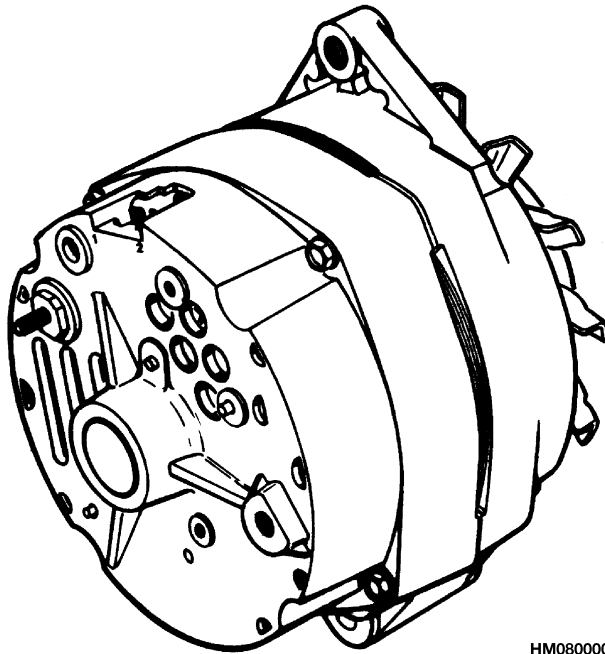


ALTERNATOR WITH REGULATOR

**DELCO, MOTOROLA, AND
LEECE-NEVILLE**

**COVERS DELCO, MOTOROLA, AND
LEECE-NEVILLE ALTERNATORS USED
ON HYSTER LIFT TRUCKS**



HM080000

HYSTER

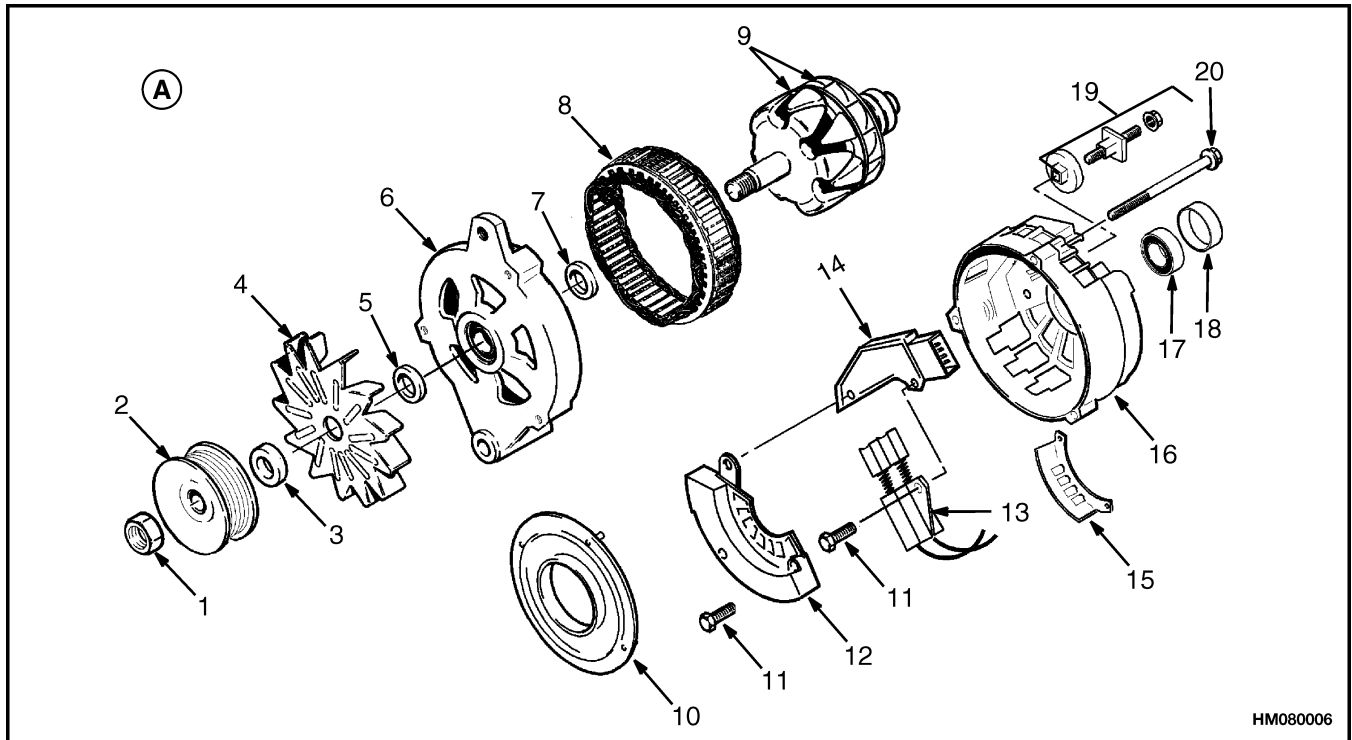
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HM080006

A. DELCO

- | | | |
|-------------------|------------------------|-------------------|
| 1. NUT | 8. STATOR | 15. COVER |
| 2. PULLEY | 9. ROTOR AND FAN | 16. REAR HOUSING |
| 3. COLLAR | 10. BAFFLE | 17. BALL BEARING |
| 4. OUTSIDE FAN | 11. SCREW | 18. RETAINER RING |
| 5. OUTSIDE COLLAR | 12. DIODE BRIDGE | 19. TERMINAL SET |
| 6. FRONT HOUSING | 13. BRUSHES AND HOLDER | 20. BOLT |
| 7. INSIDE COLLAR | 14. VOLTAGE REGULATOR | |

Figure 6. Type B Alternator, Exploded View**Assemble**

1. If the bearing was removed from the rear housing, install a new retainer ring. See Figure 6.

**CAUTION**

The bearing is not completely installed until Step 11 is complete.

2. Install a new bearing by pushing on the new bearing outer race until the bearing hits the bottom in the rear housing.
3. Assemble the voltage regulator, diode bridge, and brush holder on a flat surface. Put crimps in the connectors or solder the connectors to fasten and connect the parts as originally assembled. Use a pin to hold the brushes in the brush holder.
4. Put a thin coating of silicon grease (Delco part number 1974984) on the inside of the rear housing under the diode bridge.
5. Install the bridge, regulator, and brush holder assembly in the rear housing and install the screws as removed during disassembly.
6. Install the baffle and use a punch to fasten the pins.
7. Align the marks made during disassembly and install the stator in the rear housing. Use pliers on the connectors of the diode bridge to keep heat from the diodes. Use a soldering iron to connect the stator leads to the connectors.

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Battery is charged above normal.	Alternator is not charging correctly.	Repair or install new parts.
	Electrical ground in wire to brush or clip.	Repair or install new parts.
	High resistance in the circuit.	Repair or install new parts.
Battery uses more water than normal.	Battery is charging more than normal.	Replace voltage regulator.
	Alternator has damage in the field windings, diodes, diode bridge, or stator.	Install new parts.
	Battery has damage or is too old.	Replace battery.
There is no charge from the alternator.	The brushes are worn or damaged.	Install new brushes.
	Weak springs for brushes. Brushes or brush holders do not move freely.	Install new parts.
	Dirt on the slip rings.	Clean or install new parts.
There is no charge from the alternator. The indicator light or ammeter indicates a discharged condition when the rpm is high and the load is high.	There is an electrical ground in the field winding.	Replace rotor or alternator.
	Drive belt is not tight or is broken.	Adjust or replace drive belt.
Ammeter or the indicator light indicates a discharged condition at all speeds.	There is a short-circuit in the diodes.	Install new parts.
	There is an electrical ground at the end of the windings.	Replace rotor or alternator.
	The voltage regulator has damage.	Replace voltage regulator.

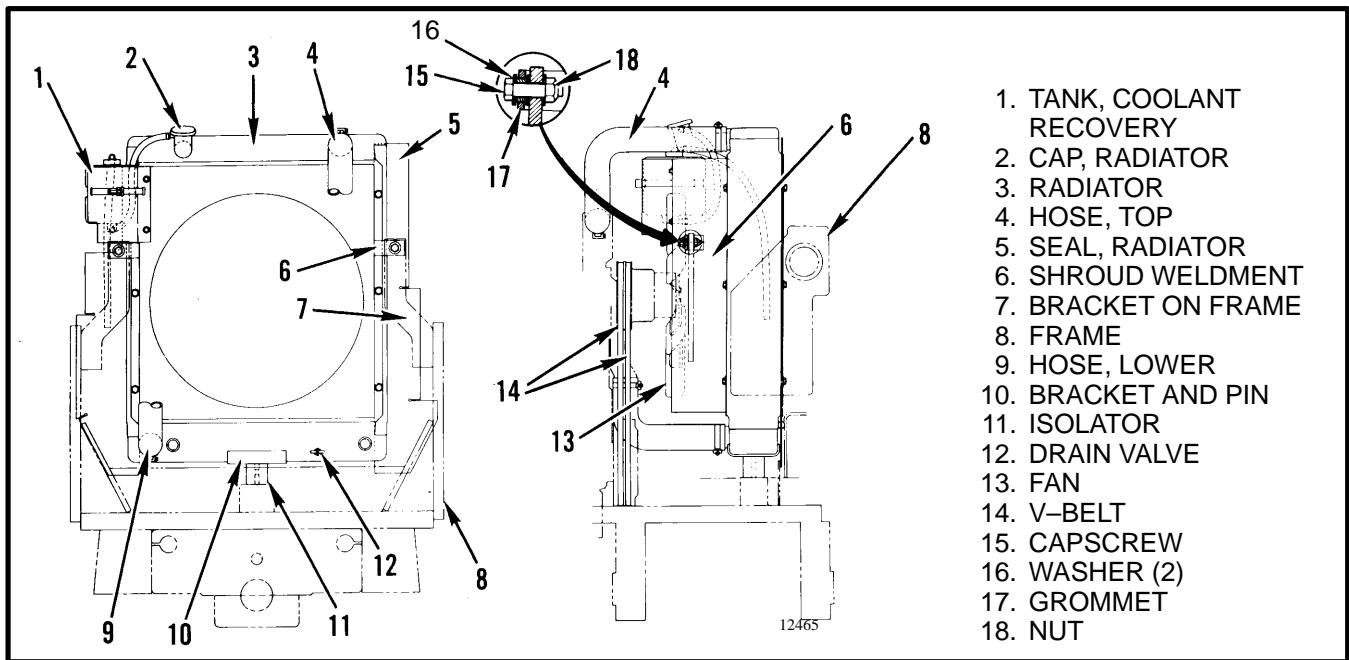


FIGURE 7. RADIATOR

RADIATOR (See FIGURE 7.)

Removal

1. Remove the hood. See the paragraphs **Hood And Air Cleaner**.
2. Drain the radiator. Disconnect the coolant hoses at the radiator.
3. Disconnect the transmission oil lines at the radiator.
4. Remove the fan from the drive pulley.
5. Remove the capscrews between the fan shroud and the radiator.
6. Remove the two capscrew and grommet assemblies that hold the radiator shroud to the bracket on the frame. Remove the radiator and shroud.

Installation

1. Install the brackets on the radiator. Install the radiator and shroud in the frame. Install the two capscrew and grommet assemblies that fasten the shroud weldment to the bracket on the frame. Install the capscrews between the fan shroud and the radiator.
2. Connect the coolant hoses to the radiator.
3. Connect the transmission oil lines to the bottom of the radiator.
4. Install the counterweight and hood assembly.

5. Fill the radiator with coolant. See Maintenance Schedule in the section **PERIODIC MAINTENANCE, 8000 SRM 433** for quantity and anti-freeze requirements.

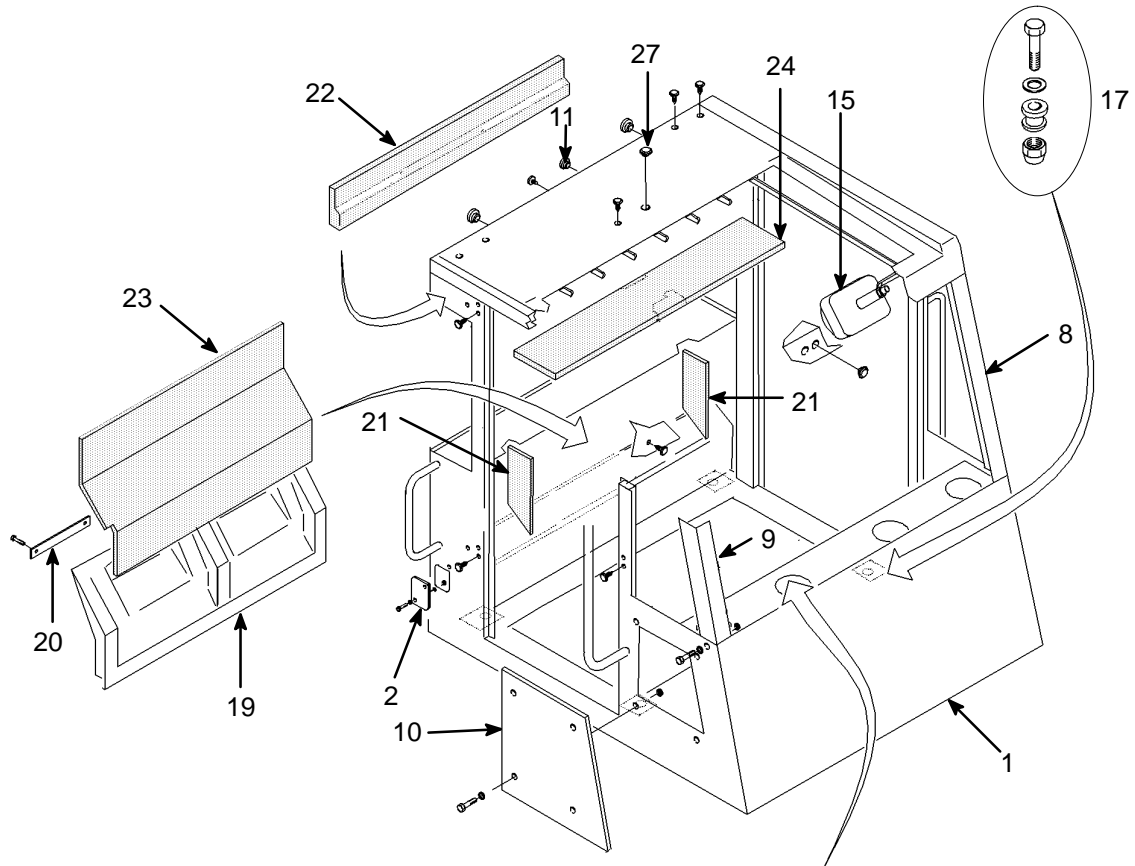
ENGINE and TRANSMISSION

See the sections **PERKINS ENGINE, 600 SRM 412** for repair of the engine. See the transmission section, **POWERSHIFT TRANSMISSION, 1300 SRM 438** for earlier production lift trucks.

Later production lift trucks use the Hyster T-50 powershift transmission. An installation kit is available that enables the installation of the T-50 transmission in earlier production lift trucks. See the section, **THREE-SPEED POWERSHIFT TRANSMISSION, REPAIRS, 1300 SRM 518** for lift trucks with this transmission. The removal of this transmission is described later in this section. See **HYSTER T-50 TRANSMISSION, REMOVAL**.

Removal (Earlier Production Lift Trucks)

1. Disconnect the cables at the battery. (Remove the ground cable first.) Remove the bracket for the battery cables.
2. **H13.00-16.00XL (H300-360XL) units.** Remove the operator compartment. See the paragraph **Operator Compartment**.
3. **H8.00-12.00XL (H165-280XL) units.** Removal of the operator compartment is not required. Tilt the opera-



- | | | |
|-------------------------|-----------------------------|-----------------|
| 1. OPERATOR COMPARTMENT | 13. LATCH ASSEMBLY | 24. SOUND LINER |
| 2. PLATE | 14. PLATE | 25. GASKET (RH) |
| 3. COVER (LH) | 15. MIRROR | 26. GASKET (LH) |
| 4. COVER (RH) | 16. PANEL | 27. PLUG (2) |
| 5. COVER | 17. MOUNT FASTENER ASSEMBLY | |
| 6. COVER | 18. SWITCHES | |
| 7. PLATE | 19. COVER | |
| 8. CORNER ANGLE (LH) | 20. PLATE | |
| 9. CORNER ANGLE (RH) | 21. SOUND LINER | |
| 10. PLATE | 22. SOUND LINER | |
| 11. PLUG (4) | 23. SOUND LINER | |
| 12. DOOR | | |

FIGURE 16. OPERATOR COMPARTMENT WITHOUT CAB

Operator Restraint System (See FIGURE 27.)

The seat belt, seat and mounting are all part of the operator restraint system. Each part must be inspected to make sure the attachment points are fastened correctly and that the part operates correctly and is in good condition.

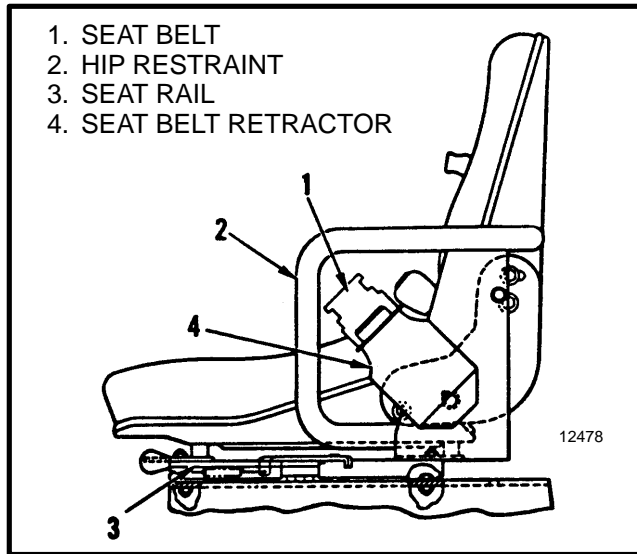


FIGURE 27. CHECK THE SEAT

The seat belt must fasten correctly. Make sure the seat belt can be pulled from the retractor and retracts smoothly and is not worn or damaged.

Make sure the seat rails are fastened correctly at the attachment points. The seat must lock in position on the

seat rails, but the seat must slide freely when it is unlocked.

LABEL REPLACEMENT (See FIGURE 28.)

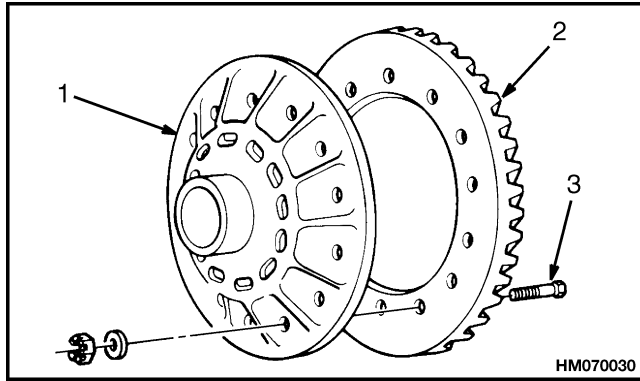
⚠ WARNING

Labels that have WARNINGS or CAUTIONS must be replaced if they are damaged. If a mast of a different size or an accessory carriage is installed, the capacity rating can change. Changes in the kind of drive tires can change the capacity rating. See a dealer for HYSTER lift trucks for a replacement nameplate. The nameplate information is a safety item and must be correct for the equipment and configuration of the lift truck.

1. Make sure the surface is dry and has no oil or grease. Do not use solvent on new paint. Clean the surface of old paint using a cleaning solvent.

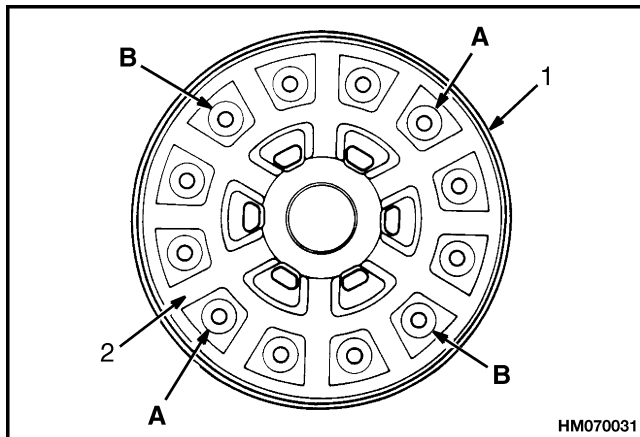
2. Remove the paper from the back of the label. Do not touch the adhesive surface.

3. Carefully hold the label in the correct position above the surface. The label cannot be moved after it touches the surface. Put the label on the surface. Make sure all air is removed from under the label and the corners and edges are tight.



1. FLANGE CASE HALF
2. RING GEAR
3. BOLT HEAD AGAINST GEAR

Figure 8. Installation with Capscrews

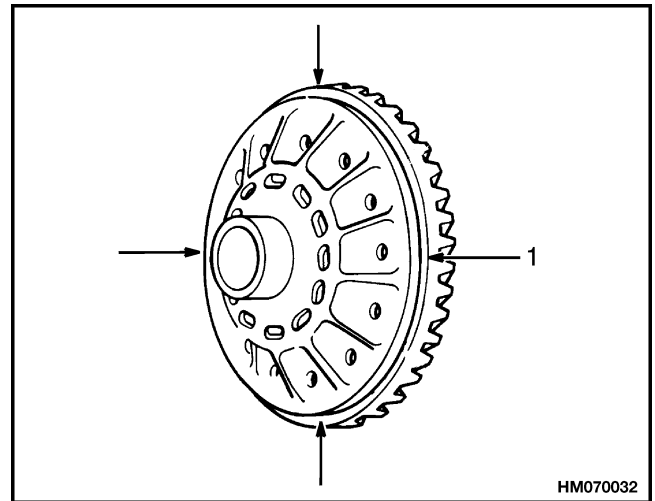


1. RING GEAR
2. CASE HALF

Figure 9. Installation with Rivets

8. Install the bearing cones on both of the case halves. Use a press and a sleeve of the correct size.
9. Apply axle lubricant to the inside surfaces of both case halves, spider (cross), thrust washers, side gears, and differential pinions.

10. Put the flange case half on a bench with the ring gear teeth toward the top.



1. CHECK FOR CLEARANCE FOUR PLACES WITH 0.08 mm (0.003 in.) GAUGE

Figure 10. Gear and Case Half Installation Check

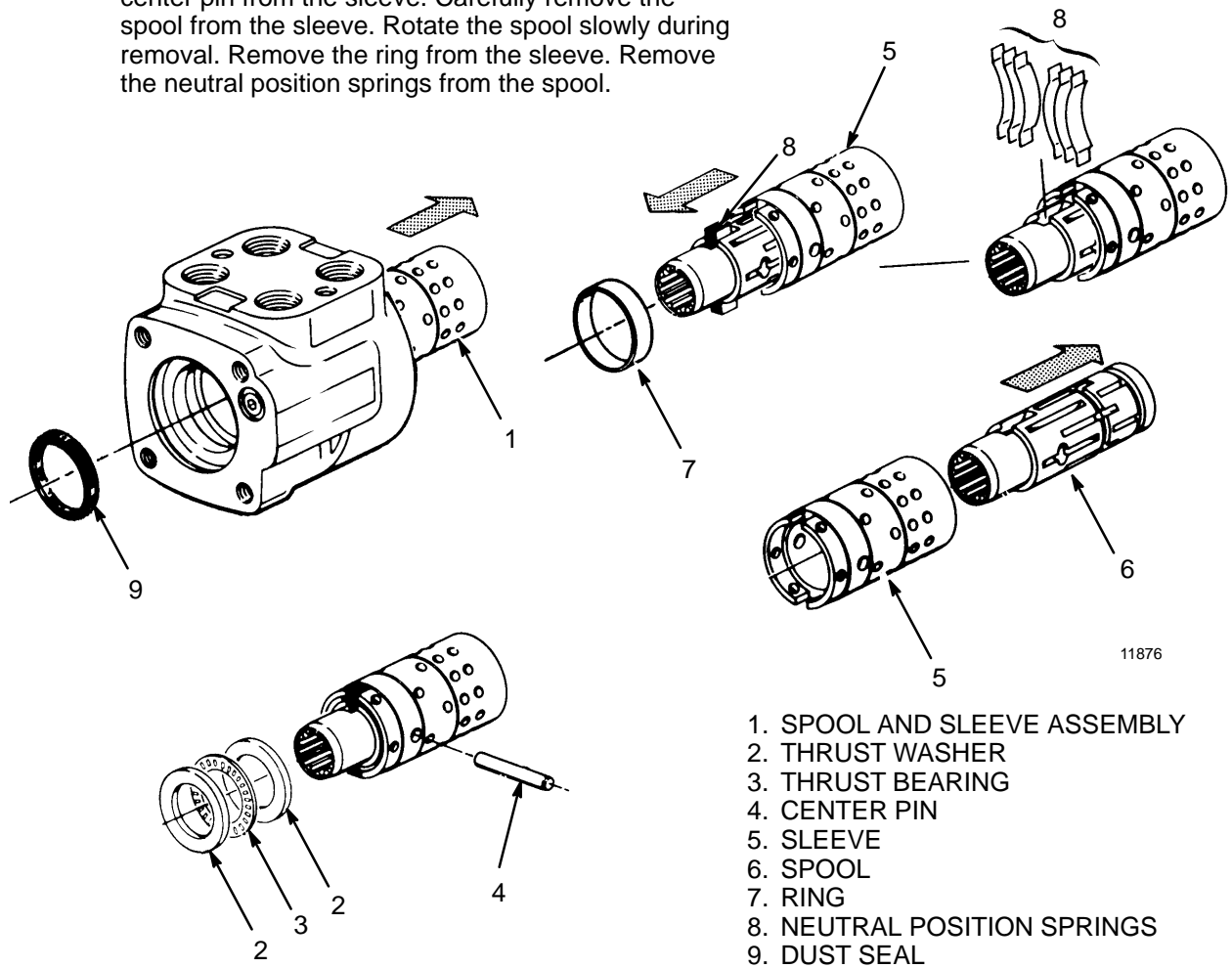
Differential Pinion and Side Gear Assembly, Assemble

1. Install one thrust washer and side gear in the case. Put the pinion gears and thrust washers on the spider. Install the spider assembly in the case. Install the other side gear and thrust washer.
2. Align the marks and assemble the two halves of the differential case. See Figure 11.
3. Use Loctite No. 272[®] on the threads of the cap-screws. Install four of the cap-screws, washers and nuts into the case halves in a cross pattern. The distance between the fasteners MUST be equal. Tighten the fasteners to the correct torque value in a pattern opposite each other. See Figure 12. Also see Table 1.

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
The lift truck will not move.	Ring and pinion gears are damaged.	Repair the damaged gears.
	Axle shaft(s) is damaged.	Replace axle shaft(s).
The differential makes noise.	The gears or shafts in the differential are damaged.	Repair the damaged gears.
	There is no oil in the axle housing.	Fill the axle with the correct oil.
	Parts of the brake assembly are damaged.	Repair the parts of the brakes.
	The mounting bolts for the differential housing are loose.	Tighten the capscrews.
	The ring and pinion are not adjusted correctly.	Check and adjust the gears.
	The nut for the input yoke is loose.	Tighten the nut.
	The thrust screw is not adjusted correctly.	Adjust and tighten the screw and jam nut.
The differential has leaks.	There is no sealant between the differential and drive axle housing.	Assemble the parts with the correct sealant.
	There are capscrews missing from the differential assembly.	Install the missing capscrews.
	There are plug(s) missing from the differential housing.	Install the missing plug(s).
	The seal for the yoke is damaged.	Install a new seal.

STEP 5. Remove the spool and sleeve assembly. Remove the thrust bearing assembly from the spool. Push the center pin from the sleeve. Carefully remove the spool from the sleeve. Rotate the spool slowly during removal. Remove the ring from the sleeve. Remove the neutral position springs from the spool. Remove the dust seal from the housing.



STEP 6. When installed, remove the snap ring, bushing, O-ring and seal ring. Remove the oil seal from the bushing or housing.

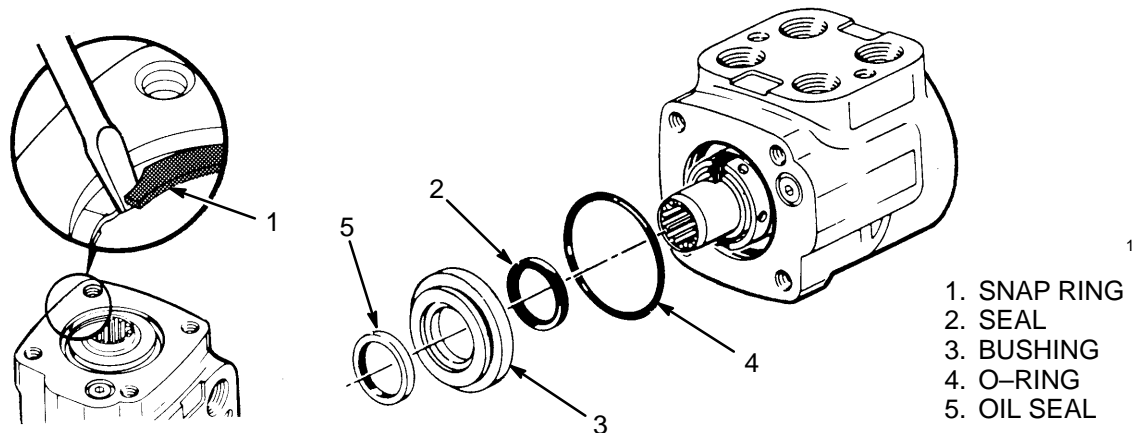


FIGURE 5. DISASSEMBLY OF THE STEERING CONTROL UNIT (2 OF 2)

1.5 1004-4 ENGINE

Power Rating at 2600 rpm	63 kW (84.5 bhp)
Number of cylinders	4
Firing order	1-3-4-2
Bore and stroke	100 x 127 mm (3.937 x 5.000 in)
Displacement	4 litres (243 in ²)
Compression Ratio	16.5:1
Minimum oil pressure (at 2600 rpm and normal operating temperature)	207 kPa (30 psi)
Governor speed (no load)	
H3.50-5.00XL(H70-110XL)	2300 to 2400 rpm
S3.50-5.50XL(S70-120XL)	2400 to 2500 rpm
S6.00-7.00XL (S135-155XL)	2400 to 2500 rpm
H6.00-7.00XL(H135-155XL)	2400 to 2500 rpm
Idle speed	
H3.50-5.00XL(H70-110XL)	725 to 775 rpm
S3.50-5.50XL(S70-120XL)	625 to 800 rpm
S6.00-7.00XL (S135-155XL)	725 to 775 rpm
H6.00-7.00XL(H135-155XL)	725 to 775 rpm
Thermostat	
Begin to open	77 to 85°C (170 to 185°F)
Fully open	92 to 98°C (198 to 208°F)
Valve clearance (cold)	
Inlet	0.20 mm (0.008 in)
Exhaust	0.45 mm (0.018 in)

1.6 1004-4T ENGINE

Power Rating at 2600 rpm	84 kW(113 bhp)
Number of cylinders	4
Firing order	1-3-4-2
Bore and stroke	100 x 127 mm (3.937 x 5.000 in)
Displacement	4 litres (243 in ²)
Compression Ratio	16.0:1
Minimum oil pressure (at 2600 rpm and normal operating temperature)	280 kPa (40 psi)
Governor speed (no load)	2700 to 2800 rpm
Idle speed	800 to 850 rpm
Thermostat	
Begin to open	77 to 85°C (170 to 185°F)
Fully open	92 to 98°C (198 to 208°F)
Valve clearance (cold)	
Inlet	0.20 mm (0.008 in)
Exhaust	0.45 mm (0.018 in)

1.7 1006-6 ENGINE

Power Rating at 2600 rpm	95 kW(127 bhp)
Number of cylinders	6

Firing order	1-5-3-6-2-4
Bore and stroke	100 x 127 mm (3.937 x 5.000 in)
Displacement	6 litres (365 in ²)
Compression Ratio	16.5:1
Minimum oil pressure (at 2600 rpm and normal operating temperature)	207 kPa (30 psi)
Governor speed (no load with sound reduction)	
H8.00-12.00XL(H165-280XL)	2460 to 2610 rpm
H13.00-16.00XL (H300-360XL)	2400 to 2550 rpm
Governor speed (no load without sound reduction)	
H8.00-12.00XL(H165-280XL)	2660 to 2810 rpm
H13.00-16.00XL (H300-360XL)	2660 to 2810 rpm
Idle speed	
H8.00-12.00XL(H165-280XL)	725 to 775 rpm
H13.00-16.00XL (H300-360XL)	725 to 775 rpm
Thermostat	
Begin to open	77 to 85°C (170 to 185°F)
Fully open	92 to 98°C (198 to 208°F)
Valve clearance (cold)	
Inlet	0.20 mm (0.008 in)
Exhaust	0.45 mm (0.018 in)

1.8 1006-6T ENGINE

Power Rating at 2600 rpm	127 kW (170 bhp)
Number of cylinders	6
Firing order	1-5-3-6-2-4
Bore and stroke	100 x 127 mm (3.937 x 5.000 in)
Displacement	6 litres (365 in ²)
Compression Ratio	16.0:1
Minimum oil pressure (at 2600 rpm and normal operating temperature)	280 kPa (40 psi)
Governor speed (no load)	2700 to 2800 rpm
Idle speed	800 to 850 rpm
Thermostat	
Begin to open	77 to 85°C (170 to 185°F)
Fully open	92 to 98°C (198 to 208°F)
Valve clearance (cold)	
Inlet	0.20 mm (0.008 in)
Exhaust	0.45 mm (0.018 in)

1.9 REMOVAL AND INSTALLATION

See the **THE FRAME** section for the procedure for removing the engine and transmission. See the **TRANSMISSION** section for the procedure to separate the transmission from the engine.

3. If the valves will be used again, make a mark on each valve head so that they can be installed again in the same positions.

4. Use the valve spring compressor and the correct adaptor to compress the valve springs and remove the retainers. Make sure the valve springs are compressed parallel to the valve stems or the valve stems can be damaged.

5. Release the valve stem compressor. Remove the valve spring cap, valve springs, seal, and seat washer.

6. Repeat steps 4 and 5 to remove the other valves.

1.28 Inspection

Check the valves for cracks. Check the stems of the valves for wear and the correct clearance in their valve guides. See 1.30 Valve Guides.

Check that the seat faces of the valves are not badly burned. A correction for minimum wear and damage to the valve and valve seat can be done by a process called “lapping”. Seat faces of valves that are damaged, but can be repaired, must be checked for valve depth when they are installed. See FIGURE 23. When new valves are installed, the valve depth must be checked.

Check that the load on the valve springs is correct at their installed length. See the ENGINE SPECIFICATIONS.

Install new valve springs during a complete overhaul of the engine.

1.29 Installation

1. Lubricate the valve stems with engine oil when they are installed in their valve guides.

2. Install the seat washer. Install new seals on the valve guides.

3. Install the inner and outer valve springs on the seat washer. Make sure that the damper coils of the valve springs are towards the cylinder head.

4. Use the valve spring compressor and the correct adaptor to compress the valve springs. Install the retainers.

Make sure the valve springs are compressed parallel to the valve stems or the valve stems can be damaged.

5. Repeat the installation procedure for each valve.

1.30 VALVE GUIDES

1.31 Inspection

Check the valve guides for wear. The maximum clearance between the valve stem and the bore of the guide is 0.13 mm (0.005 in) for inlet valves and 0.15 mm (0.006 in) for exhaust valves. If the clearance is greater than the limit when a new valve is installed, the valve guide must be replaced.

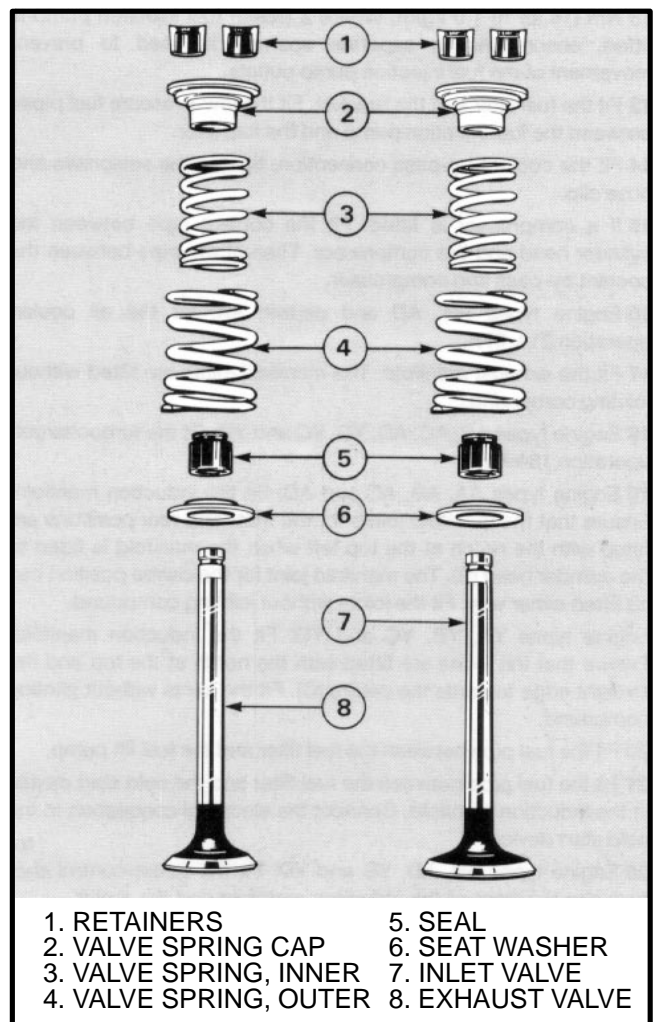


FIGURE 24. VALVE COMPONENTS

CRANKSHAFT ASSEMBLY

1.56 GENERAL

The crankshaft is forged from chrome–molybdenum steel. The 4–cylinder engines have five main journals and the 6–cylinder engines have seven main journals. The center main bearing is the thrust bearing that controls the axial movement of the crankshaft. The thrust bearing has thrust washers on both sides of the bearing. The main bearings are an alloy of tin and aluminum. The center main bearing in the 6–cylinder engines is a lead and bronze alloy. The front and rear oils seals are lip seals with an additional dust seal outside of the main lip and oil return grooves on the face of the main lip.

ENGINES AA and AB. The crankshaft has splines for the position of the front pulley. The crankshaft pulley is fastened to the crankshaft with a thrust block and three capscrews. A damper is part of the crankshaft pulley.

ENGINES YA and YB. The crankshaft pulley is fastened to the crankshaft with a plain thrust block and three capscrews. A special arrangement holds the crankshaft pulley in position. See FIGURE 47. A separate damper is sometimes fastened to the rear face of the crankshaft pulley. Some engines have the damper as part of the crankshaft pulley.

1.57 CRANKSHAFT PULLEY

1.58 Removal, Engines AA and AB

1. Remove the drive belts.
2. Remove the three capscrews which hold the pulley to the crankshaft. Remove the thrust block and pulley.
3. Clean the parts and check for damage. Replace any damaged parts.

1.59 Installation, Engines AA and AB

1. Put the pulley into position on the crankshaft. Lubricate lightly the threads of the three capscrews. Install the thrust block and the three capscrews. Tighten the three

capscrews evenly to 115 Nm (85 lbf ft). Check each capscrew again for the correct torque.

2. Install the drive belts. See 1.178 Drive Belts.

1.60 Removal, Engines YA and YB

1. Remove the drive belts.
2. See FIGURE 47. Remove the three capscrews which hold the pulley to the crankshaft. Remove the thrust block. If the crankshaft pulley will not slide from the crankshaft, **DO NOT** use a puller to remove the pulley. Hold a wood block against the inner hub of the pulley and lightly hit the wood block with a hammer. See FIGURE 46. This action will loosen the inner ring (2) and outer ring (3) so that the pulley can be removed from the crankshaft as shown in FIGURE 47.
3. If a separate damper is connected to the crankshaft pulley, remove the capscrews and remove the damper.

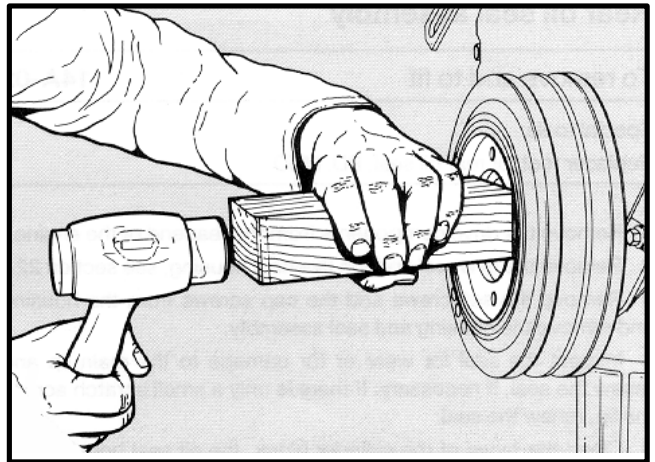


FIGURE 46. CRANKSHAFT PULLEY INSTALLATION, ENGINES YA AND YB

1.61 Installation, Engines YA and YB

1. If your engine has a separate damper that is connected to the crankshaft pulley and it was removed, install it on the crankshaft pulley. Install the clamp ring or the washers and tighten the capscrews gradually and evenly to 35 Nm (26 lbf ft).

5. Check the timing gear clearances as shown in FIGURE 61. The minimum clearances for all gears is 0.08 mm (0.003 in).

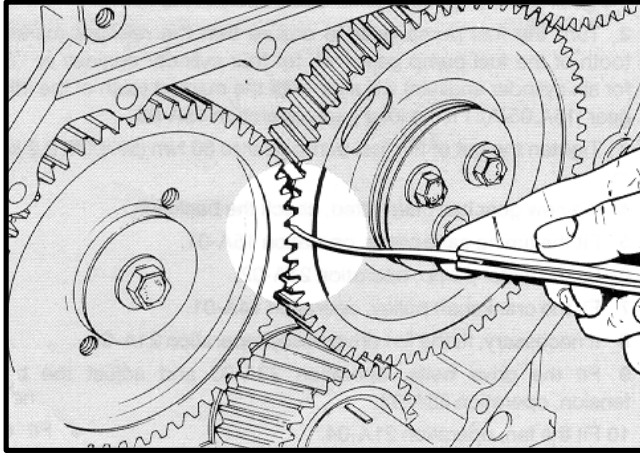


FIGURE 61. CHECK THE TIMING GEAR CLEARANCES

6. Install the timing case cover, coolant pump, crankshaft pulley, fan drive pulley, drive belts, and fan. See 1.78 Timing Case Cover, Installation.

1.85 GEAR FOR THE FUEL INJECTION PUMP OR THE CAMSHAFT GEAR

1.86 Removal

Special Tools: Gear puller with adaptors

1. Remove the timing case cover. See 1.77 Timing Case Cover, Removal.

2. Turn the crankshaft until the marked teeth of the crankshaft gear, the camshaft gear, and the gear for the fuel injection pump are aligned as shown in FIGURE 59. The marked teeth on the idler gear will not necessarily be aligned with the marked teeth of the other three gears because of the different speed of rotation of the idler gear.

CAUTION

Make sure that the crankshaft is not turned while the camshaft gear is removed. A piston can hit and damage a valve.

3. Camshaft gear. Remove the capscrew and washer. Use a puller and adaptor to pull the gear from the camshaft. Make sure that the woodruff key in the camshaft is not lost. Inspect the camshaft gear for wear and damage. See FIGURE 62.

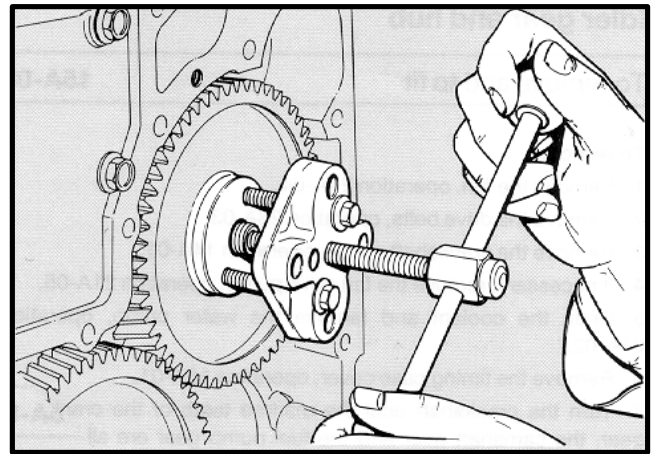


FIGURE 62. REMOVE THE CAMSHAFT GEAR

4. Gear for the fuel injection pump. Remove the nut and spring washer from the gear for the fuel injection pump. Use a puller and adaptor to remove the gear for the fuel injection pump. The gear has the letter M on the gear to indicate that the threads for the screws of the gear puller are metric. Make sure that the woodruff key in the shaft for the fuel injection pump is not lost. Inspect the gear for wear and damage. See FIGURE 63.

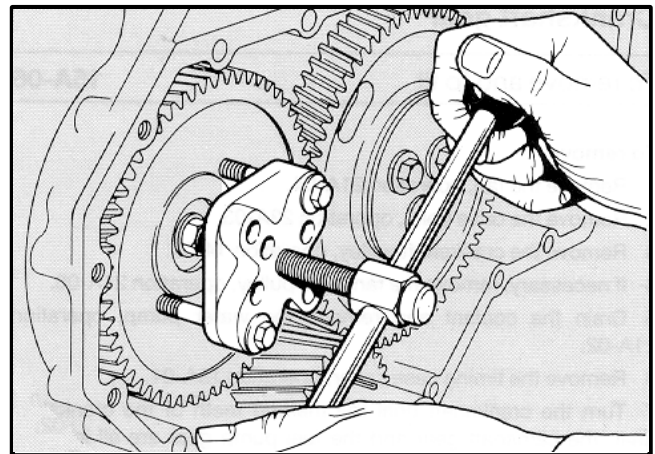


FIGURE 63. REMOVE THE GEAR FOR THE FUEL INJECTION PUMP

1.87 Installation

CAUTION

If the crankshaft or the camshaft must be turned to permit the alignment of the marks on the timing gears, a piston can hit and damage a valve. The rocker arm assembly must be loosened so that the valves are closed when the crankshaft or the camshaft are turned.

1. Make sure that the woodruff key is installed correctly in the end of the camshaft.

⚠ CAUTION

Be careful that the blades of the impeller is not damaged. If the impeller is damaged, the turbocharger must be replaced or repaired by a special repair service.

5. Put the compressor housing in a container with a solvent that is not caustic. When the dirt has loosened, use a hard brush or a soft scraper to clean the compressor housing. Use compressed air at low pressure to dry the compressor housing.

6. Clean the impeller with a soft brush.

7. Carefully push the impeller towards the bearing housing and turn the impeller with your hand. Check that the impeller turns freely and there is no noise that can indicate wear or damage. If there is a fault, the turbocharger must be replaced or repaired by a special repair service.

8. Install the compressor housing on the turbocharger. Make sure the reference marks are aligned. Install the circlip loosely on the bearing housing. Make sure that the face of the circlip with the bevel is towards the exhaust end of the turbocharger. Install the circlip in the groove.

9. Install the ducts on the inlet and outlet of the compressor housing and tighten the clamps.

LUBRICATION SYSTEM

1.111 GENERAL

The oil pump is turned by a gear on the crankshaft through an idler gear. A relief valve on the outlet of the oil pump controls the maximum oil pressure in the lubrication system. The engine oil flows from the oil pump through an oil cooler fastened on the side of the engine block. The oil flows from the oil cooler through the oil filter. The oil cooler has a by-pass valve that controls the oil pressure in the oil cooler and permits some cold oil to flow directly to the oil filter. The oil filter has a by-pass that permits oil flow directly to the main oil passage if the oil filter becomes too dirty. The normal oil flow is through the oil filter to the main oil passage in the engine block.

Engine oil from the main oil passage flows to the main bearings of the crankshaft and through the passages in the crankshaft to the rod bearings. The pistons and cylinder bores are lubricated by splash and oil mist.

Engine oil also flows from the main bearings to the journals of the camshaft. Some engine oil goes through the center camshaft bearing to the rocker arm assembly.

The hub of the idler gear has an oil passage to the main oil passage. The oil flow through the hub lubricates the timing gears.

An outlet from the main oil passage supplies oil to the bearings of the turbocharger. The engine flows through the bearings of the turbocharger and returns to the oil sump. All turbocharged engines have a cooling jet con-

nected to the main oil passage for each cylinder. The cooling jets spray engine oil on the bottoms of the pistons for additional cooling.

1.112 OIL FILTER, REPLACEMENT

1. Change the oil filter when the engine oil is changed. Put a drain pan under the filter. Remove the filter cartridge. Make sure the adaptor stays in the filter head as shown in FIGURE 74. Discard the filter cartridge.

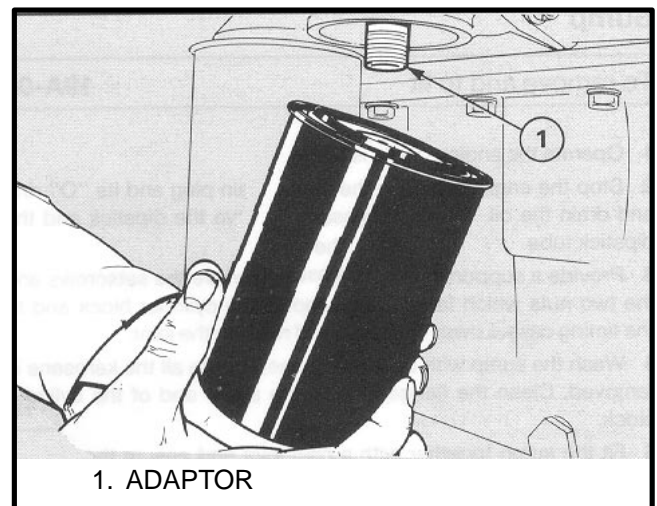


FIGURE 74. OIL FILTER

2. Clean the filter head.

3. Add some clean engine oil to the new filter cartridge. Apply clean engine oil to the gasket. Turn the filter until the gasket touches the filter head. Tighten the filter cartridge 1/2 to 3/4 turn.

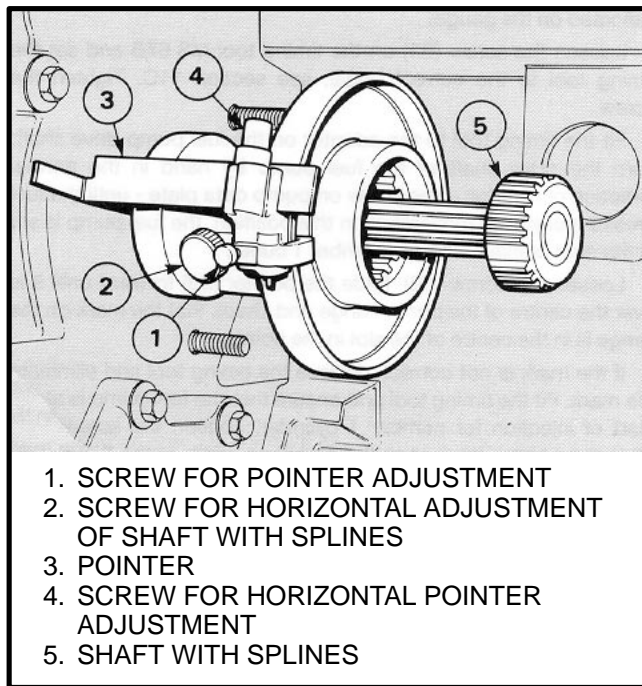


FIGURE 94. INSTALLATION OF THE UNIVERSAL TIMING TOOL

5. Check that the mark on the timing case aligns with the pointer (3). If the timing mark is not correct, remove the universal timing tool. Remove the mark on the timing case. Install the universal timing tool again. Make sure that the pointer (3) is against the timing case and make a new timing mark on the timing case.

6. Remove the timing tool and the adaptor.

7. Install the fuel injection pump. See 1.128 CAV Injection Pump, Installation.

8. Return the engine to operating condition as described in the following steps:

- a. Turn the crankshaft clockwise until the inlet valve of the rear cylinder is fully open. Adjust the valve clearance on the inlet valve of number 1 cylinder to 0.20 mm (0.008 in).
- b. Install the valve cover. See 1.12 Valve Cover, Installation.
- c. Remove the temporary pointer.

9. Remove the air from the fuel system See 1.136 Remove Air From The Fuel System

1.136 REMOVE AIR FROM THE FUEL SYSTEM

The engine can not be started if there is air in the fuel system. The air must be removed from the fuel system if any part of the fuel system has been disconnected or there is a leak in the low pressure part of the fuel system during operation of the engine. The following procedures are for removal of air from the fuel system.

1.137 Fuel Injection Pump With Vent Tube

Some engines have a fuel injection pump with a tube installed in place of the vent screw. See FIGURE 95. Air can move through the tube from the pump to the fuel return line. It is not necessary to loosen plugs or connections to remove air from this type of injection pump. Use the procedure in [Step 1](#) or [Step 2](#) to remove air from a fuel system with an injection pump that has a vent tube.

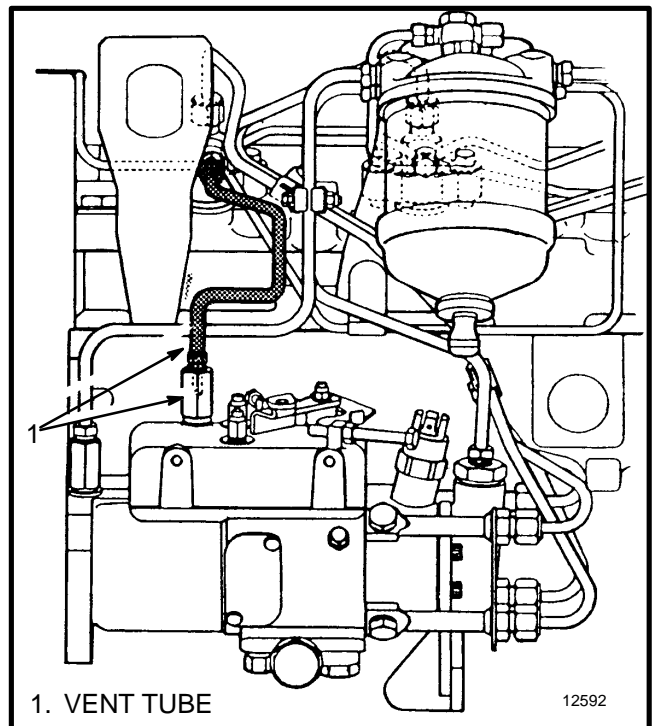


FIGURE 95. FUEL INJECTION PUMP WITH VENT TUBE

1. If the fuel system or a component in the fuel system has been drained:

- a. Turn the key switch to the ON position.
- b. Slowly operate the priming lever of the fuel pump for approximately two minutes.
- c. Operate the engine with the starter motor until the engine starts.

1.166 Disassembly And Assembly

1. Remove the capscrews and remove the cover.
2. Engine AB. Remove the lock nuts at the back of the oil cooler and remove the cooler element.

Engines YA and YB. Remove the nuts on the front of the cover and remove the cooler element from the cover.

3. Clean the cooler element and check for cracks. If a cleaning solution is used to clean the outside of the element, make sure that the cleaning solution does not enter the element. Check that there are no restrictions for the oil flow through the element. If the internal part of the element must be cleaned, use a cleaning solution that will not damage copper. Flush the element to remove the cleaning solution and dry the element with compressed air at low pressure. Then flush the internal part of the element with clean engine oil.

4. Use new O-rings on the flanges and studs as shown in FIGURE 108. or FIGURE 109.

5. Engine AB. Install the cooler on the back plate and tighten the lock nuts to 22 Nm (16 lbf ft).

Engines YA and YB. Install the cooler element on the cover and tighten the nuts to 22 Nm (16 lbf ft).

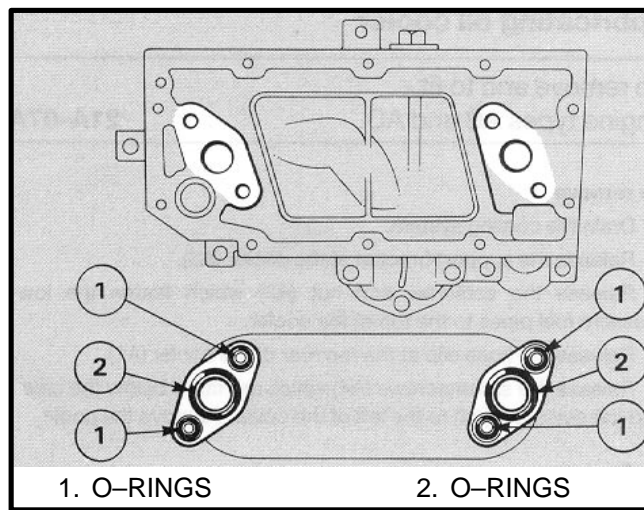


FIGURE 108. JOINTS FOR THE COOLER ELEMENT, ENGINE AB

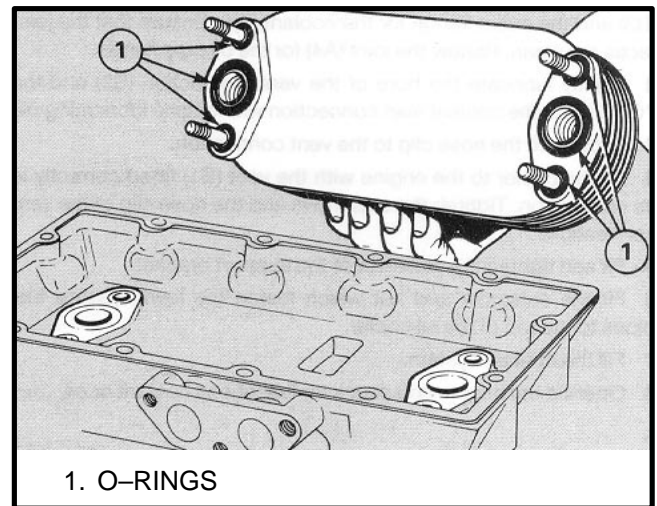


FIGURE 109. JOINTS FOR THE COOLER ELEMENT, ENGINES YA AND YB

1.167 Installation, Engine AB

1. See FIGURE 110. Use new O-rings on the inlet connection (3) for the coolant and the outlet flange (5) for the coolant. Make sure that the joint surfaces are clean. Use a new gasket (4) for the oil line flange.

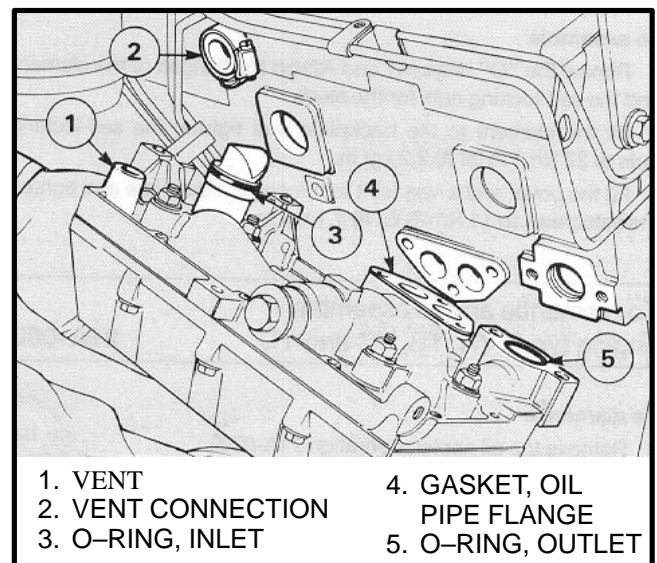


FIGURE 110. OIL COOLER JOINTS, ENGINE AB

2. Lightly lubricate the bore of the vent connection (2) and the O-ring (2) on the inlet coolant connection with engine oil.

3. Loosely install the hose clamp on the vent connection.

4. Install the oil cooler on the engine. Make sure that the vent (1) fits correctly in its connection. Install the six capscrews. Tighten the hose clamp on the vent connection.

ENGINE SPECIFICATIONS

1.194 CYLINDER HEAD ASSEMBLY

1.195 Cylinder Head

Angle of valve seat 46° (88° included angle)

Diameter of parent bore for valve guide
15.87 to 15.89 mm
(0.6247 to 0.6257 in)

Leak test pressure 200 kPa (29 psi)

Head thickness 102.70 to 103.50 mm
(4.047 to 4.078 in)

Minimum thickness of head in service
102.48 mm (4.035 in)

Maximum distortion of cylinder head. See FIGURE 126.

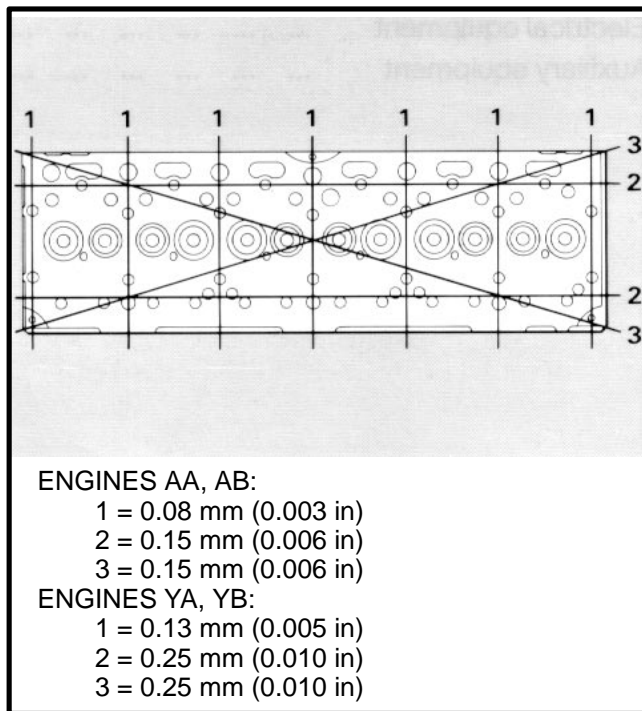


FIGURE 126. CHECK THE CYLINDER HEAD FOR DISTORTION

1.196 Valve Guides

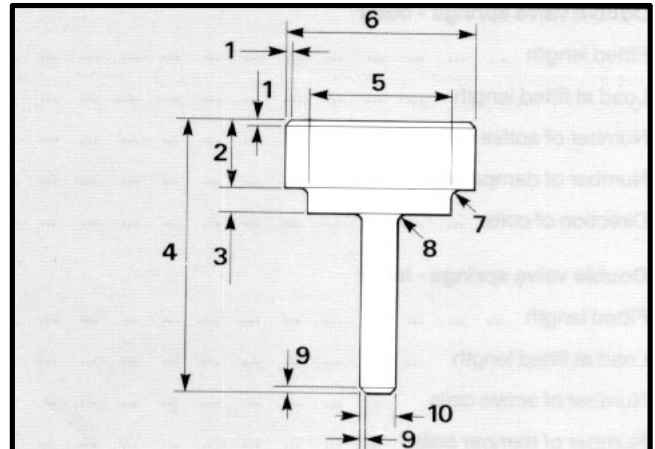
Inside diameter 9.51 to 9.56 mm
(0.3744 to 0.3764 in)

Outside diameter 15.90 to 15.91 mm
(0.6260 to 0.6265 in)

Interference fit of valve guide in cylinder head
0.03 to 0.07 mm
(0.0012 to 0.0027 in)

Total length
to Inlet 57.94 mm (2.281 in)
to Exhaust 61.10 mm (2.406 in)

Extension from bottom of recess for valve spring
15.10 mm (0.594 in)



INLET VALVE:

- 1 = 1.59 mm (0.063 in)
- 2 = 19.05mm (0.750 in)
- 3 = 6.35 mm (0.250 in)
- 4 = 76.20 mm (3.00 in)
- 5 = 37.26 to 37.28 mm (1.467 to 1.468 in)
- 6 = 51.00 to 51.23 mm (2.008 to 2.017 in)
- 7 = 0.79 mm (0.031 in)
- 8 = 1.59 mm (0.063 in)
- 9 = 1.59 mm (0.063 in)
- 10 = 9.45 to 9.47 mm (0.372 to 0.373 in)

EXHAUST VALVE:

- 1 = 1.59 mm (0.063 in)
- 2 = 19.05mm (0.750 in)
- 3 = 7.92 mm (0.312 in)
- 4 = 76.20 mm (3.00 in)
- 5 = 32.58 to 32.84 mm (1.283 to 1.293in)
- 6 = 42.39 to 42.62 mm (1.669 to 1.678 in)
- 7 = 0.79 mm (0.031 in)
- 8 = 1.59 mm (0.063 in)
- 9 = 1.59 mm (0.063 in)
- 10 = 9.45 to 9.47 mm (0.372 to 0.373 in)

FIGURE 127. PILOT TOOL TO INSERT VALVE SEATS

NM	2645L304	2645L611	230	3381	23.3
NN	2645L303	2645L612	230	3381	23.3
NP	2645L304	2645L613	220	3234	22.3
NR	2645L303	2645L614	230	3381	23.3
NS	2645L303	2645L612	250	3675	25.3
NT	2645L304	2645L615	230	3381	23.3
NU	2645L303	2645L605	220	3234	22.3
NV	2645L304	2645L616	220	3234	22.3
NW	2645L303	2645L613	220	3234	22.3
RD	KBEL66S45	DLLA140S1039	250	3675	25.3
RE	KBEL66S47	DLLA150S1055	250	3675	25.3
RF	KBEL66S47	DLLA150S1072	250	3675	25.3
RH	KBEL66S47	DLLA150S1087	250	3675	25.3
RK	KBEL66S47	DLLA145S1172	270	3970	27.4
RM	KBEL66P69	0433-175-044	250	3675	25.3
RN	KBEL66P69	0433-175-067	250	3675	25.3
RP	KBEL66P99	0433-175-044	250	3675	25.3
RR	0433-176-079	DSLA140P292	250	3675	25.3
RS	0433-175-079	3374287	250	3675	25.3
RT	KPEL66P111	0433-175-044	250	3675	25.3
RU	KPEL65P113	DSLA140P472	250	3675	25.3
RV	2645F311	2645F610	250	3675	25.3

1.244 Fuel Pump, Engines AA And AB

Type A.C. Delco, types XD
Method of drive Eccentric on camshaft
Static pressure (no delivery) 42 to 70 kPa (6 to 10 psi)

Outside diameter of shaft 15.91 to 15.92 mm
(0.6264 to 0.6267 in)
Diameter, bore of drive gear 15.88 to 15.89 mm
(0.6252 to 0.6256 in)

1.245 Fuel Pump, Engines YA And YB

Type A.C. Delco, types LU
Method of drive Eccentric on camshaft
Static pressure (no delivery) 34.5 to 55.2 kPa (5 to 8 psi)
Test pressure (75% of minimum static pressure) 26 kPa (3.75 psi)

Press fit of drive gear on shaft 0.01 to 0.04 mm
(0.0005 to 0.0016 in)
Diameter, bore of impeller 15.87 to 15.89 mm
(0.6249 to 0.6257 in)
Diameter, bearing 29.99 to 30.00 mm
(1.1807 to 1.1811 in)

1.246 Fuel Filter

Type single element
(some YA and YB engines are equipped with twin parallel flow filters)

Diameter, bore for bearing 29.96 to 29.98 mm
(1.1795 to 1.1803 in)

1.247 COOLING SYSTEM

1.248 Coolant Pump

Type centrifugal, gear drive

Press fit, bearing in pump body 0.01 to 0.04 mm
(0.0004 to 0.0016 in)
Installed dimension, impeller boss to front face of pump body 8.1 to 8.5 mm
(0.319 to 0.335 in)

Description

The purpose of the cooling system is to control the operating temperature of the engine (and in some units, the transmission, brakes, and hydraulic system). A centrifugal water pump circulates coolant through passages in the engine block and the radiator. A thermostat is installed in the water outlet fitting on the engine. As the coolant flows through the radiator, the fan moves air through the radiator to help cool the system.

The coolant is a mixture of water and antifreeze. The antifreeze prevents the coolant from freezing in cold weather, and thereby preventing damage to the engine and radiator. The antifreeze also prevents rust and lubricates the water pump.

RADIATOR

The radiator is the heat exchanger for the cooling system. The fan causes air to flow through the radiator and reduces the temperature of the coolant. The auxiliary coolant reservoir is connected to the radiator by a hose. As the engine gets hot, the coolant expands. During expansion, coolant moves from the radiator to the reservoir. When the engine stops, the coolant becomes cool and contracts. The coolant in the reservoir flows back into the radiator. In this way, the radiator is kept filled with coolant during normal operation.

On units with a powershift transmission, an oil cooler is built into the radiator. Oil from the transmission flows through coils in the radiator tank to help control the oil temperature.

RADIATOR CAP

The radiator cap is a pressure-vent type that lets the pressure in the cooling system increase to 103 kPa (15 psi). The pressure in the system prevents vapor from forming in the coolant flowing to the water pump. This action maintains the efficiency of the water pump and the performance of the cooling system. The increase in pressure also raises the boiling point of the coolant mixture to approximately 125°C (257°F) at sea level.

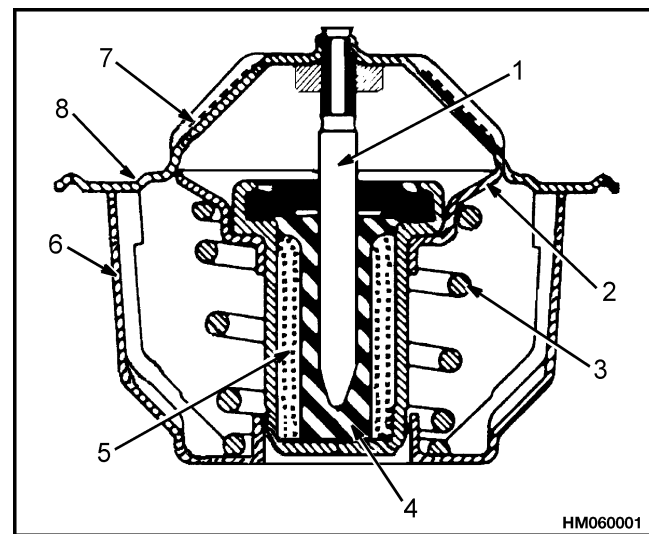
The radiator cap has a pressure valve and a vacuum valve. The pressure valve is held against its seat by a spring. The pressure valve opens when the pressure in the cooling system exceeds 103 kPa (15 psi). The vacuum valve is held against its seat

by another spring. The vacuum valve opens to relieve the vacuum created when the coolant temperature decreases. In certain conditions this vacuum can cause the radiator or top hose to collapse.

THERMOSTAT

The thermostat is a device that controls coolant flow by opening and closing to regulate coolant temperature. The thermostat uses a wax pellet to control its operation. The wax pellet expands when it is heated and contracts when it is cold. When heated, the wax pellet pushes on the piston, causing the valve in the thermostat to open. As the wax pellet cools, it contracts and lets a spring close the valve. When the engine is first started and the coolant is cold, the thermostat remains closed. During this time the coolant circulates through the engine, letting it warm quickly. As the engine becomes warm the thermostat opens, letting coolant circulate through the radiator.

The opening and closing of the thermostat helps keep the coolant within the operating limits of the system. The same thermostat is used for summer and winter seasons. Do not operate the engine without a thermostat. The engine will take longer to get warm and may run improperly. See Figure 2.



- | | |
|---------------|----------------|
| 1. PISTON | 5. WAX PELLETT |
| 2. VALVE SEAT | 6. FRAME |
| 3. SPRING | 7. FLANGE |
| 4. DIAPHRAGM | 8. VENT HOLE |

Figure 2. Typical Thermostat

Solenoid Valves (See FIGURE 4.)

The solenoid valves are installed on the body of the control valve. The solenoid valves control the flow of oil to the direction spools. There is a solenoid valve for FORWARD and one for REVERSE. The solenoid valves are operated by the switches in either the direction control lever or by the Monotrol pedal. When a solenoid is not energized, the passage for oil through the solenoid is closed. When a solenoid is energized, the spool in the solenoid moves and closes the passage to the drain circuit. At the same time, the solenoid opens the passage from the supply circuit to the passage for the pilot pressure to move the direction spool.

Inching Spool (See FIGURE 4.)

NOTE: Inching affects only the direction clutches.

The movement of the inching spool is controlled by the inching/brake pedal. When the operator pushes on the inching/brake pedal, the linkage pushes the guide for the inching spool into the valve body. Pushing the guide allows the inching spool to move and decrease the flow of oil to the direction spool. At the same time, the inching spool lets some oil from the engaged clutch flow to the drain circuit. Completely depressing the inching spool stops the flow of oil to the direction spools. During this same period the passages to the clutch pistons are open to the drain circuit.

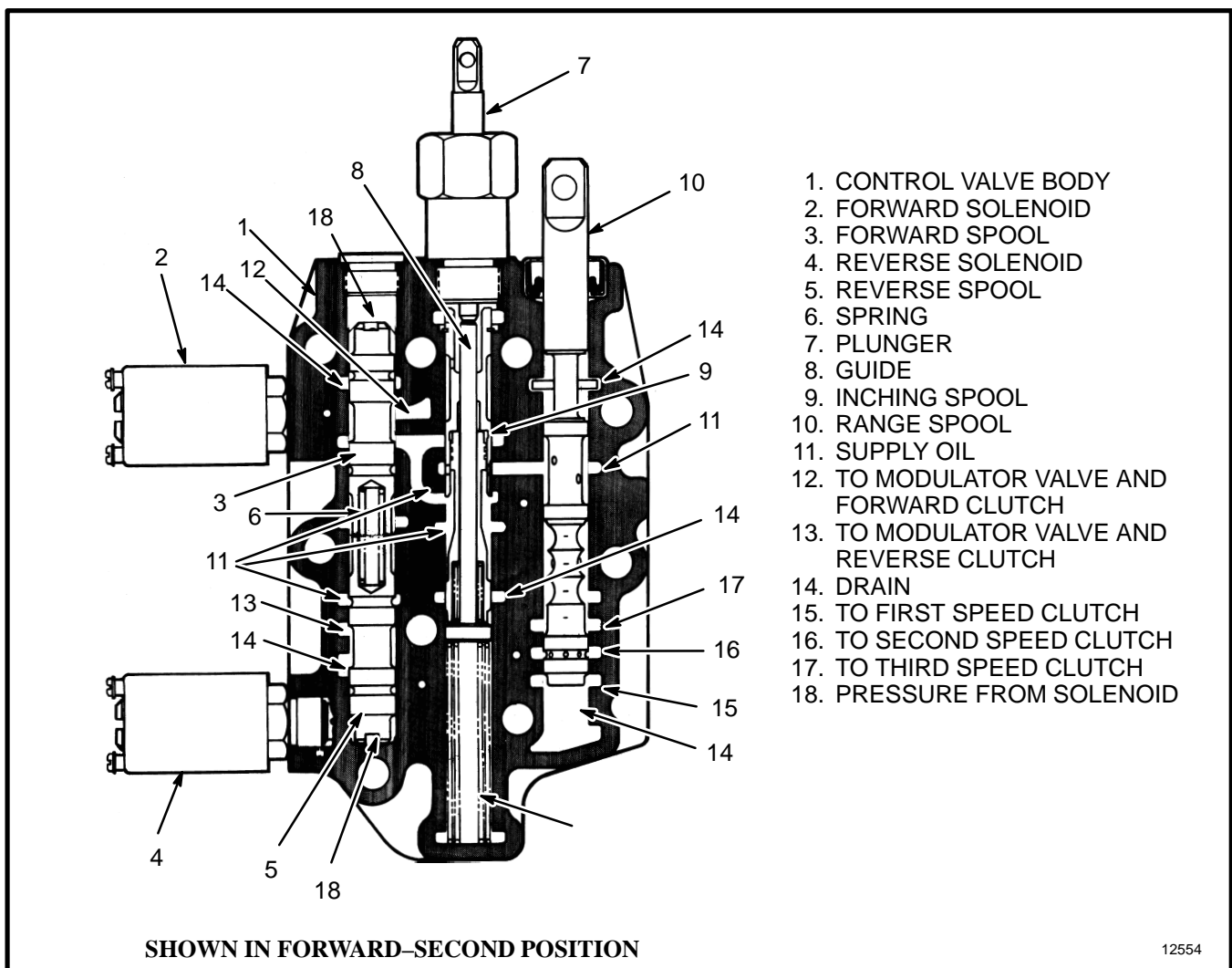


FIGURE 4. CONTROL VALVE

⚠ CAUTION

Keep the transmission level while separating the transmission from the engine so that the drive plates are not damaged.

J. Carefully separate the transmission from the fly-wheel housing. Make sure that all wires, cables and

hoses are disconnected, then use the lifting device to remove the transmission.

Disassembly

Clean the outside surface of the transmission then disassemble the transmission as shown in Figure 1.

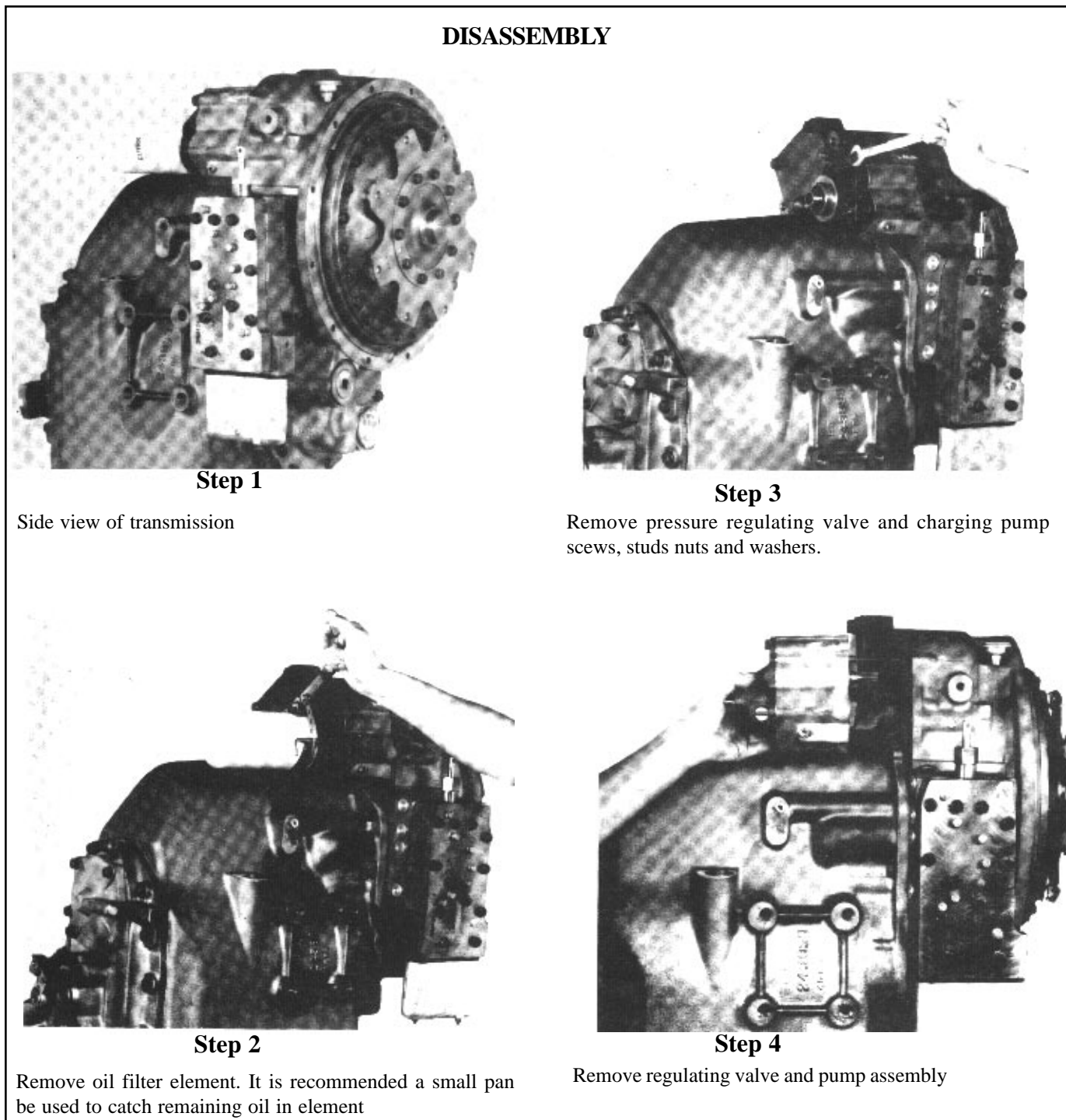
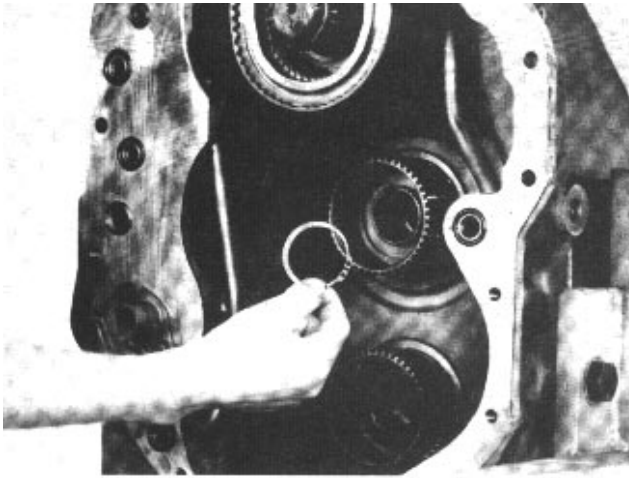


FIGURE 1. DISASSEMBLY OF THE TRANSMISSION (Sheet 1 of 25)



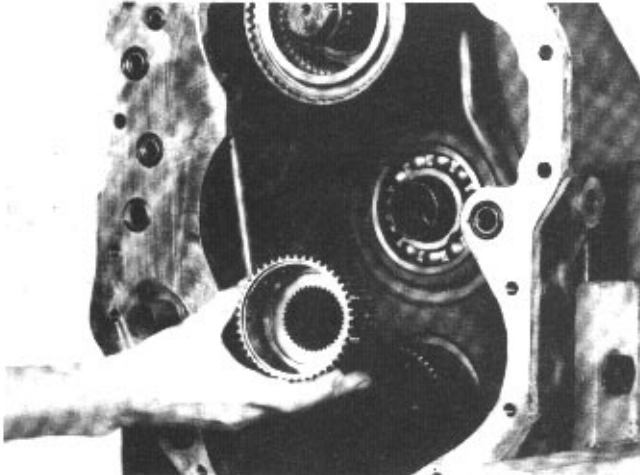
Step 58

Remove disc hub retainer ring.



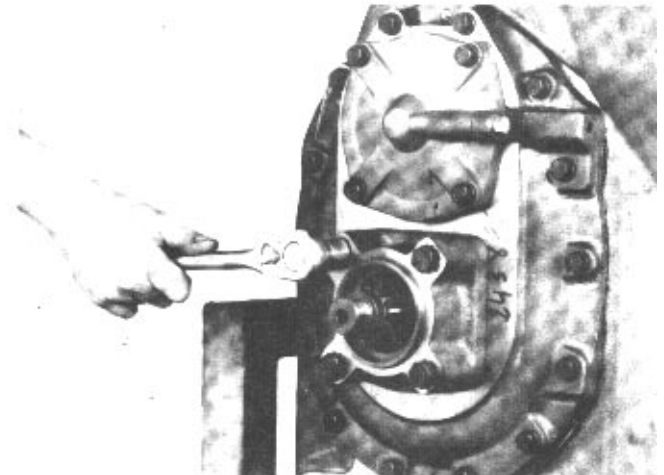
Step 61

Remove output flange.



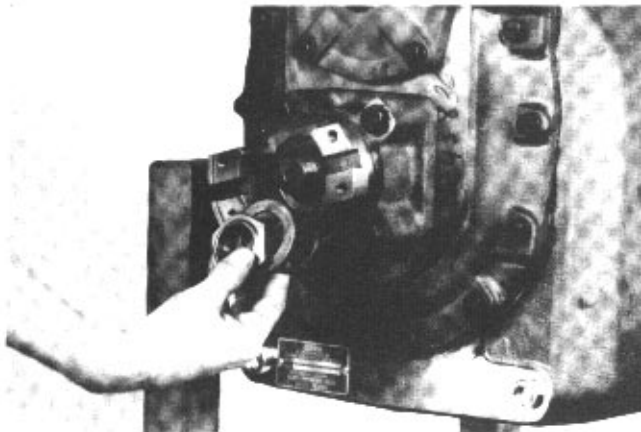
Step 59

Remove clutch disc hub. Repeat procedures 57 thru 59 for 3rd speed clutch disc hub removal.



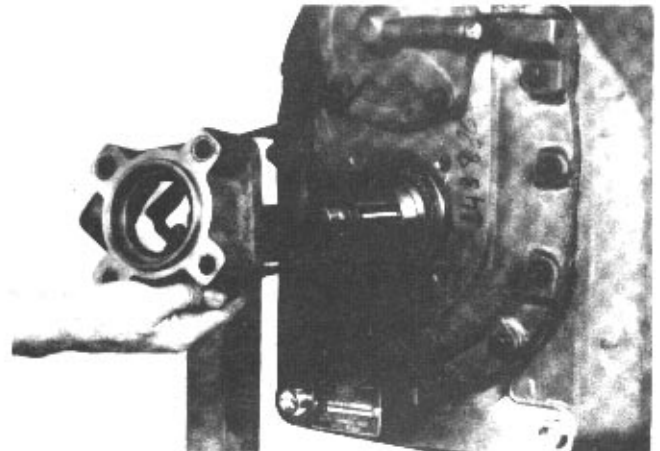
Step 62

Remove output shaft bearing cap bolts and washers.



Step 60

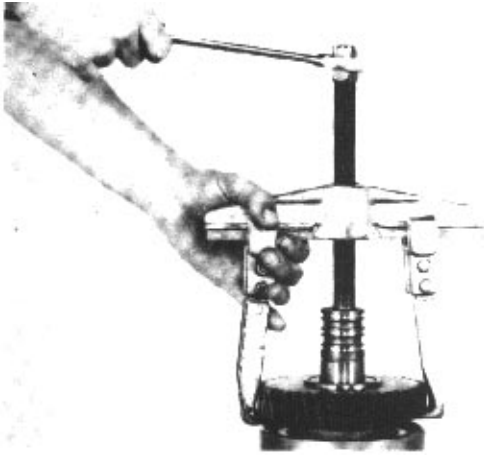
Remove output flange nut, washer and "O" ring.



Step 63

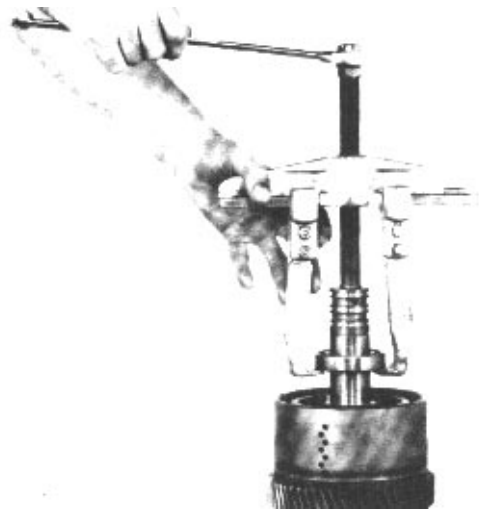
Remove bearing cap and oil seal.

FIGURE 1. DISASSEMBLY OF THE TRANSMISSION (Sheet 11 of 25)



Step 117

Remove reverse gear.



Step 120

Remove inner bearing.



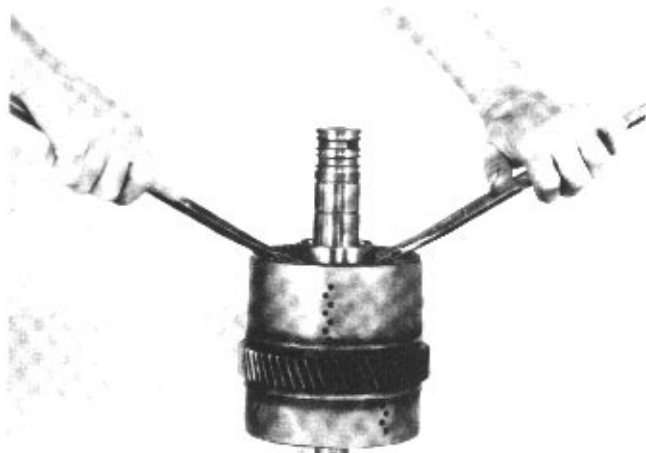
Step 118

Remove bearing spacer.



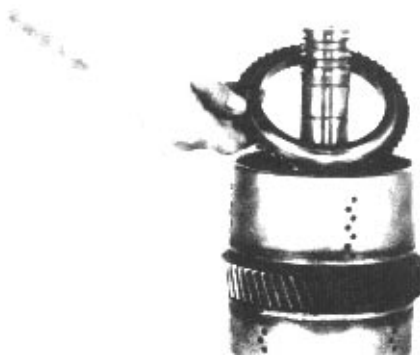
Step 121

Remove end plate retainer ring.



Step 119

Pry inner bearing up far enough to use a bearing puller.



Step 122

Remove end plate.

FIGURE 1. DISASSEMBLY OF THE TRANSMISSION (Sheet 21 of 25)

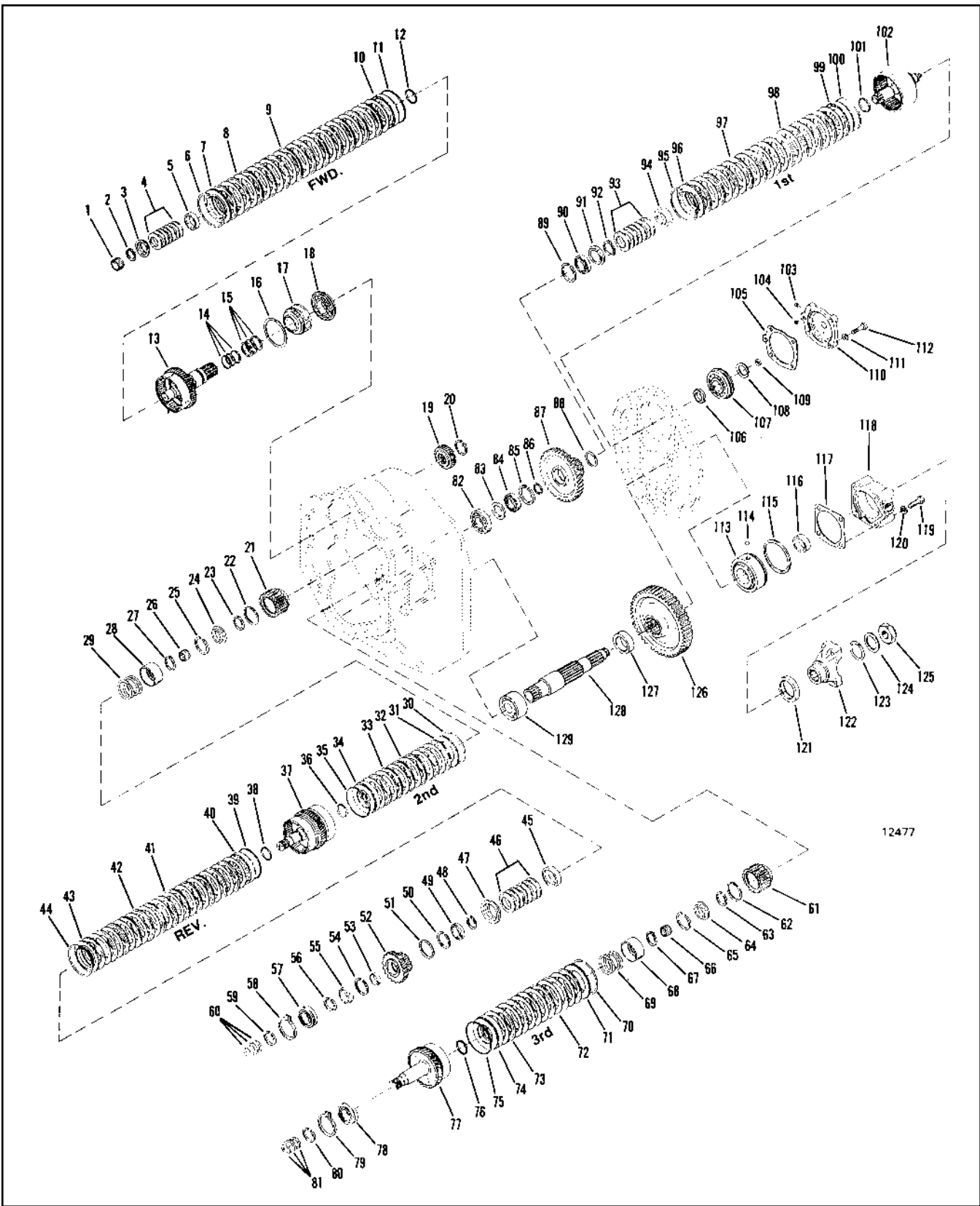


FIGURE 4. GEAR AND CLUTCH GROUP (Sheet 1 of 2)



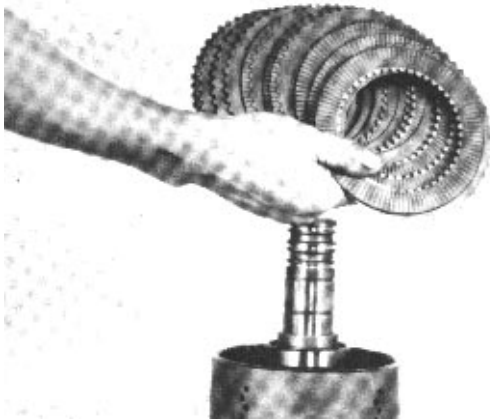
Step 37

Position bearing spacer on clutch shaft.



Step 40

Install end plate retainer ring.



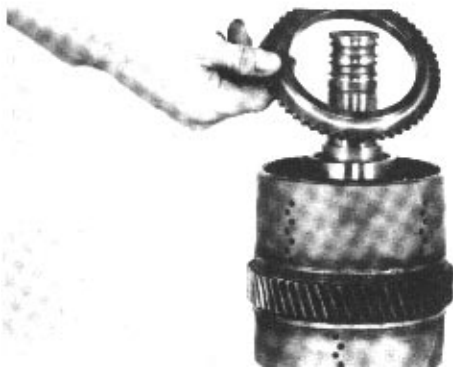
Step 38

Install one steel disc. Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.



Step 41

Install reverse gear into clutch drum. Align splines on reverse gear with internal teeth of friction discs. Do not force this operation. Gear splines must be in full position with internal teeth of all friction discs.



Step 39

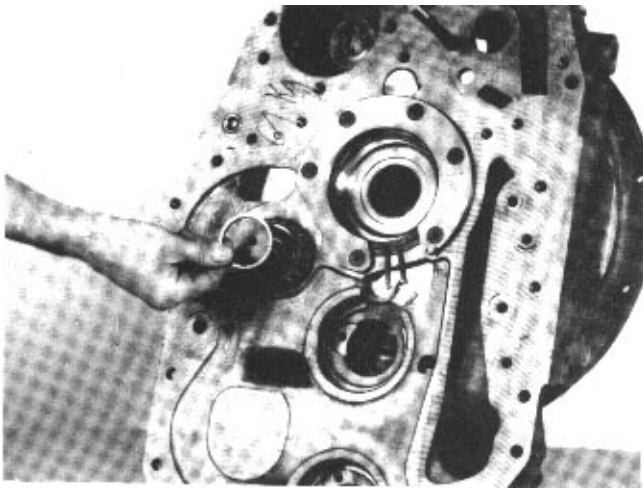
Install end plate.



Step 42

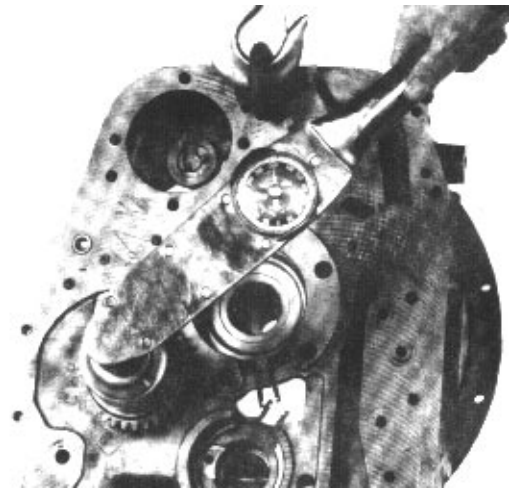
Install clutch gear outer bearing. **NOTE: Outer bearing has a shield in it, this shield must be up.**

FIGURE 6. ASSEMBLY OF THE TRANSMISSION (Sheet 7 of 23)



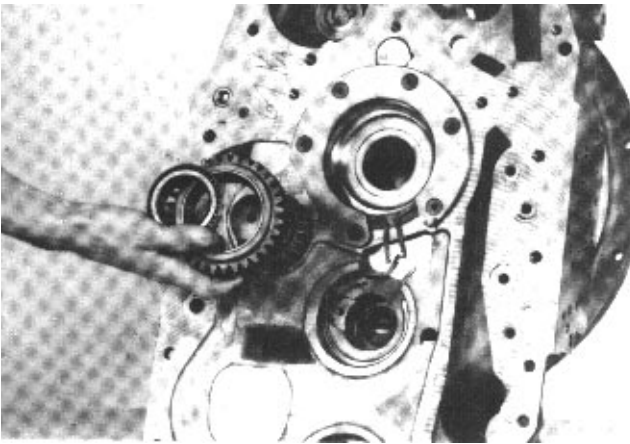
Step 93

Position bearing spacer on shaft.



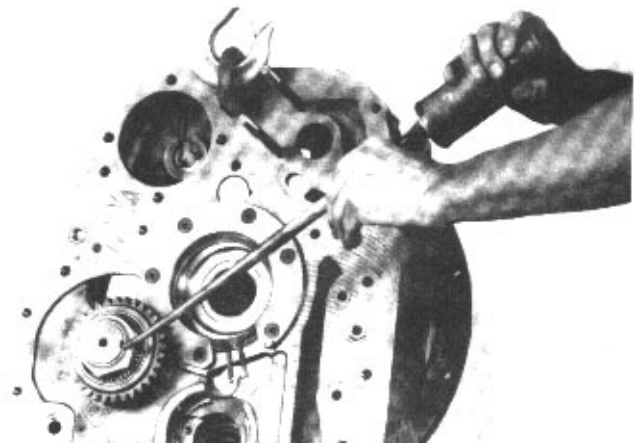
Step 96

Tighten nut 200 to 250 ft. lbs. torque [271,2-338,8 N.m].



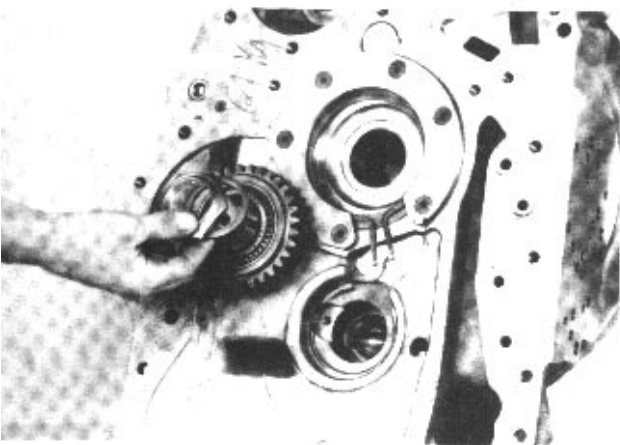
Step 94

Position idler gear on bearing with hub of gear up. Install outer taper bearing on shaft with large diameter of taper up.



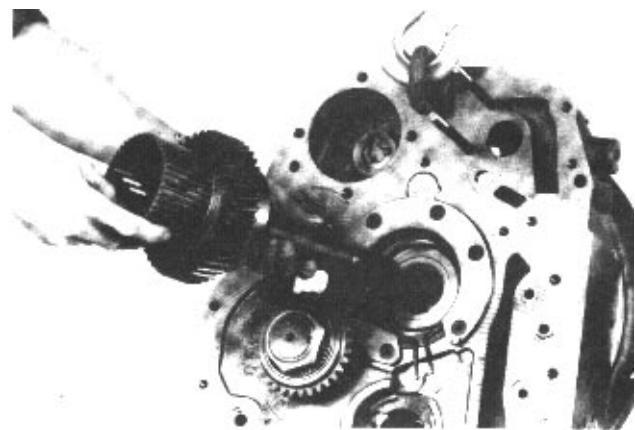
Step 97

Stake nut securely in shaft notch.



Step 95

Install outer spacer and retainer nut.



Step 98

If bearing was removed, press turbine shaft bearing into position. Install bearing washer and retainer ring. Install new turbine shaft oil sealing ring.

FIGURE 6. ASSEMBLY OF THE TRANSMISSION (Sheet 17 of 23)

Installation (See Figures 7 and 8)

A. Install two alignment studs in the housing. Install the gasket for the modulator valve and the modulator valve. Install the gasket for the control valve. Install the spring and ball in the modulator valve, then install the control valve.

B. Install and tighten the capscrews for the control valve. Remove the alignment studs.

C. Connect the linkages to the spools and the wires to the solenoids. Check the operation of the linkages and adjust them as necessary.

Removal

Remove the modulator valve with the control valve as described in the procedures for the Control Valve.

Disassembly (See Figure 9)

A. Remove the end plugs (8) for the regulator spools (9). Remove the springs (10) and the spools

B. Remove the end plugs (8) for the accumulators (6). Remove the accumulators (6), springs (3, 4 and 5) and the pins (2) from the bore.

MODULATOR VALVE

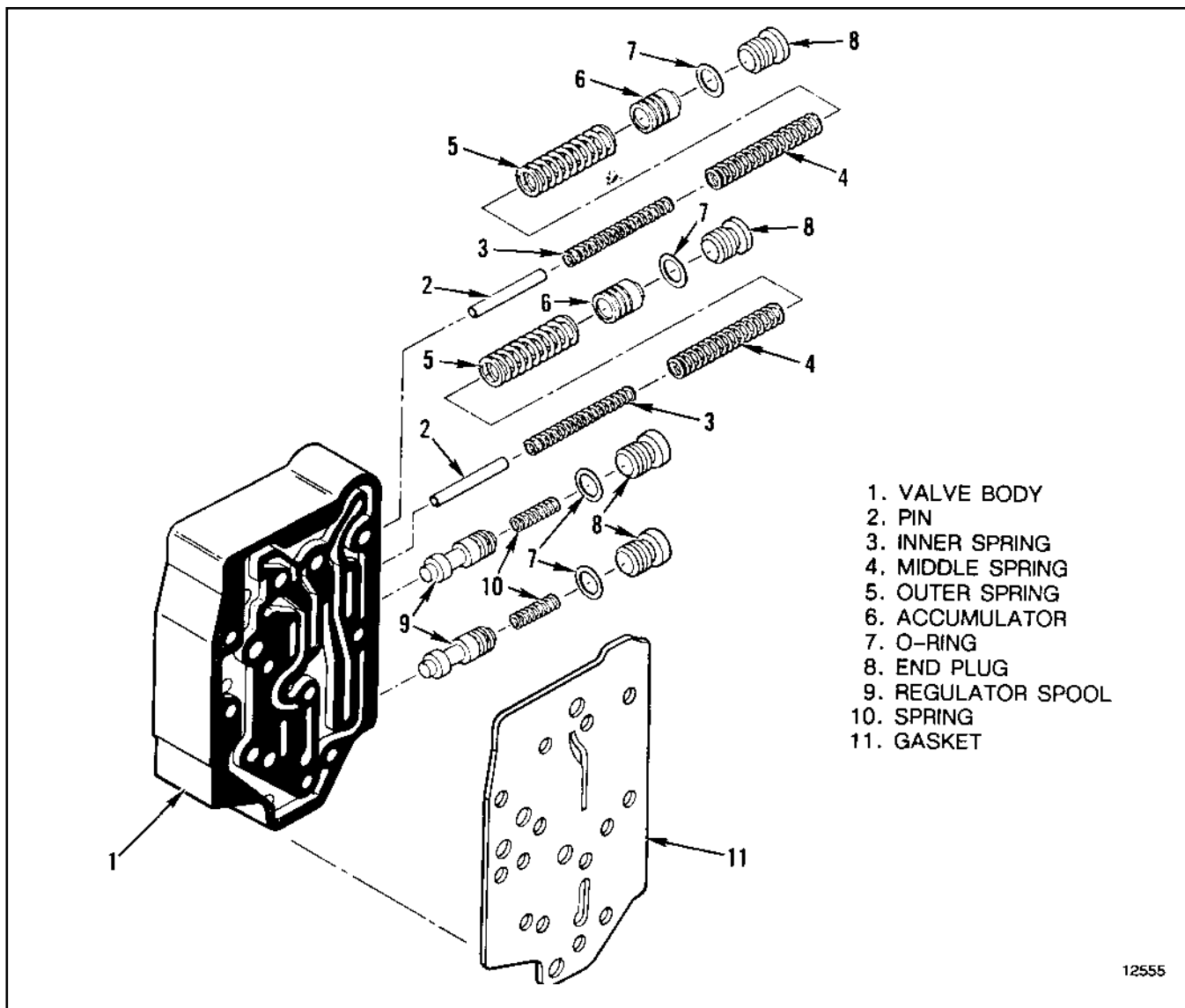


FIGURE 9. MODULATOR VALVE

INTRODUCTION

GENERAL

This section has a description and the repair procedures for the planetary gear axle.

DESCRIPTION (See FIGURE 2. and FIGURE 3.)

The planetary drive axle has an axle housing and two final drive assemblies. Each final drive assembly is a planetary gear unit. The planetary gear assembly changes the final drive ratio which increases the torque to the drive wheels. Each unit has an axle shaft, sun gear and ring gear. There are also three planetary pinions and

a planetary carrier. The differential is also installed in the axle housing. See the section **THE DIFFERENTIAL, 1400 SRM 46.**

OPERATION

Power from the engine is transmitted through the transmission to the differential. The rotation of the differential causes the axle shafts and the sun gears to rotate. The sun gears then cause the planetary pinions to rotate. Movement of the pinions causes the planetary carriers to rotate the hubs and the drive wheels. The ring gears are attached to the axle housing and do not rotate.

REPAIRS

REMOVAL

NOTE: The planetary assemblies can be removed with the drive axle installed in the lift truck. If the drive axle must be removed, do the following steps. If the drive axle will not be removed, do only steps 1 and 2, then the Disassembly procedures.

1. Put blocks under the lift truck frame to raise the drive wheels from the ground. See “How To Put The Lift Truck on Blocks” in the **OPERATING MANUAL** or the **PERIODIC MAINTENANCE, 8000 SRM 433.**

2. Remove the mast assembly from the lift truck as described in the section **THE TWO-STAGE MAST, 4000 SRM 445.**

3. Remove the air chambers as described in the section **THE BRAKE SYSTEM, 1800 SRM 441.**

4. Drain the lubricant from the axle as described in the **PERIODIC MAINTENANCE** section.

5. Disconnect the drive shaft from the drive axle.

6. Remove the wheels. See **DISASSEMBLY, steps 1 through 3.**

⚠ WARNING

Make sure that the lifting device has the capacity to lift the axle assembly and components. See Table 1 on page 4 for weights of axle components.

7. Use a lifting device (floor jack or the forks of a lift truck) to remove the drive axle. Put the lifting device under the axle to give it support. Remove the bolts and nuts that hold the axle to the frame. See FIGURE 1. Remove the drive axle from the lift truck frame. Clean all parts in solvent and dry with compressed air.

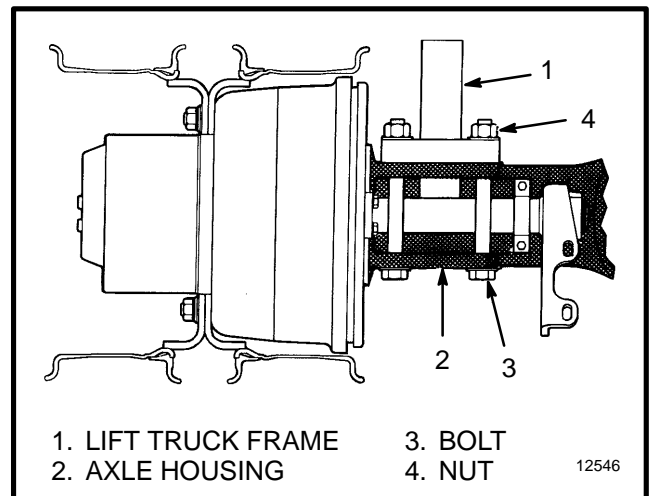


FIGURE 1. AXLE MOUNT

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Tie Rods Repair (All Units)

REMOVE



CAUTION

Do not hit the threads or the nut of the tie rod.

1. **H3.50-5.00XL (H70-110XL), S/E3.50-5.50XL (S/E70-120XL), and H6.00-7.00XL (H135-155XL) units.** Use the following procedure to remove the tie rods on these lift trucks (see Figure 1 and Figure 2):

- a. Remove the cotter pin and castle nut. To loosen the stud, hold a large hammer behind the spindle arm of the spindle. Hit the side of the spindle arm with another large hammer. The shock of the hammer from hitting the spindle arm will normally loosen the tapered stud.
- b. The spindle and tie rod can be removed as a unit. Disconnect the tie rod at the retaining pin inside the dust cover.

S/E3.50-5.50XL (S/E70-120XL) units. It is necessary to raise the steer wheels 8 to 15 cm (3 to 6 in.) from the floor. Use a hammer and a drift to push the pins for the tie rods upward.

2. **H8.00-16.00XL (H165-360XL) and H8.00-16.00XM (H165-360HD) units.** Remove the capscrew, anchor pin, and tie rod pin from each end of the tie rod. See Figure 5.

CLEAN



WARNING

Cleaning solvents can be flammable and toxic and can cause skin irritation. When using cleaning solvents, always follow the recommendations of the manufacturer.

Clean all parts except the ends of the tie rods in solvent. Make sure the bearings are clean.

INSTALL

1. Use the following procedure to install the tie rod to the spindle arm or steering cylinder (see Figure 1, Figure 2, and Figure 5):
 - a. **H3.50-5.00XL (H70-110XL), S/E3.50-5.50XL (S/E70-120XL), and H6.00-7.00XL (H135-155XL) units.** Tighten the castle nut to 165 N•m (122 lbf ft). Tighten the castle nut until the cotter pin can be installed.
 - b. **H8.00-16.00XL (H165-360XL) and H8.00-16.00XM (H170-360HD) units.** Install the seals on the tie rod bushings. Use an alignment pin to align the seals with the bushings. Lubricate the pin with an antiseize compound and install the tie rod pin into the tie rod and cylinder rod or spindle arm. The grease fittings on the tie rod pins must face downward. Install the anchor pin and capscrew to fasten the pin. Tighten the capscrew in the anchor pin to 44 N•m (32 lbf ft).

NOTE: The tie rods do not have an adjustment.

Turning the steering wheel actuates three main parts of the steering control unit: (1) The spool for the control section, (2) the sleeve for the control section and (3) the rotor in the metering section. When the steering wheel is not moving, the spool and sleeve are held in the neutral (center) position by springs. During this time, oil flows freely through the steering control unit. The oil does not flow to the steering cylinder.

OPERATION (See FIGURE 4.)

As the steering wheel is turned, the spool just begins to rotate. The springs try to move the sleeve to keep the neutral position between the spool and sleeve. However, the force necessary to turn the rotor is greater than the pressure of the springs. The springs begin to bend, letting the spool move a small amount within the sleeve. The spool stops moving when it touches the center pin. In this position, the holes in the sleeve and the spool are aligned. Oil coming into the control unit flows to the metering section.

More rotation of the steering wheel causes the spool to rotate the pin. This action causes the rotation of the sleeve and the rotor in the metering section. The oil then flows to one side of the steering cylinder. Oil from the other side of the steering cylinder flows back to the control section of the steering control unit.

When the steering wheel stops moving, the metering action in the metering section also stops. The neutral position springs return the sleeve to the neutral position. When this action occurs, the pressure stays in the steering cylinder to keep the tires in position. Oil from the pump flows through the steering control unit to the tank or other parts of the system. To return the tires to the straight position, the steering wheel must be rotated in the opposite direction. The steering control unit will operate as described, but all parts will rotate in the opposite direction.

Load Sensing Steering

When the lift truck has load sensing steering, the steering control unit has a pilot operated relief valve and an additional port (LS) for a pilot line. A priority valve is also used in the system and is connected to the hydraulic pump.

The demand for steering is sensed at the LS port in the steering control unit. The pilot line from the LS port is connected to the priority valve. The priority valve has a pilot operated spool. While steering, a spring and pilot pressure from the load sensing (LS) line hold the spool open for steering. When there is no pressure in the LS line (no steering), pilot pressure from the hydraulic pump shifts the spool. In this position, most of the oil for steering system goes to the main control valve.

REMOVAL (See FIGURE 3.)

WARNING

To prevent electrical arcs when removing the cover, disconnect the negative battery cable.

1. Remove the cover from the steering housing. Remove the steering wheel using a puller. Put tags on the hydraulic lines at the manifold block. Disconnect the hydraulic lines and put caps on the openings.
2. Remove the four capscrews that fasten the steering control unit to the bracket and remove the steering control unit. Remove the steering column from the steering control unit.

DISASSEMBLY (See FIGURE 5.)

CLEANING

WARNING

Cleaning solvents can be flammable and toxic, and can cause skin irritation. When using cleaning solvents, always follow the solvent manufacturer's recommended safety precautions.

Clean all the parts in solvent. Dry the parts with compressed air. Do not dry the parts with a cloth. Make sure all surfaces are free of scratches and sharp edges.

ASSEMBLY AND INSTALLATION (See FIGURE 6.)

Use new seals, O-rings and neutral position springs during assembly. Lubricate all parts with clean hydraulic oil.

OPERATION (See FIGURE 2. and FIGURE 3.)

Service Brakes

The operation of the service brakes is controlled by the brake pedal valves. See FIGURE 5. When the right-hand (service brake) pedal is pushed, the piston moves to the seat on the inlet valve. This action closes the exhaust passage. As the piston moves farther, the inlet valve opens. Air from the tank flows from the inlet port to the outlet port. The air from the outlet port flows through a check valve and a quick-release valve to the air chambers on the drive axle. The pressure of the air moves a piston assembly in each air chamber. The pistons actuate the brake camshafts. The brake camshafts push the brake shoes against the brake drums to apply the service brakes.

The pressure of the air at the outlet port pushes the piston in the brake pedal valve against the balance spring. As the force of the brake air pressure becomes equal to the force of the spring, the piston moves up and the inlet valve closes. When the pedal is pushed farther, the greater force that is applied through the spring gives higher air pressure at the air chambers. This action applies the brakes with greater force.

The piston moves off the seat on the inlet valve when the pedal is released. This action opens the exhaust port and releases the air pressure. The sudden decrease in air pressure opens the exhaust port of the quick-release valve. The brakes are released quickly as a result. Return springs in the brake assemblies pull the brake shoes away from the drums.

The left-hand (inch/brake) pedal operates the service brakes in the same way as the service brake pedal. The inch/brake pedal also has a linkage that is connected to the transmission control valve. The linkage disengages the transmission as the operator depresses the inch/brake pedal. The transmission is in Neutral when the inch/brake pedal is fully depressed. The linkage engages the transmission as the operator releases the inch/brake pedal.

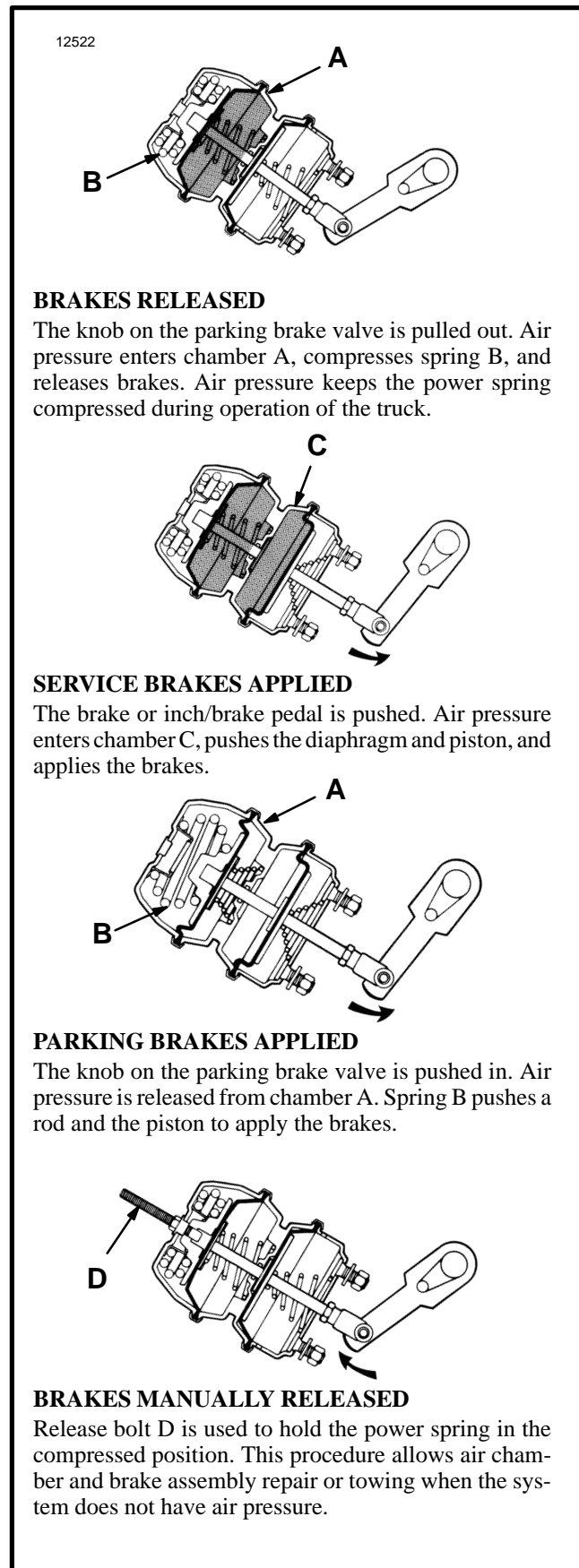


FIGURE 2. OPERATION OF THE AIR CHAMBERS

WARNING

Wear eye protection. Do not hit steel parts with a steel hammer. Parts can break and cause injury.

8. Use a brass drift to remove the top anchor pin. See FIGURE 11.

9. Rotate the top shoe to release the tension of the return spring. Remove the shoe. See FIGURE 12.

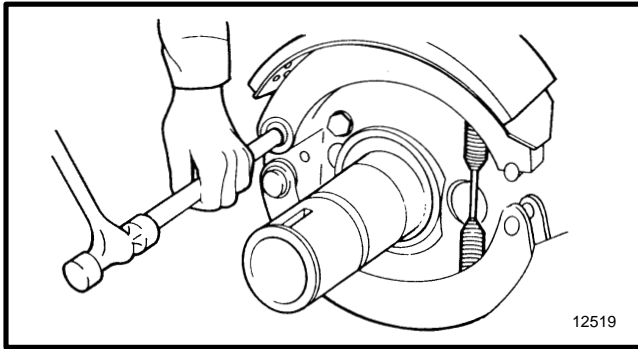


FIGURE 11.

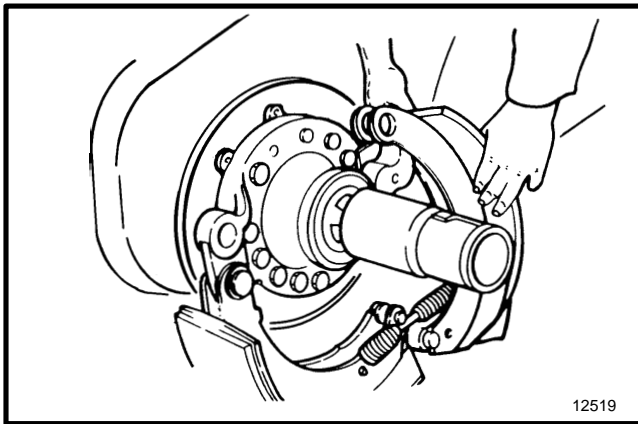


FIGURE 12.

10. Remove the bottom anchor pin (see Step 8) and the second shoe.

11. Release the retainers for the rollers and remove the rollers from the brake shoes. See FIGURE 13.

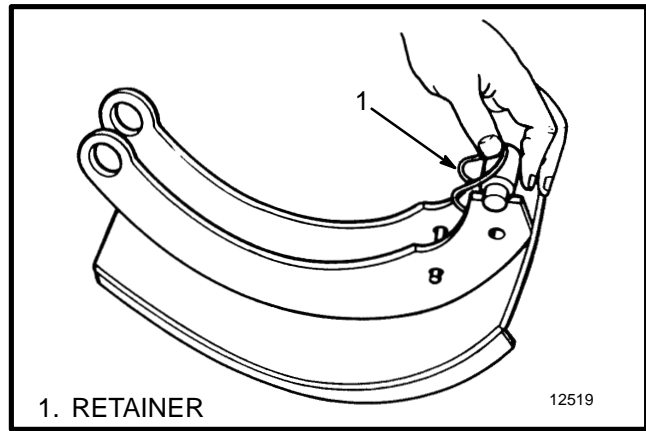


FIGURE 13.

Camshaft Removal

1. Remove the brake shoes. See Brake Shoe Removal.
2. Disconnect the actuator arm at the clevis on the air chamber.
3. Remove the snap ring (18) and washer(s) (17) from the end of the camshaft (1). Pull the actuator arm (16) off the camshaft.

4. Check for wear at the camshaft bushings as shown in FIGURE 14. If the radial clearance of the camshaft is more than 0.76 mm (0.030 in), replace the bushings. See the section **PLANETARY DRIVE AXLE, 1400 SRM 439**, to remove the planetary hub. Remove the washer(s) and seal from the camshaft and pull the camshaft from the spider. Use a driver of the correct size to remove the bushings (4) from the spider and the bracket. See FIGURE 15.

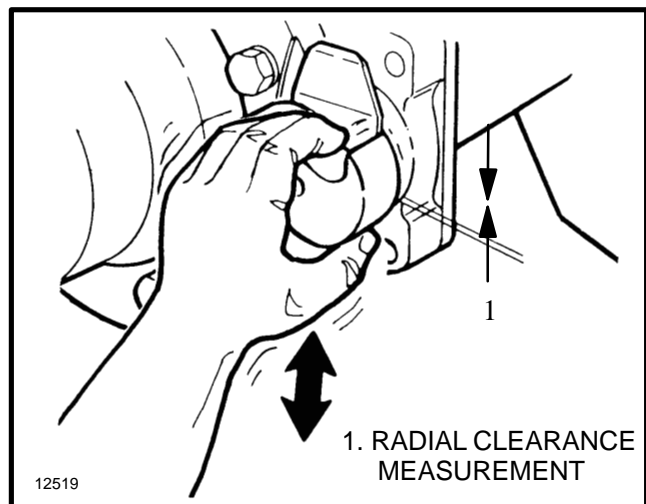


FIGURE 14.

ter position. Remove the two bolts (44) from the connecting rod (42). Remove the bottom connecting rod cap (42) and the bearing (43).

5. Mark for identification plugs (12), crankshaft (10), bolts (44), connecting rod (42), and the bearing (43).

6. Move the piston (46) to top center. Remove the crankshaft (10) from the cylinder block (2).

7. Remove the piston (46) with the connecting rod (42) from the cylinder block (2). Take the connecting rod (42) out of the piston (46) by removing the snap rings (48) and the piston pin (47).

8. Mark for identification the piston (46), snap rings (48), and the piston pin (47).

CLEANING

Clean all metal parts in cold solvent and dry them with compressed air. Make sure all carbon is removed from the cylinder head and the cylinder block.

WARNING

Compressed air can move particles so that they cause injury to the user or to other personnel. Make sure that the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent injury to the eyes.

INSPECTION

Crankshaft

Measure the diameters of the crankshaft (10) at the positions for the connecting rod bearing (43) and the crankshaft bushings (5 and 11). If the dimensions are not within the permitted tolerances shown in FIGURE 2., install a new crankshaft.

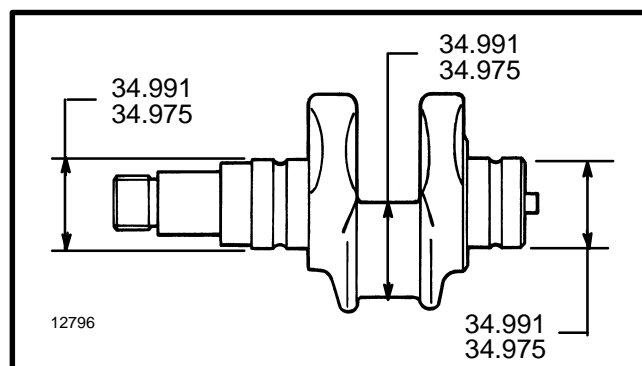


FIGURE 2. CRANKSHAFT DIMENSIONS

Connecting Rod

1. Use the connecting rod bolts (44) to fasten the upper and lower parts of the connecting rod (42) to the bearing (43). Use a torque wrench to tighten the connecting rod bolts to 11 Nm (8.12 lbf ft.). Measure the internal diameter of the connecting rod bearings (43).

2. The permitted internal dimension for the connecting rod bearing is 35.009 to 35.034 mm.

If the connecting rod bearing dimension is not within the permitted tolerance, install new connecting rod bearings.

3. Check the hole for the piston pin (47) in the connecting rod (42) with an internal micrometer. The permitted internal dimension is 20.02 to 20.033 mm.

If the hole diameter is not within the permitted tolerance, install a new connecting rod.

Crankshaft Bushings

1. Check the internal diameter of bushing (5 and 11). The permitted limits of the inner diameter are 35.030 to 35.055 mm.

If the dimensions are not within the permitted tolerances, install new crankshaft bushings.

ASSEMBLY

1. Install the piston rings (49) to piston (46) with the end clearance at approximately 120° to each other and with the “TOP” mark on the rings placed toward the top of the piston.

2. Lubricate the bore of the piston end of the connecting rod with SAE 20–30 oil. Assemble the piston (46) to the connecting rod (42) with the piston pin (47). Install the snap rings (48).

3. Inspect the piston pin (47) to make sure it is a sliding fit in the bore of the connecting rod. Make sure the snap rings (48) are fully and correctly located in their grooves.

4. Install the crankshaft bearings (43) to the connecting rod and caps. Make sure that the bearings are correctly located. Lubricate the bearing with SAE 20–30 oil.

5. Lubricate the piston (46) with SAE 20–30 oil. Install the piston into the cylinder bore to the top-center position.

CAUTION

Make sure the piston and rings are not damaged during this operation.

2. Make sure the internal parts of the pump are clean. Lubricate the parts with hydraulic oil as you install the parts.

3. Install the seal in the shaft housing.

4. Make sure the alignment pins are in the shaft housing. Install the gears, thrust plates and gear housing on the shaft housing. Make sure that the seals for the housing and thrust plate are installed.

5. Install the connection shaft in the gear shaft. Make sure that the seals and alignment pins are installed and install the center housing. Tighten the capscrews in a cross pattern in 110 N.m (80 lbf ft) steps to 271 N.m (200 lbf ft).

6. Make sure that the alignment pins are in the center housing. Install the gears, thrust plates and gear housing on the center housing. Make sure that the seals for the housing and thrust plate are installed.

7. Make sure that the alignment pins and seals are installed. Install the end housing and capscrews. Tighten the capscrews to 271 N.m (200 lbf ft).

8. Install the spool and spring for the priority valve. Install the O-ring and the plug.

9. When used, install the two-speed valve on the pump. Be sure to use a new O-ring. Install the hydraulic line between the two-speed valve and the pump.

Installation

1. Clean the flange of the pump and the mounting surface on the torque converter housing.

2. Install the pump on the torque converter housing. Use a sealant (Hyster Part No. 264159) on the flange of the pump. Tighten the capscrews to 77 N.m (57 lbf ft).

3. Connect the hydraulic line(s) to the pump. Tighten the capscrews for the flange of the high-pressure hose to 50 N.m (37 lbf ft). If necessary, tighten the capscrews for the flange of the suction hose to 77 N.m (57 lbf ft). When used, connect the wires to the two-speed valve.

PRIORITY VALVE

Removal (See FIGURE 8.)

1. Remove the floor plates.

2. Disconnect the hydraulic lines at the valve. Put tags for identification on the lines. Put caps on the open lines.

3. Remove the nuts and bolts that hold the valve to the mount plate. Remove the valve.

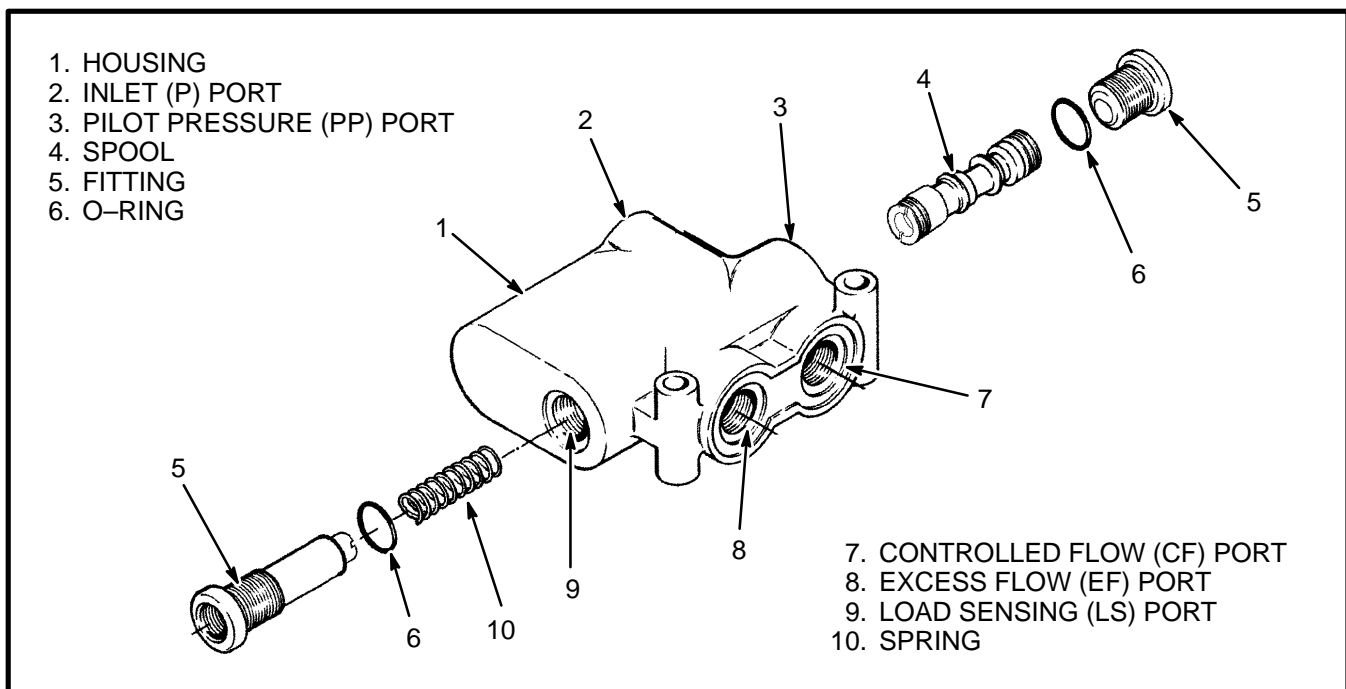


FIGURE 7. PRIORITY VALVE

Tilt Section

The operation of the tilt spool and the auxiliary spools is the same. See FIGURE 2. These spools control the direction of flow in a hydraulic circuit for a cylinder or cylinders. The cross section of the tilt section of the control valve looks like FIGURE 3., but the spool is different. When the tilt spool is moved from NEUTRAL position, oil flows out of one port in the valve section and returns through the other port. When the supply cavity for one port is opened, the other port is connected to the drain cavity.

NOTE: A separate tilt control valve is connected between the ports of the tilt section and the tilt cylinders. The tilt control valve prevents cavitation in the tilt cylinders when the mast is tilted forward with a load. See the section **2100 SRM 103, TILT CONTROL VALVE** for a description of this valve. See the section **1900 SRM 443, HYDRAULIC SYSTEM** for a complete hydraulic system diagram.

TILT BACKWARD

When the tilt spool moves up, it makes a restriction in the open-center passage. The increased pressure in the parallel passage causes the oil to flow through the check valve to the supply cavity. The oil flows from the supply cavity through the lower section of the spool to the bottom port. The oil flows from the bottom port to the tilt control valve and the rod side of each tilt cylinder. The check valve prevents movement of the load until the system pressure is great enough to control the load. Oil from the piston side of each tilt cylinder returns through the top port to the drain passage and the hydraulic tank.

TILT FORWARD

When the spool moves down, it makes a restriction in the open-center passage. The increased pressure in the parallel passage causes the oil to flow through the check

valve to the supply cavity. The oil flows from the supply cavity through the upper section of the spool to the top port. From the top port, the oil flows to the tilt control valve and the piston side of each tilt cylinder. The check valve prevents movement of the load until the system pressure is great enough to control the load. Oil from the rod sides of the tilt cylinders returns through the bottom port to the drain. A spool in the tilt control valve controls this return flow to prevent cavitation in the tilt cylinders.

Relief Valves (See FIGURE 4.)

The relief valves limit the maximum pressure in the hydraulic system. The **primary relief valve** is for the lift circuit. This valve is installed in the inlet section of the main control valve. The **secondary relief valve** in the outlet section is for the tilt and auxiliary circuits. The relief valves are the same, but the secondary relief setting is lower than the primary relief setting. The lift spool prevents the secondary relief valve from sensing lift pressure. See FIGURE 2. When the pressure in a hydraulic circuit reaches the setting of the relief valve, the valve opens a path between the inlet and the drain.

On lift trucks that have an empty container attachment, two **port relief valves** are used for the extend/retract functions. These relief valves are installed in the body of the main control valve behind the extend/retract spool. Operation of the port relief valves is similar to the operation described and illustrated in FIGURE 4.

All of the relief valves are pilot operated and are similar for the primary, secondary and port relief locations on the main control valve. This type of valve gives relief pressure that is almost constant over the range of flow from the pump. The relief valve has four poppets. See FIGURE 4. for the sequence of operation.

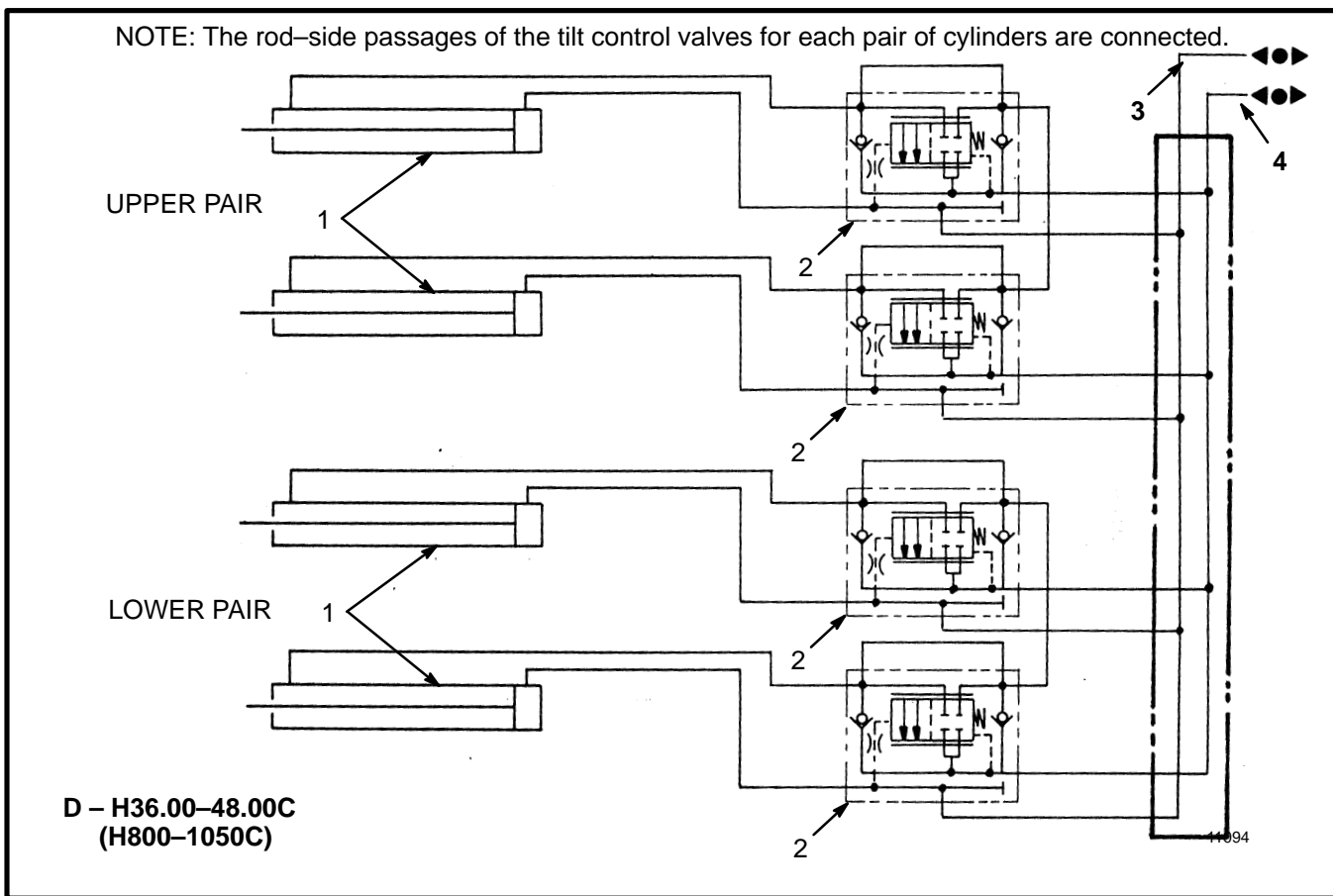


FIGURE 3. SCHEMATIC, TILT CIRCUIT (2 of 2)

REPAIRS

REMOVAL

1. Put tags on the hydraulic lines at the valve. Disconnect the lines and put caps on the open lines.

DISASSEMBLY (See FIGURE 4.)

⚠ WARNING

The spool has spring tension. Do not look into the valve when the damper fitting and spool are removed.

1. Remove the plugs, springs and check balls.
2. Remove the damper fitting, spool, spring and spool stop.
3. If necessary, remove the other fittings.

CLEANING

⚠ WARNING

Cleaning solvents can be flammable and toxic, and can cause skin irritation. When using cleaning sol-

vents, always follow the solvent manufacturer's recommended safety precautions.

⚠ WARNING

Compressed air can move particles so that they cause injury to the user or to other personnel. Make sure that the compressed air path is away from all personnel. Wear protective goggles or a face shield to prevent eye injuries.

Clean all the parts in solvent. Carefully dry the parts with compressed air. Make sure that the seats for the check balls are clean.

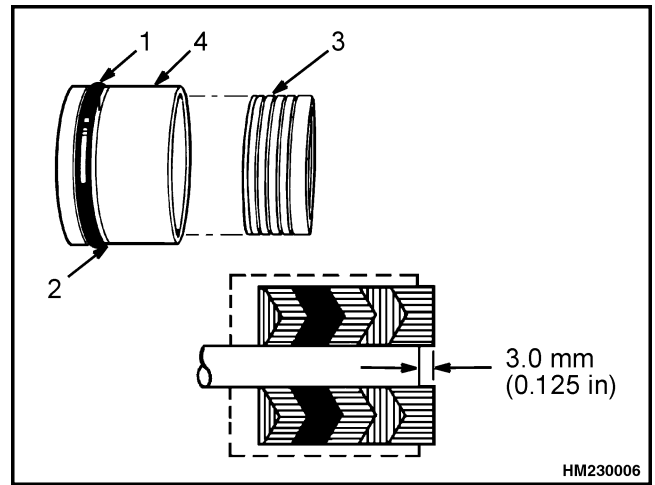
ASSEMBLY (See FIGURE 4.)

1. Lubricate all parts with clean hydraulic oil. Use new O-rings on all fittings.
2. Install the check balls as follows:
 - a. Put each ball on a seat.
 - b. Hold the ball in position with a soft drift.
 - c. Hit the drift with a hammer. This will make sure that the ball correctly fits the seat.

Install

STEP 1.

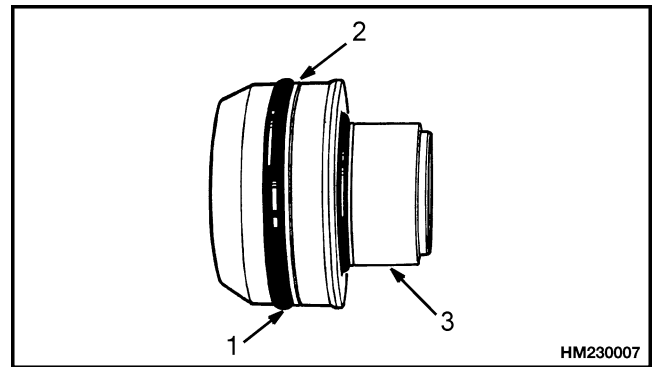
Install the O-ring and the back-up ring on the bushing. Install the packing in the bushing. The end of the packing must extend 3 mm (0.125 in.) beyond the end of the bushing.



- 1. O-RING
- 2. BACK-UP RING
- 3. PACKING
- 4. BUSHING

STEP 2.

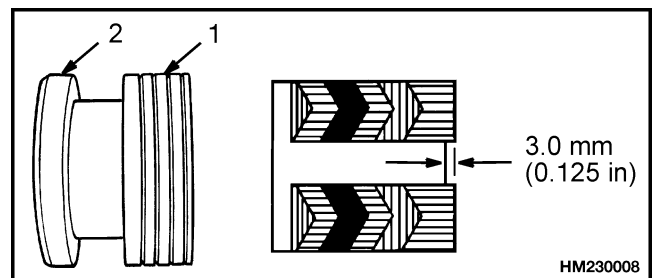
Install the O-ring and the back-up ring on the retainer. Use your hand to push the bushing into the retainer. Make sure the O-ring is not damaged during installation. Install the retainer and bushing assembly on the cylinder rod.



- 1. O-RING
- 2. BACK-UP RING
- 3. BUSHING

STEP 3.

Install the flat piston half on the cylinder rod. Put the O-ring on the rod halfway between the threads and the piston half.



- 1. PACKING
- 2. PISTON HALF

SAFETY PRECAUTIONS

MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks.
- Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:



WARNING

Indicates a condition that can cause immediate death or injury!



CAUTION

Indicates a condition that can cause property damage!

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
The starter makes too much noise.	The solenoid has damage.	Replace solenoid.
	The ring gear has damage.	Install new parts.
	The drive clutch has damage.	Install new parts.
	The battery is discharged or has damage.	Recharge or replace battery.
	The starter brushes are worn or dirty.	Replace brushes.

section **EV-100/200ZX MOTOR CONTROLLER**
Parameter Tables, 2200 SRM 595.

Display Panel

There are two display panels available on lift trucks with the EV-100ZX SCR motor controller. The lift trucks can only have one of the two display panels:

- a basic display that gives the operator basic information about the operation of the lift truck
- a performance display that includes diagnostic capabilities similar to the Hand Set.

Basic Display Panels

The EV-100 “ZX” Series motor controller can have two Basic display panels that include one of two types of Battery Indicators.

EARLY DISPLAY PANEL

When the key is turned to the **ON** position, a start program will cause each warning light to illuminate to show that the function is operating. This later display panel has the following functions:

- (1) **Hourmeter.** The hourmeter display shows the operating time of 0000 to 9999 hours. The time for the traction circuit is shown for four seconds after the lift truck has been operating and the key is turned to the **OFF** position.

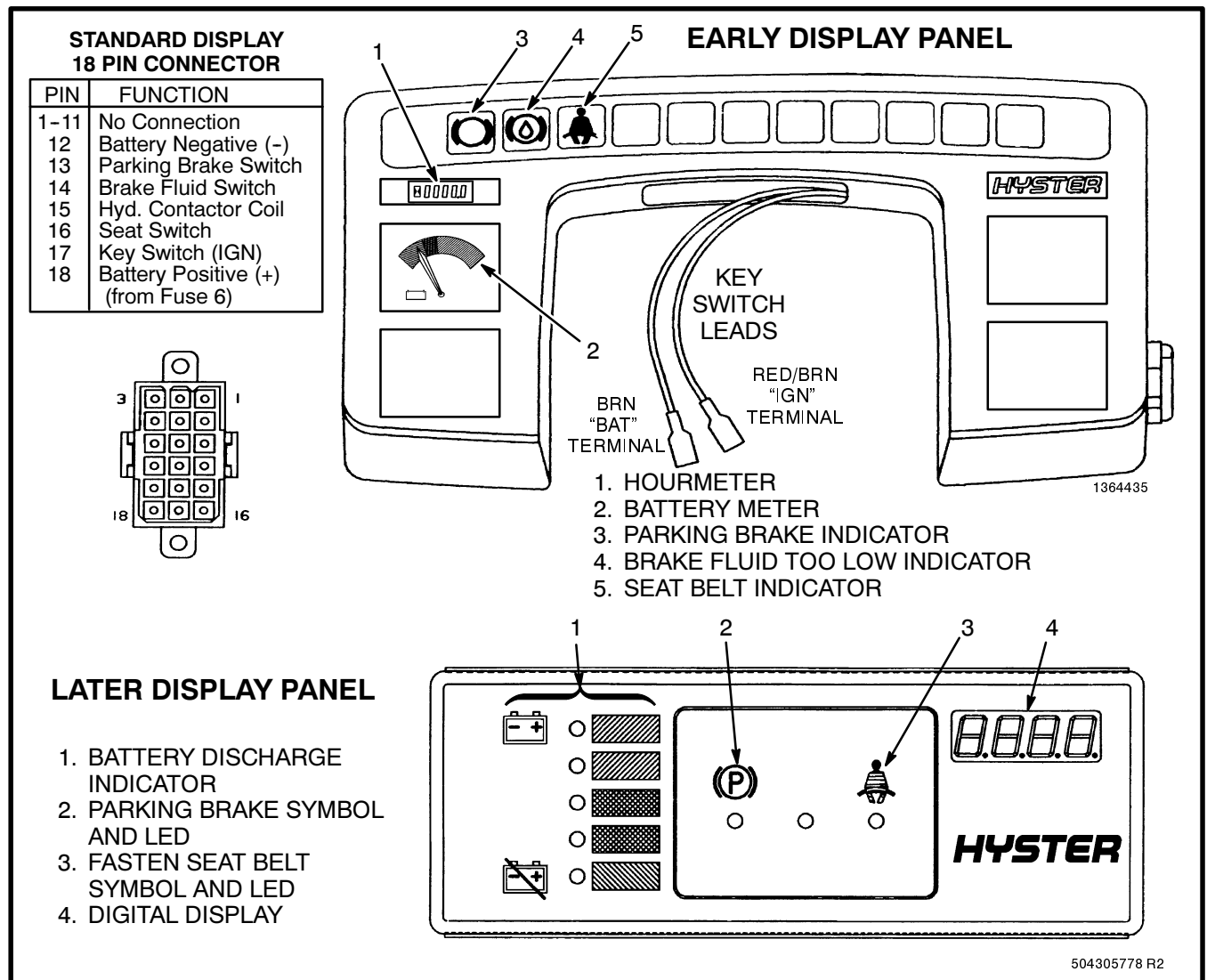


FIGURE 9. BASIC DISPLAY PANELS FOR THE EV-100/200ZX MOTOR CONTROLLERS

Replacing Parts Of The Basic Display Panel (See FIGURE 15.)

NOTE: The parts of the Basic Display Panel can be replaced with the display panel on the steering column. If the assembly housing will be replaced, remove the complete assembly from the steering column as described in Replacing Display Panel Assembly.

NOTE: The following is a complete disassembly procedure. Do ONLY those steps necessary to replace the part you want replaced.

Remove and replace the components of the Basic display panel as follows:

1. Disconnect the battery and remove the key.
2. Remove the eight screws that fasten the top cover to the panel housing. The screws are at the bottom of the

housing. See FIGURE 15. The hourmeter is fastened to the top cover with the electrical connector on the circuit board inside the housing. Carefully lift the top cover up off the housing and the indicator LEDs without damaging the O-ring gasket. The gasket for the LED indicators can stick to the LED housing as the top cover is removed. Do not lose or damage the gasket. Disconnect the three wire connector for the hourmeter.

3. If the housing or filter for the indicators will be replaced, remove the screws that fasten the LED housing to the cover. If the hourmeter or hourmeter gasket will be replaced, remove the screws that fasten it to the top cover. Install the replacement parts to the top cover. Make sure that the hourmeter is installed so that it can be read after the cover is installed.

SAFETY PRECAUTIONS

MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure all slings, chains, or cables are correctly fastened, and that the load being lifted is balanced. Make sure the crane, cables, and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand, use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks.
- Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See HOW TO PUT THE LIFT TRUCK ON BLOCKS in the **Operating Manual** or the **Periodic Maintenance** section.
- Keep the unit clean and the working area clean and orderly.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER APPROVED** parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure all nuts, bolts, snap rings, and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE tag to the controls of the unit when making repairs, or if the unit needs repairs.
- Be sure to follow the **WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), Compressed Natural Gas (CNG), and Diesel fuel are flammable. Be sure to follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area is well ventilated.

NOTE: The following symbols and words indicate safety information in this manual:



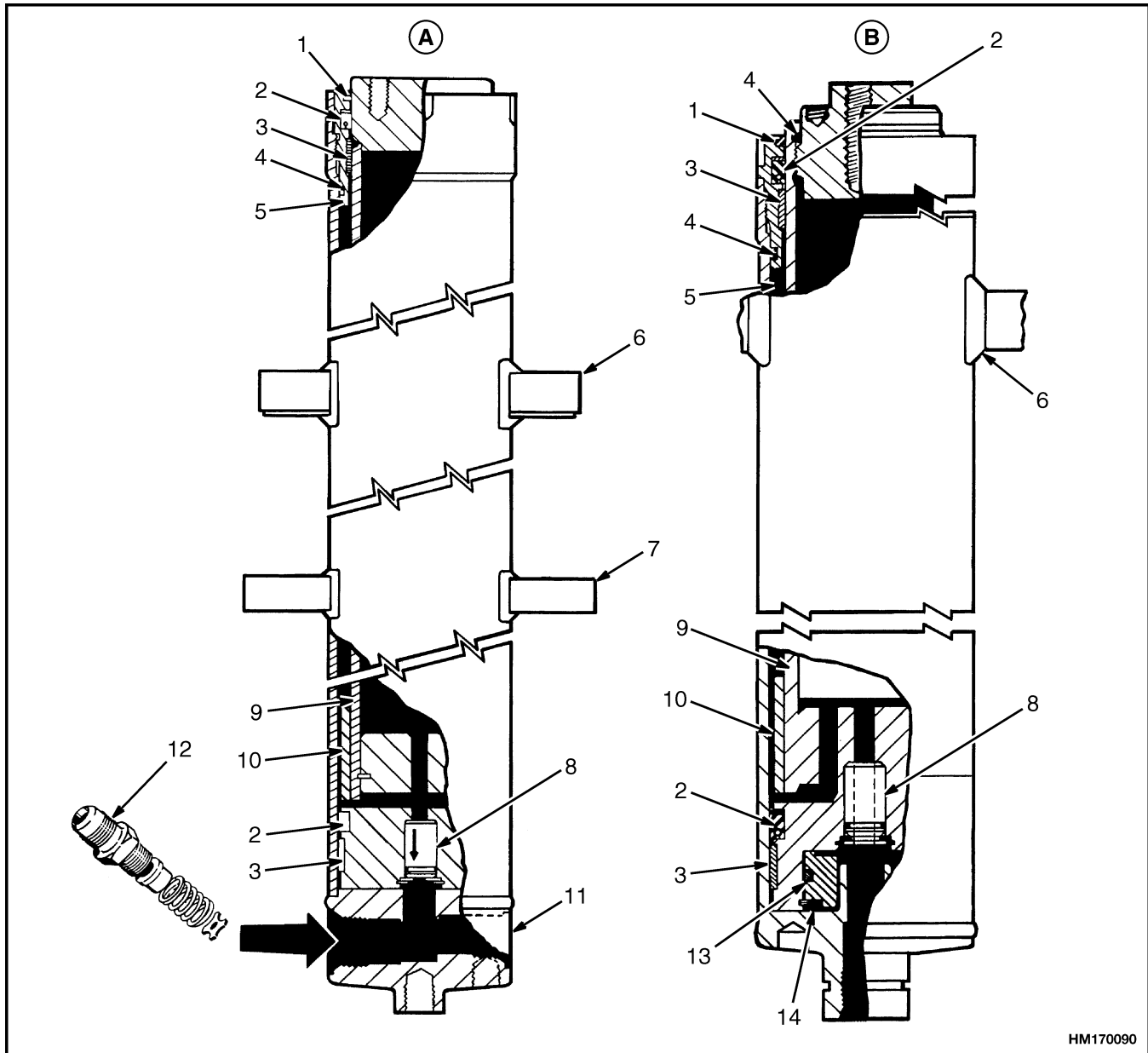
WARNING

Indicates a condition that can cause immediate death or injury!



CAUTION

Indicates a condition that can cause property damage!



HM170090

A. MAIN LIFT CYLINDER

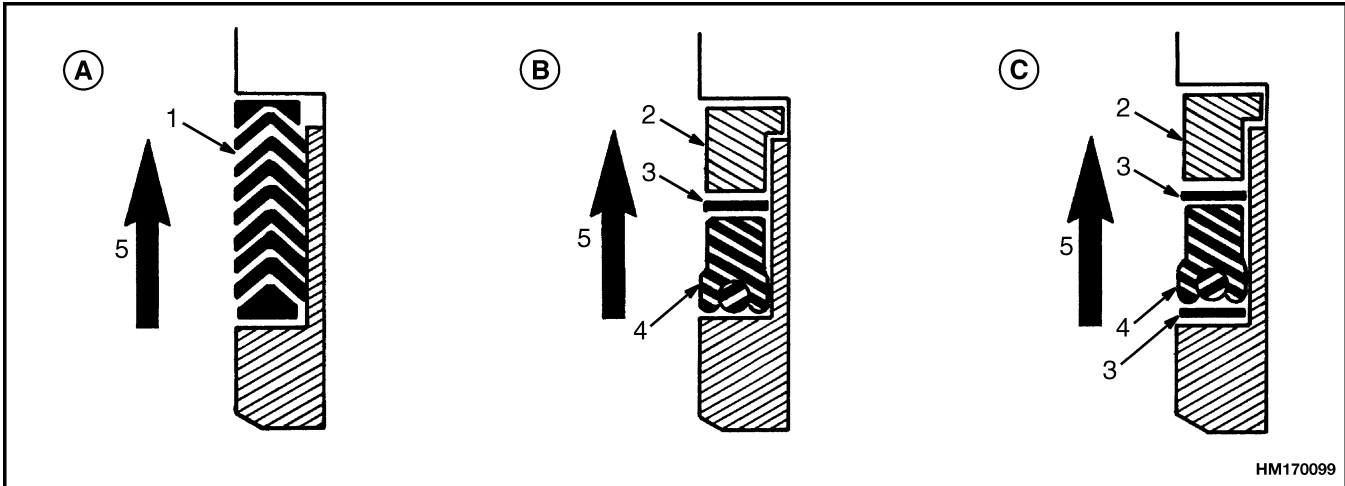
B. FREE-LIFT CYLINDER

- 1. WIPER RING
- 2. SINGLE-LIP SEAL
- 3. BEARING
- 4. O-RING
- 5. RETAINER
- 6. CHAIN ANCHOR MOUNT

- 7. HYDRAULIC LINE MOUNT
- 8. INTERNAL CHECK VALVE
- 9. ROD ASSEMBLY
- 10. SPACER
- 11. TO SENSING PORT FOR PHASING VALVE PRESSURE

- 12. LOWERING CONTROL VALVE (ALL CYLINDERS)
- 13. PISTON RING
- 14. CUSHION RING

Figure 6. Single-Stage Lift Cylinders



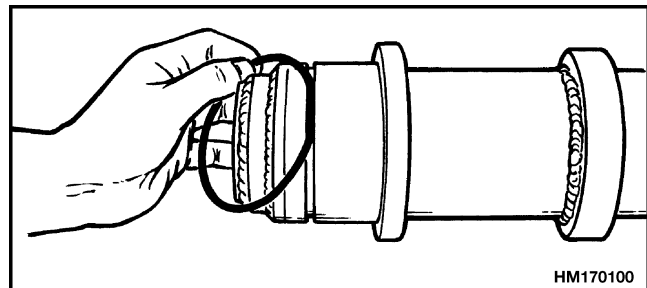
- A. MANY EARLIER PRODUCTION LIFT TRUCKS WITH LESS THAN 7000 kg (15,000 lb) CAPACITY THAT HAVE CHEVRON-STYLE PACKING CAN BE CHANGED TO SINGLE-LIP SEALS.
- B. THE PARTS ARE INSTALLED IN THE ARRANGEMENT SHOWN.
- C. IF TWO BACKUP RINGS ARE IN THE SEAL KIT, THE PARTS ARE INSTALLED IN THE ARRANGEMENT SHOWN.
- | | | |
|--------------------------|-----------------------------|------------------------------|
| 1. CHEVRON-STYLE PACKING | 3. BACKUP RING | 5. DIRECTION OF OIL PRESSURE |
| 2. ALUMINUM SPACER | 4. SINGLE-LIP SEAL ASSEMBLY | |

Figure 16. Chevron-Style Packing Replacement Seal Kits

Chevron-Style Packing Installation on Piston

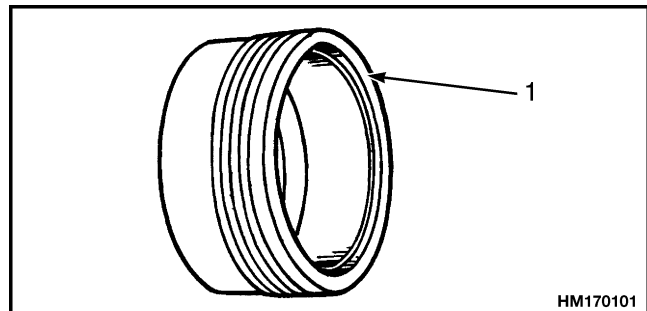
STEP 1.

Lubricate the new O-ring with hydraulic oil and then install it on the piston end of the cylinder rod.



STEP 2.

Install a new packing assembly on the piston half. The packing must extend approximately 3 mm (1/8 in.) beyond the end of the piston half.



1. THIS RING MUST EXTEND 3 mm (1/8 in.) BEYOND END OF PISTON HALF.

Table 2. Cylinder Retainer Torque Specifications and Weight Guide (Continued)

Rod Diameter		Typical Outer Retainer Torque Values		Lifting Mechanism
mm	in.	N•m	lbf ft	
Two-Stage Cylinders for Lift Trucks with Less than 5000 kg (10,000 lb) Capacity				
82.6	3.25	373-509	325-375	Use crane and slings with at least 500 kg (1000 lb) capacity to lift the cylinder.
95.3	3.75	271-305	200-225	
101.6	4.00	271-339	200-250	
114.3	4.50	339-407	250-300	
122.0	5.00	407-475	300-350	
Inner retainer torque value is 122 N•m (90 lbf ft).				

Troubleshooting

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
No movement of lift cylinders or tilt cylinders.	Pilot line(s) to control valve are disconnected or leaking.	Tighten or connect fittings.
	No oil or not enough oil in the hydraulic tank.	Fill tank. Check for leaks.
	Relief valve(s) not set correctly.	Adjust or install new relief valve.
	Hydraulic pump does not operate or has damage.	Repair or install new pump.
	Remote control valve does not operate.	Check and repair valve.
Slow movement of lift or tilt cylinders.	No oil or not enough oil to lift or tilt cylinders.	Fill tank. Check for leaks.
	Cylinders have internal or external leaks.	Repair leaks. Install new parts.
	Relief valve is not set correctly.	Adjust or install new relief valve.
	There is a restriction in a hydraulic line.	Remove restriction. Install new parts.
	Load is more than capacity.	Reduce load.

Forks Repair

REMOVE



WARNING

The mast assembly and its components are heavy. To avoid causing damage or an injury, a lifting device must be used during all service procedures.

1. Lower the carriage completely and remove capscrews, washers, keeper plate, and the pin that holds the fork in the carrier. See Figure 5.

2. Use a lifting device to move the fork, and reinstall pin, keeper plate, capscrews, and washers removed in above step.

INSTALL

1. Remove capscrews, washers, keeper plate, and the pin used to hold fork and carrier to carriage. See Figure 5.
2. Use a lifting device to move the fork to the lift truck and position the fork in the carrier. Insert the pin, keeper plate, capscrews, and washers.

Carriage Repair

REMOVE



WARNING

When working on or near the mast see Safety Procedures When Working Near Mast in this section.

1. Lower the carriage and forks on blocks so that the lift chains are loose. See Figure 5 and Figure 6.
2. If a sideshift carriage or attachment is installed, disconnect the hydraulic lines at the carriage. Put caps on the open lines.



WARNING

Keep control of the lift chains when disconnecting them from the carriage. Use wire to temporarily connect the ends of the lift chains to the mast. This procedure will prevent the lift chains from falling and causing an injury or damage.

3. Remove the pin from each chain anchor at the carriage. Disconnect the lift chains from the carriage.



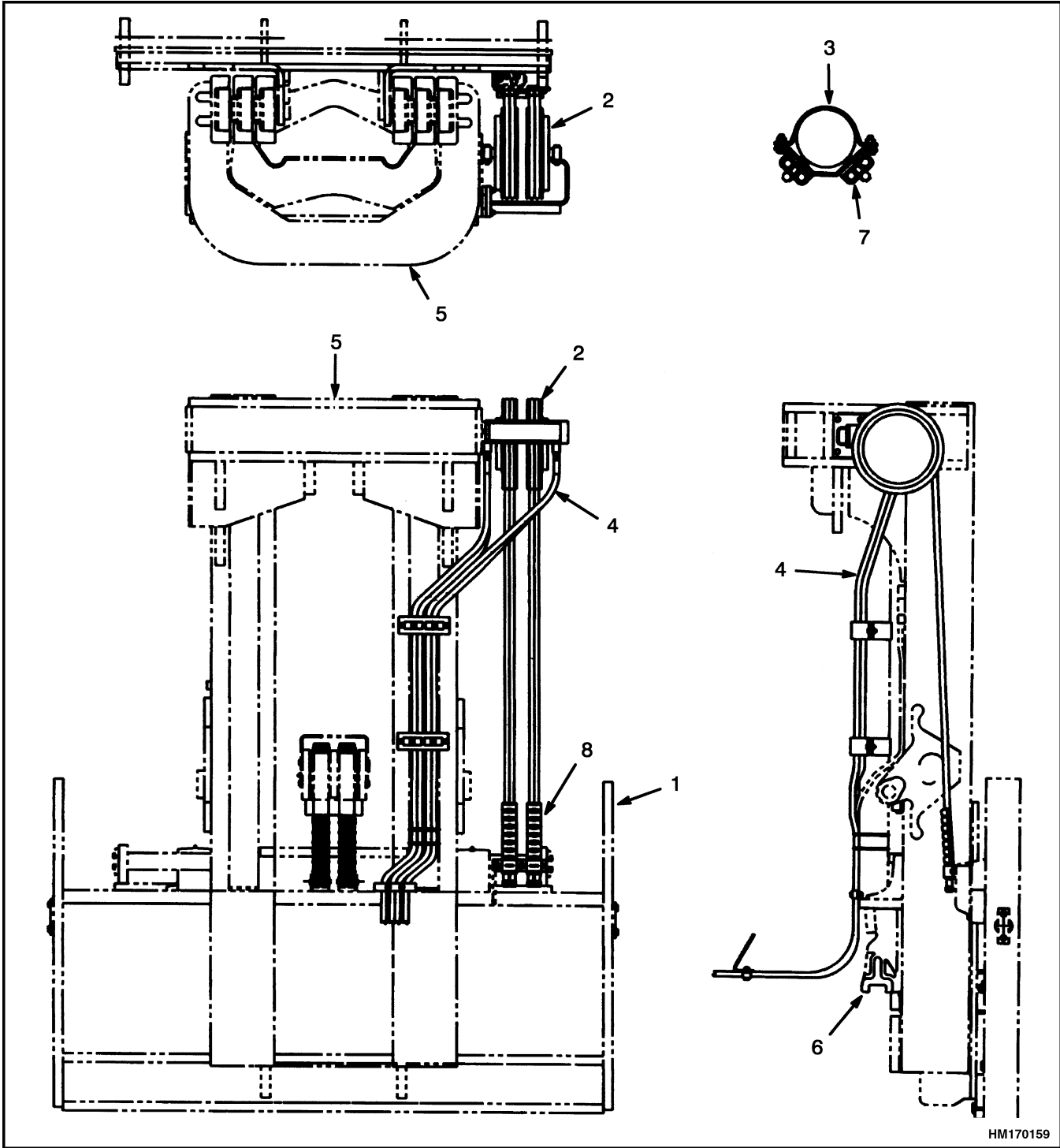
WARNING

When the carriage is not connected to the mast, it can fall and cause an injury. Make sure that the carriage has stability and will not fall over when the inner mast is raised above the carriage.

4. Put weight on the forks so that the carriage has stability and will not fall when it is disconnected from the mast.
5. Use the lift cylinders to raise the inner mast until it is above the load rollers of the carriage. If the hydraulic system cannot be used, connect a lifting device to the top of the inner mast. Carefully raise the inner mast until it is above the load rollers of the carriage.
6. Move the lift truck from the carriage. Connect a lifting device to the carriage. Make sure the carriage has stability. Remove the load backrest, fork pins, and forks. Lay the carriage on the floor so the load rollers are up. For a sideshift carriage, lay the carriage on blocks with the apron up so the load rollers are not on the ground.
7. If any of the load rollers need to be replaced, make a note of the location of the shims.

SIDESHIFT CARRIAGE, DISASSEMBLE

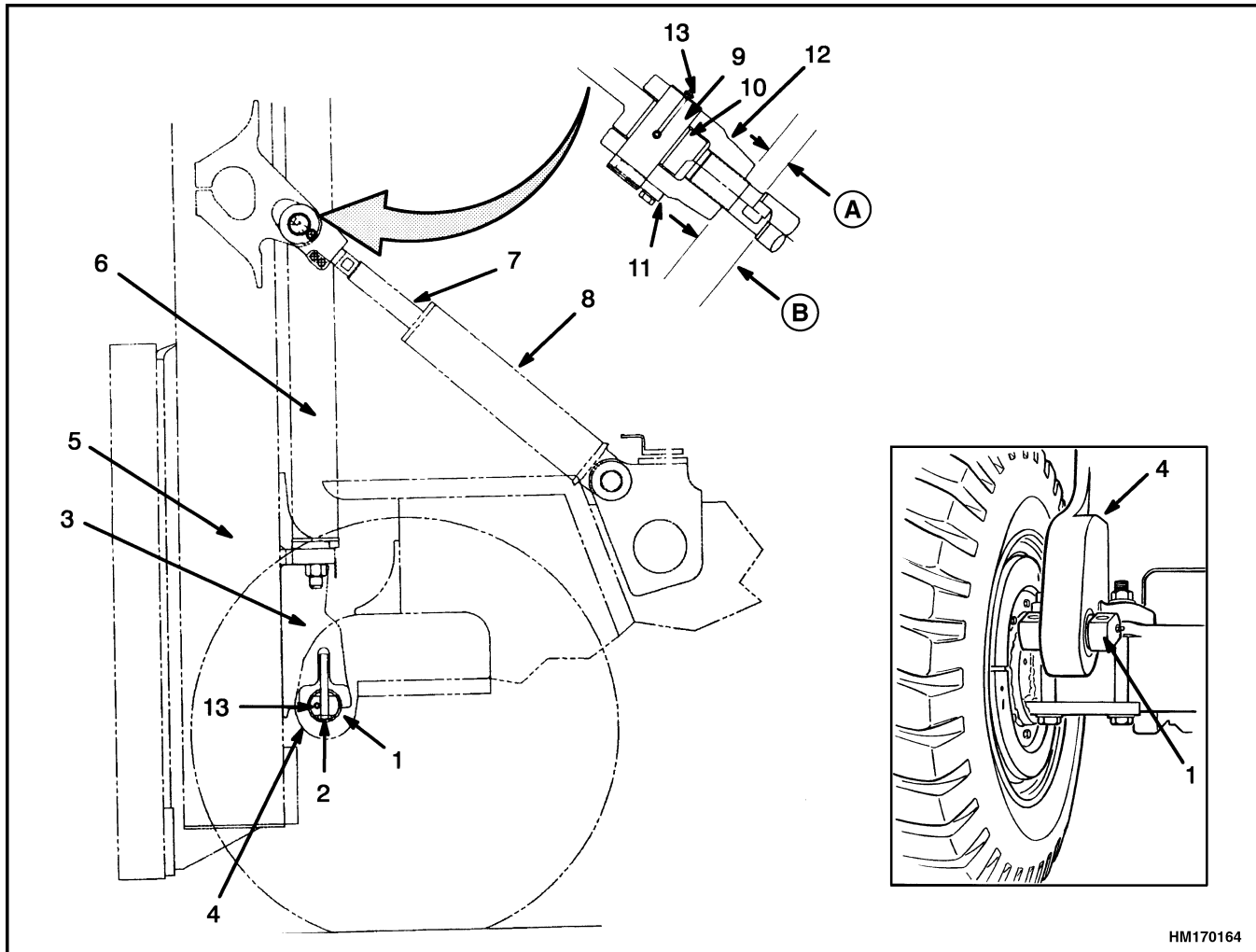
1. Disconnect the hydraulic lines at the sideshift cylinder. See Figure 5, Figure 6, and Figure 7. Put caps on the open line and plug sideshift cylinder. Remove the lock nuts from both ends of the cylinder and remove the cylinder. To remove the lock nut from the cylinder rod end, use a wrench on the flats so the rod will not turn in the cylinder.



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- | | | | |
|--------------|-------------------|---------------|------------------|
| 1. CARRIAGE | 3. BRACKET, HOSES | 5. OUTER MAST | 7. CLAMP, HOSE |
| 2. HOSE REEL | 4. HEADER HOSES | 6. MAST MOUNT | 8. STRAIN RELIEF |

Figure 12. Header Hoses - Three-Stage Mast



A. 33.0 mm (1.30 in.) FLATS ON
57.1 mm (2.25 in.) DIA. ROD

B. 60.0 mm (2.36 in.) FLATS ON
47.6 mm (1.87 in.) DIA. ROD

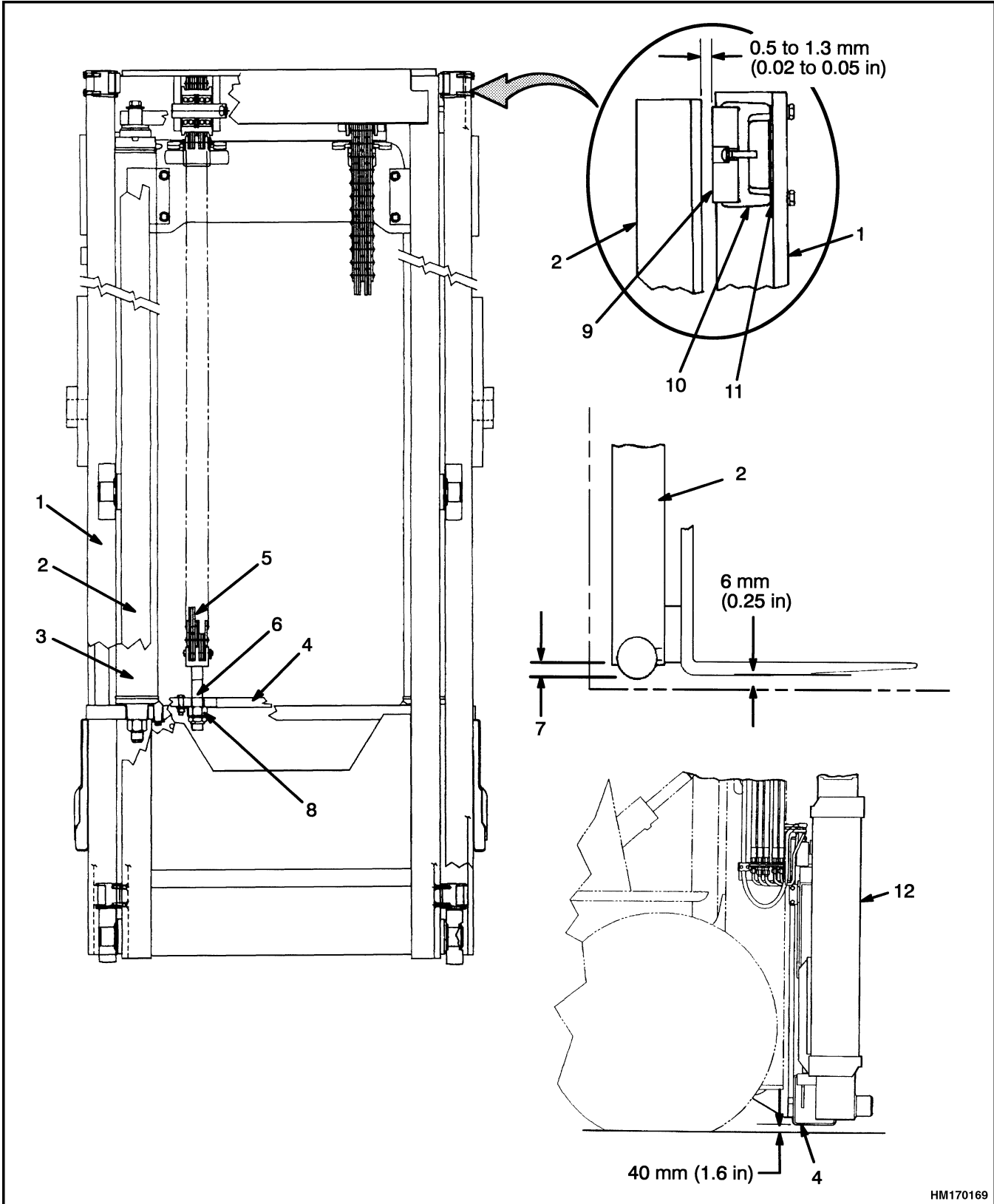
- | | | | |
|---------------------|----------------------|------------------|--------------------|
| 1. MOUNTING PIN | 5. MAST | 8. TILT CYLINDER | 11. PIN ANCHOR |
| 2. CAPSCREW (2) | 6. LIFT CYLINDER | 9. PIN | 12. ROD END |
| 3. MAST MOUNT | 7. TILT CYLINDER ROD | 10. BUSHING | 13. GREASE FITTING |
| 4. LIFT TRUCK FRAME | | | |

Figure 18. Mast Installation

Lift Cylinders Description

There are two types of lift cylinders used on these lift trucks. The H8.00-12.00XL (H165-280XL), H8.00-12.00XM (H170-280HD), H13.00-16.00XL (H300-360XL), and H13.00-16.00XM (H300-360HD) units use piston-type cylinders. The H10.00-12.00XL-12EC (H330-360XL-EC) and H10.00-12.00XM-12EC (H330-360HD-EC) units use displacement-type lift cylinders. The VISTA two-stage masts have two main lift cylinders. The



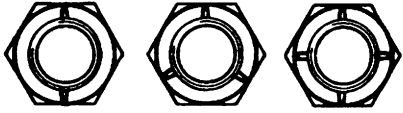
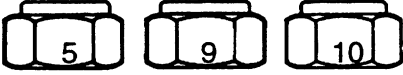
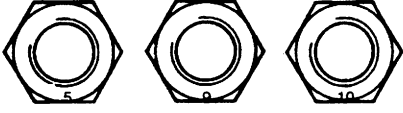

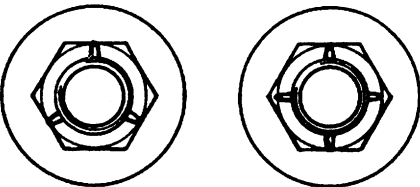
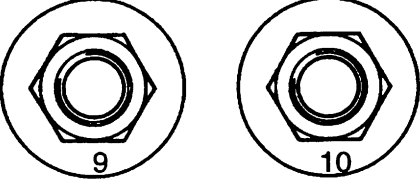
VISTA three-stage masts have two main lift cylinders and one free-lift cylinder. All lift cylinders for these lift trucks are single-action hydraulic cylinders. When hydraulic oil enters one end of the cylinder, the hydraulic force extends the rod. When the oil is allowed to drain from the cylinder, the weight of the carriage and inner mast causes the cylinder rods to retract.



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Figure 25. Lift Chain and Mast Adjustments

Table 4. Torque Nuts with Nylon Insert

<p>TYPE OF FASTENER</p>	<p>METRIC FASTENERS STRENGTH LEVELS: PROPERTY CLASS</p>	<p>INCH FASTENERS STRENGTH LEVELS: SAE GRADES</p>
 <p>NYLON INSERT PREVAILING TORQUE NUTS</p>	<p>5 9 10</p>  <p>OR</p>  <p>OR</p>  <p>OR</p> 	<p>MARKINGS NOT REQUIRED</p>
 <p>NYLON INSERT PREVAILING TORQUE NUTS</p>	<p>9 10</p>  <p>OR</p> 	<p>MARKINGS NOT REQUIRED</p>

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ITEM NO.	ITEM	8 Hr./ Daily	150 Hr./ 2 mo.	350 Hr./ 2 mo.	1000 Hr./ 6 mo.	2000 Hr./ 1 yr.	PROCEDURE OR QUANTITY	SPECIFICATION
	ENGINE SPEED (DIESEL) IDLE SPEED GOVERNED SPEED			X X			Adjust as Necessary	725 to 775 rpm 2660 to 2760 rpm
	ENGINE SPEED (GM V-8) IDLE SPEED GOVERNED SPEED			X X			Adjust as Necessary	725 to 750 rpm 2700 to 2800 rpm
	TIMING, INJECTION PUMP				X		Adjust as Required	23° BTDC Static
	TIMING, GM V-8 SPARK PLUGS				X X		Adjust as Required (8) Replace as Necessary	6° to 8° BTDC Gap = 0.89 mm (0.35 in) See Parts Manuals
	VALVE ADJUSTMENT (DIESEL) INLET (Cold) EXHAUST (Cold) GM V-8 (NO VALVE ADJUSTMENT)				X		Adjust as Required	0.20 mm (0.008 in) 0.45 mm (0.018 in)
	SPARK PLUGS (GM V-8)				C		8	0.89 mm (0.35 in) See Parts Manual
20	FINAL FUEL FILTERS (DIESEL)				C		2	See Parts Manual
	FUEL FILTER (LPG)				C			See Parts Manual
34	TRANSMISSION OIL FILTER				C		1 (See NOTE 1)	See Parts Manual
16	HYDRAULIC SYSTEM OIL FILTER					C	1 (See NOTE 1)	See Parts Manual
29	HUB BEARINGS, STEER WHEELS					C	As Necessary	Multi-Purpose Grease See NOTE 4
X= Check C=Change L=Lubricate		NOTE 1: Change filters after first 100 hours of operation on a new lift truck. NOTE 4: Multi-purpose grease with 2-4% molybdenum disulfide.						

**MAINTENANCE SCHEDULE, EMPTY CONTAINER ATTACHMENT
(Item Numbers Reference FIGURE 3.)**

ITEM NO.	ITEM	150 Hr./ 2 mo.	350 Hr./ 2 mo.	2000 Hr./ 1 yr.	PROCEDURE OR QUANTITY	SPECIFICATION
1	SIDE-SHIFT ROLLERS		L		8 Fittings	Multi-Purpose Grease ⁴
2	SIDE-SHIFT CYLINDER PINS		L		2 Fittings	Multi-Purpose Grease ⁴
3	LOCK PINS		L		2 Fittings	Multi-Purpose Grease ⁴
4	BEARING BLOCKS		X, L		As Necessary	Multi-Purpose Grease ⁴
5	ACCUMULATORS		X		Drain Moisture	
6	LOCK PIN CYLINDERS			L	Lubricate Internally	See Service Manual
X= Check C=Change L=Lubricate		NOTE 4: Multi-purpose grease with 2-4% molybdenum disulfide.				

STEERING AXLE (See FIGURE 15.)

Lubricate the grease fittings on the tie rods and the lower spindle bearings with multi-purpose grease.

WHEEL NUTS

Check the torque of the wheel nuts. Tighten the nuts to 640 to 680 N.m (470 to 500 lbf ft) in the sequence shown in FIGURE 37.

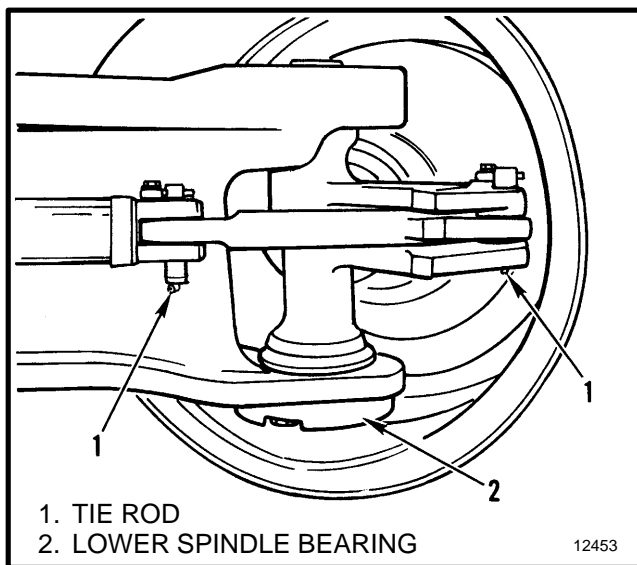


FIGURE 15. STEERING AXLE

SHAFTS FOR BRAKE ACTUATORS

Lubricate the grease fitting on the shafts for the brake actuator arms.

DRIVE AXLE AND DIFFERENTIAL

The drive axle and differential use the same oil supply. The oil level in the drive axle is correct when the oil is even with the plug in the planetary cover. Be sure to check both planetary covers and the differential when checking the oil level. Make sure the “level line” on the planetary cover is parallel to the floor.

The oil level in the differential is correct when the oil is even with the plug in the front of the housing. Add the correct oil as specified in the MAINTENANCE SCHEDULE.

HYDRAULIC TANK BREATHER (See FIGURE 2.)

Remove the hydraulic tank breather from behind the right-hand cover and clean it in solvent. Dry the breather with compressed air and install it.

AIR FILTER, HEATER

Remove the four screws and the air intake cover at the right side of the cab. Remove the spring and air filter. Clean the filter with soap and water or compressed air. Replace the filter if it is damaged.

EVERY 350 HOURS OR TWO MONTHS

NOTE: Do these procedures in addition to the 150 hour checks.

ENGINE OIL AND FILTER (See FIGURE 9.)

NOTE: Change the oil filter for the engine after the first 100 hours on new lift trucks.

CAUTION

Never run the engine without oil.

Change the filter at the same time engine oil is changed. Use the correct oil according to the specifications. Install a new filter. Apply clean oil to the gasket of the new filter. Turn the filter until the gasket touches, then tighten $\frac{1}{2}$ to $\frac{3}{4}$ turn with your hand. Start the engine. Check for leaks.

CAUTION

Long term exposure to used engine oil can cause skin irritation or cancer. Wash with detergent and water.

BRAKE ACTUATOR ARMS

Check the adjustment of the brake actuator arms as described in the section, **BRAKE SYSTEM, 1800 SRM 441**.

DRIVE BELTS (See FIGURE 16. and FIGURE 17.)

Check the drive belts for wear and damage. When a pair of drive belts are used, they must be replaced as a pair.

GENERAL PROCEDURES

CHECK THE FUEL INJECTORS (See FIGURE 29. and FIGURE 30.)

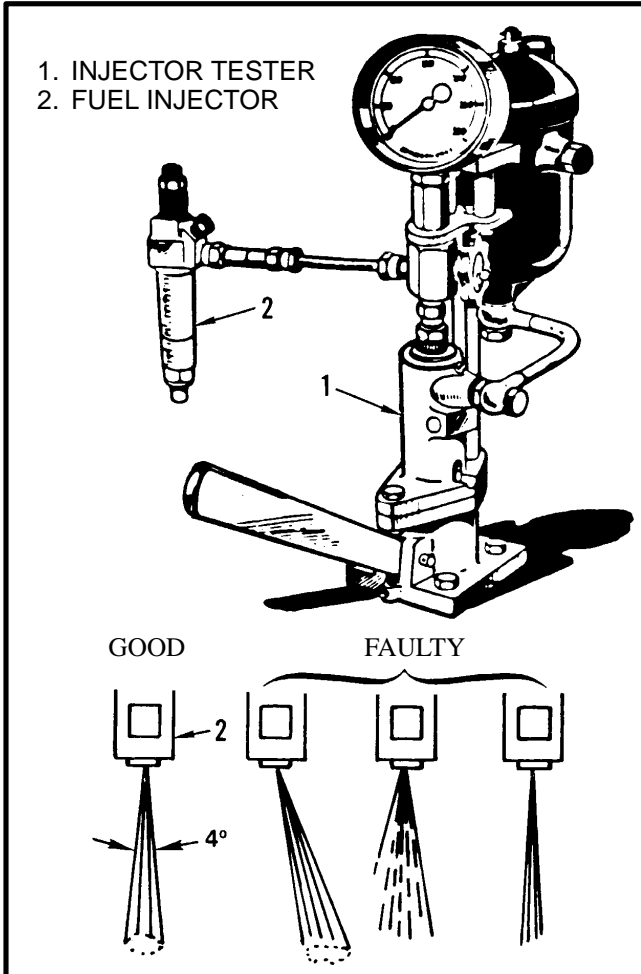


FIGURE 29. DEVICE TO CHECK THE FUEL INJECTORS

⚠ WARNING

Do not try to find leaks while the injectors are under pressure. Diesel fuel can be injected into the body by pressure and cause an injury.

Injector nozzles that have a defect will cause black smoke in the exhaust, a decrease in engine output, and an increase in engine noise.

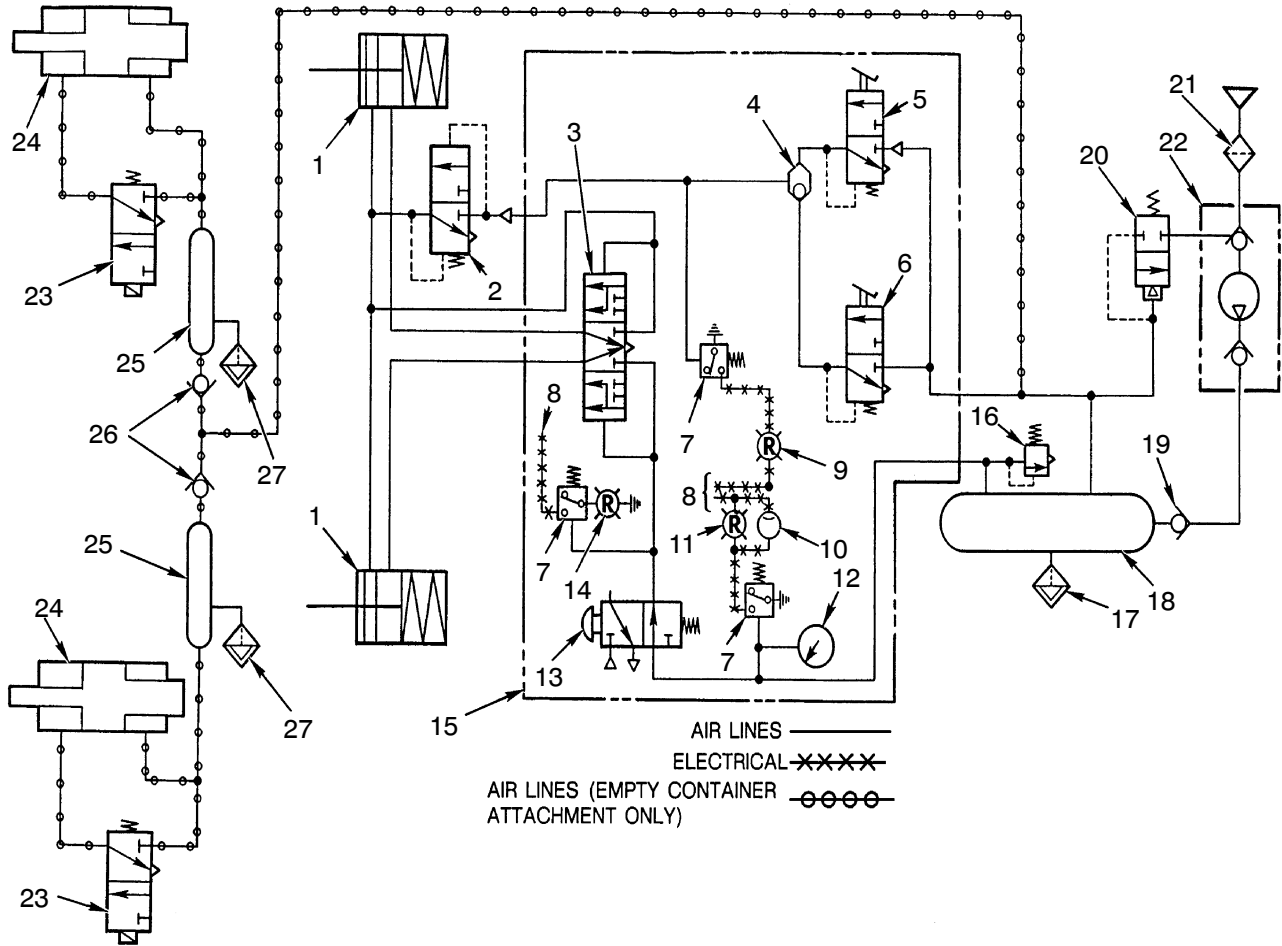
1. Start the engine and run it at half speed.
2. Loosen the fitting for the high pressure fuel line at the injector. If the engine speed does not change, the injector has a defect.
3. Use an injector tester to check the pressure at which the nozzle operates. (See FIGURE 29.)
4. To change the pressure at which the nozzle operates, add or remove washers at the nozzle holder. The correct pressure is shown in FIGURE 30.
5. Check the spray pattern of the nozzle. (See FIGURE 29.) If the spray pattern is not correct, the needle valve is not seated correctly against the valve seat. Remove carbon deposits or replace parts as required.

Code	Holder	Nozzle	Set and reset pressure		
			atm	psi	MPa
HV	LRB67014	JB6801052	250	3675	25.3
HZ	LRB67014	JB6801029	220	3234	22.3
JB	LRB67014	JB6801058	250	3675	25.3
JE	LRB67014	JB6801058	220	3234	22.3
JF	LRB67032	JB6801052	250	3675	25.3
JG	LRB67032	JB6801058	230	3381	23.3
RD	KBEL66S45	DLA140S1039	250	3675	25.3
RE	KBEL66S47	DLA150S1055	250	3675	25.3
RF	KBEL66S47	DLA150S1072	250	3675	25.3
RH	KBEL66S47	DLA150S1087	250	3675	25.3

FIGURE 30. FUEL INJECTOR CODES

ENGINE SPECIFICATIONS, PERKINS DIESEL	
ITEM	SPECIFICATION
TYPE	PERKINS 1000-6
NUMBER OF CYLINDERS	6
FIRING ORDER	1-5-3-6-2-4
BORE	100 mm (3.937 in)
STROKE	127 mm (5.000 in)
DISPLACEMENT	6 litres (365 in ³)
COMPRESSION RATIO	16.5:1
OIL PRESSURE (Minimum, at 2600 rpm and normal operating temperature)	207 kPa (30 psi)
GOVERNED SPEED	2560 rpm
IDLE SPEED	725 to 775 rpm
STALL SPEED	1925±50 rpm
FUEL INJECTION TIMING	23° BTDC (Static)
THERMOSTAT Begin to open Fully open	77° to 85°C (170° to 185° F) 92° to 98°C (198° to 208° F)
VALVE CLEARANCE (Cold) INTAKE EXHAUST	0.20 mm (0.008 in) 0.45 mm (0.018 in)

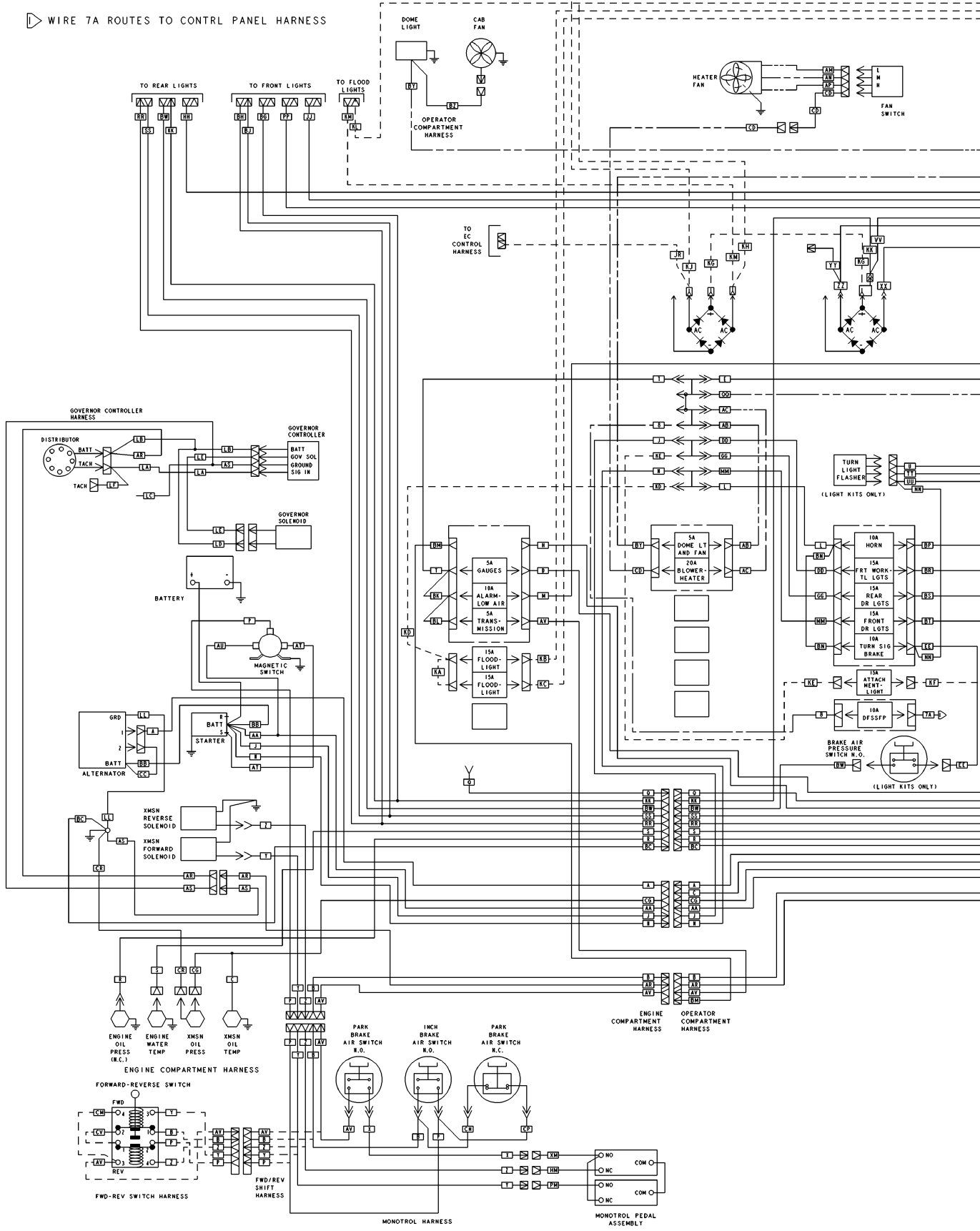
ENGINE SPECIFICATIONS, GM V8	
ITEM	SPECIFICATION
TYPE	GM V8 6-litre
NUMBER OF CYLINDERS	8
FIRING ORDER	1-8-4-3-6-5-7-2
BORE	100.076 mm (3.94 in)
STROKE	95.5 mm (3.76 in)
DISPLACEMENT	6 litres (366 in ³)
COMPRESSION RATIO	8.0:1
OIL PRESSURE (Minimum, at 800 rpm and normal operating temperature)	68.95 kPa (10 psi)
GOVERNED SPEED	2700 to 2800 rpm
IDLE SPEED	725 to 750 rpm
STALL SPEED	1925±50 rpm
IGNITION TIMING	6 TO 8 DEGREES BTDC
THERMOSTAT Begin to open Fully open	77° to 85°C (170° to 185° F) 92° to 98°C (198° to 208° F)
VALVE CLEARANCE	NO ADJUSTMENT



- | | |
|--|-----------------------------------|
| 1. AIR CHAMBER | 14. PARKING BRAKE INDICATOR LIGHT |
| 2. QUICK RELEASE VALVE | 15. OPERATOR COMPARTMENT |
| 3. QUICK RELEASE VALVE WITH DOUBLE CHECK VALVE | 16. RELIEF VALVE |
| 4. TWO-WAY CHECK VALVE | 17. DRAIN VALVE |
| 5. VALVE, SERVICE BRAKE PEDAL | 18. TANK |
| 6. VALVE, INCH/BRAKE PEDAL | 19. CHECK VALVE |
| 7. PRESURE SWITCH | 20. GOVERNOR |
| 8. 12 VOLTS (+) | 21. AIR CLEANER |
| 9. BRAKE LIGHT | 22. AIR COMPRESSOR |
| 10. LOW AIR PRESSURE ALARM | 23. SOLENOID VALVE |
| 11. LOW AIR PRESSURE LIGHT | 24. LOCK PIN CYLINDER |
| 12. AIR PRESSURE GAUGE | 25. RESERVOIR |
| 13. PARKING BRAKE VALVE | 26. CHECK VALVE |
| | 27. DRAIN |

FIGURE 1. AIR SYSTEM SCHEMATIC (WITHOUT AUTOSHIFT)

▷ WIRE 7A ROUTES TO CONTRL PANEL HARNESS



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