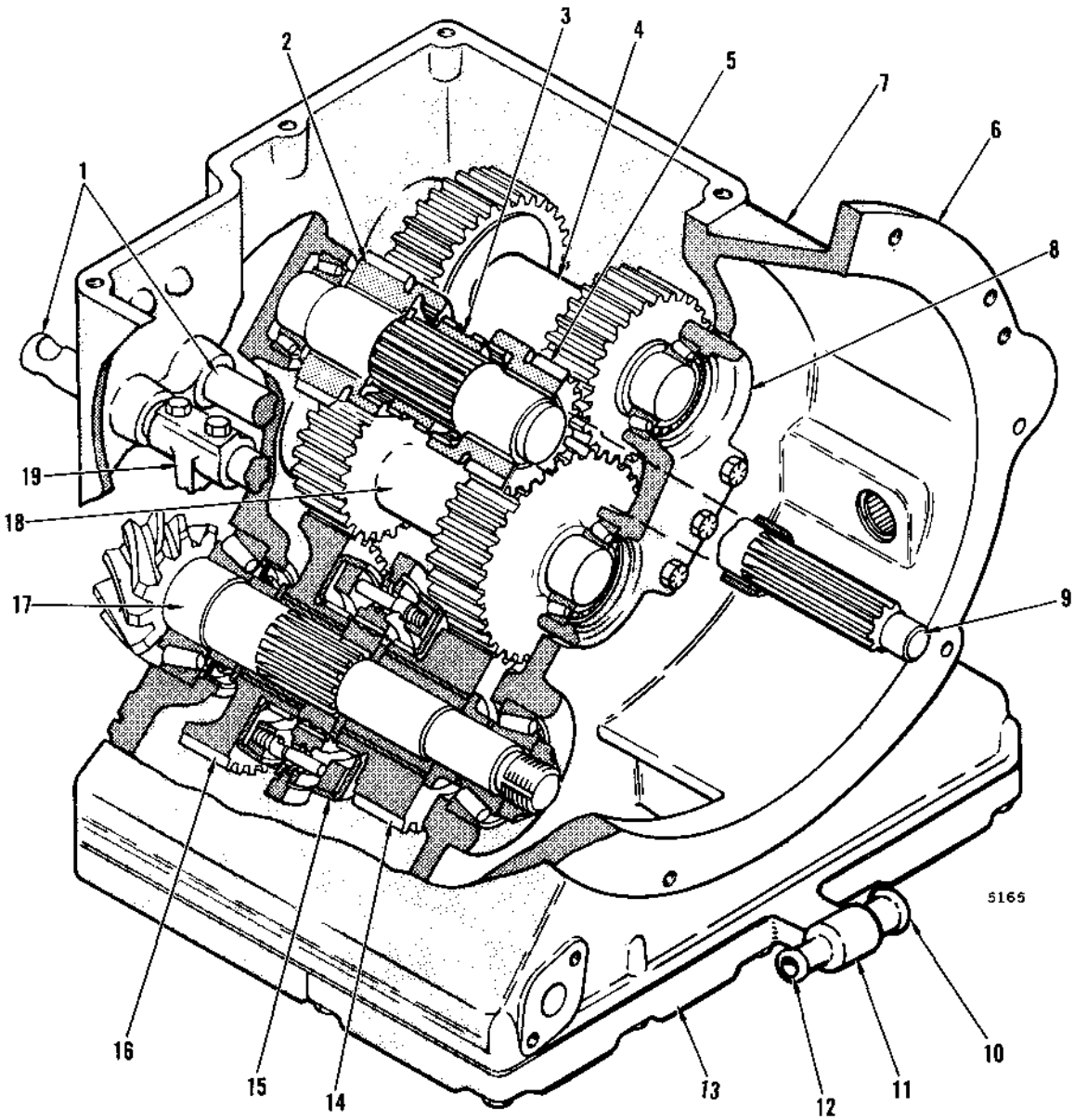
INTRODUCTION

GENERAL

This section has the description and the repair procedures for the two speed manual transmission used with the oil clutch. The repair procedures for the differential are also in this section. A troubleshooting section is included at the end of the section.

DESCRIPTION

The manual transmission has two speeds in both the forward and reverse directions. It has an input shaft, a forward idler gear, a range idler gear and an output shaft. The input shaft, forward idler gear and range idler gear are held in the transmission by the bearing carrier. The output shaft is in the lower part of the



1. SHAFTS FOR FORKS
2. FORWARD GEAR
3. SLIDING SLEEVE
4. FORWARD IDLER GEAR
5. REVERSE GEAR
6. LOCATION OF SERIAL NUMBER
7. TRANSMISSION HOUSING
8. BEARING CARRIER
9. INPUT SHAFT
10. FROM PUMP
11. TEE
12. TO FLOW CONTROL VALVE
13. SUMP COVER
14. HIGH GEAR
15. SYNCHRONIZER ASSEMBLY
16. LOW GEAR
17. OUTPUT SHAFT
18. RANGE IDLER GEAR
19. FORK

FIGURE 1. MANUAL TWO-SPEED TRANSMISSION

A. Remove the upright assembly as described in the section for THE UPRIGHT.

B. Drain the fluid from the differential and axle housing assemblies.

C. Remove the inspection cover from the differential.

CAUTION

When disconnecting the differential from the transmission, use blocks or slings to give support to the transmission.

D. Check the contact pattern and the gear clearance between the pinion and the ring gear. The procedure is described in Assembly Of The Differential.

E. Remove the six capscrews that hold the differential housing to the transmission. Make sure that the transmission has support.

F. Disconnect the axle assemblies from the lift truck as described in THE DRIVE AXLE section.

G. Roll the axle and differential assembly from the lift truck.

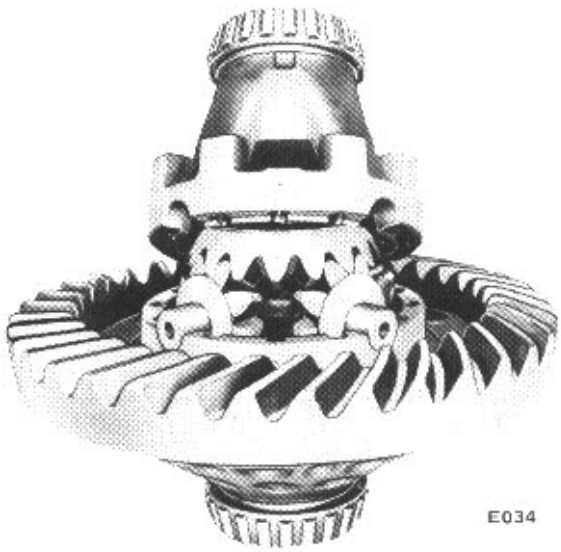
H. Pull the axle housing from the differential housing.

DISASSEMBLY

A. Make a mark between the bearing support plates and the differential housing for alignment. Remove the bearing support plates. Keep the shims with the correct plates.

B. Remove the differential assembly from the housing.

C. Put identification marks on each half of the case. See Figure 6. Remove the capscrews that hold the differential case together. Remove the spider gears, spider, thrust washers and side gears. Do not remove the ring gear unless it is damaged. Remove the bearings.



NOTE: THE DIFFERENTIAL SHOWN IS FOR A DIFFERENT MODEL. HOWEVER, THE BASIC PARTS OF THE ASSEMBLY ARE SIMILAR.

FIGURE 6. ALIGNMENT MARKS ON CASE FOR ASSEMBLY

CLEANING AND INSPECTION

Clean all the parts of the differential assembly with solvent. Dry the parts with compressed air.

Check the bearings, gears and thrust washers for wear.

NOTE

The ring gear and the hypoid pinion must be replaced as a set.

ASSEMBLY

NOTE

Lubricate the parts of the differential assembly with SAE 90 EP lubricant during assembly.

A. Install the thrust washers and side gears in the cases. Install the gears and the thrust washers on the spider. Assemble the case halves. Apply Loctite 271 on the bolts for the case. Tighten the bolts evenly to 50 1bf ft (68 N.m).

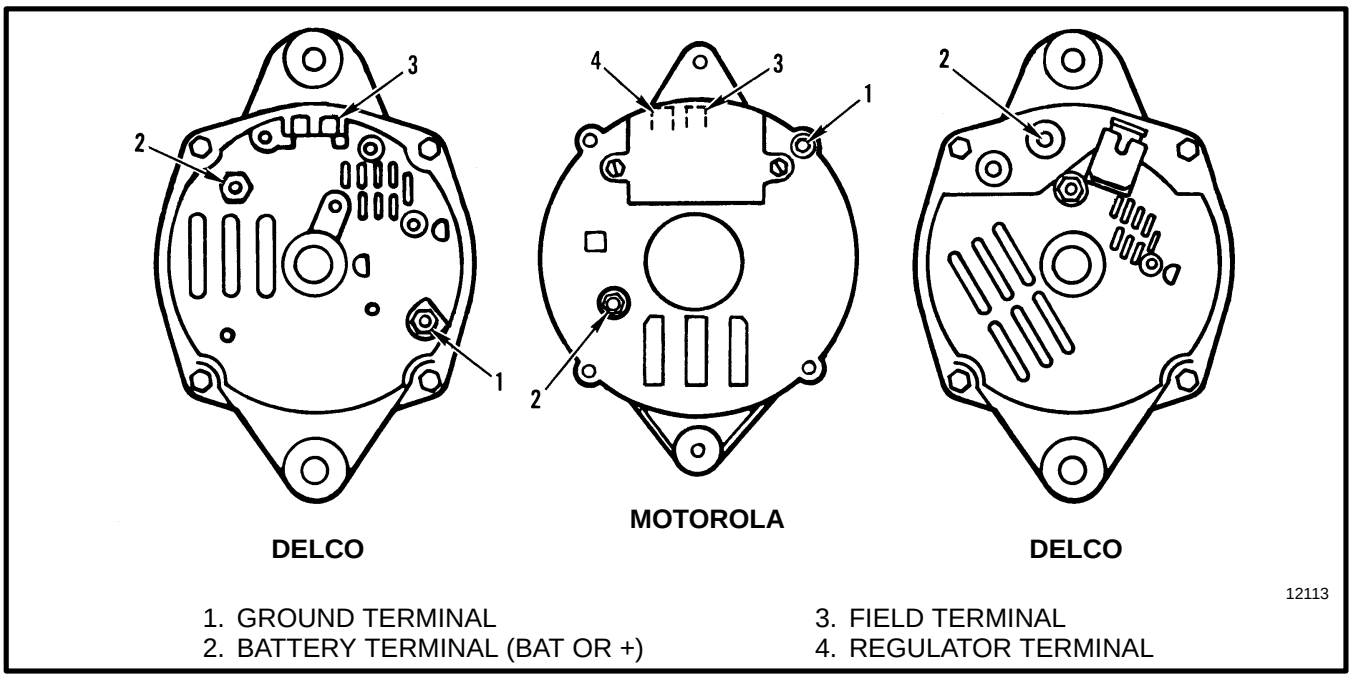


FIGURE 3. TYPE A ALTERNATORS, REAR VIEWS

ASSEMBLY (Type A) (See FIGURE 3., FIGURE 4. or FIGURE 5.)

1. For Delco (Type A) alternators, install new bearing(s) in the housings as follows:

   a. Install a new plug and seal in the rear housing. Push the bearing from the outside of the housing until the top of the bearing is even with the outside of the housing. Hold the housing with the collar on the inside of the housing. Keep the lip of the seal away from the bearing. Lubricate the bearing area with Delco–Remy grease, part number 1948791.

   b. Install a new bearing in the front housing. Fill one quarter of the grease reservoir with Delco–Remy grease, part number 1948791, or equivalent. Move the grease so that it touches the bearing when the retainer plate is installed.

   c. Add the same type of grease to fill the area between the retainer plate and the bearing. Install the spacer, gasket, and retainer plate on the bearing. Fasten the retainer plate in position with the three screws and lock washers.

2. For Motorola and Leece–Neville alternators, use a press to install the rear bearing on the rotor. Install the bearing and bearing retainer in the front housing. If used, install the spacer on the bearing.

⚠ CAUTION

Hold the rotor in a vise that has soft jaws. Do not tighten the vise more than necessary.

3. Install the front housing on the rotor. If used, install the spacer or shield, shaft key, and washer. Install the fan, pulley, lock washer, and nut. Tighten the nut to 54 to 81 Nm (40 to 60 lb_f ft).

4. Install the diode bridge and heat sink in the reverse order of disassembly. Make sure the insulators and washers are in the correct positions. Install the capacitor.

⚠ CAUTION

Be sure to install the insulators. Make sure the heat sink does not touch the housing.

5. On Delco alternators, install parts as follows:

   a. Install the brush and holder, voltage regulator, and diodes from the inside of the alternator. Make sure the insulator sleeves are on the screws for the brush holder. Install the capacitor.

   b. Install the stator in the rear housing. Connect the three wires from the stator to the diode bridge and fasten at the studs. Connect the wires from the diodes to the studs on the diode bridge. Install and tighten the three lock washers and nuts.

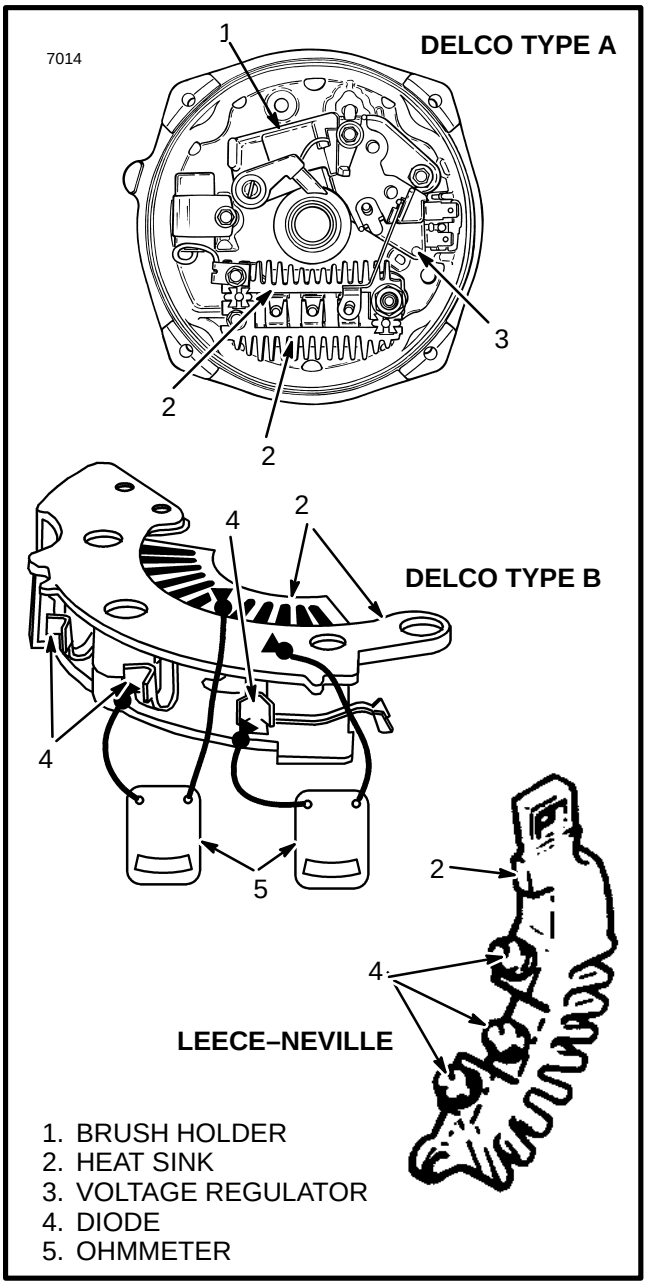


FIGURE 15. CHECK THE DIODE BRIDGE

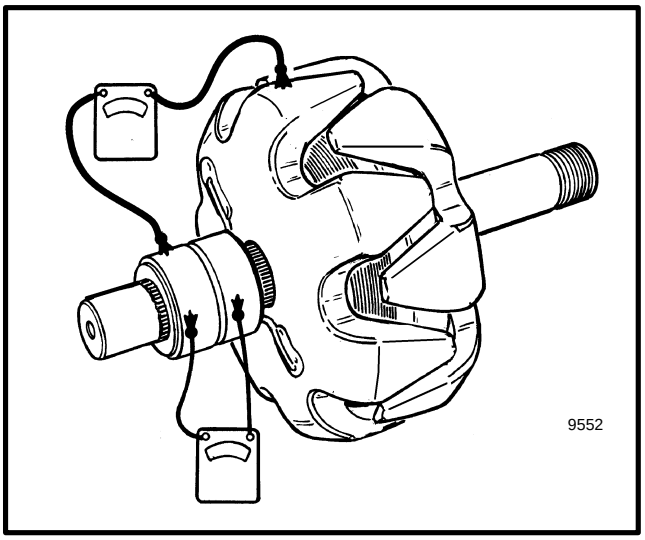


FIGURE 16. ROTOR COIL CHECKS

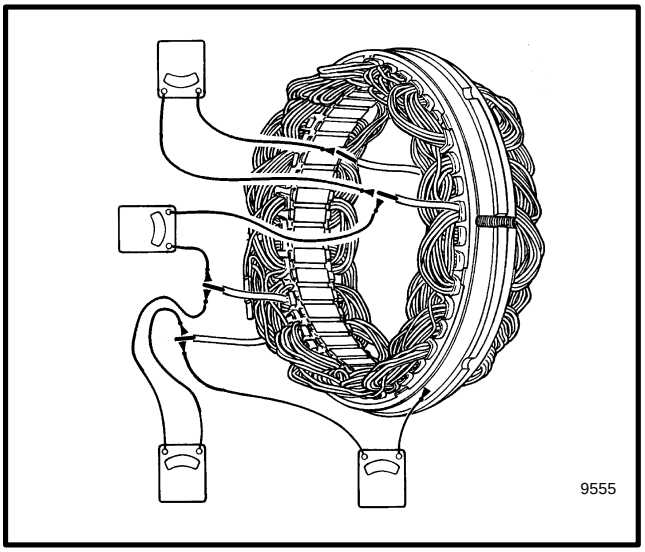


FIGURE 17. STATOR CHECKS

⚠ CAUTION

Do not use a 120 volt test lamp to check the diode bridge. Use a 12 volt tester to prevent diode damage.

CHECK THE FIELD WINDING FOR THE ROTOR (See FIGURE 16.)

Connect an ohmmeter to each slip ring and check for open circuits. If the reading is high (infinity), the winding has an open circuit. To check the resistance of the field, connect the ohmmeter to the two slip rings. The correct reading is 4.0 to 4.5 ohms. If the reading is less than specified, there is a short circuit in the windings. If the reading is more than specified, there is excessive resistance in the windings.

To check the electrical ground, connect the ohmmeter between either slip ring and the electrical ground as shown in FIGURE 16. Replace the rotor if the reading is less than infinity.

NOTE: Make sure the needle in the ohmmeter always returns to zero correctly. The readings will change when the temperature of the winding changes.

CHECK THE WINDINGS IN THE STATOR

To check the stator windings for electrical ground, connect an ohmmeter as shown in FIGURE 17. There must

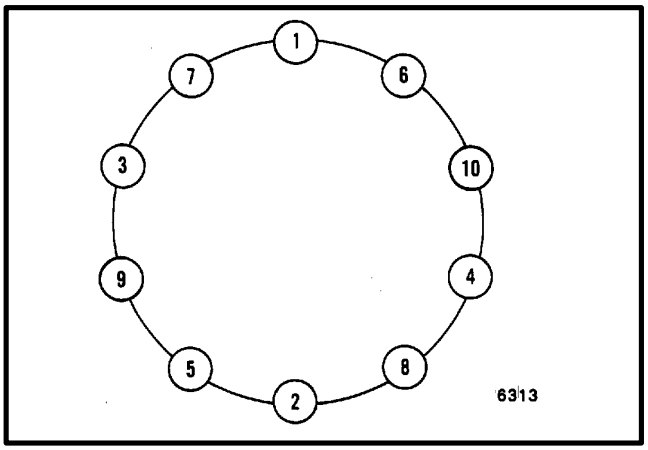


FIGURE 9. TIGHTENING SEQUENCE

4. Install the actuator levers for the parking brakes. Install the cable and the linkage.

5. Install the brake shoes. Install the spring assemblies that hold the brake shoes to the back plate.

6. Lubricate the adjuster screw with Never–Seeze. Turn the adjuster screw in for installation of the drum.

7. Install the automatic adjuster linkage. Install the return springs for the brake shoes.

8. Put some grease on the floor under the brake assembly. Slide the wheel and drum assembly on the spindle. During installation, start the engine and tilt the mast as necessary to raise or lower the axle.

9. Install the tapered thimbles, the washers and the nuts. Tighten the nuts evenly to 122 N.m (90 lbf ft) in the sequence shown in Figure 9. Tighten the nuts that hold the brake drum to the wheel to a torque of 160 N.m (120 lbf ft) for the S30–60E and S40–50F models. Tighten the nuts to a torque of 270 N.m (200 lbf ft) for the S60–120E models. Tighten the nuts in the sequence shown in Figure 9.

10. Remove the air from the brake fluid as described in Checks and Adjustments in this section.

K. Adjust the service brakes and the parking brakes as described in the Checks and Adjustments in this section.

CHECKS AND ADJUSTMENTS

ADJUSTING THE SERVICE BRAKES

The brake shoes are adjusted automatically in normal operation by applying the service brakes while moving in reverse. To manually adjust the brakes after replacing the shoes or other repair work, put a small screw driver through the hole in the wheel. Push the adjuster spring lever away from the adjuster wheel. Use a brake adjuster tool to turn the star wheel until the brake shoes contact the drum, then back off the star wheel 39 clicks. Move the truck forward and reverse and apply the brakes until the pedal assumes a normal position and becomes stabilized.

ADJUSTING THE PARKING BRAKE

Make sure that the service brakes are adjusted and that the operation of the automatic adjuster mechanism is correct. Test the operation of the parking brake. The lift truck with a capacity load must not move when the parking brake is applied on a 15% grade. If necessary, the tension of the cable for the parking brake lever can be adjusted. Loosen the lock nut (3) and then turn the adjustment screw (4) to adjust the cable. See Figure 10.

REMOVING THE AIR FROM THE BRAKE SYSTEM

The air must be removed from the brake system. Fill the reservoir of the master cylinder with brake fluid. Put one end of a rubber hose on the special fitting of the wheel cylinder. Put the other end of the hose into a clear container of brake fluid. Loosen the special fitting one turn. Slowly push the brake pedal and hold it at the end of its stroke. Close the special fitting. Repeat the procedure until there are no bubbles in the container. Check the level of the brake fluid in the master cylinder during the procedure. Make sure to keep the brake fluid at the correct level. Repeat the procedure for the other wheel cylinder.

REPAIRS

⚠ WARNING

During engine operation, be careful not to touch the fan, pulleys or drive belts. Contact with these parts can cause serious personal injury.

FAN ASSEMBLY

Removal (S30–120E)

1. Remove the two 12 point capscrews and remove the counterweight part with the HYSTER name.

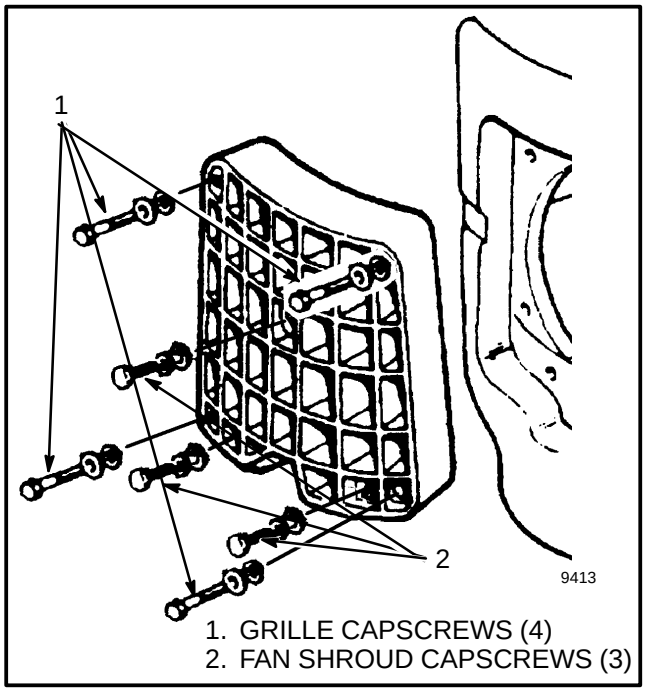
2. Remove the three capscrews that hold the fan assembly to the grille. See FIGURE 3.

3. Remove the four capscrews that hold the grille to the counterweight and remove the grille. Pull the fan assembly out of the counterweight. The drive shaft will slide out of the lower pulley hub.

4. If necessary, disconnect the drive shaft from the crankshaft pulley adaptor by removing the 12 point capscrew.

Removal (H60–110E)

1. Remove the access panel over the radiator.



1. GRILLE CAPSCREWS (4)
2. FAN SHROUD CAPSCREWS (3)

FIGURE 3. FAN ASSEMBLY MOUNT (S30–120E)

2. Drain the coolant from the radiator. Remove the radiator screen, if equipped.

3. Disconnect the radiator hoses. Disconnect the two lines to the oil cooler. Disconnect the hose to the auxiliary coolant reservoir.

4. Remove the four nuts and washers and remove the radiator from the lift truck.

5. Disconnect the drive shaft from the crankshaft pulley adaptor, by removing the 12 point capscrew. The drive shaft will slide out of the pulley hub assembly.

6. Remove the fan assembly from the frame.

Disassembly (S30–120E)

NOTE: Removing of the bearings and roller clutches during disassembly will usually damage them so that they must be replaced. Disassemble the fan assembly only enough to make repairs.

1. Remove the lower pulley housing and remove the fan belt. Remove the lower pulley (19) from the hub.

NOTE: When the upper hub assembly must be removed from the fan housing, heat the aluminum near the bearings to 120°C (250°F). Heat the area evenly so that you do not cause distortion. Push the hub assembly out of the housing.

NOTE: Heating the aluminum over 260°C (500°F) can cause permanent damage. Many service technicians use a temperature indicator such as a TEMP–STIX® to prevent damage.

2. Remove the snap ring (10) and remove the hub assembly.

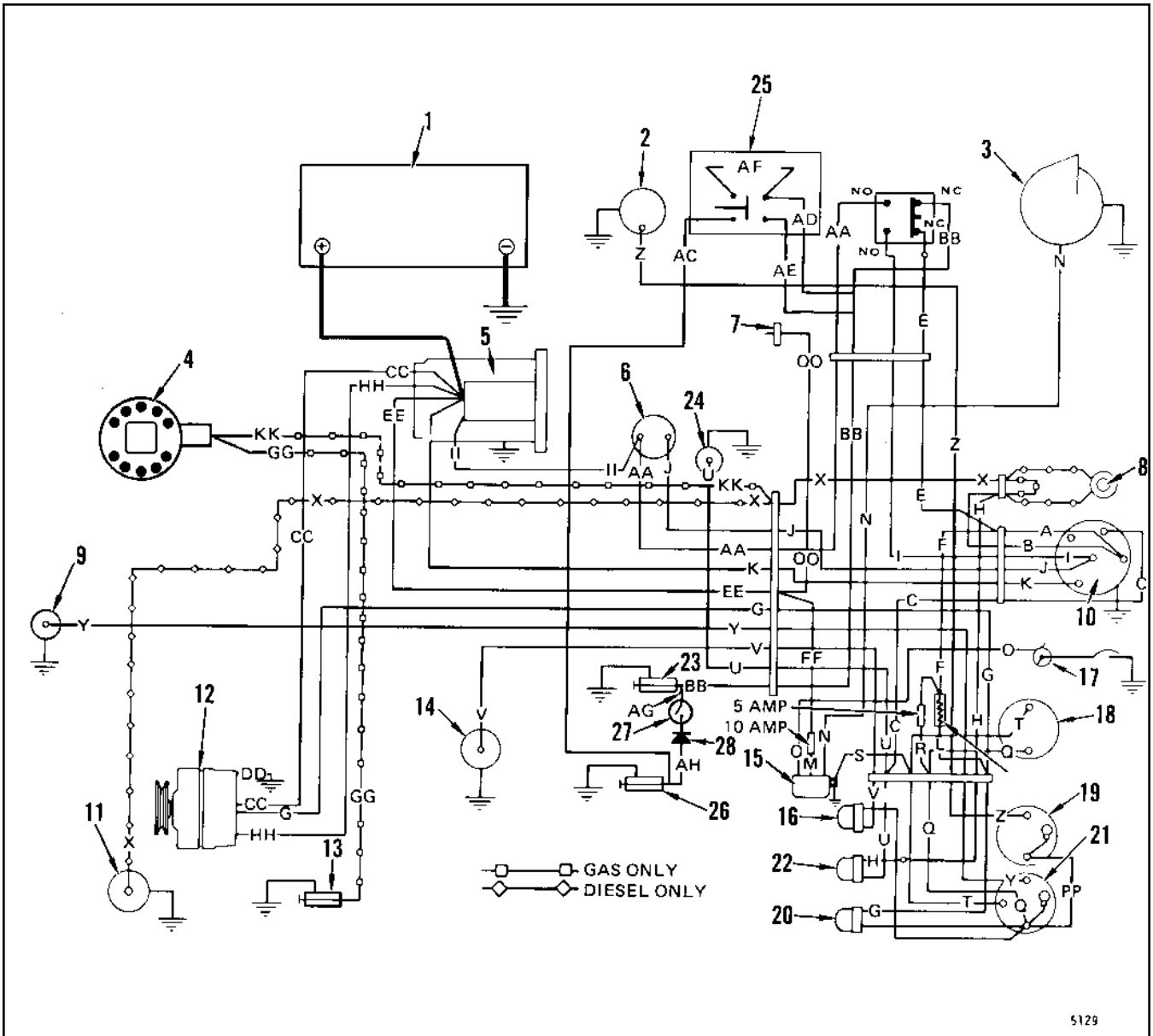
3. Remove the inner snap ring (11).

4. Use a press to remove the two bearings (12) and spacer (13) from the hub (17). Discard the bearings.

5. Use a press to push the two roller bearings (15) and the two roller clutches (16) out of the lower hub. Discard the bearings and roller clutches.

6. Remove the nut that holds the upper pulley to the shaft. Remove the pulley (7) and woodruff key.

7. Remove the nut that holds the fan to the shaft. Remove the fan (1) and woodruff key.



1. BATTERY
2. FUEL SENDER
3. HORN
4. DISTRIBUTOR (HEI)
5. STARTER
6. PARKING BRAKE SWITCH
7. LAMP OPTIONS
8. COLD START SWITCH
9. WATER TEMPERATURE SENDER
10. KEY SWITCH
11. COLD START UNIT
12. ALTERNATOR
13. IDLE STOP SOLENOID
14. OIL PRESSURE SENDER
15. HORN RELAY
16. ENGINE OIL PRESSURE LAMP
17. HORN BUTTON
18. HOUR METER
19. FUEL GAUGE
20. DISCHARGE INDICATOR
21. WATER TEMPERATURE GAUGE
22. TRANSMISSION TEMPERATURE INDICATOR
23. TRANSMISSION SOLENOID
24. TRANSMISSION TEMPERATURE SENDER
25. DIRECTION SWITCH (OPTIONAL)
26. DIRECTION SOLENOID (OPTIONAL)
27. PRESSURE SWITCH (OPTIONAL)
28. DIODE (OPTIONAL)

FIGURE 2. ELECTRICAL SCHEMATIC - LIFT TRUCKS WITH POWERSHIFT

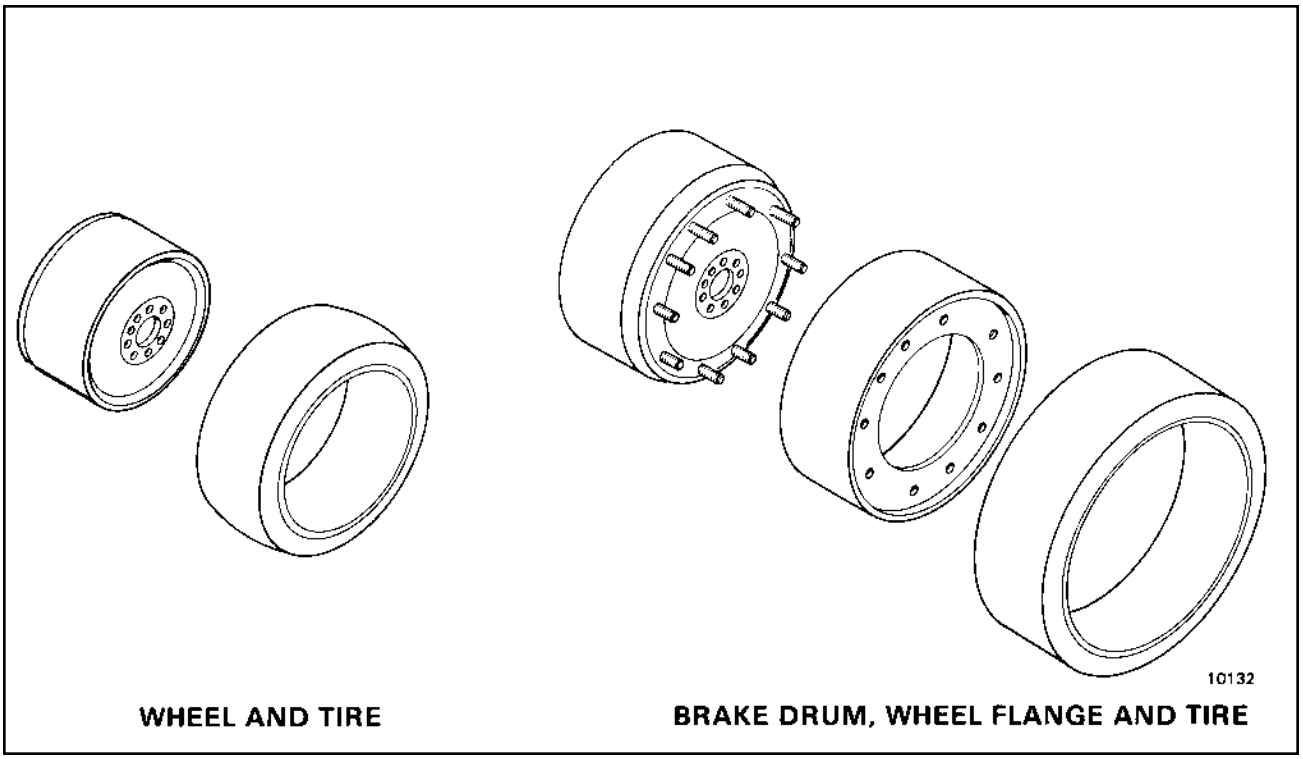
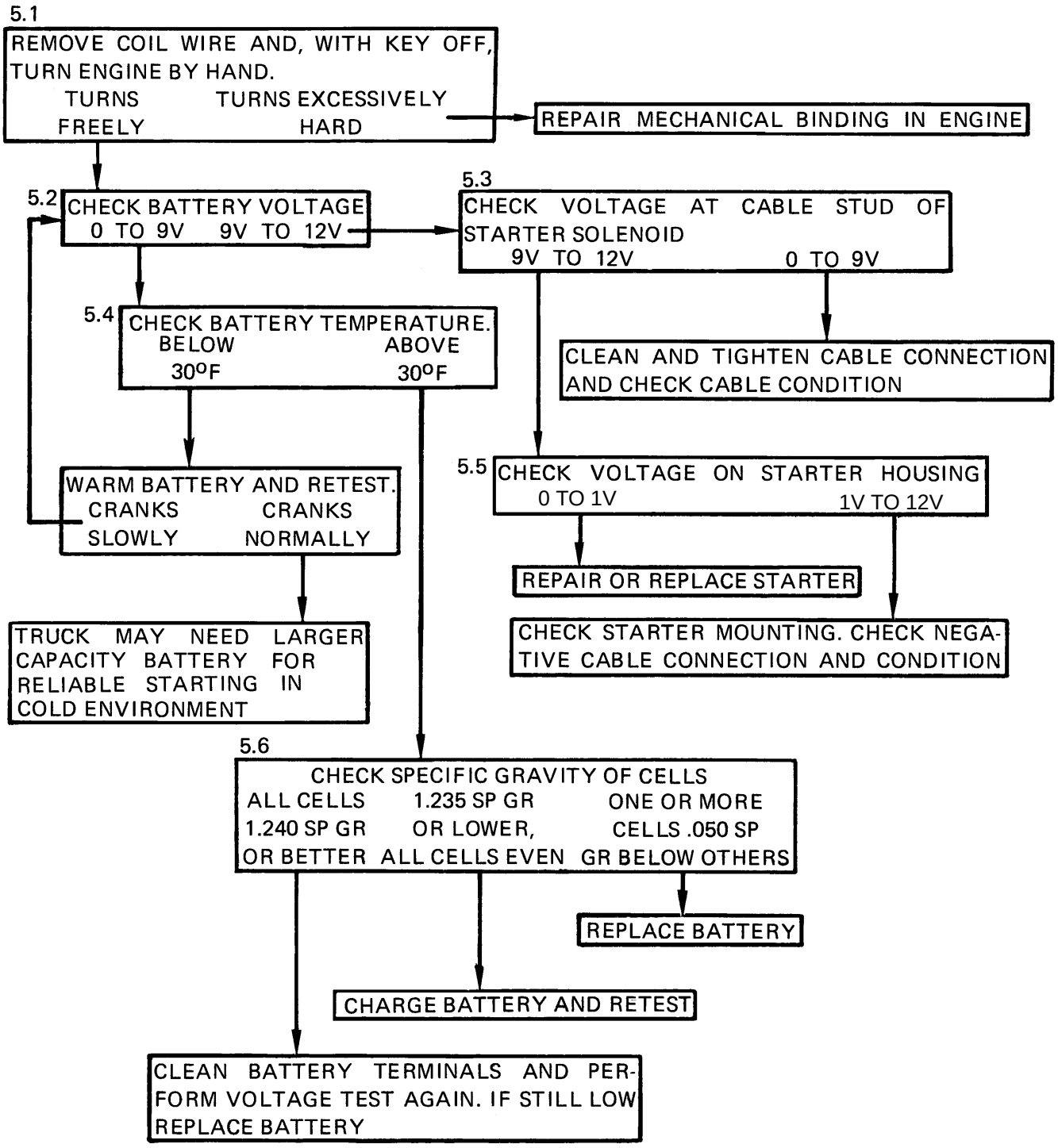


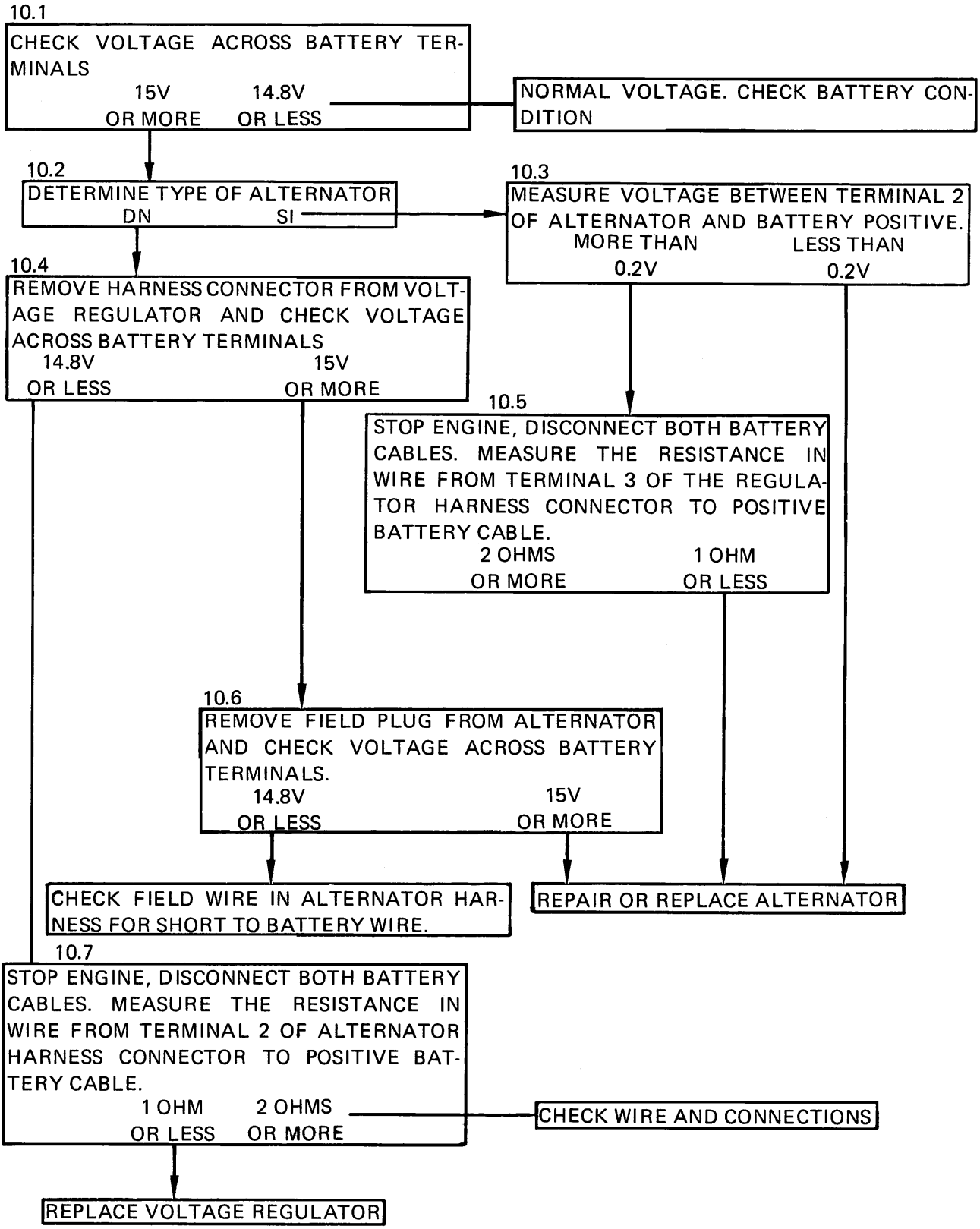
FIGURE 7. WHEELS AND CUSHION TIRES

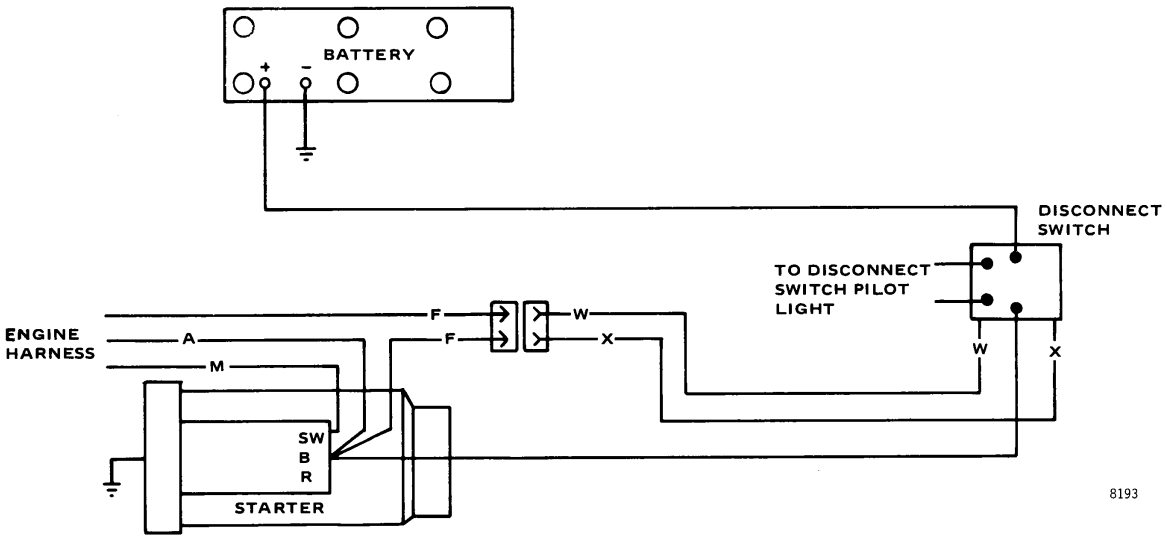
SYMPTOM 5. STARTER CRANKS SLOWLY.

NOTE: UNLESS OTHERWISE NOTED, ALL VOLTAGE TESTS IN THIS SECTION ARE PERFORMED WITH BATTERY CONNECTED AND KEY IN START POSITION.



SYMPTOM 10. BATTERY IS BEING OVERCHARGED.
NOTE: ALL TESTS ARE PERFORMED WITH ENGINE RUNNING AT 2000 RPM.





CHASSIS WIRING HARNESS

NUMBER	COLOR	GAGE
A	BLACK	12
B	RED	16
C	WHITE	12
D	YELLOW	12
E	ORANGE	12
F	GREEN	16
G	BLACK	12
H	BLACK	14
I	WHITE	16
K	RED	16
L	YELLOW	16
M	GREEN	12
O	WHITE	12
P	YELLOW	12
Q	RED	16
R	BROWN	16
S	GREEN	16
T	BLACK	16
U	RED	16

ENGINE WIRING HARNESS

A	BLACK	12
C	WHITE	14
F	GREEN	16
I	WHITE	16
M	GREEN	12
O	RED	16
R	BROWN	16
Z	GREEN	14

INSTRUMENT PANEL WIRING HARNESS

NUMBER	COLOR	GAGE
A	WHITE	14
B	RED	16
G	BLACK	14
J	BLUE	12
R	BROWN	14
T	BLACK	14

P.S. XMSN WIRING HARNESS

M	GREEN	12
N	GREEN	14
O	BLACK	16
P	YELLOW	12
Q	RED	14
R	BROWN	16

G.S. & LPS WIRING HARNESS

W	GREEN	12
X	BLUE	12

ENGINE WIRING HARNESS

A	BLACK	12
C	WHITE	14
F	GREEN	16
I	WHITE	16
M	GREEN	12
O	RED	16
R	BROWN	16
Z	GREEN	14

LPG HARNESS & WIRE

U	RED	14
V	WHITE	14
Y	BLUE	14

MISCELLANEOUS SINGLE WIRES

Q	RED	16
Z	GREEN	14
AA	RED	14
CC	WHITE	14
RR	BROWN	14

FWD-REV SHIFT LEVER

AC	BROWN	16
AD	RED	16
AE	GREEN	16
AF	RED	16
AG	ORANGE	16

FIGURE 3. ELECTRICAL SCHEMATIC H30–60H GASOLINE & LPG (Sheet 2 of 2)

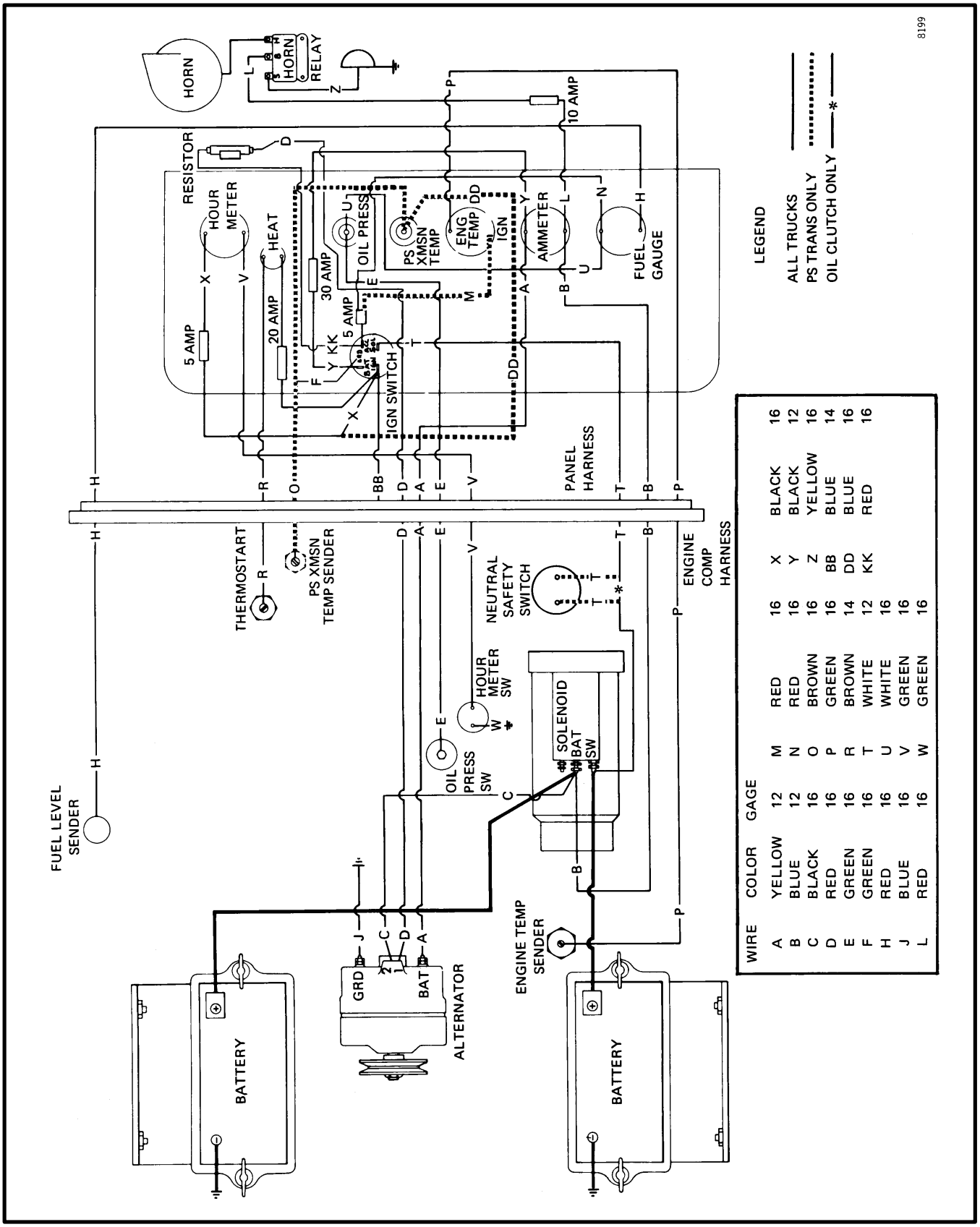
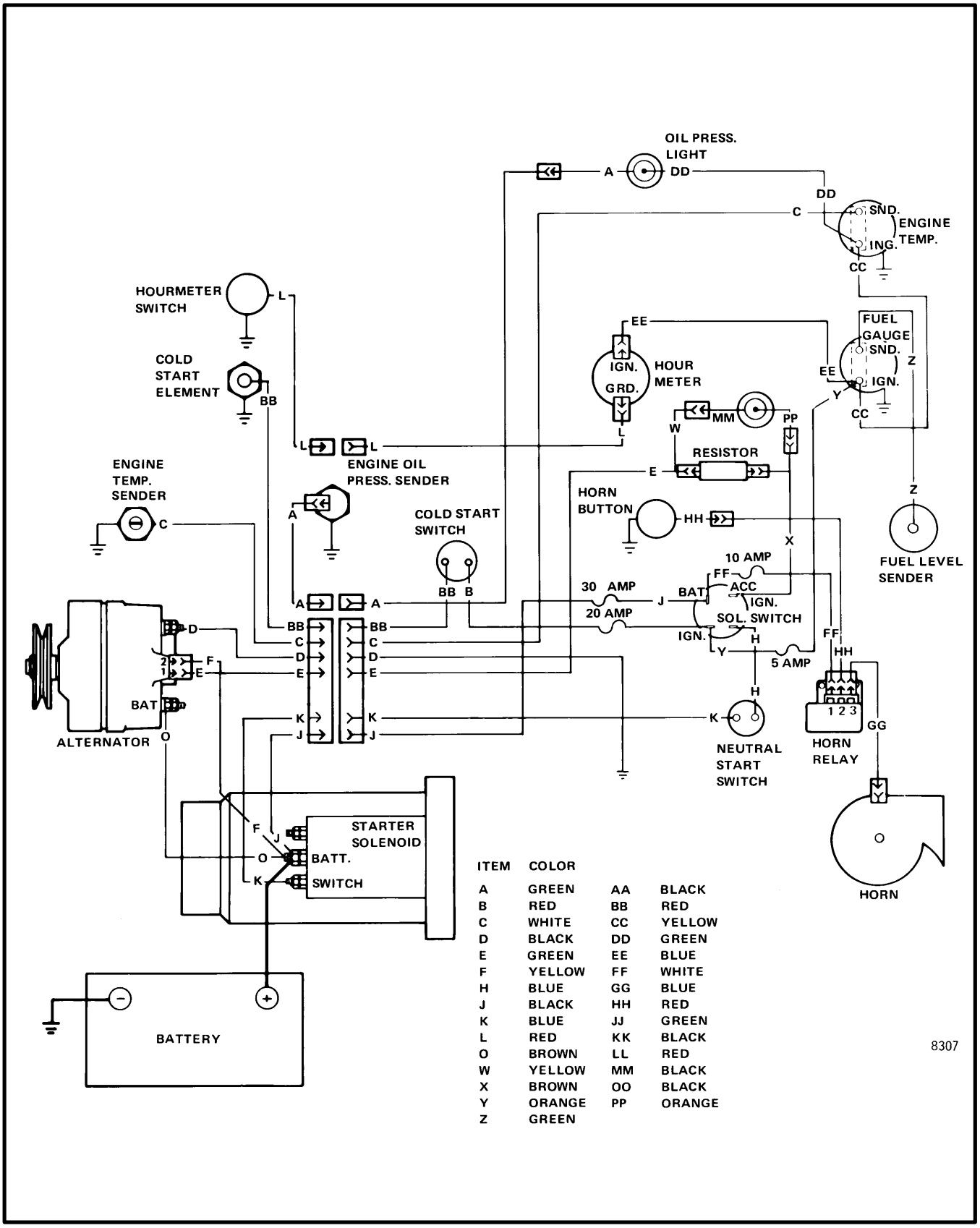


FIGURE 12. ELECTRICAL SCHEMATIC H110–150F DIESEL



ITEM	COLOR		
A	GREEN	AA	BLACK
B	RED	BB	RED
C	WHITE	CC	YELLOW
D	BLACK	DD	GREEN
E	GREEN	EE	BLUE
F	YELLOW	FF	WHITE
H	BLUE	GG	BLUE
J	BLACK	HH	RED
K	BLUE	JJ	GREEN
L	RED	KK	BLACK
O	BROWN	LL	RED
W	YELLOW	MM	BLACK
X	BROWN	OO	BLACK
Y	ORANGE	PP	ORANGE
Z	GREEN		

FIGURE 21. ELECTRICAL SCHEMATIC P40–50A DIESEL

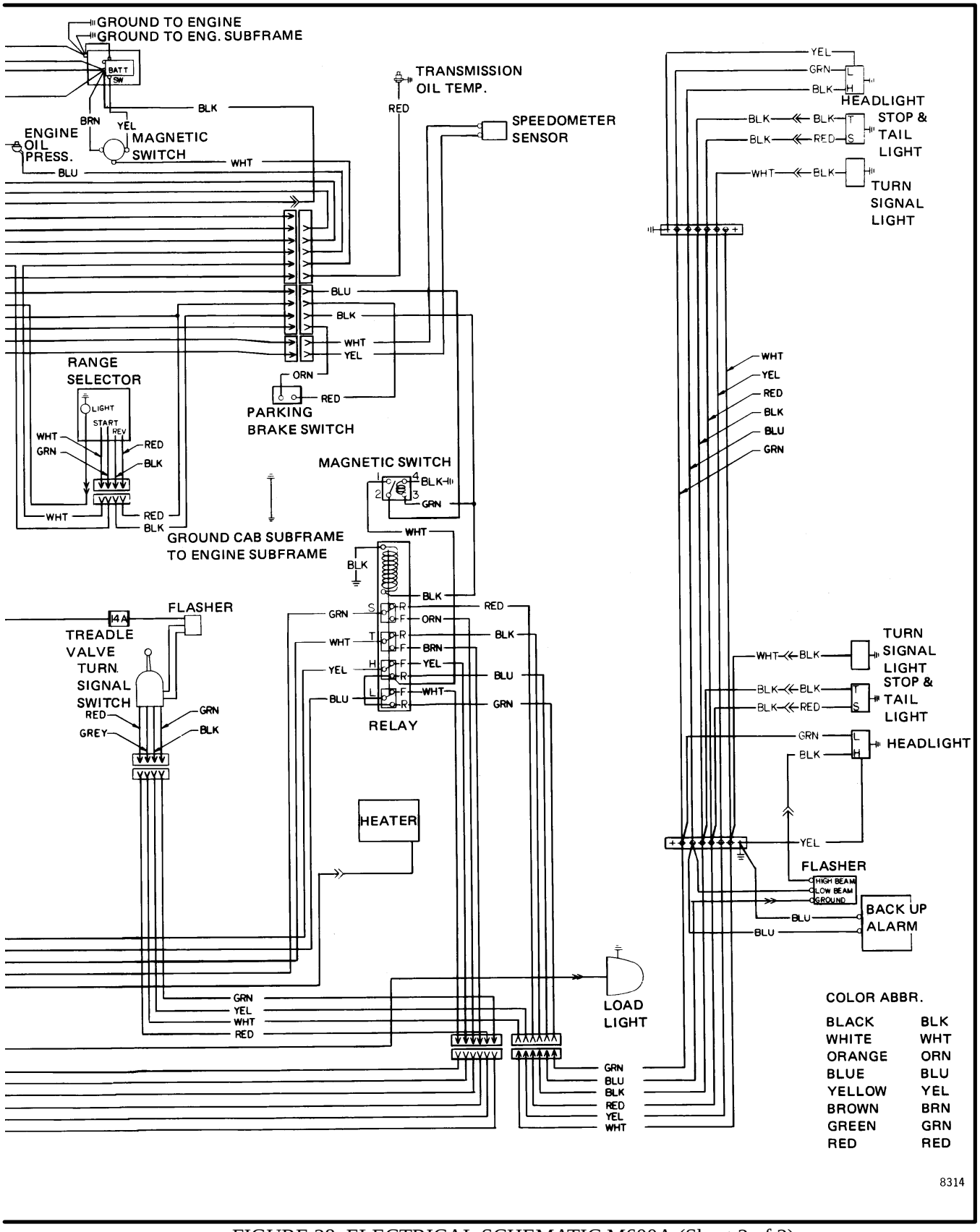
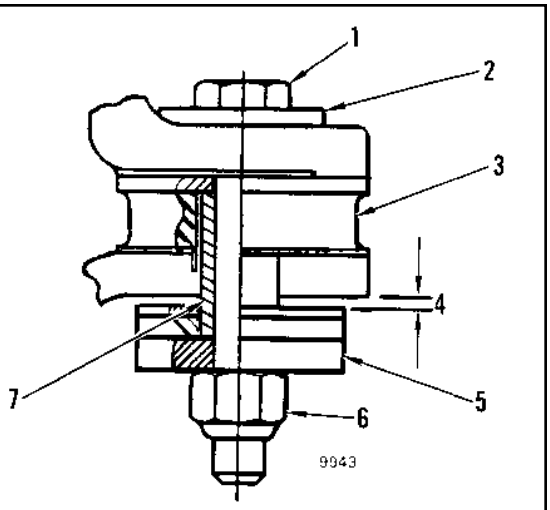


FIGURE 28. ELECTRICAL SCHEMATIC M600A (Sheet 2 of 2)

TROUBLESHOOTING

PROBLEM	CAUSE
Steering wheel is difficult to turn.	Flow control spool will not move.
	Dirt in relief valve.
	Defect in pump.
	Defect in steering control unit.
	Defect in steering cylinder.
	Relief setting too low.
	Hydraulic line has restriction.
Steering is not smooth.	Dirt in orifice of spool.
	Defect on spool or bore.
	Defect in relief valve.
	Air in the system.
	Steering control unit has defect.
	Pump has a defect.
	Cylinder has a defect.
Hoses break, pump seals have leaks.	Relief valve has a defect.
Steering wheel turns too easily.	Spool will not move.
	Return line to tank has a restriction.
	Engine speed above maximum.



1. BOLT
2. WASHER
3. MOUNT ISOLATOR
4. 4.75 mm (0.1875 in) CLEARANCE
5. SPECIAL WASHER
6. NUT
7. SPACER

FIGURE l0. MOTOR MOUNT ARRANGEMENT

D. Connect the hydraulic lines to the transmission (jet pump), hydraulic pump, and steering control unit.

NOTE

Lift trucks made after April 1981 do not have a jet pump. A replacement tee fitting is part of the sump casting. The connections are the same, but the jet pump function is not used.

Install the clamps that hold the parking brake cable and brake lines to the transmission housing.

E. Use a new gasket and connect the header pipe to the exhaust manifold. Install the alternator, engine oil filter, and steering wheel.

F. Install the pedal assemblies. Connect the MONOTROL lines to the powershift transmission and the throttle linkage. Connect the linkage for the oil clutch transmission. Connect the brake lines.

G. Install the steering wheel.

H. Connect the wiring harness at the connectors. Install the temperature sending unit for the powershift transmission oil. Connect the wires for the brake switch and the temperature sending unit.

I. Connect the fan drive.

J. Install the radiator if it was removed, and connect the radiator hoses. Connect the oil lines at the radiator for the oil cooler. Install the radiator screen. Install the air cleaner assembly.

K. Add coolant to the radiator. Add oil to the transmission and differential as specified in the section PERIODIC MAINTENANCE. Remove the pipe plug, if used, and install the breather in the hydraulic tank. Add hydraulic oil as necessary. Add engine oil as necessary.

L. Make checks and adjustments of the brakes, pedals and linkages as described in the sections for those systems. Make sure the connections of the wires, hoses, and lines are complete.

M. When the checks are complete, connect the battery cables. Disconnect the ignition wiring so that the starter can turn the engine without starting. Remove the plug from the test port of the transmission pump. Turn the engine with the starter until oil comes out of the open test port. Install the plug in the test port and connect the ignition wiring so that the engine will start.

N. Start the engine and run it at approximately 800 rev/ min. Check for the correct oil pressure and for leaks. Rotate the steering wheel from lock to lock to remove air from the steering system. Make checks and adjustments of the engine and transmission as described in the sections for those systems.

O. When the checks and adjustments are complete install the hood and overhead guard.

14. Install the rocker arm cover as described in “Rocker Arm Cover, Installation”.

15. Install and connect the PCV valve.

16. If the distributor cap was removed, install it. Connect the spark plug wires. Connect the wires and hoses fastened to brackets on the rocker arm cover.

17. Install the air cleaner, and component parts.

18. Fill the cooling system with the correct coolant. See the **PERIODIC MAINTENANCE** section for your unit.

19. Connect the battery cables at the battery.

20. When the engine can be operated, adjust the ignition timing and carburetor as necessary. See the **PERIODIC MAINTENANCE** section for additional information:

Valve Clearance Adjustment

1. Remove the cover for the rocker arm assembly.

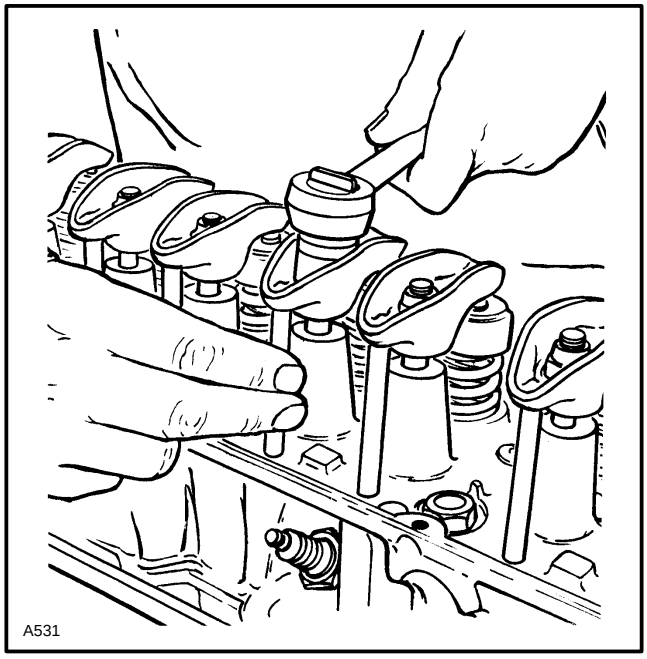


FIGURE 10. VALVE CLEARANCE ADJUSTMENTS

2. Adjust the valves for each cylinder when the piston is at top dead center on the compression stroke. Use the rotor in the distributor to find top dead center for each piston. Make an identification mark for each cylinder on the distributor housing. Make the marks directly under the connections of the spark plug wires.

3. Remove the distributor cap. Turn the crankshaft until the rotor is aligned over the mark for the number one cylinder. Now adjust both valves for the number one cylinder. Tighten the nut for the rocker arm while turning the push rod with your fingers as shown in FIGURE 10. Tighten the nut just until the movement of the push rod stops. This condition is zero clearance. Now tighten the nut one more turn.

4. Turn the crankshaft in the normal direction of rotation until the rotor aligns over the next mark. (For the six cylinder engine, the valves for the number five cylinder can now be adjusted. For the four cylinder engine, the valves for the number three cylinder can now be adjusted.) Adjust the valves as described in step 3.

5. Follow the same procedure as described in step 4 until all the valves are adjusted.

6. Install the distributor cap and the cover for the rocker arms.

Rocker Arm Cover, Installation

1. Remove all gasket material from the cylinder head and the rocker arm cover.

2. Coat the cylinder head rail with Loctite Flange Sealant.

3. Install a new gasket onto the cylinder head rail.

4. Apply Loctite Flange Sealant around the bolt holes of the gasket, and install the rocker arm cover.

5. Tighten the rocker arm cover bolts to 6 Nm (50 lbf in) in the sequence shown in FIGURE 11.

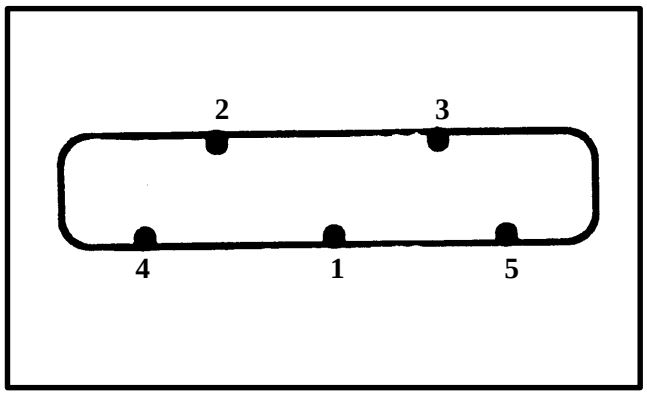


FIGURE 11. ROCKER ARM COVER TIGHTENING SEQUENCE

2. Measure the end clearance of each piston ring as shown in FIGURE 29. The end clearances are shown in the ENGINE SPECIFICATIONS. Install the piston ring into the cylinder where it will be used. Use a thickness gauge to measure the amount of end clearance. Replace the piston if the clearances are greater than the specifications.

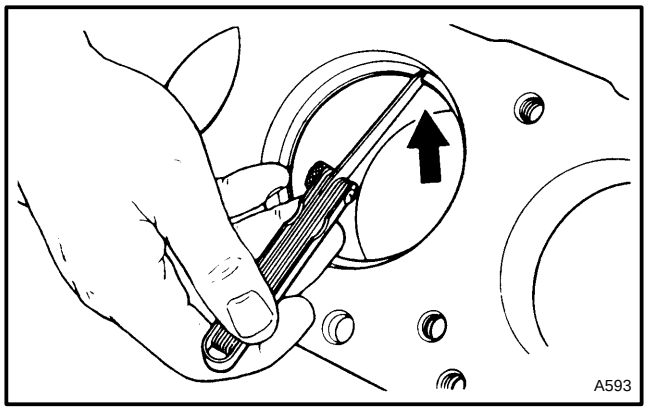


FIGURE 29. CHECK THE END CLEARANCE OF THE PISTON RINGS

Assembly

NOTE: There are notches cast in the top of all pistons to indicate the correct assembly and installation. The pistons must always be installed with this notch toward the fan end of the engine. See FIGURE 33.

The connecting rods have a notch cast in the bearing journal as shown in FIGURE 30. This notch must be opposite the notch on the top of the piston when the piston and connecting rod are assembled.

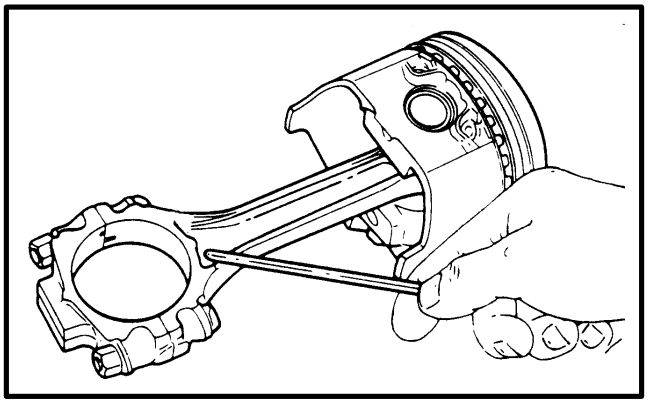


FIGURE 30. CONNECTING ROD IDENTIFICATION

1. Assemble the connecting rod to the piston. Make sure the orientation of the connecting rod and piston are correct as described in the NOTE above. Use a press to install the piston pin into the piston and connecting rod. Lubricate the piston pin with engine oil during installation.

2. Check the clearances of the piston rings as described in “Piston Rings”. Install the piston rings on the piston as shown in FIGURE 31.

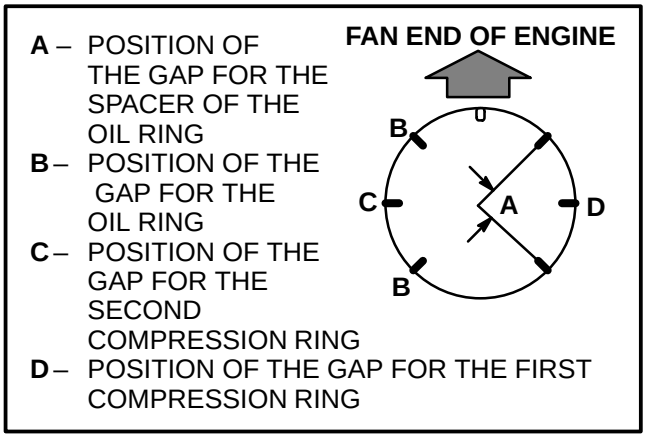


FIGURE 31. ARRANGEMENT OF THE PISTON RINGS ON THE PISTON

Piston And Connecting Rod Assemblies, Installation

1. Lubricate the assembly with engine oil during installation. Arrange the piston rings on the piston as shown in FIGURE 31. Install a ring compressor on the piston as shown in FIGURE 32.

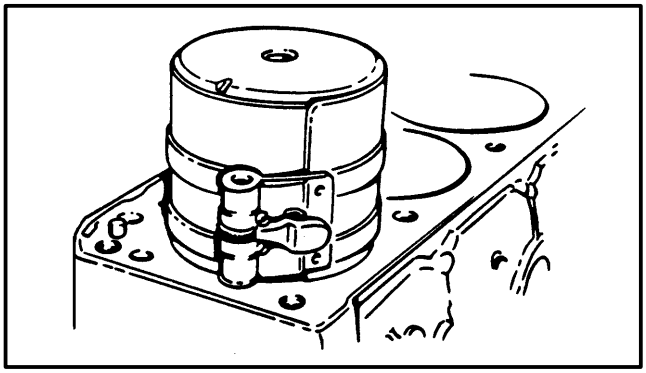
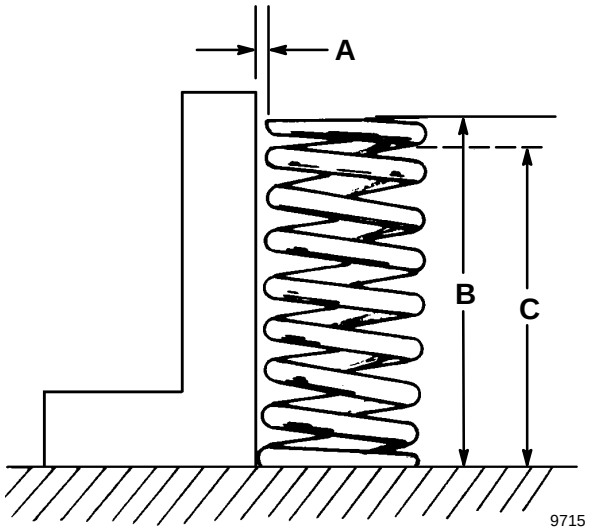


FIGURE 32. INSTALL A RING COMPRESSOR

2. Make sure that the notch in the piston is toward the fan end of the engine as shown in FIGURE 33. Install the piston and connecting rod assemblies in the cylinder bores.



A. VARIATION FROM VERTICAL:
– Production less than 1.5 mm (0.06 in)
– Service limit 2.5 mm (0.984 in)

B. FREE LENGTH:
– Standard 49.7 mm (1.96 in)
– Service Limit 48.2 mm (1.90 in)

C. INSTALLATION HEIGHT:
THE VALVE SPRINGS NEED A MINIMUM FORCE OF 347 to 383 N (76 to 86 lbf) TO COMPRESS THEM TO A HEIGHT OF 43 mm (1.69 in)

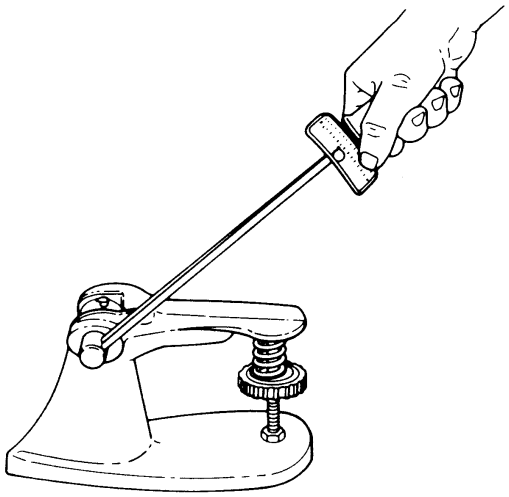


FIGURE 48. VALVE SPRING SPECIFICATIONS

Valve spring force (installed and valve is closed)
347 to 383 N @ 43 mm
(78 to 86 pounds @ 1.69 in)

Valve spring force (installed and valve is open)
756 to 800 N @ 32 mm
(170 to 180 pounds @ 1.26 in)

HYDRAULIC VALVE LIFTER

Leak rate 12 to 90 seconds with 50 lb load

Body diameter
21.3868 to 21.4046 mm (0.8420 to 0.8427 in)

Plunger travel 3.175 mm (0.125 in)

Clearance in bore 0.0635 mm (0.0025 in)

Lifter bore diameter
21.425 to 21.450 mm (0.8435 to 0.8445 in)

CAMSHAFT

Variation from front to rear of a cam lobe
– Taper with larger dimension away from No. 1 piston

Bearing journals, diameter
47.44 to 47.49 mm (1.8677 to 1.8697 in)

Bearing journals, clearance
0.01778 to 0.9685 mm (0.0007 to 0.0027 in)

Variation of a bearing journal in either diameter or axial direction 0.03 mm (0.001 in)

Axial Clearance (see FIGURE 17.)
– Production Limit
0.020 to 0.120 mm (0.001 to 0.005 in)
– Service Limit 0.2 mm (0.008 in)

PISTONS

Piston diameter (see gauge points in FIGURE 27.)

Clearance at top of cylinder
– Production Limit
0.0635 to 0.0838 mm (0.0025 to 0.0033 in)

Clearance at bottom of cylinder
– Production Limit
0.043 to 0.104 mm (0.0017 to 0.0041 in)

Clearance in cylinder (service limit for top and bottom of cylinder) 0.76 mm (0.030 in)

Piston ring to groove clearance for piston rings (see FIGURE 28.)

Compression rings No. 1 and No. 2
– Production Limit
0.0381 to 0.0889 mm (0.0015 to 0.0035 in)

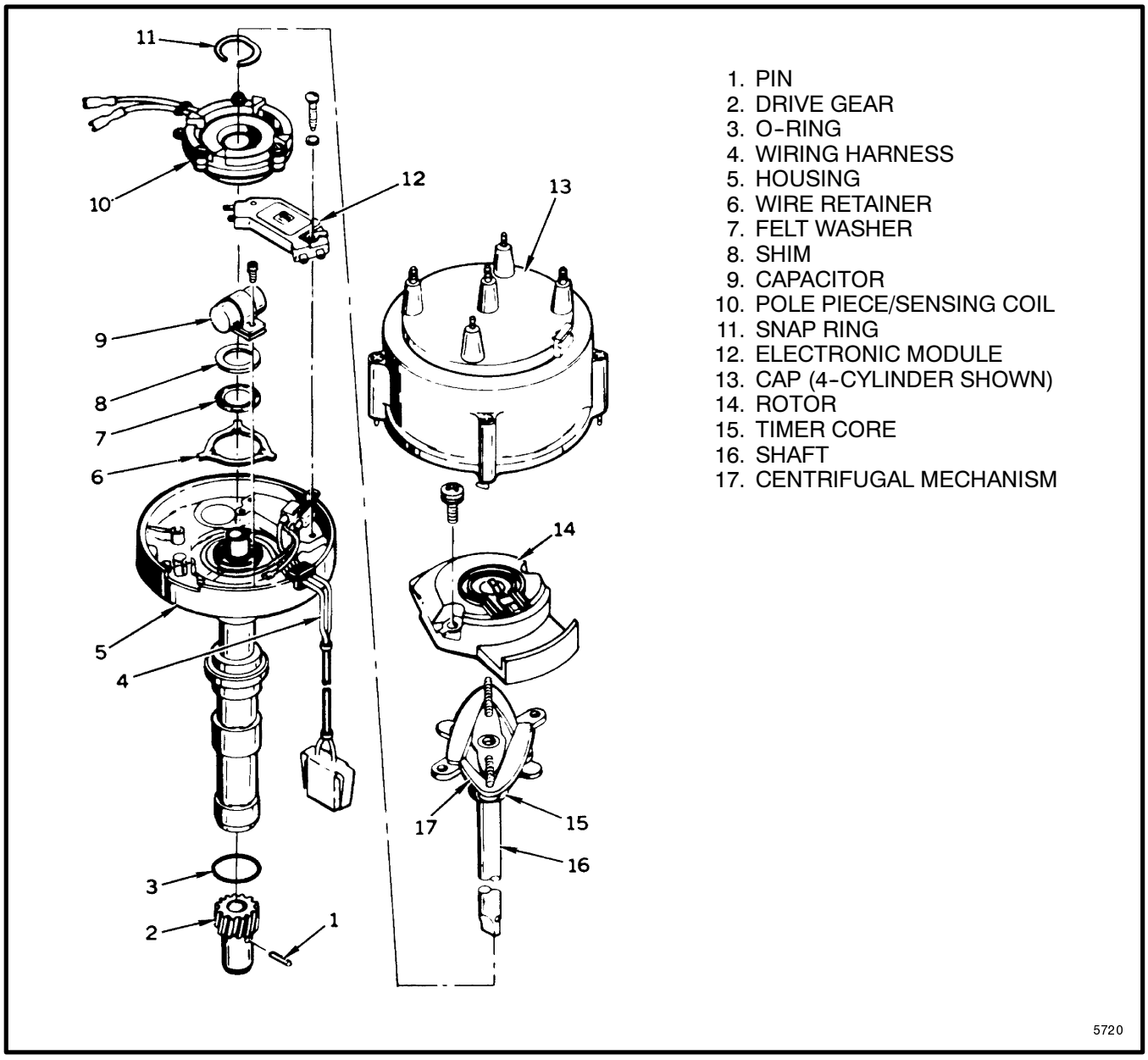


FIGURE 5. GM 4-CYLINDER AND 6-CYLINDER MODELS WITH SEPARATE COIL

3. Unlock the four screws that fasten the cap to the housing. Carefully remove the cap and turn it to the position shown in FIGURE 14.

4. Set the ohmmeter to the low scale. Connect the ohmmeter as shown in step 1 of FIGURE 14. The normal indication is less than 2 ohms. Replace the coil if the indication is infinity.

5. Set the ohmmeter to the high scale. Connect the ohmmeter as shown in steps A and B of step 2 of FIGURE 14. Install a new coil if, both the indications are infinity. A resistance indication one way and an infinity indication the other way is normal.

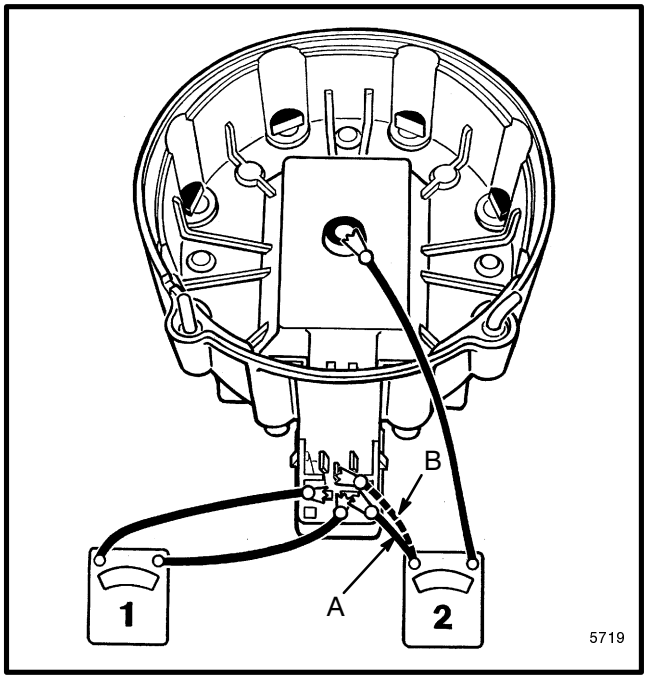


FIGURE 14. IGNITION COIL CHECKS, V8 AND SOME 4 AND 6 CYLINDER ENGINES

Separate Coil Design (See FIGURE 15.)

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

2. Disconnect the secondary wire from the coil.

3. Remove the dust cover from the primary wiring.

4. Disconnect the primary wiring harness from the coil.

5. Set the ohmmeter to the high scale. Connect the ohmmeter as shown in step 1 of FIGURE 15. If the meter indication is less than infinity, install a new coil.

6. Set the ohmmeter to the low scale. Connect the ohmmeter as shown in step 2 of FIGURE 15. If the meter does not indicate zero to one ohm, install a new coil.

7. Set the ohmmeter to the middle scale. Connect the ohmmeter as shown in step 3 of FIGURE 15. If the meter indication is infinity, install a new coil.

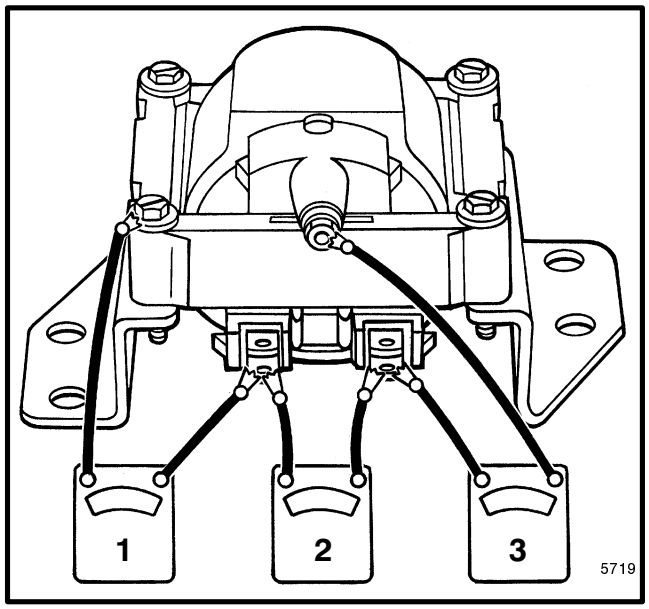


FIGURE 15. IGNITION COIL CHECKS, SOME 4 AND 6 CYLINDER ENGINES

Checking The Sensing Coil (See FIGURE 16.)

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

2. Disconnect the primary wiring connector to the distributor.

3. Unlock the latch screws that fasten the cap to the housing. Carefully remove the cap and put it away from the distributor.

NOTE: Some models use separate terminals. Some models use a double terminal.

4. Disconnect the white and the green wires from the electronic module.

5. Set the ohmmeter to a middle scale. Connect the ohmmeter as shown in step 1 of FIGURE 16. If the ohmmeter indicates less than 500 ohms or more than 1500 ohms, install a new part.

6. Set the ohmmeter to a high scale. Connect the ohmmeter as shown in step 2. Do step 2 for each wire. If the meter indication is less than infinity, install a new coil.

4. Check the thrust plates for wear or grooves. If the thrust plate is worn more than 0.05 mm (0.002 in), it must be replaced. Replace the thrust plate if it has grooves or holes. Dirty oil causes the thrust plate to wear near where the gears engage. Small holes on the outlet side the thrust plate are caused by cavitation. Lack of oil can also cause small holes in the thrust plates. If the color of the thrust plates has changed, the pump was too hot.

5. Inspect all the machined surfaces for scratches or damage. Remove with emery cloth any metal that is above the flat surface. Check the surfaces with a straight edge. Inspect the grooves for the seals for dirt or scratches.

6. Inspect the bearings for wear or damage. Replace the bearings if there is any small hole on the bearing surface. Replace the bushing if it is not round.

7. Look for damage on the seals. Replace all the seals and O–rings, even if they are in good condition. Look for cuts or changes in shape that can cause damage. Find out what damage caused the pump to fail. A damaged seal for the thrust plate can cause the shaft seal to leak. A damaged shaft seal can cause air to enter the hydraulic system.

8. Inspect the flow control valve and relief valve for dirt or scratches. Make sure the piston moves freely in the bore. Look at the poppet and seat for damage. The springs must not be broken or bent. Inspect the O–rings for damage. Make sure the orifices are open.

9. If any parts of the pump have damage from dirt in the oil, inspect the hydraulic tank. Drain the tank, clean the screen and tank, and replace the filter.

⚠ CAUTION

Do not permit dirty oil to enter the gear pump.

10. Inspect the inlet hose to the gear pump. Use a lamp to look inside the hose. Look for pieces of the rubber that are separating from the hose. Inspect the hose for restrictions at the bends. Check for loose fittings or damaged O–rings.

ASSEMBLY

1. Lubricate all parts with hydraulic oil before they are installed into the pump.

⚠ CAUTION

Make sure no dirt enters the pump during assembly.

2. Put Loctite 290® sealant around the outside of the front seal. Install the seal in the front cover. Make sure the seal is installed straight. If the pump has a ball bearing for the shaft, install it in the front cover. Install the snap rings.

3. Install the needle bearings into the front and rear covers. Use a press to push the bearings into position. Push on the end of the bearings that has the writing. If the pump has check valves, install them in the cover.

4. Install the seals for the thrust plate. Install the rubber seal with the lips away from the gears. Install the paper gasket against the rubber seal. The plastic gasket is installed between the paper gasket and the thrust plate. Install the thrust plate with the bronze side toward the gears.

⚠ CAUTION

Make sure the holes in the gaskets and seals are aligned with the hole in the output side of the pump. The pump will not operate correctly if the oil from the outlet chamber cannot flow to the thrust plate.

Some pumps have thrust plates with small grooves for the seals. The seals must be cut to the correct length. Cut two strips that are 5.5 mm (0.22 in) long from the seal strip. Put grease on the seals and install them in the grooves in the center of the thrust plate. Cut the thrust plate on the front cover. Hit the thrust plate with a plastic hammer to 0.8 mm (0.031 in) from the machined surface. Cut four strips 6 mm (0.25 in) from the seal strip. Push the strips into the slots in the thrust plate. Lightly hit the thrust plate against the machined surface. Use a sharp blade to cut the seals even with the edge of the thrust plate.

Install the seal that has a “W” shape and the spacer in the groove in the front cover. Do not bend the metal seal. Install the seal in the outer groove in the front cover. Install the bearing blocks in the same positions from which they were removed.

5. Install the gears and bearing blocks in the pump chamber housing. Make sure the gear housing is installed in the correct position. The small hole in some housings must be in the outlet chamber. The large channels in the inlet and outlet chambers must be toward the

housing. If these parts are ALL parts that were removed, do not do steps 3. and 4. Read the CAUTION after step 3.

3. If the bearings are being replaced, press the bearing cone on the sprocket or sprocket hub. Use the original shim set and assemble the driven sprocket and hub. Tighten the capscrews or place bolts to torque. Put oil for the steering system on the bearings. Temporarily install the sprocket assembly in the flywheel housing. Install the adapter plate and tighten the capscrews or place bolts to 47 N.m (35 ft lbs) torque.

⚠ CAUTION

Be careful when tightening capscrews or place bolt installed in aluminum castings. If they are tightened more than the specifications, the threads can be damaged.

4. Check for a rotation torque of 1.70 to 2.48 N.m (15 to 22 inch lbs) on the S30–120E units. Check for a rotation torque of 0.56 to 1.70 N.m (5 to 15 inch lbs) on the H40–60H and H40–60JS units. Put a string through an oil hole between the teeth of the driven sprocket. Keep the string from pulling out of the hole. Wind the string around the circumference of the sprocket. Fasten a spring scale to the end of the spring. Pull the scale away from the sprocket using a constant force. The scale must indicate 24.3 to 35.6 N (5.5 to 8.0 lbs) for the S30–120E units as the sprocket is rotating. The scale must indicate 8.0 to 24.0 N (1.8 to 5.5 lbs) for the H40–60H and H40–60JS units as the sprocket is rotating. If the indication is high, remove shims. If it is low, add shims. Make sure capscrews or place bolts are tightened to the correct value each time the shim set is changed.

NOTE: Do steps 5. and 6. when ANY of the following parts are replaced: (1) drive sprocket, (2) seal ring (when used), (3) flywheel housing(4) engine crankshaft or (5) engine. If these parts are all parts that were removed, do not do steps 5. and 6. Do step 7.

5. Align the drive sprocket to the driven sprocket within 0.13 mm (0.005 inch). Do not install the oil seal. Measure the thickness of the flywheel at the capscrew or place bolt holes. Get two capscrews that are shorter, but the same diameter as the original capscrew or place bolts. The capscrews must be the measured amount shorter than the original capscrews. Temporarily install the original shim set, the seal ring (when used) and the drive sprocket. Install the new capscrews in opposite holes. Tighten the capscrews on diesel engine units to 122 N.m (90 ft lbs) torque. Tighten the capscrews to 81 N.m (60 ft lbs) torque on gasoline and LPG engine units.

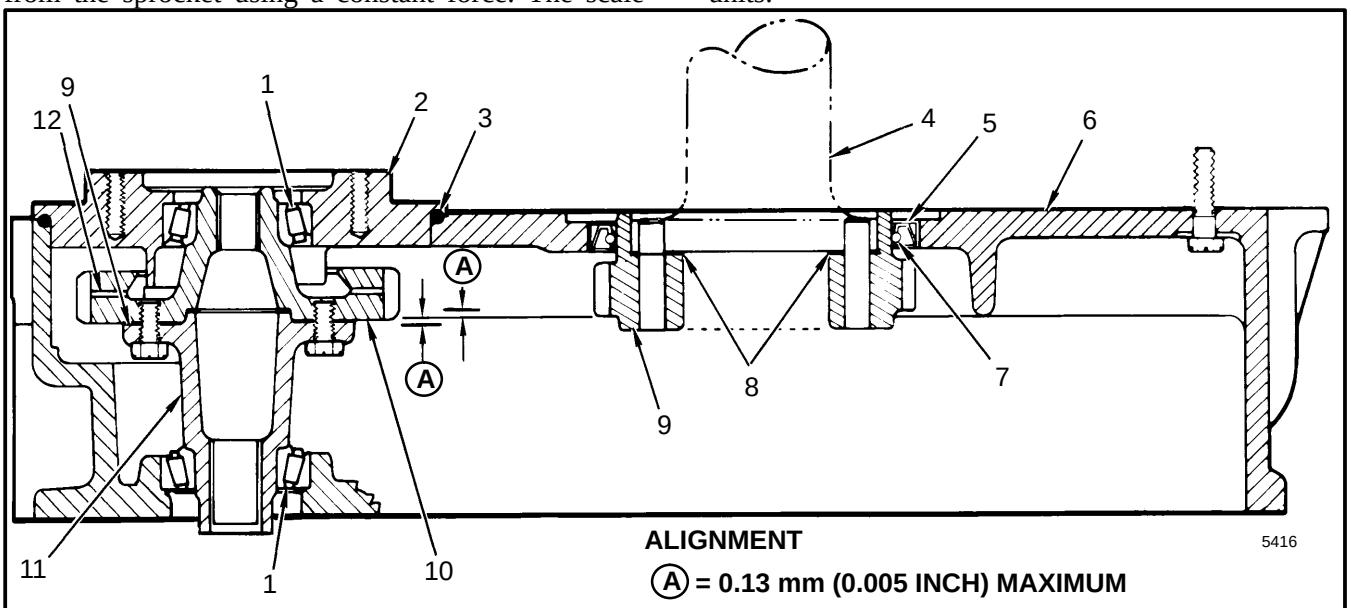


FIGURE 4. SPROCKET ALIGNMENT

SAFETY PRECAUTIONS
MAINTENANCE AND REPAIR

- When lifting parts or assemblies, make sure that all slings, chains or cables are correctly fastened and that the load being lifted is balanced. Make sure that the crane, cables and chains have the capacity to support the weight of the load.
- Do not lift heavy parts by hand. Use a lifting mechanism.
- Wear safety glasses.
- DISCONNECT THE BATTERY CONNECTOR before doing any maintenance or repair on electric lift trucks. Disconnect the battery ground cable on internal combustion lift trucks.
- Always use correct blocks to prevent the unit from rolling or falling. See “How To Put The Lift Truck On Blocks” in the **OPERATING MANUAL** or the **PERIODIC MAINTENANCE** section.
- Keep the unit and working area clean and in order.
- Use the correct tools for the job.
- Keep the tools clean and in good condition.
- Always use **HYSTER** *APPROVED* parts when making repairs. Replacement parts must meet or exceed the specifications of the original equipment manufacturer.
- Make sure that all nuts, bolts, snap rings and other fastening devices are removed before using force to remove parts.
- Always fasten a DO NOT OPERATE sign to the controls of the unit when making repairs or if the unit needs repairs.
- Make sure you follow the **DANGER, WARNING** and **CAUTION** notes in the instructions.
- Gasoline, Liquid Petroleum Gas (LPG), and Diesel are flammable fuels. Make sure that you follow the necessary safety precautions when handling these fuels and when working on these fuel systems.
- Batteries generate flammable gas when they are being charged. Keep fire and sparks away from the area. Make sure the area has ventilation.

(2) **Voltmeter.** The earlier Basic Display Panel has a battery indicator without lift interrupt (voltmeter). This meter has a green, yellow and red band on the meter face to indicate the voltage of the battery. The needle starts in the green band with a fully charged battery and moves to the red band as the battery discharges. The battery must have a current draw (load) to check the battery charge. Hold the tilt lever in the tilt BACKWARD position or for the N30XMH, hold the rotate lever in the ROTATE position and look at the indicator. If the needle is in the red band, charge the battery. Operating the lift truck with the needle in the red band can decrease battery life. Continued operation with a discharged battery can damage the battery, motors or the contactors.

(3) **Warning light, parking brake indicator.** The red light is ON when the parking brake is applied and the seat switch is closed. and goes OFF when the parking brake is released.

(4) **Warning light, brake fluid reservoir is low (Early Only).** The red light is ON for one second when the key is turned to the **START** position and must go OFF after one second. If the warning light is ON during operation, the brake fluid level in the reservoir is too low.

(5) **Warning light, fasten seat belt.** The red light is ON for eight to ten seconds after the key is turned to the **ON** position.

LATER DISPLAY PANEL

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

(1) **Battery Charge Indicator With Lift Interrupt.** Later Basic display panels have a battery indicator that is a scale with a series of 5 round LEDs in three colors (green, orange, red). See FIGURE 9. There are two green LEDs and bars at the top, two orange LEDs and bars in the center and a red LED and bar at the bottom. As the battery voltage decreases during operation, different LEDs illuminate to indicate a discharged battery. No more than two LEDs are illuminated at one time. When the battery is fully charged, the two green LEDs of the scale are illuminated. When the battery discharges during operation, the LEDs illuminate from top to bottom (green to red). The red LED indicates that the battery is discharged. The battery must be charged or a charged battery must be installed before lift truck operation can continue.

The battery charge indicator uses the traction control shunt to measure the current during operation. This current and battery voltage are checked at the same time for an accurate reading of battery voltage with a load (during use). This method can make operation of the lift truck different when the battery is low or a different battery is connected. This method permits better use of the battery charge.

The controller also checks the battery voltage each time a battery is connected. The traction control will prevent lift truck operation if the battery voltage is not correct as set by traction function 15. A status code of -16 (voltage too high) or -15 (voltage too low) will indicate on the display panel. The battery can have a voltage that is too high or too low. A battery with the correct voltage can also be deeply discharged from use or other reasons and have a voltage that is less than the minimum of the voltage range.

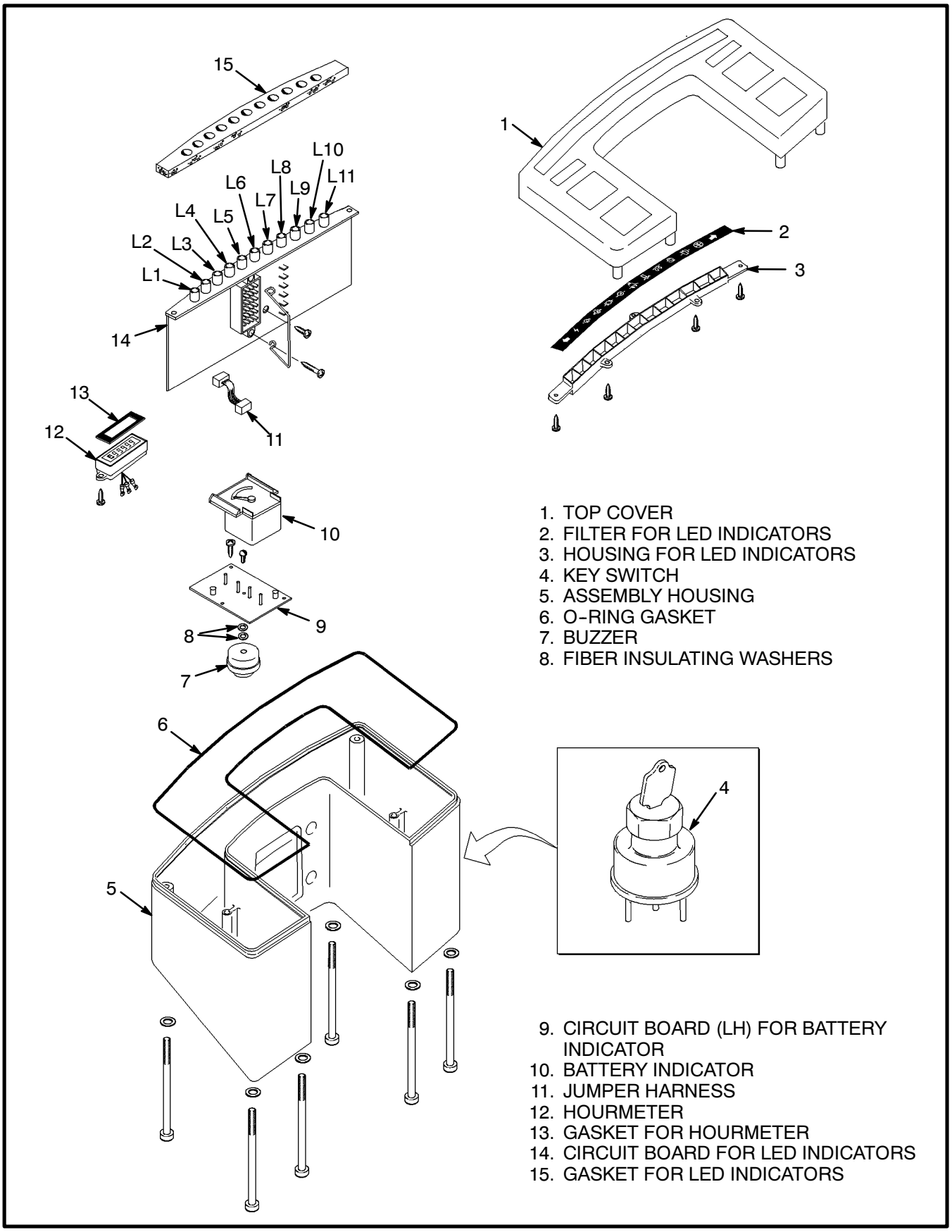
Batteries that have different ampere hour ratings or are of different ages can sometimes be used in the same lift truck. It can be necessary to adjust traction Function 14 so that the weakest battery is not damaged. Follow the procedure for adjusting traction Function 14 in the Checks And Adjustments.

(2) **Warning light, parking brake indicator.** The red light is ON when the parking brake is applied and the seat switch is closed. and goes OFF when the parking brake is released.

(3) **Warning light, fasten seat belt.** The red light is ON for eight to ten seconds after the key is turned to the **ON** position.

(4) **Digital Display.** This indicator is blank when the lift truck is operating correctly. The status codes and the hourmeter values are shown on this four-digit LCD display. When a fault occurs, the status code will be shown with a dash (-) in the left digit position. The warning light, Service Interval (11) will also be illuminated when a fault occurs.

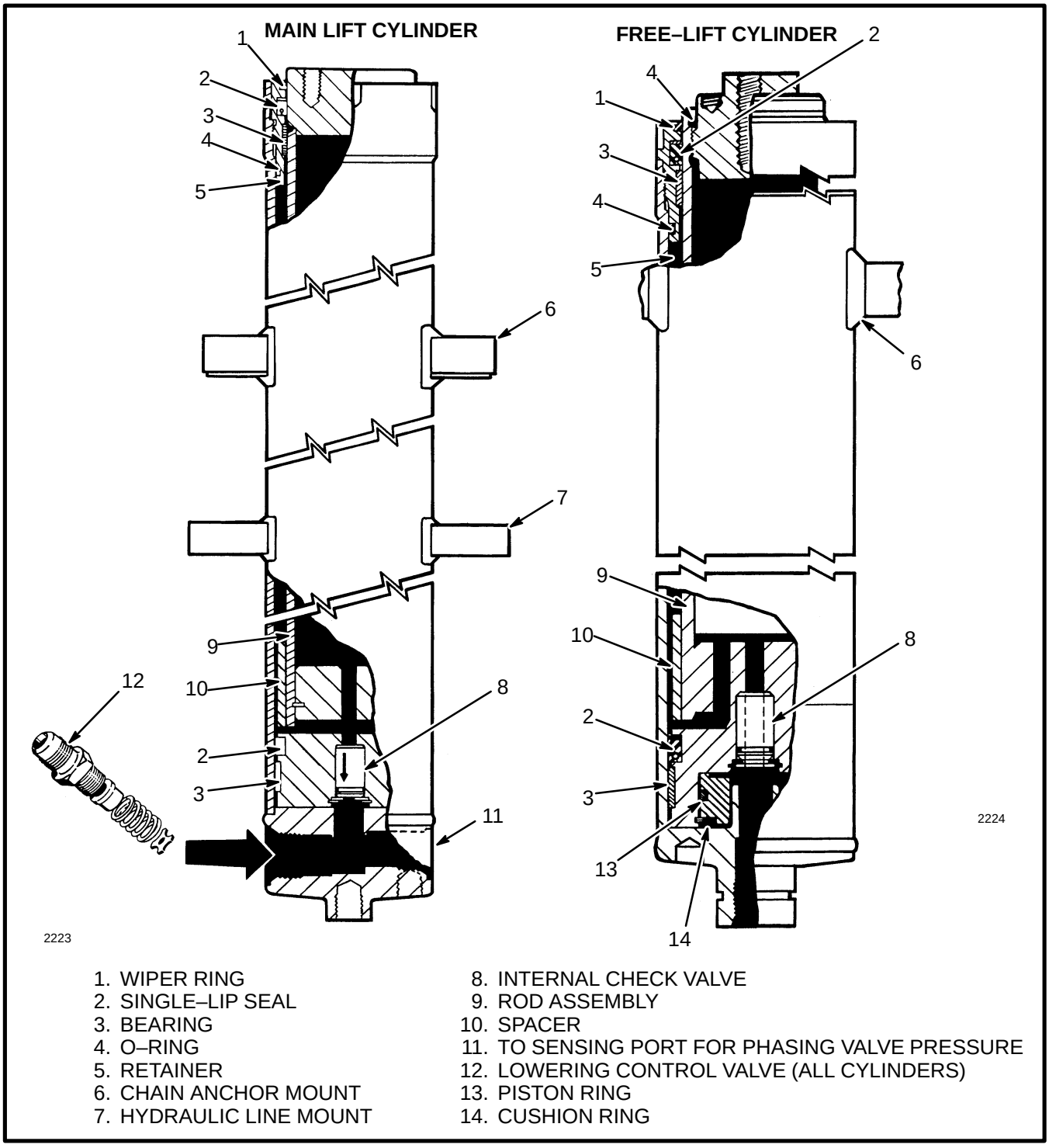
When it is time for periodic maintenance, the warning light, Service Interval (11) will be illuminated and a status code -99 will be indicated.



1. TOP COVER
2. FILTER FOR LED INDICATORS
3. HOUSING FOR LED INDICATORS
4. KEY SWITCH
5. ASSEMBLY HOUSING
6. O-RING GASKET
7. BUZZER
8. FIBER INSULATING WASHERS
9. CIRCUIT BOARD (LH) FOR BATTERY INDICATOR
10. BATTERY INDICATOR
11. JUMPER HARNESS
12. HOURMETER
13. GASKET FOR HOURMETER
14. CIRCUIT BOARD FOR LED INDICATORS
15. GASKET FOR LED INDICATORS

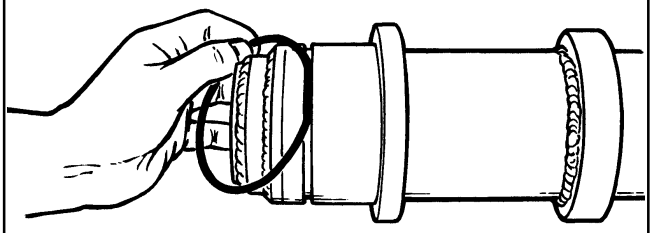
FIGURE 15. STANDARD DISPLAY PANEL

MENTS for test procedures and leakage rates within the specifications.

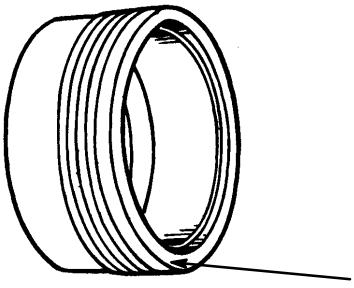


1. WIPER RING
2. SINGLE–LIP SEAL
3. BEARING
4. O–RING
5. RETAINER
6. CHAIN ANCHOR MOUNT
7. HYDRAULIC LINE MOUNT
8. INTERNAL CHECK VALVE
9. ROD ASSEMBLY
10. SPACER
11. TO SENSING PORT FOR PHASING VALVE PRESSURE
12. LOWERING CONTROL VALVE (ALL CYLINDERS)
13. PISTON RING
14. CUSHION RING

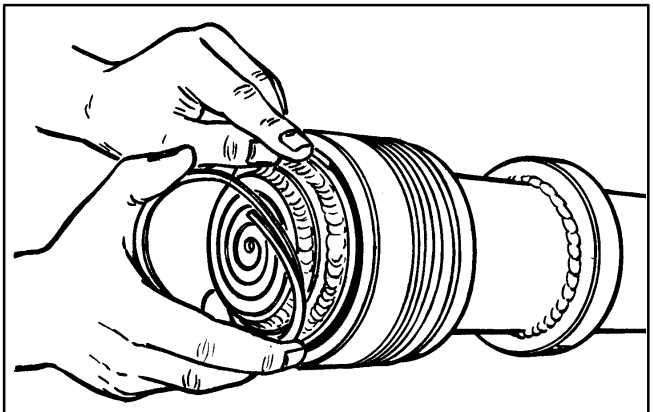
FIGURE 3. SINGLE–STAGE LIFT CYLINDERS



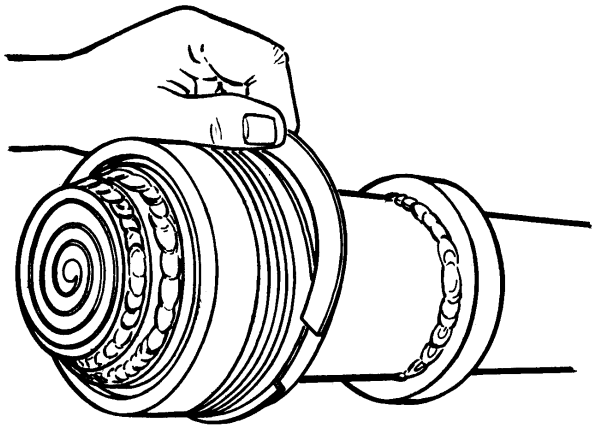
STEP 1. Lubricate the new O–ring with hydraulic oil and then install it on the piston end of the cylinder rod.



STEP 2. Install a new packing assembly on the piston half. The packing must extend approximately 3mm ($^1/_8$ inch) beyond the end of the piston half.



STEP 3. Install the piston half and snap ring.



STEP 4. Install the nylon spacer.

STEP5. Install the piston in the lift cylinder. Carefully push the piston and piston rod into the lift cylinder. Release the clamp on the packing when the packing moves past the threads of the cylinder.

1. PISTON
2. SPECIAL TOOL OR CLAMP TO INSTALL PACKING

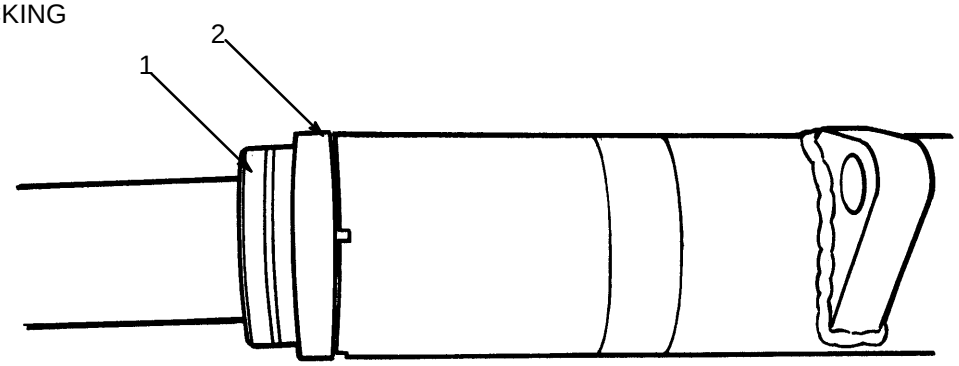


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FIGURE 13. INSTALLATION OF CHEVRON PACKING ON A PISTON

THE LPG FUEL SYSTEM (IMPCO CA 50, CA 100)

GENERAL

This section has the description and the repair procedures for the LPG fuel system installed on the 4 and 6 cylinder engines.

DESCRIPTION

The LPG fuel system has a fuel tank, hydrostatic relief valve, a filter with a fuel valve, a vaporizer, a carburetor and a governor.

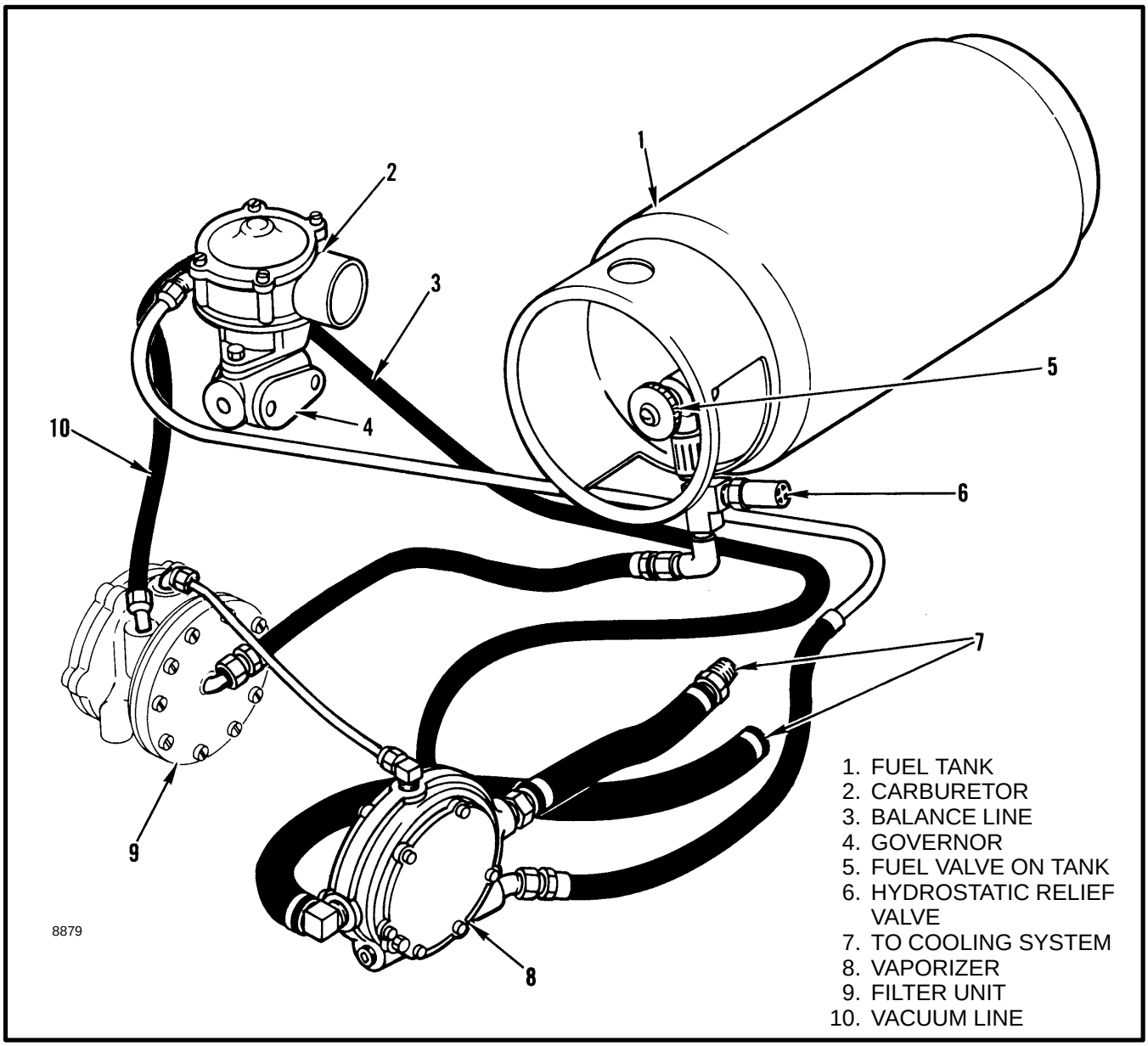


FIGURE 1. LPG FUEL SYSTEM

2. Turn the shut–off valve clockwise until the valve is completely closed.

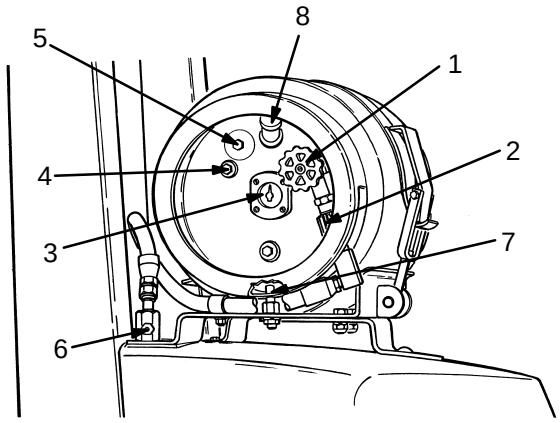
3. Run the engine until it stops, then turn the key to the **OFF** position.

4. Disconnect the quick disconnect fitting.

⚠ WARNING

LPG is very cold. Always wear gloves to protect your hands from the cold fittings. Do not permit LPG to contact the skin.

5. Release the tank latch and remove the tank from the bracket.



1. SHUT–OFF VALVE
2. QUICK DISCONNECT FITTING
3. FUEL GAUGE
4. PLUG
5. LIQUID LEVEL INDICATOR
6. RELIEF VALVE
7. ALIGNMENT PIN
8. TANK RELIEF VALVE

NOTE: Some LPG tanks have an auxiliary fill fitting instead of a plug for Item 4.

FIGURE 19. LPG TANK

Installation (See FIGURE 19.)

1. Before the tank is installed on the lift truck, check the operation of the fuel gauge. Look at the fuel gauge and move the tank. The needle of the gauge must move when the fuel moves. If the needle does not move, a new tank must be installed.

⚠ WARNING

Make sure the alignment pin extends through the correct hole in the rim of the LPG tank. The hose or fittings can be damaged if the LPG tank is not installed in the correct position. A damaged hose or fitting can release LPG fuel and cause an explosion and fire hazard.

2. Install the LPG tank in its bracket so that the alignment pin is in the correct hole in the bracket. Close the latches.

3. Connect the quick disconnect fitting to the shut–off valve on the tank. Use your hand to tighten the fitting.

4. Turn the shut–off valve counter clockwise to open the valve.

5. Inspect the fuel system for leaks when the shut–off valve is open. Frost on the surface of the tank, valves or fittings or a strong odor of LPG fuel indicates a leak.

⚠ WARNING

The shut–off valve on the tank must be closed when the truck is not being used.

REPLACE THE HOSES

The hoses installed on LPG systems are special. Hoses that are made for use with hydraulic oil are damaged by LPG. When replacing the LPG hoses, make sure to use only HYSTER Approved LPG hose. Make sure to use the correct size of hose. When replacing the hose to the quick disconnect fitting, make sure that it is the same length as the hose it replaces. A longer hose permits the tank to be installed in a position that is not correct. If a fuel hose has a restriction, it is coldest around the restriction.

HYDROSTATIC RELIEF VALVE

Removal and Installation

⚠ WARNING

LPG can cause an explosion. Do not cause sparks or permit flammable material near the LPG system. Close the fuel valve on the tank. Disconnect the negative battery cable to prevent sparks.

1. Close the shut–off valve on the tank.

2. Slowly loosen the hose fitting for the relief valve. Let the fuel drain from the fitting before removing the relief valve.

3. The valve cannot be repaired. If the valve is damaged, install a new valve. After installation, open the shut–off valve slowly and inspect the system for leaks.

CHECKS AND ADJUSTMENTS

⚠ WARNING

LPG can cause an explosion. Do not permit any sparks or open flames in work area.

CHECK THE FILTER UNIT

1. Check for leaks in the fuel valve by disconnecting the fuel inlet hose at the vaporizer. Put the end of the hose in a container of water. There must be no bubbles in the water. If there are bubbles in the water, install a new valve pad in the filter unit.

2. If there are no bubbles in the water, remove the primary wire to the distributor or cause a short circuit in coil secondary wire.

⚠ WARNING

Do not remove the coil secondary wire to cause an open circuit. A spark can cause an explosion.

Turn the key switch momentarily to the "START" position to cause a vacuum in the inlet manifold. Bubbles must appear in the container of water.

3. If there are no bubbles seen in step B, check the vacuum hose for a restriction. If there is vacuum to the filter unit, inspect the diaphragm for holes or cracks. Make sure the tank has fuel and that the tank valve is open.

CHECK THE VAPORIZER

Pressure Reducer Valve

1. Connect a pressure gauge that can measure with accuracy a pressure below 35 kPa (5 psi) to the test port of the vaporizer. The gauge must indicate 10.4 kPa (1.5 psi) when the engine is at idle. If the gauge indicates a pressure greater than 10.4 kPa (1.5 psi), the pressure reducer valve has a problem.

2. Stop the engine. The gauge must not indicate an increase in pressure. If the pressure increases when the engine is stopped, the pressure reducer valve has a problem.

Vapor Valve

1. Run the engine until it is warm.

2. To check for leaks, stop the engine and disconnect the hose from the fuel inlet port at the carburetor. Put the end of the hose just below the surface of water in a container. If bubbles are seen, the vapor valve has a problem or is dirty.

3. To check the vapor diaphragm, remove the inlet hose to the vaporizer. Remove the inlet hose at the carburetor. Put the end of the hose below the surface of the water in a container. Remove the balance line from the carburetor and apply air pressure to the line. If bubbles continue to be seen in the water, the diaphragm has a problem.

ADJUST THE CARBURETOR (See FIGURE 27.)

Idle Mixture

1. When the engine is not running, turn the idle mixture screw clockwise until it stops. In this position, the idle mixture screw prevents air from entering the air tube through the idle air port.

2. Turn the idle mixture screw $3–{}^{1}/_{2}$ turns counterclockwise. Start the engine. Adjust the screw as needed until the idle is smooth. Turning the screw counterclockwise increases the ratio of air to fuel.

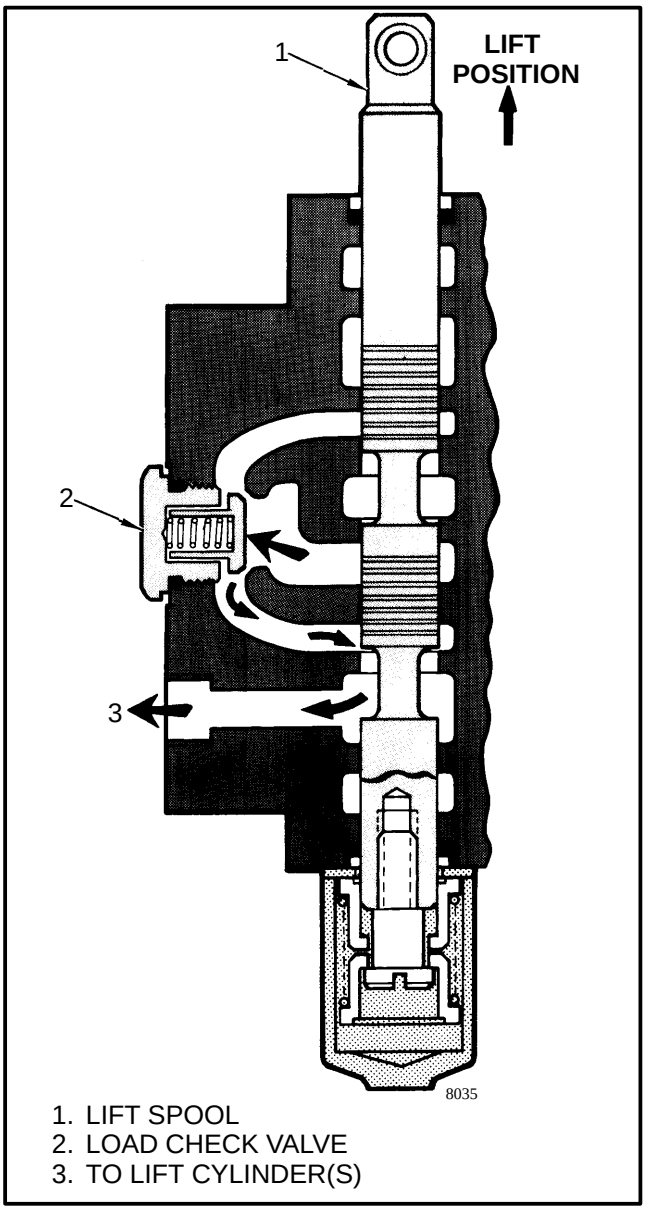
3. Stop the engine. Restart the engine. If the engine does not start easily, turn the idle mixture screw clockwise one half turn and restart the engine. Continue this procedure until the engine starts easily.

Idle Speed

Turn the idle speed screw until the idle speed of the engine is within the specification.

Power Mixture

The power mixture valve controls the flow of fuel to the carburetor when the engine is running at near full capacity. Set the power mixture valve one notch rich from center. This setting will be satisfactory for most conditions. If further adjustment is required proceed as follows: When adjusting the power mixture valve the engine RPM must not be permitted to increase to the governor limit.

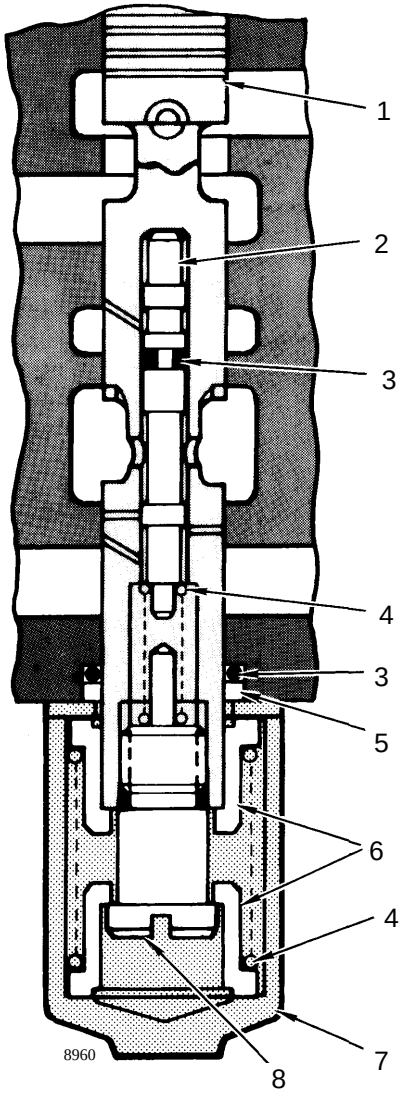


1. LIFT SPOOL
2. LOAD CHECK VALVE
3. TO LIFT CYLINDER(S)

FIGURE 4. OPERATION OF THE LIFT SPOOL

TILT FORWARD (See FIGURE 6.)

The tilt control spool prevents cavitation and gives control of the load during forward tilt. It does this by controlling the pressure differential between the pump pressure and the pressure caused by the weight of the load. In order for the mast to tilt forward, the inlet pressure must move the tilt control spool so that oil from the rod end of the cylinders can flow to the drain circuit.



1. TILT SPOOL
2. TILT CONTROL SPOOL
3. O–RING
4. SPRING
5. SEAL
6. RETAINERS
7. END CAP
8. SPECIAL SCREW

FIGURE 5. TILT SPOOL

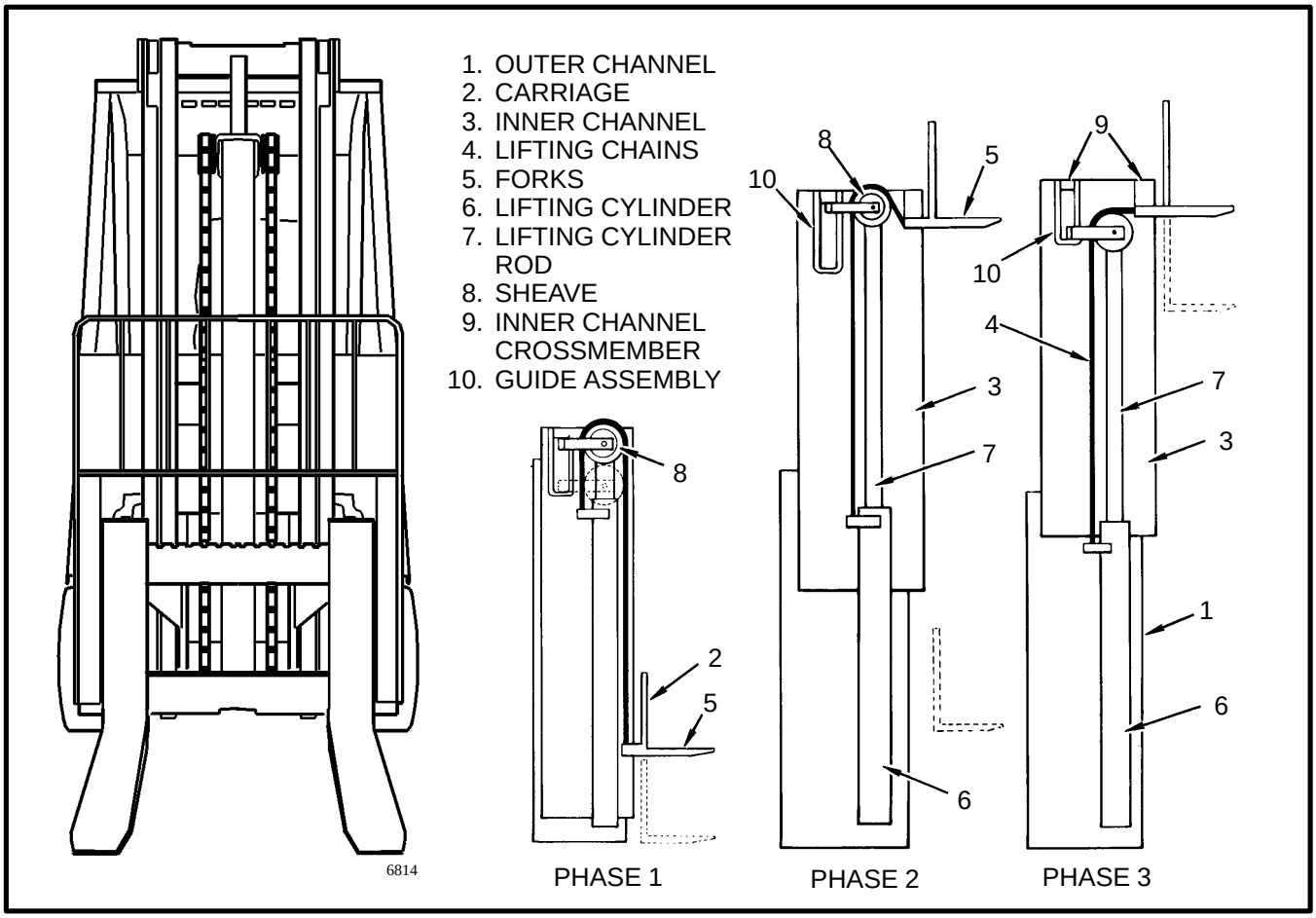


FIGURE 3. STANDARD MAST SEQUENCE

STANDARD MASTS (Mast Assemblies Having Less Than Full Free–Lift.)

Standard masts have an outer and an inner channel. A one stage lifting cylinder fastened to the bottom crossmember of the outer channel. On masts with small free–lift ability, the cylinder rod is fastened to the crossmember on the top of the inner channel. 1500 to 4000 kg (3,000 to 10,000 lb) capacity lift trucks have approximately 600 mm (2 feet) full free–lift. These masts have a crosshead and guide assembly fastened to the cylinder rod. The rod is permitted to extend approximately 300 mm (1 foot) before the crosshead begins to lift the inner channel. See FIGURE 3.

As the rod continues extending, the carriage and the inner mast raise with it. A vertical guide is welded to the inner channel crossmember. This guide gives stability to the cylinder and crosshead when the carriage is raised and lowered.

FULL FREE–LIFT MASTS (See FIGURE 4.)

Full free–lift masts have an outer and inner telescopic channel. A two–stage lifting cylinder is fastened to the bottom crossmember of the outer channel. A two stage cylinder has two telescopic piston and rod assemblies. The larger diameter rod is the primary. The smaller diameter secondary. As the primary rod extends, the secondary is raised as part of the primary rod. When the primary rod extends to the limit of its stroke, the secondary rod begins to extend. A two stage cylinder extended to full height is almost three times the height of a retracted cylinder.

The cylinder is approximately one–half the height of the retracted mast channels.

The crosshead and guide assembly is fastened to the secondary rod. The guide slides along rails welded to the inner mast. The guide gives stability to the crosshead and the lifting cylinder.

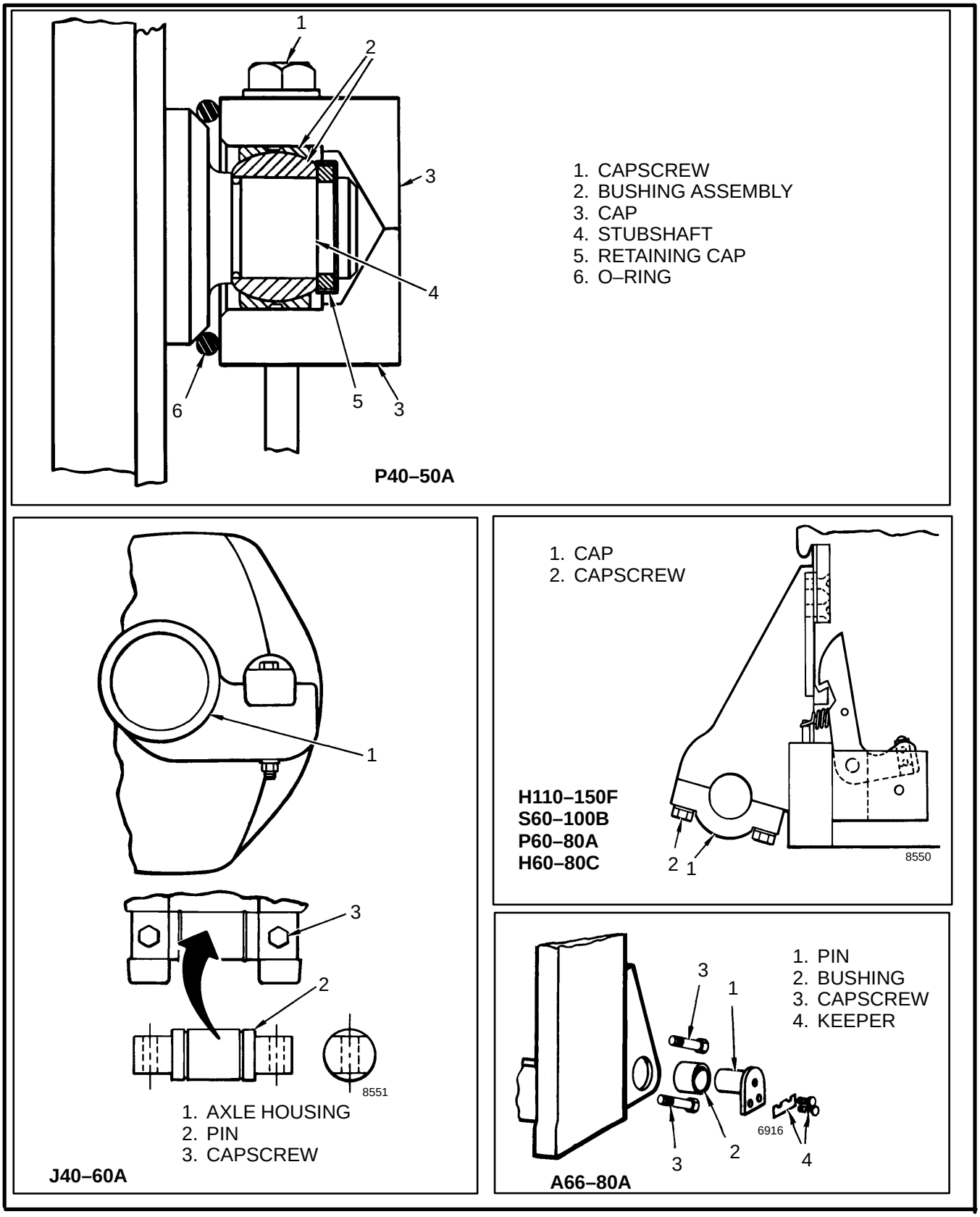


FIGURE 2. TYPICAL MAST PIVOTS (2 of 2)

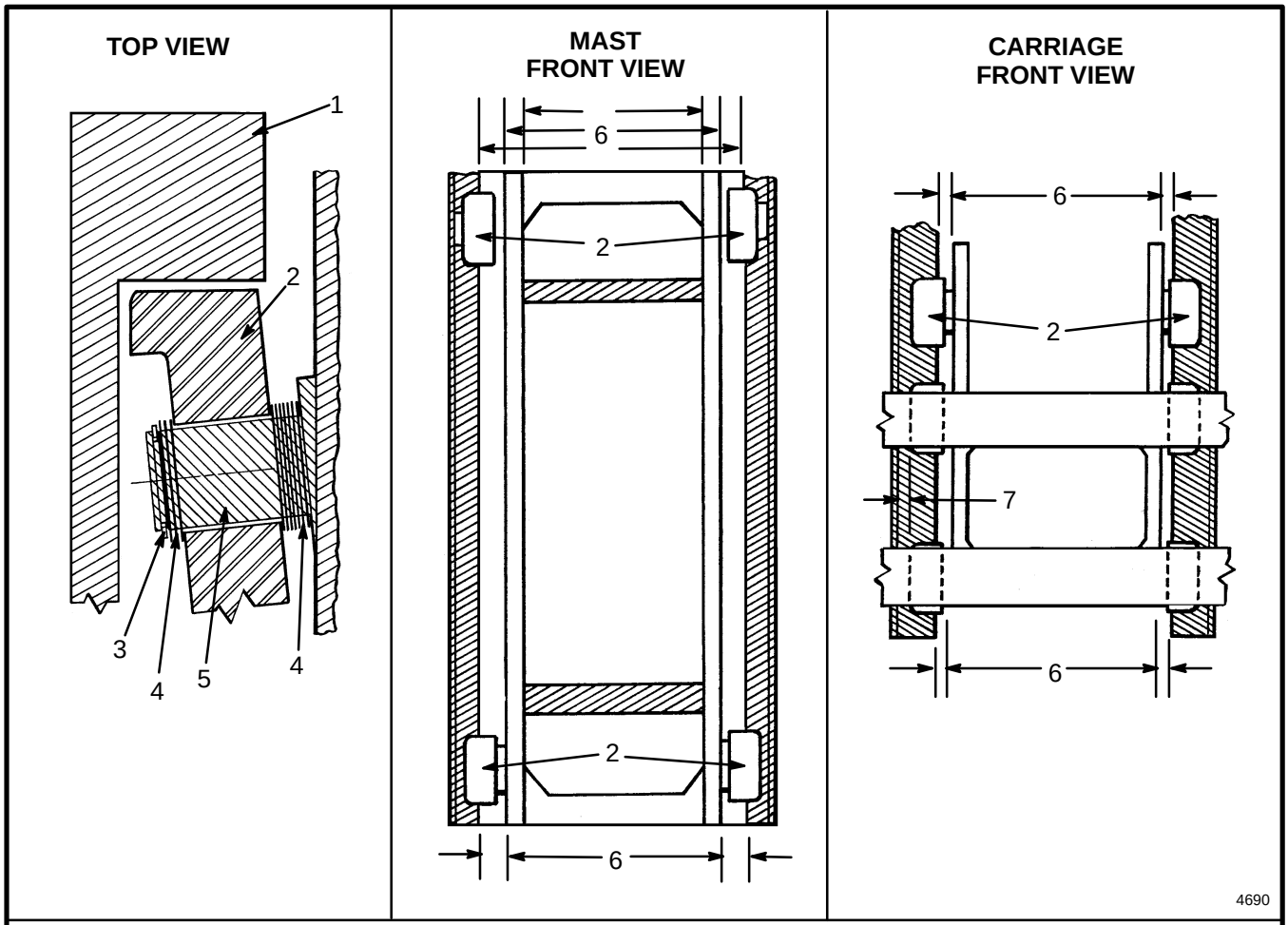
3. Adjust the strip bearings. Insert shims between the strip bearing and the spacer bar. Adjust the clearance until there is less than 0.8 mm (0.030 in) at the tightest fit. See FIGURE 11.

Guide Shoe Adjustment (See FIGURE 12.)

4. The masts having full free–lift have guide shoes. The guide shoes make sure the free–lift cylinder rod is parallel to the masts during the full travel. Adjust the guide with shims so that the cylinder is parallel to the masts when the rod is retracted. Then adjust the clearance for 0.8 mm (0.030 in) at the tightest fit in the travel of the guide shoes.

5. Cushion adjustment (standard masts with intermediate free–lift). See FIGURE 13. The adjustable cushion stops the inner channel when the lifting cylinder is fully retracted. Add or remove shims to make the top of the inner channel even with the top of the outer channel within 1.5 mm (0.060 in).

6. Latch Adjustment (full free–lift masts). See FIGURE 13. The correct operation of the latches makes necessary the correct adjustment of the inner channel load rollers and the cushion. Adjust the inner channel cushion with shims so that the latches will release smoothly and will operate as shown in FIGURE 13.



1. MAST WELDMENT (CHANNEL)
2. LOAD ROLLER
3. SNAP RING
4. SHIMS
5. STUB SHAFT
6. PARALLEL, EQUAL SPACE WITHIN 1.5 mm (0.060 in)
7. ADJUST LOAD ROLLERS FOR ZERO CLEARANCE

USE SHIMS TO KEEP CARRIAGE AND MAST PARALLEL, TO PROVIDE APPROXIMATELY EQUAL SPACE BETWEEN BOTH SIDES OF CARRIAGE AND MASTS AND TO PROVIDE THE CORRECT CLEARANCE AT TIGHTEST FIT.

FIGURE 10. MAST AND CARRIAGE ADJUSTMENTS

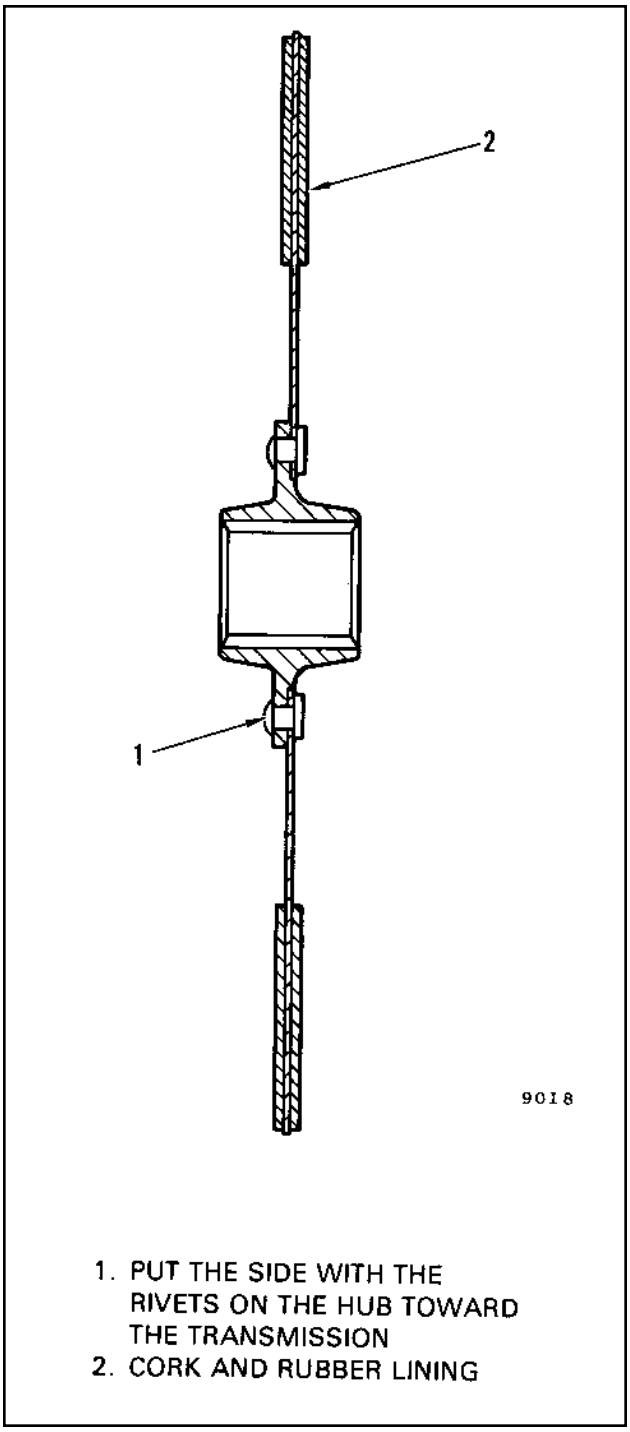


FIGURE 3. CLUTCH DISC INSTALLATION

C. The splines of the clutch disc must be aligned with the pilot bearing. Use an old input shaft or a special tool to align the clutch disc. Put the splines of the shaft in the splines of the disc. Move the shaft and the disc until the shaft can be pushed into the pilot bearing. Tighten the capscrews one turn at a time until the cover is tight against the flywheel. Tighten the capscrews to 351bf ft (47 N.m). Remove the old input shaft or special tool.

D. Install the release bearing on the release bearing collar. Make sure the flat surface of the bearing is NOT against the collar. Install the cam followers on the yoke.

E. Install new needle bearings for the release shaft. Push on the end of the bearings with the writing. Install the seal with the lip toward the clutch.

F. Slide the release shaft into the housing and into the yoke. The ear for the lock wire must be toward the clutch. Install and tighten the set screw. Use lock wire to lock the set screw. Slide the release bearing collar on the sleeve. Install the retainer spring in the yoke.

G. Fasten the lifting device to the transmission housing. Install the gasket on the flywheel housing. Move the transmission toward the flywheel housing until the input shaft is aligned with the splines of the clutch disc. Push the transmission housing against the flywheel housing. Install and tighten the capscrews to 35 1bf ft (47 N.m).

K. Install new bearings with seals in the clutch pedal, if necessary. Lubricate the bearings with grease. The bearings must be installed with the seals to the outside.

L. Connect the hoses to the hydraulic manifold. Install the hose to the transmission sump.

M. Install the engine and transmission into the lift truck as described in the section for THE FRAME.

N. Connect the linkage to the clutch pedal. Connect the booster spring to the eyebolt and fasten the eyebolt to the pedal with the nut. The spring link must be in a position so that it does not touch other parts. See Checks and Adjustments for the adjustment procedure for the release bearing clearance and the pedal height.

When adding air to tires, use equipment with a gauge or preset pressure regulator and a clip-on chuck. Make sure the hose is long enough to avoid being in the path of the wheel parts in case of an explosion.

WARNING

Stay clear of the path of wheel parts in case of an explosion.

If it is necessary to add air to a tire that is warm, check one of the other tires. Add air to the tire with low pressure so that the air pressures are equal. The tire pressure of warm tires must always be equal to or greater than tire pressure specified for cold tires.

Check that all of the wheel nuts are tight. When the wheels are removed and installed again, check the nuts for the correct torque as shown in MAINTENANCE every eight hours. When the nuts stay tight after an eight hour check, the interval for checking with a torque wrench can be extended to 350 hours.

Lift Mechanism

WARNING

Lower lift mechanism completely. Never stand under a raised carriage.

Do not put any part of the body in the lift mechanism unless all parts of the upright are completely lowered and the engine is OFF.

Always block or chain the upright weldments and carriage before inspecting the upright or attempting any repairs.

Forks (Item 9)

A. Check that the tips are aligned within 13 mm (0.5 inch) of each other (I).

WARNING

Do not try to correct the alignment by bending the forks or adding shims. Replace bent or damaged forks.

B. Check for cracks (2) in the heel of the forks and at the attachment points.

WARNING

Never repair damaged forks by heating or welding. Forks are made of special steel using special procedures. Replace damaged forks.

C. Check for cracks (2) or damage (4) in the fork hooks or pins. Replace as necessary.

D. Check each latch for proper operation. The latch should securely lock the fork to the carriage.

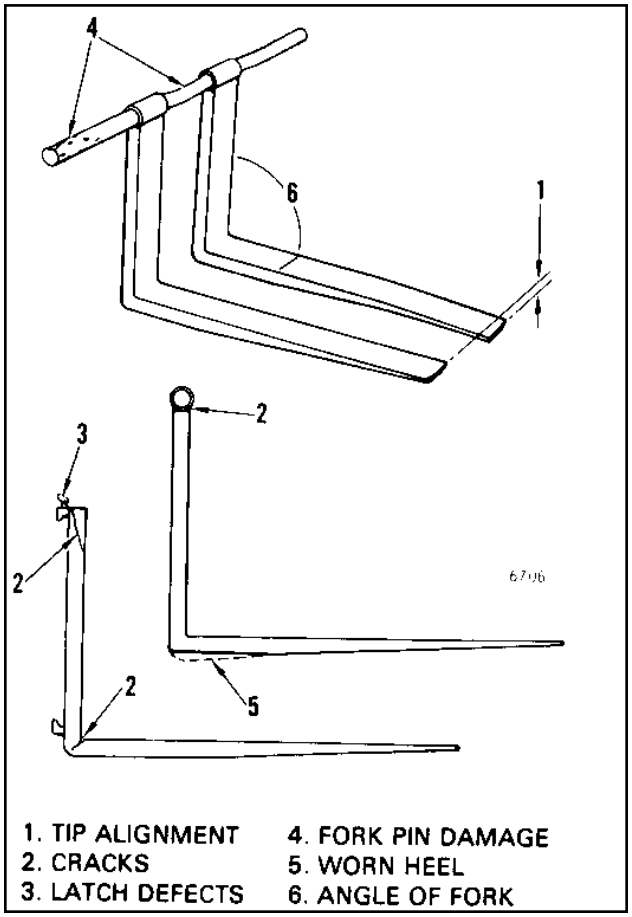


FIGURE 8. CHECK THE FORKS

Lift Chain (Item 10)

A. Check the lift chain for the proper lubrication.

B. Inspect the lift chain for cracks or broken links and pins. Check for corrosion or worn holes in the links. When the pins or holes become worn, the chain becomes longer. If a section of chain is 3~q longer than the section of new chain, the chain is worn and must be replaced.

If a chain scale is available, check the lift chain as shown. If a chain scale is not available, measure 20 links of chain. Compare the length with the chart in Figure 9. Replace the chain if the length of 201inks of the worn section is more than the maximum wear limit.

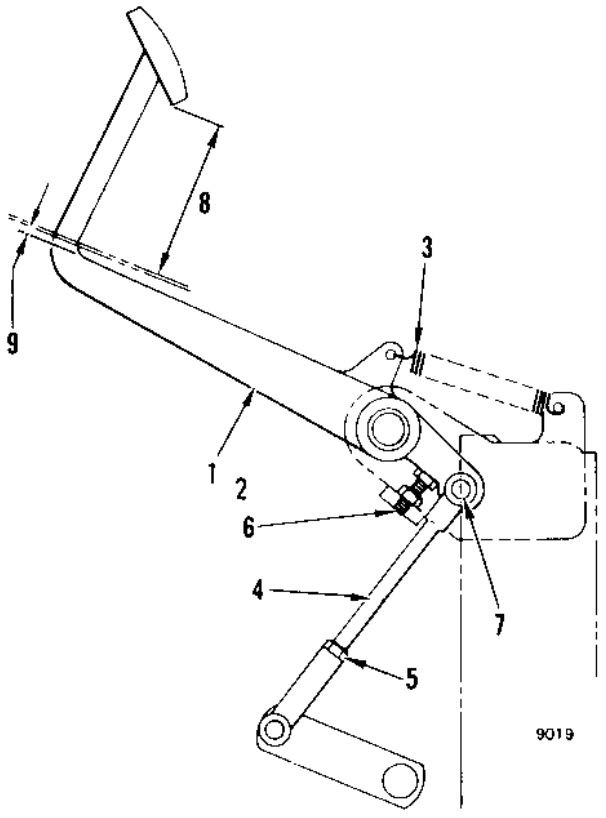
WARNING

If one chain has a defect, replace both chains. Do not try to repair a worn chain.

DIFFERENTIAL (Item 21 or 22)

Check the oil level for the oil clutch transmission and differential. Remove the plug for the oil level hole. The oil level must be even with the bottom of the hole. Add the correct oil through the hole if the level is low. Install and tighten the plug.

Check the oil level for the differential for lift trucks with powershift transmissions. Remove the plug for the oil level hole. The oil level must be even with the bottom of the hole. Add the correct oil through the hole if the level is low. Install and tighten the plug.



1. PEDAL ARM
2. SHAFT BRACKET
3. RETURN SPRING
4. THREADED ROD
5. LOCK NUT
6. CAPSCREW FOR PEDAL HEIGHT ADJUSTMENT
7. DOWEL
8. 5.38 inch (136 mm)
9. 0.06 inch (1.6 mm)

FIGURE 19. CLUTCH LINKAGE ADJUSTMENT

ADJUSTING THE OIL CLUTCH PEDAL

The clutch pedal must be adjusted so that the pedal arm does not touch the bottom of the floor plate. See Figure 19. There must be 1.6 mm (0.0625 inch) clearance between the top of the pedal arm and the bottom of the floor plate. The distance from the top of the floor plate to the bottom of the pedal pad must be 136 mm (5.38 inch). To adjust the height of the pedal, loosen the lock nut that is on the capscrew on the shaft bracket. Turn the capscrew until the pedal height is correct. Tighten the lock nut.

When the clutch pedal height is correct, adjust the clutch release linkage. The pedal must move freely 13 mm (0,5 inch) from its stop to the point where the release bearing touches the pressure plate levers. Remove the pedal return spring. Move the pedal up and down and measure the travel between the points of resistance. Adjust the length of the threaded rod to change the amount of movement of the pedal. Loosen the lock nut on the rod. Remove the cotter pin from the dowel on the pedal arm. Pull the rod from the dowel. Turn the rod to change its length. Install the rod on the dowel and measure the pedal travel. Install a new cotter pin when the pedal travel is correct. Install the pedal return spring.

HYDRAULIC SYSTEM (Item 1 and 25)

Changing The Hydraulic Oil Filter

The hydraulic filter has two elements: A screen which can be cleaned and a paper element which must be replaced.

A. Remove the capscrews that hold the filter head to the tank. Remove the filter assembly from the tank. Remove the fitting from the filter head.

WARNING

A spring pushes on the filter head and bowl. Be careful when removing the four screws.

B. Remove the 4 screws that hold the filter bowl to the head. See Figure 20.

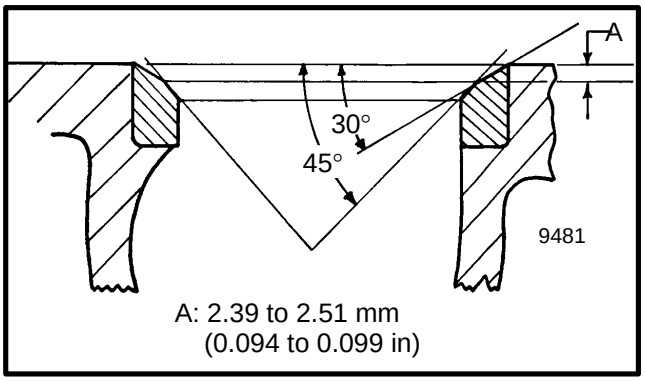


FIGURE 5. VALVE SEAT ANGLES

1. If the surface of the valve seat is not smooth, the seat must be cut or ground. The seat must ground at two angles so that the surface for the valve is not too wide. Grind the seat with the 45° stone until the surface is smooth. Use the 30° stone to make the seat narrow. See FIGURE 5.

2. Check the depth of a new valve head below the surface of the cylinder head after the seat is machined. See FIGURE 6. The exhaust valve head must not be more than 1.4 mm (0.055 in) below the surface of the cylinder head. The inlet valve head must not be more than 1.5 mm (0.061 in) below the surface of the cylinder head. If the depth of the valve head is more than the specification, the valve seat or valve must be replaced.

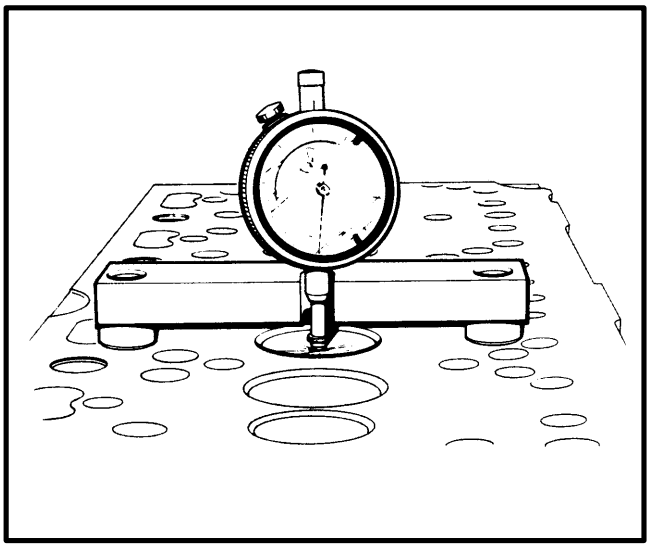


FIGURE 6. CHECKING THE DEPTH OF THE VALVE HEAD

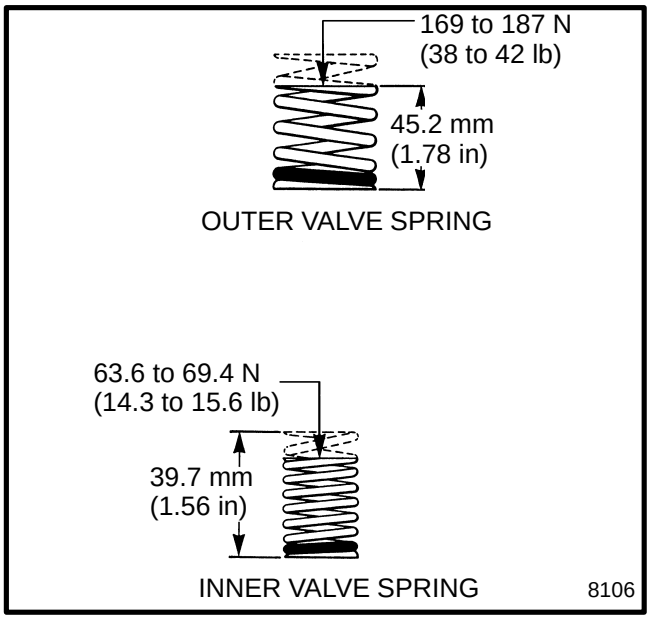


FIGURE 7. VALVE SPRINGS

3. Do not lubricate the valve seats before installation. Grind or cut the valve seats after installation as described above.

VALVE SPRINGS

Check the pressure of the valve springs when the cylinder head is disassembled. The springs must be square. The height of an inner spring that is compressed by a load of 63.6 to 69.4 N (14.3 to 15.6 lb) must be 39.7 mm (1.56 in). A load of 169 to 187 N (38 to 42 lb) is needed to compress the outside spring to a height of 45.2 mm (1.78 in). If the springs are not at the correct height when the specified load is applied, they must be replaced. See FIGURE 7.

The correct height for the inner springs when they are installed is 39.7 mm (1.56 in). The correct height for the outer springs is 45.2 mm (1.78 in).

The spring coils that are together must be installed toward the cylinder head.

VALVES

The valves must be checked for wear on the stems. The valve head must not be bent or have cracks. The valve face must be ground to a 45° angle. Do not grind too much metal from the valve or the valve head will be too far below the surface of the cylinder head.

Lubricate the valve with engine oil before installing the valve in the valve guide. Use new valve seals when assembling the valve mechanism.

3. Install and tighten the capscrews to 44 N.m (180 lbf ft).

4. Check the clearance between the crankshaft and the thrust washers. The clearance must be 0.010 to 0.38 mm (0.004 to 0.015 in). Install thicker thrust washers if the clearance is more than 0.38 mm (0.015 in).

5. Install the connecting rod bearings in the connecting rods and caps. Lubricate the bearings and install the caps on the connecting rods. Tighten the nuts to 102 N.m (75 lbf ft).

6. Install the support for the rear main bearing. Use new seals when installing the support. Make sure the rear surface of the support is even with the rear surface of the crankcase. See FIGURE 24.

7. Install the new seal in the seal housing as shown in FIGURE 25. The seal must be installed so that the lip does not touch a groove in the crankshaft flange. Install a new gasket with sealant. Lubricate the seal and install the seal housing. Make sure the flange of the crankshaft is in the center of the seal.

⚠ CAUTION

Do not damage the seal when installing the seal housing.

8. Install the flywheel housing and flywheel. Tighten the place bolts in the flywheel 122 N.m (90 lbf ft).

9. Install the oil pump and relief valve. Install the timing gear case and timing gears. Install the crankshaft pulley.

10. Install the oil pump screen and tube. Install the sump.

CAMSHAFT AND CAM FOLLOWERS

Removal

The engine must be on an engine stand to remove the camshaft and cam followers.

1. Remove the crankshaft pulley, timing case cover, timing gears and timing case. See TIMING GEAR CASE AND TIMING GEARS, Removal.

2. Rotate the engine so that the cylinder head is toward the floor.

3. Remove the sump. Remove the fuel pump.

4. Remove the thrust ring for the camshaft. Remove the camshaft.

5. Remove the cam followers as shown in FIGURE 27.

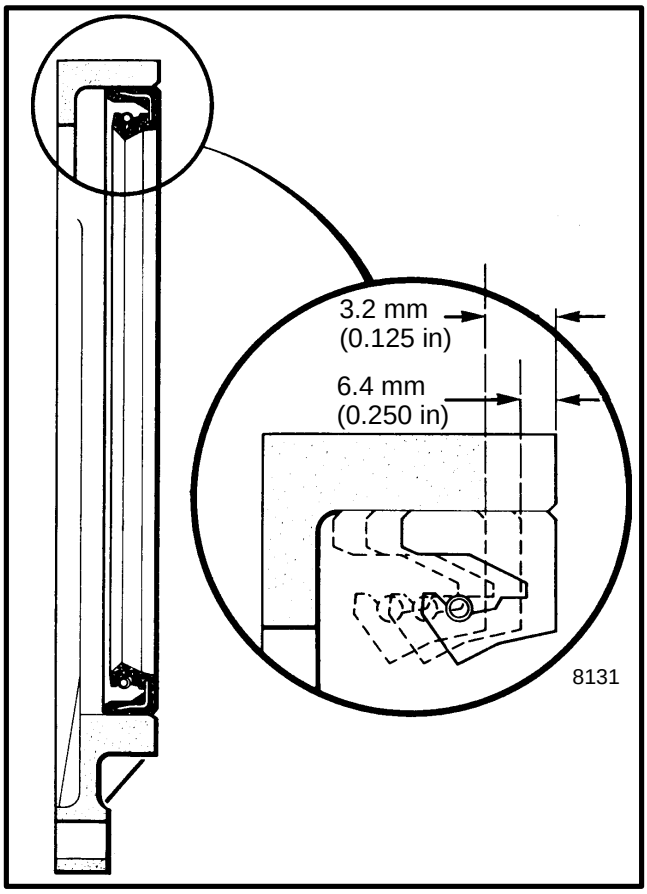


FIGURE 25. REAR OIL SEAL AND HOUSING

6. Loosen the screw (6). Set the bracket (5) so that the edge with the chamfer aligns with the correct mark. The 4.2482 is 280.5°, 4.236 is 281°.

7. Install the timing tool in the position of the fuel injection pump. See FIGURE 37. Make sure the timing tool is in the seat for the fuel injection pump. Tighten screw (1) to hold the shaft to the tool.

8. If the pointer is 180° from the timing mark, the engine is on the wrong stroke. Remove the tool and rotate the crankshaft one revolution.

9. Move the alignment bar so that it just touches the face of the timing gear case.

10. Rotate the timing tool by hand in the opposite direction to pump rotation. (See the nameplate on the fuel injection pump.) This procedure will remove the clearance between the gears. Check that the timing mark on the timing gear case aligns with the slot in the alignment bar.

CHECKING THE TIMING ANGLE OF THE FUEL INJECTION PUMP WITH THE SPECIAL TOOL

1. Remove the fuel injection pump from the engine.

2. Loosen screw (1) on the timing tool. Move the shaft with splines to the rear. See FIGURE 36.

3. Loosen screw (4) on the timing tool. Move the slot of the alignment bar o the rear. Make sure the washer for the screw (4) is in position to hold the alignment bar in position.

4. Loosen screw (6). Set the bracket so that the edge with the chamfer aligns with the 289° (4.2482) or 292° (4.236) mark for the timing of the fuel injection pump.

5. Connect the number 1 outlet (W) of the fuel injection pump to a pump for testing fuel injectors. Operate the test pump until the pressure of the fuel pressure is 3.0 MPa (440 psi).

6. Install the timing tool on the drive shaft of the fuel injection pump. Tighten screw (1) of the timing tool to hold the shaft in position.

7. Turn the pump in the direction of normal rotation until it stops. Move the alignment bar in position at the fuel injection pump. See FIGURE 41.

8. If the marks to not align, make a new mark on the fuel injection pump at the slot of the alignment bar.

9. Install the fuel injection pump with the new mark aligned with the mark on the timing gear case. Install the fuel lines.

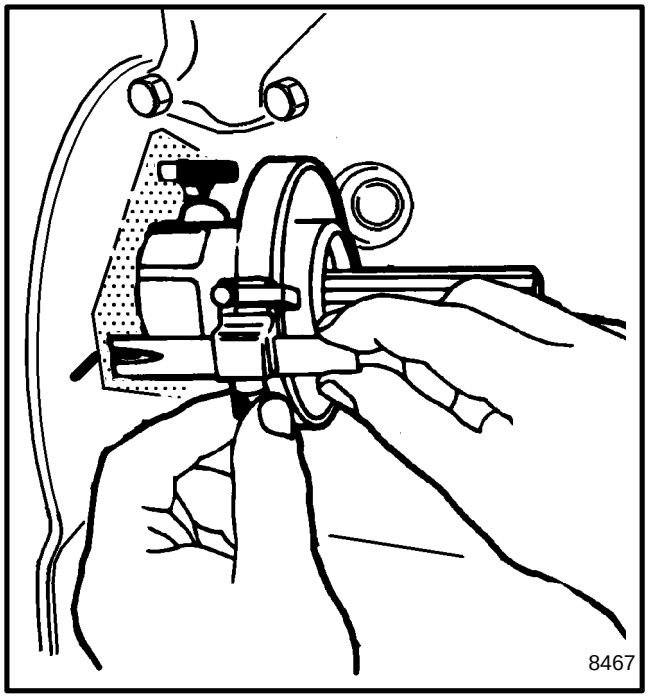
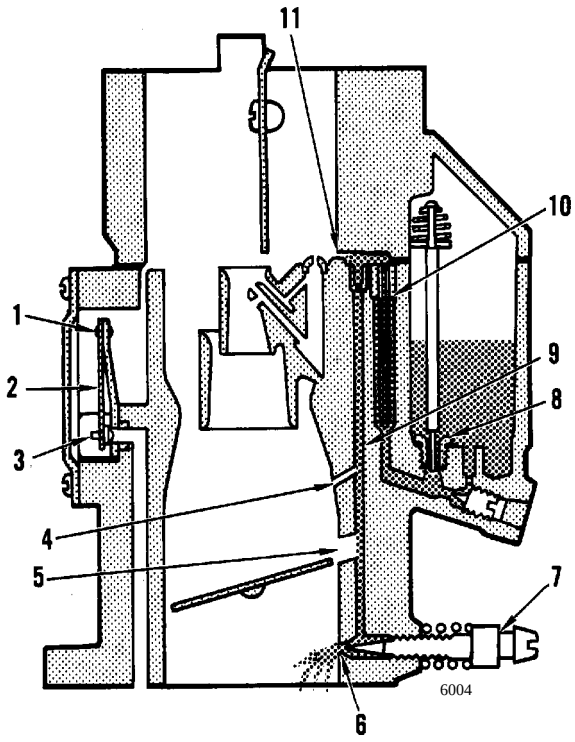


FIGURE 40. INSTALLATION OF THE TIMING TOOL

CARBURETOR FOR GM 6–250 ENGINE SHOWN



1. COMPENSATOR
2. METAL STRIP
3. VALVE
4. PORT FOR AIR
5. PORT FOR LOW SPEED
6. IDLE PORT
7. ADJUSTMENT VALVE FOR IDLE
8. MAIN JET
9. PASSAGE FOR IDLE
10. IDLE TUBE
11. PORT FOR AIR

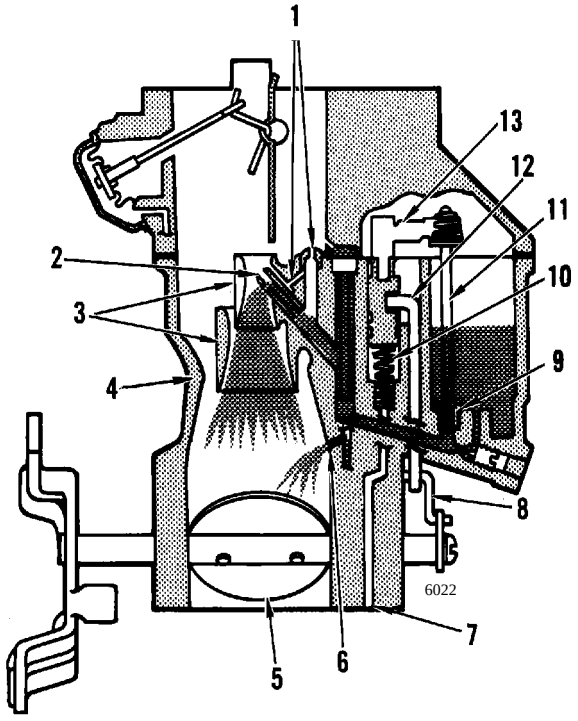
FIGURE 3. THE IDLE SYSTEM

The Main Metering System (GM 6–250) (See FIGURE 4.)

The main metering system gives fuel to the engine when the flow of air increases through the carburetor. As the throttle plate opens, the air flow increases through the venturi of the carburetor. Now the low pressure decreases at the idle ports. This decreased pressure causes the flow of the air and fuel mixture at the idle ports to stop. As this flow of the mixture decreases, air and fuel begin to flow from the main nozzle. The air and fuel flows from the nozzle because of the low pressure at the venturi.

The distribution of fuel from the float bowl to the main nozzle is controlled by a rod (12). The rod has a taper and is actuated by the throttle linkage (8). When the throttle plate (5) is opened, the rod (8) moves up and causes the metering rod to lift from a seat in the jet (9). When the air flow through the venturi is high enough to cause low pressure, fuel flows past the metering rod. The fuel moves along a passage and mixes with air from the air mixture ports (1). Then the air and fuel mixture flows from the main nozzle and into the venturi. The mixture is mixed again with air and then moves to the intake manifold.

CARBURETOR FOR GM 6–250 ENGINE SHOWN



1. PORTS FOR AIR
2. MAIN NOZZLE
3. BOOST VENTURI
4. MAIN VENTURI
5. THROTTLE PLATE
6. PORT FOR AIR
7. PASSAGE FOR VACUUM
8. THROTTLE LINKAGE
9. JET
10. SPRING
11. METERING ROD
12. ROD
13. PISTON

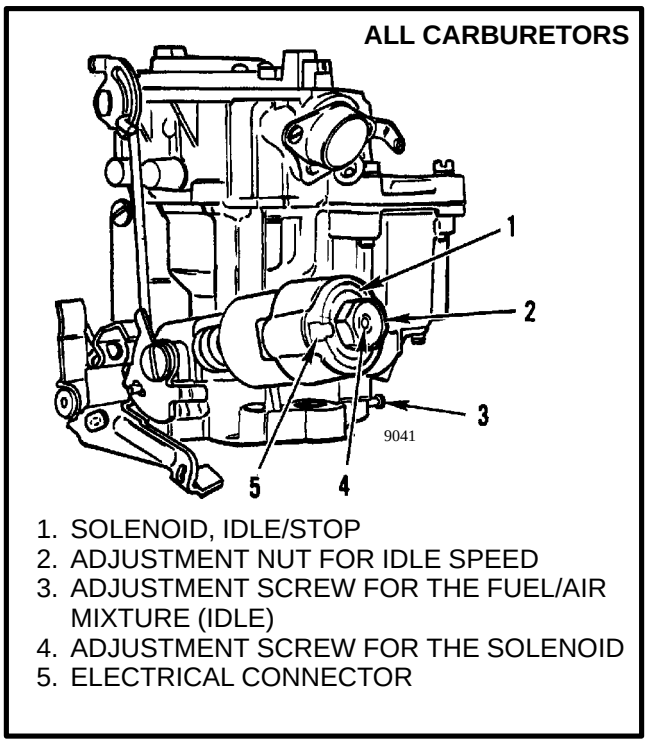
FIGURE 4. THE MAIN SYSTEM AND POWER SYSTEM

7. Turn the adjustment (socket head) screw (4) in the end of the idle/stop solenoid clockwise until the idle speed is at 450 rpm.

8. While the engine operates at 450 rpm, connect the throttle cable and ball joint to the throttle lever on the carburetor. Make sure that the cable is not so tight that it causes the idle speed to increase above 450 rpm.

⚠ CAUTION

Make sure the throttle plate is not closed completely. Expansion can occur between the throttle plate and the carburetor body and cause a seizure of these parts.



1. SOLENOID, IDLE/STOP
2. ADJUSTMENT NUT FOR IDLE SPEED
3. ADJUSTMENT SCREW FOR THE FUEL/AIR MIXTURE (IDLE)
4. ADJUSTMENT SCREW FOR THE SOLENOID
5. ELECTRICAL CONNECTOR

FIGURE 13. ADJUST THE IDLE SPEED

ADJUST THE IDLE MIXTURE (See FIGURE 13.)

There are three accepted methods to correctly set the idle fuel/air mixture; 1) adjust for highest rpm, 2) adjust for highest vacuum reading and 3) adjust for smoothest operation.

1. Use the adjustment method most suitable and turn the adjustment screw (3) for the highest performance. Turn the screw clockwise to make the mixture “lean”. Turn the screw counterclockwise to make the mixture “rich”.

2. If the idle speed was changed after the idle mixture was adjusted, repeat the procedure for ADJUST THE IDLE SPEED in this section.

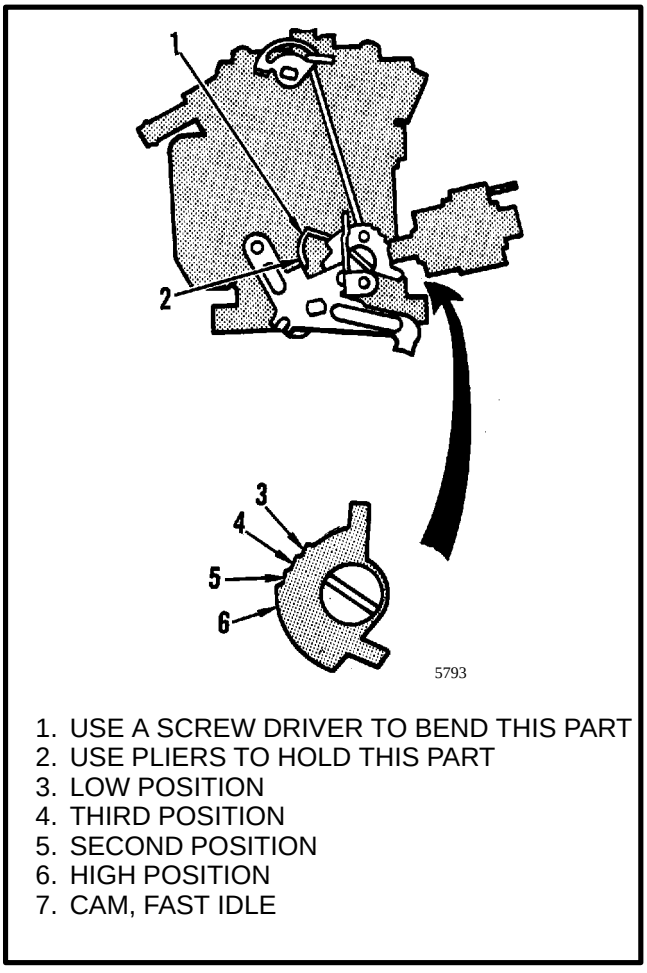
3. Check and adjust the idle speed again, if necessary.

ADJUST THE FAST IDLE (See FIGURE 14.)

1. Start the engine. Let the engine run until it reaches operating temperature.

2. Connect a tachometer to the engine.

3. Move the cam until the throttle linkage is against the “HIGH” position of the cam. Adjust the throttle linkage as shown in FIGURE 12. until the speed of the engine is 2000 rpm.



1. USE A SCREW DRIVER TO BEND THIS PART
2. USE PLIERS TO HOLD THIS PART
3. LOW POSITION
4. THIRD POSITION
5. SECOND POSITION
6. HIGH POSITION
7. CAM, FAST IDLE

FIGURE 14. ADJUST THE FAST IDLE

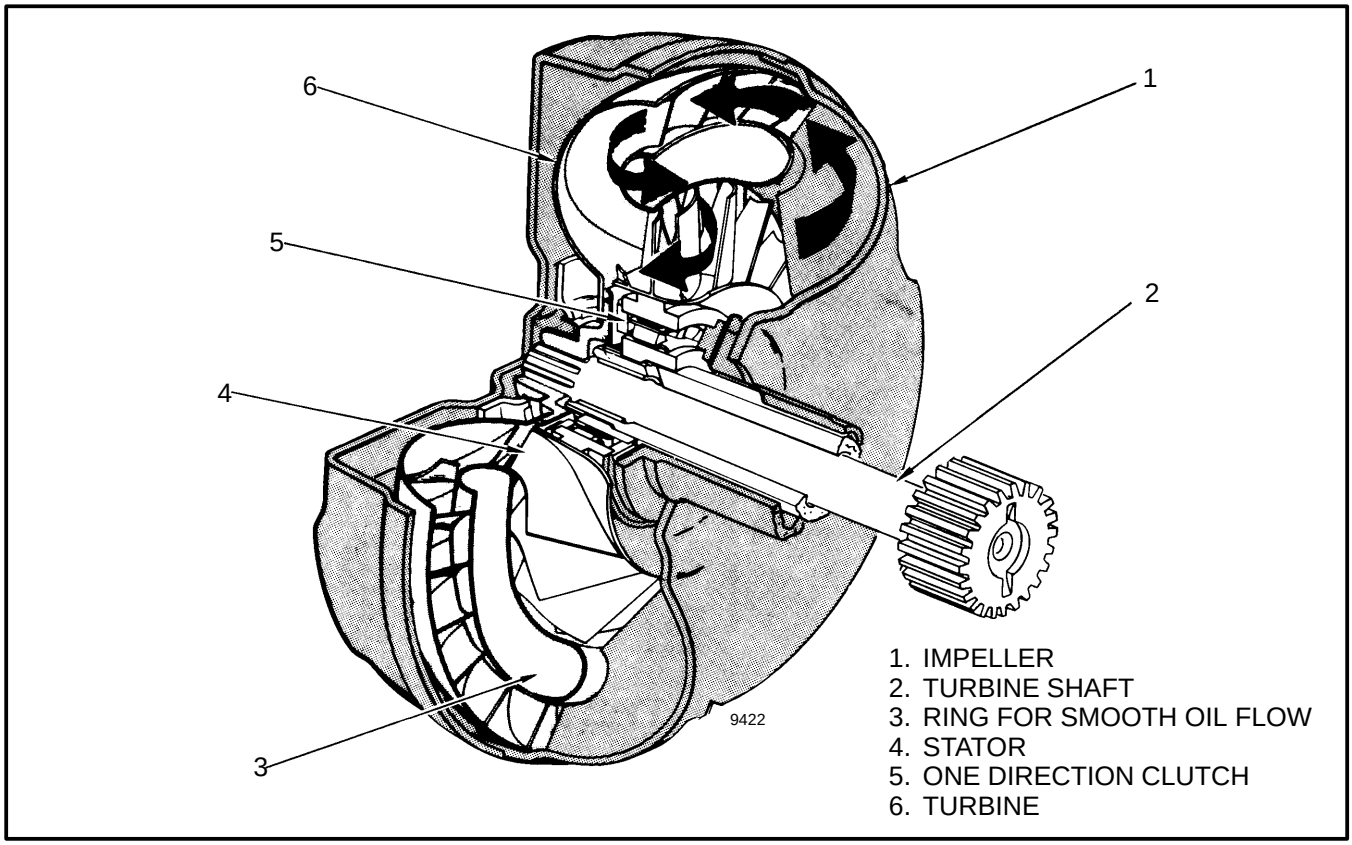


FIGURE 5. OIL FLOW IN THE TORQUE CONVERTER

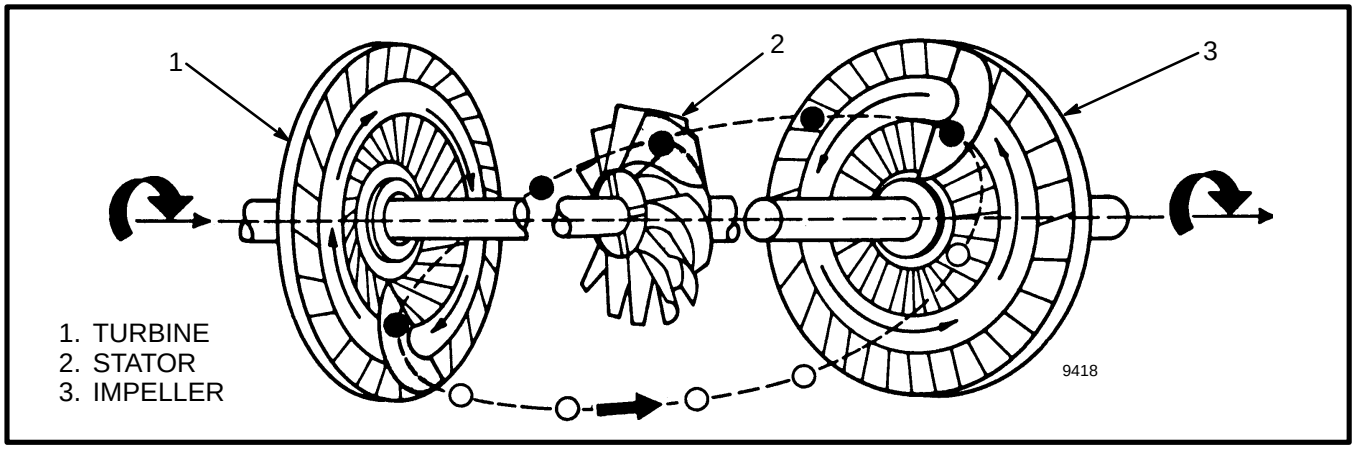


FIGURE 6. TORQUE CONVERTER OPERATION

gizes the direction solenoid. The direction solenoid is energized when the direction control lever is in the Forward position.

A pressure switch is used to prevent the parking brake solenoid from energizing when the oil pressure is too low. The oil pressure must be enough to compress the spring in the direction spool when the direction lever is in the Forward position. When the pressure to the direction spool is 415 to 550 kPa (60 to 80 psi), the pressure switch closes and the parking brake solenoid energizes. The pressure switch prevents the lift truck from moving in Reverse when the direction control lever is in the Forward position. The diode and the pressure switch prevent the direction solenoid from energizing when the parking brake solenoid is energized in Reverse. The parking brake solenoid is energized in Reverse by the switch in the direction control lever. The parking brake solenoid is deenergized by either applying the parking brake or by putting the direction control lever in Neutral.

There is a temperature warning light on the cowl that is energized by a sender unit in the transmission sump. The switch in the sender unit closes at 132°C (270°F).

OIL FLOW DIAGRAMS

The following is a description of the oil flow through the hydraulic system in four different conditions. In each condition, the engine is running.

PARK or NEUTRAL (See FIGURE 20.)

On lift trucks equipped with a Monotrol pedal, there is no Neutral position. Neutral or Park is selected by applying the parking brake. There is a Neutral position on the direction control lever for the lift trucks that do not use a Monotrol pedal. These lift trucks also have a switch on the parking brake lever. The following diagrams show the circuits for the lift trucks that have the Monotrol pedal.

“1” Circuit Monotrol

Oil enters the pump inlet port from the sump. The pump moves the oil through the cooler and filter if the oil has reached operating temperature. Some of the oil flows through the by–pass to the control valve if the oil is not warm. From the filter, the oil flows to the control valve. From the inlet port of the control valve, the oil flows to both the valve for the parking brake solenoid and to the Monotrol supply port. From the Monotrol supply port, the oil flows to the Monotrol regulator. When the pressure increases, the Monotrol regulator opens and permits oil to flow to the inching valve and clutch regulator.

When the Monotrol pedal is in the Reverse position, the oil flow in the Monotrol circuit is stopped by the Monotrol pedal. When the pedal is in the Forward position, oil flows to the end of the direction spool.

“2” Circuit – Clutch Apply

The parking brake solenoid is deenergized in Park and the solenoid valve is closed. Oil cannot flow to the parking brake spool and the inching valve stays closed. The passage from the clutch regulator to the modulation spool and the clutches is not open in Park or Neutral. Oil in the “2” circuit flows to the sump through the inching valve.

“3” Circuit – Torque Converter

When the oil pressure to the inching valve reaches the specified setting, the clutch regulator opens. Oil then flows to the torque converter and the converter regulator. The oil that flows through the torque converter must flow through an orifice in the stator support before cooling and lubricating the transmission clutches. The orifice is a restriction that keeps oil pressure in the torque converter during stall conditions. When the converter regulator opens, some of the oil flows to the sump.

FORWARD (See FIGURE 21.)

The engine is running and the parking brake is released.

“1” Circuit – Monotrol

Oil flows to the control valve in Forward like it does in Park. The parking brake solenoid is energized and the solenoid valve is open. Oil flows to the end of the parking brake spool and moves the spool to compress the spring. This action opens the inching valve.

The Monotrol pedal is in the Forward position. The oil flows through the Monotrol valve to the end of the direction spool. The oil pressure pushes the direction spool to the Forward position.

TROUBLESHOOTING

PROBLEM	CAUSE
The temperature of the transmission oil is high.	Inching and operating the lift truck with loads greater than capacity.
	Oil level is not correct.
	Clutch does not engage completely.
	Inching/brake pedal is not adjusted correctly.
	Worn or wrong friction discs or separator plates.
	The pressures for the transmission are not correct.
	Oil cooler circuit has a restriction or damage.
	Damage to the torque converter.
	The friction discs or separator plates are damaged.
	The oil filter for the transmission is dirty.
	Clutch assembly will not disengage completely because piston orifice has a restriction.
	The seal rings on the shafts are worn.
Bubbles in the oil fill tube.	Air leak on the suction side of the oil pump.
	Oil level is not correct.
	Oil is too hot.
	Damage to the torque converter.
Inching operation is not smooth.	Inching spool or plunger does not move freely.
	Broken spring(s) for the inching spool.
	Clutch piston does not move freely.
	Control valve has leaks.
	Clutch discs are bent.
Loss of power.	Engine is not running correctly.
	Clutch that is engaged is not releasing.
	Torque converter is damaged.
	Clutch does not engage completely.
Lift truck will not move in either direction.	Oil level is too low.
	Parking brake is applied or there is not enough air in the brake system.
	Forward and reverse solenoids do not operate.
	Linkage to direction spool is disconnected.
	Linkage to inching spool is disconnected.
	Switches at Monotrol pedal do not operate.
	Axle shaft(s) or differential is damaged.
	Direction spool will not move.

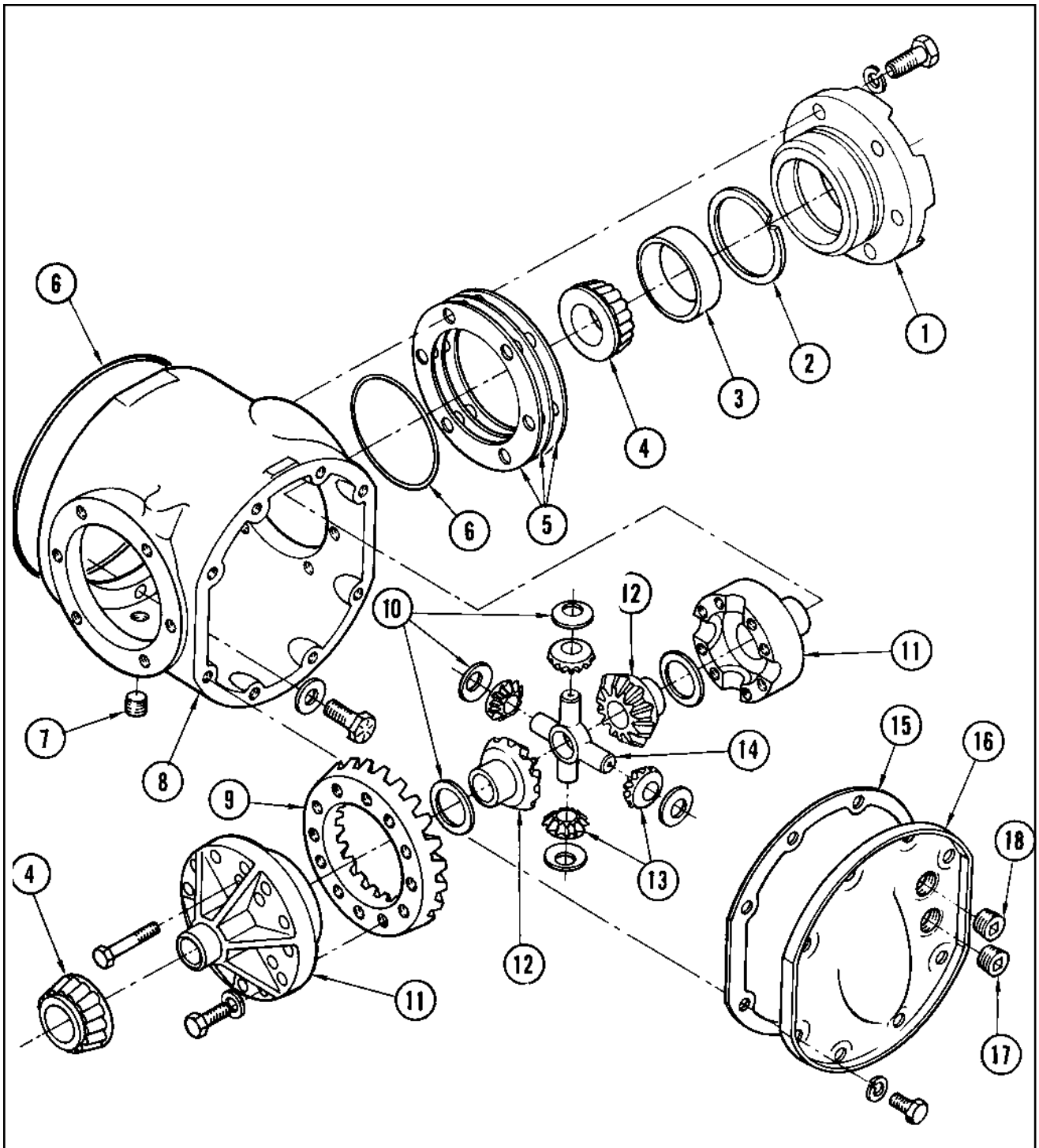


FIGURE 11. DIFFERENTIAL

INSTALLATION OF THE TRANSMISSION

A. Install the torque converter to the drive plate. Tighten the bolts that hold the torque converter to the drive plate to 20 foot pounds (27 N.m). Tighten the bolts that hold the drive plate to the flywheel to 18 foot pounds (24 N.m).

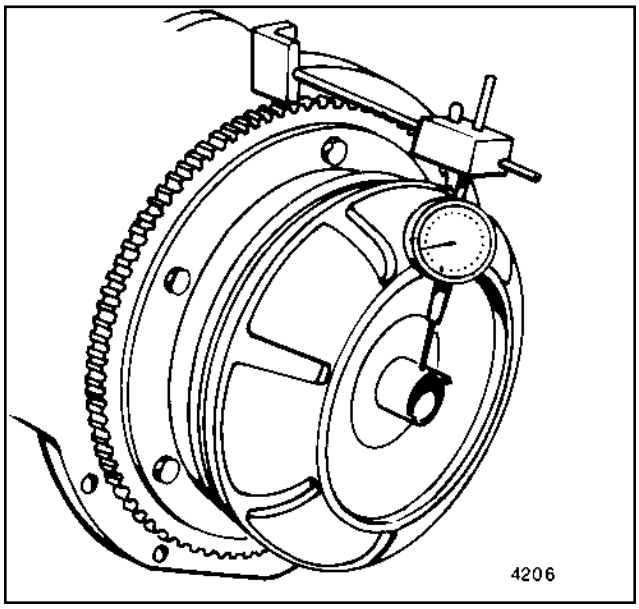


FIGURE 18. CHECKING ALIGNMENT OF TORQUE CONVERTER HUB

B. Check the alignment of the torque converter hub. Put a dial indicator in the position shown in Figure 18. Turn the flywheel and look at the dial indicator. Set the indicator on zero where the dial indicator shows the greatest movement. Turn the flywheel and read the dial indicator. The maximum reading must be 0.005 inch (0.125 mm). Bend the drive plate until the movement of the converter hub is less than 0.005 inch (0.125 mm).

C. Install the transmission to the torque converter housing. Install the capscrews that hold the housings together. Tighten the capscrews to 35 foot pounds (47 N.m).

D. Install the engine and transmission assembly to the lift truck as described in THE ENGINE section.

E. Tighten the capscrews that hold the transmission to the flywheel housing to 35 foot pounds (47 N.m).

F. Connect the lines from the oil cooler and the filter.

G. Install the lines from the MONOTROL pedal. If the lift truck is equipped with a direction control lever, connect the wire to the solenoid.

H. Fill the transmission with the correct oil. Start the engine and check the oil level of the transmission. When the torque converter fills, the oil level in the sump is lowered. Check the oil level when the oil is at operating temperature. Check for oil leaks at the fittings.

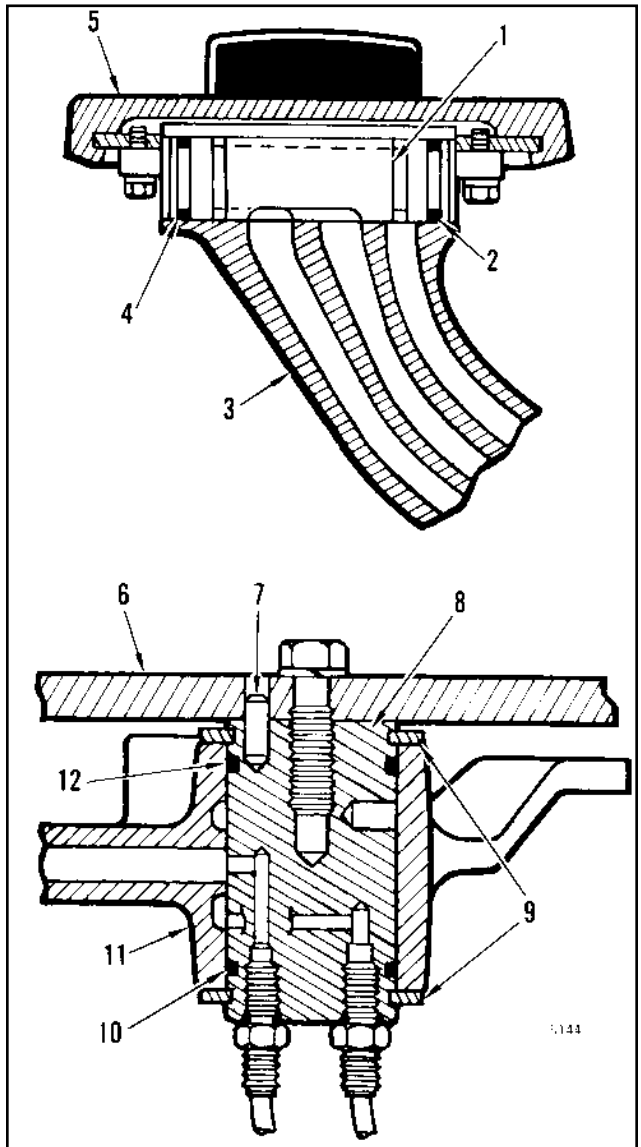


FIGURE 19. MONOTROL PEDAL

TROUBLESHOOTING

PROBLEM	CAUSE
Lift truck will not move in either direction (cont.)	Parking brake solenoid circuit has a defect
	Torque converter is disconnected from flywheel
	Bushing worn on stator support
	Air is in the hydraulic system
	No clearance between push rod and brake master cylinder
	Control valve gasket damaged
	Monotrol hoses installed wrong
Lift truck moves in one direction only	Spring broken in direction valve
	Monotrol circuit has a defect
	Direction solenoid has a defect
	Direction control has an open circuit
	Direction valve does not move
	Control valve gasket has damage
	Clutch not holding
	Clutch that is not engaged is not releasing
	Reverse piston installed in FORWARD bore
	Too many shims in transmission
	Gears are damaged
Lift truck with direction control lever moves only in REVERSE	Fuse is bad
	Direction control switch has a defect
	Pressure switch has a defect
	Low pressure at pressure switch
	Diode has a defect
Lift truck with direction control lever moves forward in REVERSE and does not move in FORWARD	Defect in pressure switch and diode
	Diode is installed backwards
Clutch does not disengage when the parking brake is applied	Solenoid valve has a defect
	Seal for solenoid plunger has a defect
	Solenoid sump tube has a restriction
	Parking switch has a defect
	Inching spool does not move
	Inching spring broken

the other on the bar 180 degrees opposite. The ohmmeter must indicate a complete circuit. Commutator bars that are burned indicate an open circuit.

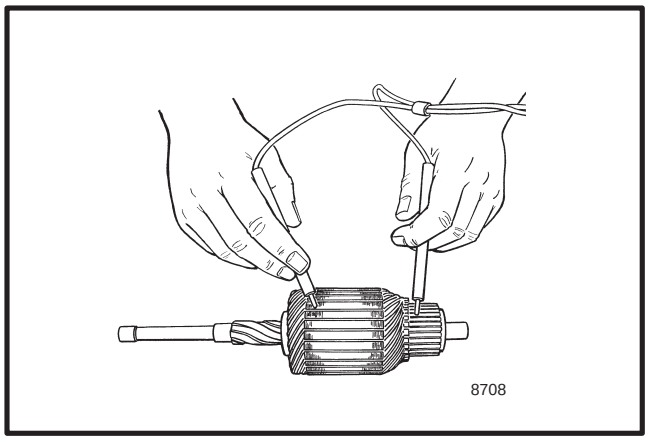


FIGURE 8. ARMATURE GROUND TESTS

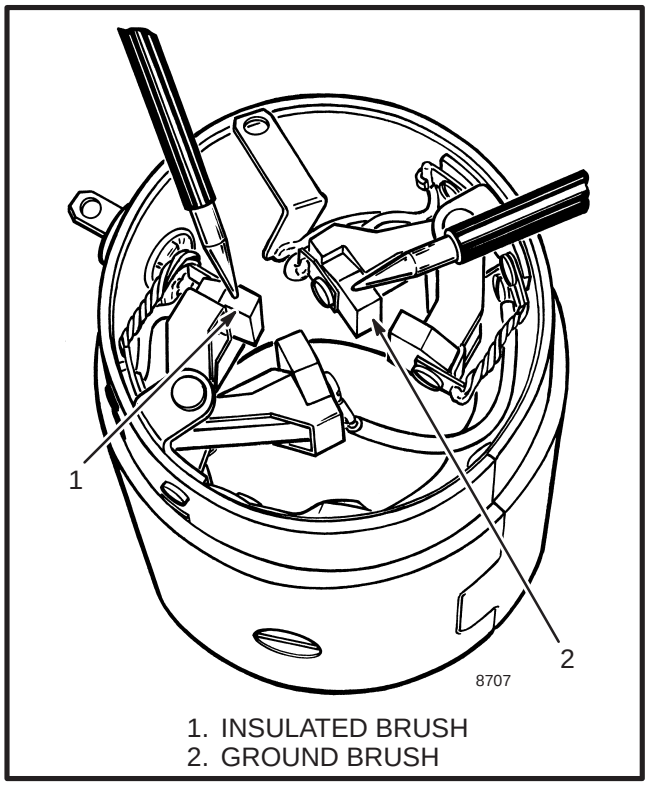


FIGURE 9. FIELD COIL GROUND TEST

e. Test for a ground in the field coil circuit. See FIGURE 9. Touch one wire of an ohmmeter to the field frame and the other to the field coil brushes. On some models it is necessary to disconnect the field ground strap. The field coils have a short–circuit to ground if the ohmmeter indicates a complete circuit.

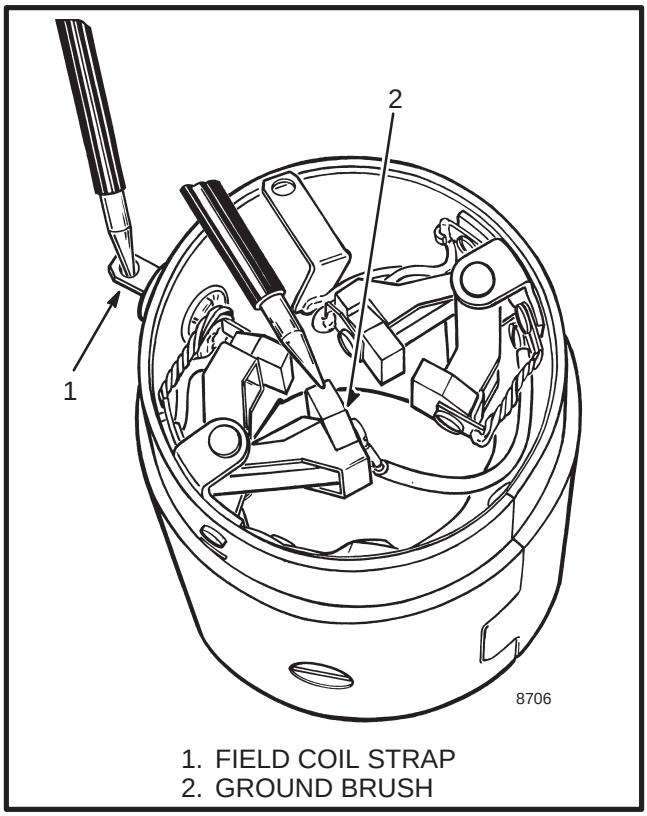


FIGURE 10. TESTING THE FIELD COIL FOR OPEN CIRCUIT

f. Test for an open circuit in the field coils. See FIGURE 10. Connect the wires of an ohmmeter to the ends of the field coils. The ohmmeter must indicate a complete circuit.

g. Check that the brush springs have enough tension.

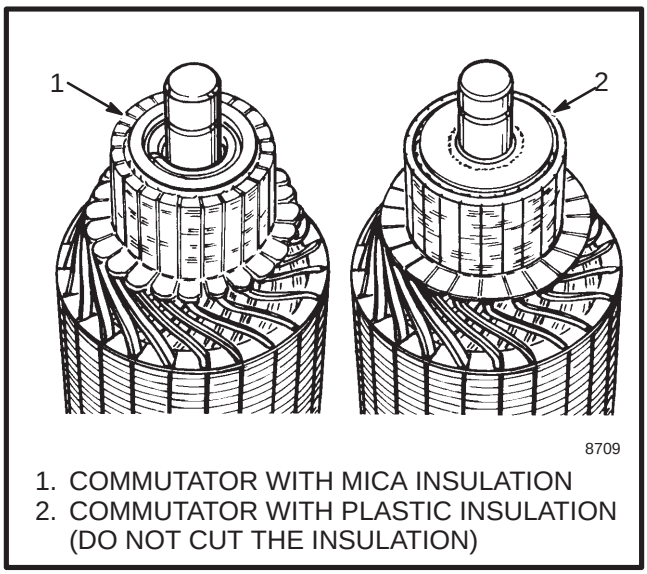


FIGURE 11. TWO TYPES OF INSULATION

grease seal install the grease seal. Lubricate the seals with grease. Press the bearing cones on the spindles.

2. Lubricate the bearings with wheel bearing grease. Press the bearing cups into the steering axle and bearing cap. Install the wear sleeves in the steering axle.

3. Install the spindle in the steering axle. Install the bearing cap without the O–ring. Measure the clearance between the bearing cap and the axle. (See FIGURE 7.) Remove the bearing cap and install enough shims to give a preload of 0.00 to 0.12 mm (0.000 to 0.005 in).

NOTE: The spindle bearings must have no clearance. Install shims 0.00 mm to 0.12 mm (0.000 to 0.005 in) thicker than the measured gap.

Install the O–ring on the bearing cap. Install the bearing cap and capscrews. Tighten the 3/8 inch capscrews to 45 N.m (35 lbf ft). On the J40–60AS with the flat frame, tighten the 1/2 inch capscrews to 110 N.m (80 lbf ft).

4. Install the tie rod to the spindle arms. Tighten the castle nuts to 160 N.m (120 lbf ft). Tighten the castle nuts until the cotter pins can be installed.

5. Install the grease caps on the top of the steering axle.

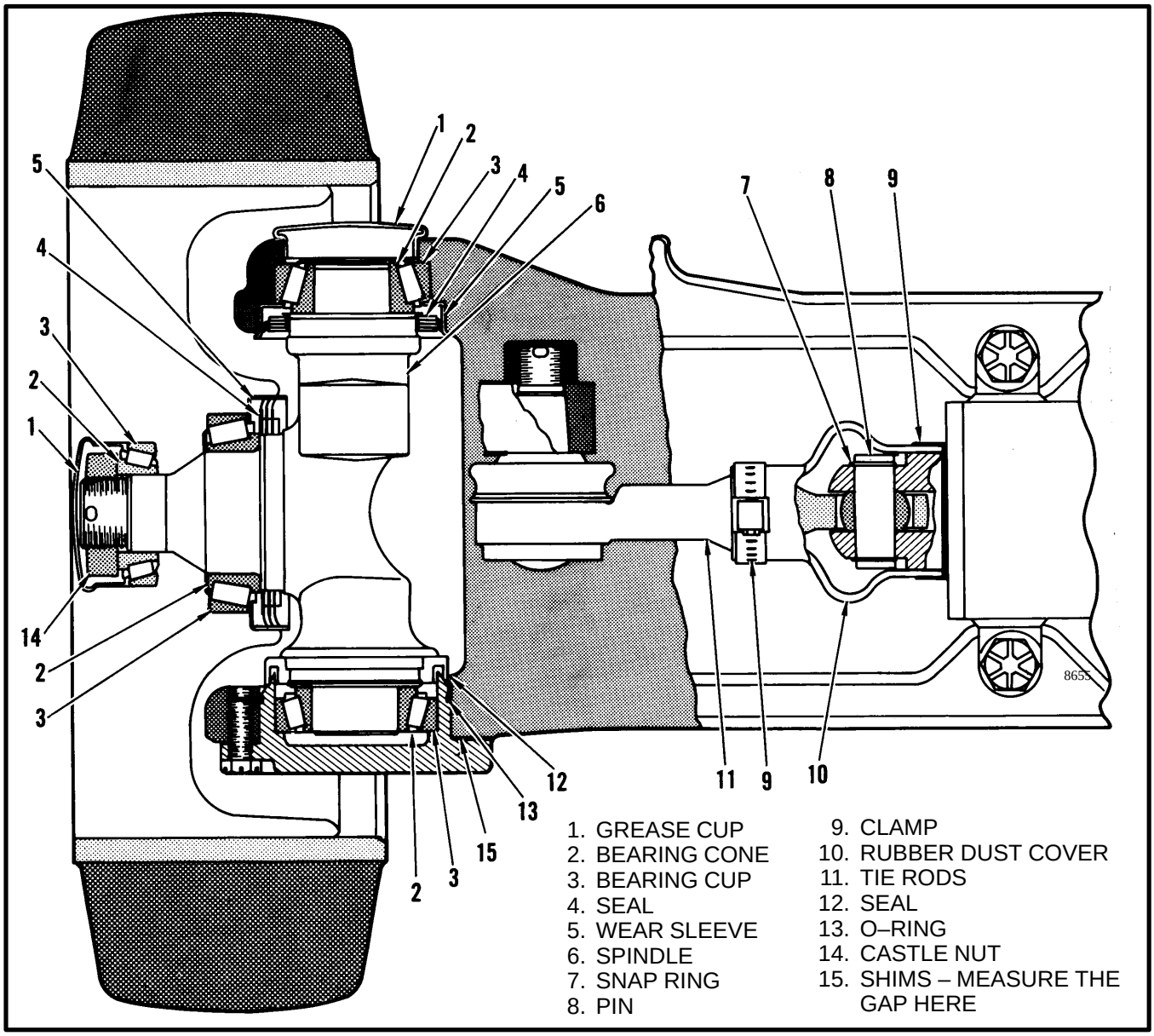


FIGURE 7. SPINDLE AND TIE ROD ASSEMBLY

H8.00–16.00XL (H165–360XL) SHOWN.
OTHERS SIMILAR.

TYPE “A” STEERING COLUMN

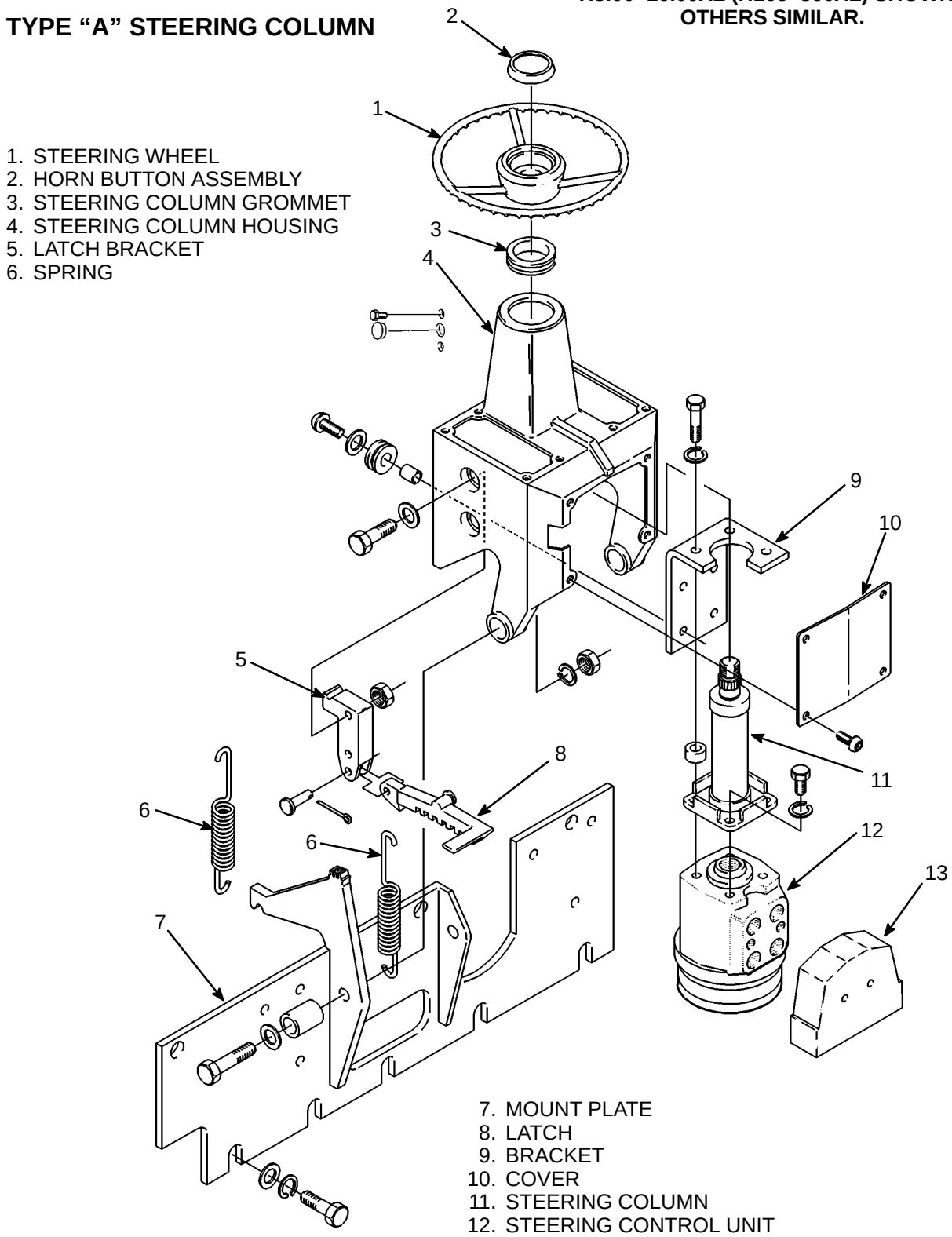


FIGURE 3. STEERING WHEEL AND STEERING COLUMN ASSEMBLY

INTRODUCTION

GENERAL

This section has a description and the repair procedures for several different types of tilt cylinders. The number and the design of the parts can be different but the operation of the tilt cylinders is the same.

DESCRIPTION

The tilt cylinders (FIGURE 2. through FIGURE 6.) are used to move the mast forward and backward. To extend the cylinder rod (tilt forward), oil enters the tilt cylinder port behind the piston. The oil pressure pushes the cylinder rod out of the cylinder. Oil in front of the piston returns to the hydraulic tank. To retract the cylinder rod (tilt backward), the oil enters the port in front of the piston. The oil pressure pushes the cylinder rod into the tilt cylinder. The oil behind the piston returns to the hydraulic tank.

REPAIRS

REMOVAL

⚠ WARNING

Before removing the tilt cylinder(s), tilt the mast forward. Use a chain to hold the mast to the frame, and prevent the mast from moving forward.

1. Disconnect the hydraulic lines at the tilt cylinder. Install caps on the hydraulic lines and ports.

⚠ WARNING

Do not push the anchor pins out of the rod end with your fingers.

Do not permit the tilt cylinders to drop and cause damage.

2. Remove the retainers for the anchor pins. Push the anchor pins out of the rod end with a tool.

3. Use a lifting device to move large tilt cylinders. Remove the anchor pins from the frame anchors. Remove the tilt cylinder from the frame.

DISASSEMBLY

1. Put the tilt cylinder in a vise with soft jaws. Remove the rod end from the rod.

2. Remove the retainer from the tilt cylinder. Remove the rod and piston from the cylinder.

3. See FIGURE 2.through FIGURE 6. Disassemble the tilt cylinder as necessary.

CLEANING

⚠ WARNING

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

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.

Clean all parts in solvent and dry with compressed air.

ASSEMBLY

NOTE: Always use new seals and O–rings. Make sure all parts are clean. Lubricate all parts with clean hydraulic oil.

Tilt Cylinders With O–Ring or Single Lip Seals (See FIGURE 1.)

NOTE: Always use new seals and O–rings. Make sure all parts are clean. Lubricate all parts with clean hydraulic oil.

NOTE: During 1980 and 1981, a change was made in the tilt cylinders used in most lift trucks. The O–ring seal between the retainer and the cylinder shell was moved from above the threads to the area below the threads. A back–up ring was added to increase the strength of the O–ring. The assembly of the tilt cylinders is the same, but caution must be used so that the O–ring seal is not damaged by the threads.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Tilt cylinder movement is slow or not smooth.	Air is in the hydraulic system.	Remove air from hydraulic system.
	The hydraulic pump is worn or damaged.	Repair or replace hydraulic pump.
	Restriction in the hydraulic lines.	Repair hydraulic lines.
	Seals in tilt cylinder are damaged.	Replace seals and inspect cylinder bore for damage.
	Tilt cylinders have internal damage.	Repair or replace cylinder.
	Load is greater than capacity.	Reduce load.
	Pressure relief valve(s) is not adjusted correctly or is damaged.	Repair or adjust relief valve(s).
	Large leaks between spool and bore.	Replace valve section.
	Spool is not fully extended or retracted	Adjust linkage to spool.
	Tilt control spool is damaged.	Repair control valve.
The tilt cylinders permit the mast to move when the Tilt control lever is in the Neutral position.	There are leaks in the hydraulic lines.	Tighten fittings or repair leaks.
	Seals in tilt cylinder are damaged.	Replace seals and inspect cylinder bore for damage.
	Tilt cylinders have internal damage.	Repair or replace cylinder.
	Tilt control spool is damaged.	Repair control valve.

SEQUENCE VALVE (See Figure 11)

NOTE: The H60–110E models use a high pressure hydraulic system and do not need a sequence valve. The high pressure system uses less flow that causes a smaller difference in pressure between the lift cylinders during maximum lift.

A sequence valve is installed on three–stage masts that use a low pressure hydraulic system. It controls the hydraulic functions for the lift cylinders. At the beginning of the lift sequence, the free– lift cylinder raises the carriage to the top of the inner weldment. When the free–lift cylinder reaches the end of its stroke, the outer lift cylinders begin to extend. The sequence valve makes sure that the lift cylinders extend in the correct sequence. The sequence valve is installed on the right–hand side of the outer weldment.

The parts of the sequence valve are shown in Figure 12. When the lift spool in the main control valve is moved to the Lift position, oil with pressure moves to the supply port of the sequence valve. The oil continues through the lowering control valve and enters the sequence valve. Now the oil can go to either the free–lift cylinder or the main lift cylinders. Since the lift cylinders are connected hydraulically in parallel, the oil will flow to the cylinder that will raise with the least force.

The surface area of the free–lift piston is approximately 15% greater than the total area of the two main lift pistons. The free–lift cyl inder must raise the weight of the carriage and the weight of the load on the forks. The main lift cylinders must raise the weight of carriage and the load on the forks plus the weight of the weldments. Because of these conditions, the force to raise the free–lift cylinder is less than the force to raise the main lift cylinders. Since oil takes the path of the least resistance, the oil flows from the sequence valve to the free–lift cylinder. See Figure 13.

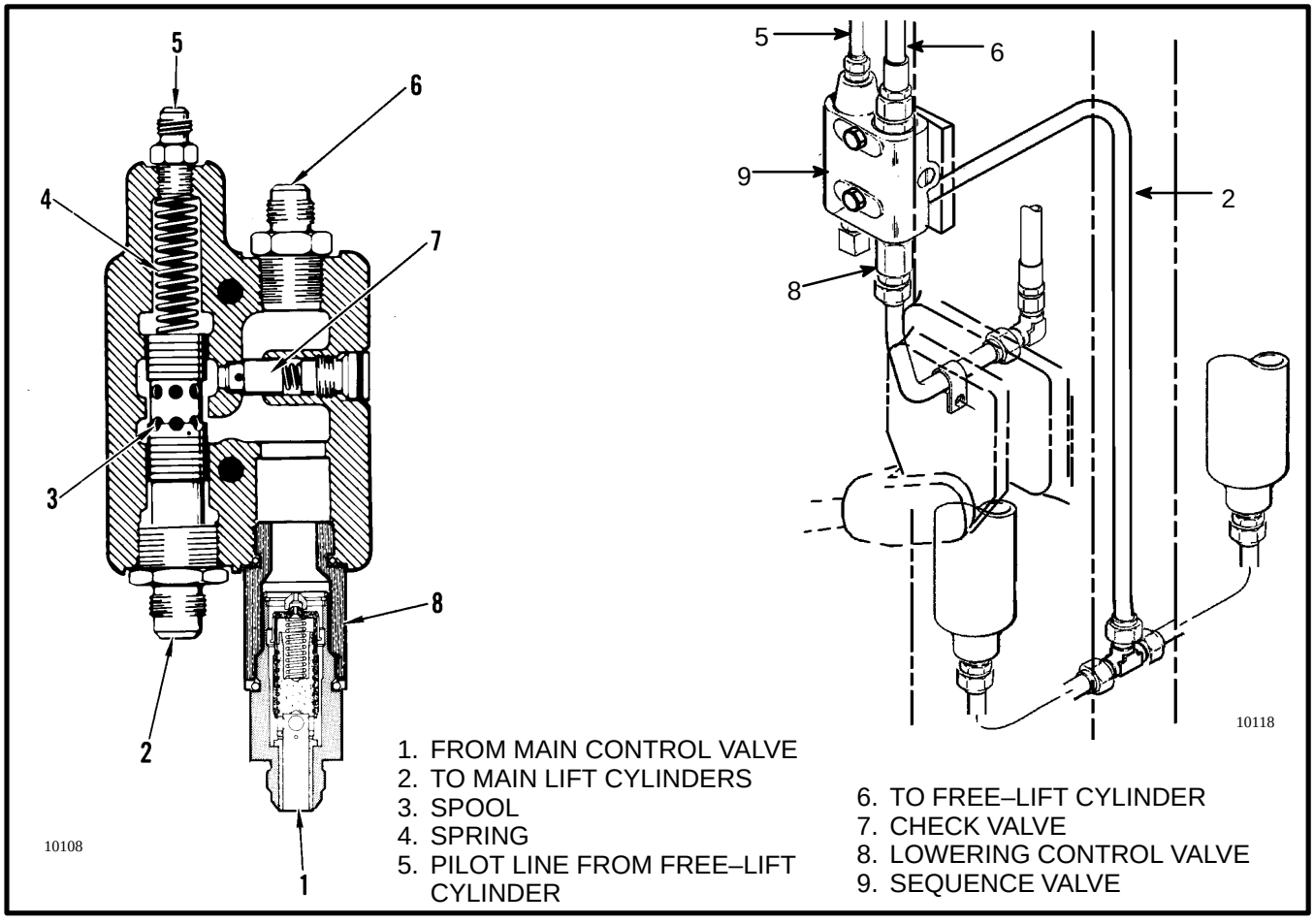


FIGURE 11. LOWERING CONTROL REGULATOR

4. Remove the chain pins to disconnect the chain from the the chain anchor. Replace the rod end pin and cotter pin on the chain. See FIGURE 5.

5. Pull the inner weldment out approximately 1 foot (30 cm) to disengage the lift cylinders from the inner channel.

6. Remove the nut and capscrew that hold each lift cylinder to the outer channel. Pull the bottom of the lift cylinder out of the guide. Then move the bottom of the lift cylinder to the opposite side of the inner weldment. Remove the lift cylinder.

7. Push the inner weldment out of the bottom of the outer weldment to get access to the load rollers and the strip bearings. Remove the snap rings from the lower and upper load rollers. Make a note of the shim arrangement for each load roller when the load roller is removed. The shim arrangement will be approximately the same when the weldments are assembled.

8. Remove the strip bearings from the outer weldment. See FIGURE 6. Make a note of the shim arrangement during removal of the strip bearings.

9. Slide the inner weldment half way out the top of the outer weldment. Connect a crane to the center of the inner weldment. See FIGURE 7. Slide the inner weldment away from the outer weldment until its lower stub shafts are in the notches of the outer weldment. Remove the inner weldment.

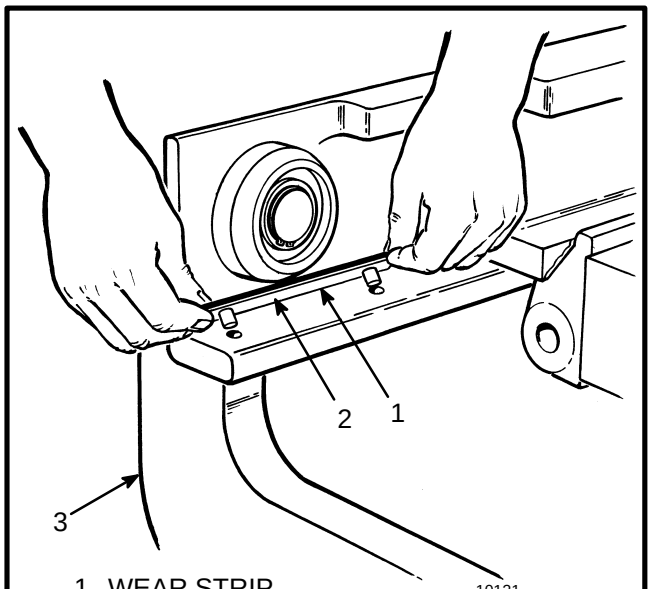


FIGURE 6. STRIP BEARINGS

10. Disassemble the sheaves and rollers as necessary for repair and cleaning.

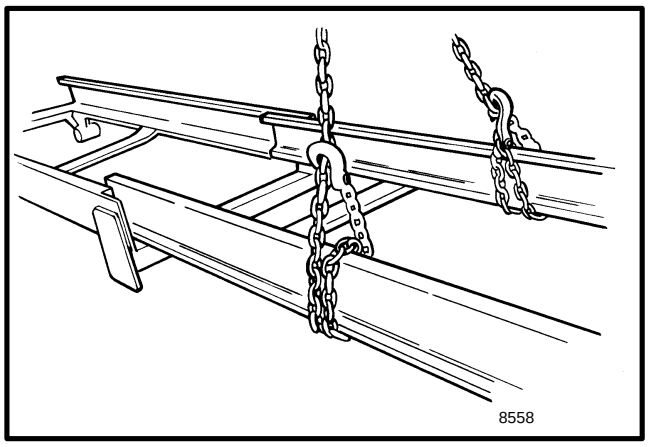


FIGURE 7. REMOVAL OF INNER WELDMENT

CLEANING AND INSPECTION

NOTE: This section for the cleaning and inspection procedures applies to both the two–stage and three–stage masts.

1. DO NOT use steam to clean the lift chains, sheaves, or load rollers. The sheaves and roller bearings are sealed and permanently lubricated. Do not wash the lubricant from the bearings.

2. Wash the lift chains with solvent. Use compressed air to dry the chains. Inspect the chains for wear and damage.

3. Inspect the lift chains for cracks or broken links and pins. Check for corrosion or worn holes in the links. When the pins or the holes wear, the chain becomes longer. The chain links that run over the chain sheaves have the most wear. If a chain is 3% longer than a new chain, the chain must be replaced. If a chain scale is available, check the lift chains as shown in FIGURE 8. If a chain scale is not available, measure 20 links of chain. Compare the measurements with the lengths given in TABLE 1. Replace the chains if the increase in length is 3% or greater.