SHOP MANUAL

JOHN DEERE

SERIES 4050-4250-4450-4650-4850

Each tractor has the following serial number plates: basic tractor, engine short block, mechanical front-wheel drive, transmission, hydraulic pump, Roll-Gard and Sound-Gard body.

The basic tractor serial number plate is located at the rear of the transmission case. The engine serial number plate is located on right side of engine behind the injection pump. The mechanical front-wheel drive serial number plate is located on the axle housing. The transmission serial number plate is located on left side of transmission case. The hydraulic pump serial number plate is located on the right side of pump housing. The Roll-Gard serial number plate is located on right-hand front post. The Sound-Gard body serial number plate is located on the windshield wiper motor access door header.

INDEX (By Starting Paragraph)

	4050	4250	4450	4650	4850
BRAKES					
Bleeding	181	181	181	181	181
Brake Accumulator	183	183	183	183	183
Brake Pistons, Plates and Discs	184	184	184	184	184
Brake Valve	182	182	182	182	182
Operation and Adjustment	180	180	180	180	180
CLUTCH					
Traction Clutch (Perma-Clutch)	94	94	94	94	...
Traction Clutch (Power Shift)	132	132	132	132	132
COOLING SYSTEM					
Fan and Viscous Clutch	54	54	54	54	54
Radiator	53	53	53	53	53
Thermostats	56	56	56	56	56
Water Pump	55	55	55	55	55
DIESEL SYSTEM					
Adjustment	73	74	74	74	74
Filter and Bleeding	63	63	63	63	63
Injection Pump	67	70	70	70	70
Injector Nozzles	77	77	77	77	77
Static Timing	68	71	71	71	71
DIFFERENTIAL	161	161	161	161	161
DIFFERENTIAL LOCK	168	168	168	168	168
ELECTRICAL SYSTEM					
Alternator and Regulator	84	84	84	84	84
Electrical Diagrams	261	261	261	261	261
Investigator II Warning System	91	91	91	91	91
Starting Motor	89	89	89	89	89

INDEX (CONT.)

ENGINE	4050	4250	4450	4650	4850
Assembly, R&R	31	31	31	31	31
Camshaft and Bearings	39	39	39	39	39
Connecting Rods and Bearings	44	44	44	44	44
Crankshaft and Bearings	45	45	45	45	45
Cylinder Head	32	32	32	32	32
Cylinder Sleeves	42	42	42	42	42
Engine Break-in Procedure	52	52	52	52	52
Flywheel	47	47	47	47	47
Oil Cooler	51	51	51	51	51
Oil Pump	49	49	49	49	49
Piston Pins	43	43	43	43	43
Pistons and Rings	41	41	41	41	41
Rocker Arms	36	36	36	36	36
Rod and Piston Units	40	40	40	40	40
Timing Gear Cover	37	37	37	37	37
Timing Gears	38	38	38	38	38
Valve Adjustment	33	33	33	33	33
Valves, Seats and Valve Guides	34	34	34	34	34
Valve Spring and Rotators	35	35	35	35	35
FINAL DRIVE					
Planetary	172	172	172	172	172
High Clearance	178	178	178	...	...
FRONT SYSTEM	1	1	1	1	1
FRONT-WHEEL DRIVE					
ZF Axle	4	4	4	4	4
John Deere Axle	250	250	250	250	250
HYDRAULIC SYSTEM					
Control Valves	221	221	221	221	221
Hydracushioned Seat	225	225	225	225	225
Main Hydraulic Pump	217	217	217	217	217
Main Hydraulic System	201	201	201	201	201
Rockshaft Housing	229	229	229	229	229
Selective Control Valve	242	242	242	242	242
POWER STEERING SYSTEM					
Metering Pump and Steering Column	26	26	26	26	26
Operation	22	22	22	22	22
Steering Motor	28	28	28	28	28
Steering Valve	27	27	27	27	27
Trouble-Shooting	23	23	23	23	23
POWER TAKE-OFF	185	185	185	185	185
TRANSMISSION					
Power Shift	120	120	120	120	120
Quad-Range	104	104	104	104	...
TURBOCHARGER	...	57	57	57	57

DUAL DIMENSIONS

This service manual provides specifications in both the U.S. Customary and Metric (SI) system of measurements. The first specification is given in the measuring system used during manufacture, while the second specification (given in parenthesis) is the converted measurement. For instance, a specification of "0.011 inch (0.28 mm)" would indicate that the equipment was manufactured using the U.S. system of measurement and the metric equivalent of 0.011 inch is 0.28 mm.

CONDENSED SERVICE DATA

GENERAL	4050	4250	4450	4650	4850
Engine Make			OWN		
Engine Model	6466D	6466T	6466T	6466A	6466A
Number of Cylinders			6		
Bore			4.56 in. (115.8 mm)		
Stroke			4.75 in. (120.7 mm)		
Displacement			466 cu. in. (7.6 L)		
Compression Ratio	17.0:1	15.8:1	15.8:1	15.8:1	15.0:1
Cylinder Sleeves			WET		
TUNE-UP					
Firing Order			1-5-3-6-2-4		
Valve Clearance—					
Intake			0.018 in. (0.46 mm)		
Exhaust			0.028 in. (0.71 mm)		
Injection Timing-Static			TDC		
Governed Engine Rpm—					
Low Idle			850		
High Idle			2375		
Full Load			2200		
Engine Power at Pto	100.95 hp (75.28 kW)	120.86 hp (90.13 kW)	140.43 hp (104.72 kW)	165.52 hp (123.43 kW)	192.99 hp (143.91 kW)
Battery—					
Volts			12		
Ground Polarity			Negative		
SIZES-CLEARANCES					
Crankshaft Main Journal Diameter			3.372-3.373 in. (85.65-85.67 mm)		
Main Bearing Clearance			0.0012-0.0042 in. (0.03-0.10 mm)		
Crankpin Diameter			2.998-2.999 in. (76.15-76.18 mm)		
Rod Bearing Clearance			0.0012-0.0042 in. (0.03-0.10 mm)		
Crankshaft End Play			0.002-0.015 in. (0.05-0.38 mm)		
Camshaft Journal Clearance			0.002-0.005 in. (0.05-0.127 mm)		
Camshaft End Play			0.0045-0.0095 in. (0.11-0.24 mm)		
Piston Skirt Clearance			0.004-0.005 in. (0.10-0.127 mm)		
CAPACITIES					
Cooling System	27 qts. (25.6 L)	27 qts. (25.6 L)	27 qts. (25.6 L)	32 qts. (30.3 L)	32 qts. (30.3 L)
Fuel Tank	65 gals. (246 L)	65 gals. (246 L)	65 gals. (246 L)	102 gals. (386 L)	102 gals. (386 L)

CONDENSED SERVICE DATA (CONT.)

CAPACITIES (CONT.)	4050	4250	4450	4650	4850
Crankcase with Filter	18 qts. (17.0 L)	18 qts. (17.0 L)	18 qts. (17.0 L)	21 qts. (19.9 L)	21 qts. (19.9 L)
Transmission-Hydraulic System*—					
Power Shift	13.5 gals. (51 L)	13.5 gals. (51 L)	13.5 gals. (51 L)	18.5 gals. (70.5 L)	18.5 gals. (70.5 L)
Power Shift with MFWD	16.0 gals. (60.5 L)	16.0 gals. (60.5 L)	16.0 gals. (60.5 L)	20.0 gals. (75 L)	20.0 gals. (75 L)
Quad-Range	16.0 gals. (60.5 L)	16.0 gals. (60.5 L)	16.0 gals. (60.5 L)	26.9 gals. (101.8 L)	. . .
Quad-Range with MFWD	17.2 gals. (65.1 L)	17.2 gals. (65.1 L)	17.2 gals. (65.1 L)	. . .	. . .

*John Deere Hy-Gard transmission and hydraulic oil or equivalent is recommended for use in all models.

Mechanical Front-Wheel Drive**—					
Axle Housing					
ZF Axle	9 qts. (8.5 L)	9 qts. (8.5 L)	9 qts. (8.5 L)	9.5 qts. (9 L)	9.5 qts. (9 L)
John Deere Axle	12 qts. (11.4 L)	12 qts. (11.4 L)	12 qts. (11.4 L)	12 qts. (11.4 L)	12 qts. (11.4 L)
Wheel Hub					
ZF Axle	2 qts. (1.9 L)	2 qts. (1.9 L)	2 qts. (1.9 L)	4.75 qts. (4.5 L)	4.75 qts. (4.5 L)
John Deere Axle	4 qts. (3.8 L)	4 qts. (3.8 L)	4 qts. (3.8 L)	6 qts. (5.7 L)	6 qts. (5.7 L)

**SAE 85W-140, GL5 gear lubricant is recommended for use in all models.

FRONT SYSTEM

ADJUSTABLE TREAD FRONT AXLE

1. AXLE HOUSING AND PIVOT BRACKET. The front axle attaches to the front support (1—Fig. 1). Clearance between axle pivot pins (13—Fig. 1 and 2—Fig. 2) and bushings (14—Fig. 1 and 1—Fig. 2) should not exceed 0.080 inch (2 mm).

When renewing pivot bushings, be sure center of "X" pattern inside bushing is aligned with grease fitting in housing. Grease hole in bushing will be slightly offset from grease fitting. Install bushing flush with bottom of chamfer.

Install front pivot pin flush with rear edge of pin bore in axle. Install shims (3—Fig. 2) on axle front pivot bolt to provide a minimum amount of clearance between front axle and support. Maximum allowable clearance is 0.015 inch (0.38 mm). Tighten nuts on pivot bolts to 220 ft.-lbs. (298 N·m). Tighten tie rod end retaining nuts to 100 ft.-lbs. (136 N·m). Lubricate pivot pins and bushings with multipurpose grease.

2. SPINDLES AND BUSHINGS. The steering arms (6—Fig. 2) are splined to spindles (10) and re-

1. Front support
3. Center steering arm
4. Spindle
8. Oil seal
9. "O" ring
10. Snap ring
11. Ball bearing
12. Bushing
13. Pivot pin
14. Bushing
15. Bearing retainer
16. Washer
17. Lockplate
18. Cap screw
19. Tie rod end

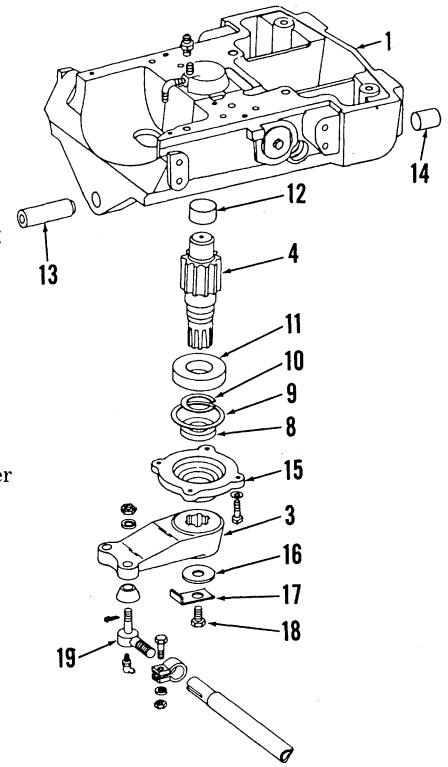


Fig.1—Partially exploded view of front axle support assembly used on 4050, 4250 and 4450 tractors. Support assembly used on 4650 and 4850 tractors is similar.

tained by a cap screw. Spindle bushings (8) are renewable. When installing new bushings, be sure hole in bushing is aligned with grease fitting in axle knee (9).

Align notches in thrust washers (12) with dowel pins (11) when reinstalling spindles. Shim washers (7) are used to adjust spindle end play to 0.010-0.040 inch (0.25-1.0 mm). Tighten steering arm retaining cap screw to 170 ft.-lbs. (230 N·m), then strike steering arm several times with lead hammer. Retorque retaining screw to 170 ft.-lbs. (230 N·m). Lubricate spindles with multipurpose grease.

To adjust front wheel bearings, tighten spindle nut to 35 ft.-lbs. (47 N·m). Back off spindle nut, if necessary, until cotter pin can be inserted.

3. TIE RODS AND TOE-IN. The tie rod outer ends (19—Fig. 2) are adjustable with several holes provided for changing axle width. Tie rod inner ends (15) are threaded to provide adjustment for toe-in. To adjust toe-in, remove bolts (18) and loosen clamp (16). Rotate tie rod tubes (17) to provide 1/8-3/8 inch (3-9 mm) toe-in. Be sure to adjust both tie rods to equal lengths. Tighten clamps and bolts to 35 ft.-lbs. (47 N·m).

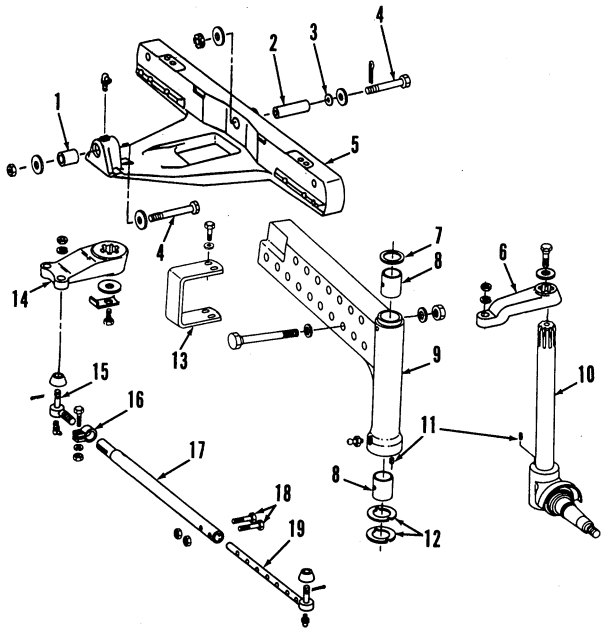


Fig. 2—Exploded view of adjustable tread front axle assembly.

1. Bushing
2. Pivot pin
3. Shim
4. Retaining bolts
5. Axle housing
6. Steering arm
7. Shim washer
8. Bushings
9. Axle knee
10. Spindle
11. Dowel pins
12. Thrust washers
13. Clamp
14. Steering motor arm
15. Tie rod end
16. Clamp
17. Tube
18. Bolts
19. Tie rod end

MECHANICAL FRONT-WHEEL DRIVE

Service procedures for John Deere 1100 Series front-wheel drive axle are located at the rear of this service manual, beginning with paragraph 250. Service procedures for ZF front-wheel drive axle used on early production tractors are contained in paragraphs 9 through 21. Paragraphs 4 through 8, containing information on operation, trouble-shooting, solenoid valve and front-wheel drive clutch, apply to all front-wheel drive tractors.

OPERATION

All Models So Equipped

4. Some models may be equipped with mechanical front-wheel drive (MFWD) unit. Power is supplied from the differential drive gear through the MFWD clutch (mounted on bottom of transmission housing). The clutch unit is hydraulically released and spring applied.

An electrically actuated solenoid valve controls flow of oil to clutch unit. Power from the clutch is transmitted through an external drive shaft to the front axle limited slip differential unit. A planetary gear reduction system is located in front wheel hubs to provide final drive to front wheels.

CAUTION: When servicing mechanical front-wheel drive tractors with engine running and rear wheels supported off the ground and turning, always support front wheels in a similar manner. A loss of electrical power or hydraulic system pressure will engage front-wheel drive and pull rear wheels off supports if front wheels are not properly supported.

TROUBLE-SHOOTING

All Models So Equipped

5. If mechanical front-wheel drive (MFWD) malfunctions, the following trouble-shooting procedure should be followed to isolate the problem.

With key switch "ON" and MFWD switch "OFF," there should be a strong magnetic attraction at clutch solenoid housing. With the MFWD switch "ON," there should be only slight residual magnetism evident at solenoid housing. If necessary, repair switch, wiring or solenoid.

Raise and support left front wheel. With engine running at 1000 rpm, transmission in "PARK" and MFWD switch "OFF," it should be possible to rotate left front wheel by hand. If wheel will not rotate, check for failure of differential or planetary gears

(disconnect drive shaft to isolate front axle components from clutch assembly), clutch pack piston could be stuck or the clutch pressure circuit could be blocked (clutch is hydraulically released).

With engine running at 1000 rpm, transmission in "PARK" and MFWD switch "ON," left front wheel should not rotate by hand. If wheel will rotate, check clutch pressure circuit.

To check clutch pressure, install a 300 psi (2000 kPa) pressure gage at system pressure test port (1—Fig. 3 or Fig. 4) on traction clutch valve housing. Install another 300 psi (2000 kPa) pressure gage at MFWD clutch test port (3—Fig. 5). Note that MFWD test port may have standard or metric threads. If 5/8 inch wrench is used to remove plug, threads are standard. If a 3/4 inch wrench is used to remove plug, threads are metric. With engine running at 1000 rpm and MFWD switch "OFF," difference between system pressure and clutch pressure should not be more than 20 psi (140 kPa). If clutch pressure is low, the solenoid valve could be sticking or oil may be leaking past clutch shaft or piston sealing rings. With engine at 1000 rpm and MFWD switch "ON," there should be no pressure at clutch test port. If there is pressure to clutch unit, solenoid valve is defective.

To check MFWD clutch for slippage, disconnect drive shaft at clutch shaft yoke. Install a second yoke to the clutch shaft, then insert pipe 6 feet (1.8 m) long through opening of yokes. With engine off, apply force of 175-200 pounds (780-890 N) to end of pipe. This will produce approximately 1000 ft.-lbs. (1355 N·m) torque load on clutch pack. If clutch slips under this load, overhaul clutch as outlined in appropriate paragraph 7 or 8.

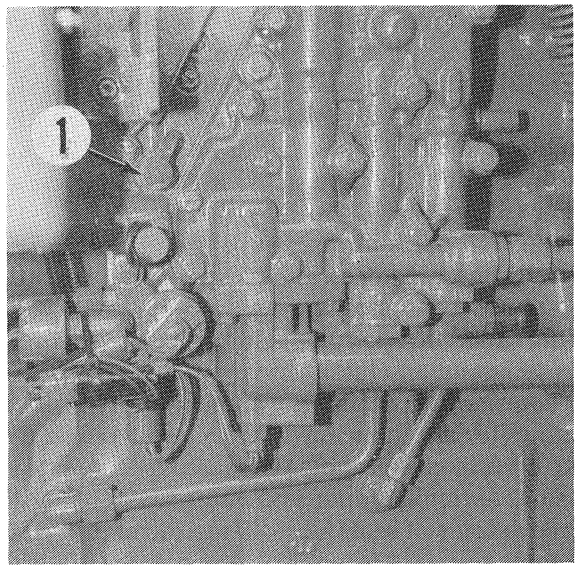


Fig. 3—When trouble-shooting mechanical front-wheel drive, install a 300 psi (2000 kPa) pressure gage at system pressure test port (1) on traction clutch valve housing. Power shift model is shown; refer to Fig. 4 for Quad-Range models.

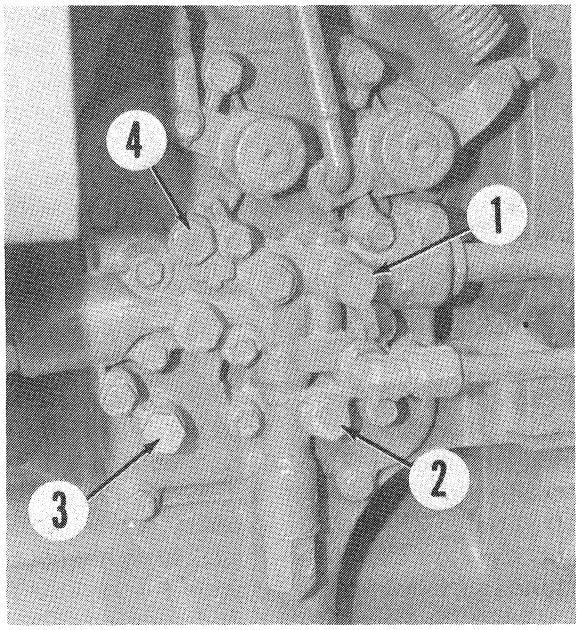


Fig. 4—View of pressure control valve used on Quad-Range models. Install 300 psi (2000 kPa) pressure gage at test port (1) to check system pressure.

SOLENOID VALVE

All Models So Equipped

6. To remove solenoid valve assembly (S—Fig. 5), disconnect wiring connector. Remove retaining ring or nut from end of electrical coil, then withdraw coil assembly (2—Fig. 6 or 6A). On late model tractors with Power Shift transmission, remove valve assembly (3—Fig. 6A) from clutch housing. On early model Power Shift tractors and all tractors equipped with Quad-Range transmission, remove screws securing retainer plate (3—Fig. 6) and pull insert (4) from housing. Remove valve spool (7), spring (9) and sleeve (8).

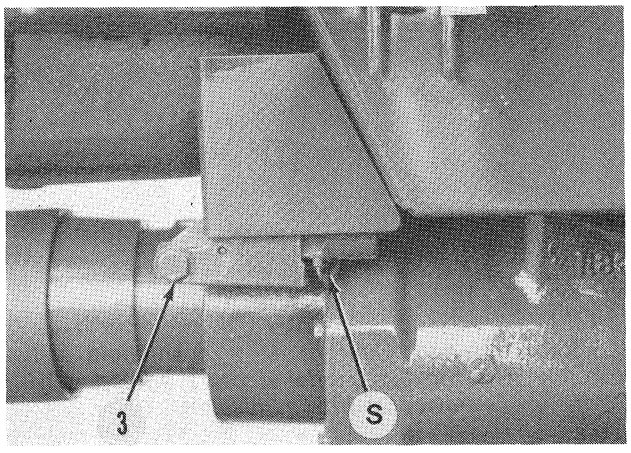


Fig. 5—Install a 300 psi (2000 kPa) gage at MFWD clutch test port (3) to check clutch hydraulic pressure. Refer to text.

Inspect all components for scoring, excessive wear or other damage. Be sure to renew all "O" rings.

To reinstall valve assembly, reverse the removal procedure.

CLUTCH

Models Equipped With Quad-Range Transmission

7. R&R AND OVERHAUL. To remove clutch assembly, first drain oil from clutch housing. Remove drive shaft. Disconnect solenoid wiring and clutch pressure oil line. Remove cap screws securing clutch housing. Support clutch assembly with two alignment dowels and a floor jack (clutch weighs about 90 pounds [41 kg]), then withdraw clutch assembly. Remove clutch drum (30—Fig. 7) from clutch housing if it does not come out with clutch assembly.

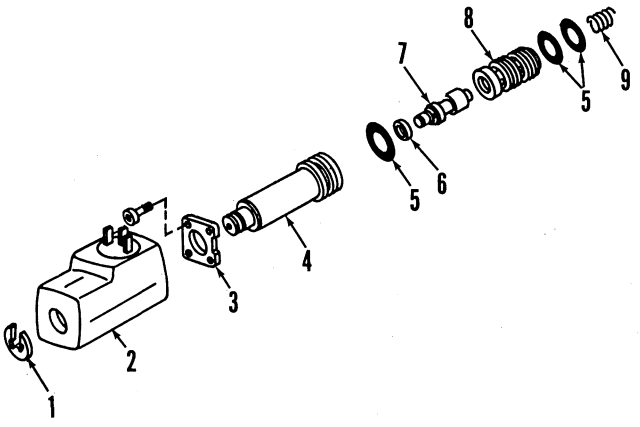


Fig. 6—Exploded view of MFWD solenoid valve assembly used on early Power Shift tractors and all Quad-Range tractors.

1. Snap ring
2. Electrical coil
3. Retainer plate
4. Insert
5. "O" rings
6. Washer
7. Valve spool
8. Sleeve
9. Spring

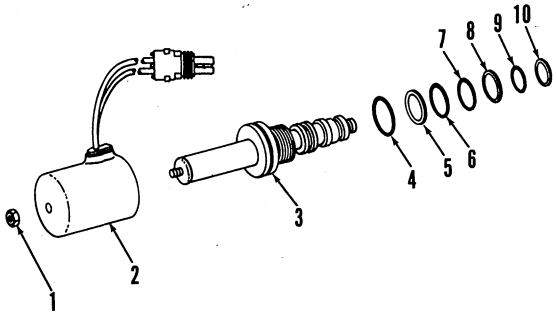


Fig. 6A—Exploded view of MFWD solenoid valve assembly used on late model tractors equipped with Power Shift transmission.

1. Nut
2. Electrical coil
3. Control valve
4. "O" ring
5. Back-up ring
6. "O" ring
7. "O" ring
8. Back-up ring
9. "O" ring
10. Back-up ring

To disassemble, remove washer (29) and straighten locking tabs on nut (28). Use a suitable horseshoe shaped tool (T—Fig. 9) to compress Belleville springs (26), then unscrew nut (28). Release Belleville spring tension, then remove nut (28—Fig. 7), washer (27), springs (26), pressure plate (25), clutch discs (24) and plates (23) and plate (22). Remove snap ring (21), washer (20) and hub (19) with pins (17). Pry piston housing (13) from quill (2). Tap piston housing on a block of wood to remove piston (16). Remove seal rings (12) and piston seals (14 and 15). Remove shaft retaining ring (11), then tap end of clutch shaft (1) on a block of wood to remove from housing. Remove bearing (8) and bushing (10). Remove oil seal (7), spacer (6), washer (5) and "O" rings (9).

Inspect all parts for excessive wear or other damage and renew if necessary. It is recommended that all "O" rings and sealing rings be renewed. Coat all sealing rings with petroleum jelly during reassembly.

To reassemble clutch, reverse the disassembly procedure while noting the following items. Install bushing (10) into housing (2) with beveled side first. Make certain clutch shaft (1) is completely seated in housing. Assemble inner and outer seals (14 and 15) so grooved side of seals faces offset side of piston (16). Assemble piston housing (13), piston, hub (19), washer (20) and snap ring (21), then use a dial indicator (Fig. 10) to check end play of hub (19). If necessary, adjust end play by changing thickness of washer (20—Fig. 7) to obtain 0.008 inch (0.2 mm) end play. Install pressure plate (22) with beveled edge toward piston. Install discs (24) and plates (23) alternately, starting with a disc and ending with a plate. Install clutch release pins (17) into hub (19). Install rear pressure plate (25) with offset side toward clutch pack. Assemble Belleville springs alternately so outer diameter of first spring (1—Fig. 11) is against pressure plate (2) and spring with measurement (3) is located on top as shown. Use drum (30—Fig. 7) to align clutch disc tangs, then remove drum making sure tangs remain aligned.

Belleville spring pack height must be adjusted as follows: Measure and record the thickness of nut (28) and washer (27). Then, compress springs with a horseshoe shaped tool and thread nut onto shaft until locking ring on nut is about even with notches on clutch shaft. Remove compression tool and position a straightedge (C—Fig. 12) across machined surface of nut. Measure distance between straightedge and machined surface of pressure plate. Subtract the nut and washer thickness from this dimension. The result should equal the dimension marked on the top spring (Fig. 11). Note that dimension on spring is given in millimeters and a decimal point should be put

1. Clutch shaft
2. Housing
3. Solenoid valve
4. Ball
5. Washer
6. Spacer
7. Oil seal
8. Bearing
9. "O" rings
10. Bushing
11. Snap ring
12. Seal rings
13. Piston housing
14. Inner seal
15. Outer seal
16. Piston
17. Pin
18. Cap
19. Hub
20. Washer
21. Snap ring
22. Plate
23. Splined plates
24. Discs
25. Pressure plate
26. Belleville springs
27. Washer
28. Nut
29. Washer
30. Drum
31. Snap ring
32. Drive gear
33. Bushing
34. Bearing
35. Gasket

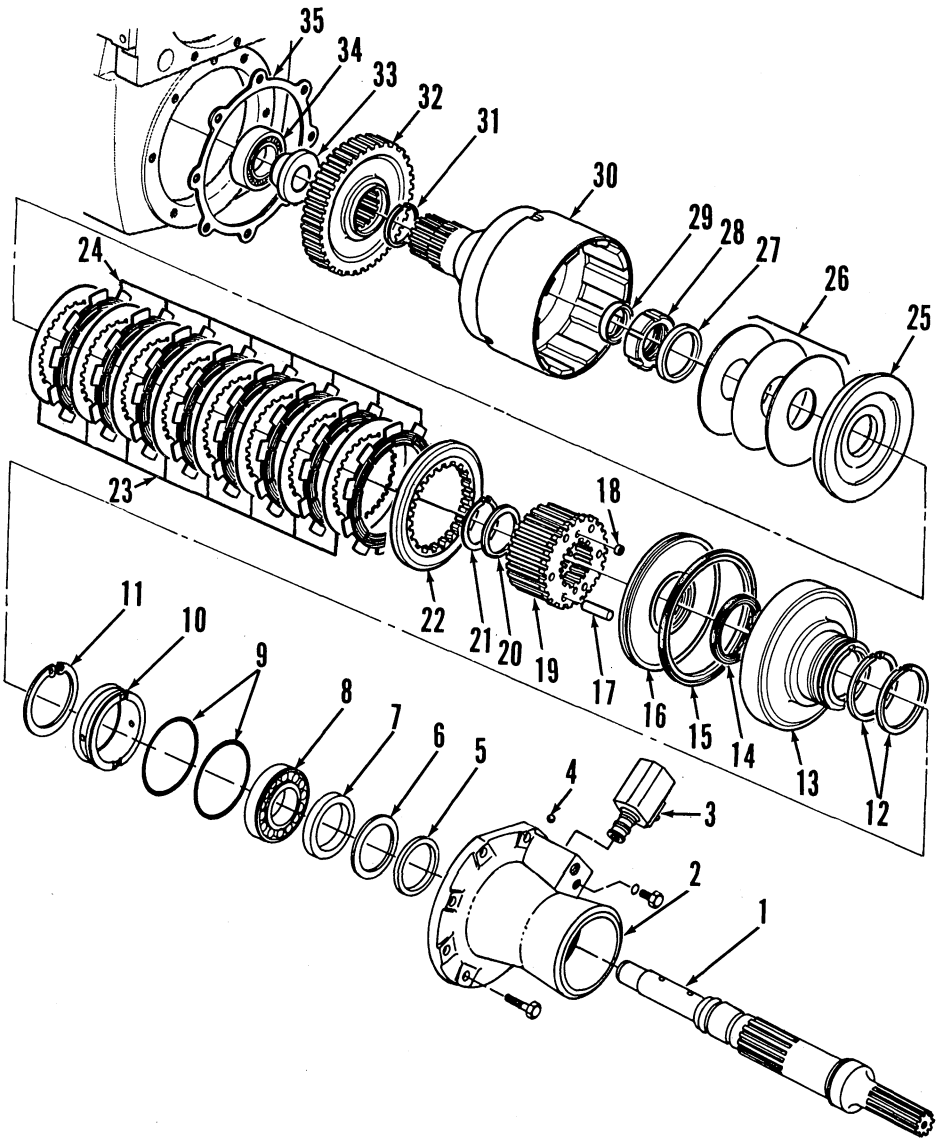


Fig. 7—Exploded view of MFWD clutch assembly used on tractors equipped with Quad-Range transmission.

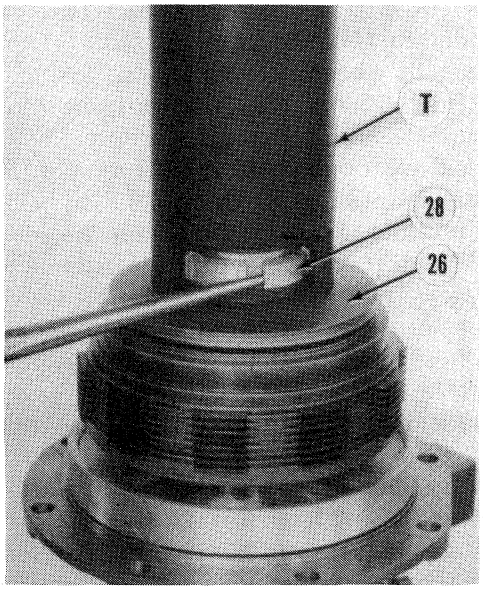


Fig. 9—Use horseshoe shaped tool (T) and a press to compress Belleville springs.

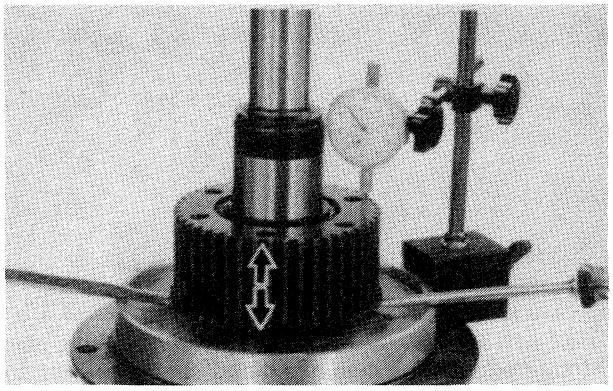


Fig. 10—Use dial indicator to check end play of clutch hub.

after the first two digits (example: 19.20 mm). If necessary, adjust nut up or down until dimensions match. Turning the nut one slot changes height approximately 0.010 inch (0.25 mm). After spring height is correctly adjusted, bend locking ring into notch in shaft to secure nut.

Free play between clutch shaft and clutch drum is adjusted by changing thickness of spacer washer (29—Fig. 7). If clutch shaft, drum or clutch housing is renewed, free play must be adjusted. When renewing any other parts, original washer should be installed. To adjust free play to recommended 0.020 inch (0.5 mm) dimension, proceed as follows: Install thinnest washer available on shaft. Washers are available in thicknesses from 0.270 inch (6.8 mm) to 0.380 inch (9.6 mm). Shape a piece of soft lead wire with diameter of 0.118 inch (3 mm) into a ring and position on top of spacer washer. Install clutch drum. Reinstall clutch assembly using a new gasket and tighten mounting cap screws to 80 ft.-lbs. (108 N·m). Then, remove clutch assembly and measure compressed thickness of lead wire. To calculate required

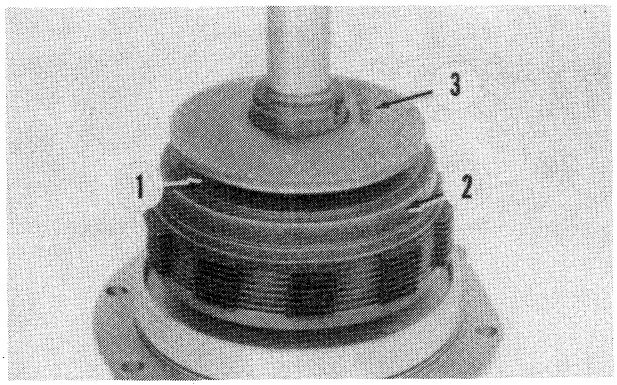


Fig. 11—Install Belleville springs so outer diameter of first spring (1) is against pressure plate (2) and spring with measurement (3) is on top.

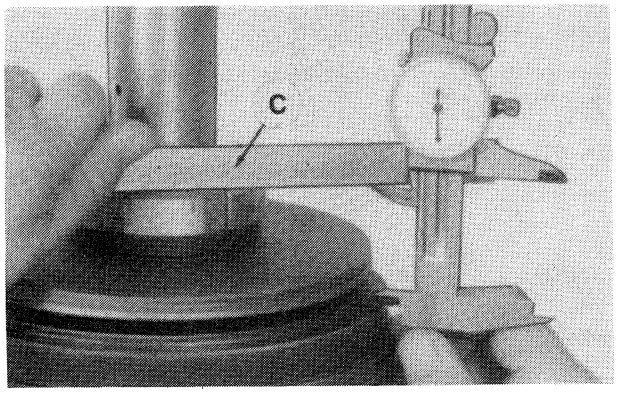


Fig. 12—To adjust Belleville spring installed height, place a straightedge (C) across machined surface of nut and measure between straightedge and surface of pressure plate. Refer to text.

washer thickness, add wire thickness to spacer washer thickness and subtract 0.020 inch (0.5 mm) from the total. The result is the required washer thickness.

To reinstall clutch assembly, reverse the removal procedure. Tighten mounting cap screws to 185 ft.-lbs. (250 N·m).

Models Equipped With Power Shift Transmission

8. R&R AND OVERHAUL. To remove clutch assembly, first drain oil from clutch housing. Remove drive shaft and yoke. Disconnect solenoid wires and clutch oil pressure line. Install a piece of pipe with 2-1/4 inch (60 mm) inside diameter and at least 3 inches (76 mm) long over end of clutch shaft and secure to shaft with a washer and cap screw. This will prevent clutch drum and clutch cover from separating during removal. Adequately support clutch assembly, then remove mounting cap screws and withdraw clutch assembly. Remove pipe from clutch shaft, then separate clutch cover (8—Fig. 14) from clutch assembly.

To disassemble clutch, first use a suitable puller to remove gear (23) and bearing cone (25). Use a press and suitable compressing tool to compress springs (20) until snap ring (22) can be removed. Release spring tension, then remove clutch pack components from clutch drum. Remove snap ring (15) and remove plate (14), thrust washer (16) and drum (10) from clutch shaft. Tap drum on a wood block to remove piston (13). Press bearing cone (7) off shaft if necessary.

Inspect all parts for excessive wear or other damage and renew if necessary. Thickness of a new clutch plate (17) is 0.060 inch (1.5 mm) and thickness of a new disc (18) is 0.072-0.074 inch (1.8-1.9 mm). It is recommended that seal rings and oil seals be renewed. When installing bearing retainer seals, install narrow seal (2) first with open side toward front of retainer (1). Be sure seal is bottomed in the bore. Then install wider seal with open side toward rear of retainer. Press seal in until it is 3/16 inch (4.5 mm) below rear face of retainer. Fill cavity between the seals with grease. When renewing clutch cover front bearing cup (6), press new cup only part way into cover. The cup will be properly located when retainer is installed. Rear cup (26) should be bottomed in its bore in clutch housing.

To reassemble, proceed as follows: If bearing cone (7) was removed, heat bearing to 300° F (150° C) maximum, then install on shaft. Lubricate piston seals (11 and 12) with oil. Stretch new outer seal (12) over outside diameter of clutch drum (10) for a few minutes, then install into groove in drum and immediately install piston. Be sure slots in piston are aligned

with slots in drum. Position drum onto clutch shaft. Install plate (14) so recessed side faces outward. Install snap ring (15) and thrust washer (16). Assemble clutch discs and plates alternately beginning with a disc (18). Use special JDG315 alignment tool or other suitable tool to align teeth of clutch discs. Make certain missing tooth on clutch discs is not aligned with rib on special tool. Install piston return plate (19—Fig. 14). Assemble spring washers (20) alternately beginning with outside diameter of first spring against return plate (19). Install washer (21) with stepped side facing up. Use a press and a compressing tool to compress spring washers until snap ring (22) can be installed. Make certain snap ring is fully seated in groove before releasing press. Be sure that clutch disc teeth are aligned, then install gear (23). Heat bearing cone (25) to 300° F (150° C) maximum, then install onto clutch shaft.

To reinstall clutch, first install clutch cover over clutch assembly being careful not to damage seals. Install pipe used in removal over end of clutch shaft and secure with a washer and cap screw. Be sure seal washer (27) is in place in recess of clutch housing. Install clutch assembly and tighten mounting cap screws to 35 ft.-lbs. (47 N·m). Use a dial indicator to check clutch shaft end play. If necessary, add or remove shims (5) between quill and housing to provide 0.001-0.005 inch (0.03-0.13 mm) end play.

AXLE AND FINAL DRIVE

Models With ZF Axle

9. R&R AXLE ASSEMBLY. To remove axle, first remove front weights and front fenders (if equipped). Disconnect drive shaft at front axle.

NOTE: Before loosening hydraulic lines, relieve system pressure by loosening brake bleed screw and pumping brake until pedal goes all the way down.

Disconnect hoses from steering assist cylinders, if so equipped. Disconnect tie rods. Place wood blocks between knuckles and steering stops. Support front of tractor and axle housing with suitable stands. Remove front and rear axle mounting bolts noting shims used on front bolt. Move axle rearward to disengage pivot pins, then remove from under tractor.

Inspect pivot pins and bushings for excessive wear. If clearance between pin and bushing exceeds 0.080 inch (2 mm), renew parts as necessary. When install-

1. Retainer
2. Seal
3. Seal
4. "O" ring
5. Shims
6. Bearing cup
7. Bearing cone
8. Clutch cover
9. Seal rings
10. Drum assy.
11. Seal
12. Seal
13. Piston
14. Plate
15. Snap ring
16. Washer
17. Clutch plates
18. Clutch discs
19. Plate
20. Springs
21. Washer
22. Snap ring
23. Gear
24. Clutch shaft
25. Bearing cone
26. Bearing cup
27. Seal washer

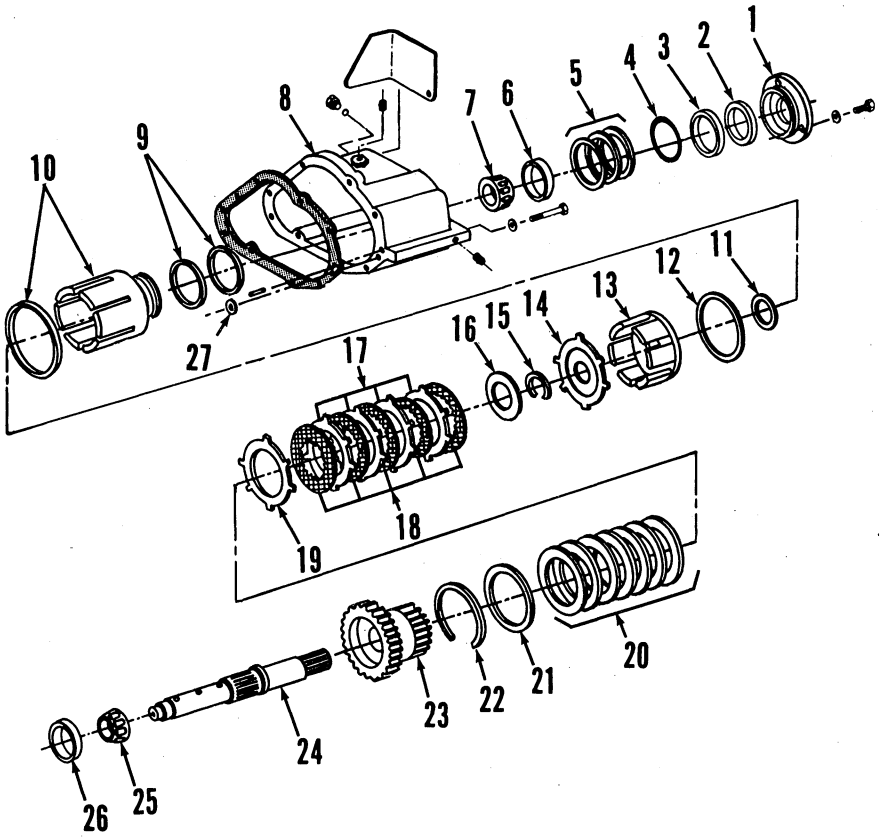


Fig. 14—Exploded view of mechanical front-wheel drive clutch assembly used on tractors equipped with Power Shift transmission.

ing new bushings, be sure center of "X" pattern inside bushing is aligned with grease fitting. Install bushing flush with bottom chamfer in housing bore.

To reinstall axle, reverse the removal procedure while noting the following items: Clearance between front axle and support is adjusted using shims on front pivot retaining bolt. Add or remove shims to obtain minimum amount of clearance. Maximum allowable clearance is 0.015 inch (0.38 mm). Tighten mounting bolts to 220 ft.-lbs. (298 N·m), tie rod end nuts to 100 ft.-lbs. (136 N·m) and drive shaft yoke cap screws to 50 ft.-lbs. (68 N·m). Lubricate pivot pins and bushings with multipurpose grease.

10. TIE RODS AND TOE-IN. Tie rod ends are nonadjustable. If ends are excessively worn, they should be renewed.

Tie rod ends are threaded to provide adjustment for toe-in. To adjust toe-in, first measure length of both tie rods. If difference in length exceeds 1/16 inch (1.5 mm), shorten the longest rod until lengths are equal. Turn steering wheel to center bellcrank, then measure distance between center of tires at the front and at the rear. Recommended difference between measurements is zero with a tolerance of 1/8 inch (3 mm) toe-in or toe-out. If necessary, loosen tie rod end jam nuts and turn each tie rod tube equally to obtain desired setting. Turning tie rod 1/8 turn will change tire centerline approximately 1/16 inch (2 mm).

11. PLANETARY ASSEMBLY. To remove, first raise and support front axle using suitable stands. Remove front wheel. Remove drain plug (2—Fig. 15) and drain oil from planetary housing. Scribe a line on planetary cover (3) and hub (4) for alignment purposes when reassembling. Remove planetary cover cap screws, then install two jack screws into threaded holes in cover to remove planetary carrier. Remove snap ring (8—Fig. 17), sun gear (7) and thrust washer (6). Straighten tangs of lockplate (5), then remove slotted nuts (4) using a suitable spanner wrench. Withdraw ring gear (3) and carrier (2) as an assembly. Remove snap ring (1) to separate carrier from ring gear. Note that late models use a one-piece ring gear and carrier.

To disassemble planetary carrier, first remove inner snap ring (18) from pinion shaft (19A) on models so equipped. On all models, press pinion shaft toward outside of housing until pinion gear (15) can be removed. Be careful not to lose bearing rollers (14). Each gear has 40 bearing rollers and three thrust washers (13).

Inspect all parts for scoring, wear or other damage and renew if necessary.

To reassemble, proceed as follows: Install ring gear and carrier and secure with inner slotted nut. Beveled side of slotted nuts should face outward. Tight-

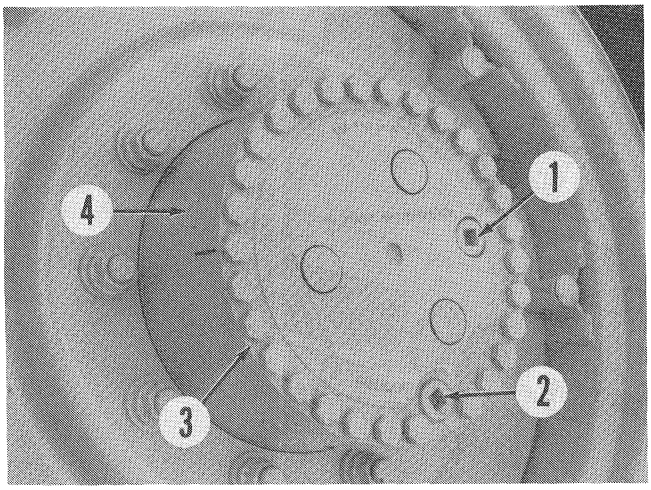


Fig. 15—Prior to removing planetary unit, scribe a line on planetary cover (3) and hub (4) for alignment when reassembling.

1. Oil level plug
2. Drain/fill plug
3. Planetary cover
4. Hub

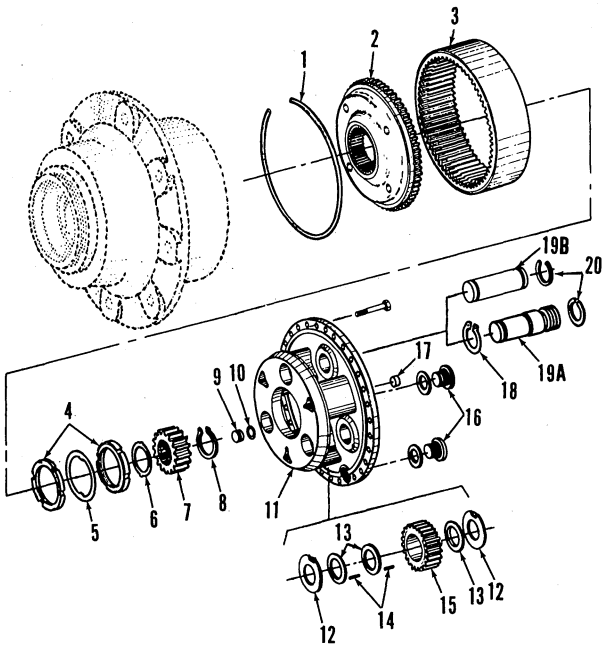


Fig. 17—Exploded view of typical planetary drive assembly. Late models use planet pin (19A) with inside snap ring (18), and ring gear (3) and carrier (2) is a one-piece unit.

1. Snap ring
2. Carrier
3. Ring gear
4. Slotted nuts
5. Lockplate
6. Thrust washer
7. Sun gear
8. Snap ring
9. Thrust plug
10. Shim
11. Planetary carrier
12. Thrust washers
13. Thrust washers
14. Bearing rollers
15. Planet gear
16. Plugs
17. Dust plug
18. Snap ring
19A. Pin (late models)
19B. Pin (early models)
20. Snap ring

en inner nut while rotating wheel hub to seat the bearings. Install a new lockplate and outer slotted nut. Tighten nuts to obtain recommended rolling drag torque specification indicated in table. Use one of the following methods to check rolling torque. The first method uses a fabricated spanner bar which is attached to the wheel hub. A nut is welded to the center of the bar to accommodate a torque wrench. The second method uses a string wrapped around wheel hub with a spring scale attached to the string. The recommended rolling torques are listed in the table below for both test methods.

Models 4050-4250-4450

Torque Wrench Method—
Bearings renewed ..... 35-62 in.-lbs. (4-7 N·m)
Bearings reused ..... 17-31 in.-lbs. (2-4 N·m)
Spring Scale Method—
Bearings renewed ..... 6.5-11 lbs. (30-49 N)
Bearings reused ..... 3.25-5.5 lbs. (16-24.5 N)

Models 4650-4850

Torque Wrench Method—
Bearing renewed ..... 62-115 in.-lbs. (7-13 N·m)
Bearings reused ..... 31-57 in.-lbs. (3.5-6.5 N·m)
Spring Scale Method—
Bearings renewed ..... 8.5-16 lbs. (38-71 N)
Bearings reused ..... 4.3-8 lbs. (19-35.5 N)

After adjusting rolling torque, bend tabs of lockplate to secure nuts. Install thrust washer, sun gear and snap ring. Assemble roller bearings and inner thrust washer (13—Fig. 17) into pinion gear using grease to hold components in place. Assemble gear and outer thrust washers (12) into carrier housing. Note tangs on thrust washers and locating slots in housing. Press pin into carrier until outer snap ring (20) contacts the housing. Install inner snap ring (18) on models so equipped.

NOTE: If wheel hub, bearings, wheel spindle or planetary carrier is renewed, the U-joint shaft end play must be checked and adjusted as follows:

Remove dust plug (17—Fig. 17) from planetary carrier. Drive brass plug (9) and shims (10) from the bore. Reinstall brass thrust plug and bottom it in the bore. Temporarily install planetary carrier and secure with two mounting cap screws. Use a depth micrometer to measure distance from carrier surface to plug. Mark position of the micrometer on carrier surface so second measurement can be taken in the same place. Using a brass drift, tap thrust plug inward against shaft until shaft is seated against sun gear snap ring. Again, measure distance to brass plug. Subtract the first measurement from the second measurement. Then, subtract an additional 0.050 inch (1.3 mm) from the difference. The result is the required shim pack thickness. Actual shim pack thickness may vary by plus or minus 0.004 inch (0.1 mm). Remove carrier and thrust plug and install appropriate shim pack. Apply sealing compound to outer diameter of brass plug. Install new dust plug.

Apply sealing compound to mounting surface of planetary carrier. Reinstall carrier aligning match marks (Fig. 15) made during removal. Tighten mounting cap screws to 63 ft.-lbs. (86 N·m). Refill planetary housing with SAE 85W-140, GL5 gear lubricant.

12. WHEEL HUB, SPINDLE AND AXLE SHAFT. To disassemble, drain oil from axle housing and planetary carrier. Remove planetary carrier, sun gear and ring gear as previously outlined. Withdraw wheel hub (12—Fig. 22) with bearings. Unbolt and remove spindle (7). Pull axle shaft (6) and U-joint assembly out of axle housing.

Inspect all parts for excessive wear or other damage and renew if necessary. To remove bearing cups

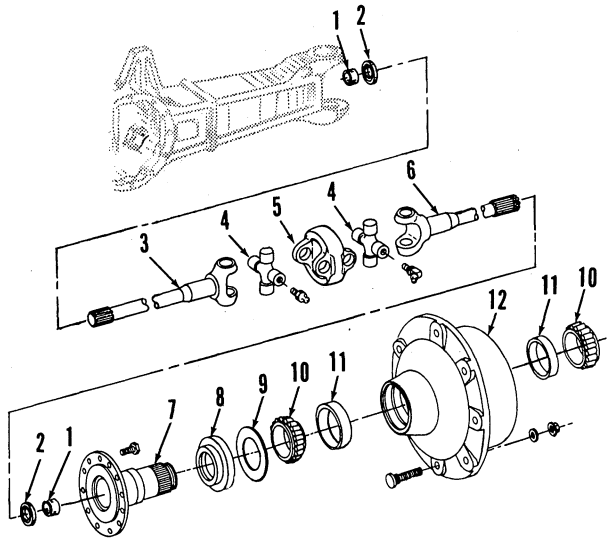


Fig. 22—Exploded view of wheel hub assembly and axle shaft assembly. Washer (9) is not used on 4650 and 4850 tractors.

1. Bushing
2. Seal
3. Inner shaft
4. U-joint cross
5. Yoke
6. Outer shaft
7. Spindle
8. Seal
9. Washer
10. Bearing cone
11. Bearing cup
12. Wheel hub

(11), use a brass drift at notches provided inside wheel hub and drive cups out of hub. Note that outer bearing cup and cone are slightly wider than inner bearing cup and cone. Use suitable drivers to install new bearing cups and oil seal. Pack inside of seal lip with lithium base EP grease.

Inside diameter of spindle and axle bushings (1) should be 1.576-1.578 inches (40.03-40.08 mm). A JT01733 collet and slide hammer may be used to remove oil seals (2) and bushings. Drive new bushings into spindle and axle housing until bottomed in bores. Pack seal lips about half full of special grease supplied with seals. Apply gasket maker compound to outer diameter of seals. Drive seal into spindle until face of seal is 1/4 inch (6 mm) below surface of spindle. Drive seal into axle housing until face of seal is 5/16 inch (8 mm) below end of housing.

To disassemble axle shaft U-joints, remove snap rings, plugs and grease fittings from U-joints. Use a suitable slide hammer puller to remove bearing caps, or clamp yoke in a vise and tap on U-joint flange to drive bearing caps out of yokes.

Renew U-joint assembly if any part shows damage or wear. To reassemble, hold U-joint cross in position in yoke and tap bearing caps into yoke until snap rings can be installed. Be careful not to dislodge bearing needles in caps. Lubricate with grease after assembly.

To reassemble, reverse the disassembly procedure. Install the two shorter spindle mounting cap screws in the bottom two holes. Tighten all spindle mounting cap screws to 218 ft.-lbs. (295 N·m). Adjust wheel hub rolling torque as outlined in paragraph 11.

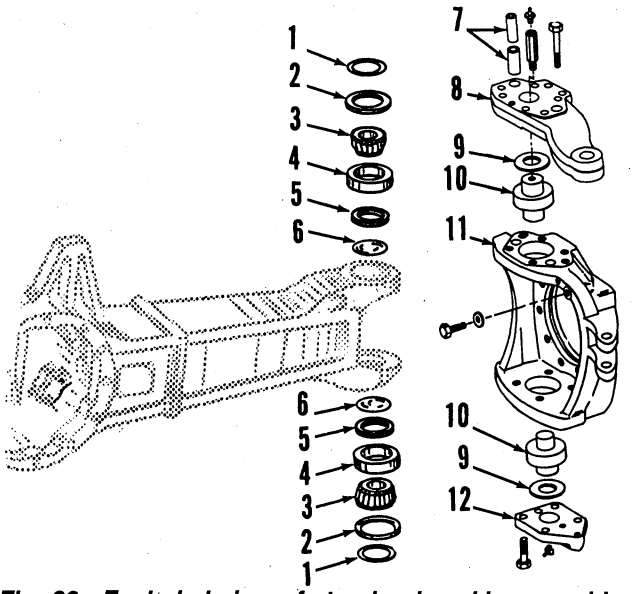


Fig. 23—Exploded view of steering knuckle assembly.

1. "O" ring
2. Cap
3. Bearing cone
4. Bearing cup
5. Washer
6. Dust plug
7. Spring pins
8. Steering arm
9. Shim washer
10. King pin
11. Knuckle housing
12. Cover

13. STEERING KNUCKLE. To service steering knuckle, first drain oil from axle housing. Remove front wheel. Support hub and planetary assembly with a suitable hoist. Remove cap screws securing spindle to knuckle housing, then withdraw planetary assembly with axle shaft. Remove bottom cover (12—Fig. 23), shim washer (9), king pin (10) and bearing (3). Remove steering arm (8) and washer (9), then use a suitable puller to remove upper king pin. To remove bearing cups (4), drive on dust plugs (6).

To reassemble, install lower king pin and bearing with original shim washer. Tighten bearing cap retaining screws to 100 ft.-lbs. (135 N·m). Install upper bearing, king pin and shim washer. Install steering arm and drive in spring pins (7). Tighten cap screws to 170 ft.-lbs. (230 N·m). Reinstall planetary and spindle assembly.

Check knuckle rolling drag torque as follows: Fabricate a spanner bar (2) with a nut in the center and attach bar to steering arm as shown in Fig. 23A. Then, use a torque wrench to measure torque required to rotate knuckle. Vary thickness of shim washers (9—Fig. 23), if necessary, to obtain rolling torque of 13-16 ft.-lbs. (18-21 N·m). Increasing shim thickness will increase rolling torque and decreasing shim thickness will decrease rolling torque. Be sure upper and lower shims are of equal thickness.

DIFFERENTIAL

Models With ZF Axle

14. REMOVE AND REINSTALL. The differential assembly can be removed with the axle assembly on the tractor. Properly support front of tractor, then remove front wheels. Drain oil from axle housing. Support planetary and wheel hub assembly with a suitable hoist. Remove spindle mounting cap screws,

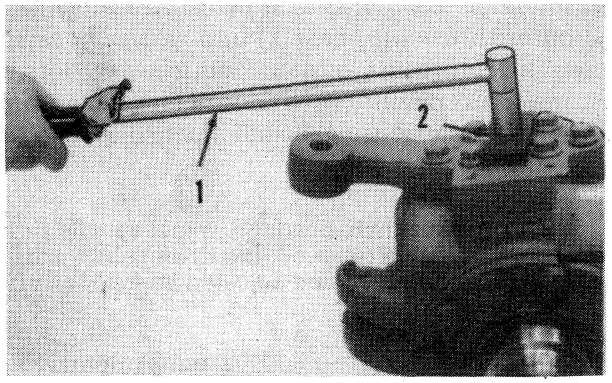


Fig. 23A—Use a spanner bar (2) with a nut welded in the center and a torque wrench (1) to measure torque required to rotate steering knuckle.

then withdraw wheel hub with axle shaft as a unit from axle housing. Remove the other planetary assembly in the same manner. Disconnect steering assist cylinders, if so equipped. Slide drive line shield rearward and remove drive line front support (2— Fig. 24). Remove cap screws attaching drive shaft front U-joint to front yoke. Remove axle rear pivot retaining nut (3). Remove differential carrier mounting cap screws. Note different lengths of cap screws and their positions for reassembly. Support carrier housing, then pry housing and differential assembly from axle housing.

To reinstall, first clean carrier housing and axle housing mating surfaces. Apply gasket maker compound to carrier housing, then install into axle housing. Apply thread sealer and locking compound to threads of mounting cap screws. Install longer screws in holes with high bosses and where dowel pin is located. Tighten all mounting cap screws to 170 ft.-lbs. (230 N·m). Tighten axle pivot nut to 220 ft.-lbs. (298 N·m), steering cylinder bracket cap screws to 54 ft.-lbs. (73 N·m), drive shaft to yoke cap screws to 45 ft.-lbs. (61 N·m) and drive line support cap screws to 35 ft.-lbs. (50 N·m). Reinstall planetary and axle shaft assemblies and tighten spindle mounting cap screws to 218 ft.-lbs. (295 N·m). Be sure two shorter cap screws are installed in bottom two holes in spindle. Refill axle housing with SAE 85W-140, GL5 gear lubricant.

Models 4050-4250-4450

15. OVERHAUL. To disassemble differential, drive out spring pins (18— Fig. 29) and remove slotted nuts (11) and bearing cups (12). Use JDG297 bearing puller or other suitable puller to remove bearing cones (13). Be sure puller is positioned over ends of bearing rollers and not on the bearing cage, otherwise damage to puller may result. Remove cap screws (11— Fig. 25) and lockplates (10). Separate housing halves (1) and remove pinion gears (7), thrust washers (6) and shafts (8). Then, remove housing halves and ring gear from carrier. Remove side gears (5), clutch discs and separator plates (2 and 3) and pressure plates (4).

Inspect all parts for excessive wear or other damage and renew if necessary.

To reassemble differential, alternately install separator plates (3) and friction discs (2) starting and ending with a separator plate. Install pressure plate (4) so side with friction surface is against the last separator plate. Install side gears. If ring gear was removed, reinstall onto ring gear housing using double spring pins (9) to secure it to housing. Assemble pinion gears and shafts into one of the housing halves (1). Position a dial indicator against one pinion gear. While holding the other pinions, check backlash between pinion gear and side gear. Recommended backlash is 0.006-0.008 inch (0.15-0.20 mm). Backlash is

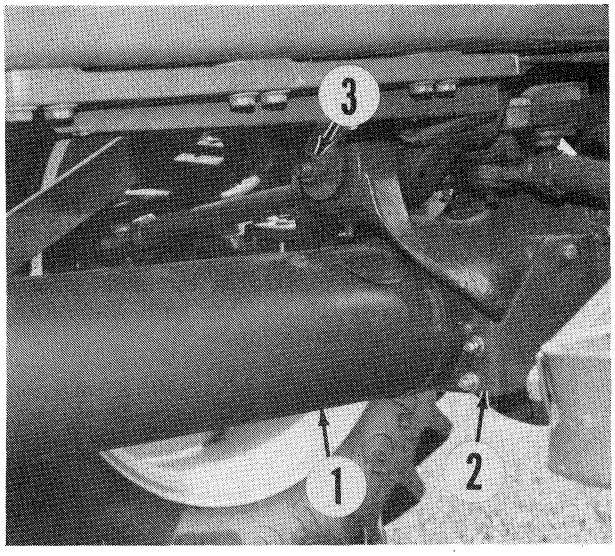


Fig. 24—Rear view of front-wheel drive axle.

1. Drive shaft cover
2. Support bracket
3. Rear pivot bolt

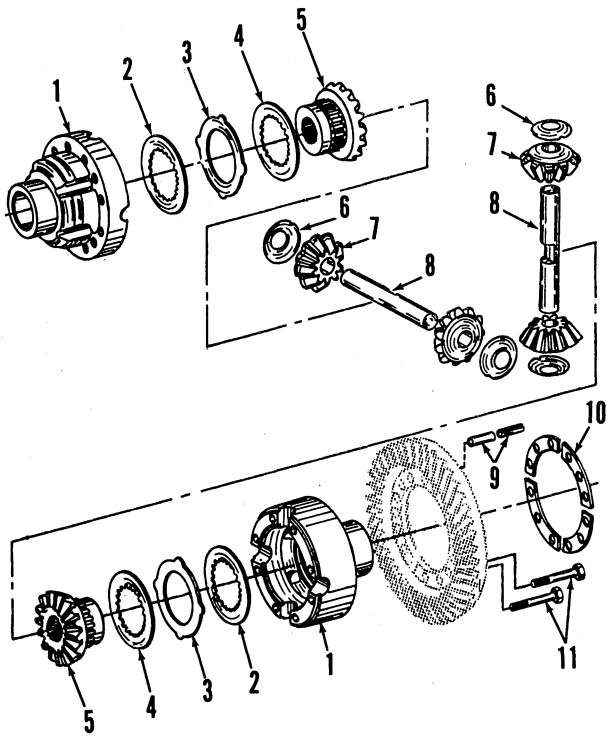


Fig. 25—Exploded view of limited slip differential used in mechanical front-wheel drive axle on Models 4050, 4250 and 4450. Pressure plate (4) is available in different thicknesses to adjust pinion gear backlash.

1. Housings
2. Friction discs (6 used)
3. Separator plates (8 used)
4. Pressure plate
5. Side gear
6. Thrust washer
7. Pinion gear
8. Pinion shaft
9. Spring pins
10. Lockplates
11. Cap screws

adjusted by installing a pressure plate (4) of appropriate thickness. A thicker plate will decrease backlash while a thinner plate will increase backlash. Transfer pinion gears and shafts to the other housing and check and adjust backlash in a similar manner.

After backlash is adjusted, remove all parts and coat with gear lubricant, then reassemble. Assemble housing half without ring gear into carrier first, then install housing with ring gear.

NOTE: Be sure ring gear is installed on correct side of bevel pinion gear (as installed in tractor); left side (17—Fig. 29) if equipped with Power Shift transmission, or right side (17A) if equipped with Quad-Range transmission.

While holding housing halves apart, install thrust washers, pinion gears and pinion shafts into housing. Make sure all components are in proper position, then bring housing halves together and secure with lockplates and cap screws. Note that cap screws without a cotter pin hole are installed in middle of lockplates. Tighten cap screws to 90 ft.-lbs. (120 N·m), then install cotter pins to secure lockplates. Using a suitable driver, install bearing cones onto housing halves.

NOTE: Wider bearing cone and cup are installed on ring gear side of housing.

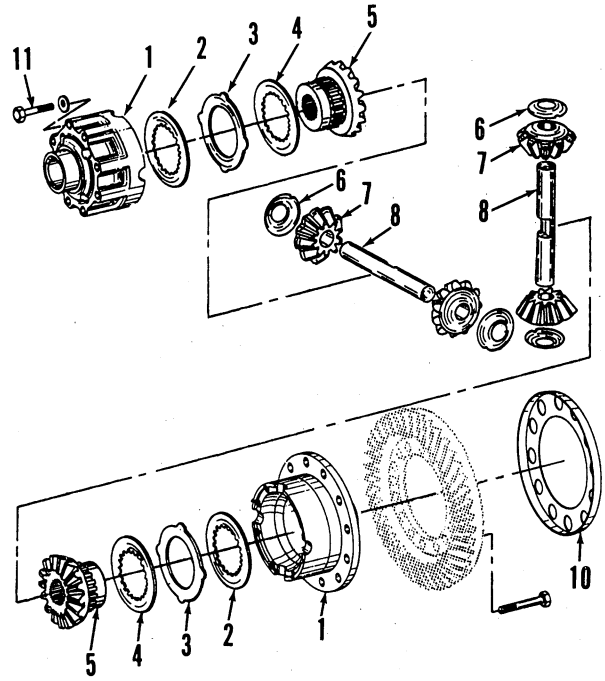


Fig. 26—Exploded view of limited slip differential used in mechanical front-wheel drive axle on Models 4650 and 4850. Refer to Fig. 25 for identification of parts. Eight discs (2) and 10 separator plates (3) are used on these models.

Install bearing cups and slotted nuts. Tighten nuts finger tight. Adjust differential carrier bearing preload and backlash between ring gear and pinion as outlined in paragraph 21.

Models 4650-4850

16. OVERHAUL. To disassemble differential, remove spring pins (18—Fig. 30) and adjusting nuts (11). Mark bearing caps (19) for proper reassembly, then remove caps and differential assembly from carrier housing. Remove cap screws (11—Fig. 26) and separate housing halves (1). Remove pinion gears (7), shafts (8) and thrust washers (6). Remove side gears (5), pressure plate (4), separator plates (3) and friction discs (2).

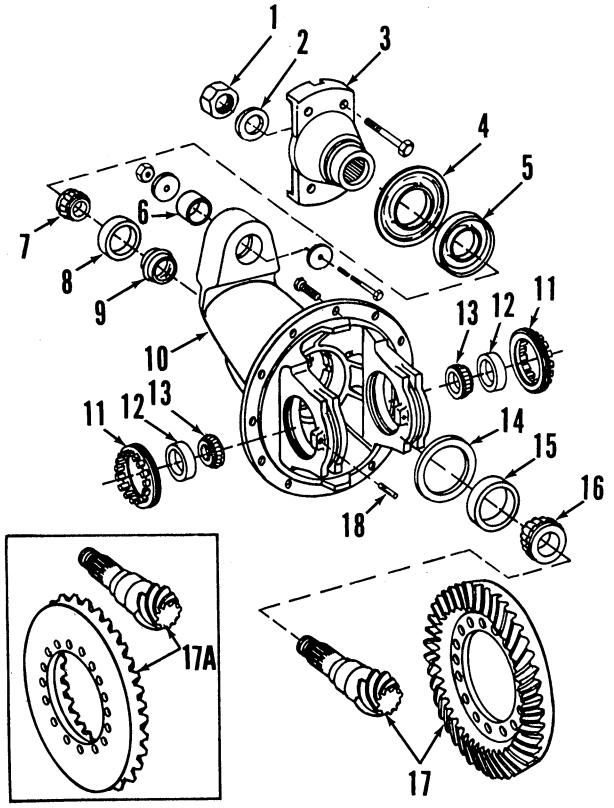


Fig. 29—Exploded view of bevel pinion and carrier assembly used on Models 4050, 4250, and 4450. Note that installed position of ring gear (17) for tractors equipped with Power Shift transmission is opposite installed position of gear (17A) for tractors with Quad-Range transmission.

1. Nut
2. Washer
3. Yoke
4. Guard
5. Oil seal
6. Pivot busing
7. Bearing cone
8. Bearing cup
9. Crush bushing
10. Carrier housing
11. Adjusting nut
12. Bearing cup
13. Bearing cone
14. Shim
15. Bearing cup
16. Bearing cone
17. Ring gear & pinion (Power Shift)
17A. Ring gear & pinion (Quad-Range)
18. Spring pin

Inspect all parts for excessive wear or other damage. Bearing cones (13—Fig. 30) must be renewed if they are pulled off housing halves.

To reassemble differential, install separator plates and friction discs alternately beginning and ending with a separator plate. Install pressure plate so side with friction material is against the last separator plate. Install side gears. Assemble pinion gears and pinion shafts into one of the housing halves. Position a dial indicator against one pinion gear. While holding the other pinion gears, measure backlash between pinion gear and side gear. Recommended backlash is 0.006-0.008 inch (0.15-0.20 mm). Backlash is adjusted by installing pressure plate (4—Fig. 26) of proper thickness. A thicker plate will decrease backlash while a thinner plate will increase backlash. Transfer pinion gears and shafts to the other housing half and adjust backlash in a similar manner.

After adjusting backlash, disassemble all parts and coat with gear lubricant, then reassemble. Assemble housing halves making sure all parts are positioned correctly, and tighten cap screws to 92 ft.-lbs. (125 N·m). If ring gear was removed, press ring gear onto housing until bottomed against shoulder. Install a new lockplate (10) and tighten cap screws to 140 ft.-lbs. (190 N·m).

Position differential housing in carrier. Be sure ring gear is positioned on correct side of pinion gear—left side for Power Shift, right side for Quad-Range (as installed in tractor). Install bearing caps noting alignment markings made during removal. Install bearing cups and adjusting nuts. Adjust differential carrier bearing preload and backlash between ring gear and pinion as outlined in paragraph 21.

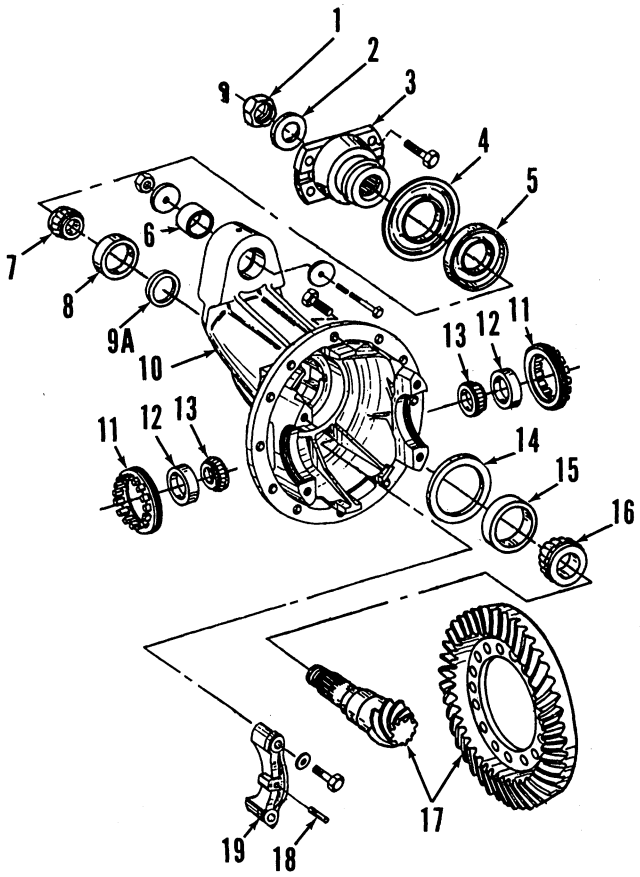


Fig. 30—Exploded view of bevel pinion and carrier assembly used on Models 4650 and 4850. Components are similar to those shown in Fig. 29 except for shim washer (9A) and bearing cap (19).

BEVEL PINION AND RING GEAR

Models With ZF Axle

17. R&R AND OVERHAUL. The bevel pinion shaft and ring gear can be removed with the axle assembly on the tractor. Refer to DIFFERENTIAL section for removal procedure.

To disassemble bevel pinion, first remove differential and ring gear assembly from carrier. Remove nut (1—Fig. 29 or 30), then carefully press pinion shaft out of carrier housing. Remove oil seal (5) and bearing cone (7). Use a brass drift in notches provided inside carrier to drive out bearing cups (8 and 15). To remove bearing cone (16) from pinion shaft, cut bearing cage and remove rollers. Heat bearing race, then drive race off shaft.

Inspect all parts for excessive wear or other damage. Bevel pinion shaft and ring gear are a matched assembly and must be renewed as a set.

NOTE: If any parts (other than oil seal) are renewed, the cone point must be adjusted as outlined in paragraph 18 before installing bevel pinion shaft.

To reassemble, heat front bearing cone (16—Fig. 29 or 30) to 300° F (150° C) and install onto pinion shaft so it seats against shaft shoulder. Install shaft with adjustment bushing (9—Fig. 29) or shim washer (9A—Fig. 30) into carrier. Heat rear bearing cone to 300° F (150° C). Support gear end of pinion shaft, then press bearing cone onto shaft. After bearing has cooled, install a new oil seal. Be sure to pack lip of seal with lithium base EP grease and press in until face of seal is flush with outer surface of carrier. Refer to appropriate paragraph 19 or 20 and adjust pinion shaft rolling drag torque.

If removed, assemble ring gear to differential case. On Models 4050, 4250 and 4450, secure ring gear to case with double spring pins and tighten retaining cap screws to 90 ft.-lbs. (120 N·m). On Models 4650 and 4850, tighten ring gear retaining cap screws to 140 ft.-lbs. (190 N·m). Check and adjust differential carrier bearing preload and backlash between ring gear and pinion as outlined in paragraph 21.

18. CONE POINT ADJUSTMENT. Whenever any part of bevel pinion assembly is renewed, shaft cone

point must be adjusted as follows: Install front and rear bearing cups without shims (14—Fig. 29 or 30) into carrier housing. Position front and rear bearing cones into their cups. Install JDG298 special cone point measuring tool (1—Fig. 31) through the bearings. Use tool marked with identifier number 4.3310 on Models 4050, 4250 and 4450, or identifier number 4.6906 on Models 4650 and 4850. Install JDG293 discs in differential bearing bores and slide JDG-74-1 shaft (2) through the discs. Measure distance between measuring tool and shaft using a feeler gage or shims (3) to determine required shim pack thickness.

NOTE: There may be numbers (such as + 0.1 mm) etched into gear end of pinion shaft. If number is positive (+), SUBTRACT it from measured gap to obtain proper shim pack thickness. If number is negative (–), ADD it to the gap measurement.

Remove special tools and front bearing cup. Install the required thickness of shims (14—Fig. 29 or 30), then reinstall bearing cup.

Models 4050-4250-4450

19. ROLLING DRAG TORQUE ADJUSTMENT. A new crush bushing (9—Fig. 29) must be installed before adjustment can be made. Install yoke (3) and washer (2). Apply thread sealer and locking compound to threads of shaft and nut (1). Hand tighten nut until all shaft end play is removed. Then, continue to tighten nut in small increments, stopping to check shaft rolling torque with a torque wrench, until specified torque of 16-25 in.-lbs (1.8-2.8 N·m) is obtained.

If by mistake the specified drag torque is exceeded by more than 88 in.-lbs. (10 N·m), shaft must be removed, crush bushing renewed and adjustment procedure repeated. If specified torque is exceeded by less than 88 in.-lbs. (10 N·m), loosen nut a maximum of 1/2 turn and hit end of shaft with a plastic hammer to free assembly. Then, retighten nut until specified drag torque is obtained.

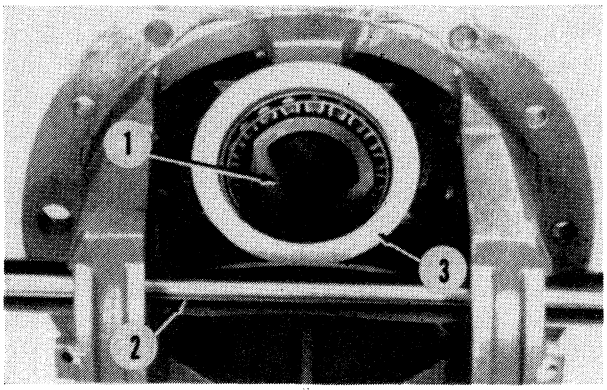


Fig. 31—To adjust pinion shaft cone point, install JDG-298 special cone point measuring tool (1) and JDG-293 discs and JDG-74-1 shaft (2) as shown. Measure gap between tools using a feeler gage or shims (3) and refer to text.

NOTE: If specified torque cannot be obtained with 1/2 turn of nut, remove shaft and renew crush bushing. Repeat adjustment procedure.

Models 4650-4850

20. ROLLING DRAG TORQUE ADJUSTMENT. The pinion shaft rolling drag torque is adjusted by changing shim washer (9A—Fig. 30) thickness. To check drag torque, install yoke (3), washer (2) and nut (1). Tighten nut to 235 ft.-lbs. (320 N·m). It may be necessary to tighten nut an additional amount until cotter pin can be installed. Do not exceed 260 ft.-lbs. (350 N·m). Use a torque wrench to measure shaft rolling torque which should be 16-25 in.-lbs. (1.8-2.8 N·m). If torque is too high, remove shaft and install a thicker shim. If torque is too low, remove shaft and install a thinner shim.

NOTE: Shims are available in 0.008 inch (0.2 mm) increments. It may be necessary to machine a shim to required thickness to obtain specified rolling torque. Be sure only flat side of shim is machined and flat side is toward yoke when installed.

All Models

21. BEARING PRELOAD AND BACKLASH ADJUSTMENT. To adjust differential carrier bearing preload and backlash between ring gear and bevel pinion, proceed as follows: Position a dial indicator against tooth of ring gear. Note backlash dimension (metric) etched on ring gear. If dimension cannot be read, use standard value of 0.008-0.011 inch (0.20-0.28 mm). Adjust slotted nuts to obtain desired backlash.

Position dial indicator against back face of ring gear. Move ring gear and differential by hand and note end play reading on dial indicator. Turn the adjusting nut on opposite side from ring gear to obtain zero end play, then tighten nut two more notches to provide desired bearing preload. Recheck backlash at three different locations around ring gear. If necessary, turn adjusting nut on ring gear side to obtain specified backlash.

NOTE: If adjusting nut on one side is loosened or tightened, the nut on the opposite side must be tightened or loosened a corresponding amount to maintain previously adjusted bearing preload setting.

Install spring pins to secure adjusting nuts. On Models 4650 and 4850, tighten bearing cap retaining screws to 140 ft.-lbs. (190 N·m).

POWER STEERING SYSTEM

OPERATION

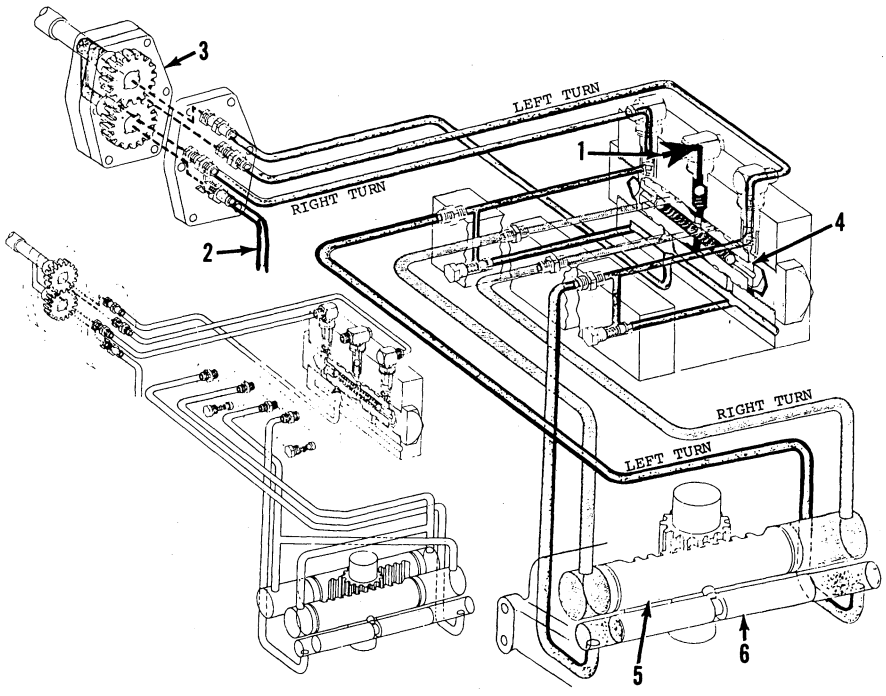
All Models

22. The power steering system consists of a metering pump (3—Fig. 32), a control valve assembly (4) and a steering motor assembly (5). Some tractors equipped with mechanical front-wheel drive (MFWD) also use external steering assist cylinders and use additional relief valves in high pressure and feedback circuits of the steering valve. No mechanical linkage exists between the steering wheel and front axle; however, steering can be manually accomplished by hydraulic pressure without normal tractor hydraulic pressure. The power steering system, in normal operation, uses pressure oil from the main hydraulic system pump to turn the front wheels.

The metering pump (3—Fig. 32) is located at the lower end of the steering wheel shaft. The oil in the metering circuit is trapped. Turning the steering wheel and metering pump gears forces the oil trapped in the metering circuit to apply pressure to one end of the control valve spool (4). The control valve spool will then move to one end of the valve body (depending on direction of turn) which opens a passage allowing pressurized main hydraulic system fluid to flow from inlet (1) through the control valve into one end of steering motor cylinder (5). As the cylinder moves, oil from the feedback piston (6) returns to the control valve and centers the valve spool after steering wheel is stopped and turn is completed.

The steering system is equipped with check valves that trap oil in the system. When engine is not running or in case of hydraulic system failure, the trapped oil is circulated within the steering system by the metering pump and pressure is exerted against both the steering motor piston and the feedback piston to turn the wheels.

There are some differences between control valves and steering motors used. The steering motor on 4650 and 4850 tractors contains two operating pistons. The pistons are identical, but on opposite sides of the spindle. Oil is directed simultaneously to opposite ends of front piston and rear piston causing pistons to move in opposite directions during a turn. On tractors equipped with MFWD, steering valve contains relief valves in the pressure oil circuit and in the return oil circuit, as oscillation of the axle when final drives are against the mechanical stops can cause higher than normal pressures in both circuits.



1. Pressure inlet
2. Metering fluid inlet
3. Metering pump
4. Control valve
5. Steering motor
6. Feedback piston

Fig. 32—Schematic view of power steering system. The dual steering motor system shown at lower left is used on 4650 and 4850 models.

TROUBLE-SHOOTING

All Models

23. Be sure all hydraulic system filters are clean and main hydraulic system is operating satisfactorily before trouble-shooting the steering system. Operate another hydraulic system function such as the rockshaft to determine whether main system has pressure. Refer to paragraph 203 if hydraulic system fails to operate properly. Some steering system problems and their possible causes are listed below.

SLOW RESPONSE OR HARD STEERING
- Tractor too heavily weighted.
- Low hydraulic system pressure. Refer to paragraph 203.
- Filter screens (17 & 23—Fig. 35) in control valve plugged.
- Steering feedback orifices plugged or damaged. Remove filter screens and check orifices in valve body.
- Cold oil in control circuit because of lack of circulation through metering pump.
- Steering valve spool (7—Fig. 35) scored or damaged causing spool to stick.
- Metering pump worn or damaged resulting in internal leakage.
- Steering motor piston seal damaged.
- Feedback piston pin (40—Fig. 37) stuck or spring (39) damaged.

STEERING WHEEL CREEPS
- The steering wheel requires constant movement to maintain straight travel.
- Steering motor feedback piston "O" rings (42—Fig. 37) damaged.
- Metering pump shims (30—Fig. 34) damaged.

FRONT WHEELS LOCK TO ONE SIDE
- Manual steering check valve seat (3—Fig. 35), ball (5) or spring (6) in steering valve defective.
- Steering valve spool (7—Fig. 35) stuck in valve body.

STEERING WHEEL CONTINUES TO TURN WITH WHEELS IN LOCK POSITION
- Check make-up oil valves (12—Fig. 35) for damage.

STEERING WANDERS
- Steering motor feedback piston pin (40—Fig. 37) stuck or spring (39) broken.

FRONT WHEELS TURN SHARPER IN ONE DIRECTION
- Steering motor spindle incorrectly indexed. Refer to paragraph 29 and Fig. 40.
- Steering stops incorrectly installed on tractor equipped with MFWD.

FRONT WHEELS TWITCH WHEN ENGINE IS STARTED OR JERK WHEN TURNING
- Air in steering system. Check for loose or damaged connections.

NO STEERING FEEL
- Metering pump friction spring (32—Fig. 34) damaged.

METERING PUMP HOSE FAILURE
- Return oil check valve (34L—Fig. 34) missing or damaged. Damage to check valve could be caused by pump friction spring (32) damage.

OIL LEAKAGE IN CONTROL SUPPORT OR OUT OF STEERING COLUMN
- Metering pump oil seal (27—Fig. 34) defective.
- Metering pump shims (30—Fig. 34) damaged.

LEAKAGE THROUGH STEERING MOTOR BLEED LINE
- Steering motor piston seal failure.

STEERING WHEEL MOVES UP AND DOWN WITH ENGINE RUNNING
- Return oil check valve (34L—Fig. 34) not seating.

ERRATIC STEERING EFFORT
- Metering pump return oil check valve (34L—Fig. 34) not seating.
- Steering control valve manual steering valves (3 and 5—Fig. 35) not seating.

LOSS OF MANUAL STEERING
- Metering pump return oil check valve (34L—Fig. 34) not seating.
- Metering pump leaking internally due to wear or damage.
- Steering valve inlet check valve (21—Fig. 35) damaged.
- Manual steering valves (3 and 5—Fig. 35) leaking.
- Make-up oil valves (12—Fig. 35) leaking.

BLEEDING

All Models

24. The power steering normally will not require bleeding. If air is present in the steering hydraulic system after service, cycling the steering wheel several times should purge air from lines and components. Air in steering system can be detected by a twitch

or jerk while turning, especially after just starting engine. If air continues to enter the system after cycling the steering wheel several times, check all lines and fittings for leaks.

PRESSURE CONTROL (PRIORITY) VALVE

All Models

25. The pressure control valve divides the main hydraulic pump fluid flow between the hydraulic lift system and the steering, brakes, differential lock and seat. The valve prevents fluid flow to the rockshaft until the demands by the "priority" functions (steering, brakes, differential lock and seat) have been met.

The pressure control valve (Fig. 33) is mounted on the right side of the clutch housing. Inspect valve spool and bore for scoring or wear and renew if necessary. Spring free length should be 4.61 inches (117 mm). Test length and load should be 3.24 inches (82.3 mm) at 56-68 pounds (248.4-303.6 N).

Refer to paragraph 215 in HYDRAULICS section to check control valve pressure setting.

METERING PUMP AND STEERING COLUMN

All Models

26. Some repairs can be accomplished without removing the steering column and metering pump from tractor. Use care not to allow dirt to enter steering system lines or ports.

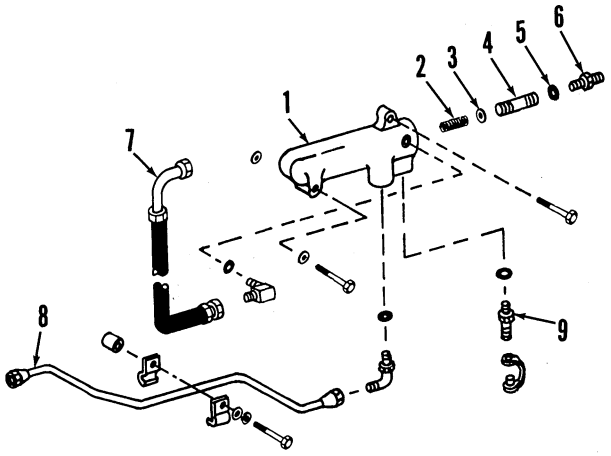


Fig. 33—Exploded view of pressure control valve and hydraulic connections used on tractors with Quad-Range transmission. Power Shift models are similar.

1. Valve body
2. Spring
3. Shim
4. Valve spool
5. "O" ring
6. Inlet from main pump
7. Hose to "priority" functions
8. Pipe to hydraulic lift
9. Test port fitting

To remove steering column and metering pump, first disconnect battery ground cables. Relieve hydraulic system pressure by turning the steering wheel several turns before disconnecting any hydraulic fittings. Remove steering wheel cap (1—Fig. 34), release knob (42) and nut (3), then remove steering wheel using a suitable puller. Remove dash cowl and dash cover. Remove snap ring (6) and withdraw sleeve (8) from steering column. Disconnect hydraulic lines from metering pump and immediately plug all openings. Detach spring (45) and remove tilt release lever (37). Remove the two cap screws securing steering column, then tilt the metering pump and steering column forward and remove column with pump through bottom opening of control support.

Unbolt and separate metering pump from steering column. Remove steering shaft (24) from steering column. Remove retaining ring (6) and separate upper steering shaft (38) from column.

Inspect bushings (19 and 22) and thrust bearing assembly (20 and 21) for wear or damage. Renew oil seal (12) if necessary. Inspect steering shaft splines for wear or damage. If splines at lower end of steering shaft are damaged, inspect metering pump for damage also.

To disassemble the metering pump, loosen the two remaining screws. Break the seal between pump body and cover, then remove screws gradually as friction spring (32) is compressed between body and cover. Examine parts of pump carefully, especially the two 0.0005 inch (0.013 mm) thick shims (30). Internal or external leakage can be caused by wrinkled, torn or otherwise damaged shims. Shims must be renewed when pump is reassembled. Pump body and gears are a matched set and must be renewed as a unit if worn or damaged. Special fittings (34) and check valve (34L) may be removed after removing jam nuts. Note location of fittings for proper reassembly.

Free length of friction spring should be 0.74 inch (18.7 mm). Spring test load should be 81-99 pounds (360-440 N) when compressed to a length of 0.52 inch (13.2 mm).

To reassemble metering pump, assemble four bolts in each corner of pump cover (35) and install two JDH-42-2 alignment dowels in center holes. Carefully install one shim onto cover, then install body over shim and cover. Position gears in body bores. Make sure that marks (1—Fig. 34A) on face of gears are toward top of pump body and that splined drive gear (2) is in upper bore. Install friction spring (32—Fig. 34) and plates (31) into idler gear. Carefully position second shim onto pump body, then lower pump base (29) over dowels onto shim. Make sure opening for steering shaft is positioned over splined drive gear. Remove and reverse position of the two lower bolts,

then install nuts and tighten to 35 ft.-lbs. (47 N·m). Remove two top bolts and alignment dowels.

Assemble steering shaft assembly and retainer plate (25) to metering pump. Tighten the four retaining bolts to 35 ft.-lbs. (47 N·m). Rotate steering shaft to make sure pump turns freely. Reinstall metering pump and steering column assembly. Start engine and cycle steering a minimum of six complete turns from lock-to-lock to bleed air from system. After bleeding, check for leaks and proper operation.

STEERING VALVE

All Models

27. The steering valve, when actuated by the metering pump, directs pressurized hydraulic fluid to the steering motor to move the front wheels. The valve body (24—Fig. 35) contains a valve spool which controls direction of pressurized oil for right or left turns and also provides a "neutral" position. Check valves are located in the valve body to provide make-up oil for the control circuit to replace oil lost during steering operations and to trap oil in steering circuit to permit manual steering when pressurized oil is not available. On tractors equipped with mechanical front-wheel drive, the steering valve (Fig. 36) also contains relief valves in the pressure and return circuits to protect system against higher than normal pressures which sometimes occur with these units.

The steering valve is located in the engine compartment. It will not be necessary to remove the valve for some service such as cleaning filter screens (17—Fig. 35). The valve spool (7) and body (24) are available only as a matched set. Specific service to valve will depend upon difficulties encountered with the steering system.

To remove steering valve, first relieve hydraulic pressure by turning steering wheel in both directions several turns. Remove side shields, grille screens and hood. Clean valve and surrounding area. Disconnect hydraulic lines and identify for proper reassembly. Cap or plug all openings in hydraulic system. Unbolt and remove valve.

To reinstall valve, reverse the removal procedure. Start engine and cycle steering to bleed air from system.

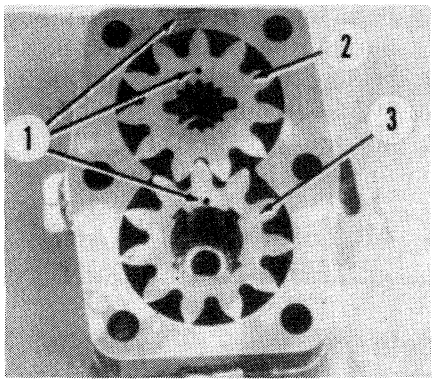
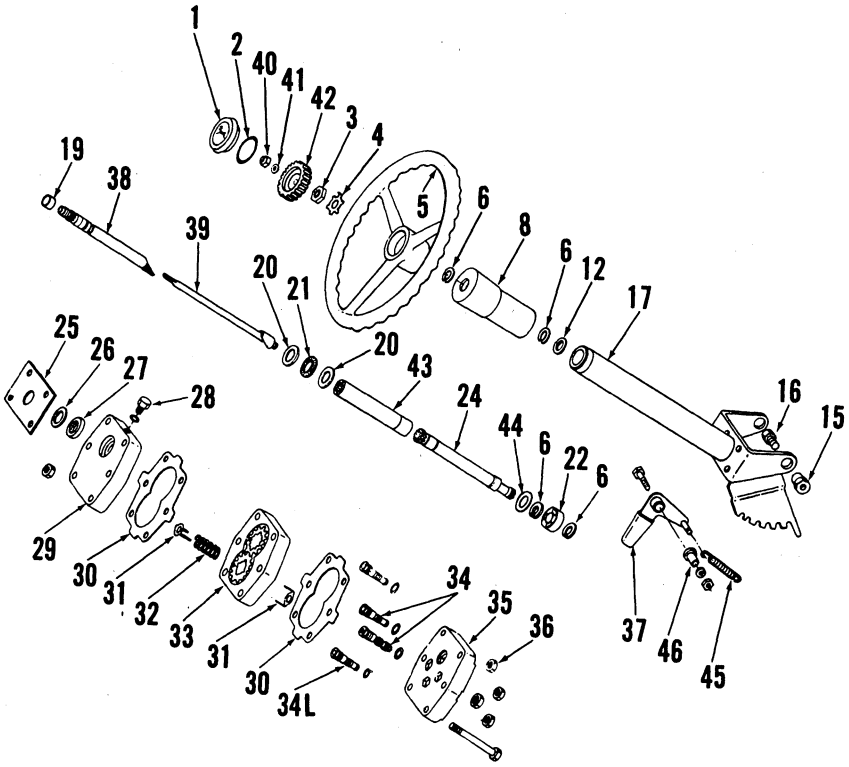


Fig. 34A—View of steering metering pump gears (2 and 3) showing proper assembly in pump body.



1. Cap
2. "O" ring
3. Nut
4. Lockwasher
5. Steering wheel
6. Snap ring
8. Sleeve
12. Oil seal
15. Bushing
16. Cap screw
17. Steering column
19. Bushing
20. Thrust races
21. Thrust bearing
22. Bushing
24. Steering shaft
25. Plate
26. Washer
27. Oil seal
28. Plug
29. Pump base
30. Shims
31. Friction plates
32. Spring
33. Pump body & gears
34. Special hose fittings
34L. Return oil check valve
35. Pump cover
36. Nut
37. Tilt release lever
38. Upper steering shaft
39. Column release rod
40. Jam nut
41. Washer
42. Release knob
43. Steering shaft coupling
44. Washer
45. Spring
46. Spacer

Fig. 34—Exploded view of metering pump and steering column assembly.

STEERING MOTOR

All Models

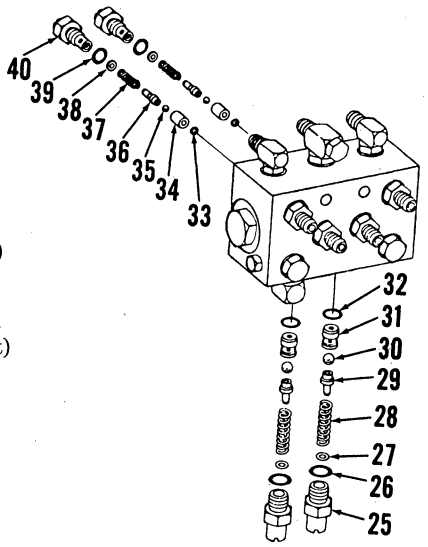
28. REMOVE AND REINSTALL. The steering motor is contained in the front axle support assembly. Most repairs can be accomplished without removing the front support on tractors not equipped with mechanical front-wheel drive by removing the front end from the side rails.

Drain oil from auxiliary reservoir and oil cooler by attaching one end of a hose to outlet of selective control valve (SCV) and secure other end of the hose in the filler tube. Operate engine at 800 rpm and actuate SCV lever so oil flows to sump. When pump begins to cavitate, shut off engine and move SCV control lever to neutral. Relieve hydraulic pressure by turning steering wheel several turns in both directions.

Remove side screens, side shields and hood. Disconnect fuel leak-off line at tank. Shut off fuel valve at bottom of tank and disconnect fuel line between tank and fuel filters. Disconnect hydraulic lines at the steering valve and at the auxiliary reservoir tank. Remove hydraulic line clamp at the radiator. Disconnect radiator tie rod from the fuel tank. Disconnect fuel sending unit wire. Unbolt and remove upper frame plates over the main hydraulic pump. Disconnect hydraulic line from top of steering motor housing. Remove cap screws securing lower frame to side frame. If equipped with mechanical front-wheel drive (MFWD), also remove cap screws securing lower frame to steering motor housing and disconnect drive shaft from front axle. Support front of tractor using a suitable stand under the clutch housing.

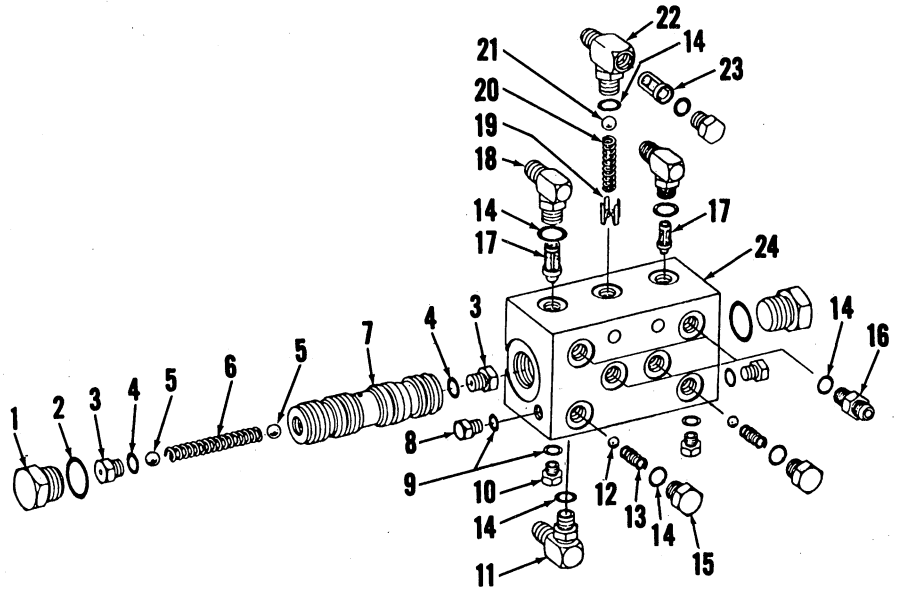
For repair without removing steering motor on tractors with standard front axle, remove front weights and support bracket. Support front end with a suitable splitting stand, then remove cap screws securing side frame rails to steering motor. Roll front end forward far enough to perform repairs to steering motor.

To remove steering motor assembly, remove front axle assembly. Remove fuel tank assembly. Disconnect hydraulic lines as necessary. Support steering motor housing with a hoist. Remove cap screws securing housing to side frames, then slide housing forward out of side frames.



25. Special plug
26. "O" ring
27. Shim
28. Spring
29. Guide
30. Steel ball
31. Relief valve seat (pressure circuit)
32. "O" rings
33. "O" rings
34. Relief valve seat (feedback circuit)
35. Steel ball
36. Spring guide
37. Spring
38. Shims
39. "O" ring
40. Special plug

Fig. 36—Additional relief valves are installed in pressure and feedback circuits in steering control valve used on tractors with mechanical front-wheel drive.



1. Plug
2. "O" ring
3. Valve seats
4. "O" ring
5. Check balls for manual steering
6. Spring
7. Control valve spool
8. Plug
9. "O" rings
10. Plug
11. Elbow
12. Check balls for make-up oil
13. Springs
14. "O" rings
15. Plug
16. Connector fitting
17. Control circuit filter screens
18. Elbow
19. Spring guide
20. Spring
21. Inlet check valve ball
22. Pressure inlet fitting
23. Filter screen
24. Valve body

Fig. 35—Exploded view of typical power steering control valve assembly. Additional parts are used on models with mechanical front-wheel drive (Fig. 36).

To reinstall steering motor housing, reverse the removal procedure. Tighten side frame to steering motor cap screws to 425 ft.-lbs. (578 N·m). On tractors with standard front axle, tighten lower frame mounting cap screws to 103 ft.-lbs. (140 N·m). On tractors equipped with MFWD, tighten lower frame to side frame cap screws to 103 ft.-lbs. (140 N·m) and lower frame to steering motor housing cap screws to 350 ft.-lbs. (475 N·m). Bleed system after installation is complete by turning steering wheel from lock-to-lock several times until operation is smooth.

29. OVERHAUL. Steering motor assembly is similar on all models. However, 4650 and 4850 tractors use two pistons while 4050, 4250 and 4450 tractors are equipped with a single piston. Refer to Fig. 37 and Fig. 38.

To disassemble, loosen cap screw securing steering arm (3) to spindle (4). Detach tie rods from steering arm if axle was not removed. Remove cap screws securing bearing retainer (15), then remove spindle assembly from housing. Remove steering arm and separate spindle and bearing from retainer. Remove washers (37). Attach a bar (B—Fig. 39) between frame mounting holes and use a spacer (S) to push piston plugs inward until retaining snap ring can be removed. Remove piston plug with "O" rings and back-up rings. Center piston (31—Fig. 37 or 38) and feedback piston (43) so pin (40) is aligned with notch in bottom of housing, then turn piston until feedback pin and spring can be removed. A special tool, JDH-42-1, is available which engages the two depressions in top of the piston to facilitate turning the piston. Withdraw steering motor piston (31) and sleeves (28). Remove snap rings (47) and plugs (46), then push feedback piston out of housing. If feedback piston bushings (41) are to be renewed, remove feedback cylinder hydraulic fittings from bottom of housing before removing bushings.

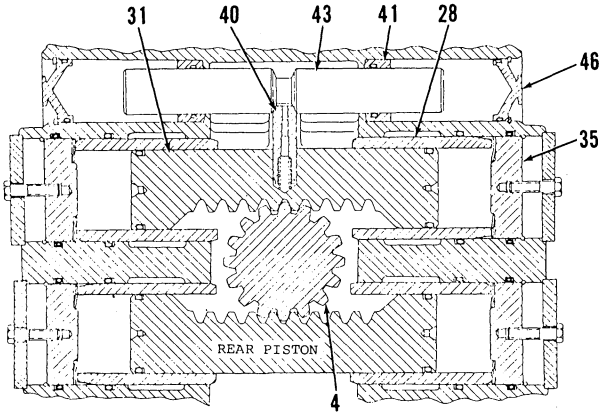
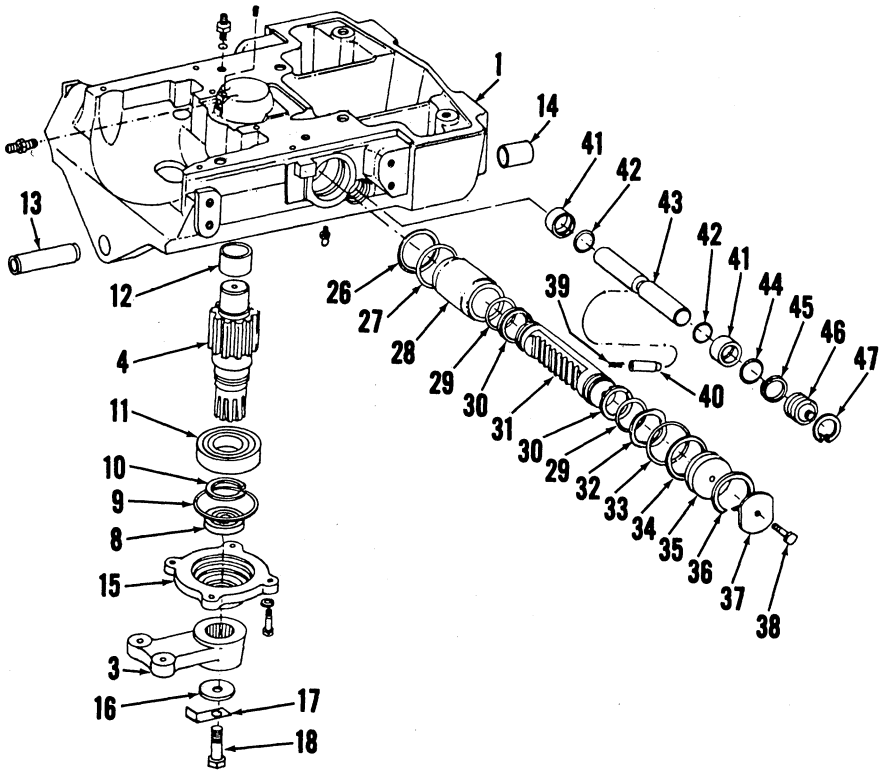


Fig. 38—Cross-sectional view of steering motor used on 4650 and 4850 tractors showing locations of pistons in relation to spindle (4). Refer to Fig. 37 legend for identification of parts.



1. Support housing
3. Steering arm
4. Spindle
8. Oil seal
9. "O" ring
10. Snap ring
11. Ball bearing
12. Bushing
13. Pivot pin
14. Bushing
15. Bearing retainer
16. Washer
17. Lockplate
18. Cap screw
26. Back-up ring
27. "O" ring
28. Cylinder sleeve
29. "O" rings
30. Back-up rings
31. Steering piston
32. Spring washers
33. "O" rings
34. Back-up rings
35. Piston plugs
36. Snap rings
37. Washers
38. Retaining screws
39. Spring
40. Special pin
41. Bushings
42. "O" rings
43. Feedback piston
44. "O" rings
45. Back-up rings
46. Plugs
47. Snap rings

Fig. 37—Exploded view of front support and steering motor assembly used on 4050, 4250 and 4450 tractors. Front support and steering motor used on 4650 and 4850 tractors is similar except two pistons (31) are used, one in front and one behind spindle (4).

Inspect all parts for excessive wear or other damage. Use the following specifications for new parts as a reference when inspecting parts for wear.

Feedback pin (40) OD—	
4050, 4250 and 4450	0.7357-0.7363 in. (18.687-18.702 mm)
4650 and 4850	0.7370-0.7375 in. (18.719-18.734 mm)
Bore for pin in piston—	
4050, 4250 and 4450	0.7365-0.7375 in. (18.707-18.733 mm)
4650 and 4850	0.7378-0.7388 in. (18.739-18.765 mm)
Pin (40) length	2.58 in. (65.6 mm)

Coat all parts with John Deere HYGARD Transmission and Hydraulic Oil or equivalent while assembling. If removed, press new feedback bushings (41) in until seated against shoulder in housing. Drive new spindle bushing (12) into housing until flush to 0.015 inch (0.38 mm) below flush with housing bore. Install spindle bearing (11) onto spindle with identification numbers toward the outside (down). Install oil seal (8), with lip facing inward, until it bottoms in bearing retainer (15). If sleeves (28) were removed, install back-up washer (26) and "O" ring (27) in housing groove. Be sure "O" ring is to the outside. Use a piloted driver to drive sleeves into bore until bottomed against housing shoulder.

Install "O" rings (42), then slide feedback piston (43) into bore. Center the feedback piston so pin groove is aligned with notch in spindle bore.

Install back-up rings (30) and "O" rings (29) in grooves of piston. Be sure back-up rings are toward center of piston. Coat piston and seal with clean hydraulic oil. Using JDH-52 piston installing tool, push piston into the sleeves in one continuous motion. Make certain the two countersunk holes in piston are toward the right side. Turn the piston to align the hole in piston with the notch in housing, then slide spring (39) and pin (40) into hole in piston. Turn piston so pin engages the groove in feedback piston. Install feedback piston plug (46) and secure with snap ring (47). Assemble back-up ring (34) and "O" ring (33) on piston plug (35) with "O" ring to the inside. Install spring washer (32) and plug into housing bore. Use bar and spacer as shown in Fig. 39 to compress spring washer enough to install retaining snap ring. Install washers (37—Fig. 37).

On 4050, 4250 and 4450 tractors, push piston against the plug on left side. On 4650 and 4850 tractors, push front piston against left plug and push rear piston against right plug. On all tractors, install spindle and bearing retainer aligning "V" mark (Fig. 40) on spindle and dash mark on retainer with dash mark on housing. Install steering arm and tighten steering arm retaining cap screw to 300 ft.-lbs. (407 N·m). Strike steering arm hub several times with a lead hammer, then retorque cap screw to specified value.

STEERING ASSIST CYLINDERS

All Models So Equipped

30. R&R AND OVERHAUL. To remove cylinders, first turn steering wheel several turns in both directions to relieve hydraulic pressure. Disconnect hydraulic lines from cylinders. Remove cap screws and retainers from pivot pins (3—Fig. 41). Thread a longer cap screw into end of pivot pins, then pull pins out of cylinder ends and remove cylinder.

To disassemble cylinder, hold cylinder barrel in a vise and pull piston (12) out of cylinder. Unscrew cylinder extension (9) from cylinder barrel.

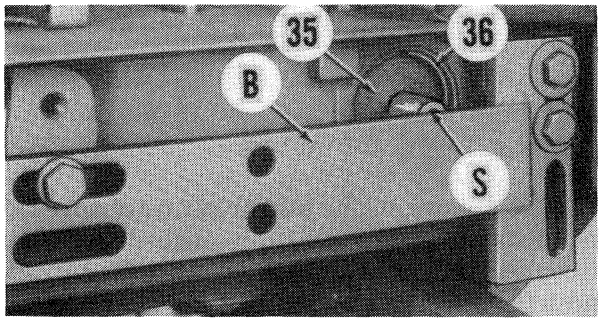


Fig. 39—Use a spacer (S) and bar (B) attached to frame mounting holes to push piston plug (35) in so snap ring (36) can be removed or installed.

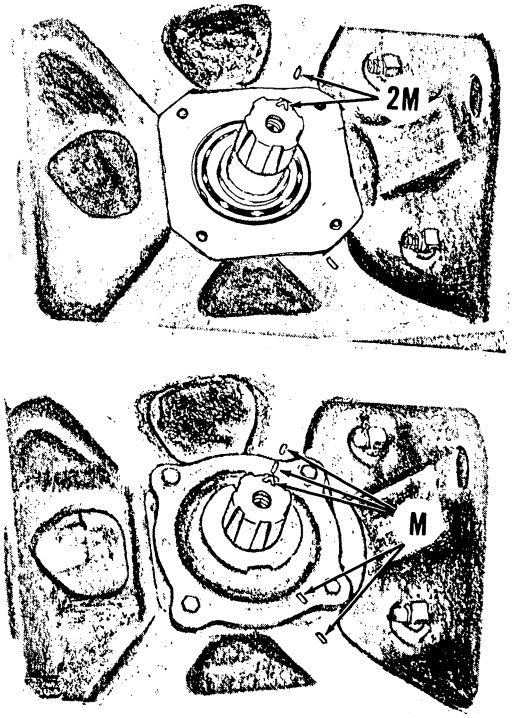


Fig. 40—Align "V" mark on spindle and dash mark on bearing retainer with dash mark on support as shown.

Inspect mounting pins (3) and thrust washers (4) for wear. Check cylinder and piston for scoring, excessive wear or other damage. Piston outer diameter should be 1.686-1.688 inches (42.82-42.88 mm) and bushing (8) inner diameter should be 1.689-1.693 inches (42.90-43.0 mm). Inspect cylinder end bushings (6) for wear or damage. When renewing bushings, be sure to align hole in bushing with the grease fitting. Bushings should be centered in the cylinder ends so thrust washers (4) will protrude about 0.040 inch (1.0 mm) above edge of cylinder ends. Renew seals (10 and 11) and "O" ring (7) in cylinder extension.

Coat all parts with John Deere HYGARD oil during assembly. Tighten cylinder extension to 170 ft.-lbs. (230 N·m). Insert piston into barrel. Reinstall cylinders onto axle. Cycle steering lock-to-lock several times to bleed air from system until operation is smooth.

ENGINE

REMOVE AND REINSTALL

All Models

31. To remove engine assembly, first remove front end assembly as follows: Drain engine coolant and disconnect battery cables. Remove batteries, right and left battery boxes and step assembly. Remove rear side shields and front side screens. Disconnect wiring to lights. Remove air intake stack, muffler extension pipe, radiator cap and fuel tank cap. Remove nuts from hood adjusting bolts, unlatch and lift off hood assembly. Disconnect air conditioning hoses at couplers under left front corner of cab. Pull hoses forward to compressor. Unbolt compressor from engine, then secure compressor and hoses to side frame with a rope. Disconnect radiator hoses, air intake hose and all wiring to front end.

NOTE: Before disconnecting hydraulic lines, relieve system pressure by loosening brake bleed screw and pumping brake until pedal goes all the way down.

Disconnect hydraulic reservoir bleed line, then loosen clamp bracket and move bleed line and wiring harness rearward to engine. Disconnect hydraulic lines from steering valve and oil cooler return line at hose connection. Shut off fuel at tank, then disconnect fuel line from fuel filter and injection leak-off line at the tank. Disconnect main pump charge line from pressure regulating valve housing. Disconnect main pump pressure line from pressure control valve and remove pressure line clamp located on side frame. If equipped with mechanical front-wheel drive, disconnect the drive shaft and remove cap screws and stud nuts securing lower frame to steering motor housing. On all tractors, remove cap screws securing lower frame to side frame rails and remove lower frame. Remove cap screws securing main hydraulic pump support to the engine. Support front of tractor at clutch housing using a suitable support stand. Remove front weights and support bracket. Support front end with D-05007ST splitting stand and D-05149ST attachments or by other suitable means. Use JDG317 socket to remove special cap screws securing engine to side frames. Pry main pump support from dowel pins on engine. Carefully roll front end assembly away from engine making sure all hydraulic lines are disconnected and not binding during separation.

Remove plug from clutch housing and drain hydraulic oil. Disconnect all wiring from engine and move rearward to cab. Disconnect heater hoses. Disconnect steering lines at the cab. Disconnect throttle control linkage and fuel shut-off cable. On Quad-Range equipped tractors, remove hitch top link attaching bracket. Remove plug from housing (behind bracket) and withdraw transmission pump drive shaft from transmission case. On Power Shift equipped tractors, loosen right-front cab mounting bolt and remove cap screws from cab mounting bracket. Disconnect C^1 and C^2 oil lines from Power Shift control valve. Remove clamp securing oil lines to clutch housing, then remove oil lines. Use JDG-268 removal tool (or similar tool) to remove clutch oil manifold tubes from clutch housing, taking care not to drop tubes into clutch housing. Remove muffler, air cleaner assembly and steering valve assembly from engine. Support engine with JDG-23 lift sling, JDG-19 mounting brackets and a suitable hoist. Remove cab floor cov-

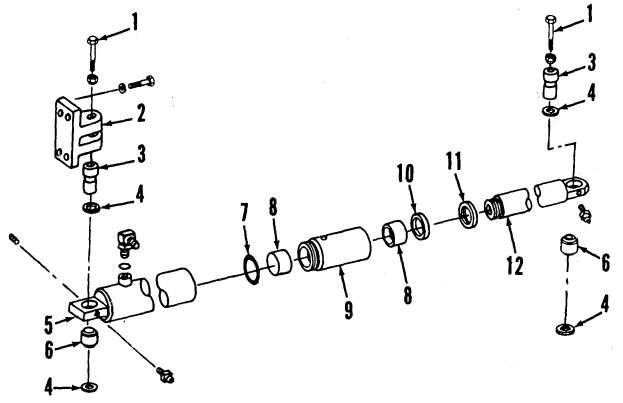


Fig. 41—Exploded view of steering assist cylinder used on some tractors equipped with mechanical front-wheel drive.

1. Cap screw
2. Bracket
3. Pin
4. Thrust washers
5. Cylinder
6. Bushing
7. "O" ring
8. Bushings
9. Cylinder extension
10. Seal
11. Seal
12. Piston

er, then remove top two engine mounting cap screws through opening in cab floor. Remove remaining cap screws securing engine to clutch housing, then separate engine from clutch housing.

NOTE: Be sure clutch shafts do not become disengaged from clutch housing and fall out during separation.

To reinstall engine, reverse the removal procedure while noting the following items: DO NOT paint mounting pad area of engine that attaches to side frames. Paint will reduce the torque retention of the special mounting cap screws.

On Power Shift equipped tractors, make certain seal rings on clutch oil manifold (2—Fig. 42) are interlocked and manifold is seated against clutch drum (1). Be sure tubes (3) are bottomed in manifold. Check for proper installation of high and low range shafts in clutch housing before reinstalling engine. When reconnecting engine to clutch housing, make certain clutch oil manifold pin (5) is engaged in pto drive gear support hole before rotating crankshaft.

On all tractors, do not use excessive force to draw engine and clutch housing together. Units should slide together when properly aligned. Tighten cap screws securing engine to clutch housing to 300 ft.-lbs. (407 N·m) and oil pan to clutch housing cap screws to 120 ft.-lbs. (163 N·m). Reinstall front end by reversing the removal procedure. Tighten cap screws securing side frame to engine to 425 ft.-lbs. (578 N·m) for 12-point screws and 480 ft.-lbs. (650 N·m) for 6-point screws. Tighten hydraulic pump support mounting cap screws to 85 ft.-lbs. (115 N·m). Tighten lower frame to side frame cap screws to 103 ft.-lbs. (140 N·m). On tractors equipped with mechanical front-wheel drive, tighten lower frame to steering motor housing cap screws to 350 ft.-lbs. (475 N·m).

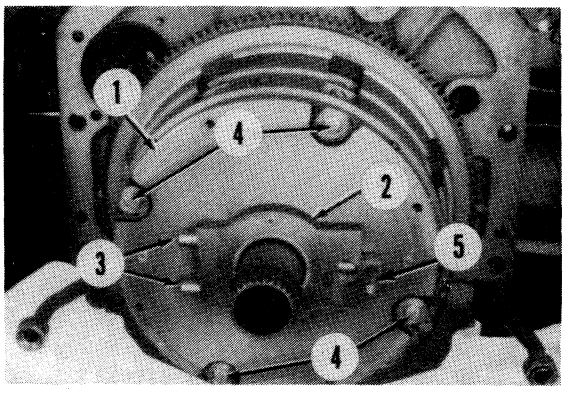


Fig. 42—Before reconnecting engine to clutch housing on Power Shift tractors, make certain that seal rings on oil manifold (2) are interlocked, tubes (3) are bottomed in manifold and manifold is seated firmly against clutch drum (1).

CYLINDER HEAD

All Models

32. To remove cylinder head, first drain cooling system and remove side panels, grille screens, air stack, exhaust stack and hood. Turn steering wheel in both directions several turns to relieve hydraulic system pressure. Disconnect and remove auxiliary reservoir hydraulic line and steering lines. Remove ether starting aid assembly. Remove lube line to turbocharger (if equipped). Remove air inlet elbow from air cleaner. Disconnect wiring harness. Remove air cleaner assembly. Remove alternator, fan and viscous fan clutch.

Remove water manifold, turbocharger (if equipped), intercooler assembly (if equipped), intake manifold and exhaust manifold. Remove fuel injection pipes and injector nozzles. Remove rocker arm cover. Remove cap screws and clamps securing rocker arm shaft, then lift rocker arm assembly off cylinder head. Identify push rods as they are removed so they can be reinstalled in their original positions. Remove cylinder head cap screws, then lift cylinder head from block using suitable lifting equipment.

NOTE: Be sure cylinder liners are held down with flat washers and bolts if crankshaft is to be turned while cylinder head is removed.

Thoroughly clean cylinder head and inspect for cracks or other damage. Use a straightedge and feeler gage to check head surface for flatness. If cylinder head is warped in excess of 0.004 inch (0.10 mm), resurface head as necessary. A maximum of 0.030 inch (0.762 mm) may be removed to true cylinder head surface. However, if distance from valve cover mounting surface to combustion face is less than 6.090 inches (154.68 mm), cylinder head must be renewed.

The cylinder head gasket is available in two different thicknesses for Model 4050. The black gasket (number R55182) is thinner than the black and blue striped gasket (number R66065). To determine which gasket to install, use a dial indicator to measure height of each piston above the cylinder block surface with pistons at top dead center. If top of the highest piston is less than 0.029 inch (0.74 mm) above cylinder block surface, use the black gasket. If the top of any one of the pistons is more than 0.029 inch (0.74 mm) above the surface of cylinder block, use the thicker, black and blue striped gasket. All other tractors use only the thinner, black gasket.

Install the cylinder head gasket dry. Cylinder head cap screws and washers should be lubricated with clean engine oil. Note different lengths of cap screws and make certain they are installed in proper location. Tighten cap screws to specified torque as follows:

NOTE: An adapter, JDE-37A, is available to tighten cylinder head cap screws located under the rocker arm shaft clamps.

Tighten cap screw (17—Fig. 44) to 165 ft.-lbs. (224 N·m) first to prevent head from moving during tightening sequence. Tighten the remaining cap screws, following sequence shown in Fig. 44, to 165 ft.-lbs. (224 N·m). Then, retighten all cap screws in the recommended sequence to a final torque of 180 ft.-lbs. (245 N·m).

Complete installation by reversing the removal procedure. Tightening torques are as follows:

Rocker shaft clamps	55 ft.-lbs. (75 N·m)
Rocker cover	25 in.-lbs. (2.8 N·m)
Injector nozzle	55-65 ft.-lbs. (75-88 N·m)
Water manifold	35 ft.-lbs. (47 N·m)
Exhaust manifold	35 ft.-lbs. (47 N·m)
Intake manifold	35 ft.-lbs. (47 N·m)
Turbocharger	35 ft.-lbs. (47 N·m)

VALVE ADJUSTMENT

All Models

33. The two-position method of valve clearance adjustment is recommended. Specified valve clearance is 0.018 inch (0.45 mm) for intake valves and 0.028 inch (0.70 mm) for exhaust valves. Refer to Fig. 45 and proceed as follows:

Turn engine crankshaft by hand using JDE-81-1 flywheel turning tool or similar engine rotation tool until number 1 and 6 pistons are at TDC. The TDC location can be determined by inserting JDE-81-4 timing pin into flywheel housing to engage timing hole in flywheel. Check the valves to determine whether number 1 or 6 piston is on compression stroke (both valves closed). Use the appropriate diagram in Fig. 45 and adjust the valves indicated. Turn crankshaft one complete revolution until the "TDC" mark is again aligned, then adjust remainder of valves indicated in the other diagram in Fig. 45.

Valves should be adjusted after the first 600 hours of operation, then every 1200 hours thereafter.

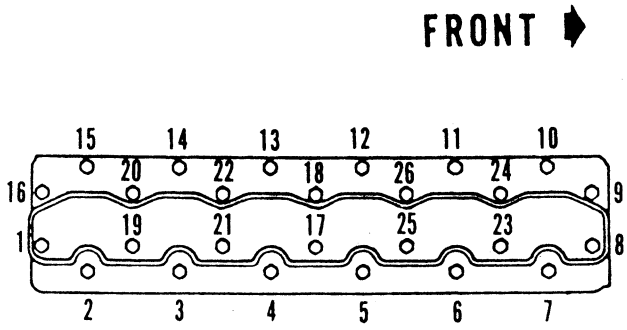


Fig. 44—Use the sequence shown to tighten the cylinder head retaining cap screws.

VALVES, SEATS AND VALVE GUIDES

All Models

34. On Model 4050, valve face angle is 44-1/2 degrees and valve seat angle is 45 degrees. On all other models, valve face angle is 29-1/2 degrees and valve seat angle is 30 degrees.

All models are equipped with hardened valve seat inserts which are pressed into machined counterbores in cylinder head. Valve seat width should be 0.083-0.093 inch (2.11-2.36 mm). After regrinding valve seats and valve faces, measure installed height of valves in cylinder head. On Model 4050, intake valve should be recessed 0.034-0.057 inch (0.86-1.45 mm) below surface of cylinder head and exhaust valve should be recessed 0.047-0.070 inch (1.19-1.78 mm). On all other models, both intake and exhaust valves should protrude 0.024-0.038 inch (0.61-0.97 mm) beyond gasket surface of cylinder head. Manufacturer recommends renewing valve seat inserts and/or valves if valve height does not meet specifications. When renewing valve seat inserts, use suitable removing and installing tools to avoid damage to

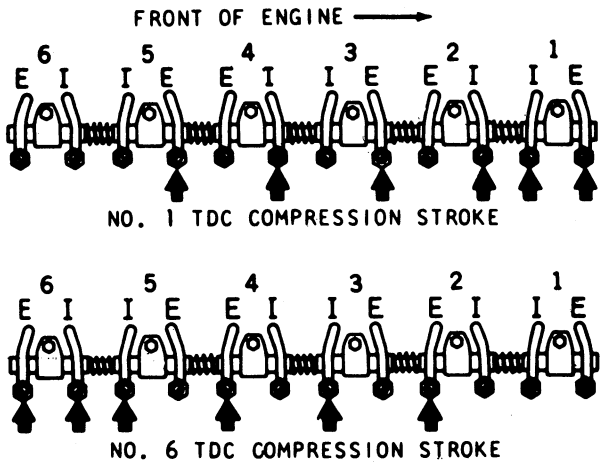


Fig. 45—Adjust valves indicated by arrows in upper half of Fig. when number 1 piston is at TDC on compression stroke. Adjust remainder of valves indicated in lower half of Fig. when number 6 piston is at TDC on compression stroke.

cylinder head or seats. Chill new seat insert in a freezer or dry ice before installing. Inserts are also available in 0.010 inch (0.25 mm) oversize for installation when cylinder head counterbore is damaged and must be machined. To install oversize inserts, machine cylinder head counterbores to the following dimensions: On Model 4050, intake should be 1.9465-1.9475 inches (49.44-49.47 mm) and exhaust should be 1.7585-1.7595 inches (44.67-44.69 mm). On all other models, both intake and exhaust should be 1.7585-1.7595 inches (44.67-44.69 mm).

Intake and exhaust valve stem diameter is 0.3715-0.3725 inch (9.44-9.46 mm). Recommended stem-to-guide clearance is 0.002-0.004 inch (0.051-0.102 mm) and maximum allowable clearance is 0.006 inch (0.15 mm). If clearance does not exceed 0.010 inch (0.25 mm), valve guides may be knurled to provide specified valve stem to guide clearance. If clearance is greater than 0.010 inch (0.25 mm), guide bore should be reamed to appropriate oversize and a new valve with a matching oversize stem installed. Be sure to reseat valve after guide has been knurled or reamed oversize. Wear caps are used on the end of the valve stem on all valves. Renew caps if pitted or worn.

VALVE SPRINGS AND ROTATORS

All Models

35. Positive type valve rotators are installed on both intake and exhaust valves. Make certain rotators turn freely. Renew the complete unit if worn or damaged.

Intake and exhaust valve springs are identical and may be installed either end up. Renew any spring which is distorted, rusted or discolored, or does not meet the following test specifications. Compressed height should be 1.81 inches (46 mm) with a force of 54-62 pounds (240-276 N) and 1.36 inches (34.5 mm) with a force of 133-153 pounds (591-680 N).

ROCKER ARMS

All Models

36. The rocker arm shaft is supported in bosses cast into cylinder head and is held in place by clamps. Shaft rotation is prevented by a spring pin in cylinder head which enters a hole in shaft and also ensures correct positioning of lubrication passages.

When disassembling rocker arms, identify all parts in order of removal so they can be reinstalled in their original positions. Rocker arms are right-hand and left-hand assemblies. Inside diameter of rocker arms should be 0.7505-0.7525 inch (19.06-19.09 mm) and outside diameter of rocker shaft should be 0.7484-0.7500 inch (19.01-19.05 mm). Inspect end of rocker arm that contacts valve wear cap for wear. Renew parts that are excessively worn or otherwise damaged. Be sure oil holes in rocker arm shaft are open before reassembling.

TIMING GEAR COVER AND CRANKSHAFT FRONT OIL SEAL

All Models

37. To remove the timing gear cover, first drain cooling system. Remove side panels, grille screens and hood. Remove attaching cap screws and slide oil cooler out right side. Disconnect radiator hoses and remove mounting cap screws. Remove shroud mounting screws and move shroud rearward against engine for clearance. Remove radiator out left side of tractor. Remove fan belts, alternator, fan idler, fan and viscous drive assembly and water pump assembly. Remove main hydraulic pump drive shaft and coupler. Remove crankshaft damper pulley using a suitable forcing screw type puller. Do not use a jaw type puller on outer diameter of pulley as rubber portion of damper may be damaged. Remove cover retaining cap screws and withdraw timing gear cover and injection pump gear cover. Use a punch to tap oil seal out of cover.

The lip type oil seal is supplied in a kit which also includes a steel wear sleeve which is pressed onto the crankshaft. To remove the wear sleeve (Fig. 47), score old sleeve lightly with a blunt chisel and pry sleeve off shaft. Do not cut through wear sleeve as the crankshaft could be damaged. Coat inner surface of new sleeve with Permatex Number 3 or equivalent, then install with a suitable screw-type driver such as JDE-3. Drive oil seal into front cover until face of seal is 0.33 inch (8.4 mm) below front surface of cover. Be sure spring side of seal faces inward. Lubricate seal lip and wear sleeve with engine oil prior to reassembly.

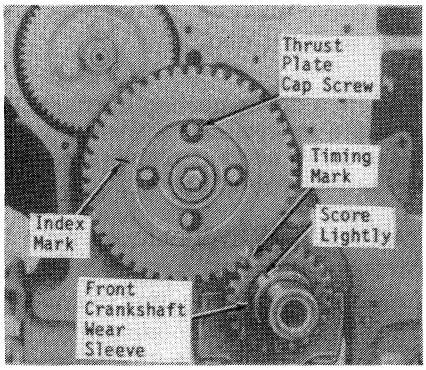


Fig. 47—To remove oil seal wear sleeve, score sleeve with a blunt chisel and pry from crankshaft. Timing "V" marks must be aligned as shown when installing timing gears.

Reinstall timing gear cover and tighten mounting cap screws evenly to 20 ft.-lbs. (27 N·m). To reinstall damper pulley, use a cap screw one inch (25 mm) longer than original screw and a hardened washer to pull pulley onto crankshaft until cap screw bottoms out. Install original cap screw with hardened washer and tighten to 150 ft.-lbs. (203 N·m). Complete installation by reversing the removal procedure.

TIMING GEARS

All Models

38. The timing gear train consists of crankshaft gear, camshaft gear, injection pump drive gear (which is mounted on rear of camshaft gear) and injection pump gear as shown in Fig. 47. Renew gears if excessively worn or damaged. Check for slippage between camshaft gear and injection pump gear. An indexing mark (Fig. 47) is scribed across the parting line of the two gears. If marks are not aligned, gear assembly should be renewed. Camshaft gear and crankshaft gear are a press fit on their respective shafts.

Before reinstalling crankshaft gear, heat gear to about 350° F (175° C). Install gear onto crankshaft using a suitable driver. To renew camshaft gear, it is recommended that camshaft be removed from engine. Make certain "V" timing marks on crankshaft and camshaft gears are aligned when gears are reinstalled.

CAMSHAFT AND BEARINGS

All Models

39. To remove camshaft, first separate front end from engine as follows: Drain cooling system. Disconnect and remove batteries. Remove battery boxes and left step assembly. Remove side panels, grille screens and hood. Disconnect air conditioning hoses at couplers under left front corner of cab, then pull hoses forward to the compressor. Remove air conditioning compressor from engine and secure to side of frame with a rope. Disconnect air intake hose and all electrical wiring to front end.

NOTE: Before disconnecting hydraulic lines, relieve pressure in hydraulic system by loosening brake bleed screw and pumping brakes until pedal goes all the way down.

Disconnect auxiliary hydraulic reservoir bleed line, oil cooler return oil line at hose connection, steering lines at steering valve, main pump charge line at pressure regulating housing and main pump pressure line at pressure control valve housing. Shut off fuel supply at the tank. Disconnect injector leak-off line at the tank and fuel supply line at the filter. Disconnect radiator hoses. Remove cap screws securing lower frame to side frames. If equipped with mechanical front-wheel drive, also remove cap screws and stud nuts securing lower frame to steering motor and disconnect drive shaft at the front axle. On all tractors, remove cap screws securing main hydraulic pump support to the engine block. Remove pressure line clamp from side frame. Remove front weights and support bracket. Support front of tractor with a suitable stand under clutch housing. Support front end assembly with a suitable splitting stand or hoist. Remove cap screws securing side frame to engine, then carefully roll front end away from engine.

Rotate crankshaft until number 1 piston is at TDC on compression stroke. Remove timing gear cover as outlined in paragraph 37. Remove rocker arm cover, rocker arm assembly and push rods. Raise and secure cam followers in their uppermost position using magnetic holders or other suitable means. Remove tachometer drive (if equipped) from right side of engine. Working through openings in camshaft gear, remove the cap screws securing camshaft thrust plate to engine block. Carefully withdraw camshaft and gear from cylinder block.

The camshaft journal outside diameter should be 2.3745-2.3755 (60.31-60.33 mm) and bushing inside diameter should be 2.3775-2.3795 inches (60.39-60.44 mm). Recommended clearance between journals and bushings is 0.002-0.005 inch (0.05-0.13 mm) and maximum allowable clearance is 0.006 inch (0.15 mm). To renew camshaft bushings, the engine must be separated from the clutch housing and the clutch, flywheel and camshaft bore plug removed. Use a suitable piloted puller, such as JDE-6, to remove and install bushings. Make sure oil supply holes in block are aligned with holes in bushings. The elongated hole in bushing goes to the top.

Inspect camshaft lobes and cam followers for wear or damage. Camshaft and cam followers should be renewed as an assembly.

Camshaft end play is controlled by the camshaft thrust plate. End play can be measured with a dial indicator when camshaft is installed, or with a feeler gage when camshaft is removed from engine. Desired end play is 0.0045-0.0095 inch (0.11-0.24 mm) and maximum allowable end play is 0.015 inch (0.38 mm). Thrust plate thickness (when new) is 0.186-0.189 inch (4.72-4.80 mm).

Camshaft gear and injection pump gear assembly are a press fit on camshaft. Be sure thrust plate and spacer are positioned on shaft before reinstalling gears. Align Woodruff key and keyway in gear, then press gear on until it bottoms against camshaft shoulder. Tighten camshaft gear cap screw to 85 ft.-lbs. (115 N·m).

Coat camshaft lobes and journals with high temperature grease before reinstalling. Align timing "V"

marks (Fig. 47) on camshaft and crankshaft gears. Make certain injection pump static timing marks are aligned as outlined in paragraphs 68 and 71. Tighten thrust plate cap screws to 20 ft.-lbs. (27 N·m). Complete installation by reversing the removal procedure.

ROD AND PISTON UNITS

All Models

40. Connecting rod and piston units are removed from above after removing cylinder head, oil pan, oil pump and rod bearing caps.

NOTE: Air impact wrench should not be used to remove or install connecting rod cap screws as damage to threads may result. Before attempting to remove rod and piston units, secure cylinder sleeves in block with short cap screws and washers (Fig. 48) and remove carbon and ring ridge (if present) from top of sleeves.

Keep bearing inserts with their respective rods and caps. Mark rods, caps and pistons to ensure correct reassembly in original location. Connecting rods and top of pistons are stamped "FRONT" for proper installation.

NOTE: Connecting rod cap screws must be renewed once they have been removed.

Tighten connecting rod cap screws using the torque-turn method as follows: Dip cap screws and washers in clean engine oil. Tighten screws in first step to 20 ft.-lbs. (27 N·m), then tighten to 55 ft.-lbs. (75 N·m) in second step. Mark the socket and rod cap as shown in Fig. 51, then tighten each rod cap screw an additional 1/4 turn (90 degrees).

PISTONS AND RINGS

All Models

41. All models are equipped with aluminum alloy, cam ground pistons which use two compression rings and one oil control ring. The manufacturer recommends cleaning pistons using Immersion-Solvent "D-Part," Hydra-Jet Rinse Gun, glass bead blasting machine or hot water with liquid detergent soap. When washing pistons, use a stiff bristle brush—NOT a wire brush—to loosen carbon deposits.

Pistons and sleeves are selectively fitted to provide specified piston to sleeve clearance. Pistons marked with an "L" and color-coded green should only be used with sleeves that are stamped "LL." Pistons stamped with "H" and color-coded yellow, should only be used with sleeves stamped with "HH." Be sure to keep matched pistons and sleeves together.

Inspect piston head and piston pin bore for cracks or other damage. Check piston skirt for scoring or ex-

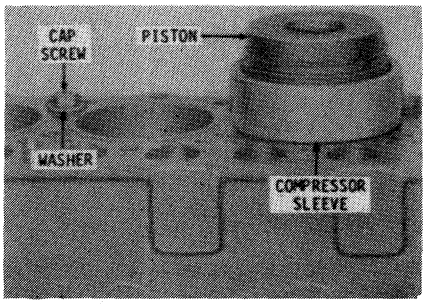


Fig. 48—When cylinder head is removed, secure sleeves in cylinder block using short cap screws and flat washers.

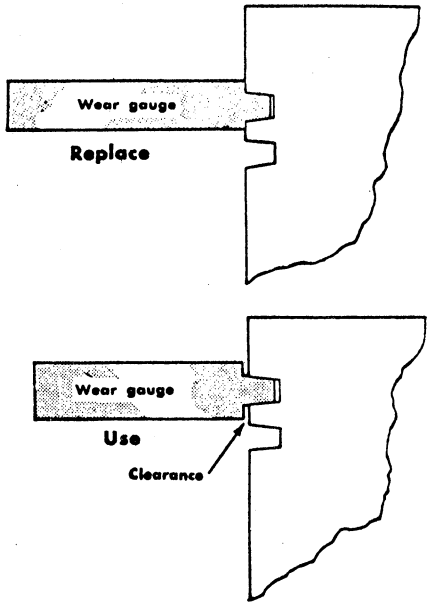


Fig. 49—Use JDE-55 Wear Gage to check keystone ring groove wear. Diagram at top shows gage inserted in worn ring groove, and lower diagram shows gage in a good ring groove. Renew piston if gage contacts ring land.

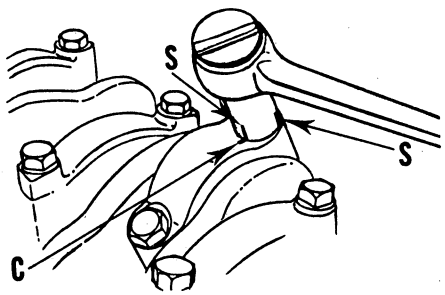


Fig. 51—Tighten connecting rod cap screws to an initial torque of 55 ft.-lbs. (75 N·m), then tighten an additional 1/4 turn (90 degrees). Do not depend on location of socket wrench handle. Instead, mark the socket at four equally spaced (90 degrees) locations (S), mark rod cap (C) in line with one mark on socket, then turn socket until next mark is aligned.

cessive wear. If any defects are found, piston and sleeve must be renewed as a unit.

All models have keystone type compression rings in the two top grooves. A rectangular oil control ring is used in the lower groove. A special ring groove wear gage, JDE-55, is necessary for checking the keystone grooves for wear. If gage shoulders contact ring land (Fig. 49), ring groove is excessively worn. If gage enters groove as shown in lower diagram, ring groove is still good. Oil control ring groove wear may be checked using a feeler gage to measure side clearance between top of a new oil ring and top of groove. Recommended clearance is 0.002-0.004 inch (0.06-0.10 mm) and maximum allowable clearance is 0.0065 inch (0.16 mm). Renew piston and sleeve if ring groove wear is excessive.

When reinstalling rings onto piston, end gap of oil control expander ring should be on opposite side of piston from end gap of oil control ring. Install compression rings with side marked "Pip" facing top of piston. End gap of second compression ring should be staggered 90 degrees from end gap of oil ring, and end gap of top compression ring should be staggered 180 degrees from oil ring end gap. Coat pistons and sleeves with SAE 10W oil and use a suitable ring compressor when reinstalling pistons into sleeves.

CYLINDER SLEEVES

All Models

42. The renewable, wet type cylinder sleeves are available only as a matched sleeve and piston set. Sleeves stamped "LL" are matched with pistons marked "L" and sleeves stamped "HH" are matched with pistons marked "H." Always keep matched pistons and sleeves together and identified with the cylinder bore from which they were removed for proper reassembly.

Sleeve flange at upper edge is sealed by the cylinder head gasket. Sleeves are sealed at lower end by square packing and "O" rings shown in Fig. 52. Sleeves normally require loosening by a sleeve puller, after which they can be withdrawn by hand.

Check sleeves visually for wear and renew if any of the following conditions are found: On turbocharged engines, the crosshatch honing pattern is not visible at upper end of top ring travel. On naturally aspirated engines, crosshatch honing pattern is not visible all the way around sleeve in more than 75 percent of the ring travel area. On all engines, renew sleeves if pitted or if they contain vertical scratches that can be detected with your fingernail.

With sleeve removed, inspect for fatigue cracks in the flange area and ring travel area. Check exterior of sleeve for pitting or erosion. Sleeve may be reused if depth of pits or erosion is less than one-half the thickness of the sleeve wall, which is 0.240 inch (6.1 mm). When reinstalling these sleeves, rotate sleeve 90 degrees from original position.

Out-of-round or taper of sleeve bore should not exceed 0.002 inch (0.05 mm). Maximum allowable clearance between piston and sleeve is 0.006 inch (0.15 mm). Specifications for new pistons and sleeves are as follows:

Model 4050

Piston Skirt Diameter*—
- Marked "L" ..... 4.5577-4.5584 in. (115.77-115.78 mm)
- Marked "H" ..... 4.5584-4.5591 in. (115.76-115.80 mm)

Sleeve Bore Diameter—
- Marked "LL" ..... 4.5615-4.5625 in. (115.86-115.88 mm)
- Marked "HH" ..... 4.5625-4.5635 in. (115.88-115.91 mm)

Piston Skirt to Sleeve
- Clearance ..... 0.0036-0.0053 in. (0.09-0.13 mm)

Models 4250-4450-4650-4850

Piston Skirt Diameter*—
- Marked "L" ..... 4.5575-4.5582 in. (115.76-115.78 mm)
- Marked "H" ..... 4.5582-4.5589 in. (115.78-115.80 mm)

Sleeve Bore Diameter—
- Marked "LL" ..... 4.5615-4.5625 in. (115.86-115.88 mm)

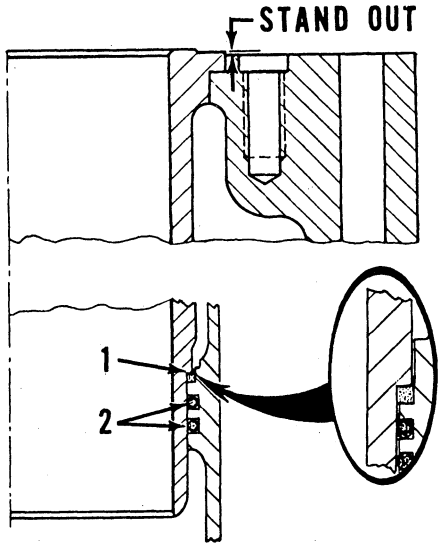


Fig. 52—Cross-sectional view of cylinder sleeve showing square section packing (1) and round "O" rings. Refer to text for correct installation of cylinder sleeves and "O" rings.

Marked "HH" ..... 4.5625-4.5635 in. (115.88-115.91 mm)
Piston Skirt to Sleeve Clearance ..... 0.0036-0.0053 in. (0.09-0.13 mm)

*Measure piston skirt at right angle to piston pin 0.090 inch (2 mm) from bottom of skirt.

When reinstalling sleeves, first make sure sleeve and block bore are clean. Carefully remove all rust and scale from seating surfaces and packing grooves in block. If sleeves are being reused, use a flexible ball type hone to deglaze sleeve bore and obtain a 45 degrees crosshatch pattern. Install sleeves without seals and secure with short cap screws and flat washers. Tighten cap screws to 50 ft.-lbs. (68 N·m). Check sleeve stand out (Fig. 52) at several locations around each sleeve. Stand out should be 0.001-0.004 inch (0.025-0.102 mm) for used sleeves and 0.002-0.005 inch (0.050-0.127 mm) for new sleeves. If stand out is excessive, check for scale or burrs. If stand out is less than specified, select another sleeve and recheck stand out. After matching sleeves to bores, remove and mark sleeves. Refer to the following paragraph for packing and "O" ring installation.

Apply liquid soap, such as part number AR54749, to square packing and "O" rings before installation.

NOTE: DO NOT use oil on packing or "O" rings as oil can cause the red "O" ring to swell.

Slide square packing ring (1—Fig. 52) up against shoulder on sleeve. Make sure the ring is not twisted. Install red "O" ring in upper groove in cylinder block and black "O" ring in lower groove in cylinder block. Be sure "O" rings are completely seated in the grooves so they will not be damaged when installing the sleeve. Coat sealing area of the cylinder liner and cylinder block with liquid soap, then install sleeves carefully into correct cylinder bore. Note "LL" or "HH" marking on sleeve flange and position sleeves so markings are toward the front of the engine. Work sleeves into position using hand pressure until upper flange is nearly flush with top of block, then use a hardwood block and a hammer to finish seating sleeves into their bores. Hold sleeves in place with flat washers and short cap screws during installation of pistons.

NOTE: Sleeves will protrude over top of cylinder block more than normal due to uncompressed packing and "O" rings.

PISTON PINS

All Models

43. The full floating type piston pins are retained in piston bosses by snap rings. The recommended fit of piston pins is a hand push fit in piston bores and a slip fit in connecting rod bushings. Standard diameter and clearances are as follows:

Model 4050
Piston Pin Diameter ..... 1.6247-1.6253 in. (41.27-41.28 mm)
Bore in Piston for Pin ..... 1.6253-1.6259 in. (41.28-41.30 mm)
Connecting Rod Bushing Bore ..... 1.6260-1.6270 in. (41.30-41.33 mm)
Piston Pin to Rod Bushing Clearance—
Desired ..... 0.0007-0.0023 in. (0.018-0.058 mm)
Wear limit ..... 0.003 in. (0.076 mm)

Models 4250-4450-4650-4850
Piston Pin Diameter ..... 1.8739-1.8745 in. (47.60-47.61 mm)
Bore in Piston for Pin ..... 1.8748-1.8752 in. (47.62-47.63 mm)
Connecting Rod Bushing Bore—
Prior to engine S.N. 227650 ..... 1.8752-1.8762 in. (47.63-47.65 mm)
Engine S.N. 227650 and after ..... 1.8762-1.8772 in. (47.65-47.68 mm)
Piston Pin to Rod Bushing Clearance—
Prior to engine S.N. 227650
Desired ..... 0.0007-0.0023 in. (0.018-0.058 mm)
Wear limit ..... 0.003 in. (0.076 mm)
Engine S.N. 227650 and after
Desired ..... 0.0017-0.0033 in. (0.042-0.084 mm)
Wear limit ..... 0.004 in. (0.10 mm)

CONNECTING RODS AND BEARINGS

All Models

44. A renewable bushing is used in small end of connecting rod and precision, insert type bearings are used in the big end. Mating surfaces of rod and cap have a milled tongue and groove which positively locate cap and prevent it from being reversed during

installation. Connecting rods are marked "FRONT" for proper installation.

Check connecting rods for wear or damage. Install cap without bearing inserts and tighten original cap screws using the "torque-turn" method as outlined later in this section. Measure inner diameter of rod bore at locations "A", "B" and "C" shown in Fig. 53. Specified bore diameter is 3.191-3.192 inches (81.051-81.077 mm). If difference between any of the measurements exceeds 0.001 inch (0.025 mm), connecting rod should be renewed. Refer to paragraph 43 for specifications concerning piston pin bushings. When renewing pin bushing, be sure to align lubrication holes in bushing and connecting rod. Bushings must be honed to proper size after installation. Check connecting rod bearings and crankpins for wear and refer to the following specifications. Undersize bearings are available.

Crankpin Standard
Diameter ..... 2.998-2.999 in. (76.15-76.18 mm)
Crankpin to Rod Bearing
Diametral Clearance—
Desired ..... 0.0012-0.0042 in. (0.03-0.10 mm)
Wear limit ..... 0.006 in. (0.15 mm)

NOTE: Connecting rod cap screws should always be renewed once they have been removed.

Connecting rod cap screws are tightened using the "torque-turn" method as follows: Dip cap screws and washers in clean engine oil. Tighten cap screws evenly to 20 ft.-lbs. (27 N·m) in the first step, then tighten to exactly 55 ft.-lbs. (75 N·m) in the second step. Finally, mark the socket at four equally spaced (90 degree) locations as shown in Fig. 51 and mark rod cap (C) in line with one mark on the socket. Then tighten each cap screw an additional 1/4 turn (90 degree) so next mark on socket aligns with mark on rod cap.

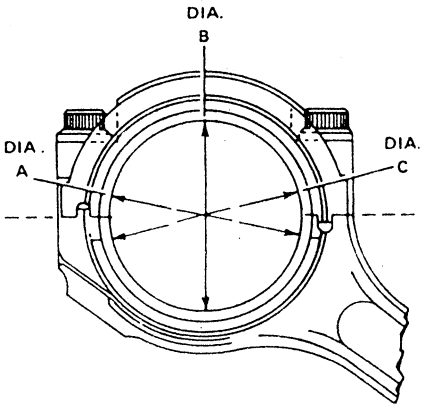


Fig. 53—Measure inner diameter of connecting rod bore (without bearing insert) at locations shown. Renew connecting rod if bore is out-of-round in excess of 0.001 inch (0.025 mm).

CRANKSHAFT AND BEARINGS

All Models

45. The crankshaft is supported in seven main bearings. Crankshaft end play is controlled by thrust washers located on both sides of fifth main bearing. All main bearing caps and bearings can be removed from below after removing oil pan and oil pump. Caps are numbered for proper reassembly.

To remove crankshaft, first remove engine as outlined in paragraph 31. Remove flywheel and rear oil seal retainer. Remove front damper pulley using a suitable forcing screw type puller. Do not use a jaw type puller as rubber portion of damper could be damaged. Remove timing gear cover, oil pan and oil pump. Remove connecting rod bearing caps. Before removing main bearing caps, make sure caps are numbered to ensure correct reassembly. Use a suitable hoist and lifting sling to lift crankshaft out of block.

Inspect crankshaft for signs of cracks, scoring or excessive wear. Measure journals to check for out-of-round or taper. Crankshaft should be reground if taper exceeds 0.0001 inch (0.0025 mm) per inch (25 mm) of journal length or if journals are out-of-round in excess of 0.001 inch (0.025 mm). Check crankshaft and bearings against the following values.

Crankshaft End Play—
Desired ..... 0.0015-0.0150 in. (0.038-0.380 mm)
Main Journal—
Standard diameter ..... 3.372-3.373 in. (85.65-85.67 mm)
Desired clearance in main bearing ..... 0.0012-0.0042 in. (0.03-0.10 mm)
Wear limit ..... 0.006 in. (0.15 mm)
Crankpin—
Standard diameter ..... 2.998-2.999 in. (76.15-76.18 mm)
Desired clearance in rod bearing ..... 0.0012-0.0042 in. (0.03-0.10 mm)
Wear limit ..... 0.006 in. (0.15 mm)

Before reinstalling the crankshaft, remove piston cooling orifices from cylinder block and clean with

a small brush. Make sure all oil passages are clean. Reinstall orifices and tighten to 85-110 in.-lbs. (10-12 N·m).

To reinstall crankshaft, proceed as follows: Assemble upper bearing inserts into cylinder block making sure oil slots are aligned with oil passages in block. Lubricate bearings and crankshaft journals with oil, then lower crankshaft into block. Assemble bearing caps with bearing inserts making sure recesses and bearing tabs are aligned. Be sure bearing caps are reinstalled in their original positions. Numbers stamped on caps should be on same side as the numbers on the block.

Dip each main bearing cap screw and washer in clean engine oil. Tighten number 5 bearing cap screws finger tight, then tighten all other bearing cap screws to 50 ft.-lbs. (68 N·m). Pry crankshaft forward and rearward to align thrust washers, then measure crankshaft end play. If end play is not within recommended range of 0.0015-0.015 inch (0.038-0.380 mm), renew thrust washers. An oversize thrust washer set is available as well as standard size.

Tighten all main bearing cap screws to 150 ft.-lbs. (203 N·m). Install a new crankshaft rear oil seal as outlined in paragraph 46. Complete installation by reversing the removal procedure.

CRANKSHAFT REAR OIL SEAL

All Models

46. The crankshaft rear oil seal is contained in a retainer plate which is mounted on rear face of cylinder block. A steel wear sleeve is used on the crankshaft rear flange. The seal is available only as an assembly which includes steel wear sleeve. Observe the following precautions to ensure proper seal installation.

Do not separate seal and wear sleeve assembly as attempt to reassemble will damage seal. Do not use any lubricant on seal during installation. Special installing tools, JDG-477 and JDG-478, must be used to properly install the seal and sleeve as an assembly. Install seal assembly with black seal lip and wear sleeve ID chamfer facing inward.

To renew oil seal, unbolt and remove seal retainer. Tap seal out of retainer. Lightly score wear sleeve with a dull chisel, then pry sleeve from crankshaft flange. Do not cut all the way through sleeve as crankshaft could be damaged. Clean crankshaft flange with emery cloth.

Reinstall seal retainer onto cylinder block but do not tighten retaining screws. Assemble JDG-478 installing tool over crankshaft flange and into seal retainer bore to center retainer, then tighten retainer cap screws to 20 ft.-lbs. (27 N·m). Remove installing tool and install JDG-477 pilot tool onto crankshaft flange. Start oil seal and wear sleeve assembly onto crankshaft flange. Assemble JDG-478 installer over pilot tool and tighten installer nut until installer tool bottoms against face of pilot tool. Oil seal and wear sleeve are now properly positioned. Remove tool set from crankshaft.

FLYWHEEL

All Models

47. Inspect flywheel and ring gear for wear or damage and renew if necessary. To remove ring gear, first heat the gear to expand it, then drive ring gear off flywheel. Heat new ring gear to 300° F (150° C) prior to installation. Do not overheat as gear heat treatment could be destroyed. Drive ring gear flush against flywheel shoulder making sure beveled edge of gear teeth face toward front of engine.

When reinstalling flywheel, coat threads of mounting cap screws with sealing compound. Tighten evenly to 85 ft.-lbs. (115 N·m).

CLUTCH SHAFT PILOT BUSHING AND ADAPTER

Quad-Range Models

48. The clutch pilot bushing is carried in an adapter which is pressed into end of crankshaft. Inside diameter of bushing should be 1.0025-1.0055 inches (25.53-25.54 mm) and outside diameter of clutch shaft should be 0.9995-1.0005 inches (25.38-25.41 mm).

The pilot bushing can be removed using a blind hole puller to withdraw bushing from adapter. If necessary, adapter can be pulled from crankshaft as shown in Fig. 54. Install a bolt and a flat washer which will fit into adapter bore. Install a snap ring in adapter bore groove to prevent washer from coming out of bore. Use a puller crossblock and two cap screws in

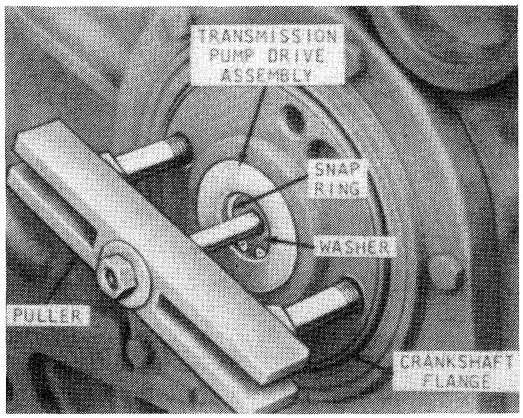


Fig. 54—Clutch shaft pilot bushing adapter can be removed from crankshaft using a suitable puller as shown. Refer to text.

crankshaft flange to pull adapter. Drive new adapter and bushing in until adapter bottoms in crankshaft bore.

OIL PUMP

All Models

49. To remove engine oil pump, first drain engine oil and remove oil pan. Remove mounting cap screws from oil cooler bypass housing and oil pump. Remove outlet tube from pump cover, then withdraw pump assembly.

Flush pump internally with clean solvent to remove oil. Place pump on a workbench with pump mounting surfaces facing upward (same as when mounted in engine). Use a dial indicator to check pump for wear. Pump is available as a complete unit only. Measure shaft end play and renew pump if end play exceeds 0.006 inch (0.15 mm). Move shaft up and down and measure shaft side movement. Renew pump if side movement exceeds 0.0065 inch (0.17 mm). Position dial indicator plunger against a tooth of pump drive gear. Hold idler gear stationary by reaching through oil discharge port, then turn drive gear back and forth to check backlash between gears. Renew pump if backlash exceeds 0.079 inch (2.0 mm).

To disassemble pump, remove drive gear (1—Fig. 55) and cover (5). Withdraw gears (4) from pump housing. Inspect for damage and renew pump if necessary.

Reinstall pump assembly onto cylinder block and tighten mounting cap screws to 35 ft.-lbs. (48 N·m). Install outlet tube with new "O" rings. Tighten bypass housing mounting cap screws to 55 ft.-lbs. (75 N·m). Tighten pump drive gear retaining nut to 40 ft.-lbs. (54 N·m). When reinstalling oil pan, make sure oil pan is flush with block flange at flywheel end. Tighten oil pan mounting cap screws, beginning at flywheel end and proceeding counterclockwise, to 40 ft.-lbs. (54 N·m). Repeat tightening sequence, but tighten only the 3/8 inch cap screws to 50 ft.-lbs. (68 N·m). Then, complete torquing sequence by tightening all 1/2 inch cap screws to 120 ft.-lbs. (162 N·m).

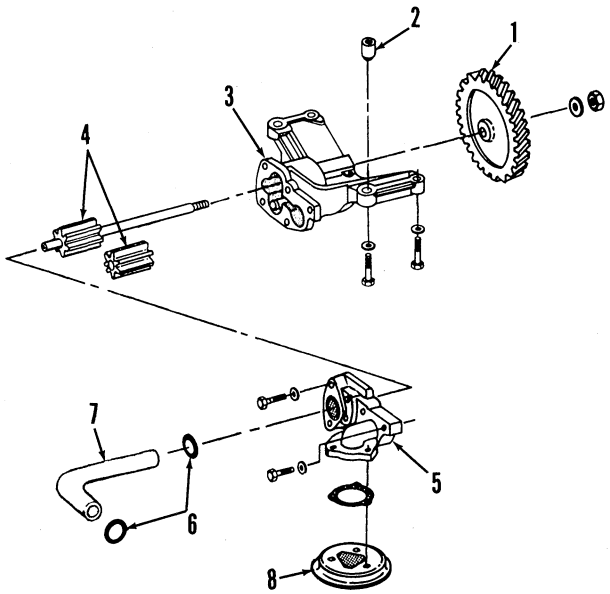


Fig. 55—Exploded view of engine oil pump.

1. Drive gear
2. Bushing
3. Pump housing
4. Pump gears
5. Cover
6. "O" rings
7. Outlet tube
8. Intake screen

PRESSURE REGULATING VALVE AND BYPASS VALVES

All Models

50. The oil pressure regulating valve (13—Fig. 60) and the oil filter bypass valve (7) are located in the oil filter housing. The oil cooler bypass valve (3—Fig. 61) is mounted on bottom of cylinder block.

The pressure regulating valve limits the maximum oil pressure. Normal engine oil pressure is 40-55 psi (280-380 kPa) with engine warm and running at 1900 rpm. Oil pressure regulating valve opening pressure can be adjusted using shims (15—Fig. 60).

The oil filter bypass valve and oil cooler bypass valve operate on a pressure differential of approximately 15 psi (105 kPa). The valves open for cold starting, or in case of oil filter or cooler restriction, to ensure continuous lubrication to engine.

Check valve springs for proper specifications as listed below and renew if necessary.

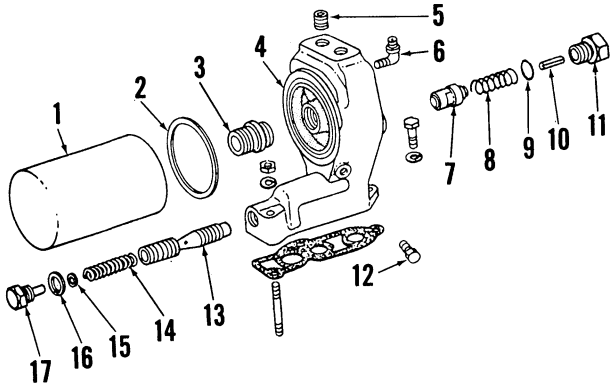


Fig. 60—Exploded view of oil filter housing and associated parts showing pressure regulating valve and oil filter bypass valve. Fitting (6) is not used on Model 4050.

1. Filter
2. Gasket
3. Adapter
4. Housing
5. Plug
6. Elbow fitting
7. Filter bypass valve
8. Spring
9. "O" ring
10. Roll pin
11. Plug
12. Plug
13. Pressure regulating valve
14. Spring
15. Shims
16. "O" ring
17. Plug

Pressure Regulating Valve Spring—
Free length ..... 2.60 in. (66.0 mm)
Test length ..... 1.91 in. (48.5 mm)
Test load ..... 30-33 lbs. (133-147 N)
Filter Bypass Valve Spring—
Free length ..... 2.03 in. (51.5 mm)
Test length ..... 1.38 in. (35.0 mm)
Test load ..... 18-22 lbs. (80-98 N)
Cooler Bypass Valve Spring—
Free length ..... 2.03 in. (51.5 mm)
Test length ..... 1.38 in. (35.0 mm)
Test load ..... 18-22 lbs. (80-98 N)

OIL COOLER

All Models

51. All models are equipped with an engine oil cooler of the type shown in Fig. 62. The oil is cooled by the engine coolant which circulates through tubes in the cooler body. Disassembly for cleaning or other service is normally not required except in cases of contamination of cooling system or lubrication system.

ENGINE BREAK-IN PROCEDURE

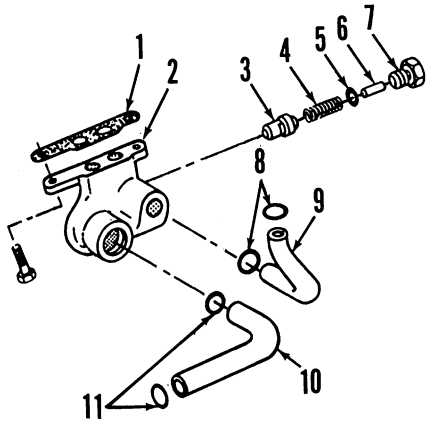
All Models

52. The manufacturer recommends the following engine break-in procedure be performed using a dynamometer. If necessary, break-in can be performed without a dynamometer using controlled field operating conditions. Refer to the following table for recommended break-in procedure.

TIME	LOAD	ENGINE RPM
5 minutes	No-load	850
5 minutes	No-load	1500-2000
5 minutes	1/4 load	1900-2100
10 minutes	1/2 load	1900-2100
10 minutes	3/4 load	1900-2100
10 minutes	Full load	2200

After performing break-in procedure, operate engine at 1500 rpm with no-load for several minutes before shut-down. Check and readjust valve clearance as outlined in paragraph 33.

During first 100 hours of operation, avoid overloading engine or excessive idling and no-load operation. Do not use foot throttle. After 100 hours of operation, renew engine oil and oil filter.



1. Gasket
2. Housing
3. Bypass valve
4. Spring
5. "O" ring
6. Pin
7. Plug
8. "O" rings
9. Outlet pipe
10. Inlet pipe
11. "O" rings

Fig. 61—Exploded view of oil cooler bypass valve. The oil pan must be removed for access to the valve.

COOLING SYSTEM

RADIATOR

All Models

53. To remove radiator, drain cooling system and remove air stack, muffler, side panels, grille screens and hood. Remove cap screws securing oil cooler, then slide oil cooler out right side of tractor. Disconnect radiator brace, upper and lower radiator hoses and overflow valve hose. Remove cap screws secur-

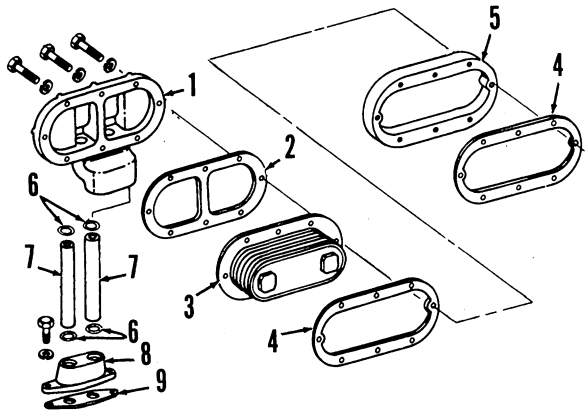


Fig. 62—Exploded view of engine oil cooler assembly. Spacer (5) is not used on Model 4050.

1. Cover
2. Gasket
3. Oil cooler
4. Gaskets
5. Spacer
6. "O" rings
7. Tubes
8. Adapter
9. Gasket

ing fan shroud and move shroud rearward for clearance. Remove radiator retaining cap screws and slide radiator out left side of tractor.

To reinstall radiator, reverse the removal procedure. Be sure shroud is centered to provide equal clearance between ends of fan blades.

FAN AND VISCOUS CLUTCH

All Models

54. To remove fan and clutch assembly, first drain cooling system and disconnect battery cables. Remove alternator. Remove coolant tube from water manifold. Remove cap screws securing fan pulley to clutch hub. Remove fan belt idler assembly, then withdraw fan and clutch assembly.

Inspect clutch assembly for damaged or missing fins. Clutch is a balanced unit. If more than one complete fin is missing, clutch assembly should be renewed as improper balance could cause viscous drive or fan failure. Inspect fan belt idler for excessive wear or other damage.

To renew idler pulley bearing, press bearing shaft pulley out of housing. Support pulley and press bearing from pulley. Press new bearing into pulley until it bottoms in pulley bore. Press shaft with pulley, into housing bore until end of bearing shaft is 1.2 inches (28.5 mm) from mounting surface of housing.

To reinstall fan assembly, reverse the removal procedure. Tighten stud nuts securing fin to clutch to 20 ft.-lbs. (28 N·m). Tighten fan idler mounting cap screws and fan pulley to clutch hub cap screws to 41 ft-lbs. (55 N·m).

WATER PUMP

All Models

55. To remove water pump, drain cooling system and remove fan and clutch assembly, as outlined in paragraph 54. Remove fan blast deflector. Disconnect lower radiator hose and remove bypass pipe from water pump. Remove pump mounting cap screws and remove pump assembly.

To disassemble pump, remove pump drive gear (14—Fig. 63) using a suitable gear puller. Remove spacer (13) and snap ring (12) from rear of pump. Remove retaining ring (7) from front of pump, then pry front cover (6) from pump housing. Press pump shaft (10) rearward out of impeller and housing. Drive seals (3 and 8) out of pump housing.

Clean all parts and inspect for wear or damage. Outside diameter of shaft should be 0.626-0.627 inch (15.90-15.93 mm) at impeller end and 0.984-0.985 inch (25.00-25.02 mm) at drive gear end. Inside diameter of impeller bore should be 0.624-0.625 inch (15.85-15.88 mm) and drive gear bore should be 0.981-0.982 inch (24.92-24.94 mm). When renewing shaft bearings, apply press force against inner race only.

To reassemble pump, proceed as follows: Install oil seal (8) with spring loaded lip facing rearward. Assemble JDG-249 seal protector (or similar device) over end of pump shaft, lubricate with light coat of grease, then install shaft and bearing assembly into housing. Install snap ring (12) in rear of pump housing with flat side facing rear bearing. Remove seal protector from shaft, then install front seal (3) using the driver that is provided with the pump seal kit. Support rear of shaft and press impeller onto shaft until flush with end of shaft. Support impeller and front of shaft, then press drive gear onto shaft until it bottoms against rear spacer. Rotate gear to make sure assembly turns freely. Lubricate a new "O" ring with liquid soap, then press front cover (6) into housing and secure with retaining ring.

Reinstall water pump by reversing the removal procedure. Tighten 3/8 inch cap screws to 35 ft.-lbs (47 N·m) and 5/16 inch cap screws to 20 ft.-lbs (27 N·m).

THERMOSTATS AND WATER MANIFOLD

All Models

56. The thermostats are contained in the front of the water manifold (1—Fig. 64). All models use dou-

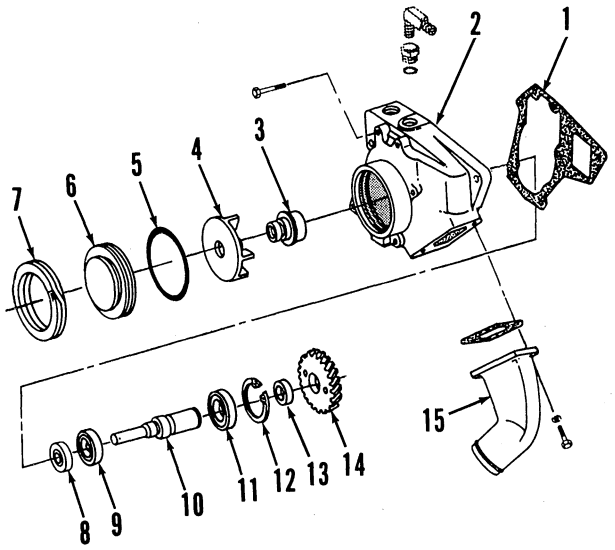


Fig. 63—Exploded view of water pump assembly.

1. Gasket
2. Pump housing
3. Seal assy.
4. Impeller
5. "O" ring
6. Cover
7. Snap ring
8. Oil seal
9. Bearing
10. Shaft
11. Bearing
12. Snap ring
13. Spacer
14. Drive gear
15. Inlet elbow

ble thermostats (3). If a thermostat is suspected of being faulty, check opening temperature in heated water with an accurate thermometer. Thermostats should start to open within the range of 175°- 182° F (80°-84° C).

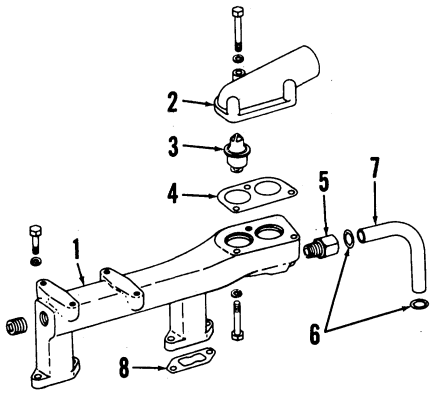


Fig. 64—Exploded view of water manifold with thermostats.

1. Water manifold
2. Thermostat cover
3. Thermostat (2 used)
4. Gasket
5. Connector
6. "O" ring
7. Bypass pipe
8. Gasket

TURBOCHARGER

SERVICE

Models 4250-4450-4650-4850

57. The exhaust driven turbocharger supplies air to the intake manifold at above normal atmospheric pressure. The additional air entering the combustion chamber permits an increase in the amount of fuel burned, therefore increased power output is possible over an engine of comparable size not so equipped. DO NOT increase horsepower output above that given in CONDENSED SERVICE DATA at the front of this manual.

A Schwitzer Model 3LM or AiResearch Model TO4B turbocharger may be used on these models. Operation of either unit is similar, but service procedures are different. If turbocharger is being exchanged, be sure to install correct replacement unit.

The turbocharger consists of three main sections: compressor (1—Fig. 65), bearing housing (15) and turbine (17). Engine oil is circulated through the bearing housing. This oil lubricates the sleeve type bearing (12) and also acts as a coolant for the hot turbine shaft. The seal rings (5) used at each end of the shaft

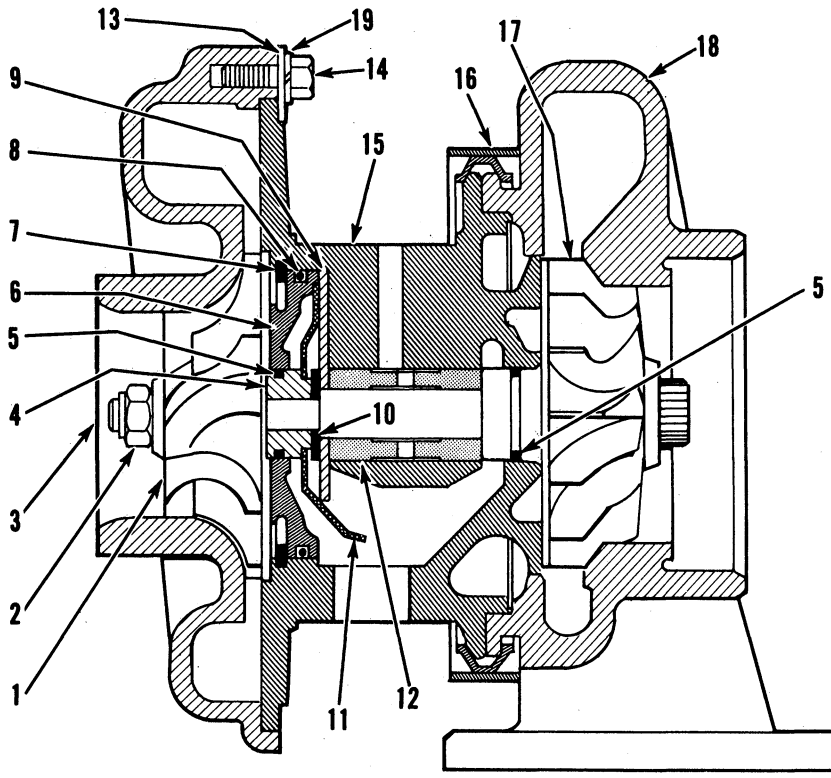


Fig. 65—Cross-sectional view of Schwitzer 3LM turbocharger showing component parts. Refer to Fig. 66 legend for parts identification.

are of the piston ring type. When servicing the turbocharger, extreme care must be taken to avoid damaging any of the parts as close tolerances and balance of rotating members are critical for satisfactory turbocharger operation.

CAUTION: DO NOT operate turbocharger without lubrication. When turbocharger is first installed, or engine has not been run for a month or more, or new oil filter has been installed, crank engine with starter, with fuel shut off, until oil pressure indicator light goes out. Then, start engine and operate at slow idle speed for a few minutes before increasing speed or putting engine under load.

Some other precautions to be observed in operating and servicing a turbocharged engine are as follows: After operating under load, allow engine to idle for a short period of time to allow turbine to slow down and cool off before stopping engine. Because of increased air flow, care of air cleaner and connections is of added importance. Check the system whenever tractor is serviced. If AIR FILTER indicator light glows, immediately clean or renew filter. Make sure exhaust pipe opening is sealed whenever tractor is transported to prevent turbocharger from turning due to air pressure.

Intake manifold pressure can be checked by disconnecting ether starting aid line from intake manifold and installing a 0-60 psi (0-400 kPa) pressure gage in its place. Connect tractor to a dynamometer and operate until normal operating temperature is reached. With engine operating at 2200 rpm at full load, observe pressure reading. Manifold pressure should be within the following specified range when engine is developing rated power.

Intake Manifold Pressure—

4250	7-12 psi (50-80 kPa)
4450	10-15 psi (70-100 kPa)
4650	12-16 psi (80-110 kPa)
4850	15-19 psi (100-130 kPa)

58. REMOVE AND REINSTALL. Prior to removing turbocharger, clean exterior and surrounding area to prevent entry of dirt into air intake system. Remove exhaust pipe, air intake pipe, side panels, grille screens and hood. Remove exhaust elbow and adapter and air cleaner hose. Disconnect oil inlet pipe and oil return tube. Remove turbocharger mounting cap screws, then lift turbocharger off exhaust manifold and intake manifold coupling.

When reinstalling, attach turbocharger to exhaust manifold using a new gasket and install intake manifold coupling with new "O" ring. Tighten cap screws to 35 ft.-lbs. (47 N·m). Install exhaust adapter and elbow making sure adapter is free to turn. The adapter must have a minimum of 1/16 inch (1.6 mm) end play. Connect oil return tube. Fill center housing with oil through the oil inlet port and turn rotating assembly by hand to lubricate bearings. Connect oil supply pipe. Reconnect air intake hose and tighten clamps securely. Before starting engine, prime the turbocharger with oil by holding engine shut-off knob out and cranking engine with starter until engine oil pressure indicator shows pressure. Start engine and run at low idle while checking for oil and air leaks.

59. INSPECTION. The following items should be checked prior to disassembly of turbocharger. This procedure will help to determine the condition of the turbocharger and help to eliminate the unnecessary replacement of a nonfailed turbocharger. In the case of a failed turbocharger, the checks will help in diagnosing the cause of failure so corrective action can be taken.

Examine turbine wheel and compressor impeller for blade damage caused by foreign objects. The source of the foreign material must be corrected to prevent further damage. Inspect tips of blades and surface of housings for indications of wheel rub damage. Compressor housing outlet port should be free of dirt or oil. If any dirt is noted, examine air intake system. Check turbine housing inlet ports for oil or excessive carbon deposits which would indicate a possible engine problem. Rotate the turbine shaft by hand. The shaft should turn freely with only a limited amount of drag. Move ends of shaft up and down while rotating the shaft. There should be no contact between either wheel and the housings at any point. Check shaft end play by moving shaft back and forth while rotating the shaft. Some end play should be evident, but wheels must not contact housings. If the turbocharger passes the inspection, it is likely a problem exists elsewhere.

If the condition of the turbocharger is still in doubt, it is recommended that the shaft radial play and end play be measured with a dial indicator. Repair of turbocharger is necessary if measured clearances do not meet the following specifications:

AiResearch TO4B

Bearing Radial Clearance	0.003-0.006 in. (0.08-0.15 mm)
Shaft End Play	0.001-0.004 in. (0.03-0.10 mm)

Schwitzer 3LM

Bearing Radial Clearance—	
Maximum	0.021 in. (0.53 mm)

Shaft End Play ..... 0.002-0.005 in. (0.05-0.13 mm)

Schwitzer Model 3LM

60. OVERHAUL. Prior to disassembling, place a row of light punch marks or scribe lines across compressor cover, bearing housing and turbine housing to ensure correct alignment when reassembling. Remove retaining clamp plates (13 and 22—Fig. 66) and carefully separate compressor cover (3) and turbine housing (18) from bearing housing (15).

CAUTION: Do not allow the weight of the bearing housing to rest on either the turbine or compressor wheel vanes as they are easily damaged.

Mount either an 11/16 inch, 12-point box end wrench in a vise or use a special holding fixture to secure turbine wheel shaft. Remove compressor wheel nut (2) being careful not to bend the shaft. Withdraw compressor wheel and turbine shaft. Remove back plate (20) and gasket (21). Remove bearing (12) from housing. Remove snap ring (7), then carefully pry insert (6) out of bearing housing. Lift out deflector (11), thrust sleeve (4) and thrust plate (9). Discard "O" ring (8), seal rings (5), gasket (21) and shaft nut (2).

Soak all parts in an approved solvent to loosen carbon deposits. Use a soft brush or plastic scraper to remove carbon from aluminum parts. A glass bead dry blast may also be used for cleaning if air pressure does not exceed 40 psi (280 kPa) and all traces of the glass beads are cleaned out before assembling.

CAUTION: Do not use a wire brush or caustic solution for cleaning as this will damage certain parts.

Inspect turbine wheel and compressor wheel for broken or distorted vanes. DO NOT attempt to straighten bent vanes. Check bearing bore in housing, floating bearing (12) and turbine shaft for excessive wear or scoring. Inspect thrust sleeve (4) and plate (9) for wear or damage. Install a new seal ring (5) into bore of insert (6). Measure ring end gap with a feeler gage and renew insert if gap is not within range of 0.002-0.007 inch (0.05-0.18 mm). Refer to the following table for specifications of new parts.

Housing Bearing
  Bore ..... 0.7500-0.7505 in. (19.0500-19.0637 mm)
Shaft Diameter—
  Bearing journal ..... 0.4400-0.4403 in. (11.176-11.184 mm)
  Compressor wheel ..... 0.3123-0.3125 in. (7.930-7.941 mm)
Piston Ring Groove
  Width ..... 0.064-0.065 in. (1.63-1.65 mm)
Thrust Plate
  Thickness ..... 0.107-0.108 in. (2.72-2.74 mm)
Thrust Sleeve Length ..... 0.517-0.519 in. (13.13-13.18 mm)
Shaft Concentricity—
  Maximum runout ..... 0.0006 in. (0.0152 mm)
Assembled Bearing Clearance—
  Shaft axial (end) play ..... 0.002-0.005 in. (0.05-0.13 mm)
Turbine wheel-to-back plate clearance ..... 0.017-0.049 in. (0.43-1.24 mm)

1. Compressor wheel
2. Nut
3. Compressor cover
4. Thrust sleeve
5. Seal rings
6. Insert
7. Snap ring
8. "O" ring
9. Thrust plate
11. Deflector
12. Bearing
13. Clamp plate
14. Cap screw
15. Bearing housing
17. Turbine wheel & shaft
18. Turbine housing
19. Lockwasher
20. Back plate
21. Gasket
22. Clamp plate
23. Lock plate
24. Cap screw

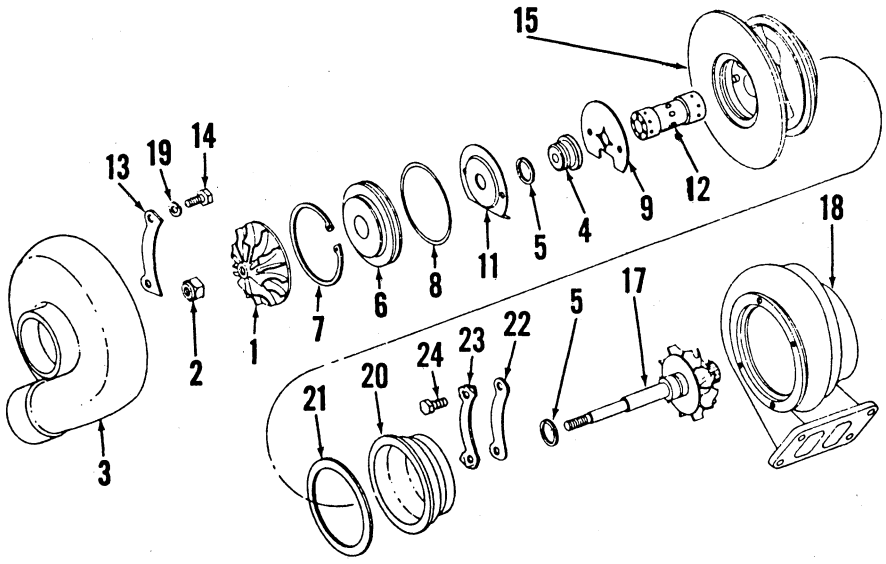


Fig. 66—Exploded view of Schwitzer Model 3LM turbocharger.

Renew all damaged parts and always use new bearing (12), thrust plate (9), piston rings (5), "O" ring (8), gasket (21), locknut (2) and clamp plates (13 and 22) when reassembling. Install back plate (20) and gasket (21) onto bearing housing (15). Install new piston ring onto turbine shaft and lubricate with clean engine oil. Assemble turbine shaft into bearing housing, then position housing and turbine wheel into turbine housing to aid with assembly. Lubricate bearing (12) with oil, then install bearing over end of turbine shaft and into bearing housing. Lubricate both sides of thrust plate (9) and install plate (bronze side out) on the aligning dowels in bearing housing. Install oil deflector (11) making certain holes in deflector are positioned over dowel pins. Install new seal ring (5) onto thrust sleeve (4), lubricate with oil and assemble into insert (6). Install new "O" ring (8) on insert, lubricate with oil and assemble insert and sleeve into bearing housing. Secure with the snap ring (7). Place compressor wheel (1) on turbine shaft, coat threads and back side of new locknut with antiseize compound. Secure turbine shaft, then tighten nut to 155 in.-lbs. (17.5 N·m).

Remove bearing housing from turbine housing and insert bearing housing into compressor cover (3—Fig. 66). Use feeler gages to measure clearance between turbine wheel (17) and back plate (20). Clearance should be 0.017-0.049 inch (0.43-1.24 mm). If clearance is not within specified range, check for burrs, carbon deposits or improper assembly and correct as necessary. Align indexing marks on bearing housing and compressor cover and tighten cap screws evenly to 60 in.-lbs. (7 N·m). Use a dial indicator to measure shaft radial clearance and end play. If clearances are not within ranges indicated in specification table, check for burrs, carbon deposits or improper assembly and correct as necessary. Align indexing marks on bearing housing and turbine housing. Apply antiseize compound to threads of retaining cap screws, then tighten to 60 in.-lbs. (7 N·m).

Fill bearing housing with oil through oil inlet port while rotating shaft. Be sure shaft turns freely with only a slight drag. Reinstall and prime turbocharger as outlined in paragraph 58.

AiResearch Model TO4B

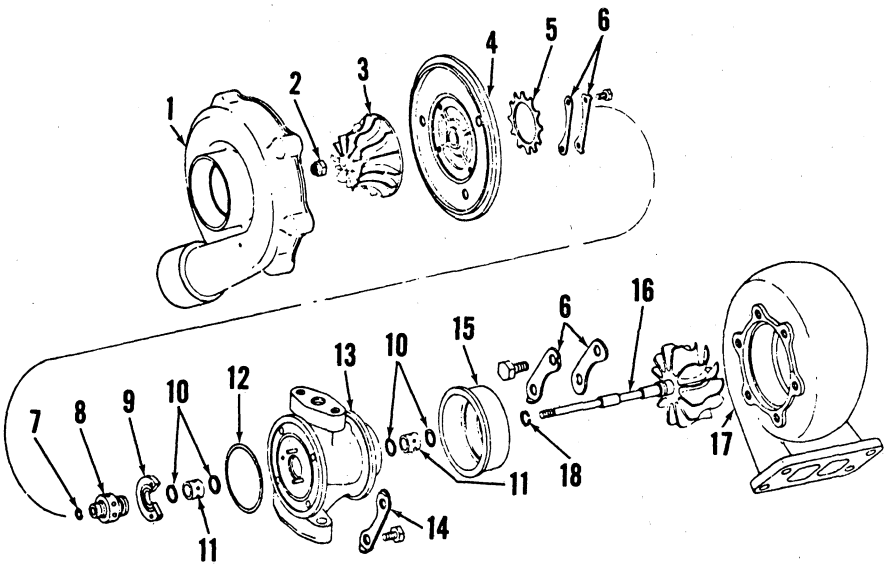
61. OVERHAUL. Prior to disassembly, scribe indexing mark on compressor housing (1—Fig. 68), center bearing housing (13) and turbine housing (17) to aid in correct alignment during reassembly.

CAUTION: Do not rest weight of center housing on compressor or turbine blades as they are easily damaged.

Remove cap screws and clamp plates (6), then carefully separate compressor housing and turbine housing from center housing. Use a suitable holding fixture to secure turbine wheel and shaft, then carefully remove nut (2).

CAUTION: Use a "T" handle or double universal socket to loosen nut (2) to avoid bending turbine shaft.

Lift off compressor wheel and withdraw turbine shaft (16) and shroud (15). Remove back plate (4), thrust bearing (9) and thrust collar (8). Do not remove spring (Fig. 69) from back plate. The back plate and spring are available only as an assembly. Carefully



1. Compressor housing
2. Nut
3. Compressor wheel
4. Back plate
5. Spring
6. Clamp plates
7. Seal ring
8. Thrust collar
9. Thrust bearing
10. Bearing retainer
11. Bearings
12. "O" ring
13. Center housing
14. Lock plate
15. Shroud
16. Turbine wheel & shaft
17. Turbine housing
18. Seal ring

Fig. 68—Exploded view of AiResearch Model TO4B turbocharger used on some models.

remove snap rings (10—Fig. 68) from outer ends of bearing housing bore, then withdraw bearings (11).

CAUTION: Be careful not to damage bearing housing when removing snap rings. The two inner snap rings do not have to be removed unless damaged or unseated from their grooves. Always renew snap rings whenever they are removed from housing grooves.

Clean all parts in an approved solvent. Do not use a caustic cleaning solution as aluminum parts will be damaged. A stiff brush (not steel wire) and plastic or wood scraper should be used to remove carbon deposits after deposits have been softened. A glass bead dry blast may also be used providing the air pressure does not exceed 40 psi (280 kPa). Use caution to prevent parts from being nicked, scratched or bent.

Inspect bearing bores in housing for scored surfaces or excessive wear. Make certain bore in center housing is not grooved in area where seal ring (18) rides. Make certain compressor wheel and turbine wheel blades are not bent, chipped, cracked or eroded. DO NOT attempt to straighten bent blades. Rotating parts must be renewed if damaged in any way. Be sure ring groove shoulders in turbine shaft and thrust collar are not stepped. Make sure all thrust surfaces on collar and back plate are smooth. If turbine shaft journals are damaged or excessively worn, shaft can be reconditioned and undersize bearings of 0.005 inch (0.13 mm) or 0.010 inch (0.25 mm) installed if so desired. Refer to the following table for maximum wear limits allowed.

Bearing Housing—
- Bearing bore ..... 0.6228 in. (15.819 mm)
- Seal bore ..... 0.703 in. (17.856 mm)

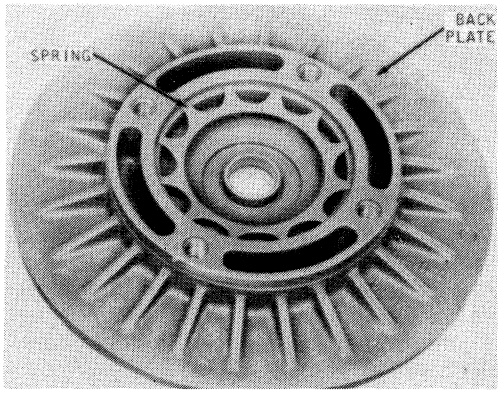


Fig. 69—On AiResearch turbocharger, back plate and spring must be renewed as an assembly if either is damaged. Do not remove spring from back plate.

Turbine Wheel & Shaft—
- Journal diameter ..... 0.3994 in. (10.150 mm)
- Ring groove width ..... 0.0735 in. (1.867 mm)
- Blade tip thickness (min.) ..... 0.025 in. (0.635 mm)

Back Plate—
- Seal bore ..... 0.501 in. (12.725 mm)

Thrust Collar—
- Ring groove width ..... 0.066 in. (1.676 mm)
- Bearing groove width ..... 0.1752 in. (4.445 mm)

Assembled Bearing Clearances—
- Radial shaft-to-bearing clearance ..... 0.003-0.006 in. (0.077-0.152 mm)
- Axial (end) play ..... 0.001-0.004 in. (0.025-0.101 mm)

The following parts should be renewed anytime turbocharger is disassembled: "O" ring (12), seal rings (7 and 18), snap rings (10), bearings (11), thrust bearing (9) and lock plates (6 and 14). If removed, install inner snap rings (10) so rounded shoulder will be toward the bearings. Lubricate bearings (11) with clean oil and install in housing (13). Install outer snap rings so side with rounded shoulder is against bearings. Assemble shroud (15) and seal ring (18) onto turbine shaft, then insert shaft through bearings while carefully compressing seal ring into place in the housing. Install new seal ring (7) into groove of thrust collar (8), then assemble thrust bearing (9) with smooth side toward seal ring end of collar. Install thrust bearing and collar assembly over shaft making certain pins in housing engage holes in thrust bearing. Install new "O" ring (12) in housing groove. Be sure spring (Fig. 69) is positioned in back plate, then carefully install back plate over seal ring (7—Fig. 68) by engaging open end of seal ring into bore of back plate first. Install lock plates and cap screws securing back plate to bearing housing, and tighten to 75-90 in.-lbs. (8.5-10 N·m). Secure turbine wheel and shaft in a suitable holding fixture, then install compressor wheel (3) and a new locknut (2). Using a double universal socket to avoid bending the turbine shaft, tighten nut to exactly 20 in.-lbs. (2.2 N·m). Then, continue to tighten nut an additional 1/4 turn (90 degrees). This procedure stretches the shaft 0.0055-0.0065 inch (0.140-0.165 mm) to provide the proper tension.

Be sure turbine wheel does not contact shroud (15). Assemble bearing housing assembly and turbine housing aligning the indexing marks made prior to disassembly. Coat cap screw threads with antiseize

compound and tighten to 100-130 in.-lbs. (11.3-14.7 N·m).

At this point, check shaft end play and radial play using a dial indicator. If clearances are not within ranges given in specification table, recheck parts for incomplete cleaning or for improper assembly and correct before proceeding with assembly.

Install compressor housing (1—Fig. 68) and align indexing marks. Tighten mounting cap screws to 110-130 in.-lbs. (12.4-14.7 N·m).

Fill bearing housing with oil through oil inlet port while rotating shaft to lubricate shaft and bearings. Be sure shaft turns freely with only a slight drag. Reinstall and prime turbocharger as outlined in paragraph 58.

INTERCOOLER

Models 4650-4850

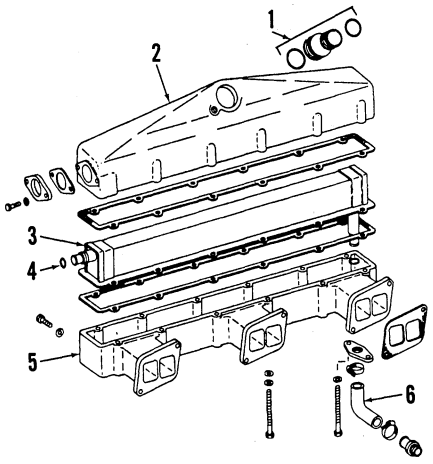
62. The intake manifold on 4650 and 4850 tractors contains an intercooler (3—Fig. 70) to lower the temperature of the intake air. Coolant from the engine cooling system flows through the intercooler core and heat from the compressed (turbocharged) intake air is conducted into the coolant. The intercooler can lower the temperature of the intake air as much as 80°-90° F (27°- 32° C), which makes the air more dense and permits more air to be delivered to the engine cylinders.

Since coolant from the radiator is circulated through the intercooler core, a leak in the core could cause serious damage to the engine by allowing coolant into the combustion area.

To remove the intercooler, drain cooling system and remove air stack, exhaust stack and hood. Remove turbocharger as outlined in paragraph 58. Disconnect both coolant hoses at the intercooler and remove both adapter plates at hose connections to intercooler. Remove aneroid pipe from intake manifold. Remove cap screws securing manifold cover, then lift off cover and intercooler core.

Test and repair procedures are much the same as for a radiator. To check for leaks, pressurize unit with 20-25 psi (140-170 kPa) of air pressure, then submerge in water and check for bubbles. Minor leaks may be repaired. However, if the condition of the core is in doubt, it is recommended that core be renewed.

Reinstall in reverse order of removal using new gasket and "O" rings. Coat threads of all cap screws with antiseize compound. Tighten intake manifold mounting cap screws to 35 ft.-lbs. (47 N·m), adapter plate retaining cap screws to 20 ft.-lbs. (27 N·m) and manifold cover cap screws to 20 ft.-lbs. (27 N·m).



1. Intake air coupling & "O" rings
2. Cover
3. Intercooler core
4. "O" rings
5. Manifold
6. Water inlet hose

Fig. 70—Exploded view of intake manifold and intercooler used on 4650 and 4850 models.

FUEL SYSTEM

FUEL FILTER

All Models

63. Some models are equipped with a single, two-stage fuel filter and sediment bowl, while other models are equipped with dual filters (5—Fig.71). An inline fuel strainer (2—Fig. 72) is also used in the fuel inlet line between the transfer pump and fuel tank. A check valve (7—Fig. 71) in the filter inlet line (9) prevents fuel from draining back when engine is stopped.

Fuel filters should be serviced as required when a loss of power under load is evident. Renew the inline filter first; then if problem still exists, renew fuel filter(s).

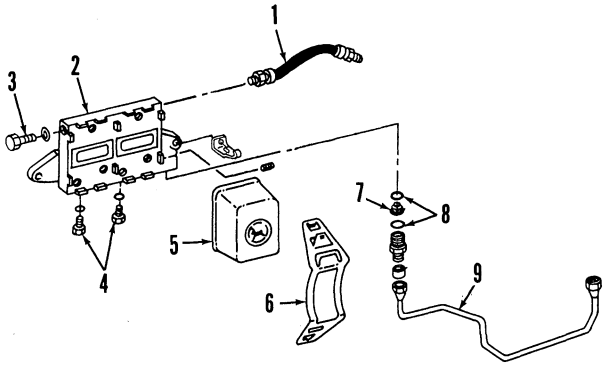


Fig. 71—Exploded view of fuel filter and pipes. Some models use a single renewable filter element while other models are equipped with dual filters.

1. Outlet hose
2. Filter base
3. Bleed plug
4. Drain plugs
5. Fuel filter
6. Retainer clamp
7. Check valve
8. "O" rings
9. Inlet pipe

To renew filters, close fuel shut-off valve located at bottom of fuel tank. Loosen bleed plug (3—Fig. 71) and remove drain plugs (4) to drain fuel from filters. Push top of retainer (6) inward to release tab. Remove old filter and install new filter. Bleed air from fuel system as outlined in paragraph 64.

64. BLEEDING. Whenever fuel lines are disconnected or filters are serviced, air must be bled from the fuel system. To bleed system, loosen bleed plug (3—Fig. 71) on filter base (2) and proceed as follows:

On Model 4050, actuate primer lever on fuel transfer pump (7—Fig. 74) until fuel flows from bleed plug opening.

NOTE: If no resistance is felt when actuating primer lever, rotate crankshaft to change position of fuel pump cam.

Retighten bleed plug, then continue to operate primer lever until slight resistance is felt. Push primer lever back toward engine before attempting to start engine.

On Models 4250, 4450, 4650 and 4850, the hand primer knob (1—Fig. 72) must be unscrewed until it can be pulled up. Pump the primer until air-free fuel flows from bleed plug opening. Tighten the bleed plug, then continue to actuate hand primer until a slight resistance is felt. Push hand primer down and tighten knob to lock in place.

On all models, if engine fails to start, it will be necessary to loosen injection lines at the injection nozzles to bleed air from injection pump and lines. Position throttle lever and engine shut-off knob in "run" position. Crank engine with the starter until fuel is discharged at the loosened injector line connections. Retighten the fittings, then start the engine.

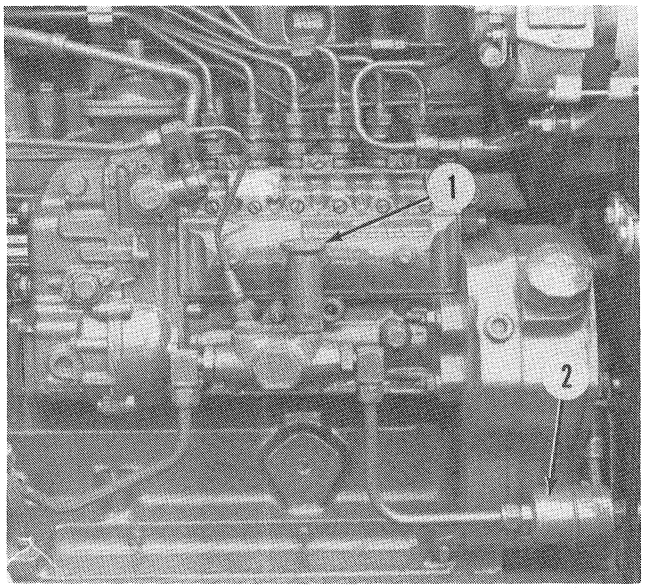


Fig. 72—To operate fuel pump hand primer on turbocharged models, unscrew knob (1) until it can be pulled upward.

FUEL TRANSFER PUMP

Model 4050

65. The diaphragm type fuel pump (7—Fig. 74) is mounted on the right side of the engine block and is driven by the camshaft. Normal operating pressure is 3.5-4.5 psi (24-31 kPa). This type of pump is available as a unit only.

Models 4250-4450-4650-4850

66. Models 4250, 4450 and 4850 may be equipped with either a Robert Bosch fuel transfer pump or a Nippondenso fuel pump. Model 4650 uses a Robert Bosch pump only. Both pumps are similar in operation and service procedures.

The fuel transfer pump is mounted on the side of the fuel injection pump and is driven by the injection pump camshaft. Normal operating pressure is 20-25 psi (138-172 N·m.).

If fuel transfer pump fails to operate properly, refer to Fig. 73 and remove plug (4) and hand primer (5) from top of pump housing. Inspect check valves (1) and valve seats for foreign material or damage. If check valves appear normal, pump must be removed for repair or renewal.

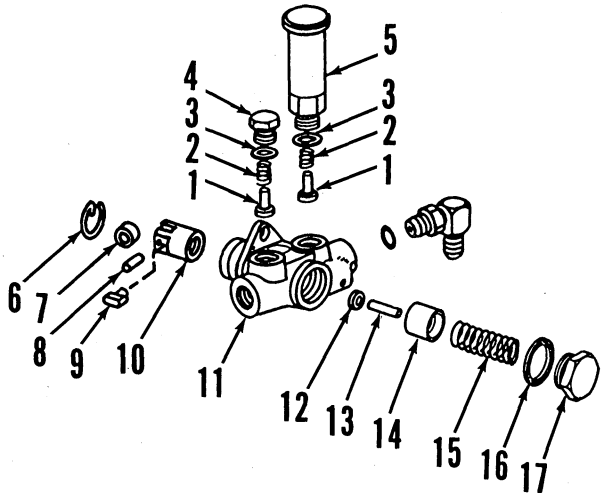


Fig. 73—Exploded view of Nippondenso fuel transfer pump used on some models. Tractors may also be equipped with a Robert Bosch pump which is similar.

1. Check valves
2. Spring
3. Gasket
4. Plug
5. Primer pump
6. Retaining ring
7. Roller
8. Roller pin
9. Guide pin
10. Roller tappet
11. Pump housing
12. Seal ring
13. Pressure spindle
14. Pump plunger
15. Spring
16. Gasket
17. Plug

With pump removed, disengage retaining ring (6) from its groove and withdraw tappet assembly. Check tappet roller (7) for wear or damage and be sure it turns freely. Check guide pins (9) and grooves in housing for wear. Shoulders of guide pins and grooves should have square edges and pins should move freely in and out of holes in tappet (10). Remove plug (17), spring (15), plunger (14) and pressure spindle (13). Surfaces of spindle, plunger and housing bore must be free of burrs or pitting and should not show signs of wear or other damage.

Dip all parts in clean diesel fuel prior to assembly. Be sure to renew "O" ring (12) and gaskets (3 and 16). Reassemble by reversing the removal procedure.

To check pump for leakage, connect a regulated air supply to pump inlet and plug the pump outlet. Submerge pump in diesel fuel and apply 28 psi (193 kPa) of air pressure. There should be no air bubbles around roller tappet when tappet is moved back and forth.

INJECTION PUMP

Model 4050

Roosa Master DM4 injection pump is used on 4050 tractors. The pump is mounted on the right side of engine and is driven by the engine timing gears.

Service to the injection pump requires use of special tools and specialized training. It is recommended that injection pump repairs be performed only by an authorized diesel service station. Therefore, this section will cover only the information required for timing of pump to engine, removal and installation and field adjustments of the pump.

67. REMOVE AND REINSTALL. To remove the injection pump, first thoroughly clean dirt from pump, lines and connections.

NOTE: Do not steam clean or pour water on a pump while it is warm or running as this could cause pump to seize.

Disconnect speed control linkage and fuel shut-off cable. Shut off fuel supply, then remove injector lines, fuel transfer pump (7—Fig.74), fuel inlet pipe (2) and fuel leak-off pipe (3). Plug all openings to prevent entry of dirt. Remove cover (4) from pump timing window. Rotate crankshaft until number 1 piston is at TDC and timing mark on pump governor weight retainer (Fig. 75) is aligned with timing mark on cam ring. Remove inspection cover from timing gear cover, then remove cap screws securing pump drive gear to drive hub. Remove pump mounting stud nuts and withdraw injection pump from engine.

To reinstall pump, reverse the removal procedure. Make certain that number 1 piston is at TDC on compression stroke (timing pin can engage timing hole in flywheel with either number 1 or 6 piston at TDC on compression stroke) and that timing marks on pump cam ring and governor weight are aligned (Fig. 75).

Tighten pump mounting nuts to 35 ft.-lbs. (47 N·m). Install pump drive gear so retaining cap screws are positioned in center of gear slots. After pump is installed, turn crankshaft in opposite direction of rotation about 1/2 turn. Then, turn crankshaft in normal direction until timing pin engages flywheel and recheck pump timing mark alignment. If necessary, loosen pump drive gear cap screws and rotate pump

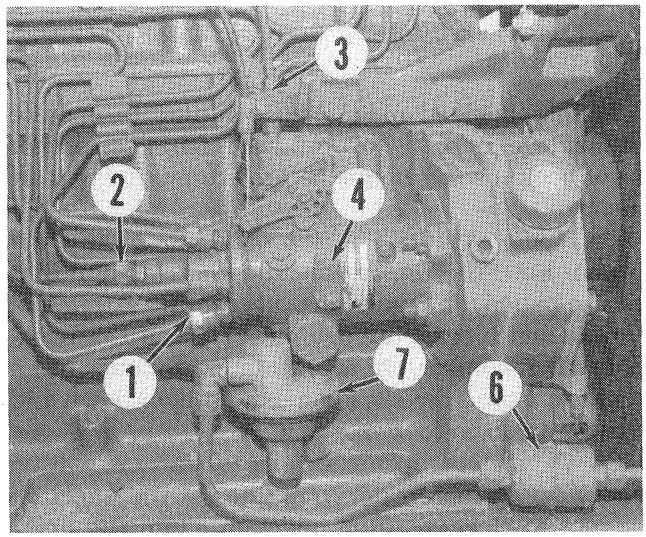


Fig. 74—View of Roosa Master DM4 injection pump used on Model 4050.

1. Injector pipes
2. Fuel supply pipe
3. Fuel leak-off pipe
4. Timing window cover
6. Fuel filter
7. Fuel transfer pump

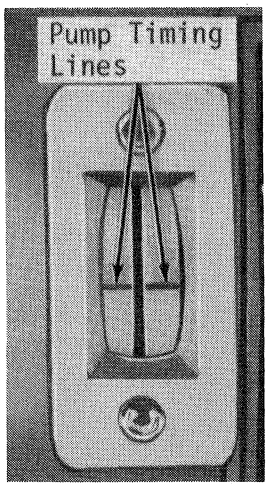


Fig. 75—On Model 4050, pump to engine timing is correct when number 1 piston is at TDC and timing mark on governor weight retainer is aligned with mark on cam ring.

drive hub to align timing marks (Fig. 75). Tighten drive gear cap screws to 35 ft.-lbs. (47 N·m.) Bleed fuel system as outlined in paragraph 64.

68. STATIC TIMING. To check injection pump static timing, shut off fuel supply, and remove pump timing window cover (4—Fig. 74). Note that some fuel will drain out of pump when cover is removed. Rotate crankshaft in normal direction until number 1 piston is at TDC on compression stroke and JDE-81-4 timing pin engages timing hole in flywheel. Pump timing is correct if timing mark on cam ring (Fig. 75) is aligned with mark on governor weight retainer.

If adjustment is required, remove cover from front of timing gear cover and loosen pump drive gear mounting cap screws. Rotate pump drive hub to align pump timing marks. Being careful not to disturb setting, retighten drive gear cap screws to 35 ft.-lbs. (47 N·m). Rotate crankshaft in normal direction two complete turns and recheck timing marks.

69. ADVANCE TIMING. The injection pump has automatic speed advance which is factory set and will not normally need to be checked or reset. However, minor adjustments can be made without removal or disassembly of pump as follows:

Shut off fuel supply and remove pump timing window cover (4—Fig. 74). Install special timing window cover number 19918. Each mark on timing window is 2 degrees. With engine at normal operating temperature, check advance timing at 2100 rpm under full-load. Total advance should be 8-1/2 to 9-1/2 degrees. To adjust advance timing, remove Allen head set screw from trimmer screw (3—Fig. 76) located on the side of pump housing. Use a small ratchet screwdriver or other means to turn trimmer screw out to advance the timing or in to retard the timing. Reinstall set screw and tighten securely.

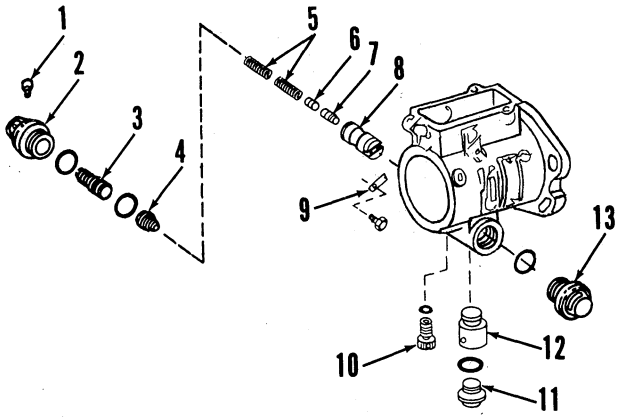


Fig. 76—On Model 4050, injection pump advance timing is adjusted by turning trimmer screw (3) located on side of pump housing. Refer to text.

1. Set screw
2. Plug
3. Trimmer screw
4. Seat
5. Springs
6. Guide
7. Piston
8. Advance piston
9. Check valve
10. Screw
11. Plug
12. Pin
13. Plug

Models 4250-4450-4650-4850

Either a Robert Bosch or a Nippondenso fuel injection pump may be used on Models 4250, 4450 and 4850. On Model 4650, only a Robert Bosch pump is used. All pumps are inline, multiple plunger type with a governor and an aneroid control.

Service to the injection pump requires use of special tools and specialized training. It is recommended that injection pump repairs be performed only by an authorized diesel service station. Therefore, this section will cover only the information required for timing of pump, removal and installation and field adjustments of the pump.

70. REMOVE AND REINSTALL. To remove the injection pump, first thoroughly clean dirt from pump, fuel lines and connections.

NOTE: Do not steam clean or pour water on a pump while it is running or warm as this could cause pump to seize.

Disconnect throttle linkage and fuel shut-off cable. Disconnect aneroid line (3—Fig. 77), oil supply line (2), fuel inlet line (4), transfer pump fuel lines (10), fuel leak-off line (6) and injection lines (5). Drain oil from oil filter housing (1), then remove filter and

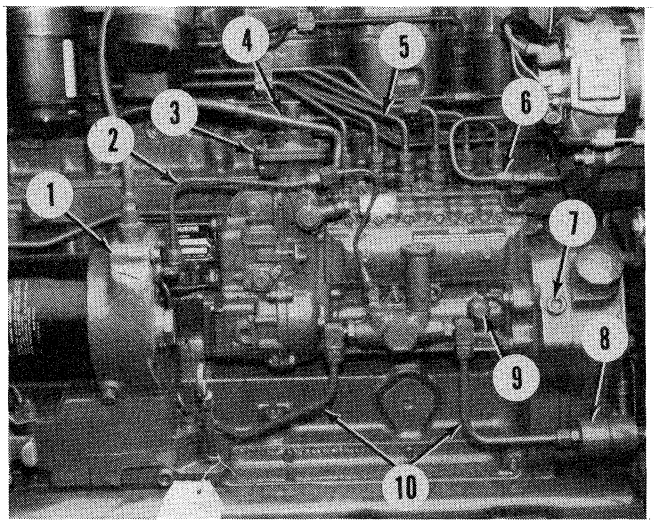


Fig. 77—View of injection pump used on all tractors except Model 4050.

1. Oil filter housing
2. Lubricating oil line
3. Aneroid
4. Fuel inlet line
5. Injector lines
6. Fuel leak-off line
7. Timing hole plug
8. Fuel filter
9. Oil filler hole plug
10. Fuel supply pump lines

housing assembly. Remove timing hole plug (7). Rotate crankshaft until number 1 piston is at TDC on compression stroke and timing marks on pump drive hub (Fig. 78) and timing pointer are aligned. Remove inspection cover from front of timing gear cover and remove cap screws securing pump drive gear to pump hub. Remove pump mounting nuts, then withdraw pump from the engine.

When reinstalling injection pump, make certain number 1 piston is at TDC on compression stroke. Note that JDE-81-4 timing pin can engage the flywheel timing hole with either number 1 or 6 piston at TDC on compression stroke. Be sure timing marks on pump drive hub and pointer (Fig. 78) are aligned. Be careful not to damage "O" ring on pump bearing plate. Tighten pump mounting nuts and pump drive gear cap screws to 35 ft.-lbs. (47 N·m). Recheck pump timing as outlined in the following paragraph and adjust as necessary. Remove oil level plug (9—Fig. 77) from side of pump housing and pour about 3/4 pint (0.5 L) of clean engine oil into pump to provide initial lubrication. Bleed air from system as outlined in paragraph 64.

71. STATIC TIMING. To check injection pump static timing, remove timing hole plug (7—Fig. 77). Rotate crankshaft in normal direction until number 1 piston is at TDC on compression stroke and JDE-81-4 timing pin (or similar tool) can be inserted through flywheel housing into timing hole in flywheel. At this position, timing marks on pump timing pointer (Fig. 78) and drive hub should be aligned if pump timing is correct.

If adjustment is required, remove access plate from front of timing gear cover and loosen the three cap screws securing gear to pump drive hub. Rotate drive hub until pump timing marks are aligned, then retighten cap screws to 35 ft.-lbs. (47 N·m). Rotate crankshaft in normal direction two complete turns and recheck alignment of timing marks.

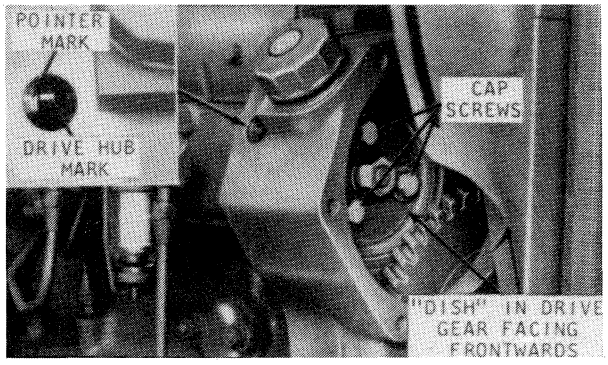


Fig. 78—With number 1 piston at TDC on compression stroke, timing mark on pump drive hub should be aligned with mark on timing pointer if injection timing is correct.

72. ANEROID. The aneroid is a diaphragm type control unit which is mounted on top of the injection pump governor housing. The diaphragm is operated by positive intake manifold pressure provided by the turbocharger. When turbocharger boost pressure is low, spring pressure pulls the aneroid shaft (14—Fig. 79) and screw (16) upward which limits the pump control rack movement. This limits fuel delivery under light loads and low speeds and allows the engine to accelerate without producing black smoke unnecessarily. When the turbocharger produces sufficient pressure against the diaphragm (7) to overcome spring pressure, the adjusting screw moves downward to permit normal movement of fuel control rack.

A hydraulic aneroid activator (Fig. 79) is mounted on the side of the governor housing. The activator uses spring pressure to hold the fuel control shaft (20) in maximum delivery position for starting. Then, when engine oil pressure reaches about 9 psi (60 kPa), the hydraulic pressure against the piston (26) overcomes the spring pressure and moves the fuel control shaft inward for aneroid control.

The aneroid must be adjusted to the pump on a test stand. If it becomes necessary to repair the aneroid assembly, the pump must be removed for calibration.

The aneroid activator may be disassembled and inspected for wear or damage. Be sure that orifice of capillary valve (29) is clean and that restrictor wire (30) is not bent and fits loosely inside capillary valve.

ADJUSTMENT

Model 4050

73. SPEED ADJUSTMENT. Fast idle speed should be 2350-2400 rpm and slow idle speed should be 830-870 rpm. To adjust speeds, first run engine until it reaches normal operating temperature. Move throttle lever (4—Fig. 80) forward until fast idle adjusting screw (5) is against the stop. Turn screw as required to obtain recommended engine speed, then tighten locknut to secure adjustment. Move throttle lever rearward until slow idle adjusting screw (8) contacts its stop. If necessary, turn screw to obtain desired engine speed. Tighten locknut securely. Refer to paragraph 76 for throttle linkage adjustment.

Models 4250-4450-4650-4850

74. SPEED ADJUSTMENT (ROBERT BOSCH PUMP). Fast idle speed should be 2350-2420 rpm and slow idle speed should be 830-870 rpm.

NOTE: If fast idle speed is more than 50 rpm below the minimum specified setting or more than 50 rpm above the maximum specified setting, the injection pump will have to be removed and adjusted on a test stand.

With engine at normal operating temperature, move governor lever (4—Fig. 81) against fast idle stop screw (5) and check engine rpm. If fast idle setting is too low, remove sealing capsule from fast idle screw and loosen locknut (7). Use a screwdriver to back out stop screw until desired speed is obtained. Retighten locknut securely.

If fast idle speed is too high, first back out the supplementary idling spring screw (10—Fig. 81). Turn the

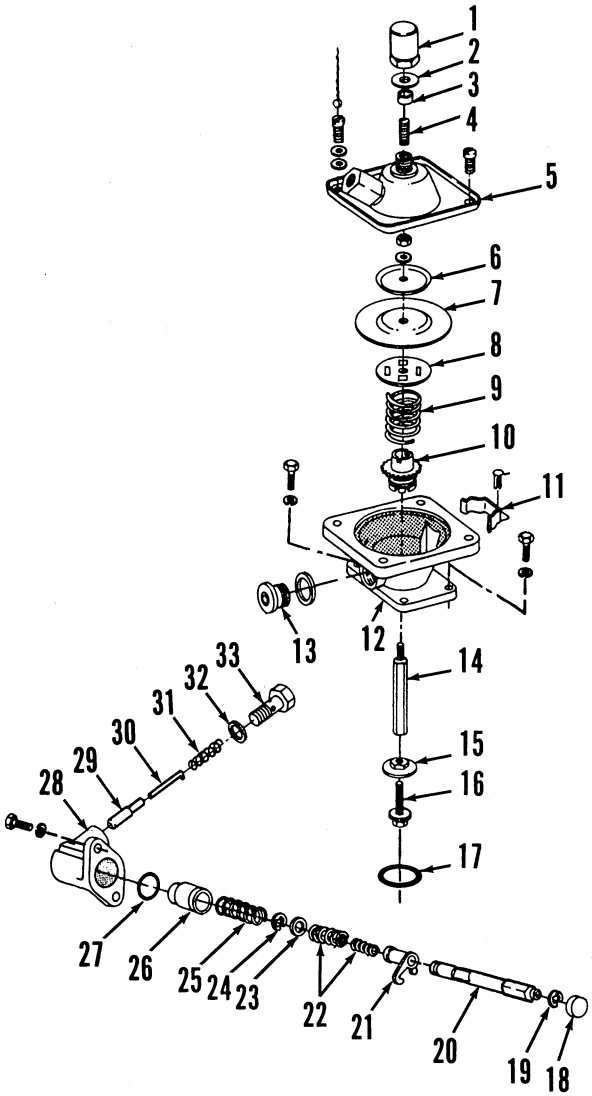


Fig. 79—Exploded view of injection pump aneroid assembly and hydraulic aneroid activator used on Models 4250, 4450, 4650 and 4850.

1. Nut
2. Washer
3. Nut
4. Adjusting screw
5. Cover
6. Thrust washer
7. Diaphragm
8. Guide
9. Spring
10. Bushing
11. Clip
12. Aneroid housing
13. Plug
14. Shaft
15. Nut
16. Screw
17. "O" ring
18. Cap
19. Snap ring
20. Fuel control shaft
21. Control arm
22. Springs
23. Shim
24. Snap ring
25. Spring
26. Piston
27. "O" ring
28. Activator housing
29. Capillary valve
30. Restrictor wire
31. Spring
32. Washer
33. Special screw

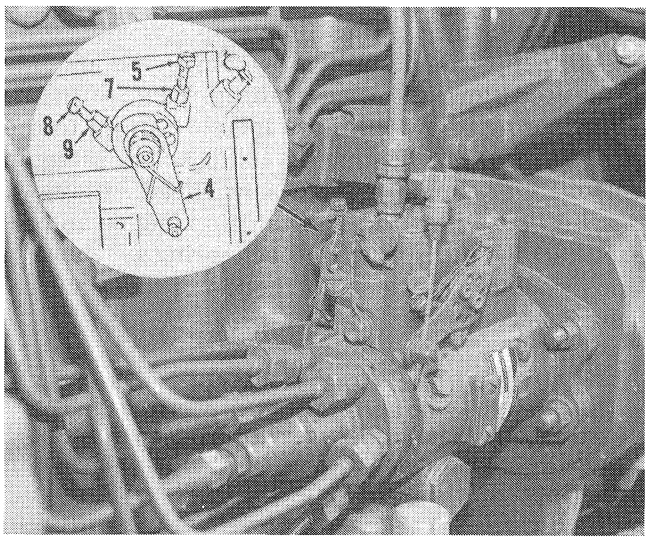


Fig. 80—Inset shows control lever and engine speed stop screws on Model 4050. High speed stop screw (5) is toward rear of pump and low speed stop screw (8) is toward front of pump.

4. Speed control lever
5. High speed stop screw
7. Locknut
8. Low speed stop screw
9. Locknut

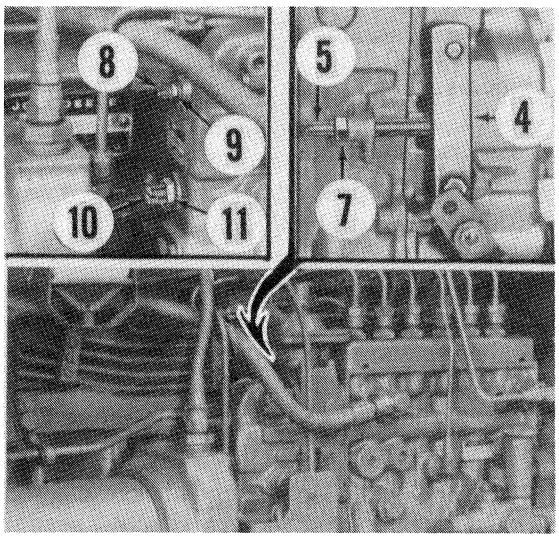


Fig. 81—Inset shows speed control lever (4) and high speed stop screw (5) on Robert Bosch injection pump used on some Model 4250, 4450, 4650 and 4850 tractors. Use of JDF-9-2A screwdriver and JDG-9-1 special wrench will make adjustment easier.

4. Speed control lever
5. High speed stop screw
7. Locknut
8. Low idle stop screw
9. Locknut
10. Supplementary idling spring screw
11. Locknut

fast idle screw (5) in until desired speed setting is obtained. Readjust supplementary idling spring screw as follows:

The slow idle stop screw (8—Fig. 81) and the supplementary idling spring screw (10) are both used to adjust slow idle speed setting. Always stop engine before making adjustments. Back out the idling spring screw three turns. Adjust idle stop screw (8) until speed is approximately 10 to 15 rpm on the low side of desired slow idle speed setting. Then, turn the idling spring screw (10) in to increase speed to the desired setting. Adjusting the idling spring screw in this manner should prevent slow speed surging. If surging continues at idle speed, stop engine and remove screw and spring. Inspect spring for damage and freedom of movement in hollow of screw and renew if necessary.

CAUTION: Do not increase idle speed more than 20 rpm with idling spring screw as overspeeding of the engine at fast idle may result. If surging persists, remove pump and check for internal wear or damage.

75. SPEED ADJUSTMENT (NIPPONDENSO PUMP). Fast idle speed should be 2350-2420 rpm and slow idle speed should be 830-870 rpm.

NOTE: If fast idle speed is more than 50 rpm above or below the specified speed setting range, the injection pump must be removed and calibrated on a test stand.

Check engine speed with engine at normal operating temperature. If fast idle setting is too low, loosen locknut on fast idle screw (2—Fig. 83) and back screw out until desired speed setting is obtained. Tighten locknut and install a new sealing wire.

If fast idle speed is too high, back out the supplementary idling spring screw. Then turn fast idle stop screw in until desired speed setting is obtained. Retighten locknut and adjust idling spring screw as follows:

The slow idle stop screw and the supplementary idling spring screw are both used to adjust slow idle speed. Engine should be stopped when making adjustments. Back out idling spring screw three turns. Adjust slow idle screw until speed is about 10 to 15 rpm below desired slow idle speed setting. Then, turn idling spring screw in to increase speed to the desired setting. Adjusting the idling spring screw in this manner should prevent surging at slow speed. If surging continues at idle speed, stop engine and remove screw and spring. Inspect spring for damage and freedom of movement in hollow of screw and renew if necessary.

CAUTION: Do not increase idle speed more than 20 rpm with idling spring screw in an attempt to smooth out idle as overspeeding of engine at fast idle may result. If surging persists, pump should be removed and checked for internal wear or damage.

All Models

76. LINKAGE ADJUSTMENT. After injection pump speed settings are properly adjusted, speed control linkage should be adjusted as follows: Remove the console cover for access to handle throttle linkage. Use a spring scale to check force required to move hand lever. If necessary, adjust lever friction cap screw until a force of 8 pounds (35 N) is required to move lever.

Move throttle lever forward to fast idle position. Adjust throttle rod turnbuckle so governor lever contacts fast idle stop screw on injection pump, then lengthen control rod by rotating turnbuckle an additional one turn.

Move control lever rearward until specified slow idle speed is obtained. Adjust throttle lever stop screw on control console until head of screw contacts throttle lever.

INJECTOR NOZZLES

All Models

All models are equipped with either Robert Bosch KDEL or Nippondenso injector nozzles. Both nozzles are similar in construction and the following service procedures apply to either injector nozzle.

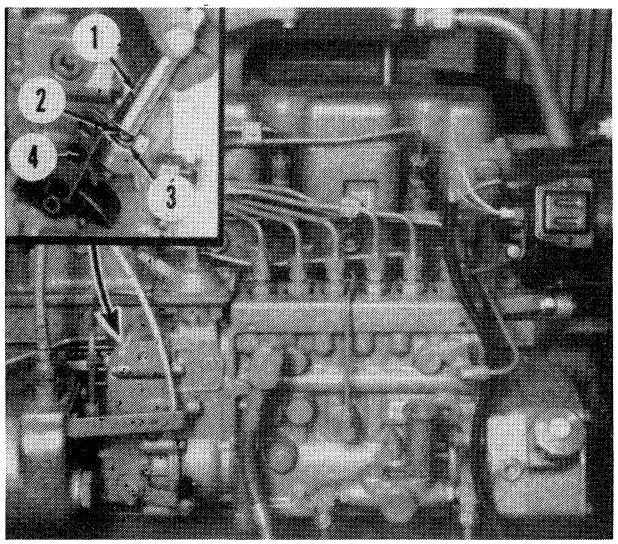


Fig. 83—Inset shows high speed adjusting screw (2) on Nippondenso injection pump used on some Model 4250, 4450 and 4850 tractors.

1. JDG-33 special wrench
2. High speed stop screw
3. Locknut
4. Speed control lever

77. LOCATING A FAULTY NOZZLE. If uneven engine operation or misfiring indicates a faulty injector, the defective unit can usually be found as follows: With engine running at the speed where malfunction is most noticeable, loosen the compression nut on high pressure line for each injector in turn and listen for a change in operation of engine. The faulty unit is the one which least affects running of engine when its line is loosened.

If a faulty nozzle is found and considerable time has elapsed since the injectors were new or have been serviced, it is recommended that all injector nozzles be removed and checked, or that new or reconditioned units be installed.

78. REMOVE AND REINSTALL. Prior to removing injectors thoroughly clean injectors, injection pump and fuel lines. Cap all openings as fuel lines are disconnected to prevent entry of dirt. When removing or installing injection lines on injection pump, be sure to secure the pump delivery valve fittings to prevent them from rotating while loosening or tightening fuel line nuts.

Remove injection lines and fuel leak-off lines. Remove leak-off connectors from injectors. Use JDE-92 wrench or a 24 mm deep socket to unscrew injector gland nut. The gland nut will raise the nozzle out of cylinder head as it is removed.

When reinstalling, make sure injector and hole in cylinder head are clean. Nozzle seat reamer (JDE-99) may be used to remove carbon from nozzle seating area in head. Apply antiseize compound to nozzle body, inside diameter of gland nut and threads of gland nut. Install injector using a new sealing washer (12—Fig. 85). Make certain fuel leak-off port in nozzle holder is facing straight outward, then tighten gland nut to 55-65 ft.-lbs. (75-88 N·m). Complete installation by reversing the removal procedure.

79. NOZZLE TEST. A complete job of testing and adjusting an injector requires the use of special test equipment. The nozzle should be tested for opening pressure, seat leakage and spray pattern as outlined in the following paragraphs.

CAUTION: Fuel leaves the nozzle tip with sufficient force to penetrate the skin. Keep all parts of your body clear of nozzle spray when testing.

80. OPENING PRESSURE. Before conducting the test, operate tester lever until fuel flows, then attach the injector using the the proper adapter. Close the valve to tester gage and pump the tester lever a few quick strokes to purge air from the injector and to make sure nozzle valve is not stuck.

Open valve to tester gage, then operate tester lever slowly while observing gage reading. Opening pressure should be within the following specifications:

4050

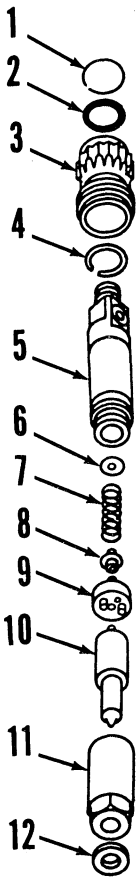
Opening Pressure—
New . . . . . 3700-3800 psi (25500-26300 kPa)
Used (min.) . . . . . 3600 psi (24800 kPa)

4250-4450-4650

Opening Pressure—
New . . . . . 3900-4000 psi (27000-27800 kPa)
Used (min.) . . . . . 3800 psi (26200 kPa)

4850

Opening Pressure—
New . . . . . 4200-4300 psi (29000-29800 kPa)
Used (min.) . . . . . 3800 psi (26200 kPa)



1. Snap ring
2. "O" ring
3. Gland nut
4. Snap ring
5. Nozzle holder
6. Shim
7. Spring
8. Spring seat
9. Plate
10. Nozzle valve assy.
11. Nozzle nut
12. Seal washer

Fig. 85—Exploded view of 21 mm Robert Bosch injector used on some models. A Nippondenso injector, used on some models, is similar except that snap rings (1 and 4) are not used.

If pressure is not correct, refer to paragraph 83, disassemble nozzle and change thickness of shim (6—Fig. 85) until opening pressure is correct. Use only specially hardened shims. Each 0.002 inch (0.05 mm) change in shim thickness will vary the opening pressure approximately 100 psi (700 kPa). Opening pressure should not vary more than 50 psi (350 kPa) between nozzles. If pressure cannot be adjusted by changing shims, disassemble injector and recondition.

NOTE: When adjusting an overhauled nozzle with a new spring (7—Fig. 85), opening pressure should be set to new nozzle specifications. This increase in pressure is to allow for initial pressure loss as the spring takes a set.

81. SEAT LEAKAGE. Wipe nozzle tip dry, then operate tester lever slowly to maintain gage pressure at 285 psi (1970 kPa) below the nozzle opening pressure. Check for leakage around nozzle retaining nut (11—Fig. 85) or at nozzle tip. If a drop forms within a period of 10 seconds, renew nozzle or recondition as outlined in paragraph 83.

82. SPRAY PATTERN. The nozzle valve should open with a soft chatter when tester lever is moved rapidly (four to six opening cycles per second). A bent or binding nozzle valve can prevent chatter. When operating properly the nozzle spray should be finely atomized and evenly distributed around the nozzle. Check for partially clogged or eroded orifices if spray is wet or ragged. If rapid stroking of tester lever does not produce proper spray pattern or chatter, disassemble nozzle for cleaning and reconditioning.

83. OVERHAUL. Clean outside of injector thoroughly. As injector is disassembled, place all parts in a pan of clean diesel fuel. If more than one injector will be disassembled, be sure to keep parts separated as they should not be interchanged.

Remove upper snap ring (1—Fig. 85), "O" ring (2), gland nut (3) and lower snap ring (4) if so equipped. Clamp flats of nozzle holder (5) in a soft jawed vise, then unscrew nozzle retaining nut (11). Withdraw nozzle valve (10), intermediate plate (9), spring (7) and shim (6) being careful not to mar polished surfaces.

Clean all parts and submerge in a pan of diesel fuel. Handle parts only with hands that are wet with diesel fuel. It may be necessary to soak parts in carburetor cleaner or other commercial solvent to loosen carbon deposits. DO NOT use steel wire brush, emery cloth or sharp metal tools to clean nozzle. To clean nozzle spray orifices, begin with a cleaning wire 0.003-0.004 inch (0.07-0.10 mm) smaller than the orifice size and finish with a cleaning wire 0.001 inch (0.03 mm) smaller than orifice size. The number and size of the orifices are etched on the nozzle tip, such as "4 x 0.33." The "4" indicates four orifices and "0.33" indicates that each is 0.33 mm in diameter. A pin vise should be used to hold cleaning wire and wire should extend only about 1/32 inch (0.8 mm) from vise to prevent breakage. Insert wire into orifice and rotate.

Inspect lapped surfaces of nozzle valve, valve body, intermediate plate and nozzle holder for scoring, pitting or wear. Renew any parts in question. The edge type filter in fuel inlet passage of nozzle holder (5—Fig. 85) can be cleaned by blowing compressed air through fuel passage at nozzle valve end of holder. Make certain nozzle valve slides freely in valve body. When wet with diesel fuel and held vertically, nozzle valve should slide down to the valve body seat by its own weight. If nozzle valve sticks, reclean or renew valve assembly. Wash anticorrosive coating off a new nozzle valve assembly before reassembling.

Assemble in reverse order of disassembly. Immerse parts in diesel fuel while assembling. Do not dry parts with towel or air. Tighten nozzle retaining nut (11) to 45-55 ft.-lbs. (60-75 N·m). Coat bore of gland nut (3) with antiseize compound before assembling. Retest injector as previously outlined.

ELECTRICAL SYSTEM

ALTERNATOR AND REGULATOR

All Models

84. A John Deere alternator is used on tractors equipped with a SOUND-GARD body while all other models are equipped with a Delco-Remy alternator. The voltage regulator used on all models is a solid-state, nonadjustable type.

CAUTION: To prevent damage to certain components of the alternator, the following precautions must be observed.

a. When installing batteries or connecting a booster battery, make certain battery cable connections are correct. Reversing polarity can cause permanent damage.

b. Do not attempt to polarize the alternator.

c. Do not operate engine with alternator or battery cables disconnected.

d. Do not short across or ground alternator terminal.

e. Disconnect battery ground cable before disconnecting or removing any electrical component.

Models With John Deere Alternator

85. TESTING. To trouble-shoot charging system, proceed as follows: With key switch "OFF" and engine stopped, connect a voltmeter to alternator out-

put terminal "B" (Fig. 86) and measure battery voltage. Battery voltage should be a minimum of 12.4 volts. Next, connect voltmeter lead to regulator coupler "S" terminal. Battery voltage (12.4 volts) should also be measured at this terminal. If either check fails to show battery voltage, check for open circuit in wiring.

With key switch "ON" and engine stopped, connect voltmeter lead to "IG" terminal of alternator and measure voltage drop of diode. Voltage should be 0.4 to 1.5 volts less than previously measured battery voltage. If voltage drop is excessive, check for open circuit at key switch "ACC" terminal, at diode below circuit breaker panel or at bulkhead connector between key switch and alternator. If voltage drop is less than 0.4 volts, renew diode below circuit breaker panel.

To check alternator output voltage, connect voltmeter to terminal "B." With key switch "ON" and engine running at 1500 rpm, output voltage should be 13.2-15.5 volts. If voltage is too high, one of the following may be the cause: Defective voltage regulator, a ground between brushes and voltage regulator or grounded rotor field circuit. If voltage is too low, remove cover from voltage regulator (2—Fig. 86). With engine running at 1500 rpm, ground regulator terminal "F" to frame of alternator. If voltage is now above 15.5 volts, voltage regulator is defective. If voltage is still too low, alternator should be disassembled and inspected as outlined in paragraph 86.

86. OVERHAUL. Before disassembling the alternator, scribe indexing marks across front housing, stator frame and rear housing to ensure correct alignment when reassembling. Remove through-bolts, then separate front and rear housings. Remove pulley nut (1—Fig. 87) and pulley from rotor shaft. Withdraw rotor (23) from front housing. Remove regulator cover (9) and regulator (10). Remove stud nuts and insulators securing rear cover (20). Lift out stator (16), rectifier bridge (17) and brush assembly.

Use an ohmmeter or test light to check rotor for grounds. There should not be continuity between rotor shaft and slip rings. Connect ohmmeter leads to each slip ring and measure resistance of rotor windings. Renew rotor if resistance is not between 3-5 ohms.

Inspect brushes and springs for damage. Renew brushes if exposed length is less than 1/4 inch (6 mm). Make certain there is no continuity between the two brushes or between brushes and ground.

Inspect stator windings for indications of burned wiring which would indicate a short circuit. Use a test light to check for continuity between each sta-

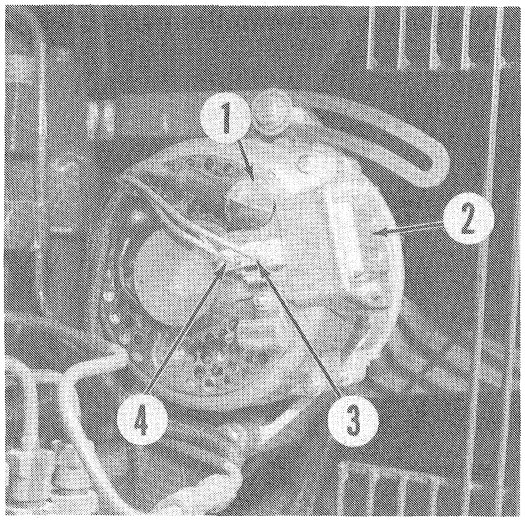


Fig. 86—Connect voltmeter to alternator "B" terminal and run engine at 1500 rpm to check alternator output voltage. If voltage is too low, ground regulator terminal "F" and refer to text.

1. "B" terminal
2. Regulator cover
3. "IG" terminal
4. "S" terminal

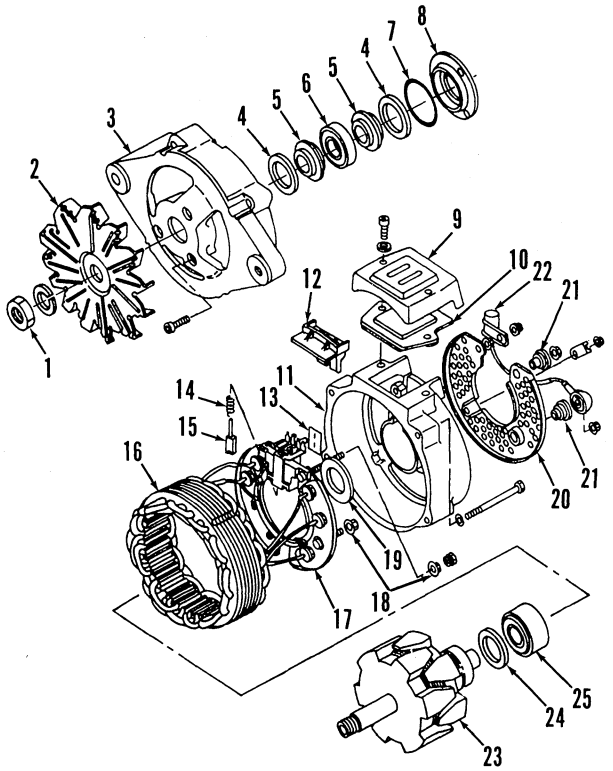


Fig. 87—Exploded view of John Deere alternator used on tractors equipped with Sound-Gard body.

1. Nut
2. Fan
3. Housing
4. Washer
5. Locking collar
6. Bearing
7. "O" ring
8. Bearing retainer
9. Cover
10. Regulator
11. Housing
12. Insulator
13. Insulator
14. Spring
15. Brush
16. Stator
17. Rectifier
18. Insulators
19. Washer
20. Cover
21. Insulators
22. Condenser
23. Rotor
24. Washer
25. Bearing

tor lead and the stator frame. Renew stator if there is continuity.

To check diodes, the stator leads must first be disconnected from the rectifier bridge. When unsoldering leads from diodes, work quickly to prevent overheating diodes. Using an ohmmeter, check continuity of each diode to rectifier metal frame, then reverse ohmmeter probes and make the same continuity checks. Each diode should indicate continuity in one direction only. Renew rectifier bridge (17) if any of the diodes test defective.

To check diodes-resistor trio touch one probe of ohmmeter to "G" terminal of brush holder and the other probe to the nearer terminal of resistor. If resistance is not approximately 100 ohms, renew rectifier bridge. Touch one probe of ohmmeter against terminal "G" and the other probe against nearer terminal of each diode. Reverse probes and recheck for continuity. Each diode should have continuity in one direction only. Renew rectifier bridge if diodes are defective.

When reconnecting stator leads, hold diode leads with needlenose pliers to act as a heat sink. Solder connections as quickly as possible to avoid overheating diodes.

There is no suitable way to test a regulator other than installing it in an alternator that is known to be good and checking for proper operation. Renew regulator if in doubt.

When reassembling alternator, be sure the insulating bushings (18 and 21—Fig. 87) are installed on studs on output side of rectifier bridge. Inspect front and rear rotor bearings and renew if necessary. Push brushes back for clearance and hold in position by inserting a wire through hole in rear housing. Remove wire after rotor is in position in rear frame. Align indexing marks made on housings prior to disassembly, then install through-bolts. Tighten pulley retaining nut to 60 ft.-lbs. (80 N·m.)

Models With Delco-Remy Alternator

87. TESTING. To trouble-shoot charging system, proceed as follows: With key switch "OFF" and engine stopped, connect a voltmeter to measure voltage at alternator "BAT" terminal (Fig. 90) and at number 2 regulator terminal. At both locations, a minimum of 12.4 volts (battery voltage) should be observed. If not, check wiring for open circuit.

Connect voltmeter to number 1 regulator terminal. With key switch "ON" and engine stopped, voltage should be 1.0 to 2.0 volts below previously measured battery voltage. If voltage drop is not within this range, check for open circuit at "ACC" terminal of key switch, at diode located below circuit breaker panel, at wiring connector between alternator and key switch or in the connecting wires. If voltage is equal to battery voltage, diode (located below circuit breaker panel) is shorted.

With voltmeter connected to alternator "BAT" terminal, key switch "ON" and engine running at 1500 rpm, alternator output voltage should be 13.2-15.5 volts. If voltage is lower than 13.2 volts, insert a screwdriver into test hole (Fig. 90) to ground field brush. If voltage goes above 15.5 volts, voltage regulator is faulty. If voltage is still low, alternator must be disassembled and internal components checked as outlined in paragraph 88.

88. OVERHAUL. Before beginning disassembly, scribe indexing marks across alternator housing to aid in alignment during reassembly. Remove through-bolts then pry front and rear housings apart. Remove pulley nut (1—Fig. 91), pulley and fan, then withdraw rotor (8).

Use an ohmmeter or test light to check rotor for ground or open circuit. There should not be continuity between rotor shaft and either slip ring. There should be continuity between the two slip rings. Check slip rings for scoring, wear or excessive runout. If necessary, surfaces can be trued by machining. Polish slip rings lightly with 400 grit or finer silicon carbide paper.

NOTE: Clean rotor and stator with compressed air only. Do not use cleaning solvent as insulation will be damaged.

Before removing stator (9), brushes (13) or diode trio (11), check for grounds between brushes and end frame. If brushes are grounded, check insulating washers on the two screws securing brush leads. If insulated screws are not the cause, renew regulator. Note that a grounded brush assembly will result in either no output or uncontrolled output, depending

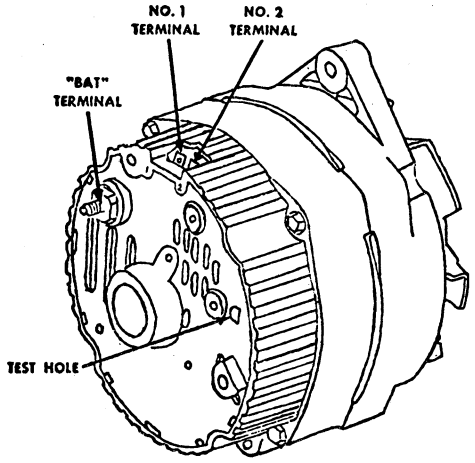


Fig. 90—View of test points for Delco-Remy alternator. Alternator output voltage should go above 15.5 volts when field brush is grounded through test hole. Refer to text.

on location of ground. A grounded brush assembly may also damage the diode trio. Be sure to check diode trio before reassembling.

To test diode trio, remove stator and diode trio noting insulator positions. Refer to Fig. 92 and check for continuity between point D and points A, B and C. Then reverse tester leads and repeat continuity check. There should be continuity in one direction only at each of the test points if diode trio is good.

Inspect stator windings for indications of discolored wiring or a burned odor which indicates a short circuit. Renew stator if there is continuity between stator frame and any of the winding leads. A stator defect is sometimes difficult to confirm; if no problem can be found with any of the other components, then renew stator.

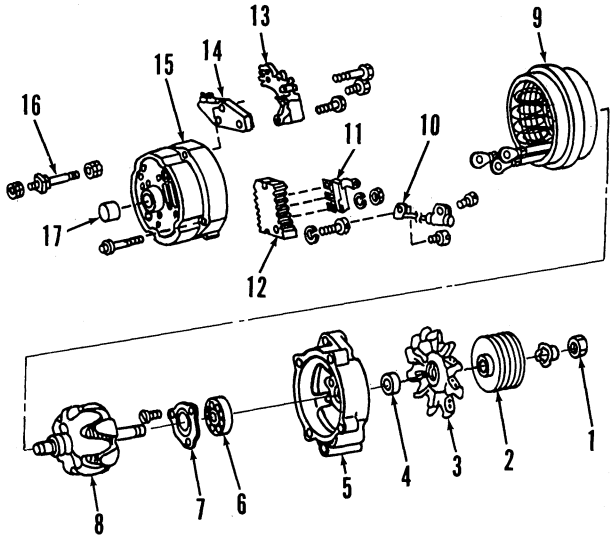


Fig. 91—Exploded view of Delco-Remy alternator used on tractors that are not equipped with Sound-Gard body.

1. Nut
2. Pulley
3. Fan
4. Spacer
5. Housing
6. Bearing
7. Retainer plate
8. Rotor
9. Stator
10. Condenser
11. Diode trio
12. Rectifier
13. Brush holder assy.
14. Regulator
15. Housing
16. Output terminal
17. Bearing

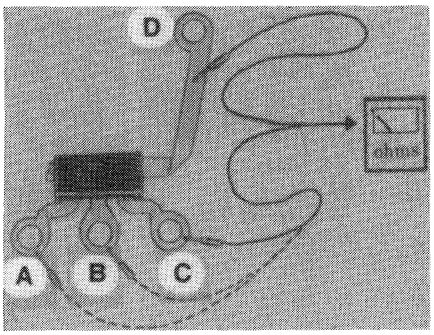


Fig. 92—Delco-Remy diode trio test points. Refer to text.

The rectifier bridge has a grounded heat sink (A—Fig. 93) and an insulated heat sink (E). To test rectifier, check for continuity between point A and points B, C and D, then reverse tester leads and recheck same points. There should be continuity in one direction only. Repeat tests between point E and points, B, C and D. Tests should show continuity in one direction only at each test point. If not, renew rectifier bridge.

Inspect rotor bearings for wear or other damage. If lubrication supply of rear bearing is exhausted, bearing must be renewed. Do not attempt to relubricate bearing. To remove bearing, press inward using a suitable driver. Press new bearing in until flush with outer surface of housing.

When reassembling alternator, be sure all insulating washers and sleeves are correctly positioned. Push brushes back, then insert a wire or plastic pin through opening in end frame to hold brushes in retracted position. Be sure brushes are clean of lubricant if reusing brushes. Assemble rotor and front housing. Align index marks on housings and install through-bolts. Remove wire securing brushes. Tighten pulley nut to 60 ft.-lbs. (80 N·m).

STARTING MOTOR

All Models

89. All tractors are equipped with a John Deere starting motor. To remove starting motor, first disconnect battery ground cable. Disconnect wires to starter solenoid. Remove starter mounting cap screws. A special wrench, JDE-80, is available for removing cap screw located behind starter. Remove starting motor from engine.

Starter no-load test may be performed to help determine condition of starter prior to disassembly. Using a tachometer, an ammeter capable of measuring several hundred amps and a 12-volt battery connected as shown in Fig. 94, measure current draw and armature speed. Current draw should be approxi-

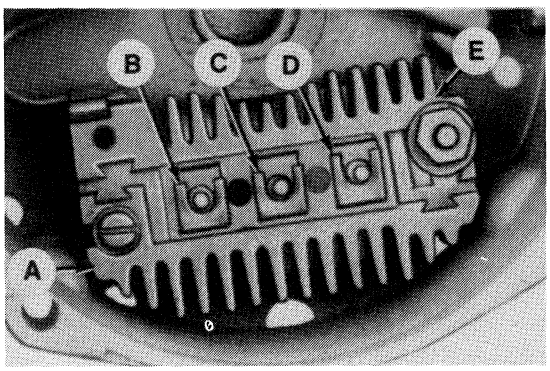


Fig. 93—View of rectifier bridge of Delco-Remy alternator showing test points. Refer to text.

mately 90 to 140 amps and armature speed should be approximately 4000 to 5000 rpm. If current draw or speed is significantly different than specified, use the following as a guide to diagnose the problem.

1. Starter fails to operate and low current draw. Could be caused by:
   a. Open series field circuit.
   b. Open armature coils.
   c. Brush not contacting armature.
2. Starter fails to operate and high current draw. Could be caused by:
   a. Grounded terminal or field circuit.
   b. Bearings seized.
3. Low speed and low current draw. Could be caused by:
   a. Defective brush contact with armature.
   b. High internal resistance.
4. Low speed and high current draw. Could be caused by:
   a. Shorted armature.
   b. Grounded armature or fields.
   c. Armature "dragging."
5. High speed and low current draw. Could be caused by:
   a. Open shunt field circuit.
6. High speed and high current draw. Could be caused by:
   a. Shorted series field coils.

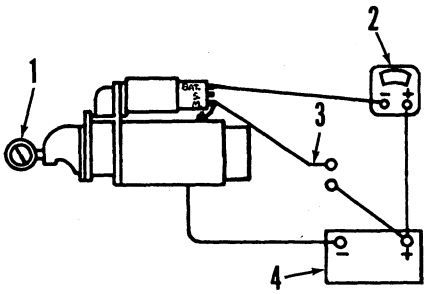
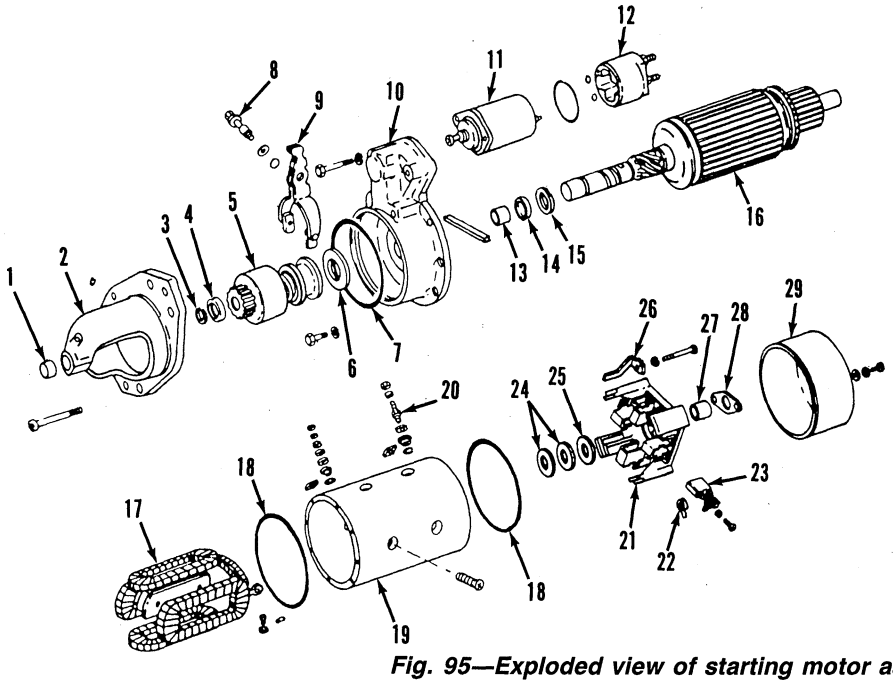


Fig. 94—Connect an ammeter, 12-volt battery and switch to starter as shown to perform no-load test. Measure armature speed with an accurate tachometer.

1. Tachometer
2. Ammeter
3. Switch
4. Battery

Refer to Fig. 95 for an exploded view of typical starting motor. Minimum brush spring tension is 40 ounces (11 N). Brushes can be renewed without removing the commutator end frame (21). Check armature for short circuit using a growler. Use an ohmmeter to check armature for grounds or open circuit. There should not be continuity between the armature core or shaft and the commutator. There should be continuity between adjacent segments of commutator. Renew armature if necessary. Check field windings for open circuit or grounds. There should not be continuity between field frame (19) and the copper terminal bolt (20). There should be continuity between the copper terminal bolt and the other end of field winding. Also, check for continuity between eyelet terminal of shunt winding and the smaller terminal bolt. There is no suitable way to check field windings for short circuits. If starting motor opera-



1. Bushing
2. Drive end housing
3. Snap ring
4. Pinion stop
5. Overrunning clutch
6. Wear ring
7. "O" ring
8. Pivot pin
9. Shift lever
10. Center housing
11. Solenoid
12. Cover
13. Bushing
14. Seal
15. Thrust washer
16. Armature
17. Field coil
18. "O" rings
19. Field frame
20. Terminal bolt
21. Commutator end frame
22. Spring
23. Brush
24. Shims
25. Thrust washer
26. Brush ground strap
27. Bushing
28. Gasket
29. End cover

Fig. 95—Exploded view of starting motor assembly.

tion is weak and no other cause can be found, renew field windings.

NOTE: Whenever starter is disassembled, apply coat of Esso Beacon 325 or Delco-Remy Number 1960954 lubricant to both end bearings, brake washer, solenoid plunger, ends of shift lever, wear pads and shift lever pivot pin.

When reassembling starter motor, use a dial indicator to check armature end play before installing drive end housing. Add or remove shims (24), if necessary, to obtain recommended end play of 0.002-0.020 inch (0.05-0.50 mm).

Reinstall starting motor and apply sealing compound to threads of mounting cap screws. Tighten screws to 35 ft.-lbs. (47 N·m).

90. NEUTRAL START SWITCH. All tractors are equipped with a neutral start switch which is designed to prevent operation of starter unless transmission is in "PARK." On models equipped with a Quad-Range transmission, the switch is located on right side of transmission housing to the rear of upper shifter shaft. On models equipped with a Power Shift transmission, the switch (1—Fig. 96) is mounted behind the switch shield on transmission control valve located on right side of transmission housing.

If starter fails to operate when transmission is in "PARK" or if starter will operate when transmission is in gear, check the following: The transmission shift linkage may be worn or misadjusted (refer to appropriate TRANSMISSION section). The neutral switch may be defective and should be renewed. The switch may be improperly adjusted (Quad-Range transmission).

To adjust switch on Quad-Range models, install just enough switch mounting shim washers so switch is open (no continuity) when shift lever is in "PARK," then remove two shim washers. Reinstall switch and cycle shift lever to make certain the switch closes (continuity) when shift lever is in "PARK." There is no provision for adjustment on Power Shift models.

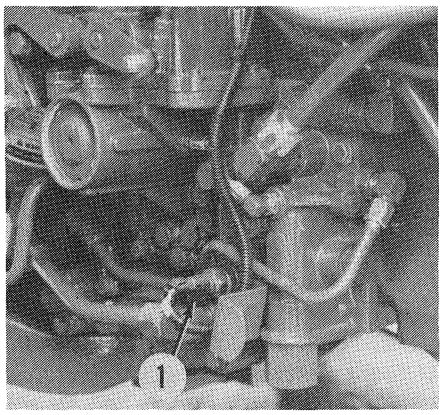


Fig. 96—Neutral start switch (1) is located on transmission control valve on tractors with Power Shift transmission.

INVESTIGATOR II WARNING SYSTEM

All Models So Equipped

91. The warning system consists of a dash mounted electronic module which receives signals from sensors located at various places on the tractor. Tractors equipped with a digital tachometer also use two additional sensors for ground speed and pto speed. The system analyzes condition of engine and drive train and indicates when a problem exists.

The following are some common warning system problems which may be encountered: A loss of ground to socket number 4 of the 37-hole module connector will cause the tel-lights, Stop Engine and Service Alert lamps and the warning horn to come on and stay on. Socket number 4 is grounded at the steering line clamp on all models except 4050 which is grounded at the steering valve. A loss of ground to socket number 22 of 37-hole connector will prevent all tel-lights, Stop Engine and Service Alert lamps and horn from activating. Socket number 22 is also grounded at the steering line clamp (steering valve on Model 4050). Loss of ground to socket number 17 of 37-hole connector will cause the transmission pressure tel-light, Stop Engine lamp and horn to come on. The circuit is grounded at the starter circuit relay. A faulty alternator diode will cause the Service Alert lamp to come on while no other circuit problems or incorrect gage readings will be indicated. If transmission pressure sensor and transmission filter sensor F1 wires are switched, the filter tel-light and Service Alert lamp will be on when key switch is on and engine is off. If transmission pressure sensor and transmission filter sensor F2 wires are switched, the filter tel-light, Stop Engine lamp and horn will be on when key switch is on and engine is off. Voltage at socket number 15 of 37-hole module connector and at socket number 14 of 16-hole tachometer connector must be within 0.2 volts of battery voltage.

NOTE: Do not disconnect module with key switch ON or start or run engine with module disconnected as digital tachometer could be damaged.

92. SENSORS. The following sensors are used on the INVESTIGATOR II Warning System:

The fuel level sensor is located on right rear side of fuel tank. Before removing sensor, fuel must be drained until below sensor level. To check sensor operation, use an ohmmeter to measure resistance as float is moved from empty to full position. Resistance should vary from approximately 0 to 95 ohms.

The engine speed sensor is mounted on right side of engine timing gear cover. The sensor transmits alternating current, produced as gear teeth pass the magnetic pickup, to the tachometer. With engine running, voltage across sensor leads should be at least 1.0 volt ac.

On models so equipped, the pto speed sensor is located on the rear of the transmission case under the pto housing. The ground speed sensor is located at the rear of the transmission housing on 4650 tractors with Quad-Range transmission and on the left side of the transmission case on all other tractors. With engine running and pto engaged, voltage across pto sensor leads should be at least 1.0 volt ac.

The engine coolant temperature sensor is located on the rear of the engine coolant manifold. Renew sensor if resistance across sensor leads is above 1700 ohms or less than 700 ohms.

The engine cylinder head temperature sensor is located on the left rear of the cylinder head. The sensor switch should close at a temperature of 248°-270° F (120°-132° C) which completes circuit to ground causing the coolant temperature gage needle to move to red area, and the coolant temperature tel-light, Stop Engine lamp and horn will come on.

The air filter restriction indicator sensor is located on the air intake tube at the left rear side of engine on all tractors except Model 4050. On Model 4050, the sensor is above the air cleaner housing in front of the radiator. Sensor switch should close when intake vacuum reaches 20 to 30 inches of water. If there is continuity before 20 inches of water vacuum or if there is no continuity between 20 to 30 inches, renew sensor.

Engine oil pressure sensor is located on the right rear side of the cylinder block. The oil pressure tel-light, Stop Engine lamp and horn should be on when oil pressure is below the following figures.

1000 rpm and below	10 psi (69 kPa)
1250 rpm	17 psi (120 kPa)
1500 rpm	24 psi (168 kPa)
1700 rpm and above	30 psi (207 kPa)

The hydraulic oil temperature sensor is located on the left side of the tractor in the rear of the oil filter relief valve housing on models equipped with Quad-Range transmission. On models equipped with Power Shift transmission, the sensor is located in the traction clutch valve housing. When oil temperature reaches 216°-221° F (102°-105° C), the sensor should cause hydraulic oil temperature tel-light, Service Alert lamp and beeping horn to come on. At temperatures above 221° F (105° C), the Stop Engine lamp and continuous horn should come on. The tel-light and Service Alert lamp should also come on if oil temperature is below 14° F (110° C). Renew sensor if resistance across leads is greater than 1700 ohms or less than 700 ohms.

The clutch temperature sensor is located on the right side of clutch housing. This sensor senses temperature of the lubricating oil flow thrown from the clutch. When temperature of the clutch oil is at least 54° F (30° C) greater than the hydraulic oil temperature, the tel-light, Service Alert lamp and horn should be activated. To check sensor, measure resistance across sensor leads. Renew if resistance is greater than 1700 ohms or less than 700 ohms.

The transmission control pressure sensor is located on left side of the tractor. On models equipped with Quad-Range transmission, sensor is located at top front side of the filter relief valve housing. On models with Power Shift transmission, sensor (2—Fig. 97) is located at bottom front of the traction clutch valve housing. If oil pressure falls below 115-125 psi (795-865 kPa) and engine speed is above 500 rpm, the sensor should close. When sensor remains closed for longer than three seconds and engine speed is 500-1050 rpm, the tel-light and Service Alert lamp should come on. If sensor remains closed for three seconds and engine speed is above 1050 rpm, the tel-light, Stop Engine lamp and horn should be activated. Specified clutch pressure is 170-180 psi (1175-1240 kPa) at 2000 rpm on all models.

Two filter restriction sensors (1—Fig. 97) are located on the left side of the tractor. The sensors are located on top of oil filter relief valve housing on tractors

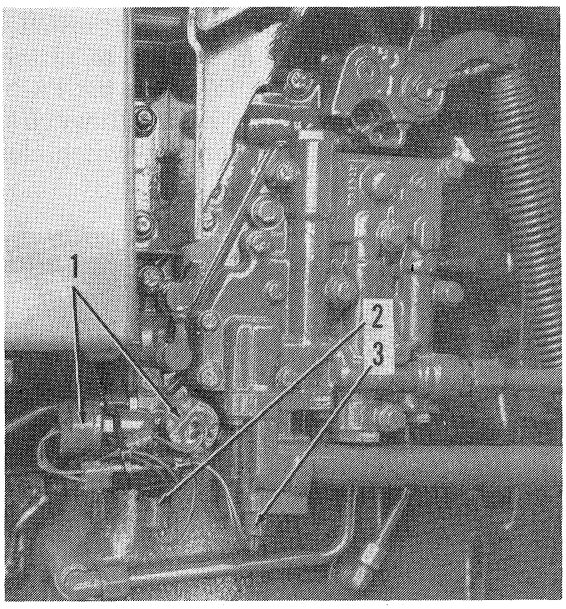


Fig. 97—Oil filter restriction sensors (1), transmission oil pressure sensor (2) and override switch (3) are located on Power Shift traction clutch valve on models with Investigator II Warning system.

with Quad-Range transmission and on the traction clutch valve on Power Shift equipped tractors. If transmission oil filter becomes restricted to cause a pressure differential of 40-55 psi (275-380 kPa), the tel-light and Service Alert lamp should come on. If pressure differential increases to 72-94 psi (500-650 kPa), the tel-light, Stop Engine lamp and horn should come on.

93. GAGE CLUSTER SENSORS. On tractors not equipped with INVESTIGATOR II Warning System, a module containing a voltage gage, fuel gage, engine coolant gage, oil pressure gage, an air filter restriction warning light and a transmission oil warning light along with the necessary sensors are used. The operation of all sensors except transmission oil warning light is similar to INVESTIGATOR II components outlined in paragraph 92.

On tractors equipped with Quad-Range transmission, the transmission oil pressure sensor (2—Fig. 98), oil filter sensor (1) and oil filter override switch (4) are located on the oil filter relief valve housing (3). The sensors act together along with a time delay device to activate the warning light. The override sensor, which is a temperature switch, prevents false filter restriction warning when the oil is cold. The oil pressure sensor should close when oil pressure is below 120 psi (827 kPa). Specified oil pressure is 170-180 psi (1175-1240 kPa). When switch is closed for longer than two seconds, warning light should come on. The oil filter sensor should close if filter becomes restricted and pressure differential exceeds 81 psi (556 kPa), completing circuit to ground for warning light. The override switch is in the same circuit with the oil filter switch. It should open at temperatures below 61° F (16° C) preventing a circuit to ground and a false restriction warning when oil is cold. The switch should normally be closed above 68° F (20° C) providing a circuit to ground for filter sensor if sensor detects filter restriction.

On tractors equipped with Power Shift transmission, the oil temperature sensor (1—Fig. 99), low oil pressure sensor (3), oil filter restriction sensor (2) and filter override switch (4) along with a time delay device all work together to activate the warning light. The light should come on if oil temperature exceeds 221° F (105° C), if oil pressure is below 120 psi (827 kPa) or if oil filter restriction pressure exceeds 81 psi (556 kPa). The filter override switch should be open at temperatures below 61° F (16° C) preventing a circuit to ground and a false warning light when oil is cold. The switch should be closed above 68° F (20° C) providing a circuit to ground for filter sensor if sensor detects filter restriction.

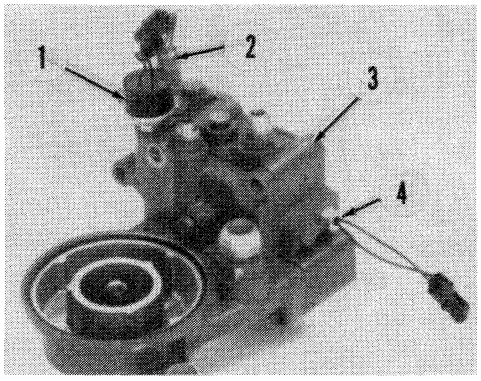


Fig. 98—Gage cluster sensors are located on oil filter relief valve housing on tractors with Quad-Range transmission.

1. Oil filter sensor
2. Oil pressure sensor
3. Filter relief valve housing
4. Override switch

ENGINE CLUTCH (PERMA-CLUTCH)

94. This section covers only the engine clutch, which is called a Perma-Clutch, that is used in tractors equipped with Quad-Range transmission. For tractors equipped with Power Shift transmission, refer to paragraph 132 for clutch removal and paragraph 142 for clutch overhaul.

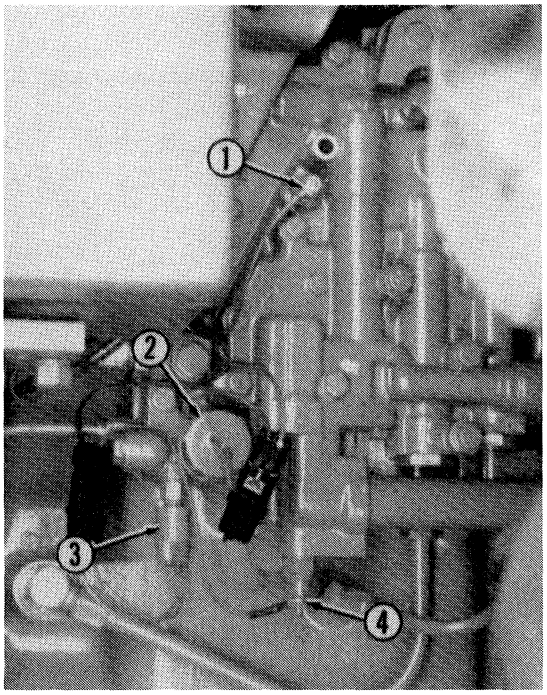


Fig. 99—Gage cluster sensors are located on traction clutch valve housing on tractors with Power Shift transmission.

1. Oil temperature sensor
2. Oil filter restriction sensor
3. Low oil pressure sensor
4. Override switch

The Perma-Clutch consists of two independently operated clutch packs mounted to the rear of the engine flywheel. The front clutch pack is the traction clutch and the rear clutch pack is the pto clutch. Both clutches are hydraulically actuated.

PERMA CLUTCH PRESSURE TESTS

Quad-Range Models

95. CLUTCH PRESSURE CHECK. To check clutch system pressure, install a 0-300 psi (0-2000 kPa) pressure gage in clutch pressure test port of pressure regulating valve housing (Fig. 100). With transmission in "PARK," transmission oil at operating temperature and engine running at 2000 rpm, clutch pressure should be 170-180 psi (1170-1240 kPa). Depress clutch pedal while observing pressure gage. Clutch pressure should fall to zero when pedal is depressed, then gradually rise as pedal is slowly released.

If pressure is below specifications, increase and decrease engine speed approximately 300 rpm. If pressure rises and falls with change in engine speed, there is an internal leak or insufficient oil flow. Test lubrication pressure as outlined in paragraph 96.

If pressure is low and changes only slightly with rpm change, remove pressure regulating valve plug (18—Fig. 103) and add shims (16) to increase pressure as needed. One shim should change pressure approximately 5 psi (35 kPa).

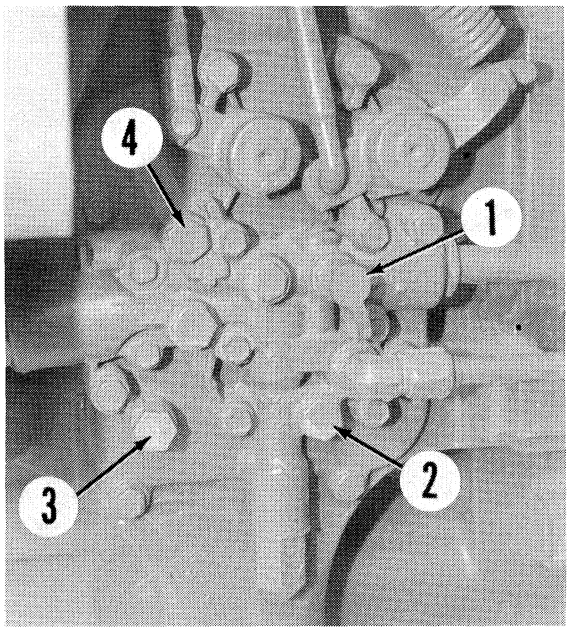


Fig. 100—View of pressure regulating valve housing used on models equipped with a Perma-Clutch and Quad-Range transmission.

1. System pressure test port
2. Clutch pressure test port
3. Pto clutch pressure test port
4. Pto brake pressure test port

96. LUBRICATION PRESSURE CHECK. The lubrication pressure can be checked by connecting a 0-60 psi (0-500 kPa) pressure gage at test port (1—Fig. 101) on return oil manifold. Pressure should be checked with engine operating at 1500 rpm and also at 2000 rpm. Specified pressure at 1500 rpm is 25 psi (170 kPa) with oil at 110° F (43° C) or 17 psi (120 kPa) with oil at 150° F (66° C). Specified pressure at 2000 rpm is 43 psi (290 kPa) with oil at 110° F (43° C) or 28 psi (190 kPa) with oil at 150° F (66° C).

Low lubrication oil pressure could be caused by: Pressure regulator valve housing mounting gasket leaking; oil leakage at pressure regulator valve adapter tube "O" rings; two-speed shift valve leaking; or malfunction in charging circuit.

Lubrication reduction valve, located in clutch operating piston housing, can be checked with same gage attachment at return oil manifold. Adjust engine speed until lubrication pressure is 10 psi (70 kPa), then depress clutch pedal. Observe gage pressure while slowly engaging clutch. If reduction valve is operating properly, a dip in pressure will occur as pedal is released. If pressure does not dip, reduction valve is probably stuck.

97. PTO CLUTCH AND BRAKE PRESSURE CHECK. Install 0-300 psi (0-2000 kPa) pressure gages at pto clutch test port (3—Fig. 100) and at pto brake test port (4) on pressure regulator valve housing. Specified pto clutch and brake pressure is 170-180 psi (1170-1240 kPa). To check pressure, proceed as follows: With engine running at 2000 rpm, engage pto clutch gradually. Clutch pressure should rise gradually to 130 psi (8900 kPa), then jump to system pres-

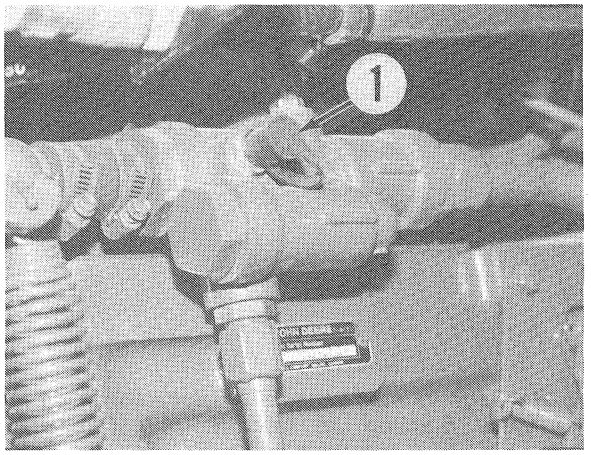


Fig. 101—To check clutch lubrication pressure, attach a 0-60 psi (0-500 kPa) pressure gage to test port (1) of return oil manifold. Refer to text.

sure. Move pto lever to brake position. The clutch pressure should immediately drop to zero and brake pressure should jump to system pressure.

If there is a pressure differential greater than 20 psi (140 kPa) between clutch pressure and brake pressure, excessive leakage would be indicated in the circuit with lower pressure. Do not place a load on pto until low pressure condition has been corrected.

CLUTCH PRESSURE REGULATING VALVE AND HOUSING

Quad-Range Models

98. The clutch pressure regulating valve housing is mounted on the left side of the transmission housing. The pressure regulating valve (14—Fig. 103), pto clutch valve (13—Fig. 103A), traction clutch control valve (17) and clutch shut-off valve (15) are contained in the valve housings. The clutch shut-off valve prevents tractor from moving until clutch pedal is depressed and released. The valve resets itself to neutral each time engine is stopped.

99. R&R AND OVERHAUL. Before removing regulator valve, first drain oil from auxiliary reservoir and oil cooler as follows: Connect a hose to one of the selective control valve (SCV) outlets and secure other end of the hose in transmission filler tube. Operate engine at 800 rpm and move SCV lever to direct oil into filler tube. Shut off engine when hy-

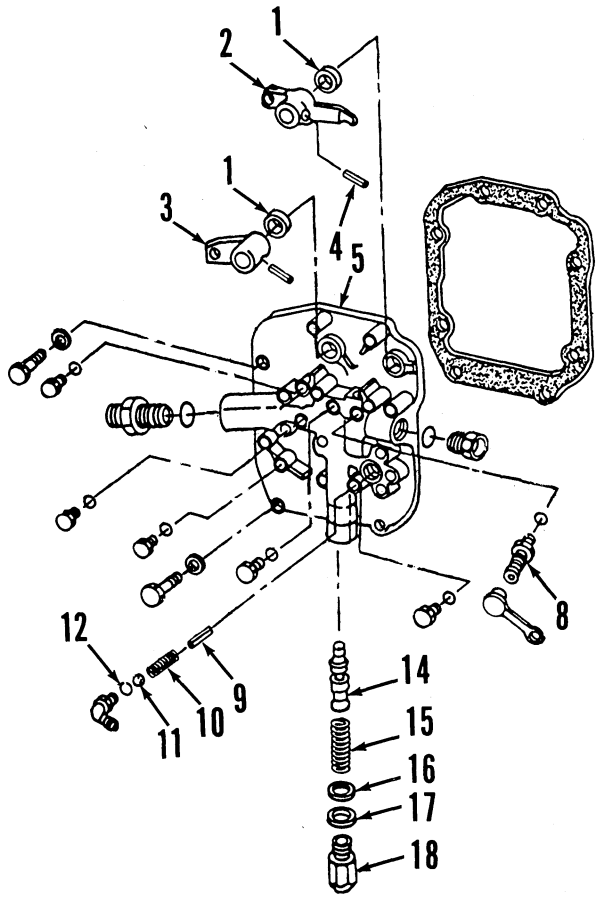


Fig. 103—Exploded view of pressure regulating valve outer housing assembly. Refer to Fig. 103A for inner valve housing components.

1. Seal
2. Clutch control arm
3. Pto control arm
4. Spring pin
5. Housing
8. Pressure test port
9. Pin
10. Spring
11. Check ball
12. "O" ring
14. Pressure regulator valve
15. Spring
16. Shim
17. Washer
18. Plug

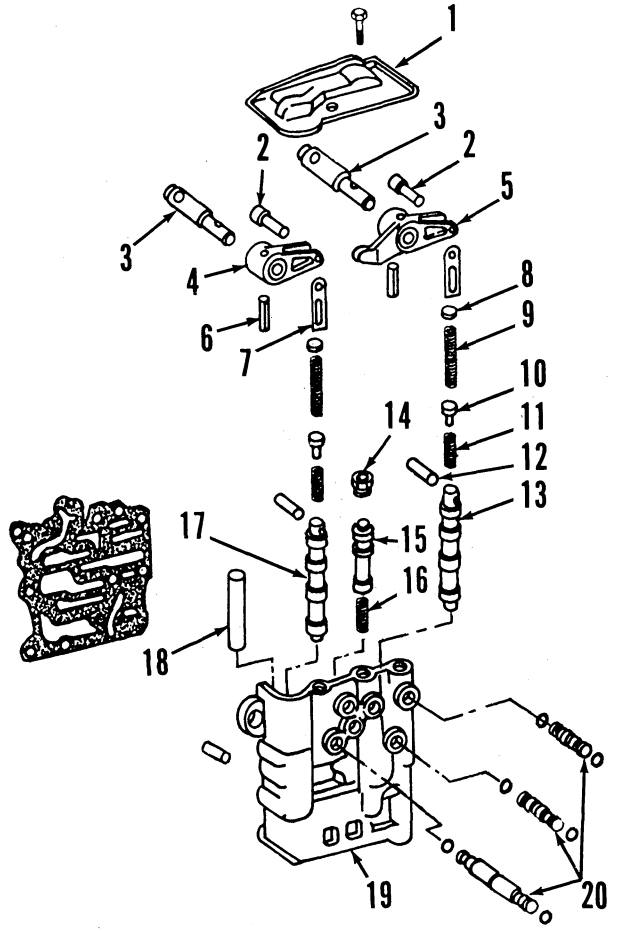


Fig. 103A—Exploded view of clutch valve inner housing assembly.

1. Cover
2. Pin
3. Shaft
4. Pto arm
5. Traction clutch arm
6. Spring pin
7. Link
8. Thrust washer
9. Outer spring
10. Spring guide
11. Inner spring
12. Pin
13. Pto clutch valve
14. Plug
15. Clutch shut-off valve
16. Spring
17. Traction clutch valve
18. Lock piston
19. Housing
20. Oil tubes

draulic pump begins to cavitate. Move SCV lever to neutral and remove hose.

Disconnect clutch rod, return spring, pto rod and hydraulic lines from valve housing. Remove eight housing mounting cap screws, then withdraw valve housing.

Remove plug (18—Fig. 103), shims (16), spring (15) and pressure regulator valve spool (14). Inspect valve spool and housing bore for nicks, burrs or scoring. Free length of spring should be 5.43 inches (138 mm) and working load should be 55-67 pounds (243-297 N) at 4.48 inches (114 mm). Regulating valve pressure setting is adjusted using shims (16). Refer to paragraph 95.

Drive out roll pins (4—Fig. 103) and remove control valve arms (2 and 3). Remove cap screws securing regulating valve housing to control valve housing and separate housings. Remove valve shield (1—Fig. 103A). Remove valve pins (2), shafts (3) and operating arms (4 and 5). Remove links (7), thrust washers (8), springs (9 and 11), pins (12) and valve spools (13 and 17). Keep parts from each valve assembly separated as they are not interchangeable. Note that traction clutch valve springs are color coded red. Remove pto lever lock piston (18). Remove plug (14) and clutch shut-off valve (15).

Inspect all parts for wear or other damage. Compare springs with the following specifications and renew if necessary.

Traction Clutch Valve Springs—

Inner Spring

Free length ..... 1.12 in. (29 mm)
Test load ..... 14-18 lbs. (64-78 N)
Test length ..... 0.60 in. (15 mm)

Outer Spring

Free length ..... 2.08 in. (53 mm)
Test load ..... 6-14 lbs. (24-61 N)
Test length ..... 2.04 in. (52 mm)

Pto Clutch Valve Springs—

Inner Spring

Free length ..... 1.10 in. (28 mm)
Test load ..... 11-13 lbs. (48-60 N)
Test length ..... 0.60 in. (15 mm)

Outer Spring

Free length ..... 2.33 in. (59 mm)
Test load ..... 51-62 lbs. (227-276 N)
Test length ..... 1.89 in. (48 mm)

Clutch Shut-Off Valve Spring—

Free length ..... 1.16 in. (29 mm)
Test load ..... 6-7 lbs. (26-32 N)
Test length ..... 0.83 in. (21 mm)

To reassemble valve, reverse the disassembly procedure while noting the following items. Be sure clutch shut-off valve (15) is installed with single-land end into housing first. Make certain valve springs are installed in their correct locations. Traction clutch valve link (7) has a notch in one end and should be installed with notched side facing outward. Tighten cap screws securing control valve housing to pressure regulator valve housing to 20 ft.-lbs. (27 N·m).

Before reinstalling valve assembly, check "O" rings on adapter tubes (20) in clutch housing and renew if necessary. Install valve housing with a new gasket and tighten mounting cap screws to 35 ft.-lbs. (47 N·m).

TRACTOR CLUTCH SPLIT

Quad-Range Models

100. To separate (split) engine from clutch housing for access to engine clutch, proceed as follows: Drain cooling system and transmission oil. Disconnect battery cables and remove batteries, battery boxes and left step. Remove air stack, muffer extension, side panels, grille screens and hood. Disconnect air conditioning hoses at couplers under left front corner of cab and pull hoses forward to the compressor. Disconnect electrical wiring as necessary and move wiring harnesses rearward to the cab. Disconnect heater hoses.

NOTE: Before disconnecting hydraulic lines, relieve hydraulic system pressure by loosening brake bleed screw and pumping brake pedal until pedal goes all the way down.

Disconnect auxiliary hydraulic reservoir bleed line, oil cooler return oil line and steering lines. Disconnect main hydraulic pump charge line from pressure regulating valve housing and main pump pressure line from pressure control valve housing. Remove hitch center link mounting bracket from rear of transmission housing. Remove plug located behind center link bracket, then withdraw pump drive shaft rearward from transmission housing. Disconnect throttle control linkage and fuel shut-off cable. If equipped with mechanical front-wheel drive, disconnect drive shaft from front axle.

Support front of tractor with a suitable rolling type splitting stand or overhead hoist. Support rear of tractor with a suitable stand at the clutch housing. Remove front end weights, if so equipped. Remove floor mat and floor plate from cab for access to the top two clutch housing mounting cap screws. Remove all cap screws securing clutch housing to engine and oil pan. Carefully roll front end and engine away from clutch housing. Be careful clutch shafts do not become disengaged from clutch housing and fall out during separation.

To reattach engine to clutch housing, reverse the splitting procedure. Do not use mechanical force to draw the tractor together. When properly aligned, units will slide together. Tighten clutch housing to engine cap screws to 300 ft.-lbs. (405 N·m) and clutch housing to oil pan cap screws to 120 ft.-lbs. (160 N·m) Tighten hitch center link bracket cap screws to 300 ft.-lbs. (405 N·m). On tractors equipped with mechanical front-wheel drive, tighten drive shaft cap screws to 50 ft.-lbs. (68 N·m).

R&R AND OVERHAUL PERMA-CLUTCH

Quad-Range Models

Unless clutch has been slipping or giving some indication of trouble, do not disassemble clutch for inspection. Check for adequate clearance between underside of the three traction clutch levers and the clutch cover by driving wedges under the outer edge of levers as shown in Fig. 104. If some clearance does not exist with levers applied, unit should be overhauled. The clutch unit is designed so clutch levers will contact the cover before the clutch discs are worn enough to damage other parts of the assembly. At this point, clutch will slip noticeably. Readjustment of levers to compensate for the wear on the discs should not be attempted as serious damage could occur to friction surfaces of backing plate and separator plates with further disc wear.

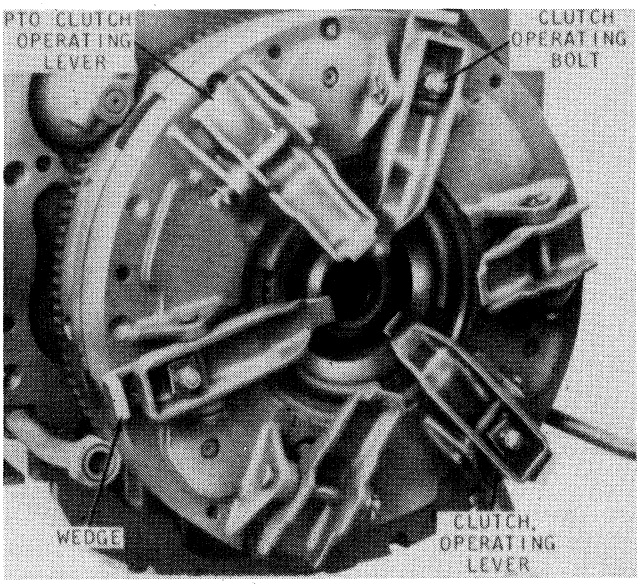


Fig. 104—Insert wedges under clutch operating levers as shown to hold clutch pack together during removal and installation. If levers bottom out on the clutch cover, clutch pack is excessively worn and should be repaired.

101. Split tractor between engine and clutch housing as previously outlined. Insert wedges under operating levers (Fig. 104) to hold clutch pack together during removal. Remove six cover cap screws and withdraw clutch unit from flywheel. Remove the locknuts and adjusting nuts from the three clutch operating levers. Lift off clutch cover, then separate clutch pack components.

Inspect traction clutch and pto discs (2 and 11—Fig. 105) for warpage and excessive wear. Renew any disc that is less than 0.110 inch (2.79 mm) in thickness, or if depth of facing grooves is less than 0.005 inch (0.13 mm). Check separator plates for roughness or excessive wear. Smooth any raised areas with em-

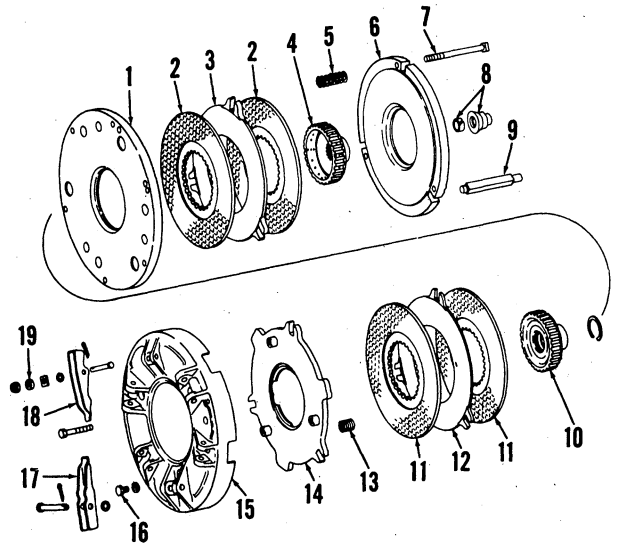


Fig. 105—Exploded view of Perma-Clutch assembly used on tractors equipped with Quad-Range transmission. On 4650 models, three separator plates (3), four traction clutch discs (2), two separator plates (12) and three pto clutch discs (11) are used.

1. Backing plate
2. Traction clutch discs
3. Separator plate
4. Clutch hub
5. Spring
6. Pressure plate
7. Operating bolt
8. Pilot adapter & bushing
9. Flywheel drive pin
10. Pto hub
11. Pto clutch discs
12. Separator plate
13. Spring
14. Pto pressure plate
15. Clutch cover
16. Adjusting screw
17. Pto clutch lever
18. Traction clutch lever
19. Adjusting nut

ery cloth. Darkened areas (if smooth) on separator plates do not affect clutch operation. Renew separator plates if warped in excess of 0.006 inch (0.15 mm). Check splines of clutch hubs (4 and 10) for wear and make certain oil holes are open.

When reassembling clutch, place pressure plate (6) with friction surface up and insert three operating bolts (7) from the underside so bolt heads are positioned in recesses of plate. Position clutch hub (4) in center of pressure plate. Alternately install traction clutch discs and separator plate(s), beginning with a disc and ending with a disc, and align slots in plates with slots in pressure plate. Install backing plate (1) with spring recesses up. Install pto hub (10) and clutch springs (5), then alternately assemble pto discs and separator plate(s), beginning and ending with a disc. Install pto springs (13) in pressure plate recesses, then install pto pressure plate (14). Make sure slots in separator plates and pressure plates are aligned (Fig. 106). Install clutch cover and operating levers. Tighten lever adjusting nuts just enough to hold backing plate firmly against the clutch cover. This will prevent pto disc from falling off hub during installation.

Install clutch assembly in flywheel aligning slots in separator plates with flywheel drive pins. It may be necessary to slightly loosen the lever adjusting nuts in order to move separator plates. Install four mounting cap screws (leaving out two cap screws opposite each other) and tighten to 35 ft.-lbs. (47 N·m). Adjust clutch levers as outlined in the following paragraph.

102. ADJUSTMENT. It is very important that clutch adjustment be accurately performed to ensure even clutch plate loading since the Perma-Clutch is hydraulically applied by a piston applying force against the clutch levers. It is equally important that levers be properly adjusted to ensure that the clutch will be fully released when hydraulic pressure is removed from the apply piston. JDE-78 clutch adjusting tool with proper spacer plates is required for accurate adjustment (Fig. 107). The spacer plates to be used for each tractor model are as follows: On Models 4050, 4250 and 4450, assemble JDE-78-3, 0.466 inch (11.8 mm), gage ring and JDE-78-12, 0.070 inch (1.7 mm), gage ring onto JDE-78-1 adjusting tool for pto clutch, and install JDE-78-4, 0.252 inch (6.4 mm), gage ring for traction clutch. On Models 4650 and 4850, use JDE-78-15, 0.159 inch (4 mm), gage ring for pto clutch and JDE-78-17, 0.147 inch (3.7 mm), gage ring for traction clutch on JDE-78-1 adjusting tool.

To adjust clutch, first remove pto clutch levers and loosen traction clutch lever adjusting nuts. Install JDE-78-1 adjusting tool gage (Fig. 107) with proper gage rings. Install JDE-78-2 gage bar so the long screw will pass through the hole in the gage bar and at the same time the three adjusting tool screws will contact a flat part of pto pressure plate, but not on the lip. Loosen the three pto clutch adjusting screws. Tighten the stud nuts and forcing screw to 20 ft.-lbs. (27 N·m). Oil the threads of clutch lever adjusting nuts, then tighten each adjusting nut in four steps to the following torques:

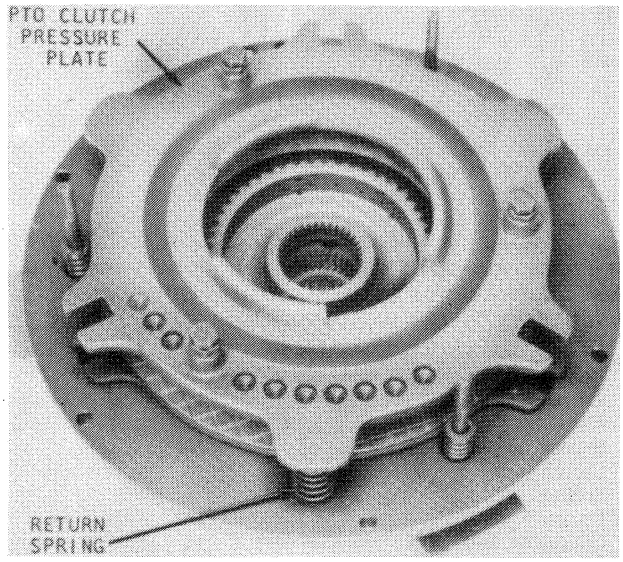


Fig. 106—Assemble pto pressure plate so tabs are over return springs as shown. Be sure notches in plates are aligned.

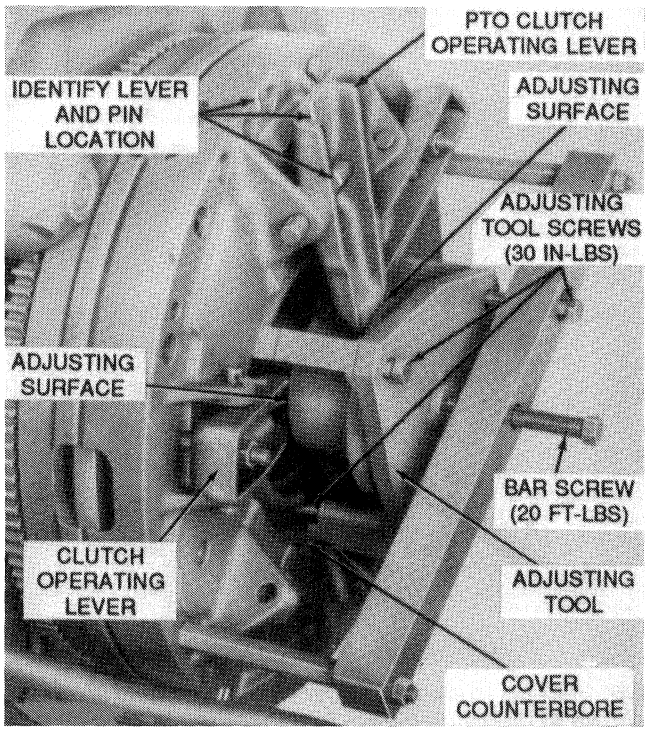


Fig. 107—JDE-78 clutch adjusting tool with proper spacer plates is required to accurately adjust Perma-Clutch.

First step . . . . . 10 in.-lbs. (1 N·m)
Second step . . . . . 40 in.-lbs. (4.5 N·m)
Third step . . . . . 70 in.-lbs. (8 N·m)
Fourth step . . . . . 90 in.-lbs. (10 N·m)

While holding the adjusting nuts, carefully tighten the locknuts. Tighten the three adjusting tool screws to 30 in.-lbs. (3.4 N·m) to load the pto pressure plate. Reinstall pto levers, then turn lever adjusting screws out until lever contacts adjusting tool. Hold adjusting screw and tighten locknut. Recheck pto levers to make certain clearance between levers and adjusting tool does not exceed 0.010 inch (0.25 mm). Remove adjusting tool. Install the two clutch cover cap screws and tighten to 35 ft.-lbs. (47 N·m).

CLUTCH OPERATING PISTON

Quad-Range Models

103. R&R AND OVERHAUL. To remove piston housing, first split tractor between engine and clutch housing as outlined in paragraph 100. Remove clutch pressure regulating housing and adapter tubes from clutch housing as outlined in paragraph 99. Remove inner and outer cap screws (Fig. 108) securing clutch piston housing. Withdraw clutch drive shaft, then remove piston housing from the clutch housing.

To disassemble, remove traction clutch piston (29—Fig. 109), straighten tangs on bearing retainer (33) and separate thrust bearing assembly from piston.

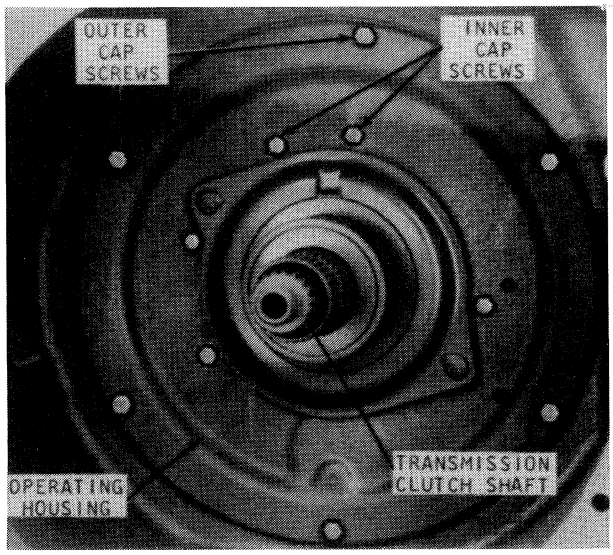


Fig. 108—View of clutch operating piston housing installed in clutch housing. To remove housing, first remove clutch drive shaft, inner cap screws and outer cap screws.

Illustration for Fig. 108 reproduced by permission of Deere & Company. Copyright Deere & Company.

Position pto gear (3) so ends of snap ring (5) are accessible through slotted hole in gear. Working through slotted hole, disengage snap ring from its groove, then withdraw pto shaft with bearing (7) from piston housing. Remove pto brake piston (if so equipped) from housing. Remove cap screws securing clutch piston sleeve (20—Fig. 109) and remove sleeve. Depress return springs (12) and remove retaining rings (10) and washers (11). Separate pto clutch operating piston (22) and thrust washer assembly from piston housing. To remove lube reduction valve (16) and piston (15), remove plug (18) and drive stop pin (13) rearward from housing until piston can be removed.

Inspect all parts for wear or other damage and renew if needed. Renew pto brake piston if friction pad is excessively worn or glazed. Inside diameter of pto shaft bushing (4) should be 1.706-1.708 inches (43.32-43.37 mm). When renewing bushing, install new bushing so open end of oil groove is facing inward. Drive bushing in until outer end is 0.343 inch (8.70 mm) below end of pto shaft. Lube reduction valve spring (17) free length should be 1.850 inches (47 mm). Spring test load is 9-11 pounds (42-52 N) when compressed to height of 0.910 inch (23 mm).

To reassemble, reverse the disassembly procedure. Tighten cap screws securing sleeve in housing to 5 ft.-lbs. (7 N·m). Install pto brake piston making sure hole in piston is aligned with dowel pin. Be sure pto clutch piston (22—Fig. 109) is positioned so notch in piston will face upward when installed in tractor. Install retainer (27) so lug on retainer is aligned with notch in piston. Install lube reduction piston (15) so smaller end will be toward valve (16).

When reinstalling piston housing, use a light coat of grease on seal rings to hold them in place in planetary housing and clutch housing. Tighten five housing-to-planetary cap screws to 20 ft.-lbs. (27 N·m) and tighten six housing-to-clutch housing mounting screws to 36 ft.-lbs. (48 N·m). Complete installation by reversing removal procedure.

QUAD-RANGE TRANSMISSION

104. The Quad-Range transmission consists of an eight-speed mechanically engaged transmission and a hydraulically shifted, two-speed planetary unit to provide 16 forward speeds. Two hand levers control speed selection.

The two-speed planetary unit is controlled by a direct drive clutch and an underdrive brake (overdrive brake is used on Model 4450). Oil to the planetary unit is supplied from the transmission pump through the clutch operating piston housing.

If problems occur after an extended period of proper operation, check condition of hydraulic oil, oil fil-

ter and filter relief valve. Without adequate hydraulic pressure and volume, planetary will not operate properly. Refer to paragraph 95 to check clutch pressure.

TWO-SPEED PLANETARY

Quad-Range Models

105. REMOVE AND REINSTALL. To remove planetary unit, tractor must be split between engine and clutch housing as outlined in paragraph 100. Remove clutch operating piston housing as outlined in paragraph 103. Remove hex bushing (14—Fig. 112) from planetary unit if it did not come out with the clutch shaft (20). Note position of shifter arm shaft for correct reassembly, then drive the spring pin upward until shaft can be separated from the shift arm.

A special tool can be fabricated to remove planetary input shaft as follows: Use a piece of rod about 12 inches (305 mm) long and bend one end to form a hook that is small enough to go through the input shaft. Insert tool through input shaft and hook rear end of the shaft. Pull shaft forward, while aligning shaft splines with sun gear splines, and remove from planetary.

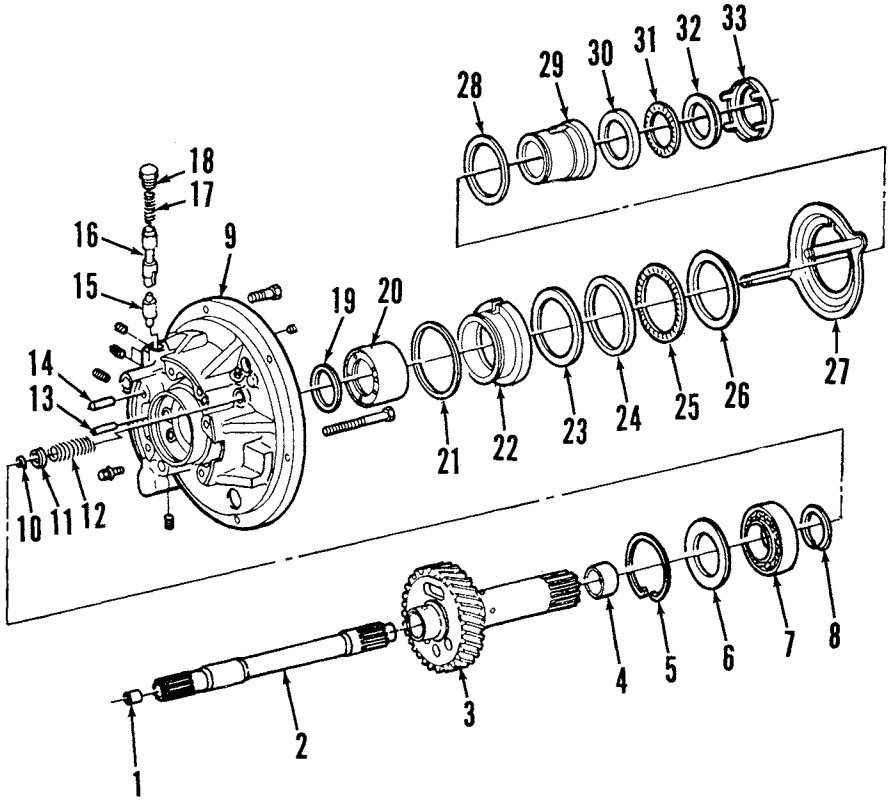
If equipped with mechanical front-wheel drive, remove cap screw from pto idler gear shaft. Use a slide hammer puller to remove idler shaft, then move idler gear out of the way. The pto drive gear does not need to be removed.

Planetary assembly can now be removed by pulling forward and tipping unit to clear pto gear. The clutch shaft may be inserted into planetary unit to serve as a handle when lifting out unit.

Reinstall planetary assembly in reverse order of removal. Make sure arm on outer end of shifter arm shaft is positioned correctly as shown in Fig. 111, as it is possible to install shaft incorrectly by 180 degrees. If equipped with mechanical front-wheel drive, tighten pto idler gear shaft cap screw to 65 ft.-lbs. (85 N·m).

106. OVERHAUL. To disassemble planetary unit, remove the six cap screws securing planetary pinion carrier to clutch drum and lift off carrier assembly. The planet gears (3—Fig. 112) can be removed by pushing planet shafts (5) out of the carrier. Be sure to catch the retainer balls (6) as shafts are removed. The low range sun gear (12) can be removed after planet gears are out of carrier. On 4450 models, remove thrust washers (10 and 15) and bearings (11 and 16).

Inspect planet gears, bearings, thrust washers and shafts for excessive wear, pitting or other damage and



1. Bushing
2. Clutch shaft
3. Pto shaft
4. Bushing
5. Snap ring
6. Oil shield
7. Bearing
8. Snap ring
9. Piston housing
10. Snap ring
11. Retainer
12. Return spring
13. Pin
14. Pin
15. Piston
16. Lubrication reduction valve
17. Spring
18. Plug
19. Seal ring
20. Sleeve
21. Seal ring
22. Pto piston
23. Seal ring
24. Inner race
25. Thrust bearing
26. Outer race
27. Retainer
28. Seal ring
29. Traction clutch piston
30. Inner race
31. Thrust bearing
32. Outer race
33. Retainer

Fig. 109—Exploded view of clutch operating piston assembly.

renew if necessary. Check carrier bushings (8) for wear. Inside diameter of bushings should be 1.385-1.387 inches (35.17-35.22 mm). When installing new bushings, drive rear bushing in until end of bushing is 0.020-0.040 inch (0.5-1.0 mm) below rear surface of carrier bore and drive front bushing in until end of bushing is 0.394 inch (10 mm) below front surface of carrier.

To disassemble clutch and brake unit, remove six cap screws which hold backing plate (46—Fig. 113) to brake housing (21). Remove piston return springs (43), brake separator plates (45) and discs (44). Lift out clutch drum (34) and remove high range sun gear, separator plates (42) and clutch discs (41). Remove brake piston (30). The clutch piston spring washers (39—Fig. 114) must be compressed using JDT-24A compressor tool or other suitable tool before snap ring (40) can be removed. Release spring pressure, then remove spring washers and piston from clutch drum.

Inspect all parts for excessive wear or other damage. Use the following specifications as a basis to determine if parts should be renewed. Reference numbers refer to Fig. 113.

Models 4050-4250-4650

Brake separator plates (45)
- Number used 4
- Thickness—new ..... 0.085-0.095 in. (2.20-2.40 mm)

Brake discs (44)
- Number used 3
- Thickness—new ..... 0.087-0.093 in. (2.21-2.37 mm)
- Minimum ..... 0.070 in. (1.78 mm)

Brake return springs (43)
- Free length ..... 0.960 in. (24.50 mm)
- Working load ..... 14-17 lbs. @ 0.820 in. (60-73 N @ 20.80 mm)

Clutch separator plates (42)
- Number used 5
- Thickness—new ..... 0.055-0.065 in. (1.40-1.70 mm)

Clutch discs (41)
- Number used 4
- Thickness—new ..... 0.070-0.076 in. (1.80-1.90 mm)
- Minimum ..... 0.057 in. (1.45 mm)

Spring washers (39)
- Number used 6
- Minumum free height ..... 0.127 in. (3.23 mm)

Thrust washer (32)
- Thickness—new ..... 0.056-0.068 in. (1.42-1.73 mm)

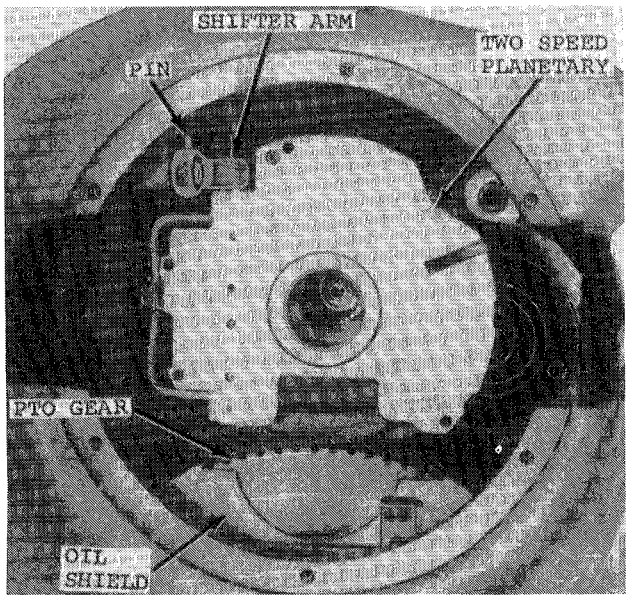


Fig. 111—View of Quad-Range two-speed planetary with clutch operating piston housing removed. Fabricate a tool with a hook on one end to remove planetary input shaft. Refer to text.

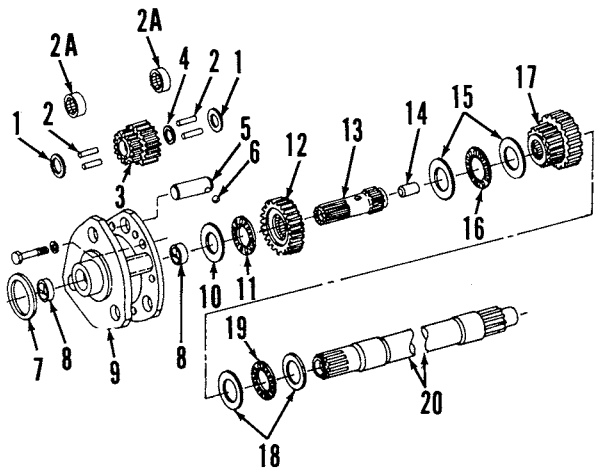


Fig. 112—Exploded view of two-speed planetary unit. Needle bearing assemblies (2A) were used on early models. On late models, there are two rows of 19 rollers (2) separated by a spacer (4).

1. Thrust washers
2. Needle rollers
2A. Needle bearing assy.
3. Pinion gear
4. Spacer
5. Pinion shaft
6. Retaining ball
7. Thrust washer
8. Bushings
9. Planetary carrier
10. Washer (4450)
11. Thrust bearing (4450)
12. Sun gear (low range)
13. Input shaft
14. Hex bushing
15. Washers (4450)
16. Thrust bearing (4450)
17. Sun gear (high range)
18. Washers (4450)
19. Thrust bearing (4450)
20. Clutch shaft

Model 4450

Brake separator plates (45)
- Number used 4
- Thickness—new ..... 0.085-0.095 in. (2.20-2.40 mm)

Brake discs (44)
- Number used 3
- Thickness—new ..... 0.087-0.093 in. (2.21-2.37 mm)
- Minimum ..... 0.070 in. (1.78 mm)

Brake return springs (43)
- Free length ..... 0.960 in. (24.50 mm)
- Working load ..... 14-17 lbs. @ 0.820 in. (60-73 N @ 20.80 mm)

Clutch separater plates (42)
- Number used 6
- Thickness—new ..... 0.055-0.065 in. (1.40-1.70 mm)

Clutch discs (41)
- Number used 5
- Thickness—new ..... 0.070-0.076 in. (1.80-1.90 mm)
- Minimum ..... 0.057 in. (1.45 mm)

Spring washers (39)
- Minimum free height ..... 0.127 in. (3.23 mm)

Thrust washer (32)
- Thickness—new ..... 0.056-0.068 in. (1.42-1.73 mm)

NOTE: If clutch disc or brake disc facing chips, flakes or scratches off easily, discs must be renewed regardless of facing thickness.

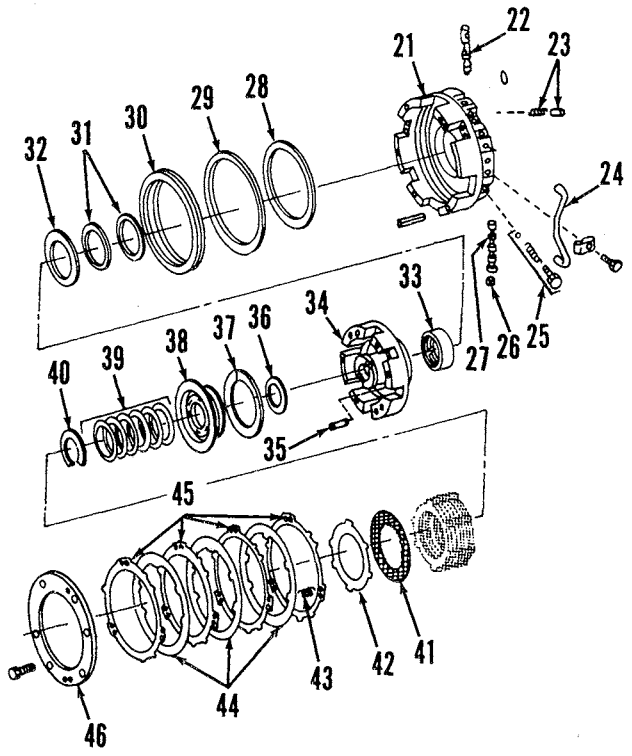


Fig. 113—Exploded view of planetary clutch and brake asssembly.

21. Brake housing
22. Control valve
23. Detent pin & spring
24. Oil pipe
25. Detent assy.
26. Plug
27. Shift valve
28. Seal ring
29. Seal ring
30. Brake piston
31. Seal rings
32. Thrust washer
33. Bushing
34. Clutch drum
35. Dowel
36. Seal ring
37. Seal ring
38. Clutch piston
39. Spring washers
40. Snap ring
41. Clutch discs
42. Separator plates
43. Return spring
44. Brake discs
45. Separator plates
46. Backing plate

Inside diameter of clutch drum bushing (33—Fig. 113) should be 2.256-2.257 inches (57.30-57.33 mm). When renewing bushing, drive new bushing in until flush to 0.020 inch (0.5 mm) below surface of clutch drum.

To disassemble control valve (22—Fig. 113) and shift valve (27), first remove oil pipe (24). Hold a cloth over housing oil port to catch detent pin and spring (23) as control valve spool (22) is pulled from housing. Remove plug, spring and shift valve detent ball (25). Drive spring pin out of housing, then remove plug (26) and shift valve spool (27).

Inspect the control valve, shift valve and their bores for burrs, scoring or wear. The valves must

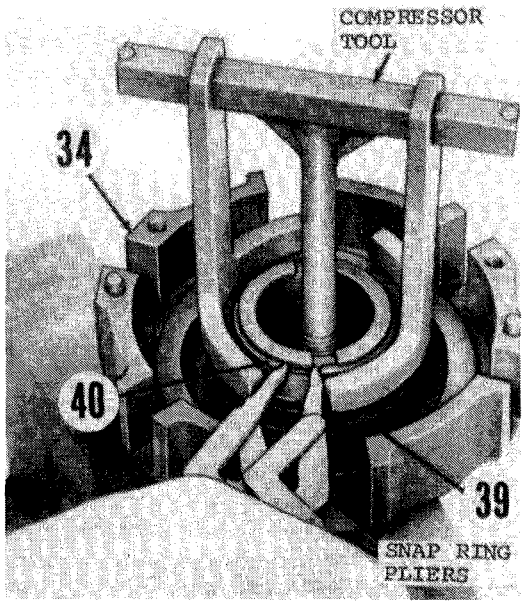


Fig. 114—Compress spring washers (39) with JDT-24A tool or other suitable tool to remove snap ring (40).

move freely in their bores. Control valve detent spring should have a free length of 1.29 inches (32.8 mm) and shift valve detent spring free length should be 1.819 inches (46.2 mm).

Coat all parts with clean hydraulic oil during reassembly. Install shift valve with countersunk end first into housing. Align hole in shift valve plug with hole in housing, then drive in spring pin until flush with flat side of housing. Install detent spring, pin and control valve. Install oil pipe and tighten retaining screw to 35 ft.-lbs. (47 N·m).

Renew piston seal rings and coat with hydraulic oil prior to assembly. Install spring washers (39—Fig. 113) alternately beginning with inner diameter of first washer against the clutch piston. Use JDT-24A compressor tool or other suitable means to compress spring washers until retaining ring can be installed. Install clutch plates (42) and discs (41) alternately beginning with a separator plate against clutch piston. Assemble first brake separator plate (45—Fig. 115) so tangs are installed over spring guide pins. Install brake discs and remaining separator plates alternately with tangs of plates located in housing slots that do not have guide pins. Install return springs (43) and backing plate and tighten cap screws to 20 ft.-lbs. (27 N·m).

Assemble bearing rollers (2—Fig. 112) and spacer (4) in pinion gears (3). Use a light coat of grease in pinions to hold bearings in place. Position low range sun gear (12) in carrier. Install pinion gears with thrust washers (1) into carrier. On Models 4050, 4250 and 4650, align marks on pinion gears (3—Fig. 116) with "V" marks (1) on sun gear. On Model 4450, align number (1, 2 or 3) stamped on carrier (B—Fig. 117) with matching number on pinion gear (C). On all models, install pinion shafts and retaining balls. Position planetary carrier onto brake housing and tighten mounting screws to 20 ft.-lbs. (27 N·m).

Before reinstalling planetary assembly, clutch and brake piston operation may be checked as follows: To test clutch piston, shift control valve (A—Fig. 118) outward and apply air pressure regulated at 50 psi (345 kPa) at port "C." To check brake piston, shift control valve inward and apply air pressure at port "B." If pistons do not operate, or if excessive air leak-

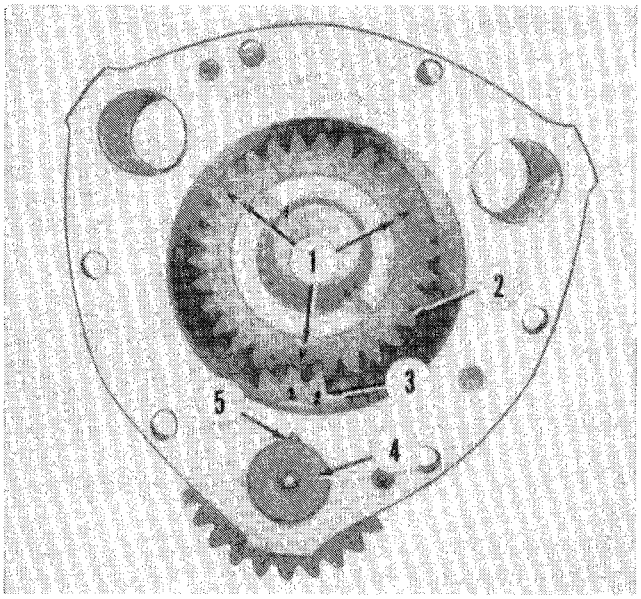


Fig. 116—On Models 4050, 4250 and 4650, be sure to align timing marks (3) on pinion gears with "V" marks (1) on sun gear.

1. "V" timing marks
2. Sun gear
3. Timing marks
4. Pinion shaft
5. Retaining ball

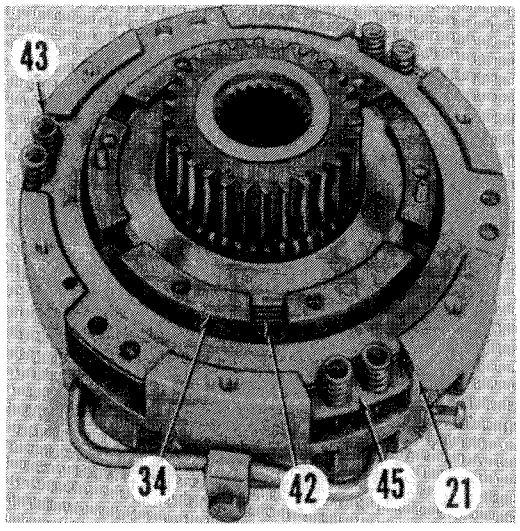


Fig. 115—When reassembling, first brake separator plate (45) is installed over return spring guide pins. Remainder of separator plates are installed with tangs located in housing slots that do not have guide pins.

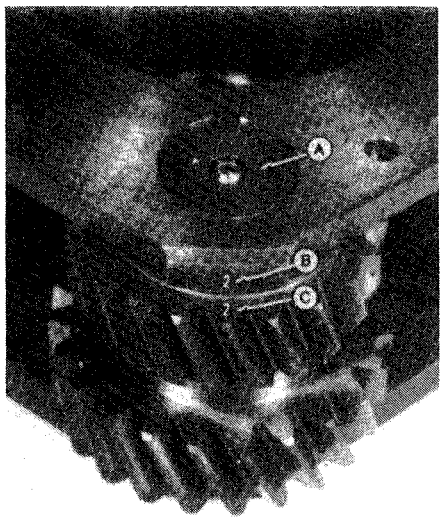


Fig. 117—On Model 4450, align stamped number (1, 2 or 3) on carrier (B) with matching number on pinion gears (C).

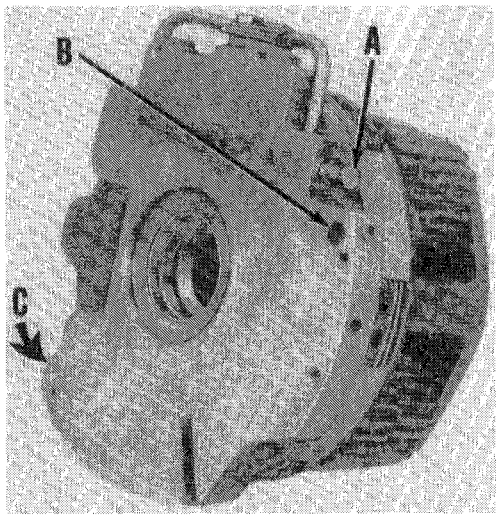


Fig. 118—Brake and clutch piston operation may be checked by moving control valve (A) and applying compressed air at ports (B) and (C). Refer to text.

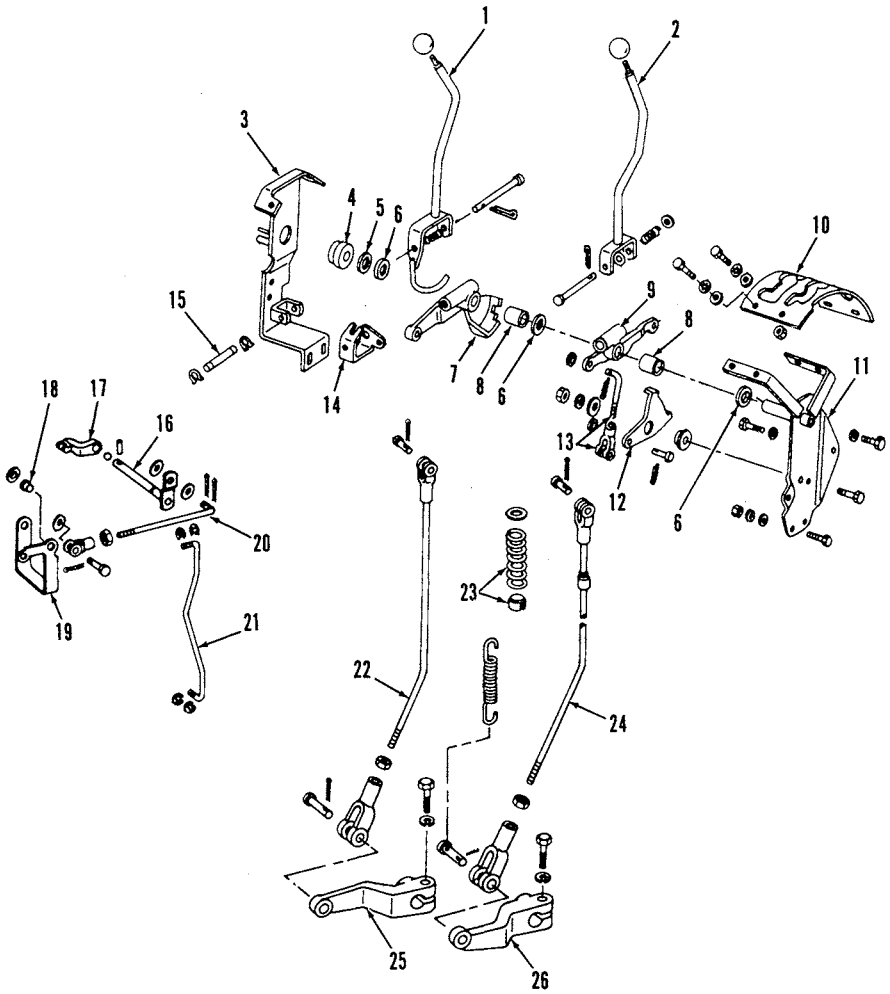
age is noted, disassemble and correct problem before proceeding with installation.

SHIFT LINKAGE

This section covers disassembly and overhaul of external shifter controls for Quad-Range transmission. Removal, inspection and overhaul of shift mechanism inside the transmission housing is included with the transmission gears and shafts section.

Quad-Range Models

107. R&R AND OVERHAUL. To remove shift lever assembly, remove the console sheet metal by removing the three cap screws under the right fender and the four cap screws inside the cab securing the panel. Disconnect control rod from throttle lever, and remove throttle lever from quadrant. Disconnect two-speed planetary control valve rod (21—



1. Speed selector shift lever
2. Range selector shift lever
3. Inner support
4. Spacer
5. Shim
6. Thrust washers
7. Speed selector arm
8. Bushings
9. Range selector arm
10. Guide plate
11. Outer support
12. Lockout latch
13. Lockout rod & yoke
14. Two-speed bellcrank
15. Pivot pin
16. Control valve shaft
17. Control valve arm
18. Bushing
19. Bellcrank
20. Two-speed rod
21. Two-speed rod
22. Speed selector rod
23. Spring & retainer
24. Range selector rod
25. Speed shift arm
26. Range shift arm

Fig. 119—Exploded view of Quad-Range transmission shift linkage and associated parts.

Fig. 119). Disconnect speed selector rod (22) and range selector rod (24) from control arms (7 and 9). Remove knobs from selector levers. Remove three cap screws securing outer support (11). Note that one cap screw is located behind a rubber plug under right fender. Remove shifter assembly.

To disassemble, unbolt and remove inner support (3). Remove speed selector lever (1) and arm (7). Disconnect lockout latch rod (13) from range selector arm (9). Remove pivot pin, range selector lever and arm.

Inspect all parts for wear or other damage. Inside diameter of range and speed selector arm pivot bushings (8) when new is 0.876-0.877 inch (22.2-22.3 mm).

To reassemble shift levers, reverse the removal procedure. Be sure two-speed shift guide on speed selector lever (1) engages notch in two-speed bellcrank (14). Check end play of selector levers and adjust to 0.002-0.020 inch (0.05-0.50 mm) using shims (5) if necessary.

Reinstall shift lever assembly into console. Tighten throttle lever spring screw so an 8 pound (35 N) pull is required to move lever. Adjust shift levers as outlined in the following paragraph.

108. ADJUSTMENT. To adjust linkage move speed selector lever to Neutral "N" position and range selector lever to Park "P" position. Tab of lockout latch (12—Fig. 119) should be centered in notch of speed selector arm (7). If not, center tab in arm and move guide plate (10) until selector lever (1) is centered at "N" position. Move range selector lever to "A" position and speed selector lever to "2" position. If necessary, adjust lockout latch rod yoke (13) so clearance between lockout tab and outer radius of speed selector arm (7) is 0.10 inch (2.5 mm).

Disconnect shifter rods (22 and 24) from shifter arms (25 and 26). Set speed shifter arm (25) at third detent from the top (1-2 position) and hold speed selector lever (1) in "2nd" speed position. If necessary, adjust yoke on speed selector rod (22) until hole in yoke is aligned with hole in arm and reinstall clevis pin. Move range shifter arm (26) to third detent position from the top. While holding range selector lever (2) in "B" range, adjust yoke on shifter rod (24), if necessary, until pin can be easily inserted into yoke and arm.

Move speed selector lever to "1st" speed position. With two-speed planetary control rod (20—Fig. 119) disconnected from bellcrank (19), rotate planetary control valve arm fully forward, then rearward one detent. Adjust control rod yoke until holes in yoke and bellcrank are aligned, then shorten rod one full turn and install clevis pin.

Check tractor for proper shifting. If two-speed planetary does not shift correctly, shorten control valve rod an additional turn.

TRANSMISSION REMOVAL

Quad-Range Models

109. To remove transmission for servicing, the Sound-Gard body (if so equipped) must first be removed as follows: Disconnect and remove batteries. Remove battery boxes and left step assembly. Remove hood. Drain coolant from radiator and cylinder block.

NOTE: Before loosening any hydraulic lines, relieve hydraulic system pressure by loosening brake bleed screws and pumping brakes until pedals go all the way down.

At rear of tractor, disconnect heater hoses and hydraulic seat valve supply line. Remove cap screws securing hydraulic control lever support and disconnect rockshaft and selective control valve linkages.

On right side of tractor, disconnect fuel shut-off cable. Remove body riser panel. Disconnect wiring harnesses at front of control support and under right access door. Disconnect throttle control cable, two-speed planetary high-low linkage, speed selector linkage and range selector linkage. Disconnect differential lock line, right brake line and hydraulic supply line for steering, brakes and differential lock.

On left side of tractor, disconnect air conditioning lines at couplers under left front corner of body. Remove body panel and pull lines forward. Disconnect wiring harnesses at front of body and under left front corner of body. Disconnect starter relay wiring. Disconnect steering lines at firewall. Disconnect traction clutch and pto clutch control linkage from clutch control valve.

From inside the Sound-Gard body, remove floor mat and floor cover. Disconnect the following items: dimmer switch, brake return line from top of clutch housing, steering return line, brake line, body ground wire, seat valve leak-off hose and seat valve return hose.

Support body with JDG-15 lifting bracket or other suitable tool and an overhead hoist. Remove four Sound-Gard body mounting bolts. Raise body approximately 3 inches (76 mm), then disconnect left selective control valve linkage. Check all disconnect points for binding, then raise body and remove rearward.

To separate transmission from clutch housing, proceed as follows: Remove drain plug from clutch housing and drain hydraulic oil. Remove hitch center link mounting bracket from rear of transmission housing. Remove plug located behind mounting bracket and withdraw pump drive shaft from transmission housing. Disconnect wiring harnesses and move wiring forward to the clutch housing. Disconnect oil cooler return line and lube hose from return oil manifold. Disconnect hydraulic lines from clutch pressure valve housing. Disconnect seat valve hose from accumula-

tor. Disconnect rockshaft supply line from pressure control valve. Remove hoses and line clamps from top of transmission, then remove transmission cover. Support front and rear of tractor with suitable splitting stands. Remove cap screws securing transmission case to clutch housing, including the three inside the transmission case, then move clutch housing away from transmission.

To reinstall transmission, reverse the removal procedure while noting the following items. Tighten transmission mounting cap screws to 300 ft.-lbs. (407 N·m). When installing Sound-Gard body, be sure front and rear body mounts are assembled as follows: Install one special washer on bottom of front mount with identification mark facing down and install two special washers on top of mount with identification marks facing up. On rear mount, install one special washer on top of mount with identification mark facing up and install one special washer on bottom of mount with identification mark facing down. Tighten mounting bolts to 150 ft.-lbs. (203 N·m).

TRANSMISSION DISASSEMBLY AND REASSEMBLY

Paragraphs 110 and 111 outline the general procedure for removal and installation of the main transmission components. Disassembly, inspection and overhaul of the removed assemblies is covered in the OVERHAUL section beginning with paragraph 112.

Quad-Range Models

110. DISASSEMBLY. The transmission must be disassembled in the approximate sequence outlined in the following paragraphs. The transmission shafts can be removed only in the following order: transmission drive shaft, differential drive shaft and countershaft.

With transmission separated from clutch housing, disassemble as follows: Remove rockshaft housing. Remove transmission drive shaft front bearing retainer (1—Fig. 124) on Models 4050, 4250 and 4450. Remove shifter detent caps, springs, retainers and balls from right side of housing. Rotate upper shifter cam (7—Fig. 122 or 122A) to its lowest position, then remove special locknut (4) from inner end of shifter shaft (9). Be careful not to drop parts into housing as they will be difficult to remove. Withdraw shifter cam and shaft from housing. Remove shift rail (6) on all models and rail (22) on 4650 models out front of transmission housing. Withdraw shifter forks (1 and 5) from housing.

Disconnect oil lines from transmission oil pump. Remove the four pump mounting cap screws and remove the pump.

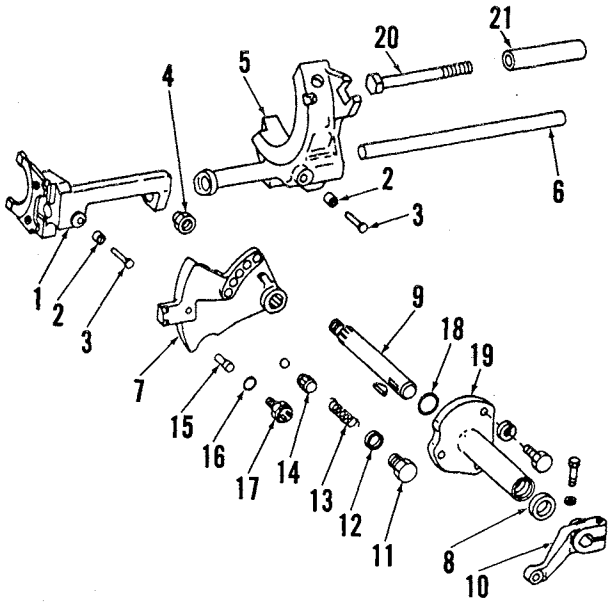


Fig. 122—Exploded view of range shifter components used on Models 4050, 4250 and 4450 equipped with Quad-Range transmission. Refer to Fig. 122A for similar parts for 4650 tractors.

1. Reverse shifter
2. Roller
3. Pin
4. Special nut
5. Low-High shifter
6. Shifter rail
7. Shifter cam
8. Oil seal
9. Shifter shaft & key
10. Shift arm
11. Plug
12. Aluminum washer
13. Spring
14. Detent ball retainer
15. Safety switch follower
16. Shim
17. Start-safety switch
18. "O" ring
19. Support
20. Stop screw
21. Sleeve

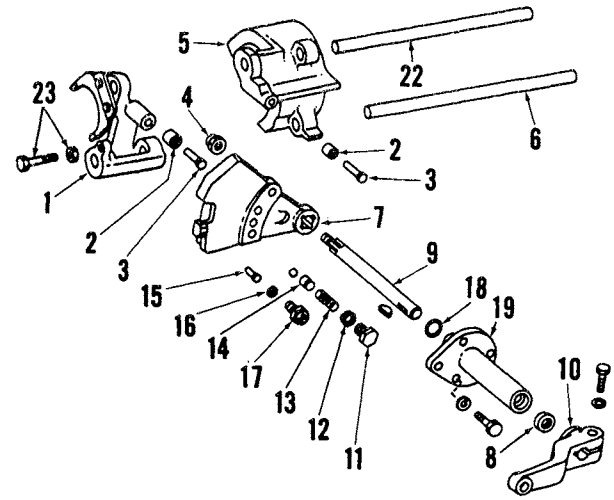


Fig. 122A—Exploded view of Quad-Range shifter components used on Model 4650. Refer to Fig. 122 for legend except for shift rail (22) and stop screw (23).

To remove transmission drive shaft, first tape synchronizer clutch drums together to prevent them from separating while shaft is being removed. Remove front bearing retainer (1—Fig. 124A) with shims. Using JDG-314 special tool or other similar tool, drive rear bearing cup rearward from housing. Move shaft rearward, then raise front of shaft and lift from housing.

To remove differential drive shaft, it is necessary to first remove final drives (paragraph 172) and differential assembly (paragraph 161 or 162). Remove special nut (4—Fig. 123 or 123A), then withdraw lower shifter cam (14) and shifter shaft (8). Remove shift rail (6) on all models and shift rail (21) on 4650 models, then rotate shifters (1 and 5) upward out of housing. Move the shift collars on the drive shaft so shaft is locked in two gears and will not turn. Remove

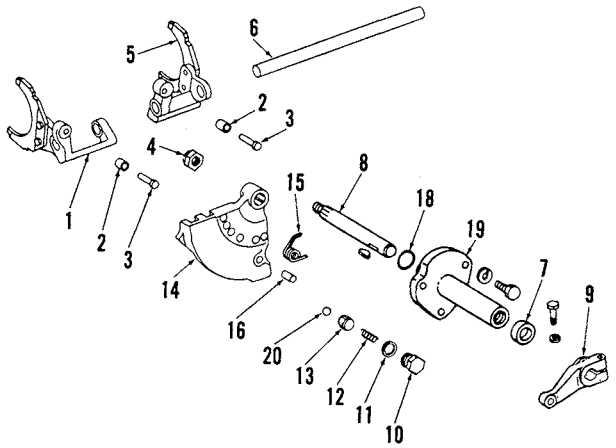


Fig. 123—Exploded view of speed change shifters and components used on Models 4050, 4250 and 4450 with Quad-Range transmission. Refer to Fig. 123A for similar parts for 4650 models.

1. Shift fork (A & D range)
2. Roller
3. Pin
4. Special nut
5. Shift fork (B & C range)
6. Rail
7. Oil seal
8. Shifter shaft
9. Shift arm
10. Plug
11. Aluminum washer
12. Spring
13. Retainer
14. Shifter cam
15. Park lock spring
16. Spring pin
18. "O" ring
19. Support
20. Detent ball

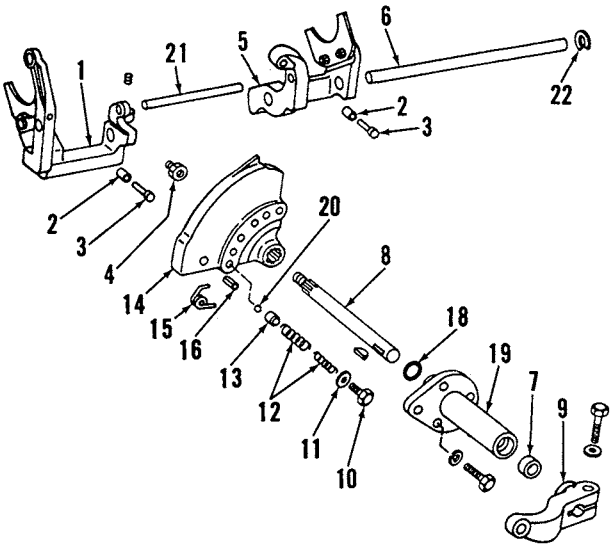


Fig. 123A—Exploded view of speed change shifter components used on 4650 models with Quad-Range transmission. Refer to Fig. 123 for legend except for shift rail (21) and snap ring (22).

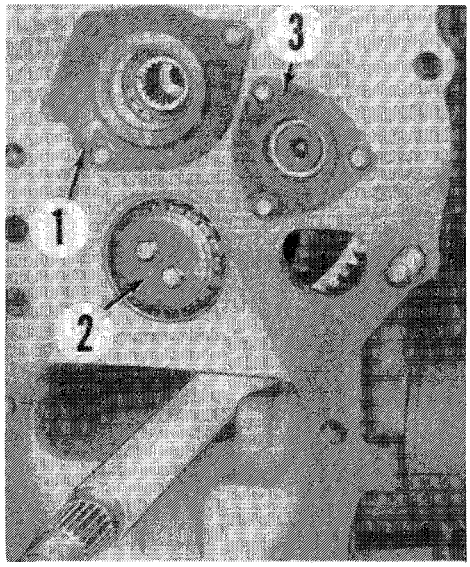


Fig. 124—View of front of Quad-Range transmission case typical of 4050, 4250 and 4450 models. Refer to Fig. 124A for 4650 model.

1. Transmission drive shaft
2. Differential drive shaft
3. Countershaft

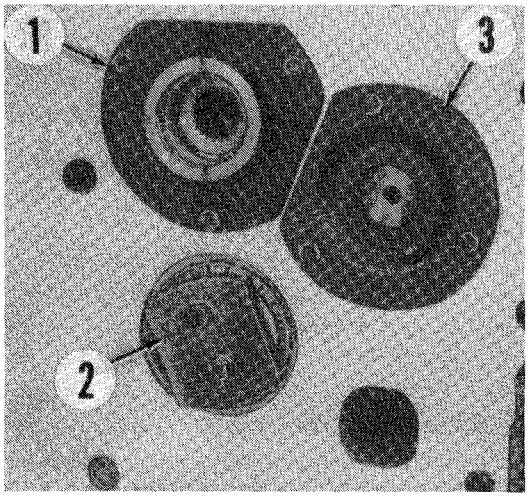


Fig. 124A—View of front of Quad-Range transmission case typical of Model 4650.

bearing retainer plate (2—Fig. 124 or 124A) from front of the shaft, or remove gear from front of shaft if equipped with mechanical front-wheel drive. Install a "C" clamp (Fig. 125) through hole in housing and tighten against front gear to hold gear against housing. Using a brass drift, drive shaft rearward and retighten "C" clamp until front bearing cone can be removed. As shaft is driven rearward, remove the four snap rings (Fig. 126), located between the gears, out of their grooves. When rear snap ring has been unseated, bump shaft rearward while sliding parts off front of shaft. Be sure to retain bearing shims for use in reassembly.

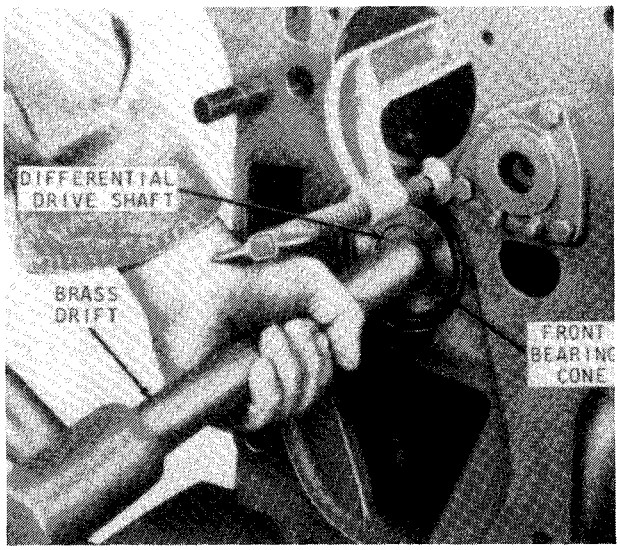


Fig. 125—Install a "C" clamp to hold front gear forward while driving differential drive shaft out of front bearing cone.

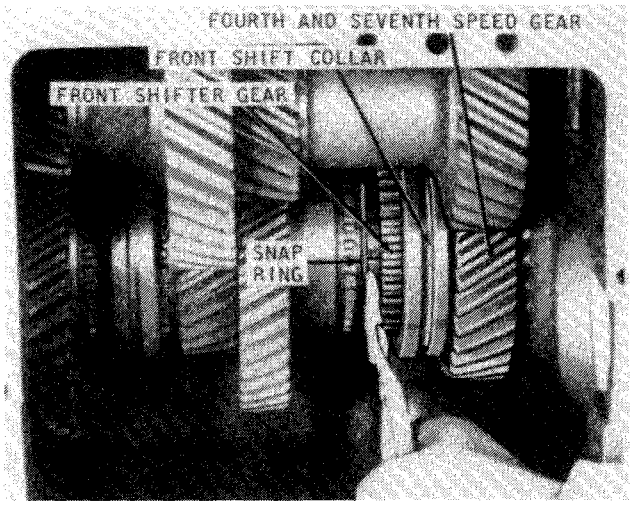


Fig. 126—Remove the four snap rings from their grooves and slide forward as differential drive shaft is moved rearward. The front snap ring located between front shifter gear and "B" range gear is shown in this view.

To remove countershaft, first remove front bearing retainer (3—Fig. 124 or 124A) with shims. On Model 4650, remove snap ring retaining rear bearing cup. Drive shaft rearward until rear bearing cup is removed, then lift out shaft assembly. On Models 4050, 4250 and 4450, drive shaft forward to remove front bearing cup. Remove shaft assembly from case.

111. ASSEMBLY. To reassemble the transmission components into transmission case, proceed as follows:

On Model 4650, install countershaft assembly into case prior to installing bearing cups. Use a suitable driver to install rear bearing cup. Drive cup inward until rear snap ring can be installed. Drive shaft and cup rearward, if necessary, to seat bearing cup against the snap ring. Install front bearing cup, then install front bearing retainer with enough shims to provide some end play. Tighten retainer cap screws evenly to 35 ft.-lbs. (47 N·m).

On Models 4050, 4250 and 4450, install rear bearing cup (if removed) first, then install shaft assembly into case. Install front bearing cup and front retainer with enough shims to provide some end play. Tighten cap screws evenly to 35 ft.-lbs. (47 N·m).

On all models, use a dial indicator to measure shaft end play. Adjust end play, if necessary, to the recommended 0.001-0.004 inch (0.03-0.10 mm) by varying the thickness of shim pack (9—Fig. 131).

If differential drive shaft (2—Fig. 136), transmission case or rear bearing cup (4) and cone (3) are being renewed, refer to paragraphs 117 and 118 for cone point and bearing adjustment procedures.

Special tools are required to reinstall differential drive shaft. Use JDT-1 snap ring pliers to expand the four snap rings and install over the JDT-10 expander cone for Model 4650 or JDT-2 expander cone for all other models. Install JDT-3A expander plates (Model 4650) or JDT-3 expander plates (all other models) to hold snap rings apart as shown in Fig. 127.

NOTE: The snap rings are of different thicknesses with the thinnest at the front and progressively thicker rings to the rear. This allows the rear and center rings to slide over the shaft without falling

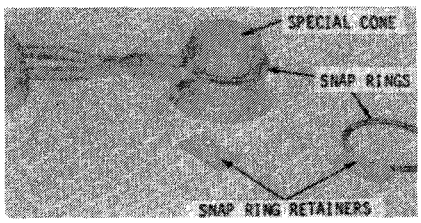


Fig. 127—Special assembly tools are used to expand and install snap rings on differential drive shaft. JDT-2 expander cone and JDT-3 retainers are used on 4050, 4250 and 4450 models, while JDT-10 expander cone and JDT-3A retainers are used on Model 4650.

into the smaller front grooves during assembly. Arrange snap rings in correct order to ensure correct assembly.

Install JDT-26-2 installation tool (Fig. 128) and JDT-26-1 arbor shaft on Model 4650 or JDT-8-1 installation tool and JDT-20-1 arbor on all other models to support parts while assembling. Position "A" range gear (6—Fig. 136) in rear of case with shifter spline teeth facing forward (gear would be difficult to install later). Position "C" range gear (17) on arbor shaft with shifter spline teeth facing rearward. Make certain "C" range gear is completely forward against housing wall, otherwise rear snap ring cannot be installed. Move the arbor shaft rearward while assembling components in the following order: Install front shifter gear (16—Fig. 136) with snap ring recess rearward, shifter collar (15), the thinnest snap ring with its expander retainer and thrust washer (14). Install "B" range gear (13) with shifter spline facing forward. On Model 4650, special stepped thrust washer (12) must be installed with flat side toward "B" range gear. On all other models, this thrust washer is flat on both sides and may be installed either way. Install second thinnest snap ring with retainer and thrust washer (11). Install "D" range gear (10) with shifter splines facing rearward and second thickest snap ring with retainer. Install rear shifter gear (9) with snap ring recess to the rear, shifter collar (8) and thickest snap ring with retainer.

NOTE: The rear shifter gear (9—Fig. 136) has a portion of the internal splines removed. Do not interchange with front shifter gear (16).

Insert differential drive shaft (2—Fig. 136) from the rear, and push shaft through the assembled components while displacing the arbor shaft. Remove snap ring retainers, then seat snap rings in their grooves. Remove installation tool from front of housing. Install thrust washer (18) with smaller OD facing forward. Install the original shim pack (19) or the shim pack determined in paragraph 118. Heat front bearing cone to 300° F (150° C) maximum, then install onto shaft. Tighten bearing retainer plate cap screws to 70 ft.-lbs. (95 N·m), or tighten drive gear retaining cap screw to 110 ft.-lbs. (150 N·m) if equipped with mechanical front-wheel drive.

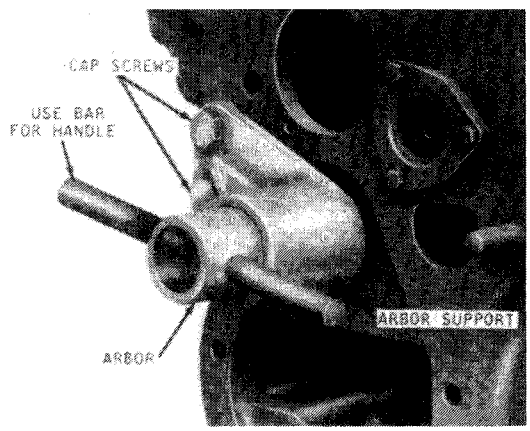


Fig. 128—Install special support and arbor to hold parts while assembling differential drive shaft. Refer to text.

Illustration for Fig. 128 reproduced by permission of Deere & Company. Copyright Deere & Company.

Install lower shifter forks and insert shift rails through the forks.

To install transmission drive shaft, position shaft in housing and install front bearing cup, shims and retainer. Install rear bearing cup part way into housing, then install transmission oil pump. The rear bearing cup will be properly located as the oil pump mounting cap screws are tightened to 20 ft.-lbs. (27 N·m). Check transmission shaft end play using a dial indicator. Adjust shim pack (21—Fig. 132 or 132A) thickness to obtain recommended end play of 0.004-0.006 inch (0.10-0.15 mm). Tighten bearing retainer cap screws to 35 ft.-lbs. (47 N·m).

Reinstall upper shifter forks and shifter rails. Install lower shifter cam and upper shifter cam making sure index "V" marks on cams and shifter shafts are aligned. Tighten locknuts securely, then check for recommended shaft end play of 0.002-0.007 inch (0.05- 0.18 mm). Excessive end play will allow detent springs to force the shifters out of proper operating position. To adjust end play, loosen actuating arm clamp bolt and slide arm on shaft.

OVERHAUL

The following paragraphs cover overhaul procedure of transmission main components after transmission has been disassembled as outlined in paragraph 110.

Quad-Range Models

112. SHIFTER CAMS AND FORKS. Refer to appropriate Fig. 122, 122A, 123 or 123A for an exploded view of shift components. Inspect shifter cams and shifter tracks for wear or damage and renew if necessary. Inspect shift rails and forks for excessive wear and renew if necessary. If park lock spring (15—Fig. 123 or 123A) is renewed, be sure the long end of the spring is installed toward the shifter cam shaft.

113. TRANSMISSION PUMP. To disassemble pump, separate the manifold (12—Fig. 130 or 130A) from pump body (18) and remove pump gears (16). Clearance between drive gear bushing and mating area in pump body should be 0.002-0.005 inch (0.05-0.13 mm). Clearance between idler gear bushing and idler shaft should be 0.002-0.003 inch (0.05-0.07 mm). If gears or body are worn, they must be renewed as a complete set. When reassembling, tighten the three

cap screws to 20 ft.-lbs. (27 N·m). Be sure pump gears turn freely.

114. COUNTERSHAFT. Refer to Fig. 131 for an exploded view of the countershaft assembly. The shaft is a one-piece unit except for the "D" range gear (5). The gear is keyed to the shaft and retained by a snap ring (4). Shims (9) are used to adjust end play to 0.001-0.004 inch (0.03-0.10 mm) when shaft is properly installed.

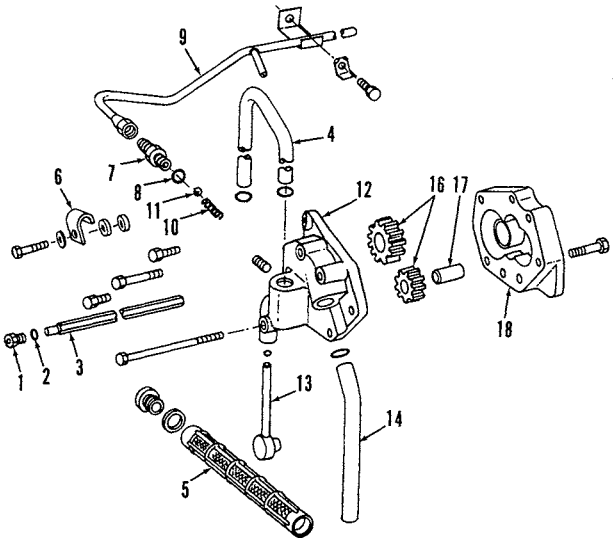


Fig. 130—Exploded view of Quad-Range transmission oil pump and associated parts used in 4050, 4250 and 4450 models.

1. Plug w/bushing
2. "O" ring
3. Hex drive shaft
4. Outlet tube
5. Intake screen
6. Clamp
7. Fitting
8. "O" ring
9. Lube line
10. Spring
11. Check valve ball
12. Manifold
13. Oil line
14. Intake tube
16. Pump gears
17. Idler gear shaft
18. Body

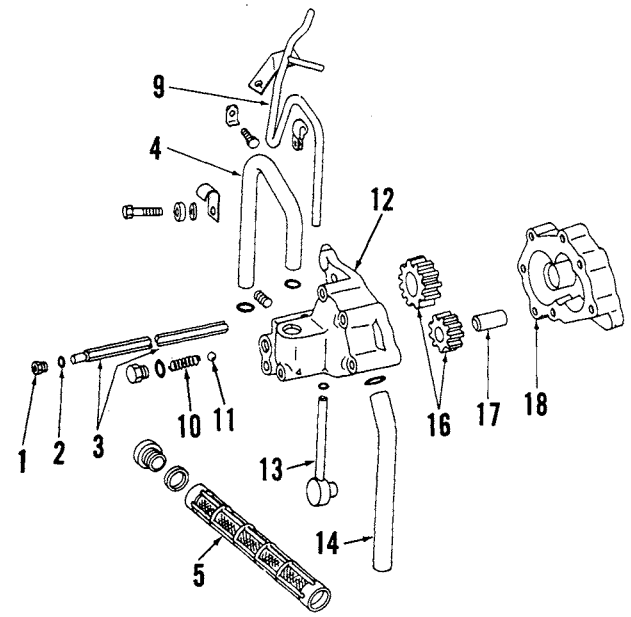


Fig. 130A—Exploded view of Quad-Range transmission oil pump used on 4650 tractors. Refer to Fig. 130 for legend.

115. TRANSMISSION DRIVE SHAFT. To disassemble the removed transmission drive shaft, remove snap ring (20—Fig. 132 or 132A). Remove bearing cone (18) and high range pinion (17) from shaft using a suitable press. Support the shaft during pressing operation as it will be free to fall when gear is removed.

CAUTION: The detent balls and springs (12) will be released when synchronizer blocker (13) is withdrawn. Use care to avoid losing the parts.

Remove high range drum (10H), then carefully withdraw blocker (13) with synchronizer plates (23 and 26) and discs (25 and 27). Pry retainers from blocker to separate plates and discs. Remove snap ring (1), then press reverse range pinion (4) and rear bearing cone (3) from shaft. Remove snap ring (6) and press reverse drive collar (7) from shaft. Remove snap ring (8) and remove low range pinion (9) and low range drum (10L). The drive collar (11) can be pressed from shaft after removing snap ring (14).

Inspect transmission drive shaft for scoring or wear in areas of range pinion rotation and make sure oil passages are open and clean. Refer to the following appropriate table and Fig. 133 for standard diameters of drive shaft.

Models 4050-4250-4450

Diameter "A"	0.879-0.881 in. (22.33-22.38 mm)
Diameter "B"	1.126-1.127 in. (28.60-28.62 mm)
Diameter "C"	1.490-1.491 in. (37.85-37.87 mm)
Diameter "D"	1.681-1.682 in. (42.70-42.72 mm)

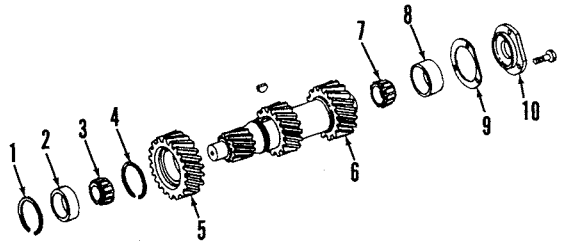


Fig. 131—Exploded view of transmission countershaft assembly. Rear snap ring (1) is used only on Model 4650.

1. Snap ring
2. Bearing cup
3. Bearing cone
4. Snap ring
5. "D" range gear
6. Countershaft
7. Bearing cone
8. Bearing cup
9. Shim
10. Bearing retainer

Diameter "E" ..... 1.687-1.688 in. (42.85-42.87 mm)
Diameter "F" ..... 1.920-1.921 in. (48.77-48.79 mm)
Diameter "G" ..... 1.626-1.627 in. (41.30-41.32 mm)

Model 4650
Diameter "A" ..... 0.879-0.881 in. (22.33-22.38 mm)
Diameter "B" ..... 1.626-1.627 in. (41.30-41.32 mm)
Diameter "C" ..... 1.874-1.876 in. (47.60-47.65 mm)

1. Snap ring
2. Bearing cup
3. Bearing cone
4. Reverse range pinion
5. Shift collar
6. Snap ring
7. Reverse range drive collar
8. Snap ring
9. Low range pinion
10H. High range synchronizer drum
10L. Low range synchronizer drum
11. Drive collar
12. Detent ball & spring
13. Synchronizer blocker assy.
14. Snap ring
16. Drive shaft
17. High range pinion
18. Bearing cone
19. Bearing cup
20. Snap ring
21. Shim
22. Bearing housing & bushing
23. Separator plates
24. Retainer
25. Discs
26. Separator plates
27. Discs
28. Retainer

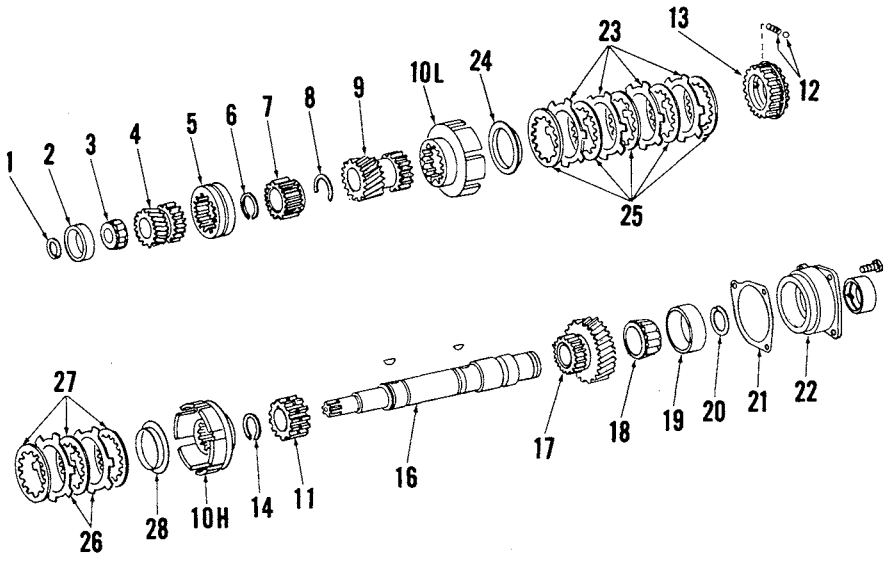


Fig. 132—Exploded view of transmission drive shaft and associated parts used on Models 4050, 4250 and 4450. Refer to Fig. 132A for Model 4650.

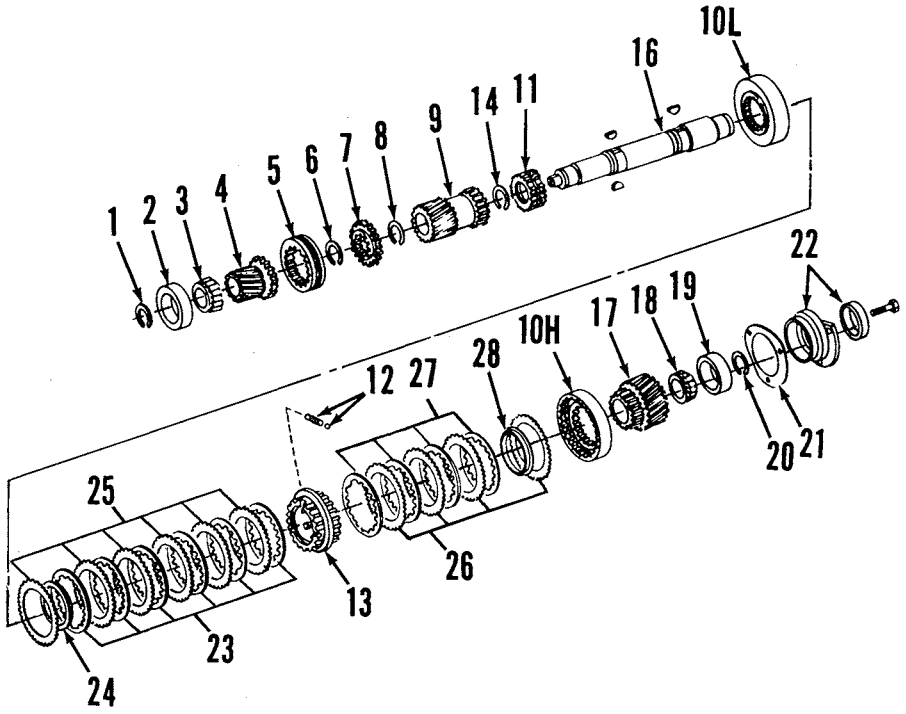


Fig. 132A—Exploded view of transmission drive shaft assembly used on Model 4650. Refer to Fig. 132 for legend.

Diameter "D" ..... 2.202-2.203 in. (55.93-55.95 mm)
Diameter "E" ..... 2.269-2.270 in. (57.63-57.66 mm)
Diameter "F" ..... 2.593-2.594 in. (65.86-65.89 mm)
Diameter "G" ..... 2.126-2.128 in. (54.00-54.05 mm)

Inspect blocker assembly and drums for wear or damage. Renew synchronizer plates (23 and 26—Fig. 132 or 132A) if they are warped, discolored or worn. Thickness of plates when new is 0.061-0.064 inch (1.55-1.61 mm) on Model 4650 and 0.048 inch (1.22 mm) on all other models. Thickness of a new synchronizer disc (25 and 27) is 0.089-0.093 inch (2.27-2.37 mm) on Model 4650 and 0.068-0.072 inch (1.73-1.83 mm) on all other models. Renew discs if facing grooves are not distinctive, or if facing chips, flakes or scratches easily.

To reassemble, proceed as follows: Wipe the contacting surfaces of the blocker and the retainers (24 and 28) free of oil. Spray Loctite primer grade "T" on the contacting surfaces and allow to air dry. On Models 4050, 4250 and 4450, begin with discs (25 and 27) against both sides of blocker backup ring and alternate installing plates and discs, ending with discs facing the retainers (24 and 28). On Model 4650, begin with plates against each side of blocker snap ring and alternate installing discs and plates ending with steel plates facing the retainers. On all models, apply Loctite RC609 adhesive to the primed surface of the retainers. Immediately (within three minutes) press retainers into blocker making sure antirotation notches are aligned with recesses of blocker. Be sure there is no adhesive in splines. On Models 4050, 4250 and 4450, stake retainers (Fig. 134) to blocker at four equally spaced locations around inside edge of retainers, no closer than 5/16 inch (8 mm) from antirotation notches (D). On Model 4650, stake retainers to blocker at 12 equally spaced locations around inside edge of retainers, no closer than 5/16 inch (8 mm) from the antirotation notches. On all models, allow adhesive four hours to cure before additional assembly.

Special tool number JDT-4A (Fig. 135) for Models 4050, 4250 and 4450 or JDT-31 (Fig. 135A) for Model 4650 is needed to hold springs and balls in place when installing blocker assembly onto shaft. When low and high drums are in place, tape the drums together to prevent separation during reassembly. After bearing cones are pressed onto ends of shaft, install the thickest snap rings (1 and 20—Fig. 132 or 132A) that will fit into the shaft grooves.

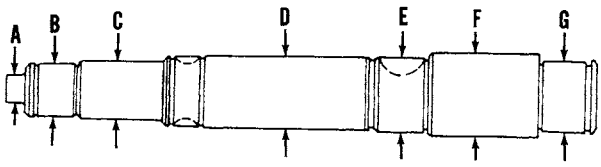


Fig. 133—Measure transmission drive shaft diameters at locations indicated when checking for wear. Refer to text for specified dimensions.

116. DIFFERENTIAL DRIVE SHAFT. Except for bearing cups in housing and rear bearing cone on shaft, the differential drive shaft components are disassembled during removal. Refer to Fig. 136 for an exploded view.

Inspect gears and shaft for wear or damage. The "A" range gear (6) contains a bushing, but the bushing is not available for service. On Models 4050, 4250 and 4450, inside diameter of bushing when new is 2.617-2.618 inches (66.47-66.50 mm) and outer diameter of shaft should be 2.612-2.613 inches (66.35-66.37 mm). On Model 4650, inside diameter of bushing when new is 2.994-2.995 inches (76.05-76.08 mm) and outer diameter of shaft is 2.989-2.991 inches (75.93-75.96 mm). The differential drive shaft is available only as a matched set with the differential bevel ring gear (1). Check thrust washers and bearings for wear or damage and renew if necessary.

If differential shaft or rear bearing cup and cone are renewed, the cone point (mesh position) must be adjusted as outlined in paragraph 117. When installing bearing cones onto the shaft, heat cones to 300° F (150° C) maximum prior to installation. Refer to paragraph 118 to adjust bearing preload.

117. DIFFERENTIAL SHAFT CONE POINT. The cone point (mesh position) of differential shaft bev-

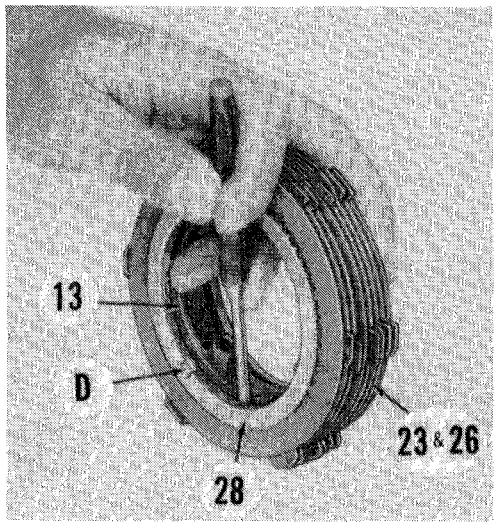


Fig. 134—The synchronizer retainers (28) should be coated with Loctite RC609 adhesive before being staked to blocker (13). Be sure notches (D) are aligned with recesses in blocker. Do not stake retainer closer than 5/16 inch (8 mm) from notches. Refer to text.

el pinion gear and bevel ring gear is adjusted by means of shims (5—Fig. 136) located in front of rear bearing cup (4).

To determine the appropriate shim pack thickness on Models 4050, 4250 and 4450, subtract the number etched on the end of the drive shaft from 8.326. The difference is the correct shim pack thickness (in inches) to be installed.

On Model 4650, subtract the number etched on the pinion end of the shaft from 9.534. The difference is the required thickness (in inches) of shim pack to be installed.

The shims are available in nominal thicknesses of 0.003, 0.005 and 0.010 inch (0.08, 0.13 and 0.25 mm). It is recommended that shims be measured individually when assembling shim pack to ensure accurate shim pack thickness. When installing shims and bearing cup, be sure that cup is properly seated in the housing.

118. DIFFERENTIAL SHAFT BEARING PRELOAD. Whenever differential shaft or bearings are renewed, bearing preload should be adjusted using shims (19—Fig. 136). Preload adjustment should be made after adjusting the cone point as previously outlined and before installing the gears as follows:

Position shaft in housing and install thrust washer (18) with smaller OD forward and the original shim pack (19) plus one 0.010 inch (0.25 mm) shim to ensure some shaft end play. Heat front bearing cone to 300° F (150° C) maximum, then install onto shaft. Install retainer plate (22) and tighten cap screws to 70 ft.-lbs. (95 N·m), or install mechanical front-wheel drive gear (23), if so equipped, and tighten retaining cap screw to 110 ft.-lbs. (150 N·m). Use a dial indicator to measure shaft end play. Remove gear or bearing retainer plate, then drive shaft out of front bearing cone. Remove shims from the shim pack equal to the measured end play plus 0.001-0.002 inch (0.03-0.05 mm) to obtain recommended preload.

To check bearing preload adjustment, reinstall bearing cone with the recommended shim pack. Wrap a string around shaft, then use a spring scale to measure force required to rotate shaft a maximum of one revolution per second. Scale reading should be within range of 7-13 pounds (3.2-5.9 kg). Spring scale reading in this range provides specified rolling drag torque of 10-20 in.-lbs. (1.1-2.3 N·m). If scale reading is not within specified range, repeat adjustment procedure.

MECHANICAL FRONT-WHEEL DRIVE INTERMEDIATE SHAFT AND DRIVE GEAR

Quad-Range Models So Equipped

119. R&R AND OVERHAUL. The MFWD intermediate shaft and drive gear are located in the clutch housing. The shaft (14—Fig. 138) can be removed after separating tractor between transmission and clutch housing as outlined in paragraph 109. To remove clutch shaft drive gear and sheet metal housing (1—Fig. 138A), the clutch housing must also be separated from the engine, and Quad-Range planetary and MFWD clutch assembly must be removed.

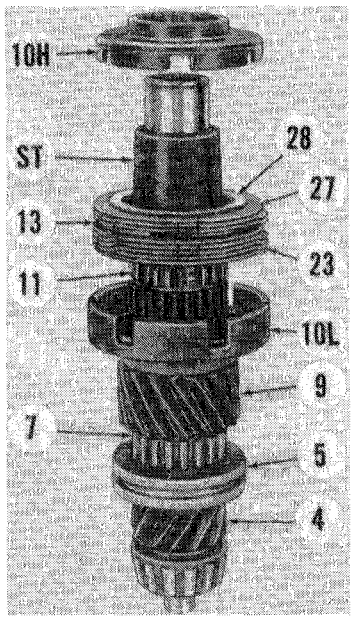


Fig. 135—Use JDT-4A special tool (ST) to hold detent balls and springs in place when installing blocker assembly on all models except 4650.

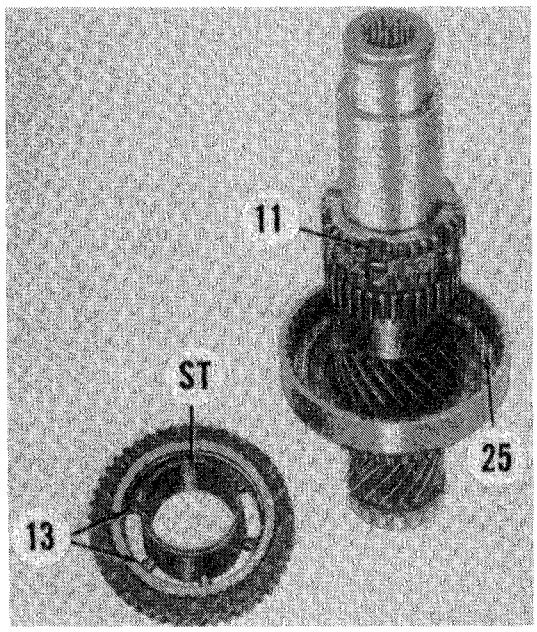
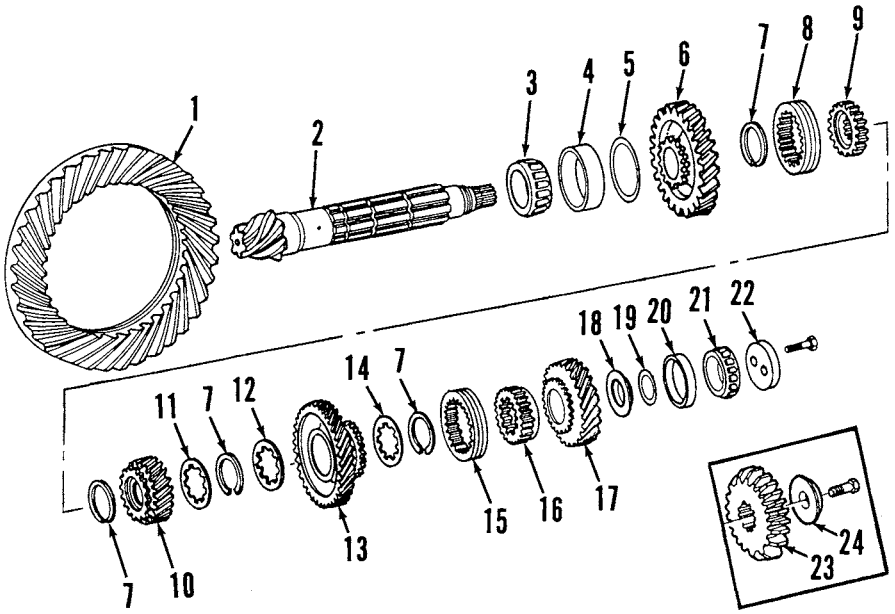


Fig. 135A—On Model 4650, use JDT-31 special tool (ST) to hold detent balls and springs in place when installing blocker assembly.

To disassemble, remove gear shield (1—Fig. 138), snap ring (2) and gear (3) from rear of shaft. Remove bearing retainer (5) mounting cap screws, then install two M10 x 50 cap screws into threaded holes of retainer and tighten evenly to remove retainer from clutch housing. Remove pto brake dowel pin (8). Remove thrust washer (6), snap ring (7) and bearing retaining ring (9). Reinstall gear (3) and rear snap ring (7) onto shaft, then use the gear like a slide hammer to pull shaft and bearing from clutch housing. Remove front bearing (11) and bushing (13) from shaft if necessary. Lift sheet metal shield (1—Fig. 138A) with clutch shaft drive gear from clutch housing.

Inspect all parts and renew if necessary. To reassemble, reverse the disassembly procedure.



1. Bevel ring gear
2. Differential drive shaft
3. Bearing cone
4. Bearing cup
5. Shim
6. "A" range gear
7. Snap rings
8. Shift collar
9. Rear shifter gear
10. "D" range gear
11. Thrust washer
12. Thrust washer
13. "B" range gear
14. Thrust washer
15. Shift collar
16. Front shifter gear
17. "C" range gear
18. Thrust washer
19. Shim
20. Bearing cup
21. Bearing cone
22. Retainer plate
23. Gear (MFWD)
24. Retainer

Fig. 136—Exploded view of differential drive shaft and associated parts. Gear (23) is used on models equipped with mechanical front-wheel drive. On Model 4650, thrust washer (12) must be installed with stepped side toward snap ring (7).

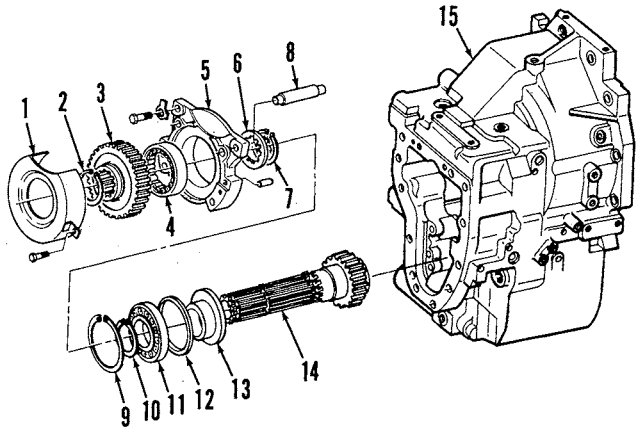


Fig. 138—Exploded view of mechanical front-wheel drive intermediate drive shaft and gear used on models equipped with Quad-Range transmission.

1. Shield
2. Snap ring
3. Gear
4. Roller bearing
5. Bearing retainer
6. Thrust washer
7. Snap ring
8. Dowel pin
9. Snap ring
10. Snap ring
11. Needle bearing
12. Washer
13. Bushing
14. Intermediate shaft
15. Clutch housing

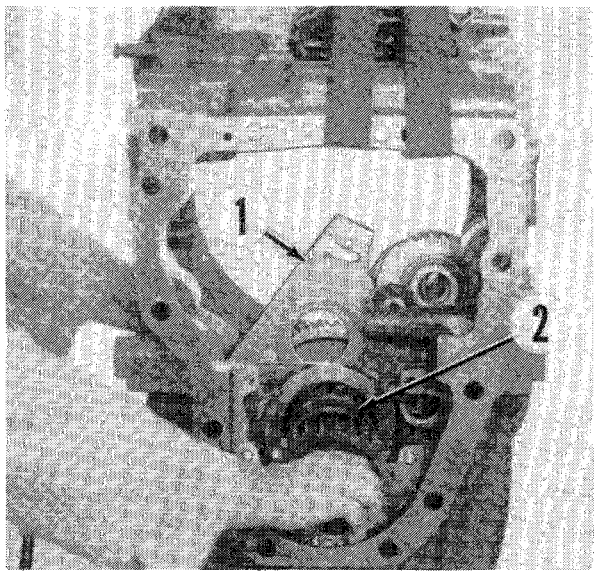


Fig. 138A—Clutch housing must be removed from tractor to remove sheet metal shield (1) and clutch shaft drive gear.

POWER SHIFT TRANSMISSION

OPERATION

Power Shift Models

120. The Power Shift transmission is available on all models. The transmission provides 15 forward speeds and 4 reverse speeds. Speed changes are hydraulically actuated and may be accomplished without stopping the tractor or operating the foot controlled clutch pedal.

The transmission assembly consists of two traction clutches, a single compound input planetary unit and a multiple compound output planetary unit as shown schematically in Fig. 139. All units are hydraulically engaged and mechanically spring disengaged. The hydraulic control units consist of the following:

The C1 traction clutch and C2 traction clutch are bolted to the engine flywheel and are splined to the respective CS1 shaft and CS2 shaft. The CS1 shaft drives directly through to the output planetary. The CS2 shaft provides input drive for the input planetary.

The input planetary, located in the clutch housing, has only two drive combinations: direct drive and overdrive. When the CLo clutch pack is engaged, the OR output shaft ring gear is driven at engine speed, or direct drive. When the BHi brake pack is engaged, the OR output shaft ring gear is driven faster than engine speed, or overdrive.

The output planetary, located in the transmission housing, is divided into two sections. The front section, consisting of B1 and B2 brake packs and a compound planetary unit, is referred to as the speed compound planetary. There are five possible drive combinations in the speed compound planetary. Four of the combinations are varying underdrive speeds while the fifth is direct drive. The rear section, consisting of B3 and B4 brake packs, C3 clutch pack and a compound planetary unit, is referred to as the direction compound planetary. There are three drive combinations possible in the direction compound planetary: direct drive, overdrive and reverse drive.

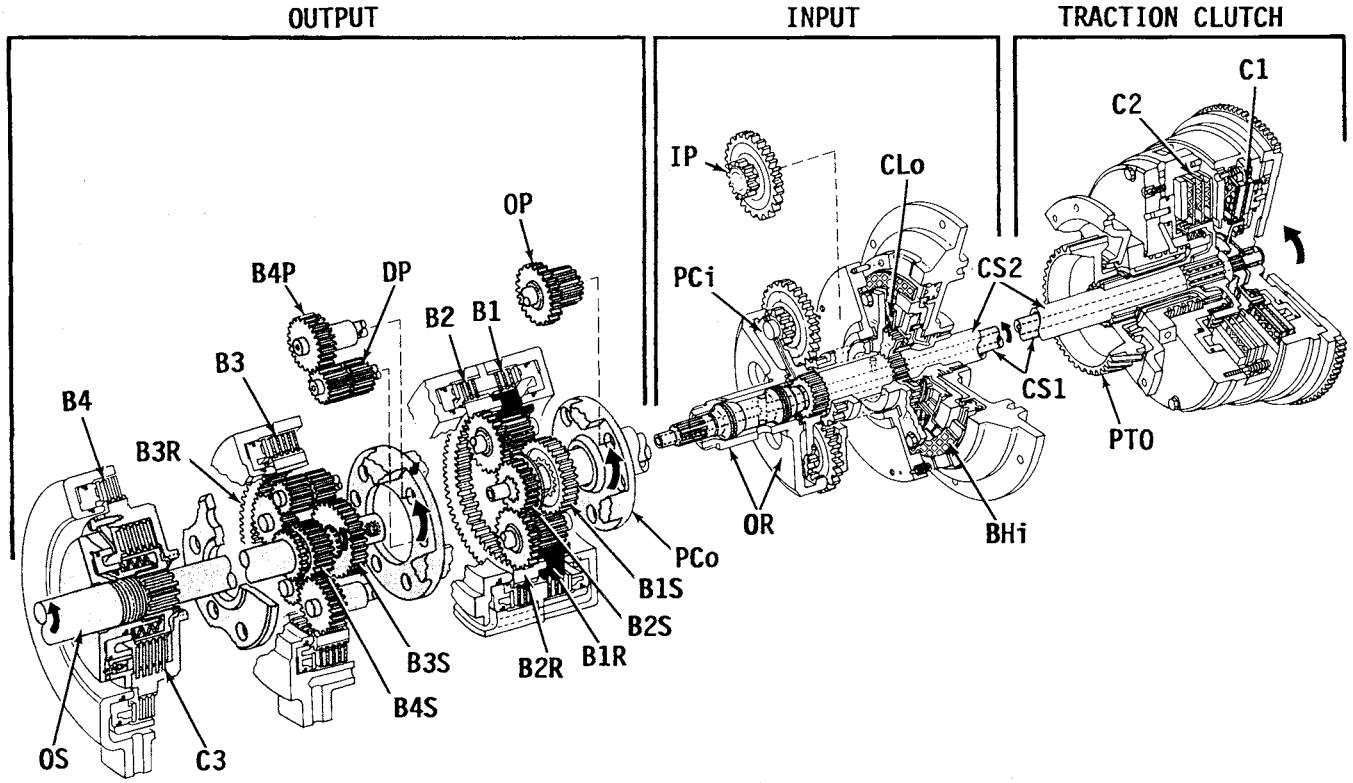


Fig. 139—Schematic view of Power Shift transmission showing primary function of units.

B1. Brake pack 1
B2. Brake pack 2
B3. Brake pack 3
B4. Brake pack 4
B4P. B4 planet pinion
B1R. B1 ring gear
B2R. B2 ring gear
B3R. B3 ring gear
B1S. B1 sun gear
B2S. B2 sun gear
B3S. B3 sun gear
B4S. B4 sun gear
BHi. Brake pack
CLo. Clutch pack
C3. C3 clutch pack
CS1. C1 clutch shaft
CS2. C2 clutch shaft
DP. Double planet pinion
IP. Input planet pinion
OP. Output planet pinion
OR. Output shaft ring gear
PCi. Planetary carrier (input)
PCo. Planetary carrier (output)
PTO. Pto drive gear
C1. C1 traction clutch
C2. C2 traction clutch

The accompanying table shown in Fig. 140 lists the control units actuated to complete the power flow in each shift position.

121. CONTROL SYSTEM. Power to operate the Power Shift transmission is supplied by a gear type hydraulic pump mounted on the inside of the traction clutch valve housing. Fluid from the hydraulic pump first passes through a full flow oil filter, then to the transmission control circuit. A pressure regulator valve, located in the traction clutch valve housing, controls maximum circuit pressure at 170-180 psi (1070-1170 kPa). Excess oil passes through the regulating valve to the oil cooler and main hydraulic pump.

The transmission control valve housing, located on the right side of transmission case, consists of a manually actuated speed selector rotary valve and a forward-reverse valve which operate through five hydraulically controlled shift valves to engage the desired clutch and brake control units. The five shift valves are contained in the shift valve housing which is mounted on the inside of transmission control valve housing.

The rotary valve selects tractor speeds by directing pilot oil pressure to shift the various control valves. The shift control valves then direct engagement oil to the various control units. Springs in the bottom of each shift valve bore keep the valves in their normally "up" position. When pilot oil is directed to the top of one of the valves, the valve spool will shift "down." The valves operate as follows:

The C1 shift valve (9A—Fig. 143) and C2 shift valve (9B) work together to route engagement oil from the traction clutch valve and forward-reverse valve to C1 and C2 clutches, B1-B2 shift valve, and pilot oil to the modulating valve housing and orificing valve. When the speed selector lever is in neutral position, both valves are in "up" positions. Engagement oil flows through the valves to the B1-B2 shift valve, and pilot oil is supplied to modulating valve housing and orificing valve. With C2 valve "up" and C1 valve "down," engagement oil from traction clutch valve flows through C2 valve to C1 valve where it is routed to engage C1 traction clutch. Engagement oil from forward-reverse valve is routed through C1 valve to the B1-B2 shift valve (9C). With both C1 and C2 shifted "down," engagement oil from traction clutch housing is directed to the C2 traction clutch. Oil from the forward-reverse valve is routed to the B1-B2 shift valve and to the modulating valve housing and orificing valve. With C2 valve shifted "down" and C1 valve "up," engagement oil from traction clutch valve is directed to engage both C1 and C2 clutch. B1-B2 shift valve, orificing valve and modulating valve housing are open to sump.

When B1-B2 shift valve (9C) is in the "up" position, engagement oil is directed to B1 brake pack. When valve is shifted to "down" position, oil is routed to engage B2 brake.

When C3-B4 shift valve (9D) is in the "up" position, oil is directed to the B4 brake. When pilot pres-

Speed	CONTROL UNIT ENGAGED								
	Traction Clutch		Input		Output				
	C1	C2	CLo	BHi	B1	B2	B3	B4	C3
4R		X		X		X	X		
3R		X	X		X		X		
2R	X			X		X	X		
1R	X		X		X		X		
N			X		X				
1	X			X	X				X
2	X			X		X			X
3	X		X		X			X	
4		X	X		X				X
5		X		X	X				X
6		X	X			X			X
7		X		X		X			X
8		X	X		X			X	
9		X		X	X			X	
10		X	X			X		X	
11		X		X		X		X	
12	X	X	X						X
13	X	X		X					X
14	X	X	X					X	
15	X	X		X				X	

Fig. 140—Table listing control units actuated in each speed range on Power Shift transmission.

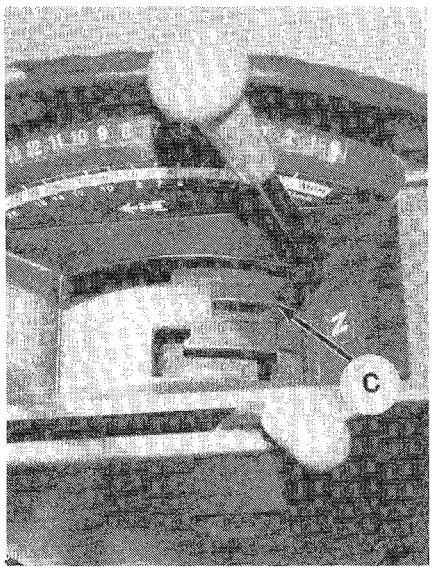


Fig. 141—Clearance (C) between front of selector lever and edge of guide plate should be 0.1 inch (2 mm). Refer to text.

sure shifts valve "down," oil is routed to C3 clutch pack. No engagement oil is routed to this valve in reverse speeds.

The CLo-BHi shift valve (6) directs pilot oil to the detented Hi-Lo shift valve. In the "up" position, oil is directed to the top of the Hi-Lo valve, which directs engagement oil to BHi brake pack in the input planetary. When shift valve is shifted to "down" position, oil is routed to the bottom of the Hi-Lo valve, which directs engagement oil to the CLo clutch pack in the input planetary.

A modulator valve (38—Fig. 160) regulates engagement time to approximately two seconds whenever speed selector lever is moved from neutral position to either forward or reverse. This gives the same effect as a gradual release of the clutch pedal which permits the transmission to be shifted into gear without using the clutch pedal.

The orificing valve (42) routes engagement oil directly through the valve to the modulator valve in speeds 1-11F. In speeds 12-15F, the valve shifts forcing the engagement oil to pass through the valve orifice before going to the control units. This softens the shifts in transport speeds.

Two accumulators are used to ensure smooth shifting. The system accumulator (7—Fig. 149) ensures that there is no temporary pressure drops in the control circuit as the different clutch and brake packs are engaged and disengaged. The C3 clutch accumulator (8) slows down the disengagement of C3 clutch pack when changing from C3 clutch pack to B4 brake pack to ensure sufficient time for B4 engagement. This prevents possible hesitation when changing from C3 to B4.

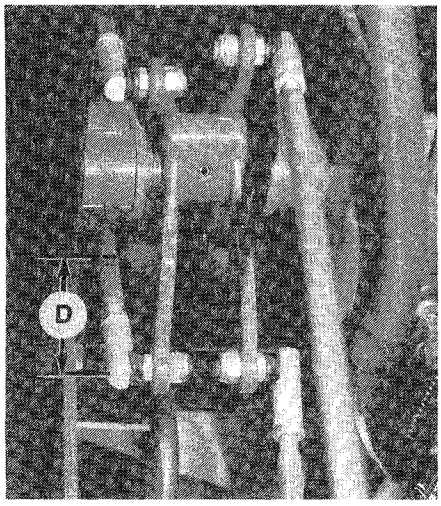


Fig. 142—View of speed selector upper control rod and center control arm. Refer to text for dimension (D) and adjustment procedure.

CONTROL LINKAGE

Power Shift Models

122. ADJUSTMENT. To adjust speed selector control linkage, first move selector lever into forward speed slot in console guide plate. There must be 0.1 inch (2 mm) clearance between side of lever and inside edge of slot in guide plate. If necessary, loosen guide plate mounting screws and reposition guide plate to obtain desired clearance.

Position selector lever between neutral-reverse and neutral-forward positions and measure clearance (C—Fig. 141) between front side of lever and edge of guide plate. Clearance should be 0.1 inch (2 mm). If necessary, adjust speed quadrant stop screw (S—Fig. 144) to obtain correct clearance. Be sure selector lever moves freely from side to side in neutral position.

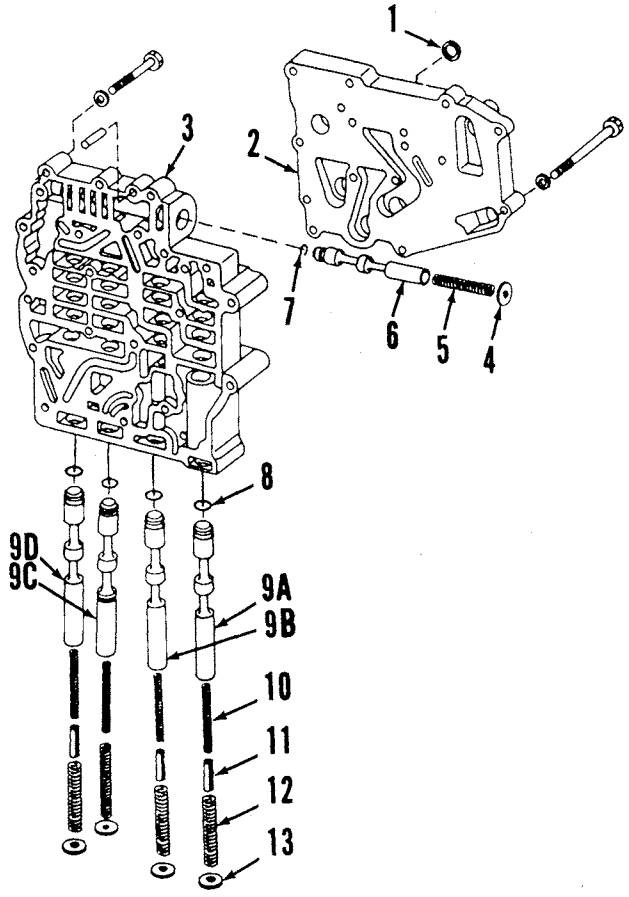


Fig. 143—Exploded view of shift control valve used on Power Shift transmission.

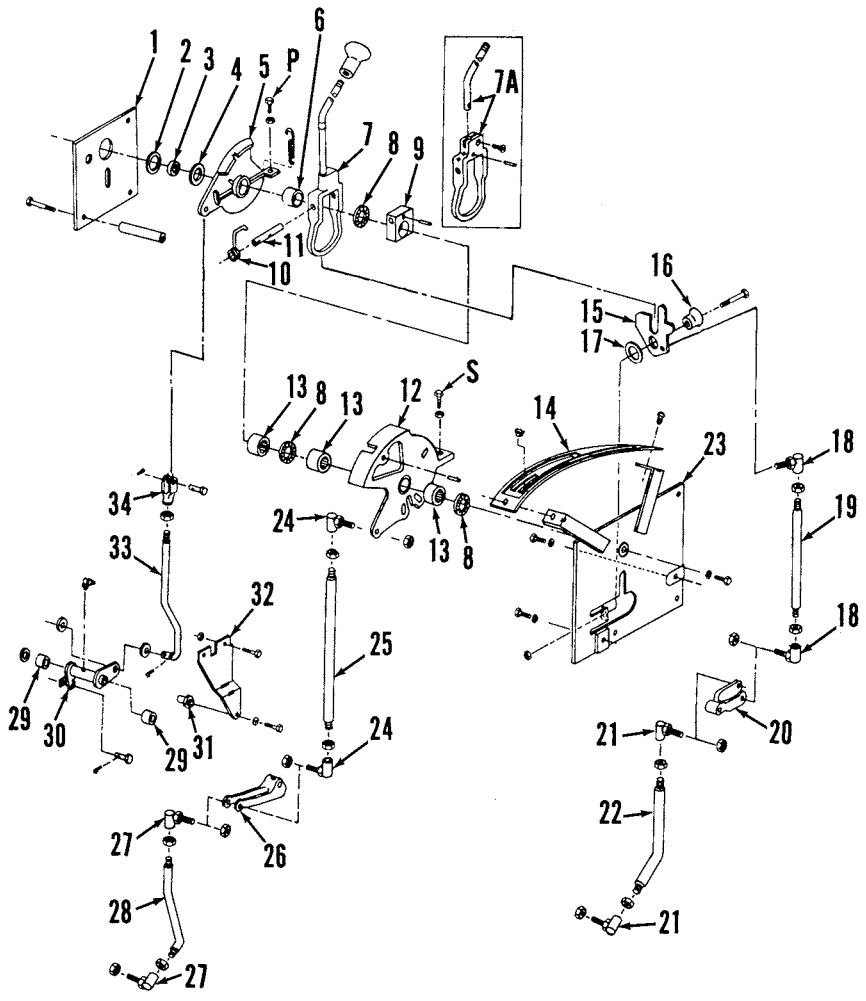
1. Seal ring
2. Manifold
3. Shift valve housing
4. Retaining washer
5. Spring
6. CLo-BHi Shift valve
7. "O" ring
8. "O" ring
9A. C1 shift valve
9B. C2 shift valve
9C. B1-B2 shift valve
9D. C3-B4 shift valve
10. Inner spring
11. Pin
12. Outer spring
13. Retaining washer

If lever drags, adjust park lock quadrant stop screw (P—Fig. 144) to align quadrant slots.

Speed selector upper control rod (25—Fig. 144) length should be exactly 20.5 inches (521 mm), measured from extreme ends of ball joints, for proper operation of transmission control assembly. To accurately measure control rod length, cut a length of small diameter rod (such as brazing rod) to exactly 16-7/8 inches (429 mm). Remove console cover and position selector lever in 15th speed position. Align end of brazing rod with top of upper control rod ball joint, then place a mark on control rod even with bottom end of brazing rod. Move speed selector lever back to neutral-forward position. Measure distance (D—Fig. 142) from mark on control rod to end of lower ball joint. The distance should be 3-5/8 inches (92 mm). Adjust rod length as necessary.

Disconnect lower control rods (22 and 28—Fig. 144) from center control arms (20 and 26). Rotate speed control arm on transmission control valve to lowest detent (neutral) position. Position speed selector lever between forward and reverse guide plate slots, then insert a 0.050 inch (1.25 mm) thickness feeler gage between front of selector lever and guide plate. With selector lever secured in this position, adjust upper ball joint on control rod until it fits freely into center control arm. Remove feeler gage, then move selector lever through all forward speed positions making sure lever engages 16 full detents (neutral plus 1 through 15). Make minor adjustments to lower control rod ball joints if necessary to obtain full detent in all speed and neutral positions.

Rotate direction control arm on transmission control valve to uppermost detent position. Connect lower control rod (22—Fig. 144) to center control arm (20). Insert a 0.020 inch (0.5 mm) feeler gage between outer side of quadrant slot and outer side of selector lever. With lever secured in this position, adjust ball joint on lower control rod until it fits freely into control valve arm. Be sure that the lever engages full de-



1. Support plate
2. Washer
3. Spacer
4. Shim
5. Park lock quadrant
6. Bushing
7. Selector lever (late models)
7A. Selector lever (early models)
8. Thrust bearing
9. Pivot
10. Spring
11. Pin
12. Speed selector quadrant
13. Needle bearing
14. Guide plate
15. Reverse bellcrank
16. Pivot
17. Washer
18. Ball joints
19. Reverse upper control rod
20. Center arm
21. Ball joints
22. Reverse lower control rod
23. Outer support plate
24. Ball joints
25. Speed selector upper control rod
26. Center arm
27. Ball joints
28. Speed selector lower control rod
29. Bushing
30. Park lock arm
31. Pivot
32. Plate
33. Park lock control rod
34. Yoke

Fig. 144—Exploded view of Power Shift control lever and associated parts.

tent in neutral-forward, neutral-neutral and neutral-reverse positions and that the lever moves freely into reverse slot in guide plate. If necessary, make minor adjustments to lower control rod length.

123. R&R AND OVERHAUL. To remove speed selector assembly, remove console wrap-around cover. Open small access door on right side of cab. Remove latch peg and four plastic plugs, then pull panel away from side of cab, but do not remove. Remove three mounting cap screws from outside of cab. Place selector lever in 7th speed, then pull shift indicator assembly up and remove. Disconnect control rod from throttle lever and remove throttle lever mounting cap screw. Disconnect park lock control rod yoke (34—Fig. 144). Remove cap screws securing inner plate (1) to cab. Remove cap screws securing control rod rubber boot plate to floor. Disconnect upper speed control arm (25) and reverse control rod (19) from center arms (20 and 26). Remove cap screw securing outer support plate (23), then remove shifter assembly.

Remove mounting cap screws from inner plate (1) and separate shift lever components. Inspect bearings, bushings, thrust washers and other components for wear or damage and renew if necessary. Note that length of upper control rods is critical for proper operation of speed selector assembly. Length of direction control rod (19) should be 15.7 inches (399 mm) and length of speed control rod (25) should be 20.5 inches (521 mm).

To reinstall, reverse the removal procedure.

TROUBLE-SHOOTING

Power Shift Models

124. SYSTEM PRESSURE TEST AND ADJUSTMENT. Before checking the transmission operating pressure, first be sure that oil filter is in good condition and that oil level is at full mark. Operate tractor until transmission oil temperature is at least 100° F (38° C).

Connect a 300 psi (2000 kPa) pressure gage at system test port (1—Fig. 145) on traction clutch valve housing. Place transmission in "Park" and operate engine at 2000 rpm. System pressure should be 170-180 psi (1170-1240 kPa). If pressure is not within specified limits, remove pressure regulator valve plug (PR) and add or remove pressure regulator valve shims (35—Fig. 157). Each shim will change pressure approximately 5 psi (35 kPa).

If adjustment of pressure regulating valve does not correct the malfunction, check operating pressures as outlined in the following paragraph.

125. OPERATING PRESSURE TEST. After checking and adjusting system pressure, a complete check of transmission hydraulic system can be performed as follows:

Connect a 300 psi (2000 kPa) gage at system test port (1—Fig. 145) on traction clutch valve housing. Install a 60 psi (400 kPa) gage at lube pressure test port (2—Fig. 146) on the return oil manifold. Place towing disconnect lever in "TOW" position. Operate engine at 1000 rpm or adjust speed to obtain 10 psi (70 kPa) lube pressure.

Hold clutch pedal fully depressed, then record lube pressure with speed selector lever in the following positions: Park, N-R, F12 (C3 element circuit) and F14 (B4 element circuit). If lube pressure drops more than 1.5 psi (10 kPa) in one of the selector positions, a leak is indicated in that circuit. If pressure is low in Park to N-R only, check for a damaged gasket in transmission control valve housing. If leakage is indicated in C3 circuit, check C3 transport modulator valve (4—Fig. 162) and accumulator piston for malfunction. If leak is indicated in B4 circuit, check B4 transport modulator valve (5) and accumulator piston.

To check for leakage in B1, C1 and C2 circuits, operate engine at 1000 rpm and check system pressure before and after depressing clutch pedal with selector lever in the following positions: Park (B1 element), R1 (C1 element) and R3 (C2 element). System pressure should not vary more than 3 psi (21 kPa). If leakage is indicated in all three elements, check for leakage between traction clutch valve and transmission control valve. If leakage at only one element is indicated, check for leakage between transmission control valve and the element.

To check remainder of elements for leakage, operate engine at 1000 rpm or adjust speed to get 10 psi (70 kPa) lube pressure. Hold clutch pedal fully

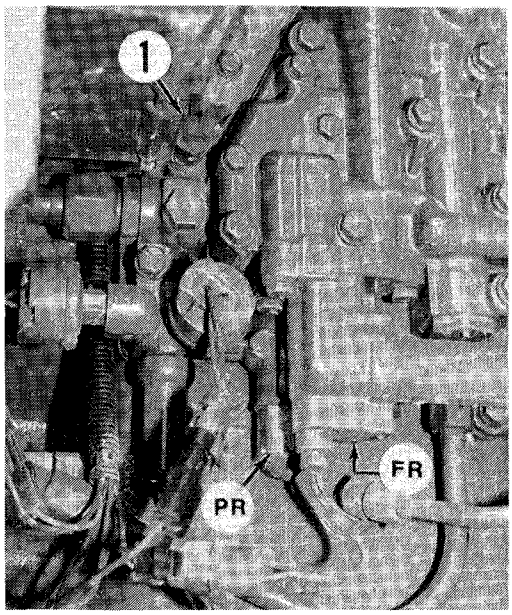


Fig. 145—To check Power Shift transmission system pressure, install a 0-300 psi (0-2000 kPa) pressure gage at traction clutch valve test port (1).

depressed, then record lube pressure with speed selector lever in each of the following positions: F1 (B1 element), F2 (B2 element), F4 (CLo element), F5 (BHi element), F7 (C3 element), F11 (B4 element), F3 (B4 element) and R1 (B3 element). Wait about 10 seconds after each shift before recording pressures. If lube pressure drops more than 1.5 psi (10 kPa) in any of the selector positions, a leak is indicated in the corresponding control element.

To further verify leakage at control element, proceed as follows: If leakage is indicated at C1 or C2 elements, install matched 300 psi (2000 kPa) gages in C1 and C2 element test ports (6 and 7—Fig. 147) in transmission control valve and system pressure test port in traction clutch valve. With engine at 1000 rpm, C1 pressure (R1 speed position) and C2 pressure (R3 position) should be within 5 psi (35 kPa) of system pressure. If leakage is indicated in B1, B2, B3, B4 or C3 elements, install matched 300 psi (2000 kPa) gages in suspected element test port on transmission control valve (Fig. 147) and in rotary valve pilot pressure port (located directly above neutral start switch). With engine at 1000 rpm, element engagement pressure should be within 7 psi (48 kPa) of pilot pressure.

When repairing, refer to the following list of possible areas of leakage and the corresponding elements which could be affected.

1. Transport modulating valve (located below transmission control valve) sticking, could affect B4 and C3 elements.
2. Modulating valve or sump valve in transmission control valve housing sticking, could affect B3, B4 and C3 elements.
3. Damaged packings between transmission control valve and transmission case, could affect C1, C2, B1, B2, B3 and B4 elements.
4. Damaged transmission control valve gasket, could affect all control elements.
5. Traction clutch valve housing gasket damage, could affect C1, C2, CLo, BHi and B1 (in park) elements.
6. Leakage at traction clutch pressure tubes, oil manifold or pistons, could affect C1 and C2 elements.
7. Leakage at detented Hi-Lo valve, oil inlet tube or input planetary pistons, could affect CLo and BHi elements.
8. Leakage at "O" rings between transmission case and output planetary, could affect B1, B2, B3 or B4 elements.

If transmission operation is erratic but control element leakage is not indicated, install test gages and check shift valve operation as follows: Install matched set of seven 300 psi (2000 kPa) gages at element test ports (Fig. 147) on transmission control valve housing. With transmission in "TOW" and engine at 1500 rpm, move selector lever through each forward and reverse speed and check gage readings for elements as indicated in chart in Fig. 140. Note

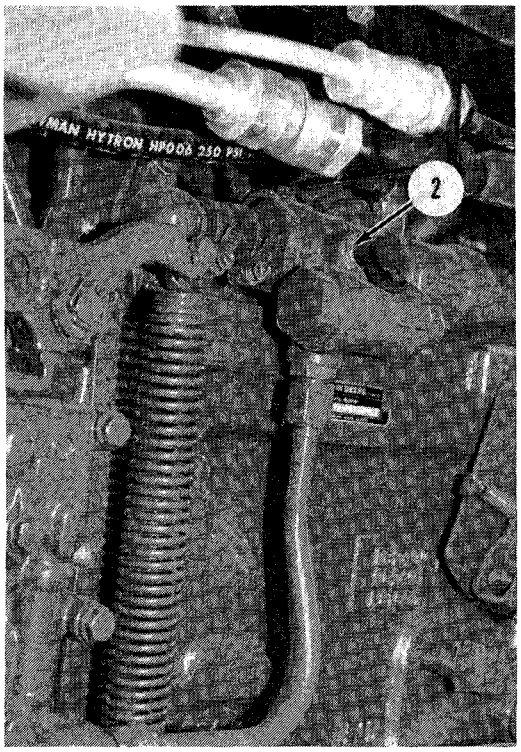


Fig. 146—To check Power Shift transmission lube pressure, install a 60 psi (400 kPa) gage at return oil manifold test port (2).

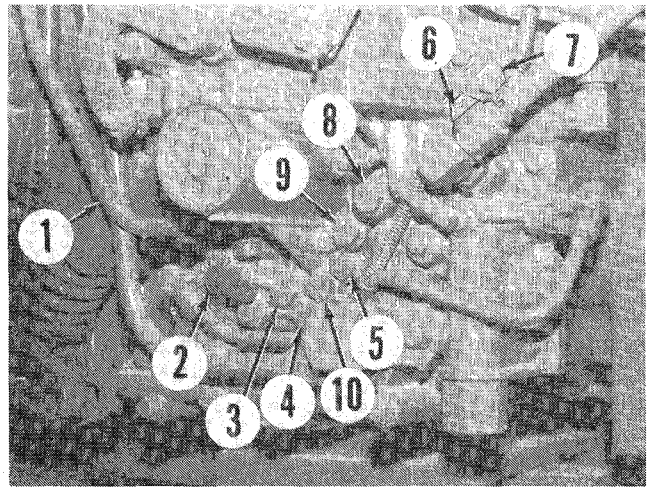


Fig. 147—To check operation of Power Shift control elements and shift valves, install matched set of seven 300 psi (2000 kPa) gages at element test ports on transmission control valve housing. Refer to text.

1. C3 clutch line
2. B4 brake
3. B1 brake
4. B2 brake
5. B3 brake
6. C1 clutch
7. C2 clutch
8. Rotary valve pilot pressure
9. HL brake
10. HL clutch

incorrect engagement or slow engagement of elements. Check for pressure at any element which should be "off" or for slow disengagement of any element. Repeat check at 2000 rpm. Repair as needed. Note that there will normally be low pressure, 15 psi (100 kPa), at B3 element in N-R and at C3 element in N-F. Low pressure at C3, B3 and B4 when each should be normally engaged is an indication that neutral-to-gear modulator valve (38—Fig. 160) is stuck or the orifice is plugged.

126. TRACTOR CREEPS IN NEUTRAL. A slight amount of drag is normal in the clutch and brake units, especially when the oil is cold. Excessive drag, aside from causing creep or erratic shifting, will contribute to loss of power, excessive heat and premature wear. Clutch or brake element drag can be caused by warped drive plates or friction discs, fragments of parts causing partial engagement, weak return springs or hydraulic pressure not being properly cut off from clutch and brake units in disengaged position.

Oil temperature must be at least 100° F (38° C) for all drag checks. To check element drag, proceed as follows:

1. Drive tractor on level surface in F3 with engine at 1500 rpm, then depress clutch pedal. If ground speed stays the same, C1 is dragging. If speed increases, C2 is dragging.

2. Drive tractor in F4 at 1500 rpm, then depress clutch pedal. If ground speed stays the same, C2 is dragging. If speed decreases but does not stop, C1 is dragging.

Place transmission in "TOW" and operate engine at 1000 rpm. Engine speed change should be less than 30 rpm between the following shifts:

3. Position speed selector lever at R2, then move lever to F2. If engine speed increases more than 30 rpm, C3 is dragging. If engine speed decreases more than 30 rpm, B3 is dragging.

4. Position speed selector lever at F4, then move lever to F8. If engine speed increases more than 30 rpm, B4 is dragging. If engine speed decreases more than 30 rpm, C3 is dragging.

5. Position speed selector lever at F5, then shift lever to F7. If engine speed increases more than 30 rpm, B2 is dragging. If speed decreases more than 30 rpm, B1 is dragging.

6. Position speed selector lever at F4, then shift lever to F5. If engine speed increases more than 30 rpm, BHi is dragging. If speed decreases more than 30 rpm, CLo is dragging.

To check for hydraulic drag, install 300 psi (2000 kPa) gage in transmission control valve test port (Fig. 147) of dragging element. Operate engine at 1500 rpm. Hold clutch pedal in fully depressed position, move selector lever to speed in which element was found to be dragging and note gage reading. There should normally be zero pressure when element is disengaged. Maximum allowable pressure is 0-2 psi (0-14 kPa) for B1, B2, B3, B4 and BHi elements. Maximum allowable pressure is 0-5 psi (0-35 kPa) for C1, C2, C3 and CLo elements. If disengaged pressure is excessive, repair transmission control valve.

127. TRANSMISSION SLIPPAGE CHECK. Operate engine at 1500 rpm while driving tractor in F7. Apply both brakes to load engine. It should be possible to stall the engine if brakes and transmission are in normal operating condition. Repeat check in F8. If ground speed decreases considerably but engine speed does not decrease, the transmission is slipping.

If slippage was in F7, one or more of the following elements is slipping: C2, B2, C3 or BHi. If slippage was in F8, one or more of the following elements are slipping: C2, B1, B4 or CLo.

128. ACCUMULATOR OPERATION CHECK. Oil temperature must be at least 100° F (38° C) before conducting operation checks. Operate engine at 1000 rpm during the checks.

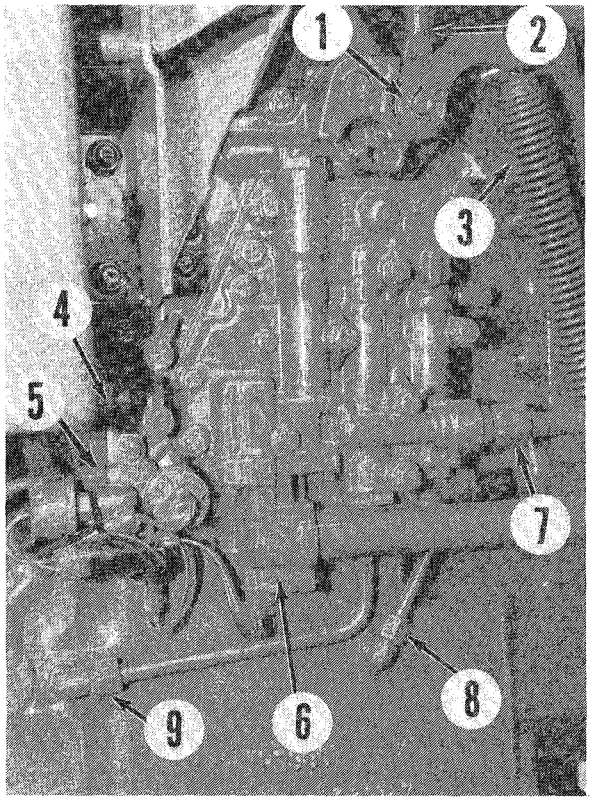


Fig. 148—Traction clutch valve housing is mounted on left side of clutch housing.

1. Traction clutch rod
2. Pto clutch rod
3. Return spring
4. Oil cooler line
5. MFWD oil line
6. Inlet oil manifold
7. Filter bypass line
8. Pto brake line
9. Pto clutch line

To check the system accumulator (7—Fig. 149), drive the tractor and shift between the following speeds: F5 to F6, F6 to F5, F7 to F8 and F8 to F7. Shifts should be smooth if accumulator is properly charged. If shifting is erratic, disconnect accumulator hydraulic line at the transmission control valve and plug both openings. Repeat shifting sequence. If shifting becomes more erratic, accumulator is properly charged and the problem is elsewhere. If shifting is the same, the accumulator is under or over charged Refer to paragraph 140 for charging procedure.

Operation of C3 accumulator (8—Fig. 149) can only be checked while operating tractor under a field load during a 7 to 8 upshift. If shift is erratic, disconnect accumulator hydraulic line from transmission control valve housing. Plug both openings, then repeat 7 to 8 upshift under load. If shifting becomes more erratic, accumulator is not the cause of the problem. If shifting is the same, accumulator is under or over charged. Refer to paragraph 140 for charging procedure.

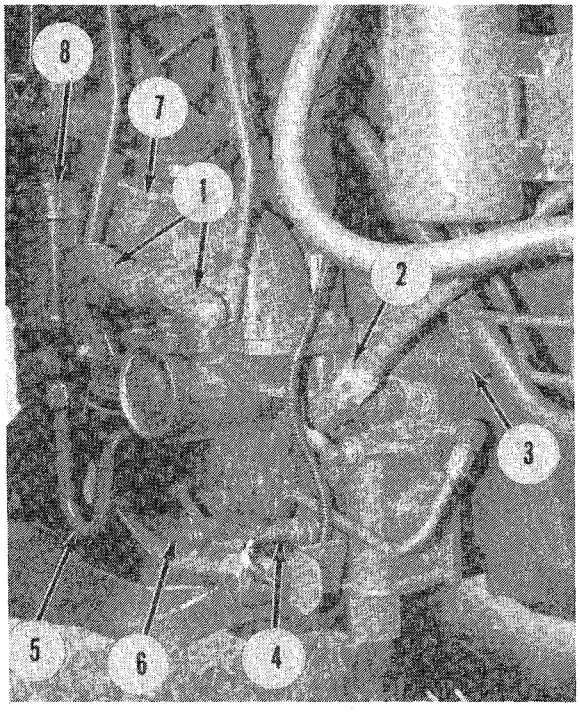


Fig. 149—Transmission control valve housing is mounted on right side of transmission case.

1. Control arms
2. C1 line
3. C2 line
4. Neutral start switch
5. Accumulator pressure line
6. Modulating valve housing
7. System accumulator
8. C3 clutch accumulator

REMOVE AND REINSTALL

Power Shift Models

129. TRACTION CLUTCH VALVE HOUSING. Remove battery, battery box and step, wiring shield and Sound-Gard body front mount from left side of tractor. Disconnect traction clutch control rod (1—Fig. 148), pto control rod (2) and return spring (3). Identify and disconnect wiring connections. Disconnect oil cooler line (4), pto clutch line (9), pto brake line (8), filter bypass line (7) and MFWD oil line (5). Remove valve housing mounting cap screws. Do not remove the six, smaller diameter cap screws that attach the transmission oil pump. Remove valve housing from transmission case.

Refer to paragraph 136 for overhaul of traction clutch valve assembly and pto control valve assembly. Refer to paragraph 137 for overhaul of transmission oil pump.

To reinstall valve housing assembly, reverse the removal procedure. Tighten mounting cap screws to an initial torque of 35 ft.-lbs. (47 N·m). Wait for 10 minutes to allow gaskets to compress, then retorque.

130. TRANSMISSION CONTROL VALVE AND MODULATING VALVE. To remove valve housings, first drain oil from transmission housing. Disconnect control rods from housing arms (1—Fig. 149). Remove neutral start switch cover and disconnect wiring from switch (4). Disconnect hydraulic lines (2, 3 and 5). Remove mounting cap screws and withdraw control valve housing with accumulator. Unbolt and remove modulating valve housing (6).

To overhaul valves, refer to paragraphs 138 and 139.

To reinstall valves, reverse the removal procedure while noting the following: Be sure "O" rings are properly seated in transmission case ports. Tighten modulating valve mounting cap screws evenly to 35 ft.-lbs. (47 N·m). Do not retorque. It is recommended that the two plugs be removed from modulating valve housing to make sure valves are free in their bores after tightening housing mounting screws. Tighten control valve housing mounting cap screws to 35 ft.-lbs. (47 N·m). Wait 10 minutes, then retorque mounting screws.

131. TRACTOR SPLIT. To gain access to traction clutch assembly, pto drive gears or Power Shift transmission components, it is first necessary to separate engine from clutch housing as follows:

Drain coolant from radiator and engine. Remove drain plug from clutch housing and drain hydraulic oil. Disconnect cables and remove batteries, battery boxes and left step. Remove side shields, side screens and hood.

Disconnect air conditioning hoses at couplers under left corner of Sound-Gard body and pull hoses forward. Disconnect heater hoses. Disconnect wiring as necessary and move rearward from engine. Disconnect throttle control rod and fuel shut-off cable.

NOTE: Before loosening hydraulic lines, relieve system pressure by loosening brake bleed screws and pumping brake pedals until they go all the way down.

Disconnect auxiliary reservoir bleed line, oil cooler return line at the air cleaner and steering lines at the cab firewall. Disconnect main pump charge line from pressure regulating valve housing and main pump pressure line from pressure control valve housing. Loosen right front Sound-Gard body mounting bolt. Remove cap screws securing body mounting bracket, then swing bracket away from clutch housing. Remove clutch oil lines from shift control valve and clutch oil manifold tubes. Use JDG-268 removal tool or other suitable tool to remove clutch oil manifold tubes from the clutch housing.

If equipped with mechanical front-wheel drive, remove the drive shaft. On all models, remove front weights if so equipped.

Using suitable splitting stands, such as JT27702 and JT27706, support clutch housing and front of tractor. Remove floor mat and cover, then use JDG-16A special wrench extension (or other suitable tool) to remove the two cap screws securing engine to clutch housing located under cab support. Remove remainder of the clutch housing-to-engine cap screws and the oil pan-to-clutch housing cap screws. Carefully roll front end and engine away from clutch housing.

To reconnect engine to clutch housing, reverse the splitting procedure while noting the following additional instructions. Be sure ends of clutch oil manifold sealing rings are interlocked and manifold (2—Fig. 150) is seated against traction clutch assembly (1) to prevent damage to seal rings during assembly. Be sure oil manifold pistons (3) are fully seated in manifold. Check for proper installation of high and low range clutch shafts in transmission by measuring the distance the shafts protrude from face of clutch housing. On 4050, 4250 and 4450 tractors, end of low range shaft should be 0.8-0.9 inch (20.5-23.0 mm) from face of clutch housing and end of high range shaft should be 2.71-2.82 inches (68.8-71.5 mm) from face of clutch housing. On Models 4650 and 4850, the low range shaft should protrude 1.17-1.27 inches (29.7-32.25 mm) and high range shaft should protrude 3.29-3.39 inches (83.5-86.0 mm). Engine and clutch housing should slide together when properly aligned. Do not use mechanical force to draw units together. Be sure clutch oil manifold pin (5) is engaged in pto drive gear support hole before rotating crankshaft. Tighten cap screws securing engine to clutch housing to 300 ft.-lbs. (407 N·m) and cap screws securing oil pan to clutch housing to 120 ft.-lbs. (163 N·m). On tractors equipped with mechanical front-wheel drive, tighten drive shaft yoke cap screws to 50 ft.-lbs. (68 N·m).

132. TRACTION CLUTCH ASSEMBLY. To remove traction clutch, separate clutch housing from engine as outlined in paragraph 131. Rotate clutch assembly until tapped hole in C1 clutch drum is at the top. Attach a lifting eye to clutch drum using a 12 mm cap screw and a flat washer. Support weight of clutch assembly with an overhead hoist, then remove the four mounting cap screws (4—Fig. 150). Pry clutch assembly from dowel pins in flywheel.

Refer to paragragh 142 for clutch overhaul procedure.

To reinstall clutch assembly, reverse the removal procedure. Tighten mounting cap screws to 35 ft.-lbs. (47 N·m).

133. INPUT PLANETARY AND TRANSMISSION PUMP. The transmission pump and input planetary assembly can be removed after detaching clutch housing from the engine as outlined in paragraph 131. Remove low and high range shafts. Support (do not raise) the Sound-Gard body with an overhead hoist and a suitable lifting bracket such as JDG-15. Remove left front body mounting bracket from clutch housing. Remove six cap screws from traction clutch valve housing securing oil pump (7—Fig. 152), then withdraw pump from clutch housing. Remove pto drive gear bearing support (5) and drive gear (6). Remove shift valve oil line (3). Remove cap screws securing input planetary housing (1). If input plantary does not break free of clutch housing, pry against plug in shift valve to free unit. Carefully lift out clutch and

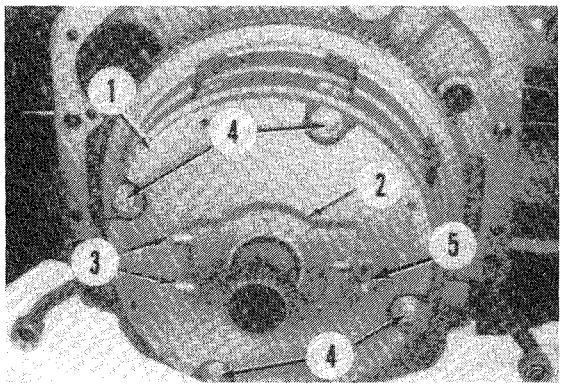


Fig. 150—View of Power Shift traction clutch assembly.

1. Traction clutch housing
2. Oil manifold
3. Oil manifold pistons
4. Mounting cap screws
5. Pin

brake piston housing, planetary carrier assembly and planetary shaft with gear.

To remove lube manifold, first remove floor mat and floor cover. Disconnect lube oil hose and remove elbow from top of clutch housing. Use a stiff piece of wire with ends bent to lift tube out of the manifold. Unbolt and remove lube manifold from clutch housing.

Refer to paragraph 143 for overhaul procedure.

To reinstall, reverse the removal procedure while noting the following instructions: Tighten lube manifold mounting cap screws to 35 ft.-lbs. (47 N·m). Install planetary shaft and ring gear. Install planetary carrier (2—Fig. 153) into planetary ring gear (1) so timing marks on planet pinions (3) are aligned with timing marks on gear hub (4). Apply a light coat of grease to thrust washer located between planetary, carrier and piston housing to hold washer in place. Make sure old plastic gasket material is removed from piston housing and mating surface of clutch housing, then apply a light coat of Loctite 277 plastic gasket to area around oil slots in the piston housing flange. Prevent the plastic gasket from running into the oil slots. Install piston housing within 15 minutes after applying gasket material and tighten mounting cap screws to 35 ft.-lbs. (47 N·m). Meshing of gear teeth may be made easier by installing high range shaft into planetary and turning shaft until teeth mesh. Install oil pump and tighten mounting cap screws to 20 ft.-lbs. (27 N·m). Wait 10 minutes, then retorque pump mounting screws.

If pto drive gear, bearings or drive gear support were renewed, the drive gear end play must be checked and adjusted as follows: Install drive gear (6—Fig. 152) and support (5) with enough shims to allow gear end play. Use a dial indicator to measure gear end play, then remove shims as necessary to obtain 0.001-0.004 inch (0.03-0.10 mm) end play. Tighten support mounting cap screws to 20 ft.-lbs. (27 N·m).

134. CLUTCH HOUSING. The clutch housing must be removed for access to reduction gear train or removal of planetary output unit. To remove clutch housing, first split tractor between engine and clutch housing as outlined in paragraph 131.

Remove Sound-Gard body as follows: Disconnect wiring harnesses as necessary. Disconnect clutch linkage rod and pto linkage rod from clutch valve housing. Disconnect neutral start switch wiring and speed and directional control linkage at transmission control valve. Disconnect park lock bracket, park lock linkage and Power Shift linkage bracket on right side of tractor. Disconnect differential lock hydraulic line, right brake line and steering, brake and differential lock supply line. At rear of cab, disconnect heater hoses, hydraulic control lever inner support, seat valve supply line and rockshaft and SCV control linkages. Remove floor mat and floor cover, then disconnect dimmer switch, differential lock and brake return line, steering return line, brake line, ground wire, seat valve leak-off hose and seat valve return hose. Support body with an overhead hoist and JDG-15 lifting bracket or other suitable bracket. Remove front and rear mounting bolts. Raise body about three inches (76 mm), then disconnect left SCV linkage. Carefully raise body and remove rearward from tractor.

Identify and mark location of hydraulic tubing if necessary, then remove hydraulic tubes from clutch housing. Disconnect sensor wiring harness and move all wiring rearward. Remove input planetary unit,

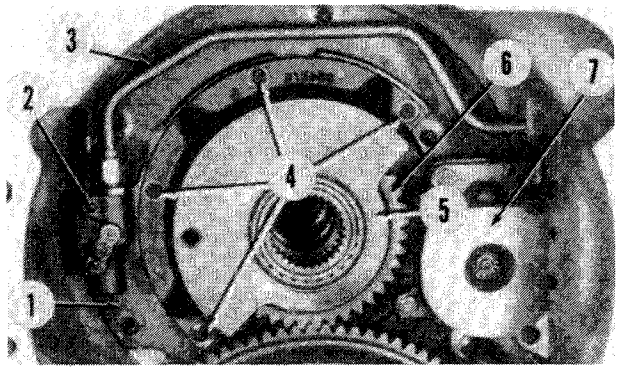


Fig. 152—View of front of clutch housing.

1. Input planetary housing
2. Hi-Lo shift valve
3. Oil line
4. Cap screws
5. Pto drive gear support
6. Pto drive gear
7. Transmission oil pump

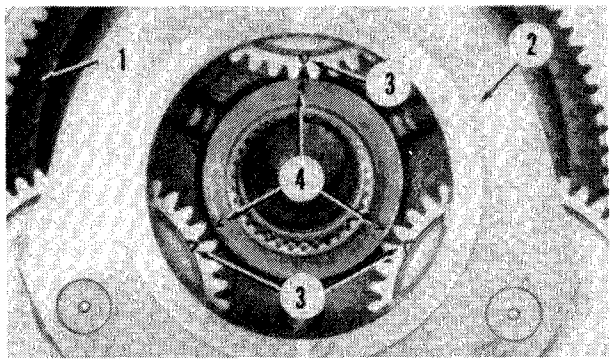


Fig. 153—Timing marks on pinion gears (3) must be aligned with timing marks on ring gear hub (4) when reinstalling input planetary.

1. Ring gear
2. Input planetary carrier
3. Pinion timing marks
4. Gear hub timing marks

transmission pump and lube manifold from clutch housing as outlined in paragraph 133. Attach lifting brackets to Sound-Gard body mounting studs on both sides of clutch housing. Support housing with a suitable hoist and sling, then remove two mounting cap screws from inside clutch housing, one cap screw and three stud nuts from bottom side of housing and eight cap screws from sides of housing. Separate clutch housing from transmission case.

When reinstalling clutch housing, be sure seal rings are in place in transmission case oil passages. Tighten two cap screws inside housing to 170 ft.-lbs. (230 N·m) and remainder of mounting cap screws and stud nuts to 300 ft.-lbs. (407 N·m).

135. OUTPUT PLANETARY. To remove the output planetary assembly, first split engine from clutch housing as outlined in paragraph 131, remove input planetary assembly, as outlined in paragraph 133, remove clutch housing as outlined in paragraph 134, remove rockshaft housing as outlined in paragraph 236.

Disconnect C3 oil line (Fig. 154) and place a piece of tape or rubber band below the flare nut to keep it from sliding to the bottom of the tube. Remove bearing retainer with shims. Thread a 7/16 inch slide hammer puller into rear end of reduction gear shaft, then pull shaft rearward from housing.

Remove transmission case top cover, then remove output planetary mounting cap screws. Install two lifting eyes into tapped holes of planetary housing as shown in Fig. 155. Use a suitable hoist to lift out planetary assembly.

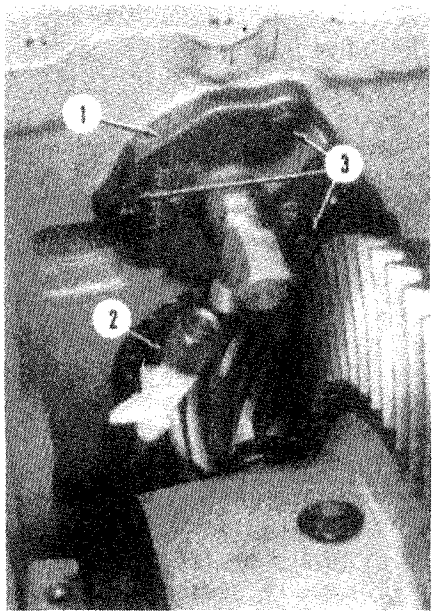


Fig. 154—View showing location of C3 oil line and reduction gear shaft bearing retainer. A piece of tape may be wrapped around oil line to prevent the flare nut from sliding to bottom end of oil line when disconnected.

Before installing planetary unit, inspect or renew the four "O" rings in brake pack pressure ports in bottom of transmission housing. If reduction gear shaft, bearings or retainer were renewed, adjust bearing preload as outlined in paragraph 158 prior to installing planetary. Lower planetary unit into transmission case and tighten mounting cap screws to 55 ft.-lbs. (75 N·m). Complete installation by reversing the removal procedure. Tighten reduction gear shaft bearing retainer cap screws to 55 ft.-lbs. (76 N·m).

OVERHAUL

136. TRACTION CLUTCH AND PTO CONTROL VALVES. The pto control valve housing (Fig.156) is mounted on traction clutch valve housing (Fig. 157). Refer to paragraph 129 for removal and installation information.

To disassemble pto control valve, drive spring pin from pto control arm. Remove retaining cap screws, then separate transmission pump and pto valve housing from traction clutch valve housing. Remove pin (4—Fig. 156) and pin (10), then remove arm (3) and link (5). Remove plug (13), then withdraw pto control valve (11) and related components. Remove modulating valve pistons (16 and 21) and related components. Remove pto lock piston (24).

Valve spools must slide smoothly in their bores and must not be scored or excessively worn. Refer to Fig. 156 and check valve springs for distortion and against the values that follow:

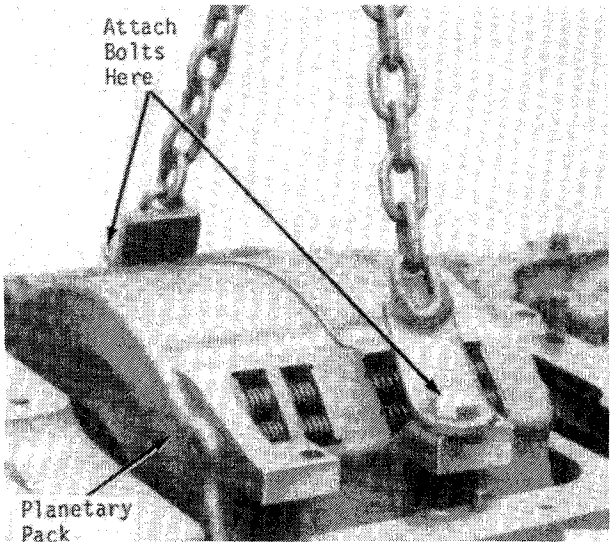


Fig. 155—Attach suitable lifting eyes at tapped holes in planetary housing, then use a hoist to lift out output planetary assembly.

Pto Valve Spring (9)—
Free length ..... 3.50 in. (89 mm)
Test ..... 39-48 lbs. @ 2.75 in. (174.3-212.3 N @ 70 mm)
Pto Modulating Valve Inner Spring (18)—
Free length ..... 4.68 in. (119 mm)
Test ..... 21-25 lbs. @ 3.81 in. (91.9-112.3 N @ 97 mm)

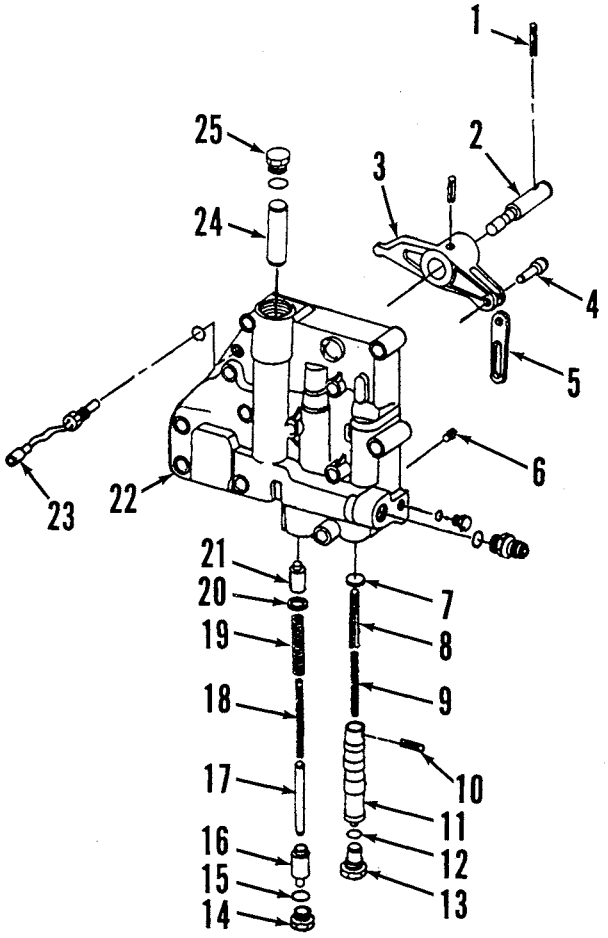


Fig. 156—Exploded view of pto clutch control valve housing assembly. Housing is mounted to outside of traction clutch valve housing.

1. Spring pin
2. Shaft
3. Arm
4. Pin
5. Link
6. Orifice
7. Thrust washer
8. Pin
9. Spring
10. Pin
11. Pto clutch valve
12. "O" ring
13. Plug
14. Plug
15. "O" ring
16. Modulating piston
17. Pin
18. Inner spring
19. Outer spring
20. Washer
21. Modulating piston
22. Valve housing
23. Oil temperature sensor
24. Pto lock piston
25. Plug

Pto Modulating Valve Outer Spring (19)—
Free length ..... 3.39 in. (86 mm)
Test ..... 8-10 lbs. @ 1.46 in. (34.6-12.7 N @ 37 mm)

To disassemble traction clutch valve, remove transmission pump from housing if not already removed. Remove plate from back side of valve housing. Drive spring pin from clutch control arm (3—Fig. 157), then remove arm and deflector (7). Remove pin (11) and pull control arm (9) and shaft (8) from housing. Remove pin (13) and link (10). Remove plug (18) and withdraw valve spool (20) and related parts. Remove adapter (24) and pto brake check valve ball (22) and spring (21). Remove plug (32), pin (30) and spring (29). Use JDG-268 removal tool or other suitable tool to pull filter relief valve (27) from housing. Remove plug (33) and withdraw shims (35), spring (36) and pressure regulating valve (37).

Make certain valve spools slide smoothly in their bores. Refer to Fig. 157 and check valve springs for distortion and against the values that follow:

Clutch Valve Spring (14)—
Free length ..... 0.94 in. (24 mm)
Test ..... 12-14 lbs. (52.0-63.6 N) when compressed solid
Clutch Valve Spring (16)—
Free length ..... 2.08 in. (53 mm)
Test ..... 51-63 lbs. @ 1.81 in. (228.1-278.9 N @ 46 mm)
Filter Relief Valve Spring (29)—
Free length ..... 3.03 in. (77 mm)
Test ..... 38-48 lbs. @ 2.20 in. (173.3-211.7 N @ 56 mm)
Pressure Regulating Valve Spring (36)—
Free length ..... 5.43 in. (138 mm)
Test ..... 55-67 lbs. @ 4.48 in. (243.3-297.3 N @ 114 mm)

When reassembling valve, renew all "O" rings. Assemble in the reverse order of disassembly. Tighten pump mounting cap screws and pto valve housing cap screws to 20 ft.-lbs. (27 N·m). Check clutch pressure as outlined in paragraph 124 to determine proper number of pressure regulating valve shims (35) required.

137. TRANSMISSION OIL PUMP. With traction clutch valve housing removed as outlined in para-

graph 129, remove six cap screws securing pump to valve housing and remove pump. Remove cap screws securing manifold (4—Fig. 158) to pump housing (9). Remove small snap ring (1), then lightly tap end of drive shaft (11) with a punch to separate shaft and pump housing from the manifold. Lift out idler gear (7). Tap drive shaft about 1/4 inch (6 mm) out of pump gear (8), then use a pry bar underneath gear to remove gear from shaft.

NOTE: Do not attempt to drive the shaft out of the gear as damage to needle bearing (10) will result from the shaft key.

Remove Woodruff key and withdraw drive shaft from pump housing.

Inspect shaft bearings (3 and 10) and renew if necessary. Inspect pump gears for wear or other damage. Inside diameter of idler gear bushing (6) when new is 0.7518-0.7528 inch (19.09-19.12 mm). Outside diameter of idler gear shaft (5) when new is 0.7497-0.7503 inch (19.04-19.05 mm). Pump gears and housing must be renewed as an assembly. When installing needle bearing (10), use a suitable size driver and press against numbered side of bearing. Press in until bearing is 0.059-0.098 inch (1.5-2.5 mm) below machined surface of pump housing.

To reassemble, reverse the disassembly procedure while noting the following special instructions. Position idler gear in pump body with side of gear marked "this side out" facing up. Use a 7/16 inch socket (or similar size tube) to press manifold and bearing onto drive shaft. Press only against inner race of bearing and make certain dowel in manifold is aligned with hole in pump body. Tighten manifold retaining cap

1. Washers
2. Seal
3. Arm
4. Bushing
5. Seal ring
6. Valve housing
7. Deflector
8. Shaft
9. Arm
10. Link
11. Pin
12. Seal
13. Pin
14. Spring
15. Pin
16. Spring
17. Thrust washer
18. Plug
19. "O" ring
20. Traction clutch valve
21. Spring
22. Pto brake check ball
23. "O" ring
24. Adapter
25. "O" ring
26. "O" ring
27. Filter relief valve
28. "O" ring
29. Spring
30. Pin
31. "O" ring
32. Plug
33. Plug
34. "O" ring
35. Shims
36. Spring
37. Pressure regulating valve
38. Orifice
39. Transmission oil pressure sensor
40. Transmission oil filter restriction sensor
41. Clutch pressure test fitting
42. Oil filter restriction sensor (Investigator II)

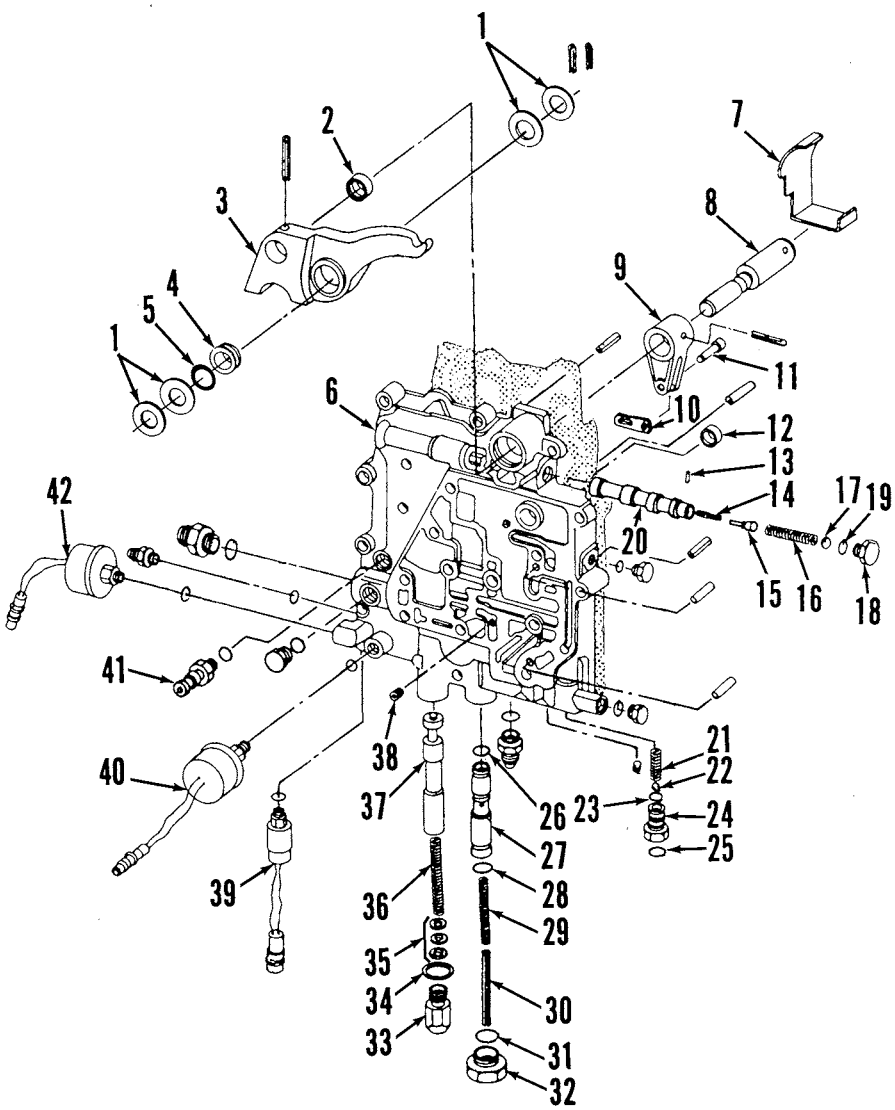


Fig. 157—Exploded view of traction clutch valve housing used on Power Shift models.

screws to 35 ft.-lbs. (47 N·m). Pour clean hydraulic oil into pump inlet port and rotate gears to lubricate pump and make sure gears turn smoothly.

Install pump onto clutch valve housing and tighten mounting cap screws to 20 ft.-lbs. (27 N·m). After 10 minutes, retorque mounting cap screws to 20 ft.-lbs. (27 N·m).

138. TRANSMISSION CONTROL VALVE ASSEMBLY. Refer to paragraph 130 for removal and installation of valve assembly.

To disassemble speed selector assembly, first remove snap ring (27—Fig. 160) from rotary valve bore. Install a M6 x 1 cap screw into threaded hole in plug (26), then pull plug from housing. Remove valve housing cover (1—Fig. 159) mounting cap screws. Move speed selector arm (13) so boss on sector (1—Fig. 161) will clear boss in housing (2) when cover is removed. Lift housing cover from valve housing. Withdraw rotary valve (24—Fig. 160), bushing (23), spring (21) and "O" ring (22) from valve housing. Disassemble engagement override valve sump valve (3 thorough 7—Fig. 159) on late models. Remove plugs and detent springs and balls (2). Remove sector stop plug (8). Drive roll pins from sector (17 or 18), then remove control arm (13), shaft and sector. Drive roll pin from forward-reverse valve (24) and remove valve. Drive roll pins from detent cam (20) and shift arm (21), then remove control arm (15) and shaft. Remove front detent and spring (19), lift out valve arm (21) and cam (20), then remove rear detent and spring (19) if necessary. Remove plug (12), pilot pressure valve (10) and spring.

To disassemble shift valve assembly, remove manifold (2—Fig. 160) mounting cap screws (one screw comes through from outer side of control valve housing) and remove manifold. Remove four cap screws retaining shift valve housing (3), then separate housing from control valve housing (20). Remove retaining washers (13) and withdraw shift valves and springs from housing bores. Note that early model tractors use an inner and outer spring (10 and 12) and a pin (11) only in C3-B4 valve bore. On later models, inner and outer springs and pin are used with C3-B4 shift valve (9D), C1 shift valve (9A) and C2 shift valve (9B). Remove retaining washer (4), spring (5) and input planetary shift valve (6). Remove orificing valve (42), modulating valve (38) and accumulator piston (31). Remove plate (14) and gaskets. Remove engagement override valve spool (16) and check valve (19).

Inspect valves and valve bores for nicks, scoring, wear or other damage. Make certain valves move smoothly in their bores. Check all springs for distortion or other damage. Renew all gaskets and "O" rings.

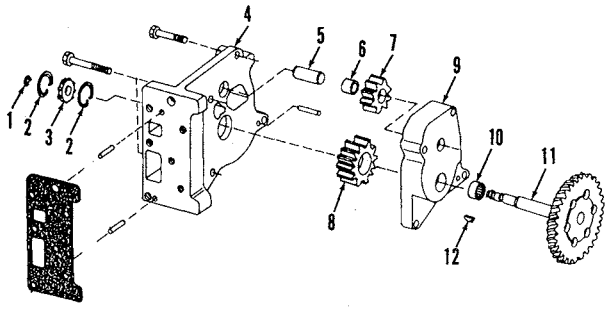


Fig. 158—Exploded view of transmission oil pump used on Power Shift models.

1. Snap ring
2. Snap ring
3. Ball bearing
4. Manifold
5. Idler shaft
6. Bushing
7. Idler gear
8. Drive gear
9. Pump housing
10. Needle bearing
11. Drive shaft
12. Woodruff key

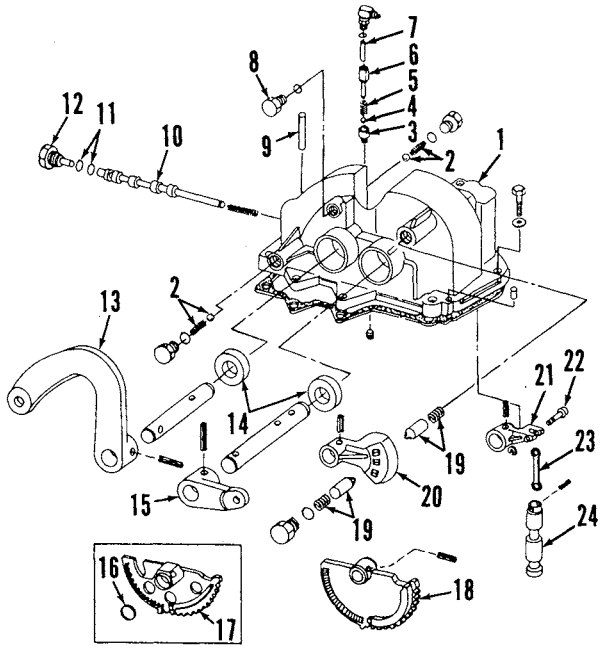


Fig. 159—Exploded view of transmission control valve housing cover and control linkage. Sector (17) and shim (16) are used on early models, and sector (18) is used on late models.

1. Cover
2. Detent balls & springs
3. Valve seat
4. Ball
5. Spring
6. Engagement override valve guide
7. Pin
8. Stop plug
9. Pin
10. Pilot pressure shift valve
11. "O" rings
12. Plug
13. Speed selector arm
14. Seals
15. Direction selector arm
16. Shim
17. Sector gear (early models)
18. Sector gear (late models)
19. Detents & springs
20. Detent cam
21. Forward-reverse arm
22. Pin
23. Link
24. Forward-reverse valve

To reassemble control valve assembly, reverse the disassembly procedure while noting the following special instructions. When installing orificing valve elbow (43—Fig. 160), first back out elbow jam nut as far as possible. Thread elbow into housing until it bottoms, then back elbow out one turn and tighten jam nut. When assembling shift valve housing (3) and manifold (2) onto control valve housing (20), use new mounting cap screws. Coat threads of cap screws with antiseize lubricant, then tighten evenly to 9 ft.-lbs. (12 N·m). After 10 minutes, retorque cap screws.

To reassemble speed selector assembly, reverse the disassembly procedure while observing the following special instructions. Make sure head of retaining pin (22—Fig. 159) is on offset side of forward-reverse arm (21). Coat lips of seals (14) with oil before installing control arm shafts. Position speed selector arm so boss on sector (1—Fig. 161) clears boss in housing

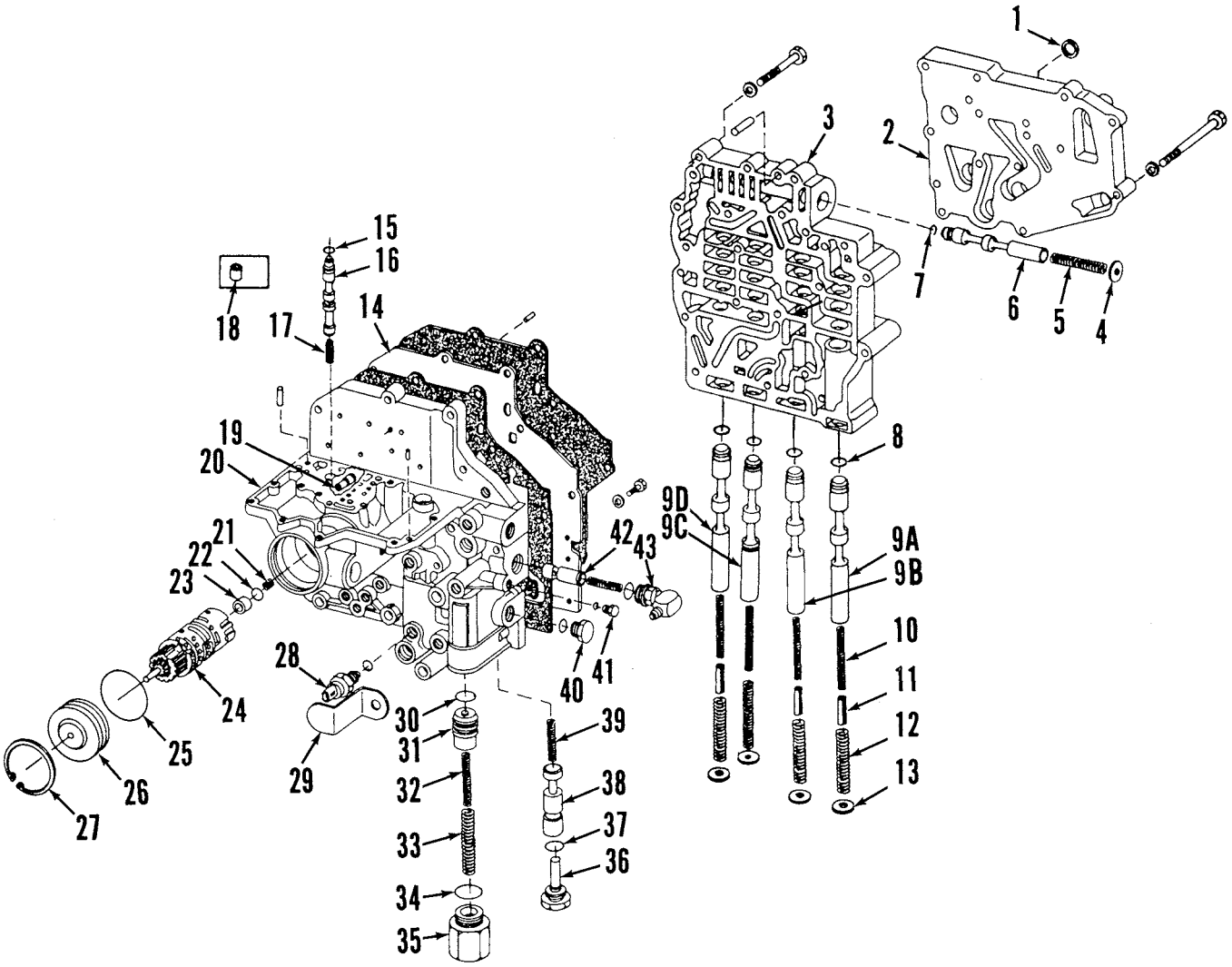


Fig. 160—Exploded view of transmission control valve and shift valve assemblies used on Power Shift models. On early models, a sleeve (18) is used in place of spring (17) on engagement override valve (16), and inner (10) and outer (12) springs and pin (11) are used only in C3-B4 shift valve (9D) bore.

1. Seal ring (5 used)
2. Manifold
3. Shift valve housing
4. Retaining washer
5. Spring
6. CLo-BHi shift valve
7. "O" ring
8. "O" ring
9A. C1 shift valve
9B. C2 shift valve
9C. B1-B2 shift valve
9D. C3-B4 shift valve
10. Inner spring
11. Pin
12. Outer spring
13. Retaining washer
14. Plate
15. "O" ring
16. Engagement override valve
17. Spring (late models)
18. Sleeve (early models)
19. Sump check valve
20. Valve housing
21. Spring
22. "O" ring
23. Bushing
24. Rotary valve
25. "O" ring
26. Plug
27. Snap ring
28. Neutral start switch
29. Shield
30. "O" ring
31. Accumulator piston
32. Spring
33. Spring
34. "O" ring
35. Plug
36. Plug
37. "O" ring
38. Modulating valve
39. Spring
40. Plug
41. Plug
42. Orificing valve
43. Elbow fitting

(2) and large tooth on sector (3) engages large slot in rotary valve (4) when installing cover onto control valve housing. Use new cover mounting cap screws and coat threads of cap screws with antiseize lubricant. Tighten cap screws to 9 ft.-lbs. (12 N·m), wait ten minutes, then retorque screws to 9 ft.-lbs. (12 N·m).

139. MODULATING VALVE. With modulating valve removed as outlined in paragraph 130, remove plugs (1—Fig. 162) and separate metering valves (4 and 5), accumulator pistons (6) and springs from valve body.

Inspect all parts for wear or other damage and renew if necessary. Free length of springs (3) is 2.08 inches (53 mm) and working load is 7-8 pounds at 1.18 inches (30-37 N at 30 mm). Free length of springs (8) is 2.08 inches and working load is 9-11 pounds at 1.30 inches (41-51 N at 33 mm). Free length of springs (7) is 2.87 inches (73 mm) and working load is 6-7 pounds at 1.34 inches (27-33 N at 34 mm).

To reassemble valve, reverse the removal procedure.

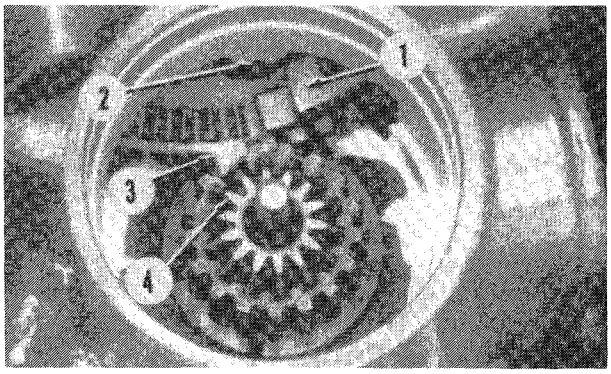


Fig. 161—Position speed selector arm so boss on sector (1) clears boss in housing (2) when removing and installing control valve housing cover. Large tooth on sector (3) must engage large slot in rotary valve (4).

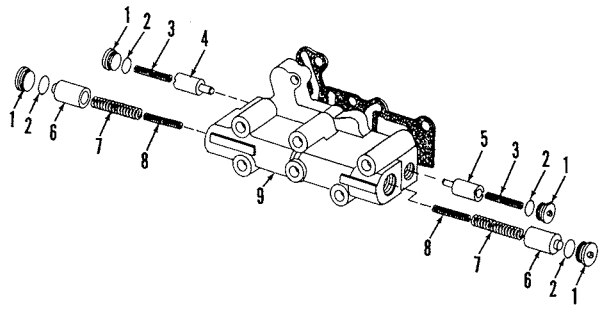


Fig. 162—The modulating valve assembly modulates engagement of C3 clutch pack and B4 brake pack to provide smooth speed increase when shifting into transport speeds (12F-15F).

1. Plugs
2. "O" rings
3. Springs
4. C3 metering valve
5. B4 metering valve
6. Accumulator pistons
7. Springs
8. Springs
9. Valve housing

140. ACCUMULATORS. The system accumulator (7—Fig. 149) and the C3 accumulator (8) provide smooth shifting when properly charged. Refer to paragraph 128 to check operation of accumulators. When recharging accumulators, use dry nitrogen only. DO NOT use oxygen or compressed air. A D-15041NU nitrogen charging kit and a low pressure regulator are required to properly charge the accumulators.

To recharge system accumulator, first remove accumulator from the tractor.

NOTE: If there is gas leakage from the accumulator oil port, renew the accumulator.

Remove slotted plug from accumulator gas port and install 2364 adapter in its place. Attach charging hose to adapter. Adjust pressure regulator screw to obtain specified charge pressure of 60-70 psi (410-480 kPa). Disconnect charging equipment and reinstall plug.

To recharge C3 accumulator, first remove accumulator. Remove plastic cover and Schrader valve cap from gas port end of accumulator.

NOTE: It is normal for a small amount of oil to leak past the piston seal and enter the gas chamber during operation. However, this oil must be removed as follows:

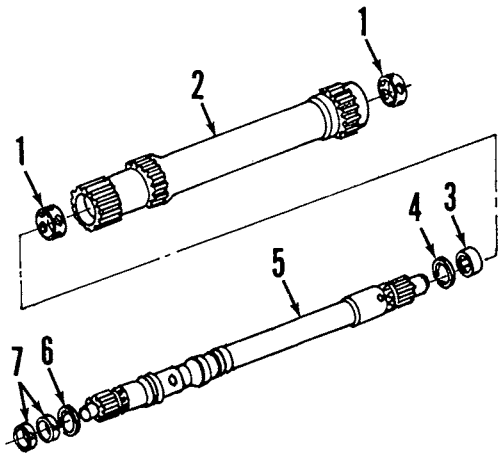


Fig. 163—Exploded view of Power Shift transmission low and high range drive shafts. The pilot needle bearing (3) for low range shaft is located in the traction clutch front drum.

1. Bushings
2. High range shaft
3. Needle bearing
4. Snap ring
5. Low range shaft
6. Snap ring
7. Seal rings

Hold accumulator with gas port end downward. Depress Schrader check valve to discharge gas and oil that may be in the chamber. If accumulator is totally discharged, connect charging hose and partially charge accumulator, then purge oil as described above.

NOTE: If there is gas leakage from the oil port, renew accumulator.

With charging hose attached to Schrader valve, adjust regulator screw to obtain specified charge pressure of 70-80 psi (480-550 kPa). Disconnect charging equipment and reinstall accumulator.

141. LOW AND HIGH RANGE DRIVE SHAFTS. Separate tractor as outlined in paragraph 131. Withdraw drive shafts from clutch housing. Remove snap ring (4—Fig. 163) and separate drive shafts.

Inspect shafts for wear or other damage. Outer diameter of low range shaft (5) when new is 1.322-1.323 inches (33.5-33.6 mm) at front bushing mating area and 1.318-1.319 inches (33.4-33.5 mm) at rear bushing mating area. Inside diameter of front and rear bushings (1) is 1.326-1.329 inches (33.69-33.77 mm).

NOTE: The thin wall (small OD) section of high range shaft (2) provides a torsional spring action to soften the shock of initial engagement at standstill and when speed changes are made while in motion. Any nicks, scratches or other damage to shaft in this area can result in premature shaft breakage.

When renewing bushings, do not clamp thin wall section of shaft in a vise. Install rear bushing flush to 0.020 inch (0.5 mm) below end surface of shaft while aligning hole in bushing with internal groove in shaft. Install front bushing 1.18 inches (30 mm) below end of shaft. Inspect shaft seal rings (7) and renew if necessary.

142. TRACTION CLUTCH AND CLUTCH OIL MANIFOLD. To disassemble traction clutch assembly, first lift pto drive shaft (23—Fig. 164) and clutch

1. Pilot bearing
2. Front clutch drum
3. Dowel pin
4. Seal ring
5. Piston
6. Seal ring
7. Belleville washers
8. Retaining ring
9. Low range hub
10. Clutch return plates
11. C1 clutch discs
11A. C2 clutch discs
12. C1 drive plates
12A. C2 drive plates
13. Separator plate
14. Spring pin
15. Snap ring
16. High range hub
17. Return spring
18. Piston
19. Seal ring
20. Dowel pin
21. Rear clutch drum
22. Snap ring
23. Pto drive shaft
24. Snap ring
25. Seal rings
26. Clutch oil manifold

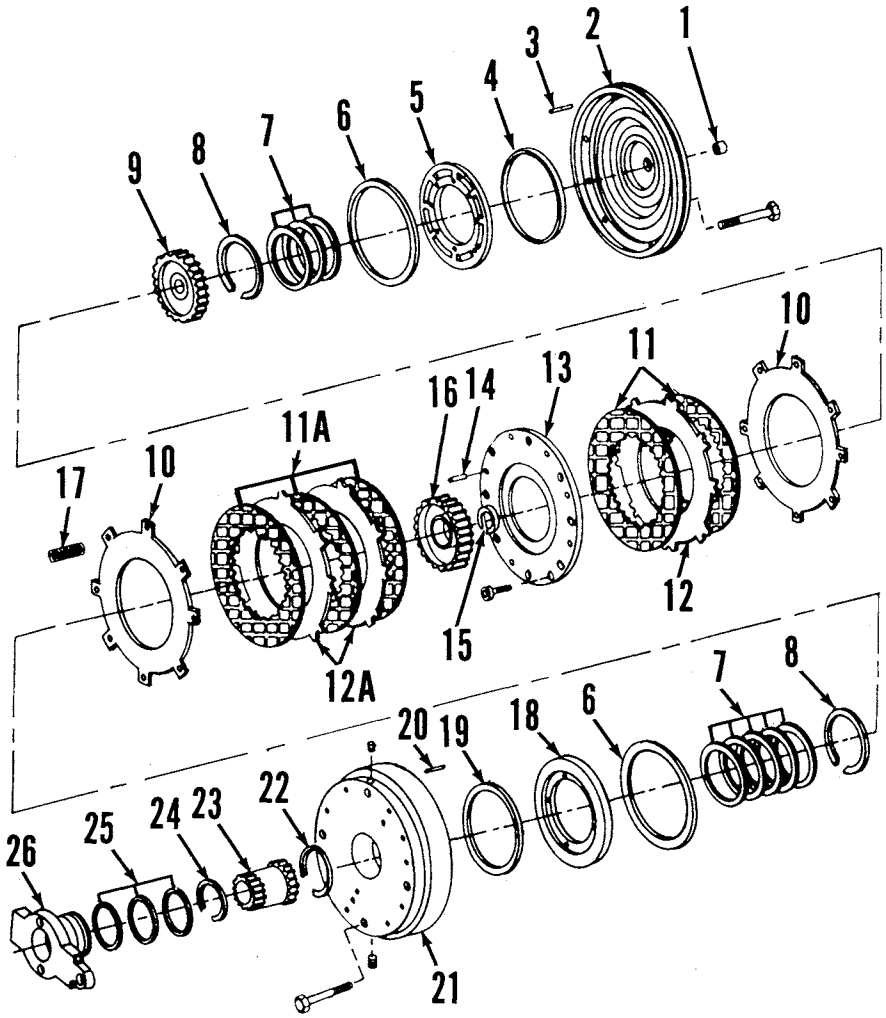


Fig. 164—Exploded view of C1 and C2 traction clutch assemblies used on Power Shift models.

oil manifold (26) from clutch pack. Remove snap ring (22) and separate shaft and manifold. Inspect seal rings (25) and "O" rings in manifold and renew if necessary.

Remove cap screws securing front clutch drum (2) to rear clutch drum (21), then separate drums. Remove return springs (17), high range clutch hub (16), clutch discs (11A), drive plates (12A) and return plate (10) from rear drum. To remove high range piston (18), use a suitable horseshoe shaped tool as shown in Fig. 165 to compress Belleville washers so retaining ring can be removed. Install two 3/8-16 UNC cap screws into threaded holes in piston, then pull piston from drum. Remove and discard seal rings (6 and 19—Fig.164).

Remove cap screws securing separator plate (13) to front clutch drum. Remove separator plate, low range clutch hub (9), clutch discs (11), drive plates (12) and return plate (10). Use a suitable tool as shown in Fig. 165 and remove low range piston (5—Fig. 164) in same manner as described for high range piston. Remove and discard piston seal rings (4 and 6).

Inspect clutch discs and plates for wear or other damage. Thickness of clutch discs when new is 0.137-0.143 inch (3.48-3.64 mm). If facing material chips, flakes or scratches off easily, discs should be renewed regardless of thickness. The thickness of drive plates and return plates when new is 0.270-0.281 inch (6.86-7.13 mm). Check plates for distortion using a straightedge and feeler gage. Renew plates if warped more than 0.018 inch (0.46 mm). Discoloration of plates does not affect performance and does not require renewal of plates. Inspect thrust washers in high range (16) and low range (9) hubs and renew hubs if excessively worn. Inspect clutch shaft pilot bearing (1) for wear. When renewing pilot bearing, press against numbered side of bearing and press bearing 0.157 inch (4 mm) below outer surface of front drum.

When reassembling, coat all parts with clean hydraulic oil. When installing clutch pistons, be sure antirotation pins (3 and 20) are aligned with hole in pistons. Assemble Belleville washers alternately, beginning with outer diameter of first washer bent toward clutch piston and ending with inner diameter of last washer contacting snap ring as shown in Fig. 166. On Models 4050, 4250 and 4450, three Belleville washers are used on low range piston, while five washers are used on high range piston. On Models 4650 and 4850, five Belleville washers are used on each clutch piston. Assemble clutch discs and drive plates alternately, beginning with a disc and ending with a disc. On Models 4050, 4250 and 4450, two discs (11—Fig. 164) and one plate (12) are used on low range clutch, while three discs (11A) and two plates (12A) are used on high range clutch. On Models 4650 and 4850, three discs and two plates are used on low range clutch pack, while four discs and three plates are used on high range clutch pack. Tighten separator plate (13) mounting screws to 22 ft.-lbs. (30 N·m). When assembling low range drum onto high range drum, be sure spring pins (14) in separator plate engage holes in high range drum. Tighten drum retaining cap screws to 37 ft.-lbs. (50 N·m). Assemble pto drive shaft and clutch oil manifold to clutch drum.

143. INPUT PLANETARY AND HI-LO BRAKE AND CLUTCH ASSEMBLY. Refer to paragraph 133 for removal procedure. Lift planetary carrier (39—Fig. 167) from brake piston housing if not done during removal. Remove Allen head cap screws and retaining pins (35) from each planet pinion shaft. Push pinion shafts (36) from pinion gears (32), then withdraw gears and thrust washers (31).

Inspect all parts for wear or other damage. Pinion shaft (36) diameter should be 0.8342-0.8346 inch (21.198-21.199 mm). Thrust washer (31) thickness should be 0.035-0.037 inch (0.88-0.93 mm). Inspect

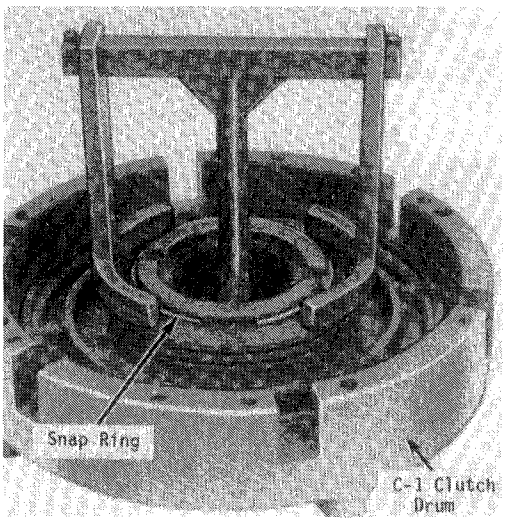


Fig. 165—Use a suitable horseshoe shaped tool to compress Belleville washers when removing and installing retaining ring.

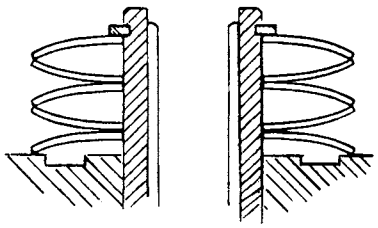


Fig. 166—Cross-sectional schematic showing correct method of installing five Belleville washers in clutch drum. Regardless of number of washers used (3 or 5), the inner diameter of the outer washer must always contact snap ring as shown.

bore of planetary ring gear shaft (41) for wear in area where low range drive shaft seal rings contact shaft bore. Outside diameter of planetary gear shaft should be 2.494-2.496 inches (63.3-63.4 mm). Inspect thrust surfaces of planetary gear and planetary carrier for scoring or wear and renew as necessary.

The lube relief valve (44) is located in the lube manifold (45). Free length of valve spring (43) should be 2 inches (52 mm) and working load should be 16-20 pounds at 1.37 inches (71-89 N at 35 mm). Inside diameter of lube manifold bushings (42) should be 2.498-2.501 inches (63.46-63.53 mm). When installing new bushings, make sure grooves in bushings point toward center of the manifold. Press front bushing in 0.137-0.157 inch (3.5-4.0 mm) below thrust washer surface. Press rear bushing in 0.059-0.078 inch (1.5-2.0 mm) below thrust washer surface.

The Hi-Lo shift valve is located on the brake piston housing. To dissassemble, remove plug and withdraw detent spring and ball (1—Fig. 168). Remove plug (2), then use a pencil magnet to withdraw valve spool (3). Inspect for wear or other damage.

To disassemble clutch and brake assembly, remove cap screws securing backing plate (29—Fig. 167) to brake piston housing (7), then separate backing plate from piston housing. Remove thrust washer (27). Remove clutch backing plate (26) mounting cap screws and pry backing plate from clutch drum (16). Remove brake disc (13) and separator plate (12). Remove clutch hub (25), clutch disc (24) and separator plate (23). (Two clutch discs and plates are used on 4650 and 4850 models.) Thread two cap screws into clutch drum (16), then lift drum from brake piston housing (7). Pull the brake piston (10) from the housing. Use a suitable horseshoe shaped tool (T—Fig. 169) to compress Belleville washers (21), then remove snap ring (22) and release spring pressure. Remove clutch piston (19) from clutch drum (16).

1. Bearing support
2. Shim
3. Bearing cup
4. Bearing cone
5. Pto drive gear
6. Bearing cone
7. Brake piston housing
8. Seal ring
9. Bushing
10. BHi brake piston
11. Seal ring
12. Drive plate
13. Friction disc
14. Seal rings
15. Thrust washer
16. Clutch drum
17. Dowel pin
18. Seal
19. CLo clutch piston
20. Seal ring
21. Belleville washers
22. Retaining ring
23. Drive plate
24. Friction disc
25. Hub
26. Backing plate (clutch)
27. Thrust washer
28. Bushing
29. Backing plate (brake)
30. Return spring
31. Thrust washers
32. Pinion
33. Needle bearings
34. Spacer
35. Retaining pin
36. Pinion shaft
37. Ball
38. Thrust washer
39. Planetary carrier
40. Retaining ring
41. Output shaft ring gear
42. Bushings
43. Spring
44. Lube relief valve
45. Lube manifold

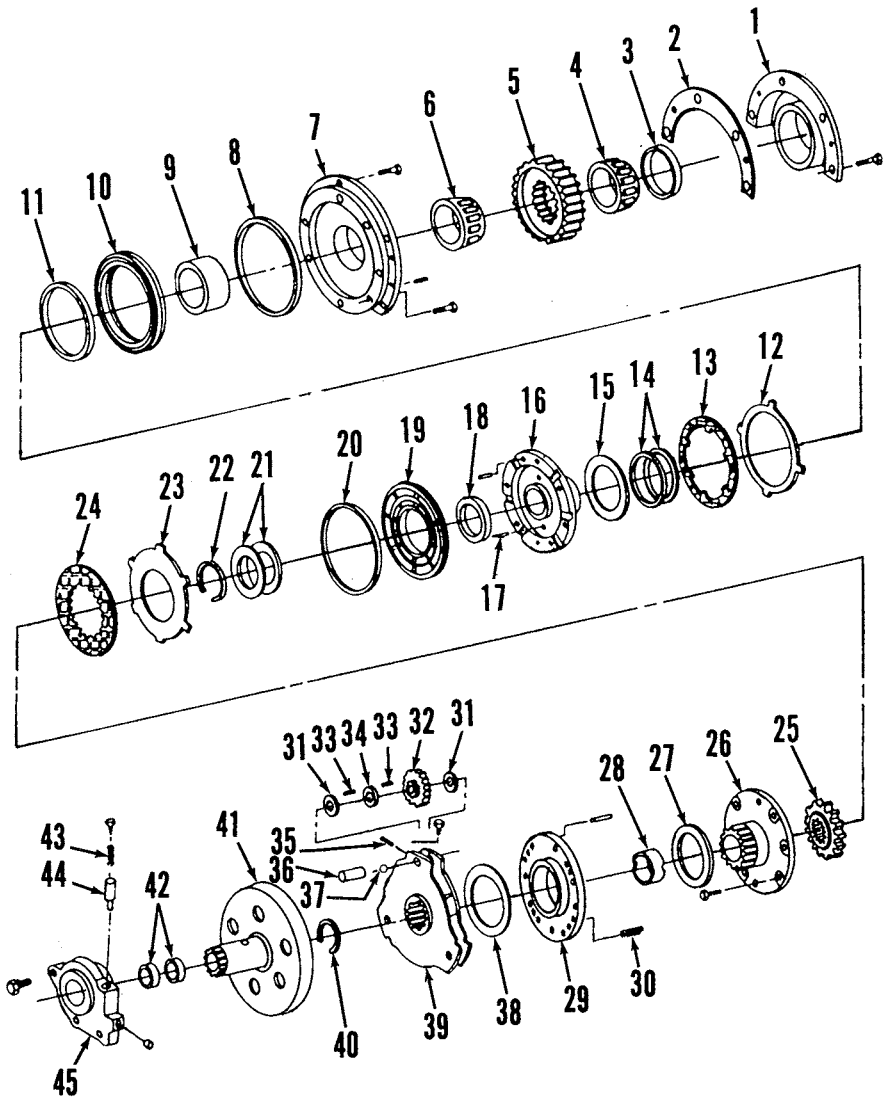


Fig. 167—Exploded view of input planetary, BHi brake and CLo clutch used on Power Shift models.

Inspect brake and clutch piston seal rings and renew if necessary. Inspect all parts for excessive wear or other damage. Inside diameter of brake piston housing bushing (9–Fig. 167) should be 3.437-3.440 inches (87.3-87.4 mm) and outside diameter of clutch drum sleeve should be 3.433-3.435 inches (87.21-87.25 mm). Inside diameter of backing plate bushing (28) should be 3.755-3.757 inches (95.3-95.4 mm). Thickness of brake separator plate (12) when new is 0.114-0.122 inch (2.9-3.1 mm) and thickness of brake disc (13) when new is 0.114-0.118 inch (2.9-3.0 mm). Thickness of clutch separator plate (23) when new is 0.118-0.122 inch (3.0-3.1 mm) and thickness of clutch disc (24) is 0.111-0.118 inch (2.8-3.0 mm).

Coat all parts with clean hydraulic oil during assembly. When installing clutch piston (19—Fig. 167), be sure holes in piston are aligned with pins (17) in clutch drum. Be careful not to damage piston packing. On Models 4050, 4250 and 4450, install first Belleville washer (21) so inside diameter of washer contacts piston. Install second Belleville washer so inside diameter of washer will contact retaining ring. On Models 4650 and 4850, three Belleville washers are used. Install first washer so outside diameter of washer contacts piston. Install remaining two washers alternately so inside diameter of third washer will contact retaining ring. Use a suitable horseshoe shaped tool to compress Belleville washers so retaining ring (22) can be installed. When renewing brake piston housing bushing (9—Fig. 167), press bushing 0.120 inch (3 mm) below outer surface of housing hub. Be sure to install separator plates against brake piston (10) and clutch piston (19), then install friction discs. Tighten backing plate (26) mounting cap screws to 20 ft.-lbs. (27 N·m). When renewing bushing (28) in backing plate (29), press new bushing in until it extends 0.050 inch (1.3 mm) above the inner surface of backing plate. Tighten backing plate (29) mounting cap screws to 20 ft.-lbs. (27 N·m). When renewing bearing cone (6), heat new bearing to 300° F (150° C) maximum prior to installation.

When reinstalling shift valve, recessed end of valve spool (3—Fig. 168) should enter valve bore first. Tighten valve retaining plug to 30 ft.-lbs. (40 N·m).

Assemble planet pinion gears (32—Fig. 167) with needle bearings into carrier. Be sure a thrust washer (31) is installed on each side of the pinions. Install pinion shafts (36) and retaining pins (35). Apply Loctite 222 to Allen head screws and tighten to 4 ft.-lbs. (6 N·m).

Reinstall and time planetary assembly as outlined in paragraph 133.

144. OUTPUT PLANETARY. Refer to paragraph 135 for removal and installation of the planetary pack. To overhaul, position unit on a bench with B4 planetary brake piston housing (59—Fig. 172) up, then proceed as follows:

145. BRAKE PACK. To disassemble, remove screws securing B4 brake piston housing (59—Fig. 172), then lift housing from planetary.

NOTE: There may be "E" rings (2—Fig. 172), used as shims, between B1, B2 and B4 brake piston housings and piston return plates. Note location of shims when disassembling.

Remove B4 planetary brake piston return plate (54), separator plates (52) and discs (51). Lift out clutch pack assembly (37 through 50). Remove third planetary brake housing (35), piston return springs, brake piston (32), return plate (31), separator plates

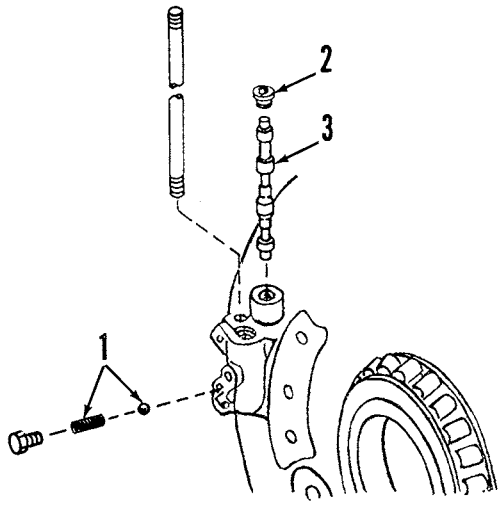


Fig. 168—The Hi-Lo shift valve is located on the front of brake piston housing. Remove plug to withdraw detent ball and spring (1). Remove plug (2) to withdraw valve spool (3).

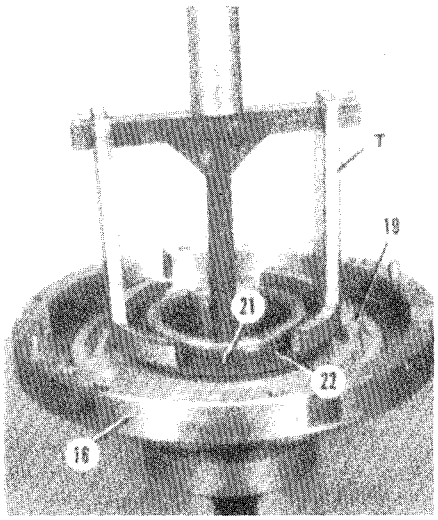


Fig. 169—Use suitable horseshoe shaped tool (T) to compress Belleville washers (21) in order to remove and install snap ring (22).

(28) and discs (29). Remove B3 planetary brake ring gear (27) and 4th sun pinion gear. On 4050 and 4250 models, remove B2 planetary brake piston housing (25), then lift out planetary carrier assembly (26). On 4450, 4650 and 4850 models, position planetary carrier so planet pinion gears are aligned with notched areas of brake piston housing, then lift out carrier assembly and remove B2 planetary brake piston housing (25). On all models, remove brake piston return plate (19), return springs, separator plates (16) and discs (15), B2 planetary brake ring gear (14) and backing plate (13). Remove brake piston return

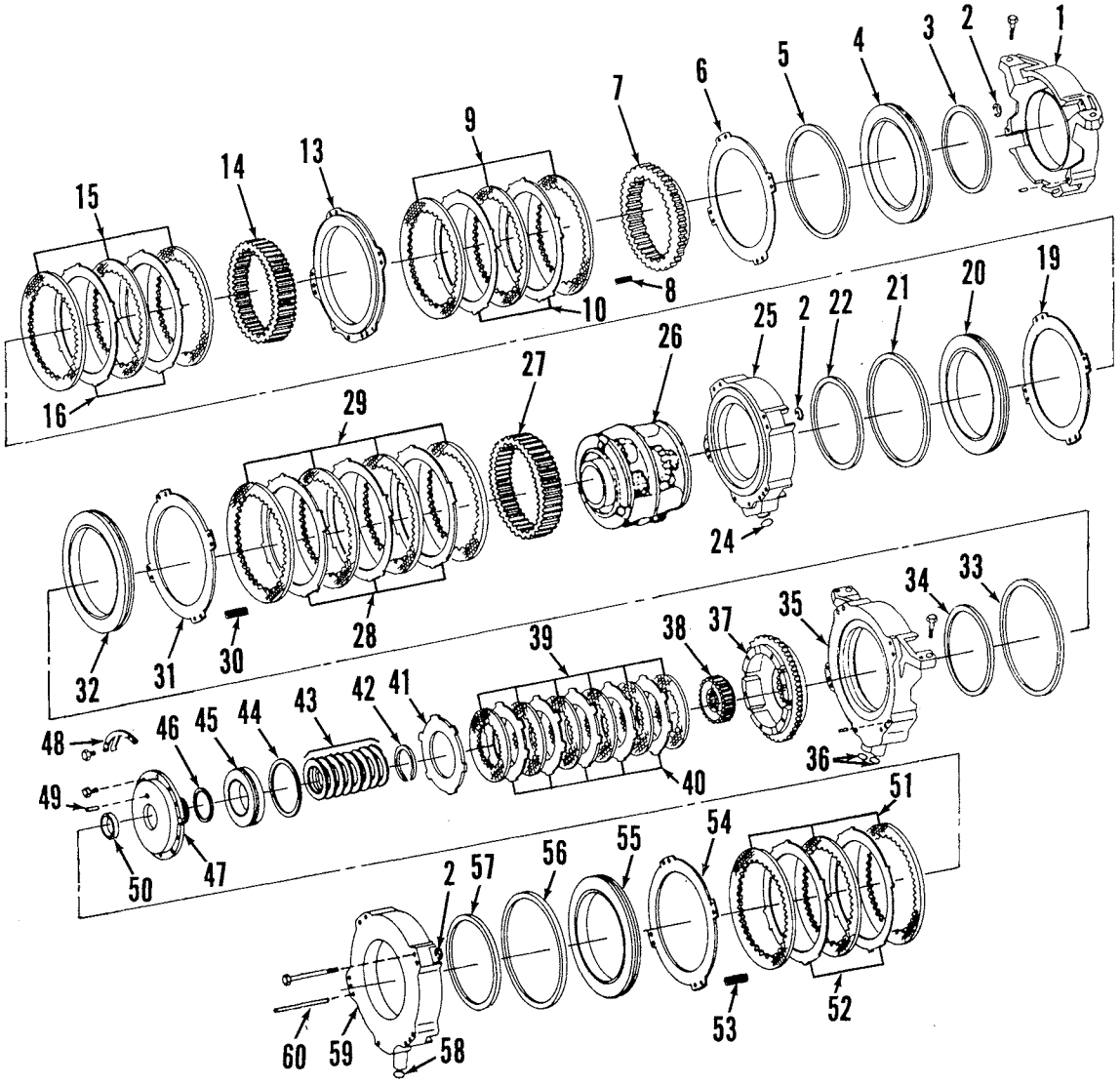


Fig. 172—Exploded view of output planetary assembly typical of all Power Shift models. Retainer plate (48) is used on Models 4050, 4250 and 4450 only. Antirotation dowel pin (49) is used on Models 4650 and 4850 only. Dowel pins (60) are not used on Model 4450.

1. Brake housing (B1)
2. "E" ring
3. Seal
4. Piston
5. Seal
6. Return plate
7. Ring gear
8. Return spring
9. Friction discs
10. Drive plates
13. Backing plate
14. Ring gear
15. Friction discs
16. Drive plates
19. Return plate
20. Piston
21. Seal
22. Seal
24. "O" ring
25. Brake housing (B2)
26. Planetary carrier assy.
27. Ring gear
28. Drive plates
29. Friction discs
30. Return spring
31. Return plate
32. Piston
33. Seal
34. Seal
35. Brake housing (B3)
36. "O" rings
37. Clutch drum (C3)
38. Clutch hub
39. Friction discs
40. Drive plates
41. Return plate
42. Retaining ring
43. Belleville washers
44. Seal
45. Piston
46. Seal
47. Clutch housing
48. Retainer (4050, 4250 & 4450)
49. Dowel pin (4650 & 4850)
50. Bushing
51. Friction discs
52. Drive plates
53. Return spring
54. Return plate
55. Piston
56. Seal
57. Seal
58. "O" ring
59. Brake housing (B4)
60. Dowel pin

springs, separator plates (10) and discs (9), B1 planetary brake piston ring gear (7), return plate (6) and brake piston (4).

Inspect all parts for wear or other damage. Check parts against the following values and renew if necessary.

4050-4250

B1 and B2 Brakes
- Piston return plate—
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
- Return springs—
  - Free length ..... 0.86 in. (22 mm)
  - Test ..... 27-32 lbs. @ 0.60 in. (119-145 @ 15.8 mm)
- Friction discs—
  - Number used 2
  - Thickness ..... 0.116-0.123 in. (2.95-3.13 mm)
  - Groove depth, min. ..... 0.005 in. (0.1 mm)
- Drive plates—
  - Number used 1
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

B3 Brake
- Piston return plate—
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
- Return springs—
  - Free length ..... 1.54 in. (39 mm)
  - Test ..... 23-29 lbs. @ 1.12 in. (104-127 N @ 28 mm)
- Friction discs—
  - Number used 3
  - Thickness ..... 0.116-0.123 in. (2.95-3.13 mm)
  - Groove depth, min. ..... 0.005 in. (0.1 mm)
- Drive plates—
  - Number used 2
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

C3 Clutch
- Piston return plate—
  - Thickness ..... 0.197-0.203 in. (5.00-5.15 mm)
- Friction discs—
  - Number used 5
  - Thickness ..... 0.112-0.118 in. (2.84-2.99 mm)
- Drive plates—
  - Number used 4
  - Thickness ..... 0.085-0.095 in. (2.16-2.41 mm)

B4 Brake
- Piston return plate—
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
- Return springs—
  - Free length ..... 0.86 in. (22 mm)
  - Test ..... 27-32 lbs. @ 0.60 in. (119-145 N @ 15.8 mm)
- Friction discs—
  - Number used 2
  - Thickness ..... 0.116-0.123 in. (2.95-3.13 mm)
  - Groove depth, min. ..... 0.005 in.
- Drive plates—
  - Number used 1
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

4450

B1 and B2 Brakes
- Piston return plate—
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
- Retrun springs—
  - Free length ..... 2.43 in. (62 mm)
  - Test ..... 51-62 lbs. @ 2.0 in. (225-275 N @ 51 mm)
- Friction discs—
  - Number used 3
  - Thickness ..... 0.126-0.134 in. (3.20-3.40 mm)
  - Groove depth, min. ..... 0.005 in. (0.1 mm)
- Drive plates—
  - Number used 2
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

B3 Brake
- Piston return plate—
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
- Return springs—
  - Free length ..... 1.76 in. (44 mm)
  - Test load ..... 23-28 lbs. @ 1.38 in. (104-127 N @ 35 mm)
- Friction discs—
  - Number used 5
  - Thickness ..... 0.126-0.134 in. (3.20-3.40 mm)
  - Groove depth, min. ..... 0.005 in. (0.1 mm)
- Drive plates—
  - Number used 4
  - Thickness ..... 0.118-0.122 in. (2.99-3.1 in.)

C3 Clutch
Piston return plate—
Thickness ..... 0.302-0.312 in. (7.67-7.92 mm)
Friction discs—
Number used 6
Thickness ..... 0.126-0.133 in. (3.20-3.37 mm)
Drive plates—
Number used 5
Thickness ..... 0.077-0.081 in. (1.95-2.06 mm)

B4 Brake
Piston return plate—
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
Return springs—
Free length ..... 0.98 in. (25 mm)
Test ..... 68-81 lbs. @ 0.82 in. (2.95-360 N @ 20 mm)
Friction discs—
Number used 3
Thickness ..... 0.126-0.134 in. (3.20-3.40 mm)
Groove depth, min. ..... 0.005 in. (0.1 mm)
Drive plates—
Number used 2
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

4650 and 4850

B1 Brake
Piston return plate—
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
Return springs—
Free length ..... 1.22 in. (31 mm)
Test ..... 22-27 lbs. @ 1 in. (100-122 N @ 25.4 mm)
Friction discs—
Number used 4
Thickness ..... 0.126-0.134 in. (3.20-3.40 mm)
Groove, depth, min. ..... 0.005 in. (0.1 mm)
Drive plates—
Number used 3
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

B2 Brake
Piston return plate—
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
Return springs—
Free length ..... 0.86 in. (22 mm)
Test ..... 27-32 lbs. @ 0.60 in. (119-145 N @ 15.8 mm)
Friction discs—
Number used 3
Thickness ..... 0.126-0.134 in. (3.20-3.40 mm)
Groove depth, min. ..... 0.005 in. (0.1 mm)
Drive plates—
Number used 2
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

B3 Brake
Piston return plate—
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
Return springs—
Free length ..... 1.76 in. (44 mm)
Test ..... 23-28 lbs. @ 1.38 in. (104-127 N @ 35 mm)
Friction discs—
Number used 4
Thickness ..... 0.126-0.134 in. (3.20-3.40 mm)
Groove depth, min. ..... 0.005 in. (0.1 mm)
Drive plates—
Number used 3
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

C3 Clutch
Piston return plate—
Thickness ..... 0.302-0.312 in. (7.67-7.92 mm)
Friction discs—
Number used 6
Thickness ..... 0.126-0.133 in. (3.20-3.37 mm)
Drive plates—
Number used 5
Thickness ..... 0.077-0.081 in. (1.95-2.06 mm)

B4 Brake
Piston return plate—
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)
Return springs—
Free length ..... 0.98 in. (25 mm)
Test ..... 66-81 lbs. @ 0.82 in. (295-360 N @ 20 mm)

Friction discs—
Number used 3
Thickness ..... 0.126-0.134 in. (3.20-3.40 mm)
Groove depth, min. ..... 0.005 in. (0.1 mm)
Drive plates—
Number used 2
Thickness ..... 0.118-0.122 in. (2.99-3.1 mm)

NOTE: If brake or clutch disc facing material chips, flakes or scratches easily, the discs should be renewed regardless of facing thickness.

During reassembly of brake packs, coat all parts with clean hydraulic oil. Install four dowel pins (B—Fig. 173) into nonthreaded holes in B1 brake housing (1) and install four fabricated dowels (A) into the threaded holes in the housing. Note that eight dowels must be fabricated for 4450 models as unit is not equipped with any dowel pins. Install B1 planet brake piston into brake housing. Install brake piston return plate (6) and piston return springs (8) over dowels. Install B1 planet ring gear (7) with notched side facing down. Alternate installation of brake discs and plates, beginning and ending with a disc. Be sure to align oil holes in brake backing plate (13—Fig. 172) and B1 brake housing (1) when assembling. Install B2 planet ring gear (14) and planetary assembly (26).

Continue reassembly of brake packs, brake piston housings and clutch pack assembly in reverse order of disassembly. Remove the fabricated dowels from the threaded holes in B1 housing after installing B4 brake housing (59). Install brake housing throughbolts and tighten to 35 ft.-lbs. (47 N·m) on Models 4050 and 4250, 30 ft.-lbs. (40 N·m) on Model 4450 or 40 ft.-lbs. (55 N·m) on Models 4650 and 4850. Refer to paragraph 146 to check and adjust brake piston return plate clearance.

146. PISTON RETURN PLATE CLEARANCE. After reassembling brake packs as outlined in previous paragraph, piston return plate clearance should be checked. If clearance exceeds specifications, "E" ring shims (2—Fig. 172) should be installed on the return spring dowels between brake piston housings and piston return plates.

NOTE: No adjustment is required on the 3rd planetary brake.

Apply 20-35 psi (140-240 kPa) air pressure to B1 pressure port (1—Fig. 174), then use a feeler gage to measure clearance between piston return plate and B1 brake piston housing (2). Measure clearance at each of the four return plate tang locations. If clearance at any of the four tang locations exceeds 0.061 inch (1.55 mm) on Models 4050 and 4250 or 0.090 inch (2.29 mm) on Models 4650 and 4850, insert an "E" ring shim on each of the four piston return spring dowel pins using JDG-390 tool or other suitable tool. If clearance exceeds 0.089 inch (2.26 mm) on Model 4450, install an "E" ring shim on each of the four equally spaced Allen head screws around the brake housing using JDG-389 tool or other suitable tool. On all models, repeat checking procedure for B2 pack (3) and B4 pack (4).

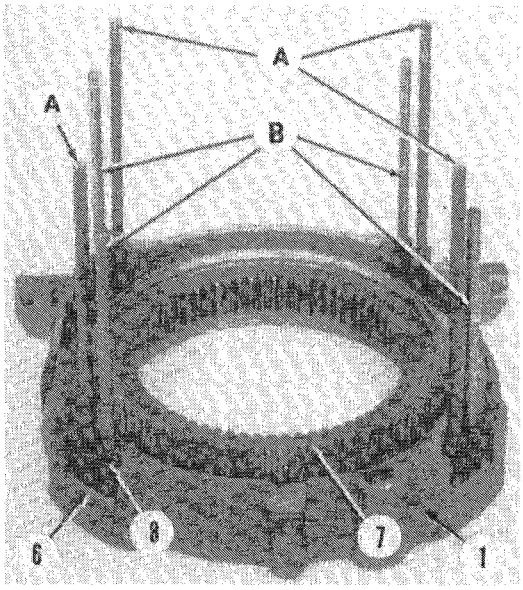


Fig. 173—Install dowels (A and B) into holes in B1 brake housing as shown when reassembling brake packs. It will be necessary to fabricate four dowels for use on Models 4050, 4250, 4650 and 4850. Eight fabricated dowels are required for Model 4450.

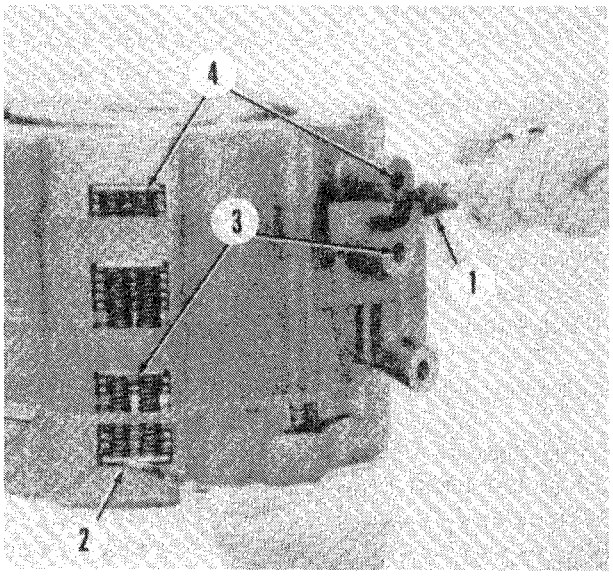


Fig. 174—To check piston return plate clearance, apply air pressure at port (1) and measure clearance with a feeler gage (2). Repeat procedure for B2 pack (3) and B4 pack (4). Adjust with "E" rings as outlined in text.

147. CLUTCH PACK. To disassemble, remove piston housing retaining cap screws, then separate piston housing (47—Fig. 172) from clutch drum (37). Remove clutch return plate (41), drive plates (40) and discs (39) and clutch hub (38). Use a press and a suitable horseshoe shaped tool to compress Belleville washers (43) so the retaining ring can be removed. Release spring pressure, then remove Belleville washers and clutch piston (45) from housing (47).

Inspect piston seal rings and renew if necessary. Inspect housing bushing (50—Fig. 172) for wear or damage. Inside diameter of bushing when new is 2.128-2.130 inches (54.05-54.10 mm). Inspect thrust washers on clutch drum (37) and clutch hub (38) for wear. If worn, clutch drum or hub must be renewed as a unit. Be sure clutch dump valve balls and springs in piston housing are free. Inspect clutch plates and discs for wear. Renew clutch discs if facing material chips, flakes or scratches easily regardless of thickness of facing material. Thickness of clutch discs when new is 0.112-0.118 inch (2.84-3.00 mm) for 4050 and 4250 models or 0.126-0.133 inch (3.20-3.37 mm) for all other models. Thickness of drive plates when new is 0.085-0.095 inch (2.16-2.41 mm) for 4050 and 4250 models or 0.077-0.081 inch (1.95-2.06 mm) for all other models. Piston return plate thickness should be 0.197-0.203 inch (5.00-5.15 mm) for 4050 and 4250 models or 0.302-0.312 inch (7.67-7.92 mm) for 4450, 4650 and 4850 models.

To reassemble clutch pack, lubricate piston seal rings with clean hydraulic oil, then carefully install piston into housing. On Models 4050, 4250 and 4450, be sure slots in piston are aligned with slots in housing. On Models 4650 and 4850, be sure pin (49—Fig. 172) in housing is aligned with hole in piston. On all models, alternate installation of Belleville washers (43) so inside diameter of the last washer contacts retaining ring. Use a suitable horseshoe shaped tool to compress Belleville washers, then install retaining ring. Install clutch hub (38—Fig. 172) in drum, then alternate installation of discs (39) and drive plates (40), beginning and ending with a disc. Install return plate (41), then assemble piston housing into the drum. On Models 4050 and 4250, install piston retaining plates (48) and tighten retaining cap screws to 20 ft.-lbs. (27 N·m). On Model 4450, install retaining plates and tighten retaining cap screws to 27 ft.-lbs. (37 N·m). On Models 4650 and 4850, self-locking cap screws are used to secure piston housing to drum. Tighten the self-locking cap screws to 27 ft.-lbs. (37 N·m).

NOTE: The self-locking cap screws may be removed and reinstalled up to three times. However, if there is no noticeable turning resistance in locking area of cap screw, renew the screw regardless of times reinstalled.

Refer to paragraph 145 for installation of clutch pack, brake packs and planetary carrier.

148. PLANETARY CARRIER (4050 AND 4250). Remove cap screws securing planet pinion shaft retainer (2—Fig. 176), then remove retainer and rear cover (3) from carrier. Remove thrust washers, B3 planet pinions (5), B4 planet pinions (12), bearings (6) and spacers (7) from pinion shafts. Withdraw planet sun gears (10 and 11). Remove front cover (26) cap screws, then pry cover from carrier. Remove thrust washers, B1 planet sun pinion (25), B2 planet sun pinion (24), B1 and B2 planet pinions (19), bearings (17) and spacers (18). If B3 and B4 pinion shafts (8) are to be renewed, drive shafts out toward rear of carrier. If B1 and B2 planet shafts (20) are to be renewed, drive shafts out toward front of carrier. Note retaining balls (9 and 21) at bottom of each shaft.

Outside diameter of all planet pinion shafts should be 0.832-0.833 inch (21.16-21.17 mm). Inside diameter of all planet pinions should be 1.022-1.023 inches (25.96-25.98 mm). Inside diameter of front cover bushing (27) should be 2.496-2.500 inches (63.4-63.5 mm). When renewing bushing, press new bushing in cover until flush to 0.020 inch (0.5 mm) below front surface of cover. Make certain slot in bushing is toward bottom of cover bore.

To reassemble planetary, reverse the disassembly procedure while noting the following special instructions: When installing B2 planet sun gear (1—Fig. 176A), align timing marks (4) on sun gear with timing marks (3) on B1 and B2 planet pinions (2). Install B1 planet sun gear (25—Fig. 176) so recessed side of gear is facing up. Tighten front cover (26) mounting cap screws to 35 ft.-lbs. (47 N·m). Install B3 planet sun gear (11) with thrust washer side facing carrier. Tighten carrier rear cover (3) mounting screws to 20 ft.-lbs. (27 N·m). Tighten cap screws securing retainer (2) to cover to 10 ft.-lbs. (14 N·m).

Refer to paragraph 145 for installation of planetary unit.

149. PLANETARY CARRIER (4450, 4650 AND 4850). Remove retaining screw (13—Fig. 177) and pin (12) from each planet pinion shaft (4). Push each planet pinion shaft rearward, removing thrust washers (14) and pinion gears (15, 18 and 19) with bearings as each shaft is withdrawn. Remove planet sun gears (1, 2, 3 and 8) from carrier.

Inspect all parts for excessive wear or other damage. Inside diameter of carrier rear bushing (6) should be 3.637-3.640 inches (92.37-92.46 mm). Inside diameter of front bushing (10) should be 2.496-2.500 inches (63.39-63.50 mm). When renewing either bushing, press new bushing into carrier until flush to 0.020 inch (0.5 mm) below surface of carrier. Inside diameter of B4 sun gear bushings (7) should be 1.751-1.753 inches (44.47-44.53 mm). When renewing bushings,

press bushing into splined end of B4 gear until it is 0.040 inch (1 mm) below surface of gear and press the other bushing into opposite end of gear until it is 0.31 inch (8 mm) below surface of gear. Inside diameter of planet pinions should be 1.254-1.255 inches (31.85-31.87 mm).

To reassemble planetary, reverse the disassembly procedure while noting the following special instructions: When assembling roller bearings into planet pinions, note that bearings on B1-B2 pinion gears (19) are separated by a narrow spacer (20) while wide spacers (17) are used on B3 and B4 pinion gears. Make sure timing marks on each of the B1-B2 planet pinions (2—Fig. 177A) are aligned with timing marks on the carrier (1). Be sure retaining balls (11—Fig. 177) are installed in each pinion shaft. Apply Loctite 222 to threads of retaining pin screws (13), then tighten to 40 in.-lbs. (4.5 N·m).

Refer to paragraph 145 for installation of planetary unit.

MECHANICAL FRONT-WHEEL DRIVE GEAR TRAIN

4050-4250-4450 Power Shift Models

150. CLUTCH IDLER SHAFT. To remove clutch idler shaft (21—Fig. 178), tractor must first be split between engine and clutch housing as outlined in paragraph 131. Remove MFWD clutch assembly as outlined in paragraph 8 and remove pto clutch assembly as outlined in paragraph 199. Remove snap ring (24) and gear (23) from front of shaft. Remove snap ring (22) and front bearing cup, then pull shaft from clutch housing.

Inspect all parts and renew if necessary. Heat new bearing cones to 300° F (150° C) maximum prior to installing on shaft.

Reinstall shaft assembly selecting proper size snap ring (22) to provide 0.001-0.006 inch (0.02-0.15 mm) shaft end play. Snap ring is available in six different thicknesses. Complete installation by reversing the removal procedure.

151. IDLER GEAR. To remove MFWD idler gear (16—Fig. 178), the clutch housing must be separated from the transmission and engine as outlined in paragraph 134. Remove pto clutch as outlined in paragraph 199. Remove cap screw (19) securing idler gear shaft (18). Thread a 5/8 × 2 inch cap screw into end of idler shaft to use as a handle, then pull shaft from clutch housing. It may also be necessary to drive on rear of shaft if shaft is stuck. Remove spacer (12) and lift out gear with bearings.

Inspect parts for wear or damage and renew if necessary. When renewing bearings, be sure bearing cone spacer (14) is installed into gear (16) from rear end with stepped side of spacer toward snap ring (15).

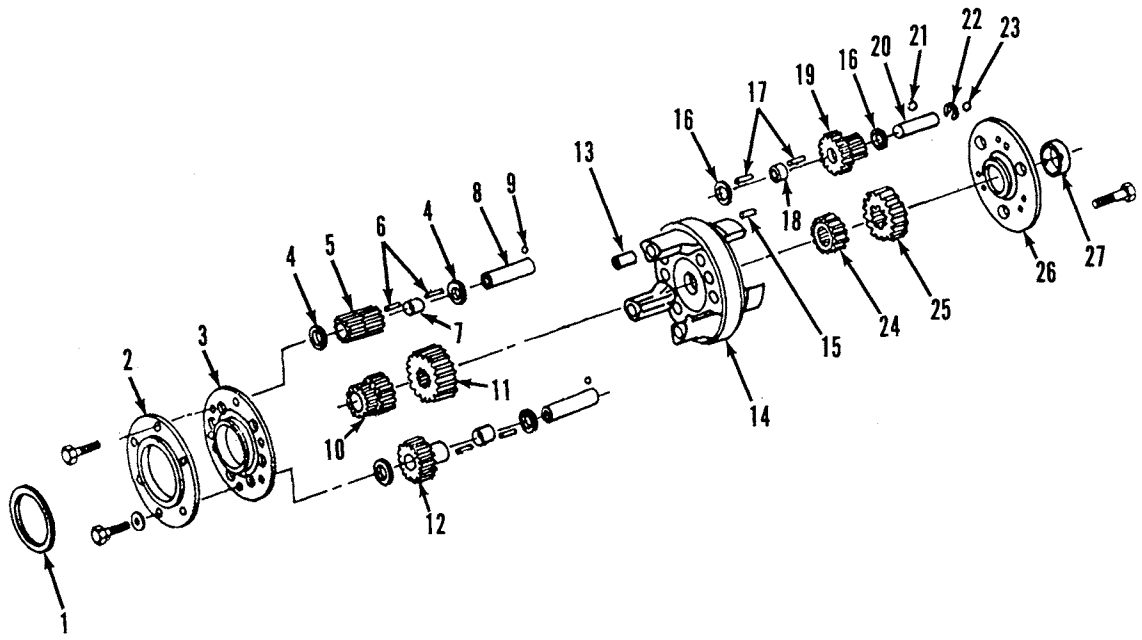


Fig. 176—Exploded view of output planetary carrier used on 4050 and 4250 Power Shift models.

1. Thrust washer
2. Retainer
3. Cover
4. Thrust washers
5. Planet pinion
6. Needle bearing
7. Spacer
8. Pinion shaft
9. Ball
10. Planet sun gear (B4)
11. Planet sun gear (B3)
12. Planet pinion
13. Bushing
14. Carrier
15. Pin
16. Thrust washers
17. Needle bearings
18. Spacer
19. Planet pinion
20. Pinion shaft
21. Ball
22. Snap ring
23. Ball
24. Planet sun gear (B2)
25. Planet sun gear (B1)
26. Cover
27. Bushing

Be sure bearing cones are properly seated against snap ring and spacer.

Position idler gear with bearings into clutch housing. Install spacer (12) so smaller ID engages recess in clutch housing. Install idler shaft and tighten retaining screw to 85 ft.-lbs. (115 N·m). Rotate gear several turns to seat bearings, then retorque retaining screw.

Complete installation by reversing the removal procedure.

152. DRIVER SHAFT. To remove driver shaft (6—Fig. 178) assembly, the transmission housing must be separated from clutch housing as outlined in paragraph 134. Remove snap ring (11), gear (10) and snap ring (9) from front of shaft. Unbolt and remove bearing retainer (8) with shims (7).

The driver shaft with front bearing cone can be withdrawn from transmission case without removing pto shaft. The rear gear (3) and bearing will remain in case supported by pto shaft.

To remove rear gear and bearing on Model 4450, the differential drive shaft and gear must first be removed as outlined in paragraph 159. On Models 4050 and 4250, the differential drive shaft does not need to be removed. On all models, remove output planetary as outlined in paragraph 135 and remove pto shaft as outlined in paragraph 197. Tip gear so bearing is down and remove from case. Remove snap ring (1) from case, then use a suitable puller to remove rear bearing cup.

Inspect all parts for wear or damage and renew if necessary. Inside diameter of bushing (4) should be 1.751-1.755 inches (44.48-44.56 mm). When renewing bushing, press new bushing in 0.118 inch (3 mm) below end of shaft.

To reinstall, reverse the removal procedure while noting the following special instructions: Install front bearing retainer (8) with enough shims (7) to ensure shaft end play. Tighten retainer cap screws to 30 ft.-lbs. (N·m), then rotate shaft to seat bearings. Use a dial indicator to measure shaft end play. Add or remove shims to provide 0.001-0.005 inch (0.03-0.13 mm) end play. Reinstall retainer and tighten cap screws to 30 ft.-lbs. (N·m).

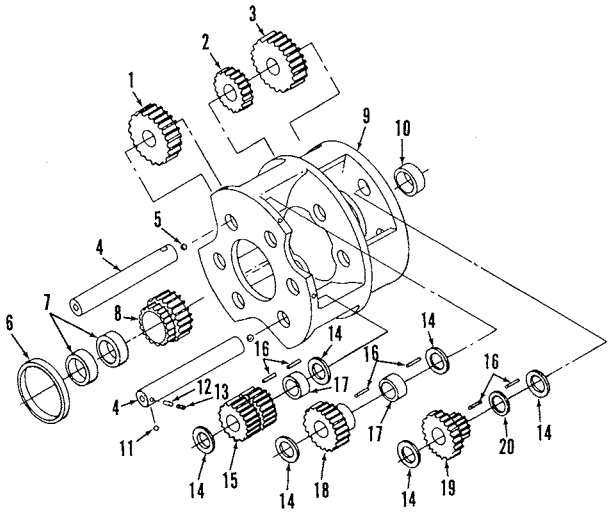


Fig. 177—Exploded view of output planetary carrier used on 4450, 4650 and 4850 Power Shift models.

1. Planet sun gear (B3)
2. Planet sun gear (B2)
3. Planet sun gear (B1)
4. Pinion shaft
5. Ball
6. Bushing
7. Bushings
8. Planet sun gear (B4)
9. Carrier
10. Bushing
11. Ball
12. Pin
13. Screw
14. Thrust washers
15. Planet pinion (B3)
16. Needle bearings
17. Spacer
18. Planet pinion (B4)
19. Planet pinion
20. Spacer

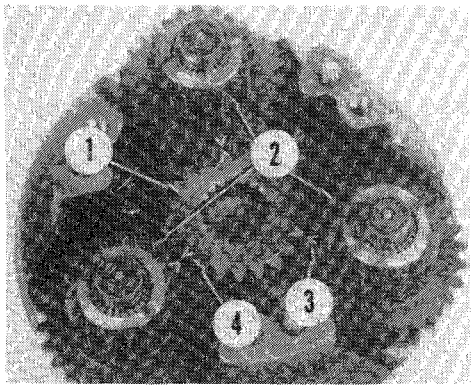


Fig. 176A—When installing B2 sun gear (1), make certain "V" marks (4) on sun gear are aligned with "V" marks (3) on planet pinions (2).

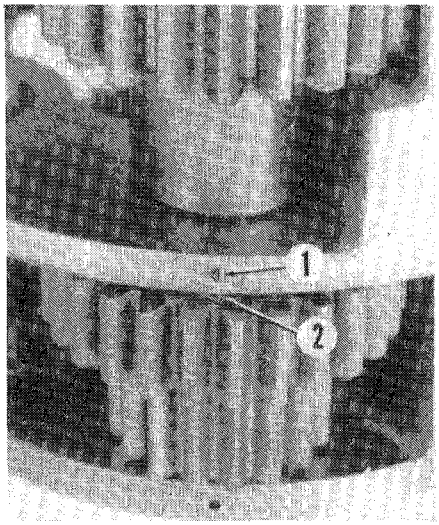


Fig. 177A—When assembling planetary gears, make certain timing marks on each of the B1-B2 planet pinions (2) are aligned with timing marks on carrier (1).

4650-4850 Power Shift Models

153. CLUTCH IDLER SHAFT. The clutch idler shaft (21—Fig. 178A) and front gear (23) can be removed after removing MFWD clutch assembly as outlined in paragraph 8. Remove snap ring (24), gear (23) and snap ring (22), then pull shaft from clutch housing. Rear gear (21A) and bearing will remain in clutch housing. Transmission must be separated from clutch housing and idler gear (16) removed as outlined in paragraph 154 before rear gear can be removed from clutch housing.

To reinstall shaft and gears, reverse the removal procedure while noting the following special instructions: Install front bearing cup with a snap ring (22) that will allow some shaft end play. Rotate shaft several turns to seat bearings, then use a dial indicator to measure shaft end play. Select and install a snap ring (22) of proper thickness to obtain 0.001-0.006 inch (0.03-0.15 mm) end play. Snap ring is available in six different thicknesses.

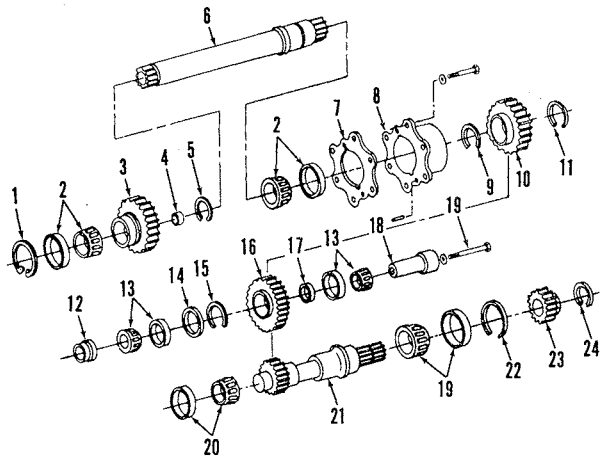


Fig. 178—Exploded view of mechanical front-wheel drive power train used on 4050, 4250 and 4450 Power Shift models.

1. Snap ring
2. Bearing
3. Gear
4. Bushing
5. Snap ring
6. Drive shaft
7. Shim
8. Bearing retainer
9. Snap ring
10. Gear
11. Snap ring
12. Spacer
13. Bearing
14. Spacer
15. Snap ring
16. Idler gear
17. Spacer
18. Idler shaft
19. Cap screw
20. Bearing
21. Clutch idler shaft
22. Snap ring
23. Gear
24. Snap ring

154. IDLER GEAR. To remove MFWD idler gear (16—Fig. 178A), transmission must be separated from clutch housing as outlined in paragraph 134. Remove snap ring (15), then move idler gear rearward to remove rear bearing cup from clutch housing bore. Remove pto brake (2—Fig. 179) to provide clearance for removal of idler gear (1). Tilt idler gear to the side and remove from clutch housing.

To reinstall idler gear, position gear with bearing cones into housing. Install pto brake assembly, aligning notch in brake backing plate behind idler gear. Tighten brake retaining cap screws evenly to 35 ft.-lbs. (48 N·m). Install rear bearing cone and snap ring. Rotate gear to seat bearings, then measure gear end play using a dial indicator. Specified end play is 0.001-0.006 inch (0.03-0.15 mm). Select and install a snap ring (15) of proper thickness to provide desired end play. Snap ring is available in six different thicknesses.

155. DRIVER SHAFT. To remove MFWD driver shaft (6—Fig. 178A), transmission must be separated from clutch housing as outlined in paragraph 134. Remove snap ring (11), gear (10) and snap ring (9) from front of shaft. Unbolt and remove bearing retainer (8) with shims (7). Pull shaft from transmission case.

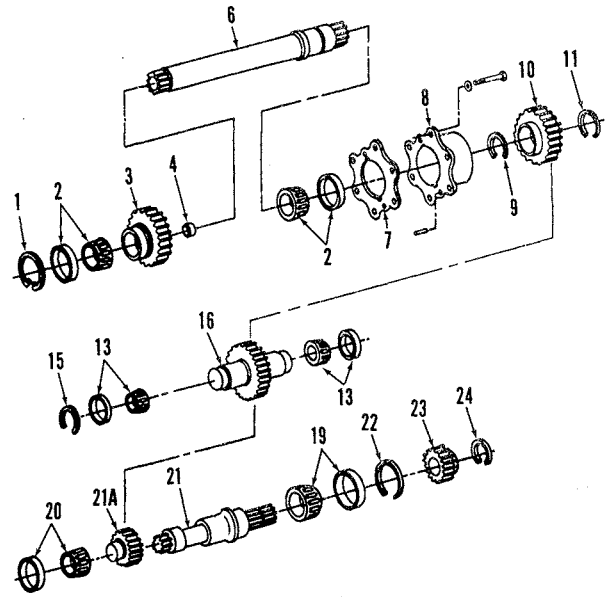


Fig. 178A—Exploded view of mechanical front-wheel drive power train used on 4650 and 4850 Power Shift models. Refer to Fig. 178 legend except for gear (21A).

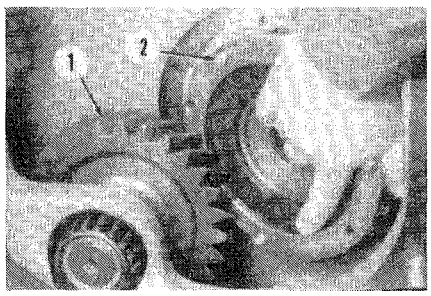


Fig. 179—On Models 4650 and 4850, pto brake (2) must be removed to provide clearance for removal of idler gear (1).

The rear gear (3) and bearing will remain in the case supported by the pto shaft. To remove rear gear, output planetary must be removed as outlined in paragraph 135 and pto shaft must be removed as outlined in paragraph 198.

Inspect all parts for wear or damage and renew if necessary. Inside diameter of shaft bushing (4) should be 1.997-2.003 inches (50.76-50.88 mm). Press new bushing in until end of bushing is 0.118 inch (3 mm) below end of driver shaft. When renewing bearings, heat new bearing cones to 300° F (150° C) maximum prior to installation.

To reinstall, reverse the removal procedure while noting the following special instructions: Install bearing retainer (8) with enough shims (7) to ensure shaft end play. Tighten retainer cap screws to 30 ft.-lbs. (40 N·m), then rotate shaft to seat bearings. Measure shaft end play using a dial indicator. Specified end play is 0.001-0.005 inch (0.03-0.13 mm). Remove retainer and add or remove shims as necessary to obtain desired end play. Reinstall retainer and tighten cap screws to 30 ft.-lbs. (40 N·m).

REDUCTION GEARS, TOW DISCONNECT AND PARK PAWL

All Power Shift Models

156. PARK PAWL. If park pawl remains engaged even though linkage operates satisfactorily, the park pawl return spring may be unhooked or broken. The unit may be inspected and spring renewed after removing Sound-Gard body as outlined in paragraph 134, the rockshaft housing as outlined in paragraph 236 and the transmission front cover. If removal of park pawl assembly is required, the differential must also be removed as outlined in paragraph 162.

To remove park pawl assembly, first remove shafts (9 and 13—Fig. 181) from tow disconnect yoke. Disconnect park pawl return spring (7—Fig. 180). On models so equipped, pull shaft retaining pin (1) from transmission case. On all models, remove lock pawl shaft (2) rearward and lift out lock pawl (5). To remove park lock cam (8), drive spring pin (11) from arm (12). Remove arm and spring, then withdraw cam with thrust bearing from inside case.

Inspect all parts for wear or damage and renew if necessary. Reinstall park pawl assembly by reversing the removal procedure. Adjust tow disconnect as outlined in paragraph 157.

157. TOW DISCONNECT. To remove tow disconnect mechanism, first remove reduction gear shaft as outlined in paragraph 158. Drive spring pin through disconnect shifter lever (4—Fig. 181). Remove stop plate mounting screws, then remove stop plate (6) and lever (4). Remove shaft (13) and special washer (12) from right side of transmission case. Remove shaft retainer (7), then pull shaft (9) out left side of transmisson case. Lift out shifter yoke (10) with shoes (11) and shifter collar.

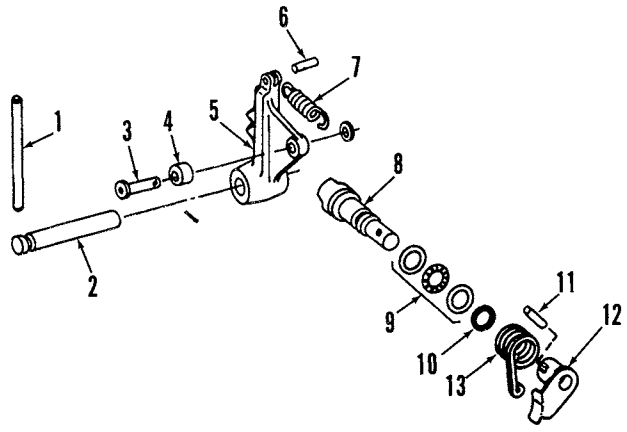


Fig. 180—Exploded view of park lock components used on 4050, 4250 and 4450 Power Shift models. Components are similar on 4650 and 4850 models except retaining pin (1) is not used.

1. Retaining pin
2. Pivot shaft
3. Pin
4. Roller
5. Pawl
6. Pin
7. Return spring
8. "O" ring
9. Thrust bearing
10. "O" ring
11. Spring arm
12. Arm
13. Spring

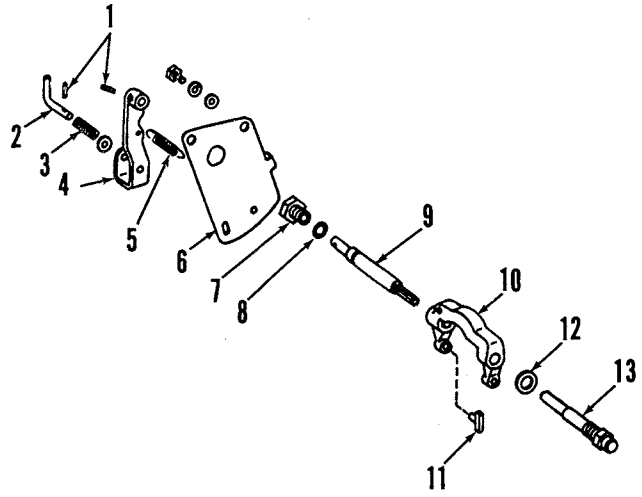


Fig. 181—Exploded view of tow disconnect shifter mechanism used on Model 4050. Other models are similar.

1. Spring pins
2. Latch pin
3. Spring
4. Disconnect lever
5. Spring
6. Stop plate
7. Retainer
8. "O" ring
9. Shaft L.H.
10. Shift yoke
11. Shoe (2)
12. Special washer
13. Shaft R.H.

Inspect all parts for wear or damage and renew if necessary. Be sure to renew shaft "O" ring (8).

To reinstall tow disconnect, proceed as follows: Position shift collar and yoke in case, then reinstall reduction shaft and gear. Install yoke shaft with special washer on right side of transmission case. Engage shift collar with reduction gear, then install splined shaft (9) into yoke so pin hole in end of shaft is positioned approximately horizontal. Install shaft retainer (7). Reinstall stop plate and actuating lever, but do not tighten stop plate mounting screws.

To adjust tow disconnect, move shift lever (3—Fig. 182) forward to position shift collar against reduction gear. Center the shift yoke shoes in the shift collar groove, then move the stop plate (2) until the "engaged" detent hole in plate is aligned with the lever latch pin (4). Tighten stop plate mounting cap screws (1), then reconnect lever spring (5).

158. REDUCTION GEAR SHAFT. To remove reduction gear shaft, first remove Sound-Gard body as outlined in paragraph 134 and remove rockshaft housing as outlined in paragraph 236. Disconnect C3 oil line (5—Fig. 184) and place a piece of tape or a clamp around pipe below the flare nut to prevent nut from sliding to bottom of the pipe. Remove bearing retainer (3) with shims. Install a 7/16 inch cap screw into threaded hole in end of reduction shaft, then use the cap screw as a handle to pull shaft from the housing. Remove tow disconnect shifter yoke shafts as outlined in paragraph 157. Lift out tow disconnect yoke, shift collar, reduction gear and front bearing cone.

Inspect all parts for excessive wear or damage and renew if necessary. Renew oil seal (9—Fig. 183 or 183A) in front of shaft if worn or damaged. Press in new seal, with lip facing inward, until seal is 0.060-0.100 inch (1.5-2.5 mm) below end of shaft. Check seal rings (4 and 10) for wear and renew if necessary. Make certain oil passages in shaft are open. If front bearing cup is being renewed, output planetary pack must first be removed. Refer to paragraph 135.

NOTE: Bearing preload must be checked and adjusted whenever shaft, bearings or rear bearing retainer are renewed. The input planetary and output planetary units must be removed to properly check and adjust bearing preload.

To check and adjust bearing preload, first install shaft and bearings into transmission case. Install rear bearing retainer with enough shims to establish shaft end play. Install two cap screws in bearing retainer and tighten to 55 ft.-lbs. (75 N·m). Rotate shaft several turns to seat bearings. Use a dial indicator to measure end play while moving shaft forward and rearward. Remove bearing retainer, then subtract shims equal to measured end play plus an additional 0.001-0.002 inch (0.025-0.050 mm) to provide desired preload. Remove shaft assembly from transmission case.

Proceed as follows for final assembly of shaft and related components: Reinstall output planetary assembly if removed. Install reduction shaft with gear and shift collar. Install rear bearing cup part way into the case, then install rear bearing retainer with proper shim pack. The bearing cup will be correctly located when bearing retainer cap screws are tightened. Tighten retainer cap screws to final torque of 55 ft.-lbs. (75 N·m). Complete installation by reversing the removal procedure.

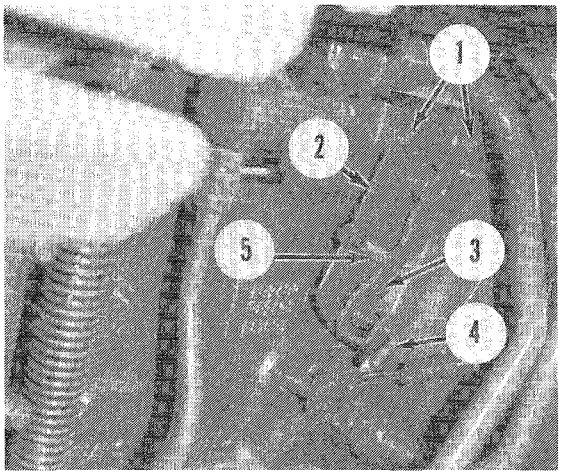


Fig. 182—When reinstalling tow disconnect assembly, align stop plate (2) and shift lever (3) as outlined in test before tightening mounting screws (1).

1. Cap screws
2. Stop plate
3. Shift lever
4. Latch pin
5. Spring
6. Spring pin

DIFFERENTIAL DRIVE SHAFT

Power Shift Models

159. REMOVE AND REINSTALL. The differential drive shaft (27—Fig. 183 or 183A) can be removed for service after removing the output planetary unit as outlined in paragraph 135 and the differential assembly as outlined in paragraph 162.

Remove cap screw (29) and front bearing retainer (16). Use a small hydraulic jack to press shaft rearward until front bearing cone, shims (19) and spacer (20) can be removed. Withdraw shaft rearward, then lift park pawl and drive gear (22) out top opening. If necessary, drive front and rear bearing cups from case. Retain shims (24) for use in reassembly. Press rear bearing cone off shaft if necessary.

The differential drive shaft is available only as a matched set with bevel ring gear (28). If differential drive shaft is renewed, the cone point must be adjusted as outlined in paragraph 160 before reinstalling drive shaft assembly.

To reinstall drive shaft and adjust bearing preload, proceed as follows: Heat front and rear bearing cones to 300° F (150° C) maximum before installing onto drive shaft. Install shaft, spacers and drive gear into case making sure small Woodruff key (21) is in place. Install original shim pack (19) plus one additional 0.010 inch (0.25 mm) shim to establish shaft end play. Support rear of shaft, then install front bearing cone. Install bearing retainer (16) and cap screw (29). Tighten cap screw to 180 ft.-lbs. (245 N·m).

Position a dial indicator against end of shaft, then move shaft forward and rearward and measure end play. Remove cap screw and press shaft rearward through front bearing cone. Remove shims equal to measured end play plus 0.001 inch (0.025 mm) to obtain recommended bearing preload.

Reinstall correct shim pack, front bearing cone, bearing retainer and cap screw. Tighten cap screw to 180 ft.-lbs. (245 N·m), then check for correct preload as follows: Wrap a string around end of shaft just in front of pinion gear. Using a spring scale, measure force required to rotate shaft at approximately one revolution per second. Spring scale reading should be 2.5-7.5 pounds (1.1-3.4 kg). If rolling drag torque is not within specifications, repeat the bearing preload adjustment procedure.

IMPORTANT: After all adjustments are completed, a new drive shaft retaining cap screw (29) must be installed and tightened to 180 ft.-lbs. (245 N·m).

Complete installation by reversing the removal procedure.

160. CONE POINT ADJUSTMENT. The cone point (mesh position) of the differential drive shaft and bevel ring gear is adjusted by means of shims

1. C3 oil pressure line
2. Rear bearing retainer
3. Ball
4. Seal ring
5. Shim
6. Bearing cup
7. Bearing cone
8. Reduction shaft
9. Oil seal
10. Seal rings
11. Shift collar
12. Reduction gear
13. Bearing cone
14. Bearing cup
15. Spring pin
16. Retainer
17. Bearing cone
18. Bearing cup
19. Shim
20. Spacer
21. Key
22. Drive gear
24. Shim
25. Bearing cup
26. Bearing cone
27. Differential drive shaft
28. Bevel ring gear
29. Cap screw

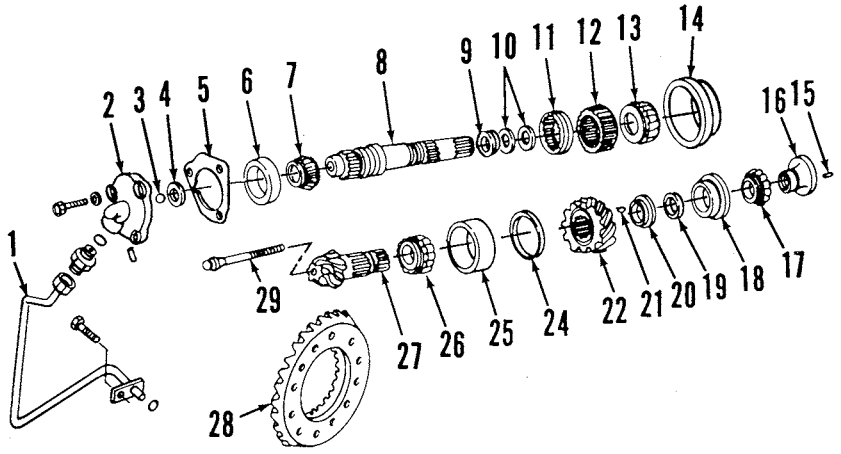


Fig. 183—Exploded view of output gear reduction shaft and differential drive shaft used on 4050, 4250 and 4450 Power Shift models. Refer to Fig. 183A for 4650 and 4850 models.

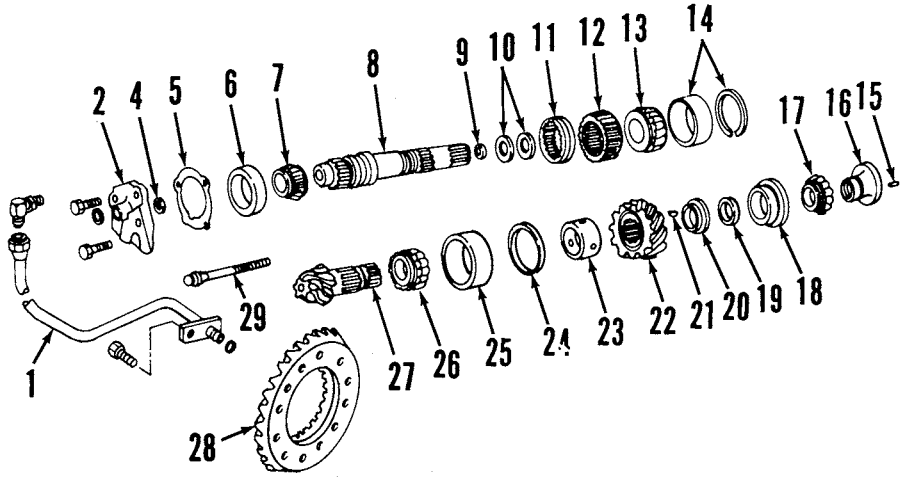


Fig. 183A—Exploded view of output gear reduction shaft and differential drive shaft used on 4650 and 4850 Power Shift models. Refer to Fig. 183 legend except for bearing cup and snap ring (14) and spacer (23).

(24—Fig. 183 or 183A) positioned in front of the rear bearing cup (25). Shims are available in 0.003, 0.005 and 0.010 inch (0.08, 0.13, and 0.25 mm) thicknesses.

The correct cone point is factory determined and assembly numbers are etched on the rear face of the differential drive shaft. To determine correct thickness of shim pack, subtract the number etched on end of the drive shaft from 8.329 on Models 4050, 4250 and 4450 or 9.538 on Models 4650 and 4850. The difference is the required shim pack thickness in inches.

Adjust drive shaft bearing preload after cone point is correctly set. Refer to paragraph 159.

DIFFERENTIAL AND MAIN DRIVE BEVEL RING GEAR

REMOVE AND REINSTALL

All Quad-Range Models

161. To remove the differential assembly, first drain transmission and hydraulic fluid. Remove Sound-Gard body as outlined in paragraph 109 and remove rockshaft housing as outlined in paragraph 236. Remove both final drives as outlined in paragraph 172. Remove brake backing plate, sun pinion and disc from each side of transmission housing. Remove transmission charge pump. Remove differential lock oil line and hydraulic fitting from bearing retainer. Remove pto shaft as outlined in paragraph 187 or 194. Remove cap screws securing load control arm support. Support differential assembly with a suitable hoist, then remove cap screws securing differential bearing retainers. Note that a nut is used inside the case on retainer top cap screw on each side on Models 4050, 4250 and 4450. On all models, remove bearing retainers keeping the shims with their respective retainer. Lift differential assembly from the case.

To reinstall differential, reverse the removal procedure while noting the following special instructions. If original parts are being reinstalled, install bearing retainers with the original number of shims. Be sure to position right bearing retainer with the differential lock oil passage at the top. If the bevel ring gear, differential housing or carrier bearings are renewed, install original shims plus one 0.010 inch (0.25 mm) shim on ring gear side to ensure end play and backlash. Adjust bearing preload as outlined in paragraph 163, then adjust backlash as outlined in paragraph 164. Tighten bearing retainer cap screws to 85 ft.-lbs. (115 N·m).

All Power Shift Models

162. To remove the differential assembly, first drain transmission and hydraulic fluid. Remove Sound-Gard body as outlined in paragraph 134 and remove rockshaft housing as outlined in paragraph 236. Remove both final drives as outlined in paragraph 172. Remove the oil trough from transmission case. Remove differential lock oil line and the oil line fitting from left bearing retainer. Wrap a piece of tape around C3 oil line (5—Fig. 184) to prevent the nut from sliding to bottom of the line, then disconnect line from reduction shaft bearing retainer. Remove reduction shaft bearing retainer with shims. Remove cap screws securing hitch load control arm support if so equipped. Use a suitable hoist and lifting tool to support differential, then remove cap screws securing the bearing retainers. Remove the retainers keeping the shims with their respective retainers. Lift differential assembly from the case.

To reinstall differential, reverse the removal procedure while noting the following special instructions. If original parts are being reinstalled, install bearing retainers with the original number of shims on each retainer. It should not be necessary to check bearing preload or backlash. Be sure to position left bearing retainer with differential lock oil passage toward the top. If the bevel ring gear, differential housing or carrier bearings are renewed, install the original shims plus an additional 0.010 inch (0.25 mm) shim on ring gear side to ensure end play and backlash. Adjust bearing preload as outlined in paragraph 163, then adjust backlash as outlined in paragraph 164. Tighten bearing retainer cap screws to 85 ft.-lbs. (115 N·m).

163. BEARING PRELOAD ADJUSTMENT. Bearing preload should be adjusted whenever differential housing or carrier bearings are renewed. Install

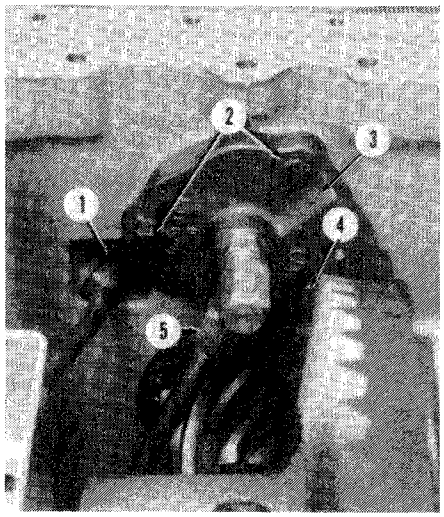


Fig. 184—View showing location of C3 oil pipe (5) and reduction shaft bearing retainer (3).

differential assembly with original shim packs plus an additional 0.010 inch (0.25 mm) shim on ring gear side to ensure end play and backlash. Tighten bearing retainer cap screws to 85 ft.-lbs. (115 N·m). Use a dial indicator to measure end play of differential housing. Deduct shims equal in thickness to measured end play plus 0.002-0.005 inch (0.05-0.13 mm) to provide desired preload. Check and adjust backlash as outlined in paragraph 164.

164. BACKLASH ADJUSTMENT. The backlash should be checked and adjusted after bearing preload is correctly adjusted. Use a dial indicator to measure backlash in at least two places around ring gear. Recommended backlash is 0.008-0.016 inch (0.20-0.40 mm).

NOTE: Move shims from one side to the other to adjust backlash. Do not add or remove shims as bearing preload would be affected.

Moving shims from the ring gear side to the side opposite ring gear will reduce backlash. To increase backlash, transfer shims to the ring gear side.

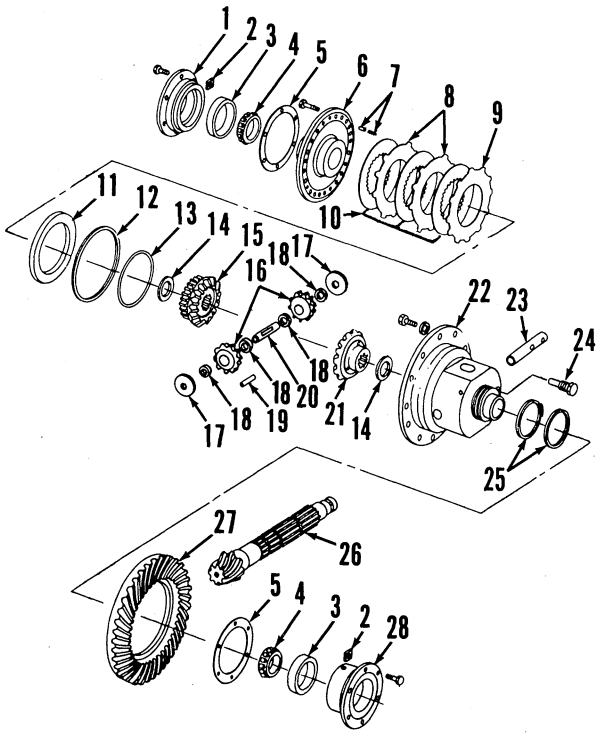


Fig. 186—Exploded view of differential assembly used on early 4050 models equipped with Quad-Range transmission. Differential assembly used on early 4050 Power Shift models is similar except components are switched end-for-end to position ring gear (27) on opposite side of differential drive shaft (26).

1. Bearing retainer L.H.
2. Nut
3. Bearing cup
4. Bearing cone
5. Shim
6. Cover
7. Return spring & guide pin
8. Separator plates (9 tangs)
9. Separator plate (12 tangs)
10. Clutch discs
11. Piston
12. Seal ring
13. Seal ring
14. Thrust washers
15. Bevel lock gear
16. Pinion gears (2 used)
17. Thrust washers
18. Washers
19. Needle bearing
20. Bearing retainer
21. Bevel gear
22. Differential housing
23. Pinion shaft
24. Cap screw
25. Seal rings
26. Differential drive shaft
27. Bevel ring gear
28. Bearing retainer R.H.

OVERHAUL

All Models

165. The differential used on early 4050 models (before Quad-Range transmission serial number 006644 and Power Shift transmission serial number 004973) was equipped with two pinion gears (16—Fig. 186). All other tractors are equipped with a differential using three pinion gears (36—Fig. 186A).

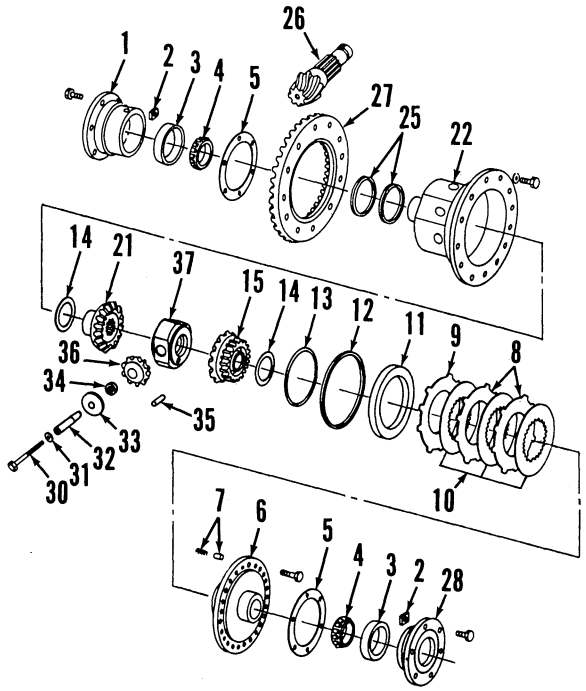


Fig. 186A—Exploded view of differential assembly used on late 4050 models and on all 4250, 4450, 4650 and 4850 models with Power Shift transmission. Differential used on these models equipped with Quad-Range transmission is similar except components are switched end-for-end to position bevel ring gear (27) on opposite side of differential drive shaft (26). Refer to Fig. 186 for legend except for the following:

30. Cap screw
31. Washer
32. Pinion shaft
33. Thrust washer
34. Washer
35. Needle bearing
36. Pinion gear (3 used)
37. Pinion shaft hub

All models are equipped with a hydraulically actuated differential lock clutch.

The multiple disc differential lock clutch can be inspected after removing cover (6). Use air pressure to remove piston (11). Refer to paragraph 166 for service information covering differential lock clutch.

On early 4050 models, remove cap screw (24—Fig. 186), then remove pinion shaft (23) and retainer (20). Withdraw pinion gears with bearing rollers, thrust washers and bevel gear.

On late 4050 models and all 4250, 4450, 4650 and 4850 models, remove the three pinion shaft retaining screws (30—Fig. 186A). Pull pinion shafts (32) from housing, then remove pinion shaft hub (37), pinion gears (36) with needle bearings, thrust washers and bevel gear.

Use suitable pullers to remove bearing cones (4) and cups (3) if necessary.

Inspect all parts for excessive wear or other damage. Use the following new part specifications as a guide to determine if renewal is necessary.

Early Model 4050 (Fig. 186)

Pinion thrust washer (17)—
Thickness ..... 0.064-0.065 in. (1.63-1.65 mm)
Needle bearing thrust washers (18)—
Thickness ..... 0.111-0.113 in. (2.82-2.87 mm)
Pinion (16) ID ..... 1.560-1.561 in. (39.63-39.65 mm)
Pinion shaft (23) OD ..... 1.190-1.191 in. (30.23-30.25 mm)
Bevel gear thrust washers (14)—
Thickness ..... 0.102-0.106 in. (2.59-2.69 mm)

Late Model 4050 and All Models 4250-4450-4650-4850 (Fig. 186A)

Pinion thrust washers (33)—
Thickness ..... 0.064-0.066 in. (1.63-1.68 mm)
Needle bearing thrust washers (34)—
Thickness ..... 0.012-0.122 in. (2.59-3.09 mm)
Pinon (36) ID ..... 1.691-1.692 in. (42.95-42.97 mm)
Pinion shaft (32) OD ..... 1.189-1.190 in. (30.20-30.23 mm)
Bevel gear thrust washers (14)—
Thickness ..... 0.102-0.106 in. (2.59-2.69 mm)

To reassemble differential used on early 4050 models, proceed as follows: Coat all parts with clean hydraulic oil. Position bevel gear (21—Fig. 186) with thrust washer (14) into housing (22). Install lock piston (11). Coat back side of thrust washers (17) with grease, then install into housing making sure tangs engage slots in housing. Assemble pinion shaft (23), washers (18), pinion gears (16) with roller bearings and the bearing retainer (20). Be sure hole in outer end of pinion shaft aligns with retaining screw hole in housing, then install cap screw (24) and tighten to 120 ft.-lbs. (163 N·m). Bend tab of bearing retainer into hole in pinion shaft. Install bevel lock gear (15). Install separator plate (9) with 12 tangs against piston, then alternate installation of the three discs (10) and the 9-tang separator plates (8). The tangs of the separator plates must be aligned to allow the three return springs (7) to rest on the 12-tang plate. Install cover (6—Fig. 186) and tighten retaining cap screws to 55 ft.-lbs. (75 N·m). If bearing cones were removed, heat new bearings to 300° F (150° C) maximum prior to installation.

To reassemble differential used on late 4050 models and all 4250, 4450, 4650 and 4850 models, proceed as follows: Coat all parts with clean hydraulic oil during assembly. Install inner bevel gear (21—Fig. 186A) with thrust washer (14) into housing. Coat back side of the pinion thrust washers (33) with grease, then install into housing engaging the tangs with recesses in housing. Assemble needle bearings into pinion gears, then install pinions, thrust washers and pinion shafts into housing. Install pinion hub (37) and push shafts into hub, then install and tighten retaining cap screws to 45 ft.-lbs. (61 N·m). Install bevel lock gear (15) with thrust washer. Install lock piston (11). Position 12-tang separator plate (9) against piston, then alternate installation of discs (10) and 9-tang separator plates (8). The tangs of the separator plates must be aligned to allow the three return springs (7) to rest on the 12-tang plate. Install cover (6—Fig. 186A) and tighten retaining cap screws to 55 ft.-lbs. (75 N·m). If bearing cones were removed, press new bearings into place.

166. DIFFERENTIAL LOCK CLUTCH. The multiple disc differential lock clutch can be inspected after removing the cover (6—Fig. 186 or 186A). Air pressure may be used to remove piston (11) from housing.

If clutch disc (10) facing chips, flakes or scratches easily, discs should be renewed regardless of facing thickness. Renew discs if thickness is less than 0.100 inch (2.5 mm). Inspect separator plates (8 and 9) for excessive wear or damage. Thickness of plates when new is 0.120 inch (3.05 mm). Free length of return springs should be 0.810 inch (20.57 mm) and springs should test 45-55 pounds at 0.540 inch (200-245 N at 13.72 mm).

Renew sealing rings (12 and 13) whenever piston is removed. Examine sealing surface in bore of bearing retainer which houses sealing rings (25) and re-

new if damaged or worn. Renew sealing rings if broken or worn.

167. BEVEL RING GEAR. The main drive bevel ring gear and the differential drive shaft are available only as a matched set. When renewing, make certain the numbers stamped on the ring gear and the pinion gear end of shaft are the same before assembly.

To remove ring gear, remove retaining cap screws and use a heavy drift and hammer to separate gear from housing. Heat the new gear to 300° F (150° C) maximum, then position gear onto housing. Tighten the retaining cap screws to 85 ft.-lbs. (115 N·m) on all models except 4650 and 4850, which should be tightened to 170 ft.-lbs. (230 N·m). Renew differential drive shaft as outlined in paragraph 116 for Quad-Range models or paragraph 159 for Power Shift models.

DIFFERENTIAL LOCK

168. All tractors are equipped with a hydraulically actuated differential lock. When engaged, the bevel lock gear (15—Fig. 186 or 186A) is locked to the differential case causing both differential output shafts and the differential case to turn together as a unit. The differential lock consists of a foot operated control valve located in the control console and a multiple disc clutch located in the differential housing.

All Models

169. ADJUSTMENT The differential lock valve is applied through an operating rod from the foot pedal to an over-center arm. The over-center feature holds the valve in applied position until either brake pedal is depressed. When a brake pedal is depressed, the head of lock adjusting screws (3—Fig. 188) contacts rod release bar (2) which pushes over-center link (1) upward to release the valve.

To adjust lock release bar, first remove cowl cover from dash. Place differential lock pedal in "ON" position. Adjust lock valve adjusting screws to obtain 0.010-0.030 inch (0.3-0.8 mm) clearance between head of screws and rod release bar. Make certain valve releases with only slight pressure on either brake pedal. Reinstall dash cowl cover.

Differential lock pressure need only be checked if valve has been overhauled or if differential lock is suspected of having a malfunction. To check pressure, disconnect differential lock clutch oil pressure line from transmission case and install a tee fitting and a 0-1000 psi (0-7000 kPa) gage in the line. Oil temperature must be at least 100° F (38° C) when checking pressure. Operate engine at 2000 rpm and depress lock pedal. Pressure should be 435-485 psi (3000-3345 kPa). If pressure is incorrect, disconnect valve links (15—Fig. 189), remove plunger (1) and add or remove shims (4). One shim should change pressure about 25-30 psi (175-205 kPa).

CONTROL VALVE

All Models

170. R&R AND OVERHAUL. To remove control valve (7—Fig. 188), first open brake bleed valves and depress brake pedals to relieve system pressure. Remove dash cowl cover. Remove differential lock pressure line from front of valve, pressure supply line and pressure return line. Remove cap screw securing over-center arm (16—Fig. 189) and disconnect operating rod (17). Remove retaining cap screw from rear end of brake pedal brace. Remove valve mounting cap screws and lift out valve unit and spacers.

When disassembling valve, note that items (10 through 14—Fig. 189) must be removed before pressure control valve (8) can be removed. All parts may be renewed individually. Be sure to renew all "O" rings.

Control valve spring free length should be 2.56 inches (65 mm) and working load length should be 1.31 inches at 9.5-11.5 pounds (33.3 mm at 42-52 N).

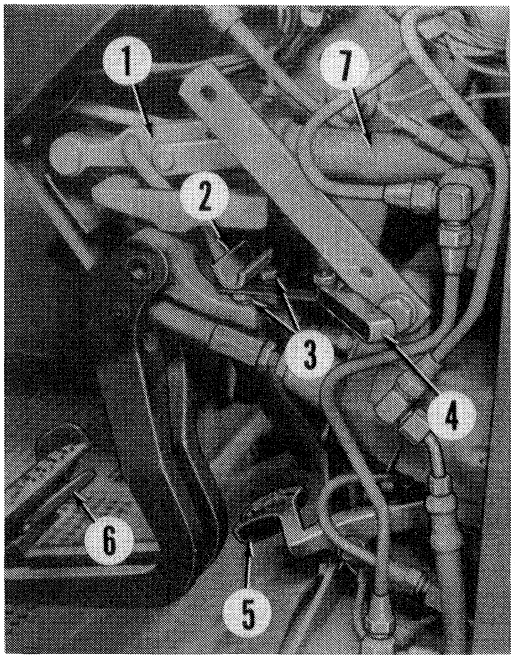


Fig. 188—With differential lock pedal "ON," adjust cap screws (3) to obtain 0.010-0.030 inch (0.3-0.8 mm) clearance between head of screws and release bar (2).

Plunger spring free length should be 2.28 inches (58 mm) and working load length should be 1.92 inches at 103-125 pounds (48.8 mm at 458-556 N).

Assemble by reversing the disassembly procedure. Adjust as outlined in paragraph 169.

REAR AXLE AND FINAL DRIVE

171. Standard equipment on all models is planetary reduction final drive with planetary unit located at inner end of axle shafts. Some models may be equipped with high clearance rear axle drop housings which contain a final reduction bull gear and pinion instead of a planetary reduction unit.

REMOVE AND REINSTALL

All Models

172. To remove either final drive, first drain the transmission and hydraulic fluid. Suitably support rear of tractor and remove rear wheel or wheels as follows: Rotate wheel until rack teeth on axle shaft face upward. Remove snap ring from end of axle. Loosen the three retaining bolts (2—Fig. 191) in wheel hub, then tighten the two jack screws (3) evenly to loosen hub sleeve. If sleeve is difficult to break loose, apply penetrating oil to sleeve, strike end of axle with a heavy hammer and retighten jack screws evenly until sleeve loosens. Turn pinion gear (1) to slide wheel off the axle.

Raise Sound-Gard body (if equipped) as follows: Disconnect battery ground cable. Measure distance between hydraulic control lever support and body

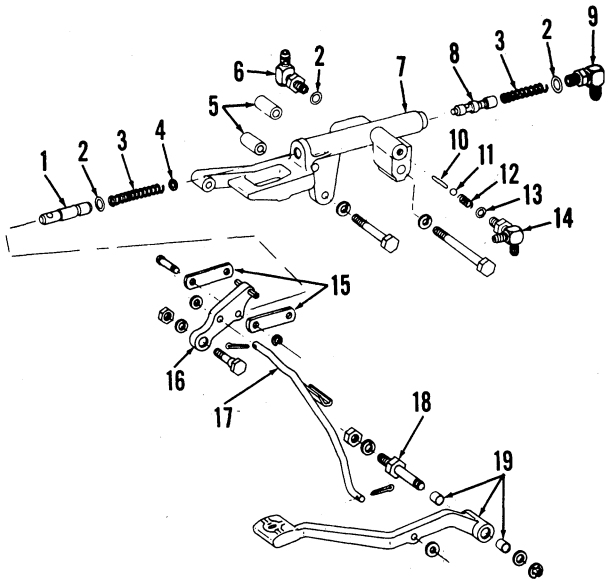


Fig. 189—Exploded view of differential lock control valve and operating linkage.

1. Plunger
2. "O" ring
3. Springs
4. Shim
5. Spacers
6. Oil return elbow
7. Lock valve housing
8. Pressure control valve
9. Pressure outlet elbow
10. Pin
11. Ball
12. Spring
13. "O" ring
14. Pressure inlet
15. Links
16. Over-center arm
17. Operating rod
18. Special pin
19. Pedal & bushings

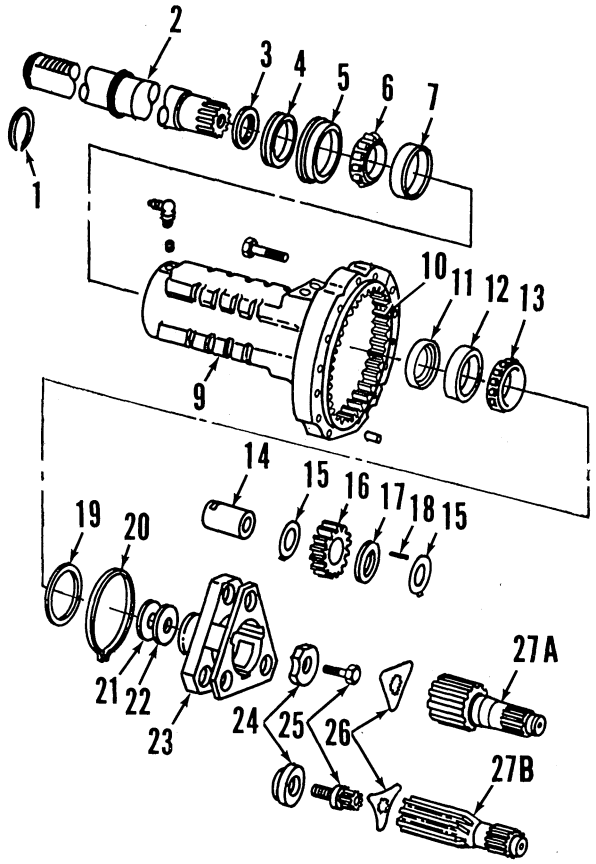


Fig. 190—Exploded view of final drive used on Model 4650. Final drive used on Models 4450 and 4850 is similar. Refer to Fig. 190A for Models 4050 and 4250.

1. Snap ring
2. Axle shaft
3. Spacer
4. Seal
5. Oil cup
6. Bearing cone
7. Bearing cup
9. Axle housing
10. Ring gear
11. Seal
12. Bearing cup
13. Bearing cone
14. Pinion shaft
15. Thrust washer
16. Planet pinion
17. Spacer (4450 & 4850)
18. Bearing rollers
19. Thrust washer
20. Snap ring
21. Shim
22. Thrust washer
23. Planetary carrier
24. Retainer
25. Cap screw
26. Lockplate
27A. Sun pinion shaft (4650)
27B. Sun pinion shaft (4450 & 4850)

panel so support can be reinstalled in original position, then disconnect support from rockshaft housing. Disconnect rockshaft and selective control valve linkages. Use JDG-15 lifting bracket or similar tool and a suitable overhead hoist to support Sound-Gard body. Loosen the two Sound-Gard body front mounting bolts and remove the two rear mounting bolts. Raise rear of body high enough to remove body mounting brackets from axle housings.

If equipped with rear fenders, disconnect wiring and remove fenders.

On high clearance models, remove 3-point hitch lower links from drawbar frame. Remove nuts and cap screws securing drawbar support to axle drop housings.

On all models, support final drive housing with a suitable hoist and lifting sling. Remove final drive housing mounting cap screws, then move housing away from transmission case.

Before reinstalling final drive housing, be sure to remove all liquid gasket deposits from transmission case and axle housing mating surfaces. Apply T43511 cleaner primer to axle housing mating surface. Apply T43514 plastic gasket to transmission case using a roller. On standard models, install sun pinion shaft and brake disc into final drive housing before assembling housing to transmission case. On high clearance models, install differential output shaft and brake disc into final drive housing before assembling housing to transmission case. On all models, assemble final drive to transmission case and tighten mounting cap screws to 150 ft.-lbs. (203 N·m).

NOTE: Final drive mounting cap screws must be tightened to specified torque within 15 minutes of assembly to ensure proper gasket seal.

Tighten cap screws securing Sound-Gard mounts to 150 ft.-lbs. (203 N·m) and Sound-Gard body mounting bolts to 150 ft.-lbs. (203 N·m). Complete installation by reversing the removal procedure. Tighten wheel hub sleeve retaining bolts (2—Fig. 191) to 300 ft.-lbs. (405 N·m) torque. Drive the tractor about 100 yards (100 meters), then retorque the three bolts to 300 ft.-lbs. (405 N·m).

OVERHAUL

All Models Except High Clearance

173. PLANETARY. To remove planet pinion carrier, slightly loosen or tighten carrier retaining cap screw (25—Fig. 190 or 190A) so lockplate (26) can be removed from head of screw.

NOTE: There may be an "O" ring stretched around the head of cap screw (25). The "O" ring is used at the factory during assembly. The "O" ring should be removed and discarded as it is not necessary to reinstall it.

Remove cap screw from carrier, then withdraw carrier assembly. Planet pinion shafts (14) are retained

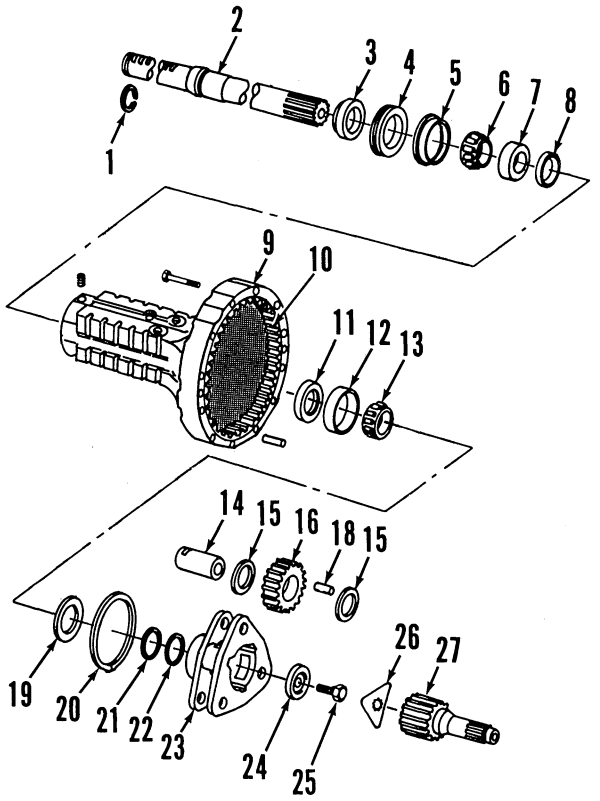


Fig. 190A—Exploded view of final drive used on Models 4050 and 4250. Refer to Fig. 190 for legend except for retainer (8).

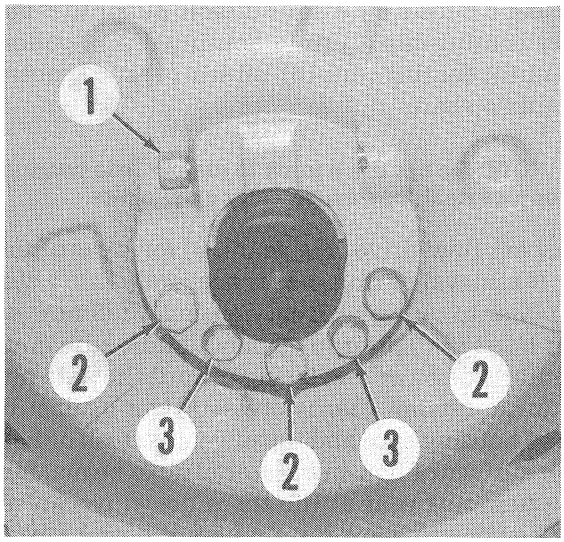


Fig. 191—View of rear wheel hub. Refer to text for removal procedure.

1. Pinion gear
2. Retaining bolts
3. Jack screws

by snap ring (20). Expand the snap ring enough to remove each shaft. Withdraw pinion gears being careful not to lose the bearing rollers.

Inspect shafts, bearing rollers and gears for wear, scoring or other damage and renew if necessary. Inspect thrust washers for wear. New thickness of planet carrier washer (19) is 0.008-0.012 inch (0.20-0.30 mm). New thickness of pinion gear washers (15) is 0.036 inch (0.91 mm).

To reassemble, install two of the three planet pinions and shafts in carrier and seat snap ring into groove in carrier and pinion shaft grooves. Then, position retainer (24) into center of carrier as follows: On early 4050 models with Quad-Range transmission serial numbers prior to 6644 or Power Shift transmission serial numbers prior to 2725, raised or flat side of retainer must face outward and recessed side must face end of axle shaft. On late 4050 models with Quad-Range transmission serial numbers 6644 and after or Power Shift transmission serial numbers 2725 and after and all 4250 models, recessed side of retainer must face outward and flat side must face end of axle shaft. On 4450, 4650 and 4850, flat side of retainer must face outward and stepped side must face end of axle shaft. Install remaining planet pinion gear and shaft into carrier and secure with snap ring.

Install planet carrier and check rolling drag torque as outlined in paragraph 177.

174. AXLE HOUSING AND SHAFT. The axle shaft (2—Fig. 190 or 190A) can be removed from inner bearing and housing by pressing on inner end of axle shaft. Use a suitable puller to remove inner bearing cup (12) if necessary. Pry inner oil seal (11) from housing. Inspect oil seal retainer (5) and pry from housing if necessary. Use a suitable puller to remove outer bearing cup (7) from housing. Use a puller to pull outer bearing cone (6), oil seal (4) and spacer (3) from axle shaft.

NOTE: Do not use a torch to remove axle bearing cone as heat may cause early axle failure.

Inspect final drive ring gear (10) for wear or damage. If removal of ring gear is necessary, use a suitable puller to pull gear from housing. Chill new gear to 0° F (−18° C) prior to installation. Be sure double chamfer side of gear is facing toward the axle housing. Make certain gear is pressed tight against bottom of housing bore and top of gear is flush or below outer surface of housing. Material must be machined from new ring gear at the three dowel pin holes in axle housing to allow installation of dowel pins. Diameter of finished holes must be 0.455-0.459 inch (11.56-11.66 mm).

Install a new inner oil seal (11—Fig. 190 or 190A) using suitable driver disc. Seal should be installed with spring side facing the driver disc and driven in to the following specified depth: On Models 4050, 4250 and 4650, seal should be 0.375 inch (9.5 mm) below finished face of bearing cup. On Model 4450, seal should be 0.236 inch (6 mm) below face of bearing cup. On Model 4850, seal should be 0.327 inch (8.3 mm) below face of bearing cup. Coat seal lip with grease.

NOTE: If outer bearing cone is loose on axle shaft on 4050 or 4250 models, check outer end of axle shaft for identification mark (D—Fig. 193) indicating axle has been modified for undersize outer bearing cone. If axle shaft is standard diameter but is worn or damaged in bearing mating area, shaft may be modified for installation of undersize bearing cone as follows:

Grind axle shaft in area (A—Fig. 193) to diameter of 3.3492-3.3502 inches (85.049-85.075 mm). Shaft must be ground concentric with diameter (B) within 0.005 inch (0.125 mm) TIR. Do not grind area (C). After modifying the shaft, use a chisel to mark outer end of shaft with identification mark (D) as shown.

When assembling axle shaft, heat spacer (3—Fig. 190 or 190A) to 465° F (240° C) maximum before installing onto shaft. Install heated spacer onto shaft with larger OD toward wheel end of shaft. Drive spacer against shaft shoulder, then allow to cool before installing oil seal. Fill seal lip of outer seal (4) with grease, then install over the spacer with metal side toward wheel end of shaft. Heat bearing cone to 300° F (150° C) maximum, then install onto shaft tight against spacer. Allow bearing to cool, then reseat bearing and spacer assembly against shaft shoulder using a brass drift and heavy hammer.

Position axle shaft in axle housing being careful not to damage inner oil seal. Heat inner bearing cone to 300° F (150° C) maximum before installing onto axle shaft. On all models except early 4050 models, install

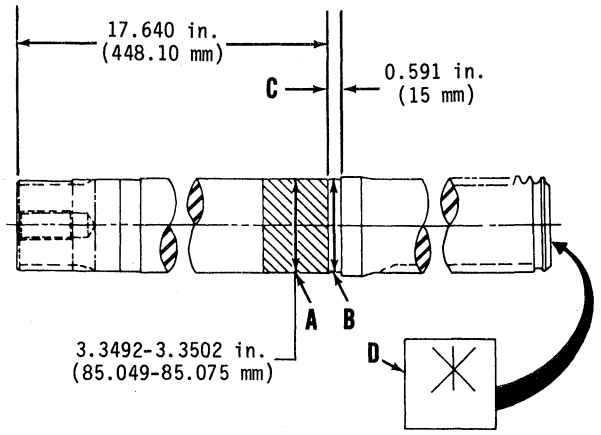


Fig. 193—On Models 4050 and 4250, axle shaft may be modified for installation of undersize outer bearing. Refer to text for details.

bearing cone only part way onto shaft to establish some end play. Adjust axle bearing end play as outlined in paragraph 176, then install planet pinion carrier and check rolling drag torque as outlined in paragraph 177.

On early 4050 models, no end play check or rolling drag torque is required. Install inner bearing cone onto axle shaft, then reinstall planet pinion carrier as outlined in paragraph 175.

Early Model 4050

175. PLANET PINION CARRIER INSTALLATION. Install thrust washer (19—Fig. 190A) and planetary carrier (23) assembly into housing. Be sure carrier retainer (24) is correctly positioned, then tighten special retaining screw (25) to 170 ft.-lbs. (230 N·m). Rotate axle housing a minimum of six revolutions in each direction to ensure bearings are properly seated, then retorque cap screw to 170 ft.-lbs. (230 N·m). Install lockplate (26) so ears are positioned in lock lugs in carrier. (It may be necessary to tighten or loosen cap screw slightly). Then, tighten cap screw slightly to wedge plate against lock lugs. Fill outer bearing compartment with TY6341 grease or equivalent high temperature-extreme pressure grease, then reinstall final drive assembly.

All Models Except Early 4050

176. AXLE BEARING END PLAY ADJUSTMENT. The axle bearings must be adjusted to provide zero end play by means of shims (21—Fig. 190 or 190A). Make certain there is a measurable amount of shaft end play before proceeding with adjustment procedure. If necessary, press axle shaft out of inner bearing slightly to provide end play.

Position two soft lead balls, which are 0.3-0.4 inch (8-10 mm) in diameter, on inner end of axle shaft. Use heavy grease to hold balls in place. Install a bronze thrust washer (19) against the inner bearing. Do not install shims (21—Fig. 190 or 190A) or washer (22) at this time. Install carrier assembly into housing and tighten retaining screw to 200 ft.-lbs. (270 N·m). Rotate axle housing a minimum of 12 revolutions in both directions to ensure bearings are properly seated, then retorque retaining screw to 200 ft.-lbs. (270 N·m).

Remove carrier assembly and measure thickness of the two lead balls. The required thrust washer and shim pack thickness is equal to the average thickness of the flattened balls. When assembling shim pack, measure thickness of the washer (22) and shims (21) individually to ensure accurate end play adjustment.

Install planet pinion carrier with required shims and check rolling drag torque as outlined in paragraph 177.

177. ROLLING DRAG TORQUE CHECK. After proper axle bearing shim pack is determined, install planetary carrier and check rolling drag torque as follows: Be sure bronze thrust washer (19—Fig. 190 or 190A) is in place against inner bearing. Install carrier with previously determined shim pack (21) and washer (22). Make certain carrier retainer (24) is correctly positioned, then tighten retaining cap screw (25) to 580 ft.-lbs. (786 N·m). Rotate the axle housing a minimum of six turns in both directions to ensure bearings are properly seated, then retorque retaining screw to 580 ft.-lbs. (786 N·m). Usual procedure for applying this much torqure is with a torque multiplying wrench such as JDST-38 or equivalent.

If axle assembly is removed from wheel hub, use a standard torque wrench on retaining screw (25) to check axle rolling torque. If axle assembly is not separated from wheel hub, fabricate a torque wrench adapter tool (2—Fig. 195) that can be mounted across center of axle housing. Rotate torque wrench 45 degrees from vertical in each direction and record rolling drag torque.

NOTE: The heavy portion of axle housing must be positioned downward to obtain an accurate rolling torque measurement when axle is attached to wheel hub. The heavy side of the casting has a flat surface.

Correct rolling drag torque is 10-23 ft.-lbs. (13-31 N·m). If rolling drag torque is not within specifica-

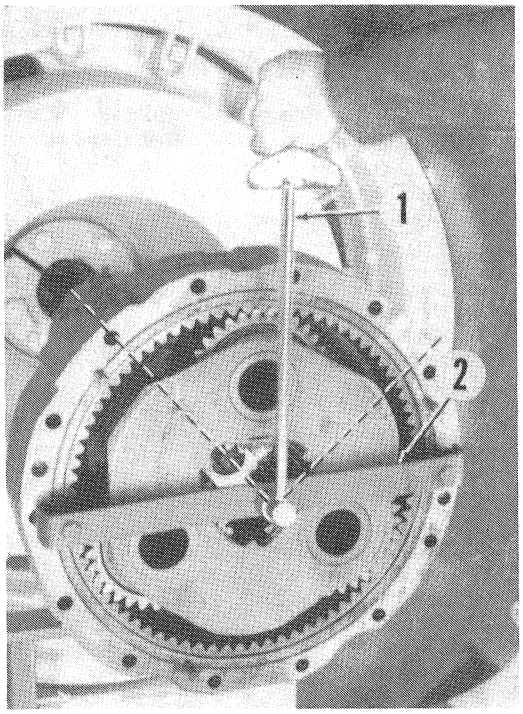


Fig. 195—If axle assembly is not separated from wheel hub, use a torque wrench (1) and adapter tool (2) to check bearing rolling torque.

tions, repeat the bearing end play adjustment and recheck rolling drag torque until specification is obtained.

Install lockplate (26—Fig. 190 or 190A) so ears are between lock lugs on carrier. With lockplate installed, tighten retaining screw slightly to wedge plate against carrier lock lugs. Fill axle outer bearing compartment with TY6341 grease or equivalent high temperature-extreme pressure grease. Reinstall final drive assembly.

High Clearance Models

178. OUTER HOUSING AND GEARS. If only the outer housing, gears, shafts, bearings or oil seals are being serviced, the complete final drive assembly will not need to be removed. Suitably support the tractor and remove wheel and tire assembly. Remove draft lower link and drawbar from gear housing. Support gear housing (19—Fig. 196) with a suitable hoist, then remove stud nuts securing gear housing to drive shaft housing (10). Install cap screws into the two threaded jack screw holes in drive shaft housing, then tighten screws evenly to force housings apart.

To disassemble, remove drive shaft bearing retainer (14—Fig. 196) using a suitable puller. Remove bull gear cover (38) and axle shaft inner bearing cover (20). Insert a brass drift between gears to lock them, then remove inner bearing nut (22) and spacer (23). Protect threaded end of axle shaft, then tap on end of shaft with a soft hammer until shaft is free from inner bearing. Lift inner bearing cone out of housing, then unseat snap ring (26) on inner side of bull gear. Remove axle shaft and bull gear from housing. Remove drive shaft pinion gear (18).

Inspect all parts for wear or damage and renew if necessary. When renewing drive shaft seal (15), install seal with spring side facing outward and drive in until seal is bottomed in bearing retainer (14). The axle shaft is equipped with two oil seals, an inner seal (29) which is pressed into housing and a two-piece outer seal (33 and 34) located in the housing and on the shaft. Use a suitable press or puller to remove

1. Differential output shaft
2. Bearing retainer
3. Shims
4. Bearing cups
5. Bearing cones
6. Differential output gear
7. Drive shaft gear
8. Oil seal
9. Gasket
10. Drive shaft housing
11. Gasket
12. Drive shaft
13. Shim
14. Bearing retainer
15. Oil seal
16. Bearing cup
17. Bearing cone
18. Drive shaft pinion gear
19. Gear housing
20. Cover
21. Gasket
22. Nut
23. Washer
24. Bearing cone
25. Bearing cup
26. Snap ring
27. Snap rings
28. Washer
29. Oil seal
30. Bearing cup
31. Bearing cone
32. Spacer
33. Oil seal cup
34. Oil seal
35. Axle shaft
36. Snap ring
37. Bull gear
38. Cover

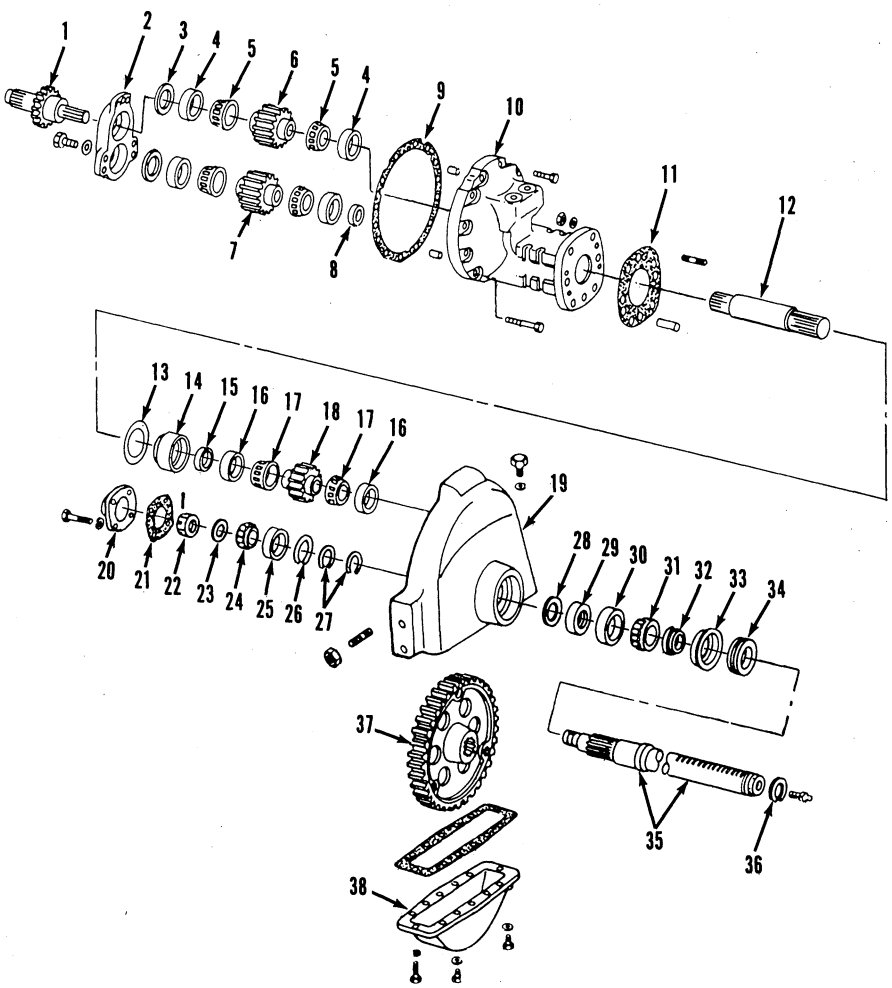


Fig. 196—Exploded view of high clearance final drive assembly which is available on some models.

outer bearing (31), seal (34) and spacer (32). When renewing axle inner bearing cup (25), make sure cup is seated against snap ring in housing.

If outer bearing cone is loose on axle shaft, check outer end of shaft for identification mark (D—Fig. 197) indicating axle has been modified for installation of undersize bearing. If shaft is standard diameter but is worn or damaged in bearing mating area, shaft may be modified for installation of undersize bearing as follows: Grind shaft in area (A) to diameter of 3.601-3.602 inches (91.465-91.491 mm). Shaft must be ground concentric with diameter (B) within 0.005 inch (0.125 mm) TIR. Do not grind area (C). After modifying the shaft, mark outer end of shaft with identification mark (D) as shown.

When reassembling, heat outer spacer (32—Fig. 196) and outer bearing cone (31) to 300° F (150° C) prior to installation. Install spacer onto axle shaft with large OD outward. Allow spacer to cool, then install outer seal (34). Install outer bearing cone (31) and outer snap ring onto axle shaft. Install pinion gear (18) and bearings. Position bull gear (37) in housing with recess in gear for snap ring facing outer side of housing. Install axle shaft through bull gear and secure with snap ring. Heat inner bearing cone to 300° F (150° C) maximum, then install onto shaft. Tighten slotted nut (22) to 200 ft.-lbs. (271 N·m) while rotating axle several times to seat bearings. Loosen slotted nut, then retorque to 50 ft.-lbs. (68 N·m). Install cotter pin through shaft and nut. It may be necessary to loosen nut slightly so cotter pin can be installed.

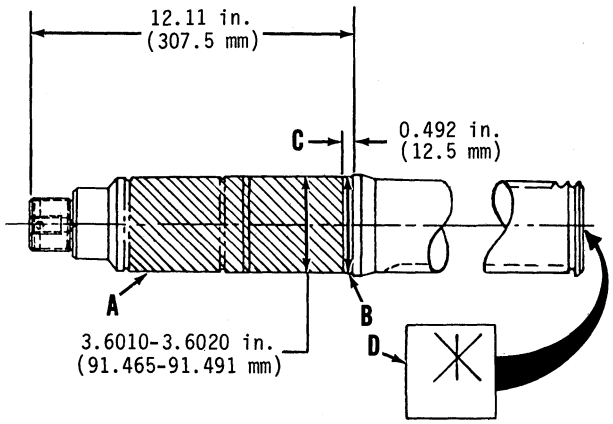


Fig. 197—Axle shaft may be modified for installation of an undersize outer bearing if necessary. Refer to text for details.

Selection of shims (13) requires using a special tool which can be fabricated using dimensions shown in Fig. 198. Install drive pinion retainer (14—Fig. 196) into housing until finished surface of retainer is flush with outer surface of housing. Position gasket (11) over studs, then install special tool over two studs as shown in Fig. 199. Tighten two stud nuts (F) to 250 ft.-lbs. (335 N·m) while making sure that screws (D) remain loose. Turn the drive shaft pinion using the drive shaft while tightening the two screws (D) evenly to 25 in.-lbs. (2.8 N·m). Use a feeler gage (B) to measure clearance between tool and machined surface of retainer (C). Remove tool and install shims (13—Fig. 196) equal to the measured clearance.

Reinstall drive gear housing to drive shaft housing and tighten stud nuts to 445 ft.-lbs. (603 N·m). Refill each final drive housing with two U.S. quarts (1.9 L) of SAE 85W-140, GL-5 gear lubricant.

179. DRIVE SHAFT HOUSING AND GEARS. To overhaul drive shaft housing and associated parts, the final drive assembly must be removed as outlined in paragraph 172. Withdraw differential output shaft

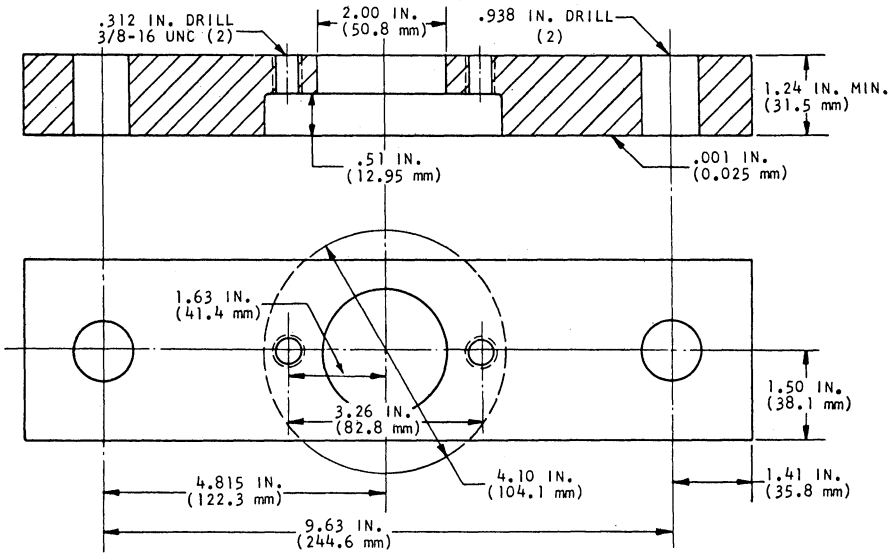


Fig. 198—Special tool shown in Fig. 199 can be fabricated using dimensions shown.

(1—Fig. 196). Remove the bearing retainer (2) and gears (6 and 7). Remove final drive shaft (12) from housing.

Inspect all parts for wear or damage and renew if necessary.

When reassembling, note that differential output gear (6) has 27 teeth while drive shaft pinion gear (7) has 23 teeth. If gears or bearings were renewed, select thickness of shims (3) that will provide gear end play of 0.001-0.005 inch (0.03-0.13 mm). Be sure bearings are properly seated and retainer cap screws are tightened to 55 ft.-lbs. (75 N·m) before checking end play. DO NOT preload bearings by installing too many shims.

BRAKES

OPERATION AND ADJUSTMENT

All Models

180. Power to the wet type single disc brakes is supplied by the system hydraulic pump through foot operated control valves when engine is running. A nitrogen filled accumulator provides standby hydraulic pressure in sufficient volume to apply the brakes several times after main hydraulic system ceases to operate. Control valves also contain master cylinders to permit manual operation when hydraulic pressure is not available.

The only adjustment provided is at operating rod and extension (1 and 11—Fig. 200A). This adjustment is used to equalize brake pedals. To adjust, first loosen both bleed screws and depress pedals to relieve hydraulic pressure. Install a 0-5000 psi (0-35000 kPa) pressure gage in brake pressure line. Disconnect return line from brake valve and connect a hose to valve fitting so oil can be directed into a container. Disconnect right operating rod extension, then adjust left extension to obtain left pedal height of 5.75-5.87 inches (146-149 mm) from footrest to upper curved surface of pedal. Reconnect right operating rod extension, lock both pedals together and bleed brake system as outlined in paragraph 181. With engine running, apply force to brake pedals to obtain 1000 psi (7000 kPa) reading on pressure gage. A continuous flow of oil from brake valve return indicates adjustment is needed. Adjust right brake rod extension until return flow is reduced to a minimum. If adjustment does not reduce oil flow, disassemble and inspect brake valve as outlined in paragraph 182.

Relieve hydraulic pressure, then remove gage and reconnect return oil line. Bleed brakes as outlined in paragraph 181.

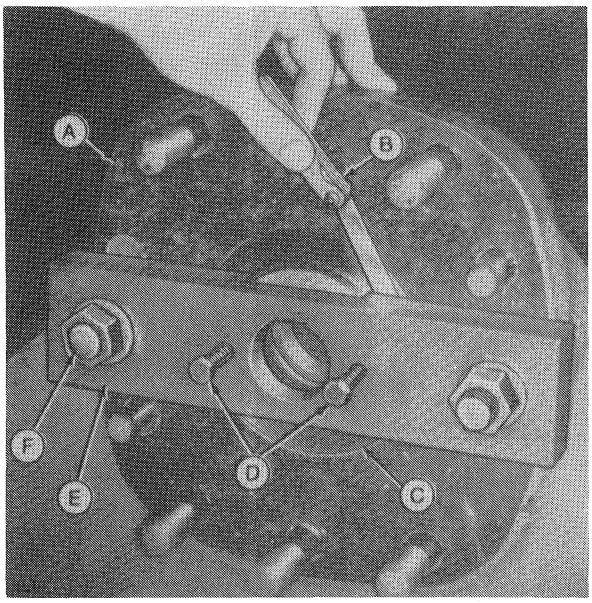


Fig. 199—Refer to text for use of special tool necessary for determining correct thickness of shims (13—Fig. 196) required for assembly.

A. Gasket
B. Feeler gage
C. Bearing retainer
D. Pressure screws
E. Special tool
F. Stud nuts

BLEEDING

All Models

181. When brake hydraulic system has been disconnected, bleed the system as follows:

Loosen right-hand bleed screw locknut, located in transmission housing at top rear of final drive housing (Fig. 200). Back out bleed screw two turns, then

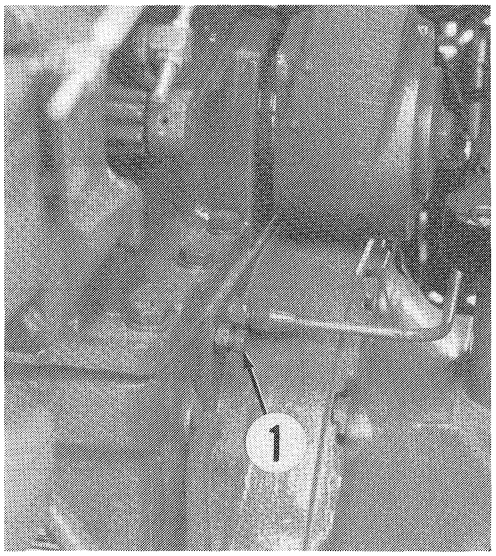


Fig. 200—Brake bleed screws (1) are located in transmission housing at rear of final drive housings.

tighten locknut to prevent external oil leak. Start engine, then depress right brake and hold down for two minutes. With pedal depressed, loosen locknut and retighten bleed screw. Release pedal and tighten locknut. Repeat procedure for left-hand brake.

Pedals should feel solid and travel should not exceed 3 inches (76 mm). Repeat bleeding procedure if necessary. If trouble is not corrected, overhaul system components.

BRAKE VALVE

All Models

182. R&R AND OVERHAUL. To remove the brake valve (1—Fig. 202), first loosen bleed screws and depress brake pedals to relieve system pressure. Remove shield from right side, disconnect the two hydraulic lines and remove the elbows from front of brake valve. Remove cowl. Disconnect hydraulic lines from brake valve. Remove special pin which secures right extension rod (11—Fig. 200A) to pedals, then remove extension rod. Remove strap (10) and right brake pedal. Remove special pin and left brake extension rod. Remove valve mounting cap screws and withdraw valve assembly.

Manual brake pistons (11—Fig. 201) and plungers (12) and equalizing valve assembly (1 through 8) can be lifted out after valve cover is removed. Use a deep socket to remove inlet valve nipples (14). Pull operating rod guides (7—Fig. 200A) from cover and remove "O" rings (8). Remove fitting (18—Fig. 201) and plugs (29 and 30) to complete disassembly of valve components.

Clean parts thoroughly and check against the values which follow:

Manual piston OD	0.933-0.935 in. (23.70-23.75 mm)
Manual piston bore in valve	0.9365-0.9375 in. (23.79-23.81 mm)
Plunger OD	0.5595-0.5605 in. (14.21-14.24 mm)

Check for free movement of operating valve guides (7—Fig. 200A) and equalizing valve pins (1—Fig. 201). Renew all "O" rings whenever unit is disassembled.

To reassemble, reverse the disassembly procedure. Tighten inlet valve nipples (14) to 40 ft.-lbs. (54 N·m). Reinstall control valve, then bleed system and adjust pedals as previously outlined.

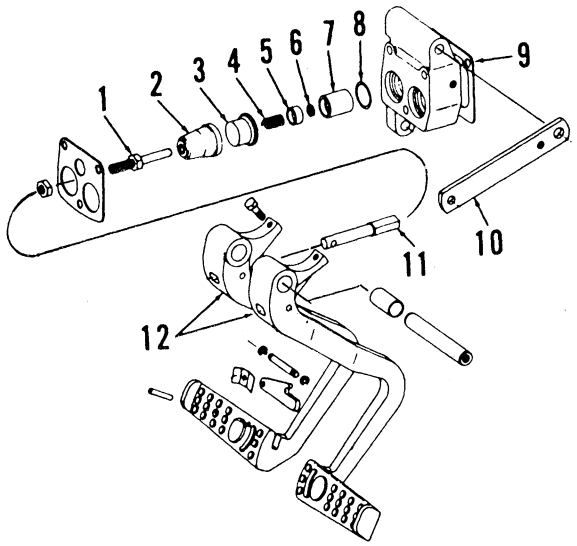


Fig. 200A—Exploded view of brake valve cover, pedals and associated parts. Right and left brake parts are identical.

1. Operating rod
2. Boot
3. Boot retainer
4. Spring
5. Stop
6. Snap ring
7. Operating rod guide
8. "O" ring
9. Cover
10. Strap
11. Extension
12. Pedals

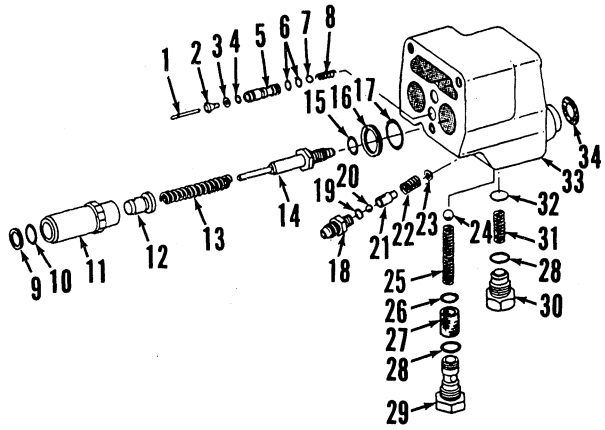


Fig. 201—Exploded view of brake valve with cover removed. Operating parts shown are for right brake.

1. Equalizing valve pin
2. Sleeve
3. Shim
4. "O" ring
5. Equalizer valve guide
6. "O" rings
7. Ball
8. Spring
9. Paper washer
10. "O" ring
11. Manual brake piston
12. Plunger
13. Spring
14. Inlet valve nipple
15. "O" ring
16. Back-up ring
17. "O" ring
18. Inlet fitting
19. "O" ring
20. Check ball
21. Guide
22. Spring
23. Washer
24. Ball
25. Spring
26. "O" ring
27. Screen
28. "O" ring
29. Plug
30. Plug
31. Spring
32. Check valve disc
33. Valve housing
34. Spacer

BRAKE ACCUMULATOR

All Models

183. R&R AND OVERHAUL The brake accumulator is located in the steering console directly below the brake control valve. To remove brake accumulator (7—Fig. 202), first loosen brake bleed screws and depress brake pedals to bleed pressure from brake system. Remove dash cover and cowl cover. Remove differential lock line (2) and fitting (6), brake pressure line (4) and return line (8). Remove differential lock pedal (3). Remove accumulator pressure line (5) and accumulator retainer clip, then withdraw accumulator.

CAUTION: Bleed nitrogen gas from accumulator before attempting to disassemble. Remove plug (1—Fig. 203) and depress charging valve (10) until all gas has escaped.

With pressure relieved, push end caps (4 and 16) into cylinder, then remove retaining rings (3). Pull end caps from cylinder barrel. Push piston (15) out of cylinder. Remove and discard all "O" rings and back-up washers. Remove thermal relief valve and inlet check valve from oil inlet end cap.

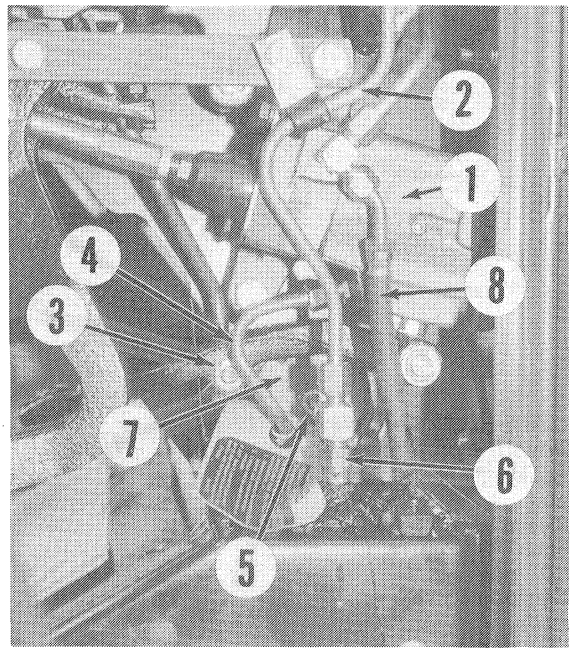


Fig. 202—The brake accumulator is located in the steering console directly below the brake control valve.

1. Brake control valve
2. Differential lock line
3. Differential lock pedal
4. Brake pressure line
5. Accumlator pressure line
6. Fitting
7. Accumulator
8. Brake return line

Check all parts for wear or damage. Check piston and cylinder for scoring or other damage and renew if necessary.

To reassemble the accumulator, reverse the disassembly procedure. Recharge the cylinder using approved charging equipment and dry nitrogen only. Nitrogen gas does not mix with oil, is not combustible, will not cause oxidation or condensation within the accumulator and is not harmful to piston seal. DO NOT use compressed air or oxygen. Recharge accumulator to a pressure of 475-525 psi (3280-3620 kPa).

Reinstall accumulator by reversing the removal procedure. Bleed brakes as outlined in paragraph 181. With accumulator properly charged, the brakes should have at least five power applications after engine is shut off.

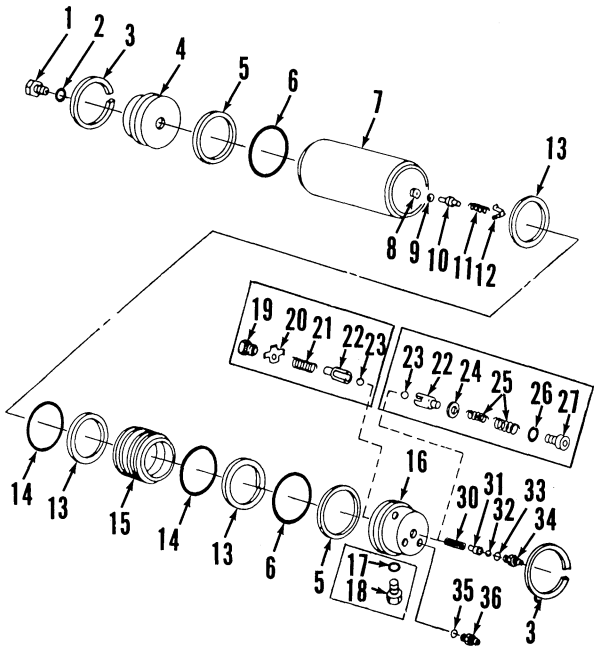


Fig. 203—Exploded view of brake accumulator. Parts shown in insets are used on early models.

1. Plug
2. "O" ring
3. Snap ring
4. Accumulator end
5. Back-up rings
6. "O" rings
7. Cylinder barrel
8. Packing
9. Washer
10. Charging valve
11. Spring
12. Guide
13. Back-up rings
14. "O" rings
15. Piston
16. Oil inlet cap
17. "O" ring
18. Plug
19. Retainer
20. Lockplate
21. Spring
22. Guide
23. Balls
24. Shim
25. Springs
26. "O" ring
27. Plug
30. Spring
31. Guide
32. Ball
33. "O" ring
34. Adapter
35. "O" ring
36. Fitting

BRAKE PISTONS, PLATES AND DISCS

All Models

184. R&R AND OVERHAUL. To remove brake discs or operating pistons, first remove the final drive units as outlined in paragraph 172. Remove the output shaft, backing plate and brake disc (Fig. 204). The three stationary brake pads are riveted to the backing plate (2—Fig. 205). The three actuating pads (5) are pressed on the operating pistons (6). The piston and pad assemblies can be withdrawn from transmission housing bores after brake disc is removed. Remove washer (7) and "O" ring (8) from piston bore.

Inspect piston and piston bore for pitting, scoring or excessive wear. Pistons should have 0.003-0.007 inch (0.08-0.18 mm) diametral clearance in bores. Inspect brake pads for missing rivets and loose or worn facings. To renew brake pads, drill out the retaining rivets. Install new pads making sure rivet heads are 0.060 inch (1.6 mm) below surface of pad. Renew brake disc if warped or excessively worn.

To reinstall, reverse the removal procedure. Bleed brake system as outlined in paragraph 181.

POWER TAKE-OFF

185. Tractors may be equipped with either a single speed (1000 rpm) or dual-speed (540 and 1000 rpm) power take-off (pto). On all tractors, the pto is driven by a hydraulically applied, independently controlled clutch. Quad-Range models use a single disc clutch mounted on the engine flywheel. Power Shift models are equipped with a multiple disc clutch assembly located in the clutch housing. Refer to paragraph 101 for clutch overhaul on Quad-Range models. Clutch overhaul procedure for Power Shift models is contained in this section.

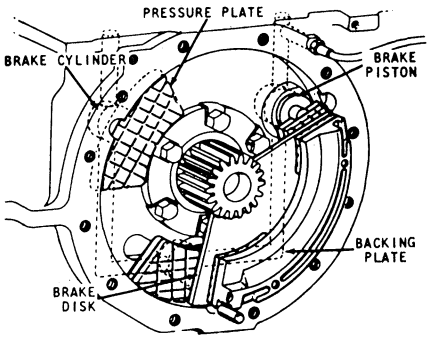


Fig. 204—Schematic view of assembled brake unit located on differential output shafts in transmission housing.

On Quad-Range models, the pto control valve is contained in the clutch pressure regulating valve housing which is mounted on left side of clutch housing. Refer to paragraph 99 for overhaul procedures. On Power Shift models, the pto control valve is contained in the traction clutch valve housing which is mounted on left side of clutch housing. Refer to paragraph 136 for overhaul procedures.

QUAD-RANGE MODELS

4050-4250-4450 Without MFWD

186. The dual-speed pto drive train used on these tractors consists of a main drive gear (39—Fig. 207), pto shaft drive gear (32), pto drive shaft with gear (25), countershaft gear (12—Fig. 206), 540 rpm gear (22) and output shaft (2A or 2B). The 1000 rpm shaft (2A) goes through the 540 rpm gear and splines directly into the main drive shaft (25). When 540 rpm is desired the 540 rpm shaft (2B) is inserted through bearing retainer and splines into the 540 rpm gear (22). The 540 rpm gear is driven by the countershaft gear (12) to provide the necessary speed reduction. The pto brake piston (33—Fig. 207) is applied against gear (32) when tractor is running but pto is disengaged.

187. OUTPUT SHAFT AND GEARS. To overhaul pto drive train at rear of tractor, first drain transmission oil. Unbolt and remove rear bearing retainer (5—Fig. 206) with stub shaft and 540 rpm gear (22). Be careful not to lose the spring washer (21). Squeeze large snap ring (26), then pull pto drive shaft (25) from transmission case. Countershaft gear (12) can be removed by pulling shaft (7) rearward from case

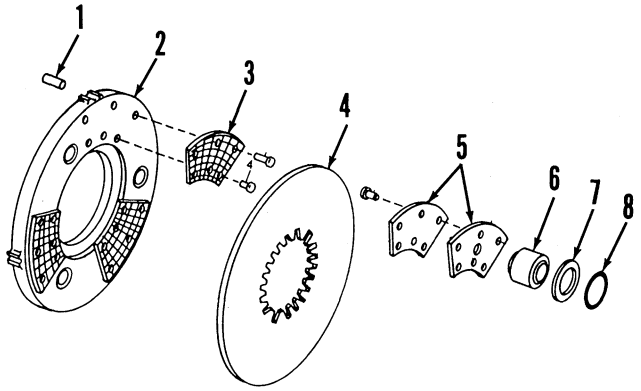


Fig. 205—Exploded view of wet type hydraulic disc brake operating parts.

1. Dowel
2. Backing plate
3. Brake lining
4. Brake disc
5. Actuating pad & back plate
6. Piston
7. Paper washer
8. "O" ring

while holding gear to prevent losing the roller bearings (10) and thrust washers (9).

Remove snap ring (29—Fig. 206) and use a suitable puller to remove drive shaft bearing (27) if necessary. Remove snap ring (1) and withdraw output shaft from bearing retainer (5). Remove speed sensor pickup disc (19) if so equipped. Remove snap ring (17) and press guide (15) and bearing (16) from retainer. Drive oil seal (13) out of retainer.

Inspect all parts for wear or other damage. Be sure to renew oil seal (13) and "O" rings (8 and 14). When reinstalling countershaft gear (12), use a light coat of grease to hold the 48 bearing rollers in place. Position countershaft (7) so notched section in end of shaft will be aligned with bearing retainer (5) when retainer is installed. Install drive shaft (25) into case and engage snap ring (26) into groove in case.

NOTE: If the large drive gear (32—Fig. 207) slipped off the sleeve (35) during disassembly, it can be properly relocated by removing the clutch pressure regulating valve housing from left side of clutch housing and repositioning the gear on the sleeve.

Complete reassembly in reverse order of disassembly. Tighten bearing retainer cap screws and stud nuts to 85 ft.-lbs. (115 N·m).

188. MAIN DRIVE GEARS. To remove main drive gear (39—Fig. 207) and pto shaft drive gear (32), tractor must be split between engine and clutch housing as outlined in paragraph 100. Main drive gear and brake piston (33) are contained in the clutch operating piston housing. Refer to paragraph 103 for overhaul procedure.

Remove the Quad-Range planetary as outlined in paragraph 105 for access to pto shaft drive gear (32). Remove drive shaft (25) as outlined in paragraph 187. Support gear and oil shield, then move gear rearward to clear bearing sleeve (35) and lift gear with shield from clutch housing.

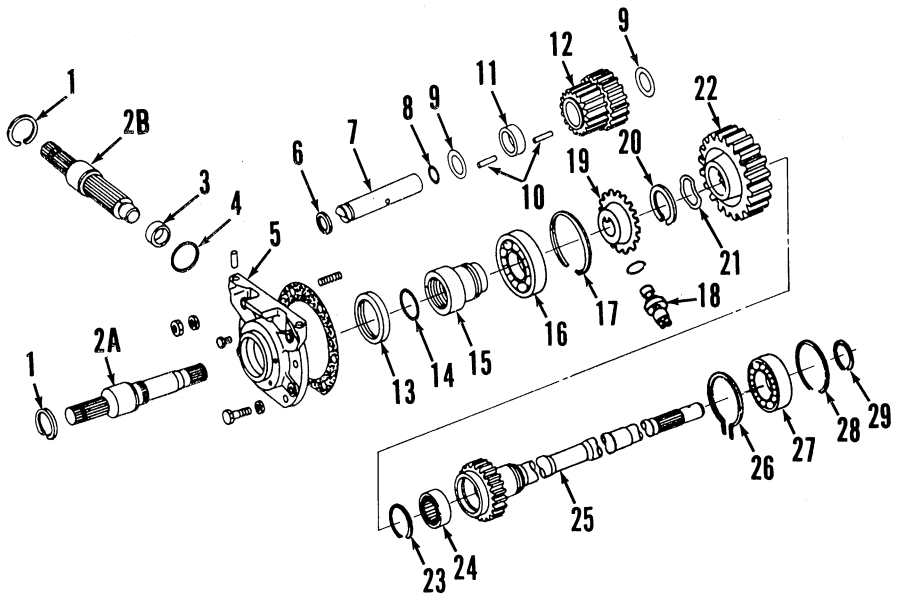
Inspect all parts for wear or damage and renew if necessary. When reinstalling drive gear, be careful not to damage oil shield. Reassemble in reverse order of disassembly.

4050-4250-4450 With MFWD

189. The rear section of the pto drive train used on these models is identical to rear section used on models not equipped with mechanical front-wheel drive (MFWD). Refer to paragraph 187 for service procedures.

To service the front section components, refer to paragraphs 190 through 192.

190. PTO IDLER GEARS. To remove pto idler gears, separate tractor between engine and clutch housing as outlined in paragraph 100. Remove clutch operating piston as outlined in paragraph 103 and remove Quad-Range planetary as outlined in paragraph 105. The upper idler gear shaft (5—Fig. 209) was removed during removal of planetary. Shift the sheet metal housing (M) and upper idler gear (3) to one side, then remove rear spacer washer (1) and bearings (2) from idler gear. To remove lower idler gear shaft (14), thread a M16 cap screw with a large washer into end of shaft. Use a suitable slide hammer puller to withdraw the shaft. Lift sheet metal housing with idler



1. Snap ring
2A. 1000 rpm shaft
2B. 540 rpm shaft
3. Bushing
4. Seal ring
5. Bearing retainer
6. Snap ring
7. Countershaft
8. "O" ring
9. Thrust washer
10. Bearing rollers
11. Spacer
12. Countershaft gear
13. Oil seal
14. "O" ring
15. Guide
16. Bearing
17. Snap ring
18. Speed sensor (if equipped)
19. Pickup disc (if equipped)
20. Snap ring
21. Spring washer
22. 540 rpm gear
23. Snap ring
24. Bearing
25. Drive shaft
26. Snap ring
27. Bearing
28. Snap ring
29. Snap ring

Fig. 206—Exploded view of reduction gears, output shafts and related parts used on all models equipped with dual-speed pto.

gears from clutch housing. Remove thrust bearing and washer from front side of lower shaft bore.

Remove lower idler gear and pinion gear from sheet metal housing. Open sheet metal housing and remove upper idler gear.

Inspect all parts for wear or other damage and renew if necessary. If upper idler gear or bearings are renewed, check and adjust gear end play prior to reassembly as follows: Assemble thinner spacer washer (4—Fig. 208), idler gear (3) with bearings and thicker spacer washer (1) onto the idler shaft. Press down on upper bearing while rotating gear to seat bearings, then use a feeler gage to measure clearance (end play) between thicker washer (1) and bearing inner race. Desired end play is 0.001-0.003 inch (0.03-0.07 mm). The end play is adjusted by installing a different thickness thin washer (4—Fig. 208). The washer is available in different thicknesses in increments of 0.002 inch (0.05 mm).

To reinstall idler gears, reverse the removal procedure while noting the following special instructions: Make sure tapered side of thrust washer (15) is inserted into housing lower bore. Make certain wider groove in end of lower idler shaft (14) is aligned with the antirotation pin in housing bore. The upper idler shaft (5) and thinner spacer washer (4) are installed after planetary assembly is installed.

191. PTO BRAKE. The pto brake is located behind the lower idler gear and is supported by two dowel pins in the clutch housing. Brake assembly can be removed after removing idler gears as outlined in previous paragraph.

To disassemble, remove sheet metal cover (29—Fig. 208) and separate components from piston housing (24). Inspect all parts and renew if necessary.

Assemble new seals (23 and 26) into housing and piston (27) so lips of seals are facing each other when piston is installed. Apply light coat of petroleum jelly to seals before reinstalling piston. Install diaphragm spring (28) so tangs of spring are against the piston. Be sure to renew paper gasket (30). Coat gasket with grease to hold it in position in clutch hous-

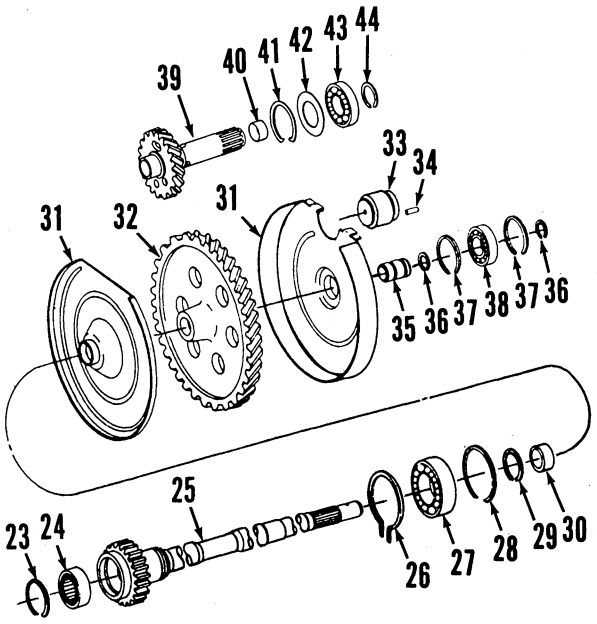


Fig. 207—Exploded view of pto front section drive gears and associated parts used on 4050, 4250 and 4450 Quad-Range models not equipped with MFWD.

23. Snap ring
24. Bearing
25. Drive shaft
26. Snap ring
27. Bearing
28. Snap ring
29. Snap ring
30. Bushing
31. Oil shield
32. Drive gear
33. Pto brake piston
34. Pin
35. Sleeve
36. Snap ring
37. Snap ring
38. Bearing
39. Drive shaft & gear
40. Bushing
41. Snap ring
42. Washer
43. Bearing
44. Snap ring

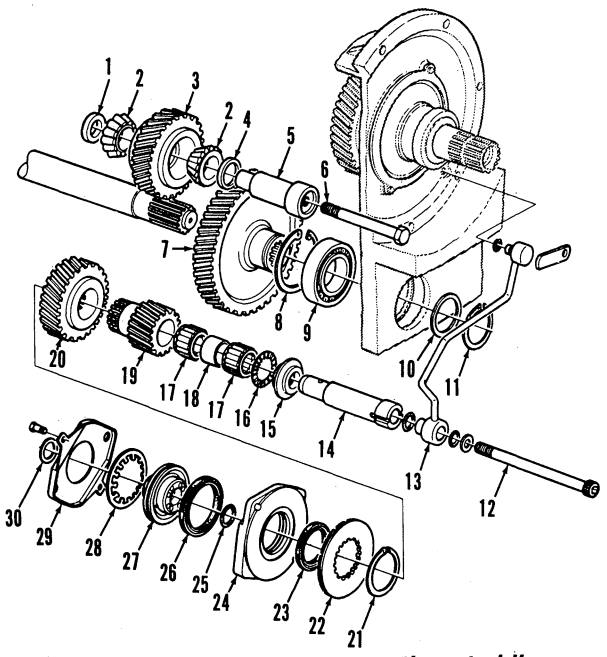


Fig. 208—Exploded view of front section pto idler gears and drive gear used on 4050, 4250 and 4450 Quad-Range models equipped with MFWD.

1. Washer (thick)
2. Bearing cones
3. Upper idler gear
4. Washer (thin)
5. Upper idler shaft
6. Cap screw
7. Pto drive gear
8. Snap ring
9. Bearing
10. Washer
11. Snap ring
12. Cap screw
13. Oil line
14. Lower idler shaft
15. Thrust washer
16. Thrust bearing
17. Bearings
18. Spacer
19. Pinion gear
20. Lower idler gear
21. Snap ring
22. Pto brake disc
23. Seal
24. Piston housing
25. "O" ring
26. Seal
27. Brake piston
28. Spring
29. Cover
30. Gasket

ing bore. Complete installation by reversing removal procedure.

192. PTO DRIVE GEAR. To remove drive gear (7—Fig. 208), remove pto idler gears as outlined in paragraph 190. Remove mechanical front-wheel drive (MFWD) clutch as outlined in paragraph 7. Separate transmission from clutch housing and remove MFWD drive shaft and drive gear as outlined in paragraph 119.

Remove snap ring (11—Fig. 208) and spacer (10) from front of gear hub. Pull gear rearward out of bearing, then lift from clutch housing. Remove snap ring (8), then use a slide hammer to pull bearing rearward from housing. Press bearing inner race off gear hub.

If bearing is being renewed, heat inner race to 300° F (150° C) maximum before installing onto gear hub. Complete installation by reversing removal procedure.

Model 4650

193. The single-speed (1000 rpm) pto drive train consists of a main drive gear (1—Fig. 211), which is contained in the clutch operating piston housing and driven by the pto clutch hub, and the pto drive gear (9) which drives the output shaft (23). The pto brake piston (10), located in the clutch operating piston housing, is applied against drive gear (9) when pto clutch is disengaged.

Service procedures covering main drive gear (1) and pto brake (10) are outlined in paragraph 101.

194. OUTPUT SHAFT. To remove shaft assembly, first drain transmission oil. Remove clutch pressure regulating valve housing from left side of transmission case as outlined in paragraph 99. It is recommended that an additional person hold pto drive gear (9—Fig. 211) forward when output shaft (23) is removed. Remove cap screws securing bearing retainer (27), then withdraw retainer and shaft from transmission case.

Remove speed sensor pickup disc (17), snap rings (16) and pin (18) if so equipped. Remove retainer plate (19) and shims (20). Use a suitable puller to remove shaft and bearings from retainer. Pry oil seal (25) from retainer.

Inspect all parts and renew if necessary. Install new oil seal so it is bottomed against shoulder in retainer. If bearing cones are being renewed, heat cones

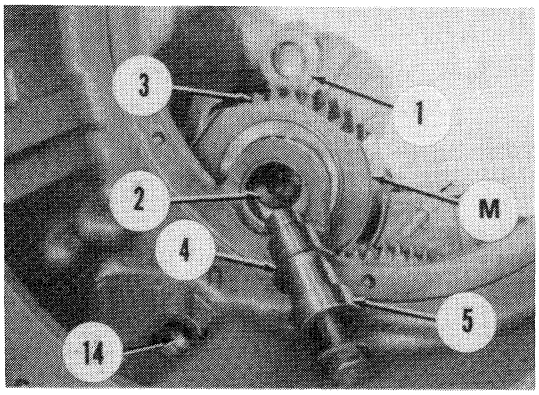


Fig. 209—View of upper pto idler gear with Quad-Range planetary removed. Upper idler shaft (5) is removed during planetary removal procedure.

1. Rear washer (thicker)
2. Bearings
3. Upper idler gear
4. Front washer (thinner)
5. Upper idler shaft
14. Lower idler shaft

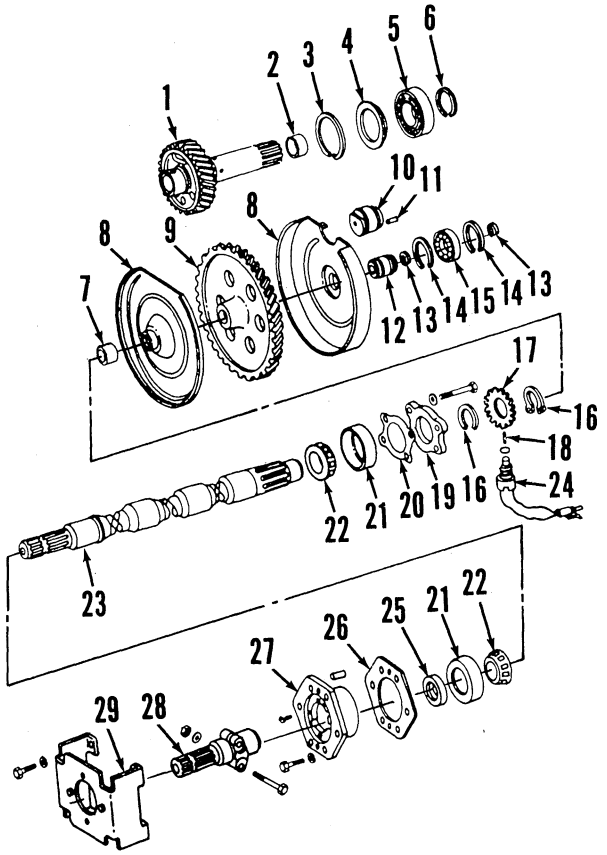


Fig. 211—Exploded view of single-speed pto power train components used on Model 4650 with Quad-Range transmission.

1. Main drive gear
2. Bushing
3. Snap ring
4. Oil shield
5. Bearing
6. Snap ring
7. Bushing
8. Oil shield
9. Pto gear
10. Brake piston
11. Pin
12. Sleeve
13. Snap ring
14. Snap ring
15. Bearing
16. Snap ring
17. Pickup disc (if equipped)
18. Pin
19. Plate
20. Shim
21. Bearing cup
22. Bearing cone
23. Pto shaft
24. Speed sensor (if equipped)
25. Seal
26. Gasket
27. Bearing retainer
28. Adapter shaft
29. Support

to 300° F (150° C) maximum before installing onto shaft. Install retainer plate with enough shims (20) to ensure end play and tighten retainer plate cap screws to 50 ft.-lbs. (68 N·m). Adjust shaft bearing end play as follows:

Secure shaft in a vise, then rotate bearing retainer in both directions to seat bearings. Install a dial indicator on retainer housing with indicator probe against end of output shaft, then move retainer forward and rearward and note indicator reading. Add or remove shims (20—Fig. 211) as necessary to obtain recommended end play of 0.001-0.005 inch (0.03-0.13 mm). Tighten retainer plate cap screws to 50 ft.-lbs. (68 N·m).

If equipped with sensor pickup disc (17), install pin (18) into hole in shaft so it protrudes 0.236 inch (6 mm). Install disc with slot over the pin. Install front snap ring with gap in line with pin.

Use of an additional person is recommended to hold pto drive gear (9) in place and assist in aligning front of pto shaft with the gear during installation. Tighten bearing retainer cap screws to 85 ft.-lbs. (115 N·m).

195. PTO DRIVE GEAR. To remove pto drive gear (9—Fig. 211), the tractor must be split between engine and clutch housing as outlined in paragraph 100 and the Quad-Range planetary removed as outlined in paragraph 105. Move drive gear and oil shield rearward to clear bearing sleeve (12), then lift gear and shield from clutch housing.

Inspect all parts for wear or other damage. To renew ball bearing (15), it is recommended that clutch housing be separated from transmission case.

To reinstall, reverse the removal procedure.

POWER SHIFT MODELS

All Models So Equipped

196. The pto drive train used on these models consists of a main drive gear mounted to the front of transmission input planetary. The main drive gear transmits power to the pto clutch and drive gear (19—Fig. 216) assembly. The pto clutch is hydraulically engaged and spring disengaged. The pto drive shaft (42) is splined to the pto clutch hub (18).

A dual-speed (540 and 1000 rpm) pto is available on 4050, 4250 and 4450 models. The 1000 rpm output shaft (2A—Fig. 212) splines directly into the pto drive shaft (25). When 540 rpm is desired the 540 rpm output shaft (2B) is installed in place of the 1000 rpm shaft. The 540 rpm shaft splines into the 540 rpm gear (22) which is driven by the countershaft gear (12) to provide necessary speed reduction.

A single speed (1000 rpm) pto is used on 4650 and 4850 models.

The pto brake (items 25 through 34—Fig. 216) is spring engaged and hydraulically disengaged. The brake hub (31) is splined to the pto output shaft to provide pto braking when pto clutch is disengaged.

Models 4050-4250-4450

197. OUTPUT SHAFT. To overhaul pto drive train at rear of tractor, first drain transmission oil. Unbolt and remove rear bearing retainer (5—Fig. 212) with stub shaft and 540 rpm gear (22). Be careful not to lose the spring washer (21). Squeeze large snap ring (26), then pull pto drive shaft (25) from transmission

1. Snap ring
2A. Output shaft (1000 rpm)
2B. Output shaft (540 rpm)
3. Bushing
4. Seal ring
5. Bearing retainer
6. Snap ring
7. Countershaft
8. "O" ring
9. Thrust washer
10. Bearing rollers
11. Spacer
12. Countershaft gear
13. Oil seal
14. "O" ring
15. Guide
16. Bearing
17. Snap ring
18. Speed sensor (if equipped)
19. Pickup disc (if equipped)
20. Snap ring
21. Spring washer
22. Drive gear (540 rpm)
23. Snap ring
24. Bearing
25. Drive shaft
26. Snap ring
27. Bearing
28. Snap ring
29. Snap ring

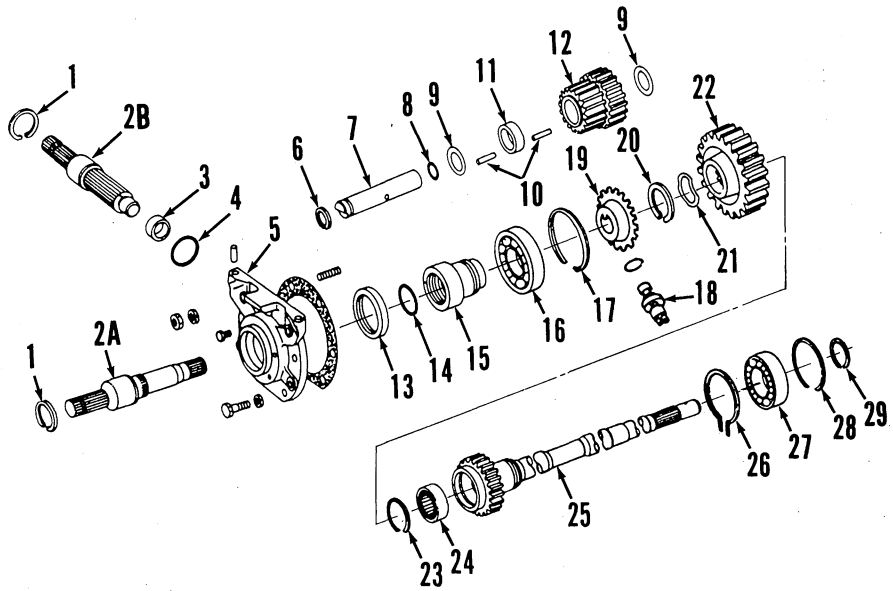


Fig. 212—Exploded view of pto reduction gears, output shafts and related parts used on all Power Shift tractors equipped with dual-speed pto.

case. Countershaft gear (12) can be removed by pulling shaft (7) rearward from case while holding gear to prevent losing the roller bearings (10) and thrust washers (9).

Remove snap ring (29—Fig. 212) and use a suitable puller to remove drive shaft bearing (27) if necessary. Remove snap ring (1) and withdraw output shaft from bearing retainer (5). Remove speed sensor pickup disc (19) if so equipped. Remove snap ring (17), then press guide (15) and bearing (16) from retainer. Drive oil seal (13) out of retainer.

Inspect all parts for wear or other damage. Be sure to renew oil seal (13) and "O" rings (8 and 14). When reinstalling countershaft gear (12), use a light coat of grease to hold the 48 bearing rollers in place. Position countershaft (7) so notched section in end of shaft will be aligned with bearing retainer housing when retainer is installed. Install drive shaft (25) into case and engage snap ring (26) into groove in case. Install bearing retainer with stub shaft and 540 rpm gear. Tighten retainer mounting nuts and cap screws to 85 ft.-lbs. (115 N·m).

Models 4650-4850

198. OUTPUT SHAFT. To remove output shaft assembly, first drain transmission oil. Remove cap screws securing bearing retainer (12—Fig. 213) to transmission case, then withdraw retainer and shaft (9) from case.

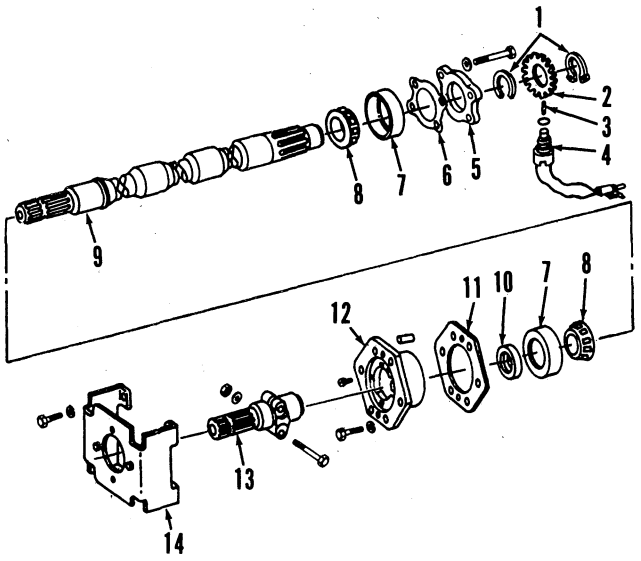


Fig. 213—Exploded view of single-speed pto output shaft and associated parts used on Models 4650 and 4850 equipped with Power Shift transmission.

1. Snap rings
2. Pickup disc
3. Pin
4. Speed sensor
5. Plate
6. Shims
7. Bearing cup
8. Bearing cone
9. Pto shaft
10. Seal
11. Gasket
12. Bearing retainer
13. Adapter shaft
14. Support

Remove speed sensor pickup disc (2), snap rings (1) and pin (3) if so equipped. Remove retainer plate (5) and shims (6). Use a suitable puller to remove shaft and bearings from retainer. Pry oil seal (10) from retainer.

Inspect all parts for wear or other damage and renew if necessary. Inspect splines on front of shaft for wear. The four wide-spaced splines mate with the pto brake hub. Install new oil seal so it is bottomed against shoulder in bearing retainer. If bearing cones are being renewed, heat new cones to 300° F (150° C) maximum before installing onto shaft. Install retainer plate with enough shims (6) to ensure bearing end play and tighten retainer plate cap screws to 50 ft.-lbs. (68 N·m). Adjust bearing end play as follows:

Secure shaft in a vise, then rotate bearing retainer in both directions to seat bearings. Install a dial indicator on retainer housing and position indicator probe against end of shaft, then move housing forward and rearward and note indicator reading. Adjust shim pack thickness as necessary to obtain recommended end play of 0.001-0.005 inch (0.03-0.13 mm). Tighten retainer plate cap screws to 50 ft.-lbs. (68 N·m).

If equipped with sensor pickup disc (2—Fig. 213), install pin (3) into hole in shaft so it protrudes 0.236 inch (6 mm). Install disc with slot over the pin. Install front snap ring with gap in line with pin. Reinstall shaft and retainer and tighten cap screws to 85 ft.-lbs. (115 N·m).

All Models

199. MAIN DRIVE GEAR AND CLUTCH. To remove main drive gear and/or clutch assembly, tractor must be split between engine and clutch housing as outlined in paragraph 131. Unbolt and remove pto drive gear support (5—Fig. 214) with shims, then

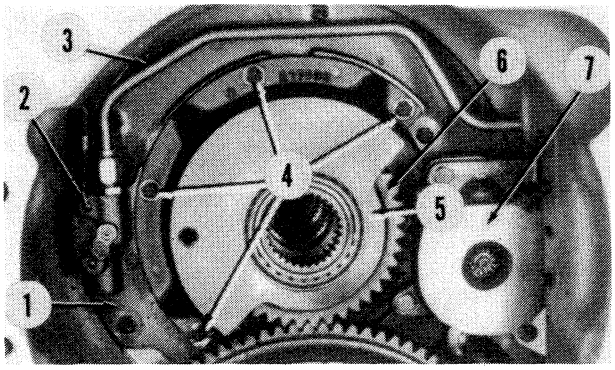


Fig. 214—View of pto drive gears with clutch housing separated from engine.

1. Input planetary housing
2. Hi-Lo shift valve
3. Oil line
4. Cap screws
5. Pto drive gear support
6. Pto drive gear
7. Transmission oil pump

withdraw main drive gear (6). Support (do not raise) Sound-Gard body with a suitable lifting bracket and hoist, then remove left front body mounting bracket to obtain access to traction clutch valve housing. Remove six cap screws securing oil pump (7) to clutch valve housing and remove pump. On Models 4650 and 4850, remove input planetary as outlined in paragraph 133. On all models, remove cap screws securing oil trough (20—Fig. 216), then disconnect and remove oil tube (21). Rotate trough and pto gear counterclockwise until trough can be removed. Remove pto output shaft as outlined in appropriate paragraph 197 or 198. Remove snap ring (1), then pull retaining cap (2) from clutch housing. Retain shims (3) for use in reassembly. Use a suitable lifting tool and a hoist to support pto gear and clutch assembly. Install a 3/8-16 × 3 inch UNC cap screw into end of support shaft (5) to use as a handle. Be sure to hold front bearing cone to prevent it from dropping into clutch housing, then pull support shaft from clutch housing. Tip gear for clearance, then lift gear and clutch assembly from housing.

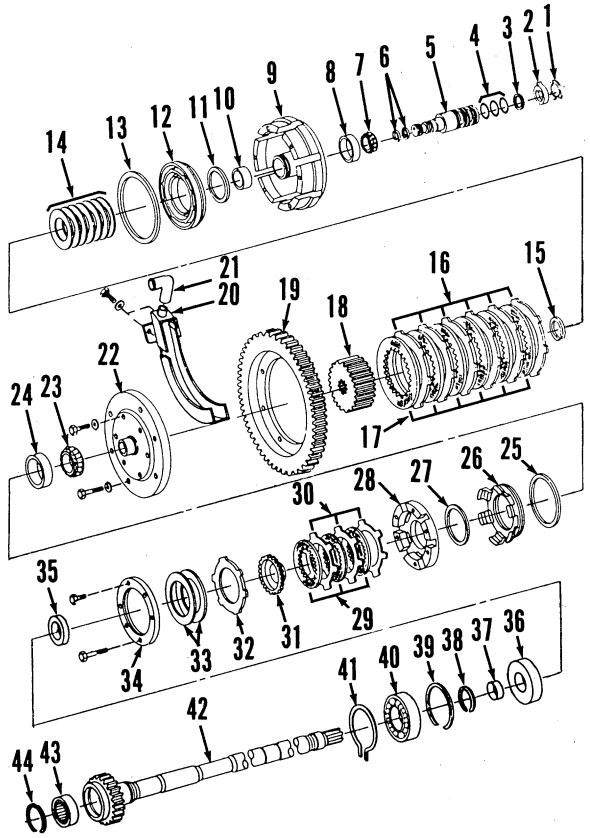


Fig. 216—Exploded view of pto clutch and brake assembly used on models equipped with Power Shift transmission. Drive shaft (42) and related components are used on Models 4050, 4250 and 4450 with dual-speed pto.

1. Snap ring
2. Cap
3. Shim
4. "O" rings
5. Support shaft
6. Seal rings
7. Bearing cone
8. Bearing cup
9. Clutch drum
10. Bushing
11. Seal
12. Clutch piston
13. Seal
14. Springs
15. Snap ring
16. Plates
17. Discs
18. Clutch hub
19. Pto gear
20. Oil trough
21. Oil tube
22. Back plate
23. Bearing cone
24. Bearing cup
25. Seal
26. Brake piston
27. Seal
28. Piston housing
29. Discs
30. Plates
31. Brake hub
32. Back plate
33. Springs
34. Cover
35. Sleeve
36. Support
37. Bushing
38. Snap ring
39. Snap ring
40. Bearing
41. Snap ring
42. Pto shaft (540 & 1000 rpm)
43. Bearing
44. Snap ring

To disassemble clutch, remove backing plate (22—Fig. 216) with gear (19) from clutch drum (9). Lift clutch hub (18), plates (16) and (17) from drum. Use a press and a suitable horseshoe shaped tool to compress spring washers (14) enough to remove snap ring (15). Remove spring washers and piston from drum.

Inspect all parts for wear or other damage and renew if necessary. Renew inner seal (11—Fig. 216) in drum and outer seal (13) in piston. Thickness of clutch discs when new is 0.127-0.133 inch (3.22-3.38 mm). If clutch disc facing chips, flakes or scratches off easily, renew discs regardless of facing thickness. Thickness of separator plates when new is 0.117-0.123 inch (2.97-3.12 mm). Be sure oil passages in support shaft (5) are open. Renew seal rings (6) if worn or damaged. Renew all "O" rings (4).

To reassemble clutch, reverse the disassembly procedure while noting the following special instructions: The wavy separator plates (16) have a punch mark on one of the tangs to identify the high side of the plate. Install plates so high side tangs are positioned in alternating slots around clutch drum. Tighten cap screws securing backing plate to drum and backing plate to gear to 40 ft.-lbs. (54 N·m).

Reinstall pto clutch assembly, bearings and support shaft. Check bearing end play as follows: Install retaining cap (2—Fig. 216) without shims and secure with snap ring (1). Push retainer cap and support shaft rearward while rotating pto gear to seat bearings. Install a dial indicator with indicator tip against retainer cap and zero the indicator. Insert a long bar through pto opening in rear of case and push clutch support shaft forward. Note indicator reading, then remove cap and install shims (3) to provide 0.001-0.006 inch (0.03-0.15 mm) end play. Reinstall retaining cap and snap ring, then recheck end play. After correct end play is obtained, clean retaining cap and housing. Apply a bead of gasket sealing compound around outer edge of retaining cap to seal the opening between cap and clutch housing.

Reinstall oil tube (21) and oil trough (20) using new copper washers on trough retaining screws. Install oil pump and tighten retaining screws to 20 ft.-lbs. (27

N·m). After 10 minutes, retorque oil pump cap screws to 20 ft.-lbs. (27 N·m). If pto drive gear (2—Fig. 216A), bearings or support (1) were renewed, check and adjust end play as follows:

Install drive gear and support with enough shims to ensure end play. Tighten support mounting screws to 20 ft.-lbs. (27 N·m). Install a dial indicator so indicator tip is against end of pto drive gear as shown in Fig. 216A. Move drive gear forward and rearward and note indicator reading. Remove dial indicator and support, then remove shims as required to obtain 0.001-0.004 inch (0.03-0.10 mm) end play. Reinstall support and tighten cap screws to 20 ft.-lbs. (27 N·m).

Complete installation by reversing the removal procedure.

All Models

200. PTO BRAKE. On models not equipped with mechanical front-wheel drive (MFWD), the pto brake can be removed by reaching through from the front side of clutch housing. The tractor must be split between engine and clutch housing and the input planetary assembly removed as outlined in paragraph 133. Remove pto output shaft as outlined in paragraph 197 or 198.

On models equipped with MFWD, the clutch housing must be removed from the tractor to remove pto brake. Remove pto clutch as outlined in paragraph 199 and remove MFWD idler gear from clutch housing as outlined in paragraph 154.

On all models, remove the three cap screws securing brake assembly to housing, then remove brake assembly. Remove backing plate (34—Fig. 216), then separate spring washers (33), backing plate (32), hub (31) and clutch pack (29 and 30).

Inspect brake discs and separator plates for wear or other damage. Renew discs if facing material chips, flakes or scratches easily. Thickness of discs when new is 0.071-0.075 inch (1.80-1.90 mm). Thickness of separator plates when new is 0.062 inch (1.57 mm). Inspect brake hub (31) for wear or damage. Renew hub if the four teeth on inner diameter of hub are worn or chipped. The hub is splined to the pto drive shaft by the four teeth mating with four splines of the pto shaft. If rear bearing cup (24) requires renewal, pto clutch assembly must be removed. Install a new bearing cup only part way into housing bore. Final location of cup will be made by installing brake housing. Pto clutch bearing end play must be checked as outlined in paragraph 199 after renewing bearing.

When reassembling, install a separator plate first, then alternately install discs and remaining plates. Install first spring washer with outer diameter against backing plate. Install second spring so inner diameter is against inner diameter of first spring. Tighten spring backing plate retaining screws to 20 ft.-lbs. (27 N·m).

To reinstall pto brake assembly, reverse the removal procedure. If equipped with MFWD, be sure to position brake so notch in brake backing plate will be in line with MFWD idler gear. Tighten brake mounting screws evenly to 35 ft.-lbs. (48 N·m).

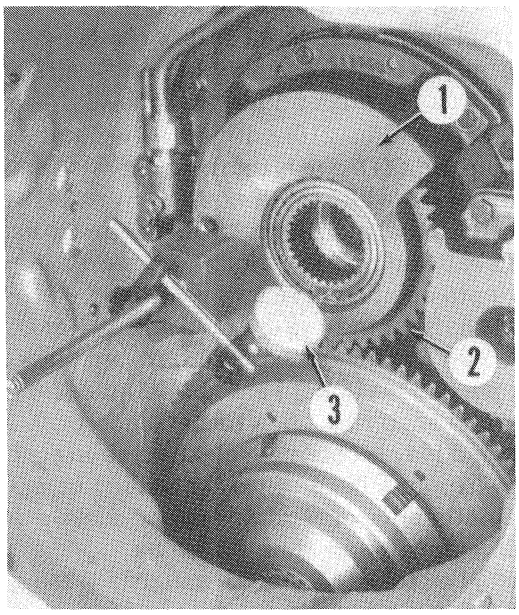


Fig. 216A—Use a dial indicator (3) to check end play of pto drive gear (2).

HYDRAULIC SYSTEM

MAIN HYDRAULIC SYSTEM

All Models

201. OPERATION. The main hydraulic system pump is mounted in front of radiator and driven by engine crankshaft through a coupler. The variable displacement, radial piston pump provides only the fluid necessary to maintain system pressure. When there are no demands on the system, the pistons are held away from the pump camshaft by fluid pressure and no flow is present. When pressure is lowered in the system by hydraulic demand or by leakage, the stroke control valve in the pump meters fluid from the camshaft reservoir, permitting the pistons to operate and supply the flow necessary to maintain system pressure.

The transmission pump provides fluid for transmission and clutch operation. The excess fluid flow from transmission pump flows through transmission oil filter and the oil cooler, then provides charge oil to inlet side of main pump.

A pressure control valve prevents flow of high pressure oil to rockshaft and selective control valves (non-priority functions) until demands made by steering, brakes, differential lock and seat (priority functions) have been met. Oil returning from rockshaft and selective control valves passes through a return oil filter to the return oil manifold. The return oil manifold combines all return oil flow, then directs oil to lubrication circuit and to inlet side of main pump.

202. RESERVOIR AND FILTERS. The hydraulic system reservoir is the transmission housing. The hydraulic fluid also provides lubrication for transmission, differential and final drive units. The manufacturer recommends that only John Deere HY-GARD Transmission and Hydraulic oil or its equivalent be used in the system. Approximate reservoir capacity is as follows:

Quad-Range Models

4050, 4250 and 4450
Without MFWD ..... 16.0 U.S. Gal. (60 L)
4050, 4250 and 4450
With MFWD ..... 17.2 U.S. Gal. (65.1 L)
4650 ..... 23.5 U.S. Gal. (85 L)

Power Shift Models

4050, 4250 and 4450
Without MFWD ..... 13.5 U.S. Gal. (51 L)
4050, 4250 and 4450
With MFWD ..... 16.0 U.S. Gal. (60 L)
4650 and 4850
Without MFWD ..... 23 U.S. Gal. (87 L)
4650 and 4850
With MFWD ..... 26 U.S. Gal. (98 L)

Check hydraulic oil level before starting engine, or a minimum of five minutes after stopping engine. With tractor on level ground, make sure fluid level is in "SAFE" range on dipstick (2—Fig. 217). Manufacturer recommends renewing hydraulic oil after every 1200 hours of operation.

The charge pump suction screen, located in transmission housing at the rear of hydraulic filters (Fig. 218 or 219), should be removed and cleaned after every 1200 hours of operation. Hydraulic oil must be drained before removing suction screen. Wash screen in solvent and blow dry with compressed air.

The transmission oil filter and hydraulic oil filter are located on the left side of transmision housing as shown in Fig. 220 or 221. Manufacturer recommends renewing filter elements after every 600 hours of operation or once a year, whichever comes first.

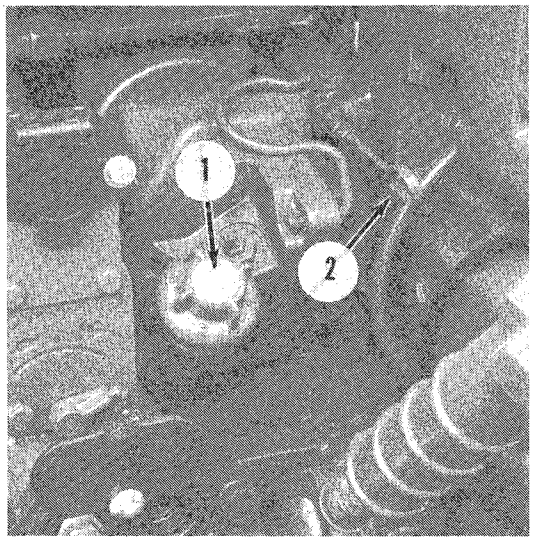


Fig. 217—Hydraulic system and transmission fluid filler tube (1) and dipstick (2) are located at rear of tractor.

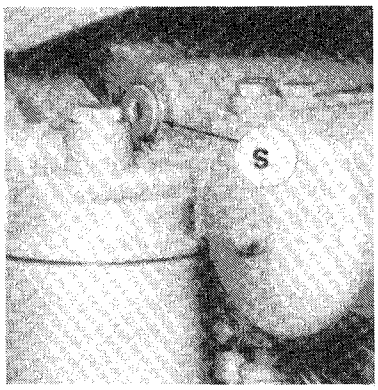


Fig. 218—View of charge pump suction screen (S) location on Quad-Range transmission.

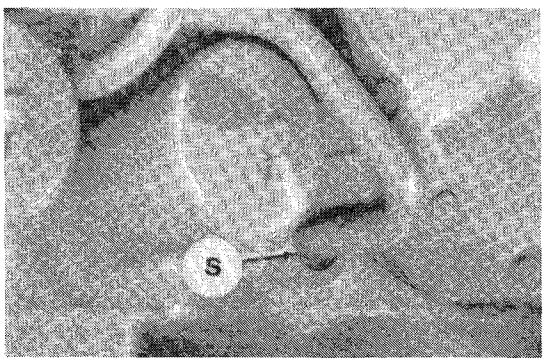


Fig. 219—View of charge pump suction screen (S) location on Power Shift transmission.

NOTE: If "TRANS FILTER" indicator warning light comes on, renew filter element regardless of length of service. Check for origin of contamination if filter life is excessively short.

The filter elements can be renewed without draining oil from the reservoir. However, a small amount of oil trapped in the filter cover will be lost as cover is removed.

TESTING AND TROUBLE-SHOOTING

All Models

203. Efficient operation of the tractor hydraulic system requires that each component operates properly. A logical step-by-step procedure for testing the system is therefore needed. Follow these procedures in sequence to isolate hydraulic system problems. Unless the indicated repair of a hydraulic unit is obvious because of breakage, these tests should be performed before attempting to repair the individual units.

NOTE: Before disconnecting any hydraulic lines, relieve system hydraulic pressure by loosening brake bleed screws and depressing brake pedals until they go all the way down.

Before beginning test procedure, disconnect transmission by shifting into "TOW" position. Make certain transmission oil filter and filter relief valve are in good operating condition. Connect a 0-60 psi (0-400 kPa) pressure gage to return oil manifold test port (2—Fig. 222). Connect a 0-5000 psi (0-35000 kPa) pressure gage to pressure control valve test port (4—Fig. 222A). On Quad-Range models, connect a 0-300 psi (0-2000 kPa) pressure gage to test port (1—Fig. 223) of traction clutch oil pressure regulating valve. On Power Shift models, connect a 0-300 psi (0-2000 kPa) pressure gage to test port (1—Fig. 223A) of traction clutch oil pressure regulating valve.

Hydraulic oil temperature should be 110° F (44° C) minimum before proceeding with tests. To heat hydraulic oil, connect a hose to left SCV coupler and secure other end of hose in transmission oil filler tube. Connect a hose to both couplers of right SCV.

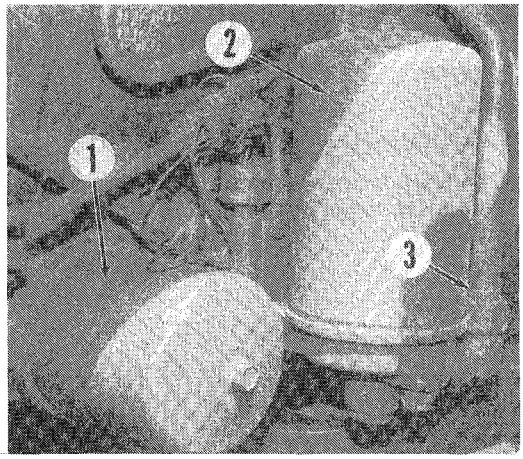


Fig. 220—View of oil filter arrangement on tractors equipped with Quad-Range transmission. Front element (1) is transmission oil filter and rear element (2) is hydraulic oil filter.

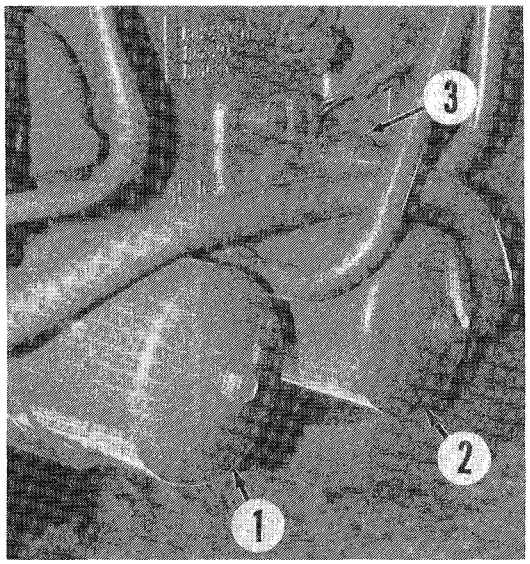


Fig. 221—View of oil filter arrangement on tractors equipped with Power Shift transmission. Front element (1) is transmission oil filter and rear element (2) is hydraulic oil filter.

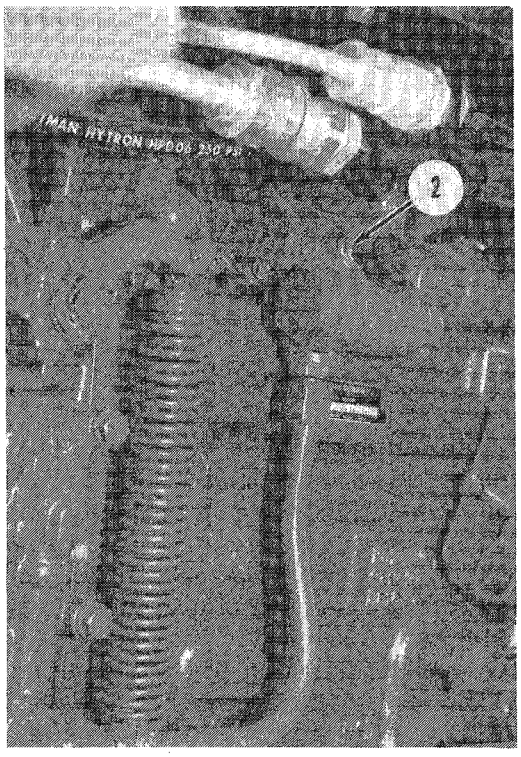


Fig. 222—To check lube pressure, install a 0-60 psi (0-400 kPa) pressure gage to return oil manifold test port (2).

Move SCV control levers to flow oil. Set SCV metering valve on right SCV to maintain 5 psi (35 kPa) lube pressure. Return control levers to neutral when desired temperature is reached.

To test hydraulic system, proceed as follows:

204. HIGH PRESSURE TO SUMP LEAK CHECK. Operate engine at 1500 rpm, fully raise rockshaft and position all other control valves in neutral. Record lube pressure at return oil manifold test port (2—Fig. 222) before and after destroking main pump. Turn destroking screw (5—Fig. 228) in to destroke pump, then turn back out after completing test. An increase in lube pressure of 0-3 psi (0-21 kPa) when pump is destroked is considered within normal leakage limits.

If pressure increase is within normal range, proceed to HIGH PRESSURE TO RETURN LEAK CHECK paragraph. If pressure increase exceeds 3 psi (21 kPa), check the following:

1. On 4650 and 4850 models, disconnect pressure line connecting rockshaft valve housing to load sensing cylinder. Cap pressure fitting on valve housing. Record lube pressure before and after destroking main pump as outlined above. If pressure increase is now within normal range, check for a stuck load sensing cylinder piston.

2. On all models disconnect pressure hose (2—Fig. 222A) from pressure control valve (1) and cap control valve fitting. Operate engine at 1500 rpm and record lube pressure before and after destroking main pump. If pressure increase is now normal, check for pressure leak to sump in power brakes, hydraulic seat or differential lock. To check these units, reconnect pressure hose to pressure control valve. Cap off pressure supply to each valve one at a time, then observe lube pressure before and after destroking main pump. The pressure increase will be within normal range when valve that is leaking is isolated.

205. HIGH PRESSURE TO RETURN LEAK CHECK. Fully raise rockshaft and position all other control valves in neutral. Operate engine at 1000 rpm.

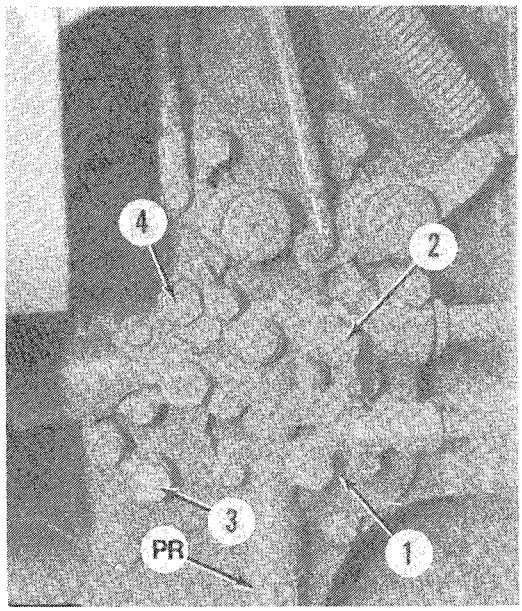


Fig. 223--On Quad-Range models, install a 0-300 psi (0-2000 kPa) pressure gage in test port (1) to check clutch pressure.

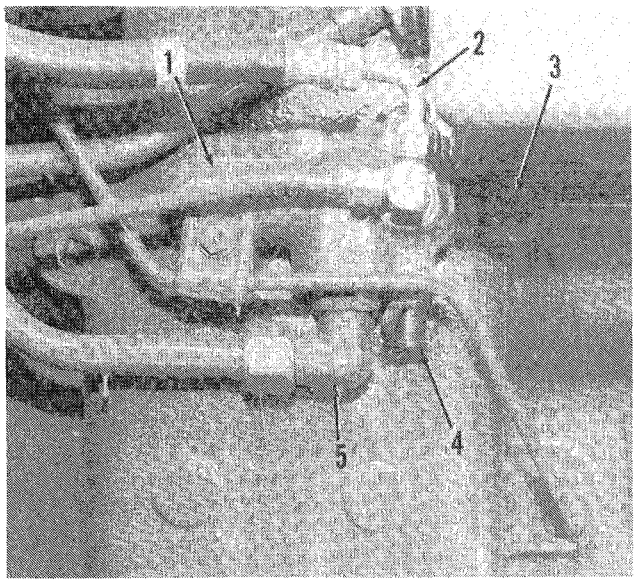


Fig. 222A—Connect a 0-5000 psi (0-35000 kPa) pressure gage to pressure control valve test port (4) to check hydraulic system pressure.

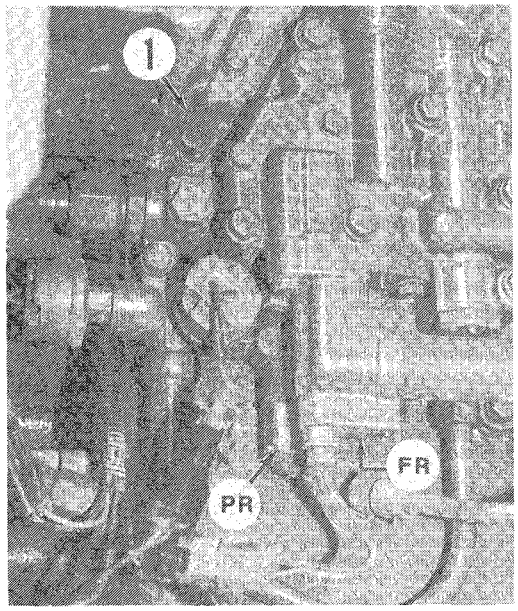


Fig. 223A—On Power Shift models, install a 0-300 psi (0-2000 kPa) pressure gage in test port (1) to check clutch pressure.

NOTE: A suitable digital tachometer must be used to accurately measure rpm if tractor is not equipped with a digital tachometer.

Turn screw (5—Fig. 228) in to destroke main pump and observe change in engine rpm. Back seat destroking screw after test. If engine speed increases less than 20 rpm, system is normal. Proceed to SELECTIVE CONTROL VALVE LEAK CHECK paragraph. If engine speed increases more than 20 rpm, excessive leakage is indicated and the following should be checked.

1. Disconnect pressure hose (2—Fig. 222A) from pressure control valve (1) and cap the valve elbow fitting. Record engine rpm before and after destroking main pump as outlined in preceding paragraph. If engine speed change is now less than 20 rpm, check for a leak to return in the steering system. Turn destroking screw back out and reconnect pressure hose after completing test.

2. Move rockshaft to halfway up position, then record engine rpm before and after destroking main pump as previously outlined. If rpm change is now less than 20 rpm, excessive leakage is indicated in the rockshaft circuit. To verify excessive leakage prior to disassembly, proceed as follows: Disconnect return oil line (3—Fig. 220) between hydraulic filter and return oil manifold on Quad-Range models. Cap fitting on return oil manifold. On Power Shift models, disconnect rockshaft return oil line (3—Fig. 221) from return filter inlet. Plug filter inlet port. On all models, place a clean container under return oil outlet. Operate engine at 1000 rpm with control valve in neutral. DO NOT move rockshaft control lever. If return oil leakage exceeds 1 pint (0.4 L) per minute, check these possible areas: Rockshaft valves misadjusted or damaged (refer to paragraph 231). Rockshaft piston packing leaking and/or cylinder scored.

206. SELECTIVE CONTROL VALVE (SCV) LEAK CHECK. Disconnect jumper hoses from SCV couplers. Operate engine at 1000 rpm, then observe change in engine speed after moving each SVC control lever forward and rearward. If engine speed changes more than 20 rpm, check the selective control valve indicated for leakage.

207. LUBE REDUCTION VALVE CHECK. To check lube reduction valve operation on Quad-Range models, adjust engine speed to obtain 10 psi (70 kPa) lube pressure at return oil manifold test port (2—Fig. 222). Fully depress clutch pedal then slowly engage clutch while observing lube pressure gage for a dip in pressure. The lube pressure should dip before clutch pressure gage reading reaches 30 psi (210 kPa). If pressure does not dip, lube reduction valve located in clutch operating piston housing is probably stuck. Refer to paragraph 103.

208. ELEMENT LEAKAGE CHECK. With all control valves in neutral, adjust engine speed to obtain 10 psi (70 kPa) lube pressure. Note any change in lube pressure while performing the following: Engage pto. Disengage pto. Engage MFWD (if equipped). Disengage MFWD. Shift to first gear (Quad-Range models). Shift to second gear (Quad-Range models). If lube pressure changes more than 3 psi (21 kPa) during any of these functions, there is excessive leakage in the element with the lower pressure. Refer to POWER SHIFT TRANSMISSION section to check Power Shift clutch and brake elements.

209. CLUTCH SYSTEM PRESSURE TEST. Operate engine at 2000 rpm and note clutch pressure reading at test port (1—Fig. 223 or 223A). On all models, clutch pressure should be 170-180 psi (1170-1250 kPa). To adjust, remove pressure regulating valve (PR) and add or remove shims as necessary. One shim will change pressure approximately 5 psi (35 kPa).

210. OIL COOLER INLET PRESSURE CHECK. First drain auxiliary reservoir and oil cooler by installing a hose between selective control valve (SCV) and filler tube. Run engine at 800 rpm and move SCV control lever to flow oil to sump. Shut off engine and move control lever to neutral when hose begins to jump.

Install a 0-300 psi (0-2000 kPa) gage in oil cooler bypass valve test port (1—Fig. 224). Operate engine at 1000 rpm and observe cooler inlet pressure reading. Pressure should be 41-67 psi (280-460 kPa) with

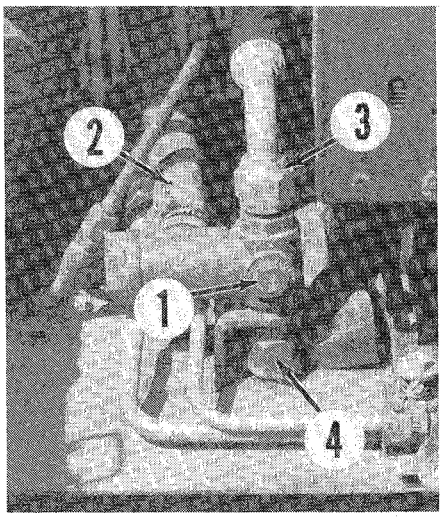


Fig. 224—To check oil cooler inlet pressure, connect a 0-300 psi (0-2000 kPa) gage to cooler bypass valve test port (1).

1. Test port
2. To auxiliary reservoir
3. To oil cooler
4. Inlet

oil temperature at 100° F (38° C), or 17-35 psi (120-240 kPa) with oil temperature at 150° F (66° C). Gage readings should be steady. Repeat test at 2000 rpm. Pressure should be 65-115 psi (450-800 kPa) with oil temperature at 100° F (38° C), or 60-110 psi (410-760 kPa) with oil temperature at 150° F (66° C). Gage readings will pulsate.

1. If oil cooler inlet pressure is above specifications, check for restrictions in the following areas: Return oil manifold, auxiliary oil reservoir or oil cooler.
2. If pressure is below specifications, check cooler bypass valve.

211. LUBE PRESSURE CHECK. With engine at 2000 rpm, observe lube pressure gage reading at test port (2—Fig. 222) and compare with the following minimum specifications:

Models 4050-4250-4450

Lube pressure (minimum)—
Oil at 100° F (38° C) ..... 25 psi (170 kPa)
Oil at 150° F (66° C) ..... 10 psi (70 kPa)

Models 4650-4850

Lube pressure (minimum)—
Oil at 100° F (38° C) ..... 23 psi (160 kPa)
Oil at 150° F (66° C) ..... 10 psi (70 kPa)

1. If lube pressure is low, check for leakage at the following areas on Quad-Range models.
   a. Lube relief valve in filter relief valve housing.
   b. Lube oil tube for low range pinion.
   c. Check valve plugs in clutch operating piston housing.
   d. Packing between clutch operating piston housing and pressure regulating valve housing.
2. If lube pressure is low on Power Shift models, check the following areas for leakage.
   a. Packing at lube manifold inlet tube in top center of clutch housing.
   b. Auxiliary oil reservoir air check valve.
   c. Lube relief valve.
   d. Worn high-range shaft front bushings.
   e. Damaged seal rings on rear of low-range shaft.
   f. Gasket between clutch housing and transmission case.
   g. Worn bushing or oil seal at front of reduction gear shaft.
   h. Pto clutch support shaft "O" rings.
3. Check transmission pump output as outlined in following paragraph.

212. TRANSMISSION PUMP FLOW CHECK. To check transmission pump output, first drain oil from auxiliary reservoir and oil cooler as outlined in paragraph 210. Then connect suitable flow meter into oil cooler circuit as follows:

On Quad-Range models, connect flow meter inlet hose to outlet of filter relief valve housing (1—Fig. 225). Disconnect oil cooler inlet hose (3—Fig. 224) from cooler bypass valve and cap outlet fitting of bypass valve. Connect flow meter outlet hose to oil cooler inlet hose.

On Power Shift models, remove filter relief valve plug (FR—Fig. 223A) and spring from traction clutch valve assembly. Install JDG-386 filter relief valve insert into valve housing in place of spring and plug. Position a container under valve housing to collect oil leakage. Install T31170 ported filter cover with JDH-58 diverter plate in place of original transmission filter cover. Refer to Fig. 226A for list of components required to fabricate the special filter cover. Connect flow meter inlet hose to the special filter cover fitting. Disconnect oil cooler inlet hose (3—Fig. 224) from filter bypass valve and cap bypass valve outlet fitting. Connect flow meter outlet hose to oil cooler inlet hose.

IMPORTANT: On all models, fully open flow meter control valve before starting engine because there is no relief protection in the circuit. DO NOT restrict flow to exceed 250 psi (1720 kPa) during testing.

With engine at 2000 rpm, close flow meter control valve to obtain 200 psi (1380 kPa) and record flow. Refer to the following table for minimum pump flow specifications.

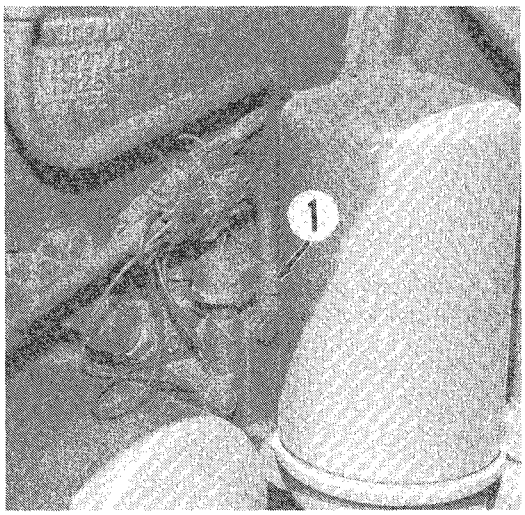


Fig. 225—To check transmission pump flow on Quad-Range models, connect flow meter inlet hose to filter housing outlet (1). Refer to text.

Quad-Range Models

4050-4250-4450

Oil at 100° F (38° C) ..... 14.5 gpm (55 L/m)

Oil at 150° F (66° C) ..... 14.0 gpm (53 L/m)

4650

Oil at 100° F (38° C) ..... 16.5 gpm (63 L/m)

Oil at 150° F (66° C) ..... 16.0 gpm (61 L/m)

Power Shift Models

Oil at 100° F (38° C) ..... 19.0 gpm (72 L/m)

Oil at 150° F (66° C) ..... 18.0 gpm (68 L/m)

Check the following area for possible causes of low transmission pump flow.

1. Pump suction air leak or restricted pump suction screen.
2. Pump discharge leakage.
3. Worn transmission pump.

213. RETURN CIRCUIT TO SUMP LEAKAGE CHECK. Operate engine at 1500 rpm and record lube pressure reading at test port (2—Fig. 222). Install a jumper hose in couplers of one of the selective control valves (SCV). Set SCV metering lever to "MAX" position. Move SCV control lever to flow oil. Readjust engine speed to 1500 rpm, then record lube pressure reading. The maximum allowable decrease in lube pressure is 6 psi (41 kPa) with oil temperature at 100° F (38° C), or 4 psi (28 kPa) with oil temperature at 150° F (66° C). If lube pressure drop is excessive, check the following areas for leakage.

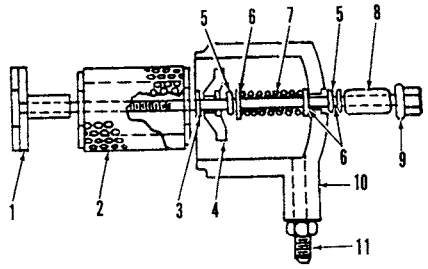


Fig. 226A—Special ported filter cover used in testing transmission pump flow can be fabricated using parts listed.

1. JDH-58 filter diverter plate
2. AR75601 filter
3. R34766 retaining ring
4. R65892 retainer
5. R394 "O" ring (2 used)
6. 24H1227A washer (3 used)
7. R66064 spring (2 used)
8. 28H2531 spacer
9. R65894 screw
10. T31170 ported filter cover
11. 1365 connector

1. Return oil filter (rear) is partially restricted.
2. Return oil filter relief valve is stuck open, scored or has a weak spring.
3. Lube relief valve damaged.
4. Rockshaft linkage lube orifice missing.
5. Rockshaft bottom cover leaking.
6. Packing between rockshaft housing and rockshaft valve housing leaking.

214. STANDBY PRESSURE CHECK. With all valves in neutral and engine operating at 2000 rpm, observe standby pressure reading at pressure control valve test port (4—Fig. 222A). Specified standby pressure is 2300-2350 psi (15900-16200 kPa) on all models. Pressure is adjusted by turning stroke control valve adjusting screw (20—Fig. 232) in to increase pressure or out to decrease pressure.

If pressure pulsates or if pressure cannot be adjusted, check the following areas: Stroke control valve stuck open. Pump crankcase outlet valve open. Pump pistons scored. Inlet or discharge valves leaking. Refer to paragraph 218 for main pump overhaul procedure.

215. PRESSURE CONTROL VALVE CHECK. To check pressue control valve (1—Fig. 222A) setting, install a jumper hose in couplers of one of the selective control valves (SCV). Set SCV metering lever at "MAX" and move SCV control lever to flow oil through jumper hose. Operate engine at 800 rpm and record pressure at pressure control valve test port (4). Specified pressure for all models is 1600-1700 psi (11000-11700 kPa). If necessary to adjust pressure, add or remove shims in pressure control valve. One shim will change pressure approximately 50 psi (345 kPa).

216. MAIN PUMP FLOW CHECK. Remove pressure control valve housing (1—Fig. 222A). Plug holes in clutch housing. Plug oil line (5) to rockshaft housing. Connect inlet hose of flow meter to main pump outlet line (3). Install outlet hose of flow meter into right coupler of SCV. Tie SCV control lever rearward. Fully open flow meter valve before starting engine.

Operate engine at 2000 rpm and adjust flow meter valve to obtain 2000 psi (13800 kPa) pressure, then record flow. The minimum specified flow for Models 4050, 4250 and 4450 is 23 gpm (82 L/m). Minimum specified flow for Models 4650 and 4850 is 26.5 gpm (100 L/m).

Refer to paragraph 217 for pump repair procedure.

MAIN HYDRAULIC PUMP

All Models

217. REMOVE AND REINSTALL. When external leaks or failure to build or maintain pressure indi-

cates a faulty hydraulic pump, remove the unit for service as follows:

First drain auxiliary oil reservoir and oil cooler by installing one end of a hose in selective control valve (SCV) outlet and secure other end of hose in the oil filter tube. Run engine at 800 rpm, then move SCV lever to flow oil into transmission housing. When hose starts jumping (pump cavitating), shut off engine and move SCV lever to neutral.

NOTE: Before disconnecting any hydraulic lines, relieve system hydraulic pressure by loosening brake bleed screws and depressing brake pedals until they go all the way down.

Remove side screens and hood. Disconnect hydraulic lines, fuel lines, electrical wiring and retaining brackets as necessary to remove front end from tractor. (Refer to paragraph 28). Remove upper frame plates from both sides. Remove cap screws securing lower frame to side frame rails. Disconnect pump drive shaft. If equipped with mechanical front-wheel drive, disconnect MFWD drive shaft. Support front of tractor with a suitable stand under the clutch housing. Remove front end weights, if equipped, and support front end with a suitable splitting stand or hoist. Remove eight cap screws securing side frame to steering housing, then roll front end forward far enough to provide access to main pump. It is not necessary to completely separate steering housing from side frame.

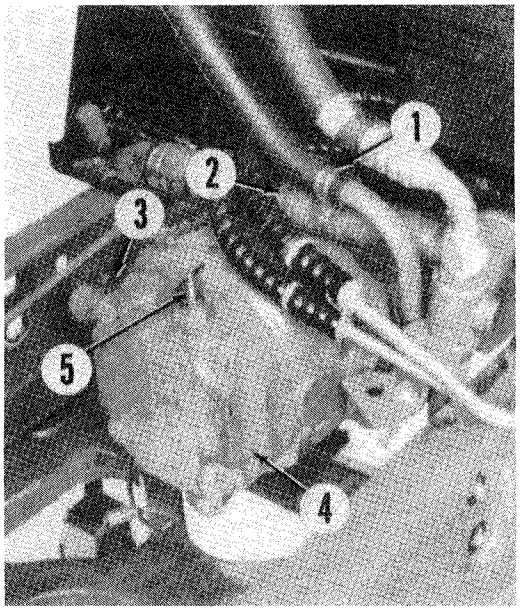


Fig. 228—Main hydraulic pump is mounted in front of radiator and is driven by engine crankshaft through a coupler. Front end must be moved forward to remove pump.

1. Oil cooler return line
2. Main oil supply line
3. Pump pressure line
4. Hydraulic pump
5. Destroking screw

Disconnect oil cooler return line (1—Fig. 228), main supply line (2) and pump pressure line (3). Remove pump mounting cap screws, then remove pump (4) from tractor.

To reinstall pump, reverse the removal procedure while noting the following special torque values:

Pump mounting cap screws	85 ft.-lbs. (115 N·m)
Side frame to steering motor cap screws	425 ft.-lbs. (578 N·m)
Pump drive shaft cap screws	35 ft.-lbs. (47 N·m)
Lower frame mounting cap screws	105 ft.-lbs. (140 N·m)
MFWD drive shaft (if equipped)	50 ft.-lbs. (68 N·m)

218. OVERHAUL. Before disassembling the pump, write corresponding numbers on the pump housing and each of the piston plugs (1—Fig. 229) and scribe indexing marks on pump housing (10) and stroke control valve housing (25—Fig. 232) to ensure correct reassembly.

NOTE: The pistons (5—Fig. 229) must be reinstalled in their original bores if they are reused.

Remove piston plugs, springs and pistons. Remove stroke control valve mounting cap screws, then remove valve housing from pump housing. Remove the eight discharge valve assemblies (12) placing each valve with its corresponding piston. The discharge valves must be reinstalled in their original bores if they are reused. Tap lightly on end of pump shaft to remove shaft with bearings.

Inspect discharge valve seats (11) for wear or damage. Valve seats may be removed using JDH-39B-1 special tool and a slide hammer puller. If special tool is not available, valve seats may be driven out of pump housing after inlet valve (7) is removed. The discharge valve seat must be renewed whenever it is removed.

Remove the plugs (6) retaining the inlet valve assemblies (7) and visually inspect valves for free valve opening movement. Inlet valve lift should be approximately 0.080-0.120 inch (2.0-3.0 mm). Do not remove inlet valves unless damaged or sticking. Inlet valve must be renewed once it is removed. To remove inlet valve, insert a small diameter punch through discharge valve seat bore and tap valve out.

Inspect pump pistons and housing bores for wear, scoring or other damage. Pistons must slide smoothly in bores and have no side play. Outside diameter of pistons when new is 0.8740-0.8744 inch (22.200-22.210 mm) on Models 4050, 4250 and 4450 or 0.9630-0.9634 inch (24.460-24.470 mm) on Models 4650 and 4850.

NOTE: The stroke control valve housing must be installed on the pump housing and mounting cap screws tightened to 30-50 ft.-lbs. (40-68 N·m) before measuring piston bores.

Piston bore inside diameter when new is 0.8749-0.8753 inch (22.223-22.233 mm) on Models 4050, 4250 and 4450 or 0.9639-0.9643 inch (24.483-24.493 mm) on Models 4650 and 4850.

Inspect piston springs (4) for wear or damage. Manufacturer recommends that the eight springs used on Models 4050, 4250 and 4450 must test within 1.5 pounds (6.7 N) of each other and within range of 34-40 pounds at 1.62 inches (151-177 N at 41.1 mm).

On Models 4650 and 4850, dual (inner and outer) piston springs (4A) are used. The outer springs must test within 1.5 pounds (6.7 N) of each other and within range of 29-35 pounds at 1.78 inches (129-156 N at 45.2 mm). Inner springs must test within 1.0 pound (4.45 N) of each other and within range of 17-21 pounds at 1.78 inches (76.93 N at 45.2 mm).

On all models, renew piston springs as a complete set. Make certain springs are color coded the same.

To disassemble pump shaft components, press bearing cones (14) off the shaft. Inspect all parts for wear, scoring or pitting and renew if necessary. Pump shaft journal diameter should be 1.7442-1.7448 inches (44.302-44.318 mm). Inside diameter of race (20) when new is 2.2457-2.2465 inches (57.041-57.061 mm) and outside diameter is 2.814-2.816 inches (71.475-71.525 mm).

A hydraulic pump overhaul kit is available which contains "O" rings, washers and seals necessary to properly reassemble pump. When assembling, apply clean hydraulic oil to all parts except "O" rings (2) and shields (3) for piston plugs (1).

Install new oil seal (9) with lip toward inside of pump housing. Be careful not to drive seal beyond inner edge of snap ring groove to avoid blocking the oil drain passage in housing. Install retaining snap ring (8) and lubricate seal lip with petroleum jelly.

If inlet valves (7) were removed, install new valves using the valve plugs (6) to push the valves into their bores. Tighten plugs to 100 ft.-lbs. (136 N·m), loosen the plugs, then retighten to 100 ft.-lbs. (136 N·m).

Install new outlet valve seats (11), if removed, using JDH-39B-1 installer and removal tool. Drive seat into housing until flange of tool bottoms against face of housing.

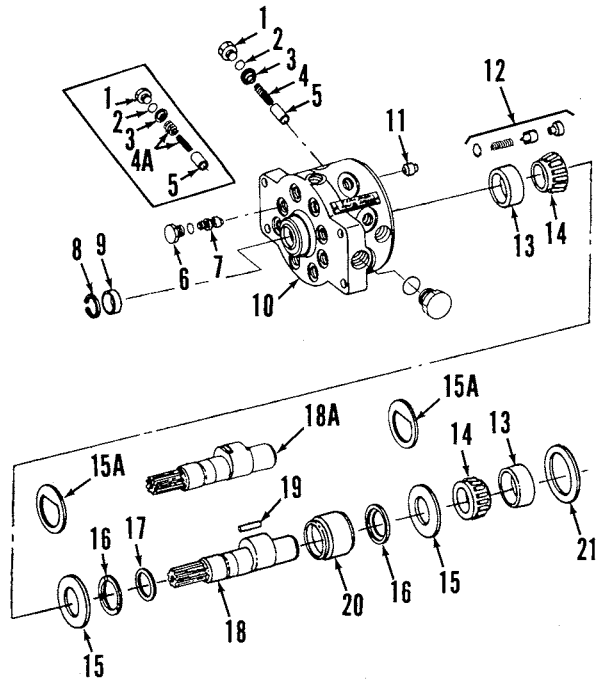


Fig. 229—Exploded view of main hydraulic pump used on all models. Refer to Fig. 232 for pump stroke control components.

1. Piston plug
2. "O" ring
3. Shield
4. Spring (4050, 4250 & 4450)
4A. Dual springs (4650 & 4850)
5. Piston
6. Plug
7. Inlet valve
8. Snap ring
9. Seal
10. Pump housing
11. Valve seat
12. Discharge valve assy.
13. Bearing cup
14. Bearing cone
15. Washer (early models)
15A. Washer (late models)
16. Thrust washer
17. Seal ring
18. Pump shaft (early models)
18A. Pump shaft (late models)
19. Needle roller (25 used)
20. Bearing race
21. Shim

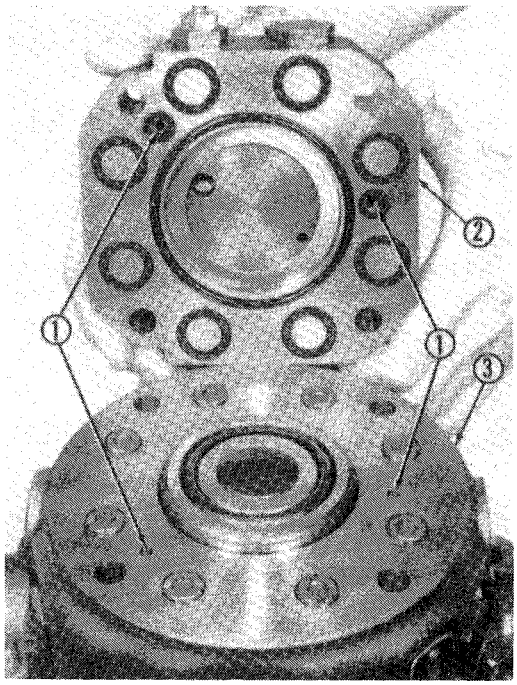


Fig. 231—When reinstalling stroke control valve housing (2), make certain high pressure passages (1) in valve housing and pump (3) are aligned.

Assemble components onto pump shaft, if removed, making sure bearing cones are bottomed against shaft shoulders. Install a suitable protector, such as JDG-494, over splines of pump shaft. Start a new seal ring (17—Fig. 229) over spline protector, then use JDG-493 seal sizing tool, or similar tool, to push seal down the shaft and into shaft groove.

Install pump shaft into housing and tap bearing cup into position. If pump shaft or bearings were renewed, do not install control valve housing "O" rings and packings or discharge valves at this time. Install control valve housing with original shims (21) onto pump housing and tighten mounting cap screws evenly to 85 ft.-lbs. (115 N·m). Check shaft end play using a dial indicator. Desired shaft end play is 0.001-0.003 inch (0.03-0.08 mm). Remove stroke control valve and add or subtract shims to obtain correct end play.

Install discharge valves (12) in their original bores. Use a small amount of petroleum jelly to hold "O" rings and packings in place on stroke control valve housing. Install control valve housing aligning index marks made during disassembly.

CAUTION: Make certain high pressure passages (1—Fig. 231) in valve housing (2) and pump housing (3) are aligned. Failure to align passages will keep the pump in full stroke resulting in possible system damage.

Tighten valve housing mounting cap screws in several steps to a final torque of 85 ft.-lbs. (115 N·m).

Install new "O" rings and shields on piston plugs. Do not apply oil to plugs or "O" rings. Install pistons and springs into their original bores, then install plugs and tighten to 114-138 ft.-lbs. (153-187 N·m).

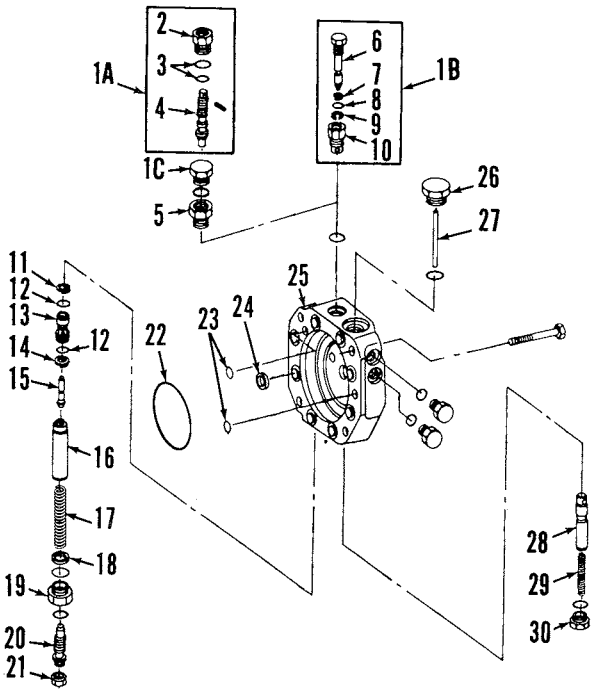


Fig. 232—Exploded view of pump stroke control valve housing showing component parts. Items in inset (1A) show early style manual destroke components. Items in inset (1B) show late style manual destroke components. Plug (1C) is used when pump is not equipped with manual destroke.

2. Fitting
3. "O" rings
4. Destroke screw
5. Fitting
6. Destroke screw
7. Back-up ring
8. "O" ring
9. Snap ring
10. Fitting
11. Washer
12. "O" rings
13. Control valve sleeve
14. Back-up ring
15. Control valve
16. Guide
17. Spring
18. Washer
19. Fitting
20. Ajusting screw
21. Nut
22. "O" ring
23. Seal washers
24. Seal washers
25. Valve housing
26. Plug
27. Pin
28. Crankcase outlet valve
29. Spring
30. Plug

219. STROKE CONTROL VALVE HOUSING. The valves located in stroke control valve housing control pump output as follows: The closed hydraulic system has no discharge except through the operating valves or components. Pressure is maintained in the system at all times for instant use. Pumping action is halted when line pressure reaches a given point by pressurizing the camshaft reservoir of the pump housing, thereby holding the pistons outward in their bores.

The pump cutoff point is controlled by pressure of spring (17—Fig. 232) and can be adjusted by turning adjustment screw (20). Refer to paragraph 214 for adjustment procedure. When pressure reaches the cutoff (standby) setting, valve (15) opens and meters the required amount of fluid at reduced pressure into crankcase section of pump to hold the pistons outward. Crankcase outlet valve (28) is held closed by hydraulic pressure and blocks the outlet passage. When pressure drops as a result of system demands, crankcase outlet valve is opened by pressure of spring (29) which releases pressurized crankcase fluid and pumping action resumes.

220. OVERHAUL. To disassemble stroke control valve housing, first remove adjusting screw (20—Fig. 232) and bushing (19), special washer (18), spring (17), spring guide (16) and control valve (15). Remove manual destroke assembly (1A or 1B) from housing. Use a wood or brass rod to drive control valve sleeve (13) out adjusting screw opening in housing. Remove plugs (26 and 30), then withdraw crankcase outlet valve (28) and pin (27). Remove and discard all "O" rings.

Inspect all parts for excessive wear or other damage. Stroke control valve (15) must move freely in valve sleeve (13) bore. Valve face and seat areas must be free of nicks or pitting. Outside diameter of valve stem should be 0.2661-0.2665 inch (6.759-6.769 mm) and inside diameter of sleeve should be 0.2667-0.2673

inch (6.774-6.790 mm). Compare springs with the following new spring specifications and renew if necessary. Control valve spring (17) free length should be about 3.62 inches (92 mm) and test length should be 3.31 inches (84 mm) at 125-155 pounds (556-690 N). Crankcase outlet valve spring (29) free length should be approximately 3.43 inches (87 mm) and test length should be 3.0 inches (76.2 mm) at 14-17 pounds (63-76 N).

Use new "O" rings, packings and seals when assembling. Oil parts liberally with clean hydraulic oil. Reassemble in reverse order of disassembly.

Reinstall valve housing onto pump housing as outlined in paragraph 218. Check and adjust pump cut-off pressure as outlined in paragraph 214.

CONTROL VALVES

All Models

221. PRESSURE CONTROL VALVE. The pressure control (priority) valve is mounted on right side of clutch housing. Refer to paragraph 25 in STEERING section for service information on the valve unit. Refer to paragraph 215 for pressure setting check and adjustment information.

Quad-Range Models

222. OIL FILTER RELIEF VALVE HOUSING. The filter relief valve housing is mounted on left side of transmission case directly behind the hydraulic filter mounting housing. Refer to Fig. 233 and disassemble valve as necessary.

Inspect valve spools and housing bores for wear, scoring or other damage. Compare valve springs with the following new part specifications. All parts are available individually for renewal.

Transmission Filter Relief
Valve Spring (3)—
Free length ..... 3.0 in. (7.67 mm)
Test ..... 39.0-4.75 lbs. @ 2.20 in. (173-212 N @ 56 mm)

Return Oil Filter Relief
Valve Spring (5)—
Free length ..... 3.5 in. (89.7 mm)
Test ..... 19-23 lbs. @ 2.5 in. (84-103 N @ 63.7 mm)

Lube Relief Valve
Spring (7)—
Free length ..... 1.45 in. (36.9 mm)
Test ..... 12.6-15.4 lbs. @ 0.9 in. (56-68 N @ 23 mm)

Power Shift Models

223. OIL FILTER RELIEF VALVE. The filter relief valve is located in the transmission housing behind the hydraulic (rear) oil filter. Drain oil from transmission before removing relief valve housing. To disassemble, press against washer (9—Fig. 234) to relieve spring pressure on snap ring (10). Remove snap ring and withdraw spring and valve (7).

Inspect valve and housing bore for pitting, scoring or wear and renew if necessary. Specifications for a new spring are as follows: Test length is 1.8125 inch (46.0 mm) at 27-33 pounds (120-147 N).

Be sure to renew "O" rings (6 and 8) during assembly.

All Models

224. RETURN OIL MANIFOLD. The return oil manifold combines return oil from hydraulic oil fil-

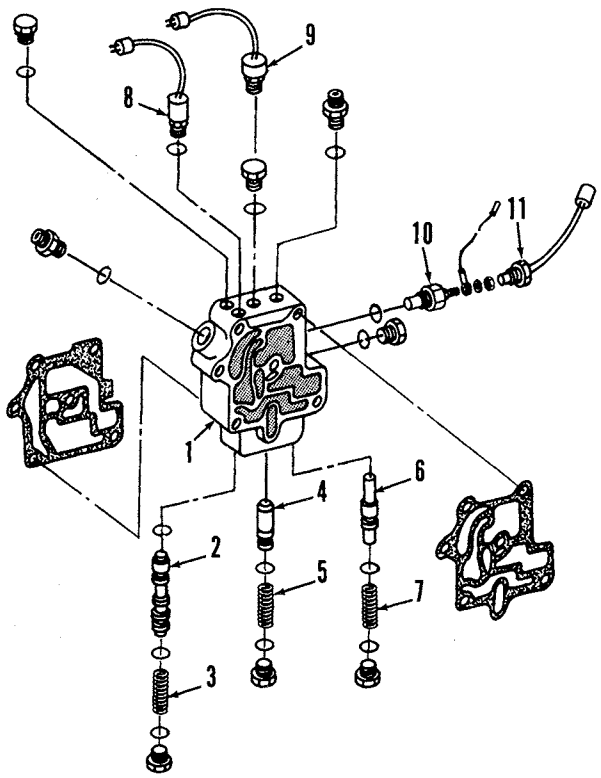


Fig. 233—Exploded view of return oil filter relief valve housing and components used on Quad-Range models.

1. Valve housing
2. Transmission filter relief valve
3. Spring
4. Return oil filter relief valve
5. Spring
6. Lube relief valve
7. Spring
8. Transmission oil pressure sensor
9. Transmission oil filter restriction sensor
10. Hydraulic oil filter override sensor
11. Hydraulic oil temperature sensor

ter, steering system, oil cooler, reservoir and transmission oil filter bypass, then routes the oil to charge the main hydraulic pump and to the transmission lubrication circuit. The return oil manifold is mounted on top left side of transmission housing directly above the oil filters.

Refer to Fig. 235 and disassemble mainfold components as necessary. Inspect filter element (10) for damage or contamination and renew if necessary. Inspect check valves (5), seats and springs (4) for wear or damage. The springs are identical and should have a test length of 1.12 inches (28.5 mm) at 4.0-4.9 pounds (18-21 N).

Renew all "O" rings when reassembling.

1. Cover
2. Gasket
3. Retainer
4. Return oil filter
5. Relief valve housing
6. "O" ring
7. Relief valve spool
8. "O" ring
9. Washer
10. Snap ring
11. Transmission oil filter

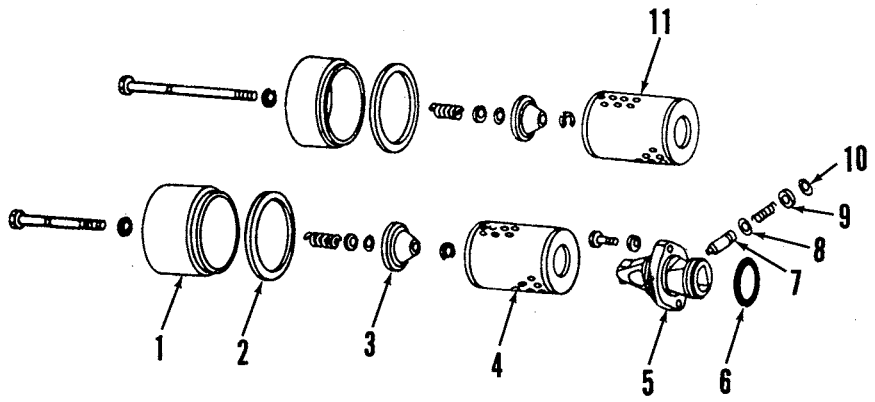


Fig. 234—Exploded view of return oil filter relief valve used on Power Shift models.

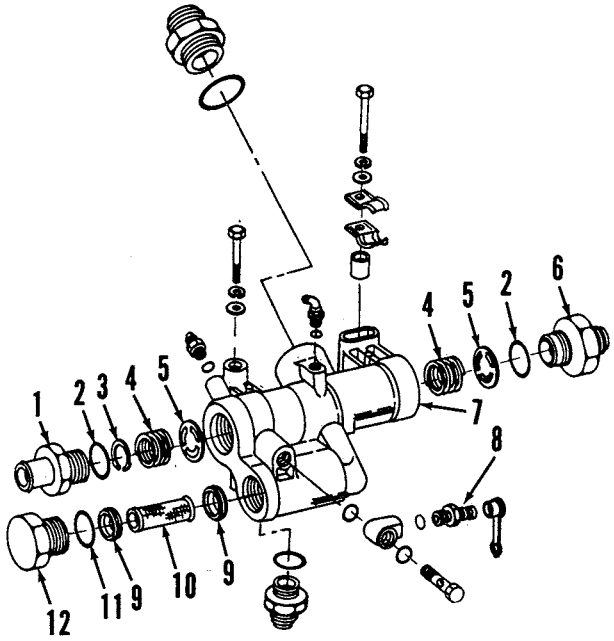


Fig. 235—Exploded view of return oil manifold showing component parts.

1. Fitting
2. "O" ring
3. Snap ring
4. Spring
5. Check valve
6. Fitting
7. Manifold
8. Diagnostic receptacle
9. Seals
10. Filter element
11. "O" ring
12. Plug

HYDRACUSHIONED SEAT

All Models So Equipped

225. OPERATION. The Hydracushioned seat is hydraulically raised, lowered and cushioned. A pressure regulating valve (3—Fig. 236) reduces tractor hydraulic system pressure at the valve inlet to approximately 300 psi (2100 kPa) operating pressure.

Moving the seat height control lever (2) upward to raise the seat (1) moves height control valve spool (4) downward. When large OD of valve spool uncovers inlet passage to the seat cylinder (7), pressure oil flows to the cylinder and raises the seat. The control valve spool moves upward with the seat, and when large OD section of valve covers the cylinder inlet passage, seat travel stops.

To lower the seat, control lever is moved downward which pulls control valve spool upward so that small OD section at bottom of valve spool uncovers cylinder oil passage. The oil in the cylinder is discharged to the sump until seat lowers and oil passage is again blocked by large OD of valve spool.

When seat is in stationary position, passage to cylinder is covered by large OD section of valve spool and no oil enters or leaves the cylinder. A gas charged

accumulator (6) is located in the cylinder oil passage to provide seat cushioning. A manually adjustable dampening valve (5) controls amount of seat cushioning.

226. TESTING. Excessive oil flow from seat valve may indicate worn "O" rings, damaged control valve or a malfunctioning pressure regulator valve. To check oil flow, shut off engine and disconnect seat valve discharge hose from top of clutch housing. Place end of hose in a suitable container. Start tractor, but do not sit in seat or operate the seat control lever. Measure volume of oil collected during a period of one minute. Discharge flow should not exceed 1.0 pint (0.5 L) per minute. Reconnect discharge hose.

NOTE: Sit on tractor seat and move control lever up and down several times to discharge pressure oil from system before removing regulating valve test port plug.

To test pressure regulating valve, remove test port plug (P—Fig. 237) from valve body and install a 0-1000 psi (0-7000 kPa) pressure gage in test port. Start tractor and check pressure reading. If pressure is not within 290-320 psi (2000-2200 kPa), adjust regulating valve as follows:

Remove front cover from seat support. Remove retainer plate (16—Fig. 238) from top of valve housing.

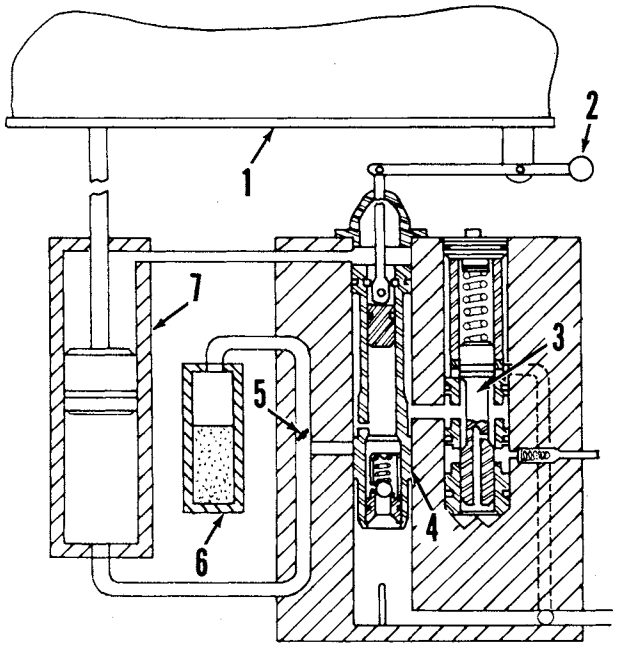


Fig. 236—Schematic view of Hydracushioned seat assembly.

1. Seat
2. Control lever
3. Pressure regulating valve
4. Height control valve
5. Dampening valve
6. Accumulator
7. Seat cylinder

Remove snap ring (1) and plug (2) from valve and add or remove shims (3) as necessary. Adding one shim should increase pressure approximately 15 psi (100 kPa).

227. SEAT ACCUMULATOR. Before removing seat accumulator, first relieve pressure in hydraulic system by sitting on the seat and moving height control lever up and down several times. The accumulator should have a precharge pressure of 85-95 psi (590-660 kPa).

To check and adjust precharge pressure, use suitable charging equipment with an adjustable pressure regulator and dry nitrogen.

NOTE: Dry nitrogen does not mix with oil, is noncombustible, will not cause oxidation or condensation within accumulator and is not harmful to piston seal. DO NOT use compressed air or oxygen to charge accumulator as damage to accumulator could result.

Connect charging equipment to gas check valve port of accumulator. Turn pressure regulator adjusting screw to obtain specified precharge pressure of 85-95 psi (590-660 kPa) in accumulator. Remove charging equipment. If gas leakage is evident at oil port end of accumulator, renew the accumulator.

228. SEAT VALVE AND CYLINDER. To remove seat valve assembly, first sit on seat and move control lever up and down several times to relieve oil pressure. Remove front cover from seat support. Raise seat and support with a block of wood. Disconnect and remove height adjusting lever. Disconnect hydraulic cylinder rod from seat frame. Disconnect ride control rod. Disconnect hydraulic lines. Remove valve mounting cap screw, then lift out valve, cylinder and accumulator as an assembly.

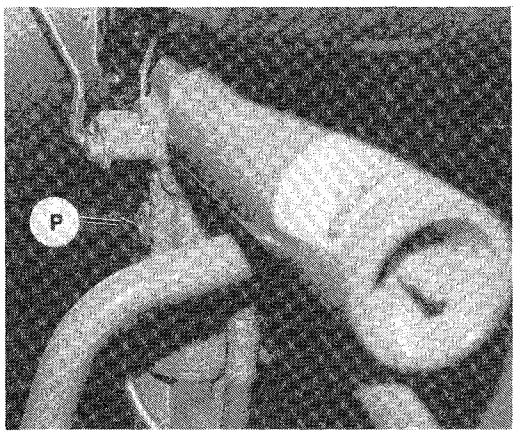


Fig. 237—Install a 0-1000 psi (0-7000 kPa) gage in seat control valve test port (P) to check pressure regulator valve setting.

Remove seat cylinder and accumulator from valve housing. Remove manifold from bottom of valve housing. Remove cap screws securing retainer plate (16—Fig. 238) and withdraw position rod (14), piston (20) and valve sleeve (24) as an assembly. Remove snap ring (18), then separate components being careful not to lose the small steel ball (19). Remove check valve assembly (25 through 30). Remove snap ring (1), plug (2) and pressure regulating valve assembly (3 through 9). Be sure to retain shims (3) for use in reassembly.

Inspect all parts for wear or damage and renew if necessary. Renew all "O" rings and back-up washers. Seat cylinder must be renewed as a complete unit if it is defective. Refer to paragraph 227 for accumulator service procedures.

Dip all parts in clean hydraulic oil during reassembly. When installing pressure regulator valve sleeve (C—Fig. 239), make certain pressure inlet holes (A) are NOT in line with inlet port (B) on early models. Later models have a drill mark on end of sleeve (C) which should be in line with inlet port (B) when

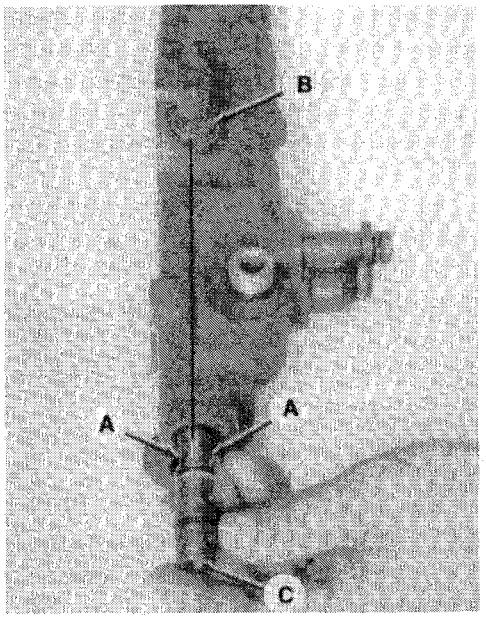


Fig. 239—When reinstalling pressure regulator valve sleeve (C), position sleeve so pressure inlet holes (A) are not aligned with seat valve inlet port (B).

1. Snap ring
2. Plug
3. Shim
4. Spring
5. Guide
6. Pressure regulator valve
7. Sleeve
8. Back-up ring
9. "O" ring
10. "O" rings (early models)
11. Back-up rings (early models)
12. Housing
13. Control lever
14. Rod
15. Seal
16. Retainer
17. Gasket
18. Snap ring
19. Ball
20. Piston
21. "O" rings
22. "O" ring
23. Ring
24. Valve
25. Guide
26. Spring
27. Check ball
28. Valve seat
29. "O" ring
30. Snap ring
31. Cylinder
32. Accumulator
33. Valve
34. Retainer
35. Ride control valve

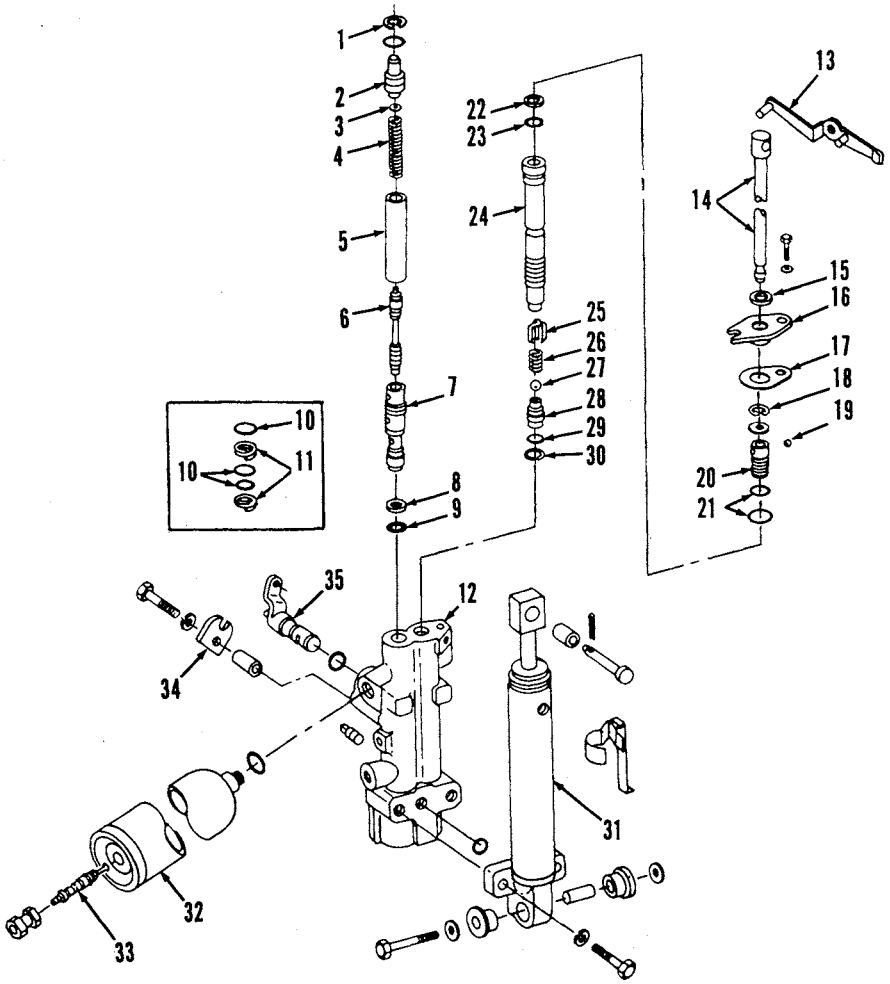


Fig. 238—Exploded view of Hydracushioned seat control valve assembly.

sleeve is correctly installed. Complete assembly of valve in reverse order of disassembly. Tighten retainer plate (16—Fig. 238) mounting cap screws and manifold mounting cap screws to 35 ft.-lbs. (47 N·m). Check accumulator precharge as outlined in paragraph 227.

Reinstall valve assembly and tighten mounting cap screw to 35 ft.-lbs. (47 N·m). Check and adjust pressure regulating valve setting as outlined in paragraph 226.

ROCKSHAFT HOUSING AND COMPONENTS

All Models

229. OPERATION. All models use a hydraulically actuated rockshaft. The rockshaft control lever controls raising and lowering of rockshaft. The rockshaft is also equipped with a draft control system. The rockshaft moves automatically to maintain desired draft load as set with a load selector knob. With selector knob in "MAX" position, load sensing response is greatest and hitch will automatically raise and lower to maintain a nearly constant draft load. Moving selector knob toward "MIN" position slows hitch response to changes in draft load and provides a more constant hitch position regardless of load. Models 4050, 4250 and 4450 are equipped with a mechanical sensing draft control system, while Models 4650 and 4850 use a hydraulic load sensing system.

Refer to appropriate Fig. 240 or 240A for a schematic view of rockshaft assembly. To raise rockshaft (3), the console lever is moved rearward. The position control linkage (17) rotates the cam (12) which opens pressure valve (10). Pressure oil is routed to the rockshaft cylinder (1) and lift-assist cylinders (if so equipped). As rockshaft rotates, the shaft servo cam (18) and linkage moves the valve operating cam (12) and pressure valve (10) back to neutral postition to hold rockshaft at desired height.

Moving the console lever forward allows the operating spring (15) to rotate operating cam (12) counterclockwise. The cam movement opens the return valve (9) which allows oil in rockshaft cylinder to flow to return passage (4). The weight of the hitch lowers the rockshaft. The adjustable throttle valve (7) controls lowering rate.

On Models 4050, 4250 and 4450, mechanical sensing of draft load operates as follows: As draft load pulls back on ends of load control shaft (28—Fig. 240), the control shaft flexes and moves the top of load control arm (27) rearward. This linkage movement operates load control cam (21) which pushes on load control valve (20). The control valve then actuates the draft control linkage (14), which rotates operating cam (12) and opens pressure valve (10). Pressure oil flows to cylinder to raise rockshaft to reduce the load. When draft load decreases, the load cam moves forward allowing spring pressure to move draft linkage and operating cam to "lower" or "neutral" position.

On Models 4650 and 4850, hydraulic sensing of draft load is used. The load control valve is actuated by variable hydraulic pressure, which is produced by placing the control valve (20—Fig. 240A) between a fixed orifice (30) and a variable orifice (35) in the load sensing cylinder (36). When draft load increases above a preset position, the sensing cylinder piston (33) and valve (34) are pulled rearward, enlarging the variable orifice (35) opening. This allows more oil to flow into the sensing cylinder (36) and to the control valve (20) than can be bled off through the fixed orifice, resulting in an increase in sensing pressure on front side of load control valve (20). The load control valve piston is pushed rearward by the increase in sensing pressure. The movement of control valve piston causes cam follower (16) and link (14) to move rearward which actuates valve operating cam (12) and opens pressure valve (10), raising the rockshaft. The rockshaft will raise until draft load decreases to preset position. When draft load decreases below preset position, sensing cylinder piston moves forward reducing variable orifice size. Oil flow into sensing cylinder is reduced and sensing pressure to front side of control valve is lowered. Spring pressure moves control valve piston (20) and cam follower (16) forward. Spring pressure then rotates valve operating cam (12) to open the return valve (9) and lower the rockshaft until draft load reaches preset value.

TROUBLE-SHOOTING

All Models

230. The following are symptoms which may occur during operation of hydraulic lift system and their possible causes. Be sure to check main hydraulic system as outlined in paragraph 203 for proper operation before assuming rockshaft hydraulic system is faulty. Refer to appropriate Fig. 240 or 240A for identification of parts.

1. Hitch will not raise or raises slowly. Could be caused by:
   a. Operating linkage malfunction or misadjusted.
   b. Return valve (9) stuck open or leaking.
   c. Flow control valve (5) misadjusted.
   d. Surge relief valve (6) or thermal relief valve (11) leaking.
   e. Rockshaft piston seal (2) leaking.
   f. Low main pump pressure.
2. Hitch will not lower or lowers slowly. Could be caused by:
   a. Operating linkage misadjusted or broken.

b. Weak or broken valve cam operating spring (15).
c. Throttle valve (7) misadjusted.
d. Dampening piston (24) stuck (4050-4250-4450).

3. Hitch chatters. Could be caused by:
a. Load selector adjusted too sensitive.
b. Operating valve clearance too tight (paragraph 231).
c. Damping system (4050-4250-4450) check valve (25) stuck.

1. Rockshaft cylinder
2. Piston
3. Rockshaft
4. Return circuit
5. Flow control valve
6. Surge relief valve
7. Throttle valve
8. To assist cylinders (if equipped)
9. Return valve
10. Pressure valve
11. Thermal relief valve
12. Valve adjusting cam
13. Cam adjusting link
14. Valve operating link
15. Spring
16. Cam follower
17. Control arm
18. Servo cam
19. Load control actuating arm
20. Load control valve assy.
21. Load control cam
22. Reservoir
23. Load selector arm
24. Damping piston
25. Check valve
26. Load control follower arm
27. Load control arm
28. Load control shaft

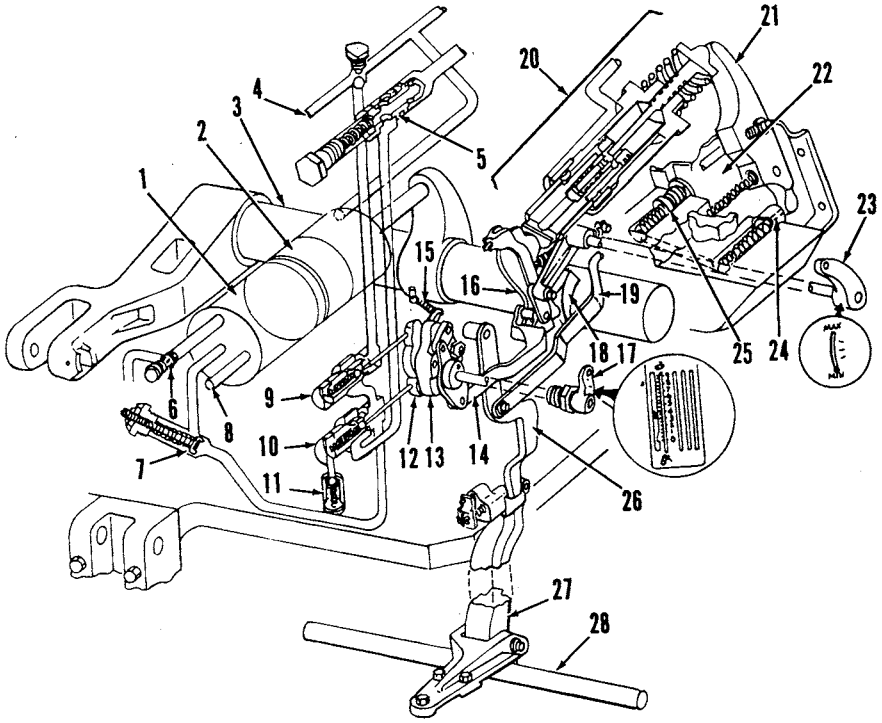


Fig. 240—Schematic view of rockshaft assembly used on Models 4050, 4250 and 4450. A mechanical load sensing draft control system is used on these models.

30. Fixed orifice
31. Filter
32. Load control selector
33. Sensing cylinder piston
34. Sensing cylinder valve
35. Variable orifice
36. Sensing cylinder
37. Draft arm
38. Draft shaft

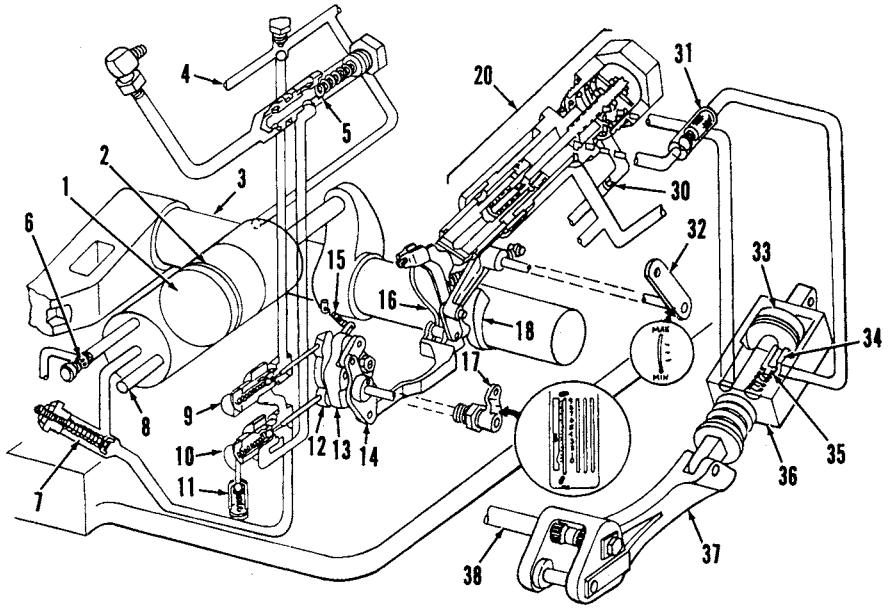


Fig. 240A—Schematic view of rockshaft assembly used on Models 4650 and 4850. A hydraulic load sensing system is used on these models. Refer to Fig. 240 legend except for the following:

4. Insufficient load response. Could be caused by:
   a. Incorrect load control linkage adjustment.
   b. Operating valves adjusted too wide (paragraph 231).
   c. Throttle valve (7) set too tight (paragraph 231).
   d. Load control valve (20) stuck.
   e. Load control arm (26) adjustment incorrect (4050-4250-4450).
   f. Draft sensing cylinder (36) attached to wrong mounting hole (4650-4850).
   g. Load control valve assembly (20) adjusted too short (4650-4850).
   h. Load control valve body filter plugged (4650-4850).
   i. Orifice (30) faulty (4650-4850).
   j. Sensing cylinder inline filter (31) plugged (4650-4850).
   k. Low main pump pressure.
5. Excessive settling with engine off. Could be caused by:
   a. Operating valve clearance too tight (paragraph 231).
   b. Return valve (9) damaged or sticking.
   c. Surge relief valve (6) or thermal relief valve (11) leaking.
   d. Rockshaft piston seal (2) or rockshaft housing damaged.
   e. Leak around pressure valve (10) or return valve (9) metering shaft.

TEST AND ADJUST

All Models

231. CONTROL LINKAGE ADJUSTMENT. To adjust control lever friction, first disconnect lower end of control rod from rockshaft housing arm. Loosen jam nut on adjusting screw (Fig. 241) located on side of console. Use a spring scale to measure force required to move control lever, which should be 7-8 pounds (31-36 N). If necessary, turn adjusting screw clockwise to decrease friction or counterclockwise to increase friction. Tighten jam nut and reconnect linkage.

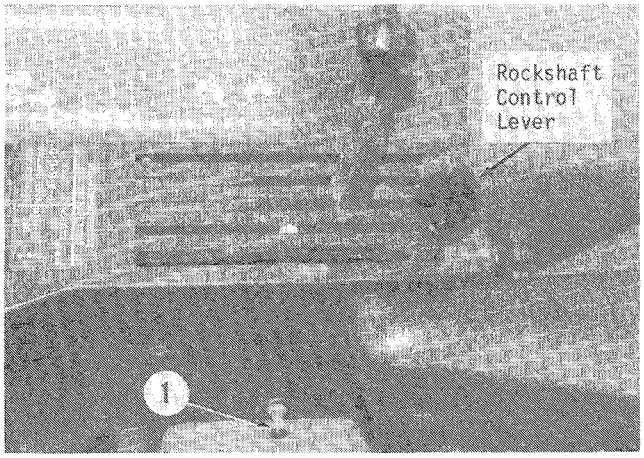


Fig. 241—The rockshaft control lever friction adjusting screw (1) is located on the side of console near the load selector lever. Refer to text for adjustment.

When making the following adjustments, hydraulic oil temperature should be at least 100° F (38° C) and no weight should be on hitch.

With engine off and rockshaft fully lowered, move console load selector knob through full range of travel. The selector knob should not bottom at either end of console slot. If necessary, adjust length of load selector rod (4—Fig. 242) to provide 1/16 inch (1.5 mm) clearance at both ends of slot.

To check and adjust rockshaft operating valve clearance, move load selector knob to "MIN" position and operate engine at 1200 rpm. Move rockshaft control lever (Fig. 241) rearward until rear edge of lever is aligned with number 3 mark on console. Slowly move console lever forward until rockshaft just starts to lower, then check position of lever on console. Lever movement of 7/8 to 1-1/4 console increments is normal. If lever movement is not within this range, remove plug (1—Fig. 244) from side of control valve housing. Working through opening in control

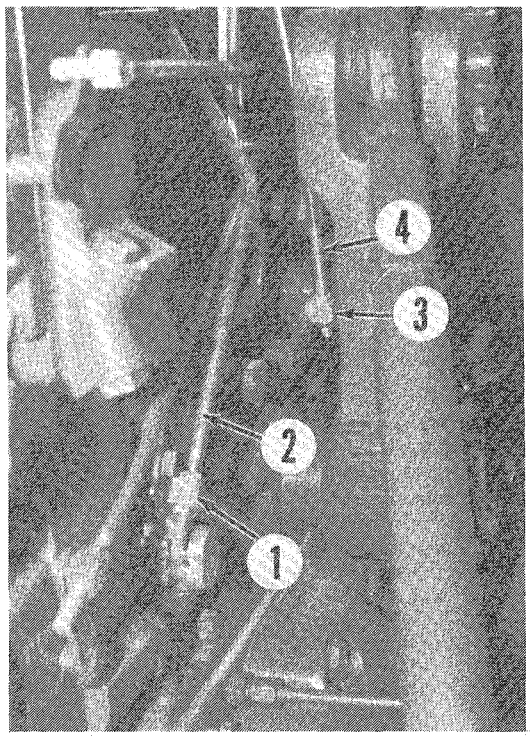


Fig. 242—Rockshaft valve control rods are adjusted at the swivels.

1. Swivel
2. Position control rod
3. Swivel
4. Load control rod

valve housing, turn adjusting screw to adjust operating valve clearance as necessary. Turn screw clockwise to reduce valve clearance and control lever movement or counterclockwise to increase valve clearance.

Check rockshaft for full raise as follows: Move rockshaft control lever fully forward and place load selector knob at "MIN" position. Operate engine at 1200 rpm, then slowly move rockshaft control lever rearward to fully raise hitch. Rockshaft should not be fully raised when rear edge of lever is still in front of console "O" mark, but hitch must be fully raised when lever is halfway past "O" mark. Adjust swivel at end of rockshaft control rod (2—Fig. 242) if necessary. Decreasing length of control rod raises rockshaft and increasing rod length lowers rockshaft.

As a final rockshaft operational check, position rockshaft control lever at front end of guide and position load selector knob at "MAX" position. Operate engine at 1200 rpm, then slowly move rockshaft control lever rearward until rockshaft starts to raise. At this point, rear edge of control lever should be between 1-3/8 and 1-5/8 increments on lever guide on Models 4050, 4250 and 4450. On Models 4650 and 4850, front edge of lever should be past 3-1/2 increments on guide before hitch begins to raise. On all models, slowly move control lever forward. Hitch must start to lower before lever has moved an equivalent of two numbered increments from previous lever position.

If rockshaft operation is not within specifications on Models 4650 and 4850, repeat rockshaft adjustment procedure. If rockshaft operation is not within specifications on Models 4050, 4250 and 4450, adjust load control arm as follows: Remove plug (1—Fig. 245) from rear of transmission case and use socket extension to turn load control adjusting screw fully clockwise. Position load control knob at "MAX" and operate engine at 1200 rpm. Move rockshaft control lever so rear edge is aligned with 1-1/2 mark on console guide. Turn load control adjusting screw counterclockwise until rockshaft is fully raised.

IMPORTANT: Use caution when performing this adjustment as rockshaft may raise unexpectedly.

232. THROTTLE VALVE. The throttle valve (1 through 8—Fig. 251) controls rockshaft drop rate. The valve adjustment is dependent on implement weight and desired lowering speed. Normal "no load" drop rate is 2-1/2 to 3 seconds. To adjust, loosen locknut and turn screw in to decrease drop rate or out to increase drop rate.

233. FLOW CONTROL VALVE. To check flow, lower rockshaft and relieve hydraulic pressure. Remove throttle valve assembly (3—Fig. 246) from cylinder end cover. Install flow meter inlet hose in throttle valve opening in end cover. Install flow meter outlet hose in right coupler of selective control valve. Tie control lever of selective control valve in rearward position. Open flow meter valve, then operate engine at 2000 rpm. Move load control knob to "MAX" position and rockshaft control lever to full rearward position. Adjust flow meter control valve to obtain 1000 psi (7000 kPa), then record flow. The flow should be within the following specifications:

Models 4050-4250-4450

Without lift assist ..... 10-11 gpm (38-42 L/min.)

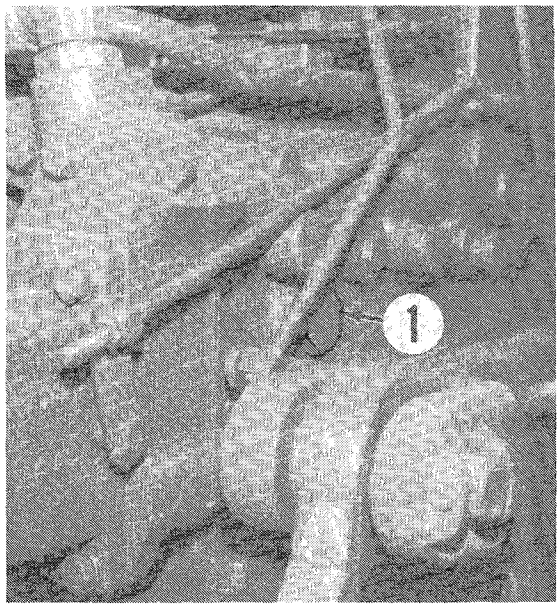


Fig. 244—Remove plug (1) located in side of control valve housing for access to valve operating cam adjusting screw. Turn screw counterclockwise to increase valve clearance or clockwise to reduce clearance.

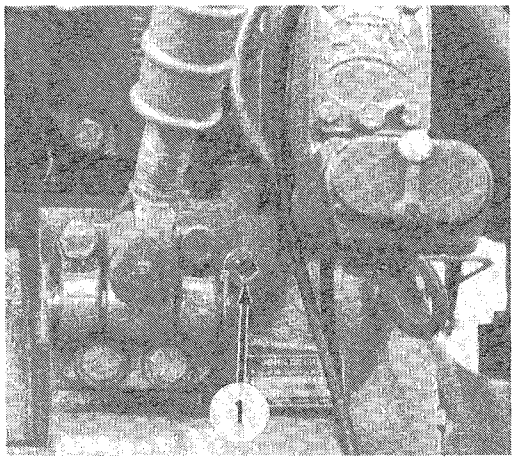


Fig. 245—Remove plug (1) from rear of transmission case and use socket extension to adjust load control arm adjusting screw on Models 4050, 4250 and 4450.

With lift assist ..... 12-13 gpm (45-49 L/min.)

Models 4650-4850

With lift assist ..... 17-18 gpm (64-68 L/min.)

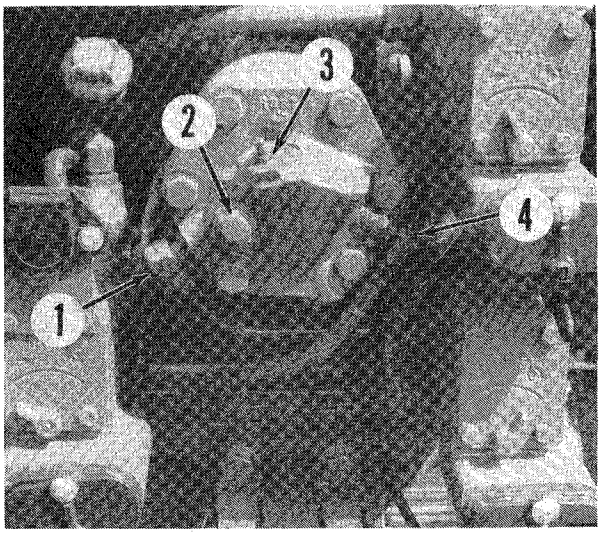


Fig. 246—View of rockshaft cylinder end cover used on models equipped with lift assist cylinder. A lowering valve is also located in the cover on some models.

1. Relief valve drain
2. Surge relief valve
3. Throttle valve
4. Lift assist line

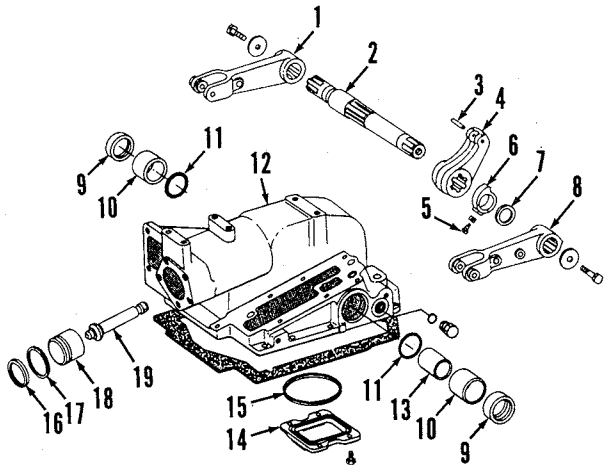


Fig. 250—Exploded view of typical rockshaft housing showing component parts. Inner bushing (13) is not used on Models 4650 and 4850.

1. Lift arm L.H.
2. Rockshaft
3. Pin
4. Crank arm
5. Set screw
6. Servo cam
7. Washer
8. Lift arm R.H.
9. Seals
10. Bushings
11. "O" rings
12. Rockshaft housing
13. Bushing
14. Cover
15. Seal ring
16. Packing
17. Seal
18. Piston
19. Rod

If necessary, add or subtract shims to flow control valve (7—Fig. 253 or 254) to obtain recommended flow. If unable to adjust flow, check for malfunction in operating valves (10A and 10B).

234. SURGE RELIEF VALVE. To test surge relief valve (15—Fig. 251), lower rockshaft arms and relieve hydraulic pressure. Remove surge valve from cylinder end cover and install in John Deere Number T37190 housing. Connect a hand pump with a pressure gage to housing. Apply pressure with hand pump while observing gage pressure reading. A sudden drop in pressure indicates relief valve has opened. Opening pressure should be 2650-3000 psi (18280-20700 kPa).

235. THERMAL RELIEF VALVE. To test thermal relief valve, relieve hydraulic pressure and remove right selective control valve housing and rockshaft control valve rear cover. Remove pressure and return valve assemblies (10A and 10B—Fig. 253 or 254) from rockshaft control valve (30). Install JDH-43 relief

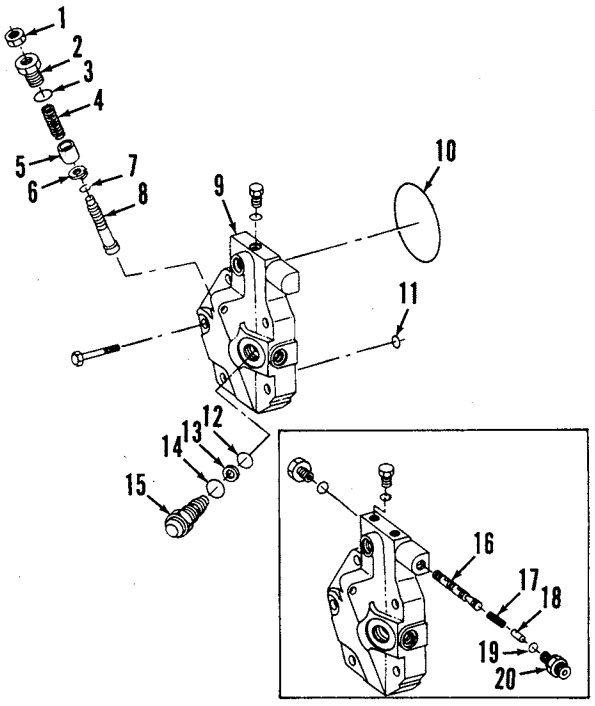


Fig. 251—Exploded view of rockshaft cylinder end cover. Lowering valve (16) shown in inset is used on early 4050, 4250 and 4450 tractors equipped with lift assist cylinder.

1. Nut
2. Fitting
3. "O" ring
4. Spring
5. Throttle valve
6. Back-up ring
7. "O" ring
8. Valve shaft
9. End cover
10. "O" ring
11. "O" ring
12. "O" ring
13. Back-up washer
14. "O" ring
15. Surge relief valve
16. Lift assist lowering valve
17. Spring
18. Pin
19. "O" ring
20. Fitting

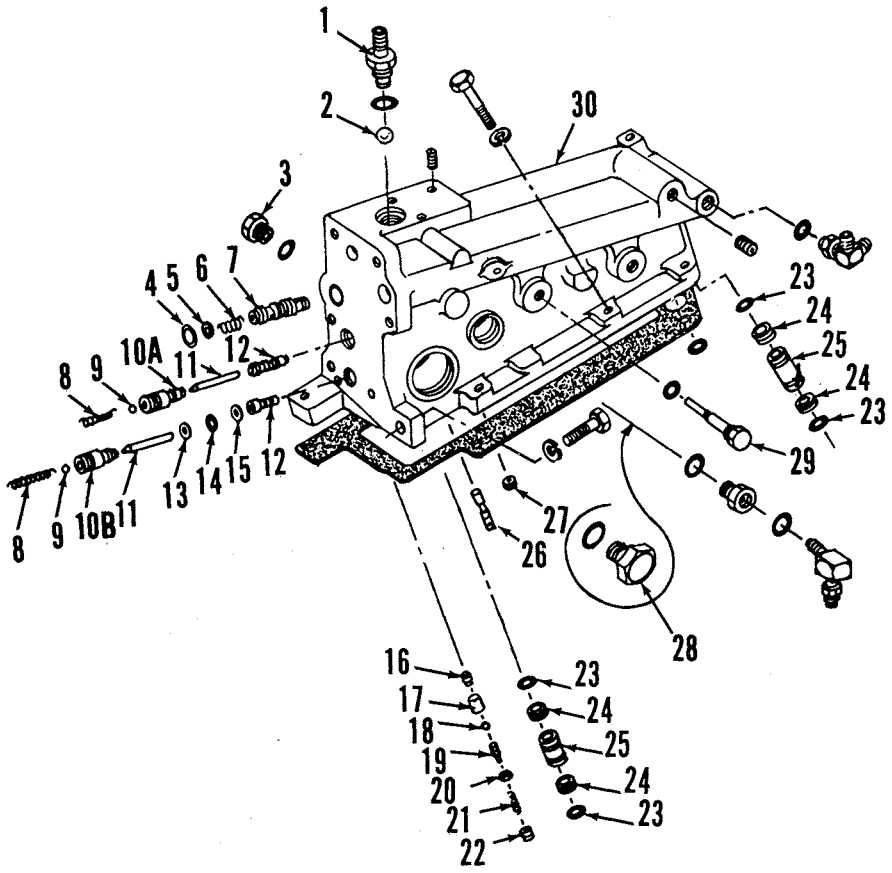


Fig. 253—Exploded view of rockshaft control valve housing used on Models 4050, 4250 and 4450.

1. Fitting
2. Ball
3. Drain plug
4. Packing
5. Shim
6. Spring
7. Flow control valve
8. Spring
9. Ball
10A. Return valve
10B. Pressure valve
11. Metering shaft
12. Guide
13. Washer
14. "O" ring
15. Back-up ring
16. Valve seat insert
17. Thermal relief valve
18. Ball
19. Pin
20. Shim
21. Spring
22. Plug
23. "O" ring
24. Back-up ring
25. Oil inlet tubes
26. Pin
27. Orifice
28. Plug (without lift assist)
29. Plug
30. Control valve housing

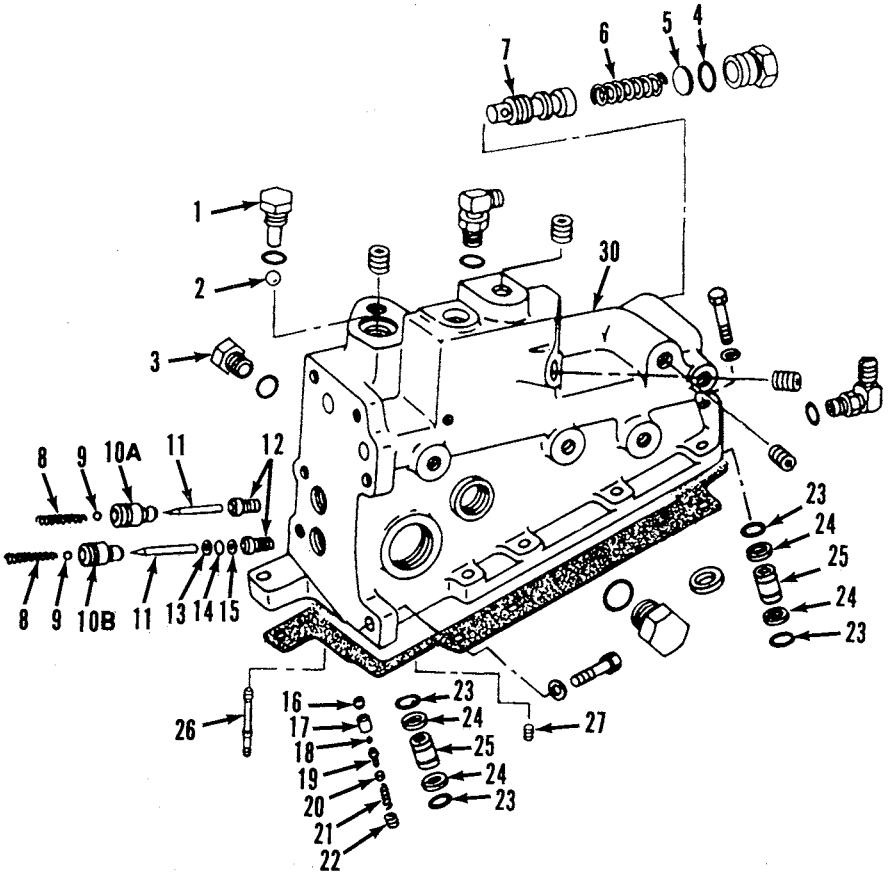


Fig. 254—Exploded view of rockshaft control valve housing used on Models 4650 and 4850. Refer to Fig. 253 for legend.

valve test kit in pressure valve bore and connect a hand pump to test valve. Apply pressure with hand pump while observing pressure gage reading. Relief valve opening is indicated by a sudden drop in pressure gage reading. Opening pressure should be 3550-3950 psi (24500-27250 kPa). If pressure is low, inspect valve (17—Fig. 253 or 254) for damage. Add shims (20) to increase pressure as necessary.

All Models

236. R&R ROCKSHAFT HOUSING. To remove housing, first lower rockshaft and operate control levers to relieve hydraulic pressure. Drain oil from rockshaft cavity by moving console lever fully forward and placing left selective control valve in float position. Connect a jumper hose to one of the couplers of the left selective control valve and place other end of hose in a suitable container. Remove throttle valve (3—Fig. 246) from piston cover, then apply 35 psi (240 kPa) air pressure into throttle valve bore until all oil is forced out through jumper hose.

If equipped with Sound-Gard body, the rear of the cab must be raised about two inches (50 mm) as follows: Disconnect clutch linkage and return spring from left side of transmission and disconnect shift linkage from right side. Disconnect control linkage from right selective control valve, then remove control valve. Disconnect control linkage rods from rockshaft control valve. Remove accumulator from hydraulic seat (if so equipped), then disconnect rockshaft return oil line and disconnect control rod from left selective control valve. Loosen Sound-Gard body front mounting bolts and remove rear mounting bolts. Raise rear of cab about 2 inches (50 mm) and block in place.

Disconnect hitch lift links from rockshaft arms and remove hitch assembly. Remove cap screws securing rockshaft control valve, then remove valve assembly. Remove transmission dipstick and dipstick tube. Remove hydraulic return oil filter, then remove rockshaft return oil line located behind oil filter case. Disconnect rockshaft pressure line from pressure control valve. Remove cap screws securing rockshaft housing to transmission case. Attach a suitable lifting tool to rockshaft housing and use a hoist to raise and withdraw rockshaft housing.

To reinstall rockshaft housing, reverse the removal procedure while noting the following special instructions: If rockshaft arms were removed, be sure to reinstall arms with index "V" mark on shaft pointing through centerline of arms. On Models 4050, 4250 and 4450, adjust load control arm extension so it is fully forward, then make sure follower arm is positioned on rear side of load control arm roller when positioning housing onto transmission case. On all models, tighten rockshaft housing mounting cap screws to 85 ft.-lbs. (115 N·m). Tighten lift arm retaining cap screws to 300 ft.-lbs. (407 N·m). Strike arms with a hammer, then retighten cap screws to 300 ft.-lbs. (407 N·m). Tighten piston cover mounting cap screws to 240 ft.-lbs. (325 N·m). Tighten rockshaft control valve cap screws to 35 ft.-lbs. (47 N·m). Tighten Sound-Gard body mounting bolts to 150 ft.-lbs. (203 N·m). Tighten lift link pin retainers to 85 ft.-lbs. (115 N·m). Adjust rockshaft control linkage as outlined in paragraph 231.

237. ROCKSHAFT HOUSING OVERHAUL. Rockshaft piston (18—Fig. 250) can be removed for inspection or renewal without removing rockshaft housing. Remove cylinder end cover, then push piston out by pushing down on rockshaft arms.

To disassemble rockshaft, use a suitable puller to remove lift arms (1 and 8—Fig. 250). Remove bottom cover (14) from housing. Remove set screw (5) from servo cam (6), then drive rockshaft out left side of housing on Models 4050, 4250 and 4450 or out right side of housing on Models 4650 and 4850. Remove crank arm (4), servo cam (6) and spacer (7) as shaft is withdrawn.

Inspect all parts for excessive wear or other damage. Compare parts with the following new part specifications and renew if necessary.

Models 4050-4250-4450

Rockshaft OD—	
L.H. end	2.872-2.874 in. (72.95-72.99 mm)
R.H. end	2.499-2.501 in. (63.47-63.53 mm)
Bushing ID—	
L.H. side	2.876-2.880 in. (73.05-73.15 mm)
R.H. side	2.503-2.507 in. (63.58-63.68 mm)
Piston OD	4.246-4.248 in. (107.85-107.90 mm)
Cylinder ID	4.2505-4.2535 in. (107.96-108.04 mm)

Models 4650-4850

Rockshaft OD—	
L.H. end	3.247-3.249 in. (82.47-82.53 mm)
R.H. end	3.622-3.624 in. (92.00-92.05 mm)
Bushing ID—	
L.H. side	3.252-3.257 in. (82.60-82.73 mm)
R.H. side	3.627-3.632 in. (92.13-92.25 mm)
Piston OD	4.371-4.373 in. (111.02-111.07 mm)
Cylinder ID	4.3750-4.3765 in. (111.125-111.163 mm)

When renewing rockshaft bushings on Models 4050, 4250 and 4450, drive inner bushing (13) flush with edge of piston rod bore. Install outer bushings (10) making sure oil holes in bushings are aligned with oil holes in housing.

When renewing rockshaft bushings on Models 4650 and 4850, install both bushings from right side of housing. Be sure oil hole in right bushing is toward bottom of housing bore. Outside edge of right bushing should be 1/4 inch (6.5 mm) from bottom of counterbore for oil seal.

Coat all parts with clean hydraulic oil prior to assembly. Reassemble by reversing the disassembly procedure while noting the following special instructions: There are special splines on crank arm and rockshaft that must be aligned. Install new oil seals into housing after rockshaft is in place. Install bottom cover with seal ring and tighten cap screws to 35 ft.-lbs. (47 N·m). Make certain index mark on ends of rockshaft is pointing through centerline of lift arms. Reinstall rockshaft housing onto tractor, then tighten lift arm retaining screws to 300 ft.-lbs. (407 N·m). Strike arms with a hammer, then retorque cap screws to 300 ft.-lbs. (407 N·m). Tighten cylinder end cover cap screws to 240 ft.-lbs. (325 N·m).

238. CYLINDER END COVER. The rockshaft end cover (9—Fig. 251) contains the throttle valve (5) and surge relief valve (15). The lowering valve (16) is used on early 4050, 4250 and 4450 tractors equipped with lift assist cylinder.

The throttle valve controls lowering rate of hitch by restricting the return oil flow from the rockshaft cylinder. Adjustment of valve is dependent on implement weight. Turning adjusting screw (8) in will decrease lowering speed and turning adjusting screw out will increase lowering speed.

The surge relief valve is designed to prevent damage from pressure spikes caused by a heavy implement bouncing while being transported. The valve should open and relieve oil to sump if cylinder pressure exceeds 2650-3000 psi (18300-20700 kPa). To check and adjust pressure setting, refer to paragraph 234.

The lowering valve is used on some models equipped with lift assist cylinder to speed lowering of hitch. The valve connects the assist cylinder directly to rockshaft cylinder when weight is on the hitch. When hitch is lowered, all oil must flow through the rockshaft cylinder and out to return oil circuit. When lowering the hitch with no weight, the valve shifts and connects assist cylinder directly to sump. The rockshaft cylinder oil still flows into return circuit. Back pressure is reduced and hitch lowering speed is increased.

Inspect valves for wear, scoring or other damage. Test valve springs and compare with following specifications for new springs.

Throttle valve spring—
Free length ..... 1.25 in. (31.8 mm)
Test length ..... 0.75 in. @ 0.5-0.7 lbs. (19 mm @ 2.2-3.1 N)

Surge relief valve spring—
Free length ..... 1.312 in. (33.3 mm)
Test length ..... 1.14 in. @ 130-150 lbs. (28.9 mm @ 578-667 N)

Tighten end cover mounting cap screws to 240 ft.-lbs. (325 N·m).

239. CONTROL VALVE HOUSING OVERHAUL. To remove the rockshaft control valve housing, disconnect operating rods from rockshaft control valve and selective control valve. Disconnect hydraulic lines from control valve housing. Remove dipstick and dipstick tube. Remove control valve mounting cap screws, then withdraw valve housing.

To disassemble, remove selective control valve and control valve cover. Remove control valves (10A and 10B—Fig. 253 or 254), metering shafts (11) and guides (12). It may be necessary to drive guides out using a wooden dowel or brass drift. Remove flow control valve (7). Remove thermal relief valve assembly (16 through 22). Remove oil inlet tubes (25) from housing. Remove special plug (1) and ball (2).

On Models 4050, 4250 and 4450, remove load control valve cover (22—Fig. 255) from valve housing. Remove special plug (13), then tap on side of valve housing to remove rocker arm pivot pin (20). Remove "E" clip, then slide rocker arm (21) off operating rod (25). Remove damping piston (19), return spring (18), valve seat (16), valve disc (15) and spring (14). Remove load control valve (7) assembly. Remove load control valve housing (9).

On Models 4650 and 4850, remove load control valve housing (8—Fig. 256) from rockshaft control valve. Withdraw load control valve (4) from rockshaft valve housing.

NOTE: Valve (4) was adjusted at factory to an overall length of 8.36 inches (212.5 mm). Do not disassemble or readjust valve unless absolutely necessary.

To disassemble rockshaft linkage, proceed as follows: On Models 4050, 4250 and 4450, remove load control valve rod (25—Fig. 255), special plug (26) and load control arm follower (24). On all models, remove load control selector lever (13—Fig. 257) with shaft (14) and control arm (16). Disconnect springs (7 and 21). Remove "E" clip from special plug (10), then withdraw plug and remove servo cam follower assembly (8 and 12). Drive out spring pin and remove operating arm (31). Remove retainer (29) and control shaft (27). Remove operating links (17, 19, 25 and 26) as an

assembly. Remove plug from side of control valve housing, then remove special shaft (22) and valve operating cam assembly (23 and 24).

Inspect all parts for wear, scoring or other damage and renew any parts in question. Control valves may be lapped to their bores, if necessary, using fine lapping compound. Inspect thermal relief valve assembly and spring for wear or damage. Test length of spring should be 0.45 inch at 13-15 pounds (11.5 mm at 55-68 N). After reassembly, thermal relief valve opening pressure can be checked and adjusted as outlined in paragraph 235. Be sure to renew all "O" rings and back-up rings.

To reassemble, reverse the disassembly procedure while noting the following special instructions: When assembling valve adjusting cam assembly, tighten locknut (1—Fig. 258) so gap between locknut and washer does not exceed 0.045 inch (1.14 mm). Tighten operating shaft retainer (29—Fig. 257) to 100 ft.-lbs. (136 N·m). Install thermal relief valve assembly and flow control valve assembly using same number of shims as removed.

Install inlet tubes with new "O" rings and back-up rings into rockshaft housing. Install control valve housing and tighten mounting cap screws to 35 ft.-lbs (47 N·m). Adjust rockshaft control linkage as outlined in paragraph 231.

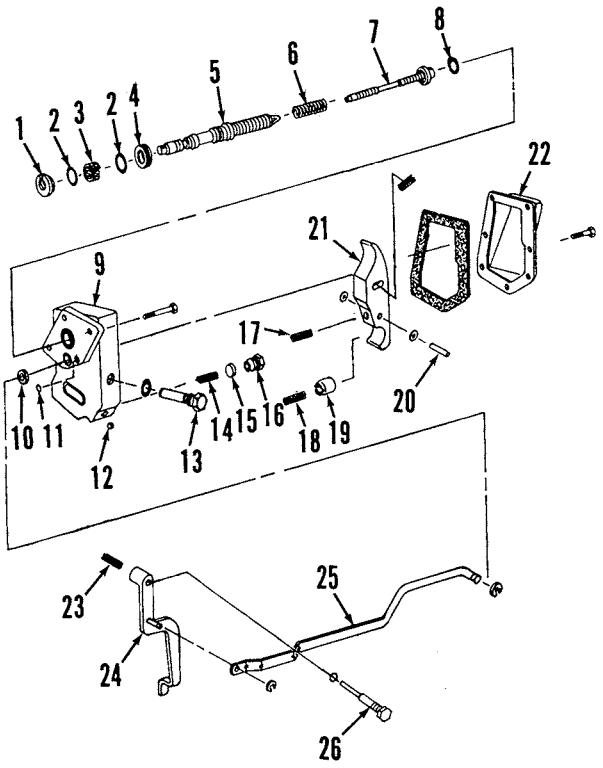


Fig. 255—Exploded view of load control valve housing showing component parts used on Models 4050, 4250 and 4450.

1. Retainer
2. "O" ring
3. Screen
4. Back-up ring
5. Sleeve
6. Spring
7. Load control valve
8. "O" ring
9. Housing
10. Washer
11. Washer
12. Ball
13. Plug
14. Spring
15. Disc
16. Valve seat
17. Spring
18. Spring
19. Damping piston
20. Pin
21. Cam
22. Cover
23. Spring
24. Load control follower arm
25. Actuating rod
26. Special plug

DRAFT SENSING COMPONENTS

Models 4050-4250-4450

240. LOAD CONTROL ARM AND SHAFT. Remove rockshaft housing as outlined in paragraph 236. On Models 4250 and 4450, remove pto output shaft as outlined in POWER TAKE-OFF section. On all models, remove cap screws securing support (12—Fig. 259 or 260). Refer to paragraph 161 or 162 for differential removal procedure, then remove differential and load control arm (8) together. Do not disassemble support (12) or follower (9) from arm unless renewal is necessary. Pin (13) is a tight press fit.

The load control shaft (11) may be removed without removing load control arm. First drain transmission fluid, then remove snap rings (9—Fig. 261) and retainers (10). Support drawbar front support (7) with a jack, then withdraw load control shaft (11) from housing. Remove bushing supports (3) with bushings. Remove snap rings (8) and drive bushings (5) from drawbar support if necessary.

Inspect all parts for wear or damage and renew if necessary. When installing bushings (5) in drawbar support, install from the inside of support inserting chamfered side of bushing first. Drive in until flat side of bushing is flush with machined surface of support.

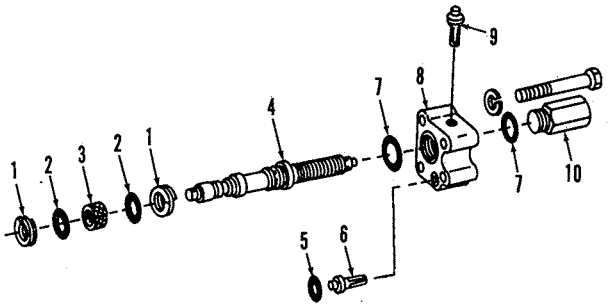


Fig. 256—Exploded view of load control valve used on Models 4650 and 4850.

1. Back-up rings
2. "O" rings
3. Screen
4. Load control valve
5. "O" ring
6. Orifice with filter
7. "O" ring
8. Retainer
9. Filter
10. Cap

Reinstall bushing supports (3) with new "O" rings (2) and tighten retaining screws to 240 ft.-lbs. (325 N·m). Reinstall load control shaft (11) along with washers (4) as required to eliminate end play. Do not force shaft through transmission case to avoid damaging control arm follower (9—Fig. 259 or 260). Install shaft retainers and snap rings, then lubricate with multipurpose grease.

Reinstall control arm assembly in reverse order of removal. Check operation of rockshaft and adjust as outlined in paragraph 231.

Models 4650-4850

241. DRAFT SENSING CYLINDER. To remove cylinder (3—Fig. 262), first lower hitch and relieve hydraulic system pressure. Disconnect hydraulic lines. Remove cylinder pin (1) and mounting cap screws.

To disassemble, remove top bracket (1—Fig. 263). Clamp cylinder rod end (16) in a vise, then loosen rod nut (3) several turns.

IMPORTANT: Do not remove rod nut at this time as spring pressure is against piston.

Clamp cylinder horizontally in a vise to relieve spring tension on rod nut, then remove nut. Release spring tension and separate components from cylinder body.

Inspect piston, rod and cylinder for scoring, wear or other damage. Inspect piston seal (4) and renew if necessary. When renewing wiper seal (13) in cylinder, install seal with lip facing outward and drive in until flush with cylinder surface.

To reassemble, first double nut piston end of rod, then remove clevis (16). Install new back-up ring (7) and "O" ring (6) on rod, then install rod into housing from piston end of housing. Install springs (14), retainer (15) and clevis (16). Tighten clevis about two turns. Install spring (10) and orifice valve (9). Install piston and nut on rod. Secure clevis in a vise, then tighten clevis and nut to 185 ft.-lbs. (250 N·m). Install top bracket with new "O" ring and tighten cap screws to 35 ft.-lbs. (47 N·m).

Reinstall sensing cylinder on tractor and tighten mounting cap screws to 35 ft.-lbs. (47 N·m). Note that cylinder pin (1—Fig. 262) is installed in upper hole as shown on 4650 tractors. On 4850 tractors, pin is installed in center hole (2).

SELECTIVE (REMOTE) CONTROL VALVES

All Models So Equipped

242. OPERATION. Tractors may be equipped with up to three selective control valves (SCV). Each SCV has an integral pair of ISO (International Standards Organization) couplers. Each SCV can operate a remote cylinder, independently or simultaneously, in combination with the other SCV's.

As with all other units of the hydraulic system, pressure is always present at the valves, but no flow exists until the valve is actuated. Refer to Fig. 264 for an exploded view of valve mechanism. The console control lever actuates two valve operating cams (40 and 42) and a detent cam (41). The operating cams open return and pressure poppet valves to provide

1. Load selector lever
2. Shaft
3. Control rod
4. Bushings
5. Arm
6. Pin
7. Spring
8. Link
9. "O" ring
10. Special plug
11. Pin
12. Follower
13. Load control arm
14. Shaft
15. "O" ring
16. Arm
17. Link
18. Bushing
19. Operating arm
20. Pin
21. Spring
22. Adjusting screw
23. Valve adjusting cam
24. Cam adjusting link
25. Lever
26. Operating arm
27. Operating shaft
28. "O" ring
29. Retainer
30. "O" ring
31. Position control arm
32. Rod
33. Arm
34. Bushings
35. Shaft
36. Guide
37. Position control lever
38. Friction adjusting screw
39. Washers
40. Springs
41. Washer

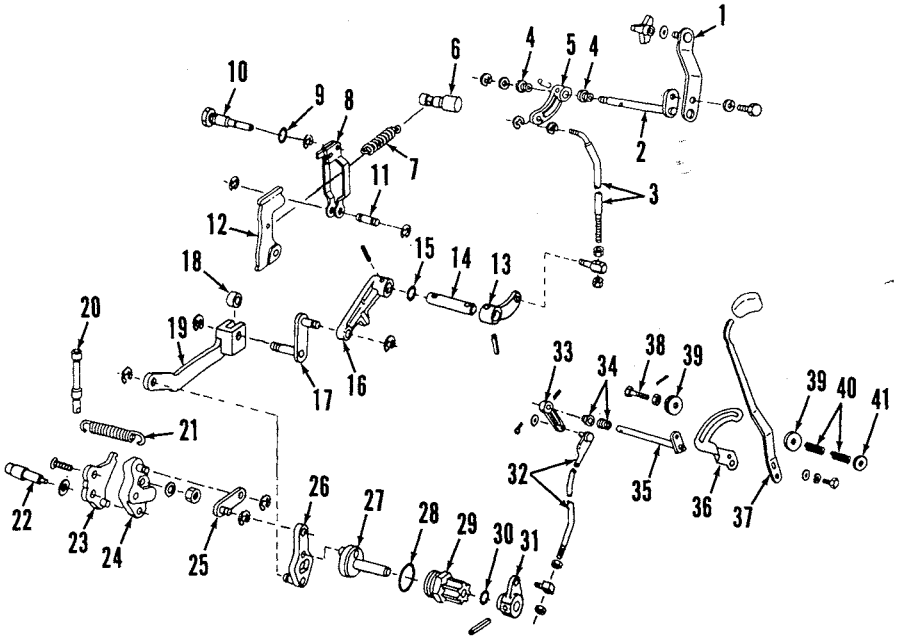


Fig. 257—Exploded view of rockshaft control linkage.

a complete circuit for pressurized oil to a remote cylinder and return oil from the cylinder. Each SCV is equipped with two return valves and two pressure valves arranged so that one of each is opened when control lever is moved off center in either direction. The metering valve (30) provides manual adjustment of flow rate through the SCV. The flow control valve (25) maintains an even flow with varying loads.

243. REMOVE AND REINSTALL. Before removing left selective control valve, oil should first be drained from rockshaft cavity as follows: Position rockshaft console lever fully forward and place left selective control valve in float position. Connect a hose to one of the couplers of left SCV and place other end of hose in a suitable container. Remove throttle valve from rockshaft cylinder end cover, then apply 35 psi (240 kPa) air pressure into throttle valve bore until all oil is expelled.

To remove selective control valve, disconnect control lever rod and hydraulic lines from valve housing. Loosen the two bottom mounting cap screws and remove the two upper cap screws. Lift selective control valve off tractor.

Renew seal ring and gasket on valve housing before reinstalling. Install selective control valve by reversing the removal procedure.

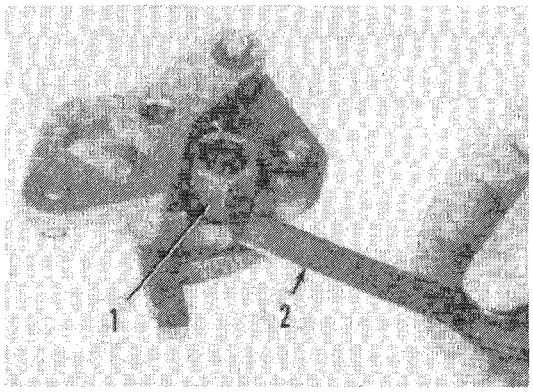


Fig. 258—When assembling valve adjusting cam assembly, tighten nut (1) so gap between washer and valve link does not exceed 0.045 inch (1.14 mm).

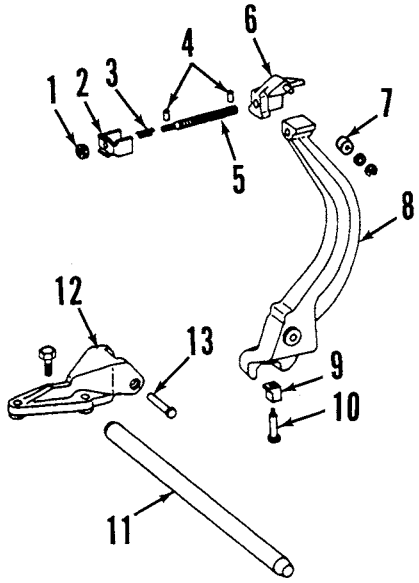


Fig. 259—Typical load control arm and associated parts used on 4050, 4250 and 4450 models equipped with Quad-Range transmission.

1. Nut
2. Lockplate
3. Spring
4. Pins
5. Adjusting screw
6. Extension
7. Roller
8. Arm
9. Follower block
10. Pin
11. Load control shaft
12. Support
13. Pin

244. OVERHAUL. Refer to Fig. 264 for an exploded view of the selective control valve. Unbolt and remove valve cap (36) carefully as poppet valve springs are compressed. Remove return valves and pressure valves with associated parts. Keep components separated and identified in order of removal as valves and springs must be returned to their original bores. Remove flow control stop (24) and valve (25). Depress detent guide (2), then remove retaining ring (1). Remove guide, "O" rings, back-up rings and detent piston assembly from housing. Removal of detent piston (11) and cam follower (12) may be easier after rocker assembly is removed.

Before removing rocker assembly, note which side of housing operating arm (39) is on to ensure correct reassembly. Pry rubber keepers (47) from adjusting screws. Drive spring pin from rocker (49), then withdraw operating arm and rocker assembly.

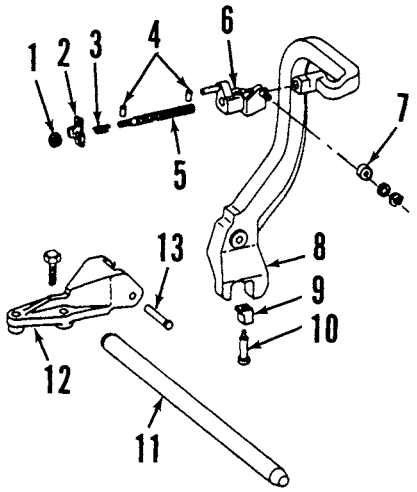


Fig. 260—Typical load control arm and associated parts used on 4050, 4250 and 4450 models equipped with Power Shift transmission. Refer to Fig. 259 for legend.

Inspect all bores, valves and valve seats. Renew parts if there is evidence of excessive wear, scoring, nicks or other damage. Resurfacing of valve seats is not recommended. Be sure to renew all "O" rings and back-up rings. Renew pressure and return valve springs if damaged or if they fail to meet the following specifications:

Pressure Valve Springs—
Color code ..... Red
Free length ..... 1.72 in. (44 mm)
Test length ..... 1.20 in. @ 36.44 lbs. (30.5 mm @ 162-196 N)

Return Valve Springs—
Color code ..... Green
Free length ..... 1.54 in. (39 mm)
Test length ..... 1.20 in. @ 18-22 lbs. (30.5 mm @ 80-98 N)

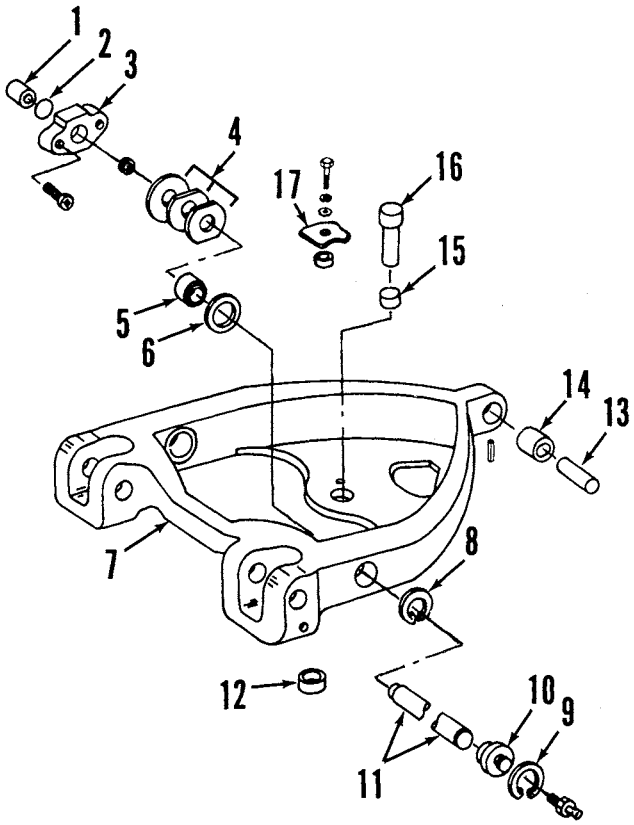


Fig. 261—Exploded view of draft link and drawbar support used on Models 4050, 4250 and 4450.

1. Bushing
2. "O" ring
3. Support
4. Washers
5. Bushing
6. Washer
7. Support
8. Snap ring
9. Snap ring
10. Retainer
11. Load control shaft
12. Bushing
13. Dowel pin
14. Bushing
15. Bushing
16. Pin

To reassemble, proceed as follows: Assemble detent cartridge using a vise or other suitable means to compress springs. Install detent cartridge in housing bore making sure long end of detent pin (10—Fig. 264) is facing outward. Do not install cam follower (12) at this time. Install new "O" ring and back-up ring into detent bore, then install spring (5), guide (2) and retaining ring (1).

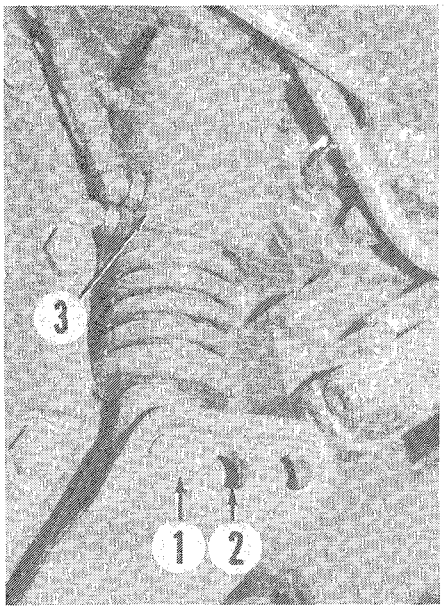


Fig. 262—Draft sensing cylinder (3) is mounted on right side of transmission housing on Models 4650 and 4850. Cylinder mounting pin is located in upper hole (1) on 4650 models and in center hole (2) on 4850 models.

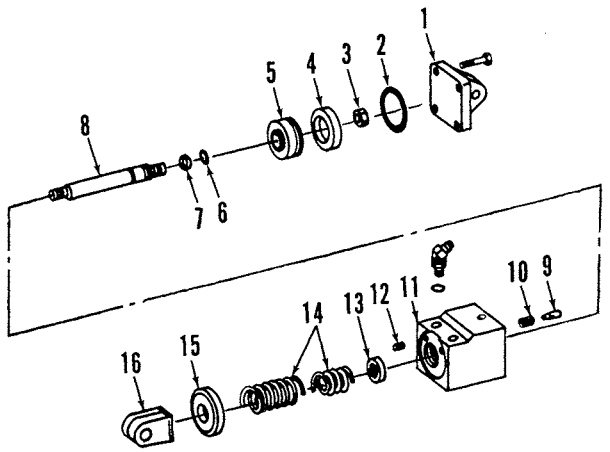


Fig. 263—Exploded view of draft sensing cylinder used on Models 4650 and 4850.

1. End cover
2. "O" ring
3. Nut
4. Seal
5. Piston
6. "O" ring
7. Back-up ring
8. Rod
9. Sensing valve
10. Spring
11. Cylinder body
12. Plug
13. Seal
14. Springs
15. Retainer
16. Rod end

Install detent cam in rocker (49—Fig. 266) with float stop (S) positioned as shown, then install retaining pins (44). Position regular cam (40) and float cam (42) on rocker. Regular cam can be identified by the beveled corner (B). Install detent cam follower (12—Fig. 264) in housing bore, then install rocker assembly and operating arm into housing.

Reinstall pressure valves and return valves into their original bores in housing making certain cam followers are aligned with cams. Adjust selective control valves as outlined in paragraph 245.

Install selective control valve springs (17) and guides (16). Note that pressure valve springs are color coded red and return valve springs are color coded green. Install flow control valve (25) and stop (24) with new "O" rings and back-up rings. Install cover (36) and tighten cap screws evenly to 35 ft.-lbs. (47 N·m).

245. ADJUST SELECTIVE CONTROL VALVE. To adjust selective control valve, remove valve cover (36—Fig. 264), valve guides (16) and springs (17) if not already removed. Install JDH-15C adjusting cover (1—Fig. 267) with the angled screw (2) pointing at detent piston pin. It may be necessary to grind some material from bottom of adjusting cover (B) to prevent interference between cover and valve housing. Use flat washers as required between cover and housing to prevent mounting cap screws from bottoming out in housing.

NOTE: Identify the two pressure valve adjusting screws (2—Fig. 265) and the two return valve adjusting screws (5) with a marker or tape to avoid confusion during adjustment.

Finger tighten the four valve seating screws (3 and 4—Fig. 267) until operating valves are seated. Be sure valve rollers are aligned with cams. Move control arm back and forth while tightening detent adjusting screw (2) until detent roller is seated in neutral detent of detent cam. Mount a dial indicator with indicator pointer contacting SCV operating arm two

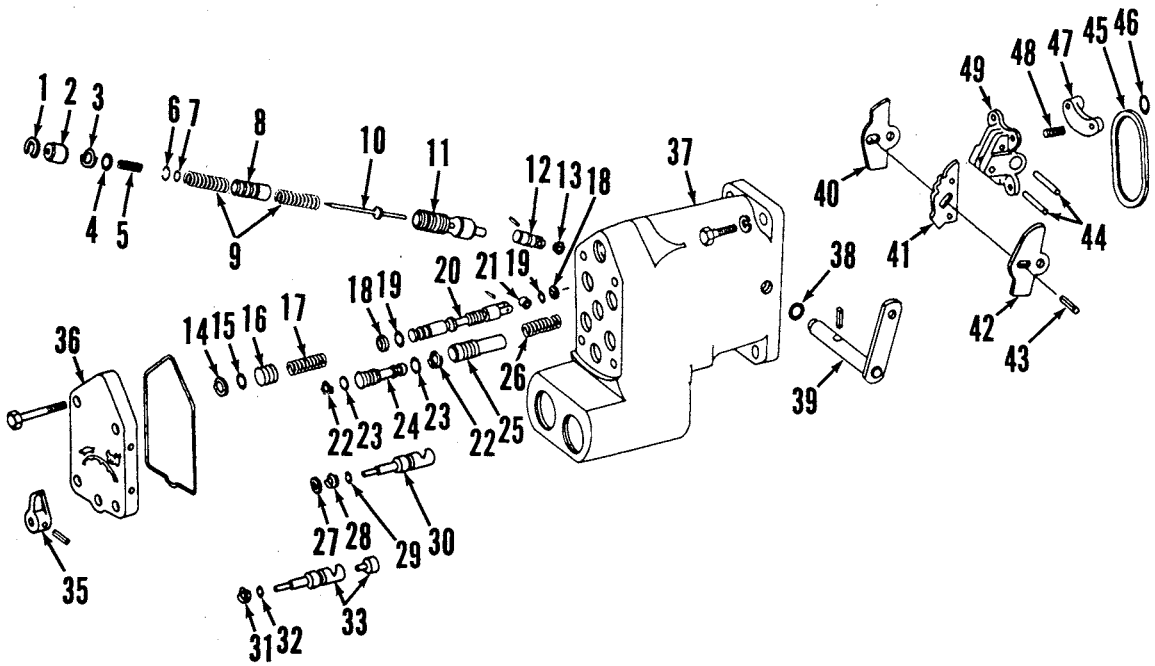


Fig. 264—Exploded view of selective control valve (SCV) assembly used on all models.

1. Snap ring
2. Guide
3. Back-up ring
4. "O" ring
5. Spring
6. Snap ring
7. Washer
8. Detent piston
9. Springs
10. Detent pin
11. Detent cartridge
12. Cam follower
13. Washer
14. Back-up ring
15. "O" ring
16. Bushing
17. Spring
18. Back-up ring
19. "O" ring
20. Poppet valve
21. Roller
22. Back-up ring
23. "O" ring
24. Valve stop
25. Flow control valve
26. Spring
27. Washer
28. Back-up ring
29. "O" ring
30. Metering valve
31. Back-up ring
32. "O" ring
33. Check valve assy.
35. Arm
36. Cover
37. Valve housing
38. "O" ring
39. Control arm
40. Regular cam
41. Detent cam
42. Float cam
43. Pin
44. Pins
45. Seal ring
46. Seal ring
47. Retainer
48. Adjusting screw
49. Rocker

inches (51 mm) from center of rocker shaft. Set indicator at zero.

Turn the four valve adjusting screws (2 and 5—Fig. 265) inward until screws, cams and valve follower rollers are all in contact. Then, back out pressure valve adjusting screws (2) 1/2 turn and back out return valve screws (5) 1/4 turn. Back out detent screw (2—Fig. 267) and a pressure and a return valve seating screw (3 and 4) on one side only of adjusting cover. Turn valve adjusting screws on opposite side (the side that has valve seating screws turned in) to obtain the following clearances measured at operating arm. Adjust return valve to obtain indicator reading of 0.020-0.030 inch (0.51-0.76 mm) from ZERO position. Adjust pressure valve to obtain reading of 0.060-0.070 inch (1.52-1.78 mm) from ZERO position.

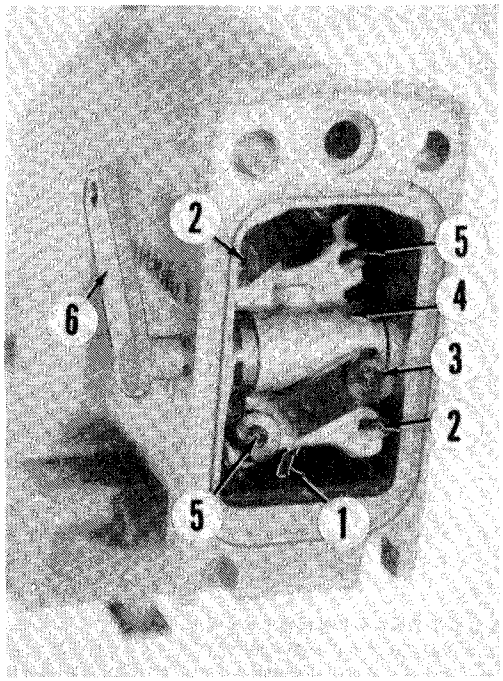


Fig. 265—Before removing SCV rocker (4), note which side of housing the operating arm (6) is located on to ensure correct reassembly.

1. Detent cam
2. Adjusting screws (pressure valves)
3. Rubber retainer
4. Rocker
5. Adjusting screws (return valves)
6. Operating arm

Retighten valve seating screws finger tight, then loosen valve seating screws on opposite side of adjusting cover. Turn detent screw in to make certain neutral position is still zero, then turn detent screw back out. Repeat the clearance adjustment procedure for the remaining two return and pressure valve adjusting screws.

This adjustment will allow return valves to open slightly before pressure valves and ensure maximum oil flow through the selective control valve.

To double-check the adjustment after all four valves are adjusted, finger tighten both pressure valve seating screws (3—Fig. 267) and loosen both return valve seating screws (4). Check for 0.060-0.070 inch (1.52-1.78 mm) clearance on each side of zero position. Finger tighten return valve seating screws and loosen pressure valve seating screws. Check for 0.020-0.030 inch (0.51-0.76 mm) clearance from zero. Readjust as necessary for correct rocker movement.

246. BREAKAWAY COUPLER. To remove the couplers, remove dust cover (2—Fig. 268) and front cover assembly (5A or 5B). Remove rear cover (35) with release lever (32) and cam (34). Depress coupler (15) to relieve spring pressure, then remove retain-

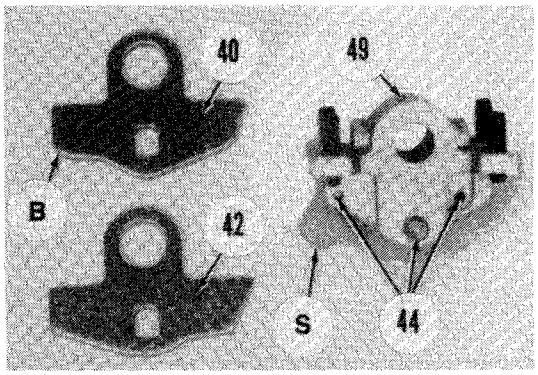


Fig. 266—Regular cam (40) can be identified by beveled corner (B) while float cam (42) has a sharper corner.

40. Regular cam
42. Float cam
S. Detent cam float stop
44. Pins
49. Rocker

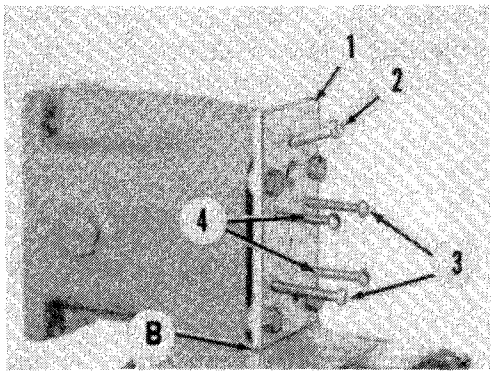


Fig. 267—To adjust selective control valve, install JDH-15C adjusting cover (1) on control valve housing as shown. It may be necessary to grind some material from bottom of cover (B) to prevent interference with housing.

1. Adjusting cover
2. Detent seating screw
3. Pressure valves seating screws
4. Return valves seating screws

ing ring (8) and sleeve (9). Withdraw spring (10) and coupler (15) being careful not to lose balls (14). Remove seals (31) from housing.

NOTE: Early style couplers used on 4050 tractors up to serial number 005005, 4250 tractors up to serial number 009053, 4450 tractors up to serial number 018173, 4650 tractors up to serial number 010095 and 4850 tractors up to serial number 008102 are not servicable except for "O" ring (12) and back-up ring (11). However, the early and late style couplers are interchangeable.

To disassemble the late style coupler, proceed as follows: Do not clamp coupler directly in a vise when disassembling. Use a suitable holding fixture to prevent coupler from turning, then unscrew receptacle (30). Separate components from coupler body. Use a small diameter rod to push ball (27) and spring (26) from piston (23).

Coat all parts with clean hydraulic oil during assembly. Renew all "O" rings and back-up washers. Reassemble in reverse order of disassembly. Tighten receptacle (30) to 35 ft.-lbs. (47 N·m). Use grease to hold balls (14) in place when reinstalling.

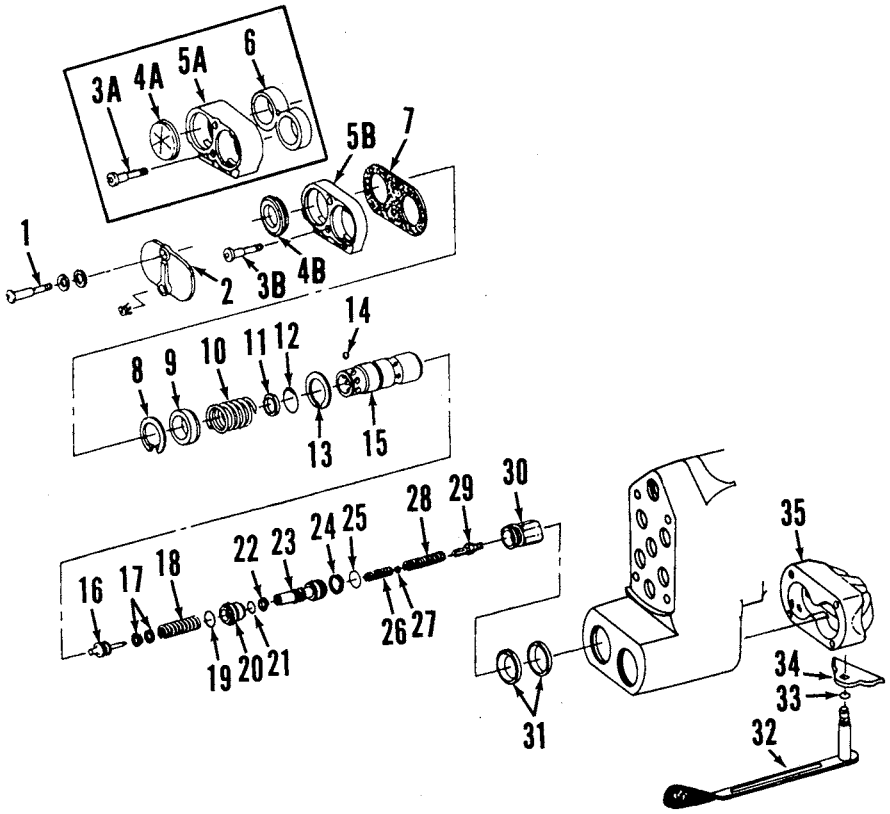


Fig. 268—Exploded view of breakaway SCV coupler assembly. Items in inset are used on early style couplers.

1. Cap screw
2. Dust cover
3A. Cap screw
3B. Cap screw
4A. Seal
4B. Grommet
5A. Retainer
5B. Retainer
6. Spacer
7. Gasket
8. Snap ring
9. Sleeve
10. Spring
11. Washer
12. "O" ring
13. Snap ring
14. Ball
15. Coupler
16. Poppet
17. Washers
18. Spring
19. "O" ring
20. Guide
21. "O" ring
22. Back-up ring
23. Piston
24. Back-up ring
25. "O" ring
26. Spring
27. Ball
28. Spring
29. Bleed valve
30. Receptacle
31. Seals
32. Lever
33. "O" ring
34. Cam
35. Cover

MECHANICAL FRONT-WHEEL DRIVE (John Deere 1100 Series Axle)

John Deere mechanical front drive axles were first used on tractors having the following tractor serial numbers:

Model	Power Shift	Quad Range
4050	007907 & up	008452 & up
4250	013982 & up	014591 & up
4450	026630 & up	028729 & up
4650	015937 & up	
4850	012320 & up	

Refer to paragraphs 4 through 8, located in the front of this service manual, for information covering front-wheel drive OPERATION, TROUBLE-SHOOTING, SOLENOID VALVE and CLUTCH. Refer to following paragraphs, 250 through 259, for service information pertaining to the John Deere mechanical drive front axle.

TIE RODS AND TOE-IN

All Models So Equipped

250. Tie rod ends are nonadjustable. If ends are excessively worn, they should be renewed.

Tie rod ends are threaded to provide adjustment for toe-in. To adjust toe-in, first measure length of both tie rods. If difference in length exceeds 1/16 inch (1.5 mm), shorten the longest rod until lengths are equal. Turn steering wheel to center the steering bellcrank, then measure distance between center of tires at the front and at the rear. Recommended difference between measurements is zero with a tolerance of 1/8 inch (3 mm) toe-in or toe-out. If necessary, loosen tie rod end jam nuts and turn each tie rod tube equally to obtain desired setting. Turning tie rod 1/8 turn will change tire centerline approximately 1/16 inch (2 mm).

AXLE HOUSING

All Models So Equipped

251. R&R AXLE ASSEMBLY. To remove axle assembly, first raise and support front of tractor and axle housing with suitable stands. Remove front fenders and front wheels. Drain oil from planetary assemblies and axle housing. Disconnect steering tie rods.

NOTE: It is recommended that planetary assemblies, wheel hubs and knuckle-spindle assemblies be removed from axle prior to removing axle housing from tractor. Removal of these components while axle is supported in a repair stand may cause the axle to become unbalanced and tip over.

Remove drive shaft shield and disconnect drive shaft from input shaft yoke. Remove front and rear pivot pin retaining cap screws. Move axle housing rearward until pivot pins are free, then lower axle from tractor.

Inspect axle pivot pins and bushings for wear or damage. To renew front pivot pin, weld a 6 inch (150 mm) × 7/8 inch (22 mm) SAE grade 8 cap screw (1—Fig. 270) to the pivot pin. Grease threads of cap screw and nut, then position a 7-1/4 inch (184 mm) long steel tube (5), steel plate (4) and hardened flat washer (3) on cap screw to be used as a puller. Tighten nut (2) to remove pin from axle housing. DO NOT apply heat to axle housing. Chill new pivot pin in a freezer for four to six hours. Clean pivot pin bore in axle housing with solvent, then apply light coat of grease to bore. Position new pin in axle housing with spring pin hole in end of pin facing upward. Protect end of pin with a soft metal plate, then drive pin into housing until it bottoms in bore. When correctly installed, pin should not protrude more than 2.1 inches (53 mm) from machined face of axle housing.

Rear pivot pin bushing can be renewed using suitable bushing removal and installation tools. When installing new bushing, be sure that "X" pattern on inside of bushing is aligned with grease fitting in pivot housing. Press bushing into housing until bushing is flush with rear counterbore of pivot housing bore. Lubricate bushing and pivot pin with grease.

To separate pivot housing from differential carrier housing, first remove drive shaft yoke from input shaft. Remove retaining cap screws and tap housing with soft hammer to break the Loctite adhesive bond between the housings. Thoroughly clean mating surfaces of carrier housing and pivot bracket. Apply bead of Loctite 277 adhesive sealant to face of carrier housing. Install pivot housing and tighten retaining cap screws to 230 ft.-lbs. (310 N·m). Install input shaft yoke and tighten retaining nut until snug. Adjust input shaft end play as follows:

Attach a chain around carrier housing and use a pry bar to push input shaft inward as shown in Fig. 271 while rotating input shaft at least five full turns. Position a dial indicator against end of input shaft, then use pry bar to move input shaft outward and

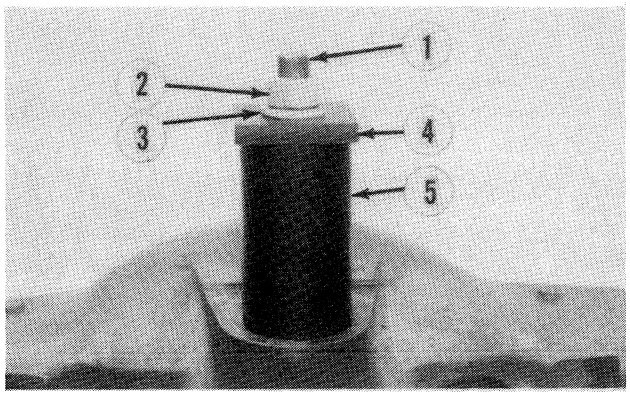


Fig. 270—View showing removal equipment used to pull front pivot pin from front-wheel drive axle. Refer to text.

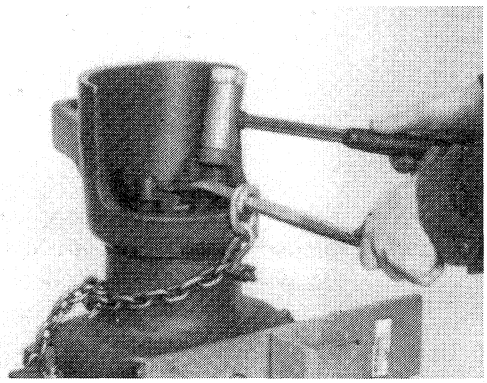


Fig. 271—To adjust bevel pinion shaft bearing preload, first apply downward force to shaft and strike end of shaft several times with a soft hammer to seat bearings. Refer to text for adjustment procedure.

note dial indicator reading. Specified end play is 0.001-0.003 inch (0.025-0.080 mm). If end play is not within specified range, tighten input shaft nut gradually and repeat the above procedure until desired end play is obtained. Then, scribe a line on yoke inline with one point of the retaining nut and tighten nut an additional 1/2 of one flat. Bend locking plate tabs over nut.

To install axle, reverse the removal procedure. Tighten pivot pin cap screw to 220 ft.-lbs. (298 N·m).

PLANETARY ASSEMBLY

All Models So Equipped

252. R&R AND OVERHAUL. To remove planetary assembly, first raise and support front axle using suitable stands. Remove front wheel. Remove drain plug and drain oil from planetary housing. Remove the two cap screws from rear of wheel hub that retain planetary carrier to wheel hub. Support planetary carrier with a hoist, then pry carrier from wheel hub using pry slots provided in carrier. To remove planetary ring gear (9—Fig. 272), pry snap ring (11) from rear of ring gear and remove ring gear from ring gear hub (10).

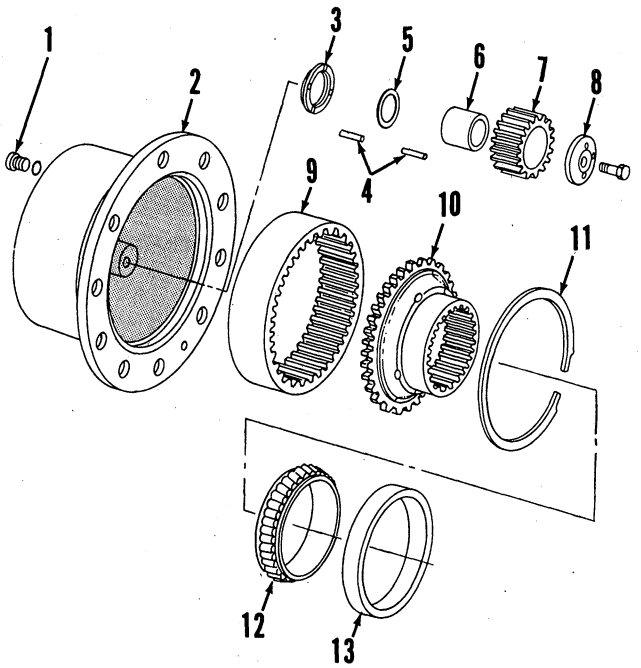


Fig. 272—Exploded view of front-wheel drive axle planetary assembly.

1. Drain/fill plug
2. Planetary carrier
3. Thrust washer
4. Needle bearing rollers
5. Spacer
6. Bearing inner race
7. Pinion gear
8. Retainer plate
9. Ring gear
10. Ring gear hub
11. Snap ring
12. Bearing cone
13. Bearing cup

Before disassembling, mark planet gears (7—Fig.273), retainers (8) and housing so parts can be reinstalled in their original position if reused. Remove retaining cap screws and withdraw planet gears, needle bearings and thrust washers.

Inspect all parts for scoring, wear or other damage and renew as necessary. If planet gear needle bearings (4—Fig. 272) are being renewed, press bearing inner race (6) onto carrier shaft until flush with top of shaft.

Install thrust washers, planet gears and needle bearings. Lubricate needle bearings with gear oil, then install retainers. Tighten retaining cap screws to 230 ft.-lbs. (310 N·m). Position sun gear and thrust washer in pinion carrier. Install carrier assembly on wheel hub and tighten two retaining cap screws to 92 ft.-lbs. (125 N·m). Refill housing with API service classification GL-5 gear lube.

WHEEL HUB, BEARINGS AND OIL SEAL

All Models So Equipped

253. R&R AND OVERHAUL. To remove wheel hub, first remove planetary carrier assembly as outlined in paragraph 252. Remove sun gear (16—Fig. 274) and Allen head screw (17). Support wheel hub, then unscrew retainer (18). Scribe alignment marks on knuckle-spindle and ring gear hub prior to removing ring gear hub. Withdraw wheel hub (24—Fig. 275) from knuckle-spindle (28) and remove oil seal and bearings from hub.

Clean and inspect all parts for wear or damage. To reassemble, apply light film of oil to lip of hub oil seal. Push hub oil seal (27—Fig. 275) by hand onto knuckle-spindle (28) until it is bottomed against shoulder of knuckle-spindle. Place wheel hub inner bearing cone (26) on the knuckle-spindle next to the hub oil seal. Assemble ring gear hub with outer bearing cone into wheel hub. Use a fabricated tool (T) as shown in Fig.

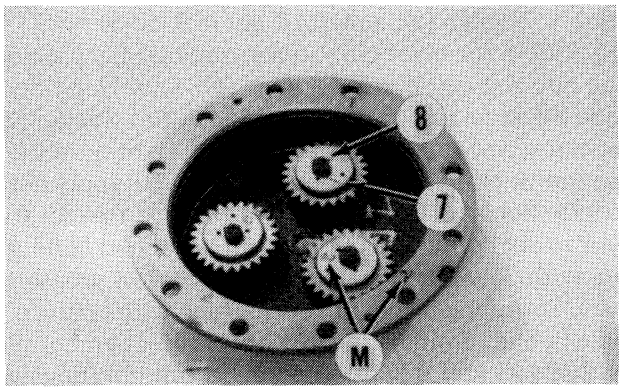


Fig. 273—Prior to disassembly, mark planet pinions (7), retainers (8) and carrier housing so that all components can be reinstalled in original positions if reused.

276 to hold wheel hub and ring gear hub together. Apply a light film of oil to outside diameter of hub seal and bore of wheel hub. Support wheel hub and ring gear hub assembly with a hoist and position unit squarely onto knuckle-spindle, aligning match marks on knuckle-spindle and ring gear hub made prior to disassembly. Install ring gear retainer (18—Fig. 274) and tighten until gap (G—Fig. 276) between wheel hub and knuckle-spindle is 1/8 inch (3 mm).

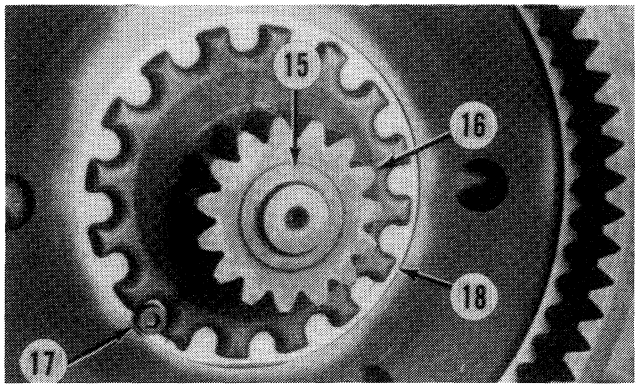


Fig. 274—View of planetary sun gear and ring gear hub retainer.

15. Thrust washer
16. Sun gear
17. Allen head screw
18. Retainer

NOTE: Once wheel hub is started onto hub oil seal, the wheel hub cannot be moved away from seal without damaging the seal.

Remove clamping tool from ring gear hub. Rotate wheel hub and strike ring gear with a soft hammer to seat bearings. Tighten ring gear hub retainer until there is zero end play. After zero end play is obtained, tighten retainer further (if necessary) to align a notch in retainer with either one of the threaded holes for Allen head screw, then tighten retainer one additional notch using the same hole. Install Allen head screw and tighten to 37 ft.-lbs. (50 N·m).

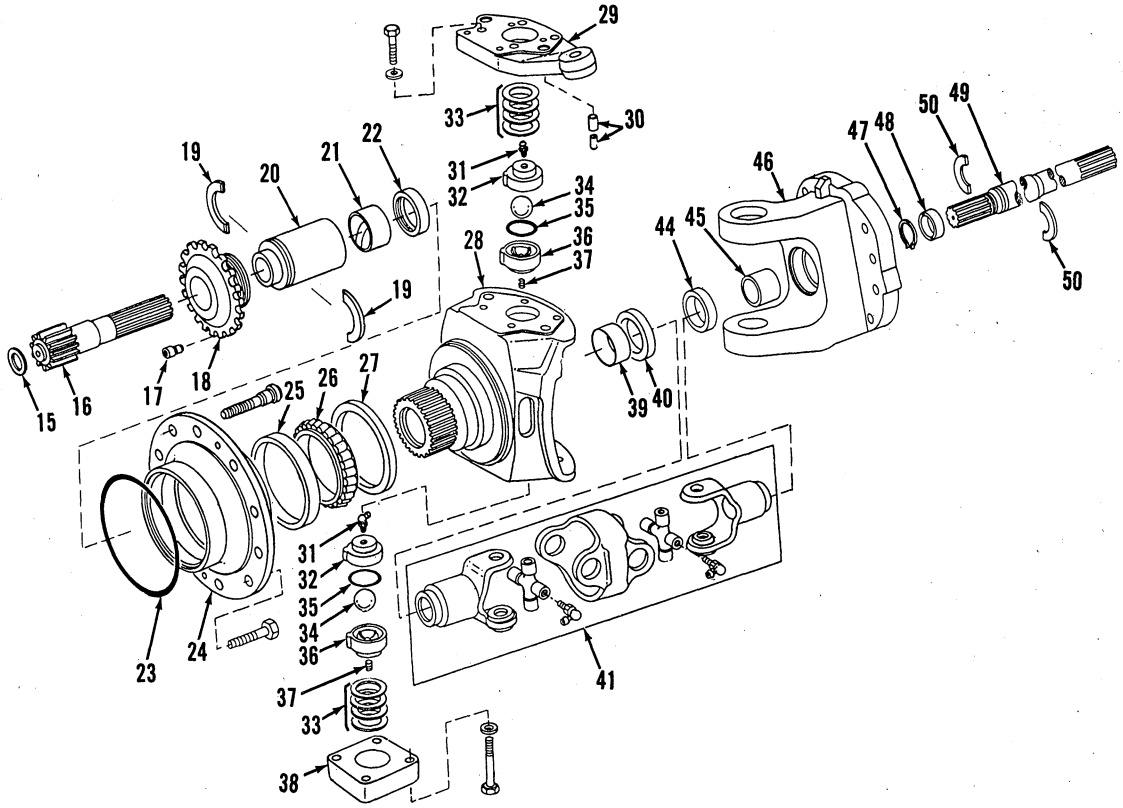


Fig. 275—Exploded view of front-wheel drive axle knuckle-spindle assembly.

15. Thrust washer
16. Sun gear
17. Allen head screw
18. Hub retainer
19. Split washer retainer
20. Sleeve
21. Bushing
22. Oil seal
23. "O" ring
24. Wheel hub
25. Bearing cup
26. Bearing cone
27. Oil seal
28. Knuckle-spindle
29. Steering arm
30. Spring pins
31. Grease fitting
32. Ball insert, upper
33. Shims
34. Ball
35. "O" ring
36. Ball insert, lower
37. Plug
38. Lower king pin cap
39. Bushing
40. Oil seal
41. Constant-velocity joint
44. Oil seal
45. Bushing
46. King pin yoke
47. Snap ring
48. Spacer
49. Axle shaft
50. Split washer retainer

KNUCKLE-SPINDLE ASSEMBLY

All Models So Equipped

254. R&R AND OVERHAUL. To remove knuckle-spindle assembly (Fig. 277), first support front axle and remove front wheel. Disconnect tie rod. Support knuckle-spindle with a hoist. Lifting tool (T) can be fabricated using dimensions shown in Fig. 278. Unbolt and remove knuckle-spindle from axle housing.

Unbolt and remove steering arm (29—Fig. 275) and lower king pin cap (38). Remove shims (33), top and bottom inserts (32 and 36), pivot balls (34) and "O" rings (35). Separate knuckle-spindle (28) from king pin yoke (46). To separate axle shaft (49) from constant-velocity joint, open snap ring (47) and withdraw axle shaft and spacer (48). Remove planetary assembly and wheel hub from knuckle-spindle as outlined in paragraphs 252 and 253.

Remove oil seals (22, 40 and 44) from sleeve (20), knuckle-spindle and king pin yoke. Inspect bushings (21, 39 and 45) for wear or damage and renew as necessary. Inside diameter of bushings in king pin yoke and sleeve should be 2.205-2.209 inches (56.01-56.11 mm). Inside diameter of bushing in knuckle-spindle should be 2.957-2.961 inches (75.105-75.205 mm).

Inspect all parts for wear or damage and renew as necessary. Outside diameter of sleeve (20) may be polished with crocus cloth. Do not use emery cloth. Renew sleeve if a groove can be felt in area that oil seal contacts. When renewing oil seals, fill space between oil seal lips at least 50 percent full of grease.

To reassemble, proceed as follows: Assemble wheel hub oil seal, bearings, wheel hub and planetary ring gear onto knuckle-spindle as outlined in paragraph 253. Position wheel hub and knuckle-spindle so knuckle-spindle faces upward, then install constant-velocity joint into knuckle-spindle sleeve. Position pivot ball inserts (32 and 36—Fig. 275) in king pin yoke (46), then lower king pin yoke into knuckle-spindle while guiding constant-velocity joint into yoke seal and bushing. Install lower king pin ball (34) and insert (32) without "O" ring and shims. Install two cap screws diagonally in bottom king pin cap (38) and tighten securely. Install upper king pin ball (34) and insert (32) without "O" ring and shims. Install a fabricated retaining plate similar to one shown in Fig. 280 in place of steering arm and tighten two diagonal cap screws alternately to 66 ft.-lbs. (90 N·m). Measure distance from steering arm mounting surface to top of ball insert. This distance is total thickness of shims (33—Fig. 275) required. Divide shims into two equal thickness shim packs and install "O" rings and shim packs on upper and lower king pins. Tighten lower king pin cap retaining screws to 230 ft.-lbs. (310 N·m). Install steering arm (29) and drive spring pins (30) into knuckle-spindle until flush with top of steering arm. Tighten steering arm retaining cap screws to 230 ft.-lbs. (310 N·m). Lubricate upper and lower king pin balls with grease.

Install axle shaft and spacer into constant-velocity joint. Use grease to hold half washers (50) in place in king pin yoke, and install knuckle-spindle and king pin yoke assembly onto axle while guiding axle shaft into axle housing and differential. Tighten king pin yoke retaining cap screws to 230 ft.-lbs. (310 N·m).

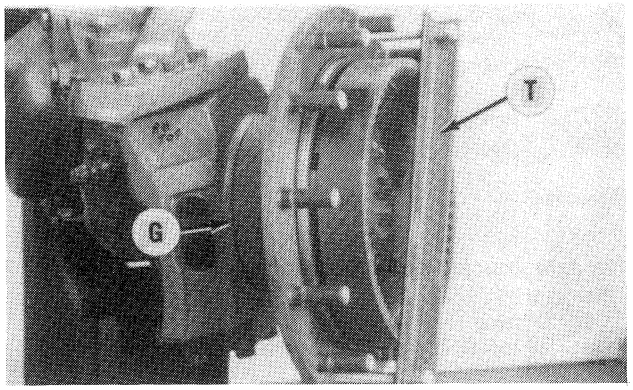


Fig. 276—A fabricated clamping tool (T) is used to hold planetary ring gear and wheel hub together during installation of wheel hub onto knuckle-spindle. Ring gear retainer should be tightened until gap (G) between wheel hub and knuckle-spindle is about 1/8 inch (3 mm).

DIFFERENTIAL

All Models So Equipped

255. R&R AND OVERHAUL. To remove differential, first drain oil from axle housing and planetary carriers. Remove wheel hubs and knuckle-spindles from axle housing. Remove axle housing from tractor as outlined in paragraph 251. Remove differential carrier mounting cap screws. Remove carrier housing and differential assembly from axle housing.

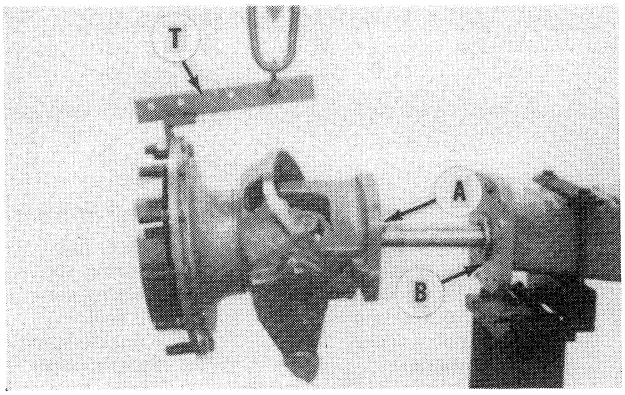


Fig. 277—Wheel hub and knuckle-spindle assembly can be removed as a unit from axle housing. Lifting tool (T) may be fabricated using dimensions given in Fig. 278.

Prior to removing differential assembly from carrier, scribe match marks on both bearing quills (1—Fig. 281) and carrier so quills can be reinstalled in their original positions. Drive spring pins (16) out until clear of quills. Support differential assembly and remove adjusting quills.

Scribe an alignment mark on differential housing halves (4 and 14—Fig. 282) prior to disassembly. Remove retaining cap screws and separate differential housing halves. Note the location of all components as differential is disassembled so they can be reinstalled in original positions if reused.

Inspect limited slip clutch packs (6 through 9) for excessive wear or damage. Renew clutch pack if metal is showing through clutch facing or if thickness of discs is less than 0.118 inch (3 mm).

Assemble side gears (10), pinion gears (12) and clutch packs into differential housing halves. Note that thick disc (9) is installed next to side gear with facing towards clutch pack. Do not install shims (5) at this time. Use a dial indicator to measure side gear end play. Recommended end play is 0.005 inch (0.13 mm) and maximum allowable end play is 0.009 inch (0.23 mm). Separate differential housing halves and install shims as necessary to obtain desired end play. Shims are installed between last separator plate and differential housing. Lubricate all parts with oil, reassemble differential and tighten housing cap screws to 92 ft.-lbs. (125 N·m).

Install differential assembly in carrier housing. Note that ring gear is positioned on left side (as viewed from rear of axle housing) for Power Shift tractors and on right side for Quad-Range tractors. Adjust carrier bearing preload and ring gear and pinion backlash as outlined in paragraph 258.

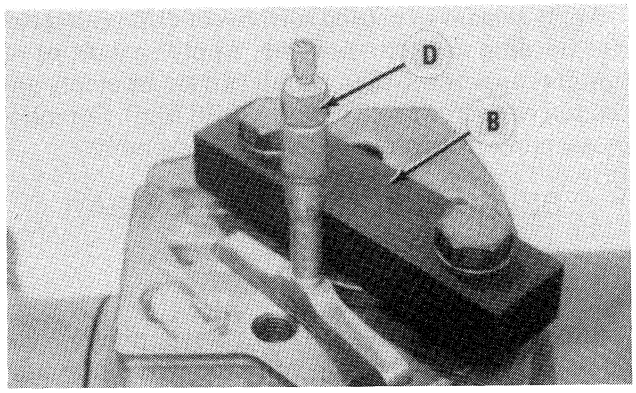


Fig. 280—To adjust king pin balls, assembly knuckle-spindle and king pin yoke without shims and install a flat retaining bar (B) in place of steering arm. Measure distance from steering arm mounting surface to top of ball insert with depth micrometer (D) or vernier scale to determine required thickness of shims.

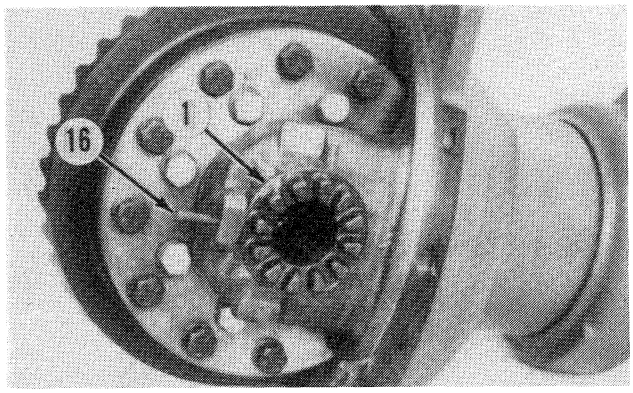


Fig. 281—Prior to removing differential assembly, scribe match marks on bearing quills (1) and carrier housing. Drive out spring pins (16) until quills can be turned.

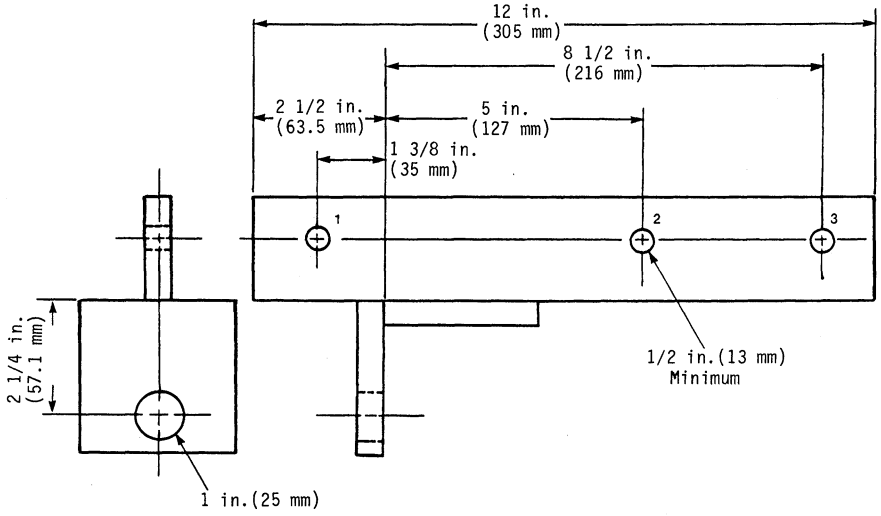


Fig. 278—Lifting tool shown in Fig. 277 may be fabricated from ½ inch (13 mm) steel plate using dimensions shown in above drawing.

Apply sealant to mating surfaces of differential carrier housing and axle housing. Apply sealant to retaining cap screws, then install carrier assembly and tighten cap screws to 230 ft.-lbs. (310 N·m). Complete reassembly in reverse order of disassembly.

BEVEL PINION AND RING GEAR

All Models So Equipped

256. R&R AND OVERHAUL. Bevel pinion shaft oil seal (6—Fig. 283) can be renewed without removing pinion shaft housing from axle. Disconnect drive shaft and remove pinion shaft yoke (5). Pull or pry old seal out of pivot housing being careful not to damage housing or shaft surfaces. Fill lip of new seal at least 50 percent full of grease, then install seal using a suitable driver. Install drive shaft yoke and tighten retaining nut until snug. Adjust pinion shaft end play as outlined in paragraph 251.

To disassemble bevel pinion, first remove differential assembly as outlined in paragraph 255. Remove drive shaft yoke (5—Fig. 283) from pinion shaft (17). Remove bevel pinion and bearings from carrier housing. Remove crush ring (10) from pinion shaft and discard the ring. Use suitable puller or press to remove bearing cone (15) from pinion shaft. Remove bearing cups (9 and 14) and shims (13) from carrier housing if necessary.

Inspect all parts for excessive wear or other damage. Bevel pinion and ring gear are a matched assembly and must be renewed as a set. If bevel pinion shaft is renewed, pinion cone point setting must be adjusted as outlined in paragraph 257.

To reassemble, install bearing cups (9 and 14) and shims (13) in carrier housing. Heat front bearing cone (15) to 300°F (150°C) and install onto pinion shaft so it seats against shaft shoulder. Install pinion shaft with new crush ring (10) into carrier. Heat rear bear-

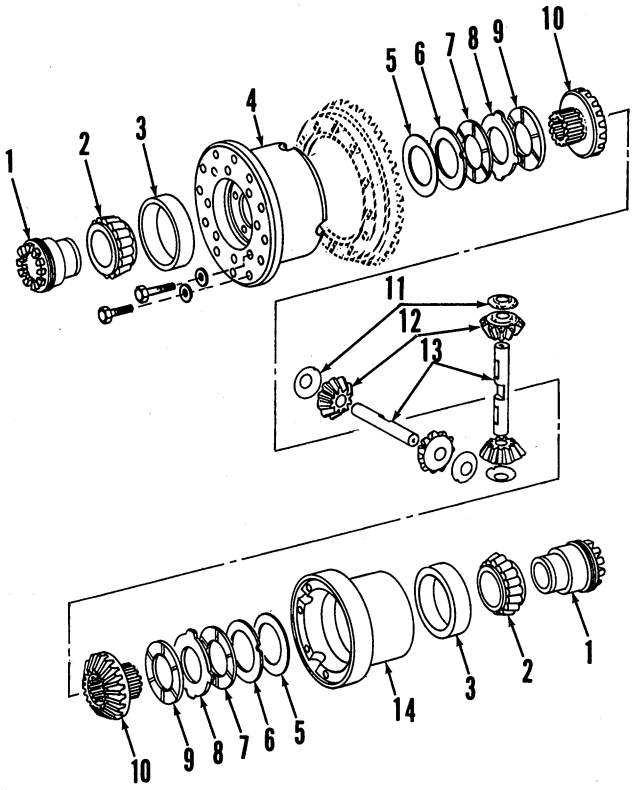


Fig. 282—Exploded view of differential assembly. Note that thick friction disc (9) is installed next to side gear (10) with friction facing towards separator plate (8). Shims (5) are installed between last separator plate and differential case.

1. Bearing adjusting quill
2. Bearing cone
3. Bearing cup
4. Differential case half
5. Shim
6. Backing plate
7. Friction disc
8. Separator plate
9. Friction disc, thick
10. Side gear
11. Thrust washers
12. Pinion gears
13. Pinion shafts
14. Differential case half

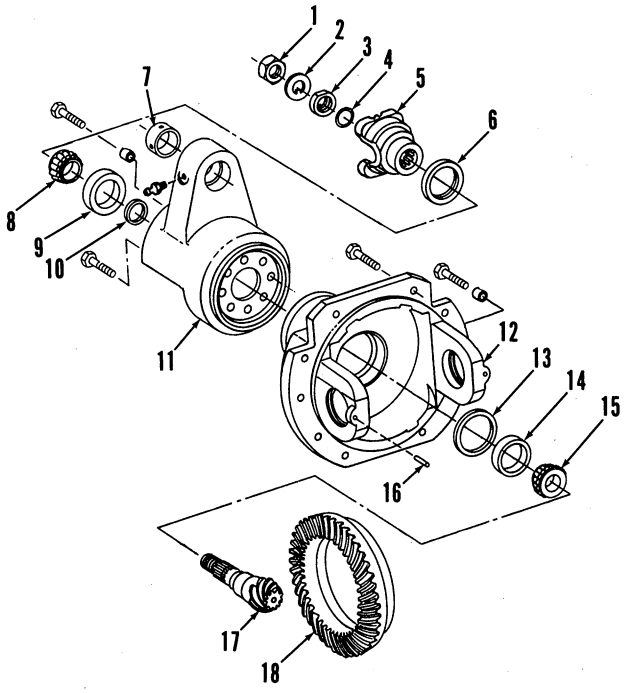


Fig. 283—Exploded view of bevel ring gear and pinion and associated components. Pinion shaft cone point is adjusted by shims (13). Pinion shaft bearings are adjusted by tightening yoke retaining nuts to compress crush ring (10).

1. Nut
2. Lockwasher
3. Nut
4. "O" ring
5. Drive shaft yoke
6. Oil seal
7. Pivot bushing
8. Bearing cone
9. Bearing cup
10. Crush ring
11. Pivot housing
12. Carrier housing
13. Shim
14. Bearing cup
15. Bearing cone
16. Spring pin
17. Bevel pinion shaft
18. Bevel ring gear

ing cone (8) and install on pinion shaft. Lubricate oil seal (6) with grease, then install seal in carrier using a suitable driver. Install yoke on pinion shaft, but do not tighten retaining nut at this time.

Heat ring gear to 210°F (100°C) and install on differential housing. Tighten retaining cap screws to 92 ft.-lbs. (125 N·m).

Install differential and ring gear assembly in carrier housing and adjust differential carrier bearings, ring gear and pinion backlash and pinion shaft bearing end play as outlined in paragraphs 258 and 259.

Apply sealant to mating surfaces of differential carrier housing and axle housing. Apply sealant to retaining cap screws, then install carrier assembly and tighten cap screws to 230 ft.-lbs. (310 N·m). Complete reassembly in reverse order of disassembly.

257. CONE POINT ADJUSTMENT. Whenever bevel pinion shaft is renewed, pinion cone point setting must be adjusted. Cone point setting is adjusted by means of shims (13—Fig. 283) located behind the large (front) bearing cup. A reference number is etched on gear end of pinion shaft. Subtract this number from a constant of 5.420 inches (137.67 mm) for Models 4050, 4250 and 4450 or 5.701 inches (144.81 mm) for Models 4650 and 4850. The difference between the two numbers is thickness of shims required to correctly set cone point.

258. BEARING PRELOAD AND BACKLASH ADJUSTMENT. To adjust differential carrier bearing preload, proceed as follows: Turn bearing quill (1—Fig. 282) on side opposite ring gear inward to bottom of threads, then turn quill outward to align notch in quill with spring pin. Turn bearing quill on ring gear side inward until resistance is felt, then turn it inward an additional three notches while rotating ring gear to seat the bearings. Turn quill on ring gear side outward five notches. Position a dial indicator to contact machined surface on face of quill support (Fig. 284). Turn quill on ring gear side inward one notch at a time, rotating ring gear each time quill is turned, until quill support is deflected 0.0005 inch (0.013 mm). Then, tighten quill no more than one notch to align notch with spring pin. Total deflection of quill support should not exceed 0.002 inch (0.05 mm) at this point.

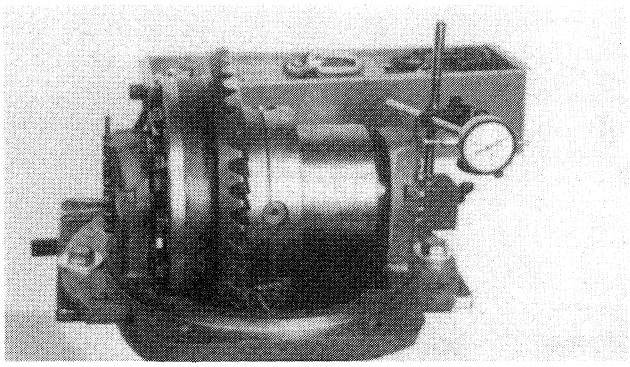


Fig. 284—Use a dial indicator to measure deflection of carrier housing when adjusting differential carrier bearing preload. Refer to text.

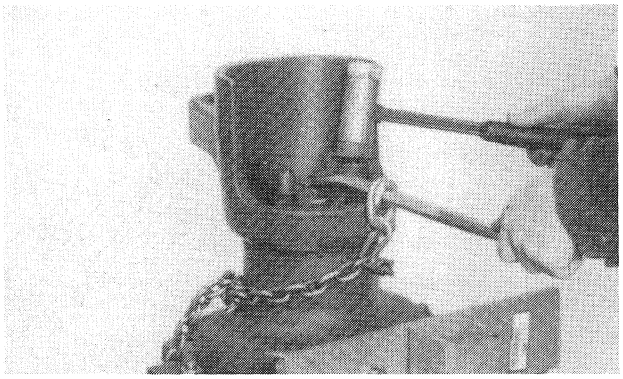


Fig. 286—Use a chain and pry bar to apply downward force on bevel pinion shaft and strike end of shaft several times with a soft hammer to seat pinion bearings.

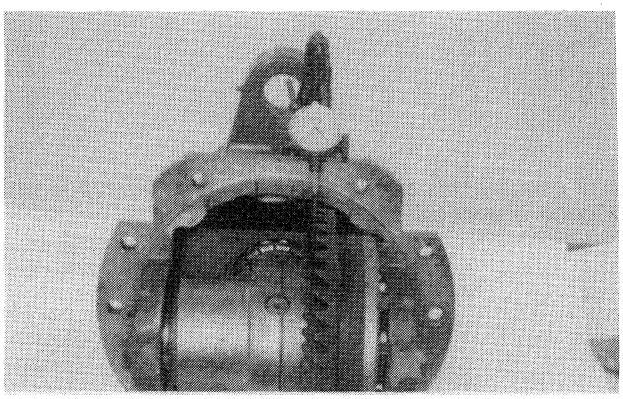


Fig. 285—Position dial indicator against tooth of ring gear to measure ring gear to pinion backlash. Recommended backlash is 0.007-0.009 inch (0.18-0.23 mm).

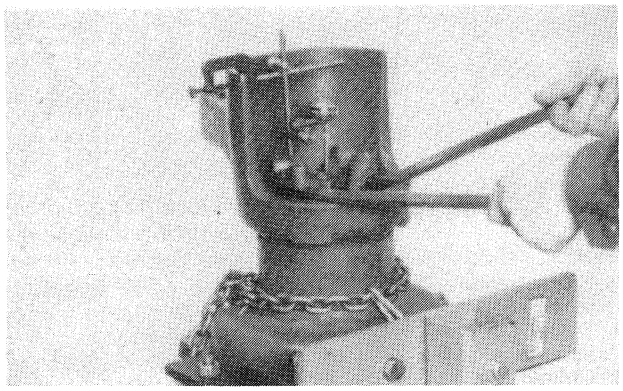


Fig. 287—Position dial indicator against end of pinion shaft, then use two pry bars to push pinion shaft up to measure end play. Recommended end play is 0.001-0.003 inch (0.025-0.080 mm). Refer to text.

To adjust backlash between ring gear and bevel pinion, position a dial indicator against tooth of ring gear (Fig. 285). Hold pinion shaft so that it cannot move, then rotate ring gear back and forth and note dial indicator reading. Specified backlash is 0.007-0.009 inch (0.18-0.23 mm). To adjust backlash, turn required quill outward one notch at a time while turning quill on opposite side inward one notch at a time until specified backlash is obtained.

259. PINION SHAFT END PLAY ADJUSTMENT. Position carrier housing so pinion shaft is in vertical position. Tighten drive shaft yoke retaining nut until snug, then rotate pinion shaft five or six turns to make sure that bearings are seated. Use a chain and pry bar to apply downward force on shaft as shown in Fig. 286 and strike end of pinion shaft about 12 times with a soft hammer. Position a dial indicator to contact end of pinion shaft, then use two pry bars to force input shaft upward and note dial indicator reading (Fig. 287). End play should be 0.001-0.003 inch (0.025-0.080 mm).

NOTE: End play must be observed the first time pinion shaft is moved upward. If shaft is pushed in and pried out again, an inaccurate reading will occur.

If end play is not within specified range, tighten yoke retaining nut in small increments and repeat the above procedure until specified end play is obtained. Bend locking tabs over retaining nut after end play is correctly set.

ELECTRICAL DIAGRAMS

261. Refer to appropriate Fig. 290 through 297 for wiring diagrams showing approximate location of electrical components on the tractor. Refer to paragraphs 84 through 93 for service procedures covering electrical system components.

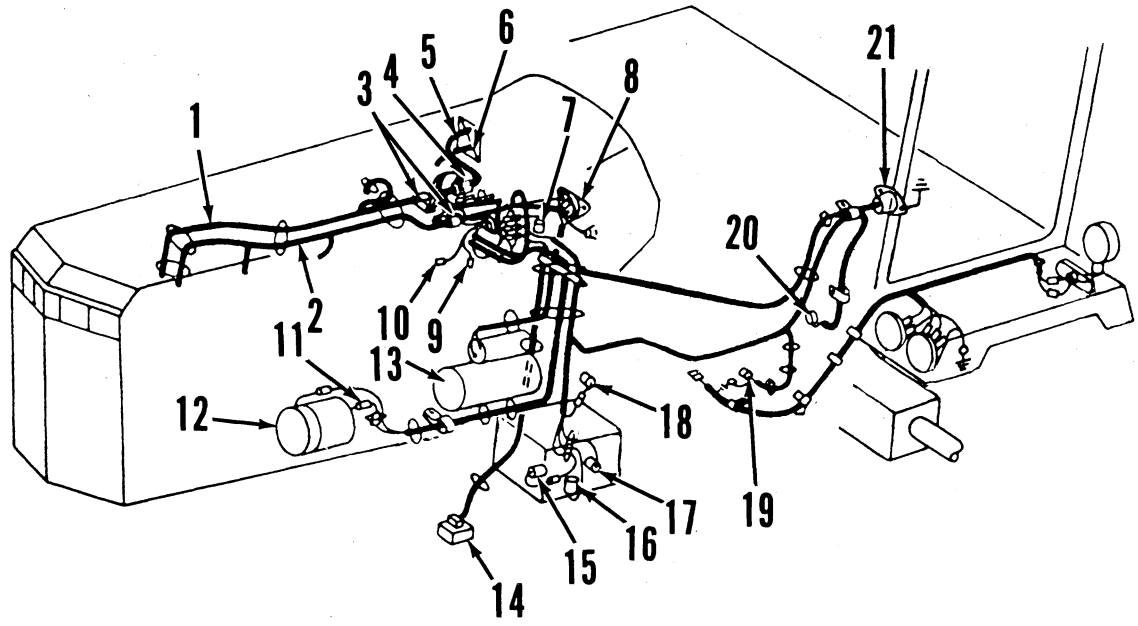


Fig. 290—Wiring harness diagram showing approximate location of components on left side of tractors equipped with Power Shift transmission and Investigator II warning system.

1. Engine sensor harness
2. Engine power harness
3. Ground
4. 23-pin connector
5. Investigator II harness
6. Instrument harness
7. Air filter restriction sensor
8. Starter circuit relay
9. Cylinder head temperature sensor
10. Engine coolant temperature sensor
11. Air conditioning high pressure sensor
12. Air conditioning compressor
13. Starter
14. MFWD solenoid
15. Hydraulic oil filter restriction sensor (service alert)
16. Transmission oil pressure sensor
17. Hydraulic oil filter restriction sensor
18. Hydraulic oil temperature sensor
19. Ground speed sensor (digital tachometer)
20. Pto speed sensor (digital tachometer)
21. Electrical outlet socket

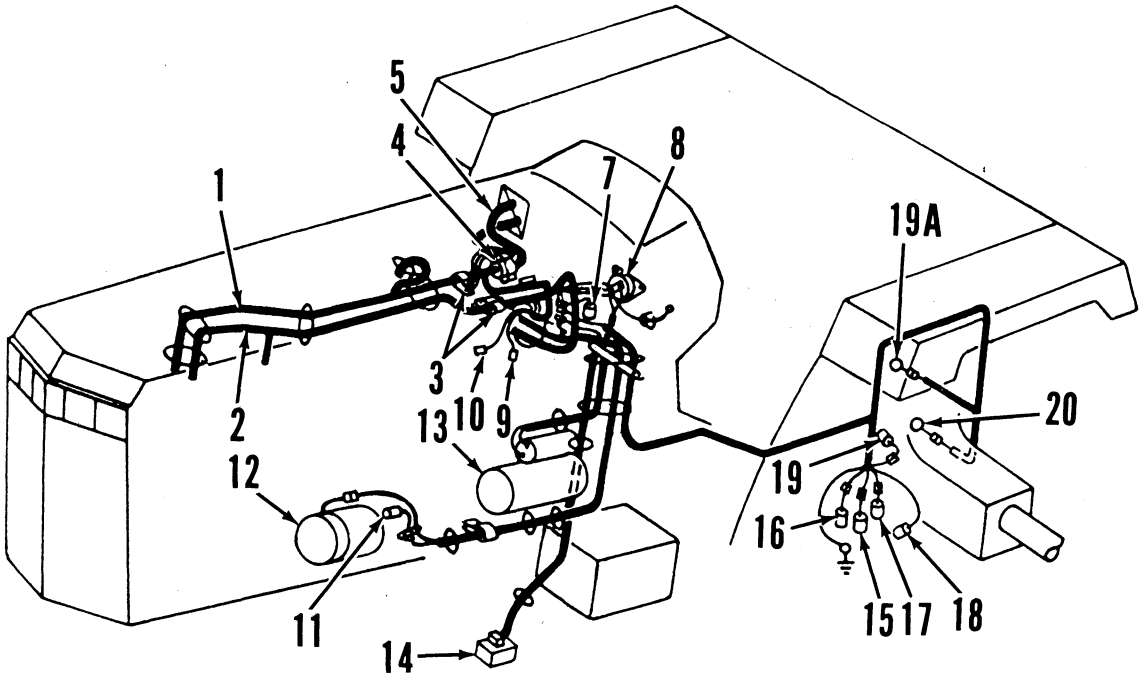


Fig. 291—Wiring harness diagram showing approximate location of components on left side of tractors equipped with Quad-Range transmission and Investigator II warning system. Refer to Fig. 290 legend except for (19A) which is ground speed sensor for Model 4650 with digital tachometer.

1. Sound-Gard body harness
2. Gear indicator lamp
3. Bulkhead harness
4. Instrument harness
5. Starter circuit
6. 23-pin connector
7. Ground
8. Engine power harness
9. Engine sensor harness
10. Air filter restriction sensor (4050)
11. Fuel gage sensor
12. Horn
13. Engine speed sensor
14. Alternator
15. Engine coolant temperature sensor
16. Cylinder head temperature sensor
17. Dimmer switch
18. Starting aid solenoid
19. Engine oil pressure sensor
20. Clutch temperature sensor
21. Neutral start switch (Power Shift)
22. Neutral start switch (Quad-Range)

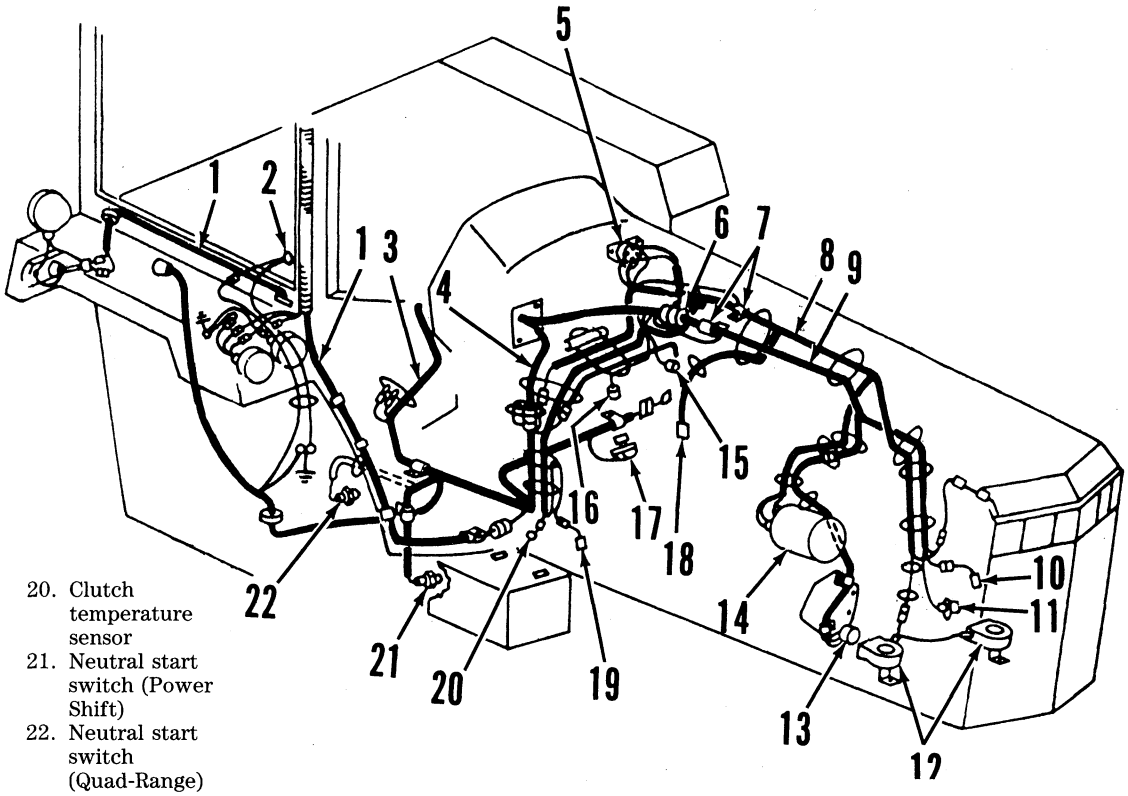


Fig. 292—Wiring harness diagram showing components on right side of tractors equipped with Investigator II warning system.

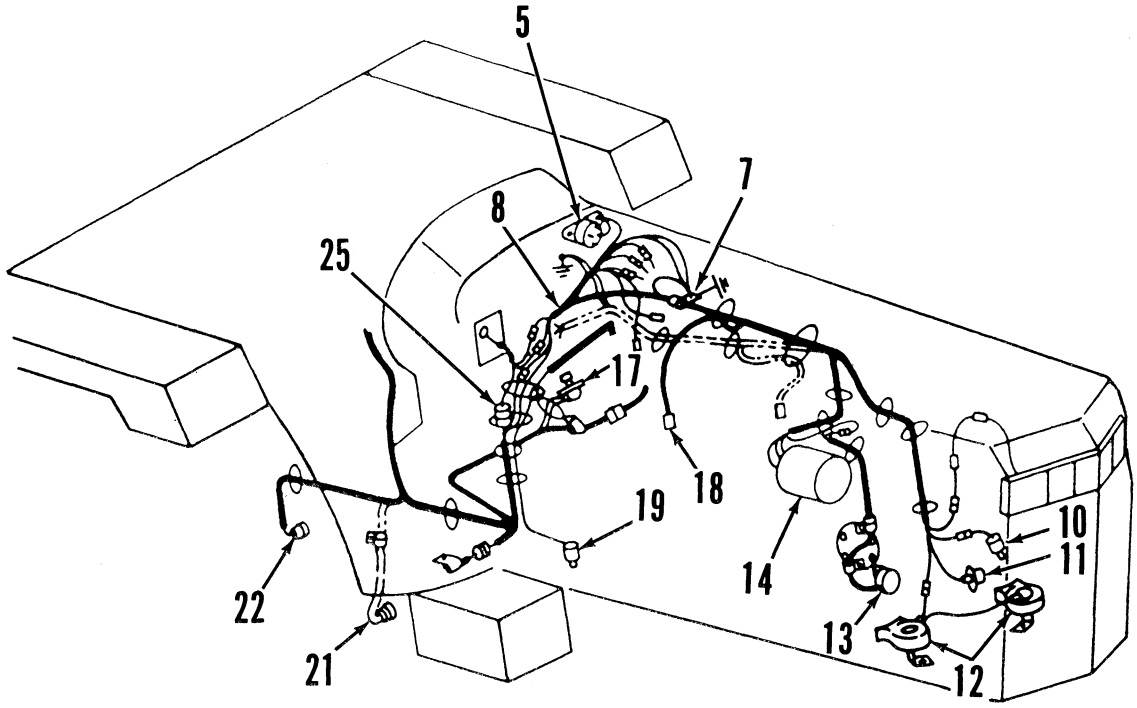


Fig. 293—Wiring harness diagram showing components located on right side of tractor equipped with gage cluster and analog tachometer. Refer to Fig. 292 legend except for 19-pin connector (25).

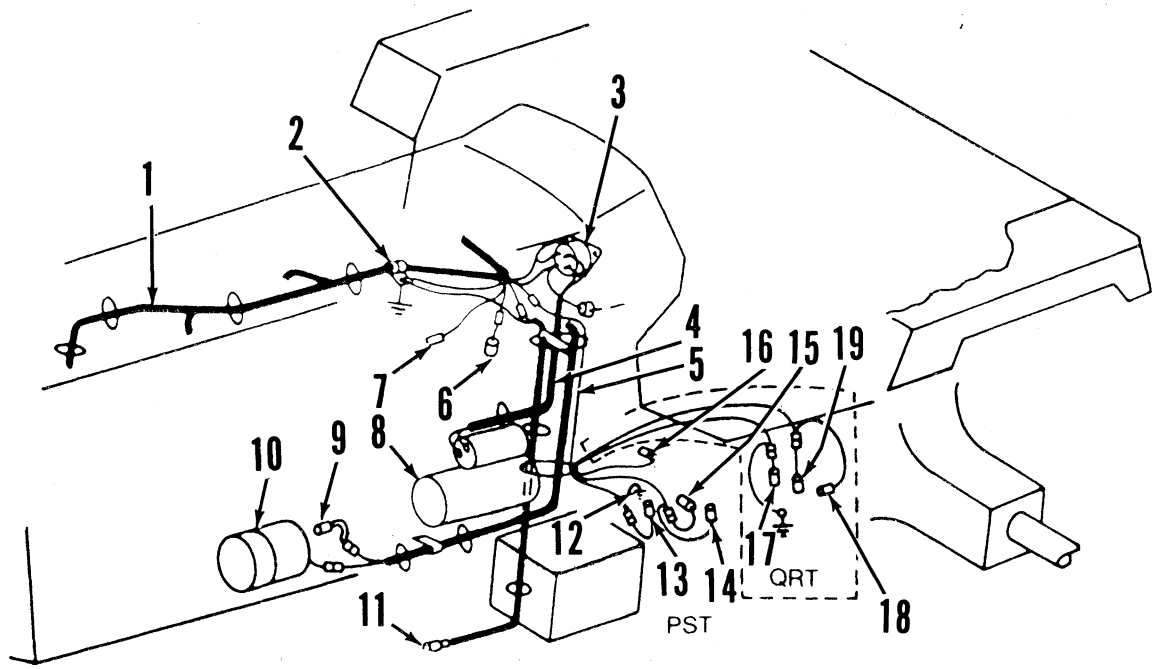


Fig. 294—Wiring harness diagram of left side of tractor equipped with gage cluster and analog tachometer.

1. Engine harness
2. Ground
3. Starter circuit relay
4. Starter circuit harness
5. Sensor harness
6. Air filter restriction sensor (except 4050)
7. Engine coolant temperature sensor
8. Starter
9. Air conditioning high pressure sensor
10. Air conditioning compressor
11. MFWD solenoid
12. Sensor ground
13. Transmission oil pressure sensor (PST)
14. Hydraulic oil filter override switch (PST)
15. Hydraulic oil filter restriction sensor (PST)
16. Hydraulic oil temperature sensor (PST)
17. Transmission oil pressure sensor (QRT)
18. Hydraulic oil filter override switch (QRT)
19. Hydraulic oil filter restriction sensor (QRT)

1. Tachometer
2. Stop engine lamp
3. Service alert lamp
4. MFWD switch
5. Horn switch
6. Lighter
7. Key switch
8. Ground connector
9. Warning horn
10. Light relays
11. Light switch
12. Starting aid switch
13. Investigator II module
14. Turn signal controller

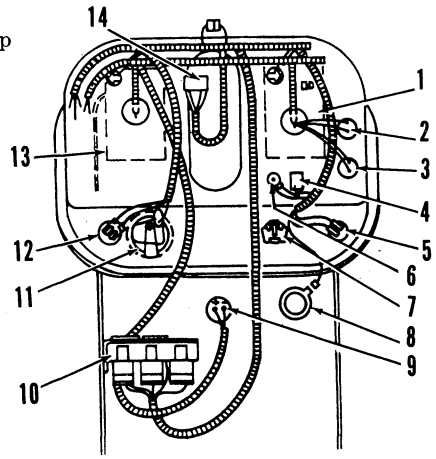


Fig. 295—Diagram of instrument panel harness used on tractors with Investigator II warning system and digital tachometer.

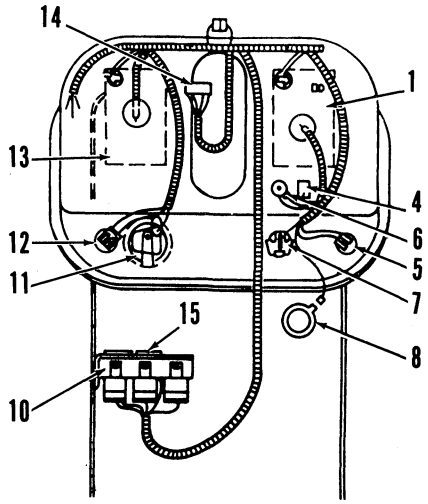


Fig. 296—Diagram of instrument panel harness used on tractors with gage cluster and analog tachometer. Refer to Fig. 295 legend except for time delay relay (15).

1. Rear flood lamps
2. Rear warning lamps
3. Radio speakers
4. Air conditioning low pressure sensor
5. Blower
6. Air conditioning timer relay
7. Wiper switches
8. Blower switch
9. Air conditioning low pressure lamp
10. Air conditioning high pressure lamp
11. Temperature control switch
12. Front warning lamps
13. Dome lamp door switch
14. Wiper motors
15. Radio
16. Dome lamp
17. Clock
18. Console lamp

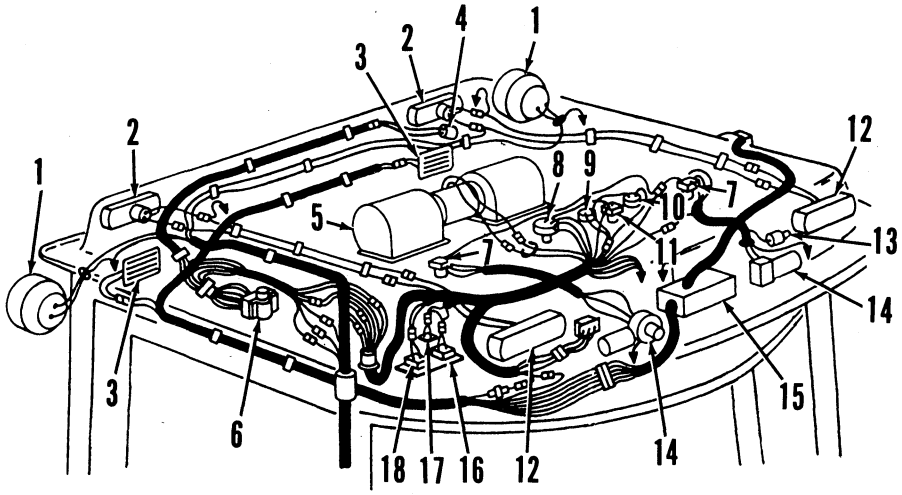


Fig. 297—Sound-Gard body electrical component diagram.