INTRODUCTION

GENERAL

This section has a description and the repair procedures for the alternator with a voltage regulator as part of the alternator.

⚠ CAUTION

When using an arc welder, always disconnect the ground lead from the lift truck battery to prevent alternator or battery damage. Attach the welding ground clamp as close to the weld area as possible to prevent welding current from damaging the bearings.

The diodes and resistors in the electrical system can be damaged if the following cautions are not followed:

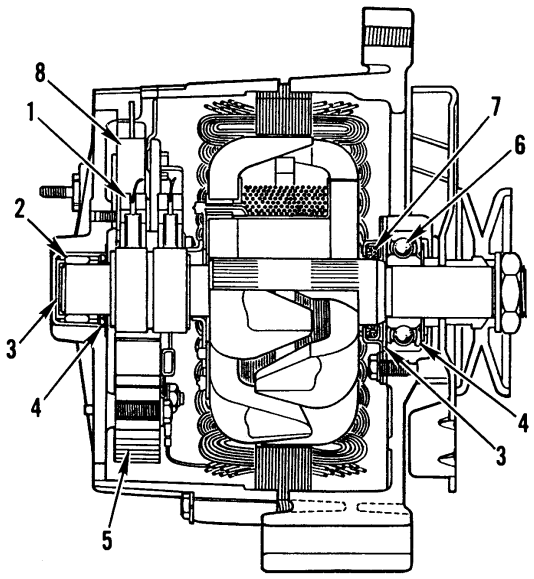
- **Do not disconnect the battery when the engine is running. The voltage surge can damage the diodes and resistors in the electrical system.**
- **Do not disconnect an electric wire before the engine is stopped and the switches are "OFF".**
- **Do not cause a short–circuit by connecting the electric wires to the wrong terminals. Make sure a correct identification is made of the wire before it is connected.**
- **Make sure a battery is the correct voltage and polarity before it is connected.**
- **Do not check for current flow by making a spark because the electronic components can be damaged.**

NOTE: Information on alternators manufactured outside the United States is in the SRM (service repair manual) sections for lift trucks that use those alternators.

DESCRIPTION (See FIGURE 1. and FIGURE 2.)

NOTE: For this SRM section, the alternators are in two groups, Type A and Type B. The two types are very similar, but the Type A alternators have a set of three diodes (diode set) as well as the diode bridge. The Type B alternator has zener diodes as part of the diodes in the diode bridge. This alternator does not have a diode set, but does have an additional fan inside the rear housing. The basic operation of both types is very similar.

The alternator generates an alternating current when the engine is running. The alternator is either **ON** or **OFF**. The alternator generates maximum current when it is **ON** and no current when it is **OFF**. The regulator switches the alternator between **ON** and **OFF** to get the average current needed to charge the battery. Alternator output is directly changed by engine speed and rotor field current. The alternating current is changed to a direct current by the diode bridge inside the alternator.



DELCO TYPE A SHOWN 7010

1. BRUSH ASSEMBLY
2. ROLLER BEARING
3. GREASE RESERVOIR
4. LIP SEAL
5. DIODE BRIDGE
6. BALL BEARINGS
7. FELT SEAL
8. REGULATOR

FIGURE 1. ALTERNATOR CROSS SECTION

The alternator has these parts:

A stator
A rotor
A diode bridge
A diode set (Type A only)
Two end housings or frame halves
A solid–state voltage regulator

The direct current from the diodes of the diode bridge flows to the output or "BAT" terminal. A capacitor between the "BAT" terminal and the electrical ground removes any remaining alternating current from the direct current. The capacitor also protects the diodes from high voltages. The voltage is controlled by the amount of

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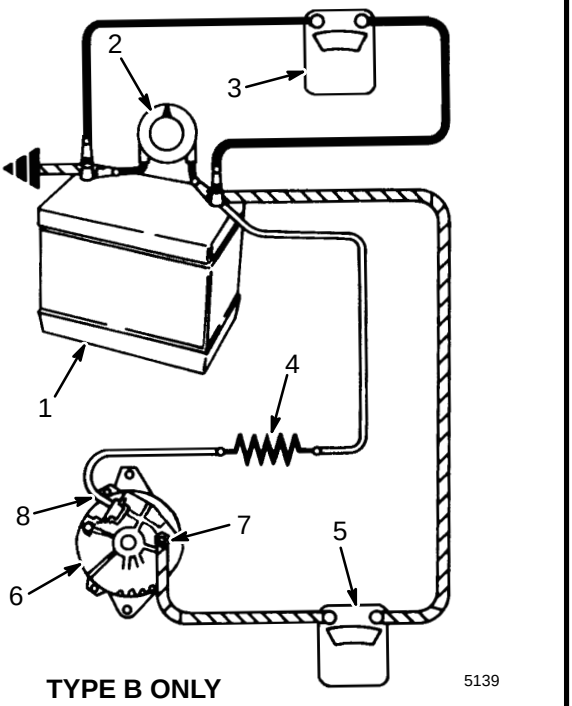
ammeter. The reading on the ammeter must be within 10% of the maximum value.



TYPE B ONLY

1. BATTERY
2. CARBON PILE
3. VOLTMETER
4. RESISTOR (35 ohm 5 watt to 500 ohm $^{1}/_{2}$ watt)
5. AMMETER
6. ALTERNATOR
7. "BAT" TERMINAL
8. CONNECT TO "L" TERMINAL

FIGURE 10. CHECK ALTERNATOR OUTPUT

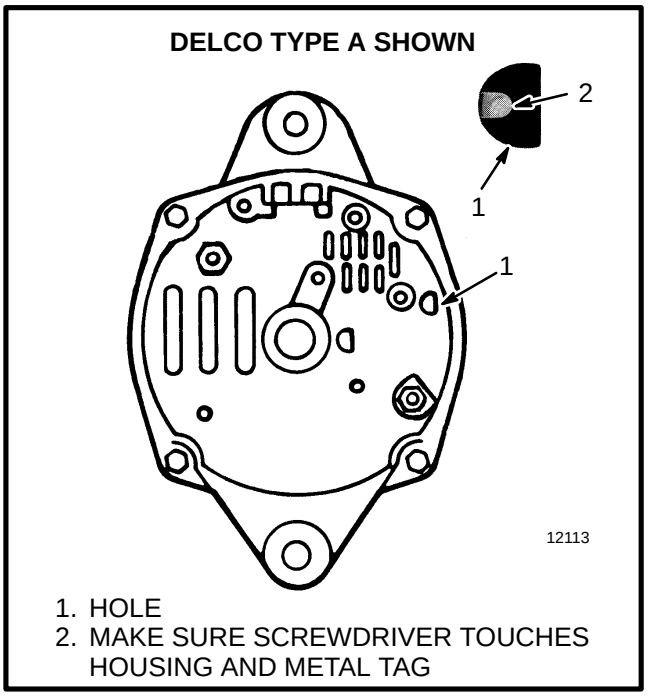
10. If the ammeter reading is within 10%, the alternator is in good condition. Check the starter or wires for problems. Some alternators on larger lift trucks have a voltage adjustment. See FIGURE 12. For alternators with the voltage adjustment do Step a to set the voltage:

a. The voltage setting can be increased by changing the position of the adjustment plug. "LO" is the lowest voltage setting. "2" is medium low and "3" is the medium setting. The voltage setting is highest when "HI" is aligned with the arrow on the alternator. Change the setting as necessary.

11. On Type A Delco alternators, do the following checks:

⚠ CAUTION

Do not push the screwdriver into the hole for more than 25 mm (1 in).



1. HOLE
2. MAKE SURE SCREWDRIVER TOUCHES HOUSING AND METAL TAG

FIGURE 11. ELECTRICAL GROUND ON THE FIELD WINDING

a. If the output shown is not within 10%, put a screwdriver into the hole shown in FIGURE 11.

b. Run the engine at 2000 to 2500 rpm. Adjust the carbon pile until the maximum charging rate is reached.

c. If the output is within 10%, check the field winding. If the field winding is in good condition, replace the voltage regulator.

d. If the output is not within 10%, check the wires to the brushes, diodes, diode bridge, field winding, and stator.

e. Remove the screwdriver, ammeter, and variable resistor.

CHECK THE ALTERNATOR FOR HIGH OUTPUT (Type A or Type B) (See FIGURE 9. or FIGURE 10.)

1. Connect a voltmeter from the regulator terminal to the electrical ground. Check the reading on the voltmeter.

2. If there are no readings, check for an open circuit between the regulator terminal and the battery.

3. If there is a reading, connect a voltmeter between the "BAT" terminal and the electrical ground.

CHECKS AND ADJUSTMENTS

BRAKE SHOES (See FIGURE 5.)

Put the lift truck on blocks so that the drive wheels do not touch the ground. Use a brake adjuster tool to adjust the brake shoes so that the brake drum will not rotate. Push the automatic adjuster lever away from the adjuster wheel with a small screwdriver. Use the brake adjuster tool to loosen the adjuster wheel 20 to 30 clicks.

Install the drive wheels. Remove the lift truck from the blocks. Operate the lift truck in the Forward and Reverse directions. Stop the lift truck 10 times in each direction.

⚠ CAUTION

If there is too much clearance, the automatic adjusters will not operate. If the clearance is too small, the automatic adjuster cannot turn the adjuster wheel to increase the clearance and the adjuster wheel will not turn until the brake shoes wear. If the adjuster wheel does not move for a long operating period, the adjuster link can wear a spot on the adjuster wheel so that it will not turn correctly.

The automatic adjuster lever (1) must be at the centerline or less than 3.0 mm (0.125 in.) above the adjuster screw wheel (2). The wrong adjustment of the lever (1) will cause too much brake pedal travel before the lever (1) can actuate the adjuster screw wheel (2). Bend the actuator link (3) as shown in FIGURE 5. so that the lever (1) is within the tolerance as shown.

NOTE: This adjustment must be made anytime new or different brake shoes are installed.

⚠ WARNING

The threads of the adjuster wheel are not the same for each side. If the adjuster assemblies are installed on the wrong side, the brake shoe clearance will increase each time the brakes are applied. The adjuster wheel for the right brake has left–hand threads. The adjuster wheel for the left brake has right–hand threads.

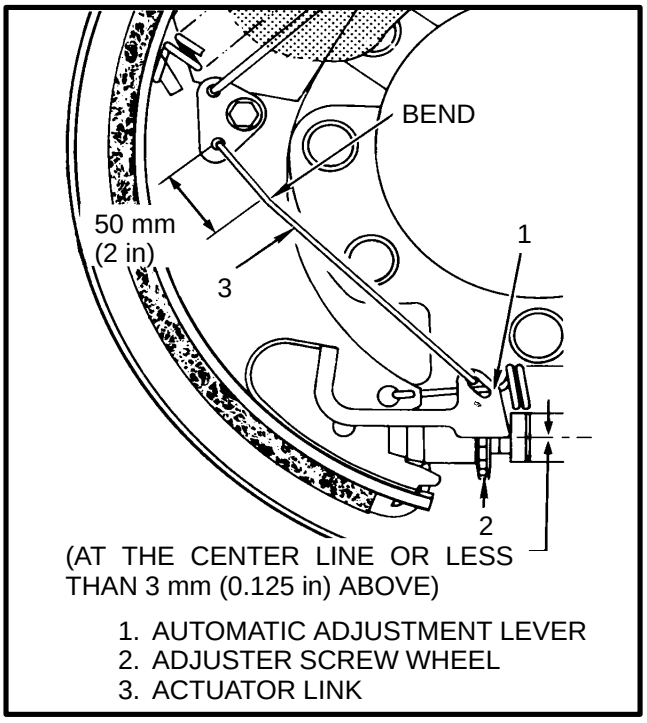


FIGURE 5. ADJUSTER LINK ADJUSTMENT

Parking Brake

Turn the knob on the hand lever to adjust the parking brake. See FIGURE 6. Adjust until a 89 N (20 lbs) pull is needed to apply the lever.

NOTE: Check the park brake after each brake job. The equalizer bar must be level when applying the park brake. If it is not level free up the sticking cable with lube.

Seat Actuated Park Brake J40–60AS (See FIGURE 7.)

1. Adjust bracket (3) so that the outer edge of the caliper pad is within 1.5 mm (0.060 in) of edge of disc. Adjust caliper (5) so that caliper is centered in its bracket.

2. Adjust bracket (8) so rod “B” is centered in the plate “E” when the brake is applied (power steering motor off).

3. Adjust “F” so that the spring height “X” is 83.5 to 86.5 mm (3.29 to 3.41 in) with the power steering motor running (brake released).

4. With power steering motor running, adjust “C” and “D” so that the parking brake caliper is in the release

⚠ CAUTION

Follow the manufacturer's instructions when using a chemical radiator cleaner.

4. If water does not clean the system, use a chemical radiator cleaner.

⚠ CAUTION

Follow the manufacturer's instructions when using special equipment to reverse clean the radiator.

5. If the radiator or cooling system is very dirty or has a restriction, use the reverse cleaning method. This method uses air pressure to force water through the radiator in the opposite direction of normal flow.

6. Check the radiator fins. Clean the exterior of the radiator with compressed air or water as needed.

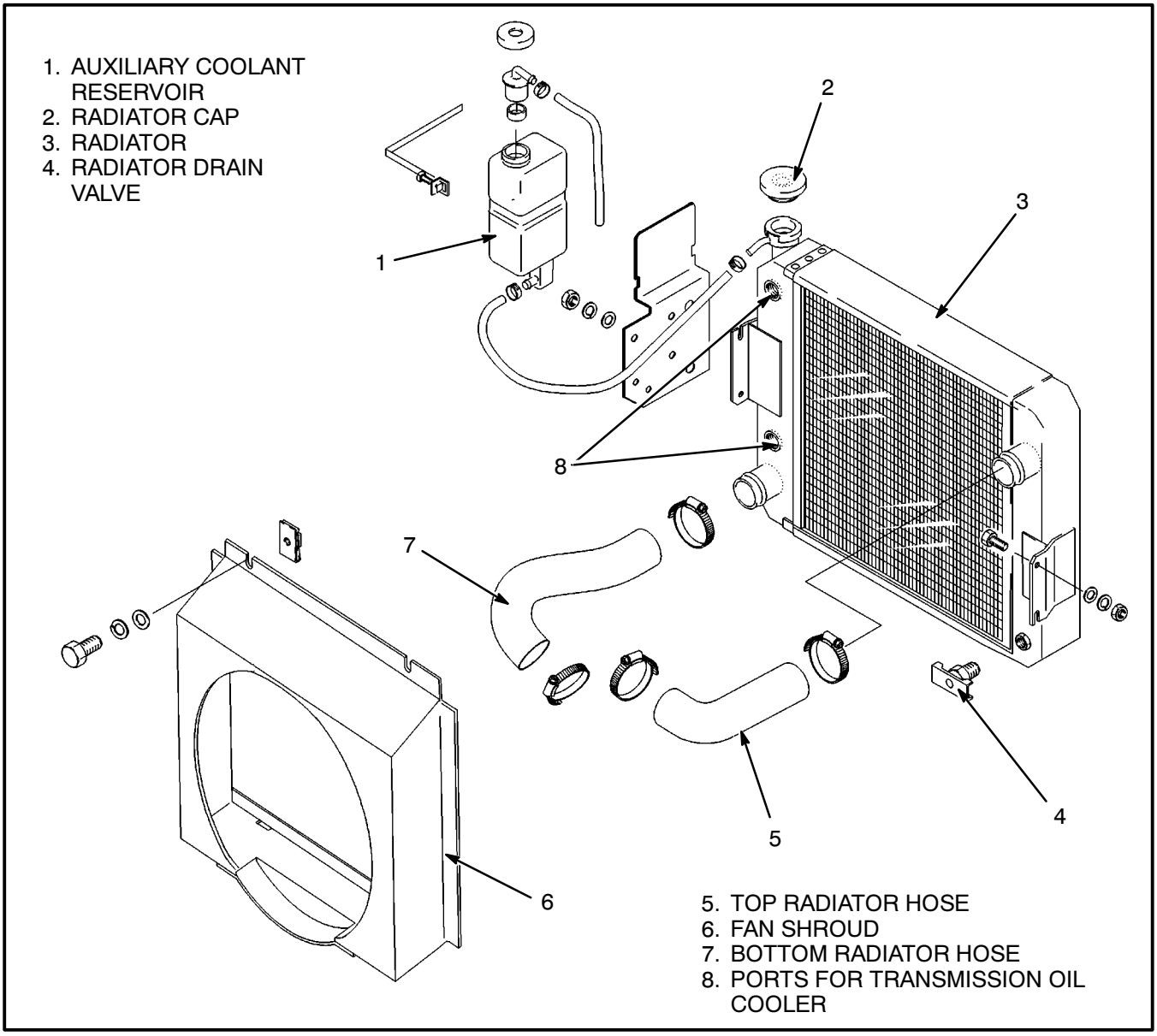


FIGURE 2. TYPICAL RADIATOR ARRANGEMENT

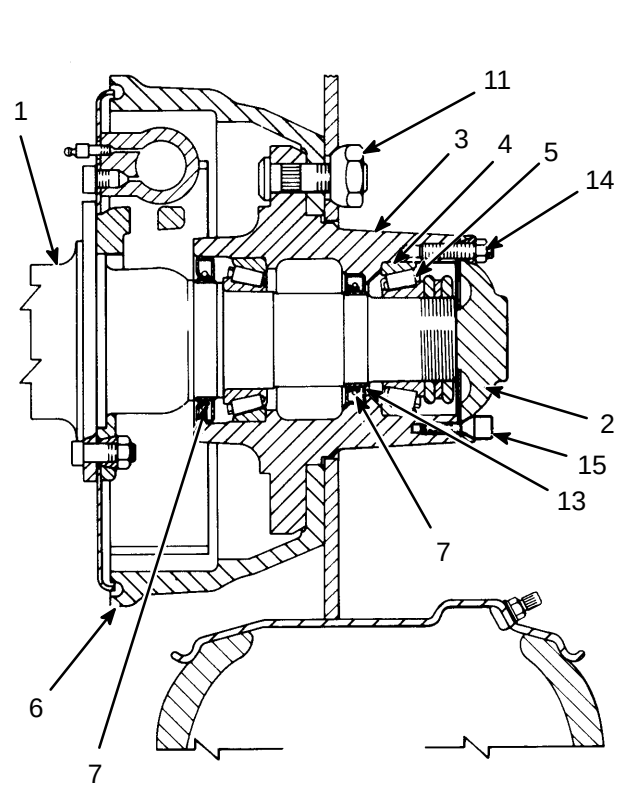
INTRODUCTION

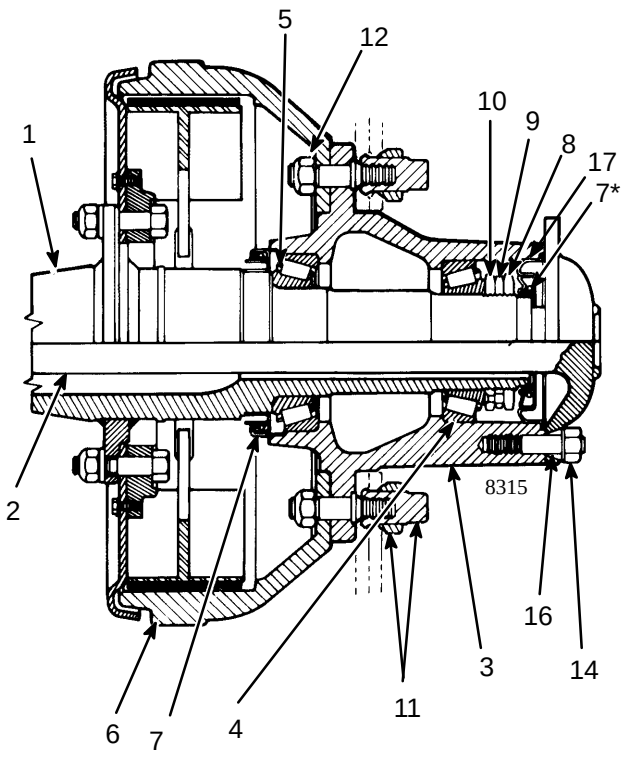
GENERAL

The size of the drive axles, hubs and wheels vary with each series of lift trucks. The disassembly, assembly and service procedures for this type of axle are similar and are described in this section.

DESCRIPTION (See Figure 1.)

The direct drive axle has a housing, two axle shafts and two hubs. The rotation of the differential turns the axle shafts and the hubs. The hubs rotate on tapered roller bearings. The brake drums and wheels are installed on the hub.





TYPE 1 USED ON: H30–60H, H40–60J, H60–80C, H60–110E, P40–50A, J40–60A

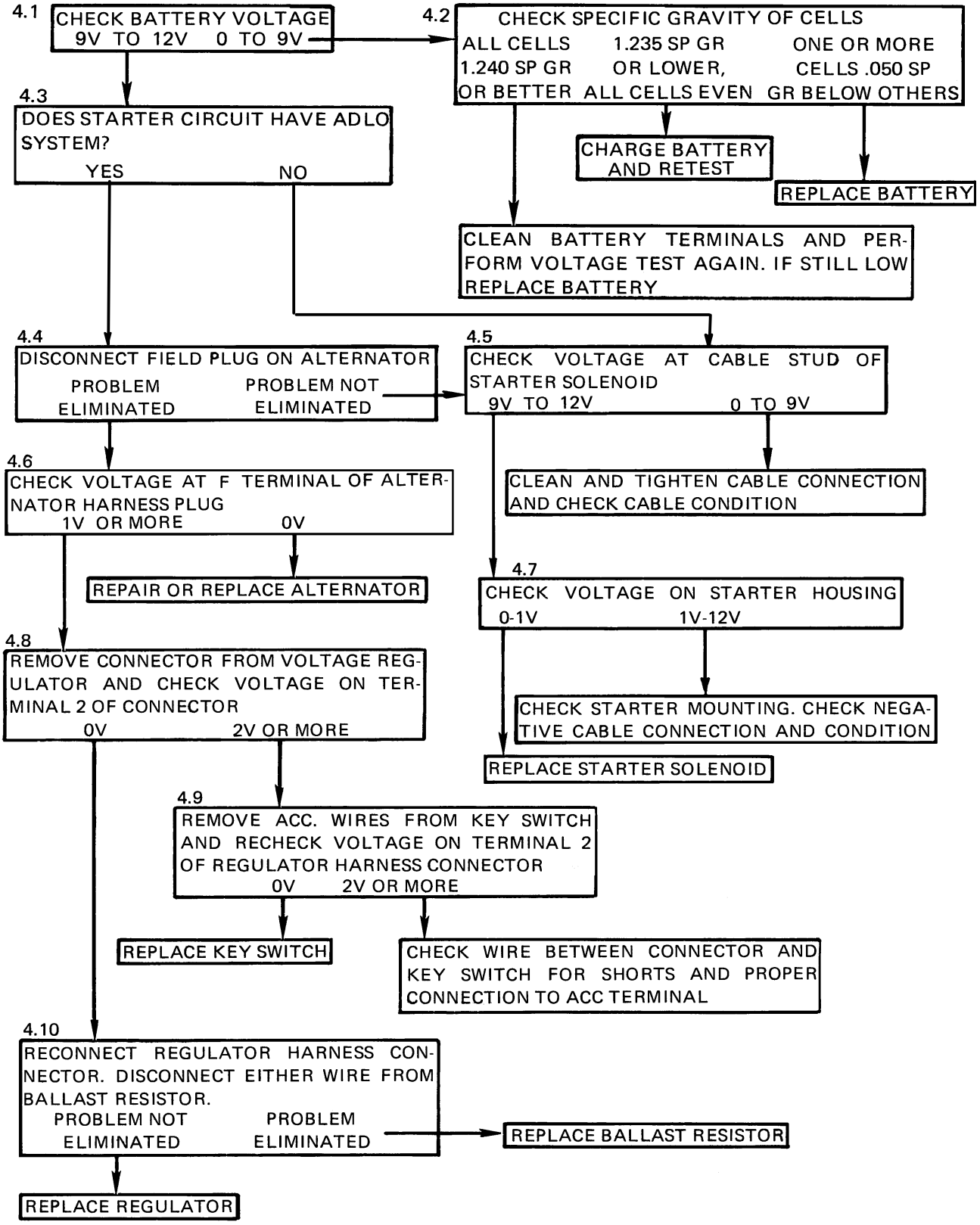
TYPE 2 USED ON: H20–30E, S20–30A, S125–150A, H100–150F, H135–155XL, H150–275H*, P60–80A, P150–200B, KE

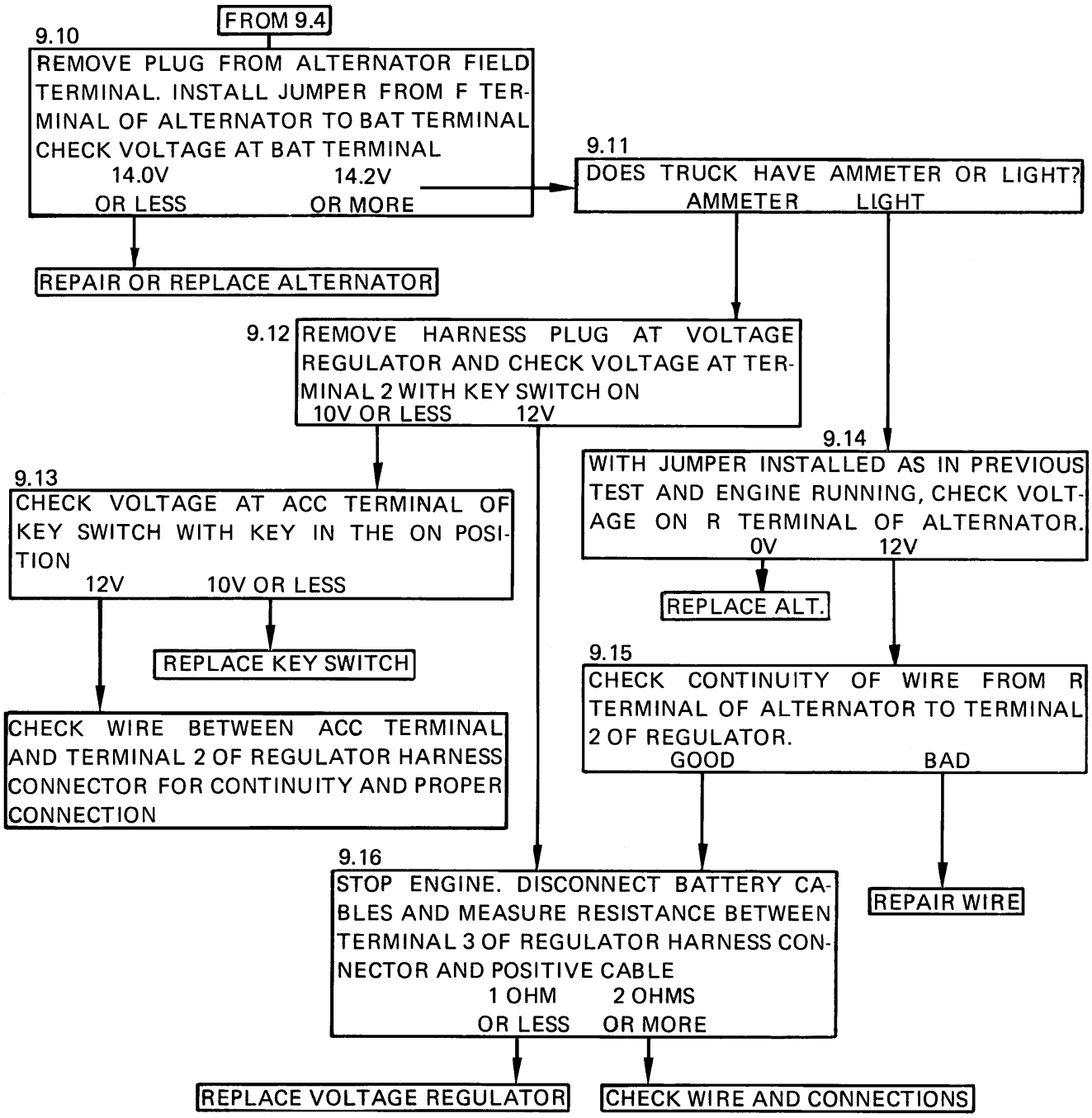
1. AXLE HOUSING
2. AXLE SHAFT
3. HUB
4. BEARING CUP
5. BEARING CONE
6. BRAKE DRUM
7. SEAL
8. LOCK NUT
9. LOCK PLATE
10. ADJUSTMENT NUT
11. WHEEL NUT
12. BRAKE DRUM NUT
13. WEAR SLEEVE
14. AXLE SHAFT NUT
15. TAPERED CAPSCREW
16. TAPERED SLEEVE
17. O–RING

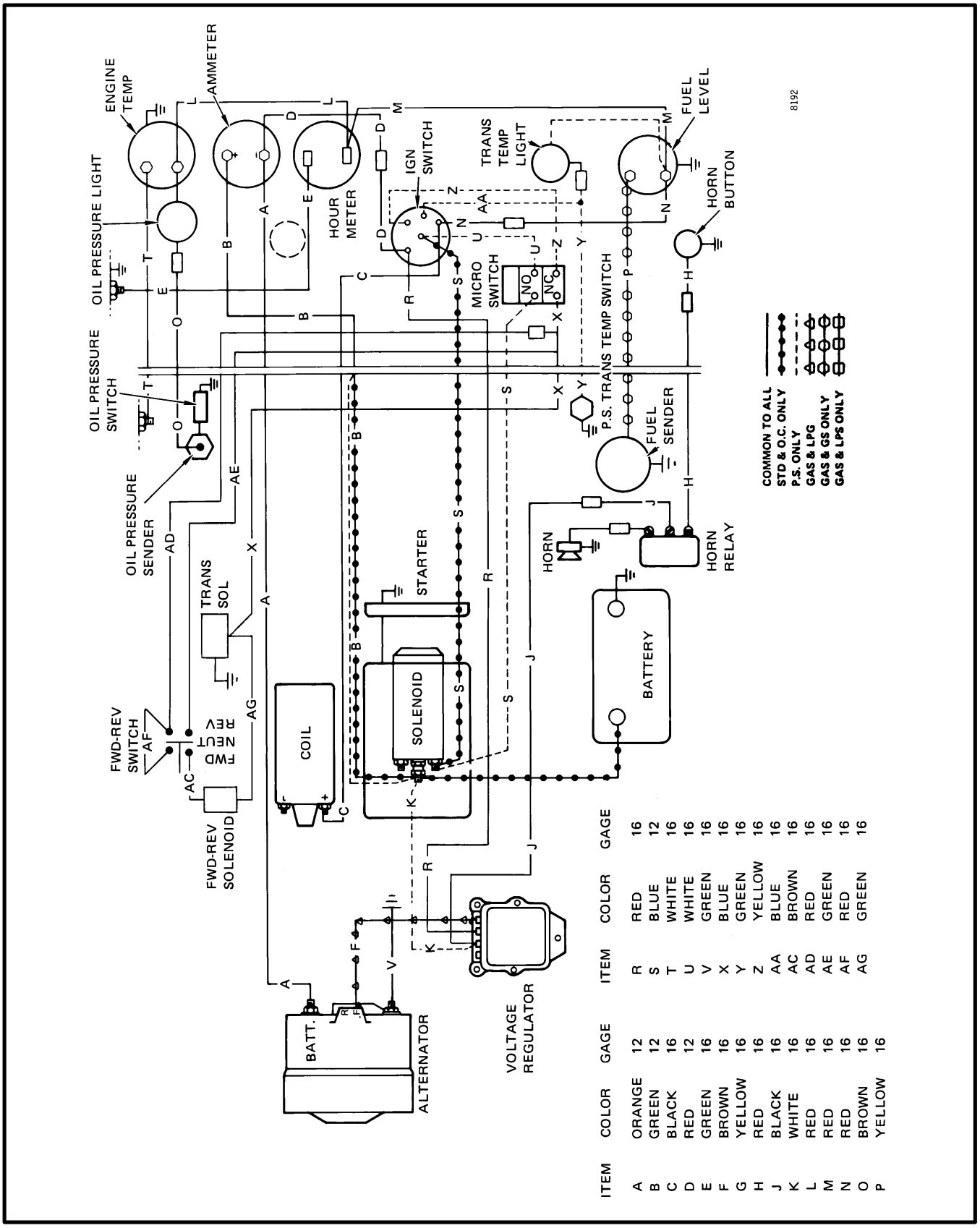
* This seal is not used on the H150–275H or P150–200B units starting with the following serial numbers: C7A–2267B, C7P–4034B, C7S–1632C

Figure 1. DRIVE AXLE

SYMPTOM 4. STARTER SOLENOID CLICKS IN AND OUT WHILE ATTEMPTING TO CRANK.
NOTE: ALL VOLTAGE TESTS IN THIS SECTION ARE PERFORMED WITH BATTERY CONNECTED AND KEY IN START POSITION.




FROM 9.4
9.10
REMOVE PLUG FROM ALTERNATOR FIELD TERMINAL. INSTALL JUMPER FROM F TERMINAL OF ALTERNATOR TO BAT TERMINAL CHECK VOLTAGE AT BAT TERMINAL
14.0V OR LESS
14.2V OR MORE
REPAIR OR REPLACE ALTERNATOR
9.11
DOES TRUCK HAVE AMMETER OR LIGHT?
AMMETER
LIGHT
9.12
REMOVE HARNESS PLUG AT VOLTAGE REGULATOR AND CHECK VOLTAGE AT TERMINAL 2 WITH KEY SWITCH ON
10V OR LESS
12V
9.13
CHECK VOLTAGE AT ACC TERMINAL OF KEY SWITCH WITH KEY IN THE ON POSITION
12V
10V OR LESS
REPLACE KEY SWITCH
CHECK WIRE BETWEEN ACC TERMINAL AND TERMINAL 2 OF REGULATOR HARNESS CONNECTOR FOR CONTINUITY AND PROPER CONNECTION
9.14
WITH JUMPER INSTALLED AS IN PREVIOUS TEST AND ENGINE RUNNING, CHECK VOLTAGE ON R TERMINAL OF ALTERNATOR.
0V
12V
REPLACE ALT.
9.15
CHECK CONTINUITY OF WIRE FROM R TERMINAL OF ALTERNATOR TO TERMINAL 2 OF REGULATOR.
GOOD
BAD
REPAIR WIRE
9.16
STOP ENGINE. DISCONNECT BATTERY CABLES AND MEASURE RESISTANCE BETWEEN TERMINAL 3 OF REGULATOR HARNESS CONNECTOR AND POSITIVE CABLE
1 OHM OR LESS
2 OHMS OR MORE
REPLACE VOLTAGE REGULATOR
CHECK WIRE AND CONNECTIONS



ITEM	COLOR	GAGE
A	ORANGE	12
B	GREEN	12
C	BLACK	16
D	RED	12
E	GREEN	16
F	BROWN	16
G	YELLOW	16
H	RED	16
J	BLACK	16
K	WHITE	16
L	RED	16
M	RED	16
N	RED	16
O	BROWN	16
P	YELLOW	16

ITEM	COLOR	GAGE
R	RED	16
S	BLUE	12
T	WHITE	16
U	WHITE	16
V	GREEN	16
X	BLUE	16
Y	GREEN	16
Z	YELLOW	16
AA	BLUE	16
AC	BROWN	16
AD	RED	16
AE	GREEN	16
AF	RED	16
AG	GREEN	16

FIGURE 2. ELECTRICAL SCHEMATIC S30–50C

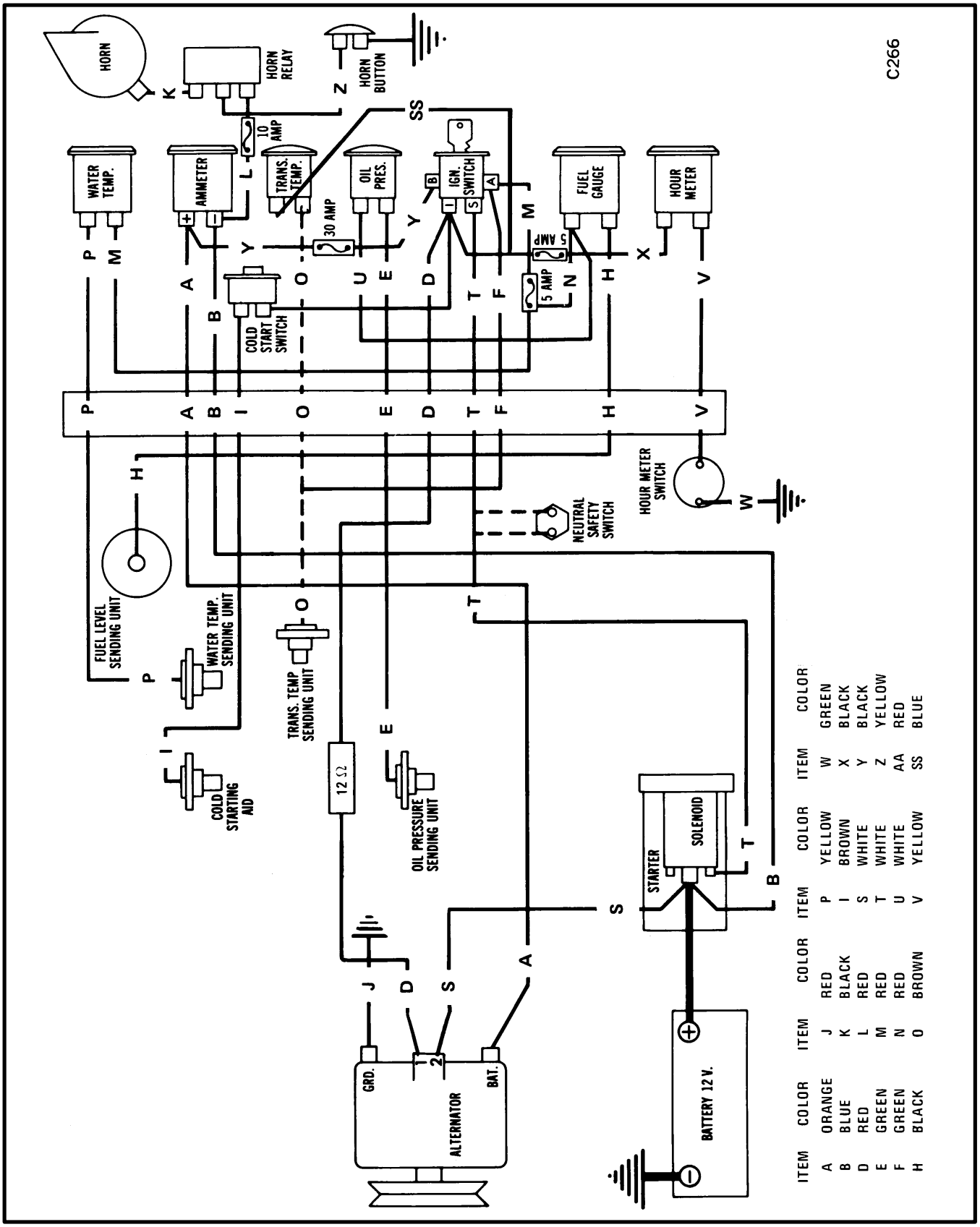


FIGURE 10. ELECTRICAL SCHEMATIC S125–150A DIESEL

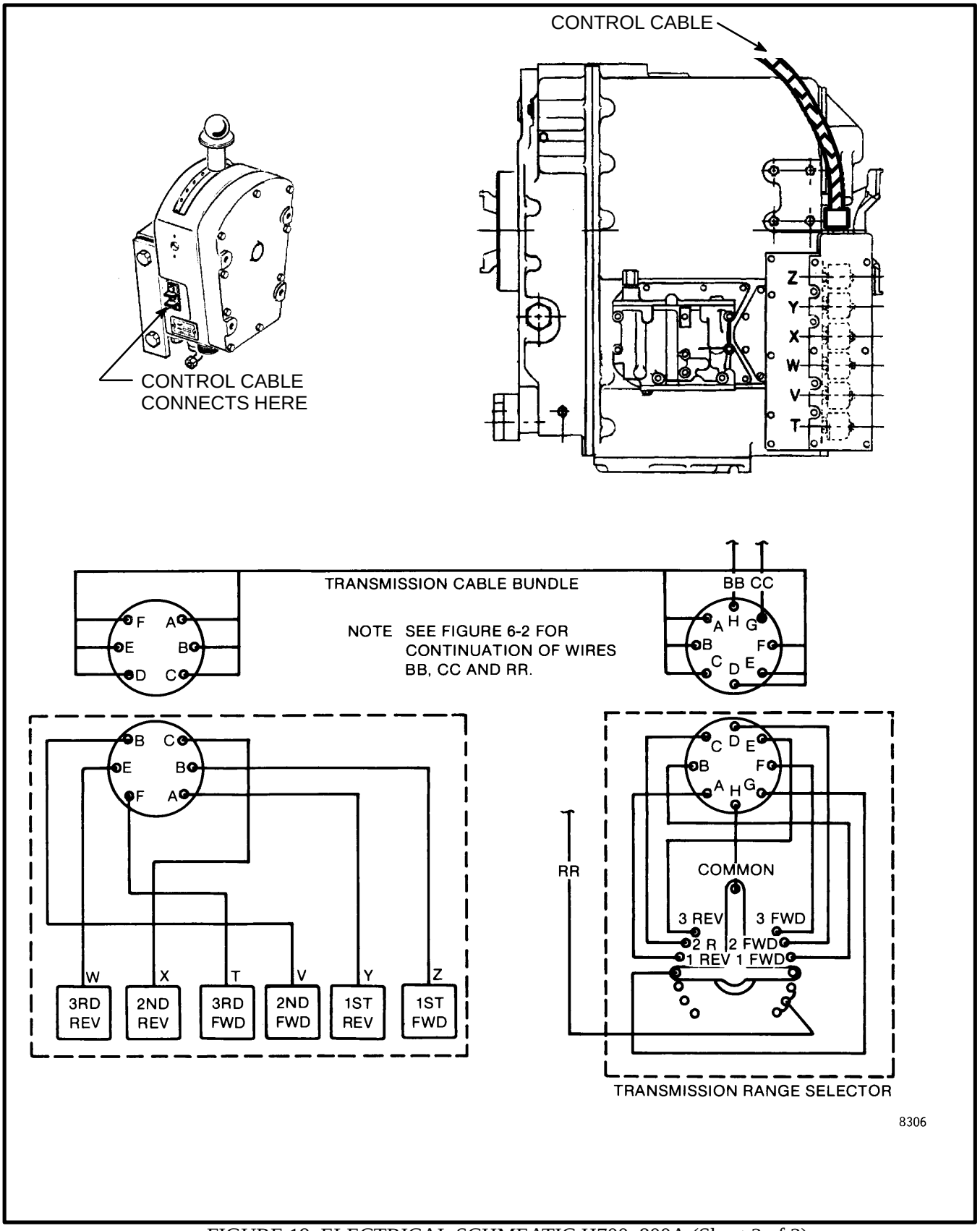


FIGURE 19. ELECTRICAL SCHMEATIC H700–800A (Sheet 2 of 2)

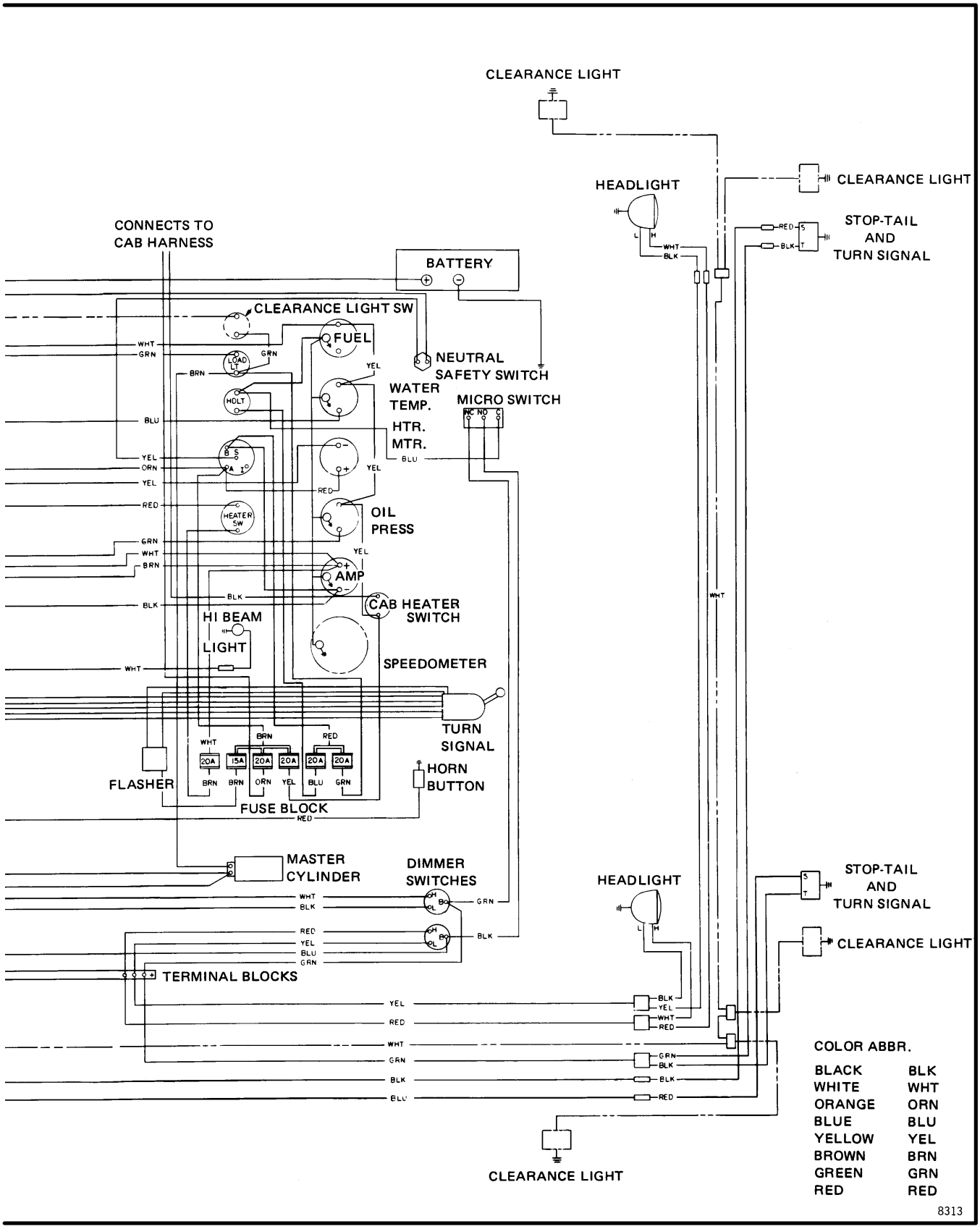


FIGURE 27. ELECTRICAL SCHEMATIC M200–400H DIESEL (Sheet 2 of 2)

3. Remove the floor plates.

4. Remove the hood and seat assembly.

5. If the engine is to be disassembled, drain the oil from the crankcase.

6. Drain the coolant from the engine and radiator. Disconnect the coolant hoses from the radiator at the engine. Disconnect the lines to the oil cooler at the bottom of the radiator. Remove the auxiliary coolant reservoir at the radiator.

7. Carefully remove the radiator and fan shroud from the lift truck. Remove the fan assembly from the idler pulley.

8. Disconnect the hydraulic supply hose at the filter. Disconnect the lines from the steering control unit, the main control valve, and the return line.

9. Disconnect the following electrical connections:

   a. Wire to the temperature sender for the hydraulic system.

   b. Two wires to the neutral start switch (oil clutch transmission or powershift transmission without MONOTROL).

   c. Connector between the engine wiring and the instrument wiring.

10. Disconnect the diesel stop cable. Disconnect the fuel line at the filter. (If equipped with LPG fuel, see the section **THE LPG SYSTEM, 900 SRM 15.**)

11. Disconnect the throttle linkage at the engine.

12. Remove the air cleaner assembly and the air duct to the engine.

13. Remove the brake pedal assembly. Disconnect the MONOTROL pedal from the bracket and put the pedal on the transmission. It is not necessary to disconnect the oil lines between the pedal and the transmission. Disconnect the linkage from the transmission on units that have an oil clutch transmission.

14. Disconnect the oil cooler lines at the transmission.

15. Disconnect the flexible exhaust pipe that connects the exhaust manifold to the muffler. (Some service persons disconnect the exhaust pipe at the frame mount so that the flexible exhaust pipe is easier to disconnect.)

16. Remove the axle shafts. See the section **THE DRIVE AXLE (1400 SRM 49)**. Remove the capscrews that fasten the transmission to the drive axle.

⚠ WARNING

When lifting the engine and transmission, make sure that the lifting device, chains or slings have the capacity to lift 500 kg (1000 lb)

17. Connect a lifting device to the engine and transmission. Raise the lifting device until there is tension in the chain or sling.

18. Remove the bolt that holds the front motor mount to the frame.

19. Carefully lift the engine and transmission assembly from the frame.

REPAIRS

FUEL OR HYDRAULIC TANK

⚠ CAUTION

Use Hyster black paint to paint the tank after repairs are complete. See the Painting Instructions section before painting. Do not get paint inside the tank.

Small Leaks

Use the following procedures to repair small leaks:

a. Use steam to clean the area around the leak. Remove all paint and dirt around the leak.

⚠ WARNING

Do not use tools that can make sparks, heat or static electricity. The vapors in the tank can cause an explosion.

b. Apply Loctite® 290 to the leak. Follow the instructions of the manufacturer

Hydraulic Valve Lifters, Cleaning And Inspection

⚠ WARNING

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

Clean all parts in a cleaning solvent and inspect them carefully. If any parts are damaged or worn, the complete hydraulic valve lifter must be replaced. If the body of the hydraulic valve lifter is worn, also inspect the bore in the engine block. If the bottom of the hydraulic valve lifter is worn or damaged, inspect the camshaft lobe for wear and damage. The bottom of the lifter must be convex for correct rotation during engine operation.

Cylinder Head, Assembly (See FIGURE 2.)

1. Install the valves in their correct ports. If a spring shim is used, install it on the valve stem. Install the valve spring, oil shield, and valve cap or rotator (exhaust valves) in position on each valve.

2. Use a valve spring compressor to compress the valve spring. Install a new oil seal on each valve stem. Make sure the oil seal is not twisted on the valve stem.

3. Install the retainers for the valve spring assembly. Make sure the retainers fit correctly in the upper groove of the valve stem. Release the spring compressor tool.

Cylinder Head, Installation

1. Clean the surface of the cylinder head and the top of the engine block. The surfaces for the gaskets must be clean. The threads for the head bolts must be clean so that the correct torque is applied during installation.

2. Install a new gasket for the cylinder head to the engine block. Do not use a sealant on the gasket.

3. Carefully install the cylinder head to the engine block. Use a sealant on the capscrews during installation. Tighten the head bolts evenly in a minimum of three steps. Tighten the head bolts evenly to a final torque of 130 N.m (95 lbf ft) in the sequence shown in FIGURE 9.

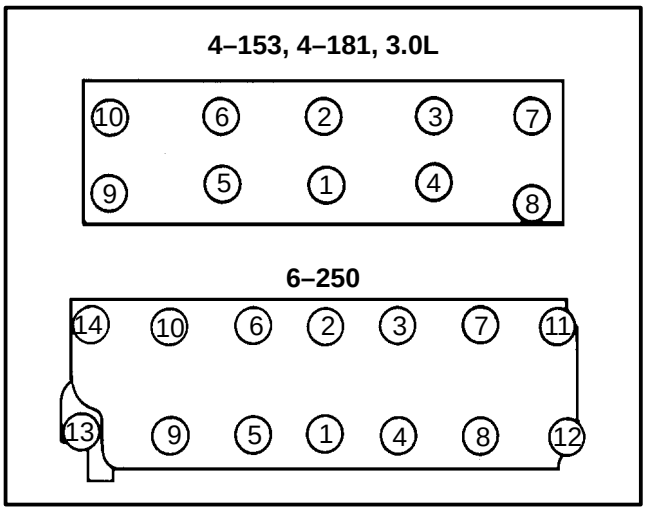


FIGURE 9. TIGHTENING SEQUENCE FOR THE CYLINDER HEAD

4. If the hydraulic valve lifters (cam followers) were removed, install them in their positions in the engine block. Install the side cover for the hydraulic valve lifters.

5. Install the push rods in their positions in the engine. Make sure each push rod fits in its socket in its hydraulic valve lifter.

6. Lubricate the rocker arms and rocker arm balls with engine oil during installation. Install the rocker arms, rocker arm balls, and rocker arm nuts. Tighten the rocker arm nuts until there is zero clearance.

7. Install the intake manifold and exhaust manifold. Connect the exhaust pipe at the exhaust manifold.

8. Install the carburetor. Connect the carburetor linkage, fuel line and hoses.

9. Install the alternator and bracket.

10. Install the dipstick tube for engine oil.

11. Connect the coolant hose to the housing for the thermostat.

12. Adjust the clearance of the rocker arm assemblies as described in "Valve Clearance Adjustment".

NOTE: If performing repair on the GM 3.0 liter engine got to step 14.

13. When the valve clearances are adjusted correctly, install the rocker arm cover. Use a new gasket between the cylinder head and the rocker arm cover. Install the retaining bolts and tighten them to 6 Nm (50 lbf in).

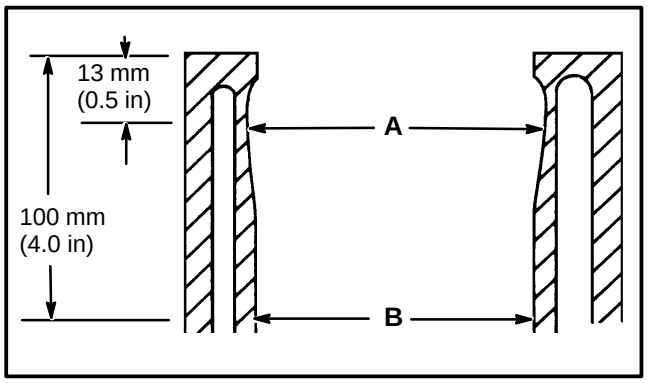


FIGURE 26. PATTERN FOR NORMAL CYLINDER WEAR

A cylinder bore that has been repaired with a hone or a boring machine must be fitted with a piston that is the correct size. Measure the outer diameter of the piston and the inner diameter of the cylinder bore as shown in FIGURE 27. Using different oversize pistons in the engine does not affect the dynamic balance of the engine. Replacement pistons from standard size to 0.030 in oversize normally have the same weight. The clearance specifications between a piston and its cylinder bore is shown in the ENGINE SPECIFICATIONS.

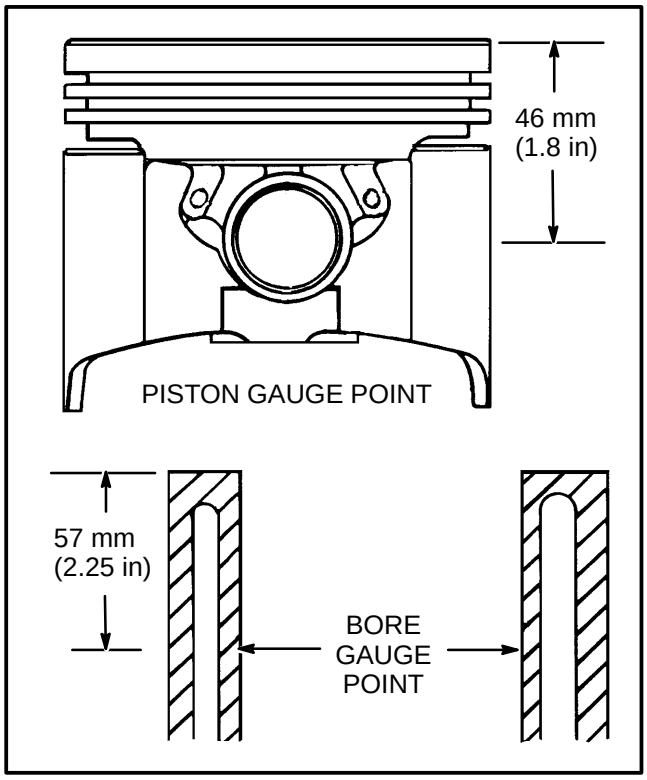


FIGURE 27. GAUGE POINTS FOR PISTON AND CYLINDER BORE

Piston Rings

NOTE: Check the clearance of the piston rings in the cylinder after the surface of the cylinder has been finished with a hone. New piston rings are available for the several piston size. See the Parts Manual for sizes. The piston rings must match the size of the piston on which they are installed. Check the side clearance and the end clearance of the piston rings as described in the following paragraphs.

Each compression ring has a mark on one surface. This mark must be toward the top of the cylinder when the piston ring is installed. The No. 1 compression ring normally has a chrome or molybdenum surface.

The oil control ring has three pieces. There are two thin steel rings separated by a spacer.

1. Measure the clearance between the piston ring and the groove in the piston as shown in FIGURE 28. The clearances are shown in the ENGINE SPECIFICATIONS. Replace the piston if the clearances are greater than the specifications.

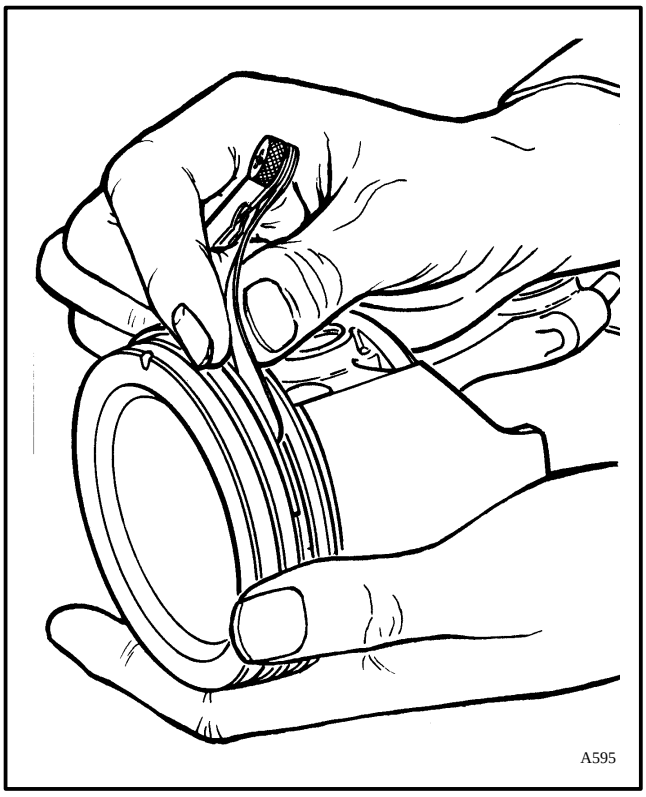


FIGURE 28. CHECK THE CLEARANCE BETWEEN THE PISTON RING AND THE GROOVE

Stop the engine. Rotate the cooling fan and fan drive by hand. The rotation must be smooth with some resistance. A small amount of movement side–to–side will occur at the tips of the fan blades because of bearing clearance. Approximately 5 mm (0.2 in) maximum of side–to–side movement at the tips of the fan blades is permitted. If the cooling fan can not be rotated by hand or has a rough rotation, the fan drive must be replaced. A very small leakage of oil around the bearing is normal. If oil has leaked from the fan drive, the cooling fan will turn too easily. If the cooling fan will turn more than three revolutions when pushed by the hand and released, the viscous fan drive must be replaced.

ENGINE SPECIFICATIONS

ENGINE DATA

GM 4–153

Number of cylinders 4

Firing order 1–3–4–2

Bore and stroke 98.45 x 82.5 mm (3.876 x 3.25 in)

Displacement 2512 cm^3 (153 in^3)

Compression Ratio 8.25:1

Governor speed See the **PERIODIC MAINTENANCE** section for each model of lift truck

GM 4–181

Number of cylinders 4

Firing order 1–3–4–2

Bore and stroke 101.6 x 91.44 mm (4.00 x 3.60 in)

Displacement 2965 cm^3 (181 in^3)

Compression Ratio 8.25:1

Governor speed See the **PERIODIC MAINTENANCE** section for each model of lift truck

GM 3.0L

Number of cylinders 4

Firing order 1–3–4–2

Bore and stroke 101.6 x 91.44 mm (4.00 x 3.60 in)

Displacement 2965 cm^3 (181 in^3)

Compression Ratio 8.25:1

Governor speed See the **PERIODIC MAINTENANCE** section for each model of lift truck

GM 6–260

Number of cylinders 6

Firing order 1–5–3–6–2–4

Bore and stroke 98.45 x 89.66 mm (3.88 x 3.53 in)

Displacement 4095 cm^3 (250 in^3)

Compression Ratio 8.25:1

Governor speed See the **PERIODIC MAINTENANCE** section for each model of lift truck

CYLINDER HEAD

Valve seat specifications See FIGURE 6.

Valve seat width, intake valves
0.896 to 1.897 mm (0.035 to 0.074 in)

Valve seat width, exhaust valves
1.468 to 2.468 mm (0.058 to 0.0971 in)

Clearance between intake valve and guide
– Production Limit
0.0254 to 0.0686 mm (0.0010 to 0.0027 in)

– Service Limit 0.094 mm (0.0037 in)

Clearance between exhaust valve and guide
[**NOTE:** The valve stems for the exhaust valves have a taper of 0.0025 mm (0.001 in)]

– Production Limit (top of taper)
0.0254 to 0.0686 mm (0.0010 to 0.0027 in)

– Service Limit 0.119 mm (0.0047 in)

– Production Limit (bottom of taper)
0.0508 to 0.0939 mm (0.0020 to 0.0037 in)

– Service Limit 0.145 mm (0.0057 in)

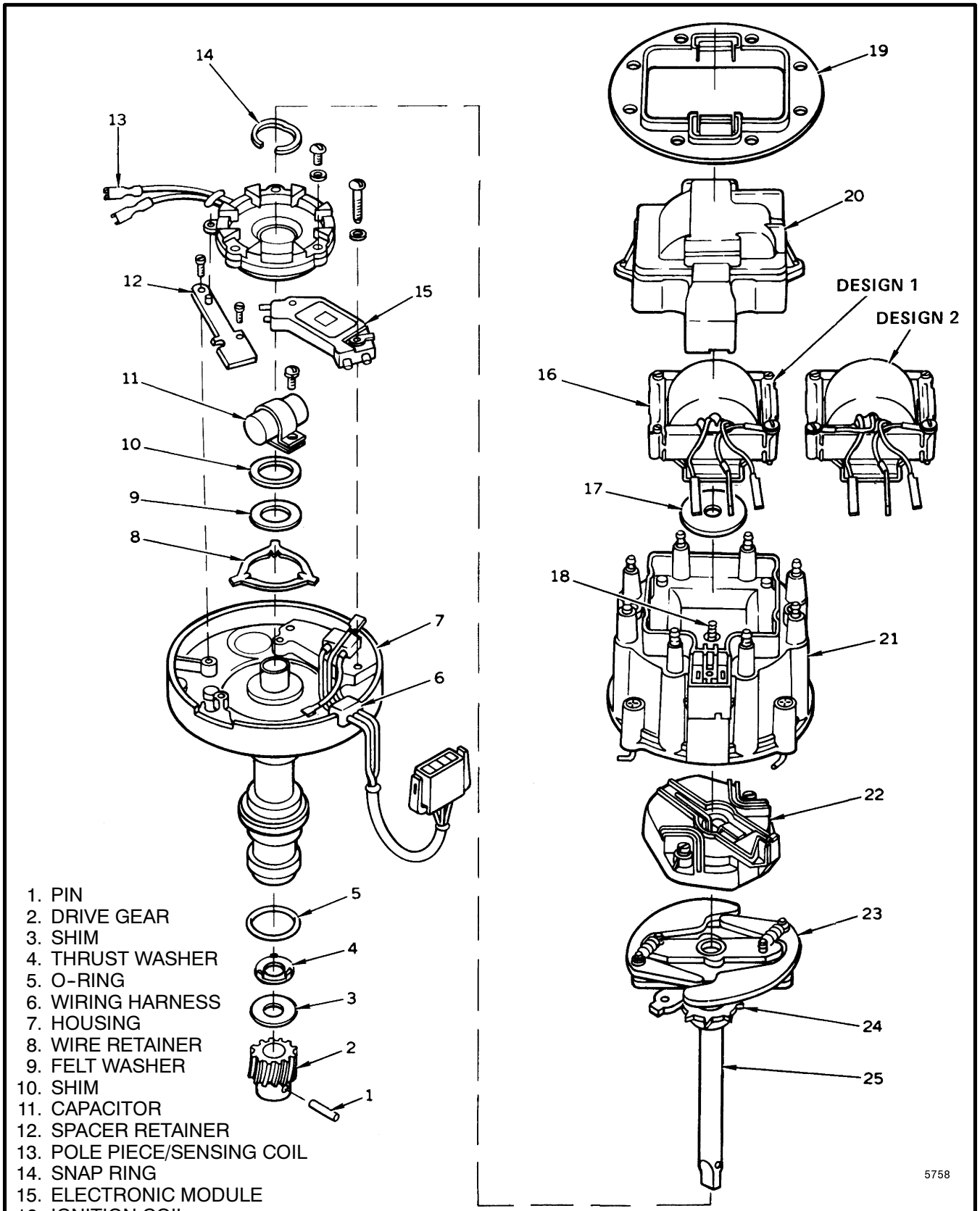
Diameter of exhaust valve stem
8.6817 to 8.9665 mm (0.3418 to 0.3425 in)

Diameter of intake valve stem
8.6995 to 8.6817 mm (0.3425 to 0.3418 in)

Valve head diameter (all)
8.6817 to 8.6995 mm 0.3418 to 0.3425 in)

Valve installed height (all)
42.926 mm (1.69 in)

Valve spring, free length (See FIGURE 48.)
52.8 mm (2.08 in)



1. PIN
2. DRIVE GEAR
3. SHIM
4. THRUST WASHER
5. O-RING
6. WIRING HARNESS
7. HOUSING
8. WIRE RETAINER
9. FELT WASHER
10. SHIM
11. CAPACITOR
12. SPACER RETAINER
13. POLE PIECE/SENSING COIL
14. SNAP RING
15. ELECTRONIC MODULE
16. IGNITION COIL
17. SEAL
18. SPRING
19. WIRE RETAINER
20. COIL COVER
21. CAP
22. ROTOR
23. CENTRIFUGAL MECHANISM
24. TIMER CORE
25. SHAFT

FIGURE 4. GM-V8, SOME MODELS

⚠ WARNING

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

2. Clean the area around the spark plug with compressed air.

⚠ CAUTION

Use a deep socket for removing the spark plug. Make sure the insulator is not damaged.

3. Remove the spark plugs. If used, remove the gaskets.

4. Inspect the spark plugs for normal operation. If damaged, replace the plugs.

Installation

1. Clean the thread area where the spark plugs screw into to the cylinder head. Make sure the seat area is clean.

2. Check the clearance between the electrodes. Bend the side electrode, to get the correct clearance.

⚠ CAUTION

Do not use a gasket if the spark plug has a tapered seat.

3. Install the spark plugs and if used, the gaskets.

⚠ CAUTION

Do not tighten the spark plugs to more than the specification.

4. Tighten the plugs to the correct torque.

5. Connect the wires to the spark plugs. Push the wire terminal until the wire locks to the plug.

CHECKS AND ADJUSTMENTS

Visual Checks

⚠ WARNING

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

The HEI distributor will operate for a long time without causing problems. A visual inspection of the distributor when the spark plugs are changed is a good check. Remove the distributor cap. Inspect the rotor and the inside of the cap for dust and carbon deposits. Clean the dust from the parts with compressed air. Inspect the rotor and cap for damage. If parts are damaged, replace with new parts. Remove the rotor. Inspect the pivot area of the centrifugal weights. If the pivot has a rust condition, put one drop of oil on the pivot. If the pivot is damaged, replace the damaged parts with new parts.

Check The High Voltage Wires

The high voltage wires must be handled very carefully. Do not pull on the wires. The core can separate and cause ignition problems. If the wires are causing a problem, do the following checks:

⚠ WARNING

Do not remove the high voltage wires with the engine running. The high voltage can cause electric shock.

a. Disconnect each wire by pulling on the terminal cover. Turn the cover to loosen the wire.

b. Connect the wires from an ohmmeter to the high voltage wire. Set the ohmmeter to a high scale.

c. Move the high voltage wire a little while looking at the ohmmeter. If the ohmmeter indicates more than 2500 ohms, replace the wire with a new part. If the ohmmeter indication changes from infinity to any value, replace the wire with a new part.

e. Check the wire without moving it. Replace the wire with a new part if the meter indications are not within specifications.

⚠ CAUTION

Make sure the new wires have a diameter of 8mm and have silicone insulation.

Checking The Ignition Coil

Coil In Distributor Cap Design (See FIGURE 14.)

1. Disconnect the wire from the negative terminal of the battery.

2. Disconnect the primary wiring connector to the distributor.

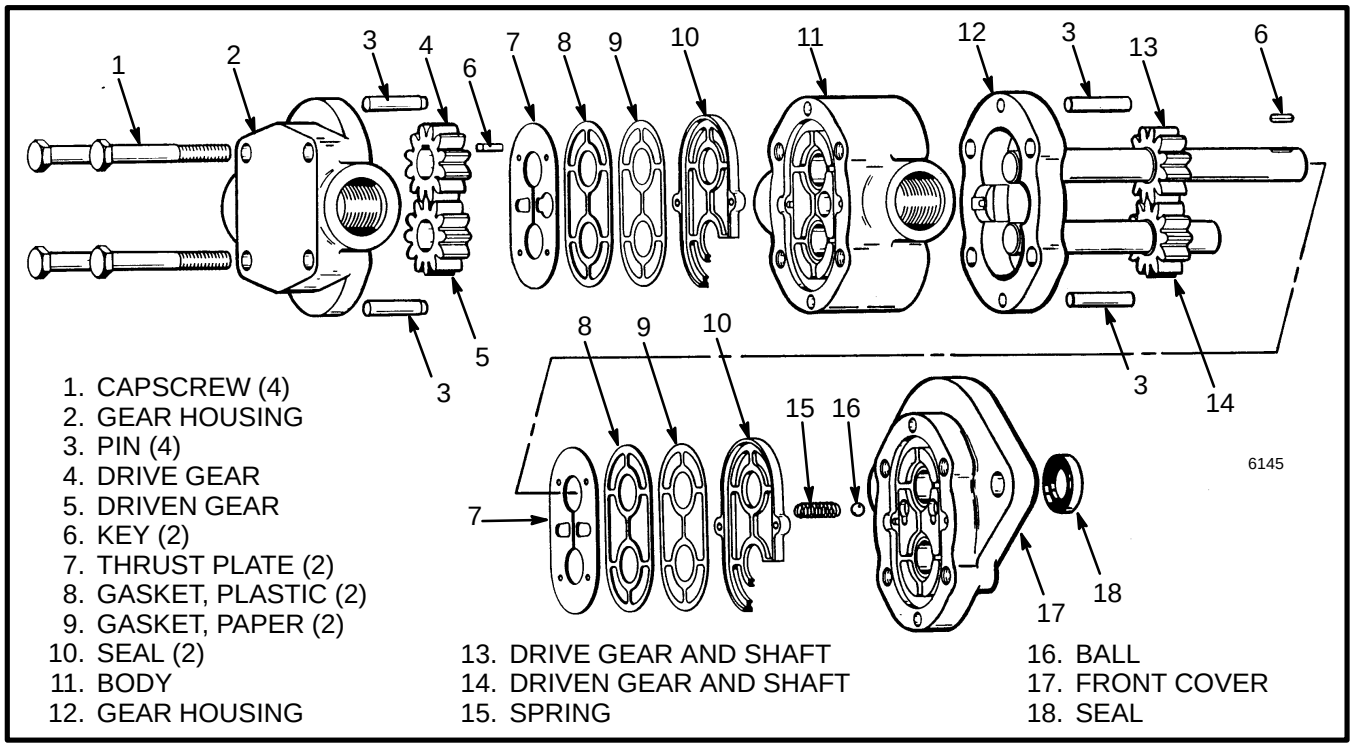


FIGURE 8. HYDRAULIC GEAR PUMP, TANDEM

CLEANING

Clean all parts of the pump with solvent. Use compressed air to dry the parts. Do not use a cloth to dry the parts. Pieces of the cloth can cause restrictions in the hydraulic system. Make sure the work area and tools are very clean.

⚠ CAUTION

Any dirt that enters the hydraulic system can cause damage to the parts.

INSPECTION

1. Inspect the outside edges of the gear teeth for grooves or scratches. If the edges of the gear teeth are sharp, use emery cloth to break the edges. Replace the gears if there are deep grooves on the gears.

2. If the gear shafts have grooves or are worn more than 0.05 mm (0.002 in), they must be replaced. Wear on the seal area of the shaft indicates that there is dirt in the oil or a hard seal. Inspect the seal to see if it has been too hot. Look for small cracks in the seal surfaces. If the seal was too hot or the wrong oil was used, the seal will be too hard or too soft. Inspect the splines or key groove for damage.

NOTE: Some pump bodies will show gear marks where the gears rotate because of the small clearances between the parts. These gear marks do not indicate a worn or damaged pump unless the pump will not supply the volume and pressure shown in the specifications.

3. Inspect the gear housing for wear or grooves. Most wear occurs on the inlet side of the gear chamber. Put a straight edge across the inlet side of the gear chamber. If a 0.13 mm (0.005 in) thickness gauge fits between the straight edge and the housing, the gear housing must be replaced. If the gear housing is worn, inspect the bearings for wear. If the system pressure is too high, the gear housings will wear quickly. Grooves in the gear chamber indicate dirt is in the oil. Small holes in the outlet side of the gear chamber indicate that cavitation has occurred. Make sure the inlet hose, fittings and tank have no restrictions. Cavitation can also occur when the engine speed is too high.

If the surfaces of the gear chamber or gear teeth have blue marks, the pump was too hot. Heat damage in the pump can be caused by hot oil or lack of oil. Check the front seal surface to see if air was entering the pump through the front seal. Make sure the oil is the correct viscosity. The wrong viscosity oil can increase leakage within the pump. Leakage inside the pump increases the oil temperature.

6. Remove the driven sprocket assembly and the leaf chain. If the bearings need replacing, use a puller to remove the bearing cones from the sprocket assembly. The bearing cups must be pressed out of the adapter plate or flywheel housing. Remove the cap in the flywheel housing after the housing is removed from the engine. If the driven sprocket, hub OR bearings need replacing, remove the hub and shims from the driven sprocket.

⚠ CAUTION

Be careful when pressing parts installed in aluminum castings. It can be necessary to use low temperature heat on the aluminum. The aluminum is easily damaged.

Use a puller to remove the bearing cup in the H30–60H flywheel housing.

7. If the special blocks need replacing, remove the two capscrews that fasten the upper block. Remove the two nuts that fasten the lower block. Do not let the washers fall as the lower block is removed. Remove both blocks. If there are oil leaks at the special capscrews, or the capscrews are damaged, remove the capscrews.

8. If the flywheel housing needs replacing, remove the capscrews or place bolts that fasten it to the engine. Remove the special capscrews for the special blocks.

CLEANING

⚠ WARNING

Do not use solvent in an area where there is bad ventilation, flame, sparks or burning material.

Clean all parts using solvent. Do not use steam or gasoline to clean parts.

INSPECTION

The leaf chain must be replaced if it is too long. The check must be done when the chain is installed. The check is done as a step in the Removal and Disassembly procedure. See step 3. and FIGURE 3. Any parts showing wear are normally replaced now. Bearings must be replaced as a set.

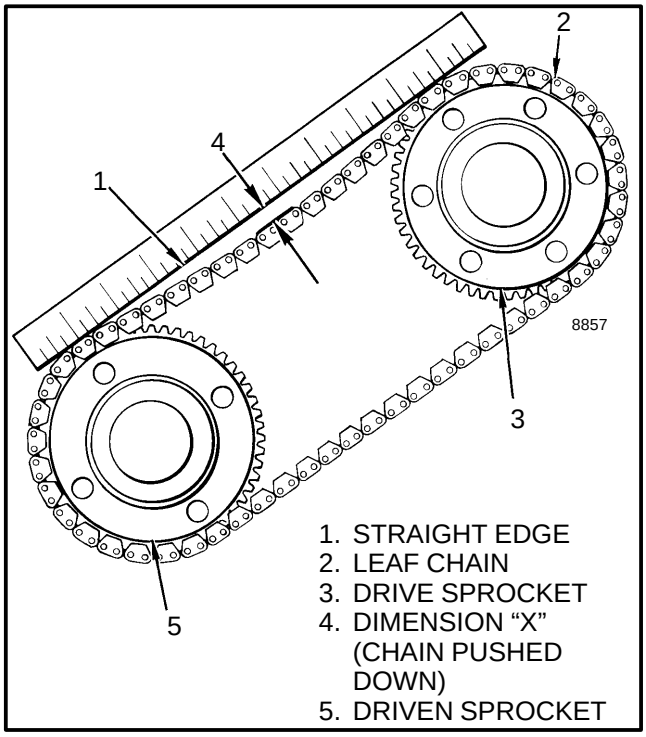


FIGURE 3. CHAIN LENGTH

ASSEMBLY AND INSTALLATION (See FIGURE 2. and FIGURE 4.)

1. If the bearing in the flywheel housing is replaced, use a press to install the new bearing cup. If the special capscrews are removed from the flywheel housing, install the capscrews using new O–rings. Make sure the capscrews having a threaded bore are installed in the two holes for the top block. Tighten the special capscrews to 47 N.m (35 ft lbs) torque. If the flywheel housing is removed, install it on the engine. Use thread sealant on the threads and heads of the capscrews inside the H30–60H flywheel housing.

⚠ CAUTION

Bearing cups and cones must be replaced as a set. Never replace only the cup or cone.

Be careful when pressing parts that are installed in aluminum castings. It can be necessary to use low temperature heat on the aluminum. The aluminum is easily damaged.

2. If the bearing cup in the adapter plate is removed, use a press to install it.

NOTE: Do steps 3. and 4. if ANY of the following parts are replaced: (1) driven sprocket, (2) bearings, (3) driven sprocket hub, (4) adapter plate or (5) flywheel

trucks:

H30-60F (Serial Code B3)
H30-60H (Serial Code D3)
H30-60H (Serial Code E3)

A separate relief valve for lift and tilt was changed to a single relief valve for the hydraulic system during production of the D3 model. This section does not describe the arrangement of the two separate relief valves. See the SERVICE MANUAL for the H30-60H(D3) (Form 599351) for the dual relief valve arrangement

When the hydraulic pressure was increased from approximately 13.8 kPa (2000 psi) to 15.2 kPa (2200 psi) in the F3 series, the relief valve cartridge was changed to give the higher pressure. (See the Hydraulic Specifications at the end of this section.)

Relief Valve (See Figure 5)

The relief valve is a spool valve that is pilot operated. There is a pilot poppet with a spring inside the relief spool. The pilot poppet senses the pressure of the oil that goes through the by-pass orifice and the sensing orifice. A spring and the pressure of the oil from the sensing orifice balances the spool against the pressure of the main hydraulic supply.

The relief valve prevents the pressure in the hydraulic system from increasing beyond the specification. The pressure in the hydraulic system increases when a control spool causes a restriction in the by-pass oil flow. When the pressure increases to the limit, the oil pressure moves the pilot poppet against the pilot spring. The small oil flow through the sensing orifice and the orifice of the pilot poppet reduces the pressure on the side of the spool with the spring. The difference in pressure opens the relief valve spool against the return spring. The open relief valve permits the oil flow from the hydraulic pump to return to the hydraulic tank and keep the pressure within the limits. When the hydraulic pressure decreases, the return spring moves the relief spool to its seat.

The spool and spring for the pressure relief valve is also used as a flow control for the by-pass. The restriction of the by-pass orifice causes less pressure after the orifice than before. The difference in pressure between the two sides of the orifice increases as the flow increases. The inlet pressure pushes against spool return spring and the by-pass pressure. When the flow from the hydraulic pump is greater than 26.51itres/min (28 qt/min), the relief valve opens. Part of the flow goes through the return passage. When another control spool is operated, the pressure increases in the by-pass passage and sensing passage until it is the same as the inlet pressure. The return spring pushes the relief valve spool closed. (See Figure 6.)

Control Spools

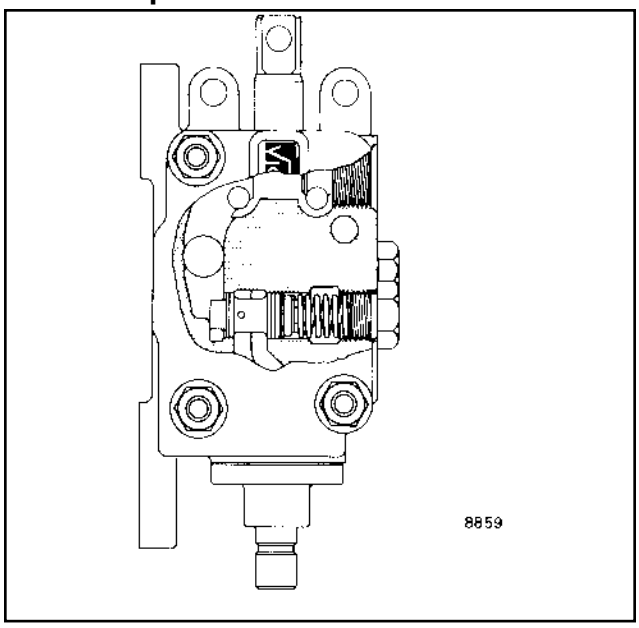


FIGURE 6. SPOOL FOR PRESSURE RELIEF AND BY-PASS FLOW CONTROL

LIFT

The lift spool has three positions. In the LIFT position, the spool causes a restriction of oil flow through the by-pass passage. The pressure increases and pushes the check ball from its seat. Oil flows to the center of the spool and to the""A" port. The oil then flows to the bottom of the lift cylinder and extends the cylinder rod. See Figure 7.

When the lift spool is in the NEUTRAL position, the oil flows through the by-pass orifice to the by-pass passage. The oil flows to the outlet port and to the hydraulic tank.

When the lift spool is moved to the LOWER position, hydraulic oil flows from the lift cylinder to the return passage in the valve body. he lift spool does not cause a restriction in the by-pass passage in the LOWER position and the pressure does not increase. The oil flows from the return passage to the hydraulic tank. (See Figure 8.)

STRENGTH IDENTIFICATION

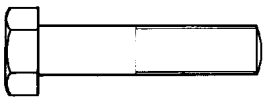
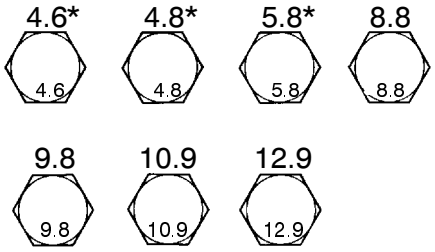
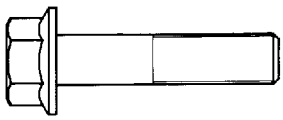
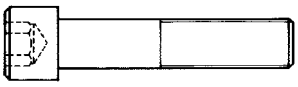
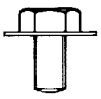
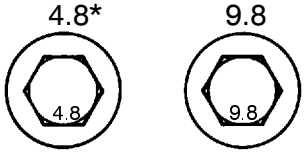
The most common property classes for metric fasteners are 8.8 and 10.9. The property class is marked with a number on the head of the capscrew or on a nut. Property classes less than 8.8 are often not marked. Grades for inch bolts go from 2 to 8. Grade 2 fasteners normally do not have any marks. The following tables show the marks that identify the grades and property classes for different fasteners.

⚠ CAUTION

When fasteners must be replaced, the new fasteners must be of the same strength or greater than the original fasteners. The new fasteners must also be the correct size.

NOTE: Identification marks are according to bolt strength. The higher the number or the increase in the number of marks indicates increased bolt strength.

TABLE 1. BOLTS AND SCREWS

TYPE OF FASTENER	INCH FASTENERS STRENGTH LEVELS: SAE GRADES * MARKINGS NOT REQUIRED	METRIC FASTENERS STRENGTH LEVELS: PROPERTY CLASS * MARKINGS NOT REQUIRED
 HEX HEAD BOLTS AND CAPSCREWS		 MARKINGS FOR SIZE M5 AND LARGER
 HEX HEAD FLANGE SCREWS		SAME AS ABOVE
 12-POINT FLANGE SCREWS		
 HEX SOCKET HEAD CAPSCREWS	MARKINGS NOT REQUIRED	
 SEMS		

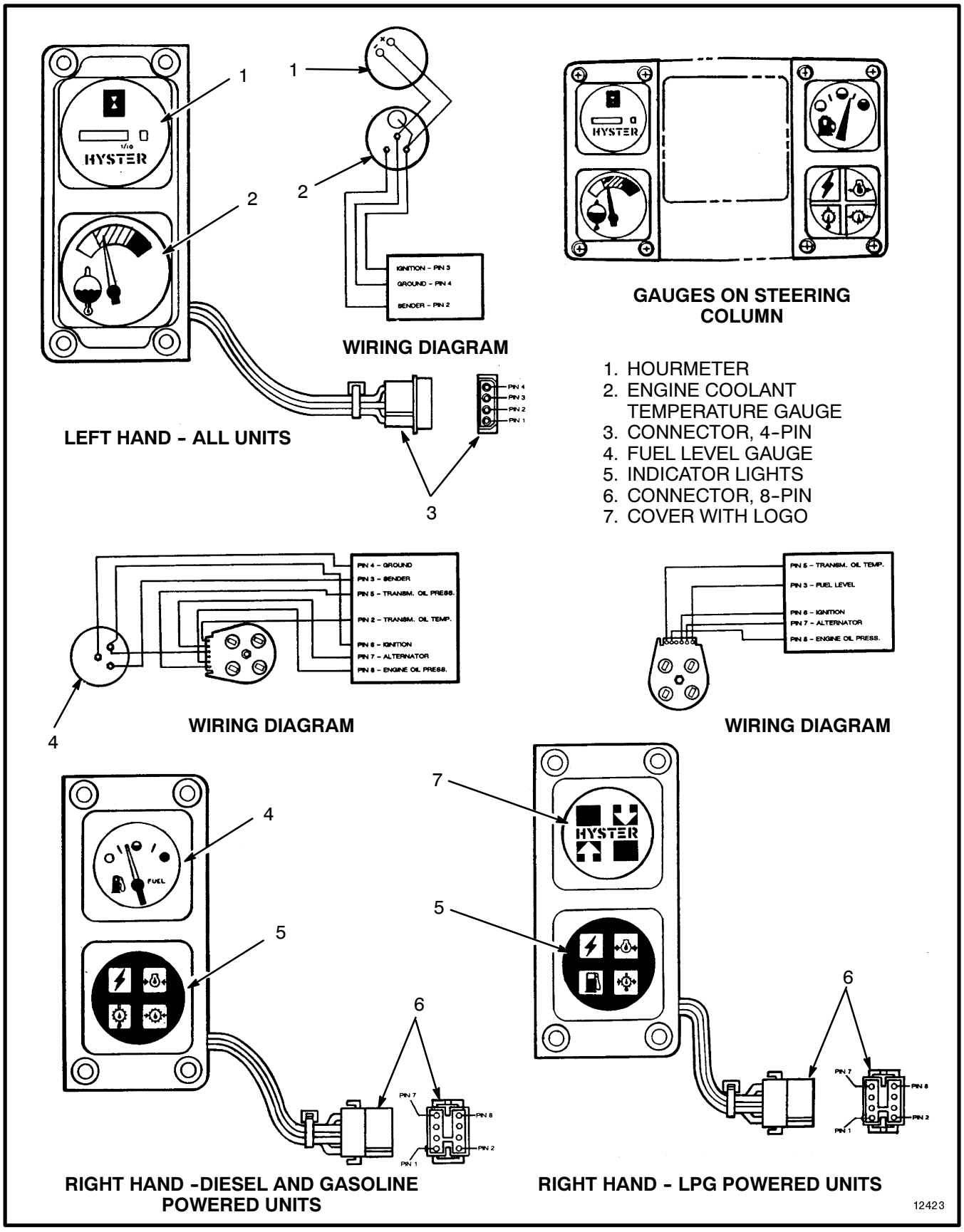


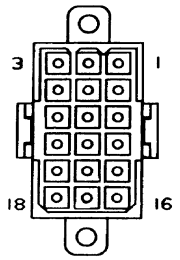
FIGURE 3. TYPICAL METERS ON STEERING COLUMN ASSEMBLY FOR LIFT TRUCKS WITH ENGINES

Hand Set or a PC must be used to clear the status code from the register.

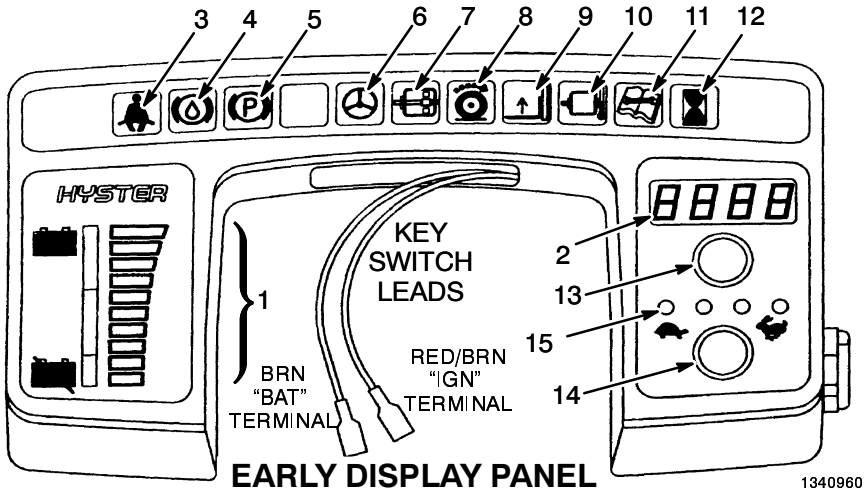
If the button is pushed twice and then held down, the indicator light for the hydraulic pump motor (9) will illuminate. The status codes in memory for the detected faults will be displayed, starting with the most recent fault. If the push button is released, the display will stop. If the button is pushed twice to start the sequence again, the display will start from the beginning. The hourmeter time and the battery charge at the time of the fault will not be shown. A Hand Set or a PC must be used to show this additional information. A Hand Set or a PC must be used to clear the status code from the register.

ENHANCED DISPLAY
18 PIN CONNECTOR

PIN	FUNCTION
1	Traction Card PY 5
2	Pump Card PY 5
3	No Connection
4	Traction Card PY 14
5	Traction Card PY 13
6	Pump Card PY 14
7	Pump Card PY 13
8	No Connection
9	Traction Card PY 4
10	Pump Card PY 4
11	Brush Wear Indicator & Temperature Jumper*
12	*
13	Parking Brake Switch
14	Brake Fluid Switch
15	No Connection
16	No Connection
17	Key Switch (IGN)
18	No Connection



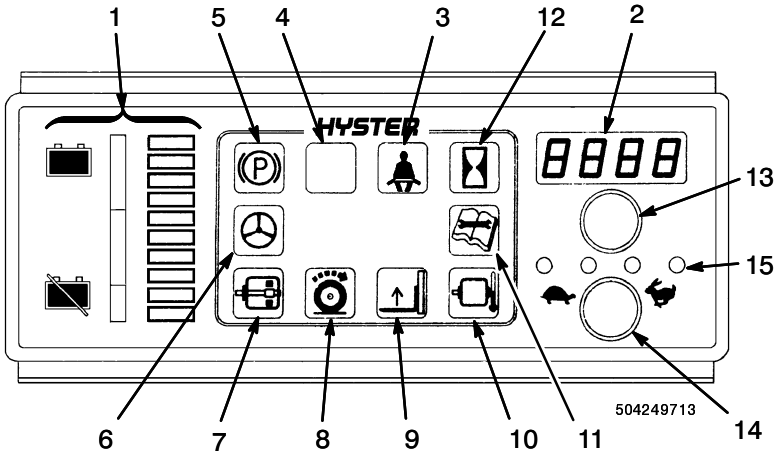
* PIN 11 TO 12 JUMPER (IN WIRE HARNESS). BWI AND TEMPERATURE LED's DISABLED IF CUT.



EARLY DISPLAY PANEL

1340960

LATER DISPLAY PANEL



1. BATTERY DISCHARGE INDICATOR
2. DIGITAL DISPLAY
3. FASTEN SEAT BELT INDICATOR
4. BRAKE FLUID TOO LOW INDICATOR
5. PARKING BRAKE INDICATOR
6. STEERING PUMP MOTOR INDICATOR
7. BRUSH WEAR INDICATOR
8. TRACTION MOTOR INDICATOR
9. LIFT PUMP MOTOR INDICATOR
10. MOTOR TEMPERATURE INDICATOR
11. STATUS CODE/MAINTENANCE INDICATOR
12. HOURMETER INDICATOR
13. STATUS CODE BUTTON
14. PERFORMANCE LEVEL BUTTON
15. PERFORMANCE LEVEL LEDS

FIGURE 10. PERFORMANCE DISPLAY PANELS FOR THE EV-100/200ZX MOTOR CONTROLLERS

TROUBLESHOOTING

TABLE 3. METER TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	CORRECTIVE ACTION
No Indication All Meters	Battery disconnected.	Clean the battery terminals and battery cable connectors. Install connectors.
	Battery malfunction or discharged.	Change or replace battery.
	Wiring group connector or connectors not connected.	Fasten the connector or connectors.
No Indication – Only One Meter	Meter wires damaged or not connected.	Replace the broken wires or connectors. Install connectors on proper meter terminals
	Separate sender wire damaged or not connected.	Replace broken wire or connector. Install connector on sender terminal.
	Meter malfunction. Voltage is at terminal	Replace meter.
	Sender malfunction. Voltage is at terminal	Replace sender.
Incorrect Indication	Battery is discharged.	Charge battery.
	Meter movement or needle is damaged or has a malfunction.	Replace meter.
	Separate sender malfunction.	Replace sender.
	Sender will not sense because system has corrosion.	Clean and flush system.

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NOTE: OIL LEAKAGE IS NOT CONTROLLED BY THE TORQUE ON THE PACKING GLAND.

TIGHTEN THE PACKING RETAINER (7) TO STOP OIL LEAKS. REPLACE CHEVRON PACKING WHEN PACKING RETAINER (7) CAN NOT COMPRESS PACKING FURTHER TO CONTROL OIL LEAKS. DO NOT TIGHTEN MORE THAN NECESSARY TO STOP OIL LEAKS.

1. WIPER
2. NYLON RING
3. CHEVRON PACKING
4. BACK–UP RING
5. O–RING
6. ROD HEAD
7. PACKING RETAINER
8. PACKING GLAND
9. CYLINDER SHELL
10. INLET AND OUTLET PORT
11. WEAR RING

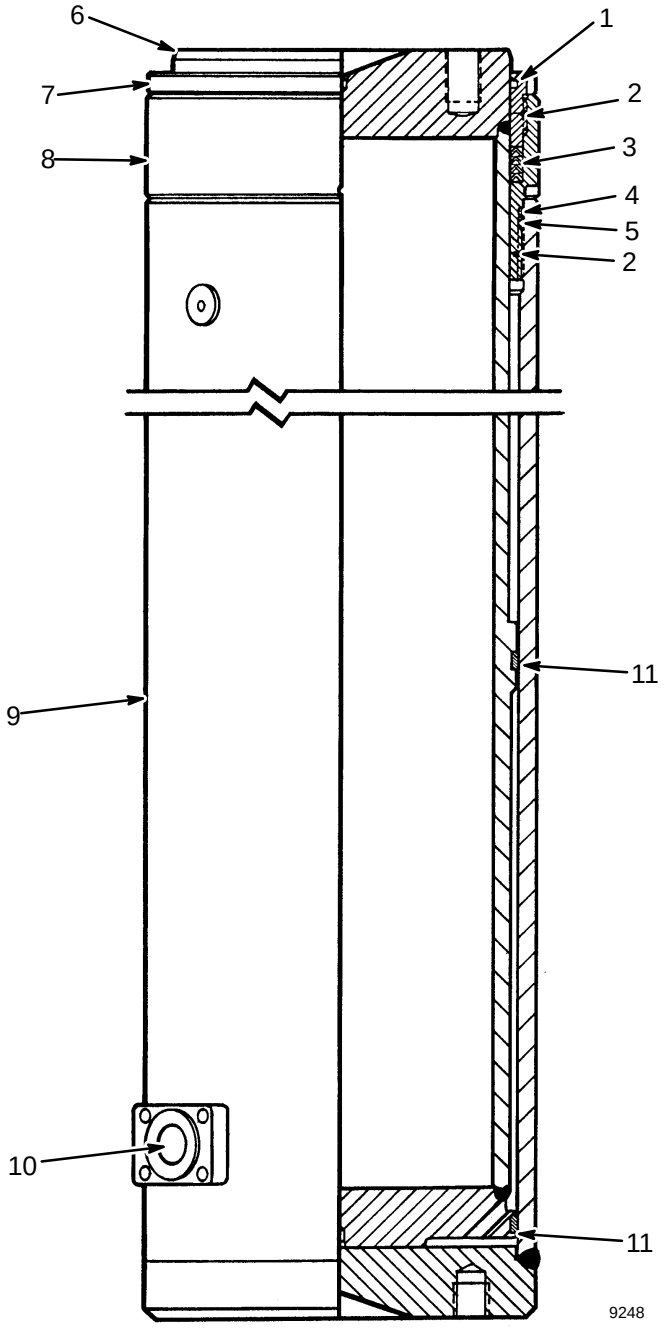


FIGURE 7. DISPLACEMENT CYLINDERS

Cylinders (H360–460B)

The lift cylinders used in the H360–460B lift trucks are displacement cylinders. The design and repairs for these cylinders are similar to the other lift cylinder in this section. A displacement cylinder does not have a piston or piston seal. The rod diameter is almost the same as the inside diameter of the cylinder. There are wear rings on the rod that are the bearings between the rod and the walls of the cylinder. The wiper seal at the top of the cylinder is also the high pressure seal for these cylinders. The wiper seal is a chevron packing. See FIGURE 7.

Cylinders (Two–Speed)

Two–speed lift cylinders are single–stage lift cylinders with a special valve and path for the hydraulic oil. The lift cylinder is filled with oil on both sides of the piston. For loads less than 45% of the rated capacity, the cylin-

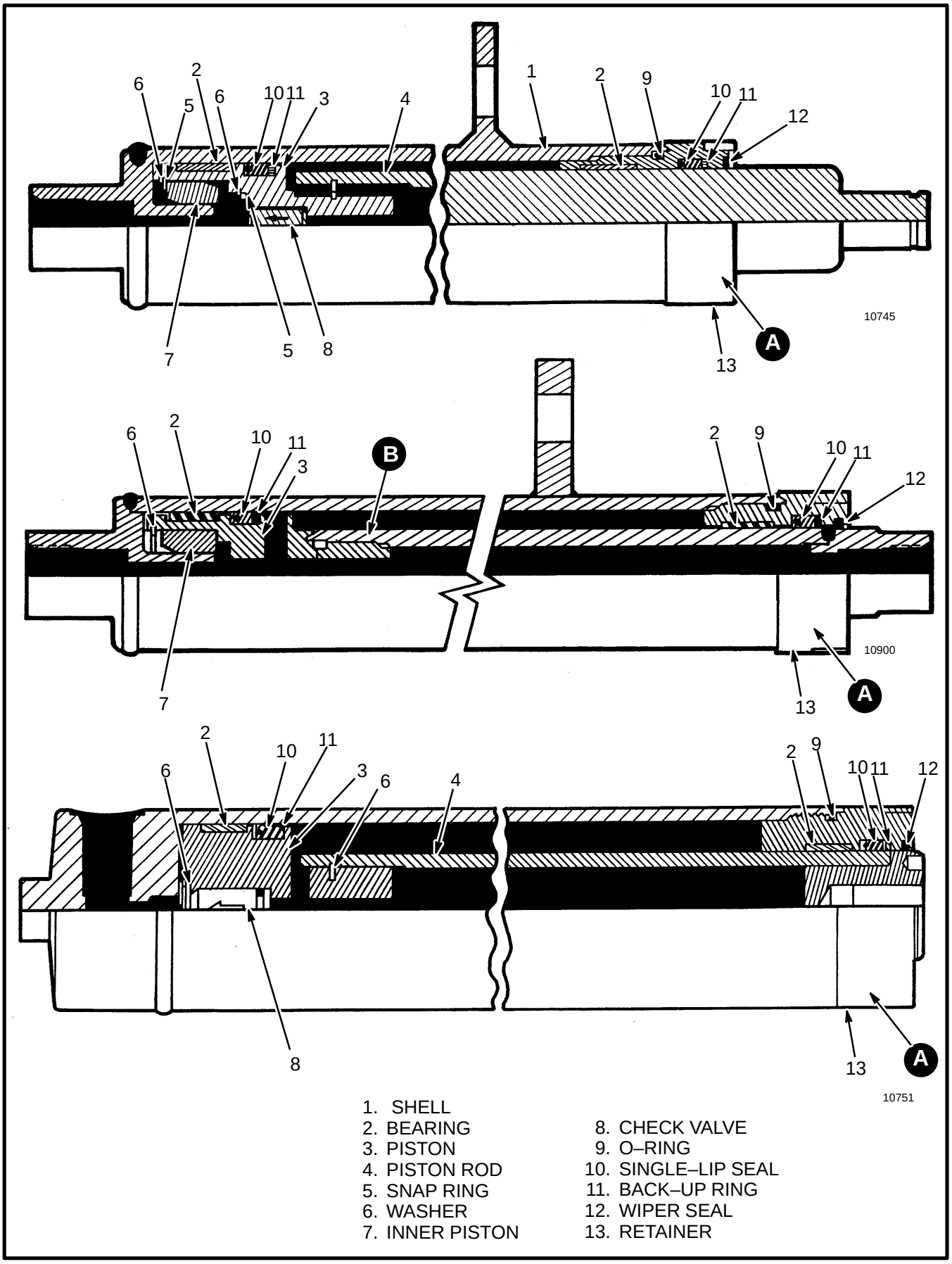
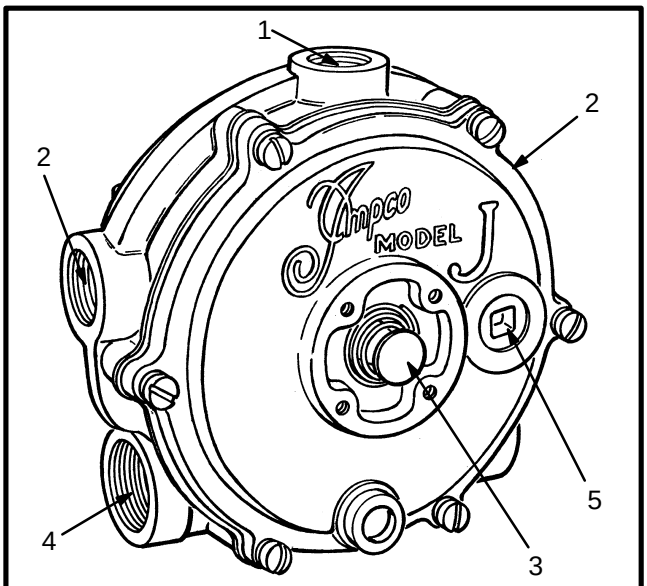


FIGURE 16. TYPICAL LIFT CYLINDERS, VISTA MASTS

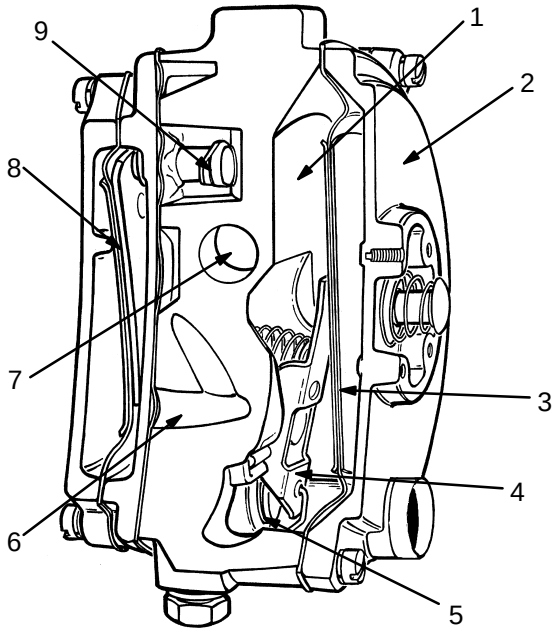
chamber leaves the vapor chamber to flow through the carburetor. The pressure on the vapor diaphragm then decreases. Air pressure on the other side of the vapor diaphragm pushes on the diaphragm and opens the vapor valve. The gas flows from the expansion chamber to the vapor chamber and then to the solenoid valve and carburetor. The pressure in the expansion chamber decreases and again the pressure reducer valve opens to repeat the operation. When the carburetor throttle is closed, the vacuum in the vapor chamber decreases and the vapor valve closes. The pressure in the vapor chamber stays at 10.3 kPa (1.5 psi).

A balance line connects the air pressure side of the vapor diaphragm to an air inlet port at the carburetor. If the air filter has a restriction, the pressure decreases in the carburetor and in the vapor chamber of the vaporizer. When a balance line is not installed, this decrease can cause the diaphragm to move and open the vapor valve. When a balance tube is connected, the restriction causes an equal decrease on both sides of the diaphragm. The balance line prevents an increase in the fuel mixture in the carburetor. A button in the housing can be used to manually open the vapor valve. LPG vapor then flows to the carburetor for starting the engine.

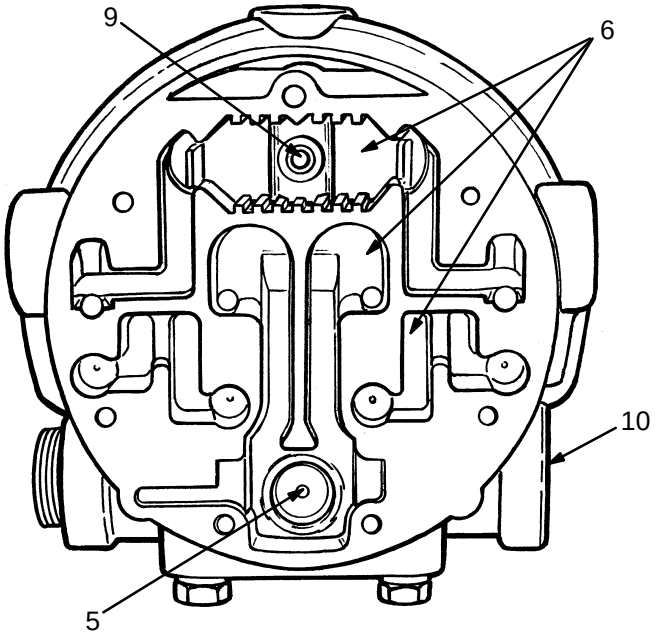


1. FUEL INLET
2. COOLANT PORTS
3. BUTTON FOR LOW PRESSURE VALVE
4. FUEL OUTLET
5. BALANCE LINE PORT

FIGURE 5. VAPORIZER

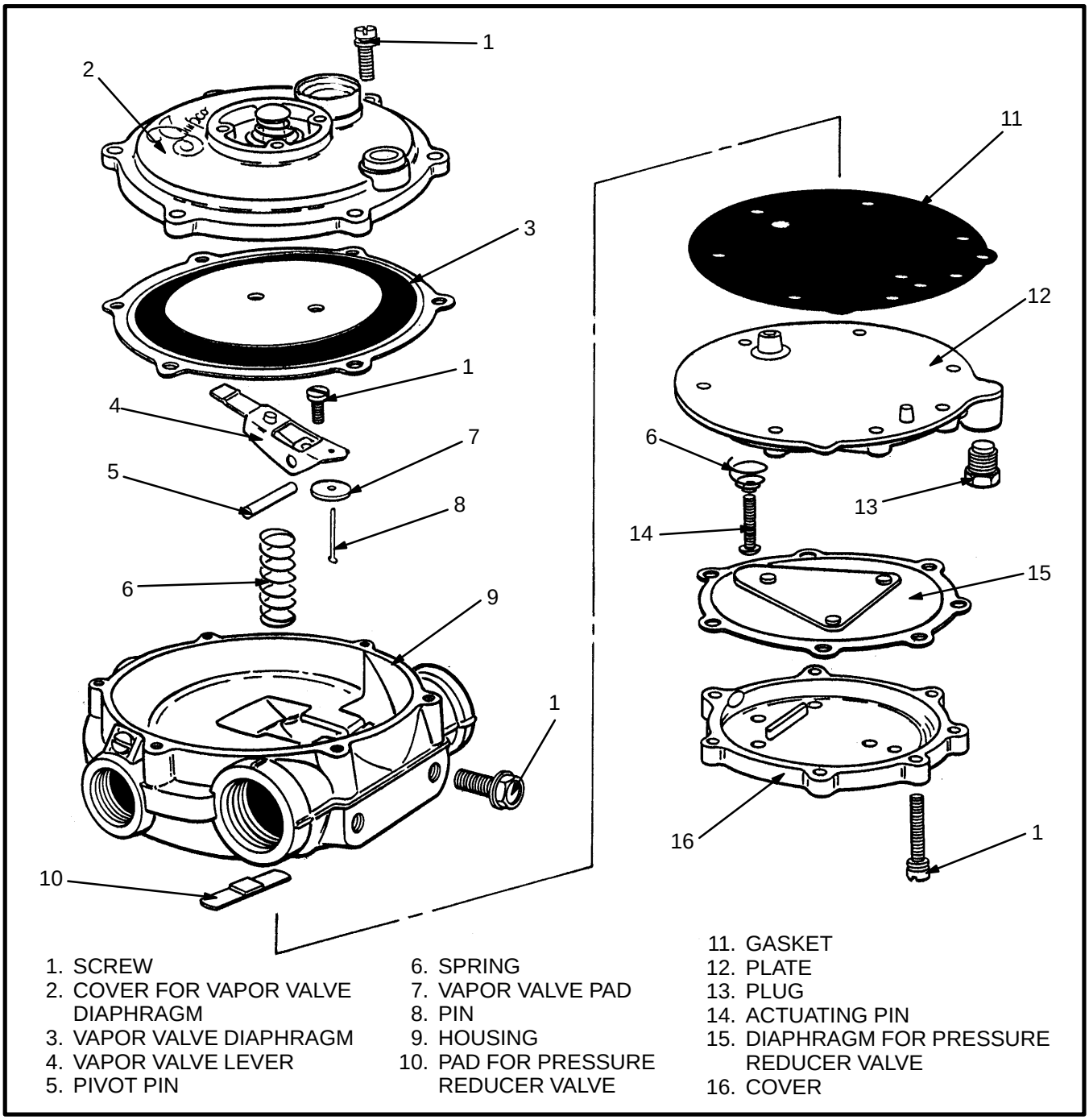


1. VAPOR CHAMBER
2. COVER
3. DIAPHRAGM FOR VAPOR VALVE
4. VAPOR VALVE LEVER
5. VAPOR VALVE



6. EXPANSION CHAMBER
7. COOLANT PASSAGE
8. DIAPHRAGM FOR PRESSURE REDUCER VALVE
9. PRESSURE REDUCER VALVE
10. OUTLET

FIGURE 6. INSIDE THE VAPORIZER



1. SCREW
2. COVER FOR VAPOR VALVE DIAPHRAGM
3. VAPOR VALVE DIAPHRAGM
4. VAPOR VALVE LEVER
5. PIVOT PIN
6. SPRING
7. VAPOR VALVE PAD
8. PIN
9. HOUSING
10. PAD FOR PRESSURE REDUCER VALVE
11. GASKET
12. PLATE
13. PLUG
14. ACTUATING PIN
15. DIAPHRAGM FOR PRESSURE REDUCER VALVE
16. COVER

FIGURE 21. PARTS OF THE VAPORIZER

TROUBLESHOOTING

Problem	Possible Cause	Correcting Action
The engine will not start easily. The vaporizer is freezing.	1. Low coolant level.	1. Check coolant level at radiator and coolant recovery reservoir. Fill to correct level.
	2. Water hoses have a restriction or are too small.	2. Make sure there is adequate water flow to vaporizer. Install larger hoses.
	3. Air lock in coolant line to the vaporizer.	3. Remove air from coolant line.
	4. Belt for water pump is loose or broken.	4. Adjust tension. Install new drive belt.
	5. Hose from vaporizer to carburetor has a leak.	5. Find and repair leak. Install new hose.
	6. Thermostat is not operating correctly.	6. Install new thermostat.
	7. Ignition system does not function correctly. Starter is damaged.	7. See troubleshooting chart ”Electrical System: Dual Fuel”,
	8. Idle mixture screw is not adjusted correctly.	8. Adjust idle mixture screw.
	9. Fuel valve in carburetor is damaged.	9. Install new fuel valve. Overhaul carburetor. Install new carburetor.
	10. Solenoid valve is disconnected or does not operate correctly.	10. Connect wire to solenoid. Install new solenoid valve.
	11. Air filter is dirty.	11. Check air restriction indicator. Clean or install new filter element.
	12. Balance line is disconnected.	12. Connect balance line.
	13. Accelerating too soon after engine is started.	13. Allow longer warm–up time before starting operation.
Engine idle speed is too high.	1. Idle mixture screw is not adjusted correctly.	1. Adjust idle mixture screw.
	2. Idle speed screw is loose.	2. Tighten screw and adjust idle speed.
	3. Idle control actuator is not adjusted correctly or the vacuum hose is disconnected.	3. Connect vacuum hose. Adjust the idle control actuator.
Engine does not run smoothly.	1. The governor is damaged.	1. Install new governor.
	2. Low pressure diaphragm or valve in vaporizer is damaged.	2. Repair or install new vaporizer.
	3. Wrong or damaged fuel valve in carburetor.	3. Repair or install new carburetor.
	4. PCV system has a restriction.	4. Remove restriction. Install new PCV valve.
	5. Air leaks in the intake manifold.	5. Repair leaks.
	6. Balance line has a restriction.	6. Remove restriction.

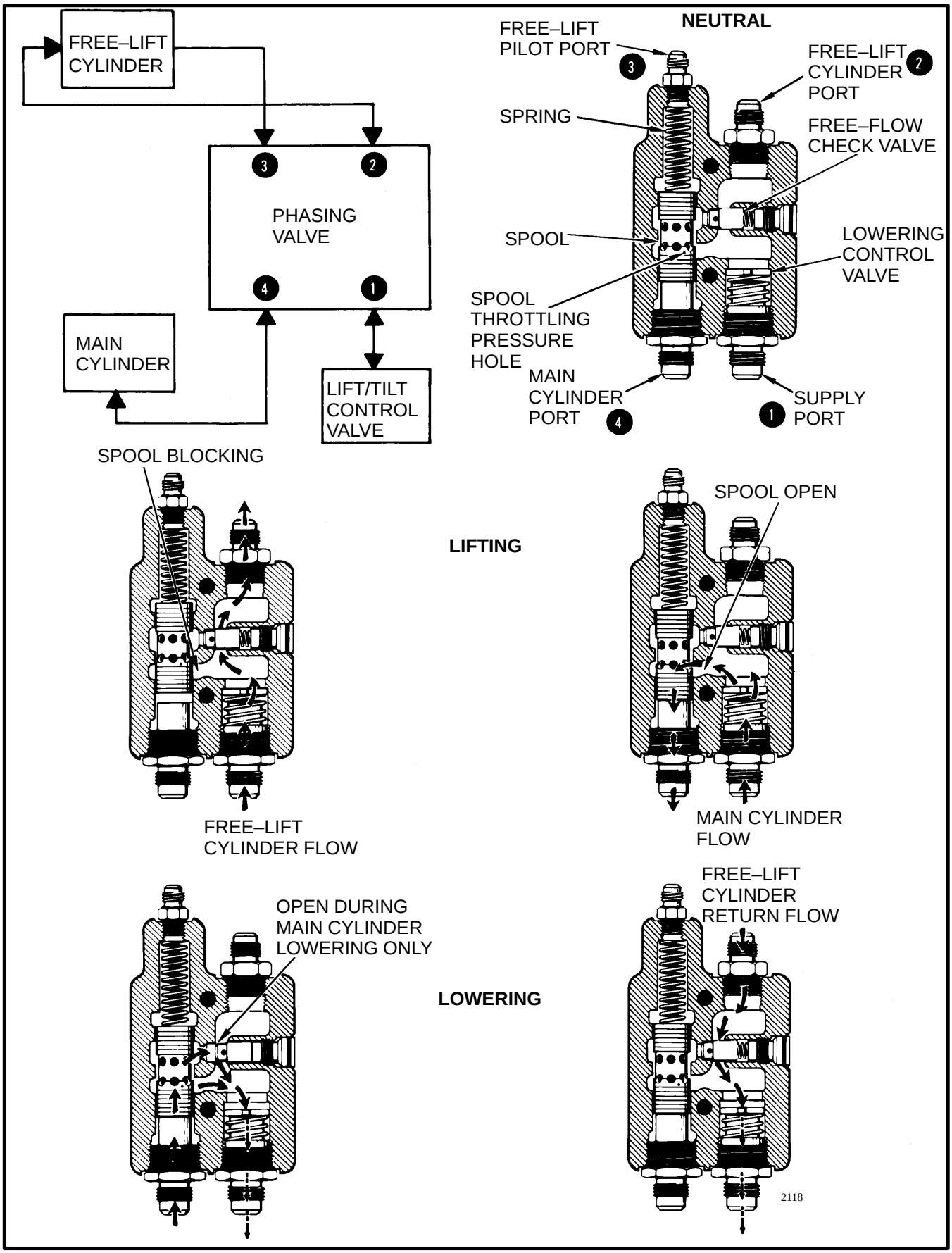


FIGURE 8. SEQUENCE VALVE

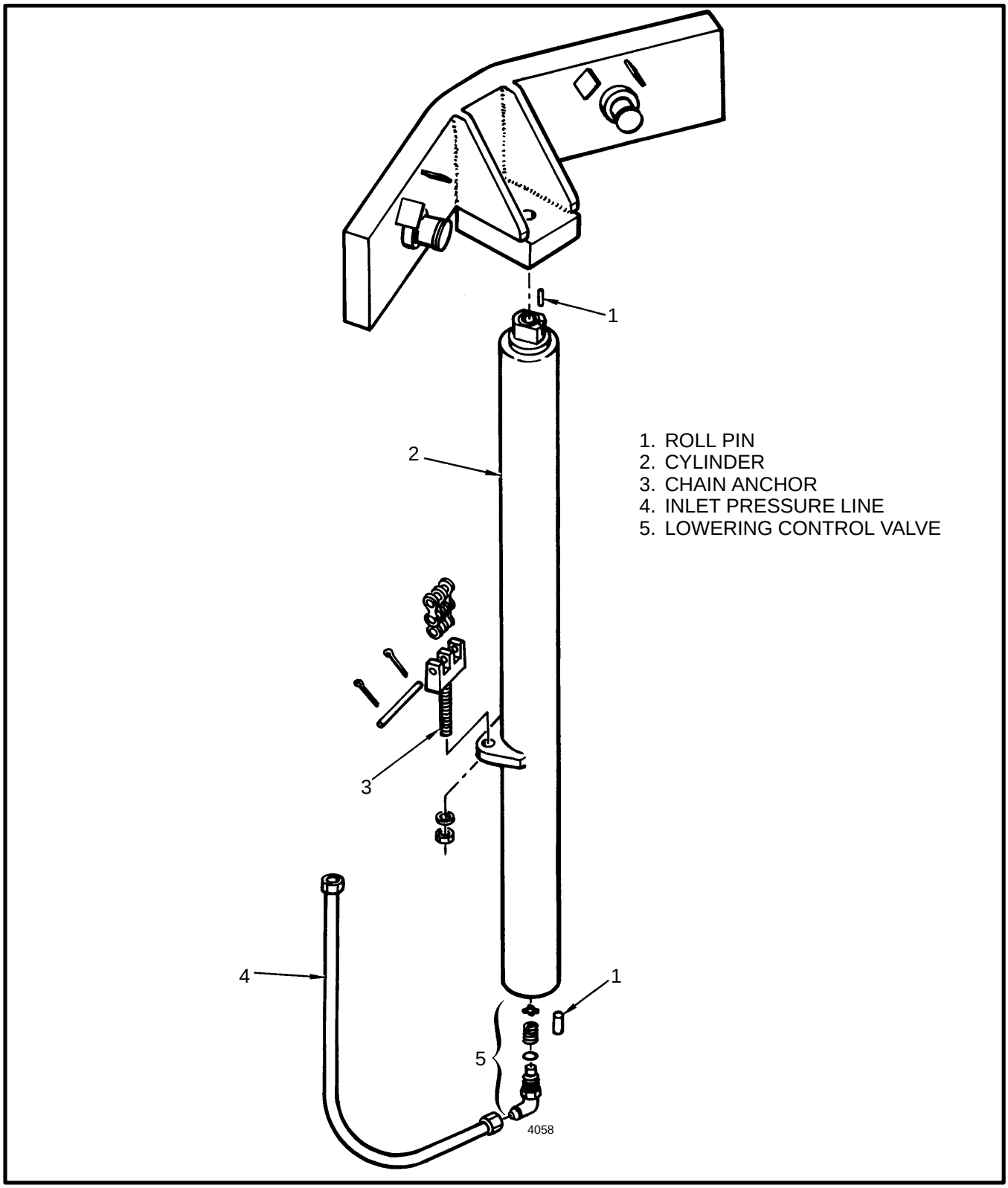


FIGURE 5. MAST WITH A MAIN LIFT CYLINDER (2 of 2)

4. Remove the main lift chains

5. Slide the inner channel out of the bottom of the next outer channel until there is access to the load rollers. See FIGURE 6.

TROUBLESHOOTING

TROUBLE	POSSIBLE CAUSE	PROCEDURE OR ACTION
No movement of the lift or tilt cylinders.	Linkage at the control valve is disconnected.	Connect and adjust linkage.
	No oil or not enough oil in the hydraulic tank.	Fill tank. Check for leaks.
	Relief valve is not set correctly.	Adjust or install new relief valve.
	Hydraulic pump does not operate or has damage.	Repair or install new pump.
Slow movement of the lift or tilt cylinders.	No oil or not enough oil to the lift cylinders.	Fill tank. Check for leaks.
	Cylinders have internal or external leaks.	Repair leaks. Install new parts.
	Relief valve is not set correctly.	Adjust or install new relief valve.
	There is a restriction in a hydraulic line.	Remove restriction. Install new parts.
	Load is more than capacity.	Reduce load.
	Hydraulic control linkage is incorrectly adjusted.	Adjust the linkage.
Rough movement of the mast assembly.	There is air in the hydraulic system.	Remove air. Check for loose connections or breaks in lines.
	Lift cylinder(s) is damaged.	Repair or install new lift cylinder.
	Mast weldments are damaged or not aligned.	Align weldments. Install new parts.
	Mast weldments are not lubricated correctly.	Correct lubrication.
Lift or tilt cylinders extend or retract when the control valve lever (spool) is in the Neutral position.	Load check valve/s and spool/s have damage.	Repair or install new load check valve and spool.
	Cylinder seals have leaks.	Install new seals.
	Hydraulic lines have leaks.	Repair leaks. Install new parts. Remove air from the system.
	Leaks between the spool and the bore.	Install new spool and O–ring seals.

6. Cut the wire and remove the two lock screws from the clutch shaft. Pull the clutch fork shaft through the fork for the release bearing. Slide the release bearing from the input shaft. Remove the capscrews, bearing retainers, shims and bearing cups from the ends of the two main shafts. Keep the shims separate as a reference for assembly.

7. Remove the capscrews and pull the input shaft and bearing retainer from the housing. To remove the retainer from the bearing, remove the snap ring from the groove in the retainer. Put the side of the retainer with the gear on blocks. Use a brass hammer or a press to push the shaft and bearing from the retainer. Remove the snap ring from the shaft. Use a tool for removing bearings as a support for the bearing. Put the tool between the bearing and the gear. Use a press to push the shaft through the bearing. See FIGURE 14. and FIGURE 15.

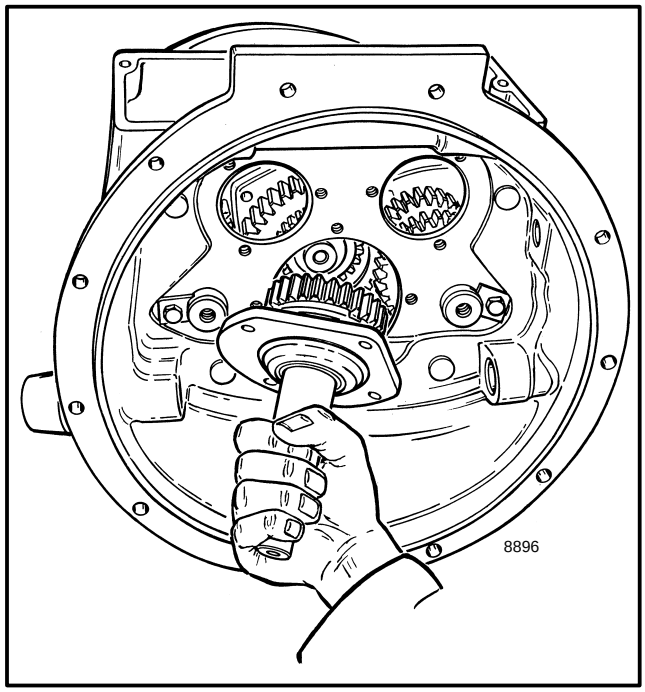


FIGURE 14. REMOVE THE INPUT SHAFT AND BEARING RETAINER

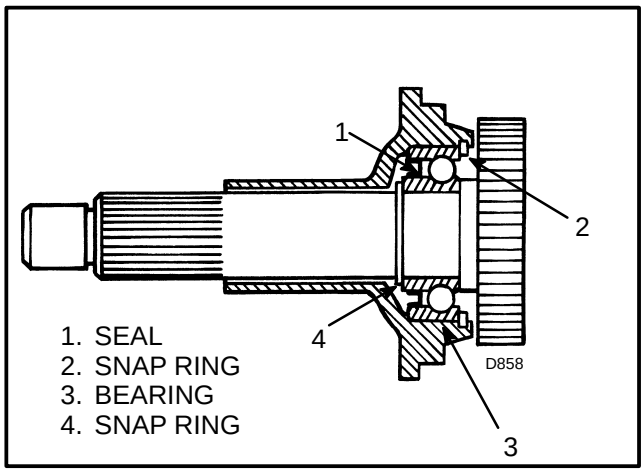


FIGURE 15. INPUT SHAFT ASSEMBLY

8. Turn the transmission so that the clutch housing is on two large blocks. The blocks must be in a position to permit the main shafts to be removed from the housing. Remove the capscrews and washers from the output end of the shaft.

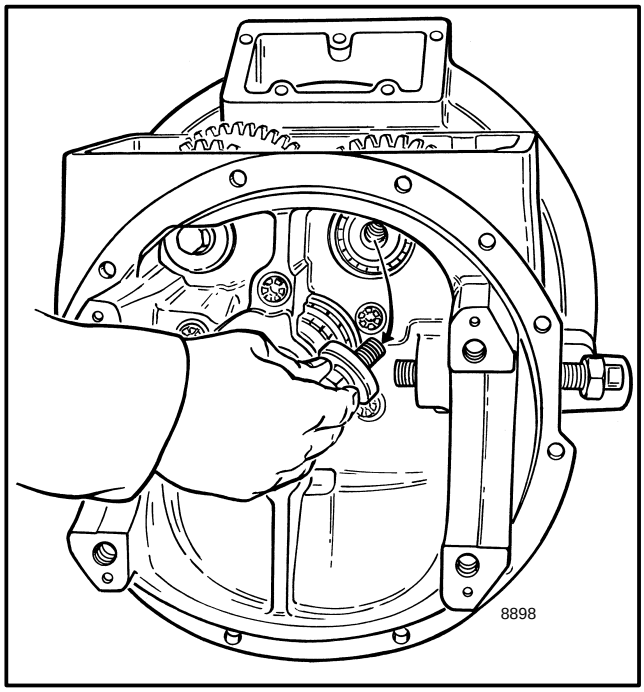


FIGURE 16. REMOVE CAPSCREWS AND WASHERS FROM MAIN SHAFTS

9. Put two wood wedges between the forward gear and the housing. Use a soft drift to push the direction shaft toward the clutch housing. Remove the direction main

shims, O–ring and cover. Install the capscrews and tighten them to 10 to 15 foot pounds (13 to 20 Nm).

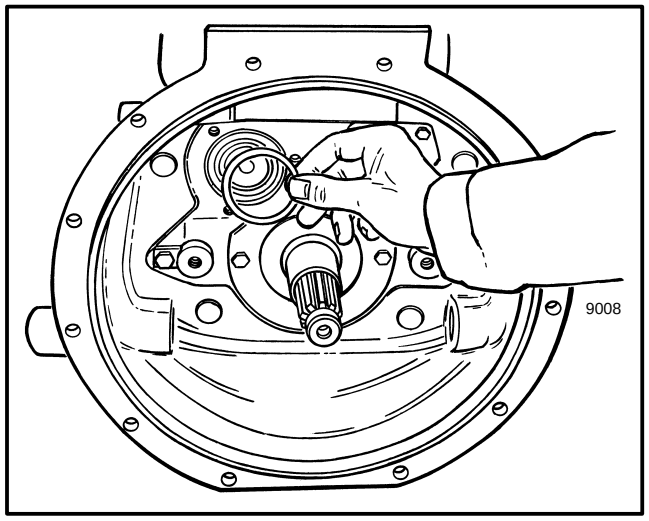


FIGURE 44. ADJUST THE BEARING PRELOAD WITH SHIMS

19. Check the torque needed to keep the shaft turning. See Step 17. for the procedure and specifications.

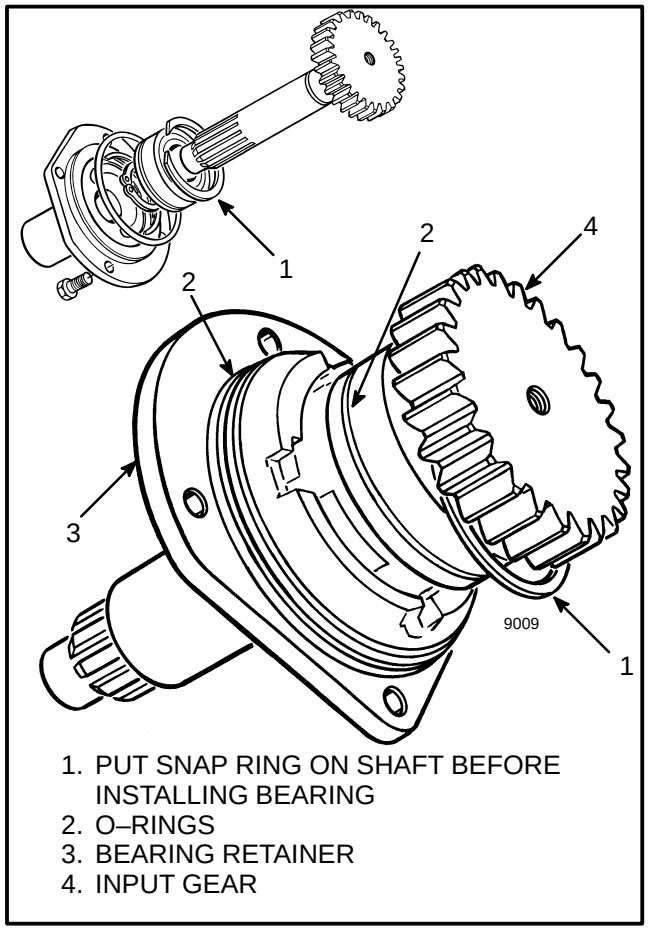


FIGURE 45. ASSEMBLE THE INPUT SHAFT ASSEMBLY

20. When both main shafts have the correct preload on the bearings, assemble and install the input shaft assembly. Put the large snap ring on the shaft before installing the bearing. Use a press to install the bearing on the input shaft. The seal in the bearing must be toward the splines on the shaft. Install the snap ring on the shaft. Install the bearing retainer on the bearing and install the snap ring in the retainer. Install the O–ring. Install the assembly in the housing and tighten the capscrews to 10 to 15 foot pounds (13 to 20 Nm). See FIGURE 45.

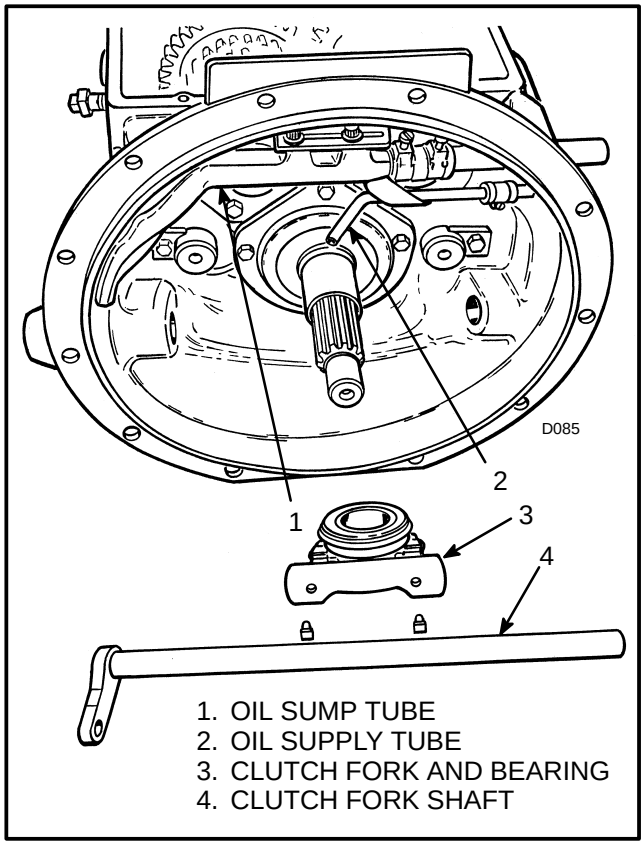


FIGURE 46. CLUTCH HOUSING

21. Slide the clutch bearing and fork on the input shaft. Slide the shaft through the housing and fork. Install and tighten the screws that hold the fork to the shaft. Use wire to hold the screws in position.

22. Replace the gasket for the cover for the control forks. Put the forks in the Neutral Position. Make sure the sliding sleeves are in the Neutral position. Install the cover. Make sure the forks are engaged with the grooves in the sliding sleeves. See FIGURE 47.

23. Install the oil sump tube and oil supply tube. Do not tighten the two capscrews until transmission is fastened to the engine.

INTRODUCTION

GENERAL

This section has the instructions that are necessary for correct periodic maintenance. This section has two parts: Maintenance Schedule and Maintenance Procedures. The Maintenance Schedule has the maximum time in intervals between maintenance checks. The Maintenance Procedures has the instructions for doing the maintenance checks.

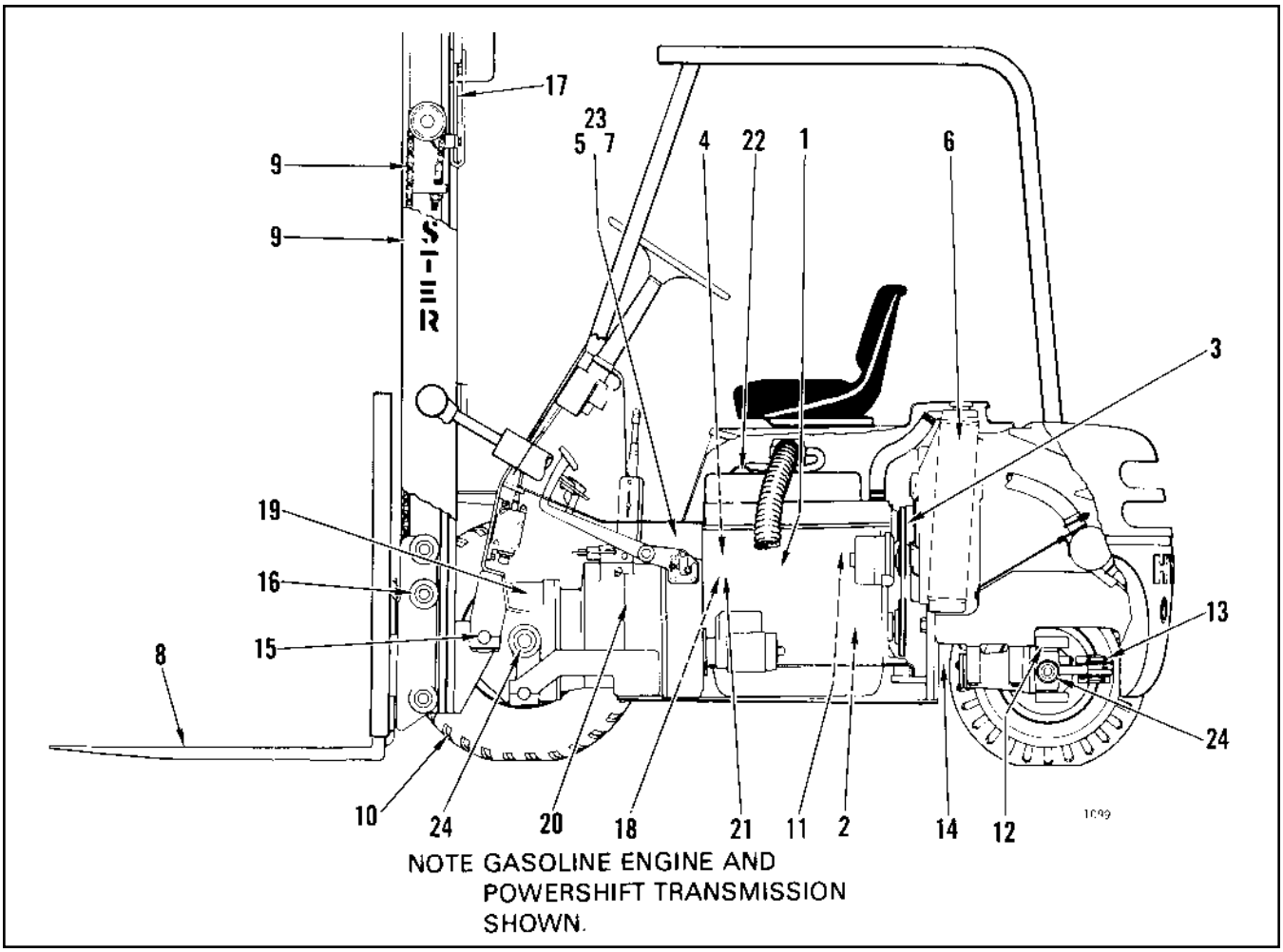


FIGURE 1. MAINTENANCE POINTS

MAINTENANCE SCHEDULE

The Maintenance Schedule is a program that includes periodic inspection and lubrication. The schedule used the operating hours on the hour meter. The table for the Maintenance Schedule has two schedules: the hour schedule and the period schedule. If the lift truck is operated more than eight hours each day, the hour schedule must be used. If the lift truck is operated less than eight hours each day, the period schedule must be used. The numbers in the column on the left of the Maintenance Schedule are used with Figure 1.

CAUTION

The maintenance schedules are made according to the maximum service intervals. Service the lift truck more often when operating in bad conditions.

REMOVING AIR FROM THE DIESEL FUEL SYSTEM (See Figure 12)

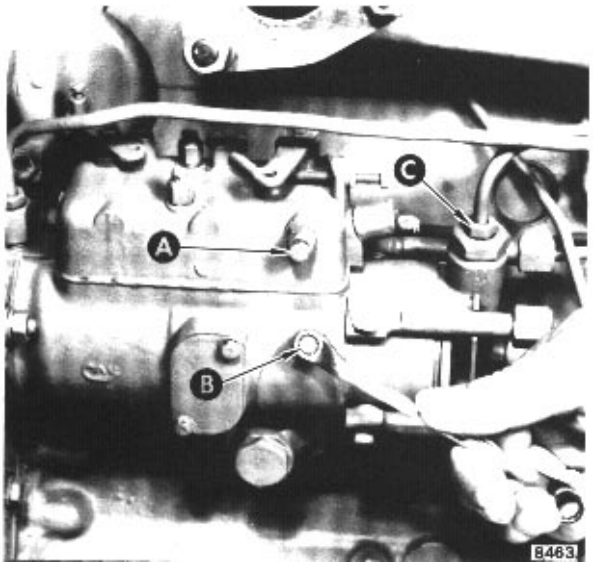


FIGURE 12. REMOVING AIR FROM DIESEL FUEL SYSTEM

Air must be removed from the diesel fuel system if the engine has run out of fuel or when a fuel line has been disconnected. Remove air from the fuel system as follows:

CAUTION

Do not start the engine until air is removed from the fuel system.

A. Loosen vent screw A at the fuel injector pump. (See Figure 12.)

B. Loosen vent screw B at the pump. (See Figure 12.)

C. Operate the lever under the fuel pump. When fuel that is without air bubbles comes from each screw, close the vent screws in the following sequence.

1. Vent screw B
2. Vent screw A

D. Loosen the top nut C for the fuel tube at the fuel injector pump. (See Figure 12.)

E. Operate the lever under the fuel pump until fuel without bubbles comes out of the threads. Tighten the nut.

F. Loosen the nuts for the lines at two injectors.

G. Start the engine. Tighten the nuts to 15 foot pounds (20 N.m) when fuel, free from air bubbles, comes from the threads.

EVERY 1000 HOURS OR SIX MONTHS

CHANGING THE GASOLINE FUEL FILTER

The filter element for gasoline must be replaced at the intervals shown in the Maintenance Schedule.

CHANGING THE FUEL FILTER FOR LPG

Remove the filter from the filter unit as described in the LPG SYSTEM.

CHECKING THE IGNITION SYSTEM

Replace the spark plugs and check the ignitin timing. Adjust as necessary.

CHECKING THE SERVICE BRAKES (See Figure 13)

A. The master cylinder is under the floor plate on the right side of the lift truck. Checks for leaks and correct operation.

D. Install the oil pump drive gear to the pump. Make sure the flat face of the drive gear is outward. Press the gear just past the snap ring groove on the oil pump shaft. Install the snap ring on the oil pump shaft.

E. Apply RTV sealant compound on a new gasket for the oil pump. Install the oil pump to the engine.

F. Install the oil pump idler gear and thrust washer. Install the snap ring on the idler gear shaft.

G. Install the oil suction tube on the oil pump.

H. Install the oil pressure tube on the oil pump.

RELIEF VALVE (See Figure 7)

The relief valve for the oil pressure is set to release pressure at 50 to 65 psi (345 to 448 kPa).

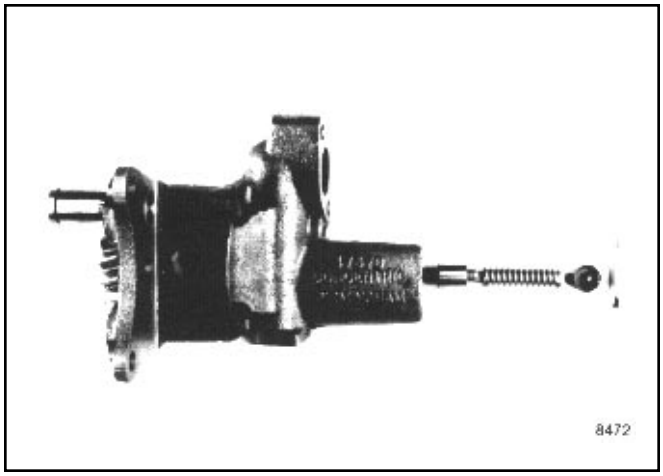


FIGURE 7. RELIEF VALVE FOR THE OIL PRESSURE

TIMING GEAR CASE AND CAMSHAFT

TIMING GEAR COVER

REMOVAL

A. See cooling system for removing water pump.

B. Remove the crankshaft pulley.

C. Remove the timing gear cover.

INSTALLATION

A. Install a new crankshaft seal into the cover. Make sure it is installed as shown in Figure 8. The outer face of the seal must be 0.25 in (6.35 mm) Below the surface of the cover.

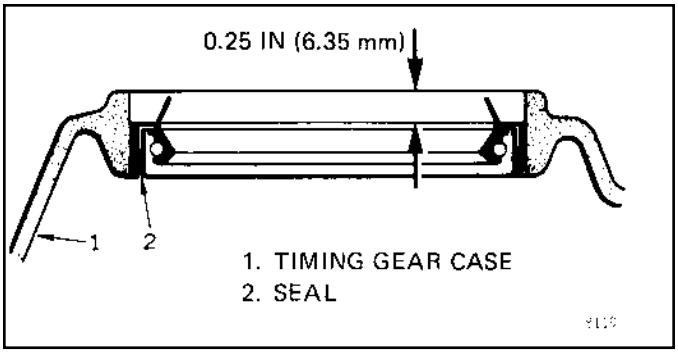


FIGURE 8. CRANKSHAFT SEAL

B. Apply RTV sealant compound to a new gasket for the cover. Install the cover to the engine.

C. Before tightening the cover capscrews, make sure to put the crankshaft pulley on the crankshaft. This aligns the oil seal correctly.

D. Tighten the crankshaft capscrew to 110 foot pounds (149 N.m).

TIMING GEARS (See Figure 9)

IDLER GEARS

CAUTION: Make sure to set the number 1 piston at TDC on the compression stroke before removing any timing gears. (When the engine is set this way, all the timing marks on the timing gears will align (See Figure 9).

REMOVAL

A. Remove the timing case cover as described in Timing Gear Case.

B. Remove the oil fitting from the lower idler gear.

C. Remove the nuts, washers and the plates from the lower gear and upper gear.

FUEL INJECTORS

CHECKING THE FUEL INJECTORS COLD START AID

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

A. Start the engine and run it at half speed.

B. Loosen the fitting for the high pressure fuel line at the injector. If the engine speed does not change, the injector has a defect.

C. Use an injector tester to check the pressure at which the nozzle operates. (See Figure 29). The operating pressure is listed on page 29.

D. To change the pressure at which the nozzle operates, remove cap, loosen lock nut and turn adjusting screw.

E. Check the spray pattern of the nozzle. If the spray pattern is not correct, the needle valve is not seated correctly against the valve seat. Remove carbon deposits or replace parts as required.

REPAIRS

Unless special equipment is available, do not repair the fuel injector.

INSTALLATION

A. Clean the fuel injector. Clean the seal for the fuel injector in the cylinder head. Make sure the old copper washer is removed.

B. Install a new copper washer on the fuel injector. The correct thickness is 0.030 in (0.76 mm). Install the injector into the cylinder head.

C. Tighten the fuel injector nuts evenly to 12 pounds (15 N.m).

D. Connect the fuel lines to the fuel injectors. Tighten the fittings on the high pressure fuel lines to 15 foot pounds (20 N.m).

E. Remove the air from the fuel system as described in Checks and Adjustments.

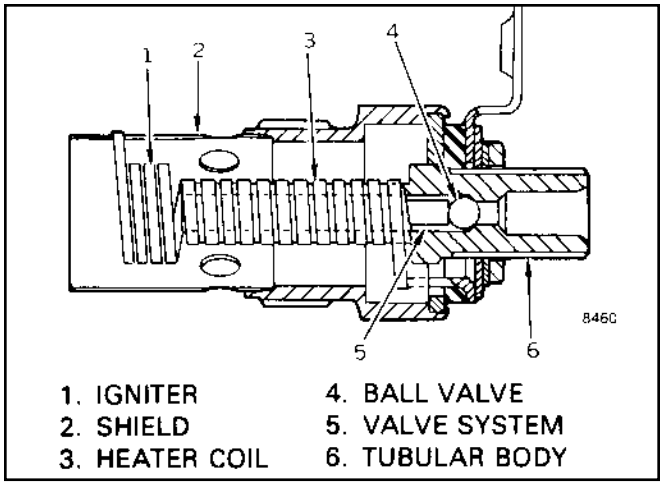


FIGURE 24. COLD START AID

DESCRIPTION (See Figure 24)

The cold start aid is used to help start a cold engine. It is installed in the intake manifold. Pushing the button for the cold start aid heats the body of the cold start aid. When heated, hot air and fuel enter the intake manifold. This mixture then enters the combustion chamber for starting.

REMOVAL

A. Disconnect the fuel line at the cold start aid. Put a cap on the fuel line.

B. Disconnect the wire at the cold start aid.

C. Remove the cold start aid.

INSTALLATION

A. Install the cold start aid in the intake manifold.

B. Connect the wire to the cold start aid.

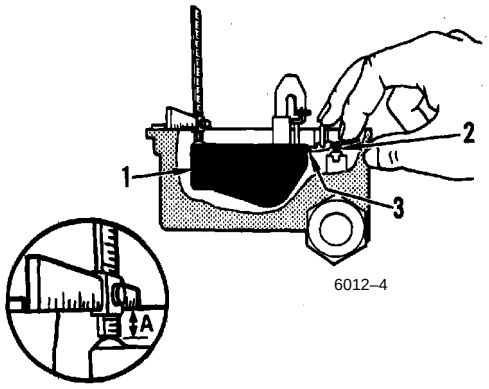
C. Remove air from the fuel line as follows:

1. Rotate the engine until fuel flows from the fuel line.

2. Connect the fuel line to the cold start aid.

D. Start the engine and check for leaks and correct operation.

Outer Valve Spring	
Installed Length	1.500 in (38.10 mm)
Rocker Arm Shaft	
Length	16.875 in (428.62 mm)
Outside Diameter	0.622-0.624 in (15.80-15.84 mm)
Rocker Arm	
I.D. of Bushing	0.624-0.626 in (15.86-15.89 mm)
LUBRICATION SYSTEM	
Oil Pump	
Inner Rotor to Outer Rotor Clearance	0.002-0.004 in (0.06-0.11 mm)
Inner Rotor End Clearance	0.002-0.004 in (0.04-0.09 mm)
Outer Rotor End Clearance	0.001-0.003 in (0.03-0.08 mm)
Relief Valve	
Pressure Setting	50-65 psi (345-448 kPa)
Oil Filter	
By-Pass Valve Pressure Setting	13-17 psi (90-117 kPa)
TIMING CASE, TIMING DRIVE AND CAMSHAFT	
Camshaft Gear	
Bore Diameter	2.000-2.001 in (50.80-50.83 mm)
O.D. of Camshaft Hub	2.000-2.001 in (50.80-50.83 mm)
Crankshaft Gear	
Bore Diameter	1.500-15.01 in (38.09-38.13 mm)
Crankshaft Diameter for Gear	1.500-1.501 in (38.09-38.13 mm)
Idler Gears and Hubs	
Bore Diameter of Gears	2.000-2.001 in (50.79-50.82 mm)
O.D. of Hub	1.996-1.997 in (50.70-50.72 mm)
Gear End Clearance	0.001-0.007 in (0.02-0.18 mm)
Fuel Injection Pump Gear	
Bore Diameter	1.750-1.751 in (44.45-44.47 mm)
O.D. of Pump Shaft	1.748-1.749 in (44.40-44.42 mm)
Idler Gear For Oil Pump	
Bore Diameter	0.750-0.751 in (19.05-19.07 mm)
O.D. of Bushing	0.752-0.753 in (19.10-19.13 mm)
I.D. of Bushing	0.656-0.657 in (16.67-16.69 mm)
O.D. of Gear Shaft	0.655 in (16.63-16.64 mm)
Camshaft	
O.D. of No. 1 Bearing Surface	1.869-1.870 in (47.47-47.50 mm)
O.D. of No. 2 Bearing Surface	1.859-1.860 in (47.22-47.24 mm)
O.D. of No. 3 Bearing Surface	1.839-1.840 in (46.71-46.74 mm)
End Clearance	0.004-0.008 in (0.10-0.20 mm)

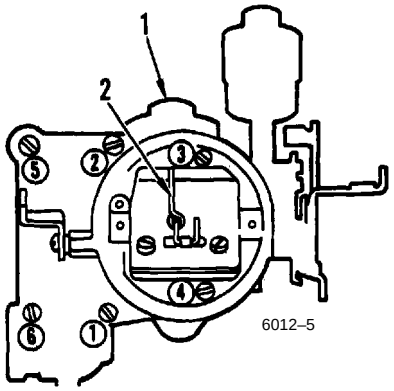


1. FLOAT
2. FLOAT NEEDLE
3. BEND HERE TO ADJUST

STEP 4.

Use a special tool to install the seat for the float needle. Install the needle in the seat. Install the pin to the float then install the float assembly. Make sure that the pin is installed correctly.

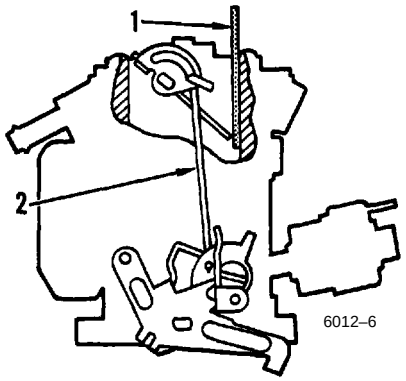
Check the height of the float. Hold the retainer pin and push the float as shown. Bend the arm of the float as shown until dimension “A” is 3.2 mm (0.125 in).



1. DIAPHRAGM
2. PLUNGER

STEP 5.

Install the body of the choke assembly to the float bowl assembly. Use a new gasket during installation. Tighten the screws as shown in the sequence. Install the diaphragm and the cover to the carburetor. Make sure that the actuator rod is installed correctly.



1. 2.03 mm (0.080 in) GAUGE
2. BEND THE ROD HERE TO ADJUST

STEP 6.

ADJUSTMENT OF THE CHOKE ROD

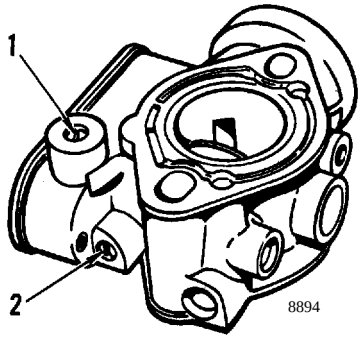
1.Turn the cam until the throttle linkage is against the second position for fast idle (See FIGURE 11.). Hold the cam and the throttle linkage at this position.

2. Close the choke plate. Put a gauge or drill of 0.080 inch (2.03 mm) between the choke plate and the bore of the carburetor.

3. Bend the choke rod as shown to get the correct clearance.

FIGURE 8. ASSEMBLY OF THE CARBURETOR (SHEET 2 OF 3)

HOOF Type Governor USED ON EARLIEST GM 6–250 and 4–153 ENGINES



1. MAIN ADJUSTING SCREW
2. SECONDARY ADJUSTING SCREW

FIGURE 19. GOVERNOR ADJUSTMENTS

2. If the governor control operates too slowly, there will be a large variation between the load and no load engine speeds. Turn the secondary adjusting screw counter-clockwise 1/4 turn at a time. Turn the main adjusting screw one full turn clockwise each time the secondary adjusting screw is turned 1/4 of a turn.

When the adjustments are complete, install the following parts:

- brass lock washer (PART NO. 181764)
- plug (PART NO. 181765)

Make sure the tab of the lock washer engages the slot of the adjusting screw. If these parts are not installed, the governor will not stay in adjustment and there can be a leak in the intake system.

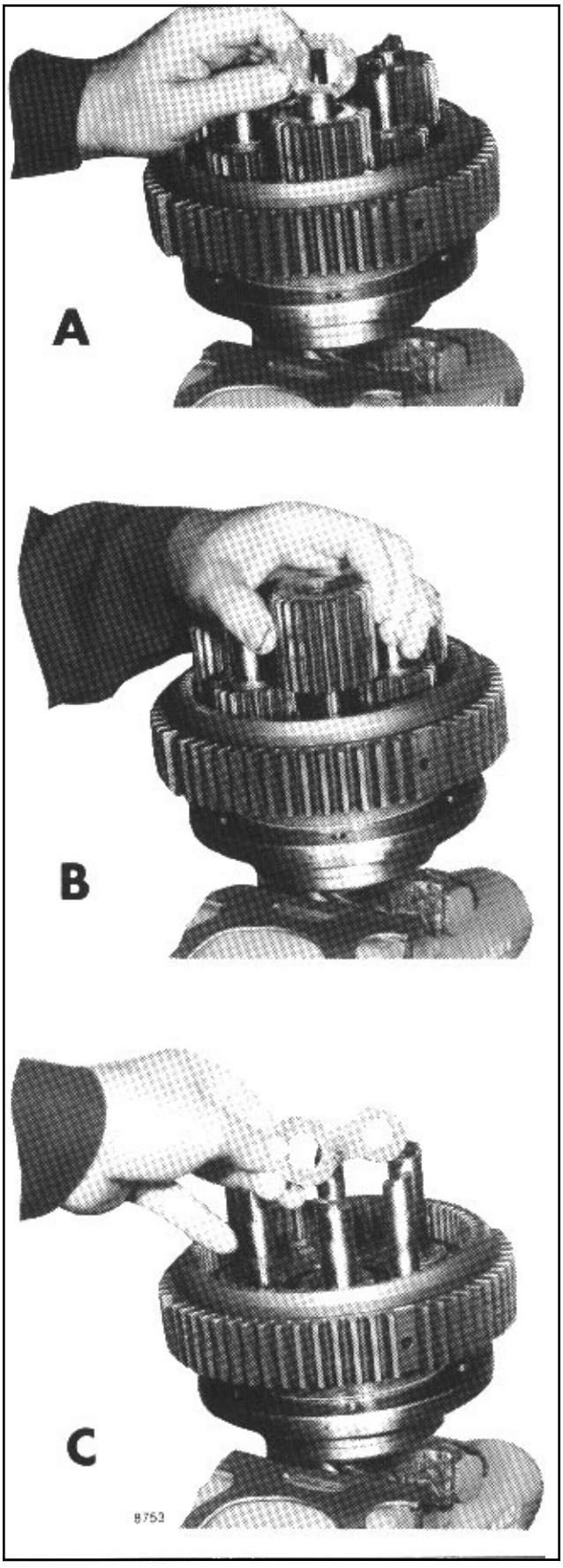


FIGURE 24. DISASSEMBLING THE PLANETARY GEAR CARRIER

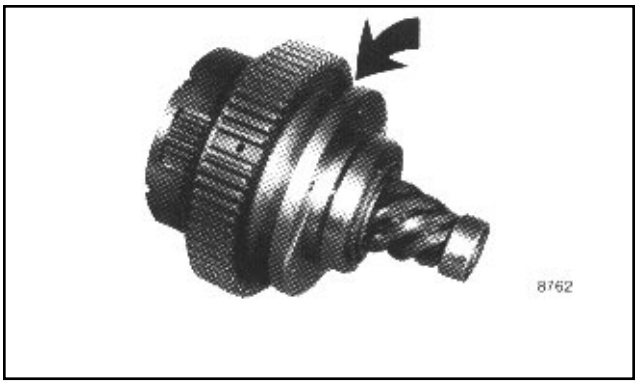


FIGURE 25. CHECK THE CLEARANCE HERE

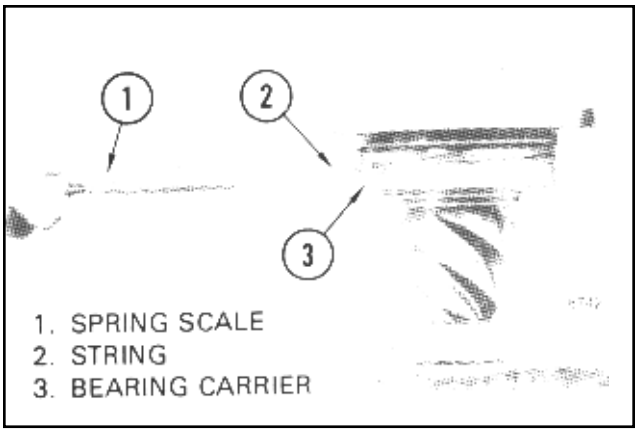


FIGURE 26. CHECKING THE PRELOAD OF THE PINION BEARINGS

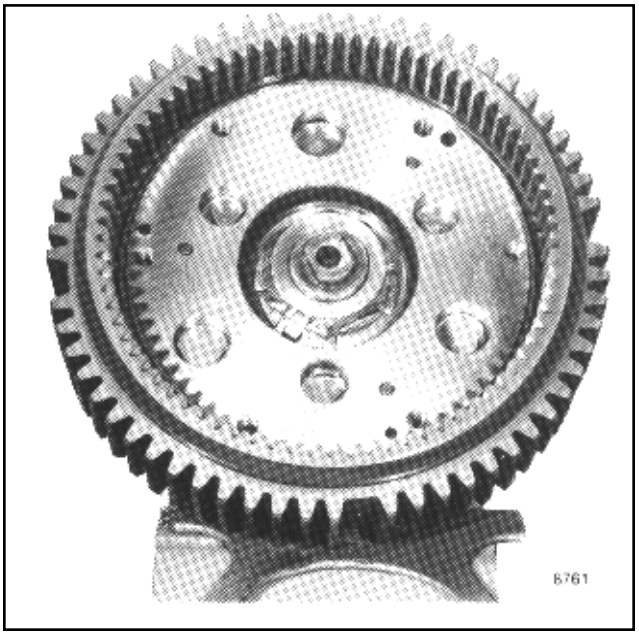


FIGURE 27. REMOVING LOCK PLATE AND NUT

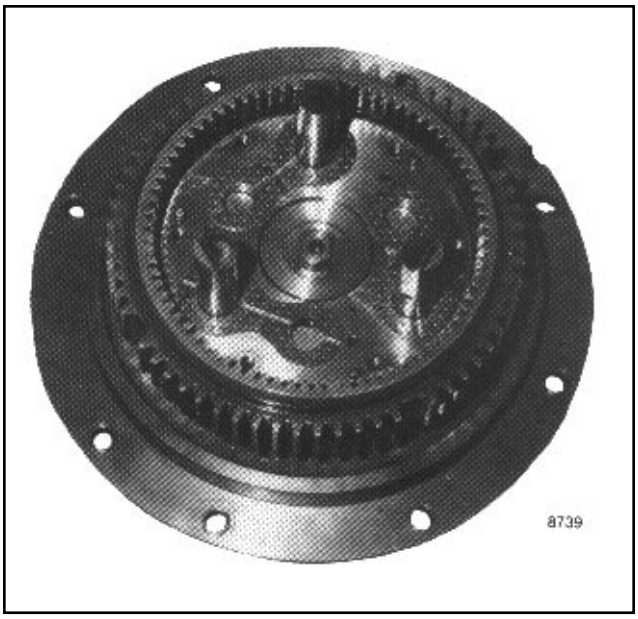


FIGURE 48. INSTALLING THE PLANETARY GEAR SHAFTS AND THRUST WASHERS

Q. Lubricate with hydraulic oil and install the six shafts and the three double thrust washers. The bronze side of the thrust washer must be toward the planetary gears. See Figures 48 and 49.

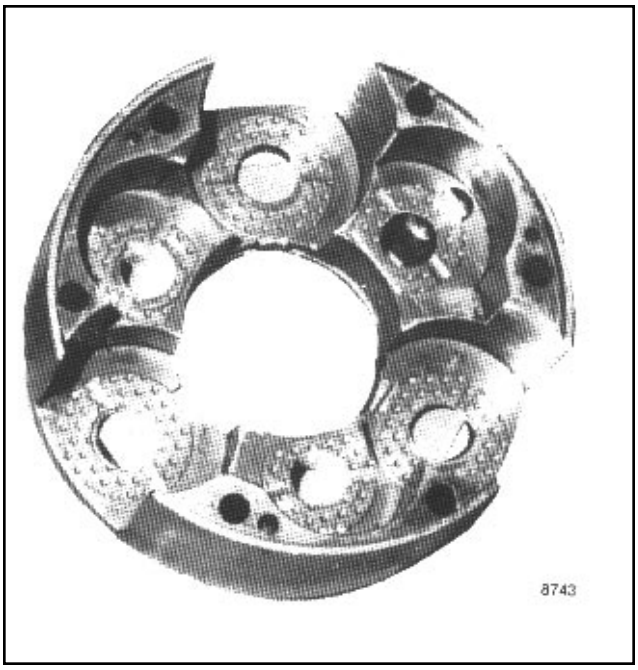


FIGURE 49. INSTALLING THE THRUST WASHERS

R. Install the three long and three short planetary gears. Use a light grease to hold the thrust washers in position on the planetary carrier. Put the planetary carrier over the gears. Install the capscrews and tighten to 20 foot pounds (27 N.m). Align the shafts and install the thrust plate. Use Loctite 290 and tighten the screws with an allen wrench to 86 inch pounds (0.97 N.m). See Figure 50.

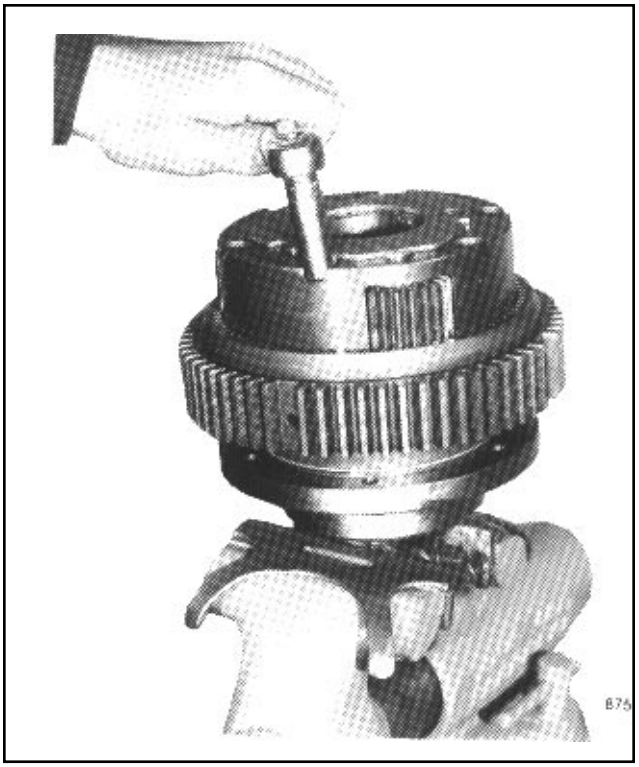


FIGURE 50. TIGHTENING THE CAPSCREWS

S. Put an O-ring on the pinion bearing carrier and install the shims that were removed. Install the assembly in the transmission housing. Install the capscrews and tighten to 35 foot pounds (46 N.m).

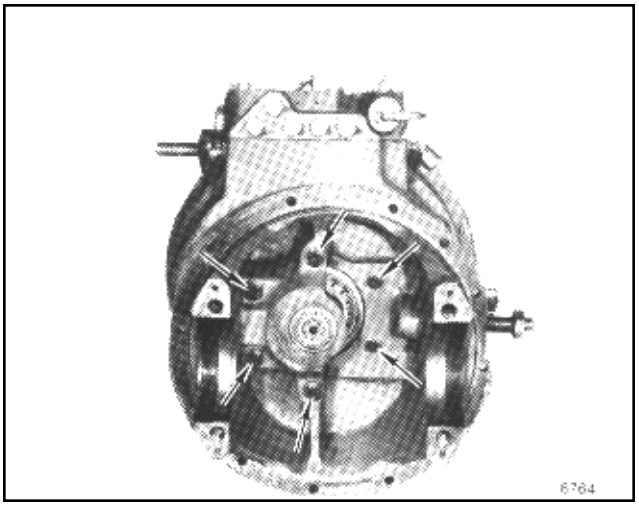


FIGURE 51. CAPSCREWS FOR THE PINION BEARING CARRIER

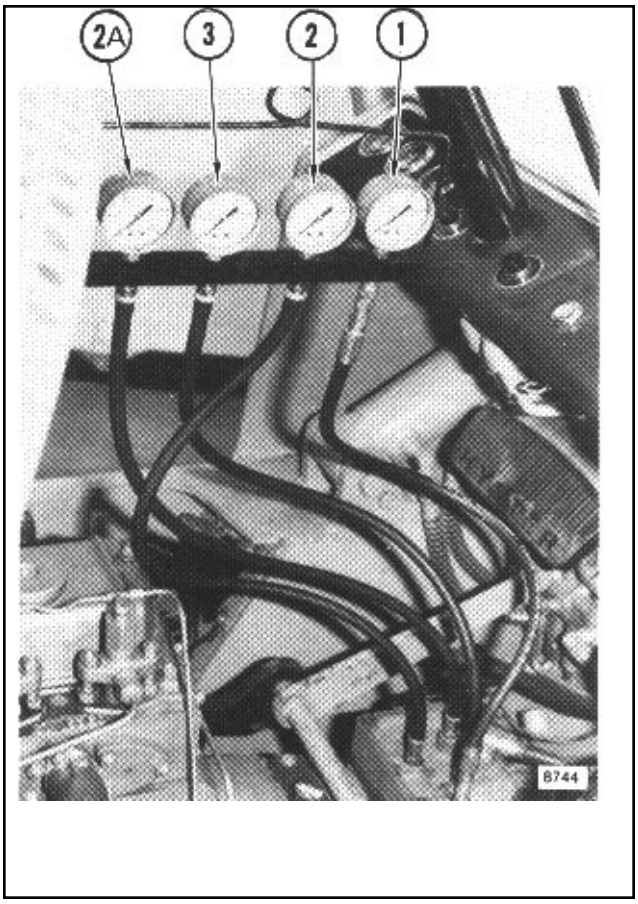


FIGURE 74. CHECKING TRANSMISSION PRESSURES

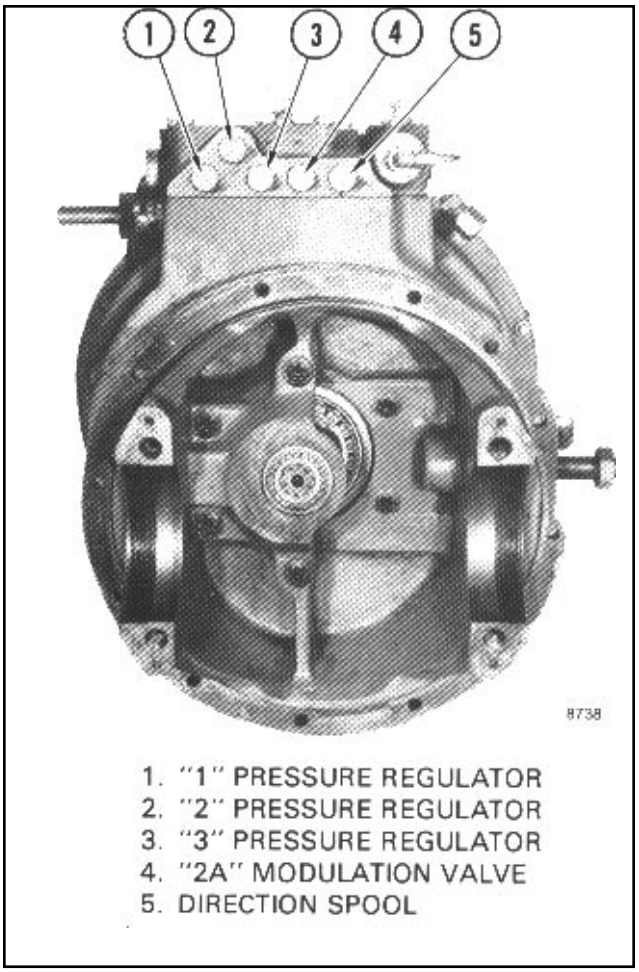


FIGURE 76. VALVE LOCATION

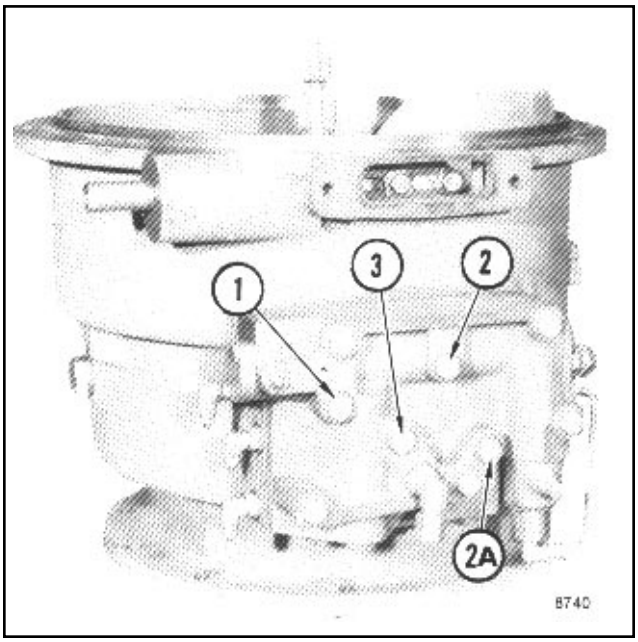


FIGURE 75. TEST PORT LOCATION

Monotrol Pressure

A. To test the Monotrol control circuit, read the gauge installed in the "1" test port.

B. Apply the parking brake and run the engine at 1000 revolutions per minute. The pressure indication on the "1" gauge must be 95 to 100 psi (655 to 690 k Pa).

C. Put the transmission in the forward position. Release the parking brake. Run the engine at 1000 revolutions per minute. The "1" and "2" gauge indications must not decrease momentarily by more than 10 psi.

D. Run the engine at 1000 revolutions per minute and change the transmission to the reverse position. The "1" and "2" gauges must indicate a momentary decrease and then return to normal.

PROBLEM	CAUSE
Gear noise only when turning	Worn spider gears Worn side gears or thrust washers Worn differential case
Shocks felt when changing direction	Worn ring and pinion Worn differential case Worn spider Axle or side gear splines worn Loose ring gear bolts Worn bearings
Gear noise only in "Reverse"	Loose pinion nut
Loss or increase of oil	Seal between transmission and differential is bad Drain or fill plug loose Axle seals are damaged

SPECIFICATIONS

FLUID TYPE

H30-60H	SAE 10
H40-50J, 60JS	JOHN DEERE SPECIFICATIONS J20A TRANSMISSION AND HYDRAULIC OIL, ANTI -CHATTER

MANUFACTURER	BRAND NAME
Amoco Oil Co.	Amoco 1000 Fluid
Atlantic Richfield	Arco Tractor Fluid
Bessel-KOK	Tractor ELF 15W30
Chevron U.S.A.	Tractor Hydraulic Fluid
Exxon Company	Torque Fluid 56A
Getty Refining Company	Veedol Hydro Trans 303 Tagolene 303
Mobil Oil Co.	Mobilfluid 423
Pennzoil	Hydra-Tranz & Wet Brake Lube
Shell Oil Co.	Donax T4
Sun Oil Co.	Sunfleet TH Universal Tractor Fluid
Texaco	1893 TDH Oil
Union Oil Co.	Union Hydraulic/Tractor Fluid

equipped with a diesel engine and an oil clutch transmission, the oil flow is 2.5 gal/min (9.5 liters/min). The steering control unit controls and measures the oil flow to the steering cylinder when the steering wheel is operated.

The repairs for the steering control unit is described in 1600 SRM 54 THE STEERING CONTROL UNIT. The steering column assembly must be removed to repair the steering control unit. A drawing of the steering column assembly is shown in Figure 2.

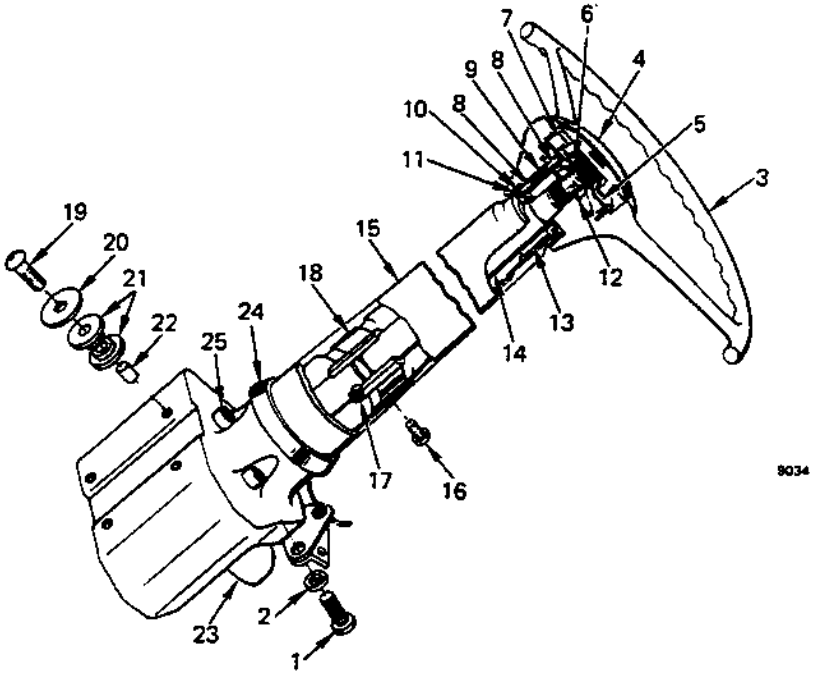
The steering cylinder actuates the linkage in the steering axle. The steering axle is connected to the counterweight and gives support and direction control to the lift truck. A center pivot connects the steering axle to the counterweight.

The steering cylinder (see Figure 3) has a piston rod that extends from one end of the cylinder shell. There are two walls in the cylinder shell. Hydraulic oil is sent to the cylinder through two ports at one end of the cylinder. One port permits oil flow to the piston and causes the rod to extend. The other port sends the oil flow between the inner and outer walls to the rod end of the cylinder. The oil flow and pressure causes the cylinder to retract. The piston has a small poppet valve. When the piston reaches the end of its stroke, the increased oil pressure opens the poppet valve. The oil flows from the high pressure to the low pressure side of the piston. This relief valve decreases high pressures in the steering cylinder.

The steering cylinder is a part of the drag link assembly. (See Figure 4). The tie rods are connected between the steering spindles and the center arm pivot. The drag link actuates the center arm pivot and turns the steering spindles.

Each spindle turns on two sets of needle bearings in the axle frame. Each hub and wheel assembly rotates on two sets of tapered roller bearings. The hub bearings are held in position by a castle nut and cotter pin.

The steering axle is fastened to the counterweight with four 3/4 UNC x 5 1/2 inch capscrews. The steering axle is articulated and is connected to the counterweight by a center pivot shaft (see Figure 7).



1. CAPSCREW (2 REQ'D.)
2. LOCKWASHER
3. STEERING WHEEL
4. HORN BUTTON COVER
5. CUP
6. SPRING
7. BASE PLATE
8. BRUSH
9. SPRING
10. CONTACT RING ASSEMBLY (WITH CABLE)
11. INSULATOR RING
12. JAM NUT (WITH WASHER)
13. BUSHING
14. SHAFT AND COUPLING
15. COLUMN
16. CAPSCREW
17. SNAP RING AND PIN
18. RETAINING RING
19. SCREW
20. SPECIAL WASHER
21. ISOLATOR
22. SPACER
23. GROMMET
24. CAPSCREW (4 REQ'D.)

FIGURE 2. STEERING COLUMN ASSEMBLY

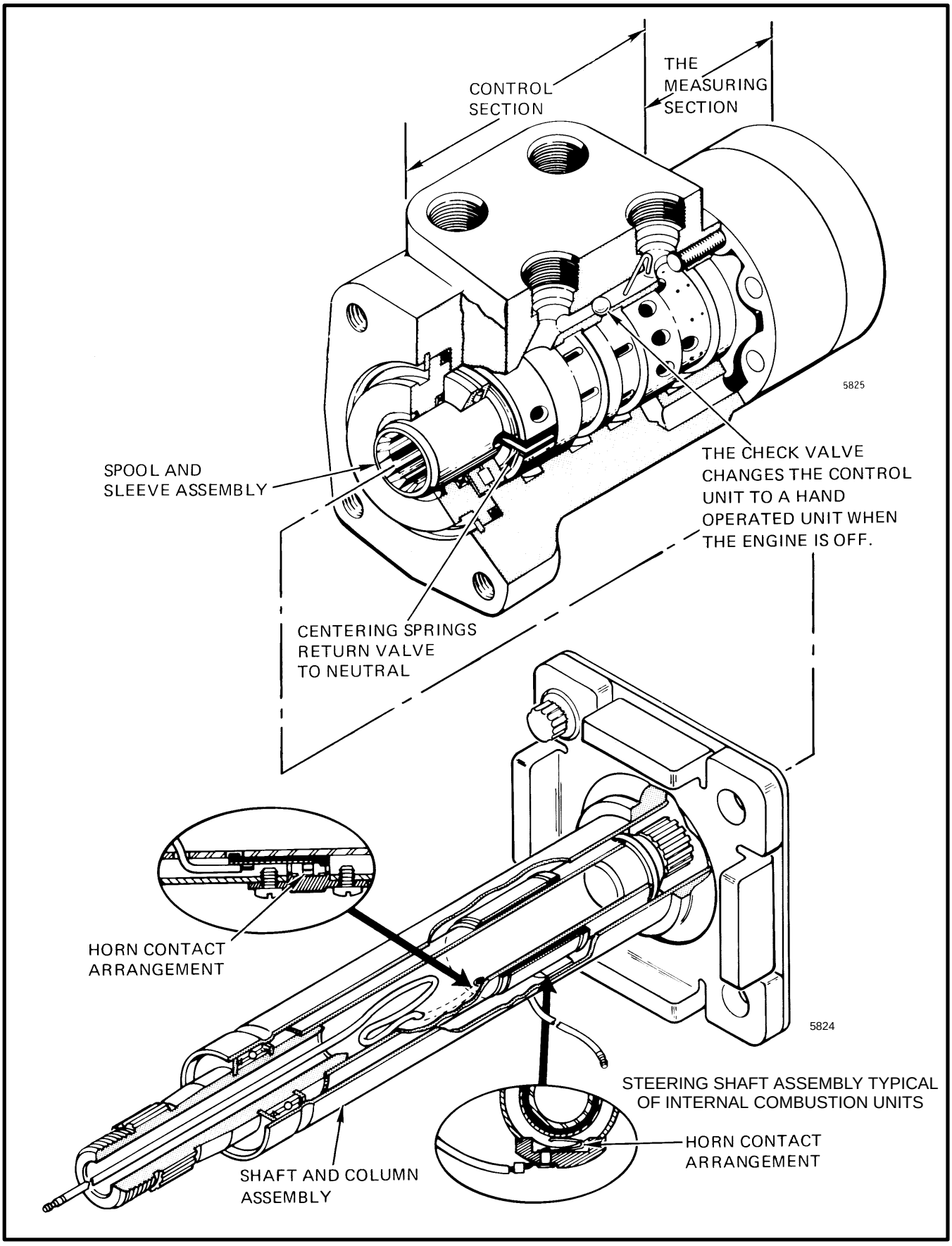
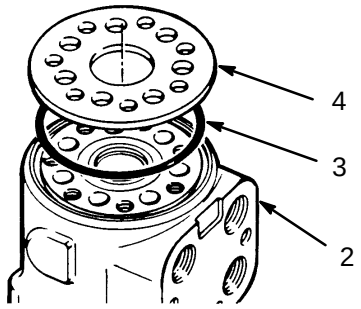
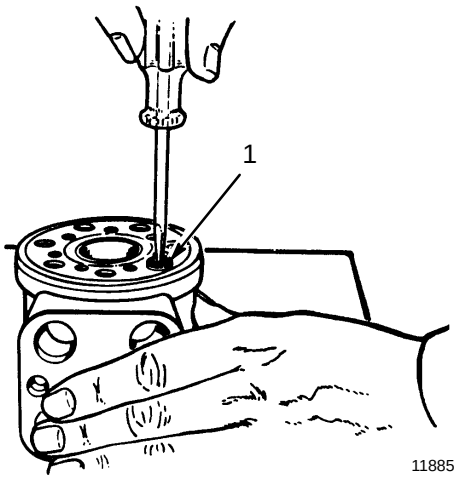


FIGURE 1. STEERING CONTROL UNIT

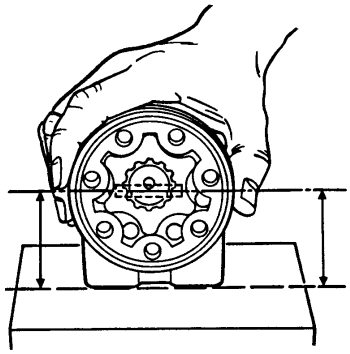
STEP 5. When the check valve is at the end of the housing as shown here, install the check ball and sleeve. Make sure the sleeve is even with or below the surface of the housing (2). Lubricate the O–ring (3) and install the O–ring and port plate (4). Align the holes in the port plate with the holes in the housing.



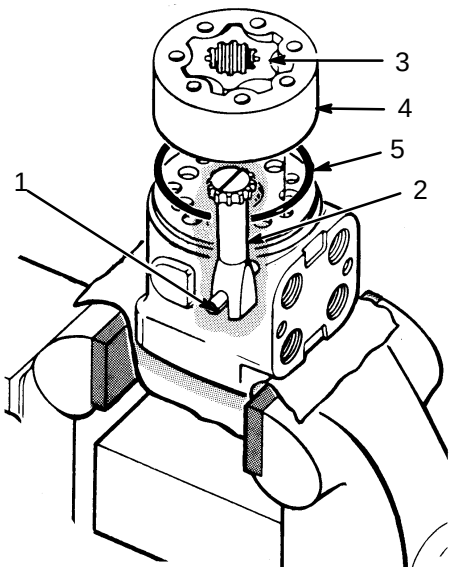
1. CHECK BALL SLEEVE
2. HOUSING
3. O–RING
4. PORT PLATE



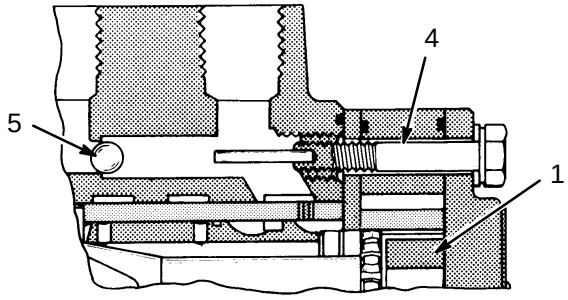
STEP 6. Install the center shaft (2) so that it engages with the center pin (1) in spool and sleeve assembly. Make sure the center pin is still parallel to the surface with the ports. Install the rotor (3) on the center shaft. Make sure that a valley in the rotor aligns with the slot (center pin) in the center shaft. Install the O–ring (5) and stator (4). Make sure to align the marks made during disassembly.

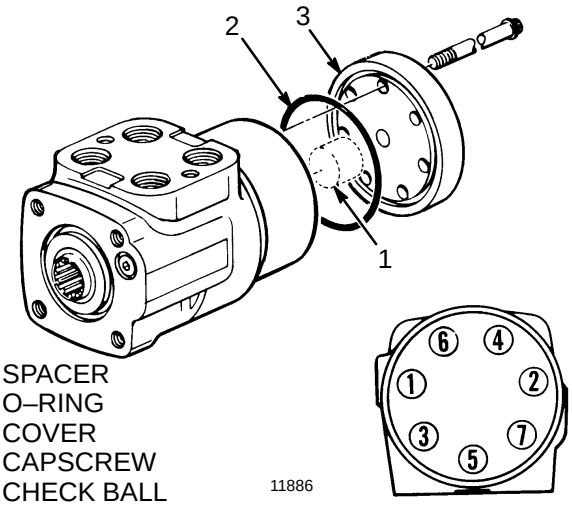


1. CENTER PIN
2. CENTER SHAFT
3. ROTOR
4. STATOR
5. O–RING



STEP 7. When used, install the spacer (1). Install the O–ring (2) and the cover(3). Tighten the capscrews for the cover in the sequence shown to 17 Nm (150 lbf in), then tighten them to 30 Nm (265 lbf in). Make sure the capscrew (4) with the pin fits in the hole for the check ball (5).





1. SPACER
2. O–RING
3. COVER
4. CAPSCREW
5. CHECK BALL

FIGURE 6. ASSEMBLY OF THE STEERING CONTROL UNIT (3 of 4)

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