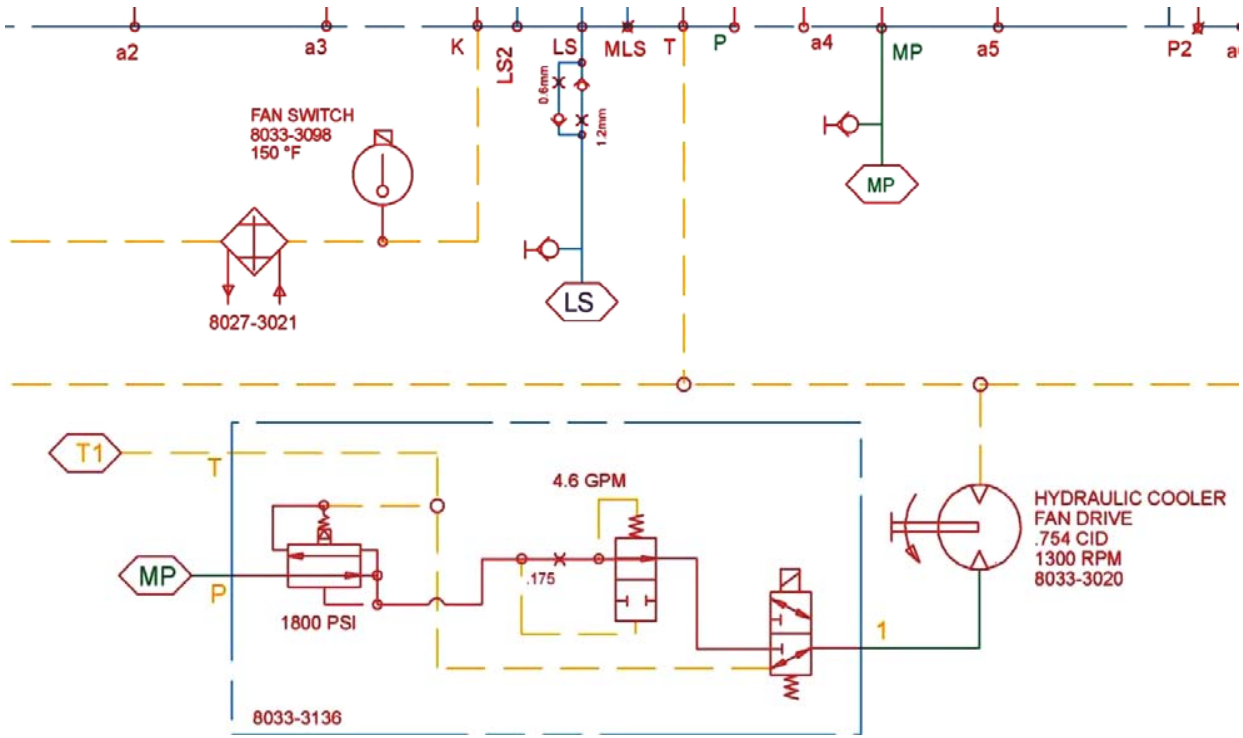
Filter is a high density 10 micron rated filter.



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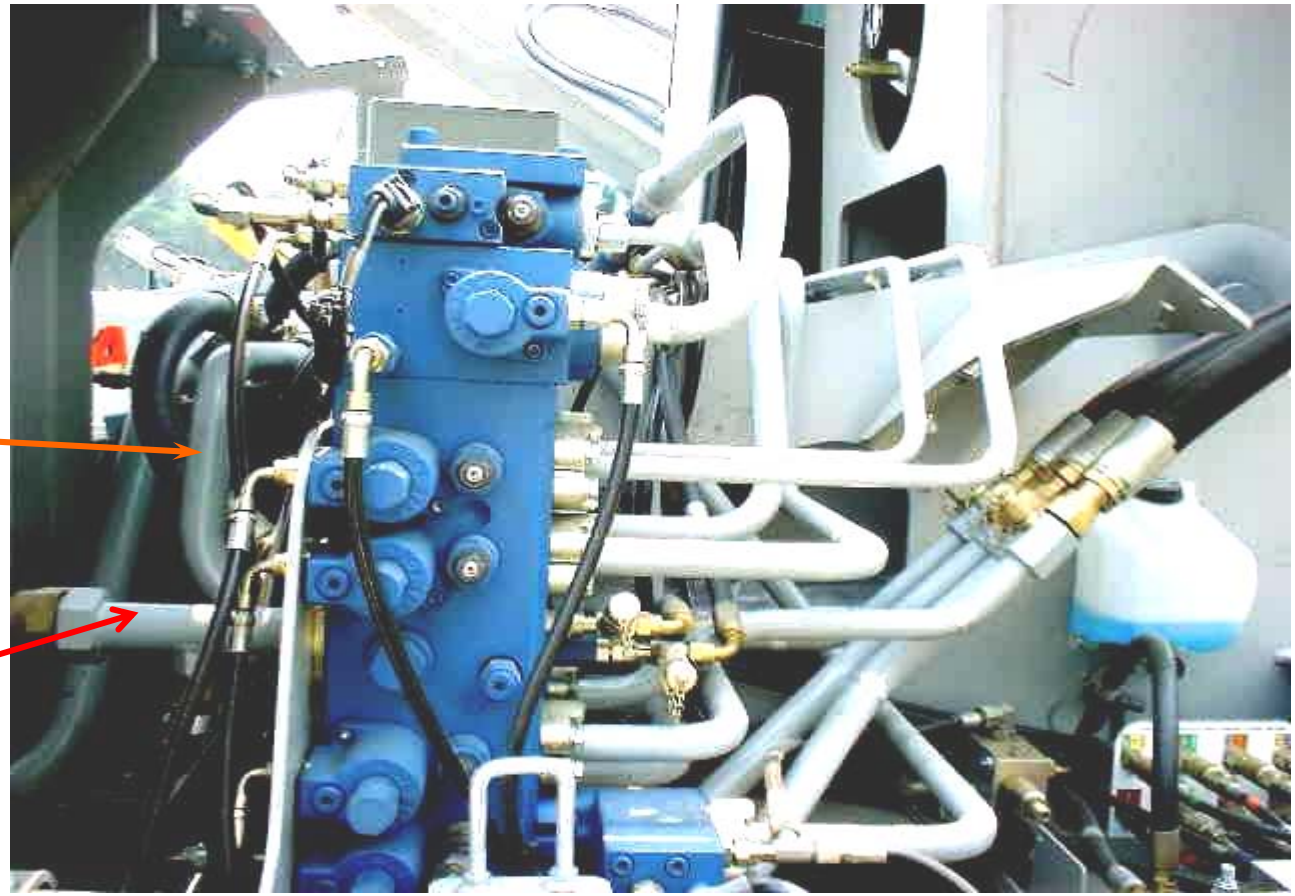
Heat Exchanger Circuit

Heat exchanger circuit uses two check valves built into the control valve- one set at 48.5 psi and the other set at 101.5 psi. The low pressure opens first letting the oil flow through the oil cooler. If back pressure reaches 101.5 psi the second opens sending the remaining oil directly to tank. The cooler return circuit contains a temperature switch that closes at 150° F.



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XL3100 Pump & Cooling plumbing



Pump Supply Line

Pump supply and heat exchanger connections, original XL3100.

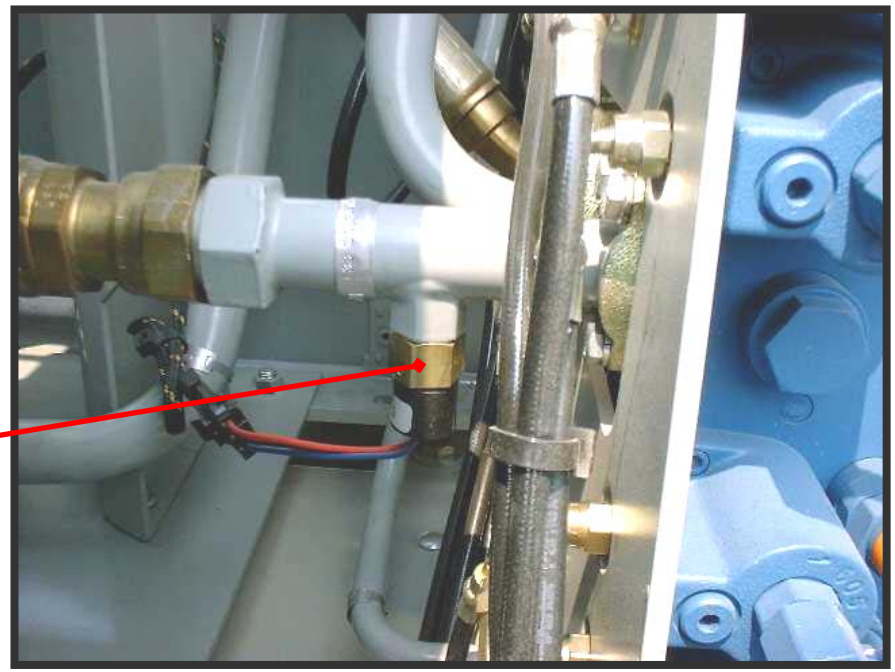
Flow line to the Cooler

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Cooling fan temperature switch

Temperature switch in cooler supply line sends signal to solenoid enabling flow to cooler fan motor. Motor speed is controlled by Flow Regulator. Fan Motor Pressure is not adjustable.

Temperature Switch
150° F trigger point



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Hydraulic Cooling fan motor location

Cooler Fan Motor has a controlled flow setting measured by fan speed. Setting is 1600-1800 rpm's.



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Cooler Fan Valve

Flow regulator
for the fan motor



When the return line temperature switch closes, a signal is sent to the solenoid valve. The solenoid opens letting oil flow to the fan drive motor. A pressure reducer limited pressure to to 1800 psi.

A flow regulator as well as a fixed orifice reduces the flow to 4.6 gpm driving the motor/fan at 1600-1800 RPM to cool the hydraulic oil before it returns to tank.

The Cooler Fan Solenoid
8.9 - 9.2 Ohms

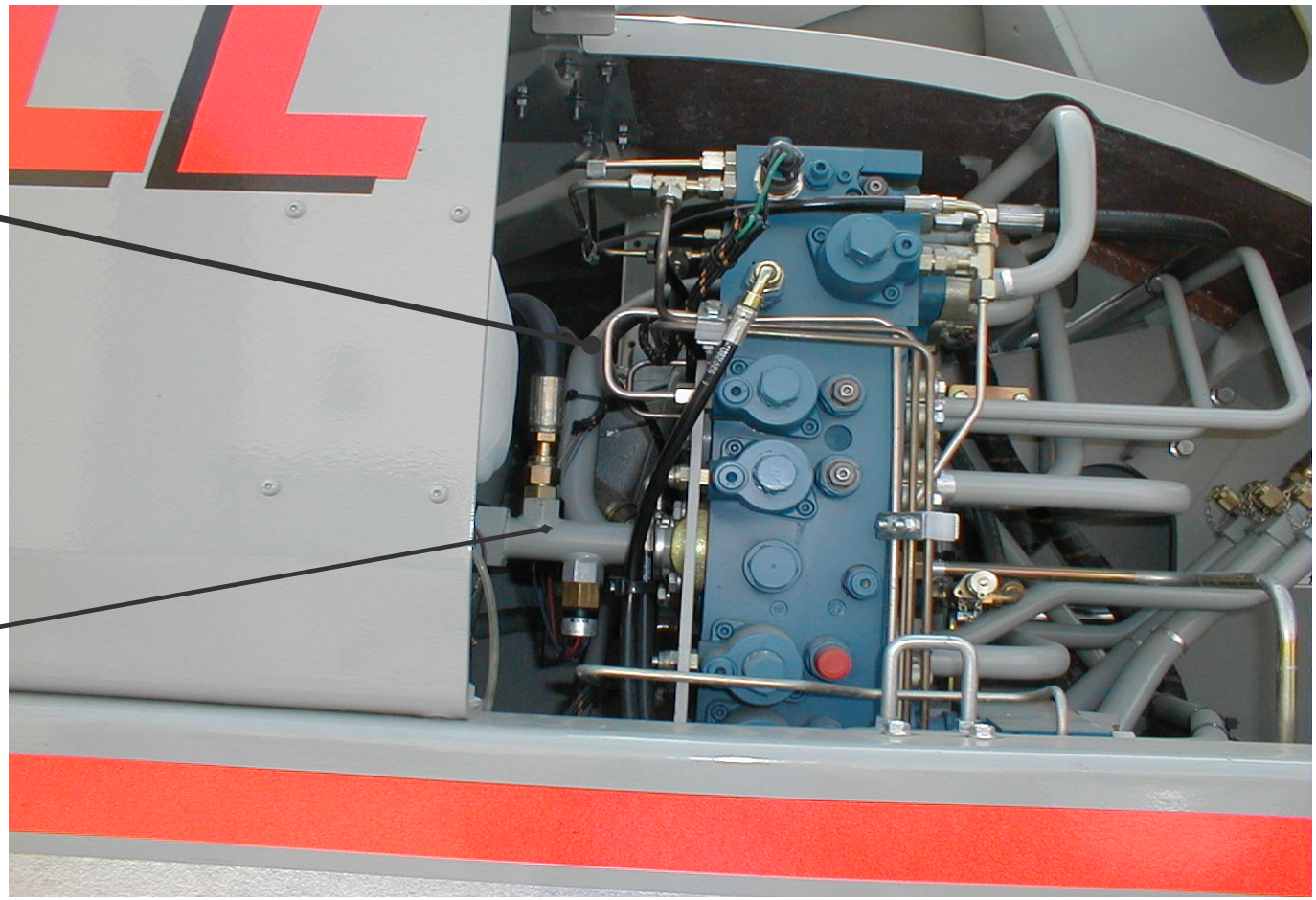
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Pump and cooler plumbing – Series II

Pump to Valve supply

Heat exchanger plumbing as found on Series II machines.

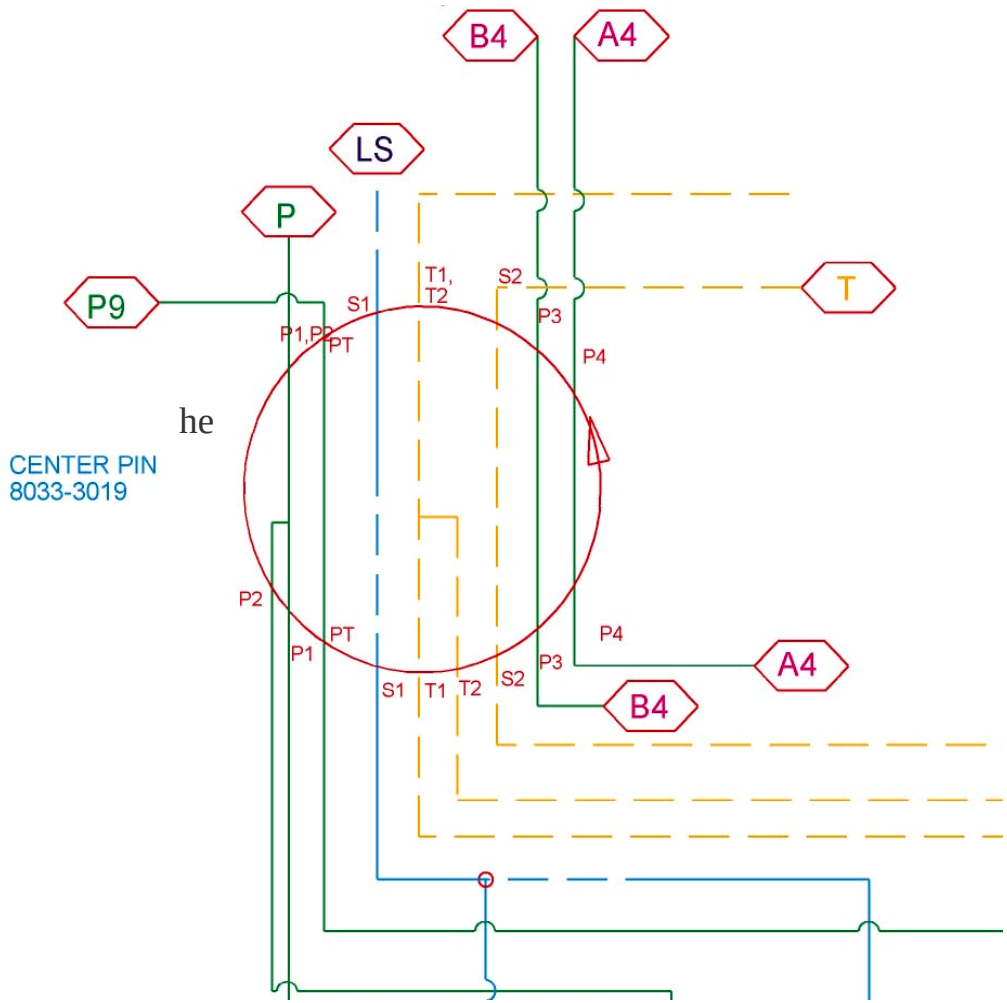
Cooler supply tube & temperature switch



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Return to tank through centerpin

Notice that the return is similar to the pump supply, it enters the center pin as a single line and exits with two lines. A Load Sense line through the center pin allows the control valve to signal the hydraulic pumps. No passages for air are used in the center pin as chassis air system control in remote is electrically operated.



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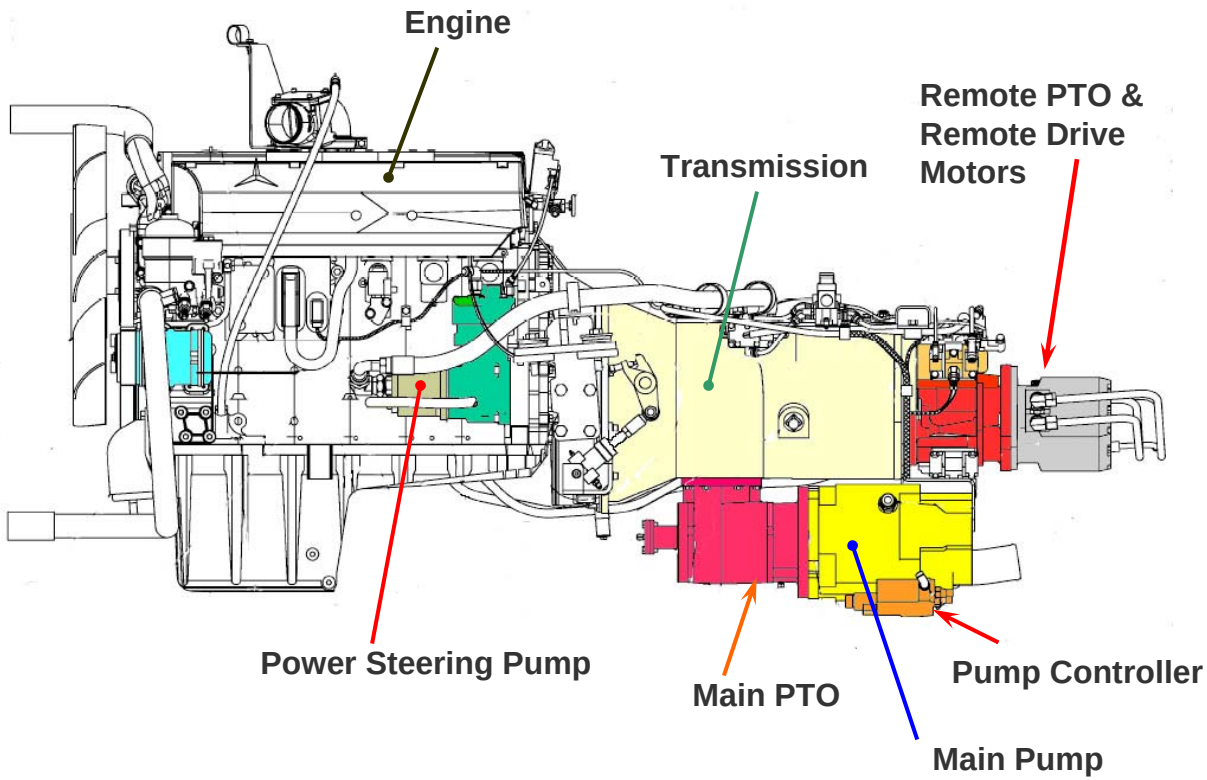
Power Unit Assembly

Note! XL4100-II power unit shown, XL3100 is similar.

Chassis power unit supplies power for both hiqhway speed and remote (excavator) operation. Diesel engine drives through the transmission to provide power for highway speed drive.

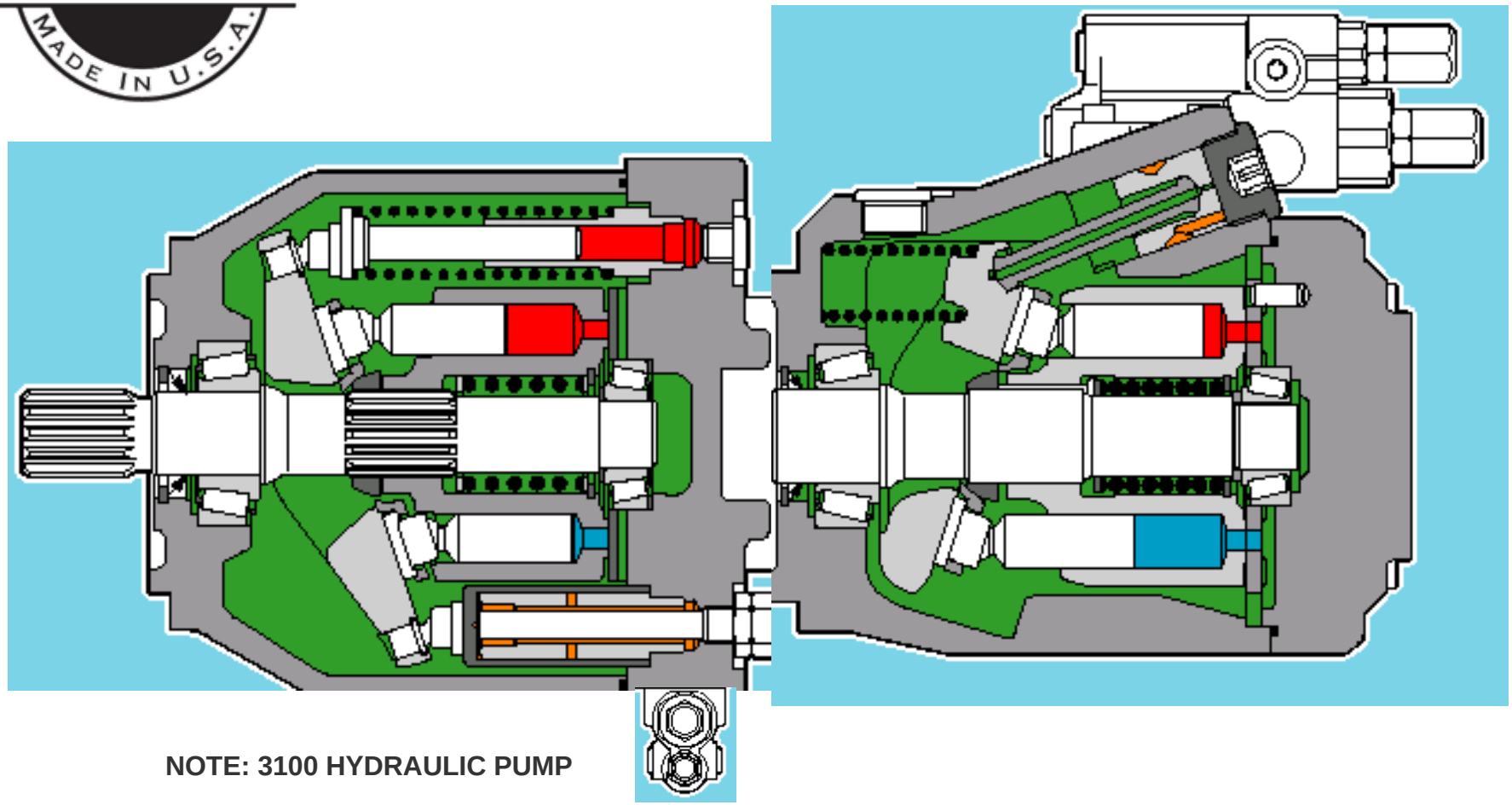
Transmission is also used along with 3 PTO's to provide pump drive for excavator operation (Main PTO) and remote drive via the transmission auxiliary box to provide remote drive (remote PTO).

PTO's are air shifted for remote and highway speed positions. Engine speed is controlled from both cabs.



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Main Hydraulic Pump



NOTE: 3100 HYDRAULIC PUMP

Variable displacement pump for open circuits, swivel to one side only; infinitely variable swivel angle; single direction of rotation of drive.

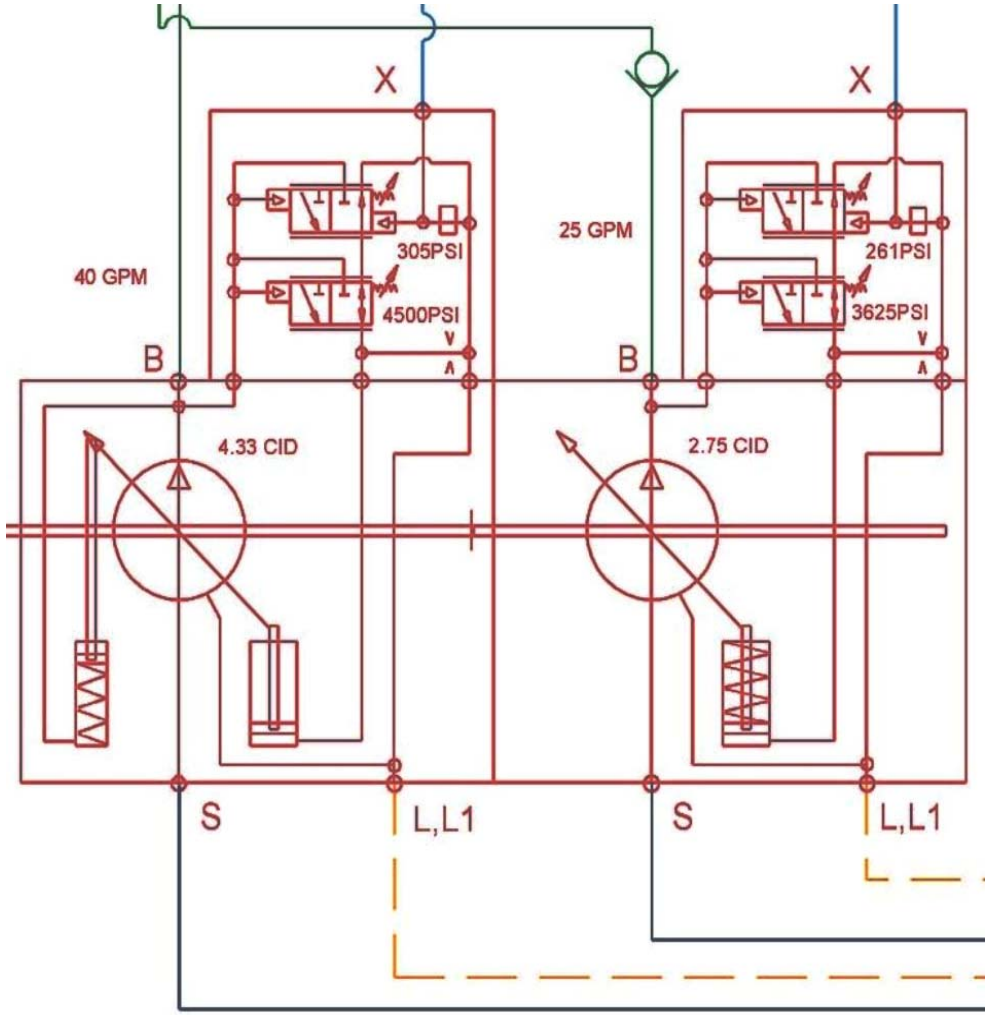
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Main Hydraulic Pump

The pump consists of two variable displacement, axial piston pumps that have a combined flow of 65 GPM. Front pump has a DR control, rear has a DFR control. The output flow is variable by adjusting the position of the swashplate. With independent pumps, a flow check in line between the pumps is required to prevent the front pump from over running the rear. The front pump has a stand-by setting of about 305 PSI with a pump cut off of 4500 PSI. The rear pump stand-by is about 260 PSI with a cut off of 3625 PSI. Pump output pressure and load sense pressure at the control determines pump swashplate angle.

Both pumps are spring loaded to full stroke when off and hydraulically de-stroked as needed on start up.

The PTO turns at 1900 RPM, gearing within the PTO turns the pump at 2200 RPM. Verify engine RPM before performing any hydraulic tests.



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Pump to Centerpin

The center pin has a one piece housing and pin. Note the two pump outlets are combined into one common port entering on the post and exiting from the swivel gland. A 24 circuit electrical center pin is attached to the top of the hydraulic center pin



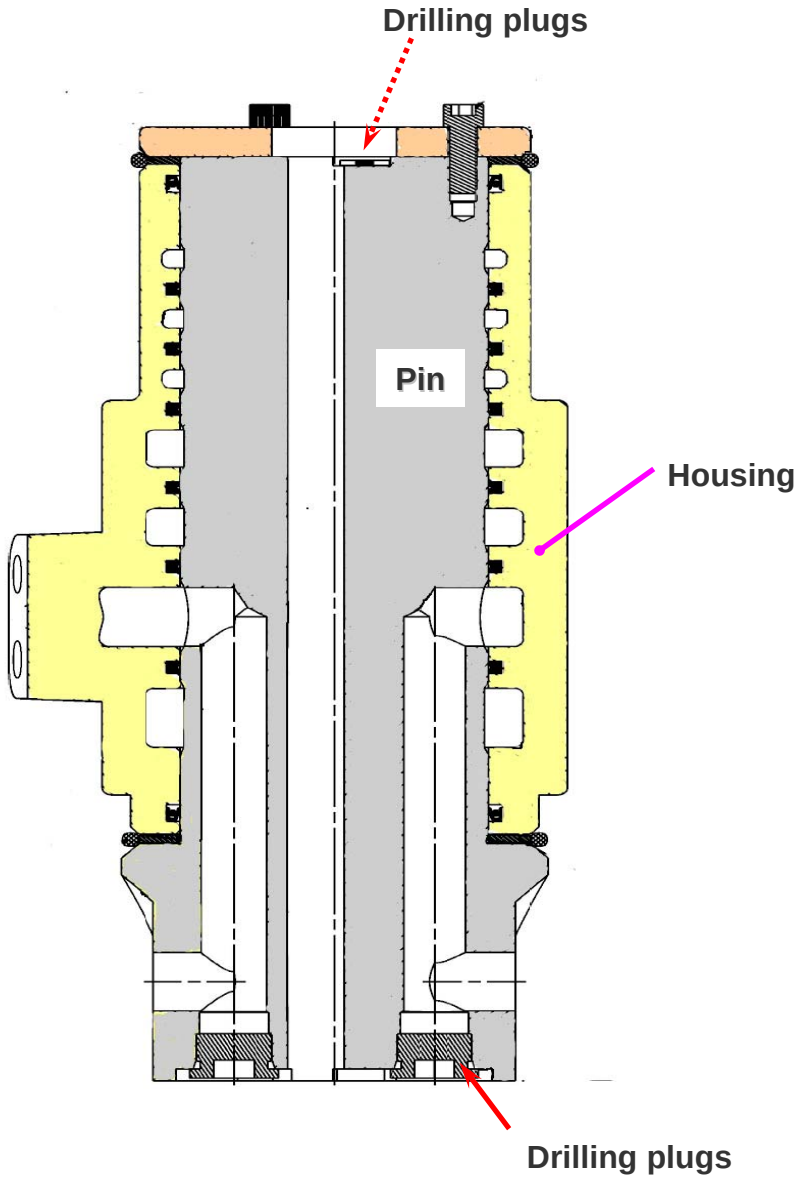
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Center Pin Cross Section

Hydraulic center pin for highway speed excavators consists of a hydraulic and electrical center pin. The hydraulic is shown in this slide.

Hydraulic center pin consists of a housing and pin. The pin is bolted to the chassis, the housing is rotated by the excavator upperstucture.

Ports and drillings in the housing and pin route the oil from the chassis to the upper and back as required.

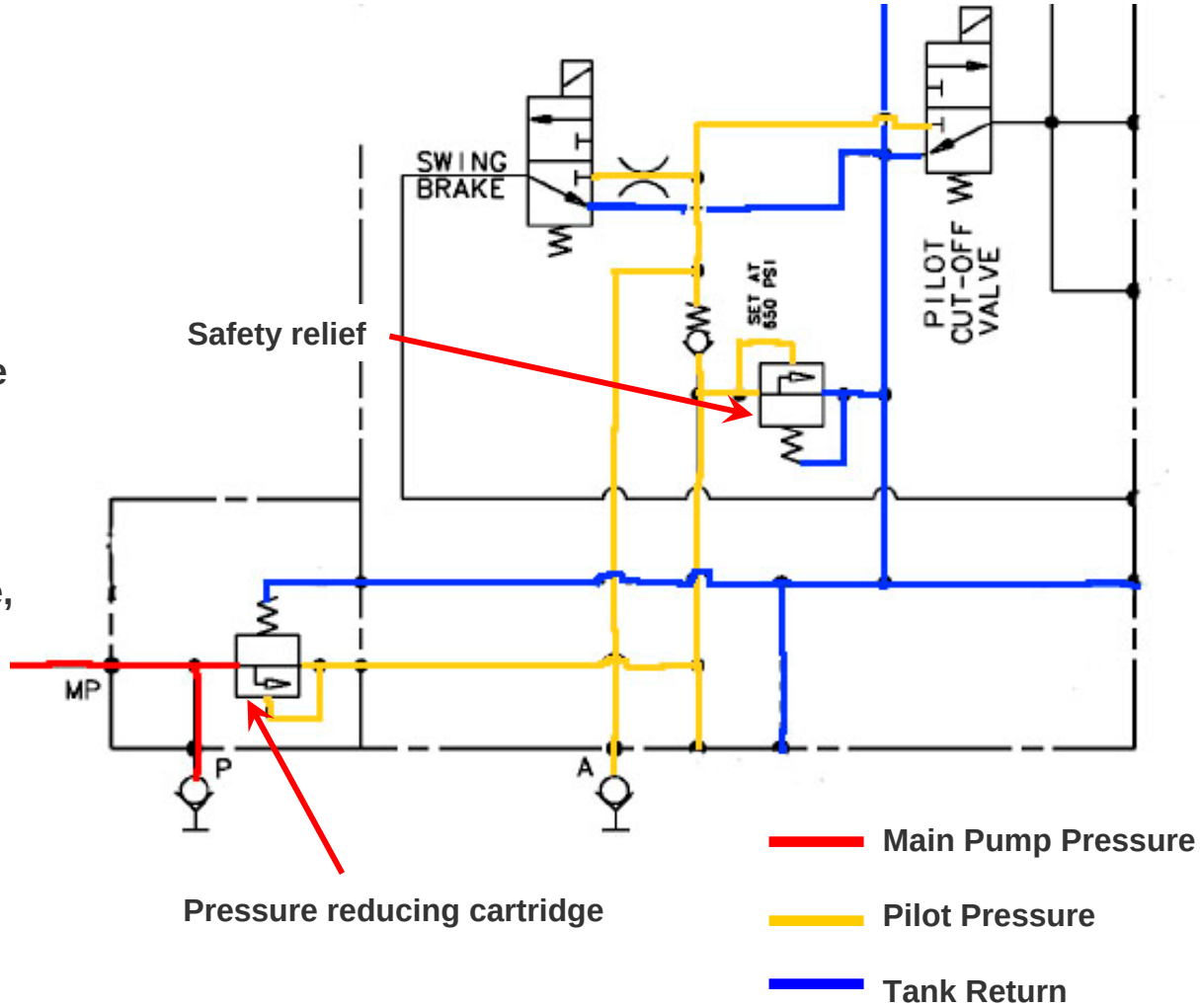


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Basic Pilot System

Basic pilot system uses oil supply from main pump to provide pilot pressure. Main pump pressure is supplied to pilot manifold from main valve “MP” port. Pressure reducing cartridge reduces system pressure to pilot pressure for use by pilot manifold for joysticks, swing brake release, tilt solenoids, and other functions.

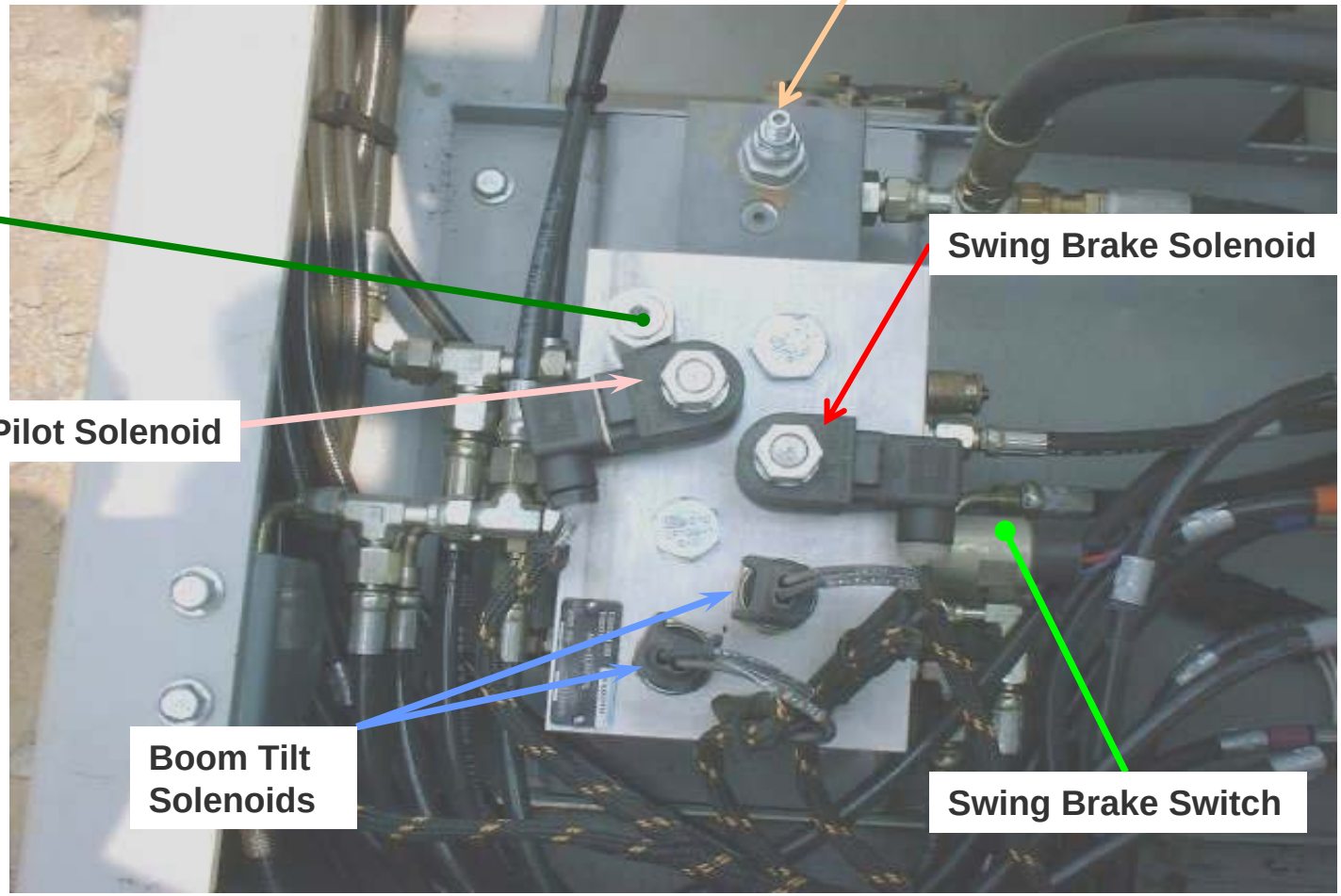
A 650 psi safety relief is in the pilot manifold to provide protection in case pressure reducing cartridge sticks.



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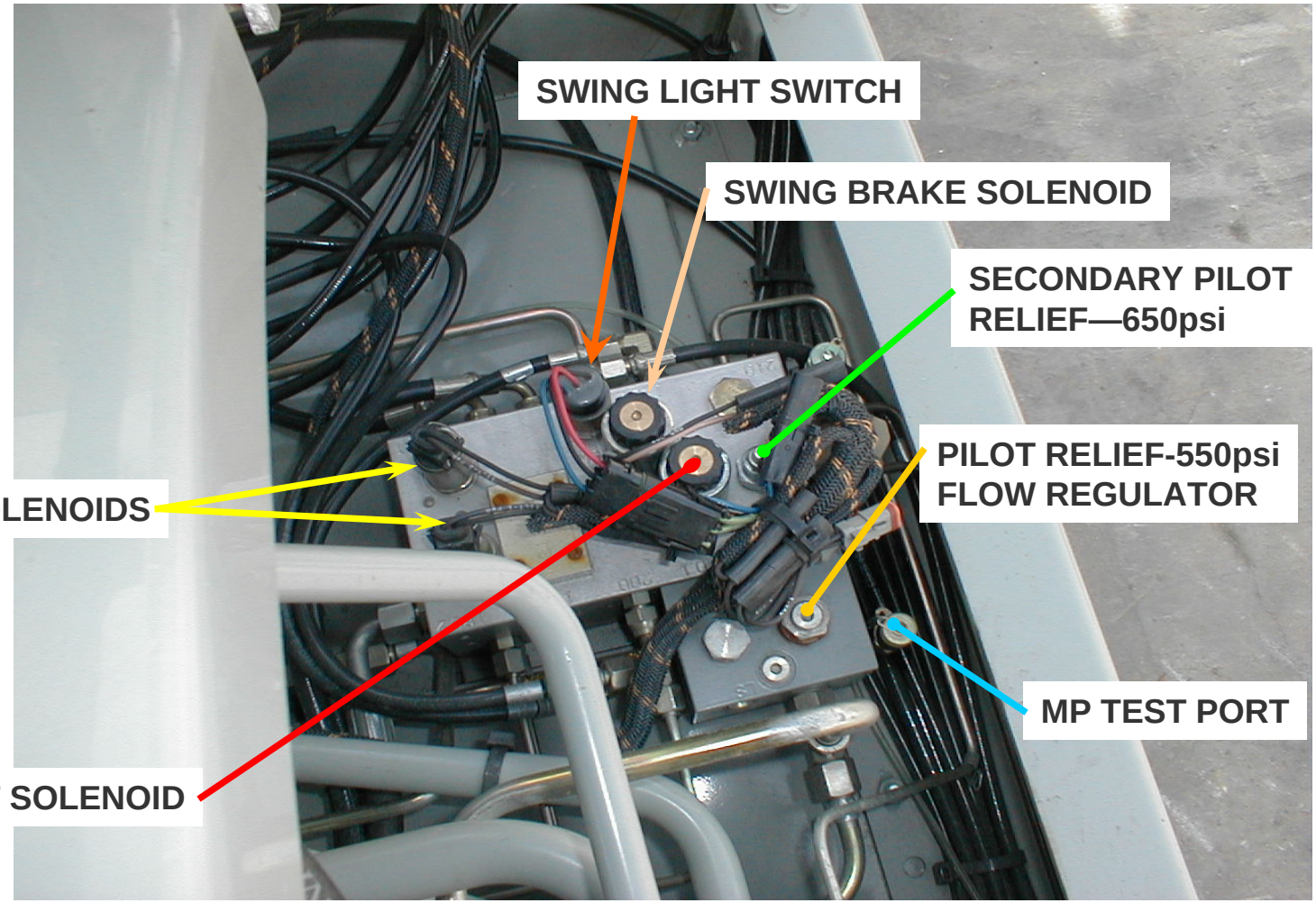
Pilot Manifold, XL3100

Pilot Secondary Relief set at 650psi. Note the 550 Pilot Relief is a flow control.



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Pilot Manifold Series II Machines



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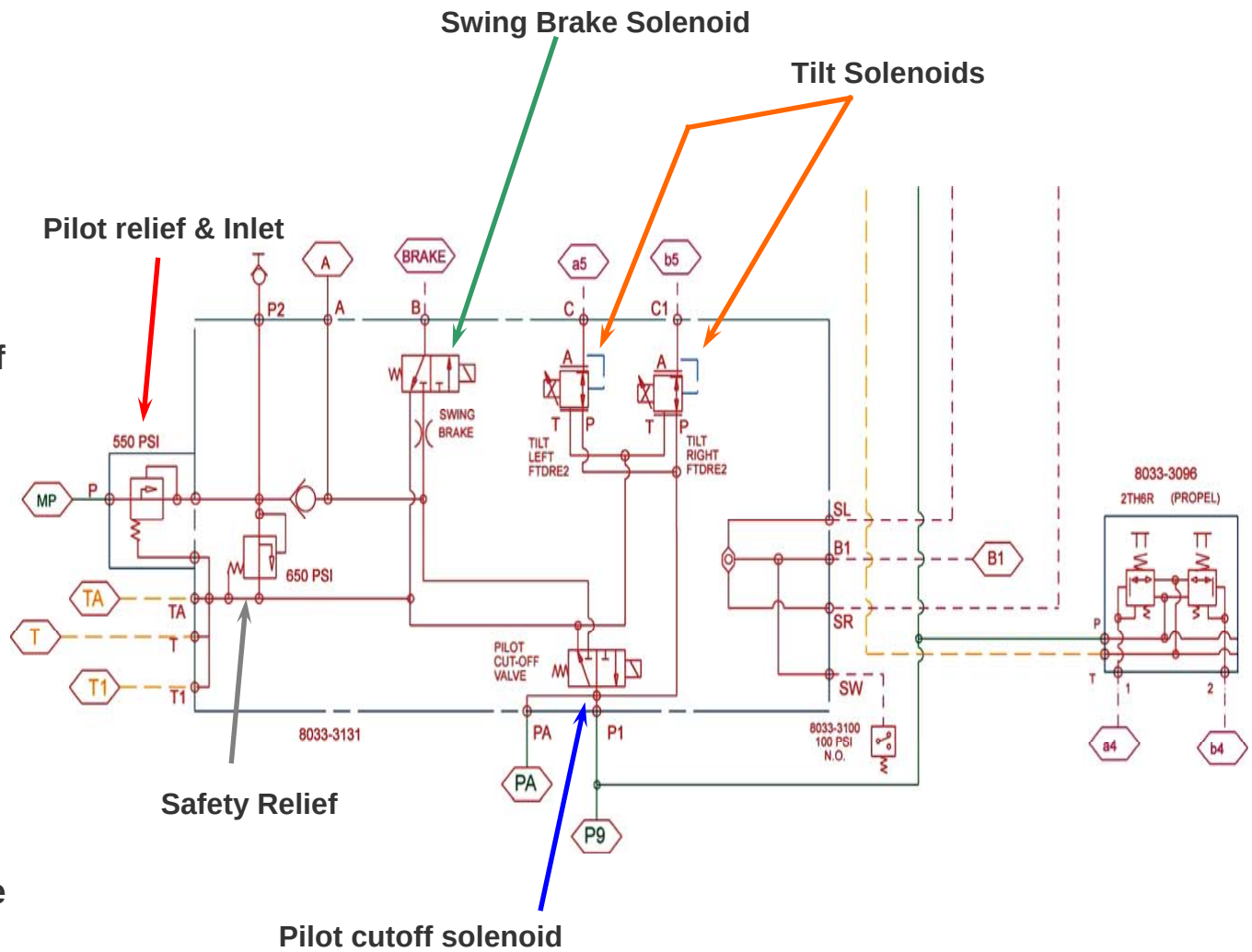
Pilot system and manifold

Pilot system receives oil from main valve “MP” port. Inlet of the pilot manifold has a relief that reduces “MP” pressure to pilot operating pressure of 5500 – 600 PSI. A safety relief is provided set at 650 PSI.

Pilot cutoff solenoid is provided to turn controls on/off.

Swing brake solenoid is used to release swing brake.

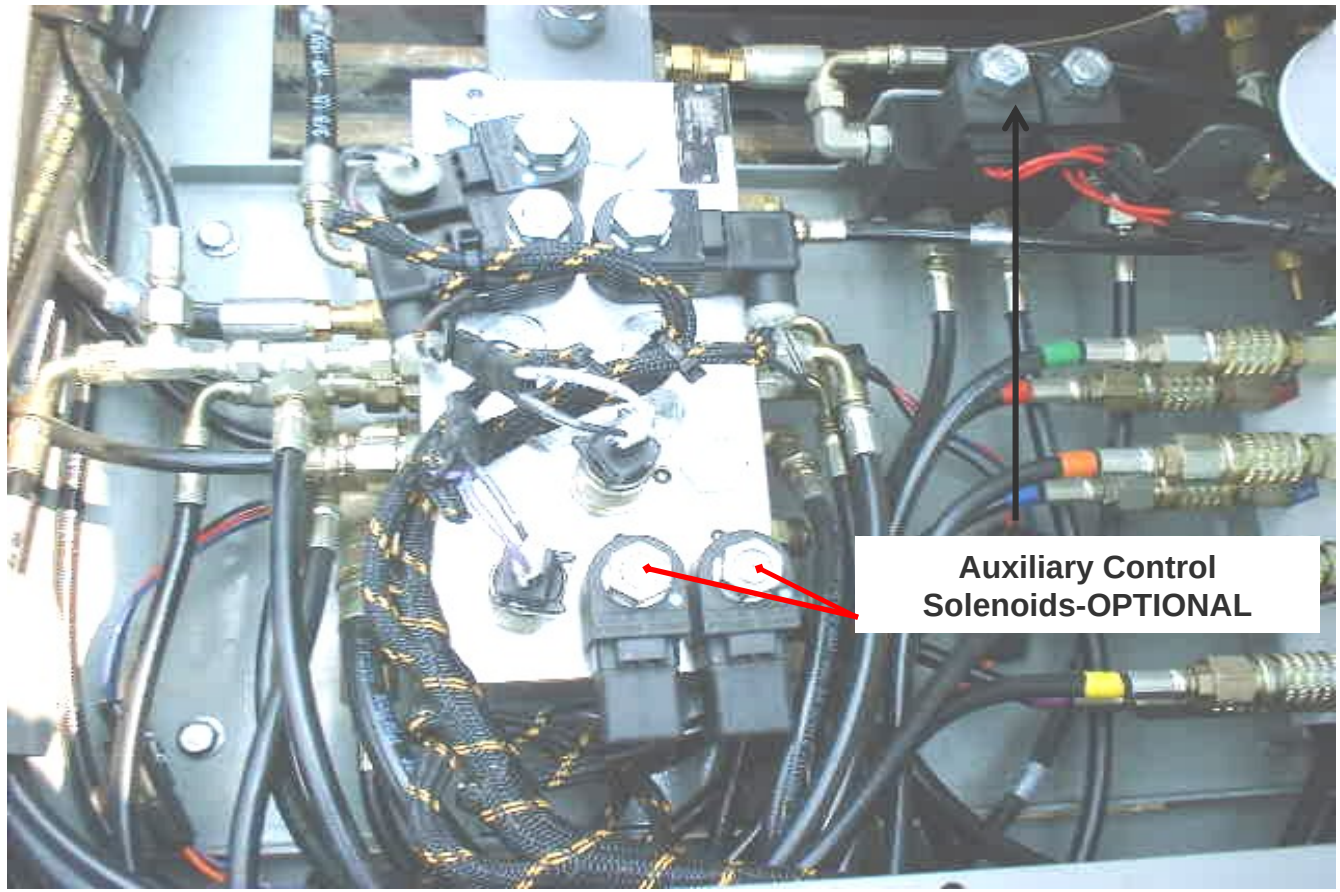
Proportional solenoids are used for controlling tilt speed



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Auxiliary Hydraulics, solenoids at Pilot Manifold Series I

SOLENOIDS indicated are for Aux.Hydraulics option. They receive signals from joystick switches and send pilot oil to the auxiliary valve section as needed.



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Pilot cutoff lever switch

Cab is equipped with pilot cutoff lever. When raised, it turns off pilot feed to joysticks. When lowered, it turns on pilot to joysticks.

Pilot cutoff lever uses a “Hall Effect” switch to turn pilot cutoff solenoid on/off. It also is used for starter lockout. Pilot cutoff lever must be up to start engine.

Switch does require a gap for proper operation. Gap is set by adjusting nuts on switch body.

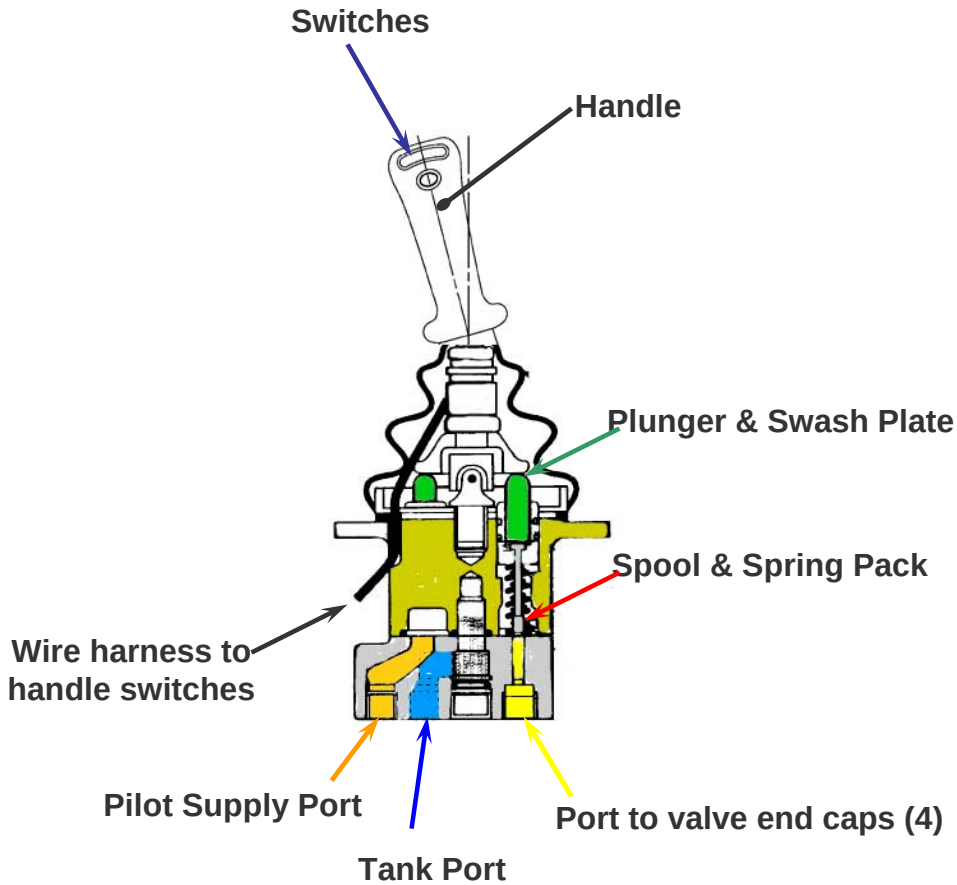


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Joystick

Joystick control is provided in operator's cab. There are left & right controls. Joystick is a pressure metering control that uses pilot system pressure metered to the control valve end caps to shift spools. A spool and spring pack control pressure metering. The springs provide the metering curve and feel to the joystick handle.

The handle is angled and shaped for operator comfort. Switches are part of the handle to allow additional control functions to be run from the joystick. Each switch is an electrical function. Typical functions that are controlled from the joystick switches are: Horn, boom tilt, power boost, & auxiliary (optional).



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Control pattern bulkhead – Series II

Control pattern changes are made with color-coded connections. Top row hoses stay on top and bottom row stay on bottom row.



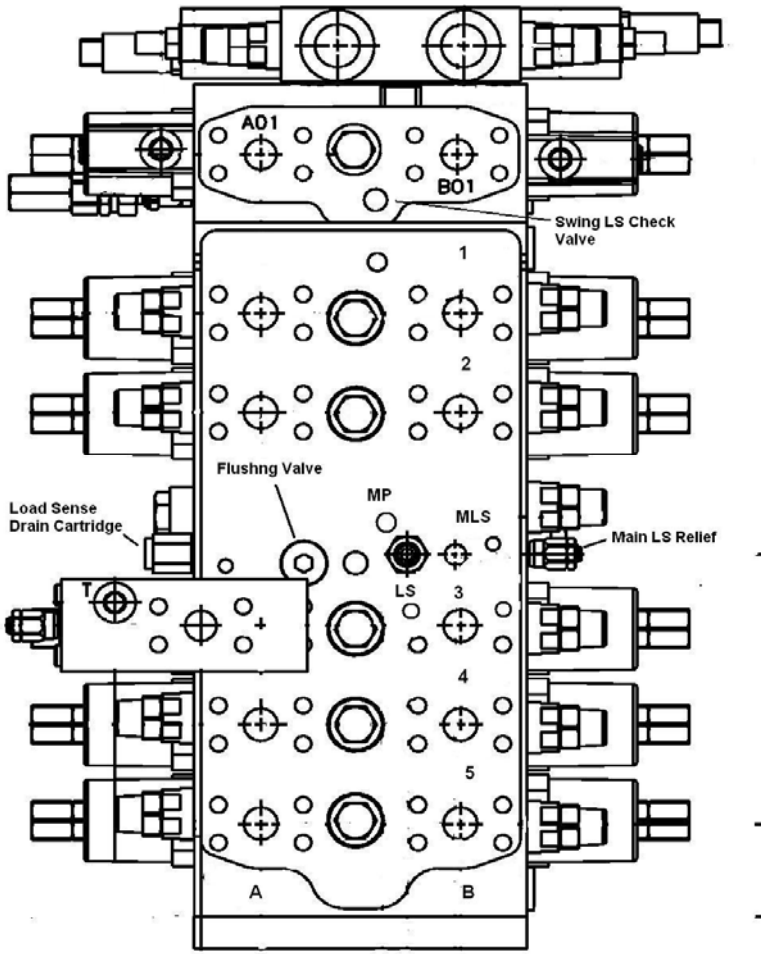
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Main Control Valve – On Highway

Main Control valve receives oil from the center pin on the LH side of the upper structure.

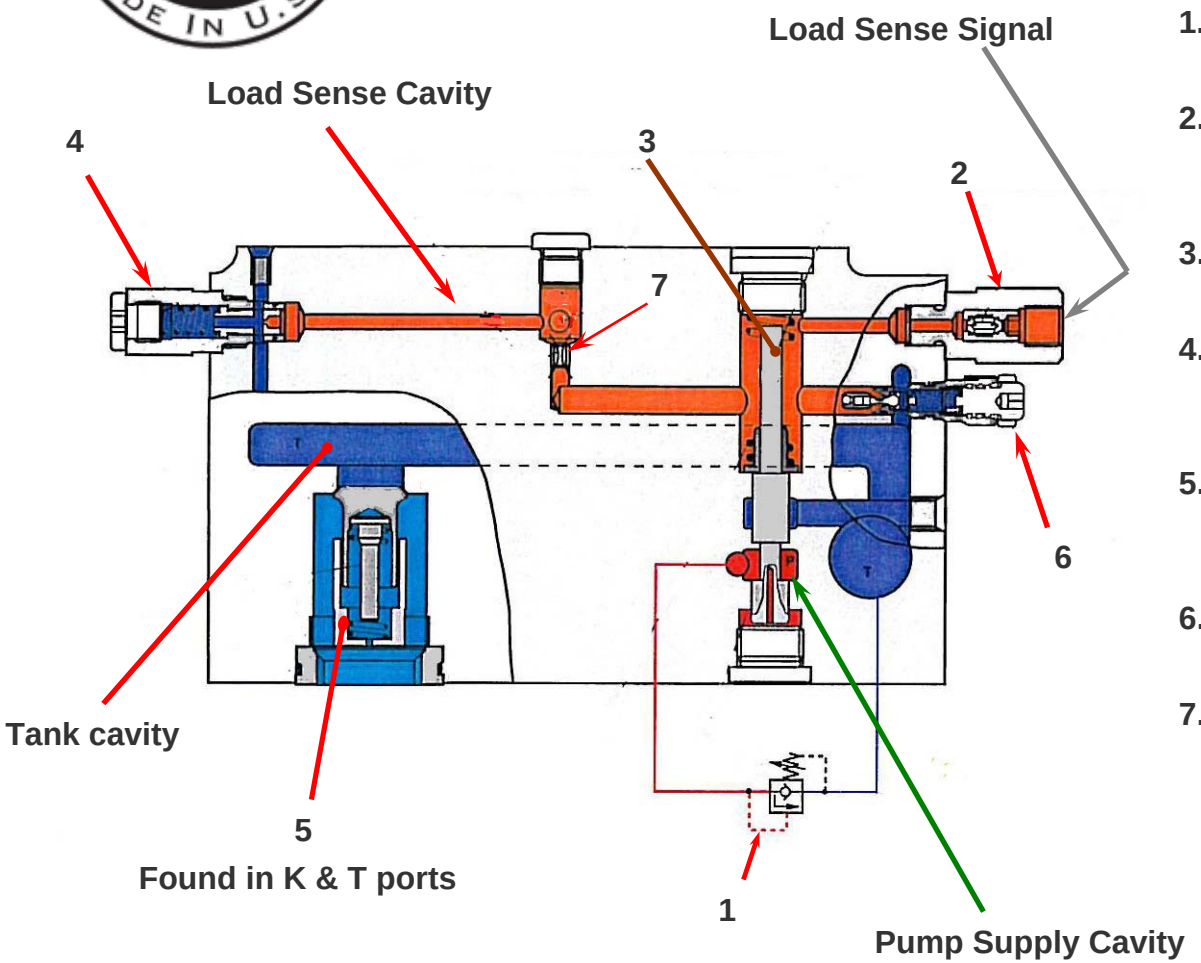
Main control valve is a monoblock type valve, with a bolt on swing and heater/A/C section. If auxiliary hydraulic option is added, a 3rd bolt on section is provided.

Major functions are pilot operated from the joysticks. Heat/A/C is solenoid operated as is auxiliary.



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Main Valve Inlet Section

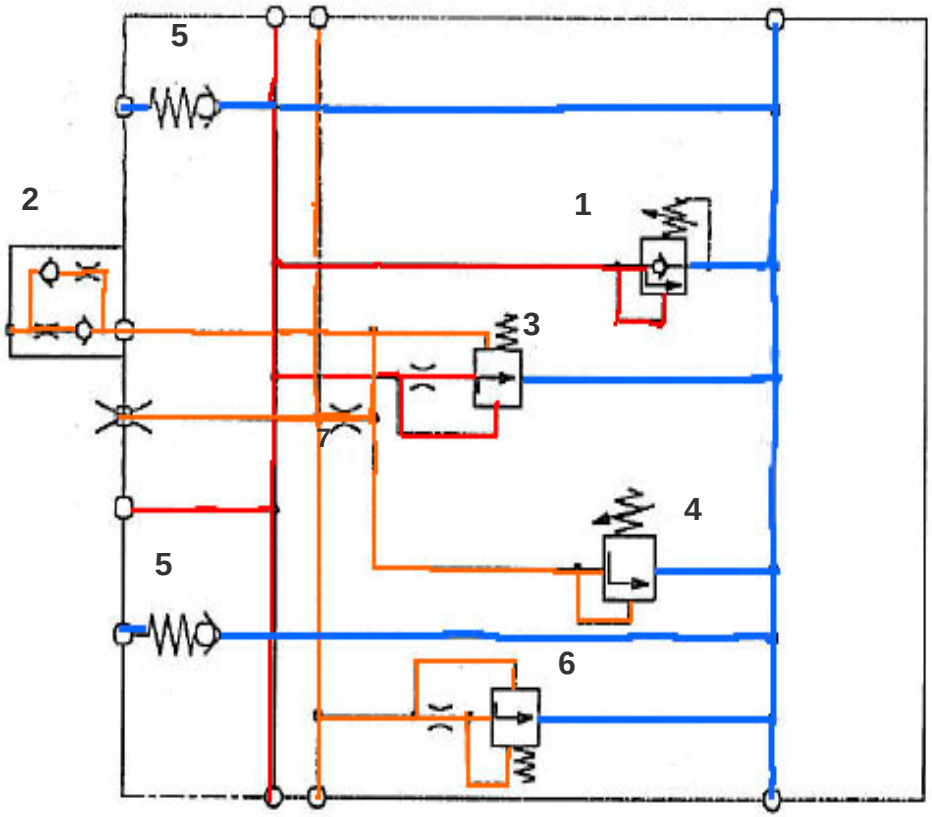


Main Valve inlet serves as inlet/outlet for oil to the valve along with many other important valve functions:

1. Primary Pressure relief – protects pump & valve
2. Load Sense Orifice Shuttle – Meters LS signal to the pump, drains signal in neutral
3. Flushing Valve – Allows flushing of valve with no LS signal.
4. Load Sense Drain Valve – Provides continuous drain of LS signal for stability
5. Tank/Cooler Check Valves – 2, located in ports “K” & “T”. Provides valve backpressure
6. Load Sense Relief – Primary system pressure control
7. Central Load Sense Orifice – prevents saturation of load sense relief and drain valves

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Main Valve Inlet Section - Schematic

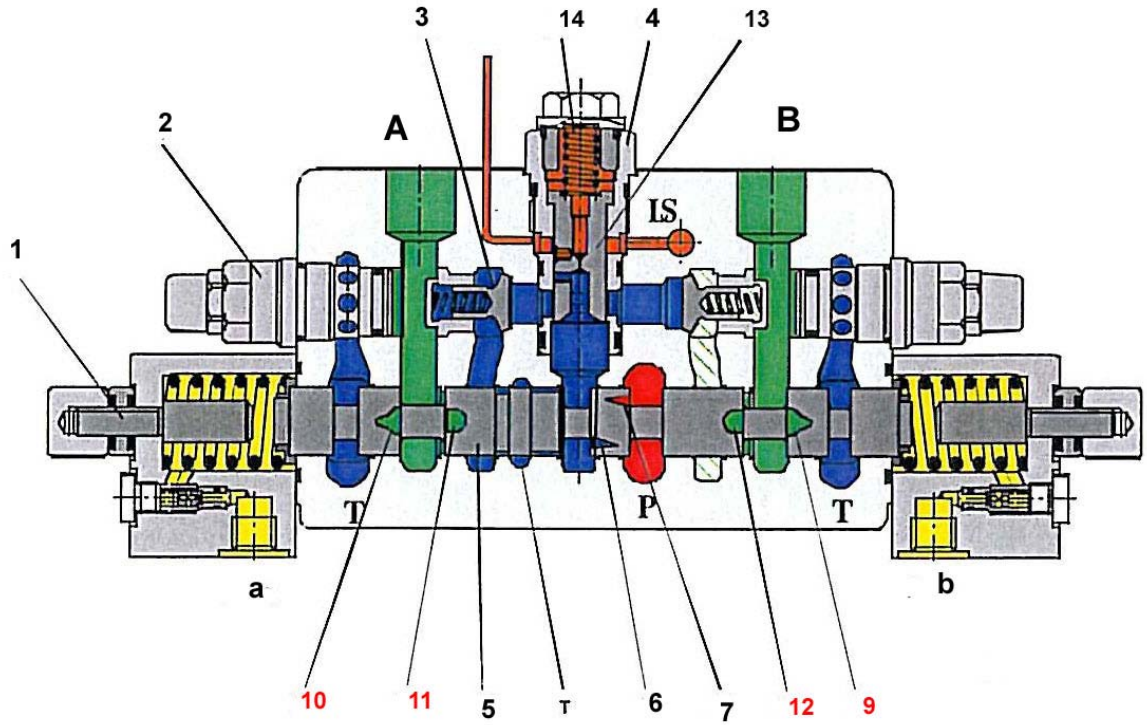


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Typical Main valve section

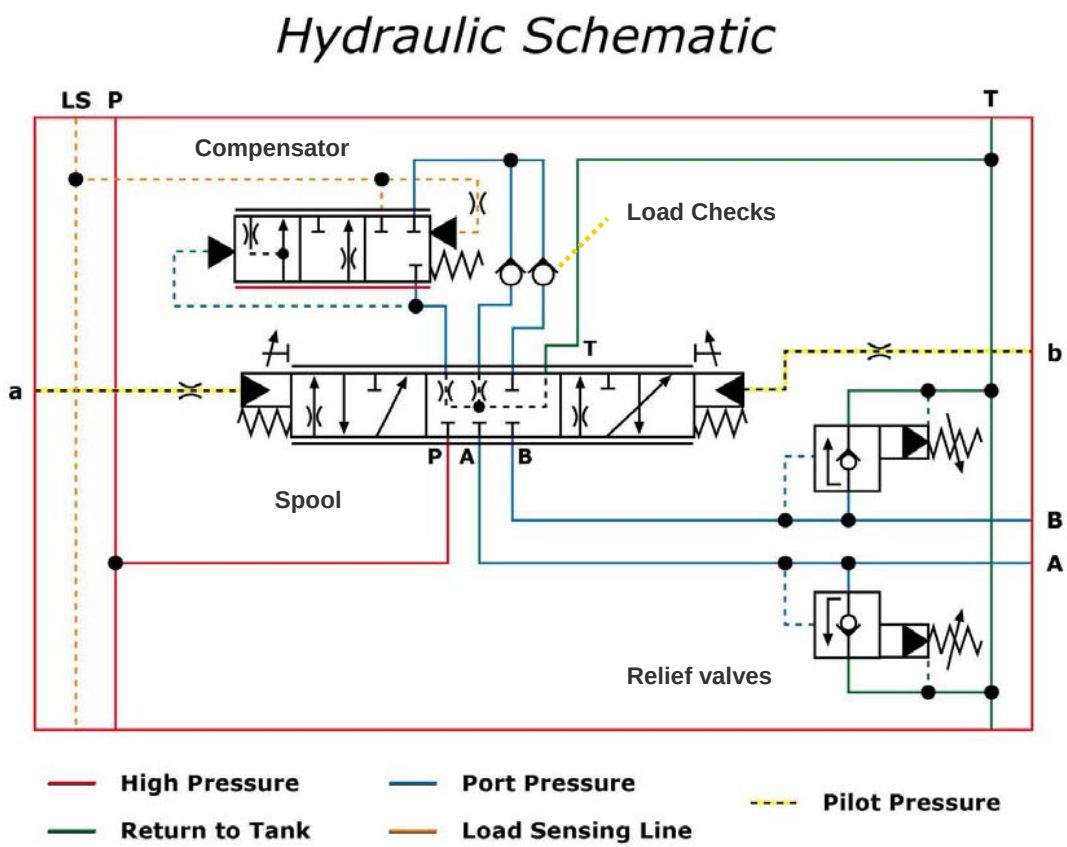


Typical main valve cross section:
1-End cap with stroke limiter and damper orifice
2-Work port relief/anti-cavitation check to protect work ports
3-Load check holding valves between pressure core and work ports.
4-Compensator spring and spool. Compensator meters oil between pump cavity and load sense when main spool is shifted
5-Main spool controls flow from pump core to compensator and work ports. 6, 7, 0, 10, 11, & 12 are metering notches that may be present depending on functions to allow finer control
13-Compensator spool
14 Compensator spring
T-Tank core

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Control Valve – Schematic view

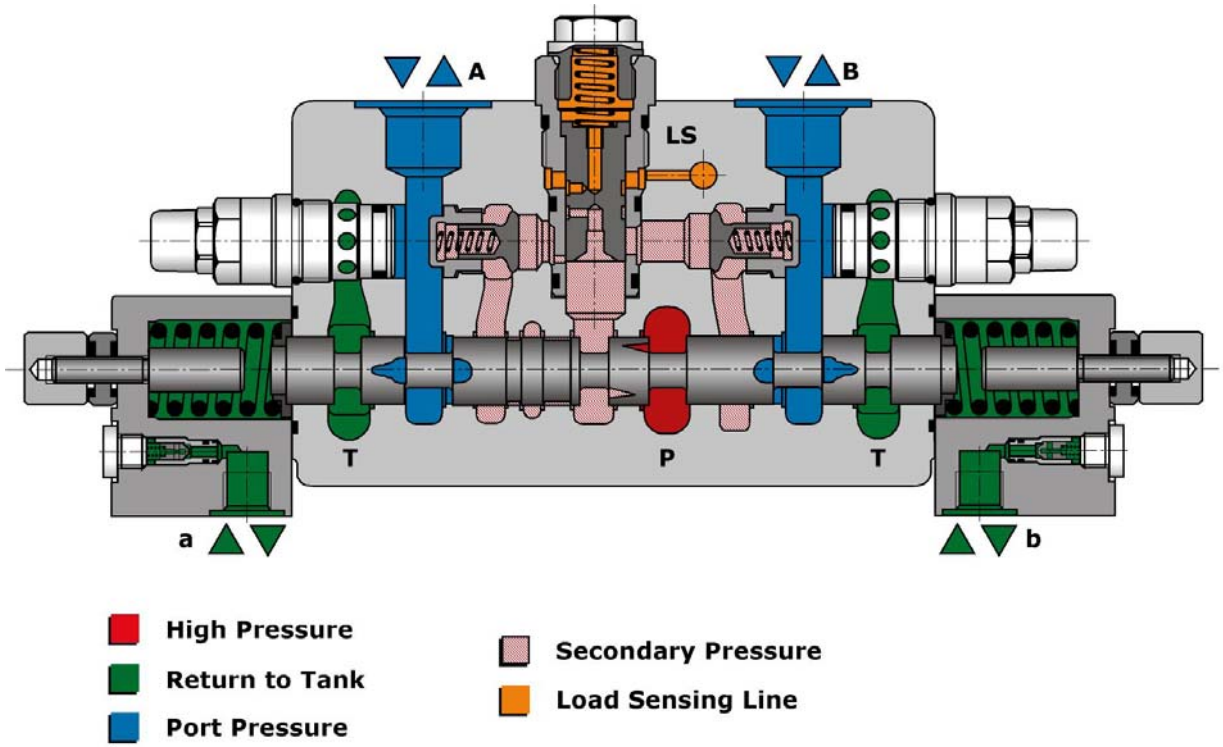
Schematic view of the control valve section. Components of the valve are noted.



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Control Valve - Neutral

View of valve when spool is in neutral. Work ports are blocked, oil in pressure cavity is available to other sections. Load sense signal at compensator is higher than valve, compensator is in close position.

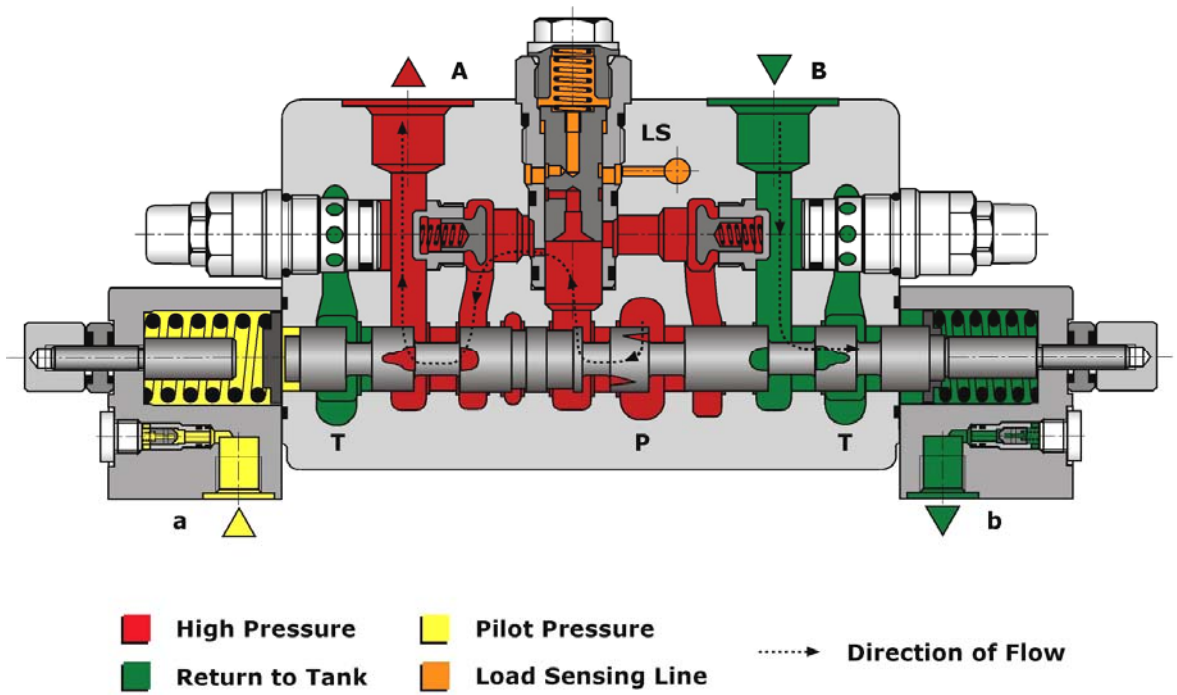


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Control Valve – shifted to “A” port

Valve shifted for flow out “A” port. Pilot pressure at “a” end cap shifts spool. Oil from pressure cavity is metered across spool to compensator. Compensator works against spring and system load sense and meters oil across load check and out “A” port to work function. If valve pressure is greater than load sense & spring pressure, compensator moves to open position to signal load sense. As flow/pressure in valve changes, compensator maintains pressure drop across valve to work port and signals pump to maintain differential between pump and work port.

“B” port is drained to tank cavity of the valve.

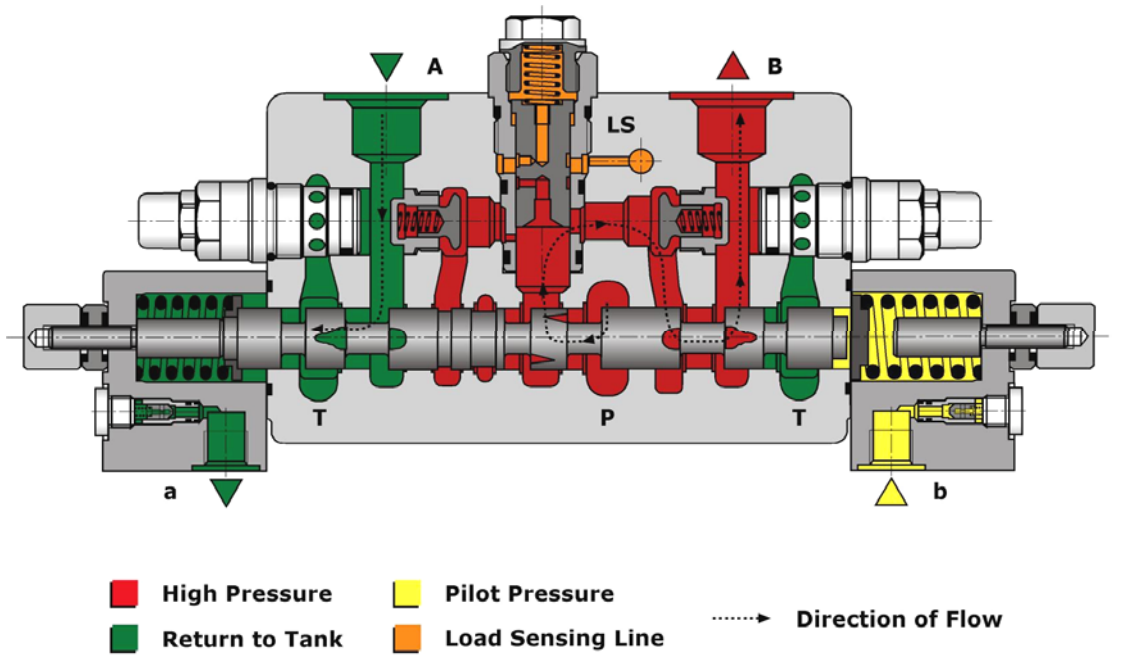


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Control Valve – shifted to “B” port

Valve shifted for flow out “B” port. Pilot pressure at “b” end cap shifts spool. Oil from pressure cavity is metered across spool to compensator. Compensator works against spring and system load sense and meters oil across load check and out “A” port to work function. If valve pressure is greater than load sense & spring pressure, compensator moves to open position to signal load sense. As flow/pressure in valve changes, compensator maintains pressure drop across valve to work port and signals pump to maintain differential between pump and work port.

“A” port is drained to tank cavity of the valve.

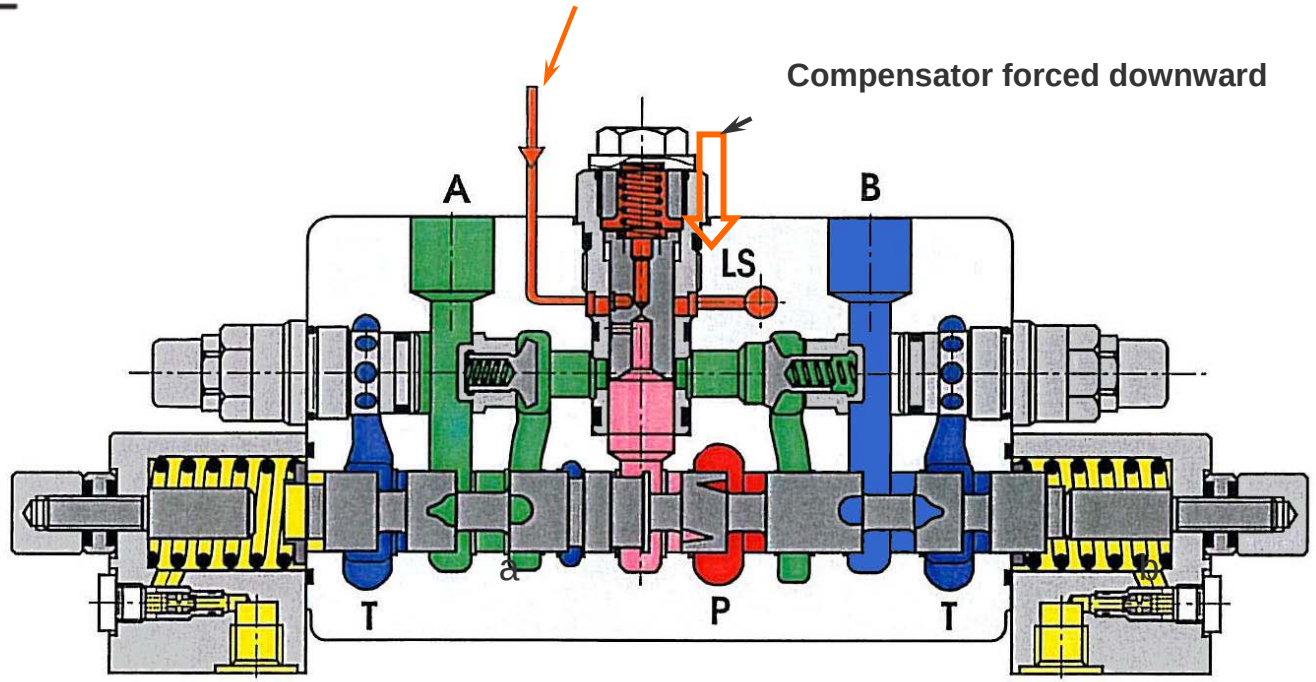


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Section Operation, Multiple Functions

Load sense higher than valve work port pressure

Compensator forced downward



When multiple functions are operated, compensator works a bit different than previous slides. When multiple functions are used, LS pressure acts on compensator to force it downwards to meter oil from spool to work port causing additional pressure drop. Pressure drop across the spool from pressure cavity to compensator remains the same.

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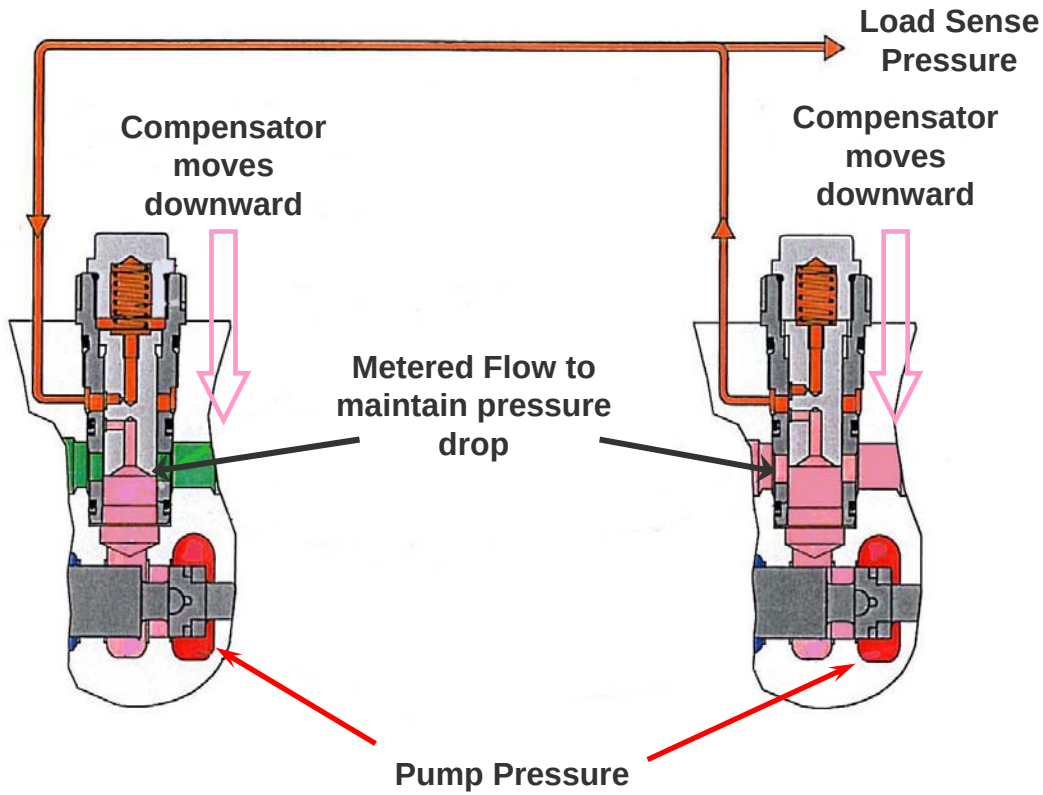
Multiple Function Operation – Load Sense

Flow Demand Greater than Pump Flow

When demand for pump flow is greater than pump is able to produce (flow limit or horsepower cutoff), pressure drop at spool can not be maintained. Since all compensators are acted upon by highest pressure, compensators shift downward until pressure drop is maintained at compensator instead of spool.

Machine functions will slow proportionally. Functions will remain moving in proportion to operator input.

As system demand decreases and pump flow increases, the compensators will move back up and allow pressure drop to be controlled across the spool again.



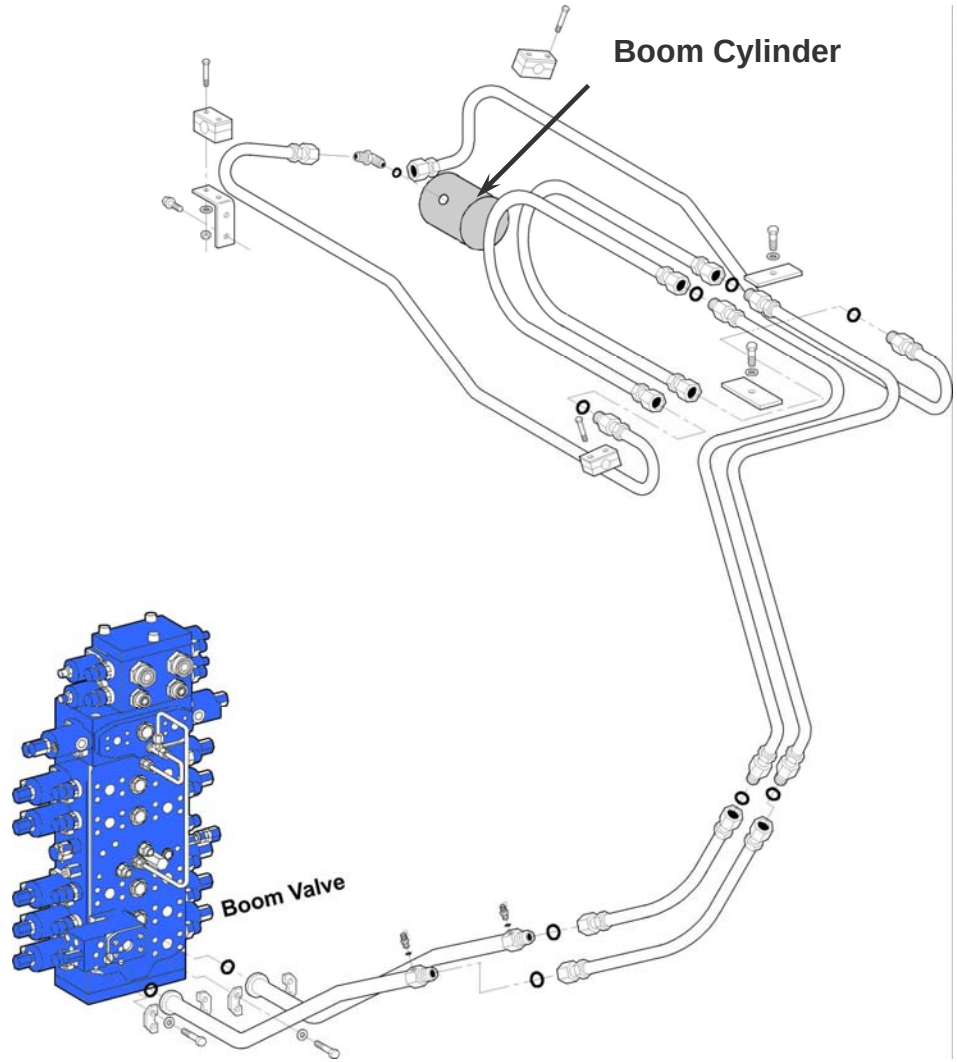
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Boom Cylinder Circuit

Boom valve directs oil into boom circuit to boom cylinder mounted at the rear of the main boom. Operator uses the joystick to direct boom to retract or extend.

Boom joystick shifts the boom valve at end cap using pilot pressure. When the spool is shifted, oil from the valve pump cavity is routed to the selected port across the spool. A load sense signal is generated and is used by the valve & pump to provide adequate flow for load conditions.

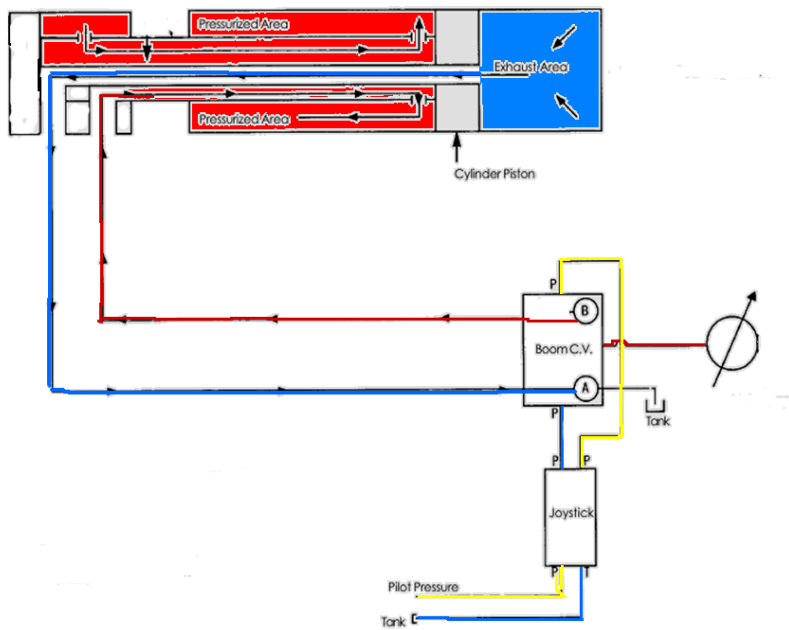
Oil is routed to the boom cylinder through a series of hoses and tubes from the boom valve to the boom cylinder.



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Boom Retract Circuit Operation

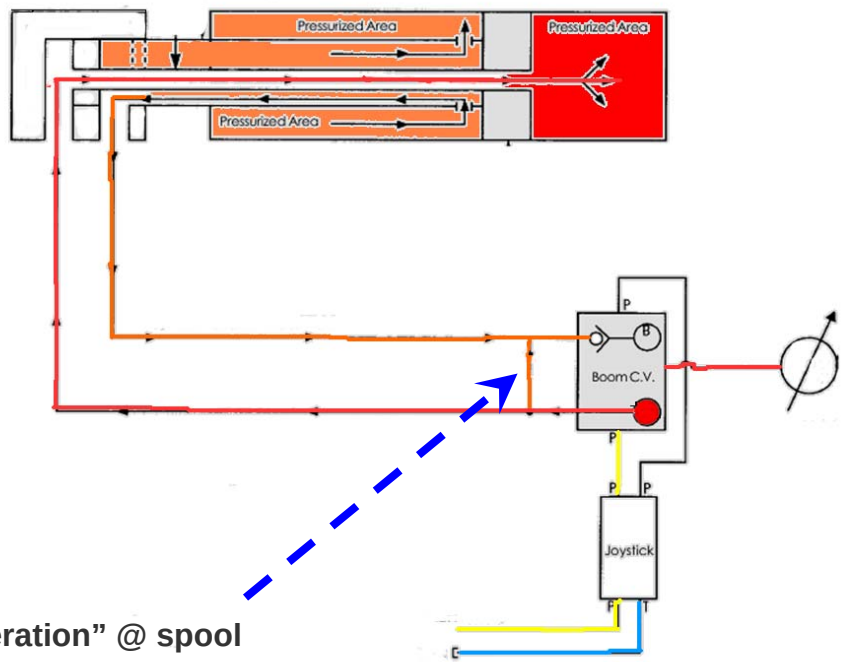
During boom retract operation, control valve routes oil to rod side of boom cylinder to retract boom. Oil on base side is routed to tank through the control valve.



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Boom Regeneration Circuit

During boom extend function, control valve shifts to send oil to base end of cylinder. As cylinder extends, oil returns to control valve. The boom control valve uses a special spool that allows “regeneration” to occur. All oil returned from cylinder to valve is returned to base end. This gives fast boom out action. Cylinder runs at virtually same pressure on both sides of piston during boom out. Difference in surface area allows cylinder to extend.

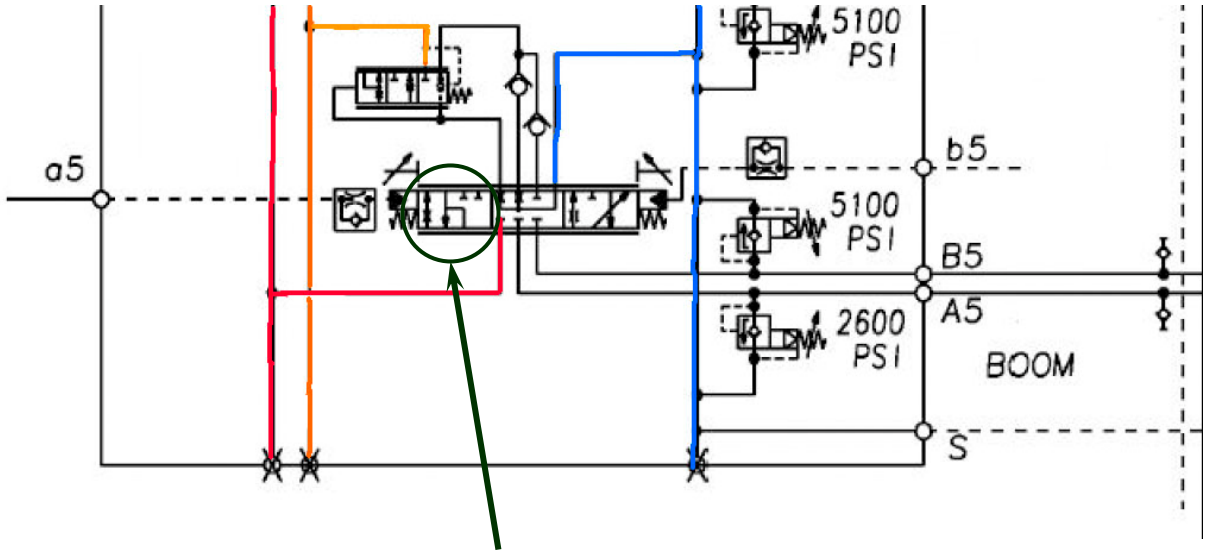


“Regeneration” @ spool

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Boom Valve Schematic

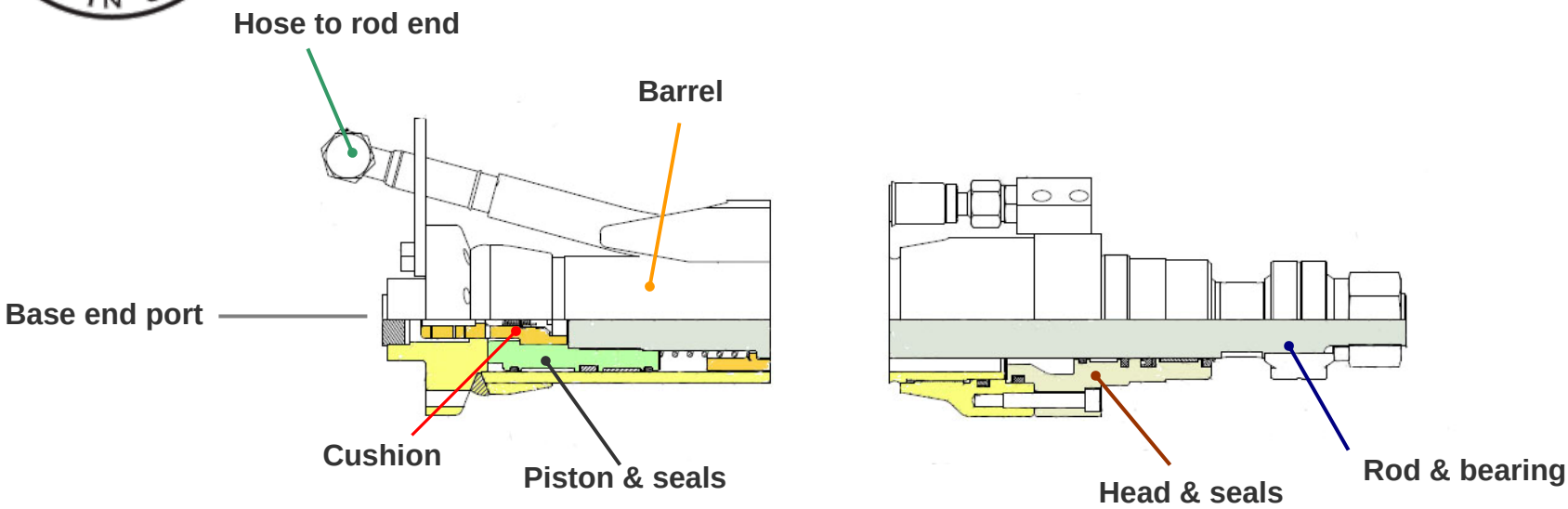
Boom valve is different than other control valves. Boom circuit uses “regeneration” to achieve boom out speed. Note the difference in the schematic!



Note symbol for regeneration

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Boom Cylinder



Boom cylinder is a double acting cylinder. It has 2 cushions to dampen cylinder stop at each end of stroke. Rod side cushion is spring loaded sliding valve, base end cushion is a plunger type cushion retained by the piston. A spring & check ball in the plunger allows fast start for boom extend. Piston is threaded onto the rod. Cylinder barrel bolts to the main boom. Rod end has a spherical bearing attached to telescope boom to allow tilt action.

Seals and bearings are provided for sealing and support of piston. Head has seals to prevent leakage of hydraulic fluid at cylinder head. Piston is threaded onto the rod for retention. Head is retained in barrel by cap screws.

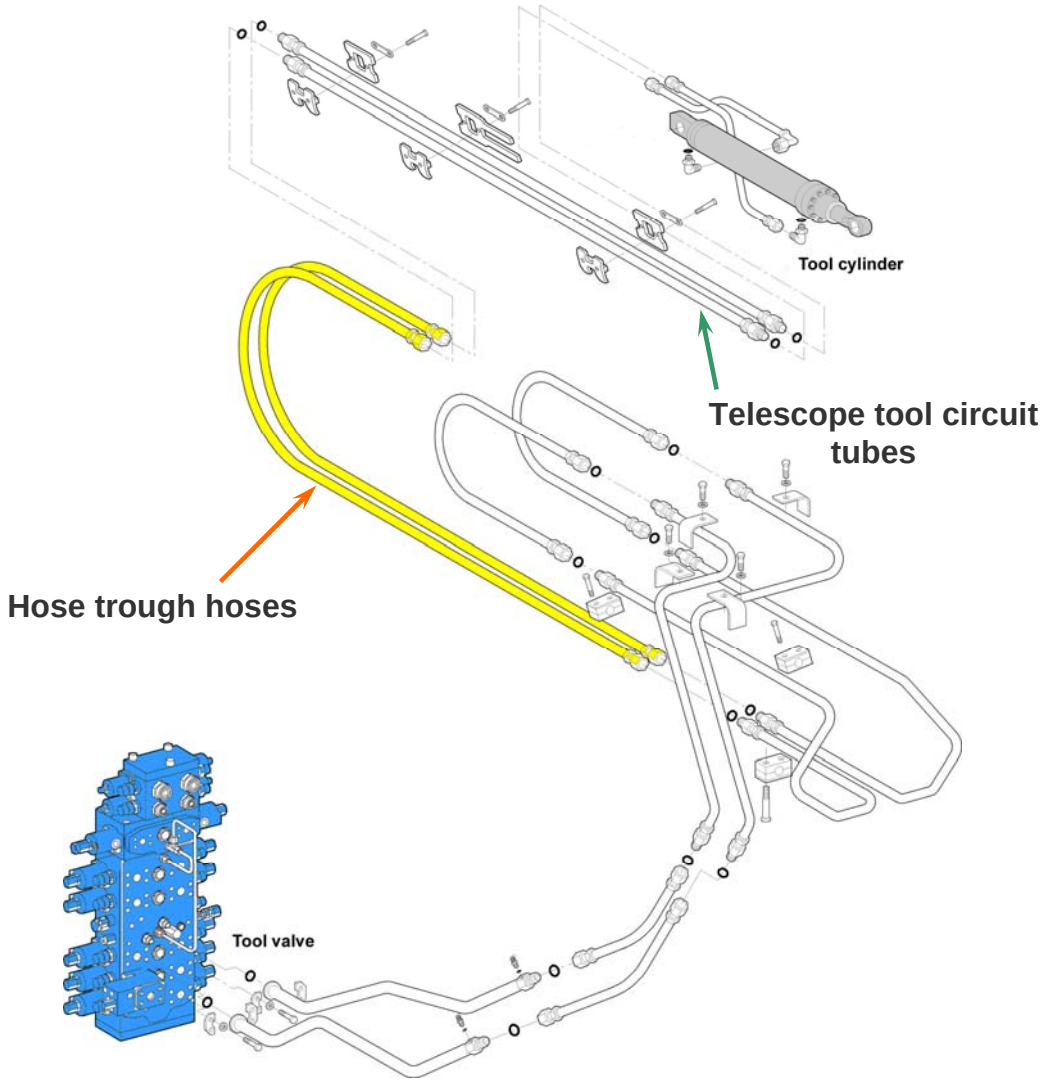
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Tool Circuit

Tool valve directs oil into tool circuit to tool cylinder mounted at the front of the telescope boom. Operator uses the joystick to direct tool to retract (open) or extend (close).

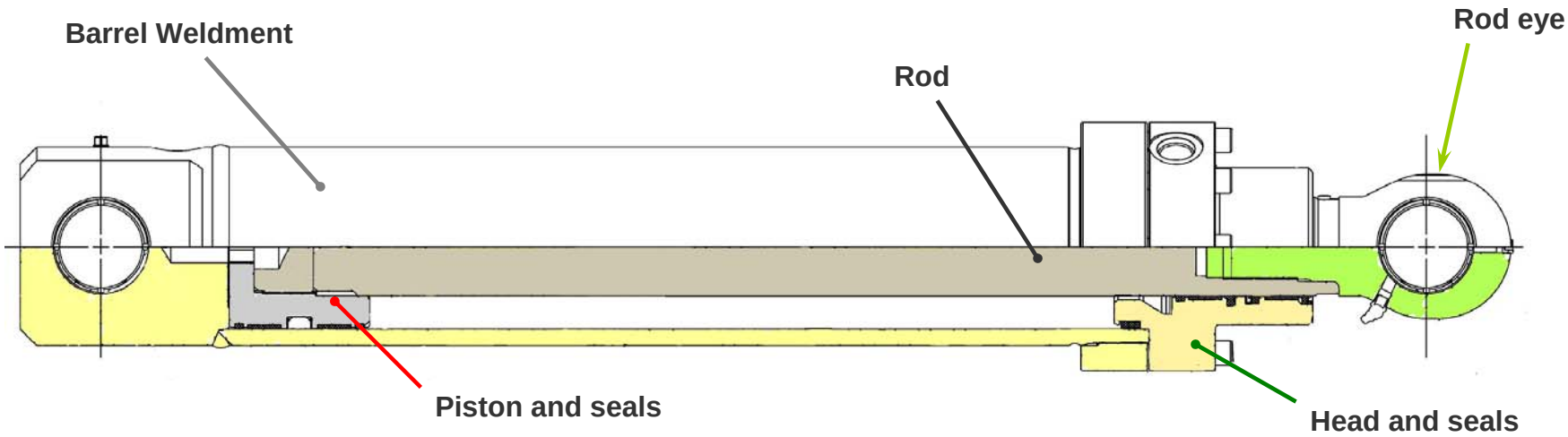
Tool joystick shifts the tool valve at end cap using pilot pressure. When the spool is shifted, oil from the valve pump cavity is routed to the selected port across the spool. A load sense signal is generated and is used by the valve & pump to provide adequate flow for load conditions.

Oil is routed to the tool cylinder through a series of hoses and tubes from the tool valve to the tool cylinder. Hose trough hoses in the main boom along with tubes in the telescope boom allow for boom movement.



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Tool Cylinder

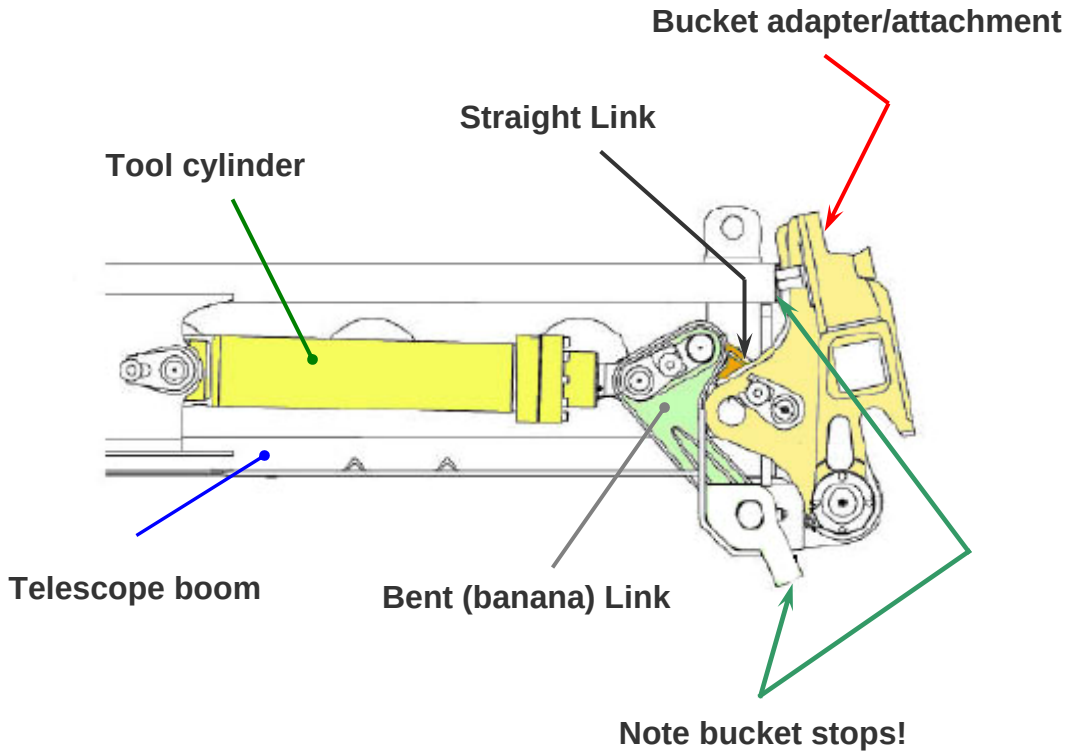


Tool cylinder is a double acting cylinder. Piston is threaded onto the rod. Rod eye is also threaded into the rod. Head is retained into the barrel using cap screws. Piston has seals and wear rings for high pressure, rod seals are to seal rod area from leakage. A dust seal is provided to reduce dirt being drawn into cylinder.

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Tool @ boom end

Tool cylinder at boom end moves the tool (bucket) through linkage. Tool cylinder is attached at the base end to the telescope boom. Rod end attaches to the bent link, which moves the bucket adapter through the straight link. Buckets attach to bucket adapter using wedge bolts to retain bucket to bucket adapter.



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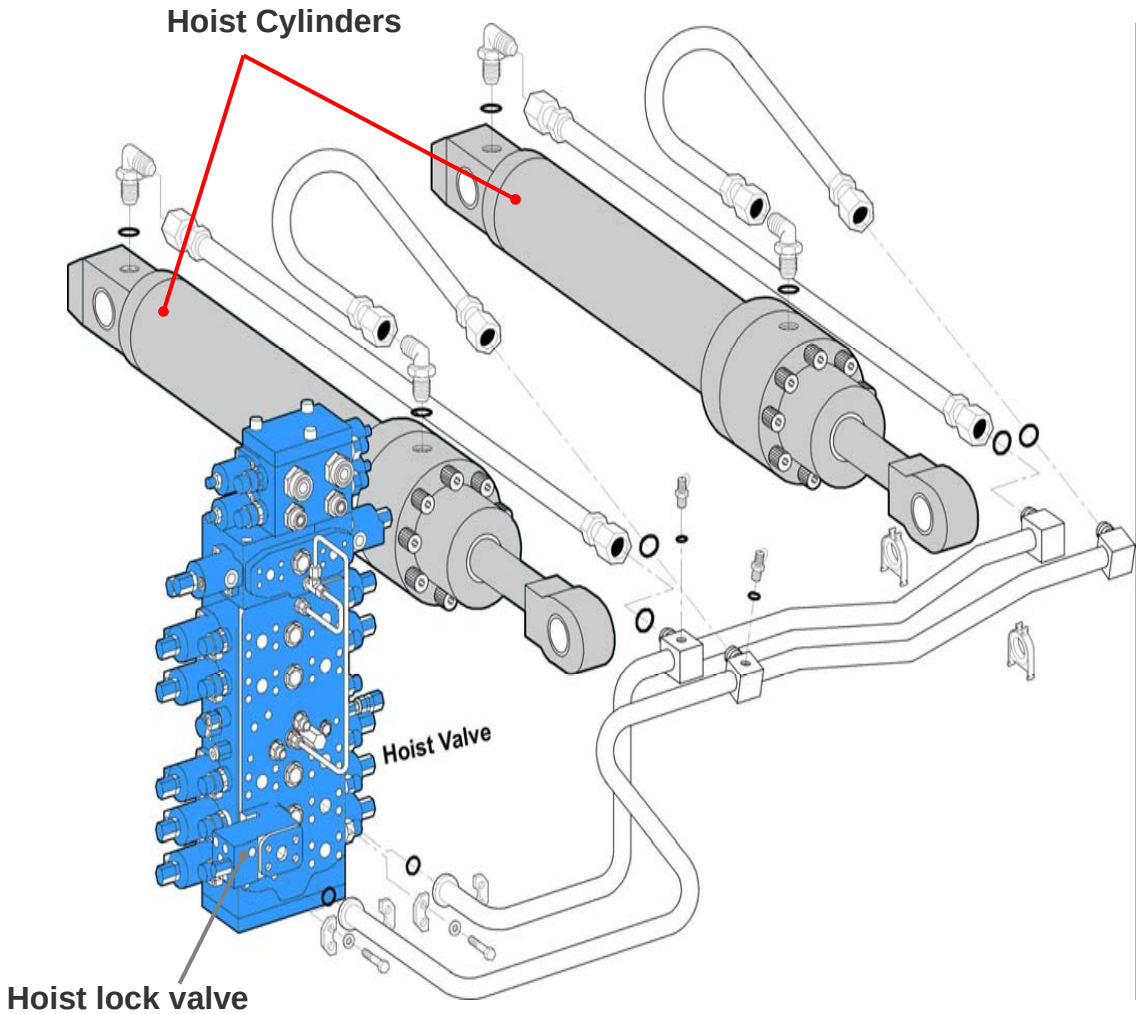
Hoist circuit

Hoist valve directs oil into hoist circuit to hoist cylinders mounted to frame and acting on cradle. Operator uses the joystick to direct hoist to retract (lower) or extend (raise).

Hoist joystick shifts the hoist valve at end cap using pilot pressure. When the spool is shifted, oil from the valve pump cavity is routed to the selected port across the spool. A load sense signal is generated and is used by the valve & pump to provide adequate flow for load conditions.

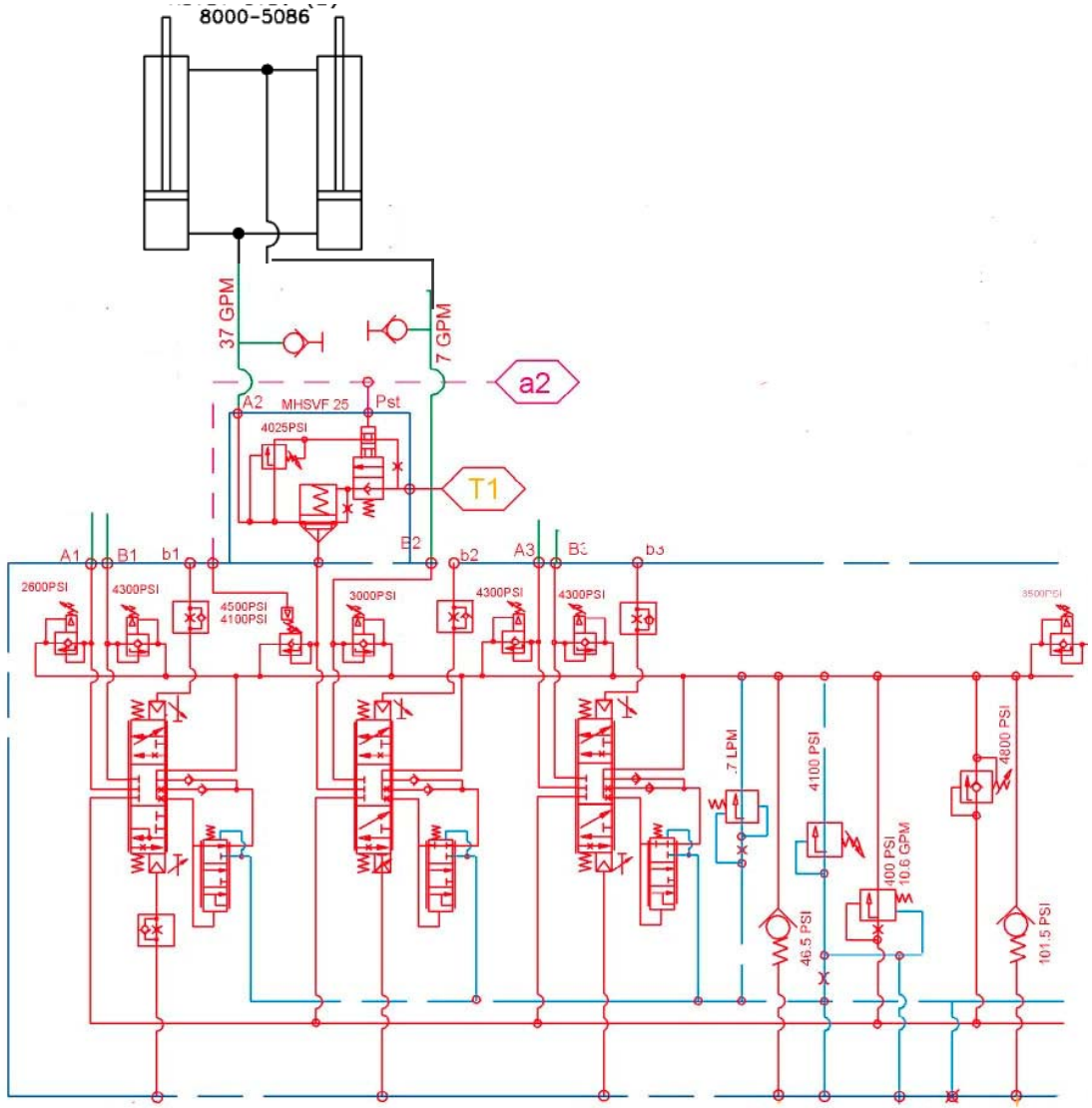
Oil is routed to the hoist cylinder through a series of hoses and tubes from the hoist valve to the hoist cylinders.

Hoist lock valve prevents excess cylinder drift.



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Hoist Circuit Schematic

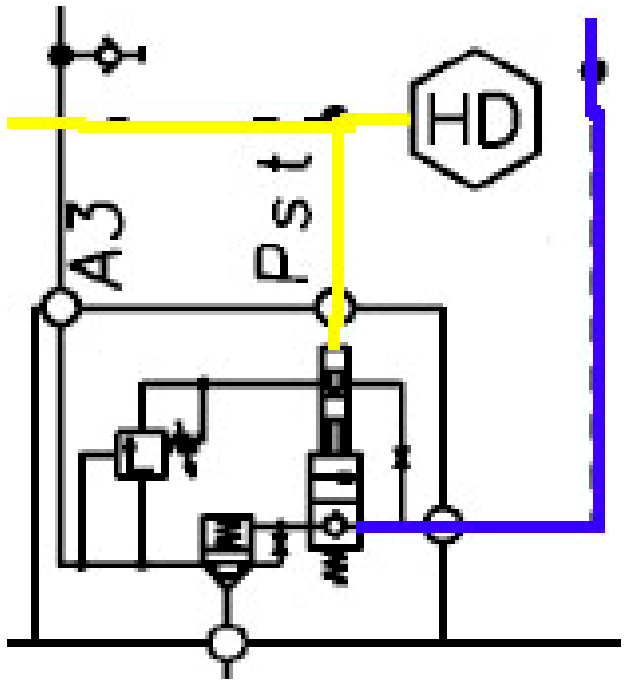


Schematic view of Hoist circuit.
Note hoist lock valve.

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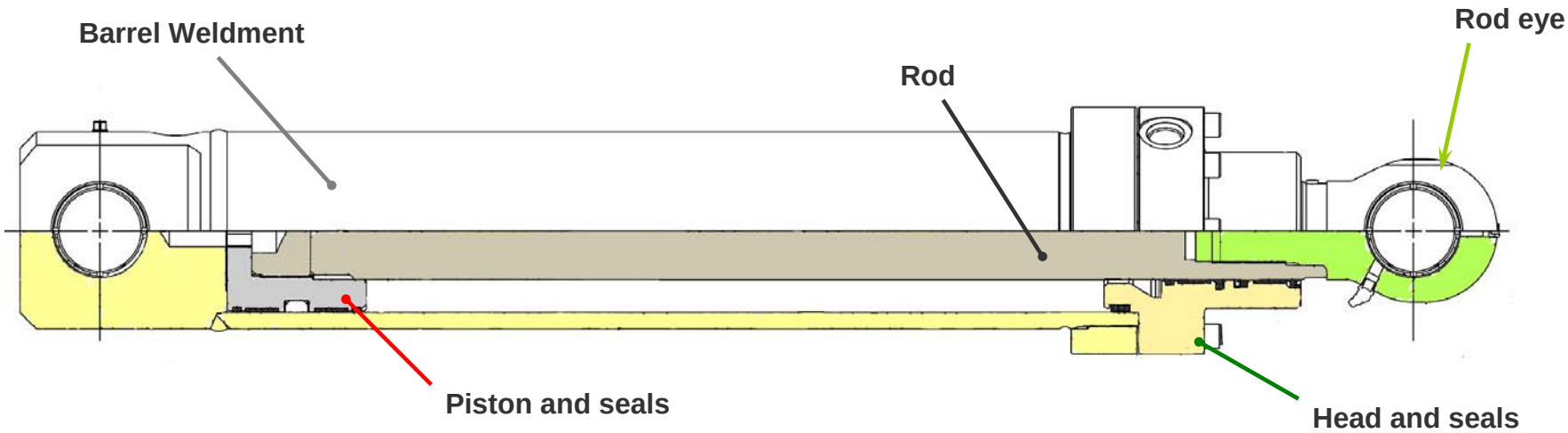
Hoist Lock Valve

Hoist lock valve is supplied on “A” port of valve. Hoist lock is used to prevent excess drift of hoist circuit when hoist is not active. Spool is shifted by pilot pressure to allow hoist movement during hoist down. Spool works with check valve to control hoist down oil flow. Relief valve is provided to prevent overpressure of circuit.



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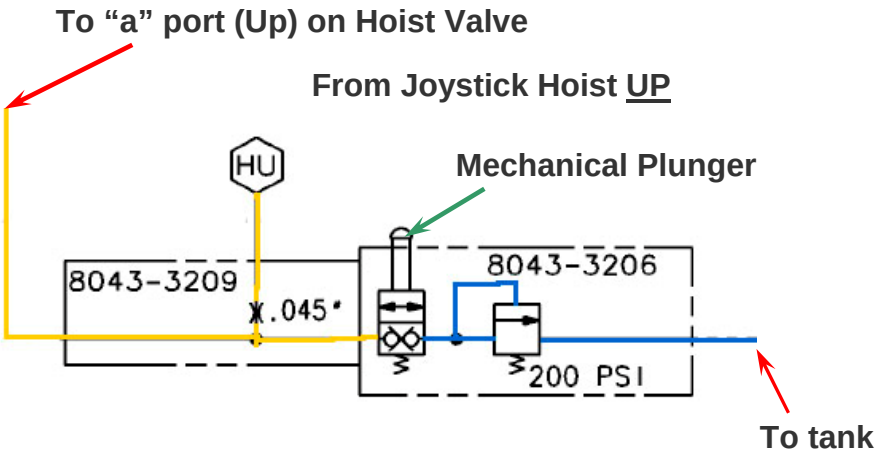
Hoist Cylinder

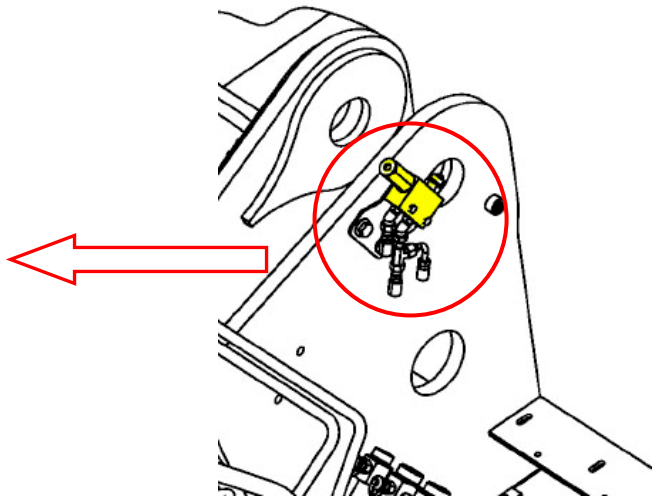


Hoist cylinders are double acting cylinders. Piston is threaded onto the rod. Rod eye is also threaded into the rod. Head is retained into the barrel using cap screws. Piston has seals and wear rings for high pressure, rod seals are to seal rod area from leakage. A dust seal is provided to reduce dirt being drawn into cylinder.

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Hoist Up Cushion Circuit – XL4100-II

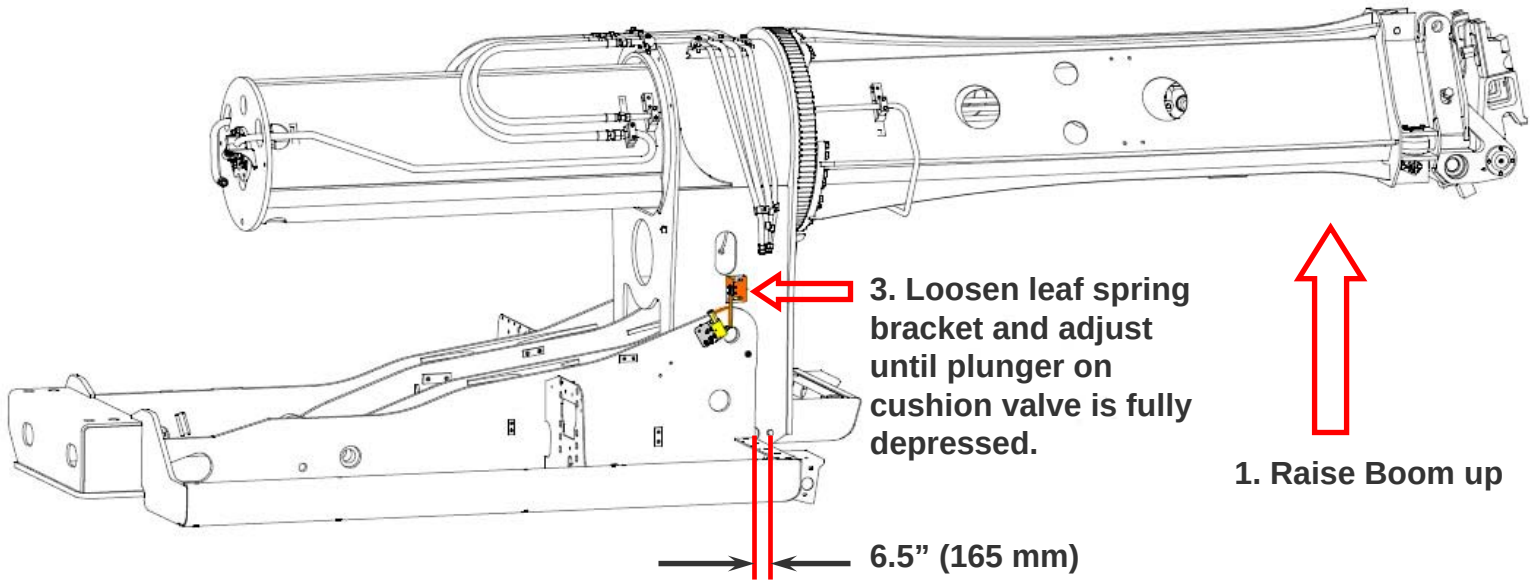




Hoist up has a cushion valve provided. Mechanically actuated valve on side of frame limits hoist up pilot pressure as hoist comes to up stop. When leaf spring on boom cradle contacts plunger, hoist up pilot pressure is reduced to 200 psi to limit hoist up speed as it comes against hoist up boom stop.

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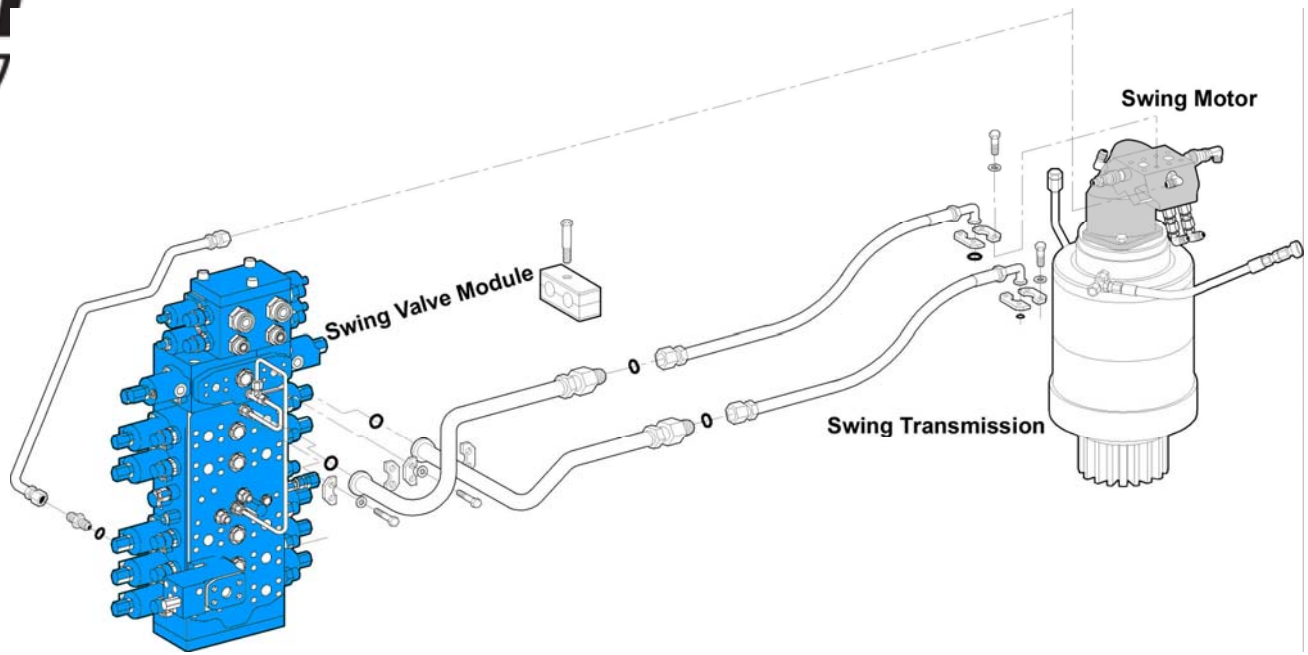
Hoist Cushion Adjustment – XL4100-II



Hoist cushion valve requires mechanical adjustment to work correctly. Follow the above steps to adjust correctly.

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Swing Circuit



Swing valve module directs oil into swing circuit to swing motor mounted on swing transmission. Operator uses joystick to direct swing to rotate upperstructure clockwise or counterclockwise.

Swing joystick shifts the swing valve module at end cap using pilot pressure. When spool is shifted, oil from the pump cavity is routed to the selected port across the spool. A load sense signal is generated and used by valve and pump to provide adequate flow for load conditions. A check valve in the swing module load sense gives priority to load sense signal for swing circuit.

Oil is routed to the motor through hoses and tubes.

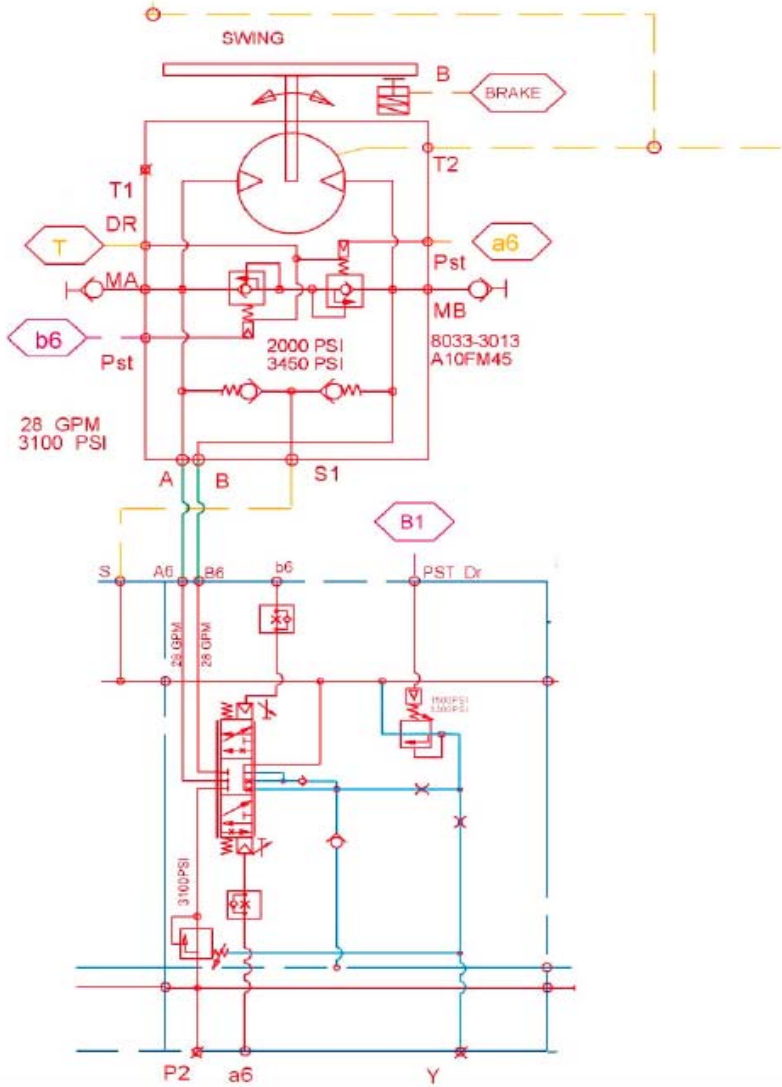
2 stage relief at valve controls swing pressure (torque). 2 stage relief valves at motor provide high pressure for swing, low pressure for stop (cushioning)

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Swing Circuit Schematic

Swing circuit consists of bolt on valve section, piston motor, spring apply, hydraulic release brake, and planetary swing transmission.

Swing is has relief valves to set maximum pressure and dual stage relief valves to provide swing cushion to stop the machine. The brake holds it from movement when not swinging.

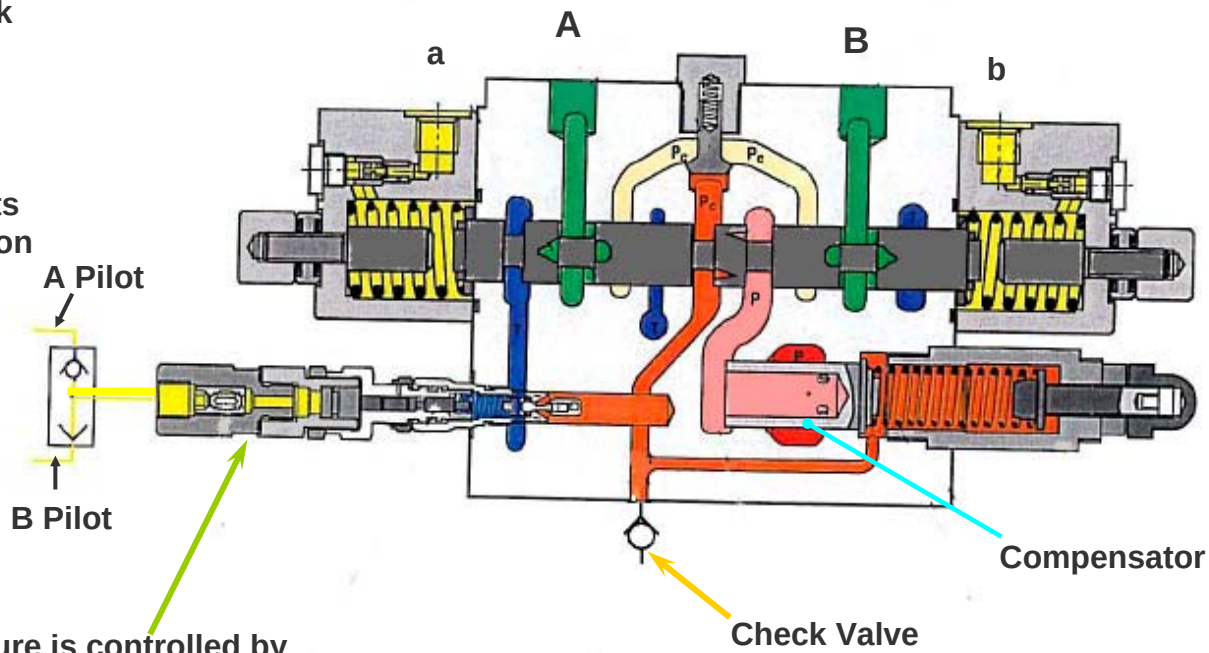


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Swing Valve Module

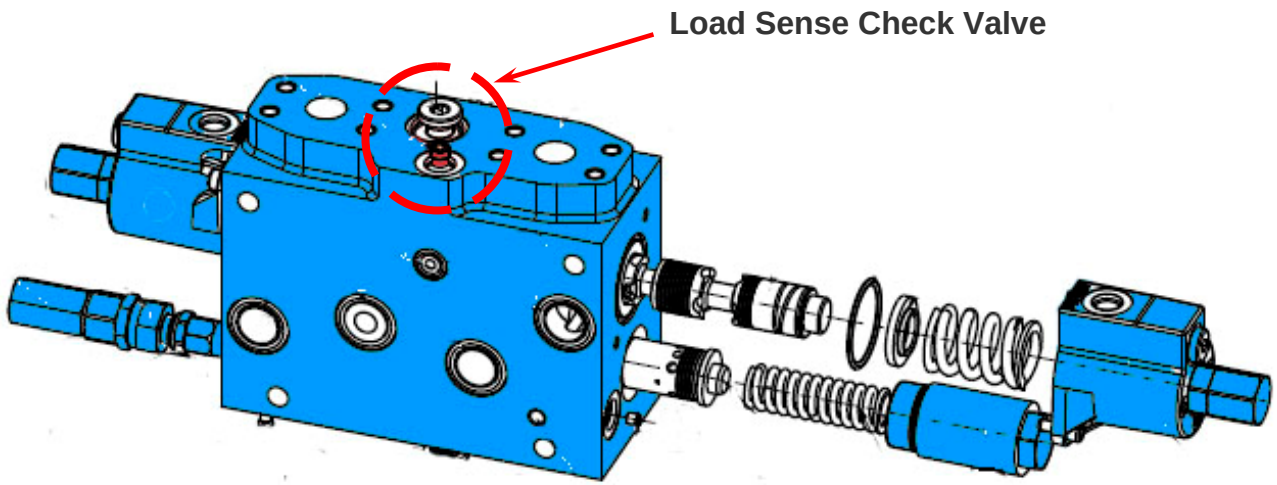
Swing module is a bolt on valve that is pre compensated. Check valve between swing and main valve allows swing priority.

Swing will have reduced flow when total system requirements exceed pump output based upon Valve load sense signal.



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Swing Valve Load Sense Check



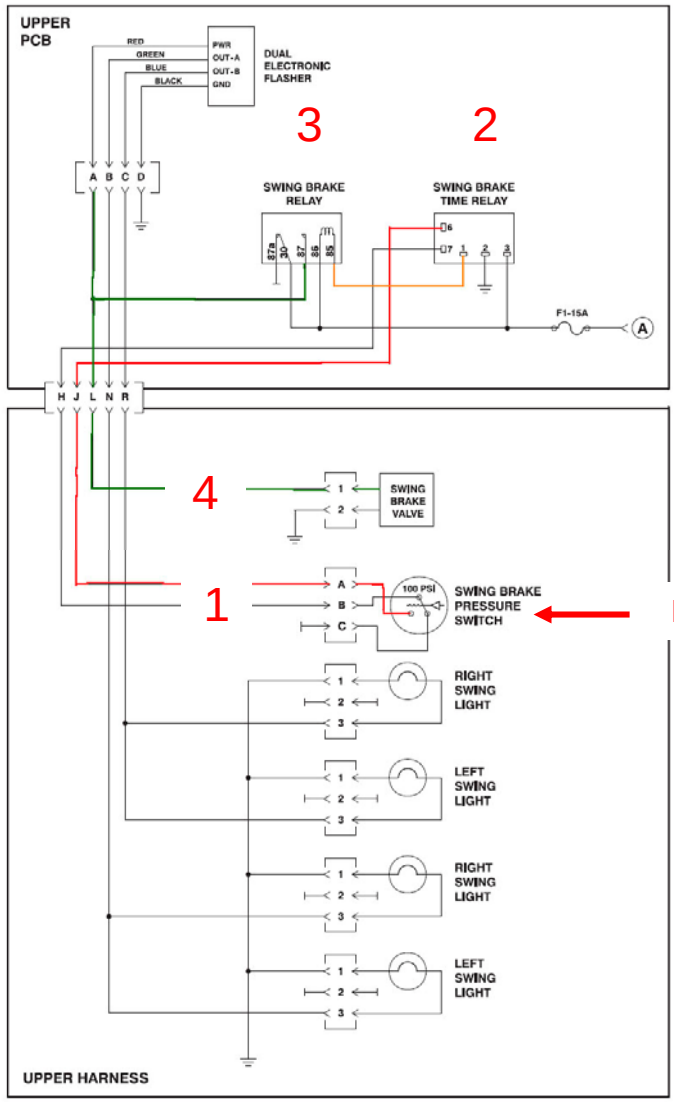
Swing Valve Module has a check valve for priority circuit. Check valve is used to isolate main valve load sense from swing valve when swing is not used. If check valve is stuck open, load sense of machine will be weak until swing circuit is used.

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Swing brake electrical

Swing circuit also has electrical function that controls brake release. Swing brake pressure switch in pilot manifold receives pilot signal from joystick and closes (1). Electrical signal then travels to swing brake time delay relay (2) in cab console. Time delay relay closes sending signal to swing brake relay (3) also in cab console. Swing brake relay closes and sends electrical signal to electronic flasher and swing brake valve (4) at pilot manifold. Swing brake valve shifts and sends pilot oil signal to release swing brake.

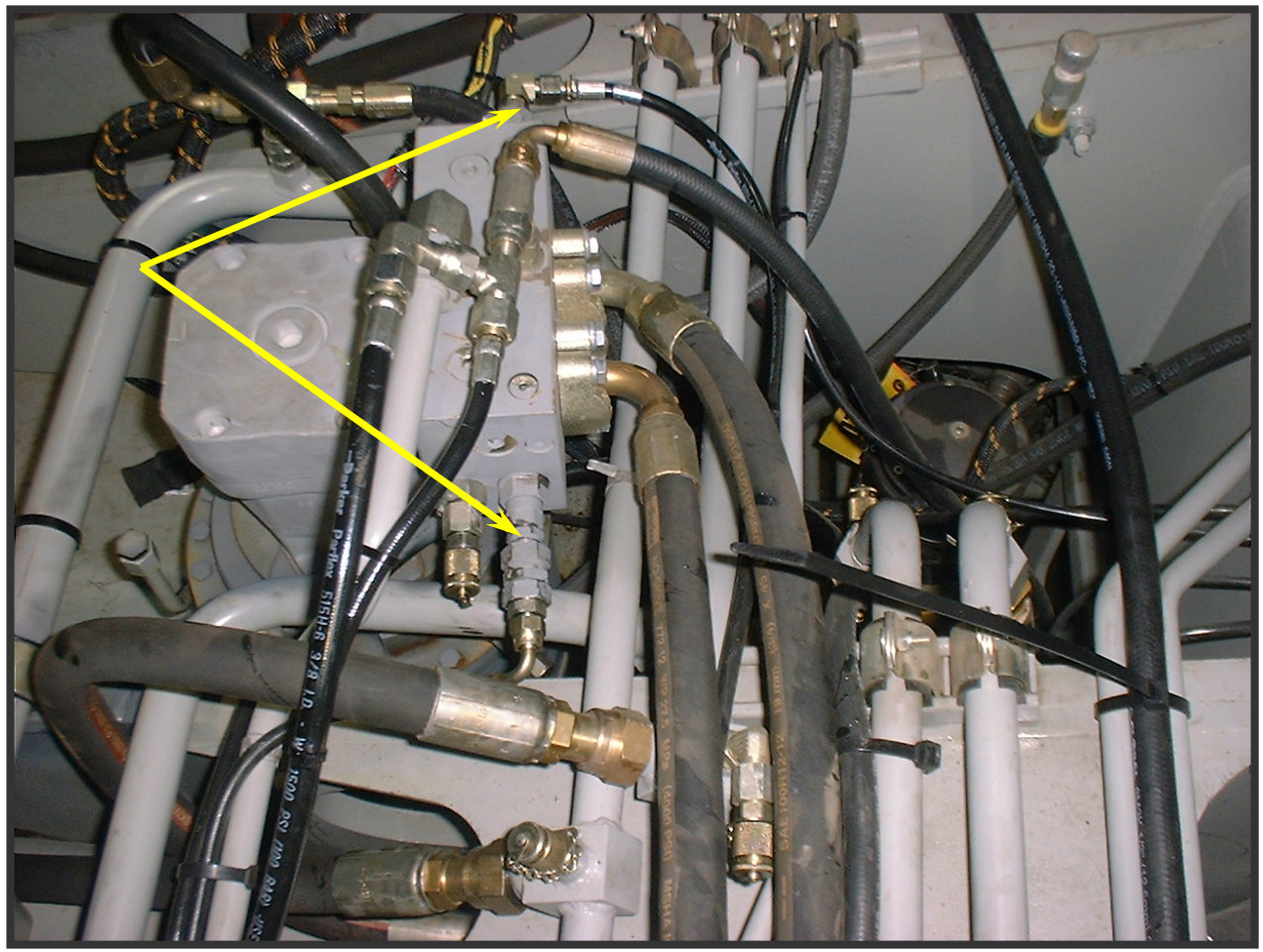
When joystick is moved to neutral, swing uses motor to cushion stop. Time delay relay holds the brake off for a specified time to allow swing to stop. Then swing brake sets.



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Swing Motor Relief Valves

Two stage pilot relief valves for swing circuit cushioning and protection

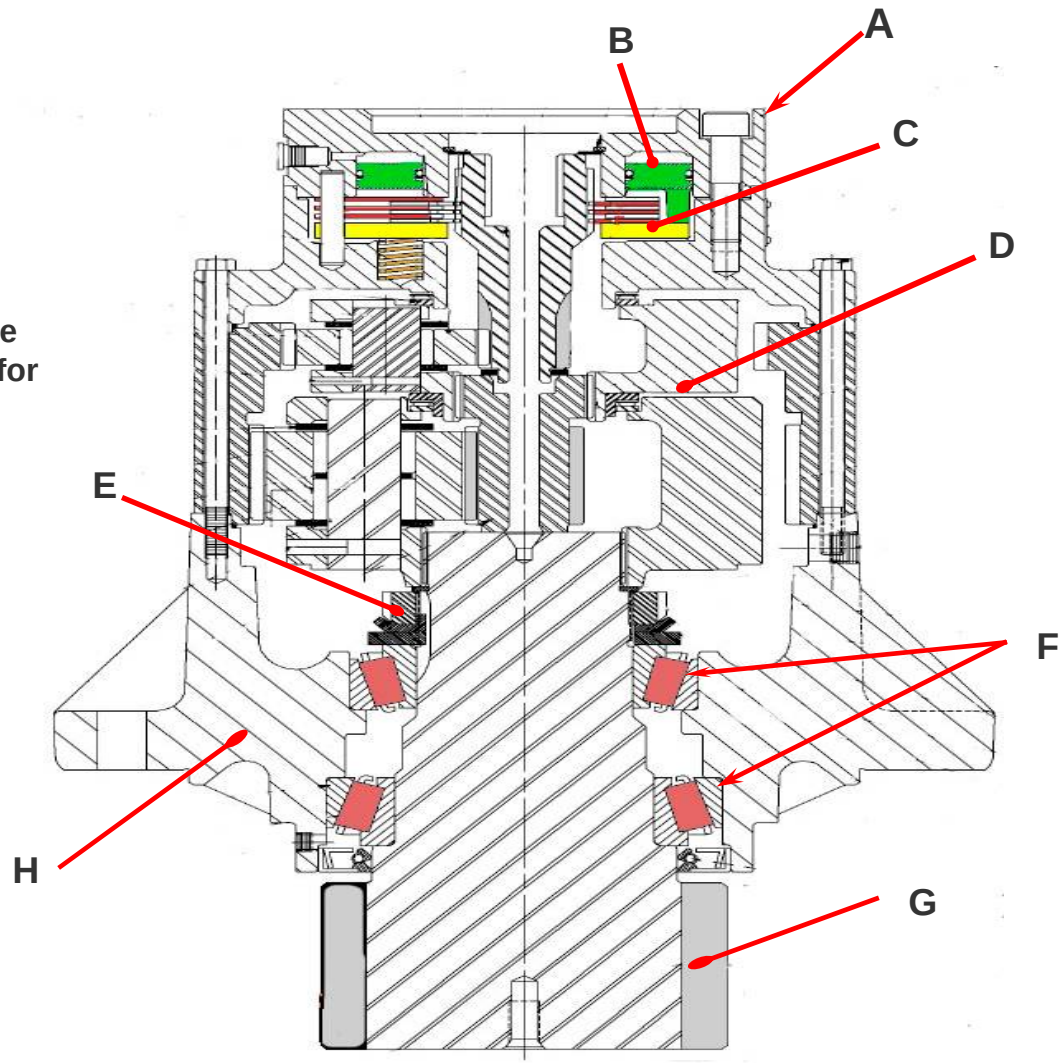


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Swing Transmission & Brake

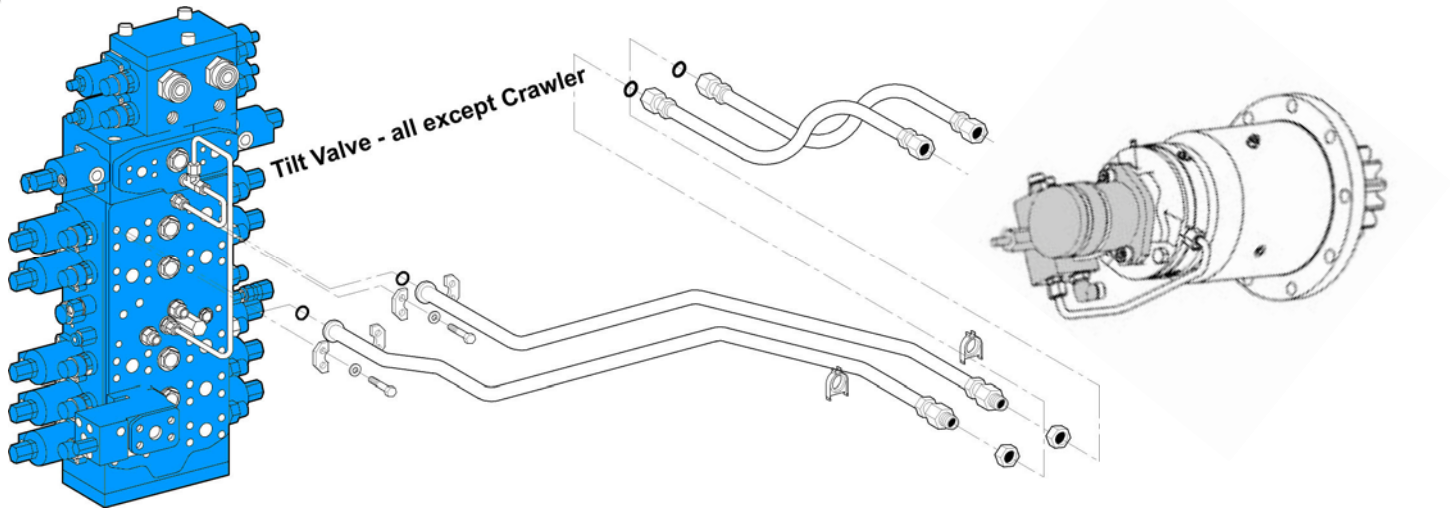
Swing transmission and brake is an assembly located in the center frame area. Transmission is filled with oil for lubrication. It consists of several major components:

A. Brake
B. Piston
C. Pressure plate
D. Double reduction gear sets
E. Locknut
F. Bearings
G. Output pinion
H. Housing



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Tilt Circuit – Truck & Rough Terrain



Tilt valve directs oil into tilt circuit to tilt motor mounted on tilt transmission. Operator uses the rocker button on joystick to direct hoist to retract (lower) or extend (raise).

Tilt rocker buttons shifts the tilt valve at end cap using pilot pressure. When the spool is shifted, oil from the valve pump cavity is routed to the selected port across the spool. A load sense signal is generated and is used by the valve & pump to provide adequate flow for load conditions.

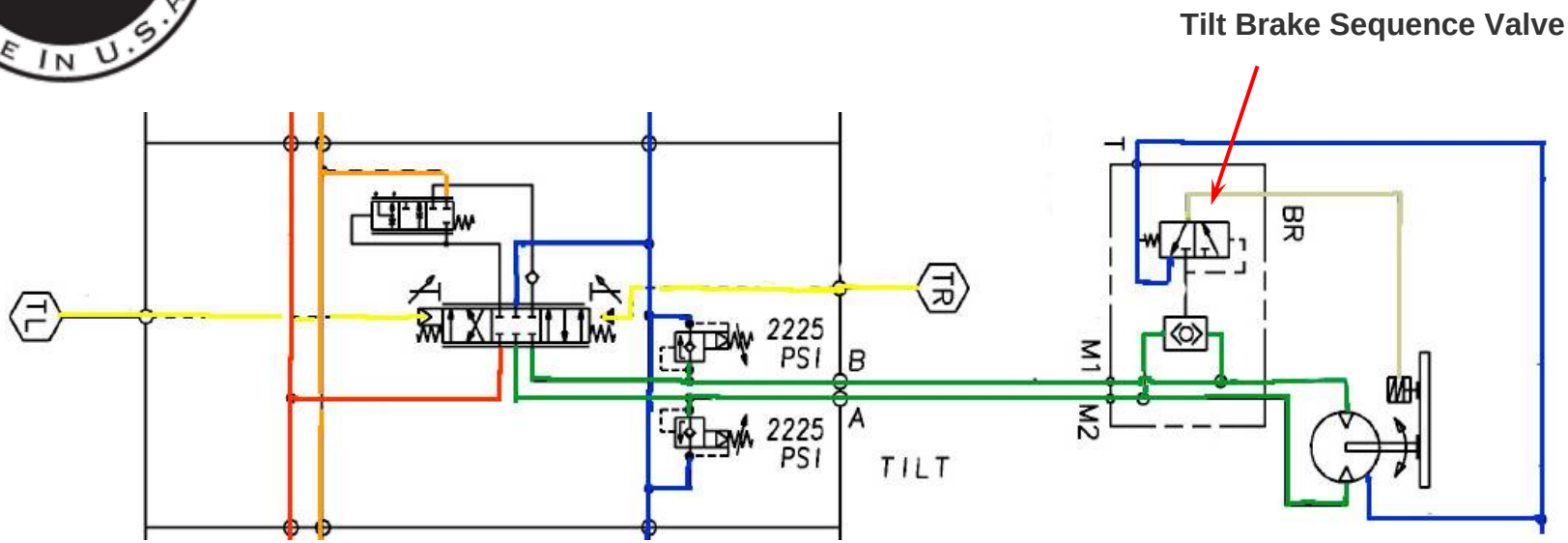
Oil is routed to the tilt motor through a series of hoses and tubes from the tilt valve to the tilt motor.

Tilt brake is released by tilt sequence valve attached to tilt motor.

Tilt end caps are shifted by pilot signal from pilot manifold & tilt solenoids. Speed can be controlled by the operator using the tilt speed control.

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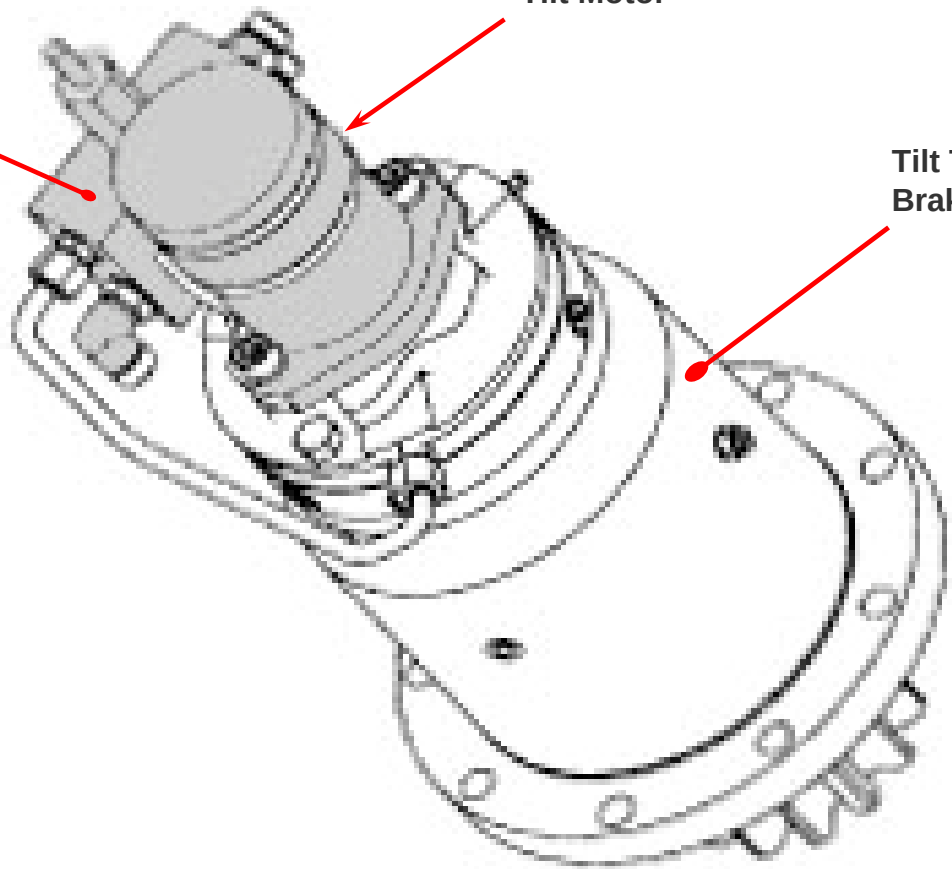
Tilt Circuit Schematic



Schematic of tilt circuit. Note circuit has a tilt brake that is released by the tilt brake sequence valve located on the tilt motor itself.

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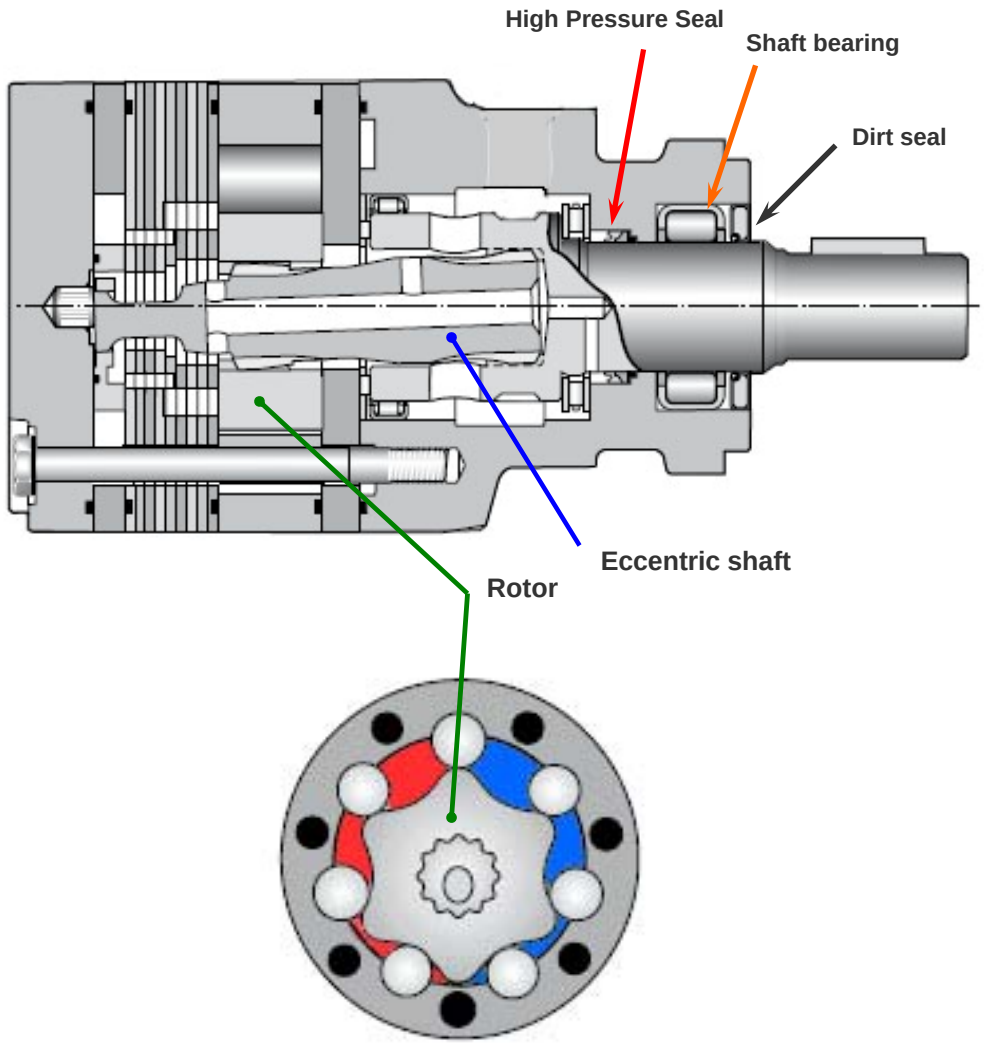
Tilt Drive Assembly



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Tilt Motor

Tilt on standard machines uses a “gerotor” type motor to drive tilt transmission. Gerotor motor provides high torque, low speed output to drive boom tilt.



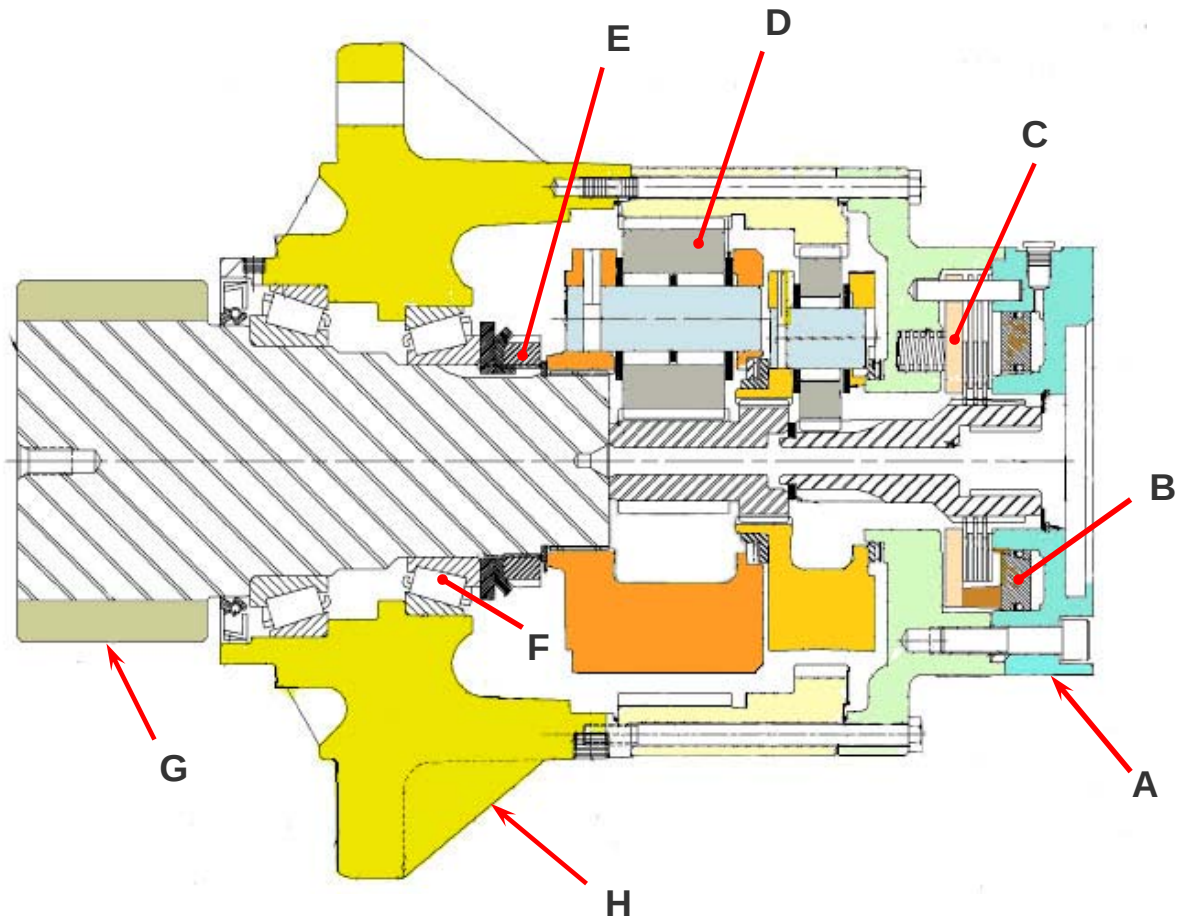
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Tilt Transmission & Brake

Swing transmission and brake is an assembly located in the center frame area. Transmission is filled with oil for lubrication. It consists of several major components:

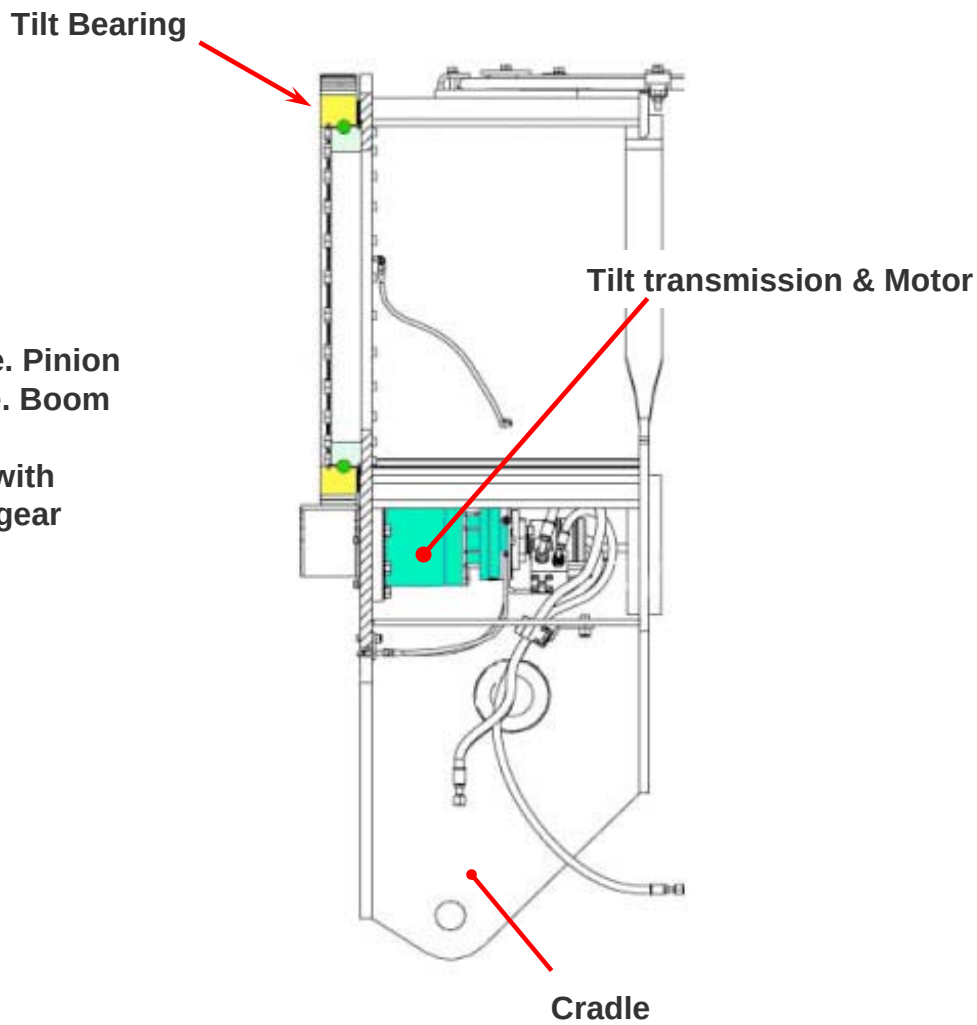
A - Brake
B - Piston
C - Pressure plate
D - Double reduction gear sets
E - Locknut
F - Bearings
G - Output pinion
H – Housing

Tilt drive is driven by the tilt motor.



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Tilt Drive and Cradle



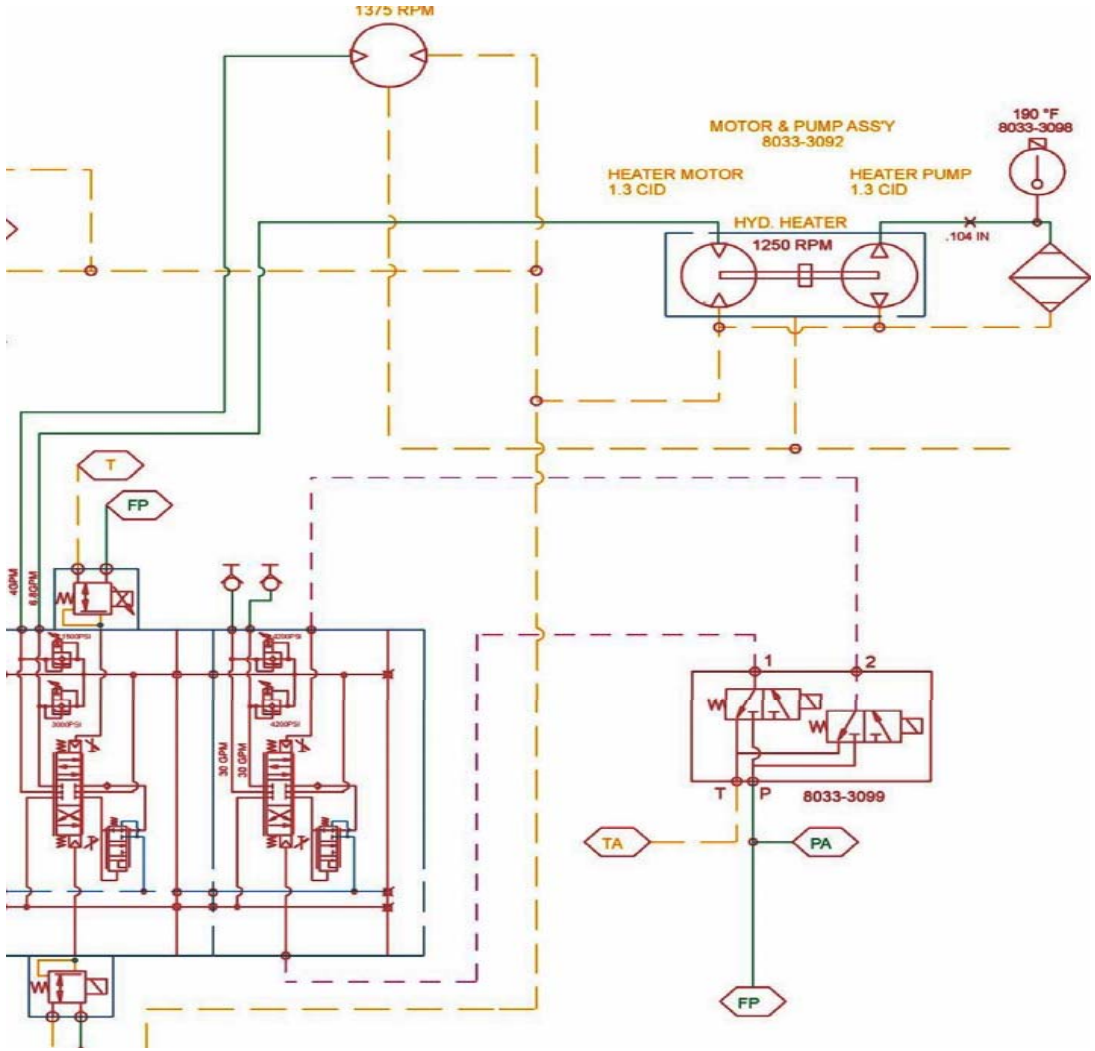
Tilt drive and motor are located inside cradle. Pinion drives gear on tilt bearing mounted to cradle. Boom assembly bolts into tilt bearing. On standard machines, a stop is provided. On machines with optional 360° tilt, no stop is provided. Open gear teeth require lubrication with open face gear lubricant.

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Heater & A/C Circuit

Heater & A/C drive circuit is shown. Heater circuit has a 3000 psi relief valve setting. Oil flow is controlled with the spool and a proportional solenoid valve. The oil leaves the valve and goes to the hydraulic heater unit which is a pump and motor combination. As the motor drives the pump, oil is routed across a relief valve. The oil is heated as it is forced across the relief. Heat is given up in the heat exchanger in the cab heater.

The A/C circuit is controlled by a single acting solenoid valve. Oil from the valve is routed to the A/C unit motor when A/C is active.

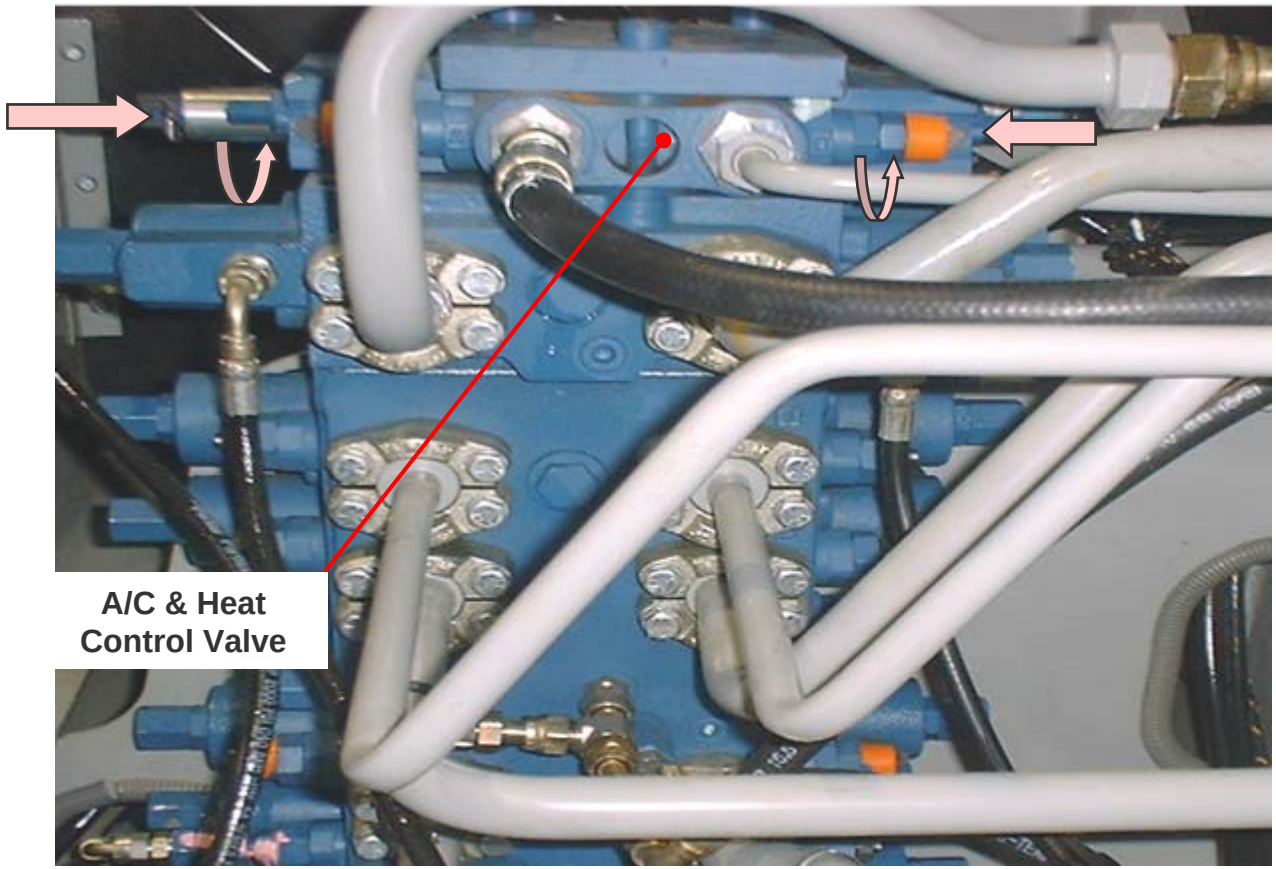


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Heater & AC Valve

Right arrow shows limit screw for HEATER speed; Left arrow shows limiter for A/C.

A/C Relief is orange cap behind heater speed; Heater relief is behind a/c speed.

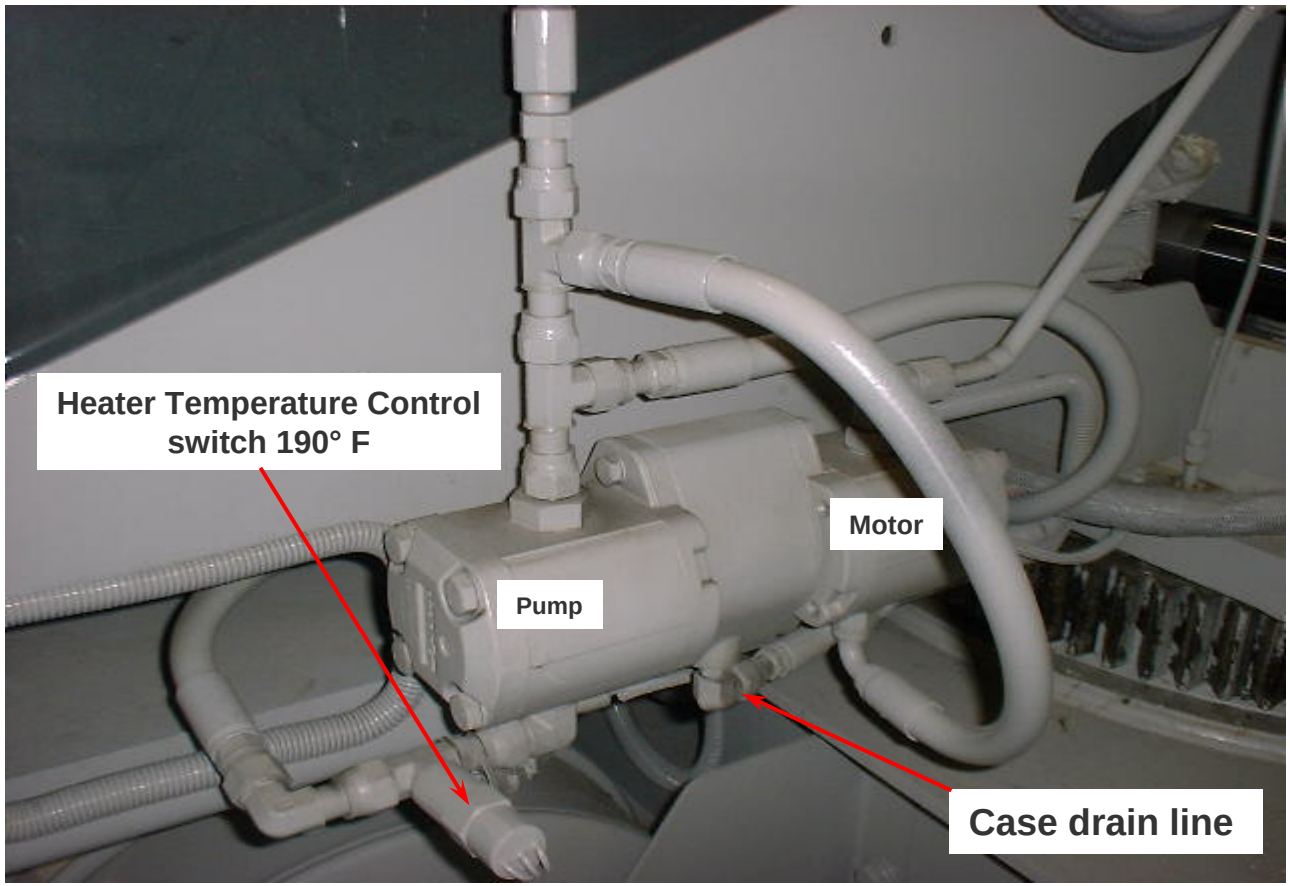


A/C & Heat Control Valve

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Hydraulic Heater Unit – XL3100

Heater hydraulic unit as used on original XL3100 machines.



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Hydraulic Heater Unit

HEATER **used on late XL3100 machines and all SERIES II units. Arrow shows relief which Is set at 2200psi-measured at LS test port-with motor running at 2500 rpm (5-6gpm.)**

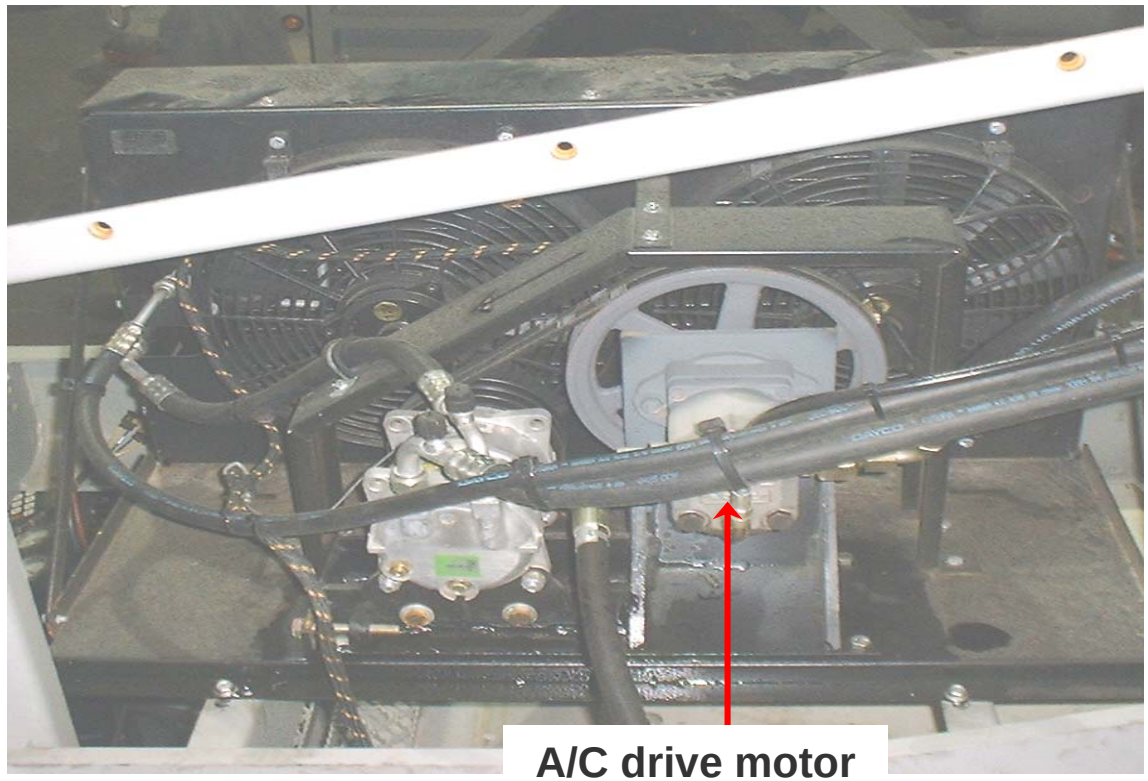


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A/C unit - Optional

A/C unit consists of a hydraulic motor, compressor, dryer, and condenser. It is mounted on the LH side of the machine.

Motor receives oil from the A/C port of the A/C/Heater valve. Motor drives the compressor through a belt.

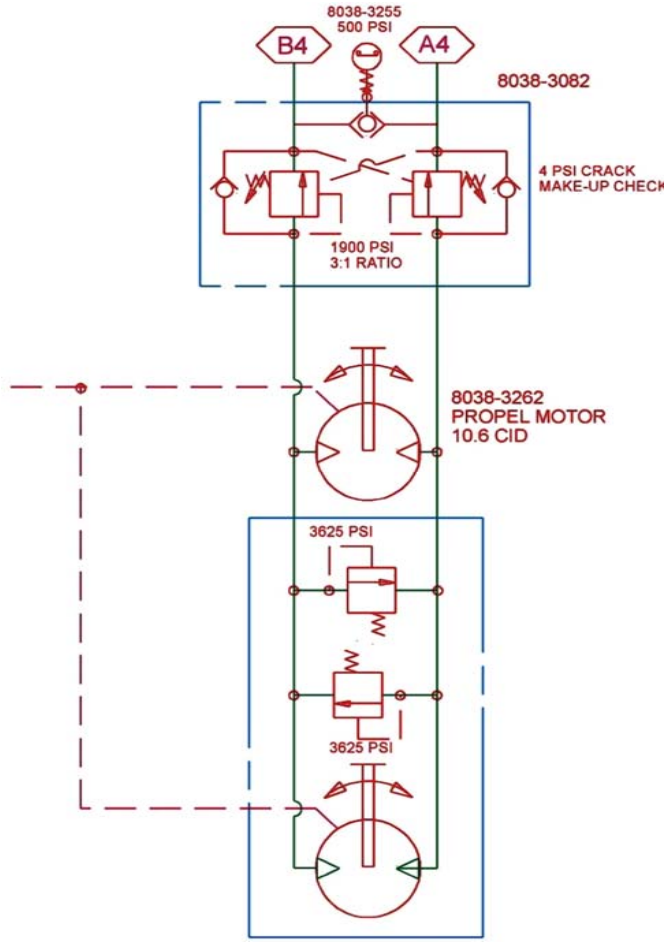


A/C drive motor
2450 Rpm's

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Remote drive Circuit

The counter balance valve and remote propel motors. Oil enters from either the A or B (forward or reverse) ports. Once it enters the valve the switch closes sending a signal to the brake release valve as well as the travel alarms. The oil then passes through the actual counter balance valves and goes on to the propel motors. The RH side motor is larger as it has an additional set of counterbalance valves contained within it. Though they LOOK like reliefs, the CB valves are NOT adjustable. Motors share common pressure and return lines.

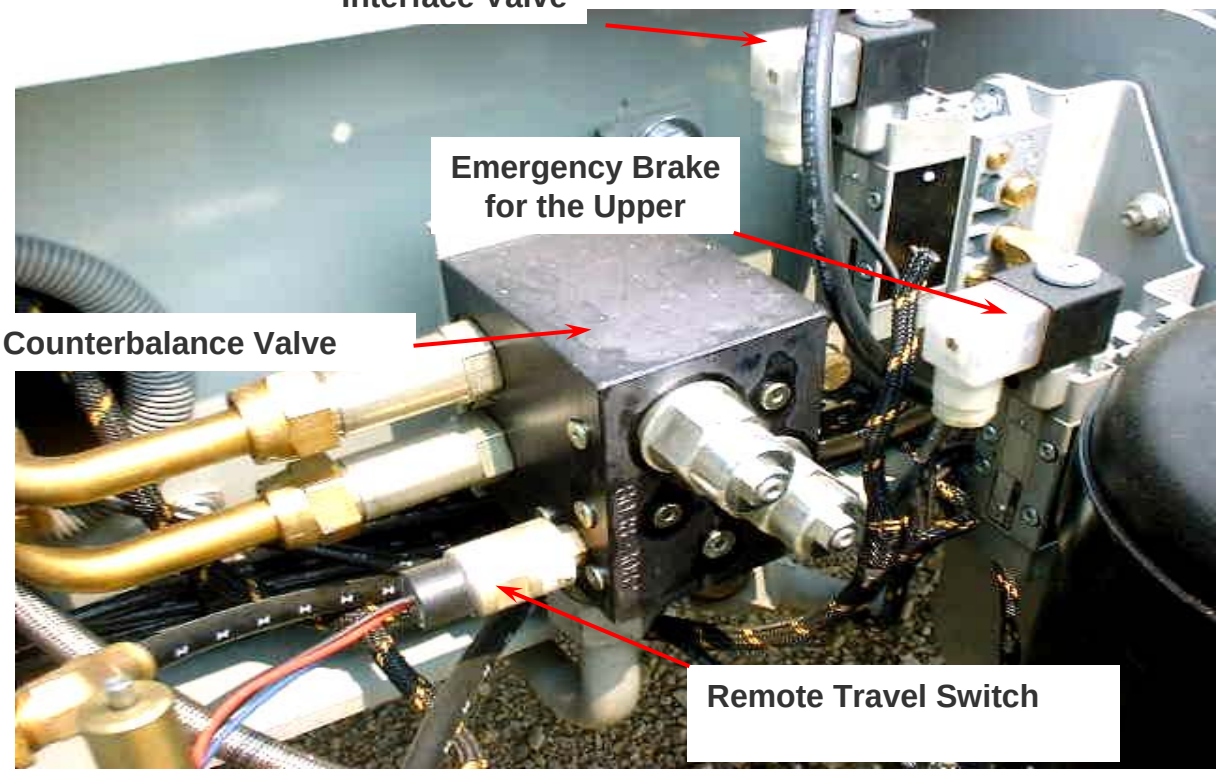


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Counterbalance Valve – XL3100

Counterbalance valve and related air valves as installed on original XL3100 machines.

Detail changes were made during production life, but each of the components shown were used until end of production.



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Remote Drive Counterbalance Valve

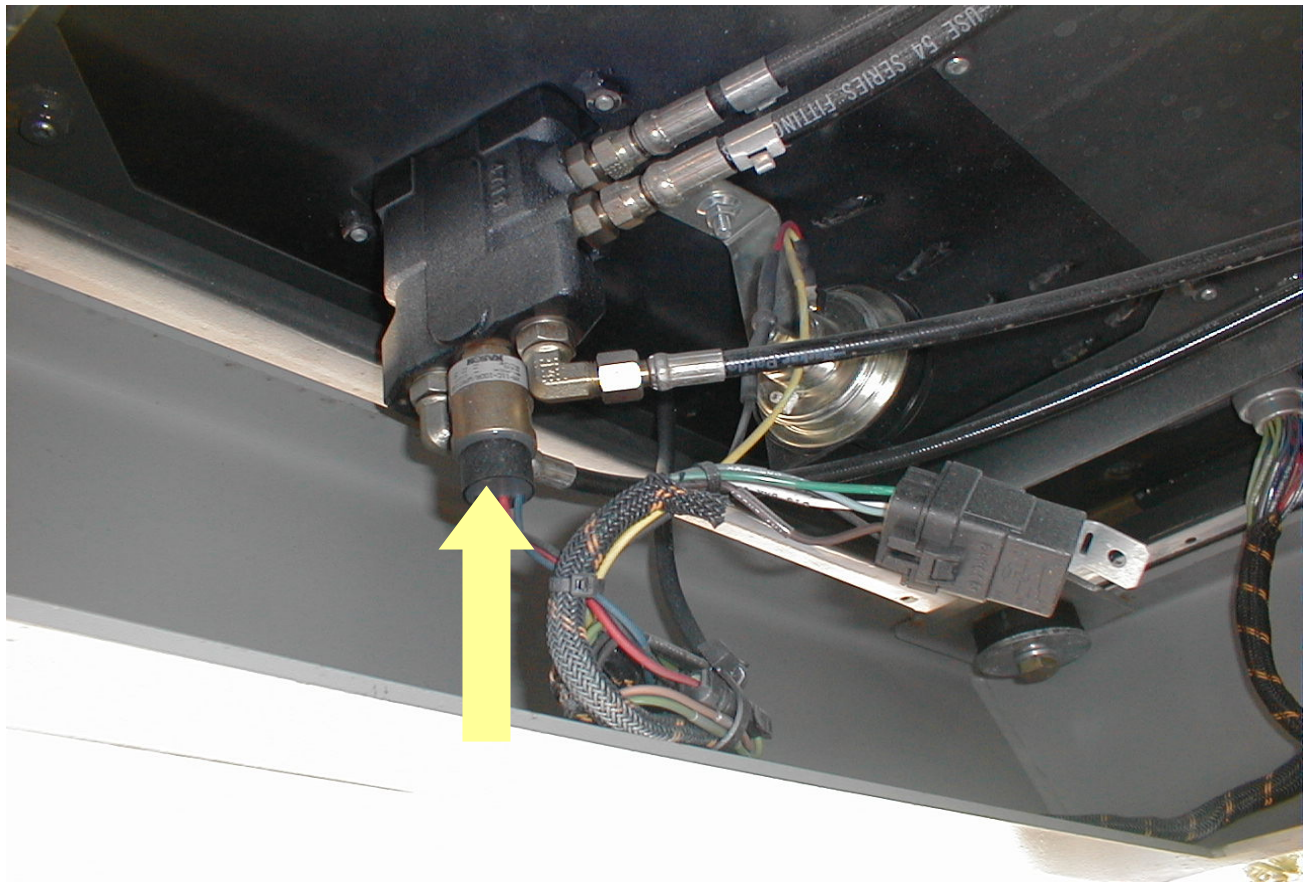
Counterbalance Valve used on SERIES II units.
Note - no brake release switch is located on counterbalance valve.



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Travel brake switch location, Series II

Series II Units have Brake Release Valve in Remote Travel Valve under the upper cab floor.



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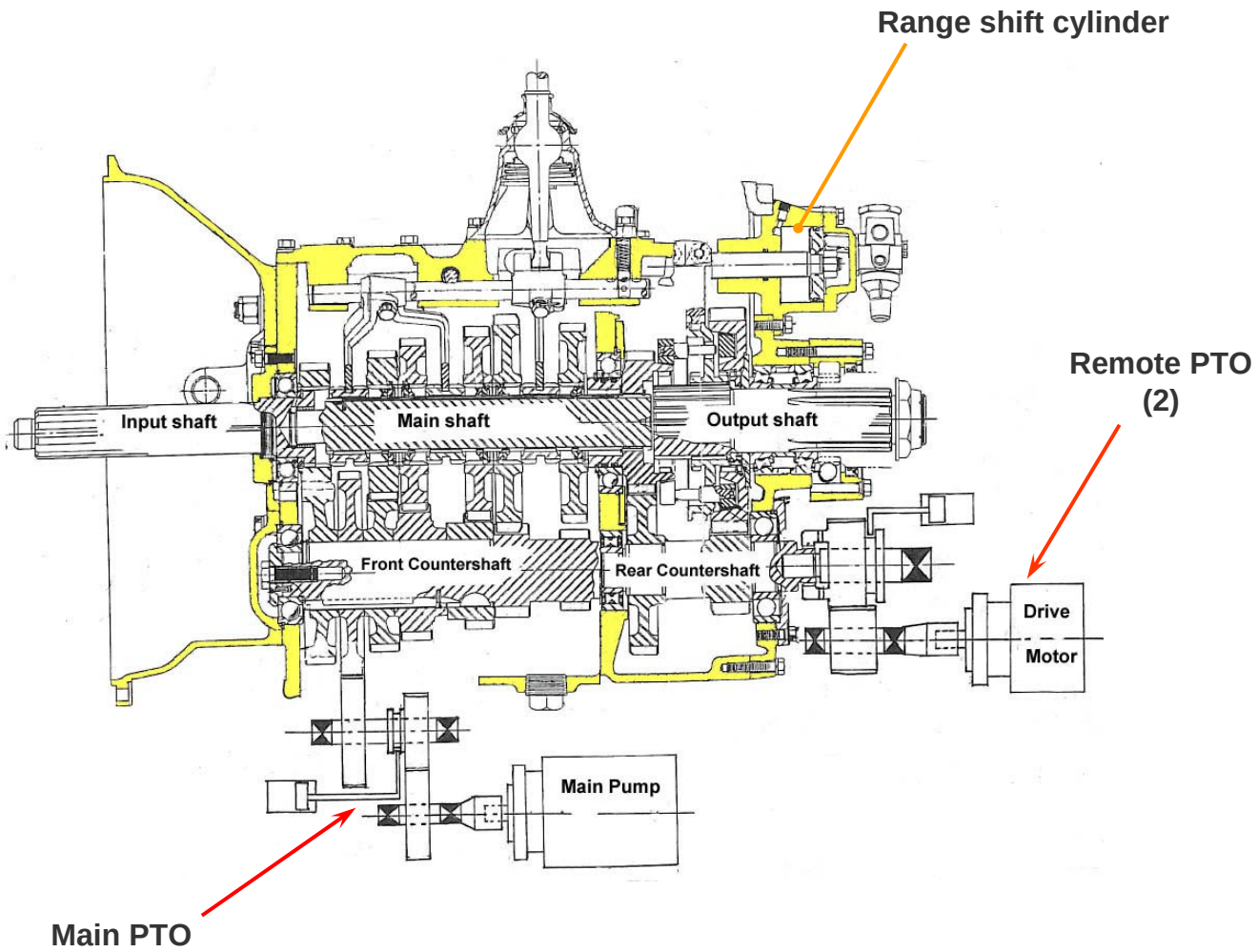
Main Transmission and PTO's

Chassis and excavator are use a 9 speed transmission and 3 PTO's for excavator operation.

Main PTO is driven off the main box and provides engine power to the main hydraulic pump

2 remote PTO's are attached at the rear of the trans. Using hydraulic motors for power, they provide drive for the excavator in remote.

The main trans. is used by the chassis during highway speed operation.

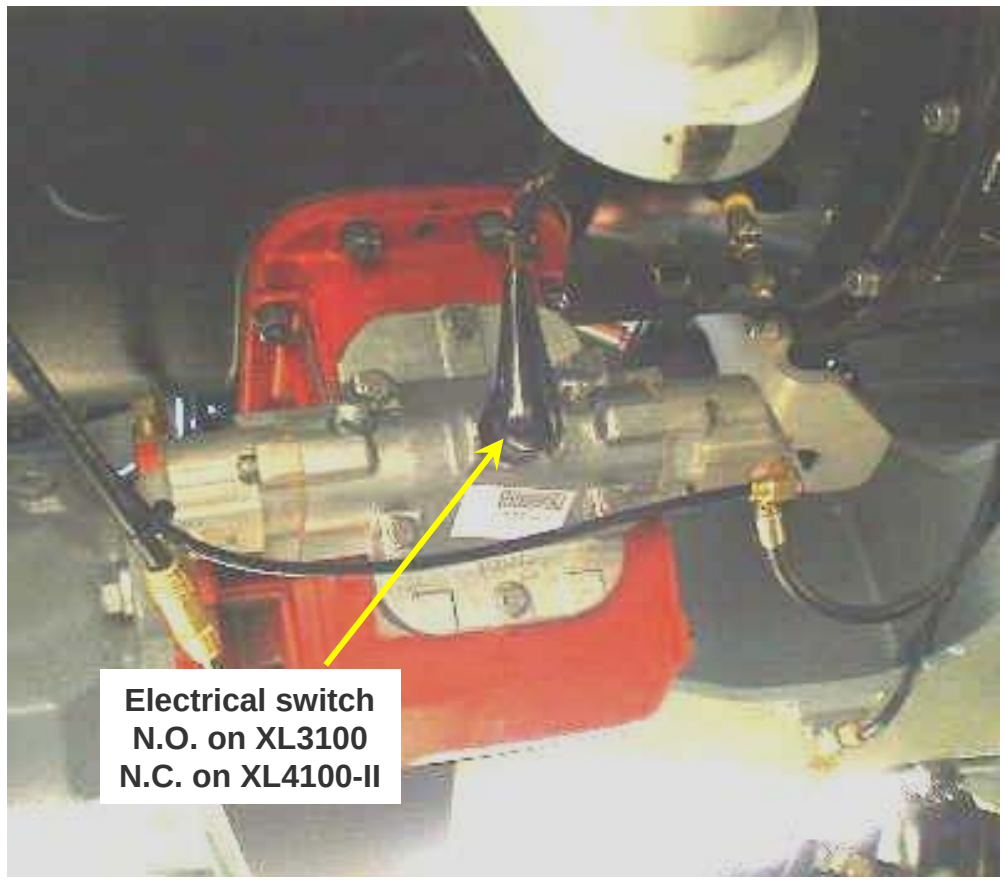


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Main PTO Installation, XL3100 shown

View of main PTO as installed on main transmission case (XL3100 shown). PTO uses air shift to engage & disengage. PTO is lubricated by transmission oil supply.

When removing/installing PTO, backlash must be checked between PTO and transmission.

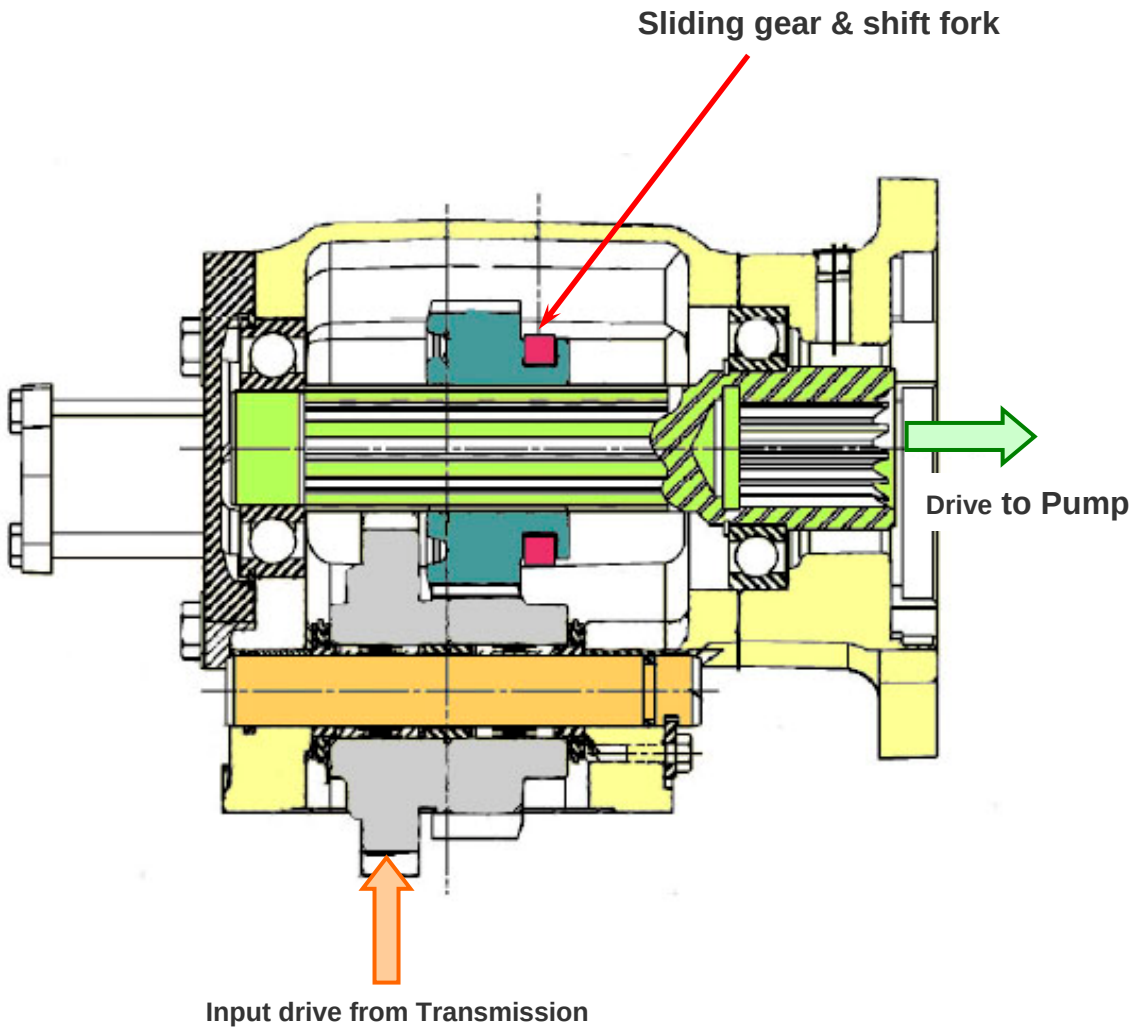


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Main Pump PTO

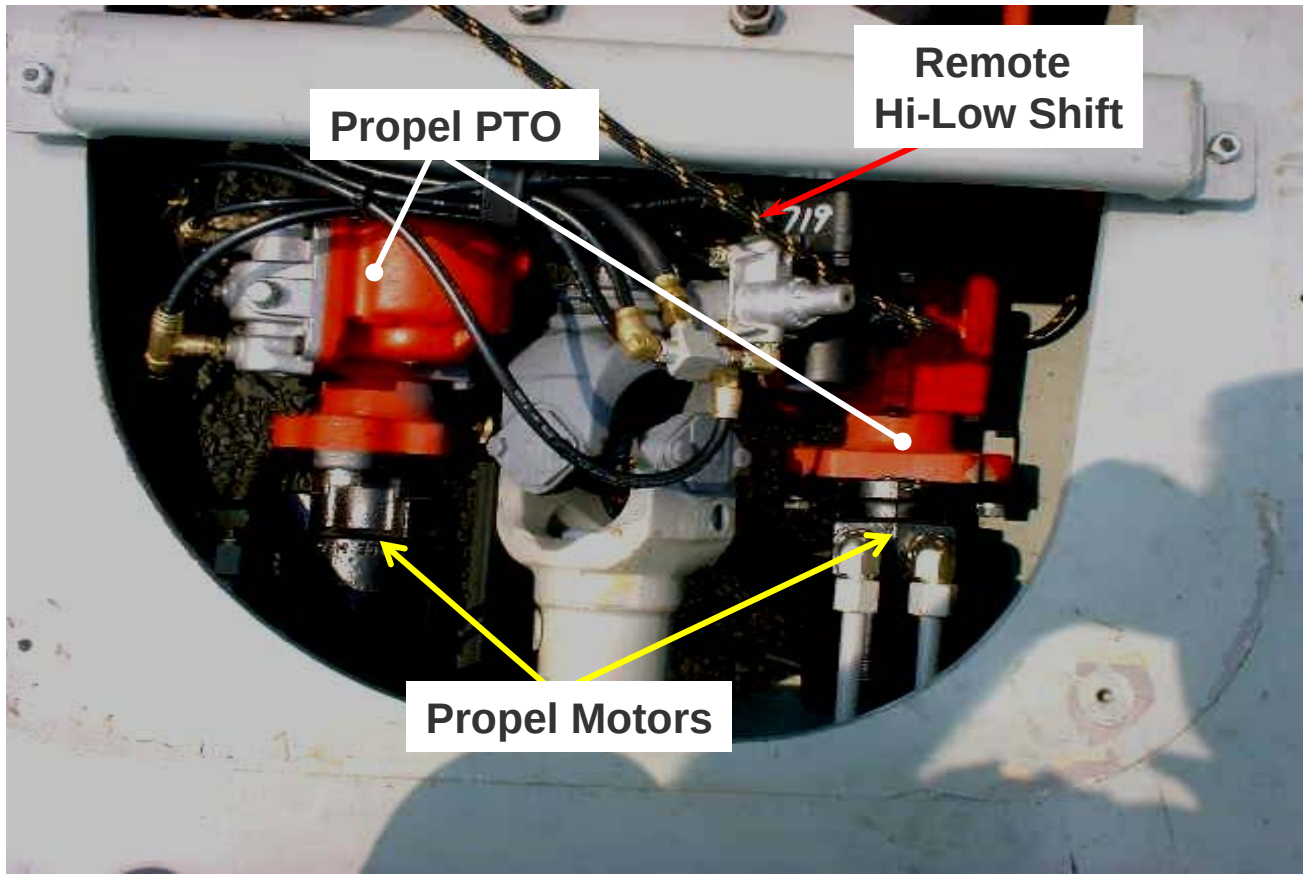
Main PTO attaches to bottom of transmission. Pump is attached to and driven by PTO. Pump is only engaged during remote operation.

Electrical switch on PTO shift rail signals engagement and disengagement. Full engagement/disengagement is required to allow engine start.



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Propel Motors & PTO's

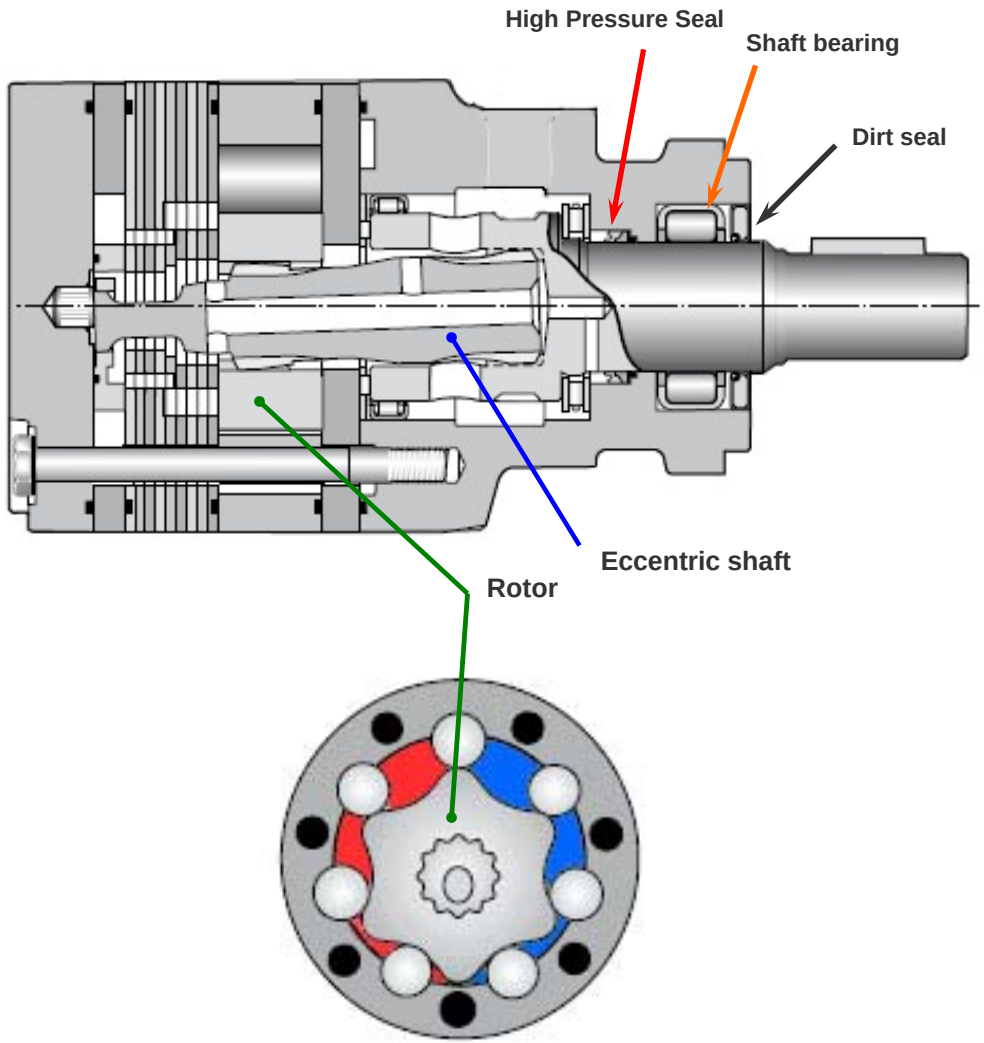


Close-up view of Remote Motors and PTO's. Range shift cylinder for transmission is also shown

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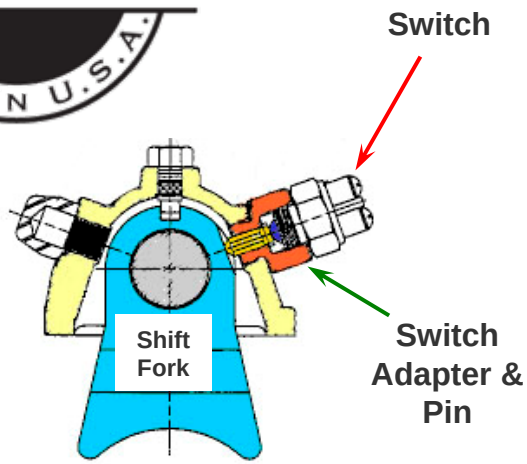
Remote Drive Motor

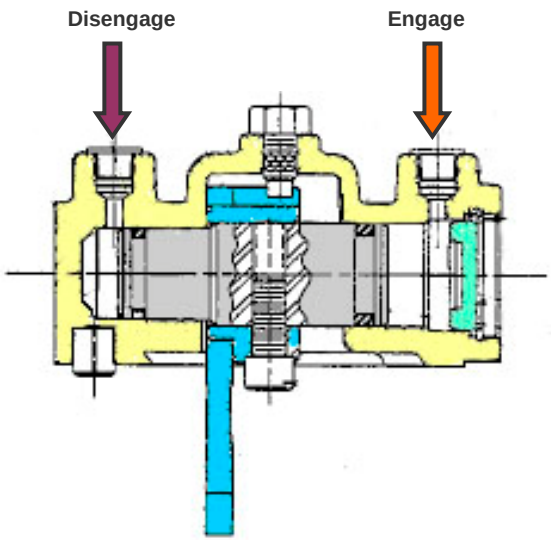
Remote drive uses a “gerotor” type motor to drive transmission and drive train during remote operation. Gerotor motor provides high torque, low speed output to drive boom tilt.

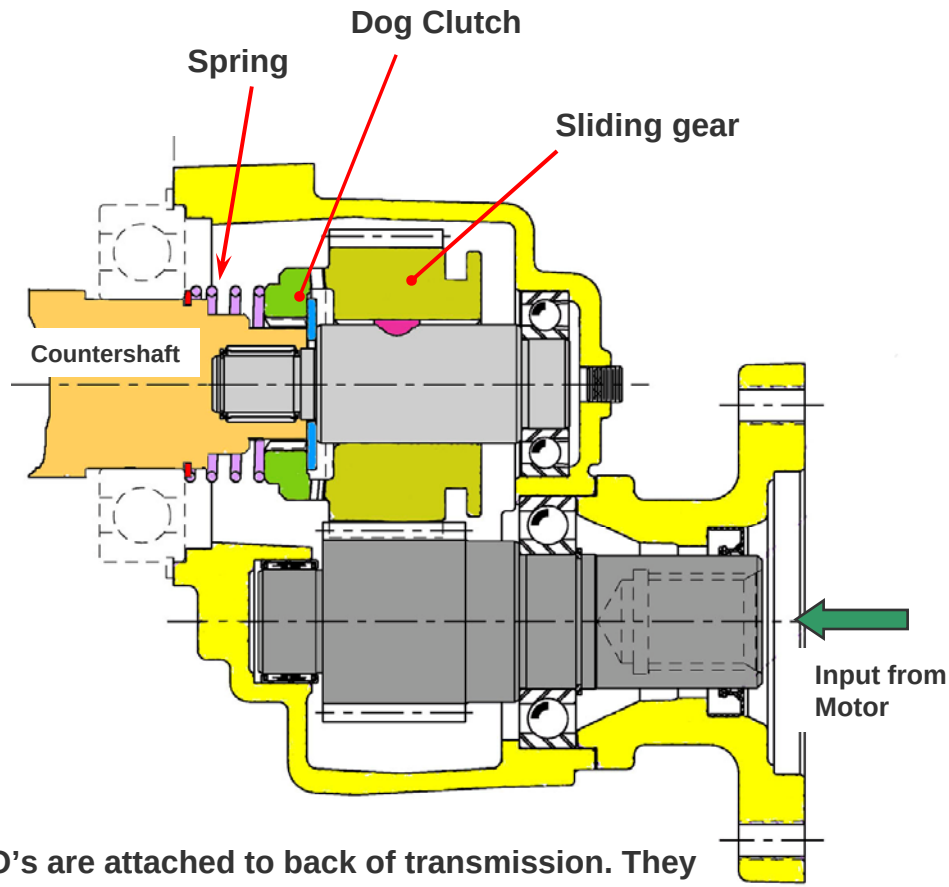


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Remote PTO







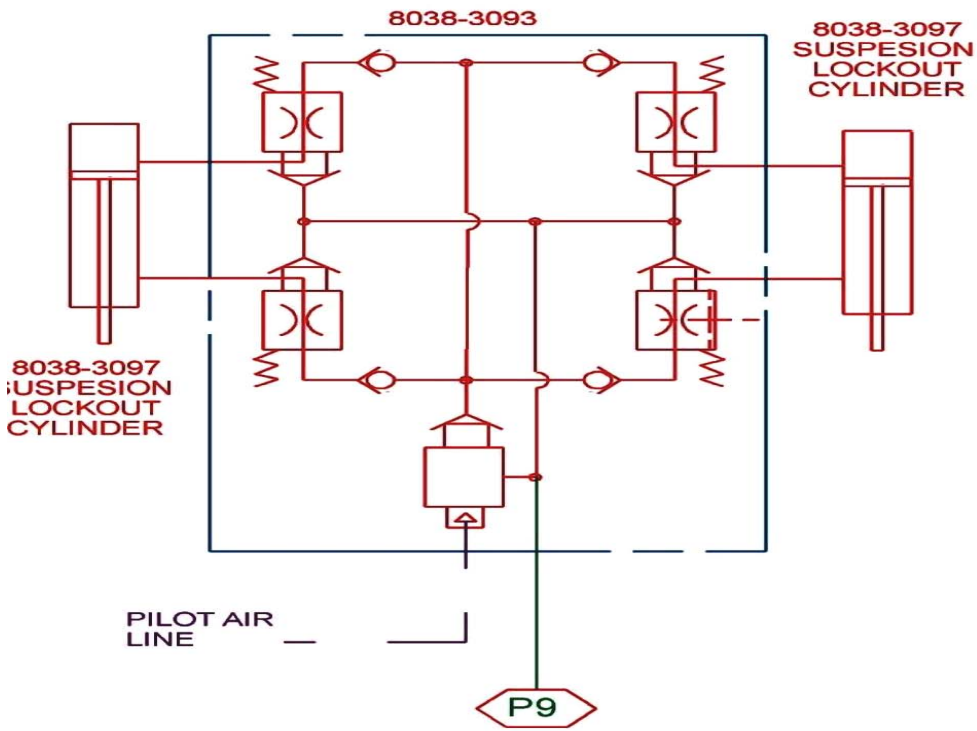
2 remote PTO's are attached to back of transmission. They provide mechanical connection between remote drive motor and chassis drive line. PTO is air shift for engage & disengage. Switch triggered by a pin acting against shift fork signals shift rail movement of PTO. PTO engages transmission countershaft through dog clutch that uses a spring to maintain contact.

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Front suspension lock valve circuit

Suspension Lock Valve is air-controlled from front-brake relay valve. Air signal releases solenoids allowing front springs to move. Pilot oil is supplied for make-up purposes.

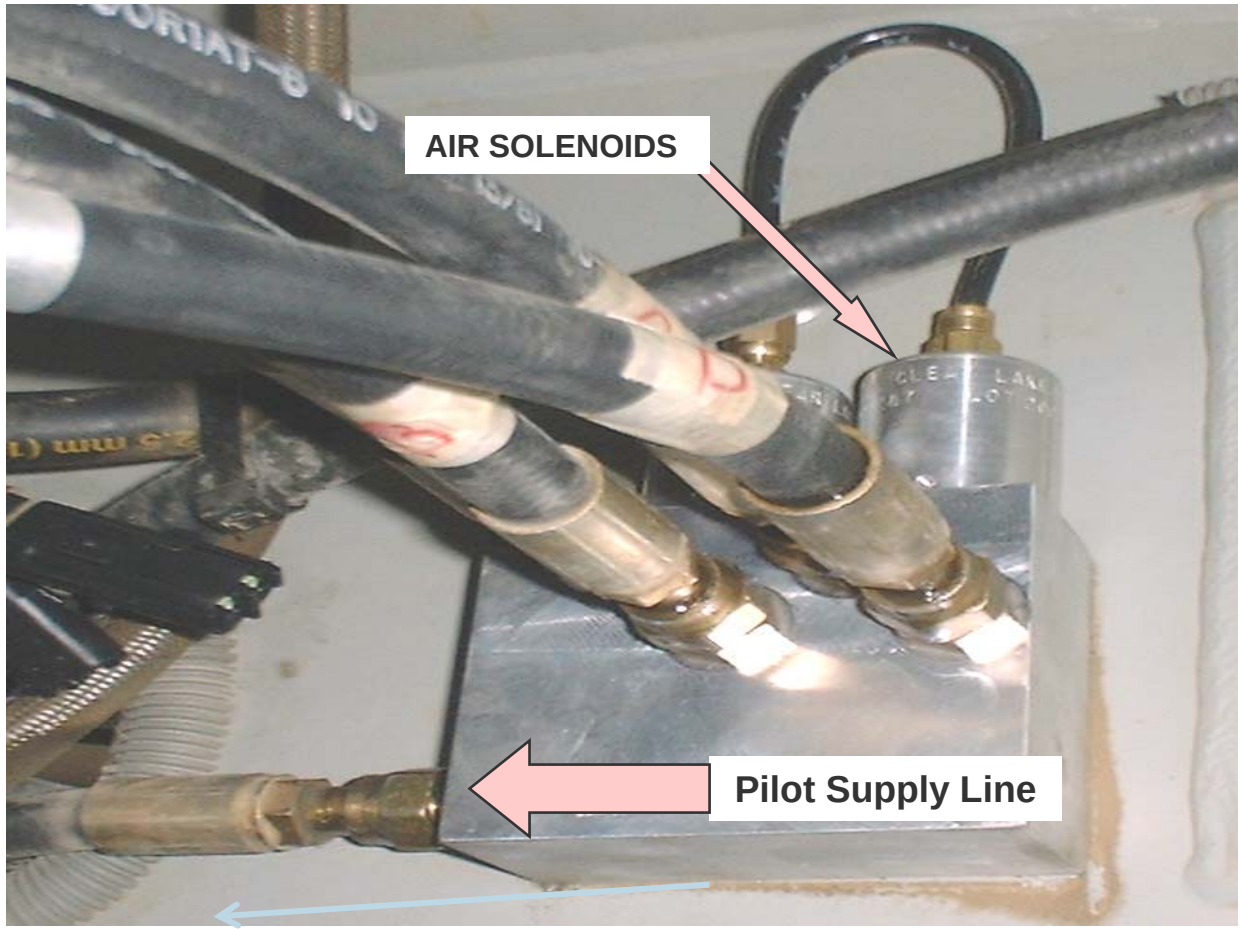
Lock circuit only works in remote control. During travel mode, axle is free to move.



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Lock Valve - Stabilizers

Lock valve is located on RH inner frame rail near engine. Air solenoids are used to lock and unlock the stabilizers cylinders when in remote.



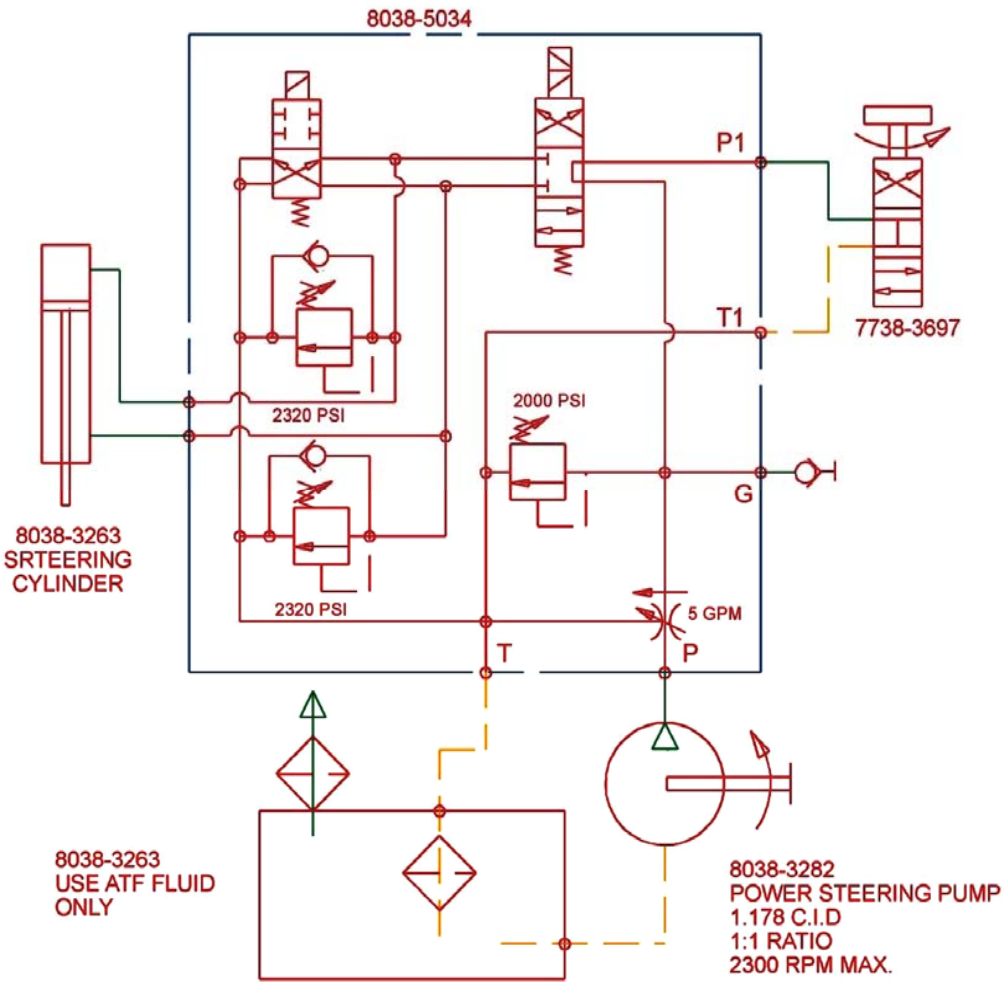
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Steering Circuit

Steering uses same pump in both travel & remote. Oil from pump goes to the steering valve.

A flow divider makes oil available to either the Steering Gear (travel) or to the Electric Solenoid (remote.)

If remote steering is active, oil goes to L or R steer solenoid. Activation of the R or L steer solenoid directs oil to steering cylinder. As the steer cylinder moves, power steering is used to assist remote steering.



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Power Steering Pump

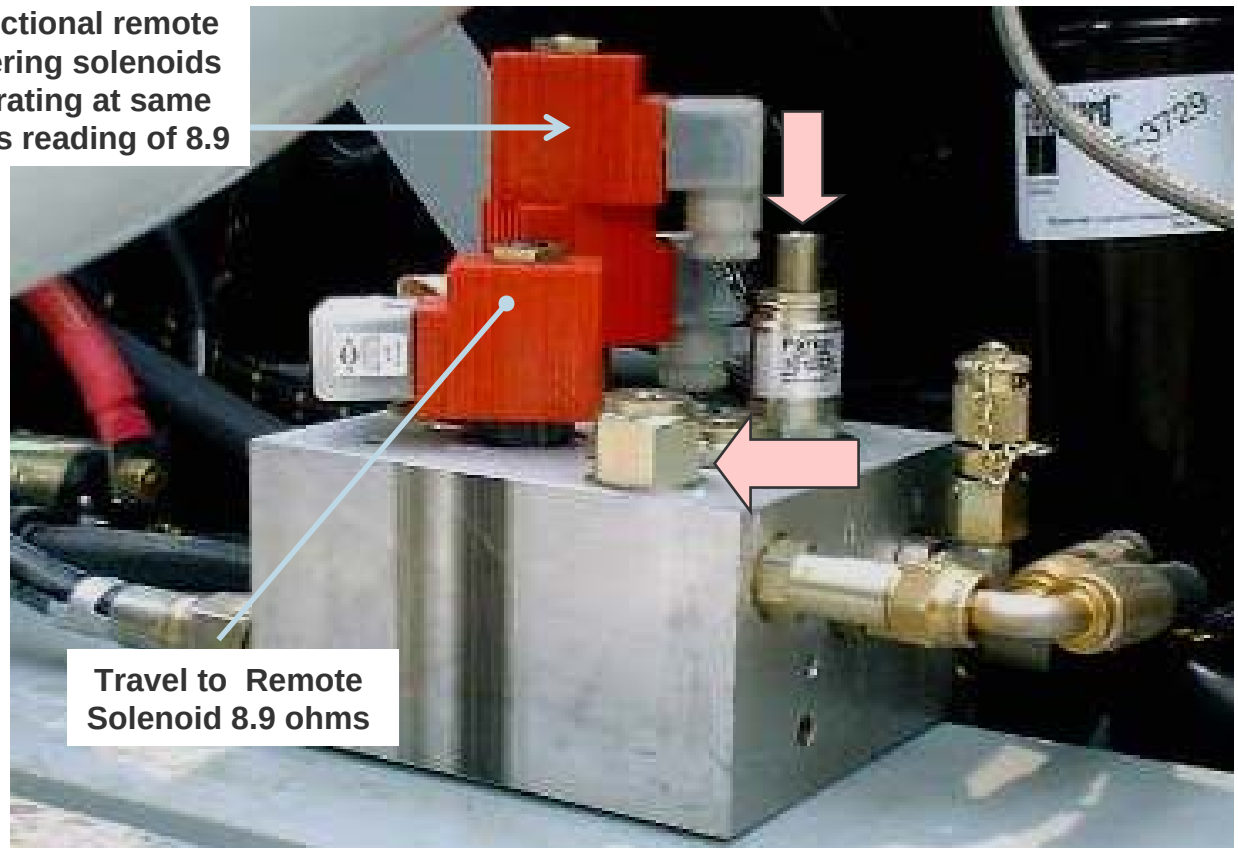
Steering pump is driven by the air compressor auxiliary drive. During the production life, 2 different pumps were used. Only the late style is available for service replacement. Pumps must always have the air bled from the pump before initial start up.



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Steering Valve

Directional remote Steering solenoids operating at same ohms reading of 8.9



Arrows show the Relief Valve (2100psi) as well as the Steering Test port. Valve is mounted on chassis on right side of engine.

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GRADALL®

XL 4100 II

HYDRAULIC PRESSURE SETTING MANUAL



ALAMO GROUP

- **This is a high-pressure hydraulic system so extreme caution is advised.**
- **All of the testing requires that a function be active. It is best to have an operator or second mechanic to help with the machine operation.**
- **It is recommended that digital gages be used when testing the machine for a more accurate reading.**

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Flushing Pressure

The flushing circuit is used to make sure that the control valve is staying full of oil, which prevents cavitation and provides cooling and lubrication.

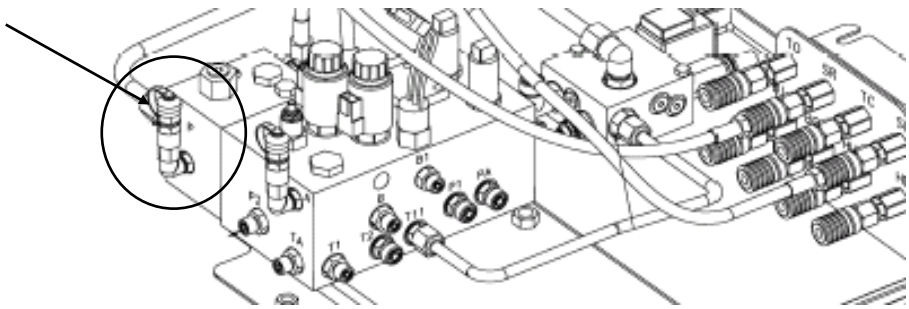
While checking the flushing pressure this is the amount of oil that is passing through the inlet orifice of the control valve. When checking the flushing pressure use a **1000 lbs** gauge. Do not connect before start up due to the pumps being at full stroke, this will cause damage to the gauge. Once the machine is running, connect the gauge to the MP port on the front of the control valve.

With the engine running at high idle and the safety lever in the Off piston the correct reading will be **360 –570 PSI**.

The pressure setting at the LS port should be **50 PSI + or – 5 lbs**.

If the pressure is incorrect, the pump must be removed and returned to be reset.

MP Port



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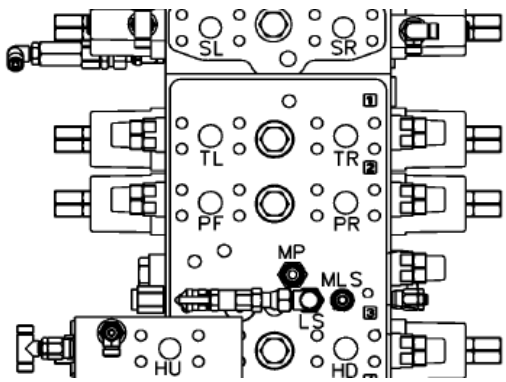
Pump Differential XL 41OO - II

When checking differential pressure, using a set of digital gauges is recommended. This is the differential pressure of the main pump.

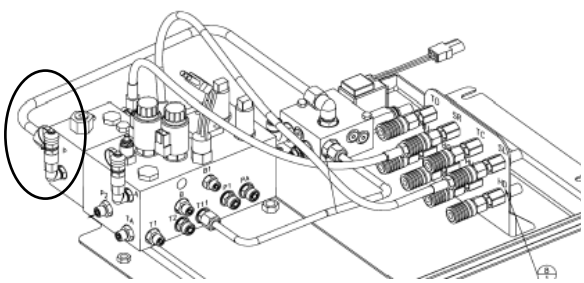
Connect a high pressure gauge at the MP port on the pilot valve and a second high pressure gauge to the LS port on the front of the control valve.

With the gauges connected to the MP and LS test ports and the engine operating at high idle. Extend the tele-boom all the way out and hold it. With the system-stalled, record the two readings and subtract. The difference should be **275 – 295 PSI**. If an adjustment is needed this will be done on the pump.

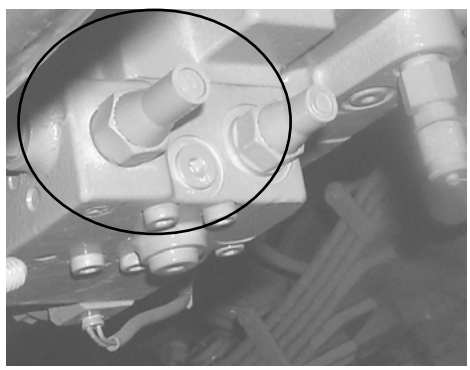
Remove the cap. Loosen the jam nut and turn the allen screw In to increase the setting and out to decrease the setting.



NOTE:
When ever checking the pump differentials you must unplug the cooling fan switch.



Pump Adjustment

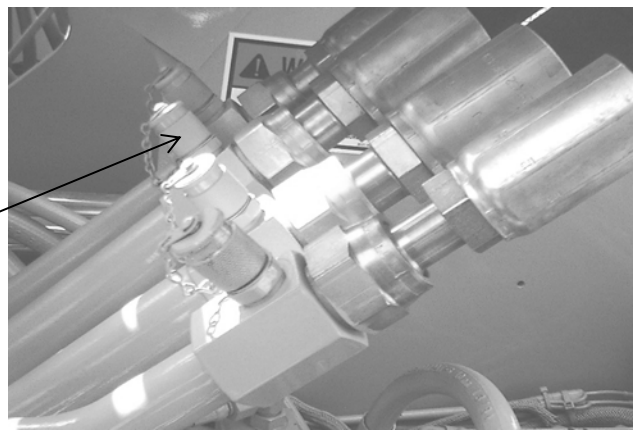


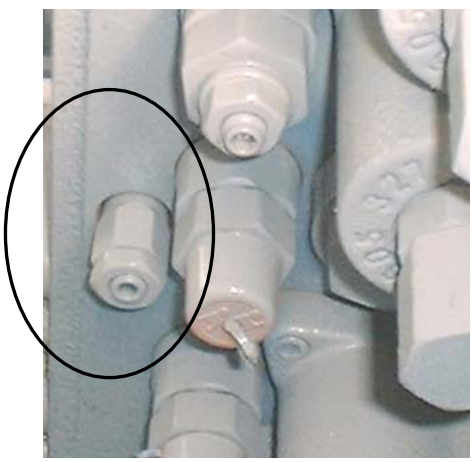
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Load Sense Pressure

With the engine running at high idle retract and stall the boom cylinder and record the reading. The correct reading is **4650 – 4750 PSI**. If the setting is incorrect then make an adjustment.

Using an allen wrench and a back up wrench, loosen the jam nut and turn the screw in to increase and out to decease the pressure. Recheck the pressure because the setting can change if the jam nut is over tightened.



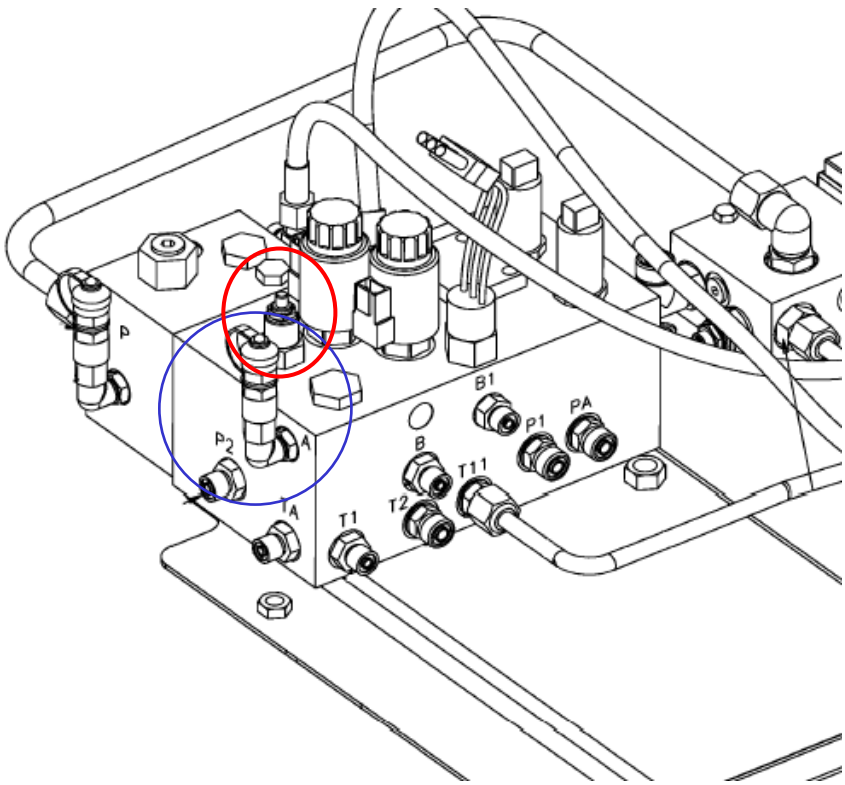


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Joystick Pilot Pressure

When checking the pilot pressure use a lower pressure gauge. This pressure operates the functions.

To check the pilot circuit operate the boom circuit. Do not stall the circuit, but keep it moving. The pilot circuit should read **500-620 PSI**. If an adjustment is needed, turn the relief in to increase. The pressure reducing valve is non-adjustable and must be replaced if the pressure is low and will not increase by turning in the relief adjustment or if the pressure is too high do not try to lower the pressure by backing out the relief.



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Boom Circuit (Retract)

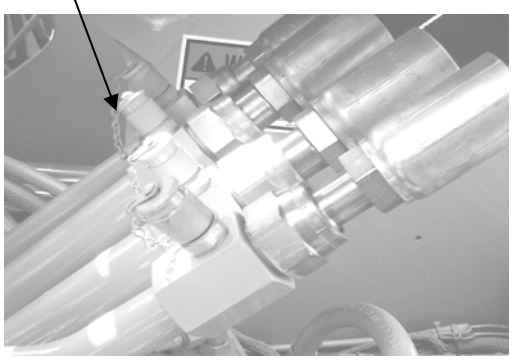
Take the pressure readings for the boom circuit at the two inside hoses located next to the boom cradle.

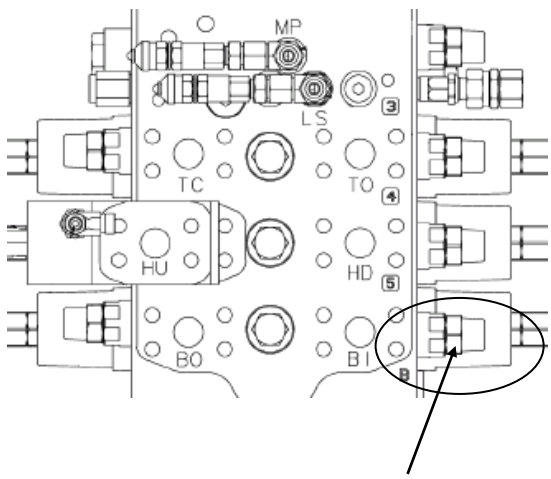
When retracting the boom, The reading is the load sense pressure and not the circuit pressure. The load sense pressure is set at **4700 PSI,** it will be required to increase the load sense setting as to achieve the correct reading for the retract circuit.

Once the load sense setting has been increased, retract the boom and stall it. The reading for the boom retract should be **5000 - 5150 PSI**. If an adjustment is required, screw the port relief in to increase the setting and out to decrease. Once the the correct setting has been achieved, lower the load sense pressure to **4700 PSI**.

Cycle times:
Boom Level Out 4.6 – 5.0
Boom Level In 5.2 – 5.8

Boom Retract





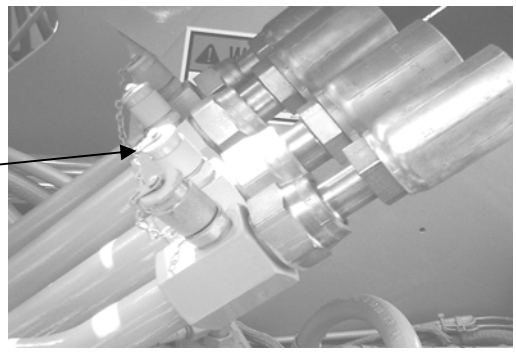
Boom Retract

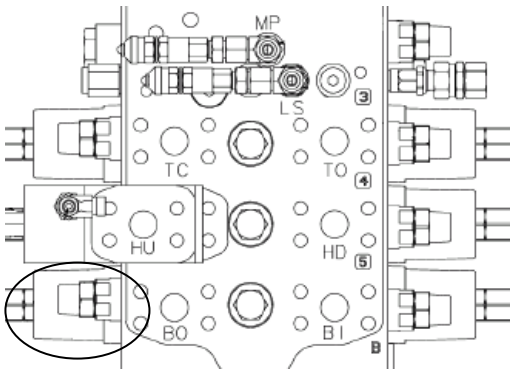
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Boom Circuit (Extend)

When checking the extend circuit, run the boom all the way out and stall it. The correct setting should be **2500 – 2700 PSI.**
If an adjustment is required, screw the port relief in to increase the setting and out to decrease.

Boom
Extend





Boom
Extend

https://truckmanualshub.com/

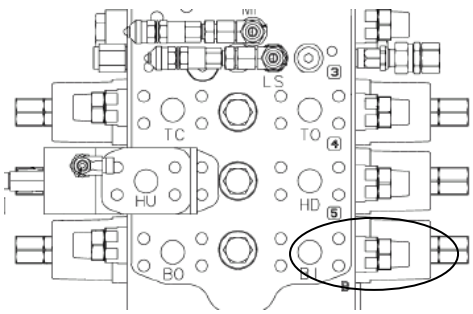
Hoist Circuit (Down)

When checking the hoist down circuit, connect a high pressure gauge to the test fittings at the cylinders.

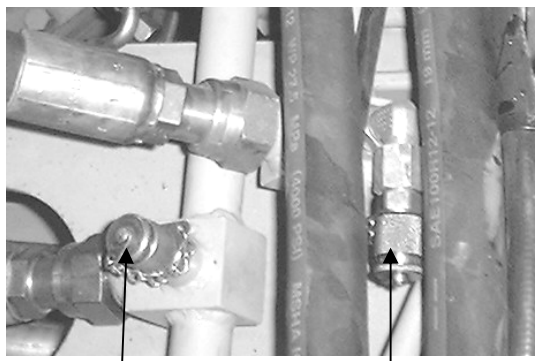
When checking the down side of the circuit, place the bucket Against the ground and stall the circuit. The correct reading is **3000 – 3200 PSI.**

If an adjustment is required, screw the port relief in to increase the setting and out to decrease.

Cycle Times: HOIST
Boom Retracted
Raise from ground 2.5 – 3.1
Boom Retracted
Lower to ground 1.5 – 2.3



Hoist Down
Port Relief



Hoist
Down

Hoist Up

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Hoist Circuit (Up and Holding Valve)

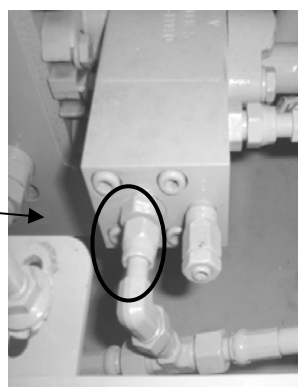
Install a gauge in the hoist up circuit test fitting. Then using the largest bucket, fill it completely, lift the bucket off the ground. **With the engine off**, remove the pilot line from the holding valve assembly. Plug the line at the elbow fitting and leave the fitting in the valve open to atmosphere.

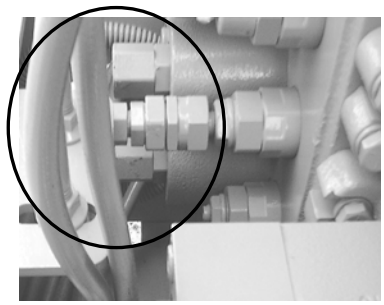
With the boom fully extended and the bucket full of material, begin easing the controller forward to see a reading of **4625-4650 PSI** when the holding valve opens. If an adjustment is required you will need to adjust the allen screw on the holding valve.

Once the holding valve pressure is adjusted, it is required to reconnect the pilot line for the holding valve.

With the hoist up port regulator, remove the pilot line going to the port regulator for the hoist up side of the valve. Plug the line leaving the connection in the regulator open to atmosphere. The pressure is the low side of the regulator. Raising the boom to the max position and stalling, the reading should be **4700 PSI**.

Remove the line and plug with a #4 ORS fitting





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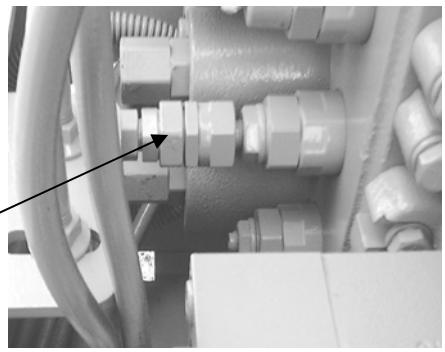
Hoist Circuit (Up and Holding Valve)

If the regulator needs adjusted, loosen the jam nut and turn the high side of the valve. Turning it in will increase the pressure. The adjustment is very fine and you may see a pressure increase after the jam nut has been set.

Recheck the pressure because the setting can change if the jam nut is over tightened.

Reconnect all of the pilot lines that have been disconnected. Now, the high side of the regulator can be checked. With the hoist in the max up and bottomed position, the reading should be 5075 psi.

- NOTE:
  The adjustment on the hoist up port regulator is very fine. Once the adjustment has been made make sure that the jam nut is torque properly.



Low side adjustment of hoist up regulator

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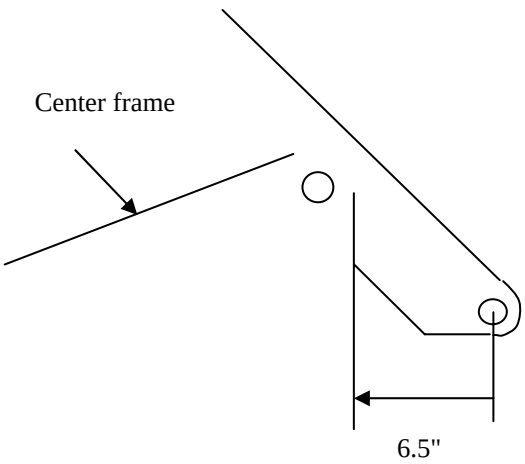
Hoist Limit Valve

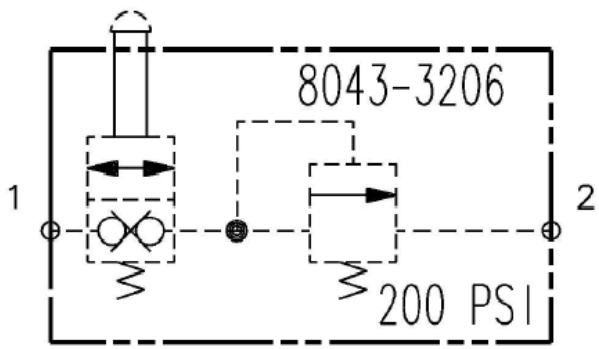
When adjusting the hoist limit valve,
have the hoist cylinder extended 6.5” in front
of the upper structure center frame.

Measure from the center of the hoist
cylinder pin to the front of the center frame.

Adjust valve and/or striker plate until plunger valve
Is in full compression.

Re-torque the fasteners.





HYDRAULIC SCHEMATIC

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Tool Circuit

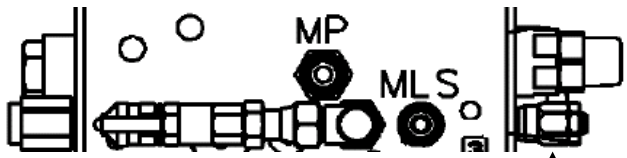
When testing the tool circuit, install a set of high pressure gauges into the first and fourth lines.

The fourth line over from the outside (if equipped with aux. hydraulics will be the sixth line over) is for tool retract (open).

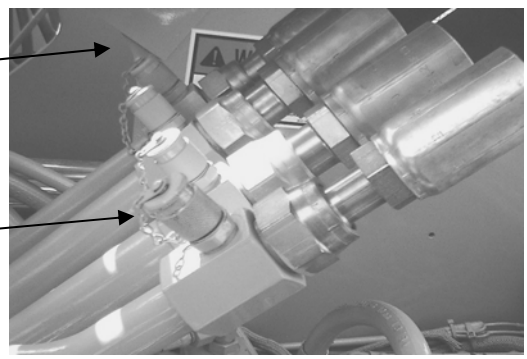
The first line over from the outside (if equipped with aux. hydraulics will be the second line over) is for tool extend (close).

When testing the tool circuit, turn the load sense valve in so that the setting is higher than the circuit. Remember that the circuit is higher then the load sense adjustment.

Cycle Times:
Tool Open 1.8 – 2.2
Tool Close 3.3 – 3.9



Load Sense Relief



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Tool Circuit

Tool Extend (close) first line:

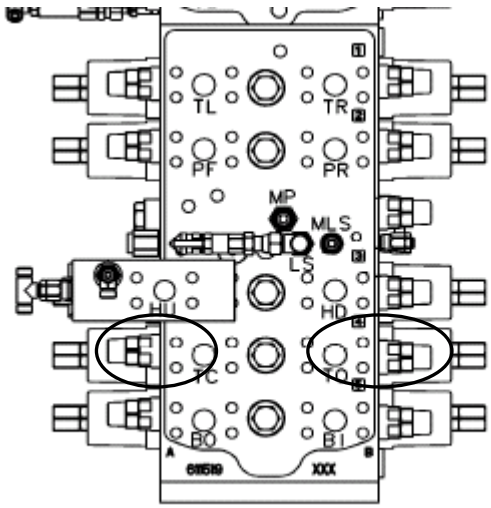
With a high pressure gauge in the extend side and the load sense adjusted up the correct reading should be **5000 – 5150 PSI**. If an adjustment is required you will turn the relief in to increase and out to decrease.

Tool Retract (open) four line:

With a high pressure gauge in the retract side and the load sense adjusted up the correct reading should be 5000 – 5150 psi. If an adjustment is required, you will turn the relief in to increase and out to decrease.

After setting the tool circuit pressures, Reset the load sense circuit pressure.

Tool Close
Port relief



Tool Open
Port relief

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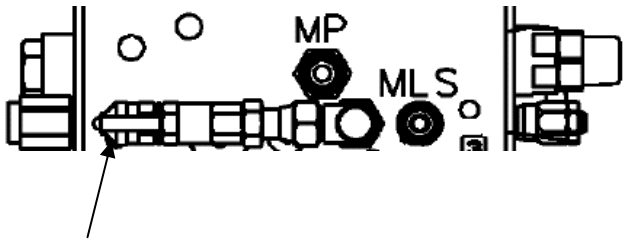
Tilt Circuit

To test the tilt circuit connect a high pressure gauge into the load sense fitting at the control valve.

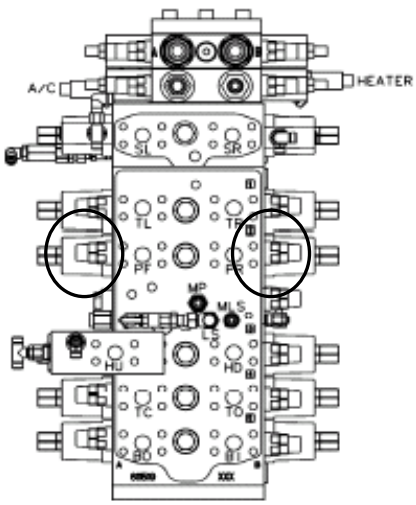
With the gauge connected at the load sense test port at the main valve, Tilt the boom to the left (CCW) and check the gauge. The setting is **2125 – 2325 PSI**. If the setting is not correct adjust the port relief valve. In to increase the setting and out to decrease.

With the gauge still connected to the load sense test fitting, operate the tilt in the opposite direction and check the setting If the setting is not correct, adjust the port relief valve. In to increase the setting and out to decrease.

Cycle Times:
Tilt CW 8.4 – 10.3
Tilt CCW 8.4 – 10.3



Load Sense test port



Tilt left (CCW)

Tilt right (CW)

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Propel Circuit

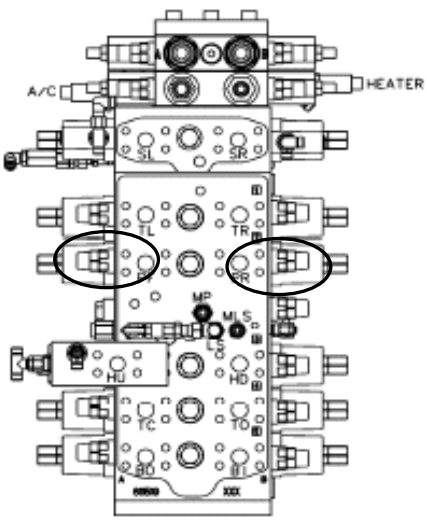
Checking the propel circuit use a high pressure gauge.
This test will be performed with the engine running at high idle, the emergency brake in the on piston and the range two speed in high.

With the engine at high idle, move the travel pedal forward slowly making sure that the emergency brake is holding the setting is **3450-3550 PSI**.

If the setting is incorrect adjust the forward port relief. Holding the adjusting screw and using a combination wrench, loosen the jam nut. By turning it in the pressure will increase. By turning it out the pressure will decrease. Once the correct setting has be achieved lock the jam nut in place and recheck the setting.



Reverse



Forward

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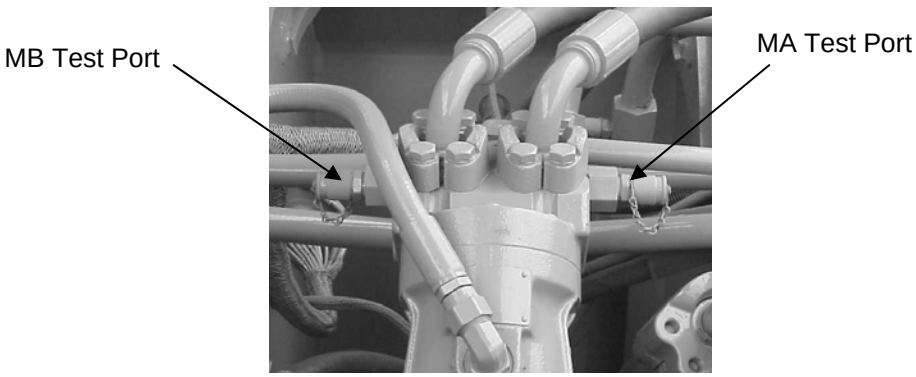
Swing Circuit

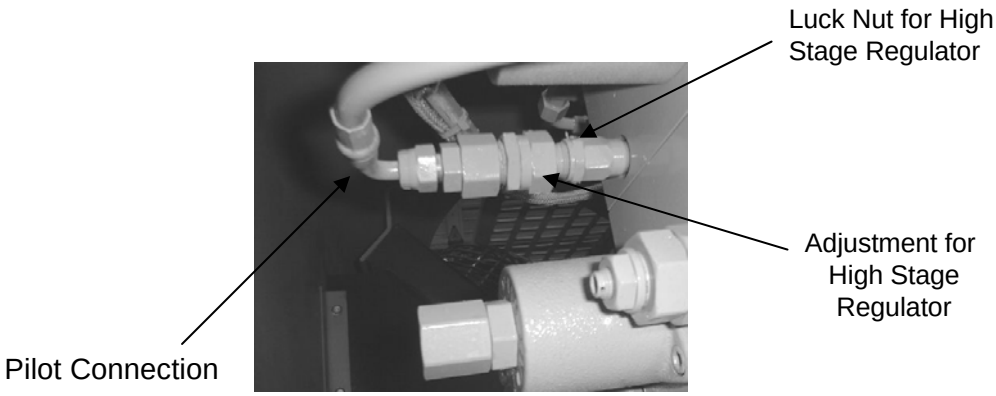
The first procedure is the placement of the bucket against the ground. During several of the tests you will be stalling the swing circuit.

Next, install a pair of high pressure gages into the MA (right) and MB (left) test ports.

These test ports are located on the manifold on top of the swing motor.

On the valve section, bottom the HIGH STAGE of the section REGULATOR VALVE. Remove the pilot line and plug the line leaving the fitting open to atmosphere. This valve is set to 4200PSI which is lower than the high stage setting on the swing motor two stage relief.





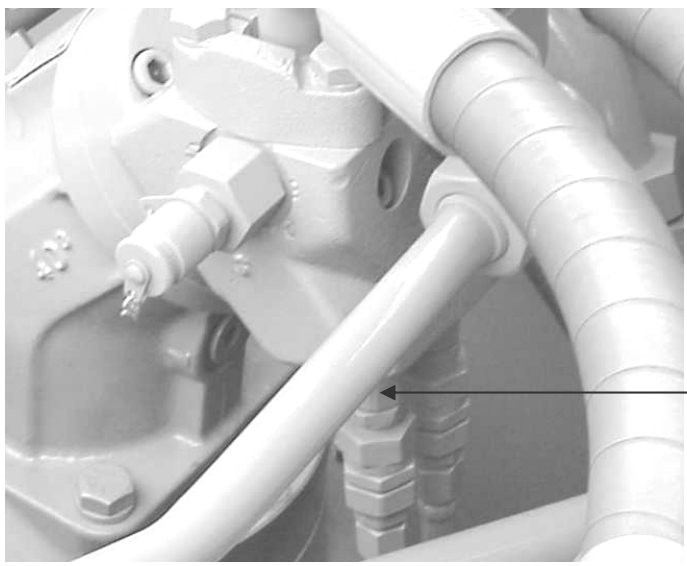
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Swing Circuit

With the engine operating at full throttle and the bucket firmly against the ground. Stall the swing in one direction or the other. The correct reading is **4150 - 4250 PSI**.

If it is out of adjustment, adjust the TWO stage regulators at the motor.

If an adjustment is required turn the high side in to increase and out to decrease the settings. This is a very fine adjustment and when torqueing the nut the reading might change so always recheck the settings.



The High side of the TWO stage regulator at the swing motor

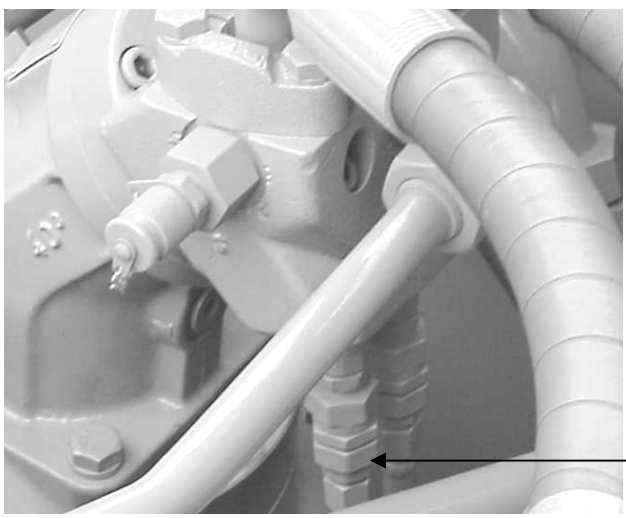
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Swing Circuit

Next, check the low side of the regulators. Before Checking or adjusting, first remove the pilot lines to the regulators on the swing motor and plug them leaving the connecting fittings open to atmosphere.In this configuration, It is possible to check the low stage setting by stalling swing with the boom on the ground. The correct setting is **2900 – 3100 PSI**.

Once again remember that turning the regulator in will increase the. Setting and turning it out will decrease the setting. If an adjustment was made, recheck the setting after the lock nut has been torqued.

Reconnect the pilot lines. Now, check the dynamic braking of the swing circuit. With the gages still connected swing the machine at Full speed and watch the gages. Release the controller to stop the swing motion, at this point the pressure on the opposite direction should read **3000 PSI**.

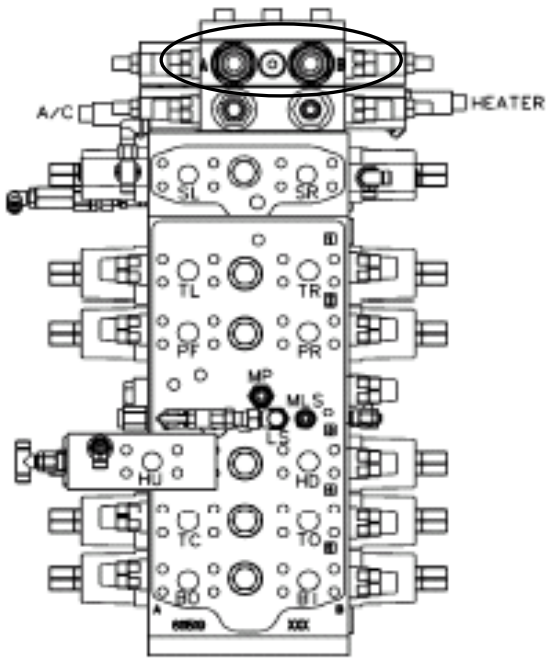


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Auxiliary Circuit

With gauges connected to the work port lines of the auxiliary circuit. Operate the auxiliary control valve switch in either direction. The correct pressure setting is **3000 - 3200 PSI**.

The flow for the auxiliary circuit is **30 GPM**.

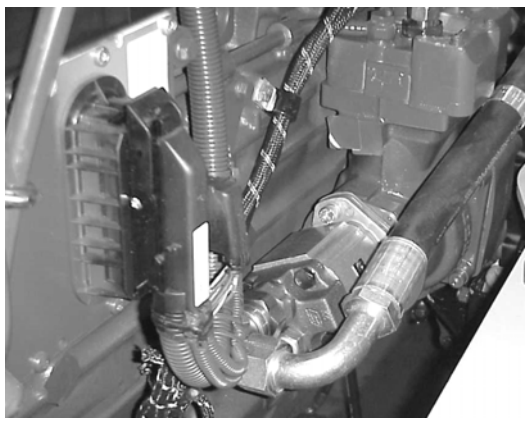


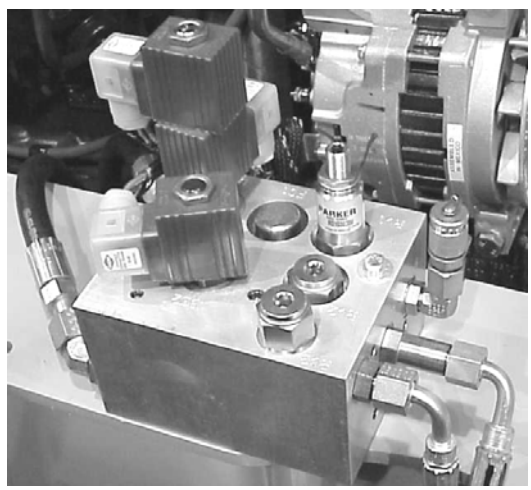
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Power Steering

The remote steering to the 4100 II is an all-new circuit. The power steering pump is located on the back of the Air compressor. It is a gear style pump that will produce **5 GPM**.

The steering is changed from travel to remote at the steering valve located on the right frame rail in the engine compartment. The single solenoid is where the change is made. In the travel position, oil will flow through the valve so the remote steering cylinder can extend or retract. When in the remote mode of machine operation, the solenoid blocks the passage. The oil flow is controlled by the double stack valve in the same picture. Stall the steering in either direction and check the pressure at the steering valve. There is a pressure test port located on the front of the steering valve. The setting is **1950 - 2050 PSI**.



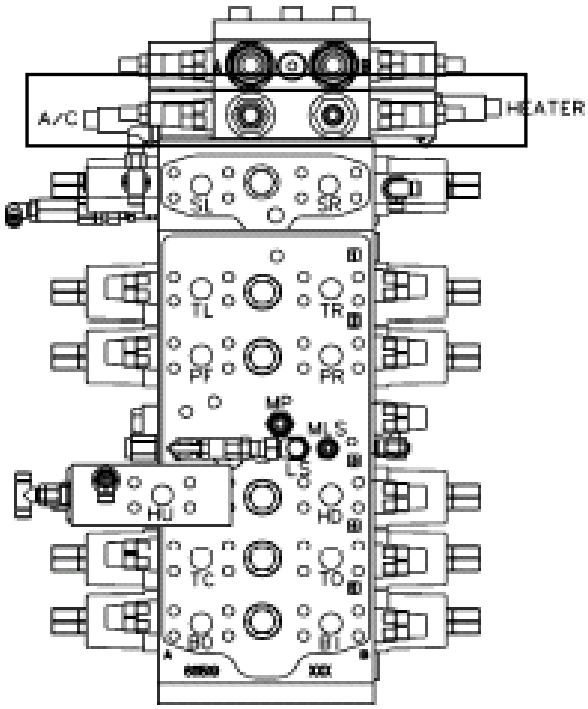


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A/C and Heating

When checking the pressure to the a/c drive motor, Plumb a fitting into the control valve blocking off the port.The correct setting for the a/c drive motor is **3350 – 3550 PSI**. Also check the pulley speed on the drive motor for **2000 RPM'S**. The a/c port relief is located on the outside of the valve section.

Check the hydraulic drive for the heater circuit by blocking off the inside port and the pressure should be at **1500 – 1700 PSI**.

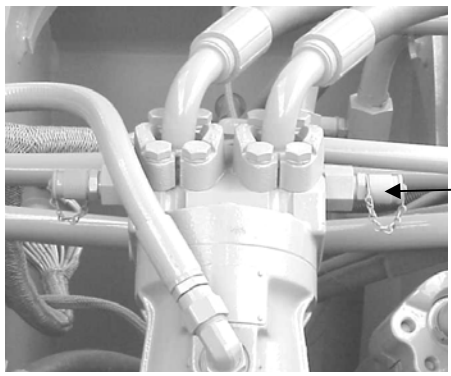


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System Dump

When checking the system dump pressure connect a high pressure gauge into the MA test port on the swing motor.

With the gauge connected, stall the hoist down and the boom retract the correct reading is **290-400 PSI**. This is not a reading that can be adjusted. This pressure would be monitored for attachments with specific return pressures.



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The Gradall Company, New Philadelphia Ohio

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DRAWING NUMBER: **8040-9002**
REVISION: **E**
ORIG. REL. DATE: **10-18-02**
BY: **CES**

REV	DESCRIPTION	CHECKED	APPROVED
E	EC-040197 CES 11-24-04 UPDATED PRESSURE VALUES FOR PROPEL, TILT, AUX, BOOM OUT, AND HOIST DOWN	GTB	JAB

GRADALL® *FINAL TEST REPORT*

8040-9002
Model XL4100 Series II

TRACKING # _____

SERIAL # _____

DATE _____

PRESSURE TEST		GAGE LOCATION	(P.S.I.) MIN. - MAX.	ACTUAL
I.	**Flushing** Pressure (No Functions Moving, High Idle)	P (pilot manifold)	360 - 570****	
II.	**Pump Differential** (Diff. between P & LS ports, Boom out Bottomed)	P - LS (at valve)	275 - 295****	
III.	**Joystick Pilot Pressure** (With Tool Moving)	A (pilot manifold)	500 - 620	
IV.	**Engine Speed** (RPM) (1900 RPM Rated)			
	A. High Idle	Monitor	1850 - 1950****	
	B. Low Idle	Monitor	800 - 900****	
V.	**Propel**			
	A. [forward = in , rev. = out]	X @ Valve	3400 – 3550	
	B. [forward = in , rev. = out]	X @ Valve	3400 – 3550	
VI.	**Boom**			
	A. Cyl. Bottomed - Retracted, (Inside Relief Valve)	X @ Valve	5000 - 5150***	(Not Factory Checked)
	B. Cyl. Bottomed - Extended, (Outside Relief Valve)	X @ Valve	2575 - 2775	
	C. ”Pump” Setting (Cylinder Bottomed, Retracted)**	X @ Valve	4650 - 4750	
VIII.	**Tilt**			
	A. Tilt Motor CCW, (Inside Relief Valve)	P (pilot manifold)	2425 - 2625	
	B. Tilt Motor CW, (Outside Relief Valve)	P (pilot manifold)	2425 - 2625	
IX.	**Hoist**			
	A. Cyl. Stalled - Retracted (Inside Relief Valve)	X @ Valve	3075 - 3275	
	B. Lock Valve Setting (Boom Starts To Drift W/ Load)	X @ Valve	4625 - 4650	
	C. Hoist Up Port Relief (Boom Starts To Fall W/ Load)	X @ Valve	4700 - 4750	
	D. Hoist Up Port Relief, High Stage(Hoist up)	X @ Valve	5000 - 5150	(Not Factory Checked)
X.	**Tool** (Over Power Tool Cyl. With Boom Function)			
	A. Tool Cyl. Extended, Inside Hose Port	X @ Valve	5000 - 5150 ***	(Not Factory Checked)
	B. Tool Cyl. Retracted, Outside Hose Port	X @ Valve	5000 - 5150 ***	(Not Factory Checked)
XI.	**Swing**			
	A. Swing Regulator Pressure**	MA port on motor	4150 - 4250	
	B. Dynamic Braking (Joystick in Neutral) Right (Inside valve)	MA port on motor	2900 - 3100	
	C. Dynamic Braking (Joystick in Neutral) Left (Outside valve)	MB port on motor	2900 - 3100	
XII.	**System Dump** Pressure (Hoist Down, Boom Retract)	MA port on motor	290 - 400*****	
XIII.	**A/C** Pressure (Optional Equipment) - Outside Relief Valve	X @ Valve	3350-3550	
XIIIV.	**Auxiliary** (Optional Equipment)			
	A. Inside Relief	X @ Valve	3075 - 3275	
	B. Outside Relief	X @ Valve	3075 - 3275	
XIV.	**Power Steering** (Chassis)			
	A. Relief	G @ Valve	1950-2050	
XV.	**Drawdown – RPM** (Propel & tool stalled; hoist up and boom out At full speed)	Minidiag tool	1725 - 1825	

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NOTE: See hydraulic system set-up procedure for detailed system adjustment if required.
*Pressure test to be performed with oil at operating temp. and engine running full throttle
**Pressures correspond to regulator compensator setting or loadsense line relief.
***Specified pressures of these reliefs correspond to 1/2 GPM flow.
****Values to be measured with the cooling fan off, heater off, and air conditioning off.
*****To be tested after operating time test is conducted.

TRACKING # _____

8040-9002 GRADALL TEST REPORT

Model XL4100 Series II SERIAL # _____

DATE _____

OPERATING TIME TEST		SECONDS MIN. - MAX.	ACTUAL
I.	Run Boom Out - level	4.6 - 5.0	
II.	Run Boom In - Level	5.2 - 5.8	
III.	Hoist		
	A. Boom In - Raise from Ground to 30° (*12.5*" Stroke)	2.5 - 3.1	
	B. Boom In - Lower from 30° to Ground (With Bucket)	1.5 - 2.3	
IV.	Tool Open	1.8 - 2.2	
V.	Tool Close	3.3 - 3.9	
VI.	Swing Right 360° Boom In or Boom Out	7.4 - 7.9	
VII.	Swing Left 360° Boom in or Boom Out	7.4 - 7.9	
VIII.	Swing Brake Sets	3.0 - 3.2	
IX.	Tilt 220° Max. CW (nominal flow = 15 gpm. = 3.82 rpm.)		
	A. Max. CW	8.4 - 10.3	
	B. Max. CCW	8.4 - 10.3	
X.	Propel Speed 10:00 x 20 Tires: (**0.87 MPH** / 3.3 MPH High)		
	1. Time for 100 Ft. (**Low Speed**) Forward	73 - 83	
	2. Time for 100 Ft. (**Low Speed**) Reverse	73 - 83	
XI.	Hydraulic Cooling Fan Speed RPM (Test w/ boom bottomed, fan switch on, engine at idle, and Hyd. Oil Temp at 70 F Min., Full RPM cannot be obtained w/controls in neutral)	2000 - 2300	
XII.	Air Conditioner Motor Speed RPM (Optional Equipment) (Test with engine at idle, w/controls in neutral, cooling fan running, Hyd.Oil Temp. at 70 Min.)	2000 - 2150	

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8040-9002
Model XL4100 Series II

GRADALL TEST REPORT
INSPECTION CHECKLIST

TRACKING # _____

SERIAL # _____

_____ Reservoir Oil Level
_____ Gear Lube in Swing Tran.
_____ Upperstructure Greased
_____ Hyd. Oil in Swing Brake
_____ Gear Lube in Tilt Trans.
_____ Heater/Defroster and Controls Function (upper heater – minimum 115 degrees F at bottom air duct on max heat setting and fan speed on "1" after 20 min running, door & windows closed)
_____ Two Speed Functions Control Orientation & Operation Correct
_____ Tilt Speed Override Switch Works

_____ Hoses In Boom not Twisted
_____ Boom Rollers Adjusted
_____ Cont. Levers & Switches Funct.
_____ Hoses Clear of Interference
_____ All Cylinder Pins Locked
_____ Window Moves Freely
_____ Window Latches Work
_____ Windshield Wiper & Washer OK
_____ Cab Door Latches Hold
_____ Access Doors Aligned

_____ Tool Cylinder Rod Not Damaged
_____ Swing Brake (Bleed)
_____ Boom Drift _____" in 5 minutes (max. spec. is 2" in 5 min. @ Operating Temperature with 36" Bucket)
_____ Attachments Fit
_____ Horn Functions (Upper)
Travel Alarm Functions: (2 Modes)
_____ Forward
_____ Reverse
_____ Upper Park Brake Functions
_____ No Delay in Joystick Controls
_____ Engine Alarms

_____ Remote Controls Function (Oscillation Cyls Lock, Brakes Set, Park Brake Sets, Low Air Warning)

Tested By: _____ Date: _____

SHIPPING INSPECTION CHECKLIST

GRADALL UPPER
_____ Machine Conforms to Order
_____ All Name Plates Applied
_____ All Inst. Plates Applied
_____ Tool Kit on Machine
_____ Reservoir Oil Level
_____ No Paint on Cylinder Rods
_____ Swing Gear Lubed
_____ Keys
_____ Swing Lights Work
_____ Machine Controls Set to SAE or Other Pattern Per Order.
_____ Proper Control Decal Installed On Operators Window

GENERAL
_____ Nonstandard Controls Identified
_____ Paint & Appearance OK
_____ All Decals Installed
_____ Belly Pans in Place
_____ Travel Alarm Functions

MANUALS REV
_____ Operator _____
_____ Parts _____
_____ Service _____

ENGINE
_____ Coolant Level Correct
_____ Engine Oil Level Correct

CHASSIS
_____ Keys
_____ All Lights Function
_____ Horn Works
_____ Door Locks
_____ Correct Tires

Inspected By: _____ Date: _____

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8040-9002

XL-4100 Series II UNDERCARRIAGE TEST REPORT

TRACKING NUMBER: _____

SERIAL NUMBER: _____

A.) ENGINE

_____ Oil Pressure, Engine At Operating Temp (No Load)
_____ Oil Level Full
_____ Coolant Level and Protection Level to -30 F
_____ Belt Alignment OK
_____ Air Cleaner Connections Tight
_____ Battery Connections & Fluid OK
_____ All Panel Gauges Function
_____ Heater/Defroster & Controls Function
_____ The 3 DDC Indicator Lights Work (With Key Switch On, The 3 Lights Will Glow For Approx. 2 Seconds, Then Go Off).
_____ No Engine Protection System Faults (With Switch On, An Active Fault Is Indicated By Either Glowing Red Engine Stop Light Or Yellow Check Engine Light. If There Is A Fault, Contact DDC Rep.)
_____ Low Idle (675 - 775 RPM)
_____ High Idle, no load, compressor unloaded (2250-2350RPM)
_____ Alternator System Charging Voltage At Battery (Acceptable Range 13.3 - 14.7 Volts)

B.) LUBRICATION

_____ All Fittings Accept Grease
_____ Front Drive Axle Lube Level
_____ Rear Axles Lube Level
_____ Transmission Lube Level

C.) STEERING/WHEELS

_____ P.S. Res. Oil Level Full
_____ Wheel Stops Correct
_____ Steering Properly Adj.
_____ Tire Pressure Correct (Contact Eng. if not listed below)
10.00 x 20 LR"G" = 90 psi
15.00 x 22.5 LR"H" = 85 psi
_____ Gearbox Poppets 1300 PSI. Max. @ Low Idle
_____ Ball Joints Adj. & Locked

D.) BRAKES & AIR SYSTEM

_____ Service Brakes adjusted Properly
_____ Chassis Parking Brake holds On Ramp @ 11
_____ Air System meets GTP-W-0145

E.) LIGHTS FUNCTION PROPERLY

_____ Head Lights Low Beam
_____ Head Lights High Beam
_____ Tail Lights
_____ Brake Lights
_____ Clearance Lights
_____ Back-Up Lights
_____ Flashers & Directionals

F.) SHIFT CONTROL INTERLOCK

WITH AIR SYSTEM AT OPERATING PRESSURE

From Chassis Cab

_____ Place transmission in any gear. Verify starter will not engage.
_____ Verify "Low Air, "Axle Diff", "Park Brake", "Neutral", "Main PTO", "Left PTO", "Right PTO", "Front Axle Drive", and "Interaxle Diff" indicator lights illuminate when key is moved to start position.
_____ Return transmission to neutral and follow remote control procedure. With mode switch set to remote, verify the only response when turning the key to run or start is the Illumination of the "Chassis Key" indicator light. (Note: Accessory functions are active until the upper key is Switched on.)

From Upper Cab

_____ If main PTO (pump) is not engaged, verify that "Check Engine" indicator light on upper monitor is illuminated When key is switched to run position and that starter is Limited to 2 second engagements.
_____ Verify "Low Air", "Hyd Fluid Level", "Hyd Fluid Suction" "Hyd Fluid Return", and "Hyd Fluid Temp" indicator lights illuminate when key is moved to start position.

G.) TRAVEL/REMOTE MODE

_____ With Air Up, Machine Mode Switched To Remote, Upper Key On, Pump PTO Engaged, Dig Brakes Set, Engine Can Be Start/Stop From Upper Cab.
_____ Frt. Wheel Drive (6 X 6 only)
A. Engaged When 6 X 6 Selected. (Light on)
B. Disengaged When 6 X 4 Position Selected. (Light off)
_____ Diff. Lock Engaged (Light On) When Diff. Lock Is Selected.
_____ Vehicle Speed _____MPH (5th Gear, Engine at 2300 RPM, Full Throttle)
_____ Brake Performance OK
_____ Transmission Shifts Properly
_____ Travel Alarms Function (In Reverse)

H.) MISCELLANEOUS

_____ Sheet Metal and Fiberglass Cover Condition Acceptable
_____ Horn Functions
_____ Optional Equipment/Systems Operate Properly
_____ All Hoses Clear, Sharp Edges
_____ Check Unit for Leaks

Tested By _____Date_____

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Remote Drive PTO Removal & Replacement

The following procedure is to be used for removal and replacement of remote drive PTO's as used on ***GRADALL*** Highway Speed excavators. Correct disassembly and assembly procedures are essential for proper operation of the remote PTO system. If any part of the procedure is not clear or needs further explanation, please contact your regional ***GRADALL*** service manager or the factory service department at 1-800-445-4752.

With any procedure, always work safely. Make sure machine is parked in a safe place, parking brake must be applied, remove the keys from the ignition, attach a "Do not operate" tag on the steering wheel, block the wheels, and use adequately rated lifting equipment. Use personal protective equipment such as safety glasses, safety shoes, and hearing protection as required.

This procedure requires normal mechanic's tools. It will also require use of calibrated torque wrenches, approved sealant, crow's foot type wrenches for access to some hardware, scraping tools to remove old sealant/gaskets, and other specialty tools and supplies identified in the procedure.

For parts required to remove and replace the remote drive PTO's, refer to the parts manual for your machine. The following parts listed are supplies available from ***GRADALL*** to install the remote drive PTO's. Substitution of different sealer and thread locking material may prove inadequate.

Part Number	Quantity	Description
S4405342	1	Loctite 518 Sealant
0100011S	1	Loctite 242 Thread Locker

Torque values for all fasteners are found within the instructions. At the end of the instructions, a torque chart is provided that includes metric conversion of torque values. All fasteners must be hand tightened to the values shown for the installation. Failure to hand torque the fasteners to the correct values may result in damage and failure to function of the remote drive PTO installation!

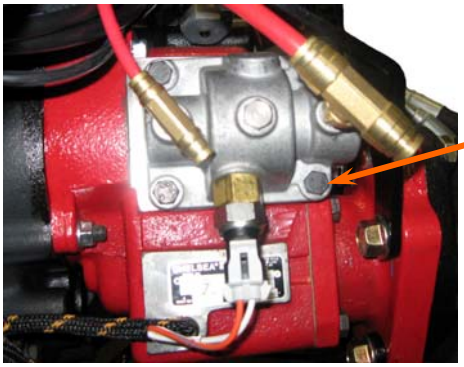
1. Park machine in a safe location to perform repair, Apply parking brake, remove the keys from the ignition, attach a "Do Not Operate" tag on the steering wheel, block the wheels. Drain air tanks. Remove transmission cover (and bucket carry rack if installed).
2. If lower right hand PTO is to be removed, drain the transmission by removing the pipe plug in the right hand PTO to allow it to drain.
3. Remove bolts retaining drive motor to PTO. Separate motor from PTO mounting flange. Note - due to the type of sealant used, it may be necessary to use a thin, sharp putty knife in the joint to separate the motor and PTO. Do not use blunt object like a screwdriver or chisel as it may cause damage to the mounting flange. Set the motors on the frame web behind and below the

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PTO's. It will not be necessary to disconnect the plumbing if the motors have hose style plumbing. *If it is tube style plumbing (Some XL3100's & XL4100-II's)*; removal of the plumbing is necessary, which requires capping all open ports to avoid contamination of hydraulic components.

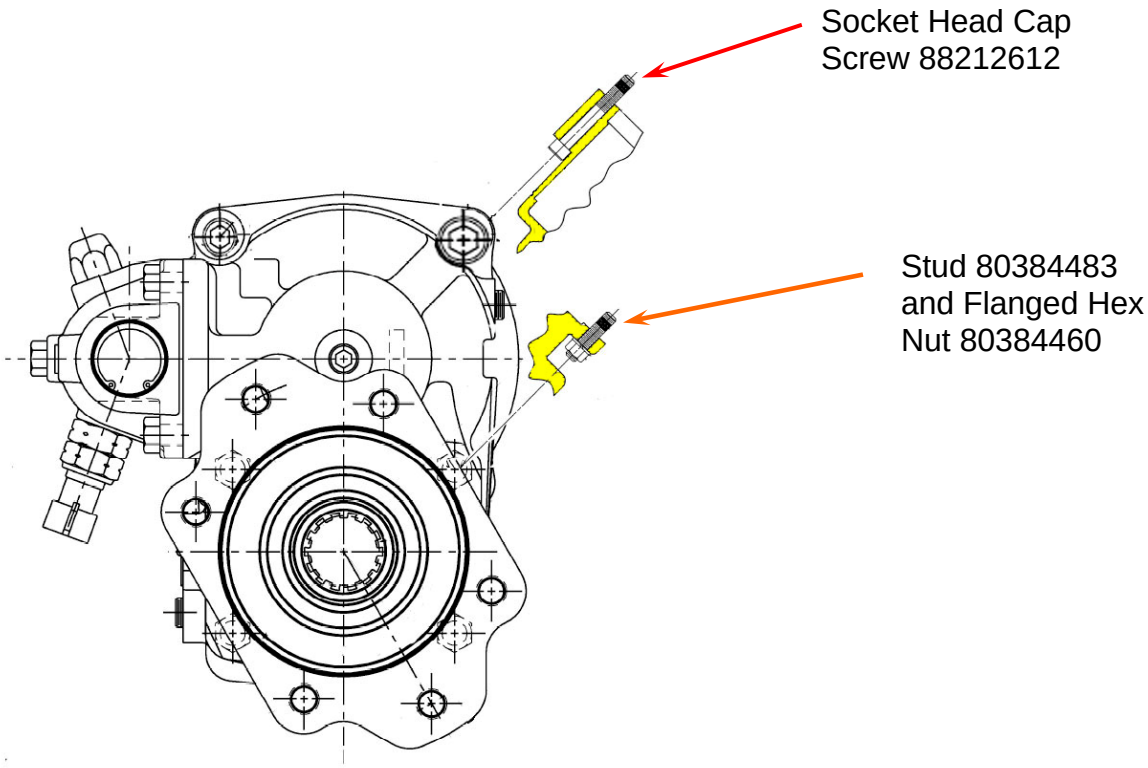
4. Remove air lines from the fittings at the PTO(s). Remove the screws in the PTO switches (prior to Series III machines). For Series III machines, disconnect plug at PTO switch. Move air lines and wires to a safe place.
5. For machines equipped with PTO support brackets (Most Series II and all Series III machines), remove both upper and lower PTO support brackets. Upper bracket requires removal from the transmission support also. Set aside.
6. Remove hardware from the PTO(s) to be removed. **Discard** all hardware after removal.
7. The PTO may need to be separated from the transmission using a sharp putty knife as described above for the motors. Do not use blunt objects like screwdrivers or chisels!
8. Carefully remove the PTO from the transmission. The PTO is heavy and requires care lifting out of the frame area. Use lifting equipment as needed.
9. Drain any remaining oil from PTO(s). Clean mounting surfaces of PTO completely of any sealant and gasket material. Clean mounting flange of both motors of sealant. Clean mounting flange on transmission of sealant and gasket material. Remove studs and springs from transmission and **discard**.
10. Inspect mounting surface on transmission for any damage to surface or raised areas around threaded holes. If raised areas exist, flatten with a fine file and lightly countersink edge of holes. Inspect PTO mounting flanges for damage. Address any damage as required.
11. Threaded holes in transmission for studs and capscrews must be cleaned before assembly. Use a 3/8-16-2A tap to clean threads of remaining Loctite and other debris. Use a cleaning agent (such as brake cleaner) to flush the threaded holes.
12. Clean PTO mounting face with a cleaner. When dry, cover entire mounting surface with Loctite 518. Do not use a gasket between remote drive PTO and transmission mounting flange. Note - substitution of sealant will give unacceptable performance. Use specified item only.
13. **IMPORTANT! - Loosen all 4 bolts of shift cover until cover is just loose from the case. Do not remove.**

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Loosen all 4 shift cover mounting screws before installing remote drive PTO

14. Put 2 drops of Loctite 242 (P/N 0100011S) on threads of studs (P/N 80384460) Install studs into correct holes in back of transmission. Fully tighten studs into transmission.



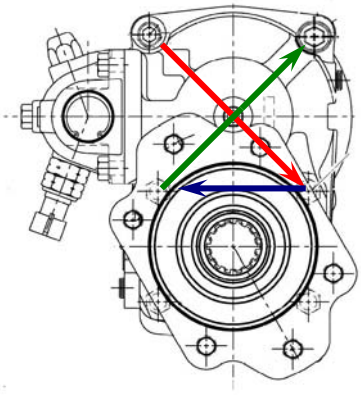
Note! – Do not use any washers under the socket head cap screws or the flange nuts.

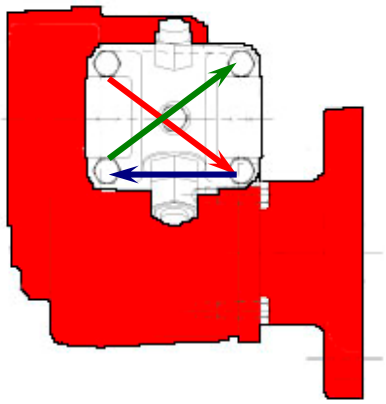
15. Coat mounting face of transmission with Loctite 518. Install new clutch spring onto transmission countershaft. Install clutch onto countershaft. Carefully install PTO onto the studs, but do not seat onto back of transmission. Just start flange nuts onto studs. Install new socket head cap screws (P/N

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88212612) in remaining holes after putting 2 drops of Loctite 242 (P/N 0100011S) on threads.

16. Fully seat the PTO onto the transmission. **Hand torque** all hardware to 40 +5/-0 ft./lb. It is necessary to use a crow's foot type wrench to access the flange nuts. Torque in a crossing pattern. Failure to torque to correct value and in correct pattern may lead to premature hardware failure! **Tighten shift cover cap screws (loosened in Step 14) to 16 - 20 ft/lb after PTO is correctly tightened.**





Note tightening pattern for remote drive PTO mounting hardware and PTO shift cover hardware

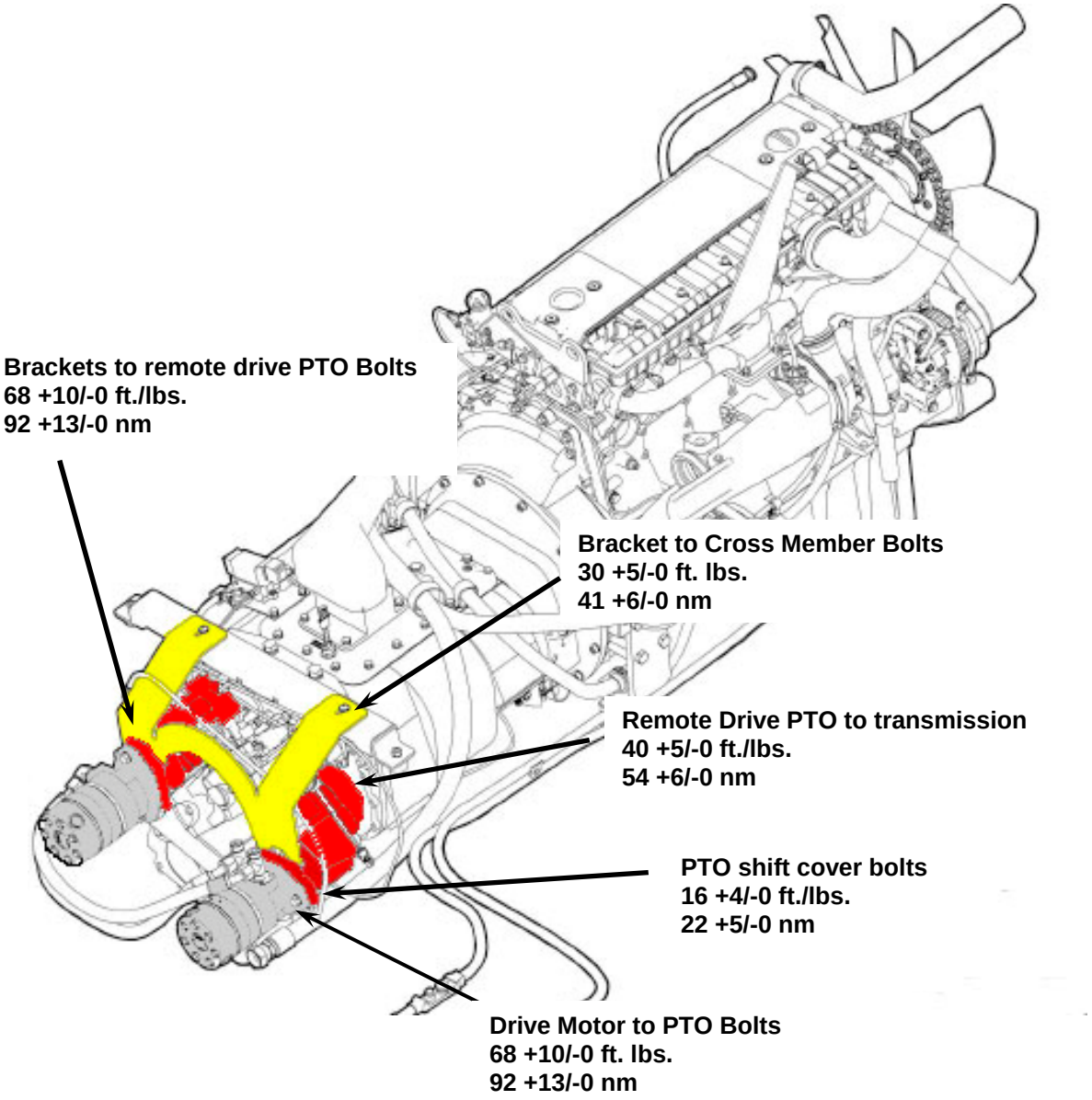
17. Install upper and lower support brackets (early machines were not built with brackets). Hand torque hardware attaching brackets to remote drive PTO to specification of 68 +10/-0 ft. lb. Hand torque hardware retaining brackets to cross member to torque of 30 +5/-0 ft. lb.
18. Coat mounting face of drive motor with Loctite 518. Install onto PTO and replace hardware. Torque to specification of 68 +10/-0 ft. lb. Install hydraulic plumbing if it had been removed.
19. Install air lines and wiring back onto PTO. Install drain plug(s). Refill transmission with oil. Reinstall transmission cover and bucket carrier (if equipped). **Note** - for best results, machine should sit overnight with no oil in

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the transmission to allow Loctite products to cure. Tag machine and allow it to sit overnight before adding oil and completing assembly and testing.

20. After the Loctite products have cured, add oil and start machine and build up air pressure. When air pressure is adequate, shut off machine and shift into remote mode. Restart from upper structure and verify that PTO's shift correctly and drive correctly.
21. If operation is correct, warm hydraulic oil to at least 120°. Verify travel speed and travel pressure are correct to factory specification for machine. Correct if not within specification. Failure to set to specification may result in damage to PTO's or drive motors. .

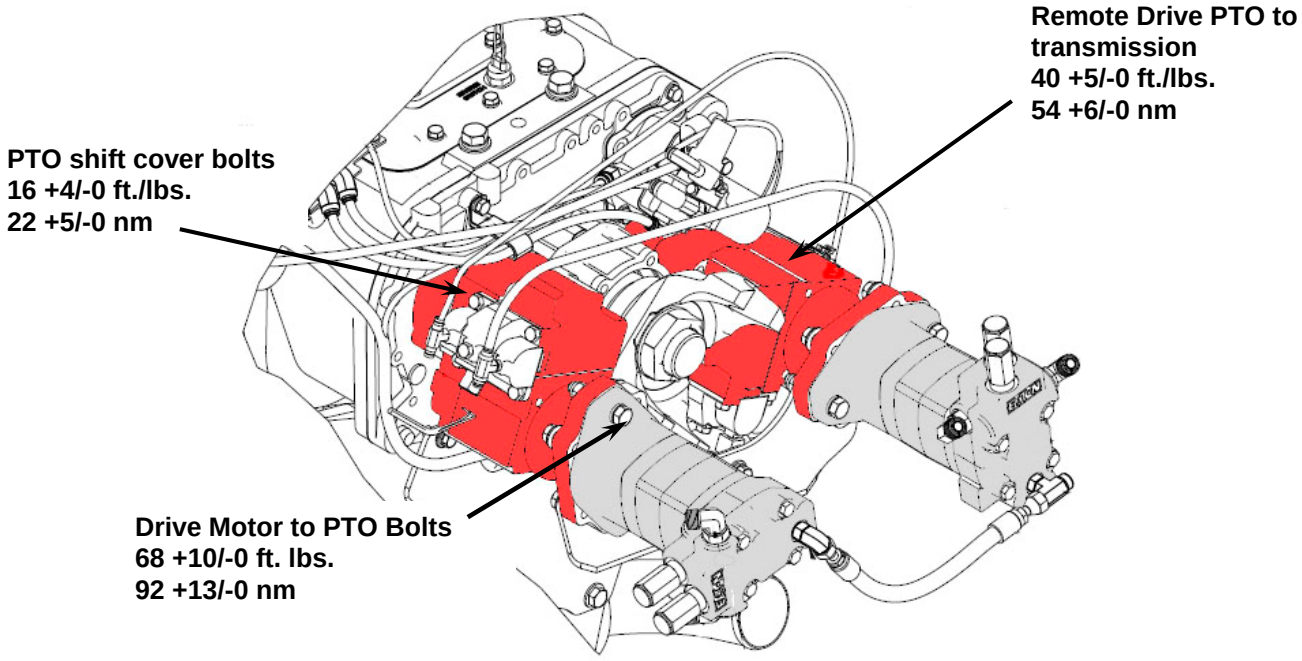
Torque Chart for Remote Drive PTO Installation – Series II Style Brackets

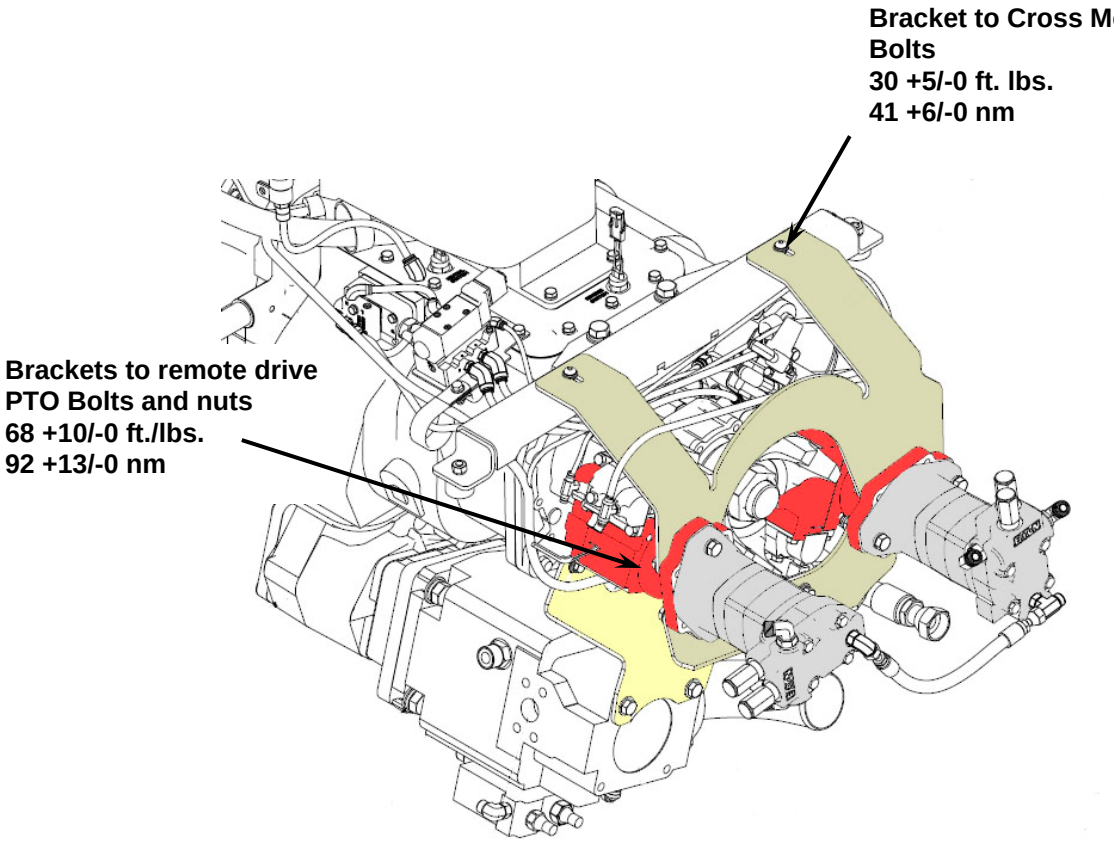


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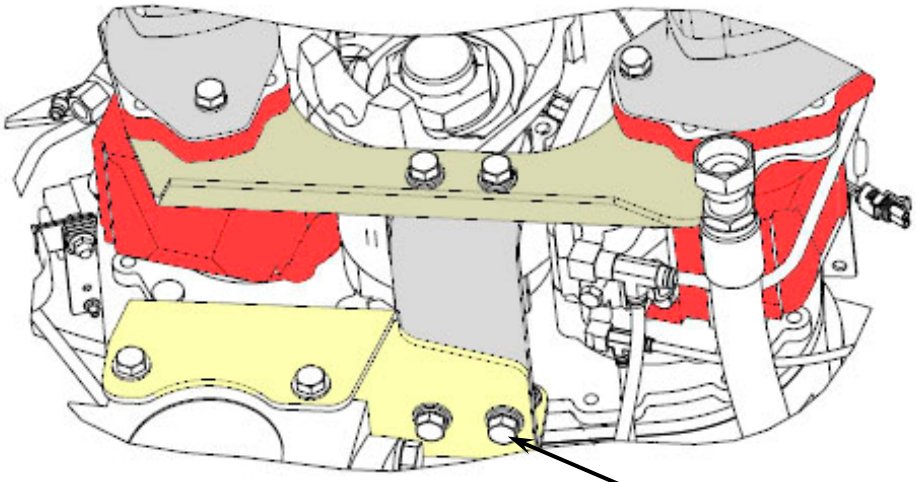
Torque Chart for Remote Drive PTO Installation – Late Series III Style Brackets

(January 2010 production and later)





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Stiffener Bracket Bolts
(4 places)
68 +10/-0 ft./lbs.
92 +13/-0 nm

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GRADALL®

EXCAVATOR

MAINTENANCE MANUAL

COVERING ALL

TRUCK MOUNTED UNITS



ALAMO GROUP

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The manual is designed to help the maintenance departments responsible for the up keep of the units.

The manual will answer questions about dash lights for the carrier as well as to the information center in the upper cab when glowing.

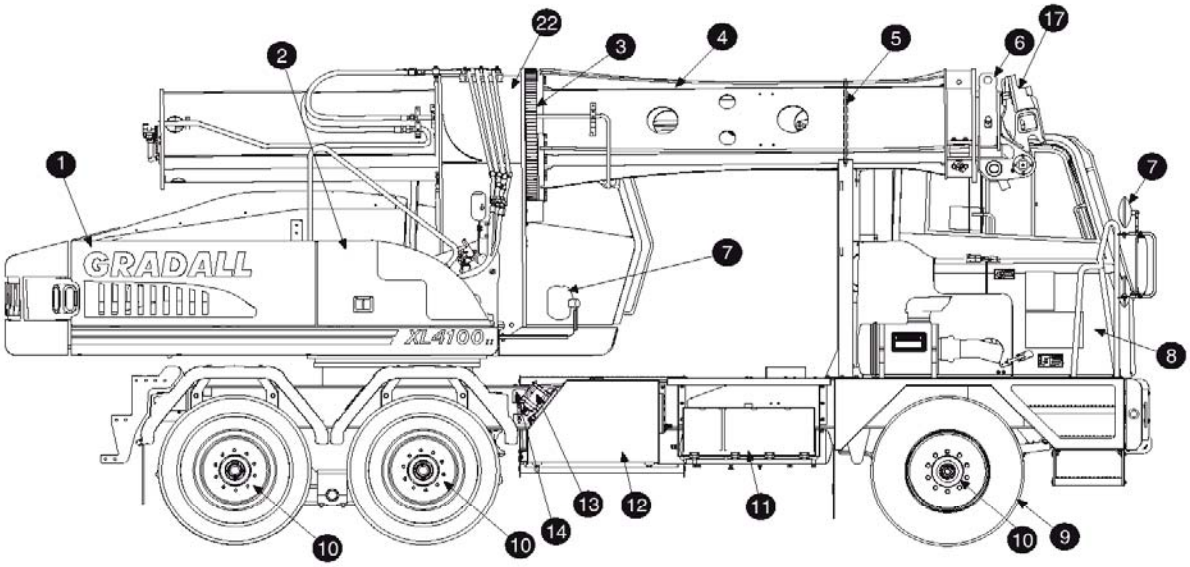
Manual has information about service intervals for the different components used on the Gradall Excavators.

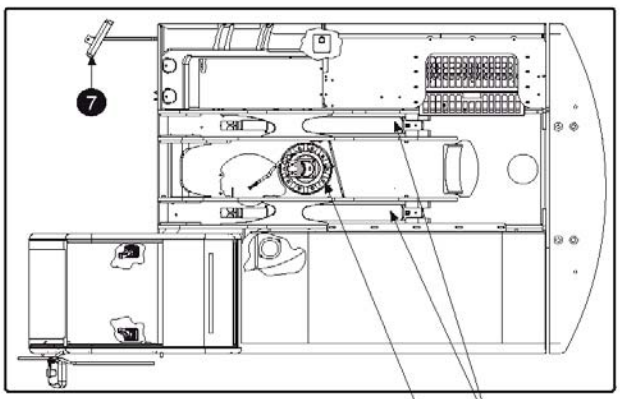
Manual is to be used with all truck mount units either
4 X 2 / 4 X 4 or 6 X 4 / 6 X 6

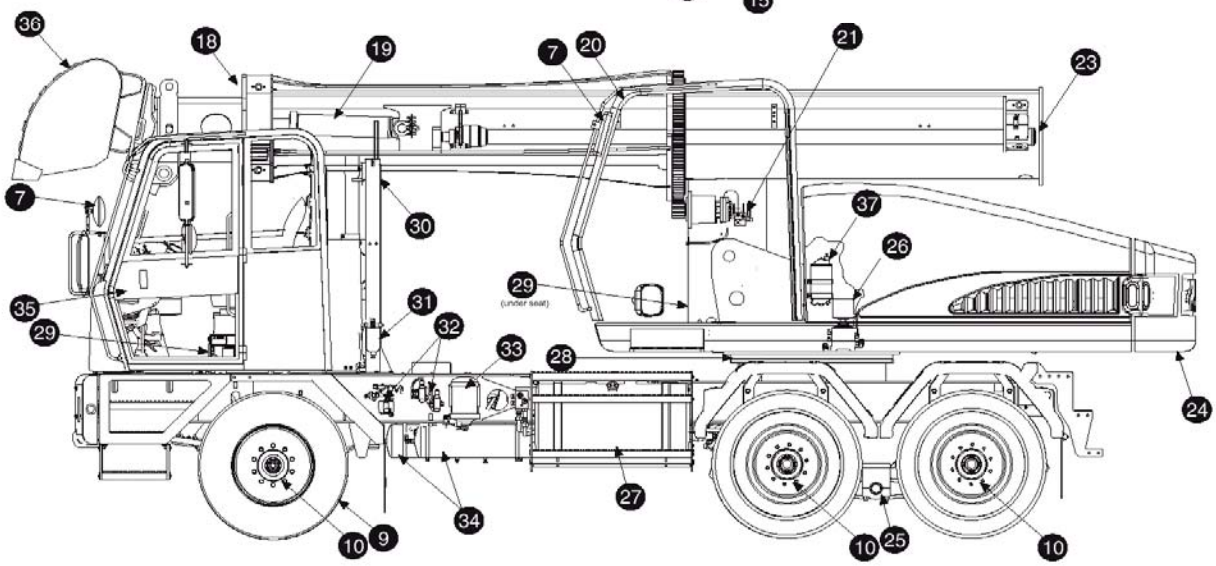
It is not designed to replace the Owner/Operators Manual but to accompany it for correct and better maintenance.

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NOMENCLATURE







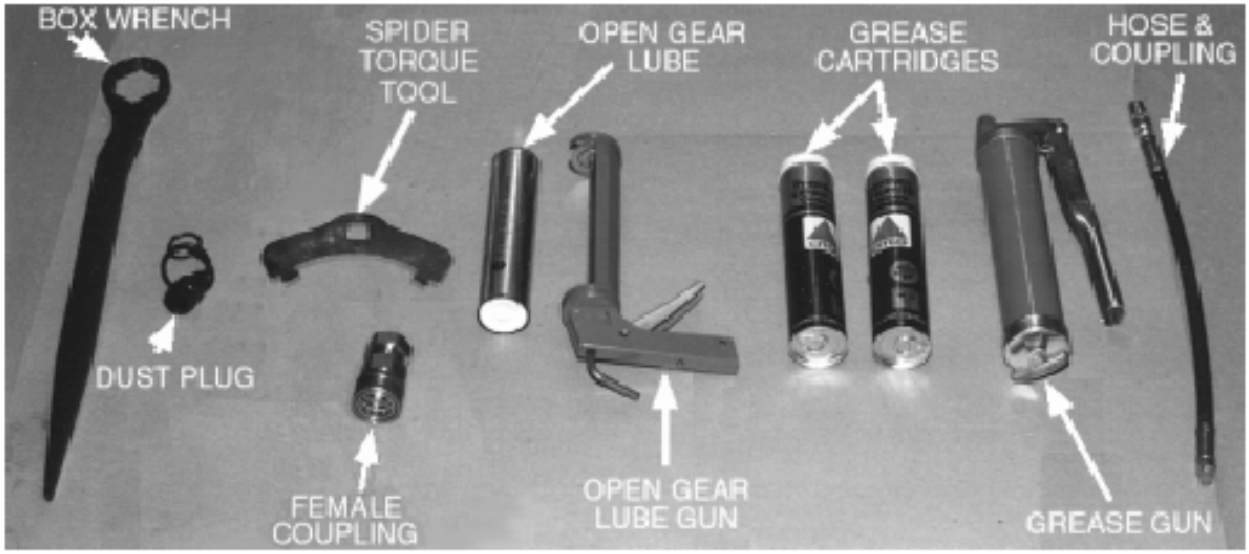
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NOMENCLATURE

ITEM	DESCRIPTION
1	Hydraulic Oil Cooler
2	Valve Compartment
3	Tilt Bearing
4	Main Boom
5	Boom Tie Down Chain
6	Telescoping Boom
7	Mirror
8	Engine/Transmission Pump Compartment
9	Steering Axle
10	Disc Wheel
11	Battery Compartment
12	Hydraulic Reservoir
13	Main “In Line” Filter
14	Hydraulic Reservoir Breather
15	Hoist Cylinder
16	Swing Transmission
17	Bucket Adapter
18	Boom Rollers
19	Tool Cylinder
20	Upper Operator Cab
21	Tilt Transmission
22	Cradle
23	Telescoping Boom Cylinder
24	Counterweight
25	Tandem Axle
26	Center Pin
27	Fuel Tank
28	Swing Bearing
29	Manual Storage Drawer
30	Boom Rest
31	Fuel Filter
32	Air Valve
33	Air Dryer
34	Air Tanks
35	Carrier Operator Cab
36	Bucket Attachment
37	Upper Cab Heater

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TOOL KIT



(Kit can be ordered under part number 8030-5008)

QTY	PART NO.	DESCRIPTION	USE
1	8042-1115	Spider Torque Tool	Torque collar on boom cylinder
1	8345-1128	Female Coupling	Pressure fill hydraulic reservoir
1	8362-3027	Dust Plug	Protect female coupling
1	8504-1300	Grease Gun	Apply grease to fittings
1	8504-1301	Hose and Coupling	Adapt grease gun to fittings
2	8504-1302	Grease Cartridges	Initial supply for grease gun
1	8504-1356	Box Wrench (1-7/8")	Install and remove attachment
1	8664-1304	Open Gear Lubricant	Lubricate swing & tilt gears
1	8664-1305	Open Gear Lubricant Gun	Apply open gear lubricant to gears
1	1440-4645	12 oz. Can Boeshield (not shown)	Apply to cylinder rods

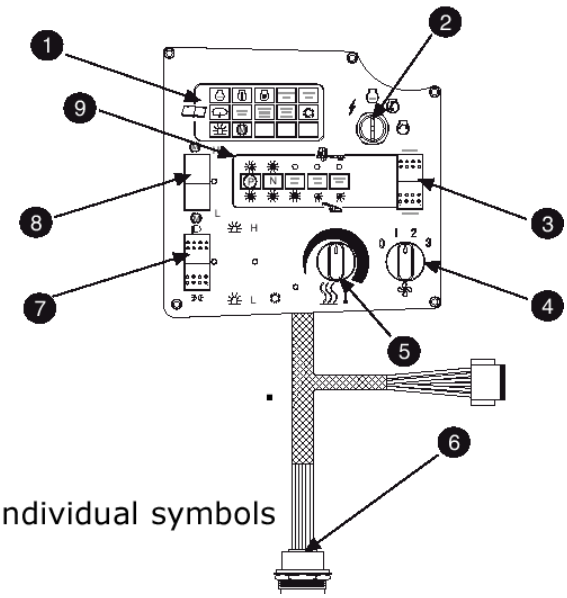
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Carrier Control & Instrument Identification

Information Center

On Carrier R.H. Dash Panel is an information center that has display areas that will glow when activated.

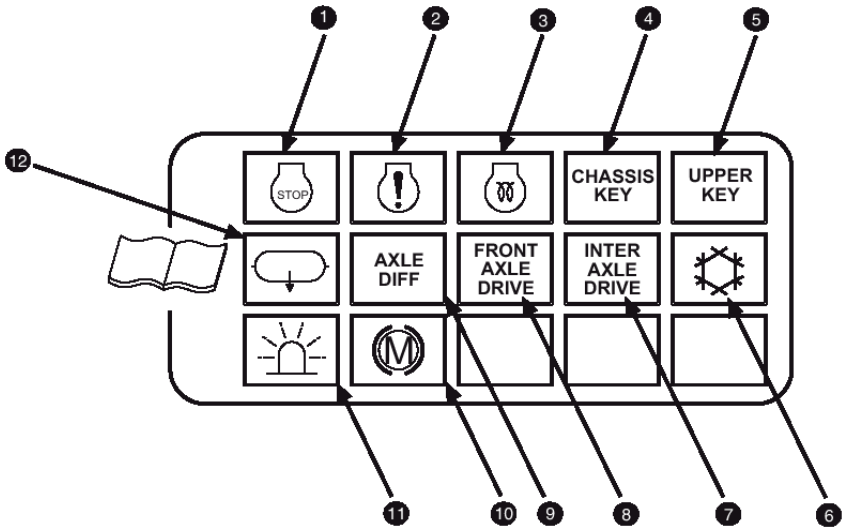
1. **Information Display Area:** Individual symbols glow to indicate a mechanical malfunction, need to service, or status
2. **Ignition Switch**
3. **Carrier/Remote Switch**
4. **Fan Speed**
5. **Temperature Control**
6. **Switch Panel Harness**
7. **Light Switch**
8. **Engine Brake Switch (optional)**
9. **Carrier/Remote Display Area:** Individual symbols glow to show activated functions



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CARRIER OPERATOR'S CAB

Information Display Area



Engine Stop, Check Engine, and optional Engine Preheat will glow for about two seconds and then go off. Depending on the temperature, the optional Engine Preheat light may continue to glow until intake manifold (grid heaters are optional) warms to proper temperature.

1. **Engine Stop:** Display glows (red) to indicate excessive engine temperature or low engine oil pressure. A pulsing alarm is also activated.

2. **Check Engine Light:** Symbol glows (yellow) to indicate a malfunction. **Malfunction must be investigated and repaired at earliest opportunity.**

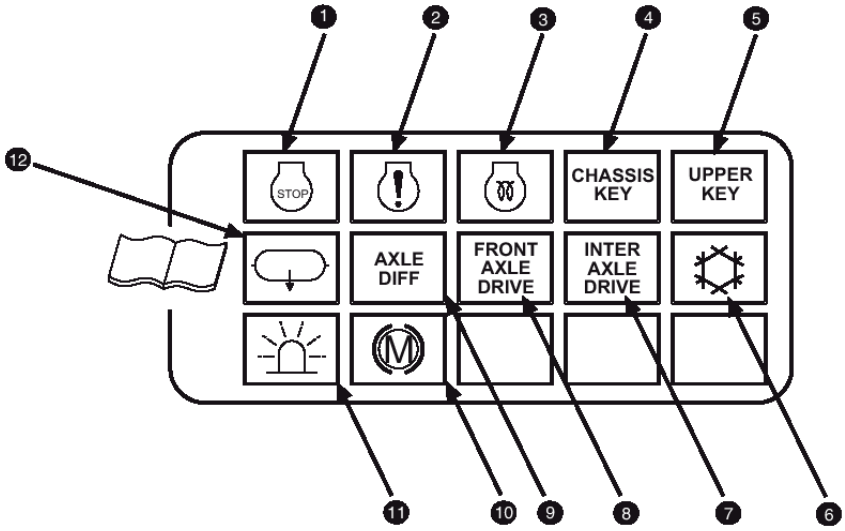
3. **Engine Preheat (optional):** Display glows (yellow) to indicate grid heaters are warming intake manifold to proper starting temperature.

4. **Chassis Key:** Symbol glows (green) to indicate carrier key is in the "run" position.

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CARRIER OPERATOR'S CAB

Information Display Area



.

5. **Upper Key:** Symbol glows (green) to indicate upperstructure key is in the "run" position.

6. **Air Conditioning (optional):** Symbol glows (green) to indicate air conditioner is activated.

7. **Interaxle Drive:** Display glows (green) to indicate interaxle differential lock is engaged.

8. **Front Axle Drive - 6x6 (optional):** Symbol glows (green) if front axle Drive is activated.

9. **Axle Differential Lock:** Display glows (green) to indicate rear axle differential lock is engaged.

10. **Engine Brake (optional):** Display glows (green) if engine brake is activated.

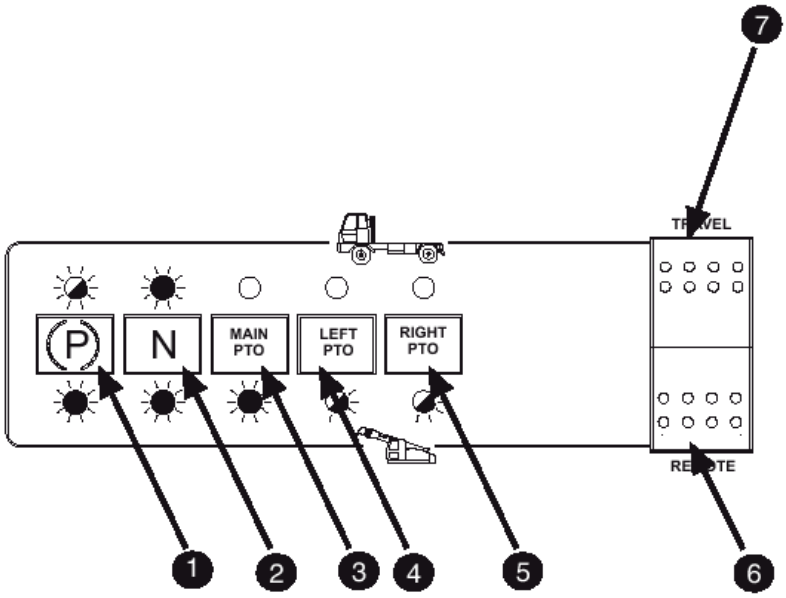
11. **Beacon (optional):** Symbol glows (green) if beacon is activated.

12. **Low Air :** Display glows (red) to indicate air system pressure is below minimum operating pressure (60 psi). An audible alarm is also activated.

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Carrier/Remote Display Area

On Carrier R.H. Dash Panel is an information center that has display areas that will glow during the start-up sequence.



1. **Parking Brake:** Display glows (red) to indicate parking brake is activated. Must be on to start in remote control mode.

2. **Transmission in Neutral:** Display glows (green) to indicate unit is in neutral gear. Must be on in remote control mode. Must be on in carrier mode to start.

3. **Main PTO:** Display glows (green) to indicate Main PTO (pump) is engaged. Must be off to start in carrier control mode. Must be on to start in remote control mode.

4. **Left PTO:** Display glows (green) to indicate Left PTO (travel motor) is engaged.

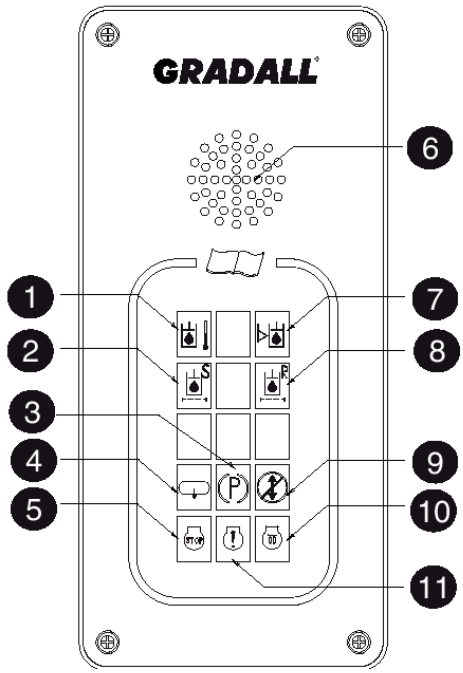
5. **Right PTO:** Display glows (green) to indicate Right PTO (travel motor) is engaged.

6. **Remote Control Active:** Switch is pressed for remote operation.

7. **Travel Control Active:** Switch is pressed for carrier (travel) operation.

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Upperstructure Control & Instrument Identification



Monitor Display & Symbols

On Upperstructure console, Engine Stop, Check Engine , and optional Engine Preheat will glow for about two seconds and then go off. Depending on the temperature, the optional Engine Preheat light may continue to glow until intake manifold (grid heaters are optional) warms to proper temperature.

Caution Symbols & Alarms

1. **Hydraulic Oil Temperature:** Symbol glows (yellow) in response to excessive hydraulic temperature (190° F./88° C.).

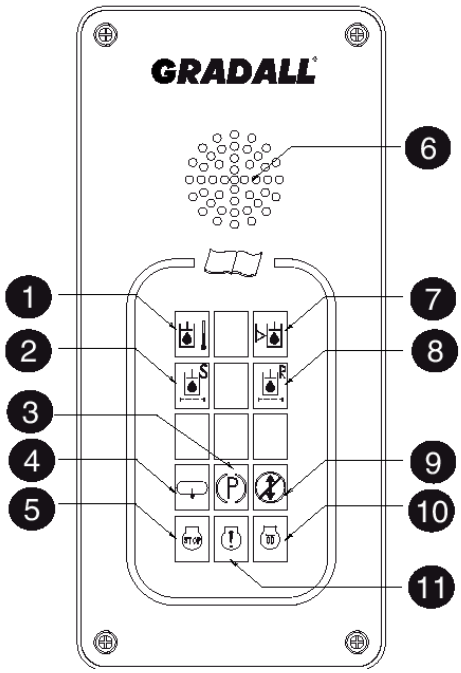
2. **Hydraulic Oil Suction Filter:** Symbol glows (yellow) in response to several conditions

3. **Parking Brake:** Symbol glows (red) to indicate the parking brake is activated.

4. **Low Air Light:** Symbol glows (red) to indicate brake system pressure is below minimum operating pressure (60 psi). An audible alarm is also activated.

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Upperstructure Control & Instrument Identification



5. **Engine Stop:** Symbol glows (red) to indicate excessive engine temperature or low engine oil pressure. A pulsing audible alarm is also activated.

6. **Mini-Siren:** Pulsing sound indicates engine shutdown has been initiated - Steady sound indicates low air system pressure or a travel lockout condition.

7. **Hydraulic Oil Level:** Symbol glows (red) if oil level falls below acceptable operating level.

8. **Hydraulic Oil Return Filter:** Symbol glows (yellow) in response to excessive resistance to flow. Cold oil can cause symbol to glow (refer

9. **Travel Lockout:** Symbol glows (yellow) if travel motors or range gear are not engaged. An audible alarm is also activated.

10. **Engine Preheat (Optional):** Symbol glows (yellow) to indicate optional grid heaters are still warming intake manifold to proper starting temperature.

11. **Check Engine:** Symbol glows (yellow) to indicate a malfunction. **Malfunction must be investigated and repaired at earliest opportunity.**

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Lubrication & Maintenance Diagram's

Lubrication Notes

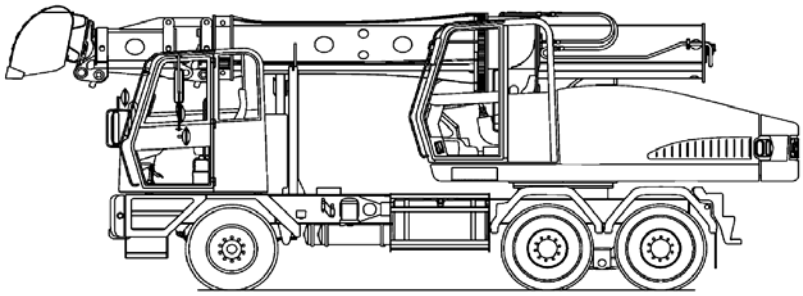
- See recommended lubric
- Drain engine and gear cases only after operation when lubricant is hot.
- Check lubricant levels when lubricant is cool.
- Clean lubrication fittings before lubricating.
- Intervals shown are normal (8 hour day) usage and conditions. Adjust intervals for abnormal usage and conditions
- Clean filter and air cleaner housing and reusable elements using cleaning solvent or diesel fuel. Dry components thoroughly using a lint free cloth.
- Lubricate points indicated by dotted leaders on both sides of unit.
- Apply a light coating of engine oil to all linkage pivot points.

SYMBOLS

- - - - - = Service Both Sides

Lubricant Symbols

CG - GREASE (extreme pressure)
GO - MULTI-PURPOSE LUBE
HF - HYDRAULIC FLUID
MC - MOLYCOTE (open gear lube)



Service intervals are based on machine usage of 1500 hours annually. Use of your unit may vary significantly and you must adjust service frequency for your usage to obtain maximum service life. Frequency headings in the schedule indicate a calendar limit and an operating hour limit. Always check hourmeter and date at beginning of shift to be certain services are performed at proper interval. Perform service at whichever interval occurs first.

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Recommended Lubricants & Capacities

Application	Symbol	Grade**	Specifications	Capacities*	
				English	Liters
Engine Crankcase	EO (engine oil)	15W-40	MIL-L-2104E	29.6 quarts	28
Engine Cooling System	AF/CC (anti-freeze/water)	50/50 mix	Permanent	9.5 gallons	36
Grease Fittings	CG (extreme pressure lube)	No. 2	-	-	-
Hydraulic System	HF (hydraulic fluid)	***	-	63 gallons	238.5
Upper Cab Heater	HF (hydraulic fluid)	***	-	1.3 gallons	4.9
Steering System	ATF (auto transmission fluid)	DEX III	-	2 gallons	7.6
Swing Brake	HF (hydraulic fluid)	***	-	6.75 ounces	0.2
Swing Bull Gear	CG (extreme pressure lube)	No. 2	-	-	-
Swing Transmission	GO (multi-purpose lube)	EP 90	MIL-L-2105D	5 quarts	4.73
Tilt Bull Gear	GL (open gear lubricant)	-	P/N 8664-1304	-	-
Tilt Transmission	GO (multi-purpose lube)	80W90	P/N 1440-3126	32-34 ounces	0.9-1
Transmission (includes pump PTO)	TF (transmission fluid)	Mobil SHC 50	-	17 quarts	16.1
Tandem Axle (forward)	GO (multi-purpose lube)	EP 90	MIL-L-210513	34 pints	16.1
Tandem Axle (rear)	GO (multi-purpose lube)	EP 90	MIL-L-210513	31 pints	14.7
Transfer Case (6x6)	TF (transmission fluid)	Mobil SHC 50		3 pints	1.4
Front Axle (6x6)	GO (multi-purpose lube)	EP 90	MIL-L-210513	27 pints	12.8

* Capacities are approximate - Check level to be sure

** May vary; check vendor literature in service manual for ambient temperature limits.

*** Hydraulic Fluid Specifications:
Pour Point -46°F., SSU @ 100° F. 275; Flash Point 442°F.
Approved Supplier & Type: Mobil Mobilfluid 424

NOTE: Lubricants described in this table are used in standard machines when they are shipped from Gradall. Alternative lubricants (for varying conditions) are included in your service manual.

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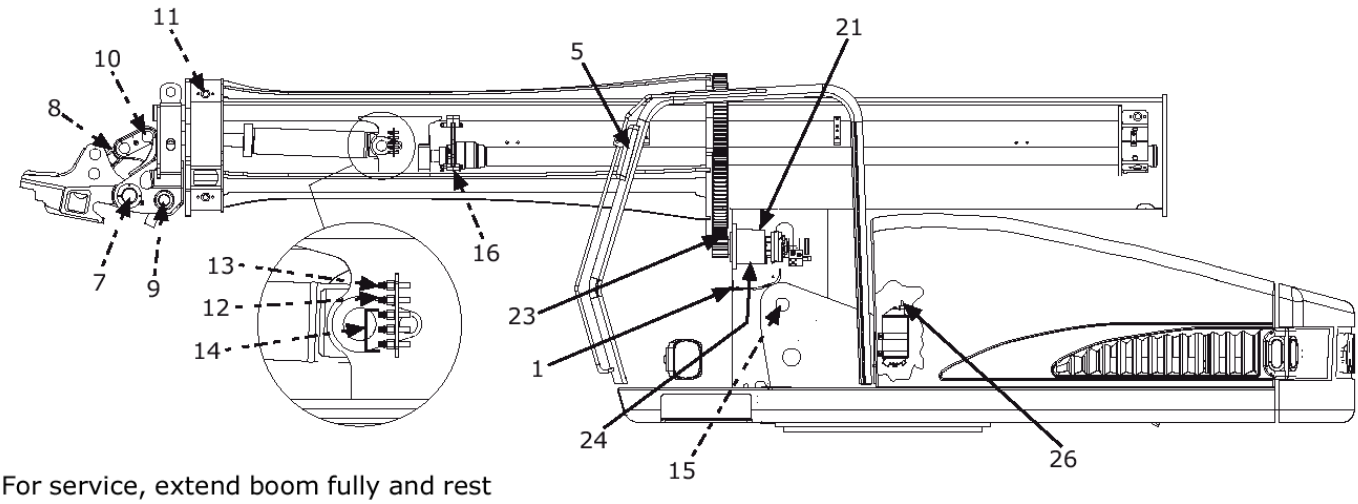
Torque Chart

APPLICATION	QUANTITY	THREAD SIZE (GRADE)	TORQUE (lubricated)			
			POUND / FEET		NEWTON / METERS	
			MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
Extension Boom Roller Eccentric Keepers	6	1/2-13 (8)	100	110	136	150
Boom Cylinder Rod Retainer	6	5/8-11 (8)	200	215	272	292
Main Boom Roller Eccentric Keepers	10	1/2-13 (8)	100	110	136	150
Swing Bearing	72	5/8-11 (8)	200	215	272	292
Swing Motor	4	1/2-13 (5)	68	78	92	105
Swing Transmission	10	3/4-10 (8)	340	365	461	496
Tilt Bearing	63	3/4-10 (8)	340	365	461	496
Tilt Motor	2	1/2-13 (8)	68	78	92	105
Tilt Transmission	8	5/8-11 (8)	200	215	272	292
Wheel Lug Nuts	ALL	M22x1.5 (8)	450	550	610	678

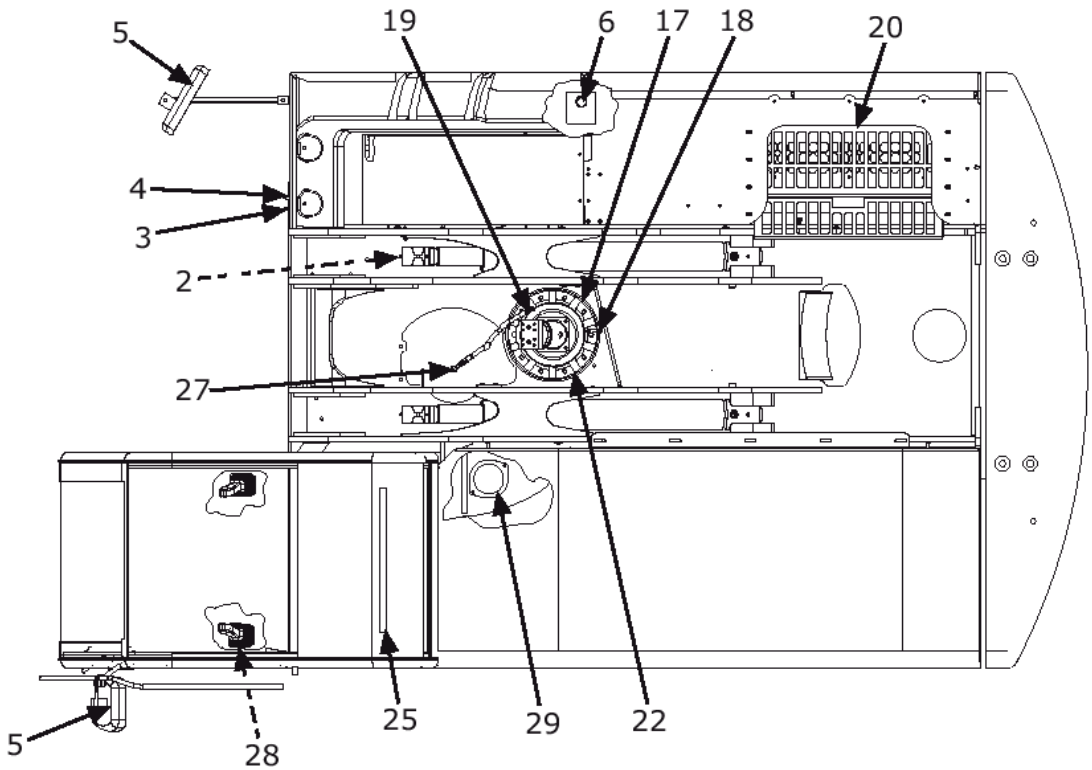
The following bolt torque chart covering English and Metric fasteners are the ones used by Gradall engineering. Gradall ratings are for lubricated fasteners. Do not exceed the allowable rating. An over-torqued bolt in most cases will fail as rapidly as an under-torqued one.

To check GRADALL torque values, set the torque wrench at 95% of rated torque value and check fastener. If the torque wrench releases before the fastener moves, assume fastener torque is correct. When setting GRADALL torque values, use the values given on the following chart. DO NOT EXCEED allowances.

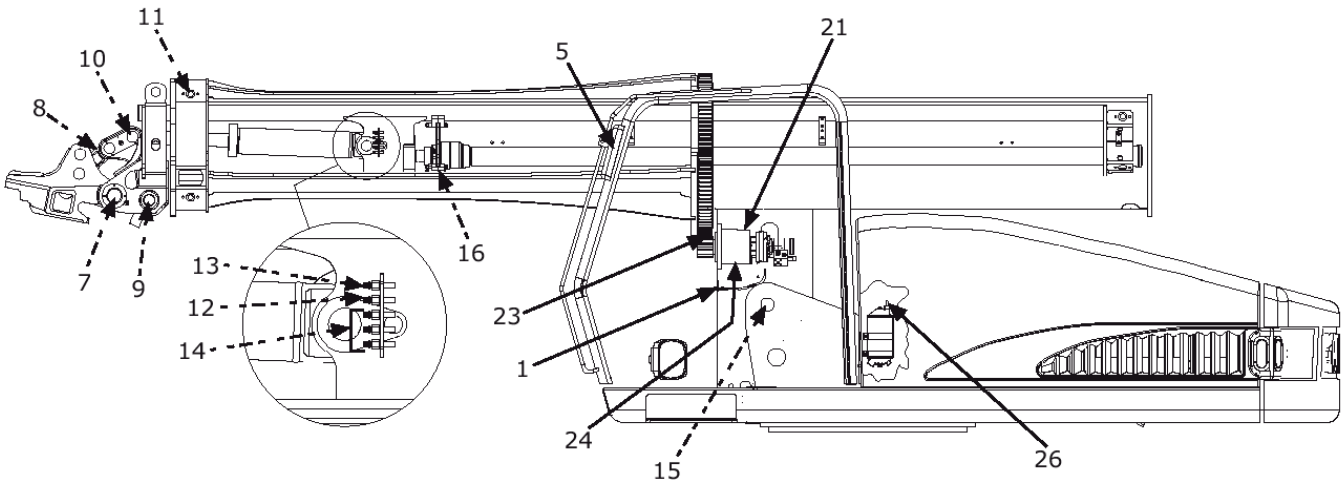
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For service, extend boom fully and rest bottom of bucket flat on ground.
Stop engine and remove key.



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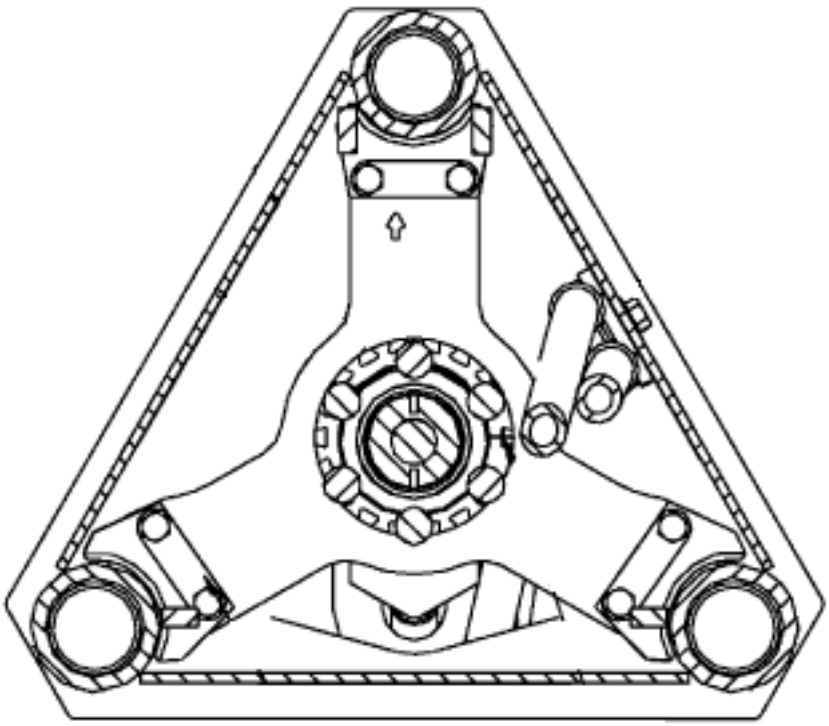


Daily or Shift (10 Hour Maximum) Lubrication & Maintenance

1. Tilt Bearing (Front of Cradle)
2. Hoist Cylinder Rod Pivot (Inside Cradle Legs)
3. Swing Bearing (Internal race and balls)
4. Hoist Cylinder Barrel Pivot (Front of Upper Frame, Valve side)
5. Mirrors (clean and adjust for proper visibility)
6. Windshield/ Washer Fluid Bottle (Clean cab glass)
7. Bucket Adapter Pivot (one fitting each side)
8. Straight Link Pivots (one fitting each end)
9. Bent Link Pivot (two at pivot base sides)
10. Tool Cylinder Rod Pivot
11. Main Boom Rollers
12. Tool Cylinder Barrel Pivot
13. Boom Cylinder Rod Pivot
14. Telescoping Boom Rollers
15. Cradle Pivot
16. Boom Cylinder Spider (as needed in adverse conditions)

Gradall considers the above diagram to be taken care of first thing every shift that the machine is used

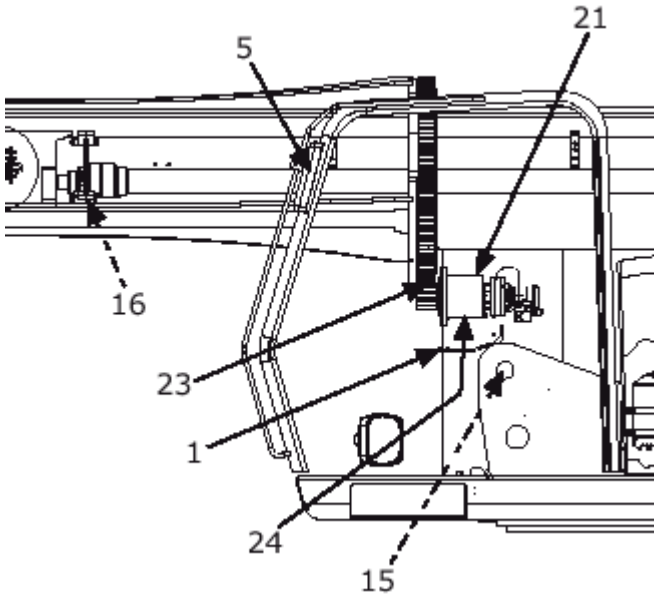
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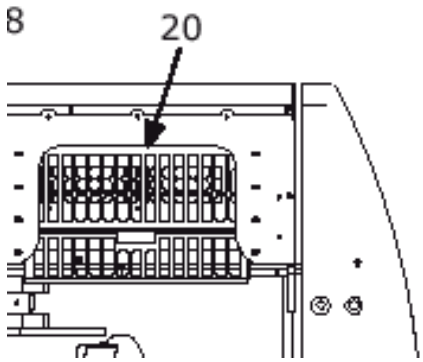


16. Boom Cylinder Spider CG

NOTE: Boom spider pads may require additional grease application to the slide path areas to reduce noise and pad wear in adverse conditions.

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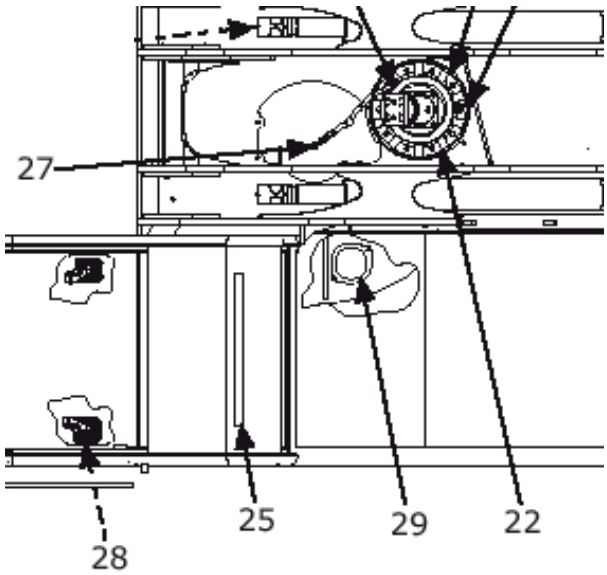
Weekly (50 hour Maximum) include all previous periodic services.

16. Boom Cylinder Spider — CG
    NOTE: Boom spider pads may require additional grease application to the slide path areas to reduce noise and pad wear in adverse conditions.
17. Swing Transmission Level Cap — GO
    (remove fill plug [18] and oil unit it runs from level cap port [19] - reinstall cap and fill plug)
20. Oil Cooler Assembly (Clean fins from inside to outside of machine) — —
21. Tilt Transmission level Plug (check and refill as required) — GO

At end of first 30 days (250 hours Maximum) include all previous periodic services.

22. Swing Transmission (Drain and Refill) — GO
23. Tilt Gear teeth (Apply Open Gear lubricant) — MC

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Every 250 Hours, include all previous periodic services.

25.	Heater Air Filter (Inspect and clean or replace)	—
26.	Hydraulic Cab Heater Oil Reservoir (check level and refill as required)	HF

Semi-Annual (750 hour Maximum) include all previous periodic services.

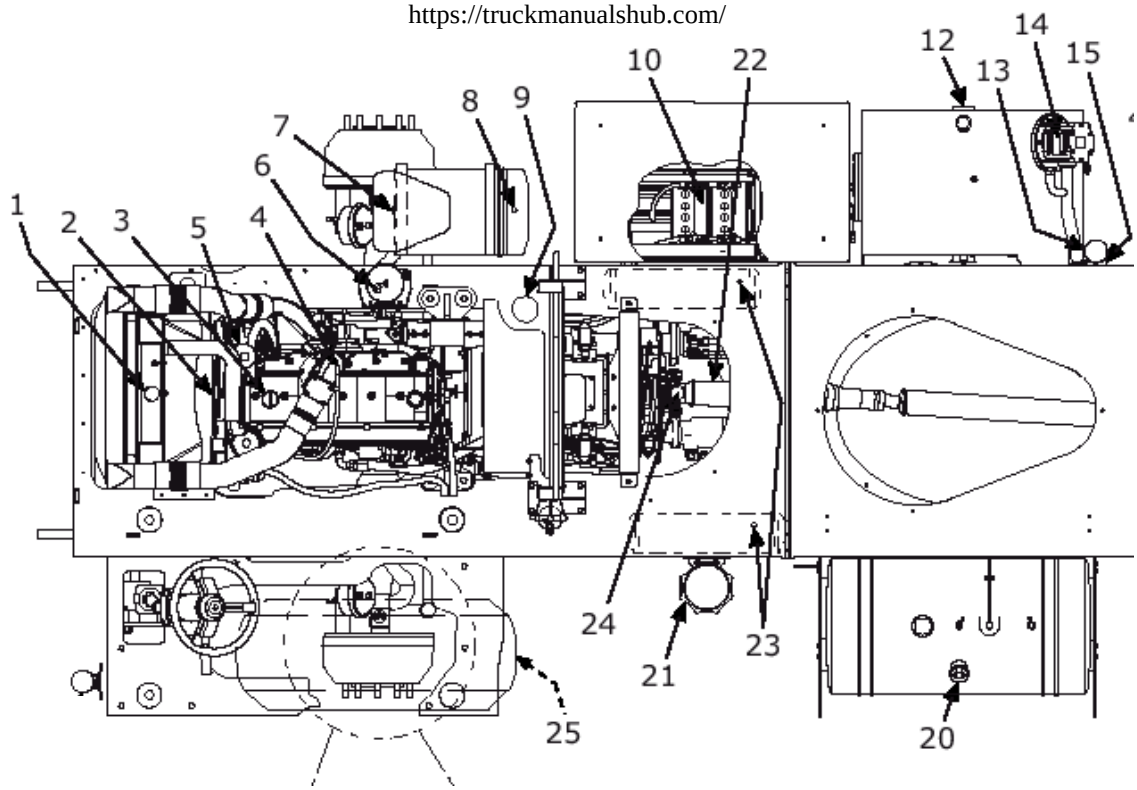
27.	Swing Transmission Breather (Remove, clean and replace)	—

NOTE: Check condition of all hydraulic lines
Check torque of all items listed in torque table

Annual (1,500 Hour Maximum) include all previous periodic services.

22.	Swing Transmission (Drain and Refill)	GO
28.	Joystick Plungers (raise boot, lube rounded top of each plunger)	CG
26.	Hydraulic Cab Heater Oil Reservoir (drain, change filter, and refill)	HF
29.	Swing Bull Gear (internal tooth bearing, check grease add as needed)	CG

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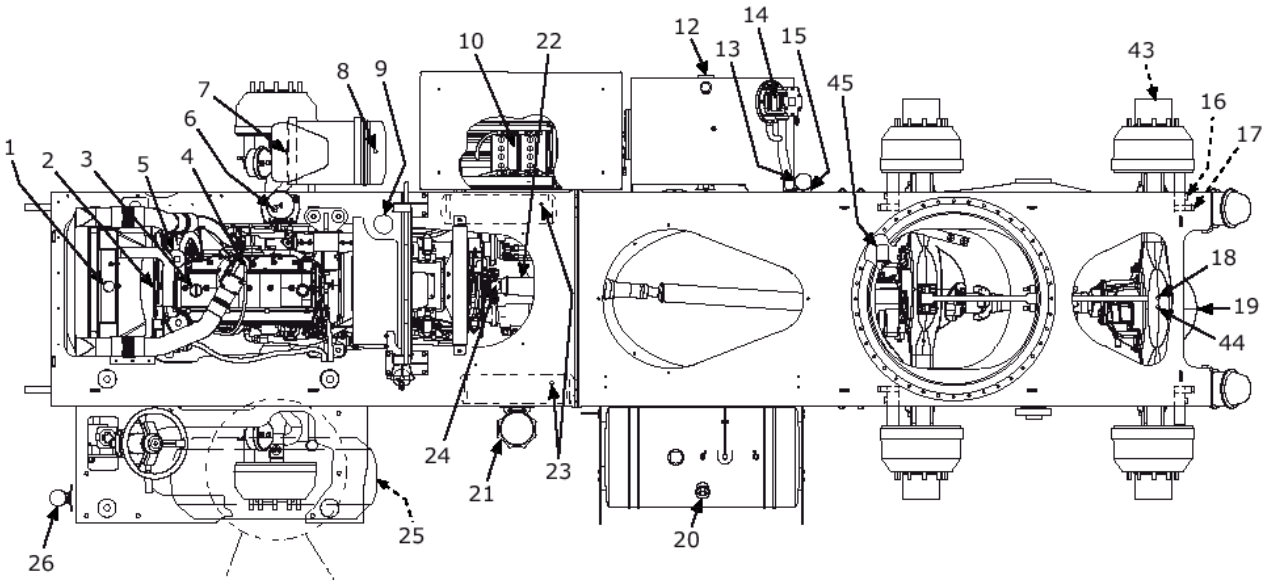
Daily or Shift (10 Hour Maximum) Lubrication & Maintenance

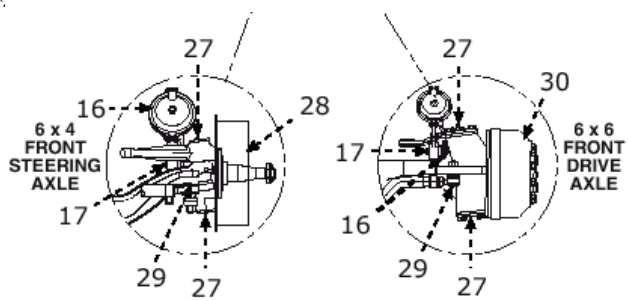
1. Radiator (check coolant level & antifreeze at surge tank - refill as required)
4. Crankcase Dipstick (check level & replenish [3] as req'd)
7. Air Cleaner Condition Indicator (check indicator & clean or replace element as req'd & reset indicator)
12. Hydraulic Reservoir Sight Gage (check level with boom retracted & level & bucket open - replenish as req'd [15] - depress breather plunger [13] to relieve reservoir pressure before removing filter cover)
14. Hydraulic Filter Condition Indicator (check with oil at operating temperature and replace elements as req'd)
20. Fuel Tank (fill tank at end of each shift to minimize condensation)

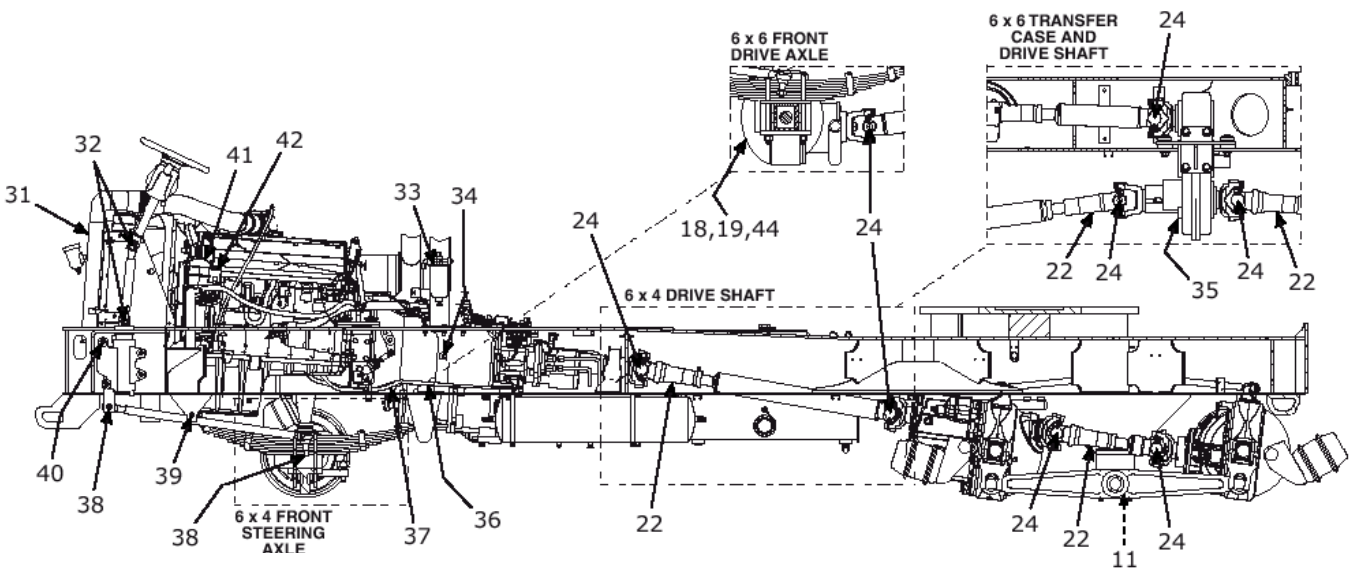
Weekly (50 Hour Maximum) include all previous periodic services

6. Steering System Reservoir (check level & replenish as req'd)
8. Air Cleaner Vacuator (check for damage & obstructions)
21. Brake System Air Drier (check & service per service manual)
23. Air Reservoir Drain Cocks (drain & check for moisture - if significant water is found, check operation of air drier [19])
25. Tires (check condition & pressure)
    front - 15x22.5, 16 ply - 85 psi
    rear - 10 x 20, 14 ply - 90 psi

Gradall considers the above diagram to be taken care of first thing every shift that the machine is used


1
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22
12
13
14
15
45
43
16
17
18
19
44
24
21
23
20
25
26


27
16
28
6 x 4
FRONT
STEERING
AXLE
17
29
27
27
30
6 x 6
FRONT
DRIVE
AXLE
17
16
29
27


6 x 6 FRONT
DRIVE AXLE
6 x 6 TRANSFER
CASE AND
DRIVE SHAFT
24
32
41
42
31
33
34
24
18,19,44
24
22
24
35
24
22
6 x 4 DRIVE SHAFT
40
38
39
38
6 x 4 FRONT
STEERING
AXLE
37
36
22
24
22
24
11

Monthly (125 Hour Maximum) Lubrication & Maintenance (include all previous periodic services)

2. Engine Drive Belt (check condition & tension - replace as req'd)
10. Battery (check condition and connections)
11. Walking Beam Pivots
13. Hydraulic Reservoir Breather (remove, clean & replace)
17. Slack Adjusters
19. Differential Level Plug (check level & replenish as req'd)
22. Drive Shaft Splines
24. Universal Joints
26. Clutch Reservoir (check level & replenish as req'd) (located under cab front cover)
27. King Pin Pivots
29. Tie Rod Pivots
30. Front Wheel Ends (6x6)
31. Cooler Cores (inspect & clean as req'd)
32. Steering Column Universal Joints
34. Transmission (check level & refill as req'd)
35. Transfer Case (6x6) (check level & refill as req'd)
37. Clutch Release Bearing
38. Draglink
39. Spring Hanger Pins

- Check torque of all items listed in torque table (page 18.0)

Periodic (600 Hours) Lubrication & Maintenance (include all previous periodic services)

3. Engine Oil (drain & refill to level - 600 hours)
5. Engine Oil Filter (replace element at every oil change - 600 hours)

Semi-Annual (750 Hours Maximum) Lubrication & Maintenance (include all previous periodic services)

14. Hydraulic System (have hydraulic fluid analyzed to determine condition - use test port mini-check in pump line to obtain sample) (drain, flush and replenish system if req'd)
16. Brake Camshafts (lube sparingly)
17. Slack Adjusters (check for proper function - refer to page 19.0)
18. Differential Breather (remove, clean & replace)
19. Differential (drain & refill to level)
28. Front Wheel Bearings (6x4) (remove, clean, pack & install)
33. Fuel/Water Separator (replace element)
40. Steering Gear Dirt Seal (purge old grease slowly using manual grease gun)
41. Fuel Filter (replace element - 1200 hours)
42. Fuel Strainer (check and clean every filter change)

Annual (1500 Hour Maximum) Lubrication & Maintenance (include all previous periodic services)

1. Engine Cooling System (drain & refill system based on period suggested by manufacturer)
6. Steering System Reservoir (drain and refill)
14. Hydraulic system (unless hydraulic fluid is analyzed semi-annually to determine level of contamination, system must be drained, flushed & replenished on annual basis)
21. Air Drier (replace cartridge)
34. Transmission (drain, replace filter [9], refill)
35. Transfer Case (6x6) (drain & refill)
36. Pump PTO Coupling (drain & refill)
43. Wheel Ends (fill to level with level plug at 3 or 9o'clock position
44. Differential Drain Plug (drain & refill)
45. Differential Filter (replace element)

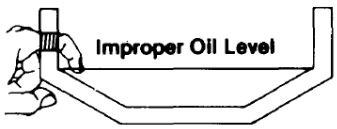
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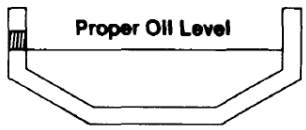
EATON | Fuller®

Heavy Duty Transmissions

Service Manual TRSM-0430 December 1993

8608L Series
11/14608LL Series
11/12/13/14609 Series
11/14/15613 Series
11/14813 Series





Proper Oil Level

Make sure oil is level with filler opening. Because you can reach oil with your finger does not mean oil is at proper level. **One inch of oil level is about one gallon of oil.**

Recommended Lubricants

Type	Grade (SAE)	Fahrenheit (Celsius) Ambient Temperature
Eaton® Roadranger® CD50 Transmission Fluid	**50**	**All**
Heavy Duty Engine 011 MIL-L-2104B, C or D or API-SF or API-CD (Prewous API designations acceptable)	50 40 30	Above 10"E(-12"C.) Above 10"F.(-12"C,) Below 1O"F,(-12"C,)
Mineral Gear Oil with rust and oxidation inhibitor API-GL-1	90 80W	Above 1O"F,(-12"C.) Below IO"F.(-12°C,)

HIGHWAY USE

First 3,000 to 5,000 miles (4827 to 8045 Km)	Factory fill initial drain.
Every 10,000 miles (16090 Km)	Inspect lubricant level. Check for leaks.
Every 50,000 miles (80450 Km)	Change transmission lubricant.

OFF-HIGHWAY USE

First 30 hours	Change transmission lubricant on new units.
Every 40 hours	Inspect lubricant level. Check for leaks,
Every 500 hours	Change transmission lubricant where severe dirt conditions exist.
Every 1,000 hours	Change transmission lubricant (Normal of highway use),

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MERITOR.

Lubrication

Front Driving Axle Oil Change Intervals and Specifications*

Operation	On-Highway	Off-Highway
Initial Oil Change	3,000 miles (4800 km)	3,000 miles (4800 km)
Check Oil Level	3,000 miles (4800 km) or 200 operating hours (whichever comes first)	3,000 miles (4800 km)
Petroleum Oil Change	30,000 miles (48 000 km) or 2,000 operating hours (whichever comes first)	30,000 miles (48 000 km) or 2,000 operating hours (whichever comes first)
Synthetic Oil Change	—	—

Oil Change Intervals and Specifications for All Rear Drive Axles①

Vocation or Vehicle Operation	Linehaul Motorhome Intercity Coach	City Delivery School Bus Fire Truck	Construction Transit Bus Refuse Yard Tractor Logging Heavy Haul Mining Oil Field Rescue
Initial Oil Change	No longer required as of January 1, 1993		
Check Oil Level	Every 25,000 miles (40 000 km), or the fleet maintenance interval (whichever comes first)	Every 10,000 miles (16 000 km), once a month, or the fleet maintenance interval (whichever comes first)	Every 5,000 miles (8000 km), once a month, or the fleet maintenance interval (whichever comes first) ②
Petroleum Based Oil Change on Axle with or without Pump and Filter System	Every 100,000 miles (160 000 km) or annually, whichever comes first	Every 50,000 miles (80 000 km) or annually, whichever comes first	Every 25,000 miles (40 000 km) or annually, whichever comes first
Synthetic Oil Change on Axle without Pump and Filter System ③	Every 250,000 miles (400 000 km) or annually, whichever comes first	Every 100,000 miles (160 000 km) or annually, whichever comes first	Every 50,000 miles (80 000 km) or annually, whichever comes first
Synthetic Oil Change on Axle with Pump and Filter System ③	Every 500,000 miles (800 000 km)	Every 250,000 miles (400 000 km)	Every 100,000 miles (160 000 km)
Filter Change on Axle with Pump and Filter System	Every 100,000 miles (160 000 km)	Every 100,000 miles (160 000 km)	Every 100,000 miles (160 000 km)

① If a No-Spin differential is installed, change the oil (petroleum or synthetic) at minimum interval or 40,000 miles (64 000 km) or a maximum interval or 50,000 miles (80 000 km).

② For continuous heavy-duty operation, check the oil level every 1,000 miles (1600 km). Add the correct type and amount of oil as required.

③ This interval applies to approved semi-synthetic and fully synthetic oils only. F

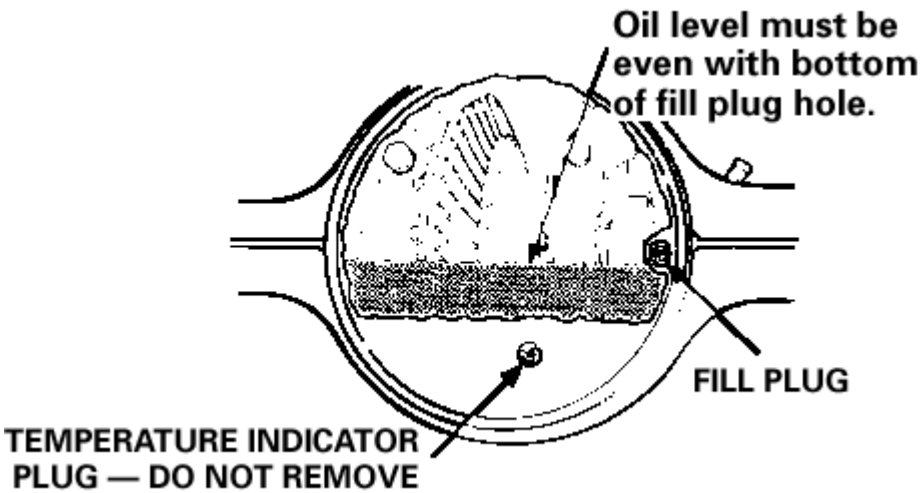
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Check and Adjust the Oil

WARNING

Check the oil level when the axle is at room temperature. When hot, the oil temperature may be 190°F (88°C) or more and can cause burns. Also, a correct level is not obtained when the axle is warm or hot. Serious personal injury and damage to components can result.

1. Park the vehicle on a level surface. The axle must be cold or near room temperature.
2. Clean the area around the fill plug. Remove the fill plug from the differential carrier or the axle-housing bowl (depending on the axle). Do not remove the temperature indicator plug.
3. Check the oil level. The level must be even with the bottom of the fill plug hole.
4. Install the fill plug. Tighten the plug to 35-50 lb-ft (48-67 N•m). (T)



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Transfer Case Oil Change Intervals

Operation	On-Highway	Off-Highway
Check Oil Level	2,000 miles (3200 km)	40 operating hours
Initial Oil Change	2,500 miles (4000 km)	40-100 operating hours
Scheduled Oil Change	12,000-25,000 miles (19 000-40 000 km)	200-300 operating hours

Transfer Case Oil Specifications①④⑤

Oil Description	Meritor Specification	A.P.I. Specification	Military Specification	SAE Grade	Outside Temperature
Petroleum GL-1 Oil with Rust and Oxidation Inhibitor ②	—	A.P.I. GL-1	—	90W 80W	Above 10°F (–12°C) Above –15°F (–26°C)
Heavy Duty Engine Oil ②		A.P.I.-CD, CE, SF or SG ⑥		50W 40W 30W	Above 10°F (–12°C) Above 10°F (–12°C) Above –12°F (–26°C)
Full Synthetic Oil ③	O81	—	—	50W	Above –40°F (–40°C)
A.P.I. GL-5 (Axle Lube) ①	DO NOT USE IN TRANSFER CASES				

① Do Not use multi-viscosity (I.E. 80/90W) GL-5 Gear Oil (axle lube).

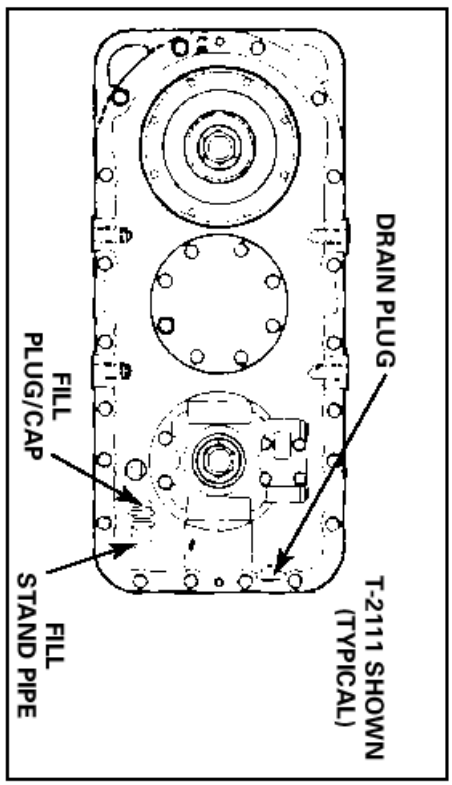
② 90W GL-1 or 50W motor oil is same viscosity and commonly used above 10°F (–12°C).

③ Meritor approved full synthetic oil for manual ZF Meritor transmissions is also approved for Meritor transfer cases. Use synthetic oil only if the transfer case was initially filled with synthetic oil.

④ Do not mix or switch oil types. Use the same oil that initially filled the transfer case.

⑤ Do not use multi-viscosity oils.

⑥ Current designations are acceptable.



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Bendix® AD-9™ Air Dryer

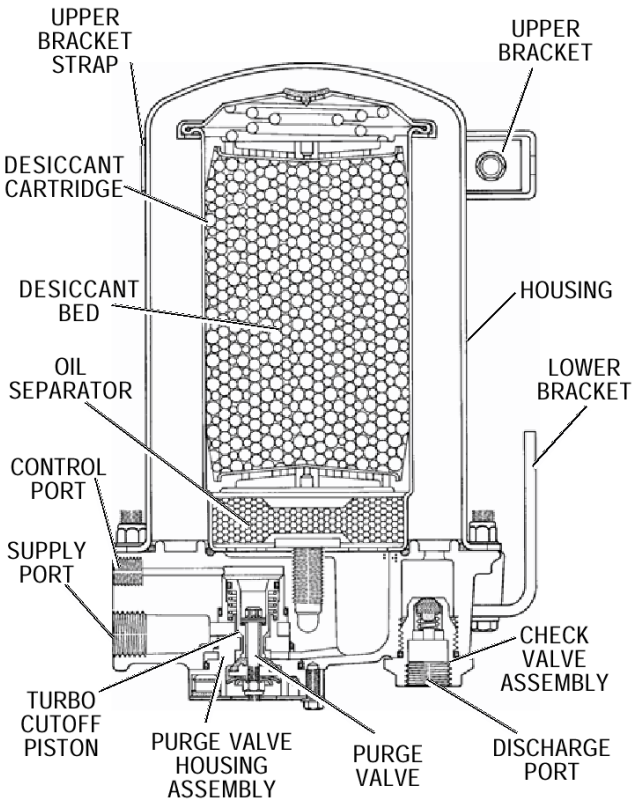
Every 10,800 hours; 300,000 miles or 36 months:

1. Rebuild the air dryer including the desiccant cartridge.

Note: The desiccant change interval may vary from vehicle to vehicle. Although typical desiccant cartridge life is three years, many will perform adequately for a longer period of time. In order to take maximum advantage of desiccant life and assure that replacement occurs only when necessary, it is important that *Operation & Leakage Tests* be performed.

WARNING!

This air dryer is intended to remove moisture and other contaminants normally found in the air brake system. Do not inject alcohol, anti-freeze, or other de-icing substances into or upstream of the air dryer. Alcohol is removed by the dryer, but reduces the effectiveness of the device to dry air. Use of other substances can damage the air dryer and may void the warranty.

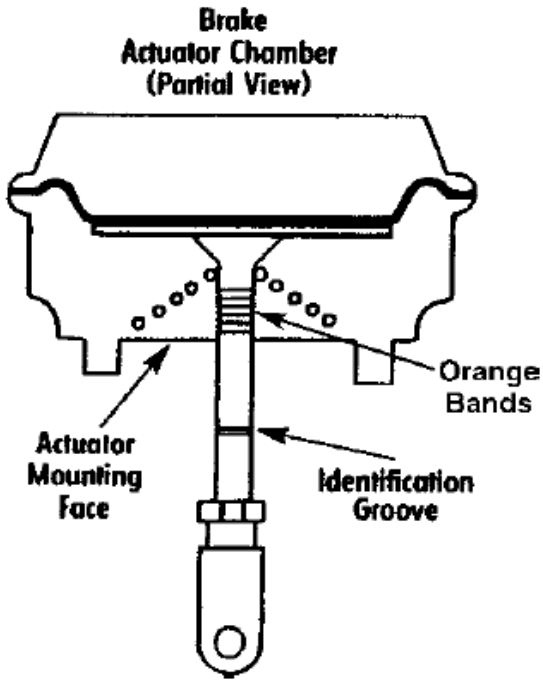


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CHECKING AUTOMATIC SLACK ADJUSTERS

Brake actuator chambers on your unit provide visual indication that automatic slack adjusters are or are not, working properly. These indications must be observed with brake system fully charged (125 psi) and digging brake applied.

Brake actuator chamber push rods have a series of orange bands which will appear at mounting face of actuator (not bracket) if automatic adjustment fails to occur at proper time. These push rods also have a groove machined in push rod (near clevis) to provide identification **(see figure 19-1).**



1. Position unit in a safe, level area.
2. With brake system fully charged (125 psi). Apply digging brake and stop engine.
3. Install wheel chocks as additional caution to prevent carrier movement.
4. Inspect actuator push rods to determine position with digging brake applied. If one or more orange bands are visible at mounting face of any actuator, immediately notify your supervisor and/or maintenance personnel for inspection and/or repair.
5. In event of slack adjuster replacement, installation of new brake shoes or drum turning, refer to your service manual for instructions to install/adjust automatic slack adjusters.

Eaton® Spicer® Adjustment Procedures

https://truckmanuals.net/

Before adjusting anything, review the conditions required for proper clutch action.
A pull-type clutch permits use of a simple clutch brake when used with a non-synchronized transmission. The brake "squeeze" should begin about 1 Inch from the floor board or the end of pedal stroke.
Any clutch will slip and burn up if there is no free pedal.
To release properly, the clutch release bearing must move about 1/2 inch. This occurs between the end of free pedal travel and the brake actuation point.

IMPORTANT

FOR SPECIFIC APPLICATIONS, REFER TO VEHICLE MANUFACTURER'S MANUAL FOR CORRECT ADJUSTMENT

UNDERSTANDING SPICER CLUTCH ADJUSTMENT

To assure optimum performance of Spicer Clutches:

a. 1/2" to 9/16" release travel is required

b. 1/8" free travel (clearance between release bearing and release yoke)

TERMINOLOGY:

1. RELEASE TRAVEL: 1/2" to 9/16"

Proper release travel assures that the release bearing is capable of moving 1/2" minimum, allowing the driven disc(s) to spin freely, avoiding clutch drag.

2. CLUTCH FREE TRAVEL: 1/8"

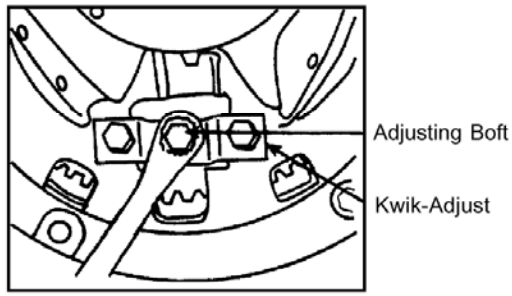
Free travel is the clearance between the release yoke and clutch release bearing wear pads. This dimension regulates how much free pedal is obtained in the cab. Adjust prior to loss of free travel.

3. INTERNAL CLUTCH ADJUSTMENT. (NORMAL SERVICE ADJUSTMENTS). Wear is compensated by internal adjustment in the clutch through rotation of the adjusting ring. This adjustment moves the release bearing toward the transmission and re-establishes the 1/2" release travel and 1/8" free travel.

STEP 1

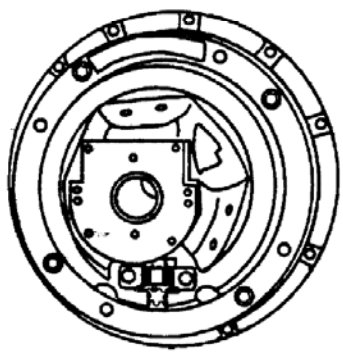
NOTE: Internal adjustments are performed with pedal down (clutch released).

Manual Adjust:
Kwik-Adjust



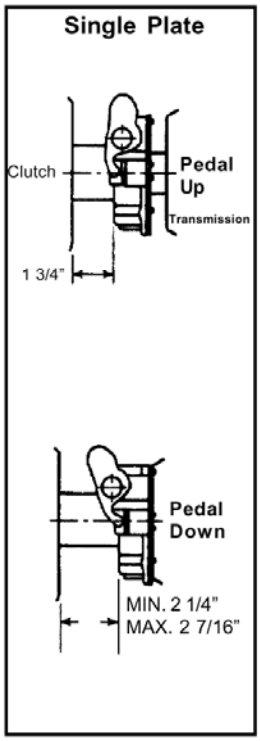
Depress Adjusting Bolt & Rotate
NOTE: OPEN-END WRENCHS ARE NOT RECOMMENDED.

Kwik-Adjust will re-angage at 1/3 of a turn.

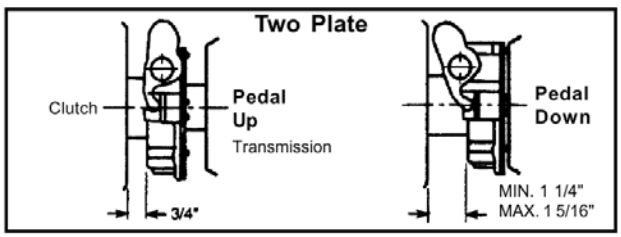


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STEP 2
Set Bearing Position
A. CLUTCH ADJUSTMENT WITHOUT CLUTCH BRAKE FOR SYNCHRONIZED TRANSMISSION ONLY



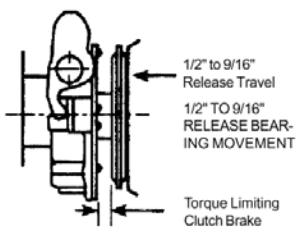
To set 1 3/4" dimension for single plate, or set 3/4" dimension for two plate: With pedal down, turn adjusting ring to obtain approximately 1 3/4" for single plate or 3/4" for two plate with pedal up as shown in both illustrations. Turning the adjusting ring clockwise moves the release bearing toward the transmission. Turning the adjusting ring counterclockwise moves the release bearing toward the engine.
Check Release Travel dimensions with Release Yoke rotated toward Release Bearing, eliminating excess play in system. Having set this, depress pedal down fully releasing clutch and check release travel to settings shown:



NOTE: It may be necessary to reduce the 3/4" or 1 3/4" settings to be able to achieve 1/ 2" - 9/16" travel on some models of transmissions.

B. FOR MANUAL CLUTCHES WITH CLUTCH BRAKE

Measure clearance between release bearing housing and clutch brake. See Figure 1.
It clearance is less than 1/2" or greater than 9/16", adjust clutch as outlined in following steps:



1. PUSH PEDAL DOWN.
2. ADJUST THE CLUTCH INTERNALLY TO GET 1/2' TO 9/16" CLEARANCE WHEN PEDAL IS UP. THIS IS DONE BY DEPRESSING AND TURNING THE KWIK-ADJUST.

1. If clearance between release bearing housing and clutch brake is less than 1/2", rotate the adjusting ring counterclockwise which moves the release bearing toward the engine.
2. If clearance between the release bearing housing and clutch brake is greater than 9/16", rotate the adjusting ring clockwise which moves the release bearing toward the transmission.

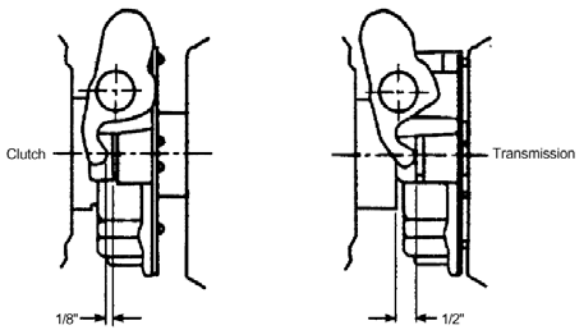
STEP 3
SET YOKE TO BEARING CLEARANCE
To set 1/8" dimension:

Adjust external linkage by shortening or lengthening to obtain 1/8" between the release yoke fingers and the wear pads on the release bearing housing. To eliminate potential housing movement check the 1/8" dimension on both sides of housing simultaneously. This 1/8" will provide approximately 1" to 3" of free travel at the pedal. Be sure to tighten all locknuts

Full pedal stroke in the cab must move the release bearing a minimum of 1/2"
If 1/2"-9/16" release travel is not obtained refer to O.E. service manuals for pedal height and linkage settings.

NOTE: Hydraulic linkage—Refer to manufacturer's specifications for proper adjustment of system and free pedal settings.

(FIG.4)



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Vehicles with nonsynchronized transmissions. Verify clutch brake setting.

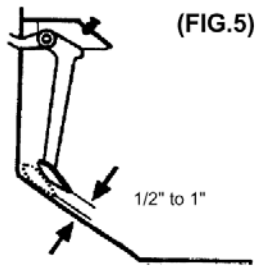
1. Depress clutch pedal. With correct release travel and free travel settings, clutch brake “squeeze” should occur approximately 1" from the end of pedal stroke. Depress the clutch pedal. The pedal should be 1/2" to 1" from the end of stroke at the beginning of the clutch brake squeeze. See Fig. 5.

A. To check this, insert a .010" feeler gauge or business card between the release bearing and clutch brake (refer to Fig. 3). Depress the clutch pedal and squeeze the card. Let the pedal up slowly. Stop when the card can be pulled out. The pedal should be 1/2" to 1" from the end of stroke.

-If more than 1", increase 1/8" setting from Step 3

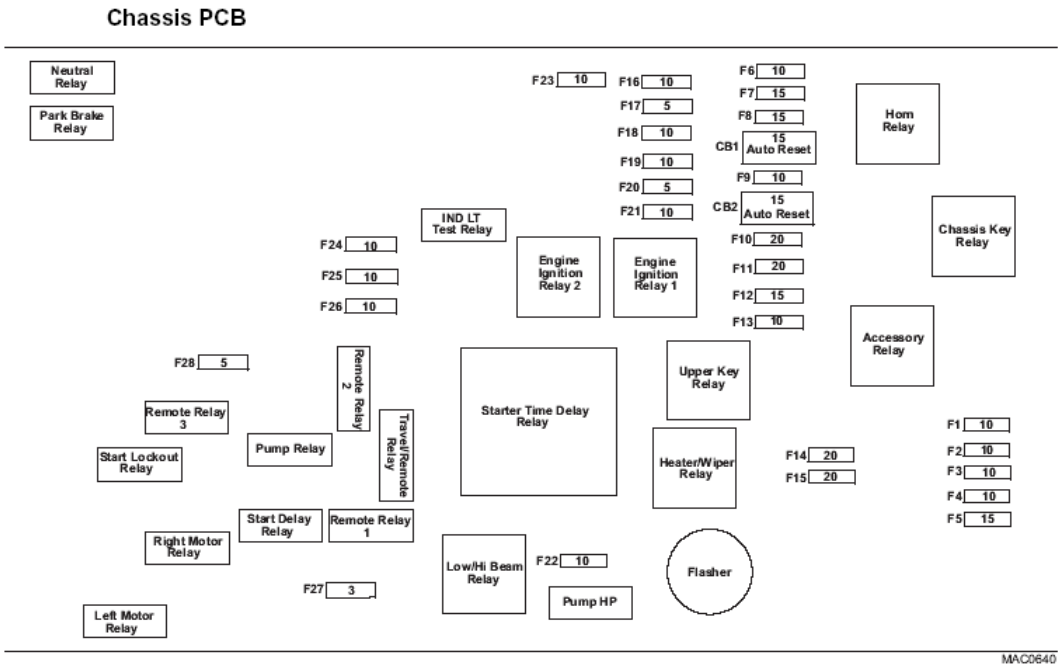
-If less than 1/2", gain additional pedal stroke by raising upper pedal stop and resetting the 1/8" dimension in Step 3.

(FIG.5)



Circuit Board & Fuse location for Chassis PCB

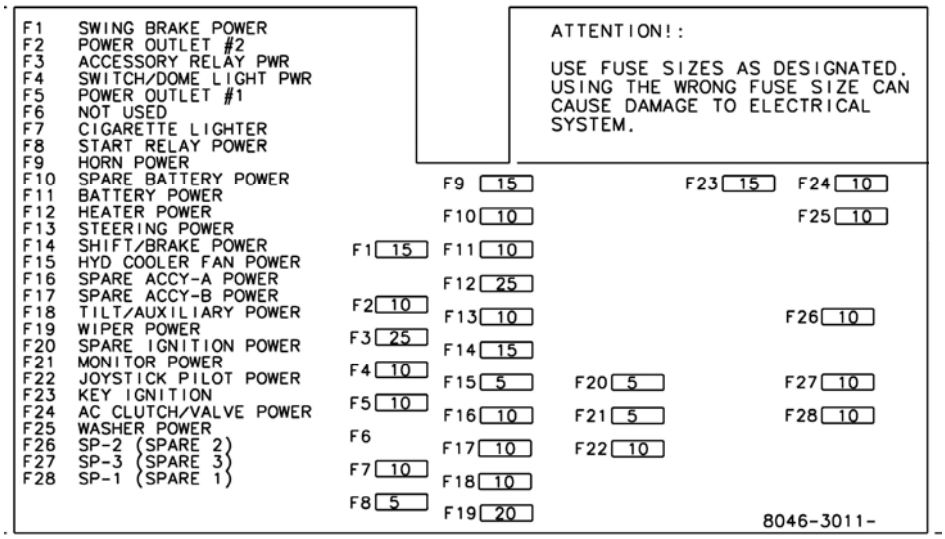
F1	SPARE ACCY 1
F2	SPARE ACCY 2
F3	BEACON
F4	RADIO ACCESSORY
F5	FLASHER/STOP LTS
F6	ADM BATTERY
F7	HORNS
F8	CHASSIS KEY BAT
CB1	MARKER LIGHTS
F9	DOME LT/RADIO BAT
CB2	HEADLIGHTS
F10	SPARE BAT 2
F11	SPARE BAT 1
F12	UPPER KEY BAT
F13	DIAGNOSTIC BATTERY
F14	WIPER
F15	HEATER/BLOWER
F16	AC CLUTCH
F17	ENGINE LTS
F18	SPARE ENGINE IGN
F19	DRYER/GRID HTR RLY
F20	GAGE POWER
F21	TRV ALARM/BACKUP LTS
F22	REMOTE POWER
F23	WIPER WASHER
F24	ADM IGNITION
F25	DIAGNOSTIC IGNITION
F26	MR IGNITION
F27	STARTER RELAY
F28	SPARE TRAVEL IGN



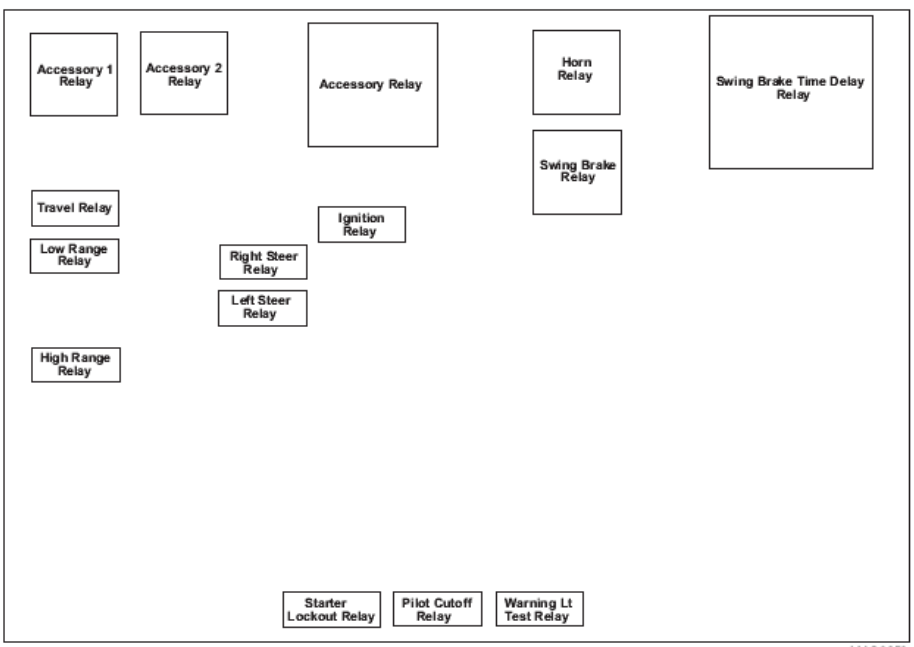
ATTENTION! :

USE FUSE SIZES AS DESIGNATED. USING THE WRONG FUSE SIZE CAN CAUSE DAMAGE TO ELECTRICAL SYSTEM.

Circuit Board & Fuse location for Upper PCB



Upper PCB (back side)

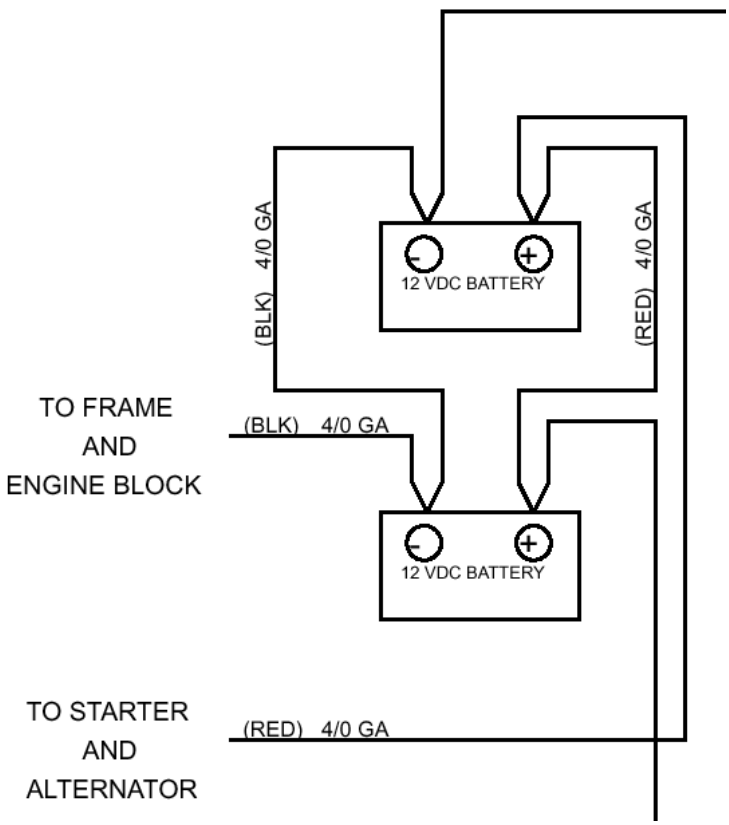


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⚠ WARNING

WELDING MAY DAMAGE ELECTRICAL WIRES,ENGINE ELECTRONICS AND NYLON AIR BRAKE HOSES. TURN OFF IGNITION. DISCONNECT BOTH THE POSITIVE (+) AND THE NEGATIVE (-) BATTERY CABLES FROM BATTERY POSTS ONLY. DO NOT DISCONNECT CABLE LEADS FROM STUDS ON BATTERY BOX PANEL. CONNECT POSITIVE (+) AND NEGATIVE (-) CABLES TOGETHER USING THE NEGATIVE (-) CABLE BRASS JUMP START BUSHING AND STUD BEFORE WELDING TO PREVENT DAMAGE TO ELECTRONIC COMPONENTS. REMOVE AND/OR SHIELD THE NYLON AIR BRAKE HOSE ADEQUATELY IN THE IMMEDIATE AREA PRIOR TO WELDING. DAMAGED ELECTRONIC COMPONENTS OR AIR HOSES COULD LEAD TO AN ACCIDENT DUE TO LOSS OF VEHICLE CONTROL RESULTING IN SEVERE INJURY

8038-3389

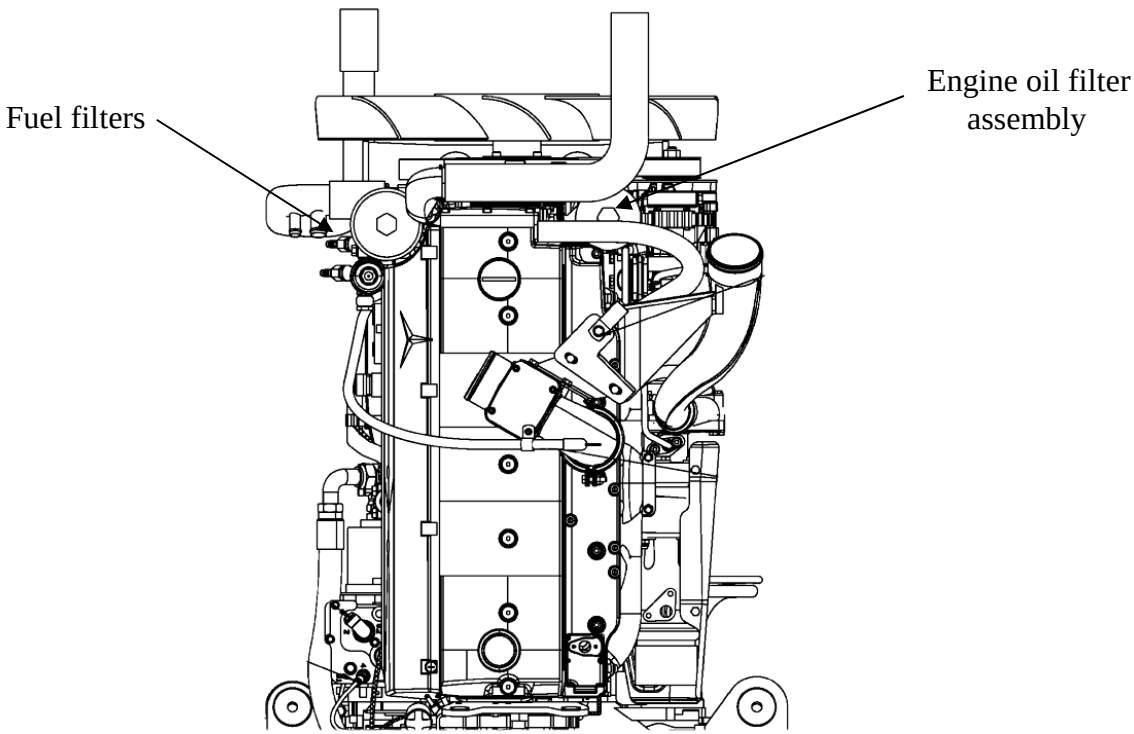


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Detroit Diesel recommends that the engine oil and filter be serviced after every 600 hours of service. This is the requirements that Gradall follows. If you have a different guideline to follow this will be ok as long as it does not exceed the above stated recommendations.

When servicing the engine oil and filter Gradall recommends that you remove the plug from the engine oil can first. Then remove the oil filter cartridge cover and remove the cartridge from housing. Once it has been removed the trapped dirty oil will drain to the oil pan.

It is recommended to change the fuel filters when engine oil is changed. The smaller filter is to removed and washed and dried reinstalled the second filter is to be replaced. There is a fuel filter assembly located on the boom rest behind the lower operators remove old filter before installing new filter cartilage fill with clean fuel.



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GRADALL®

Hydraulic Equipment

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FAX: (330) 339-8468
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GRADALL Product Support Information

GRADALL Industries Inc.
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Service Dept. Fax: 330-339-8468

Release Date: September 15, 2006
Number: EXC2006-7

Service Information

To: All ***GRADALL*** Excavator Distributor Service Managers

Affected Model: ***GRADALL*** Models XL3100 & XL4100-II Hydraulic Excavators

Subject: Clutch adjustment procedure

This procedure is for the above stated models equipped with a hydraulically actuated "pull-type" clutch. The Service Manual supplied with each of these models contains "Installation and Adjustment Procedures" for the clutch which details the internal adjustments of the clutch; but, refers the technician to the ***GRADALL*** Service Manual for Hydraulic Actuation. The purpose of this service information is to provide the ***GRADALL*** adjustment procedure for the hydraulic clutch.

Affected Units: All ***GRADALL*** model XL3100 & XL4100-II hydraulic excavators

Corrective Action: To maximize service life from the clutch, correct adjustment is necessary. The clutch is an operator-controlled friction device that can be subjected to abuse which may shorten its life substantially. Incorrect adjustment will also shorten the service life. During machine use some situations may force the clutch to be used in a manner which will create the need for adjustment(s) earlier than expected. The hydraulic actuation eliminates linkage adjustments; but the clutch still requires mechanical adjustment(s). Therefore, check the adjustment at least every 200 hours **OR** anytime the operator reports a problem such as clutch slippage or difficult gear shifting.

The following instructions and pictures provide the ***GRADALL*** adjustment procedures and are to be used in conjunction with internal clutch adjustment procedures provided in the service manual.

Picture 1) shows the clutch master cylinder which is located under the cab front cover. Note that the outlet hose is toward the center of the machine and the "bleed-hole" is pointing up. Correct fluid for the clutch master cylinder reservoir is ATF. **Note** - early machines were not equipped with bleeders. If you need to install a bleeder, it is necessary to rotate the cylinder and move the hose to allow bleeding. If needed, add the bleed screw part number (8033-3190) and the elbow adapter part number (8033-3192).

Picture 2) shows the clutch pedal and its push rod. The correct adjustment is 9/16" to 11/16" outside-edge to outside-edge of the nuts on the push rod. Adjust as necessary.

Picture 3) shows the slave-cylinder and square-headed adjusting screw. Clutch pedal must be in the **UP** position while checking adjustments in this step! Remove the clutch access cover plate on the bottom of the transmission bell housing. Check position of clutch release fingers in relation to the throw out bearing. When properly adjusted, the fingers should have .015" - .020" clearance to the bearing. If adjustment is

needed, adjust the square head screw until the correct gap exists between the bearing and fingers. Tighten lock nut after adjustment. This step will take the “play” out of the linkage and assures the bearing is not preloaded.

Picture 4) With the clutch access cover still removed from previous step, check the throw-out bearing to clutch-brake spacing. The specification for this clearance is ½” with the clutch pedal **UP**. If this is not correct proceed to next step.

Picture 5) shows the “Kwik-Adjust” bolt on the pressure plate used to set throw out bearing to clutch brake clearance. This adjustment is made with the clutch pedal **DEPRESSED.** To adjust, depress the bolt and turn it about 1/3 turn - a gentle “click” occurs-which adjusts the clutch internally. Turn the Kwik-Adjust bolt counterclockwise to increase the gap, clockwise to decrease the gap.

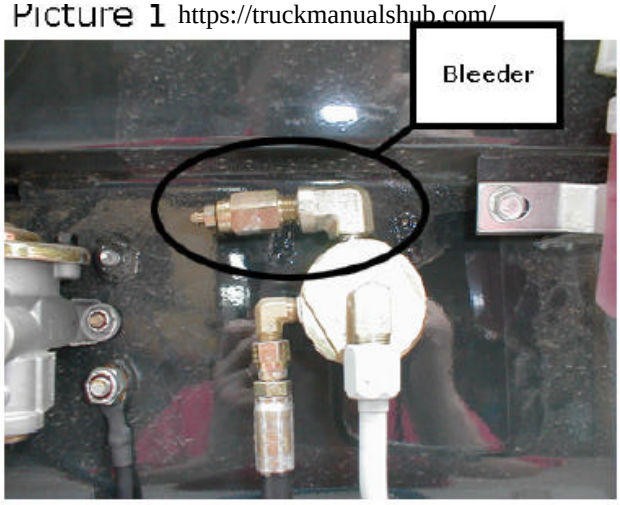
Finally, operate the clutch a several times to verify the adjustment(s) are correct. Replace any access covers that were removed to make adjustments.

Recommended Action: Provide this information to your service technicians and customer service personnel. This service information has been provided for information only. No warranty repairs are authorized or expected to be done as a result of this bulletin.

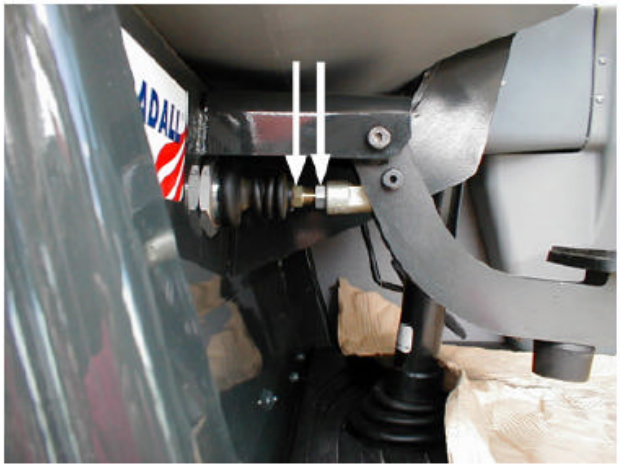
Contacts: Should you have any questions or require further assistance concerning this bulletin, please contact your ***GRADALL*** Excavator Regional Service Manager or the ***GRADALL*** Excavator Service Department at 1-800-445-4752.

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Picture 1

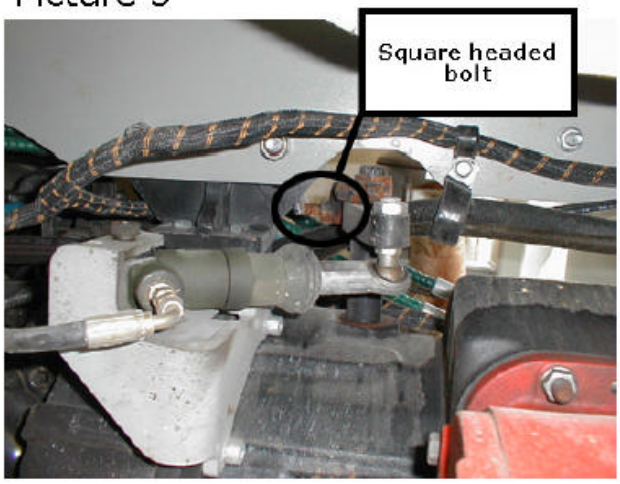


Picture 2

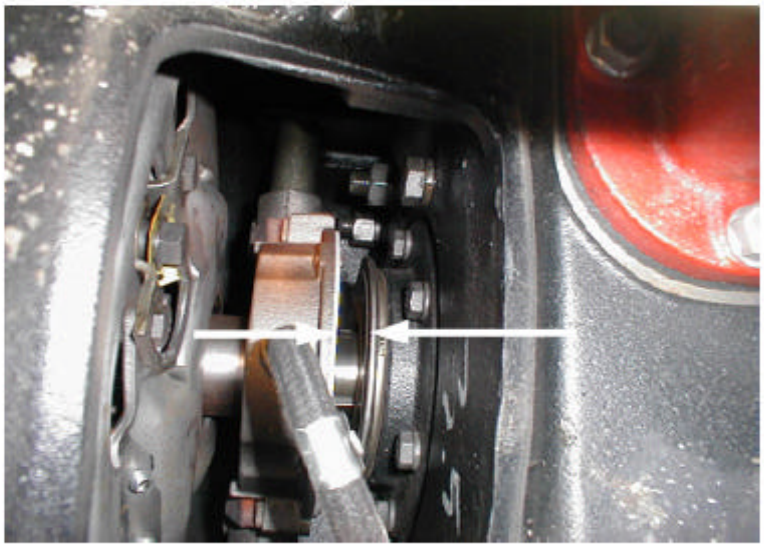


9/16” to 11/16” outside edge to outside edge of nuts

Picture 3

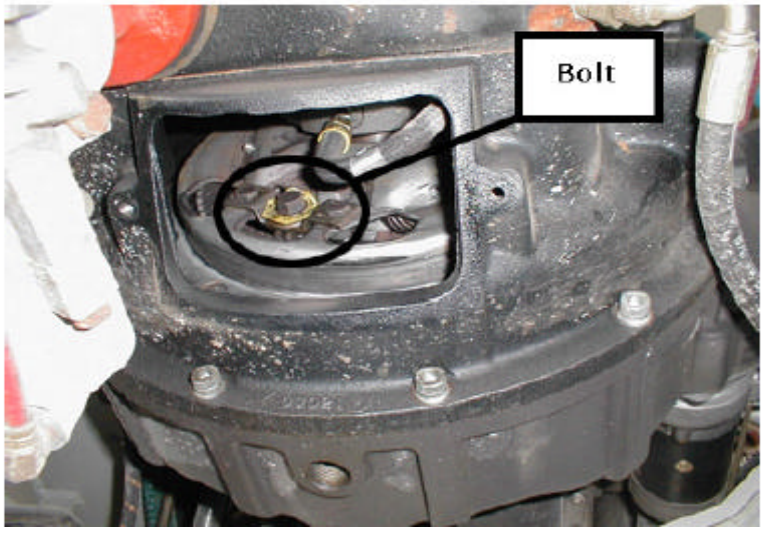


Picture 4



1/2” clearance with pedal UP

Picture 5

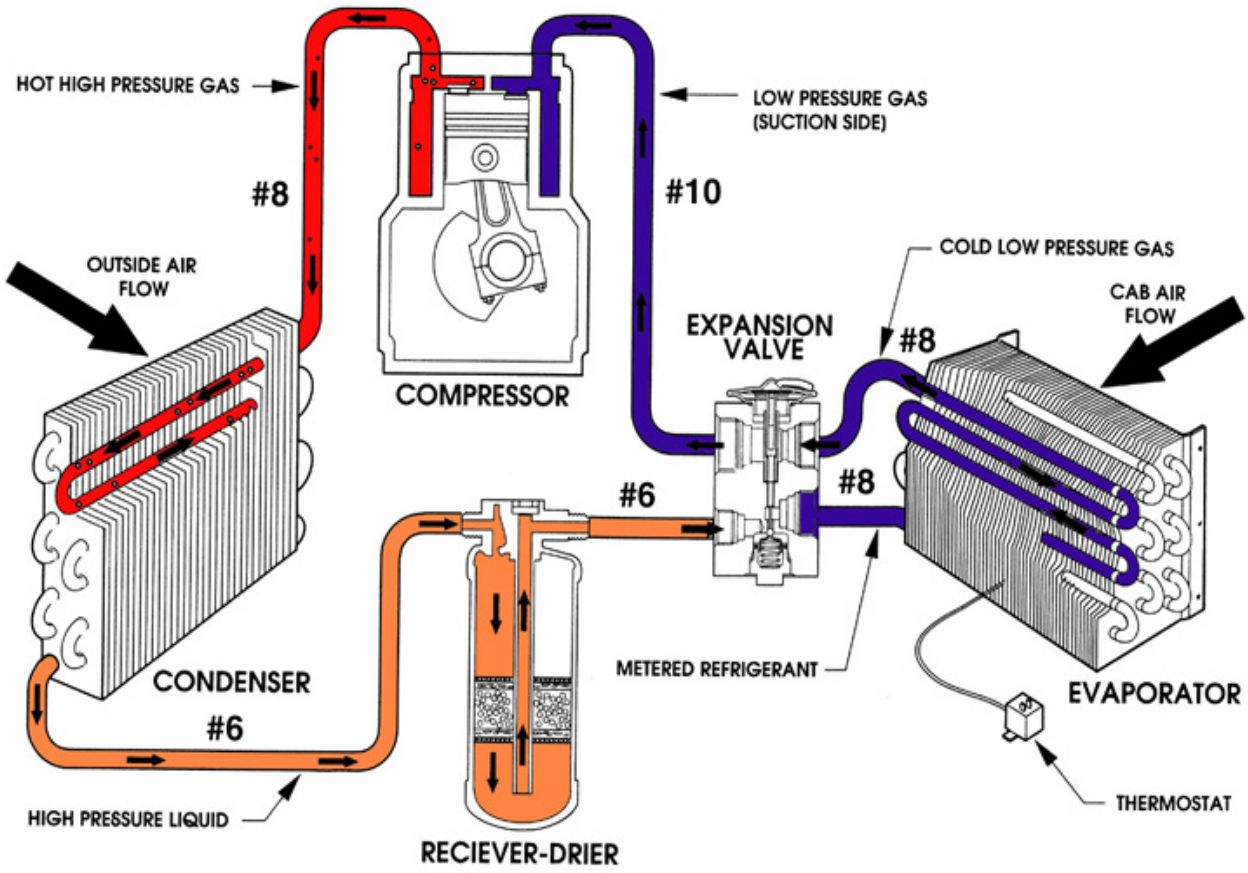


Turn clockwise to decrease gap, Clockwise to increase gap

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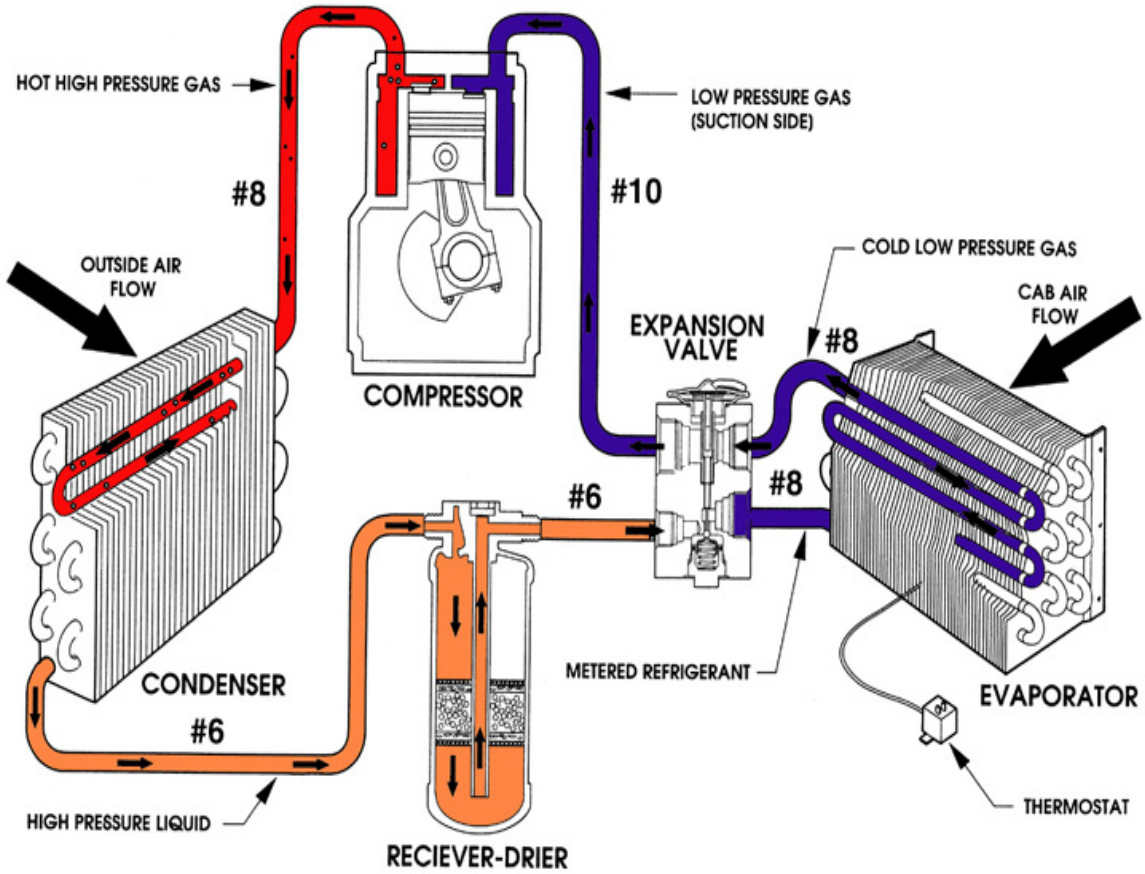
Climate Control Systems

A Typical A/C System Layout A



Compressor

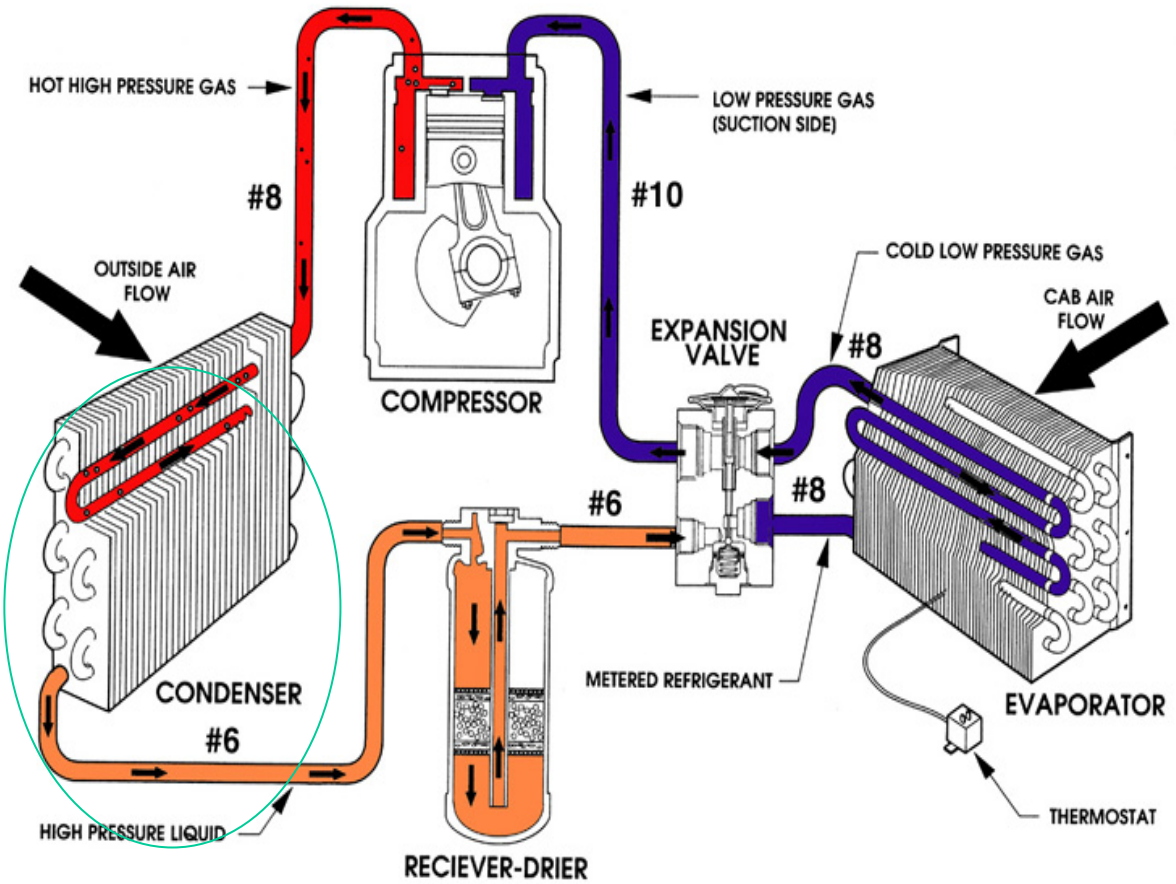
The Compressor receives refrigerant from the low-pressure side of system. It then compresses the gas making it hot and delivers it to high-pressure side. Notice that outlet hose is smaller diameter than inlet hose. This assists in maintaining pressure rise due to smaller volume to fill. Most *GRADALL* A/C Systems use 2.5 pounds of R134a refrigerant and 6-8 ounces of PAG (Poly-Alkyd-Glycol) oil.



Problems include leaks,seizure,noise and wear leading to low pressure.

Condenser

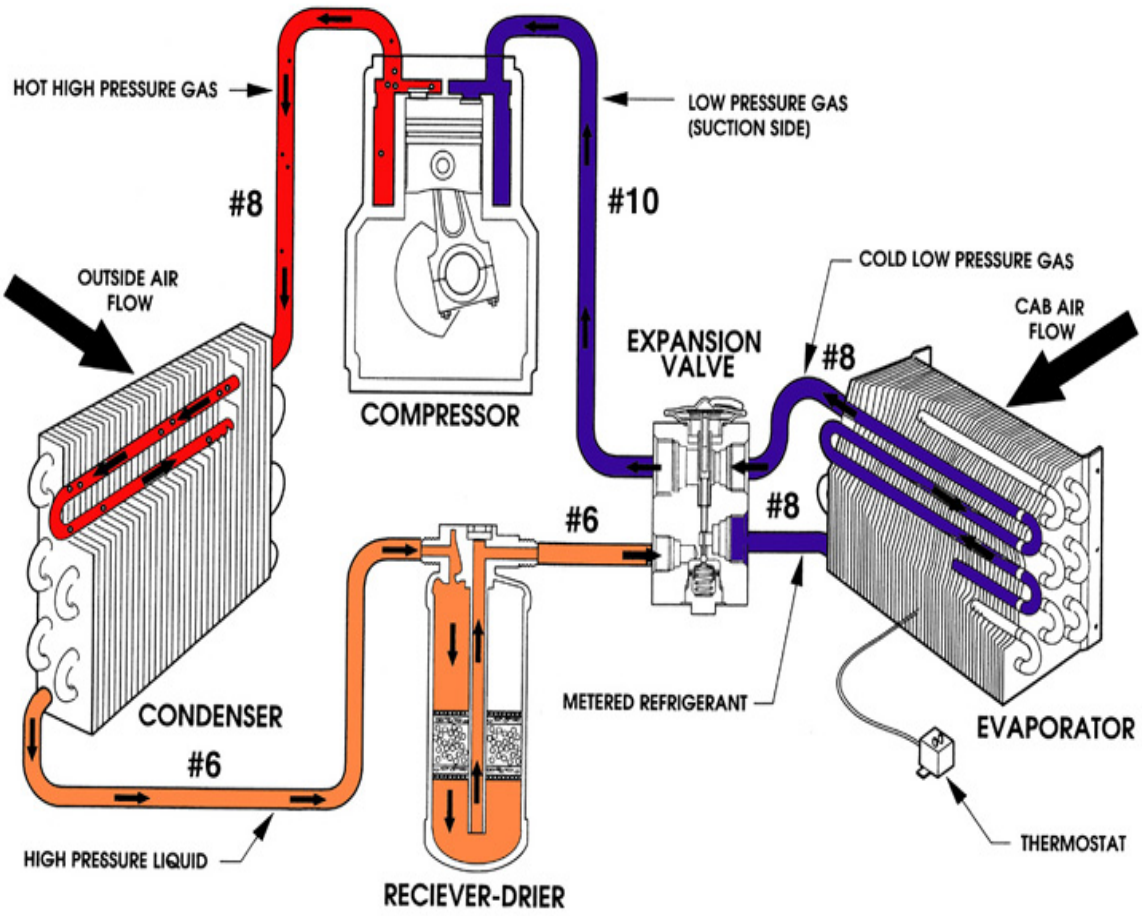
The Condenser changes R134a from vapor to liquid by transferring heat to atmosphere. By design, the condenser becomes more efficient by increasing the air flow available through it.



Problems include damage, clogging and restrictions generally leading to excess “HIGH” pressure.

Receiver-Dryer

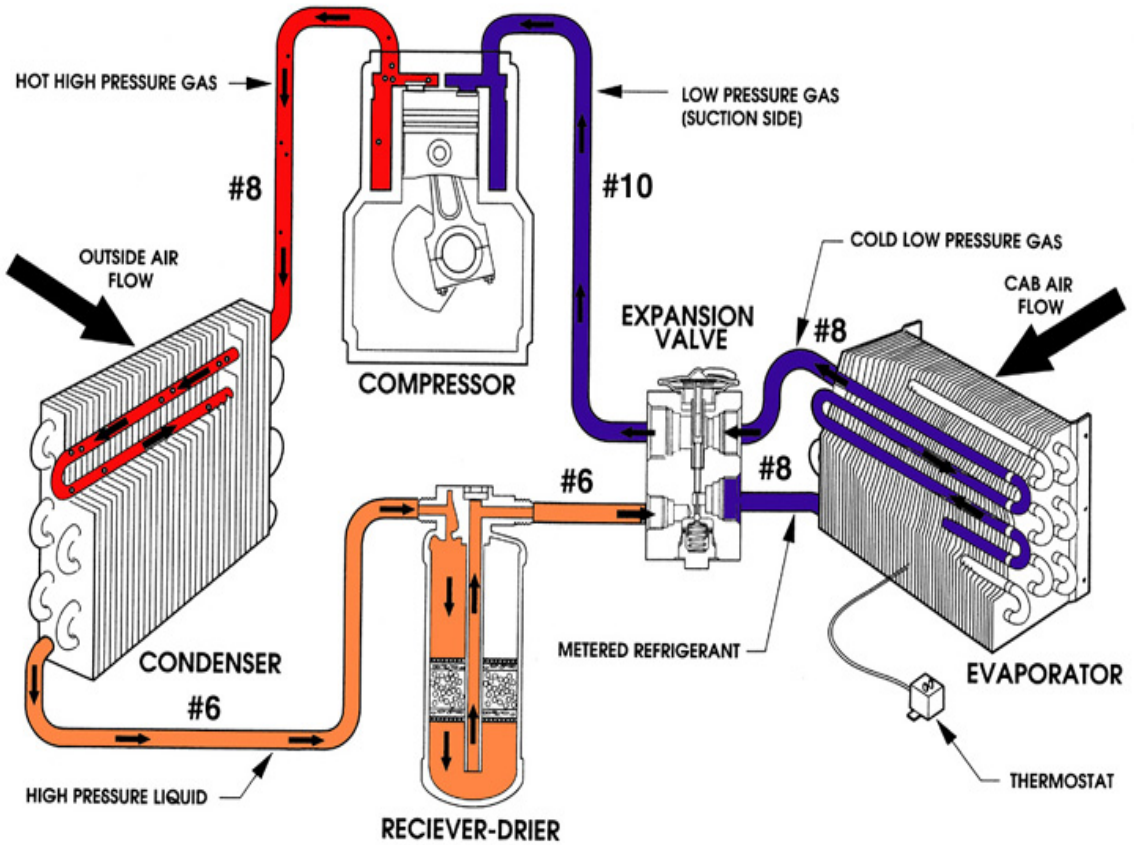
The Receiver-Dryer filters and stores moisture removed from R134a. While dryers should be cold during operation, they should not frost. Dryers should be replaced EVERY TIME the system is opened, or on a yearly basis.



Problems include leaks and poor cooling due to excess moisture contained in the dessicant.

Expansion Valve

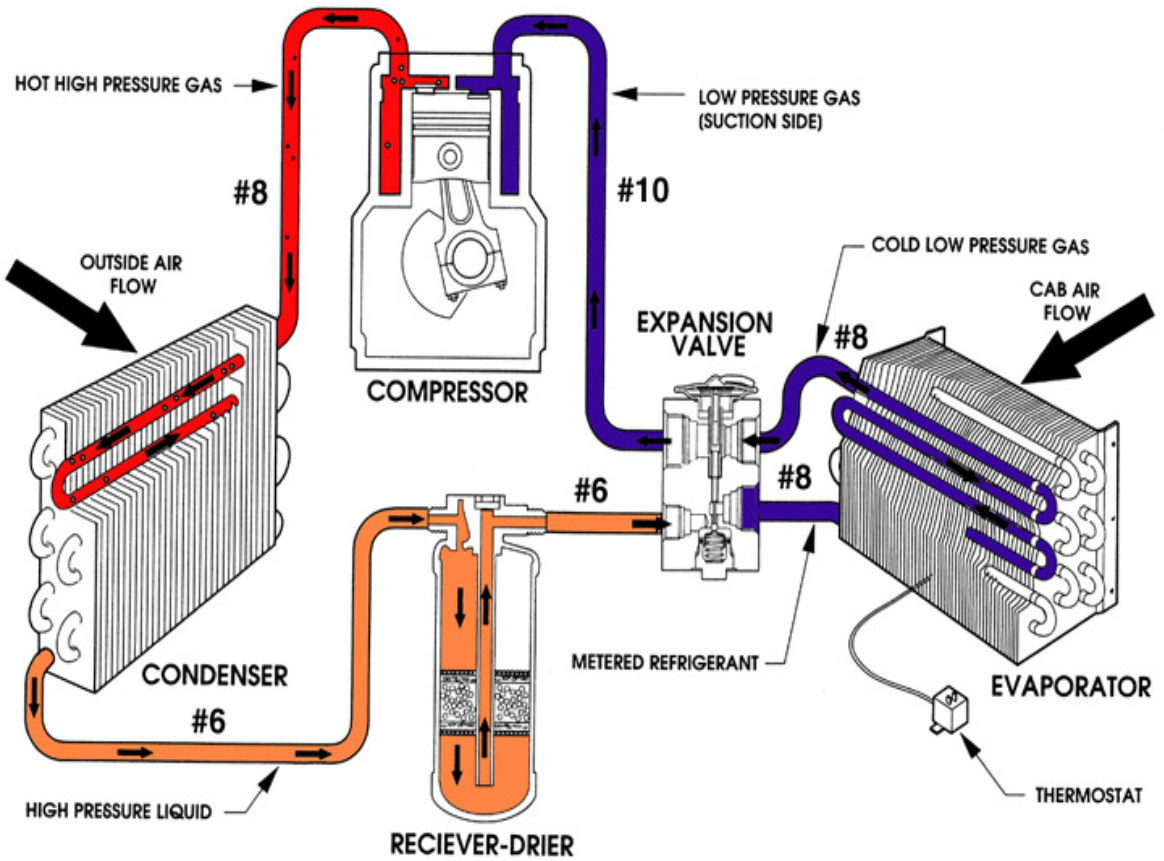
The Expansion Valve acts as a throttle to control the flow of LIQUID R134a both in and out of the evaporator. It uses temperature-sensitive components to provide a balanced flow and stable cooling. Notice that hose diameter shrinks exiting the condenser, increases exiting the Expansion Valve and grows again exiting the Valve. These size changes aid in maintaining pressure and flow as gas/liquid changes take place.



Problems include internal failure leading to poor cooling, frost on valve and system “in-vacuum.”

Evaporator

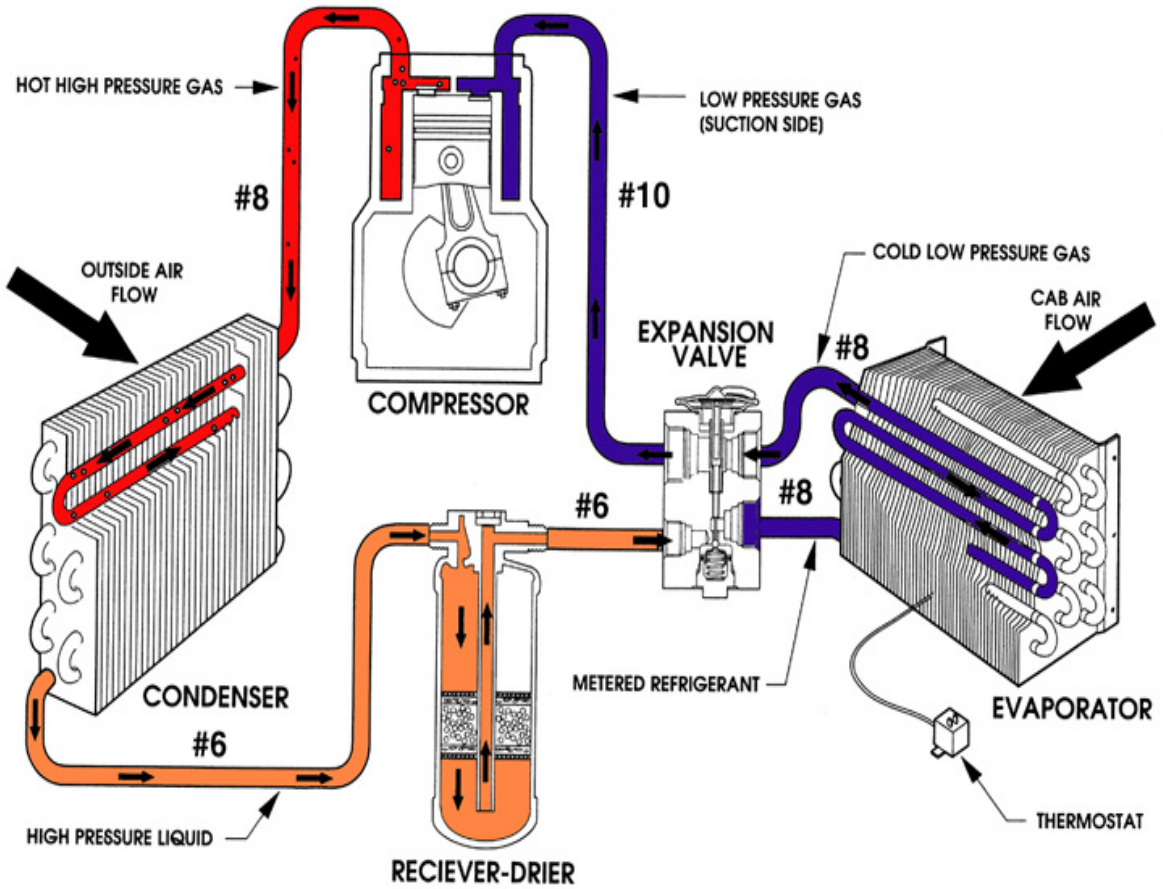
The evaporator changes R134a from liquid to vapor by extracting the cold energy from it and putting that cold into the air passing through it. As R134a flows through, it warms and again passes through the
Expansion Valve expanding I-n-t-o the greater area of the larger hose exiting the Expansion Valve.



Problems include leaks and internal or external clogging.

Thermostat

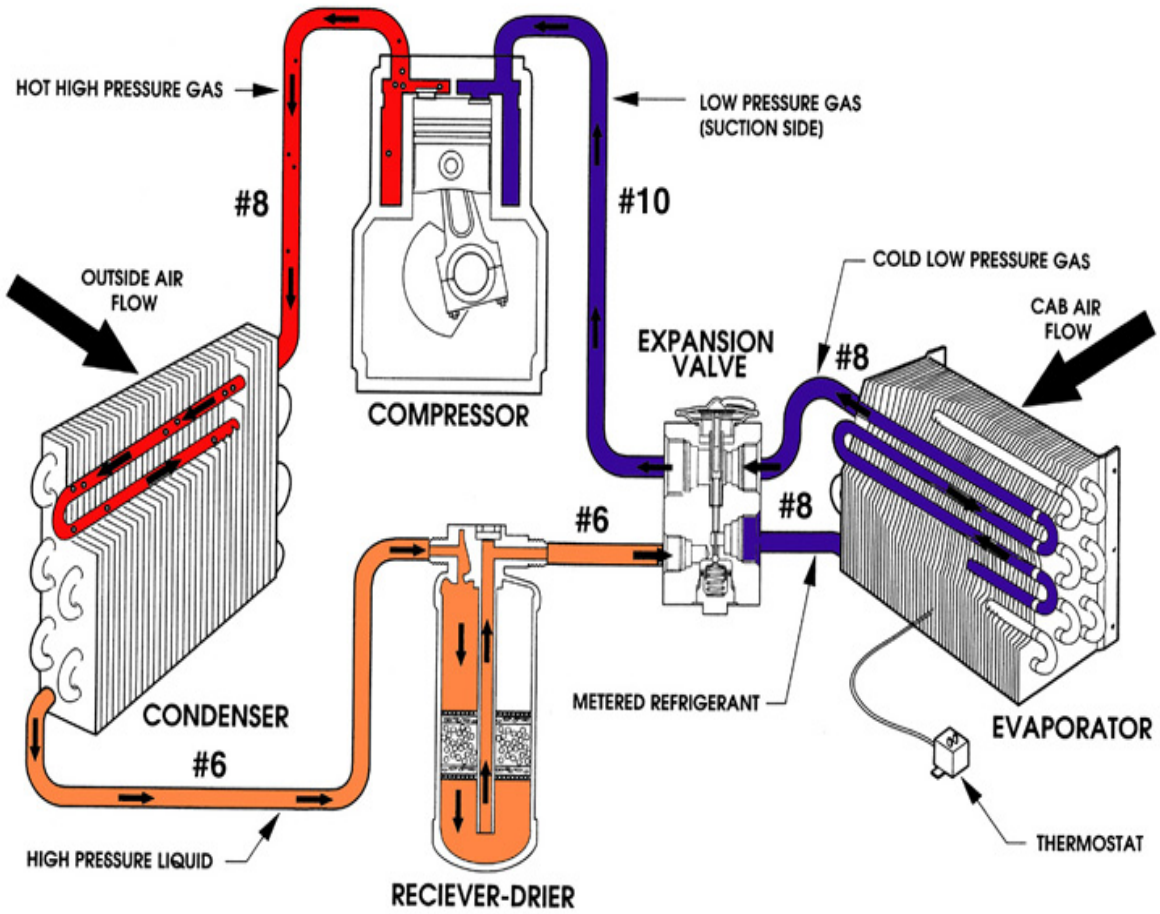
The Thermostat limits the formation of ice on the evaporator. It does so by electrically stopping the compressor which stops the flow of cold R134a.
This produces a “cycling” effect to the system typically stopping the compressor at 26 degrees and starting it at about 35 degrees measured at the probe in the Evaporator. The probe must be on the “cold” side of the Evaporator.



Problems include incorrect temperature range and inability to either start or stop the compressor.

High Side//Low Side

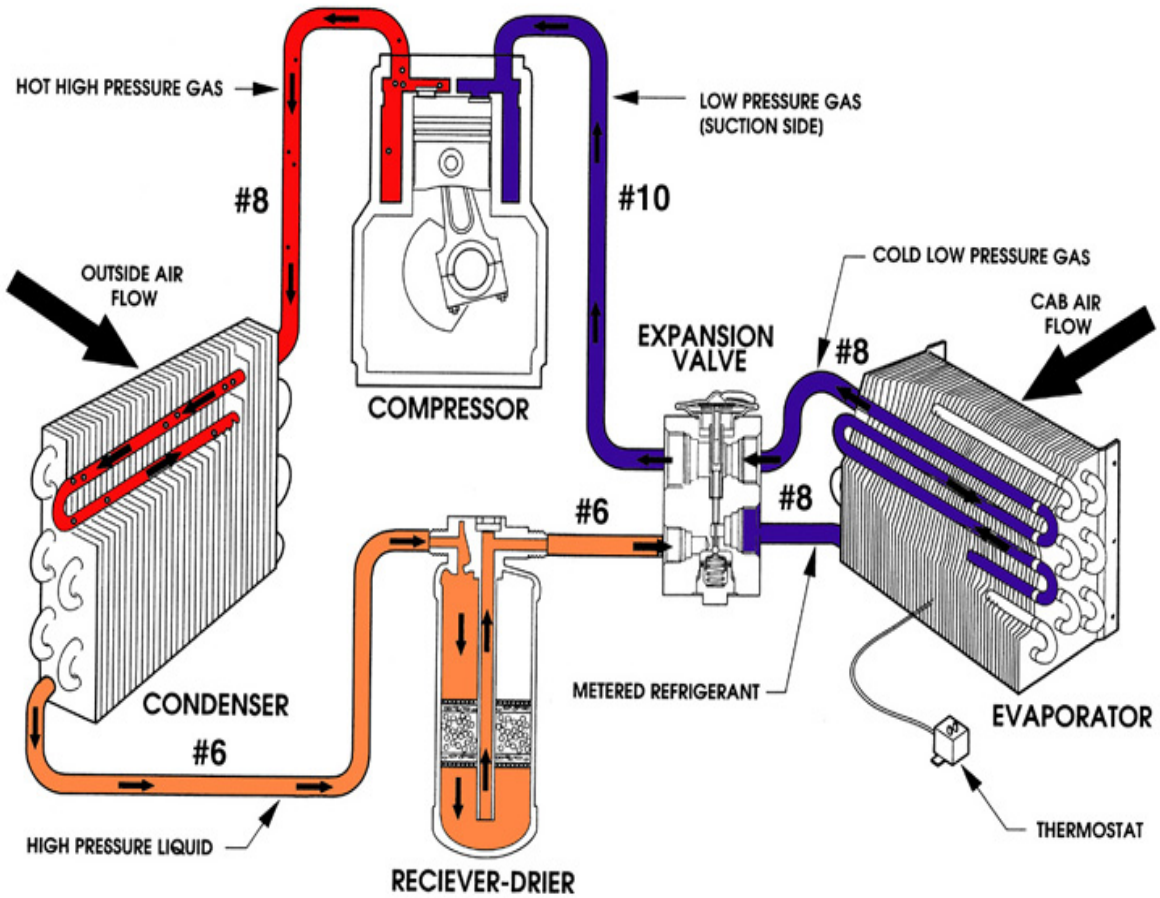
Notice that the HIGH SIDE runs from the Compressor *outlet* to the Evaporator *inlet.* The LOW SIDE runs from the Evaporator *outlet* to the Compressor *Inlet.* When the system is *Static*, pressures are equal and are roughly equal to ambient temperature as well.



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Hydraulic vs. Engine Drive

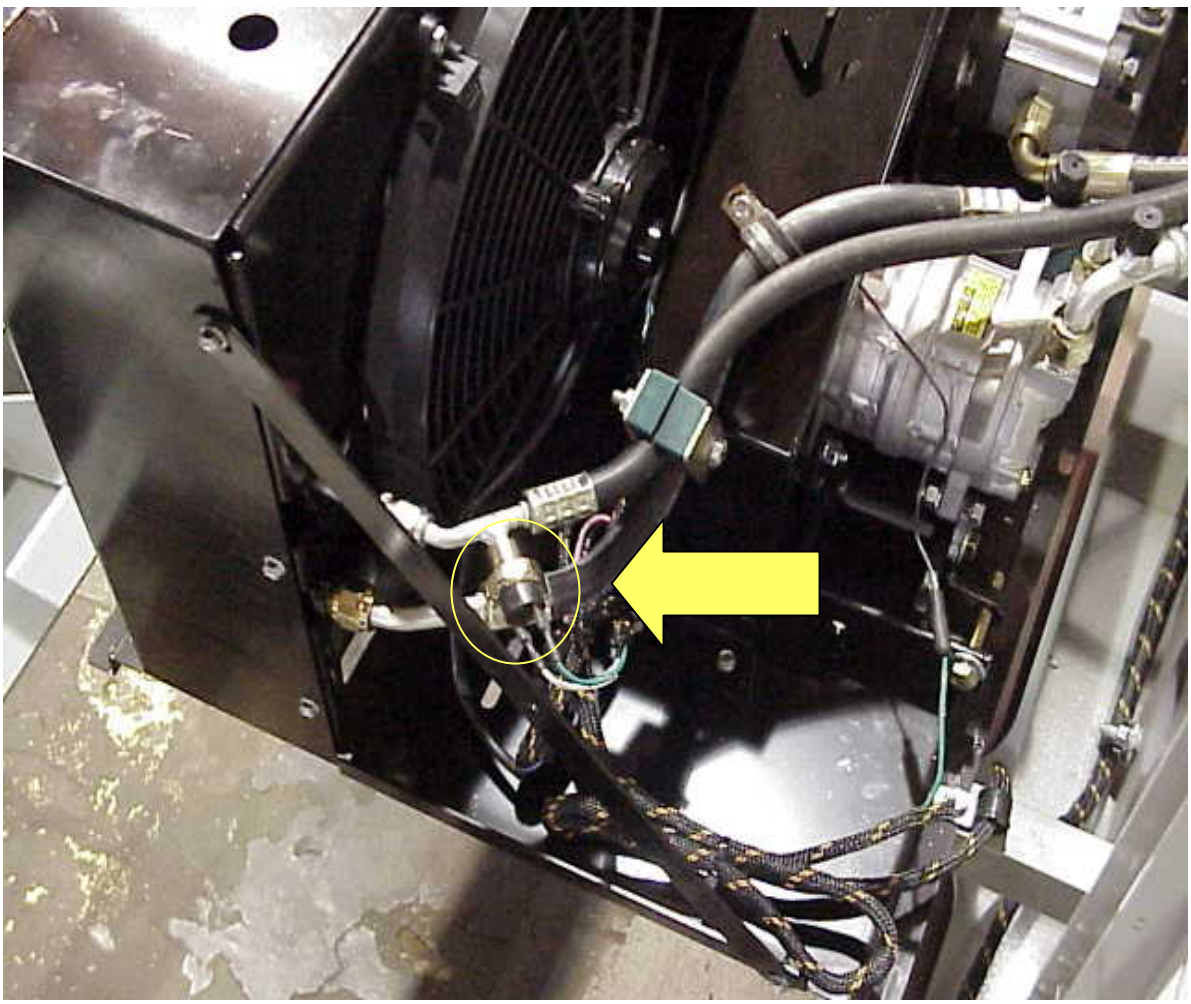
XL3100's and *XL4100-II's* use a hydraulic motor to drive their upper A/C units. Most other models use the engine fan belt to drive their compressors. Though the drives are different, the rest of the systems are identical and in fact, are simply common, R134a mobile systems. Routine troubleshooting and repair procedures apply.



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Pressure Switch

The Pressure Switch, sometimes called a *Binary* switch, acts like a relief valve by electrically disconnecting the Compressor when pressure rises too high. It also protects the compressor from seizure by opening if pressure drops too low. Some models have this switch mounted in other places, primarily near the evaporator. Typical static pressures are roughly equal to normal ambient temperatures.



Hydraulically Driven A/C Unit

This is the unit used on *XL3100* and *XL4100-II* uppers. The Motor Speed is set at 2000 RPM at High Idle. The Motor Operating Pressure is set at 3500 PSI dead-headed at the A/C Relief Valve. Typical hydraulic operating pressures are **1900-2200 PSI** measured at the LS test port.



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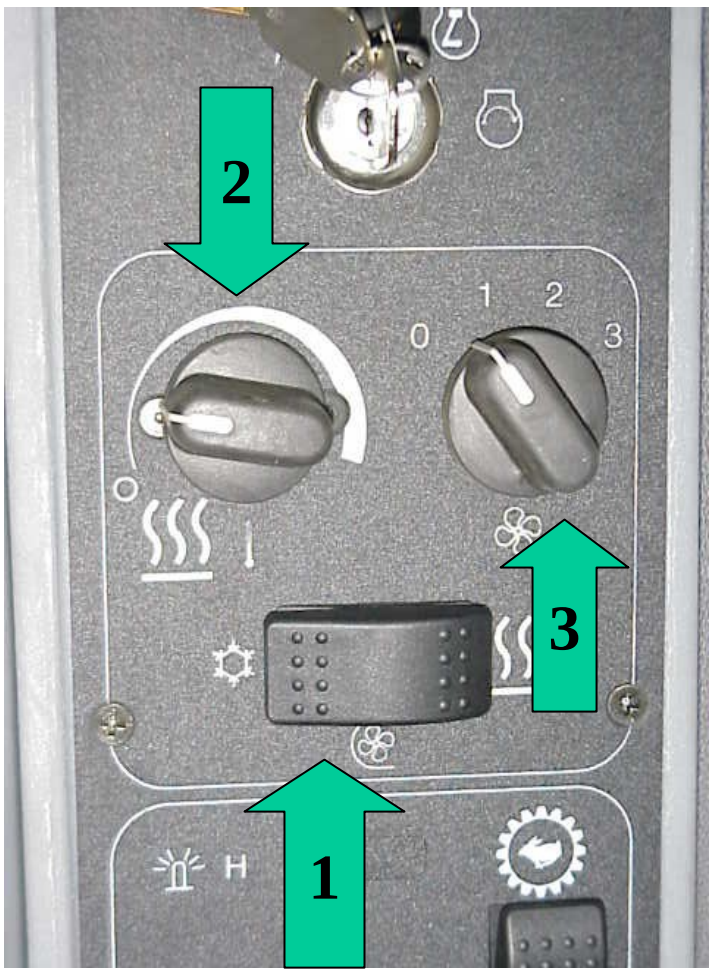
Upper Climate Controls

Upper Climate Controls consist of three items.

1) Heat/Air Conditioning switch.

2) Temp Control Knob—for heat *only.*

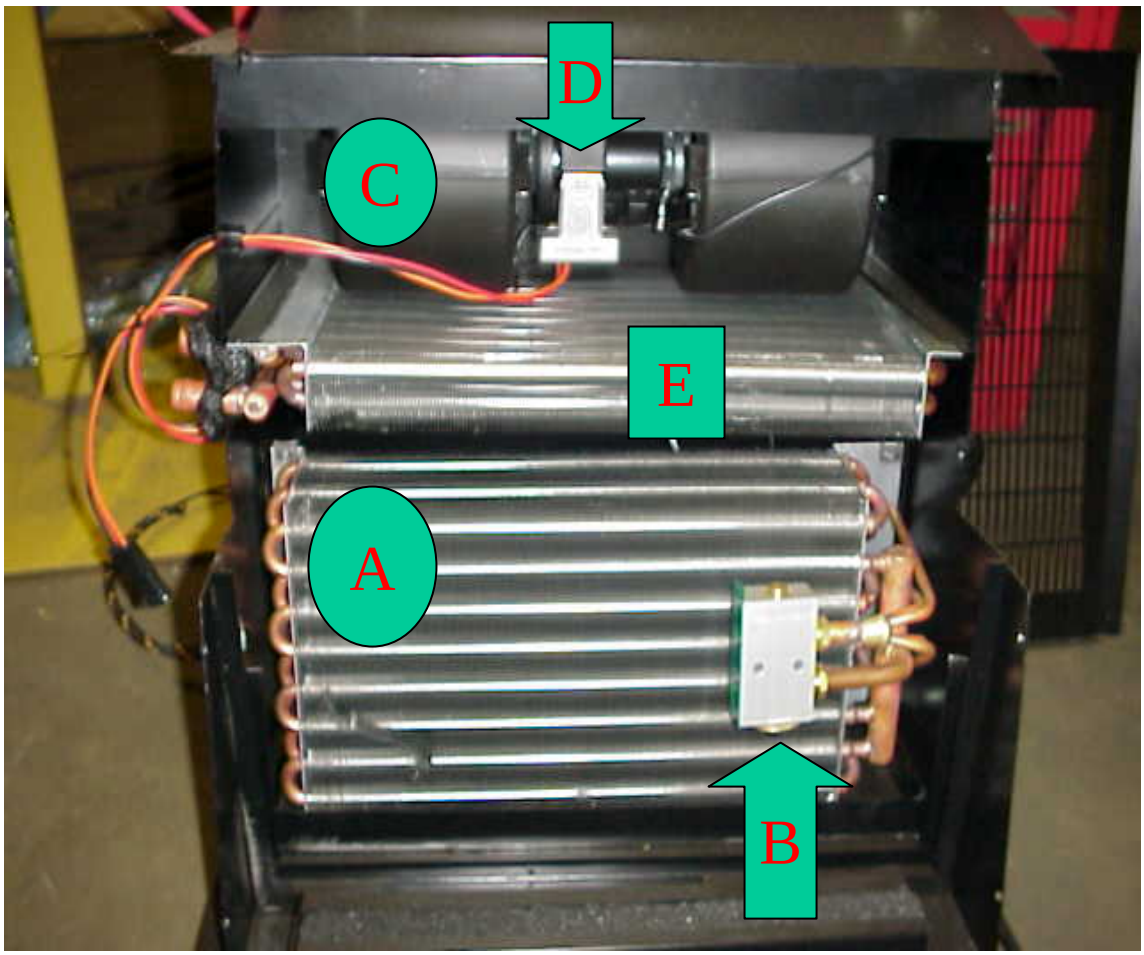
3) Fan Control Switch—must be *on* for either function to work.



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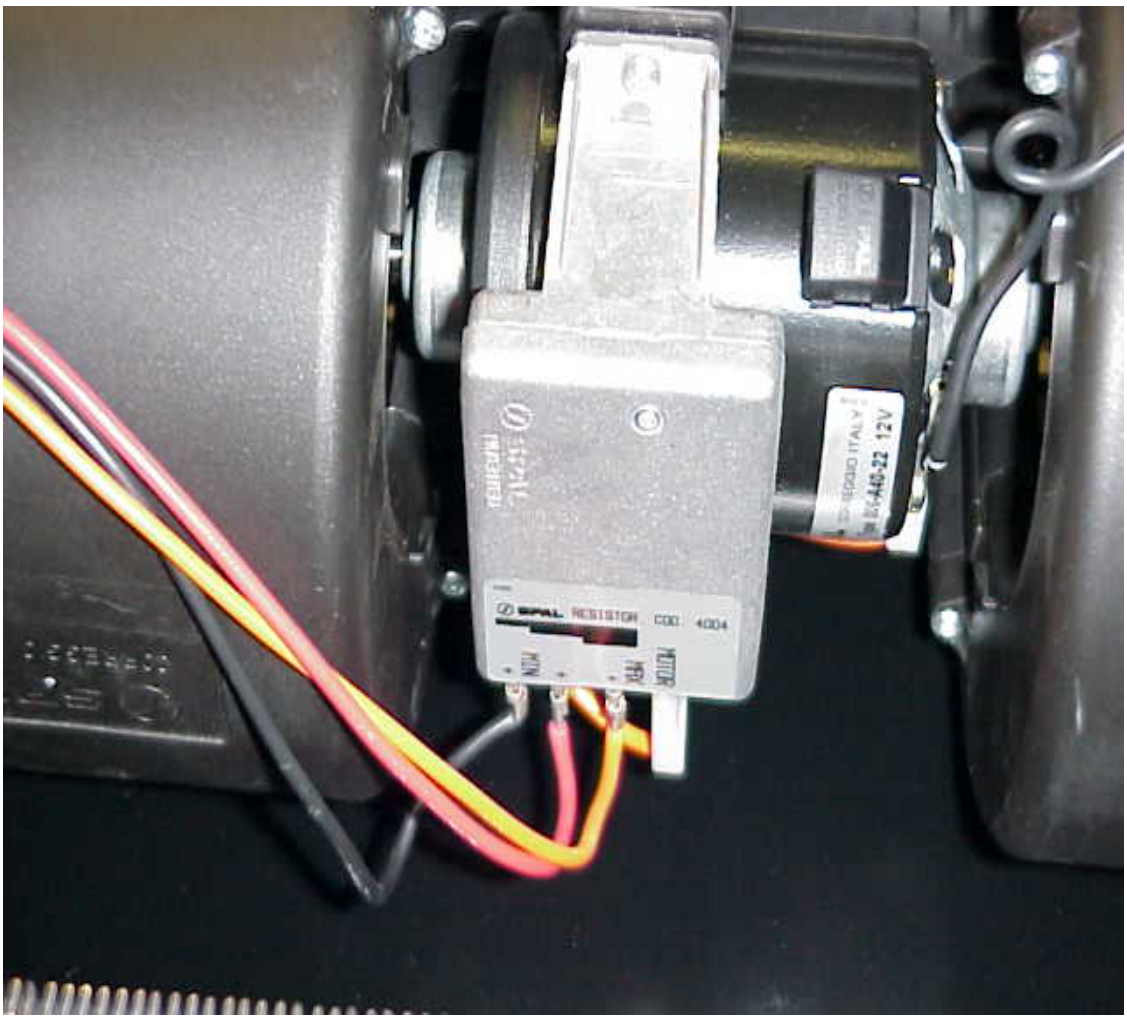
Air Handler Box

The Air Handler Box is floor-mounted behind the seat and contains several components.
A is the A/C Evaporator.
B is the Expansion Valve. The Thermo Switch probe is inserted into the fins directly behind the Expansion Valve.
C is the double squirrel-cage Blower controlled by an Electronic card-D.
E is the Heater Core.
Not shown is the Aluminum Screen type air filter.



Blower Motor

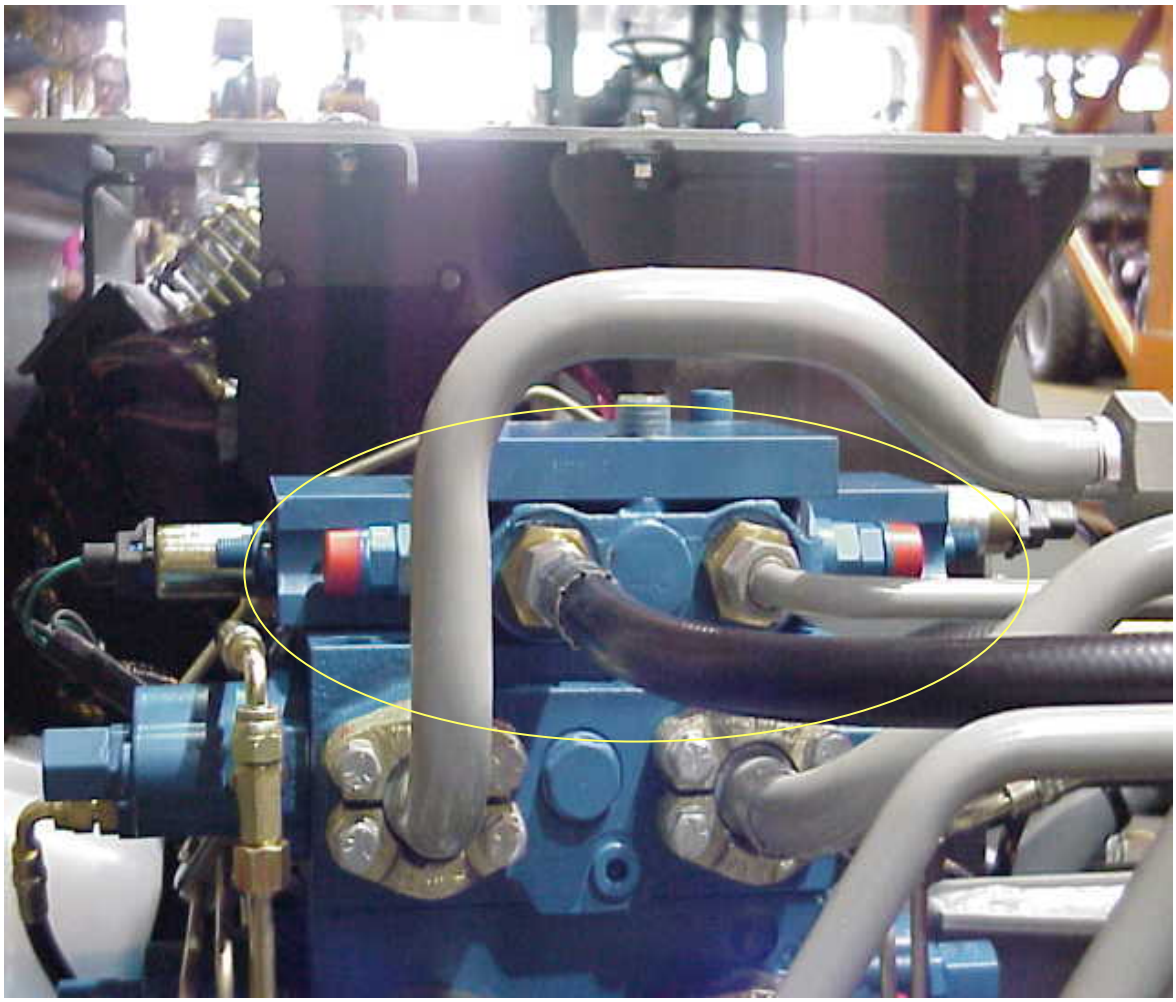
The Blower Motor Speed is determined by a 3-Wire Electronic Controller marked “MIN” which uses a black wire; a middle position using a red wire; and “MAX” using a yellow wire. All receive 12V from the fan switch which is converted to varying motor speeds. This controller is screwed to the blower motor and is available separately.



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Hydraulic Climate Control Valve

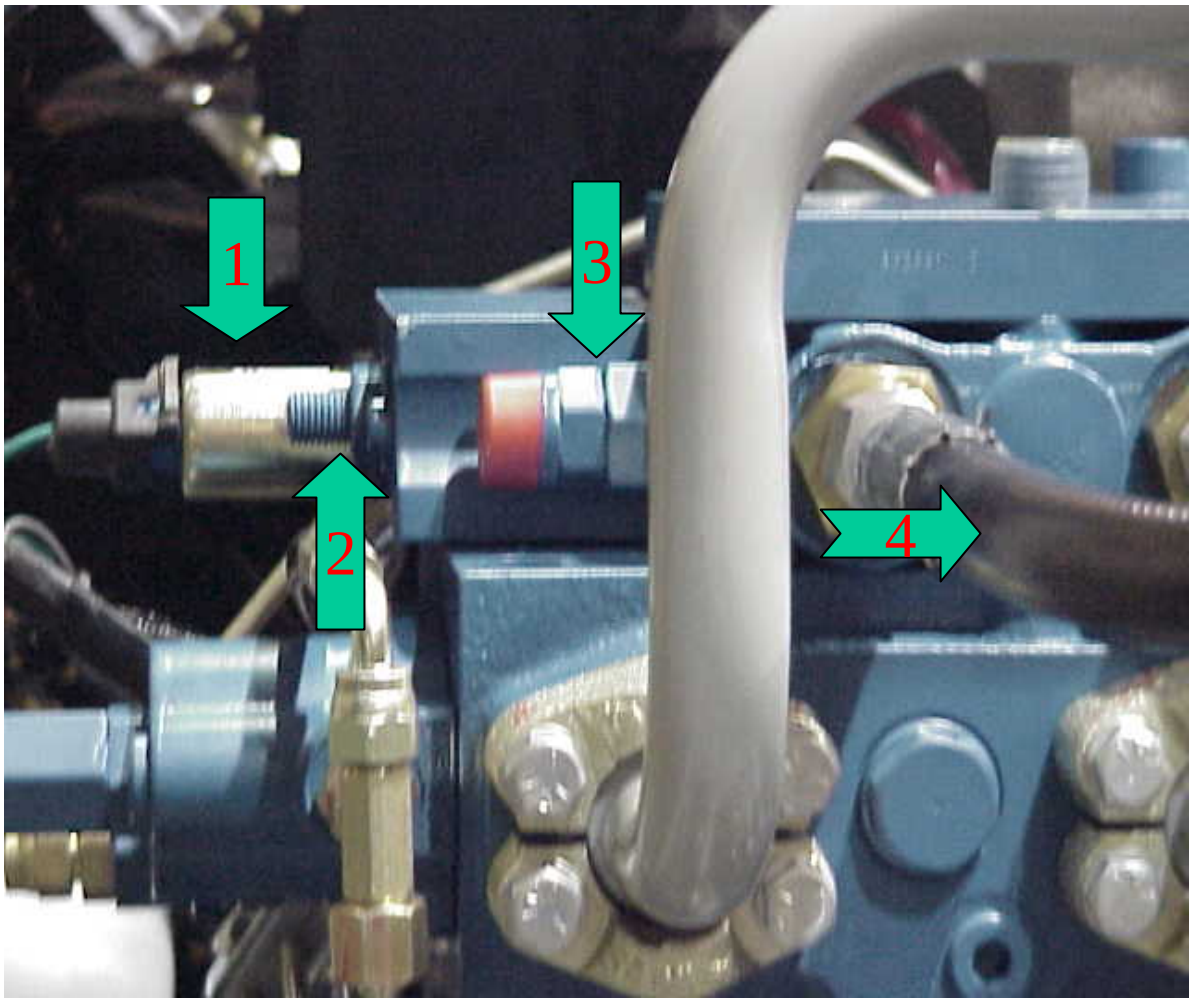
Provides oil to both the heater and A/C units. Valve is separate from monoblock main valve and is part of the Load Sense loop.



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A/C Control Side

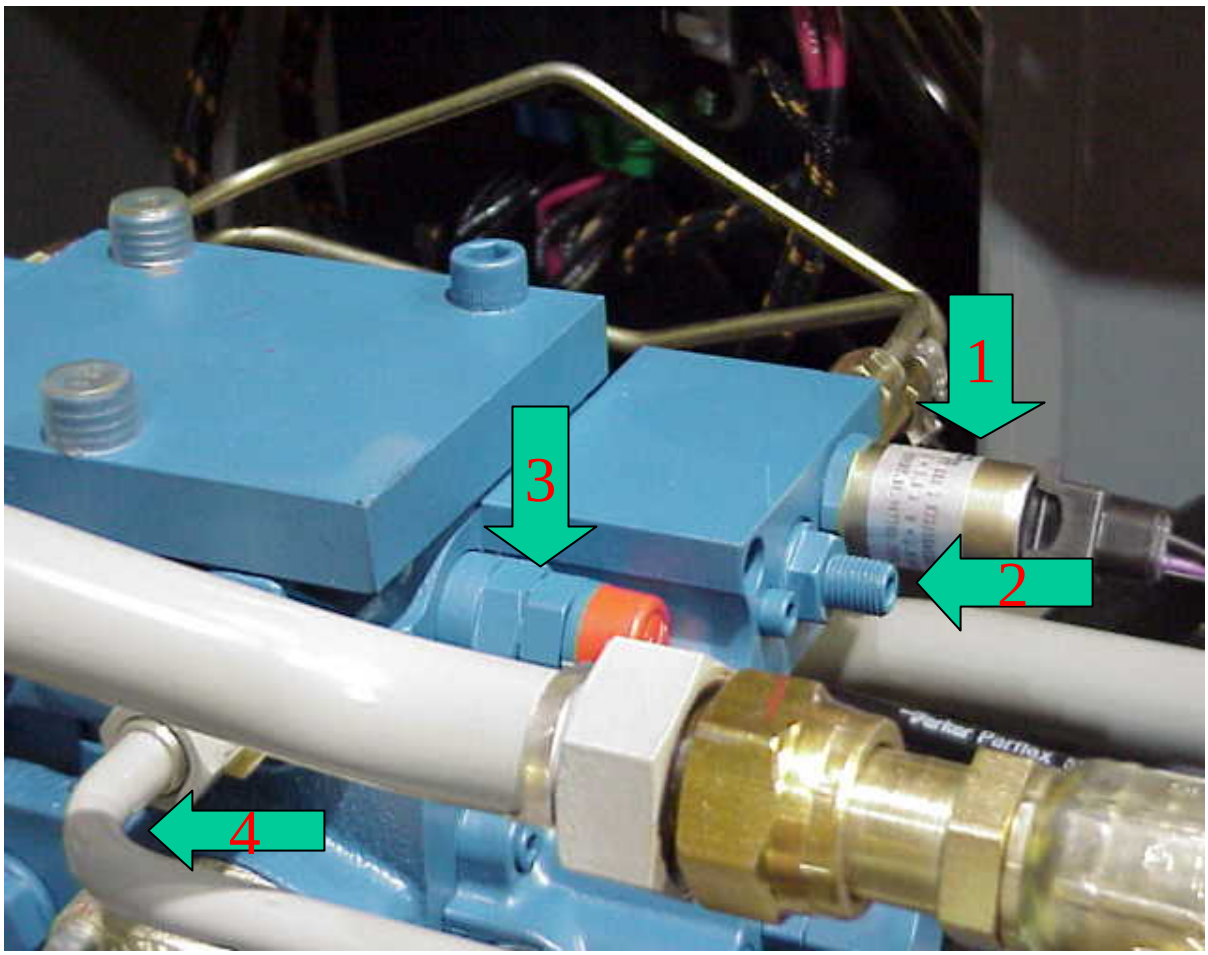
1- is variable solenoid for A/C drive motor.
2- is spool limit screw that controls *heater* motor speed.
3- is A/C relief—set at 3550 PSI.
4- is A/C Drive Motor supply hose.



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Heater Control Side

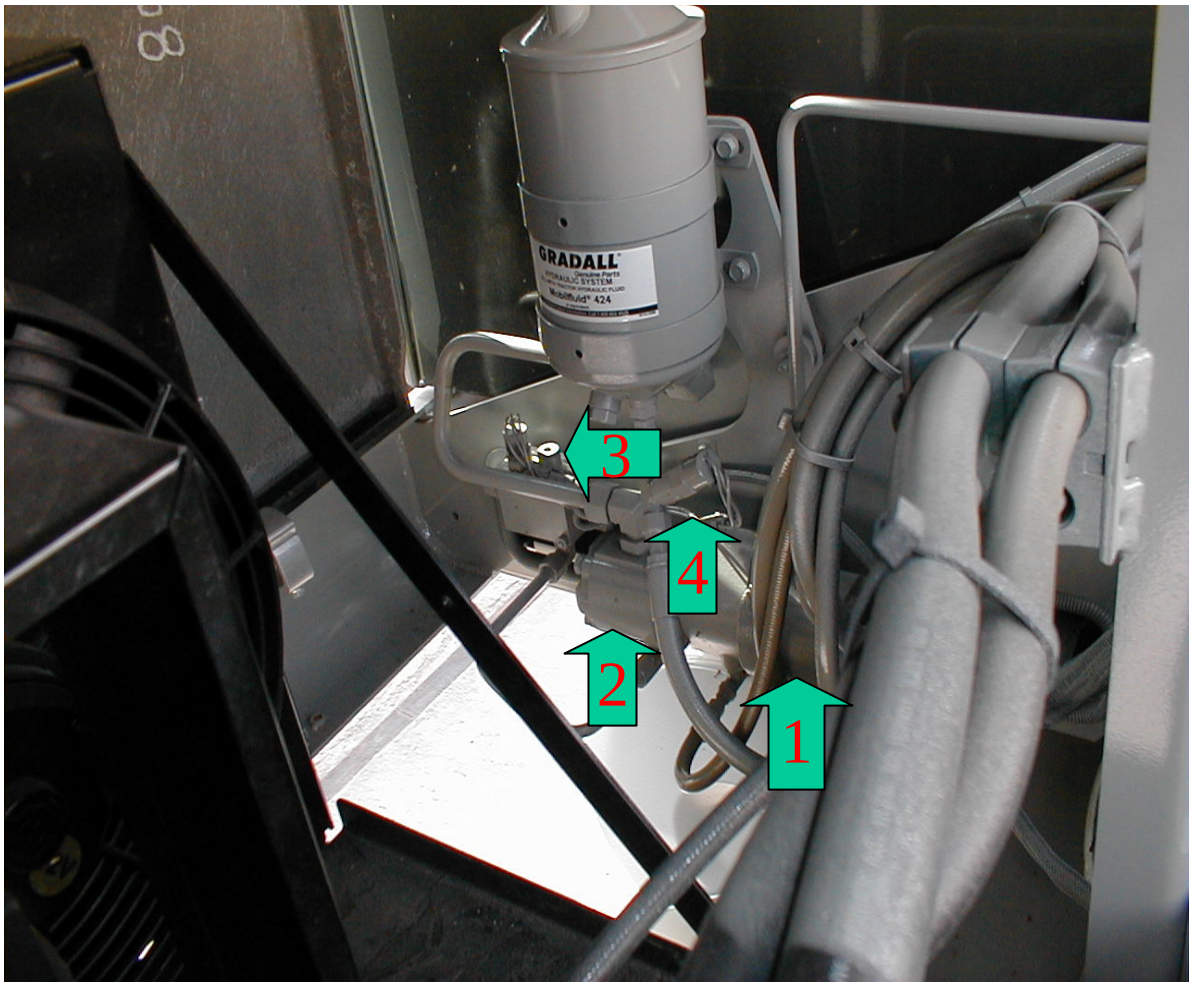
1- is Variable Solenoid that Controls heater motor speed.
2- is spool limiter for *A/C* speed.
3- is heater relief set at 2500 psi.
4- is heater motor supply line.



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Hydraulically-Powered Heater

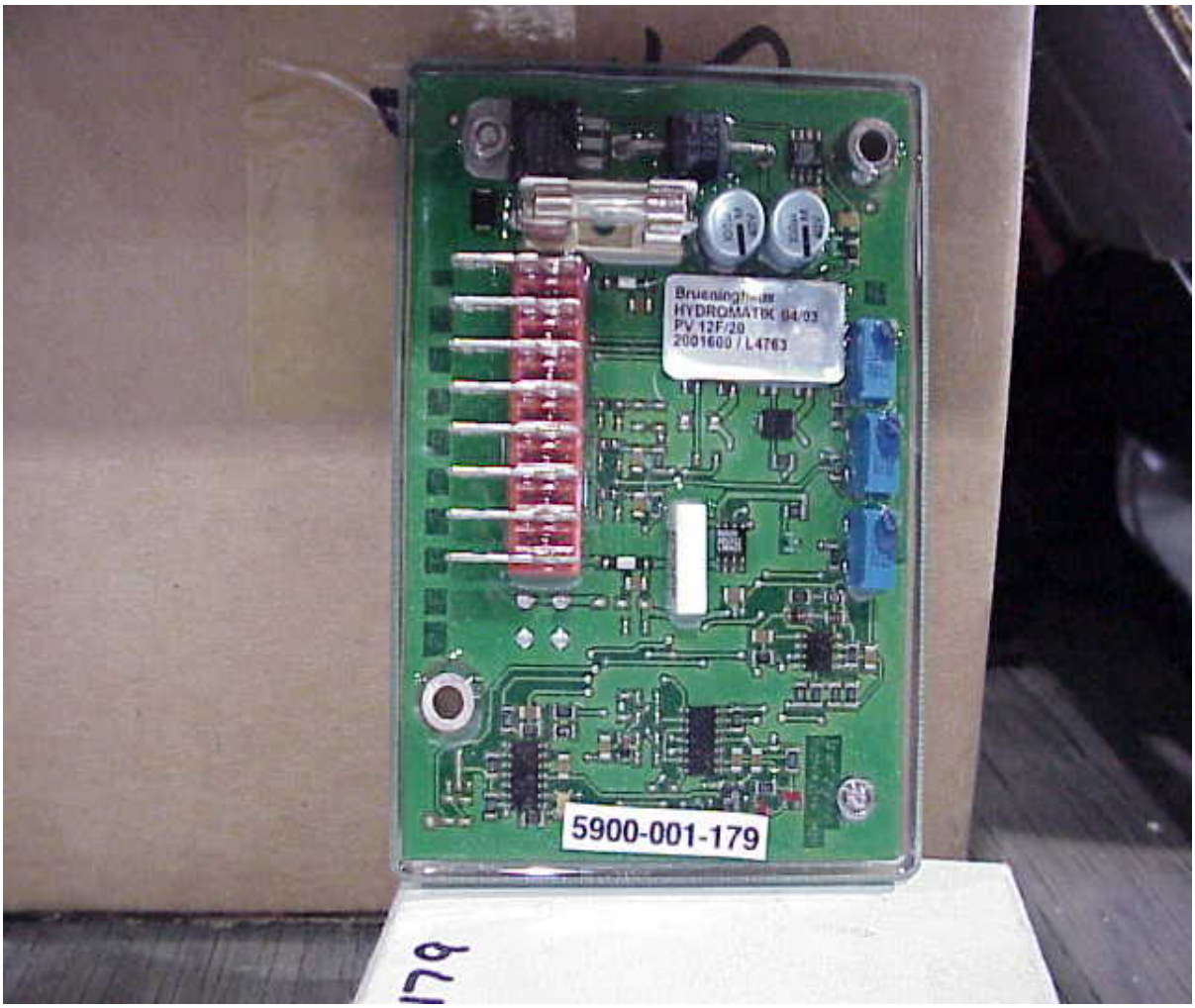
Upper Heaters on 3100 & 4100's are hydraulically powered. The Motor (1) turns a pump (2) sending hydraulic oil in a closed loop over relief (3)creating heat. The motor is driven from the same valve as the upper A/C. Motor speed is 2500 RPM and relief is set to provide about 2200 psi in load sense loop. Temperature control is provided by fan speed as well as oil flow through hydraulic valve, regulated by a "card" driving a variable solenoid. Protection against overheat is provided by a thermal Switch(4).



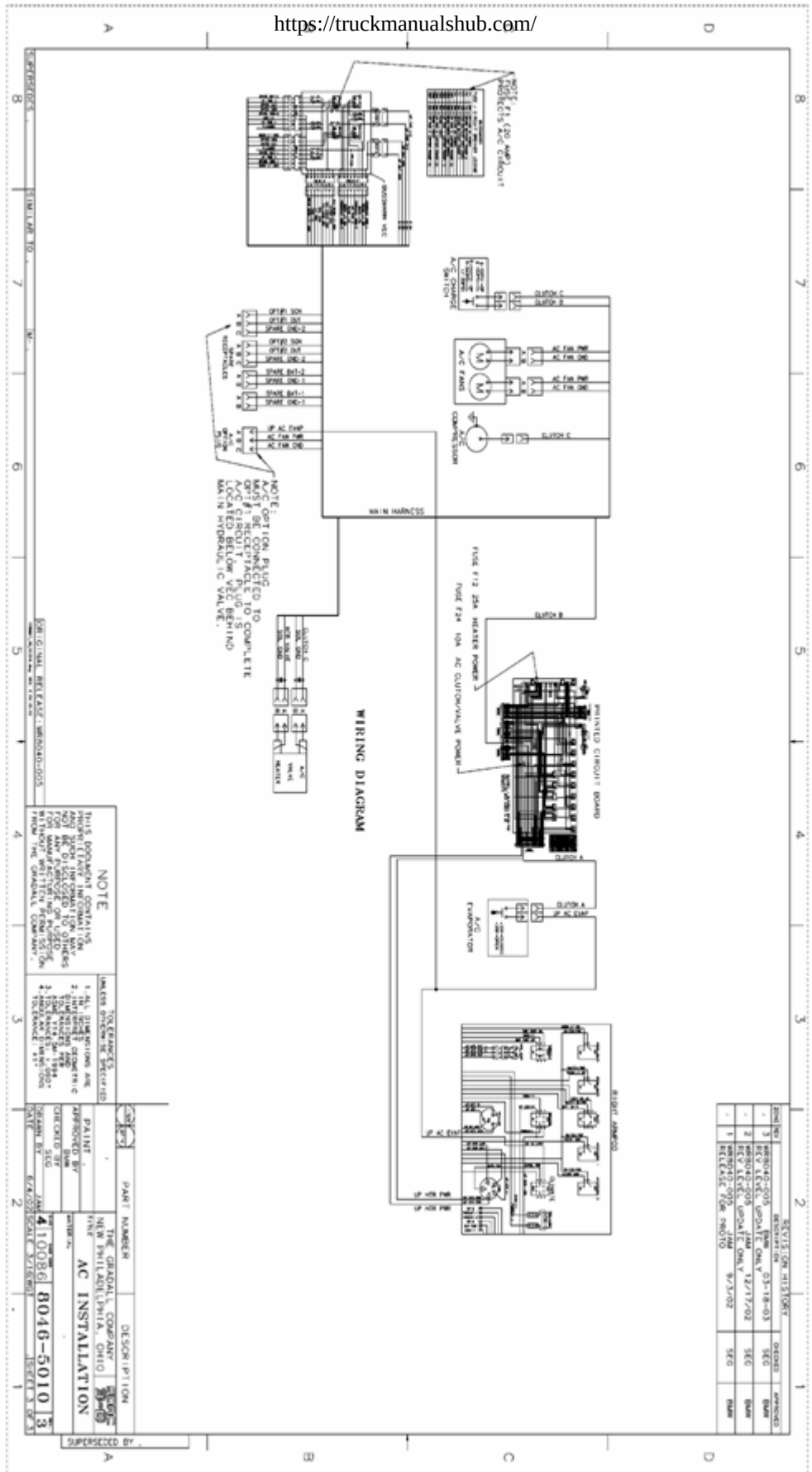
https://truckmanualshub.com/

Heater Control Card

The Heater Control Card electronically provides fine control of heater output. It is located in the left armpod and has a relay next to it. Temperature control is provided by varying the voltage sent to the variable solenoid which controls the oil flow to and thereby the speed of the heater motor.



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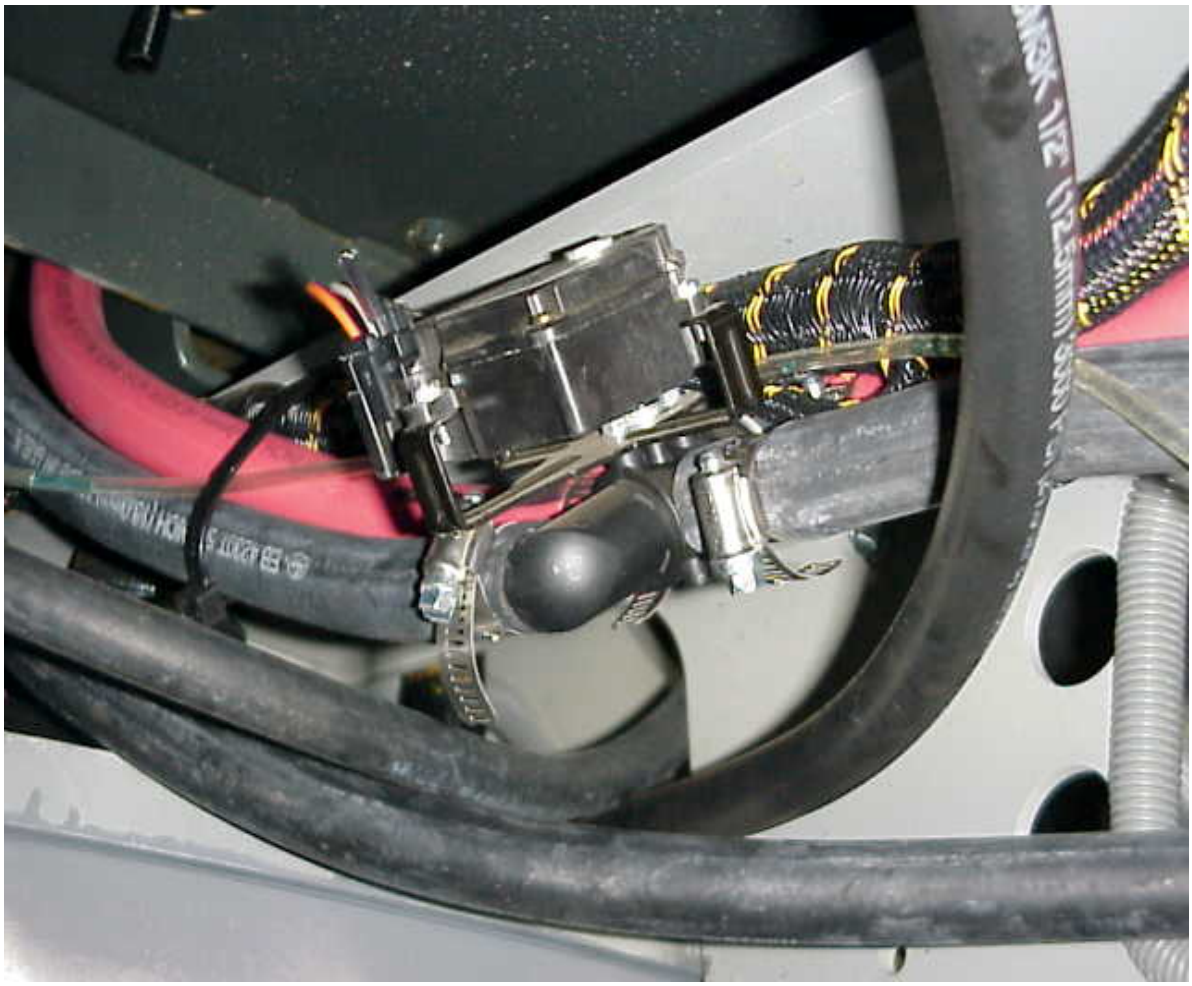


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Water Flow Valve

3100 & 4100 Lowers, 3200, 4200, 3300 and 4300 Cabs use a water flow control valve to control temperature in the heater core. The valve is controlled by the temperature control knob onthe dash and and is a simple linear control.



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Water Control Valve

The valve contains a small motor. The signal from the temperature control switch varies the water flow to the heater core.



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Lower Climate Controls

As with the uppers, the fan must be on for Heat or A/C to function. If unit has A/C, rocker switch is mounted above the “snowflake.’



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GRADALL Product Support Information

Subject: Mercedes Benz 900 Series Engine Oil Pan Drain Plugs

Affected Model: All ***GRADALL*** Excavators equipped with Mercedes Benz 900 series Engines

Affected Units: Any machine listed above

The Mercedes engines in the above listed machines use an aluminum oil pan and steel oil pan drain plug. While performing scheduled maintenance on any of the above listed machines and draining the engine oil, it is possible to pull the threads out of the oil pan by over-tightening the plug when re-installing the oil pan drain plug.

Corrective Action: To eliminate the possibility of the oil pan drain plug pulling the threads out of the oil pan, the correct torque specification should be used when tightening the drain plug on machines equipped with the Mercedes engine. The correct torque for the oil pan drain plug is 59 foot pounds (80 nM). Please make sure that all customers in your area that own an excavator listed above are aware of the correct oil pan drain plug torque. Failure to tighten the plug properly can result in the need to replace the engine oil pan. For more information, please refer to the Engine Operator's Guide.

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GRADALL Product Support Information

Subject: AC System Receiver Dryers

Affected Model: All ***GRADALL*** Hydraulic Excavators equipped with R134a AC Systems

Affected Units: An machine equipped with R134a AC System

The receiver dryer is an important part of the machine air conditioner system. This service information provides additional information about the receiver dryer.

Corrective Action: The receiver dryer is installed in the air conditioner system between the condenser and evaporator. The receiver dryer is used to store, filter, and dry the high pressure liquid refrigerant. By collecting and storing refrigerant, a consistent supply of liquid refrigerant is available to flow into the evaporator when the compressor is operating. The receiver dryer does have a limited service life. The internal filter can become clogged or the desiccant bag can become saturated with moisture. It is recommended for best air conditioner performance to replace the receiver dryer every 3 to 4 years of use. The receiver dryer should also be replaced anytime a compressor is replaced.

The receiver dryer is equipped with a sight gauge. New receiver dryers will have the sight gauge covered with tape to protect the sight gauge until installation. Remove the tape when installing a receiver dryer. In servicing modern R134a refrigerant air conditioning systems, the sight gauge should not be a primary diagnostic tool for charge weight. R134a refrigerant systems require actual measurement of the charge weight or use of gauges on the test ports to obtain most accurate readings. In typical R134a refrigerant systems, the sight gauge will give an inaccurate reading of charge condition.



Mask installed on sight gauge



Mask removed

The receiver dryer must also be installed correctly. The receiver dryer will have the word “IN” stamped on the fitting near the sight gauge. The hose from the condenser must be hooked to the fitting marked “IN”. The hose to the evaporator in the cab must be hooked to the fitting with no marking. Failure to install the receiver dryer correctly will result in incorrect air conditioner operation and possible failure of system components.

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GRADALL Product Support Information



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GRADALL Product Support Information

Subject: R134a AC Systems and Compressed Air

Affected Model: All ***GRADALL*** Hydraulic Excavators equipped with R134a AC Systems

Affected Units: Any machine with R134a AC system

Certain precautions must be observed using compressed air around R134a AC systems as installed on GRADALL Excavators.

Corrective Action: R134a service equipment or vehicle air conditioner systems should never be leak tested or pressure tested with compressed air. Certain combinations of air and R134a refrigerant can be combustible at elevated pressures and can result in fire or explosion causing injury, damage, or even death.

Compressed air can contain moisture. Never use compressed air to blow out lines or components of a R134a AC system.

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GRADALL Product Support Information

Subject: AC System Moisture Contamination

Affected Model: All ***GRADALL*** Hydraulic Excavators equipped with R134a Refrigerant

Affected Units: Any machine equipped with R134a AC system

R134a refrigerant as used in *GRADALL* Excavators is a hygroscopic (attracts & absorbs moisture) material. In addition, the oil used in R134a refrigerant systems is also hygroscopic. Special care must be taken to avoid contaminating R134a air conditioner systems with moisture.

Corrective Action: Some important precautions must be observed when servicing R134a air conditioner systems to avoid contaminating the AC system with moisture. Moisture allows internal AC sytem freeze up and loss of air conditioner operation. The moisture will also react with the refrigerant oil to produce sludge and acid which will cause serious damage to the system.

Any time an R134a AC system is serviced, all hoses, ports, tubes and components MUST be capped immediately when the connection is opened. To avoid damage due to moisture, never leave any component or the air conditioner system open to atmosphere more than 5 minutes.

When installing new components, caps on a fitting or compoent port should not be removed until time of installation, Components that are not capped should not be used.

Never reuse evacuated oil from the system. Evacuated oil should be disposed of by approved method in your local area. Evacuated oil should NEVER be put into a container of unused oil.

When adding oil to the system, use new oil from a clean container. Immediately cap the container after adding oil. If the container of oil is of unknown age, it is recommeded the container be disposed of properly and replaced with new oil.

Never use compressed air to blow out lines or components. Compressed air contains moisture and will contaminate the system. Dry nitrogen gas should be used to blow out lines.

Any time a R134a AC system is evacuated for service, a vacuum must be pulled on the system to remove air and moisture. The vacuum will cause remaining moisture to “boil off”. Pulling a vacuum of 29 in Hg for at least 30 minutes provides adequate evacuation of the system. It is possible to assist the “boil off” process by preheating the evaporator. Run the engine with heater on, fan in high speed, until normal heater temperature is reached for at least 10 minutes. This will preheat the evaporator prior to evacuating the AC system.

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GRADALL Product Support Information

Subject: Swing Transmission Lubricant Check and Refill Requirements

Affected Model: XL2200, XL2210, XL2300, XL3100, XL3100-III, XL3200, XL3200-III, XL3210, XL3210-III, XL3300, XL3300-III, XL3310-III, XL4100, XL4100-II, XL4100-III, XL4200, XL4200-II, XL4200-III, XL4210, XL4210-II, XL4210-III, XL4300, XL4300-III, XL4310, XL4310-III, XL5100, XL5100-III, XL5110, XL5200, XL5200-III, XL5210, XL5210-III, XL5300, XL5310-III, XL6210

Affected Units: All machines of each listed model are affected

Field experience indicates some confusion exists regarding lubricant check, fill, and replacement requirements for the planetary swing transmission as used on all listed ***GRADALL*** Excavators. Failure to follow the specified lubricant check, fill, and replacement requirements may lead to less than anticipated performance from the swing transmission assembly.

Corrective Action: The swing transmission requires the lubricating oil level to be checked weekly or 50 hours of use, whichever comes first. On most models, it is necessary to remove a cap to check the oil level in the stand pipe assembly that is part of the swing transmission. On recent models, a dipstick is provided to check swing tranmission lubricant level.

At the end of the first 30 days or 250 hours, whichever comes first, it is necessary to drain and refill the swing transmission with fresh lubricating oil.

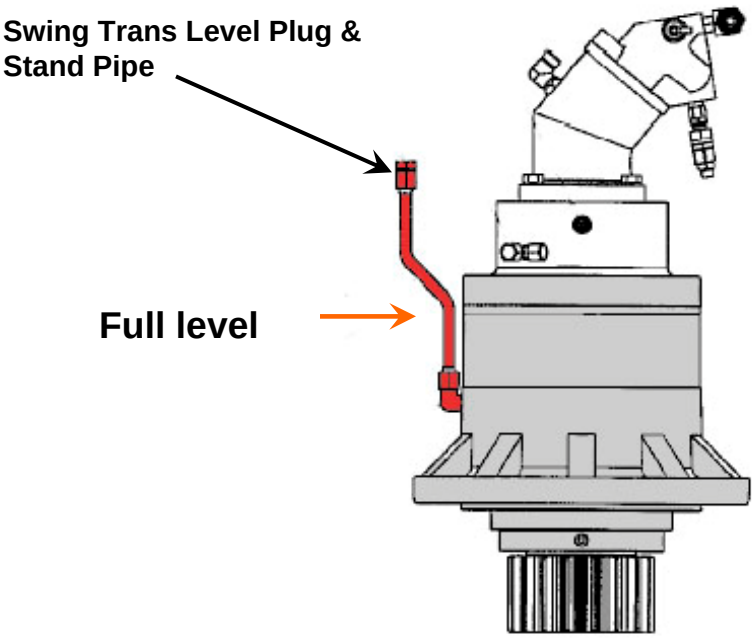
Every 6 months or 750 hours, whichever comes first, the swing transmission breather is to be cleaned or replaced as needed.

Once per year or 1500 hours, whichever comes first, the swing transmission oil is required to be drained and refilled with fresh lubricating oil.

On all models, use EP 90 (MIL-L-2105D) gear oil to add or refill the transmission.

Please notify your service technicians and your customer maintenance personnel of the swing transmission lubricant check, fill, and replacement requirements. The information covered in this Service Information is also outlined in the Operator's Manual maintenance section for each affected model.

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Typical Swing Transmission Shown.

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GRADALL Product Support Information

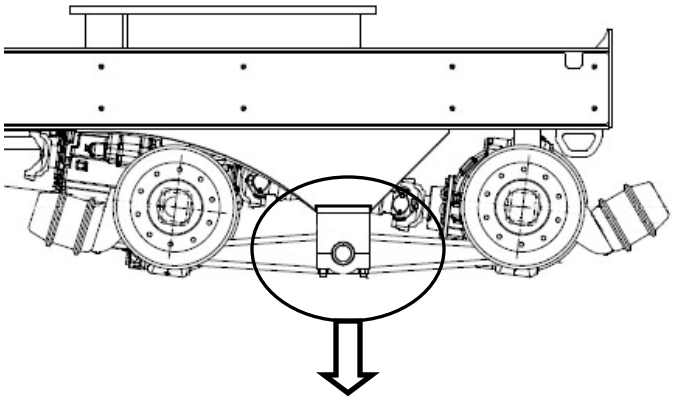
Subject: Rear Axle Walking Beam Clearance

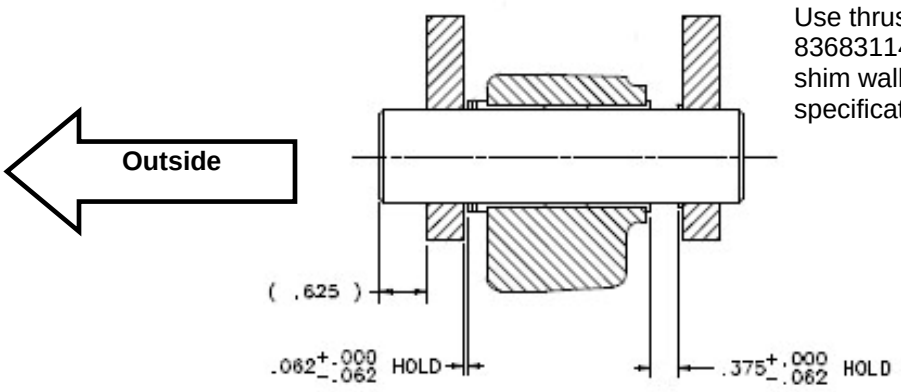
Affected Model: XL4100-II, XL4100-III, XL5100-III

Affected Units: All machines of affected models

The rear axles of the subject machines use walking beams for suspension. The walking beams are shimmed for proper fit to the suspension brackets on the chassis frame. Due to normal wear and changes in specifications during the production of the affected models, excess clearance can exist. Excess clearance at the walking beam pivots can result in noise while driving and affect excavator controllability, especially in the swing and boom hoist functions

Corrective Action: It is recommended the walking beam clearance to the frame be checked once a year or 1500 hours whichever comes first. Also the walking beam clearance should be checked if an unusual banging or slapping noise is heard at the rear of the machine or if the operator reports roughness or bouncing while swinging the excavator or raising or lowering the boom. The walking beam uses thrust washer P/N 83683114 (1/8", 3 mm) to set clearance between the walking beam and suspension support brackets on both sides of the machine





Use thrust washers P/N 83683114 as required to shim walking beams to specification.

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Roadranger®

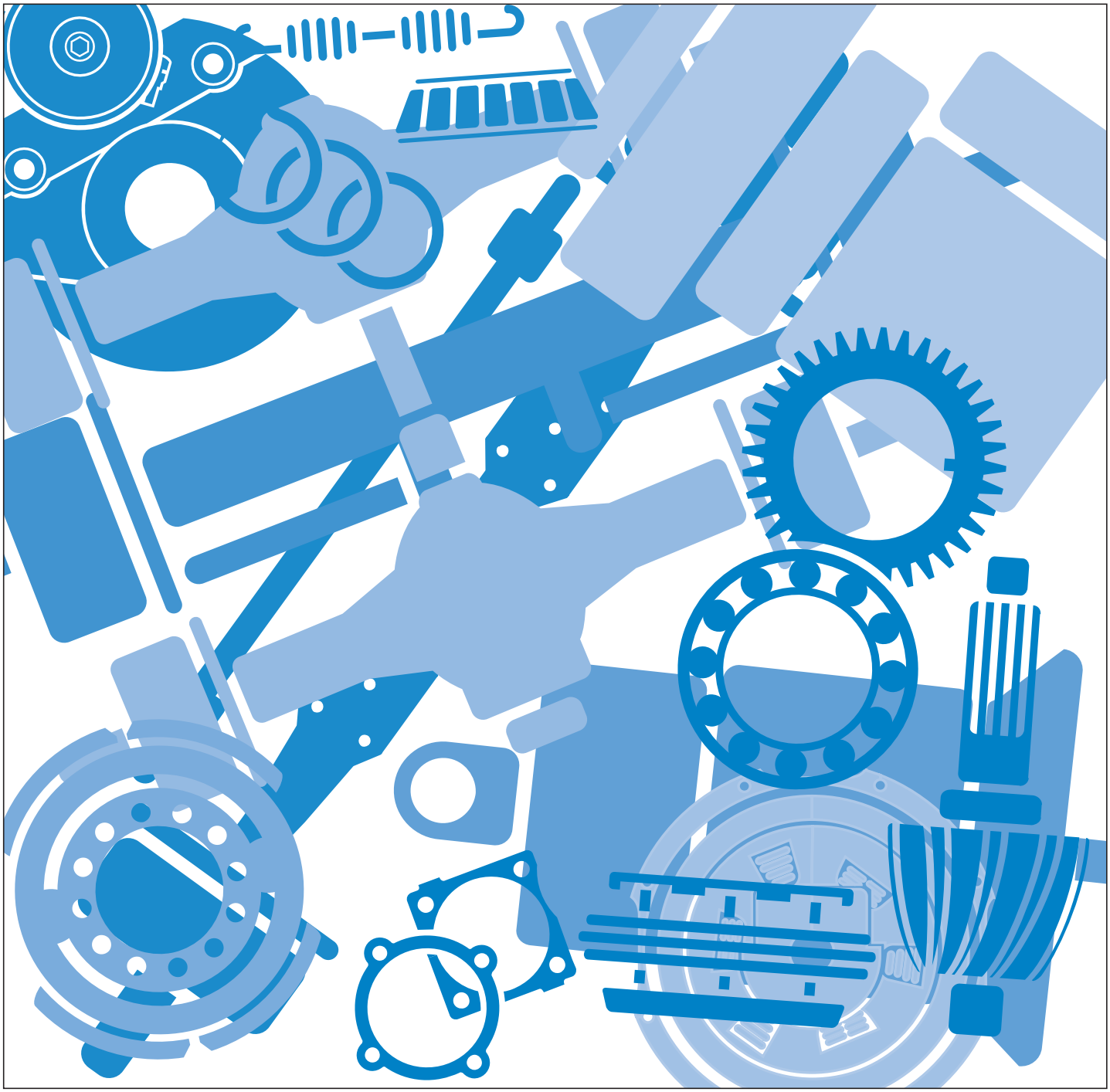
Eaton® Fuller® Heavy Duty Transmissions

8608L Series	12609 Series	14613 Series
11608LL Series	13609 Series	15613 Series
14608LL Series	14609 Series	11813 Series
11609 Series	11613 Series	14813 Series

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One Great Drivetrain from Two Great Companies

Service Manual TRSM-0430 December 1993



For the most current information, visit the Roadranger web site at www.roadranger.com

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FOREWORD

This manual is designed to provide detailed information necessary to service and repair the Fuller® Transmission listed on the cover.

As outlined in the Table of Contents, the manual is divided into 3 main sections:

a. Technical information and reference
b. Removal, disassembly, reassembly and installation
c. Options

The format of the manual is designed to be followed in its entirety if complete disassembly and reassembly of the transmission is necessary. But if only one component of the transmission needs to be repaired, refer to the Table of Contents for the page numbers showing that component. For example, if you need to work on the Shifting Controls, you will find instructions for removal, disassembly and reassembly on page 48. Instructions for installation are on page 174. Service Manuals, Illustrated Parts Lists, Drivers Instructions, and other forms of product service information for these and other Fuller Transmissions are available upon request. A Technical Literature Order Form may be found in the back of this manual. You may also obtain Service Bulletins, detailing information on product improvements, repair procedures and other service-related subjects by writing to the following address:

EATON CORPORATION
TRANSMISSION DIVISION
Technical Service Department
P.O. Box 4013
Kalamazoo, Michigan 49003
(616) 342-3344

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MODEL DESIGNATIONS AND SPECIFICATIONS

Nomenclature:

RTOF-11609A

- **Roadranger®**
- **Twin Countershaft**
- **Overdrive**
- **X = Overdrive model with a direct shift pattern, replacing "O" designation (RTXF-11609A).**
- **Forward position of gear shift lever. Does not affect shift pattern.**
- **Ratio Set**
- **Forward Speeds**
- **Multi-Mesh Gearing**
- **× 100 = Nominal Torque Capacity**

IMPORTANT: All Eaton Fuller Transmissions are identified by model and serial number. This information is stamped on the transmission identification tag and affixed to the case.
DO NOT REMOVE OR DESTROY THE TRANSMISSION IDENTIFICATION TAG.

8-Speed "LL" Series Transmissions

Models	No. Spds.	Gear Ratios											Relative Speed PTO Gear To Input R.P.M.		1 Length In. (mm)	2 Weight Lbs. (Kg.)	3 Oil Cap Pints (Liters)
		LowLow	Low	1st	2nd	3rd	4th	5th	6th	7th	8th	Reverse	Right	Left			
RTO-11608LL	8+2	14.05	9.41	6.23	4.62	3.40	2.53	1.83	1.36	1.00	.74	2.89/9.83 14.69	.935	.935	32.1 (815)	644 (289.8)	29 (13.6)
RTO-14608LL	8+2	14.66	9.41	6.23	4.62	3.40	2.53	1.83	1.36	1.00	.74	2.89/9.83 15.33	.935	.935	33.6 (853.4)	698 (314.1)	29 (13.6)

RT-8608L Series Transmissions

Models	No. Spds.	Gear Ratios										Relative Speed PTO Gear To Input R.P.M.		1 Length In. (mm)	2 Weight Lbs. (Kg.)	3 Oil Cap Pints (Liters)
		Low	1st	2nd	3rd	4th	5th	6th	7th	8th	Reverse	Right	Left			
RT-8608L	9	17.21	10.23	7.23	5.24	3.83	2.67	1.89	1.37	1.00	4.70/17.99	.575	.575	28.9 (734.0)	666 (299.7)	27 (12.69)

CHART NOTES:

1 Lengths measured from face of clutch housing to front bottoming surface of companion flange or yoke.

2 Weight — Listed weights are ***without*** clutch housing. Weights include standard controls, which consist of gear shift lever housing, gear shift lever, range and splitter controls and attaching lines. Weight of standard controls is approximately 10 lbs. (4.5 kg). All weights are approximate.

3 Oil Capacities are approximate, depending on inclination of engine and transmission. Always fill transmission with proper grade and type of lubricant to level of filler opening. See LUBRICATION.

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MODEL DESIGNATIONS AND SPECIFICATIONS

Speed Transmissions

Models	No. Spds.	Gear Ratios										Relative Speed PTO Gear To Input R.P.M.		1 Length In. (mm)	2 Weight Lbs. (Kg.)	3 Oil Cap Pints (Liters)
		Low	1st	2nd	3rd	4th	5th	6th	7th	8th	Reverse	Right	Left			
RT-11609A	9	12.65	8.38	6.22	4.57	3.40	2.46	1.83	1.34	1.00	3.89 / 13.22	.696	.696	28.9 (734)	590 (265.5)	27 (12.69)
RTO-11609A	9	9.41	6.23	4.62	3.40	2.53	1.83	1.36	1.00	.74	2.89 / 9.83	.935	.935	28.9 (734)	590 (265.5)	27 (12.69)
RTO-11609B	9	12.56	7.47	5.28	3.82	2.79	1.95	1.38	1.00	.73	3.43 / 13.14	.788	.788	28.9 (734)	590 (265.5)	27 (12.69)
RT-12609A	9	12.65	8.38	6.22	4.57	3.40	2.46	1.83	1.34	1.00	3.89 / 13.22	.696	.696	28.9 (734)	602 (270)	27 (12.69)
RTO-12609A	9	9.41	6.23	4.62	3.40	2.53	1.83	1.36	1.00	.74	2.89 / 9.83	.935	.935	28.9 (734)	602 (270)	27 (12.69)
RTO-12609B	9	12.56	7.47	5.28	3.82	2.79	1.95	1.38	1.00	.73	3.43 / 13.14	.788	.788	28.9 (734)	602 (270)	27 (12.69)
RT-13609A	9	12.65	8.38	6.22	4.57	3.40	2.46	1.83	1.34	1.00	3.89 / 13.22	.696	.696	28.9 (734)	679 (308)	27 (13)
RTX-13609A	9	9.41	6.23	4.62	3.40	2.53	1.83	1.36	1.00	.74	2.89 / 9.83	.935	.935	28.9 (734)	679 (308)	27 (13)
RTX-13609B	9	12.56	7.47	5.28	3.82	2.79	1.95	1.38	1.00	.73	3.43 / 13.14	.788	.788	28.9 (734)	679 (308)	27 (13)
RT-14609A	9	12.65	8.38	6.22	4.57	3.40	2.46	1.83	1.34	1.00	3.89 / 13.22	.696	.696	29.5 (749)	616 (277.2)	27 (12.69)
RTO-14609A	9	9.41	6.23	4.62	3.40	2.53	1.83	1.36	1.00	.74	2.89 / 9.83	.935	.935	29.5 (749)	616 (277.2)	27 (12.69)
RTO-14609B	9	12.56	7.47	5.28	3.82	2.79	1.95	1.38	1.00	.73	3.43 / 13.14	.788	.788	29.5 (749)	616 (277.2)	27 (12.69)

Models	No. Spds.	Gear Ratios										Relative Speed PTO Gear To Input R.P.M.		1 Length In. (mm)	2 Weight Lbs. (Kg.)	3 Oil Cap Pints (Liters)
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	Reverse	Right	Left			
RTX-11609P	9	10.58	7.55	5.39	3.83	2.77	1.97	1.41	1.00	.83	2.89 / 11.06	.935	.935	28.9 (734)	590 (265.5)	27 (12.69)
RTX-12609P	9	10.58	7.55	5.39	3.83	2.77	1.97	1.41	1.00	.83	2.89 / 11.06	.935	.935	28.9 (734)	602 (270.9)	27 (12.69)
RTX-13609P	9	10.58	7.55	5.39	3.83	2.77	1.97	1.41	1.00	.83	2.89 / 11.06	.935	.935	28.9 (734)	679 (308)	27 (13)
RTX-14609P	9	10.58	7.55	5.39	3.83	2.80	2.01	1.41	1.00	.83	2.89 / 11.06	.935	.935	29.5 (749.3)	616 (277.2)	27 (12.69)
RTX-11609R	9	10.58	7.55	5.39	3.83	2.77	1.97	1.41	1.00	.80	2.89 / 11.06	.935	.935	28.9 (734)	590 (265.5)	27 (12.69)
RTX-12609R	9	10.58	7.55	5.39	3.83	2.77	1.97	1.41	1.00	.80	2.89 / 11.06	.935	.935	28.9 (734)	602 (270.9)	27 (12.69)
RTX-13609R	9	10.58	7.55	5.39	3.83	2.77	1.97	1.41	1.00	.80	2.89 / 11.06	.935	.935	28.9 (734)	679 (308)	27 (13)
RTX-14609R	9	10.58	7.55	5.39	3.83	2.80	2.01	1.41	1.00	.80	2.89 / 11.06	.935	.935	29.5 (749.3)	616 (277.2)	27 (12.69)

13-Speed Transmissions

Models	No. Spds.	Gear Ratios													Relative Speed PTO Gear To Input R.P.M.		1 Length In. (mm)	2 Weight Lbs. (Kg.)	3 Oil Cap Pints (Liters)
		Low	1st	2nd	3rd	4th	5UD	5th	6UD	6th	7UD	7th	8UD	8th	Reverse	Right	Left			
RT-11613	13	12.56	8.32	6.18	4.54	3.38	2.86	2.46	2.12	1.83	1.56	1.34	1.16	1.00	3.89 / 13.13	.696	.696	32.1 (815)	653 (293.8)	28 (13.2)
RT-14613	13	12.56	8.32	6.18	4.54	3.38	2.86	2.46	2.12	1.83	1.56	1.34	1.16	1.00	3.89 / 13.13	.696	.696	32.4 (823)	665 (299.2)	29 (13.6)
RT-15613	13	12.56	8.32	6.18	4.54	3.38	2.86	2.46	2.12	1.83	1.56	1.34	1.16	1.00	3.89 / 13.13	.696	.696	32.4 (823)	685 (308.2)	29 (13.6)
		Low	1st	2nd	3rd	4th	5th	5OD	6th	6OD	7th	7OD	8th	8OD						
RTO-11613	13	12.56	8.32	6.18	4.54	3.38	2.46	2.15	1.83	1.60	1.34	1.17	1.00	.87	3.89 / 13.13	.696	.696	32.1 (815)	653 (293.8)	28 (13.2)
RTOO-11613	13	12.12	7.21	5.09	3.69	2.70	1.95	1.66	1.38	1.17	1.00	.85	.73	.62	3.43 / 12.68	.788	.788	32.1 (815)	653 (293.8)	28 (13.2)
RTO-14613	13	12.56	8.32	6.18	4.54	3.38	2.46	2.15	1.83	1.60	1.34	1.17	1.00	.87	3.89 / 13.13	.696	.696	32.4 (823)	665 (299.2)	29 (13.6)
RTOO-14613	13	12.13	7.21	5.09	3.69	2.70	1.95	1.66	1.38	1.17	1.00	.85	.73	.62	3.43 / 12.68	.788	.788	32.4 (823)	665 (299.2)	29 (13.6)
RTO-15613	13	12.56	8.32	6.18	4.54	3.38	2.46	2.15	1.83	1.60	1.34	1.17	1.00	.87	3.89 / 13.13	.696	.696	32.4 (823)	685 (308.6)	29 (13.6)

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LUBRICATION

Proper Lubrication . . . the Key to long transmission life

Proper lubrication procedures are the key to a good all-around maintenance program. If the oil is not doing its job, or if the oil level is ignored, all the maintenance procedures in the world are not going to keep the transmission running or assure long transmission life.

Eaton® Fuller® Transmissions are designed so that the internal parts operate in a bath of oil circulated by the motion of gears and shafts.

Thus, all parts will be amply lubricated if these procedures are closely followed:

1. **Maintain oil level. Inspect regularly.**
2. **Change oil regularly.**
3. **Use the correct grade and type of oil.**
4. **Buy from a reputable dealer.**

Lubrication Change and Inspection

Eaton® Roadranger® CD50 Transmission Fluid	
HIGHWAY USE	
First 3,000 to 5,000 miles (4827 to 8045 Km)	Factory fill Initial drain,
Every 10,000 miles (16090 Km)	Check fluid level. Check for leaks.
Every 250,000 miles (402336 Km)	Change transmission fluid.
OFF-HIGHWAY USE	
First 30 hours	Factory fill Initial drain.
Every 40 hours	Inspect fluid level, Check for leaks.
Every 500 hours	Change transmission fluid where severe dirt conditions exist.
Every 1,000 hours	Change transmission fluid (Normal off-highway use).

Heavy Duty Engine Lubricant or Mineral Gear Lubricant	
HIGHWAY USE	
First 3,000 to 5,000 miles (4827 to 8045 Km)	Factory fill initial drain.
Every 10,000 miles (16090 Km)	Inspect lubricant level. Check for leaks.
Every 50,000 miles (80450 Km)	Change transmission lubricant.
OFF-HIGHWAY USE	
First 30 hours	Change transmission lubricant on new units.
Every 40 hours	Inspect lubricant level. Check for leaks,
Every 500 hours	Change transmission lubricant where severe dirt conditions exist.
Every 1,000 hours	Change transmission lubricant (Normal of highway use),

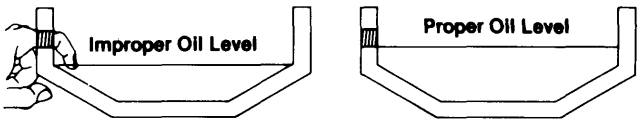
Recommended Lubricants

Type	Grade (SAE)	Fahrenheit (Celsius) Ambient Temperature
Eaton® Roadranger® CD50 Transmission Fluid	**50**	**All**
Heavy Duty Engine 011 MIL-L-2104B, C or D or API-SF or API-CD (Prewous API designations acceptable)	50 40 30	Above 10"E(-12"C.) Above 10"F.(-12"C,) Below 1O"F,(-12"C,)
Mineral Gear Oil with rust and oxidation inhibitor API-GL-1	90 80W	Above 1O"F,(-12"C.) Below IO"F.(-12°C,)

The use of mild EP gear oil or multi-purpose gear oil is not recommended, but if these gear oils are used, be sure to adhere to the following limitations:

Do not use mild EP gear oil or multi-purpose gear oil when operating temperatures are above 230°F (110°C). Many of these gear oils, particularly 85W140, break down above 230°F and coat seals, bearings and gears with deposits that may cause premature failures. If these deposits are observed (especially a coating on seal areas causing oil leakage), change to Eaton Roadranger CD50 transmission fluid, heavy duty engine oil or mineral gear oil to assure maximum component life and to maintain your warranty with Eaton. (Also see "Operating Temperatures".)

Additives and friction modifiers are not recommended for use in Eaton Fuller transmissions.



Proper Oil Level

Make sure oil is level with filler opening. Because you can reach oil with your finger does not mean oil is at proper level. **One inch of oil level is about one gallon of oil.**

Draining Oil

Drain transmission while oil is warm. To drain oil remove the drain plug at bottom of case. Clean the drain plug before re-installing.

Refilling

Clean case around filler plug and remove plug from side of case. Fill transmission to the level of the filler opening. If transmission has two filler openings, fill to level of both openings.

The exact amount of oil will depend on the transmission inclination and model. Do not over fill—this will cause oil to be forced out of the transmission,

When adding oil, types and brands of oil should not be mixed because of possible incompatibility.

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LUBRICATION

Operating Temperatures —With Eaton® Roadranger® CD50 Transmission Fluid Heavy Duty Engine Oil and Mineral Oil

The transmission should not be operated consistently at temperatures above 250°F (120°C). However, intermittent operating temperatures to 300°F (149°C) will not harm the transmission. Operating temperatures above 250°F increase the lubricant's rate of oxidation and shorten its effective life. When the average operating temperature is above 250°F, the transmission may require more frequent oil changes or external cooling.

The following conditions in any combination can cause operating temperatures of over 250°F: (1) operating consistently at slow speeds, (2) high ambient temperatures, (3) restricted air flow around transmission, (4) exhaust system too close to transmission, (5) high horsepower, overdrive operation.

External oil coolers are available to reduce operating temperatures when the above conditions are encountered.

Transmission Oil Coolers are:

Recommended

— With engines of 350 H.P. and above with overdrive transmissions

Required

— With engines 399 H.P. and above with overdrive transmissions and GCW'S over 90,000 lbs.

— With engines 399 H.P. and above and 1400 Lbs.-Ft. or greater torque

— With engines 450 H.P. and above

— With EP or Multipurpose Gear Oil

Mild EP gear oil and multipurpose gear oil are not recommended when lubricant operating temperatures are above 230°F (110°C). In addition, transmission oil coolers are not recommended with these gear oils since the oil cooler materials may be attacked by these gear oils. **The lower temperature limit and oil cooler restriction with these gear oils generally limit their success to milder applications.**

Proper Lubrication Levels as Related to Transmission Installation Angles

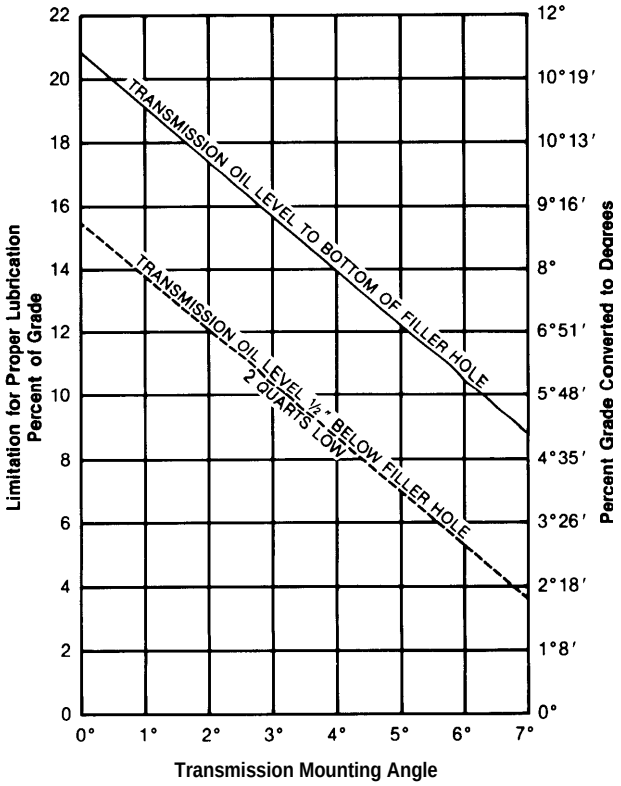
If the transmission operating angle is more than 12 degrees, improper lubrication can occur. The operating angle is the transmission mounting angle in the chassis plus the percent of upgrade (expressed in degrees).

The chart below illustrates the safe percent of upgrade on which the transmission can be used with various chassis mounting angles. For example: if you have a 4 degree transmission mounting angle, then 8 degrees (or 14 percent of grade) is equal to the limit of 12 degrees. If you have a O degree mounting angle, the transmission can be operated on a 12 degree (21 percent) grade.

Anytime the transmission operating angle of 12 degrees is exceeded for an extended period of time the transmission should be equipped with an oil pump or cooler kit to insure proper lubrication.

Note on the chart the effect low oil levels can have on safe operating angles. Allowing the oil level to fall 1/2" below the filler plug hole reduces the degree of grade by approximately 3 degrees (5.5 percent).

Proper Lubrication Levels are Essential!



Dotted line showing "2 Quarts Low" is for reference only. Not recommended.

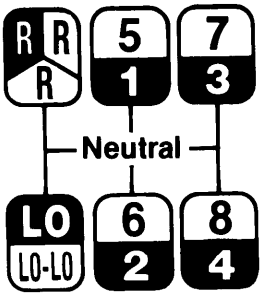
https://truckmanualshub.com/

OPERATION

8-Speed "LL" Series Transmissions

Shift Lever Patterns and Shifting Controls

RTX (Overdrive) Models



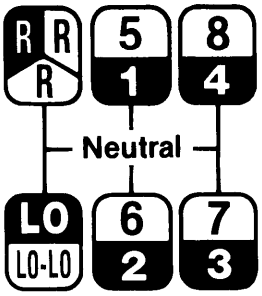
14651



A-5015



RTO (Overdrive) Models

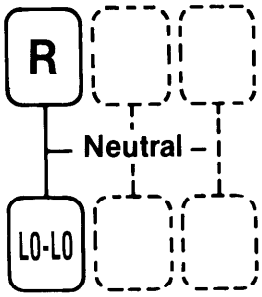


With Deep Reduction Lever/ Button in the "OUT"/REARWARD position . . .

Shift LO-1-2-3-4 in LOW RANGE.

Range Shift . . .

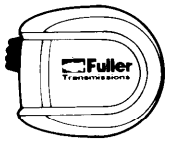
Shift 5-6-7-8 in HIGH RANGE.

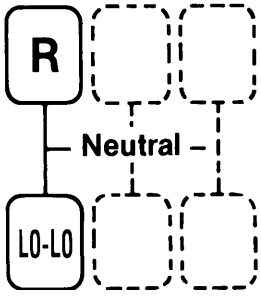


14651



A-5015

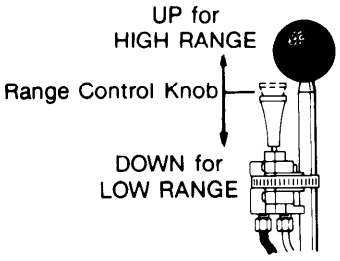




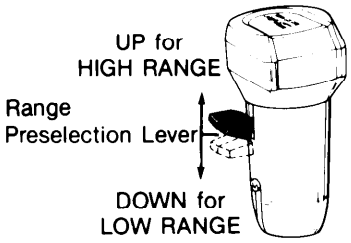
WHILE IN LOW RANGE ONLY and shift lever in LO . . .

LO-LO can be obtained by moving Deep Reduction Lever/Button to the "IN"/FORWARD position.

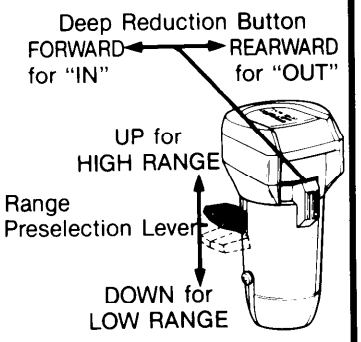
Range Control Valve (A-3546)



Roadranger Valve (A-5010)



Roadranger Valve (A-5015)

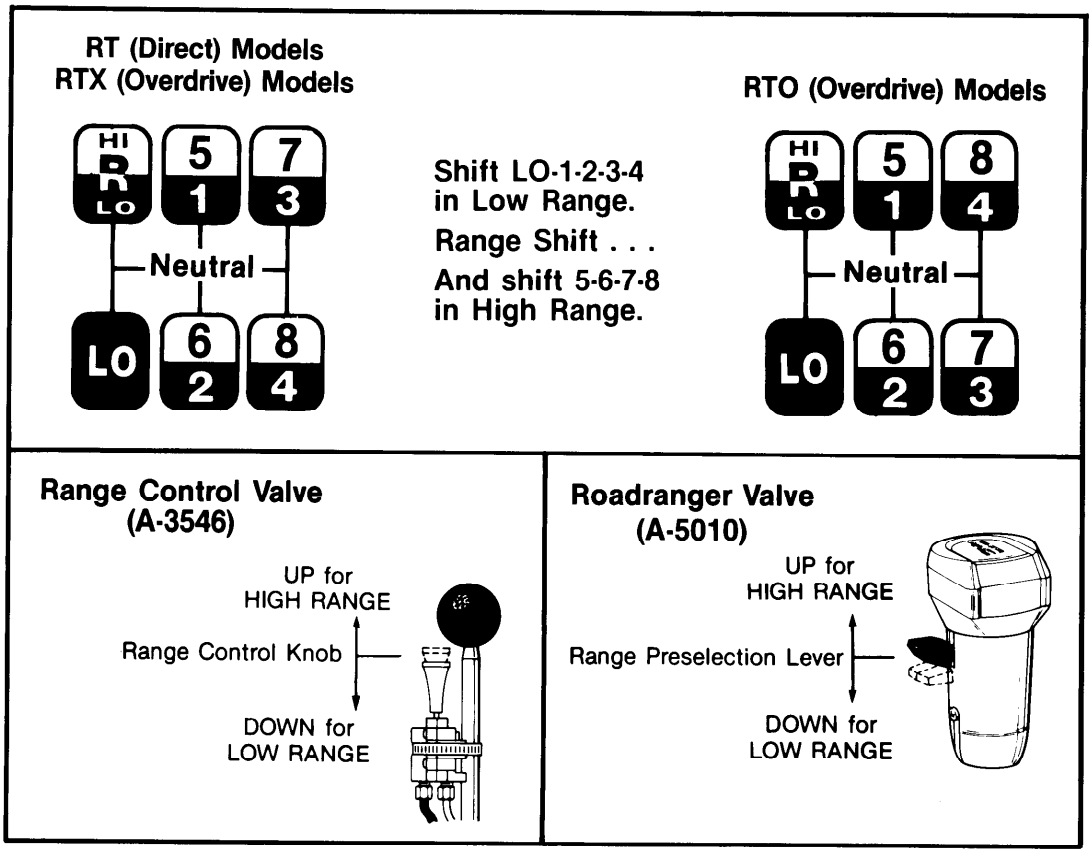


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OPERATION

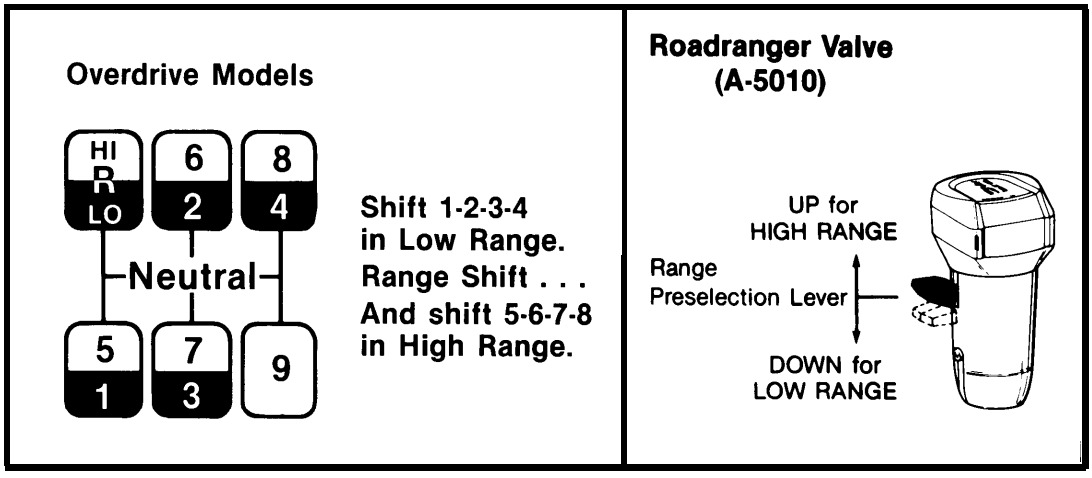
9-Speed and RT-8608L Transmissions

Shift Lever Patterns and Shifting Controls



RTX-11609P and RTX-11609R Transmissions
RTX-12609P and RTX-12609R Transmissions
RTX-14609P and RTX-14609R Transmissions

Shift Lever Patterns and Shifting Controls

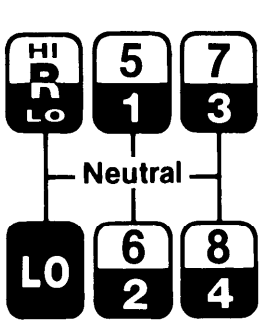


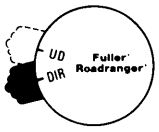
https://truckmanualshub.com/

OPERATION

13-Speed Underdrive Models

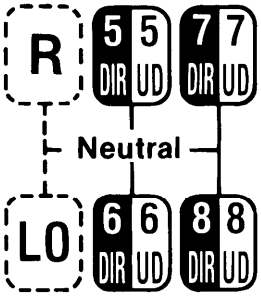
Shift Lever Patterns and Shifting Controls

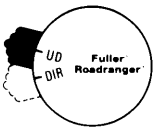






With Splitter Control Button in "DIR."/ REARWARD position . . .
Shift LO-1-2-3-4 in LOW RANGE.
Range shift . . .
And shift 5-6-7-8 in HIGH RANGE (Direct).



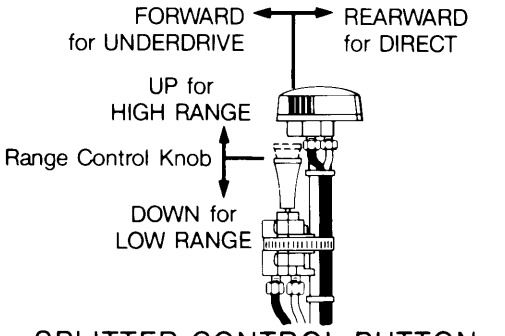




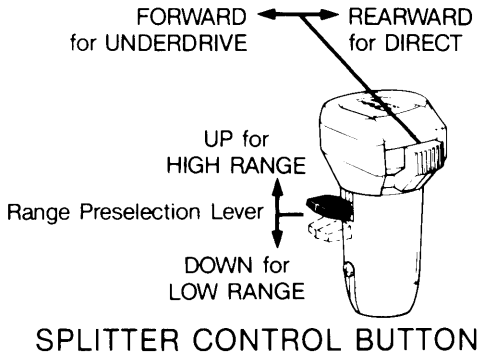
WHILE IN HIGH RANGE ONLY . . .
Ratios can be split by moving Splitter Control Button to the "U.D."/ FORWARD position to gain UNDERDRIVE 5-6-7-8.

Two-Position Splitter Control Valve (A-4493)

Range Control Valve (A-3546)



Roadranger Valve (A-4900)



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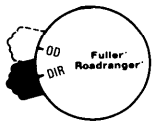
OPERATION

13-Speed Overdrive Models

Shift Lever Patterns and Shifting Controls

RTO (Overdrive) Models
RTOX (Double-Overdrive) Models

RTOO (Double-Overdrive) Models



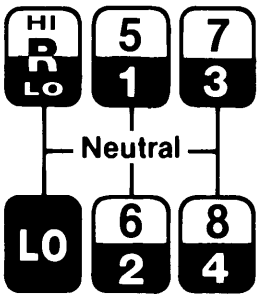


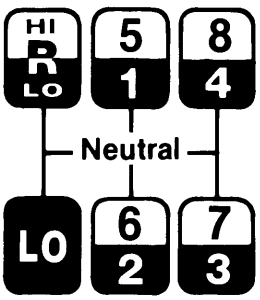
With Splitter Control Button in "DIR."/REARWARD position . . .

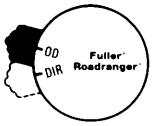
Shift LO-1-2-3-4 in LOW RANGE.

Range shift . . .

And shift 5-6-7-8 in HIGH RANGE (Direct).

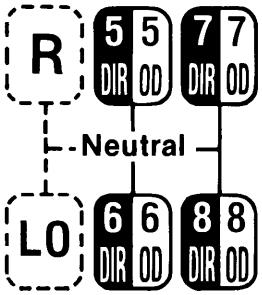


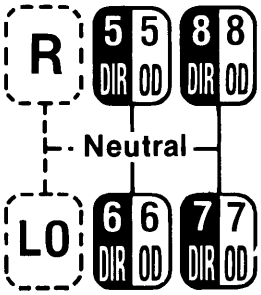






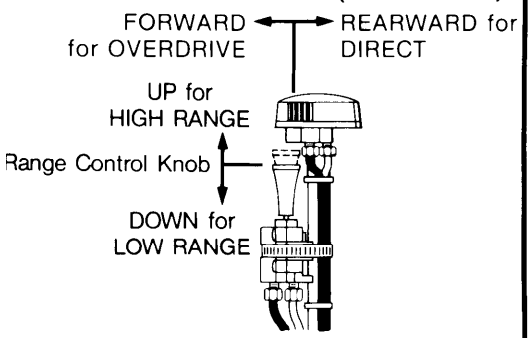
WHILE IN HIGH RANGE ONLY . . .
Ratios can be split by moving Splitter Control Button to the "O.D."/ FORWARD position to gain OVERDRIVE 5-6-7-8.





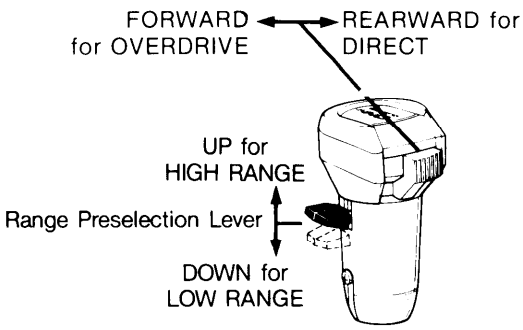
Range Control Valve (A-3546)

Two-Position Splitter Control Valve (A-4491/4494)



SPLITTER CONTROL BUTTON

Roadranger Valve (A-4900)



SPLITTER CONTROL BUTTON

https://truckmanualshub.com/

POWER FLOW

The transmission must efficiently transfer the engine's power, in terms of torque, to the vehicle's rear wheels. Knowledge of what takes place in the transmission during torque transfer is essential when trouble-shooting and making repairs become necessary.

Front Section Power Flow (All Models)

1. Power (torque) from the vehicle's engine is transferred to the transmission's input shaft.
2. Splines of input shaft engage internal splines in hub of main drive gear.
3. Torque is split between the two countershaft drive gears.
4. Torque is delivered along both countershaft to mating countershaft gears of "engaged" mainshaft gear. The following cross section views (Figures 2-4) illustrate a 1st/5th speed gear engagement. Figure 1 illustrates the engagement of the Lo Speed Gear.
5. Internal clutching teeth in hub of engaged mainshaft gear transfers torque to mainshaft through sliding clutch.
6. Mainshaft transfers torque directly to auxiliary drive gear.

Auxiliary Section Power Flow: LO-LO (8-Speed "LL" Models)

7. The auxiliary drive gear splits torque between the two auxiliary countershaft drive gears.
8. Torque is delivered along both auxiliary countershaft to the mating "engaged" deep reduction gear on output shaft.
9. Torque is transferred to output shaft through sliding clutch.
10. Output shaft delivers torque to driveline as LO-LO.

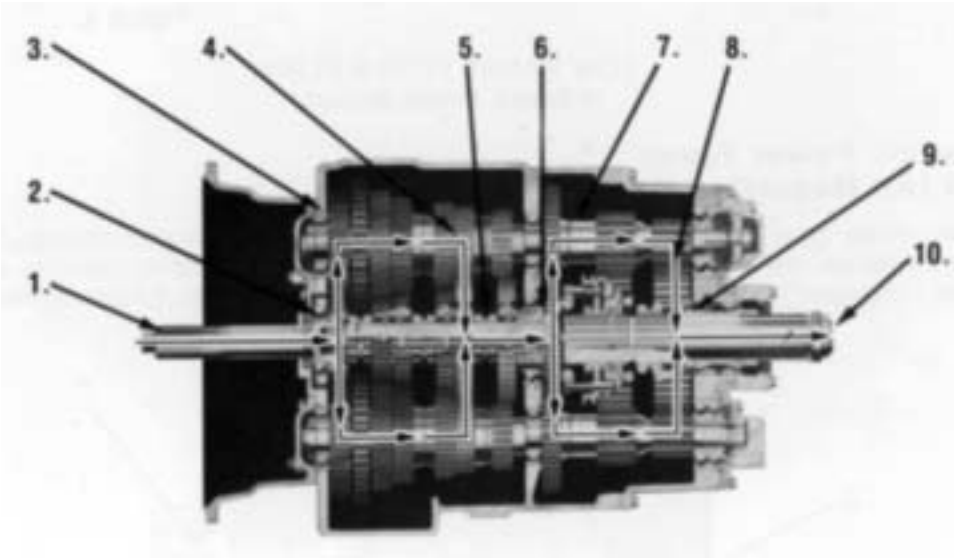


Figure 1.

PR15

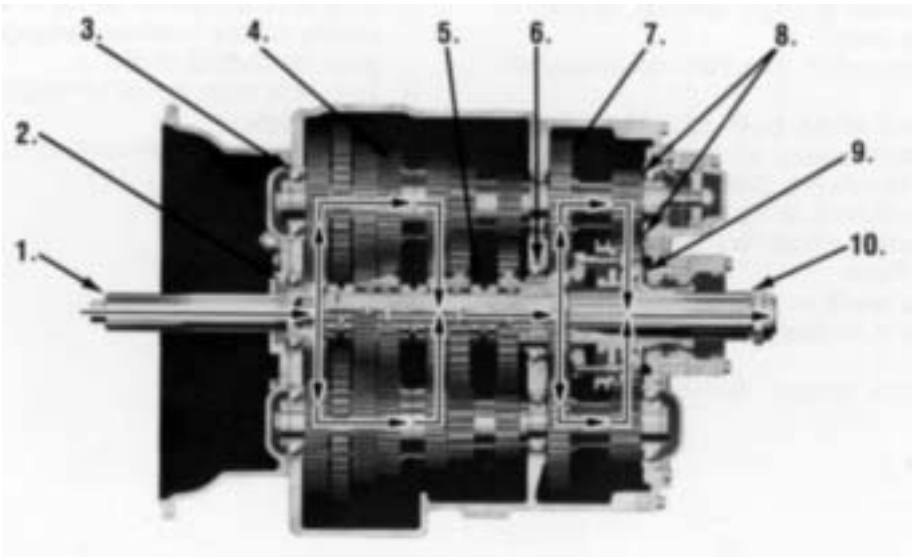
LO-LO POWER FLOW

https://truckmanualshub.com/

POWER FLOW

Auxiliary Section Power Flow: LOW RANGE (All Models)

7. The auxiliary drive gear splits torque between the two auxiliary countershaft drive gears.
8. Torque is delivered along both countershaft to "engaged" low range gear on range mainshaft or output shaft.
9. Torque is transferred to range mainshaft or output shaft through sliding clutch.
10. Torque is delivered to driveline as LOW RANGE 1st.



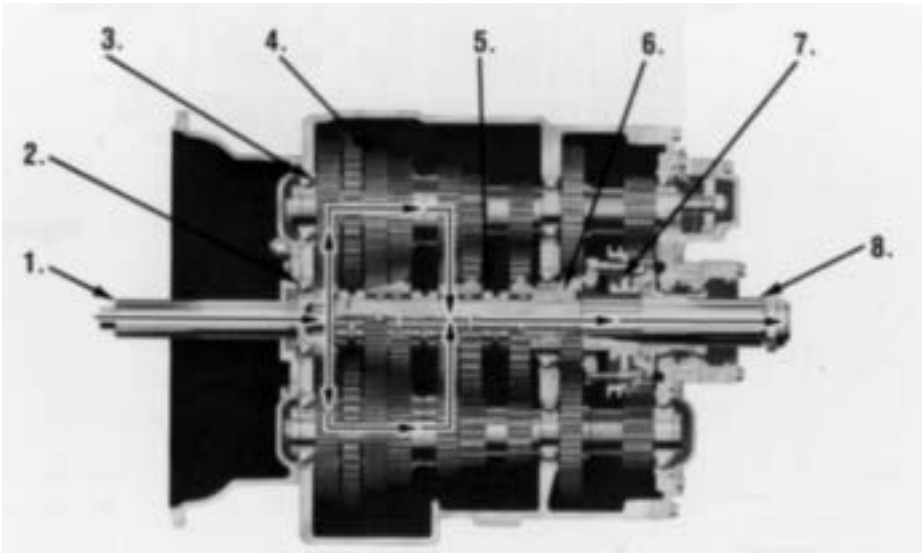
PL1O

Figure 2.

LOW RANGE POWER FLOW
(9-Speed Model Shown.)

Auxiliary Section Power Flow: HIGH RANGE (All Models)

7. The auxiliary drive gear transfers torque directly to the range mainshaft or output shaft through "engaged" sliding clutch.
8. Torque is delivered through range mainshaft and/or output shaft to driveline as HIGH RANGE 5th. 5th direct with 13-speed models.



PH1O

Figure 3.

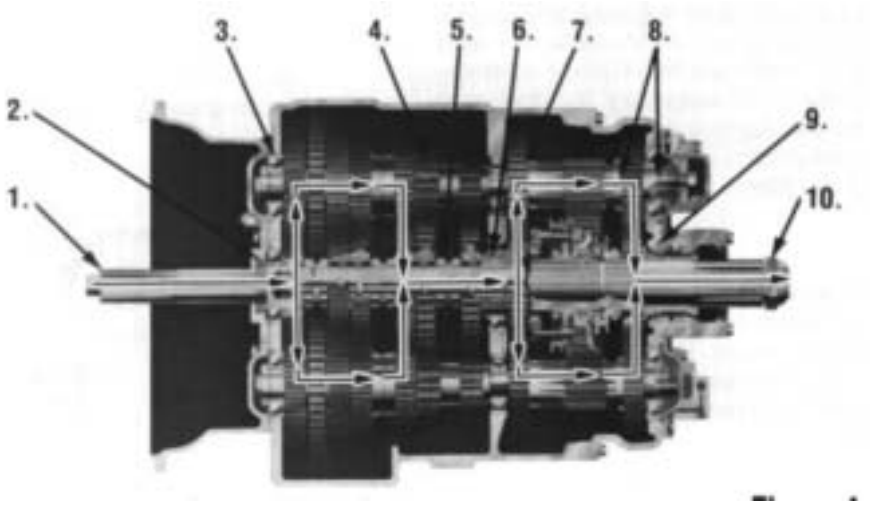
HIGH RANGE POWER FLOW
(9-Speed Model Shown.)

https://truckmanualshub.com/

POWER FLOW

Auxiliary Section Power Flow: UNDERDRIVE/OVERDRIVE (13-Speed Splitter Models ONLY)

7. The auxiliary drive gear splits torque between the two auxiliary countershaft drive gears.
8. Torque is delivered along both auxiliary countershafts to mating countershaft gears of "engaged" underdrive or overdrive splitter gear on output shaft.
9. Torque is transferred to output shaft through sliding clutch.
10. Output shaft delivers torque to driveline as 5th UNDERDRIVE or OVERDRIVE.



Pu/o 10

Figure 4.

UNDERDRIVE/OVERDRIVE POWER FLOW

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TIMING

Timing Procedures: All Models

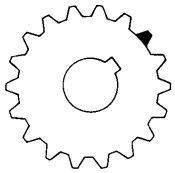
It is essential that both countershaft assemblies of the front and auxiliary sections are "timed." This assures proper tooth contact is made between mainshaft gears seeking to center on the mainshaft during torque transfer and mating countershaft gears that distribute the load evenly. If not properly timed, serious damage to the transmission is likely to result from unequal tooth contact causing the mainshaft gears to climb out of equilibrium.

Timing is a simple procedure of marking the appropriate teeth of a gear set prior to installation and placing them in proper mesh while in the transmission. In the front section, it is necessary to time only the drive gear set. And depending on the model, only the low range, deep reduction, or splitter gear set is timed in the auxiliary section.

Front Section

A. Marking countershaft drive gear teeth.

1. Prior to placing each countershaft assembly into case, clearly mark the tooth located directly over the keyway of drive gear as shown. This tooth is stamped with an "O" to aid identification.

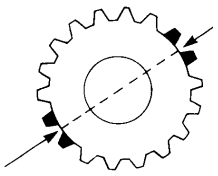


cut 7300

A. TOOTH MARKED ON EACH COUNTERSHAFT DRIVE GEAR FOR TIMING PURPOSES

B. Marking main drive gear teeth.

1. Mark *any* two adjacent teeth on the main drive gear.
2. Mark the two adjacent teeth located directly opposite the first set marked on the main drive gear. As shown below, there should be an equal number of unmarked gear teeth on each side between the marked sets.

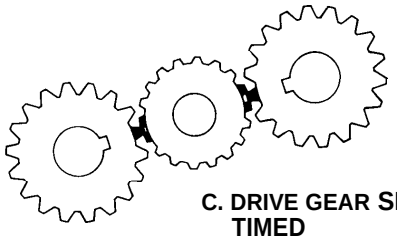


Cut 7300A

B TEETH MARKED ON MAIN DRIVE GEAR FOR TIMING PURPOSES

C. Meshing marked countershaft drive gear teeth with marked main drive gear teeth.
(After placing the mainshaft assembly into case, the countershaft bearings are installed to corn= plete installation of the countershaft assemblies.)

1. When installing the bearings on left counter; shaft, mesh the marked tooth of countershaft drive gear with either set of two marked teeth on the main drive gear.
2. Repeat the procedure when installing the bearings on right countershaft, making use of the remaining set of two marked teeth on the main drive gear to time assembly.



C. DRIVE GEAR SET PROPERLY TIMED

Cut 7300B

Auxiliary Section

A. Timing the deep reduction gear set of 8-speed "LL" models; the low range gear set of 9-speed models; or the splitter gear set of 13-speed models.

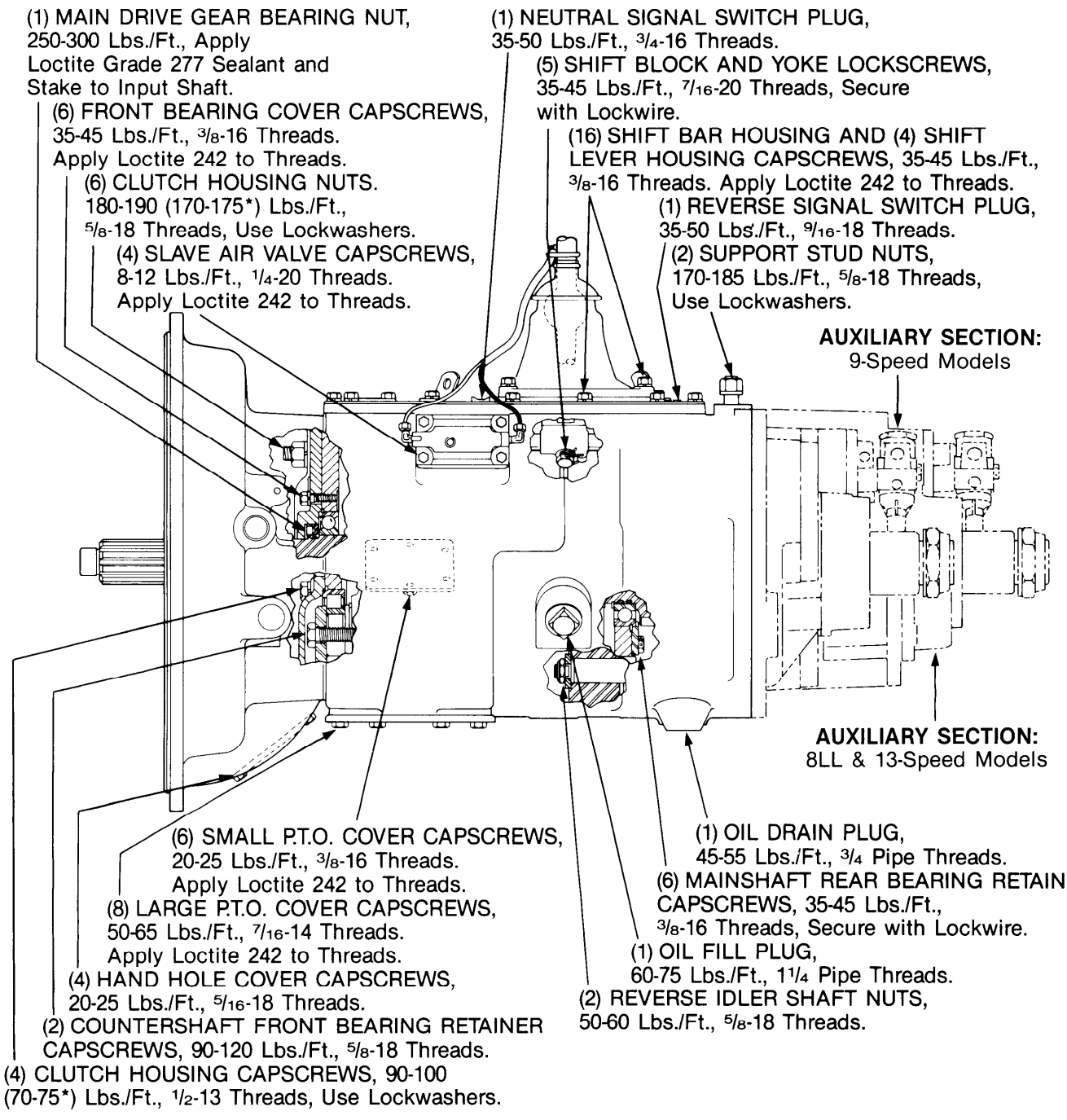
1. Mark *any* two adjacent teeth on the mainshaft gear of set to be timed. Then mark the two adjacent teeth located directly opposite the first set marked as shown in Illustration B.
2. Prior to placing each auxiliary countershaft assembly into housing, mark the tooth stamped with an "O" on gear to mate with timed mainshaft gear as shown in Illustration A.
3. Install the mainshaft gear in position on range mainshaft OR output shaft.
4. Place the auxiliary countershaft assemblies into position and mesh the marked teeth of mating countershaft gears with the marked teeth of mainshaft gear as shown in Illustration C.
5. Fully seat the rear bearings on each countershaft to complete installation.

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TORQUE RECOMMENDATIONS

Correct torque application is extremely important to assure long transmission life and dependable performance. Over-tightening or under-tightening can result in a loose installation and, in many instances, eventually cause damage to transmission gears, shafts, and/or bearings. Use a torque wrench whenever possible to attain recommended lbs./ft. ratings. Do not torque capscrews dry.

FRONT SECTION: ALL MODELS



*With Aluminum Clutch Housing

Cut 7190-11/84

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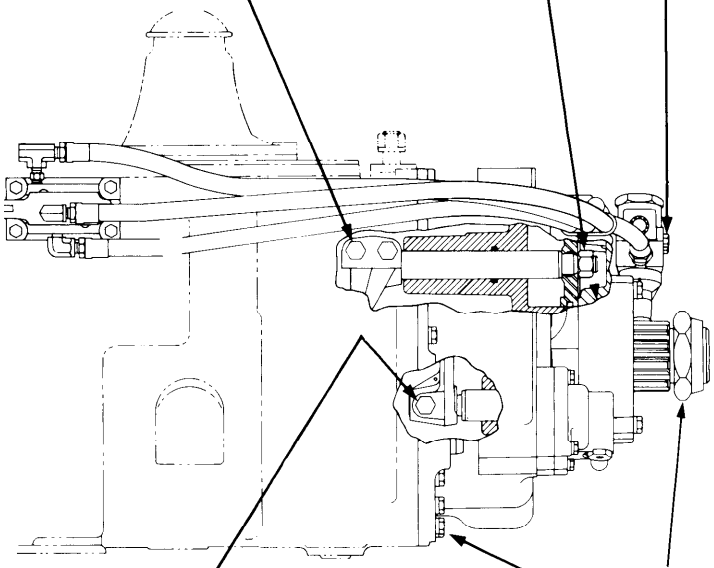
TORQUE RECOMMENDATIONS

AUXILIARY SECTIONS

(2) AIR FILTER/REGULATOR MOUNTING CAPSCREWS 8-12 Lbs./Ft., 1/4-20 Threads. Apply Loctite 242 to Threads.

(1) RANGE CYLINDER SHIFT BAR NUT, 70-85 Lbs./Ft., 5/8-18 Threads.

(2) RANGE SHIFT YOKE CAPSCREWS, 50-65 Lbs./Ft., 1/2-20 Threads, Secure with Lockwire.



(1) REDUCTION OR SPLITTER SHIFT YOKE LOCKSCREW, 35-45 Lbs./Ft., 7/16-20 Threads, Secure with Lockwire.

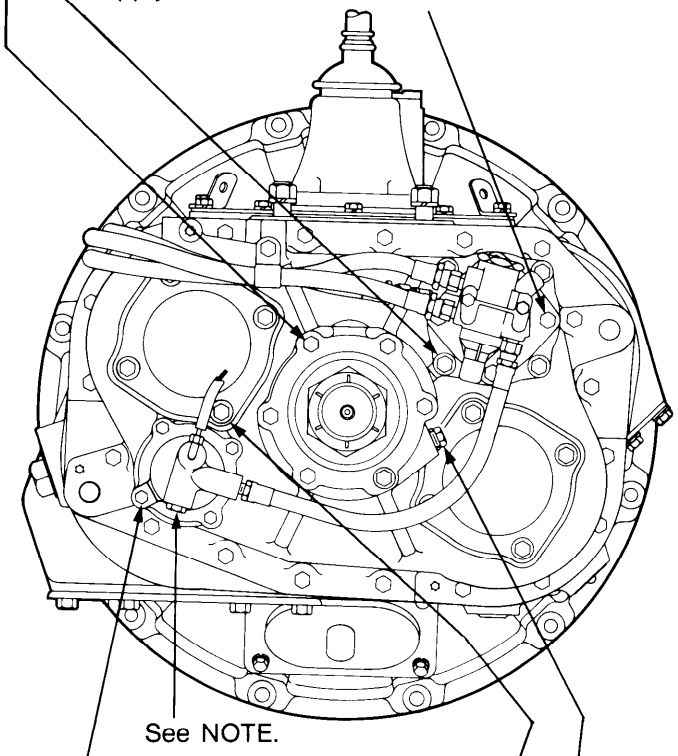
(19) AUXILIARY HOUSING CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.

(1) OUTPUT SHAFT NUT, 450-500 Lbs./Ft., 2-16 Threads Oiled at Vehicle Installation.

(6) MAINSHAFT REAR BEARING COVER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.

(4) RANGE CYLINDER MOUNTING CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.

(4) RANGE CYLINDER COVER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.



See NOTE.

(4) REDUCTION OR SPLITTER CYLINDER COVER CAPSCREWS, 20-25 Lbs./Ft., 5/16-18 Threads. Apply Loctite 242 to Threads.

(8) COUNTERSHAFT REAR BEARING COVER CAPSCREWS, 35-45 Lbs./Ft., 3/8-16 Threads. Apply Loctite 242 to Threads.

(1) SPEEDOMETER HOUSING PLUG, 35-50 Lbs./Ft., 13/16-20 Threads. Apply Loctite 242 to Threads.

NOTE: If insert valve is used in reduction or splitter cylinder cover. . .
(1) RETAINING NUT/PLUG, 40-50 Lbs./Ft., 5/8-18 Threads.

Cut 7191-11/84

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TOOL REFERENCE

Some repair procedures pictured in this manual show the use of specialized tools. Their actual use is recommended as they make transmission repair easier, faster, and prevent costly damage to critical parts.

But for the most part, ordinary mechanic's tools such as socket wrenches, screwdrivers, etc., and other standard shop items such as a press, mauls and soft bars are all that is needed to successfully disassemble and reassemble any Fuller Transmission.

The specialized tools listed below can be obtained from a tool supplier or made from dimensions as required by the individual user. Detailed Fuller Transmission Tool Prints are available upon request by writing.

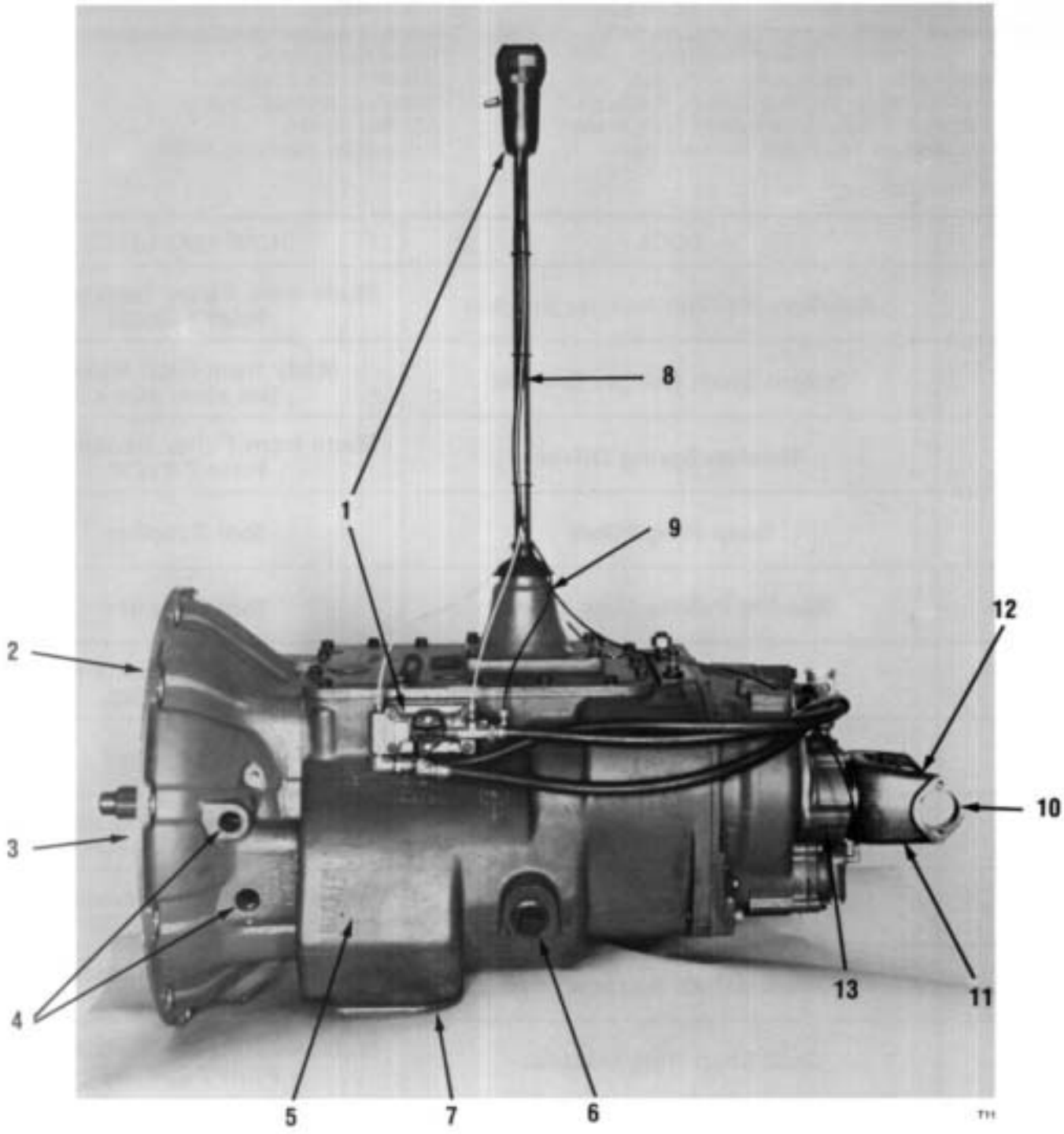
Eaton Corporation
Transmission Division
Technical Service Dept.
P.O. Box 4013
Kalamazoo, Michigan 49003

PAGE	T O O L	HOW OBTAINED
62	Auxiliary Section Hanger Bracket	Made from Fuller Transmission Print T-22823
62	Output Shaft Hanger Bracket	Made from Stop Nut and flat steel stock
54	Tension Spring Driver	Made from Fuller Transmission Print T-11938
66	Snap Ring Pliers	Tool Supplier
67	Bearing Pullers (Jaw-Type)	Tool Supplier
109	Bearing Puller w/Set Screw	Made from Fuller Transmission Print T-10325
137	Impact Puller (1/2-13 Threaded End)	Tool Supplier
130	Bearing Drivers (Flanged-End)	Made from Fuller Transmission Print Series T-18042*
99	Oil Seal Driver	Made from Fuller Transmission Print T-18088-23
167	Countershaft Support Tool	Made from Fuller Transmission Print T-22247
77	Quill Snap Ring Installer	Made from Fuller Transmission Print T-22917-F
173	Torque Wrench, 1000 Lbs./Ft. Capacity	Tool Supplier
170	Input Shaft Nut Installer	Made from Fuller Transmission Print T-22553-A

*Dimensions necessary to determine specific tool number required.

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PREVENTIVE MAINTENANCE



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PREVENTIVE MAINTENANCE

PREVENTIVE MAINTENANCE CHECK CHART

CHECKS WITHOUT PARTIAL DISASSEMBLY OF CHASSIS OR CAB

1. Air System and Connections

a. Check for leaks, worn air lines, loose connections and capscrews. See AIR SYSTEM.

2. Clutch Housing Mounting

a. Check all capscrews of clutch housing flange for looseness.

3. Clutch Release Bearing (Not Shown)

a. Remove hand hole cover and check radial and axial clearance in release bearing.

b. Check relative position of thrust surface of release bearing with thrust sleeve on push-type clutches.

4. Clutch Pedal Shaft and Bores

a. Pry upward on shafts to check wear.

b. If excessive movement is found, remove clutch release mechanism and check bushings in bores and wear on shafts.

5. Lubricant

a. Change at specified service intervals.

b. Use only the types and grades as recommended. See LUBRICATION.

6. Filler and Drain Plugs

a. Remove filler plugs and check level of lubricant at specified intervals. Tighten filler and drain plugs securely.

7. Capscrews and Gaskets

a. **Check all capscrews, especially those on** PTO covers and rear bearing covers for looseness which would cause oil leakage. See TORQUE RECOMMENDATIONS.

b. Check PTO opening and rear bearing covers for oil leakage due to faulty gasket.

8. Gear Shift Lever

a. Check for looseness and free play in housing. If lever is loose in housing, proceed with Check No. 9.

9. Gear Shift Lever Housing Assembly

a. Remove air lines at slave valve and remove the gear shift lever housing assembly from transmission.

b. Check tension spring and washer for set and wear.

c. Check the gear shift lever spade pin and slot for wear.

d. Check bottom end of gear shift lever for wear and check slot of yokes and blocks in shift bar housing for wear at contact points with shift lever.

CHECKS WITH DRIVE LINE DROPPED

10. Universal Joint Companion Flange or Yoke Nut

a. Check for tightness. Tighten to recommended torque.

11. Output Shaft (Not Shown)

a. Pry upward against output shaft to check radial clearance in mainshaft rear bearing.

CHECKS WITH UNIVERSAL JOINT COMPANION FLANGE OR YOKE REMOVED

NOTE: If necessary, use solvent and shop rag to clean sealing surface of companion flange or yoke. DO NOT USE CROCUS CLOTH, EMERY PAPER OR OTHER ABRASIVE MATERIALS THAT WILL MAR SURFACE FINISH.

12. Splines on Output Shaft (Not Shown)

a. Check for wear from movement and chucking action of the universal joint companion flange or yoke.

13. Mainshaft Rear Bearing Cover

a. Check oil seal for wear.

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PRECAUTIONS

Disassembly

It is assumed in the detailed assembly instructions that the lubricant has been drained from transmission, the necessary linkage and air lines disconnected and the transmission has been removed from vehicle chassis. Removal of the gear shift lever housing assembly (or remote control assembly) is included in the detailed instructions (Disassembly and Reassembly - Shifting Controls); however, this assembly MUST be detached from shift bar housing before transmission can be removed.

FOLLOW CLOSELY EACH PROCEDURE IN THE DETAILED INSTRUCTIONS, MAKING USE OF THE TEXT, ILLUSTRATIONS AND PHOTOGRAPHS PROVIDED.

1. **BEARINGS** - Carefully wash and relubricate all reusable bearings as removed and protectively wrap until ready for use. Remove bearings planned to be reused with pullers designed for this purpose.
2. **ASSEMBLIES** - When disassembling the various assemblies, such as the mainshaft, countershaft, and shift bar housing, lay all parts on a clean bench in the same sequence as removed. This procedure will simplify reassembly and reduce the possibility of losing parts.
3. **SNAP RINGS** - Remove snap rings with pliers designed for this purpose. Snap rings removed in this manner can be reused, if they are not sprung or loose.
4. **INPUT SHAFT** - The input shaft can be removed from transmission without removing the countershafts, mainshaft, or main drive gear. Special procedures are required and provided in this manual.
5. **CLEANLINESS** - Provide a clean place to work. It is important that no dirt or foreign material enters the unit during repairs. Dirt is an abrasive and can damage bearings. It is always good practice to clean the outside of the unit before starting the planned disassembly.
6. **WHEN USING TOOLS TO MOVE PARTS** - Always apply force to shafts, housings, etc, with restraint. Movement of some parts is restricted. Never apply force to the part being driven after it stops solidly. The use of soft hammers, bars and mauls for all disassembly work is recommended.

Inspection

Before reassembling the transmission, check each part carefully for abnormal or excessive wear and damage to determine reuse or replacement. When replacement is necessary, use only genuine Fuller Transmission parts to assure continued performance and extended life from your unit.

Since the cost of a new part is generally a small fraction of the total cost of downtime and labor, avoid reusing a questionable part which could lead to additional repairs and expense soon after initial reassembly. To aid in determining the reuse or replacement of any transmission part, consideration should also be given to the unit's history, mileage, application, etc.

Recommended inspection procedures are provided in the following checklist.

A. BEARINGS

1. Wash all bearings in clean solvent. Check balls, rollers and raceways for pitting, discoloration, and spalled areas. Replace bearings that are pitted, discolored, or spalled.
2. Lubricate bearings that are not pitted, discolored, or spalled and check for axial and radial clearances.

   Replace bearings with excessive clearances.
3. Check bearing fits. Bearing inner races should be tight to shaft; outer races slightly tight to slightly loose in case bore. If bearing spins freely in bore, however, the case should be replaced.

B. GEARS

1. Check gear teeth for frosting and pitting. Frosting of gear tooth faces present no threat of transmission failure. Often in continued operation of the unit, frosted gears will "heal" and not progress to the pitting stage. And in most cases, gears with light to moderate pitted teeth have considerable gear life remaining and can be reused. But gears with advanced stage pitting should be replaced.
2. Check for gears with clutching teeth abnormally worn, tapered, or reduced in length from clashing in shifting. Replace gears found in any of these conditions.

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PRECAUTIONS

Inspection (cont'd.)

3. Check axial clearance of gears. Where excessive clearance is found, check gear snap ring, washer, spacer, and gear hub for excessive wear. Maintain .005" to .012" axial clearance between mainshaft gears.

C. SPLINES

1. Check splines on all shafts for abnormal wear. If sliding clutch gears, companion flange, or clutch hub have worn into the sides of the splines, replace the specific shaft affected.

D. TOLERANCE/LIMIT WASHERS

1. Check surfaces of all limit washers. Washers scored or reduced in thickness should be replaced.

E. REVERSE IDLER GEAR ASSEMBLIES

1. Check for excessive wear from action of roller bearings.

F. GRAY IRON PARTS

1. Check all gray iron parts for cracks and breaks. Replace or repair parts found to be damaged. Heavy castings may be welded or brazed provided the cracks do not extend into bearing bores or bolting surfaces. When welding, however, never place the ground so as to allow current to pass through the transmission.

G. CLUTCH RELEASE PARTS

1. Check clutch release parts. Replace yokes worn at cam surfaces and bearing carrier worn at contact pads.

2. Check pedal shafts. Replace those worn at bushing surfaces.

H. SHIFT BAR HOUSING ASSEMBLY

1. Check for wear on shift yokes and blocks at pads and lever slot. Replace excessively worn parts.

2. Check yokes for correct alignment. Replace sprung yokes.

3. Check lockscrews in yokes and blocks. Tighten and rewire those found loose.

4. If housing has been disassembled, check neutral notches of shift bars for wear from interlock balls.

I. GEAR SHIFT LEVER HOUSING ASSEMBLY

1. Check spring tension on shift lever. Replace tension spring and washer if lever moves too freely.

2. If housing is disassembled, check spade pin and corresponding slot in lever for wear. Replace both parts if excessively worn.

J. BEARING COVERS

1. Check covers for wear from thrust of adjacent bearing. Replace covers damaged from thrust of bearing outer race.

2. Check bores of covers for wear. Replace those worn oversize.

K. OIL RETURN THREADS AND SEALS

1. Check oil return threads in front bearing cover. If sealing action of threads has been destroyed by contact with input shaft, replace bearing cover.

2. Check oil seal in rear bearing cover. If sealing action of lip has been destroyed, replace seal.

L. SLIDING CLUTCHES

1. Check all shift yokes and yoke slots in sliding clutches for extreme wear or discoloration from heat.

2. Check engaging teeth of sliding clutches for partial engagement pattern.

M. SYNCHRONIZER ASSEMBLY

1. Check synchronizer for burrs, uneven and excessive wear at contact surface, and metal particles.

2. Check blocker pins for excessive wear or looseness.

3. Check synchronizer contact surfaces on the auxiliary drive and low range gears for excessive wear.

N. O-RINGS

1. Check all O-rings for cracks or distortion. Replace if worn.

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PRECAUTIONS

Reassembly

Make sure that interiors of case and housings are clean. It is important that dirt and other foreign materials be kept out of the transmission during reassembly. Dirt is an abrasive and can damage polished surfaces of bearings and washers. Use certain precautions, as listed below, during reassembly.

1. **GASKETS -** Use new gaskets throughout the transmission as it is being rebuilt. Make sure all gaskets are installed. An omission of any gasket can result in oil leakage or misalignment of bearing covers.
2. **CAPSCREWS** - To prevent oil leakage, use Loctite 242 thread sealant on all capscrews. For torque ratings, see TORQUE RECOMMENDATIONS.
3. **O-RINGS** - Lubricate all O-rings with silicon lubricant.
4. **ASSEMBLY** - Refer to the illustrations provided in the detailed disassembly instructions as a guide to reassembly.
5. **INITIAL LUBRICATION** - Coat all limit washers and splines of shafts with Lubriplate during reassembly to prevent scoring and galling of such parts.
6. **AXIAL CLEARANCES** - Maintain original axial clearances of .005" to .012" for mainshaft gears.
7. **BEARINGS** - Use of flanged-end bearing drivers is recommended for the installation of bearings. These special drivers apply equal force to both bearing races, preventing damage to balls/rollers and races while maintaining correct bearing alignment with bore and shaft. Avoid using a tubular or sleeve-type driver, whenever possible, as force is applied to only one of the bearing races. See TOOL REFERENCE.
8. **UNIVERSAL JOINT COMPANION FLANGE OR YOKE** - Pull the companion flange or yoke tightly into place with the output shaft nut, using 450-500 foot-pounds of torque. Make sure the speedometer drive gear or a replacement spacer of the same width has been installed. Failure to pull the companion flange or yoke tightly into place will permit the output shaft to move axially with resultant damage to the rear bearing.

IMPORTANT: REFER TO THE APPROPRIATE ILLUSTRATED PARTS LIST (SPECIFIED BY MODEL SERIES) TO ENSURE THAT PROPER PARTS ARE USED DURING REASSEMBLY OF THE TRANSMISSION.

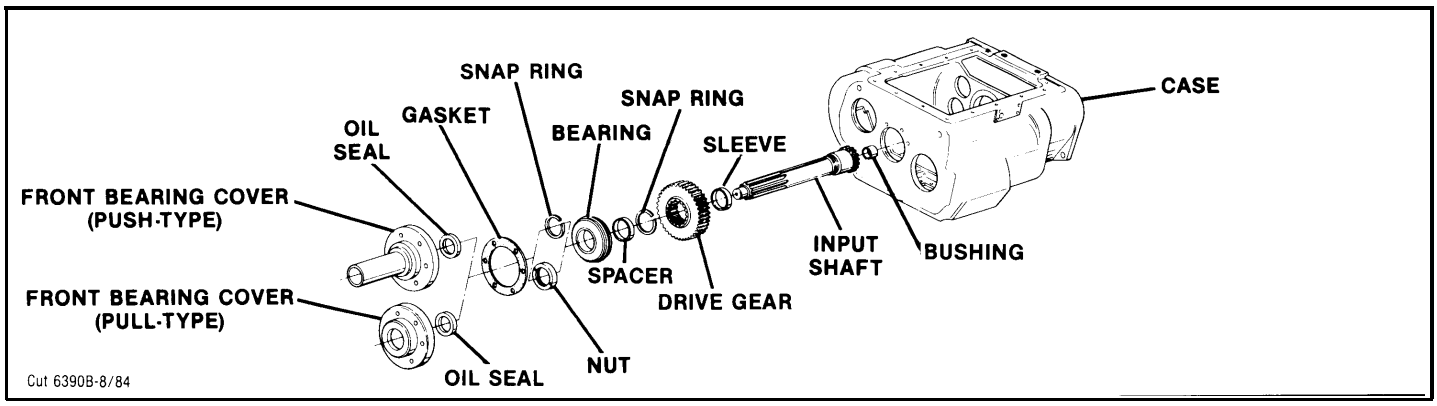
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CHANGING INPUT SHAFT

Special Procedure

In some cases, it may become necessary to replace the input shaft due to excessive clutch wear on the splines. Except for removal of the shift bar housing assembly, the input shaft can be removed without further disassembly of the transmission. Removal of the clutch housing is optional.

NOTE: The following illustration and instructions pertain to changing the input shaft ONLY. To change the main drive gear, disassembly of the front section is required.



Disassembly

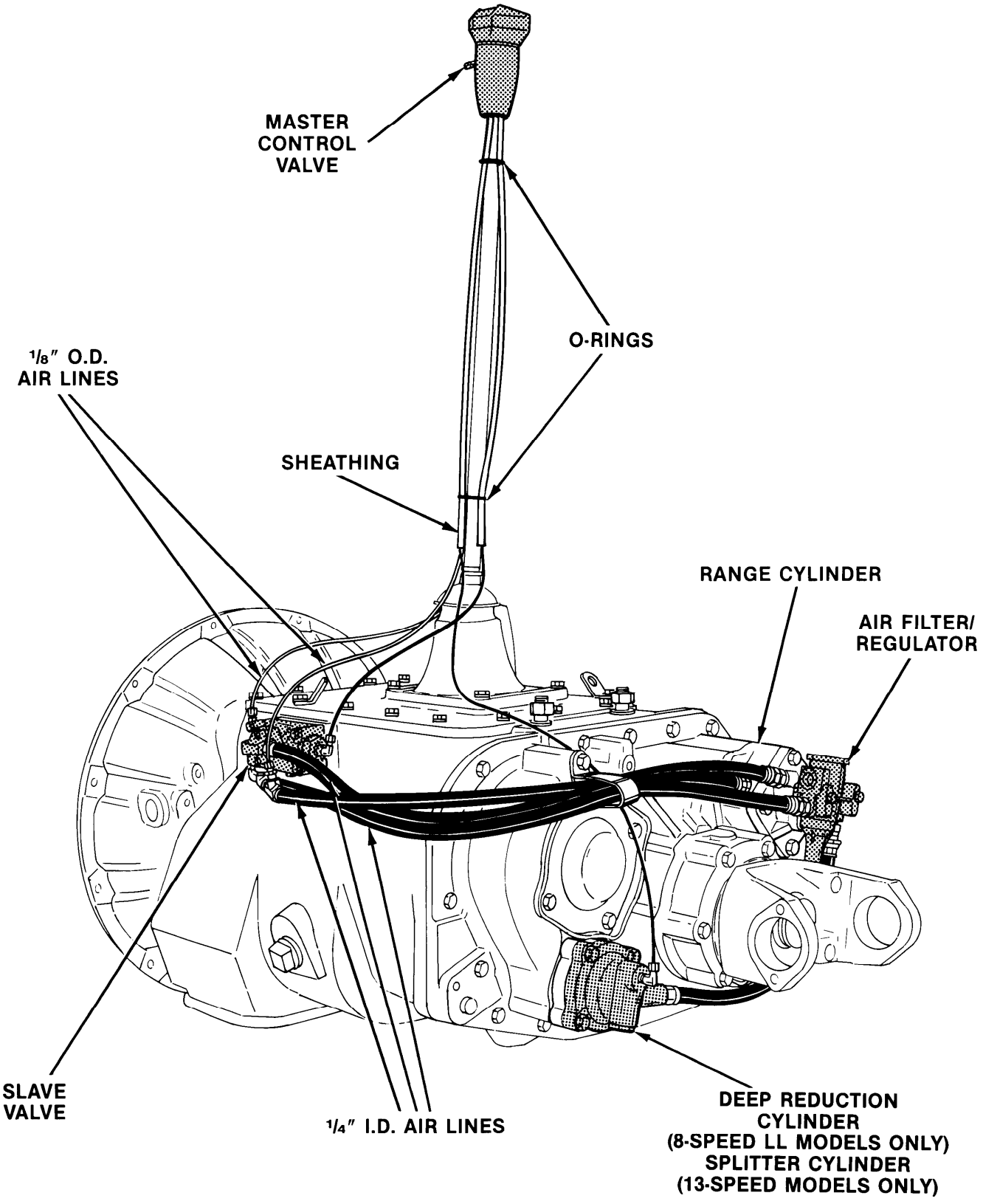
1. Remove the gear shift lever housing assembly (or remote control assembly) from shift bar housing, if necessary, and the shift bar housing assembly from transmission case.
2. Remove the front bearing cover and gasket. If necessary, remove the oil seal from cover of models so equipped.
3. Remove the drive gear bearing nut (left hand threads) or snap ring from input shaft.
   Suggestion: For removal of nut ONLY, engage Iwo mainshaft sliding clutches into gear to prevent the mainshaft from rotating.
4. Move the main drive gear assembly as far forward as possible and remove the drive gear bearing.
5. Remove the spacer from input shaft.
6. From the front of transmission, remove the snap ring from I.D. of main drive gear using two small screwdrivers. If mainshaft was previously locked in two gears, it may become necessary to place sliding clutches in the neutral position to rotate input shaft for removal of snap ring.
7. Pull the input shaft forward and from splines of drive gear.

Reassembly

1. If necessary, install bushing in pocket of input shaft.
2. Install new input shaft into splines of main drive gear just far enough to expose snap ring groove in I.D. of drive gear.
3. Install snap ring in groove of drive gear.
4. install spacer on input shaft.
5. Using a flanged-end driver, install the drive gear bearing on shaft and into case bore. When applying force to driver, use caution so as not to damage bearing shield.
   Suggestion: Engaging the sliding clutch into main drive gear and blocking it forward will hold the input shaft forward.
6. When drive gear bearing nut is used, degrease the threads of input shaft and new nut. DO NOT REUSE OLD NUT. When snap ring is used, install the snap ring in groove of input shaft and proceed to #10.
7. Apply Fuller Transmission adhesive sealant #71204 or equivalent to the cleaned threads of input shaft and nut, using caution so as not to contaminate bearing with sealant.
8. Engage two mainshaft sliding clutches into gear to prevent the mainshaft from rotating and install the new drive gear bearing nut, left-hand threads, on input shaft. Tighten nut with 250-300 Lbs./Ft. of torque.
   Suggestion: To avoid damaging the O.D. of nut, use the tool specifically designed for this purpose. See TOOL REFERENCE.
9. With a punch and maul, peen the nut into the two milled slots of input shaft, using caution so as not to distort O.D. of nut.
10. To facilitate proper reinstallation of the shift bar housing assembly on case, make sure mainshaft sliding-clutches are placed in the neutral position.
11. Reinstall the shift bar housing assembly, the front bearing cover and all other parts and assemblies previously removed, making sure to replace the gaskets used.

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AIR SYSTEM



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AIR SYSTEM

RANGE SHIFT AIR SYSTEM—ALL MODELS

Operation

The Range Shift Air System consists of the air filter/regulator, slave valve, a Range Control Valve or Master Control Valve, range cylinder, fittings and connecting air lines. See Air System Schematics.

CONSTANT AIR from the air filter/regulator is supplied to the “S” or Supply Port of slave valve and passed through to the INLET or “S” Port of control valve.

WHILE IN LOW RANGE, the control valve is OPEN and AIR is returned to slave valve at the “P” or End Port. This signals the valve to supply AIR in line between the Low Range or “L” Port of slave valve and the Low Range Port of range cylinder housing. AIR received at this port moves the range piston to the rear and causes the auxiliary low range gear to become engaged.

WHILE IN HIGH RANGE, the control valve is CLOSED and NO AIR is returned to the slave valve. This signals the slave valve to supply AIR in line between the High Range or “H” Port of valve and the High Range Port of range cylinder cover. AIR received at this port moves the range piston forward to engage the auxiliary drive gear with sliding clutch and bypass the low range gear set.

Range shifts can be made ONLY when the gear shift lever is in, or passing through, neutral. Thus, the range desired can be PRESELECTED while the shift lever is in -a gear position. As the lever is moved through neutral, the actuating plunger in the shift bar housing releases the slave valve, allowing it to move to the selected range position.

Trouble Shooting

If the transmission fails to make a range shift or shifts too slowly, the fault may be in the Range Shift Air System or actuating components of the shift bar housing assembly.

To locate the trouble, the following checks should be made with normal vehicle air pressure applied to the system, but with the engine off.

CAUTION: NEVER WORK UNDER A VEHICLE WHILE ENGINE IS RUNNING as personal injury may result from the sudden and unintended movement of vehicle under power.

1. INCORRECT AIR LINE HOOK-UPS
(See Air System Schematics)
With the gear shift lever in neutral, move the control that provides range selection UP and DOWN.

A. If the air lines are crossed between control valve and slave valve, there will be CONSTANT AIR flowing from the exhaust port of control valve WHILE IN HIGH RANGE.

B. If the air lines are crossed between the slave valve and range cylinder, the transmission gearing will not correspond with the range selection. A LOW RANGE selection will result in a HIGH RANGE engagement and vice versa.

2. AIR LEAKS
With the gear shift lever in neutral, coat all air lines and fittings with soapy water and check for leaks, moving the control that provides range selection UP and DOWN.

A. If there is a steady leak from the exhaust port of control valve, O-rings and/or related parts of the control valve are defective.

B. If there is a steady leak from breather of slave valve: an O-ring in valve is defective, or there is a leak past O-rings of range cylinder piston.

C. If transmission fails to shift into LOW RANGE or is slow to make the range shift and the case is pressurized, see Check No. 7 of this section.

D. Tighten all loose connections and replace defective O-rings and parts.

3. **AIR FILTER/REGULATOR**
(See illustration, Page 27.)
With the gear shift lever in neutral, check the breather of air filter/regulator assembly. There should be NO AIR leaking from this port. The complete assembly should be replaced if a steady leak is found.

Cut off the vehicle air supply to the air filter/regulator assembly, disconnect the air line at fitting in Supply OUTLET and install an air gage in opened port. Bring the vehicle air pressure to normal. Regulated air pressure should be 57.5 to 62.5 PSI.

DO NOT ADJUST SCREW AT BOTTOM OF REGULATOR TO OBTAIN CORRECT READINGS. The air regulator has been PREADJUSTED within the correct operating limits. Any deviation from these limits, especially with regulators that have been in operation for some time, is likely to be caused by dirt or worn parts. If replacement or cleaning of the filter element does nothing to correct the air pressure readings, replace the complete assembly, as the air regulator is nonserviceable.

4. CONTROL VALVE (See Pages 28 and 29.)
With the gear shift lever in neutral, select HIGH RANGE and disconnect the 1/8" O.D. air line at the OUTLET or “P” Port of control valve.

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A. When LOW RANGE is selected, a steady blast of air will flow from opened port. Select HIGH RANGE to shut off air flow. This indicates the control valve is operating properly. Reconnect air line.

B. If control valve does not operate properly, check for restrictions and air leaks. Leaks indicate defective or worn O-rings.

5. HIGH RANGE OPERATION

With the gear shift lever in neutral, select LOW RANGE and disconnect the 1/4" I.D. air line at the port of range cylinder cover. Make sure this line leads from the High Range or "H" Port of slave valve.

A. When HIGH RANGE is selected, a steady blast of air should flow from disconnected line. Select LOW RANGE to shut off air flow.

B. Move the shift lever to a gear position and select HIGH RANGE. There should be NO AIR flowing from disconnected line. Return the gear shift lever to the neutral position. There should now be a steady flow of air from disconnected line. Select LOW RANGE to shut off air flow and reconnect air line.

C. If the air system does not operate accordingly, the slave valve or actuating components of the shift bar housing assembly are defective.

IMPORTANT: RANGE PRESELECTION
The plunger pin, located in case bore between the slave valve and actuating plunger of shift bar housing, prevents the slave valve from operating while the shift lever is in a gear position. When the lever is moved to or through the neutral position, the pin is released and the salve valve becomes operational.

6. LOW RANGE OPERATION

With the gear shift lever in neutral, select HIGH RANGE and disconnect the 1/4" I.D. air line at the fitting on range cylinder housing. Make sure this line leads from the Low Range or "L" Port of slave valve.

A. When LOW RANGE is selected, a steady blast of air should flow from disconnected line. Select HIGH RANGE to shut off air flow.

B. Move the shift lever to a gear position and select LOW RANGE. There should be NO AIR flowing from disconnected line. Return the gear shift lever to the neutral position. There should now be a steady flow of air from disconnected line. Select HIGH RANGE to shut off air flow and reconnect air line.

C. If the air system does not operate accordingly, the slave valve or actuating components of the shift bar housing assembly are defective.

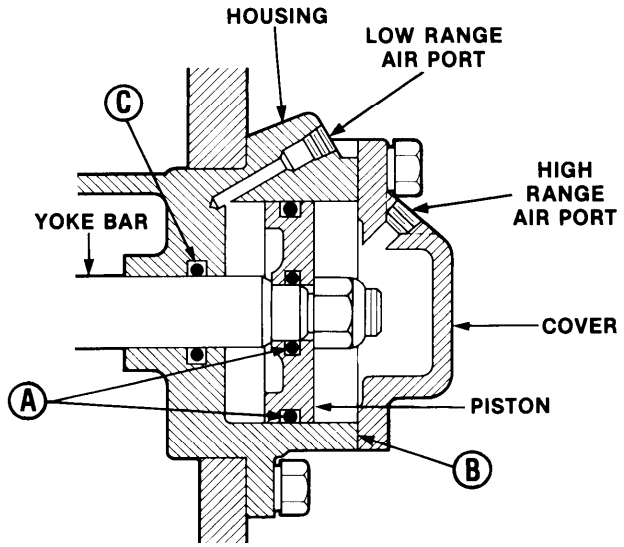
7. RANGE CYLINDER (Refer to the following illustration.)

If any of the seals in the range cylinder assembly are defective, the range shift will be affected.

A. Leak at either O-ring A results in complete failure to make a range shift; steady flow of air from breather of slave valve in both ranges.

B. Leak at gasket B results in a steady flow of air to atmosphere while in HIGH RANGE.

C. Leak at O-ring C results in a slow shift to LOW RANGE; pressurizing of transmission case.



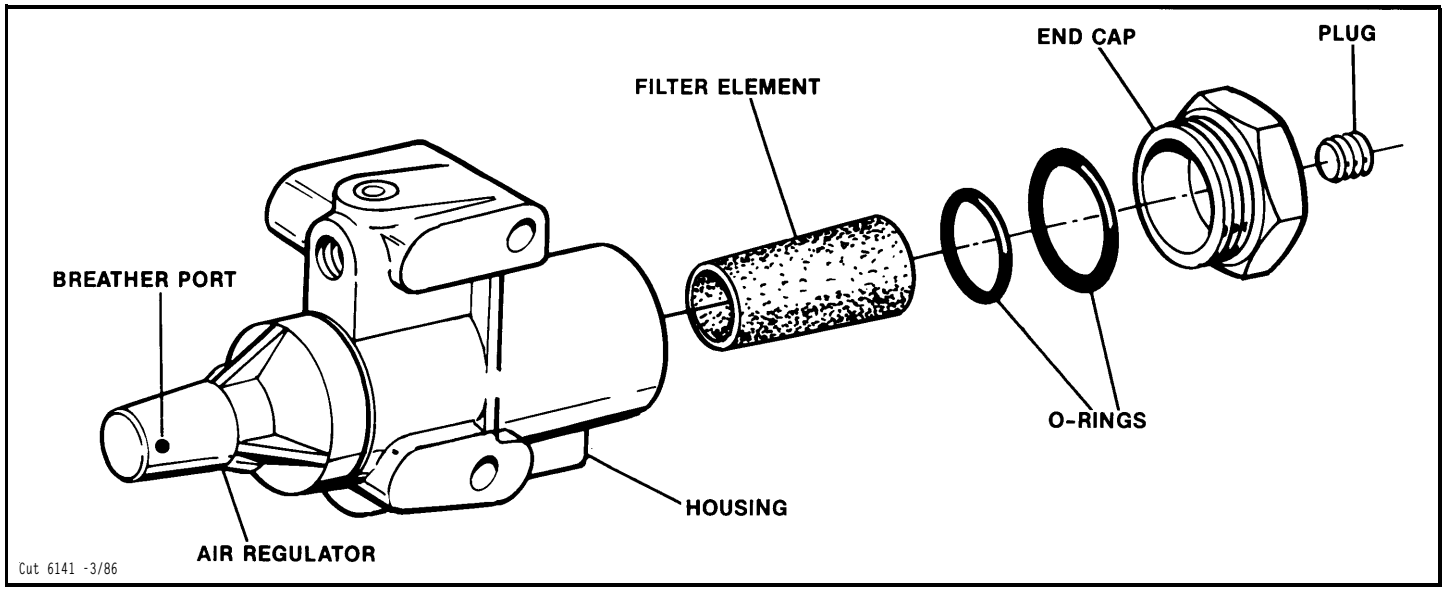
Cut 7420-4/84

Range Cylinder Assembly—All Models

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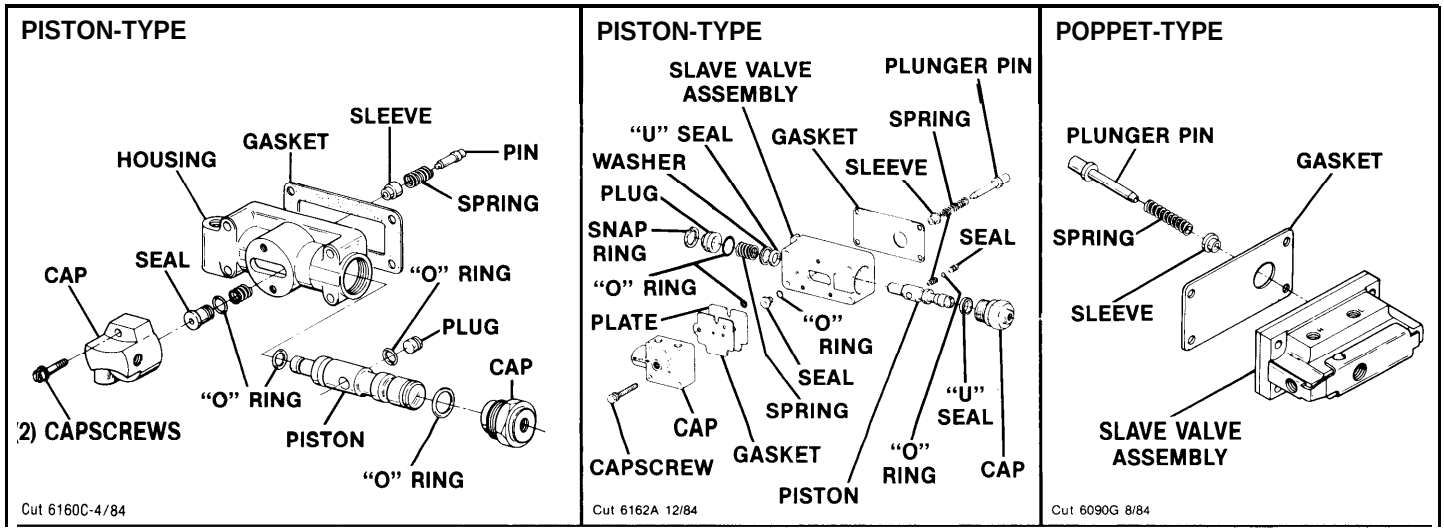
AIR SYSTEM

AIR FILTER/REGULATOR ASSEMBLY



The air filter contains a replaceable filter element which can be removed by turning out the end cap. This element should be cleaned at each oil change, or more often under high humidity conditions. Replace if necessary.

SLAVE VALVES



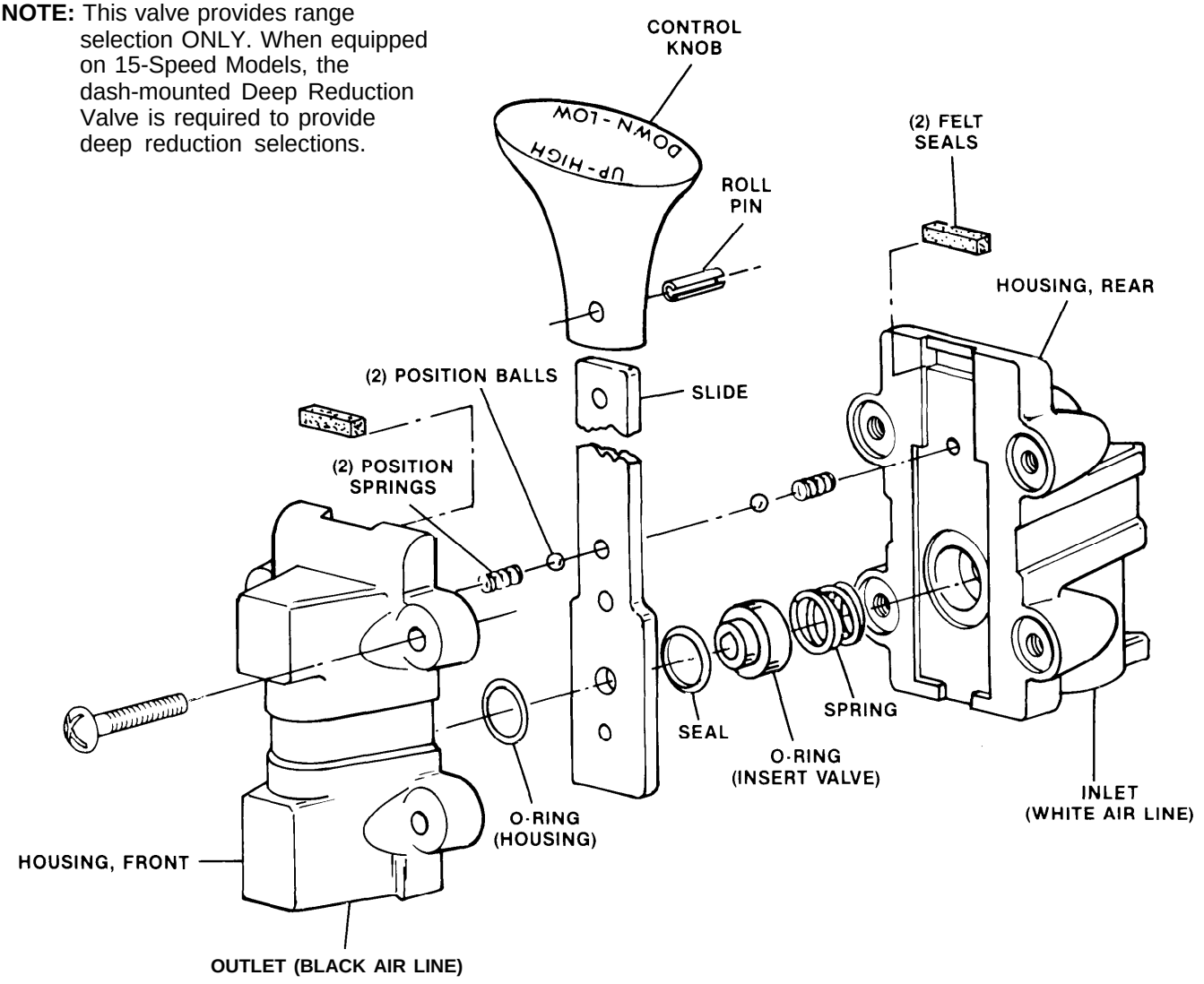
Refer to the drawing for disassembly and reassembly of the piston-type slave valve assemblies. **Should the poppet-type slave valve assembly prove to be defective, replace the complete assembly, as it is non-serviceable.** The actuating components used with these valve assemblies are non-interchangeable. Failure to use the correct plunger pin, spring, and alignment sleeve during installation on the transmission will cause hard shifting in Low Range gears.

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AIR SYSTEM

RANGE VALVE A-3546

NOTE: This valve provides range selection ONLY. When equipped on 15-Speed Models, the dash-mounted Deep Reduction Valve is required to provide deep reduction selections.



Cut 6155-1/84

Removal and Disassembly

1. Disconnect the air lines and loosen clamp securing the valve to gear shift lever. Remove valve.
2. Remove the four screws to separate the front and rear housings and remove the slide and two sets of position springs and balls.
3. Remove the seal, insert valve O-ring and spring from rear housing.
4. If necessary, remove the two felt seals. Punch out the roll pin to remove the control knob from slide.

Reassembly and Installation

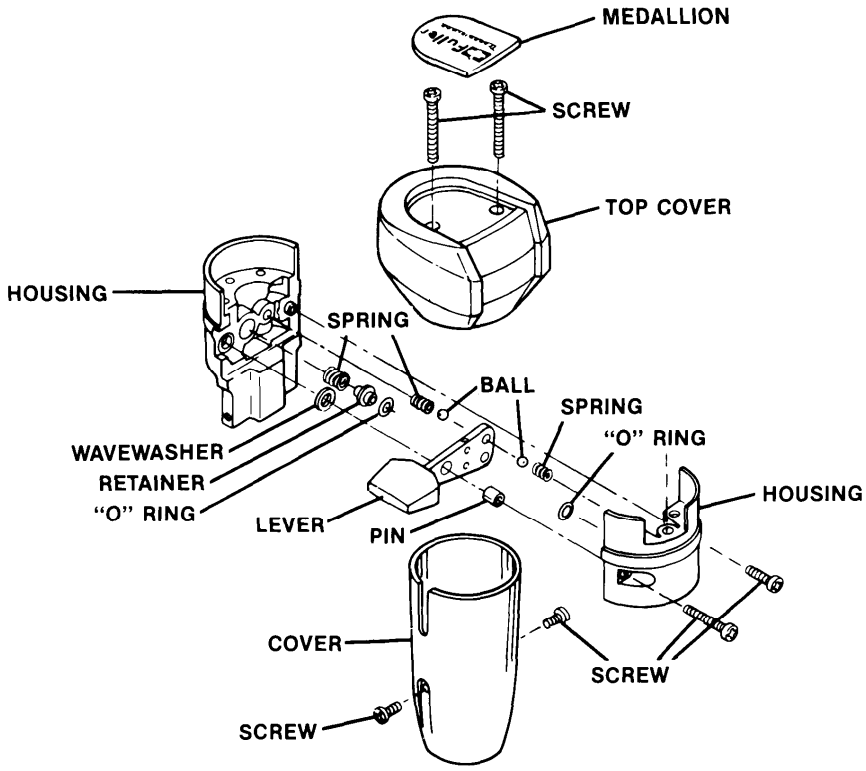
1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly.
2. Install the air lines with their sheathing and O-rings on the gear shift lever.
3. Secure the valve on gear shift lever with mounting clamp. The control knob should face to the front and be approximately 6“ below the centerline of ball grip.
4. Attach the air lines.

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AIR SYSTEM

RANGE VALVE A-501 O

ROADRANGER VALVE ASSEMBLY



Removal and Disassembly

1. Remove two screws holding bottom cover to valve and slide cover down gearshift lever to expose air line fittings. Disconnect air lines.
2. Loosen jam nut and turn control valve from gear shift lever.
3. Pry medallion from recess in top cover.
4. Turn out the two screws to remove the top cover from valve housing.
5. Turn out the two screws in side of valve housing to separate the housing.
6. Remove the Range Preelection Lever from left housing and the position balls and guide from lever.
7. If necessary, remove spring and O-ring from bores in left housing.
8. If necessary, remove springs, O-ring and sleeve from bores in right housing.

Reassembly and Installation

1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly.
2. Reinstall control valve on gear shift lever and tighten jam nut.
3. Attach air lines and reinstall bottom cover.

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AIR SYSTEM

DEEP REDUCTION AIR SYSTEM: 8-SPEED "LL" MODELS ONLY

Operation

In addition to the various components of the Range Shift Air System, the Deep Reduction Air System utilizes a reduction cylinder and a separate dash-mounted Deep Reduction Valve OR the Master Control Valve A-5015.

CONSTANT AIR from the air filter/regulator assembly is supplied to the reduction cylinder at the port on right side of cylinder cover. See Air System Schematics.

With the Deep Reduction Lever in the "OUT" position, the valve is OPENED and AIR is supplied to the Center Port of cylinder cover, moving the reduction piston forward to disengage deep reduction gearing. With the lever moved to the "IN" position, the valve is CLOSED and NO AIR is supplied to the Center Port. CONSTANT AIR from the air filter/regulator assembly moves the reduction piston rearward to engage reduction gearing.



Lever to "OUT"
(Valve OPENED)

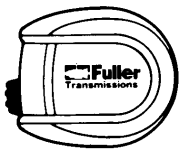


Lever to "IN"
(Valve CLOSED)

For models equipped with the Master Control Valve A-5015, AIR is supplied to the built-in deep reduction valve ONLY WHILE IN LOW RANGE from tee fitting at the Low Range or "L" Port of slave valve. The insert valve (see page 37) MUST be installed in cylinder cover to provide the proper air flow needed to move the reduction piston in the cylinder. See schematic provided on Page 32.

NOTE: The insert valve is NOT USED in the reduction cylinder cover of models equipped with the dash mounted Deep Reduction Valve.

With the Deep Reduction Button in the REARWARD position, the "SP" Port of control valve is CLOSED and NO AIR is supplied to the Center Port of cylinder cover.



Button REARWARD
("SPY' Port CLOSED)

WHILE IN THE LO SPEED GEAR POSITION, the button can be moved FORWARD to operate in LO-LO. The "SP" Port of valve is OPENED when deep reduction selection is made, supplying AIR to the Center Port of cylinder cover.



Button FORWARD
("SPY' Port OPENED)

NOTE: WHILE IN HIGH RANGE, the mechanical interlock of Master Control Valve prevents movement of Deep Reduction Button to the FORWARD position.

Trouble Shooting

If the transmission fails to shift or shifts too slowly to or from LO-LO, the fault may be in the Deep Reduction Air System or related components of the Range Shift Air System.

To locate the trouble, the following checks should be made with normal vehicle air pressure supplied to the system, but with the engine off. See CAUTION, Page 25.

NOTE: It is assumed that correct PSI readings were obtained from the air filter/regulator and all air lines have been checked for leaks.

For Models Equipped with the Deep Reduction Valve . . .

1. Air Supply (See Air System Schematics.)

With the gear shift lever in neutral, loosen the connection at the INLET (End Port) of Deep Reduction Valve until it can be determined that CONSTANT AIR is supplied to valve. Reconnect air line.

If there is NO AIR, check for a restriction in line between the Deep Reduction Valve and slave valve, making sure this line is connected to tee fitting at the Supply or "S" Port of slave valve.

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AIR SYSTEM

2. Deep Reduction Valve (See Air System Schematics.)
With the gear shift lever in neutral, disconnect the air line leads from OUTLET of Deep Reduction Valve.

A. WHILE IN LOW RANGE, move the Deep Reduction Valve Lever to the "IN" position. There should be NO AIR flowing from disconnected line.

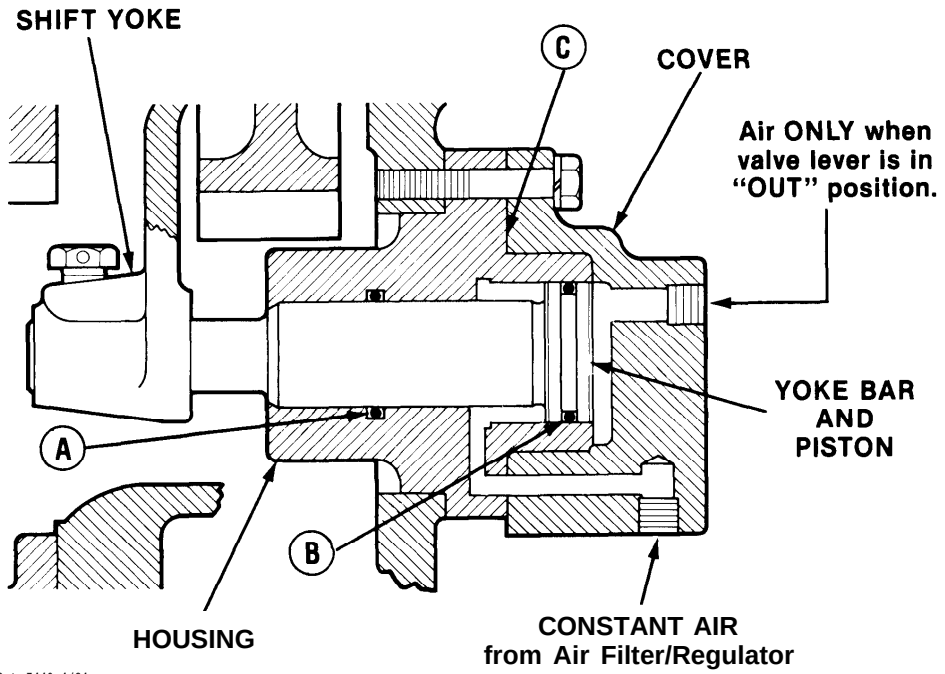
B. Move the valve lever to the "OUT" position. There should now be CONSTANT AIR flowing from disconnected line. Return the valve lever to the "IN" position to shut off air flow and reconnect air line.

3. Reduction Cylinder (Refer to the following illustration.)
If any of the seals in the reduction cylinder assembly are defective, the deep reduction shift will be affected. The degree of air lost will govern the degree of failure, from slow shifting to complete shift failure.

A. Leak at O-ring A results in a slow shift to engage deep reduction gearing; pressurizing of transmission case; deep reduction gearing can be disengaged.

B. Leak at O-ring B results in slow shifting or complete failure to engage and disengage deep reduction gearing; steady flow of air from exhaust port of Deep Reduction Valve when lever is in the "IN" position.

C. Leak at gasket C results in a slow shift to disengage deep reduction gearing; steady flow of air to atmosphere.



REDUCTION CYLINDER ASSEMBLY
(Models equipped with Deep Reduction Valve ONLY.)

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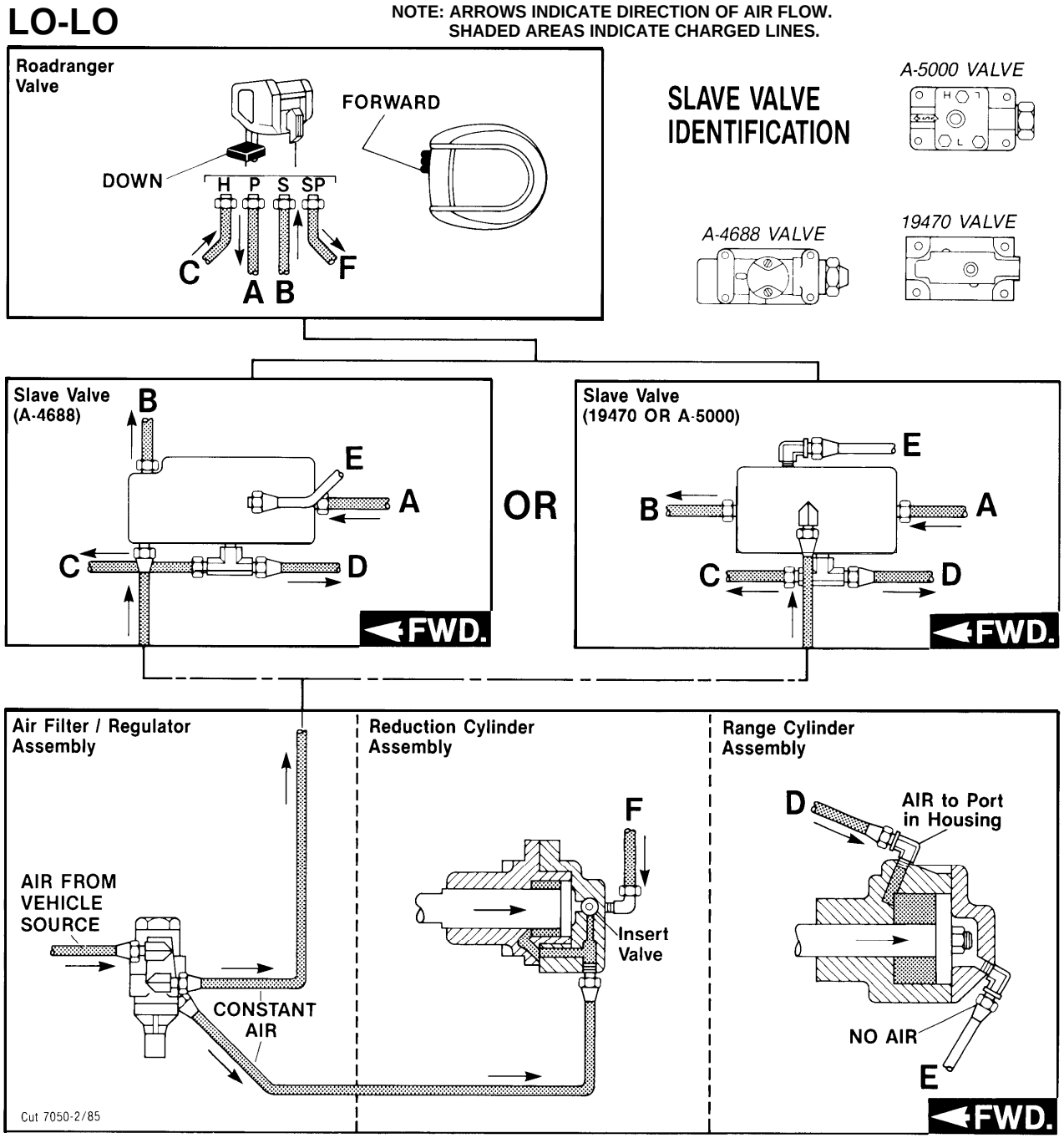
AIR SYSTEM

For Models Equipped with the Master Control Valve A-5015 . . .

1. Air Supply (See schematic below.)

With the gear shift lever in neutral, select LOW RANGE and loosen the connection at the "H" Port of control valve until it can be determined that AIR is supplied to valve. Reconnect air line.

If there is NO AIR, check for a restriction in the 1/8" O.D. air line between the control valve and slave valve, making sure this line is connected to tee fitting at the Low Range or "L" Port of slave valve.



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AIR SYSTEM

2. Roadranger Valve (See Page 34 and schematic on preceding page.)

With the gear shift lever in neutral, disconnect the 1/8" O.D. air line at the Center Port of reduction cylinder cover, making sure this line leads from the "SP" Port of control valve.

A. WHILE IN LOW RANGE, move the Deep Reduction Button FORWARD. There should be AIR flowing from disconnected line. Move the button REARWARD to shut off air flow and reconnect air line.

B. If the preceding conditions did not exist, the control valve is defective, or there is a restriction in the air lines.

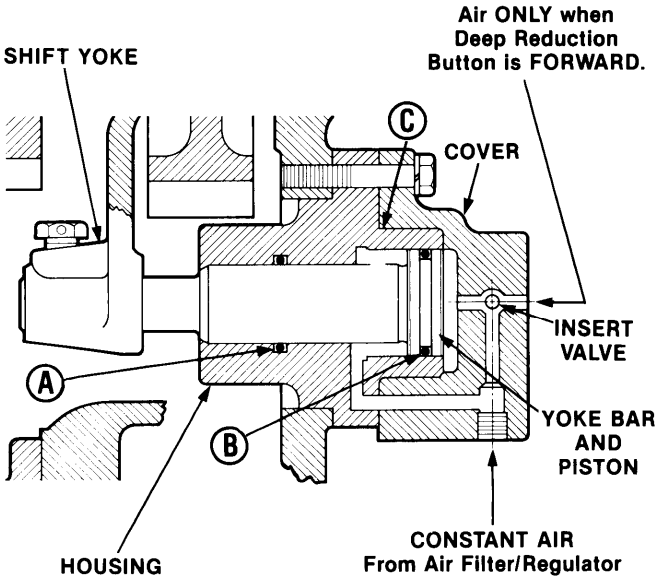
3. Reduction Cylinder (Refer to the following illustration.)

If any of the seals in the reduction cylinder assembly are defective, the deep reduction shift will be affected. The degree of air lost will govern the degree of failure, from slow shifting to complete shift failure.

A. Leak at O-ring A results in a slow shift to engage deep reduction gearing; pressurizing of transmission case; deep reduction gearing can be disengaged.

B. Leak at O-ring B results in slow shifting or complete failure to engage and disengage deep reduction gearing; steady flow of air from exhaust port of control valve and/or cylinder cover when Deep Reduction Button is in the FORWARD position.

C. Leak at gasket C results in a slow shift to disengage deep reduction gearing; steady flow of air to atmosphere.



Cut 7441-4/84

REDUCTION CYLINDER ASSEMBLY
(Models equipped with Master Control A-5015 ONLY.)

4. Insert Valve (See page 37.)

Any constant flow of air from exhaust port of cylinder cover usually indicates a faulty insert valve. Exhaust should occur ONLY BRIEFLY when Deep Reduction Button is moved FORWARD WHILE IN LOW RANGE.

A faulty insert valve, leaking at the O-rings of valve O.D. or from inner seals will result in shift failure. Two indications of defective O-rings or seals are:

A. CONSTANT AIR flowing from exhaust port of cylinder cover.

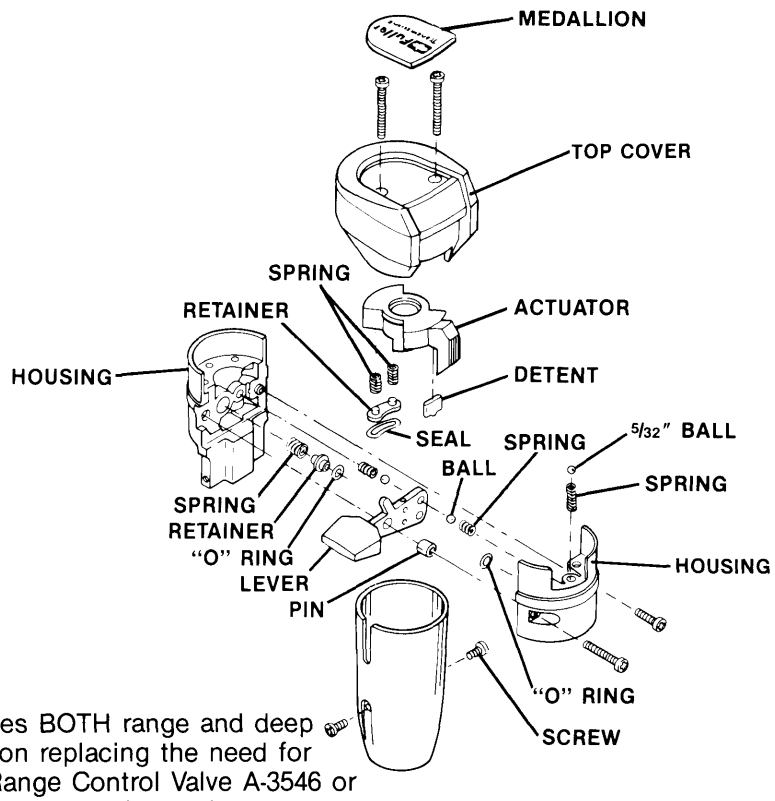
B. CONSTANT AIR flowing from exhaust port "E" of control valve WHILE DEEP REDUCTION BUTTON IS REARWARD (providing the control valve is operating properly).

The three O-rings in position on valve O.D. can be replaced. However, if an inner seal is damaged, the complete assembly MUST be replaced.

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AIR SYSTEM

ROADRANGER VALVE A-5015



NOTE: This valve provides BOTH range and deep reduction selection replacing the need for separate units (Range Control Valve A-3546 or Roadranger Valve A-5010 with dash-mounted Deep Reduction Valve.)

Cut 6147A-11/83

Removal and Disassembly

1. Remove two screws holding bottom cover to valve and slide cover down gearshift lever to expose air line fittings. Disconnect air lines.
2. Loosen jam nut and turn control valve from gear shift lever.
3. Pry medallion from recess in top cover.
4. Turn out the two screws to remove the top cover from valve housing.
5. Remove the actuator button from valve housing and the spring retainer, springs, seal & detent parts from actuator and/or valve housing.
6. Turn out the two screws in side of valve housing to separate the housing.
7. Remove the Range Preelection Lever from left housing and the position balls and guide from lever.
8. If necessary, remove springs, O-ring and retainer from bores in right housing.

Reassembly and Installation

1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly.
2. Reinstall control valve on gear shift lever and tighten jam nut.
3. Attach air lines and reinstall bottom cover.

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AIR SYSTEM

SPLITTER SHIFT AIR SYSTEM: 13-SPEED SPLITTER MODELS ONLY

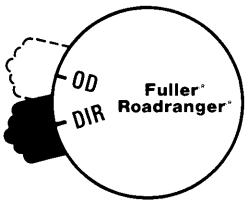
Operation

In addition to the various components of the Range Shift Air System, the Splitter Shift Air System utilizes a splitter cylinder and a separate lever-mounted Splitter Selector Valve OR the Roadranger Control Valve A-4900. See Air System Schematics.

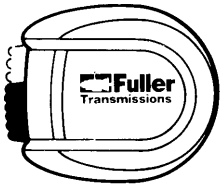
CONSTANT AIR from the air filter/regulator assembly is supplied to the splitter cylinder at the port on right side of cylinder cover. The Insert valve installed in cover (see Page 37) provides the proper air flow needed to move the splitter piston in the cylinder (rearward to engage splitter gearing; forward to disengage splitter gearing).

WHILE IN HIGH RANGE ONLY, AIR needed to make the splitter selection and complete the shift is supplied to the control valve from tee fitting at the High Range or "H" Port of slave valve. When the splitter selection is made, the AIR passes through the control valve and is supplied to the Center Port of cylinder cover.

With Splitter Control Button in the "DIR."/ REARWARD position, the "D" or "SP" Port of control valve is CLOSED and NO AIR is supplied to the Center Port of Splitter cylinder cover.

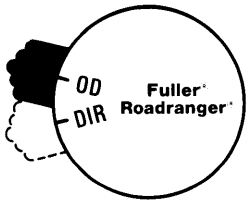


Button in "DIR."
("D" Port CLOSED)

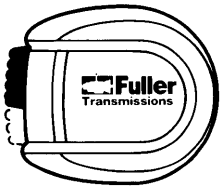


Button REARWARD
("SP" Port CLOSED)

WHILE IN HIGH RANGE, the button can be moved FORWARD to operate in UNDERDRIVE or OVERDRIVE. The "D" or "SP" Port of valve is OPENED when splitter selection is made, supplying AIR to the Center Port of Splitter cylinder cover.



Button in "U. D." or "O.D."
("D" Port OPENED)



Button FORWARD
("SP" Port OPENED)

NOTE: WHILE IN LOW RANGE, the mechanical interlock of Master Valve prevents movement of Splitter Control Button to the FORWARD position.

Trouble Shooting

If the transmission fails to shift or shifts too slowly to or from the "split" position, the fault may be in the Splitter Shift Air System or related components of the Range Shift Air System.

To locate the trouble, the following checks should be made with normal vehicle air pressure supplied to the system, but with the engine off. See CAUTION, Page 25.

NOTE: It is assumed that correct PSI readings were obtained from the air filter/regulator and ail air lines have been checked for leaks.

1. Air Supply (See Air System Schematics.)

With the gear shift lever in neutral, select HIGH RANGE and loosen the connection at the "S" Port of Splitter Selector Valve or "H" Port of Master Control Valve until it can be determined that AIR is supplied to valve. Reconnect air line.

If there is NO AIR, check for a restriction in the 1/8" O.D. air line between the control valve and slave valve, making sure this line is connected to tee fitting at the High Range or "H" Port of slave valve.

2. Selector or Roadranger Valve (See Pages 38-39 and Air System Schematics.)

With the gear shift lever in neutral, disconnect the 1/8" O.D. air line at the Center Port of splitter cylinder cover, making sure this line leads from the "D" Port of Splitter Selector Valve or "SP" Port of Master Valve.

A. WHILE IN HIGH RANGE, move the Splitter Control Button FORWARD. There should be AIR flowing from disconnected line. Move the button REARWARD to shut off air flow and reconnect air line.

B. If the preceding conditions did not exist, the control valve is defective, or there is a restriction in the air lines.

3. Splitter Cylinder. (Refer to the following illustration.)

If any of the seals in the splitter cylinder assembly are defective, the splitter shift will be affected. The degree of air lost will govern the degree of failure, from slow shifting to complete shift failure.

A. Leak at O-ring A results in a slow shift to engage splitter gearing; pressurizing of transmission case; splitter gearing can be disengaged.

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B. Leak at O-ring B results in slow shifting or complete failure to engage and disengage splitter gearing; steady flow of air from exhaust port of control valve and/or cylinder cover when Splitter Control Button is in the FORWARD position.

C. Leak at gasket C results in a slow shift to disengage splitter gearing; steady flow of air to atmosphere.

4. Insert Valve (See Page 37).

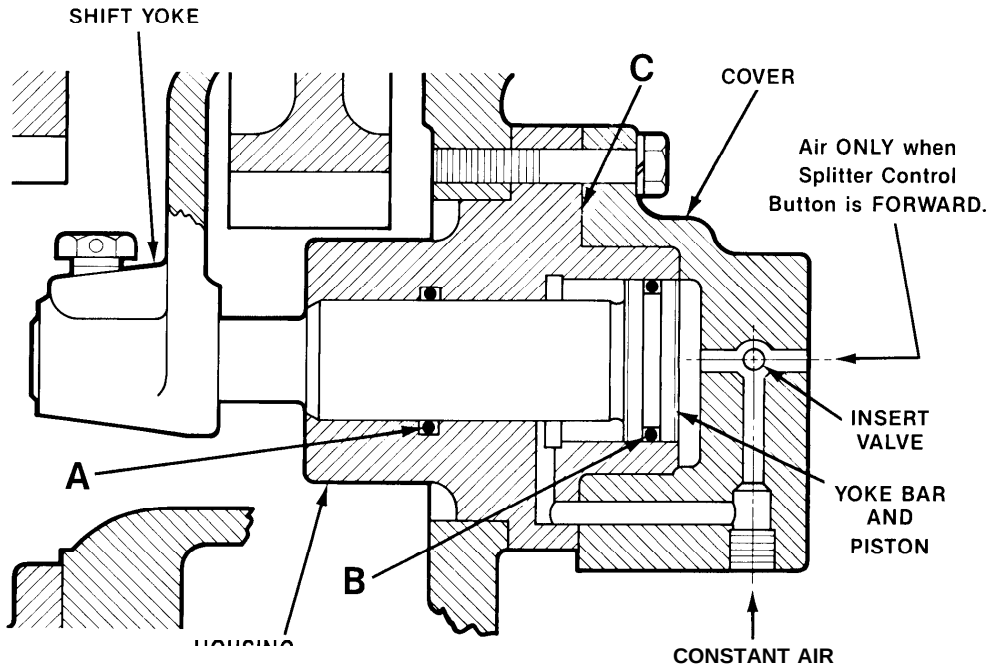
Any constant flow of air from exhaust port of cylinder cover usually indicates a faulty insert valve. Exhaust should occur ONLY BRIEFLY when Splitter Control Button is moved FORWARD WHILE IN HIGH RANGE.

A faulty insert valve, leaking at the O-rings of valve O.D. or from inner seals will result in shift failure. Two indications of defective O-rings or seals are:

A. CONSTANT AIR flowing from exhaust port of cylinder cover.

B. CONSTANT AIR flowing from Exhaust Port "E" of control valve WHILE SPLITTER CONTROL BUTTON IS REARWARD (providing the control valve is operating properly).

The three O-rings in position on valve O.D. can be replaced. However, if an inner seal is damaged, the complete assembly MUST be replaced.



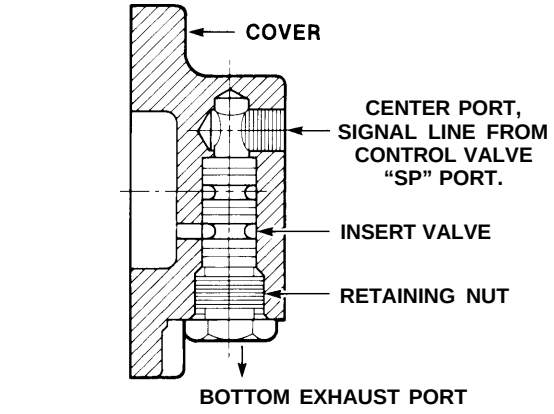
SPLITTER CYLINDER ASSEMBLY (13-Speed Splitter Models ONLY)

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AIR SYSTEM

INSERT VALVE: 8-SPEED "LL" MODELS (EQUIPPED WITH ROADRANGER VALVE A-5015) AND 13-SPEED SPLITTER MODELS

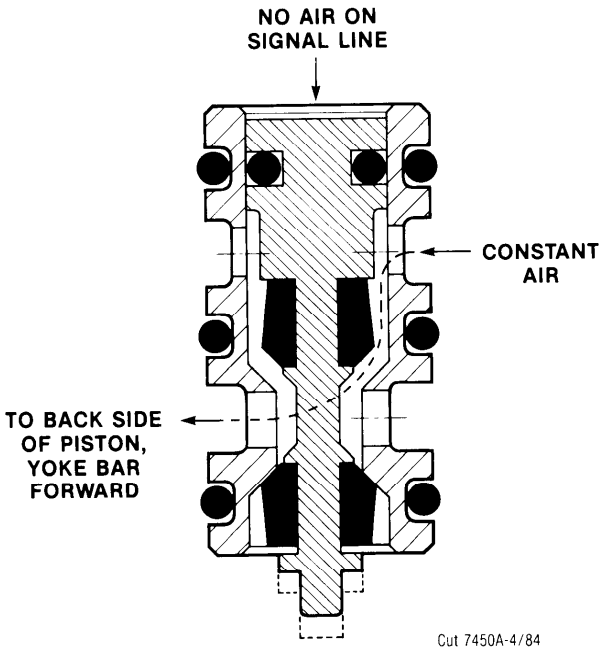
The insert valve is a self-contained 1-3/16" valve assembly located in the reduction or splitter cylinder cover. It CANNOT be disassembled except for the three O-rings on outer diameter. The O-rings provide a stationary seal and do not move in cylinder.



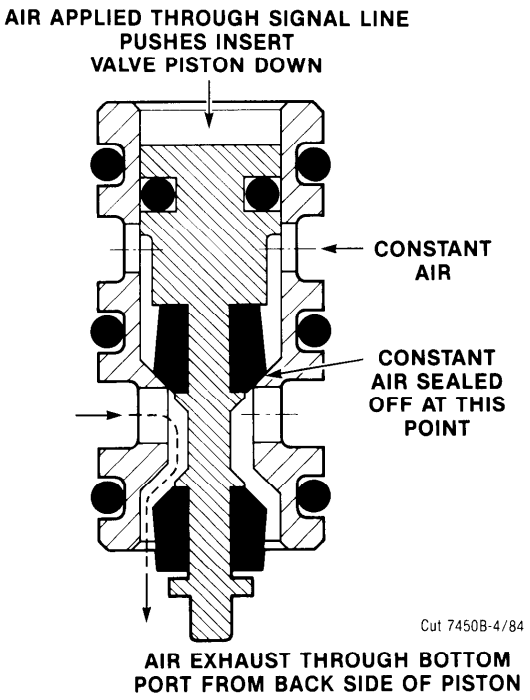
When installing the insert valve in bottom edge of cover, apply Fuller #71206 silicone lubricant or its equivalent to O-rings and cylinder walls. Install valve in bore with flat surface to the inside. When installing the special valve retaining nut, apply Fuller #71204 adhesive/sealant or its equivalent to threads and tighten. See TORQUE RECOMMENDATIONS.

Travel of the small insert valve piston is only 3/16" As shown in the illustrations below, when NO AIR is applied to the top side of valve piston, CONSTANT AIR supplied from the regulator passes freely through the insert valve and to the backside of cylinder piston, moving the yoke bar forward to disengage deep reduction or splitter gearing (LOW RANGE AND HIGH RANGE OR DIRECT). When AIR is applied to the top side of valve piston through signal line, the piston moves down to cut off air supplied to the backside of cylinder piston. This air is exhausted out bottom port of cover when CONSTANT AIR supplied from the regulator is directed to the frontside of cylinder piston, moving the yoke bar rearward to engage deep reduction or splitter gearing (LO-LO AND UNDERDRIVE/OVERDRIVE).

LOW RANGE AND HIGH RANGE OR DIRECT



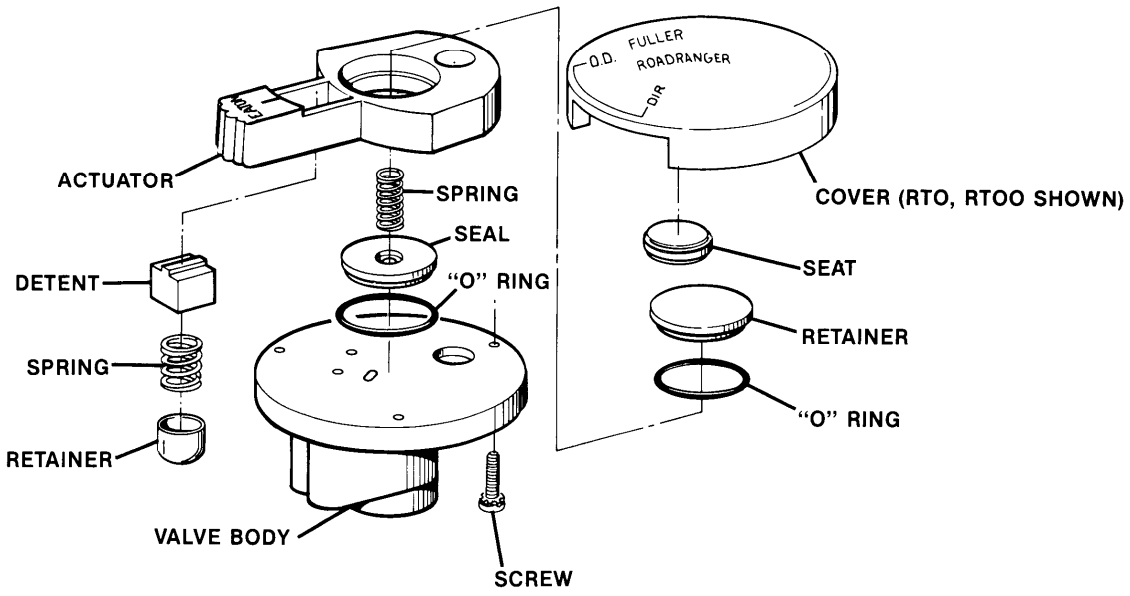
LO-LO OR UNDERDRIVE/OVERDRIVE



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AIR SYSTEM

SELECTOR VALVE



NOTE: This valve is used as a separate unit with Range Valve to provide splitter selections.

Cut 6152-3/84

Removal and Disassembly

1. Disconnect all air lines to the valve. Loosen the jam nut securing the valve to gear shift lever and turn the valve from lever.
2. Turn out the three screws from bottom of valve body and remove the top cover.
3. Remove the actuator (control button) from cover post and the springs, seals, O-rings and detent parts from actuator.

Reassembly and Installation

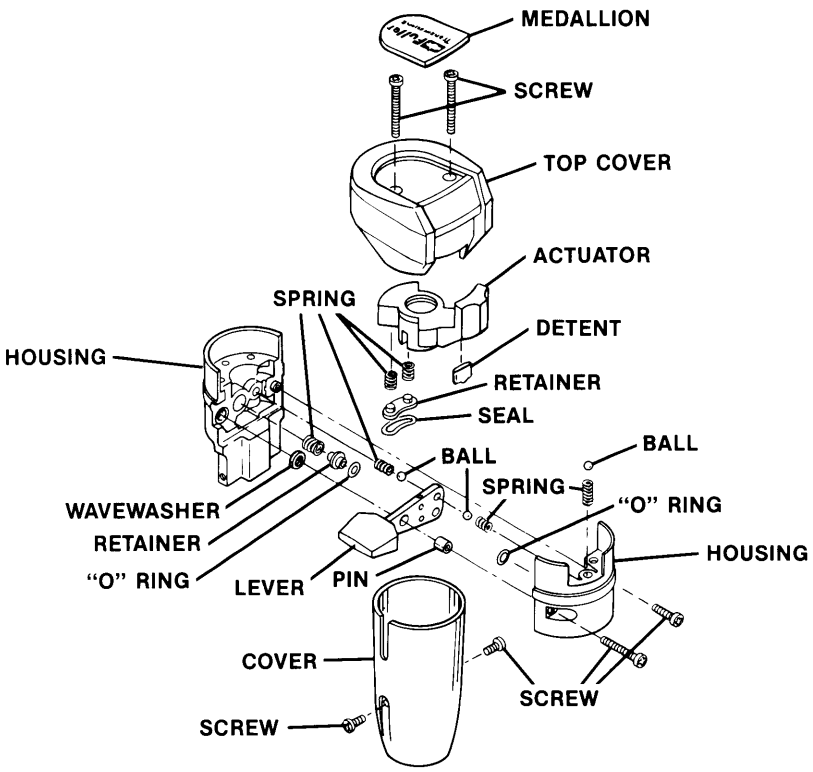
1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports.
2. Install the air lines with their sheathing and O-rings on the gear shift lever.
3. Install the jam nut and valve on lever. Use the nut to lock the valve in position with control button on driver's side.
4. Connect the 1/8" O.D. air line from Center Port of splitter cylinder cover to "D" Port; air line from tee fitting at the High Range or "H" Port of slave valve to "S" Port.

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AIR SYSTEM

ROADRANGER VALVE A-4900

ROADRANGER VALVE ASSEMBLY



Cut 6145 G-2/88

Removal and Disassembly

1. Remove two screws holding bottom cover to valve and slide cover down gear shift lever to expose air line fittings. Disconnect air lines.
2. Loosen jam nut and turn control valve from gear shift lever.
3. Pry medallion from recess in top cover.
4. Turn out the two screws to remove the top cover from valve housing.
5. Remove the actuator button from valve housing and the spring retainer, springs, seal and detent parts from actuator and/or valve housing.
6. Turn out the two screws inside of valve housing to separate the housing.
7. Remove the Range Preelection Lever from left housing and the position balls and guide from lever.
8. If necessary, remove the spring and O-ring from bores in left housing.
9. If necessary, remove the springs, O-ring and retainer from bores in right housing.

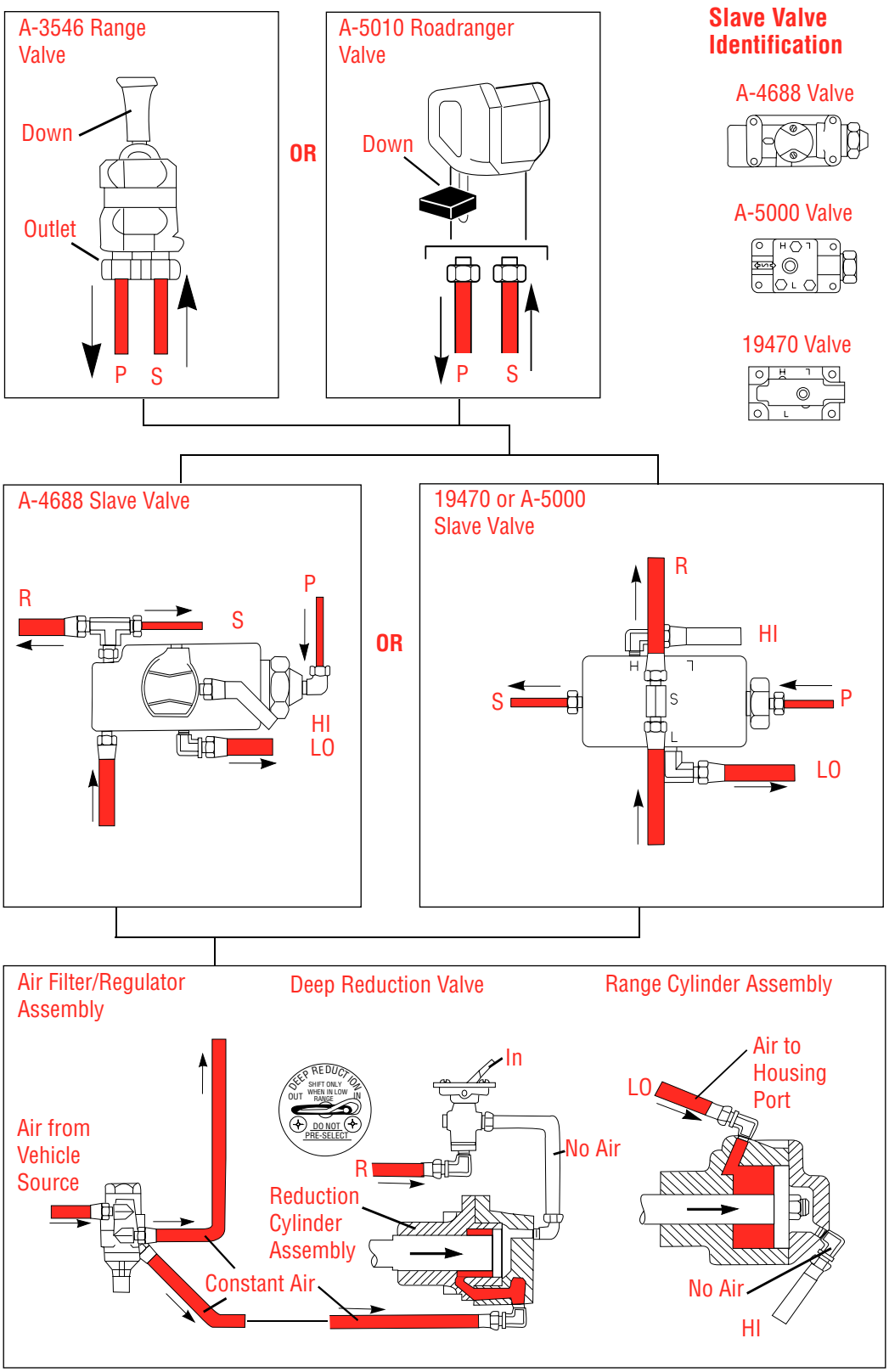
Reassembly and Installation

1. Refer to the drawing for proper reassembly. Use a VERY SMALL amount of silicone lubricant on the O-rings to avoid clogging ports. A small amount of grease on the position springs and balls will help to hold them in place during reassembly
2. Reinstall control valve on gear shift lever and tighten jam nut.
3. Attach air lines and reinstall bottom cover.

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RT, RTO, & RTX XX607LL: XX608LL: and XX615 Models

Deep Reduction



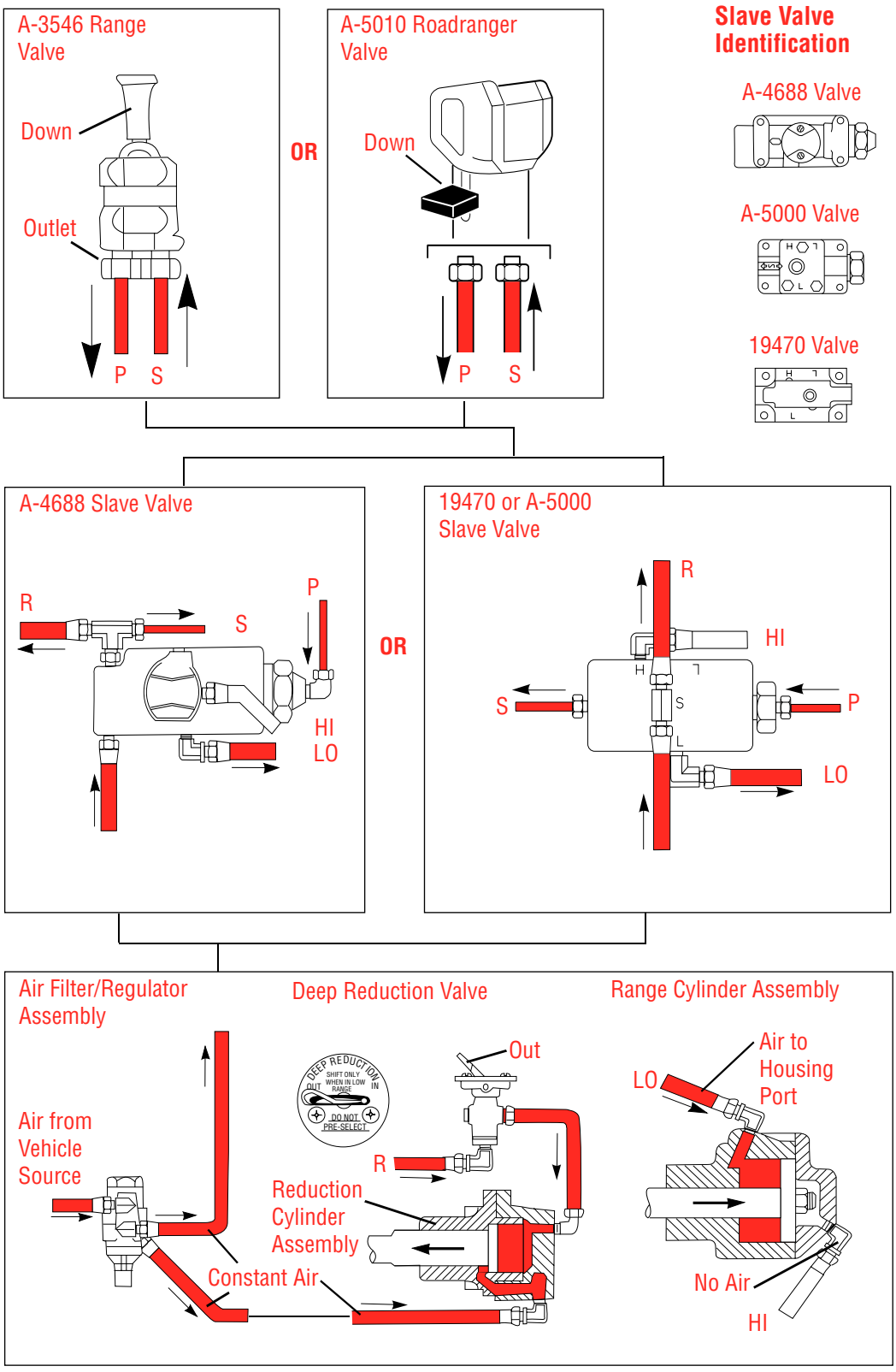
Schematic

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

https://truckmanualshub.com/

RT, RTO, & RTX XX607LL: XX608LL: and XX615 Models

Range—LO



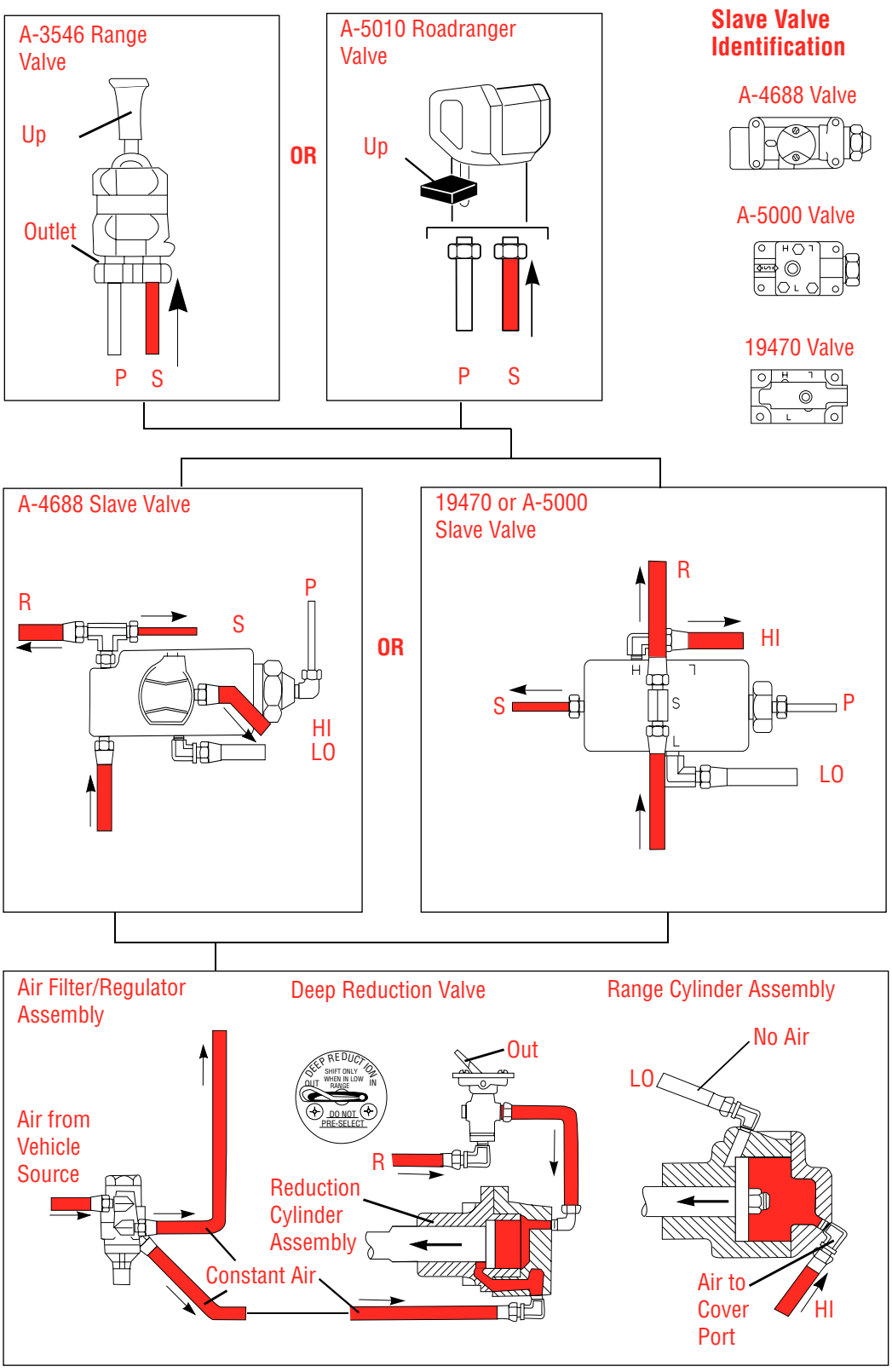
Schematic

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

https://truckmanualshub.com/

RT, RTO, & RTX XX607LL: XX608LL: and XX615 Models

Range—HI



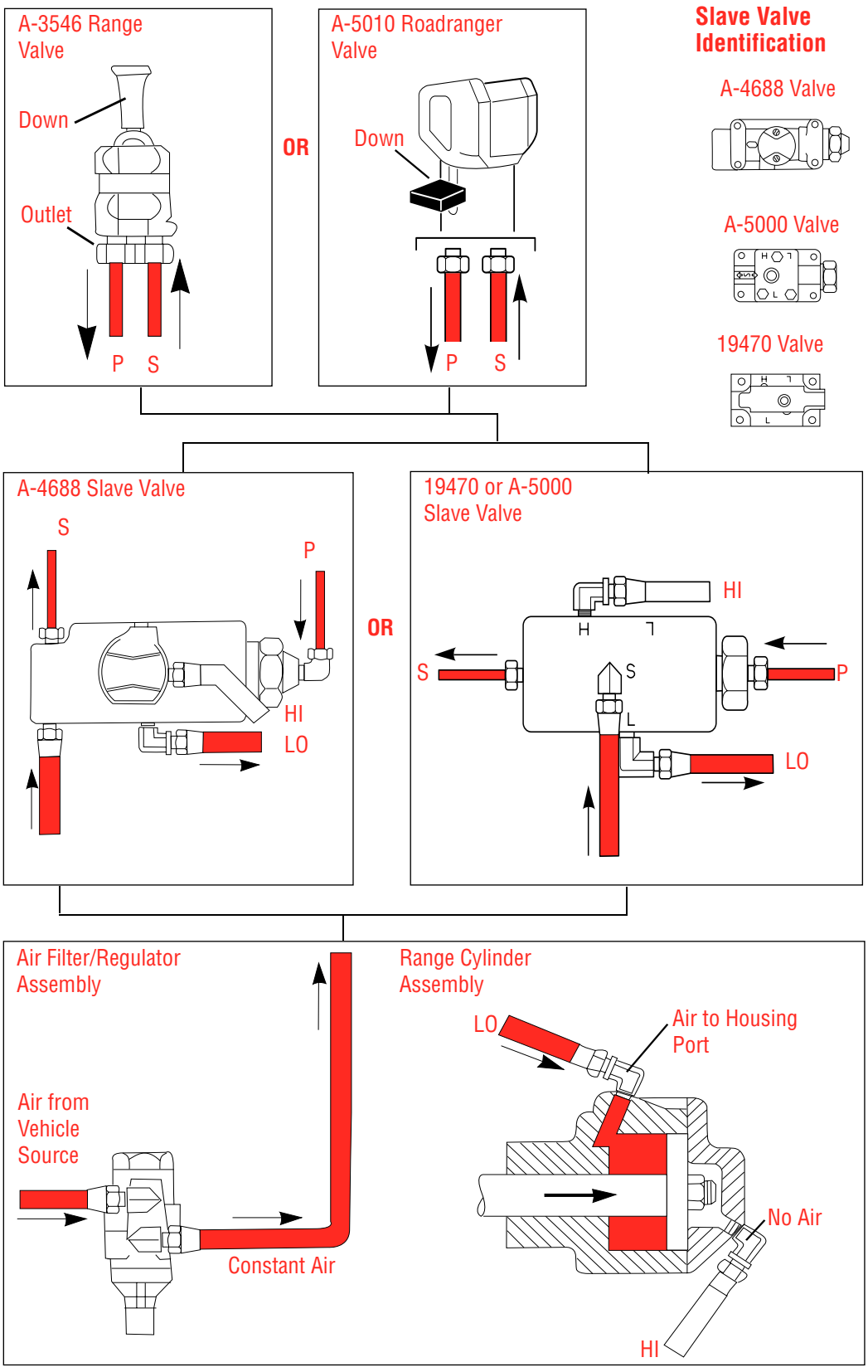
Schematic

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

https://truckmanualshub.com/

7L: 8: 9: and 10 Speed (2-Speed Auxiliary)

Range—LO



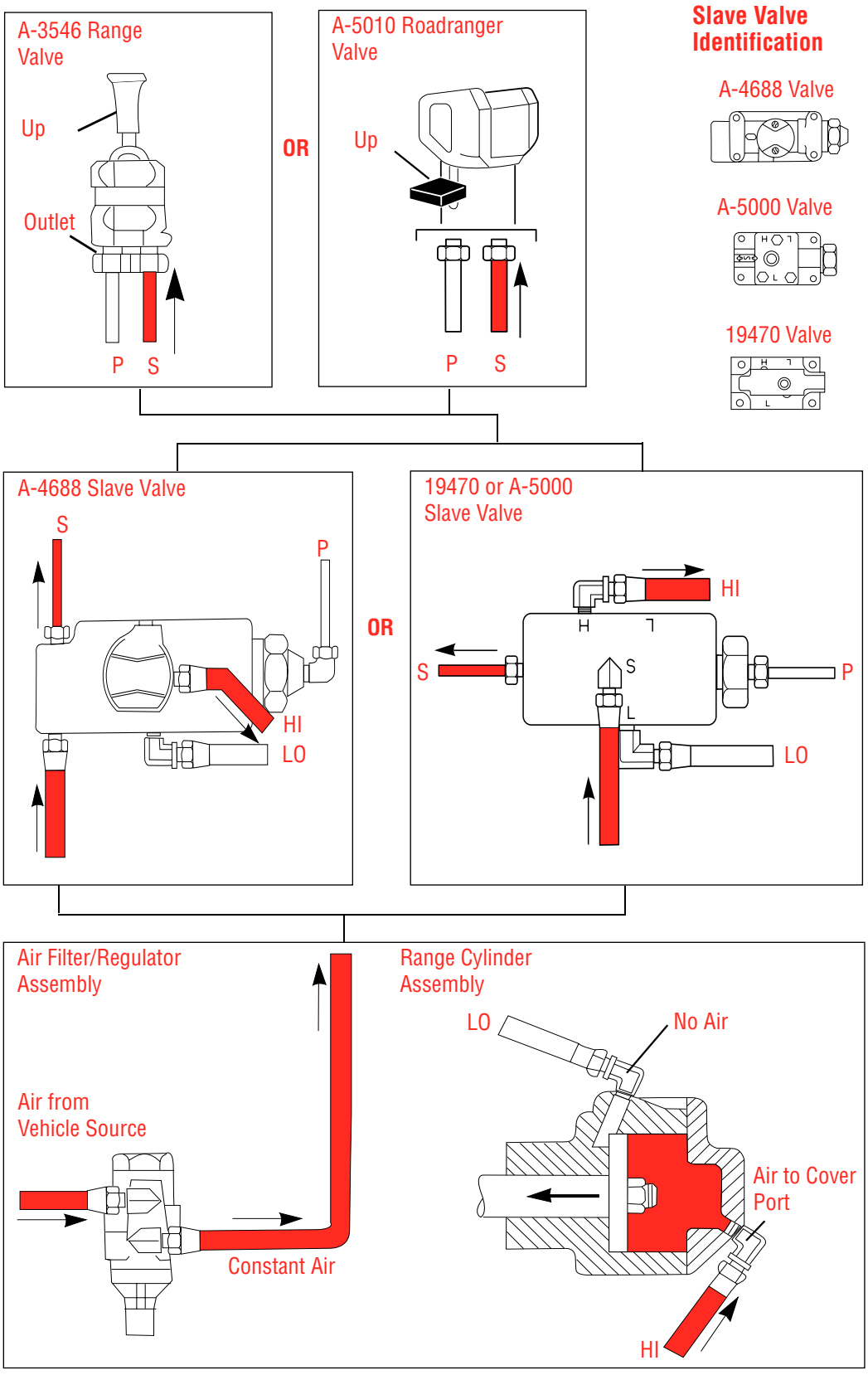
Schematic

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

https://truckmanualshub.com/

7L: 8: 9: and 10 Speed (2-Speed Auxiliary)

Range—HI



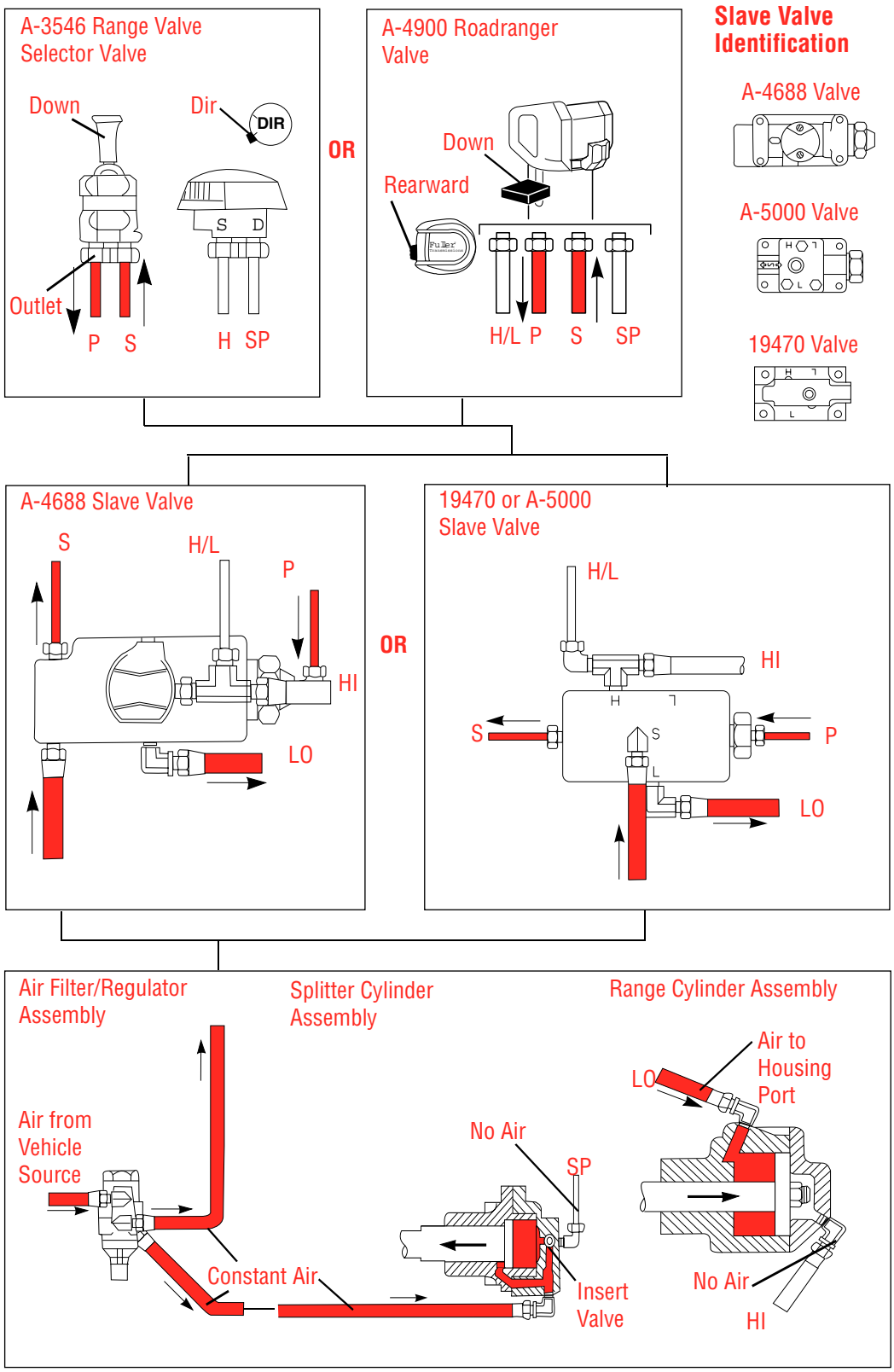
Schematic

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

https://truckmanualshub.com/

RT, RTO, & RTOO XX613 and XX813 Models

Range—LO



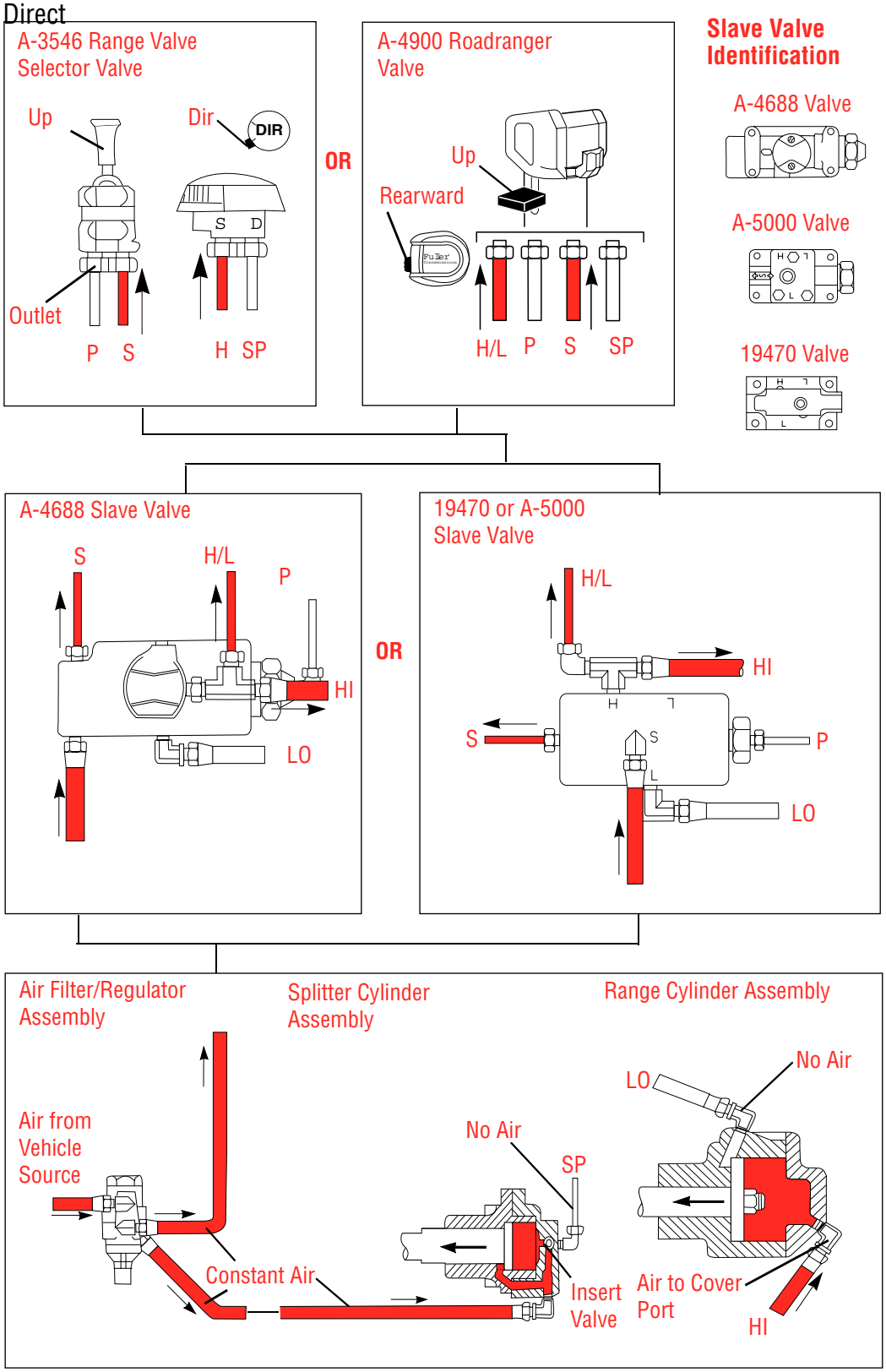
Schematic

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

https://truckmanualshub.com/

RT, RTO, & RTOO XX613 and XX813 Models

Range—HI/Splitter—Direct



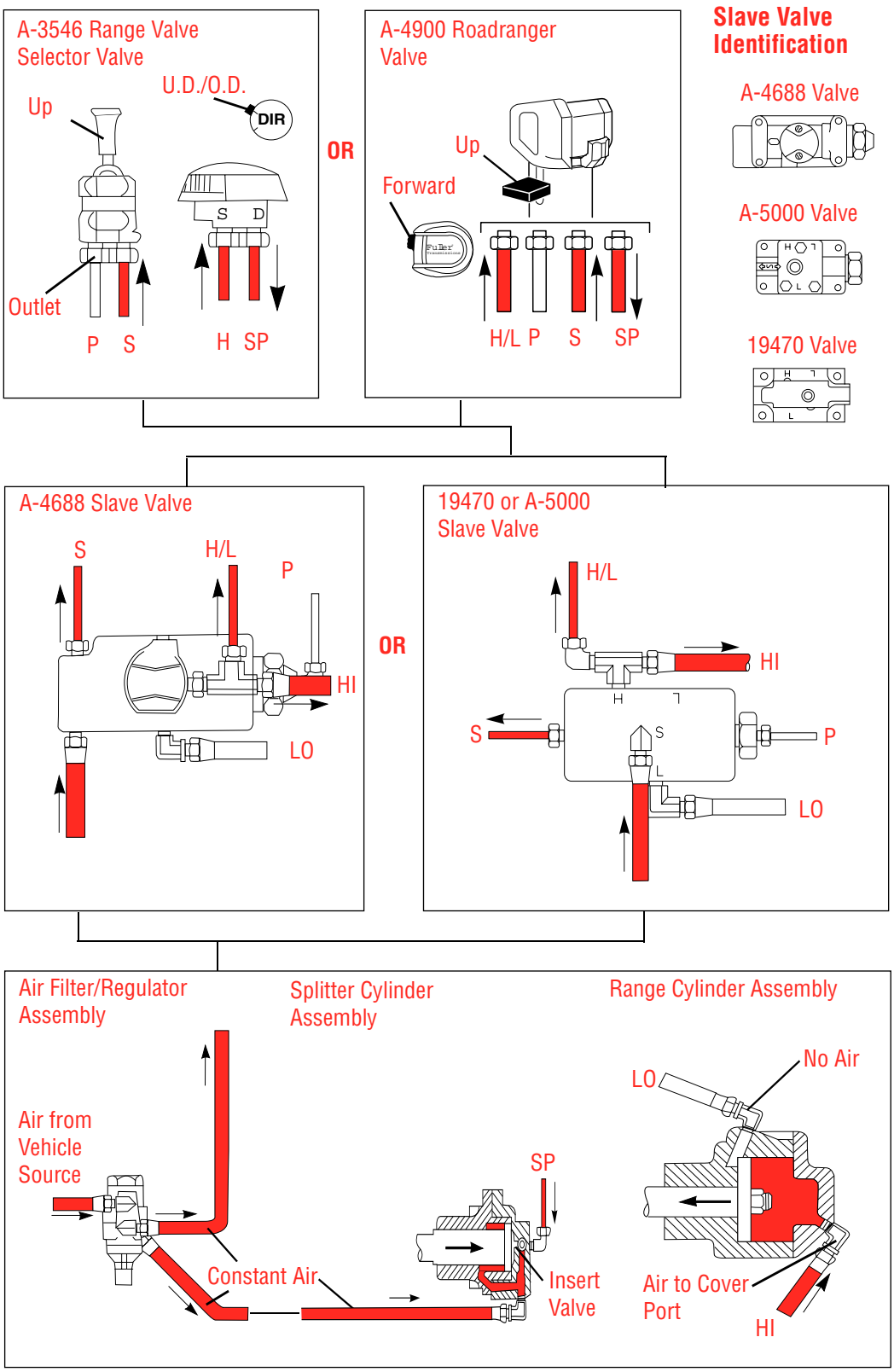
Schematic

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

https://truckmanualshub.com/

RT, RTO, & RTOO XX613 and XX813 Models

Range—HI/Splitter—Underdrive or Overdrive



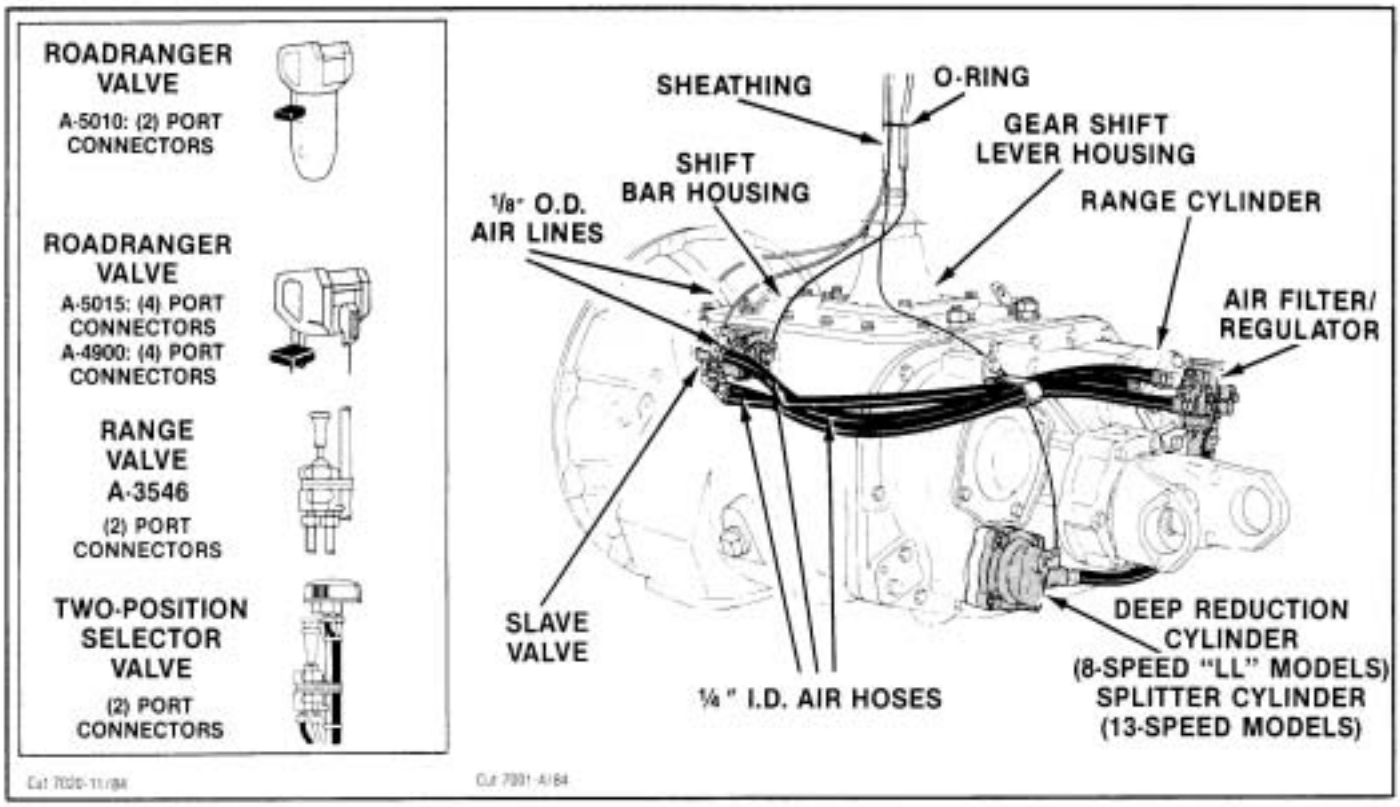
Schematic

For all questions concerning removal and replacement, refer to Eaton Service and Parts Literature.

https://truckmanualshub.com/

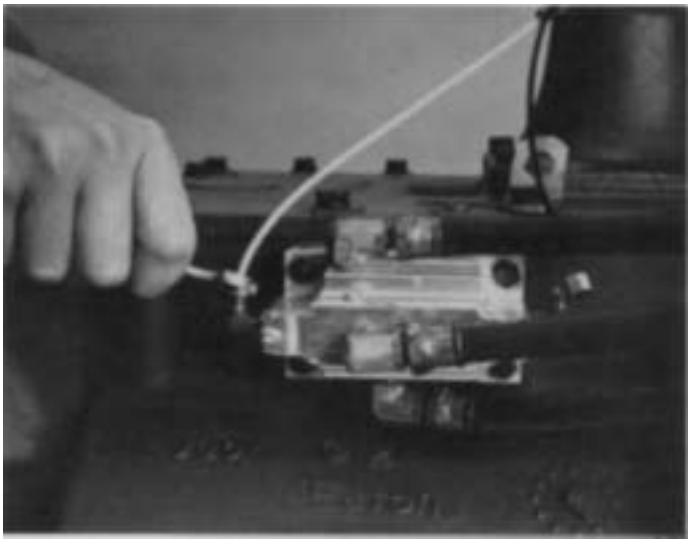
DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

AIR SYSTEM



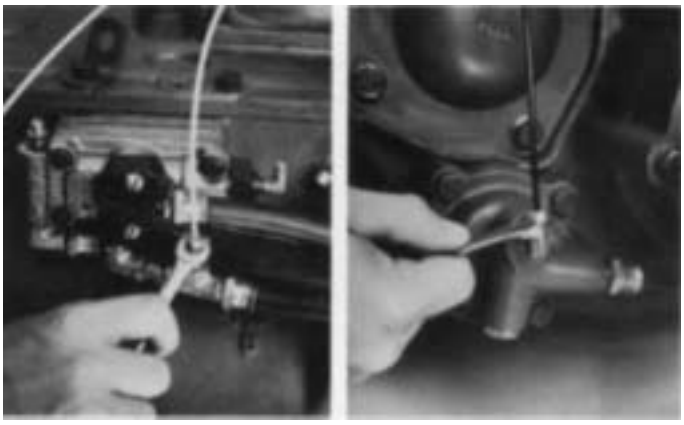
A. Removal of Air Control

NOTE: For removal and disassembly of models also equipped with the Countershaft Actuator Valve, see OPTIONS.



1. Disconnect the two 1/8" O.D. air line or at the "S" or Supply Port and the "P" or End Port of slave valve on transmission case.

NOTE: For models equipped with the A-3546 or Roadranger Valve A-5010, the gear shift lever housing assembly can now be removed from shift bar housing.

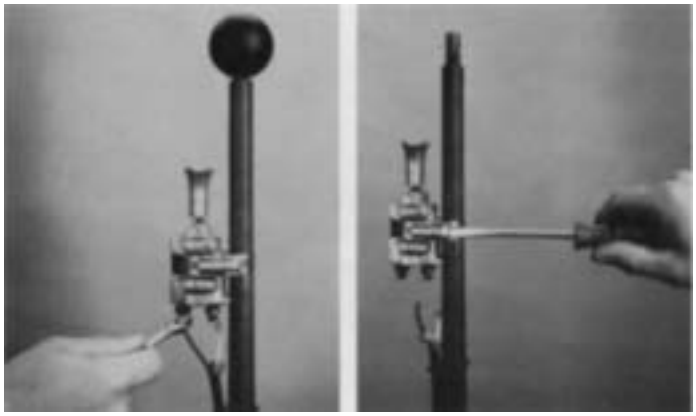


2. For models equipped with the Roadranger Valve A-5015 or A-4900, also disconnect the 1/8" O.D. air hose line at the "L" or Low Range Port of slave valve (left); and the 1/8" O.D. air line at the Center Port of reduction cylinder/splitter cylinder cover (right).

NOTE: If desired, the gear shift lever housing assembly can now be removed from shift bar housing.

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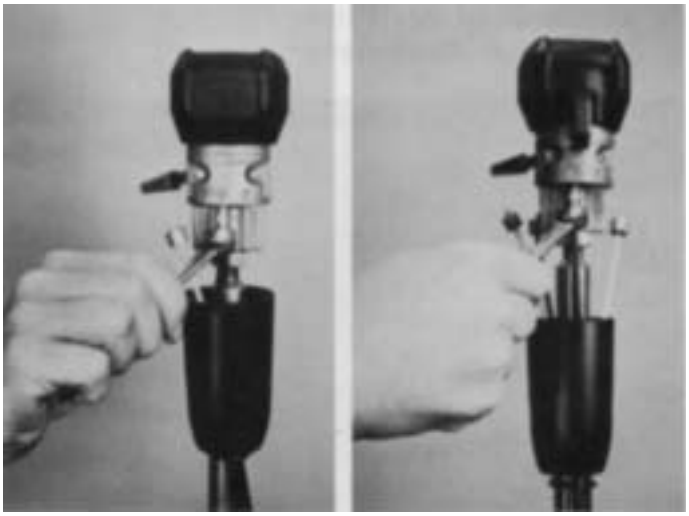
DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



1. Disconnect the two 1/8" O.D. air lines at the Range Valve of models so equipped (left). Remove the ball grip, loosen the valve mounting clamp and remove the valve, mounting clamp, air lines, sheathing and O-rings from gear shift lever (right).
NOTE: For disassembly and reassembly of Range Valve, see Page 28.



4. For models so equipped, turn out the two mounting screws in valve cover.



5. Slide the cover down shift lever to expose valve ports and disconnect the 1/8" O.D. air lines.



6. Loosen the jam nut and turn the Valve and nut from gear shift lever. Remove the valve cover, air lines, sheathing and O-rings from lever.

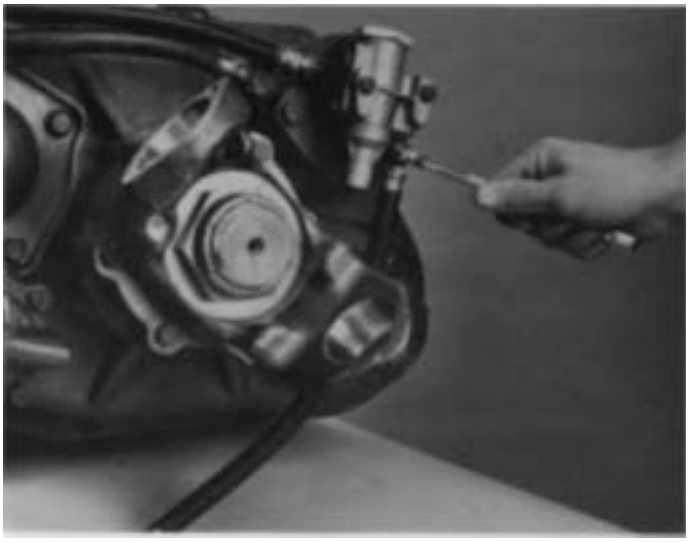
https://truckmanualshub.com/

DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

B. Removal of Air Filter Regulator Assembly



1. Disconnect and remove the 1/4" I.D. air hose between the slave valve and air filter/regulator assembly.



2. For 8-Speed "LL" or 13-Speed Models, also disconnect the 1/4" I.D. air hose between the air filter/regulator assembly and reduction/splitter cylinder.



3. Turn out the two capscrews and remove the air filter/regulator assembly.
NOTE: For disassembly and reassembly of Air Filter/Regulator Assembly, see Page 27.

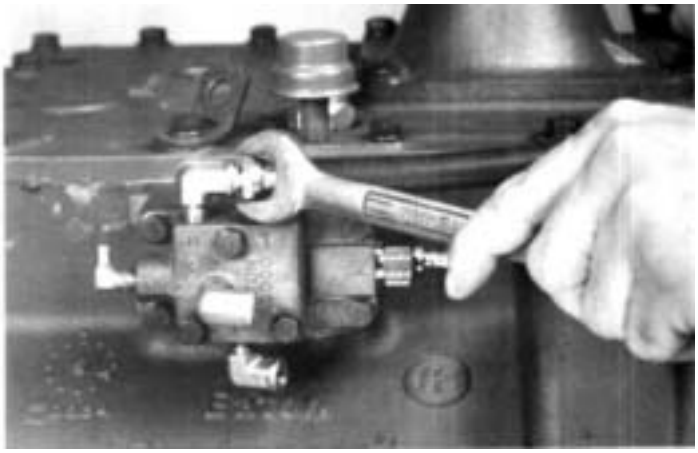
C. Removal of Slave Valve



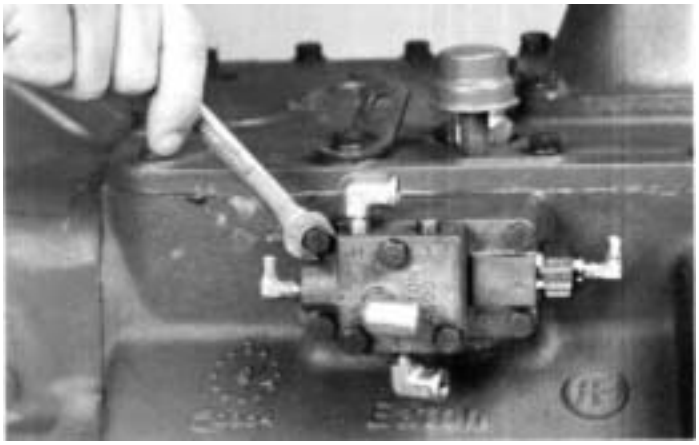
1. Disconnect and remove the 1/.4" I.D. air hose between the slave valve and Low Range Port in housing of range cylinder.

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DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



2. Disconnect and remove the 1/4" I.D. air hose between the slave valve and High Range Port in cover of range cylinder.



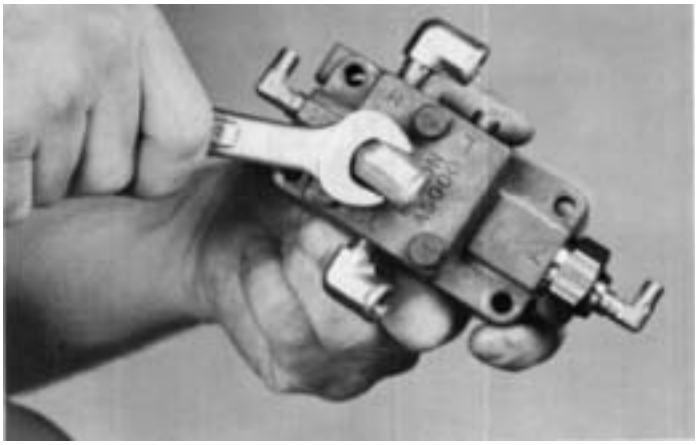
3. Turn out the four retaining capscrews and remove slave valve from transmission case.



4. Remove the hat-type alignment sleeve from bore in slave valve.



5. Remove the spring and plunger pin from bore in transmission case. Remove slave valve gasket.

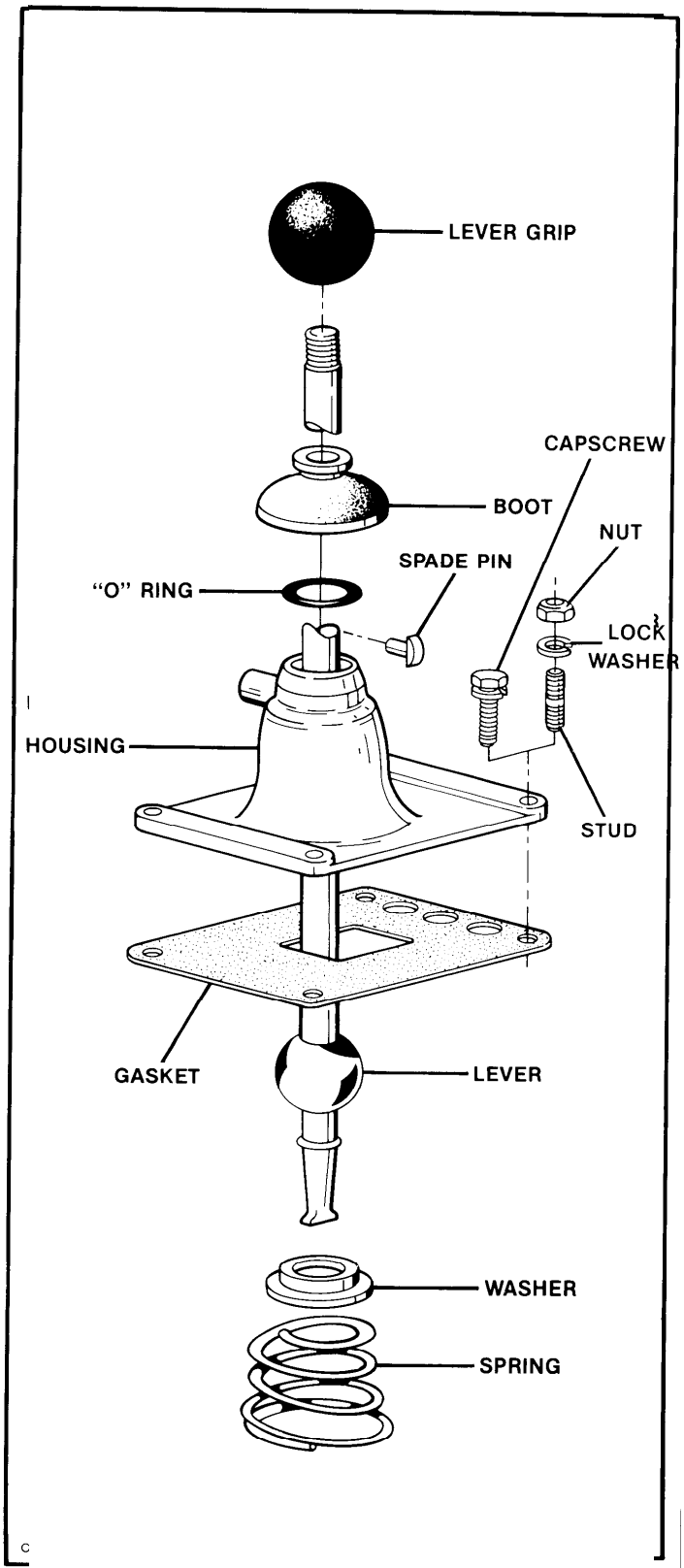


6. If necessary, remove the air hose fittings from slave valve.

NOTE: For disassembly and reassembly of piston-type Slave Valve Assembly ONLY, see Page 27.

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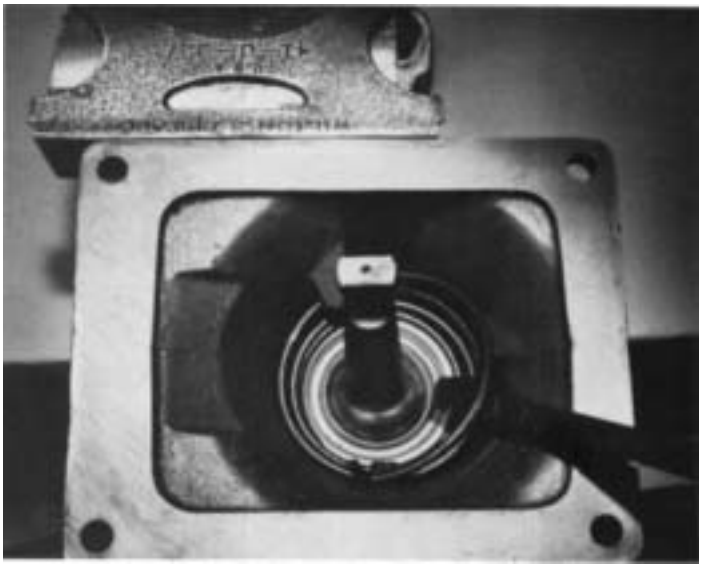
DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



A. Removal and Disassembly



1. Turn out the four retaining capscrews, jar lightly to break gasket seal and remove the gear shift lever housing and gasket from shift bar housing. NOTE: Remote control housings are removed from shift bar housing in the same manner. For disassembly and reassembly of LRC Assemblies, see Illustrated Parts List No. P-541. For disassembly and reassembly of SRC Assemblies, see Illustrated Parts List No. P-515.



2. Remove the boot from gear shift lever and secure assembly in vise with bottom of housing up. Use a large screwdriver to twist between the spring and housing, forcing the spring from under the lugs in housing. Do one coil at a time.

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DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

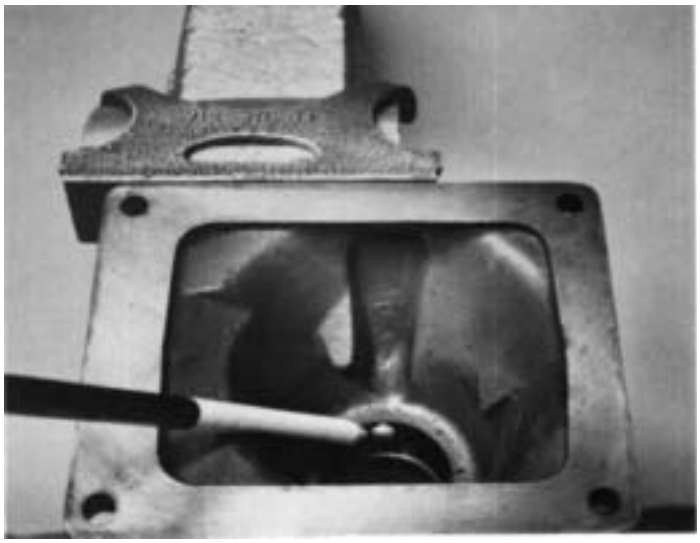


3. Remove the tension spring, washer and gear shift lever from housing.



4. Remove the spade pin from bore in housing tower. If necessary, remove the O-ring from groove inside tower.

B. Reassembly of Gear Shift Lever Housing Assembly



1. With the gear shift lever housing secured in vise as during disassembly, install the spade pin in bore of housing tower. If previously removed, install the O-ring in tower groove.



2. Position the gear shift lever in housing with spade pin in lever ball slot and install the tension spring washer over ball, dished-side up.

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DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



3. Install the tension spring under lugs in housing, seating one coil at a time. Use of a spring driving tool is recommended.

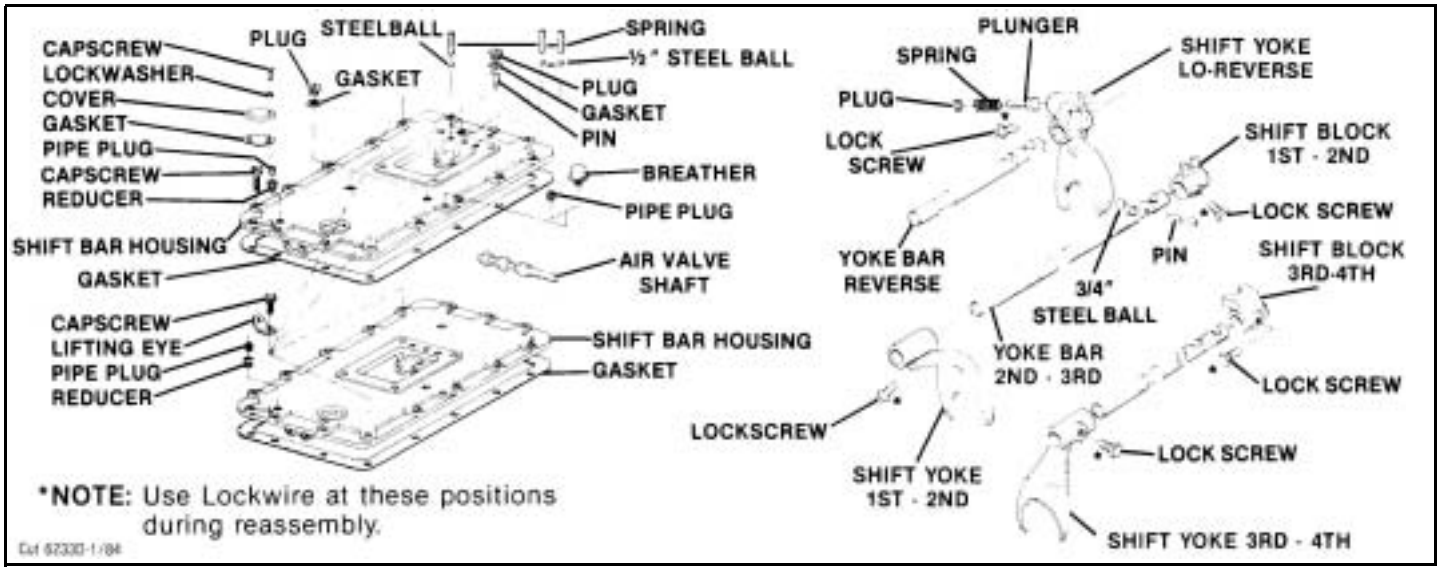


4. Remove the assembly from vise and install the rubber boot over gear shift lever and against housing.

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DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

SHIFT BAR HOUSING ASSEMBLY



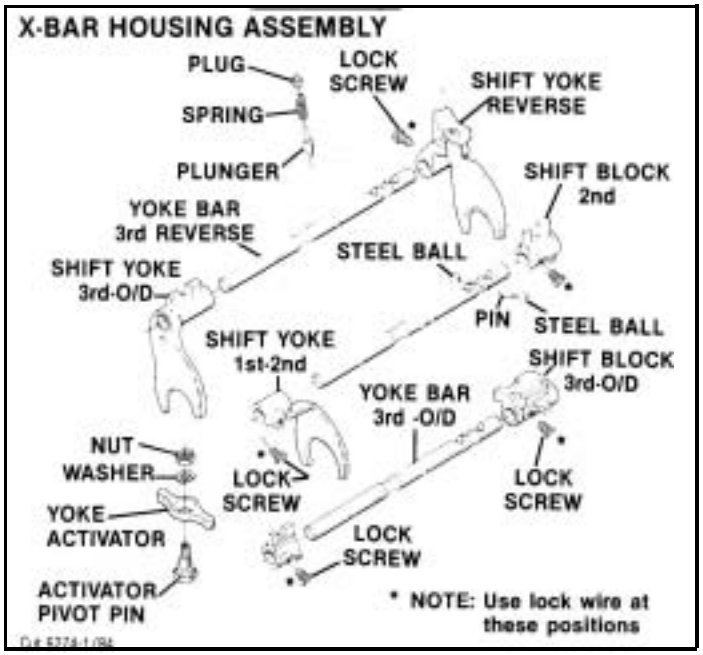
A. Removal and Disassembly

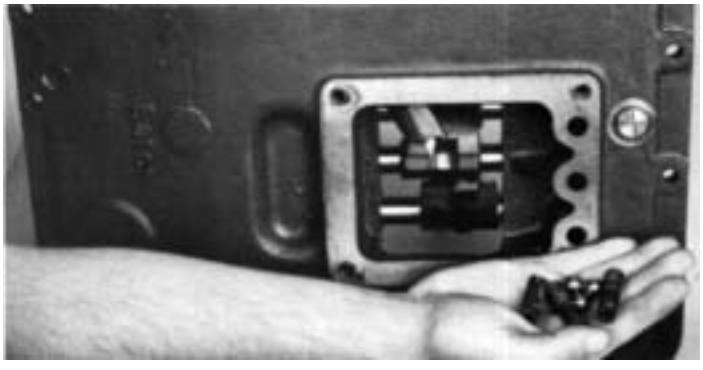
NOTE: For models equipped with an Oil Pump and/or Cooler Assemblies, make sure to disconnect the lube line at fitting on shift bar housing prior to proceeding with the following instructions.



1. Turn out the retaining capscrews, jar to break gasket seal and lift the shift bar housing from case. Remove gasket.

NOTE: During disassembly, lay all parts on a clean bench in order of removal from housing to facilitate reassembly. Shift bars not being removed MUST be kept in the neutral position or interlock parts will lock bars. For disassembly and reassembly of "X" and "F" model assemblies, see Illustrated Parts List.

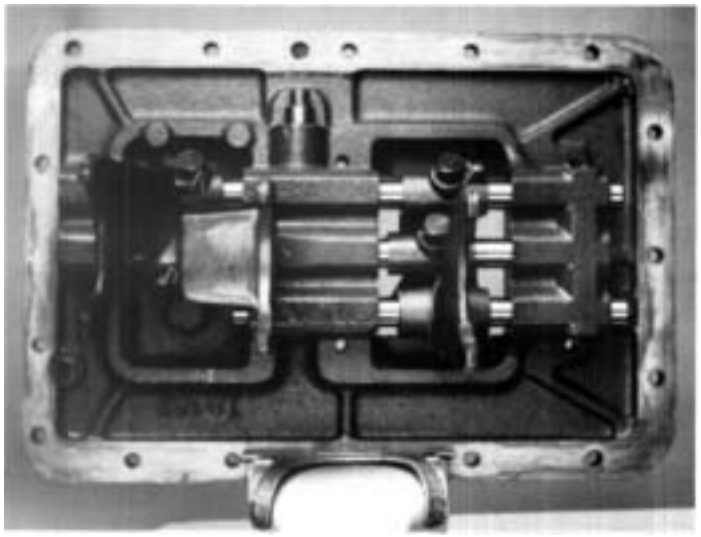




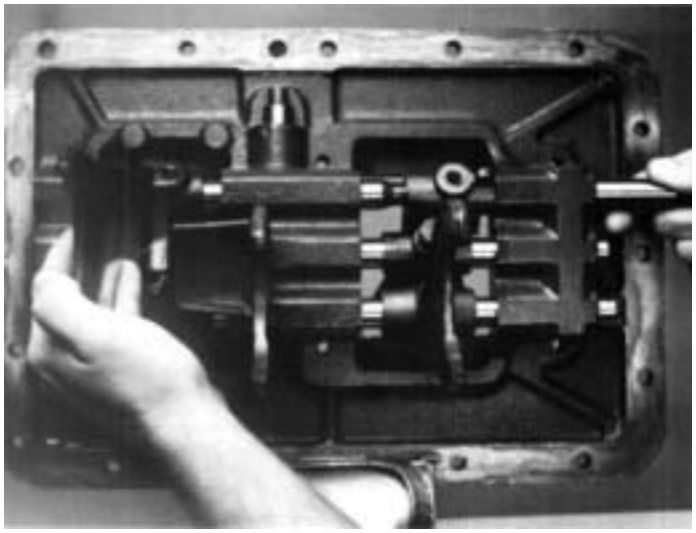
2. Tilt the assembly and remove the three sets of tension springs and balls from bores in top of housing.

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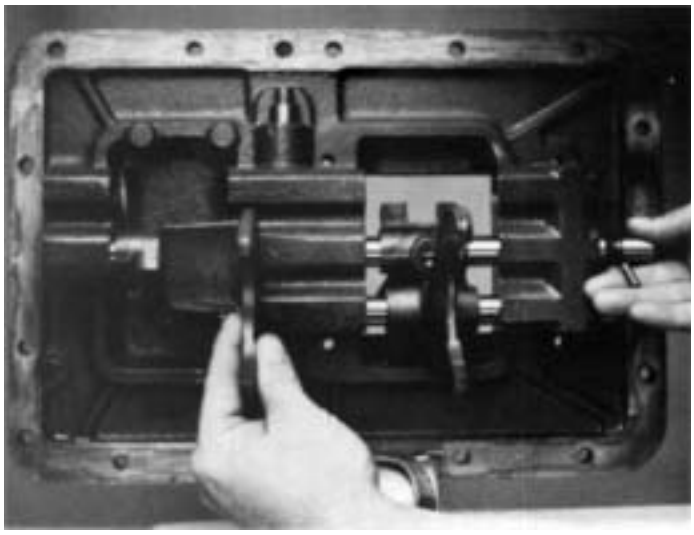
DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



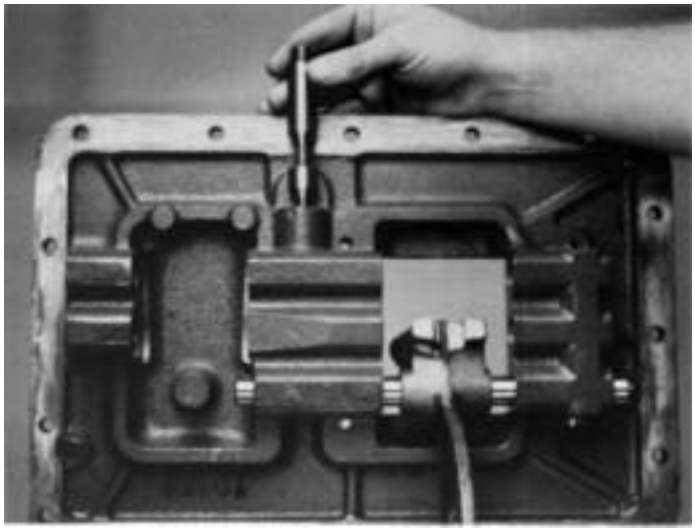
3. Mount the assembly in a vise with plunger-side up and secure on housing flange. (The front of housing will be to the left.) For models so equipped, cut lockwire and turn out the retaining capscrews to remove oil trough from housing.
NOTE: Starting with the upper shift bar, move all bars to the right and out bore of rear boss. Cut lockwire and remove lockscrews from each bar just prior to their removal from housing.



4. Move the 3rd-4th speed shift bar to the rear of housing, removing the yoke and block from bar.



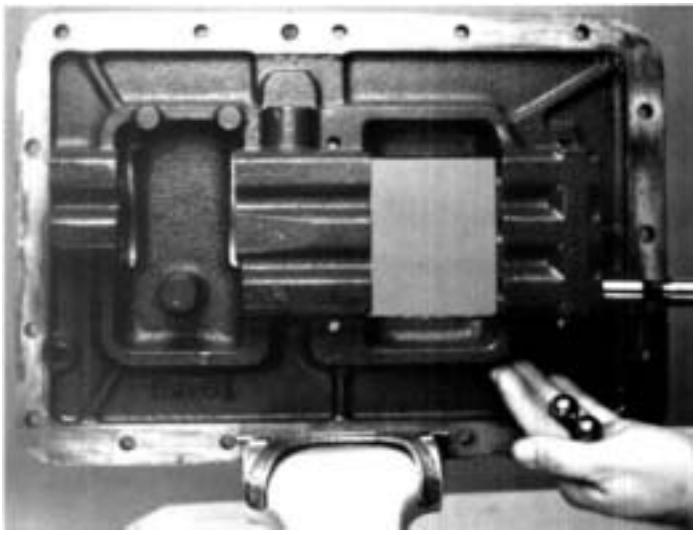
5. Move the 1st-2nd speed shift bar to the rear of housing, removing the yoke and block from bar. As the neutral notch in bar clears the rear boss, remove the small interlock pin from bore at notch.



6. Remove the actuating plunger from bore at top of center boss.

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DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



7. Move the short LO-Reverse speed shift bar to the rear of housing, removing the yoke from bar. As the shift bar is removed from housing, two %Ò interlock balls will drop from bottom bore of rear boss.



8. If necessary, remove the plug, spring and reverse-stop plunger from bore in LO-Reverse speed shift yoke.

B. Reassembly of Shift Bar Housing Assembly



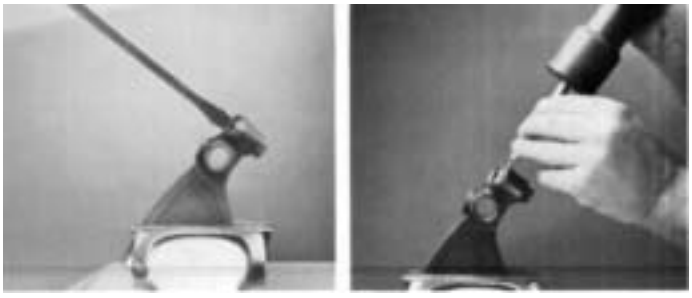
1. If previously removed, install the reverse-stop plunger in LO-Reverse shift yoke, making sure plunger is fully seated in bore at yoke slot.



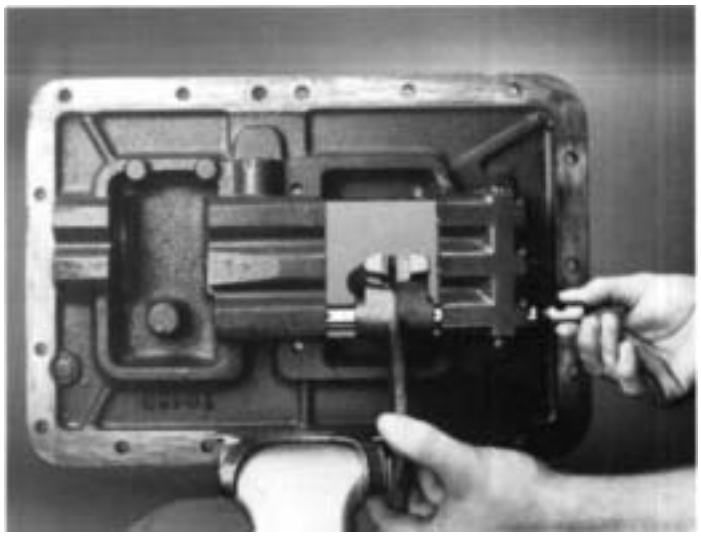
2. Install the spring in bore of yoke and onto shank of plunger.

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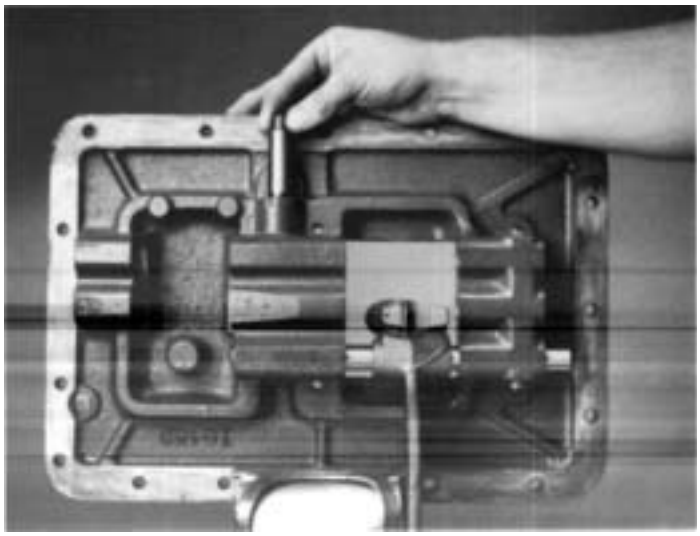
DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS



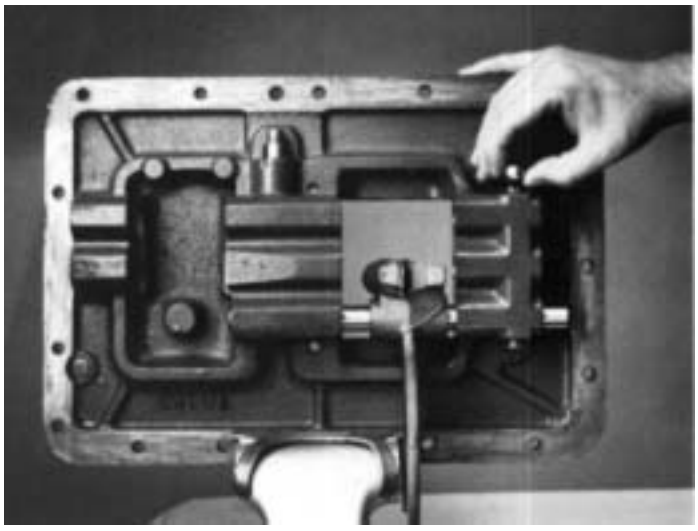
3. Install the plug and tighten to compress spring (left). Back the plug out 1-1 1/2 turns and stake plug through the small hole in yoke (right).



4. With the shift bar housing secured in vise as during disassembly, hold notched-end of short LO-Reverse speed shift bar and install in lower bore of housing bosses, positioning the yoke on bar between the bosses. Install the yoke lock-screw, tighten and wire securely.
NOTE: Start with the lower shift bore of rear boss and move to the left (front of housing). Keep bars in the neutral position during installation. DO NOT EXCEED the recommended torque ratings for yoke lockscrews as over-tightening may distort shift bars.



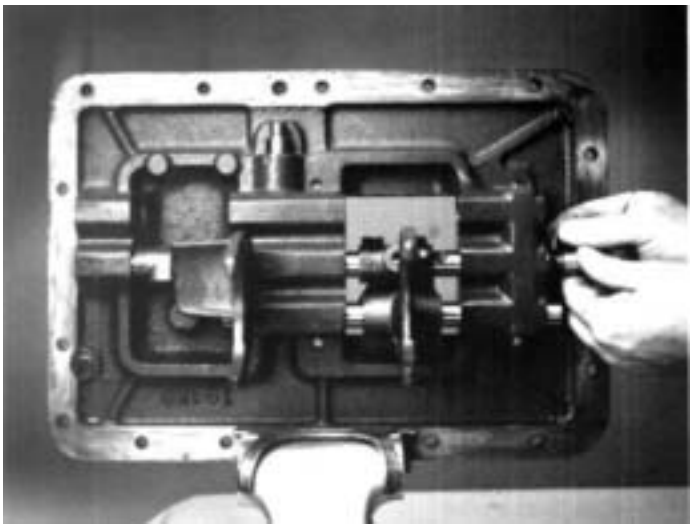
5. Holding shank of plunger, install the actuating plunger in bore at top of center boss.



6. Install one 3/4" interlock ball in bore at top of rear boss. This ball rides between LO-Reverse and 1st-2nd speed shift bars.

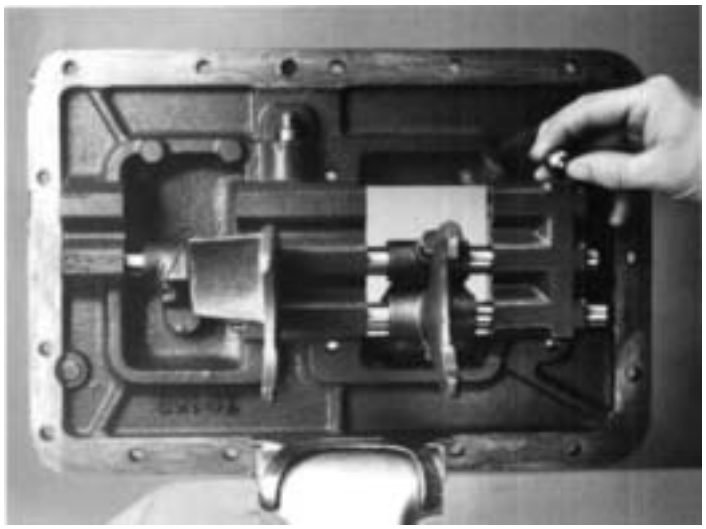
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DISASSEMBLY AND REASSEMBLY SHIFTING CONTROLS

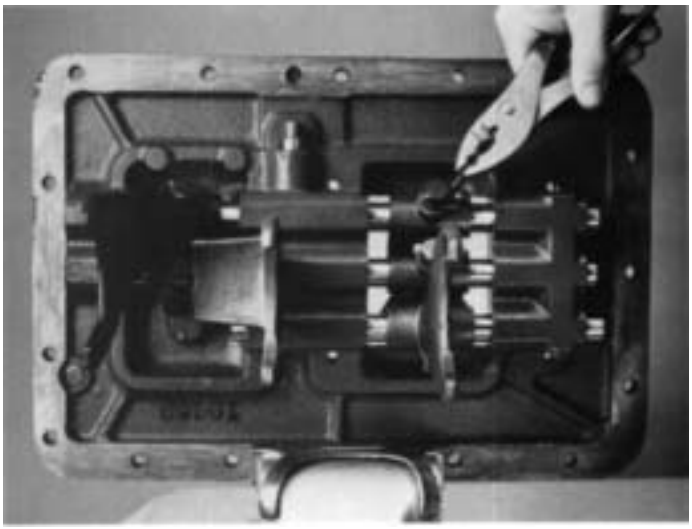


7. Holding notched-end of bar, install the 1st-2nd speed shift bar in middle bore of housing boss, positioning the shift block on bar between the center and rear bosses; and the yoke on bar between the front and center bosses, long hub to the front of housing. Just prior to inserting notched-end of bar in rear boss, install the small interlock pin VERTICALLY in bore at neutral notch. Install the block and yoke lockscrews, tighten and wire securely.

NOTE: It is necessary that interlock pin remain in a vertical position during reassembly as rotation of the bar will cause pin to jam in tension spring bores.

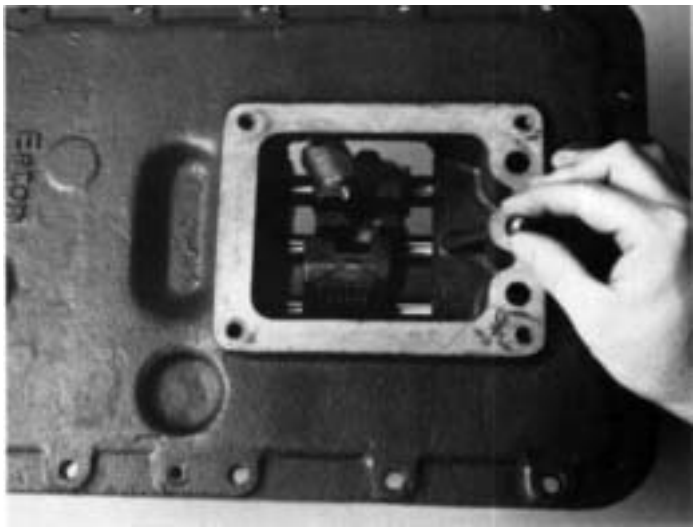


8. Install the other 3/4" interlock ball in bore at top of rear boss. This ball rides between the 1st-2nd and 3rd-4th speed shift bars,



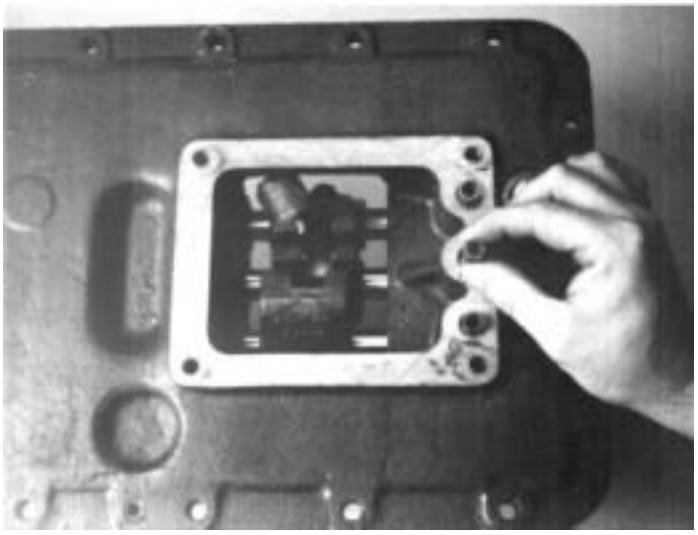
9. Holding notched-end of bar, install the 3rd-4th speed shift bar in upper bore of housing boss, positioning the shift block on bar between the center and rear bosses; and the yoke on bar between the front and center bosses, long hub to the rear of housing. Install the block and yoke lockscrews, tighten and wire securely.

10. For models so equipped, install the oil trough on housing. Tighten capscrews and wire securely.



11. Remove the assembly from vise and install the three tension balls, one in each bore on top of housing.

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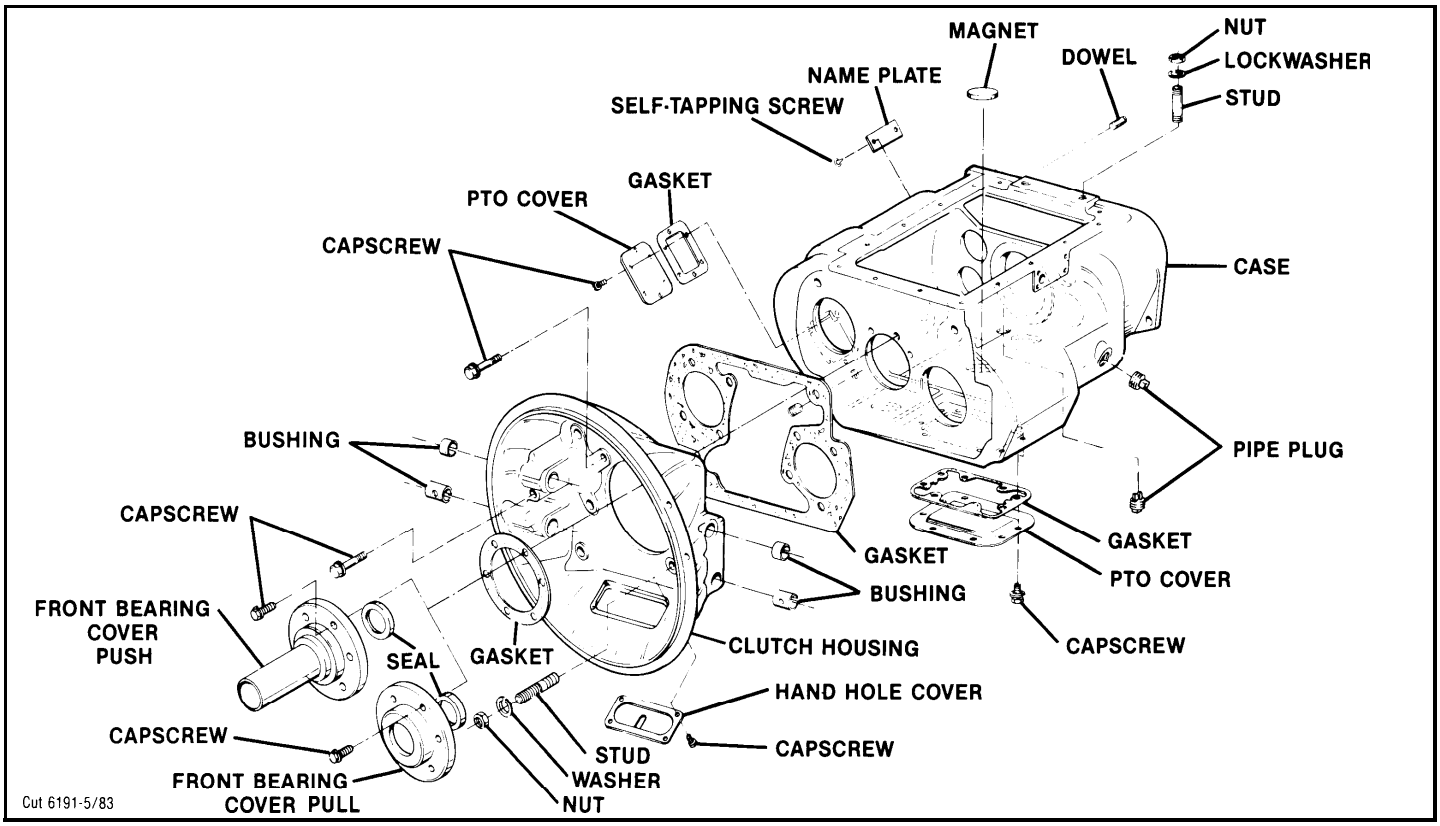


12. Install the three tension springs, one over each ball in housing bores.

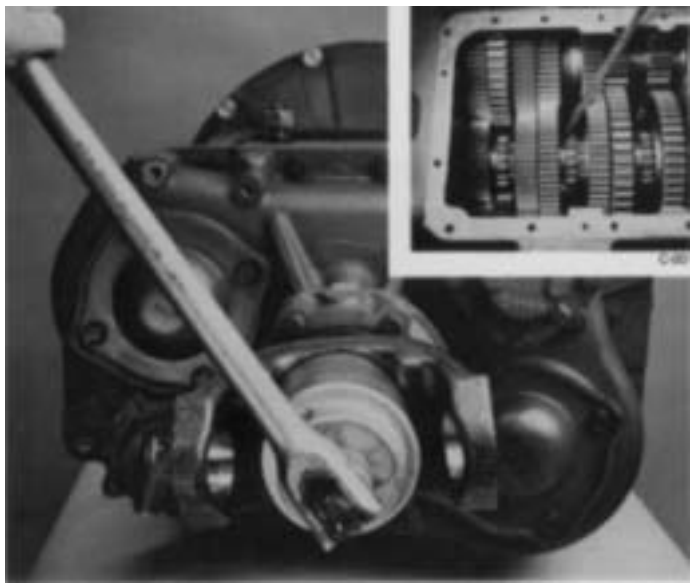
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REMOVAL - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING



A. Removal of Universal Joint Companion Flange or Yoke



1. Lock the transmission by engaging two mainshaft gears with sliding clutches (inset). Use a large breaker bar to turn the nut from output shaft and remove washer if so equipped.

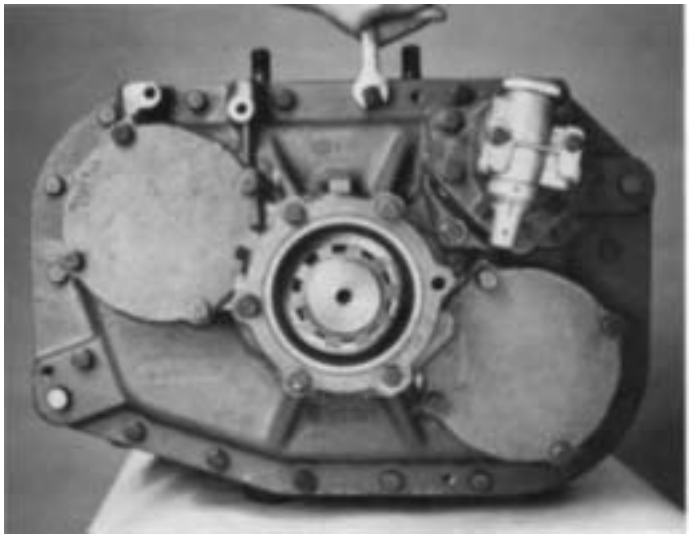


2. Pull the companion flange or yoke from splines of output shaft. Remove the speedometer drive gear or replacement spacer from hub of flange/yoke or from inside rear bearing cover remaining on output shaft (inset). For some models, it is necessary to remove the snap ring in groove of output shaft PRIOR to removal of the speedometer gear or spacer.

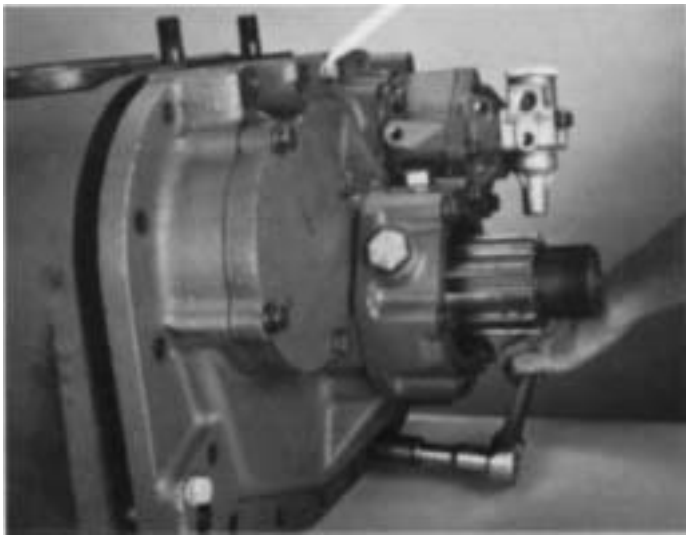
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REMOVAL - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

B. Removal of Auxiliary Section



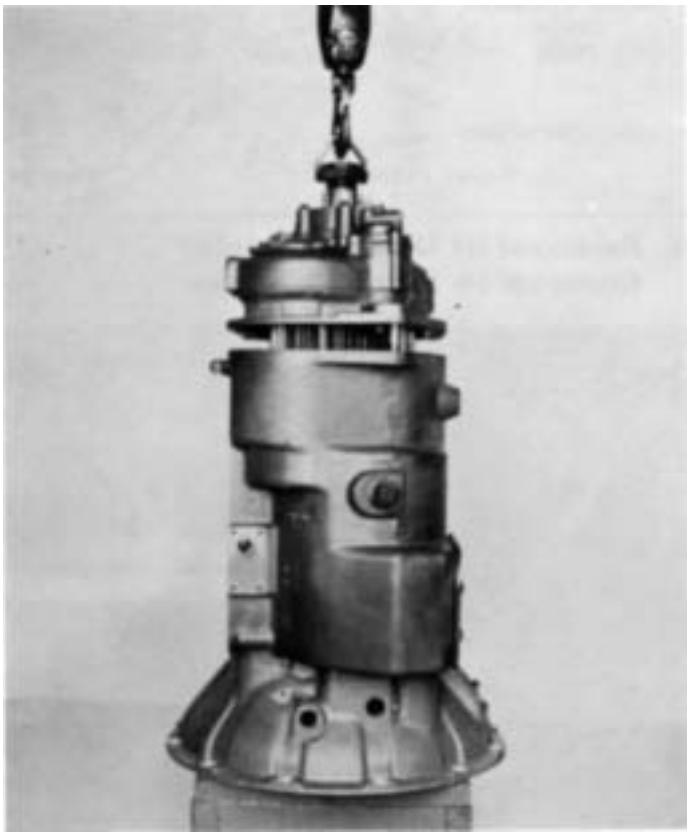
1. Turn out the retaining capscrews in auxiliary housing flange.



2. Insert three puller screws in the tapped holes of housing flange. Tighten evenly to move auxiliary section to the rear and just far enough from front section to break gasket seal.



3. Remove puller screws and attach a chain hoist to auxiliary section. Move the assembly to the rear until free of front section and remove gasket.



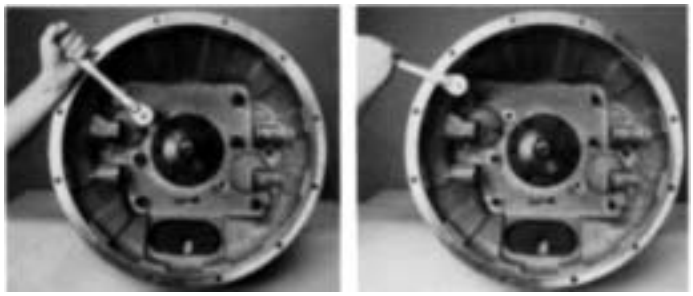
4. The auxiliary section can also be removed with transmission set in the vertical position. Block under the clutch housing to prevent damage to the input shaft, remove the retaining capscrews in housing flange and lift the assembly from front section. Remove gasket.

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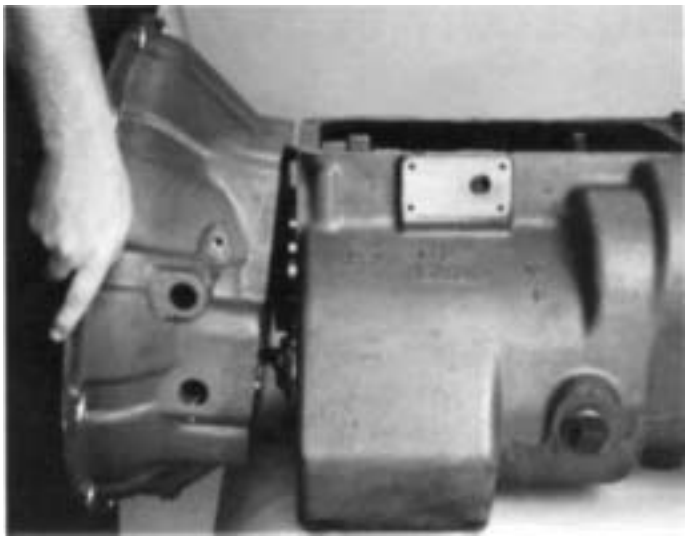
REMOVAL - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

C. Removal of Clutch Housing

1. For models so equipped, remove the clutch release mechanism and/or clutch brake assembly. See OPTIONS.



2. Turn out the four capscrews and remove the six nuts and lockwashers from studs securing the clutch housing to transmission case.

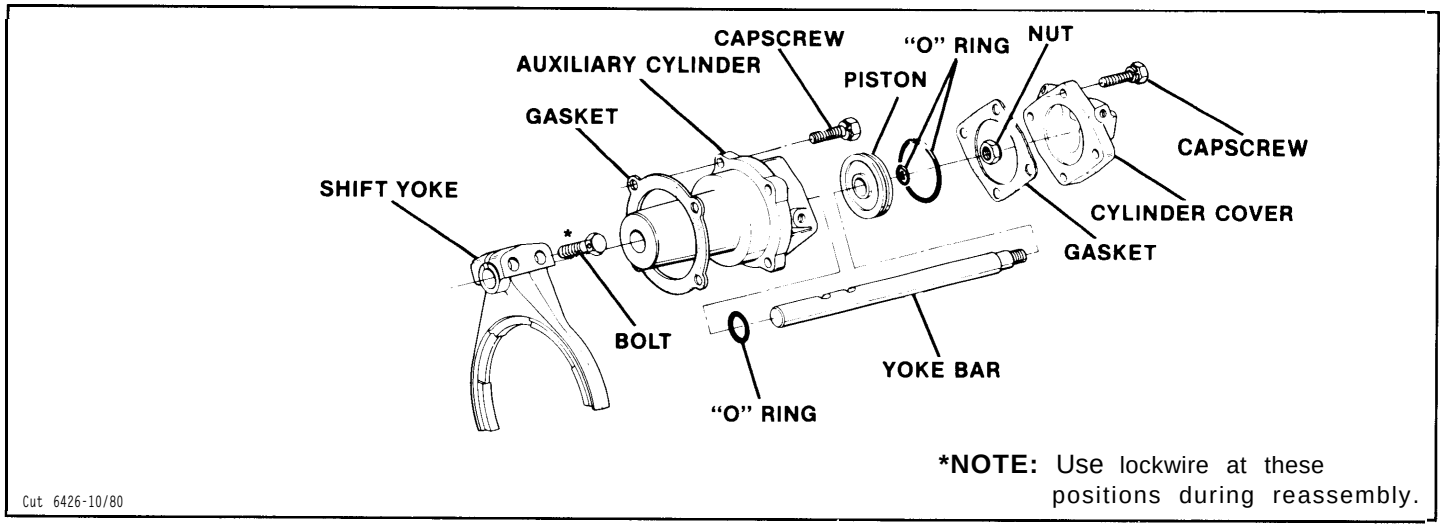


3. Jar clutch housing with a rubber mallet to break gasket seal and pull from transmission case. Remove gasket.

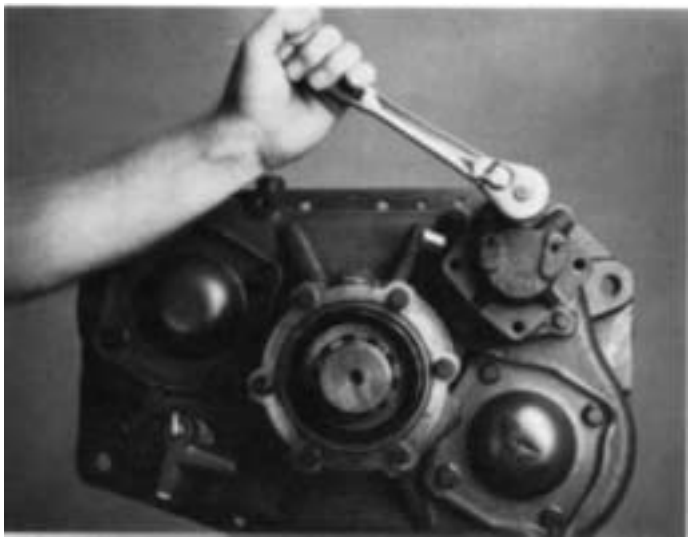
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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

AUXILIARY SECTION (8-SPEED "LL" MODELS)



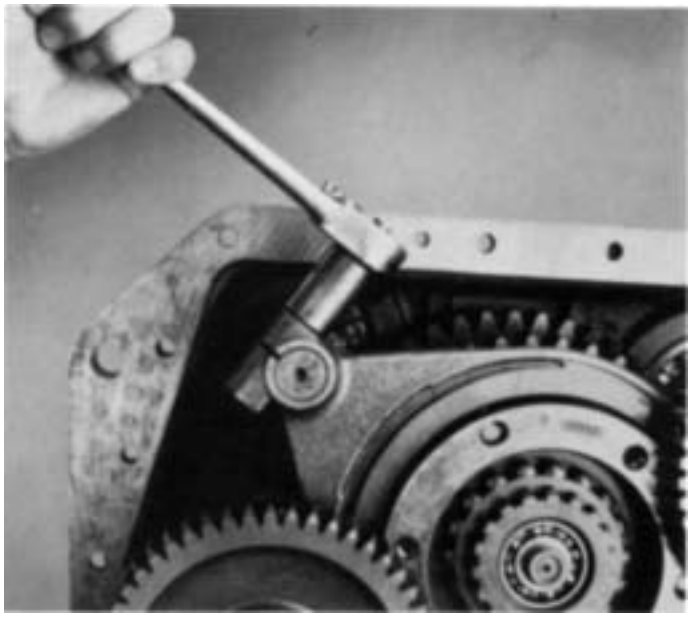
A. Removal and Disassembly of Range Cylinder Assembly



1. For ease of disassembly, mount the auxiliary section upright in a vise. Turn out the capscrews and remove the range cylinder cover and gasket.



2. Remove nut from end of yoke bar.



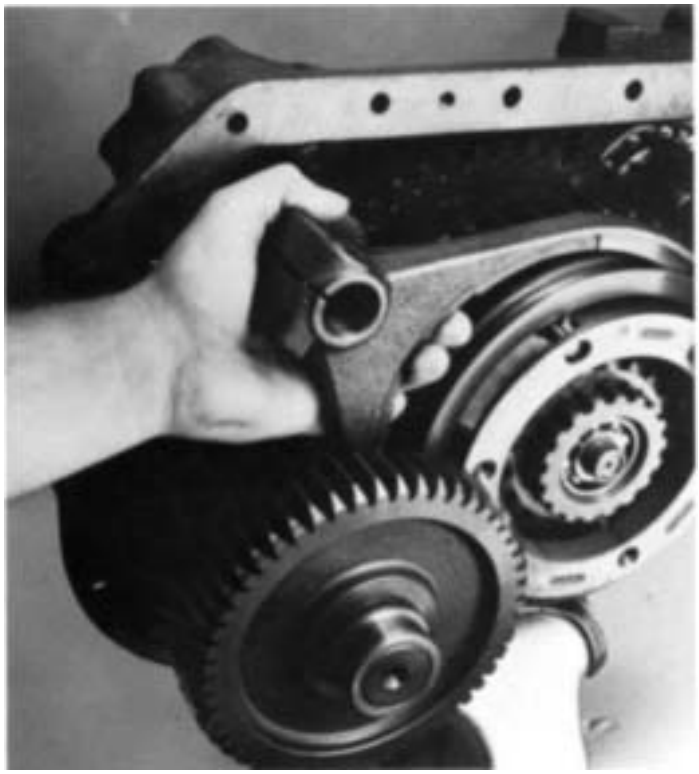
3. Cut lockwire and remove two yoke lockscrews.

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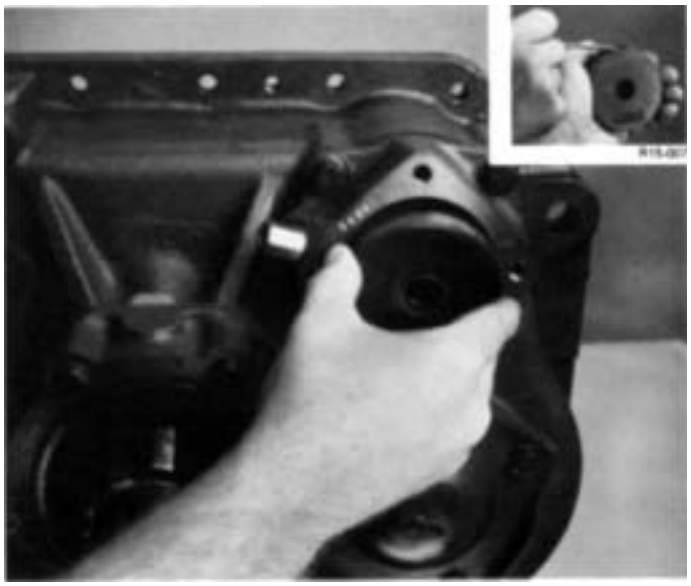
DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



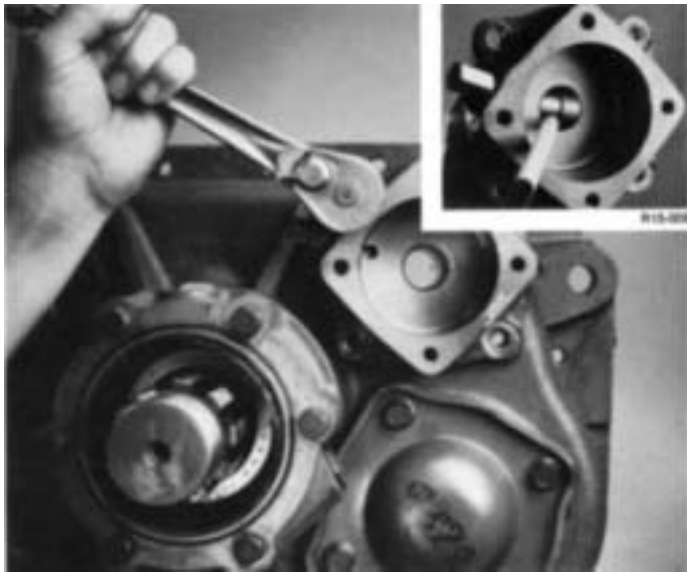
4. Pull yoke bar from bore of cylinder housing.



5. Remove range yoke from sliding clutch of synchronizer assembly.



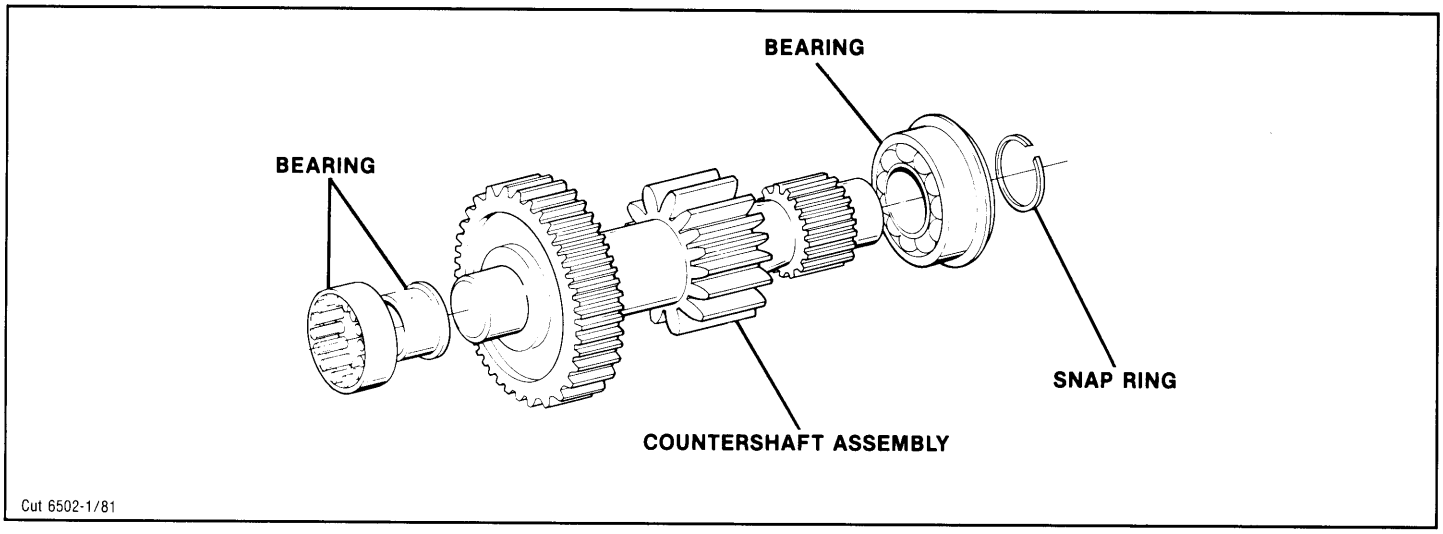
6. Remove the rance piston from cylinder bore. If necessary, remove the O-rings from piston I.D. and O.D. (inset).



7. Turn out the capscrews and remove the range cylinder housing and gasket. If necessary, remove the small O-ring from groove in housing bore (inset).

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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



B. Removal of Auxiliary Countershaft Assemblies



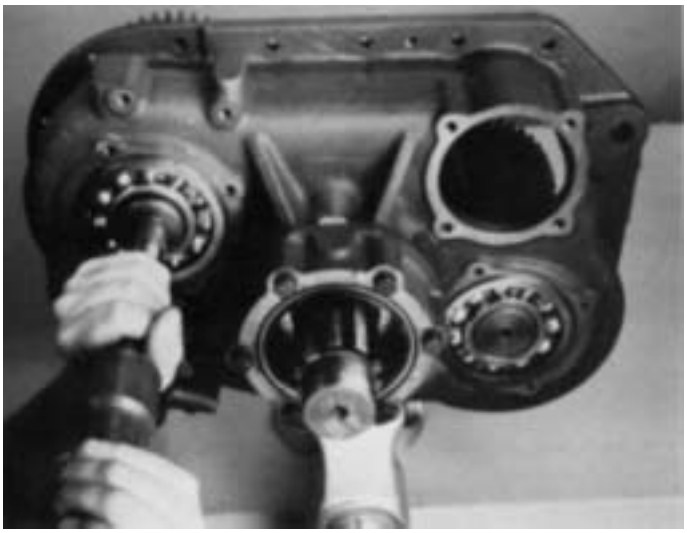
1. Turn out the capscrews and remove both countershaft rear bearing covers.
NOTE: For removal and disassembly of models equipped with an Auxiliary Oil Pump Assembly on rear of countershaft, see OPTIONS.



2. Remove the snap ring from groove at rear of each countershaft.

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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



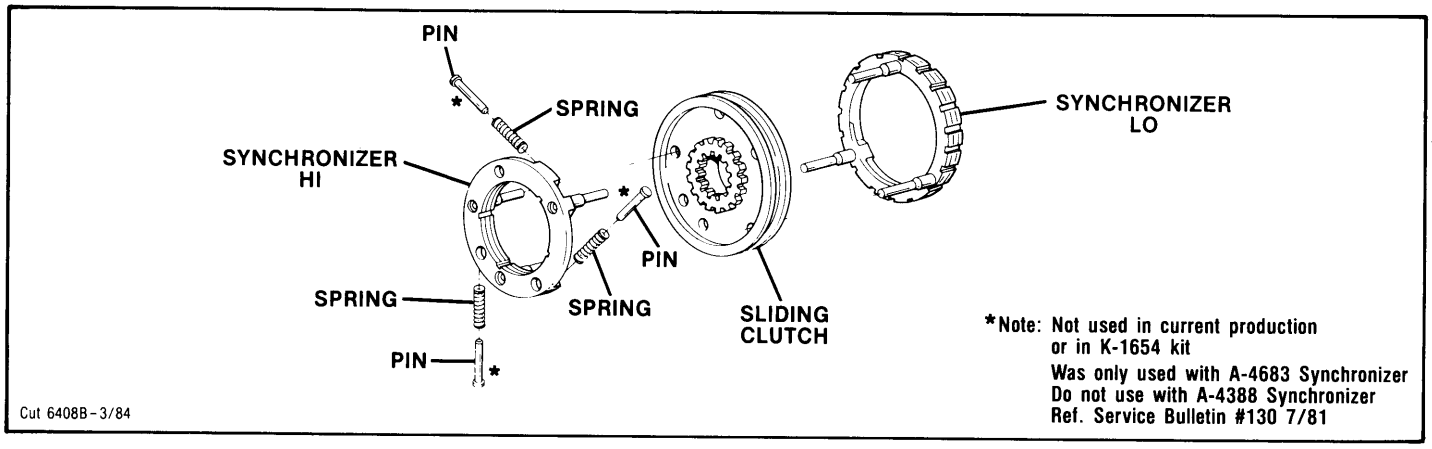
3. Use a soft bar and maul to drive the countershaft forward and from rear bearings.



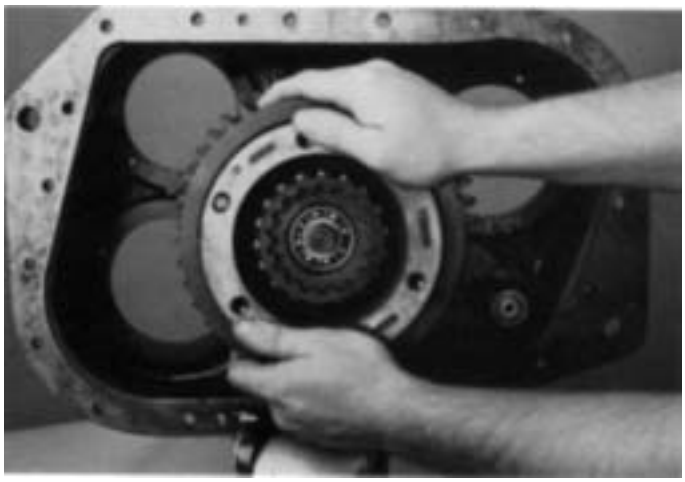
4. If necessary, secure the assembly in a vise and remove the bearing inner race from front of countershaft with jaw pullers.
   NOTE: The vise used should be equipped with brass jaws or wood blocks to prevent damage to the countershaft.

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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



C. Removal and Disassembly of Synchronizer Assembly



1. Pull the synchronizer assembly from the splines of range mainshaft.



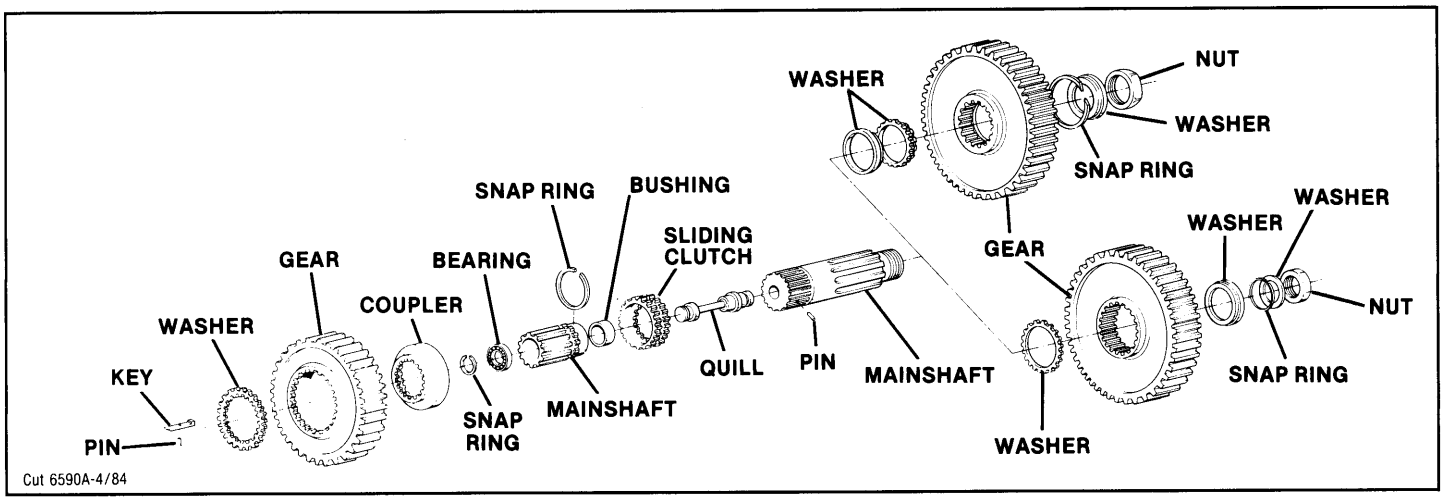
2. Place the larger low range synchronizer ring on bench and pull the high range synchronizer from blocker pins. However, before doing so, cover the assembly with a shop rag to prevent losing the three springs released from high range synchronizer at pin locations.



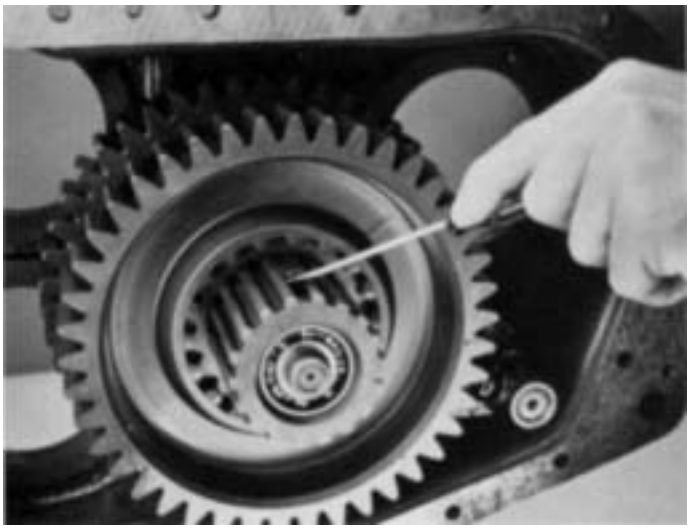
3. Remove the sliding clutch from pins of low range synchronizer ring.

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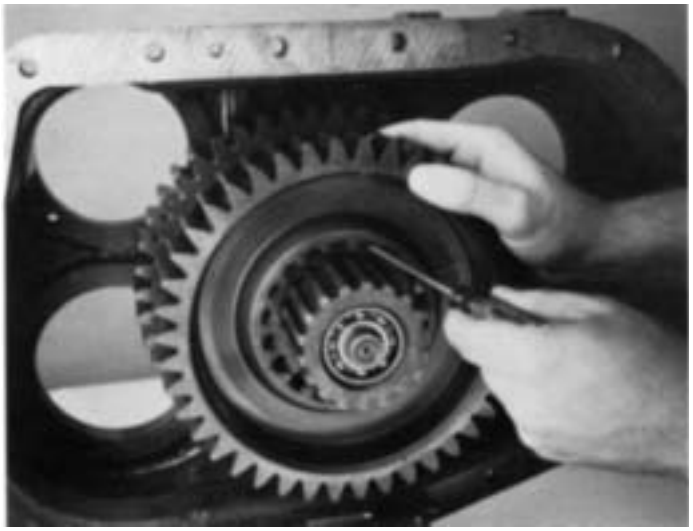
DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



D. Removal of Low Range Gear



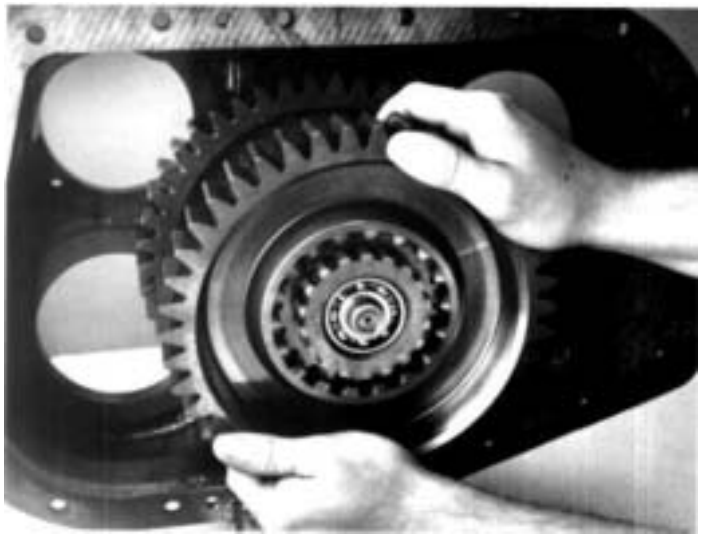
1. Remove the key from keyway of range mainshaft.



2. Turn the washer located in the hub at low range gear so that the splines of washer align with the splines of mainshaft.

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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



3. Pull the low range gear and washer from splines of range mainshaft.

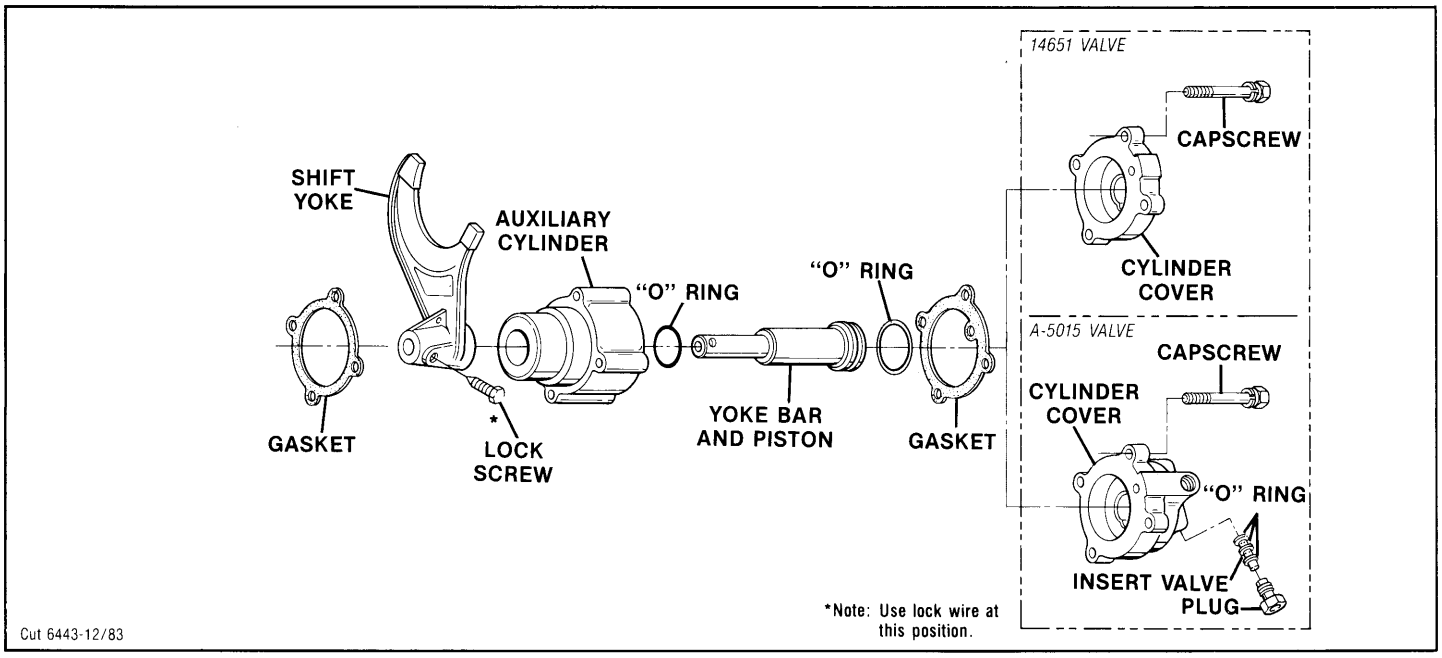


4. Remove the coupler from splines of range mainshaft.

NOTE: If desired, Removal and Disassembly of Range Mainshaft Assembly may be performed prior to Removal and Disassembly of Deep Reduction Cylinder Assembly.

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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



E. Removal and Disassembly of Deep Reduction Cylinder Assembly



1. Turn out the capscrews and remove the deep reduction cylinder cover and gasket.



2. If necessary, turn out the insert valve retaining nut of covers so equipped and remove insert valve from bore.

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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



3. Cut lockwire and remove the lockscrew from shift yoke.



4. Pull the yoke bar from cylinder housing and remove shift yoke. If necessary, remove the O-ring from piston O.D. (inset).



5. Remove the deep reduction cylinder housing and gasket from auxiliary housing. If necessary, remove the small O-ring from bore in cylinder housing.

F. Removal and Disassembly of Range Mainshaft Assembly

NOTE: Refer to the illustration provided at Part D of this section.



1. Remove snap ring from range mainshaft.



2. Remove deep reduction sliding clutch.

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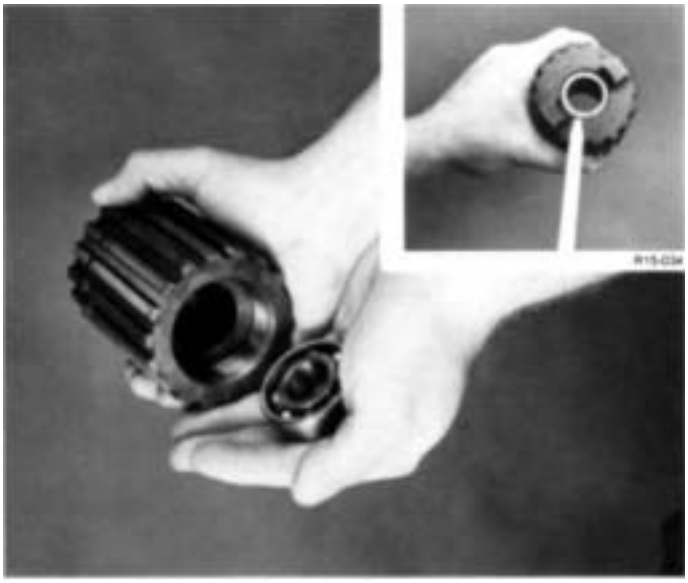
DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS]



3. Remove the "C" ring from groove at front of mainshaft quill.



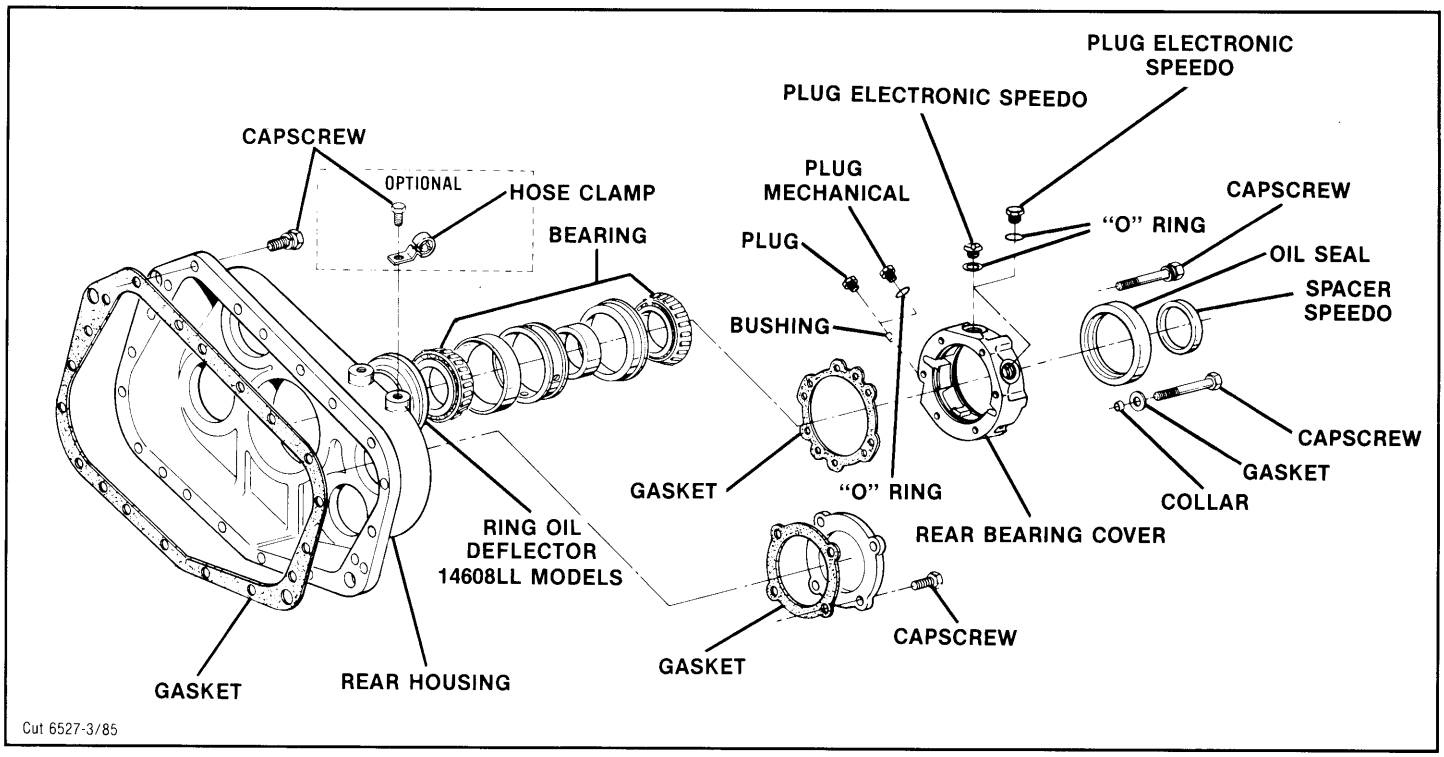
4. Insert jaws of puller behind range mainshaft and pull from quill.



5. Remove the front bearing from bore in range mainshaft. If necessary, press the bushing from mainshaft bore (inset).

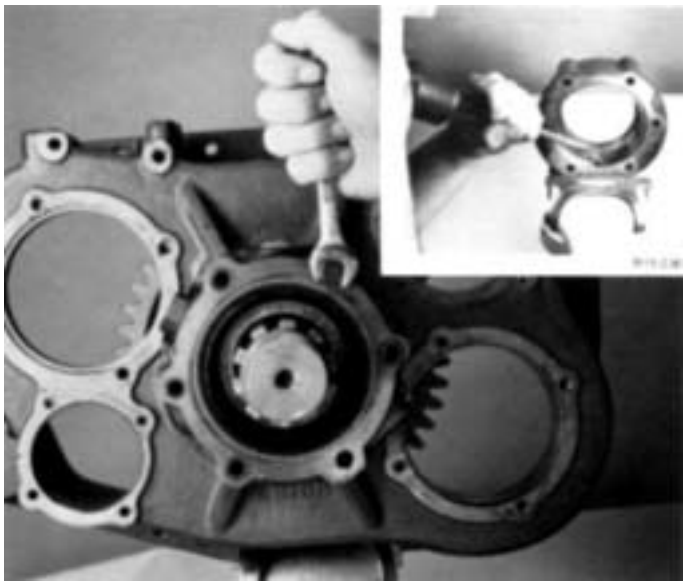
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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



G. Removal and Disassembly of Output Shaft and Rear Bearing Assemblies

NOTE: In addition to the above, refer to the illustration provided at Part D of this section.



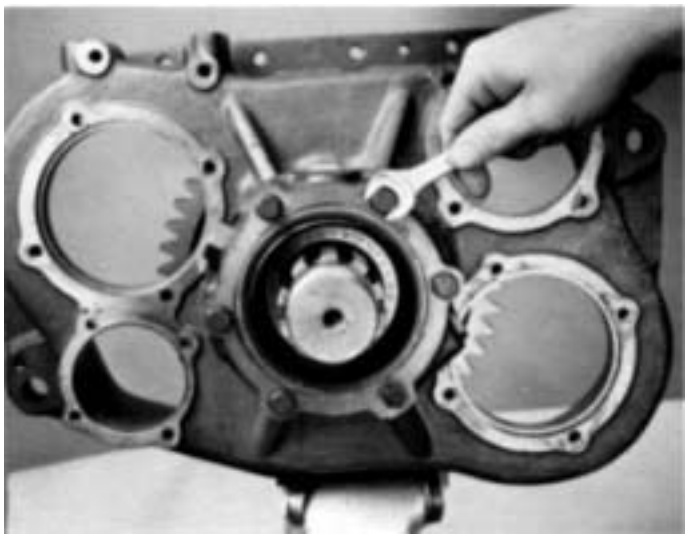
1. Turn out the capscrews and remove the rear bearing cover and gasket. If necessary, remove the oil seal from cover (inset).



2. If not previously done so, remove the snap ring and speedometer drive gear or replacement spacer from output shaft of models so equipped.

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DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



3. Temporarily reinstall rear bearing cover in position on housing ONLY to catch rear bearing cone released from bore in the following procedure.



4. Use a soft bar and maul to drive the output shaft forward and through rear bearing assembly. This will cause the rear bearing cone to be released from bore in auxiliary housing. **NOTE:** When applying force to rear of output shaft, DO NOT AMAGE THREADS. Support front of shaft to avoid damaging the mainshaft quill once output shaft is free of bearing.



5. Remove rear bearing cover and bearing cone.



6. Remove the two bearing cups and outer spacer from bore in auxiliary housing.

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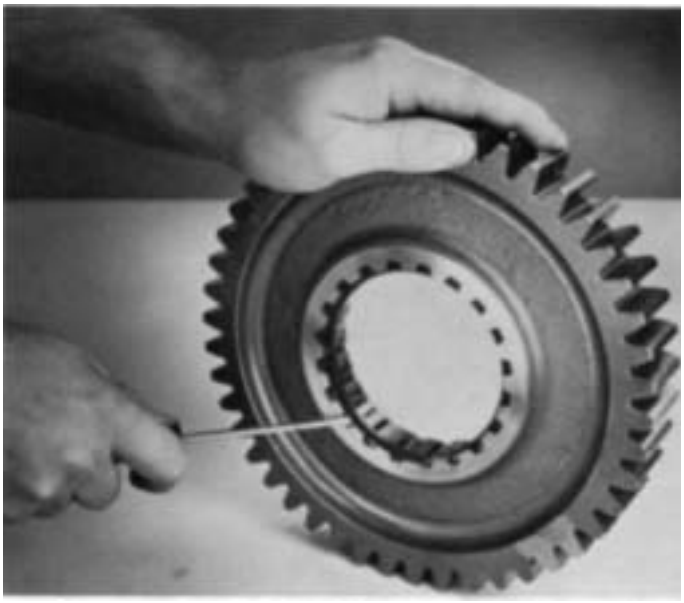
DISASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



7. Remove the bearing inner spacer from output shaft.



8. Using the front face of deep reduction gear as a base, press the output shaft through the bearing and gear. This will free the bearing, gear, washer, and, for models so equipped, the spacer or oil retention ring. DO NOT DAMAGE MAINSHAFT QUILL.



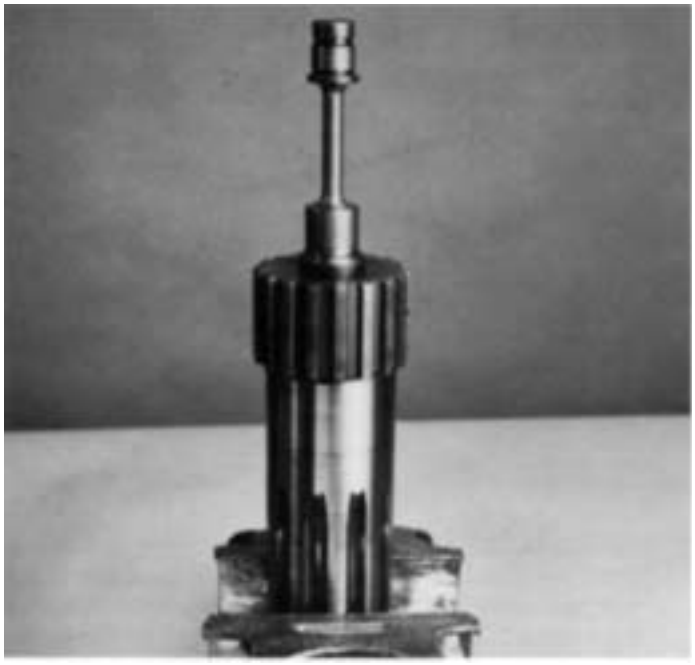
9. If necessary, remove the snap ring from I.D. of deep reduction gear of models so equipped.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

AUXILIARY SECTION (8-SPEED "LL" MODELS)

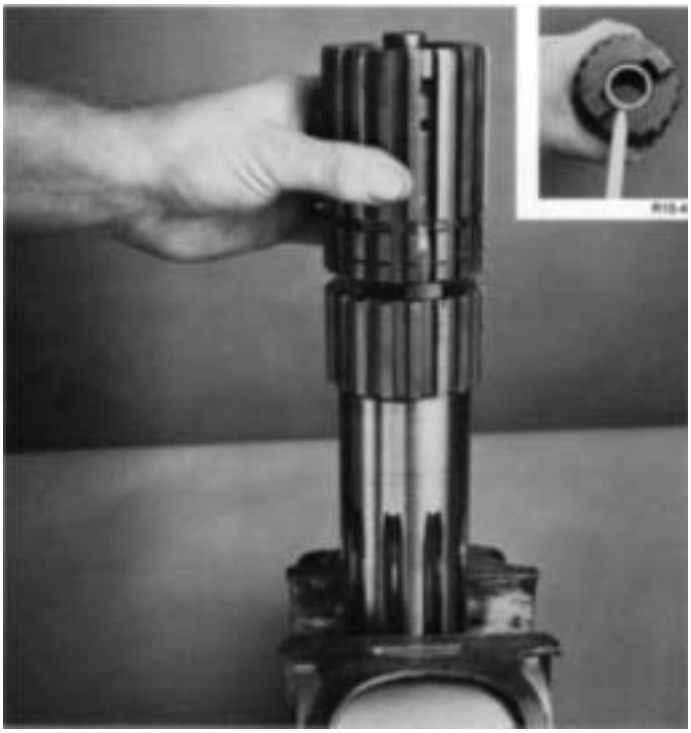
A. Reassembly and Installation of Range Mainshaft Assembly



1. Secure the output shaft in a vise with mainshaft quill up.



3. Install the bearings in front bore of range mainshaft. Use a small flanged-end driver to properly seat bearing in bore on mainshaft quill.



2. If necessary, press the bushing in rear bore of range mainshaft (inset) and install the mainshaft in position on quill,



4. Install the "C" ring in groove of mainshaft quill to retain bearing.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

B. Reassembly and Installation of Output Shaft and Rear Bearing Assemblies

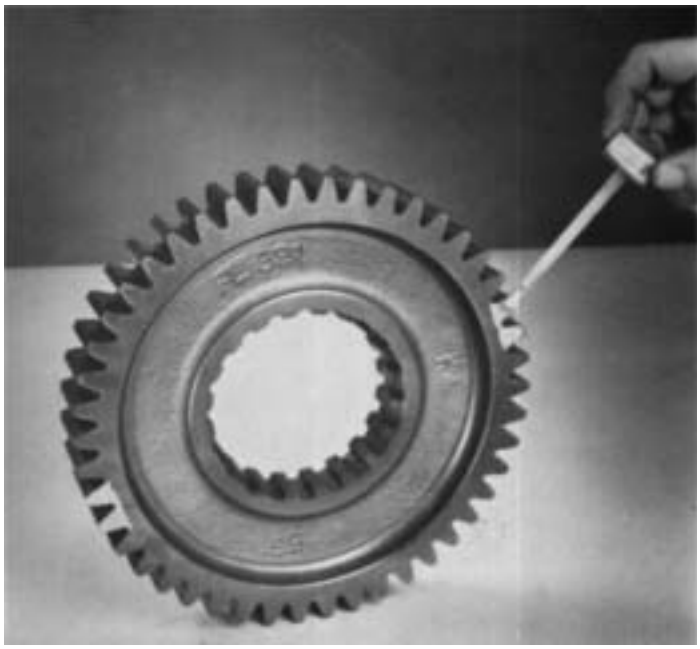


1. Remount the output shaft in vise with threaded-end up and secure on range mainshaft. For models so equipped, install the stepped washer on shaft, large diameter step down.

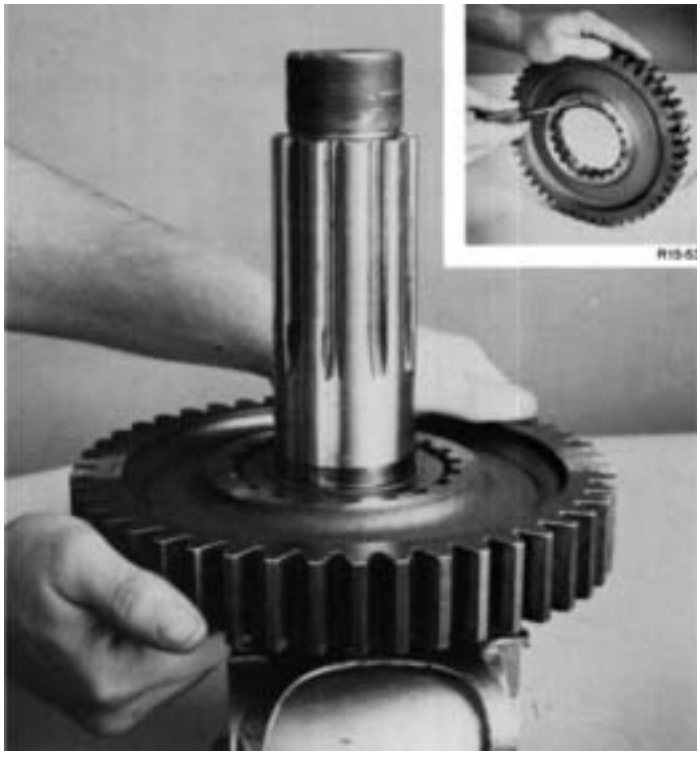




2. Install the splined spacer on output shaft. For models equipped with stepped washer on shaft, install the spacer with large diameter splines down (right).



3. IMPORTANT: Mark any two adjacent teeth on deep reduction gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakersÕ dye is recommended for making timing marks.



4. If previously removed, install the snap ring in deep reduction gear of models so equipped (inset). Install the gear on output shaft, clutching teeth down and engaged with splines of spacer.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)




5. Install the washer on shaft against deep reduction gear, small diameter step down (Left: 11608LL Models); or side with large groove up (Right: 14608LL Models).
NOTE: For models not equipped with the oil retention ring in auxiliary housing, proceed to No. 8.




6. 14608LL Models only - Place the oil retention ring in housing bore, cupped side up (left). Use a soft bar and two rear bearing outer spacers stacked on top of each other to move the oil retention ring 2" deep into bore. The ring will be at the proper depth when top of second spacer is flush with housing bore. Remove the spacers when installation is completed.




7. Place two mainshaft spacers or flat steel stock of equivalent thickness (.190 ") on rear face of deep reduction gear, 180º from each other (left). Install the auxiliary housing over end of output shaft assembly, allowing the housing to rest on blocking (right).




8. Heat the front bearing cone and install on output shaft against oil retention ring, bearing taper up (left). For models not equipped with the oil retention ring in auxiliary housing, install the heated bearing cone on shaft against washer, taper up (right).
NOTE: DO NOT HEAT BEARING ABOVE 275º (136°C). If possible, use heat lamps as source.




9. Install the bearing inner spacer on output shaft against front bearing cone.




10. Place the front bearing cup in housing bore, taper to the inside, and use a soft bar to start cup into bore.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)




11. Stack the bearing outer spacer and rear bearing cup on top of the front bearing cup in proper sequence. Use a soft bar or a flanged driver to move all three parts evenly into housing bore until lip of rear bearing cup seats on housing.




12. If not previously done so, install the auxiliary housing over end of output shaft assembly. Heat the rear bearing cone and install on shaft, taper down and inside bearing cup.
NOTE: DO NOT HEAT BEARING ABOVE 275º (136°C).




13. For 14608-LL Model, install the speedometer drive gear or replacement spacer on output shaft and retain with snap ring installed in groove of shaft (left). Remove the blocking (two mainshaft spacers or flat steel stock) from between the deep reduction gear and auxiliary housing (right).



14. Remount assembly upright in vise and secure. install the deep reduction-sliding clutch on output shaft, internal splines toward gear and engaged with splines of shaft.



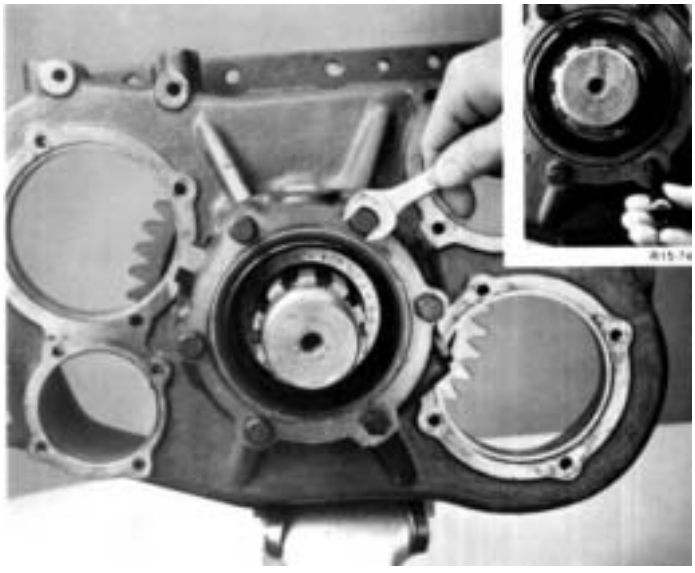
15. Install snap ring in groove of range mainshaft.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS]

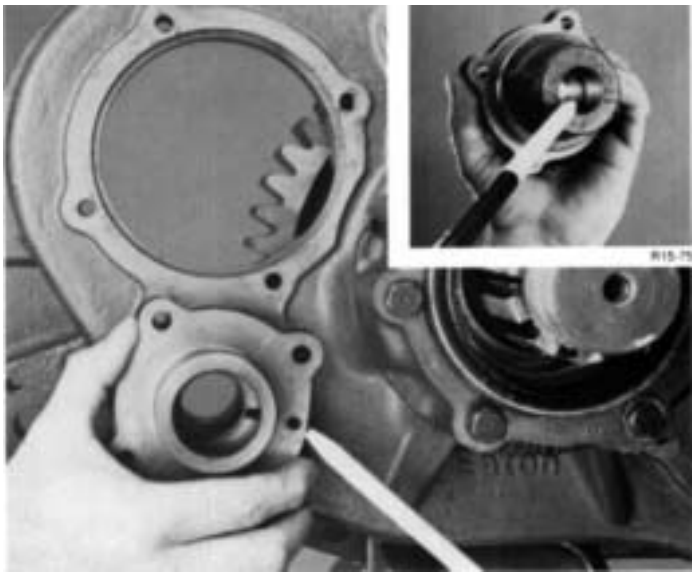


16. If previously removed, install the oil seal in rear bearing cover (inset). Seal should be installed so the spring is to the front of cover.



17. Position gasket on cover mounting surface and install the rear bearing cover on auxiliary housing. Use the nylon collar and brass washer with capscrew at the chamfered hole which intersects speedometer bore (inset). Tighten capscrews to secure cover to housing.
NOTE: Because the collar becomes distorted when compressed, DO NOT REUSE OLD NYLON COLLAR.

C. Reassembly and Installation of Deep Reduction Cylinder Assembly



1. If previously removed, install the small O-ring in bore of cylinder housing (inset). Position the corresponding new gasket on housing mounting surface and install the deep reduction cylinder housing in rear bore of auxiliary housing, air channel to the right.



2. If previously removed, install the O-ring in groove of yoke bar piston.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



3. Place the reduction yoke into position with sliding clutch, lockscrew hole to the front. From rear of auxiliary housing, insert the yoke bar through cylinder bore and into yoke, aligning the notch in bar with yoke lockscrew hole.



4. Install the yoke lockscrew, tighten and wire securely.



5. For models so equipped, install the insert valve in bottom exhaust port of cylinder cover as shown (left). Install the valve retaining nut in exhaust port of cover and tighten to recommended torque ratings (right).
NOTE: Prior to installation of insert valve, apply a small amount of silicone lubricant to O-rings on O.D. of valve.

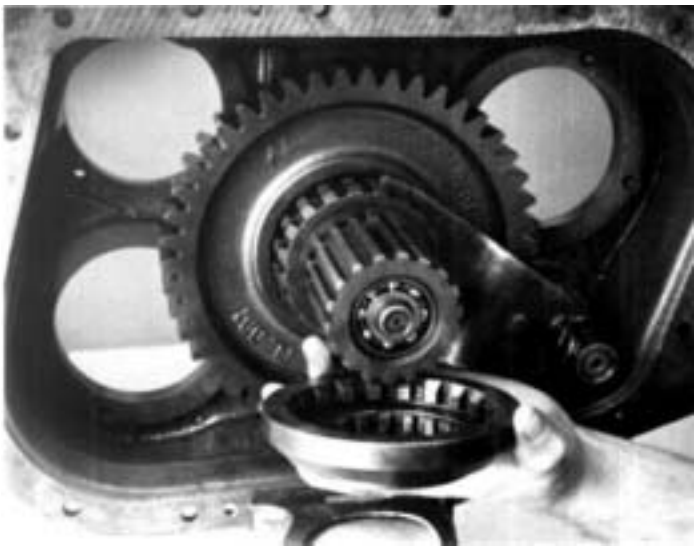


6. Position the corresponding new gasket on cover mounting surface and install the deep reduction cylinder cover, aligning the air channel with channel in cylinder housing housing. Tighten capscrews to secure cover to cylinder housing.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

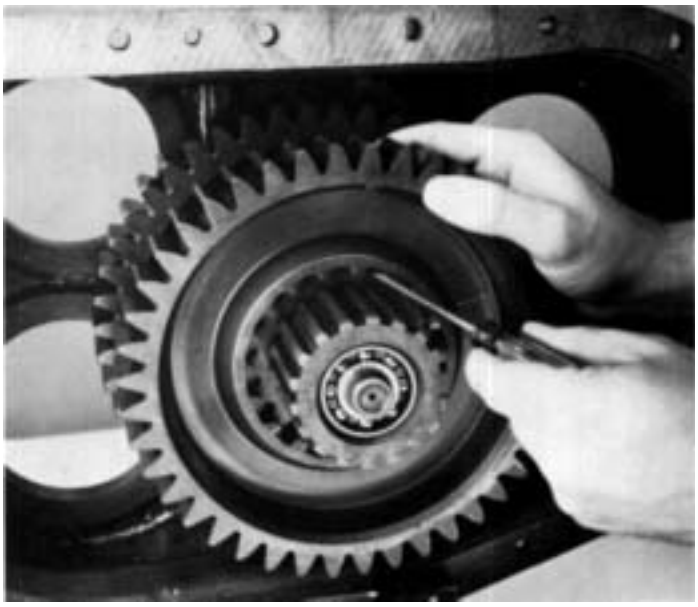
D. Installation of Low Range Gear



1. Install the coupler on range mainshaft, clutching teeth to the rear.



2. Install the low range gear on mainshaft against coupler, clutching teeth to the front.



3. Install the splined tolerance washer on mainshaft and in hub of low range gear. Rotate the washer in groove of mainshaft to engage external splines with clutching teeth of gear and align square internal spline with keyway of mainshaft.
IMPORTANT: This washer is available in varying thicknesses. Use the splined tolerance washer that provides a snug fit in gear hub.



4. Install the key in keyway of range mainshaft, inserting the thick end of key in square internal spline of tolerance washer to lock low range gear on shaft.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

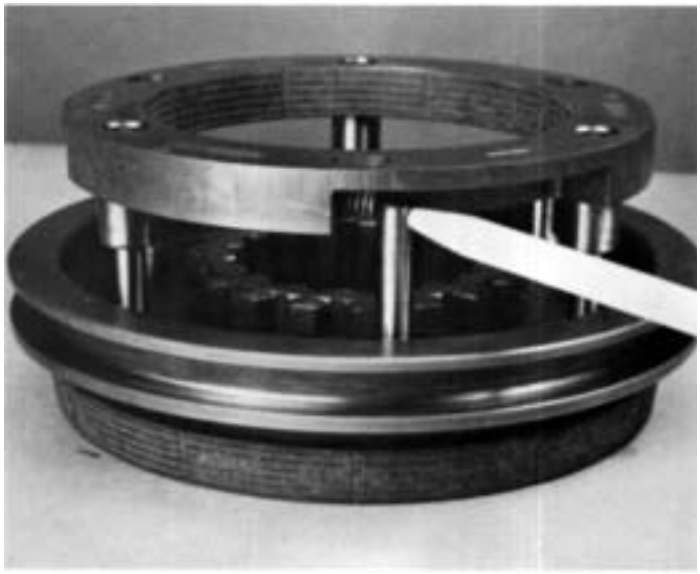
E. Reassembly and Installation of Synchronizer Assembly



1. Place the larger low range synchronizer ring on bench and install the sliding clutch on blocker pins, recessed side up.



2. Install the three springs in bores of high range synchronizer ring.



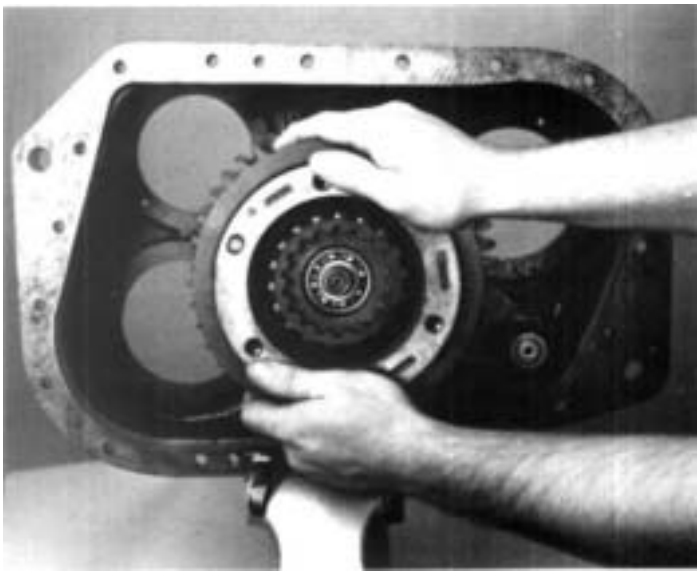
3. Place the high range synchronizer ring over blocker pins of low range synchronizer, seating the springs against pins.



4. Apply downward pressure to the high range synchronizer ring WHILE TWISTING COUNTER-CLOCKWISE to compress the springs and fully seat ring on blocker pins of low range synchronizer.

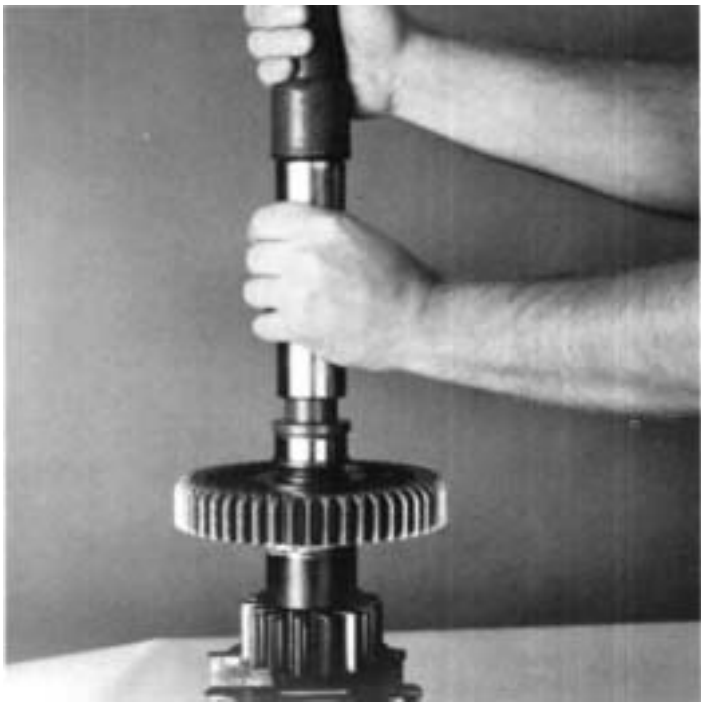
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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

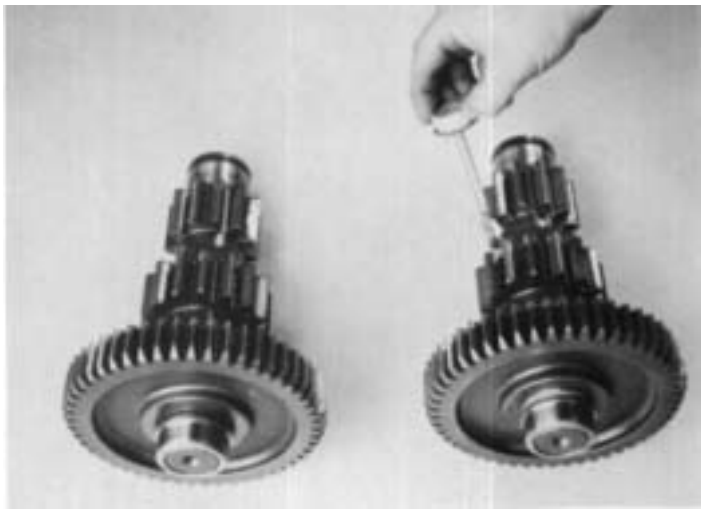


5. Install the synchronizer assembly on splines of range mainshaft, low range ring towards rear.

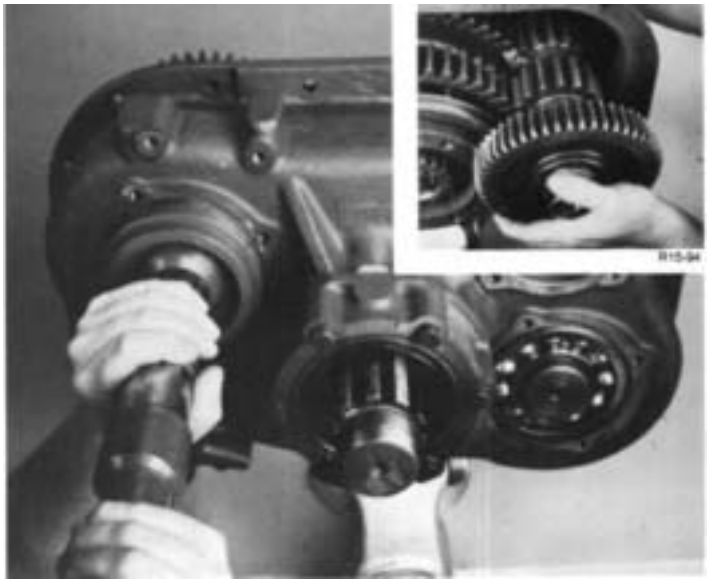
F. Timing and Installation of Auxiliary Countershaft Assemblies



1. If previously removed, install the bearing inner race on front of each countershaft.



2. IMPORTANT: On the low range gear of each auxiliary countershaft assembly locate the "O" stamped on one tooth. Align tooth with "O", with smaller deep reduction gear tooth and mark with high visible color of toolmakers' dye.

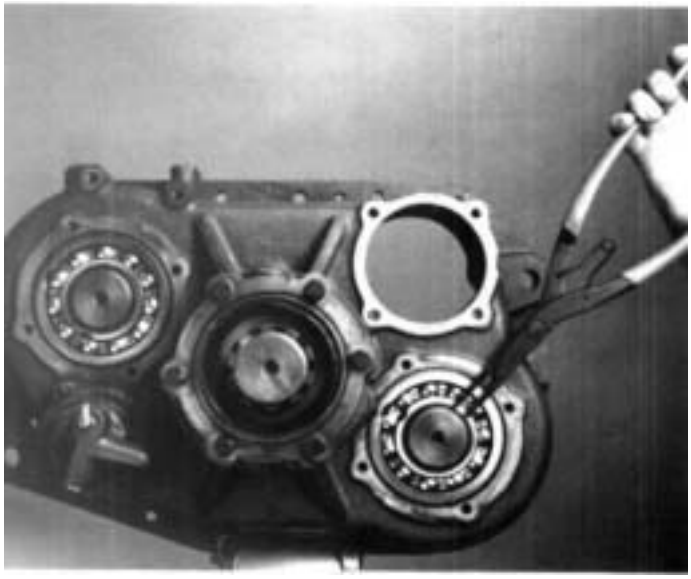


3. Place one countershaft into position in housing, meshing the marked tooth of countershaft gear with either set of two marked teeth of mainshaft deep reduction gear (inset). Center rear of countershaft in bearing bore, start rear bearing in bore and complete installation with a flanged-end driver and maul. Repeat the procedure with other auxiliary countershaft assembly, making sure the deep reduction gear set remains in time during bearing installation.

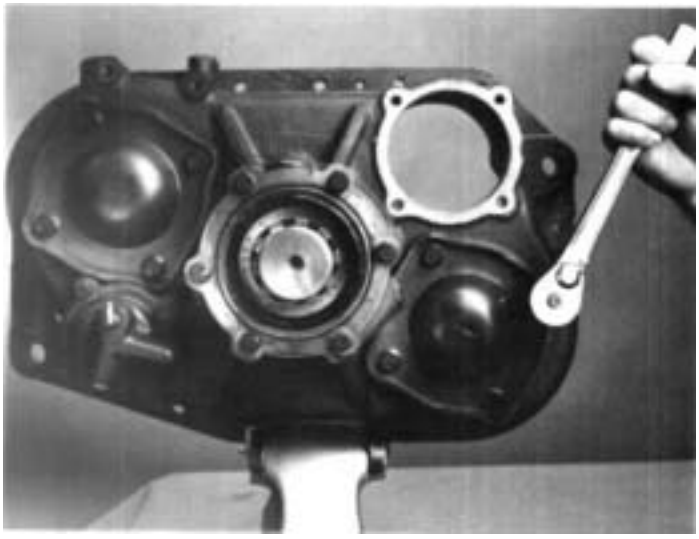
NOTE: Check synchronizer assembly for springs that may be released during bearing installation.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)

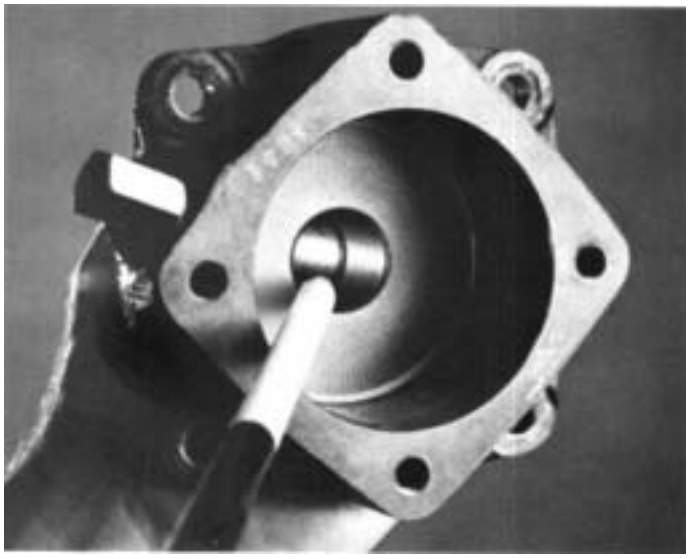


4. Install the snap ring in groove at rear of each countershaft .

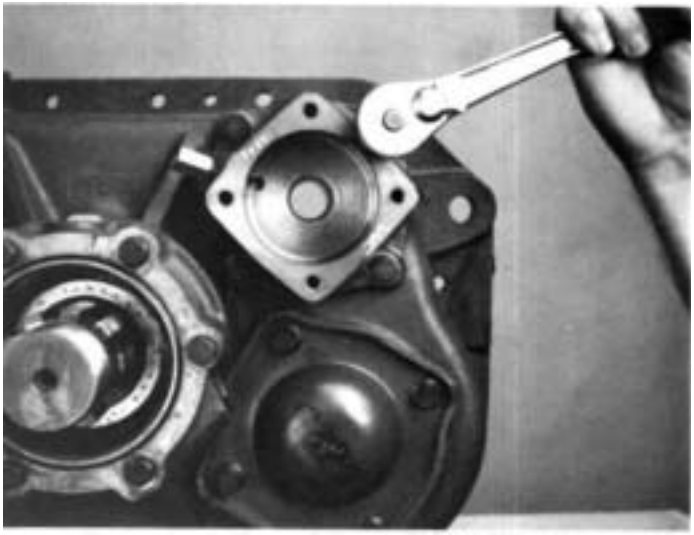


5. Position the corresponding new gasket on cover mounting surface and install both rear bearin g covers. Tighten capscrews to secure covers to auxiliary housing.

NOTE: For reassembly and installation of models equipped with an Auxiliary Oil Pump Assembl y on rear of countershaft, see OPTIONS.



1. If previously remvoed, install the O-ring in bore of range cylinder housing.



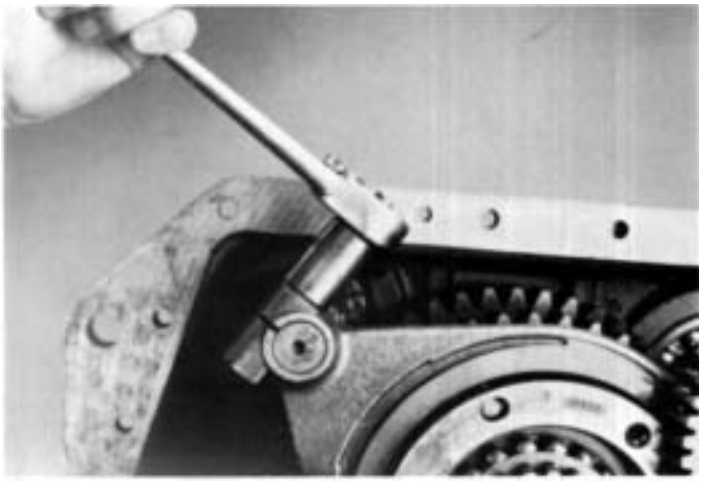
2. Position the corresponsding new gasket on housing mounting surface and install the cylinder housing in rear bore of auxiliary housing, air fitting to the upper left. Tighten capscraews to secure cylinder housing to auxiliary housing.

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REASSEMBLY - AUXILIARY SECTION (8-SPEED "LL" MODELS)



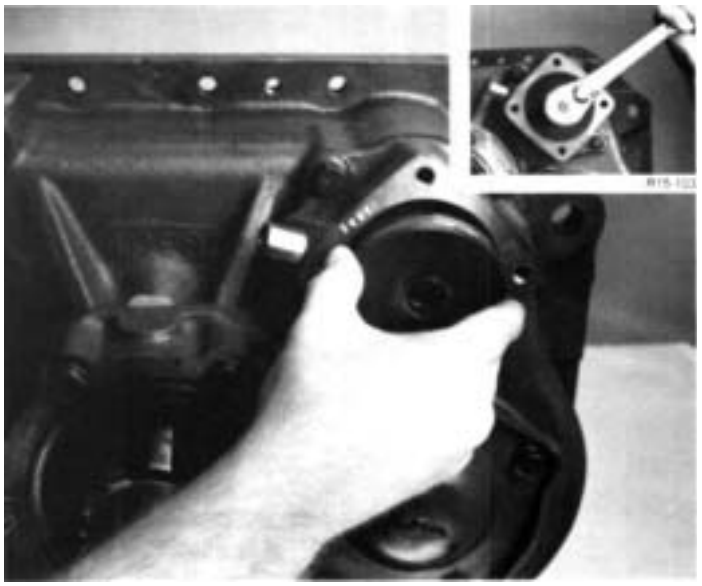
3. Place the range yoke into position with sliding clutch of synchronizer assembly, long hub of yoke to the rear. Insert threaded-end of yoke bar through yoke and into bore of range cylinder housing, aligning the notches in bar with yoke lockscrew holes.



4. Install the two yoke lockscrews, tighten and wire securely.



5. If previously removed, instll the O-rings in th e I.D. and O.D. of range piston.



6. In cylinder housing bore, install the range piston on yoke bar, flat side to the rear. Secure with nut tightened to recommended torque ratings (inset).

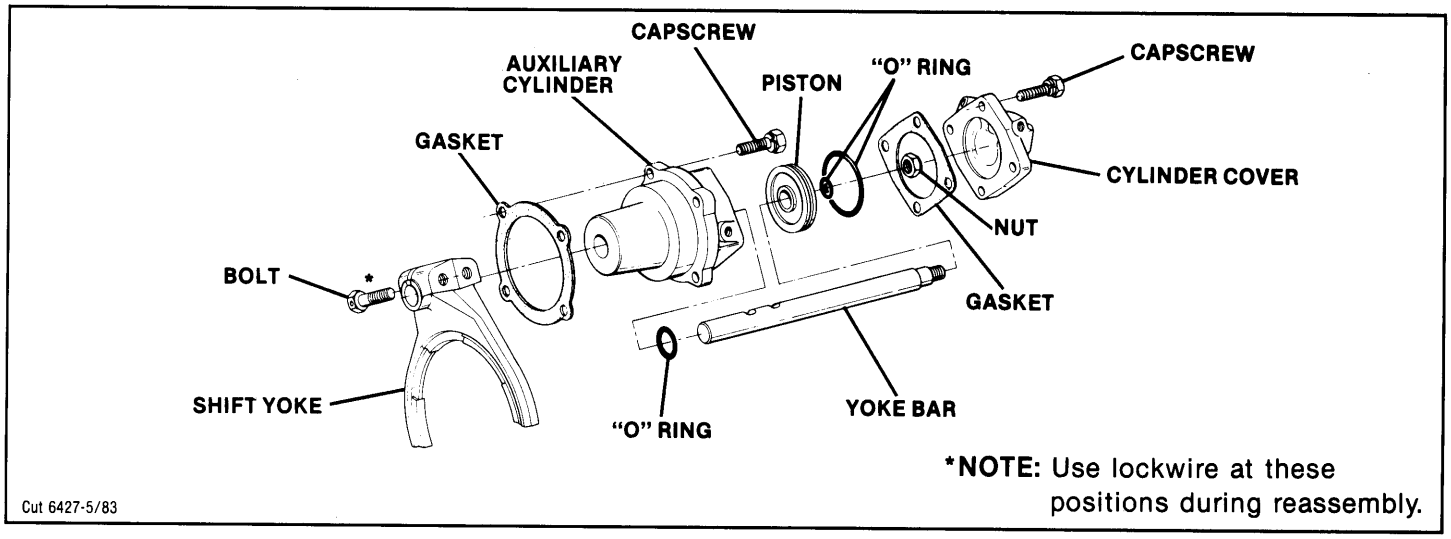


7. Position the corresponding new gasket on cover mounting surface and install teh range cylinder cover on housing, open port to the upper left. Tighten capscrews to secure cover to housing.

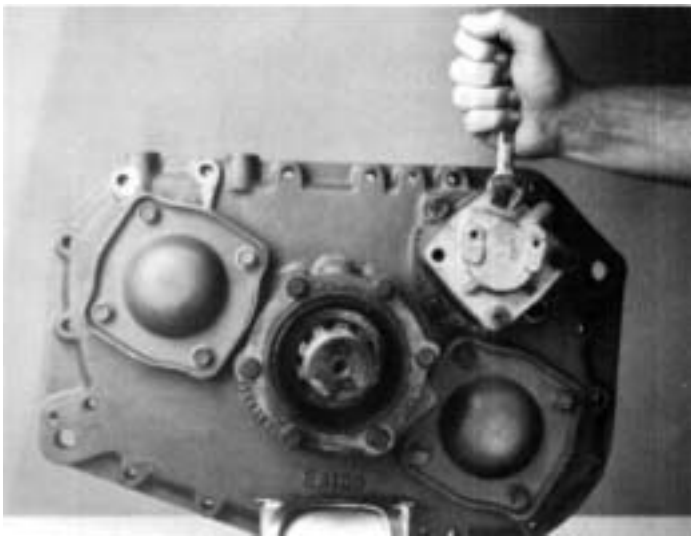
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DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

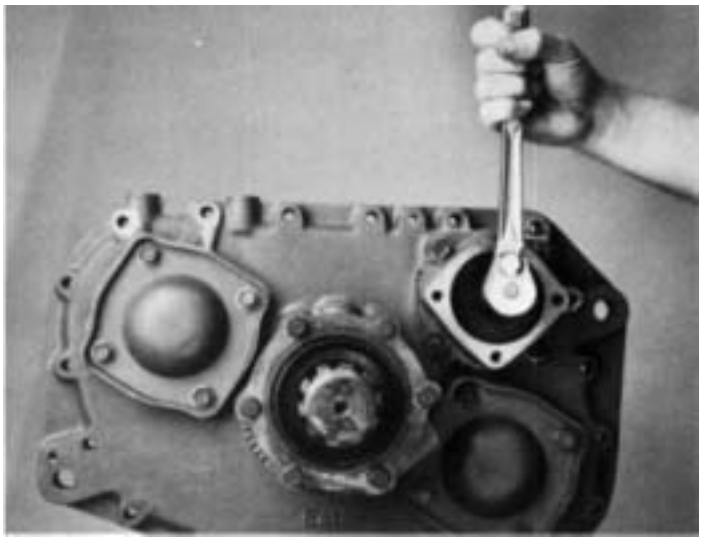
AUXILIARY SECTION (9-SPEED MODELS)



A. Removal and Disassembly of Range Cylinder Assembly



1. For ease of disassembly, mount the auxiliary section upright in a vise. Turn out the capscrews and remove the range cylinder cover and gasket.



2. Remove nut from end of yoke bar.

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DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



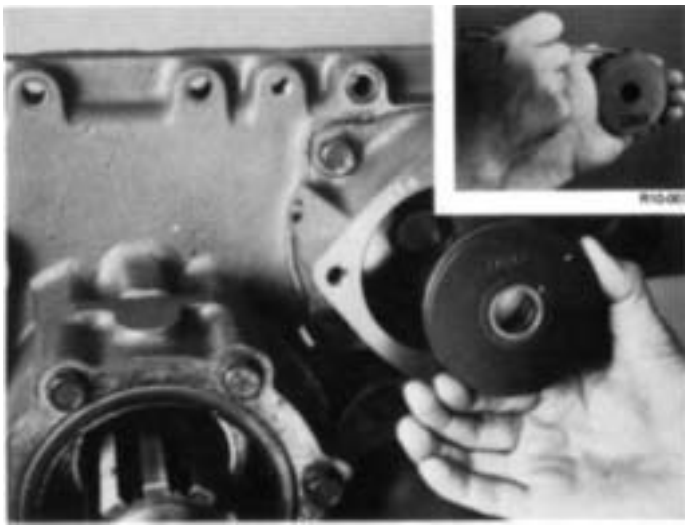
3. Cut lockwire and remove two yoke lockscrews.



4. Pull yoke bar from bore of cylinder housing.



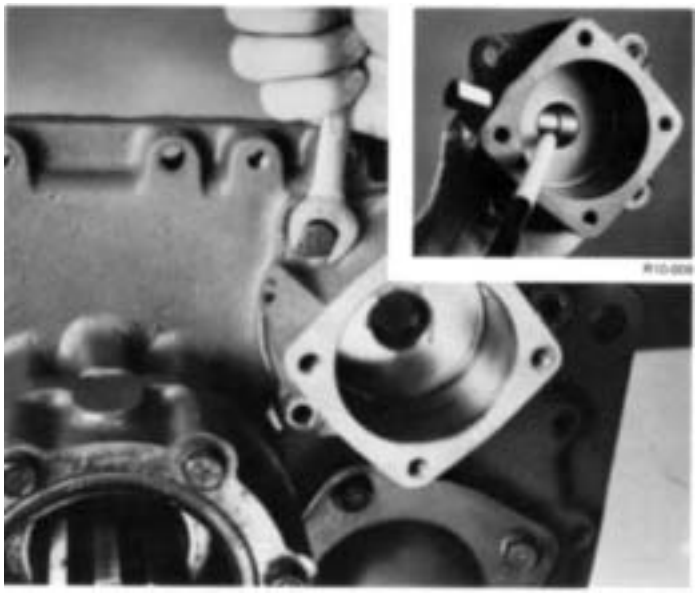
5. Remove range yoke from sliding clutch of synchronizer assembly.



6. Remove the range piston from cylinder bore. If necessary, remove the O-rings from piston I.D. and O.D. (inset).

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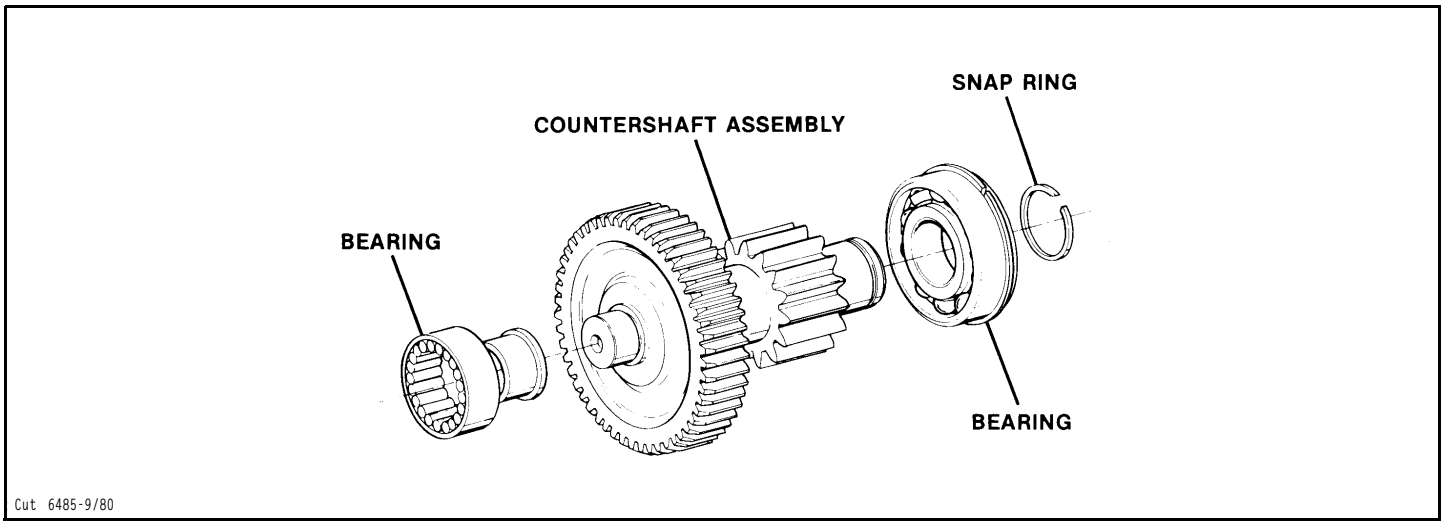
DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS]



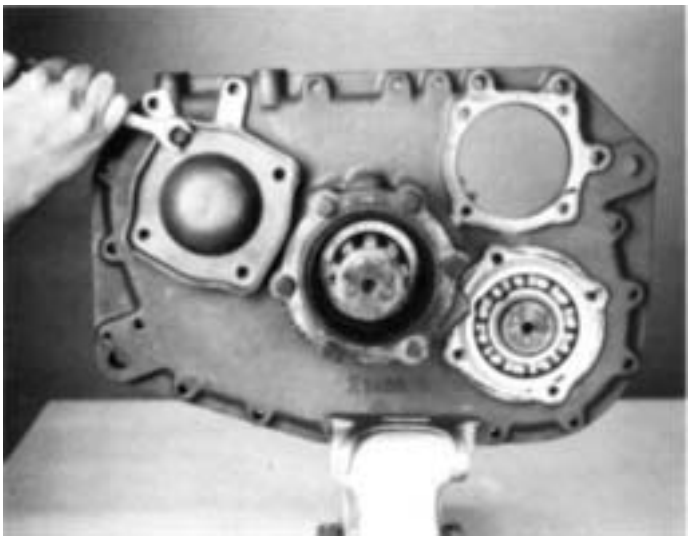
7. Turn out the capscrews and remove the range cylinder housing and gasket. If necessary, remove the small O-ring from groove in housing bore (inset).

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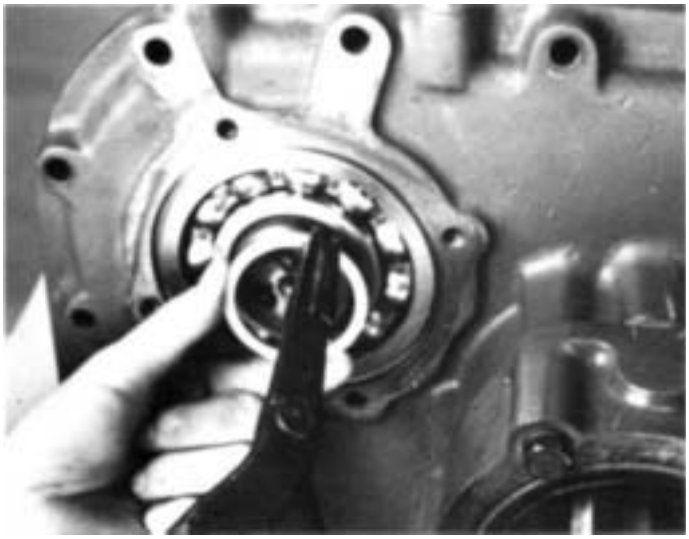
DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



B. Removal of Auxiliary Countershaft Assemblies



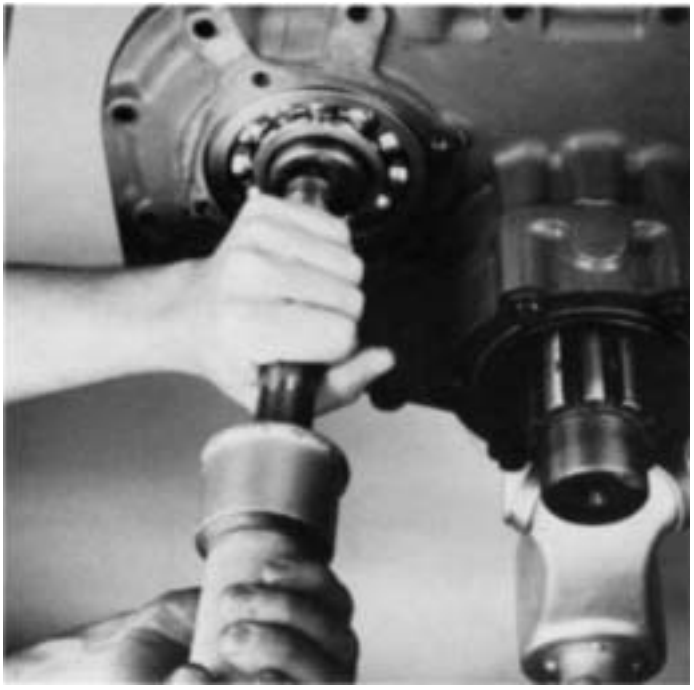
1. Turn out the capscrews and remove both countershaft rear bearing covers and gaskets.



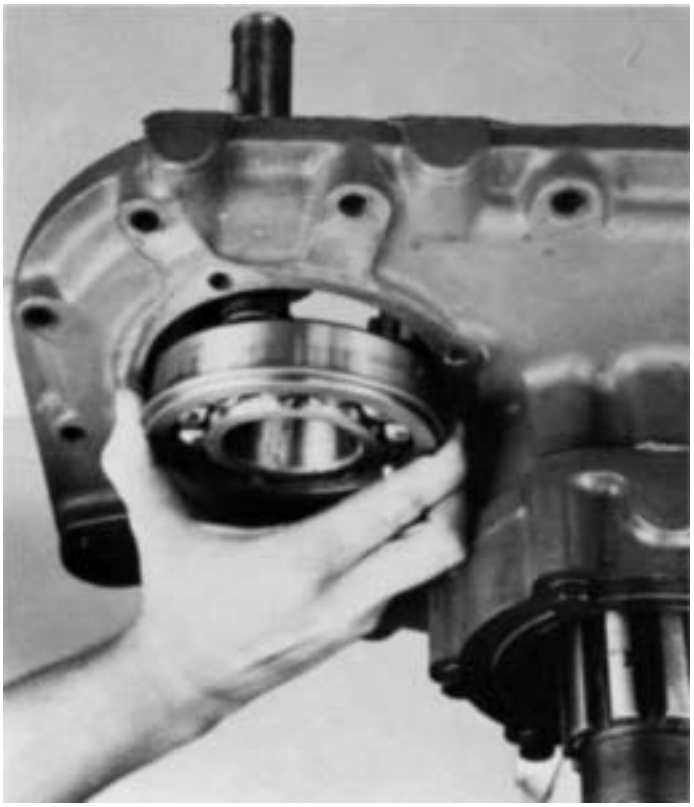
2. Remove the snap ring from groove at rear of each countershaft.

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DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS]



3. Use a soft bar and maul to drive the countershaft forward and from rear bearings.



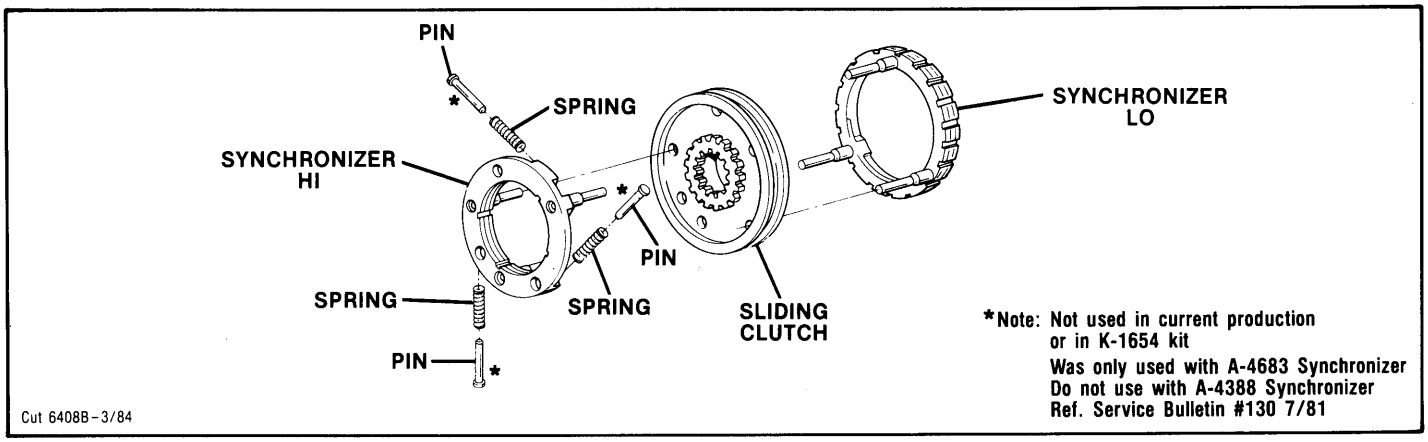
4. Remove the bearings from bores in auxiliary plate by tapping lightly and evenly to the rear with a soft bar.



5. If necessary, secure the assembly in a vise and remove the bearing inner race from front of countershaft with jaw pullers.
NOTE: The vise used should be equipped with brass jaws or wood blocks to prevent damage to the countershaft.

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DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



C. Removal and Disassembly of Synchronizer Assembly



1. Pull the synchronizer assembly from the splines of output shaft.



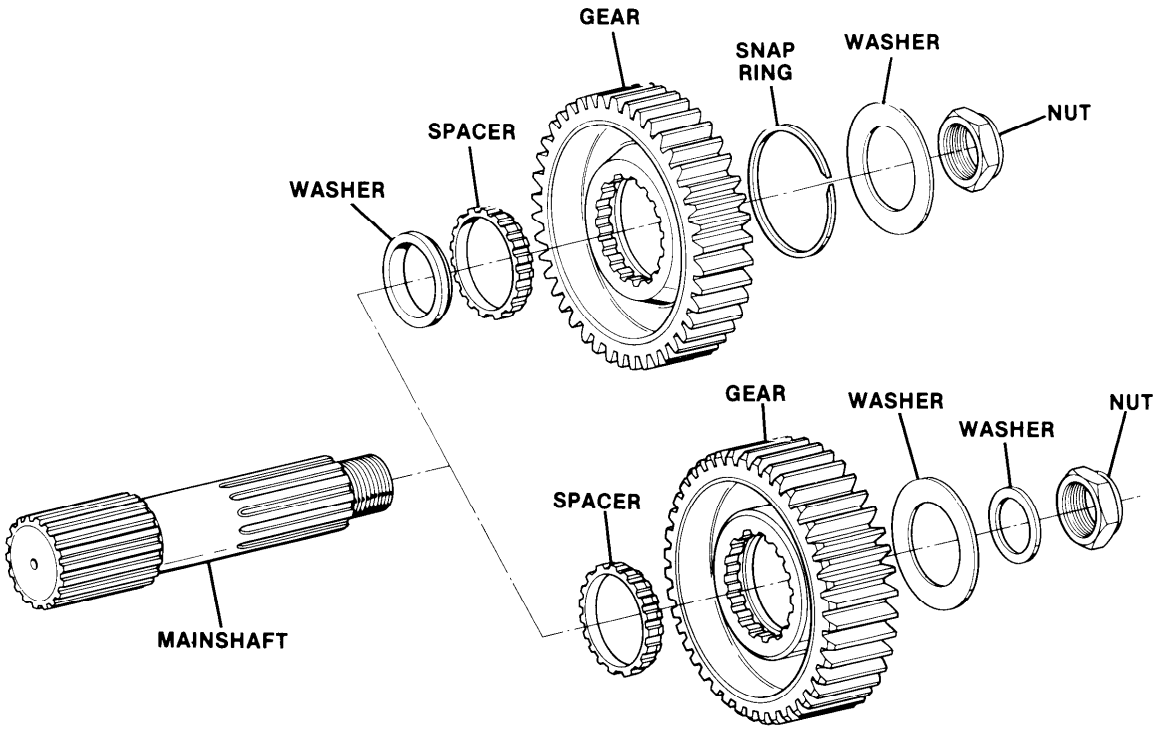
2. Place the larger low range synchronizer ring on bench and pull the high range synchronizer from blocker pins. However, before doing so, cover the assembly with a shop rag to prevent losing the three springs released from high range synchronizer at pin locations.

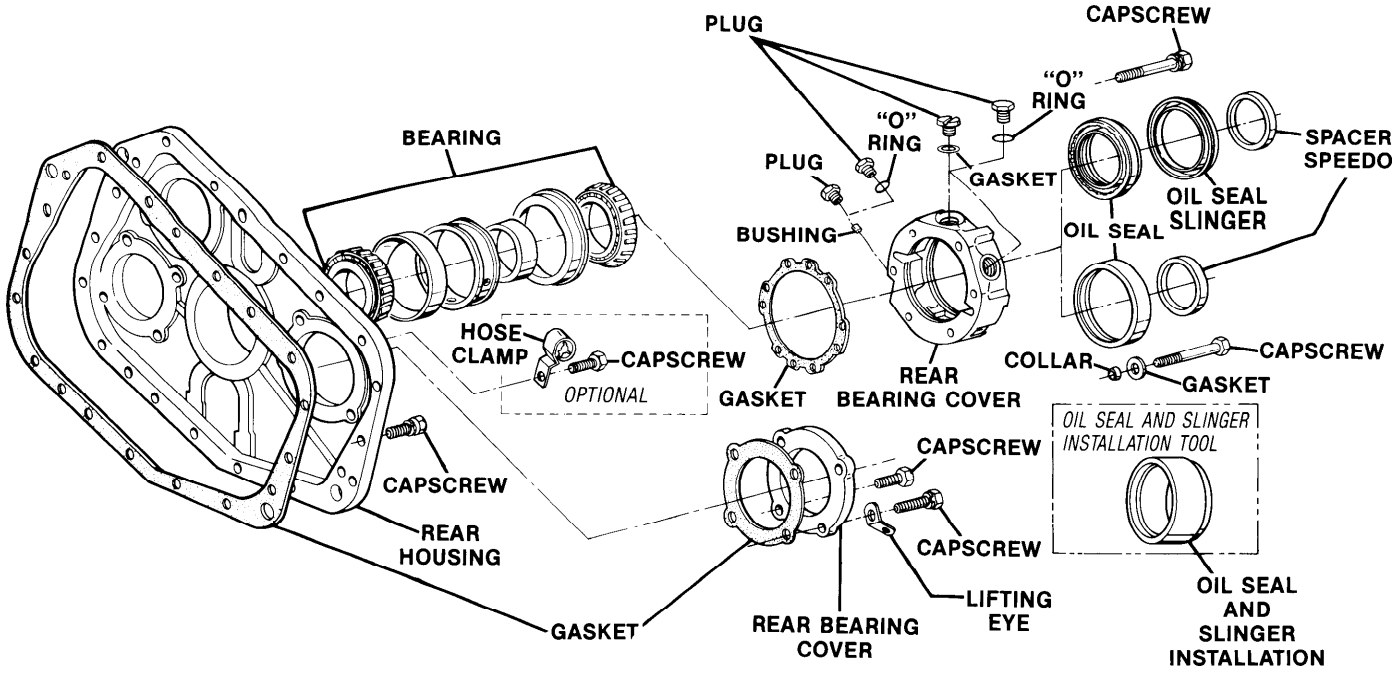


3. Remove the sliding clutch from pins of low range synchronizer ring.

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DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)





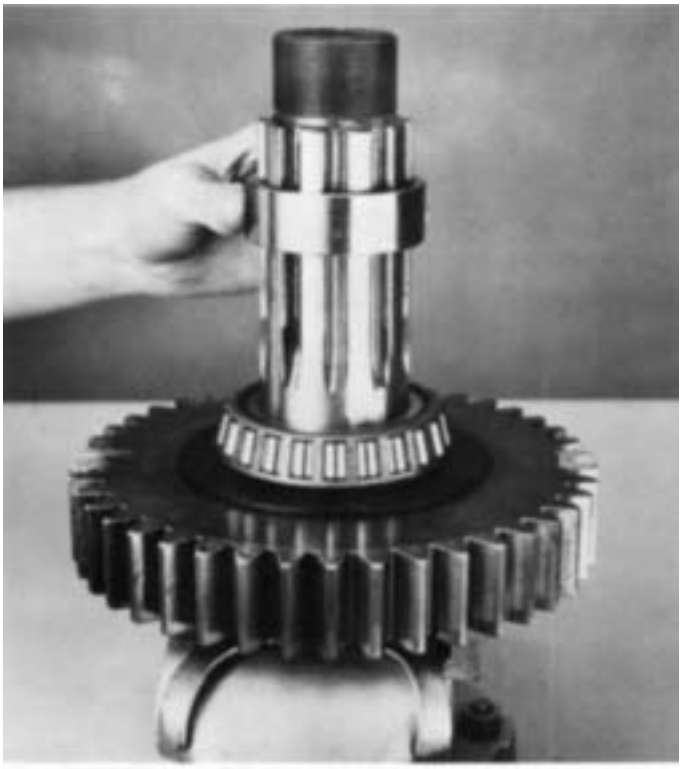
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DISASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

D. Removal and Disassembly of Output Shaft and Rear Bearing Assemblies



1. Use a soft bar and maul to drive the output shaft forward and through rear bearing assembly.



2. Remove the bearing inner spacer from output shaft.



3. Using the front face of low range gear as a base, press the output shaft through the gear and bearing. Remove the bearing and washer from hub of low range gear.



4. If necessary, remove the snap ring from low range gear of models so equipped.

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DISASSEMBLYÑAUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



5. Remove the splined spacer from output shaft.



6. Remove the stepped washer from shaft of models so equipped.



7. Turn out the capscrews and remove the rear bearing cover and gasket. The rear bearing cone will drop from bore in auxiliary plate when cover is removed. If necessary, remove the oil seal from cover (inset).



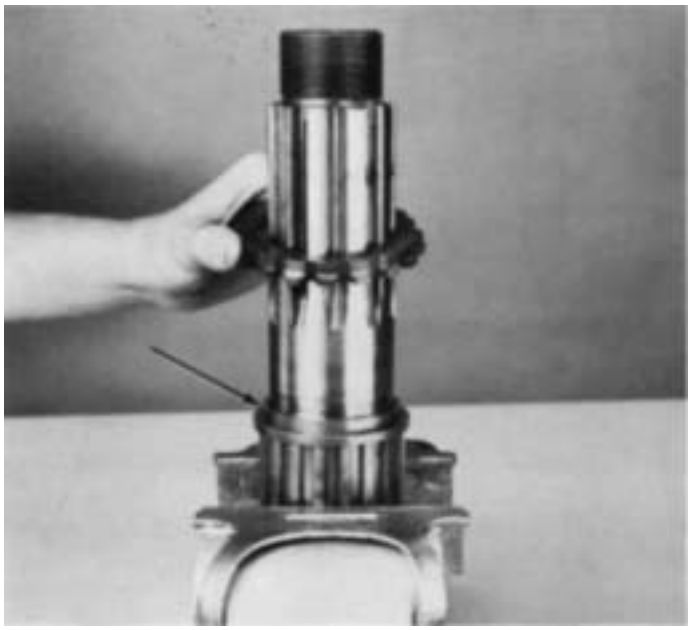
8. Remove the two bearing cups and outer spacer from bore in auxiliary plate.

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REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

AUXILIARY SECTION (9-SPEED MODELS)

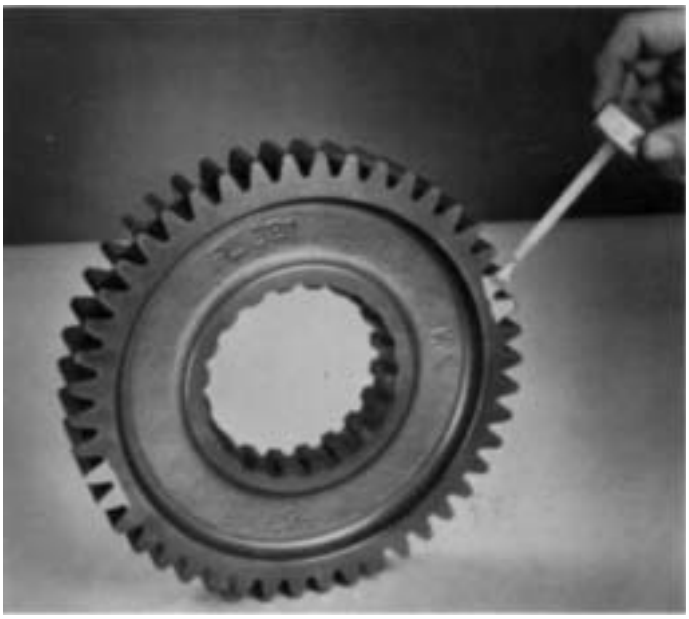
A. Reassembly and Installation of Output Shaft and Rear Bearing Assemblies



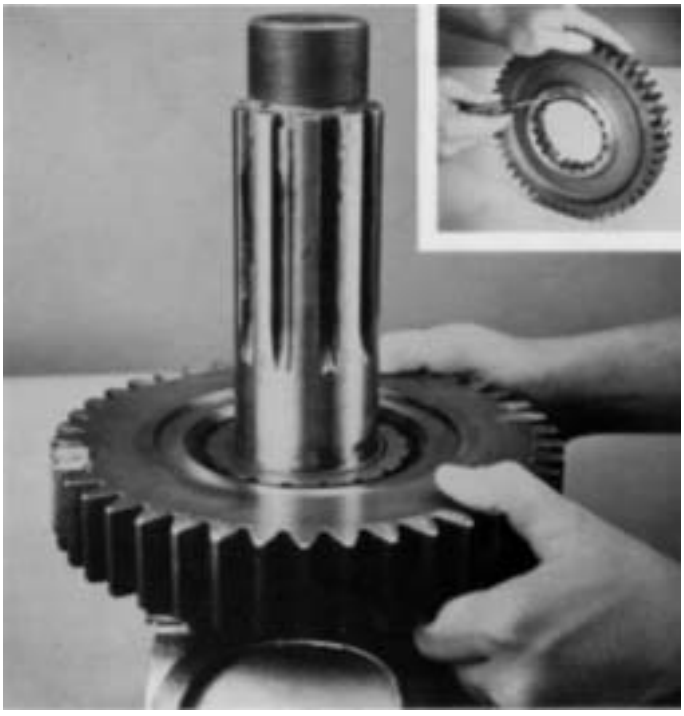
1. Secure the output shaft in a vise with threaded end up. For models so equipped, install the stepped washer on shaft large diameter step down (arrow), then install the splined spacer.



2. For 14609 models, install the spacer with large diameter splines down.



3. IMPORTANT: Mark any two adjacent teeth on low range gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakers Õ dye is recommended.



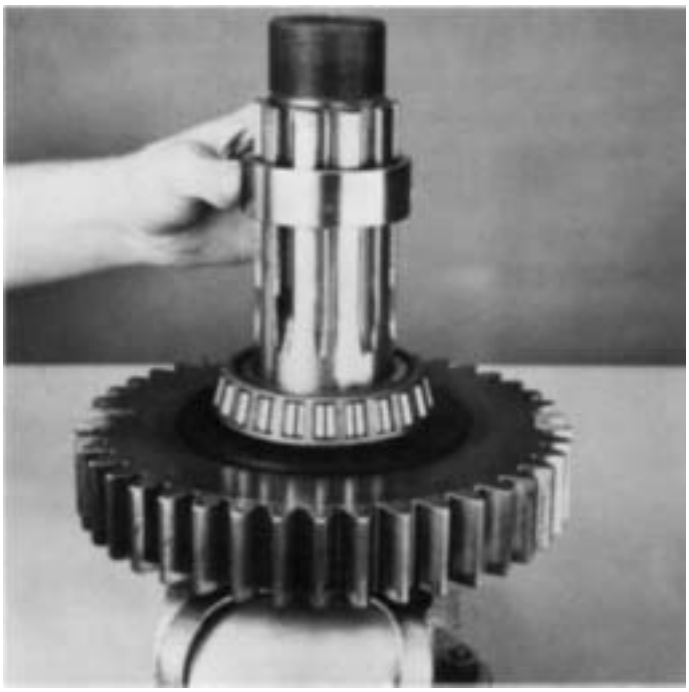
4. If previously removed, install the snap ring in low range gear of models so equipped (inset). Install the gear on output shaft, clutching teeth down and engaged with splines of spacer.

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REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



5. Install the washer on shaft; 11609, 12609 models flat side of washer facing up, 14609 models flat side of washer facing down.



7. Install the bearing inner spacer on output shaft.



6. Heat the front bearing cone and install on shaft against washer, bearing taper up.
NOTE: DO NOT HEAT BEARING ABOVE 275ºF (136ºC). If possible, use heat lamps as source.



8. Install the front bearing cup in bore of auxiliary plate, taper to the inside. Use a soft bar to start cup into bore.

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REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



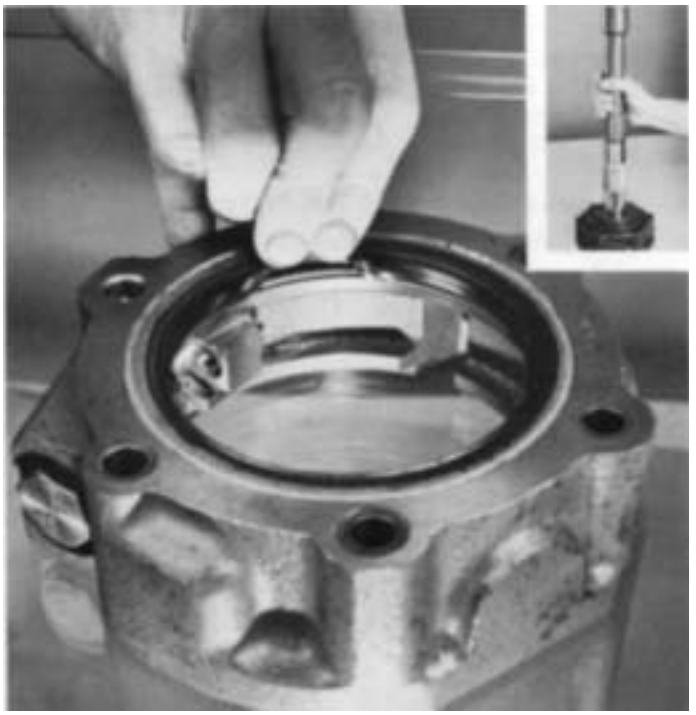
9. Place the bearing outer spacer against cup and use a soft bar or flanged-end driver to move both parts evenly into bore.



10. Place the rear bearing cup against spacer. Use a flanged-end driver to move all three parts evenly into bore until lip of rear bearing cup seats on auxiliary plate.



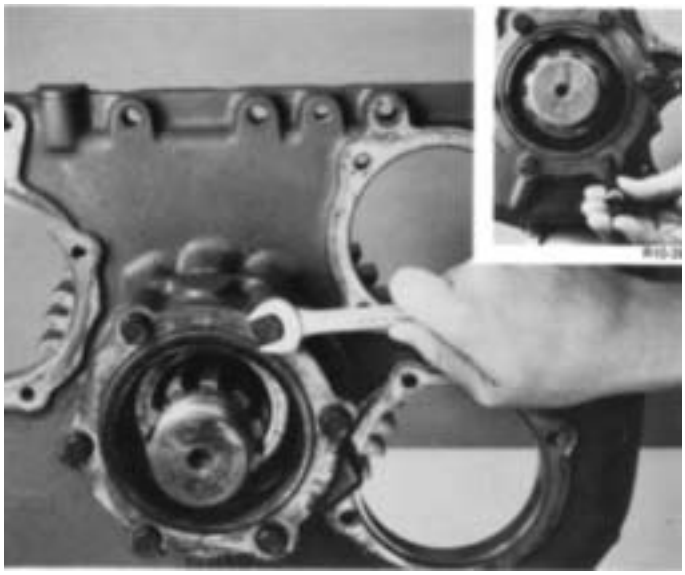
11. Install the auxiliary plate over end of output shaft assembly. Heat the rear bearing cone and install on shaft, taper down and inside bearing cup. NOTE: DO NOT HEAT BEARING ABOVE 275ºF (136ºC).



12. If previously removed, install the oil seal in rear bearing cover with a flanged driver (inset). Seal should be installed so the spring is to the front of transmission.

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REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



13. Remount the assembly upright in vise and secure on flange of auxiliary plate. Position the corresponding new gasket on cover mounting surface and install the rear bearing cover. Use the nylon collar and brass washer with capscrew at the chamfered hole which intersects speedometer bore (inset} Tighten the capscrews to secure cover to auxiliary plate.

NOTE: Because the collar becomes distorted when compressed, DO NOT RE-USE OLD NYLON COLLAR.

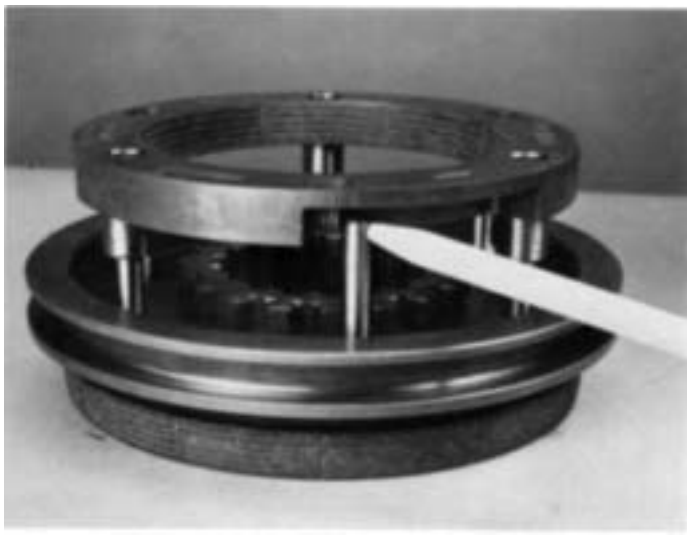
B. Reassembly and Installation of Synchronizer Assembly



1. Place the larger low range synchronizer ring on bench and install the sliding clutch on blocker pins, recessed side up.



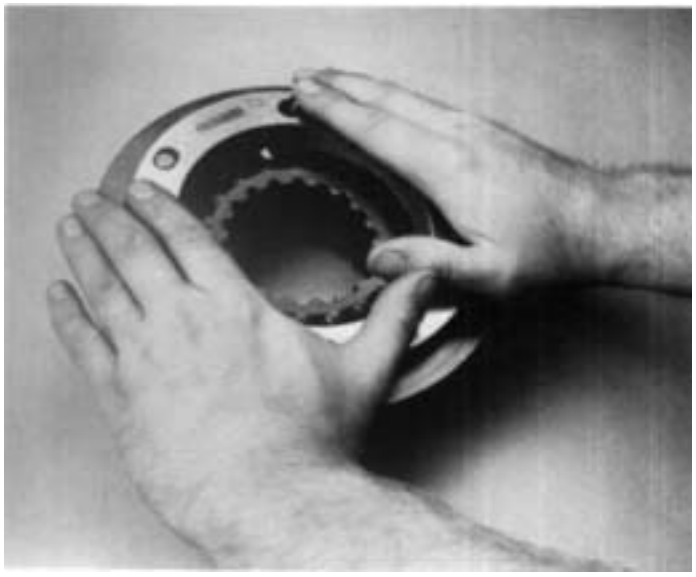
2. Install the three springs in bores of high range synchronizer ring.



3. Place the high range synchronizer ring over blocker pins of low range synchronizer, seating the springs against pins.

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REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

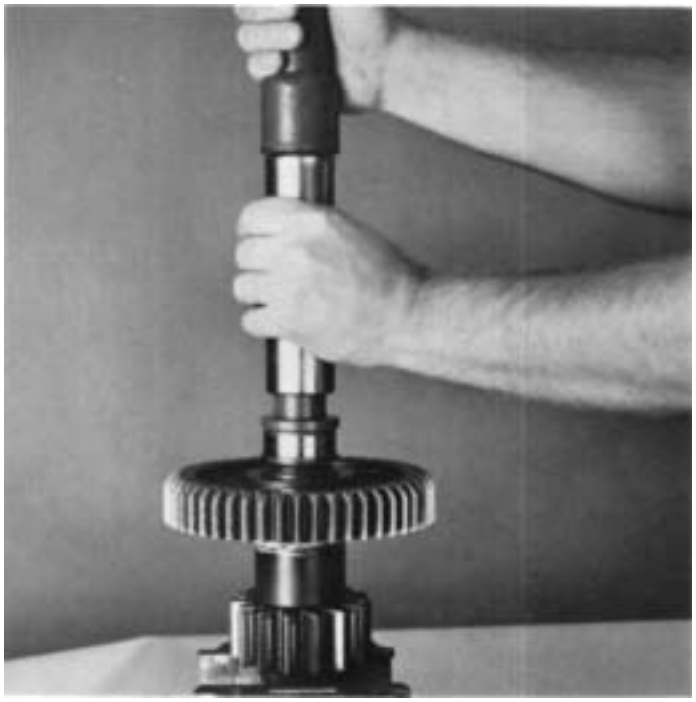


1. Apply downward pressure to the high range synchronizer ring WHILE TWISTING COUNTER-CLOCKWISE to compress the springs and fully seat ring on blocker pins of low range synchronizer.

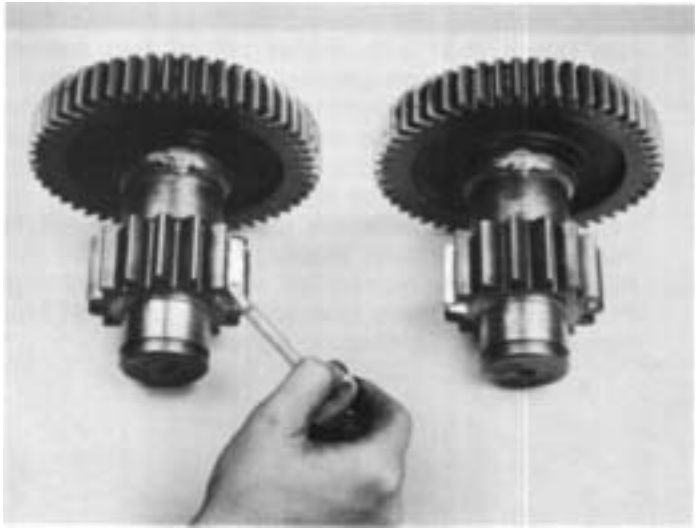


5. Install the synchronizer assembly on splines of output shaft, low range ring in recess of low range gear.

C. Timing and Installation of Auxiliary Countershaft Assemblies



1. If previously removed, install the bearing inner race on front of each countershaft.



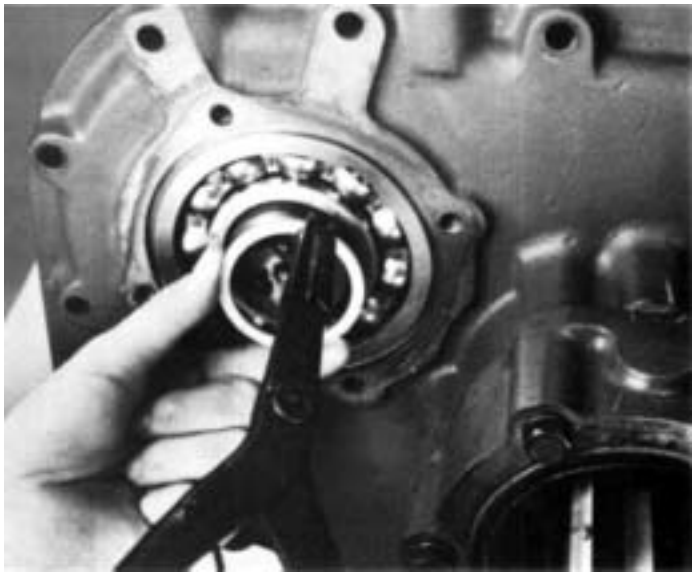
2. IMPORTANT: On the low range gear of each auxiliary countershaft assembly, use a highly visible color of toolmaker's dye to mark the tooth stamped with an "O" for timing purposes.

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REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



3. Place one of the assemblies into position in rear plate, meshing the marked tooth of countershaft low range gear with either set of two marked teeth of low range gear on output shaft (inset). Center rear of countershaft in bearing bore, start rear bearing in bore and complete installation with a flanged-end driver and maul. Repeat the procedure with other auxiliary countershaft assembly, making sure the low range gear set remains in time during bearing installation.
NOTE: Check synchronizer assembly for springs that may have been released from bores in high range ring during bearing installation.



4. Install the snap ring in groove at rear of each countershaft .

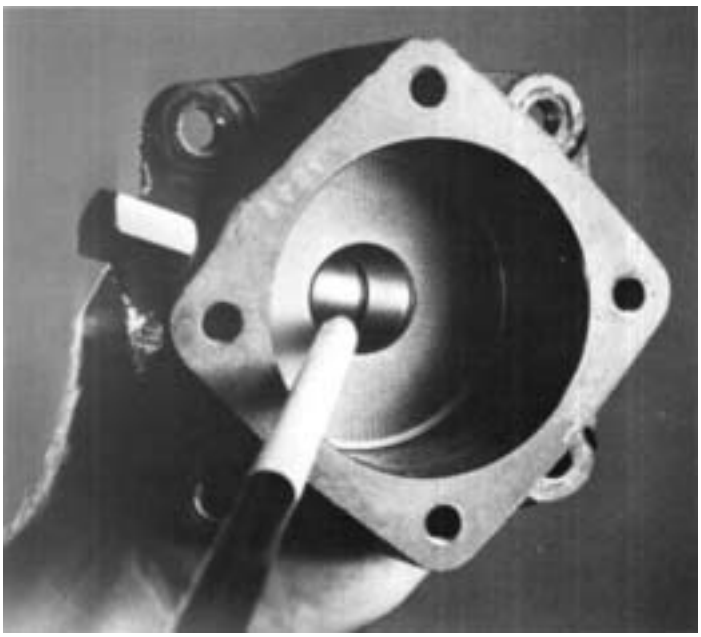


5. Position the corresponding new gasket on cover mounting surface and install both rear bearing covers. Tighten capscrews to secure covers to auxiliary plate.

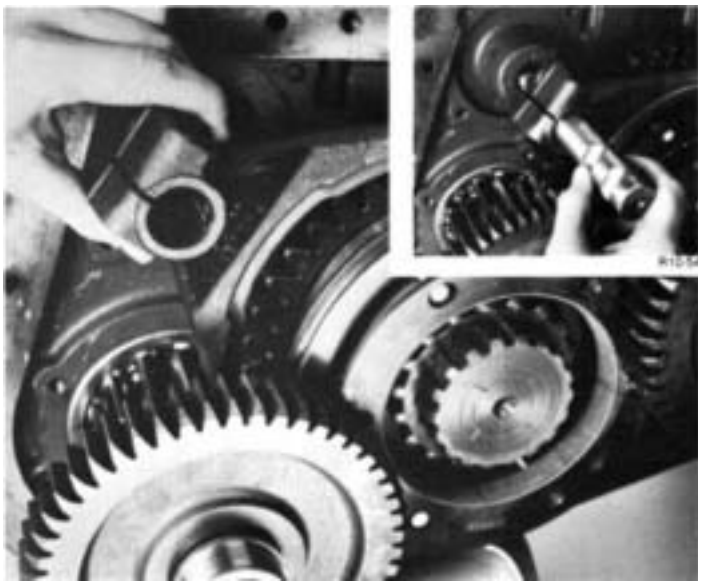
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REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)

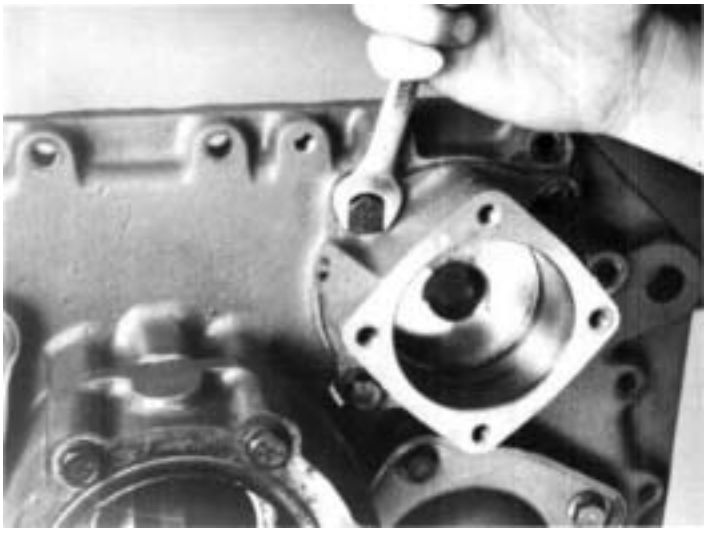
D. Reassembly and Installation of Range Cylinder Assembly



1. If previously removed, install the O-ring in bore of range cylinder housing.



3. Place the range yoke into position with sliding clutch of synchronizer assembly, long hub of yoke to the front (RT-11609/12609 Series); long hub of yoke to the rear (RT-14609 Series). Insert threaded-end of yoke bar through yoke and into bore of range cylinder housing, aligning the notches in bar with yoke lockscrew holes (inset).



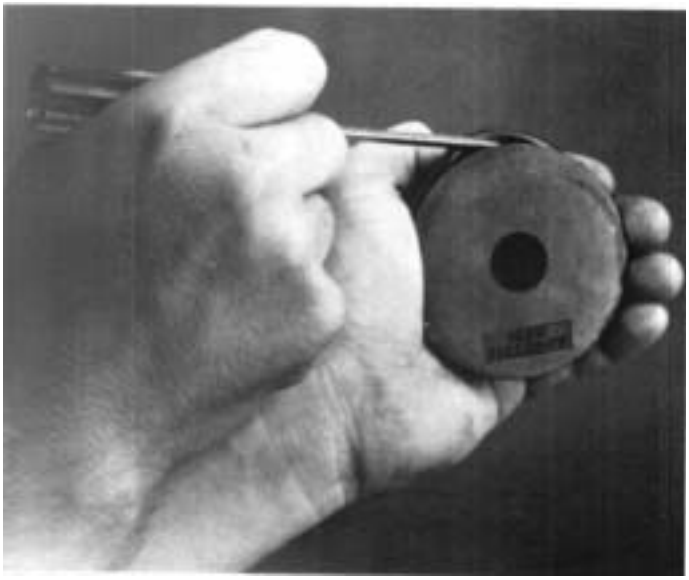
2. Position the corresponding new gasket on housing mounting surface and install the cylinder housing in rear bore of auxiliary plate, air fitting to the upper left. Secure housing to plate with capscrews tightened to recommended torque ratings.



4. Install the two yoke lockscrews, tighten and wire securely.

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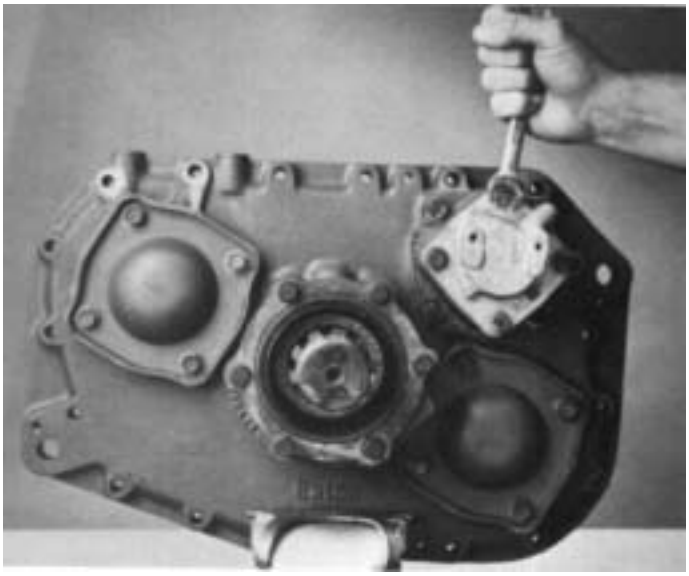
REASSEMBLY - AUXILIARY SECTION (9-SPEED AND RT-8608L MODELS)



5. If previously removed, install the O-rings in the I.D. and O.D. of range piston.



6. In cylinder housing bore, install the range piston on yoke bar, flat side to the rear. Secure with nut tightened to recommended torque ratings (inset).

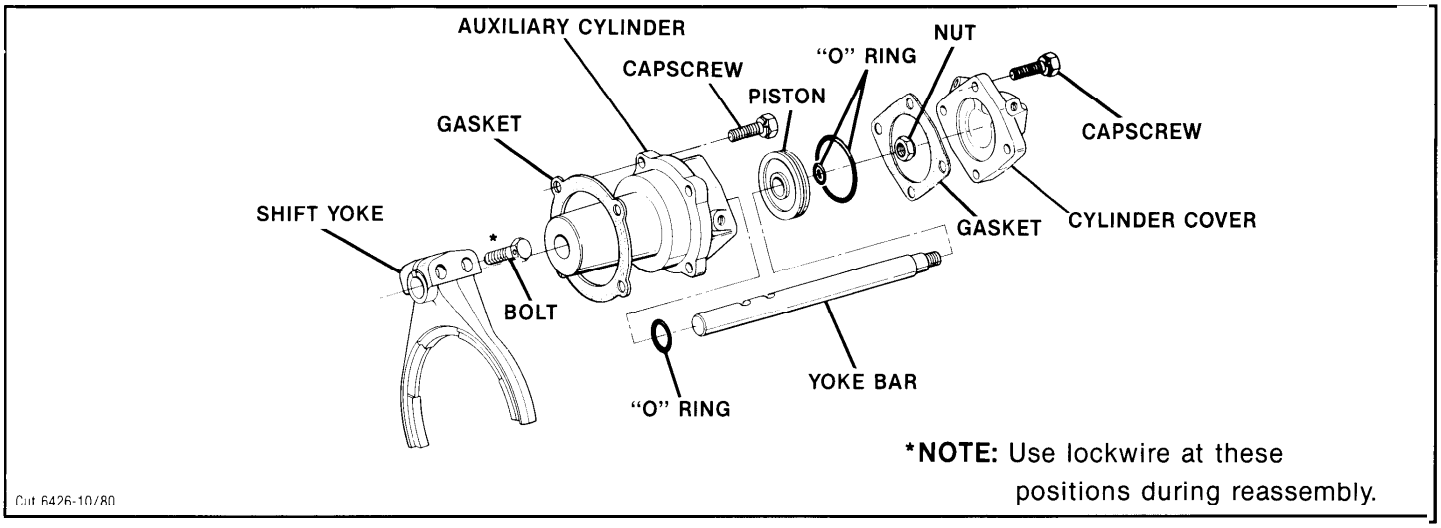


7. Position the corresponding new gasket on cover mounting surface and install the range cylinder cover on housing, open port to the upper left. Tighten capscrews to secure cover to housing.

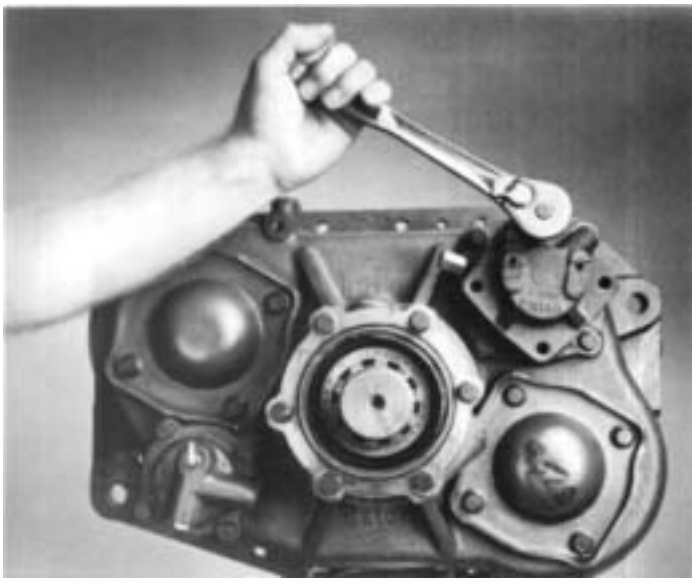
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DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

AUXILIARY SECTION (13-SPEED SPLITTER MODELS)



A. Removal and Disassembly of Range Cylinder Assembly



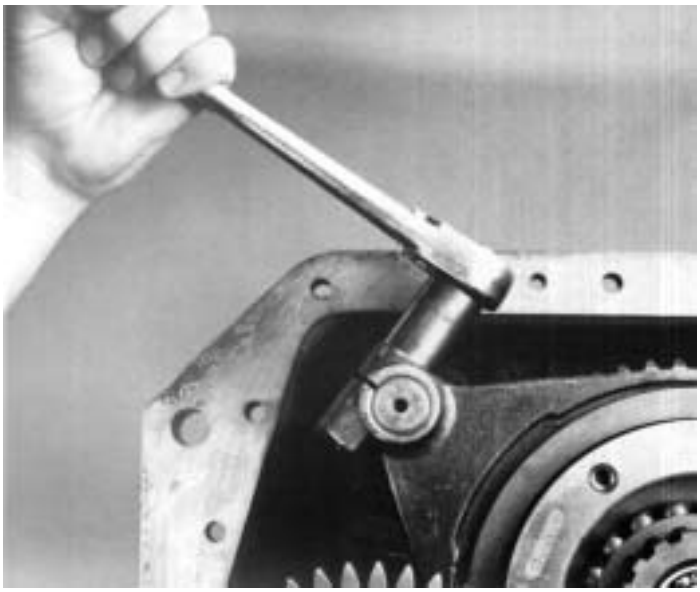
1. For ease of disassembly, mount the auxiliary section upright in a vise. Turn out the capscrews and remove the range cylinder cover and gasket.



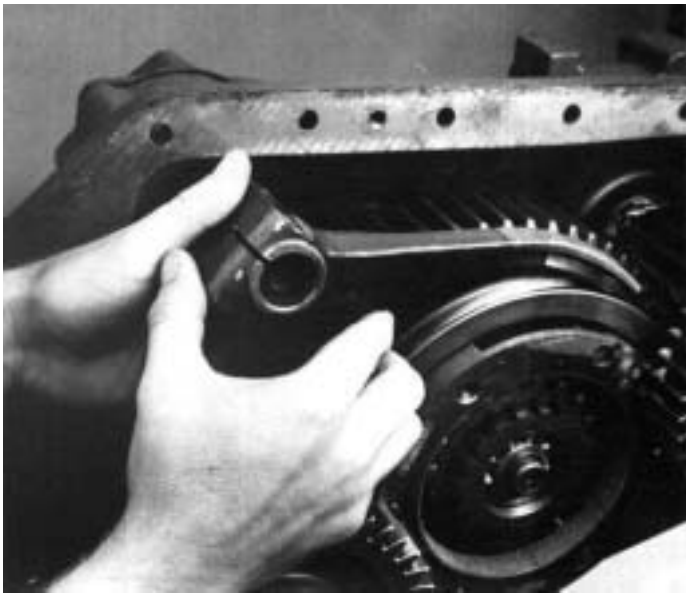
2. Remove nut from end of yoke bar.

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DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



3. Cut lockwire and remove two yoke lockscrews.



5. Remove range yoke from sliding clutch of synchronizer assembly.



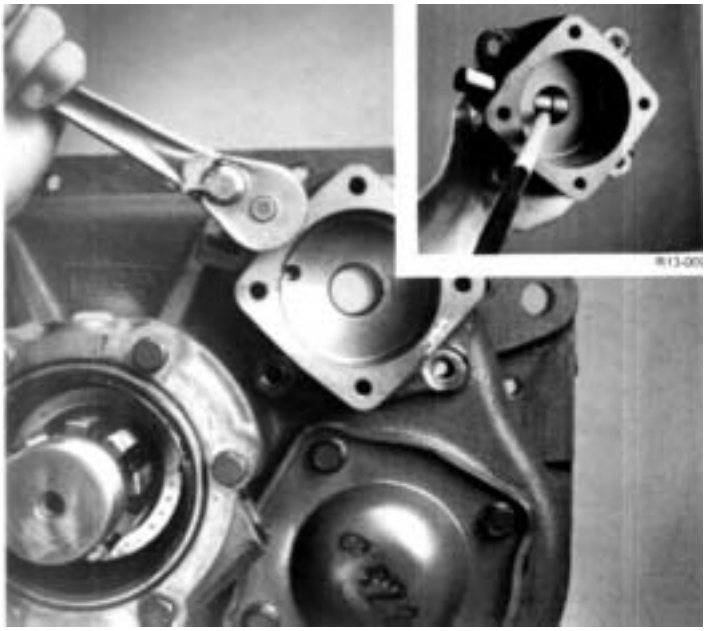
4. Pull yoke bar from bore of cylinder housing.



6. Remove the range piston from cylinder bore. If necessary, remove the O-rings from piston I.D. and O.D. (inset).

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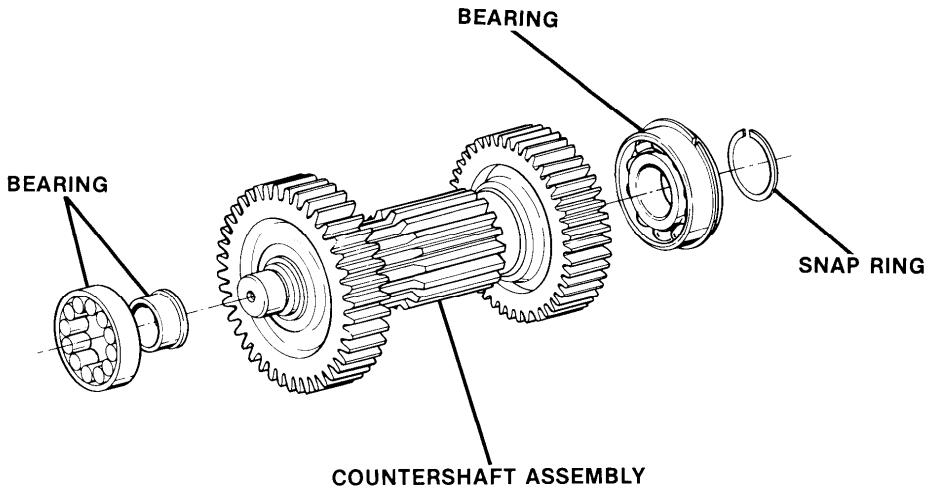
DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



7. Turn out the capscrews and remove the range cylinder housing and gasket. If necessary, remove the small O-ring from groove in housing bore (inset).

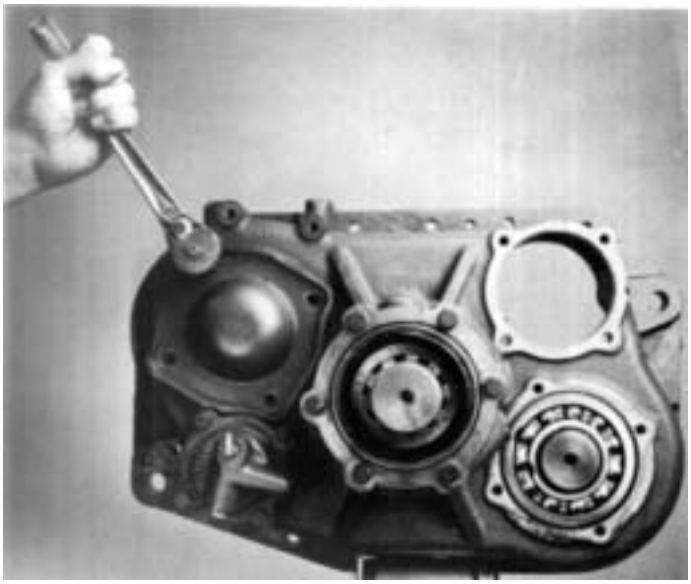
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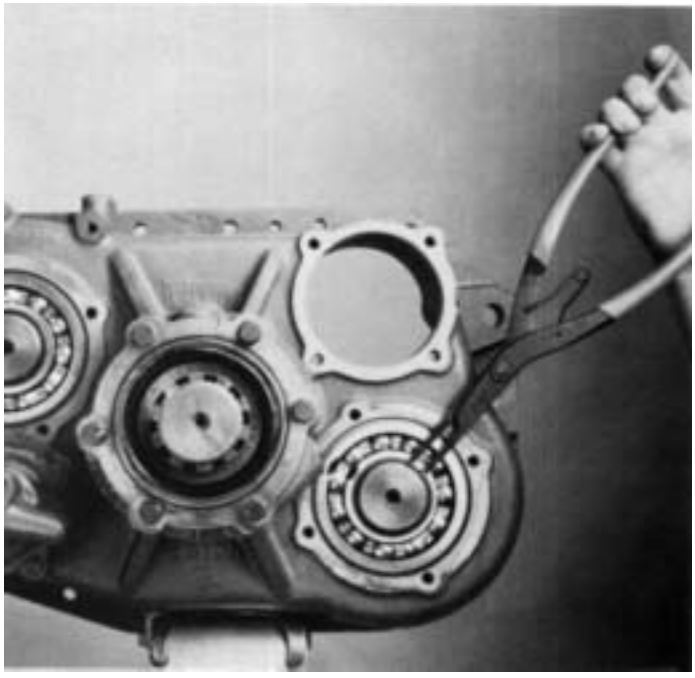
DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



Cut 6503-9/80

B. Removal of Auxiliary Countershaft Rear Bearings



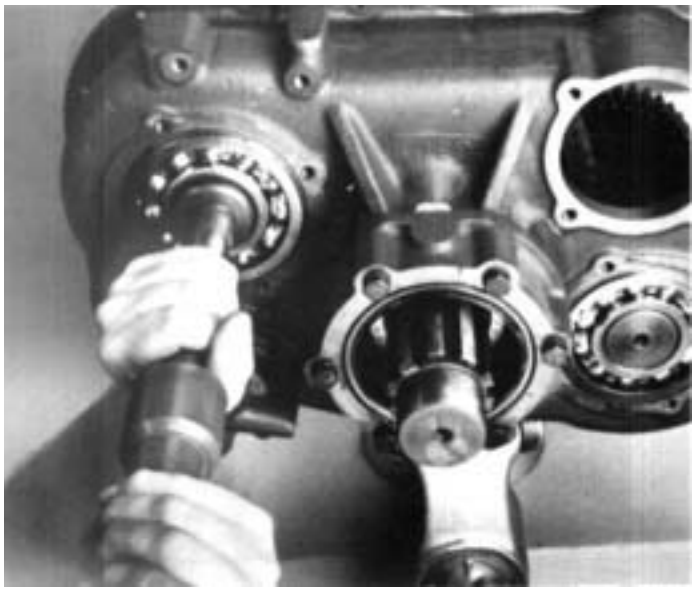


1. Turn out the capscrews and remove both countershaft rear bearing covers.
NOTE: For removal and disassembly of models equipped with an Auxiliary Oil Pump Assembly on rear of countershaft, see OPTIONS.

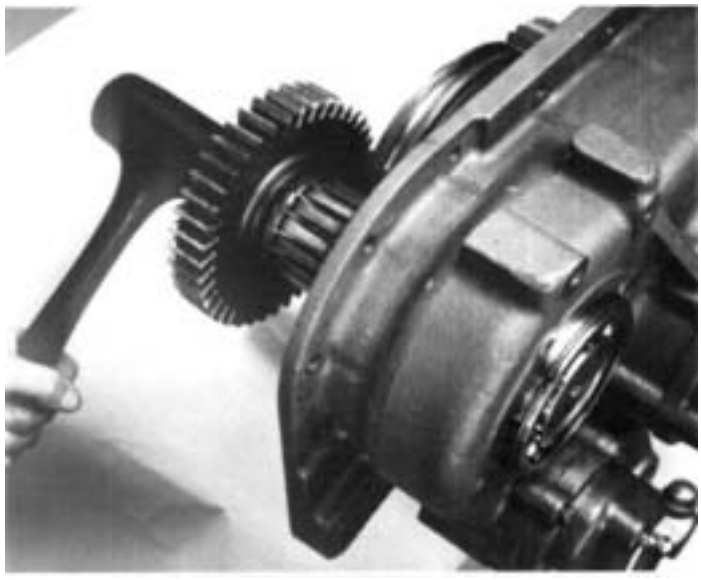
2. Remove the snap ring from groove at rear of each countershaft.

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DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)



3. Use a soft bar and maul to drive the countershaft forward far enough to partially unseat rear bearings.



4. Using caution so as not to damage the bearing inner race on front of each countershaft, drive the shafts to the rear to expose the bearing snap rings.

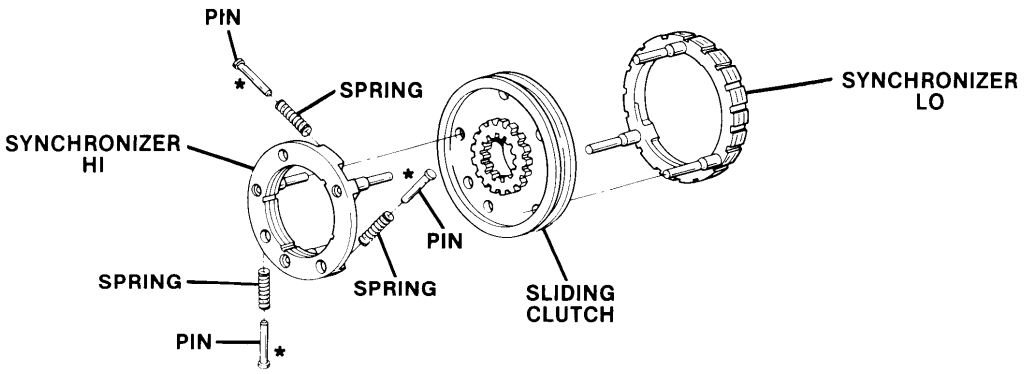


5. Use a puller to remove the countershaft rear

NOTE: The auxiliary countershaft assemably CANNOT be removed from housing until splitter shift yoke is removed.

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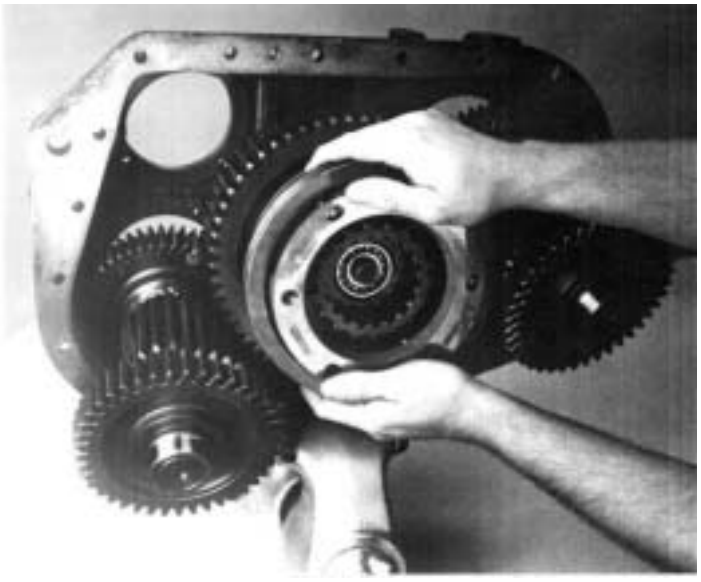
DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

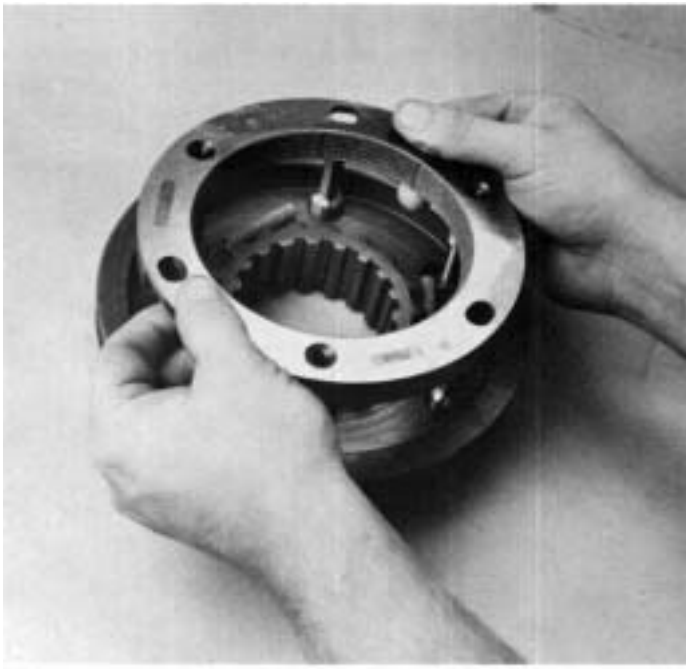


*Note: Not used in current production or in K-1654 kit
Was only used with A-4683 Synchronizer
Do not use with A-4388 Synchronizer
Ref. Service Bulletin #130 7/81

Cut 6480 B-3/84

C. Removal and Disassembly of Synchronizer Assembly





1. Spread the countershaft assemblies and pull the synchronizer assembly from splines of rang e mainshaft.

NOTE: To spread countershaft far enough to remove synchronizer on RTO & RTOO models , move the splitter clutch to the forward position.

2. Place the larger low range synchronizer ring on bench and pull the high range synchronizer from blocker pins. However, before doing so, cover the assembly with a shop rag to prevent losing the three springs released from high range synchronizer at pin locations.

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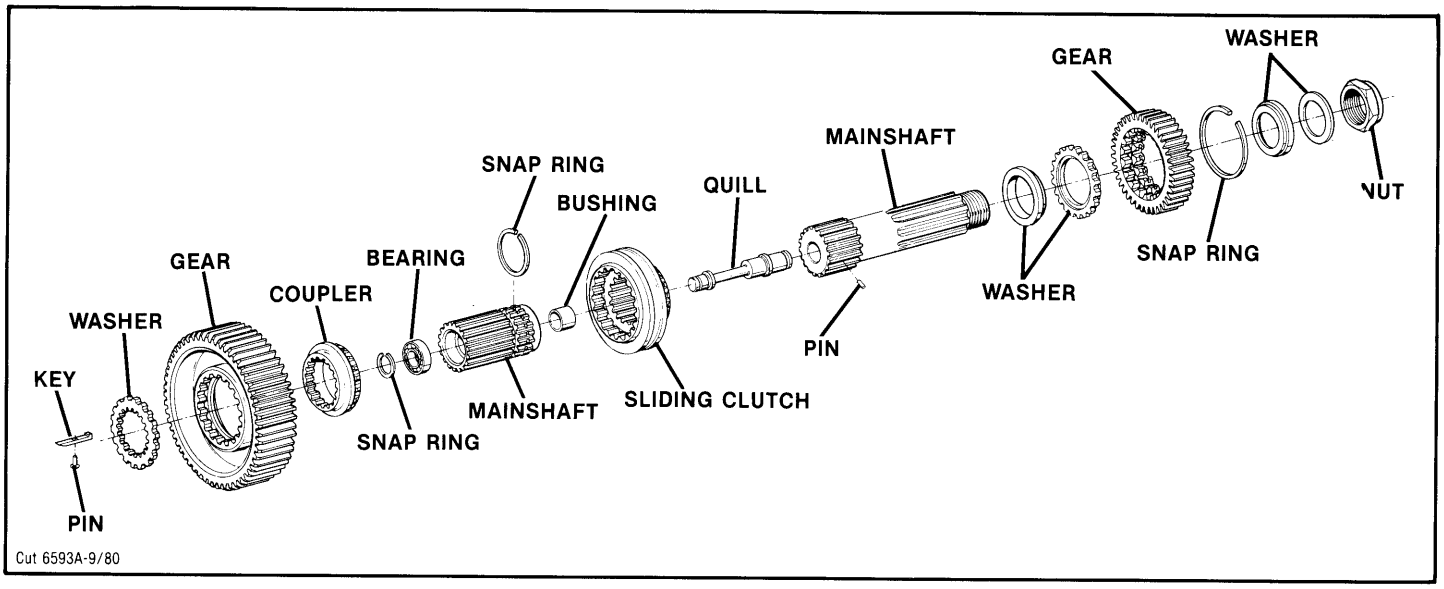
DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



3. Remove the sliding clutch from pins of low range synchronizer ring.

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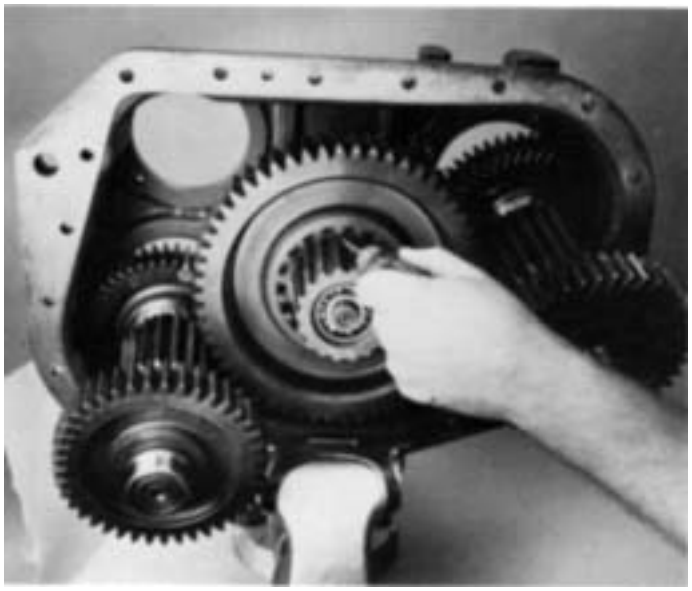
REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



D. Removal of Low Range Gear



1. Remove the key from keyway of range mainshaft.



2. Turn the washer located in the hub of low range gear so that the splines of washer align with the splines of mainshaft.

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DISASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)



3. Spread the countershaft assemblies and pull the low range gear and washer from splines of mainshaft.

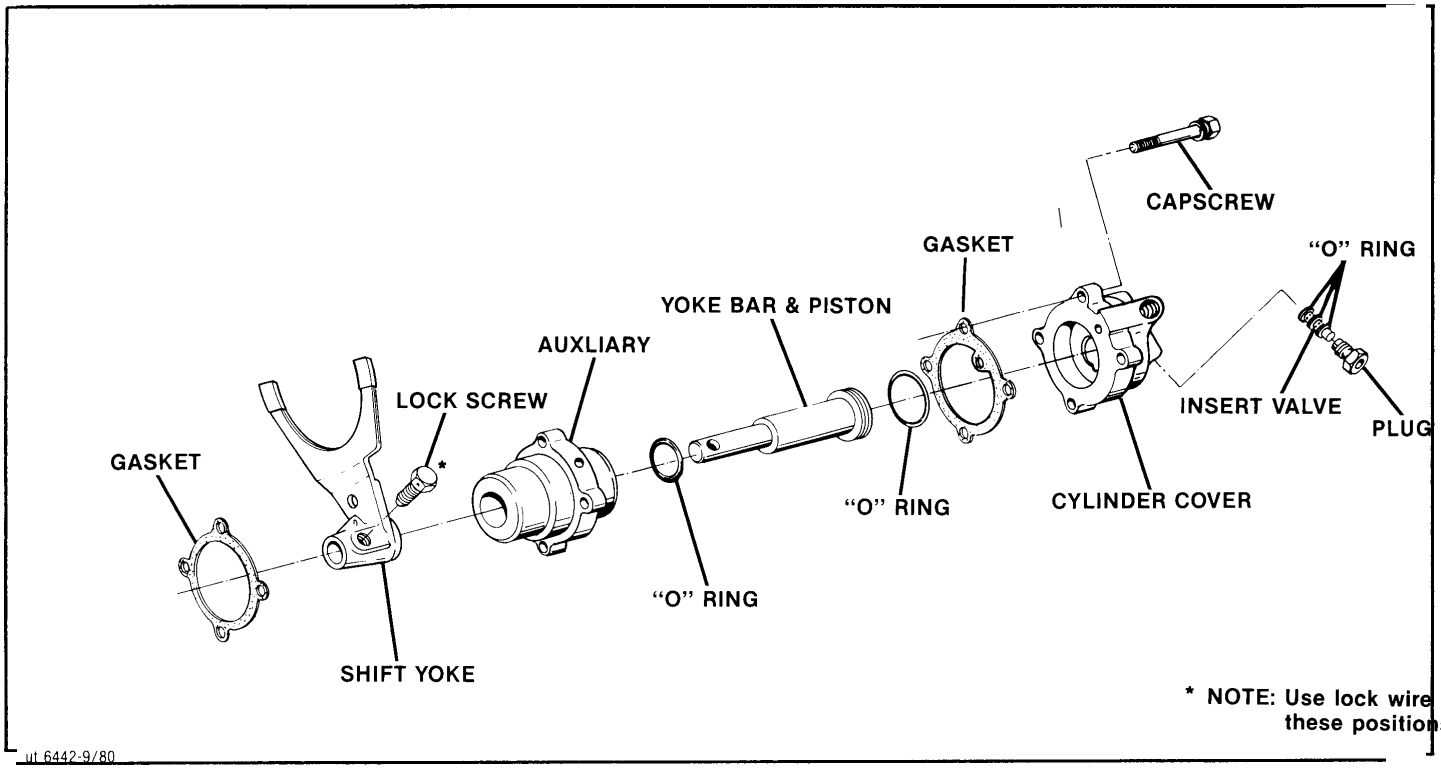


4. Remove the coupler from splines of range mainshaft.

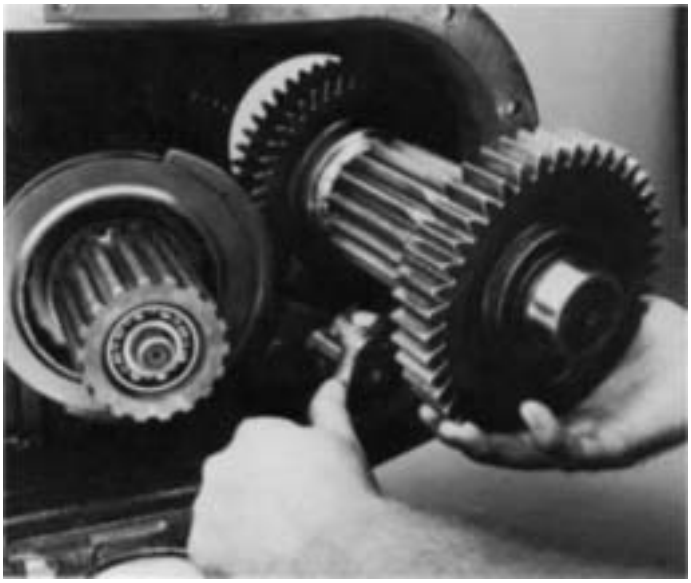
NOTE: If desired, Removal and Disassembly of Range Mainshaft Assembly may be performed prior to Removal and Disassembly of Splitter Cylinder Assembly.

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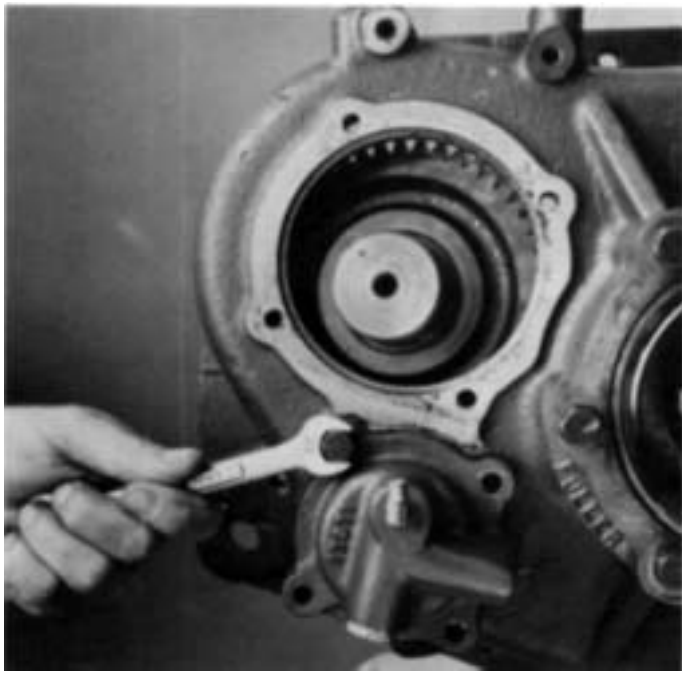
DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



E. Removal and Disassembly of Splitter Cylinder Assembly



1. Cut lockwire and remove the lockscrew from shift yoke.



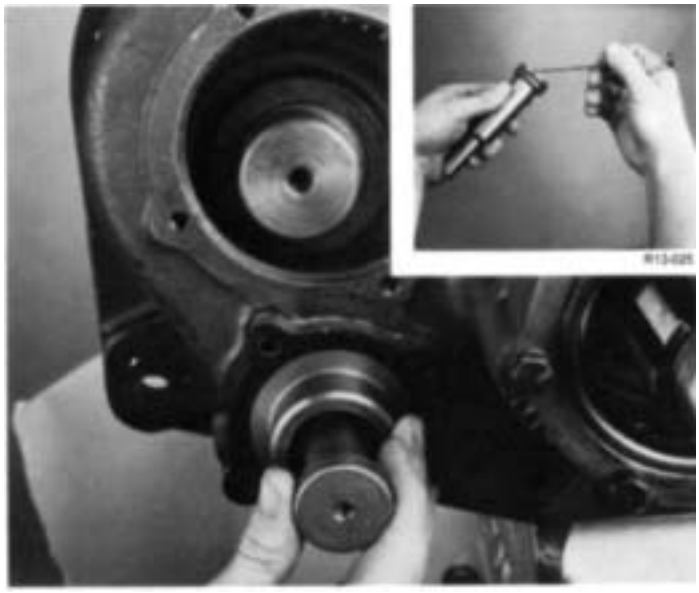
2. Turn out the capscrews and remove the splitter cylinder cover and gasket.

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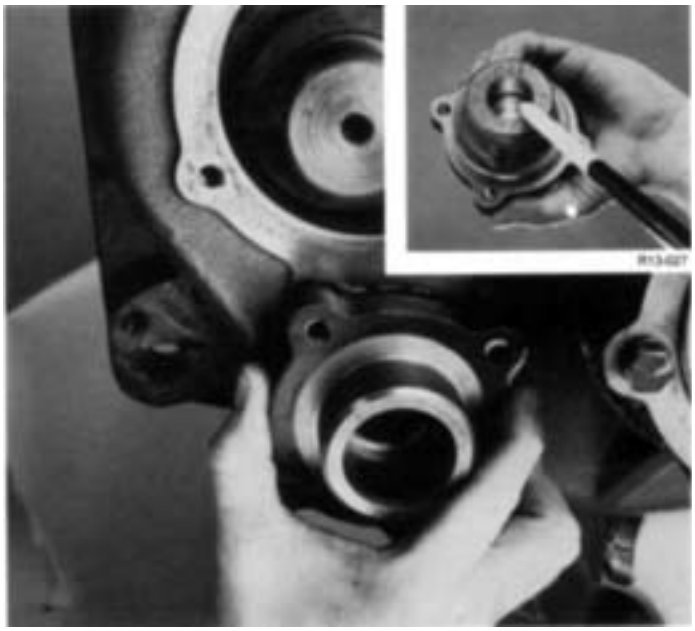
DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



3. If necessary, turn out the plug in bottom bore of cover and remove the insert valve.



4. Remove the yoke bar from cylinder housing bore. If necessary, remove the O-ring from piston O.D. (inset).



5. Remove the splitter cylinder housing and gasket from auxiliary housing. If necessary, remove the small O-ring from bore in cylinder housing (inset).

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DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

F. Removal and Disassembly of Range Mainshaft Assembly



1. Remove the snap ring from the groove of range mainshaft.



2. Remove splitter shift yoke and sliding clutch.



3. Remove both auxiliary countershafts.



4. Remove the "C" ring from the groove at front of mainshaft quill.

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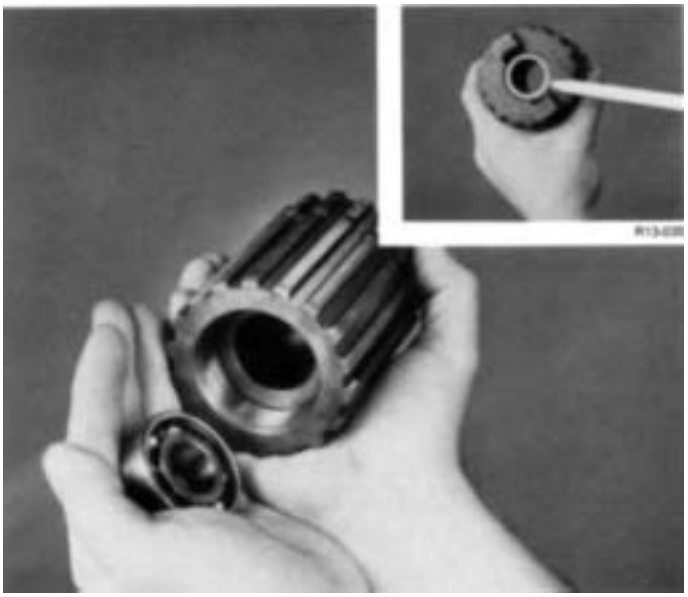
DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



5. Remove range mainshaft with jaw puller.



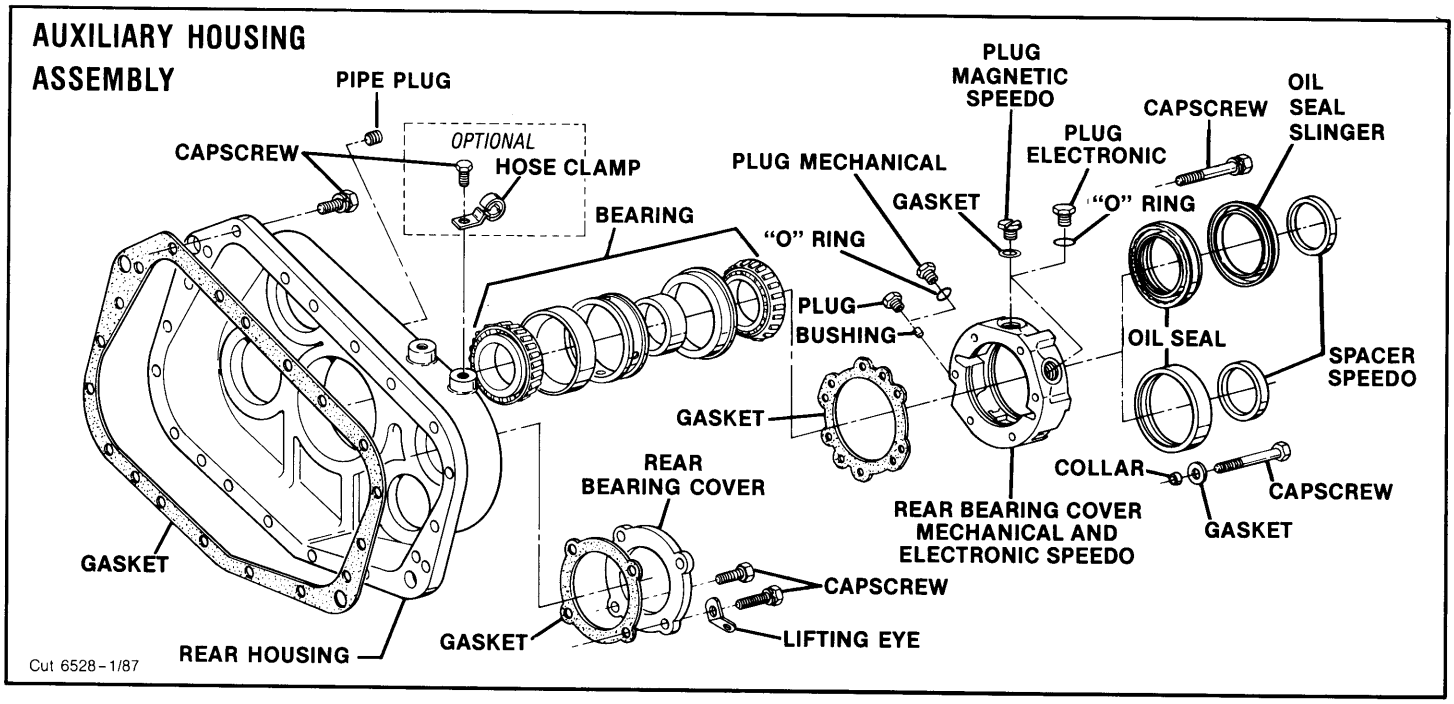
7. Remove bearing inner race from front of countershaft with jaw puller.



6. Remove bearing from front bore of mainshaft. If necessary, press bushing from mainshaft (inset).

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DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

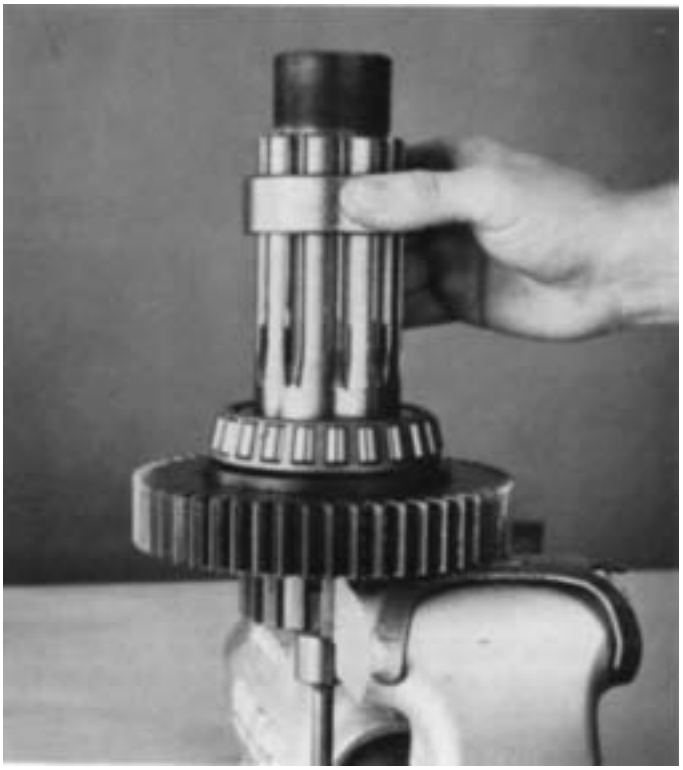


G. Removal and Disassembly of Output Shaft and Rear Bearing Assemblies

NOTE: In addition to the above, refer to the illustration provided at Part D of this section.



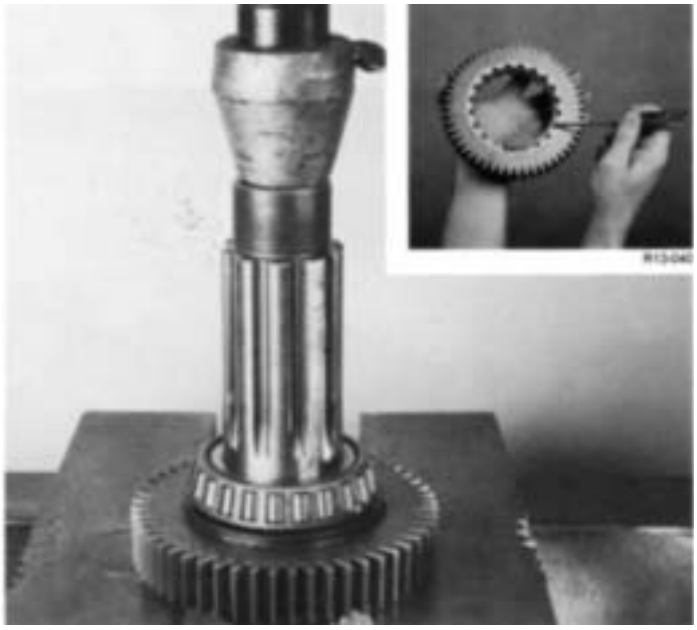
1. Use a soft bar and maul to drive the output shaft forward and through rear bearing assembly.
NOTE: When applying force to rear of output shaft, DO NOT DAMAGE THREADS. Support front of shaft to avoid damaging the mainshaft quill once output shaft is free of bearing assembly.



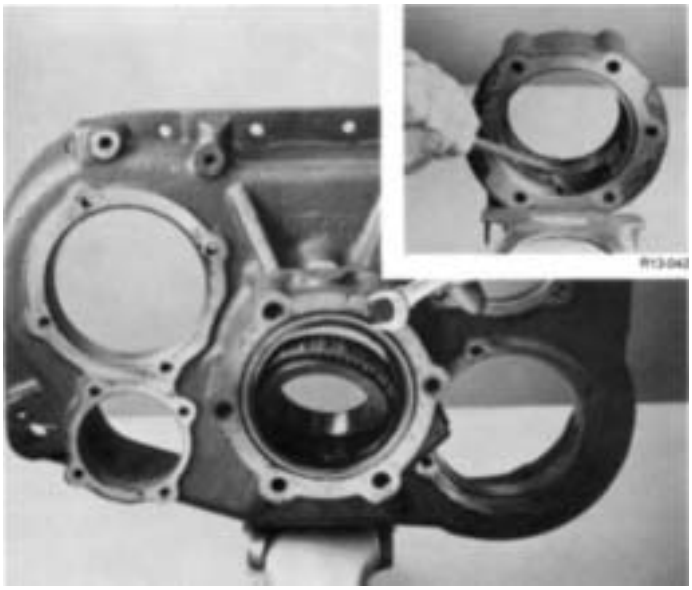
2. Remove the bearing inner spacer from output shaft.

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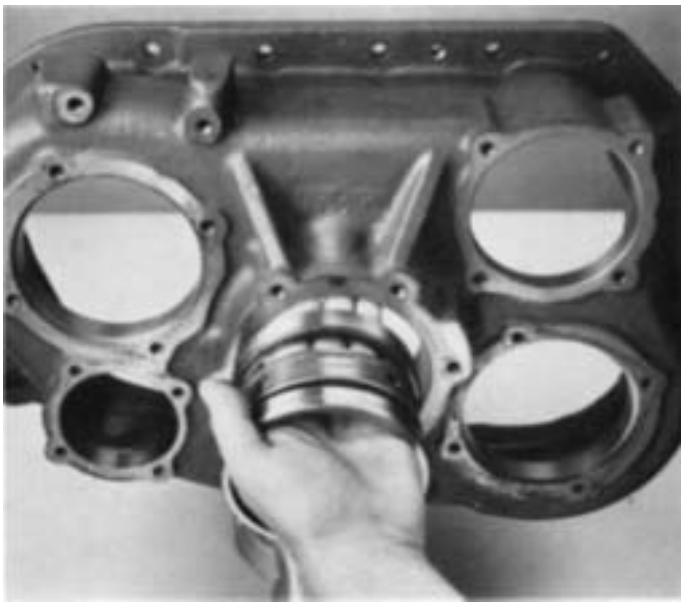
DISASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



3. Using the front face of splitter gear as a base, press the output shaft through the bearing, washer and gear. DO NOT DAMAGE MAINSHAFT QUILL. If necessary, remove the snap ring from I.D. of splitter gear (inset).



4. Turn out the retaining capscrews and remove the rear bearing cover and gasket from auxiliary housing. The rear bearing cone will drop from housing bore when cover is removed. If necessary, remove the oil seal from cover (inset).



5. Remove the two bearing cups and outer spacer from housing bore.

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REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

AUXILIARY SECTION (13-SPEED MODELS)

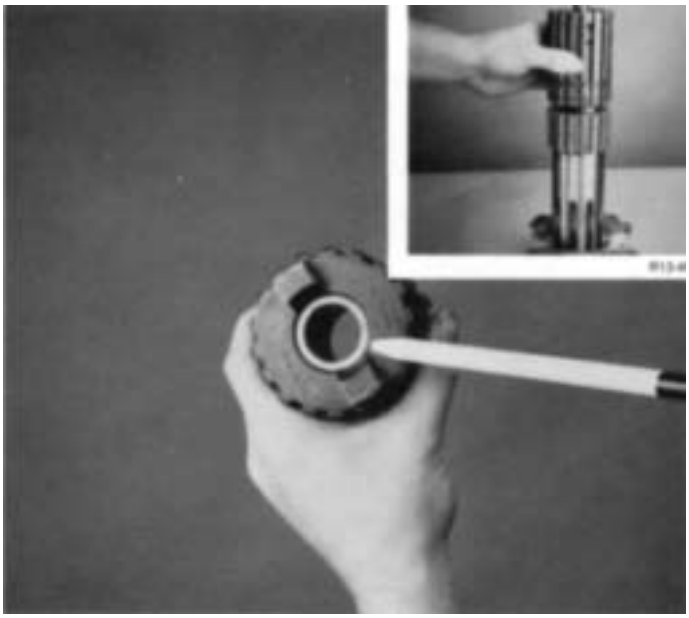
A. Reassembly and Installation of Range Mainshaft Assembly



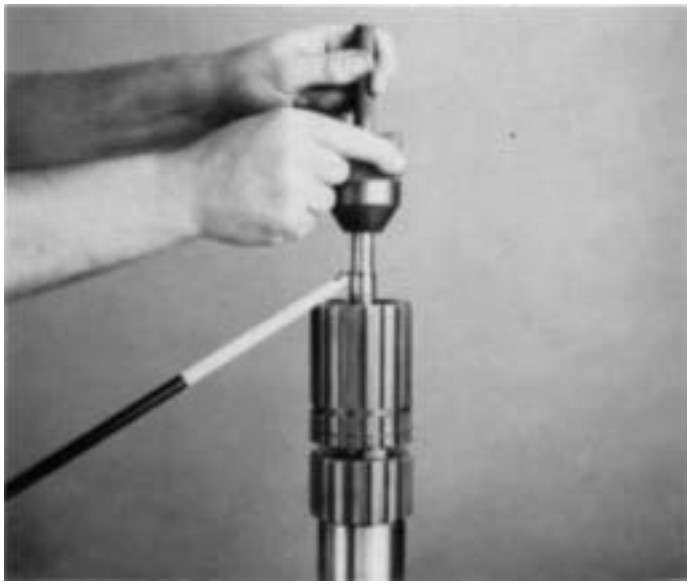
1. Secure the output shaft in a vise with mainshaft quill up.



3. Install the bearing in front bore of range mainshaft. Use a small flanged-end driver to properly seat bearing in bore on mainshaft quill.



2. If necessary, press the bushing in rear bore of range mainshaft and install the mainshaft in position on quill. (inset)



4. Install the "C" ring in groove of mainshaft quill to retain bearing.

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REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

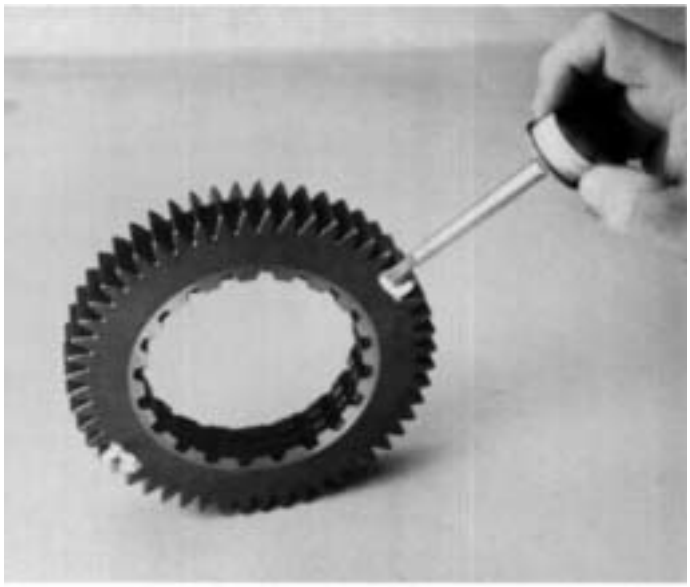
B. Reassembly and Installation of Output Shaft and Rear Bearing Assemblies



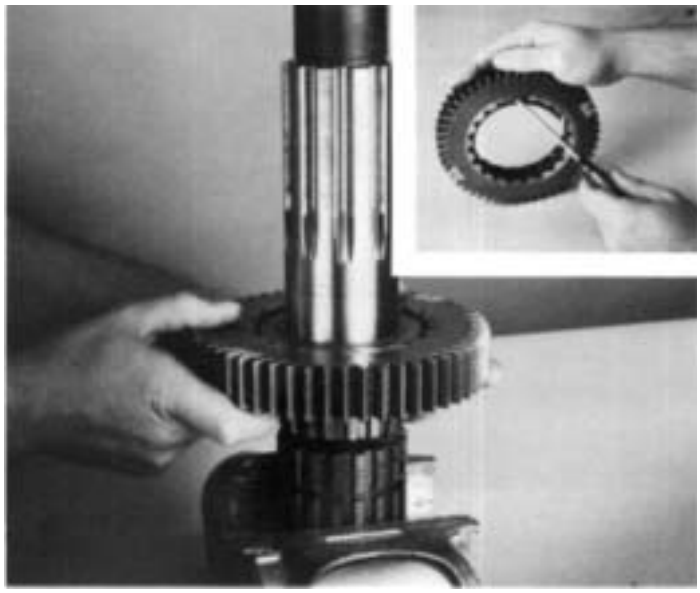
1. Remount the output shaft in vise with threaded-end up and secure on range mainshaft. Install the stepped washer on shaft, flat side down.



2. Install the splined spacer and output shaft against washer, shoulder up.



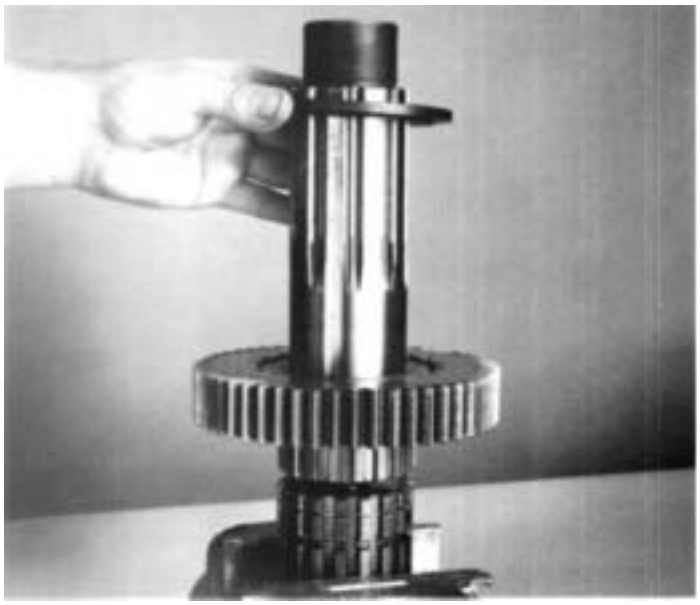
3. IMPORTANT: For timing purposes, mark any two adjacent teeth on splitter gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakers' dye is recommended.



4. If previously removed, install the snap ring in splitter gear (inset). Install the gear on output shaft, snap ring up and clutching teeth engaged with splines of spacer.

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REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



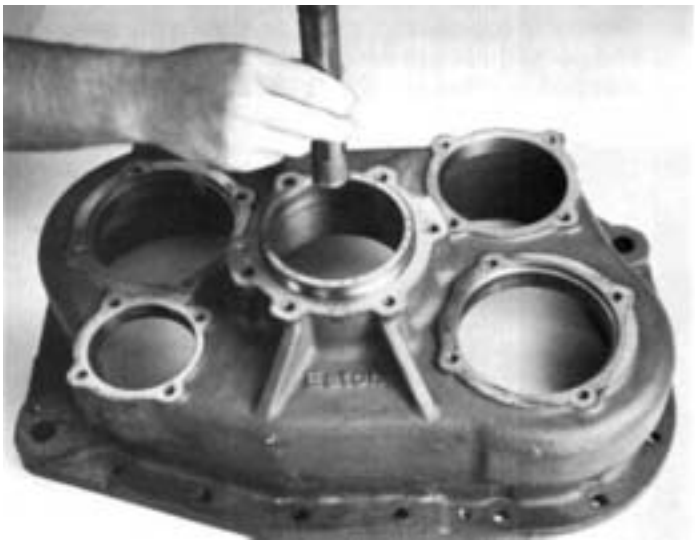
5. Install the stepped washer on shaft against gear, flat side up.



7. Install the bearing inner spacer on output shaft.



6. Heat the front bearing cone and install on output shaft against washer, bearing taper up.
NOTE: DO NOT HEAT BEARING ABOVE 275ºF (136˚C). If possible, use heat lamps as source.



8. Place the front bearing cup in housing bore, taper to the inside, and use a soft bar to start cup into bore.

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REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



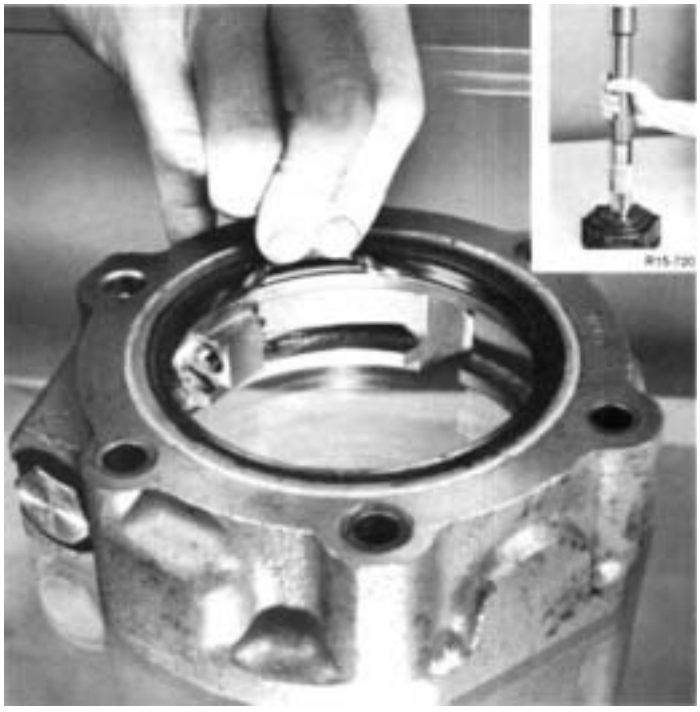
9. Stack the bearing outer spacer and rear bearing cup on top of front bearing cup in proper sequence. Use a flanged-end driver to move all three parts evenly into bore until lip of rear bearing cup seats on housing.



11. Heat the rear bearing cone and install on shaft, taper down and inside cup. Make sure the lip of rear bearing cup is fully seated on housing with bearing installed.
NOTE: DO NOT HEAT BEARING ABOVE 275ºF (136ºC).



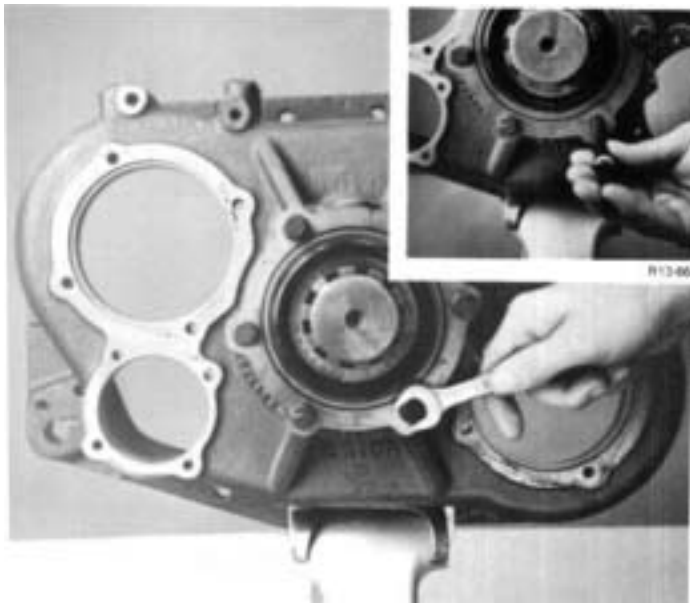
10. Install the auxiliary housing over end of output shaft assembly, seating the front bearing cone on shaft in cup.



12. If previously removed, install the oil seal in rear bearing cover. Seal should be installed so the spring is to the front of cover (inset).

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REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



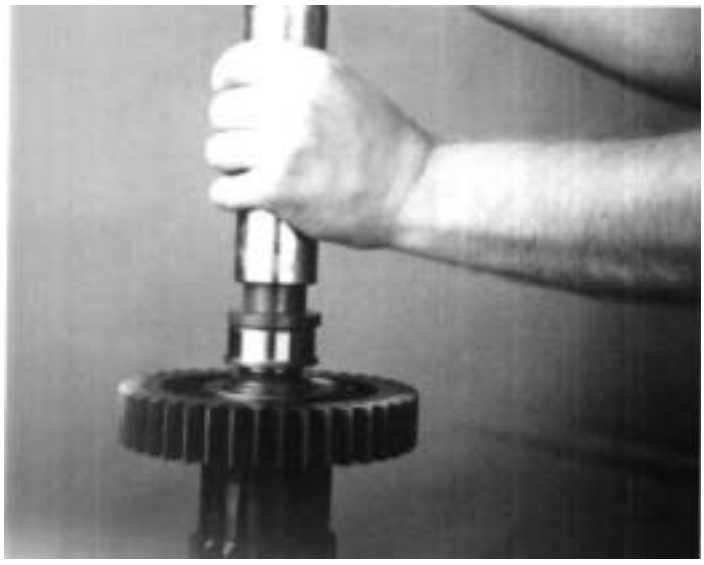
13. Position the corresponding new gasket on cover mounting surface and install the rear bearing cover on auxiliary housing. Use the nylon collar and brass washer with capscrew at the chamfered hole which intersects speedometer bore (inset). Tighten the capscrews to secure cover to housing.
NOTE: Because the collar becomes distorted when compressed, DO NOT REUSE OLD NYLON COLLAR.

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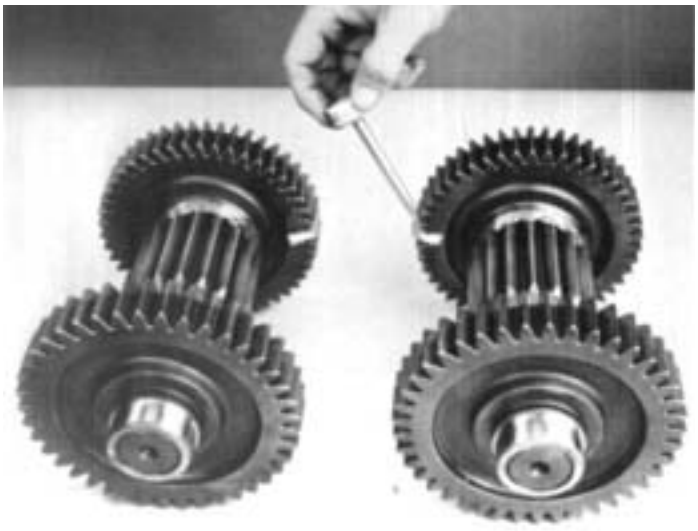
REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

C. Timing and Installation of Auxiliary Countershaft Assemblies

NOTE: The auxiliary countershaft assemblies CANNOT be installed in housing with prior installation of the splitter shift yoke.



1. If previously removed, install the bearing inner race on front of each countershaft.



2. On the splitter gear of each assembly, use a highly visible color of toolmakers' dye to mark the tooth stamped with an "O" for timing purposes.



3. Place the left countershaft assembly into position in housing and mesh the marked tooth of countershaft splitter gear with either set of two marked teeth of splitter gear on output shaft. DO NOT INSTALL REAR BEARING AT THIS TIME.

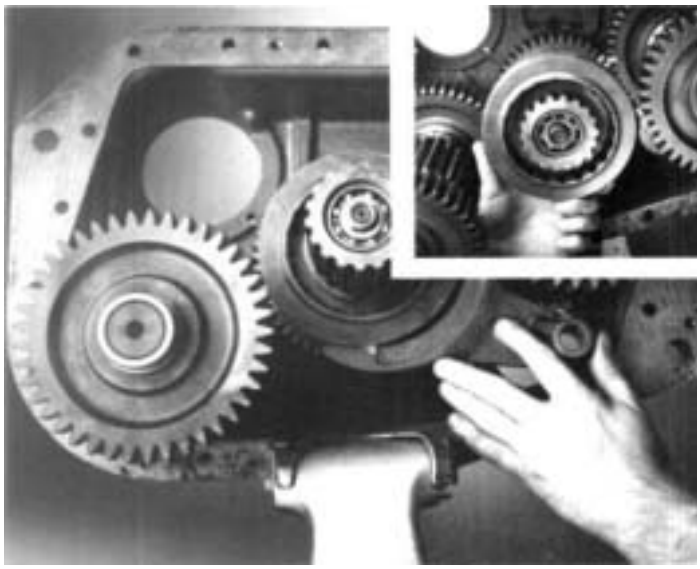


4. Repeat the previous procedure with the right countershaft assembly, meshing the marked tooth of countershaft splitter gear with the remaining set of two marked teeth of splitter gear on output shaft. DO NOT INSTALL REAR BEARING AT THIS TIME.

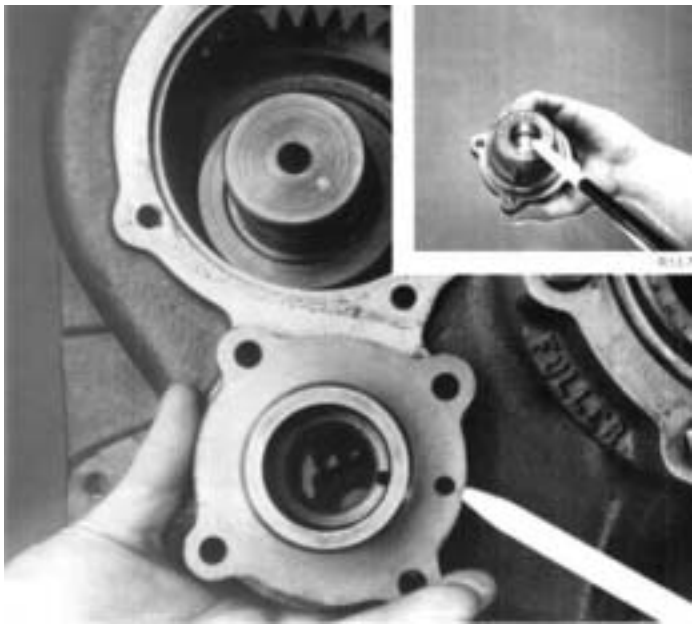
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REASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)

D. Reassembly and Installation of Splitter Cylinder Assembly



1. Install the splitter sliding clutch on output shaft, internal splines toward gear and engaged with splines of shaft (inset). Place the splitter shift yoke into position with sliding clutch on output shaft, yoke hub to the front of housing.



2. If previously removed, install the small O-ring in bore of cylinder housing (inset). Position the corresponding new gasket on housing mounting surface and install the splitter cylinder housing in rear bore of auxiliary housing, air channel to the right.



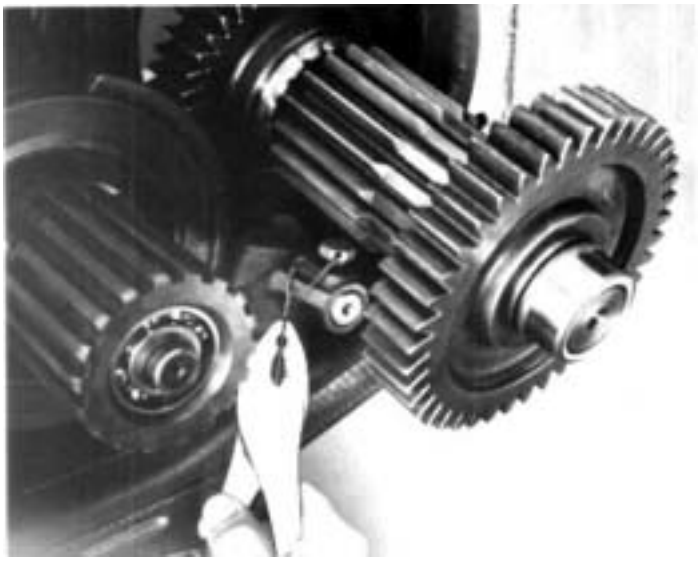
3. If previously removed, install the O-ring in O.D. groove of yoke bar piston.



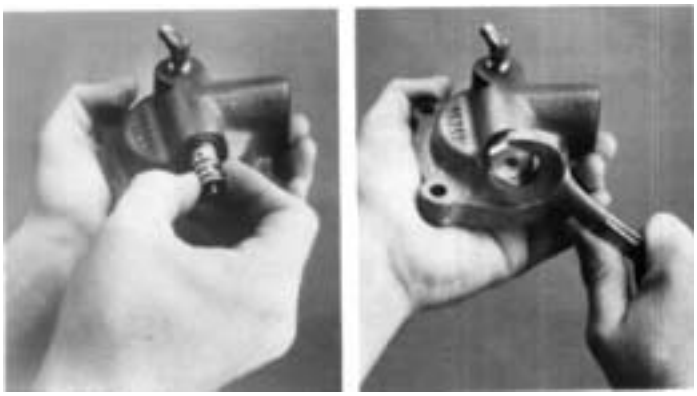
4. From the rear of housing, insert the yoke bar through cylinder bore and into shift yoke, aligning the notch in bar with lockscrew hole in yoke hub.

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REASSEMBLY-AUXILIARY SECTION (13-SPEED MODELS)



5. Install the yoke lockscrew, tighten and wire securely.

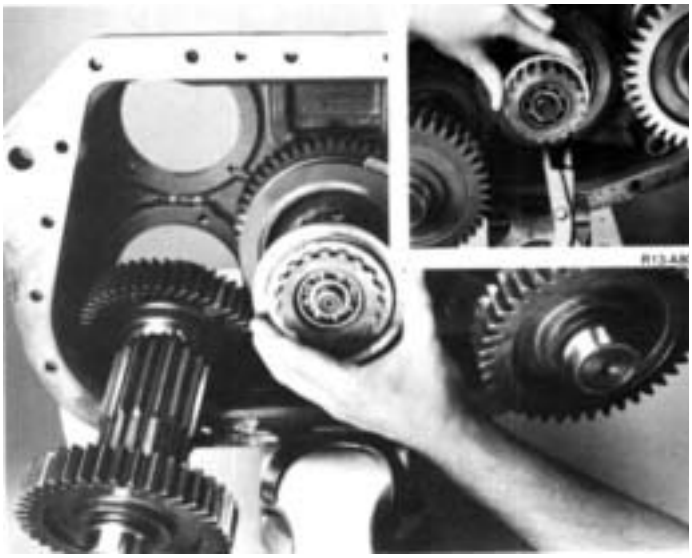


6. If previously removed, install the insert valve in bottom bore of cylinder cover, flat end to the inside (left). Install the valve retaining nut in exhaust port of cover and tighten to recommended torque ratings (right).
NOTE: Prior to installation of insert valve, make sure the three O-rings on valve O.D. are not defective. Replace, if necessary.



7. Position the corresponding new gasket on cover mounting surface and install the splitter cylinder cover on cylinder housing, exhaust port down. install the capscrews in cover and tighten to secure the assembly on auxiliary housing.
NOTE: With the cover installed in this manner, the air channel of cover will align with that of cylinder housing.

E. Installation of Low Range Gear



1. Install the snap ring in groove of range mainshaft (inset). Install the coupler on range mainshaft against snap ring, clutching teeth to the rear.

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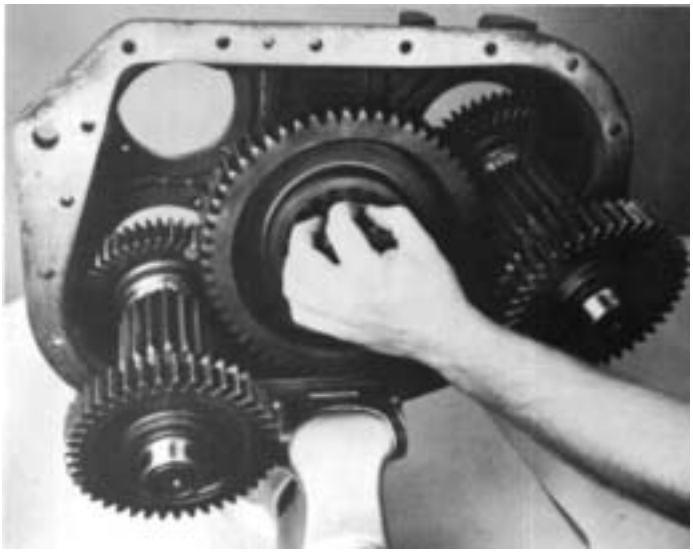
REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



2. Spread the countershaft assemblies with splitter gear set remaining in time and install the low range gear on shaft against coupler, clutching teeth to the front.
NOTE: To spread countershaft far enough to install low range gear, move the splitter clutch to the forward position.



3. Install the splined tolerance washer on mainshaft and in hub of low range gear. Rotate the washer in groove of mainshaft to engage external splines with clutching teeth of gear and align the keyway of washer with keyway of mainshaft.
IMPORTANT: This washer is available in varying thicknesses. Use the splined tolerance washer that provides a snug fit in gear hub.



4. Install the key in keyway of range mainshaft, inserting the thick end of key in keyway of tolerance washer to lock low range gear on shaft.

F. Reassembly and Installation of Synchronizer Assembly



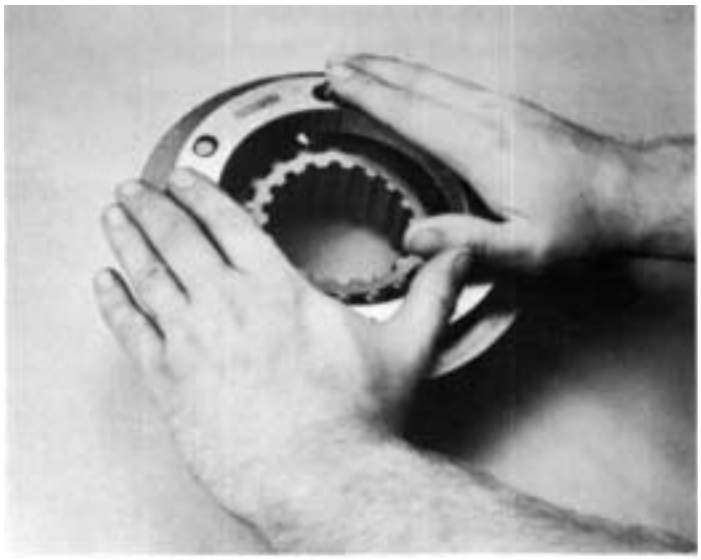
1. Place the larger low range synchronizer ring on bench and install the sliding clutch on blocker pins, recessed side up.

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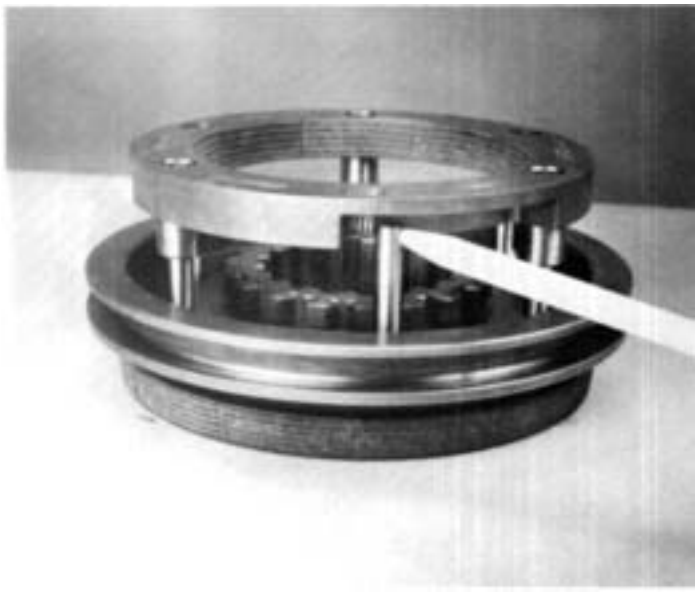
REASSEMBLY - AUXILIARY SECTION (1 3-SPEED MODELS]



2. Install the three springs in bores of high range synchronizer ring.



4. Apply downward pressure to the high range synchronizer ring WHILE TWISTING COUNTER-CLOCKWISE to compress the springs and fully seat ring on blocker pins of low range synchroni-



3. Place the high range synchronizer ring over blocker pins of low range synchronizer, seating the springs against pins.



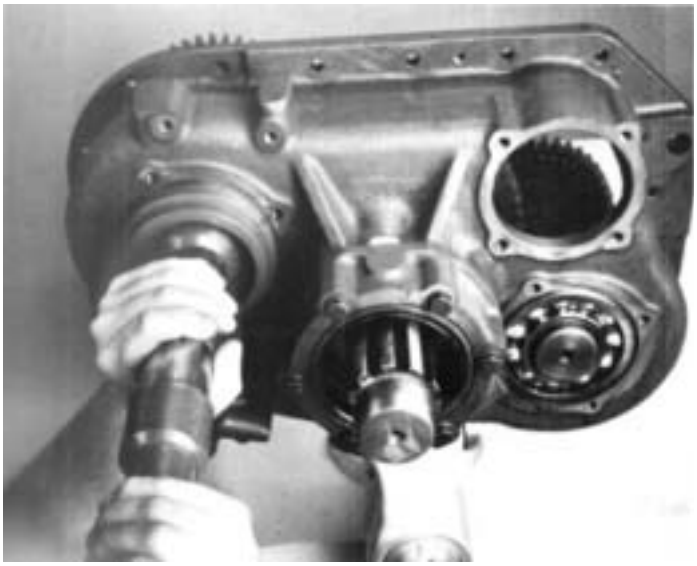
5. Spread the countershaft assemblies with splitter gear set remaining in time and install the synchronizer assembly on splines of range mainshaft, low range ring in recess of low range gear.

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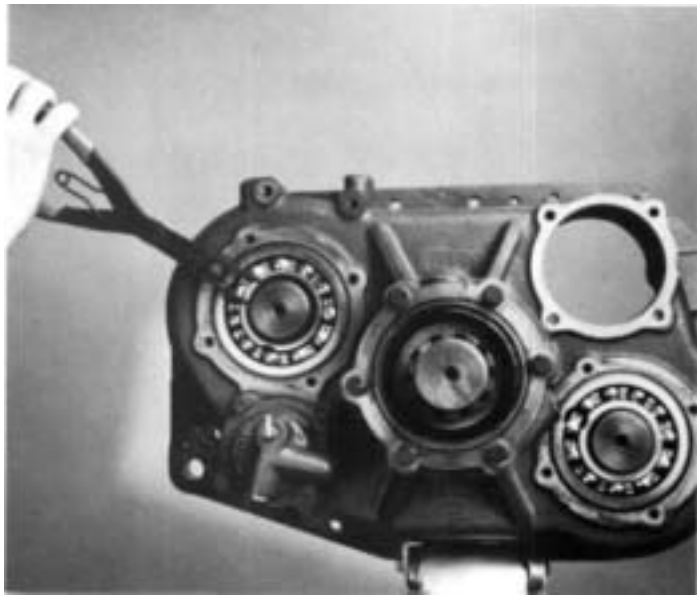
REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

G. Installation of Auxiliary Countershaft Rear Bearings

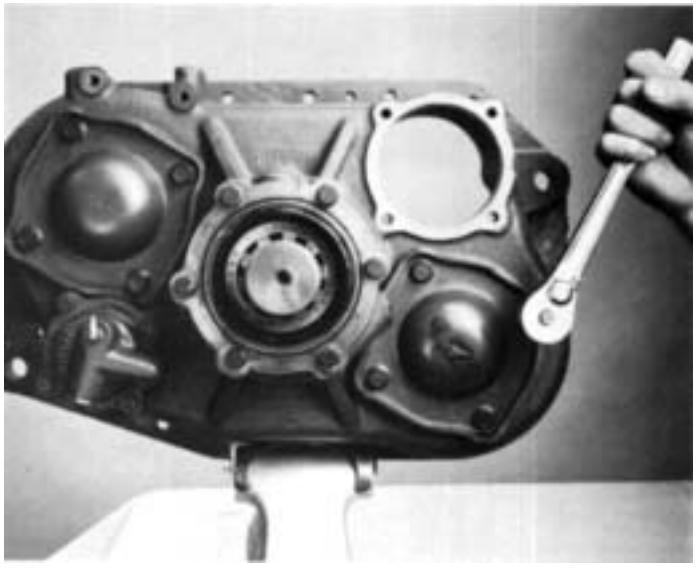
NOTE: The splitter gear set MUST remain in time during the installation of rear bearings.



1. Center the rear of either countershaft assembly in bearing bore and use a soft bar to start rear bearing in bore. Complete installation with a flanged-end bearing driver and maul. Repeat the procedure with other auxiliary countershaft assembly, making sure the splitter gear set has remained in time.
NOTE: Check the synchronizer assembly for springs that may have been released from bores in high range ring during bearing installation.



2. Install the snap ring in groove at rear of each countershaft.

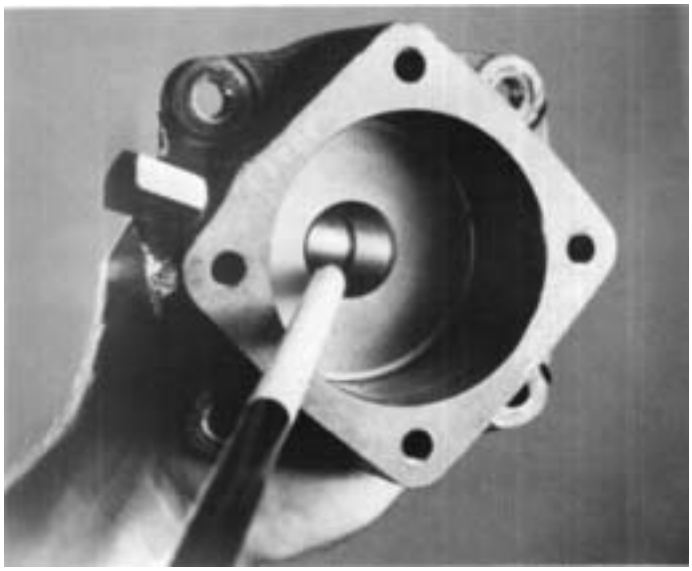


3. Position the corresponding new gasket on cover mounting surface and install both rear bearing covers. Tighten capscrews to secure covers to auxiliary housing.
NOTE: For reassembly and installation of models equipped with an Auxiliary Oil Pump Assembly on rear of countershaft, see OPTIONS.

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REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)

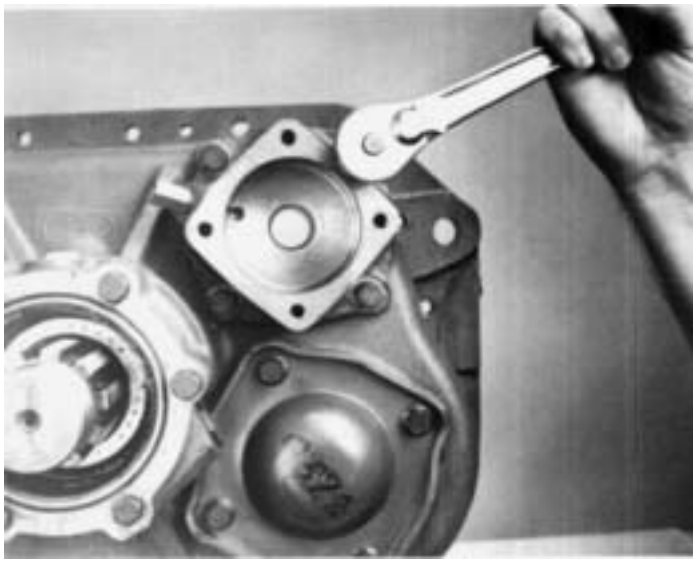
H. Reassembly and Installation of Range Cylinder Assembly



1. If previously removed, install the O-ring in bore of range cylinder housing.



3. Place the range yoke into position with sliding clutch of synchronizer assembly, long hub of yoke to the rear. Insert threaded-end of yoke bar through yoke and into bore of range cylinder housing, aligning the notches in bar with yoke lockscrew holes.



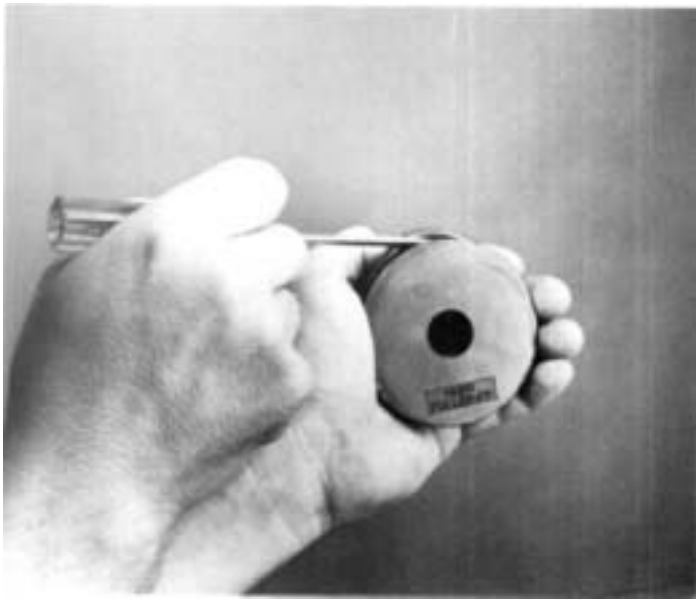
2. Position the corresponding new gasket on housing mounting surface and install the cylinder housing in rear bore of auxiliary housing, air fitting to the upper left. Tighten capscrews to secure cylinder housing to auxiliary housing.



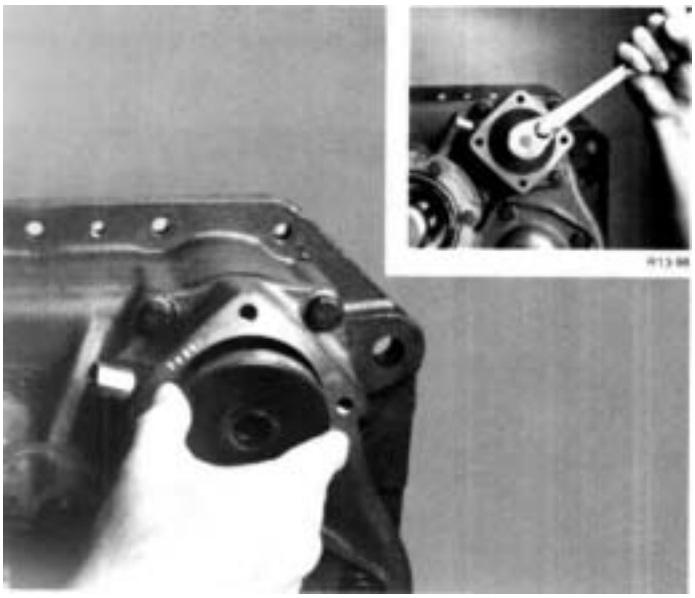
4. Install the two yoke lockscrews, tighten and wire securely.

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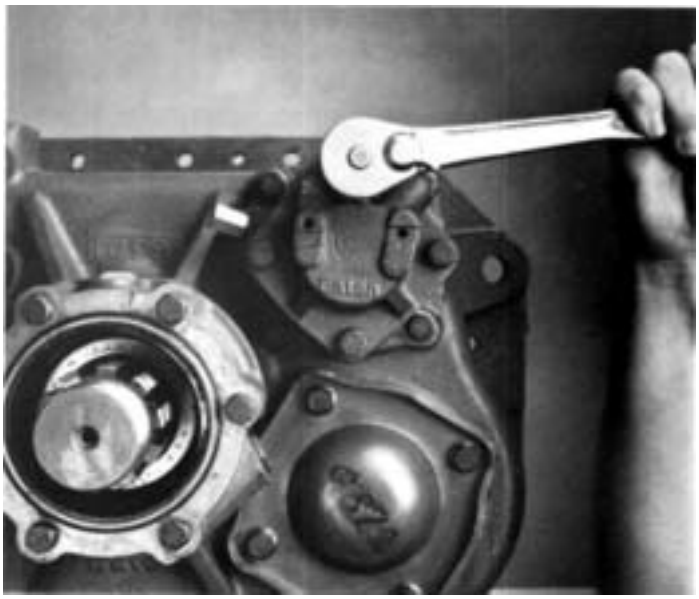
REASSEMBLY - AUXILIARY SECTION (13-SPEED MODELS)



5. If previously removed, install the O-rings in the I.D. and O.D. of range piston.



6. In cylinder housing bore, install the range piston on yoke bar, flat side to the rear. Secure with nut tightened to recommended torque ratings (inset).

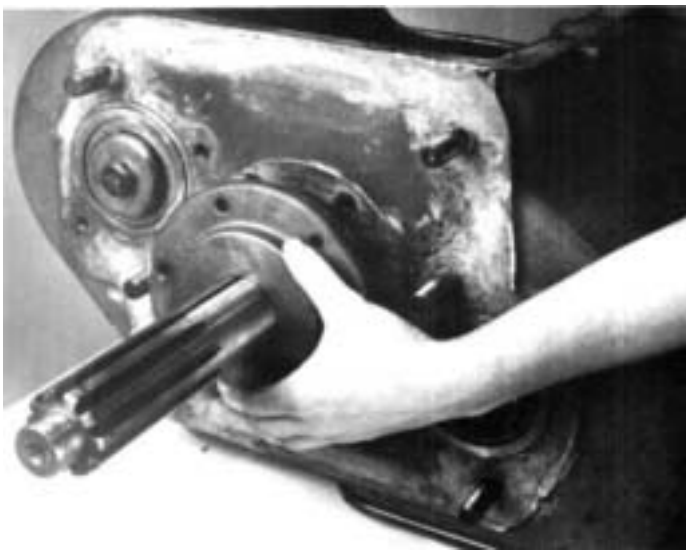


7. Position the corresponding new gasket on cover mounting surface and install the range cylinder cover on housing, open port to the upper left.

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DISASSEMBLY - FRONT SECTION

A. Removal of Front Bearing Cover and Input Shaft Nut



1. Turn out the retaining capscrews and remove the drivegear bearing cover and gasket.



2. If necessary remove the oil seal from cover of models so equipped.

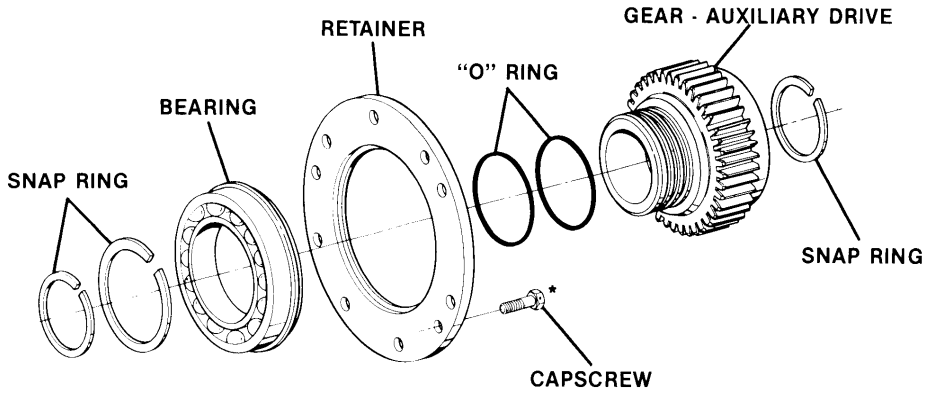


3. Engage two mainshaft sliding clutches into gear, this prevents transmission from rotating. Remove nut (left hand thread) with drive gear nut removing tool.

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DISASSEMBLY - FRONT SECTION

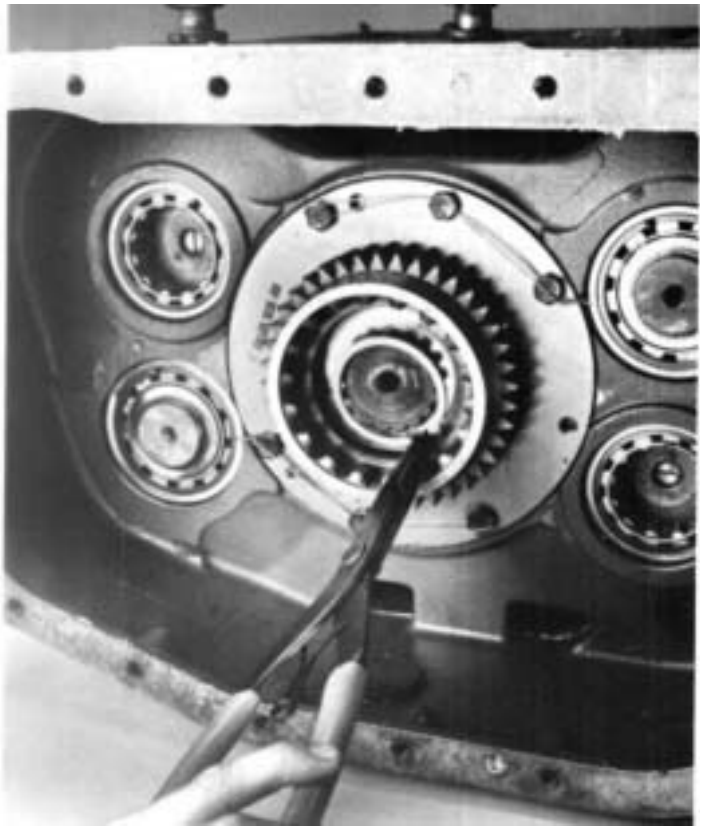
CASE ASSEMBLIES



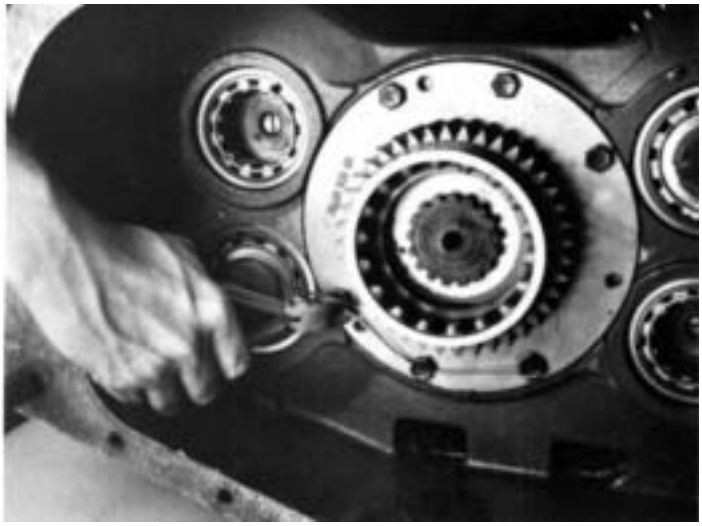
Cut 6417-9/80

***NOTE:** Use lockwire at these positions during reassembly,

B. Removal and Disassembly of Auxiliary Drive Gear Assembly



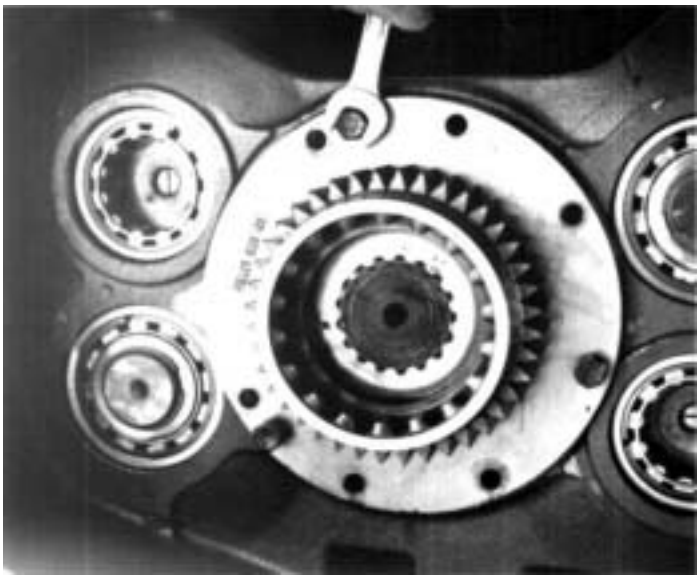
1. Remove the snap ring from groove at rear of mainshaft.



2. Cut lockwire and remove the capscrews from bearing retainer ring.

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DISASSEMBLY - FRONT SECTION



3. Insert three puller screws in the specially tapped holes of retainer ring. Tighten screws evenly to



5. Using the rear face of retainer ring as a base, press the drive gear through bearing.



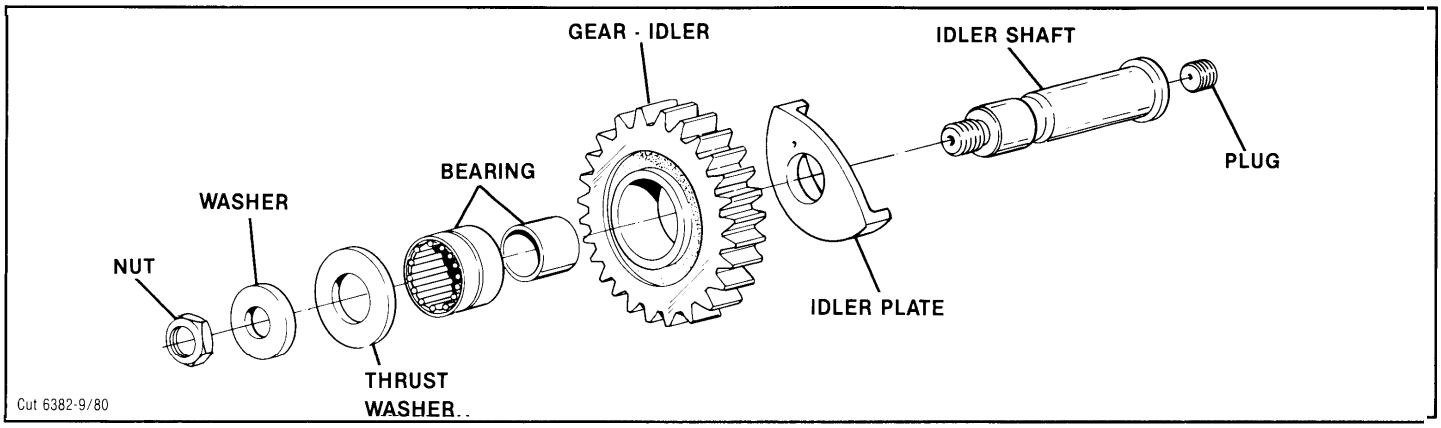
4. Remove the snap ring from hub of auxiliary drive gear.



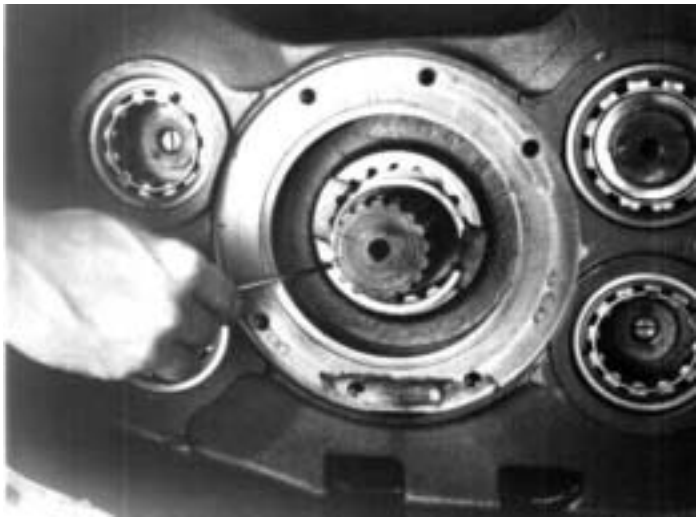
6. If necessary, remove the O-rings from hub O.D. of auxiliary drive gear.

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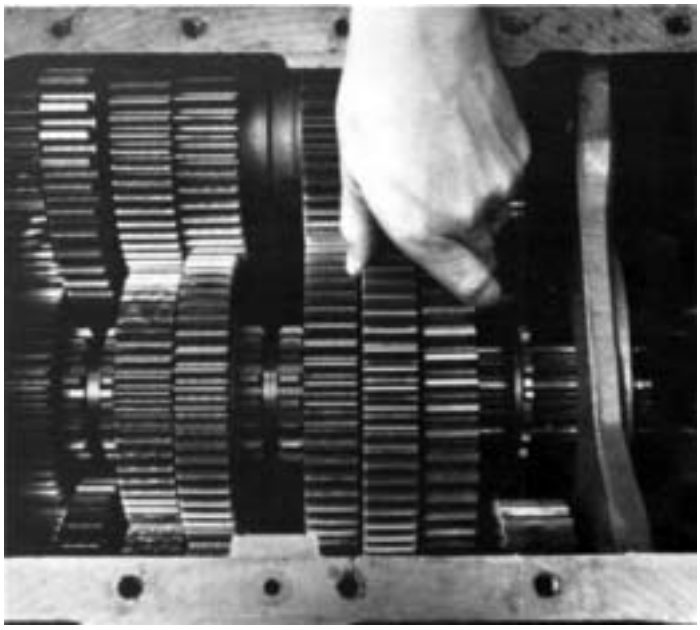
DISASSEMBLY - FRONT SECTION



C. Removal and Disassembly of Left Reverse Idler Gear Assembly



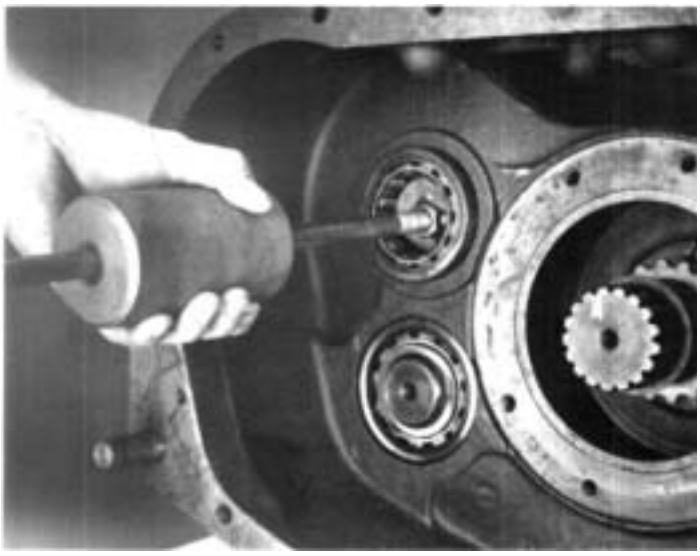
1. Move the mainshaft reverse gear as far to the rear as possible and remove the snap ring from I.D. of gear.



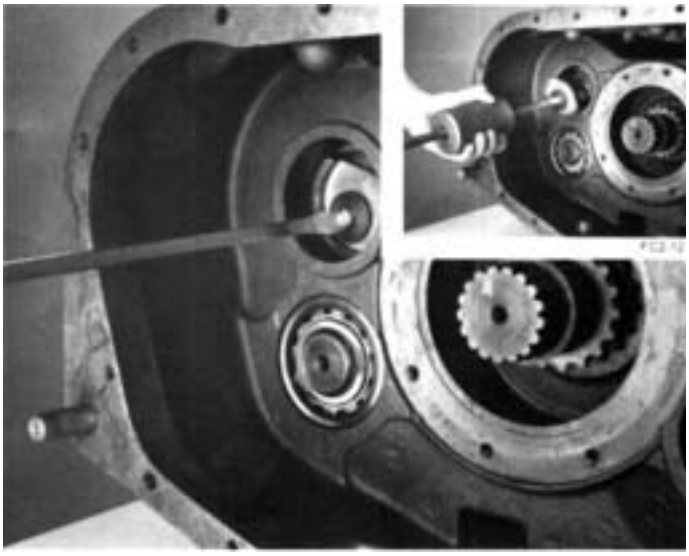
2. Move the reverse gear forward and against the LOW speed gear, engaging the splines of mainshaft sliding clutch.

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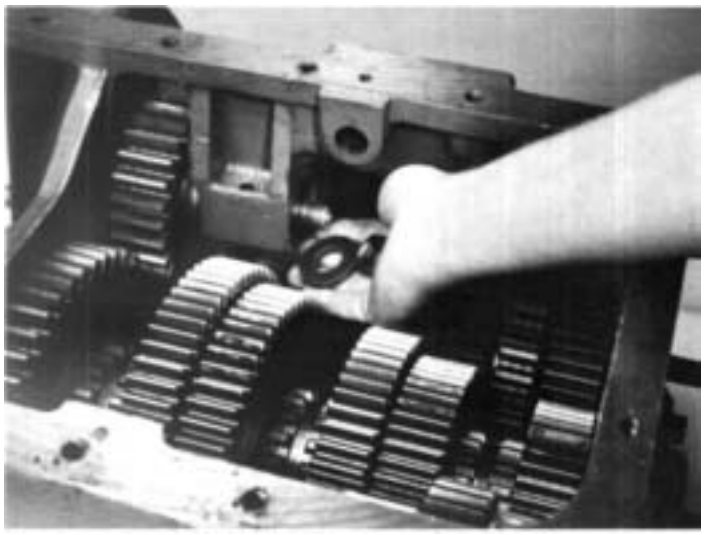
DISASSEMBLY - FRONT SECTION



3. Using jaw pullers or impace puller, remove the auxiliary countershat front bearing from left reverse idler gear bore. If necessary, repeat the procedure for removing the auxiliary countershaft front bearing from right reverse idler gear bore.



5. Remove the pipe plug from rear of idler shaft and use an impact puller, 1/2-13 threaded end, to remove shaft from case bore (inset).



4. Turn out the stop nut from front of idler shaft and remove washer.



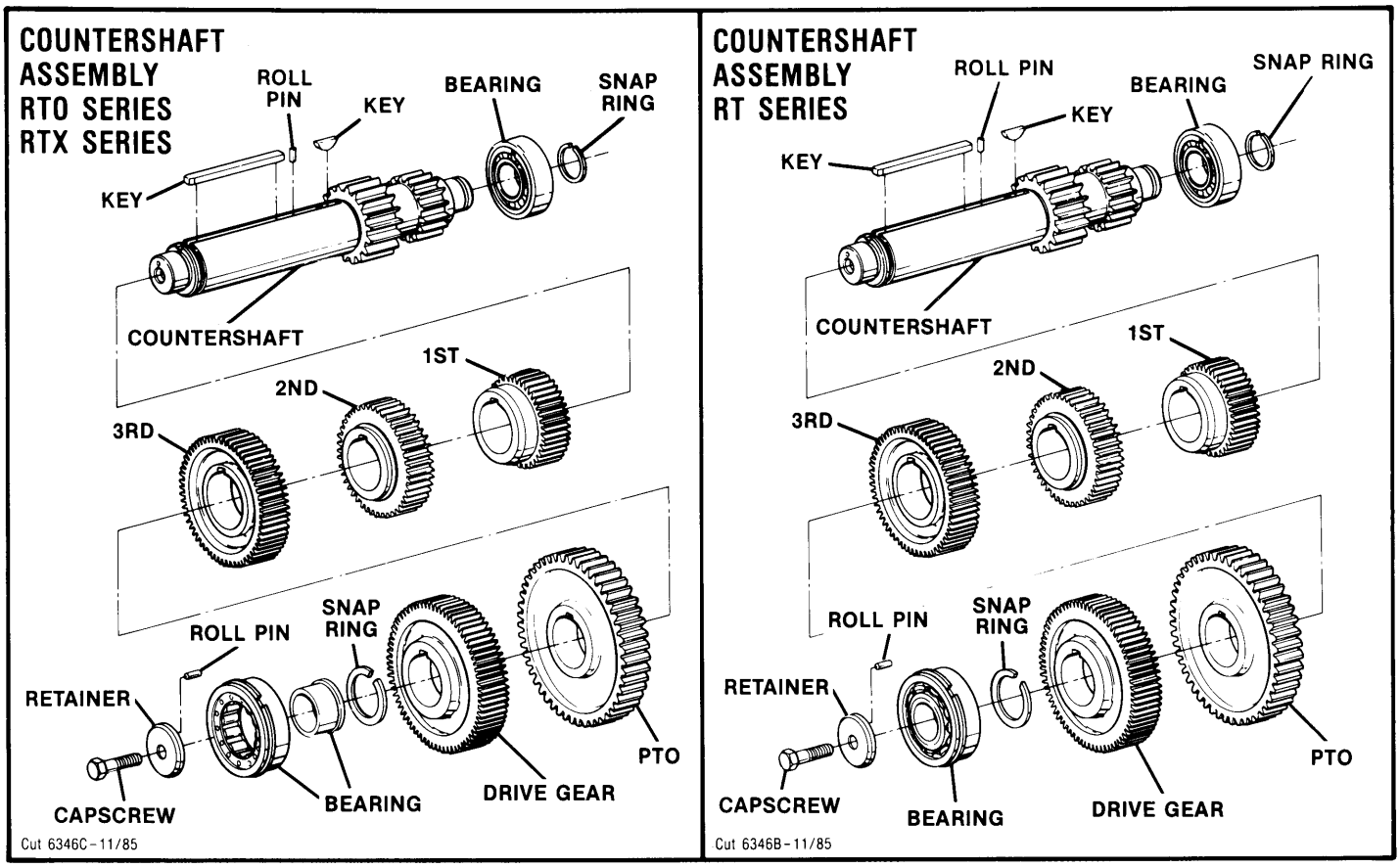
6. As the idler shaft and idler plat are moved to the rear, remove the thrust washer, and gear from case.



7. If necessary, remove the inner race from bearing and press needle bearing from idler gear.

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DISASSEMBLYÑ FRONT SECTION

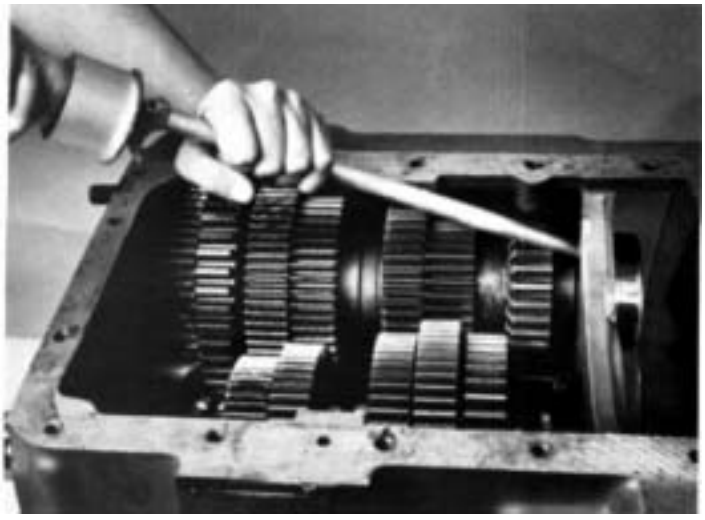


D. Removal of Countershaft Bearings

NOTE: In the following instructions, the front and rear bearings from BOTH countershaft are removed. For removal of the mainshaft assembly from case, it is necessary to remove the bearings from right countershaft ONLY.



1. Remove the snap ring from groove at rear of each countershaft.

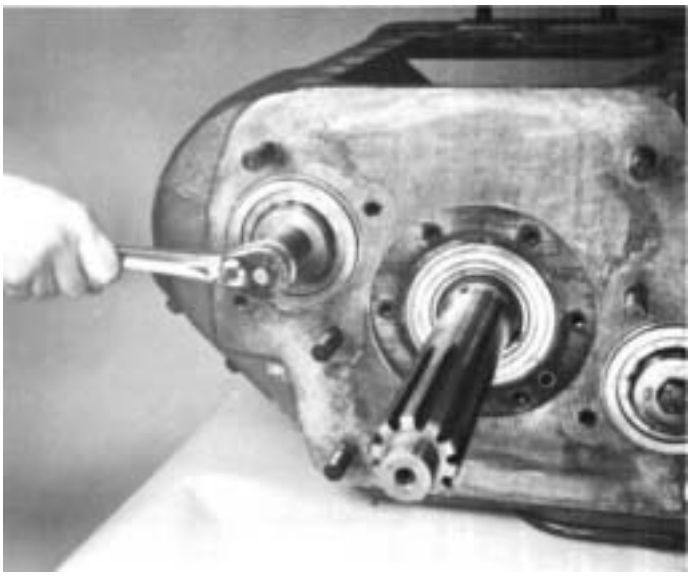


2. From inside the case, use a soft punch and maul to drive the countershaft rear bearings to the rear and from case bores.

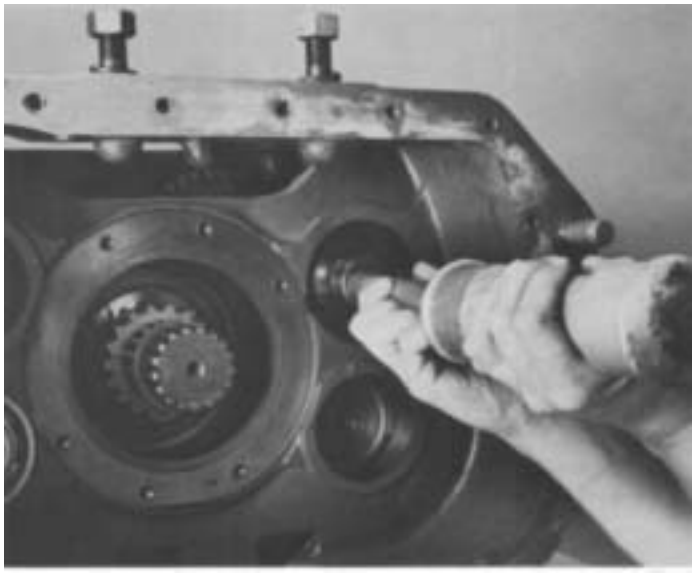
NOTE: This procedure will damage the bearings and should not be attempted unless replacement of the bearings is planned.

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DISASSEMBLY - FRONT SECTION



3. Turn out the capscrew and remove the front bearing retainer plate from each countershaft.



5. From the rear of case, use a soft bar and maul to drive each countershaft forward to unseat the front bearings from case bores and expose the bearing snap rings.



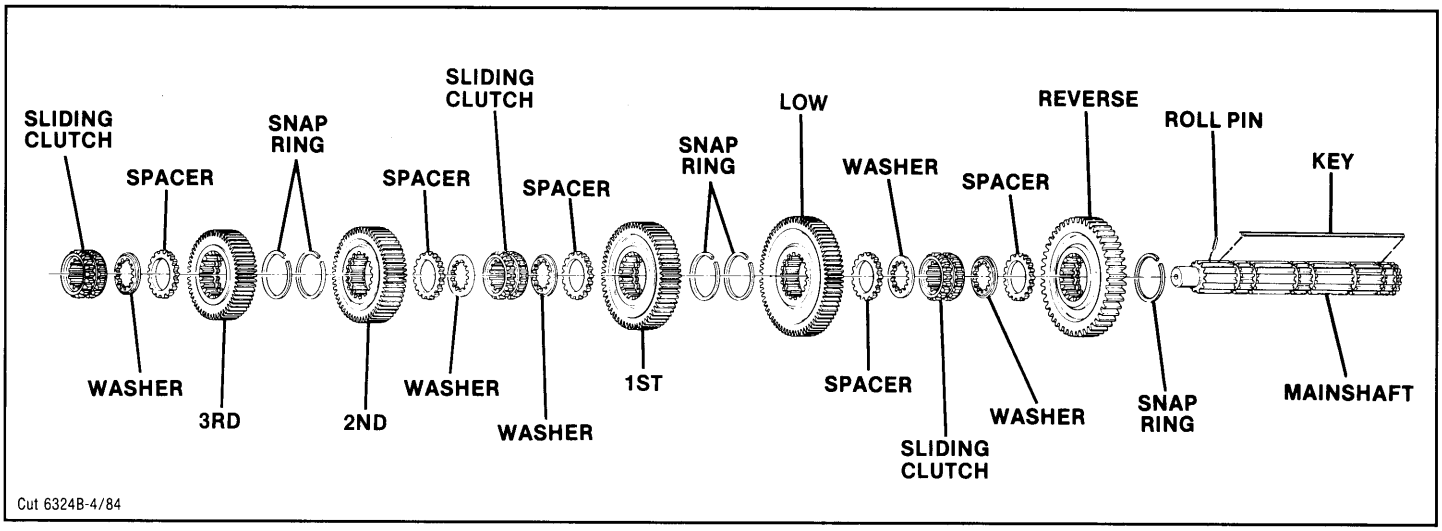
4. Use a soft bar and maul to drive each countershaft to the rear as far as possible. This will partially unseat the front bearings.
NOTE: The soft bar used should have a flattened end that is large enough so as not to damage holes for roll pin and capscrew.



6. Use a bearing puller or pry bars to remove the countershaft front bearings.
NOTE: The bearing inner race of models equipped with roller-type front bearings will remain pressed on countershaft.

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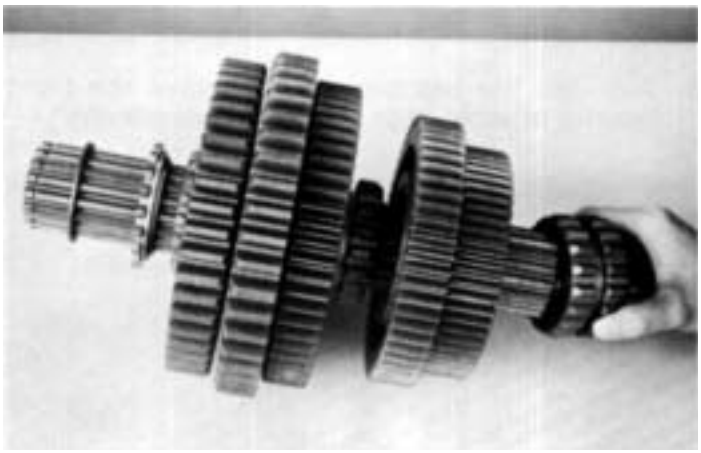
DISASSEMBLY - FRONT SECTION



E. Removal and Disassembly of Mainshaft Assembly



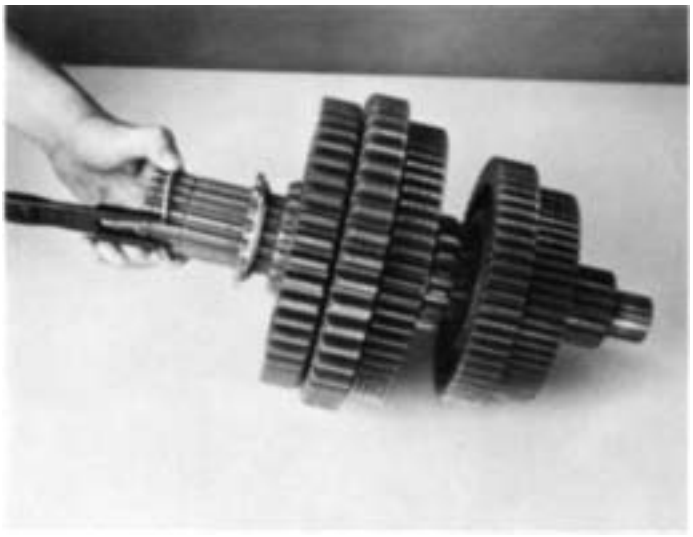
1. Block the right countershaft assembly against case wall and pull the mainshaft assembly to the rear to free pilot from pocket of input shaft. Tilt front of mainshaft up and lift the assembly from case (inset). Use caution as the reverse gear is free and can fall from shaft.



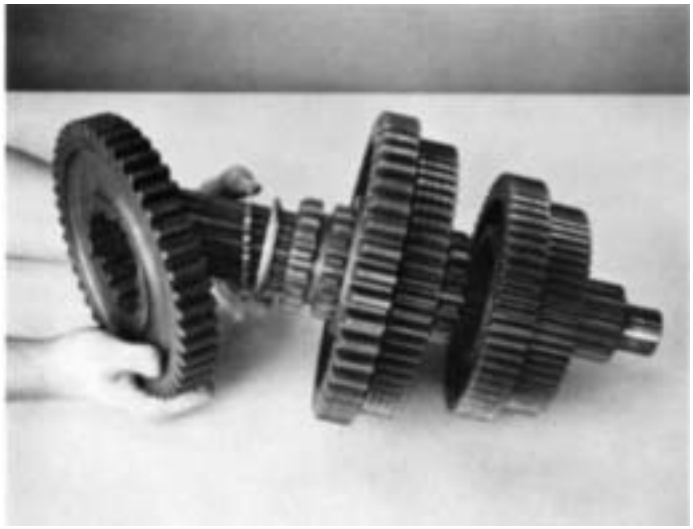
2. Remove the 3rd-4th speed sliding clutch from front of mainshaft.

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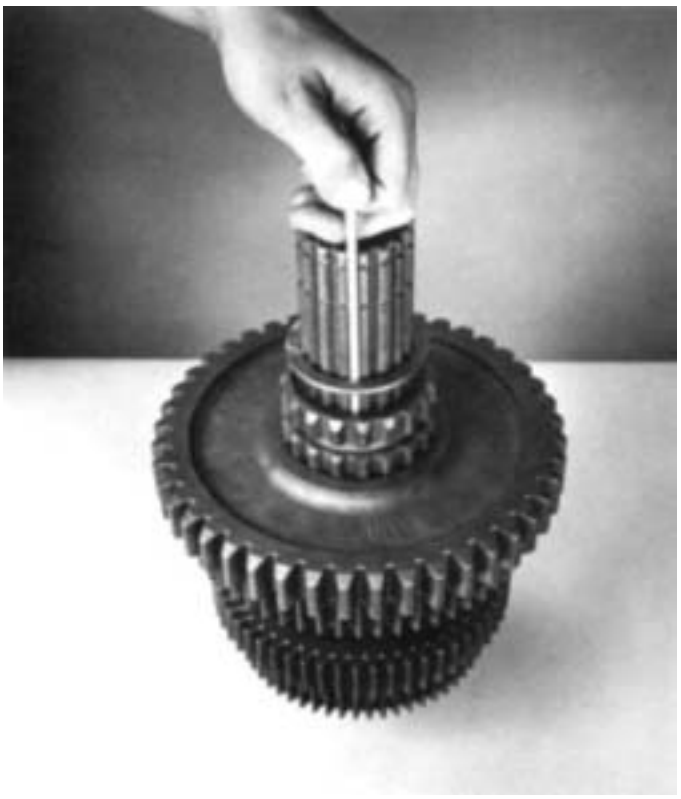
DISASSEMBLY - FRONT SECTION



3. Remove the snap ring from groove at rear of mainshaft.

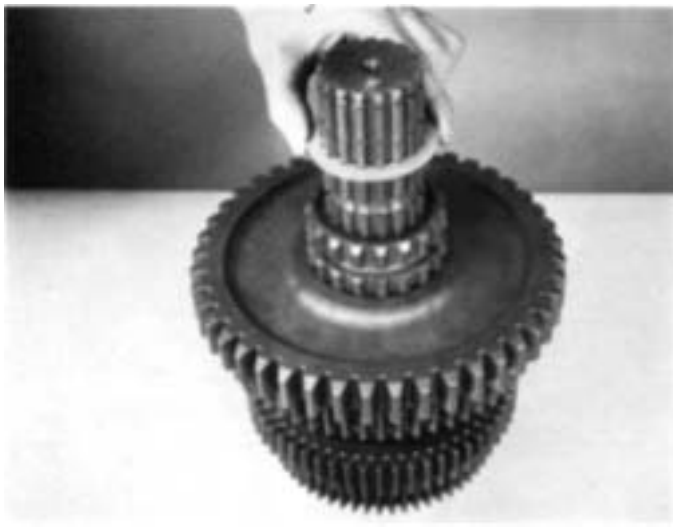


4. Remove the reverse gear and spacer from rear of mainshaft.



5. From rear of mainshaft, pull the key from mainshaft keyway.

NOTE: When removing limit washers, spacers and gears, note their location on mainshaft to facilitate reassembly. Keep the internal-splined washers and external-splined spacers with the gear from which they were removed. There is ONLY one limit washer and one spacer belonging to each gear.



6. Turn the reverse gear limit washer to align its splines with those of mainshaft and remove washer.

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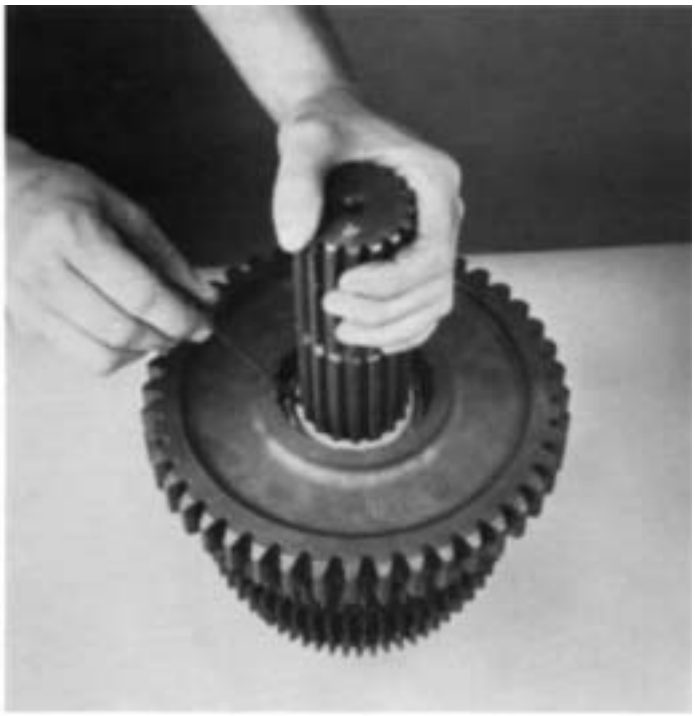
DISASSEMBLY - FRONT SECTION



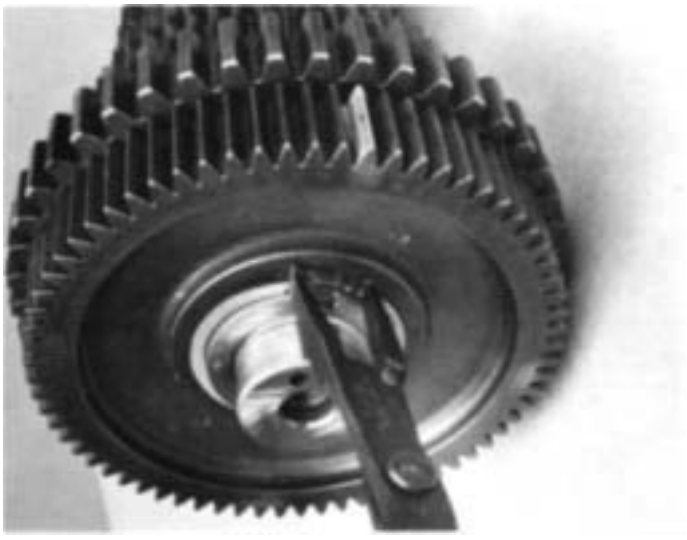
7. Remove the LO-Reverse speed sliding clutch from mainshaft.



9. Pull the LO speed gear from rear of mainshaft to remove limit washer, spacer and gear. If necessary, remove the snap ring from I.D. of gear (inset).



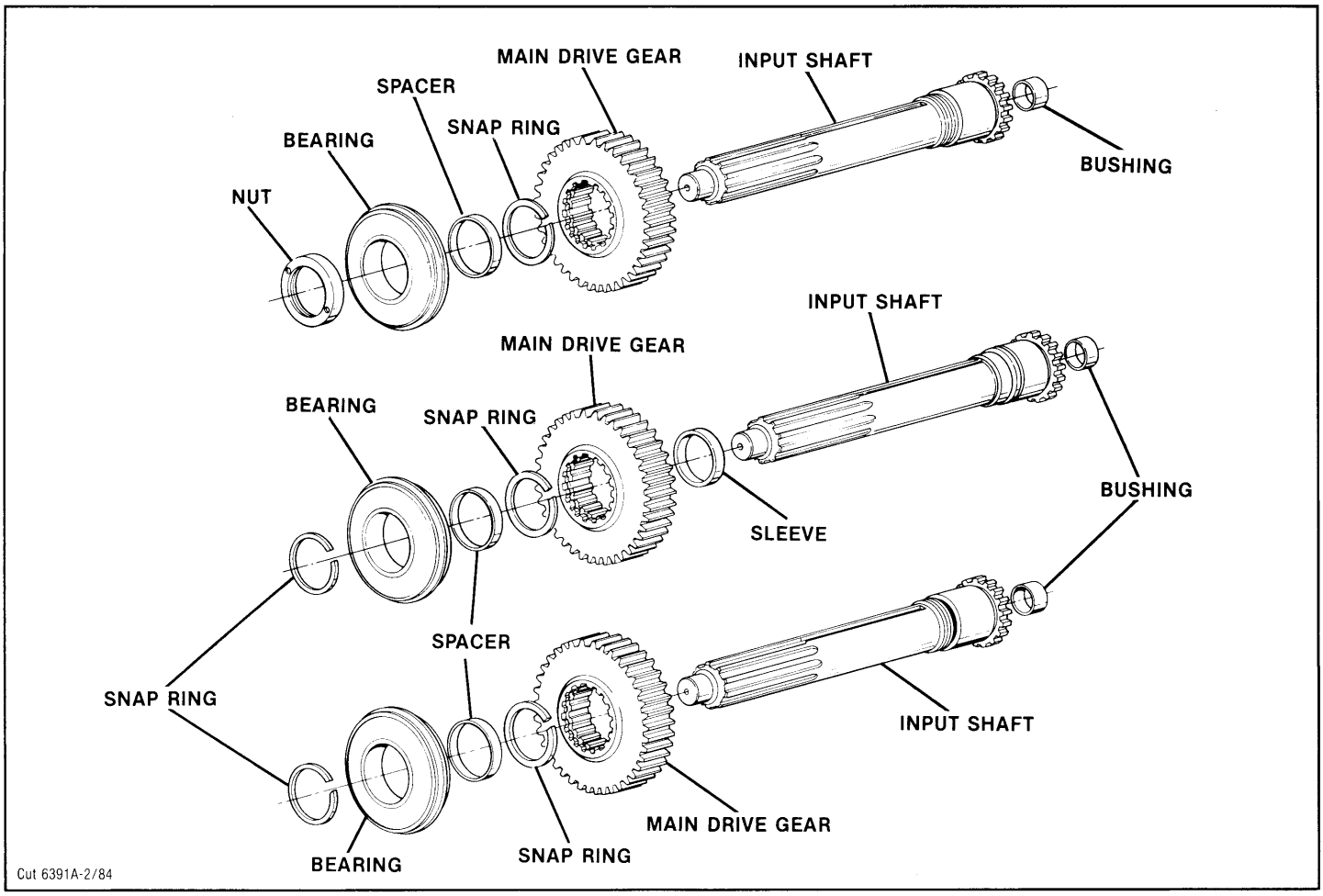
8. Using a small screwdriver, turn the limit washer in hub of LO speed gear to align its splines with those of the mainshaft.



10. Remove each remaining gear, limit washer, spacer and sliding clutch from mainshaft in the same manner previously detailed. And, if necessary, remove the snap ring from I.D. of each gear.

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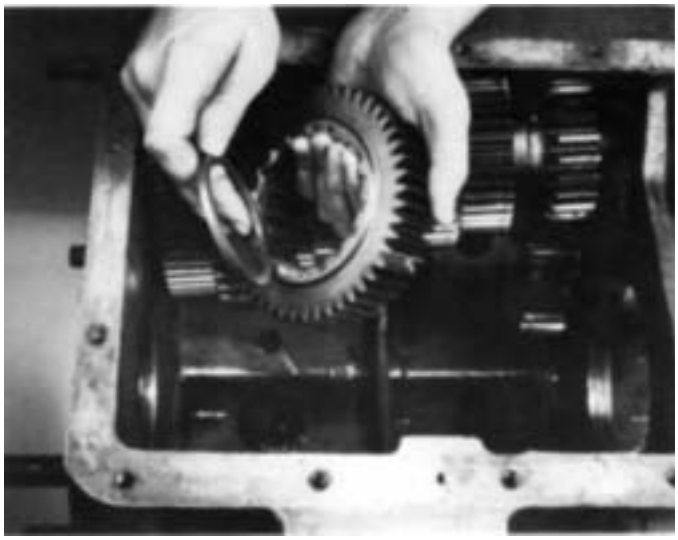
DISASSEMBLY - FRONT SECTION



F. Removal and Disassembly of Main Drive Gear Assembly



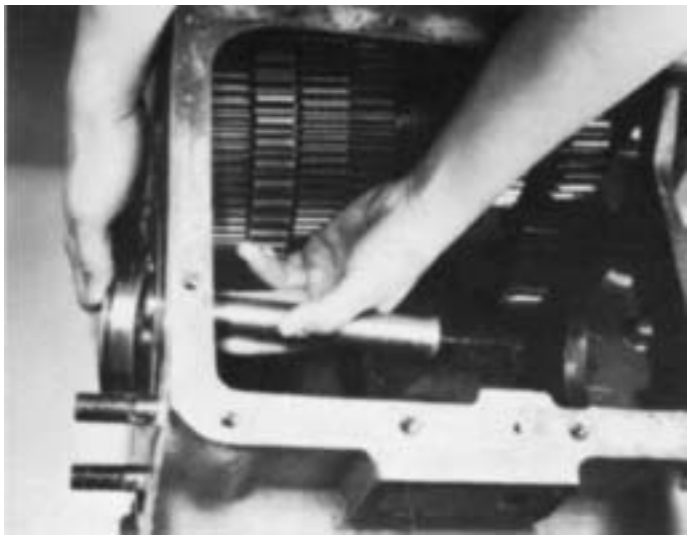
1. Drive the input shaft back through bearing with a soft bar and maul. Remove input shaft from case (inset).



2. Move upper countershaft to right and remove drive gear and spacer from case.

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DISASSEMBLY - FRONT SECTION



3. Drive the input shaft bearing out the front of case.



4. If necessary, remove the snap ring from drive gear.



5. Check the bushing in pocket of input shaft and replace if worn or damaged.

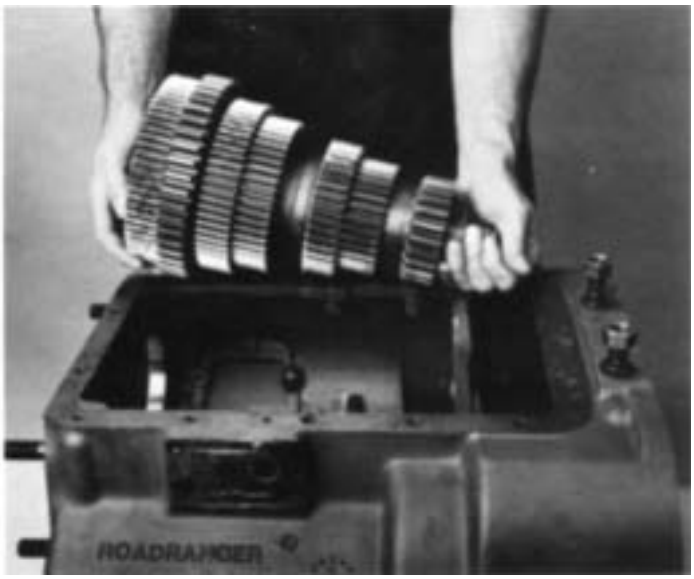
6. Remove the front and rear bearings from left countershaft as described in Part D of this section.

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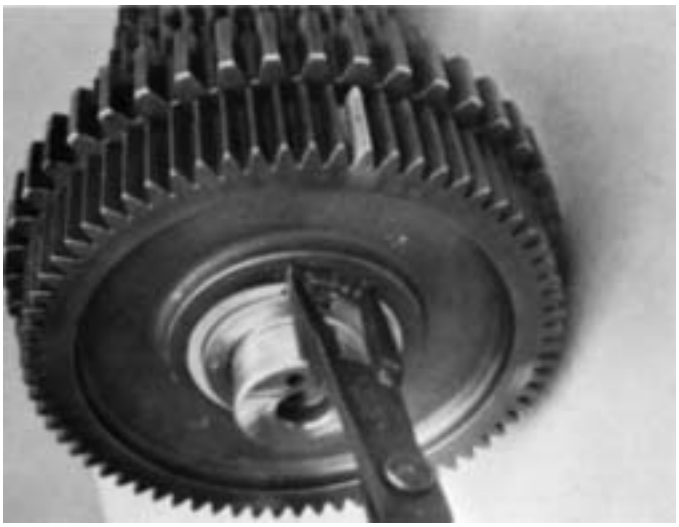
DISASSEMBLY - FRONT SECTION

G. Removal and Disassembly of

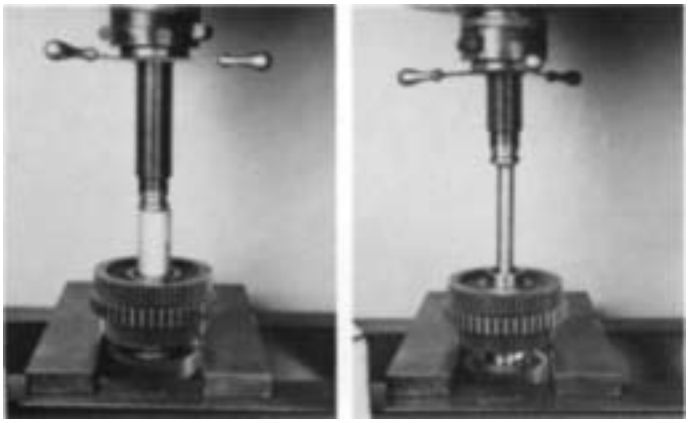
NOTE: Refer to the illustration provided at Part D of this section. Except for the PTO gears, the left and right countershaft assemblies are identical and disassembled in the same manner.



1. Move the right countershaft assembly to the rear as far as possible so front of shaft can be removed from case bore and moved to the center of case. Lift the assembly from case and repeat the procedure for left countershaft assembly.
NOTE: The left and right reverse idler gear assemblies are identical and disassembled in the same manner. If removal and disassembly of this assembly is necessary, refer to Part C of this section.



2 . Remove the drive gear retaining snap ring from front of each countershaft.



3. Using the rear face 3rd speed gear as a base, press the drive gear, PTO gear and 3rd speed (or overdrive) gear from each countershaft (left). This will also remove the front bearing inner race from countershaft of models so equipped (right).
IMPORTANT: NEVER USE THE PTO GEAR AS A PRESSING BASE. The narrow face width of this gear makes it very susceptible to breakage.



4. Using the rear face of 1st speed gear as a base, press the 2nd speed and 1st speed gears from each countershaft.
NOTE: Always use caution when pressing a cluster of gears from countershaft. It is necessary to press these gears off in a cluster of three and, then, in a cluster of two.

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DISASSEMBLY-FRONT SECTION



5. If necessary, remove the keys and roil pin from countershaft.

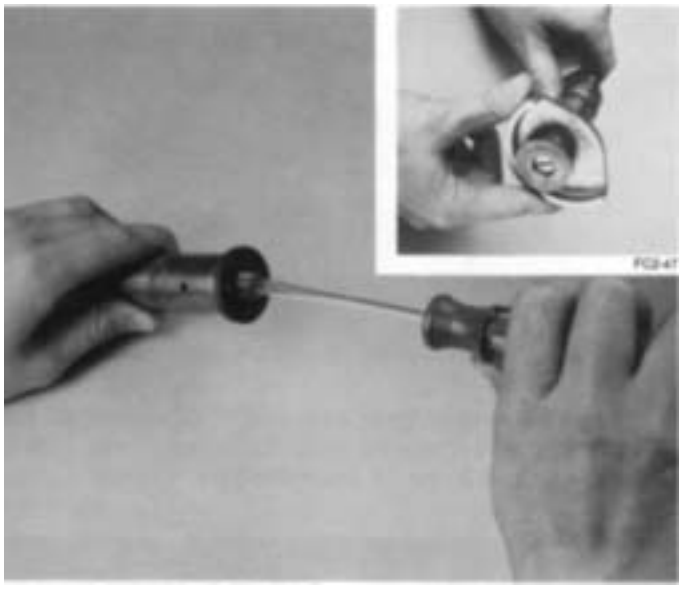
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REASSEMBLY - FRONT SECTION

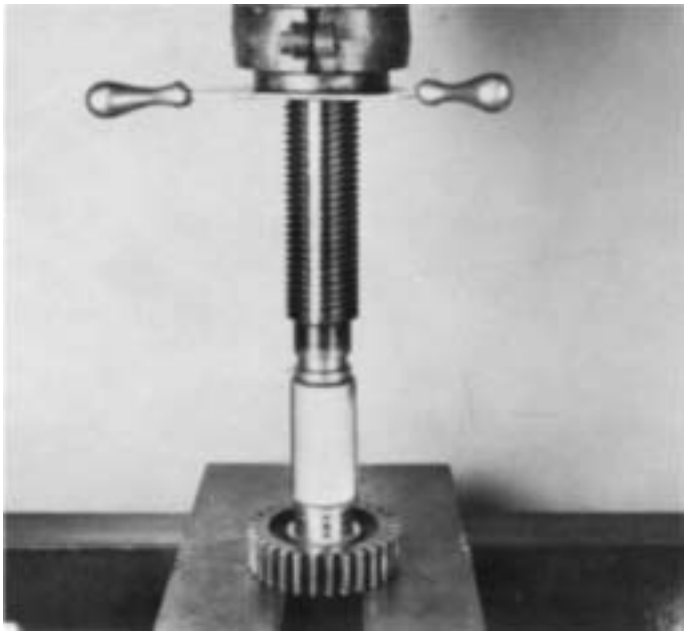
CASE ASSEMBLIES

NOTE: Before starting reassembly, make sure the three magnetic discs are solidly in place at bottom of case. These can be secured to disc mounting surfaces with Scotch Grip Rubber Adhesive or equivalent adhesive.

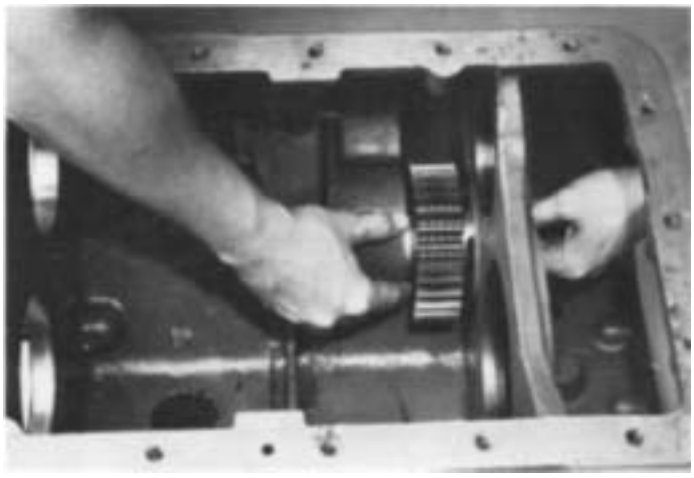
A. Reassembly and Installation of Right Reverse Idler Gear Assembly



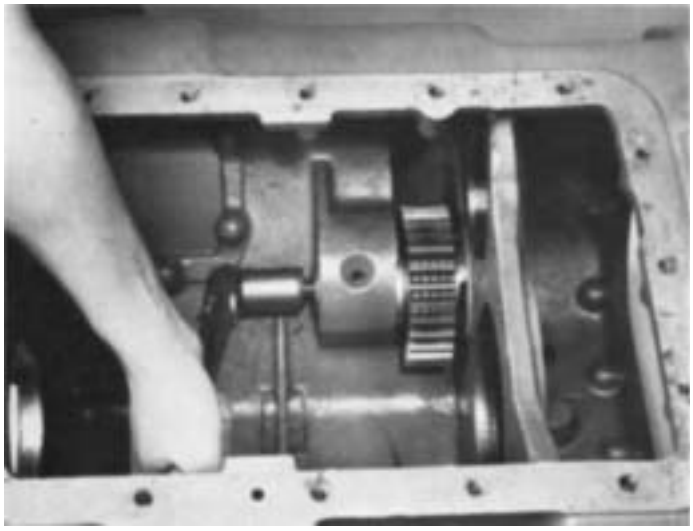
1. If previously removed, thread pipe plug in rear of reverse idler shaft and tighten. Install the idler plate on shaft, flat side to the front (inset).



2. If previously removed, press the needle bearing into bore of reverse idler gear.



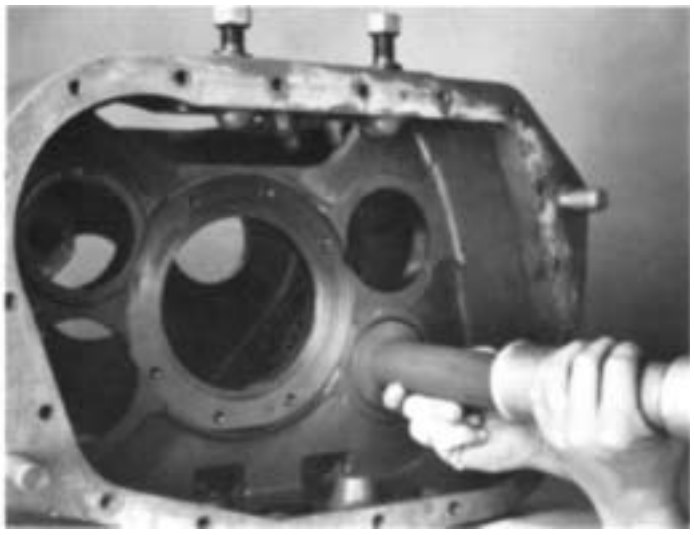
3. Install the bearing inner race on idler shaft and insert shaft into case bore, threaded-end of shaft to the front. As the idler shaft is moved forward, install the reverse idler gear on shaft, long hub to the front and seating on bearing inner race. Position the thrust washer on shaft between the gear and support boss in case and continue with movement of idler shaft forward into bore of support boss.



4. Making sure that the reverse idler shaft is seated in bore of support boss and forward as far as possible, install the washer and stop nut on front of shaft. Tighten nut to recommended torque rating.

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REASSEMBLY-FRONT SECTION



5. Install the OUTER RACE of auxiliary countershaft front bearing into case bore and against idler plate.
NOTE: The bearing INNER RACE is installed on front of auxiliary countershaft and never with outer race.

B. Reassembly of Countershaft Assemblies

NOTE: Except for the PTO gears, the left and right countershaft assemblies are identical and reassembled in the same manner.



1. If previously removed, install the roll pin and key in keyway of countershaft.



2. Align keyway of gear with key in countershaft and press the 1 st speed gear on shaft, long hub of gear to the front of countershaft.



3. Press the 2nd speed gear on countershaft, long hub of gear against 1st speed gear hub.

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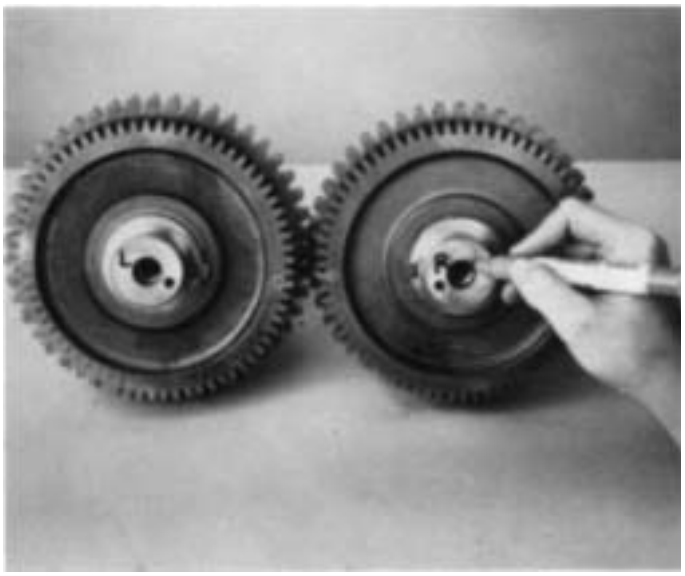
REASSEMBLY - FRONT SECTION



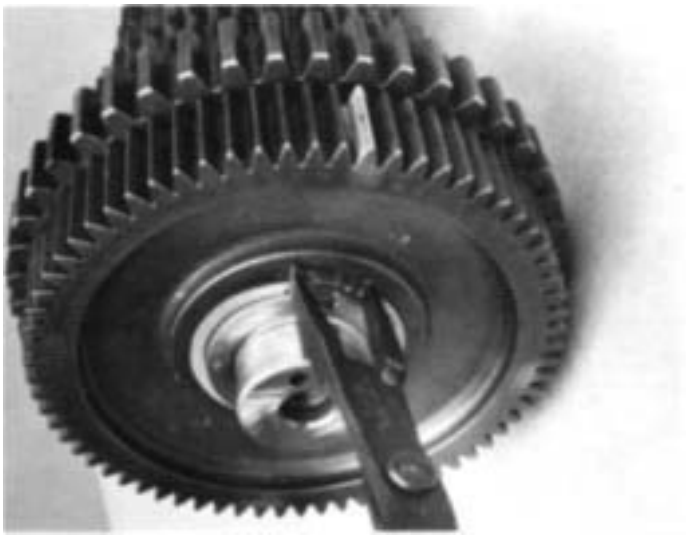
4. Press the 3rd speed (or Overdrive) gear on countershaft, long hub of gear to the front of shaft.



5. Start the PTO gear onto countershaft, bullet-nose side of teeth facing up and toward rear of shaft. Align keyway of drive gear with key in countershaft and press BOTH gears onto shaft, long hub of drive gear against PTO gear.
NOTE: The left countershaft assembly has a 47-tooth PTO gear; the right countershaft assembly has a 45-tooth PTO gear.



6. To avoid confusion during installation, mark the end of left countershaft with an "L"; the end of right countershaft with an "R".



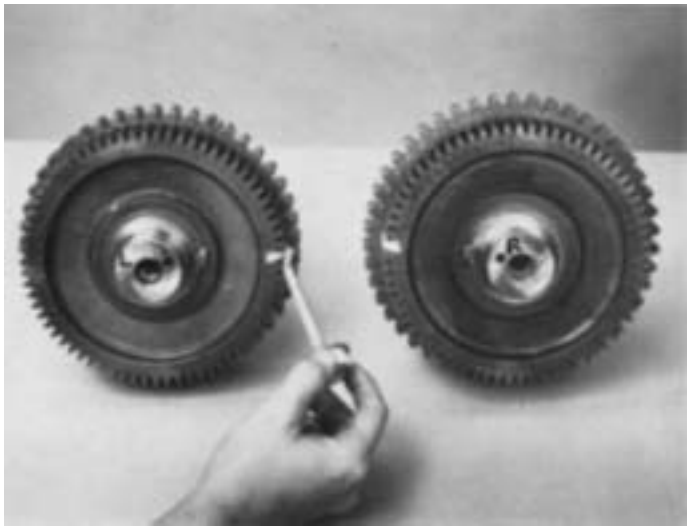
7. Install the drive gear retaining snap ring in groove on front of each countershaft.

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REASSEMBLY - FRONT SECTION

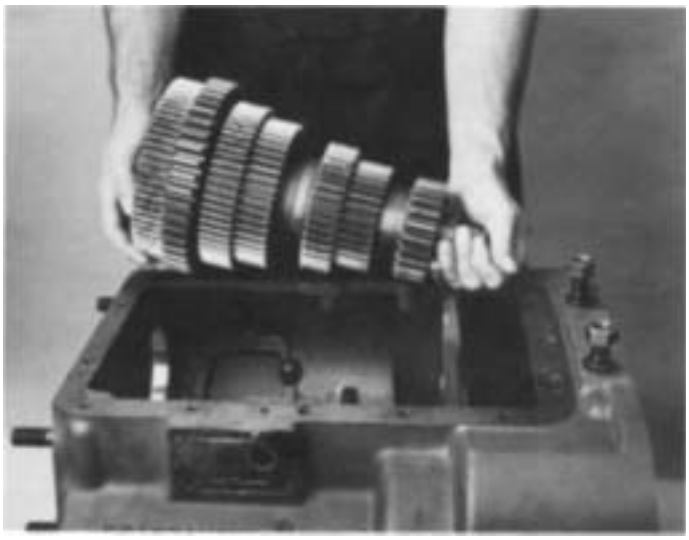


8. For models equipped with roller-type front bearings, use a rubber mallet or flanged-end driver to install bearing inner race on shaft, shoulder of race against shoulder of countershaft.



IMPORTANT: Mark the countershaft drive gear for timing purposes. On the drive gear of each countershaft assembly, mark the tooth aligned with key. way of gear and stamped with an "O" for easy identification. A highly visible color of toolmakers' dye is recommended for making timing marks.

C. Partial Installation of Countershaft Assemblies



1. Place the left countershaft assembly into position in case, making sure that the "L"-marked assembly has the larger 47-tooth PTO gear.



2. Place the right countershaft assembly into position in case, making sure that the "R"-marked assembly has the smaller 45-tooth PTO gear.

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REASSEMBLY - FRONT SECTION

D. Bearing Installation of Left Countershaft Assembly



1. Move the left countershaft assembly to the rear and insert countershaft support tool or blocking to center shaft in rear case bore.



2. Use a flanged-end bearing driver to start the bearing in case bore.
NOTE: The inner race of roller-type front bearing is pressed on front of countershaft.



3. Center the front of left countershaft in bearing and move the assembly forward.



4. Use a flanged-end bearing driver to completely seat front bearing or bearing outer race in case bore.

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REASSEMBLY - FRONT SECTION



5. Position the retainer plate on front of left countershaft, roll pin in hole at end of shaft, and secure with capscrew tightening to recommended torque ratings.



6. Remove countershaft support tool or blocking from rear case bore and install the left countershaft rear bearing with larger I.D. lead chamfer to the front of shaft and install the snap ring in groove at rear of left countershaft.

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REASSEMBLY - FRONT SECTION

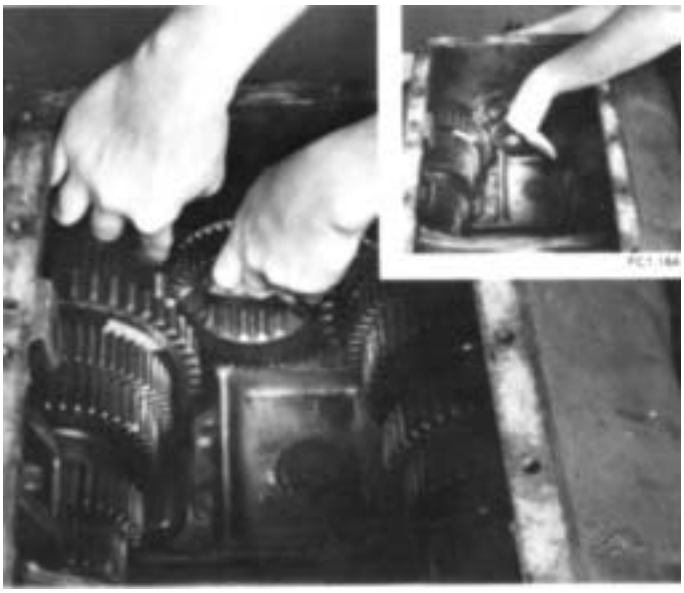
E. Reassembly, Installation and Timing of Main Drive Gear Assembly



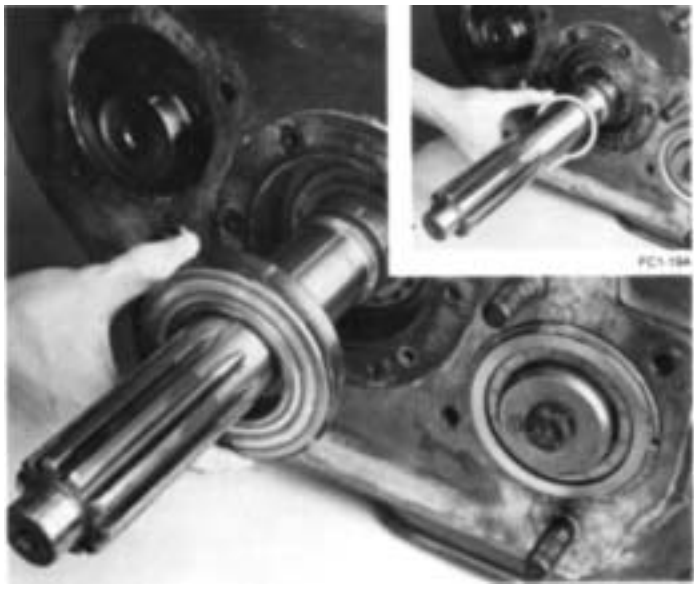
1. If previously removed, install the snap ring in I.D. of main drive gear and the bushing in pocket of input shaft (inset).



2. Mark the main drive gear for timing purposes. Mark any two adjacent teeth on drive gear and repeat the procedure for the two adjacent teeth directly opposite the first set marked. A highly visible color of toolmakers' dye is recommended for making timing marks.



3. Mesh the marked tooth of left countershaft drive gear with either set of two marked teeth on main drive gear. Slide the input shaft through the main drive gear (inset).



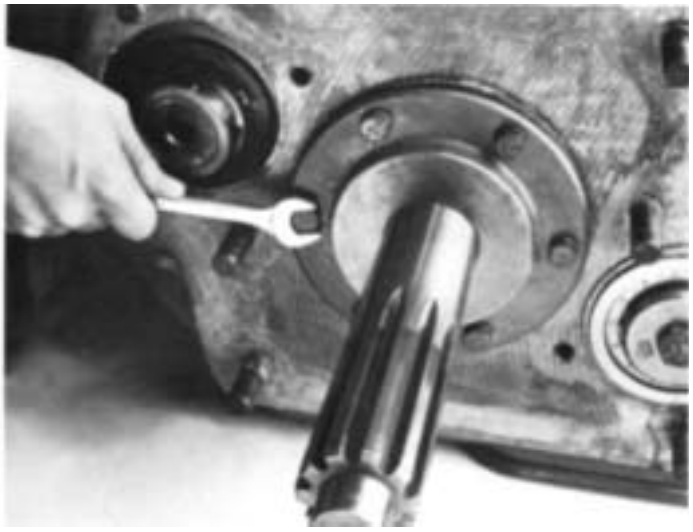
4. Install spacer (inset) and bearing on the input shaft with external snap ring to the outside.

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REASSEMBLY - FRONT SECTION



5. Tap the bearing into position in the bore with a soft mallet.



6. Temporarily install the front bearing cover,



7. Use a soft bar and maul to drive the input shaft through bearing. Remove front bearing cover.

F. Reassembly of Auxiliary Drive Gear Assembly

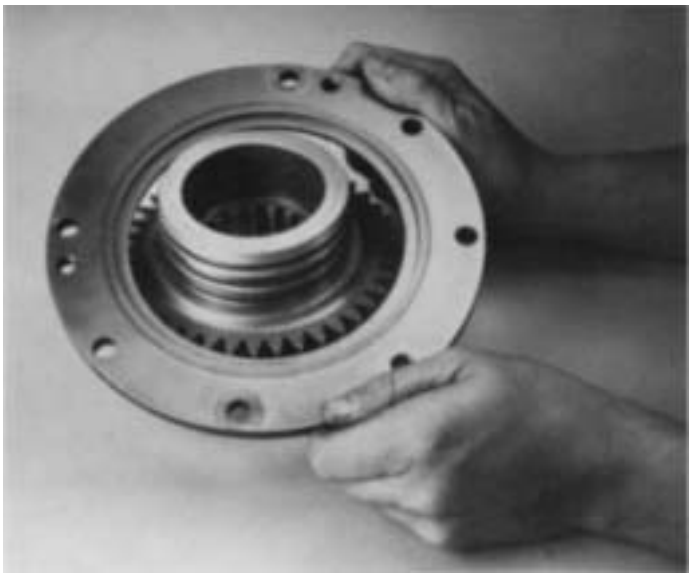
NOTE: Because the auxiliary drive gear assembly is used in checking reverse gear axial clearances and centering mainshaft in rear bearing bore during Reassembly and Partial Installation of Mainshaft Assembly, it is necessary to complete the following instructions BEFORE proceeding to Part G.



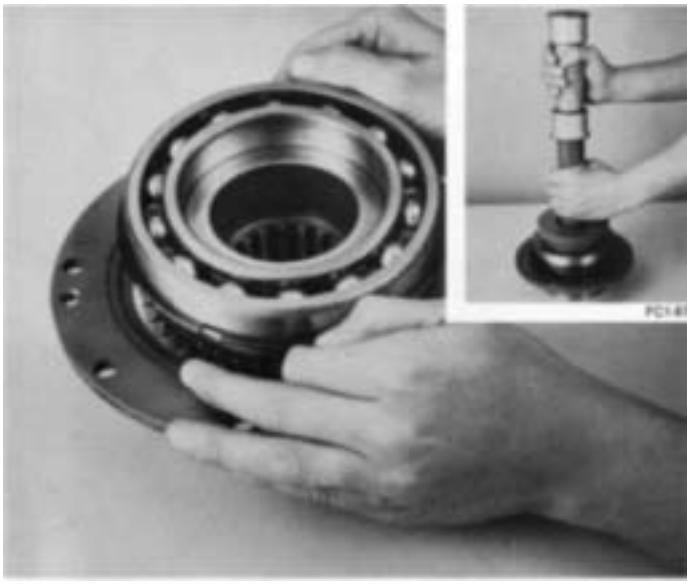
1. If previously removed, install the O-rings on extended front hub of auxiliary drive gear.

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REASSEMBLY - FRONT SECTION



2. Install the retainer ring on auxiliary drive gear, snap ring groove facing front hub and away from gear teeth.



3. Start the auxiliary drive gear bearing on front hub, bearing snap ring facing groove in retainer ring. Using both the inner and outer race of bearing as a base, press the bearing on gear with snap ring in groove of retainer ring or use a bearing driver (inset).



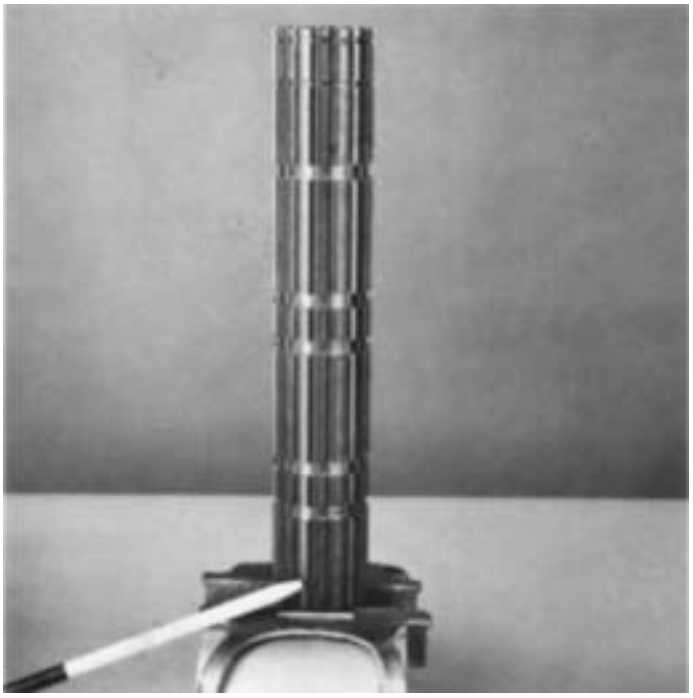
4. Install the snap ring in groove of front gear hub to retain bearing.

G. Reassembly and Partial Installation of Mainshaft Assembly

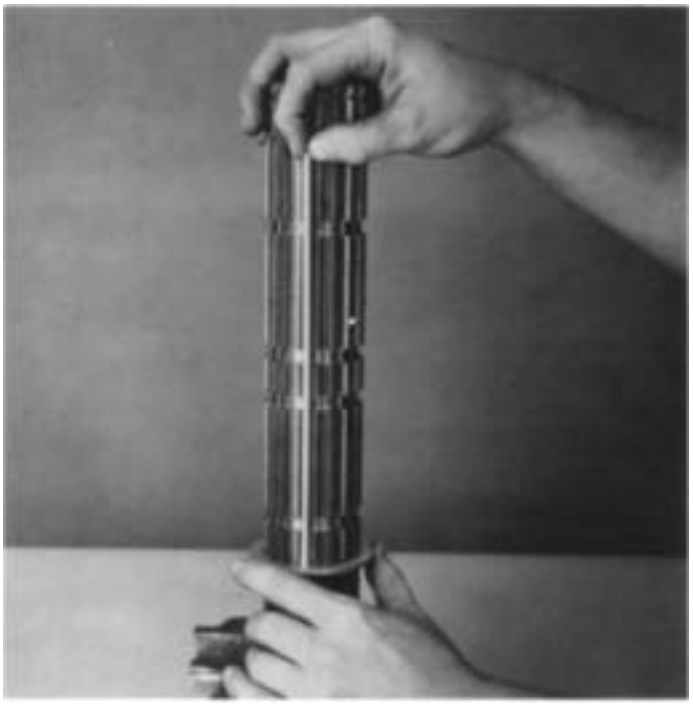
1. If previously removed, install the corresponding snap rings in I.D. of mainshaft gears.

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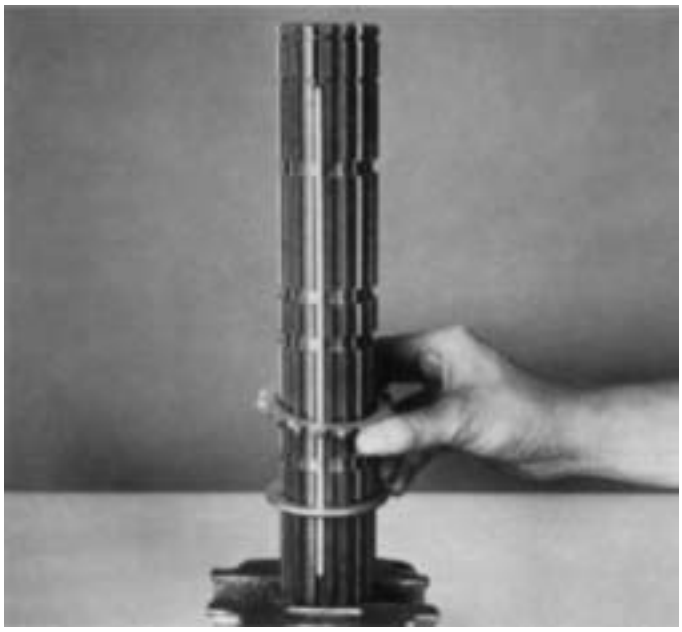
REASSEMBLY - FRONT SECTION



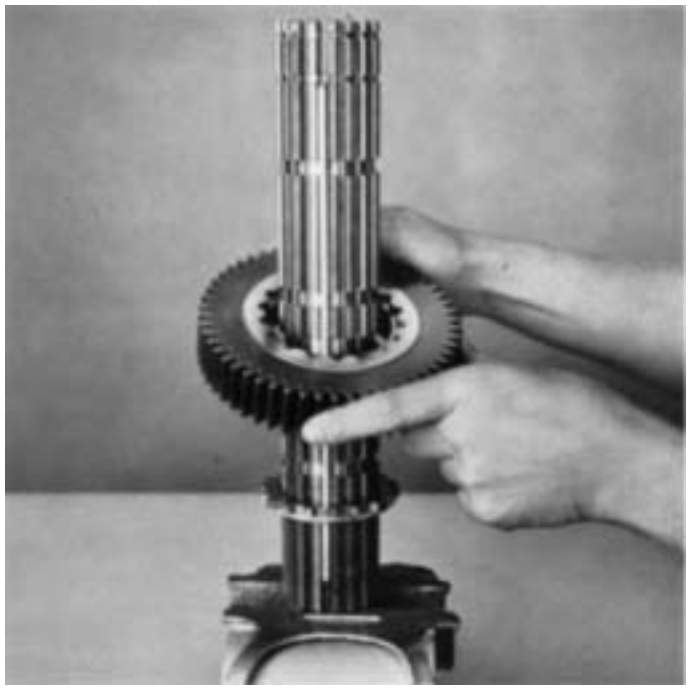
2. Secure the mainshaft in a vise equipped with brass jaws or wood blocks, pilot-end of shaft down. If previously removed, install the roll pin in keyway.



3. Install the 3rd speed gear limit washer on mainshaft, flat side of washer up. Rotate washer in the 1st or bottom groove of mainshaft to align the splines of washer with those of the mainshaft. install the key in mainshaft keyway to lock washer in place.



4. Install the spacer on shaft against washer.

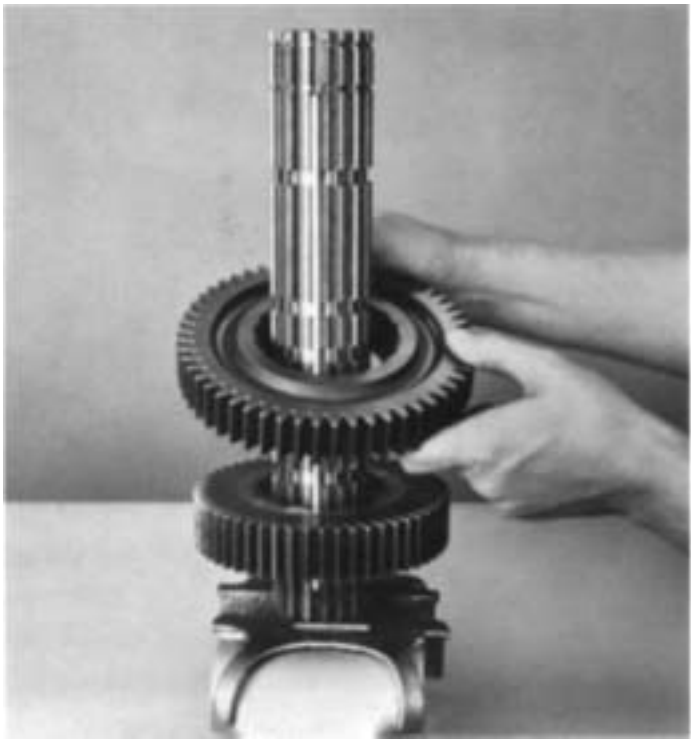


5. Install the 3rd speed (or Overdrive) gear on mainshaft, clutching teeth down and engaged with external splines of spacer.

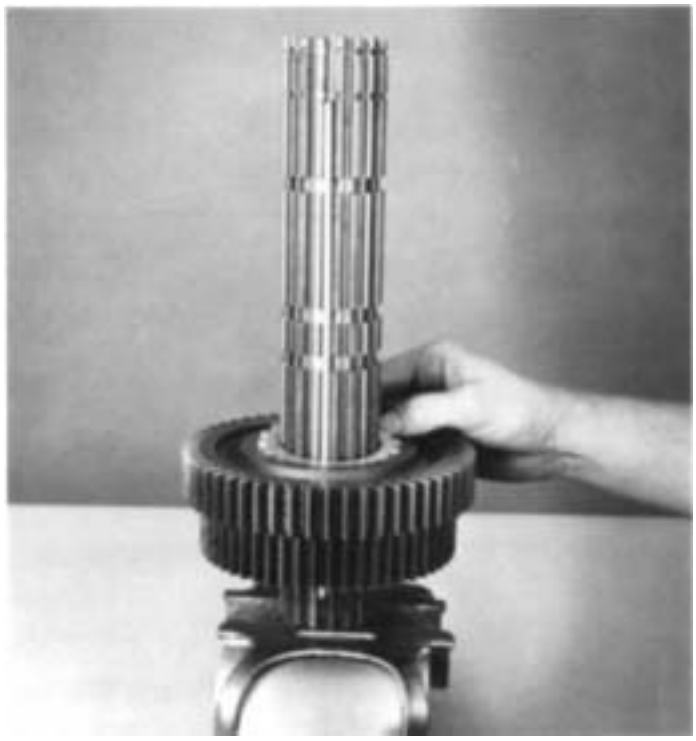
NOTE: Gear limit washers are internally splined and locked to mainshaft by the key. Gear spacers are externally splined to engage with clutching teeth in gear hubs. There is one limit washer and one spacer for each gear in the mainshaft assembly.

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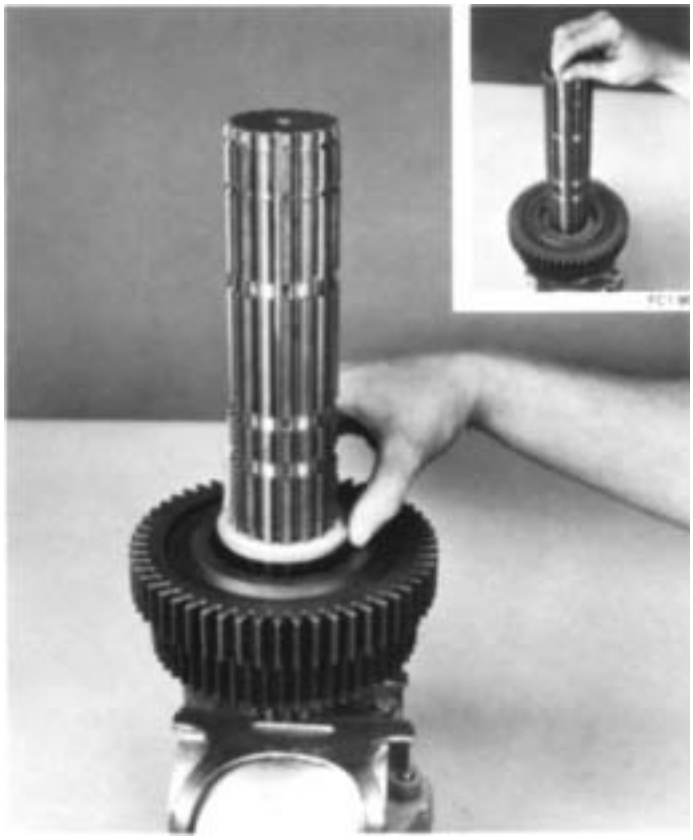
REASSEMBLY - FRONT SECTION



6. Install the 2nd speed gear on shaft against 3rd speed (or Overdrive) gear, clutching teeth up.



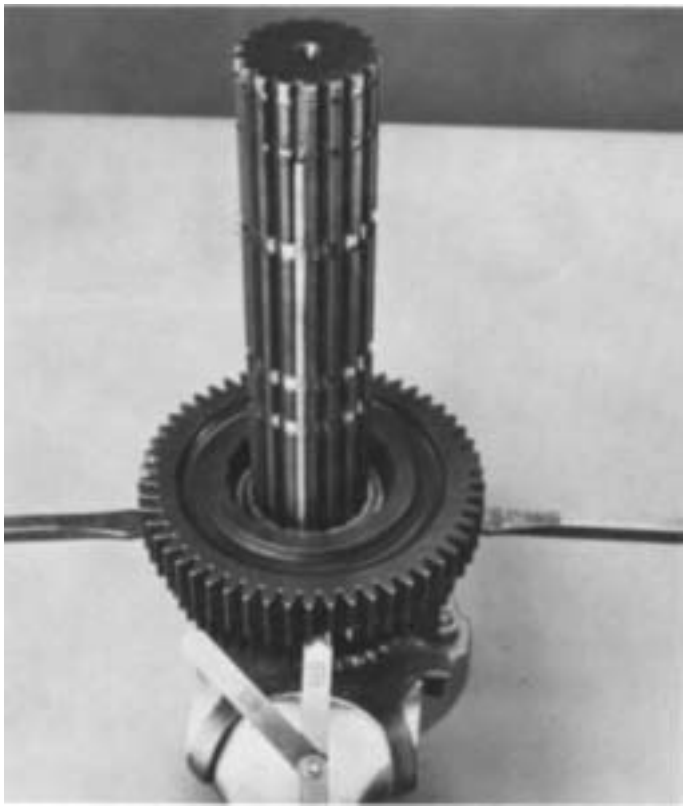
7. Install the spacer in 2nd speed gear, engaging the external splines of spacer with clutching teeth of gear.



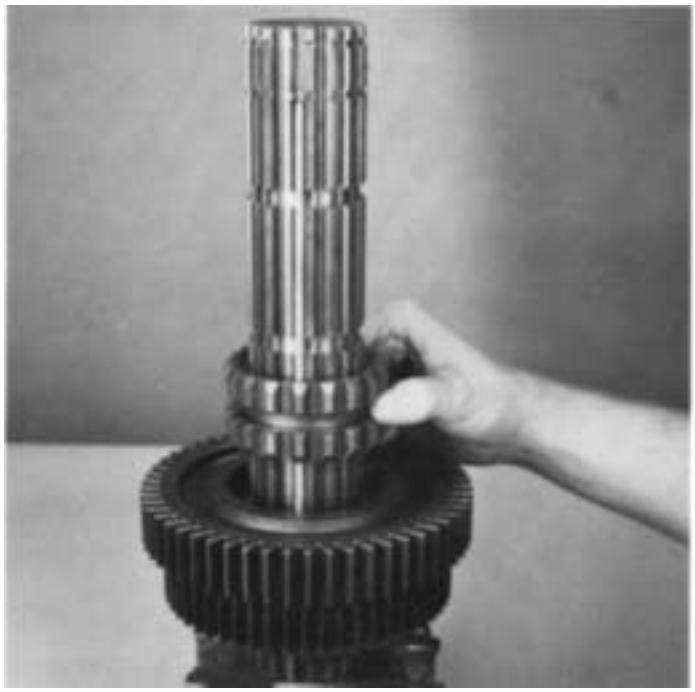
8. Remove the key from keyway and install the 2nd speed gear limit washer on mainshaft, flat side of washer down and against spacer. Rotate washer in the 2nd groove of mainshaft to align the splnes of washer with those of the mainshaft and reinsert key in keyway to lock washer in place (inset).

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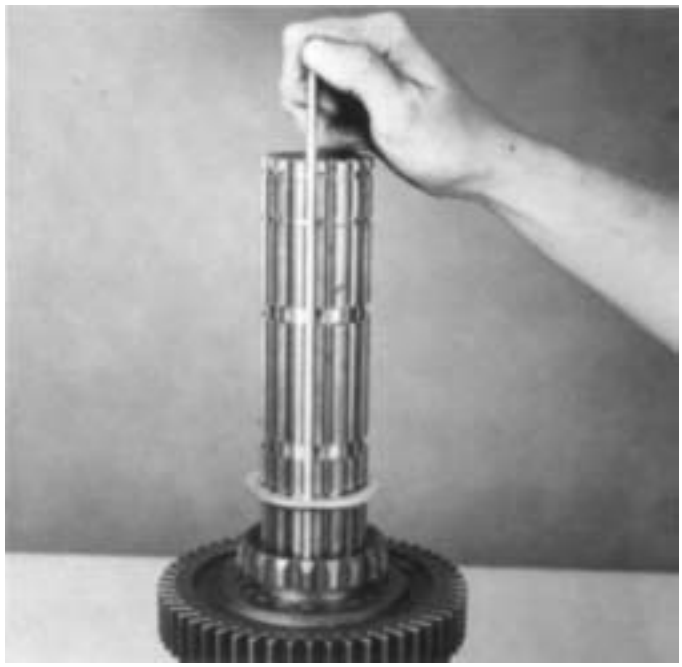
REASSEMBLY - FRONT SECTION



9. Insert two large screwdrivers between the 2nd and 3rd speed (or Overdrive) gears to check axial clearances. Apply slight downward pressure on screwdriver handles to spread gears evenly. Making sure the gear hubs are parallel, insert a feeler gage between hubs. Correct axial clearance should be from .005" to .012". If the clearance is less than the minimum .005" tolerance, the limit washer in the 2nd speed gear should be replaced by a thinner limit washer. This will increase the axial clearance between the gears. If the clearance checked is greater than the maximum .012" tolerance, a thicker limit washer should be installed in the 2nd speed gear. This would decrease the axial clearance between the gears.



10. Install the 1st-2nd speed sliding clutch, aligning the missing internal spline of sliding clutch with key in mainshaft.



11. Remove the key from keyway and install the 1st speed gear limit washer on mainshaft, flat side of washer up. Rotate washer in the 2nd groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place.

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REASSEMBLY—FRONT SECTION

SETTING CORRECT AXIAL CLEARANCES FOR MAINSHAFT GEARS

Axial Clearance (End-Play) Limits Are:
.005'' -,012" for all mainshaft gears

Washers are used to obtain the correct limits; six thicknesses are available as follows:

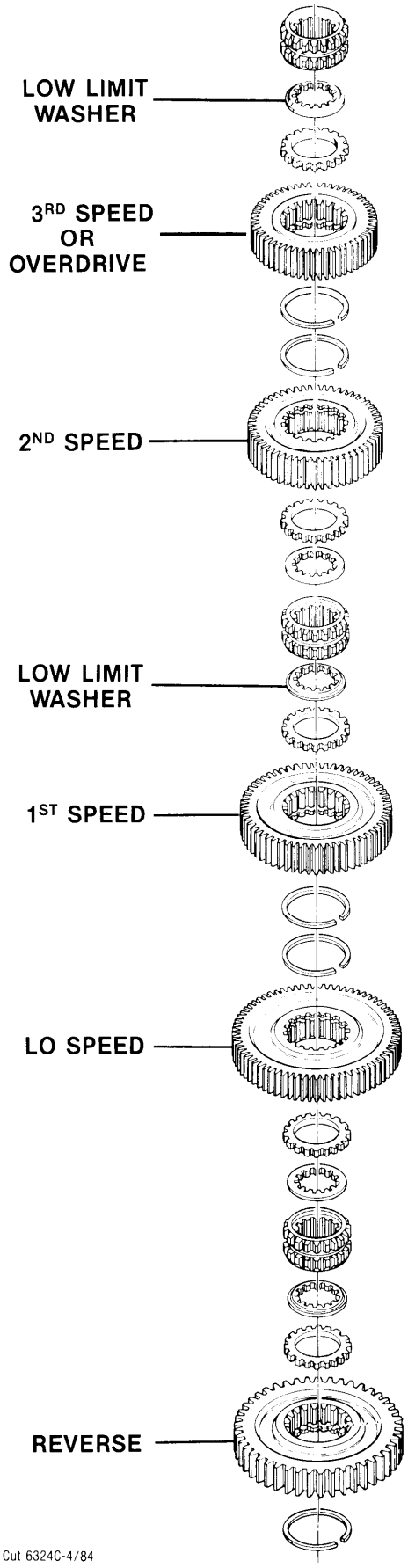
LIMITS (INCH)	COLOR CODE
.248 -.250	WHITE
.253 -.255	GREEN
.258 -.260	ORANGE
.263 -.265	PURPLE
.268-.270	YELLOW
.273 -.275	BLACK
*	"PLUS RED"

***NOTE:** New style limit washers come in a full range of tolerances as corresponding colors listed above "plus red." (Example: "Orange plus red" limit washer has an inch limit thickness of .258 -.260.)

Refer to Illustrated Parts Lists for washer part numbers.

Always use the .248-.250" low limit washer ('(White" or "white plus red") in the 1st and 3rd speed gear Dositions as' shown at right.

IMPORTANT: REFER TO THE APPROPRIATE iLLUSTRATED PARTS LIST (SPECIFIED BY MODEL SERIES) TO ENSURE THAT PROPER PARTS ARE USED DURING REASSEMBLY OF THE TRANSMISSION.



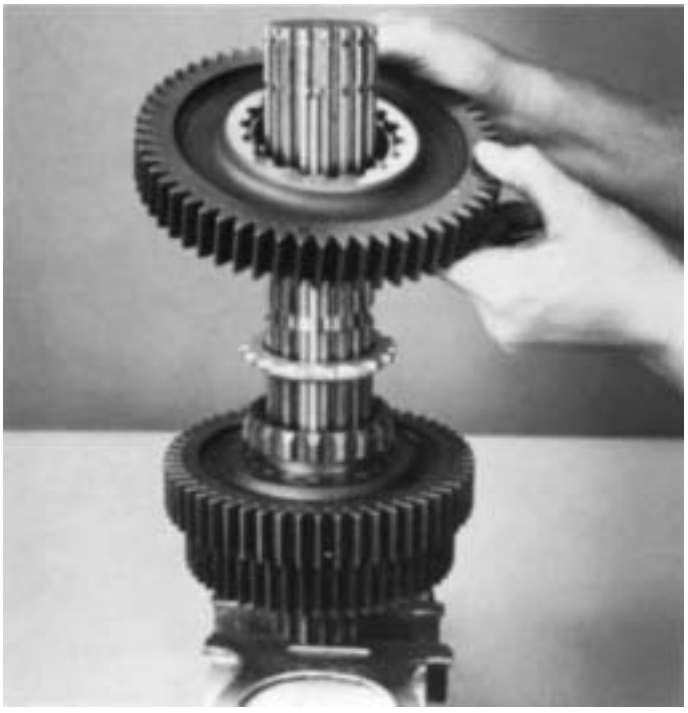
Cut 6324C-4/84

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REASSEMBLY - FRONT SECTION



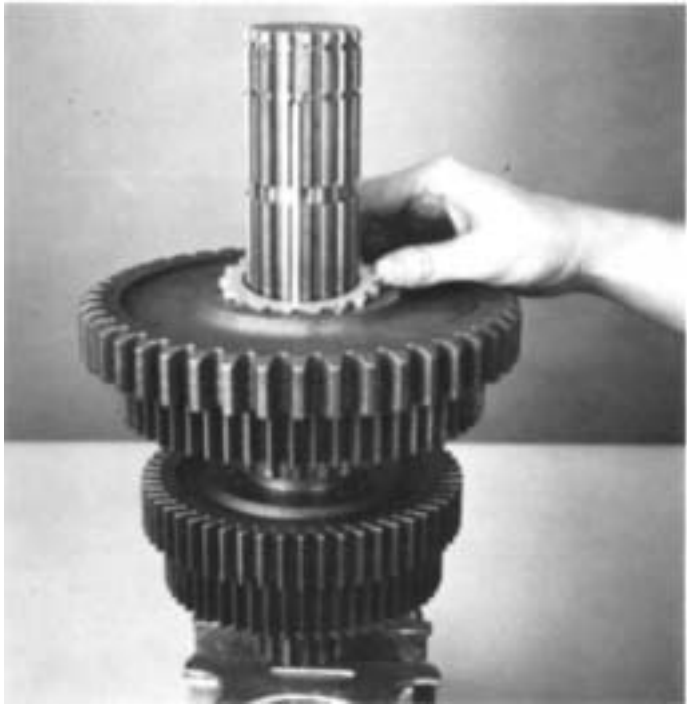
12. Install the spacer on shaft against washer.



13. Install the 1st speed gear on mainshaft, clutching teeth down and engaged with external splines of spacer.



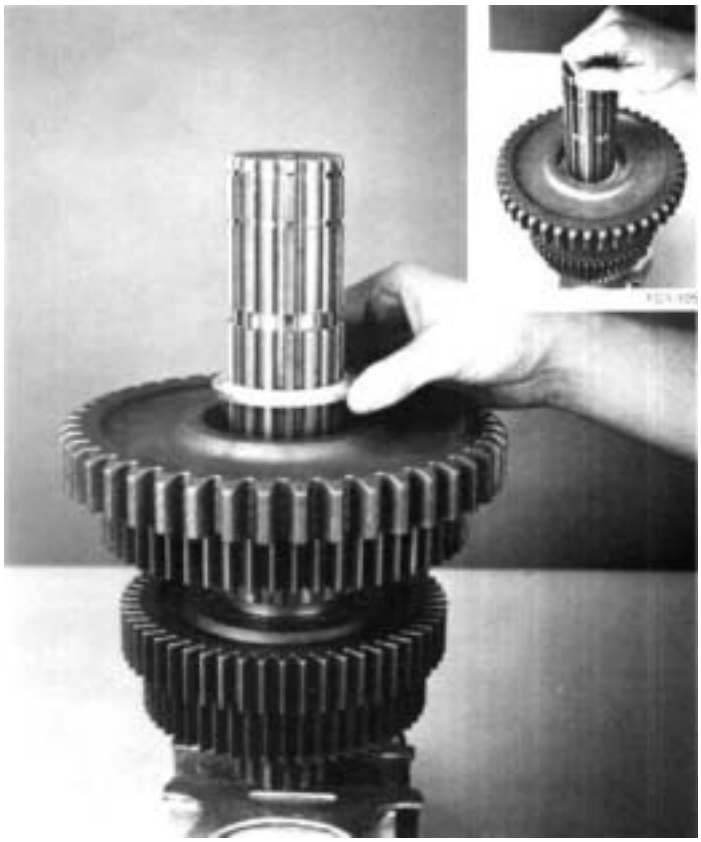
14. Install the LO speed gear on shaft against 1st speed gear, clutching teeth up.



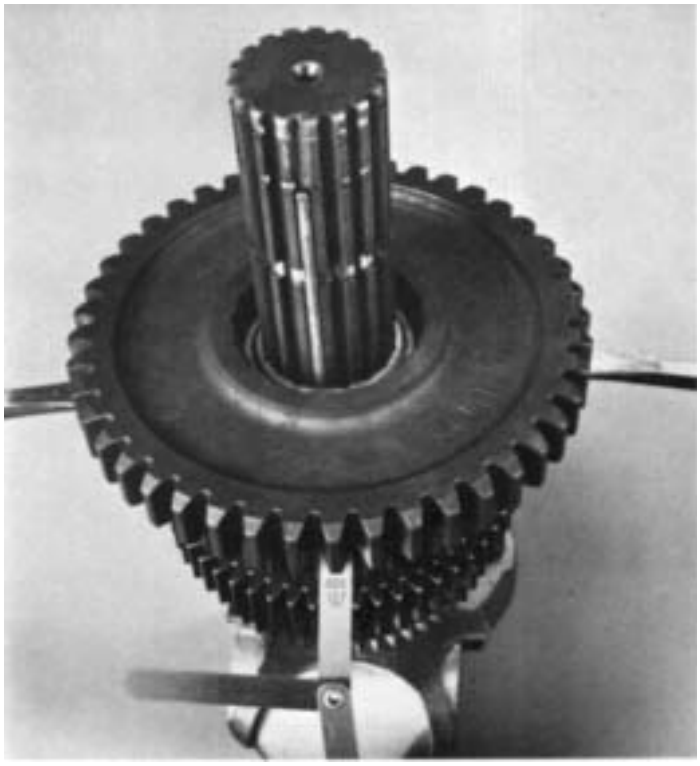
15. Install the spacer in LO speed gear, engaging the external splines of spacer with clutching teeth of gear.

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REASSEMBLY-FRONT SECTION



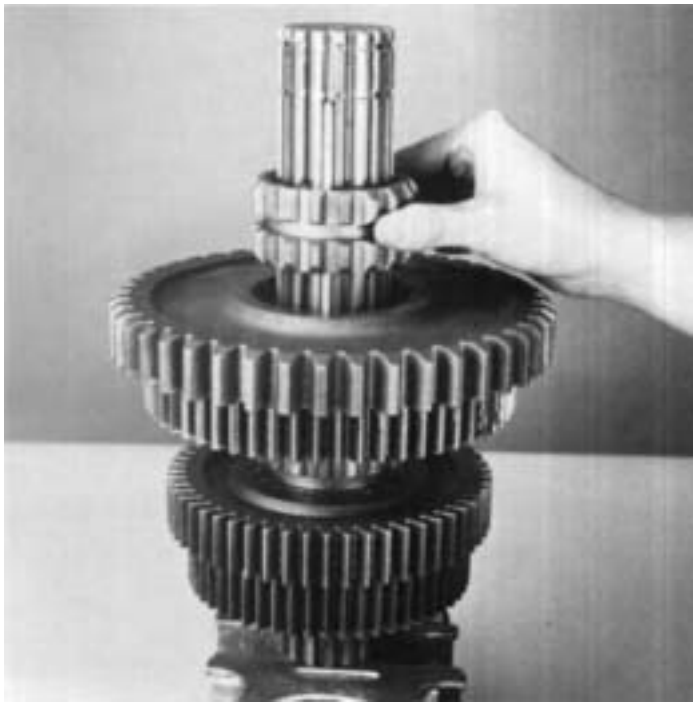
16. Remove the key from keyway and install the LO speed gear limit washer on mainshaft, flat side of washer down and against spacer. Rotate washer in the 4th groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place (inset).



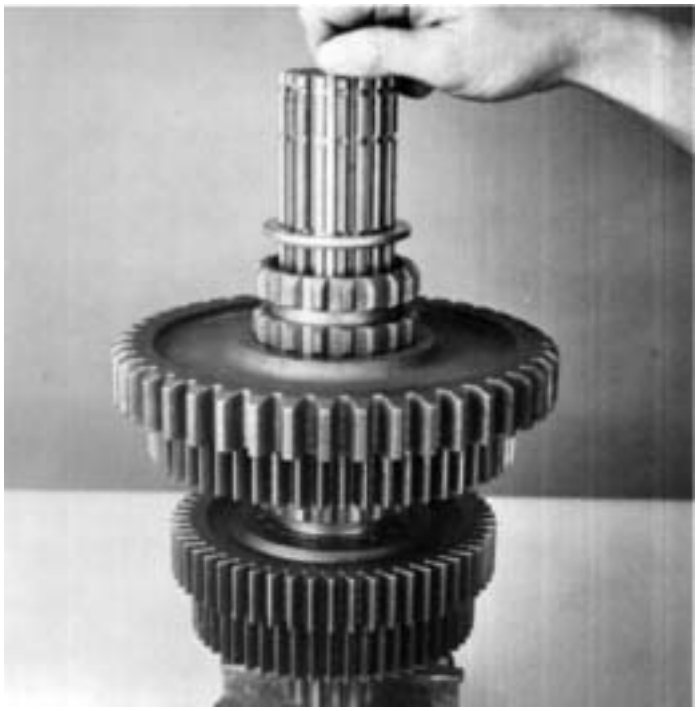
17. Check axial clearance and make adjustments, if necessary, between the LO and 1st speed gears as described.

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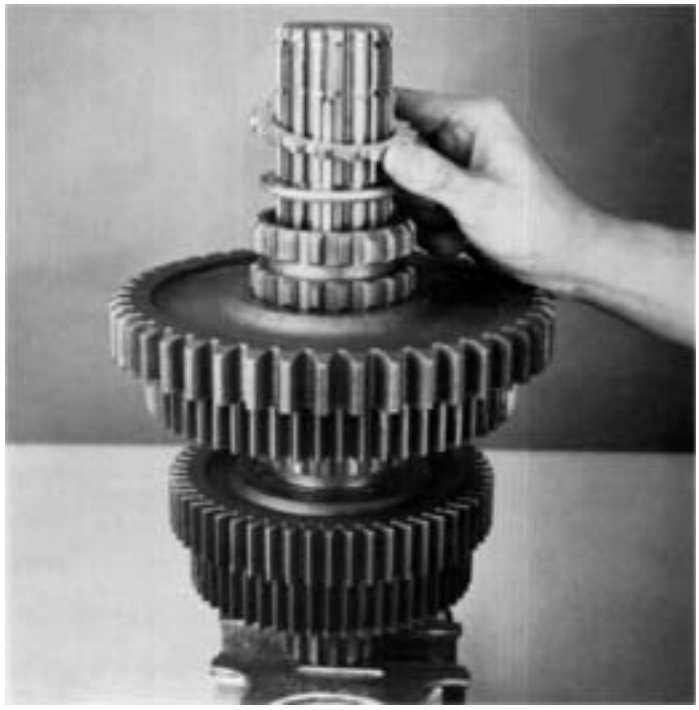
REASSEMBLY-FRONT SECTION



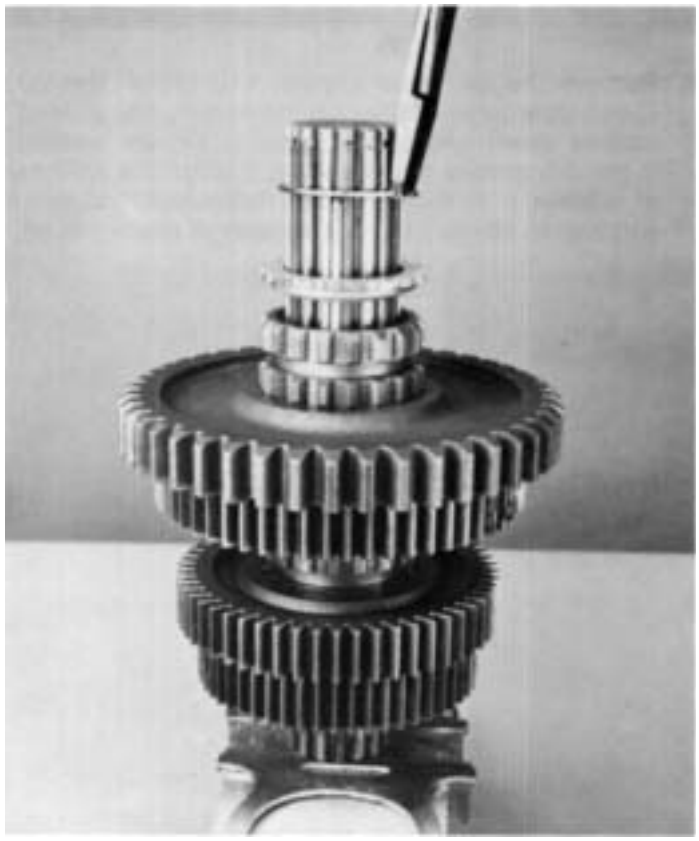
18. Install the LO-Reverse speed sliding clutch, aligning the missing internal spline of sliding clutch with key in mainshaft.



19. Remove the key from keyway and install the reverse gear limit washer on mainshaft, flat side of washer up. Rotate washer in the 5th groove of mainshaft to align the splines of washer with those of the mainshaft and reinsert key in keyway to lock washer in place.



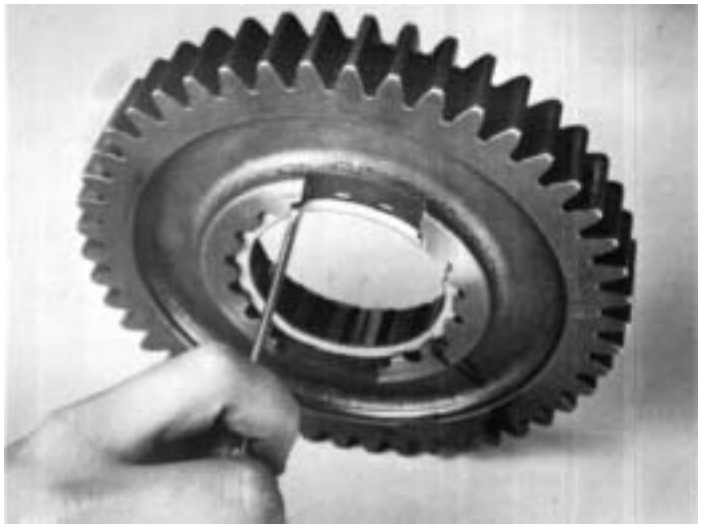
20. Install the spacer on shaft against washer.



21. Install the snap ring in 6th groove of mainshaft to retain key in keyway.

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REASSEMBLY-FRONT SECTION



22. Install the snap ring in hub of reverse gear ONLY TO CHECK AXIAL CLEARANCE (END-PLAY) LIMITS.



23. Install the reverse gear on mainshaft, clutching teeth down and engaged with external splines of spacer.



24. Install the auxiliary drive gear assembly in its proper position on rear of mainshaft.

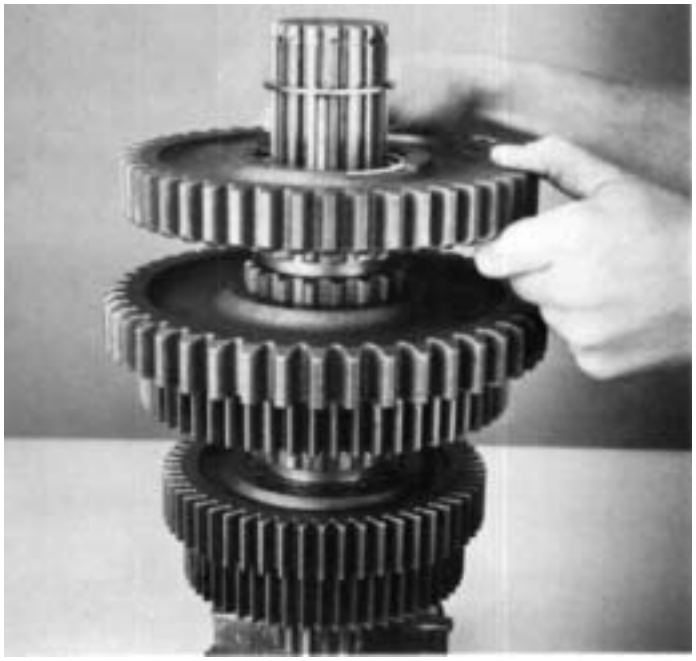
https://truckmanualshub.com/

REASSEMBLY - FRONT SECTION



25. Force both the reverse gear and auxiliary drive gear downward on the shaft to flatten their respective snap rings. Making sure the gear hubs are parallel, insert a feeler gage between the hubs of the reverse gear and auxiliary drive gear. Correct axial clearance should be from .005" to .012". If clearance is less than the minimum .005" tolerance, the reverse gear limit washer should be replaced by a thinner limit washer. This will increase the axial clearance between the gears. If the clearance checked is greater than the maximum .012" tolerance, a thicker limit washer should be installed in teh reverse gear. This would decrease the axial clearance between the gears.

NOTE: THIS CHECK IS MADE WITHOUT SPREADING THE GEARS WITH SCREWDRIVERS.



26. With the proper reverse gear limit washer installed on mainshaft, remove the auxiliary drive gear assembly and reverse gear.



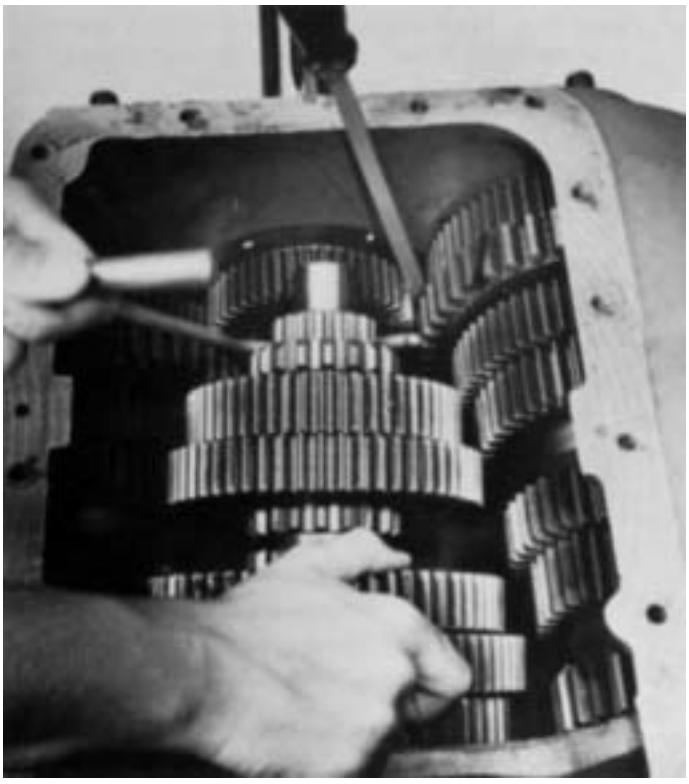
27. Remove the snap ring from hub of reverse gear and reinstall the gear on mainshaft. Engage the clutching teeth of gear with the splines of spacer and sliding clutch and move the reverse gear against the LO speed gear.

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REASSEMBLY-FRONT SECTION



28. Remove the mainshaft assembly from vise. Align the missing internal spline of 3rd-4th speed sliding clutch with key in mainshaft and install on front of shaft, engaging the external splines of sliding clutch with clutching teeth of 3rd speed (or Overdrive) gear.



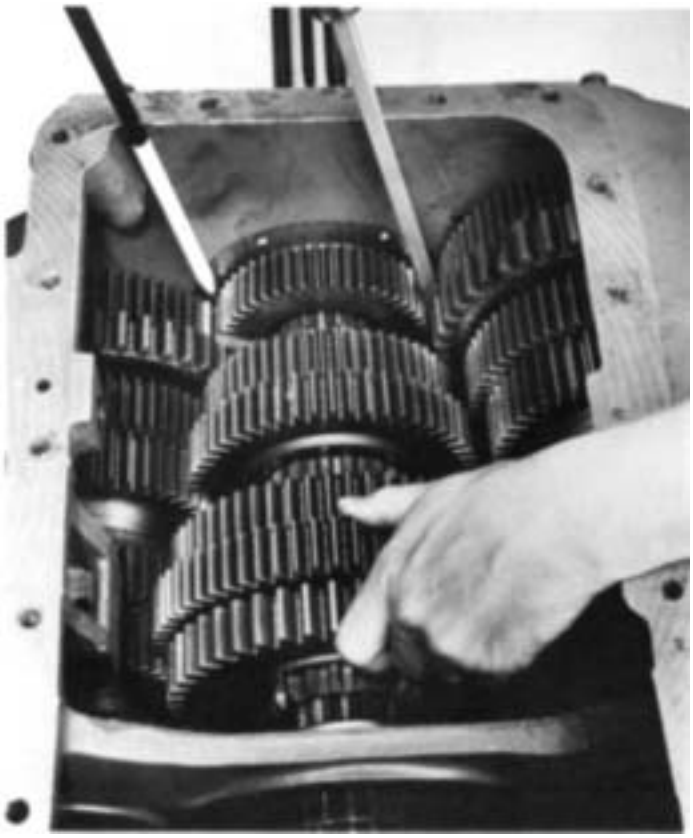
29. Block the right countershaft assembly against case wall and lower the mainshaft assembly into position with the reverse gear held against LO speed gear and rear of shaft moved into case bore.



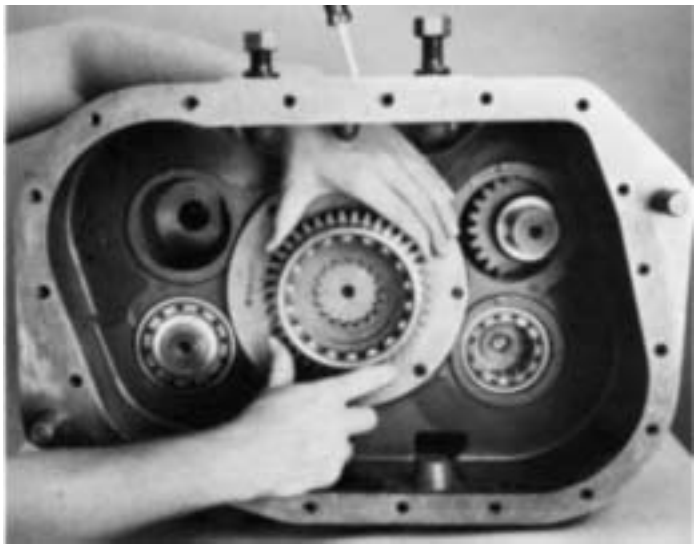
30. Move the pilot-end of mainshaft into pocket bushing of input shaft.

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REASSEMBLY - FRONT SECTION



31. With the reverse gear remaining against LO speed gear, mesh the corresponding forward speed gears of left countershaft assembly. Check to make sure that marked tooth on left countershaft drive gear has remained in mesh with marked set of teeth on main drive gear.



32. Center rear of mainshaft in case bore and install the auxiliary drive gear assembly on shaft, partially seating the bearing in bore. DO NOT COMPLETE INSTALLATION AT THIS TIME.

H. Bearing Installation and Timing of Right Countershaft Assembly

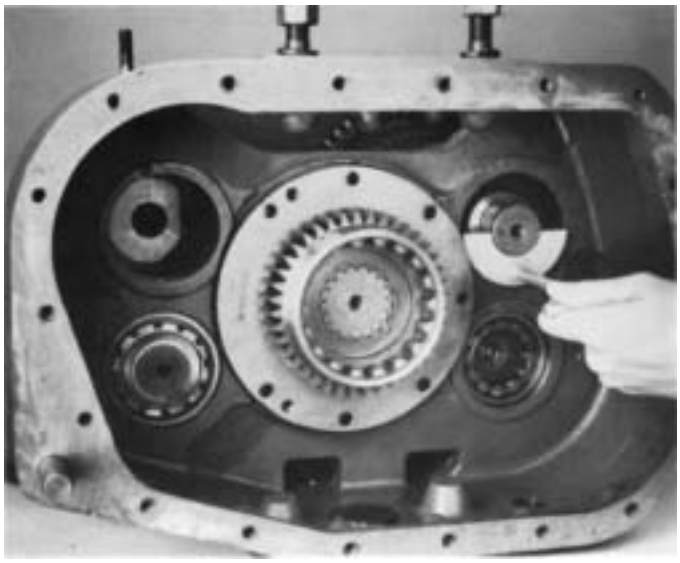
IMPORTANT: The left countershaft assembly MUST remain in time with main drive gear when timing right countershaft assembly.



1. Remove blocking from right countershaft assembly and place it parallel to mainshaft assembly. Mesh the marked tooth of right countershaft drive gear with remaining set of two marked teeth on main drive gear.

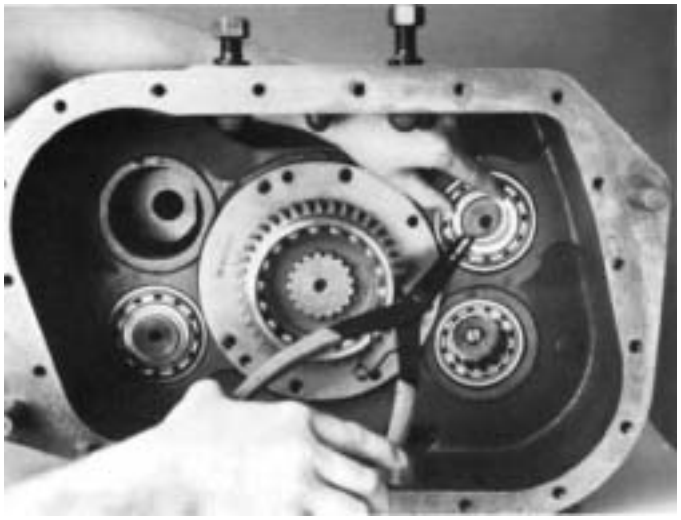
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REASSEMBLY - FRONT-SECTION

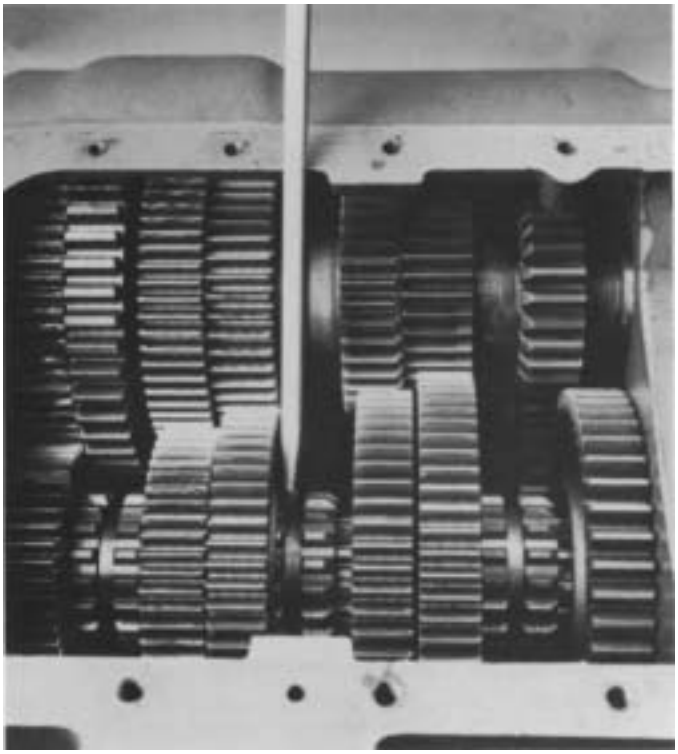


2. Insert countershaft support tool or blocking in rear bearing bore.

3. Install the right countershaft bearings in the same manner described in Part D for left countershaft bearings.



4. With bearing installation complete, install the snap ring in groove at rear of right countershaft.



5. Move the reverse gear to the rear on mainshaft and use a screwdriver to engage sliding clutches with all forward speed gears. A sliding clutch that will not engage with a gear indicates the gear set is not in proper mesh. The bearings of the right countershaft would then need to be removed and the drive gear set retimed.

NOTE: Do not engage sliding clutches with more than one gear at the same time. This will lock the gearing and prevent the mainshaft and countershaft assemblies from rotating.

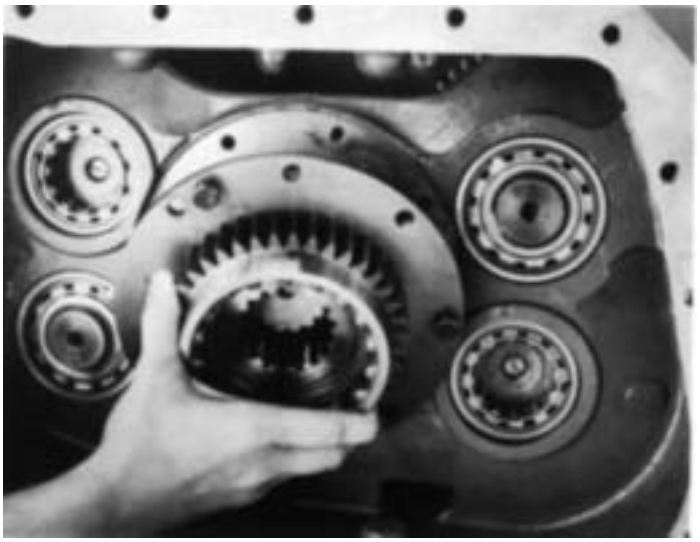
1. Reassembly and Installation of Left Reverse Idler Gear Assembly

NOTE: Since the left and right reverse idler gear assemblies are identical, reassembly and installation of the left reverse idler gear assembly should be performed at this time as described in Part A of this section.

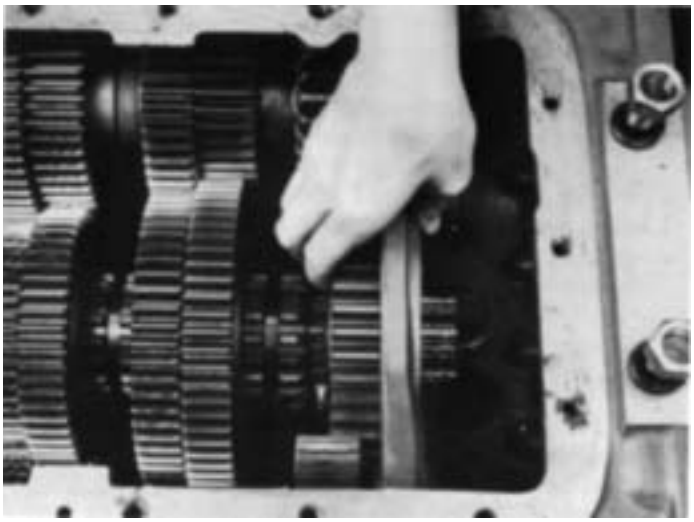
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REASSEMBLY - FRONT SECTION

J. Completed Installation of Mainshaft and Auxiliary Drive Gear Assemblies



1. Remove the auxiliary drive gear assembly from mainshaft and rear bearing bore. Do not allow mainshaft to move to rear when removing auxiliary drive gear.



2. Move the reverse gear to the rear as far as possible, meshing teeth of gear with those of the reverse idler gears.



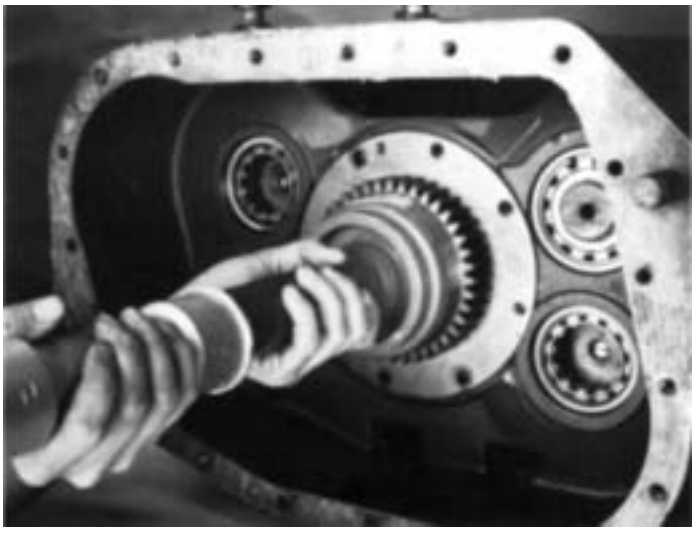
3. Align the external splines of spacer with clutching teeth of reverse gear and move spacer forward on mainshaft and into gear.



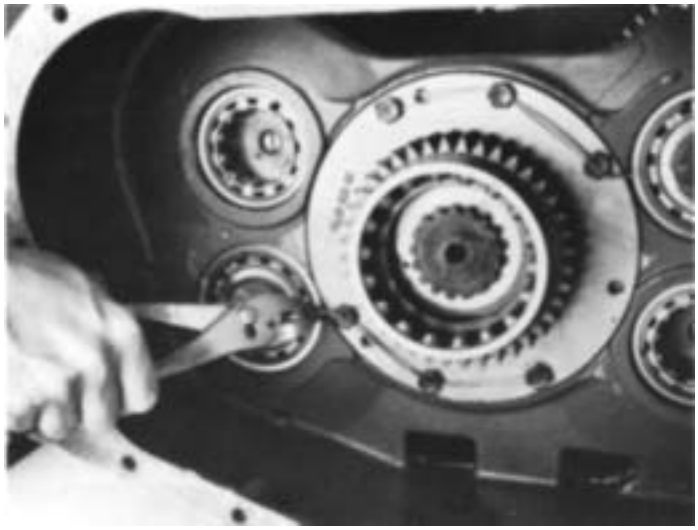
4. Install the snap ring in hub of reverse gear and move the reverse gear forward on mainshaft and into proper position in case.

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REASSEMBLY - FRONT SECTION



5. Reinstall the auxiliary drive gear assembly on rear of mainshaft. Use a flanged-end driver and maul to seat bearing in case bore.



6. Align the six capscrew holes in retainer with the tapped holes in case and install capscrews. Tighten to recommended torque ratings and lock-wire the capscrews in groups of three.



7. Install the snap ring in groove at end of main-shaft.

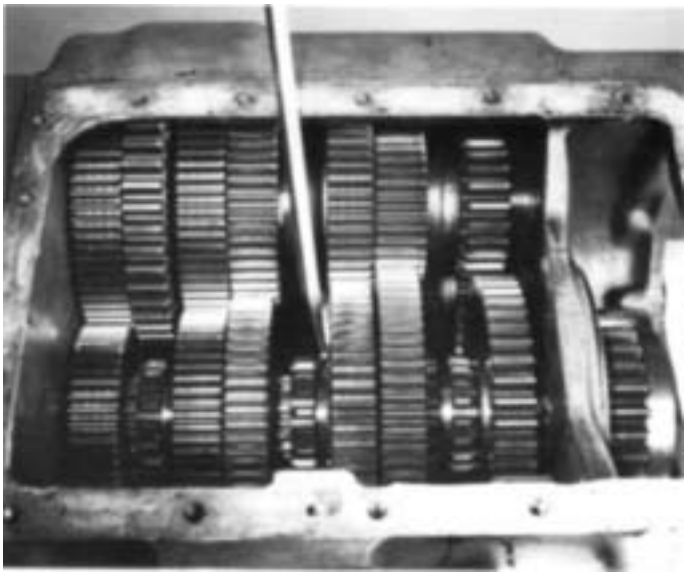
K. Installation of Drive Gear Nut and Front Bearing Cover



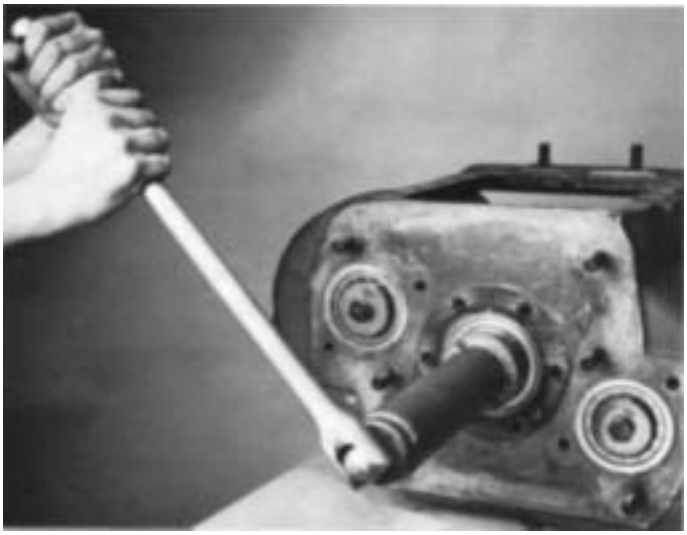
1. Apply Loctite grade 277 sealant to cleaned threads of new drive gear bearing nut. DO NOT REUSE OLD NUT.
NOTE: For models equipped with a snap ring to retain bearing, install the snap ring in groove of input shaft and proceed to No. 4.

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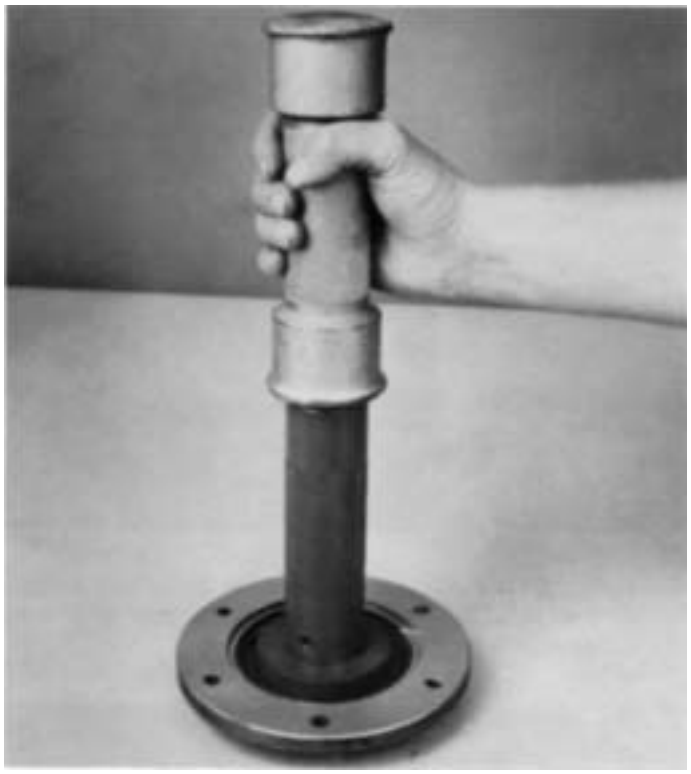
REASSEMBLY-FRONT SECTION



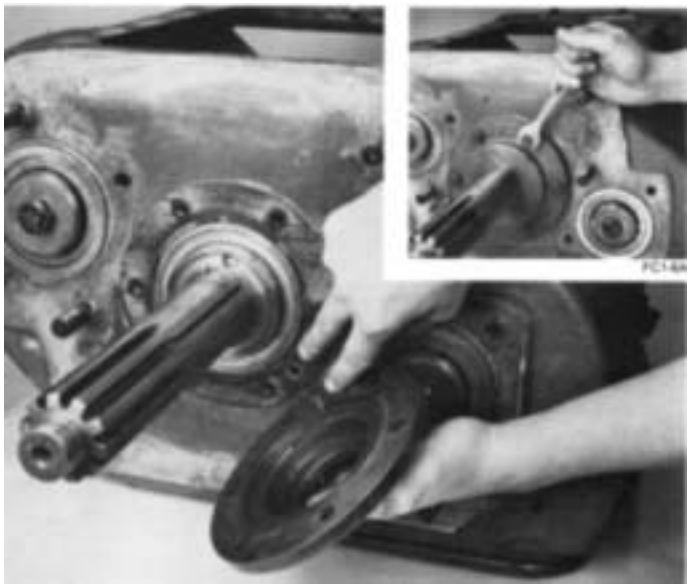
2. Engage two mainshaft sliding clutches into gear to prevent transmission from rotating.



3. Install the nut on shaft (left hand threads). Using a drive gear nut installer, tighten to 250-300 lbs/ft of torque. Use a punch and maul to peen the nut into the two milled slots of input shaft.



4. If previously removed, install the oil seal in drive gear bearing cover of models so equipped.



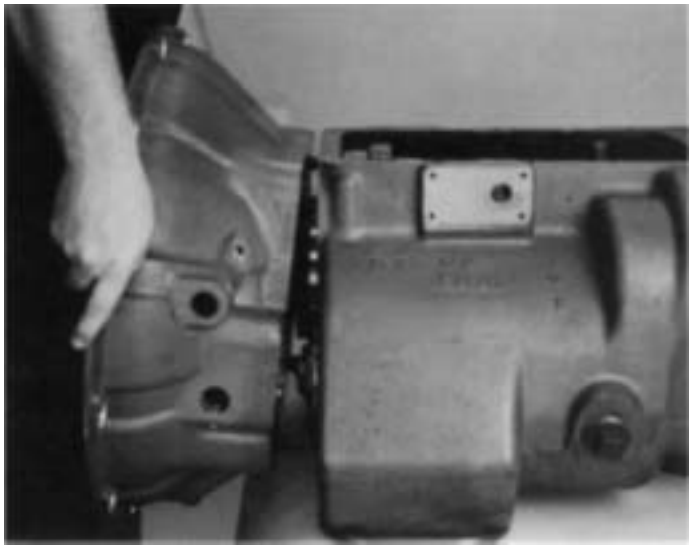
5. Install the drive gear bearing cover and gasket, making sure to align the oil return hole in case. Secure cover on case with retaining capscrews (inset).

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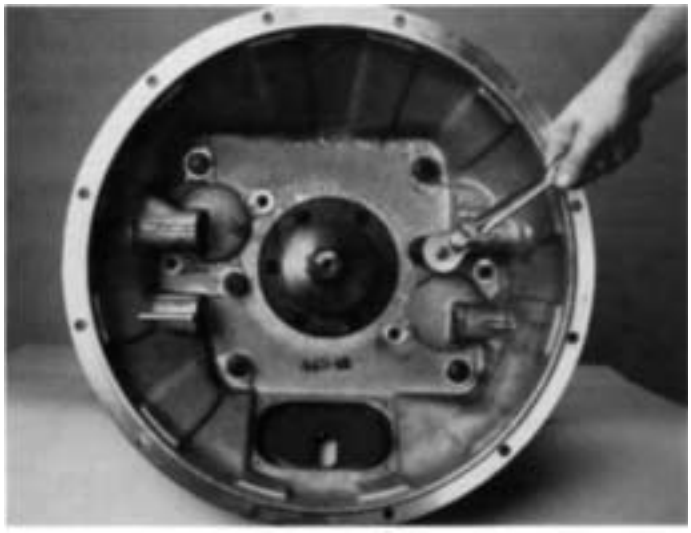
INSTALLATION - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

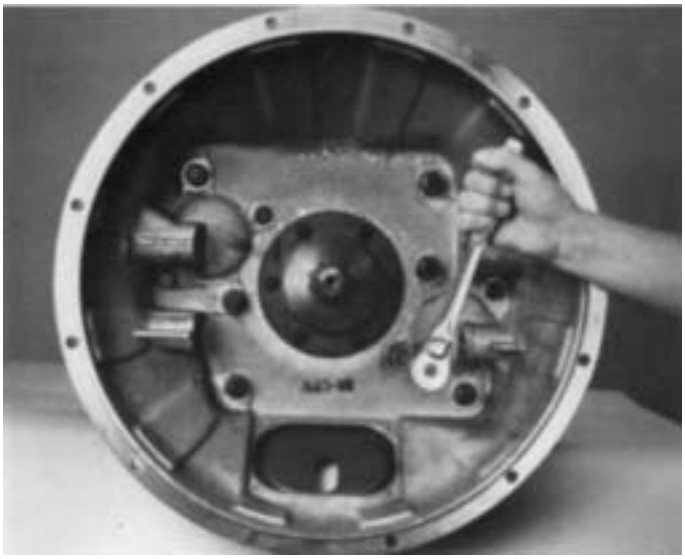
A. Installation of Clutch Housing



1. Position the corresponsing new gasket on housing mounting surface and install the clutch housing on front case, piloting on the six studs and drive gear bearing cover.



2. Install the six nuts with washers or lockwashers on studs and tighten. See TORQUE RECOMMENDATIONS.



3. Install the four capscrews with lockwashers and tighten. See TORQUE RECOMMENDATIONS.

4. For models so equipped, install the clutch release mechanism and/or clutch brake assembly. See OPTIONS.

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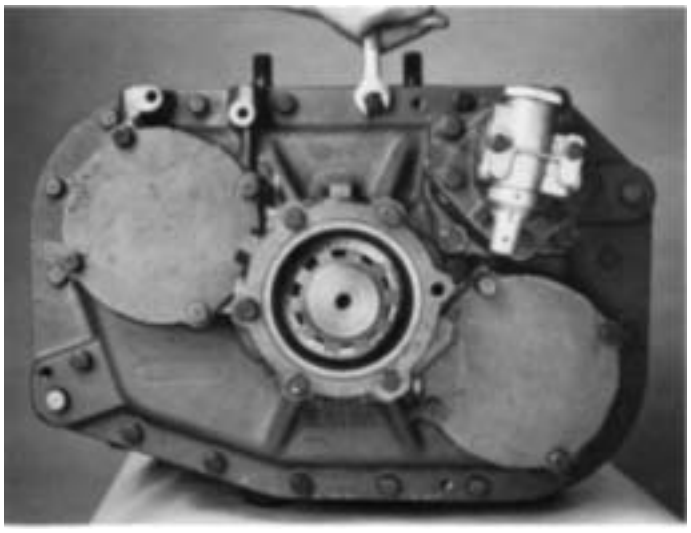
INSTALLATION-COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

B. Installation of Auxiliary Section

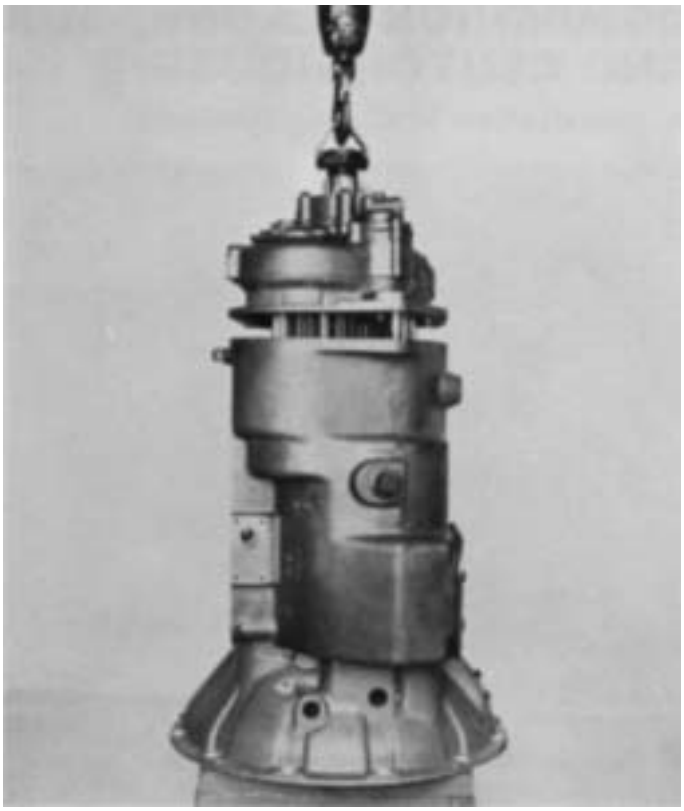
NOTE: Make sure the bearing inner race is installed on front of each auxiliary countershaft BEFORE proceeding with the following.



1. Attach a chain hoist to auxiliary. Move the assembly evenly into rear of front case, piloting it on the dowel pins. As assembly is moved forward, the countershaft drive gears will mesh with the auxiliary drive gear.
IMPORTANT: On 8-speed "L" model auxiliary sections, shift the deep reduction sliding clutch into deep reduction before installing auxiliary. This will prevent possible timing error.



2. Install the retaining capscrews in flange of auxiliary plate/housing and tighten to secure the auxiliary section to the front section. See TORQUE RECOMMENDATIONS.



3. The auxiliary section can also be installed with transmission set in the vertical position. Block under the clutch housing to prevent damage to the input shaft, position the corresponding new gasket on plate/housing mounting surface and lower the assembly onto rear of front case. Install the retaining capscrews and tighten securely. See TORQUE RECOMMENDATIONS.
IMPORTANT: On 8-speed "LL" model auxiliary sections, shift the deep reduction sliding clutch into deep reduction before installing auxiliary. This will prevent possible timing error.

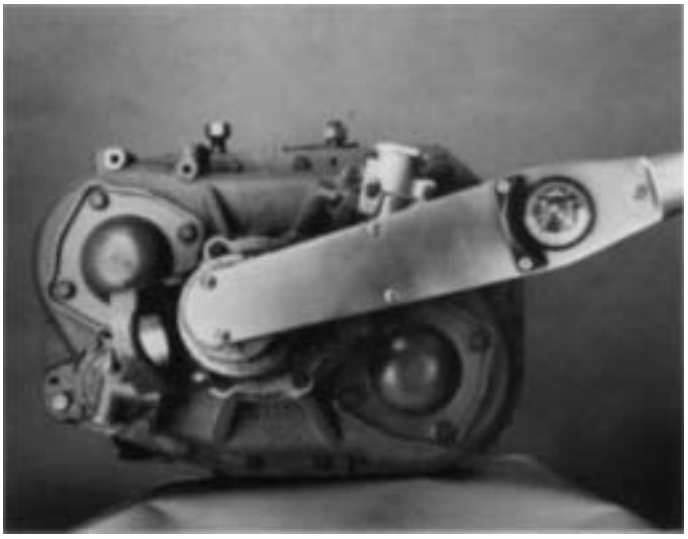
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INSTALLATION - COMPANION FLANGE, AUXILIARY SECTION AND CLUTCH HOUSING

C. Installation of Universal Joint Companion Flange or Yoke



1. For models so equipped, install the speedometer drive gear or replacement spacer in position on hub of companion flange or yoke. Install the companion flange or yoke on splines of output shaft and move into rear bearing cover.
NOTE: For 14608LL models, the speedometer drive gear or replacement spacer is installed on output shaft prior to installation of rear bearing cover.



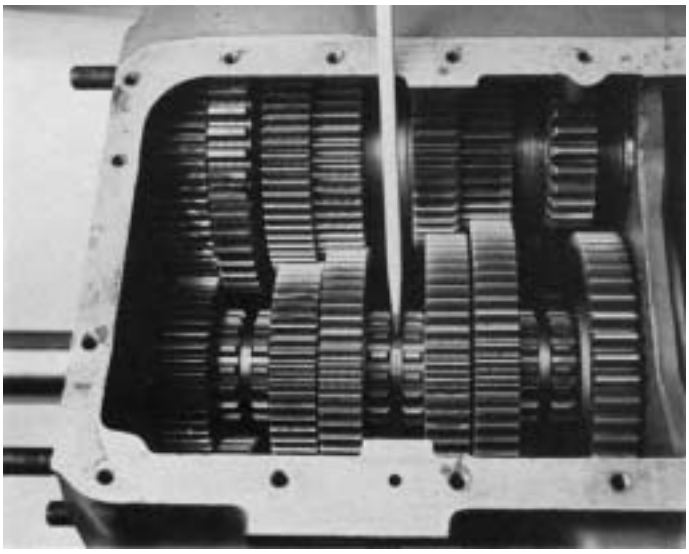
2. Lock the transmission by engaging two mainshaft gears with sliding clutches. Install the washer and/or nut on output shaft and tighten nut using 450-500 lbs/ft of torque.

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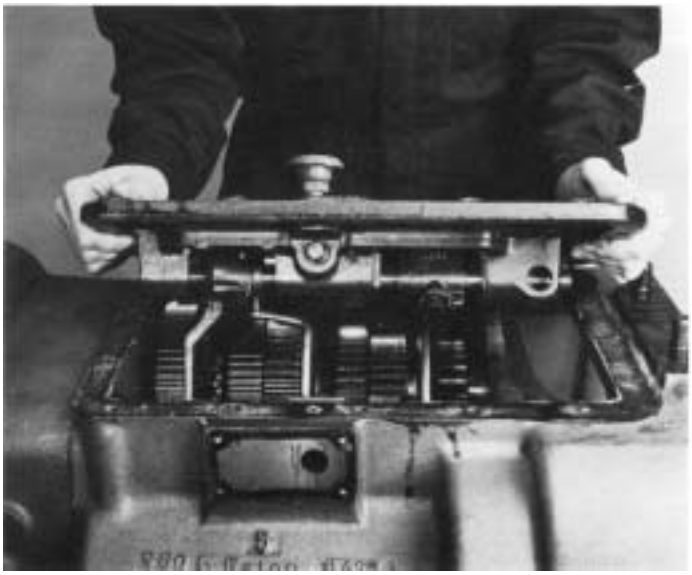
INSTALLATION - SHIFTING CONTROLS

SHIFT BAR HOUSING ASSEMBLY

A. Installation



1. Place all three mainshaft sliding clutches in the neutral position.



Install the new shift bar housing gasket in position on case.

2. With all three shift bars in the neutral position, install the shift bar housing assembly on case, fitting the shift yokes into slots of corresponding sliding clutches.
NOTE: Avoid tilting the assembly during installation as the three sets of tension springs and balls are free to be released from bores in top of housing.



3. Install the capscrews in housing and tighten to secure the assembly to case.

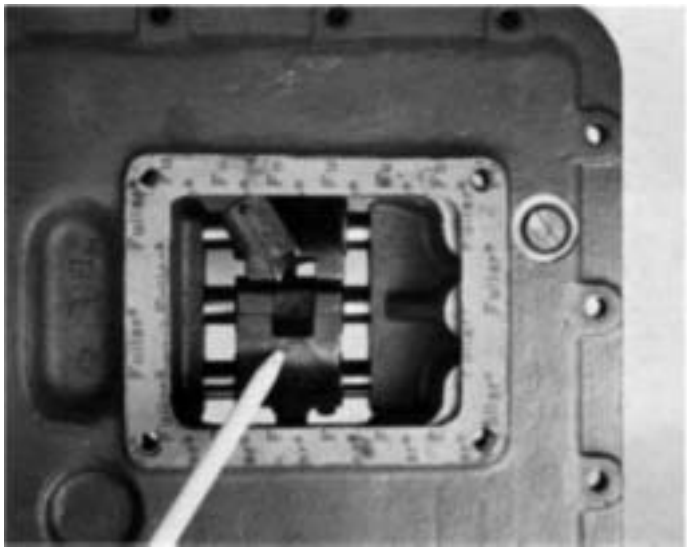
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INSTALLATION-
SHIFTING CONTROLS

GEAR SHIFT LEVER HOUSING ASSEMBLY

A. Installation

NOTE: For models equipped with a LRC or SRC Assembly, the housing is installed in the same manner described in the following instructions.



1. Check the shift bar housing assembly to make sure shift block and yoke notches are aligned in the neutral position.



2. Install the new gear shift lever housing gasket in position on shift bar housing and install the gear shift lever housing assembly on shift bar housing, fitting the lever into shift bar and yoke notches.



3. Install the retaining capscrews in housing flange and tighten to secure the assembly to shift bar housing.

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INSTALLATION - SHIFTING CONTROLS

AIR SYSTEM

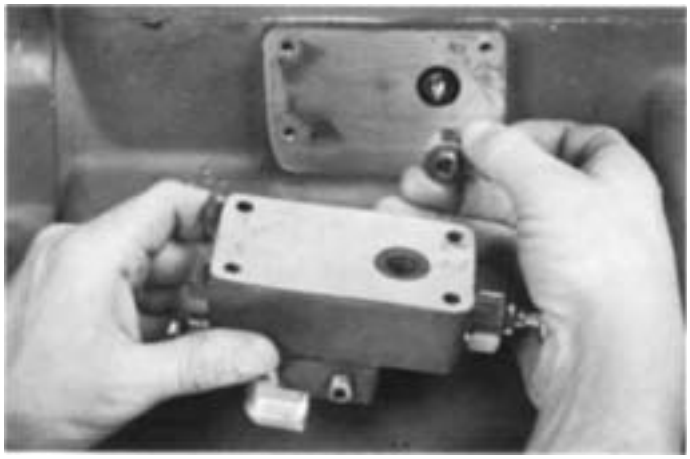
A. Installation of Slave Valve



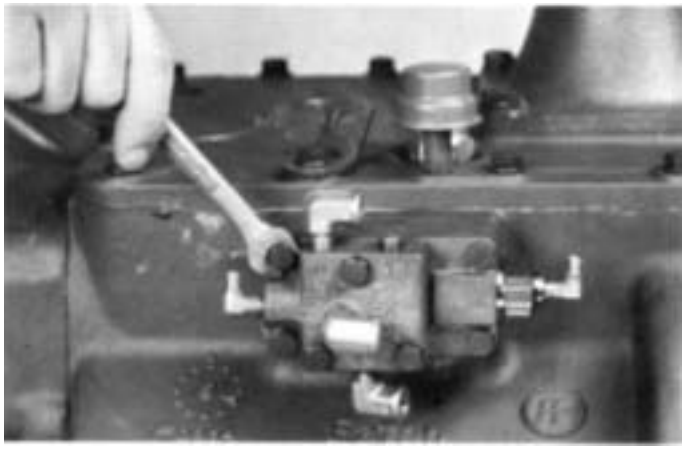
1. If previously removed, install the air line fittings on slave valve.



2. Install the spring on shank of actuating pin and insert in bore of transmission case.



3. Install the hat-type alignment sleeve in bore of slave valve.



4. Position the corresponding new gasket on valve mounting surface and install the slave valve on case, inserting the end of actuating pin into alignment sleeve. Secure the valve to case with four retaining capscrews tightened evenly.

B. Installation of Air Lines

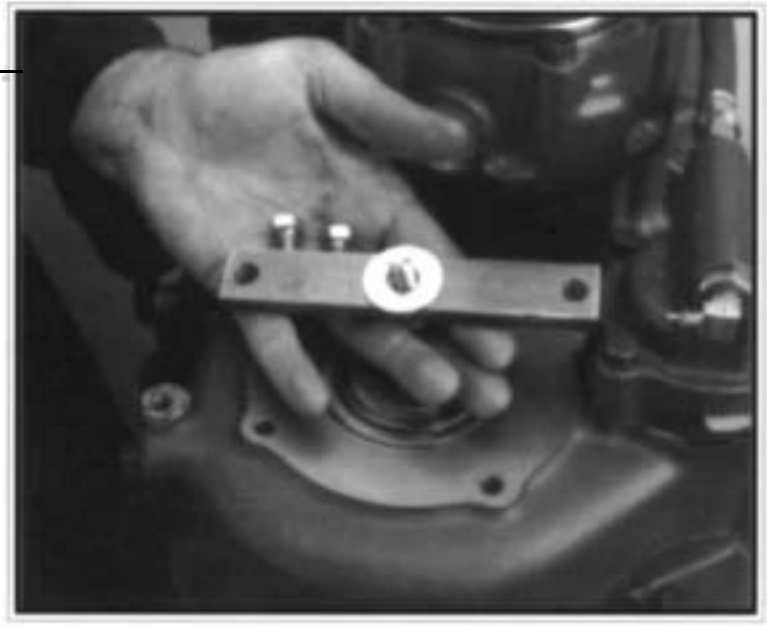
(See Air System Schematics on pages 40-47.)

Tapered Roller Bearing Shimming Procedure

Note: The auxiliary section may be shimmed in either the vertical or horizontal position. Vertical shimming is performed with the transmission removed from the truck while horizontal shimming takes place with the transmission still in the truck.

1

Before installing the auxiliary section, install countershaft straps on each countershaft. Use three (3) 3/8" x 1" capscrews for each strap.



2

For vertical shimming, place the transmission in the vertical position. Place (2) wood blocks under the clutch housing to prevent the transmission from tipping and damaging the input shaft. Place the auxiliary housing on the front box.



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3

Install the auxiliary housing capscrews. Tighten to the recommended torque.

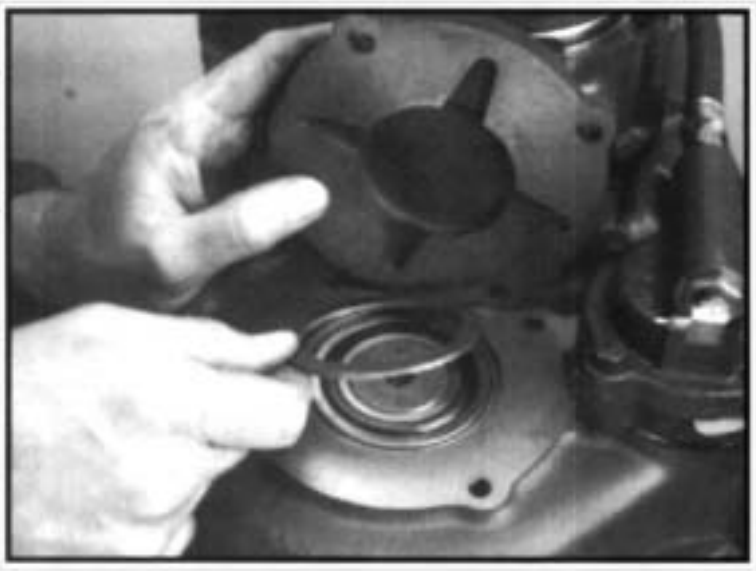


4

Remove each countershaft strap.

5

Install the .125 gaging shim and the countershaft bearing cover. **Make sure the shim is properly aligned on the bearing race.**



6

Use two (2) 3/8" x 1" capscrews without lock washers. Install the capscrews directly across from each other.



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7



Tighten to 7 in. lbs. of torque.

Do not over torque. Incorrect readings will be produced. Make sure the countershaft rear bearing cover gaskets have been removed.

8



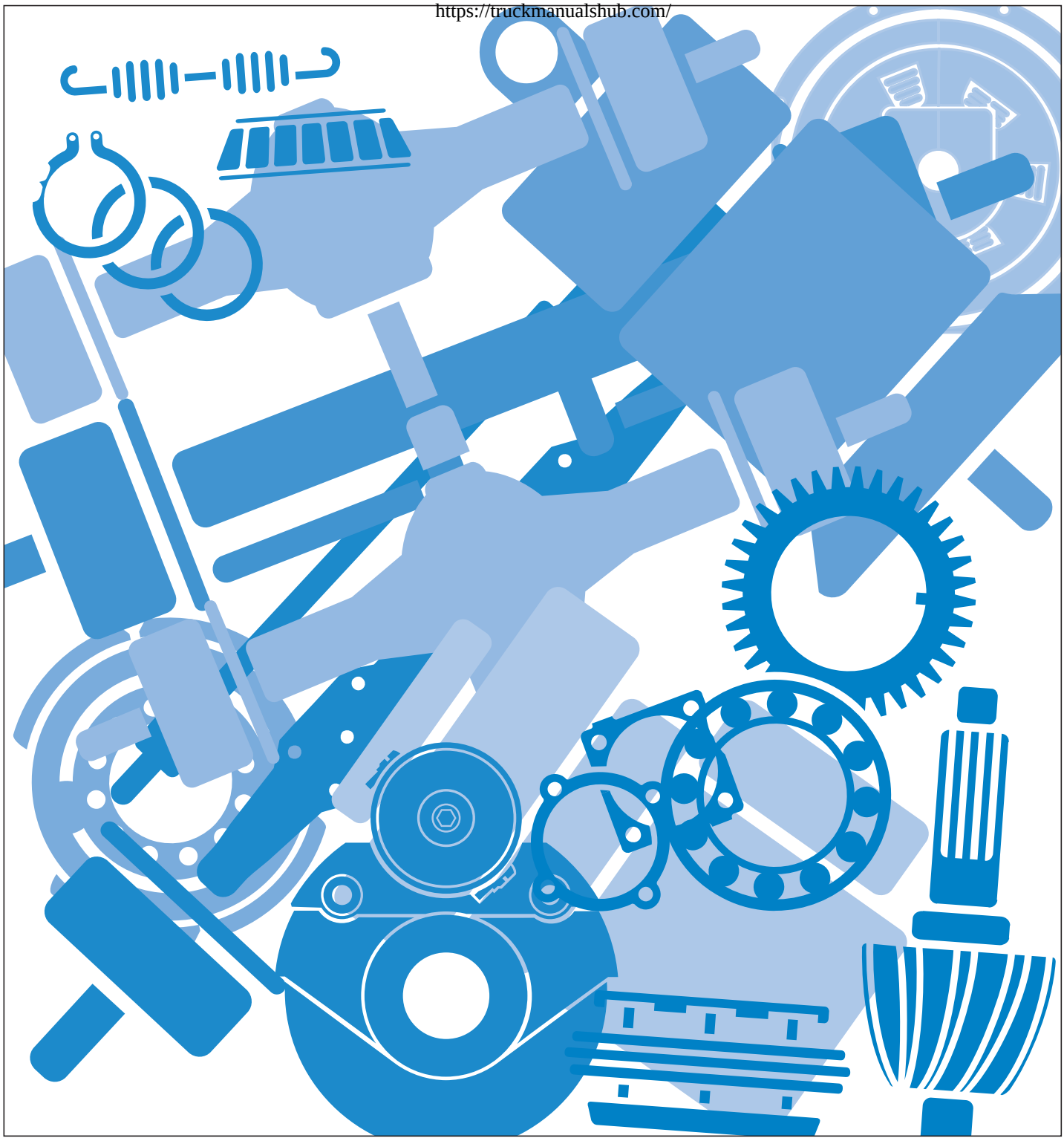
Rotate the output shaft six times in the clockwise direction, then six times counterclockwise to properly seat the bearings. Use a feeler gauge to measure the clearance between the shim gauge and auxiliary housing surface near each capscrew location. Record each measurement and average the two measurements. Refer to the Shimming Endplay Chart and select the number in the left column which corresponds to the average measurement which was achieved. Follow the column to the right to determine the proper thickness and shim required. Note part number and shim color. Repeat this procedure for the other countershaft.

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After the correct shim has been selected, place the shim on the rear countershaft bearing race, install the countershaft rear bearing gasket and cover. Check for proper shim alignment. If misaligned, the bearing cover may be damaged when final torque is applied to cover capscrews. Perform the same procedure on the other rear countershaft.

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HYDRAULIC HEATER CIRCUIT AND A.C. CIRCUIT OPERATION



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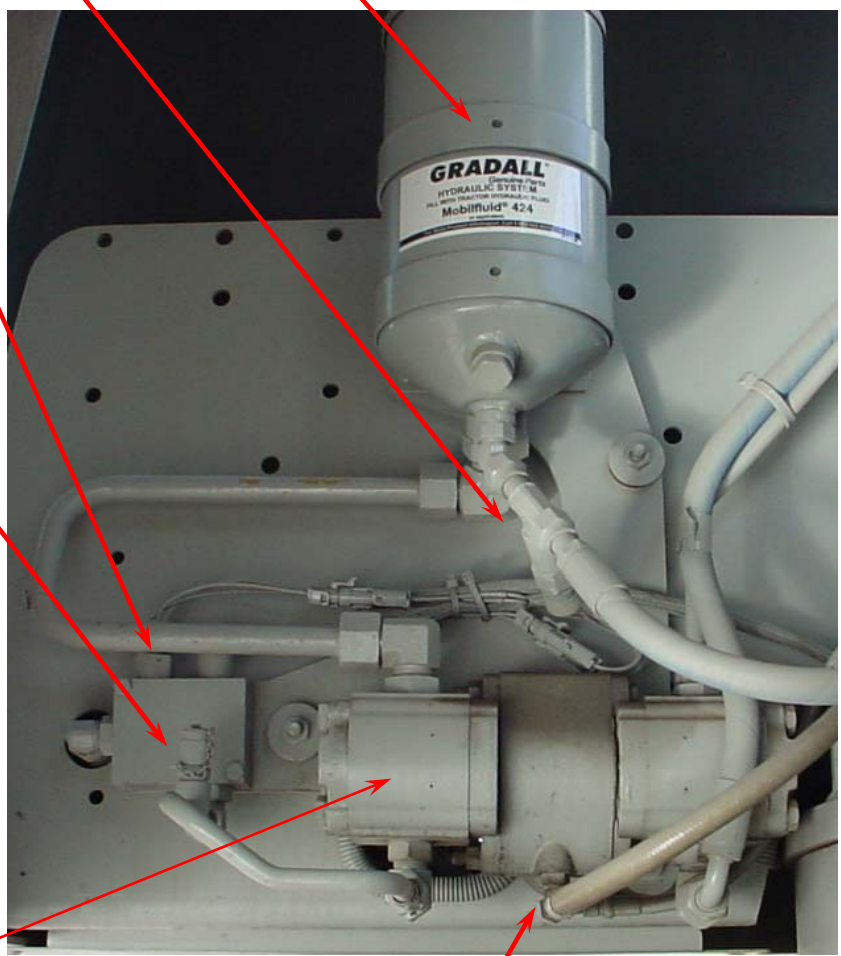
SERIES II HEATER SYSTEM AND COMPONENTS

Reservoir with filter

220 degree
High Temperature Cut
Off Switch

195 degree
Low Temperature Cut Off
Switch

Gauge quick
coupler
Adjustable
pressure relief
valve
1100 psi cold
1050 psi hot



Heater
Pump/Motor

Pump/Motor case drain

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MAIN CONTROL
HEATER/A.C. VALVE SECTION / (Description of components)

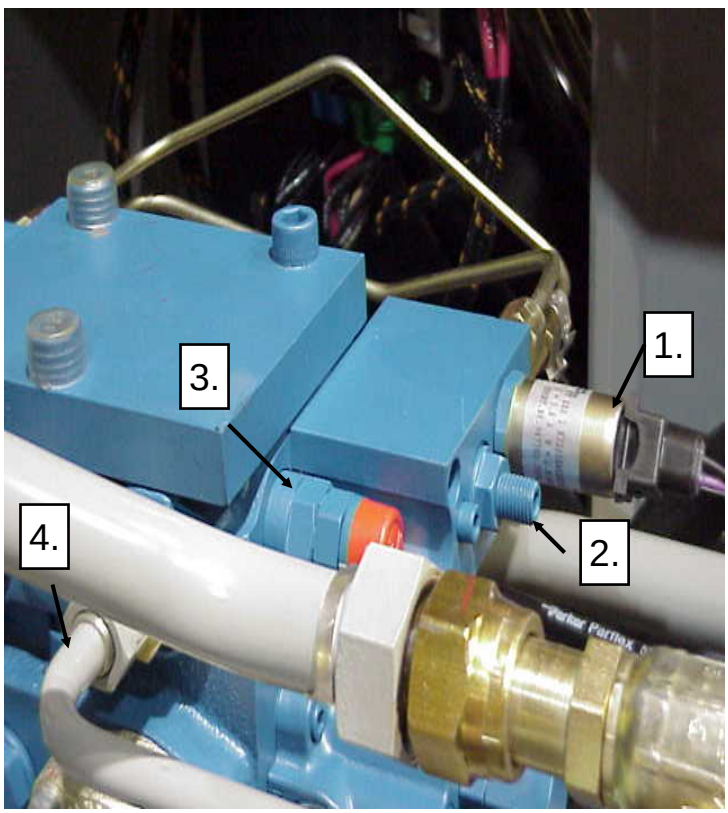
1- Is Variable Solenoid that Controls heater motor speed.

Note: heater solenoid end is black in color and a/c solenoid end is blue in color.

2- Is spool limiter for *A/C* speed.
heater spool limiter is on opposite end.

3- Is heater relief set at 2500 psi.

4- Is heater motor supply line.



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HEATER SYSTEM CHECK AND ADJUSTMENT INFORMATION

- **AFTER 20 MINUTES OF OPERATION WITH HEAT CONTROL SWITCH AT THE MAXIMUM POSITION AND THE FAN CONTROL SWITCH IN THE NO. 1 POSITION THE DESIRED HEAT AT THE BOTTOM LEFT LOUVER AT THE REAR PLANTUM SHOULD READ 115-120 DEGREES.**

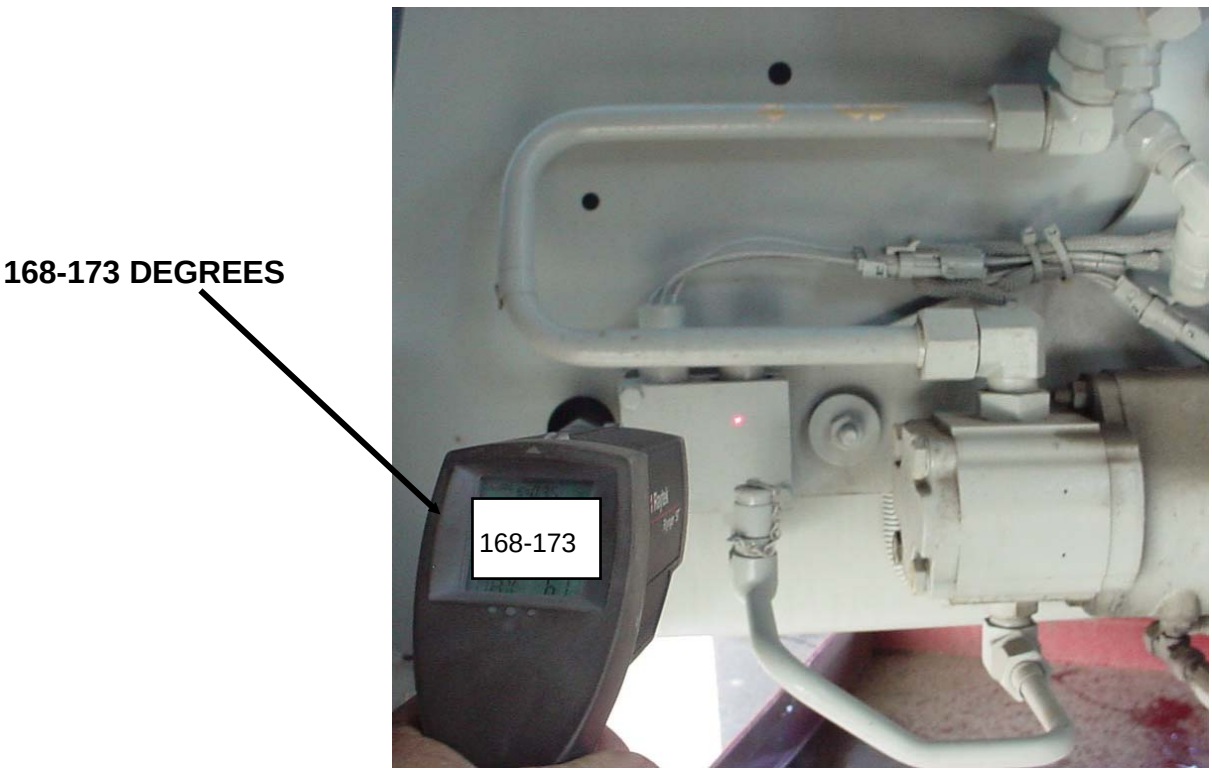
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CHECK BOTTOM LEFT LOUVER AFTER 20 MINUTES / 115-120 DEGREES



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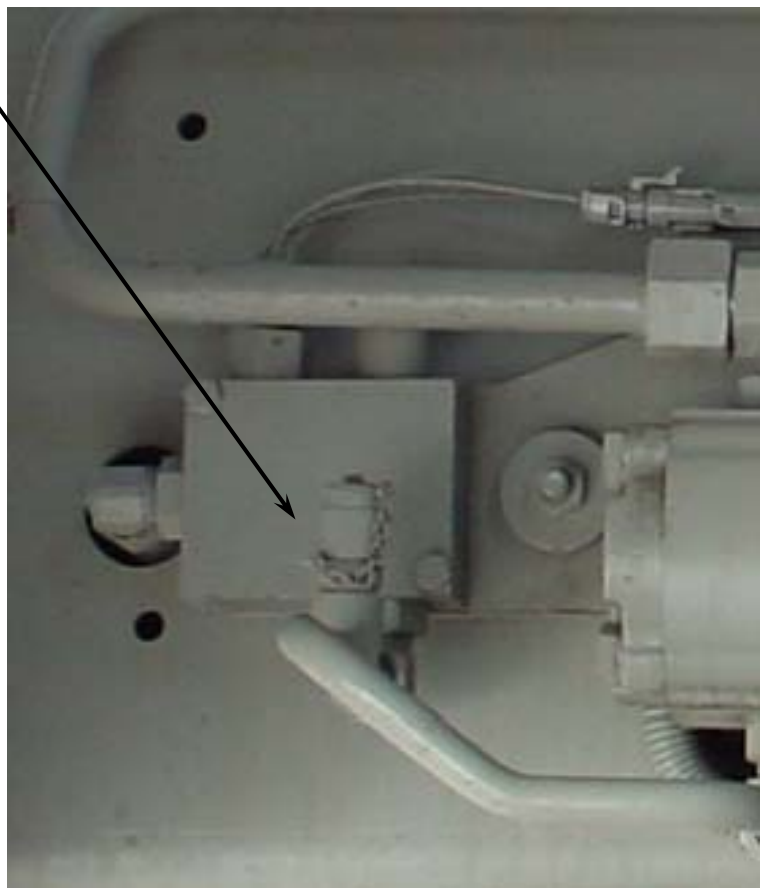
CHECK THE TEMPERATURE OF THE HEATER VALVE BODY, SHOULD HAVE 168-173 DEGREES AFTER 20-30 MINUTES OF OPERATION



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HEATER CIRCUIT: WITH TEST GAUGE INSTALLED AT THE HEATER SYSTEM QUICK COUPLING HEATER SYSTEM PRESSURE SHOULD READ 1050-1100 PSI.

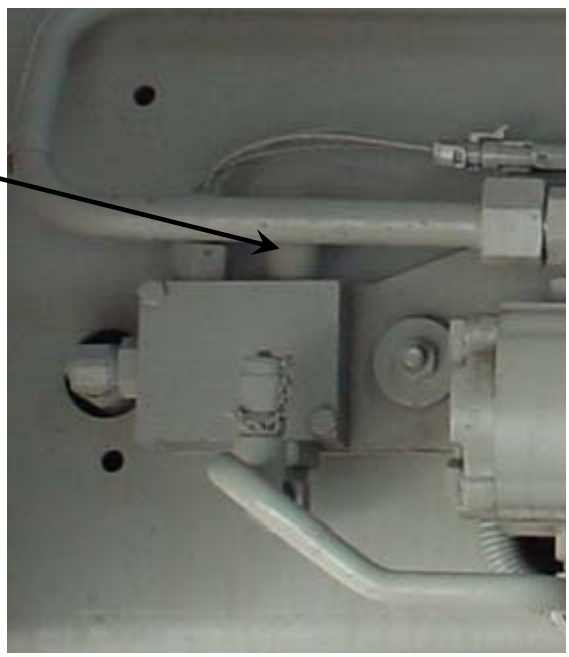
HEATER CIRCUIT
TEST COUPLING



https://truckmanualshub.com/

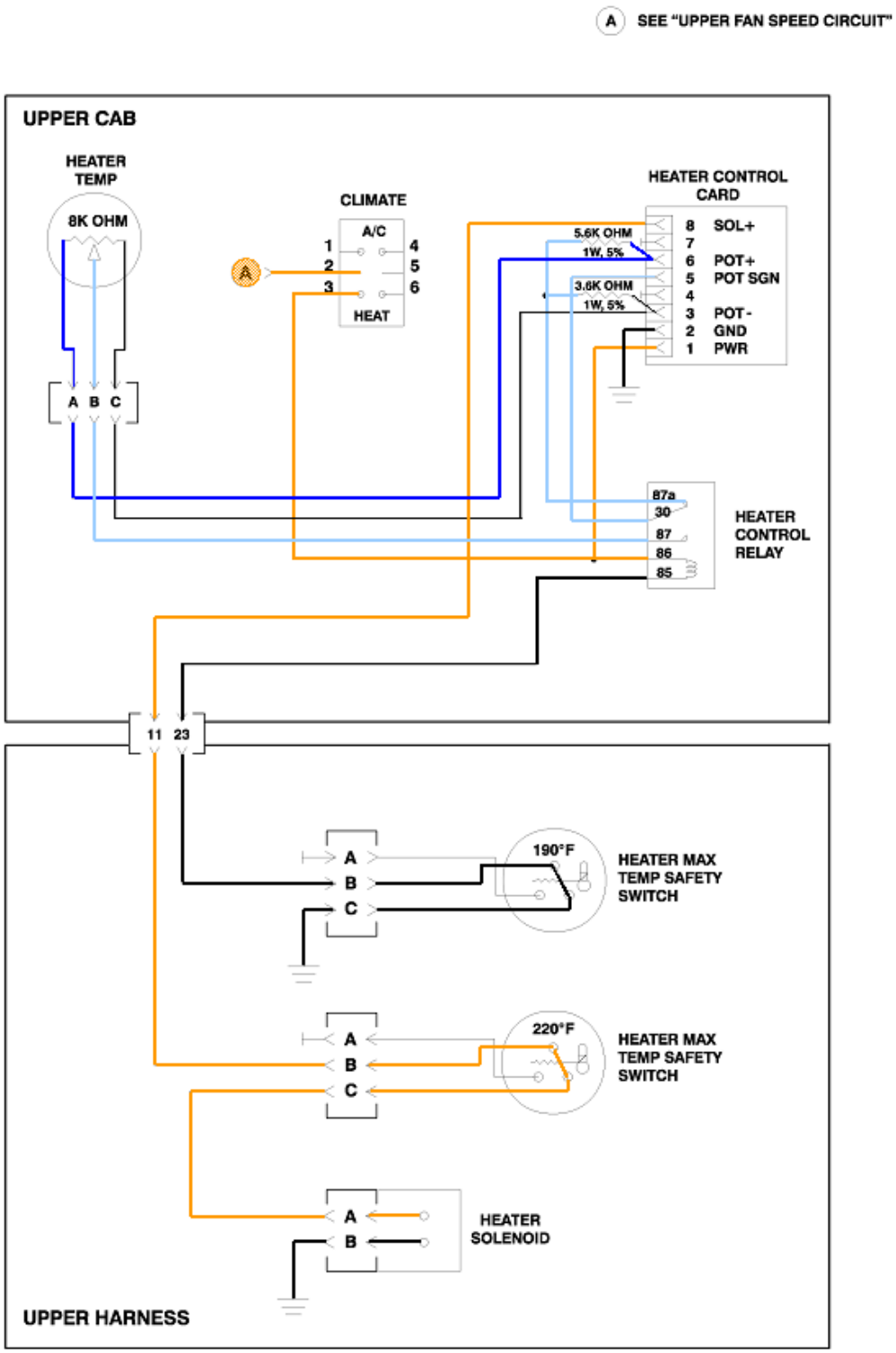
IF THE HEATER OUT IS NOT CORRECT. WITH ENGINE OFF REMOVE THE S.A.E. CAP PLUG FROM THE TOP OF THE INTERNAL RELIEF VALVE CARTRIDGE AND INSIDE TURN THE HEX. HEAD SCREW 1/16 CW TO INCREASE THE TEMPERATURE. RECHECK PRESSURE. IF AFTER ¼ TURN AND PRESSURE DOES NOT INCREASE HEATER SPOOL STROKE LIMITER MAY NEED TO BE ADJUSTED OUT CCW TO INCREASE FLOW THE THE HEATER MOTOR.

INTERNAL ADJUSTABLE RELIEF VALVE



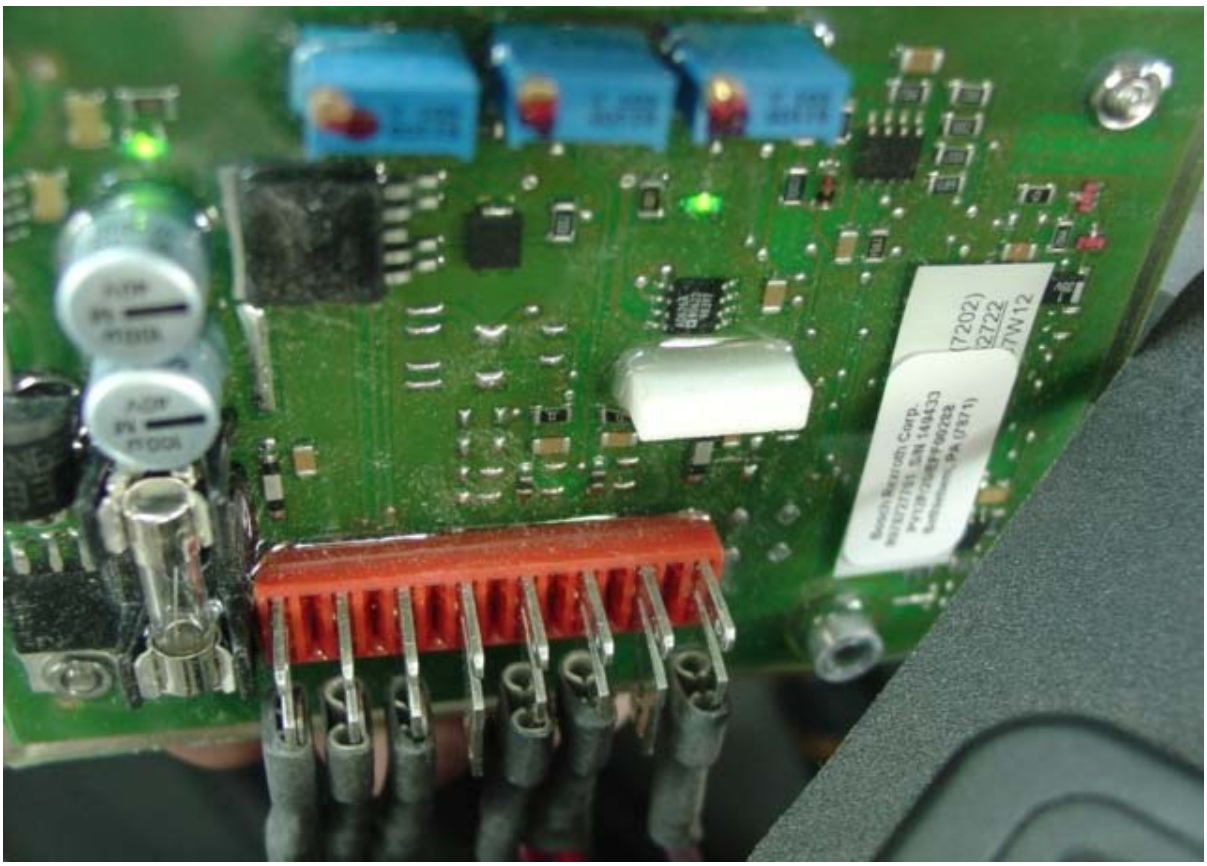
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UP-8 TEMPERATURE CONTROL



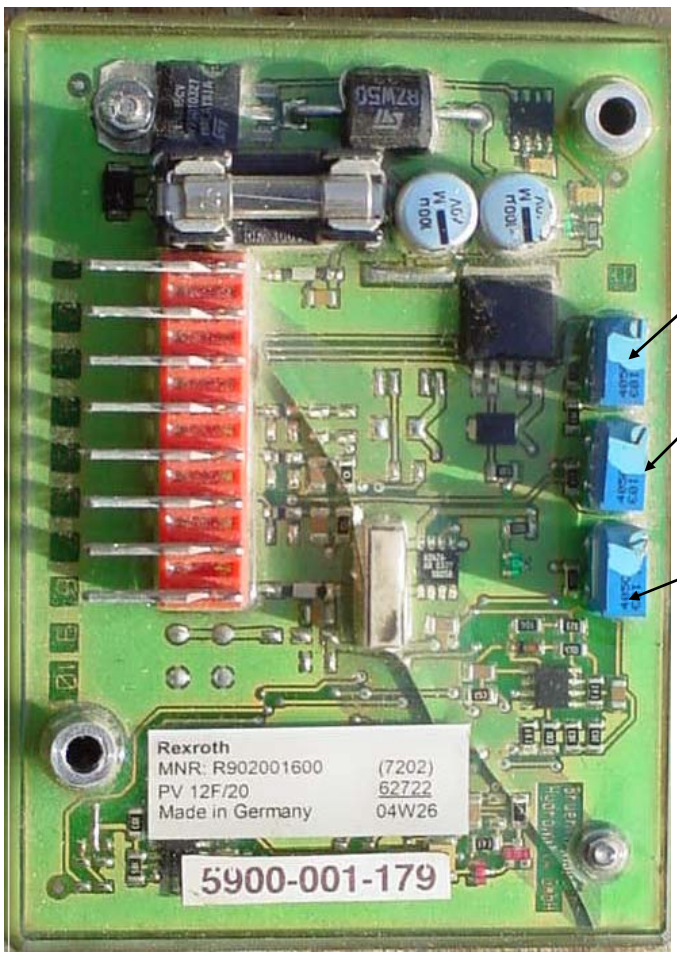
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TWO GREEN LED'S GLOWING INDICATE HEATER CARD INPUT AND OUTPUTS ARE CORRECT.



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HEATER CARD OUTPUT ADJUSTMENTS



R1=Ramp adjustment

R2=Max. adjustment 1500 MA

R3=Min. adjustment 900 MA

Adjustment screw: CW increase CCW decrease

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HEATER CARD CONNECTION READINGS WITH FAN SPEED CONTROL SWITCH IN POSITION #1 HEATER CONTROL SWITCH AT MAXIMUM OUTPUT

WIRE CONNECTOR AT THE CARD		
8	SOL +	3.93 VOLTS
7	SOL -	.060 VOLTS
6	POT+	7.73 VOLTS
5	POT SGN	7.72 VOLTS
4	N/C	.006 VOLTS
3	POT-	.060 VOLTS
2	GND	.059 VOLTS
1	PWR	13.37 VOLTS

MIN. RAMP (0+2 S)

900 MA START

1500 MA MAX-6.8 GPM

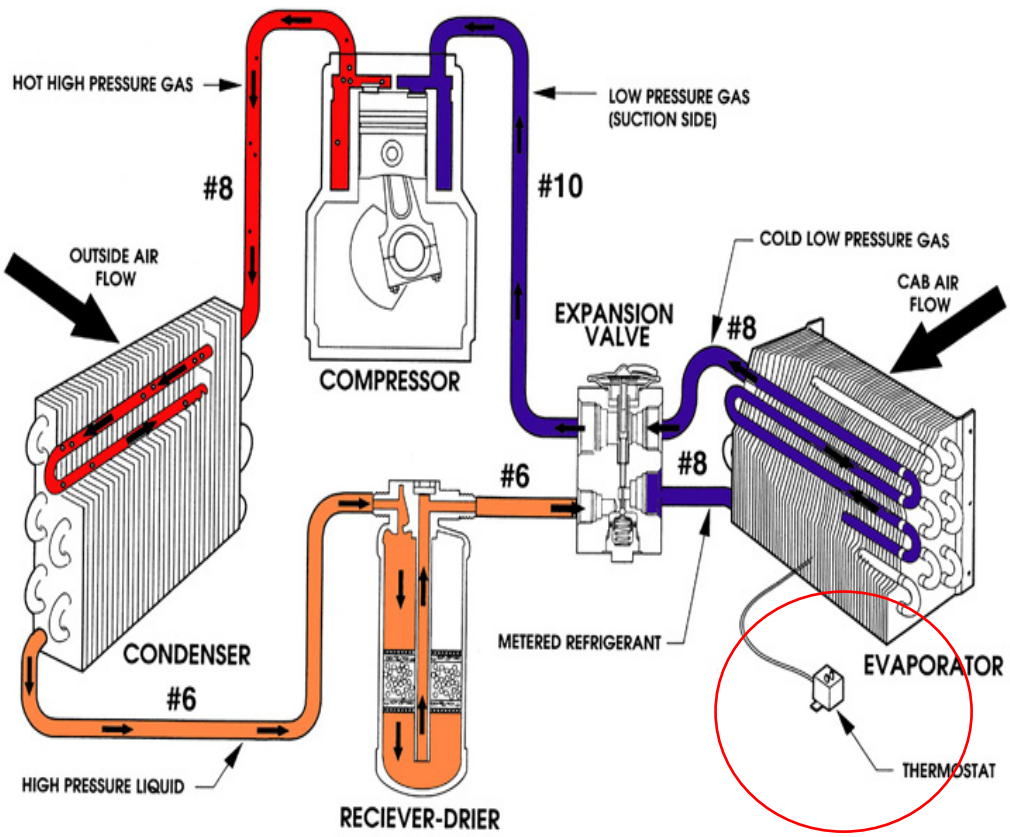
1150 MA STBY=1.5 GPM

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GRADALL R-134a A.C. SYSTEM OPERATION

- ❑ **THERMOSTATIC CUT-OFF SWITCH**

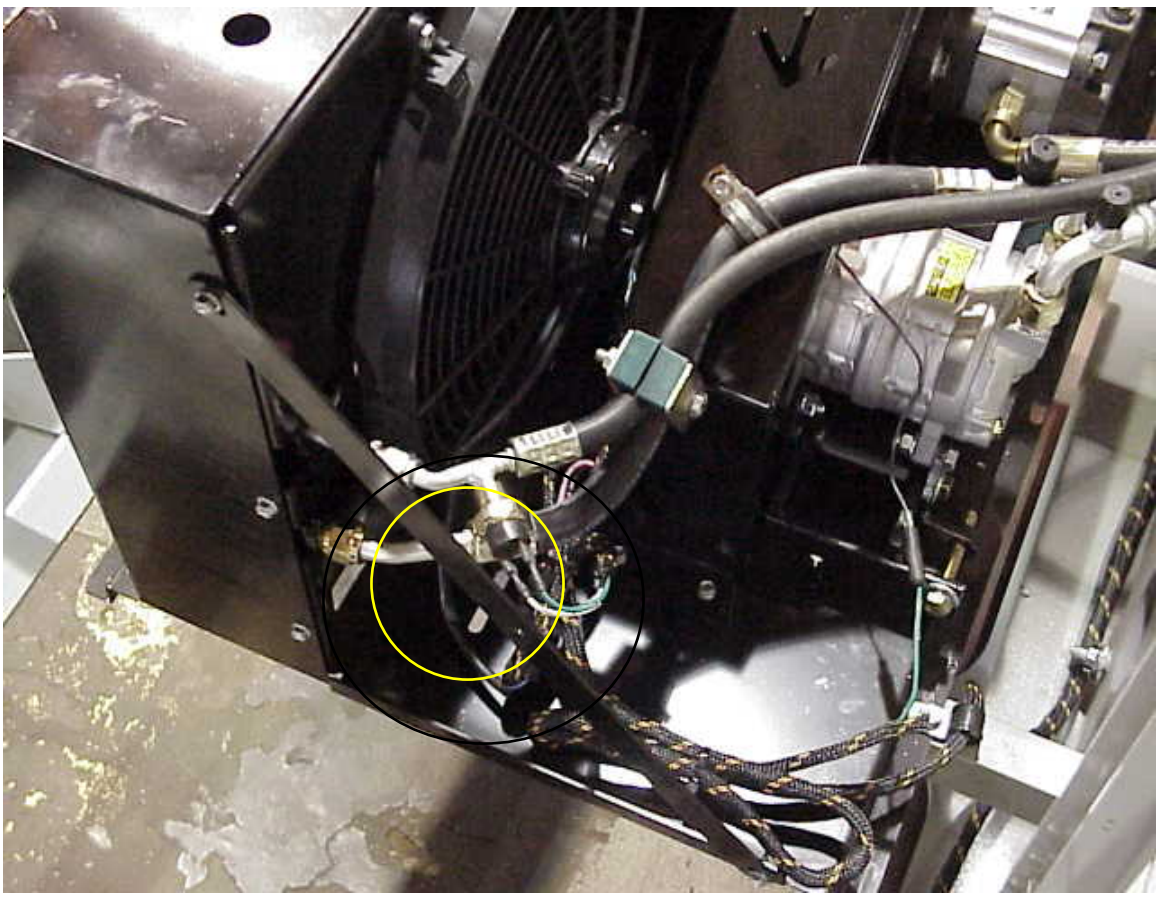
1. **Normally closed switch**
2. **Opens @ 26 degrees F falling temperature. Re-closes @ 35 degree F rising temperature.**



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- **BINARY PRESSURE SWITCH**

1. **Switch is placed in high pressure liquid line at receiver/dryer.**
2. **If pressure falls below 22 psi, then switch opens, switch will re-close once pressure rises above 42 psi.**
3. **If pressure climbs above 455 +- 30 psi, then switch opens. Switch will re-close once pressure falls below 340 +- psi.**



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TYPICAL OPERATING PRESSURE

(90 degree F. ambient; moderate humidity)

1. Low side pressure typically run 20-30 psi range.

Note: a low value could indicate a restriction in the expansion valve.

2. High side pressure typically run 275-300 psi range.

a. Higher temperature/high humidity will drive this value up slightly.

b. Lower temperature/lower humidity will drive this value down slightly.

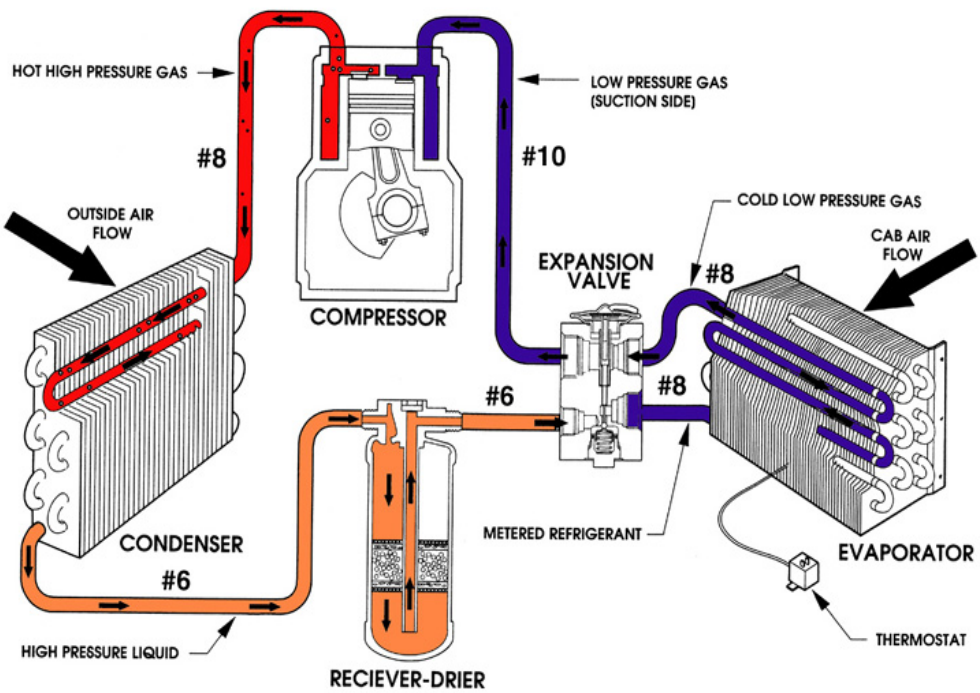
c. If high pressure is significantly higher than 275-300 psi, regardless of weather conditions, system is probably in a state of “OVER-CHARGED”.

d. If system cycles on/off rapidly and does not “COOL”. Sufficiently when running, system is likely “ UNDER-CHARGED.”

e. System Capacity 3 LBS. R-134a.

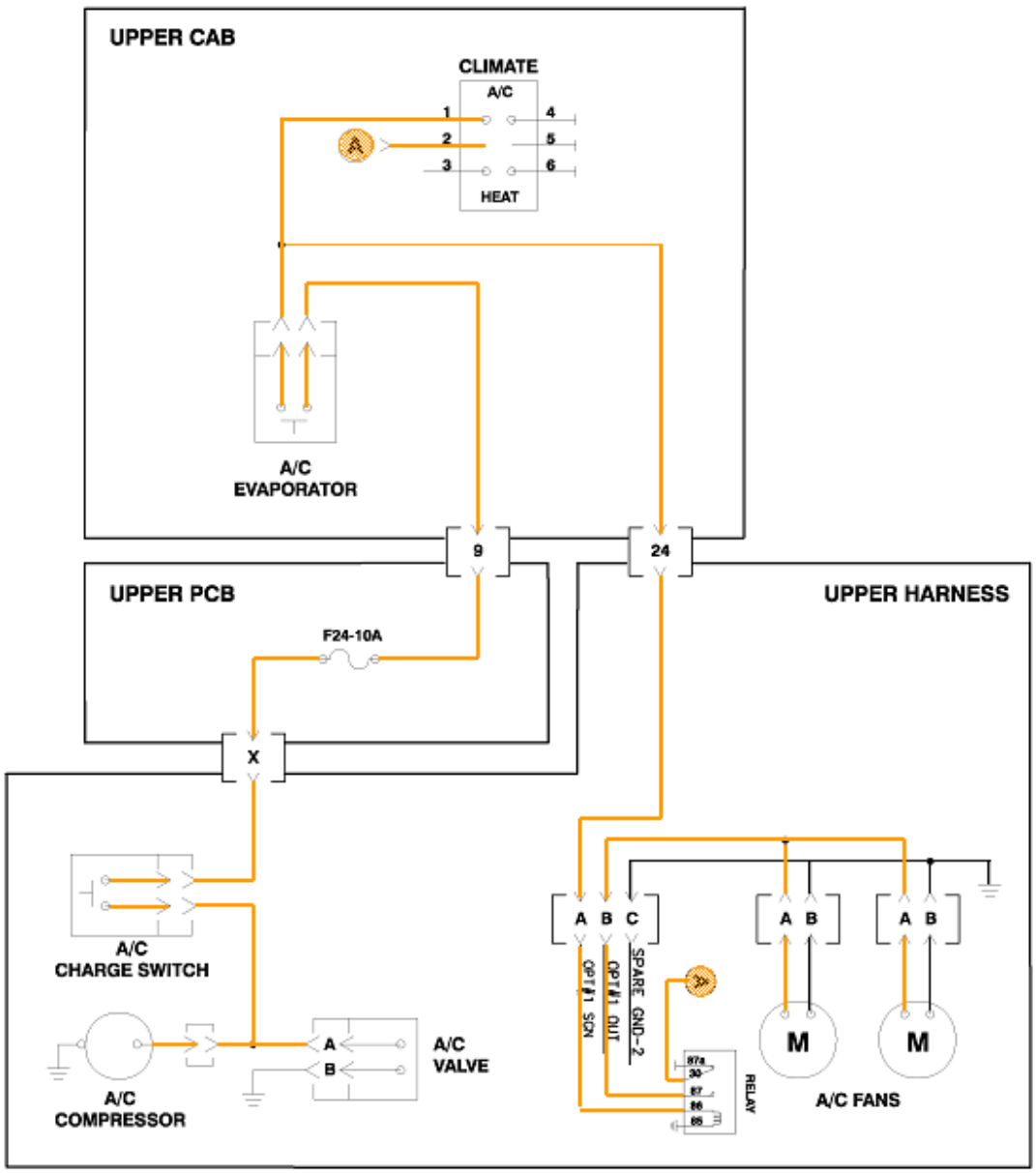
f. Compressor is shipped with oil.

g. System takes 6 oz. of oil.



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UP-23 UPPER A/C (OPTIONAL)



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REVISION HISTORY				
ZONE	REV.	DESCRIPTION	CHECKED	APPROVED
D-4	B	EC 040191 JGK 11/17/04 REVISED SCHEMATIC TO SHOW SHUTTLE VALVE ALONG WITH NEW LINES.	JGK	GTB

190°F SWITCH 8033-3154
1000 PSI
8043-3130
8043-3129 HEATER PUMP/MOTOR ASSEMBLY
220°F SWITCH 8043-3185
8038-3263
A/C COMPRESSOR MOTOR 8036-3199
8044-3003 SWING MOTOR
8032-3026 TILT MOTOR
HOIST
TOOL
BOOM
TRAVEL PEDAL 8043-3128
8048-3133 100 PSI N.O.
LEFT HAND JOYSTICK 8043-3207
RIGHT HAND JOYSTICK 8043-3208
QUICK DISCONNECT BULKHEAD SAE PATTERN SHOWN
8033-3100 100 PSI N.O.
AUX 8043-3143 (OPTIONAL)
TILT RIGHT
TILT LEFT
SWING BRAKE
SET AT 850 PSI
PILOT SHUT OFF VALVE
PILOT MANIFOLD 8043-3199
SET AT 500 PSI
8043-3009 MAIN VALVE
8033-3136 6.3 GPM 1800 PSI
8033-3201 1800 RPM
8027-3021
8033-3098 150 DEG F
8043-3209 .045"
8043-3206 200 PSI
8038-3388
2320 PSI
2000 PSI
7738-3697
POWER STEERING CIRCUIT
8038-3384 .55 IN^3/REV
8038-3263
8038-3302
8038-3097 SUSPENSION LOCKOUT CYLINDER
8038-3097 SUSPENSION LOCKOUT CYLINDER
CENTER PIN 8033-3019
MAIN PUMP 8043-3015
8093-3068 10 PSIG BREATHER
.3 PSIG
8097-3044
8038-3082 1900 PSI 3:1 RATIO
4 PSI MAKE-UP CHECK
8048-3001
8023-3077 5" HG
8027-3086 100 MESH
8038-3310
HYDRAULIC RESERVOIR 8048-6010
TOTAL TANK VOLUME: 69.0 GAL
HIGH COLD VOLUME: 37.6 GAL
HIGH HOT VOLUME: 48.6 GAL
LEVEL SWITCH 8093-3061
8038-3209 190°F SWITCH

NOTE

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TOLERANCES UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS ARE IN INCHES
2. INTERPRET GEOMETRIC DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994
3. TOLERANCES: ±.060"
4. ANGULAR DIMENSIONS TOLERANCE: ±1°

ITEM QTY	PART NUMBER	DESCRIPTION
,	PAINT ,	

APPROVED BY BMW
CHECKED BY CES
DRAWN BY JAM
DATE 8/20/02

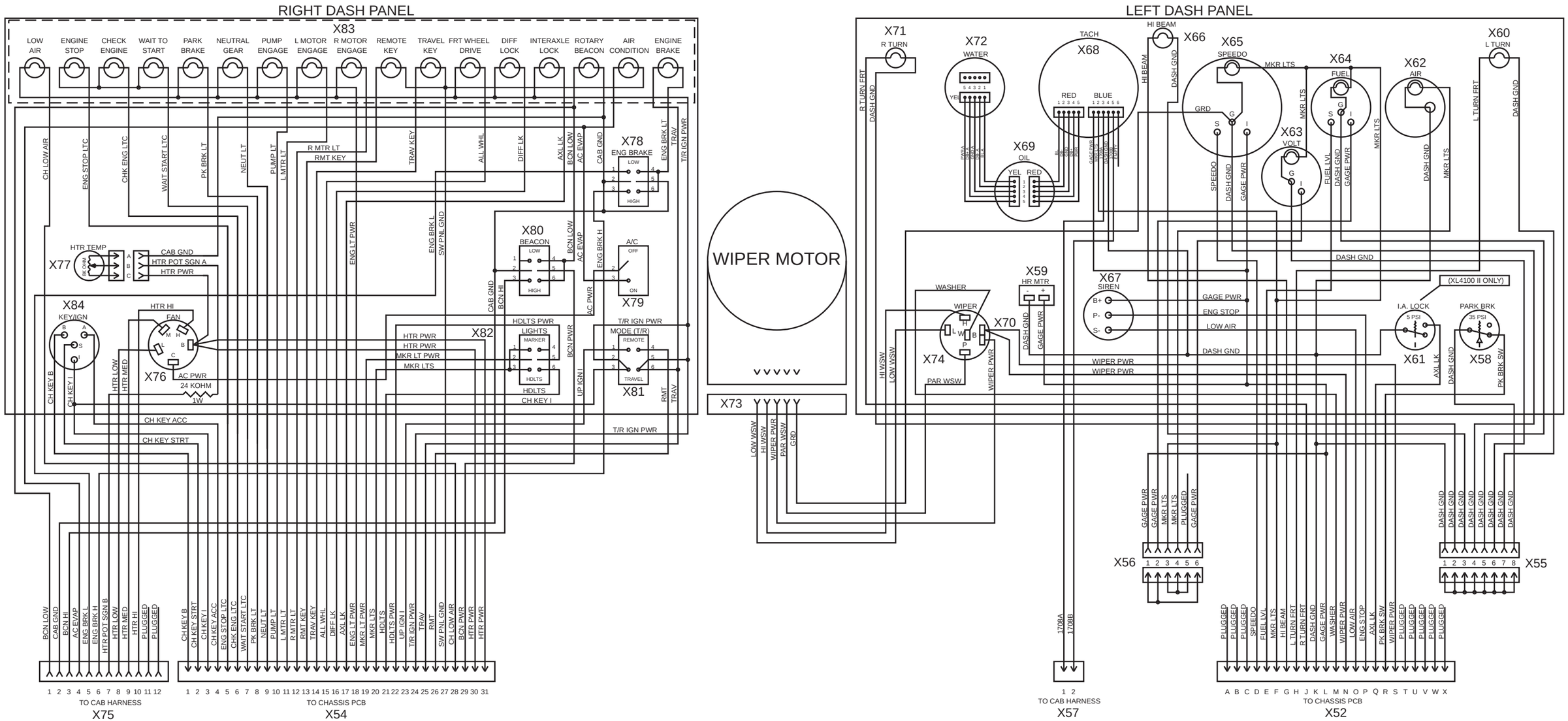
THE GRADALL COMPANY
NEW PHILADELPHIA, OHIO

TITLE: HYDRAULIC SCHEMATIC
MATERIAL: XL4100 II
SIZE 4 | CAGE CODE 10086 | 8040-9001 | REV. B
SCALE , | WGT , | SHEET 1 OF 1

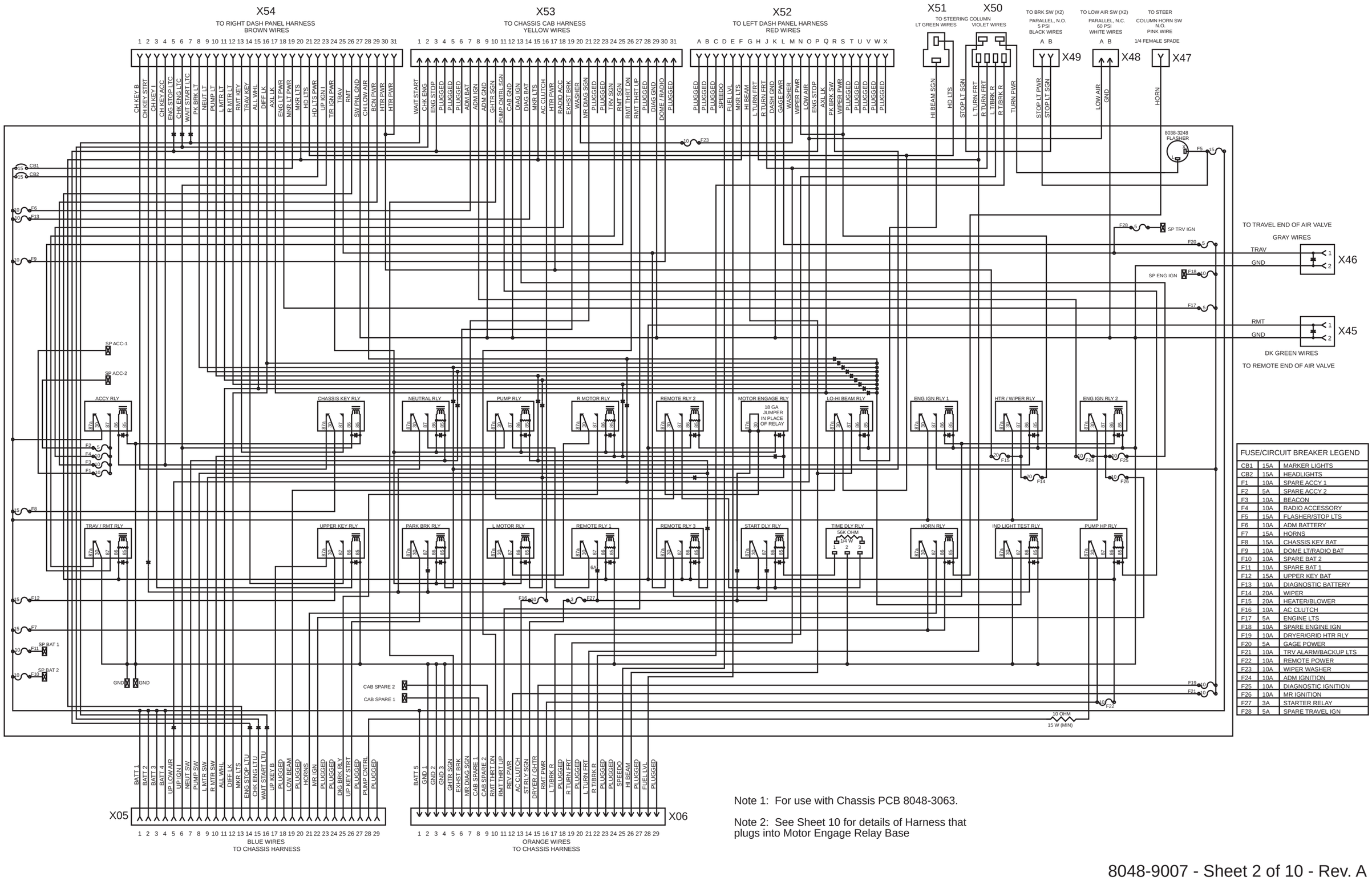
SUPERSEDES , | SIMILAR TO , | M- 8040-0000
ORIGINAL RELEASE: ,
FORMAT_3D_SIZE4.dwg REV. D 07-02-02

SUPERSEDED BY ,

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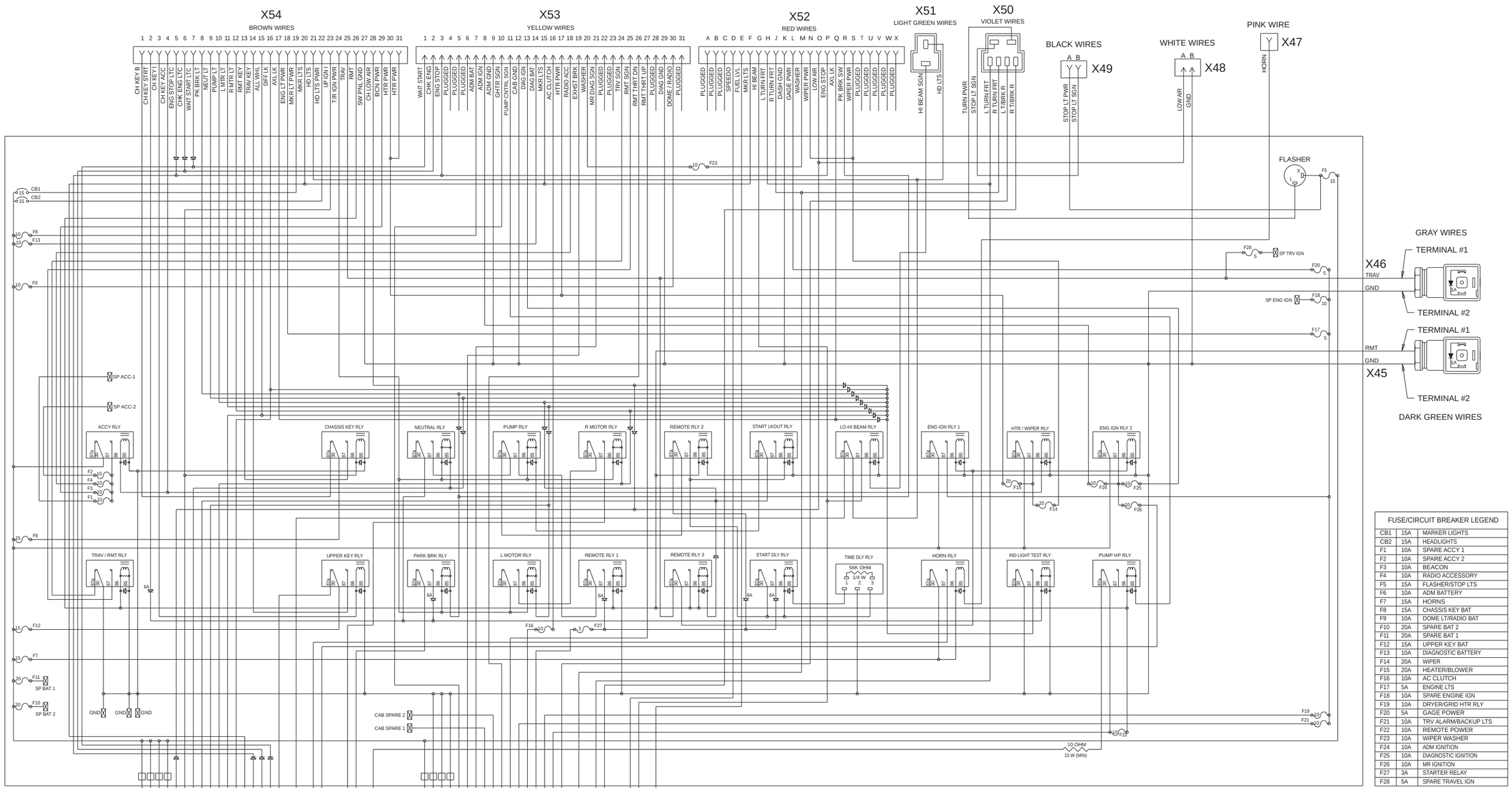


FUSE/CIRCUIT BREAKER LEGEND		
CB1	15A	MARKER LIGHTS
CB2	15A	HEADLIGHTS
F1	10A	SPARE ACCY 1
F2	5A	SPARE ACCY 2
F3	10A	BEACON
F4	10A	RADIO ACCESSORY
F5	15A	FLASHER/STOP LTS
F6	10A	ADM BATTERY
F7	15A	HORNS
F8	15A	CHASSIS KEY BAT
F9	10A	DOME LT/RADIO BAT
F10	10A	SPARE BAT 2
F11	10A	SPARE BAT 1
F12	15A	UPPER KEY BAT
F13	10A	DIAGNOSTIC BATTERY
F14	20A	WIPER
F15	20A	HEATER/BLOWER
F16	10A	AC CLUTCH
F17	5A	ENGINE LTS
F18	10A	SPARE ENGINE IGN
F19	10A	DRYER/GRID HTR RLY
F20	5A	GAGE POWER
F21	10A	TRV ALARM/BACKUP LTS
F22	10A	REMOTE POWER
F23	10A	WIPER WASHER
F24	10A	ADM IGNITION
F25	10A	DIAGNOSTIC IGNITION
F26	10A	MR IGNITION
F27	3A	STARTER RELAY
F28	5A	SPARE TRAVEL IGN

Note 1: For use with Chassis PCB 8048-3063.

Note 2: See Sheet 10 for details of Harness that plugs into Motor Engage Relay Base

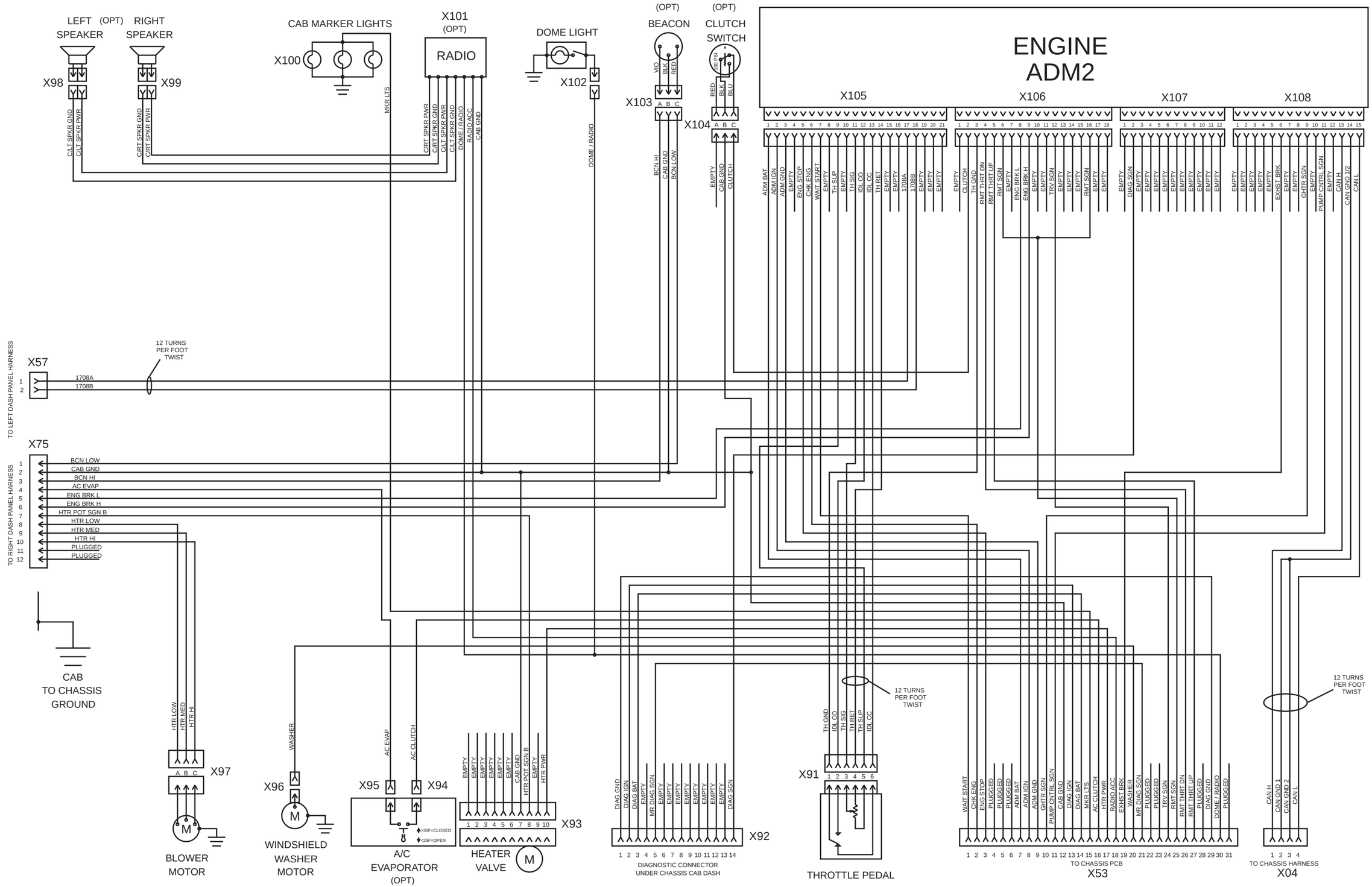
https://truckmanualshub.com/



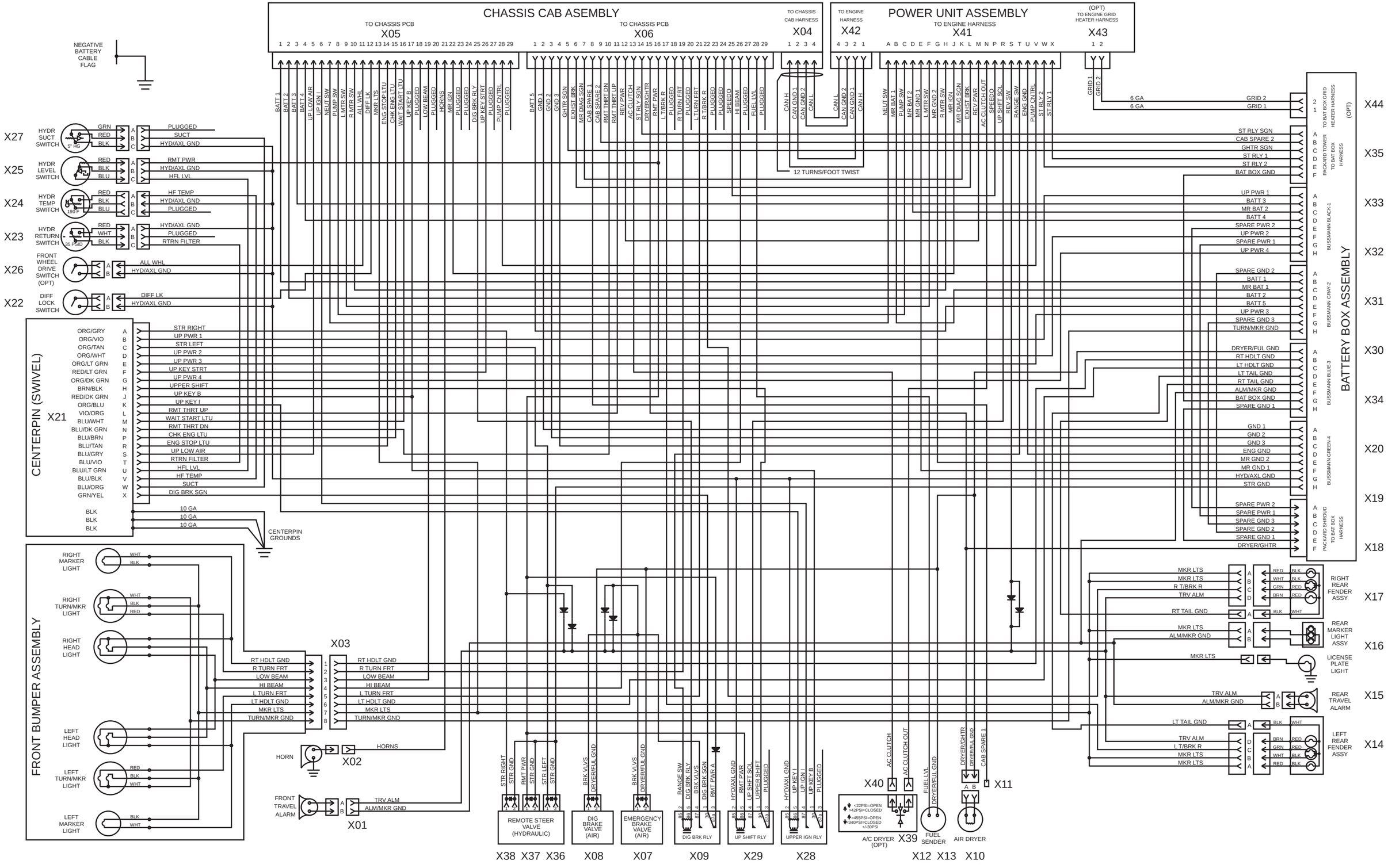
Note: For use with Chassis PCB 8048-3172.

FUSE/CIRCUIT BREAKER LEGEND		
CB1	15A	MARKER LIGHTS
CB2	15A	HEADLIGHTS
F1	10A	SPARE ACCY 1
F2	10A	SPARE ACCY 2
F3	10A	BEACON
F4	10A	RADIO ACCESSORY
F5	15A	FLASHER/STOP LTS
F6	10A	ADM BATTERY
F7	15A	HORNS
F8	15A	CHASSIS KEY BAT
F9	10A	DOME LT/RADIO BAT
F10	20A	SPARE BAT 2
F11	20A	SPARE BAT 1
F12	15A	UPPER KEY BAT
F13	10A	DIAGNOSTIC BATTERY
F14	20A	WIPER
F15	20A	HEATER/BLOWER
F16	10A	AC CLUTCH
F17	5A	ENGINE LTS
F18	10A	SPARE ENGINE IGN
F19	10A	DRYER/GRID HTR RLY
F20	5A	GAGE POWER
F21	10A	TRV ALARM/BACKUP LTS
F22	10A	REMOTE POWER
F23	10A	WIPER WASHER
F24	10A	ADM IGNITION
F25	10A	DIAGNOSTIC IGNITION
F26	10A	MR IGNITION
F27	3A	STARTER RELAY
F28	5A	SPARE TRAVEL IGN

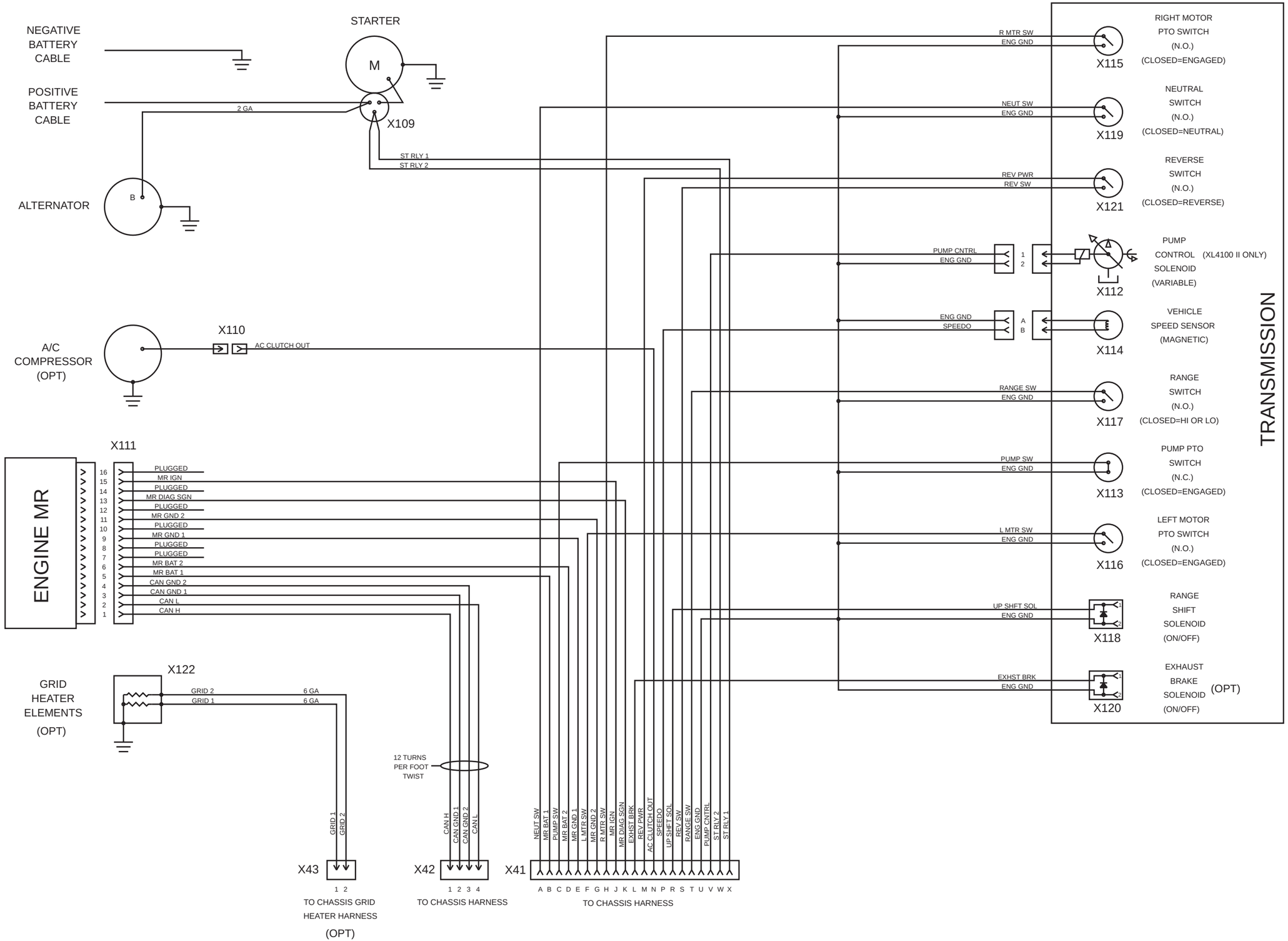
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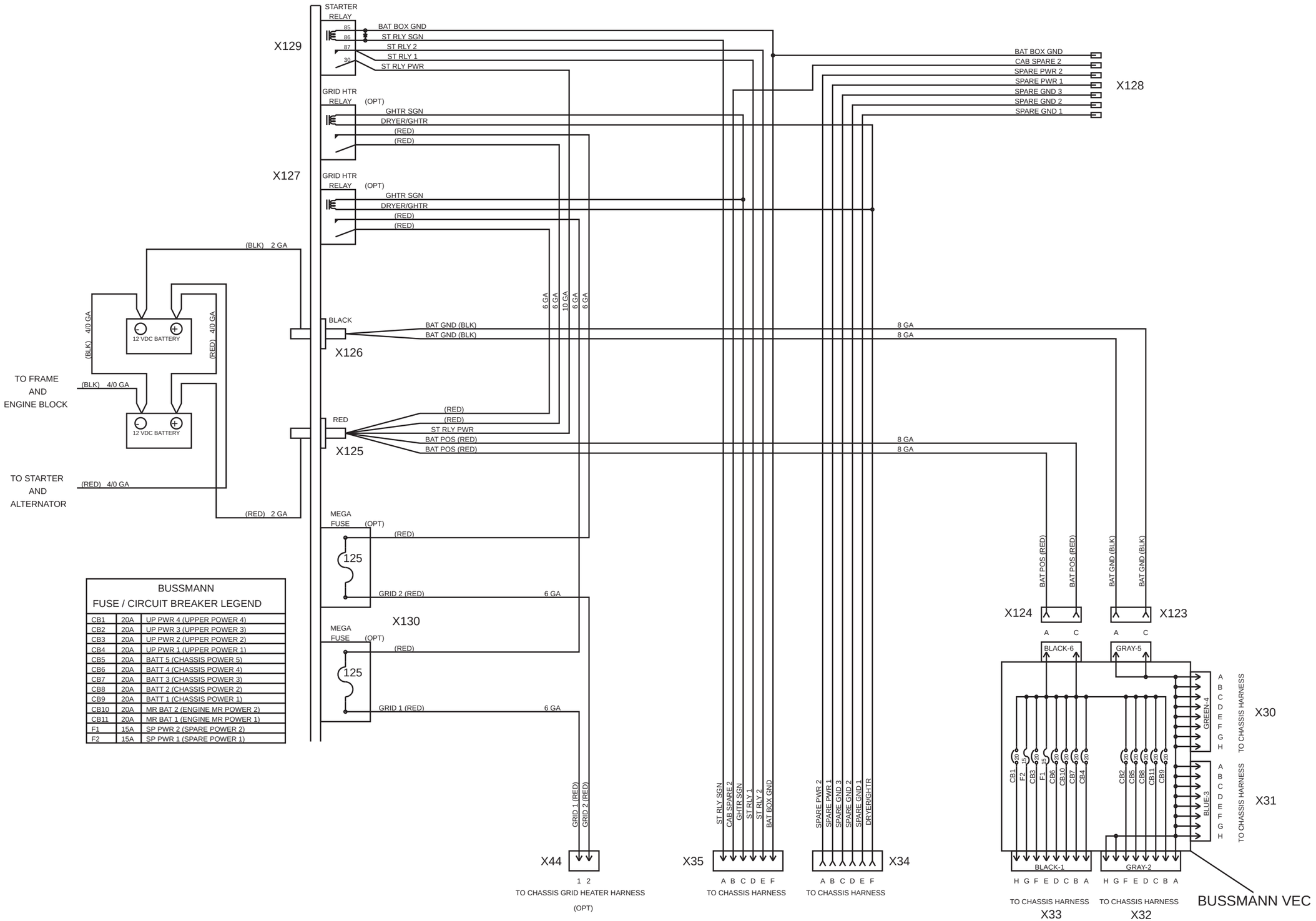
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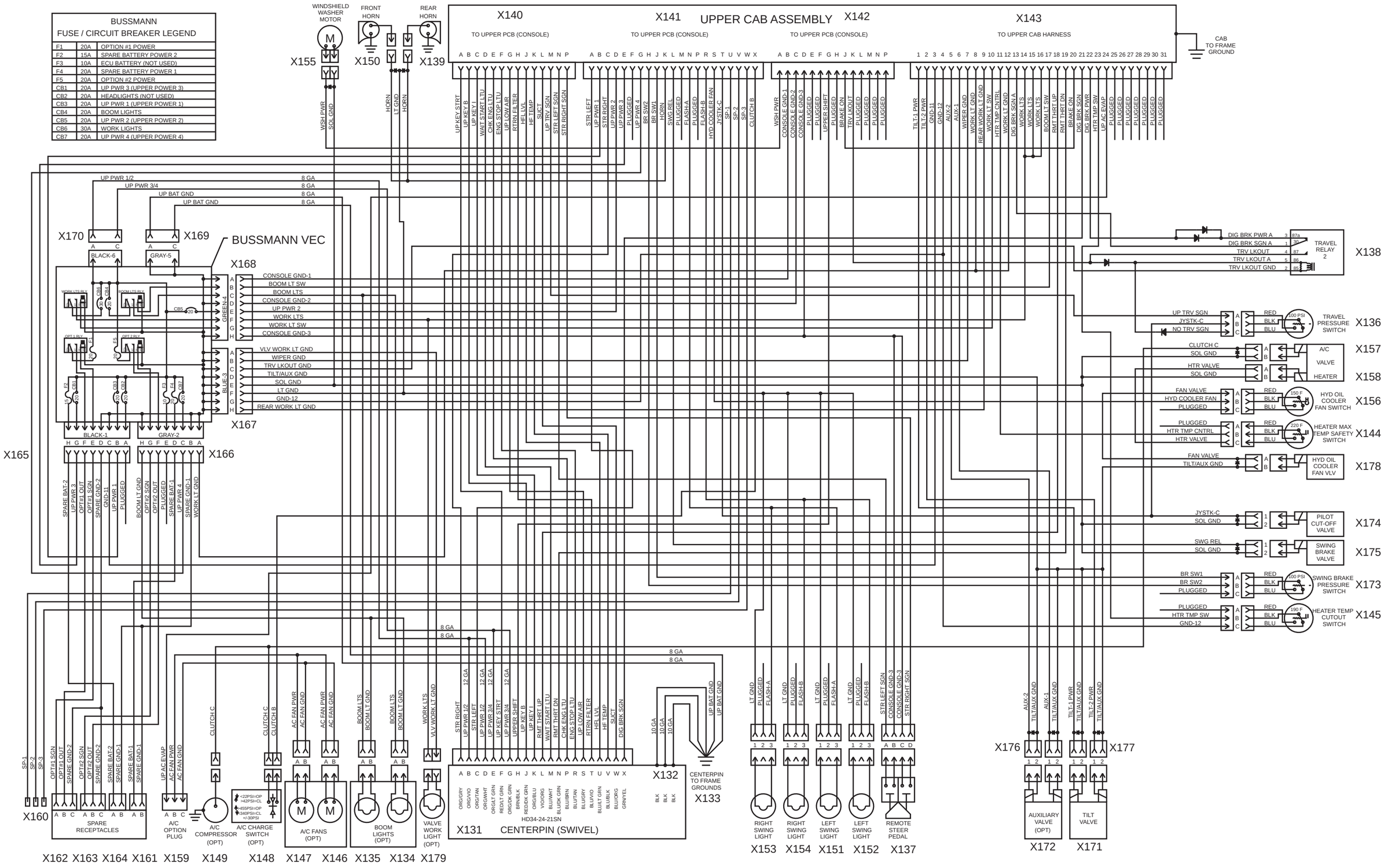


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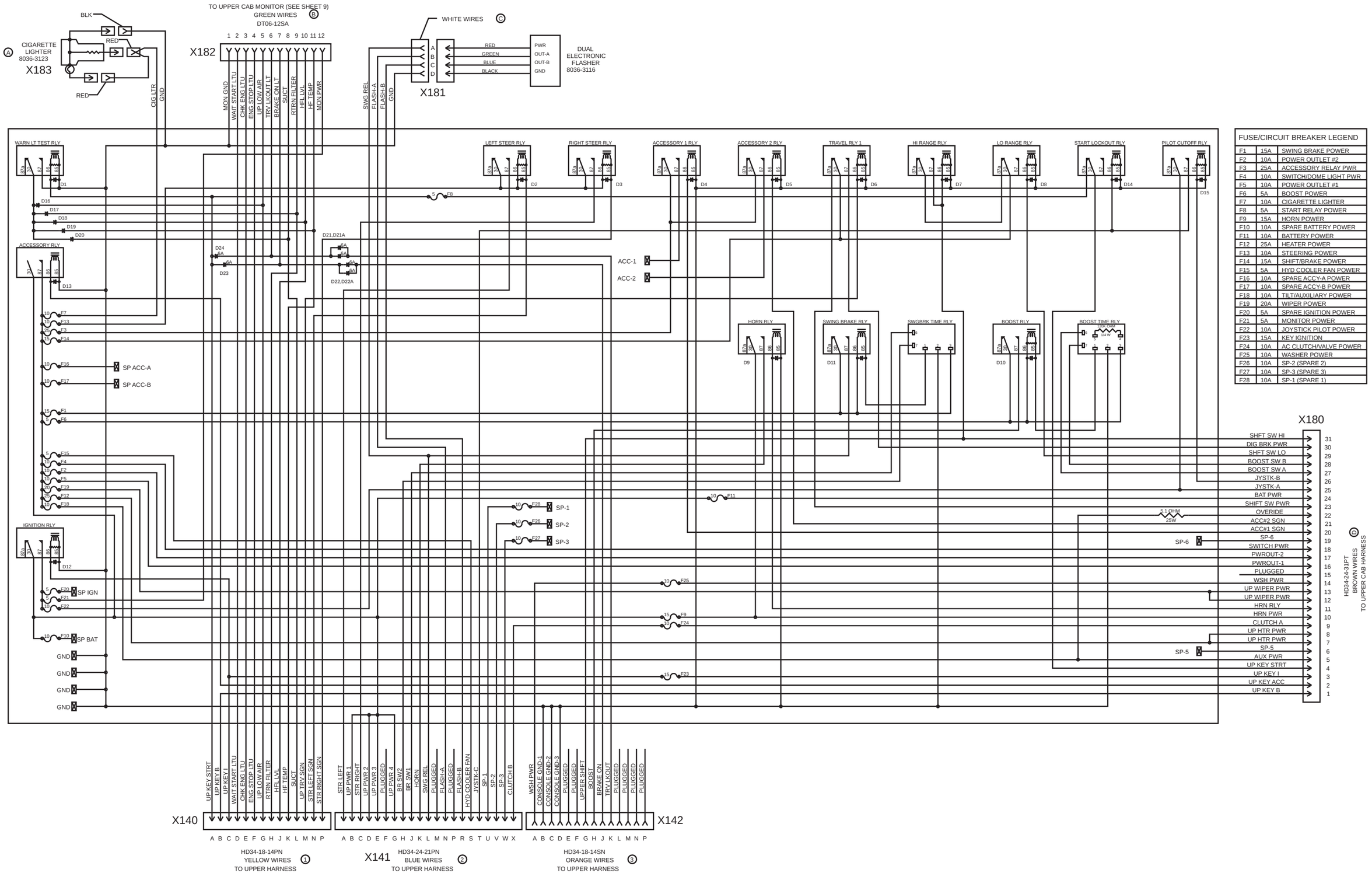


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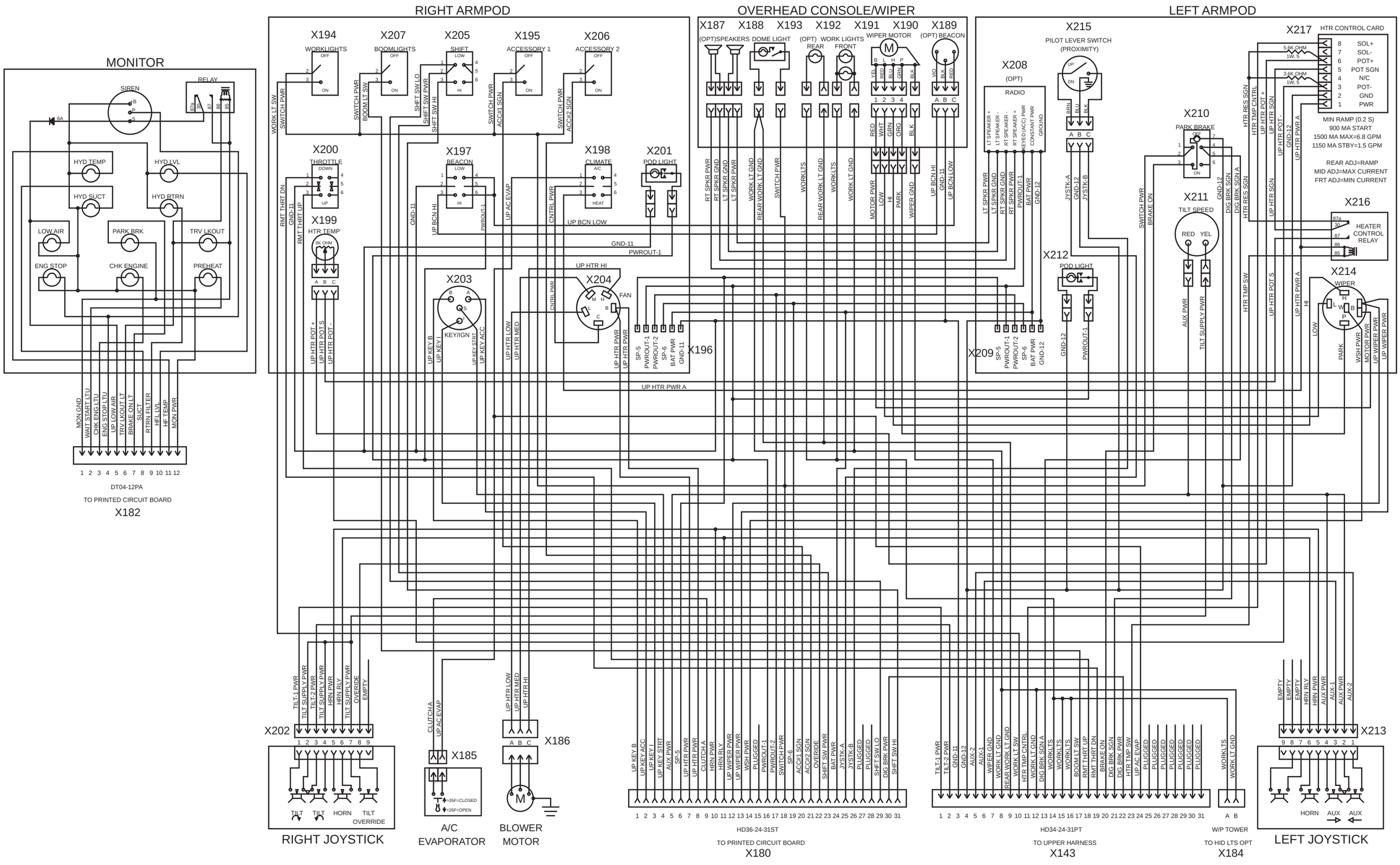
BUSSMANN FUSE / CIRCUIT BREAKER LEGEND		
F1	20A	OPTION #1 POWER
F2	15A	SPARE BATTERY POWER 2
F3	10A	ECU BATTERY (NOT USED)
F4	20A	SPARE BATTERY POWER 1
F5	20A	OPTION #2 POWER
CB1	20A	UP PWR 3 (UPPER POWER 3)
CB2	20A	HEADLIGHTS (NOT USED)
CB3	20A	UP PWR 1 (UPPER POWER 1)
CB4	20A	BOOM LIGHTS
CB5	20A	UP PWR 2 (UPPER POWER 2)
CB6	30A	WORK LIGHTS
CB7	20A	UP PWR 4 (UPPER POWER 4)



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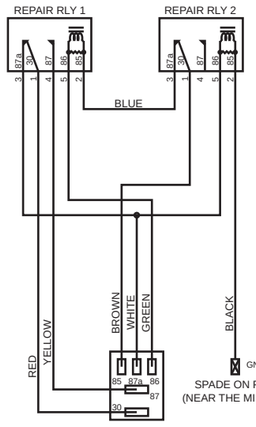
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AMENDMENT TO SHEET 2-CHASSIS PRINTED CIRCUIT BOARD

STARTER ENGAGEMENT PROTECTION FOR 8048-3063 PRINTED CIRCUIT BOARD-FEBRUARY 2003
(THIS AMENDMENT DOES NOT APPLY TO 8048-3172 PRINTED CIRCUIT BOARD)



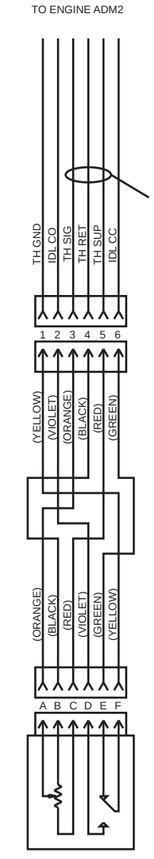
SPADE ON PCB
(NEAR THE MIDDLE)

RELAY SOCKET ON CIRCUIT BOARD
LABELED 'PUMP RLY'
(LOWER RIGHT AREA OF PRINTED CIRCUIT BOARD-DISCARD RELAY)

RELAY SOCKET LEGEND
GREEN (86): TRAVEL AND REMOTE IGNITION POWER ON THIS TERMINAL
BLACK (85): GROUND ON THIS TERMINAL IF PUMP PTO ENGAGED, OTHERWISE 12V
RED (30): UPPER KEY START SIGNAL FROM NEUTRAL RELAY ON THIS TERMINAL
YELLOW (87): UPPER KEY START SIGNAL TO STARTER RELAY ON THIS TERMINAL
WHITE (87a): UPPER KEY START SIGNAL TO TIMED RELAY PWR ON THIS TERMINAL

AMENDMENT TO SHEET 3-CHASSIS CAB

CHANGE FROM MORSE THROTTLE PEDAL
TO WILLIAMS THROTTLE PEDAL-MARCH 2003



THROTTLE PEDAL
(WILLIAMS)

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REVISION HISTORY				
ZONE	REV.	DESCRIPTION	CHECKED	APPROVED
.	A	EC 030105 ALG 05/15/03 ADDED FRONT DRIVE VALVE, AND TRANSFERCASE VALVE	SNM	JAB
.	2	GIBB 03/12/03 TANK#1 (LH) WAS TANK#2. TANK#2 (RH) WAS TANK#1.	SNM	JAB
.	1	WR 8048-003 KRH 5/31/02 RELEASE FOR PROTOTYPE	SNM	JAB

FRONT RELAY
FRONT BRAKE CHAMBERS
REAR SERVICE RELAY
AIR DRYER
AIR COMP.
M
85 PSI PRESS. REGULATOR
SPRING RELAY
REAR BRAKE CHAMBERS
REAR/REAR BRAKE CHAMBERS
EMERGENCY BRAKE VALVE
S
D
NORMALLY CLOSED PRESS. SW. PARK BRAKE LIGHT
BRAKE PEDAL VALVE
REAR
LOW AIR SW.
FRONT
LOW AIR SW.
BRAKE LIGHT SW.
BRAKE LIGHT SW.
AIR GAGE
(FRONT) WHITE POINTER
(REAR) RED POINTER
SPRING BRAKE VALVE
55 PSI
DEL
C
RES
#2 TANK (RH)
65 PSI
#1 TANK (LH)
150 PSI
REAR/REAR SERVICE RELAY
RANGE SELECTOR (SHIFTER HANDLE)
DOWN-LOW UP-HIGH (SHOWN DOWN)
BLACK TUBE
P
S
E
RED TUBE
TRANS. FILTER/REGULATOR
T
42
315
INTERAXLE DIFF LOCK VALVE
INTERAXLE DIFF. LOCK (ON AXLE)
ENGAGE / DISENGAGE
REMOTE/TRAVEL VALVE (SHOWN IN TRAVEL)
3
4
5
2
4
UPPER EMERGENCY BRAKE VALVE (SETS SPRING BRAKES WHEN IN REMOTE AND UPPER IGN. SW. IS OFF.)
BRAKE INTERFACE VALVE
315
24
5 PSI
ORIFICE CHECK SOFTENS REMOTE BRAKE APPLICATION
ORIFICE ADJUSTMENT: 3/4 TURN FROM FULLY CLOSED
DIFF. LOCK VALVE
REAR AXLE DIFF. LOCK (ON AXLE)
DISENGAGE / ENGAGE
FRONT DRIVE VALVE (6X6 ONLY)
TRANSFER CASE FRONT AXLE DRIVE (6X6 ONLY)
ENGAGE / DISENGAGE
ENGAGE / DISENGAGE
PUMP AND REMOTE MOTOR PTO'S
22
22
OSCILATION LOCK VALVE
RANGE SLAVE ACTUATING SHAFT
P
S
L
H
RANGE SLAVE VALVE
UPPER SHIFT SOLENOID VALVE
315
14
24
HI RANGE
LO RANGE
TRANS. RANGE SHIFT CYL.
(OPTIONAL) EXHAUST BRAKE VALVE
315
24
(OPTIONAL) EXHAUST BRAKE AIR CYLINDER
OFF / ON

ITEM	QTY	PART NUMBER	DESCRIPTION
.	.	.	.

NOTE

THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION AND SUCH INFORMATION MAY NOT BE DISCLOSED TO OTHERS FOR ANY PURPOSE OR USED FOR MANUFACTURING PURPOSE WITHOUT WRITTEN PERMISSION FROM THE GRADALL COMPANY.

TOLERANCES UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS ARE IN INCHES
2. INTERPRET GEOMETRIC DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994
3. TOLERANCES: ±.060"
4. ANGULAR DIMENSIONS TOLERANCE: ±1°

PAINT .
APPROVED BY JAB
CHECKED BY SNM
DRAWN BY KRH
DATE 5/31/02

THE GRADALL COMPANY
NEW PHILADELPHIA, OHIO

TITLE: XL4100-II AIR SCHEMATIC
MATERIAL: 6X4 & 6X6
SIZE 4 | CAGE CODE 10086 | 8048-9004 | REV. A
SCALE . | WGT . | SHEET 1 OF 1

SUPERSEDED BY .

SUPERSEDES .	SIMILAR TO .	M-8048-5001, 5002

ORIGINAL RELEASE: WR 8048-003

FORMAT_3D_SIZE4.dwg REV. C 04-30-02

FOLIO 1