CASE/DAVID BROWN

Models ■ 885 ■ 995 ■ 1210 ■ 1212 ■ 1410 ■ 1412

Previously contained in I&T Shop Service Manual No. C-31

J I CASE (DAVID BROWN)

MODELS: 885-885N-995-1210-1212-1410-1412

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CONDENSED SERVICE DATA

GENERAL	885	995	1210, 1212	1410, 1412
Engine Make	Own	Own	Own	Own
Engine Model	355011	455071	455031	455011
No. of Cylinders	3	4	4	4
Bore, Inches	3.939	3.939	3.939	3.939
Stroke, Inches	4.5	4.5	4.5	4.5
Displacement, Cubic Inches	164	219	219	219
Compression Ratio	17:1	17:1	17:1	16:1
Pistons Removed From:	Above	Above	Above	Above
Cylinder Sleeves	None	None	None	None
Main Bearings, No. of	4	3	3	3
Generator & Starter Make	Lucas	Lucas	Lucas	Lucas
Forward Speeds, No. of	12	12	12	12
Battery Terminal Grounded	Neg.	Neg.	Neg.	Neg.
TUNE-UP				
Firing Order	1-2-3	1-2-4-3	1-2-4-3	1-2-4-3
Valve Tappet Gap, Cold:				
Intake, Inch	0.010	0.010	0.010	0.010
Exhaust, Inch	0.010	0.010	0.010	0.010
Valve Face & Seat Angle	45°	45°	45°	45°
Injection Timing, See Paragraph	110	113	115	115
Engine Low Idle RPM	650-700	650-700	650-700	650-700
Engine High Idle RPM	2350	2350-2450	2450	2450
Max. Full Load RPM	2200	2200	2300	2300
Hp at Full Load RPM†	43.2	58.77	65.98 (65.38*)	80.88 (80.61**)
SIZES-CAPACITIES-CLEARANCES				
(All dimensions are in inches unless otherwise specified.)				
Crankshaft Main Journal Dia.	2.4990-2.4995			
Crankpin Journal Diameter	2.3730-2.3735			
Camshaft Journal Dia., Front	2.3725-2.3735	1.870-1.872		
No. 2 Journal Dia.	1.8707-1.8720	1.825-1.827		
No. 3 Journal Dia.	1.8409-1.8422	1.810-1.811		
No. 4 Journal Dia.	1.7940-1.7954	1.810-1.811		
No. 5 Journal Dia.	1.7475-1.7488	1.763-1.765		
No. 6 Journal Dia.	.....	1.747-1.749		
Piston Pin Diameter	1.250			
Cylinder Bore Diameter	3.9388-3.9396			
Piston Skirt Diameter	3.9315-3.9323			
Valve Stem Diameter	0.3722-0.3732			
Main Bearings Running Clearance	0.002-0.004			
Rod Bearings Running Clearance	0.002-0.004			
Crankshaft End Play	0.002-0.010			
Camshaft End Play	0.002-0.006	0.010-0.020		
Cooling System-Quarts	9	14½	15	15
Crankcase-Quarts (With Filter)	6½	8	8	8
Front Differential (FWD)-Pints	.....	.....	6½	.....
Front Hubs (FWD)-Pints	.....	.....	3	.....
Transmission-Quarts (Includes Differential & Hydraulic System)	24	24	46,43	46,50
Final Drive, Each-Pints	2½	2½	4¾	4¾
Steering Gear-Pints	2½	2½	6	6

†Nebraska Test
*1212 Model
**1412 Model

FRONT AXLE (TWO WHEEL DRIVE)

FRONT WHEEL BEARINGS

All Models Except 885N

1. A typical front wheel spindle, wheel hub and bearing assembly is shown in Fig. 1 or 4.

The tapered inner and outer roller bearings are the same size on some models, however if bearings are to be reused they should be reinstalled with mating bearing cones and cups together.

Note that lip of oil seal is installed away from inner bearing. It is recommended that bearings be lubricated with a pressure gun until grease is forced out past seal lip after each 60 hours of operation.

When adjusting wheel bearings, tighten nut to provide 0.003 inch end play to 0.002 inch preload and install cotter pin.

Model 885N

2. The Model 885N front wheel spindle, wheel hub and bearing assembly shown in Fig. 2 is similar to other models except that bearing adjustment is controlled by shims (5). Vary shims as required to provide 0.003 inch end play to 0.002 inch preload and secure heads of cap screws with tabs of lock plate (3).

Shims (5) are available in thicknesses of 0.005, 0.010 and 0.030 inch.

SPINDLES

All Models

3. **R&R SPINDLES.** To remove spindle, support front of tractor and remove wheel. Remove cap screw and washer which retains steering arm and remove steering arm from spindle.

NOTE: If steering arm is tight on spindle, loosen cap screw about two or three turns and rap head of cap screw sharply to loosen steering arm from spindle. Withdraw spindle and remove upper "O" ring and thrust washer or thrust bearing and lower "O" ring. Reinstall by reversing removal procedure and tighten steering arm retaining cap screw to 120 ft.-lbs. torque.

4. **SPINDLE BUSHINGS.** With spindle removed, spindle bushings can be removed from axle extension using a suitable drift punch. New bushings are presized and should not require reaming if carefully installed. Outer ends of bushings should be flush with axle

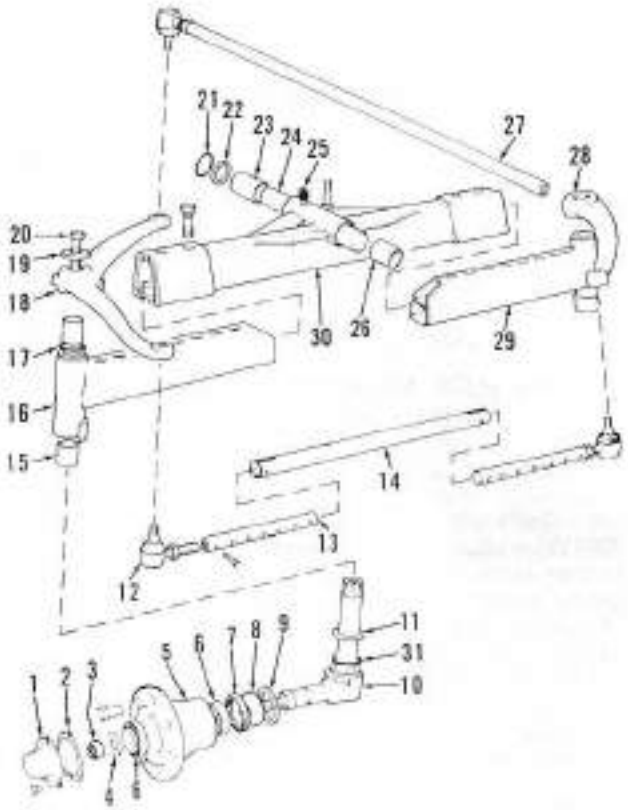


Fig. 1—Exploded view of front axle, wheel spindle, hub and bearing assembly typical of those used on Models 885 and 995. Model 885N is shown in Fig. 2. Oil seal is installed with lip away from inner bearing.

1. Hub cap
2. Gasket
3. Nut
4. Washer
5. Hub
6. Bearings
7. Seal
8. Sleeve
9. Dirt excluder
10. Spindle
11. Thrust washer
12. Tie-rod end
13. Tie-rod inner tube
14. Tie-rod outer tube
15. Bushing
16. Axle extension, L.H.
17. "O" ring
18. Steering arm, L.H.
19. Washer
20. Cap screw
21. "O" ring
22. Thrust washer
23. Bushing, front
24. Pivot pin
25. Threaded insert
26. Bushing, rear
27. Drag link
28. Steering arm, R.H.
29. Axle extension, R.H.
30. Main member
31. "O" ring

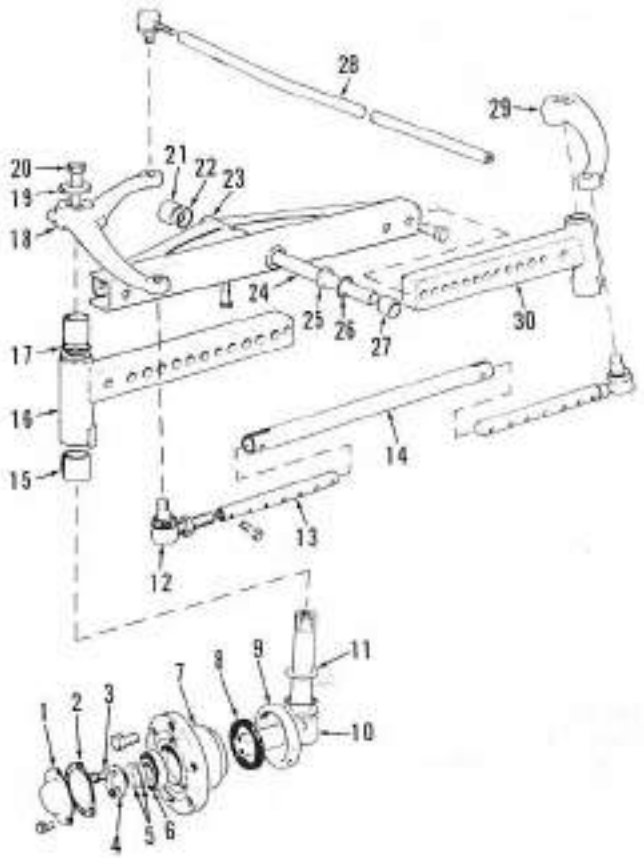


Fig. 2—Exploded view of Model 885N front axle, wheel spindle, hub and bearing assembly. Note shims (5) used to adjust bearings.

1. Hub cap
2. Gasket
3. Lock plate
4. Washer, special
5. Shims (.005, .010, .030)
6. Bearings
7. Hub
8. Seal
9. Seal housing
10. Spindle
11. Thrust washer
12. Tie-rod end
13. Tie-rod inner tube
14. Tie-rod outer tube
15. Bushing
16. Axle extension, L.H.
17. "O" ring
18. Steering arm, L.H.
19. Washer
20. Cap screw
21. Bushing, front
22. "O" ring
23. Main member
24. Pivot pin
25. Thrust washer
26. "O" ring
27. Bushing, rear
28. Drag link
29. Steering arm, R.H.

extension. Bushings are alike for 8 series and 9 series (with 52-76 inch width axle) tractors but upper bushing has a smaller I.D. for 9 series (with 56-80 inch width axle), 12 series and 14 series tractors.

TIE-RODS AND TOE-IN

All Models

5. Toe-in of front wheels should be 1/16-1/8-inch and can be adjusted by lengthening or shortening the tie-rod. Adjust tie-rod ends an equal amount.

Tie-rod ends are available as a unit only.

AXLE MAIN MEMBER AND PIVOT PIN

All Models

6. On early 995 (prior ser. no. 934315) tractors it is necessary to split tractor between front support and main frame using the following procedure: Remove hood and drain cooling system. Disconnect radiator hoses, battery cable and air cleaner hose at rear side of radiator. Disconnect drag link (manual steering) or steering ram (power steering) from steering arm. Support tractor under main frame and attach a hoist to front unit. Unbolt front support from main frame and roll assembly away from tractor.

Loosen the pivot pin retaining cap screw about five turns, rap on head of cap screw to dislodge threaded insert, then remove cap screw and threaded insert. Attach a slide hammer, pull pivot pin rearward from front support and front axle, then raise front support until it clears axle assembly. Remove the thrust washers and sealing "O" rings.

The two rear bushings (B-Fig. 5) may be removed with suitable driver. To remove the two front bushings from blind hole, use a cape chisel and pliers. Drive new forward front bushing into blind hole until it bottoms or is forward of lubrication hole, then drive second front bushing in flush with support casting. Drive rear bushings into support from each side until bushings are flush with support casting. Bushings are pre-sized and should not require reaming if carefully installed. Be sure pivot pin is a free fit in bushings before reinstalling front axle to front support.

The axle front to rear float in front support should be 0.002-0.014 inch. Renew pivot thrust washers if front to rear float is excessive.

When rejoining front support to main frame, tighten bolts to 45 ft.-lbs. torque.

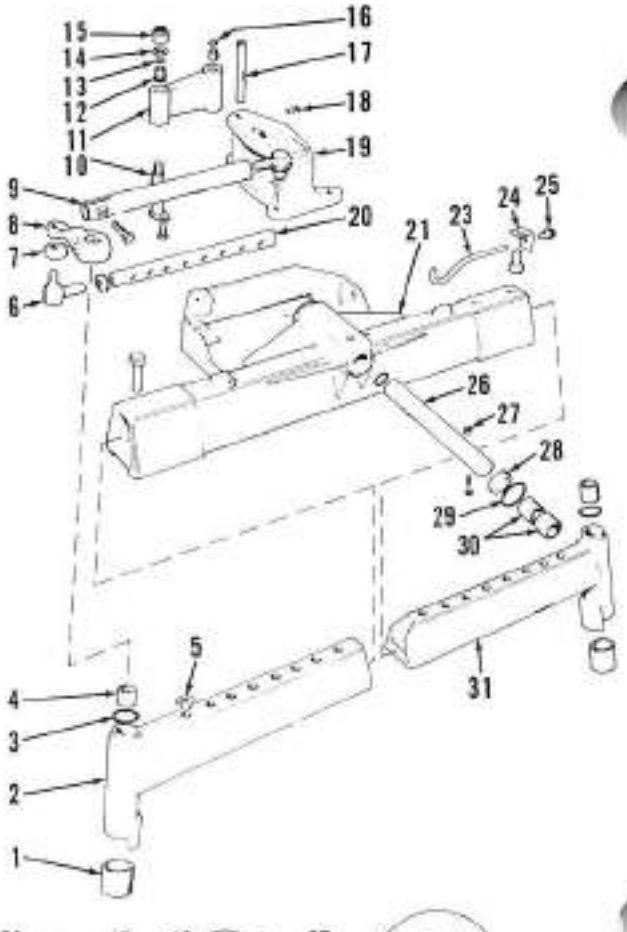


Fig. 3—Exploded view of front axle assembly used on Models 1210, 1212, 1410 and 1412 equipped with transverse mounted power steering cylinder. Models 1210 and 1212 with manual steering or side mounted power steering cylinder have axles similar to that shown in Fig. 1.

1. Bushing, lower
2. Axle extension, R.H.
3. "O" ring
4. Bushing, upper
5. Plastic plug
6. Tie-rod end
7. Dirt excluder
8. Steering arm
9. Tie-rod outer tube
10. Pivot pin
11. Pivot link
12. Bushing
13. "O" ring
14. Washer
15. Nut
16. "O" ring
17. Pivot pin
18. Spring pin
19. Fork
20. Tie-rod inner tube
21. Main member
23. Grease tube
24. Bracket
25. Grease fitting
26. Pivot (trunnion) pin
27. Threaded insert
28. Thrust washer
29. "O" ring
30. Bushings
31. Axle extension, L.H.

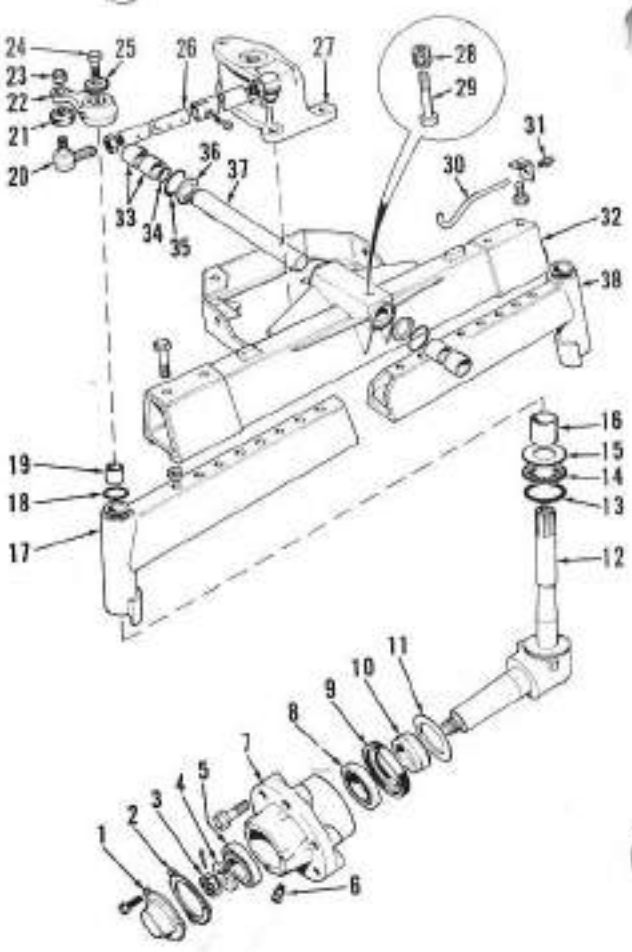


Fig. 4—Exploded view of Models 1410 and 1412 front axle, wheel spindle, hub and bearing assembly. Seal (9) is installed with lip facing away from inner bearing.

1. Hub cap
2. Gasket
3. Nut
4. Washer
5. Bearing
6. Grease fitting
7. Hub
8. Bearing
9. Seal
10. Seal sleeve
11. Dirt excluder
12. Spindle
13. "O" ring
14. Thrust bearing
15. Thrust washer
16. Bushing
17. Axle extension
18. "O" ring
19. Bushing
20. Tie-rod end
21. Dirt excluder
22. Steering arm
23. Locknut
24. Cap screw
25. Washer
26. Tie-rod inner tube
27. Fork
28. Threaded insert
29. Cap screw
30. Grease tube
31. Grease fitting
32. Main member
33. Bushings
34. "O" ring
35. "O" ring
36. Thrust washer
37. Pivot pin
38. Main member

7. On all models except early 995, remove axle main member as follows: Disconnect drag link, or side mounted steering ram from left steering arm; or on models with transverse steering rams, disconnect steering pipes at rear of axle and place a suitable container under pipe ends. Loosen cap screw retaining pivot pin about five turns, rap head of cap screw to dislodge threaded insert, then remove cap screw and threaded insert. Remove expansion plug from front support casting and remove pivot pin with slide hammer threaded into front end of pivot pin.

Remove old bushings and install new bushings using a suitable driver. New bushings are pre-sized and should not require reaming if carefully installed. Bushings in some models are different lengths and bushing location should be noted during removal and installation. Renew sealing "O" rings, thrust washers and expansion plug during reassembly.

FRONT SUPPORT

Models 885, 885N

8. The front support is an integral part of the main frame casting. To renew the main frame, first remove engine as outlined in paragraph 57. Remove air cleaner and support assembly, battery and battery tray. Remove front axle pivot pin as outlined in paragraph 7, then unbolt and remove main frame from transmission housing. When reassembling, tighten main frame to transmission bolts to a torque of 45 ft.-lbs.

All Models Except 885, 885N

9. To renew the front support casting, proceed as outlined in paragraph 6 and also remove radiator, air cleaner, battery and battery tray and, on models so equipped, remove front mounted hydraulic pump and bracket assembly.

FRONT AXLE (FOUR WHEEL DRIVE)

Model 1210 tractors are available with a front drive axle which is driven from the transmission bevel pinion shaft via a transfer case and a drive shaft. A shifting mechanism in the transfer case allows connecting or disconnecting power to the front axle as required.

Front wheel toe-in on tractors equipped with the front drive axle should be 0 to 3/64 inch.

FRONT AXLE ASSEMBLY

Model 1210

10. **R&R FRONT AXLE.** The four wheel drive front axle can be serviced without removing it from tractor. However, if removal is required, proceed as follows:

Disconnect steering ram from left steering arm and axle housing and secure to main frame. Disconnect drive shaft from flange of differential. Loosen pivot pin retaining cap screw about five turns, rap head of cap screw to dislodge threaded insert (18-Fig. 6), then remove cap screw and insert. Attach hoist to front of tractor and take weight off tractor. Place a rolling floor jack under front axle to prevent it from tipping and remove pivot pin. Raise front of tractor until it clears front axle and roll axle from under tractor.

Reinstall front axle by reversing removal procedure.

TIE-ROD AND TOE-IN

Model 1210

11. Recommended toe-in for front drive axle is zero (0-3/64) inch. Tie-rod has one adjustable end and should be adjusted to maintain the zero inch toe-in.

FINAL DRIVE ASSEMBLIES

Model 1210

12. The final drives (outer reduction units) for all practical purposes are identical. The primary differences being the left hand carrier (15-Fig. 7) has the power steering ram attached to it and

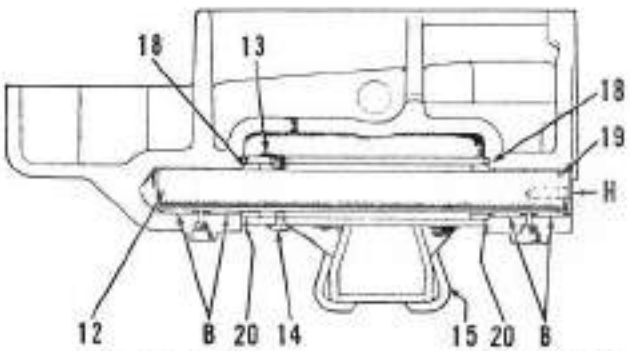


Fig. 5—Cross-sectional view showing a typical pivot pin installation. A tapped hole (H) is provided so pivot pin can be removed with a slide hammer. Bolt (14) is located toward rear of pivot pin on 9, 12 and 14 series tractors. Thrust sleeves (18) are no longer used.

B. Bushings
H. Tapped hole
12. Pivot pin
13. Threaded insert
14. Retaining bolt
15. Axle main member
18. Thrust sleeves
19. "O" rings
20. "O" rings

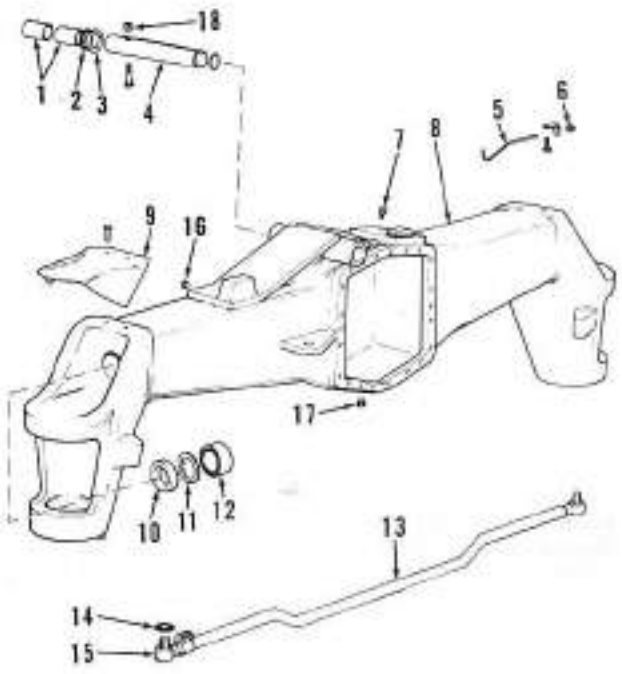


Fig. 6—View of front axle housing used on Model 1210 four-wheel drive tractors.

1. Bushings
2. "O" ring
3. Thrust washer
4. Pivot pin
5. Grease tube
6. Grease fitting
7. Breather
8. Axle housing
9. Cover plate
10. Oil seal
11. Snap ring
12. Bearing
13. Tie-rod
14. Seal
15. Tie-rod end

the right hand axle shaft is shorter than the left hand axle shaft.

13. **REMOVE AND REINSTALL.** To remove final drive, jack up affected side of axle, remove wheel and tire and drain housing. Disconnect tie-rod from carrier and if left hand unit is involved, also disconnect the power steering ram from carrier. Remove cover plate (9-Fig. 6). Remove cap screw and lock (21-Fig. 7) and adjusting nut (20), then remove king pin (22) using tapped hole in bottom of king pin. Withdraw final drive unit from axle housing and take care that axle shaft does not damage bearing (15-Fig. 8) located in axle housing.

NOTE: If necessary, a tool for removal of king pin can be fabricated using the dimensions shown in Fig. 9. The values shown are in millimeters. Also note when using removal tool, removal of king pin will be a three-step operation.

Bearing (19-Fig. 7), lower washer (18), "O" ring (17) and seal (16) can now be removed.

DO NOT remove upper bearing (11) unless it is to be renewed or other new final drive parts are being installed.

If necessary, axle bearing (15-Fig. 8) can be pulled from axle housing after removing oil seal (17) and snap ring (16).

14. The final drive assembly is installed by reversing removal procedure, however if a new axle housing, final drive housing (carrier), king pin upper bearing or spacer is installed, the mounting dimensions of axle housing and final drive housing must be checked and reset, if necessary, to insure that axle halves are in alignment.

During machining of the final drive housing (carrier) and axle housing, plus or minus deviations can occur and are stamped on final drive carrier and axle housing as shown in Fig. 10. The reference dimension for final drive housing (carrier) is 107.00mm and reference dimension for axle housing is 72.90 mm. Plus deviations are added to reference dimensions and minus deviations are subtracted from reference dimensions. If there is no deviation during machining the deviation stamping will be "O" (zero). Also needed to calculate the required thickness of spacer is the overall thickness of king pin upper bearing assembly. Standard thickness of bearing is 25.60 mm but it should be measured as deviations can occur.

Refer to the following paragraph for an example to calculate spacer thickness.

15. Assume the final drive housing (carrier) is stamped with +0.18 deviation, the axle housing with – 0.12 deviation and upper bearing measures 25.60 mm.

Reference dimension of final drive housing	107.00 mm
Plus deviation	+0.18 mm
Final drive housing dimension	107.18 mm

Reference dimension of Axle housing	72.90 mm
Minus deviation	- 0.12 mm
Axle housing dimension	72.78 mm
Final drive housing dimension	107.18 mm
Minus axle housing dimension	- 72.78 mm
Minus bearing thickness	- 25.60 mm
Equals spacer thickness required	8.80 mm

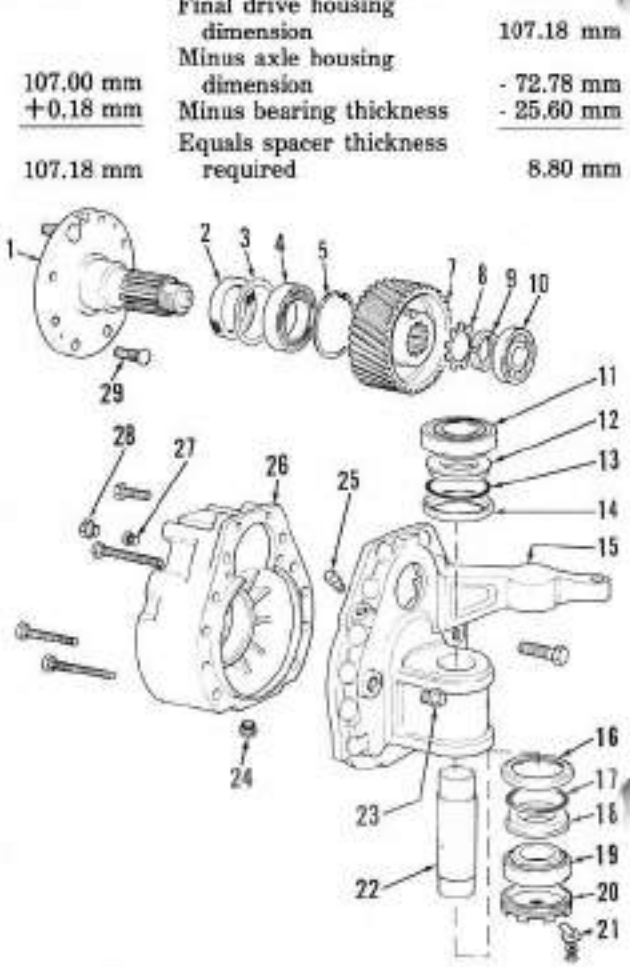


Fig. 7—Exploded view of final drive shaft and reduction housing. Final drive shaft gears (7) are right and left hand. Refer to text for information on spacer (12).

1. Final drive shaft
2. Oil seal
3. Shim
4. Bearing assy.
5. Snap ring
7. Gear
8. Tab washer
9. Nut
10. Bearing assy.
11. Bearing assy.
12. Spacer
13. "O" ring
14. Seal
15. Carrier
16. Seal
17. "O" ring
18. Washer
19. Bearing assy.
20. Adjusting nut
21. Lock plate
22. King pin
23. Level plug
24. Magnetic drain plug
25. Breather
26. Housing
27. Plug
28. Plug
29. Wheel stud

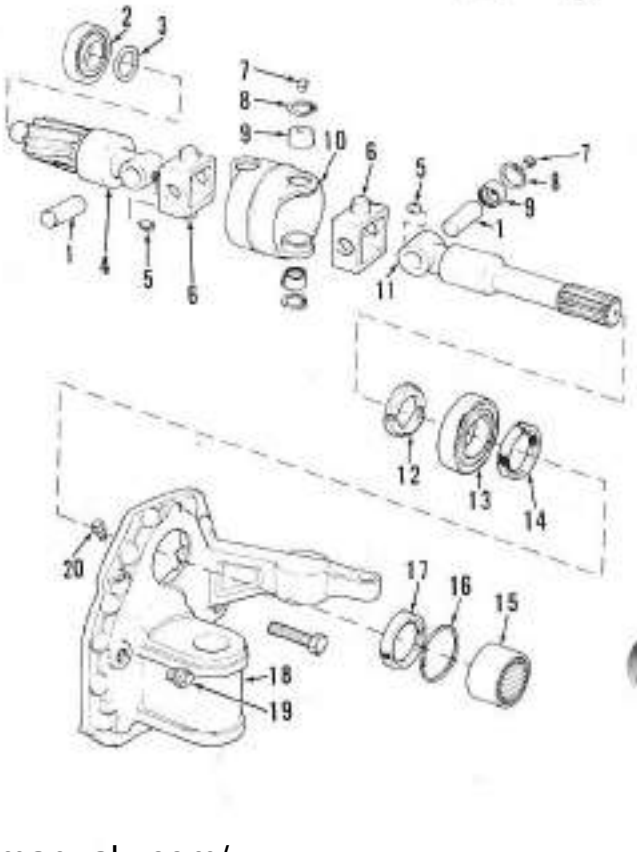


Fig. 8—Right and left hand axle shaft assemblies are identical except for overall length and all parts are available for service. Items 19, 20 and 21 are installed in axle housing. Spacer (3) is available in thicknesses of 1.60 mm through 2.70 mm.

1. Pin
2. Bearing assy.
3. Spacer
4. Shaft and gear
5. Set screw
6. Cross piece
7. Plug
8. Snap ring
9. Bearing
10. Center yoke
11. Axle shaft
12. Split bushing
13. Bearing assy.
14. Oil seal
15. Bearing
16. Snap ring
17. Oil seal
18. Carrier
19. Level plug
20. Breather

Upper bearing spacer is available in thicknesses of 8.0 mm through 10.4 mm in increments of 0.2 mm.

16. When spacer thicknesses has been determined, install final drive (outer reduction unit) as follows: If axle bearing (15-Fig. 8) was removed, drive bearing into axle housing only far enough to allow installation of snap ring (16). Coat outer diameter of seal (17) with sealant and install with lip toward inside.

Drive upper bearing cup into axle housing with taper facing downward. Install upper bearing cone, spacer (12-Fig. 7) "O" ring (13) and seal ring (14) in upper bearing seat using grease to hold them in position. Start axle into axle housing being careful not to damage oil seal and position final drive assembly in axle housing. Install a M14 x 30 mm cap screw in tapped hole in king pin (22), then drive king pin through final drive carrier and into upper bearing by rapping on cap screw head. Remove cap screw after king pin is in position. Install seal ring (16), "O" ring (17), lower washer (18) into lower bearing seat and then install lower bearing cone on end of king pin with taper toward bottom. Install lower bearing race over bearing, lubricate and install adjusting nut (20), then tighten nut until 22 ft.-lbs. torque is required to turn the final drive unit. Install lock plate (21) to retain adjusting nut.

Reinstall cover plate (9-Fig. 6) and tie-rod, and if left hand unit, connect power steering ram to carrier. If necessary, use approved oil and fill housing to level of plug (23-Fig. 7).

NOTE: Drain plug (24) is magnetic. Be sure any metal particles are removed prior to filling housing.

17. **OVERHAUL.** With final drive assembly (reduction unit) removed, disassemble as follows: Remove cap screws which retain housing (26—Fig. 7) to carrier (15), then install two M10 x 60 mm cap screws into the two M10 tapped holes provided in the carrier. Remove the plug from upper outer face of housing (26) and if plug thread in housing is M12 x 1.5, install a M12 x 1.5 x90 mm cap screw through hole in hub of final drive shaft and thread into plug hole until cap screw butts against axle shaft.

If plug thread in housing is M22 x 1.5, a drift (punch) is inserted through hole in hub of final drive shaft and the plug hole and against axle shaft.

Housing is separated from carrier by equally turning the three removal cap screws; or by equally turning the two removal cap screws in carrier and rapping on drift.

NOTE: Bearing (2-Fig. 8) may bind during removal and axle shaft may need to be turned occasionally. If bearing does bind, remove cap screw, or punch, and turn axle shaft one complete revolution, then reinstall cap screw, or punch, and continue operation.

All parts of final drive (reduction) unit are now available for service.

18. FINAL DRIVE SHAFT. Prior to removing final drive shaft from housing, measure and record the distance from retaining (ring) nut (9-Fig. 7) and end of final drive shaft (1). Straighten locking tabs of lockwasher (8), then using a spanner wrench, remove nut (9). Install two M16 x 100 mm cap screws in tapped holes of gear (7) and pull gear from final drive shaft. Install two M10 x 100 mm cap screws in the tapped holes in hub (flange) of final drive shaft (1), turn cap screws equally and pull final drive shaft from bearing (4). Remove snap ring (5), then remove bearing (4) and oil seal (2) by driving them from outside toward inside of housing (26). Do not lose or damage shim (3). Inboard bearing (10) can be removed from carrier (15) any time after housing and carrier are separated.

Clean and inspect all parts and renew as necessary. Oil all parts prior to assembly and reinstall final drive shaft as follows:

Install inboard bearing (10-Fig. 7) if necessary. Coat outside diameter of seal (2) with sealant, drive seal into housing (26) with lip of seal toward inside and grease seal lip. Install shim (3), bearing (4) and snap ring (5).

NOTE: Shim (3) is available in thicknesses of 0.2, 0.3 and 0.5 mm and can be used to obtain the previously recorded distance from nut (9) to end of final drive shaft after final drive shaft is installed. Also, if axle shaft outboard bearing (2-Fig. 8) has been removed, it must be installed in housing (26-Fig. 7)

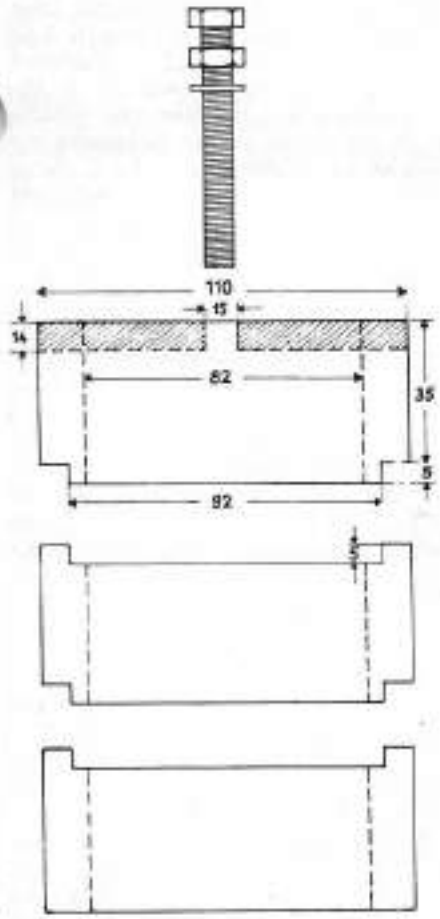


Fig. 9—Extraction tool for king pin can be fabricated locally using dimensions shown. Dimensions are in millimeters. Removal of king pin will be a three-step procedure when using this tool.

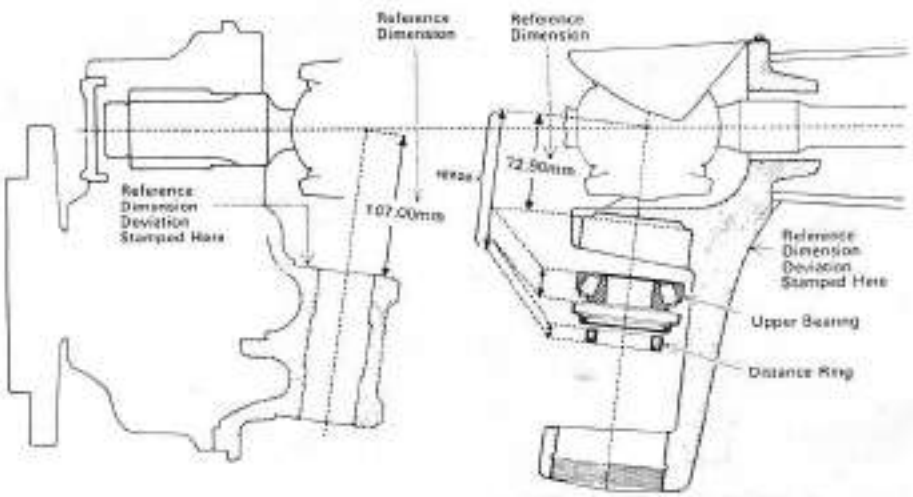


Fig. 10—View showing location of the stamped reference deviations which appear on final drive carrier and axle housing. Refer to text for installation procedure.

prior to installing final drive shaft gear (7).

Position final drive shaft with wheel studs down and block under shaft so wheel studs are not touching. Place housing (26) over final drive shaft. Heat gear (7) to about 100 degrees F., start gear on splines of final drive shaft, then press or drive gear and housing on final drive shaft. Install lockwasher (8) and nut (9) and tighten nut securely. Distance from nut to end of shaft should be the same as that recorded prior to disassembly, about 3 mm (1/8-in.) of final drive shaft thread should be exposed with nut tightened. Retain nut by bending tabs of lockwasher into slots in nut and gear.

Refer to paragraph 20 for information to join housing to carrier.

19. AXLE SHAFT. To remove axle shaft from carrier, support carrier and axle shaft and drive bearing cone (13-Fig. 8) into carrier far enough to allow removal of split bushing (12). Use a soft faced hammer and drive axle shaft out of bearing and carrier. Seal (14) and bearing cup (13) can now be removed from carrier. Outboard bearing assembly (2) cannot be removed unless final drive shaft gear (7-Fig. 7) has been removed. Spacer (3) should have been retrieved when housing and carrier were separated.

NOTE: The axle universal joint can be disassembled as follows: Remove snap rings (8-Fig. 8) and pull needle bearings (9). Tip cross pieces (6) out of center yoke (10), remove set screws (5), then remove pins (1) and separate axle halves from cross pieces.

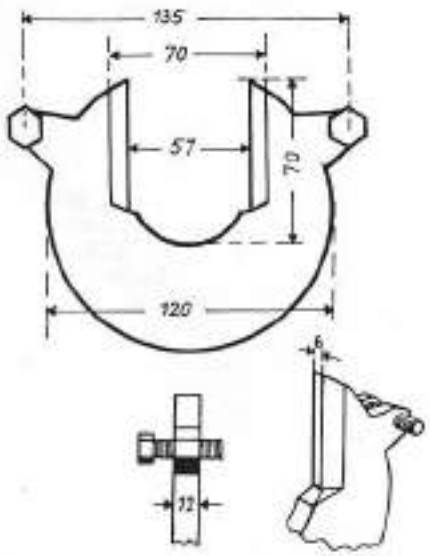


Fig. 11—A holding clamp can be fabricated locally to prevent axle movement during assembly. Dimensions are in millimeters.

Clean and inspect all parts and renew as necessary. Install axle shaft in carrier as follows: Coat outside diameter of seal (14) with sealant and install in carrier (18) with lip toward inside. Grease lip of seal. Drive bearing cup into carrier with taper facing in, then insert gear end of axle through oil seal and bearing cup. Hold axle in position and drive bearing cone on axle shaft until the split bushing can be installed with flat side up. Use a soft faced hammer and bump end of axle shaft until axle shaft gear seats on split bushing.

NOTE: Care should be taken after axle is installed to prevent damage to oil seal (14-Fig. 8) by movement of axle shaft during subsequent assembly. Use of a clamp, shown in Fig. 11, is recommended by the manufacturer and clamp is installed between carrier and universal joint. Clamp must be fabricated locally and note that dimensions are in millimeters.

20. ASSEMBLY. Before joining carrier (18-Fig. 8) and housing (26-Fig. 7) the preload for axle shaft must be determined. The axle operates with a 0.25 mm preload and preload is controlled by spacer (3-Fig. 8). Spacer is available in thicknesses from 1.60 mm through 2.70 mm in increments of 0.05 mm.

Determine correct spacer thickness as follows:

1. Measure from inner race of bearing (2-Fig. 8) to mating face of housing (26-Fig. 7). For the example, assume it to be 72.5 mm.

2. Measure from inner end of axle shaft gear (4-Fig. 8) to upper face of carrier (18). For the example, assume it to be 70.5 mm.

3. Subtract measurement 2 from measurement 1 which, for the example, is 2.0 mm.

4. Add recommended axle preload of 0.25 mm to difference of measurements 1 and 2 which will give spacer thickness which, for the example, is 2.25 mm.

Example:

Measurement 1	72.5 mm
Minus measurement 2	- 70.5 mm
Equals difference	2.0 mm
Add preload	+0.25 mm
Required spacer thickness	2.25 mm

With thickness of spacer determined proceed as follows: Apply sealant to mating surfaces of housing (26-Fig. 7) and carrier (15), then position final drive shaft housing on bench with wheel studs down. Lower carrier and axle shaft assembly onto final drive shaft housing and be sure that axle shaft and final drive shaft enter their bearings (use hoist if necessary). Axle shaft is a push fit in the outboard bearing and can be seated in the bearing using a hammer and suitable drift. Install the carrier to housing cap screws and tighten securely. If clamp (Fig. 11) was used, remove clamp and

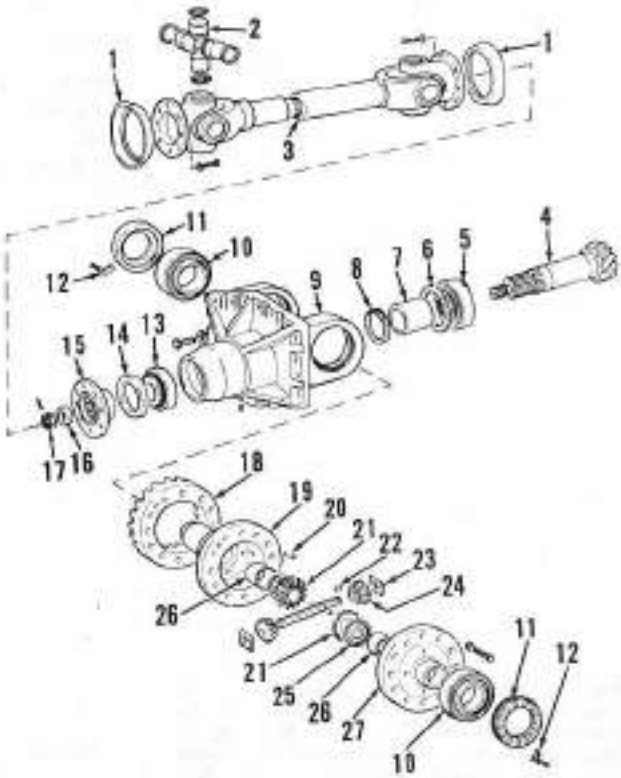


Fig. 12—Exploded view of front drive differential and drive shaft used in Model 1210 four wheel drive tractors.

1. Guard
2. "U" joint repair kit
3. Drive shaft
4. Pinion shaft
5. Bearing assy.
6. Shim
7. Spacer
8. Shim
9. Carrier
10. Bearing assy.
11. Adjuster
12. Lock plate
13. Bearing assy.
14. Oil seal
15. Flange
16. Washer
17. Nut
18. Bevel gear
19. Diff. cage
20. Dowel
21. Side gear
22. Lock pin
23. Thrust washer
24. Pinion gear
25. Thrust washer
26. Bushing
27. Cage end plate

turn axle shaft by hand to check for proper assembly. Install drain plug and oil level plug.

Install final drive (reduction unit) assembly on axle housing as outlined in paragraph 13.

FRONT DIFFERENTIAL

Model 1210

21. **REMOVE AND REINSTALL.** To remove differential, first drain axle housing, then support front axle and remove final drive assemblies as outlined in paragraph 13. Disconnect drive shaft from pinion shaft flange (15-Fig. 12). Disconnect one end of tie-rod and swing tie-rod out of the way, then unbolt and remove differential assembly from axle housing.

Reinstall by reversing removal procedure.

22. **OVERHAUL.** With differential removed, disassemble as follows: Remove pin from pinion shaft nut (17-Fig. 12) and loosen nut about two turns. If bevel gear (18) is to be removed, cut and remove lock wire from retaining cap screws, then loosen the cap screws about two turns. Remove lock plates (12) and bearing adjusters (11). Use a tapered drift against inner race of bearing located on long hub of differential and drive bearing assembly from carrier and differential. Set differential assembly on end with end plate (27) down, then bump on upper (long) end of differential and drive lower bearing cup from carrier. Differential can now be tipped out of carrier and bearing cone removed.

With differential out of carrier, remove cap screws and pull end plate (27) from differential cage (19). Remove side gear (21) and thrust washer (25) from end plate. Remove lock pin (22), pinion pin, pinion gears (24) and thrust washers (23), then remove side gear and thrust washer from differential cage. Bevel gear (18) can be removed from differential cage by using jack screws in the two tapped holes provided in differential cage.

23. To remove pinion shaft (4), remove the previously loosened nut (17) and washer (16). Attach a suitable puller and pull flange (15) from pinion shaft, then bump pinion shaft out of carrier and remove shim (8), spacer (7) and bearing cone from pinion shaft. Remove oil seal (14) bearing cone (13) and bearing cups and shim (6) from carrier.

24. Clean and carefully inspect all parts. Renew any parts which are not completely free of defects. Bevel gear (18) and pinion shaft (4) are available as a set only and both are identified with an inspection number which will be the same on both parts. Also a variation mark will be etched on front of pinion shaft and it must correspond to a similar mark on bevel gear. If pinion bearings or pinion shaft is renewed, it will be necessary to establish the pinion shaft setting to insure correct meshing of pinion shaft gear and bevel gear. Refer to following paragraph.

25. To determine the correct thickness of shim (6-Fig. 12) required for pinion shaft setting, use the following procedure.

1. Note the housing setting dimension which in this example is 158.00 mm (See Fig. 13). Also check to see what deviations occurred during machining and this will be found marked on flange face of housing (carrier). Plus deviations are added to and minus deviations are subtracted from the stated (158.00 mm) housing setting dimension. If there is no deviation, marking will be "0.00".

2. Note pinion setting dimension which is 124.70 mm (See Fig. 13). Also check to see what deviations occurred during machining and this will be found on face of pinion shaft gear as well as on bevel gear. Plus deviations are added to and minus deviations are subtracted from the stated (124.70 mm) pinion setting dimension. If there is no deviation, marking will be "0.00".

3. Measure width of inner bearing assembly (5-Fig. 12). Standard width of bearing (cup and cone) is 29.25 mm but deviations up to 0.5 mm are possible.

4. Subtract the calculated pinion setting dimension from the calculated housing setting dimension, then from this difference, subtract the bearing thickness which will give the required thickness of pinion setting shims (6). Shims are available in thicknesses from 3.3 mm through 4.8 mm in increments of 0.1 mm. See example below.

Example:

Assume housing is marked +0.15, pinion shaft -0.10 and bearing is standard width of 29.25 mm.

Housing dimension	158.00 mm
Plus deviation	+0.15 mm
Equals	158.15 mm
Pinion shaft dimension	124.70 mm
Minus deviation	-0.10 mm
Equals	124.60 mm
Housing dimension	158.15 mm
Minus pinion dimension	- 124.60 mm
Equals	33.55 mm
Minus bearing thickness	-29.25 mm
Equals shim thickness	4.30 mm

NOTE: Values used are examples

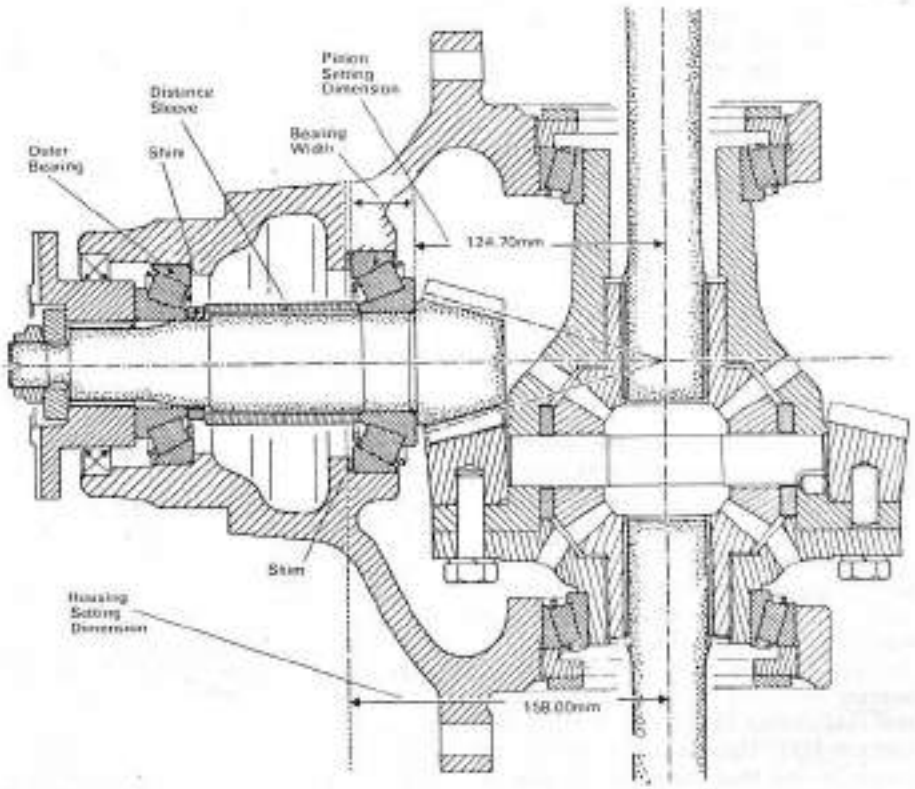


Fig. 13—Cross-sectional view of the differential assembly. Note the housing and pinion shaft setting dimensions. Refer to text for procedure to determine shim thickness.

only and actual measurements must be used. However, use same procedure.

26. With thickness of pinion shaft setting shim determined, assemble differential as follows: Place shim (6-Fig. 12) in bearing cup (5) seat then install bearing cup and be sure cup seats firmly. Install bearing cone (5) on pinion shaft (4) with taper of bearing cone toward outer (threaded) end of pinion shaft. Drive bearing cup (13) into flange end of housing with taper towards flange until it seats firmly.

At this time the thickness of shim (8) must be calculated to provide zero end play (no end play or no preload) for the pinion shaft bearings and the following measurements must be made in every case.

Measure and record overall width of bearing cone (13) only for subsequent use. Standard bearing cone width is 25.00 mm but deviations can occur. Insert pinion shaft and bearing into housing, then with threaded end of pinion shaft up, block under pinion shaft gear to support assembly. Place spacer (7) over pinion shaft, then measure and record the distance from flange end of housing (9) to upper end of spacer (7). Remove pinion shaft from housing, place bearing cone of bearing assembly (13) in the bearing cup previously installed, then measure and record distance from end of housing to inner race of bearing. Subtract housing end to bearing distance from the housing to spacer distance, then from this difference, subtract the width of bearing cone which will give the required shim thickness. Shims are available in thicknesses from 4.60 mm through 7.60 mm in increments of 0.05 mm. See example below.

Example:

Distance housing to spacer	49.55 mm
Less distance housing to bearing	-18.10 mm
Equals	31.45 mm
Less bearing width	-25.00 mm
Equals shim (8) thickness	6.45 mm

NOTE: Values used are examples only and actual measurements must be used. However, use same procedure.

Check the pinion shaft bearing adjustment (calculated shim thickness) before completing pinion shaft installation as follows. Insert pinion shaft and bearing into housing, install spacer (7), the pre-selected shim (8) and outer bearing cone (13). Without installing oil seal (14), install flange (15), washer (16) and nut (17). Tighten nut securely and check to see that pinion shaft has no end play or preload and can be turned by hand. If bearing adjustment is not satisfactory, change shim (8) as required. When bearing adjustment is correct, remove flange, coat outside diameter of oil seal (14) with sealant and install in housing with lip toward inside. Lubricate lip of seal, coat face of flange which contacts bearing with sealant, then install flange, washer and nut. Fully tighten nut and secure with split pin.

26A. Press new bushings (26) into differential cage (19) and cage end plate (27) if necessary, then lubricate thrust washers (25) and side gears. Install thrust washers on side gears and install side gears in differential cage and cage end plate. Place thrust washers (23) and pinion gears (24) in differential cage, install pinion pin and secure with lock pin (22). Hold side gear in cage end plate, place end plate on differential cage, then while holding parts together, set assembly on end plate so long end (boss) of differential is pointing up. Install dowels (20) into bevel gear (18), then if an oven is available, heat bevel gear to about 110 degrees F. and install bevel gear on differential cage. If no oven is available, align dowels with holes and carefully tap bevel gear into position using a soft faced hammer. Install bevel gear retaining cap screws and tighten to 145 ft.-lbs. torque. Check to see that bevel gear is seated all the way around, then secure cap screws with lock wire.

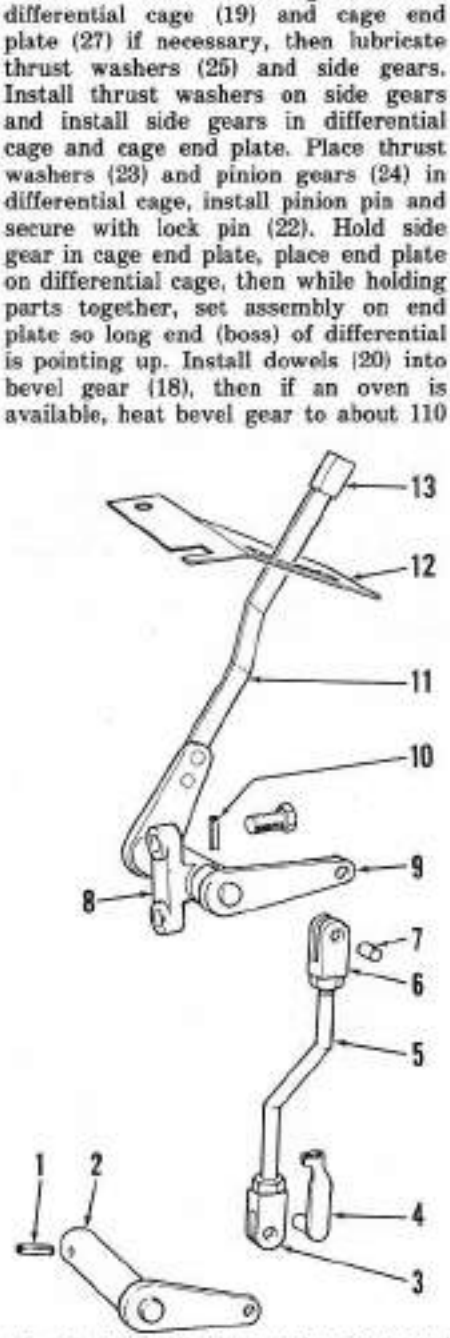


Fig. 14—Exploded view showing component parts of the transfer gearbox engagement lever.

1. Pin
2. Lever
3. Clevis
4. Retaining pin
5. Rod
6. Clevis
7. Pin
8. Bracket
9. Lever
10. Pin
11. Hand lever
12. Gate
13. Knob

Place differential in housing (carrier) so that bevel gear will be on right side of pinion gear when unit is installed in tractor and set assembly on end so long boss of differential cage is pointing up. Place carrier bearing on differential cage with taper pointing out and drive bearing on cage until it seats. Install bearing cup and drive it into carrier until adjuster thread is fully exposed. Screw adjuster into carrier until about two threads are showing, then turn carrier over and fit other carrier bearing assembly in a similar manner.

Bearing adjusters control the differential bearing adjustment as well as the backlash between bevel gear and pinion shaft gear. Differential can be shifted back and forth as necessary by loosening one adjuster and tightening the opposite an equal amount. Adjust bearings and gear backlash as follows:

Maintain clearance (backlash) between bevel gear and pinion shaft gear and tighten bearing adjusters until differential has zero end play to not more than 0.20 mm preload. Mount a dial indicator at right angles to bevel gear, hold pinion shaft stationary, then rock differential back and forth and check backlash which should be 0.15-0.18 mm. If backlash is not as stated, shift differential as required by loosening one bearing adjuster and tightening the opposite. Carrier bearing adjustment should be maintained during this operation. As a final check, coat several teeth of the bevel gear with marking compound and turn pinion shaft in direction of normal rotation. If gear contact pattern is not in middle of tooth and towards inner end an error has been made in calculating the pinion setting shim (6-Fig. 12) and shim thickness must be recalculated.

Install adjuster lock plates (12) when adjustment is complete.

Reinstall differential by reversing the removal procedure.

TRANSFER GEARBOX AND DRIVE SHAFT

Model 1210

27. **REMOVE AND REINSTALL.** To remove the transfer gearbox, first drain transmission (approx. 9 gal.) and disconnect engagement lever (2-Fig. 14). Remove transmission top cover,

then remove bolt from coupling (28-Fig. 15) and slide coupling rearward on transmission pinion shaft until it clears transfer gearbox housing. Disconnect drive shaft from driving flange (4) and place a jack under transfer gearbox. Remove cap screws retaining transfer gearbox to tractor main frame and lower assembly from tractor.

NOTE: Save the laminated gasket (25) for use during reinstallation. If a new gasket is used, the thickness will have to be adjusted to provide correct alignment of coupling (28) and drive gear (24).

Reinstall transfer gearbox by reversing removal procedure and if a new gasket (25) is used, peel laminations from gasket until coupling (28) freely enters drive gear (24).

28. **OVERHAUL.** With transfer gearbox removed, disassemble as follows: Remove base plate (41) and gasket (40). Cut lock wire and remove cap screws (1), retaining plate (2) and "O" ring (3), then attach a puller and pull driving flange (4) from output shaft (16). Fabricate a bar long enough to span front opening of front cover (6), drill two holes in it to coincide with cap screw holes in output shaft (16), then using two cap screws secure bar to output shaft. Install two cap screws in the tapped holes provided in front cover (6), tighten screws evenly and remove output shaft and front cover assembly from housing (39). Remove oil seal (5) and if necessary, the snap ring from bearing. Remove spacer (9) from output shaft and needle bearing (17) from forward end of driven shaft (38). Insert a punch through hole front of housing and drive out pin (12). Pull selector shaft (11) out of housing and fork (14) and remove fork from bottom of housing. Do not lose trunnion pins (15). Remove coupling (18) through front bearing bore. Remove oil seal (10). Cup plug (13) need not be removed unless damaged or leaking. Remove snap ring (31) from driven shaft (38), and if so equipped, the thin shim located behind snap ring. Remove rear cover (35) and gasket (36), then bump shaft (38) rearward and remove driven gear (34) from bottom of housing. If gear cannot be removed, bump bearing (33) forward enough to allow removal, then with gear removed, remove bearing (33) by bumping it rearward. Remove bearing (37) from driven shaft (38). Remove snap ring retaining bearing (30), bump the intermediate shaft (29) rearward to remove shaft and bearing and remove intermediate gear (21) from bottom of housing. Remove bearing (30) from shaft (29) and snap ring (19) and bearing (20) from housing. Remove snap ring (27), then bump drive gear (24) rearward to remove gear and bearing (26) from housing. Remove bearing (26) from drive gear (24) and snap ring (22) and bearing (23) from housing.

Clean and inspect all parts for excessive wear, chipped teeth, damaged bearings or other defects. Lubricate all parts during assembly and assemble as follows.

Install snap ring (22) in front bore of housing. Install bearings (23 and 26) on drive gear (24), install assembly in rear bore and drive assembly forward until snap ring (27) can be installed. Tap on both ends of drive gear to seat bearings against snap rings and be sure drive gear turns freely.

Install roller bearing (20) in front bore of housing far enough to allow

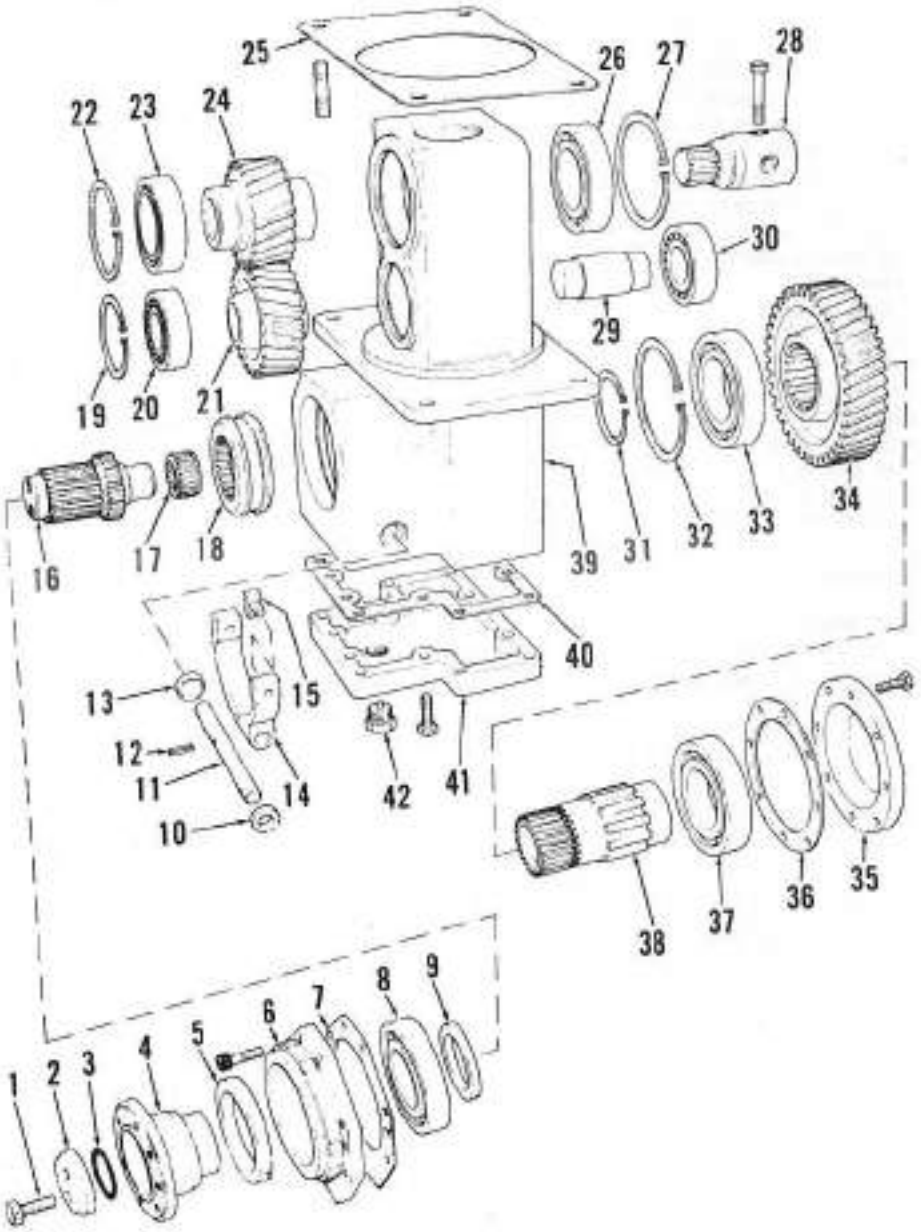


Fig. 15—Exploded view of transfer gearbox showing component parts and their relative positions. Also see Fig. 16.

1. Cap screw
2. Retaining plate
3. "O" ring
4. Driving flange
5. Oil seal
6. Front cover
7. Gasket
8. Ball bearing
9. Spacer
10. Oil seal
11. Selector shaft
12. Pin
13. Cup plug
14. Selector fork
15. Trunnion pin
16. Output shaft
17. Needle bearing
18. Sliding clutch
19. Snap ring
20. Roller bearing
21. Intermediate gear
22. Snap ring
23. Ball bearing
24. Drive gear
25. Laminated gasket
26. Ball bearing
27. Snap ring
28. Coupling
29. Intermediate shaft
30. Roller bearing
31. Snap ring
32. Snap ring
33. Ball bearing
34. Driven gear
35. Rear cover
36. Gasket
37. Ball bearing
38. Driven shaft
39. Housing (case)
40. Gasket
41. Base plate
42. Magnetic plug

installation of snap ring (19), then install roller bearing (30) on end of intermediate shaft (29) until it bottoms on shoulder. If an oven is available, heat intermediate gear (21) to about 120 degrees F., insert gear through bottom of housing, then install shaft through gear and bump bearing (30) into housing until snap ring can be installed. Bump shaft both ways to seat bearings against snap rings and check to see that gear rotates freely.

Install bearing (37) on rear end of driven shaft (38), insert driven gear (34) into housing, then install driven shaft through driven gear until bearing meets gear. Support rear end of driven shaft (38), drive front bearing (33) on front of shaft, then install thin spacer (if used) and snap ring (31). Bump shaft both ways to seat bearings and check to see that gear and shaft rotate freely. Use new gasket (36) and install rear cover (35).

Use sealant on outside diameter of oil seal (10), then with lip of seal toward inside drive seal into housing until it is flush with housing. Place coupling (18) on splines of driven shaft with shoulder of coupling toward rear. Use grease to hold trunnion pins (15) in fork (14) and insert fork into housing so that trunnion pins are in groove of coupling. Align retaining pin holes of selector shaft (11) and fork, insert selector shaft through oil seal and fork and install retaining pin (12). If cup plug (13) is being renewed, coat outer diameter with sealant prior to installation.

Coat outside diameter of oil seal (5) with sealant and with lip toward inside, press oil seal into front cover (6). Lubricate lip of seal, place front cover over flange (4), then press bearing (8) on flange. Place spacer (9) on output shaft (16) and press shaft into flange (4). Install "O" ring (3) and retaining plate (2) on front of output shaft, tighten cap screws (1) to 80 ft.-lbs. torque and secure cap screws with lock wire.

Place needle bearing (17) in front bore of driven shaft (38), then using a new gasket (7), install output shaft and front cover assembly into housing. Bump front cover in until retaining cap screws can be started, then tighten cap screws evenly to seat front cover to housing. Turn flange and operate engaging mechanism during installation to insure that assembly operates correctly.

Clean base plate (41) making sure the magnetic plug (42) is clean, then using a new gasket (40), install base plate to housing. Reinstall transfer gearbox assembly to tractor as outlined in paragraph 27.

DRIVE SHAFT

Model 1210

29. The four-wheel drive axle driveshaft shown in Fig. 12 is a conventional type and repair of the universals is accomplished by installation of repair kits indicated by item (2). Repair will be obvious after an examination of the unit. Drive shaft is installed with slip-joint toward the transfer gearbox.

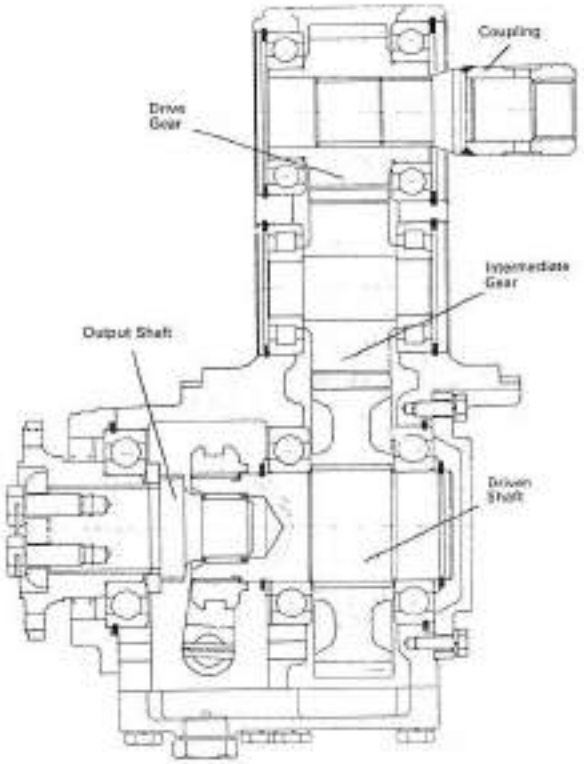


Fig. 16—Cross-sectional view of transfer gearbox. Also see Fig. 15.

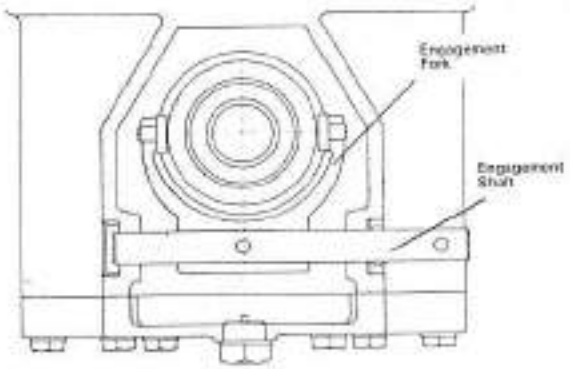
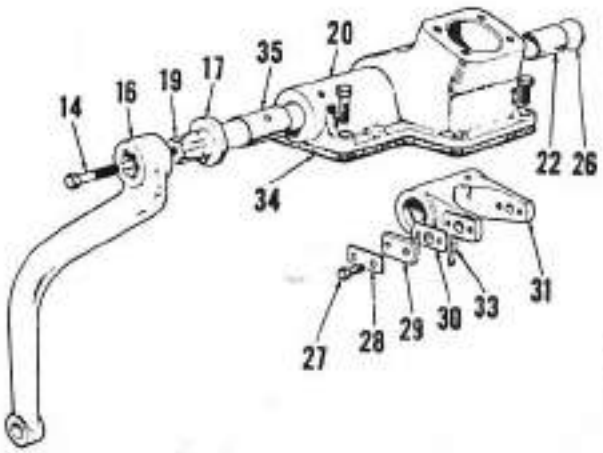


Fig. 17—Exploded view of Model 885 and 885N steering gear housing, cross shaft and steering (drop) arm. Shims (30) are provided to adjust ball nut peg (29) preload against ball nut.



14. Cap screw
16. Steering arm
17. Spacer
19. Cross shaft
20. Housing
22. Bushing (short)
26. Expansion plug
27. Cap screws
28. Lock plate
29. Ball nut pegs
30. Shims
31. Rocker arm
33. Cotter pin
34. Gasket
35. Bushing (long)

MANUAL STEERING GEAR

Models 885, 885N, 995 and 1210 may be equipped with manual steering and the steering gear assemblies are shown in exploded views 17, 18 and 19. For models equipped with Hydrostatic steering, refer to the Power Steering System section of this manual.

REMOVE AND REINSTALL

Models 885, 885N and 995

30. To remove steering gear, remove lever from lower end of hand throttle shaft, unscrew Nylock nut on shaft at underside of panel and withdraw throttle shaft from instrument panel. Remove hood, then remove the two rear bolts securing fuel tank support brackets to clutch housing. Raise instrument panel, allow tank to pivot on front bolts, then reinstall rear bolts under brackets to hold rear of tank clear of steering gear housing bolts. Disconnect drag link from steering arm, remove bolts retaining steering gear housing to transmission top cover, then lift off steering gear assembly and retrieve the two dowel rings.

The oil sump for steering gear is in the transmission top cover and because there is no filler plug, sump must be filled before reinstalling steering gear unit. Fill sump to a maximum of 1-inch below face of transmission top cover.

Reinstall steering gear assembly by reversing removal procedure.

Model 1210

31. To remove steering gear unit, first remove hood, then drain steering gear housing. Disconnect controls and wiring to instrument panel. Unbolt throttle lever shaft bracket from steering gear housing, then unbolt and remove fuel tank and instrument panel as a unit. Unbolt and remove the steering gear assembly from transmission cover.

When reinstalling unit, tighten bolts to a torque of 75 ft.-lbs. and fill steering gear to level of filler plug with proper lubricant.

OVERHAUL STEERING GEAR

All Models So Equipped

32. Refer to exploded view of typical steering column assembly in Fig. 18, remove acorn nut (12) and using a puller, remove steering wheel from steering shaft (5). Remove Woodruff key and dirt excluder (11), remove nut (10), then unscrew upper bearing race (9) and remove the twelve loose bearing balls (8).

Refer to Fig. 17 for Models 885 and 885N; to Fig. 18 for Model 995; or to Fig. 19 for Model 1210. Remove the four cap screws and both pegs (19—Fig. 18 or 29—Figs. 17 and 18), then withdraw the steering shaft and ball nut assembly from bottom of unit. Lower bearing race (7—Fig. 18) and spherical seat (6) can now be removed from steering column and rubber baffle (4) from steering shaft. Unscrew ball nut assembly from steering shaft and retrieve the 28 loose steel balls (1).

On models except 1210, remove cotter pin (33-Fig. 17), or locating screw (30-Fig. 18) and withdraw cross shaft and steering arm as a unit. On Model 1210, refer to Fig. 19 and remove end cover (26), split thrust

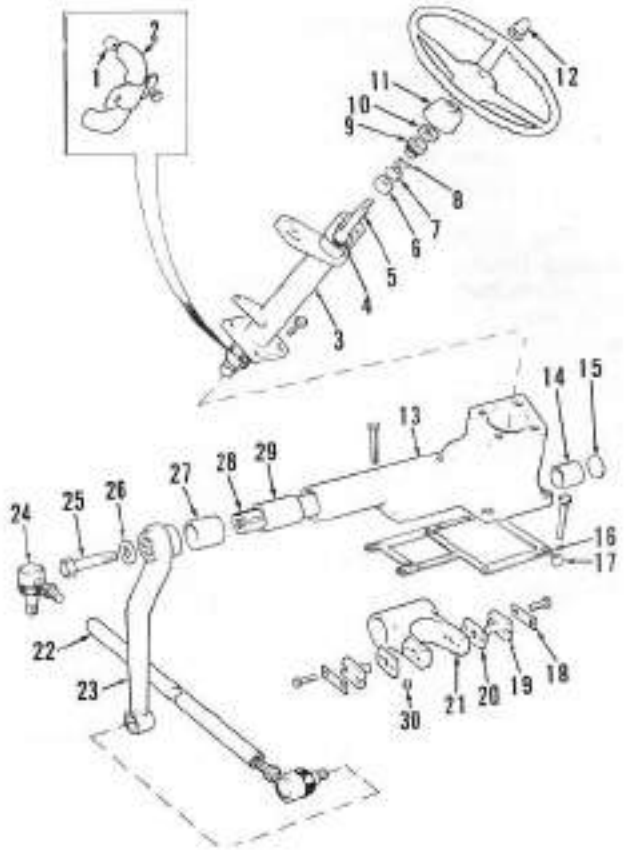


Fig. 18—Exploded view of steering gear housing, cross shaft and steering arm assembly used on Model 995. Also note steering shaft assembly typical of all models.

1. Recirculating balls (28)
2. Ball tube
3. Steering column
4. Rubber baffle
5. Steering shaft
6. Spherical seat
7. Lower bearing race
8. Ball bearings (12)
9. Upper bearing race
10. Locknut
11. Dirt excluder
12. Acorn nut
13. Housing
14. Bushing (short)
15. Expansion plug
16. Gasket
17. Ring dowel
18. Lock plate
19. Ball nut pegs
20. Shims
21. Rocker arm
22. Drag link
23. Steering arm
24. Drag link end
25. Cap screw
26. Washer
27. Dust seal
28. Cross shaft
29. Bushing (long)
30. Locating screw

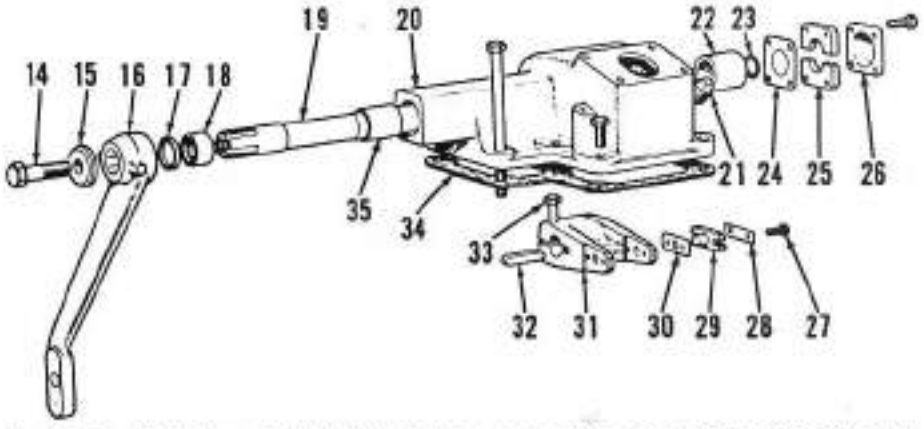


Fig. 19—Exploded view of Model 1210 steering gear housing, cross shaft and steering arm. Shims (24) are used to center rocker arm only and do not control cross shaft end play.

14. Cap screw
15. Washer
16. Steering arm
17. Oil seal
18. Needle bearing
19. Cross shaft
20. Housing
21. Filler-level plug
22. Bushing
23. "O" ring
24. Shims
25. Thrust plate
26. End cover
27. Cap screws
28. Lock plates
29. Ball nut pegs
30. Shims
31. Rocker arm
32. Key
33. Bolt
34. Gasket
35. Bushings (2)

washer (25), shims (24) and bolt (33). Withdraw cross shaft and steering arm. Be careful not to lose any of the shims (24).

If cross shaft bushings are to be renewed, be sure to note their size and location so new ones can be installed properly.

On all models except 1210, be sure that lubrication holes in bushings and gearbox are aligned. Cross shaft must not bind in installed bushings.

To reassemble, remove ball nut tube (2-Fig. 18) from ball nut and place nut over ball track on lower end of steering shaft. Insert steel balls into nut until track is filled; removing oil from all parts and turning steering shaft back and forth will aid in filling the track. Stick remainder of steel balls into tube (2) with grease and fit tube to nut. Place rubber baffle in groove on steering shaft and insert shaft up through housing.

Position rocker arm in gear housing with stop down. Reinstall cross shaft and secure with cotter pin, locating screw or bolt. On Model 1210, install "O" ring, shims, split thrust plate and end cover and vary the shims as necessary to center rocker arm in the housing. Shims are available in thicknesses of 0.003, 0.005, 0.010 and 0.030 inch.

Install one ball nut peg (29A-Fig. 20) without shims and tighten the two cap screws securely. Install second ball nut peg (29B) without shims and tighten the two cap screws evenly until inner end of peg binds ball nut lightly. Using a feeler gage, measure gap (G) between ball nut peg (29B) and rocker arm (31). The shims to be used in final assembly should be 0.001 to 0.003 inch less than measured gap (G) and divided equally as possible for installation under each ball nut peg. The shims are available in thicknesses of 0.003, 0.005, 0.007 and 0.010 inch. After the ball nut pegs are reinstalled with proper number of shims, tighten the four cap screws securely and bend lock tabs against the cap screw heads. When installing drop arms, align marks on drop arm and cross shaft.

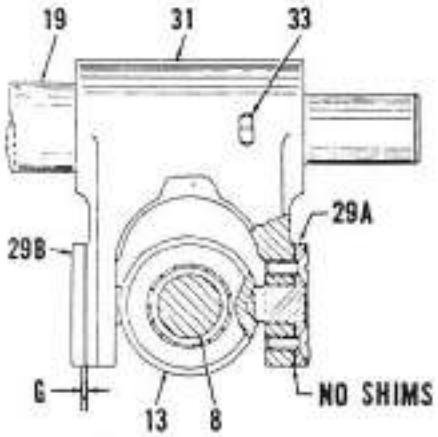


Fig. 20—View showing method of selecting shims for ball nut peg preload. Refer to text for procedure and to Fig. 17, 18 or 19 for legend.

Insert spherical seat (6-Fig. 18) with flat face down, then install lower race (7) with round face in spherical seat. With bearing race positioned just below groove in steering column, drop in the ten loose bearing balls (8). Install new "O" ring in groove on upper race (9), then thread upper race onto steering shaft so as to remove all play from bearing, yet allow shaft to turn freely. Back off upper bearing race 1/8-turn to provide 0.000-0.003 inch end play of steering shaft, hold upper race in position and tighten locknut (10) to 120 ft.-lbs. torque.

NOTE: The locknut has a recess on one side which must be fitted against upper bearing race. Install dirt excluder (11), Woodruff key and steering wheel. Tighten acorn nut to not more than 20 ft.-lbs. torque.

DRAG LINK

All Models

33. Drag link ends are of the non-adjustable automotive type and must be renewed as a complete unit.

Adjust length of drag link if steering gear internal stop contacts before spindle contacts stop on axle extension.

If new drag link ends are installed, set the center to center distance of drag link ends as follows: 885, 46.0 inches; 995, 46.56 inches; 1210, 52.5 inches.

POWER STEERING

Hydrostatic power steering is optionally available for Models 885, 995 and 1210 whereas it is standard for Models 1210 4WD, 1212, 1410 and 1412 models.

The hydrostatic steering system is comprised of a pump, steering (control) valve and a steering cylinder and thus, tractor is steered hydraulically with no mechanical connection between steering wheel and front axle.

The power steering pump for Model 885 is a roller type utilizing a separate reservoir while all other models use a gear type pump having the reservoir as an integral part of the pump. Steering cylinders for Models 885, 995 and some 1210 and 1212 are side mounted. Some 1210 and 1212, 1210 4WD, 1410 and 1412 models have steering cylinders which are transverse mounted.

Steering (control) valves for all models are the same.

Refer to Fig. 21 for a schematic view showing the basic power steering arrangements.

FLUID AND BLEEDING

Side Mounted Cylinders and 1210 4WD

34. Fill reservoir to within 3/8-inch of filler rim on Model 885 tractors, or to level of filler hole on all other models. Use a good grade 10W oil.

Raise front of tractor until front wheels clear the ground, then on

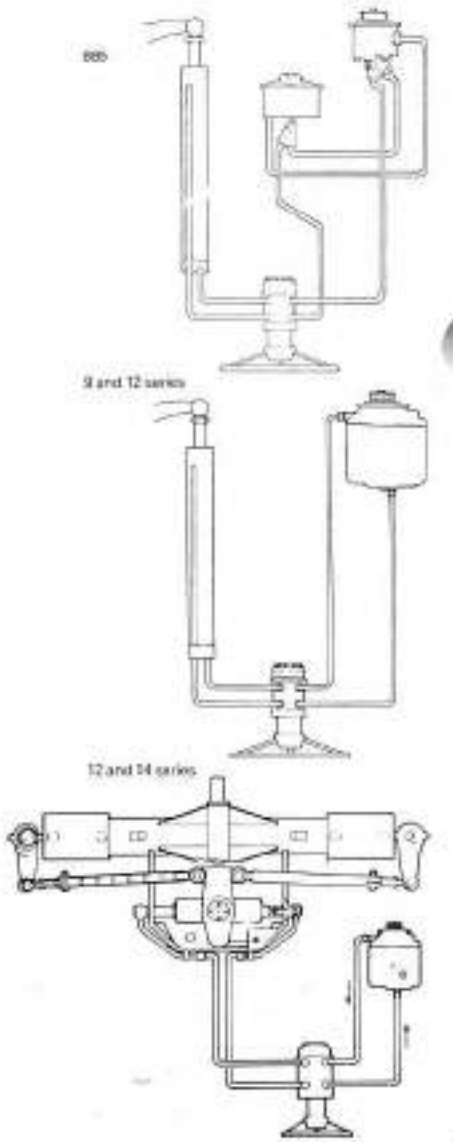


Fig. 21—Schematic views showing basic arrangement of power steering systems. Note that the 12 series tractors may have steering cylinders either side mounted or transverse mounted.

Model 885 only, place throttle control in **STOP** position and use starter to turn engine over for 10 to 15 seconds to prime pump. Recheck oil level in reservoir. On all models, start engine and run at idle speed. Turn steering wheel one full turn in each direction several times but do not allow front wheels to reach stops. Recheck reservoir level. With engine still running at idle speed, turn steering wheel until front wheels reach stops in both directions several times. Do not hold front wheels against stops for more than a few seconds at a time.

Lower front of tractor and again check reservoir level.

Transverse Mounted Cylinders (Except 1210 4WD)

35. Fill pump reservoir to level of filler hole, if necessary. Raise front of tractor until front wheels clear the ground, then start engine and run at idle speed. Loosen bleed screw on top left side of steering cylinder one full turn, turn steering wheel right until front wheels reach their stop, then tighten the left hand bleed screw. Loosen bleed screw on top right side of steering cylinder one full turn, turn steering wheel left until front wheels reach their stop, then tighten the right hand bleed screw. Turn front wheels from stop-to-stop several times and check operation. Repeat above procedure if operation is not satisfactory. Stop engine, lower front wheels to ground, then check and refill reservoir as necessary.

SYSTEM OPERATING PRESSURE

All Models

36. A pressure test of the power steering circuit will disclose whether the pump, relief valve or some other unit in the system is malfunctioning. To check system pressure, proceed as follows:

Connect a pressure test gage and shut-off valve in series with the pump pressure line and be sure the pressure gage is connected in the circuit between the shut-off valve and pump. Open the shut-off valve and bleed the system as in paragraph 34 or 35. Operate engine at slow idle speed until fluid is at normal operating temperature. Then, with engine running at fast idle speed, close the shut-off valve and retain in closed position only long enough to observe pressure gage reading which should be as follows: Model 885 (with separate reservoir), 700 psi; all other models (with integral reservoir), 1000 psi.

NOTE: Pump may be seriously damaged if valve is left in closed position for more than a few seconds. If gage reading is within 40 psi of normal system pressure with shut-off valve fully closed, pump and relief valve are OK and any trouble is located in the steering cylinder and control valve.

If gage pressure is excessively high, relief valve is probably stuck in closed position or incorrectly installed in valve bore. If gage pressure is more than 40 psi below normal system pressure, adjustment shims should be added in the gear type pump, or a new relief valve assembly should be installed in the roller vane type pump. If gage pressure still remains low, pump should be overhauled.

R & R PUMP

Model 885

37. Remove pulley guard (19—Fig. 22), then clean pump and surrounding area. Place a suitable container under pump, disconnect pump inlet and by-pass hoses and the connection at outlet line. Loosen the two cap screws attaching pump bracket (16) to tractor frame, slide bracket downward to slacken drive belt, then remove belt from pulley. Complete removal of attaching cap screws and remove pump and bracket assembly.

If further service is to be performed on pump, remove pulley (18) and key, then unbolt and remove bearing retainer (17) and bracket (16).

Reinstall by reversing removal procedure and bleed system as outlined in paragraph 34.

38. RESERVOIR. To remove reservoir, place a suitable container under reservoir (33), remove inlet and by-pass hoses and drain reservoir. Unbolt and remove reservoir from support bracket (31).

Reinstall reservoir by reversing the removal procedure and bleed system as outlined in paragraph 34.

All Other Models

39. Clean exterior of pump and the surrounding area. Shut off fuel, remove lines from fuel pump, then unbolt and remove the fuel pump. Loosen alternator mounting bolts, disconnect alternator adjuster strap and remove drive belt, then swing alternator upward and tighten alternator bolts to retain alternator in this position. Make provision to catch oil and disconnect inlet and outlet lines from pump. Unbolt pump from engine front plate, withdraw pump rearward until it clears timing gear and lift off pump. Remove and discard gasket (2-Fig. 26).

Reinstall by reversing removal proce-

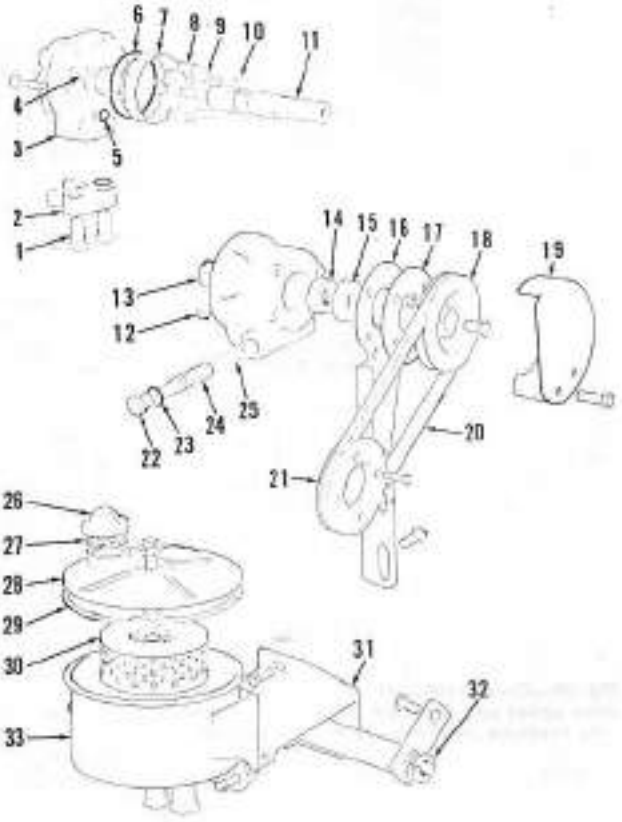


Fig. 22—Exploded view of roller type power steering pump used on Model 885 tractors. Note separate reservoir.

1. Banjo bolt
2. Connector
3. Cover
4. Dowel
5. "O" ring
6. "O" ring
7. Cam
8. Carrier
9. Rollers
10. Drive pin
11. Shaft
12. Locking pin
13. Bushing
14. Oil seal
15. Bearing
16. Mounting bracket
17. Bearing retainer
18. Pulley
19. Guard
20. Belt
21. Pulley rim
22. Plug
23. "O" ring
24. Flow control valve spool
25. Spring
26. Filler cap
27. Sealing ring
28. Cover
29. Gasket
30. Filter element
31. Support bracket
32. Grommet
33. Reservoir

dure and bleed system as outlined in paragraph 34 or 35.

OVERHAUL PUMP

Model 885 (Roller Pump)

40. Clean pump and place a scribe line across pump halves and mounting bracket to aid in reassembly. Remove pulley and key, then remove bearing retainer (17-Fig. 22) and mounting bracket (16). Remove cap screws and separate rear cover (3) from body. Remove rollers (9) and carrier (8) from body, then remove drive pin (10) from shaft. Remove cam ring (7) and cam ring lock pin (12), then using a soft faced hammer, bump shaft (11) and bearing (15) forward out of body. Remove bearing from shaft and oil seal (14) from body. Discard "O" ring (6). Remove plug (22), flow control valve (24) and spring (25). Discard "O" ring (23).

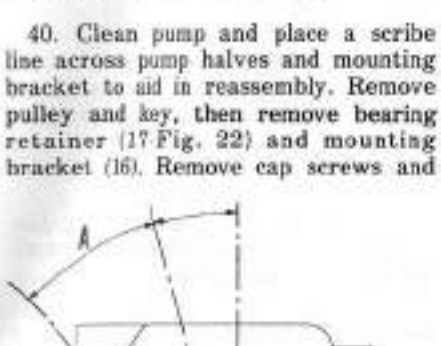


Fig. 23—When installing carrier, the larger angle (A) of roller slot should be toward direction of pump rotation. Refer to Fig. 22 for parts identification.

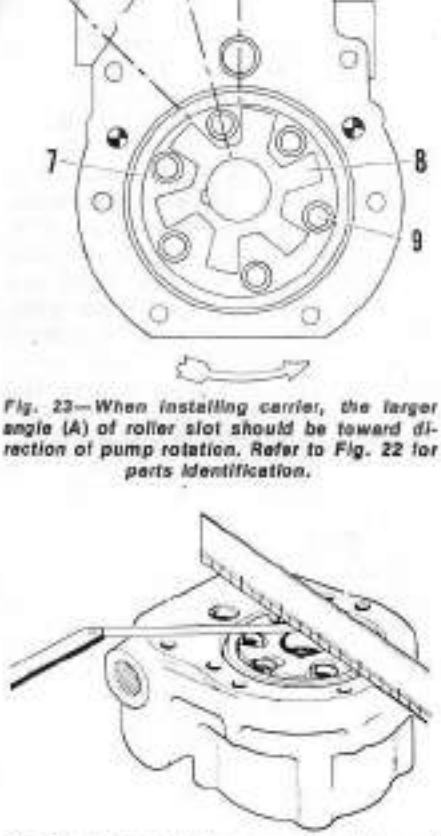


Fig. 24—Use method shown to check end clearance of carrier and rollers. Refer to text.

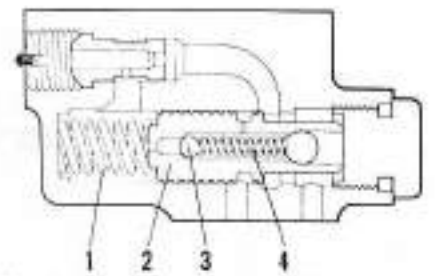


Fig. 25—Cross-sectional view of flow control valve spool and pressure relief valve assembly. Pressure relief valve is not serviceable.

1. Spring
2. Flow control valve spool
3. Relief valve ball
4. Relief valve spring

Clean and inspect all parts. If pump body or cover is renewed, new ports are fitted with bushings although bushings are cataloged separately. Check cam (7), carrier (8) and rollers (9) assembly as follows: Install cam locking pin (12) in body, install cam so slot in cam engages locking pin and cam seats in pocket, then place carrier in cam so that larger angle (A-Fig. 23) is toward direction of pump rotation. Place rollers in slots of carrier, then using a straight edge across face of body as shown in Fig. 24, measure clearance between carrier and rollers and straight edge. If clearance exceeds 0.002 inch, new cam, carrier and rollers must be installed as an assembly as they are not available separately. Inspect pump shaft and bearing for wear or other signs of damage. If bearing is rough or excessive grease has seeped out, renew bearing. Flow control valve spring (25) should test 8-9 lbs. when compressed to a length of 0.82 inch.

NOTE: The pump pressure relief valve is located inside the flow control valve spool as shown in Fig. 25. The valve is non-adjustable and the pressure preset at the factory. No attempt should be made to disassemble relief valve. If necessary to correct pump relief pressure (700 psi), renew the complete flow control valve spool.

41. Reassemble pump as follows: Install new oil seal (14-Fig. 22) in body with lip toward inside and lubricate lip of seal. Press bearing (15) on shaft (11) and install shaft and bearing in pump body. Install locking pin (12) in body, then align slot in cam (7) with pin and seat cam in pocket. Place drive pin (10) in slot of shaft (11), then install carrier (8) so widest angle of roller slots are toward direction of pump rotation as shown in Fig. 23. Install rollers (9-Fig. 22) in slots of carrier. Install "O" ring in groove of body, then with "O" ring (5) in place, install cover (3) and tighten retaining cap screws evenly to 18 ft.-lbs. torque. Install mounting bracket (16) and bearing retainer (17) and tighten retaining cap screws securely. Install pulley key and pulley and tighten pulley retaining cap screw to 20 ft.-lbs. torque. Insert spring (25), flow control valve spool (stem end out), then with new "O" ring (23), install plug (22) and tighten securely.

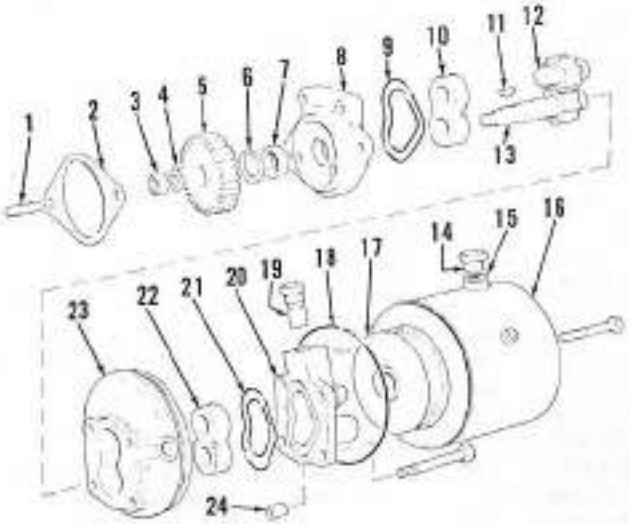
All Other Models (Gear Pump)

42. Hold pump assembly over a container, remove center bolt and pull reservoir (16-Fig. 26) from pump body (23). Lift off filter element (17). Straighten tab of lock washer (4), remove nut (3), then using a puller, remove drive gear (5) and Woodruff key (11).

NOTE: Do not drive on end of shaft as damage to bearings (10 and 22) could result. Remove the four through bolts and separate cover (20) and mounting flange (8) from pump body (23). If necessary, tap cover lightly with a soft faced hammer to remove from dowels (24). Identify bearings (10 and 22) so they can be reinstalled in their original positions and remove bearings and rotors (gears) from pump body.

Fig. 26—Exploded view of gear type power steering pump used on all models except Model 885.

1. Stud
2. Gasket
3. Nut
4. Tab washer
5. Drive gear
6. Snap ring
7. Oil seal
8. Mounting flange
9. Sealing rings
10. Bearing
11. Woodruff key
12. Driven rotor
13. Drive rotor
14. Filler plug
15. Gasket
16. Reservoir
17. Filter element
18. "O" ring
19. Relief valve
20. Pump cover
21. Sealing rings
22. Bearing
23. Pump body
24. Dowels



Remove snap ring (6) and bump seal (7) from mounting flange (8). Discard seal and "O" rings (9, 18 and 21). Remove relief valve (19) and note that it is a preset assembly.

43. Clean and inspect all parts. It is normal for the gears to cut a light track on inlet side of body, however if track exceeds 0.004 depth, body, rotors and bearings must be renewed. Inspect bearings for wear or scoring. Pay particular attention to the lubrication scrolls in shaft bores and the seal bridge area between shaft bores. If bearings are worn or scored, renew both bearings. Inspect journals of rotor shafts for scoring or wear. Light scoring of journals can be cleaned up using "O" grade emery paper lubricated with kerosene. Shaft journals must be within 0.005 of being equal while gear width must be within 0.002 of being equal. Measure overall width of the gears and bearings assembly and compare this with the width of pump body. See Fig. 27. Width of gear body must not be more than 0.008 wider than width of gears and bearings assembly.

44. Reassemble pump as follows: Use a tool 1.0937 inches in diameter and press (do not drive) seal (7-Fig. 26) into mounting flange (8). Install snap ring (6) and lubricate inside diameter of seal. Install relief valve (19), then install seal rings (9 and 21) in cover (20) and mounting flange (8). Install cover (20) on dowels (24) and set pump on cover end. Lubricate inner bearing (22) and install in body (23) with recesses toward rotors and largest cut-out toward inlet side of pump. Install rotors, then lubricate front bearing (10) and install in body with recesses next to rotors and largest cut-out toward inlet side of pump. Install mounting flange (8), align bolt holes and install through bolts and tighten bolts evenly to 30 ft.-lbs. torque. Install Woodruff key (11), drive gear (5), lock washer (4) and nut (3). Hold drive gear, tighten nut to 45 ft.-lbs. torque and secure nut with tab of lock washer. Install new "O" ring (18) on pump body, then install filter element (17) and reservoir (16).

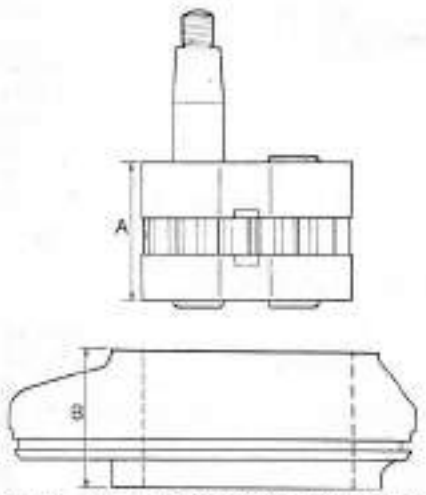


Fig. 27—Width (A) of rotors and bearings assembly must be not more than 0.008 narrower than width (B) of pump body.

NOTE: When installing reservoir center bolt, hold reservoir against element spring, tighten bolt until it contacts sealing washer, then tighten the bolt an additional ¾ to one turn only. Also be sure locating plate inside reservoir mates with locating lug on pump body.

R & R STEERING CYLINDER

Models 885, 995, Some 1210 and 1212

45. Power steering cylinders for the above models are side mounted. Refer to Fig. 28 for an exploded view.

To remove steering cylinder, identify oil lines to their connectors, then place a container under steering cylinder and disconnect lines. Disconnect ball joints from steering arm and anchor bracket and lift off steering cylinder.

Reinstall by reversing removal procedure and bleed system as outlined in paragraph 34.

NOTE: If ball joints were disturbed while steering cylinder is removed, adjust cylinder overall length prior to installation as follows: Turn front ball joint on piston rod full thread depth and tighten lockout. Turn rear ball joint into housing until center-to-center distance between ball joints is 27.0 inches with cylinder fully retracted and tighten lockout.

Model 1210 4WD

46. Power steering cylinder for Model 1210 four-wheel drive tractors is transverse mounted behind front axle. Refer to Fig. 29 for an exploded view.

To remove steering cylinder, identify oil lines to their connectors, then place a container under steering cylinder and disconnect lines. Disconnect cylinder from axle and left steering arm and remove steering cylinder.

Reinstall by reversing removal procedure and bleed system as outlined in paragraph 34.

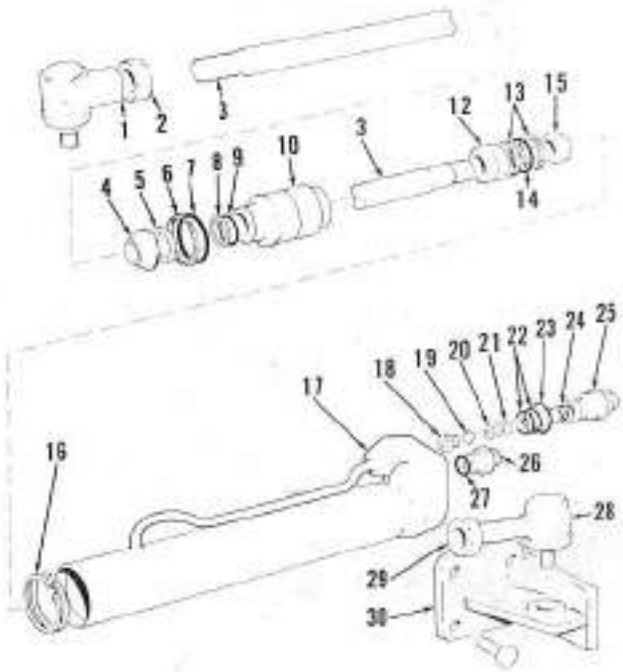
Models 1410, 1412, Some 1210 and 1212

47. Power steering cylinder for above models is transverse mounted in front axle main member. Refer to Fig. 30 for an exploded view and to Fig. 31 for an installed view.

To remove steering cylinder, first remove front axle as outlined in paragraph 6. Disconnect tie-rods from yoke (15-Fig. 30). Remove snap rings (38) from connectors (36) remove pipes (17 and 39) from connectors, then unscrew connectors from ends of piston rod (34). Remove special nut (6) and pivot pin (1), then lift cylinder and pivot link assembly from front axle. Do not lose washers (shims) (35). Remove screws (10) which retain ball pegs (12).

Fig. 28—Exploded view of steering cylinder used on Models 885, 995 and some of Model 1210 and 1212 tractors. Refer also to Figs. 29 and 30.

1. Ball joint
2. Locknut
3. Piston rod
4. Scraper seal
5. Seal ring
6. Back-up ring
7. "O" ring
8. Back-up ring
9. "O" ring
10. Sleeve
12. Piston
13. Back-up rings
14. "O" ring
15. Locknut
16. Snap rings
17. Cylinder
18. Valve seat
19. Valve plunger
20. Washer
21. Spring
22. "O" rings
23. "O" ring
24. Spring support & "O" ring
25. Valve body
26. Connector
27. "O" ring
28. Ball joint
29. Locknut
30. Anchor bracket



pry out ball pegs and save shims (13). Remove cylinder from yoke.

48. To reinstall steering cylinder, proceed as follows: Soak the felt ball peg seals in clean engine oil. Position cylinder in yoke and install lower ball peg (with grease fitting) along with any shims that were removed, then install upper ball peg (with relief valve) along with any shims that were removed and tighten retaining cap screws. Check movement of cylinder in yoke and if tight, vary shims as required but keep cylinder centered in yoke. Place cylinder and yoke assembly on front axle and be sure washers (shims) are located at each end of piston rod. Washers (shims) are available in thickness of 0.185, 0.189, 0.195 and 0.201 inch and should be selected to provide 0.005 clearance to 0.001 preload of piston rod before connectors (36) are tightened. With two washers (3) on pivot pin (1), install pin, tighten the special nut (6) to provide 0.000-0.001 inch preload on pivot link and install cotter pin. Install pipes (17 and 39) on connectors (36) and install snap rings (38).

Reinstall front axle and bleed system as outlined in paragraph 35.

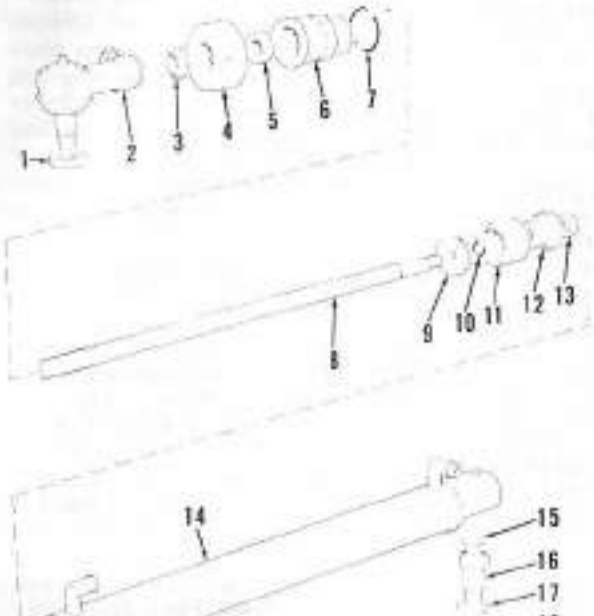


Fig. 29—Exploded view of steering cylinder used on 1210 4 WD tractor. Cylinder is transversely mounted behind front axle. Also see Figs. 28 and 30.

1. Seal
2. Ball joint
3. Wiper seal
4. End cover
5. Seal
6. Sleeve
7. "O" ring
8. Piston rod
9. Piston outer half
10. "O" ring
11. Piston seal
12. Piston inner seal
13. Nut
14. Cylinder
15. Snap ring
16. Pivot pin
17. Snap ring
18. Seal

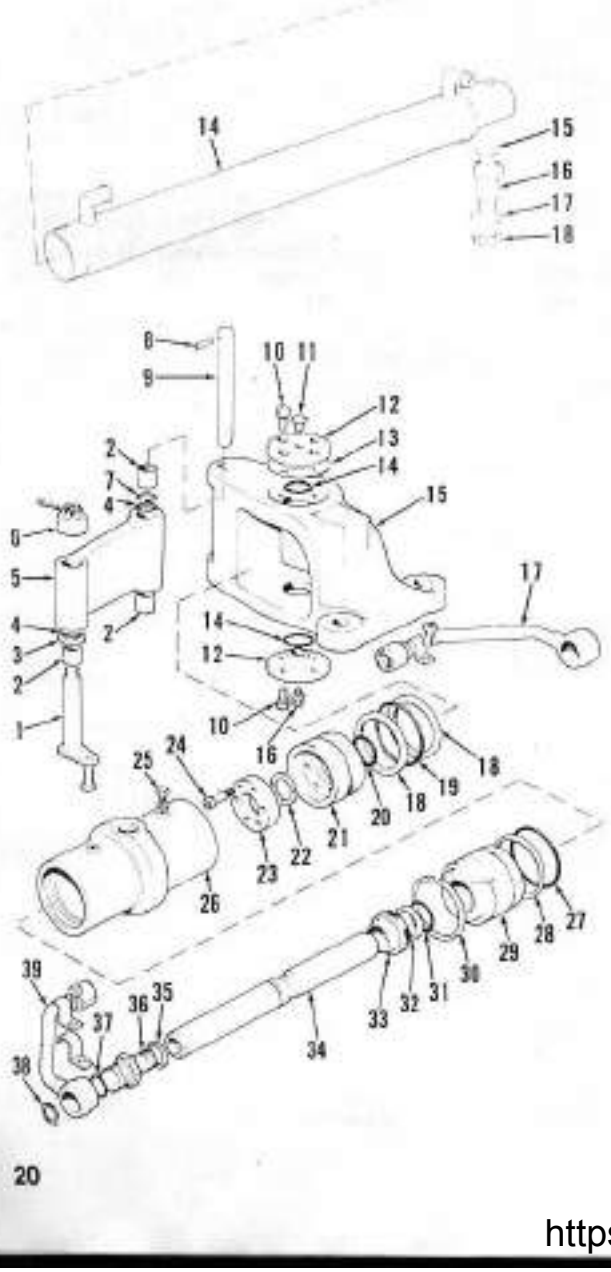


Fig. 30—Exploded view of steering cylinder and yoke assembly used on some 1210 and 1212 model tractors and all 1410 and 1412 model tractors. Refer also to Figs. 28 and 29.

1. Pivot pin
2. Bushing
3. Washer
4. "O" ring
5. Pivot link
6. Special nut
7. "O" ring
8. Spring pin
9. Pivot pin
10. Special screw
11. Relief valve
12. Ball peg
13. Shims
14. Seal
15. Yoke
16. Grease fitting
17. Pipe, LH
18. Special washer
19. "O" ring
20. "O" ring
21. Piston
22. Split ring
23. Locking plate
24. Cap head screw
25. Bleed screw
26. Cylinder
27. "O" ring
28. Back-up ring
29. Sleeve
30. Snap ring
31. "O" ring
32. Special washer
33. Scraper seal
34. Piston rod
35. Washer (shim)
36. Connector
37. "O" ring
38. Snap ring
39. Pipe, RH

OVERHAUL STEERING CYLINDER

Models 885, 995, Some 1210 and 1212

49. Refer to Fig. 28 for an exploded view of steering cylinder and proceed as follows: Clear cylinder of oil if necessary by moving piston rod through its full stroke. Remove scraper seal (4) and the two snap rings (16), then pull piston rod and piston and sleeve (10) from cylinder. Clamp sleeve in a soft jawed vise to hold piston rod, then remove nut (15), piston (12) and sleeve (10) from piston rod. Remove and discard all "O" rings, back-up rings and seals from piston and sleeve. Line valve (items 18 through 25) can be removed after removing valve body (25) from cylinder housing.

Clean and inspect all parts. Cylinder bore must be smooth and free of score marks. Piston and piston rod must be free of nicks or burrs. Small nicks or burrs can be removed with a fine stone but parts must be thoroughly cleaned.

Reassembly is the reverse of disassembly, however keep the following in mind. Back-up rings should be soaked in light engine oil for 30 minutes and an additional 30 minutes allowed for drying (absorption) before final installation. Install back-up rings in sleeve with rough side toward piston and install "O" rings next to rough sides of back-up rings. Install sleeve on piston rod with tapered shoulder toward piston. Install piston on piston rod with chamfered end of hole against shoulder of piston rod. Clamp sleeve in vise to hold piston rod and tighten piston retaining nut to 100 ft.-lbs. torque. Lubricate all parts prior to assembly.

Model 1210 4WD

50. Refer to Fig. 29 for an exploded view of steering cylinder and proceed as follows: Clear cylinder of oil if necessary by moving piston rod through its complete stroke. Loosen ball joint clamp and unscrew ball joint from piston rod. Use a spanner wrench and remove cylinder end cover (4) and pull piston rod, piston and sleeve (6) from

cylinder. Remove piston nut (13) and pull piston halves (9 and 12), seal (11) and "O" ring (10) from piston rod. Discard all "O" rings and seals including wiper seal (3) and seal (5). Pivot pin (16) can be removed after removing snap ring (17).

Clean and inspect all parts. Cylinder bore should be smooth and have no score marks. Small nicks or burrs can be removed from piston rod and piston with a fine stone, however parts must be thoroughly cleaned.

Use new "O" rings and seals and reassemble by reversing disassembly procedure. Lubricate all parts prior to installation.

Models 1410, 1412, Some 1210 and 1212

51. With steering cylinder removed as outlined in paragraph 47, refer to Fig. 30 for an exploded view and proceed as follows: Clear oil from cylinder if necessary by moving piston rod through its complete stroke. Clamp cylinder in a soft jawed vise in a vertical position, then compress snap ring (30), tap on opposite end of piston rod (34) and bump sleeve (29) and snap ring from cylinder (26). Reverse cylinder in vise and remove opposite sleeve and snap ring in the same manner. Pull piston rod and piston from cylinder. Remove cap screws (24), locking plate (23) and split ring (22), then remove piston (21) with "O" ring (20) from piston rod (34).

Clean and inspect all parts. Cylinder bore should be smooth and free of score marks. Inspect piston and piston rod for nicks or burrs. Small nicks or burrs can be removed with a fine stone, however parts must be thoroughly cleaned. Discard all "O" rings, back-up rings and seals.

Reassemble by reversing disassembly procedure, however keep the following points in mind. Soak back-up rings in light engine oil for 30 minutes, then allow them to dry (absorb) for an additional 30 minutes prior to installation. Install back-up rings with rough side next to "O" rings. Use Loctite on cap screws (24) and tighten to 8 ft.-lbs. torque. Fill snap ring grooves in ends of cylinder with thick grease to help protect piston and sleeve seals during installation. Be sure all parts are lubricated prior to installing.

R & R STEERING VALVE

All Models

52. Identify the location of the four lines attached to steering valve, then disconnect the lines. On all models, disconnect throttle linkage (lever) from lower end of throttle lever shaft. On Model 995, remove nylon nut at top of throttle lever shaft and withdraw shaft from instrument panel. On 1210, 1212, 1410 and 1412 model tractors, unbolt fuel tank from supports and steering column and raise rear of fuel tank.

On Models 885, 995, 1210 and 1410, unbolt support bracket from transmission cover and lift off steering column, support bracket and steering valve, then remove the four cap screws from flange of steering column and remove steering valve from end of steering shaft.

On Models 1212 and 1412, unbolt support plate from support casting and lift off steering column, support plate and steering valve, then remove the four cap screws from steering column flange and remove steering valve from end of steering shaft.

53. Reinstall by reversing removal procedure and bleed system as outlined in paragraph 34 or 35.

OVERHAUL STEERING VALVE

All Models

54. With steering valve removed as outlined in paragraph 52, disassemble as follows: Clamp unit lightly in a vise with rotor end up, remove the seven cap screws which retain end cap (3-Fig. 32) and discard sealing washers (2). Also note location of cap screw (1) which has the pin. Remove end cap (3), spacer (4), rotor set (5 and 7), plate (8) and drive shaft (9). Remove threaded insert (11) and steel ball (10). Remove unit from vise and push spool and sleeve (17 and 19-Fig. 33) assembly from bottom of housing. Remove washer (12), bearing (13), bearing race (14) and centering spring retaining ring (15) from valve spool and sleeve. Remove drive pin (18), then push spool (17) out of sleeve (19) toward centering spring end. Remove the six centering springs (16) from spool. Carefully pry seal (22) from housing, then remove the "O" ring (21) and seal ring (20) assembly. Discard all seals and "O" rings.

55. Clean all parts in a suitable solvent and inspect for undue wear or other damage. Pay particular attention to matched surfaces for scuffs and scratches and to thrust bearing for undue wear or damage. Check splines for undue wear and all parts for nicks and burrs. Be sure centering pin is not bent or worn and that centering springs are in good condition.

56. When reassembling, use all new "O" rings and seals which are available as a kit. Lubricate all parts prior to assembly and assemble unit as follows:

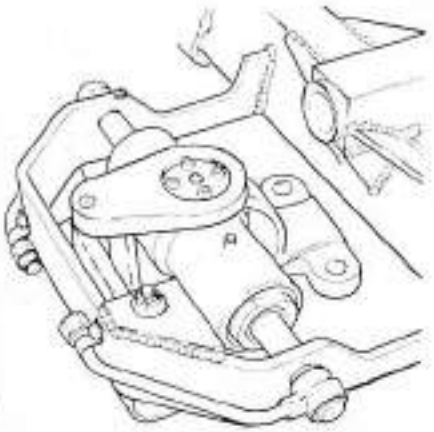


Fig. 31—View showing installation of power steering cylinder on some 1210 and 1212 model tractors and all 1410 and 1412 model tractors.

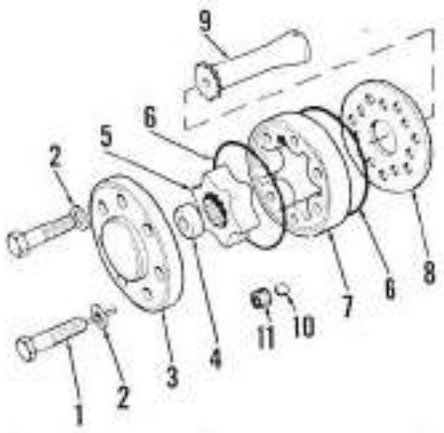


Fig. 32—Exploded view showing steering valve rotor set, drive shaft and related parts.

1. Cap screw (w/pin)
2. Sealing washer
3. End cap
4. Spacer
5. Rotor
6. "O" ring
7. Stator
8. Plate
9. Drive shaft
10. Steel ball
11. Threaded insert

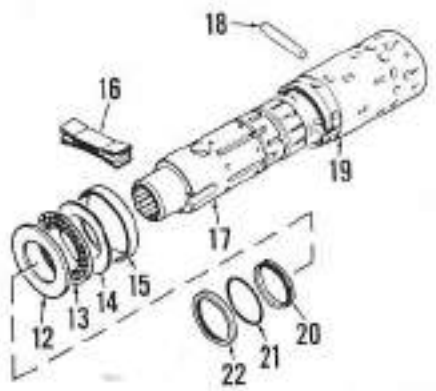


Fig. 33—Exploded view of steering valve spool, sleeve, bearings and seals.

12. Washer
13. Bearing
14. Bearing race
15. Spring retaining ring
16. Centering springs
17. Spool
18. Pin
19. Sleeve
20. Seal ring
21. "O" ring
22. Seal

Slide spool (17-Fig. 33) into sleeve (19) and align centering spring slots. The fit of these two parts is very close and turning the spool slightly while inserting will aid installation. Assemble centering springs (16) in two sets of three each, then with arches facing one another, insert springs through sleeve and spool.

NOTE: If available, Case tool number 964173, will aid in installing centering springs. To use tool, slide tool through spring slots of sleeve and spool, assemble springs and place ends in slot of tool, then compress opposite end of springs and slide springs into position while pushing tool out. See Fig. 34.

Install drive pin (18-Fig. 33) and be sure ends of pin are flush with outer surface of sleeve. Install centering spring retaining ring (15), bearing race (14), bearing (13) and washer (12) on spool and make sure that chamfer on inside diameter of bearing race faces away from bearing. Use a suitable driver and install shaft seal (22) in valve body with lip toward outside. Grease "O" ring (21), install it on outside diameter of seal ring (20), then install assembly on end of spindle of Case tool number 964172 (See Fig. 34). Push seal and spindle into sleeve of special tool until firm resistance is met and insert assembly into valve body until sleeve bottoms. Use a rotating motion and push on tool spindle until "O" ring seats in body and remove tool. Install sleeve, spool and bearing assembly into body and rotate assembly as it passes through seal assembly, then with assembly installed, position so that drive pin is at right angles to the flat surface containing pipe (hose) ports. Place unit in a soft jawed vise with bottom end up and install check ball (10-Fig. 32) and threaded insert (11). Do not overtighten the threaded insert. Place new "O" ring in body, then install drive shaft (9) with slot engaging drive pin. Install plate (8) and align oil holes with oil holes of body. Install rotor (5) over splines of drive shaft and **BE SURE** that one valley of the rotor aligns with drive pin slot of drive shaft.

NOTE: Be sure rotor is timed as outlined. Otherwise tractor will steer in a direction opposite to direction steering wheel is turned.

Install spacer (4) on drive shaft. Install new "O" ring on each side of stator (7), install stator over rotor and align bolt holes. Use new seals (2) on cap screws and install end cap (3) making sure cap screw with pin (1) is in correct location (over check ball). Tighten cap screws to 20 ft.-lbs. torque.

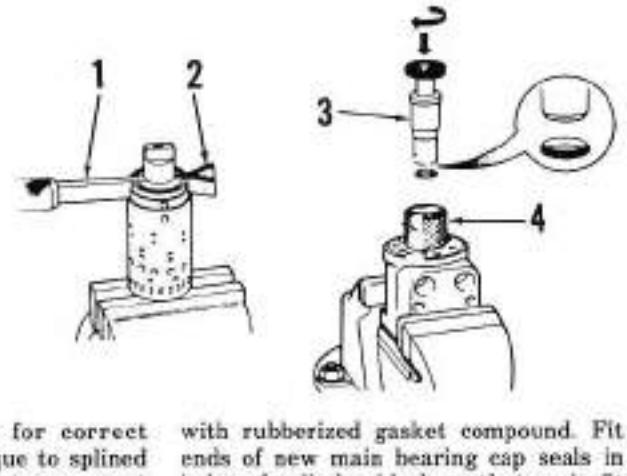


Fig. 34—View showing method of installing centering springs and shaft seal.

1. Special tool
2. Centering springs
3. Special tool spindle
4. Special tool sleeve

Check steering valve for correct assembly by applying torque to splined end of steering shaft. This torque must not exceed 18-ft.-lbs.

ENGINE

R & R ENGINE ASSEMBLY

3-Cylinder Engines

57. To remove engine assembly, proceed as follows: Remove hood, disconnect hourmeter cable, throttle and engine stop controls and disconnect wiring to instrument panel. Drain fuel tank if desired to reduce weight, then unbolt and remove fuel tank and instrument panel as an assembly. Drain cooling system, disconnect radiator hoses and remove radiator. If equipped with power steering, disconnect oil lines from steering valve. Drain crankcase and remove oil pan to allow removal of three cylinder block to frame bolts located inside engine. Note: One of the three bolts is located below fuel injection pump. Securely support tractor under front end of transmission housing and drive wood wedges tightly between each side of front support (main frame extension) and front axle. Remove vent cover from bottom of flywheel housing. With wood block on a rolling floor jack, support rear end of engine under flywheel housing. Unbolt flywheel housing from transmission and roll front unit away from rear section. Place secure supports under front assembly and remove rolling floor jack, then unbolt and remove clutch assembly, flywheel and flywheel housing. Unbolt cylinder block from frame, then taking care not to damage oil pump, lift engine from frame.

58. When reinstalling engine, make sure that mating surfaces of cylinder block are clean and free of all traces of old gasket. Coat gasket surface of main frame and both sides of new gaskets with rubberized gasket compound. Fit ends of new main bearing cap seals in holes of cylinder block so that seals fit snugly in bearing caps. Install two 3/8-inch UNC guide studs opposite each other in sides of main frame, then lower engine assembly into place. Install, but do not tighten, the cylinder block to main frame bolts. Place new "O" ring in rear end of camshaft bore, then install flywheel housing, tightening the bolts to a torque of 30 ft.-lbs. Then, tighten the cylinder block to main frame bolts to a torque of 30 ft.-lbs.

Install flywheel and tighten bolts to a torque of 50 ft.-lbs., then reinstall clutch assembly. Rejoin front section to rear and tighten flywheel housing to transmission bolts to a torque of 50 ft.-lbs., then complete reassembly of tractor by reversing disassembly procedure.

Models 995

59. To split tractor for engine removal, proceed as follows: Remove hood, disconnect battery ground strap, remove fan and drain cooling system. Disconnect linkage and remove throttle lever. Disconnect engine controls, engine speed indicator and instrument panel wiring. Disconnect leak-off lines and fuel lines from fuel tank, then remove fuel tank and instrument panel. Support rear half of tractor with a rolling floor jack; jack should be located just behind clutch cover on bottom of transmission housing. Drive wood wedges tightly between front support (extension) at front axle at each side of tractor to prevent front end from tipping. Disconnect pipes (lines) from power steering servo (control) valve, cap all openings, and when necessary, remove pipe (line) retaining clips where fitted.

On manual steering models, disconnect steering drag link from steering arm. Remove engine starter. Unbolt transmission housing (main frame) and clutch housing from engine and front

main frame, then roll rear section back until clutch shaft is clear of clutch assembly. Unbolt cylinder block from front main frame and note that four of the bolts are long bolts installed from bottom side of main frame. Take care not to damage oil pump and lift engine, flywheel and clutch assembly from frame.

60. When reinstalling engine, make sure that engine and frame gasket surfaces are clean and free of all old gasket material. Apply rubberized gasket compound to gasket surface of frame and to both sides of new gaskets. Insert ends of main bearing cap seals in holes in cylinder block so that seals fit snugly in main bearing caps. Install two 3/8-inch UNC guide studs opposite each other in sides of main frame, then lower engine, flywheel and clutch assembly onto frame. Complete remainder of reassembly by reversing removal procedures. Tighten the cylinder block to main frame bolts to a torque of 30 ft.-lbs. and tighten transmission (main frame) to front frame bolts to a torque of 50 ft.-lbs.

Models 1210, 1212, 1410 and 1412

61. To remove the engine and clutch assembly, first disconnect the battery ground cable, then remove hood. Drain cooling system and remove radiator hoses. Remove fan from water pump. Disconnect hydraulic pump drive shaft from crankshaft pulley and remove the rubber spacer. Disconnect linkage and remove hand throttle lever, then disconnect wiring and engine speed indicator cable. Disconnect fuel line and leak-off line from fuel tank and remove fuel tank and instrument panel as a unit.

On Model 1210, when equipped with manual steering, drain steering gear housing, disconnect drag link from drop arm, then remove the steering gear assembly. On all models with power steering, drain power steering pump reservoir, remove all lines from pump and servo (control) valve, then remove steering column, servo valve and support bracket. Remove starter, then unbolt and remove clutch cover. Keep wedge and shims with clutch cover. Loosen seat adjustment, slide seat fully rearward, then unbolt and remove transmission cover. Drain transmission lubricant, remove power take-off assembly and withdraw power take-off shaft from rear of tractor. Lift snap ring from its groove in clutch shaft, slide snap ring forward on shaft, then slide muff coupling forward until it clears transmission shaft. Do not misplace any shims which might be located at rear of coupling. On early 1210 models, remove the pivot bolt from left side of power take-off release fork and the cotter pin from right side of fork. Disconnect lubrication line from bearing carrier.

Unbolt engine from front main frame. Note that four bolts are inserted from bottom of main frame. Taking care not to damage the oil pump as engine is removed, carefully lift engine up until oil pump is clear of main frame.

62. When reinstalling engine make sure that engine and frame gasket surfaces are clean and free of all old gasket material. Apply rubberized gasket compound to gasket surface of frame and to both sides of new gaskets. Insert ends of main bearing cap seals in holes in cylinder block so that seals fit snugly in main bearing caps. Install two 3/8-inch UNC guide studs opposite each other in sides of main frame, then lower engine, flywheel and clutch assembly onto frame. Be sure transmission release fork engages slots in bearing sleeve as engine is lowered. With engine positioned on main frame, be sure that muff coupling slides freely onto transmission shaft and with snap ring installed, coupling should have not less than 0.008 inch end play. If coupling end play is not correct, vary shims at rear of coupling as required. Shims are 0.032 inch thick.

Complete remainder of reassembly by reversing disassembly procedure. Tighten the cylinder block to main frame bolts to a torque of 30 ft.-lbs. and the transmission to front frame bolts to a torque of 50 ft.-lbs.

R & R CYLINDER HEAD

All Models

63. To remove the cylinder head, first remove engine hood and drain cooling system. Remove upper radiator hose and the hose connecting intake manifold to air cleaner. Disconnect temperature gage sending unit. Loosen water pump by-pass hose clamps and disconnect by-pass hose (if so equipped). Remove leak-off pipe from top of fuel injectors and the injection pump to injector high pressure lines and immediately cap all openings. Remove the fuel injector assemblies. Remove external rocker arm oil tube that connects cylinder head to block. Remove the intake and exhaust manifolds. Remove engine breather pipe, breather and rocker arm cover. Remove rocker arms assembly and push rods. Unbolt and remove the cylinder head loosening the bolts in reverse order of tightening sequence shown in Fig. 35 or 36; otherwise, distortion of cylinder head may occur.

64. If cylinder head retaining stud bolts have been removed from block, they should be reinstalled to a torque of 35 ft.-lbs. Cylinder sealing rings should protrude 0.002-0.005 inch above cylinder block. If a copper faced head gasket is being installed, coat both sides of gasket with gasket sealing compound. Composition type head gasket should be installed dry. On models having rubber sealing ring between water pump and cylinder head, clean the recessed seats in cylinder and water pump and place new rubber sealing ring in water pump recess; on other models, install new by-pass hose on water pump. Lower cylinder head onto cylinder block, loosely install the cylinder head retaining nuts and cap screws and, on models so equipped, tighten by-pass hose clamps. Refer to Fig. 35 for 3-cylinder engines, or to Fig. 36 for four cylinder engines, and tighten the cylinder head retaining nuts and cap screws to a torque of 30 ft.-lbs. following appropriate tightening sequence. Re-tighten the nuts and cap screws to a torque of 60 ft.-lbs., then finally tighten to a torque of 90 ft.-lbs.

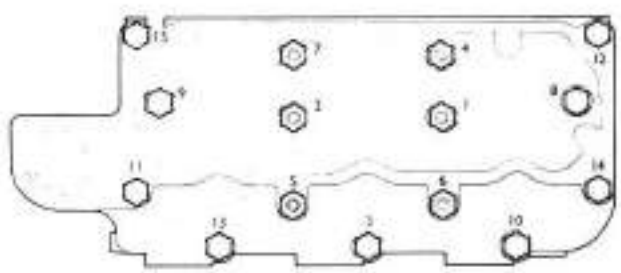


Fig. 35—Sequence for tightening cylinder head bolts on three-cylinder engines.

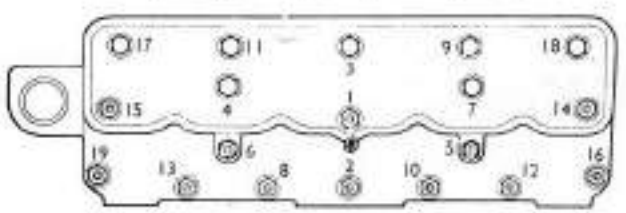


Fig. 36—Sequence for tightening cylinder head bolts on four-cylinder engines.

After installing push rods and rocker arms assembly, adjust valve clearance with engine cold as outlined in paragraph 66 for three-cylinder engines, or as in paragraph 67 for four cylinder engines. Complete reassembly of tractor by reversing disassembly procedure, start engine and operate for one-half hour. Stop engine and re-tighten cylinder head retaining nuts and cap screws in proper sequence to a torque of 90 ft.-lbs. Allow engine to cool, then readjust valve clearance as outlined in paragraph 66 or 67.

ROCKER ARMS AND SHAFT

All Models

65. To remove rocker arms and shaft assembly, remove hood, disconnect breather tube and remove rocker arm cover. Then, unbolt and remove rocker arms assembly by evenly loosening and removing the retaining cap screws.

To disassemble, remove the brass plug (P-Fig. 37) from each end of shaft and withdraw the rocker arms, springs and shaft brackets and place them in order as they are removed. Rear bracket has shaft retaining set screw (SS).

Rocker arm shaft diameter is 0.748-0.749 inch and bushing inside diameter is 0.750-0.7505 inch, resulting in a clearance of 0.001-0.0025 inch. Rocker arm and bushing are available as an assembly, or bushing may be renewed where shaft to bushing clearance is excessive. When installing new bushing, be sure that the oil hole in bushing is aligned with oil hole in rocker arm, then ream or hone bushing inside diameter for proper clearance. If valve stem contact face of rocker arm is excessively worn, it may be reground providing original curvature is maintained; remove no more material than necessary to renew contact face.

When reassembling, first install shaft in rear bracket with oiling holes down and secure shaft with set screw. Then, peen the bracket around screw to retain screw tightly and complete reassembly. Right-hand (R) and left (L) rocker arms are installed in pairs at each support bracket with offset ends towards each other as shown in Fig. 37.

VALVE GAP ADJUSTMENT

3-Cylinder Engines

66. Adjust valve gap (tappet clearance) with engine cold on all models and set valve gap to 0.010 inch for all valves.

To adjust valves, proceed as follows: Turn engine so that timing peg will fall into indention in flywheel through "TDC" hole in transmission or flywheel housing. If No. 1 cylinder is on compression stroke, adjust both the intake and exhaust valves on No. 1 cylinder, the exhaust valve on No. 2 cylinder and the intake valve on No. 3 cylinder. If No. 1 cylinder is on exhaust stroke (both valves partly open), adjust intake valve on No. 2 cylinder and exhaust valve on No. 3 cylinder. Then, turn engine one complete revolution so that timing peg will again fall into indentation in flywheel and adjust remaining valves. Refer also to Figs. 38 and 39 for adjustment procedure.

4-Cylinder Engines

67. Valve gap (tappet clearance) is adjusted on all models with engine cold. Set valve gap to 0.010 inch for all valves.

To adjust valves, proceed as follows: Turn engine so that timing peg will fall into indention in flywheel through "TDC" hole in flywheel housing. If No. 1 piston is on compression stroke, adjust both the intake and exhaust valves on No. 1 cylinder, exhaust valve on No. 2 cylinder and intake valve on No. 3 cylinder. If No. 1 piston is on exhaust stroke, adjust intake valve on No. 2 cylinder, exhaust valve on No. 3 cylinder and both the intake and exhaust valves on No. 4 cylinder. Then turn the engine one complete revolution so that timing peg will again fall into indention in flywheel and adjust remaining valves. Refer also to Figs. 40 and 41 which show adjustment procedure.

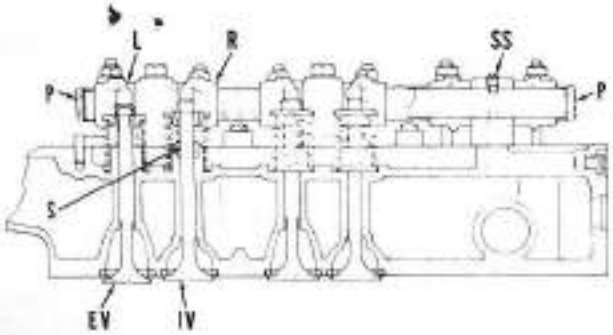


Fig. 37—Cut-away view showing rocker arm and valve installation in three-cylinder engine; four-cylinder engines are of basically similar construction.

EV. Exhaust valve
IV. Intake valve
L. Left-hand rocker arm
P. Plugs
R. Right-hand rocker arm
S. Valve stem seal
SS. Set screw

Fig. 38—With No. 1 piston on TDC compression stroke on three-cylinder engines, adjust intake and exhaust valve gap on No. 1 cylinder, exhaust valve gap on No. 2 cylinder and intake valve gap on No. 3 cylinder. Refer also to Fig. 39.

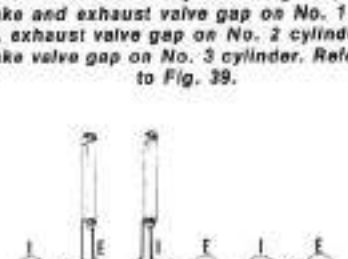


Fig. 39—With No. 1 piston on TDC exhaust stroke on three-cylinder engines, adjust intake valve on No. 2 cylinder and exhaust valve on No. 3 cylinder. Refer also to Fig. 38.

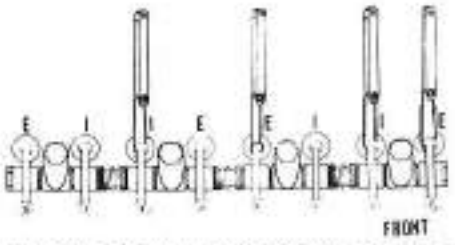


Fig. 40—On four-cylinder engines, adjust intake and exhaust valves of No. 1 cylinder, exhaust valve on No. 2 cylinder and intake valve on No. 3 cylinder when No. 1 piston is at TDC on compression stroke. Refer to Fig. 41.

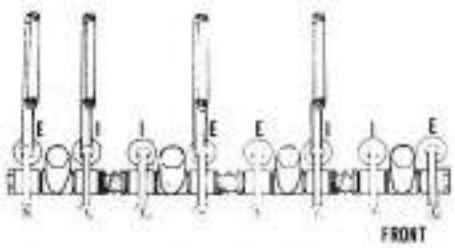


Fig. 41—With No. 1 piston of four-cylinder engine on TDC exhaust stroke, adjust intake valve on No. 2 cylinder, exhaust valve on No. 3 cylinder and the intake and exhaust valves on No. 4 cylinder. Refer also to Fig. 40.

VALVES, GUIDES AND SEATS

All Models

68. Intake and exhaust valve face and seat angle is 45 degrees. Intake and exhaust valves seat on renewable inserts in cylinder head. If seats are rough or pitted, they should be re-ground using a 45 degree stone. If grinding seats results in a seat width of over 0.065 inch, the insert should be renewed. To remove old valve seat, first crack it with a sharp chisel taking care not to damage the cylinder head and covering the insert with a cloth to catch any flying pieces. Remove insert and clean the counterbore, then chill new insert with dry ice and quickly install seat, chamfered edge first, into counterbore using a suitable driver. After seat is installed, grind off seat flush with cylinder bore, then grind new seat with 45 degree stone. Desired seat width is approximately 3/64-inch.

Stem diameter of both intake and exhaust valves is 0.3722-0.3732 inch and guide bore diameter is 0.374-0.375 inch, resulting in a stem to guide clearance (new) of 0.0008-0.0028 inch. Valve guides are integral with cylinder head. When guides are worn more than 0.006 inch, they should be reamed to 0.384-0.385 (0.010 oversize), or to 0.394-0.395 (0.020 oversize) and new valves with 0.010 or 0.020 oversize stems be installed.

NOTE: Exhaust valves used in engines of 1410 and 1412 model tractors are made of different material, and while they are dimensionally the same as other valves, they must not be interchanged. These valves can be identified by the hemispherical indentation in center of valve head.

INTAKE VALVE STEM SEALS

All Models

69. Special intake valve stem seals (S-Fig. 37) may be fitted into a counter bore at top of guide on some engines. Since the groove in top end of valve stem will damage the seal as valve is removed, it will be necessary to install new seals as follows:

Clean counterbore at top of intake valve guide making sure that there are no burrs around edge of hole. Lubricate outside of new stem seal, then drive it into counterbore using suitable piloted driver (David Brown tool No. 961236, if available). Lubricate valve stems, and making sure the correct valves are being installed, reassemble cylinder head using normal procedure.

VALVE SPRINGS

All Models

70. Valve springs are the same for all models, however intake and exhaust valve springs are not interchangeable. Refer to the following specifications.

Part No. 921435
(Intake Valve Spring):

Free length, inches	2.127
Lbs. force when compressed to 1.646 inches	38
Lbs. force when compressed to 1.148 inches	77
Identification spot color	yellow

Part No. 921436
(Exhaust Valve Spring)

Free length, inches	2.132
Lbs. force when compressed to 1.608 inches	45
Lbs. force when compressed to 1.180 inches	82
Identification spot color	blue

TIMING GEAR COVER

3-Cylinder Engines

71. To remove timing gear cover, remove engine hood, remove battery, drain cooling system and remove radiator. Loosen the alternator and power steering pump and disengage drive belts from crankshaft pulley. Remove alternator and/or alternator brackets on models where they will interfere with timing gear cover removal. Remove crankshaft pulley retaining nut and the pulley from crankshaft, then unbolt and remove timing gear cover.

Reinstall cover using new gasket and crankshaft oil seal, making sure lip of seal is towards inside of cover. Be sure correct cap screws are installed in lower bolt holes as installing long bolts at this location will force the engine front plate forward causing an oil leak and possible damage. Complete reassembly by reversing disassembly procedure.

NOTE: Install crankshaft pulley to center the cover and oil seal before tightening cover retaining bolts.

4-Cylinder Engines

72. To remove timing gear cover, remove engine hood, drain cooling system and remove radiator lower hose. Unbolt hydraulic pump drive flange from crankshaft pulley and using jack screws threaded into the tapped holes in flange, extract flange from pulley. Remove the rubber spacer disc located at rear end of pump driveshaft and slide driveshaft rearward until free of pump drive coupling. Some force will be required to pull the shaft splines past the "O" ring in coupling. Remove alternator and alternator mounting bracket. Remove crankshaft pulley retaining nut and remove pulley from crankshaft. The timing gear cover can then be unbolted and removed from engine.

Reinstall timing gear cover using new gasket. Note that the four cap screws located at lower side of crankshaft pulley are just the correct length to thread through the engine front plate. Using longer cap screws in this position will force lower side of engine front plate forward resulting in an oil leak and possible damage. Take care not to damage crankshaft oil seal while installing cover and crankshaft pulley. Tighten crankshaft pulley retaining nut securely. Place retaining "O" rings on hydraulic pump driveshaft and place flange on rear end of shaft. Insert front end of shaft into pump drive coupling, then push front "O" ring into retaining notch in coupling. Position rubber spacer between rear end of shaft and front end of crankshaft, then slide flange over the spacer and into pulley.

NOTE: Spacers are available in thicknesses of 7/16, 9/16 and 5/8-inch.

Install and securely tighten the flange cap screws, then push rear "O" ring into retaining groove of drive flange. Complete remainder of reassembly by reversing disassembly procedure.

TIMING GEARS

3-Cylinder Engines

73. The timing gears on all three cylinder engines consist only of the camshaft gear and crankshaft gear. To renew timing gears, first remove timing gear cover. Turn engine so that No. 1 piston is on TDC of compression stroke and timing pin will fall into flywheel detent through "TDC" hole in transmission cover. At this time, the marked tooth on camshaft gear should be centered between the two punch marked teeth on crankshaft gear. Fig. 42 shows timing marks for earlier model tractors. The current camshaft gears will have one tooth identified by a "D" stamped into the gear and a second tooth with a "G" stamped into gear face. On diesel engines, the tooth marked "D" should be located between the two punch marked teeth of crankshaft gear.

With timing gear cover removed, the crankshaft gear can be removed; the gear should be a snug, but not tight fit

on the crankshaft splines. To remove camshaft gear, remove the retaining cap screw and washer and pull gear from shaft, then remove Woodruff key from camshaft.

CAUTION: Do not turn camshaft or crankshaft with timing gears removed or damage may be caused from interference between pistons and valve heads.

To install new gears, slide crankshaft gear onto crankshaft making sure that the punch marks (SM) on shaft and gear are aligned as shown. Install key in camshaft, then install camshaft gear with tooth marked "D" between the two punch marked teeth on crankshaft gear. Install camshaft gear retaining washer and cap screw and tighten cap screw to a torque of 40 ft.-lbs.

4-Cylinder Engines

74. The timing gears consist of the crankshaft gear, camshaft gear, fuel injection pump drive gear and an idler gear. To renew the gears, first remove the timing gear cover, remove battery, then proceed as follows:

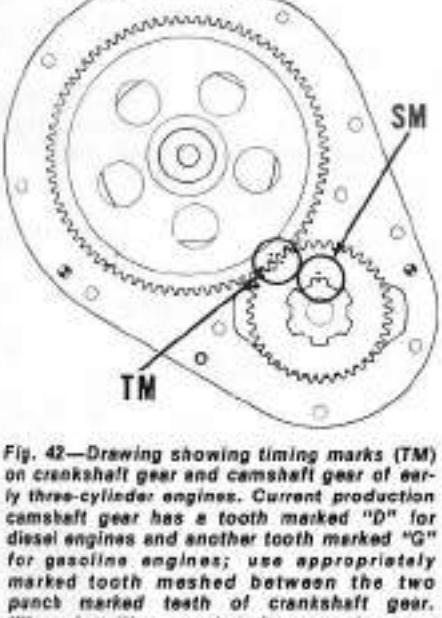


Fig. 42—Drawing showing timing marks (TM) on crankshaft gear and camshaft gear of early three-cylinder engines. Current production camshaft gear has a tooth marked "D" for diesel engines and another tooth marked "G" for gasoline engines; use appropriately marked tooth meshed between the two punch marked teeth of crankshaft gear. When installing crankshaft gear, be sure spline marks (SM) are aligned as shown.

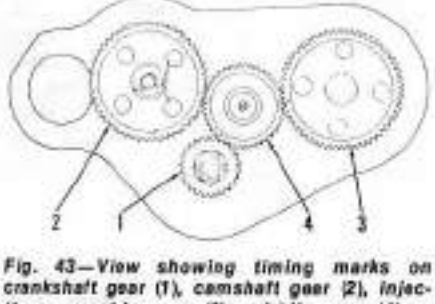


Fig. 43—View showing timing marks on crankshaft gear (1), camshaft gear (2), injection pump drive gear (3) and idler gear (4) on four-cylinder engines.

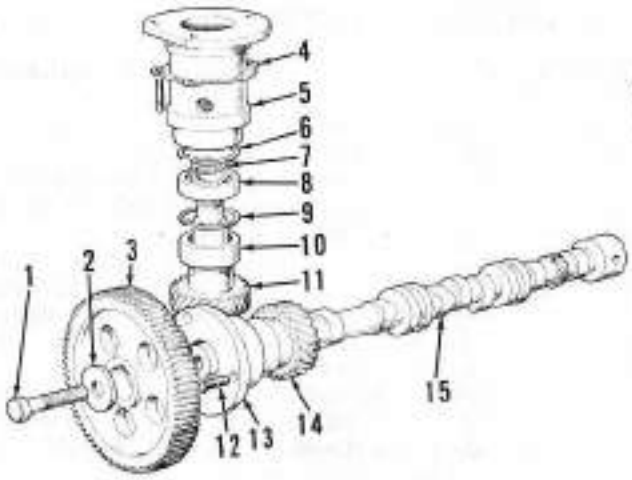


Fig. 44—Exploded view showing three-cylinder diesel camshaft and fuel injection pump drive assemblies.

1. Cap screw
2. Flat washer
3. Camshaft gear
4. Gasket
5. Drive gear housing
6. Snap ring
7. Snap ring
8. Ball bearing
9. Snap ring
10. Needle roller bearing
11. Pump drive gear
12. Cap screws
13. Front bearing & retainer
14. Driving gear
15. Camshaft

Turn the engine so that No. 1 piston is at TDC on compression stroke; at this time, timing punch marks on crankshaft gear, camshaft gear and fuel injection pump drive gear should be towards center of idler gear, although the timing marks on idler gear probably will not be aligned with those of other gears.

Cut locking wire on camshaft gear retaining cap screw and remove the cap screw taking care not to turn the shaft from set position. Using suitable puller, remove camshaft gear. Do not remove camshaft gear retaining plate cap screws. Remove Woodruff key from camshaft.

Unbolt idler gear shaft support bracket (11-Fig. 45) and remove the bracket taking care not to lose any shims, if present, between bracket and engine front plate. Remove gear from shaft, then withdraw shaft from bore in cylinder block. If necessary, remove slotted head plug from end of shaft, thread adapter bolt into shaft and remove shaft with slide hammer.

On 995 engines with C.A.V. injection pumps, straighten tab washer and remove the three cap screws and fuel injection pump drive gear from pump drive hub.

NOTE: Gear is timed to hub by a dowel pin.

On models with Simms injection pumps, straighten the tab washer, remove nut and pull fuel injection pump drive gear (8-Fig. 45) from injection pump camshaft. Take care not to lose Woodruff key from pump shaft.

The crankshaft gear is keyed and press fitted to the crankshaft and should not be removed unless renwal is indicated. Remove the gear using a suitable puller and extract Woodruff key from shaft.

Carefully inspect all gear teeth for excessive or unusual wear patterns, chipped teeth, etc. Specifications for timing gear backlash are not available. Clearance (new parts) between idler gear shaft and gear bore should be 0.001-0.003 inch; renew gear and/or shaft if bearing surface of shaft or gear is scored of if clearance between shaft and gear is excessive.

75. To reinstall timing gears, proceed as follows: Be sure camshaft has not been turned (keyway in shaft should be downward) and install Woodruff key, gear, retaining washer and cap screw. The punch marked tooth on camshaft gear should then point towards center of idler gear shaft bore in cylinder block.

NOTE: It is not necessary to time power steering pump drive gear with camshaft gear.

If crankshaft gear was removed, install Woodruff key in crankshaft (key way in shaft should be downward), then install new gear with punch

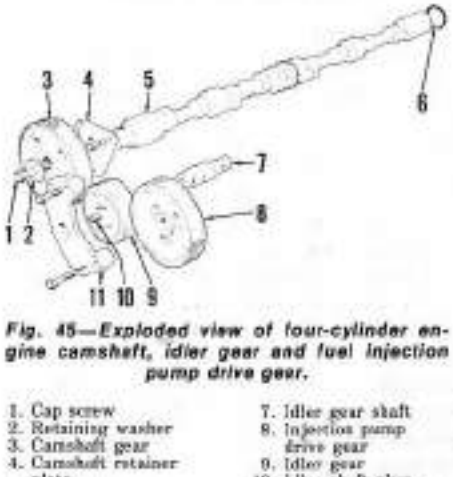


Fig. 45—Exploded view of four-cylinder engine camshaft, idler gear and fuel injection pump drive gear.

1. Cap screw
2. Retaining washer
3. Camshaft gear
4. Camshaft retainer plate
5. Camshaft
6. "O" ring
7. Idler gear shaft
8. Injection pump drive gear
9. Idler gear
10. Idler shaft plug
11. Idler shaft support bracket

marked teeth out and pointing towards center of idler gear shaft bore in cylinder block.

On models with Simms injection pumps, install fuel injection pump drive gear, tab washer and retaining nut, tighten nut to a torque of 45 ft.-lbs. and turn gear so that punch marked tooth is towards center of idler gear shaft bore.

On models with C.A.V. injection pumps, install pump drive gear on dowel pin in hub, then secure with locking plate and the three cap screws. Tighten cap screws to a torque of 20 ft.-lbs., and bend washer against cap screw heads.

If slotted head plugs have been removed from idler gear shaft, reinstall using Loctite. Install shaft into bore in cylinder block, then lubricate shaft and gear and install idler gear so that all timing marks are aligned as shown in Fig. 43. Install idler gear support bracket with any shims found when bracket was removed, then check end play of idler gear on shaft. If end play is not within the limits of 0.002-0.004 inch, remove the support bracket and add shims to increase end play, or remove shims to decrease end play as required.

Reinstall the timing gear cover.

VALVE TAPPETS (CAM FOLLOWERS)

All Models

76. The mushroom type tappets ride directly in unbushed bores in cylinder block and can be removed after removing engine camshaft. Tappet diameter (new) is 0.623-0.624 inch.

CAMSHAFT AND BEARINGS

3-Cylinder Engines

77. To remove camshaft without removing engine from tractor, proceed as follows: Remove hood, drain cooling system and remove radiator. Following general procedure outlined in paragraph 71, remove timing gear cover, then remove camshaft gear as in paragraph 73. Remove rocker arm cover, rocker arms and shaft assembly and push rods. Disconnect engine speed indicator drive cable at engine and remove drive unit (see Fig. 46). Disconnect fuel lines and remove fuel lift (transfer) pump assembly. Refer to paragraph 111 and remove the fuel injection pump, then remove pump drive assembly as in paragraph 112. Do not misplace thrust spring located in counterbore in top end of oil pump drive shaft. Remove tappet and push rod covers from side of cylinder block, lift up each tappet (cam follower) and retain in lifted position by placing a ½-inch I.D. "O" ring on each tappet. The camshaft can then be withdrawn from front end of cylinder block after unbolting and removing the camshaft front bearing support (locating housing).

The fuel injection pump and oil pump drive gear (14-Fig. 44) is renewable separately from camshaft. Using suitable sleeve, press gear towards rear of shaft to remove. When installing gear, be sure Woodruff key is in place in camshaft, then press gear onto shaft with keyway aligned until it fits tightly against shoulder on shaft.

Camshaft specifications are as follows:

Front journal dia.	2.3725-2.3735 inches
No. 2 journal dia.	1.8707-1.8720 inches
No. 3 journal dia.	1.8409-1.8422 inches
No. 4 journal dia.	1.7940-1.7954 inches
Rear journal dia.	1.7475-1.7488 inches
Camshaft end float	0.002-0.006 inch
Front bearing support thickness	0.311-0.313 inch

Install the camshaft and gear assembly in cylinder block, then install front bearing support and retainer (locating plate). Check to see that camshaft end float is within limits of 0.002-0.006 inch, then complete reassembly by reversing disassembly procedure. Retime fuel injection pump as outlined in paragraph 111.

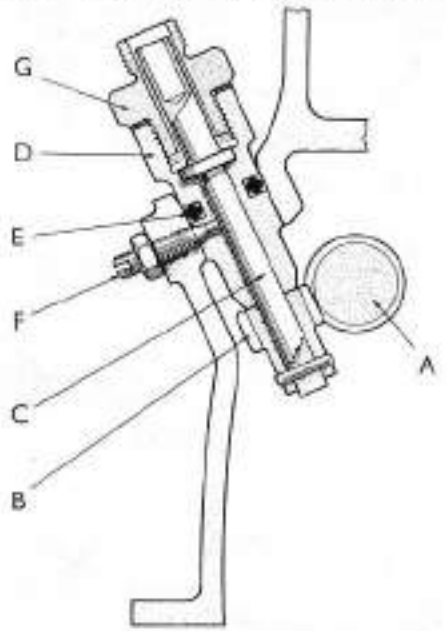


Fig. 46—Cross-sectional view of engine speed indicator drive assembly for three-cylinder engines. Set screw (F) must be removed and the assembly withdrawn from crankcase to permit camshaft removal.

A. Camshaft
B. Drives gear
C. Drive shaft
D. Housing
E. "O" ring
F. Set screw
G. Adapter

4-Cylinder Engines

78. To remove the camshaft without removing engine from the tractor, proceed as follows: Remove hood, drain cooling system and remove radiator. Remove rocker arm cover, rocker arms and push rods. Remove timing gear cover as outlined in paragraph 72, then remove camshaft gear as in paragraph 74. Drain oil sump and remove oil pan and oil pump. Disconnect fuel lines and remove fuel lift (transfer) pump. Remove tappet (push rod) covers from side of cylinder block and using ½-inch I.D. "O" rings or spring clips, retain the tappets (cam followers) in raised position. Then, unbolt camshaft retainer plate and withdraw camshaft from engine.

Camshaft specifications are as follows:

Front journal dia.	1.870-1.871 inches
No. 2 journal dia.	1.825-1.827 inches
No. 3 & No. 4 journal dia.	1.810-1.811 inches
No. 5 journal dia.	1.763-1.765 inches
Rear journal dia.	1.747-1.749 inches
Camshaft end float	0.010-0.020 inches
Retainer plate thickness	0.240-0.245 inches

Install the camshaft in cylinder block, then install retainer plate. Check to see that camshaft end float is between the limits of 0.010 and 0.020 inch, then complete reassembly by reversing disassembly procedure. Make sure to remove all of the spring clips or "O" rings used to retain the tappets in raised position.

NOTE: Remove the engine speed indicator drive cable from cylinder block to permit easy installation of oil pump, then reconnect hour meter drive cable.

CAMSHAFT REAR SEAL

All Models

79. The camshaft rear bore is sealed by an "O" ring inserted in counterbore which seals against flywheel housing on Model 885, or against engine rear plate on other models.

CONNECTING ROD AND PISTON ASSEMBLIES

All Models

80. Connecting rod and piston assemblies are removed from above after removing cylinder head, oil pan, pump assembly with tubes and suction screen and removing the connecting rod caps.

NOTE: Be sure that rod and cap are marked with cylinder number before removing the caps. Marks are on camshaft side.

When reinstalling connecting rod and piston assemblies, first be sure that piston and connecting rod are properly assembled; valve recesses in top of piston should be on same side as cylinder identification number on rod and cap. Install the assemblies with valve recesses in piston and rod and cap numbers towards camshaft side of engine. Tighten rod cap retaining nuts to a torque of 50 ft.-lbs.

NOTE: Be sure that cap is installed with machined notch for bearing tang to same side of assembly as notch in connecting rod.

PISTON PINS AND BUSHINGS

All Models

81. Piston pins are fully floating and are retained in pistons by snap rings; piston pins are 1.250 inch diameter on all models. To remove piston pin, first remove the snap rings, then heat piston in hot oil. The pin should then be easily pushed from piston. Pins are available in standard size only.

Connecting rods are fitted with renewable piston pin bushings. Using suitable mandrel, press old bushings from rods, then carefully align oil holes in new bushings with oil holes in connecting rods as bushings are pressed into place. After installing new bushings, hone or ream so that piston pin is a light push fit in bushing. Pin should be light drive fit in piston.

Heat pistons in hot oil to facilitate reassembly. Be sure that valve recesses in piston and cylinder identification numbers on rod and cap are to same side of assembly, then securely install piston pin retaining snap rings.

CONNECTING RODS AND BEARINGS

All Models

82. Connecting rod bearings are of the slip-in, precision type, renewable from below after removing oil pan, oil pump and connecting rod caps. When installing new bearing inserts, make sure that rod and bearing cap numbers are in register and face towards camshaft side of engine. Bearing inserts are available in undersizes of 0.010, 0.020 and 0.030 inch as well as standard size. Check crankshaft crankpins and the connecting rod bearings against the following values:

All Models

Crankpin dia. . . . . 2.3730-2.3735 inches
Bearing to crankpin
clearance . . . . . 0.002-0.004 inches

On all models, tighten the connecting rod cap nuts to a torque of 50 ft.-lbs.

PISTONS AND PISTON RINGS

All Models

83. Pistons for all diesel engines are of aluminum alloy and have a combustion chamber machined in their crown as well as recesses to clear the intake and exhaust valve heads. Three compression rings are fitted above the piston pin and an oil scraper ring is located below the piston pin. Piston pin is fully floating and is retained by a snap ring at each end of pin.

On all models, nominal ring side clearance in groove is 0.002-0.0035 inch for all rings; pistons should be renewed where ring side clearance is 0.010 or more when measured with a new ring. Nominal piston ring end gap is 0.011-0.016 inch. Maximum allowable ring end gap, measured in unworn part of cylinder bore, is 0.060 inch. Oil control ring sets are available and should control oil consumption in cylinder bores worn up to 0.010 inch larger than nominal cylinder bore size; refer to paragraph 84. Pistons and rings are available in oversizes of 0.020 and 0.040 inch.

Piston skirt to cylinder bore clearance is 0.0065-0.008 inch. Piston skirt diameter at right angles to piston pin hole is 3.9315-3.9323 inches.

CYLINDER BORES

All Models

84. Cylinder bores are not sleeved. Standard bore diameter is 3.9388-3.9396 inches. Where excessive cylinder wear has occurred, cylinders can be rebored to fit the 0.020 or 0.040 oversize pistons and rings available for service.

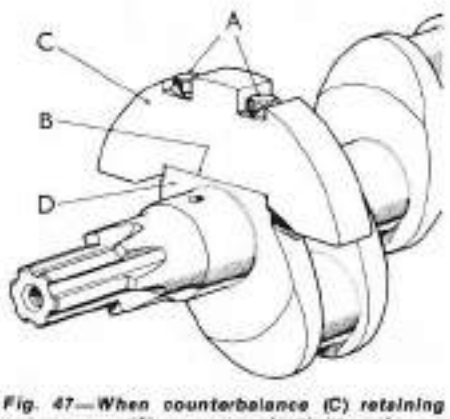


Fig. 47—When counterbalance (C) retaining cap screws (A) are properly tightened, gap (B) between counterbalance weight and crankshaft (D) should not permit entry of 0.002 feeler gage.

CRANKSHAFT AND MAIN BEARINGS

3-Cylinder Engines

85. With engine removed, proceed as follows:

Remove crankshaft pulley and timing gear cover. Turn engine so that No. 1 piston is on compression stroke, then continue turning engine until timing marks are aligned as shown in Fig. 42. Remove the camshaft gear, crankshaft gear and engine front plate. Remove engine clutch and flywheel, then remove the two socket head screws retaining lower rear crankshaft oil seal half to upper half. Unbolt and remove oil pump, suction screen and tube assembly. Check to see that the rod and main bearing caps are identified as to location, then unbolt and remove the rod and main bearing caps and lift out crankshaft.

Standard main journal diameter is 2.4990-2.4995 inches. Bearing inserts are available in undersizes of 0.010, 0.020 and 0.030 as well as in standard. Desired main bearing running clearance is 0.002-0.004 inch. Crankshaft end play is controlled by thrust washers at the No. 3 main journal. Standard width of the No. 3 main journal (distance between thrust faces) is 1.624-1.626 inches. New thrust washers are available in oversizes of 0.005 and 0.020 as well as standard. Crankshaft end play should be within limits of 0.002-0.010 inch. When regrinding crankshaft, it is important that the original fillet radius at all journals be maintained and that they be smoothly blended into crankshaft journals.

It will be necessary to remove the crankshaft balance weights (Fig. 47) only when regrinding crankshaft. When reinstalling balance weights, always use new retaining cap screws and tab washers. Tighten the cap screws to a torque of 40 ft.-lbs., then check to see that there is no gap between weight and crankshaft. If a 0.002 inch thick feeler gage can be inserted between weight and shaft, the weights are either incorrectly installed or foreign material is between weight and shaft.

When installing front bearing cap, it is necessary that a thin film of gasket sealer be applied to the face of the cap in the area in front of the sealing ring groove in cap. See Fig. 48. Tighten the main bearing cap retaining cap screws to a torque of 120 ft.-lbs., then bend corners of retainers against flats on cap

screw heads. Refer to paragraph 88 regarding crankshaft rear oil seal.

4-Cylinder Engines

86. To remove crankshaft, first remove engine from tractor, then proceed as follows:

Unbolt and remove crankshaft pulley and timing gear cover. Turn the engine so that No. 1 piston is at TDC and the timing marks on camshaft gear and crankshaft gear are towards center of idler gear. Taking care not to turn engine, unbolt and remove the clutch and flywheel. Remove the two socket head screws securing lower rear main oil seal retainer to upper half. Remove the timing gears, oil pump and lines and the engine front plate. Check to see that rod and main bearing caps have location identity numbers, then remove the caps. The crankshaft can then be removed.

Standard main journal diameter is 2.4990-2.4995 inches. New Bearing inserts are available in undersizes of 0.010, 0.020 and 0.030 as well as in standard. Desired main bearing running clearance is 0.002-0.004 inch. Crankshaft end play is controlled by thrust washers at center main journal. Standard width of center main journal (distance between thrust faces) is 2.124-2.126 inches. New thrust washers are available in oversizes of 0.005 and 0.020 as well as standard. Crankshaft end play should be 0.002-0.010 inch. When regrinding crankshaft it is important that the original fillet radius be maintained at all journals and that the radius be smoothly blended into journals.

When reassembling, tighten main bearing retaining cap screws to a torque of 140 ft.-lbs., then bend corners of tab washers against the flats of cap screw heads. Refer to paragraph 88 regarding the crankshaft rear oil seal.

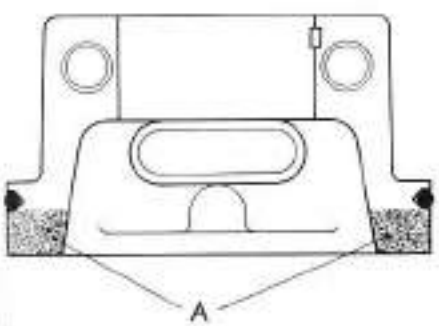


Fig. 48—When installing front main bearing cap on three-cylinder engine, coat area at front of seal ring (indicated by shaded area "A") with a light film of gasket sealer.

CRANKSHAFT OIL SEALS

All Models

87. **FRONT OIL SEAL.** The lip type crankshaft front oil seal is carried in the timing gear cover and it is possible to renew the seal after removing crankshaft pulley. Be sure that seal lip is towards inside of timing gear cover. On three cylinder models, a sealing "O" ring is also used between crankshaft pulley retainer washer and pulley. Seal lip rides on crankshaft pulley hub.

88. **REAR OIL SEAL.** When installing new rear oil seal, first remove old packings and clean grooves of retainer. Coat one of the seals with adhesive to prevent it turning during service and press seals into grooves of retainer. Complete installation of seals by rolling them completely into position with a smooth bar or dowel and trimming ends until they are flush with retainer faces. Press corners of seals into a chamfer so they will not interfere with mating of retainer halves, use a non-hardening sealant (gasket cement) and stick gasket halves to retainer, then trim ends of gasket as shown in Fig. 49.

NOTE: Late gaskets are one-piece.

Lightly coat mating faces of retainer and seal ends with sealant, install seal assembly on crankshaft and using copper washers, install socket head cap screws with heads towards top. Do not tighten socket head screws completely at this time. Install retainer cap screws, then tighten screws as follows: Tighten socket head screws securely, then back-off ⅓-turn. Tighten retaining cap screws securely, then retighten socket head screws. Back-off retaining cap screws ⅓-turn, then retighten evenly and securely.

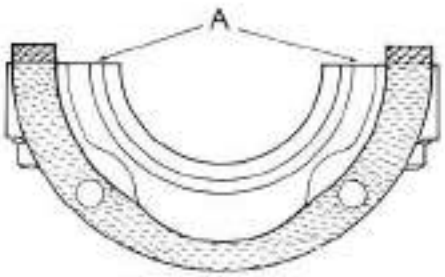


Fig. 49—Cement gasket to halves of rear main bearing seal retainer, as shown, then using sharp blade, trim gasket flush with surface (A). Early type is shown.

ENGINE OIL FILTER

All Models

89. A full flow, replaceable element type filter is used on all models. Recommended filter renewal is after each 250 hours of operation, to coincide with every other oil change interval of 125 hours.

A separate by-pass valve assembly (refer to exploded view of oil filter assembly in Fig. 50) opens when the pressure difference between filter inlet and outlet exceeds 10 psi. Therefore, when the filter element becomes clogged, the engine is supplied with unfiltered oil.

When installing new filter element, be sure that the by-pass valve, filter element and related parts are installed as shown in Fig. 50.

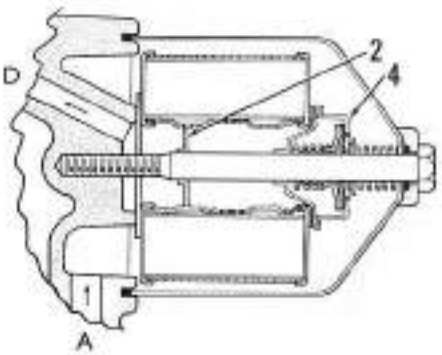
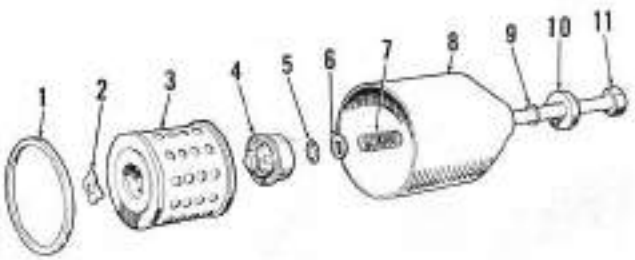


Fig. 51—Cross-sectional view of oil filter. When pressure difference between inlet (A) and outlet (D) exceeds 10 psi, by-pass valve (4) opens to allow unfiltered oil to flow past filter. Locating plate (2) should be tight fit on cap screw.

Fig. 50—Exploded view of oil filter. Proper installation is quite important because the by-pass valve (4) cannot operate properly if unit is not assembled as shown. On any complaint of incorrect oil pressure, the unit should be checked for proper assembly and a new filter element of correct type installed. Refer also to cross-sectional view in Fig. 51



1. Sealing ring
2. Locating plate
3. Filter element
4. By-pass valve
5. Sealing washer
6. Flat washer
7. Spring
8. Filter cover
9. Sealing ring
10. Collar
11. Cap screw

OIL PUMP AND RELIEF VALVE

All Models

90. **R&R PUMP ASSEMBLY.** To remove oil pump, first drain crankcase and remove the oil pan. Unscrew oil pressure tube nuts and remove the cap nut or loosen locknut on pump retaining screw (2-Fig. 52 or 53). The pump can then be removed from below after removing the retaining screw from outside of cylinder block. On three-cylinder engines, be careful not to lose thrust spring from counterbore in top end of oil pump drive shaft.

When reinstalling pump on four-cylinder engines, disconnect hourmeter cable at engine to facilitate installation of pump, then reconnect drive cable after pump is installed. On three-cylinder engines, stick thrust spring in top end of pump shaft with heavy grease prior to reinstalling pump.

90A. **RELIEF VALVE.** On three-cylinder engines, the relief valve adjusting screw (10-Fig. 52), spring (8) and plunger (7) can be removed after removing oil pan and loosening locknut (9).

On four-cylinder engines, remove the oil pan and the oil suction screen (16-Fig. 53) and the wire that holds adjusting screw in place, then remove the adjusting screw (15), spring (14) and valve plunger (13).

NOTE: Plunger (13) now has a flat seat instead of the conical seat shown.

NOTE: When removing relief valve adjusting screw, carefully count number of turns required to remove the screw so that screw can be reinstalled to same approximate adjustment.

Renew valve plunger if scored or worn. Renew pressure relief spring if free length is not approximately equal to that of new spring.

Reinstall adjusting screw to same position as when removed. If necessary to readjust relief valve, one turn of the adjusting screw will change relief pressure approximately 6 psi. Secure three-cylinder adjusting screw with locknut and securely wire adjusting screw through hole in pump cover on four-cylinder units.

91. **OVERHAUL PUMP.** Disassembly of pump is obvious after examination of unit and with reference to Fig. 52 for three-cylinder engines or to Fig. 53 for four-cylinder engines. Refer to the following specifications:

Relief pressure with engine hot is 40 psi for three-cylinder engines or 45 psi for four-cylinder engines.

Gear backlash	0.020-0.026 inches
Gear width	1.1855-1.1865 inches
Housing depth	1.1875-1.1890 inches
Gear end float	0.001-0.0035 inches
Shaft diameter	0.4895-0.490 inches
Bushing inside diameter	0.4905-0.4925 inches
Shaft to bushing clearance	0.0005-0.003 inches

Bushing is pre-sized and should not require reaming if carefully installed. Be sure to align oil hole in bushing with oil hole in pump housing. Note that the drive gear (4-Fig. 53) and the pump driven gear (14-Fig. 52 or 9-Fig. 53) are retained to shaft by press fit only.

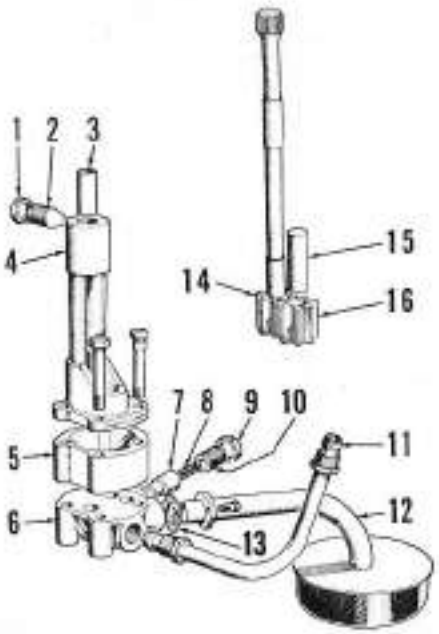


Fig. 52—Exploded view of oil pump for three-cylinder diesel engine. Drive shaft has ¼-inch hole in top end to carry fuel injection pump drive shaft thrust spring.

1. Locknut
2. Set screw
3. Bushing
4. Bracket
5. Gear body
6. Cover assembly
7. Relief valve plunger
8. Relief valve spring
9. Locknut
10. Adjusting screw
11. Pressure tube
12. Suction pipe & screen
13. Gasket
14. Driven gear
15. Idler shaft
16. Idler gear

OIL COOLER

Models 1410, 1412

91A. Model 1410 and 1412 tractors are equipped with engine and transmission oil coolers which are mounted in front of radiator. Mounting position of engine oil cooler depends on whether tractor is equipped with a single or tandem hydraulic pump as shown in Figs. 53A and 53B.

Connector housing (4) is secured to engine cylinder block by special screw (7) and can be removed, if necessary, by removing engine oil filter, disconnecting oil lines (5 and 6) and removing special screw.

Any further disassembly required will be obvious upon examination.

OIL PAN (SUMP)

All Models

92. Oil pan is bolted to bottom of tractor main frame and can be unbolted and removed after draining crankcase.

When reinstalling, tighten the retaining cap screws to a torque of 20 ft.-lbs.

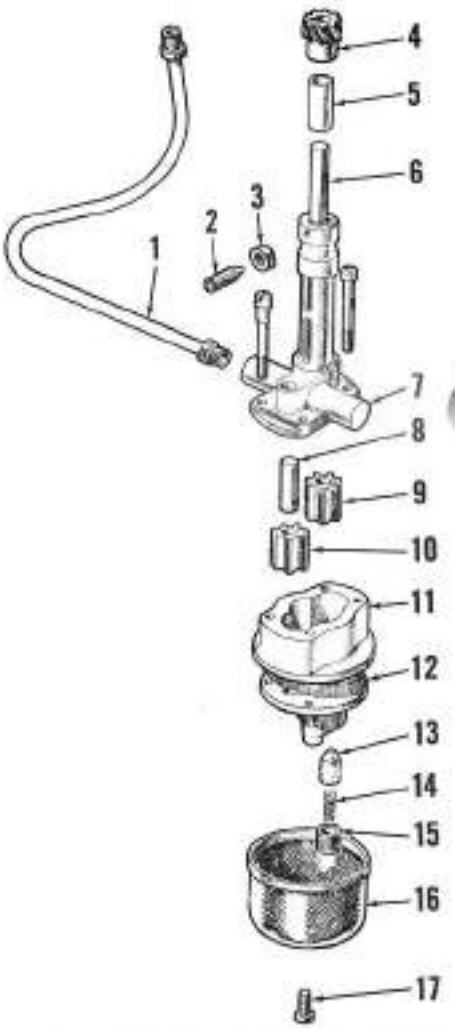


Fig. 53—Exploded view of oil pump used on four-cylinder engines. Adjusting screw is secured by wire through hole in cover (12) and slot in adjusting screw. Plunger (13) now has a flat seat instead of conical seat shown.

1. Pressure tube
2. Set screw
3. Locknut
4. Driving gear
5. Bushing
6. Drive shaft
7. Bracket
8. Idler shaft
9. Driven gear
10. Idler gear
11. Gear body
12. Cover
13. Relief valve plunger
14. Relief valve spring
15. Adjusting screw
16. Suction screen
17. Screen retaining cap screw

FLYWHEEL

All Models

93. The flywheel can be unbolted and removed after removing the clutch assembly.

Starter ring gear is installed from front face of flywheel; therefore, the flywheel must be removed to renew ring gear. Heat gear with a torch from front side and knock gear off flywheel. Heat new gear evenly until gear expands enough to slip onto flywheel. Tap gear all the way around to be sure it is properly seated and allow to cool.

Flywheel is properly positioned on crankshaft by a dowel pin. Tighten flywheel retaining nuts to a torque of 50 ft.-lbs., then bend tabs of retainers against flats of nuts.

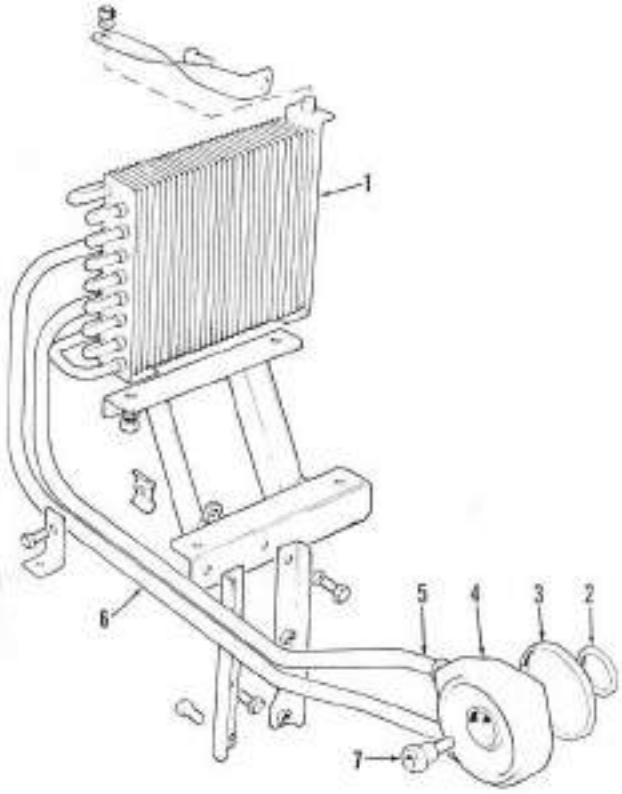


Fig. 53A—View showing engine oil cooler and mounting bracket arrangement used on 1410 and 1412 tractors with single hydraulic pump.

1. Cooler
2. Sealing ring
3. Sealing ring
4. Connector housing
5. Outlet line
6. Return line
7. Special bolt

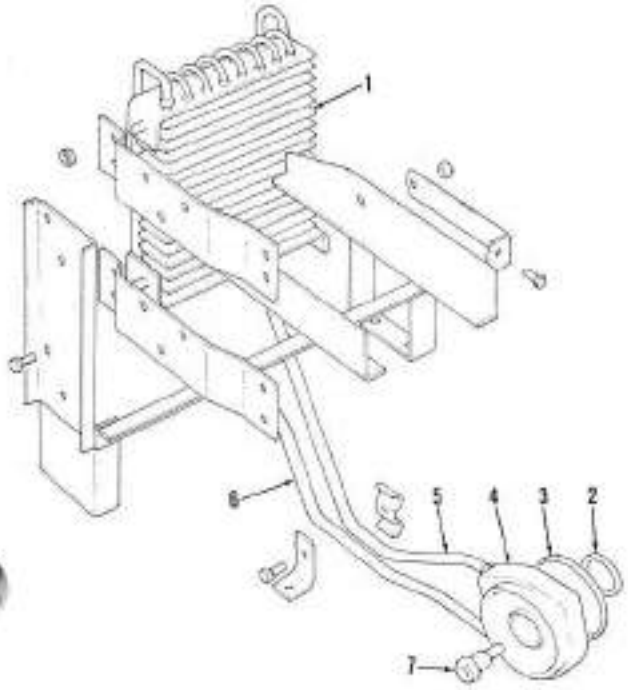


Fig. 53B—View showing engine oil cooler and mounting bracket arrangement used on 1410 and 1412 tractors with tandem hydraulic pump.

1. Cooler
2. Sealing ring
3. Sealing ring
4. Connector housing
5. Outlet line
6. Return line
7. Special bolt

TURBOCHARGER

Models 1410-1412

93A. **REMOVE AND REINSTALL.** Remove hood and clean turbocharger and the surrounding area, then loosen clamps and remove hoses between air cleaner and turbocharger and turbocharger and intake manifold. Disconnect oil supply line, then loosen clamps of hose on oil return line and slide hose onto lower half of line. Disconnect and remove upper half of line. Unbolt exhaust elbow from manifold and remove exhaust elbow and the coupling located beween elbow and turbocharger, then unbolt and remove turbocharger.

NOTE: It may be necessary to remove return oil line fitting to provide adequate clearance for removal of left front mounting nut.

Reinstall turbocharger by reversing removal procedure, however before attaching oil supply line fill oil chamber with oil to provide initial lubrication.

93B. **OVERHAUL.** Remove turbocharger as outlined in paragraph 93A. Before disassembling, place a row of light punch marks across compressor cover, bearing housing and turbine housing to aid in reassembly. Clamp turbocharger mounting flange (exhaust inlet) in a vise and remove cap screws (14-Fig. 53C), lockwashers and clamp plates (13). Remove compressor cover (3). Remove nut from clamp ring (16), expand clamp ring and remove bearing housing assembly (15) from turbine housing (18).

CAUTION: Never allow the weight of the bearing housing assembly to rest on either the turbine or compressor wheel vanes. Lay the bearing housing assembly on a bench so that turbine shaft is horizontal.

Remove locknut (2) and slip compressor wheel (1) from end of shaft. Withdraw turbine wheel and shaft (17) from bearing housing. Place bearing housing on bench with compressor side up. Remove snap ring (7), then using two screwdrivers, lift flinger plate insert (6) from bearing housing. Push spacer sleeve (4) from the insert. Remove oil deflector (11), thrust ring (10), thrust plate (9), end bearing washer (not shown) and bearing (12). Remove "O" ring (8) from flinger plate insert (6) and remove seal rings (5) from spacer sleeve and turbine shaft.

Soak all parts in metal cleaner and use a soft brush, plastic blade or compressed air to remove carbon deposits.

CAUTION: Do not use wire brush, steel scraper or caustic solution for cleaning, as this will damage turbocharger parts.

Inspect turbine wheel and compressor wheel for broken or distorted vanes. **DO NOT** attempt to straighten bent vanes. Check piston ring grooves of turbine wheel shaft for signs of side scoring or scratches. Groove width is 0.066-0.068 inch with a maximum allowable width of 0.070 inch. Outside diameter of turbine wheel shaft at bearing area is 0.4800-0.4803 inch with a minimum allowable diameter of 0.4799 inch. Inspect bearing for scratches, scoring or wear and if any is excessive, bearing renewal is required. Outside diameter of bearing is 0.8714-0.8719 inch and inside diameter is 0.4815-0.4818 inch. Bearing is tin coated which will allow easy observance of wear patterns. Check ring groove of spacer sleeve in the same manner as those in turbine shaft. Check thrust plate for scoring or wear in thrust washer area, then inspect thrust washer for wear or scoring. Thrust washer has a minimum allowable thickness of 0.104 inch. Check the thin flat steel bearing end washer for wear or scoring and the bearing housing for scoring or metal transfer from bearing as well as for scoring or wear in the seal ring area. Bearing housing bore for seal rings should be 0.875-0.877 inch.

Renew all damaged parts and use new "O" ring (8) and seal rings (5) when reassembling. The seal ring used on turbine shaft is larger in diameter than the seal ring used on spacer sleeve. Refer to Fig. 53C as a guide when reassembling.

Install seal rings on turbine shaft, lubricate seal rings and install turbine wheel and shaft in bearing housing. Lubricate I.D. and O.D. of bearing (12), install bearing over end of turbine shaft and into bearing housing. Install the thin flat steel washer on compressor end of bearing. Lubricate both sides of thrust plate (9) and install plate (bronze side out) on the aligning dowels. Install thrust ring (10) and oil deflector (11), making certain holes in deflector are positioned over dowel pins. Install new seal ring on spacer sleeve (4), lubricate seal ring and press spacer sleeve into flinger plate insert (6). Position new "O" ring (8) on insert, lubricate "O" ring and install insert and spacer sleeve assembly in bearing housing, then secure with snap ring (7). Snap ring is installed with beveled face up. Place compressor wheel on turbine shaft, coat threads and back side of nut (2) with graphite grease or equivalent, then install and tighten nut to a torque of 13 ft.-lbs. At this time, check the rotating assembly to be sure it rotates without rubbing or binding. If any binding or rubbing is noted, disassemble and recheck the rotating unit. Pay particular attention to thrust washer (10-Fig. 53C). Assemble bearing housing to turbine housing and align punch marks. Install clamp ring, install nut and torque to 10 ft.-lbs. (120 in.-lbs.). Install compressor cover, align punch marks and secure cover with cap screws, washers and clamp plates. Tighten cap screws evenly to a torque of 5 ft.-lbs. (60 in.-lbs.). Fill the oil inlet with engine oil and turn turbine shaft by hand to lubricate bearing and thrust plate.

Check rotating unit for free rotation within the housings. Cover all openings until the turbocharger is reinstalled.

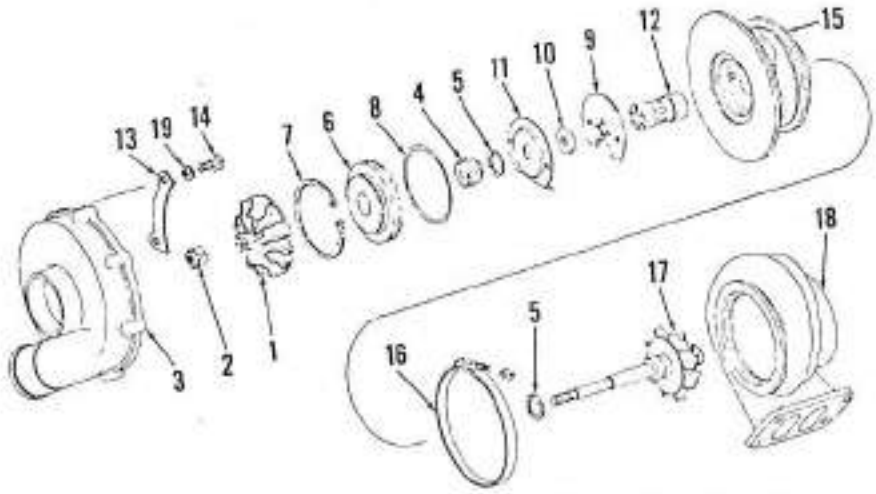


Fig. 53C—Exploded view of turbocharger used on 1410 and 1412 model tractors. Not shown is a thin flat steel washer located between bearing (12) and thrust plate (9).

1. Compressor wheel
2. Locknut
3. Compressor cover
4. Spacer sleeve
5. Seal rings
6. Flinger plate insert
7. Snap ring
8. "O" ring
9. Thrust plate
10. Thrust ring
11. Oil deflector
12. Bearing
13. Clamp plate
14. Cap screw
15. Bearing housing
16. Clamp ring
17. Turbine wheel and shaft
18. Turbine housing
19. Lockwasher

DIESEL FUEL SYSTEM

The diesel fuel system consists of three basic components: the fuel filters, injection pump and injection nozzles. When servicing any unit associated with the fuel system, the maintenance of absolute cleanliness is of utmost importance. Of equal importance is the avoidance of nicks or burrs on any of the working parts.

Probably the most important precaution that service personnel can impart to owners of diesel powered tractors is to urge them to use an approved fuel that is absolutely clean and free from foreign material. Extra precaution should be taken to make certain that no water enters the fuel storage tanks.

TROUBLESHOOTING

All Models

94. If the engine will not start, or does not run properly after starting, refer to the following paragraphs for possible causes of trouble.

95. **FUEL NOT REACHING INJECTION PUMP.** If no fuel will run from line when disconnected from pump, check the following:

Be sure fuel supply valve is open.
Check the filters for being clogged (Including filter screen in fuel lift pump).
Bleed the fuel filters.
Check lines and connectors for damage.

96. **FUEL REACHING NOZZLES BUT ENGINE WILL NOT START.** If, when lines are disconnected at fuel nozzles and engine is cranked, fuel will flow from connections, but engine will not start, check the following:

Check cranking speed.
Check throttle control and engine stop control adjustments.
Check pump timing.
Check fuel lines and connections for pressure leakage.
Check engine compression.

97. **ENGINE HARD TO START.** If the engine is hard to start, check the following:

Check cranking speed.
Bleed the fuel filters.
Check for clogged fuel filters.

Check for water in fuel or improper fuel.
Check for air leaks on suction side of transfer pump. (Models with C.A.V. pump).
Check engine compression.

98. **ENGINE STARTS, THEN STOPS.** If the engine will start, but then stops, check the following:
Check for clogged or restricted fuel lines or fuel filters.
Check for water in fuel.
Check for restrictions in air intake.
Check engine for overheating.
Check for air leaks in lines on suction side of transfer pump (models with C.A.V. pump).

99. **ENGINE SURGES, MISFIRES OR POOR GOVERNOR REGULATION.** Make the following checks:
Bleed the fuel system.
Check for clogged filters or lines or restricted fuel lines.
Check for water in fuel.
Check pump timing.
Check injector lines and connections for leakage.
Check for faulty or sticking injector nozzles.
Check for faulty or sticking engine valves.

100. **LOSS OF POWER.** If engine does not develop full power or speed, check the following:
Check throttle control rod adjustment.
Check maximum no-load speed adjustment.
Check for clogged or restricted fuel lines or clogged fuel filters.
Check for air leaks in suction line of transfer pump.
Check pump timing.
Check engine compression.
Check for improper engine valve gap adjustment or faulty valves.
Check maximum no-load speed adjustment.

101. **EXCESSIVE BLACK SMOKE AT EXHAUST.** If the engine emits excessive black smoke from exhaust, check the following:
Check for restricted air intake such as clogged air cleaner.
Check pump timing.
Check for faulty injectors.
Check engine compression.
Check to see that manual retard screw is open on models with C.A.V. pump.
Check to see that excess fuel delivery device is disengaged on models so equipped.

FUEL FILTERS

All Models

102. **MAINTENANCE.** The fuel filter base is fitted with two renewable type elements. Primary and final filter elements are identical; primary filtration is through front element on three-cylinder engines and rear element on four-cylinder engines. The primary element should be renewed at regular intervals, but the final filter element should require renewal only occasionally. Filter service life will be determined by condition of the fuel. Fuel that is clean and free of water should allow approximately 500 hours of use on primary element and about two years on final filter element. With contaminated fuel, service life of the filter elements will be considerably reduced.

To renew filter element(s), clean outside of filter assembly, then remove cap screw from upper side of base that is threaded into filter element cover. Remove cover and element, discard element, rubber sealing rings and cap screw sealing washer and thoroughly flush base and cover with clean diesel fuel. Install new element using new rubber sealing rings and cap screw sealing washer; make sure the rubber sealing rings are properly positioned in base and cover before tightening cap screw. Clean the fuel lift pump sediment bowl and filter screen, then bleed the fuel system as outlined in following paragraphs 103, 104 or 105.

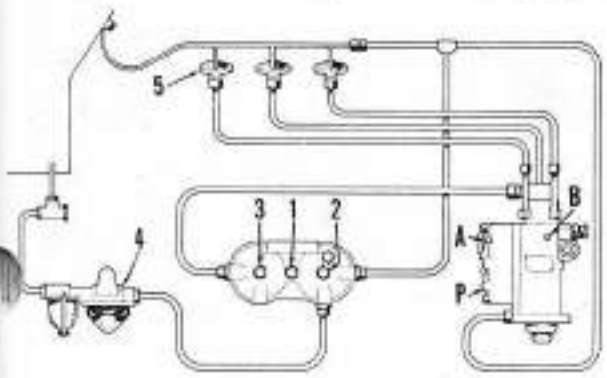


Fig. 54—Drawing showing lay-out of diesel fuel system for 3-cylinder engine. Fuel pump (4) provides fuel under pressure to primary fuel filter (2).
1. Bleed plug
2. Primary filter
3. Secondary filter
4. Fuel pump
5. Injectors

BLEEDING FUEL SYSTEM

Model 885

103. Make sure fuel tank contains at least two gallons of fuel, open fuel supply valve, refer to Figs. 54 and 55 and proceed as follows:

Turn engine, if necessary, so that primer lever of fuel pump (4-Fig. 54) will operate fuel lift pump. Open filter bleed screw (1). Actuate primer lever until fuel flows freely without trace of air bubbles from bleed screw opening. While maintaining flow of fuel with primer lever, tighten bleed screw (1). Refer to Fig. 55, open bleed screw (B) and actuate primer until air free fuel flows from bleed opening. Tighten the bleed screw (B) while maintaining flow of fuel with primer lever, then repeat this operation with bleed screw (A) and pump cover. Tighten bleed screw (A) and loosen the fuel line to injector nuts. Be sure stop control is in run position and open throttle. Crank engine until fuel is ejected at all fuel injector connections and then tighten the connections. Engine is now ready to start using normal starting procedure.

Model 995

104. To bleed fuel system, there must be a minimum of two gallons of fuel in tank. Open the fuel supply valve, refer to Figs. 56 and 57, then proceed as follows:

Turn engine, if necessary, so that primer lever (20-Fig. 56) will operate fuel lift pump. Loosen bleed screw (15) in filter. Actuate primer until fuel flows freely with no air bubbles from the

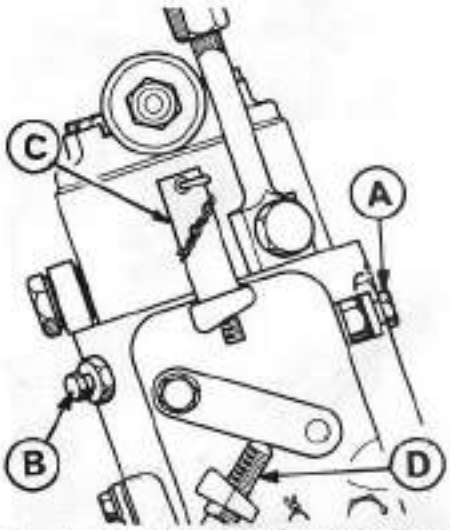
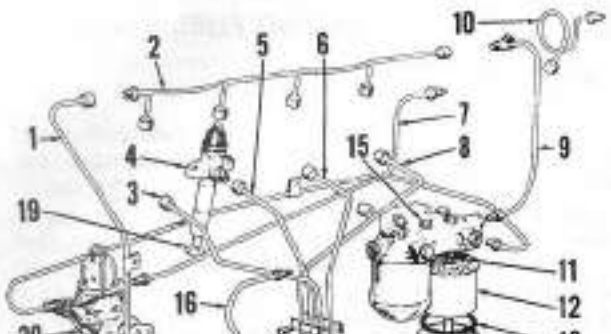


Fig. 55—Plug (B) located on pump bleeds the high pressure side of pump while plug (A) located in governor housing bleeds governor and drive cavity. Refer to text for bleeding procedure. High idle speed screw is located at (C); low idle speed screw is (D).



1. Pump return line
2. Injector leak-off line
3. No. 1 injector line
4. Fuel injector assembly
5. No. 2 injector line
6. No. 3 injector line
7. Tank to lift pump line
8. No. 4 injector line
9. Filter return line
10. Return line to tank
11. "O" ring
12. Primary filter element
13. Sealing ring
14. Filter cover bowl
15. Filter bleed plug
16. Filter to pump line
17. Lift pump push rod
18. Gasket
19. Copper sealing washer
20. Lift pump & primer lever
21. Fuel injection pump
22. Gasket

Fig. 56—Drawing showing lay-out of a typical 4-cylinder CAV fuel injection system. Fuel lift pump (20) is located on right side of engine; the fuel filter and fuel injection pump are located on left side of engine. Return line (10) returns flow of fuel from pump return line (1), injector leak-off line (2) and filter return line (9) to fuel tank. An assistant to operate primer lever (20) while bleeding the fuel system will be helpful.

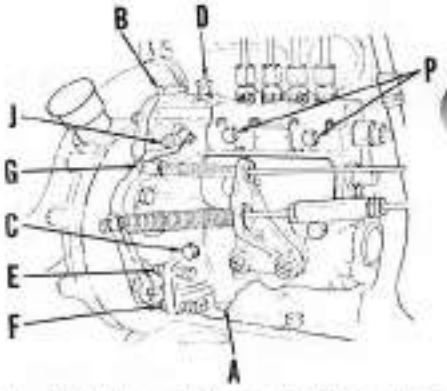


Fig. 59—View of Simms injection pump showing service points.

A. Drain plug
B. Filler plug
C. Level plug
D. Max. fuel delivery stop screw
E. High idle stop screw
F. Low idle stop screw
G. Engine stop lever
J. Excess fuel delivery button
P. Bleed plugs

bleeder opening. Tighten the bleed screw while maintaining flow of fuel with lift pump. Refer to Fig. 57 and repeat bleeding operation, first with bleed screw (B) on pump body, then with bleed screw (A) on pump governor housing. Loosen fuel injector line connections at fuel injectors, be sure stop control is in run position and that throttle is wide open. Crank engine until fuel ejects from all fuel injector line connections, then tighten the connections. Engine is now ready to start.

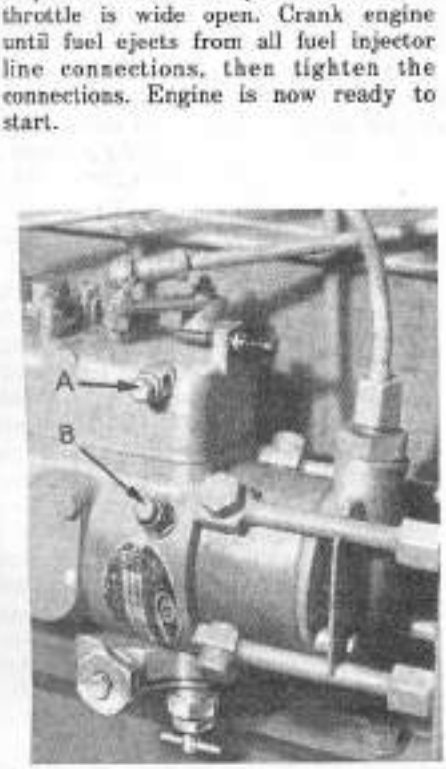


Fig. 57—Model 995 fuel injection pump bleed screws. Governor and drive component cavity is bled by plug (A); bleed plug (B) is for high pressure side of pump.

Models 1210, 1212, 1410 and 1412

105. Check to see that fuel tank contains at least two gallons of fuel, open the fuel supply valve and refer to Figs. 58 and 59. Turn engine, if necessary, so that primer lever (4-Fig. 58) will operate fuel lift pump. Loosen bleed screw (1) on filter base. Operate primer lever until fuel flows freely with no trace of air bubbles from the bleed screw opening. Tighten the bleed screw while maintaining flow of fuel with primer lever. Open the bleed screws (P-Fig. 59), then operate primer lever until air free fuel flows from both bleeder openings and tighten bleeder screws while maintaining flow of fuel. Loosen the fuel injector line connections at injectors, be sure stop control is in run position and move throttle to wide open position. Crank engine until fuel is ejected from all injector line connections, then tighten the connections. Start engine using normal procedure.

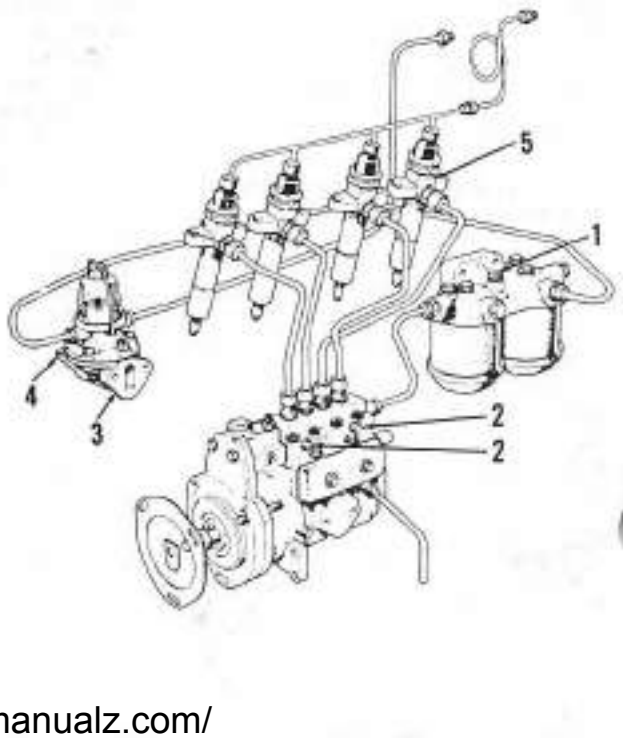


Fig. 58—Drawing showing lay-out of diesel fuel system for 4-cylinder engines equipped with Simms fuel injection pump.

1. Bleed plug
2. Bleed plugs
3. Fuel pump
4. Primer lever
5. Injectors

COLD WEATHER STARTING AIDS

All Models

106. **ETHER STARTING PLUG.** For use in temperatures below 0 degree F., remove the plastic plug from intake manifold (see Fig. 60), dip the felt attached to plug in ether, reinstall plug and immediately crank engine.

CAUTION: Do not add ether in excess of that which is absorbed by the felt; serious damage can be caused by excessive use of ether.

Models With C.A.V. Fuel Injection Pump

107. **MANUAL RETARD DEVICE.** Refer to Fig. 61; turning the manual retard screw in will keep the injection timing from advancing as the engine is being cranked. As soon as the engine is running, back the screw out to fully open position; otherwise, erratic running, excessive smoke and lack of power will occur.

NOTE: Do not turn the manual retard screw in immediately after an unsuccessful attempt to start engine; wait for about 20 seconds to allow pressure inside the pump to fall and the advance piston to return to retard position.

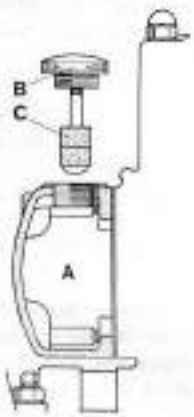


Fig. 60—Cross-sectional view of ether starting aid plug in diesel intake manifold. Plastic plug (B) has felt (C) which is suspended in intake manifold cavity (A); refer to paragraph 106.

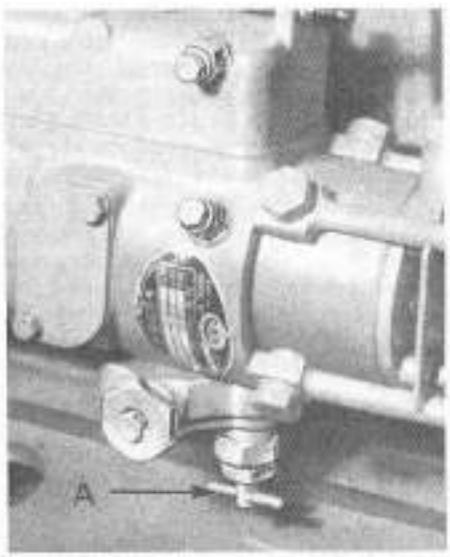


Fig. 61—Turning screw (A) in will close off pressure passage to advance piston, thus keeping pump timing retarded as starting aid. Screw must be in fully open position when engine is running.

Models With Simms Fuel Injection Pump

108. **EXCESS FUEL DELIVERY DEVICE.** Refer to Fig. 59. Move throttle to wide open position and depress excess fuel delivery button (J) which will allow pump rack to by-pass the normal fuel stop position, allowing pump to deliver excess amount of fuel when cranking engine. As soon as engine starts, the spring loaded button will disengage and return to normal position.

FUEL LIFT PUMP

All Models

109. The automotive type fuel pump is actuated by an eccentric on the engine camshaft via a short push rod carried in a bore in cylinder block. When removing the fuel pump, take care not to lose the push rod as pump is being removed. Overhaul of the pump is conventional. When installing new diaphragm, hold priming lever to compress spring as the cover screws are tightened.

FUEL INJECTION PUMP

3-Cylinder Engines

110. **PUMP TIMING.** Provided the injection pump drive gear to camshaft timing (see paragraph 112) has not been disturbed, the C.A.V. fuel injection pump is properly timed when timing mark on pump housing is aligned with timing mark on drive housing flange as shown in Fig. 62. If the pump drive gear has been removed, refer to paragraph 112.

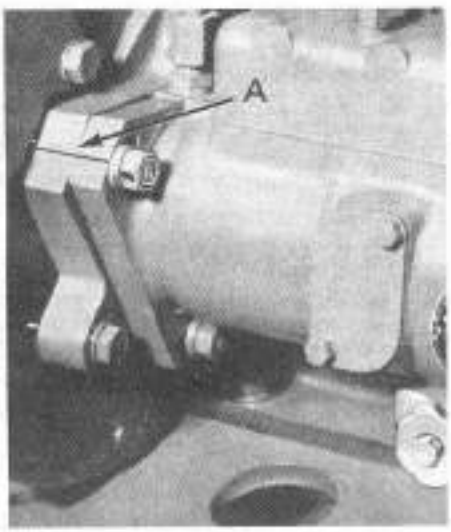


Fig. 62—View showing C.A.V. fuel injection pump timing marks.

111. **R&R FUEL INJECTION PUMP.** Thoroughly clean pump, lines and surrounding area. Disconnect throttle and fuel shut-off controls. Remove fuel injector lines and disconnect fuel inlet and return lines from pump. Immediately cap all openings. Unbolt and remove pump from drive housing. The splined drive shaft may be lifted out with pump; if so, take care not to drop the shaft. Remove shaft and thrust spring from bore in end of oil pump shaft.

To reinstall pump, first install the thrust spring in bore in top end of oil pump shaft, then insert splined (quill) shaft in drive gear with chamfered end up. Install the pump using a new gasket, align the timing marks as shown in Fig. 62, then tighten pump retaining nuts. Reconnect the fuel lines leaving injector line connections loose at the injectors. Install throttle and stop controls and bleed the fuel system as outlined in paragraph 103.

112. **FUEL INJECTION PUMP DRIVE GEAR.** Refer to Fig. 64 for exploded view of fuel injection pump drive gear and related parts and to Fig. 65 for cross-sectional view.

To remove the drive gear and housing assembly, first remove fuel injection pump, splined (quill) shaft and the drive shaft thrust spring as outlined in paragraph 111, then lift the gear and housing assembly from cylinder block.

To disassemble unit, remove snap ring (7 Fig. 64) from top end of gear (11) and press gear downward out of housing.

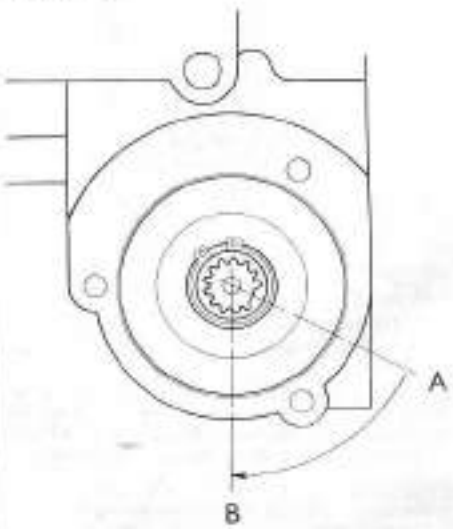


Fig. 63—View showing timing of 3-cylinder diesel injection pump drive gear to camshaft; refer to paragraph 112.

Remove the caged needle roller bearing (10) and lower ball bearing snap ring (9) from housing, then press ball bearing (8) down out of housing. When reassembling, install new ball bearing (8) first, then install retaining snap ring (9) and press new needle roller bearing into position.

NOTE: **Use a sleeve that will contact outer edge of bearing race only and press against lettered side of cage when installing bearing. Do not drive the needle bearing into place.**

To install gear and housing assembly, first remove rocker arm cover and turn engine until No. 1 piston is on compression stroke, then continue turning engine until timing pin will drop into detent in flywheel through TDC hole in housing. Refer to Fig. 63 and install gear and housing with master spline at "4 o'clock" position (A); as the gear engages with drive gear on camshaft, the master spline should move to "6 o'clock" position (B).

NOTE: If not possible to position gear at exact "6 o'clock" position, use tooth mesh that will position master spline at just after this timing position.

With fuel injection pump drive gear properly meshed with camshaft gear, reinstall fuel injection pump as outlined in paragraph 111.

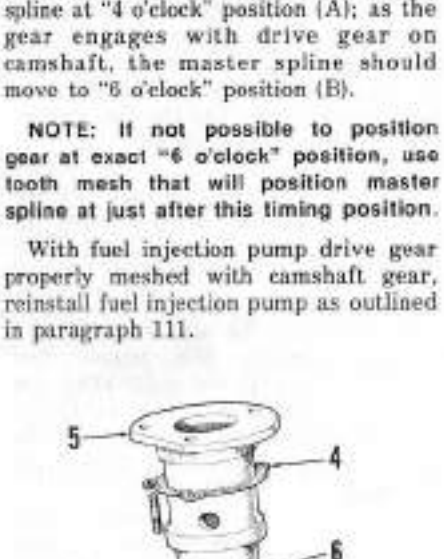


Fig. 64—Exploded view of 3-cylinder diesel injection pump drive gears; refer to Fig. 65 for cross-sectional view and to Fig. 63 for retiming pump drive gear to camshaft.

1. Cap screw
2. Washer
3. Camshaft gear
4. Gasket
5. Drive gear housing
6. Snap ring
7. Snap ring
8. Bearing
9. Snap ring
10. Needle bearing
11. Pump drive gear
12. Cap screw
13. Camshaft bearing
14. Injection pump camshaft gear
15. Engine camshaft

Model 995

113. **PUMP TIMING.** Pump is properly timed when timing mark on fuel injection pump housing is aligned with mark on engine front (carrier) plate, and when pump drive gear is properly timed with engine timing gears. Pump is timed during installation as outlined in following paragraph 114.

114. **R&R FUEL INJECTION PUMP.** Disconnect battery ground cable so engine will not be turned. Unbolt and remove pump drive gear cover plate, clean the pump drive gear and idler gear face and place a timing mark across the gears with felt tip pen or other marking device. Disconnect throttle and engine stop controls from pump. Disconnect fuel supply and return lines from pump and remove the fuel injector lines, then immediately cap all openings. Straighten the tab washer and unbolt pump drive gear from pump hub. Unbolt and remove pump from engine front plate leaving the drive gear in timing gear housing.

To reinstall pump, match the timing marks applied to fuel pump drive gear and idler gear, then mount pump on engine front plate and install gear retaining washer and cap screws. Rotate pump so that timing mark on pump housing is aligned with timing mark on engine front plate and securely tighten pump mounting bolts. Tighten gear retaining cap screws to a torque of 20 ft.-lbs. and bend tabs of washer against cap screw heads. Reconnect throttle and engine stop controls. Reconnect fuel supply and return lines and reinstall injector lines, leaving connectors at injectors loose. Bleed the fuel system as outlined in paragraph 104. Reinstall fuel injection pump cover and start engine using normal procedure.

NOTE: If timing marks were not applied prior to removing pump, it is **possible to move the gears out of time when removing or installing pump; therefore it will be necessary to remove timing gear cover to align timing marks.**

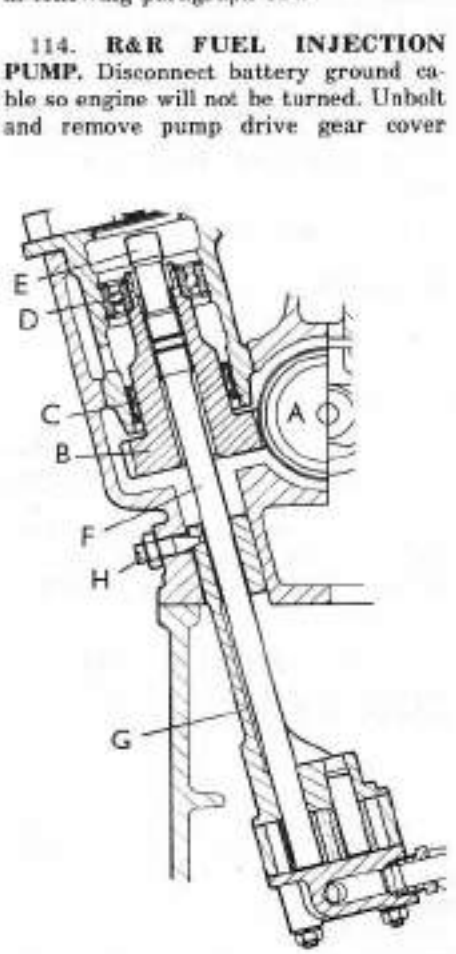


Fig. 65—Cross-sectional view of 3-cylinder diesel injection pump drive. Engine oil pump shaft (F) is counterbored at top end and fitted with thrust spring to hold fuel injection pump shaft (E) in proper position.

A. Camshaft pump drive gear
B. Drive gear
C. Needle roller bearing
D. Ball bearing
E. Injection pump drive shaft
F. Oil pump drive shaft
G. Oil pump housing
H. Oil pump retaining screw

Models 1210, 1212, 1410 and 1412

115. **PUMP TIMING.** Providing that mesh position of the pump drive gear and idler gear are correct, the fuel injection pump is properly timed when the timing marks on pump housing and engine front (carrier) plate are aligned. Refer to paragraph 74 regarding timing of idler and fuel injection pump drive gears.

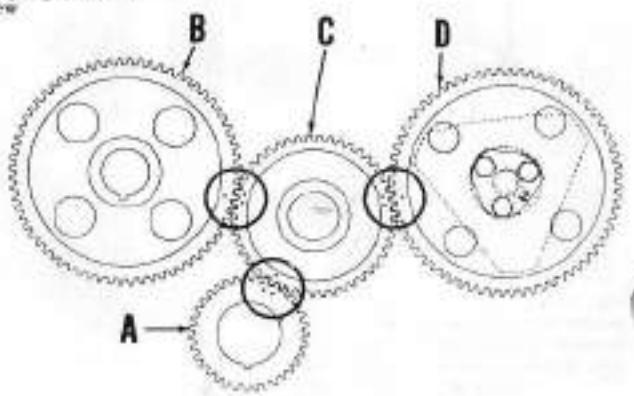


Fig. 66—View showing 4-cylinder diesel injection pump drive gear and idler gear timing marks.

A. Crankshaft gear
B. Camshaft gear
C. Idler gear
D. Injection pump drive gear

116. **LUBRICATION.** The Simms fuel injection pump is lubricated by oil sump in the pump cam box. After each 500 hours of operation, the pump should be drained and refilled to proper level with new, clean engine oil. Use same weight and type oil as for engine crankcase. Refer to Fig. 59 for location of drain plug (A), oil level plug (C) and filler plug (B).

Whenever installing a new or rebuilt fuel injection pump, be sure the cam box is filled with engine oil to level of the oil level plug (C) before attempting to start engine. There will be some oil dilution with diesel fuel during engine operation and after engine has been shut off, some of the fuel-oil mixture may run from outlet tube.

117. **R&R FUEL INJECTION PUMP.** Thoroughly clean pump, lines and surrounding area. Disconnect throttle and engine stop control from pump. Disconnect fuel supply line from pump and remove the fuel injector lines, then immediately cap all openings. Remove cover plate from front side of timing gear cover, clean the pump drive gear and idler gear and using a felt tip pen or other marking device, place timing marks on idler gear and pump gear. Straighten the tab washer and remove nut from injection pump camshaft. Using suitable pullers, loosen pump drive gear from tapered camshaft. Unbolt and remove fuel injection pump, taking care not to lose the Woodruff key from camshaft.

To reinstall pump, align keyway in camshaft with keyway in pump drive gear when gear is meshed with applied timing marks aligned. Mount pump on engine front (carrier) plate so that timing marks on pump housing and plate are aligned, taking care not to dislodge Woodruff key from shaft and to keep timing marks on gears aligned. Reinstall nut with new tab washer, tighten nut to a torque of 45 ft.-lbs. and bend tab against nut. Reinstall cover plate on timing gear cover. Reconnect throttle and engine stop controls. Reconnect fuel lines, leaving connections loose at the fuel injectors. Bleed fuel system as outlined in paragraph 105, then start engine using normal procedures.

NOTE: Refer to paragraph 116 regarding fuel injection pump lubrication.

DIESEL GOVERNOR ADJUSTMENTS

Simms Pump

118. Start engine and bring to normal operating temperature. Disconnect throttle linkage from fuel injection pump governor arm and hold the arm so that stop lever contacts the slow idle speed stop screw. If engine speed is not then within the range of 650-700 rpm, loosen the locknut on stop screw and turn screw in or out until proper slow idle speed is obtained and tighten locknut. Hold the arm so that stop lever is against the high idle (maximum) speed stop screw; engine high idle speed should then be 2425-2475 rpm. If high idle speed is not within the specified range the stop screw should be adjusted.

CAUTION: The high idle (maximum) speed stop screw adjustment is sealed with a sealing wire at the factory; this seal should only be broken by authorized diesel service personnel if tractor is within factory warranty.

To adjust high idle speed, break wire seal, loosen locknut and turn adjusting screw in or out until proper speed is obtained; then, tighten locknut and reseal adjusting screw. Reconnect throttle linkage. The throttle lever quadrant stops should be adjusted so that throttle lever just contacts the stops as control lever on fuel injection pump comes in contact with speed adjustment screws.

C.A.V. Pump

119. To check idle speed adjustments proceed as follows: Start engine and bring to normal operating temperature. Disconnect throttle linkage from governor arm on fuel injection pump. Hold the governor arm against the slow idle speed stop screw; slow idle speed should then be 650-700 rpm. If not, loosen the locknut on the slow speed stop screw (D-Fig. 55) and turn the screw in or out to obtain proper slow idle speed, then tighten the locknut. Hold the injection pump governor arm against the high idle (maximum) speed stop screw; engine speed should then be 2325-2375 rpm. If not within specified speed range, the high idle speed stop screw should be adjusted.

CAUTION: The high idle speed stop screw is sealed at the factory with a sealing wire and cover tube (C-Fig. 55); this seal should only be broken on tractors within factory warranty by authorized diesel service personnel.

To adjust high idle speed, break the wire seal, remove the cover tube and loosen the locknut on adjusting screw; then, turn screw in or out to obtain specified high idle speed, tighten locknut and reseal the screw. Reconnect throttle linkage. The throttle lever quadrant stops should be adjusted so that lever just contacts the stops as control lever on pump comes in contact with the speed adjusting screws.

FUEL INJECTORS

All Models

All models are equipped with a direct type fuel injection system. The injectors each have four spray orifices. Orifice diameter is 0.30 mm. (0.012 inch).

CAUTION: When testing nozzles, fuel is ejected with sufficient force to penetrate the skin which could cause blood poisoning. When testing nozzles, keep clear of nozzle spray.

120. **LOCATING A FAULTY NOZZLE.** If rough or uneven engine operation, or misfiring, indicates a faulty injector, the defective unit can usually be located as follows:

With engine running at low idle speed, loosen the high pressure connection at each injector in turn. As in checking spark plugs, the faulty unit is the one which, when its line is loosened, least affects the running of the engine.

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

121. **REMOVE AND INSTALL INJECTORS.** Before loosening any lines, wash the nozzle holder and connections with clean diesel fuel or kerosene. After disconnecting the high pressure and leakoff lines, cover open ends of connections with composition caps to prevent the entrance of dirt or other foreign material. Remove the nozzle holder stud nuts and carefully withdraw the nozzles from cylinder head, being careful not to strike the tip end of nozzle against any hard surface.

Thoroughly clean the nozzle recess in the cylinder head before reinstalling the nozzle and holder assembly. Use only wood or brass cleaning tools to avoid damage to seating surfaces and make sure the recess is free of all dirt and carbon. Even a small particle could cause the unit to be cocked and result in a compression loss and improper cooling of the fuel injector.

When reinstalling the injector, always renew the copper gasket. Torque each of the two nozzle holder stud nuts in 2 ft.-lb. increments until each reaches the final torque of 9-12 ft.-lbs. This method of tightening will prevent holder from being cocked in the bore.

122. **NOZZLE TESTING.** A complete job of testing and adjusting the nozzle requires the use of a special tester as shown in Fig. 67. Use only clean, approved testing oil in the tester tank. Operate the tester lever until oil flows; then attach injector to tester and make the following tests:

123. OPENING PRESSURE. Close gage valve and operate tester lever several times to clear all air from the injector. Then open gage valve and while slowly operating tester lever, observe the pressure at which the injection spray occurs. This gage pressure should be 2575 psi. If the gage pressure is not as specified, remove the cap nut (A-Fig. 68), loosen the locknut (C) and turn adjusting screw (D) in or out as required to increase or decrease opening pressure. If opening pressure cannot be adjusted to 2575 psi, overhaul nozzle as outlined in paragraph 127.

NOTE: On new injector assemblies or if new spring is installed, adjust opening pressure to 2725 psi.

124. SPRAY PATTERN. Operate the tester handle slowly and observe the spray pattern. All four sprays must be similar and spaced equidistantly in a nearly horizontal plane. Each spray must be well atomized and should spread into a 1 inch cone at a 3 inch distance from the injector tip. If spray pattern is not as described, overhaul the nozzle as outlined in paragraph 127.

NOTE: Rapid operation of the tester lever will frequently produce a spray pattern as described even if the injector is faulty. Be sure to operate the tester lever as slowly as possible and still cause the nozzle to open.

125. SEAT LEAKAGE. Wipe nozzle tip dry with clean blotting paper; then, operate tester handle to bring gage pressure to 2425 psi and hold this pressure for five seconds. If any fuel appears on nozzle tip, overhaul injector as outlined in paragraph 127.

126. NOZZLE LEAK BACK. Operate the tester handle to bring gage pressure to 2200 psi, then note time required for gage pressure to drop to 1500 psi. This time should be between 6 and 24 seconds.

If elapsed time is not as specified, nozzle should be cleaned or overhauled as outlined in paragraph 127.

NOTE: A leaking tester connection, check valve or pressure gage will show up in this test as excessively fast leak back. If, in testing a number of injector nozzles, all fail to pass this test, the tester rather than the injectors should be suspected.

127. **OVERHAUL.** Hard or sharp tools, emery cloth, crocus cloth, grinding compounds or abrasives of any kind should NEVER be used in the cleaning of nozzles.

Wipe all dirt and loose carbon from the injector assembly with a clean, lint free cloth. Carefully clamp injector assembly in a soft jawed vise or injector fixture and remove the protecting cap (A-Fig. 68). Loosen the jam nut (C) and back off the adjusting screw (D) enough to relieve the load from spring (E). Remove the nozzle cap nut (I) and nozzle assembly (J and K). Normally, the nozzle valve needle can easily be withdrawn from the nozzle body. If it cannot, soak the assembly in fuel oil, acetone, carbon tetrachloride or similar carbon solvent to facilitate removal. Be careful not to permit the valve or body to come in contact with any hard surface.

If more than one injector is being serviced, keep the component parts of each injector separate from the others by placing them in a clean compartmented pan covered with fuel oil or solvent. Examine the nozzle body and remove any carbon deposits from exterior surfaces using a brass wire brush. The nozzle body must be in good condition and not blued due to overheating.

All polished surfaces should be relatively bright without scratches or dull patches. Mating faces (F-Fig. 75) must be absolutely clean and free from nicks, scratches or foreign material as these surfaces must register together to form a high pressure joint.

Clean out the small fuel feed channels, using a small diameter wire as shown in Fig. 70. Insert the special groove scraper (see Fig. 71) into nozzle body until nose of scraper locates in the fuel gallery. Press nose of scraper

Fig. 67—An injector tester is necessary to check condition of nozzle and adjust injector pressure setting.

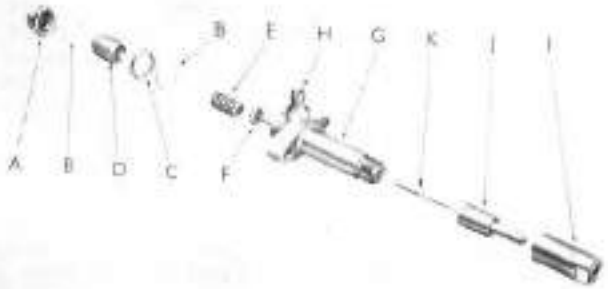


Fig. 68—Exploded view of typical fuel injector assembly. Refer to Fig. 69 for cross-sectional view.

A. Cap
B. Copper washers
C. Locknut
D. Adjusting screw
E. Spring
F. Spindle
G. Injector body
H. Fuel inlet
I. Nozzle retaining cap
J. Injector nozzle
K. Needle

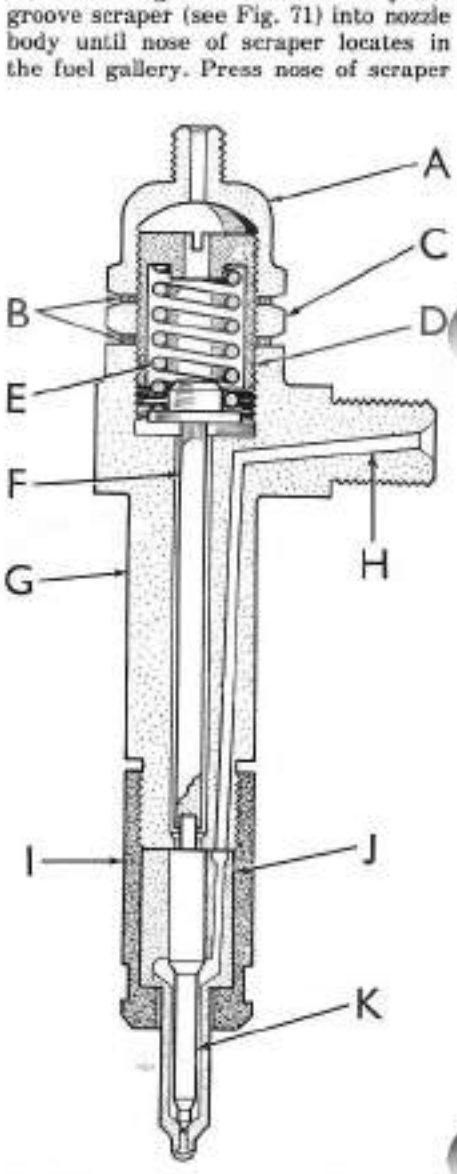


Fig. 69—Cross-sectional view of injector assembly. Refer to Fig. 68 for exploded view and legend.

hard against side of cavity and rotate scraper to clean all carbon deposits from the gallery. Using seat scraper, clean all carbon from valve seat by rotating and pressing on scraper as shown in Fig 72. Then, clean dome cavity in nozzle tip with dome cavity scraper as in Fig. 73.

Using a pin vise with proper size cleaning wire, thoroughly clean carbon from the four spray holes in nozzle tip as shown in Fig. 74, use an 0.011 inch diameter cleaning wire.

NOTE: Cleaning wires (probes) available through David Brown parts are listed by size of spray hole, not by actual wire size.

Examine the stem and seat end of the nozzle valve and remove any carbon deposit using a clean, lint free cloth. Use extreme care, however, as any burr or small scratch may cause valve leakage or spray pattern distortion. If valve seat has a dull circumferential ring indicating wear or pitting, or if valve is blued, the valve and body should be turned over to an authorized diesel service station for possible overhaul.

Before reassembling, thoroughly rinse all parts in clean diesel fuel and make certain that all carbon is removed from the nozzle holder nut. Install nozzle assembly and cap nut making certain that the valve stem is located in the hole of the holder body and the two dowel pins (P-Fig. 75) enter holes in nozzle body. Tighten the holder nut to a torque of 40-60 ft.-lbs.

Install the spindle (F-Fig. 68) spring (E), adjusting screw (D) and locknut (C) using new copper washer (B). Connect the injector to a nozzle tester and adjust opening pressure to 2575 psi. Use new copper gasket and install cap nut (A). Recheck nozzle opening pressure to be sure adjustment was not changed by tightening the locknut and cap nut.

Retest the injector as outlined in paragraphs 124, 125 and 126. If injectors fails to pass these tests, renew the nozzle and needle assembly (J and K).

COOLING SYSTEM

RADIATOR

All Models

128. To remove radiator on all models except 1410 and 1412, drain cooling system and remove complete hood assembly. Disconnect air cleaner hoses and radiator upper and lower hoses. Move battery out of the way, then unbolt and remove radiator.

NOTE: In some cases, radiator removal will be simplified if fan is removed and allowed to rest in radiator shroud.

129. To remove radiator from 1410 and 1412 model tractors, proceed as follows: Drain cooling system and remove complete hood assembly. Be sure to disconnect headlight wires before removing front hood. Disconnect and remove battery. Disconnect inlet and outlet lines from hydraulic pump and cooler, then unbolt pump mounting bracket and remove pump and mounting bracket with cooler attached. Disconnect hydraulic pump drive shaft coupling from crankshaft pulley and let drive shaft rest in radiator lower tank opening. Disconnect coolant hoses from radiator, then unbolt and remove radiator.

Reinstall radiator by reversing removal procedure but be sure hydraulic pump drive shaft is inserted through opening in radiator lower tank before installing radiator.

Fig. 70—Clean out small feed channel bores with drill or wire as shown. These bores are rarely choked and insertion of drill or wire by hand will be sufficient.

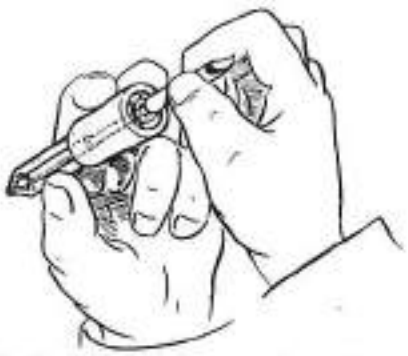


Fig. 72—Use seat scraper to clean all carbon from needle seat in tip of nozzle by rotating scraper and pressing it against seat as it is rotated.

Fig. 74—Using pin vise and proper size of cleaning wire to probe all carbon from the four injection spray holes in each nozzle tip.

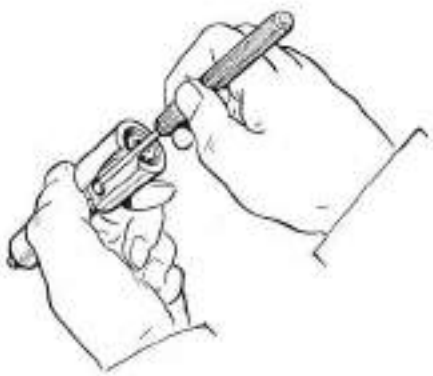


Fig. 71—Insert special groove scraper until hooked nose of scraper enters fuel gallery. Press scraper hard against side of gallery and rotate nozzle to clear any carbon deposit from this area.

Fig. 73—Remove any carbon from dome (tip) cavity with dome cavity cleaner as shown above.

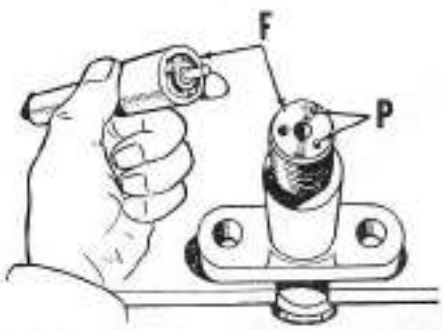


Fig. 75—When reassembling nozzle and needle assembly in holder, be sure pressure faces (F) of nozzle and holder are clean and that dowel pins (P) on holder enter proper holes in nozzle.

THERMOSTAT

All Models

130. Thermostat is located in front end of cylinder head and is accessible after draining radiator and removing water outlet housing from cylinder head.

Standard thermostat should start to open at 174 to 183 degrees F. and should be fully open at 200 degrees F. If placed in boiling water, the thermostat should be fully open in 60 to 90 seconds.

WATER PUMP

All Models

131. To remove water pump, first drain cooling system, then loosen alternator and disengage drive belt from alternator pulley. Remove fan from water pump pulley and allow fan to rest in radiator shroud. Do not lose the retaining plate located on front side of fan. Remove drive belt from water pump pulley and disconnect coolant hose from water pump, then unbolt and remove water pump from cylinder block taking care not to lose by-pass sealing ring.

132. To disassemble water pump, refer to Figs. 76 and 77 and proceed as follows: On four cylinder engine pumps, remove "O" ring (7-Fig. 77) from impeller housing (5) and housing (5) from body (14). Remove ring dowels (10) if necessary. Discard "O" ring (7) and gasket (11). On all pumps, use a suitable puller and pull pulley (3) from shaft. Straighten tab of tab washer and remove locating screw (13), then support pump body in a press with impeller end up and press shaft and bearing assembly (4) out of impeller (8) and body (14). Seal (9) can now be removed.

Clean and inspect all parts. Always renew "O" rings, gaskets and seals and reassemble pump as follows:

Align locating hole in shaft bearing (4) with locating screw hole in body (14), press shaft and bearing into body until holes index, then install locating screw (13) with tab washer (15). Secure locating screw with tab washer. Support impeller end of shaft and press pulley on shaft until shaft end is flush with bore in pulley. Install new seal, then support pulley end of shaft with a piece of 7/8-inch diameter bar stock and press impeller on shaft until impeller blades to pump body clearance is 0.005 inch. On four cylinder engine pumps, install ring dowels (10-Fig. 77) and impeller housing (5) using new gasket (11). Check to see that pump shaft will turn without binding, then using new "O" ring (7) and by-pass sealing ring (12), install pump by reversing removal procedure.

ELECTRICAL SYSTEM

ALTERNATOR

All Models

132. All tractors are equipped with Lucas alternators which are similar. Any trouble in the charging system (alternator) can be located by following

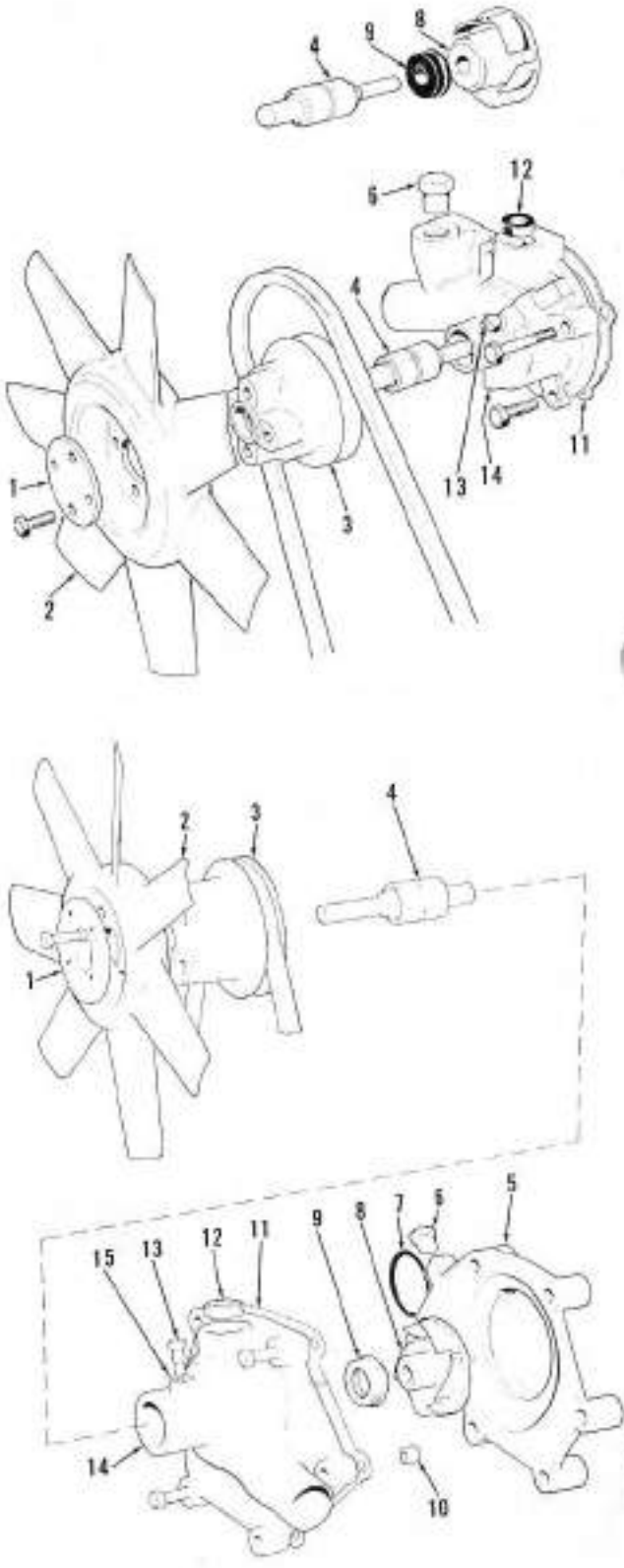


Fig. 76—Exploded view of water pump used on 3-cylinder engines.

1. Retaining plate
2. Fan
3. Pulley
4. Shaft & bearing assy.
6. Bleed plug
8. Impeller
9. Seal
11. Gasket
12. By-pass sealing ring
13. Locating screw
14. Pump body

Fig. 77—Exploded view of water pump used on 4-cylinder engines.

1. Retaining plate
2. Fan
3. Pulley
4. Shaft & bearing assy.
5. Impeller housing
6. Bleed plug
7. "O" ring
8. Impeller
9. Seal
10. Ring dowel
11. Gasket
12. By-pass sealing ring
13. Locating ring
14. Pump body
15. Tab washer

the testing procedure given in the following paragraph 133.

133. **TESTING.** Prior to beginning test, be sure battery is fully charged, all leads are connected, clean and tight, and that alternator drive belt is properly adjusted. Check cable continuity as follows: Remove connector plug from alternator, turn switch to "ON" position and using a voltmeter, check to see that battery voltage is present at both "IND" and "POS" (+) terminals of connector. See Fig. 78. Failure to show battery voltage at either terminal indicates a broken circuit which must be corrected before proceeding. No voltage at "IND" terminal could be caused by a failed warning light bulb.

With battery voltage present at both terminals, install connector on alternator, then with switch "ON" check to see that warning light is illuminated. If warning light does not illuminate, and bulb is known to be good, the alternator has an open field and alternator must be removed and defect corrected.

If warning light is illuminated, proceed with alternator output test as outlined in paragraph 134.

134. Run engine until normal operating temperature is reached, then stop engine and disconnect battery ground cable. Disconnect the alternator main output lead from solenoid and install an ammeter in the circuit. See Fig. 79. Remove connector from alternator, then remove cover from alternator and short out the regulator.

NOTE: If regulator is a Model 8TRD, it will have a green lead and the regulator can be shorted out by connecting a jumper wire between green lead and alternator frame as shown in Fig. 80. If alternator has a 14TR regulator, the regulator case is insulated from the alternator and the regulator can be shorted out by connecting a jumper wire between regulator case and alternator frame as shown in Fig. 81.

Reinstall connector to alternator and reconnect battery ground strap. Turn switch "ON", check to see that warning light is illuminated, then start engine and slowly increase engine rpm to 1500. At this time the ammeter should show the maximum alternator output (28 amps.). If alternator output is low, stop engine and disconnect the surge output diode as shown in Fig. 82. If output is then satisfactory, install a new surge diode. If output is still low, alternator is faulty and should be removed for service.

135. The voltage regulator setting can be checked as follows: Disconnect the battery ground cable, disconnect the main feed wire from alternator to starter solenoid, then connect an ammeter between alternator wire and solenoid terminal as shown in Fig. 83. Connect a voltmeter across the battery terminals, reconnect battery ground cable, then start engine and run at

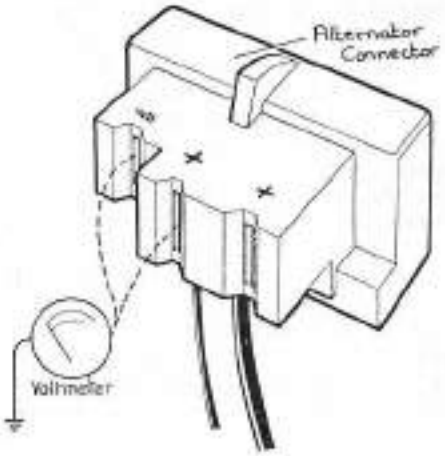


Fig. 78—View showing method of checking cable continuity.

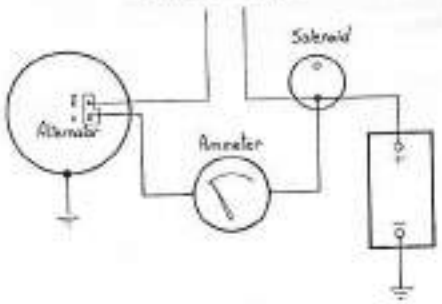


Fig. 79—Use method shown to check alternator output. Refer to text.

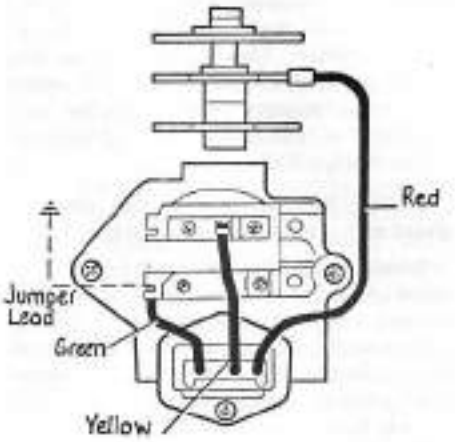


Fig. 80—Schematic view of 8TRD regulator.

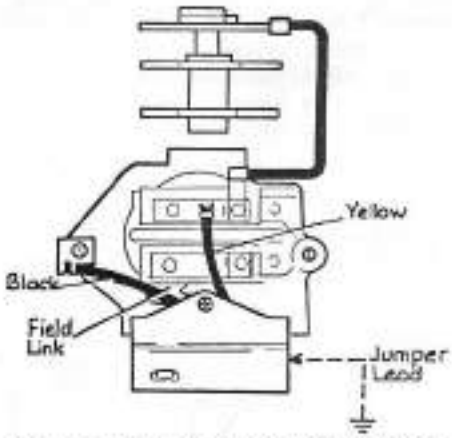


Fig. 81—Schematic view of 14TR regulator.

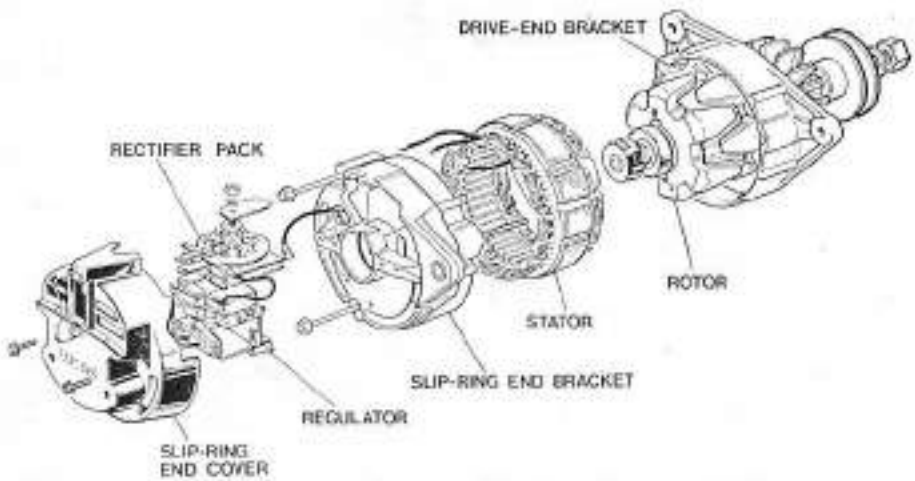


Fig. 77A—Exploded view showing the components parts of alternator.

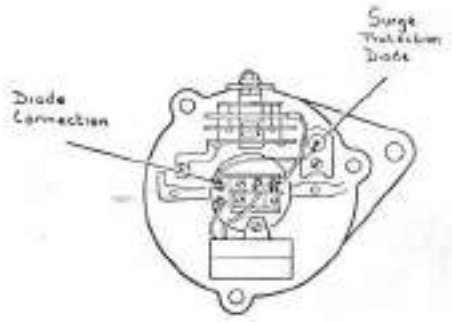


Fig. 82—Surge protection diode can be disconnected as shown.

approximately 1500 rpm. When ammeter reading falls below 10 amps. check the voltmeter reading which should be 13.6-14.4 volts. If this reading is obtained, regulator is satisfactory. However, if reading is not within this range, or is unstable, regulator is faulty and should be renewed.

136. When testing is completed, be sure all jumper wires, meters or other equipment is removed and circuits are restored to original connections.

137. **OVERHAUL.** With alternator removed from tractor, refer to Fig. 77A and disassemble alternator as follows: Remove end cover, note location of stator leads and unsolder leads from rectifier. Use **CAUTION** to not overheat diodes. Loosen nut on rectifier bolt, remove brush holder and regulator mounting screws, and remove brush holder and rectifier.

NOTE: Rectifier diodes can now be checked as outlined in paragraph 138.

Brushes and brush springs can be checked at this time. New brushes are ½-inch long, however brushes can be considered satisfactory for service if they protrude at least 0.3 inch from holder while in released (free) position. Renew brushes that do not protrude at least 0.3 inch and if brushes are renewed, be sure not to lose the small leaf spring located at side of inner brush. Use a push-type gage and check brush spring pressure by pushing on brush until it is flush with housing. Brush spring pressure should be 9-13 oz. and if not within this range, renew the brush assembly.

Inspect surface of slip rings which should be smooth and free of oil or other foreign material. Surfaces can be cleaned with solvent, or if signs of arcing are evident, use very fine sandpaper. It is not recommended that slip rings be machined.

If further disassembly is required, remove through bolts and pull slip ring end frame and stator from rotor and drive end frame. If difficulty in removal is encountered, use a piece of tubing that will slide over slip rings and butt against bearing outer race and bump bearing from end frame. Rotor can be pressed out of drive end frame after removing nut, washers, pulley and key. Drive end bearing can be removed after removing snap ring. To remove slip ring end bearing, unsolder leads from slip ring, remove slip ring assembly from shaft, then remove bearing and note that bearing is installed with shielded side facing slip ring assembly.

Rotor and stator can now be checked as follows: **ROTOR:** To check rotor winding resistance, use either an ohmmeter or a 12-volt battery with an ammeter (See Fig. 84) and check between slip rings. Rotors with pink windings should show readings of approximately 4.3 ohms or 2.8 amperes. Rotors with purple windings should show readings of approximately 3.3 ohms or 3.6 amperes. If readings vary considerably from those given, renew rotor. To test insulation of rotor winding use a 110 volt test light fitted with a 15 watt bulb (See Fig. 85) and check between slip ring and a rotor pole. If bulb lights winding is shorted to rotor and rotor assembly must be renewed. **STATOR:** Check continuity of stator windings by using a test lamp fitted with a bulb of not less than 36 watts and a 12-volt battery (See Fig. 86) and connect test light to any two of the stator leads. Test light bulb should illuminate. Repeat test by replacing either of the two wires used by the third wire, at which time bulb should again illuminate. Failure of bulb to illuminate on either test indicates an open circuit and stator must be renewed. Check insulation of stator windings using a test light fitted with a 15 watt bulb (See Fig. 87) and connect test light between any of the three stator leads and the laminations (stator frame). If test bulb illuminates, winding is shorted to laminations and stator assembly must be renewed.

138. DIODES. The diodes can be tested at this time; or if desired, they can be tested at the time the regulator, brush holder and rectifier pack is removed as outlined in paragraph 137.

To test diodes, (See Fig. 88), use a test light fitted with a 1.5 watt bulb connected to a 12-volt battery and proceed as follows:

Unsolder wires from diode pins and connect one lead of test light to diode

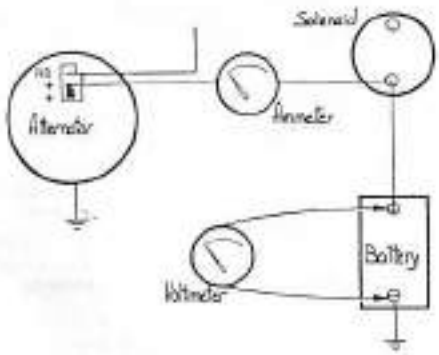


Fig. 83—Voltage regulator can be checked as shown. Refer to text.

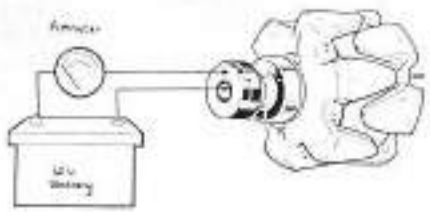


Fig. 84—Check rotor winding resistance as shown.

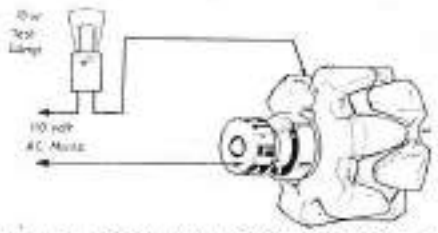


Fig. 85—Check rotor winding insulation as shown.

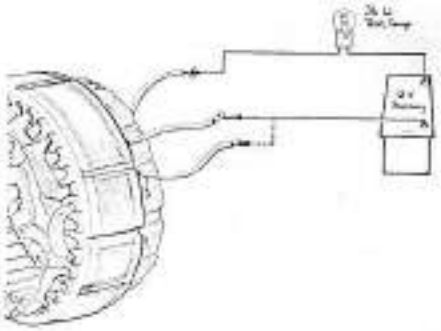


Fig. 86—Continuity of stator windings can be checked as shown.

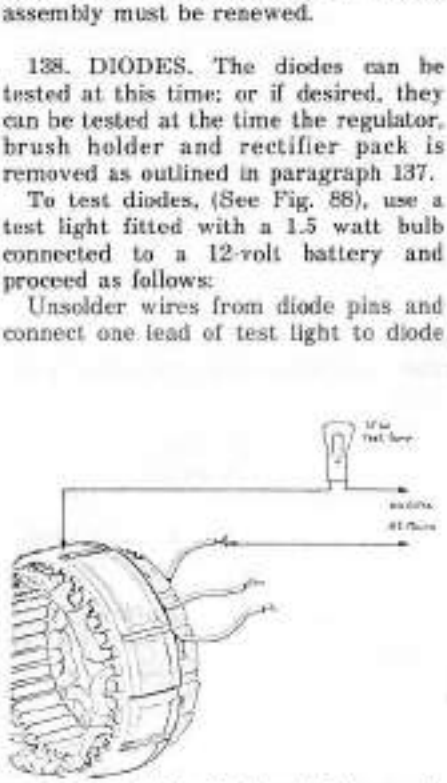


Fig. 87—Insulation of stator windings can be checked as shown.

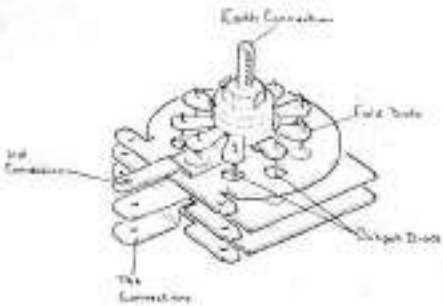


Fig. 88—View of diode pack. Renew complete assembly if defective diode is found.

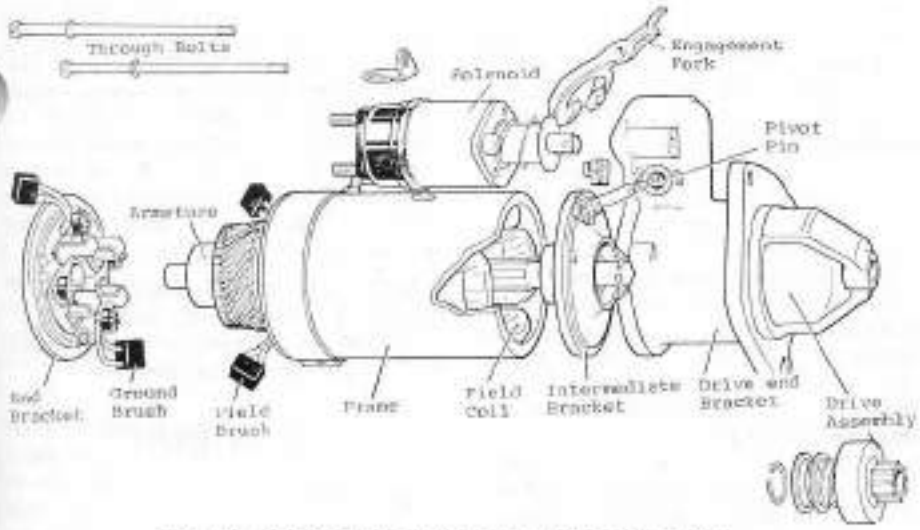


Fig. 89—Exploded view showing a typical starting motor.

pin and the other test light lead to the heat sink of the diode being tested. Check light bulb, then reverse test light leads and again check bulb. If test light bulb lights in both directions, or not at all, diode is defective (Bulb should light in one direction only). Repeat this test for all diodes and if a defective diode is found, renew rectifier (diode) pack.

CAUTION: When resoldering diodes, take care not to overheat diodes or bend diode pins. Lightly grip diode pins with long nosed pliers to conduct heat away from diodes and complete soldering operation as quickly as possible.

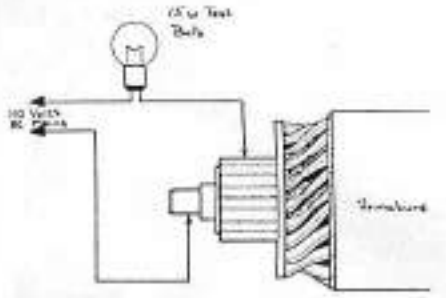


Fig. 90—Use test light as shown to test starter armature insulation.

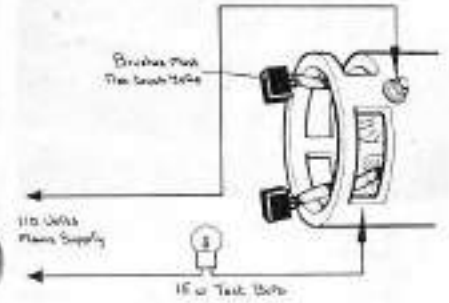


Fig. 91—When checking field coil insulation, brushes must not touch frame.

NOTE: Surge protection diode can be checked in same manner.

139. Reassemble alternator by reversing disassembly procedure and tighten through bolts to 55 in.-lbs. torque.

STARTING MOTOR

All Models

140. Lucas type M45 and M50 starters are used. No lubrication is required in service and the only maintenance required is a periodic check of connections and of mounting bolts for tightness.

Using Fig. 89 as a guide, disassemble and service starter as follows: Remove connecting link between solenoid and starter, remove solenoid mounting screws, then while disengaging solenoid plunger from engagement fork, remove solenoid. Remove band (cover) from frame and lift brushes from brush holders. Remove the two through bolts and separate end bracket and frame from drive end bracket. Remove the rubber seal from drive end bracket. Loosen locknut on engagement fork pivot pin, then remove pivot pin and engagement fork from drive end bracket. Use a pipe of proper diameter to dislodge thrust washer from snap ring at front of intermediate bracket, lift snap ring from its groove, then slide drive assembly and intermediate bracket from armature shaft. Save any shims which may be located between intermediate bracket and armature core.

Inspect all brushes and renew brushes if they are not at least 5/16-inches long. New brushes must be resoldered during installation. New brushes are preformed and will not require dressing or running-in.

Clean and inspect armature commutator and if it is worn, rough or pitted, place armature in a lathe and true commutator but do not reduce commutator diameter to less than 1.50 inches. Polish commutator with very fine sandpaper and **DO NOT** undercut insulators between commutator segments. Armature insulation can be checked with a 110 volt test light fitted with a 15 watt bulb as follows: Connect one probe of test light to armature shaft, then connect remaining probe to each commutator segment in turn (See Fig. 90) and observe bulb. If bulb illuminates, windings are shorted to armature and armature must be renewed. Use same test light and check field coils by connecting test light to

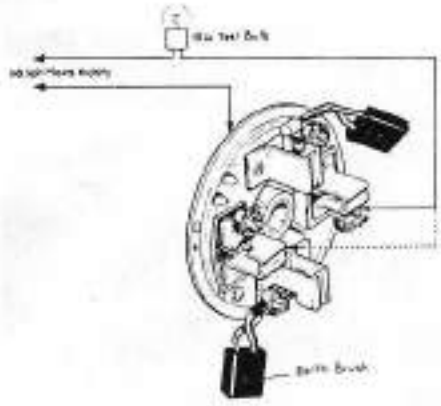


Fig. 92—Test the grounded brush holder insulation shown.

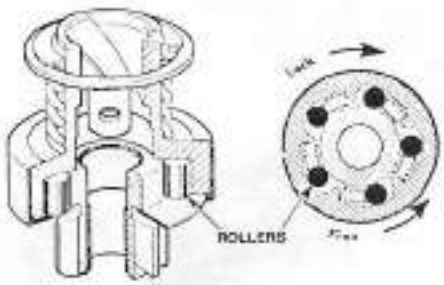


Fig. 93—Cross-sectional view of roller clutch assembly. Clutch will lock up when turned in one direction but will turn freely when turned in opposite direction.

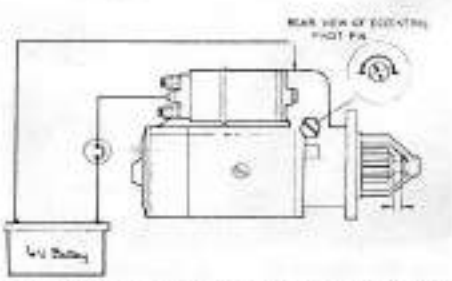


Fig. 94—Use a 6-volt battery when checking pinion setting. Refer to text.

terminal end frame (See Fig. 91) while making sure brushes are not touching frame. If bulb illuminates, coils are shorted to frame and field coils should be renewed.

NOTE: Prior to renewing field coils be sure that insulation at terminal and between field coils and frame is satisfactory.

The commutator end bracket has two insulated brush holders and insulation can be checked by using the same test light that was used in previous tests. Connect one probe of test light to end bracket and the other probe to one of the insulated brush holders (See Fig. 92). Repeat check on remaining insulated brush holder and if bulb illuminates in either case, brush holder is shorted and a new end bracket must be installed.

Solenoid windings resistance can be checked with an ohmmeter and should test as follows: Closing coil 0.25-0.27 ohms; hold-in coil 0.76-0.80 ohms; both coils (in series) 1.01-1.07 ohms.

141. Inspect the three armature shaft bushings and renew bushings if inside diameter is greater than 0.505 in. for commutator end bracket, 1.127 in. for intermediate bracket, or 0.675 in. for drive end bracket. The blind commutator end bushing can be pulled using a 9/16-inch tap. Soak bushings in oil for 24 hours prior to installation and use a closely fitting piloted arbor when installing. **DO NOT** ream bushings after installation.

Check the roller clutch drive assembly. Roller clutch should lock up immediately when rotated in one direction but should turn freely and smoothly when rotated in opposite direction. See Fig. 93. Clutch assembly should also move freely on shaft splines. If assembly shows any signs of malfunction, renew complete assembly as it is not serviced. On type M50 starters only, splines of roller clutch assembly should be lubricated.

142. Reassemble starter by reversing disassembly procedure and tighten through bolts to 8 ft.-lbs. torque on units with ¼-inch bolts, or 10 ft.-lbs. torque on units with 5/16-inch bolts. Check armature end play after through bolts are tightened. Armature end play should be 0.005-0.020 in. and if not as stated, vary the number of shims located between armature and the intermediate bracket as required.

With starter assembled, refer to Fig. 94 and adjust pinion setting as follows: Connect a 6 volt battery between solenoid body and blade terminal, then while holding pinion lightly toward armature, turn the eccentric pivot pin until the distance between pinion and thrust washer is 0.005-0.015 in. for M45 starters, or 0.005-0.045 in. for M50 starters and tighten pivot pin locknut. Do not turn pivot pin so that arrow head on pivot pin moves from between the two arrows embossed on housing. Use "Loctite", or equivalent to secure locknut.

CLUTCH

Model 885, 885N and 995 tractors are fitted with Borg and Beck double clutches which are basically similar except that clutches in Models 885 and 885N are fitted with 10 inch transmission and pto driven plates whereas those in Model 995 are fitted with an 11 inch transmission driven plate and a 10 inch pto driven plate.

Some Model 1210 and 1212 tractors may also be fitted with a Borg and Beck clutch having 11 inch transmission and pto driven plates; however, construction differs from those used in 885 and 995 tractors in that clutch is fitted with separate transmission and pto release levers and release lever plates.

Some 1210 and all 1410 and 1412 model tractors are equipped with Laycock dual clutches which have 12 inch transmission and pto driven plates.

Clutch shafts will differ between models because of transmission variations and can be noted after referring to Figs. 101, 103, and 104.

NOTE: Beginning August 1972, suffix letters "B" (Borg and Beck) or "L" (Laycock) are stamped on engine block following engine serial numbers.

ADJUSTMENT

Model 885

143. Clutch pedal free play should be 1-1½ inch. When free play is taken up, pedal pad should be a distance of 7½ to 9 inches from foot rest.

Adjust clutch free play by loosening locknut and turning adjusting screw (8-Fig. 95) in to increase free play and reduce pedal height, or back screw out to decrease free play and increase pedal height. If proper amount of free play cannot be obtained by adjusting screw, or pedal height is not correct when free play is properly adjusted, lever (9) must be repositioned on clutch cross shaft. Scribe a mark across shaft and lever, remove bolt and pull lever from shaft. Move lever one serration at a time and in a clockwise direction to increase free play and reduce pedal height, or in a counter-clockwise direction to reduce free play and increase pedal height. Reinstall and tighten bolt when lever is properly positioned.

The clutch pedal stop bolt (1) on foot rest is normally adjusted to 9/16-inch

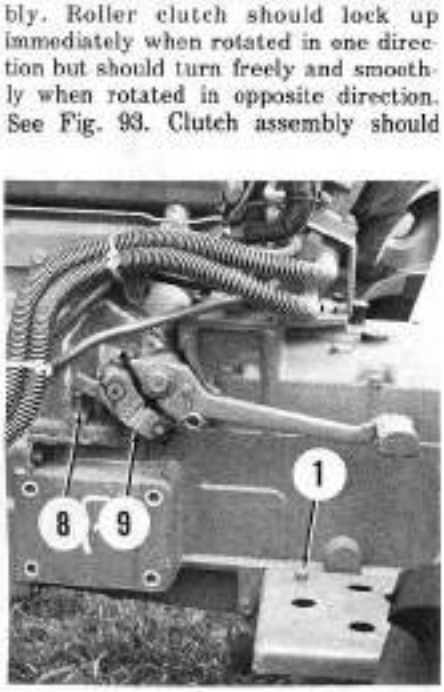


Fig. 95—Clutch pedal free play for 885 models is adjusted by turning screw (8). Refer to text.

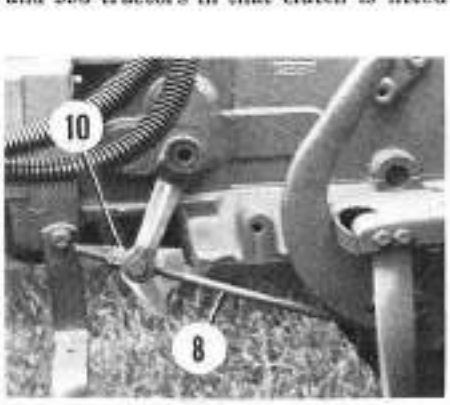


Fig. 96—On some tractors, adjust clutch by turning adjusting nut (10). Item (8) is clutch control rod.

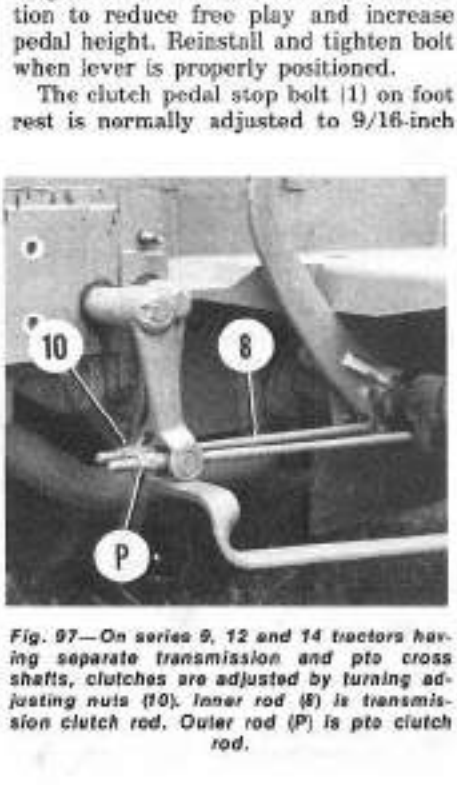


Fig. 97—On series 9, 12 and 14 tractors having separate transmission and pto cross shafts, clutches are adjusted by turning adjusting nuts (10). Inner rod (8) is transmission clutch rod. Outer rod (P) is pto clutch rod.

and should not require readjustment from this position.

Model 995

144. Clutch pedal free play should be 1-1½ inches and is controlled by length of clutch pedal rod (8-Fig. 96 or 97). When pedal free play decreases to approximately 1-inch, readjust by turning adjusting nut (10) as required. Loosening adjusting nut will increase, or tightening adjusting nut will decrease, the clutch pedal free play.

NOTE: Depending on clutch installed, Model 995 tractors may be fitted with two cross shafts and two clutch rods as shown in Fig. 97. The outer clutch rod (P) is the pto control rod. Refer to the pto section of this manual for adjustment information.

Models 1210, 1212, 1410 and 1412

145. The Series 12 and 14 tractors are fitted with separate transmission clutch and pto clutch release mechanisms. The transmission clutch release mechanism is similar to that used on Model 995. See Fig. 97.

Clutch pedal free play is 1-1½ inches and is adjusted by turning adjusting nut (10). Loosening adjusting nut will increase, or tightening nut will decrease, the clutch pedal free play.

Refer to the pto section of this manual for adjustment of pto clutch.

R & R CLUTCH

Models 885 and 995

146. Remove hood and disconnect throttle and engine stop control linkages. On Model 995, remove throttle lever and engine starting motor. On all models, disconnect fuel lines and wiring, then remove fuel tank and instrument panel as a unit. Disconnect drag link from steering gear arm on manual steering models or lines from steering servo valve on power steering models.

Drive wood wedges between each side of front support (main frame extension) and axle beam so that engine unit will not tilt on front axle pivot pin. Using a suitable wood block placed on rolling floor jack, support rear end of engine under flywheel housing or under rear end of engine frame. Adequately support front end of transmission, then unbolt transmission and cover from flywheel housing on Model 885, or from engine on Model 995, and roll front unit forward.

Place nuts or other suitable spacers between clutch cover and release levers as cover is unbolted from flywheel. Remove the cover and pressure plate assembly and the transmission clutch lined disc. Mark separator and flywheel, withdraw the separator plate from flywheel, then remove the pto lined disc and the three separator plate thrust springs from flywheel.

To reinstall clutch assembly, proceed as follows: Place pto clutch disc in flywheel with hub forward. Insert the separator plate thrust springs in bores in flywheel, then with marks aligned, install separator plate.

NOTE: If plate is being reused, be sure to reinstall with same side forward as when removed.

Using a pilot tool made to dimensions shown in Fig. 98, position the transmission clutch disc with hub forward. With both the pto and transmission clutch discs aligned with pilot inserted through discs into pilot bearing, install the clutch cover and pressure plate assembly. Remove the nuts or other spacers from between cover plate and release levers as the clutch retaining screws are tightened. Remove clutch disc pilot and complete reassembly of tractor by reversing disassembly procedure. Adjust clutch as outlined in paragraph 143 or 144.

Models 1210 and 1212

147. Remove muffler and hood.

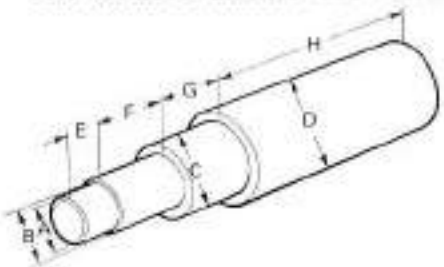


Fig. 98—When installing clutch in Models 885 and 995, use a pilot made to the dimensions shown in legend.

A. 0.874
B. 0.915
C. 1.420
D. 1.771
E. 5/8 inch
F. 1½ inches
G. 1¾ inches
H. 6 inches

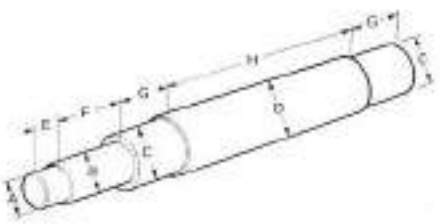


Fig. 99—When installing clutch in Models 1210 and 1212 equipped with Laycock clutch, use a pilot made to the dimensions shown in legend.

A. 4.874
B. 0.915
C. 1.374
D. 1.420
E. ⅝ inch
F. 2⅛ inches
G. 1¼ inches
H. 6 inches

Remove grille, disconnect battery and remove engine starter. Disconnect main wiring harness connectors under fuel tank and wiring to oil pressure warning light switch, then release guide tube wiring after disconnecting engine speed indicator cable. Disconnect fuel supply and leak-off lines from fuel tank, disconnect throttle and stop cables from injection pump, then remove cable bracket from pump. If tractor (1210) is equipped with manual steering, disconnect drag link from steering arm. On models equipped with power steering, disconnect all lines from steering servo (control) valve, extract the two large lines forward from under fuel tank and then cap all openings to prevent contamination. Remove cover at bottom of clutch and install retaining clips (available from J I Case) over each pto release lever, or if desired, wire can be used. Remove adjusting nuts from forward ends of pto and transmission clutch rods, then disconnect transmission cross shaft return spring anchor from main frame. Drain transmission, separate hydraulic pump pressure line at union under right hand foot plate and disconnect pump inlet line from filter. Unbolt drawbar from pto, then remove pto unit and pull pto shaft rearward until it clears clutch. Drive wood wedges between front support (main frame extension) and axle beam so front unit will not tilt, then remove two center bolts from main frame so a rolling floor jack can be located under front frame behind engine oil pan. Support rear frame (transmission) so it will maintain alignment during separation. Unbolt clutch cover from engine and main frame, then remove remaining front-to-rear main frame bolts. Carefully separate tractor halves until there is a 3-4 inch gap between halves, then remove bolt from transmission cross shaft return spring lever so cross shaft can turn as tractor is separated. Disconnect release bearing lube line from side of main frame, if so equipped. Continue separation of tractor until clutch is accessible, then remove the clutch assembly from flywheel.

NOTE: On models equipped with Borg and Beck clutches, the clutch is retained on flywheel with nine long bolts. Do not remove any of the six short cap screws retaining clutch cover to separator plate. On models equipped with Laycock clutches, the clutch is retained to flywheel by six bolts.

To reinstall clutch, reverse the removal procedure and use a pilot made to the dimensions shown in Fig. 99 to align the driven plates prior to tightening the clutch mounting bolts. After tractor is assembled, refer to para-

graph 145 for external adjustment. Bleed fuel system and power steering system.

Models 1410 and 1412

148. Remove muffler and hood. Remove grille and disconnect battery. If fuel tank is full, drain some fuel to ease handling of tank, then disconnect fuel lines from tank. Disconnect wiring and engine controls and remove fuel tank and instrument panel as a unit. Disconnect all lines from steering servo (control) valve and remove right hand steering pipe which is attached to lower side of main frame. Cap all ports and openings to prevent contamination. Remove front tool box bracket and pivot throttle bracket rearward. Remove starter motor and let it rest in main frame. Remove adjusting nuts from forward ends of transmission and pto clutch control rods, then remove cover at bottom of clutch and unhook transmission cross shaft return spring. Drain transmission, then disconnect hydraulic pump inlet line at filter end and pressure line at union mid-way along line. Remove pto unit and pull pto shaft rearward until it clears clutch assembly. Drive wood wedges between front axle and front extension to prevent tipping, then support rear end of front frame. Support front end of rear main frame with a rolling floor jack, then unbolt clutch cover from engine and main frame, front frame from rear frame and drive dowels rearward until they clear front frame. Carefully separate tractor halves, allowing pto release fork to tilt rearwards until fork disengages from bearing sleeve, then move tractor halves apart enough to provide working room. Remove bolts from pto release fork and cross shaft return spring lever. Remove snap ring from right end of cross shaft, then while tapping release fork, remove pto cross shaft from left side and retrieve fork keys when they clear release fork. Fit spacers between transmission release levers and clutch cover and install retaining clips (available from J I Case) to pto levers to prevent Belleville spring from shifting.

NOTE: Pto levers can be wired if necessary. Loosen bolts retaining clutch to flywheel evenly and be prepared to catch the pro driven plate which will drop as clutch is removed.

149. When reinstalling clutch, use a pilot made to the dimensions shown in Fig. 100. Pto drive plate is installed with long boss toward flywheel. Pto release fork is installed with offset toward clutch. Use two ½ x 5 inch long guide studs when joining tractor and be sure pto release fork properly engages bearing sleeve as main frames mate. Do not use force when joining main frames. If alignment is correct, main frames will mate without difficulty. Transmission clutch cross shaft return spring can be hooked by inserting a strong piece of cord through hole in main frame and attaching cord to spring, then using a large screwdriver, or similar lever, pull cord to stretch return spring until it can be hooked in hole in main frame. Complete reassembly of tractor by reversing disassembly procedure and adjust clutch as outlined in paragraph 145.

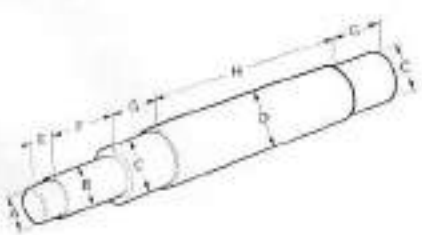


Fig. 100—When installing clutch in Models 1410 and 1412 equipped with Laycock clutch, use a pilot made to the dimensions shown in legend.

A. 0.874
B. 0.912
C. 1.50
D. 1.769
E. ¾-inch
F. 2¾ inches
G. 1⅝ inches
H. 6 inches

OVERHAUL CLUTCH

Models 885 and 995

NOTE: Following procedure for clutch overhaul assumes shop is not equipped with special David Brown clutch fixture; if special fixture is available, disregard the following instructions and use tool for disassembly, reassembly and adjustment of clutch unit as outlined in instructions with tool kit.

NOTE: Clutches for these models are similar except that Model 885 clutch has 10 inch transmission and pto driven discs, whereas Model 995 has an 11 inch transmission driven disc and a 10 inch pto driven disc. Service procedure remains the same.

150. With clutch assembly removed, remove engine flywheel and plate flywheel on bench with clutch friction surface up. Assemble clutch on flywheel with plates properly positioned, using long stud bolts and nuts instead of regular clutch cover retaining cap screws. Tighten the nuts equally until cover flange is tight against flywheel, removing the nuts or other spacers from between cover and release levers as the stud nuts are tightened.

Refer to exploded view of typical clutch assembly in Fig. 101 and proceed as follows: Remove retaining springs (24) and the release lever plate (15) from release levers (19). Remove the fulcrum pins (20), anti-rattle springs (23) and the release levers. Remove roller pins (22) from levers, catching the 19 loose needle rollers and roller (21) as each pin is removed.

Evenly loosen the stud nuts retaining cover to flywheel, taking care that the studs do not turn, until clutch springs are free, then remove the studs and nuts and disassemble clutch unit. Note that the transmission clutch springs are double, with the inside springs coiled in opposite direction from the outside spring coils.

Carefully inspect all clutch parts for excessive wear, cracks, scoring or other damage and renew any part not

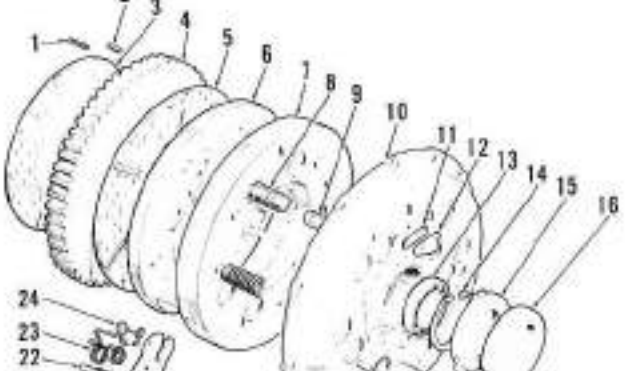


Fig. 101—Exploded view of clutch typical of these used in Models 885 and 995. All clutches are similar except for diameter of clutch discs.

1. Thrust springs
2. Dowel pins
3. Pto disc
4. Separator plate
5. Transmission disc
6. Transmission pressure plate
7. Inner cover
8. Pressure springs (outer)
9. Pressure springs (inner)
10. Clutch cover
11. Shims
12. Adjusting pad
13. Ball bearing
14. Snap ring
15. Release plate
16. Release bearing
17. Adjusting screw locknuts
18. Adjusting screws
19. Release levers
20. Pivot pins
21. Rollers
22. Roller pins
23. Anti-rattle springs
24. Release plate springs

suitable for further service. If either the pressure plate or the separator or the separator plate is slightly scored, the surface can be refaced providing no more than 0.015 material thickness is removed from surface; thus a total of 0.030 may be removed from separator plate. Separator plate thickness, new, is 0.760-0.765 inch on Model 995 and 0.700-0.705 inch on 885 models. Check the clutch springs against the following values:

Transmission Clutch Outer Spring—
Model 885
Spring part No. 902512
Color Code ..... Brown
Lbs. Pressure at 2.60 Inches 125

Transmission Clutch Outer Spring—
Model 995
Spring part No. 928922
Color Code ..... Red
Lbs. Pressure at 1.41 Inches 135

Transmission Clutch Inner Spring—
All Models
Spring part No. 902513
Color Code ..... Brown
Lbs. Pressure at 2.60 Inches 82

PTO Clutch Springs-Model 995
Spring Part No. 902514
Color Code ..... Pink
Lbs. Pressure at 2.26 Inches 117

PTO Clutch Spring-Model 885
Spring part No. 900261
Color Code ..... Buff
Lbs. Pressure at 2.26 Inches 91

151. To reassemble and adjust, place flywheel on workbench with clutch friction surface up, then proceed as follows:

Equally space four 0.310 thick spacers on pto clutch friction surface of flywheel; refer to cross-sectional view in Fig. 102. Insert separator plate in flywheel on top of the 0.310 thick spacers, then equally space four 0.349 thick spacers on transmission clutch friction surface of separator plate so that each 0.349 thick spacer is just above each 0.310 thick spacer. Place a straight edge across center of separator plate as shown; the straight edge must be less than 0.349 thick. Place pressure plate on top of the four 0.349 thick spacers.

Place clutch inner cover down over release lever lugs on pressure plate, then insert the six outer (large) transmission clutch springs through holes of inner cover. Insert the inner springs inside the outer springs. Place the six pto clutch springs on bosses of inner cover, then place the spring cups over the springs. Carefully place clutch cover down over the spring cups and the lugs of pressure plate. Turn the assembly as necessary so that the clutch cover bolt and dowel pin holes are aligned with flywheel, taking care that the spacers and straight edge are not moved out of proper position. Insert the long studs through cover bolt holes into flywheel, then install and evenly tighten the stud nuts until cover flange is tight against flywheel.

Stick the 19 loose needle rollers into each release lever roller with grease, then assemble in the release levers. Install the release levers, anti-rattle springs, release plate and springs. Move the unit to a press or use other means to actuate the release levers approximately six times to be sure release linkage is seated. Take care that the spacers and straight edge are not dislodged.

Referring to Fig. 102, measure distance (Y) between lower face of release plate (15) and top of straight edge. This measurement, added to thickness (Z) of straight edge, gives clutch release lever setting (X) which should be 3.445 inches on Model 995 or 3.345 inches on 885 models. Shims (11-Fig. 101) are added between clutch cover and release lever stops (12) to increase release lever setting, or removed to decrease setting. Shims are available in thicknesses of 0.002, 0.003, 0.010 and 0.020. A variation of 0.001 in shim pack thickness will change release lever adjustment about 0.0045. Take release lever measurement at each lever and adjust all levers to as near equal height as possible.

With release lever stops properly shimmed, place nuts or other suitable spacers between outer ends of release levers and clutch cover, then loosen stud nuts until the spacers take up spring tension, remove the nuts and studs and clutch components from flywheel. Reinstall flywheel, clutch and clutch shaft.

Models 1210 (Prior Ser. No. 11154230) and 1212

152. With clutch removed, remove engine flywheel and place flywheel on bench with clutch friction surface up. Place pto friction disc on flywheel, then install clutch assembly on flywheel using nine 5/16 UNCx7 inch stud bolts, flat washers and nuts. Remove the six cap screws retaining clutch cover to separator housing, disconnect pto release levers (16-Fig. 103) from eye bolts (13) and disconnect the transmission clutch release levers (19) from lugs on transmission clutch pressure plate. Hold the stud bolts from turning while evenly loosening the nuts. When free of all spring pressure, remove the nuts and disassemble clutch.

Transmission clutch friction disc thickness (new) is 0.340 inch and PTO friction disc thickness (new) is 0.324 inch. Check the clutch springs against the following specifications:

Transmission Clutch Springs:
Part Number 625262
Color Code ..... Violet/Black
Lbs. Pressure at 1.69 Inches 150
Part Number (Heavy Duty) 625211
Color Code (Heavy Duty) ..... Buff/Black

PTO Clutch Springs:
Part Number 625209
Color Code (Heavy Duty) ..... Buff/Black
Lbs. Pressure at 1.41 inches 131-140

Reassemble clutch with new part as required by reversing disassembly procedure. After clutch is fully assembled on flywheel, adjust transmission release lever adjusting screws so that face of release plate (18) is 5.215 to 5.385 inches from face of flywheel. Adjust PTO clutch links so that PTO release plate (17) face is 6.27 to 6.37 inches from face of flywheel. Be sure linkage locknuts and clutch cover to separator housing cap screws are tight, then remove clutch from flywheel. Install flywheel on engine crankshaft, then reinstall clutch.

Models 1210 (Serial No. 11154230 and up), 1410 and 1412

153. With clutch assembly removed, remove engine flywheel and place

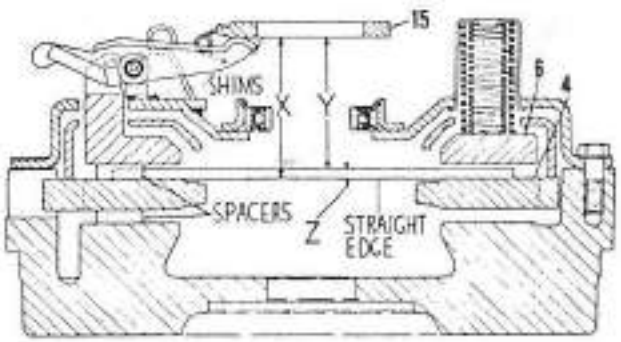


Fig. 102—Cross-sectional view showing placement of spacers and straight edge for assembly adjustment of clutch. Add thickness (Z) of straight edge to measurement (Y) to obtain release lever height. Vary shims at location shown to adjust lever height to dimensions as outlined in text. Refer to exploded view in Fig. 101 for numerical legend.

flywheel on bench with clutch friction surface up. Place pto clutch disc (1-Fig. 104) in flywheel, then bolt the clutch assembly to flywheel. Mark clutch cover and both pressure plates so clutch can be reassembled in same position to maintain balance. Remove retainers from release levers. Remove pto release lever pins (14) and anti-rattle springs (15), then swing pto release levers (17) outward beyond clutch cover. Remove transmission release lever pins (21), pull springs (23) out until they clear holes in release plate (12), then lift release plate from levers (20) and complete removal of levers with rollers (22). Loosen bolts retaining clutch to flywheel evenly until all spring pressure is relieved, then remove locknuts, and using an Allen wrench, remove adjusting screws (7). If necessary, complete removal of retaining bolts and separate clutch assembly while noting position of belleville washer (5) and insulators (4). Links (19) can be removed from pto pressure plate (2) if necessary and note that holes in links are offset toward center of clutch.

Clean and inspect all parts for signs of undue wear. Renew clutch disc facings if badly glazed, heat discolored, oil soaked or if worn to rivet heads. Renew clutch discs if rivets are loose or hub splines are excessively worn. Pressure plate lug clearance in cover new, is 0.004-0.009 inch with a maximum allowable clearance of 0.029 inch. Friction surfaces of clutch cover and pressure plates can be refinished providing the following dimensions are not exceeded. Maximum depth of clutch cover from friction face to flywheel face, 2.867 inches. Minimum thickness of transmission pressure plate from friction face to belleville spring seat, 0.936 inch. Minimum thickness of pto pressure plate from friction face to belleville spring seat, 1.127 inches. Clutch pressure springs are color coded pink, have a free length of 1.51 inches and should test 83-92 lbs. when compressed to a length of 1.137 inches. Belleville washer should have a free height of 0.386-0.399 inch (minimum allowable height 0.386) and should test 1280-1450 lbs. when compressed to a height of 0.191 inch. Belleville washer is color coded pink. Renew release lever springs if they have lost their tension.

154. Reassemble clutch assembly as follows: Place pto clutch disc in flywheel with long hub toward flywheel. Place pto pressure plate on pto clutch disc with friction face down, install twelve fiber washers (4-Fig. 104) in spring seats, then place clutch pressure springs (3) on top of fiber washers. Place belleville spring (5) on pressure plate with concave side up (outside diameter higher than inside diameter).

NOTE: Belleville spring is located only by the recesses of pressure plates.

Assemble pto levers and links (if necessary), then be sure links are installed to pto pressure plate with offset of holes toward center of clutch. Place remaining twelve fiber washers (4-Fig. 104) in spring seats of transmission pressure plate, then while aligning previously affixed balance marks, set transmission pressure plate on pressure springs. Check to make sure all springs are seated on the fiber washers. Place transmission disc (8) on pressure plate (6) with dished hub toward the pressure plate, then using the pilot shown in Fig. 100, insert pilot through both clutch discs and into pilot bearing in flywheel. Install bearing (10) and snap ring (11) in cover (9), align the previously affixed balance marks and install cover over pressure plates. Insert retaining bolts in their holes, turn assembly if necessary to align bolts with tapped holes in flywheel, then using a criss-cross pattern, tighten bolts until pto release levers and springs can be installed in cover.

NOTE: While tightening bolts it is essential that no binding occurs between pressure plate lugs and clutch cover and that belleville washer is correctly seated in recess in transmission pressure plate. Belleville washer can be seen through ventilation slots in cover.

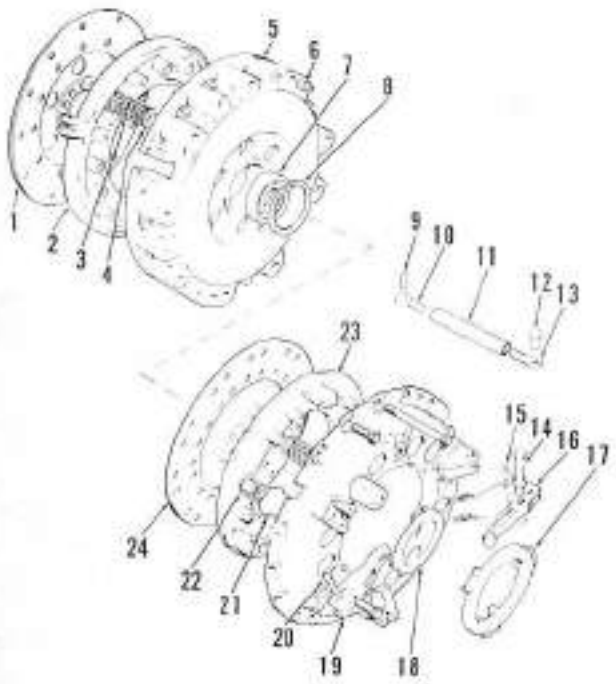


Fig. 103—Exploded view of 11 inch clutch used in some 1210 models and all 1212 models.

1. Pto disc
2. Pto pressure plate
3. Pto pressure springs
4. Insulating washers
5. Separator housing
6. Dowel
7. Ball bearing
8. Snap ring
9. Pin
10. Eye bolt
11. Turnbuckle
12. Pin
13. Eye bolt (L.H.)
14. Lever pin
15. Anti-rattle spring
16. Pto release lever
17. Pto release plate
18. Transmission release plate
19. Transmission release lever
20. Lever pin
21. Spring cup
22. Transmission pressure spring
23. Transmission pressure plate
24. Transmission disc

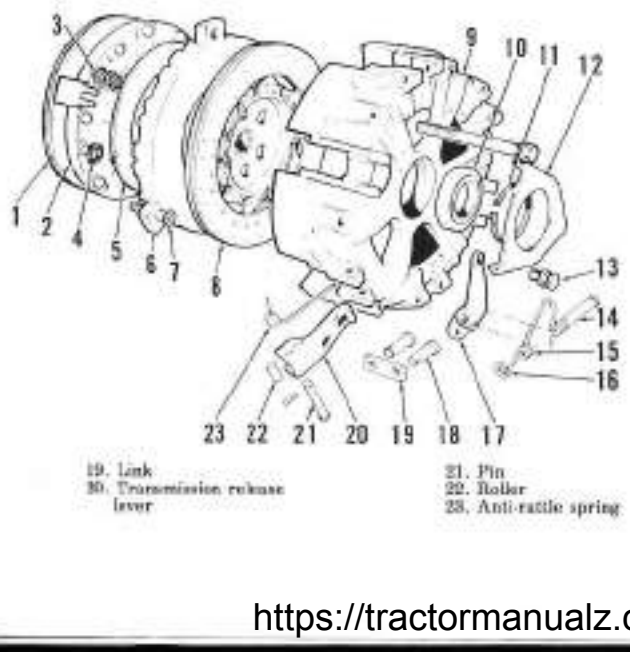


Fig. 104—Exploded view of Laycock clutch used on some 1210 models and all 1410 and 1412 models.

1. Pto disc
2. Pto pressure plate
3. Pressure springs
4. Fiber washers
5. Belleville washer
6. Transmission pressure plate
7. Adjusting screw
8. Transmission disc
9. Clutch cover
10. Bearing
11. Snap ring
12. Release lever plate
13. Adjusting screw
14. Pin
15. Anti-rattle spring
16. Washer
17. Pto release lever
18. Pin
19. Link
20. Transmission release lever
21. Pin
22. Roller
23. Anti-rattle spring

With pto levers and springs installed, continue to tighten cover bolts until cover is tight against flywheel then remove pilot. Install adjusting screws (7) in pressure plate (6), install locknuts but do not tighten at this time. Assemble rollers (22) in transmission release levers (20), position levers in cover, then position release lever plate (12) over release levers so ends of plate enter cut-outs in ends of release levers. Push long ends of springs (23) into levers (over roller) and enter end of springs into holes in ends of release plate. Align spring loops, holes in release levers and holes in cover, install pins (21) and secure with washers and cotter pins.

155. While clutch is still mounted on flywheel, adjust release levers as follows: Hold down on pto release lever and turn adjusting screw (13) as required until the distance from adjusting screw to face to flywheel is 5.125 inches, then tighten locknut. Hold down firmly on release lever plate and using square end of adjusting screw (7), turn adjusting screw as required until distance from flywheel face to release plate is 4.125 inches and tighten locknut.

Be sure each set of levers are adjusted equally and install retaining clips to pto levers to insure that belleville washer does not slip when removing clutch flywheel or during subsequent handling.

156. With release levers adjusted and retaining clips installed on pto release levers, remove clutch assembly from flywheel, then reinstall flywheel on engine crankshaft. Use pilot shown in Fig. 100 and reinstall clutch on flywheel.

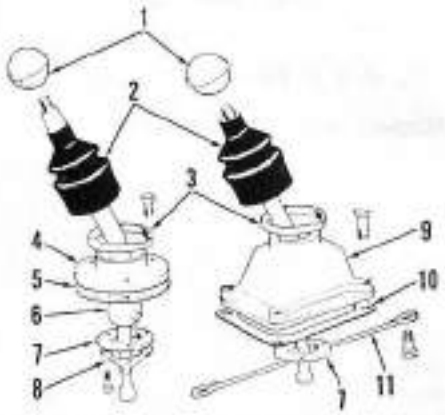


Fig. 105—Exploded view of shift levers typical of type used on all models.

1. Knobs
2. Dust boots
3. Clamps
4. Ball housing
5. Gasket
6. Gear shift lever
7. Support plate
8. Tab washer
9. Range lever ball housing
10. Gasket
11. Ball spring

TRANSMISSION

Models 885 and 885N are available with either a six or twelve speed synchromesh transmission. The twelve speed transmission is basically similar to the six speed transmission except that a reduction unit has been fitted on the front end plate of transmission which provides an underdrive ratio for all forward and reverse speeds.

Model 995 is equipped with the same twelve speed synchromesh transmission as used in the 885 and 885N model tractors.

Models 1210 and 1410 also are equipped with a twelve speed synchromesh transmission which differs somewhat from the twelve speed units used in the 885, 885N and 995 models.

Models 1212 and 1412 are equipped with a Hydra-Shift transmission which has two sections. The forward section is a semi-automatic, four speed planetary assembly and is followed by a rear constant mesh range gear section having three (creep, field and road) forward speeds and one reverse speed. The front four speed planetary section is hydraulically controlled and changes between any of the ratios can be made with tractor in motion without use of transmission clutch and without interruption of the power flow. Gear (range) speeds in the rear section are selected in the conventional manner and transmission clutch must be used.

SHIFT LEVERS

All Models

157. Refer to Fig. 105 and Fig. 106 for exploded views showing shift levers.

The shift lever assemblies are removable on all models by unbolting shift lever ball retainer from top of transmission cover. To disassemble, straighten the tab washer and unbolt lever support plate from bottom of ball retainer. Refer to appropriate exploded view for disassembly and reassembly guide and for identification of the different levers if all are removed at same time. Use new gaskets when reassembling and be sure to secure support plate cap screws by bending tab washer against all screws.

The shift rails are carried in the transmission assembly end plates. Refer to transmission overhaul procedure for removal and assembly of the shift

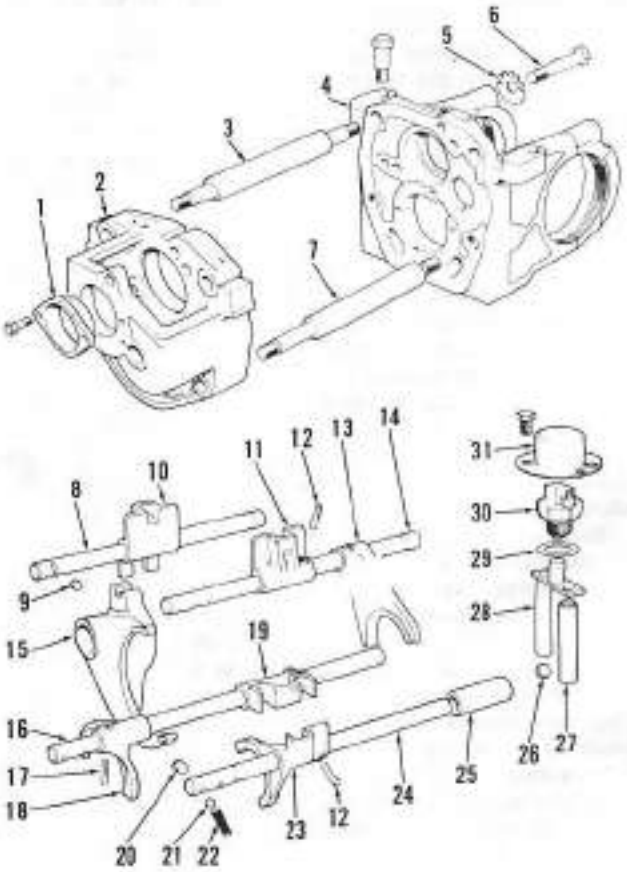


Fig. 106—View of end plates, shift rails and shift forks on Models 885, 885N and 995 six and twelve speed synchromesh transmissions. Front end plate (2) and some shift forks and rails will vary between six and twelve speed units.

1. Bearing housing
2. Front end plate
3. Top spacer bar (2)
4. Rear end plate
5. Tab washer
6. Diff. bearing cap bolt
7. Bottom spacer bar (2)
8. 2nd & 3rd shift rail
9. Gear lock
10. 2nd & 3rd selector
11. 1st & rev. selector
12. Pin
13. 1st & rev. shift fork
14. 1st & rev. shift rail
15. 2nd & 3rd shift fork
16. Slow/normal (creeper) shift rail
17. Pin
18. Shift fork
19. Selector
20. Gear lock
21. Detent ball (4)
22. Detent spring (4)
23. Shifter fork
24. Range shift rail
25. Sleeve
26. Steel ball (2)
27. Lower plunger
28. Plunger and plate
29. Shims (.002, .005, .010)
30. Starter safety switch
31. Cover

rails and forks. Fig. 107 shows cut-away view of typical transmission front plate shift rail bores, detent balls and spring and interlock pin location.

R & R TRANSMISSION COVER

Model 885

158. To remove transmission cover, proceed as follows: Disconnect throttle control rod and on manual steering models, remove steering gear arm from steering gear shaft then unbolt and remove steering gear. On power steering models, disconnect all lines from steering (servo) valve, then unbolt valve bracket and remove valve and steering column. Remove shift lever assemblies from top of transmission cover. Unbolt and remove transmission cover from tractor main frame. Note that five cover retaining cap screws extend through rear axle casting into rear end of cover.

If rear axle to cover and main frame gasket is damaged, remove all traces of gasket extending above tractor main frame; then, carefully cut top portion from new gasket and cement into place on rear axle casting. Using new gaskets, position cover on tractor main frame and loosely install all cover retaining cap screws. Install the shift lever assemblies using new gaskets and taking care that levers correctly engage shift rail forks. Tighten the rear cover retaining cap screws that extend through rear axle casting, then tighten remaining cover cap screws. Complete remainder of reassembly by reversing disassembly procedure.

Model 995

159. To remove transmission cover, first disconnect throttle control rod and on manual steering models, remove steering arm from steering gear, unbolt and remove steering gear unit. On power steering models, disconnect all lines from steering (servo) valve, then unbolt valve bracket and remove valve, steering column and bracket.

Remove the cap screws at front end of cover that extend into clutch cover, then remove the wedge and shims located between transmission cover and clutch cover. Unbolt and remove shift lever assemblies, then unbolt and remove transmission cover. Note that five cap screws extend through the rear axle casting into rear end of transmission cover.

Before reinstalling cover, check the rear axle housing to transmission cover and main frame gasket. If gasket is damaged, remove old gasket extending above main frame, then carefully cut top portion of new gasket and cement into place on rear axle housing. Using new gaskets, position cover on tractor main frame and loosely install all cover retaining cap screws except those extending into clutch housing. Install the shift lever assemblies using new gaskets and taking care that the levers correctly engage the shift rail forks. Tighten the rear cover retaining cap screws that extend through axle housing, then tighten the cover to main frame cap screws. Position the wedge between transmission cover and clutch cover with sufficient number of shims (0.040 thick) so that wedge will have to be driven into place with soft faced hammer, then install and tighten transmission cover to clutch cover cap screws on manual steering models, fill the steering gear cavity to ½-inch to top, then install steering gear assembly.

NOTE: The long cap screws will have to be inserted in steering gear before positioning it on transmission cover unless the fuel tank and instrument panel assembly has been removed.

Models 1210, 1212, 1410 and 1412

160. Transmission removal procedure is as follows: Remove seat and seat support assembly. Disconnect throttle linkage from lower end of throttle hand lever and remove hand lever. Disconnect engine stop control bracket. Disconnect battery cable, instrument panel wiring, tachometer drive and fuel lines, then remove fuel tank and instrument panel.

On models with manual steering disconnect drag link from drop arm, drain steering gear, then remove steering gear, steering column and steering wheel as an assembly.

On models with power steering, identify and disconnect lines from servo (control) valve, then remove bracket, valve, steering column and steering wheel as an assembly.

Remove the cap screws at front end of cover that extend into clutch cover, then remove the wedge and shims located between transmission cover and clutch cover. Unbolt and remove the shift lever assemblies (and control valve rod on Hydra-Shift models), then unbolt and remove transmission cover. Note that five cap screws extend through the rear axle casting into rear end of transmission cover.

Before reinstalling cover, check the rear axle housing to transmission cover and main frame gasket. If gasket is damaged, remove old gasket extending above main frame, then carefully cut top portion of new gasket and cement into place on rear axle housing. Using new gaskets, position cover on tractor main frame and loosely install all cover retaining cap screws except those extending into clutch housing. Install the shift lever assemblies using new gaskets and taking care that the levers correctly engage the shift rail forks. Tighten the rear cover retaining cap screws that extend through axle housing, then tighten the cover to main frame cap screws. Position the wedge between transmission cover and clutch cover with sufficient number of shims so that wedge will have to be driven into place wth soft faced hammer, then install and tighten transmission cover to clutch cover cap screws, on manual steering models, fill the steering gear cavity to ½-inch to top, then install steering gear assembly. Complete balance of reassembly and bleed hydraulic system and power steering system if so equipped.

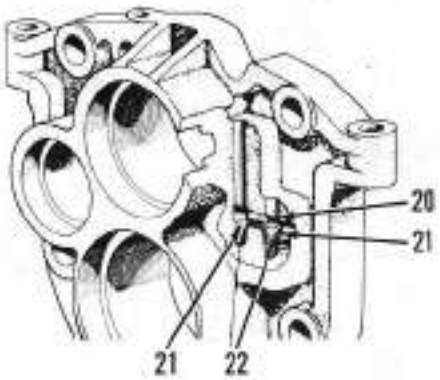


Fig. 107—Cut-away view of transmission front plate for six-speed transmission showing detent ball and spring location and interlock pin for low/reverse and 2nd/3rd shift rails. Other models are similar.

R & R TRANSMISSION

Models 885, 885N and 995

161. On models with 12-speed transmission, the transmission must be removed from rear as outlined in paragraph 164. On models with 6-speed transmission, the transmission can be removed by lifting from main frame as outlined in paragraph 165, however, depending on service required it may be as quick to follow the procedure outlined in paragraph 164.

Models 1210-1410

162. To remove transmission assembly from Models 1210 and 1410, follow procedure outlined in paragraph 165.

Models 1212-1412

163. To remove transmission from Models 1212 and 1412, follow procedure outlined in paragraph 164.

R & R TRANSMISSION FROM REAR

164. To remove transmission by splitting tractor between rear axle casting and main frame, proceed as follows:

Drain transmission and on models with Hydra-Shift transmission, remove transmission filter housing cover and remove filter. Unbolt and remove drawbar and lift linkage. Disconnect sensing unit cable and remove sensing unit, then remove pto housing and gear unit. Withdraw pto cardan (drive) shaft from rear end of tractor. Unbolt hydraulic pump inlet line from hydraulic pump. Remove both final drive units as outlined in paragraph 207. Remove oil seal housing from right end of axle housing, then reaching through opening, disengage differential lock sliding sleeve and spring from the differential right side gear. Attach hoist to rear axle housing, then unbolt and remove housing from tractor main frame and transmission cover; axle housing will have to be pried off locating dowels. Remove transmission cover following the general procedures given in paragraphs 158, 159 and 160. Remove the transmission oiling tubes and the cap screws and spacers attaching transmission to tractor main frame. Attach hoist to transmission (do not lift), then slide transmission rearward and lift unit from tractor main frame. Be sure not to lose any of the shims located at rear of coupling joining clutch shaft to transmission input shaft on models so equipped.

To reinstall transmission, reverse removal procedure. On models so equipped, place the muff coupling shims on transmission input shaft. Position the transmission assembly on tractor main frame and install the retaining cap screws without the spacer bushings. Tighten the cap screws securely, then loosen the nuts on front end of spacer bars. Tap each spacer bar with soft faced hammer to align the transmission unit, then retighten the spacer bar nuts to a torque of 70 ft.-lbs. Remove the transmission retaining cap screws, insert the spacer bushings in the cap screw holes, then reinstall and tighten the retaining cap screws to a torque of 100 ft.-lbs. On models with muff coupling, check muff coupling end float; if not within limits of 0.010 to 0.040, disengage snap ring at front end of the coupling, slide coupling forward and add or remove shims as required. Complete balance of reassembly by reversing removal procedure on models with Hydra-Shift transmission renew transmission filter, then on all models refill transmission with proper lubricant and bleed the hydraulic system.

R & R TRANSMISSION FROM ABOVE

165. To remove transmission without removing rear axle housing from tractor main frame, proceed as follows:

Remove the pto housing and gear assembly, then withdraw the pto cardan (drive) shaft from rear end of tractor. Remove the final drive units. Remove the oil seal housing from right end of axle housing and reaching through the opening, disengage differential lock sleeve and spring from differential side gear.

Remove transmission cover, then on six speed transmission disengage the snap ring at front side of muff coupling, then slide snap ring and coupling forward as far as possible.

Remove the transmission oiling tubes, cap screws and the spacer bushings retaining transmission to tractor main frame. Attach hoist to transmission and lift the assembly, front end first, out of tractor main frame. Slide the transmission forward as it is lifted to clear the rear axle housing.

To reinstall transmission, reverse removal procedure and observe the following: Using hoist, lower the transmission unit, rear end first, into tractor frame. Slide the transmission unit rearward as the front end is lowered into position. Install the retaining cap screws without the spacer bushings, tighten the cap screws and loosen the four spacer bar nuts. Tap each spacer bar with a soft faced hammer to align transmission end plates, then tighten the spacer bar nuts to a torque of 70 ft.-lbs. Remove the cap screws, install the spacer bushings, then reinstall and tighten the cap screws retaining transmission to tractor main frame to a torque of 100 ft.-lbs. Be sure the muff coupling shims are on transmission input shaft, slide coupling into position and engage snap ring in groove at front side of coupling. Vary shim thickness at rear side of coupling as required to obtain coupling end float of 0.010-0.040.

Complete balance of ressembly by reversing disassembly procedure. Refill the transmission with proper lubricant and bleed the hydraulic system.

OVERHAUL TRANSMISSION

Models 885, 885N and 995

166. With transmission removed as outlined in paragraph 161, mark differential bearing caps, then remove bearing caps and lift differential from rear end plate. Engage first gear, wedge two gears so bevel pinion shaft is locked, then loosen but do not remove pinion shaft nut.

NOTE: Pinion shaft nut is left hand thread.

On twelve speed transmissions, push shifter fork in creeper unit forward to preclude bending of shifter rail, drive pin out of shifter fork and rail, then push shifter rail rearward to free detent ball and drive pin from selector and shift rail. Remove shift rail.

Unscrew bevel pinion nut, remove washer and bearing, then reinstall nut. Remove the four nuts which retain front end plate to spacer bars, tap front end plate forward a short distance. Tap the high/low range and 2nd/3rd gear shift rails toward rear until front end plate can be moved far enough forward to allow shift rails to clear detent balls, then push 1st/rev. shifter rail rearward to release its detent balls. Place finger over detent balls as they are uncovered so they will not fly out. When shifter rails are clear of detents, front end plate removal can be completed. Turn front end plate on its side after removal so interlock pins and detent springs will fall out. Raise (lift) top shaft slightly, remove idler shaft (36-Fig. 108), then remove complete top shaft and save shims (23) located behind rear bearing (22).

Remove nut, spacers, shims and special (splined) washer from pinion shaft, then slide 3rd (high) gear (47) from pinion shaft and retrieve bearing pads (48). Remove the sliding gear and synero cones (50) and slide shifter fork off the spacer bar at the same time. Remove first drive collar (dog clutch) (49), then remove snap ring and remove second drive collar (dog clutch) and 2nd gear (53) and retrieve bearing pads (52). Remove special (splined) washer (54), split ring (55) and 1st (low) gear (56), then withdraw pinion shaft rearward from rear end plate.

On twelve speed transmission, the creeper gear idler gear assembly is mounted in the front end plate and can be removed by removing lock (27) and pushing spindle (28) from front end plate.

167. Clean and inspect all parts and pay particular attention to the following: If jumping out of gear has been a problem, check fit of detent

balls in grooves of shifter rails as well as detent springs, depth of spring holes and gear teeth. Shift rails have grooves with straight 60 degree sides and the detent spring hole depth is 1-1/8 inches grooves. If necessary, grind groove bottom taking care not to touch sides, until detent ball has sufficient clearance at bottom of groove. Detent springs have a free length of 1¼ inches and detent spring hole depth is 1-1/8 inches below shift rail bore. If detent spring holes are too keep, use suitable shims during reassembly.

Gear teeth should be evenly marked along length of teeth. If gear teeth have been shaved, or show irregular wear pattern, the gear should be renewed along with its mating gear.

The cups and gears (47 and 53-Fig. 108) of synchromesh mechanism are riveted together, however after a short time some radial clearance (looseness) may develop. This radial clearance is not detrimental to operation of the mechanism. The sliding gear and synchro cones (50) are also riveted together and no attempt should be made to disassemble it. The only parts that can be removed are the six centralizer springs (51) and they should slide easily in their grooves with no binding. Note that the synchro cones are faced with a molybdenum deposit which has been sprayed on and while not a smooth finish, care must be taken not to chip or scratch finish on cones.

168. Fore and aft position of the bevel pinion shaft is adjusted by changing the thickness of shims (58-Fig. 108). End play of idler shaft (32) is adjusted by varying the thickness of shims (34). To determine the thickness of shims (58) to install, use special Churchill tool Number DB. 8208. To determine correct thickness of shims (34), proceed as follows: Assemble the spacer bars (61 & 62), rear end plate (63) and front end plate (64), with bearings (35 & 37) and idler shaft (36) in position. Be sure bearing cups are fully seated, then check end play of idler shaft.

NOTE: It is important that idler shaft have some end play when making this check. If idler shaft does not have end play, remove front bearing cup and some shims (34), then reassemble and recheck.

Be sure that spacer bar nuts are tightened to 70 ft.-lbs. torque. Disas-

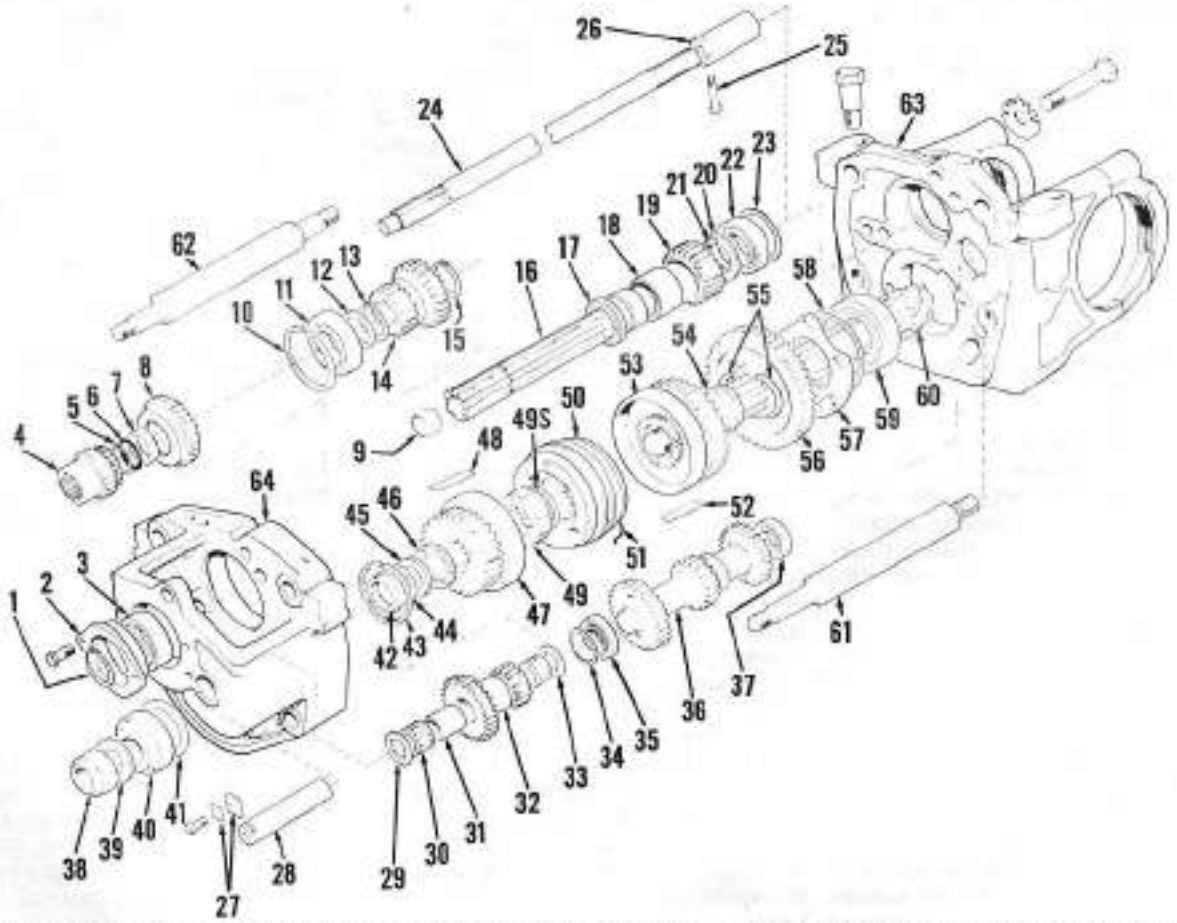


Fig. 108—Exploded view of shafts and gears which comprise the six and twelve speed transmissions used in Models 885, 885N and 995. Items 1 through 8 and 27 through 33 are used in twelve speed transmission only.

1. Snap ring
2. Bearing housing
3. Needle bearing
4. Driving gear
5. Snap ring
6. "O" ring
7. Oil seal
8. Driven gear
9. Bushing
10. Snap ring
11. Ball bearing
12. Spacer
13. Snap ring
14. Range pinion
15. Snap ring
16. Drive shaft
17. Carrier bushing
18. Bushing
19. Reverse gear
20. Thrust washer
21. Pin
22. Ball bearing
23. Shims (.003, .005, .020)
24. Pto shaft
25. Coupling bolt
26. Coupling
27. Lock plate and locator plate
28. Spindle
29. Thrust washer
30. Needle bearing
31. Spacer
32. Idler shaft & gears
33. Thrust washer
34. Shims (.002, .003, .007, .010)
35. Roller bearing
36. Idler shaft & gears
37. Roller bearing
38. Nyloc nut (left hand thread)
39. Washer
40. Roller bearing
41. Spacer
42. Spacer
43. Snap ring
44. Shims (.002, .005, .010, .030)
45. Spacer
46. Special washer
47. High gear
48. Bearing pad (6)
49. Drive collar (dog clutch gear)
49S. Snap ring
50. Sliding gear & cones
51. Spring (8 used)
52. Bearing pad (6)
53. Medium gear
54. Special washer
55. Split ring
56. Low gear
57. Bearing plate
58. Shim (.002, .003, .010, .030)
59. Roller bearing
60. Bevel pinion shaft
61. Lower spacer bars
62. Upper spacer bars
63. Rear end plate
64. Front end plate

semble and add enough shims (34) in front of bearing (35) to reduce end play of idler shaft (36) to 0.002-0.004 inch. Check end play after changing thickness of shims to be sure of correct adjustment.

169. To assemble, proceed as follows: Position pinion shaft (60-Fig. 108), bearing (59) and correct shims (58) into bore of rear end plate (63). Be sure that screws for retaining plate (57) are tight. Slide first gear (56) over shaft splines and assemble fork (13-Fig. 106), selector (11) and rod (14). Install split ring halves (55-Fig. 108) and special washer (54). Position second gear (53) against special washer. Coat the six bearing strips (48 & 52) with grease, then position on splines of pinion shaft. Slide one of the two drive collars (49) onto shaft, with relieved teeth toward front. Notice also that one of the teeth is punch marked. Install snap ring (49S) then install the remaining drive collar (49) onto shaft with relieved teeth toward rear and punch marked tooth aligned with punch marked tooth of previously installed drive collar. Install sliding gear and cones (50) into position along with the appropriate selector fork. Check to be sure that sliding gear (50) moves smoothly on drive collars and that shift fork moves freely on lower space bar. Install third gear (47). Grease the six remaining bearing strips and position them in splines of bevel pinion shaft. Install splined washer (46) and spacer (45).

Install drive shaft (16), complete with reverse gear (19), range gear (14) and associated parts. Install the range selector fork (23-Fig. 106) and selector rod (24) at the same time. Be sure that sleeve (25) is in position at rear of selector rod.

On 12 speed models, assemble the auxiliary reduction as follows: Measure assembled length of thrust washers (29 & 33-Fig. 108), roller bearings (30) and spacer (31), then measure space in front end plate. The space in the front end plate must be 0.010-0.050 inch more than assembled bearing assembly to assure clearance for bearing cages to rotate. The spacer (31) may be carefully shortened if necessary to provide clearance. Oil gears (32), bearings (30), thrust washers (29 & 33) before assembling and installing spindle (28). Install lock plate and locator plate (27). Bend lock plate up around screw after tightening.

Slide the front end plate (64) onto spacer bars (61 & 62) until selector rails begin to enter holes in end plate. Install first/reverse gear detent spring and ball in front end plate, use a suitable tool to push ball against spring, then push selector rod into position over detent ball. Move selector rod to neutral position and install locking plunger (9-Fig. 106). Install detent spring and ball for second/third gear shift rail, use a suitable tool to push ball against spring, then move rail forward over detent ball.

Install range selector rod (24), creeper selector rail (16), detent springs (22), detent balls (21) and locking plunger (20) in a similar way. Install shift fork (18) and gear (8-Fig. 108), but do not install locating pin in fork or selector. Install nuts on spacer bars (61 & 62). Install original shims (44) plus approximately 0.008 inch to provide a measureable amount of end play. Install spacer (42), spacer (41), bearing (40), washer (39) and nut (38). Be sure that outer race of bearing (40) is seated firmly against spacer (41) and snap ring (43), then tighten nut (38). Measure end play of bevel pinion shaft (60) with a dial indicator. Remove nut (38), washer (39), bearing (40) and spacer (42), then remove shims (44) equal in thickness to the measured end play. Reassemble and measure end play again. When assembled with correct thickness of shims (44), bevel pinion should have 0.002 inch end play to 0.002 inch bearing pre-load.

On 12 speed models, install pin through selector (19-Fig. 106) and rod (16), then install pin (17) through fork (18) and rod (16). Check to be sure that pins are correctly installed and shift interlocks work correctly.

Models 1210 and 1410

170. With transmission removed, proceed as follows:

Mark the differential bearing caps so they can be reinstalled in same position, then unbolt and remove the caps and the differential assembly. Refer to paragraph 204 for overhaul of the differential and bevel ring gear assembly.

Lock the transmission by engaging two gears at once, then unscrew (left-hand threads) pinion shaft nut (38-Fig. 112 or Fig. 113). Remove tapered roller bearing cone (40), spacers (42 & 45) and the bearing adjusting shims (44) from front end of bevel pinion shaft. Turn transmission bottom side up and withdraw bevel pinion shaft (60) from rear end of transmission, leaving gears suspended on shift forks inside transmission.

Remove the four spacer bolt nuts from front end of transmission and withdraw the two upper bolts (62) from rear. Remove snap ring (82) at rear end of drive shaft (16), then bump rear end plate (63) from transmission while tapping drive shaft forward out of ball bearing (22). Remove spacer housing (65) from transmission; it will be necessary to turn housing as it is

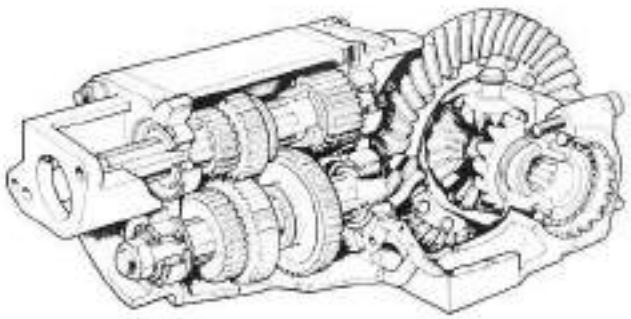


Fig. 109—Cross-section of six speed transmission typical of 1210 models.

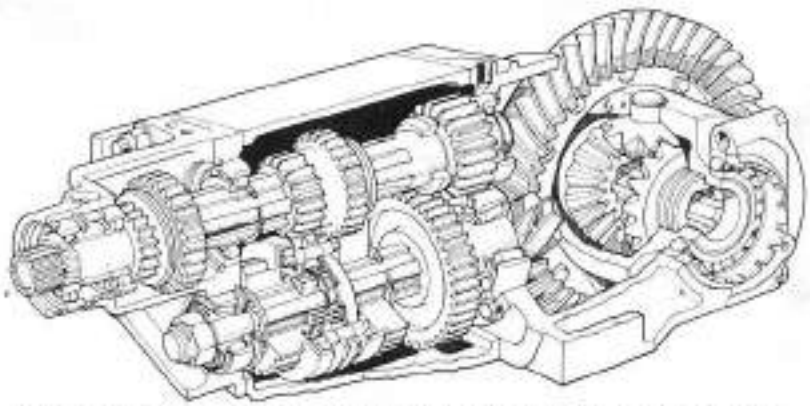


Fig. 110—Cross-section of twelve speed transmission typical of 1210 models.

removed from front end plate (64) and gears. Setting transmission in vertical position with front end down will aid in removing spacer housing.

The pinion shaft gears, idler shaft, drive shaft assembly, shift rails and forks can now be removed from transmission front end plate. To remove drive shaft rear bearing (22), remove the retaining bolt (66) and washer, then push bearing forward out of rear end plate. Pinion rear bearing cup retainer (57), mesh adjusting shims (58) and bearing cup can now be removed from rear end plate. Remove pinion front bearing cup (40) and spacer (41) from front side of front end plate. Idler shaft front bearing (35) cup and adjusting shims (34) can be removed from front end plate and rear bearing (37) cup from rear end plate.

On 12-speed models, refer to Fig. 112 or 113) and proceed as follows: Remove pin (67), push creeper drive shift rail (69) from front end plate (64) and remove shift fork (68), detent ball, detent spring and interlock pin (70). Lift creeper driven gear (8) from front end plate. Remove snap ring (39) from front end of creeper drive gear (4), then remove gear, bearing (76) and spacers (77 & 78) from rear side of front end plate. Remove snap ring (1) from bearing (79) from end plate. Remove spring pin (27) and drive idler shaft (28) forward, removing plug (not shown) from bore with shaft. Lift idler gears (32) with thrust washers from front end plate. Needle bearings (30) are retained by thrust washers (29 & 33) at each end and separated by a spacer sleeve (31). When assembled, spacer sleeve end play between bearing cages should be 0.020-0.050.

Carefully clean and inspect all parts and renew any not suitable for further service. Bushing (9) in front end of drive shaft (16) and bushing (18) in reverse idler gear (8) are renewable if shaft and/or gear are otherwise suitable for further service. Reassemble transmission as follows:

171. To reassemble transmission, first refer to paragraph 201 and adjust

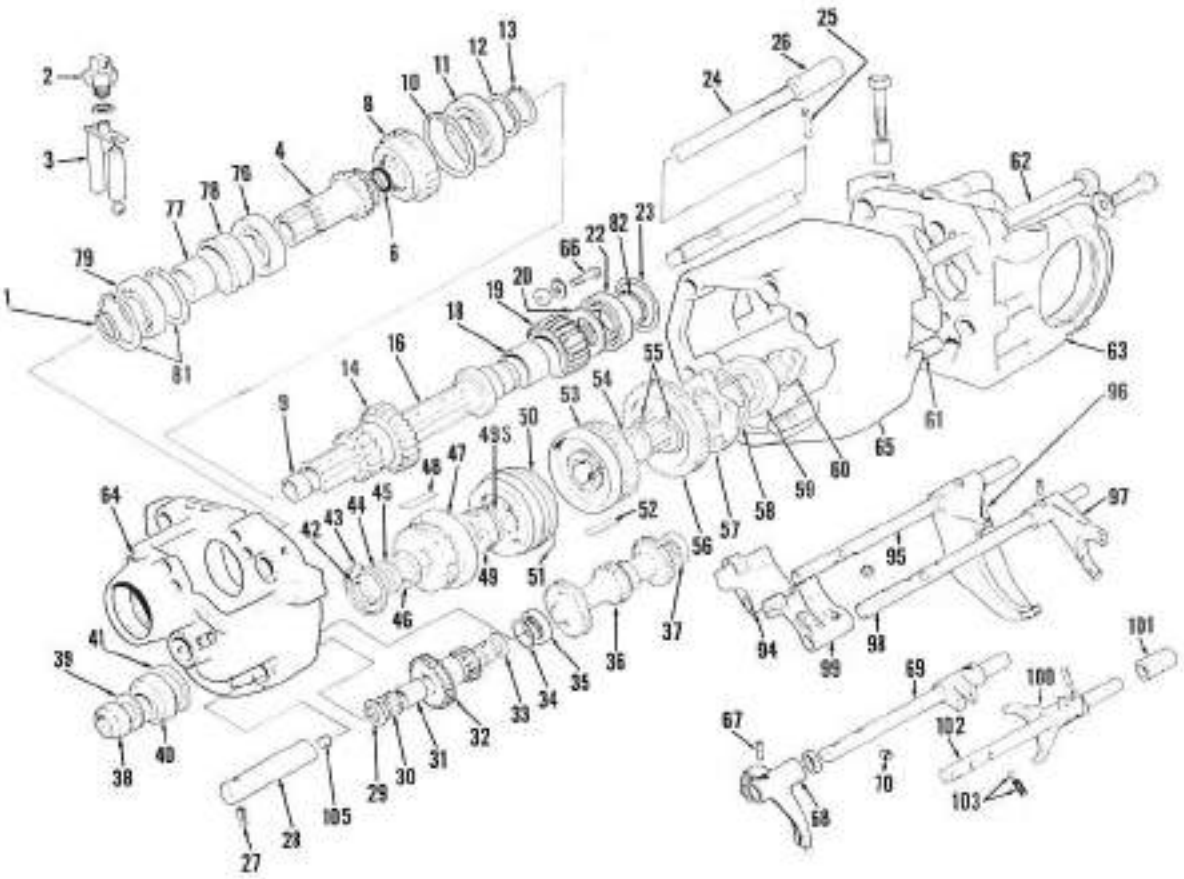


Fig. 112—Exploded view of transmission gears, shafts and associated parts used for Model 1210. Refer to Fig. 108 for 885, 885N and 995 models and to Fig. 113 for 1410 model.

1. Snap ring
2. Starter safety switch
3. Plungers, plate & 3/8-inch steel balls
4. Driving gear
6. Sealing ring
8. Driven gear
9. Bushing
10. Snap ring
11. Ball bearing
12. Spacer
13. Snap ring
14. Range pinion
16. Driveshaft
18. Bushing
19. Reverse gear
20. Thrust washer
22. Ball bearing
23. Shims (.005, .005, .020 in.)
24. Pto shaft
25. Coupling bolt
26. Coupling
27. Locating pin
28. Spindle
29. Thrust washer (same as 33)
30. Needle bearing (2 used)
31. Spacer
32. Idler shaft and gears
33. Thrust washer (same as 29)
34. Shims (.002, .005, .007, .010 in.)
35. Roller bearing (same as 37)
36. Idler shaft & gears
37. Roller bearing (same as 35)
38. Nyloc nut (left hand thread)
39. Washer
40. Roller bearing
41. Spacer
42. Spacer
43. Snap ring
44. Shims (.002, .005, .010, .030 in.)
45. Spacer
46. Special washer
47. High gear
48. Bearing pad (same as 52)
49. Clutch dog gear
49S. Snap ring
50. Sliding gear & cones
51. Spring (6 used)
52. Bearing pad (same as 48)
53. Medium gear
54. Special washer
55. Split ring
56. Low gear
57. Bearing plate
58. Shims (.002, .008, .010, .030 in.)
59. Roller bearing
60. Bevel pinion shaft
61. Lower studs
62. Upper screws
63. Rear end plate
64. Front end plate
65. Spacer housing
66. Retainer screw and washer
67. Pin
68. Slow-normal shift fork
69. Shift rail
70. Interlock plunger (2 used)
76. Roller bearing
77. Spacer
78. Spacer
79. Ball bearing
81. Snap ring
82. Snap ring
94. Selector jaw (2nd & 3rd)
95. Shift rail
96. Shift fork (2nd & 3rd)
97. Shift fork (1st & Rev.)
98. Shift rail
99. Selector jaw (1st & Rev.)
100. Shift fork (high-low)
101. Sleeve
102. Shift rail
103. Detent spring & ball (4 used)
105. Plug (7/16-in.)

pinion mesh position, then proceed as follows:

Install idler shaft front bearing (35) cup in front end plate without shims and install rear bearing (37) cup in rear end plate. Assemble the end plates to spacer housing with only the idler shaft and bearings in place and tighten spacer bolt nuts to a torque of 80 ft.-lbs. Insert pinion shaft through the end plates, then install spacers (41, 42 & 45) with shims (44) as removed on disassembly, bearing cone (40), flat washer (39) and nut (38). Tighten pinion shaft nut to a torque of 200 ft.-lbs.

NOTE: Temporarily install differential assembly to hold pinion shaft from turning while tightening nut.

Check pinion shaft end play and, if necessary, add or remove shims (44) between the spacers (42 & 45) to obtain end play of 0.001-0.002. Check idler shaft end play and record end play for shim selection on reassembly. Remove bevel pinion shaft nut, front bearing cone, spacers and shims and retain for reassembly. Withdraw pinion shaft and disassemble the end plates, spacer housing and idler shaft.

To provide proper idler shaft end play, remove front bearing cup from front end plate and install shims of thickness equal to measured end play less 0.002-0.004 shim thickness, then reinstall bearing cup. Then, reassemble transmission by reversing disassembly

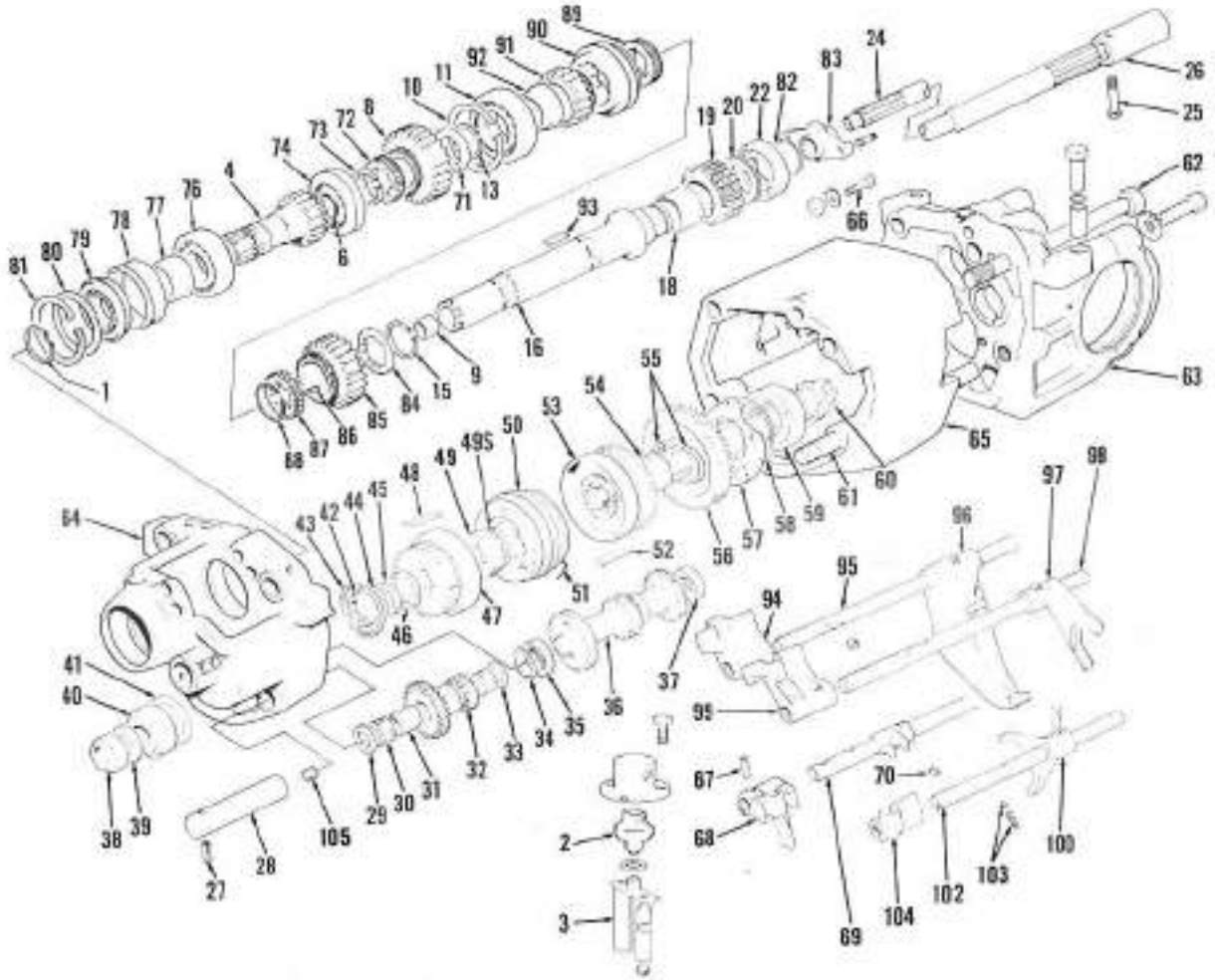


Fig. 113—Exploded view of transmission gears, shafts and associated parts used for 1410 models. Refer also to Fig. 108 and 112.

1. Snap ring
2. Starter safety switch
3. Plungers, plate & 3/8-inch steel balls
4. Driving gear
5. Sealing ring
6. Driven gear
7. Bushing
10. Snap ring
11. Ball bearing
12. Snap ring
16. Drive shaft
18. Bushing
19. Reverse gear
20. Thrust washer
22. Ball bearing
24. Pto shaft
25. Coupling bolt
26. Coupling
27. Locating pin
28. Spindle
29. Thrust washer (same as 33)
30. Needle bearing (2 used)
31. Spacer
32. Idler shaft and gears
33. Thrust washer (same as 29)
34. Shims (.002, .005, .007, .010 in.)
35. Roller bearing (same as 37)
36. Idler shaft & gears
37. Roller bearing (same as 35)
38. Nyloc nut (left hand thread)
39. Washer
40. Roller bearing
41. Spacer
42. Spacer
43. Snap ring
44. Shims (.002, .005, .010, .030 in.)
45. Spacer
46. Special washer
47. High gear
48. Bearing pad (same as 52 & 86)
49. Clutch dog gear
49S. Snap ring
50. Sliding gear & cones
51. Spring (6 used)
52. Bearing pad (same as 48 & 86)
53. Medium gear
54. Special washer
55. Split ring
56. Low gear
57. Bearing plate
58. Shims (.002, .005, .010, .030 in.)
59. Roller bearing
60. Bevel pinion shaft
61. Lower studs
62. Upper screws
63. Rear end plate
64. Front end plate
65. Spacer housing
66. Retainer screw and washer
67. Pin
68. Shift fork (slow-normal)
69. Shift rail
70. Interlock plunger (2 used)
71. Special washer
72. Fixed dog clutch
73. Snap ring
74. Sliding dog clutch (slow-normal)
76. Roller bearing
77. Spacer
78. Spacer
79. Ball bearing
80. Spacer
81. Snap ring
82. Snap ring
83. Special washer
85. High range gear
86. Bearing pad (same as 48 & 52)
87. Fixed dog clutch (same as 89)
88. Snap ring
89. Fixed dog clutch (same as 87)
90. Low-High sliding gear
91. Low speed gear
92. Shouldered bushing
94. Selector jaw (2nd & 3rd)
95. Shift rail
96. Shift fork (2nd & 3rd)
97. Shift fork (1st & Rev.)
98. Shift rail
99. Selector jaw (1st & Rev.)
100. Shift fork (high-low)
102. Shift rail
103. Detent spring and ball (4 used)
104. Selector jaw
105. Plug (7/16-inch)

1. Plate
2. Center housing
3. Spacer
4. Shims (0.002, 0.005, 0.015 & 0.030 in.)
5. Roller bearing
6. Drive shaft
7. Roller bearing
8. Pin shaft
9. Coupling
10. Bevel pinion and shaft
11. Roller bearing
12. Shims (0.002, 0.005, 0.015 & 0.030 in.)
13. Spacer
14. First range gear
15. Roller bearing & inner race (2 used)
16. Sliding dog clutch (same as 22)
17. Fixed dog clutch (same as 23)
18. Third range gear
19. First range gear
20. Collar
21. Shims (0.002, 0.005, 0.015 & 0.030 in.)
22. Sliding dog clutch (same as 16)
23. Fixed dog clutch (same as 17)
24. Second range gear
25. Roller bearing & inner race
26. Spacer
27. Spacer
28. Roller bearing
29. Washer
30. Nut (left hand thread)
31. Locknut
32. Grub screw
33. Shims (0.002, 0.005, 0.015 & 0.030 in.)
34. Roller bearing (same as 36)
35. Layshaft
36. Roller bearing (same as 34)

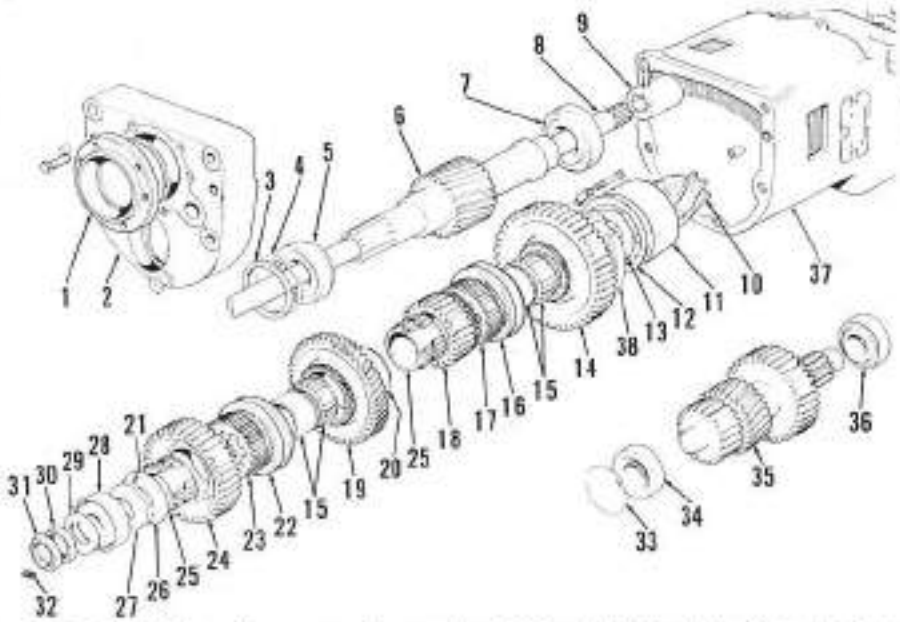


Fig. 115—Exploded view of range gear box used on 1212 and 1412 models. Center housing (2) and plate (1) are also shown in Fig. 116.

procedure. Tighten spacer bolt nuts to a torque of 70 ft.-lbs. and pinion shaft nut to a torque of 200 ft.-lbs. Reinstall differential assembly and adjust bevel gear backlash and carrier bearings as outlined in paragraphs 202 and 203.

Models 1212 and 1412

175. Remove transmission from rear as outlined in paragraph 164. Identify and mark the two sequence valves (1 & 2-Fig. 120) so that valves can be reinstalled in original locations. Valves are alike but are adjusted to different settings. Remove both brake cylinders (61-Fig. 116 and Fig. 119) and loosen fixed ends of bands (53 & 84-Fig. 116). Remove snap rings (59-Fig. 116 and Fig. 119), flat washer (58) and nuts, then withdrsw springs (55) and piston stops (54). Unbolt and remove support

1. Plate
2. Center housing
37. Freewheeling unit
38. Abutment plate
39. Ball bearing
40. Carrier end cover
41. Spacer (between bearing 43)
42. Bearing pins
43. Roller bearings (6 used)
44. Thrust washer
45. Spacer blocks
46. Sun gear (24 teeth)
47. Planet gears
48. Carrier
49. Backing plate (0.184, 0.192, 0.198 or 0.204 in.)
50. Bronze plates (3 grooved & 1 plain)
51. Conical washer
52. Plug
53. Rear brake band
54. Stop
55. Spring
56. Sleeve
57. Spherical washer
58. Flat washer
59. Snap ring
60. Piston
61. Cylinder
62. Steel plate
63. Thrust washer
64. Inner springs (9 used, each clutch)
65. Outer spring (18 used, each clutch)
66. Clutch piston
67. Inner seal ring
68. Outer seal ring
69. Cylinder
70. Ball bearings
71. Drive shaft
72. Thrust washer
73. Seal rings
74. Housing
75. Plate
76. Carrier end cover
77. Bearing pins
78. Roller bearings (6 used)
79. Sun gear
80. Planet gears
81. Carrier
82. Backing plate (0.184 & 0.192 in.)
83. Bronze plates (2 grooved)
84. Front brake band
85. Conical washer
86. Plug
87. Thrust washer
88. Bushing
89. Seal ring
90. Drive shaft
91. Thrust washer
92 Steel plates
93. Clutch piston
94. Cylinder
95. Wedgelock screws (4 used)
96. Support sleeve
97. Bushing
98. End plate
99. Oil seal
100. "O" rings
101. Support snout
102. Studs
103. Locating screws and locknuts

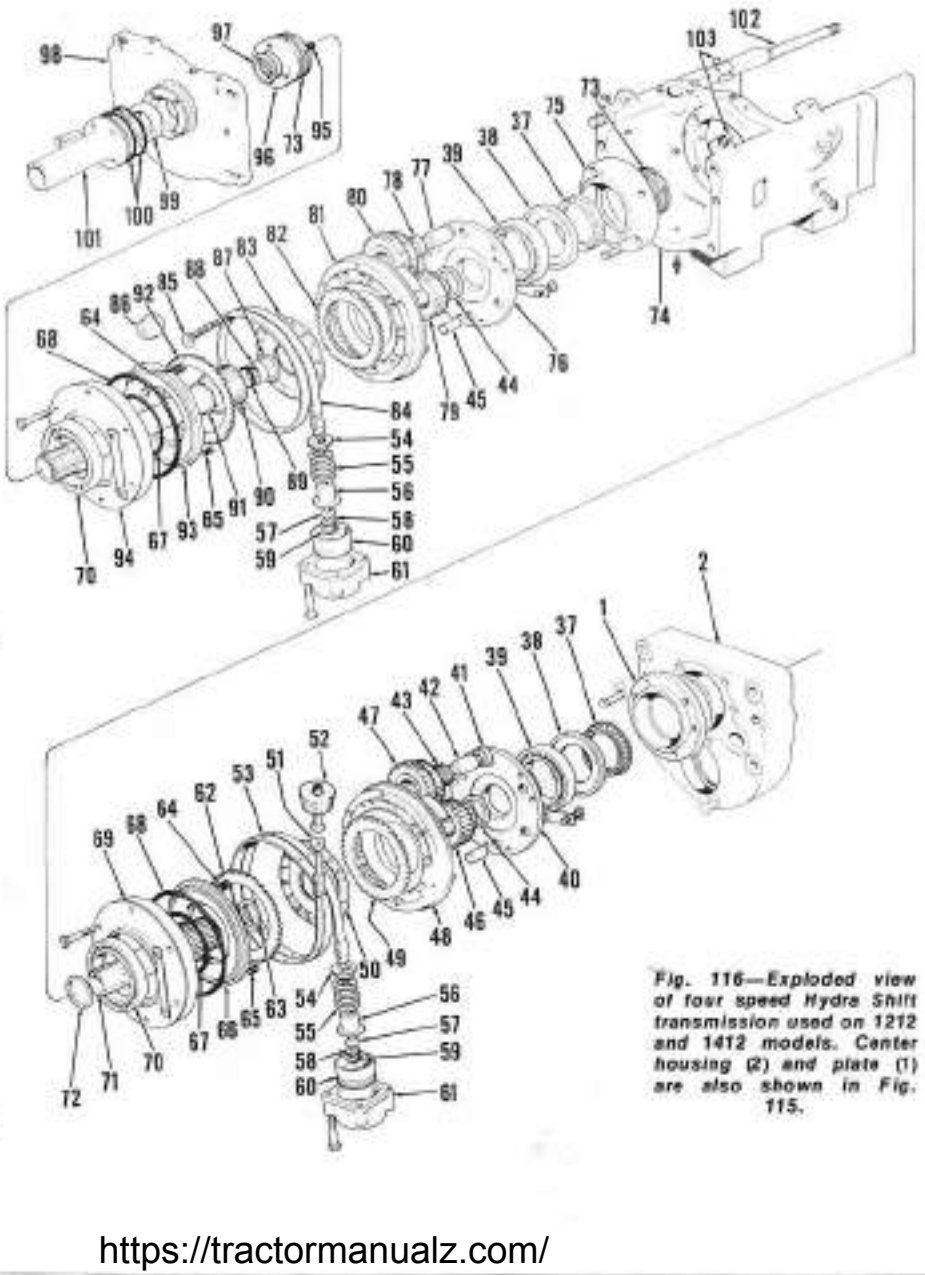


Fig. 116—Exploded view of four speed Hydra Shift transmission used on 1212 and 1412 models. Center housing (2) and plate (1) are also shown in Fig. 115.

snout (101-Fig. 116), then unbolt and remove front end plate (98). Rotate front unit so that one planet gear is at top of case, move upper ends of band inside case then remove band by withdrawing fixed end first, piston end last. Be sure that one planet gear is toward top, then carefully lever unit forward until clear of bearing, then withdraw from case. Withdraw abutment plate (38) and freewheel unit (37). Remove the four speed section casting (74) complete with rear planetary unit. The rear planetary unit can be withdrawn if desired after removal of complete unit. To disassemble planetary units, mark all three parts of carrier, unlock tab washers, then loosen the six screws evenly. If springs do not cause parts to separate, bump parts gently before removing screws. Mark original location of bushings, shafts and planet gears if any is to be reinstalled.

To disassemble range gear box, mark differential carrier caps for correct installation, remove caps, then lift differential out. Install a 13½ inch long, ½-inch diameter tube over each of the four case studs, install a washer and nut on each stud to clamp end plate in place temporarily. Check and record

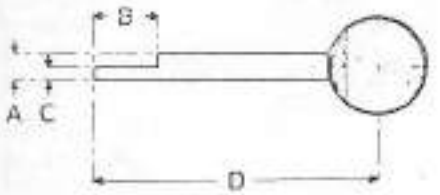


Fig. 117—A special tool can be fabricated to help install detent springs, detent balls and shift rails. Rod diameter (A) should be 3/8-inch, length of cut-away (B) should be 5/8-inch, depth (C) should be 3/16-inch. Overall length (D) should be about 6 inches.

Fig. 118—Exploded view of shift controls for Hydra Shift models. Valve (1) is shown as (4) in Fig. 120 and forks (22 & 23) move sliding dog clutches (16 & 22—Fig. 115).

1. Control valve
2. Fork end
3. Pin
4. Rod
5. Knob
6. Hydra Shift lever
7. Pin
8. Pin
9. Cover
10. Starter safety switch
11. Shims (0.002, 0.005 & 0.010 in.)
12. Plunger & plate
13. Steel balls 3/8-in. (2 used)
14. Plunger
15. Knob
16. Range shift lever
17. Boot
18. Clip
19. Ball housing
20. Support plate
21. Tab washer
22. Selector fork (2nd & Rev.)
23. Selector fork (1st & 3rd)
24. Pin
25. Shift rail (1st & 3rd)
26. Shift rail (2nd & Rev.)
27. Detent ball 3/8-in. (2 used)
28. Detent spring (2 used)
29. Interlock plunger

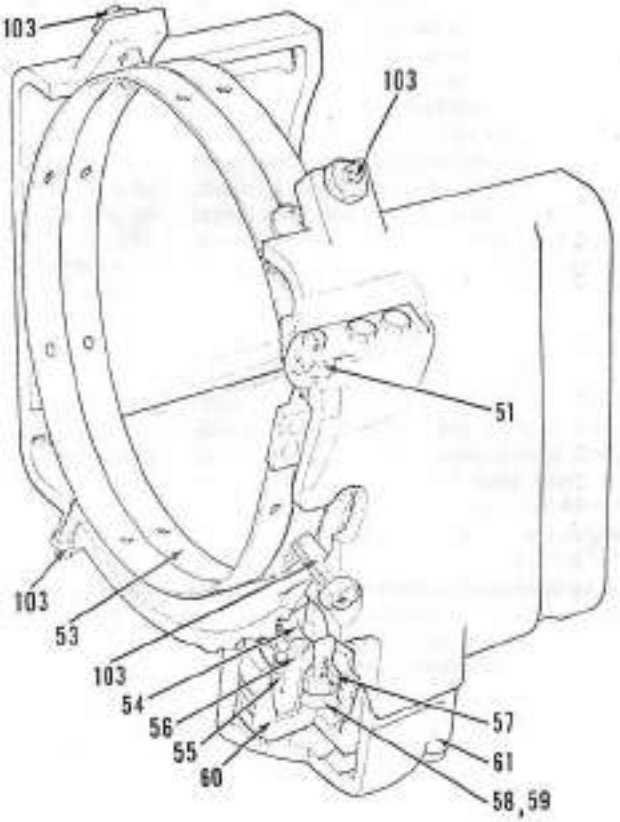


Fig. 119—Cross-section drawing of rear brake band assembly. Front band is similar. Refer to text for adjustments and to Fig. 116 for legend.

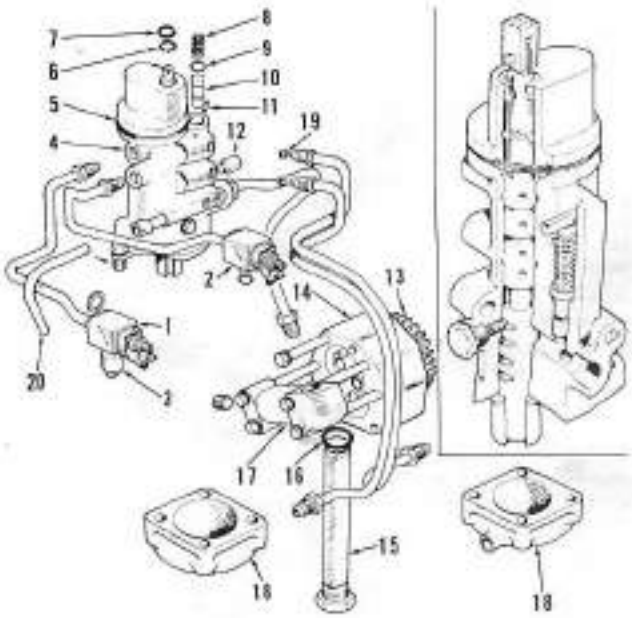


Fig. 120—Partially exploded drawing of control valve (4), pump (14), sequencing valves (1 & 2) and connecting tubes. Adapter (3) is only used on front sequencing valve.

1. Front sequencing valve
2. Rear sequencing valve
3. Adapter
4. Control valve
5. "O" ring
6. Snap ring
7. Oil seal
8. Relief valve spring
9. "O" ring
10. Relief valve
11. Pin
12. Plug
13. Pump drive gear
14. Oil pump
15. Inlet filter
16. "O" ring
17. Pump outlet connector
18. Band cylinders
19. Restrictor plugs
20. Lubrication pipe

end play of each shaft with dial indicator before disassembling.

Remove grub screw (32—Fig. 115), then remove nuts (30 & 31). Notice that nuts are left hand thread. Remove stud nuts, washers and spacer tubes, then remove the remaining short screw which attaches end plate to range transmission housing. Withdraw end plate (2) from studs, turn housing vertical and withdraw pinion shaft downward. Remove gears, spacers and bearings from case.

Shift selectors shaft can be withdrawn by first removing one shaft with other shaft in neutral. Take care not to lose detent balls, springs or interlocking plunger. Unbolt and withdraw oil pump. Pump driven gear is on tapered end of shaft and must be removed with puller. DO NOT pound on end of shaft.

Clutch plates must be free from distortion and not excessively worn. Depth of grooves in bronze clutch facings should be 0.003 inch deep. Buffer springs (64 & 65-Fig. 116) should protrude 0.050 inch. Height (H-Fig. 121A) with 2500 pound load should be 1.20-1.21 inches (wear limit 1.185 inches) for front clutch; 1.535-1.545 inches (wear limit 1.510 inches) for rear clutch. New clutch plates should be used when checking loaded height, but thickness of backing plates (1-Fig. 121A) is chosen by manufacturer to provide correct loaded height. Several different thicknesses of backing plate have been used so DO NOT interchange backing plates from another clutch assembly. Plate (P-Fig. 121A) can be fabricated from 5/8-inch thick steel to a diameter of 6-1/16 inches and is used with press to load clutch evenly when checking loaded height.

Individual parts of pump (14-Fig. 120), control valve (4) and sequence valves (1 & 2) are not available; however, each may be disassembled, inspected and reassembled if desired. Service sequence valves are factory set at 34-36 psi at 0.5 gpm flow. IF a new service sequence valve is installed in front position, increase the factory setting by loosening locknut, then turning adjuster IN two full turns. If valve is used in rear position, nominal setting is satisfactory. The nominal factory setting of 34-36 psi with 0.5 gpm flow can be obtained as outlined in paragraph 193. Be sure to adjust sequence valve two turns further in if valve is used in front position.

Before assembling transmission, it is necessary to temporarily assemble the range gear box to determine thickness of shims required to obtain correct setting distance for bevel pinion and to give correct amount of end play to shafts. If all original parts are to be reinstalled, shims do not need to be changed except to correct end play which was measured before disassembly.

Install top shaft (6-Fig. 115) and layshaft (35) with bearings, spacers, shims and other related parts. Install center housing (2), then install one 13½ inch long spacer tube over each of the four studs. Install washers over studs and tighten stud nuts to 75 ft.-lbs. torque. Use a dial indicator and measure end play of top shaft (6) and layshaft (35). Both shafts should have 0.002-0.004 inch end play. If incorrect, change end play by varying thickness of shims (4) and (33) as required. Be sure to recheck end play after changing shims (4 or 33).

The bevel pinion mesh position should be checked and adjusted as outlined in paragraph 202 if bevel pinion (10), bearing (11) or case (37) is renewed or if mesh position is questioned.

Begin final assembly by installing selector rods. A special tool can be fabricated to dimensions shown in Fig. 117 to assist installation of shift rods by holding detent balls down.

Assemble shift forks and rods (22 through 29-Fig. 118) and range transmission (Fig. 115) in housing (37). Install center housing (2) using thickness of shims (4 & 33) which was determined to be correct. Install shims (21) that were originally installed, washers (27) and cone for bearing (29). Install washer (29) and nut (30). Use the four 13½ inch long tubes, washers and nuts to hold center housing and range transmission housing together firmly and tighten the center housing screws and the four stud nuts to 75 ft.-lbs. torque. Tighten nut (30) to 200 ft.-lbs. torque and measure end play of bevel pinion shaft. The correct thickness of shims (21) will provide bevel pinion shaft with from 0.002 inch end play to 0.002 preload in bearings. Correct adjustment is accomplished by first installing enough shims (21) to provide slight (about 0.002 inch) end play with

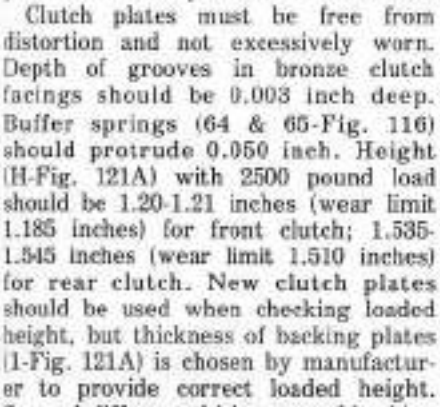


Fig. 121—Drawing showing adapter (C) for pressure gage (A) installed through hole in cover into valve in place of plug (12—Fig. 120). Band adjustment holes are at (X) and valve protrudes at (B). All openings in cover are covered for normal operation.

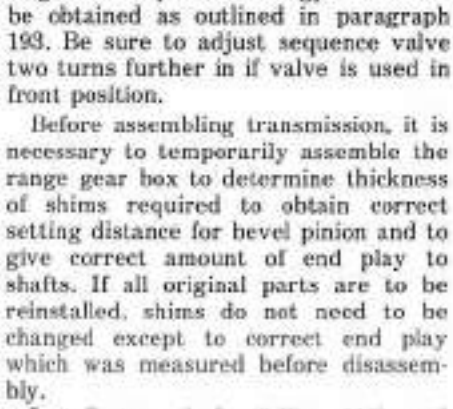


Fig. 122—Early transmission side cover can be carefully modified by drilling a hole at location indicated. Tap hole for ¾-inch or larger pipe plug. Hole is on right side of cover. Distance (A) from front is 11-1/16 inches; distance (B) from top surface is 2-5/16 inches.

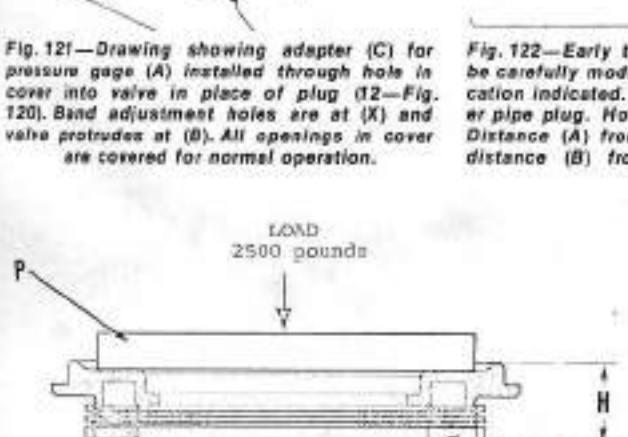


Fig. 121A—Refer to text for checking height (H) of clutch assemblies. Thickness of backing plate (1) is varied at factory and matched to the piston to provide correct height (H) with new clutch plates.

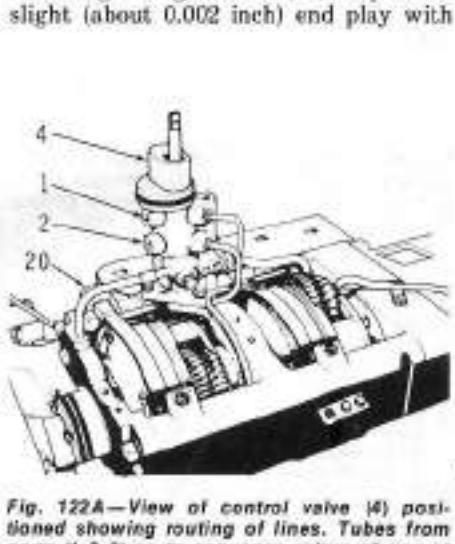


Fig. 122A—View of control valve (4) positioned showing routing of lines. Tubes from ports (1 & 2) go to sequence valves shown at (1 & 2—Fig. 120).

nut (30) tightened to 200 ft.-lbs.; then, reducing thickness of shims (21) by the amount of end play.

Install and tighten locknut (31) after correct thickness of shims (21) has been determined and installed and nut (30) is tightened to 200 ft.-lbs. torque. The grub screw (32) must be installed to lock the two nuts (30 & 31) to shaft. New pinion shafts must be drilled and tapped for grub screw. Do not attempt to operate without locking grub screw installed.

To assemble the four speed section of transmission refer to Fig. 116 and proceed as follows:

Position rear pinion carrier (48) on bench with bearing pins (42) up. Coat bearings (43) and pins (42) with oil, then install one bearing (43) above and one bearing below spacer (41) on each of the three pins (42). Install pinions (47) on bearings (43) so that punch marked tooth of each is toward center and meshed with sun gear (46). Shoulder of sun gear should be toward thrust washer (44). Install end plate (40) over dowels with mark aligned with similar mark on carrier (48). Install screws with locking plates. Bend tabs of plates over flats of cap screws after tightening screws. Be sure that lock tabs are tightly shaped to prevent fouling on pinion nut. Turn the assembly over and insert drive shaft (71) into sun gear (46). Position the thick steel plate (49) into recess in carrier (48), followed alternately by bronze plates (50) and the thin steel plates (62). Notice that one of the bronze plates is not grooved; this plain bronze plate should be in center of stack. A total of four thin steel plates (62), three grooved bronze plates (50), one plain bronze plate (50) and one thick steel plate (49) is used in the rear clutch. Install "O" rings (67 & 68) in piston grooves and position piston in cylinder. Position the eighteen springs (65) in holes of carrier (48) and the nine buffer springs (64) in piston (66). Grease should be used liberally on springs (64) to prevent falling out when assembling. Align assembly marks on cylinder (69) and carrier (48), then bolt assembly together and lock with tab plates.

Assemble the front clutch and planetary in a similar way. Only two bronze plates (83) are used, both of which are grooved. Two thin steel plates (92) are used. There is no spacer between bearings (78) of planetary.

Position freewheel cage (37) in plate (75) with flange toward rear (in) and abutment plate (38) with shoulder toward front (out). Install front carrier assembly with one of the planet gears centered in open section of housing (74) and carefully engage splines of rear unit drive shaft (71) if it is installed. Rotate the carrier clockwise to engage freewheeling unit (37). Position brake band (84) over carrier and into housing. End of brake band with longest threaded end should be in hole in housing for piston (60); other end should be in adjustment hole in housing. Be sure that thrust washer (87) is in recess of sun gear and bushing (88) and seal (89) are in drive shaft (90), then slide drive shaft hub into splines of clutch bronze plates and into mesh with planet gears. Be sure that sealing rings (73), thrust washer (91), bushing (97), seal (99) and "O" rings (100) are in good condition, then carefully lower assembled front cover (98) down over drive shaft (90). Be careful not to damage sealing rings.

Position the rear brake band (53) in housing with longer threaded end through hole in housing for piston (60). Be sure that seal rings (73) are lubricated and centered and that thrust washer (72) is properly located, then slide rear carrier assembly into housing.

Position the freewheeling cage (37) in plate (1) with flange toward rear (in) and abutment plate (38) with shoulder toward front (out). Be sure that thrust washer (44) is in place, then carefully slide the assembled four speed transmission (Fig. 116) over the studs (102) and engage splines of shaft (6-Fig. 115). Sliding the four speed section (Fig. 116) and range transmission section (Fig. 115) should be accomplished with both units in horizontal position. It will be necessary to rotate carrier assembly (40-Fig. 116) while engaging the rear freewheeling unit. Be careful not to damage freewheeling unit (37) or seal rings (73) while sliding assemblies together. Tighten nuts for studs (102) to 75 ft.-lbs.

Turn all the locating screws (103-Fig. 119) back away from band as far as possible, align the bands with holes in housing, then install special washers (51) and nuts. Turn nuts onto threaded end of band until flush with threaded end. Assemble retainer (54), stop spring (55), sleeve (56) and nuts on end of bands. Turn nut at piston end until spring sleeve (56) is 1-1/8 inches from machined facing of housing if new brake band is installed. Correct setting for used brake band is 1-3/16 inches from spring sleeve to machined surface of housing. Check to be sure that threaded end of band does not protrude through nut past flush with sleeve face. Install washer and snap ring (58 & 59). Tighten each locating screw (103) until they contact band. Three locating screws are used on front band and each of the three screws should be loosened exactly ¾ turn, then tighten locknut. Four locating screws are located around rear band and correct setting is exactly ½ turn back from contact with band. Install pistons (60) and cylinders (61). Cylinder pipe connections should be toward center. Tighten attaching screws to 20 ft.-lbs. torque.

Install the two sequence valves, being sure that valves are adjusted as outlined in paragraph 193 or that each is installed in original position. Install oil pump (14-Fig. 120) and connector (17) using all new "O" rings. Tighten attaching screws to 20 ft.-lbs. torque.

CHECKS AND ADJUSTMENTS

Models 1212 and 1412

190. Use the following procedures to check operation of the transmission, before attempting any repairs or adjustments.

Operate tractor in high range with engine at 1800 rpm. Select a higher gear and observe the exhaust note. The tractor should accelerate within one second of Hydra Shift lever being moved. The engine speed will drop momentarily.

Move Hydra Shift lever to select a lower gear. Complete engagement of lower gear, indicated by exhaust note, should occur within 2-3 seconds of lever movement.

Faulty changes from 1st to 2nd and from 3rd to 4th are probably caused by the front clutch unit. Changing upward between these gears depends mainly on adequate volume of oil to the front clutch unit. Faulty upward change from 1st to 2nd may show up as a delayed change of several seconds between valve movement and clutch change. Improper upward gear change from 3rd to 4th may be indicated by delayed shifting or, if oil supply is extremely low, the transmission may drop back to 1st gear. Faulty (delayed) shifting from 2nd to 1st and from 4th to 3rd are probably caused by band wear.

Changes between 2nd and 3rd gears involve both reduction units and is synchronized by the two sequence valves. Changing from 2nd to 3rd causes the rear clutch to be engaged and the front clutch to disengage. If, when shifting from 2nd to 3rd the rear clutch engages before the front clutch disengages, there may be a slight jerk caused by the transmission shifting to 4th gear for a moment. Also, when shifting from 3rd to 2nd, the tractor may appear to free wheel for some distance before braking and the governor will cut in just before braking (2nd gear engage) because 4th gear is

engaging before 2nd gear. This overlap of clutch engagements is a result of rear clutch and front clutch not synchronized.

If, when shifting from 2nd to 3rd, the tractor speed decreases before being accelerated into 3rd with a surge, the transmission may be engaging 1st gear for a moment. When changing from 3rd to 2nd, the tractor may appear to free wheel some distance, before braking (2nd gear engagement) but there will be no governor surge. This may be caused by both clutches (and both bands) being disengaged for an instant. When shifting from 3rd to 2nd, the front band changes from engaged to released, the rear band changes from released to engaged, the front clutch is engaging and the rear clutch is disengaging.

TROUBLE SHOOTING

DELAY BEFORE 4-3 SHIFT OR 2-1 SHIFT. The front brake band is slow to clamp and stop carrier. Could be caused by worn band, incorrect adjustment, or block orifice in sequence valve.

DELAY BEFORE 3-2 SHIFT, MAY CHANGE TO 4th FOR A FEW SECONDS. The rear brake band may be slow to clamp and stop carrier or loss of proper sequencing. Could be caused by worn band, incorrect adjustment, blocked orifice in sequence valve, low oil pressure, leakage at front unit, excessive travel of front clutch piston, or rear sequence valve out of adjustment.

SLIPPAGE IN 4th GEAR. Clutch of either reduction unit is slipping. Could be caused by low oil pressure, binding clutch piston, or worn clutch plates.

SLIPPAGE IN 3rd GEAR. Brake band not applied on front reduction unit. Could be caused by brake band for front unit worn excessively or by sticking brake piston.

SLIPPAGE IN 2nd GEAR. Brake band not applied on rear reduction unit. Could be caused by excessively worn brake band for rear reduction unit or by sticking brake piston.

WILL NOT SHIFT FROM 1st TO ANY OTHER GEAR. Insufficient oil supply. Could be caused by oil too thick, blocked filter, faulty pressure relief valve, worn or damaged oil pump, excessive leakage of front and/or rear clutch units, pump sucking air at mounting face, or valve spool turned 180 degrees. Check oil pressure before disassembly.

WILL NOT SHIFT FROM 1st TO 2nd OR FROM 3rd TO 4th (1st & 3rd operational). Front clutch not engaging. Could be caused by excessive leakage of front unit. Check piston/cylinder sealing rings, supply line and sequence valve. Check oil pressure before disassembly.

WILL NOT ENGAGE 3rd OR 4th GEARS (1st & 2nd operational). Rear clutch not engaging. Could be caused by excessive leakage of rear unit. Check piston/cylinder sealing rings, supply line and sequence valve. Check oil pressure before disassembling.

OCCASIONALLY DROPS BACK TO 1st GEAR FROM HIGHER GEAR. Intermittent oil supply. Could be caused by low oil level or blocked oil filter.

SLOW ENGAGEMENT WHEN CHANGING FROM 1st TO 2nd OR FROM 3rd TO 4th. Front clutch is slow to engage. Could be caused by low oil pressure, front clutch sealing rings leaking, excessive travel of front clutch piston or front sequence valve sticking. Check oil pressure before disassembling.

ON GEAR CHANGE FROM 2nd TO 3rd, 1st GEAR TEMPORARILY ENGAGED. Loss of proper sequencing. Could be caused by low oil pressure, leaking front clutch sealing rings, excessive rear clutch piston travel, front sequence valve out of adjustment or front brake piston sticking. Check oil pressure in all gears first then check band adjustment, followed by sequence valve adjustment before disassembling.

4th GEAR TEMPORARILY ENGAGED WHEN CHANGING FROM 2nd TO 3rd GEAR (may remain in 4th gear). Loss of proper sequence. Could be caused by sticking, blocked or improperly set front sequence valve. Attempt to clean and adjust valve.

APPEARS TO HAVE INTERMEDIATE RATIO BETWEEN 1st AND 2nd OR BETWEEN 3rd AND 4th. Front clutch slipping slightly. Could be caused by low oil pressure, excessive leakage of front unit seals or sticking front clutch piston. Check pressure in all gears before disassembling.

APPEARS TO HAVE INTERMEDIATE RATIO BETWEEN 2nd AND 3rd OR BETWEEN 3rd AND 4th. Rear clutch slipping slightly. Could be caused by low oil pressure, excessive leakage of rear unit seals or sticking rear clutch piston. Check pressure in all gears before disassembling.

191. **TESTS.** Before testing, be sure that transmsision is filled with correct amount and type of fluid and that fluids have reached normal operating temperatures. Shift range unit to high and Hydra Shift lever to 1st gear. Operate tractor on level ground at 1800 engine rpm and shift to each higher gear (2nd, 3rd & 4th) then shift to each lower gear (3rd, 2nd & 1st). Be sure to move Hydra Shift lever in quick positive manner to assure correct engaging of each gear and notice gear change action. Repeat test on incline, shifting to higher gear while ascending incline (it may not be possible to engage 4th) and shifting to lower gears while descending incline. When checking while traveling downhill, set engine speed at 1800 rpm, and transmission in 4th gear. Move the lever to 3rd gear and check to be sure that change takes place. Brake tractor until engine speed drops back to 1800 rpm, then shift to 2nd gear and observe shift. Brake tractor until engine speed again drops back to 1800 rpm without changing throttle setting, then shift to 1st gear and observe shift. The downward gear changes should occur within 2-3 seconds after moving lever.

If the preceding operational tests on level ground and on incline indicate faulty operation, refer to paragraph 190 for suggested corrective actions. If preceding tests do not indicate a problem, continue tests as follows: Operate the tractor on level ground at 1000 rpm, shifting up one gear at a time, then down one gear at a time and observe gear change. A few seconds may elapse between shifts but transmission should change gear smoothly. If tractor will not shift out of 1st gear, gradually increase engine speed until gear change is made. No repair is necessary if change occurs at 1200 engine rpm or less and pressure is within limits. If difficulty is encountered, continue with pressure tests.

A 0-100 psi or equivalent gage is required for checking pressure. Check point is a 0.448 inch AF plug on valve spool of early tractors, a 0.500 inch AF plug on valve spool of later models. Access to the check point is obtained by removing plug on right side of gear box cover of later tractors or early modified tractors. The gear box cover will need to be removed from early tractors for checking pressure unless cover is already modified as shown in Fig. 122. Connect gage as shown in Fig. 121, then as soon as system oil reaches normal temperature, move Hydra Shift lever to 1st gear and observe pressure gage. If relief pressure is less than 69 psi, remove cover and install shims above relief spring (8-Fig. 123) as shown. Each 0.020 inch thick shim will increase pressure approximately 3 psi. Recommended setting pressure is 71-75 psi. New "O" ring (9) should be

installed when setting pressure and late relief valve with 1/8-inch thick head should be installed if thicker earlier type is installed.

If relief pressure in 1st gear is correct, then shift from 1st to 2nd gear and observe pressure gage. The pressure should drop initially, then increase to about 0.25 psi less than similar test in 1st gear. Pressure drop of more than 0.25 psi indicates excessive leakage in the front clutch and/or line.

Shift unit to 3rd gear observe pressure gage. After the initial drop in pressure, pressure should increase to 2.5 psi more than pressure when checked in 1st gear. Less than this amount of pressure increase indicates leakage of rear clutch and/or line.

Shift unit to 4th gear and observe gage. Pressure should be about 3.75 psi more than when checked in 1st gear. Low pressure in 4th gear will also be indicated by low pressure in 2nd and/or 3rd gear too.

193. **SEQUENCE VALVE ADJUSTMENT.** Sequence valves (1 & 2-Fig. 120) control the release timing of the front and rear clutch units. Normally these valves will not require any adjustment and adjustment of valves will not cure other malfunctions. Slight adjustment may, however, be necessary to match individual transmission actions. The front sequence valve (1) controls the release of the front clutch (change from 2nd to 3rd); the rear sequence valve (2) controls release of the rear clutch (change from 3rd to 2nd). Turning the sequence valve adjustment screws out (counter-clockwise) will slow the clutch release time and turning screws in (clockwise) will result in faster release time.

All sequence valves for service parts are set at factory to 34-36 psi with flow of ½ gpm at 113-122 degrees F. If a new service sequence valve is installed in front position, increase the factory setting by loosening locknut, then turning adjuster IN two full turns. If valve is used in rear position, nominal setting is satisfactory. The nominal factory setting of 34-36 psi with 0.5 gpm flow can be obtained as follows:

Disassemble sequence valve, plug orifice in piston using masking tape, then reassemble valve. Connect sequence valve up to the brake band piston actuator. Use suitable adapters to attach a hand test pump and pressure gage to inlet. Operate hand pump smoothly and slowly and notice gage pressure. The pressure will fall when piston has traveled far enough to open outlet port to the clutch cylinder. Adjust the sequence valve so that highest pressure before drop is 31-32 psi. This pressure will be the equivalent to the slightly higher pressure with 0.5 gpm flow. Be sure to remove masking tape from piston when adjustment is complete. Also, be sure to adjust sequence valve two turns further in if valve is used in front position.

195. **BRAKE BAND ADJUSTMENT.** Brake bands provide braking on overrun and wear will be indicated by delay in shifting down or failure to hold in gear. Brake bands can be adjusted if not worn beyond limits of adjustment as follows:

Late tractors are provided with plugged access holes (X-Fig. 121) to facilitate adjustment of brake bands; however, early models must have gear box cover removed to adjust bands. Be sure to clean area around plugs or around cover before removing to prevent dirt from falling into transmission.

On early models, remove fuel tank, steering column, gear box cover, both sequence valves and pipes. Connect the brake piston actuator and pressure gage in place of front sequence valve connection on spool control valve (Fig. 124). Move spool up to 1st gear position. Connect a lever type grease gun filled with transmission oil to the actuator and apply a constant pressure of 70 psi so that front brake piston is held against its stop. With hydraulic pressure applied, tighten adjusting nut until all slack is removed from band. Check by moving band sideways by hand, then tighten one flat more. Do not overtighten or band will be stretched. If adjustment nut runs out of threads, before adjustment is complete, it will be necessary to remove the gear box and adjust at piston end. Release oil pressure, then unscrew adjustment nut four complete turns. Install lock plate after adjustment is complete. Move gage and actuator to connection for rear sequence valve on control valve and adjust rear band in same way as front. Reassemble after adjustment is complete.

On late models, remove plugs covering both openings (X-Fig. 121). Loosen locknut, then loosen adjuster nut for front band (right side adjuster). Remove the ¾ BSP plug (third plug on right side of transmission cover), then remove the pressure checking port plug (inside) from valve body. Connect pressure gage to checking port using an adapter. Be sure that range lever is in neutral and start engine. Move Hydra Shift lever to 4th speed position and increase engine speed until pressure is at least 70 psi. (Engine speed will be approximately 1200 rpm.) Tighten the band adjusting nut of front band slowly until engine speed drops about 25 rpm, then depress clutch pedal immediately. Back adjusting nut (loosen adjustment) exactly four turns. If adjustment nut runs out of threads before rpm drops about 25 rpm, it will be necessary to remove gear box and adjust at piston end. Adjust the rear band in same way as front. Reassemble, install locknuts and plugs after adjusting.

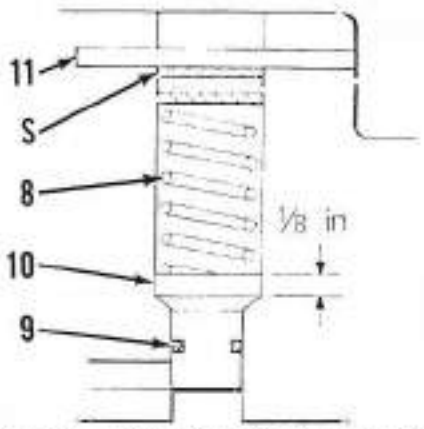


Fig. 123—Cross-section of pressure relief valve. Latest type has 1/8-inch head as shown. Shims are located as indicated. Refer to Fig. 120 for legend.

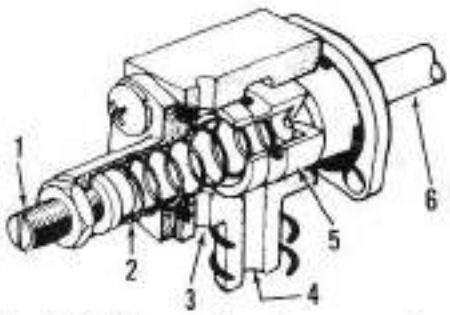


Fig. 123A—Cross-section of sequence valve. Valves are alike but are adjusted to different settings.

1. Adjusting screw
2. Spring
3. Spill port
4. Connection to clutch cylinder
5. Piston
6. Oil inlet tube

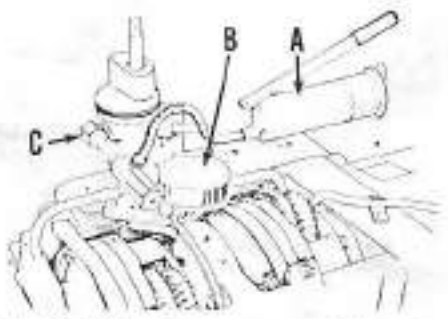


Fig. 124—A hand pressure pump (A) can be connected to adapter (C) and pressure gage (B) as shown for pressurizing brake cylinders.

MAIN DRIVE BEVEL GEARS AND DIFFERENTIAL

R & R DIFFERENTIAL ASSEMBLY

All Models

200. To gain access for removal of differential and to adjust bevel gear mesh, backlash and differential carrier bearings when reinstalling the differential, first remove the transmission as outlined in paragraph 164 and 165, then proceed as follows:

Carefully mark each differential bearing cap so the cap can be reinstalled in same position. The caps are machined after installation so they are not interchangeable. The transmission rear end plate and bearing cap assembly must be renewed if either cap is broken or otherwise damaged beyond further use. The differential and bevel gear assembly can be removed from transmission rear end plate after removing the bearing caps.

If the bevel ring gear is renewed, the bevel pinion must also be renewed as the ring gear and transmission bevel pinion shaft are available in matched sets only. Refer to TRANSMISSION OVERHAUL section for information on renewal of bevel pinion shaft. Refer to paragraph 201 or paragraph 202 for adjusting bevel pinion mesh position; paragraph 203 for differential installation and carrier bearing adjustment.

ADJUST PINION MESH POSITION

All Models Except 1212 and 1412

201. If not already assembled, install cup for pinion shaft bearing (59-Fig. 108, Fig. 112 or Fig. 113), retainer plate (57) and original stack of shims (58) that were removed. Install snap ring (43), spacer (41) and cup for bearing (40) in front end plate (64). Assemble front and rear end plates (63 & 64) and on models so equipped, install spacer housing (65-Fig. 112 and Fig. 113). On all models, tighten nuts for studs (61 &62-Fig. 108, Fig. 112 and Fig. 113) to correct torque, which is 70 ft.-lbs. torque for 885, 885N and 995 models; 80 ft.-lbs. torque for 1210 and 1410 models. Insert the bevel pinion shaft (60) with cone for bearing (59) through end plates. Install cone of bearing (40), flat washer (39) and nut (38). Tighten nut (38) only enough to remove all pinion shaft end play and preload pinion bearings slightly. Tap pinion shaft (60) and cup for bearing (59) forward to be sure that bearing cup and cone are both seated.

Observe etched dimension marking on rear face of pinion shaft, then add this dimension (if positive number) or subtract number (if minus sign precedes etched number) to 6.3125. For example, if etched number was -0.010, then 6.3125-0.010 would be 6.3025; or if etched number was +0.005, then 6.3125+0.005 would be 6.3175. This number is the desired setting distance for the bevel pinion shaft. To measure the actual position of the bevel pinion, place a straightedge diagonally across from one upper differential bearing cap face on rear end plate to opposite lower bearing cap face. Then, carefully measure distance from rear face of pinion bearing cone to straightedge using an inside micrometer. Thickness of shims (58-Fig. 108, Fig. 112 or Fig. 113) is correct if measured distance is equal to desired setting dimension. If measured distance is less than adjustment dimension, subtract thickness of shims equal to difference between the two values. Add shims if measured distance is more than adjustment dimension.

Special service setting tool (Part Number DB 8208) is available for measuring the bevel pinion position.

Models 1212 and 1412

202. If not already assembled, install pinion shaft (10-Fig. 115) with bearing (11) into case (37), then install front bearing (28), washer (29) and inner nut (30). Do not install gears. Tighten nut (30) until all end play is just removed and be sure that cup for rear bearing (11) is seated. Use special setting gage (Tool No. DB 8208) to determine thickness of shims (12). Use the 6.3125 inch spacer and measure clearance between spacer and outer race of bearing (11), observe the number etched on end of pinion and use the following to determine shims (12) to be removed or installed.

Specified Dimension	0.030 inch
Etched Number (+ or -)	XXX inch
	Total is correct setting dimension
Measured Gap	XXX inch
Computed Setting Dimension as determined above	-XXX inch
Additional shims required	XXX inch

If Computed Setting Dimension is larger than Measured Gap, shims equal to this must be removed.

Recheck pinion shaft setting after changing shims (12).

ADJUST DIFFERENTIAL CARRIER BEARINGS AND BEVEL GEAR BACKLASH

All Models

203. On all models, adjustment of differential carrier bearings to provide proper bevel gear backlash and bearing adjustment is correlated with pinion mesh position adjustment as outlined in paragraph 201 or 202.

Install differential assembly on transmission rear end plate and install, but do not securely tighten, the bearing cap retaining cap screws. Turn the ring

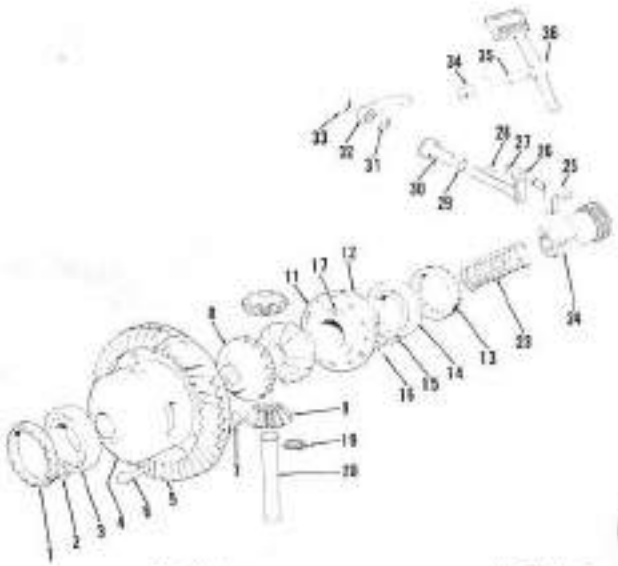


Fig. 125—Exploded view of typical two pinion differential and lock assembly. Refer to Fig. 126 for differential used on 1410 and 1412 models.

1. Ring nut
2. Lock plate
3. Ball bearing
4. Differential housing
5. Bevel ring gear
6. Special bolts
7. Lock plates
8. Side gears
9. Pinion gears
11. End plate
12. Lock plates
13. Ring nut
14. Ball bearing
15. Cap screws
16. Lock plates
17. Dowel pins
19. Snap rings
20. Pinion pin
23. Return spring
24. Locking sleeve
25. Fork
26. Shaft arm
27. Snap ring
28. Key
29. Snap ring
30. Bushing
31. "O" ring
32. Arm
33. Snap ring
34. Pivot pin
35. Bushing
36. Foot pedal

nuts (1 & 13-Fig. 125 or Fig. 126) in so that end play of differential in carrier bearings is less than 0.002, but without preloading the bearings. Then, move the assembly sideways as required to obtain bevel gear backlash of 0.007-0.009 by loosening one ring nut and tighten opposite ring nut a like amount. When bevel gear backlash and differential carrier bearings are properly adjusted, install the ring nut locks (2) and tighten differential carrier bearing cap retaining cap screws to a torque of 120 ft.-lbs.

OVERHAUL DIFFERENTIAL ASSEMBLY

All Models

204. With differential assembly removed as outlined in paragraph 200, refer to exploded view of unit in Fig. 125 or Fig. 126 and proceed as follows:

Straighten the tab washers and remove the cap screws retaining end plate (11) to differential housing (4). Mark position of end plate on housing, then separate plate from housing and remove side gear (8). On models with two pinion differential, remove snap ring (19-Fig. 125) from one end of pinion pin (20), remove pin and extract the pinion gears (9) and remaining side gear (8).

On all models, inspect the carrier bearings (3 & 14) and if rough or excessively worn, remove bearings from housing.

If bevel ring gear is worn or damaged, remove gear from differential housing. Refer to appropriate transmission overhaul paragraph and remove the bevel pinion shaft; ring gear and pinion are available in a matched set only and one new gear should never be installed without also installing mating gear.

To reassemble differential, proceed as follows: Using transmission lubricant or good grade of light grease, lubricate all parts prior to reassembly. Install one of the side gears (8), pinion gears (9) and pinion shaft (20). On models with two pinion differential, secure pinion shaft (20-Fig 125) with the two snap rings (19). On all models install the remaining side gear (8-Fig. 125 or Fig. 126) and end plate (11).

On two pinion differential, be sure that end plate correctly engages dowel pins (17-Fig. 125) and tighten screws (15) to 30 ft.-lbs. torque. Lock plate (16) should cover the smaller holes in end plate for dowels (17). Tighten nuts for bevel ring gear screws (6) to 50 ft.-lbs. torque. Be sure to bend tabs of lock plates (7 & 16) around flats of screws and nuts to prevent loosening.

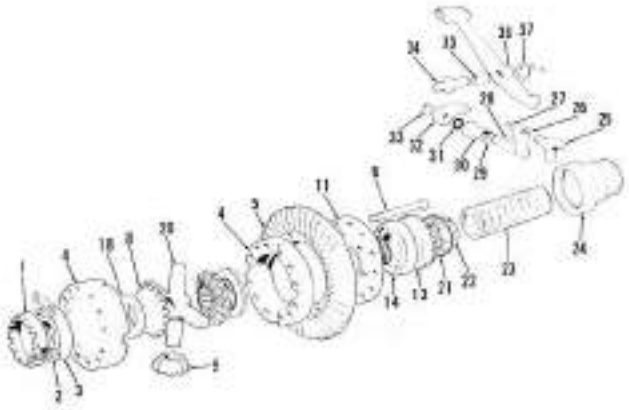


Fig. 126—Exploded view of four pinion differential used on 1410 and 1412 models. Refer to Fig. 125 for legend except the following.

8. Side gears (2 used)
9. Pinion gears (4 used)
18. Thrust washers (2 used)
20. Pinion shafts
21. Gear ring
22. Snap ring

On four pinion differential, install screws (6-Fig. 126) from side shown. Tighten nuts to 75 ft.-lbs. torque and lock by bending tabs of plates (7) around nuts.

On all models, install carrier bearings (3 & 14-Fig. 125 and Fig. 126) with side marked "THRUST" on outer race away from differential (toward ring nuts).

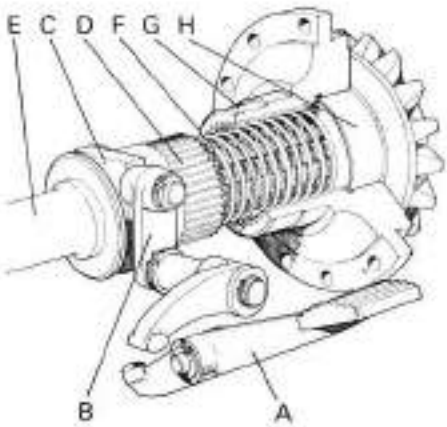


Fig. 127—View showing differential lock operation. When sleeve (D) external splines are engaged with internal splines in differential side gear (H), differential is locked as solid unit.

A. Foot pedal
B. Shaft arm
C. Fork
D. Locking sleeve
E. Final drive shaft
F. Return spring
G. End plate
H. Side gear

DIFFERENTIAL LOCK

All Models

205. When differential lock foot pedal (A-Fig. 127) is depressed, locking sleeve (D) is pushed against differential end plate (G). When splines on sleeve and in end plate are aligned, the sleeve enters end plate. As both the locking sleeve and differential side gear (H) are splined to final drive shaft (E), the differential is locked up and both final drives must turn at same speed. When pedal is released and traction on both wheels becomes equal, of if clutch is momentarily disengaged, spring (F) returns locking sleeve to disengaged position allowing differential to function normally.

All components of the differential lock can be removed after removing the right final drive unit as outlined in paragraph 207 and the bull pinion shaft inner seal retainer. Working through opening in right end of axle housing, remove locking sleeve (24-Fig. 125 or Fig. 126) and spring (23); It may be necessary to manipulate pedal (36) or arm (32) to disengage fork (25) from groove in locking sleeve. Remove snap ring (33), arm (32) and key (28). Push shaft and arm assembly (26) into axle housing and remove from oil seal retainer opening. Fork (25) can now be

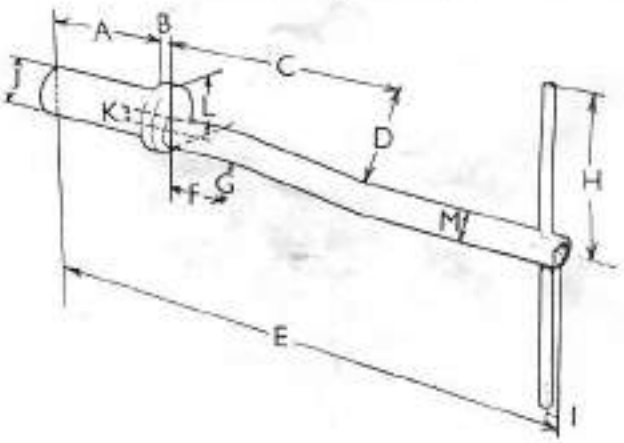


Fig. 128—Tool shown can be fabricated locally and used to install differential lock sleeve. Refer to text for tool use procedure; dimensions are as follows:

A. 4½ inches
B. ½-inch
C. 6½ inches
D. 4 inch offset
E. 19¾ inches
F. 1½ inches
G. 4 inch offset
H. 8 inches
I. ½-inch
J. 1½ inches
K. ½-inch
L. 2¾ inches
M. 1-inch

removed from arm (26) if necessary. Disengage snap ring (29) and remove bushing (30) from outside of housing. Remove pedal (36) and renew pin (34) and/or pedal bushing (35) if worn. Refer to differential overhaul (paragraph 204) if necessary to renew differential end plate.

Reinstall operating linkage in axle housing, then install locking sleeve and spring as follows: Insert spring in differential end plate. Using tool fabricated to dimensions shown in Fig. 128, place locking sleeve on tool, outer end first, and with offset in tool turned to move groove end of sleeve away from fork, push the sleeve against the spring until sleeve contacts differential end plate. Turn the tool to bring locking sleeve groove into engagement with fork, then depress pedal to push sleeve into differential end plate. While holding pedal in the engaged position, wire arm in engaged position as shown in Fig. 129, then release pedal. The final drive unit can now be reinstalled on axle housing.

FINAL DRIVE

The final drive assemblies, consisting of the rear axle, axle (bull) gear, spur (bull) pinion and brake drums (or brake disc assembly), can be removed as a unit.

LUBRICATION AND BREATHER

All Models

206. Lubricating oil for the final drive gears is contained in each final drive housing and other than a breather, the final drive unit is sealed. The breather must be kept open or oil will be forced past the shaft seals. On some models, a breather is fitted in a tapped hole in the final drive cover; breather tube is used on some models; while on other models, the top cap screw retaining cover to final drive housing is drilled (this cap screw must be reinstalled in top bolt hole and a solid cap screw must not be substituted for the drilled cap screw). A grease fitting may be located in the outer face of rear axle shaft or in axle seal housing. This fitting is not for bearing lubrication; the lubricant passage leads to the seal cavity and fresh grease is used to force dirt from the axle shaft seal. Thus, grease should appear from seal housing whenever grease is forced through the lubrication fitting. Lack of regular lubrication at fitting will allow dirt to damage oil seal resulting in leakage of final drive lubricating oil.

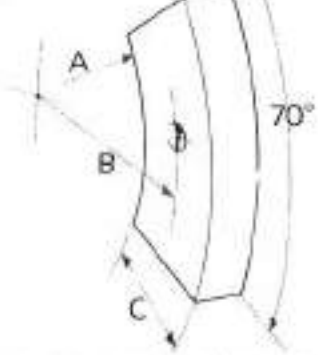


Fig. 130—View showing thrust pad which can be fabricated locally and used to pull wheel axle shaft from bearings, spacers and axle gear. Dimensions are indicated in legend.

A. 2 9/16 inches
B. 3 inches
C. 1 5/16 inches
D. 9/16-inch

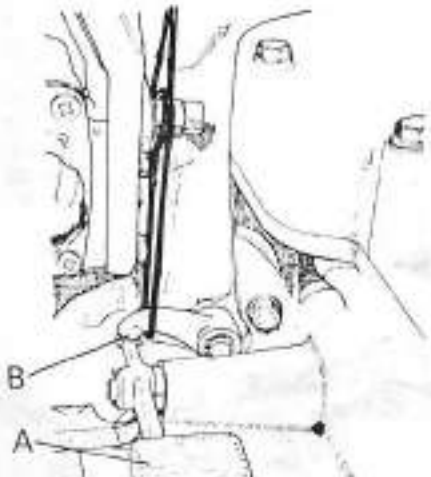


Fig. 129—To retain locking sleeve in differential end plate, thus allowing removal or installation of final drive unit, depress pedal (A) to engage differential lock and wire arm (B) in engaged position.

R & R FINAL DRIVE ASSEMBLIES

All Models

207. Securely support tractor under rear axle housing and remove rear wheel. On models with drum brakes, loosen brake adjustment so that brake drum will not drag on brake shoes. Before removing right final drive assembly from all models, engage the differential lock and wire actuating arm in engaged position as shown in Fig. 129. If final drive unit is to be disassembled, drain lubricant from housing. On 1412 models with disc brake, disconnect brake rod and remove cotter pin and clevis pin from cam lever end. Tap rod to be sure that it is free. On all models, attach hoist to final drive housing, unbolt housing from rear axle casting, then withdraw the unit until spur gear shaft clears axle housing.

Before reinstalling final drive assembly, inspect seals and brakes.

To reinstall final drive unit, reverse removal procedure. Tighten final drive to axle housing bolts to a torque of 100 ft.-lbs. on 1200 models; 75 ft.-lbs. on all other models. Refill final drive housing to level plug opening with SAE 140 gear lubricant.

WHEEL AXLE SHAFT, AXLE GEAR, BEARINGS & SEALS

All Models With Drum Brakes

208. **REMOVE AND REINSTALL.** Support tractor under rear axle housing and remove rear wheel. Drain final drive lubricant and remove cover plate. Straighten the tabs on locking plate (29-Fig. 131) at inner side of axle (bull)

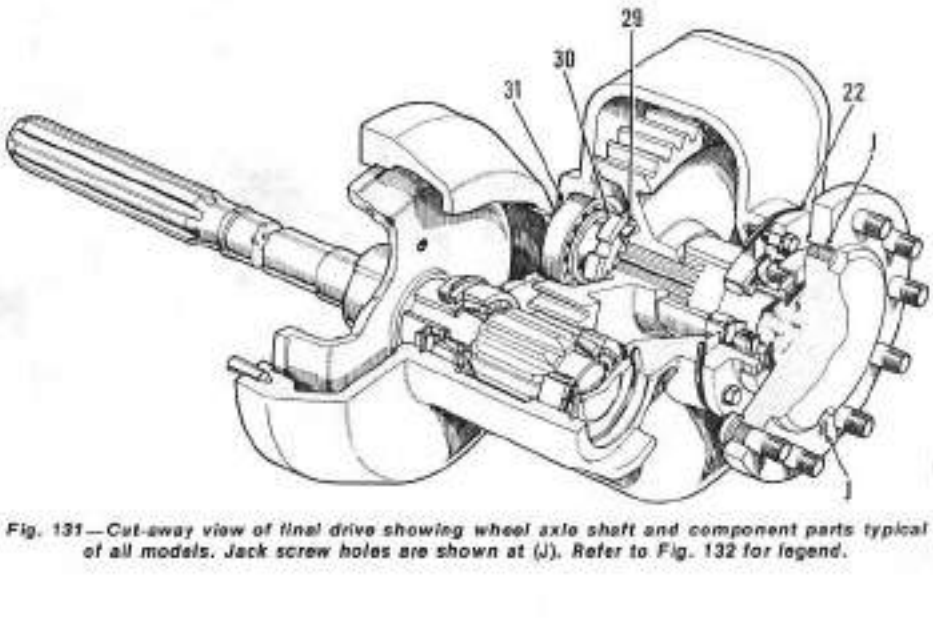


Fig. 131—Cut-away view of final drive showing wheel axle shaft and component parts typical of all models. Jack screw holes are shown at (J). Refer to Fig. 132 for legend.

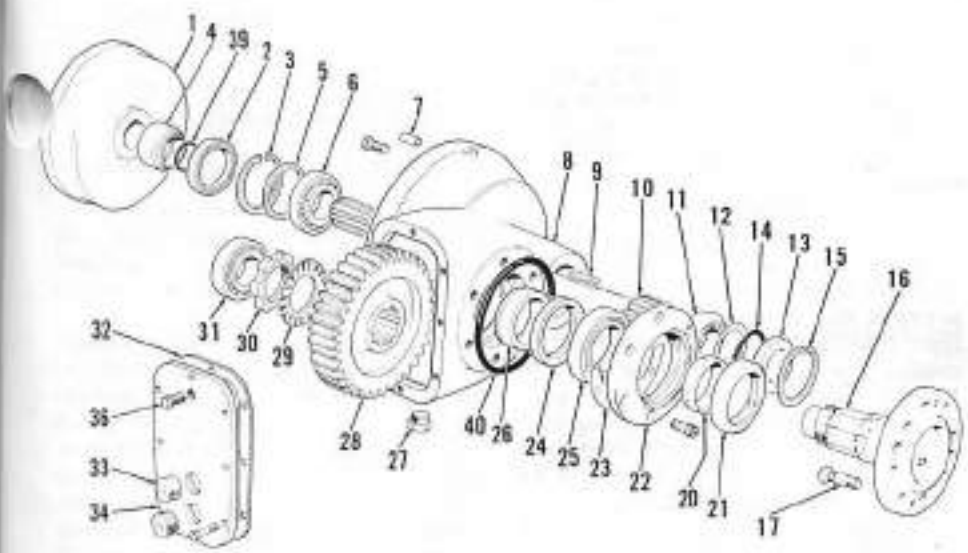


Fig. 132—Exploded view of Model 885 final drive assembly. Axle shaft taper bearings (25 & 31) are adjusted by varying thickness of shims (23). Bearing (31) is installed in blind hole from inside housing (8).

1. Brake drum
2. Oil seal
3. Snap ring
4. Spacer
5. Spacer
6. Taper bearing
7. Dowel pin
8. Housing
9. Brake drum key
10. Spur (bull) pinion
11. Taper bearing
12. Shims
13. Thrust plate
14. "O" ring
15. Snap ring
16. Axle shaft
17. Wheel bolt
20. Spacer
21. Oil seal
22. Seal housing
23. Shims
24. Oil seal
25. Taper bearing
26. Spacer
27. Drain plug
28. Axle (bull) gear
29. Locking plate
30. Ring nut
31. Taper bearing
32. Gasket
33. Oil level plug
34. Cover
36. Drilled cap screw (breather)
39. "O" ring
40. "O" ring

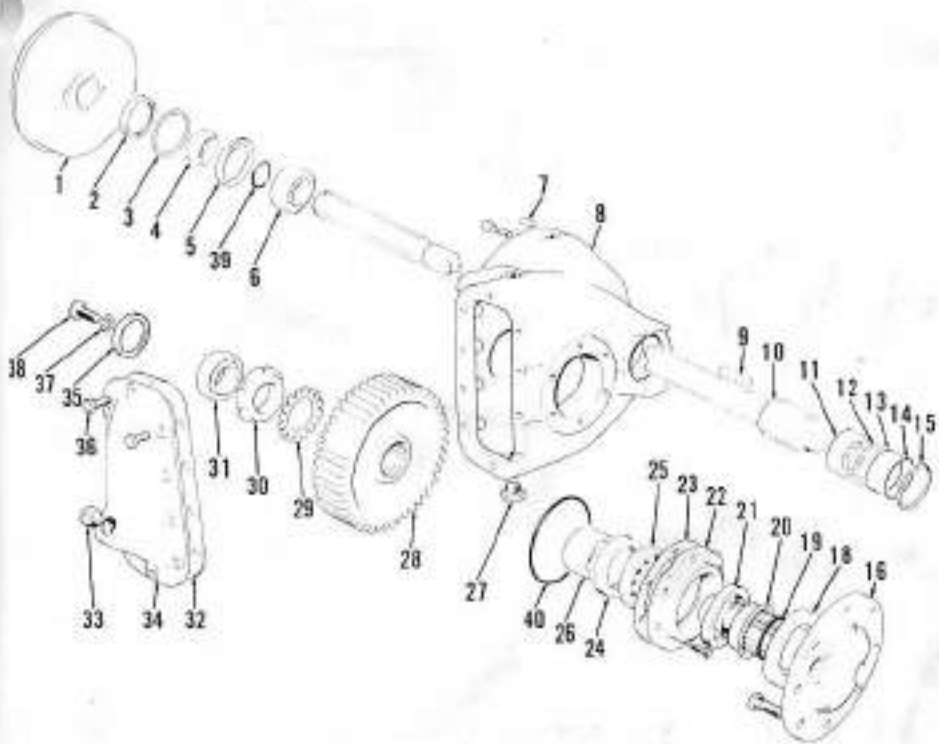


Fig. 133—Exploded view of final drive assembly typical of type used on 995, 1210 and 1212. Except for parts (35, 37 & 38) 995 models are similar. Axle bearings (25 & 31) are adjusted by shims (23) on 995 models. Axle bearings are adjusted on 1210 and 1212 models by shims (37) under screw (38) which changes setting of thrust plate (35). Gasket is located at (23) and "O" ring (40) is not used on 1210 and 1212 models. Refer to Fig. 132 for legend except the following.

18. Dust seal
19. "O" ring
23. Gasket
35. Thrust plate
37. Shims
38. Screw

gear and using spanner wrench, loosen ring nut (30). Using a ½-inch BSF tap, clean the jackscrew holes (J) in axle shaft flange. Thread jackscrews into the holes and place thrust pads (refer to Fig. 130) between inner ends of jackscrews and oil seal housing (22-Fig. 131).

NOTE: Oil seal housing must be securely bolted to final drive housing when pulling rear axle; otherwise, housing will be distorted when pressure is applied.

While tightening the jackscrews to withdraw axle shaft from gear and bearings, loosen ring nut at inner side of gear as shaft moves outward. With shaft removed, withdraw the axle gear, spacers, locking plate and nut and bearing cones from cover plate opening. Unbolt and remove seal housing (22-Fig. 132), shims (23) and "O" ring (40) from final drive housing. Remove cup for outer bearing (31) from bore in final drive housing.

Carefully clean and inspect all parts and renew any not suitable for further service. Renew axle shaft oil seal and reassemble as outlined in following paragraphs.

Install oil seal (21-Fig. 132 or Fig. 133) in housing (22) with lip toward inside, then on models so equipped, install dust seal (18-Fig. 133) and "O" ring (19). On all models, install spacer (20-Fig. 132 or Fig. 133) on axle shaft (16) and insert axle through installed seal (21) and housing (22). Install cup for bearing (25) over axle, then bearing cone, spacer (24) and spacer (26) over axle shaft. On models so equipped, install thrust plate (35-Fig. 133) in housing bore. On all models, press cup for bearing (31-Fig. 132 or Fig. 133) in housing bore. Position bearing roller and cone assembly in bearing cup (31), insert axle assembly through shims or gasket (23), "O" ring (40) and into housing (8). Slide gear (28), locking plate (29) and ring nut (30) over end of axle, then thread nut onto threads of axle. Install three equally spaced screws in housing (22). Tighten nut (30), then bend tab of lockwasher (29) to retain position of nut.

Axle shaft bearings (25 & 31-Fig. 132) are adjusted on 885, 990 and 995 models by varying the thickness of shims (23) between housings (8 and 22). Tighten the three evenly spaced screws which attach housing (22) to housing (8) equally. To determine the correct thickness of shims (23), measure clearance between housing (22) and housing (8) with a feeler gage. Install shims (23) equal to 0.005 inch less than the measured clearance. This will provide

bearings (25 & 31) with correct amount of preload. Shims are available in thicknesses of 0.003, 0.006, 0.009 and 0.015 inch. Shims are split for easier installation and sealing is accomplished on these models by "O" ring (40). Tighten screws retaining housing (22) evenly to 50 ft.-lbs. torque after correct thickness of shims (23) are installed. If equipped with grease fitting in housing (22), fitting should be located at 7 o'clock position. Screws retaining cover (34) should be tightened to 30 ft.-lbs. torque.

Axle shaft bearings (25 & 31-Fig. 133) are adjusted on 1210 and 1212 models by turning screw (38-Fig. 134). The adjusting screw (38) should be removed, then reinstalled loosely without shims (37-Fig. 133) before tightening screws which retain housing (22) to 50 ft.-lbs. torque. Bump outer end of axle toward tractor with a soft faced hammer to seat bearings (25 & 31), then turn screw (38) in until all end play is removed from axle bearings. Measure clearance between head of adjusting screw (38) and shoulder of housing (8), then install shims (37) 0.006 inch less than measured thickness to provide bearings with correct amount of preload.

Models With Disc Brakes

209. **REMOVE AND REINSTALL.** Support tractor under rear axle housing and remove rear wheel. Drain final drive lubricant and remove cover (34-Fig. 135). Lift snap ring (43) from groove in axle, remove screws attaching housing (22) to housing (8), then withdraw axle (16) and associated parts from housing (8). Remove snap ring (44), lock screw (42) and nut (41), then bearing (25), seals and axle (16) can be separated.

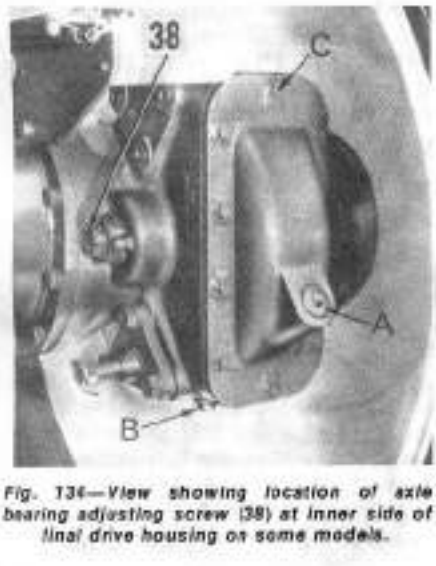


Fig. 134—View showing location of axle bearing adjusting screw (38) at inner side of final drive housing on some models.

If collar (20) is removed, be sure to install new "O" ring (19). Bearing (25) must be located in housing (22) before installing seal (24). Spring loaded side of seal (24) should be toward gear (28) and spring loaded side of seal (21) should be toward flange of axle (16). Pack grease inside seals before assembling axle shaft. Tighten nut (41) securely, coat lock screw (42) with Loctite, then install lock screw to prevent nut from loosening. Install inner bearing (31) in housing bore, then position the axle (16), housing (22) and bearing (25) in housing (8) without gear (28) or shims (23). Grease fitting (45) should be directly toward rear and three equally spaced screws should be used to retain housing (22) to housing (8). To determine correct thickness of shims (23), measure clearance between housing (22) and housing (8) with a feeler gage. Install shims (23) equal to 0.005 inch less than the measured clearance. This will provide bearings (25 & 31) with correct amount of preload. Shims are available in thicknesses of 0.003, 0.005, 0.015 and 0.030 inch. Sealing is accomplished by "O" ring (40). Tighten screws retaining housing (22) evenly to 50 ft.-lbs. torque after correct thickness of shims (23) are installed. Tighten screws retaining cover (34) to 30 ft.-lbs. torque.

SPUR PINION SHAFT, BEARINGS AND SEAL

All Models With Drum Brakes

210. With final drive assembly removed as outlined in paragraph 207, remove axle shaft and gear as outlined in paragraph 208, then proceed as follows:

Using tapped holes provided in brake drum, pull drum from pinion shaft and extract brake drum key from keyway in shaft. Remove snap ring (15-Fig. 132 or 133) at outer side of final drive housing, then bump inner end of pinion shaft to drive the shaft, outer bearing, shims and thrust plate from housing. Using a long punch, bump oil seal (2) from inner side of final drive housing, then drive inner bearing cup to inside of housing. A spacer (5) is located between snap ring (3) and inner bearing cup.

Reassemble final drive as follows: Install inner bearing spacer (5) against snap ring (3), then install bearing cup against spacer. Install inner bearing cone and roller assemblies tightly against shoulders on shaft. Insert

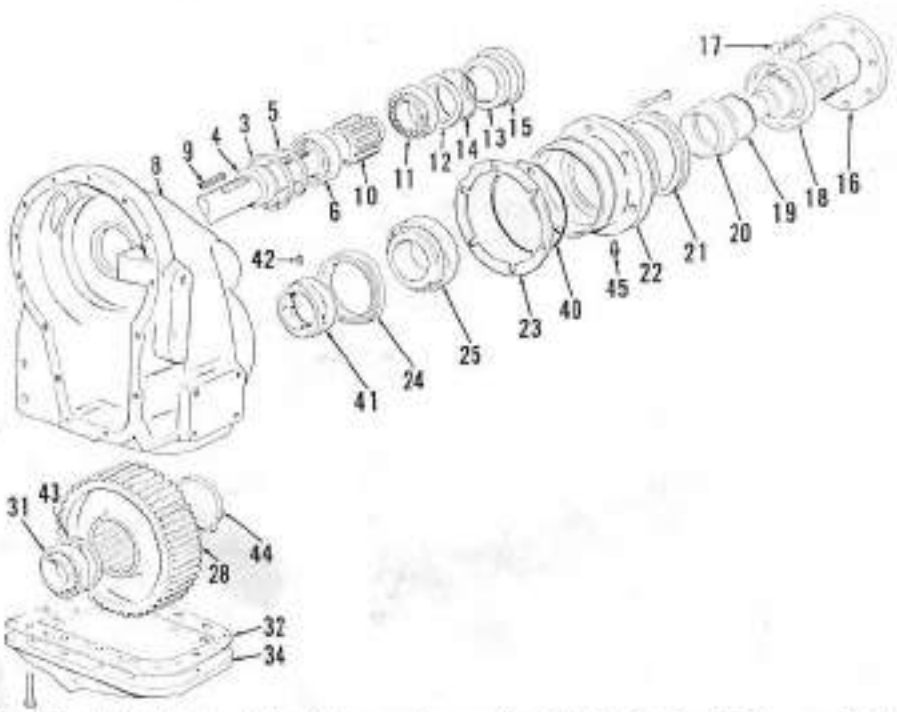


Fig. 135—Exploded view of final drive used on models with disc brakes. Brake assembly is located in housing as shown in Fig. 145.

3. Snap ring
4. Spacer
5. Spacer
6. Bearing
8. Final drive housing
9. Key
10. Spur (bull) pinion
11. Taper roller bearing
12. Shims
13. Thrust plate
14. "O" ring
15. Snap ring
16. Axle shaft
17. Stud
18. Oil seal
19. "O" ring
20. Collar
21. Oil seal
22. Seal and bearing housing
23. Shims
24. Oil seal
25. Bearing
28. Axle (bull) gear
31. Bearing
32. Gasket
34. Cover
40. "O" ring
41. Nut
42. Set screw
43. Snap ring
44. Snap ring
45. Grease fitting

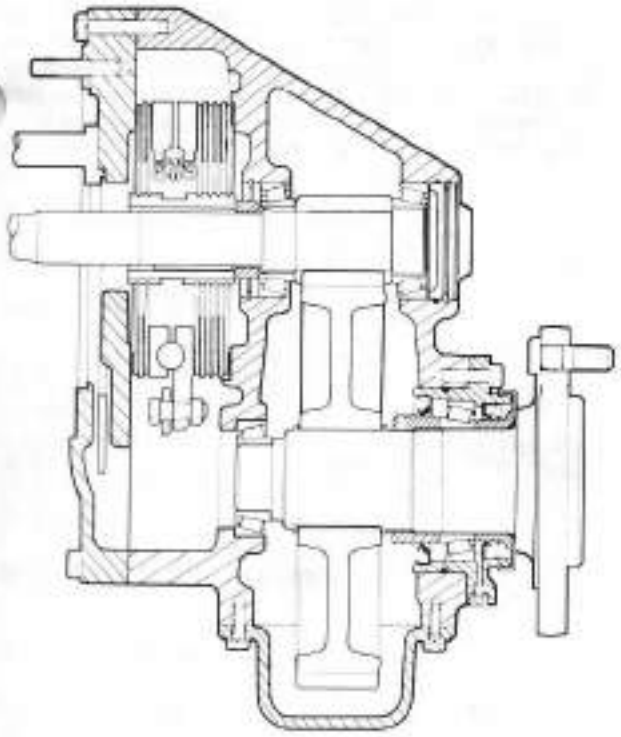


Fig. 135—Cross-section drawing of final drive and disc brake assemblies shown in Figs. 135 and 147.

against spacer (4).

Select total adjustment shim clearance of 0.003 inch greater than measured gap to give desired bearing preload, then install the shims, thrust plate with "O" ring and retaining snap ring.

Reinstall axle shaft and gear assembly as outlined in paragraph 208. Reinstall final drive assembly as outlined in paragraph 207.

Models With Disc Brakes

211. Remove the final drive assembly as outlined in paragraph 207 and remove axle shaft and gear as outlined in paragraph 209, then remove brake discs as outlined in paragraph 218. Remove snap ring (15-Fig. 135) from outer side of final drive housing, then bump inner end of pinion shaft. The shaft (10), outer bearing (11), shims (12) and thrust plate (13) will come from housing. Bearing (6), spacer (5) and snap ring (3) can be removed from housing bore at inner side of housing.

Reassemble snap ring (3), spacer (5), bearing (6) and pinion shaft (10), then install outer bearing (11), thrust plate (13) and snap ring (15). Do not install any shims (12) or "O" ring (14) until after checking to see how many shims should be installed. Push thrust plate (13) in to remove all end play from bearings (6 & 11), then measure the pinion shaft in final drive housing, then install outer bearing cup. Install outer bearing thrust plate (13) and retaining snap ring (15) without shims or "O" ring. Push thrust plate in to remove all end play from pinion shaft in bearings, measure the gap between thrust plate and snap ring and record measurement for reassembly. Drive new oil seal (2) into final drive housing with lip of seal toward pinion gear. Clean the shaft and inside of spacer (4) that is to be fitted between inner bearing and brake drum, coat shaft with Loctite and slide spacer onto shaft, through the seal and against inner bearing. Remove snap ring (15) and thrust plate (13) at outer end of pinion shaft. Support outer end of pinion shaft, insert brake drum key in keyway of pinion shaft, then using section of pipe, drive brake drum onto pinion shaft until it is seated firmly

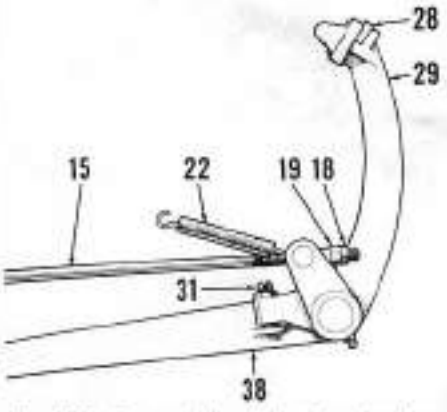


Fig. 139—On models with drum brakes, brake rods (15) are adjusted by loosening locknut (18) and turning adjusting nut (19); refer to text. Adjusting screw (31) is to maintain pedal alignment so that pedals are equal height in released position.

15. Brake rod
18. Locknut
19. Adjusting nut
22. Return spring
28. Pedal lock plate
29. Right foot pedal
31. Adjusting screw
38. Hand brake lever

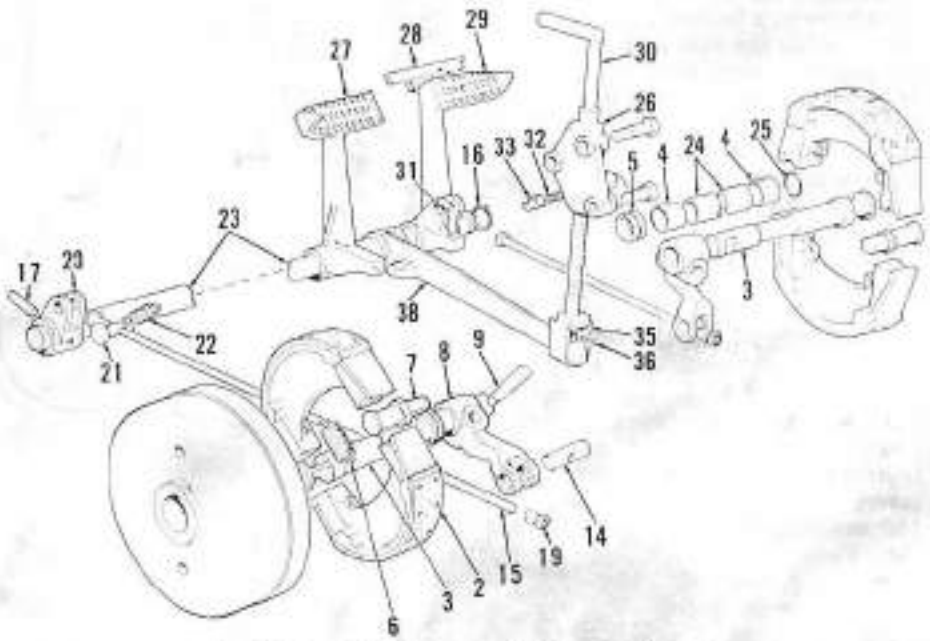


Fig. 140—Exploded view of typical drum brake system.

2. Brake shoes
3. Camshaft
4. Bushings
5. Dust seals
6. Shoe return spring
7. Anchor bolt
8. Brake arm
9. Taper bolt
14. Pin
15. Brake rod
16. Snap ring
17. Pin
19. Adjusting nut
20. Lever
21. Pin
22. Return spring
23. Cross-shaft
24. Dust shield
25. "O" ring
26. Housing
27. Left foot pedal
28. Pedal lock plate
29. Right foot pedal
30. Hand lever
31. Adjusting screw
32. Pawl spring
33. Pawl
35. Fork
36. Pin
38. Hand brake lever

gap between thrust plate and snap ring (15). Remove snap ring (15) and thrust plate (13), then select shims (12) equal to measured clearance plus 0.003 inch to give recommended preload. Install the selected shims, thrust plate (13) and "O" ring (14), then install snap ring (15). Reinstall spacer (4) and brake parts as described in paragraph 218. Reinstall axle housing as described in paragraph 209. Adjust brakes as outlined in paragraph 216.

BRAKES

ADJUSTMENT

All Models With Drum Brakes

215. If brake pedals are not aligned when released, align right pedal (29-Fig. 139) with left pedal by loosening locknut and turning adjustment screw (31) as required, then tighten locknut. Check to see that pedal lock plate (28) can be engaged.

To adjust brakes, proceed as follows: Jack tractor up until both rear wheels are free to turn. With hand lever in released position and both pedals released, turn the adjusting nut (19-Fig. 140 on one brake rod only until brake starts to bind when turning wheel on that side, then loosen nut until wheel turns freely and tighten locknut. Apply hand lever to a latched position so that the wheel on the side already adjusted can just be turned, then loosen locknut on opposite brake rod and turn adjusting nut on that rod so that same effort is required to turn both rear wheels. Tighten locknut, release hand lever and road-test brakes for satisfactory operation. Adjusting the brake rods provides adjustment for both foot pedals and hand lever.

Models With Disc Brakes

216. Wear of brake facing material will necessitate adjustment of brakes. Clean dirt from around all of the adjustment areas before removing any covers or plugs. Remove cover (4-Fig. 145) and plug (P) from housing on each side. Fully apply brake and measure clearance (C) between clevis pin and edge of opening as shown. Clearance (C) should be 5/16-inch and can be changed by turning adjuster nut (1). Check for even adjustment by depressing center pedal and noticing position of the two outside pedals. Turn adjusting nut (1) as required so that outside pedals remain level when center pedal is depressed. Use new gasket and non-hardening sealer on cover (4). Do not overtighten plug (P) when installing.

Linkage will not usually need adjustment; however, if changes are necessary, adjust as follows: Clean dirt from around all adjustment areas before removing any covers or plugs. Remove cover (4-Fig. 145) and plug (P). Release hand brake, pull center pedal up, loosen locknuts (N-Fig. 146), then turn adjusting screws (S) as required to

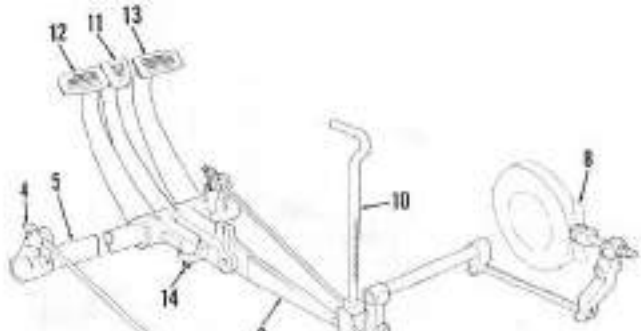


Fig. 142—Drawing showing general layout of disc brake control rods, shafts, pedals and associated parts.

1. Adjustment nut
2. Link
3. Lever
4. Adjustment nuts
5. Cross shaft
6. Clevis and rod
7. Lever
8. Actuator links
9. Hand brake operating lever
10. Hand lever
11. Master (center) brake pedal
12. Left brake pedal
13. Right brake pedal
14. Pedal stop adjustments
15. Shaft
16. Brake disc assembly

Fig. 145—View of final drive (F) and brake housing (H) showing brake adjustment points on models with disc brakes.

1. Adjustment nut
4. Cover
5. Clevis pin
C. Clearance
F. Final drive housing
H. Brake housing
P. Plug
R. "O" ring

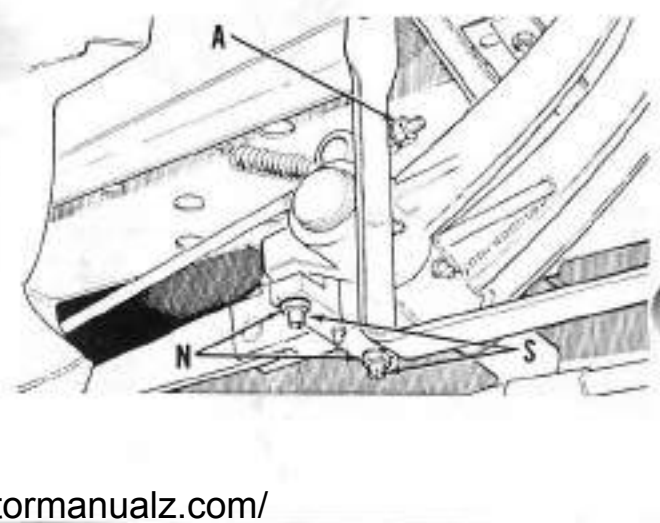


Fig. 146—View of brake pedal stop and control rod adjustment points for models with disc brakes.

A. Rod adjuster nut
N. Locknuts
S. Pedal stop adjustment screws

align the two outside pedals with the center pedal. Tighten locknuts (N) when aligned. Depress the center brake pedal and observe positions of the two side pedals. If all the pedals are not aligned, change the connecting rod length as required by turning adjusting nut (A) on each rod.

R & R BRAKE SHOES OR DISCS

All Models With Drum Brakes

217. The brake shoes can be removed after removing final drive assemblies as outlined in paragraph 207. Brake shoes and linings are available separately or as an assembly. Upper and lower shoes and linings are interchangeable.

Models With Disc Brakes

218. To remove the brake discs, first refer to paragraph 207 and remove the final drive assembly. Unbolt and remove brake housing (H-Fig. 145) then withdraw brake discs and actuator. Refer to Fig. 147.

When assembling, the four lined discs (15-Fig. 147) and three separator plates (21) should be toward final drive housing (F-Fig. 145). Two discs and one separator should be next to brake housing (H). Refer to paragraph 216 for adjustment after installation.

R & R RENEW BRAKE DRUMS

All Models With Drum Brakes

219. Brake drums can be removed from final drive pinion shaft after removing final drive assemblies as outlined in paragraph 207. Thread adapters for leg type pullers into tapped holes in drum, then pull drum from shaft and remove key from keyway in pinion shaft.

To install brake drums, outer end of final drive pinion shaft must be supported while driving drum onto pinion shaft. Remove the snap ring, thrust plate and bearing adjustment shims from final drive housing at outer end of pinion shaft; take care not to lose any of the shims. Being careful that pinion shaft is not pushed outward far enough to foul inner bearing ball or roller retainer against axle (bull) gear, support outer end of shaft while driving brake drum onto pinion shaft with a length of pipe. Be sure that keyway in drum and key in pinion shaft are aligned before starting to drive drum onto shaft. Reinstall all of the bearing adjustment shims removed. Install new "O" ring on thrust plate, then install thrust plate and snap ring.

BRAKE LINKAGE

All Models

220. Brake linkage models with drum brakes is shown in Fig. 140. Cross-shaft (23) passes through transmission compartment inside a tube which is sealed at each end by end plate, gasket and "O" ring. Brake shoe anchor bolt (7) and actuating camshaft (3) can be renewed whenever removing or renewing brake shoes. Camshaft is supported in renewable bushings (4) located in axle housing.

Brake linkage for models with disc brakes is shown in Fig. 142. The center brake pedal (11) actuates both left and right wheel brakes.

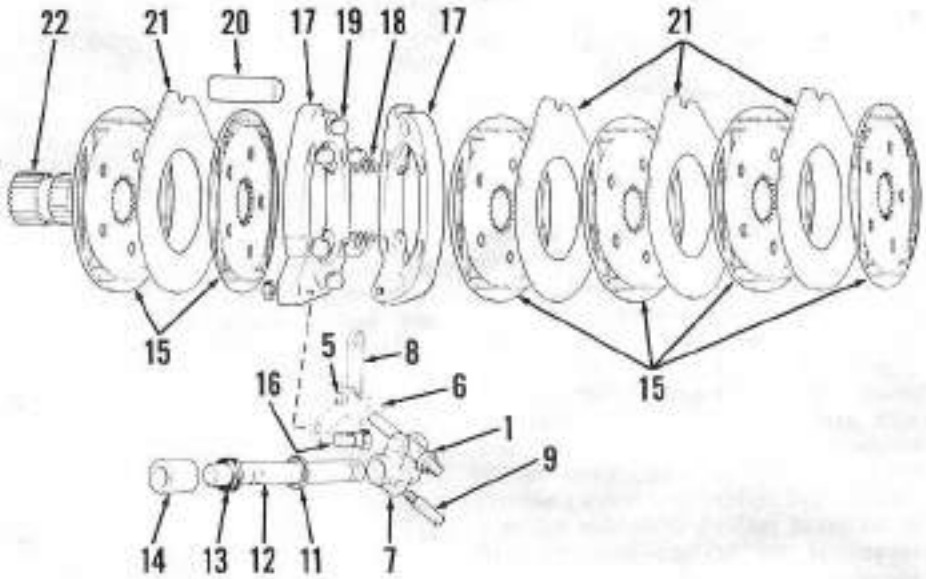


Fig. 147—Exploded view of disc brake assembly. Side with four discs (15) should be toward final drive housing when assembling. Hub (22) is keyed to pinion shaft (10—Fig. 135) with key (9—Fig. 135).

1. Adjuster nut
5. Clevis pin
6. Clevis and rod
7. Lever
8. Actuator links
9. Taper bolt
11. Lip seal
12. Shaft
13. Dust shield
14. Spacer
15. Brake lined discs
16. Link attaching screws
17. Actuating (cam) plates
18. Springs
19. Actuating balls
20. Reaction pin
21. Separator plates
22. Hub

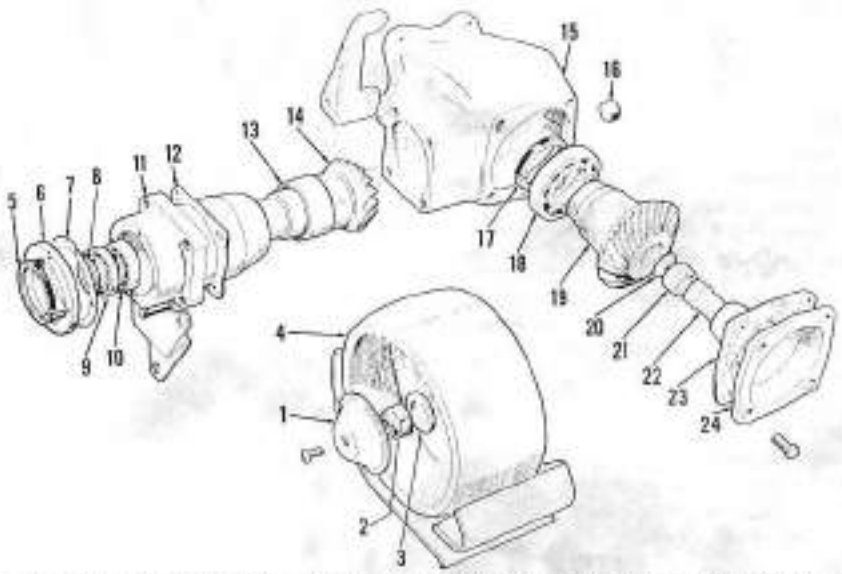


Fig. 150—Exploded view of belt pulley assembly available on 885 models. Refer to Fig. 151 for heavy duty unit available for all models.

1. Cover
2. Pulley nut
3. Flat washer
4. Belt pulley
5. Oil seal
6. Retainer
7. Gasket
8. Shim
9. Roller bearing
10. Ball bearing
11. Housing
12. Shims
13. Needle roller bearing
14. Output gear
15. Gear box
16. Plugs (2)
17. Oil seal
18. Thrust type ball bearing
19. Input gear
20. Expansion plug (w/vent hole)
21. Needle roller bearing
22. Bearing pin
23. Shims
24. Cover

BELT PULLEY

A belt pulley attachment that mounts on PTO housing and is driven from PTO shaft is available for all models. Refer to Fig. 150 for exploded view of light duty unit available only for 885 model and to Fig. 151 for heavy duty unit available for all models including 885. Venting of the unit shown in Fig. 150 is accomplished by a hole drilled through the expansion plug (20) in input gear (19); thus, oil leakage will occur if unit is stored with mounting end down. Refer to following paragraphs for overhaul of belt pulley unit.

OVERHAUL

225. To renew pulley shaft oil seal (5-Fig. 150 or 151) only, remove cover (1), unscrew pulley nut (2) and remove pulley. Unbolt and remove retainer (6) taking care not to lose or damage any shims (8) and install new seal in retainer with lip inward. Lubricate seal with grease, place new gasket (7) on retainer, be sure all shims (8) are present inside housing, then install retainer and tighten cap screws securely. Reinstall pulley and tighten nut to a torque of 100 ft.-lbs., then reinstall cover (1).

For complete overhaul of unit, proceed as follows: Remove plugs (16) and drain lubricant. Remove belt pulley, then unbolt and remove output housing (11) and gear assembly from gearbox (15). Unbolt and remove rear cover (24). Be careful not to lose or damage shims (12 or 23). On light duty models (Fig. 150), drive input gear (19) rearward out of gearbox.

NOTE: Do not insert drift pin through the splined part of gear as driving against expansion plug (20) will damage both plug and needle bearing (21). Remainder of disassembly will be evident on both models.

To disassemble output (pulley) housing and gear, remove retainer (6-Fig. 150 or Fig. 151) with shims (8) from outer end of housing and press gear (14) out inner end. Remove the roller bearing (9) and ball bearing (10) from housing of early models or identical taper bearings (9 & 10) from late models. If worn or damaged, remove needle roller bearing (13) from inner end of housing.

Carefully clean and inspect all parts. If needle bearing (21-Fig. 150) in output gear of light duty models is worn or damaged and gear set is usable, remove bearing from gear. Also, check needle bearing journal on pin (22) and remove pin from rear cover (24) if journal shows signs of wear.

To reassemble light duty models, coat edge of expansion plug (20) with gasket sealer, then insert plug in gear (19) and expand with drift pin. Using proper size mandrel and pressing against lettered end of bearing cage only, install needle roller bearing (21) in gear; take care that bearing is not pressed in far enough to cover oil hole in gear. Press on lettered end of new bearing (13) to install bearing in housing (11).

If either gear (14 & 19-Fig. 150 or 14 & 19G-Fig. 151) is worn or damaged beyond further use, both gears should be renewed as a matched set.

Lubricate needle bearing (13-Fig. 150 or Fig. 151) with grease. Install bearings (9 & 10) in housing. Install new seal (5), then install retainer with new gasket (7) and same shims (8) as removed. Position the housing, bearing and seal assembly on hub of belt pulley, insert output gear (14) in housing and press gear in until seated against ball bearing. Remove the assembly from belt pulley and check shaft end play. On early models with ball bearing at (10), shaft should turn smoothly in bearings and have an end play of 0.004-0.006 inch. On later models, with taper roller bearings at (9 & 10), shaft should turn smoothly and have approximately 0.003 in. preload on bearings. If end play is not within these limits, remove retainer and add or remove shims (8) as necessary to obtain correct end play or bearing preload.

Install new oil seal (17) in gearbox with lip to inside. Press bearing (18) onto gear so that side of outer bearing race marked "THRUST" will be towards oil seal, then insert input gear into housing, carefully working gear through the seal. On light duty models, lubricate needle bearing (21-Fig. 150) with grease, then install cover (24) and pin (22). On heavy duty unit, install shaft (19S-Fig. 151), gear (19G), bearing (21) and cover (24).

On all models, install output shaft and housing assembly with same shims (12-Fig. 150 or Fig. 151) as removed on disassembly, then check gear backlash. If backlash is not within the limits of 0.005-0.007 inch, remove the output shaft and housing assembly and add or remove shims (12 & 23) as necessary to obtain correct backlash.

When output shaft end play and gear backlash are correct, install belt pulley and tighten nut to a torque of 100 ft.-lbs. Fill gearbox to a level of lower plug with SAE 140 transmission/hydraulic oil.

PTO

The two speed pto shown in Fig. 155 is available for 885 and 995 models; the multi (two) speed pto shown in Fig. 157 is available for 1210, 1212, 1410 and 1412 models; the single speed (540 rpm) pto shown in Fig. 158 is available for 1410 and 1412 models; the reversible shaft pto shown in Fig. 159 is

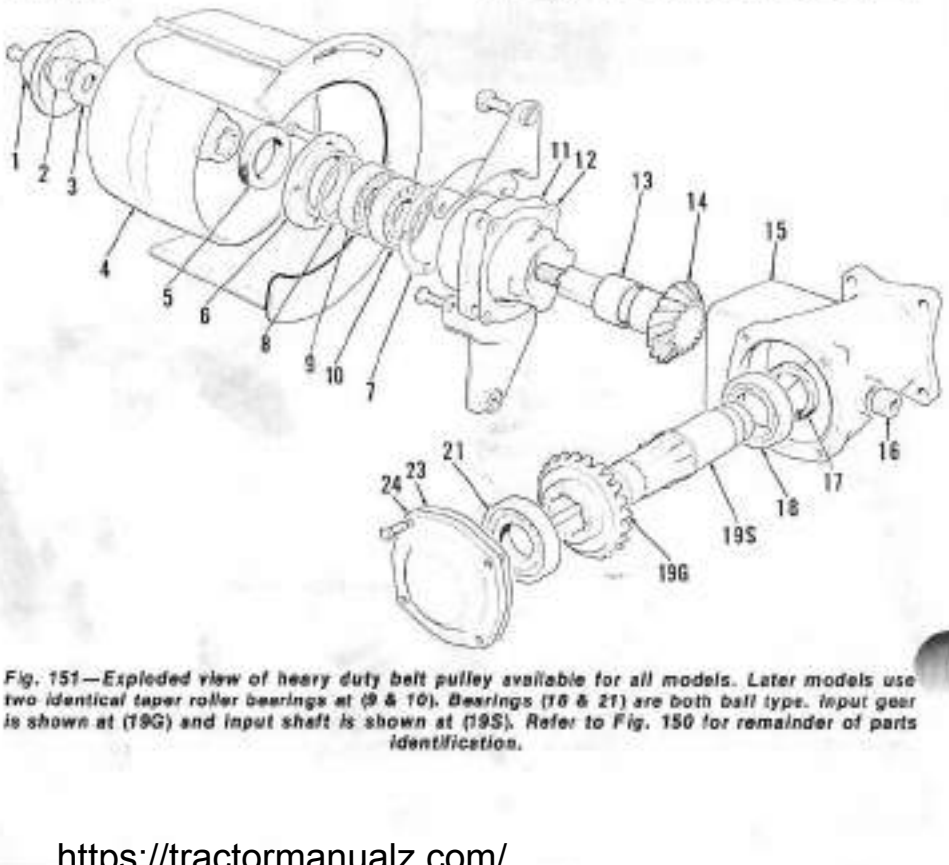


Fig. 151—Exploded view of heavy duty belt pulley available for all models. Later models use two identical taper roller bearings at (9 & 10). Bearings (16 & 21) are both ball type. Input gear is shown at (19G) and input shaft is shown at (19S). Refer to Fig. 150 for remainder of parts identification.

available on 1410 and 1412 models. Refer to appropriate paragraphs and Fig. for service.

R & R POWER TAKE-OFF ASSEMBLY

All Models

230. To remove the pto housing and gear assembly, first drain transmission lubricant, then proceed as follows: Unbolt and remove drawbar assembly and lower link or sway chain brackets from pto housing. On Selectamatic models, refer to paragraph 281 and remove the hydraulic system top link sensing unit. On Models 885 and 995, remove the warning lamp sensor (1-Fig. 275) from pto housing. On all models, attach hoist to pto housing. Unbolt housing from rear axle, move assembly rearward until splined coupling is disengaged, and lift unit from tractor.

OUTPUT SHAFT OIL SEAL

All Models

231. On all models except 1410 and 1412 with reversible pto, the output shaft oil seal can be renewed without removing pto assembly from tractor; proceed as follows:

Thoroughly clean pto housing rear cover and surrounding area and place oil pan under housing. Unbolt and remove rear cover plate and remove old seal and cover plate gasket. Install new seal in cover plate with lip forward and lubricate seal with grease. Install cover plate with new gasket, taking care to work lip of seal over pto shaft or use a seal protector. Clean threads of four lower cover retaining cap screws, treat with hydraulic grade Loctite and securely install all cap screws. Refill transmission to proper level.

OVERHAUL PTO ASSEMBLY

885 and 995 Models

232. With assembly removed as outlined in paragraph 230, pour all lubricant from housing, then refer to exploded view in Fig. 155 and proceed as follows:

Remove shift rail retaining pin (12); a hole is drilled in upper end of pin to aid in removal. Push shift rail (13) forward out of housing, catching the detent ball and spring (9) as rail is withdrawn from fork (11). Remove shift fork.

Remove snap ring (not shown) from rear end of input shaft (17) and drive the shaft forward until clear of rear bearing (16). Push bearing rearward out of housing, then remove second snap ring from rear end of input shaft. The shaft can now be withdrawn out front of housing; remove gear (15) out top opening. Remove snap rings and press input shaft from pump drive gear (1) and bearing inner race (3) if necessary. Inspect needle roller bearing (2) and remove from housing if worn or damaged.

Remove snap ring (18) from front end of idler shaft, remove idler gear (37) and bearing assembly, leaving stub shaft (6) in housing at this time. Remove snap rings and press bearing (4) from gear if bearing is excessively worn or rough.

Remove the socket head screw (36) from front end of output shaft (20), then using soft drift pin and hammer, drive output shaft rearward out of housing. Take care not to damage internal threads in front end of shaft. Lift gears out top of housing and remove retaining washer, locking pin and needle bearing inner race (33) from front of housing. Inspect needle roller bearing (34) and remove if worn or damaged. Remove ball bearing (24) with snap ring, spacer (26) and shims (25) from rear of housing, if not removed with shaft.

Carefully clean and inspect all parts and renew any not suitable for further service. Reassemble by reversing disassembly procedure and observing the following: When installing output shaft,

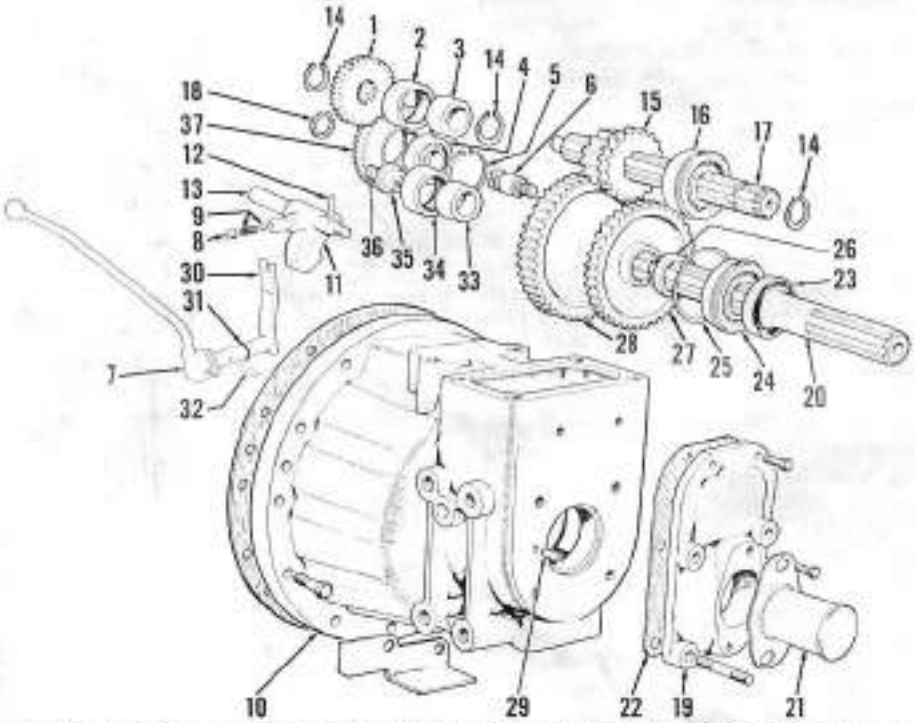


Fig. 155—Exploded view of two speed pto used on 885 and 995 models. Gear (1) on front end of input shaft (17) drives idler gear (37) mounted on stub shaft (6); idler gear drives hydraulic system pump. Shift lever (7) slides gear (15) on input shaft to engage with either low speed gear (28) or high speed gear (27) on output shaft; a neutral detent is also provided.

1. Pump drive gear
2. Needle roller bearing
3. Bearing inner race
4. Ball bearing
5. Snap ring
6. Idler stub shaft
7. Shift lever
8. Plug
9. Detent spring & ball
10. Housing
11. Shift fork
12. Retaining pin
13. Shift rail
14. Snap ring
15. Sliding gear
16. Ball bearing w/snap ring
17. Input shaft
18. Snap ring
19. Rear cover plate
20. Output shaft
21. Pto shaft guard
22. Gasket
23. Oil seal
24. Ball bearing w/snap ring
25. Shims
26. Spacer
27. High speed gear
28. Low speed gear
29. Dowel
30. Shift shaft & lever
31. "O" ring
32. Pin
33. Inner race
34. Needle bearing
35. Washer
36. Screw
37. Idler gear

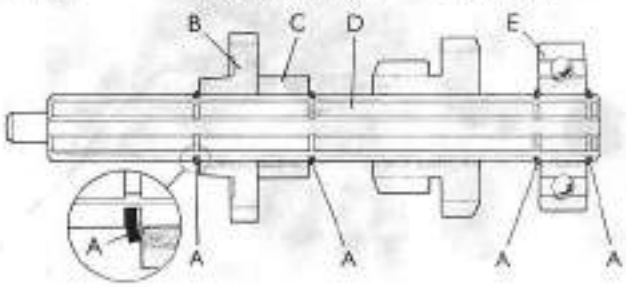


Fig. 156—When installing snap rings (A) on input shaft (D) for Models 885 and 995, be sure that cup side of snap ring is toward gear (B), bearing race (C) or ball bearing (E) as shown in inset.

install shims (25) as necessary so that rear face of bearing (24) protrudes 0.002-0.005 inch from face of housing. Peen inner diameter of washer (35) against head of screw (36) after securely tightening screw. Refer to Fig. 156 for proper installation of snap rings on input shaft. Clean threads of four lower rear cover retaining cap screws and apply hydraulic grade Loctite sealant, then securely tighten screws.

Models 1210, 1212, 1410 and 1412 With Two Speed Pto

233. Remove housing and gear assembly as outlined in paragraph 230, drain all lubricant from housing, refer to exploded view in Fig. 157 and proceed as follows:

Unbolt and remove rear cover plate (9), then remove shims (7 and 13), keeping shims from each bearing bore separate and identified. Bump input shaft rearward out of housing; remove bearing cone and roller assemblies from shaft and bearing (4) cup from housing if worn or scored. Move shift lever to work shift rail (17) rearward out of bore, then withdraw rail catching detent ball (26) and spring (27) as rail is removed from fork (24). Remove fork from housing. Bump output shaft (15) rearward from housing and remove front bearing cone and gear (16) out top opening. Remove rear bearing cone from output shaft and front bearing cup from housing. Drive out pin (29), remove shift lever (21) and withdraw shaft (23) from inside of housing. Remove "O" ring (22) from groove in shaft.

Reassemble by reversing disassembly procedure and observing the following: Install same shim thickness as removed at rear side of shaft rear bearings, then install rear cover plate with new gasket and check shaft end play. End play of each shaft in bearings should be 0.002-0.004 inch. If end play of either shaft is not within limits, remove rear cover plate and vary thickness of shims (7 and/or 13) as necessary to obtain correct end play. When end play of both shafts is correct, remove the four lower cap screws, clean the threads and apply hydraulic grade Loctite sealant, then securely reinstall the cap screws.

Models 1410 and 1412 With Single Speed Pto

234. Remove housing and gear assembly as outlined in paragraph 230, drain all lubricant from housing and refer to exploded view in Fig. 158. Disassembly and reassembly procedures will vary depending upon service required. Smear roller bearings (3) with grease before assembling in gear (5). Spacer (4) must be between roller bearings (3). Fill cavity in seal (32) with grease after pressing into rear cover (28) with spring loaded lip of seal toward inside. Shaft end play should be 0.002-0.004 inch after assembly and is adjusted by varying thickness of shims

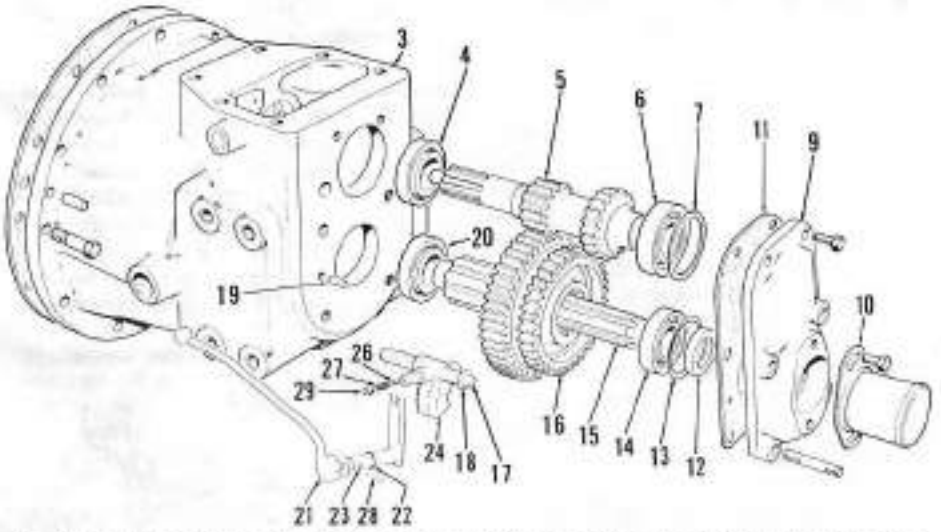


Fig. 157—Exploded view of multi speed pto available for 1210, 1212, 1410 and 1412 models. Sliding gear (16) on output shaft (15) engages either the low speed (front) gear or high speed (rear) gear machined on input shaft (5); a neutral detent for shift fork (24) is also provided.

3. Housing
4. Taper roller bearing
5. Input shaft
6. Taper roller bearing
7. Shims
9. Rear cover plate
10. Pto shaft guard
11. Gasket
12. Oil seal
13. Shims
14. Taper roller bearing
15. Output shaft
16. Sliding gear
17. Shift rail
18. Snap ring
19. Dowel pin
20. Taper roller bearing
21. Shift lever
22. "O" ring
23. Shift shaft & lever
24. Shift fork
26. Detent ball
27. Detent spring
28. Pin
29. Plug

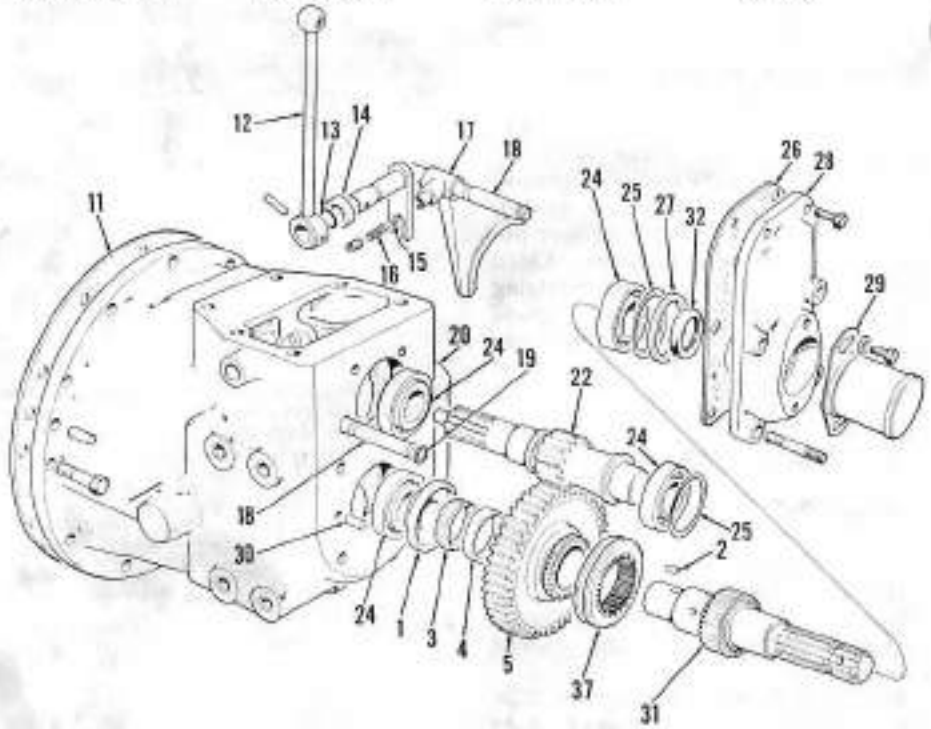


Fig. 158—Exploded view of single speed pto assembly for 1410 and 1412 models. Shift fork (17), coupling and related parts permit disengagement of driven gear (5) from shaft (31).

1. Spacer
2. Key
3. Roller bearing (2 used)
4. Spacer
5. Driven gear
11. Gasket
12. Shift lever
13. "O" ring
14. Shift shaft & lever
15. Detent ball
16. Spring
17. Shift fork
18. Shift shaft (shown twice)
19. Snap ring
20. Housing
22. Input shaft and gear
24. Taper roller bearings (4 used)
25. Shims
26. Gasket
27. Spacer
28. Rear cover plate
29. Shaft guard
30. Dowel pin
31. Output shaft
32. Oil seal
37. Sliding coupling

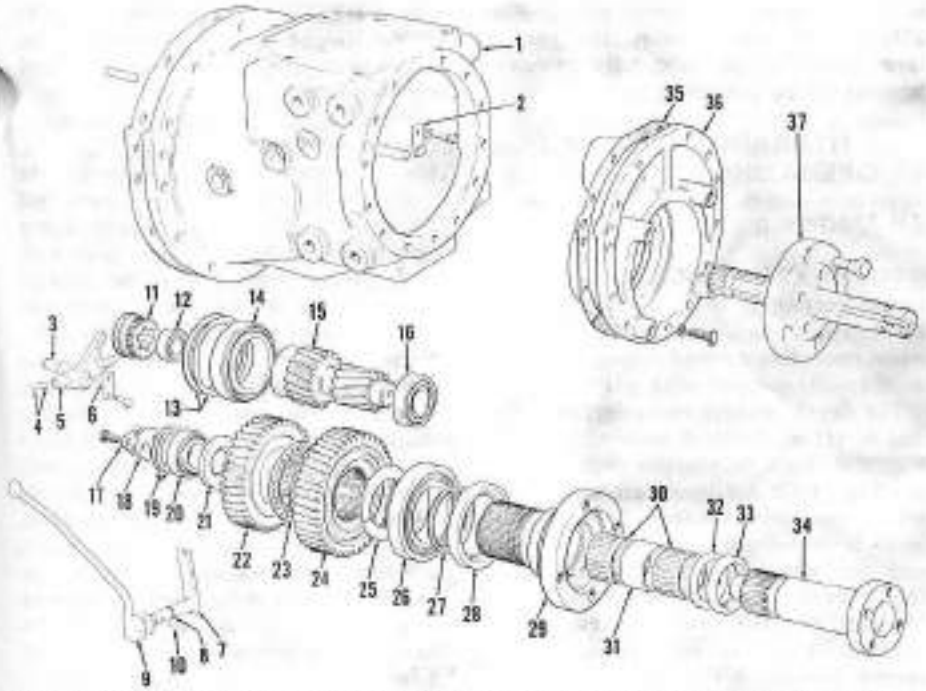


Fig. 159—Exploded view of reversible shaft pto available on 1410 and 1412 models. Output shaft (37) can be installed with fine spline out with attaching screws installed at inner diameter into shaft (34) for high speed output. Output shaft (37) can be installed as shown with attaching screws installed through holes farther from center into shaft (29) for lower pto output shaft speed.

1. Housing
2. Plate
3. Shift rail
4. Detent ball & spring
5. Shift fork
6. Retaining plate
7. Shaft and lever
8. "O" ring
9. Shift lever
10. Pin
11. Shift (in or out) coupling
12. Ball bearing
13. Shims
14. Taper roller bearing
15. Input shaft
16. Taper roller bearing
17. Tab washer
18. Bearing retainer
19. Shims
20. Taper roller bearing
21. Special washer
22. Gear
23. Needle thrust bearing
24. Gear
25. Split ring
26. Taper roller bearing
27. Special washer
28. Oil seal
29. Low speed output shaft
30. Needle roller bearings
31. Spacer
32. Spacer
33. Oil seal
34. High speed output shaft
35. Gasket
36. End cover
37. Output shaft (reversible)

(25). Be sure to check both shafts (22 & 31) and be sure that all races for bearings (24) are fully seated.

Models 1410 and 1412 With Reversible Shaft

235. Remove housing and gear assembly as outlined in paragraph 230, drain all lubricant from housing and refer to exploded view in Fig. 159. Disassembly procedure may vary depending upon service required. Clean and inspect all bearings and bearing races carefully. Smear roller bearings (23 & 30) with grease before assembling. Fill cavity in seals (28 & 33) with grease after pressing into appropriate bore with spring loaded lip toward inside. End play of gears, shafts and related parts (20 through 34) should be 0.002-0.004 inch and is changed by varying total thickness of shims (19). End play of shaft (15) is adjusted by varying thickness of shims (13) to provide correct end play of 0.002-0.004 inch.

SELECTAMATIC HYDRAULIC SYSTEM

The Selectamatic hydraulic system incorporates four types of hydraulic control; depth (draft) control, height (position) control, traction control (T.C.U.) and control of remote external hydraulic cylinders. Hydraulic power is supplied by a front mounted, crankshaft driven pump on Models 1210, 1212, 1410 and 1412, and by a pump mounted in PTO housing and driven from PTO gear input shaft on all other models.

For explanation of system operation, refer to the following paragraphs 241 through 244. Schematic diagram of the system is shown in Fig. 267 and Figs. 268, 269 and 270 show views of the hydraulic system controls.

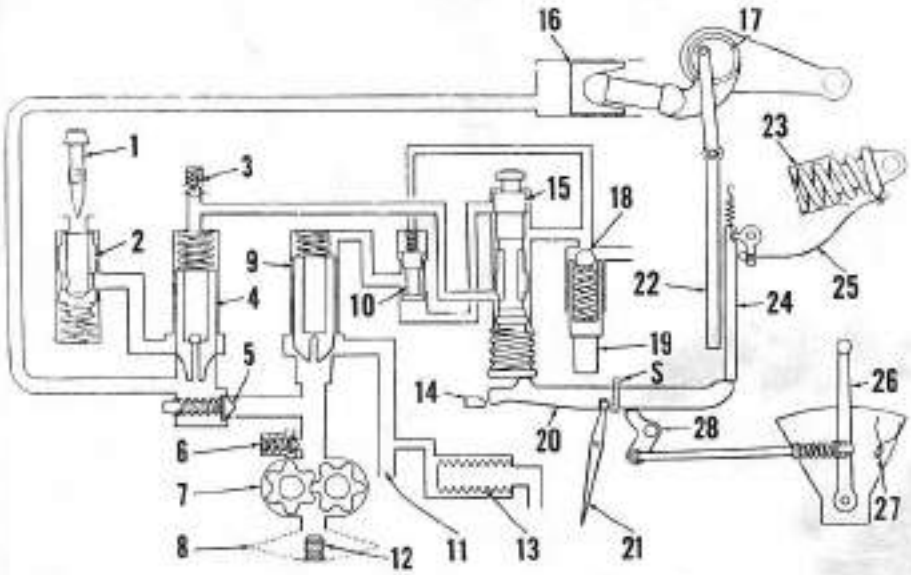


Fig. 267—Schematic diagram of "Selectamatic" hydraulic system. Selector lever (21) moves rocker arm (20) to different positions for depth (draft) control, height (position) control or for traction control (T.C.U.). Traction control position is also used for operating external ram cylinder. Rocker arm (20) is shown in depth control position. Note that though selector lever actually moves rocker arm sideways, it is shown in the schematic view that rocker arm is moved endways; this is for simplification of diagram only. Some models use full flow suction filter instead of by-pass filter (13).

1. Lowering rate adjuster
2. Flow control valve
3. Cylinder relief (safety) valve
4. Hold valve plunger
5. Non-return (check) valve
6. Pump relief valve
7. Hydraulic filter
8. Suction screen filter
9. By-pass valve plunger
10. Latching valve plunger
11. Lubrication pipe
12. Magnetic filter
13. By-pass filter (not all models)
14. Abutment plate
15. Spool valve
16. Ram cylinder
17. Ram cylinder rockshaft
18. Traction control valve ball
19. Traction control valve plunger
20. Rocker lever
21. Selector dial
22. Height control push rod
23. Sensing unit
24. Depth control push rod
25. Depth (draft) sensing cable
26. Control lever
27. Lever return spring
28. Control lever cam

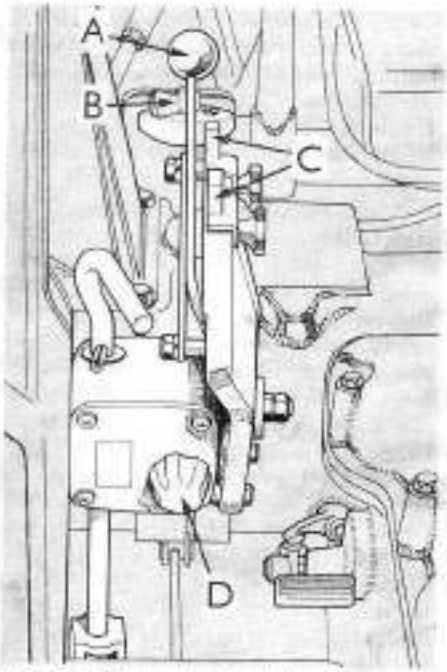


Fig. 268—Drawing showing hydraulic system controls. Refer also to Fig. 269 and 270.

A. Control lever
B. Selector dial
C. Control lever stop guides
D. Rate of lowering adjustment

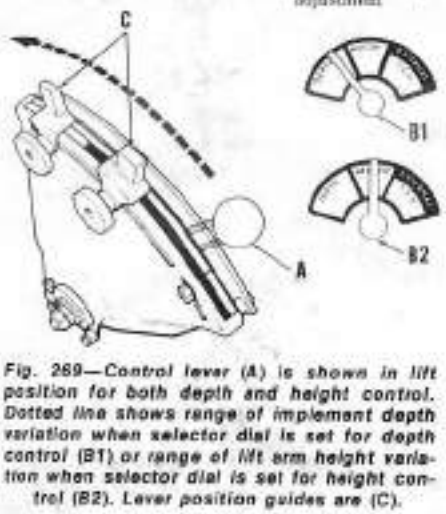


Fig. 269—Control lever (A) is shown in lift position for both depth and height control. Dotted line shows range of implement depth variation when selector dial is set for depth control (B1) or range of lift arm height variation when selector dial is set for height control (B2). Lever position guides are (C).

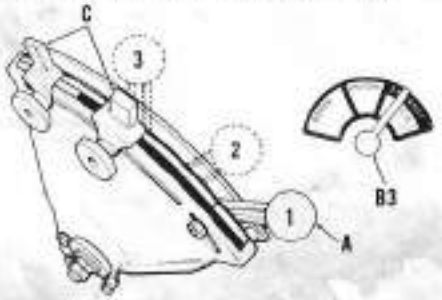


Fig. 270—When selector dial is set at T.C.U./external position (B3), control lever must be pulled rearward against spring pressure to position (1) to raise lift linkage or pressurize external cylinder. When released, control lever will return to hold position (2). Minimum traction control pressure is obtained with lever approximately as shown at (3).

NOTE: To move selector dial (B-Fig. 268) to different position, the control lever (A) must be held fully rearward against spring pressure.

HYDRAULIC SYSTEM OPERATING PRINCIPLES

All Models

241. **DEPTH (DRAFT) CONTROL.** Depth control is used to maintain desired operating depth of implement when operating ground engaging implements not equipped with gage wheels.

For depth control operation, selector dial is set at position shown at B1 in Fig. 269. This moves the rocker lever (20-Fig. 267) to position shown in schematic view so that rear end of lever is under push rod (24) and front end contacts spool valve (15); lever then pivots on control lever cam (28). Moving control lever rearward to contact, but not compress, return spring (position A-Fig. 269) places spool valve in raising position. Moving control lever forward as shown by dotted arrow in Fig. 269 lowers the implement until force transmitted by top link of the 3-point hitch compresses draft control spring (23-Fig. 267) and moves spool valve to hold position. The farther forward that control lever is moved, the greater the force required on draft control spring to return valve spool to hold position. Thus, deeper penetration of implement is obtained by moving control lever forward. Guides (C-Fig. 269) may be set to desired position so that implement can be returned to same depth after being raised from ground.

242. **HEIGHT (POSITION) CONTROL.** Height control is used where lift linkage is required to be maintained in a certain position.

For height control, selector dial is set at position shown at B2 in Fig. 269. This positions rear end of rocker lever (20-Fig. 267) under rockshaft push rod (22) and front end of rocker lever against spool valve (15); lever pivots on control lever cam (28). When control lever is moved to position "A" shown in Fig. 269, spool valve is placed in raise position until rockshaft turns, forcing push rod (22) downward and returning spool valve to hold position. Moving control lever forward places spool valve in lowering position, then linkage will lower until rockshaft push rod is lifted, returning spool valve to hold position. Thus, for any position of control lever within range shown by dotted arrow in Fig. 269, the lift linkage will be moved to a relative position. When control lever is fully forward, lift linkage will be fully lowered.

243. **TRACTION CONTROL (T.C.U.).** Traction control is used with implements equipped with gage wheels and provides for transfer of implement weight to tractor rear wheels for increased traction.

For traction control, selector dial is set at T.C.U. position (B3-Fig. 270). This moves rocker lever (20-Fig. 267) so that front end of lever rests on abutment plate (14), screw (S) in lever is below traction control valve and rear end of lever is moved away from both the depth control push rod (24) and height control push rod (22). Lever

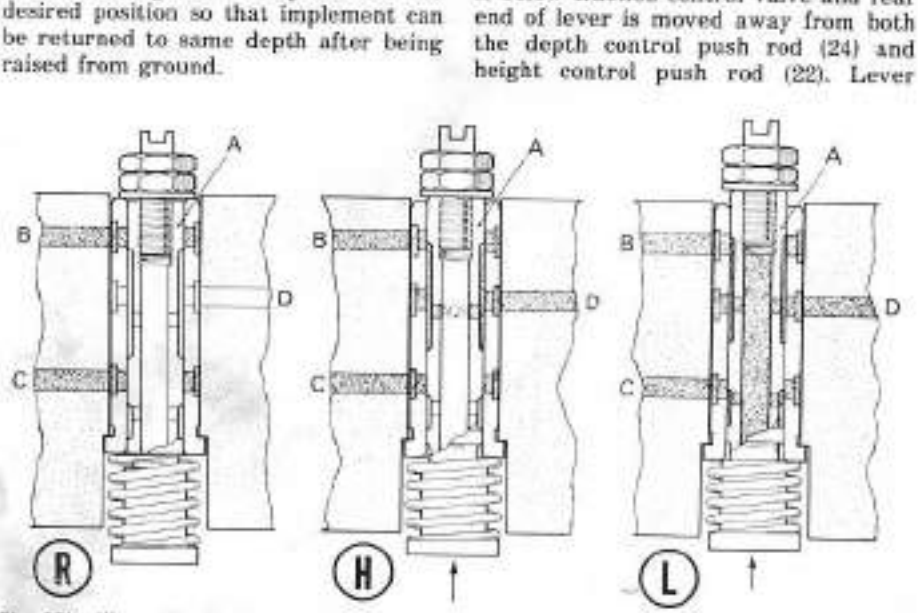


Fig. 271—Views showing control valve spool (A) in raise (R), hold (H) and lower (L) positions. In raise position, passages (B & C) from hold and by-pass valves are blocked, closing the valves (see Figs. 272 & 273). In hold position, passage (B) from by-pass valve is open, allowing by-pass valve plunger to open and unload hydraulic pump; hold valve passage (C) remains blocked, holding hold valve closed and retaining fluid in ram cylinder. When in lowering position, both passages (B & C) are open allowing fluid in ram cylinder to return to sump. Spool valve discharge passage is (D). Refer also to Fig. 267.

then pivots on abutment plate and is controlled only by the control lever cam (28). Moving control lever fully rearward to a position (1-Fig. 270) compressing quadrant spring (27-Fig. 267) places control valve spool in raising position. When lift linkage is raised and the control lever released, quadrant spring will return the lever and spool valve to hold position. Moving lever forward from hold position (2-Fig. 270) will place spool valve in lowering position. To locate minimum traction control position (3) of control lever, lower the lift linkage and without any weight or implement on linkage, slowly move control lever forward from lowering position. When control lever reaches position where lift arms just start to raise, move upper guide (C) to this position. Moving control lever forward from minimum traction control position will increase traction control pressure as the screw in rocker lever is pushing upward against traction control valve plunger (19). Maximum traction control pressure is with control lever fully forward. Position for proper traction control pressure can be determined only with implement in working position in ground and with tractor moving at desired speed; when this position is found, move lower guide (C) in alignment with lever so that lever may be returned to proper position after lifting implement at end of field.

244. **EXTERNAL (REMOTE CYLINDER) CONTROL.** For operating single acting remote cylinders, selector dial is set at T.C.U. position and control lever is used in raising and lowering position. Fluid pressure is directed to remote cylinder instead of rockshaft ram cylinder by means of a three-way valve shown in Fig. 316.

A remote control valve (refer to paragraph 284) for operating remote cylinders independently from lift control system is available for most models.

FLUID CONTROL VALVES

All Models

245. **PUMP RELIEF VALVE.** The pump relief valve (6-Fig. 267) is mounted on pump cover plate and is factory adjusted, then sealed, to open at 2000 psi.

246. **CONTROL (SPOOL) VALVE.** The spool valve (15-Fig. 267) is located in control valve housing and handles only the fluid flow required to operate the pressure balanced hold and by-pass valves described in following paragraph 247. Refer to Fig. 271 for views showing spool valve in raise (R), hold (H) and lower (L) positions. In raise position, the spool valve blocks passages from both the by-pass and hold valves, retaining the valves in closed position. In hold position, spool valve blocks passage from hold valve, retaining this valve closed, but opens passage from by-pass valve, allowing by-pass valve to direct fluid from pump to lubrication circuit. In lowering position, both the passages from hold and by-pass valves are open, allowing fluid in rockshaft ram cylinder to return to sump and also by-passing fluid from pump to lubrication circuit.

247. **HOLD AND BY-PASS (PRESSURE BALANCED) VALVES.** The by-pass valve (9-Fig. 267) controls flow to hydraulic fluid from pump, directing

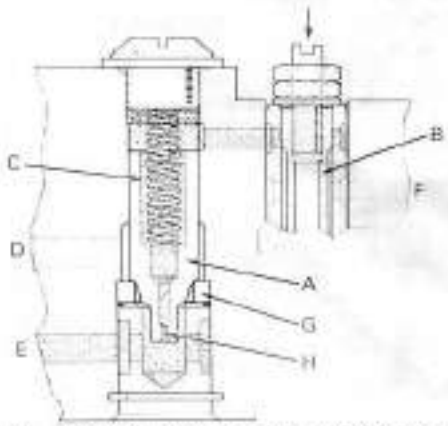


Fig. 272—View showing pressure balanced valve operation. With spool valve (B) blocking passage from top side of valve plunger (A), pressure above valve is maintained via orifice (H) to same pressure as below valve in passage (E), thus spring (C) holds plunger on seat (G) closing outlet passage (D).

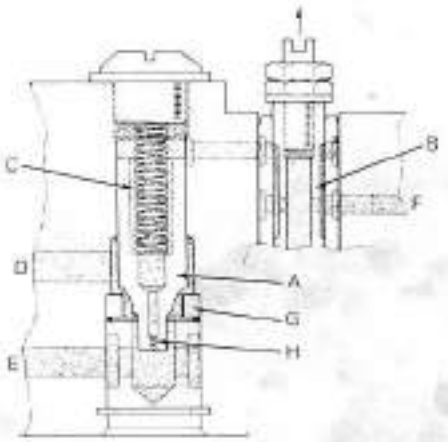


Fig. 273—View showing pressure balanced valve operation. With spool valve (B) passage (F) open, fluid pressure above valve is lowered as flow through metering hole (H) is not sufficient to overcome loss through open spool valve. Thus, pressure in passage below valve pushes plunger (A) away from seat (G) allowing oil to flow out passage (D). Fluid flowing through metering hole flows out through passage (F).

the flow to rockshaft cylinder when necessary to raise lift linkage and directing flow to lubrication circuit at all other times. The hold valve (4) retains fluid in rockshaft cylinder until necessary to lower the lift linkage, then opens to allow fluid in cylinder to return to sump. Refer to Fig. 272 and Fig. 273 for flow diagram of pressure balanced valve unit typical of both the hold and by-pass valves.

248. **LATCHING VALVE.** The latching valve (10-Fig. 267) is interposed in the passage between the by-pass valve (9) and the spool valve (15). When lift arms are in raised position and weighted with implement, any leakage in ram cylinder circuit will allow linkage to lower slowly and gradually place spool valve in raising position. The latching valve will then snap closed, providing a sharp response of by-pass valve.

249. **TRACTION CONTROL (T.C.U.) VALVE.** The spring loaded traction control valve ball (18-Fig. 267) is used to increase the back pressure on the hold and by-pass valves, thus causing a low pressure rise in ram cylinder circuit. This provides a light lifting pressure on ground engaging implements, adding weight to tractor rear wheels and increasing traction. Traction control lifting pressure is regulated by movement of the spring plunger (19); plunger is actuated by screw in rocker lever contacting plunger when dial selector is moved to forward part of quadrant.

250. **HOLD (RAM CYLINDER SAFETY) RELIEF VALVE.** The hold relief valve (3-Fig. 267) is adjusted to open at 2500 psi, thus allowing hold valve (4) to open whenever pressure in ram cylinder circuit exceeds this relief pressure. Very high hydraulic pressure in the ram cylinder circuit could occur from shock loads imposed by heavy implements; however, the hold relief valve prevents these pressures from exceeding that which could cause damage to the ram cylinder or related parts.

251. **RATE OF LOWERING VALVE.** The rate of lowering valve (2-Fig. 267) is a flow control valve regulated by opening or closing needle valve (1), thus regulating the flow of oil returning from ram cylinder to sump. The rate of lowering of lift linkage can then be controlled to desired speed, regardless of implement weight.

252. **NON-RETURN (CHECK) VALVE.** The non-return valve (5-Fig.

267) prevents oil in ram cylinder from returning to pump outlet passage when hold valve (4) is closed and by-pass valve (9) is open.

HYDRAULIC FLUID

All Models

254. Transmission lubricating oil is utilized for the hydraulic system fluid. Recommended lubricant is Case TFD or equivalent. Do not use Automatic Transmission Fluid; however, SAE 20W/40 motor oil may be used if Case TFD is not available. To coincide with alternate service intervals of the hydraulic system filters as outlined in paragraph 255, lubricant should be discarded after 1000 hours of use and the system refilled with new clean oil.

Refill capacity is approximately 24 quarts for all 885 and 995 models and approximately 43 quarts for other models. Exact capacity will depend upon tractor equipment.

CAUTION: Air may be admitted to suction side of hydraulic pump when transmission oil is drained.

If control lever is in "raise" position when engine is restarted, pump may fail to prime and become damaged due to oil starvation. **Be sure** to place hydraulic control lever in forward (lowering) position before restarting engine after refilling transmission. When engine is restarted, run at minimum idling speed for ½-minute, then move control lever to "raise position. If no response is noted, stop engine, return lever to "lower" position and loosen pressure line connections between pump and relief valve(s). Restart engine and tighten the connections when oil starts to flow, then recheck to be sure hydraulic lift is operative.

HYDRAULIC SYSTEM FILTERS

All Models

255. The transmission lubricant should be drained and the suction screen, magnetic filter and control valve by-pass plunger screen cleaned and the paper filter elements renewed after each 500 hours of operation. After 1000 hours of use, the transmission oil should be discarded and system refilled with new oil; refer to paragraph 254. Oil with 500 hours use may be reused providing that it is drained into a clean container, allowed to settle and when being poured back into transmission, the last gallon in container retained so that any foreign material settled to bottom will not be returned to transmission. Add new oil to bring level to full mark on dipstick.

The suction strainer screen (4A-Fig. 275 or Fig. 276) and magnet (32) can be cleaned on models so equipped; however, filter element (36) must be renewed. A warning light is provided on instrument panel of some models which, if lighted, indicates low pressure in pump suction tube usually caused by clogged filter element (36).

NOTE: The oil filter warning light may come on when transmission oil is cold or when engine is operating at speeds above 1800 rpm; however, this does not indicate that filter is plugged. Filter should be renewed if light comes on when transmission oil is at operating temperature and engine is operating at speeds below 1800 rpm, regardless of time interval since filter element was last renewed.

Models 1210, 1212, 1410 and 1412 are equipped with a pressure filter (Fig. 277) which is located between the pto housing and the right side rockshaft bracket. New filter element (2) should be installed after every 500 operating hours. Filter can be removed without draining system.

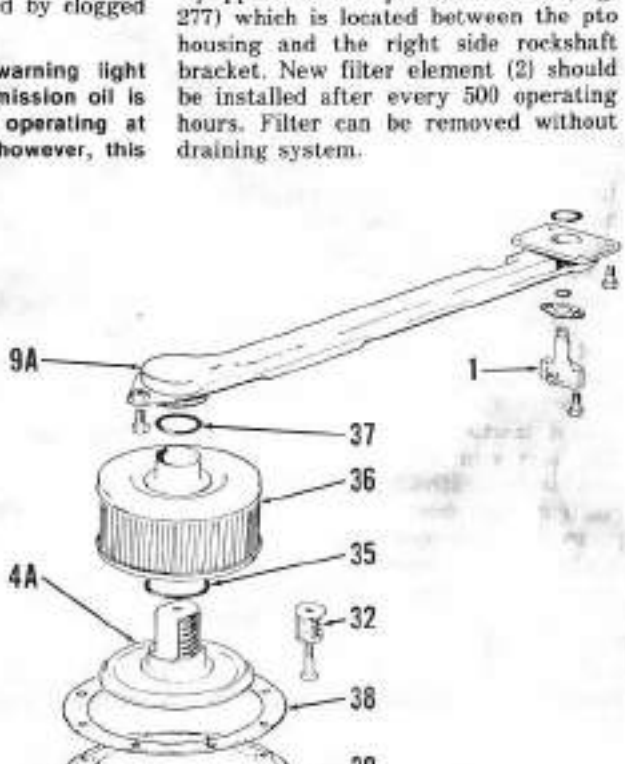


Fig. 275—View of filter element and suction typical of all 885 and 995 models.

1. Warning lamp sensor
4A. Suction filter and by-pass valve
9A. Pump intake tube
32. Magnetic filter
35. "O" ring
36. Filter element
37. "O" ring
38. Gasket
39. Cover
40. Drain plug

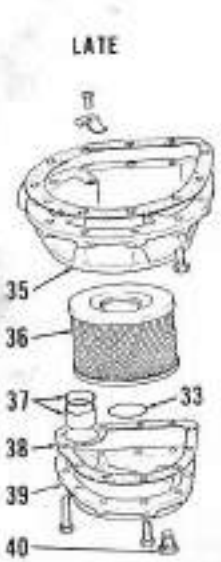


Fig. 276—Exploded view of pump suction filters and covers for early and late 1210, 1212, 1410 and 1412 models.

1. Inlet pipe
4A. By-pass valve and screen (early models)
32. Magnetic filter
33. "O" ring
34. Connector tube
35. Filter housing
36. Filter element
37. Cover insert and "O" ring
38. Gasket
39. Gear box sump cover
40. Drain plug

TROUBLE SHOOTING

All Models

256. When trouble shooting problems are encountered with Selectamatic hydraulic system, refer first to paragraphs 241 through 255 to be sure problem is not with misunderstanding the operation of the system or is not caused by improper maintenance. With knowledge of how the system should operate, refer to the following list of malfunctions and possible causes as an aid in locating source of trouble.

A. FAILURE TO LIFT UNDER ALL CONDITIONS; PUMP IS QUIET. Could be caused by:

1. Faulty depth/height control linkvalve plunger stuck open or plunger orifice plugged.
2. Hold valve plug seal leaking, hold valve plunger stuck open, plunger orifice plugged or hold relief (cylinder safety) valve is faulty.
3. Faulty pump relief valve.
4. Faulty hydraulic pump.
5. Pump drive failure.
6. Faulty "O" ring seals or ruptured high pressure pipe.

B. FAILURE TO LIFT UNDER ALL CONDITIONS; PUMP IS NOISY. Could be caused by:

1. Low oil level in transmission.
2. Pump suction filter is plugged.
3. Non-return (check) valve seat loose.

C. FAILURE TO LIFT EXCEPT WITH SELECTOR DIAL IN TRACTION CONTROL (T.C.U.) POSITION. Could be caused by:

1. Faulty depth/height control linkage.
2. Spool valve stuck in open (lower) position; will lift light load with control lever fully forward to maximum traction control position.
3. Spool valve not properly adjusted; will lift light load when control lever is fully forward in maximum traction control position.

D. FAILURE TO LIFT UNDER LOAD. Could be caused by:

1. Faulty pump relief valve.
2. Faulty or worn hydraulic pump.
3. Faulty "O" ring seals on high pressure connections or on ram cylinder piston.
4. Faulty hold (cylinder safety) relief valve.

E. WILL NOT HOLD AFTER RAISING. Could be caused by:

1. Quadrant (control lever return) spring not properly adjusted.
2. Faulty sensing unit or depth control cable, or cable not properly adjusted.
3. Leaking sealing washer on hold valve plug.
4. Faulty hold (cylinder safety) relief valve.
5. Hold valve plunger sticking.
6. Ram cylinder piston seals leaking.
7. Faulty non-return (check) valve.
8. Leaking "O" ring seals at high pressure pipe connections or pipe leaking.

F. ERRATIC OR INCORRECT TRACTION CONTROL OPERATION. Could be caused by:

1. Sticking latching valve.
2. Hold plunger ball missing.
3. Incorrect control lever adjustment.
4. Incorrect setting of traction control adjusting screw in rocker lever.
5. Incorrect adjustment of traction control valve retainer.
6. Weak traction control valve spring.

G. ERRATIC OR INCORRECT DEPTH CONTROL. Could be caused by:

1. Incorrect adjustment of implement.
2. Loose control lever pivot.
3. Seized or incorrectly adjusted sensing cable.
4. Seized or faulty sensing unit.
5. Sticking hold valve or by-pass valve plungers.
6. Sticking latching valve.

H. LIFT LINKAGE LOWERS TOO SLOWLY. Could be caused by:

1. Lowering control not fully open.
2. Incorrect grade of transmission lubricant.
3. Incorrect control lever adjustment.
4. Hold valve plunger sticking.
5. Incorrectly adjusted traction control cable.
6. Incorrectly adjusted spool valve.
7. Flow control valve plunger sticking.

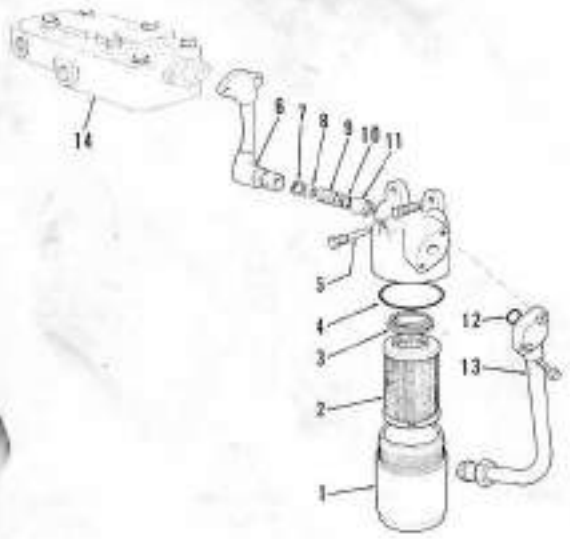


Fig. 277—Exploded view of pressure filter used on 1210, 1212, 1410 and 1412 models. Unit is located between pto housing and right side rockshaft bracket.

1. Cover
2. Element
3. Spring
4. "O" ring
5. Retaining pin
6. Filter to distribution block pipe
7. Snap ring
8. By-pass valve spring retainer
9. Spring
10. By-pass valve washer
11. By-pass valve plunger
12. "O" ring
13. Union to filter pipe
14. Distribution block

SYSTEM CHECKS AND ADJUSTMENTS

All Models

257. **HYDRAULIC PRESSURE CHECK.** Pump relief pressure on all models is 2000 psi. Method of checking pressure will depend upon model being serviced; refer to the following procedure.

258. MODELS 885 & 995. On these models, the pump relief valve can be checked directly as follows: Refer to Fig. 279, remove axle connection plate (C) and install a special plug (P) (David Brown tool No. 961977) as shown, then reinstall connection plate with sealing rings. Connect a 3000 psi hydraulic pressure gage (G), then start engine and observe gage reading.

CAUTION: It is important that this test be carried out with engine running at slow idle speed only and with transmission oil temperature above 75 degree F.

With top link sensing unit removed, it can be observed whether low pressure reading is due to faulty pressure relief valve or other failure. Renew relief valve if pressure is not approximately 2000 psi and oil is observed running from relief valve shield.

259. MODELS 1210, 1212, 1410 & 1412. To directly check hydraulic pump relief pressure, remove remote control valve cover plate (F-Fig. 280) and install test plate (David Brown tool No. 962234). Hydraulic pressure gage can then be connected to port in plate. Start engine and run at slow idle speed

only: oil temperature must be above 75 degree F. Gage reading should then be 2000 psi. If gage reading is low, check relief valve (or valves) at bottom of transmission housing. If valves are hot or "buzzing", renew the relief valve. Low pressure gage reading with no noticeable by-pass through relief valve indicates faulty pump.

If test plate is not available, connect pressure gage to one of the remote control valve cylinder ports (A or B) and pressurize port by operating control lever (C). If control valve is not faulty, gage reading will be pump pressure.

NOTE: Control valve lever will return to neutral position if not held to pressurize port.

260. **CHECK FOR RAM CYLINDER LEAKAGE.** If a 3-way control valve is installed at front end of rockshaft ram cylinder (left front side of axle housing), raise lift linkage with heavy implement attached, then close valve to ram cylinder. If linkage lowers with valve closed, ram cylinder seal rings are leaking.

On 885 and 995 models not equipped with 3-way valve, remove connector at front side of ram cylinder and install special connector with shut-off valve (David Brown tool No. 961821). With valve open, lift linkage with heavy implement attached, then close the valve; if linkage lowers, piston ring seals are faulty.

261. **BLEED HYDRAULIC SYSTEM.** To bleed the front mounted hydraulic pump on 1210, 1212, 1410 and 1412 models, refer to paragraph 254. To bleed the control valves and ram cylinder on all models, proceed as follows:

Remove plate from rear axle housing to expose the hold and by-pass valve plunger plugs (Q-Fig. 281). Start engine and, on 885 and 995 models loosen plug (P) in axle housing plate. Pull control lever fully rearward against spring pressure and hold in this position until oil free of any air bubbles runs from loosened plug, then push lever forward and tighten plug. On all models, loosen hold and by-pass valve plugs (Q) and pull control lever fully rearward against spring pressure until flow of bubble free oil is obtained, then push lever forward and tighten plugs. Loosen the ram cylinder bleed plug and again pull control lever fully rearward against spring pressure. When lift linkage is fully raised and bubble free oil is running from bleed screw, tighten the screw. Note that the ram cylinder bleed screw has the appearance of a grease fitting.

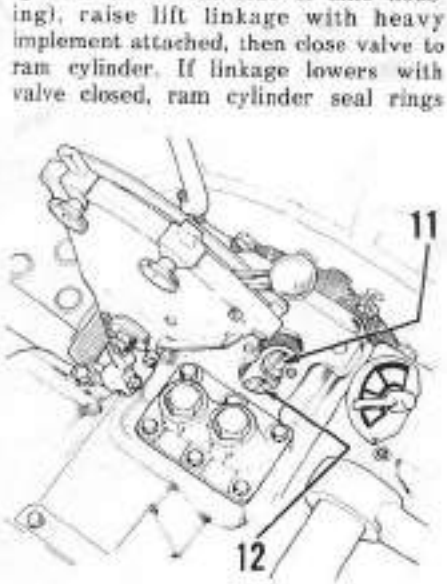


Fig. 278—To clean nylon screen in by-pass valve plunger, remove plug (11) and withdraw the spring and by-pass plunger assembly. For exploded view of by-pass plunger, refer to items 5, 6, 7 and 8 in Fig. 298. Hold valve plunger retaining plug is (12).

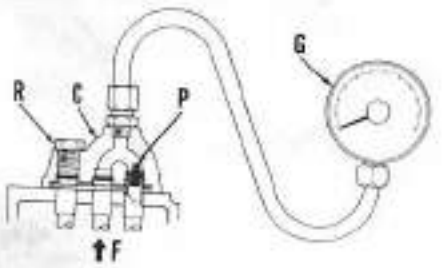


Fig. 279—View showing installation of gage for checking hydraulic pump relief pressure on 885 and 995 models. Axle cover plate (C) must be removed and a special plug (P) installed to block passage to control valve. Flow (F) is then closed except to gage (G). Return port (R) is for external hydraulic use.

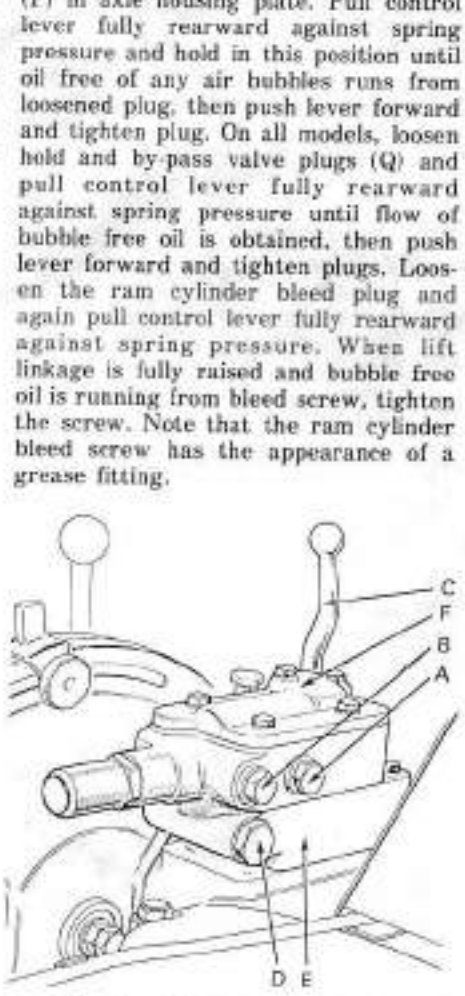


Fig. 280—On 1210, 1212, 1410 and 1412 models, where special test plate which is installed in place of control valve cover (F) is not available, check pressure by connecting test gage to remote port (A or B) and pressurizing that port. Control lever must be held to keep it from returning to neutral when detent release pressure is reached. Plug (D) in adapter plate (E) seals external hydraulic return port.

262. **EXTERNAL ADJUSTMENTS.** The control lever and the sensing unit cable can be adjusted without disassembly of any unit; refer to following paragraphs 263 and 264.

263. CONTROL LEVER ADJUSTMENT. The control lever should move without binding, yet have sufficient tension to hold a set position without moving due to vibration. To adjust control lever tension, loosen the pivot nuts (U-Fig. 282), tighten inner nut to

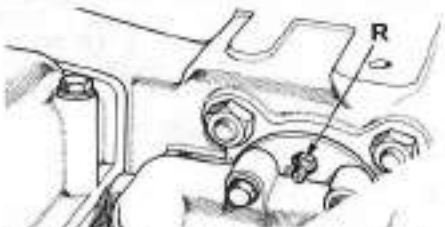


Fig. 281—View showing bleeding points for hydraulic system; refer to text for procedure.

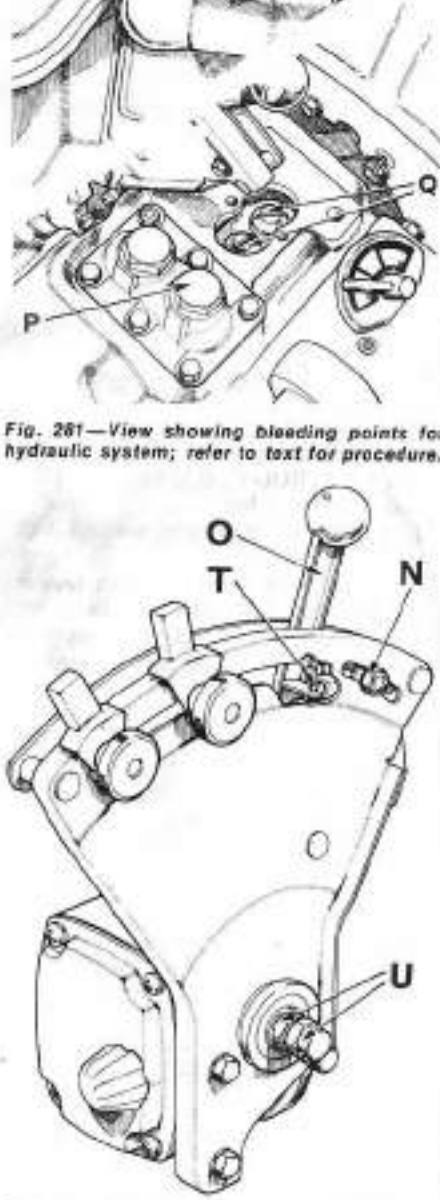


Fig. 282—Hydraulic system control lever adjusting points; refer to text for procedure.

desired tension, then hold inner nut while tightening outer nut.

To check adjustment of quadrant ("select" position return) spring (T), loosen spring carrier nut (N), move lever fully rearward and turn selector dial to "Height" position. Engage lift linkage latch, start engine and hold control lever fully rearward. When linkage is fully raised and relief valve opens, slowly move lever forward until pump unloads and relief valve stops making noise. Move the spring carrier forward until spring just touches, but does not move the control lever, then tighten nut (N). As overheating of oil and wear of pump will occur if pump relief valve is in continuous operation, be sure relief valve operates only when control lever is held rearward against spring pressure and ceases to operate when control lever is released and spring moves lever forward. Readjust carrier if necessary.

264. ADJUST SENSING UNIT CABLE. On models with double acting sensing unit, adjust cable as follows: With weight on lower links and top link disconnected, place selector dial in "Depth" position. Loosen locknut and turn adjuster (S-Fig. 283) fully inward so that cable is slack. Move control lever (O) rearward until it contacts quadrant spring (T), start engine and allow lift linkage to raise fully and reach hold position, then stop engine. With control lever still touching quadrant spring, slowly turn adjuster out until linkage starts to creep downward, then turn adjuster back in 9¼ turns on 885 models, 5¼ turns for all other models. While holding adjuster in this position, retighten locknut.

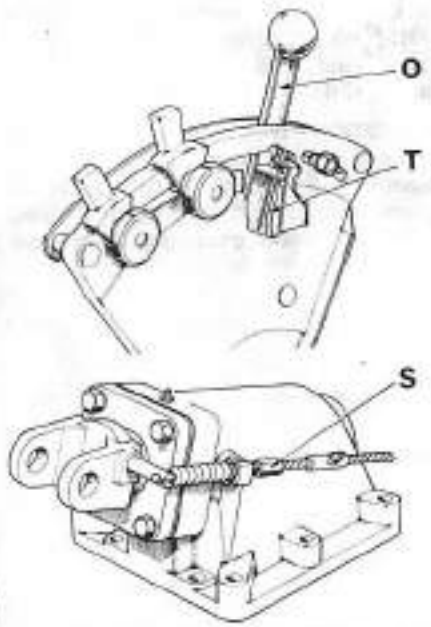


Fig. 283—Adjusting points for top link sensing unit flexible cable; refer to text for procedure.

265. **SYSTEM INTERNAL ADJUSTMENTS.** When installing new control valve assembly or right rockshaft bracket on which the valve mounts, it will be necessary to adjust the abutment plate as outlined in paragraph 266 and the traction control (T.C.U.) valve as outlined in paragraph 267. Rockshaft cam is adjusted as outlined in paragraph 268 and connecting link nut as in paragraph 269. For adjustment of spool valve, traction control valve and hold relief valve, refer to paragraph 276.

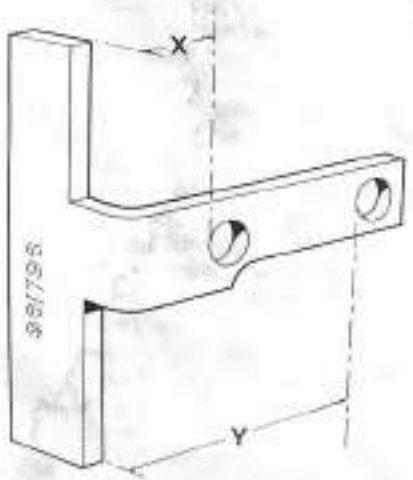


Fig. 284—Adjusting gage (David Brown part No. 961796) for hydraulic control mechanism. Dimension "X" is 0.437 inch; dimension "Y" is 1.580 inches.

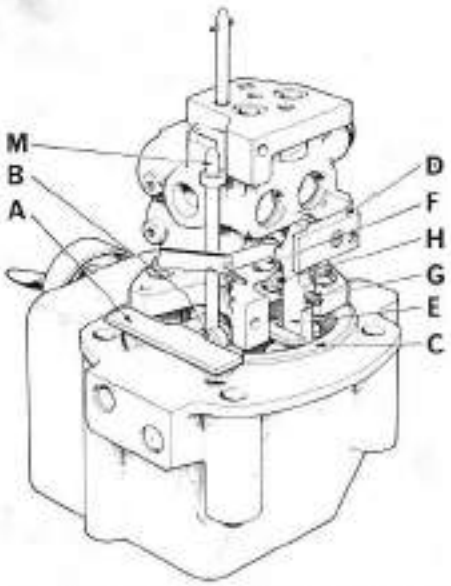


Fig. 285—Using adjusting gage to check setting of abutment plate (D); refer to text for procedure.

A. Adjusting gage
B. Rocker shaft
C. Bracket face
D. Abutment plate
E. Rocker lever
F. Spool valve
G. T.C.U. screw
H. T.C.U. valve
M. Connecting link

266. SHIMMING ABUTMENT PLATE. To position the abutment plate when installing new control valve and/or rockshaft right bracket, proceed as follows:

After bolting control valve assembly to bracket, turn selector dial to T.C.U. position. Engage inner hole of adjusting gage (see Fig. 284) on rocker shaft pin (B-Fig. 285) and hold base of gage against boss on bracket as shown at A in Fig. 285. With abutment plate (D) tightly bolted in position, check clearance between rocker lever (E) and spool valve (F) with feeler gage. Clearance should be 0.001-0.003; if not, remove abutment plate and add or remove shims under plate as required to obtain proper clearance.

267. ADJUST TRACTION CONTROL VALVE ACTUATING SCREW. After adjusting abutment plate as outlined in paragraph 266, adjust traction control valve as follows:

With selector dial at T.C.U. position, engage outer hole of adjusting gage (Fig. 285) on rocker shaft pin (B-Fig. 285) and hold base of gage against boss on bracket as shown in Fig. 286. Loosen locknut on traction control screw (G) in rocker lever (E), then turn screw in or out until it just contacts traction control valve (H), but does not compress spring. Turn screw one additional turn from where it just contacts valve. As point at which valve spring starts to compress is not easy to determine, adjustment should be done with assembly inverted and with a 0.002 inch thick feeler gage inserted between valve plunger and adjusting screw. When screw is turned in far enough to start holding feeler gage, withdraw gage and turn screw in farther as required.

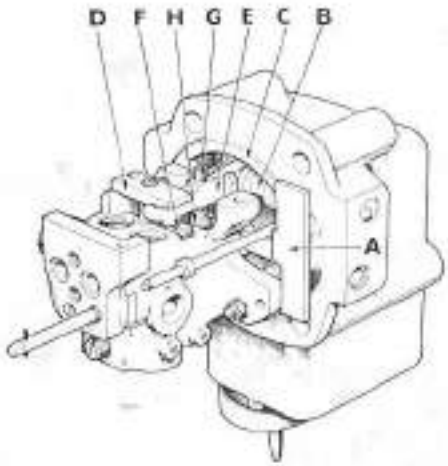


Fig. 286—Using adjusting gage to check setting of traction control valve screw in rocker lever. Refer to text for procedure. Refer to Fig. 285 for legend.

268. ADJUST ROCKSHAFT CAM. With tractor and hydraulic system assembled, but with cover plate removed from right rockshaft support bracket, lift linkage by hand and engage locking latch to hold the linkage in raised position. Then, refer to Fig. 287 and check to see that push rod roller (I) is seated in cam indentation (J). If cam is not in this position, loosen nuts (K) and turn cam by inserting lever under end of rockshaft and holding push rod down against its spring until roller engages cam indentation, then retighten nuts and install cover plate.

269. ADJUST CONNECTING LINK NUT. With tractor and hydraulic system assembled, but with cover removed from front side of control lever housing and with axle housing plate or dumping valve removed to expose hold and by-pass valve plugs as shown in Fig. 288, proceed as follows:

With lift linkage in lowered position and engine not running, unscrew nut (L) until nut is flush with end of rod (M). Loosen quadrant spring carrier nut and move control lever to extreme rear position of quadrant. Place a small wrench or other spacer between control lever and rear quadrant guide, move the guide rearward to where it holds control lever fully rearward and tighten guide nut. Place finger on top of control valve spool (F), then switch selector dial back and forth between T.C.U. and Height control positions, noting that spool valve will lift each time selector dial is moved. Then, tighten nut (L) one turn at a time and recheck for spool valve movement, noting that spool valve movement will be reduced as nut is tightened. Continue to tighten nut until no spool valve movement can be noted as selector dial is moved from T.C.U. to Height control position, then back to T.C.U. position.

Later models have a plug at rear of axle housing cover plate so that a dial indicator may be used to detect spool valve movement. Position dial indicator so that plunger rests on top of valve spool, then proceed with adjustment as previously described. Dial indicator reading will be the same when selector dial is in either T.C.U. or Height control when adjustment of nut (L) is correct. Note that dial indicator needle may "flick" as selector dial is moved, but this is not an indication of spool valve movement.

With connecting rod nut properly adjusted, reinstall cover plate on control lever housing and the plate or dump valve on axle housing. Readjust quadrant spring as outlined in paragraph 263.

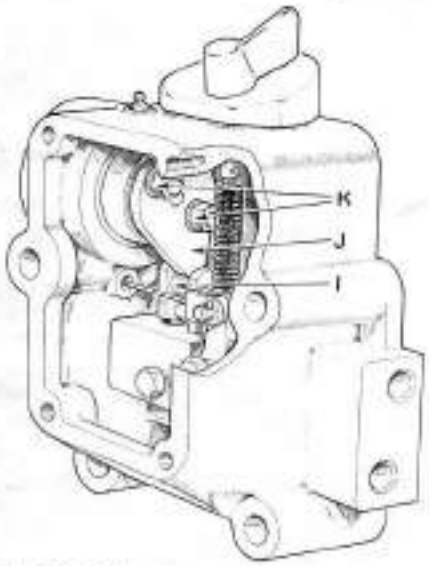


Fig. 287—Adjusting rocker shaft cam; refer to text for adjustment procedure and specifications.

I. Push rod roller
J. Rockshaft cam
K. Cam retaining units

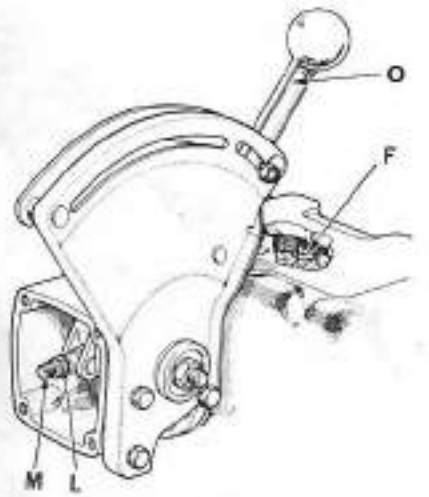


Fig. 288—Adjusting points for connecting rod nut (L); refer to text for adjusting procedure.

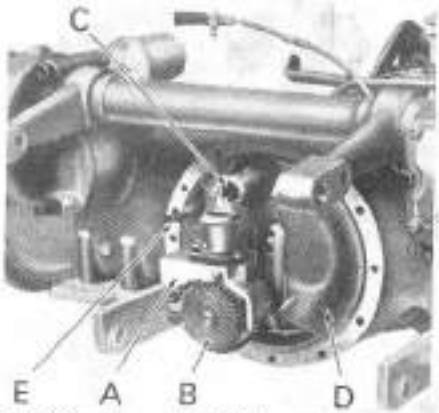


Fig. 289—View with PTO housing and gear assembly removed showing early type pump (A).

A. Pump assembly
B. Pump drive gear
C. PTO cardan shaft
D. Pump mounting plate
E. Lubrication pipe

R & R AND OVERHAUL PUMP

Models 885 and 995

270. To remove hydraulic pump, first remove pto housing and gear assembly as outlined in paragraph 230. The pump and relief valve assembly can then be unbolted and removed from mounting plate; refer to Fig. 289.

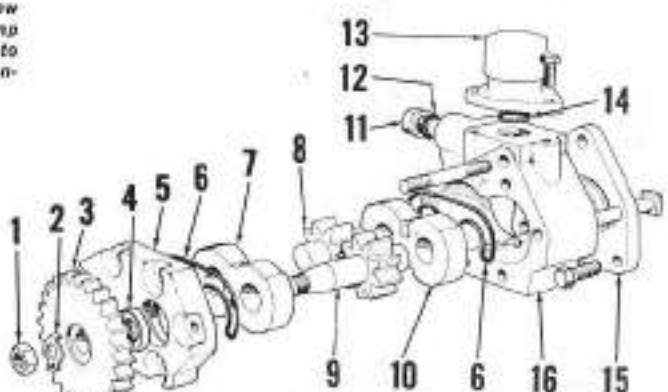
Exploded view of Plessey pump assembly is shown in Fig. 293. Note that the Plessey pump has a one-piece inner (10) and outer (7) bushing.

Before disassembling pump, scribe a mark across mounting plate, pump body and cover to aid in reassembly. Unscrew retaining nut and remove pump drive gear with suitable puller. Remove the bolts, nuts and washers retaining pump cover and mounting plate and separate mounting flange from pump body. Tap flange with mallet if difficult to remove.

CAUTION: Do not attempt to pry the pump apart. Remove the "O" ring from mounting flange and, noting position of gears (rotors) and bushings in pump body, withdraw gears and bushings.

Fig. 293—Exploded view of Plessey hydraulic pump assembly. Refer also to Fig. 294 for cross-sectional view of pump.

1. Gear retaining nut
2. Tab washer
3. Drive gear
4. Oil seal
5. End plate
6. Sealing ring
7. Outer bearing
8. Idler rotor
9. Drive rotor
10. Inner bearing
11. Plug
12. Sealing ring
13. Relief valve assembly
14. "O" ring
15. Mounting (front end) plate
16. Pump body



Remove end cover from body and remove "O" ring from cover. Remove oil seal from end cover and blanking plug from pump body. Discard "O" rings and shaft seal as new rings and seal must be used on reassembly.

Carefully clean and inspect all parts. If bearings are not excessively worn, they may be lightly polished by lapping on O grade emery paper lubricated with kerosene; be sure emery paper is on an absolutely flat surface.

NOTE: Thickness of bearing must not vary more than 0.002 inch.

The outer face of bearing may be lightly polished to obtain free movement in pump body. Inspect gear track in pump body for scoring or excessive wear, especially at intake side of pump. It is normal for gears to cut a light track at intake side of body. If body is reusable, remove any burrs at edge of gear track with fine emery cloth. Inspect gears for scoring or wear of teeth, side faces or journals. The gear journals must be within 0.0005 inch of each other and gear widths equal within 0.0002 inch. Overall length of gears and bushing assembly should be 0.003 to 0.007 inch less than depth of gear pocket in pump body. Be sure that the scroll lubricating grooves in bushings are free from damage and foreign material.

When reassembling, lubricate seal with grease and all metal parts with clean motor oil. Refer to Fig. 294 and to previously applied scribe marks for assembly guides. Spring side of shaft seal must face out. Tighten assembly bolts to a torque of 40 to 50 ft.-lbs. and tighten gear retaining nut to a torque of 40 ft.-lbs. Be sure that pump can be turned by hand; pump should have a light even drag with no tight or rough spots.

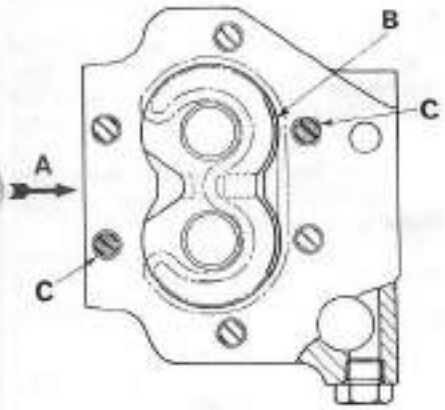


Fig. 294—Cross-sectional view of Plessey hydraulic pump; refer to Fig. 293 for exploded view.

A. Inlet side
B. Bearing
C. Dowel bolts

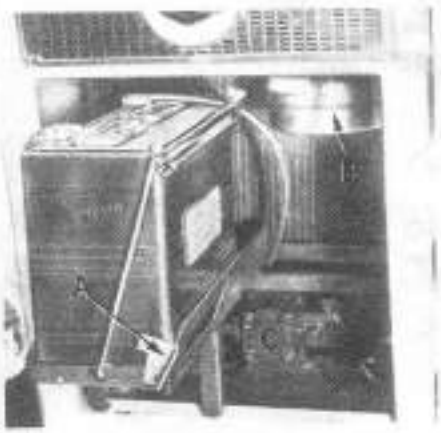


Fig. 295—On Models 1210, 1212, 1410 and 1412, the hydraulic pump (C) is accessible after removing grille and swinging battery tray outward. Oil cleaner is (B); battery tray latch is (A).

Models 1210, 1212, 1410 & 1412

273. To remove hydraulic pump, first remove the radiator grille. The pump is accessible through grille opening; refer to Fig. 295. Thoroughly clean pump, lines and surrounding area, then disconnect inlet and pressure lines from pump. Unbolt mounting bracket (7-Fig. 296) from tractor frame and remove the pump and bracket assembly. Straighten tab washer and remove nut retaining coupling (6) to pump shaft, then using suitable pullers, remove coupling and Woodruff key from shaft. Unbolt pump flange (23) from bracket.

Prior to disassembly of pump, scribe a mark across pump flange (23), body (10) or bodies and center spacer (18) and end plate (12) to aid in reassembly of unit. Remove the through bolts (8) and separate pump components on bench and lay them out in position as they are removed. Carefully clean and inspect the pump body (10). If body of single pump or either body of dual pump has excessive wear or scoring in gear track, it will be necessary to renew the complete pump assembly as body, end cover, flange and on the dual pump, the spacer are not serviced separately.

Reassemble using all new "O" rings (13 and 14) and new shaft seal (24). Install seal with lip to inside of flange (23). Reassemble using new bushings or matched gear sets as required, referring to exploded view in Fig. 296 and to previously affixed scribe marks as reassembly guides.

R & R CONTROL VALVE ASSEMBLY

All Models

274. To remove control valve assembly, first remove rockshaft and right hand bracket assembly with control valve attached as follows: Remove cover, complete with lowering control knob, from front of control lever housing and remove nut from connecting rod. Disconnect brake linkage from lower end of hand brake lever. Unbolt and remove control lever housing from

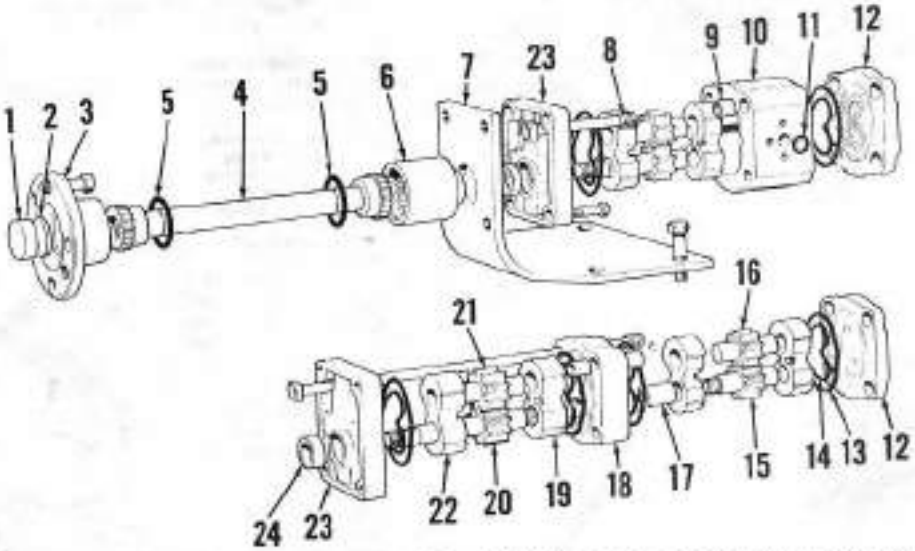


Fig. 296—Exploded view showing construction of both the single and dual pump assemblies typical of type used on 1210, 1212, 1410 and 1412 models. Pump drive components and mounting bracket are also shown; pump is mounted in front of radiator (see Fig. 295) and is driven from engine crankshaft through shaft (4).

1. Rubber disc
2. Metal disc
3. Drive flange
4. Drive shaft
5. "O" rings
6. Drive coupling
7. Mounting bracket
8. Bearings
9. Hollow dowels
10. Pump body
11. "O" ring
12. End plate
13. "O" ring
14. Sealing ring
15. Dual pump drive rotor
16. Dual pump idler rotor
17. Drive connector
18. Separator plate
19. Bearing
20. Drive rotor
21. Idler rotor
22. Bearing
23. Flange end plate
24. Oil seal

front of rear axle housing; it may be necessary to loosen or remove quadrant to remove all four housing bolts. With control lever housing removed, remove the two cap screws (A-Fig. 297) retaining pressure pipes to control valve housing. Loosen locknut while holding set screw (B), then back set screw out nine turns.

NOTE: Do not turn set screw out more than 9 turns as lubrication pipe will be disengaged.

Disconnect flexible cable from top link sensing unit, then remove sensing unit and place temporary cover over opening in pto housing to prevent dirt from entering system. Disconnect lift and leveling links from rockshaft arms and remove cover from right hand rockshaft bracket. Unbolt cover from rear end of ram cylinder housing (rockshaft left bracket).

NOTE: About 1 quart of oil will run out as ram cylinder housing cover is removed.

Unbolt right hand rockshaft bracket from axle housing and support rockshaft so that it will remain level, then remove rockshaft and right hand support bracket (with control valve attached) from rear axle housing.

With rockshaft and bracket assembly removed, unbolt and remove control valve from right hand bracket. Valve housing may be a tight fit on the locating dowels. To reinstall control valve, reverse removal procedure.

NOTE: If set screw (B-Fig. 297) does not turn fully back into same position (9 turns) as before, loosen the set screw and relocate lubrication pipe.

Refer to paragraphs 262 through 269 for necessary readjustments and to paragraph 261 for bleeding the system after reassembly.

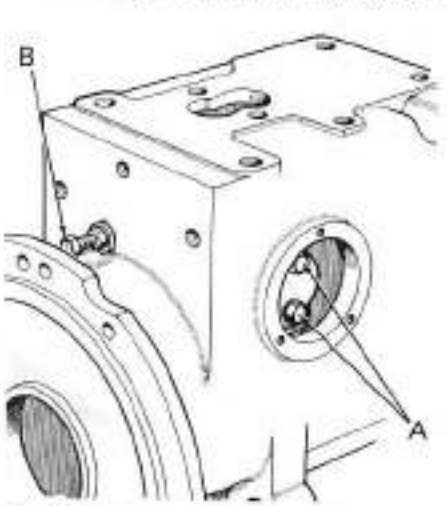


Fig. 297—To remove control valve assembly, unbolt pressure line at (A) and unscrew lubrication line retaining set screw (B) 9 turns.

OVERHAUL CONTROL VALVE ASSEMBLY

All Models

275. With control valve assembly removed as outlined in paragraph 274, refer to Fig. 298 and proceed as follows: Remove lowering control valve needle (1) and abutment plate (35), taking care not to lose any of the shims (29) located between plate and valve body. Remove the two locknuts (not shown) from spool valve (34) and withdraw the valve. **Do not** attempt to remove the spool valve sleeve. Remove the two plugs (11 & 12) from top of valve body, lift out the springs (9) (hold valve spring is not shown) and turn valve body upside down so that hold and by-pass valve plungers will fall out.

NOTE: The small steel ball (14) inside hold valve plunger (15) will also fall out when valve body is inverted.

If the plungers do not fall out, insert a ½-inch wood dowel into the plungers to withdraw them. Remove plugs (8) from bypass valve plunger (5) and remove the orifice washer (7) and nylon screen (6); early models did not have screen, but screen may be fitted in service. Remove relief valve plug (16) and remove the spring (17), plunger (18), shims (19), seat (20) and restrictor (21); take care not to lose any of the shims.

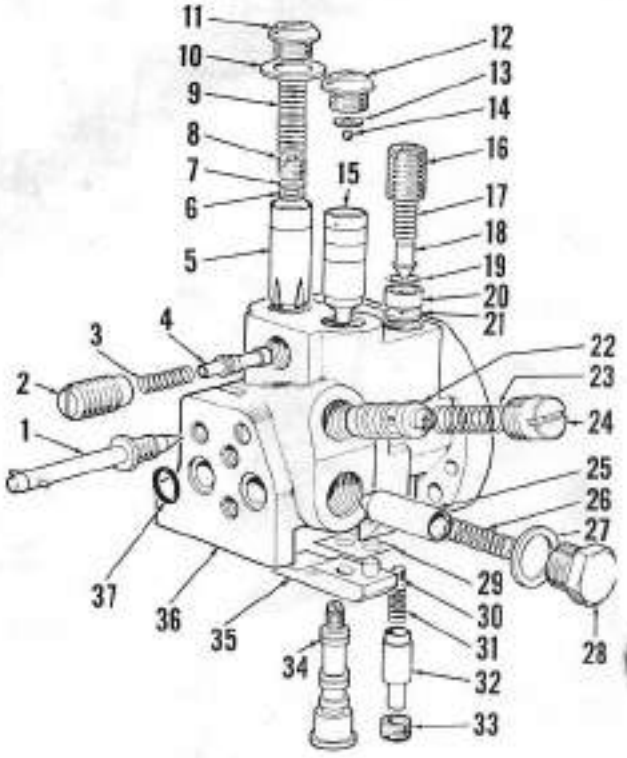
Fig. 298—Exploded view of Selectamatic control valve assembly.

1. Lowering valve needle
2. Latching valve plug
3. Latching valve spring
4. Latching valve
5. By-pass valve plunger
6. Nylon filter
7. Orifice washer (0.020)
8. Retaining plug
9. Valve plunger springs (2)
10. Sealing washer
11. Retaining plug
12. Hold valve plug
13. Ball retainer
14. Steel valve ball
15. Hold valve plunger
16. Relief valve retainer
17. Relief valve spring
18. Relief valve poppet
19. Adjusting shims
20. Relief valve seat
21. Orifice washer
22. Lowering valve
23. Lowering valve spring
24. Retaining plug
25. Non-return (check) valve
26. Non-return valve spring
27. Sealing washer
28. Retaining plug
29. Shims
30. T.C.U. valve ball
31. T.C.U. valve spring
32. T.C.U. valve plunger
33. Retaining plug
34. Spool valve
35. Abutment plate
36. Valve body
37. "O" ring

Remove the two plugs (24 & 28) from side of valve body and remove the non-return (check) valve plunger (25) and spring (26) and the lowering valve plunger (22) and spring (23). Remove plug (2) from front of body and remove the latching valve spring (3) and plunger (4). Unscrew the retainer (33) from bottom of valve and allow the traction control plunger (32), spring (31) and valve ball (30) to fall out. **Do not** disturb the remaining plugs and seats in valve body.

Thoroughly clean valve body in kerosene and clean with compressed air; **do not** use rags or shop towels to wipe the valve body or any component as lint from cloth will cause malfunction of valve. Clean all plungers and spools and be sure they are free to slide and rotate in their bores with light finger pressure. If there are any signs of binding or sticking, the plungers may be polished using jeweler's rouge or diesel injector lapping compound. If the plungers or bores are scored, or if any of the seat faces (except the non-return valve seat) are worn or damaged, the valve is not suitable for further service and should be renewed with complete new valve assembly. The plungers are match ground to the bores and cannot be supplied separately. If all parts of the valve body except the non-return (check) valve seat are serviceable, renew seat as follows:

Using tool fabricated to dimensions shown in Fig. 299, remove the damaged check valve seat. Check fit of new seat



is bore after cleaning all traces of Loctite sealant from valve body. If standard size seat (identifiable by one groove around outside) fits loosely, use a new 0.001 inch (two identification grooves) or 0.002 inch (three identification grooves) seat. Treat the bore and outside of new seat with Loequic primer, then apply a small amount of Loctite to outside diameter of seat and press seat into position. Be sure to clean any excess Loctite from valve body.

With all valve parts cleaned in kerosene, air dried and lubricated with clean oil, reassemble as follows: Fit spring (not shown) on lower end of spool valve (34-Fig. 298). Push valve into position against spring and install the flat washer and two locknuts, finger tight, on upper end of valve.

Install nylon screen (6) and orifice washer (7) in by-pass plunger (5) and secure with retainer (8). On early models without filter screen (6), a screen may be installed by using new, shorter retainer (8). Install plunger in bore, then install spring (9) and plug (11) with new gasket (10).

Install hold valve plunger (15), drop steel ball (14) into plunger, then install retainer washer (13), spring (not shown) and plug (12) with new gasket. Early models were not fitted with retainer washer (13); however, a new washer can be installed between ball (14) and spring on these models.

Install latching valve plunger (4) and spring (3), then install plug (2) tightly. Place restrictor washer (21) in relief valve bore, then install seat (20), same shims (19) as removed, valve (18), spring (17) and retainer (18).

NOTE: New relief valve assembly has correct number of shims for proper pressure setting.

Install non-return valve plunger (25), spring (26) and plug (28) with new gasket (27). Invert valve body and drop traction control valve ball (30) into bore, then install spring (31), plunger (32) and retainer (33); do not tighten retainer at this time. Adjust spool valve, traction control valve and hold relief valve as outlined in following paragraph.

ADJUST CONTROL VALVE ASSEMBLY

All Models

276. With valve assembled as outlined in paragraph 275, adjust assembly as follows:

Clamp control valve assembly in soft jawed vise and mount dial indicator plunger against adjusting nut end of spool valve as shown in Fig. 300. Push opposite end (A) of spool valve inward to fully compress thrust spring and zero dial indicator with valve at this position. Release spool valve and observe dial indicator reading. Adjust inner nut so that total movement of spool valve is within 0.001 inch of dimension etched on the valve, then tighten outer nut. Recheck movement of spool valve to be sure dial indicator reading is still within 0.001 inch of setting dimension and readjust nuts if necessary.

With spool valve properly adjusted, remove control valve assembly from vise and turn retainer (33-Fig. 298) on traction control valve plunger (32) in until plunger free movement is restricted to 0.002, then back retainer out ⅔-turn. Mount control valve in soft jawed vise as shown in Fig. 301 and set dial indicator plunger on top of the traction control valve plunger (A). With valve plunger resting on spring, zero the dial indicator. Then, using needle nose pliers as shown, lift valve plunger up against retainer and observe dial indicator reading. If reading is not within limits of 0.034 to 0.040 inch, readjust traction control valve retainer until correct movement of valve plunger is obtained. Stake the retainer to hold it in the correct position.

With the spool valve and traction control valve properly adjusted, valve assembly can be bench tested for hold valve relief pressure and excessive leakage as follows: Fabricate an adapter to dimensions shown in Fig. 302 so that a hydraulic hand pump (with pressure gage) can be attached to control valve assembly as shown in Fig. 303. Apply pump pressure and allow all passages of control valve to fill with oil.

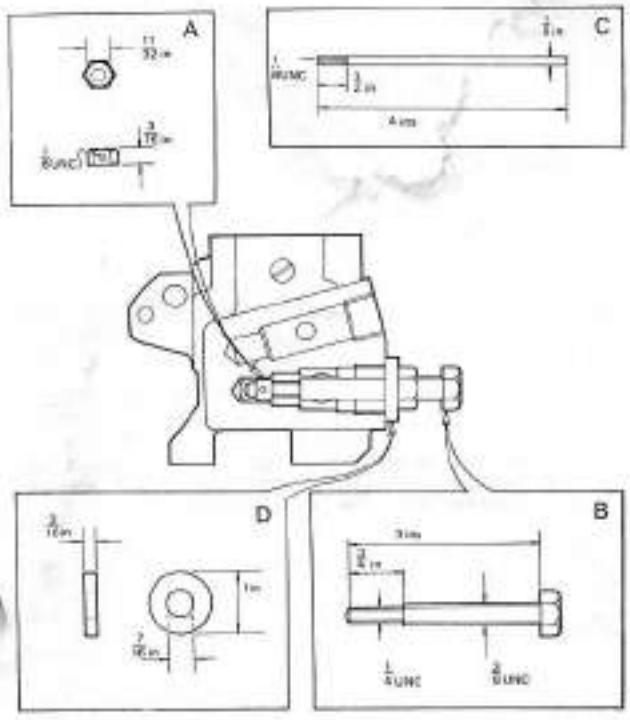


Fig. 299—To renew non-return (check) valve seat, a tool can be fabricated to dimensions shown. Cross-sectional drawing of valve body in center view shows tool in position to remove valve seat. Pin (C) is used to position small nut (A) while puller bolt (B) is threaded into nut, then pin is unscrewed from nut. Hold bolt and turn outer (large) nut to remove seat.

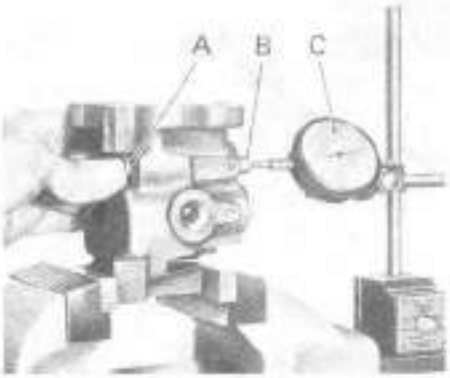


Fig. 300—View showing dial indicator being used to adjust spool valve; refer to text for procedure.

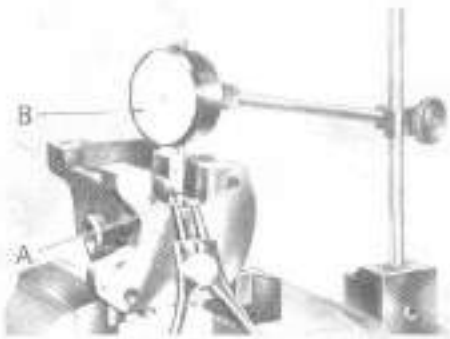
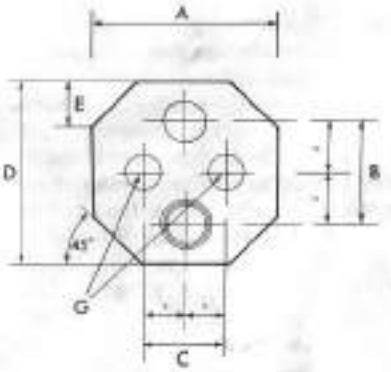


Fig. 301—View showing dial indicator being used to adjust traction control valve; refer to text for procedure.



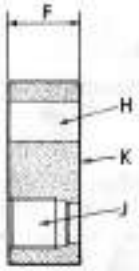


Fig. 302—View showing adapter that can be made to connect a hand hydraulic pump to control valve assembly for testing purposes. Dimensions are given in legend.

A. 2 inches
B. 1 1/8 inches
C. 7/8 inch
D. 2 inches
E. ½-inch
F. ¾-inch
G. 13/32-inch diameter
H. 7/16-inch diameter
J. Drill and tap suitable diameter for available connector
K. Surface grind this face

NOTE: New, clean transmission lubricant should be used in test pump.

Build up pressure until gage reading is 2000 psi and observe for leakage past hold valve, non-return (check) valve and spool valve. Slight leakage at openings (A, B & C) is normal; however, excessive flow at any of these openings will indicate a faulty valve. Leakage at hold valve plunger will allow oil to escape past flow control valve and appear at (A). Incorrect seating of non-return valve will allow oil to escape at hole (B) in adapter block. Sticking or incorrectly adjusted spool valve will allow oil to leak out small drilled hole (C) in valve body.

If only slight seepage of oil occurs at each of the points, valve can be considered serviceable. Check hold relief pressure by building up gage pressure until oil appears at valve plug (D); gage pressure should then be approximately 2500 psi. If hold relief valve pressure is not correct, shims (19-Fig. 298) may be added or removed between retainer (16) and valve seat; removing shims will increase relief pressure. Shims are available in thicknesses of 0.003, 0.007 and 0.015 inch.

R & R AND OVERHAUL CONTROL MECHANISM

All Models

277. Remove control lever housing and rockshaft with right hand bracket as outlined in paragraph 274. Refer to Fig. 304 as guide to disassembly and reassembly guide of overhaul control lever housing assembly; procedure for doing so is evident from inspection of unit and with reference to exploded view.

To remove and disassemble control mechanism from rockshaft bracket, proceed as follows: Disconnect flexible cable (C-Fig. 306) and withdraw cable from bracket. Remove guide bracket (61-Fig. 305) and push rods (52 & 53), then unbolt and remove control valve assembly from bracket. Unbolt and remove cam (56) and withdraw rockshaft from bracket. Remove snap ring (40) and connecting rod (13) from rocker shaft (37). Drive spring pin (35) from selector fork (34) and remove expansion plug (63) from right hand side of bracket by drilling hole through plug and prying it out. Drive selector rod (41) out and remove fork (34), catching detent ball (36) as rod is removed from bracket. Extract spring (42) with wire hook.

Remove rocker shaft locating screw (38) (screw may be hidden by gasket) and slide rocker arm (66) from shaft. Turn rocker shaft so that arm pin is to center of bracket, then slide shaft from bore. It is not necessary to remove expansion plug (39). Remove pin (47) and pull selector dial pointer (46) from shaft. Remove dial (48), breather pad (49) and "O" ring (45). If rockshaft bushing (50) is worn, drive bushing from bracket.

278. To reassemble control mechanism, reverse disassembly procedure and note the following: Be sure that rockshaft bushing (50) is installed in bracket so that grease hole is aligned

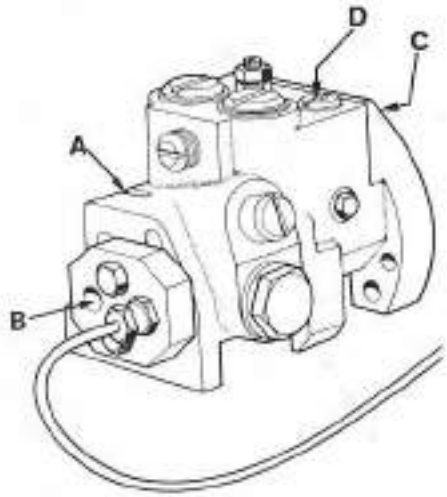


Fig. 303—View showing adapter connecting pressure line to control valve assembly. Very slight leakage from valve openings is normal. If excessive leakage shows at any of the openings (A, B, C, or D), refer to text for location of faulty valve.

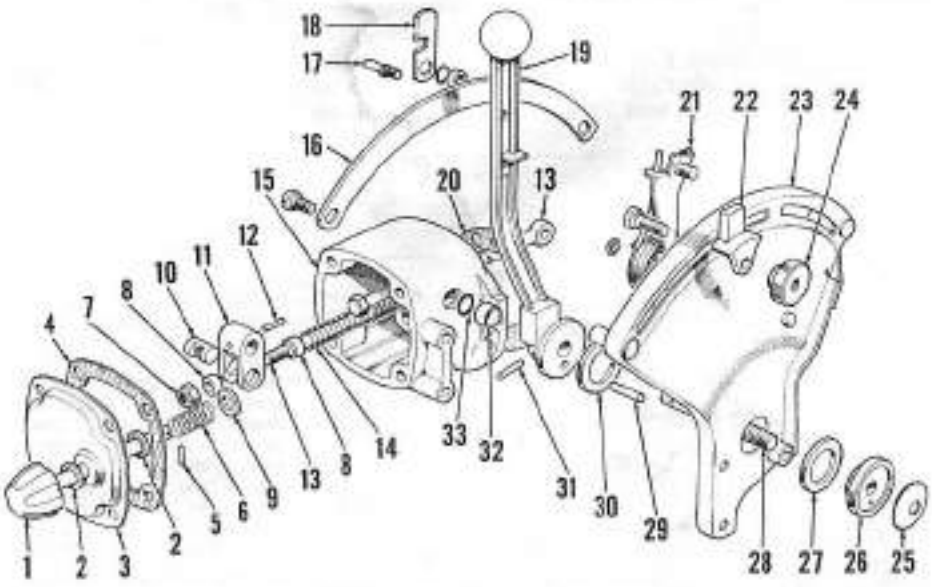


Fig. 304—Exploded view of control lever housing assembly. Note that connecting rod (13) is also shown in exploded view of control mechanism (rockshaft right hand support bracket) housing. Refer also to assembly drawing in Fig. 306.

1. Lowering control knob
2. Friction discs
3. Cover plate
4. Gasket
5. Spring pin
6. Spring
7. Connecting rod nut
8. Spacers
9. Flat washer
10. Trunnion
11. Fork
12. Spring pin
13. Connecting rod
14. Spring
15. Control lever housing
16. Quadrant plate
17. Special stud (optional)
18. Lever latch (optional)
19. Control lever
20. Gasket
21. Quadrant spring & bracket
22. Re-set guide
23. Quadrant
24. Knurled nut
25. Belleville washer
26. Friction plate
27. Friction washer
28. Control lever shaft
29. Dowel pin
30. Friction washer
31. Spring pin
32. Plastic bushing
33. "O" ring

with grease fitting (F) and with split in bushing to rear side of bracket. Fit new "O" ring (62) on rockshaft before installing shaft through bushing. Hold detent ball (36) in with pin punch when inserting selector rod in bracket.

After unit is reassembled and installed on tractor, refer to paragraphs 262 through 269 and make necessary adjustments for proper performance of hydraulic system.

R & R AND OVERHAUL ROCKSHAFT CYLINDER

All Models

279. The ram cylinder piston can be removed without removing ram cylinder from axle case. Support lift linkage in fully raised position by blocking up or wiring up rear end of lift links. Remove ram cylinder cover (rockshaft left support bracket) and drive pin from ram arm, then remove connecting rod. Remove the three-way valve or connector from front end of ram cylinder and insert a small diameter rod through oil feed hole to push piston rearward out of cylinder. Inspect piston and cylinder for scoring and renew piston rings as follows: Soak new leather back-up ring in thin oil for one-half hour prior to installation. Remove old leather and rubber rings from piston, then install new leather ring with rough side towards front (closed) end of piston. Install rubber "O" ring at front side of leather ring, then let piston set for about one-half hour until leather ring settles into groove. Lubricate piston and cylinder bore with clean motor oil, then reinstall piston. Cylinder bore is chamfered to compress the rings as piston is pushed into cylinder.

If piston and cylinder bore are scored, the cylinder may be renewed or honed to 0.020 inch oversize and a new, oversize piston installed. To remove cylinder, first remove rockshaft and right support assembly as outlined in paragraph 274. Then, remove connector or three-way valve from front end of ram cylinder and bump cylinder rearward out of rear axle housing. If cylinder bore is being honed oversize, it must be finish honed to prevent excessive wear of piston rings. To reinstall honed cylinder or install new cylinder, reverse removal procedure using new gasket and "O" ring.

ROCKSHAFT AND SUPPORT LATCH

All Models

280. The rockshaft is supported in renewable bushings. Refer to paragraph 277 for information on renewing bushing in right hand support bracket (control mechanism housing). The bushings (10 & 16-Fig. 307) at left end of rockshaft can be renewed after removing ram cylinder cover (23). Be sure that grease hole in bushings are aligned with grease fitting holes (H) in cover.

Refer to Fig. 308 for cross-sectional view showing lift linkage latch assem-

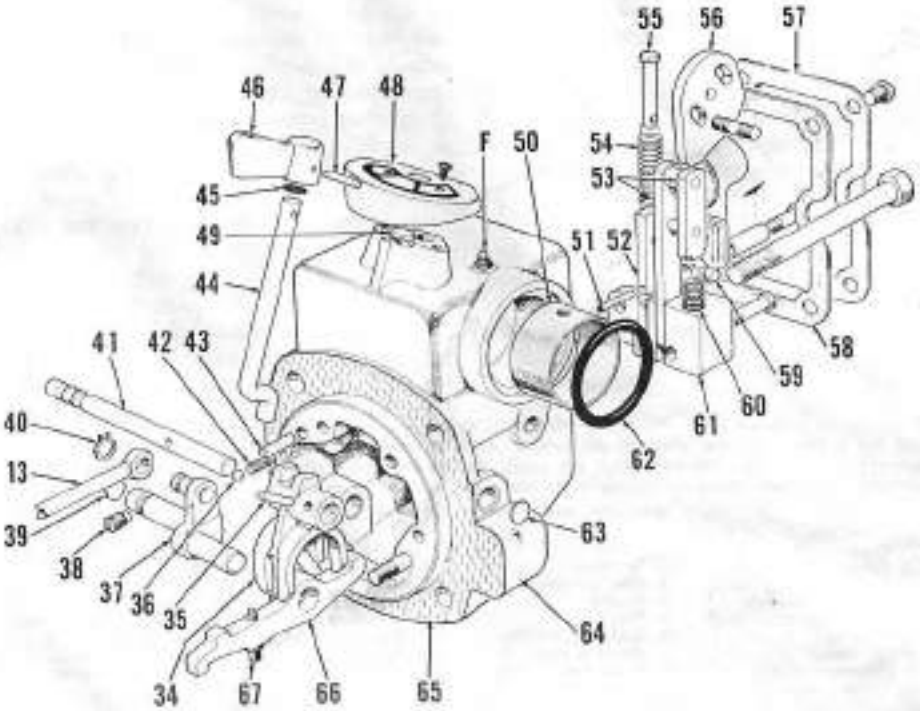


Fig. 305—Exploded view of hydraulic system control mechanism that is mounted in rockshaft right hand support bracket (64). Note that connecting rod (13) is also shown in Fig. 304. Refer also to the assembly view in Fig. 306.

F. Grease fitting
13. Connecting rod
34. Selector fork
35. Spring pin
36. Detent ball
37. Rocker shaft
38. Locating screw
39. Expansion plug
40. Snap ring
41. Selector shaft
42. Detent spring
43. Dowel pin
44. Selector rod
45. "O" ring
46. Selector dial indicator
47. Spring pin
48. Selector dial
49. Breather pad
50. Rockshaft bushing
51. Spring pin
52. Depth control push rod
53. Height control push rod
54. Spring
55. Spring anchor
56. Rockshaft cam
57. Cover plate
58. Gasket
59. Actuating lever
60. Spring
61. Guide bracket
62. "O" ring
63. Expansion plug
64. Rockshaft right support
65. Gasket
66. Rocker lever
67. T.C.U. screw

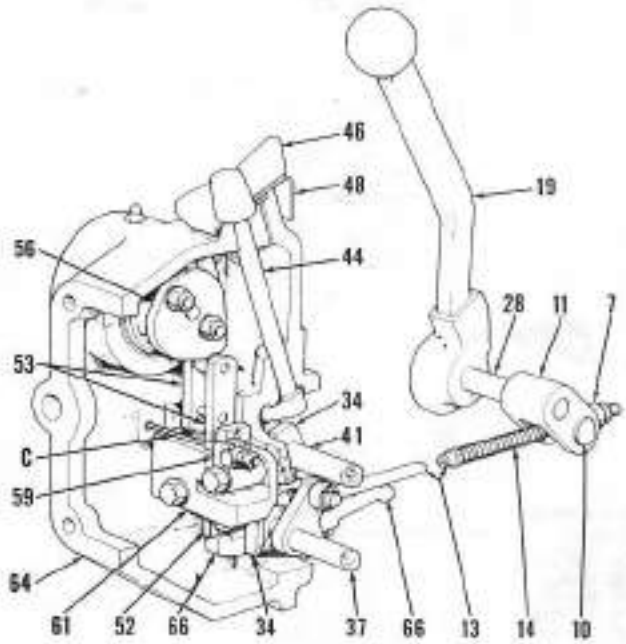


Fig. 306—Assembly view of control lever and control mechanism. Refer to Figs. 304 and 305 for exploded view of control lever and mechanism.

C. Flexible cable
7. Connecting rod nut
10. Trunnion
11. Fork
13. Connecting rod
14. Spring
19. Control lever
28. Control lever shaft
34. Selector fork
37. Rocker shaft
41. Selector shaft
44. Selector rod
46. Selector indicator
48. Selector dial
52. Depth control push rod
53. Height control push rod
56. Rockshaft cam
59. Actuating lever
61. Guide bracket
64. Rockshaft right support
66. Rocker lever

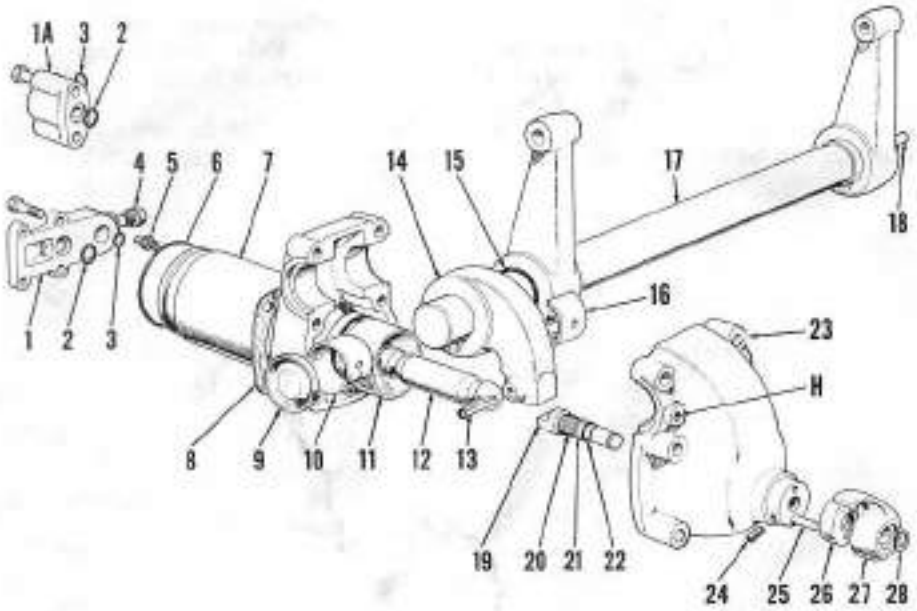


Fig. 307—Exploded view of typical rockshaft cylinder and rockshaft assembly. Refer to Fig. 308 for cross-sectional view of rockshaft latch assembly. No attempt should be made to remove or reposition the rockshaft lift arms. Rockshaft ram cylinder arm (14) is renewable by splitting old arm, then pressing arm from shaft. Heat new arm to expand it, press into position and allow to shrink fit to shaft.

H. Grease fitting hole
1. Connector (except 1210, 1212, 1410, 1412)
1A. Connector (models 1210, 1212, 1410, 1412)
2. "O" ring
3. "O" ring
4. Connector plug
5. Bleeder valve
6. "O" ring
7. Ram cylinder
8. Gasket
9. Plug
10. Rockshaft bushing
11. Piston & rings
12. Piston rod
13. Spring pin
14. Ram cylinder arm
15. "O" ring
16. Rockshaft bushing (2 halves)
17. Rockshaft
18. Cam pivot pin
19. Lift linkage latch
20. Spring
21. Spacer
22. "O" ring
23. Ram cylinder cover
24. Locating screw
25. Pin (needle bearing rollers)
26. Dust shield
27. Latching lever
28. Snap ring

bly. During normal operation of hydraulic system, the latch (19) is withdrawn by lever (27) riding on ends of the steel pins (25). When it is desired to latch lift linkage in raised position, turn lever (27) so that pins enter recesses in lever allowing spring (20) to push latch forward to engage ram cylinder arm. Linkage can be disassembled after removing ram cylinder cover (23) by holding latch rearward against spring pressure while removing the snap rings (28). A guide screw (24-Fig. 307) engages slot in latch plunger (19) to keep it from turning. The pins (25) are actually needle bearing rollers; thus if broken, are too hard to be drilled out. Ram cylinder cover can be salvaged if pin is broken by drilling new pin holes offset slightly from the original holes.

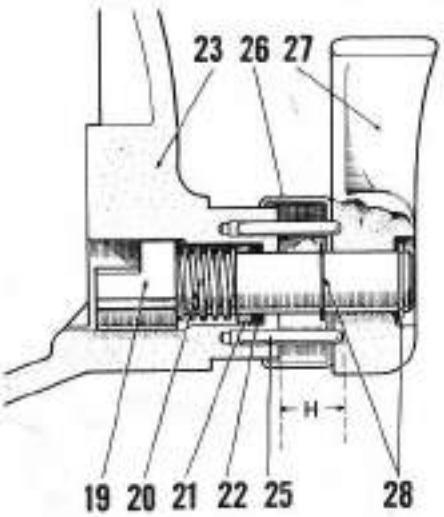


Fig. 308—Cross-sectional view of lift linkage latch located in ram cylinder cover (23). Refer also to Fig. 307.

19. Lift linkage latch
20. Spring
21. Spacer
22. "O" ring
23. Ram cylinder cover
25. Pins
26. Dust shield
27. Latching lever
28. Snap rings

TOP LINK SENSING UNIT

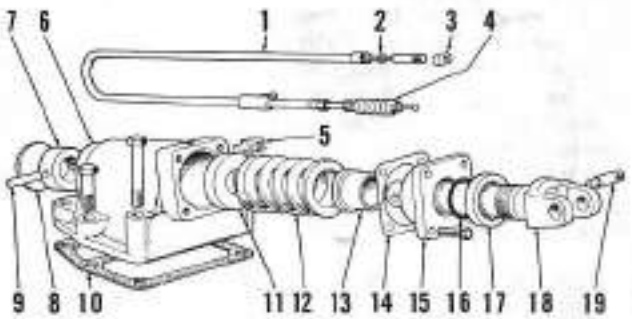
All Models

281. Refer to Fig. 309 for exploded view of top link sensing unit typical of all models.

Disassembly and reassembly of unit is obvious from examination of unit and with reference to Fig. 309. Sleeve (13) is secured to shaft (18) with Loctite. Spacer (17) is not used on all models. Spring (12) end play on assembled shaft should not exceed 0.010. If end play of spring is more than 0.010, install a thicker thrust washer (11); thrust washers are available in thicknesses of 0.355 to 0.405 in steps of 0.010. When unit is being assembled, check end play of shaft assembly as end plate (15) retaining cap screws are being tightened. End play should be at minimum when cap screws are fully tightened. If end play decreases as cap screws are tightened, then starts to increase when cap screws are fully tightened, shim (14) thickness is not sufficient and shims must be added. If end play is at minimum when cap screws are fully tightened, but exceeds 0.010, shim thickness is too great and shims equal to excessive end play must be removed. Shims are available in thicknesses of 0.005, 0.010 and 0.030 inch.

After unit is reinstalled, check and adjust flexible cable as outlined in paragraph 264.

Fig. 309—Exploded view of top link sensing unit typical of all models. Spacer (17) is used on some models.



1. Flexible cable
2. "O" ring
3. Actuating arm pin
4. Boot
5. Cable support, outer
6. Housing
7. Collar
8. Expansion plug
9. Pin
10. Gasket
11. Thrust washer (variable thickness)
12. Sensing spring
13. Sleeve
14. Shims
15. End plate
16. "O" ring
17. Spacer
18. Top link yoke shaft
19. Cable support, inner

HYDRAULIC LINES AND FILTERS

Models 885 and 995

282. Refer to Fig. 312 for exploded views showing typical internal hydraulic line installations, suction filter units. When the filter element (36) becomes clogged, oil starvation to pump could occur; thus, a vacuum switch (34) is incorporated in the suction line (9A) to activate a warning light on instrument

panel if vacuum in line becomes excessive. Note that it is normal for warning light to be on when transmission lubricant is cold or when operating at engine speeds above 1800 rpm. Suction filter must be renewed whenever light stays on with transmission lubricant at normal operating temperature and with engine running below 1800 rpm.

Models 1210, 1212, 1410 and 1412

283. Refer to Figs. 314 and 315 for views showing hydraulic lines and filters. All hydraulic lines except control valve to adapter plate line (22-Fig. 314 or 19-Fig. 315) and lubrication pipes (25-Fig. 314) are located externally. Remote control valve(s) (not shown) are fitted between adapter plate and cover plate (15-Fig. 314 or 11-Fig. 315).

On models with dual hydraulic pump (see Fig. 315), a combining valve (14) allows oil from both pumps to be used for remote control valve or separates flow with oil from one pump section being used to operate tractor lift system and from second pump section being available for remote control usage.

Models with single pump assembly (Fig. 314) are equipped with full flow suction filter and warning light as described for other models in paragraph 282.

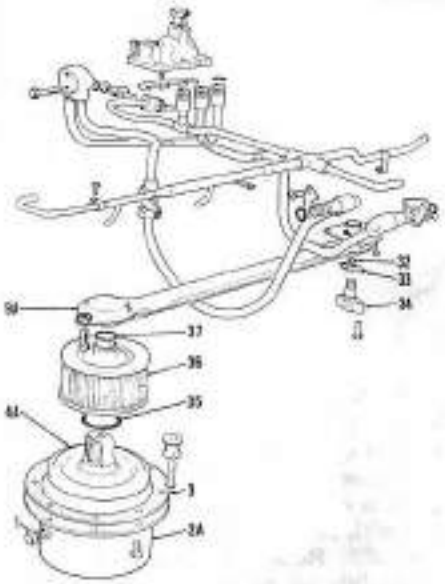


Fig. 312—On 885 and 995 models, a full flow filter element (36) is used. Warning light switch (34) is actuated when filter becomes clogged.

1. Drain plug
2A. Filter cover
3. Gasket
4A. Suction screen
6A. Suction pipe
32. "O" ring
33. Gasket
34. Switch
36. "O" ring
36. Filter element
37. "O" ring

REMOTE (EXTERNAL) CONTROL VALVES

Three-way Valve Assembly, All Models

284. Refer to Fig. 316 for exploded view of three-way valve used on all models. The valve mounts on front end of rockshaft ram cylinder and is used to control flow of oil to ram cylinder or to a remote cylinder by closing passage to ram cylinder and opening passage to remote cylinder port.

Valve spool (8) and valve body (14) are not serviced except as a complete assembly which includes all parts shown except port sealing plugs and mounting bolts. All other parts are available separately. Be sure that breather (13) is clean and not damaged in any way. Detent balls (7) and springs (6) are located in bore of lever bracket (2); install one spring and ball in blind hole and hold ball depressed with pin when installing lever bracket on valve and valve body assembly. Then, install second detent ball and spring and retain with plug (5).

Two-Way Remote Control Valve, All Models So Equipped

285. Refer to Fig. 318 for exploded view of remote control valve that can be used to operate remote cylinders independently of tractor hydraulic lift system. Valve cover plate is not shown; refer to Fig. 314 or 315.

Valve spool (24-Fig. 318) and valve body (29) are not serviced except as a complete valve assembly which includes all parts shown except operating lever (18).

Disassembly and reassembly of unit is evident from inspection of unit and

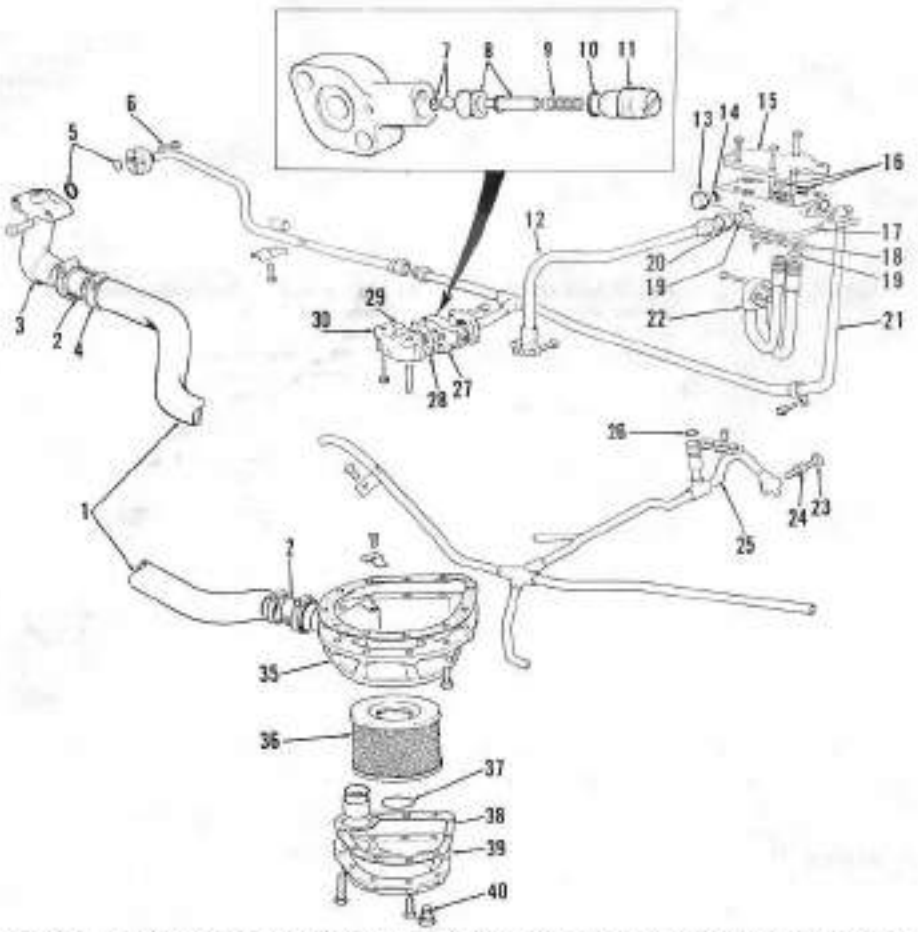


Fig. 314—Exploded view of hydraulic lines and filters for models with single hydraulic pump.

1. Pump suction pipe
2. Hose connector
3. Elbow
4. Hose clamps
5. "O" rings
6. Pump pressure pipe, front
7. Ball & retainer
8. Valve seat & plunger
9. Spring
10. "O" ring
11. Plug
12. Ram cylinder pipe
13. Return port plug
14. Adapter plate
15. Control valve cover
16. "O" rings
17. Gasket
18. Clamp
19. "O" ring
20. Connector
23. Pump pressure pipe, rear
22. Control valve pipe
23. Set screw
24. Bushing
25. Lubrication pipe
26. "O" ring
27. Bleed valve assembly
28. Gasket
29. "O" ring
30. Pump relief valve
35. Filter housing
36. Filter
37. "O" ring
38. Gasket
39. Cover
40. Drain plug

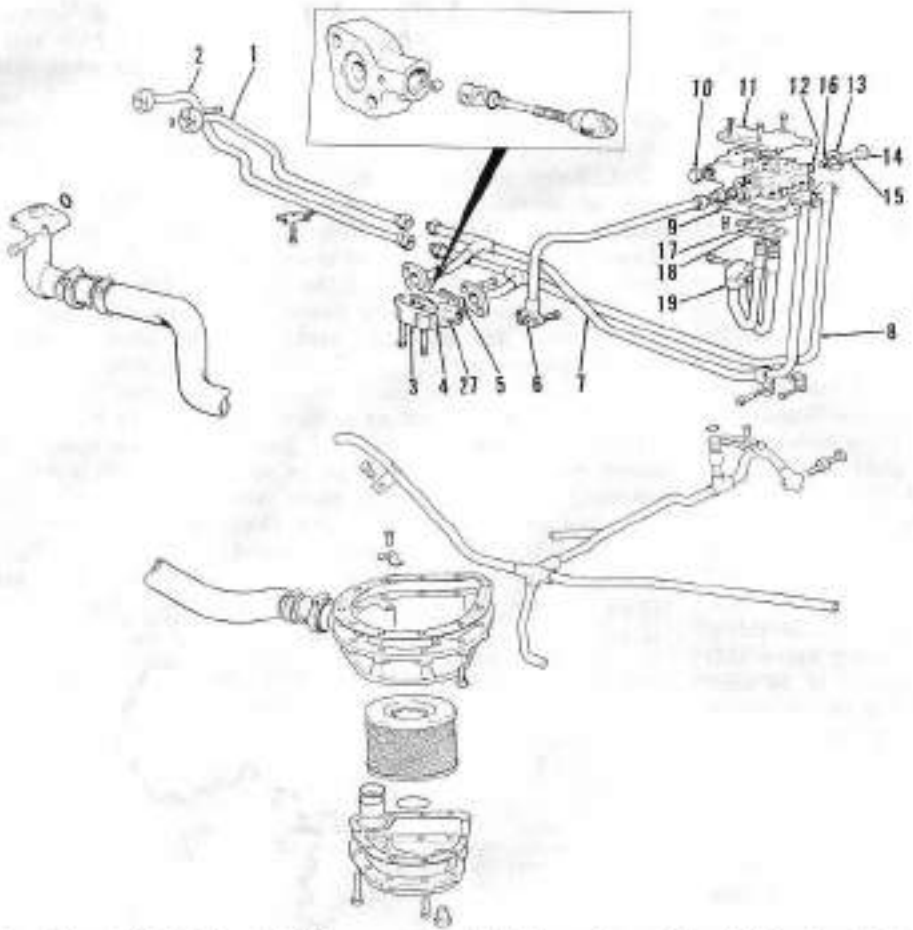


Fig. 315—Exploded view of high pressure hydraulic lines for models with dual hydraulic pump; pump suction lines, filters and lubrication line are as shown in Fig. 314 for models with single hydraulic pump. Combining valve (14) separates flow of one pump to tractor hydraulic piston and flow of second pump to remote control valve, or combines flow of both pumps to remote control valve.

1. Rear pump pressure line
2. Front pump pressure line
3. Relief valves (2)
4. Gaskets
5. "O" rings
6. Ram cylinder line
7. Front pump rear line
8. Rear pump rear line
9. Gasket
10. Plug
11. Remote valve cover
12. "O" ring
13. Retainer
14. Combining valve
15. Screws
16. "O" ring
17. Clamp
18. "O" rings
19. Control valve pipe
27. Bleed valve

with reference to exploded view. Be sure not to lose any of the shims (14); shims are used to adjust pressure at which the poppet valve (17) opens, releasing the detent balls (9) and allowing valve spool to return to neutral (hold) position. Note that the detent release pressure must be lower than the hydraulic pump relief pressure, otherwise the detent relief valve will not operate.

When reassembling valve unit, clean the threads on detent spring retainer (10) and inner end of control valve spool and secure with Loctite compound. Use all new sealing "O" rings when reassembling unit.

Dump Valve, All Models So Equipped

286. Refer to Fig. 319 for exploded view of dump valve assembly; inset shows installation of valve in rear axle housing. To operate the dump valve, first place Selectamatic control lever in lowering position, then twist dump valve knob to release valve and pull knob upward. When remote cylinder is lowered, return dump valve to closed position and lock in place by twisting knob. Valve should not be used to lower 3-point lift linkage unless there is no load on the lift links.

Disassembly and reassembly of dump valve is obvious from inspection of unit and with reference to exploded view in Fig. 319. Reassemble using new "O" rings, lubricating the rings with light grease prior to reassembly. When reinstalling valve, tighten cap screws (1) snug, but not tight, then start engine and pull control lever fully rearward against quadrant spring pressure until all air is expelled, then tighten valve retaining cap screws to a torque of 40 ft.-lbs.

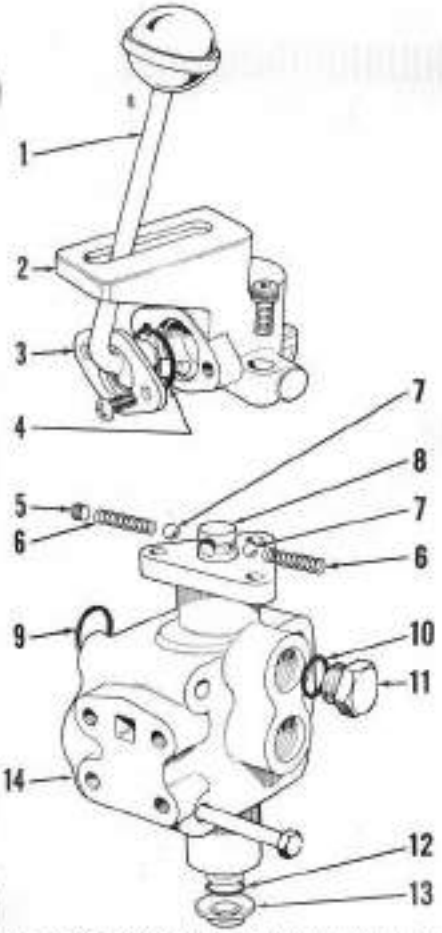


Fig. 316—Exploded view of three-way valve assembly.

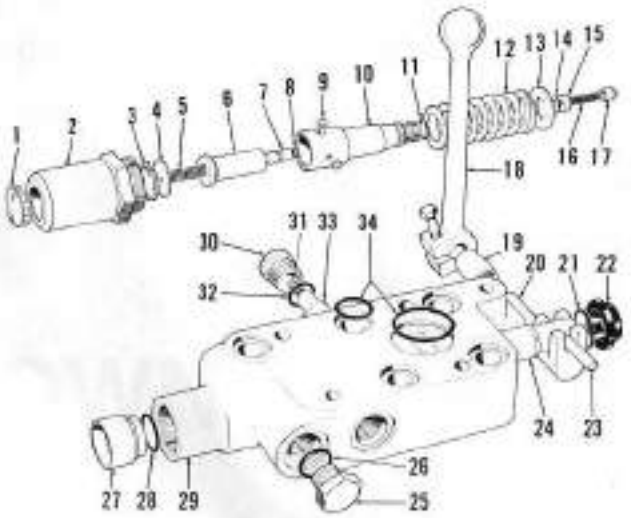
1. Control lever
2. Lever bracket
3. Retainer
4. "O" ring
5. Plug
6. Detent springs
7. Detent balls
8. Valve spool
9. "O" ring
10. "O" ring
11. Plug
12. "O" ring
13. Breather
14. Valve body

Fig. 318—Exploded view of remote control valve assembly available for all models. Refer to Fig. 314 or Fig. 315 for adapter plate and valve cover.

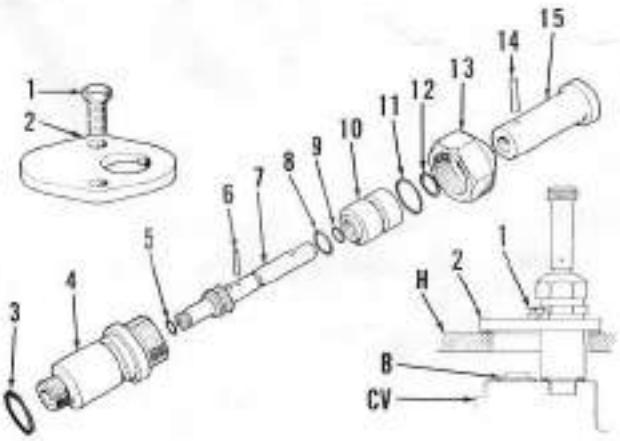
1. Plug
2. Detent cap
3. Snap ring
4. Washer
5. Detent piston spring
6. Detent release plunger
7. Detent piston
8. "O" ring
9. Detent balls
10. Centering spring retainer
11. "O" ring
12. Centering spring
13. Washer
14. Shims
15. Spring guide
16. Poppet valve spring
17. Poppet valve
18. Operating lever
19. Bushing
20. Lever shaft
21. "O" ring
22. Wiper seal
23. Pin
24. Valve spool
25. Plug (when port is not used)
26. "O" ring

Fig. 319—Exploded view of dump valve. Valve is installed to obtain faster return of oil from remote cylinders than can be obtained through standard tractor hydraulic lift system circuit. The dump valve is fitted in place of the axle cover plate over Selectamatic control valve and also replaces the hold valve release plug; refer to cross-sectional view in inset.

B. By-pass valve plug
CV. Control valve
H. Axle housing
1. Cap screw
2. Valve mounting plate
3. "O" ring
4. Valve body
5. "O" ring
6. Pin
7. Valve plunger
8. "O" ring
9. "O" ring



27. Bushing
28. "O" ring
29. Valve body
30. Plug
31. Spring
32. "O" ring
33. Check valve
34. "O" rings



10. Bushing
11. "O" ring
12. "O" ring
13. Special nut
14. Pin
15. Valve knob