REPAIR MANUAL
for
FORD 8700 & 9700
TRACTORS

40870020

Ford Tractor Operations

Ford Motor Company

Reprinted

NOTE: *Do not remove the rocker arm shaft retaining bolts unless it is necessary to disassemble the rocker arm shaft.*

18. Remove the valve push rods from their holes in the cylinder head and arrange them in a rack in the order in which they were removed. It is important that the rods are installed in the same bores during reassembly.

19. Loosen and remove the cylinder head retaining bolts evenly, working from the ends to the center of the head, and carefully lift the cylinder head from the block.

B. DISASSEMBLY

1. Before removing the valves from the cylinder head, clean all carbon deposits from the valve heads.

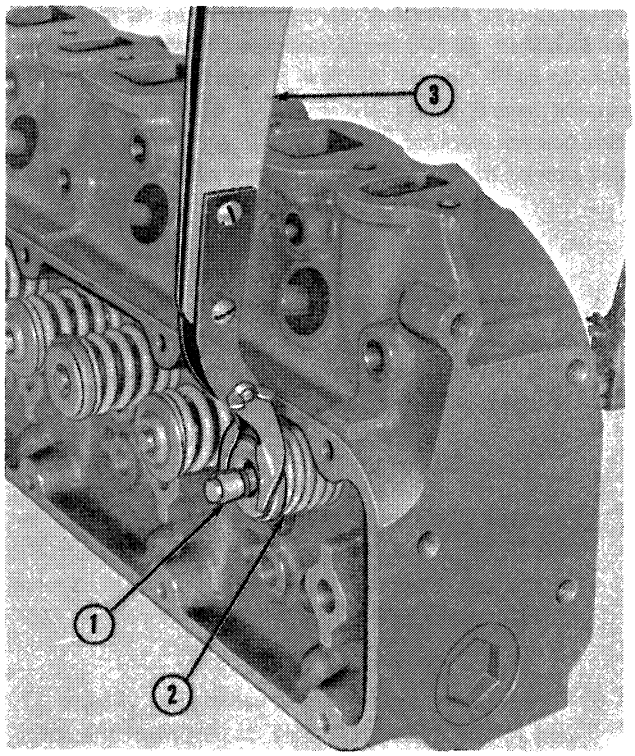

Figure 8
Removing Valves

1. Retainer Locks
2. Valve Spring
3. Valve Spring Compressor

2. Position the valve spring compressor over the valve and spring, as shown in Figure 8, and compress the spring.

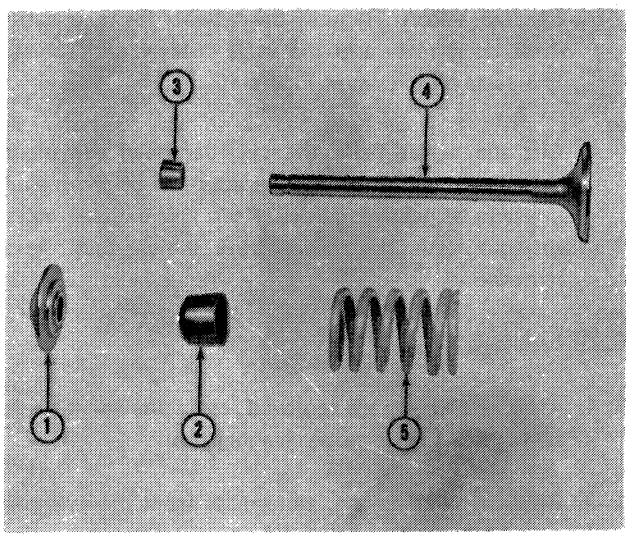

Figure 9
Intake Valve Assembly

1. Retainer
2. Seal
3. Retainer Locks
4. Intake Valve
5. Spring

Intake Valves: Remove the retainer locks, spring retainer, spring, and valve stem seal. The parts are shown in Figure 9.

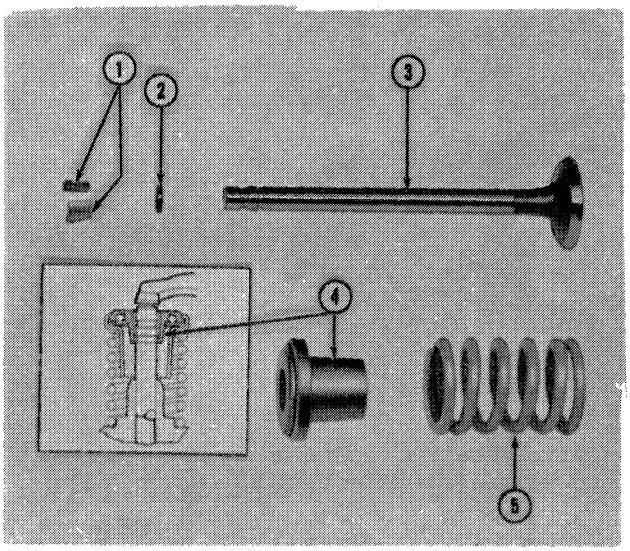

Figure 10
Exhaust Valve Assembly

1. Retainer Locks
2. Seal
3. Exhaust Valve
4. Rotator
5. Valve Spring

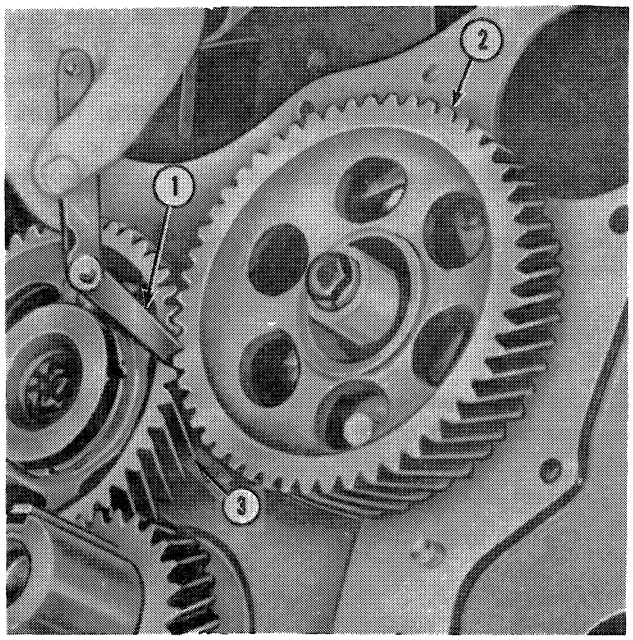

Figure 26
Checking Timing Gear Backlash

1. Feeler Gauge
2. Camshaft Gear
3. Camshaft Drive Gear

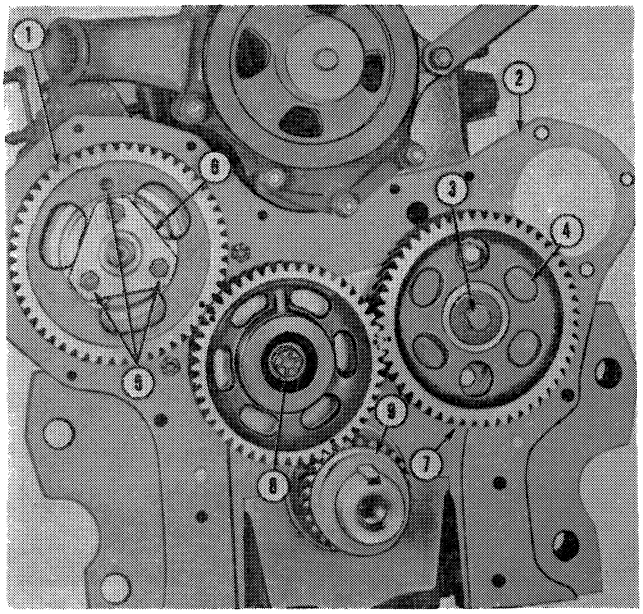

Figure 27
Engine Front Cover Removed

1. Injection Pump Gear
2. Front Cover Plate
3. Retaining Bolt
4. Washer
5. Attaching Bolts
6. Adapter Plate
7. Camshaft Gear
8. Self-Locking Bolt
9. Slinger

INJECTION PUMP GEAR

A. REMOVAL

1. Turn the crankshaft until the camshaft gear is in the approximate timed position, Figure 27.

2. Remove the three attaching bolts that retain the injection pump gear, Figure 27, to the pump adapter plate and remove the gear.

B. CLEANING AND INSPECTION

1. Clean the gear in solvent.

2. Inspect gear teeth for scores and nicks and the condition of the teeth contact pattern.

3. Use a carborundum stone to remove minor gear teeth imperfection. If gear teeth wear or damage is severe install a new gear.

C. INSTALLATION

1. Time the engine before installing the injection pump gear. To do this remove the camshaft drive gear, place No. 1 piston at top dead center, and reinstall the camshaft drive gear in mesh and the timing marks aligned to the other gears as shown in Figure 27. Tighten the camshaft drive gear adapter bolt to the specified torque, page 76.

2. Install the new injection pump gear on the pump adapter plate, with the timing mark aligned.

3. Install the three bolts and the adapter plate and tighten to the specified torque, page 76.

CAMSHAFT DRIVE GEAR AND ADAPTER

A. REMOVAL

1. Remove the self-locking bolt that retains the camshaft drive gear and adapter to the cylinder block.

2. Remove the adapter and camshaft drive gear. Refer to Figure 28.

2. Check for wear at the top ring by measuring the ring groove with a 1/8 in - 150 "keystone" gauge. If the shoulders of the gauge contact the face of the piston, Figure 41, the groove is worn beyond serviceable limits and the piston must be replaced. If the special gauge is not available, insert a new keystone ring in the groove and place a 0.006 in. feeler gauge between the top of the ring and the ring groove. If the feeler gauge can be inserted to the depth of the ring, the groove is excessively worn and the piston should be replaced.

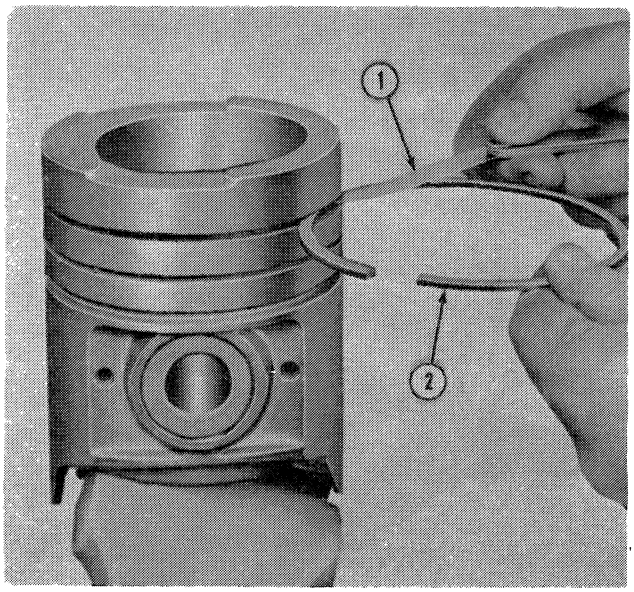

Figure 42
Checking Ring Side Clearance
1. Feeler Gauge
2. Piston Ring

3. Check all other piston ring grooves with a new ring and feeler gauge, Figure 42. The grooves should have the clearances shown on page 74. Replace pistons with excessive clearance.

4. Replace pistons with excessive skirt clearance, wavy wing lands, fractures, and pistons that show damage from detonation.

5. Replace worn or damaged piston pins. Always use new piston pin snap rings (circlips) when replacing piston pins.

CONNECTING ROD ALIGNMENT

1. Place each connecting rod in an alignment fixture, as shown in Figure 43.

2. If the connecting rod is twisted more than 0.0120 in. (0.3048 mm.), or bent more than 0.0040 in. (0.1016 mm.), install a new rod.

E. REPAIR

CONNECTING ROD BUSHING

1. Remove the connecting rod bushing from the connecting rod with Driving Mandrel No. 815, Adapter No. T-809, and an arbor press, Figure 44.

2. Clean the connecting rod bore and make sure there are no burrs or scratches in the bore. Line up the oil feed hole of the bushing to that of the connecting rod and press the new bushing into the connecting rod, using the same bushing tool used for removal.

3. **8700:** Using the hole in the top of the connecting rod as a guide, drill a 3/64 inch (1.21 mm) diameter hole in the bushing, Figure 45.

   9700: Drill a 3/64 in. (1.19 mm) hole in the bottom half of the connecting rod bushing. Using a long drill, drill a 3/64 in. hole in the top half of the bushing. See Figure 46.

4. Using an expansion reamer, ream the bushing in the connecting rod to obtain the specified bushing-to piston pin clearance, page 73. A spiral expansion reamer is recommended.

FITTING PISTONS

1. Pistons are available in both standard and oversize to fit all engines. New pistons should be installed if the clearance exceeds the specified limits.

2. The cylinder bores must be checked for taper and out-of-round before fitting a piston, as outlined on page 33, under "A. Cylinder Block Inspection."

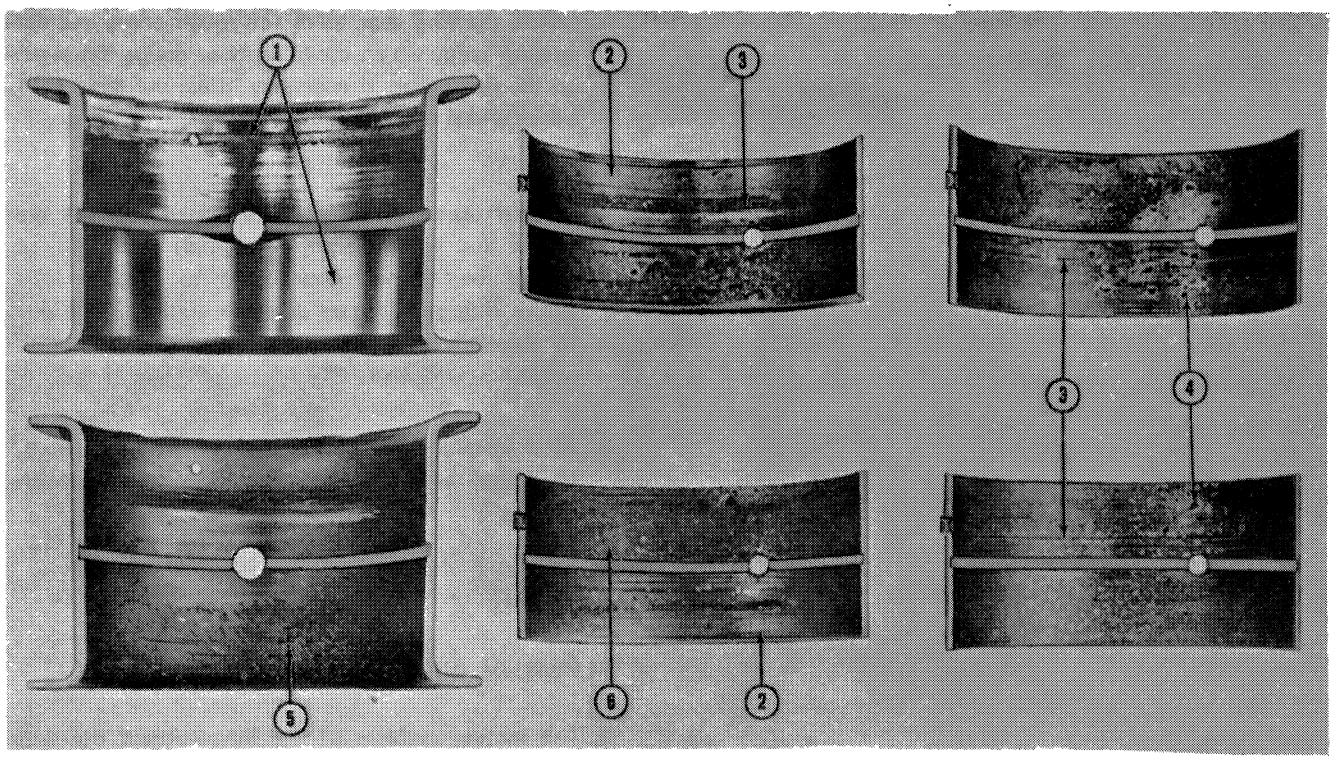

Figure 60
Typical Bearing Failures

1. Overlay Worn
2. Radii Ride
3. Scratches
4. Imbedded Dirt
5. Craters Or Pockets
6. Fatigue Failure

BEARING LINERS AND CRANKSHAFTS

1. Bearing liners are fitted in production to obtain the desired liner-to-crankshaft journal clearances. Because of the variation in tolerances, different conditions of liners (color codes) are used to obtain the desired clearances. (The difference between the liners is in the wall thickness.)

2. When fitting standard liners in service, using the "Plastigauge" method, it may be necessary to fit color code red, color code blue, or a combination of both liners on the same journal to obtain the desired clearance.

3. Engines may be assembled with liners of different material. For example, one journal may be fitted with aluminum tin alloy liners, while another journal may be fitted with copper lead liners. However, the top and bottom liners of any one bearing should be of the same material.

FLYWHEEL

The flywheel mounts on a flange at the rear of the crankshaft and is retained by six bolts. The mounting holes are unevenly spaced so that it can be mounted in only one position. The starter ring gear is mounted on the flywheel.

A. REMOVAL

1. Separate the tractor between the engine and transmission as outlined in Part 9, "COMPONENT REMOVAL."

2. Remove the pressure plate and clutch disc assembly from the flywheel as outlined in Part 4, "TRANSMISSION AND CLUTCH."

3. Before removing the flywheel attaching bolts, check the runout with a dial indicator, Figure 61. Measure runout between outer edge of friction surface and mounting bolt holes.

Part 1
ENGINE SYSTEM

Chapter 2
TURBOCHARGER

1. DESCRIPTION AND OPERATION

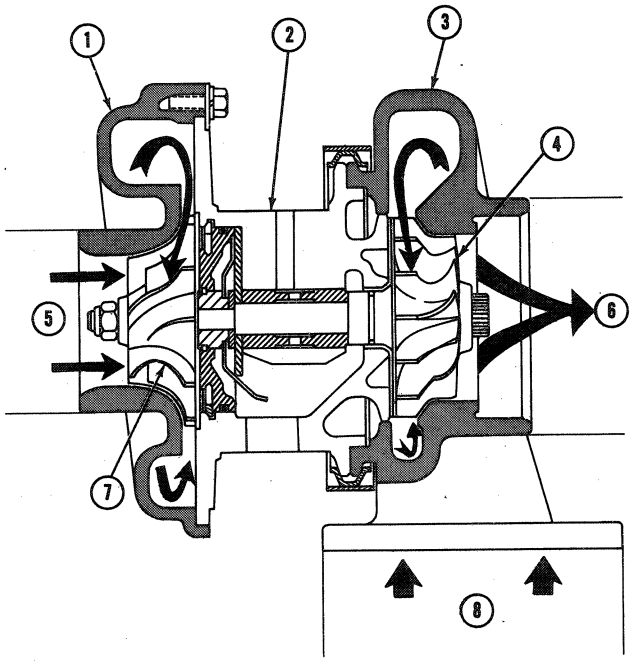

Figure 72
Turbocharger Air Flow

1. Compressor Cover
2. Bearing Housing
3. Turbine Housing
4. Turbine Wheel
5. From Air Cleaner
6. To Exhaust Stack
7. Compressor Wheel
8. From Exhaust Manifold

The turbocharger is a small turbine mounted directly on the engine exhaust manifold. A sectional view of the turbocharger is shown in Figure 72. The turbine wheel and the compression wheel are mounted on a common shaft, supported by bearings in the bearing housing. Exhaust gasses from the engine flow into the turbine housing and drive the turbine wheel and shaft assembly and the compressor wheel at speeds in excess of 80,000 rpm. The compressor wheel forces clean air drawn from the air cleaner into the engine at an increased rate. This increased air supply helps the engine develop more power and better fuel economy.

The turbocharger consists of a turbine, bearing and compressor housings. The turbine housing is flange mounted on the exhaust manifold and ducted to the exhaust stack. It contains the turbine wheel and shaft assembly. The turbine wheel is made of cobalt steel to withstand the high temperatures of the exhaust gasses.

The compressor housing consists of the compressor wheel and cover. The cover is ducted to the air intake manifold. The compressor wheel is made from aluminum since it operates in relatively cool air. The turbocharger design breaks up exhaust harmonics to reduce the noise level and reduces the need for a muffler, with no additional back pressure.

21. Spin the turbine wheel. The compressor wheel and the turbine wheel should rotate freely. If a drag is felt, remove the compressor cover and turbine housing to determine the problem area. If necessary, completely disassemble the unit and inspect all parts again. Reassemble and recheck.

Before installing the turbocharger on the tractor the following checks must be made and corrected if necessary:

- Check the exhaust and air intake systems for leaks, and remove any loose, foreign, or deteriorating material.
- Clean the air cleaner element.

Foreign material can quickly damage the turbocharger blades and destroy the precise balance of the rotating components. Exhaust and air intake leaks or restrictions will cause a reduction in the air supply to the engine and result in high exhaust temperatures.

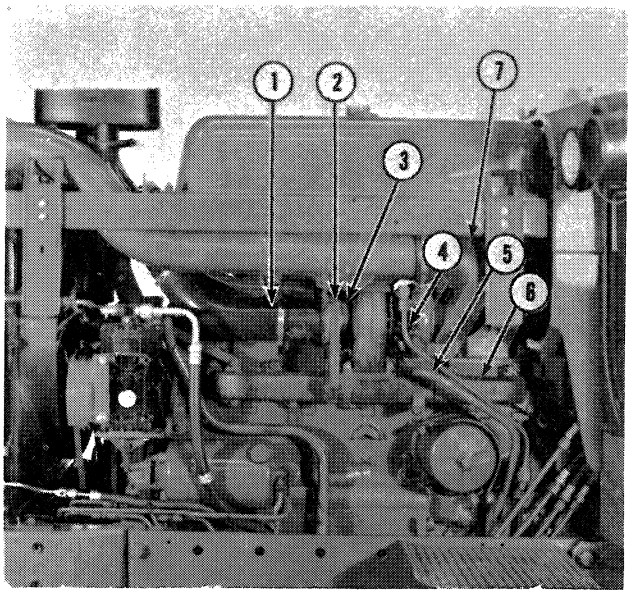

Figure 85
Turbocharger Components

1. Exhaust Pipe
2. Exhaust Flange
3. Seal Ring
4. Oil Supply Tube
5. Oil Return Tube
6. Exhaust Manifold
7. Air Cleaner - To - Turbocharger Tube

1. Position a new gasket and the turbocharger on the manifold, Figure 85. Secure the turbocharger with the four nuts and new tabbed lock washers and tighten the nuts to a torque of 30-35 lbs. ft. (41 - 47 Nm). Bend the lock tabs to retain the nuts.

2. Install a new gasket and the oil supply tube as shown in Figure 85. Secure with the two bolts and lock washers. Tighten the bolts securely.

3. Connect the oil supply tube and tighten the connector securely. Do not connect the oil return tube at this time.

4. Position the exhaust seal ring into the recess of the turbine hub. Install the exhaust flange and secure it to the adapter with the four bolts and lock washers. Tighten the bolts securely.

IMPORTANT: *Make certain that the intake manifold tube is not producing a strain on the compressor cover. If necessary, loosen the clamp plate bolts and realign the cover with the intake manifold tube. Be sure that the mating flanges of the compressor cover are properly seated and the clamp plate bolts are properly tightened* to a torque of 60 lbs. in. (7 Nm).

5. Connect the turbocharger-to-intake manifold tube as shown in Figure 86, and secure it with the clamps. Tighten each clamp bolt to a torque of 15-20 lbs. in. (1.7 - 2.2 Nm)

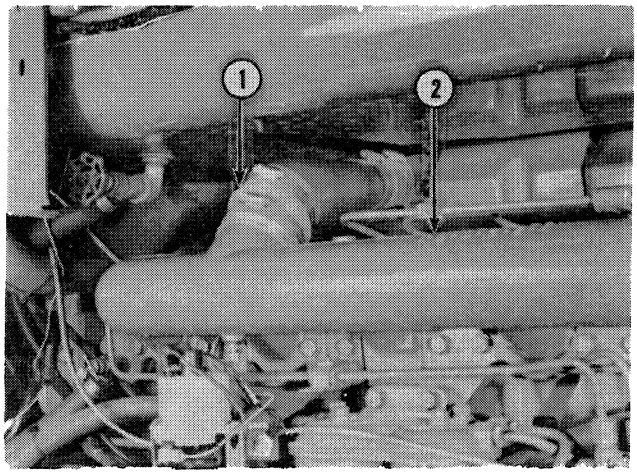

Figure 86
Turbocharger Components

1. Turbocharger - To - Intake Manifold Tube
2. Intake Manifold

Part 1
ENGINE SYSTEM

Chapter 5
SPECIFICATIONS AND SPECIAL TOOLS

1. SPECIFICATIONS

ENGINE

Displacement . . . . . 401 cu. ins. (6580 cc)

Compression Ratio 16.5:1

Stroke . . . . . 4.4 ins. (111.75 mm)

Bore . . . . . 4.4 ins. (111.75 mm)

Bore/Stroke Ratio 1.00:1

Firing Order 1-5-3-6-2-4

Rated Engine Speed:
- Ford 8700 . . . . . 2300 rpm
- Ford 9700 . . . . . 2200 rpm

Idle Speed . . . . . 700-800 rpm

Maximum No-Load Speed:
- Ford 8700 . . . . . 2530-2580 rpm
- Ford 9700 . . . . . 2420-2470 rpm

Compression Pressure at 200 rpm Cranking Speed with the Throttle Closed and Stop Control Out . . . . . 430 ± 50 psi (29.6 ± 3.4 bar)

TORQUE SPECIFICATIONS (Lubricated Threads) (CONT'D.)

	Thread Size	Pounds Feet	Newton Meters
Oil Pan Drain Plug	7/8-16	25-35	33.9-47.4
Valve Rocker Cover Bolts	5/16-18	10-15	13.5-20.3
Crankshaft Pulley-to-Crankshaft	3/4-16	130-160	176.1-216.8
Self-Locking Screw – Valve Rocker Arm	7/16-20	9-26	12.2-35.2
Injector Attachment Bolts	5/16-24	10-15	13.5-20.3
Oil Pump to Block	3/8-16	23-28	31.2-37.9
Water Pump-to-Cylinder Block	3/8-16	23-28	31.2-37.9
Turbine Housing Clamp Band	—	120 lbs. in.	13.5
Compressor Cover Cap Screws	—	60 lbs. in.	6.8
Compressor Wheel Lock Nut	—	156 lbs. in.	17.6
Water Pump Cover-to-Pump	5/16-18	18-22	24.4-29.8
Oil Pan-to-Cylinder Block (Stamped)	3/8-16	20-24	27.1-32.5
Oil Pan-to-Cylinder Block (Cast)	3/8-16	30-35	40.6-47.4
Injector Line Nuts	M 12 x 1.5	18-22	24.4-29.8
Injection Pump-to-Front Adapter Plate	5/16-24	20-25	27.1-33.9
Camshaft Drive Gear-to-Block	1/2-20	100-105	135.5-142.3
Front Adapter Plate-to-Cylinder Block	5/16-18	13-18	17.6-23.0
Front Cover-to-Front Adapter Plate	5/16-18	13-18	17.6-24.4
Camshaft Gear Bolts	7/16-14	40-45	54.2-60.9
Oil Filter Retaining Bolt	3/4-16	45-50	60.9-67.7
Oil Filter Mounting Bolt Insert	1-3/8-12	120-130	162.6-176.1
Starting Motor-to-Rear Adapter Plate	7/16-14	30-35	40.6-47.4
Oil Pump Gear Stop	1-1/8-16	65-75	88.1-101.6
Oil Pressure Switch Assembly		20-25	27.1-33.9

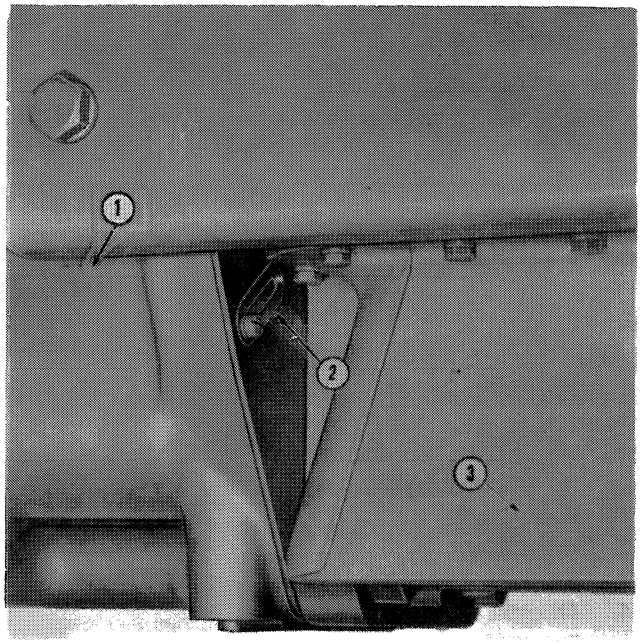

Figure 4
Flywheel Access Cover

1. Transmission Case
2. Flywheel Access Cover
3. Oil Pan

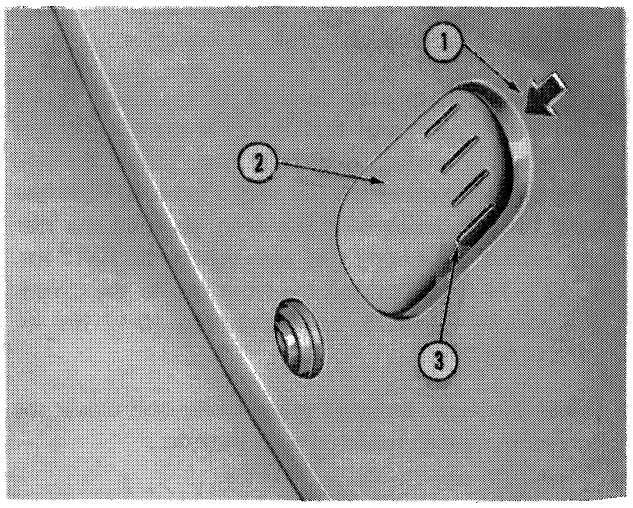

Figure 5
Timing Opening

1. Arrow
2. Flywheel
3. Timing Marks

NOTE: *Turn the flywheel clockwise. This will take up the backlash in the timing components. If the flywheel must be rotated counterclockwise, go past the mark and come back to it clockwise to take up the backlash.*

3. If the two dots, Figure 6, on the visible end of the injection pump camshaft are near the timing mark, the number one piston is on its compression stroke and beginning the fuel injection as required. If the two dots are away from the mark, the piston is on its exhaust stroke. The flywheel must be cranked one full revolution to bring the piston to its compression stroke for proper timing. Repeat Step 2 to accomplish this.

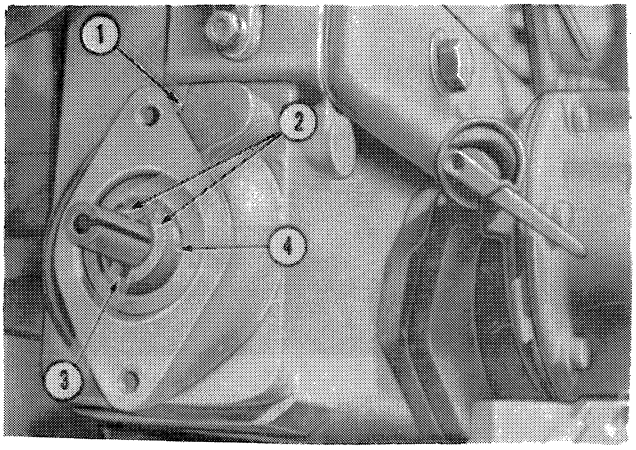

Figure 6
Rear of Injection Pump

1. Timing Marks
2. Dots on Camshaft
3. Notch
4. Injection Pump Camshaft

4. If the middle of the notch, Figure 6, between the two dots is exactly in line with the timing mark, the engine is timed. If the middle of the notch is not in line with the timing mark, time the engine as in Step 5.

5. Remove the injection pump timing cover from the right front of the engine (at the other end of the pump). If the timing marks are not aligned, loosen the three retaining bolts at the front of the pump gear plate, Figure 7. Rotate the gear plate until the marks line up. Tighten the three bolts to 20-25 lbs. ft. (27.1-33.9 Nm).

6. Install the tachometer connector, the timing cover, and the flywheel access cover.

NOTE: *If the tractot is not equipped with timing marks, time the tractor using the spill timing method. See page 14.*

Part 2
FUEL SYSTEM

Chapter 3
INJECTORS

Section | Page

1. DESCRIPTION AND OPERATION

A sectional view of an injector is shown in Figure 22. Fuel from the injection pump enters the injector fuel inlet and passes through the injector body before reaching the needle valve seat. The pressure of the fuel from the injection pump causes the needle valve to open against the action of the injector spring. Fuel is then forced in a highly atomized state through the holes in the nozzle tip.

When the pressure from the injection pump drops off, the injector spring forces the needle valve back on its seat. A small amount of fuel leaks up between the valve and the nozzle body, thus providing lubrication. The excess fuel rises to the top of the injector where it is gradually forced back to the fuel line through the injector leak-off line.

2. REMOVING AND INSTALLING INJECTORS

A. REMOVAL

1. Clean dirt and foreign material from the area near the injectors to be removed.

2. Disconnect the injector leak-off line, Figure 23, at each injector and at the fuel return line.

3. Loosen the injector lines at the pump and at the injectors. Disconnect the lines from each injector. Cap off the lines.

4. Remove the two nuts which hold the injector to the cylinder head and carefully withdraw the injector. Do not let dirt or other foreign material drop into the injector seat.

Part 3
ELECTRICAL SYSTEM

Chapter 1
WIRING, LIGHTS & INSTRUMENTS

Chapter 2
BATTERY

Chapter 3
ALTERNATOR CHARGING SYSTEM

WIRE COLOR INDEX

N	Brown	LG	Light Green	K	Pink
U	Blue	W	White	O	Orange
R	Red	Y	Yellow	V	Violet
P	Purple	B	Black	GR	Grey
G	Green	S	Slate		

NOTE: *Wires marked Z are non-standard color codes.*

NOTE: *Circuits are shown de-engergized.*

1. Instrument Cluster
2. Turn Warning Lamp—Left Hand
3. Fuel Gauge
4. Panel Lamp
5. Oil Warning Lamp
6. Panel Lamp
7. Air Cleaner Warning Lamp
8. Implement Warning Lamp
9. Main Beam Warning Lamp
10. Turn Warning Lamp—Trailer 1
11. Turn Warning Lamp—Trailer 2
12. Panel Lamp
13. Panel Lamp
14. Alternator Warning Lamp
15. Turn Warning Lamp—Right Hand
16. Temperature Gauge
17. Connector—Turn Indicator Switch
18. Horn Push
19. Ether Prime Push
20. Turn Indicator Switch
21. Fuel Gauge Change Over Switch
22. Implement Lamp Switch
23. Connector—Switch
24. Flasher Unit
25. Hazard Warning Switch
26. Warning Lamp
27. Ignition Relay
28. Light Switch
29. Cigar Lighter
30. Stoplamp Switch
31. Connector—Rear Lighting Main
32. Sidelamp—Right Hand
33. Connector—Rear Lighting Right Hand
34. Rear Lamp—Right Hand
35. Trailer Socket
36. Rear Lamp—Left Hand
37. Connector—Rear Lighting Left Hand
38. Sidelamp—Left Hand
39. Connector—Bulkhead
40. Fuel Level Sender—Auxiliary
41. Ether Solenoid
42. Starter Motor
43. Auxiliary Fuel Pump
44. Fuse Panel No.2
45. Thermostart
46. Air Cleaner Vacuum Switch
47. Horn
48. Blower Motor
49. Starter Solenoid
50. Battery Temperature Sensor
51. Headlamp—Left Hand
52. Headlamp—Right Hand
53. Ignition Switch with Thermostart (Shown in "Off" Position)
54. Ignition Switch less Thermostart (Shown in "Off Position)
    - A. Start
    - B. Ether Prime
    - C. Auxiliary (Ignition)
    - D. Feed
55. Safety Start Switch
56. Alternator
57. Fuse Link
58. Battery
59. Temperature Sender
60. Fuel Level Sender—Main
61. Oil Pressure Switch
62. Windscreen Washer Pump
63. Fuse Panel No.1
64. De-Icing Switch
65. Air Compressor Clutch
66. Thermostatic Switch
67. Blower Motor Switch
68. Wiper Motor
69. Windscreen Washer/Wiper Switch
70. Licence Plate Lamps
71. Dome Lamp
72. Dome Lamp Switch
73. For Changing Systems with separate Alternator and Regulator
74. Battery
75. Starter Solenoid
76. Fuse Link
77. Alternator
78. Regulator
79. Connector—Bulkhead
80. Loudspeaker
81. Radio
82. Implement Lamps
83. In-Line Fuse—2 Amp
84. Connector—Roof
85. Diode
86. Connector—Instrument Cluster

Key to Figure 4

(Electrical System Schematic — Tractors with Cab and "A" or "B" Prefixed Serial Numbers)

N. ENGINE COOLANT TEMPERATURE AND OIL PRESSURE SENDER SWITCHES

The location of the engine coolant temperature and the oil pressure senders are shown in Figure 12. Any time the senders are removed and reinstalled they should be checked for leaks.

O. AIR CLEANER RESTRICTION SWITCH

The air cleaner restriction switch is mounted in the air intake tube. When installing a new switch, verify its correct operation by blocking the air intake tube while the engine is running and observing the indicator lamp in the instrument cluster. The indicator light should light under this condition.

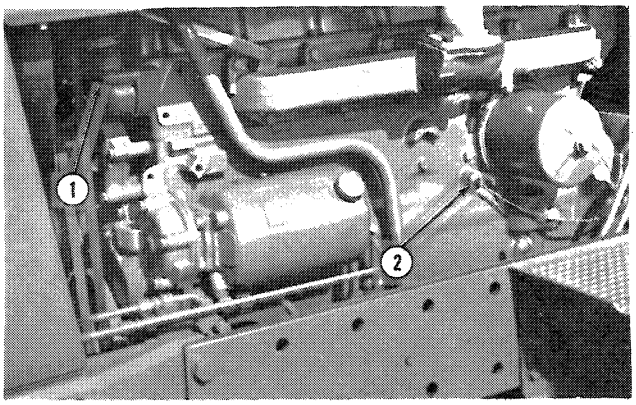

Figure 12
Coolant Temperature and Oil Pressure Sender Switch Location
1. Coolant Temperature Sender Switch
2. Oil Pressure Sender Switch

4. INSTRUMENT CLUSTER

The instrument cluster houses the engine coolant temperature gauge, the fuel gauge, the tachometer, warning lights and the illumination lights. All lights are removed from the back of the panel as described under removal and installation of instrument panel lights, page 16. The water temperature gauge and the fuel gauge plug into the circuit board.

Removal and Installation:

1. Disconnect the battery negative cable from the battery. Remove the four screws that secure the instrument panel in place.

2. Pull the panel out from the top and remove the tachometer drive cable from the tachometer.

   NOTE: *It may be necessary to disconnect the tachometer cable from the fuel injection pump to provide enough slack to lift the panel out far enough to gain access to the tachometer drive on the rear of the panel.*

3. Tag all wires for identification purposes, then disconnect the wires from the switches and disconnect the cluster connector plug.

4. Remove the seven screws that hold the cluster to the instrument panel. Remove the glass.

5. **Fuel Gauge:** Remove the attaching screws and pull the gauge off the clip terminal.

6. **Water Temperature Gauge:** Remove the attaching screws and pull the gauge off the clip terminal.

7. **Tachometer:** Remove the tachometer retaining screws, and remove the cable retaining clip.

8. Place the gauges in their respective places aligning the pegs on the case with the holes in the gauge assembly. Install the gauge retaining screws. Install the tachometer clip on the back of the tachometer gauge.

9. Place the glass on the cluster assembly and secure the assembly to the instrument panel with the seven retaining screws.

10. Place the instrument panel assembly on the rear hood. Attach wires to switches and plug in the main connector. Be sure that the connector tangs snap into the recesses. Attach the cable to the tachometer drive housing, making certain the cable end snaps onto the cable clip.

11. Install instrument panel-to-rear hood retaining screws. Connect battery negative cable to the battery.

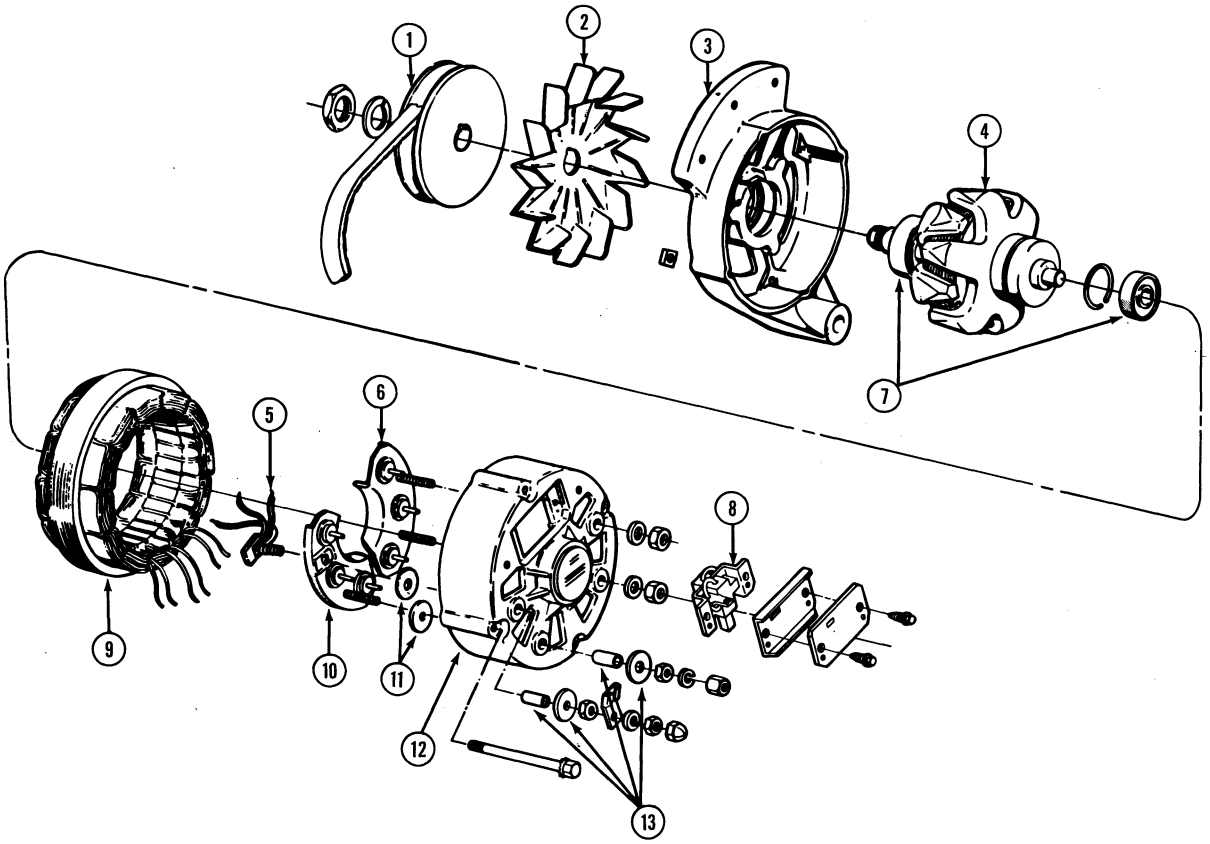

Figure 18
Alternator — Exploded View

1. Pulley
2. Fan
3. Front Housing
4. Rotor and Shaft Assembly
5. Field Diode
6. Negative Diode Assembly
7. Support Bearings
8. Brush Assembly
9. Stator Assembly
10. Positive Diode Assembly
11. Insulators
12. Rear Housing
13. Insulators

The core is made up of a number of thin steel plates that, when assembled, contain 36 equally spaced slots on the inner surface, Figure 19. These slots retain the coil windings. Three separate wires form the coil windings (phases) of the stator. Each wire is started in a separate slot and routed through every third slot. In assembly, each wire is wound clockwise several times between the beginning slot and the third slot. The wire is then turned at right angles to the beginning slot and, skipping two slots, it is similarly would an equal number of turns, but in a counterclockwise direction. This alternating of every third slot, and the direction of winding, continues around the core with each wire forming 12 separate loops. The ends of each wire are connected to the two diode assemblies in the rear housing.

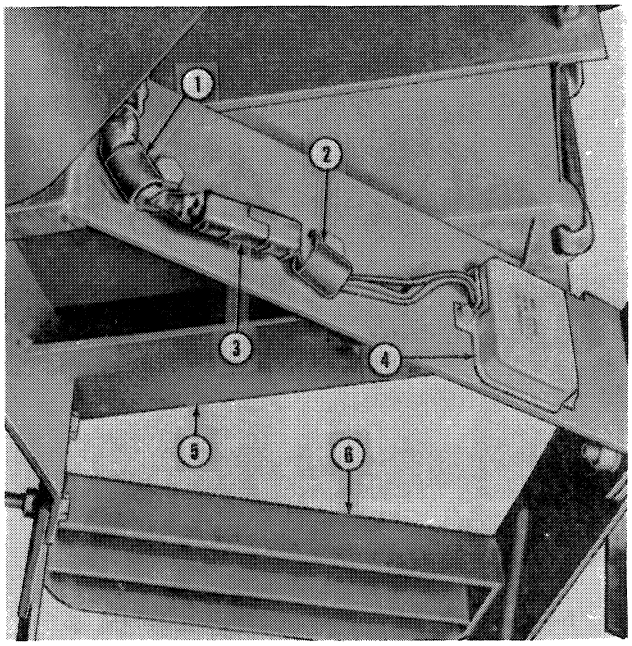

Figure 33
Alternator Regulator Location — Viewed from Under Tractor

1. Harness Clip
2. Regulator Wire Clip
3. Connector
4. Regulator
5. Battery Box
6. Right Hand Step

4. Remove the attaching screws from the regulator. Remove the regulator from the step bracket.

Installation:

1. Attach the voltage regulator to the inside of the right side step bracket with the attaching screws.
2. Connect the wiring harness to the regulator quick disconnect.
3. Install the wire clip.
4. Connect the battery ground (negative) cable to the battery.

5. ALTERNATOR OVERHAUL AND BENCH CHECK

ALTERNATOR OVERHAUL

A. Removal

1. Disconnect the battery ground (negative) cable from the battery.
2. Disconnect all wires from the alternator, Figure 32.
3. Remove the alternator from the tractor by removing the attaching bolts.

B. Disassembly

Brush Removal:

1. Remove the two brush mounting screws, then lift the cover and dust shield from the brush assembly.
2. Grasp the field terminal and gently pull the brush assembly down and away from the alternator. Refer to page 41 for inspection and repair of the brush assembly.

Rear Housing Removal:

1. Using a scribe, scribe a line across the front housing (1), Figure 34, the stator (2), and the rear housing (3) to make reassembly easier.
2. Remove the four through bolts and square nuts holding the housings together. See Figure 34.
3. Insert two small screwdrivers in the stator slots between the stator (1), Figure 35, and the front housing (2).

IMPORTANT: *Do not insert the screwdriver blades deeper than 1/16" (1.59 mm), see Figure 36, to avoid damaging the stator winding.*

TEST B — Slip ring and rotor coil ground test:

Defective coil or lead wire insulation allowing the wire to contact any metal parts of the rotor will ground the rotor (field) coil. Damage to the regulator can result and the alternator will fail to reach its rated output. By using a relatively high voltage for this check, slight leakage can be detected before actual failure occurs. The test instrument is a 115 volt to 120 volt alternating current test light. This can be made locally using a 15 watt bulb, bulb holder, male wall plug, and necessary wiring. See Figure 60.

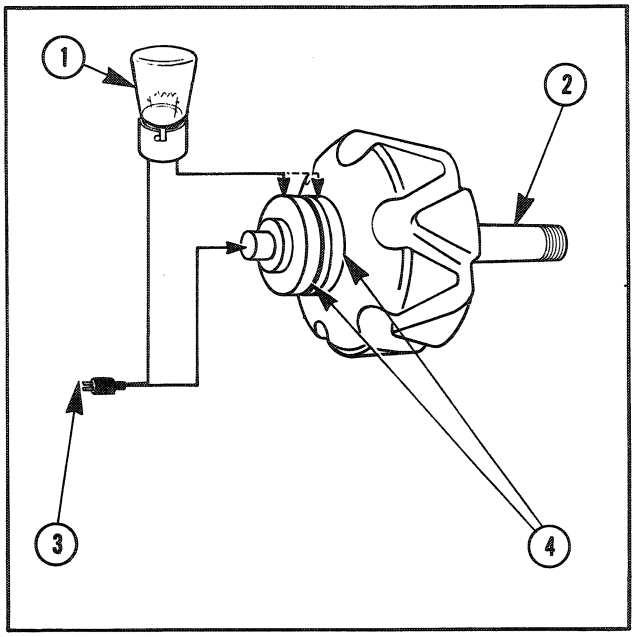

Figure 60
Rotor Coil (Field) Ground Test

1. Rotor Shaft
2. Slip Rings
3. 115-120 Volt A.C. Supply
4. 15 Watt Test Lamp

- Insert the plug into a 115 to 120 volt alternating current outlet.

CAUTION: *Avoid touching the bare test probes as severe electrical shock will result.*

- Touch one test probe to the rotor shaft (2), Figure 60, and the other probe to one of the slip rings (4). After checking one slip ring move the probe to the other slip ring.
- Replace the rotor assembly if even the slightest glow is seen in the test lamp when touching one or othe other slip rings, as this indicates a grounded coil or slip ring.

NOTE: *A grounded rotor winding will probably damage the regulator and provide uncontrolled output, therefore, causing damage to the battery.*

14. Clean the brush contacting surface of the slip rings with fine abrasive cloth, wipe off all dust and residue.

ASSEMBLY

ROTOR AND FRONT HOUSING ASSEMBLY

Assemble the front housing and the rotor as covered in the preceding "Rotor and Front Housing Inspection" procedure.

PULLEY, FAN AND SPACER INSTALLATION

1. Place the spacer (2), Figure 38, over the shaft and install the Woodruff key (1).
2. Place the fan and pulley over the shaft. Install the lockwasher and nut.
3. Clamp the pulley in a vise, using an old oversize belt (1), Figure 37, to protect the pulley as shown. Tighten the pulley nut 35-50 lbs. ft. (47.5-67.8 Nm).

STATOR AND REAR HOUSING ASSEMBLY

1. Place the insulating sleeves and washers (1), Figure 61, over the positive rectifying diode studs (3).
2. Insert the heat sink studs through the openings in the rear housing. Place the 3/4 inch (19.05 mm) insulating washers (3), Figure 62, over the studs. Install the locknuts as shown and tighten securely.

DISASSEMBLY

Refer to Figure 72 to identify the components.

1. Secure the starting motor in a vise equipped with soft jaws. Do not over tighten the vise.
2. Remove the two brush holder screws and seals from the brush end cover (1).
3. Remove the two thru-bolts (3), lockwashers, tab washers and seals.
4. Remove the brush end cover (1) while at the same time using a blade screwdriver to keep the brush holder assembly (2) on the armature commutator.
5. Remove the cover seal.
6. Raise the springs on the two field coil (insulated) brushes and pull the brushes out of the holders.
7. Remove the brush plate assembly from the commutator.
8. Disconnect the copper link and the flexible link from the two solenoid terminals.
9. Remove the two solenoid retaining nuts and lockwashers and remove the solenoid (6) and gasket.
10. With the drive assembly in the fully engaged position, lift the solenoid plunger from the drive lever yoke (11).
11. Loosen the locknut on the drive lever pivot pin (10) and remove the nut and pin.
12. Remove the drive end housing (8) and remove the dust seal.
13. Lift the drive lever (11) from the drive assembly (22).
14. Remove the armature (17), drive assembly (22) and intermediate plate (20) from the frame and coil assembly.
15. Move the drive assembly fully back on the armature. Slide the stop collar (23) away from the retainer (24). Spread the retainer and slide it off the armature.
16. Remove the stop collar, drive assembly, intermediate plate, and thrust washer, if used.

BENCH TESTS

FIELD COIL OPEN CIRCUIT TEST

1. Connect the voltmeter positive lead to the starting motor field terminal (3), Figure 73.

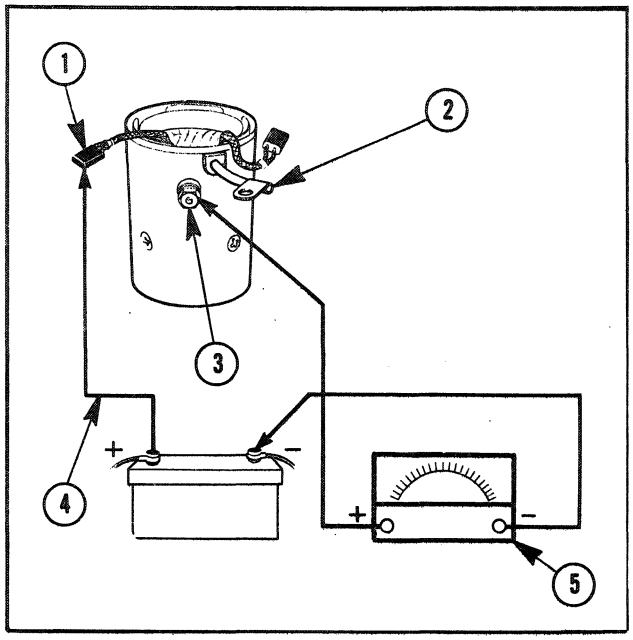

Figure 73
Testing Field Coils for Opens

1. Insulated Brush
2. Eyelet Wire
3. Field Terminal
4. Jumper Wire
5. Voltmeter

2. Connect the voltmeter negative lead to the battery negative terminal.
3. Attach a jumper lead (4) between the battery positive terminal and one of the insulated brushes. The voltmeter should indicate battery voltage.
4. Repeat the complete test with the jumper lead connected to the other insulated brush. The voltmeter should indicate battery voltage.

Part 3
ELECTRICAL SYSTEM

Chapter 5
CAB ELECTRICAL

1. GENERAL

The cab wiring harness, Figure 88, contains the electrical connections for the interior light and switch, the rear work and flasher lamps, see "Lights and Switches," page 71, windshield wiper motor and washer system, ceiling mounted radio, and the heating and air conditioning controls.

If a problem is encountered in the cab electrical system, refer to Chapter 1. Check all connections and grounds thoroughly. When making continuity checks be sure to disconnect the battery negative cable from the battery.

STARTING SYSTEM TROUBLE SHOOTING GUIDE

Trouble	Possible Causes
1. Engine Will Not Crank and Starting Motor Solenoid Does Not Click	1. Battery completely discharged. 2. Key-starter switch, safety starter switch, or starting motor solenoid inoperative. 3. Starting circuit open or has a high resistance.
2. Engine Will Not Crank but Starting Motor Solenoid Clicks	1. Burned solenoid interior terminal contacts. 2. Defective starting motor or loose or defective battery cables and connections. 3. Defective starting motor drive assembly. 4. Low charge in battery. 5. Hydrostatic lock in engine cylinders. 6. Engine seized.
3. Starting Motor Spins but Does Not Crank Engine	1. Defective starting motor drive assembly. 2. Defective flywheel ring gear.
4. Engine Cranks Slowly	1. Battery low in charge. 2. Excessive resistance in starting circuit. 3. Defective starting motor. 4. Tight engine.

2. SPECIFICATIONS

LIGHTS AND INSTRUMENTS

Headlamps:
- Outboard Work Lamps (Low Beam) (Sealed Beam) ..... No. 4440
- Inboard Headlamps (High Beam) (Sealed Beam) ..... No. 4410 or 4406, No. 4411

Rear Lamp:
- Sealed Beam ..... No. 4422
- Taillight Bulb ..... No. 1141

Flasher Warning Lamp Bulb ..... No. 1156
Instrument and Warning Light Bulbs ..... No. 194
Light Circuit Fuse ..... 4 amp.

CHARGING SYSTEM

Battery:
- Capacity (Ampere Hour at 20 Hour Rate) 128
- Voltage 12
- Cells 6
- Plates Per Cell 25
- Ground Terminal ..... negative

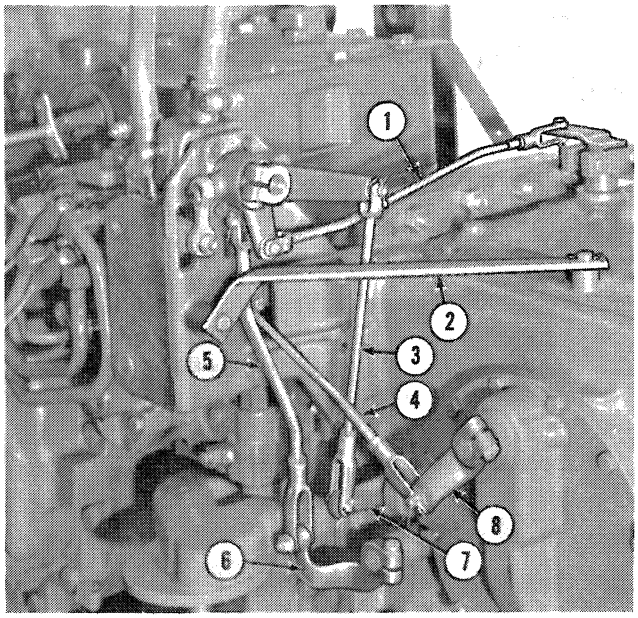

Figure 7
Gearshift Linkage

1. Parking Brake Control Rod
2. Support Brace
3. Interlock Control Rod
4. Gearshift Control Rod
5. High/Low Control Rod
6. High/Low Shift Arm
7. Lower Interlock Shift Arm
8. Gearshift Arm

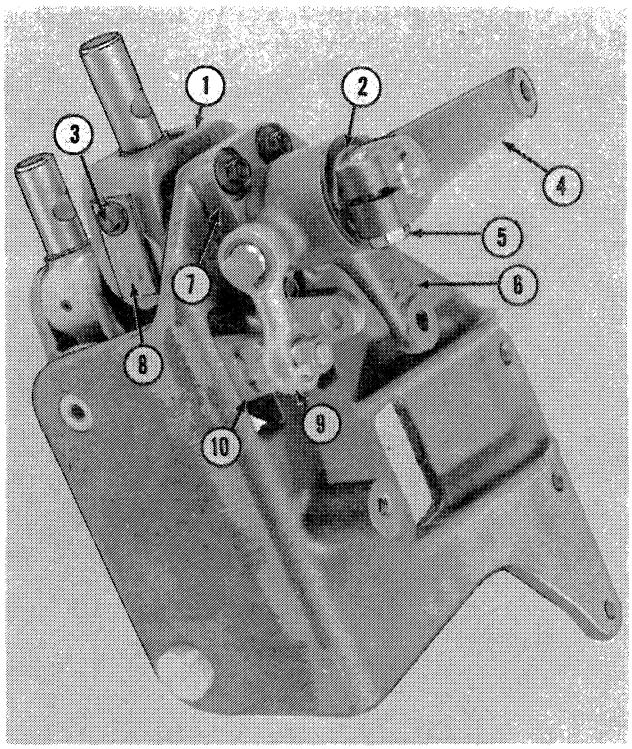

Figure 8
Shift Mechanism

1. Gearshift Bellcrank
2. Snap Ring
3. Support Pin Bolts
4. Interlock Shift Arm
5. Interlock Shift Arm Bolt
6. Park Bellcrank
7. Support
8. Gearshift Bellcrank Support Pin
9. Universal Connector
10. Parking Brake Bellcrank

4. Loosen the interlock shift arm bolt (5), Figure 8. Remove the interlock shift arm (4), the snap ring (2), the universal connector (9), and the park bellcrank (6).

   NOTE: *Take care not to lose the detent ball and spring when removing the park bellcrank.*

5. Remove the support (7), Figure 8, from the main support by removing the four support plate mounting bolts.

6. Remove the support pin attaching bolts (3) and remove the gearshift bellcrank support pins (8), Figure 8 (one on each side of the gearshift bellcrank). Remove the gearshift bellcrank (1).

7. Remove the parking brake and high/low bellcrank trunnions (5 & 3) respectively, Figure 9, by loosening the trunnion bolt (4) and tapping to unseat the parking brake bellcrank trunnion (3). Remove the trunnion bolt and unseat the high/low bellcrank trunnion (5) with a punch. Remove the high/low selector lever assembly (1) and the high/low bellcrank (8) and the parking brake bellcrank (9). Note the order of the washers (2) and shims (7) to facilitate reassembly.

8. Remove the interlock pin (11), Figure 9, by sliding it out of its bore.

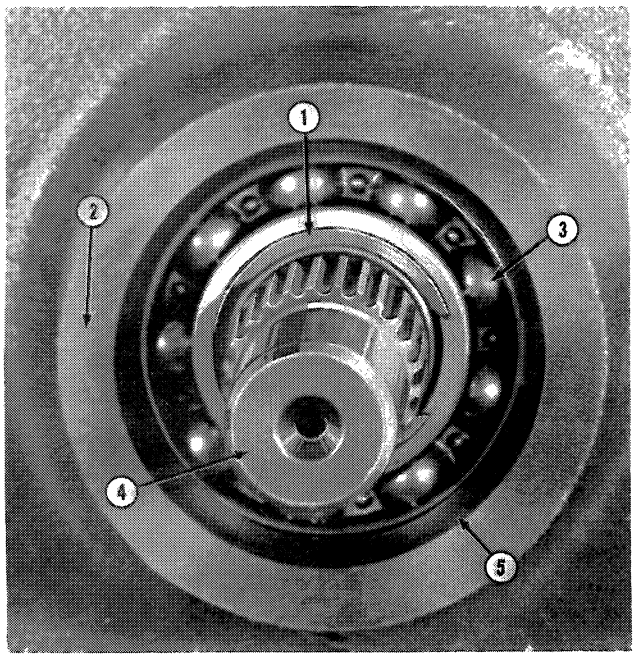

Figure 17
P.T.O. Shaft Bearing

1. Lock Ring
2. Bearing Retainer
3. P.T.O. Shaft Bearing
4. P.T.O. Shaft
5. Shaft Snap Ring

6. Remove the output shaft assembly (6), Figure 16, by pulling it straight out. Remove the secondary countershaft (4), from the case and remove the thin thrust needle bearing from the front of the countershaft.

7. Remove the six retaining bolts from the output shaft bearing retainer (7), Figure 15. Gently and evenly pry the retainer out to avoid binding and possible damage to the shims located behind the retainer. Remove the retainer shims.

8. Remove the high/low gearshift sliding coupling (1), Figure 18, from the shift fork fingers (8). Loosen the high/low shift fork lock nut and screw (4). Remove the high/low detent seat (11), Figure 12, and remove the spring and ball. Use a magnet if necessary to remove the ball.

   IMPORTANT: *The high/low detent assembly must be removed from the case to avoid damage to the detent spring when the high/low shift rail is installed.*

9. Remove the high/low shift rail (4), Figure 19, from the case and remove the shift fork (3) from the parking brake pawl (2).

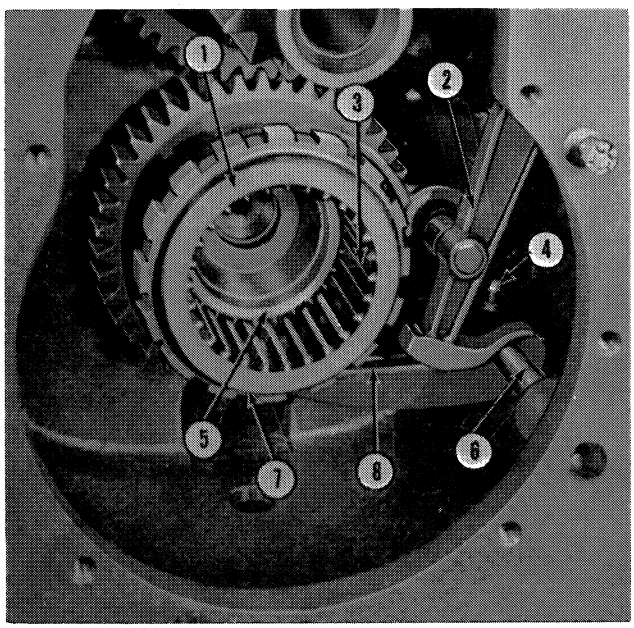

Figure 18
Sliding Coupling and Brake Pawl

1. High/Low Sliding Coupling
2. Parking Brake Pawl
3. Internal Splines
4. Shift Fork Bolt and Nut
5. Dog Teeth
6. High/Low Shift Rail
7. Parking Brake Teeth
8. High/Low Shift Fork

B. Inspection and Repair

1. Inspect the P.T.O. shaft for excessive wear or damage. Note wear or damage to the splines at the shaft ends.

2. Inspect the P.T.O. bearing for wear or damage. If necessary, remove the lock ring (1), Figure 17, securing the bearing on the shaft and remove the bearing. Use Tool Number 1002 as shown in Figure 20. Install a new bearing using a sleeve of convenient length and appropriate diameter, 1-3/8 inch (3.49 cm) I.D. and 2-13/16 inch (7.16 cm) O.D., and Tool Numbers 630-6 and 951 as shown in Figure 21. Install both lock rings to secure the bearing.

3. Inspect the secondary countershaft bearing retainer (2), Figure 22, for distortion or damage and replace if necessary. Examine the bearing for excessive wear or damage. If necessary, remove the bearing (4) using Tool Number 954 and 956-2 as shown. Install a new bearing using Tool Number 630-15 as shown in Figure 23.

sleeve of the proper diameter, 2-3/8 inch (6.03 cm) I.D. and 2-5/8 inch (6.66 cm) O.D., as shown.

5. Inspect the clutch release fork (5), Figure 33, for cracks or excessive wear and install a new fork, if necessary.

6. Examine the cross shaft (2), Figure 33, and arm for distortion or excessive wear and install a new assembly, if necessary. Inspect the shaft bushings in the transmission case for excessive wear and install new bushings, if necessary, using Tool Number 630-4.

7. Inspect the planetary cover (7), Figure 33, for damage or distortion. Check the face of the cover and its mating surface for nicks or burrs. Stone as required to remove imperfections.

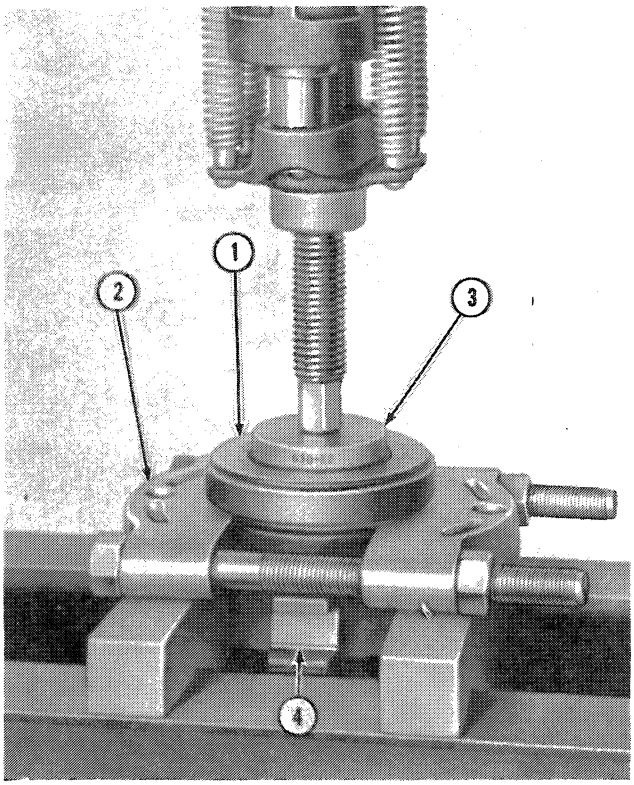

Figure 41
Removing Clutch Release Bearing
1. Release Bearing
2. Tool No. 951
3. Tool No. 630-10
4. Release Hub

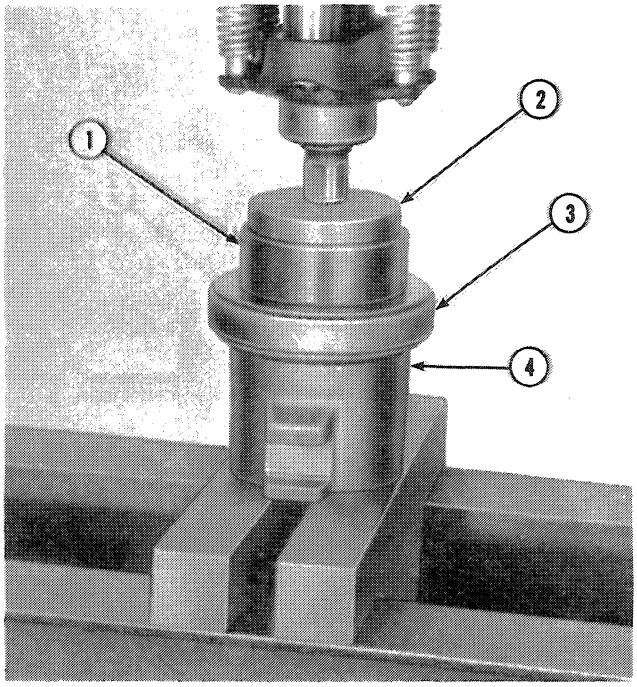

Figure 42
Installing Clutch Release Bearing
1. Sleeve 2-3/8 inch (6.03 cm) I.D., 2-5/8 inch (6.66 cm) O.D.
2. Tool No. 630-13
3. Release Bearing
4. Release Hub

8. Inspect the planetary carrier and gears (2), the planetary shaft (11), the pilot bearing (3) and the thrust washer (12). If damage or wear is present on any part, remove the pilot bearing (3), Figure 43, from the shaft using Tool Numbers 1002, 630-4 and 951, as shown. Separate the shaft (6) from the planetary carrier (4) and remove the thrust washer. Install new parts where necessary and reassemble. Install a new pilot bearing on the shaft using a press and a convenient length sleeve of the proper diameter, 1-5/8 inch (4.13 cm) I.D. and 1-7/8 inch (4.76 cm) O.D.

9. Inspect the sun gear (9), Figure 34, for excessive wear or damage to the teeth.

10. Inspect the three seals (1), Figure 36, from the rear hub of the direct drive clutch assembly for damage, distortion or cracks.

11. Examine the direct drive clutch housing externally for cracks or damage and internally for wear and piston scuffing. Examine the housing external splines for cracked, broken or missing teeth.

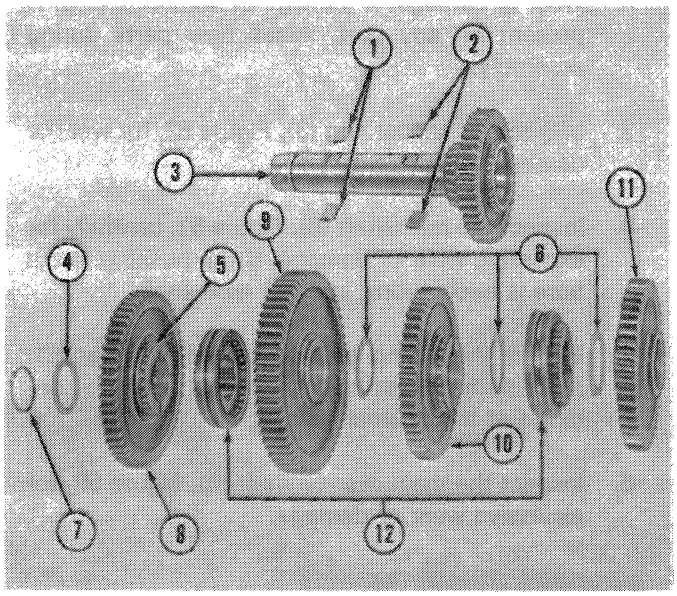

Figure 54
Main Countershaft and Associated Components — Exploded View

1. Forward Keys
2. Rear Keys
3. Main Countershaft
4. Thrust Washer
5. Dog Teeth
6. Thrust Washers
7. Snap Ring
8. 55 Tooth Gear
9. 61 Tooth Gear
10. 49 Tooth Gear
11. 47 Tooth Gear
12. Sliding Coupling and Connectors

15. Install a bolt and jam nut on the rear end of the shift rail. Using a wrench, turn the shift rail so that the detent passage (6), Figure 55, on the shift rail aligns with the detent passages (8) on the shift forks so that the detent balls and springs can be removed as the shift rail is removed. For easy removal of the springs and balls, when removing the shift rail, use a magnet to remove them from the shift forks.

NOTE: *Be careful when pulling the shift rail, as the detent balls will fly out when the holes come into alignment.*

16. Remove the shift rail from the rear of the transmission case. Remove the detent springs and balls per Step 15 as the rail is removed.

17. Remove the 1st-5th, 2nd-6th, shift fork (3), Figure 55, the 3rd-7th reverse shift fork (2), the 4th-8th shift fork (1) and the parking brake pawl (4) from the case. Keep the shift forks in order to simplify assembly.

18. Remove the clamp bolt on the high/low lever (4), Figure 57, and remove the lever from the control shaft (3).

19. Remove the control arm shaft from the case. Remove the O-ring.

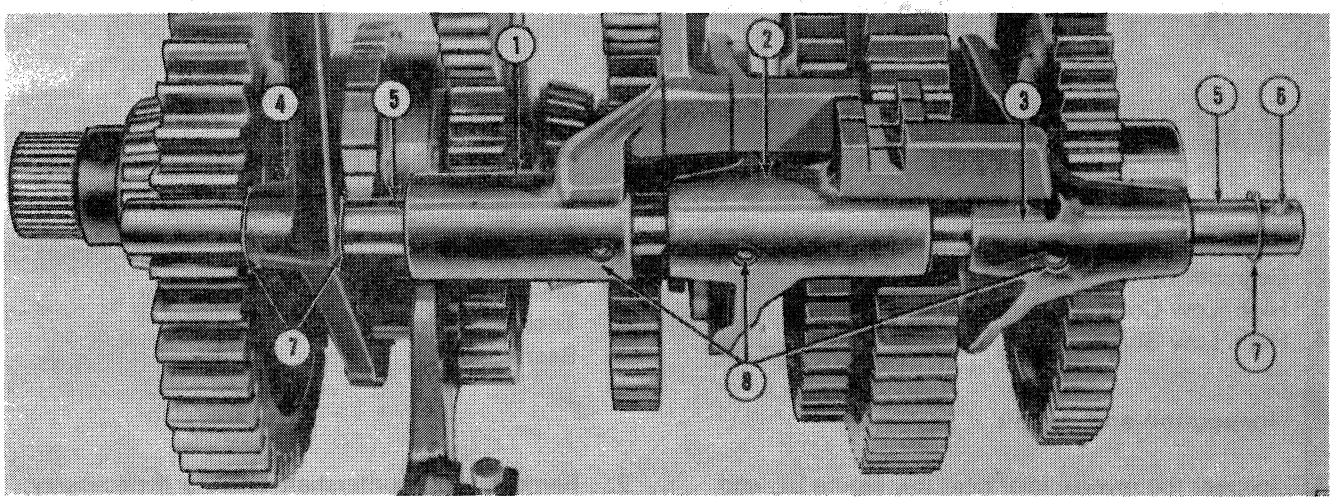

Figure 55
Shift Rail and Related Components

1. 4th-8th Shift Fork
2. 3rd-7th Reverse Shift Fork
3. 1st-5th, 2nd-6th Shift Fork
4. Parking Brake Pawl
5. Shift Rail
6. Shift Rail Detent Passage
7. Snap Ring
8. Shift Fork Detent Access Passage

IMPORTANT: *Ford 8700 clutches do not have pressure springs at locations marked "X," Figure 65. Note carefully the positions of the springs before removing them from the pressure plate.*

C. Inspection

Examine the pressure plate for cracks, scoring or distortion. Check for distortion using a straight edge. Examine the release levers (4), Figure 65, and yokes (6) for cracks, distortion or excessive wear. If necessary, install a new release lever and pressure plate assembly.

Pressure springs which do not give a load of 140.5 lbs. (6.73 kg) ± 5 lbs. (2.3 kg) at a compressed length of 1.539 inches (3.9 cm) or show extreme discoloration from overheating should be discarded. Install new springs if needed.

Install a new clutch disc if the cera-metallic facings are loose or worn excessively. Heat discoloration is normal. Investigate for the cause of any oil leaks.

D. Assembly and Adjustment

WITH TOOL NUMBER SW 510

NOTE: *A new clutch assembly should be checked and adjusted if necessary. Follow steps 3 and 6 — 14 after placing the assembly on the fixture base.*

1. Place the clutch pressure plate assembly on the clutch fixture base. Place all springs (2), Figure 65, in their original positions as noted.

   NOTE: *Ford 8700 clutches do not have pressure springs at locations marked "X," Figure 65.*

2. Place the clutch cover over the springs and align mating holes and reference marks. Do not move the springs.

3. Install the adapter plate (6), Figure 68, the bridge (4), the thrust washer (1), and the spindle nut (2) on the spindle. Hand tighten the spindle nut and check the alignment of all parts.

4. Carefully tighten the spindle nut to compress the release springs. Adjust the alignment of the parts as needed. Make sure that the yokes (3), Figure 68, and the lugs (5) come through the clutch cover and do not bind the assembly.

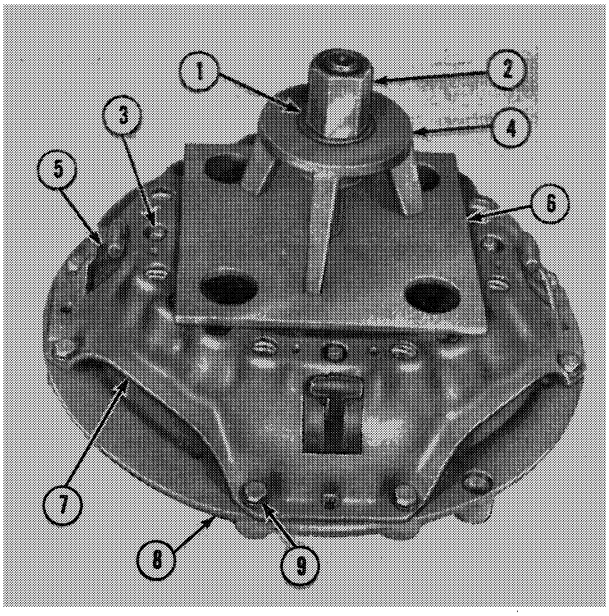

Figure 68
Clutch Secured for Adjustment

1. Thrust Washer
2. Spindle
3. Yoke
4. Bridge
5. Lug
6. Adapter Plate
7. Clutch Cover
8. Fixture Base
9. Cover-to-Flywheel Bolt

5. Place the adjusting nuts on the yokes to keep them centered in the cover holes.

6. Tighten down the spindle nut until the clutch cover fully contacts the fixture base. Install the eight cover-to-flywheel bolts (9), Figure 68, to secure the clutch cover to the fixture base.

7. Remove the spindle nut (2), Figure 68, the thrust washer (1), the bridge (4) and the adaptor (6) plate from the spindle.

   NOTE: *When preparing a new clutch assembly, remove the eight bolts securing the four thrust plates. Refer to Figure 64.*

8. **Ford 8700:** Install the Gauge Spacer, No. SW 510-H (6), Figure 69, and the Release Lever Gauge, No. SW 510-2 (1) on the spindle as shown.

9. **Ford 9700:** Install the Gauge Spacer, No. SW 510-J (6), Figure 69, and the Release Lever Gauge, No. SW 510-2 (1) on the spindle as shown.

PROBLEM	POSSIBLE CAUSE	8-Speed	Dual Power	CORRECTIVE ACTION
8. No power to rear wheels and the mainshaft does not turn	1. Defective input shaft or mainshaft splines	X	X	1. Refer to "FRONT END OVERHAUL," Page 32.
	2. Planetary gear set components damaged or defective		X	2. Refer to "PLANETARY GEAR SET OVERHAUL," Page 23.
	3. Clutch problem	X	X	3. Refer to "CLUTCH TROUBLE SHOOTING CHART," Page 61.
9. No power to rear wheels in a specific gear ratio	1. Defective ratio power flow components	X	X	1. Check the components involved and refer to "COMPLETE OVERHAUL," Page 35.
10. Failure to engage high or low range	1. Defective splines on high-low sliding couplings or dog teeth on output shaft gear and main countershaft or output shaft splines	X	X	1. First refer to "REAR END OVERHAUL," Page 16, for the main countershaft if damaged.
	2. Improper adjustment of high-low shift lever linkage	X	X	2. Refer to "HIGH-LOW LEVER & GEARSHIFT LEVER LINKAGE ADJUSTMENT," Page 11.
11. Lubrication pressure too low	1. Weak or broken back pressure valve spring or, valve stuck open	X	X	1. Clean and inspect back pressure valve. Refer to Part 6,, "HYDRAULIC SYSTEM."
	2. Plugged or restricted oil cooler	X	X	2. Service oil cooler. Any oil cooler repairs should be performed by a qualified radiator repairman.
12. Lubrication pressure too high	1. Incorrect back pressure valve spring (spring too stiff) or valve stuck closed	X	X	1. Clean and inspect back pressure spring, refer to Part 6 , "HYDRAULIC SYSTEM."
	2. Plugged or restricted hydraulic oil filters	X	X	2. Replace oil filters and/ or change hydraulic system oil.

3. PRESSURE CHECKS

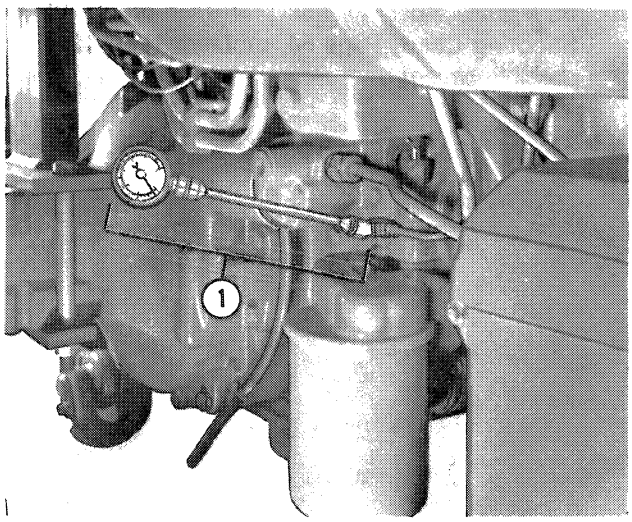

Figure 81
Dual Power Pressure Check Hook-Up
1. N-774-E Kit

DUAL POWER SYSTEM PRESSURE CHECK

System pressure for Dual Power transmissions can be checked by tapping into the 1/4" pressure line leading from the hydraulic pump cover assembly with the N-774E Select-O-Speed Gauge Kit as shown in Figure 81.

Check the pressure as follows:

1. Operate the tractor until the hydraulic system oil is at normal operating temperature (120°F.).

2. Stop the engine and connect the gauge as shown in Figure 81.

3. Start the engine and set its speed at 1000 rpm.

4. Observe the pressure gauge reading when engaging direct drive and again when engaging underdrive. The pressure gauge reading should be 150-180 psi (10.34-12.41 bar) when in direct drive and 155-185 psi (10.69-12.76 bar) when in underdrive. The difference between readings should not exceed 10 psi (.69 bar). If the readings are above or below those specified, refer to the Dual Power Trouble Shooting Chart, Page 58, for possible causes and corrective action.

   NOTE: *If the pressure gauge reading drops off during either test condition, leakage exists in the circuit.*

LUBRICATION PRESSURE CHECK

The lubrication pressure to the transmission can be checked by disconnecting the cooler outlet hose from the cooler outlet tube and connecting the gauge as shown in Figure 82. The purpose of the test is to determine if adequate pressure exists in the lubrication circuit.

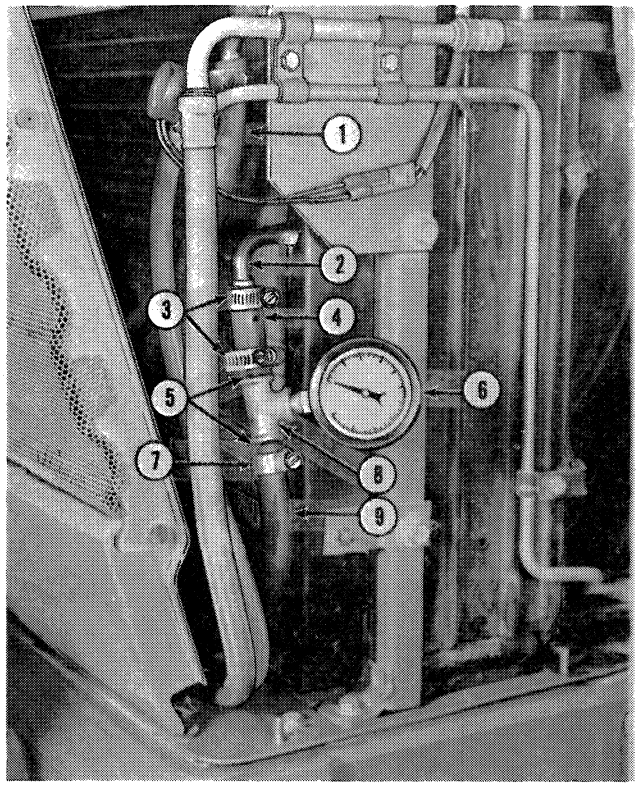

Figure 82
Lubrication Pressure Check Hook-Up
1. Cooler Inlet Hose
2. Cooler Outlet Tube
3. Hose Clamps
4. 3 inch x 1/2 inch (7.62 cm x 1.27 cm) Hose
5. 1/4 inch (.64 cm) Pipe Nipples
6. N-774-1 Pressure Gauge
7. Existing Hose Clamp
8. 1/4 inch (.64 cm) Pipe Tee
9. Cooler Outlet Hose

Perform the lubrication pressure check as follows:

1. With the tractor remote valves in neutral and the P.T.O. and differential lock disengaged, operate the tractor until the hydraulic system oil is at normal operating temperature (120°F.).

BRAKE SYSTEM TROUBLE SHOOTING CHART (CONT'D.)

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
5. Brake Pedals Gradually Go To Floor Under Constant Pressure	1. Worn piston seals, cracked piston or cracked center housing.	1. Service the brake discs, page 31.
	2. Worn or damaged seals on master cylinder pistons.	2. Service the brake master cylinder, page 34.
6. Excessive Pedal Effort	1. Brake disc worn.	1. Service the brake discs, page 31.
7. Uneven Pedal Effort	1. Air in one side of system.	1. Bleed the brakes, page 35.
	2. Brake pedal free travel incorrect.	2. Adjust pedal free travel, page 9.
	3. Warped or dished inner brake disc.	3. Service the brake discs, page 31.

POWER TAKE-OFF TROUBLE SHOOTING CHART

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
1. P.T.O. System Pressure Too High	1. Extremely cold oil in rear axle center housing.	1. Operate tractor to warm oil.
	2. Incorrect P.T.O. regulating valve spring, Figure 62, (spring too stiff) or valve stuck closed.	2. Clean and inspect valve and spring, page 40, "Control Valve Linkage Overhaul".
2. P.T.O. System Pressure Too Low	1. Rear pumping element (Piggy-Back) in hydraulic pump worn or seals missing between pump rear cover and rear body.	1. Remove, disassemble, and inspect hydraulic pump, Part 6, "Hydraulic System", Chapter 2, Section 4. Check for worn element and missing seals.

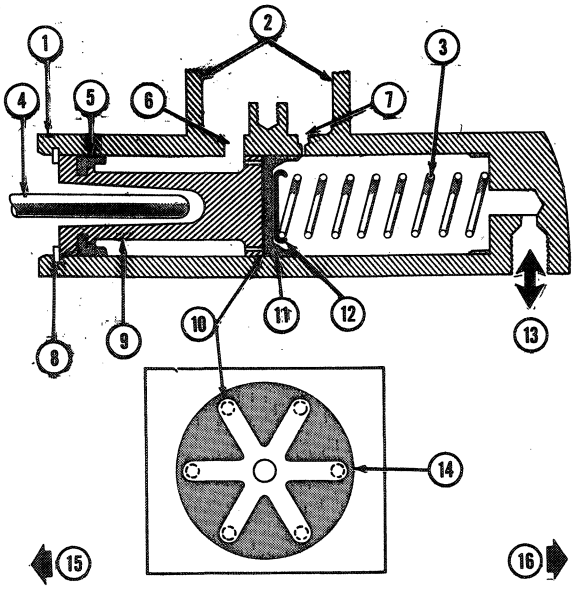

Figure 8
Brake Master Cylinder — Cut-Away View

1. Cylinder
2. Reservoir
3. Return Spring
4. Adjustment Rod
5. Rear Seal
6. Port
7. Orifice
8. Retaining Ring
9. Piston
10. Protector
11. Front Seal
12. Spring Cap
13. To and From Brakes
14. Piston and Protector
15. Rear
16. Front

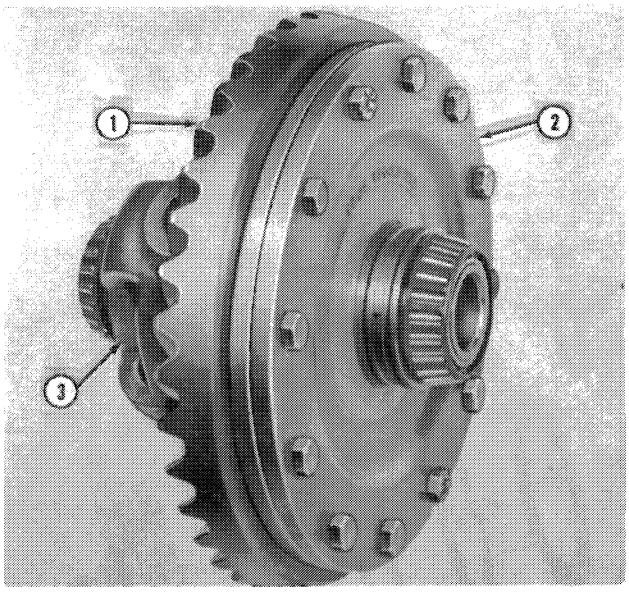

Figure 27
Differential Assembly Removed
1. Ring Gear
2. Housing Cover
3. Differential Case

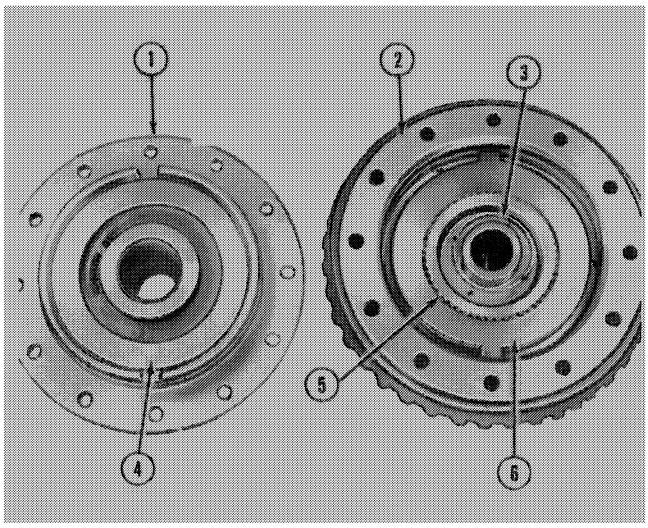

Figure 28
Differential Cover Separated From Case
1. Cover
2. Case
3. Thrust Washer
4. Differential Lock Piston
5. Right Hand Side Gear
6. External Spline Differential Lock Plates

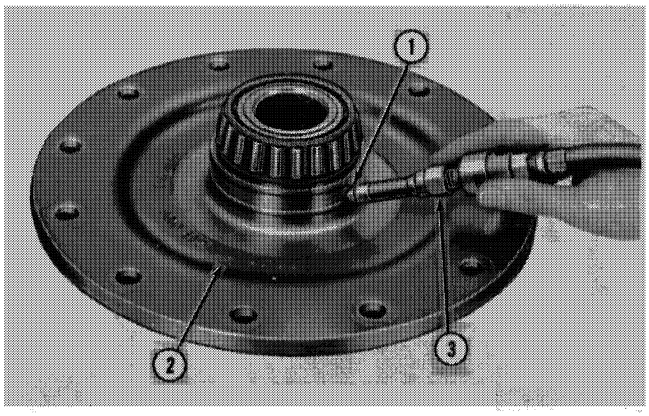

Figure 29
Removing Differential Lock Piston From Cover
1. Oil Port
2. Cover
3. Compressed Air Hose

4. The differential lock piston (4), will be held in the cover (1) and can be removed by introducting compressed air at the cover oil port (1), Figure 29.

5. Drive out the roll pin (9), Figure 30, that secures the pinion shaft (12) in the case, then remove the pinion shaft, pinion gears (4), pinion thrust washers (13), left-hand side gear (11) and thrust washer (2) from the case.

C. Inspection and Repair

1. Clean and inspect all parts for damage and excessive wear. If damage or excessive wear is present, replace the affected part with a new part on reassembly.

2. Remove the ring gear (2), Figure 31, using an arbor press (1), as shown.

   NOTE: *The ring gear is matched with the pinion. If the ring gear is to be replaced, the pinion must also be replaced. Refer to Section 4, page 28, this chapter, for pinion overhaul.*

3. Remove the right-hand and left-hand diffferential bearings (3), Figure 32, using Puller No. 927 (1), Puller No. 951 (4), and Step Plate No. 630-10 (2) as shown.

4. Install the differential bearings using Tool No. SW 507 (1), Figure 33, and arbor press (2), as shown.

6. Pull the axle housing from the tractor. Remove the brake discs.

7. Remove the brake piston (2), Figure 47, from the center housing.

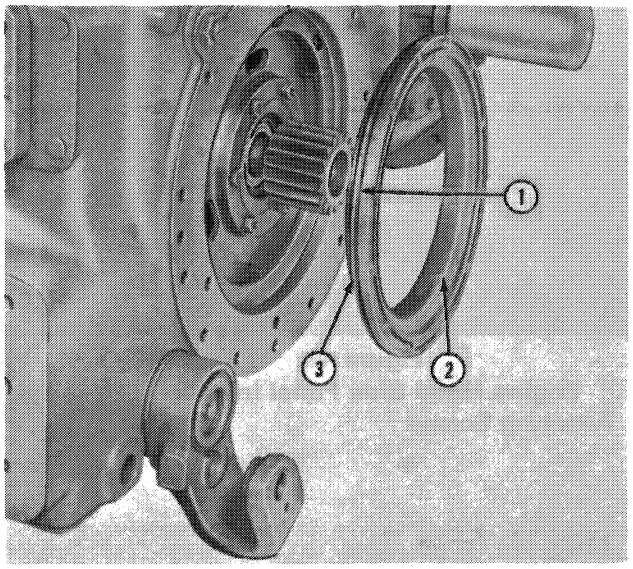

Figure 47
Brake Piston Removed

1. Outer Seal
2. Piston
3. Inner Seal

B. Inspection and Repair

1. Clean the brake discs and piston with mineral spirits, denatured alcohol, or kerosene.

   NOTE: *Use of water, steam, glycols, keytones, chlorinated solvents or aromatic hydrocarbons to clean brake discs may cause premature wear, deterioration or flaking of the friction material.*

2. Place the two outer discs together and visually check for warpage. If warped, replace.

3. Using flat outer discs, check both brake discs for warping by placing them, one at a time, between the outer discs. Clearance measured with a feeler gauge, on either side, should not exceed .010 in. (.254 mm). If it does, replace the disc.

4. If the brake disc is not warped, per the procedure in Step 3, place a straight edge over the disc and check to see that the splines are clear of the straight edge. Do this on both sides. If the splines are not clear of the straight edge on either side, replace the disc.

5. Inspect the piston for wear. Replace if necessary.

6. Check the locating pins (2), Figure 48, and notches in the outer discs for wear. If worn, replace.

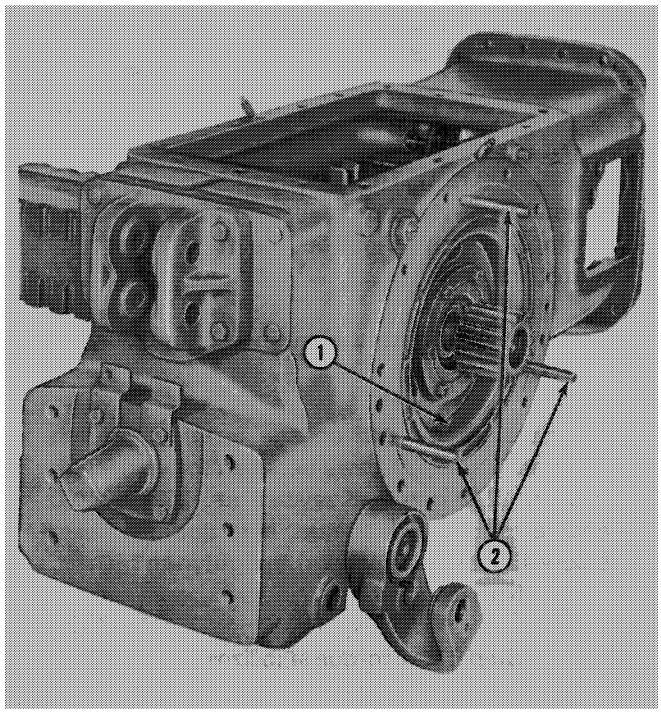

Figure 48
Brake Piston Installed

1. Piston
2. Brake Locating Pins

7. Whenever the piston is removed from the center housing, replace the inner seal (3), Figure 47, and the outer seal (1).

C. Installation

1. Install the brake piston (2), Figure 47, taking care not to damage the inner seal (3), and outer seal (1).

2. Install the locating pins (2), Figure 48, in the center housing. Then, position the inner disc (1), Figure 46, brake disc assembly (6) and outer disc (2) on the pins (5) and sun gear (4).

3. Install a new gasket on the dowel pins, then position the axle housing on the center housing, aligning the sun gear teeth with the planet gears and the pins with their holes.

3. POWER TAKE-OFF SHAFTS AND GEARS OVERHAUL

A. Removal

1. Remove the drain plug (4), Figure 64, from the center housing rear bottom cover and drain the oil from the P.T.O. gear compartment.

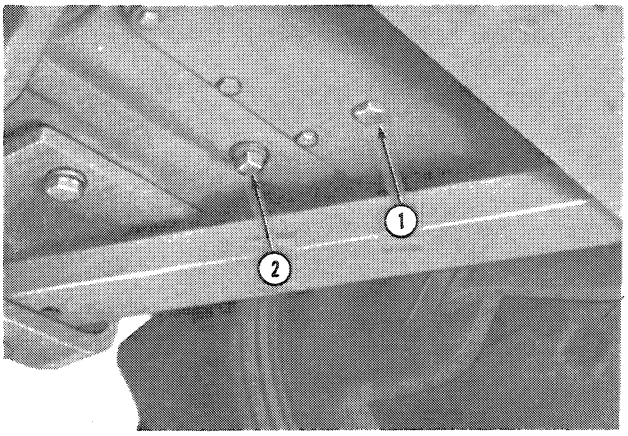

Figure 64
P.T.O. and Rear Axle Drain Plugs
1. P.T.O. Drain Plug 2. Rear Axle Drain Plug

2. Remove the four bolts that secure the upper shaft bearing retainer (1), Figure 65, then remove the retainer, gasket (5), P.T.O. drive gears (2), bearings, and the shaft (3).

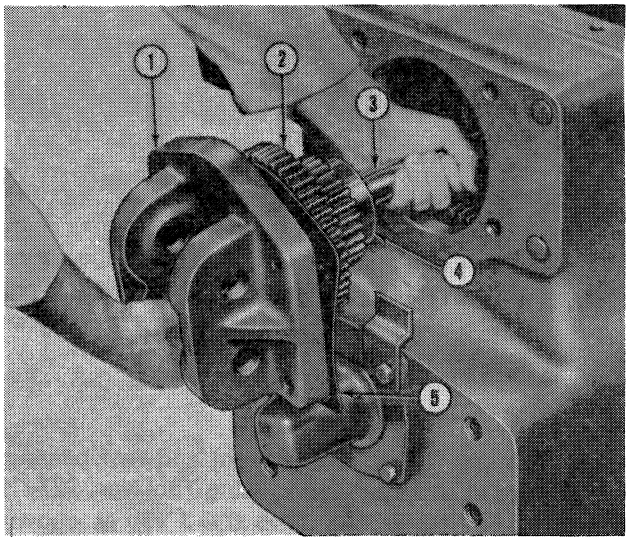

Figure 65
Removing P.T.O. Upper Shaft and Gears
1. Retainer 3. Shaft
2. Gear Assembly 4. Front Bearing
5. Gasket

3. Remove the P.T.O. output shaft cap, then remove the retaining ring (1), Figure 66. Remove the output shaft (3).

4. Remove the four bolts that secure the output shaft bearing retainer (2), then remove the bearing retainer.

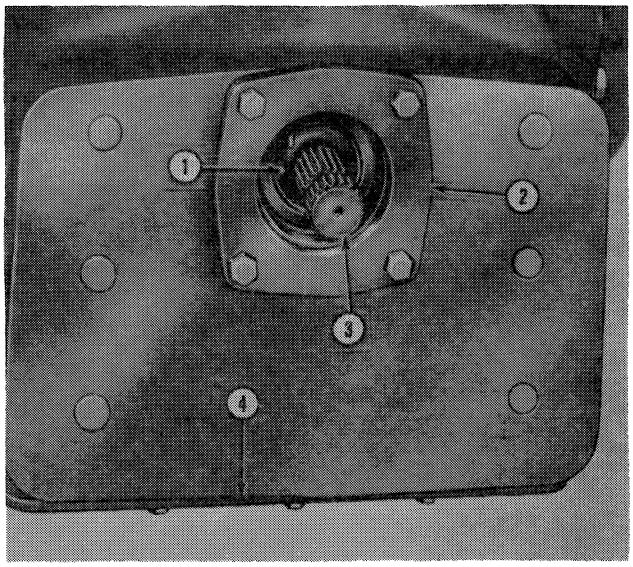

Figure 66
P.T.O. Output Shaft Installed
1. Retaining Rings
2. Bearing Retainer
3. Output Shaft
4. Rear Bottom Cover

5. Remove the bolts that secure the rear bottom cover (3), Figure 67, to the center housing, then remove the cover and gasket.

6. Hold the P.T.O. output shaft driven gears in position, and remove the output shaft sleeve (2), bearing (1), and seal.

7. Remove the driven gears (1 and 2), Figure 68, through the bottom of the center housing. Figure 69 shows the P.T.O. shafts (4 and 5), gears and sleeve (7) removed and in relative position.

Part 6
HYDRAULIC SYSTEM

Chapter 1
HYDRAULIC SYSTEM AND REMOTE CONTROL VALVE OPERATION, AND PRESSURE CHECKS

1. HYDRAULIC SYSTEM — OPERATION

Figures 1, 2, and 3 illustrate the hydraulic system oil flow under three different conditions, i.e. "NEUTRAL", "LIFTING," and "LOWERING". For simplicity, these schematics show the hydraulic system without remote control valves. The valves, when used, have first priority to the oil flow. Therefore, they are mounted on top of the hydraulic pump cover (4) and under the manifold (2).

The key to the operation of the hydraulic lift system is the spring-loaded pilot controlled flow control valve (3) used in conjunction with the main control valve (8) and the pilot pressure tube (10). The operation of these components are explained under each different condition.

To protect the system from shock loads, caused by bouncing implements, a safety valve (1) is used to relieve pressures above 2750 psi (189.5 bar) in the lift cylinder.

NEUTRAL

Figure 1 shows the hydraulic system oil flow in "NEUTRAL". The control valve (8) is positioned so that it shuts off supply pressure to the pilot pressure tube (10). At the same time, the check valve (7) stops oil flow to the cylinder. However, the pilot pressure tube is open at the control valve to allow trapped oil to return to sump. An orifice in the flow control valve causes a large pressure differential at the flow control valve, allowing the supply pressure to slide the flow control valve spool to the right against spring pressure. The flow control valve has now opened the supply pressure passage to sump.

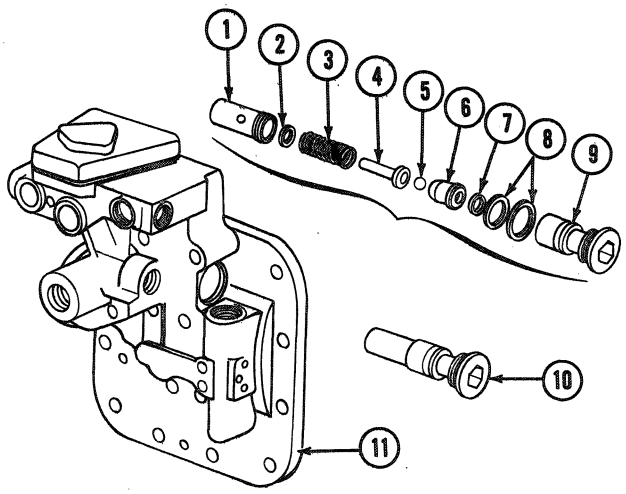

Figure 11
Hydraulic System Relief Valve

1. Relief Valve Cap
2. Shims
3. Spring
4. Retainer
5. Ball
6. Seat
7. Seal
8. O-rings
9. Relief Valve Body
10. Relief Valve Assembly
11. Hydraulic Pump Cover Assembly

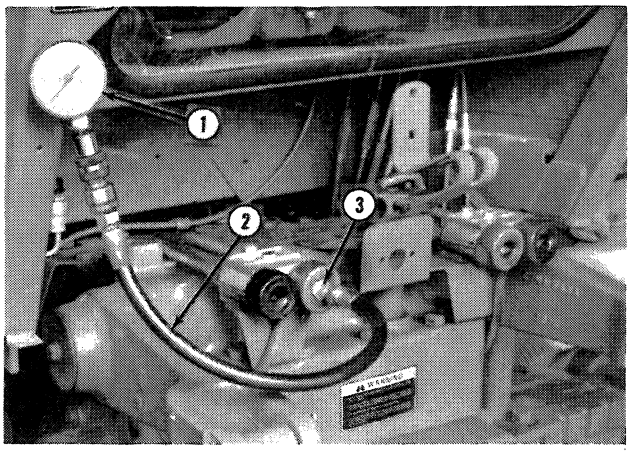

Figure 12
System Relief Valve Pressure Check

1. Tool No. D-22
2. Tool No. D-19-HP
3. Tool No. D-8F

SHIMMING SYSTEM RELIEF VALVE

If the system relief valve pressure, as recorded in the preceding test, was not to specification, the system relief valve must be removed from the tractor and shims added or removed. If the pressure reading is BELOW 2450 psi (168.8 bar), add shims (2), Figure 11, if the pressure reading was ABOVE 2550 psi (175.7 bar), remove shims. Every 0.010 inch (.254 mm) change in shim thickness will change the system pressure approximately 100 psi (6.90 bar).

NOTE: *Maximum permissible shim thickness is 0.080 inch (2.032 mm). If system relief pressure cannot be obtained with 0.080 inch (2.032 mm) shims installed, the hydraulic pump or safety valve is at fault. Refer to Page 32, for pump removal, disassembly, inspection and repair, and installation procedures. Refer to "Lift Cylinder and Control Valve Assembly" on Page 20, for safety valve removal, disassembly, and inspection and repair procedures.*

1. With a suitable solvent, clean the area around the relief valve on the hydraulic pump cover assembly to prevent dirt from entering the hydraulic system when removing the valve. Blow dry with compressed air.

2. Disconnect the differential lock pedal shank from the actuating rod by removing the cotter pin. Unscrew the differential lock actuator rod guide cap to gain access to the relief valve. Unscrew the relief valve assembly (10), Figure 11, from the hydraulic pump cover assembly (11).

3. Disassemble the valve by unscrewing the relief valve cap (1), Figure 11, from the body (9).

4. Add or remove shims (2), as required, to obtain the specified pressure. Every 0.010 inch (.254 mm) change in shim thickness will affect system pressure approximately 100 psi (6.90 bar). Maximum permissible shim thickness is 0.080 inch (2.032 mm).

5. Refer to the exploded view, Figure 11, and assemble the valve. Install a new O-ring on the valve body (9). Screw the valve into the cover and tighten securely.

6. Install the differentail lock guide cap and connect the actuator to the shank with a new cotter pin.

7. Re-check the system pressure.

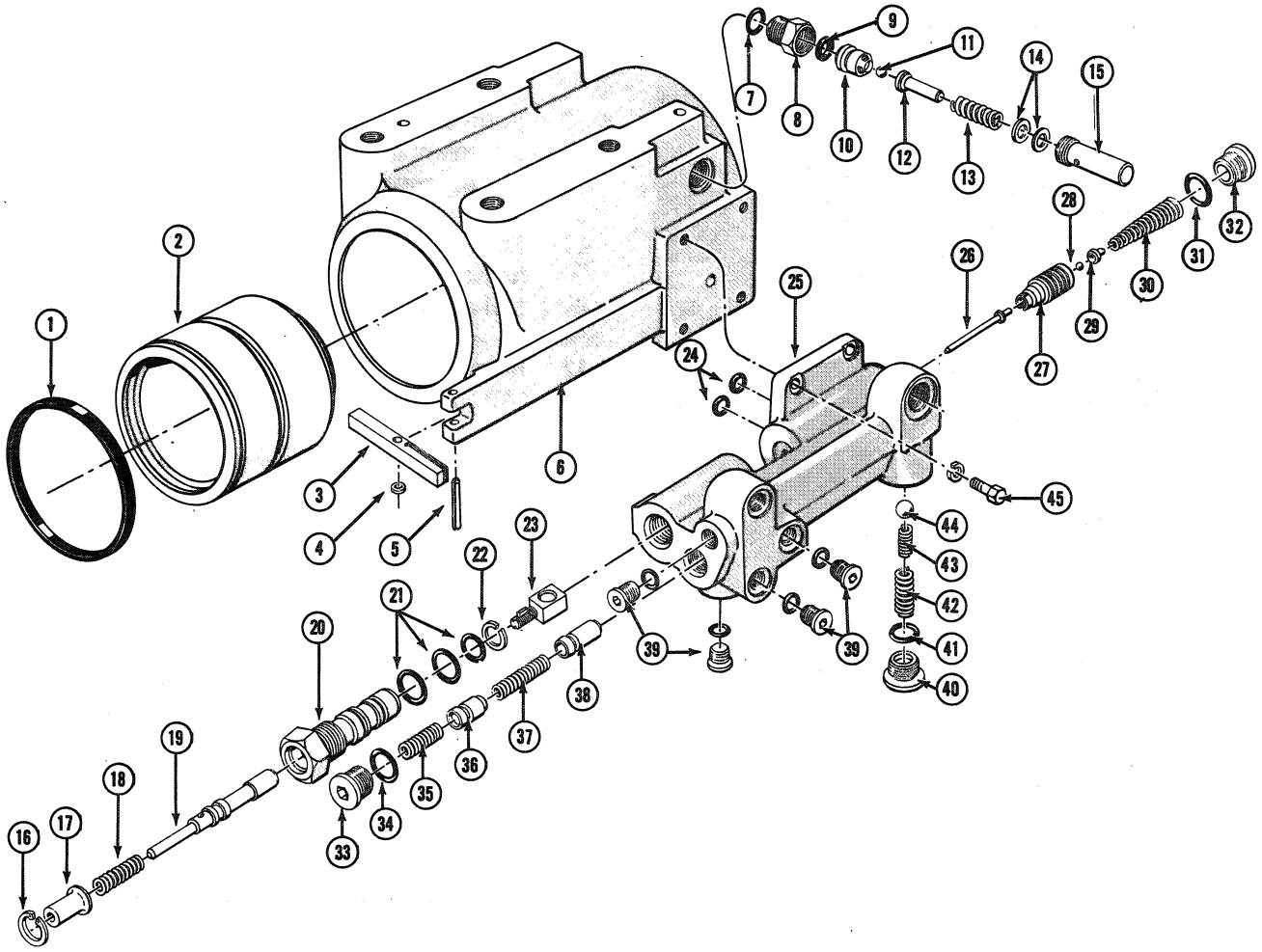

Figure 27
Hydraulic Lift Cylinder and Control Valve Assembly

1. Lift Piston Seal
2. Lift Piston
3. Lift Shut-Off Pivot
4. Washer
5. Roll Pin
6. Lift Cylinder
7. O-Ring
8. Safety Valve Body
9. Safety Valve Seal
10. Safety Valve Seat
11. Ball
12. Ball Retainer
13. Spring
14. Shims
15. Safety Valve Cap
16. Spring Seat Retainer
17. Spring Seat
18. Spring
19. Lift Control Valve
20. Lift Control Valve Bushing
21. O-Rings
22. Backup Ring
23. Control Valve Keeper
24. O-Rings
25. Control Valve Body
26. Lift Drop Poppet Actuator
27. Lift Drop Poppet
28. Ball
29. Ball Seat
30. Poppet Spring
31. O-Ring
32. Poppet Valve Plug
33. Exhaust Valve Plug
34. O-Ring
35. Exhaust Valve Pressure Spring
36. Exhaust Pressure Valve
37. Exhaust Valve Control Spring
38. Exhaust Control Valve
39. Plugs and O-Rings
40. Lift Check Plug
41. O-Ring
42. Lift Check Ball Guide (Spring Type)
43. Check Ball Spring
44. Check Ball
45. Hex Head Bolt and Lock Washer

3. Position the lift cylinder on blocks as shown in Figure 28. Push the piston (3) from the cylinder with compressed air.

CAUTION: *Very little pressure will push the piston from the cylinder. Do not use a sudden blast of air.*

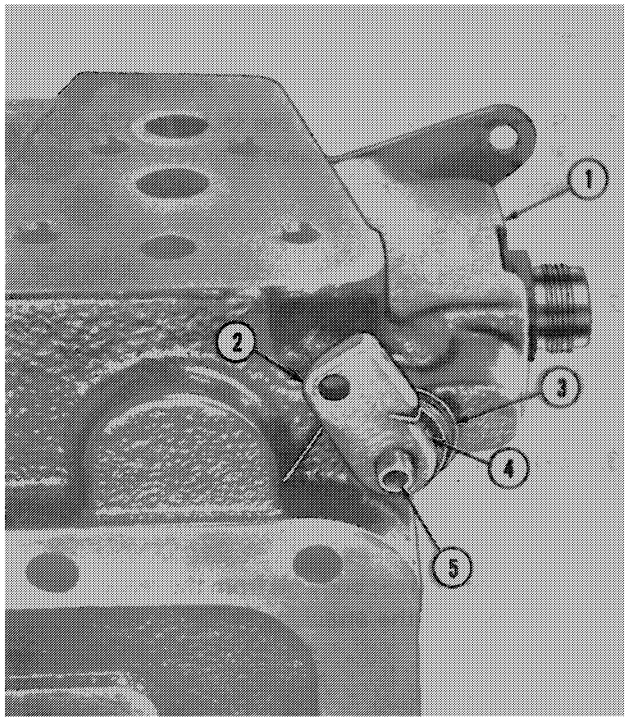

Figure 38
Variable Flow Override Spring
— Rear View

1. Pump Cover
2. Arm
3. Override Spring
4. Roll Pin
5. Variable Flow Valve

10. Place the control valve override spring (3), Figure 38, and arm (2) over the end of the variable flow control valve as shown and secure with the roll pin (4).

11. Place the check ball guide (4), Figure 37, in the cooler backpressure valve hole. Install the ball (2) in the guide. Insert the check valve spring (3) in the guide and install the retainer (6) with the O-ring (5).

12. Install all remaining plugs and O-rings.

E. Installation

1. Attach the hydraulic pump to the hydraulic pump cover assembly by installing the four attaching bolts. Be sure new seals are installed between the pump and cover. Tighten the attaching bolts to 20-25 lbs. ft. (27.1-33.9 Nm).

2. Remove all old gasket material from the mating surface of the hydraulic pump cover assembly and install a new gasket.

3. Position the assembly on the side of the center housing so the inlet hole in the pump fits over the inlet tube in the center housing, and so the dowels in the cover enter their mating holes in the housing. Install one or two attaching bolts to hold the cover in place.

IMPORTANT: *If the inlet tube attaching bracket was moved from its original position, remove the hydraulic pump from the cover assembly. Place the pump over the inlet tube in the center housing, then bolt the cover assembly to the pump and housing. Failure to make sure the inlet tube enters the pump inlet hole can result in severe pump damage due to cavitation.*

Also, make sure that the seals between the pump and cover remain in place. Use grease to hold them in place.

4. Install the remaining attaching bolts. Do not tighten the bolts until after the system pressure tube, (4), Figure 31, is installed.

5. Connect the override rod (3), Figure 31, and spring to the override lever.

6. Connect the flow control rod to the flow control lever.

7. Install the system pressure tube (4), Figure 31, and pilot pressure tube (1). Tighten the pilot pressure tube fittings to 20-25 lbs. ft. (27.1-33.9 Nm). Tighten the system pressure tube fitting at the lift cover to 20-25 lbs. ft. (27.1-33.9 Nm). Tighten the other end at the hydraulic pump cover to 50-55 lbs. ft. (67.8-74.6 Nm).

8. Tighten the hydraulic pump cover attaching bolts to 30-40 lbs. ft. (40.6-54.2 Nm).

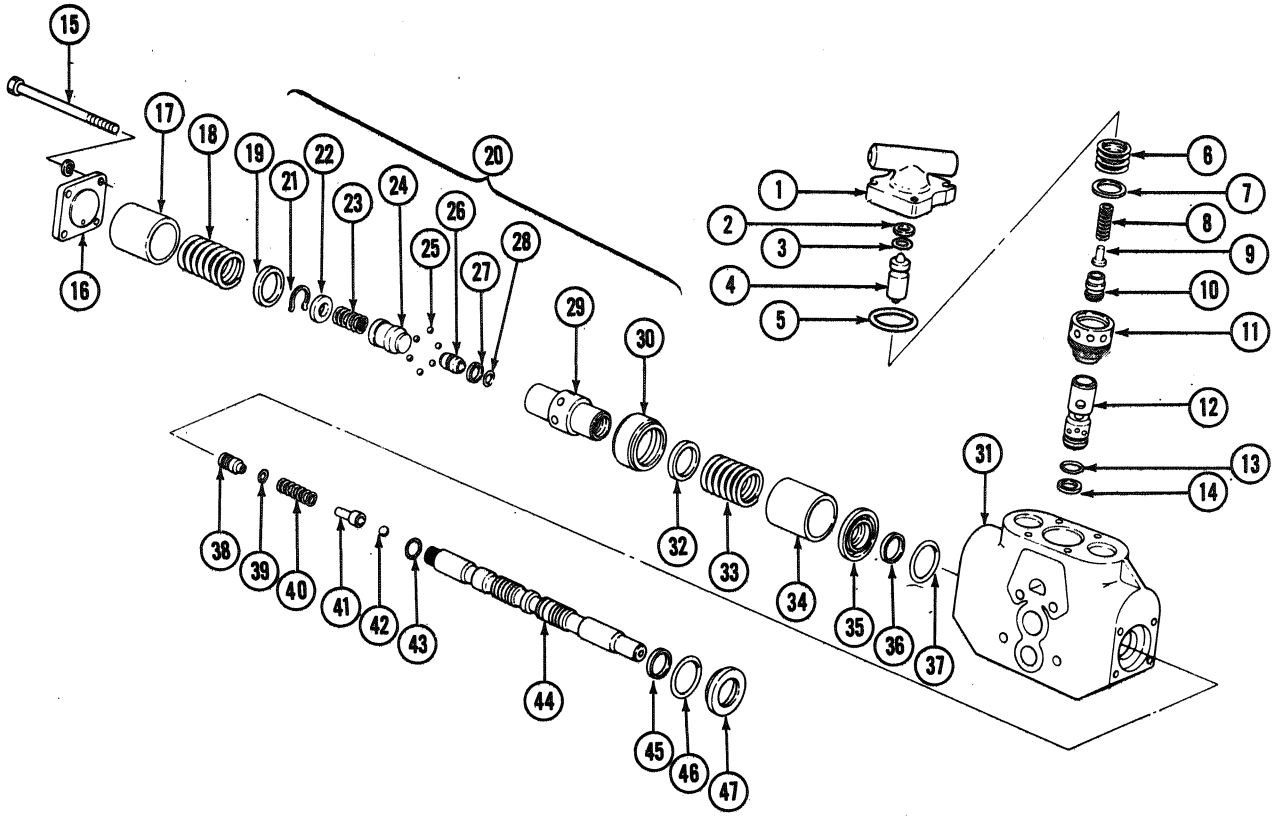

Figure 54
Remote Control Valve — Exploded View

1. Flow Control Actuator Housing
2. Back-up Ring
3. O-ring
4. Flow Control Poppet
5. O-ring
6. Flow Valve Spring
7. Washer
8. Flow Relief Spring
9. Relief Poppet
10. Flow Piston
11. Flow Sleeve
12. Flow Guide
13. O-ring
14. Back-up Washer
15. Bolt (4)
16. End Cap
17. Sleeve
18. Centering Spring
19. Stop
20. Detent Guide
21. Snap Ring
22. Detent Spacer
23. Detent Spring
24. Detent Piston
25. Detent Balls
26. Piston End
27. Back-up Ring
28. O-ring
29. Detent Guide
30. Detent Ring
31. Valve Body
32. Stop
33. Centering Spring
34. Sleeve
35. Valve Plate
36. Quad Ring
37. O-ring
38. Adjusting Screw
39. O-ring
40. Relief Spring
41. Seat
42. Check Ball
43. O-ring
44. Spool
45. Quad Ring
46. O-ring
47. Valve Plate

1. Clean all parts thoroughly with a suitable solvent.

2. Check the flow valve spring (6), Figure 54, the flow poppet spring (8), the centering springs (18 and 33), the detent spring (23) and the relief spring (40) for "set" by comparing them with new springs. Install new springs where necessary. If the relief spring (40) is replaced it will be necessary to perform the "Remote Control Valve Pressure Check", **page 12,** when the valve is reassembled and installed on the tractor.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
2. Failure to lift under load (Continued)	6. Clogged oil inlet filter and faulty by-pass valve	6. Change oil filter and check by-pass valve.
	7. Exhaust pressure valve (36), Figure 27, sticking	7. Clean and inspect the valve, page 22.
	8. Faulty safety valve, Parts (7) thru (15), Figure 27.	8. Clean and inspect the valve, page 22.
3. Occasional failure to lift (not due to overloading)	1. Lift control valve out of adjustment	1. Adjust the valve, page 44.
	2. Exhaust pressure valve (36), Figure 27, installed backwards or sticking	2. Make sure valve is installed shallow end first, page 23, Step 9. Clean and inspect the valve, page 22.
4. Excessive lift corrections	1. Safety valve leakage. Parts 7 thru 15, Figure 27.	1. Check valve for damaged valve seat or cut or missing O-rings, page 22.
	2. Damaged or missing O-rings between lift cylinder (6), Figure 27, and control valve body (25) or damaged lift piston seal (1)	2. Check for cut or missing O-rings and for a damaged seal, page 22.
	3. Lift drop poppet, ball, or seat leaking (27), (28), (29), Figure 27.	3. Check the parts for wear or damage, page 22.
5. Slow lift response	1. Hydraulic lift control lever linkage incorrectly adjusted	1. Adjust linkage, page 44.
	2. Lift control valve out of adjustment	2. Adjust the valve, page 44.
	3. Variable flow control valve, Figure 33, stuck in slow lift position	3. Check for correct hydraulic lift control lever linkage adjustment, page 44.
	4. Exhaust pressure valve (36), Figure 27, installed backwards or sticking	4. Make sure valve is installed shallow end first, page 23, Step 9. Clean and inspect the valve, page 22.

1. Motor and Tilt Mechanism
2. Hose Assembly — Motor to Pump
3. Hose Assembly — Motor to Cylinder
4. "O"-Ring
5. Pump Return Tube
6. Hose
7. Clamp
8. Pump Pressure Tube
9. Elbow
10. "O"-Ring
11. Left Turn Upper Tube
12. Right Turn Tube
13. Frame Member
14. Clamp
15. Bolt
16. Nut
17. Pump and Reservoir
18. Pump Mounting Bolt
19. Washer
20. Rear Tube Clamp
21. Union
22. Cylinder Tube
23. Bolt
24. Washer
24a. "O"-Ring
25. Right Turn Hose
26. Left Turn Hose
27. Elbow
28. "O"-Ring
29. Hose Support
30. Strap
31. Tube Adapter
32. "O"-Ring
33. Cylinder Assembly
34. Front Axle Support
35. Shim
36. Bolt (Support to Oil Pan)
37. Bolt (Engine to Support)
38. Nut

The lower end of the input shaft (18) is splined to engage and drive the drive ring (20). The drive ring (20) is externally splined to engage and drive the spool (25A). The drive ring (20) splines are wider than the input shaft (18) splines allowing a pre-determined amount of free play. This provides a mechanical link between the shaft (18) and spool (25A) for manual steering in event of pump failure, and limits the amount of twist on the torsion bar (22).

A helical groove is machined in the side of the input shaft (18). The actuating ball (24) is held captive between the helical groove and a pocket inside the spool.

When the steering wheel is turned, the torsion bar (22) is held stationary by the pressure of the oil in the metering section. As the wheel is turned the torsion bar (5) twists and the spool (25A) is moved up or down, uncovering oil ports leading to the metering system.

Metering System

The metering system 32-40, Figure 2, meters oil to the steering cylinders, thus maintaining the relationship between the steering wheel and the steered front wheels. In addition, the metering system acts as a manually operated hydraulic pump in the event the power steering pump fails.

3. COMPONENT OVERHAUL

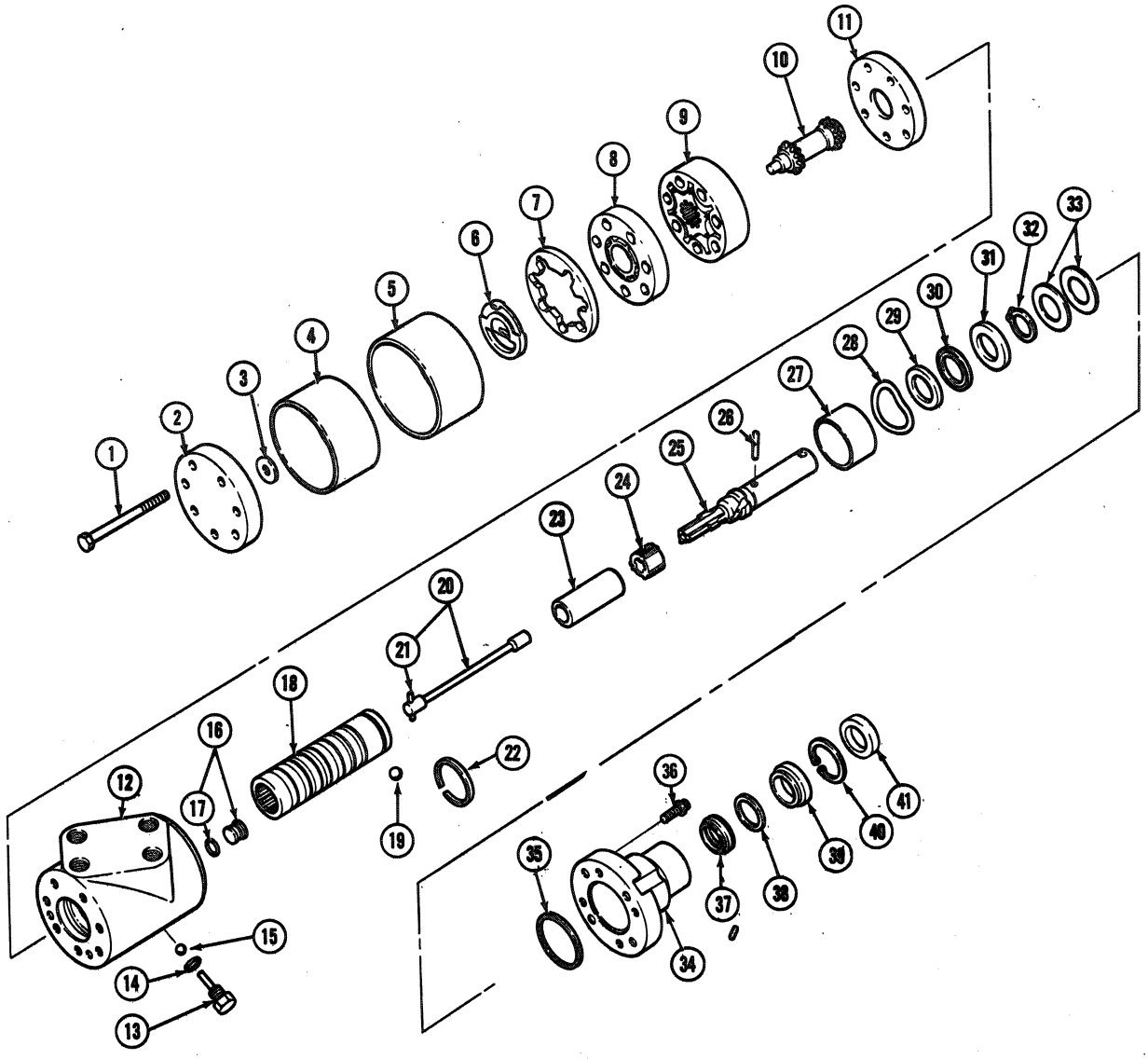

Figure 13
Steering Motor

1. Bolt
2. End Cover
3. Washer
4. Rotor Seal
5. Seal Retainer
6. Commutator
7. Commutator Ring
8. Manifold
9. Metering Element
10. Drive Link
11. Spacer
12. Housing
13. Plug
14. "O"-Ring
15. Steel Ball
16. Plug and "O"-Ring
17. "O"-Ring
18. Valve Spool
19. Steel Ball
20. Torsion Bar
21. Pin
22. Spool Spring
23. Spacer
24. Drive Ring
25. Input Shaft
26. Pin
27. Spacer
28. Spring Washer
29. Thrust Washer
30. Valve Thrust Bearing
31. Thrust Washer
32. Snap Ring
33. Shims
34. Upper Cover Assembly
35. Seal
36. Screw
37. Cover Assembly
38. Packing Seal
39. Seal Ring
40. Snap Ring
41. Dust Seal

1. Tab Washer
2. Main Drive Gear
3. "O"-Ring (Pump to Engine)
4. Snap Ring
5. Gear Seal
6. Pump Flange
7. Inner Seal
8. Outer Seal
9. Bearing/Bushing
10. Pump Body
11. "O"-Ring
12. Bearing/Bushing
13. Relief Plug
14. Seal
15. Shim
16. Spring
17. Relief Valve
18. Seal Ring
19. Pump Gears
20. Cover Seal
21. Flow Control Plug
22. Seal
23. Pump Cover
24. Washer
25. Seal
26. Pump Spool
27. Spring
28. Seal(2)
29. Flow Control Plug
29A. Flow Control Valve Assembly
30. Spacer
31. Pump Bolt
32. Filter
33. Retaining Ring
34. Vent Spring
35. Vent Valve
36. Seal
37. Cap
38. Seal Ring
39. Reservoir Bolt
40. Reservoir

POWER STEERING PUMP AND RESERVOIR (See Figure 27)

A. Disassembly

1. Remove the reservoir bolt and reservoir (39, 40), filter (32) and O-Ring (11).
2. Straighten the tab on the drive gear lock washer (1), remove the nut, washer and drive gear (2).
3. Remove the four thrubolts and pump cover (6).
4. Remove the Woodruff key from the pump shaft and remove the pump body (10).
5. Remove the bearing/bushing assemblies (9, 12) and the gear set (19) from the pump body (10) as an assembly.
6. Remove the pressure relief valve, (13 thru 18).
7. Remove the flow control valves (21 and 29A).
8. Remove the drive gear seal snap ring (4) and the drive gear seal (5) from the pump flange (6).

B. Cleaning, Inspection and Repair

1. Clean all parts in a suitable solvent and air dry. Lightly oil machine surfaces. Keep disassembled parts in position to facilitate assembly.
2. Inspect the bearing and bushing assemblies (9 and 12) for signs of seizure or scoring on the face of the bushings. Remove light scoring marks on the journals by lapping with "O" grade emery paper and kerosene.
3. Examine the gear track in the pump body for wear. If the track is deeper than .0025 in. (.0635 mm) on the inlet side, replace the pump body.
4. Examine the gear set for excessive wear or damage to journals, gear faces and teeth. Run-out across the gear face to the tooth edge should not exceed .001 in. (.025 mm). Shaft journals can be polished lightly with "O" grade emery paper to remove wear marks. Gear faces may be polished by sandwiching the emery paper between the gear face and a scrap bearing block, then rotating the gear. When new gears are fitted, the journals on both sides of each gear must be within .001 in. (.025 mm) in diameter. The gears are supplied in matched sets.
5. Replace all seals and O-Rings when servicing the pump.

C. Assembly

1. Insert a new drive shaft seal (5) in the pump flange (6) and replace the snap ring (4).
2. Install the pressure relief valve (13-17). Torque to 30-40 lbs. ft. (40.6-54.2 Nm).

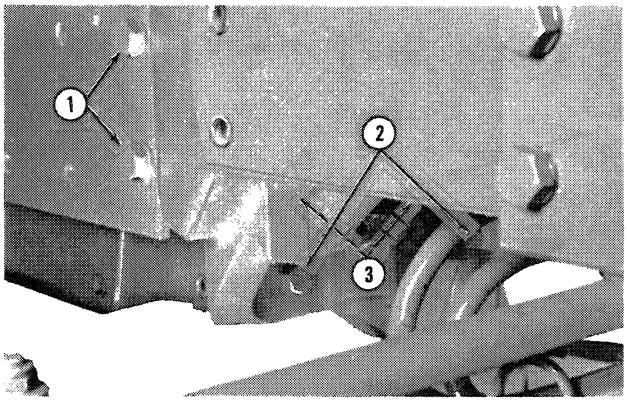

Figure 41
Front Axle Support
1. Side Frame to Front Axle Support Bolts
2. Front Axle Support to Oil Pan Bolts
3. Engine to Front Axle Support Bolts (Not Visible)

B. Installation

1. Attach a chain hoist to the front axle support and front axle. Move the unit to the tractor.

2. If the original front axle support, oil pan, and cylinder block is installed, replace the shims between the support and the oil pan, the support to oil pan bolts, and the engine to front support bolts. Torque the bolts to 270-330 lbs. ft. (365.8-447.1 Nm). See Figures 40 and 41.

NOTE: *If a new front axle support, oil pan or cylinder block is installed, reshim between the support and the oil pan as described below.*

3. Remove the floor stand.

4. Replace the radiator, oil cooler lines and refrigerant lines, if so equipped.

5. Replace the coolant, refrigerant (if so equipped), the air cleaner assembly and the tractor sheet metal.

C. Shimming Procedure

1. Tighten the front axle support to engine bolts to 180-220 lbs. ft. (243.9-298.1 Nm).

2. Jack up the tractor under the transmission until the front wheels clear the floor.

3. Tighten the oil pan to transmission bolts to 180-220 lbs. ft. (243.9-298.1 Nm).

4. Using a feeler gauge, determine the gap between the front axle support and the oil pan, Figure 37. Remove the support to oil pan bolts.

5. Install shims equal in thickness to the width of the gap. Install the bolts and torque to 270-330 lbs. ft. (365.8-447.1 Nm). See "Specifications" for a list of shims available.

5. FRONT AXLE CONVERSION

The long wheel base tractor can be converted to a short wheel base tractor by turning around the front axle center assembly. The change requires new right and left spindle arms, steering arm sleeve, and cylinder anchor. See Figure 33.

Conversion

1. Jack up the front of the tractor until the front wheels clear the floor.

2. Remove the steering cylinder, rod end and anchor.

3. Remove the tie rod.

4. Remove both spindle arms and remove the wheels and spindle from the center axle. Remove the right and left axle assemblies.

5. Support the axle assembly with a jack, remove the front axle support and the front axle assembly from the tractor.

6. Reverse the center axle assembly and replace the front axle support, Figure 42.

TREAD RANGE*	WEIGHTS					
	TOTAL VEHICLE**		REAR AXLE ONLY			
			No Implement or Implement Lowered		Implement Raised	
	(Lbs.)	(KG)	(Lbs.)	(KG)	(Lbs.)	(KG)
8700						
80" (2032 mm) or less	15,000	6804	12,000	5443	15,000	6804
94" (2388 mm) or less	14,800	6713	11,800	5352	14,000	6350
102" (2591 mm) or less	14,500	6577	11,600	5262	13,000	5897
120" (3048 mm) or less	13,000	5897	10,200	4627	11,000	4990
9700						
80" (2032 mm) or less	18,000	8165	14,500	6577	15,000	6804
94" (2388 mm) or less	17,500	7938	14,000	6350	14,000	6350
102" (2591 mm) or less	16,500	7484	13,000	5897	13,000	5897
120" (3048 mm) or less	14,500	6577	11,000	4990	11,000	4990

*Applies to both Single and Dual Rear Wheels. Use the mean tread setting of duals.

**Includes all weights, liquid ballast, front end loader, filled accessory tanks (sprayer, etc.) that may be installed. Does not include implements.

Figure 55
Tread Range

When using front mounted equipment, add weight to the rear axle until the rear axle does not come off the ground and the tractor feels stable.

CAUTION: *If proper stability cannot be obtained within the weighting limitations below, reduce the load on the tractor until stability is obtained.*

NOTE: *Do not exceed the tire load and inflation specifications in the Tire Inflation vs. Permissible Load Chart. See Figure 59.*

Weighting Limitations

Figure 55 shows maximum weights at various tread widths. Do not load the vehicle in excess of these weights. Determine the weight by placing each axle on a scale, then place the total vehicle on a scale.

NOTE: *Use maximum weighting only when necessary. Use only the amount of ballast or weight needed. This will reduce fuel consumption, ground compaction and tractor wear.*

CAST IRON WEIGHTS

Cast iron weights are available as accessories. Weights can be mounted on the front wheels, on the front of the tractor or on the rear wheels. See Figures 56 and 57 for rear wheel weights.

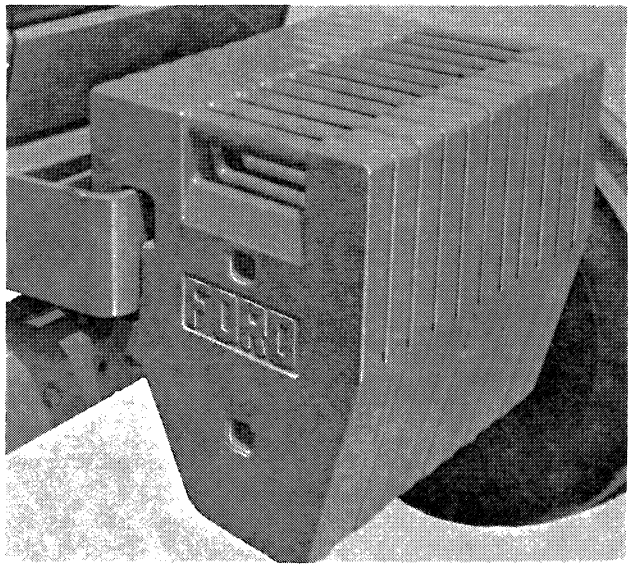

Figure 56
Front End Weights

Part 8
AIR CONDITIONING AND HEATING

Chapter 1
AIR CONDITIONING

Chapter 2
HEATING

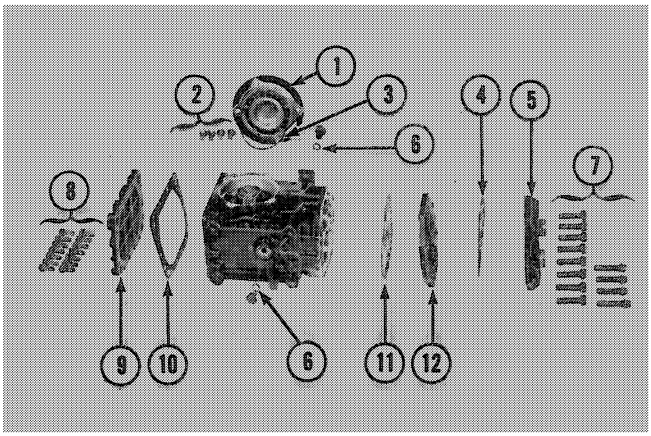

Figure 18
Compressor Gasket Kit Installation

1. Back Plate
2. Screws
3. Back Plate O-Ring
4. Metal Gasket
5. Compressor Head
6. Oil Plug O-Ring
7. Cap Screws
8. Cap Screws
9. Base Plate
10. Base Plate Gasket
11. Paper Gasket
12. Valve Plate

2. Drain the oil from the compressor crankcase.

3. Remove the four screws from the back plate and carefully pry the back plate from the compressor housing and rear bearing.

4. Remove the back plate O-ring and install a new O-ring.

5. Apply compressor oil to the back plate O-ring and bearing cup. Also apply oil to the bearing race and the compressor back plate mating surface.

6. Install the back plate and secure with the four screws. Be careful to align the rear bearing with the bearing cup in the back plate. Tap into place. Torque the back plate screws to 9-17 lbs. ft. (12.2-23.0 Nm). (See Chapter 3 for tightening sequence.)

H. Base Plate Gasket Removal and Installation

1. Drain the oil from the compressor crankcase.

2. Remove the fourteen cap screws securing the base plate, Figure 18. Be careful not to damage the machined gasket surface when removing the base plate.

3. Clean the compressor and base plate machined surfaces.

4. Apply oil to both machined surfaces and to the new base plate gasket.

5. Install the gasket and base plate and secure with the cap screws. Torque the base plate cap screws to 12-18 lbs. ft. (16.3-24.4 Nm). See Chapter 3 for tightening sequence.

6. Refill the compressor crankcase with 12 oz. (0.35 l) of compressor oil.

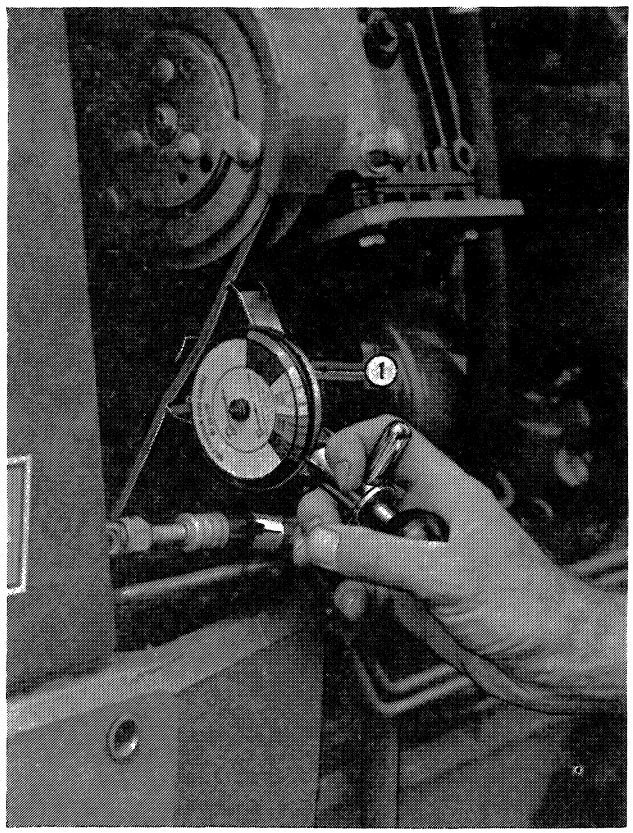

Figure 19
Belt Tension

1. Gauge

3. SERVICE AND MAINTENANCE PROCEDURES

Normal servicing of the heating system is not required with the possible exception of the engine thermostat. Refer to the Engine Section of this manual for thermostat location and replacement.

4. SERVICING THE HEATING SYSTEM

Coolant Shut-Off Valve

A. Removal

1. Shut off both coolant shut-off valves, Figure 28.
2. Remove the hose clamps and hoses from the coolant shut-off valves, and drain coolant into a suitable container, Figure 28.
3. Remove the coolant shut-off valves and replace.

B. Installation

1. Apply pipe thread cement to the coolant shut-off valve's threads and install.
2. Connect the hoses to the valves using hose clamps. (Open valve)
3. Fill the radiator to the required level and start the engine.
4. Turn the heater control valve on at the switch panel and test for heat when the engine reaches operating temperature.

Heater Control Valve

A. Removal

1. Shut off both coolant shut-off valves, remove the hose clamps and hoses from the control valve and drain coolant into a suitable container, Figure 30.
2. Remove all control knobs, Figure 27.
3. Remove attaching screws and control panel facing.
4. Remove cab cover's five retaining bolts.

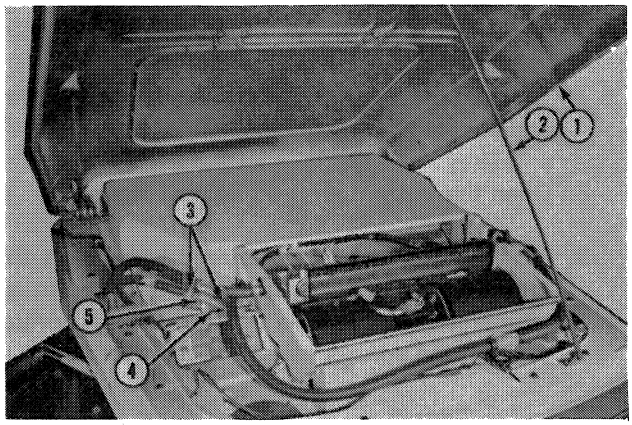

Figure 30
Heater Control Valve Removal

1. Cab Cover
2. Support Rod
3. Hoses and Clamps
4. Attaching Screws
5. Heater Control Valve

5. Lift the cab cover and insert the support rod, Figure 30.
6. Cover radio, if so equipped, to prevent coolant from accidentally spilling into it.
7. Remove the two hose clamps, hoses and cap the, Figure 30.
8. Remove the attaching screws that hold the control valve to the inner roof, Figure 30.
9. Remove control valve, Figure 30.
10. Check the valve for foreign material and proper operation. If necessary, replace the valve.

B. Installation

1. Install the control valve and secure it to the inner roof, Figure 30.

Part 9
COMPONENT REMOVAL

Chapter 1
REMOVING AND INSTALLING PROCEDURES

Chapter 2
SPECIAL TOOLS

3. Disconnect the hydraulic oil cooler tubes, Figure 19.

4. Remove the right hand frame member, Figure 19.

5. Disconnect the following from the top of the saddle fuel tank; (a) main fuel hose, (b) return fuel inlet hose, (c) fuel outlet hose, and (d) fuel gauge sender wire.

6. If the tank is full, drain the fuel for ease of handling.

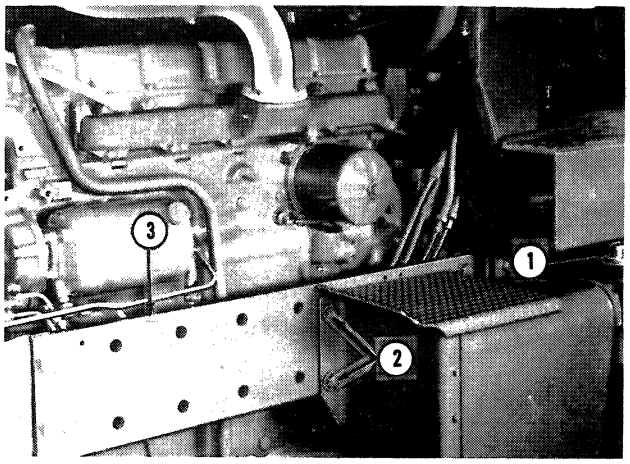

Figure 20
Removing Fuel Tank
1. Fuel Hoses and Sender Wire
2. Saddle Tank Front Support Bolts
3. LH Frame Member

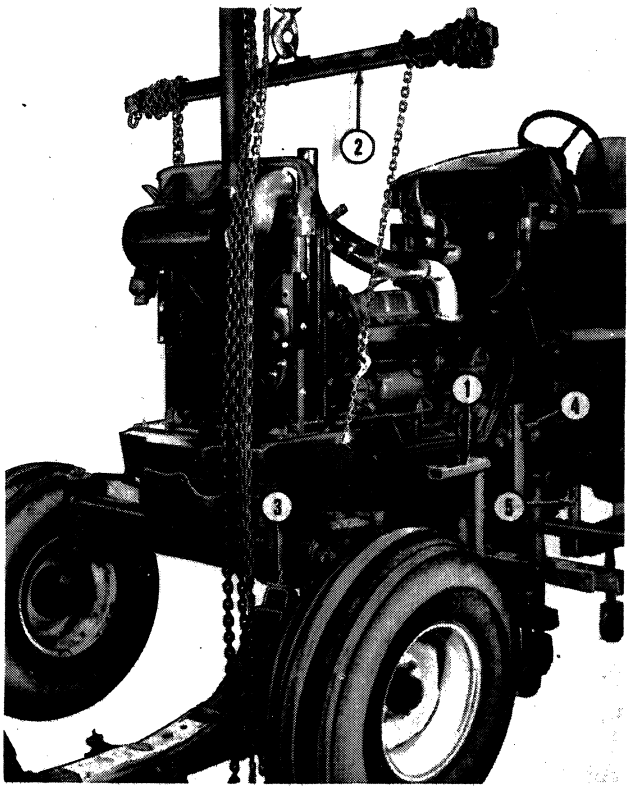

Figure 21
Removing Tractor Front End
1. Engine Section, Tractor Splitting Stand
2. Front End Support
3. Floor Jack
4. Transmission Section, Tractor Splitting Stand
5. Rear End Section, Tractor Splitting Stand
6. Wedges

7. Remove the saddle tank front support bolts, the rear support pin and remove the tank, Figure 20.

8. Remove the left hand frame member, Figure 20. Remember to remove the tube clamp attached to the inner side of the frame member.

9. Support the engine on the engine section of the Owatonna Tractor Splitting Stand No. 201387. See Figure 21. Support the transmission on the transmission section of the Tractor Splitting Stand. See Tractor Splitting Stand installation instructions.

10. Support the tractor front end with a spreader bar, crane and chains, or other suitable method. Place a floor jack under the pin of the front axle assembly. See Figure 21.

11. Insert wedges (6), Figure 21, unbolt the front end assembly from the engine and oil pan (6 bolts) and separate the front end assembly from the engine, Figure 22.

REMOVING THE ENGINE

1. Disconnect the battery cables and wires from the starter solenoid. Remove the starter.