
TECHNICAL MANUAL

MAINTENANCE/OVERHAUL INSTRUCTIONS

**TRUCK, ARTICULATED FORKLIFT
MODEL M13K**

NSN 3930-01-182-0119

JI Case, a Tenneco Company
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Table 1-1. Specifications (Continued)

ELECTRICAL SYSTEM (Continued)

Alternator

Manufacturer	Delco-Remy
Manufacturer's part number	1105510
Rated output of alternator	50 amperes at 24 volts
Voltage regulator	An internal part of the alternator.
	The voltage regulator is solid state, and is not adjustable.

Starter

Manufacturer	Delco-Remy
Manufacturer's part number	1114872
Model number	R45968
No-load test at 80°F (27°C)	
Volts	20
Current draw	70-110 amperes
Armature speed	5500-9000 rpm
Pinion clearance	0.33-0.39 in.
Torque for allen head screws (in starter drive housing)	13-17 ft-lbs
Lubricant	SAE 10 engine oil

Solenoid

Manufacturer	Delco-Remy
Manufacturer's part number	1115559
Hold-in coil test at 80°F (27°C)	6-7 amperes at 20 volts
Pull-in coil test at 80°F (27°C)	10-11.5 amperes at 5 volts

Circuit Breakers

Light switches	15 amperes
Starting circuits	40 amperes
Cab instruments	5 amperes
Heater	15 amperes
Rear wiper	3 amperes
Defroster Fan	3 amperes
Dome light and front wiper	3 amperes

Replacement Lights

Rear floodlights	No. 4578 — 24V
Driving lights	No. 4880 — 24V
Combination taillight and brakelight	No. 1683 — 24V
Dome light	No. 93 — 24V
Instrument cluster warning & illumination lights	No. 194 — 12V
R.H. instrument panel lights	No. 363 — 12V
Water temperature indicator	No. 303R — 12V

HYDRAULIC SYSTEM

Reservoir	Air pressurized with one suction filter in reservoir
Equipment control valve main relief valve setting	2100 to 2200 psi at 2200 rpm
Hydraulic reservoir air pressure	5 to 15 psi at 750 rpm
Pump Output:	
Loader section	48 U.S. gpm at 2200 rpm at 2150 psi
Steering system	23 U.S. gpm at 2200 rpm at 2150 psi
Capacity and oil:	
(Refer to table 1-1, FUEL, FLUIDS and LUBRICANTS)	

1-10. ELECTRICAL SYSTEM. The electrical system is a direct current type in which there are two 12 volt batteries connected in series.

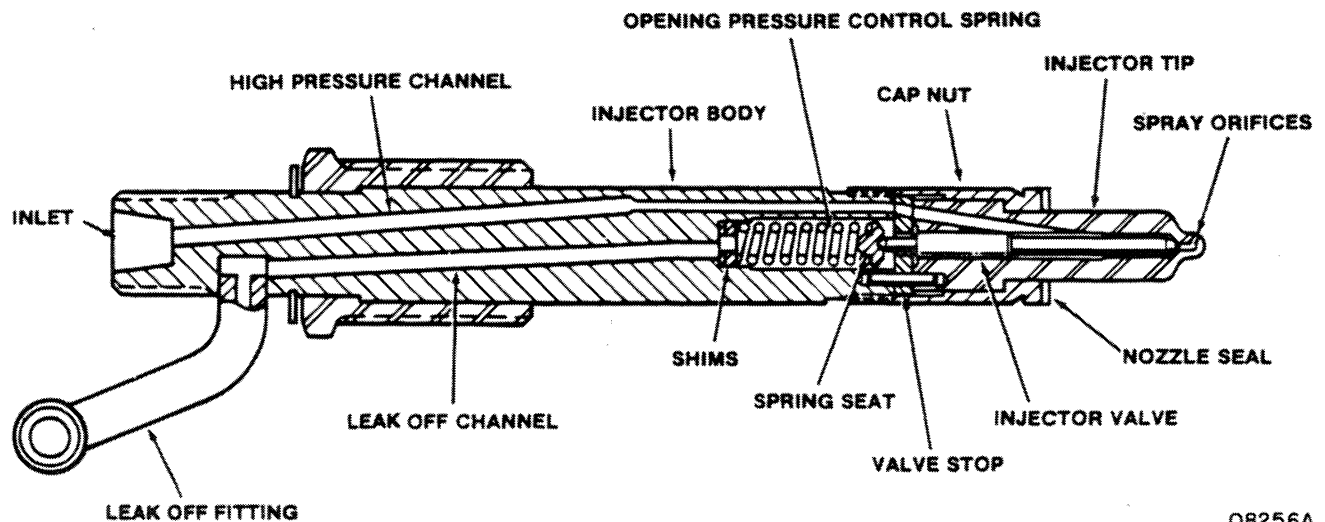
a. Components (Refer to figure 1-6, sheet 1). The battery system supplies power for engine starting, lighting and actuation of certain controls. An engine driven 50 ampere alternator supplies current for battery charging. System voltage is controlled at a nominal 24 volts by a solid state, non-adjustable regulator. The starter system is equipped with a "slave" receptacle which is connected directly across the battery terminals for cold weather jump starting. Interconnection between the front and rear wiring harnesses is made by means of a bulk-head mounted type of receptacle and plug. Circuit breakers are provided for protection of the various operating components. Refer to table 1-1 for system component specifications.

b. Auxiliary Steering Circuit (Refer to figure 1-6, sheet 2). This circuit consists of the steering motor and pump, a flow switch mounted in the hydraulic system, the control module, and a warning lamp and buzzer. The auxiliary steering circuit operates automatically to provide hydraulically assisted steering if the engine or hydraulic pump stops operating. The auxiliary steering motor and pump is an electrically operated motor with hydraulic oil pump mounted on the output shaft of the motor. Installed on the left of the rear chassis near the transmission, it automatically operates when hydraulic oil flow stops flowing through the hose in which the flow switch is installed. The flow switch is installed in the steering filter output line. When the hydraulic pump mounted on the transmission is operating, the flow switch provides 24 volts at its N.O. contact to relay A, pin 2. If hydraulic oil flow stops, the flow switch routes 24 volts at its N.C. contact to relay A, pin 6. The control module is mounted inside the cab on the left side of the chassis and contains control circuitry for turning on the auxiliary steering motor and pump. Relay A is connected as a latching relay. 24 volts applied to relay A coil at pin 2 from contact N.O. of the flow switch when the engine is cranked energizes relay A. 24 volts applied to pin 1 and switched out pin 3 latches relay A coil on. Relay A, pin 6 switched to pin 8 has no effect on the circuit. When hydraulic oil flow stops either due to engine, transmission, or hydraulic pump failure, the flow switch routes voltage from its contact N.C. to relay A, pin 6. This voltage is switched out pin 8 and applied through 47 ohm resistor to relay B, pin 2 and 2000 microfarad capacitor. 2000 microfarad capaci-

tor and 47 ohm resistor provide a small time delay before relay B coil energizes. When relay B coil energizes, 24 volts at pins 1 and 3 latch relay B coil and the 24 volts at pins 6 and 8 sounds the auxiliary steering buzzer, turns on the warning lamp, and energizes the auxiliary steering motor solenoid turning on the motor. With the motor operating, the hydraulic pump attached to its output shaft starts oil flow through hoses. The flow switch will switch 24 volts from contact N.C. to N.O., which has no effect on the circuit due to the relays being latched. Auxiliary steering motor and pump will continue to operate until the ignition switch is turned off. When the ignition switch is turned off, 2000 microfarad capacitor will discharge through 50 ohm resistor and diode.

1-11. HYDRAULIC SYSTEM. The truck hydraulic system (figure 1-7) provides hydraulic fluid under pressure to two separate subsystems having fixed displacement pumps (1) mounted on and driven by the transmission. These subsystems are used to steer the vehicle and to operate the forklift. Each subsystem has its own filter (5) in the return line. Both subsystems are supplied by a common 17 gallon reservoir (2) having a sight level gauge (3). The complete hydraulic system capacity is 29 gallons.

a. Steering (Refer to figure 1-7, sheet 1). The steering function is controlled by the steering wheel in the cab. The wheel is mechanically connected to the steering control valve (6). Position of the wheel varies the flow of oil to the cylinders (8), controlling direction. The flow control valve (7) reduces oil flow from the pump (1) to approximately 13 gallons per minute. A non-adjustable relief valve set at 2500 \pm 100 psi is located in the flow control valve. Check valve (10) prevents fluid from the auxiliary steering motor and pump (12) entering the pump (1) when the auxiliary steering motor and pump is operating. The auxiliary steering motor and pump (12) automatically operates providing steering hydraulic power if the engine shuts down or if pump (1) fails. Check valve (11) prevents fluid from the pump (1) entering the auxiliary steering pump when pump (1) is operating. If pump (1) stops pumping oil, the flow switch (9) operates to electrically activate auxiliary steering circuit (paragraph 1-10.b). When the control circuit is activated, the auxiliary steering motor and pump operate to provide hydraulic power to the steering subsystem. Return oil flow is through the oil cooler (4), filter (5), and flow switch (9) to the manifold connected to the input of the pump (1).



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Figure 1-11. Fuel Injector

engine firing order and for a very definite period of time in relation to load and engine speed requirements.

Engine speed is controlled by means of the cab accelerator pedal which is connected to the throttle lever on the side of the governor. Manual fuel shutoff (emergency or routine) is accomplished by the Fuel Shutoff Knob in the cab which is connected to a lever on the opposite side of the governor. Mechanical connections consist of flexible cable linkage.

d. Fuel Injector. The fuel injectors (figure 1-11) are in the cylinder head. There is one injector for each cylinder. The fuel injector sends a measured quantity of fuel to the combustion chamber from the injection pump. Each quantity of fuel must be sent to the combustion chamber in the form of fine particles. This will make sure that there is complete combustion and efficient engine performance.

WARNING

The injector tip and valve is a matched assembly. The two parts are made smooth to fit together with accuracy. The injector tip or valve can not be replaced separately for service. If it is necessary to replace either the valve or tip, replace the complete tip assembly. **Do not** mix the tip assemblies and bodies while the injectors are being disassembled.

Major components are as follows:

(1) *Injector Body.* The body holds the injector parts in the correct position in the cylinder head. The body has a high pressure channel and a leak off channel. The lower face of the body has a finished surface and has two holes in the surface for locating dowels.

(2) *Injector Valve.* The valve controls the flow of the fuel from the injector.

(3) *Valve Stop.* The valve stop has two dowel pins which hold the valve tip to the valve body. This will make a spray pattern that is correct. Both faces of the valve stop have a fine surface finish. The valve stop controls the distance that the valve will move.

(4) *Opening Pressure Control Spring.* The spring controls the fuel pressure that is necessary to lift the valve from the seat.

(5) *Shims.* The shims push down on the spring to keep a given pressure on the valve.

(6) *Injector Tip.* The valve and the valve seat are in the injector tip. There are orifices in the injector tip that atomize the fuel for better combustion and separate the fuel spray to mix the fuel spray with air.

(7) *Cap Nut.* The cap nut holds the tip assembly and the valve stop to the body.

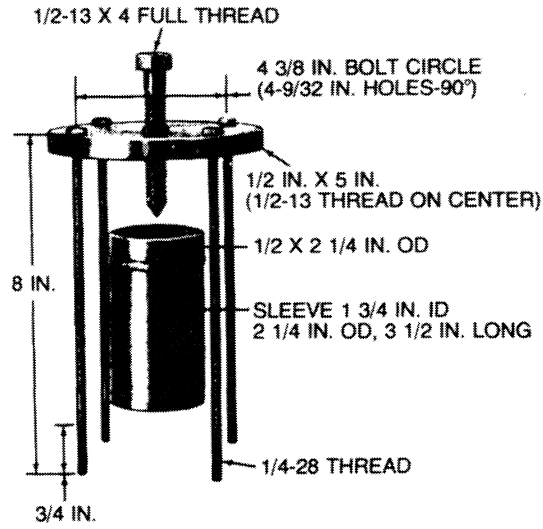


Figure 2-6. Puller Assembly and Sleeve

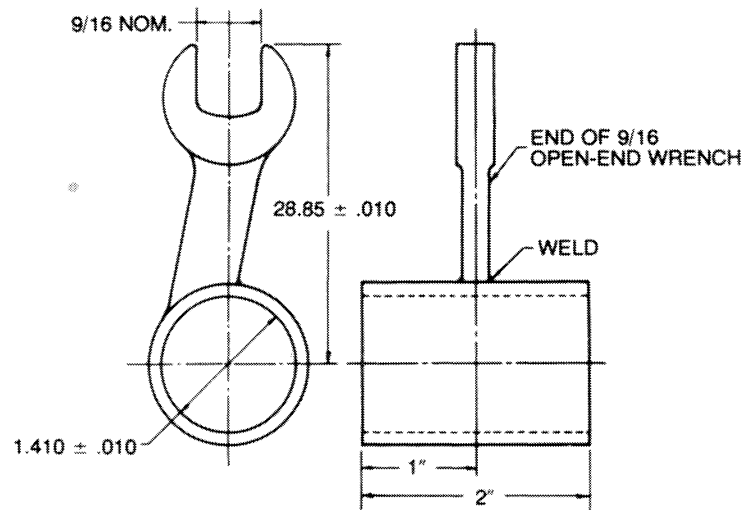


Figure 2-7. Holding Fixture

Table 4-2. Troubleshooting Chart

TROUBLE	PROBABLE CAUSE	CHECKOUT PROCEDURE AND REMEDIAL ACTION
ENGINE		
1. Engine hard to start or will not start a. No smoke from exhaust	1. Fuel shutoff not open completely 2. Final air filter plugged 3. Slow cranking speed a. Batteries, cables, solenoid, starting motor b. Damage to pistons and sleeves c. Improper camshaft or crankshaft end play d. Defective rod or crank bearings. e. Oil pump, air compressor, water pump or hydraulic pump 4. Fuel supply shutoff or no fuel 5. Air in fuel system 6. Camshaft damaged 7. Fuel injection nozzle not seated in head 8. Fuel line plugged 9. Fuel filter clogged 10. Wrong or contaminated fuel 11. Sticking rack control	Check that knob is completely in. Check lever travel. Inspect cables for damage and slipping. Check filter restriction indicator or service filter. Check starter amperage draw. Inspect pistons and sleeves. Check end play. Inspect or change bearings. Check pumps and hydraulics. Check tank shutoff valve and fuel supply in tank. Bleed fuel system until bubbles disappear. Check for air leaks at fittings. Remove cylinder head cover and check valve timing. Check for damaged nozzle gasket or seals, loose nozzle, or broken stud. Check fuel flow through line. Check and service fuel filters. Drain fuel tank and refill with correct fuel. Remove injection pump cap and check rack.

Table 4-2. Troubleshooting Chart (Continued)








TROUBLE	PROBABLE CAUSE	CHECKOUT PROCEDURE AND REMEDIAL ACTION
ENGINE (Continued)		
6. Engine lacks power (cont'd)	5. Wrong or contaminated fuel	Check for preignition or detonation problems. Drain fuel tank and refill with correct fuel.
	6. Low operating temperature	Check for defective thermostats, and be sure to maintain at least 50% anti-freeze year round.
	7. Engine timing incorrect	Check for preignition or detonation problems or damage. Check for proper timing.
	8. Low compression	If engine is hard to start, perform a compression test.
	9. Fuel injection nozzles malfunctioning	Low cracking pattern, improper spray pattern or plugged spray orifice will affect combustion. Remove and test fuel injector nozzles.
	10. Clogged fuel filter	Check and service fuel filters.
	11. Air in fuel system	Bleed fuel system until no bubbles appear in fuel. Check fittings for air leaks.
	12. Camshaft timed wrong	If timing is off and engine does not run smoothly, check camshaft timing.
	13. Crankcase overfilled with oil	Check for high oil level from coolant leakage, extra engine oil or oil leakage from adjoining compartment.
	14. Valves damaged	Check for defective valves by listening through manifolds. Perform compression test.
	15. Valves out of adjustment	Check valve adjustment carefully in tune-up or overhaul.
	16. Injection pump malfunction	Adjust or replace the injection pump.
	17. Fuel line plugged	Remove line at injection pump and check for plugging.

Table 4-2. Troubleshooting Chart (Continued)

TROUBLE	PROBABLE CAUSE	CHECKOUT PROCEDURE AND REMEDIAL ACTION
HOSES AND FITTINGS (Continued)		
Fitting pulled from hose or a hole in the hose (cont'd)	2. Pressure setting for relief valve is too high	Check and adjust the main relief valve and the secondary relief valve according to the instructions in this section.
Damaged threads	1. Connection tightened too tightly	Tighten all connections to specifications in table 9-3.
CYLINDERS		
Slow or no movement	1. Damaged cylinder packing 2. Piston cap screw is loose 3. Hoses are not connected correctly	Check the cylinder packing according to the instructions under Bad Performance of a Single Circuit. Install new cylinder packing as needed. Disassemble cylinder and tighten piston cap screw. See paragraph 5-162 through 5-165 and check the connections.
Damaged cylinder bearings	1. Cylinder pivot points did not get the correct amount of lubrication	See figure 4-1 for lubrication intervals and the correct grease.
Cylinder packing wear fast	1. Dirty oil 2. Damaged cylinder tube 3. Air in the oil 4. Pressure setting for main relief valve is too high	See paragraph 4-19d. and clean the hydraulic system. Inspect cylinder tube carefully. Make repairs as necessary. See paragraph 5-159 and check and adjust the main relief valve.
Piston rod is bent	1. Pressure setting for main relief valve or the secondary relief valve is too high 2. Cylinder pivot points did not get the correct amount of lubrication	Check and adjust the pressure settings of the main relief valve and secondary relief valve. See figure 4-1 for the lubrication intervals and the correct grease.
CONTROL VALVE		
Oil leakage around the spool	1. Damaged spool seals	Replace spool seals.

Symbol	Temperature Ranges		
	Below 32°F (0°C)	10°F to 50°F (-12°C to 10°C)	Above 32°F (0°C)
OE	Oil, Engine, SAE10W Case Type HDM (CD Commercial Class D)	Oil, Engine, SAE20W Case Type HDM (CD Commercial Class D)	Oil, Engine, SAE30 Case Type HDM (CD Commercial Class D)
ATF	MIL-L-46152, GR 10, Case TCH or Tenneco Hytrans Type C-2	MIL-L-46152, GR 10, Case TCH or Tenneco Hytrans Type C-2	MIL-L-46152, GR 10, Case TCH or Tenneco Hytrans Type C-2
GL	Lubricant, Gear, SAE75W Hypoid Gear Oil MIL-L-2105 or API-GL-5	Lubricant, Gear, SAE80W Hypoid Gear Oil MIL-L-2105 or API-GL-5	Lubricant, Gear, SAE140 Hypoid Gear Oil MIL-L-2105 or API-GL-5
CG	Grease, Chassis MIL-G-3278A or Moly-disulphide No. 2	Grease, Chassis MIL-G-3278A or Moly-disulphide No. 2	Grease, Chassis MIL-G-3278A or Moly-disulphide No. 2
HO	Oil, Hydraulic, SAE5W MIL-L-46152, GR 10 or Case TCH or Tenneco Hytrans, Type C-2	Oil, Hydraulic, SAE5W or SAE10W MIL-L-46152, GR 10 or Case TCH or Tenneco Hytrans, Type C-2	Oil, Hydraulic, SAE10W MIL-L-46152, GR 10 or Case TCH or Tenneco Hytrans, Type C-2
AFC	Coolant, Antifreeze Ethylene Glycol, 60% Mil Spec MIL-C-11755	Coolant, Antifreeze Ethylene Glycol, 50% Mil Spec MIL-C-11755	Coolant, Antifreeze Ethylene Glycol, 50% Mil Spec MIL-C-11755
MF	Methanol Fed Spec O-M-232F	—	—
BF	Silicone Brake Fluid MIL-B-46176	Silicone Brake Fluid MIL-B-46176	Silicone Brake Fluid MIL-B-46176
RC	Radiator Cleaner Available commercial brand	Radiator Cleaner Available commercial brand	Radiator Cleaner Available commercial brand

Interval Key

						
Daily, or Shift Change	Weekly or 50 hrs.	150 hrs.	250 hrs.	300 hrs.	Semi- Annually or 1000 hrs.	Annually or 2000 hrs.

Application Key




	Grease Gun		Oil Can		Hand
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Figure 4-1. Lubrication Chart (Sheet 2 of 3)

portion of antifreeze required for lowest expected temperature. Then fill the cooling system with enough water so that the coolant level is approximately 2 inches below the level of the radiator cap opening.

NOTE

Mix the antifreeze and water thoroughly by running the engine at operating temperature for about 5 minutes. This must be done before the loader is left outside in temperatures below 32°F (0°C).

If possible, use soft water. If only hard water is available, check the system at frequent intervals for signs of scale formation.

4-11. COOLING SYSTEM MAINTENANCE.

a. Cleaning. Clean the cooling system at least once a year; more often if hard (mineralized) water is used in radiator.

NOTE

Radiator drain valve is located at lower right hand side of radiator core.

- (1) While coolant is still hot, open the radiator drain valve (11, figure 5-33), oil cooler drain (figure 4-16), and engine block drain valve (figure 4-17). Drain all coolant and close the valves.

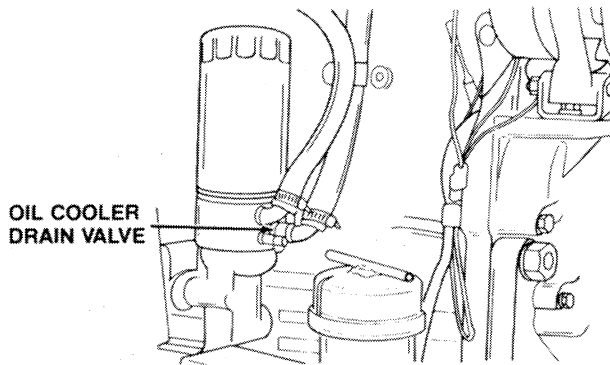


Figure 4-16. Oil Cooler Drain Valve

- (2) Add a radiator cleaner to the system and refill with clean water. Refer to table 5-1 for cleaning solvent specifications.
- (3) Check the hoses, elbows, pump and water manifold for leakage. If damage is discovered, refer to paragraph 5-51 for repair instructions.
- (4) After draining the cleaning solvent, flush the system with clean water before refilling the radiator.

WARNING

Compressed air used for cleaning and drying purposes must be reduced to 30 psi and used then only with adequate chip guarding and personal protective equipment.

- (5) Make sure the engine area is clean and that the radiator fins are free of accumulations. Blow dirt and debris from the radiator with compressed air.
- (6) Refill the cooling system to within two inches of the top of the radiator neck.
- (7) Run the engine for five minutes with pressure cap loosened to bleed the air out of the system. Recheck coolant level and add coolant if necessary.

b. Thermostats. The cooling system is equipped with two thermostats that start to open at 175°-192°F (80°-83°C). Thermostats are fully open at 202° (94°C). Coolant temperature varies with the workload.

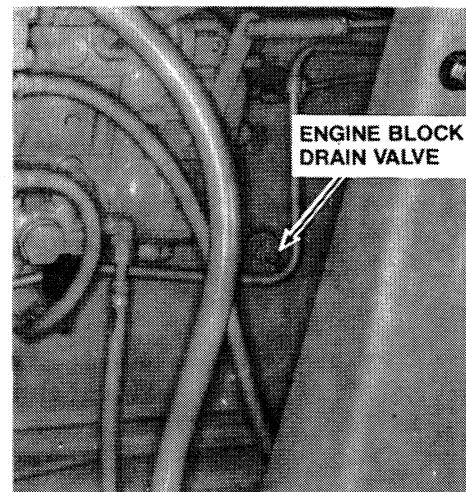
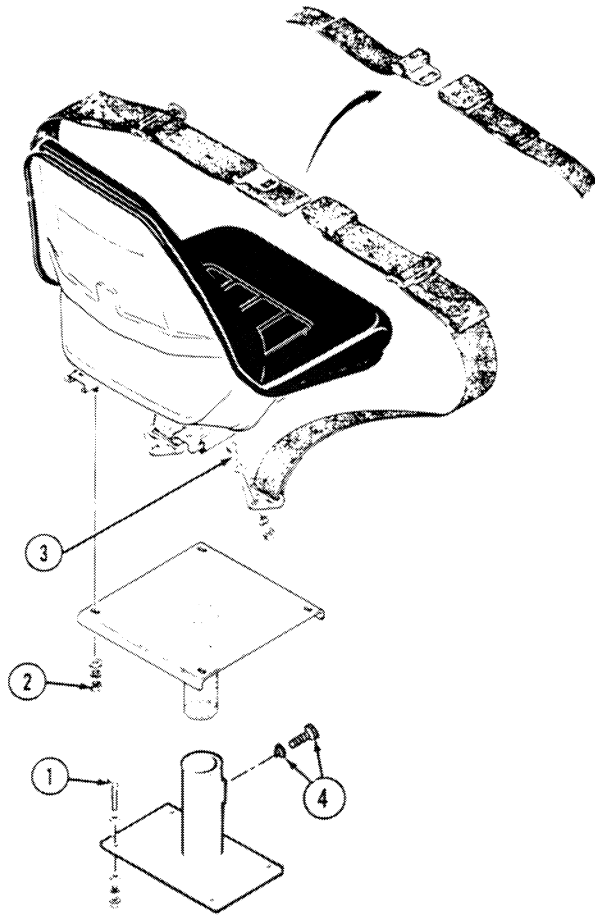


Figure 4-17. Engine Block Drain Valve



1. Floor Mounting Bolts, Tighten 25-35 ft-lb Torque
2. Bracket Mounting Nuts, Tighten 15-20 ft-lb Torque
3. Belt Anchor Bolts, Tighten 65-85 ft-lb Torque
4. Seat Height Bolt, Tighten 25-35 ft-lb Torque

Figure 4-33. Operator's Seat

- (6) Keep seat belts clean and dry.
- (7) Clean only with a mild soap solution and lukewarm water.
- (8) Do not bleach or dye belts since this may severely weaken them.

c. Operator's Seat and Trim (figure 4-33). The operator's seat is a standard vinyl upholstered type. The following maintenance applies:

- (1) Clean seat and interior of cab with mild soap or detergent solution. Use a cloth dampened in the solution and wipe dry immediately.

- (2) Inspect seat mounting and attaching hardware for tightness. See torque requirements of figure 4-33.

4-18. HYDRAULIC SYSTEM — GENERAL. Servicing the hydraulic system consists of checking the oil level, checking for leaks, adding oil, changing the oil and filters, and cleaning the system. Refer to figures 1-7 and 1-9 for air and hydraulic schematics.

a. Oil Level Check. Check oil every 50 hours or weekly. Oil should be at operating temperature, 120°F (49°C).

- (1) Park the truck on a level surface. Lower the forks to the ground. Shut off engine and set parking brake.
- (2) Look at the sight level gauge for the hydraulic reservoir (figure 4-34).
- (3) If oil is visible in the sight level gauge, the level of the oil in the hydraulic reservoir is correct.

NOTE

Refer to pressure relief procedure, paragraph 4-19.a.

- (4) If oil is not visible in the sight level gauge, check system for leaks. If none are found, add oil.

b. Checking for leaks.

WARNING

Hydraulic systems are highly pressurized. Escaping hydraulic oil, even an invisible pinhole leak, can penetrate body tissues causing serious injury. Use a piece of wood or cardboard when looking for leaks - never use the hands or other parts of the body.

Relieve hydraulic pressure before disconnecting circuits. When reassembling, make absolutely certain that all connections are tight.

If injured by hydraulic oil escaping under pressure, see a doctor immediately. Serious complications may arise if medical attention is not given at once.

c. Valve Tappet Adjustment, Cold Setting (figure 4-37).

- (1) Remove breather tube.
- (2) Remove valve covers and gaskets from all cylinders.
- (3) Crank engine until timing pointer is aligned with TDC timing mark on crankshaft pulley.
- (4) Check push rods on No. 1 cylinder for looseness. If push rods are loose, No. 1 cylinder is at TDC on the compression stroke. If push rods are tight, crank

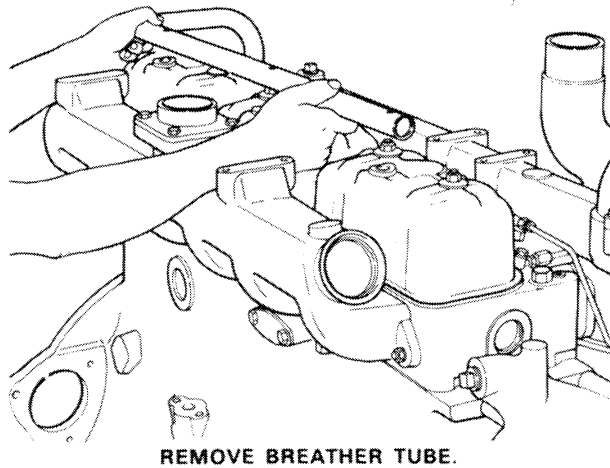
engine one complete revolution and align timing pointer with TDC mark on pulley.

- (5) Check and adjust the intake and exhaust valves as indicated by the arrows in step (5) of figure 4-37.
- (6) Crank the engine one complete revolution and align the timing pointer with the TDC mark on crankshaft pulley. Check and adjust the intake and exhaust valves as indicated by the arrows in step (6).

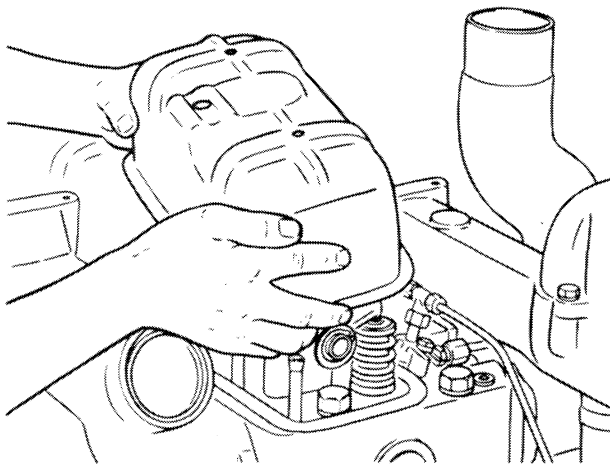
NOTE

After completing cold setting valve tappet adjustment, proceed to paragraph 4-20.d.

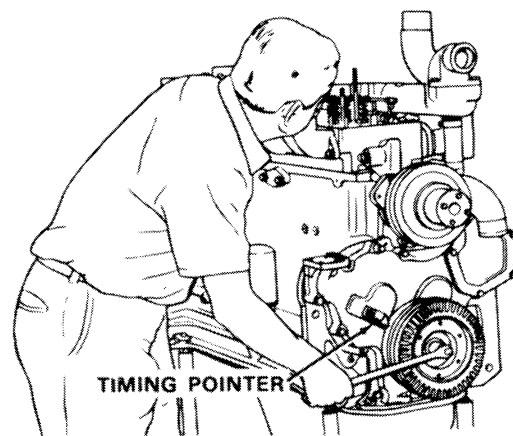
STEP 1



STEP 2



STEP 3



STEP 4

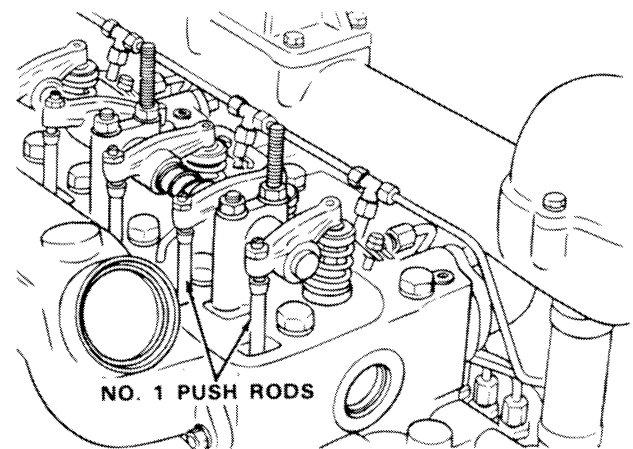


Figure 4-37. Adjusting Tappets, Cold Setting (Sheet 1 of 2)

- (5) Crank engine revolution plus 7° ATDC. The dial indicator should give a reading of 0.053". If a reading of 0.053" is not obtained, check the complete valve train assembly.

NOTE

This procedure can also be used to check the proper assembly of cam to crankshaft gear teeth without removing the front gear cover.

4-21. ENGINE SPEED ADJUSTMENTS.

CAUTION

Unauthorized changes in the governed speed of the diesel engine will automatically void and waive any warranty by the manufacturer.

a. Checking Engine Conditions. Before making any changes in the no load governed engine speed, check that the engine speed is not affected by one or more of the following conditions:

- (1) Check to be sure the engine is equipped with the correct injection pump. The pump can be identified by the number stamped on the serial number plate on the governor housing.
- (2) Engine not carefully "run-in".
- (3) Engine lubricating oil viscosity not according to recommendations.
- (4) Incorrect oil viscosity in the transmission or hydraulic system.

NOTE

The transmission and hydraulic oil must be warmed up to the proper temperature before taking an engine speed reading.

- (5) Fuel does not meet the required specifications for number 2 diesel fuel.
- (6) Plugged air cleaner.

- (7) Fuel tank breather partially plugged.
- (8) Fuel filter bleed valves not closed completely.
- (9) Lack of fuel to the injectors due to plugged fuel filters, air or water in the fuel system, or faulty pressure relief valve.
- (10) Fuel injection pump not timed as described in paragraph 4-20.g.
- (11) Valve tappet clearance not adjusted and set correctly. Refer to paragraph 4-20.c. and 4-20.d.
- (12) One or more faulty injectors.
- (13) Loss of compression in one or more cylinders.
- (14) Fuel shutoff control out of adjustment.

b. Checking Engine Speed.

WARNING

Make sure the power train is in neutral, and the parking brake is applied to prevent injury to personnel.

NOTE

Checking engine speeds is critical and can only be made with a tachometer that is known to be accurate. Revolution counters of any type, on tachometers used for a long time without accuracy control **MUST NOT** be used. Refer to table 2-1.

Refer to the engine data decal on the engine valve cover for the engine no load governed speed and rated speed. Also refer to table 1-1 for engine speed specifications.

- (1) Temporarily disconnect the truck tachometer from its mounting to the engine. Refer to paragraph 5-58.

CAUTION

Do not clean tires, lubricant seals, rubber hose, or electrical components with cleaning solvent.

h. A degreasing machine may be used to remove heavy grease and oil from metal parts. Trichloroethylene, Military Specification MIL-T-27602B is used as a degreasing agent (6, table 5-1).

CAUTION

To prevent corrosion, parts should be dipped in rust preventive (48, table 5-1) within two hours of degreasing.

i. On removal of parts, from degreasing machine, and immediately prior to coating with rust preventive, check all oil passages and cavities for cleanliness and freedom from obstructions. A thin, flexible wire should be run through oil passages to make certain that they are not clogged. Using a pressure spray gun and kerosene or cleaning solvent, clean dirty passages.

j. To remove carbon deposits from metal parts, soak parts for at least 75 minutes in a heated mixture of one part creosol base cleaning compound (55, table 5-1) and four parts water. The solution container should be equipped with an exhaust system to expel fumes, and should be able to heat the solution to 140°F.

NOTE

Magnesium parts should not be soaked for more than 3 hours.

k. All parts that have been soaked in carbon removal solution should be rinsed with cleaning solvent (1, table 5-1). Rinsing should be accomplished in a solvent spray booth equipped with a filter and hand spray gun. After soaking, use a soft-bristle brush to remove carbon deposits. A cloth buffing wheel may also be used.

l. Electrical parts, such as coils, junction blocks, and switches, should not be soaked or sprayed with cleaning solutions. Clean these parts with a clean lint-free cloth moistened with cleaning solvent (1, table 5-1).

m. Oil and fuel tanks and similar reservoirs should be flushed, using a spray gun and cleaning solvent.

CAUTION

Do not use soap or alkalies to clean tank interiors.

n. The cooling system radiator core should be cleaned with steam or hot water. If sediment cannot be completely removed by this method, boil the core in a solution of sodium carbonate and water. Use a solution of one pound of sodium carbonate (3, table 5-1), to each gallon of water. Flush with clean, hot water or steam.

o. Clean electrical system battery exterior with a weak solution of baking soda and water. Apply the solution with a bristle brush to remove any corrosive buildup on the battery cable clamps, terminals, and battery tray.

p. Wash painted surfaces of truck with a solution of 1/4 pound of soap chips (42, table 5-1) to 1 gallon of water.

5-5. GENERAL INSPECTION INSTRUCTIONS.

a. Inspect all surfaces in contact with gaskets, packings or seals for nicks, burrs, scratches, etc., which might damage the new seals upon reassembly. If any defect is found, remove it as outlined under "General Repair Instructions" before assembly.

b. Examine bearings for rusted or pitted balls, races, or separators. Examine balls and races for brinelling, abrasion, and serious discoloration. The following are causes for bearing rejection:

- (1) Cuts or grooves parallel to ball or roller rotation.
- (2) Fatigue pits (as opposed to minor machine marks or scratches).
- (3) Cracks detected during magnetic particle inspection.

e. Assembly (figure 5-4).

- (1) Install chain rollers (5) between supports on carriage frame. Install roller pins (4) through rollers and frame. Drive roll pins (3) through frame and roller pins to secure.
- (2) Coat surface of fork load pin (13) with number two molybdenum-disulfide grease (table 5-1, item 15). Install forks (21 and 22) in position on carriage (23). Slide fork load pin (13) through carriage and forks.
- (3) Install keeper plates (10) on carriage frame fork load pin (13). Secure keeper plates with capscrews (11) and lock-washers (12).
- (4) Install cylinder assembly (9) in position on carriage frame and fork. Extend cylinder rod to align holes in fork brackets with cylinder rod. Install pins (7) and spacer washers (8) through frame, fork, and cylinder. Secure pins with roll pin (6).
- (5) Install chain anchors (16) on forks (21 and 22). Secure with nuts (7). Thread chain (18) over chain rollers. Connect ends of chain to chain rollers.
- (6) Lift backrest (2) into position on carriage frame (23) and slide into tubes on side of frame. Secure backrest with lock pins (1).

f. Installation (figure 5-3).

- (1) Carefully lift assembled carriage and forks into position on lift arms. Support carriage in this position.
- (2) Install pins (4) through carriage and ends of lift arms. Install spacing washers (5) in position when installing pins. Secure pins to frame with retaining rings (2).
- (3) Install tilt cylinder rod ends in position at top of carriage frame. Install pins (8) and washers (7) through frame and cylinder rod end. Secure with retaining rings (6).
- (4) Move tubes into position and connect to fork spacing cylinder. Secure hydraulic tube to carriage with clamp (figure 5-3).

- (5) If needed, install conveyors on forks.

g. Testing.

- (1) Start truck engine and operate hydraulic system.
- (2) Operate lever to open and close fork spacing. Check travel of forks. Forks should travel evenly in equal distance both opening and closing.
- (3) If fork spacing requires adjustment, loosen nuts on chain anchors. Then lengthen or shorten chain travel to obtain equal fork spacing.

5-15. FORKLIFT FRAME AND RELATED PARTS.

The forklift frame parts group (figure 5-5), consists of the lift frame (22), the lift cylinders (11), the tilt cylinders (16), the pivot shafts (10, 15 and 20) and associated assembly hardware. Refer to paragraphs 5-16 and 5-17 for additional instructions.

5-16. LIFT AND TILT CYLINDERS.

NOTE

Cylinders include a non-repairable fail safe valve which must be replaced if found defective. Refer to paragraph 8-18 for valve testing procedure.

a. Removal.

NOTE

Steps (1) through (6) apply to both cylinders.

- (1) Rest the carriage and fork on the floor. Position the carriage as required for easy access to the cylinder being removed.
- (2) Remove accumulated dirt from cylinder with a cloth and clean outside of hoses and tube fittings before disconnecting lines.
- (3) Tag or otherwise identify hoses to assure correct reassembly.
- (4) When lines are disconnected, close all openings with a clean cap or plug to exclude dirt from the system.
- (5) With the engine stopped, move the cylinder control levers in both directions to equalize circuit pressures.

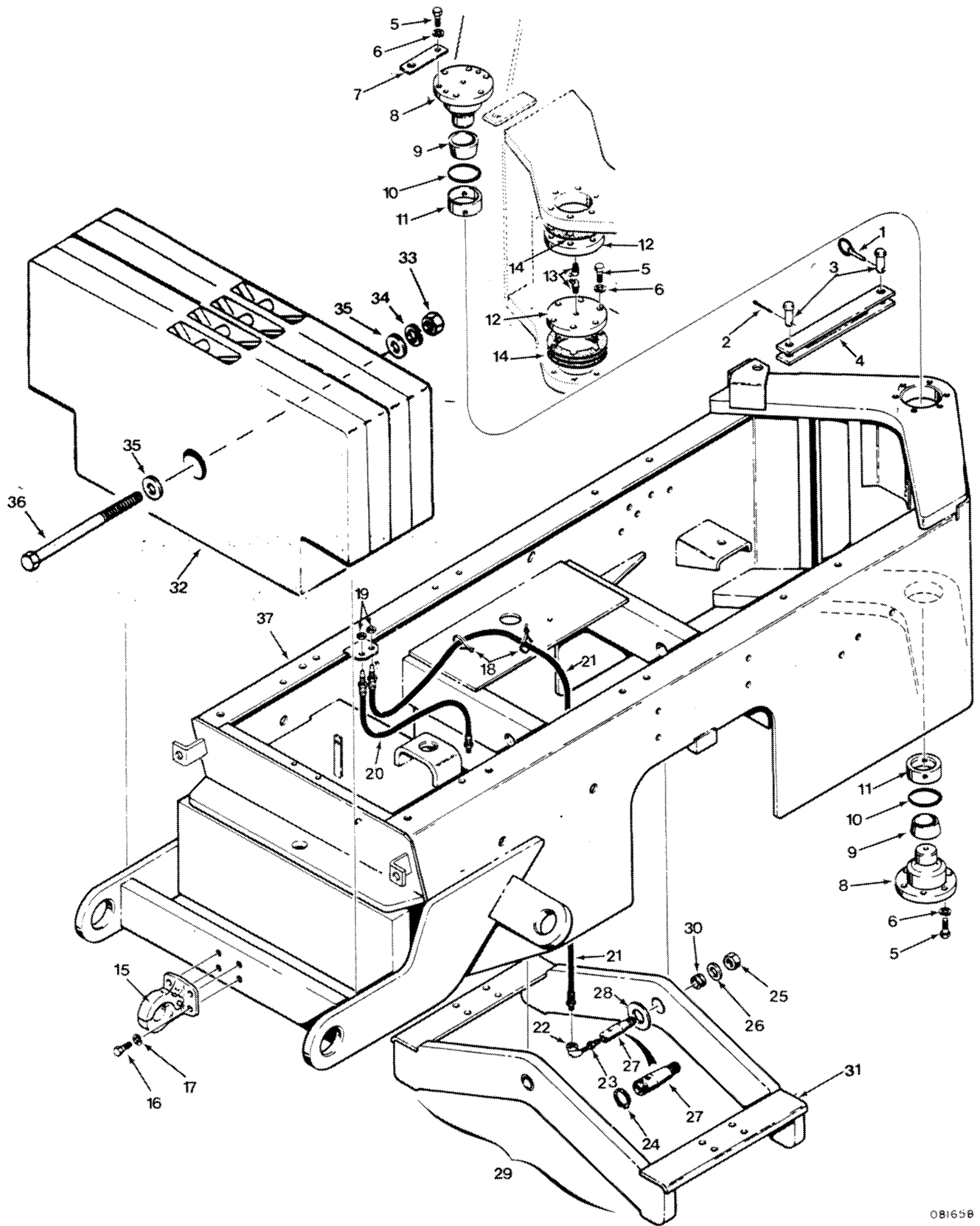
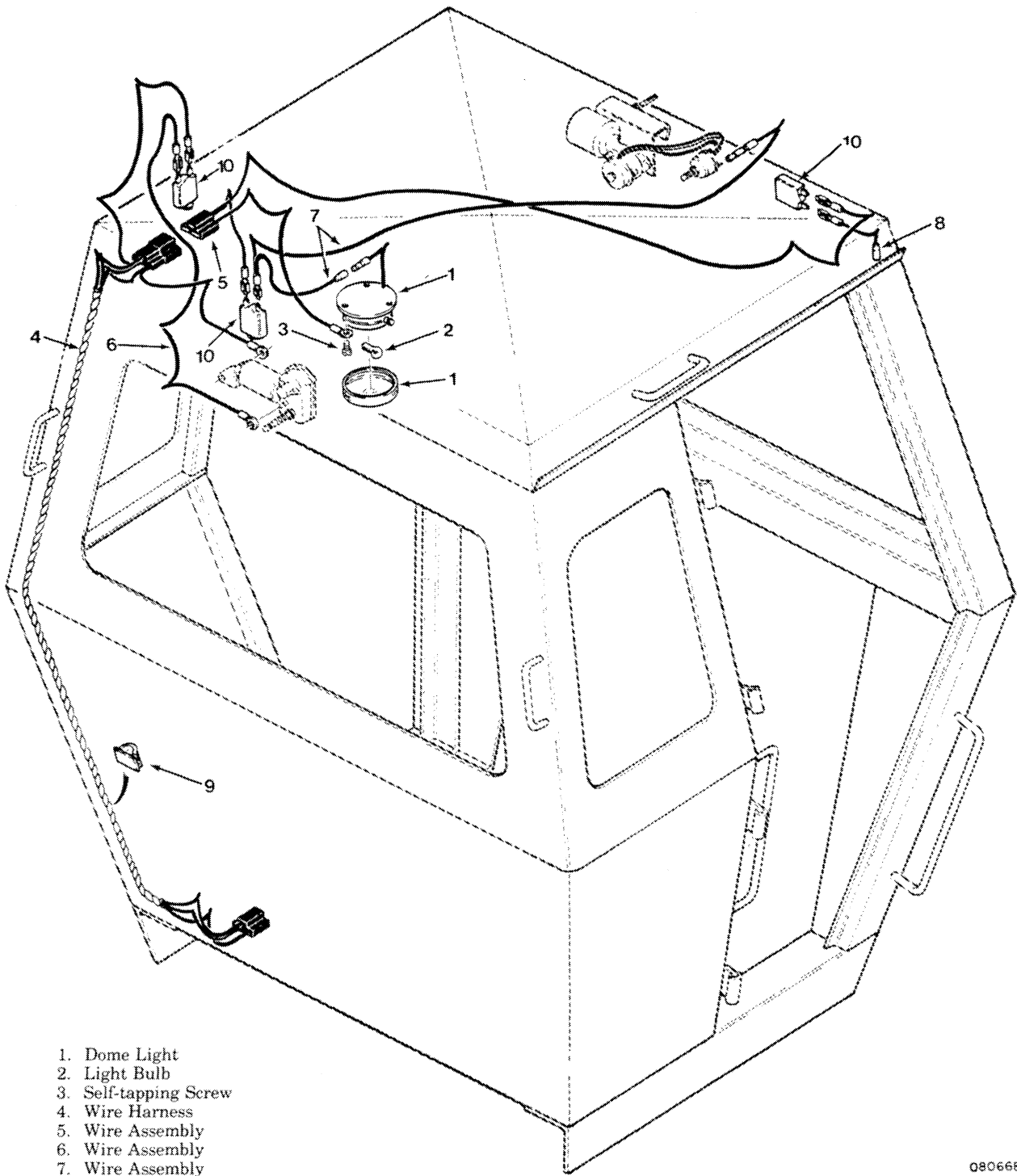


Figure 5-10. Rear Frame and Trunnion Group (Sheet 1 of 2)

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1. Dome Light
2. Light Bulb
3. Self-tapping Screw
4. Wire Harness
5. Wire Assembly
6. Wire Assembly
7. Wire Assembly
8. Wire Assembly
9. Wire Clip
10. 3 Amp Circuit Breaker

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Figure 5-15. Cab Electrical System Group

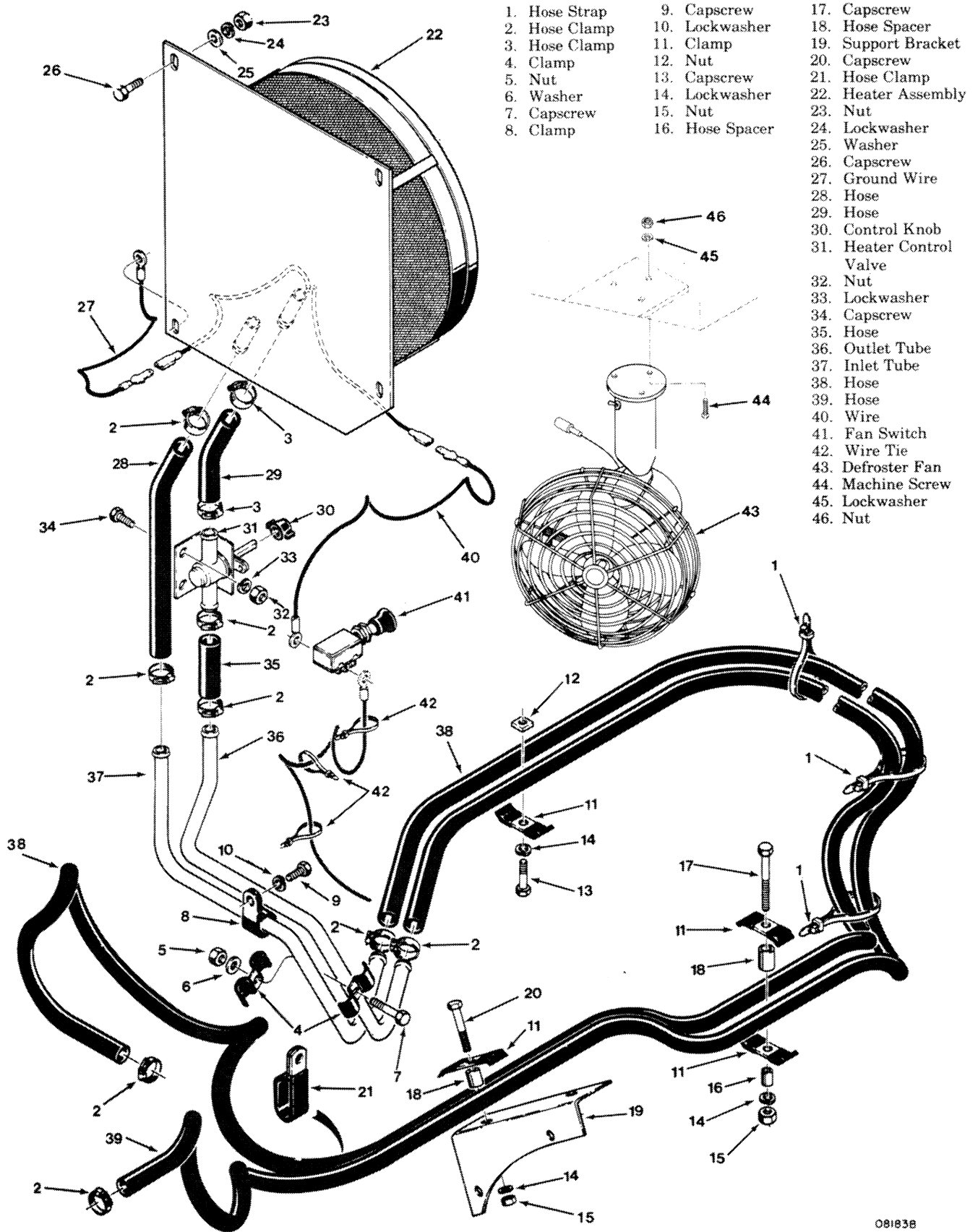


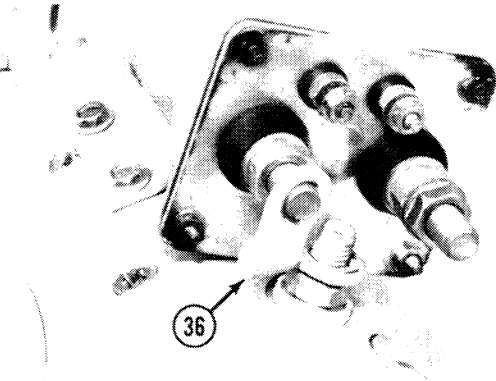
Figure 5-22. Cab Heater and Defroster System

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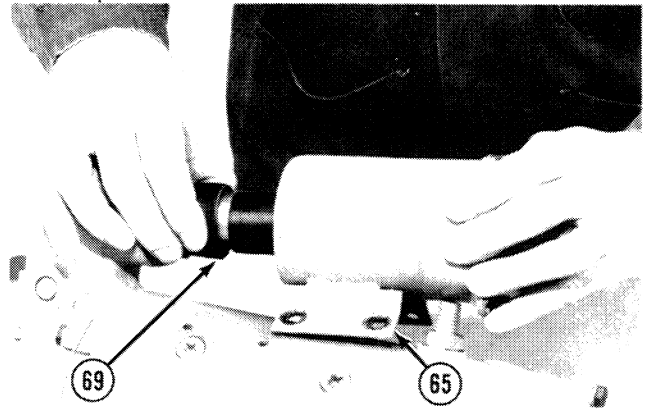
LEGEND FOR FIGURE 5-27

- | | | |
|----------------------------|-----------------------------|---------------------------|
| 1. Capscrew | 27. Field Coil | 53. Shifter Lever |
| 2. Capscrew | 28. Terminal Stud | 54. Pivot Stud |
| 3. Lockwasher | 29. Pole Shoe | 55. Preformed Packing |
| 4. Washer | 30. Machine Screw | 56. Preformed Packing |
| 5. Warning Decal | 31. Coil Terminal Insulator | 57. Retaining Ring |
| 6. End Frame | 32. Coil End Insulator | 58. Drive End Housing |
| 7. Plug | 33. Bushing | 59. Armature Bushing |
| 8. Oil Wick | 34. Terminal Insulator | 60. Plug |
| 9. Bushing | 35. Washer | 61. Oil Wick |
| 10. Bolt | 36. Connector | 62. Gasket |
| 11. Lockwasher | 37. Washer | 63. Machine Screw |
| 12. Brush Holder Plate | 38. Nut | 64. Machine Screw |
| 13. Spring | 39. Special Nut | 65. Solenoid |
| 14. Starter Brush | 40. Machine Screw | 66. Capscrew |
| 15. Screw | 41. Plug | 67. Solenoid Plunger |
| 16. Machine Screw | 42. Shift Lever Housing | 68. Boot |
| 17. Insulating Bushing | 43. Armature Bushing | 69. Boot Seat |
| 18. Washer | 44. Oil Seal | 70. Plunger Return Spring |
| 19. Lockwasher | 45. Brake Washer | 71. Inner Spring Seat |
| 20. Solenoid Wire (Ground) | 46. Plug | 72. Outer Spring Seat |
| 21. Preformed Packing | 47. Oil Wick | 73. Retaining Ring |
| 22. Armature | 48. Plug | 74. Nut |
| 23. Thrust Washer | 49. Gasket | 75. Field Frame |
| 24. Thrust Washer | 50. Special Bolt | (Non-replaceable item) |
| 25. Inspection Plug | 51. Lockwasher | (Phantom) |
| 26. Gasket | 52. Starter Drive | |

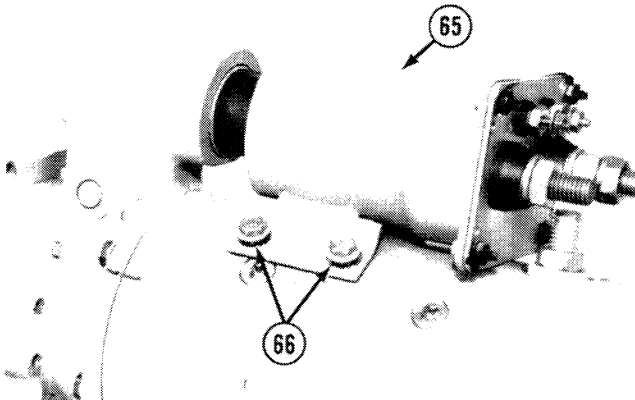
(7) Remove the connector.



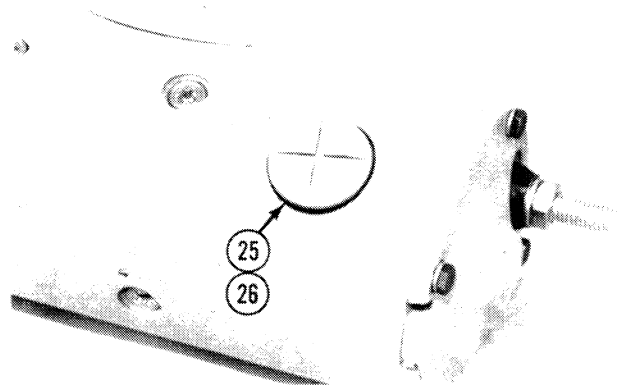
(9) Separate the solenoid and plunger.



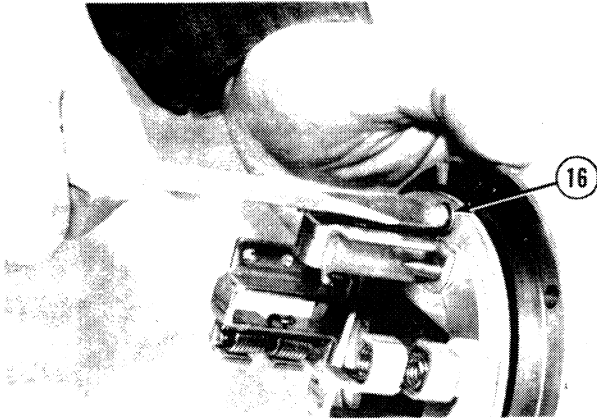
(8) Loosen and remove the cap screws that hold the solenoid to the field frame.



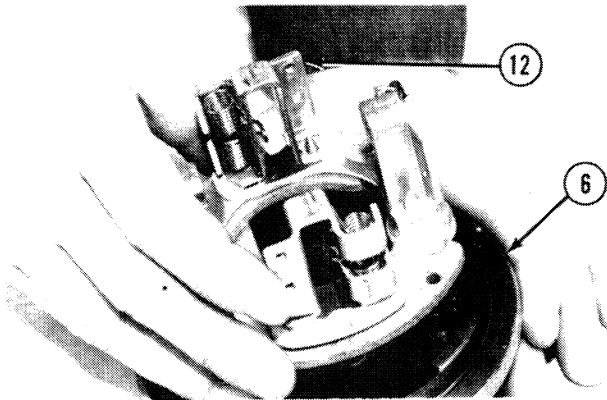
(10) Loosen and remove one plug from the field frame.



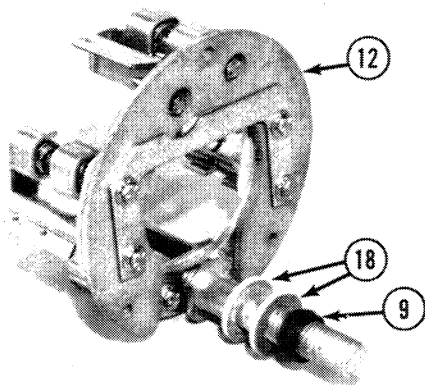
- (7) Loosen and remove the screws that fasten the brushholder to the end cap.



- (8) Remove the brushholder from the end cap.



- (9) Remove the rubber bushings and insulating washers from the ground terminal.

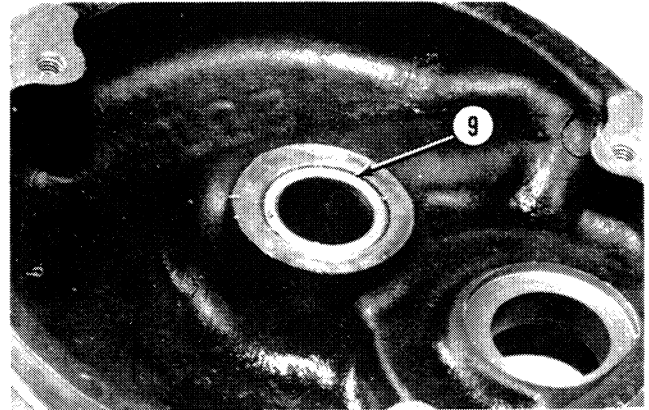


c. Assembly. Assembly of brushholder and cap is the exact opposite sequence of disassembly. Refer to paragraph 5-32.b, steps (1) through (9).

5-33. END CAP.

a. Disassembly.

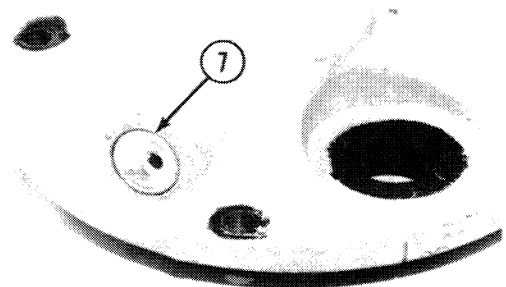
- (1) If the bushing in the end cap is damaged, use acceptable tools to remove the bushing.



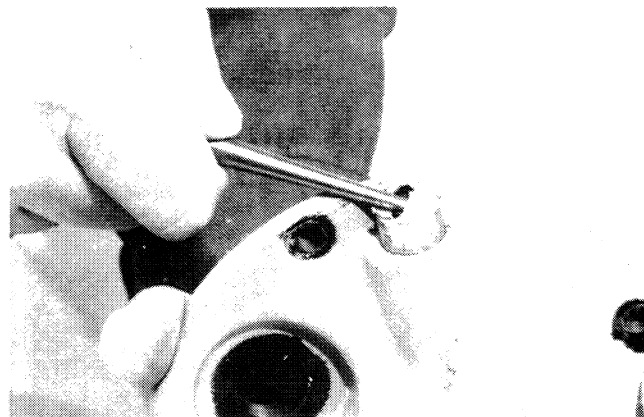
WARNING

Drilling operations are hazardous to the eyes. Eye protection is required. Good general ventilation is normally adequate.

- (2) Drill or punch a hole in the cap plug in the end cap.

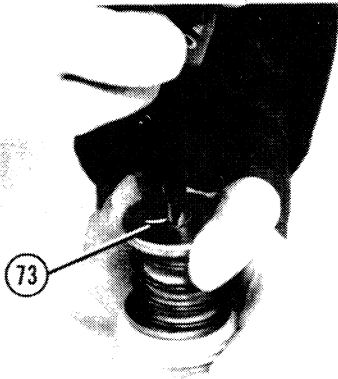


- (3) Remove the cap plug.

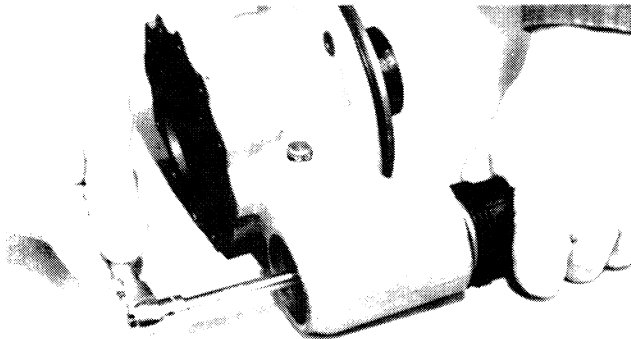


(14) Install the flat washer into the boot. Install the boot, inner spring seat, spring, and outer spring seat on the plunger. Assembly is reverse sequence of disassembly. Refer to illustration for step a(8)(d).

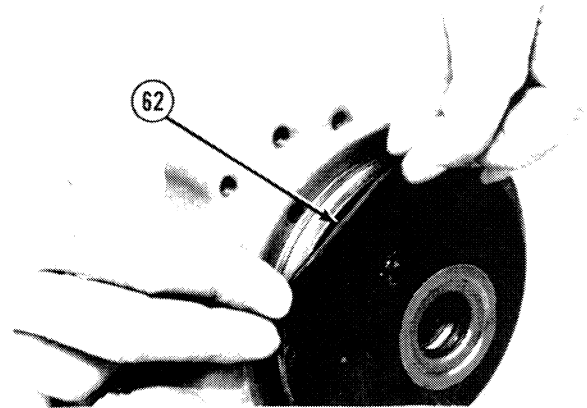
(15) Push down the outer spring seat and install the snap ring on the plunger.



(16) Install the plunger into the shift lever housing. The end of the plunger must be through the shift lever. Install the self-locking nut the same number of turns as was needed to remove the self-locking nut. Refer to step a(6).



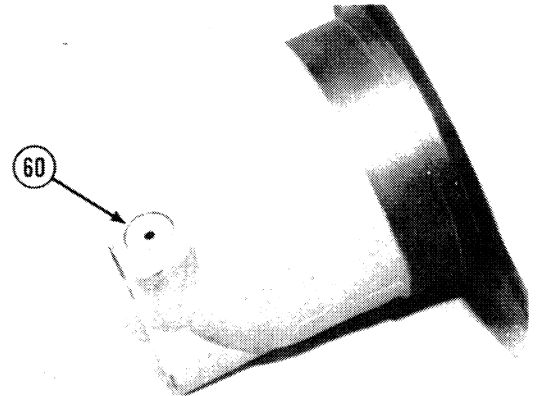
(17) Install the gasket in the groove in the shift lever housing.



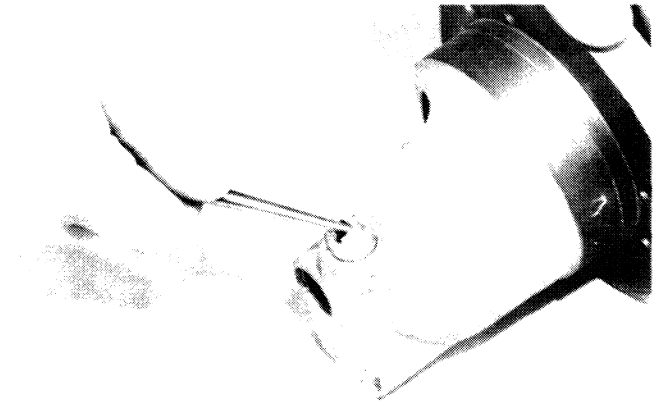
5-36. STARTER DRIVE HOUSING.

a. Disassembly.

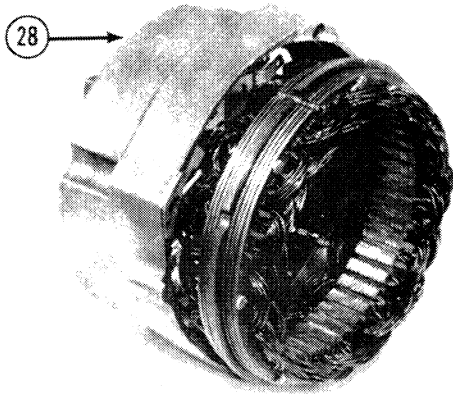
(1) Drill or punch a hole in the cap plug.



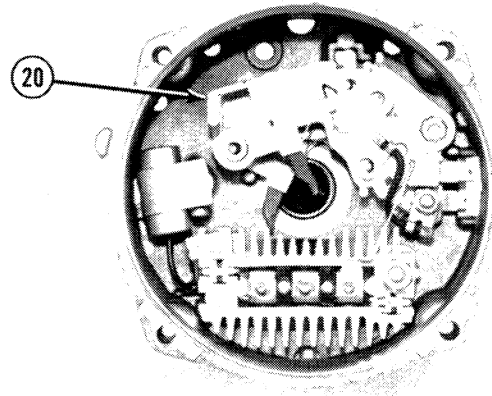
(2) Remove the cap plug.



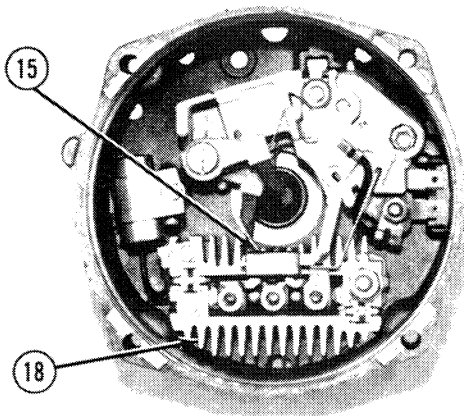
(7) Remove the stator from the rear housing.



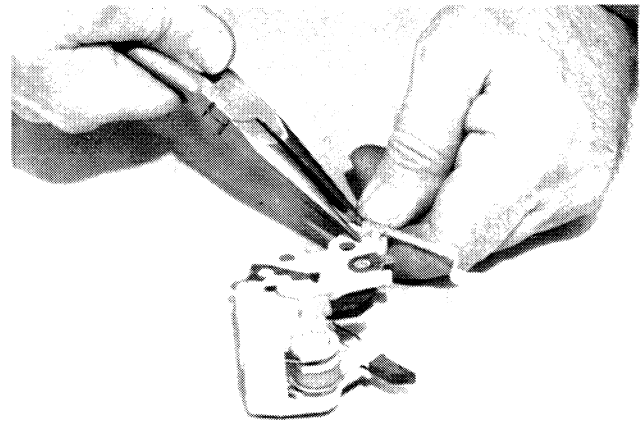
(10) Remove the brushholder from the rear housing.



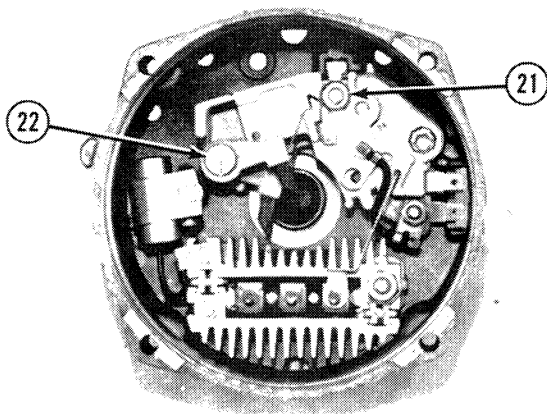
(8) Remove the diode trio from the rectifier bridge.



(11) If a brush is less than 3/8 inch long on the short side of the brush, a new brushholder must be used when the alternator is assembled. The brushes are not available separately. The connector must be removed for use with the new brushholder. Use a pair of needle nose pliers to push the tab on the connector into alignment with the brushholder as shown below. Remove the connector from the brushholder.

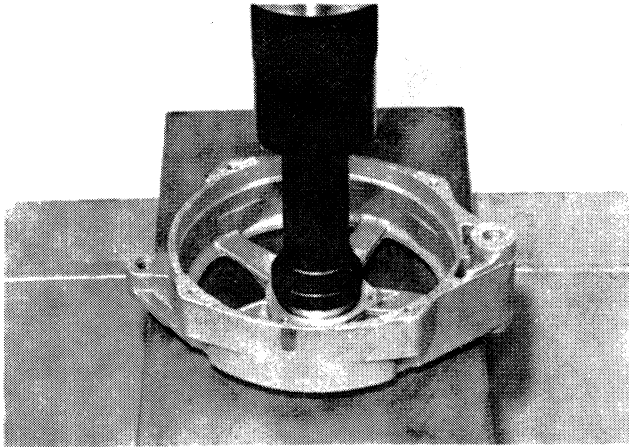


(9) Remove the insulator screw and flat head screw that hold the brushholder in place.

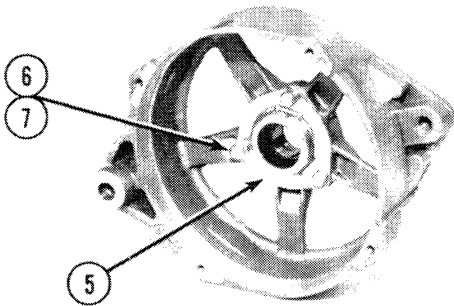


(12) Remove the capscrew that fastens the voltage regulator to the rear housing.

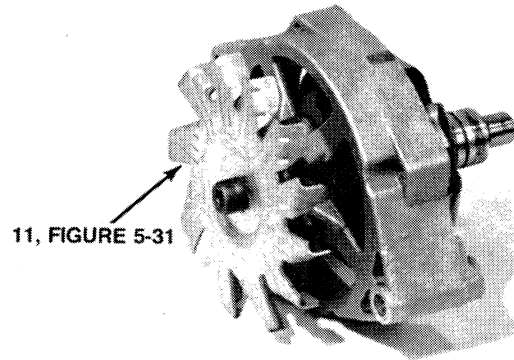
- (19) Use a driver that will be in contact with the outer race of the bearing. Press the bearing into the front housing until the bearing stops moving.



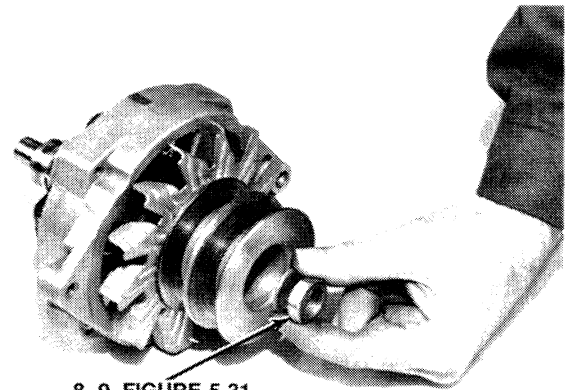
- (20) Fill the area above the bearing with bearing grease until the grease is even with the top of the bore for the bearing.
- (21) Use new screws with lockwashers to fasten the bearing retainer to the front housing.



- (22) Install the rotor in the front housing. Refer to illustration for step b(24).
- (23) Put the collar on the rotor shaft. Refer to illustration for paragraph b(23).
- (24) Put the fan on the rotor shaft.



- (25) Put the pulley on the rotor shaft. Refer to illustration for paragraph b(21).
- (26) Put the lockwasher and nut on the rotor shaft.

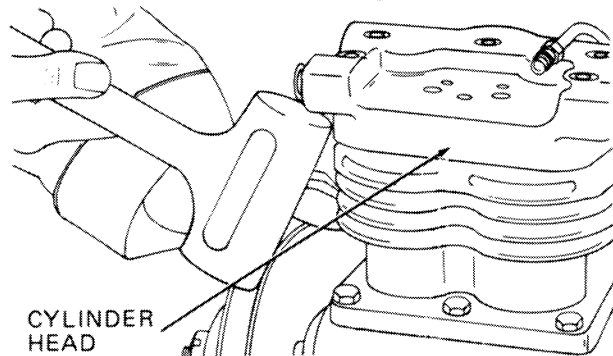


LEGEND FOR FIGURE 5-36

1. Tube	18. Seat	34. Gasket	50. Bearing Cap
2. Fitting	19. Washer	35. Lock Nut	51. Seal
3. Capscrew	20. Valve Guard	36. Connecting Rod Cap	52. Gasket
4. Unloader	21. Inlet Valve	37. Insert	53. Bearing
5. Retainer	22. Plug	38. Capscrew	54. Crankshaft
6. Seal	23. Capscrew	39. Connecting Rod	55. Screw
7. Disk	24. Lockwasher	40. Compression Ring	56. Plate
8. Diaphragm	25. Outlet Port	41. Oil Ring	57. Crankcase
9. Spring	26. Gasket	42. Expander Ring	58. Cotter Pin
10. Plunger	27. Gasket	43. Button	59. Nut
11. Spring	28. Capscrew	44. Wrist Pin	60. Pulley
12. Capscrew	29. Cylinder Block	45. Piston	61. Key
13. Capscrew	30. Capscrew	46. Capscrew	62. Capscrew
14. Cylinder Head	31. Lockwasher	47. End Cover	63. Lockwasher
15. Stop	32. Inlet Port	48. Gasket	64. Mounting Plate
16. Exhaust Valve	33. Gasket	49. Capscrew	65. Gasket

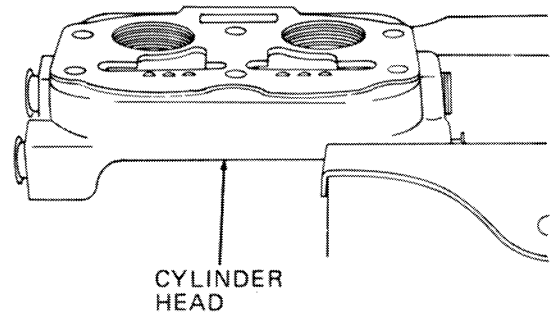
b. Cylinder Head and Unloader Disassembly (figure 5-36).

- (1) Loosen and disconnect unloader tube (1) from two fittings (2). Remove unloader tube.
- (2) Remove two fittings (2).
- (3) Remove air compressor governor (paragraph 5-44a).
- (4) Remove two capscrews (3) and unloader (4).
- (5) Remove and discard two retainers (5), seals (6), disks (7), diaphragms (8), and springs (9) from unloader (4).
- (6) Remove and discard two plungers (10) and springs (11) from cylinder head (14).
- (7) Remove capscrew (12) and five capscrews (13).
- (8) Using rubber mallet, hit cylinder head (14) to break seal of gasket (27).

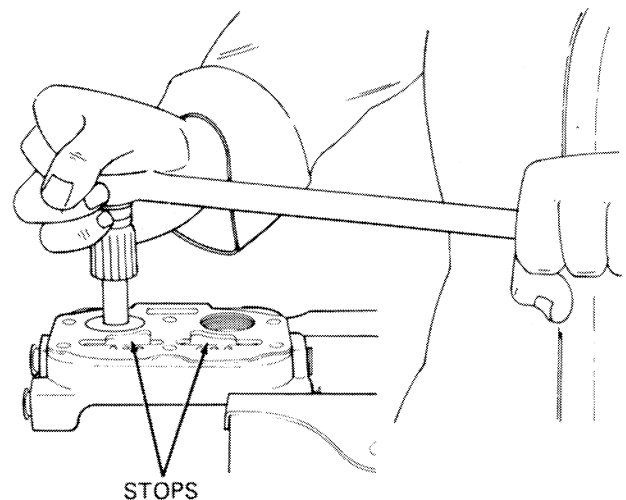


- (9) Remove cylinder head assembly (14 through 26).

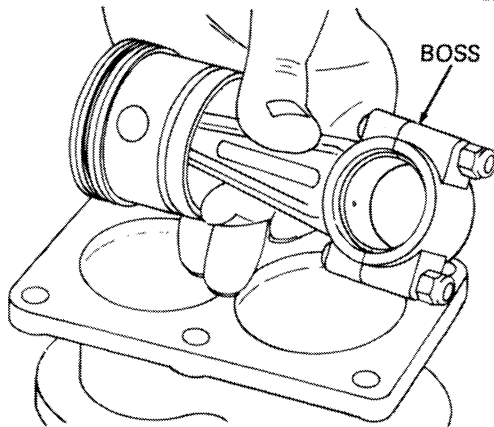
- (10) Put cylinder head assembly (14 through 26) in vise, machined surface up.



- (11) Loosen and remove two stops (15) from cylinder head (14).



- (26) Install front and rear piston and connecting rod assemblies (35 through 45) in associated bores in cylinder block (29), with bosses on connecting rods (39) toward center of cylinder block. Use hammer handle to push pistons into bores.



NOTE

Do not mix piston and connecting rod mating parts. Install connecting rod cap (36) on same connecting rod (39) from which it was removed.

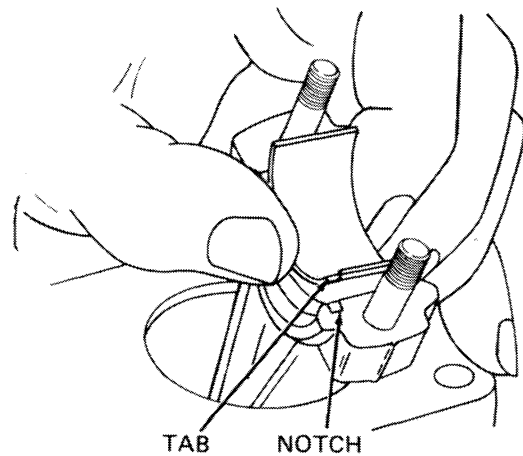
- (27) Remove connecting rod caps (36), lock nuts (35), and screws (38) from connecting rods (39).

NOTE

If crankshaft (54) journals were reground, install oversize inserts (37).

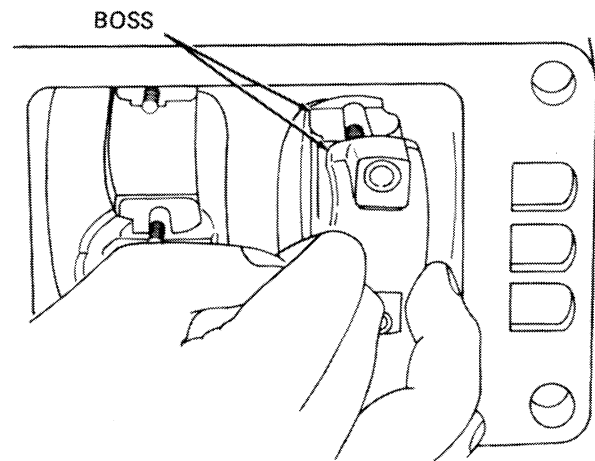
- (28) Install new inserts (37) in connecting rods (39). Make sure tab on each insert engages notch on connecting rod.
- (29) Position new gasket (34) on crankcase (57).
- (30) Install cylinder block assembly (29 through 45) on crankcase (57).
- (31) Install six capscrews (28). Tighten center capscrews first. Then tighten alternate capscrews to 120-160 lb-in until all capscrews are tight.

- (32) Install new insert (37) in front connecting rod cap (36). Make sure tab on insert engages notch on connecting rod cap.



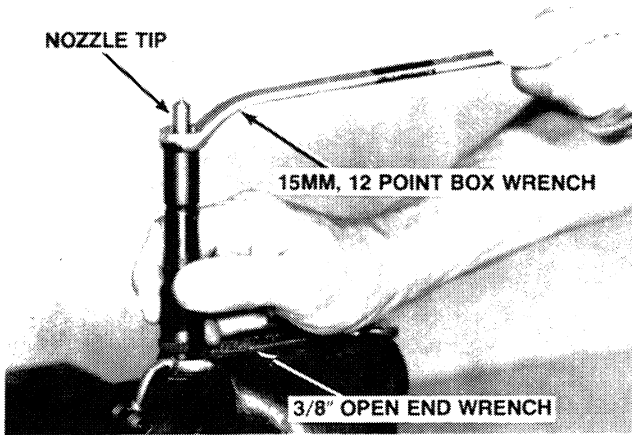
- (33) Lubricate inserts (37) and journals on crankshaft (54) with clean lubricating oil.

- (34) Install front connecting rod cap (36) on front connecting rod (39), making sure boss on connecting rod is aligned with boss on connecting rod cap.



- (35) Install two capscrews (38) and lock nuts (35). Tighten lock nuts to 100-140 lb-in.
- (36) Repeat steps (29) through (31) above for rear connecting rod assembly (35 through 39).

- (2) Use force to make the cap nut (1) turn a small amount. Use a 12 point box wrench. Look at the nozzle to see if it turns with the cap nut. If the nozzle turns, stop.



CAUTION

The nozzle is being held in position in the cap nut, if the nozzle turns with the cap nut. Carbon deposits between the two parts will cause this. Do not loosen the cap nut. This will cause damage to the dowel pins and valve stop as well as the body pressure face. Wet the nozzle and body in cleaning solvent (item 1, table 5-1), until the nozzle is free in the cap nut. Replace the valve stop assembly (4) if there is damage to dowel pins or valve stop.

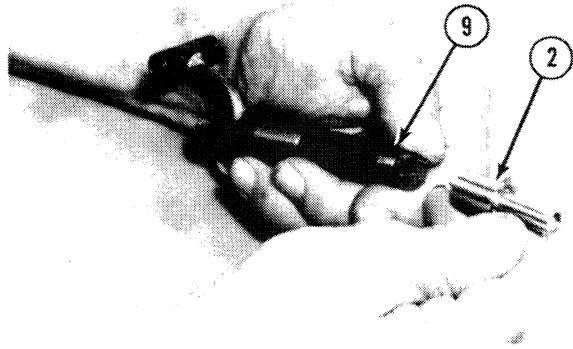
- (3) Loosen and remove the nozzle cap nut (1).

NOTE

The injector has parts with tight tolerances. Dirt will damage a smooth surface. Keep the work location and all tools clean and dry. Disassemble and reassemble all parts carefully to prevent damage.



- (4) Remove the nozzle assembly (9).



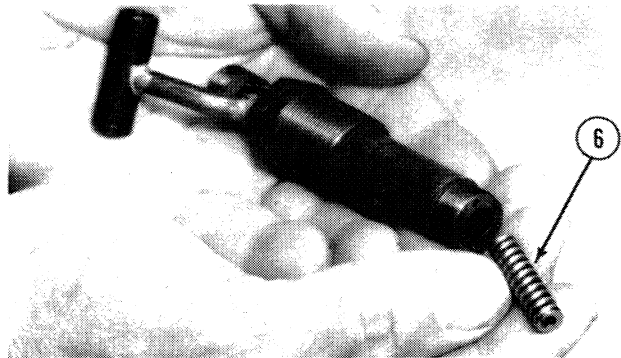
- (5) Remove the valve stop assembly (4).



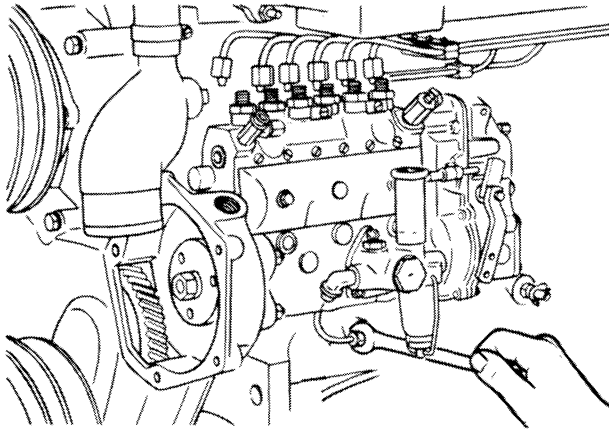
- (6) Remove the pressure spring seat (5).



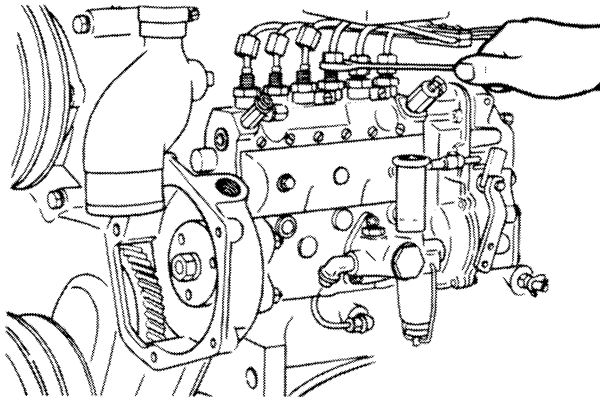
- (7) Remove the pressure spring (6).



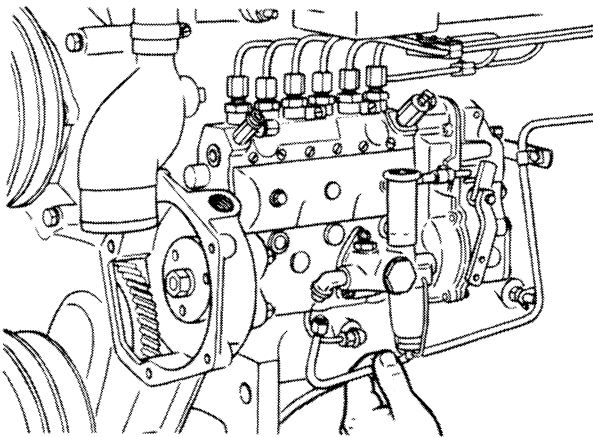
(5) Connect pump lube line.



(6) Connect high pressure fuel lines finger tight plus 1/8 turn.



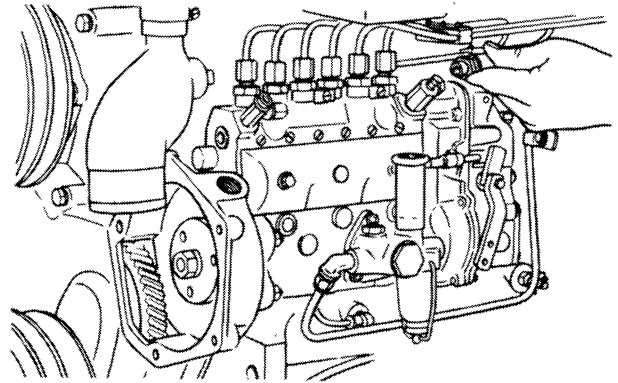
(7) Connect low pressure line.



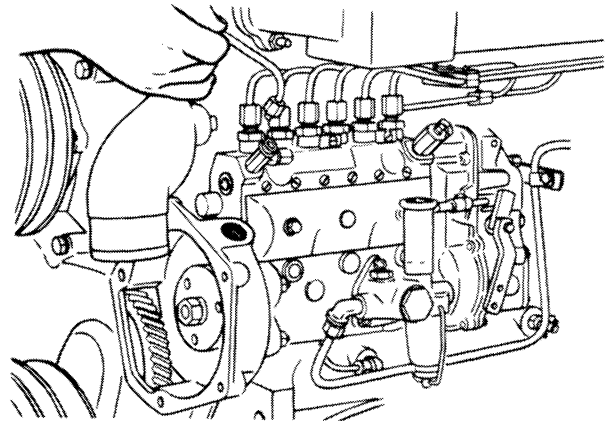
NOTE

Nut must seat against shoulders of fittings. Rubber sleeves must seat properly and not bind.

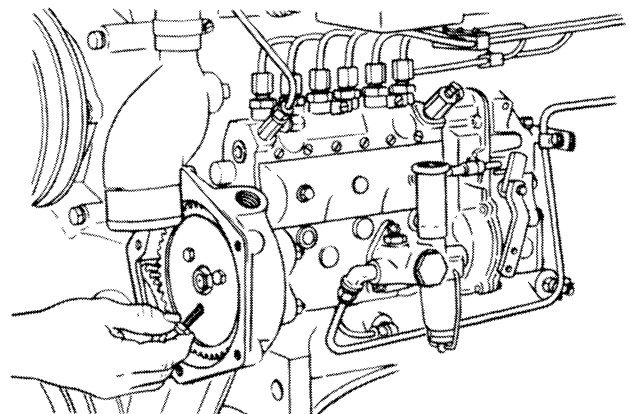
(8) Connect fuel hose.



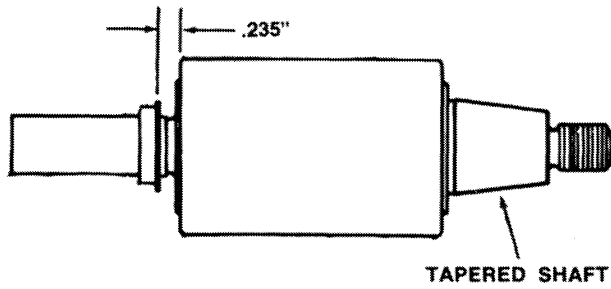
(9) Connect leak-off return line.



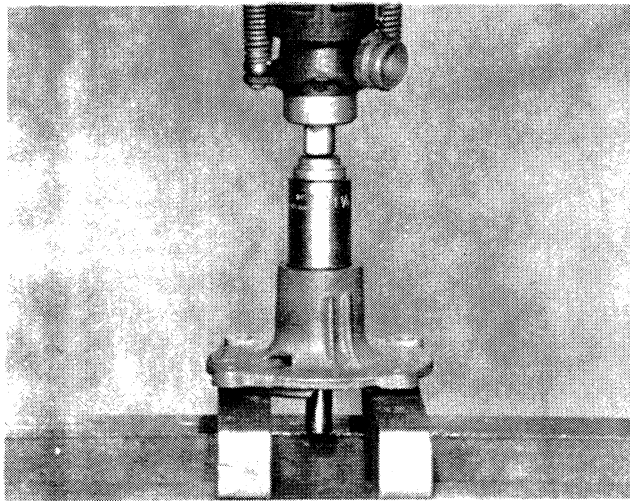
(10) Install pump gear with machined flange toward pump flange. Install mounting bolts.



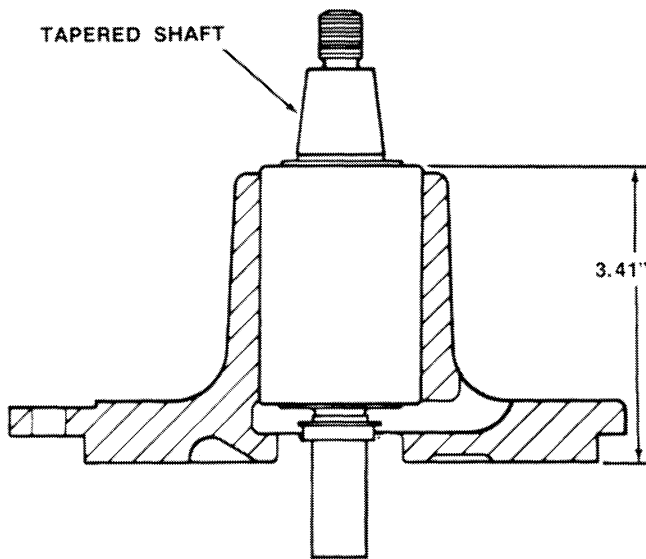
(7) Install a new slinger on bearing shaft to the dimensions shown.



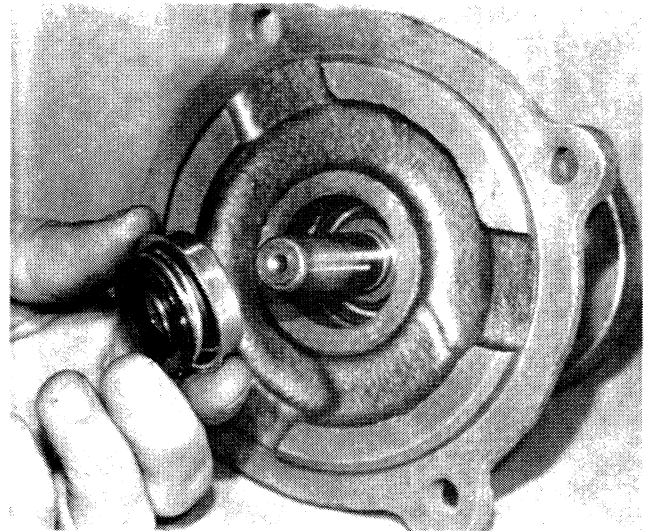
(8) Press shaft bearing into housing to dimension shown. Press on bearing outer race only. Do not press on shaft.



TAPERED SHAFT

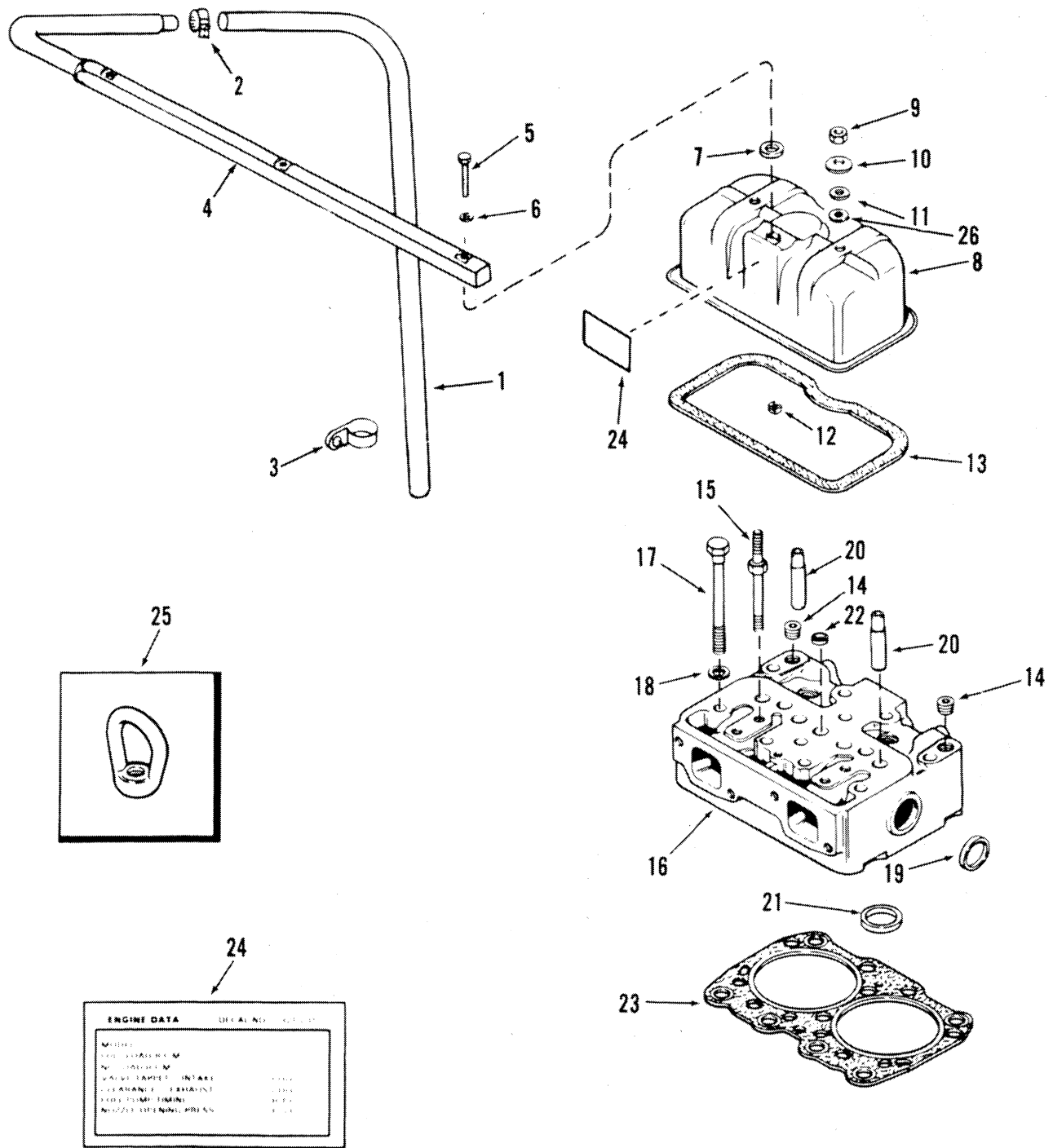


(9) Install new seal assembly in water pump. Press only on seal outer metal ring during installation.



(10) Install new pump seat assembly in impeller.

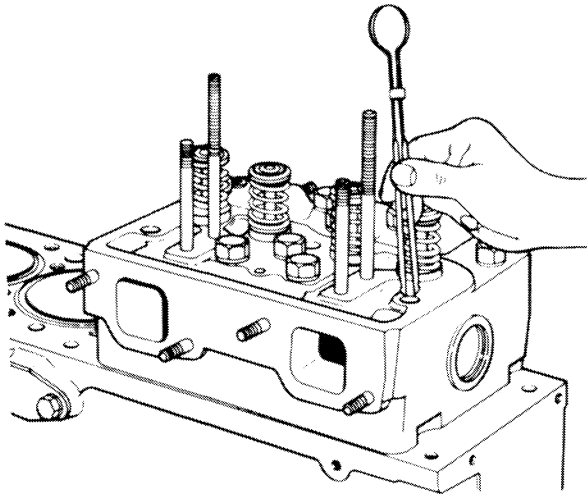




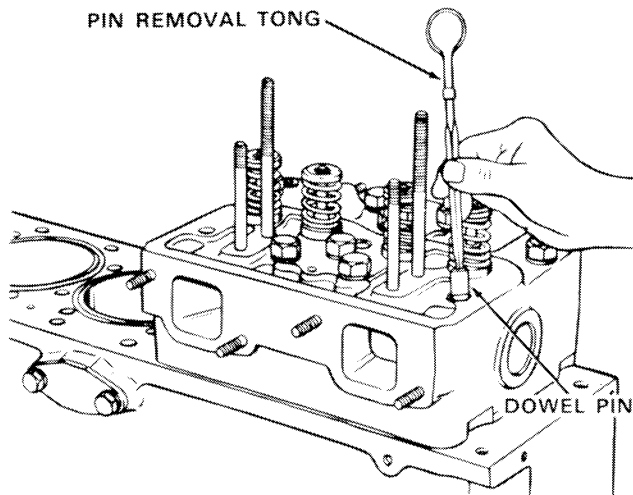
- | | | |
|------------------------|----------------------|-----------------------|
| 1. Hose | 10. Washer | 18. Washer |
| 2. Clamp | 11. Washer | 19. Cup Plug |
| 3. Clamp | 12. Self-locking Nut | 20. Valve Stem Guide |
| 4. Oil Breather Tube | 13. Gasket | 21. Valve Seat Insert |
| 5. Capscrew | 14. Plug | 22. Cup Plug |
| 6. Gasket | 15. Stud | 23. Head Gasket |
| 7. Gasket | 16. Cylinder Head | 24. Decal |
| 8. Cylinder Head Cover | 17. Capscrew | 25. Engine Lift Eye |
| 9. Nut | | 26. Grommet |

Figure 5-47. Cylinder Head and Cover Group

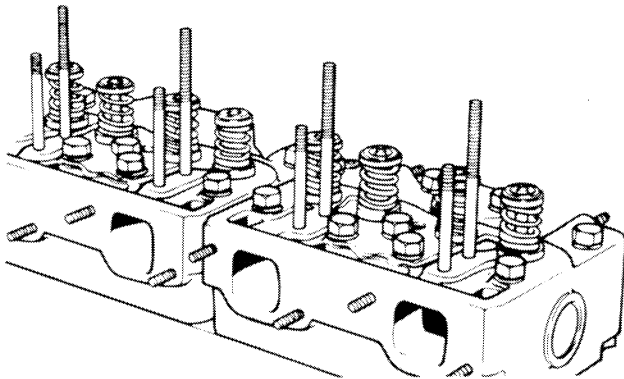
(11) Insert dowel pin removal tong (table 2-1).



(12) Remove dowel pins and install remaining cylinder head bolts and washers.



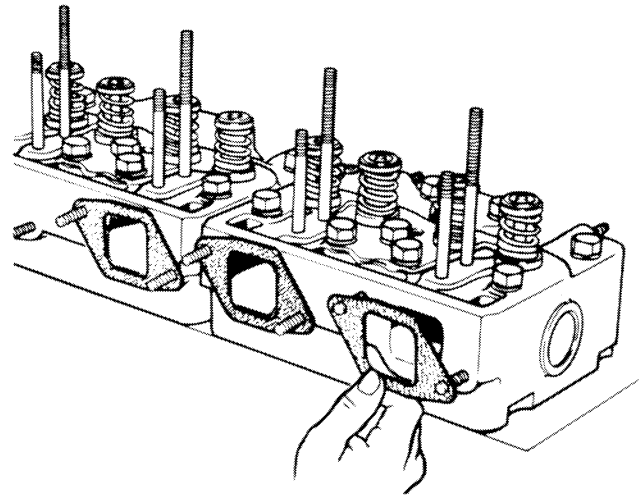
(13) Install remaining cylinder heads.



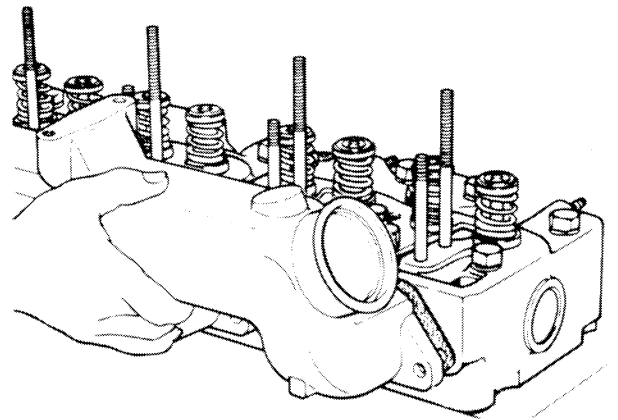
NOTE

DO NOT torque mounting bolts at this time. Manifolds must be installed and torqued to insure seating of manifold gaskets before torquing cylinder head bolts.

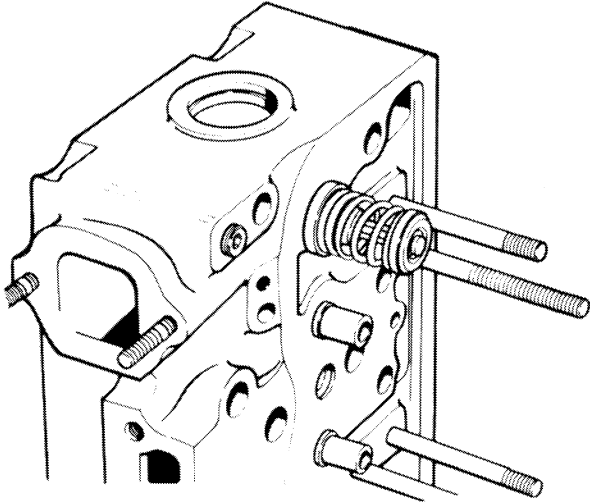
(14) Install new intake manifold gaskets.



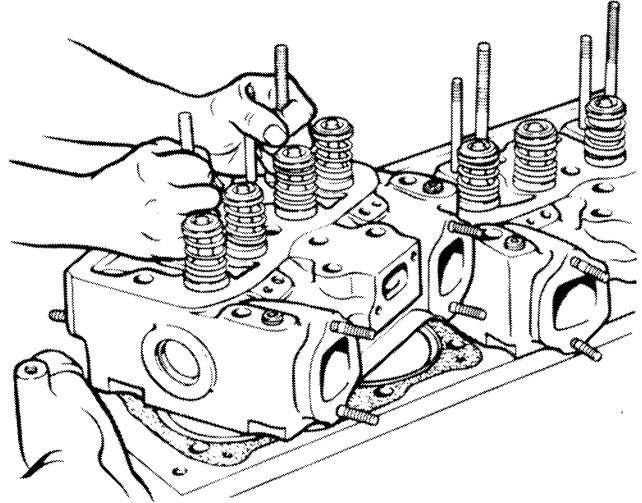
(15) Install intake manifold and torque retaining nuts as follows: Cast iron manifold (std. hex. nuts) — 25 to 30 ft-lb. Aluminum manifold (heavy hex. nuts) — 35 to 42 ft-lb.



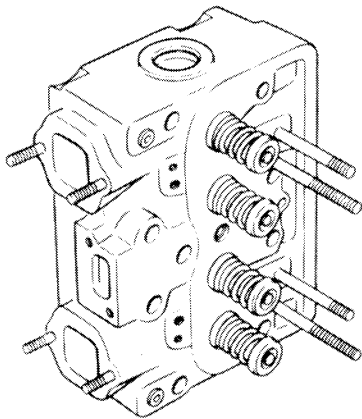
(19) Remove spring compressor and tap valve stem end to seat keepers.



(21) Reinstall cylinder head on engine following procedure outlined in paragraph 5-54.



(20) Install teflon seals on the other intake and exhaust valves, following the same procedure.



NOTE

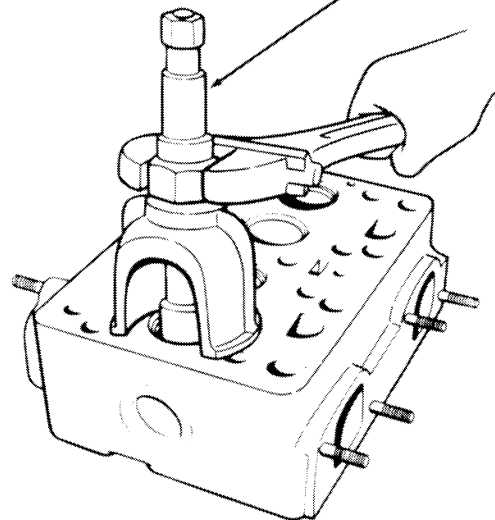
Steps (22) and (23) cover **valve seat replacement**.

(22) Remove valve seats with a seat removal tool or have the seats machined out.

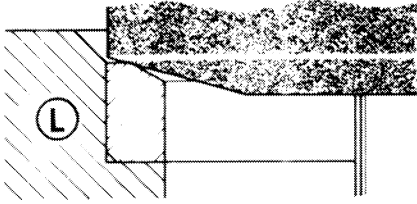
CAUTION

Never attempt to remove valve seats with center punch, cold chisel or pry bar.

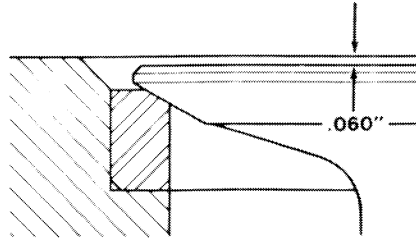
SEAT REMOVAL TOOL



→ USE A 15° NARROWING STONE TO LOWER UPPER CONTACT AREA

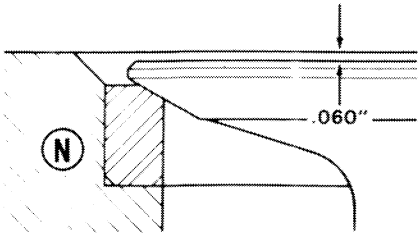


→ CHECK THAT VALVE HEAD HAS NOT RECEDED MORE THAN .060" BELOW CYLINDER HEAD SURFACE



→ IF VALVE HEAD HAS RECEDED MORE THAN .060", REPLACE VALVE AND VALVE SEAT

→ CHECK THAT VALVE HEAD HAS NOT RECEDED MORE THAN .060" BELOW CYLINDER HEAD SURFACE

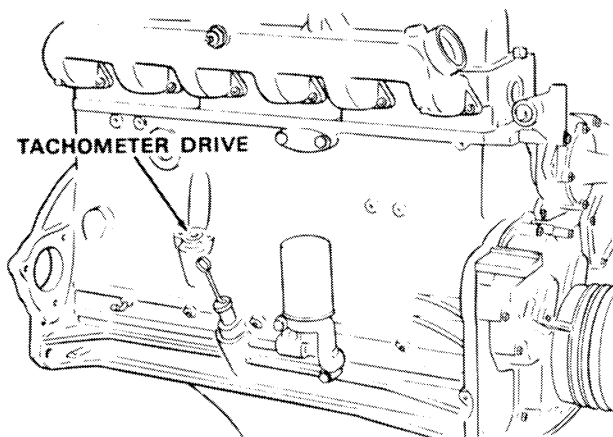


→ IF VALVE HEAD HAS RECEDED MORE THAN .060", REPLACE VALVE AND VALVE SEAT.

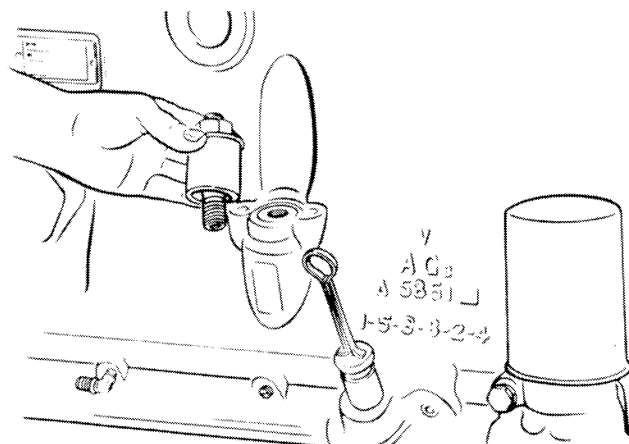
5-57. CAMSHAFT GROUP. Servicing of this group necessitates cross reference to paragraphs 5-47, 5-48, 5-49, 5-60 and 5-67. Refer to figure 5-50 and perform the following procedures:

a. Removal and Disassembly.

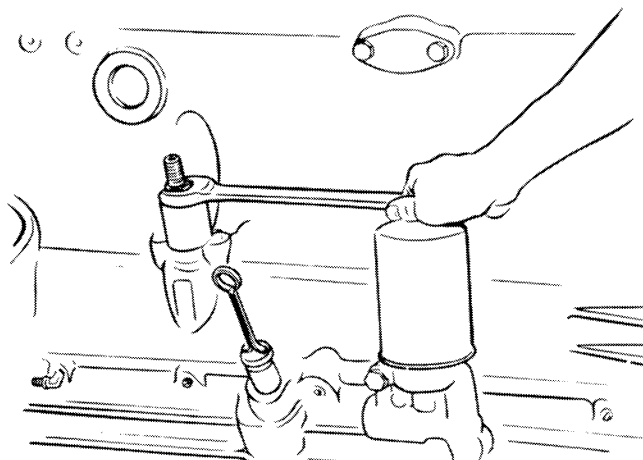
- (1) Before the camshaft can be removed from the engine, the tachometer drive must be removed.



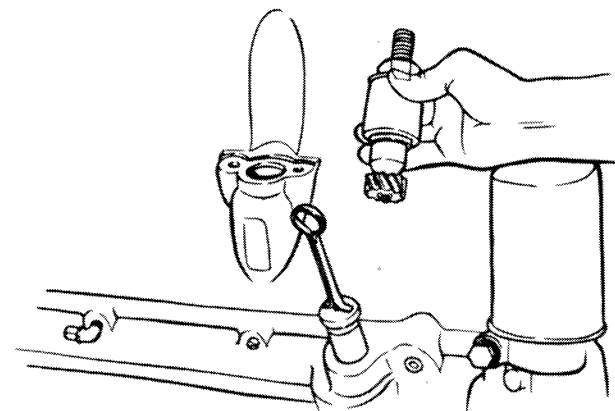
- (2) To remove the tachometer drive, a special tool must be made. Refer to specification for making special tools, table 2-1.



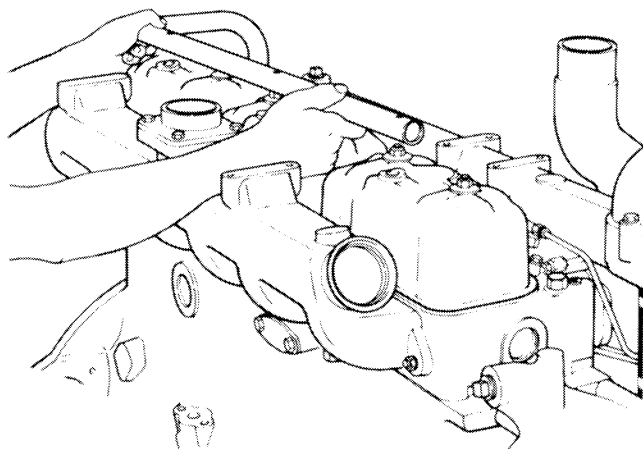
- (3) Screw the tool into the tachometer drive and pull drive from engine.



- (4) Remove the tachometer drive from the special tool.



- (5) Remove the breather tube and valve covers.



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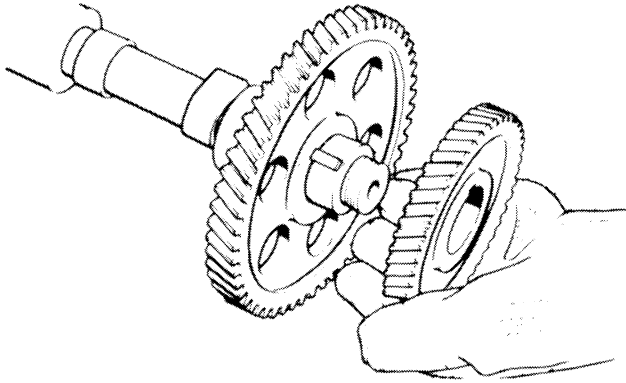
- Thank you very much for reading the preview of the manual.
- You can download the complete manual from: www.heydownloads.com by clicking the link below



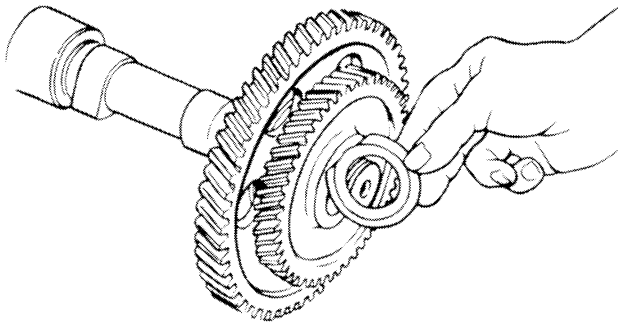
- Please note: If there is no response to CLICKING the link, please download this PDF first and then click on it.

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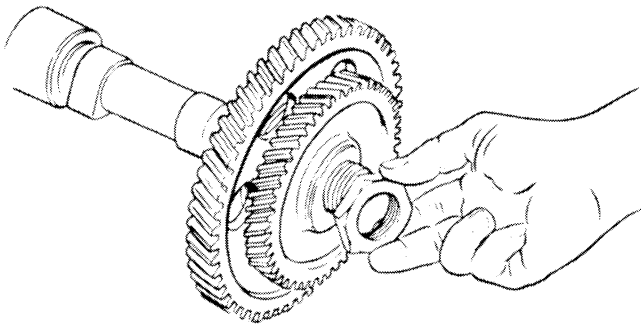
- (4) Install the heated idler drive gear on the camshaft with the large hub side of gear towards the camshaft gear.



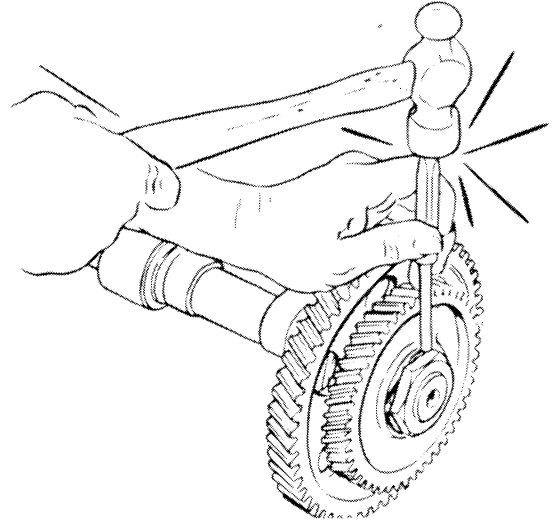
- (5) Install lockwasher on the camshaft.



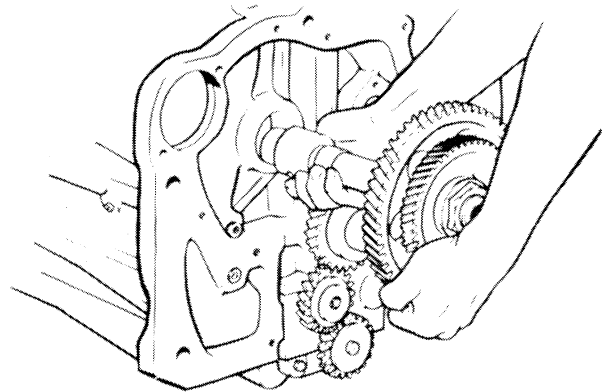
- (6) Install the retaining nut and torque nut as follows:
Retainer nut with clipped lockwasher — 95 to 105 ft-lb.
Retainer nut with hardened washer — 195 to 205 ft-lb.



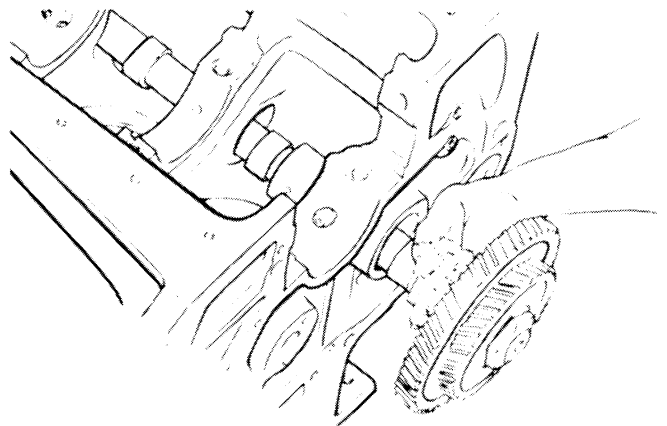
- (7) Bend the lip of the clipped lockwasher over one of the flats on the retaining nut.



- (8) Install the camshaft part way into the engine block.



- (9) Lubricate the thrust washer with OE (30W oil), figure 4-1.



b. Cleaning, Inspection, Repair and Replacement.

NOTE

To facilitate servicing, these four functions have been combined.

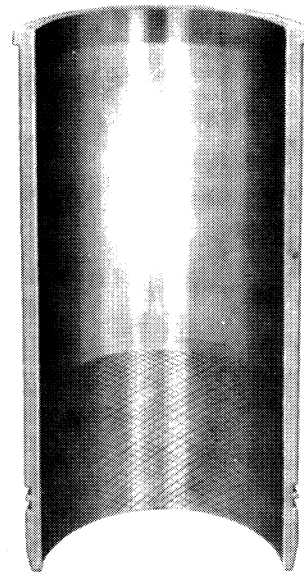
- (1) Refer to paragraph 5-4 and 5-5 for general cleaning and inspection procedures.
- (2) Tools referenced herein are listed in table 2-1.
- (3) Repair is limited to deglazing of sleeves and replacement of defective or deficient parts.
- (4) Certain in-process inspection is also required during assembly to provide criteria for the re-use or rejection of a part.

NOTE

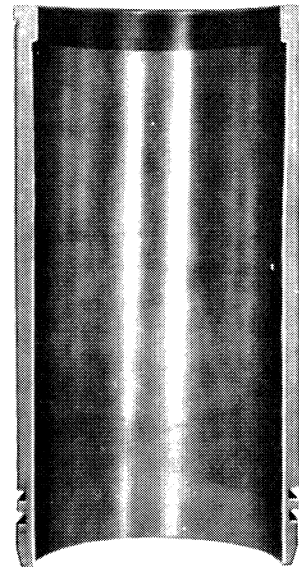
Steps (5) through (8) apply to inspection of the cylinder sleeves.

- (5) Inspect the cylinder sleeves for the following conditions:
 - (a) Normal Wear. A smooth shiny surface between the upper and lower limits of the ring travel indicates normal wear. There will always be slight wear present due to combustion pressure forcing the top ring outward against the cylinder sleeve. Normal

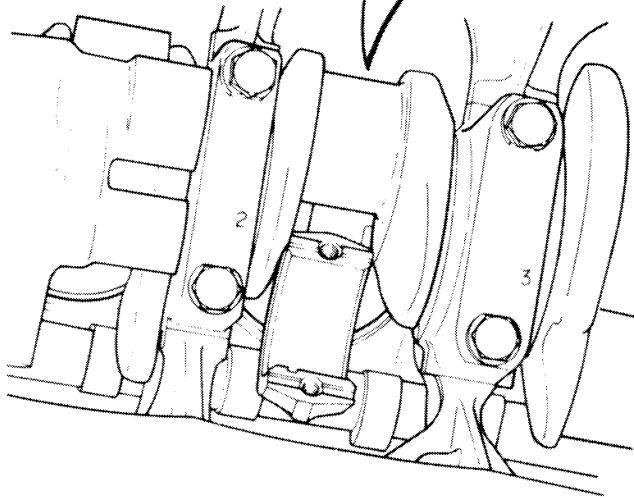
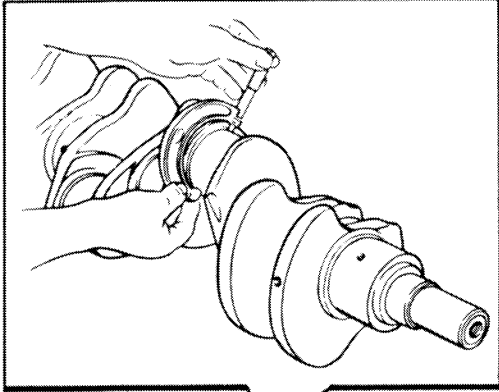
wear indicates satisfactory sleeve conditions and the sleeve need not be replaced.



- (b) Worn Out Sleeve. A smooth shiny surface the complete length of the cylinder sleeve indicates a worn out sleeve due to normal wear and it should be replaced.

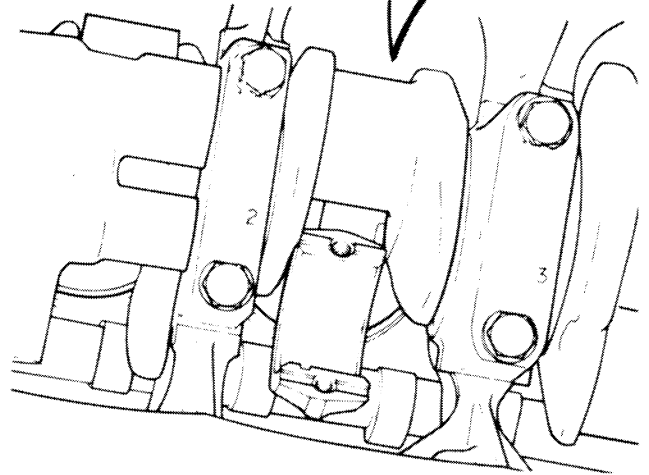
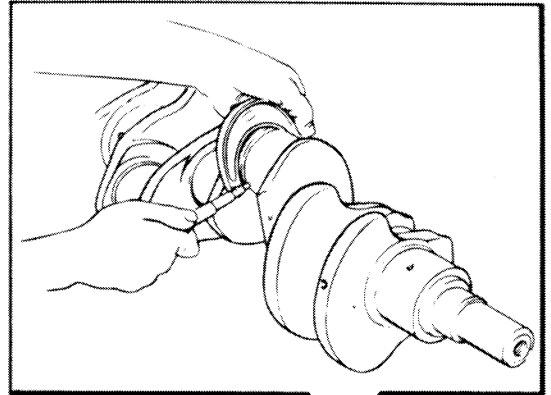


(9) Measure the connecting rod journals on the crankshaft. Measure the front and rear of each journal, checking taper. If taper exceeds 0.0005 inch, the journals must be refinished.

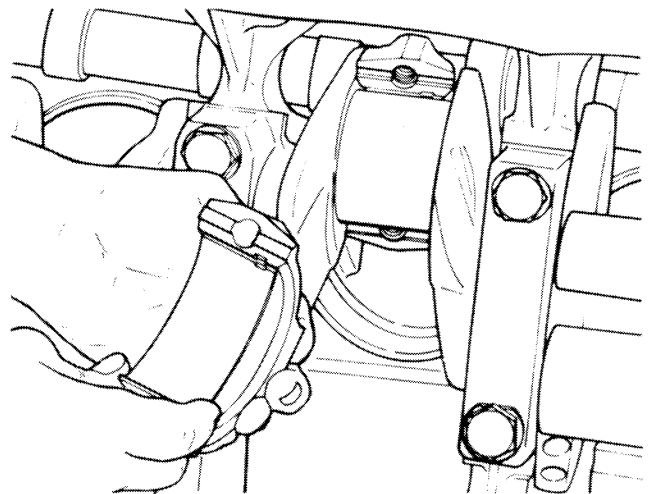


(10) Recheck the rod journals, 90 degrees from the first measurements for out of round-

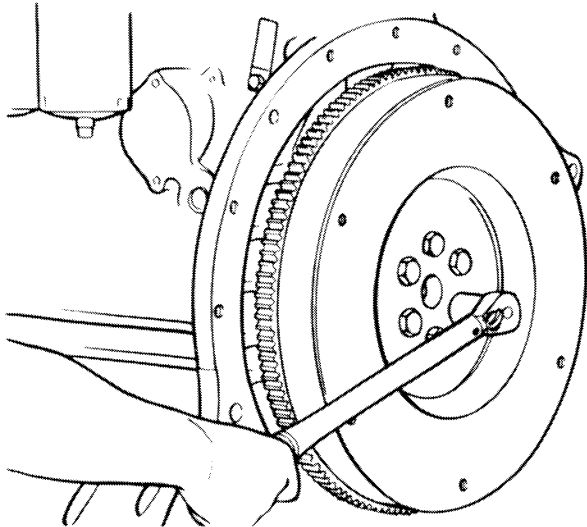
ness. If out of roundness exceeds 0.0005 inch, the journals must be refinished.



(11) When installing liners, make sure liner locks line up. Use a sliding type movement when installing liners. Never press on center of liners.



- (11) Install the flywheel. Tighten the retaining screws to the following torques:
Without hardened washers — 180 to 190 ft-lb.
With hardened washers — 230 to 250 ft-lb.

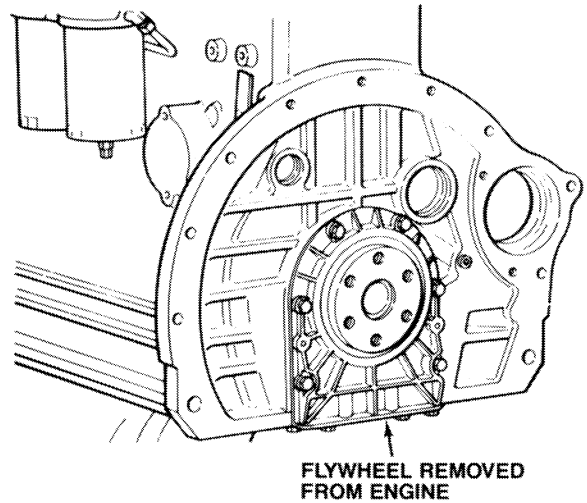
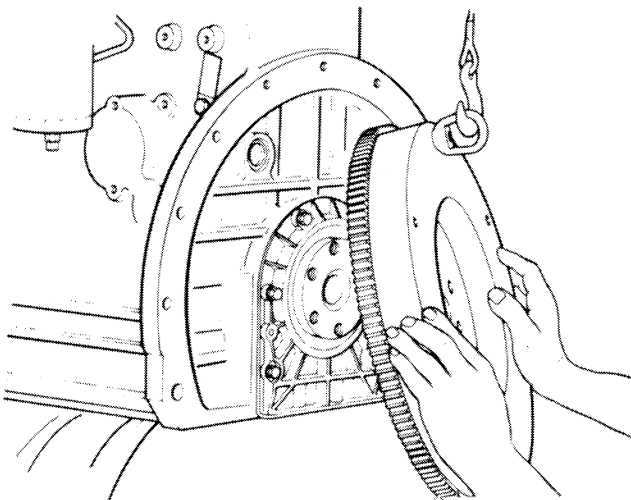


NOTE

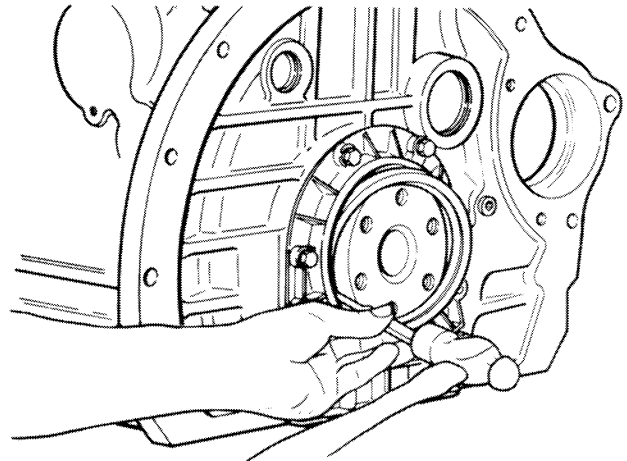
The following subparagraphs apply to installation of an *oversized seal and wear ring*.

e. Removal and Assembly – Oversized Seal.

- (1) In order to replace the rear oil seal, the engine must be removed from the machine and flywheel removed from engine.



- (2) Using a punch, carefully remove seal from seal carrier.



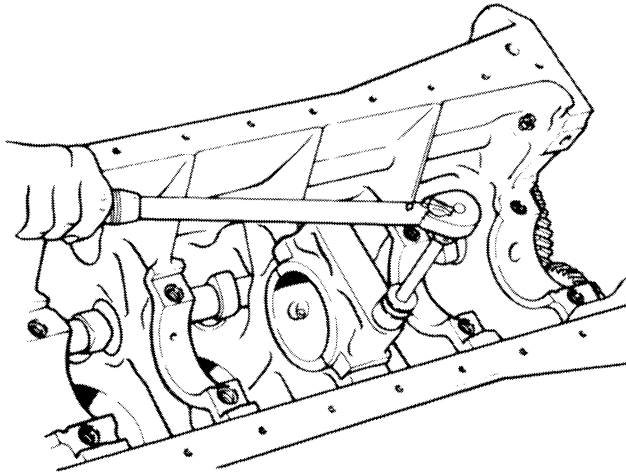
f. Cleaning and Inspection. Refer to general cleaning and inspection procedures of paragraphs 5-4 and 5-5.

g. Repair and Replacement. Repair is limited to replacement of defective components. See Assembly and Installation.

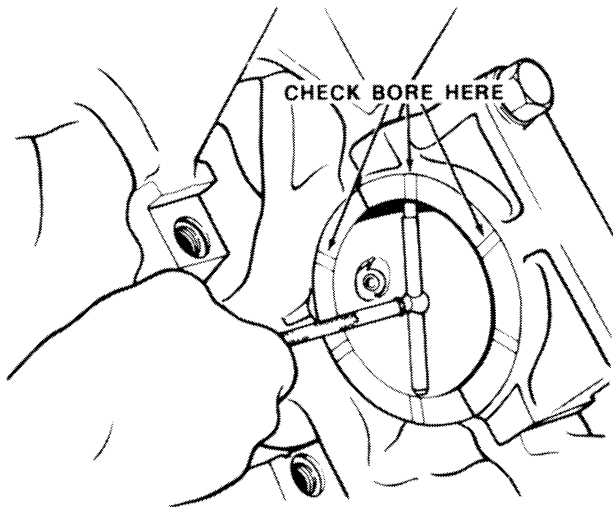
- (1) Install the bolt in the bearing cap. Tighten the bolt to the following torque.

Without hardened washers — 145 to 155 ft-lb.

With hardened washers — 195 to 215 ft-lb.



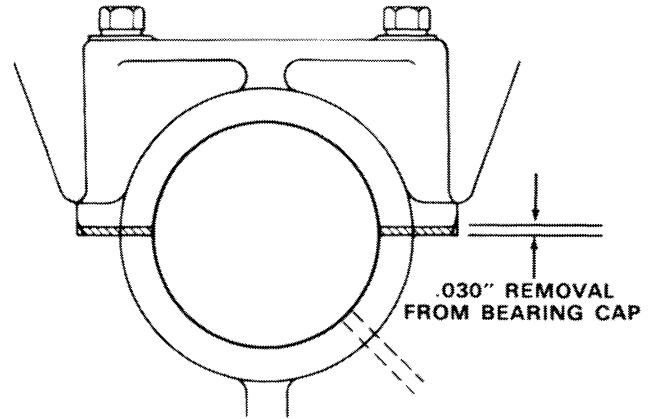
- (2) Check bore diameter at three angular locations indicated. All must be within tolerance, 3.692/3.691 inches.



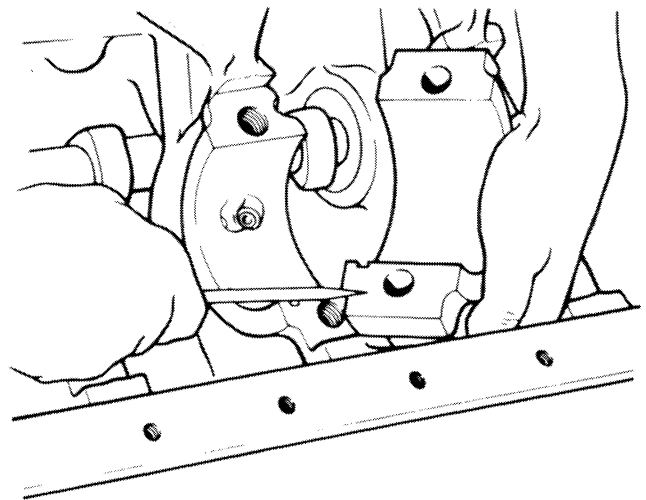
NOTE

One of the three above dimensions can be up to 0.005 inch over the specified dimensions and not require reboring.

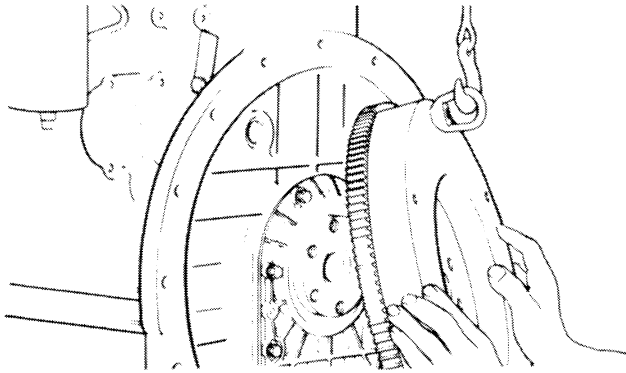
- (3) If vertical dimension is out of tolerance, or cap is shifted side-wise, rework cap by removing 0.030 inch stock from mating surface and then bore out to meet tolerance as specified in step (2).



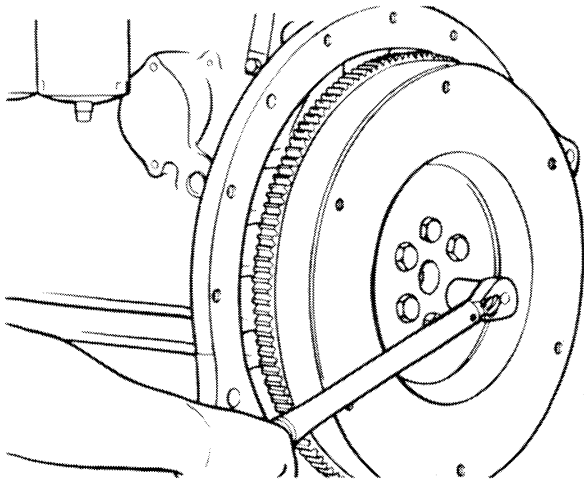
- (4) Machine new mounting surface flat, so that cap will set solid without wobbling in block.



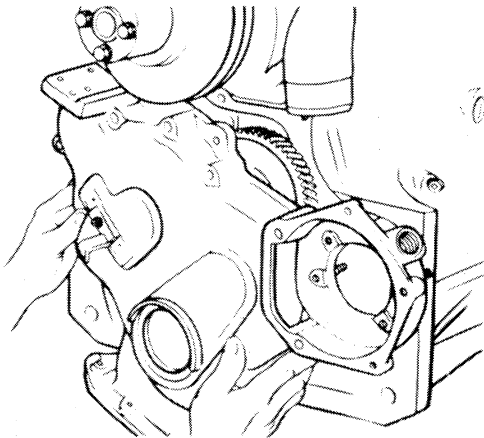
(41) Install flywheel to crankshaft.



(42) Tighten the flywheel retaining screws to the following torques:
Without hardened washers — 145 to 155 ft-lb.
With hardened washers — 195 to 215 ft-lb.



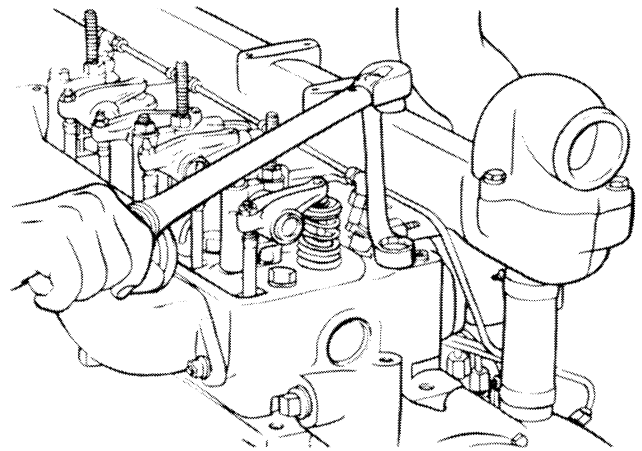
(43) Install the timing gear cover.



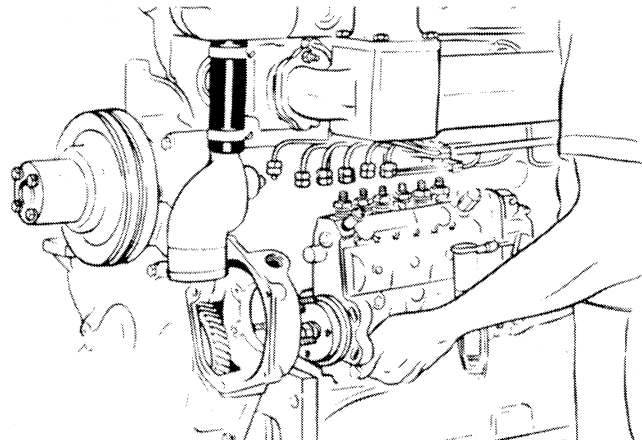
(44) Torque timing gear cover retaining bolts 35 to 42 ft-lb.

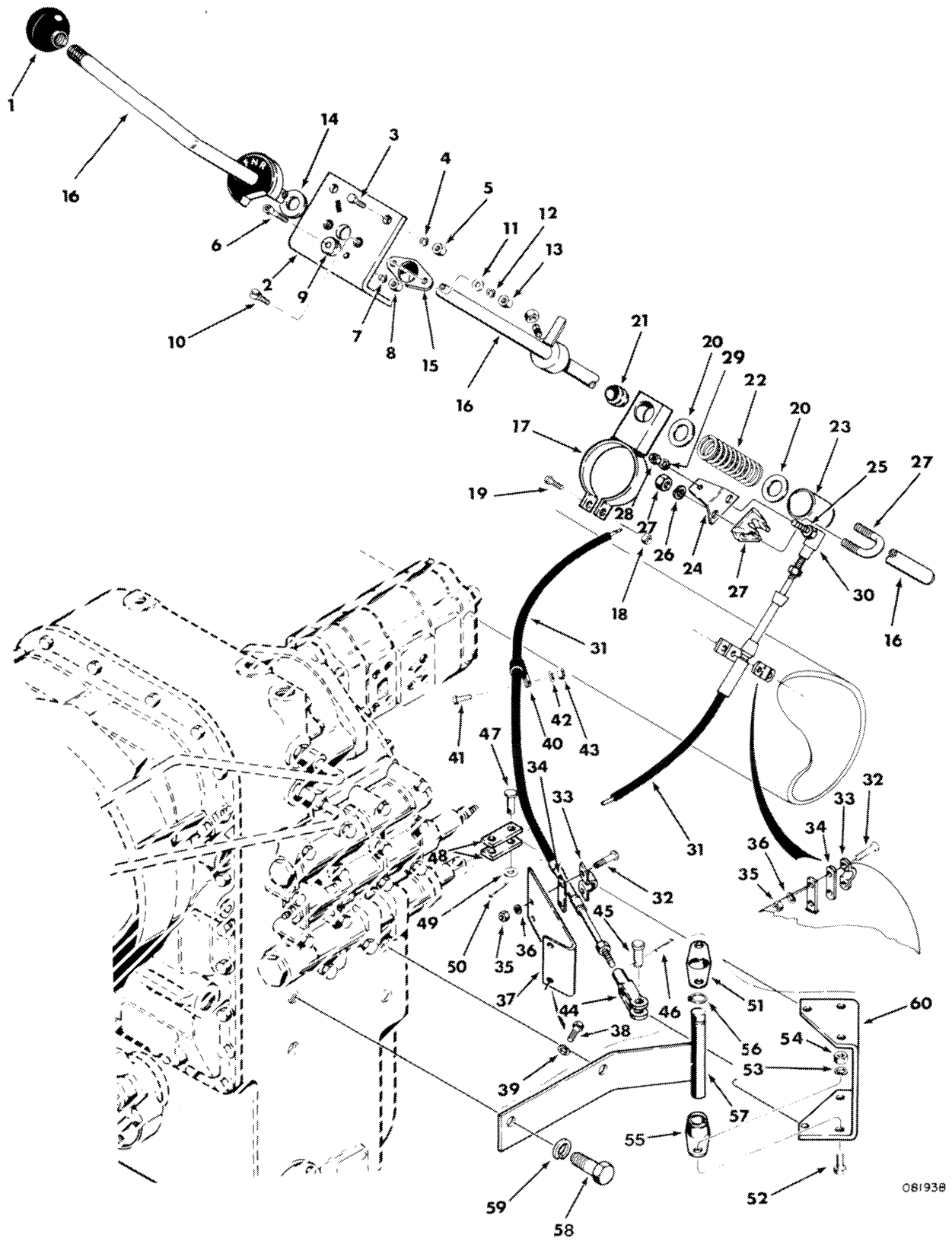


(45) Install the cylinder heads and manifolds, refer to paragraphs 5-51, 5-52, and 5-54 for installation procedure.



(46) Install the fuel injector pump, refer to paragraphs 5-45 and 5-47.





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Figure 5-58. Transmission Control Parts Group

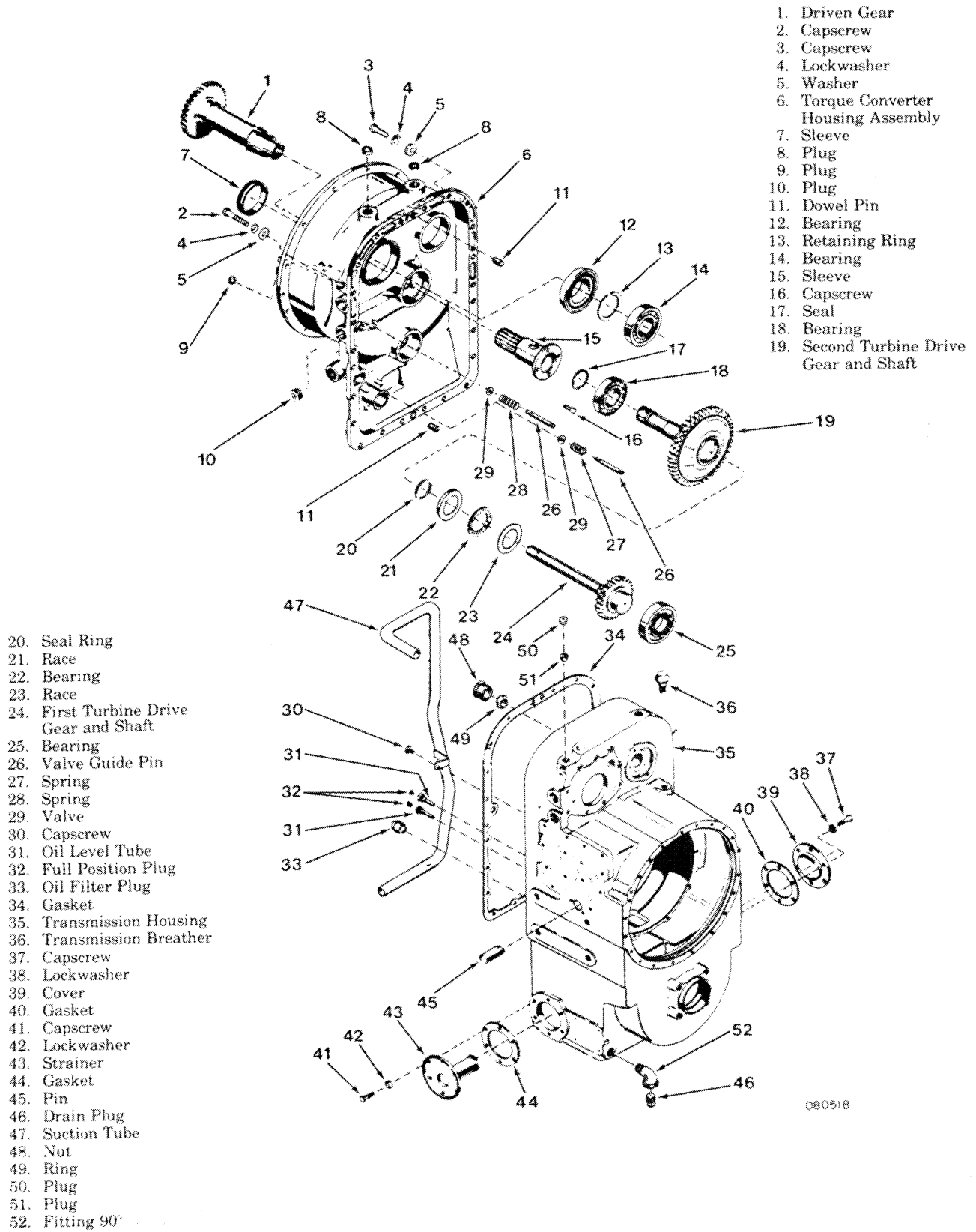


Figure 5-61. Converter/Transmission Housing and Gears

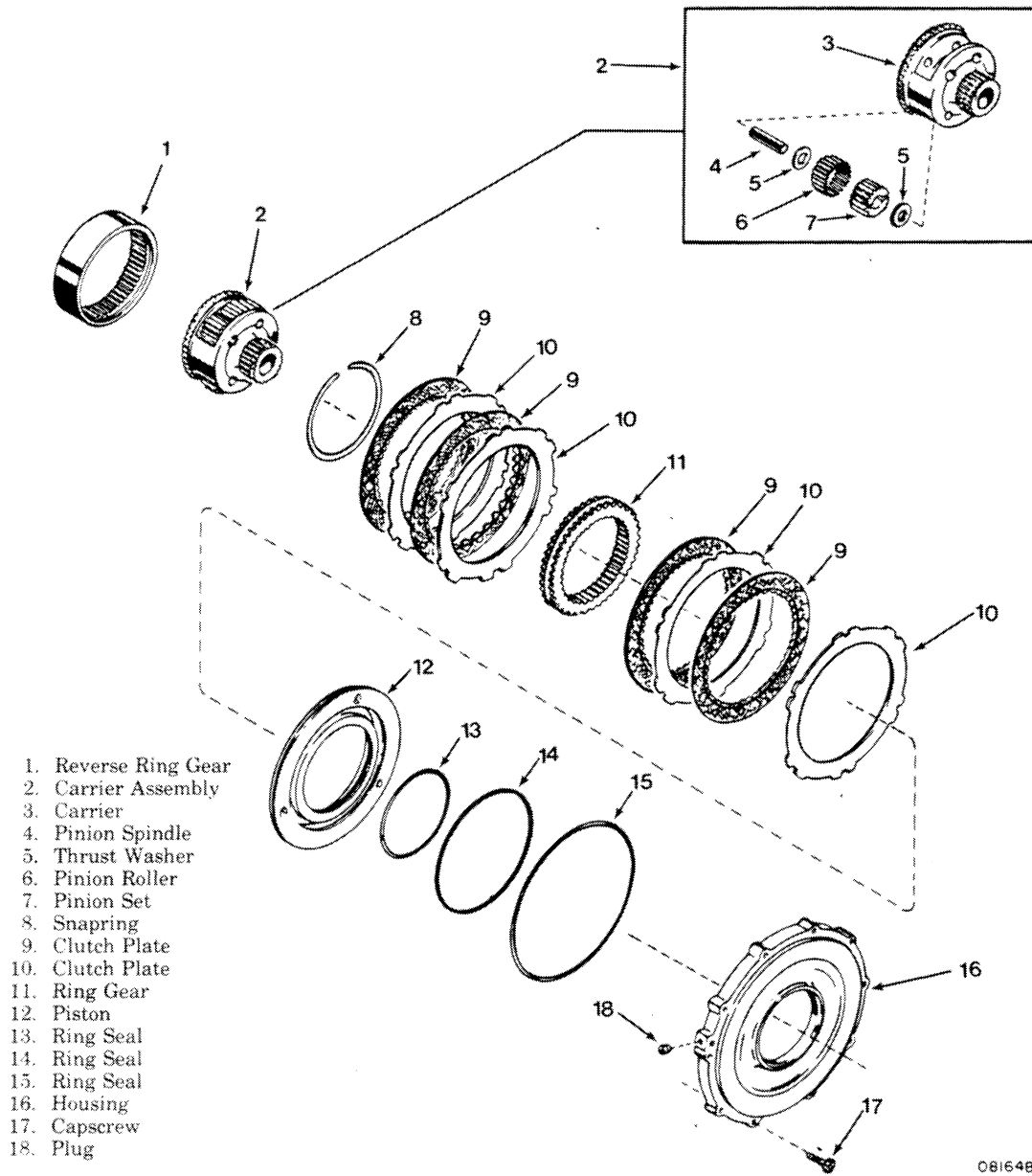
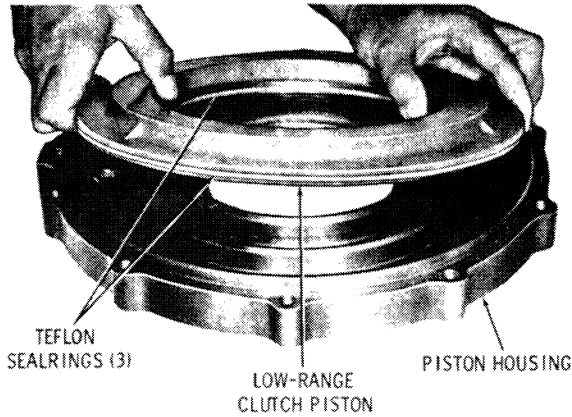


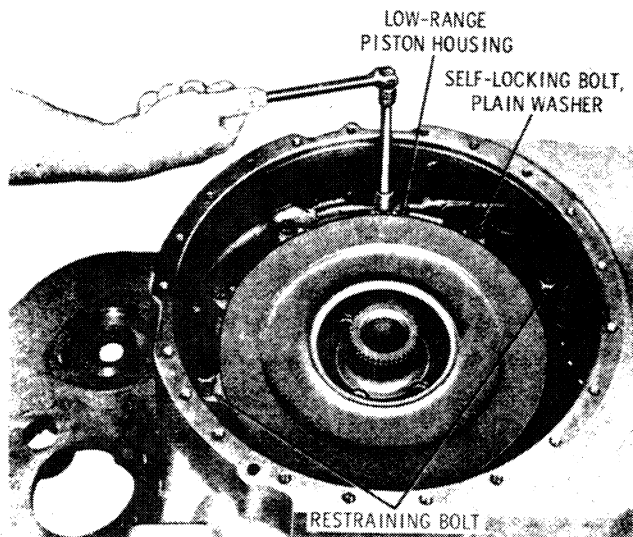
Figure 5-64. Forward Clutch and Planetary Group

(6) If plug (18, figure 5-64) was removed from low-range clutch piston housing (16), replace it. Apply nonhardening sealant onto the plug threads, and install the plug into the housing. Tighten the plug sufficiently to prevent leakage.

(7) Install the low-range clutch piston (12) (as assembled in paragraph 5-106), flat side first, into the low-range clutch piston housing (16).

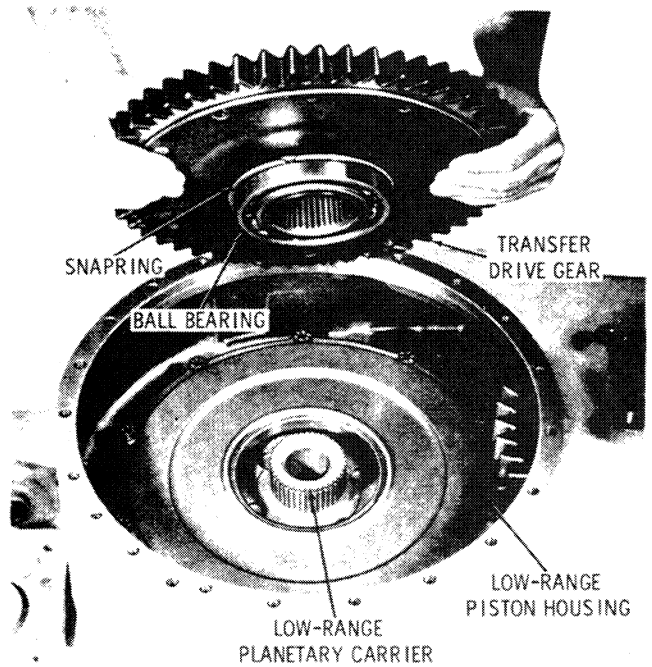


(8) Install the low-range clutch piston housing and piston assembly and attach it with ten 3/8-16 x 1-1/2 inch self-locking bolts (17). Use two of the longer valve body mounting bolts (3/8-16 x 2-1/2) to draw the piston housing down sufficiently to engage the 3/8-16 x 1-1/2 inch self-locking bolts. Remove the two draw bolts, and install the two remaining 3/8-16 x 1-1/2 inch, self-locking bolts. Tighten the bolts to 36 to 43 ft-lb torque.

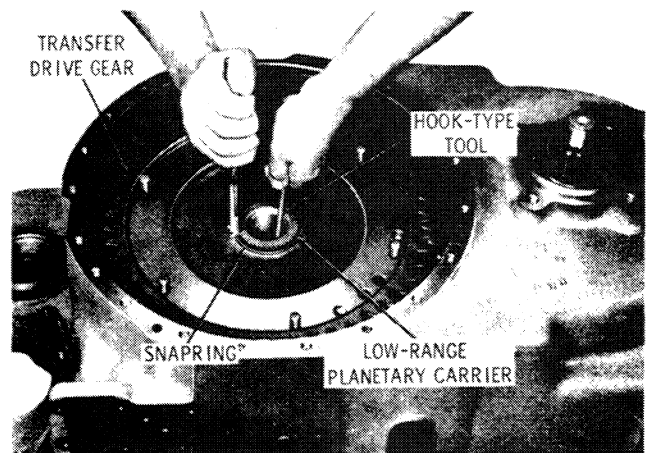


c. Transfer Drive Gear, High-range Clutch Assembly. Refer to figure 5-65 and the following:

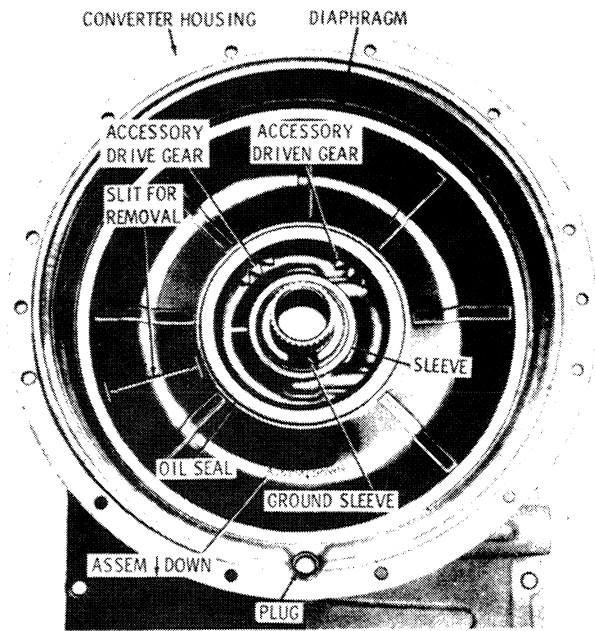
(1) Install the transfer drive gear (20) as assembled in paragraph 5-104, bearing first, onto the splined hub of the low-range planetary carrier.



(2) Using a suitable hook-type tool, raise the low-range planetary carrier sufficiently to expose the snapping groove in the splined hub, and install snapping (18).

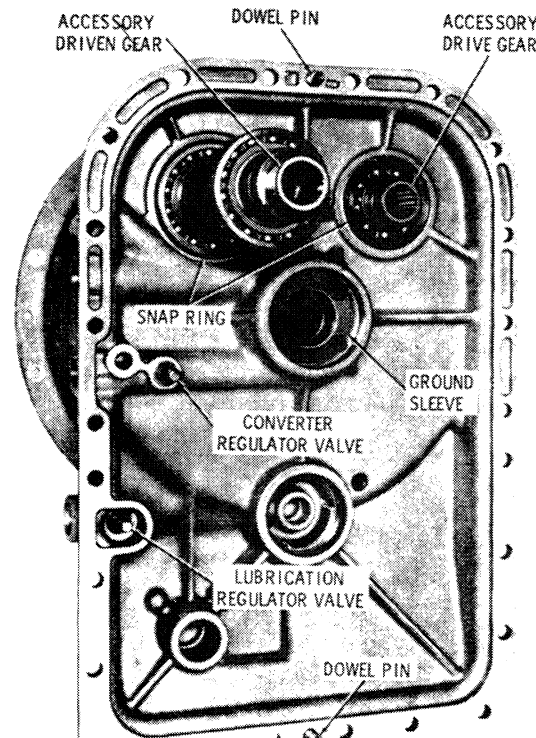


- (5) Remove step-joint seal (25) from the converter housing sleeve. If replacement of the housing sleeve is needed, remove it from the front housing.



- (6) See figure 5-61. Remove snapping (13) from accessory driven gear bearing (12) at the rear of the converter housing. Tap accessory driven gear (1) forward and remove it and the attached part from the housing. See illustration following step (12).
- (7) Press bearing (14) from accessory driven gear (1). Also remove snapping (13) and bearing (12).
- (8) If replacement of ground sleeve (15, figure 5-61) is needed, remove four attaching capscrews (16) and press the sleeve from the converter housing. Use care during this operation to prevent damage to the protruding converter pressure regulator valve (29) or lubrication bypass tube (47) (if present).
- (9) If converter pressure regulator valve spring (28) is not colored light blue, remove components (28 and 29) by twisting pin (26) from the converter housing.

- (10) If spring (28) is colored light blue, remove the components (26, 28 and 29) only if necessary to replace.
- (11) If lubrication regulator valve components (27 and 29) require replacement, remove them by twisting pin (26) from the converter housing.
- (12) Do not remove plugs (9) or (10) unless necessary for cleaning or replacement. Do not remove dowel pins (11) unless replacement is needed.



b. Cleaning and Inspection. Refer to paragraphs 5-4 and 5-5 for general procedures. Refer to paragraph 5-70 for specific transmission procedures.

c. Repair and Replacement. Repair is limited to replacement of damaged and defective parts. Replace all seals gaskets, and retaining rings.

d. Assembly. Refer to figures 5-60, 5-61 and the following:

- (1) If plugs (9 and 10, figure 5-61) were removed, reinstall them and tighten securely to prevent leakage. Install new

NOTE

When properly installed, end faces of both gears will project 0.002 to 0.003 inch above the front surface of the pump body (measured before gasket is installed). If end faces of the gears are below the flush line of the pump body, the pump will not perform satisfactorily and should be replaced.

- (5) Apply a liberal amount of oil onto the pump gears, and install cover gasket (9) and cover (10). Position the pump assembly front upward, until ready for installation onto the transmission housing.

NOTE

Temporarily tie or clamp parts together and seal off ports to exclude dirt if pump is not to be installed immediately.

- e. Installation.* Refer to paragraph 5-95.

5-109. TRANSMISSION HYDRAULIC SYSTEM AND OIL FILTER.

- a. Removal.* Refer to paragraph 5-70.

b. Disassembly (figure 5-59). Disassemble generally in the sequence shown and only to the extent necessary to replace defective parts. Refer also to paragraph 4-5 to change filter.

c. Cleaning and Inspection. Refer to paragraphs 5-4 and 5-5 for general cleaning and inspection procedures. Refer to paragraph 5-70 for specific inspection procedures for transmission components.

d. Repair and Replacement. Repair is limited to replacement of defective parts. Replace filter and packing whenever disassembled.

e. Assembly and Installation. Proceed essentially in reverse sequence of removal and disassembly.

5-110. TRANSMISSION HOUSING.

a. Disassembly. Refer to figure 5-61 and the following:

- (1) Remove six capscrews (37) and lockwashers (38), and remove core hole cover (39) and gasket (40).

- (2) Remove plug (50), but do not remove filter plug (51) unless replacement is necessary. If necessary, measure and record the depth of installed plug (51) prior to removal.

- (3) Remove breather (36).

- (4) Remove oil level tube (31) and plugs (32) from the inner face of housing (38).

b. Cleaning and Inspection. Refer to paragraphs 5-4 and 5-5 for general cleaning and inspection procedures. Refer to paragraph 5-70 for specific cleaning and inspection procedures for transmission components.

c. Repair and Replacement. Repair is limited to replacement of defective parts.

d. Assembly.

- (1) If oil level tube (31) and plug (32) were removed, replace them. Tighten the plugs sufficiently to prevent leakage.

- (2) Install breather (36) and tighten it sufficiently to prevent leakage.

- (3) If plug (51) was removed, apply nonhardening sealant onto the outside diameter of the new plug. Install the new plug, closed end first, into the passage. Press the plug to the exact depth recorded prior to removal in a(2), above. Install plug (50) and tighten it sufficiently to prevent leakage.

- (4) Install core hole cover (39) and gasket (40), and retain with six 3/8-16 x 7/8 inch capscrews (37) and lockwashers (38). Tighten to 26 to 32 ft-lb torque.

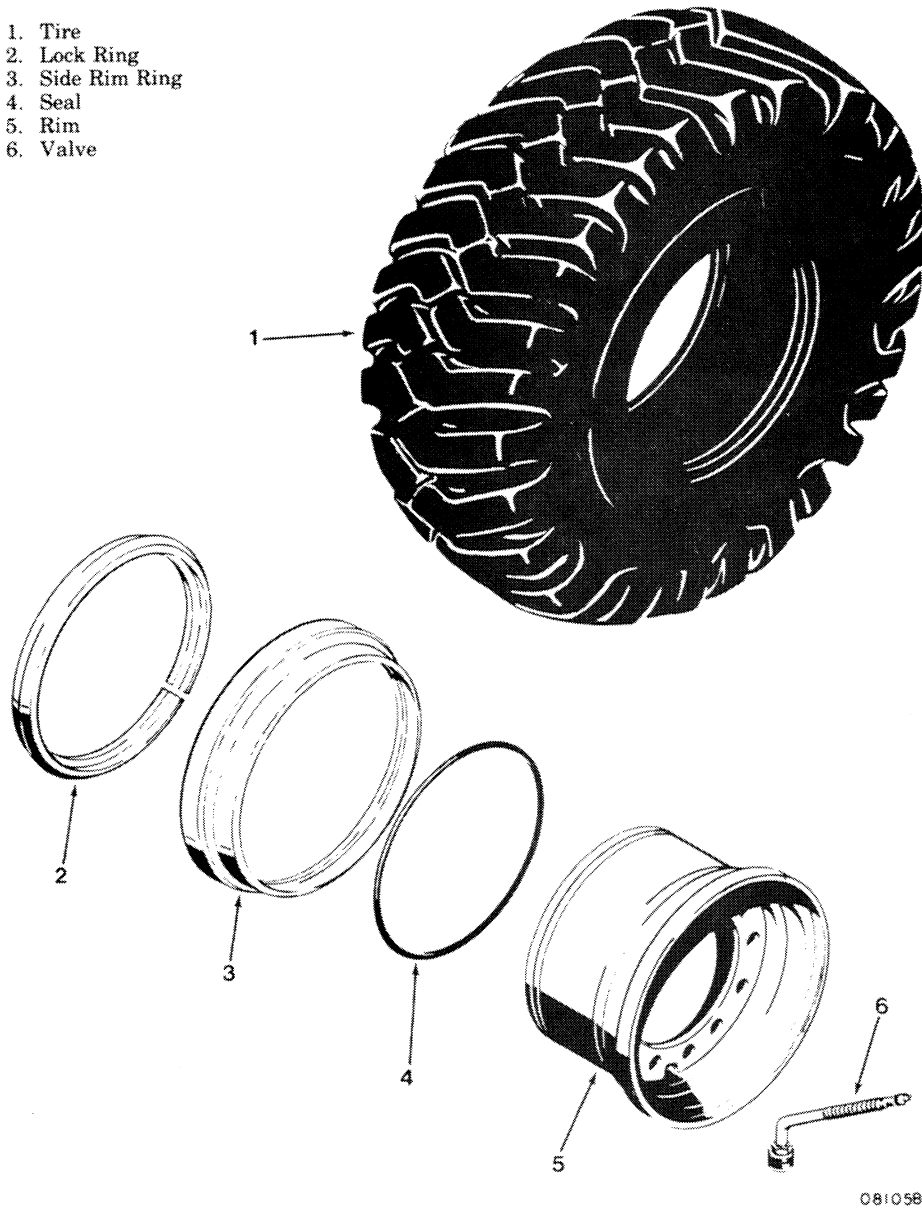
5-111. TRANSMISSION CONTROL PARTS.

a. Removal. Refer to paragraph 5-70.

b. Disassembly (figure 5-58). Disassemble generally in the sequence shown and only to the extent necessary to replace defective parts.

c. Cleaning and Inspection. Refer to paragraphs 5-4 and 5-5 for general cleaning and inspection procedures.

1. Tire
2. Lock Ring
3. Side Rim Ring
4. Seal
5. Rim
6. Valve



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Figure 5-72. Wheels and Tires

- (4) Install ring gear (19 and 20) and wheel hub (33) according to the instructions in paragraph 5-124.

5-127. AXLE BREATHER.

NOTE

The axle breather element must be removed and cleaned every six months of operation.

a. Removal and Disassembly (figure 5-73).

- (1) Remove the screw from the top of breather (41).
- (2) Remove the breather cover and the element.

b. Cleaning and Inspection. Clean the element by washing in cleaning solvent. Dry with compressed air. Apply air from the inside of the element.

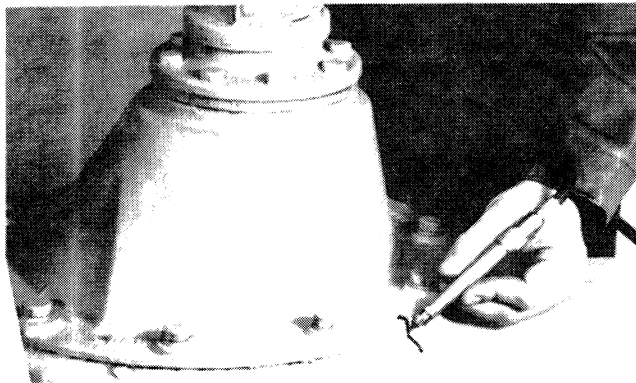
c. Assembly and Installation.

- (1) Install the element on the breather stem.
- (2) Install the breather cover and fasten the cover in position with the screw.

5-128. DIFFERENTIAL AND CARRIER ASSEMBLY.

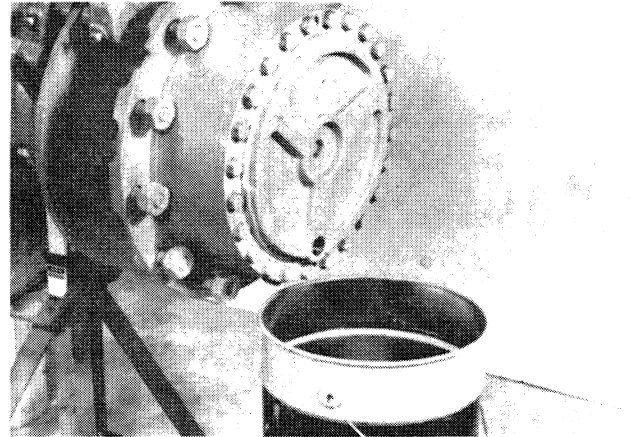
a. Removal (figure 5-74).

- (1) Lift the truck with a jack and remove the tires and wheels. Put blocks under the truck to keep it in position. Disconnect the drive shaft. Make a mark on the differential carrier and axle housing.

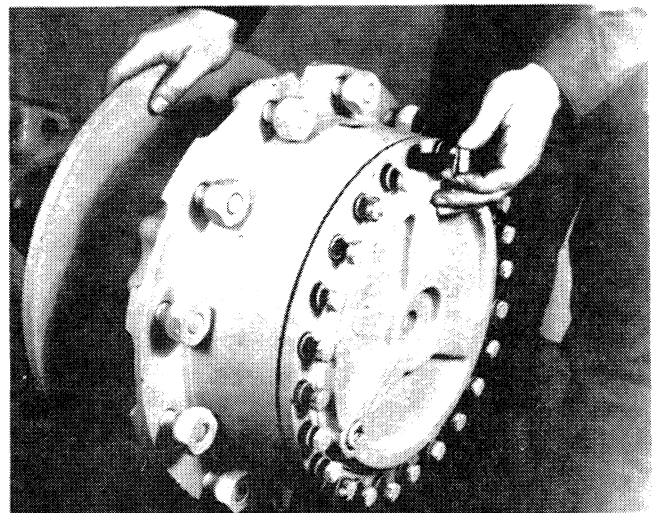


- (2) Put a drain pan under the differential assembly. Remove the capscrew stamped "drain" from the differential housing. Drain the oil from the differential assembly.

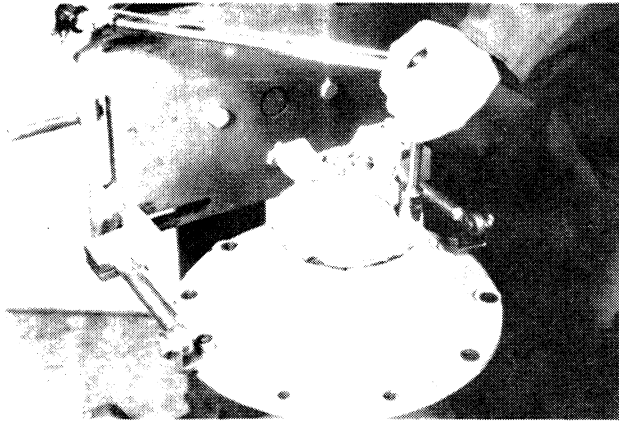
- (3) Put a drain pan under the planetary ends of the axle. Remove oversize capscrew (3) from planetary spider (1) and drain the oil from the planetary ends.



- (4) Remove the remainder of capscrews (2) and washers (4) from planetary spider (1).



- (19) Tighten the capscrews to 60-63 ft-lb torque.

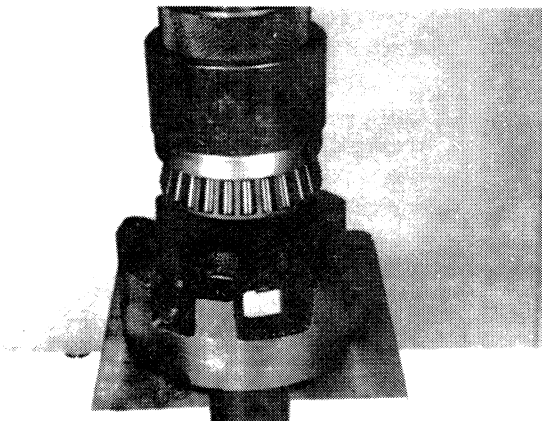


- (20) If ring gear (28) was removed from differential case half (18), clean the case half and ring gear. Heat the ring gear in an oven to 300°F.

WARNING

Use insulated gloves or mittens when working with hot parts.

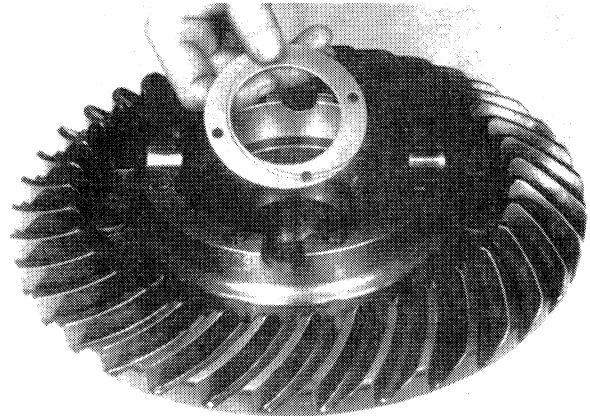
- (21) Remove the ring gear from the oven. Put ring gear (28) on the differential case half (18). Make sure the holes in the ring gear and the case (18) are aligned.
- (22) Let the ring gear cool. When cooled, install capscrews, lockwashers, and nuts to fasten ring gear to the case half (18).
- (23) Put differential case halves (18) in a press and install bearings (21 and 22) on each case half.



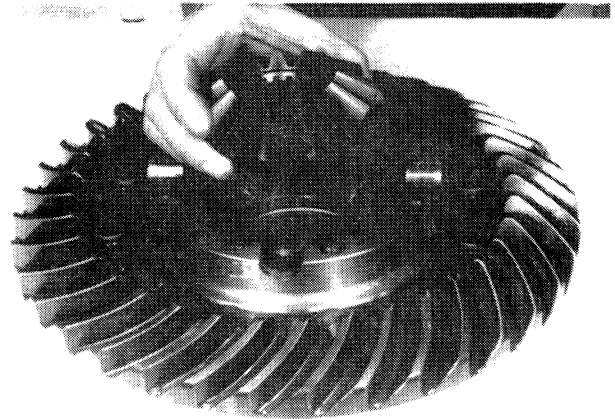
NOTE

For front axle, go to step (24) below to install spider gear parts. For rear axle, install no spin differential assembly (33) and go to step (28) below.

- (24) Lubricate case (18), thrust washers (23 and 25), spider (27), pinion gears (26), and side gears (24) with clean gear oil. Install thrust washer (23) in case (18).

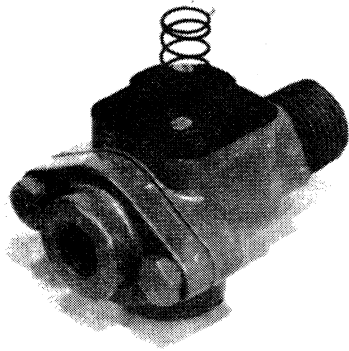


- (25) Install side gear (24) in case (18).



- (26) Assemble spider (27), pinion gears (26), and thrust washers (23 and 25). Install this assembly in differential case half (18).

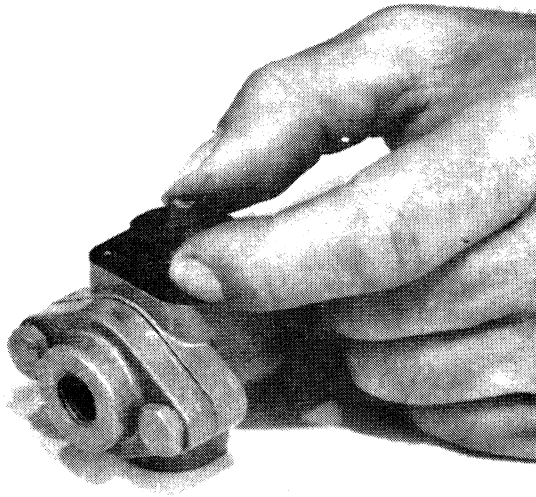
(3) Remove spring (10).



(6) Remove gasket (9) from the body of valve.



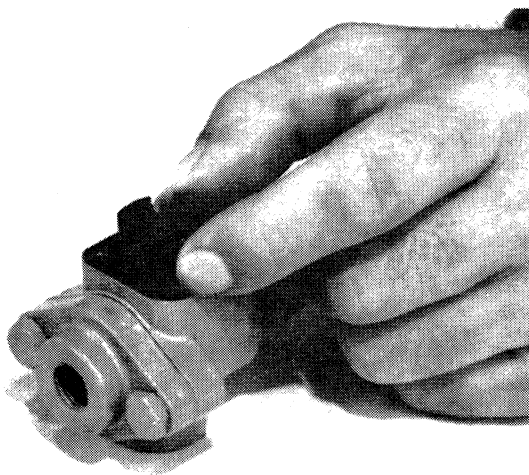
(4) Remove contact strip (11).



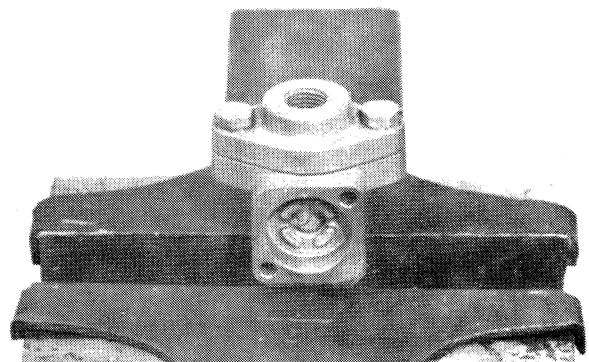
(7) Remove diaphragm (13) from valve.



(5) Remove piston (12).

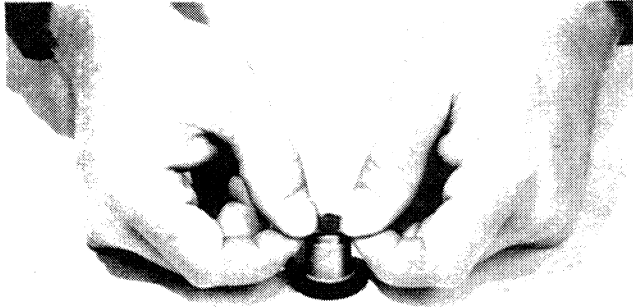


(8) Install the valve assembly in a vise with soft jaws.

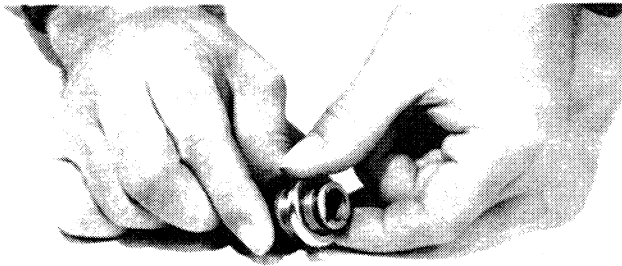


d. Assembly (figure 5-77).

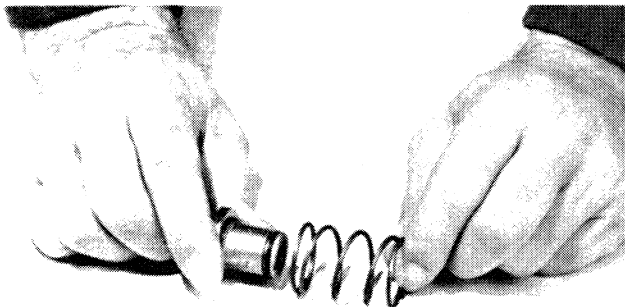
- (1) Use liquid silicone lubricant (47, table 5-1) to lubricate the preformed packings, the piston, and the valve bores.
- (2) Install preformed packing (30) in the groove on inlet/exhaust valve (27).



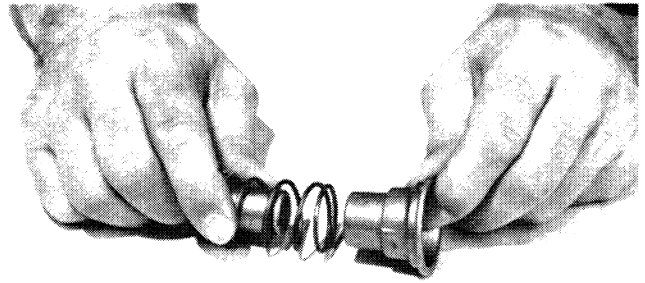
- (3) Install retainer (29) on the valve so that the lip of the retainer is toward the rubber end of the valve.



- (4) Install spring (28) on the valve.



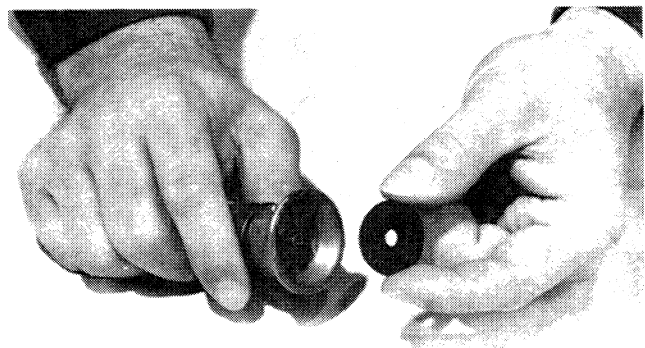
- (5) Install check valve seat (32) in the spring.



- (6) Carefully push the valve and the seat together so that the end of the valve goes into the seat. Install the preload spring (33) into the seat and the valve so that the hook in the side of the preload spring makes contact with the shoulder inside the valve. The eye of the preload spring must be over the screw hole in the bottom of the check valve seat. The preload spring (33) must hold the valve and the check valve seat together.



- (7) Install diaphragm (34) over the screw hole in the bottom of preload spring (33).



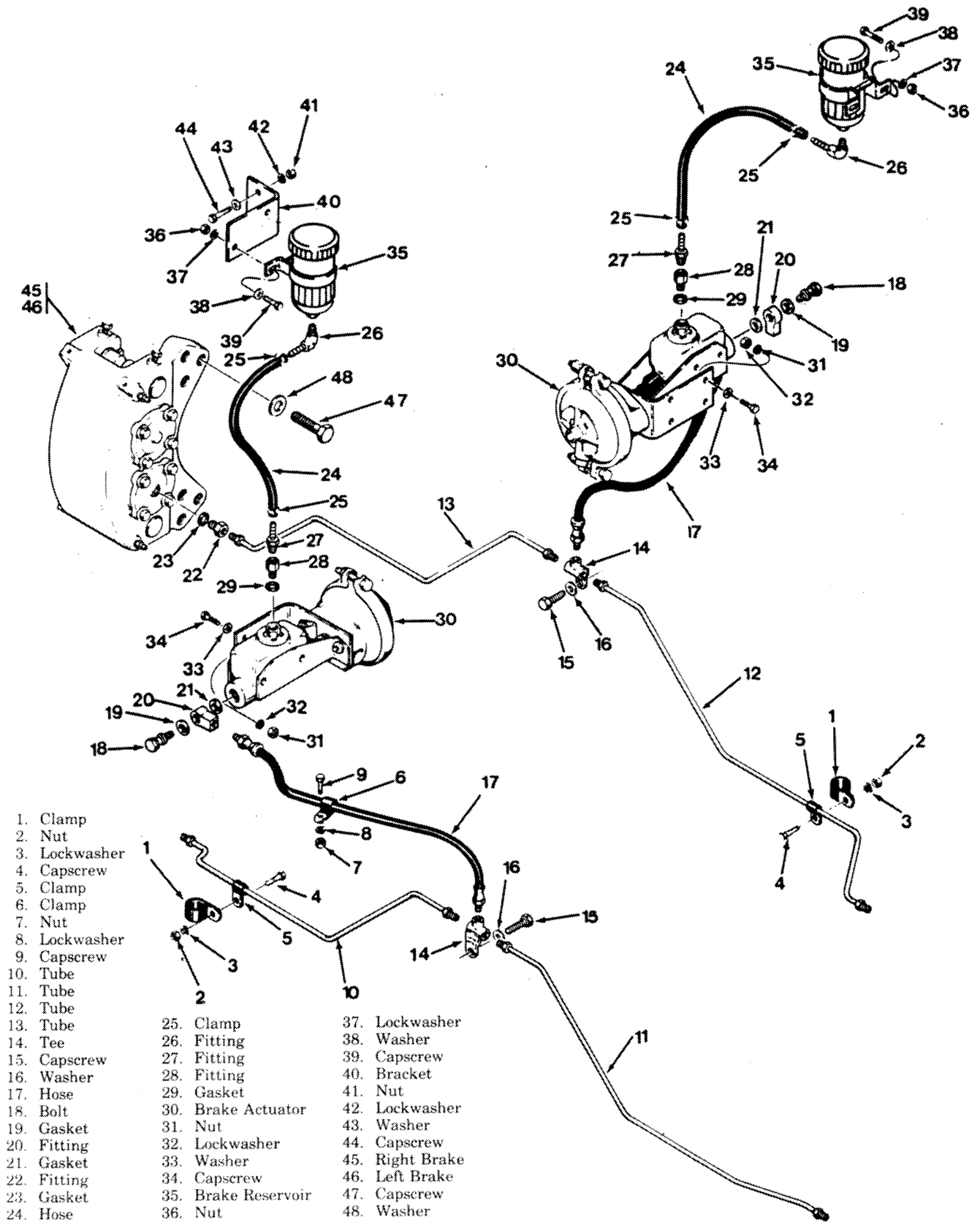


Figure 5-79. Brake Actuator to Wheel Cylinders Group

- (5) Install cap (2) into the valve body. Install button (9) and cotter pin (8).

e. Installation (figure 5-83).

- (1) Install the horn valve to the floor plate, and secure with screw (13), lockwasher (12) and nut (11).
- (2) Connect tube (3) and elbow (6).
- (3) Start the engine and pressurize the air system.

5-142. PRESSURE PROTECTION VALVE ASSEMBLY.

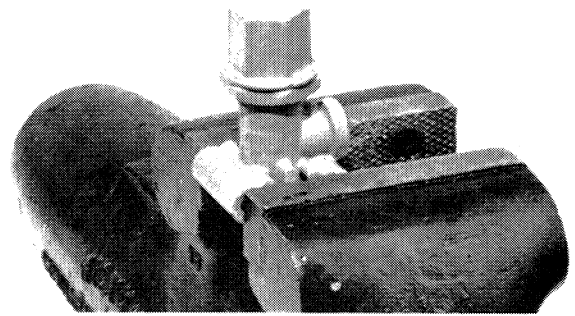
a. Removal (figure 5-82).

- (1) Apply the parking brake and stop the engine.
- (2) Open the drain valve in the air reservoir.
- (3) Open the access door on the front chassis.
- (4) Remove all dirt and grease from the air lines, the fittings, and the pressure protection valve.
- (5) Close the air shutoff valve between the pressure protection valve and the relief valve.
- (6) Disconnect the air line from the fitting in the pressure protection valve.
- (7) Remove the hardware that fastens the pressure protection valve and the pressure regulator valve to the mounting bracket.
- (8) Disconnect the pressure protection valve from the pipe nipple.

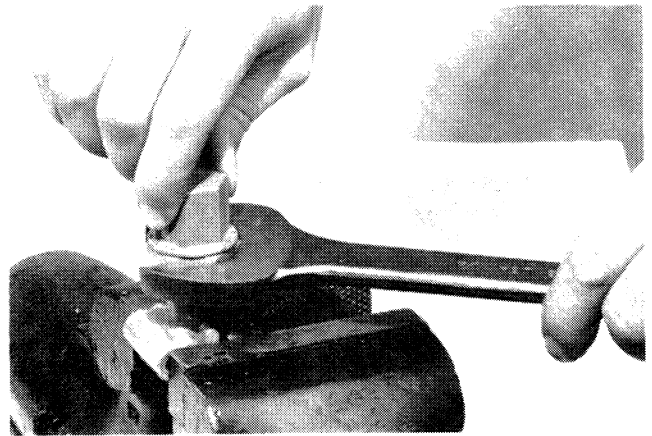
b. Disassembly (figure 5-84).

- (1) Put the pressure protection valve in a vise. Make match-marks on the cap and

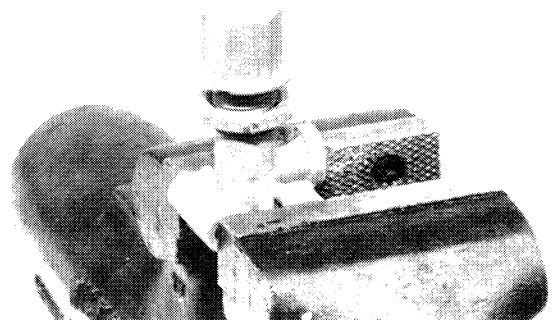
body to aid in alignment during assembly.



- (2) Loosen palnut (3) without turning cap (2).



- (3) Record the number of turns to remove cap, to aid installation during reassembly of valve.



f. Installation (figure 5-82).

- (1) Install horn body assembly into the truck.
- (2) Connect the inlet air line to the horn.
- (3) Close the air reservoir drain valve. Start the engine and fill the air system to test horn.

5-145. PARKING BRAKE LINKAGE.

a. Removal (figure 5-87).

- (1) Park machine on level surface, lower forks to the floor, and stop the engine.
- (2) Block the wheels and release the parking brake.
- (3) Remove the return spring (16) from the parking brake caliper (9) lever.
- (4) Remove cotter pin (19), clevis pin (18) and cable (11) clevis from caliper lever.
- (5) Remove hardware (3, 4, 5 and 8) securing clamps (7) and plates (20) at ends of cable (11).
- (6) Remove tie strap (10), capscrew (13), nut (14), lockwasher (15) and clamp (12).
- (7) Disconnect cable (11) from parking brake lever (1). Loosen nut securing clevis to cable, and remove nut and clevis.
- (8) Pull end of cable through grommet (17) and remove cable and grommet from machine.
- (9) Remove hardware (3, 4, 5 and 6) securing parking brake lever (1) to brackets (2). Note location of black wire lead and lockwasher (6) to aid installation.
- (10) Remove 20 ohm resistor from in-line fuseholder and lift parking brake lever (1) from brackets (2).
- (11) Remove parking brake switch from parking brake lever (1).
- (12) Remove hardware (3, 4, 5 and 6) and brackets (2) from machine.

NOTE

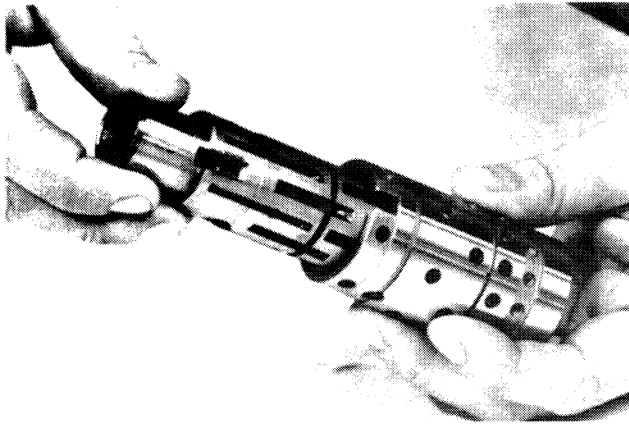
Replace a defective parking brake lever (1) as an assembly. The parking brake lever is not economically repairable.

b. Cleaning and Inspection. Refer to paragraphs 5-4 and 5-5 for general cleaning and inspection procedures.

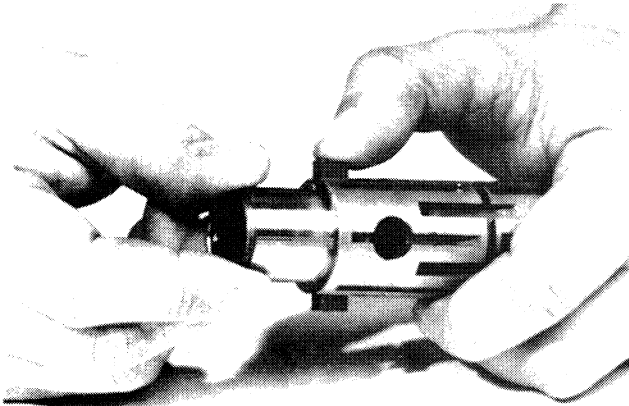
c. Installation.

- (1) Install brackets (2) using four capscrews (3), lockwashers (5), nuts (4) and one lockwasher (6).
- (2) Install parking brake switch on parking brake lever (1).
- (3) Position parking brake lever (1) on brackets (2).
- (4) Install black wire lead and lockwasher (6) at location noted during removal, then secure parking brake lever (1) to brackets (2) using hardware (3, 4 and 5).
- (5) Install the 20 ohm resistor in the in-line fuseholder.
- (6) Install grommet (17) and guide end of cable (11) through grommet.
- (7) Route cable from grommet (17) to parking brake caliper (9).
- (8) Secure each end of cable (11) using clamp (7), plate (20) and hardware (3, 4, 5 and 8).
- (9) Install tie strap (10), clamp (12), capscrew (13), lockwasher (15) and nut (14).
- (10) Loosen setscrew on parking brake lever (1) handle. Turn handle out fully.
- (11) Install clevis and nut on end of cable (11). Adjust cable clevis so that the pin will slip freely through the connected clevis.
- (12) Connect cable (11) clevis to parking brake lever (1).
- (13) Connect cable (11) clevis to parking brake caliper (9) lever using clevis pin (18) and cotter pin (19).

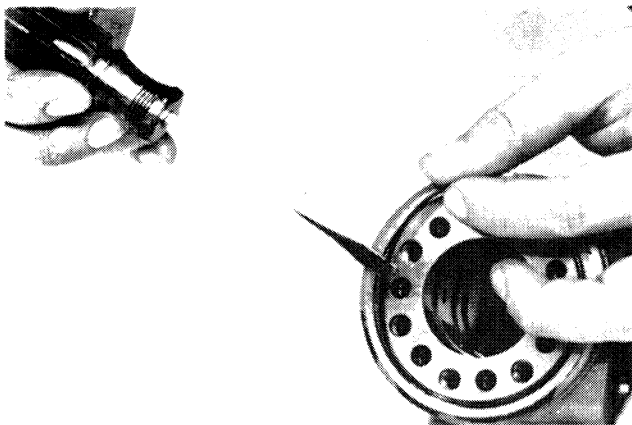
(15) Pull the spool straight out of the sleeve. Turn the spool in both directions while pulling it from the sleeve.



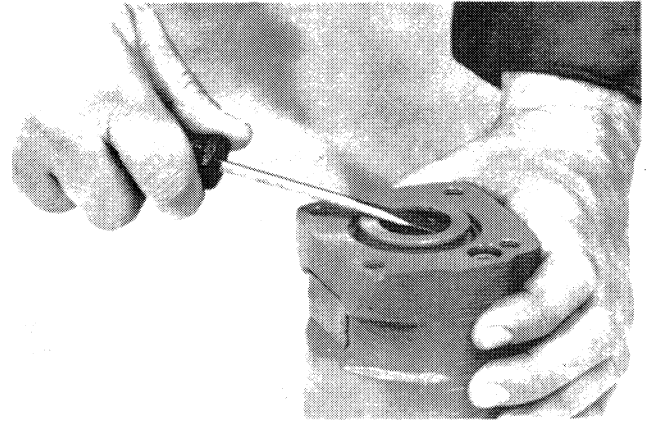
(16) Push centering springs (27) out of the spool. Keep the six centering springs together.



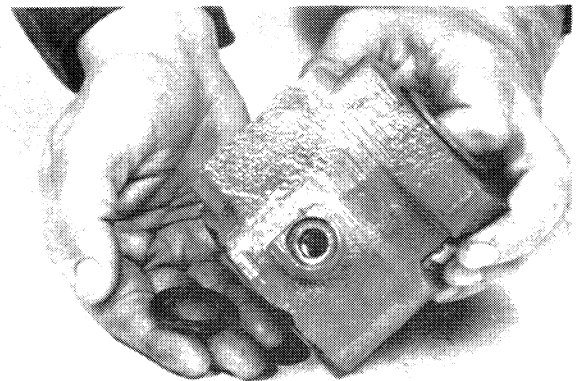
(17) Remove and discard preformed packing (8) from the body.



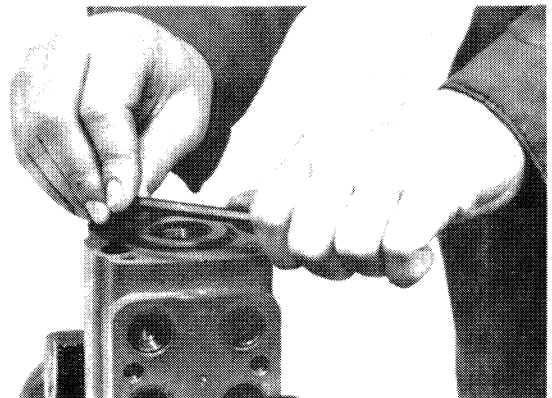
(18) The gland (6) in the body of the steering control valve is difficult to remove. If there was no leakage around the gland, do not remove it. Use a screwdriver to remove seal (5) from the gland.



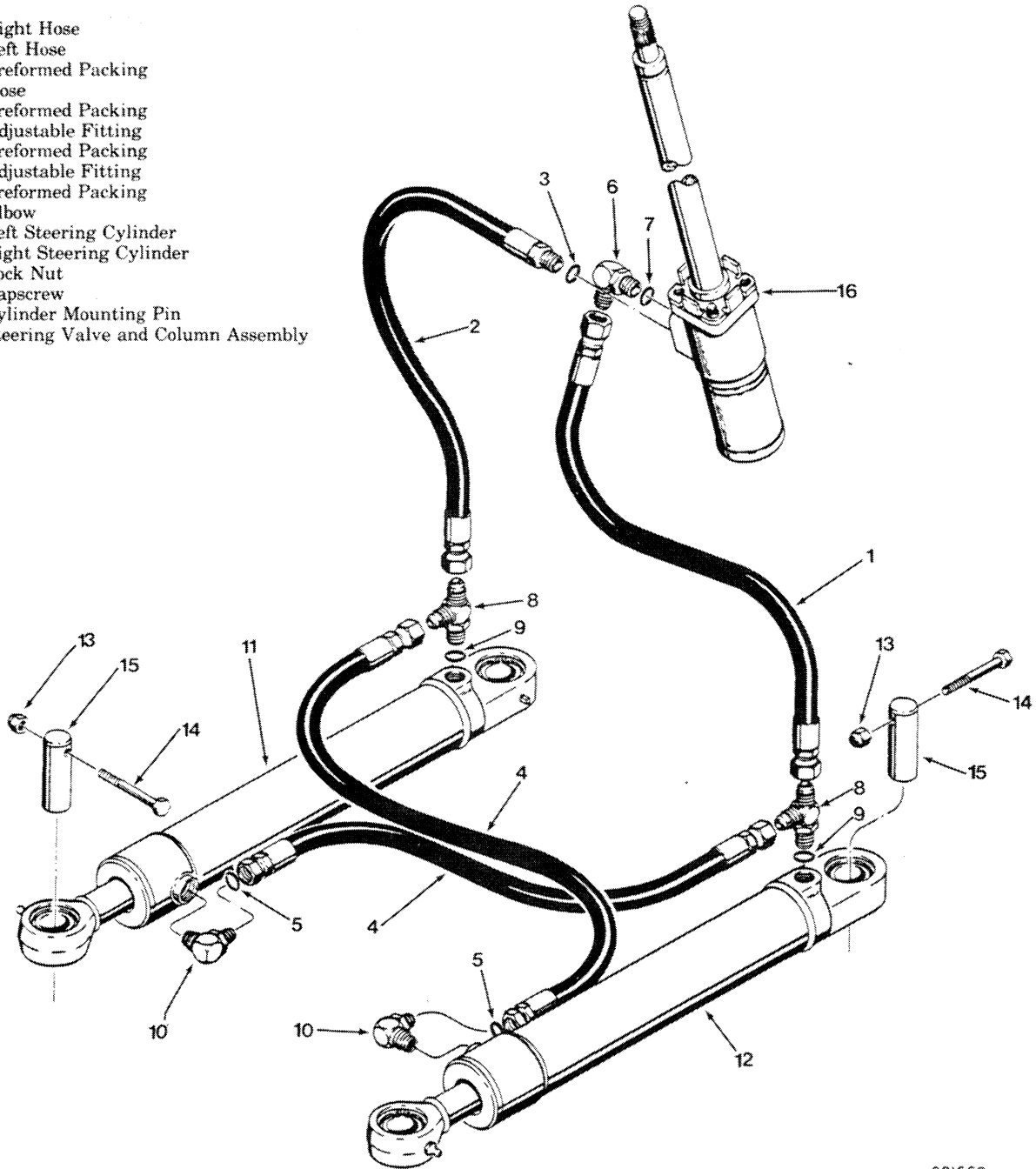
(19) Push the quad ring (7) out of the bottom of the gland with your finger.



(20) Remove the socket head plug (9) from the body of the steering control valve.



1. Right Hose
2. Left Hose
3. Preformed Packing
4. Hose
5. Preformed Packing
6. Adjustable Fitting
7. Preformed Packing
8. Adjustable Fitting
9. Preformed Packing
10. Elbow
11. Left Steering Cylinder
12. Right Steering Cylinder
13. Lock Nut
14. Capscrew
15. Cylinder Mounting Pin
16. Steering Valve and Column Assembly



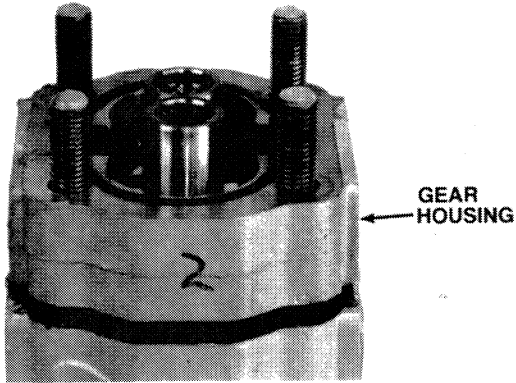
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Figure 5-91. Steering Control Valve to Cylinders Group

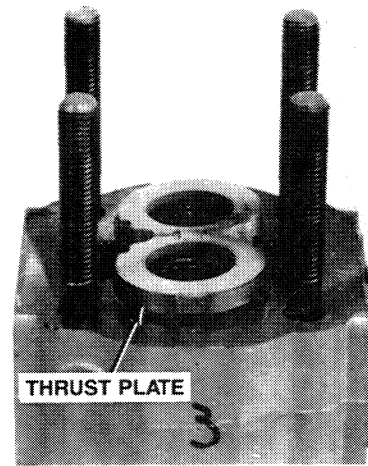
b. Disassembly. Refer to paragraph 5-149 for disassembly of steering control valve and column assembly, figure 5-90. Refer to paragraph 5-151 for disassembly of steering cylinders, figure 5-92.

c. Cleaning and Inspection. Refer to paragraphs 5-4 and 5-5 for general cleaning and inspection procedures. Refer to the appropriate paragraphs referenced for specific inspection procedures.

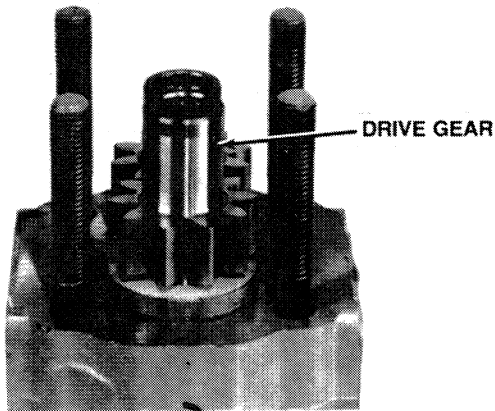
(9) Remove gear housing (11).



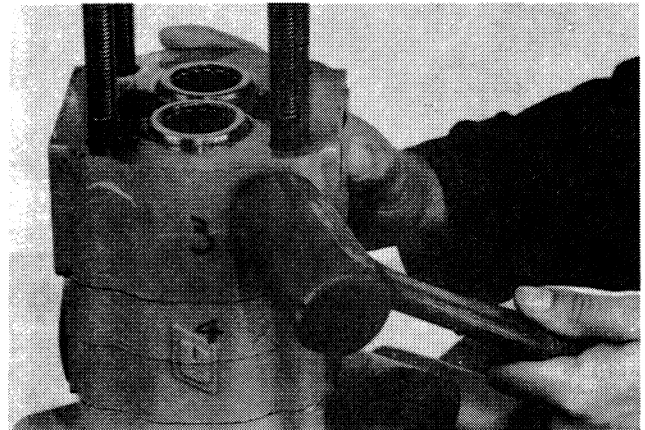
(12) Remove thrust plate (9) from bearing plate (13).



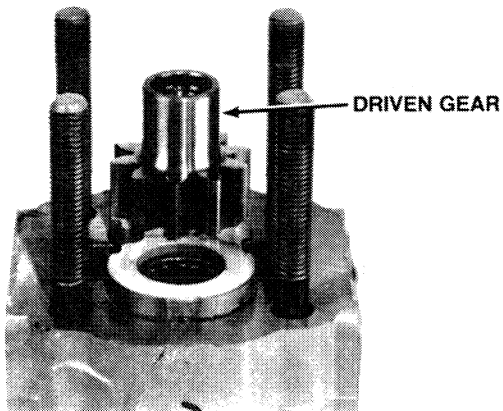
(10) Remove drive gear (12).



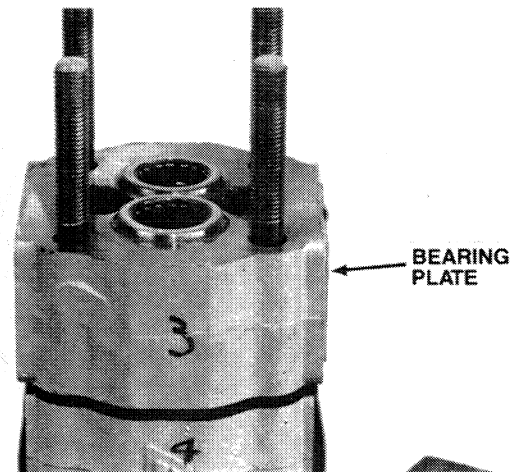
(13) Hit the bearing plate with a soft hammer to loosen it from the gear housing.



(11) Remove driven gear (12).



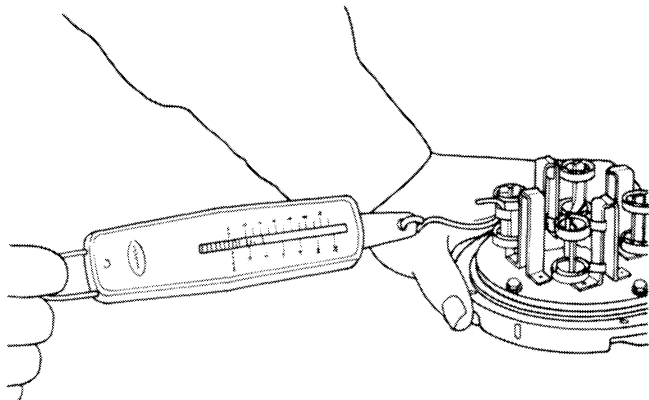
(14) Remove bearing plate (13).



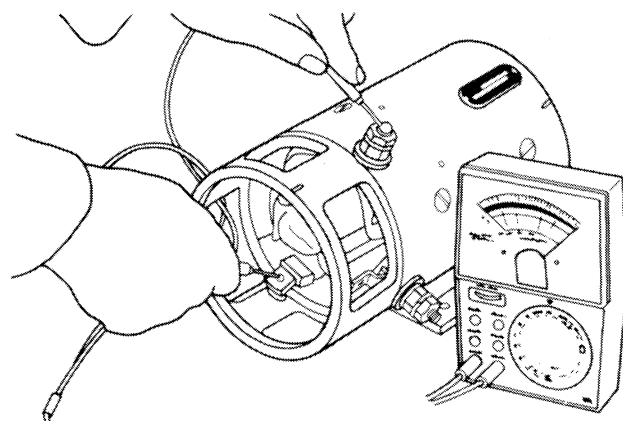
- (4) Connect the suction tube (22) and flange (21) to the hydraulic pump using capscrews (23) and lockwashers (24). Tighten clamps (14) on hose (13).
 - (5) Check preformed packing (25, figure 5-93) in the manifold fitting (24). Install manifold fitting on hydraulic pump using capscrews (30) and lockwashers (29), and connect tube (23) to manifold fitting.
 - (6) Connect hose (19) to suction tube.
 - (7) Connect hose (16, figure 5-93A) to suction tube and tighten clamp (17).
 - (8) Check preformed packing (22, figure 5-97) in the outlet tube (19). Connect tube (19) to hydraulic pump using capscrews (20) and lockwashers (21). Install clamp (8) to fasten the outlet tubes together. Install capscrew (11), lockwasher (10), and nut (9) to fasten the clamp in position.
 - (9) If a vacuum pump was used to keep the oil in the hydraulic reservoir, disconnect the vacuum pump.
 - (10) If oil was removed from the hydraulic reservoir, do the following steps:
 - (a) Install the drain plug in the hydraulic reservoir.
 - (b) Install 17 U.S. gallons of oil in the hydraulic reservoir.
 - (11) Install the fill cap on the hydraulic reservoir.
 - (12) Start and run the engine at low idle.
 - (13) Run the engine at low idle while the buzzer is sounding. When buzzer stops, run the engine at 1500 rpm.
 - (14) Turn the steering wheel all the way left and then all the way right to remove any air from the steering system.
 - (15) Move the fork control levers to operate all the cylinders in both directions several times to remove any air from the hydraulic system.
 - (16) Stop the engine and check for leaks.
 - (17) Check the oil level in the hydraulic reservoir.
- g. Testing.** Refer to paragraphs 8-14 and 8-15 for hydraulic pump tests and troubleshooting. These two flowmeter tests give pump efficiency readings and pressure indications.
- 5-154A. AUXILIARY STEERING GROUP.** The auxiliary steering group consists of the pump and motor assembly, oil cooler and filter, flow switch, relay assembly, hoses, various fittings and elbows and attaching hardware.
- a. Removal.** Refer to paragraph 5-154B, figures 5-93, 5-93A and 5-93B for parts detail to aid in removal.
- b. Disassembly.** Refer to paragraph 5-154C, figure 5-93C for disassembly of auxiliary steering pump. Refer to paragraph 5-154D, figures 5-93C and 5-93D for disassembly of auxiliary steering motor.
- c. Cleaning and Inspection.** Refer to paragraphs 5-4 and 5-5 for general cleaning and inspection procedures. Refer to the appropriate paragraphs referenced for specific inspection procedures.
- d. Repair and Replacement.** Replace parts found defective following specific repair procedures.
- e. Assembly.** Refer to paragraph 5-154C, figure 5-93C for assembly of auxiliary steering pump and to paragraph 5-154D, figures 5-93C and 5-93D for assembly of auxiliary steering motor.
- f. Installation.** Refer to paragraph 5-154B, figures 5-93, 5-93A and 5-93B for installation procedures.
- g. Testing.** Refer to paragraph 8-19 for auxiliary steering motor and pump testing procedure.
- 5-154B. AUXILIARY STEERING PUMP AND MOTOR AND RELATED PARTS.**
- a. Removal (figure 5-93).**
- (1) Park the truck on a level surface.
 - (2) Turn the truck to the right to make removal easier.

b. Cleaning and Inspection.

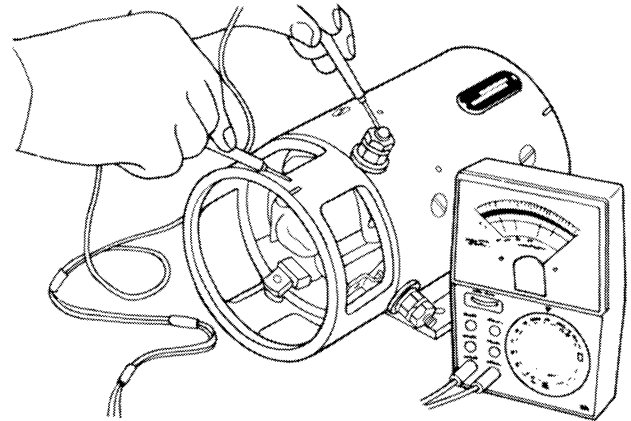
- (1) Refer to paragraph 5-4 and 5-5 for general cleaning and inspection procedures.
- (2) Clean the exterior of the housing using a clean cloth moistened with cleaning solvent. Dry with a clean cloth.
- (3) Clean armature, brush set and field coil by wiping with a clean, lint free cloth. Don't use cleaning solvent to clean these parts.
- (4) Measure length of brushes. Replace brush set if any brush is less than 3/8 inch long.
- (5) Connect an indicating dial scale to brush spring as shown. Pull the scale and record scale indication. Repeat for remaining seven brush springs. Replace all brush springs if scale indication for any one brush spring is not 3-1/4 to 4 pounds.



- (6) Connect a multimeter to terminal stud as shown. Replace field coil and housing if the multimeter does not indicate continuity.



- (7) Connect a multimeter between terminal stud and housing as shown. If the multimeter pointer moves, there is a short circuit between the housing and field coil. Replace terminal assembly (24 through 32).

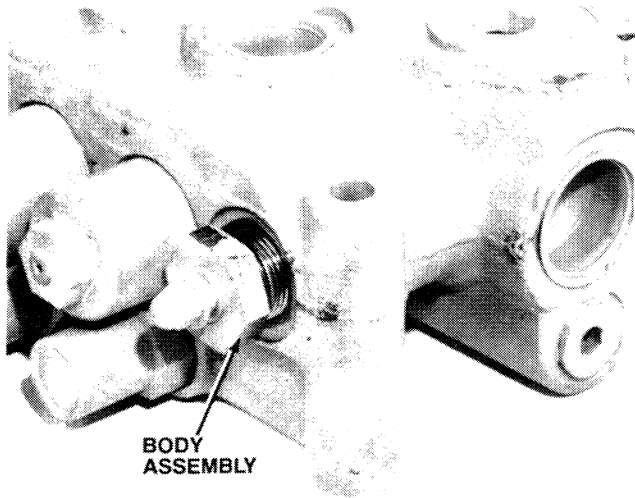


- (8) Connect a multimeter between the two terminal studs. If the multimeter pointer moves, there is a short circuit between the ground terminal stud and field coil (33). Replace ground terminal assembly (24 through 32).
- (9) Check that bearings (3 and 4) turn freely. If the bearings do not turn freely, replace.
- (10) Check fan for bent fins, distortion, cracks, or other damage. Replace if any of these conditions are seen.
- (11) Check brush plate (18) for damage to the brush and spring holders. Check for cracks, deformation, or other damage. Replace as necessary.
- (12) Place armature (7) in a growler as shown and turn power on.
- (13) Touch one test probe to the armature core, other test probe to the commutator as shown. If the test lamp glows, the armature or commutator is grounded. Replace armature.

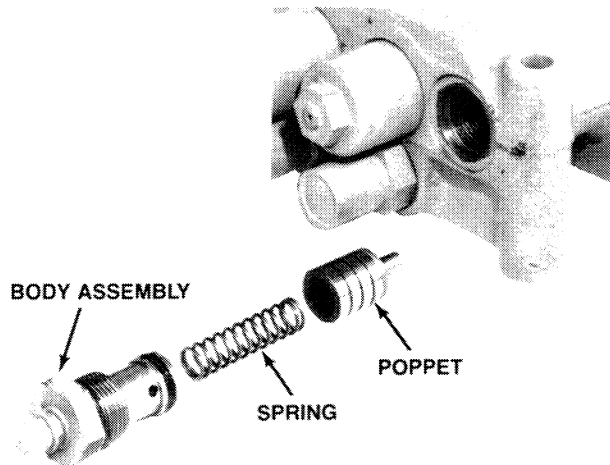
5-159. MAIN RELIEF VALVE.

a. Removal and Disassembly (figure 5-99).

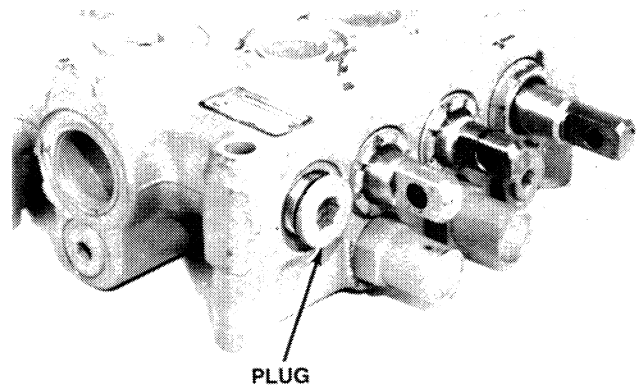
- (1) Loosen the body assembly of the main relief valve.



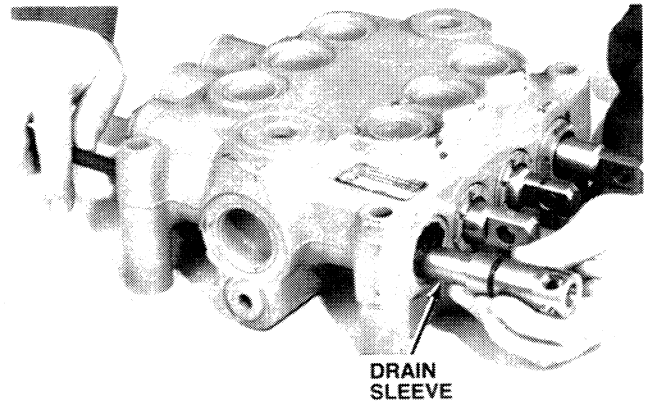
- (2) Remove body assembly (1), spring (13), and poppet (14) from the body of the hydraulic control valve.



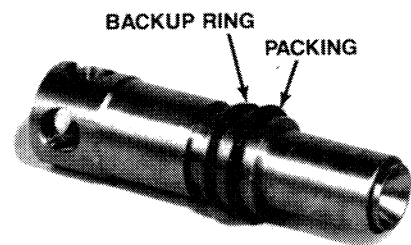
- (3) Loosen and remove plug (19).



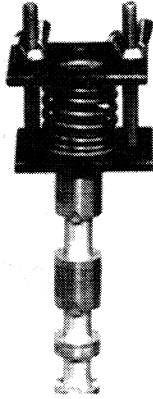
- (4) Use a rod to push drain sleeve (17) from the forklift control valve body.



- (5) Remove preformed packing (15) and backup ring (16) from the drain sleeve.

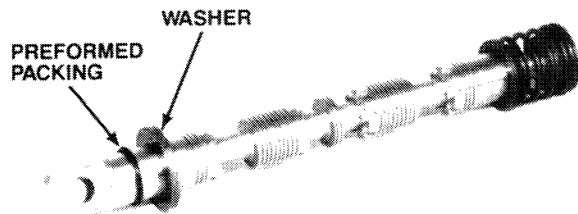


- (6) Tighten the nuts on the tool to compress the centering spring. Install snapping (3) to fasten the centering spring to the spool.

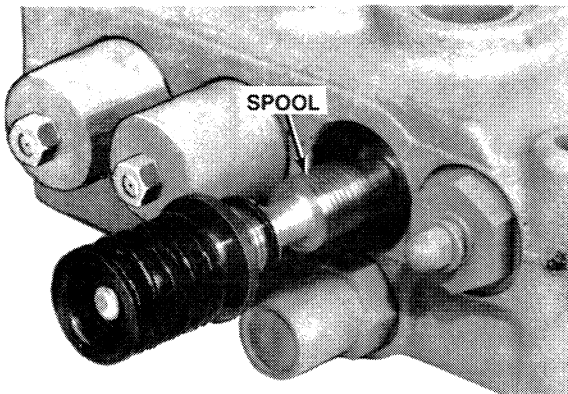


- (7) Remove the spool from the vise. Remove the tool from the spool.

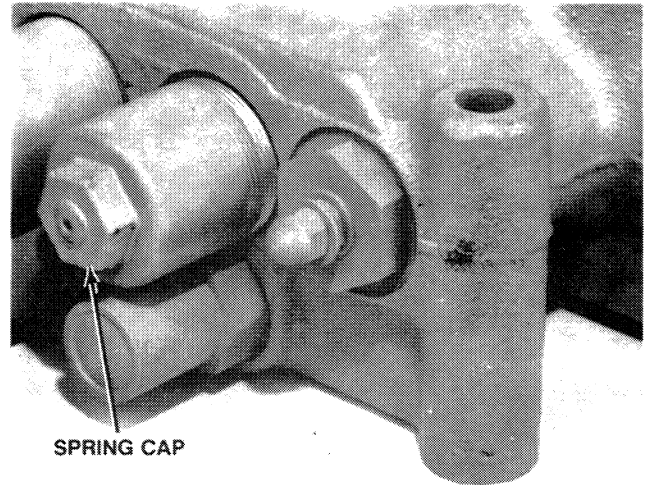
- (8) Install the washer and a new preformed packing on the spool.



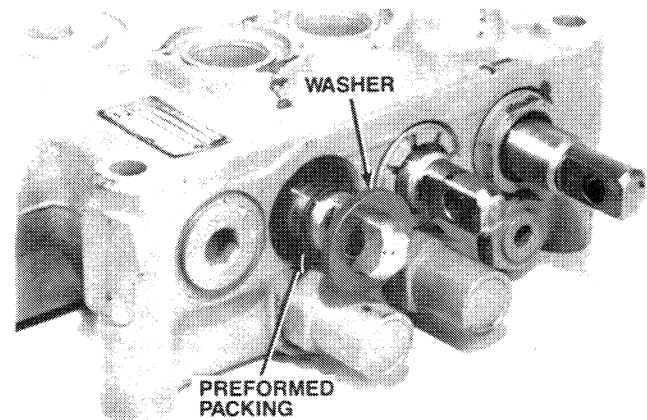
- (9) Put clean oil on the spool. Install the spool in the body.



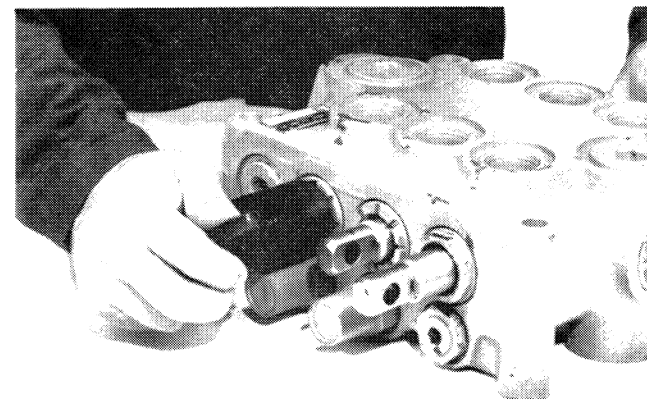
- (10) Install spring cap (2) in the body.



- (11) Install a new preformed packing (10) and washer (11) on the spool.



- (12) Install gland (9).



5-167. FUEL TANK AND RELATED PARTS.

a. Removal and Disassembly (figure 5-106).

- (1) If it is ever necessary to remove fuel tank (20), remove related parts and recoverable parts from tank. Loosen and remove plug (24) and drain water condensed in tank.
- (2) Remove hose (2) and fitting (15) from fuel return tube (16).
- (3) Remove fuel intake tube (4) and fitting (5) from fuel tank.
- (4) Remove capscrews (33) and lockwashers (34). Remove plate assembly (32) and gasket (36). Remove fuel tank sending unit (27) and gasket (31) with plate assembly.
- (5) Loosen and remove capscrews (21), lockwashers (22), and flat washers (23) from fuel tank. Use a hoist or proper lifting equipment to remove fuel tank from truck.

b. Cleaning and Inspection.

- (1) Inspect fuel tank for leaks, damage or worn welds. Clean or replace strainer (26) and clean fuel tank if necessary.
- (2) Inspect hoses and tubes for cracks, leaks or damage. Inspect fittings and connections for good fit.
- (3) Test fuel tank sender. Replace if damaged or defective.
- (4) Use new gasket when reassembling. Scrape off any gasket residue from mounting surfaces.

c. Repair and Replacement. Replace any parts found defective following inspection procedures.

d. Assembly and Installation. Reassemble fuel tank in reverse of removal and disassembly steps. First install tank into truck if removed for any reason.

5-168. ACCELERATOR AND LINKAGE GROUP.

a. Removal and Disassembly (figure 5-107).

- (1) Disconnect ball joint (24) for accelerator linkage (31) from the throttle lever at the fuel injection pump.
- (2) Disconnect ball joint (30) at the accelerator end. Remove other parts as necessary. The accelerator linkage system consists of cable mounting bracket (36) and pedal mounting block (32), fastened by capscrews (35) and nuts (33), the cable return bracket (37) and return spring (41), accelerator pad (44), pedal (45) and pivot pin (47).
- (3) Disassemble as far as necessary to effect repair. To adjust throttle linkage, follow step one and refer to cleaning and inspection.

b. Cleaning and Inspection.

- (1) Remove oil and grease from linkage, joints, cables and hardware. Inspect cables for wear or damage. Check cable clamps to make sure cables are positioned correctly.
- (2) To adjust the throttle linkage:
 - (a) Disconnect the ball joint from the fuel injection pump throttle lever.
 - (b) Check the engine speeds according to the procedures in paragraph 4-21. Adjust the engine speeds as necessary.
 - (c) Make sure that the accelerator is all the way up. Make sure that the throttle lever on the fuel injection pump is in the low idle position.
 - (d) Loosen the nut that fastens the ball joint in position on the end of the cable. Turn the ball joint as necessary to connect it to the throttle lever without moving the throttle lever. Connect ball joint to throttle lever.

SECTION VIII TESTING

8-1. GENERAL. Upon completion of overhaul of certain components of the truck, tests shall be made to determine the effectiveness of the repair. The test shall be made immediately prior to, or just after installation. The testing time depends upon the nature of the test and the component to be tested.

a. Unless otherwise specified in component testing procedures, all systems and system components should be tested for proper operation and compliance with specification requirements when installed. When any component has been removed and reinstalled for any reason, the component and the system of which it is a part should be checked. In general, after repair check pneumatic, hydraulic, and fuel system for leaks. Check that all vehicle lighting and electrical systems function as required. Check mobile operation of vehicle and vehicle material handling systems and components.

b. The following general information is applicable to reinstallation of components.

- (1) In general, when performing any overhaul procedure and tests, always park the truck on a level surface. Always apply the parking brake and turn off the engine. Install the safety link when working near large moving components of the truck, to prevent the possible movement of the truck frame.
- (2) Test procedure instructions in Section VIII do not cover obvious requirements such as shutting down engine before testing, parking truck in a well-ventilated and flat area, etc. Follow all applicable warnings and cautions included in this section and in the Safety Summary in Section I.
- (3) Make certain that lubrication is accomplished after overhaul and prior to operation of the truck. Refer to Section IV, figure 4-1, for lubrication requirements.
- (4) After testing and installation of hydraulic components, bleed air from related hydraulic system. Apply pressure and slightly open connection or bleed plug at component until fluid flow is free from air bubbles.

8-2. BATTERY TESTS.

a. General. Use the battery check sheet, table 8-1 during inspection of batteries. (If necessary, make extra copies for ease of reference.) Refer also to general specifications, table 8-2.

b. Visual Checks.

WARNING

Disconnect the ground cable first when the battery cables are disconnected from the battery.

Connect the ground cable last when the battery cables are connected to the battery.

Never use booster batteries to start the engine if the electrolyte in the battery on the machine is frozen.

Never cause sparks to occur or smoke near batteries that are charging or have been recently charged.

Never wear rings or metal watch bands that may ground a live circuit.

POISON/DANGER. Battery acid causes severe burns. Batteries contain sulfuric acid. Avoid contact with skin, eyes, or clothing. Antidote: **EXTERNAL** — Flush with water. **INTERNAL** — Drink large quantities of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Call physician immediately. **Eyes:** Flush with water for 15 minutes and get prompt medical attention.

Batteries produce explosive gases. Keep sparks, flame, and cigarettes away. Ventilate when charging or using in enclosed area. Always shield eyes when working near batteries.

- (1) Check for cracks or other damage in the battery case, the battery cover, and the battery posts. If you find damage, discard the battery.

- (2) See figure 8-5. Connect the positive voltmeter lead to the positive battery post of the right battery.
- (3) Connect the negative voltmeter lead to the negative battery post of the left battery.
- (4) Turn the IGN switch to the ON position.
- (5) Hold the START button in while you read the indication on the voltmeter. Write the indication on a sheet of paper.
- (6) If the indication on the voltmeter was 18 volts or more, no other testing is needed.
- (7) If the indication on the voltmeter was less than 18 volts, do Test step c, Test step f, and Test g as needed.
- (8) Turn the IGN switch to the Off position.

e. Voltage Loss in the Positive Battery Cable and the Starter Solenoid Together.

- (1) Select the voltmeter range that will measure 24 volts.

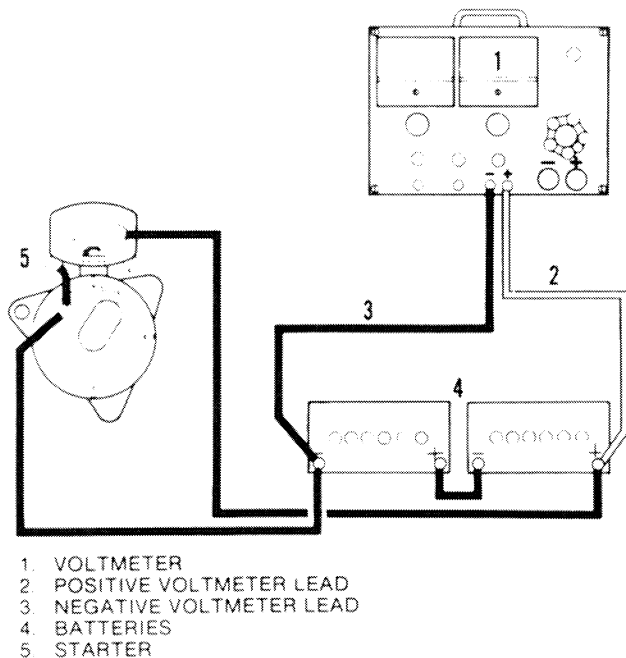


Figure 8-5. Test Connections for Complete Starting Circuit

- (2) See figure 8-6. Connect the negative voltmeter lead to the Motor terminal (A) on the starter solenoid.
- (3) Connect the positive voltmeter lead to the positive battery post of the right battery.
- (4) Pull out the fuel shutoff control until the fuel shutoff control stops moving.
- (5) Turn the IGN switch to the ON position.
- (6) Hold the START button in start position. Select the lowest range on the voltmeter. Continue to hold the START button while you read the indication on the voltmeter. Select the voltmeter range that will measure 24 volts. Turn the IGN switch to the Off position.
- (7) If the indication was 0.5 volt or less, do Test step f.
- (8) If the indication was more than 0.5 volt, do Test step g.

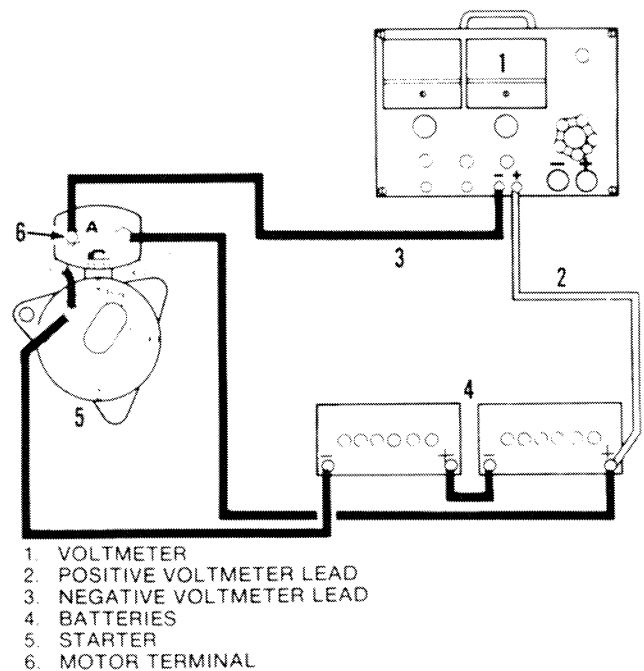


Figure 8-6. Test Connections for Positive Battery Cable with Starter Solenoid

(4) Connect the injector to the upper fitting when testing for leakage rates or pressure falls. Close the gauge valve. This will separate the gauge and nozzle from the test stand so that accurate measurements can be taken.

(5) The lower discharge fitting is used for normal tests on hydraulically operated nozzles. The upper discharge fitting is used for leakage rate measurements.

c. Injector Test Procedures.

(1) See figure 8-16. The injector must be cleaned before testing the injector. Wash the body, nozzle tip and the cap nut in cleaning solvent (1, table 5-1) to remove external dirt, grease and carbon deposits. Use an injector cleaning brush (table 2-1) to remove hard deposits from the cap, body or the outside diameter of the tip.

NOTE

Do not permit the wire brush to contact the tip (spray hole area) of the nozzle.

(2) See figure 8-17. Connect the injector to the test stand. The nozzle tip must be down. Use test pump adapters (table 2-1) and elbow.

WARNING

When testing or adjusting fuel injectors, do not place your hands or arms in front of the injector nozzle.

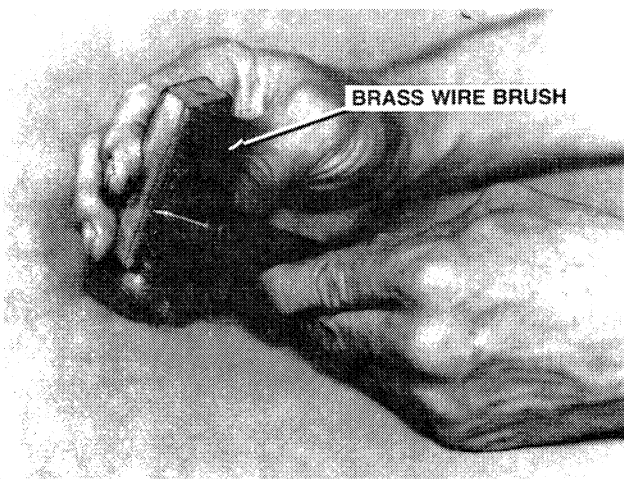


Figure 8-16. Cleaning Injector Tip

(3) Fuel from the spray orifices can enter clothing and skin, causing serious damage. The tip must always be put in a receptacle to hold the spray.

d. Checking Opening Pressure.

(1) Close the pressure gauge valve and flush the injector by operating the test pump rapidly. Open the gauge and raise the pressure slowly until the injector valve opens (the gauge reading will fall quick at this point). Check the opening pressure against the specifications.

NOTE

There must not be more than 100 psi difference between any of the injectors that have been removed from the engine.

(2) If the injectors do not meet the given opening pressures:

(a) New injectors can be adjusted to the given opening pressures. See paragraph 5-46.

(b) Injectors in use must be disassembled and cleaned. See paragraph 5-46.

(c) Check for broken or weak opening pressure control springs. See spring specifications in table 9-5.

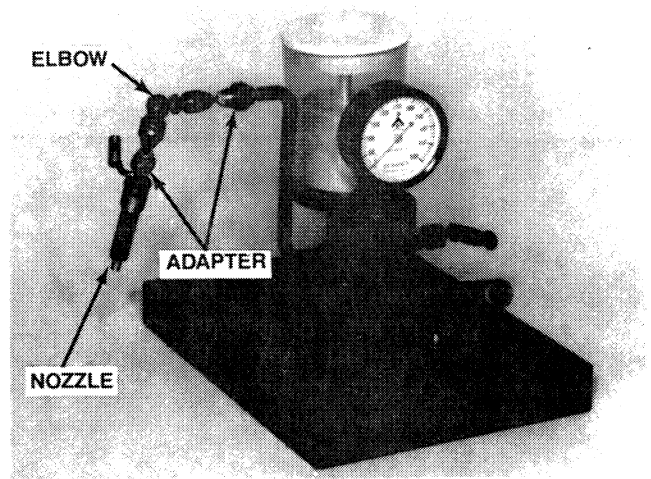


Figure 8-17. Injector Test Stand Connections

- (10) Connect a pressure gauge to the quick disconnect coupling as shown (43A and 43B, figure 5-93).
- (11) Install the cap in the hydraulic reservoir. Open the air shutoff valve at the hydraulic reservoir.
- (12) Start and run the engine at full throttle.
- (13) Turn the steering wheel to the right until the machine stops moving.
- (14) Continue to hold the steering wheel for a full right turn and look at the pressure gauge.
- (15) The pressure gauge must indicate 1800 to 2100 psi.
- (16) If the pressure setting is not correct, there is a problem in the flow control valve. See paragraph 5-153 and make repairs as necessary.

a. Bad Performance in a Single Circuit. This fault may be caused by worn cylinder packing, worn spool, worn spool bore or leakage through the load check valve. Perform these steps:

- (1) Check lift cylinder packing as follows:
 - (a) Move the lift arms control lever to the RAISE position.
 - (b) Hold control lever in RAISE position until the forklift frame stops moving.
 - (c) Stop the engine. Put a support under the frame to keep the carriage and frame in position.
 - (d) Disconnect the tube from the fitting at the rod end of each lift cylinder.
 - (e) Loosen the clamp that fastens the tubes to the lift cylinders. Move the tube away from the fitting in the rod end of each cylinder.
 - (f) Start and run the engine at full throttle. Hold the control lever in the RAISE position.
 - (g) Hold the control lever in position. Check for leakage from the fitting in the rod end of each lift cylinder.

8-13. HYDRAULIC CYLINDER TESTS.

NOTE

These procedures cover various problems which can occur in connection with the lift and tilt cylinder circuits and provide suggested corrective action. Refer to table 8-11, specifications.

Table 8-11. Hydraulic System Specifications

Pump output	
Equipment Section	48 U.S. gpm at 2200 rpm at 2150 psi
Steering Section	23 U.S. gpm at 2200 rpm at 2150 psi
Pressure settings of relief valves	
Main relief valve	2250 - 2350 psi at 2150 - 2250 rpm
Secondary relief valves	Hand Pump
Bucket A port	1450 - 1850 psi
Bucket B port	2550 - 2950 psi
Clam A and B ports	2550 - 2950 psi
The lift section has no secondary relief valves.	
Capacity and oil	
Hydraulic reservoir	17 U.S. gallons
Complete system	29 U.S. gallons
Hydraulic oil	MIL-L-46152, GR10 or Case TCH Fluid
Alternate oil	Engine oil SD service class D
	Above 32°F (0°C) SAE 10W
	Below 32°F (0°C) SAE 5W

NOTE: Do not mix TCH Fluid and engine oil.

- (2) If the flow indication for a circuit was lower than the flow indication at the same pressure in Test Number One, there is a leakage in that circuit. The leakage can be caused by a damaged cylinder packing or too much leakage inside the forklift control valve. See paragraph 8-12 and find the cause of the leakage.

8-17. FLOWMETER TEST NUMBER FOUR.

a. *Steering Circuit Leakage Test.*

- (1) Remove the plug from the tube connected to the front of the hydraulic pump. Remove the cap from the hose.
- (2) See figure 8-23 and connect the hose to the tube.
- (3) The inlet and outlet of the flowmeter are connected the same as for Test Number Two.
- (4) Refer to figure 8-21. Make sure that the pressure valve on the flowmeter is completely open.
- (5) Start and run the engine at 1000 rpm.
- (6) Look at the thermometer on the flowmeter. The oil temperature in the hydraulic system must be 130-150°F (54-66°C).
- (7) Increase the engine speed to full throttle.

WARNING

Personnel must keep clear of the pivot area to avoid injury during this test.

- (8) Turn the steering wheel to the right. Slowly close the pressure valve on the flowmeter.
- (9) After the truck halves stop turning, continue to hold the steering wheel for a full right turn.
- (10) Look at the flow gauge on the flowmeter and continue to close the pressure valve on the flowmeter.

- (11) The flow gauge indication will decrease slowly as the pressure valve is turned. When the steering relief valve starts to open, the flow gauge on the flowmeter will show a rapid decrease in volume. Stop turning the pressure valve and write the pressure gauge indication on the check sheet. This pressure is the pressure at which the steering relief valve starts to open.

- (12) Continue to close the pressure valve on the flowmeter.

- (13) When the flow gauge indication is zero or very near zero, write the pressure gauge indication on the check sheet. This pressure is the pressure at which the steering relief valve is completely open.

- (14) Open the pressure valve on the flowmeter.

- (15) If the pressure found in step (11) is not 1900-2100 psi, the steering relief valve is damaged. See paragraph 5-161. After the steering relief valve has been repaired or replaced, repeat steps (8) through (14).

- (16) If the pressure setting was correct, and the pressure at which the steering relief valve started to open was 1700 psi or lower, see paragraph 5-152 and make repairs as necessary.

- (17) Start and run the engine at 2000 rpm. Check to make sure that the temperature of the oil is not more than 150°F (66°C).

- (18) Close the pressure valve on the flowmeter until the pressure gauge indicates 1800 psi.

- (19) Turn the steering wheel all the way to the right. When the wheel stops turning, continue to hold the steering wheel for a full right turn.

- (20) Keep the engine running at 2000 rpm. Write the flow gauge indication on the check sheet. Open the pressure valve on the flowmeter until the pressure gauge indicates 1000 psi.

Table 9-2. General Torque Values for Transmission

THREAD SIZE	STANDARD HEAT-TREATED BOLTS AND SCREWS (FT-LBS)	SPECIAL HEAT-TREATED BOLTS, SCREWS, SOCKET HEAD SCREWS AND SELF-LOCKING CAPSCREWS (FT-LBS)	NUTS (FT-LBS)
1/4-20	9-11	9-11	
1/4-28	10-12	10-12	
5/16-18	13-16	17-20	14-18
5/16-24	14-18	19-23	
3/8-16	26-32	36-43	33-40
3/8-24	33-40	41-49	
7/16-14	42-50	54-65	
7/16-20	50-60	64-77	
1/2-13	67-80	81-97	
1/2-20	83-100	96-115	
5/8-11	117-140	164-192	134-160
5/8-18	134-160	193-225	

Table 9-3. General Torque Values for Hydraulic Fittings

DASH SIZE	TUBE OD HOSE ID	THREAD SIZE	37 DEGREE FLARE (FT-LBS)	STRAIGHT THREAD WITH PACKING (FT-LBS)
4	1/4 in.	7/16-20	6-12	12-19
5	5/16 in.	1/2-20	8-16	16-25
6	3/8 in.	9/16-18	10-25	25-40
8	1/2 in.	3/4-16	15-42	42-67
10	5/8 in.	7/8-14	25-58	58-92
12	3/4 in.	1-1/16-12	40-80	80-128
14	7/8 in.	1-3/16-12	60-100	100-160
16	1 in.	1-5/16-12	75-117	117-187
20	1-1/4 in.	1-5/8-12	125-165	165-264
24	1-1/2 in.	1-7/8-12	210-250	250-400

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