IMPORTANT

This manual obsolotes the similar shop manual data in manuals AC-6, AC-12 and AC-13. If you have AC-6, AC-12 and/or AC-13 destroy them.

T&T SHOP SERVICE

ALLIS-CHALMERS

SHOP MANUAL

MODELS ■ D-14 ■ D-15 ■ Series II D-15 ■ D-17
■ Series III D-17 ■ Series IV D-17

MANUAL NO. AC-17

KNOWLEDGE
The Measure of a Mechanic

Technical Publications

Information and Instructions

This individual Shop Manual is one unit of a series on agricultural wheel type tractors. Contained in it are the necessary specifications and the brief but terse procedural data needed by a mechanic when repairing a tractor on which he has had no previous actual experience.

The material is arranged in a systematic order beginning with an index which is followed immediately by a Table of Condensed Service Specifications. These specifications include dimensions, fits, clearances and timing instructions. Next in order of arrangement is the procedures section.

In the procedures section, the order of presentation starts with the front axle system and steering and proceeds toward the rear axle. The last portion of the procedures section is devoted to the power take-off and power lift systems. Interspersed where needed in this section are additional tabular specifications pertaining to wear limits, torquing, etc.

HOW TO USE THE INDEX

Suppose you want to know the procedure for R&R (remove and reinstall) of the engine camshaft. Your first step is to look in the index under the main heading of ENGINE until you find the entry "Camshaft." Now read to the right where under the column covering the tractor you are repairing, you will find a number which indicates the beginning paragraph pertaining to the camshaft. To locate this wanted paragraph in the manual, turn the pages until the running index appearing on the top outside corner of each page contains the number you are seeking. In this paragraph you will find the information concerning the removal of the camshaft.

I&T SHOP SERVICE

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SHOP MANUAL

ALLIS-CHALMERS

MODELS D-14, D-15, D-15 SERIES II, D-17, D-17 SERIES III AND D-17 SERIES IV

Model D-14 tractors were available in single wheel tricycle, dual wheel tricycle and adjustable axle versions with non-diesel engines only.

Model D-15 tractors were available in single wheel tricycle, dual wheel tricycle, adjustable or heavy duty non-adjustable front axle versions with either 175 cubic inch diesel or 149 cubic inch non-diesel engines

Model D-15 Series II tractors are available in single wheel tricycle, dual wheel tricycle, adjustable or heavy duty non-adjustable front axle versions with either 175 cubic inch diesel or 160 cubic inch non-diesel engine.

D-17, D-17 Series III and D-17 Series IV tractors are available in single wheel tricycle, adjustable or heavy duty non-adjustable front axle versions with either 262 cubic inch diesel or 226 cubic inch non-diesel engine.

INDEX (By Starting Paragraph)

INDEX (Continued)

CONDENSED SERVICE DATA

GENERAL	D-14	D-15 Non-Diesel	D-15 Diesel	D-17 Non-Diesel	D-17 Diesel
Engine Make	Own	Own	Own	Own	Own
Cylinders	4	4	4	4	6
Bore—Inches	3½	3⅛*	3⅜	4	3⅜
Stroke—Inches	3⅞	3⅞	4⅝	4⅛	4⅝
Displacement—Cubic Inches	149	149*	175	226	262
Pistons Removed From	Above	Above	Above	Above	Above
Main Bearings, Number of	3	3	5	3	7
Main Bearings Adjustable?	No	No	No	No	No
Rod Bearings Adjustable?	No	No	No	No	No
Cylinder Sleeves	Wet	Wet	Wet	Wet	Wet
TUNE-UP					
Firing Order	1-2-4-3	1-2-4-3	1-2-4-2	1-2-4-3	1-5-3-6-2-4
Valve Tappet Gap (Hot)					
Intake	0.012-0.014	0.008-0.010	0.010	0.012-0.014	0.010
Exhaust	0.012-0.014	0.014-0.016	0.019	0.012-0.014	0.019
Valve Seat & Face Angle					
Intake	45	45	45	30	See Paragraph 39
Exhaust	45	45	45	45	45
Ignition Distributor Make	D-R	D-R	—	D-R	—
Mark Indicating:					
Retarded Timing	"DC"	"Center"	—	See	—
Full Advanced Timing	"Fire"	"F-25"	—	Paragraph	—
Mark Location	Flywheel	Flywheel	—	147	—
Breaker Point Gap	0.022	0.022	—	0.022	—
Spark Plug Gap	0.030	0.025**	—	0.025**	—
Injection Pump Make	—	—	RoosaMaster	—	RoosaMaster
Injection Pump Timing	—	—	See Paragraphs 124 and 125	—	See Paragraphs 124 and 125
Compression Pressure at Cranking Speed—Gasoline or Diesel	135	160	325	145	385
Low Idle RPM	450	550	625	400	625
High Idle RPM	2025	2200	2200	1975	1955
Full Load RPM	1650	2000	2000	1650	1650

* Series II D-15 engine cylinder bore 3⅝ inches; displacement is 166 cubic inches.
**Spark plug gap for D-15 and D-17 LP-Gas models should be 0.020.

FRONT SYSTEM

SINGLE WHEEL TRICYCLE

1. **WHEEL ASSEMBLY.** The single front wheel assembly may be removed after raising front of tractor and removing bolts (3—Fig. 1) at each end of front wheel spindle (1).

To renew bearings and/or seals, first remove wheel assembly; then, unbolt and remove bearing retainer (10—Fig. 2), seal (4), seal retainer (5) and shims (9). Drive or press on opposite end of spindle to remove spindle (8), bearing cones (7) and bearing cup from retainer side of hub. Then drive remaining seal and bearing cup out of hub. Remove bearing cones from spindle.

Soak new felt seals in oil prior to installation of seals and seal retainers. Drive bearing cup into hub until cup is firmly seated. Drive bearing cones tightly against shoulders on spindle. Pack bearings with No. 2 wheel bearing grease. Install spindle and bearings in hub and drive remaining bearing cup in against cone. When installing bearing retainer, vary the number of shims (9) to give free rolling fit of bearings with no end play.

Fig. 1 — Exploded view of single front wheel fork and associated parts.

1. Spindle
2. Fork
3. Bolts (2)
4. Mud shield
5. Plug

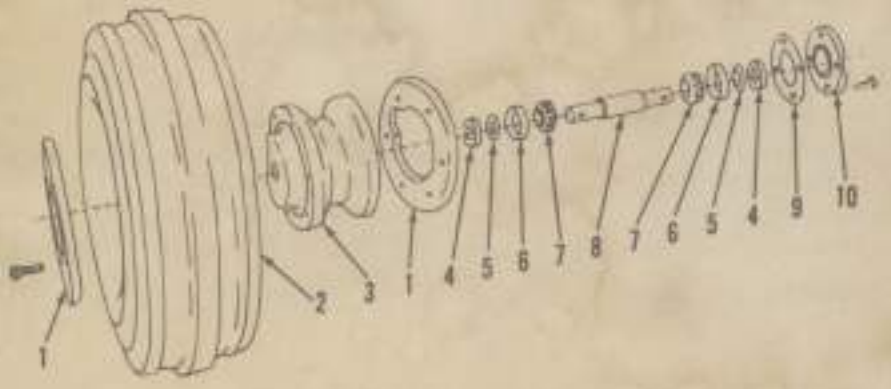


Fig. 2—Exploded view of single front wheel assembly.

1. Rim rings (2)
2. Tire
3. Wheel
4. Seals (2)
5. Seal retainers (2)
6. Bearing cups (2)
7. Bearing cones (2)
8. Spindle
9. Shims
10. Bearing retainer

Front wheel bearings should be repacked with No. 2 wheel bearing grease after each 500 hours of use.

CAUTION: If necessary to renew single front wheel hub or repair tire, completely deflate tire before unbolting tire retaining rings.

2. **R&R SINGLE FRONT WHEEL FORK.** Remove wheel assembly as outlined in paragraph 1. Then unbolt and remove fork (2—Fig. 1) from steering sector shaft (14—Fig. 8 or Fig. 24).

When reinstalling fork, tighten the retaining cap screws to a torque of 130-140 Ft.-Lbs.

DUAL WHEEL TRICYCLE

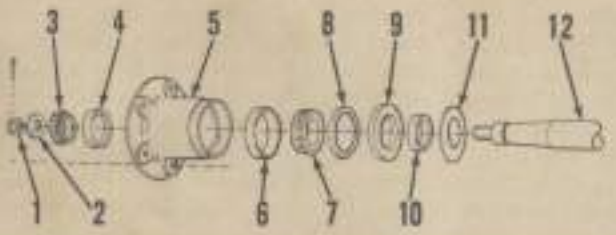
3. **WHEEL ASSEMBLY.** Front wheel and bearing construction on dual wheel tricycle models is of conventional design. Stamped steel wheel disc is reversible on hub. Bearing adjustment is made by tightening retaining nut on spindle until bearings are firmly seated and then backing nut off one castellation and installing cotter pin. Bearings should be repacked with No. 2 wheel bearing grease after each 500 hours of use.

On models D-14, D-15 (prior to Serial No. D15-9001) and D-17 (prior to Serial No. D17-42001), dual wheel pedestal spindles were equipped with bearing spacers (10—Fig. 3) and seal retainers (11). Install seal retainer (11) and bearing spacer (10) on spindle; install seal retainer (8) in hub with cupped side to bearing. Soak felt seal in oil prior to installing seal in hub.

Models D-15 (after tractor Serial No. D15-9000) and D-17 (after tractor Serial No. D17-42000) have an external lip type seal. The three lips on outside diameter of seal contact a steel wear sleeve that is pressed into the front wheel hub. Install bearing spacer on spindle with flanged edge against shoulder on spindle. Install seal over spacer with crimped edge of seal against spacer flange. Pack wheel bearings with No. 2 wheel bearing grease and install inner cone in cup. Drive wear sleeve into hub with crimped edge of wear sleeve towards bearing.

4. **R&R PEDESTAL.** Raise front of tractor, then remove cap screws retaining pedestal to front support casting. The splined coupling (6—Fig. 4) will be removed with the pedestal assembly.

When reinstalling pedestal, hold steering wheel in the center (straight ahead) position and install pedestal with wheels in straight ahead position (caster to rear).



1. Nut
2. Washer
3. Bearing cone
4. Bearing cup
5. Wheel hub
6. Bearing cup
7. Bearing cone
8. Seal retainer
9. Felt seal
10. Bearing spacer
11. Seal retaining washer
12. Spindle

Fig. 3 — Exploded view of front wheel hub assembly used on dual front wheel tricycle models. Wide front axle models are similar except spacer (10) and washer (11) are not used.

Fig. 4 — Exploded view of typical pedestal and associated parts.

1. Mud shield
2. Cap screw
3. Washer
4. Shims
5. Snap ring
6. Splined coupling
7. Cap screw
8. Pedestal
9. Bearing cup
10. Bearing cone
11. Oil seal
12. Spindle shaft

5. **OVERHAUL.** To overhaul the removed unit, remove cap screw (2—Fig. 4), washer (3), shims (4) and coupling (6). NOTE: Make certain that shims (4) are not lost or damaged as they provide the proper bearing adjustment. With splined coupling removed, spindle shaft can be withdrawn from pedestal. Pack bearing (10) with No. 2 wheel bearing grease. Oil seal (11) is of the lip type and should be installed with lip towards bearing. Coupling should be installed on spindle shaft with end of coupling nearest internal snap ring downward. When reassembling, vary the number of shims (4) to provide shaft with a free rolling fit and no end play.

WIDE FRONT AXLE

NOTE: D-15 and D-17 models may be equipped with either a standard or heavy duty adjustable front axle or a heavy duty non-adjustable wide front axle. Servicing procedures are similar for all wide front axle models.

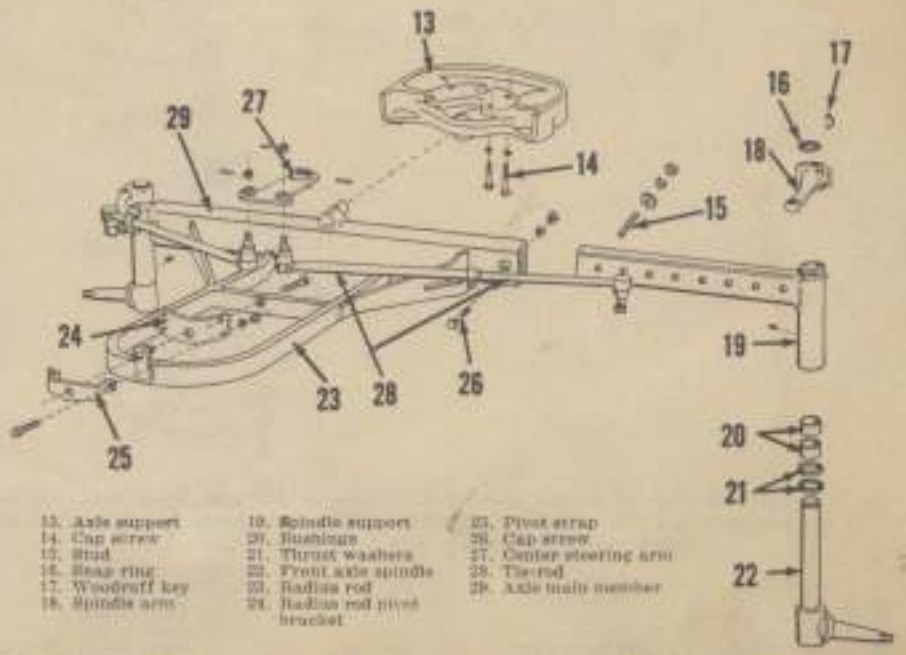
6. **WHEEL ASSEMBLY.** Front wheel and bearing construction on wide front axle models is of conventional design. Stamped steel wheel disc is reversible on hub. Bearing adjustment is made by tightening retaining nut on spindle until bearings are firmly seated; then, backing nut off one castellation and installing cotter pin. Bearings should be repacked with No. 2 wheel bearing grease after each 500 hours of use.

On models D-14, D-15 (prior to tractor Serial No. D15-9001) and D-17 (prior to tractor Serial No. D17-42001), a felt type seal was used in front wheel hubs. Install seal retainer (8—Fig. 3) in hub with cupped side of retainer towards bearing. Soak felt seal in oil prior to installing in hub. Bearing spacer (10) and retainer (11) are not used on wide front axle models.

A lip-type seal is used in the front wheel hubs on D-15 models (after Serial No. D15-9000) and D-17 models (after Serial No. D17-42000). The three lips on outside diameter of seal contact a steel wear sleeve that is pressed into the wheel hub. Install the seal over spindle with crimped edge of seal against shoulder on spindle. Pack wheel bearings with No. 2 wheel bearing grease and install inner cone in cup. Drive the wear sleeve into hub with crimped edge of sleeve towards bearing.

7. **ADJUSTMENTS.** Front wheel toe-in should be checked after each tread width adjustment on adjustable front axle models. All wide front axle models are provided with toe-in alignment marks; however, it is advisable to measure front wheel toe-in and adjust to 1/16-1/8 inch if necessary. Be sure that tie rod clamps are securely tightened.

8. **REMOVE AND REINSTALL.** Support tractor, and disconnect tie rods from center steering arm (27—Fig. 5). Detach radius rod pivot bracket (24) from torque tube and lower rear of radius rod. NOTE: Some rear pivots may be different from type shown in Fig. 5. Move front axle assembly rearward and roll axle assembly away from tractor. Axle sup-



13. Axle support
14. Cap screw
15. Stud
16. Snap ring
17. Woodruff key
18. Spindle arm
19. Spindle support
20. Bushings
21. Thrust washers
22. Front axle spindle
23. Radius rod
24. Radius rod pivot bracket
25. Pivot strap
26. Cap screw
27. Center steering arm
28. Tie-rod
29. Axle main member

Fig. 5 — Exploded view of typical adjustable axle and associated parts. Radius rod (23) is welded to axle main member (29).

port (13) can be removed from the front support after removing the attaching cap screws (14). Center steering arm is attached to steering shaft with a roll pin.

STEERING KNUCKLES (SPINDLES)

9. The procedure for removing the spindles is evident after an examination of the unit and reference to Fig. 5. Bushings (20) should be installed flush with spindle support (19). These bushings are pre-sized and if carefully installed will need no reaming. Tie-rod length should be varied to provide a toe-in of 1/16-1/8 inch.

FRONT SPLIT

Detaching (splitting) the front wheels and steering gear assembly from the tractor is a partial job required in several other jobs such as removing the timing gear cover.

13. To detach (split) the front wheels and steering gear assembly from tractor, first remove the grille and both hood side panels. Drain the coolant from radiator and disconnect the upper and lower radiator hoses. Disconnect tubes from oil cooler on shuttle clutch equipped models. Disconnect wiring to headlamps if mounted on radiator shell. Unbolt the hood center channel from radiator shell, radiator from front support casting and the radiator shell from side rails. Remove the front support breather, then lift the radiator and radiator shell from tractor as a unit. On tractors equipped with power steering, remove the pump inlet (suction) line, the pump to control valve pressure line and the by-pass line. On all models, support the tractor under the torque tube and unbolt the front support from the side rails. On wide front axle models, disconnect the radius rod from its pivot bracket. On all models, roll the complete front assembly away from tractor.

MANUAL STEERING SYSTEM

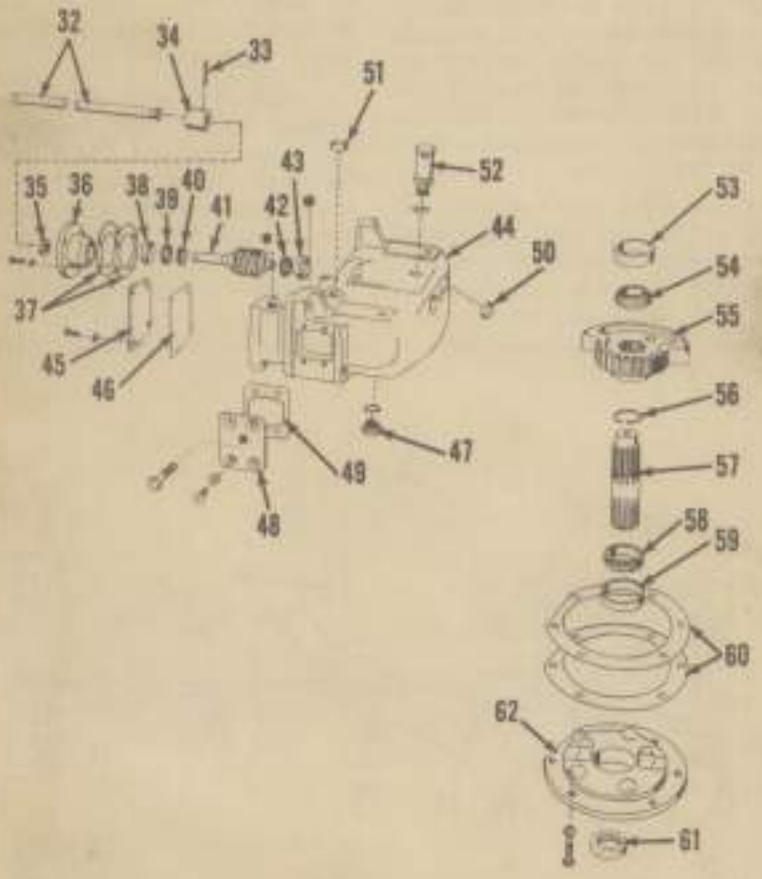


Fig. 7 — Exploded view of manual steering front support and associated parts. Shims (37) are available in 0.005 vellum or steel; shims (60) are available in either vellum or steel, vellum being 0.005 and steel 0.010 thick.

32. Steering shaft
33. Ball pin
34. Splined coupling
35. Oil seal
36. Bearing retainer
37. Shims (0.005)
38. Bearing cup
39. Bearing
40. Bearing cone
41. Steering worm
42. Bearing cone
43. Bearing cup
44. Front support
45. Cover
46. Gasket
47. Drain plug
48. Cover
49. Gasket
50. Plug
51. Plug
52. Breather
53. Bearing cup
54. Bearing cone
55. Steering gear
56. Snap ring
57. Steering shaft
58. Bearing cone
59. Bearing cup
60. Shims (0.005 & 0.010)
61. Oil seal
62. Shaft retainer

The worm and sector type manual steering gear unit is contained in the front support casting (44—Fig. 7). Recommended steering gear lubricant is SAE 80 EP gear lube. Capacity is approximately 3¾ quarts. Oil level should be maintained at top of steering (sector) gear.

14. **ADJUSTMENT.** The gear unit is provided with two adjustments as follows:

WORMSHAFT BEARINGS. To adjust the steering wormshaft bearings, remove the front support as outlined in paragraph 13 and proceed as follows: Unbolt and remove bearing retainer (36—Fig. 7) and vary the number of shims (37) to remove all shaft end play without causing any binding tendency. Alternate paper and steel shims for proper sealing.

STEERING SHAFT BEARINGS. Support front end of tractor. On single wheel tricycle models, unbolt and remove fork (2—Fig. 1) and wheel assembly from steering sector shaft (14—Fig. 8). On dual wheel tricycle models, unbolt pedestal from steering shaft bearing retainer. On all wide front axle models, unbolt front axle support from front support (steering gear unit); then, raise front of tractor so that front axle support can be removed. Drain oil from front support on all models.

On single wheel tricycle models, refer to Fig. 8 and proceed as follows: Unbolt retainer (9) from bottom of front support and remove re-

Fig. 8 — On single front wheel tricycle models, above parts are used in steering gear instead of items 53 through 62 shown in Fig. 7. Mark on hub of sector gear (5) must be aligned with punch mark on top of sector shaft (14).

1. Cap screw
2. Lockwasher
3. Flat washer
4. Shims
5. Sector gear
6. Bearing cone
7. Bearing cup
8. Gaskets
9. Bearing support
10. "O" ring
11. Bearing cup
12. Bearing cone
13. Seal
14. Sector shaft

tainer, shaft and gear unit. Remove cap screw (1), lockwasher (2), flat washer (3) and vary the number of shims (4) to remove all end play from bearings without causing any binding tendency. Reinstall unit using two new gaskets and tighten retaining cap screws to a torque of 75 Ft.-Lbs. Timing of sector and worm gears is not necessary. Reinstall wheel and fork assembly and tighten fork retaining cap screws to a torque of 130-140 Ft.-Lbs.

On dual wheel tricycle and wide front axle models, steering shaft end play is adjusted by varying the number of shims (60—Fig. 7) between bearing retainer (62) and front support casting (44). Unbolt and remove retainer, shaft and gear assembly and vary the number of shims to remove all bearing end play without causing any binding tendency. Alternate paper and steel shims for proper sealing. Tighten bearing retainer to front support cap screws to a torque of 70-75 Ft.-Lbs. Reinstall dual wheel pedestal or wide front axle support and tighten retaining cap screws to a torque of 70-75 Ft.-Lbs.

NOTE: Late production models may have an "O" ring seal between the front support (44—Fig. 7) and bearing retainer (62) or (9—Fig. 8).

15. **OVERHAUL GEAR UNIT.** After removing front support as outlined in paragraph 19, unbolt and remove steering shaft bearing retainer, shaft, bearings and sector gear from bottom of casting. Unbolt and remove wormshaft bearing retainer, wormshaft and bearings from rear of casting. Drive expansion plug (50—Fig. 7) from front of casting; then, drive front bearing cup (43) out to rear. Use a bearing cup puller to remove bearing cup (53) on dual wheel tricycle and wide front axle models.

16. SINGLE FRONT WHEEL SECTOR SHAFT. On single front wheel tricycle models, refer to Fig. 8; then, overhaul removed sector gear, shaft and retainer assembly as follows: Remove cap screw (1), lockwasher, flat washer and shims; then, drive the shaft (14) out of sector gear, bearings and retainer. Further disassembly procedure is evident from reference to Fig. 8 and inspection of parts. Renew any questionable parts. Reassemble using new "O" ring (10) and seal (13) as follows: Drive bearing cups (7 & 11) into retainer (9) making sure that they are firmly seated. Pack lower bearing cone with No. 2 wheel bearing grease and place cone in lower cup. Soak new seal (13) in oil prior to installation, apply sealer to outer rim and install with lip towards bearing.

Install new "O" ring in groove of shaft and insert shaft through seal and bearing cone. Make sure that shoulder on shaft is firmly seated against lower bearing cone. Install upper bearing cone on shaft. Install sector gear on shaft with line mark on hub of gear down and aligned with marked spline on shaft. Install proper number of shims (4) to provide free rolling fit of bearings without end play when cap screw (1) is tightened securely. Install unit in front support using two gaskets (8) and tighten retaining cap screws to a torque of 70-75 Ft.-Lbs.

NOTE: Late production models may have an "O" ring seal between bearing support (9) and front support (44—Fig. 7).

17. DUAL WHEEL TRICYCLE AND WIDE AXLE SECTOR SHAFT. Disassembly of sector shaft unit is evident from exploded view in Fig. 7. To reassemble, drive bearing cups into front support and bearing retainer making sure that they are firmly seated. Soak new seal in oil prior to installation. Apply sealer to outer rim of seal and install seal in retainer with lip towards bearing. Drive lower bearing cone firmly against snap ring (56) on shaft. Install sector gear (see Fig. 9) with line mark on bottom of gear hub aligned with marked spline on shaft. Install upper bearing cone making sure that sector gear is seated against snap ring and that upper cone is tight against sector gear. Insert shaft assembly into front support casting and install bearing retainer (62—Fig. 7) with proper number of shims (60) to provide a free rolling fit of bearings without end play. Alternate paper and steel shims for proper sealing on early models. Late production models are equipped with an "O" ring seal between retainer (62) and front support (44). Tighten retaining cap screws to a torque of 70-75 Ft.-Lbs.

18. WORMSHAFT UNIT — ALL MODELS. Refer to Fig. 7 for disassembly of wormshaft unit. Rear wormshaft bearing is in three pieces; cup (38), roller assembly (39) and cone (40). Drive front bearing cup (43) into front support until cup is firmly seated against shoulder in bore. Apply sealer to rim of expansion plug (50) and drive plug into front support casting only far enough to seal hole. Drive rear bearing cup into retainer (36) until cup is firmly seated. Soak new seal (35) in oil and install

Fig. 9 — Align punch mark on steering shaft with line at bottom of steering gear hub as shown.

seal with lip forward in retainer. Drive bearing cones on wormshaft and make sure that they are firmly seated against shoulders on shaft. Insert shaft into front support casting; then, install rear bearing assembly (39) and retainer. Use proper number of shims (37) between retainer and front support casting to provide free rolling fit of bearings without end play. Alternate paper and steel shims to provide proper sealing. Paper and steel shims are each 0.005 thick. No timing of worm gear to sector gear is necessary. Fill front support with SAE 80 EP lubricant to top of sector gear (approximately 3¾-quart capacity).

19. **R&R FRONT SUPPORT.** Remove the front support from tractor as follows: Remove grille and drain radiator. Remove both hood side panels and unbolt hood center channel from radiator shell. Disconnect tubes from oil cooler on shuttle clutch equipped models. Disconnect both radiator hoses and unbolt radiator shell from side rails and radiator from front support. Remove front support breather and lift radiator and radiator shell from tractor as a unit. Support front end of tractor. Attach a hoist to front support.

On wide front axle models, disconnect tie rods, unbolt front support from side rails and lift front support and front axle support from the front axle pivot pin. Unbolt and remove front axle support from steering gear unit and remove steering arm from steering shaft. Drain oil from unit while attached to hoist; then move unit to work bench.

On tricycle models, unbolt and remove single wheel fork and wheel or pedestal and wheels from steering gear unit. Drain oil from steering gear. Unbolt front support from side rails and lift front support to work bench.

Reverse removal procedures to reinstall front support. Tighten wide front axle support and dual front wheel pedestal retaining cap screws to a torque of 70-75 Ft.-Lbs. Tighten single wheel fork retaining cap screws to a torque of 130-140 Ft.-Lbs.

POWER STEERING SYSTEM

NOTE: The maintenance of absolute cleanliness of all parts is of utmost importance in the operation and servicing of the hydraulic power steering system. Of equal importance is the avoidance of nicks or burrs on any of the working parts.

LUBRICATION AND BLEEDING

20. The front support casting (steering gear housing) is utilized as the power steering fluid reservoir. Fluid level should be maintained at ⅝-inch above the top of the sector gear. Capacity is approximately 5 quarts.

Type "A" automatic transmission fluid is recommended for use as power steering fluid in Series II D-15, Series III D-17 and Series IV D-17 tractors. Recommendations for the very earliest production units was SAE 20W oil for all temperatures. On later models, the recommendation was SAE 5W-20 oil for temperatures below 0° F. and SAE 10W-30 oil for temperatures above 0° F. Due to several different oils having been recommended, it would be advisable to check with the tractor operator or owner on type of oil being used before adding any oil to the fluid reservoir. Power steering system should be drained and refilled with new oil after each six months of use.

Fig. 10 — Drawing showing the positions of the various power steering tubes, on D-14 and D-15 non-diesel tractors.

Whenever the power steering oil lines have been disconnected, reconnect the lines, fill the reservoir and cycle the system several times to bleed out any trapped air. Then, check fluid level and refill if necessary.

SYSTEM OPERATING PRESSURE AND RELIEF VALVE

21. A pressure test of the hydraulic circuit will disclose whether the pump, relief valve or some other unit in the system is malfunctioning. To make such a test, proceed as follows: Connect a pressure test gage in series with the pump discharge (pressure) tube (refer to Figs 10, 11, 12, 13 and 13A), run engine at low idle speed until oil is warmed, then turn the steering wheel to either the extreme right or left position. The steering wheel should be held in the extreme position only long enough to observe the gage reading. Pump may be seriously damaged if steering wheel is held in this extreme position for an excessive length of time. Correct engine speed and power steering pressure are as follows:

D-14	2000 rpm	1000 psi
D-15 Non-Diesel	2200 rpm	1200 psi
D-15 Series II Non-Diesel	2000 rpm	1600 psi
D-17 Non-Diesel	2000 rpm	1000 psi
All Diesel Models	2000 rpm	1200 psi

If gage reading is correct, pump and relief valve are O.K. and any trouble is located in the control valve, power steering cylinder and/or connections.

If the pump output pressure is too high, relief valve is either improperly adjusted or is stuck in the closed position. If the output pressure is too low, the relief valve is improperly ad-

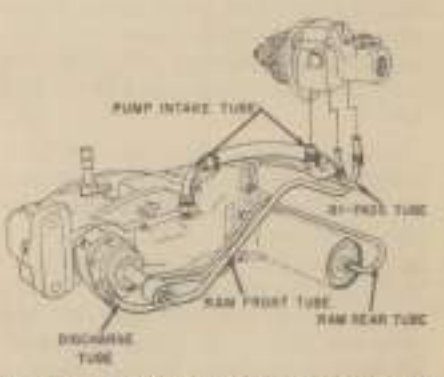


Fig. 11 — Drawing showing the positions of the various power steering tubes used on D-17 non-diesel tractors prior to tractor Serial No. D17-42001.

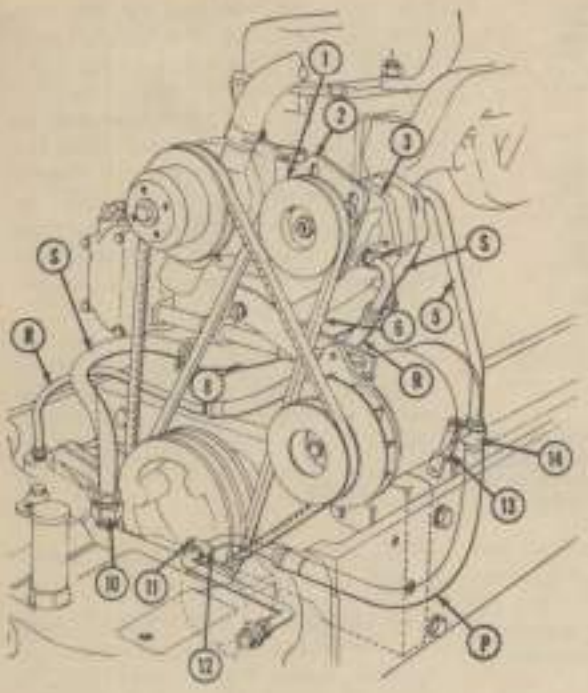


Fig. 12—Drawing showing location of power steering pump and tubes on D-17 non-diesel models, tractor Serial No. D17-42001 and up. Control valve to ram tubes are not shown.

1. Pump drive pulley
2. Pump mounting bracket
3. Pump
P. Pressure tube
R. Return (by-pass) tube
S. Suction tube

justed, is stuck in open position or the pump requires overhauling. In any event, the first step in eliminating trouble is to adjust the relief valve.

On D-14 and D-15 non-diesel models, the relief valve is adjusted by removing relief valve plug and varying number of shims (9—Fig. 14) as required. If adjustment will not restore pressure, overhaul pump as in paragraph 22A.

On D-17 non-diesel models prior to tractor Serial No. D17-42001, adjustment of the relief valve is accomplished by first removing the power steering pump as outlined in paragraph 23. Remove the relief valve plug and vary the number of shims (2—Fig. 15) as required to obtain the correct opening pressure.

On D-17 diesel and non-diesel Series III and Series IV models equipped with Webster power steering pump, remove hex plug (10A—Fig. 17) and add or remove shims (12) as necessary to obtain the correct opening pressure.

On D-15 and D-17 diesel models with Barnes power steering pump, the relief valve opening pressure is adjusted by removing the cap nut (12—Fig. 19 or 20) and turning the adjusting screw (14) in or out as necessary to obtain the correct opening pressure.

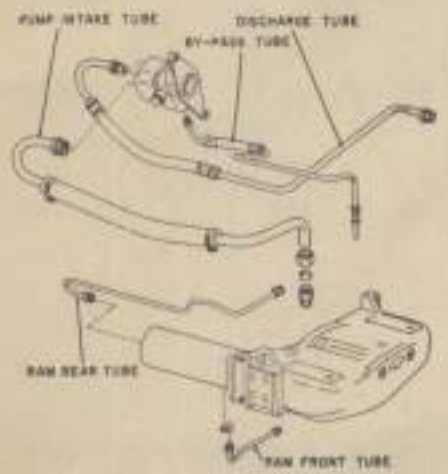


Fig. 13 — Drawing showing the positions of the various power steering tubes used on all D-15 diesel tractors and D-17 diesel models prior to tractor Serial No. D17-38964.

PUMP

D-14 and D-15 Non-Diesel

22. **REMOVE AND REINSTALL.** To remove the power steering pump, disconnect all oil tubes; then remove the two nuts attaching the pump to the engine.

Reinstall in the reverse order and after all tubes are connected and the reservoir is filled, bleed the system as outlined in paragraph 20. NOTE: On D-14 tractors, "O" ring is used to seal pump to engine instead of gasket (18—Fig. 14).

22A. **OVERHAUL.** To disassemble pump, remove the screws retaining pump cover (23—Fig. 14) to pump body (4) and carefully separate cover and body. CAUTION: No gasket is used between cover and body. Machined surfaces which are depended upon for sealing cover to body can be damaged if pump is pried apart.

After separating body and cover, remove driven gear (3) and woodruff key, idler gear (22) and shaft assembly. Remove cotter pin, nut (15) and gear (14) from drive shaft (11); then, remove snap ring (13) from pump body and press shaft, snap ring (16) and ball bearing (12) out to front.

Remainder of disassembly is evident from inspection of unit and reference to Fig. 14.

When renewing needle bearings (2), press on lettered end of bearing cage only. On D-15 idler shaft bearings, ends of bearing cages must be 1/16-inch below machined surfaces to provide clearance for snap rings. Other needle bearings should be just below flush with the machined surfaces.

Install drive shaft oil seal (10) with lip to rear. Assemble snap ring (16) and ball bearing (12) on drive shaft and carefully insert shaft through oil seal. CAUTION: Press on outer race of ball bearing only to install shaft and bearing assembly in pump body. Then, install snap ring (13) in pump body and install drive gear, nut and cotter pin on drive shaft.

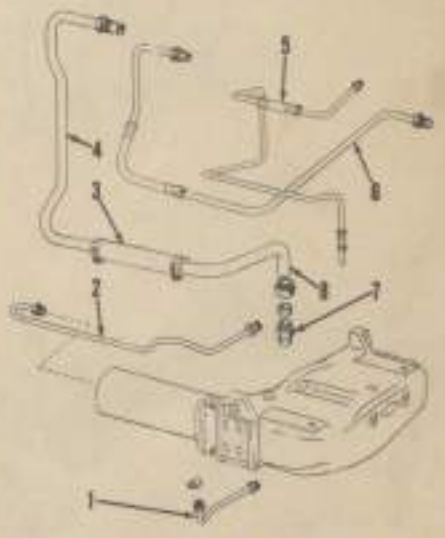


Fig. 13A — Exploded view showing general layout of power steering tubes used on D-17 diesel models at tractor Serial No. D17-38964 and up.

1. Control valve to ram front tube
2. Control valve to ram rear tube
3. Suction tube connector hose
4. Upper suction tube
5. By-pass return tube
6. Pump to control valve pressure tube
7. Suction tube fitting
8. Lower suction tube

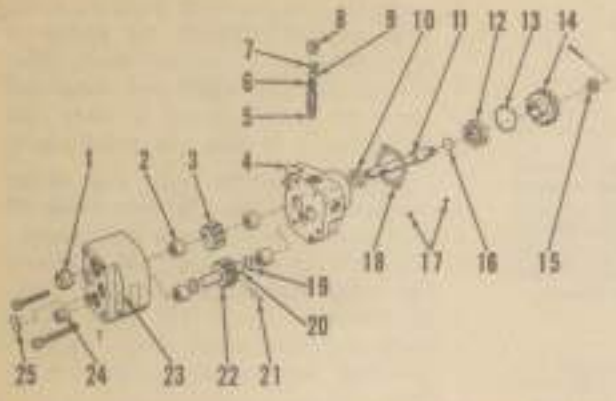


Fig. 14 — Exploded view of D-15 non-diesel power steering pump. D-14 power steering pump is similar except that an "O" ring is used to seal pump to engine instead of gasket (18); snap rings (19) are not used on idler shaft (20) in D-14 pump. Webster power steering pump used on D-15 models after serial number D15-7870 is similar.

Be sure machined surfaces of pump body and cover are clean and free of any nicks and burrs; then, carefully align cover on dowel pins and press cover and body together. Install and tighten screws that retain cover to body.

D-17 Non-Diesel (Prior to Tractor Serial No. D17-42001)

23. **REMOVE AND REINSTALL.** To remove the power steering pump, first remove the distributor. Disconnect the governor control rod and oil lines from the governor and power steering pump; then, remove the three stud nuts attaching the pump cover (15—Fig. 15) to the rear face of block flange. Withdraw the governor, power steering pump and distributor drive assembly.

To reinstall, reverse the removal procedure and re-time the distributor as outlined in paragraph 147. Bleed the system as outlined in paragraph 20 after all tubes are connected and reservoir is filled.

23A. **OVERHAUL.** Disassemble the pump as follows: Remove plug (3—Fig. 15); then, remove nut (5) and gear (6). Remove the socket head screws (15A) and separate the body (8) from the cover (15). The remainder of disassembly procedure will be evident after an examination of the unit and reference to Fig. 15. Renew any parts which are scored, worn or are in any way questionable. Bearings (10—Fig. 15) should be pressed in bores until end of bearing is just below the machined surfaces.

When reassembling, reverse the disassembly procedure. Mating surfaces of pump body (8) and cover (15) should be coated lightly with plastic lead sealer or equivalent. Reinstall the distributor drive gear (6) with long hub inward.

D-17 Non-Diesel (Tractor Serial No. D17-42001 & Up)

24. **REMOVE AND REINSTALL.** Disconnect the suction, pressure and by-pass tubes from power steering pump. Remove nut and lockwasher that retain the pump drive pulley, loosen the four cap screws attaching pump to pump mounting bracket and remove pump drive belt and pulley. Unbolt and remove pump from mounting bracket. Reverse removal procedures to reinstall pump; then, refill reservoir and bleed system as outlined in paragraph 20.

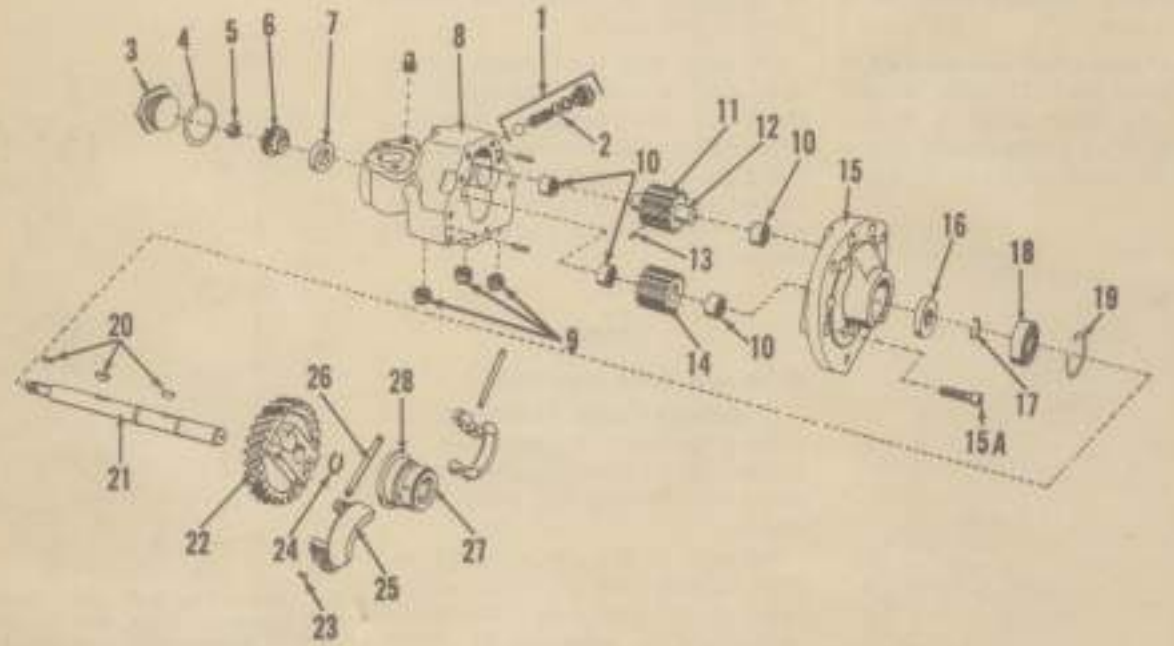


Fig. 15 — Exploded view of the D-17 non-diesel governor, distributor drive and power steering pump assembly used prior to tractor Serial No. D17-42001. Allen head screws (15A) retain the cover (15) to the body (8).

24A. **OVERHAUL.** After removing the pump as outlined in paragraph 24, scribe a line across cover, gear plate and pump body to aid in reassembly and proceed as follows: Remove pressure relief valve plug (10A —Fig. 17), "O" ring (11), shims (12), outer spring (13), inner spring (14) and relief valve (15) from pump body. Be careful not to lose or damage any of the shims (12).

After removing the six socket head cap screws (1 and 2—Fig. 16) from cover (rear) end of pump, carefully separate the cover (3), gear plate (4) and body of pump to avoid damage to the mating surfaces. No gaskets are used and the machined surfaces are depended upon for sealing. The hollow dowel pins (5) are a tight fit in the cover, gear plate and pump body.

Inspect all parts for wear, scoring or other damage and renew as necessary. New pump body includes bearings, seal, by-pass tube seat and relief valve assembly. New pump cover includes bearings, expansion plugs, discharge (pressure) tube seat and suction (inlet) tube seat. However, all other pump parts (including those in the body and cover assemblies) are available separately.

Fig. 16 — Exploded view of Webster power steering pump used on D-17 non-diesel models, tractor Serial No. D17-42001 and up. Pump is also used on diesel models, tractor Serial No. D17-28963 and up, alternately with a Barnes pump.

1. ⅜-inch cap screws
2. ¼-inch cap screws
3. Cover assembly
4. Gear plate
5. Hollow dowels
6. Drive gear and shaft
7. Driven gear and shaft
8. Woodruff key
9. Body assembly
10. Relief valve assembly

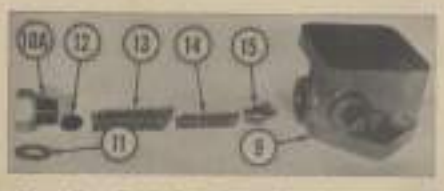


Fig. 17 — Exploded view of Webster power steering pump relief valve assembly shown at 10 — Fig. 16.

9. Pump body
10A. Hex plug
11. "O" ring
12. Shims
13. Outer spring
14. Inner spring
15. Valve

For method of removal and installation of pump shaft bearings, refer to Fig. 18. Bearings (18) in cover may be driven out towards rear after removing the expansion plugs (19). Driven shaft bearing (21) in pump body must be pulled from blind hole. The drive shaft bearings (16 and 16A) can be driven out front end of body after removing seal (22). New bearings should be pressed into place. Press on lettered end of cage only as opposite end of cage is soft and is easily distorted. Press bearings into cover 0.020 below flush with surface towards gear plate. Press driven shaft bearing 0.020 below flush with surface of pump body. Press rear drive shaft bearing (16A) into body against shoulder in bore and front drive shaft bearing (16) in flush with counterbore. NOTE: Do not force rear bearing cage in against shoulder. Press new double lip seal (22) in flush with mounting surface of pump body with heaviest sealing lip inward.

To install drive shaft and gear, use a seal protector on end of shaft or use suitable smooth pointed tool to work inner lip of seal over shoulder on drive shaft. Install idler gear, gear plate and cover making sure that previously scribed mark across cover, gear plate and body is realigned. The ⅛-inch hole in gear plate must align with the ⅛-inch hole in rear cover. Install the two ¼-inch socket head cap screws through holes with hollow dowel pins. Tighten the ¼-inch screws to a torque of 95-105 inch-pounds and the ⅜-inch screws to a torque of 190-210 inch-pounds.

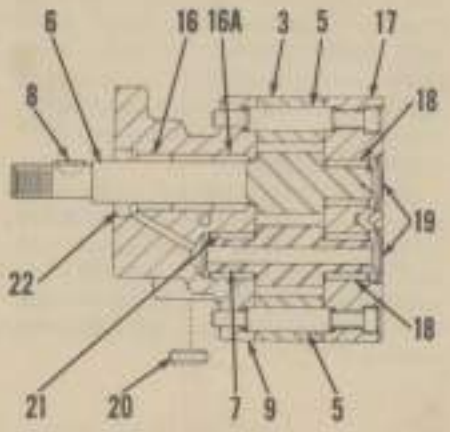


Fig. 18 — Cross-sectional view of Webster power steering pump showing bearing and seal location. Refer to Fig. 16 and Fig. 17 for exploded views.

2. Gear plate
5. Hollow dowels
6. Drive gear and shaft
7. Driven gear and shaft
9. Pump body
16. Needle bearing
16A. Needle bearing
17. Pump cover
18. Needle bearings
19. Expansion plugs
20. Tube seat
21. Needle bearing
22. Shaft seal

D-15 Diesel and D-17 Diesel (Prior to Tractor Serial No. D17-38964)

25. **REMOVE AND REINSTALL.** The power steering pump is mounted on the rear cover of the generator and is driven by a coupling splined to the generator armature shaft. Removal procedure is self-evident.

25A. **OVERHAUL.** Refer to Fig. 19. To disassemble pump, remove screws retaining pump housing (2) to pump body (7) and carefully separate housing and body. Note: Machined surfaces of housing and body are depended upon for sealing and can be damaged if pump is pried apart.

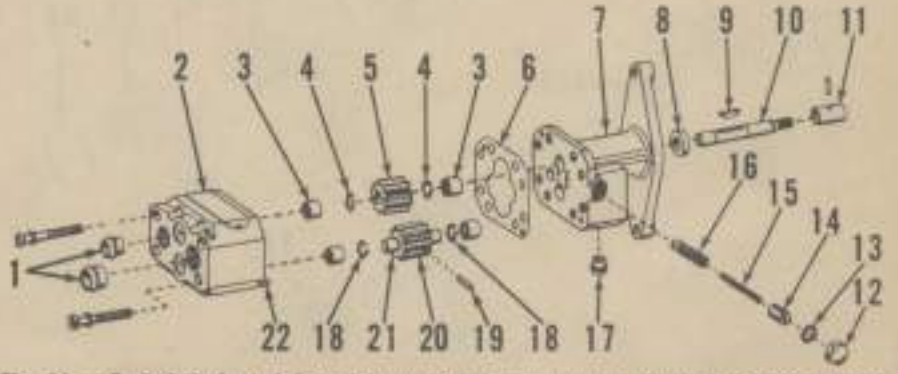


Fig. 19 — Exploded view of Barnes power steering pump used on all D-15 diesel models and D-17 diesel models prior to tractor Serial No. D17-38964. Gasket (6) was not used in early production units; however, it may be used in servicing the earlier pumps. The Barnes pump used alternately with the Webster pump (Figs. 16, 17 & 18) after tractor Serial No. D17-28963 is similar to above pump except for drive end. Refer to Fig. 20.

1. Tubing seats
2. Pump housing
3. Needle bearings (4)
4. Snap rings (2)
5. Drive gear
6. Gasket
7. Pump body
8. Seal
9. Woodruff key
10. Drive shaft
11. Drive coupling
12. Acorn nut
13. Gasket
14. Adjusting screw
15. Inner spring
16. Ball & spring assembly
17. Tubing seat
18. Snap rings (3)
19. Pin
20. Idler gear
21. Idler shaft
22. Dowel pins (2)

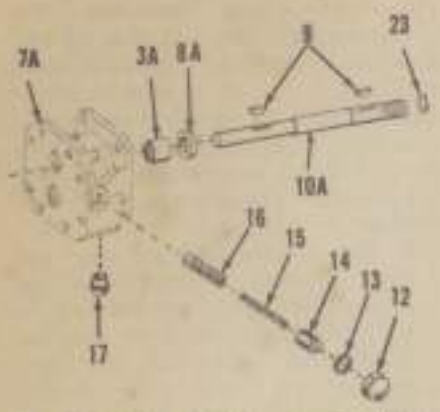


Fig. 20 — After diesel tractor Serial No. D17-38963, a Barnes pump similar to that shown in Fig. 19, except for drive end parts shown above, is used alternately with a Webster pump.

3A. Needle bearing
7A. Pump base
8A. Shaft seal
9. Woodruff keys
10A. Drive shaft
12. Acorn nut
13. Gasket
14. Adjusting screw
15. Inner spring
16. Ball and spring assembly
17. Tubing seat
23. Snap ring

Idler gear on early production pumps is secured to shaft with pin driven into blind hole in gear and shaft. On later production pumps, pin (19) in shaft (21) engages keyway in idler gear (20) and gear can be removed from shaft after removing snap rings (18). Drive gear (5) can be removed from drive shaft after removing snap rings (4).

Gasket (6) was not used on early production pumps, although the 0.0005 thick plastic gasket can be used in reassembly of these earlier units. Install seal (8) with lip to rear.

When renewing needle bearings (3), press on lettered end of bearing cage only. Opposite end of bearing cage is soft and is easily distorted. If no snap rings are used on idler shaft, press idler shaft bearings to just below flush with machined surfaces. If equipped with snap rings, press bearing cages to $\frac{1}{32}$-inch below flush with machined surfaces.

Be sure that machined surfaces of housing and cover are clean and free of nicks or burrs. Place gasket (6) over dowel pins; then, carefully align housing on dowel pins, press housing and body together and install housing retaining screws.

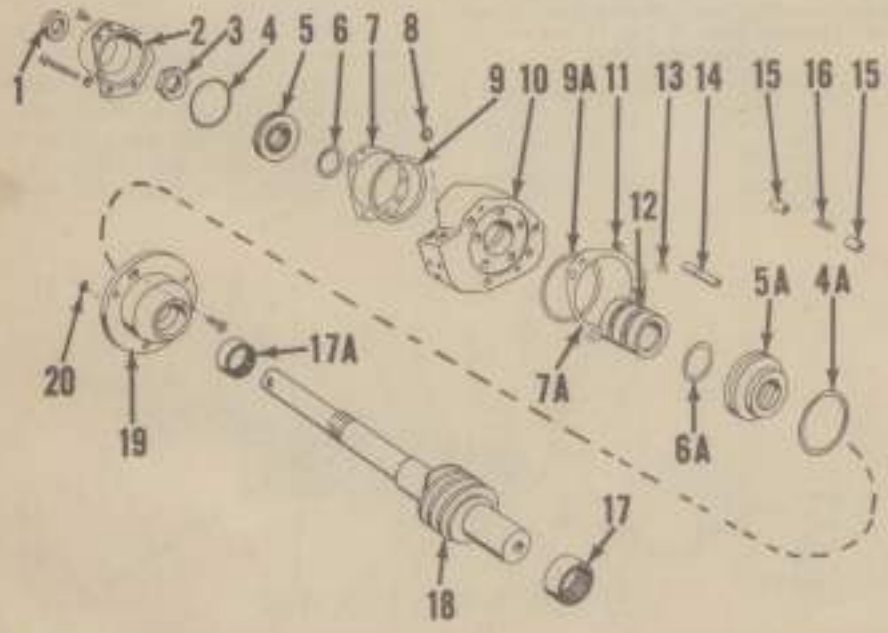


Fig. 21 — Exploded view of power steering control valve unit. Later production unit is shown; early production valves may be overhauled as described in text using later parts shown above.

1. Seal
2. Rear cover
3. Adjusting nut
4. "O" ring
4A. "O" ring
5. Thrust bearing
5A. Thrust bearing
6. "O" ring
6A. "O" ring
7. Shim
7A. Shim
8. Tube seat
9. "O" ring
9A. "O" ring
10. Control valve body
11. Check valve
12. Control valve spool
13. Plug
14. Inactive plunger
15. Active plunger
16. Spring
17. Needle bearing
17A. Needle bearing
18. Wormshaft
19. Front cover
20. "O" ring

D-17 Diesel (After Tractor Serial No. D17-38963)

26. **REMOVE AND REINSTALL.** Loosen the nut retaining the pulley to the pump drive shaft. Disconnect the pressure, by-pass and suction tubes from the pump. Loosen the cap screws retaining pump to pump mounting bracket and remove drive pulley and belt. Remove pump from mounting bracket.

26A. **OVERHAUL.** If equipped with a Barnes power steering pump, refer to Fig. 20 and to paragraph 25A. Follow same general overhaul procedures as outlined for the prior production Barnes pump that was mounted on rear of generator.

If equipped with the optional Webster power steering pump, refer to overhaul procedures as outlined in paragraph 24A for non-diesel power steering pump.

STEERING CONTROL VALVE

27. **REMOVE AND REINSTALL.** To remove the steering control valve and wormshaft unit (Fig. 21), first remove the front support as outlined in paragraph 32. With the front support removed, disconnect the power steering tubes from the control valve; then, unbolt and withdraw the control valve and wormshaft unit.

Reinstall by reversing the removal procedure. Install new gasket (37—Fig. 23) and tighten retaining cap screws to a torque of 24 Ft.-Lbs. After installation is complete and reservoir is filled, bleed the system as outlined in paragraph 20.

27A. **OVERHAUL.** After removing the unit as outlined in paragraph 27, scribe a line across rear cover (2—Fig. 21), body (10) and front cover (19) to aid in reassembly of the unit. Then, proceed as follows:

Unbolt and remove the rear cover (2), unstake and remove the bearing adjusting nut (3) and lift out the thrust bearing (5). Withdraw the body and spool assembly (10 and 12) and thrust bearing (5A). Be careful when removing the body and do not drop or nick any of the component parts. Carefully slide the spool (12) from the valve body and remove the active plungers (15) and centering spring(s) (16).

NOTE: There are five drilled holes through the control valve housing surrounding the valve spool bore. On some early production units, active (centering) plungers and springs were used in three holes; the

remaining two holes being filled with inactive plungers (steel rods). Later control valves incorporated a 0.031 I.D. restrictor in one of the holes, active plungers with centering springs were used in two holes and two holes were filled with inactive plungers. These later valves were then modified by removing the active plungers and centering spring from one hole and filling the hole with another inactive plunger. Steel shims (7 and 7A—Fig. 21) were also added to the control valve assembly at that time. When servicing a control valve containing two sets of active plungers (four plungers and two centering springs), one set of the active plungers should be discarded and a new inactive plunger installed in that bore. Shims (7 and 7A) should also be installed. Refer to the following service procedure.

The inactive plungers (14—Fig. 21) need not be removed if they are tight in their bores and ends of plungers are flush with ends of valve housing. The inactive plungers are steel rods serving no purpose other than filling the drilled holes in the valve housing in which centering plungers or the restrictor bushing are not used. If for some reason, the inactive plungers have been removed, they should be reinstalled with the stake mark on plunger to outside of valve body to prevent distortion of the valve spool bore. Note: Later production valve bodies may not have the extra drilled holes.

Carefully clean the control valve parts in fuel oil or other solvent and be sure the restrictor passageway is open and clean as well as other oil passages in the valve body. The restrictor may be checked and cleaned with a No. 68 wire size drill. Be careful not to enlarge the restrictor I.D. above the 0.031 dimension.

As the control valve body and valve spool are a matched assembly, they are not available separately for service. However, the following parts in control valve body are renewable: Active plungers and centering spring (15 and 16), inactive plungers (14), core hole steel sealing balls (13), check valve assembly (11) and tubing seats (8).

Renew all "O" rings, seal (1) and adjusting nut (3) when reassembling. Renew needle bearing (17A) in front cover or needle bearing in front support casting if loose or damaged. Renew all other questionably worn or scored parts.

To reassemble, place front cover and bearing on wormshaft. To facilitate further assembly, clamp wormshaft in a vertical position (rear end up) in a vise. Be careful not to damage gear or bearing surfaces. Place thrust bearing on shaft with small side towards front cover. Press bearing down on shaft into front cover until flush with cover. Place one shim on cover. Lubricate valve spool and place spool in housing with identifying groove in spool I.D. to front side of valve body. Insert centering spring with plunger at each end of spring in active plunger bore. If the inactive plungers have been removed, be sure that active plungers and centering spring are installed in bore nearest restrictor passage and install inactive plungers in remaining bores with punch mark on plungers to outside of valve body. Place large "O" ring in groove on front side of valve body and small "O" ring in groove in thrust bearing. Lower the valve body and spool assembly over shaft using attaching cap screws as guide pins to align body, shim and front cover. Install the flat head screws that retain front cover to valve body. Place small "O" ring in rear thrust bearing groove and install thrust bearing over shaft with "O" ring next to valve spool. Install adjusting nut and torque nut to 60 inch-pounds; then, back off nut ⅛-turn (two flats). Using a center punch, stake nut to shaft at keyway. Place shim and large "O" ring on valve body and install rear cover with new seal. Secure cover to valve body with two flat head screws.

STEERING CYLINDER (RAM)

28. **R&R AND OVERHAUL.** To remove the power steering ram, first remove the front support as outlined in paragraph 32, then proceed as follows: Remove the rack adjusting block (48—Fig. 23) and make certain that shims (49) are not lost or damaged. Disconnect oil lines from the ram, remove the retaining cap screws and, while holding the rack away from the idler gear (64), withdraw the ram assembly from the front support casting.

To overhaul the removed unit, refer to Fig. 22 or 22A and proceed as follows: Remove the pin attaching rack (68) to the piston rod (73A); then, extract snap ring (69) retaining the rear cap (70) in cylinder (67) and withdraw the rod and piston unit.

Examine all parts and renew any that are scored or show excessive wear. Lubricate all parts prior to assembly, renew all "O" rings and reassemble by reversing disassembly procedure. Note: Prior to attaching the rack (68—Fig. 23) to the piston rod, insert the rack into the steering gear housing in mesh with the idler gear, reinstall rack adjusting block and shims, and check backlash between rack and idler gear. The rack should move freely without backlash. If it does not, vary the number of shims between the rack adjusting block (48) and the front support casting to provide this condition. Paper

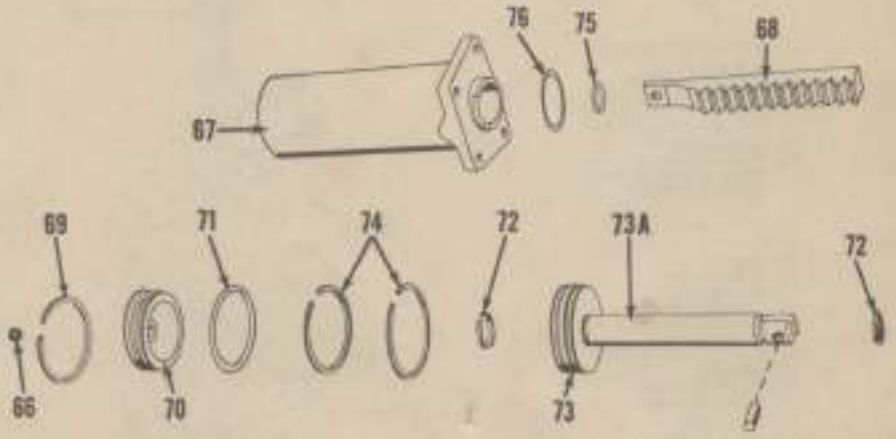


Fig. 22 — Exploded view of the power steering ram (cylinder) typical of all models except D-14 and D-15 non-diesel.

66. Port seal	69. Snap ring	72. Snap rings	74. Piston rings
67. Ram cylinder	70. Rear cap	73. Ram piston	75. Piston rod "O" ring
68. Ram rack	71. "O" ring	73A. Piston rod	76. Ram support "O" ring

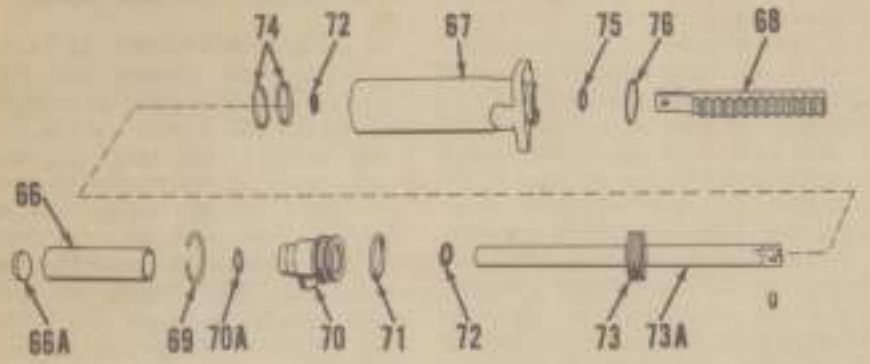
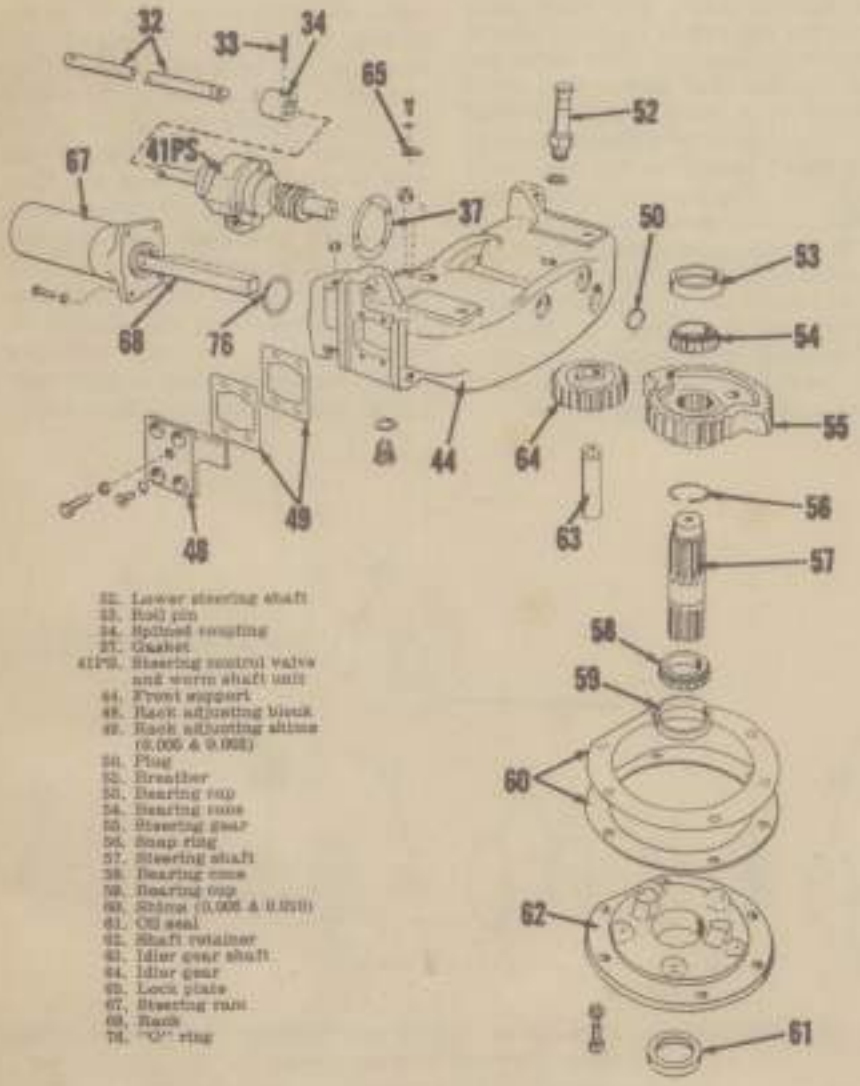


Fig. 22A — Exploded view of the power steering ram (cylinder) typical of type used on D-14 and D-15 non-diesel models.

66. Ram shield
67. Ram cylinder
68. Ram rack
69. Snap ring
70. Rear cap
70A. "O" ring
71. "O" ring
72. Snap rings
73. Ram piston
73A. Piston rod
74. Compression rings
75. Piston nut "O" ring
76. Ram support "O" ring



32. Lower steering shaft
33. Roll pin
34. Splined coupling
37. Gasket
41PS. Steering control valve and worm shaft unit
44. Front support
48. Rack adjusting block
49. Rack adjusting shims (0.005 & 0.003)
50. Plug
52. Breather
53. Bearing cup
54. Bearing cone
55. Steering gear
56. Snap ring
57. Steering shaft
58. Bearing cone
59. Bearing cup
60. Shims (0.005 & 0.010)
61. Oil seal
62. Shaft retainer
63. Idler gear shaft
64. Idler gear
65. Lock plate
67. Steering ram
68. Rack
76. "O" ring

Fig. 22 — Partially exploded view of the power steering front support. For exploded views of the control valve unit (41PS) and ram (67) refer to Figs. 21, 22 and 22A.

shims (0.005 thick) and steel shims (0.003 thick) should be alternately placed for proper sealing. When proper adjustment is obtained, remove the rack adjusting block, taking care not to lose or damage shims and remove rack from housing. Attach rack to piston rod with pin and rivet pin securely taking care not to draw ears of piston rod together.

29. To reinstall the ram, reverse the removal procedure and position the rack as follows: Rotate the steering shaft (57) to the full right (counter-clockwise as viewed from lower end of steering shaft), then pull the ram rack to the fully extended position. Engage the rack and idler gear teeth; then, install the rack adjusting block (48) with proper number of shims (49) as selected during previous step. Alternate paper and steel shims for proper sealing.

GEAR UNIT

The worm and sector type gear unit is contained in the front support casting (44—Fig. 23). Lubricating oil for the gear unit is also used as power steering fluid. Oil level should be maintained at ⅝-inch above the sector (steering) gear. Refer to paragraph 20 for filling and bleeding procedures and for recommended power steering fluid.

30. **ADJUSTMENTS** The gear unit is provided with two adjustments: Rack mesh position is adjusted by varying the number of shims between the front support casting and the rack adjusting block (48—Fig. 23). Steering shaft bearing end play is also adjustable by varying the number of shims (4—Fig. 24) between the sector gear (5) and flat washer (3) on single front wheel models and by varying the number of shims (60—Fig. 23) between the bearing retainer (62) and front support casting (44) on dual wheel tricycle and all wide front axle models. However, these adjustments are more in the nature of assembly procedure when overhauling the front support (steering gear) assembly than routine adjustment. Therefore, these adjustments will be discussed under reassembly of gear unit. Refer to paragraph 31.

31. **OVERHAUL FRONT SUPPORT.** With unit removed as outlined in paragraph 32, proceed as follows:

Remove power steering tubes from ram cylinder and control valve. Un-

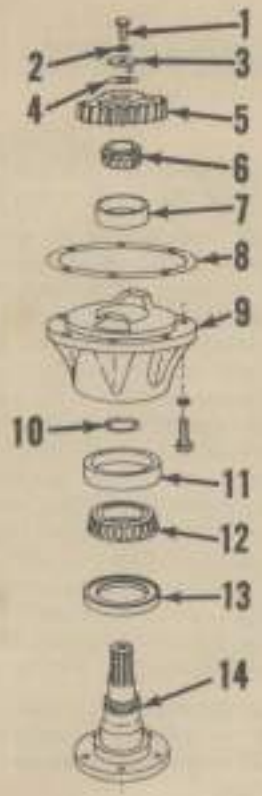


Fig. 24 — On single front wheel tricycle models, above parts are used in steering gear instead of items 53 through 62 shown in Fig. 23. Mark on hub of sector gear (5) must be aligned with punch mark on top of sector shaft (14).

1. Cap screw
2. Lockwasher
3. Washer
4. Shims
5. Sector gear
6. Bearing cone
7. Bearing cup
8. Gaskets
9. Bearing support
10. "O" ring
11. Bearing cup
12. Bearing cone
13. Seal
14. Sector shaft

bolt, remove and overhaul the ram cylinder as outlined in paragraph 28. Unbolt, remove and overhaul control valve and wormshaft unit as outlined in paragraphs 27 and 27A.

Unbolt bearing retainer (9—Fig. 24 on single front wheel models or 62—Fig. 23 on other models) and remove bearing retainer, steering shaft and sector gear assembly from bottom of front support casting. Be careful not to loose or damage shims (60—Fig. 23) on dual wheel tricycle or wide front axle models. Note: Late production models will have an "O" ring seal between bearing retainer and front support casting.

Remove idler shaft lock (65) then pull idler shaft from top of front support casting. (Top end of idler shaft has threaded hole to facilitate removal). Withdraw idler gear through bottom opening in casting.

Thoroughly clean the front support casting because it functions as the power steering fluid reservoir and cleanliness is of utmost importance. Following procedures should be observed in overhaul and reassembly of unit.

SINGLE FRONT WHEEL STEERING SHAFT ASSEMBLY. Refer to Fig. 24. Remove cap screw (1), lockwasher (2), flat washer (3) and shims (4). Be careful not to lose or damage shims. Drive or press the shaft (14) out of sector gear, bearings and retainer. Further disassembly is evident from reference to Fig. 24 and inspection of unit.

Check teeth of sector gear and and splines in gear hub and on steering shaft for wear. Any excessive play between steering unit gears or looseness of sector gear on shaft may cause shimmy of front wheels. Renew any questionable parts. Inspect bearings for damage or wear and renew if necessary.

To reassemble, install new "O" ring (10) in groove on steering shaft. Drive both bearing cups into retainer until they are firmly seated. Pack lower bearing cone with No. 2 wheel bearing grease and place cone in cup. Soak new seal in oil, apply sealer to outer rim of seal and install in bearing retainer with lip towards bearing. Insert steering shaft through seal and the lower bearing cone and make sure that shoulder on shaft is seated against bearing cone. Install the upper bearing cone on shaft. Install sector gear on shaft with line mark on bottom of gear hub aligned with marked spline on shaft. Install cap screw, lockwasher and flat washer with proper amount of shims (4) to provide a slight pre-load on bearings when capscrew is tight.

DUAL FRONT WHEEL OR WIDE FRONT AXLE STEERING SHAFT ASSEMBLY. Refer to Fig. 23 for disassembled view of steering (sector) shaft unit (items 53 through 62). Check teeth of sector gear and splines in gear hub and on shaft for wear. Any excessive play (backlash) between steering unit gears or looseness of sector gear on shaft may cause shimmy of front wheels. Renew any questionable parts. Inspect bearings for damage or wear and renew if necessary.

Drive lower bearing cup into bearing retainer (62) and upper bearing cup into front support casting (44) until cups are firmly seated. Soak new seal (61) in oil, apply sealer to outer rim of seal and install seal in bearing retainer with lip of seal towards bearing.

Install snap ring (56) in groove on steering shaft. Drive lower bearing cone tightly against snap ring. Refer to Fig. 9 and install sector gear on shaft in proper alignment. Be sure that hub of gear is tight against upper side of snap ring (56—Fig. 23) and install upper bearing cone tightly against sector gear.

IDLER GEAR AND SHAFT. Check idler gear (64—Fig. 23), for any wear or damage of gear teeth or looseness on shaft (63) and renew gear and/or shaft as necessary. Place gear in front support casting through bottom opening and drive the shaft into place from top. Install lock (65).

ASSEMBLY AND ADJUSTMENT. Install the previously assembled single front wheel steering shaft unit using two new gaskets (8—Fig. 24); or, on other models, install steering shaft assembly (items 53 through 62—Fig. 23) using proper number of shims (60) to give a slight pre-load to bearings. Note: Late production models also have an "O" ring seal between the bearing retainer and front support casting. Use paper shims (0.005 thick) and steel shims (0.010 thick) alternately for proper sealing on models not equipped with "O" ring. Tighten retaining cap screws to a torque of 75 Ft.-Lbs. Check backlash between idler gear and sector gear. If backlash is excessive, renew parts as necessary to correct this condition. Note: it may be possible to eliminate a small amount of backlash by re-positioning the idler gear. If this procedure is followed, be sure to mark mesh position of gears so that they may be reinstalled in this same relative position. Backlash should be checked with the sector shaft in mid (straight ahead) position. After being sure that no noticeable backlash is present, remove the sector gear and shaft assembly so that the rack mesh adjustment may be made as outlined in paragraph 28. After the rack mesh position is adjusted, reinstall sector shaft and gear assembly; then, complete the assembly of cylinder unit and install the cylinder as outlined

in paragraph 28. Tighten sector shaft bearing retainer cap screws to a torque of 90-100 Ft.-Lbs. and check to see that sector (steering) shaft can be turned an equal distance each way from centered position.

Install the power steering control valve and wormshaft unit using a new gasket (37) and tighten cap screws to a torque of 24 Ft.-Lbs. No timing of wormshaft gear to sector gear is necessary. Note: The wormshaft is mounted on straight needle bearings to allow end play in the shaft which is necessary to actuate the power steering control valve spool.

Reinstall the power steering tubes to ram cylinder and control valve; then, reinstall the front support as outlined in paragraph 32 and refill and bleed the system as outlined in paragraph 29.

FRONT SUPPORT

32. **REMOVE AND REINSTALL.** Remove grille and drain radiator. Remove both hood side panels and unbolt hood center chanel from radiator shell. Unbolt radiator shell from side rails and radiator from front support. Disconnect tubes from oil cooler on shuttle clutch equipped models. Disconnect both radiator hoses. Remove front support breather and remove radiator and radiator shell as a unit. Support front end of tractor. Unbolt and remove single front wheel fork and wheel assembly, dual wheel tricycle pedestal and wheel assembly or wide front axle support casting. On wide front axle models, drive pin from center steer-arm and remove steering arm from shaft. Drain power steering fluid from front support on all models.

Disconnect tubes from power steering pump. Attach hoist to front support; then, unbolt and remove front support from side rails.

Reverse removal procedures to reinstall front support. Refill front support with proper fluid and bleed any trapped air from system as outlined in paragraph 20.

ENGINE AND COMPONENTS

R&R ENGINE WITH CLUTCH

Non-Diesel

33. To remove the engine and clutch as a unit, first drain the cooling system and, if engine is to be disassembled, drain the oil pan. Perform a front split as outlined in paragraph 13 and proceed as follows: Disconnect the ground strap from battery; then, disconnect wiring from generator and ignition coil. Remove the hood center channel, muffler and the right side sheet from below fuel tank. Remove the air cleaner tube and front governor control rod. Disconnect oil pressure gage line, fuel line, choke rod and temperature gage bulb from engine. Disconnect the lower steering shaft from universal joint; then, unbolt and remove both engine side rails. Support engine in hoist, remove the cap screws retaining engine adapter plate to torque housing, separate the engine from torque housing and move the engine to a stand or work bench.

Reinstall engine and clutch unit by reversing removal procedures.

Diesel

34. To remove the diesel engine and clutch as a unit, first drain the cooling system and, if engine is to be disassembled, drain the oil pan. Perform a front split as outlined in paragraph 13 and proceed as follows:

On D-17 models after tractor Serial No. D17-42000, disconnect ground strap from batteries; then, disconnect wiring from intake manifold heater, generator and voltage regulator. Disconnect tubes from air cleaner and unbolt and remove hood center channel with air cleaner and voltage regulator attached.

On D-17 models prior to tractor Serial No. D17-42001 and all D-15 models, remove the air cleaner and air cleaner tube from engine. Unbolt and remove the hood center channel.

On all models, proceed as follows: Remove the main fuel line running to the primary filter and the fuel leak-off line from fuel tank to engine. Remove the muffler, left side sheet from below fuel tank and the throttle and fuel shut-off rods. Disconnect the oil pressure gage line and the temperature bulb from engine. Disconnect the lower steering shaft from universal joint; then, unbolt and remove both engine side rails. Support engine in hoist, remove the cap screws retaining engine adapter plate to torque housing, separate engine from torque housing and move the engine to a stand or bench.

Reinstall engine and clutch unit in reverse of removal procedure. Bleed the fuel system as outlined in paragraph 113.

CYLINDER HEAD

D-14 and D-15 Non-Diesel

35. **REMOVE AND REINSTALL.** To remove the cylinder head, remove both hoods and center channel. Drain coolant, then remove upper radiator hose and thermostat housing. Remove carburetor hose and link spring; then, disconnect carburetor link, fuel line and choke rod from carburetor. Unbolt and remove manifolds, carburetor and muffler as a unit. Remove rocker arm cover, rocker arm assembly and push rods. Disconnect spark plug wires, oil line to head and temperature gage bulb. Remove head retaining cap screws, then remove head.

When reinstalling, reverse the removal procedure and tighten the head retaining cap screws in order shown in Fig. 29. Retighten after engine has reached operating temperature to a torque of 80-85 Ft.-Lbs.

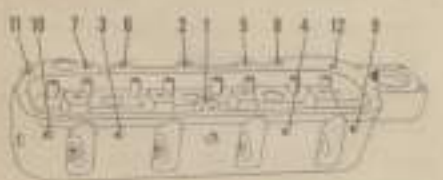


Fig. 29 — Tighten D-14 and D-15 non-diesel cylinder head cap screws in sequence shown.

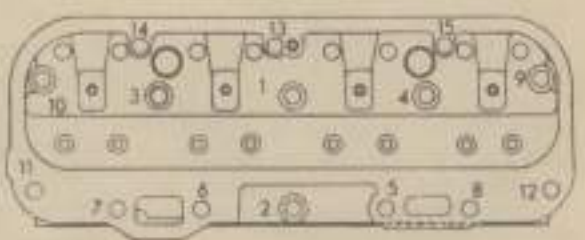


Fig. 30 — Tighten D-17 non-diesel cylinder head cap screws and stud nuts in sequence shown. Refer to text for torque specifications.

D-17 Non-Diesel

36. REMOVE AND REINSTALL. To remove the cylinder head, first drain the cooling system, then proceed as follows: Remove both hood side panels and the center channel. Remove the air cleaner tube and disconnect the carburetor link, fuel line and choke rod from carburetor. Unbolt and remove manifolds, carburetor and muffler as a unit. Disconnect the temperature gage bulb and remove the four nuts from cylinder head studs that extend through the water manifold (thermostat housing) and core hole cover. Disconnect upper hose from radiator and by-pass hose from water pump; then, remove the thermostat housing and hoses as a unit. Disconnect spark plug wires and oil line to cylinder head. Remove the rocker arm cover, rocker arm assembly and push rods. Remove cylinder head retaining cap screws and lift head from engine.

When reinstalling cylinder head, reverse removal procedures and tighten the head retaining cap screws and stud nuts in order shown in Fig. 30. Tighten the ½-inch cap screws and the four stud nuts to a torque of 90-95 Ft.-Lbs. and the $\frac{7}{16}$-inch cap screws to a torque of 70-75 Ft.-Lbs. Recheck torque after engine has reached operating temperature.

D-15 and D-17 Diesel

37. REMOVE AND REINSTALL. To remove the cylinder head, proceed as follows: Remove both hood side panels and the center channel. Drain the cooling system, disconnect water pump drain tube and unbolt water pump from head. Remove the oil line that runs from the oil gallery to cylinder head and disconnect the heat indicator bulb from water outlet casting (manifold) on top of head. Disconnect by-pass hose from thermostat housing and remove the cap screw retaining the water inlet pipe to cylinder head. Remove the thermostat housing from water manifold and water manifold from cylinder head. Remove the intake manifold heater cable and remove the manifold air inlet tube. Remove the fuel return lines from between injector pump and injector leak-off line and from between fuel tank and the rear injector. Disconnect high pressure lines from injector nozzles. Remove rocker arm cover, rocker arm assembly and push rods. Remove the cylinder head retaining stud nuts or cap screws and washers and lift cylinder head from engine. Note: Some mechanics may prefer to remove the intake and exhaust manifolds from cylinder head before removing head from engine.

Latest type cylinder head gasket has individual "fire rings" for each cylinder. After cleaning head and block surfaces, place gasket on block with imprint "THIS SIDE DOWN" against block. Hold gasket in place with guide studs and place a fire ring in each cylinder opening of gasket with rounded side of ring up. Set cylinder head down over guide studs taking care not to disturb placement of cylinder head gasket and fire rings.

When reinstalling the cylinder head, tighten the stud nuts or cap screws progressively from the center of head outward. Tighten the stud nuts on D-17 diesel engines prior to engine Serial No. 105101 to a torque of 95 Ft.-Lbs. Later D-17 diesel engines and all D-15 diesel engines use screws and washers instead of stud bolts and nuts. Tighten the cap screws to a torque of 105 Ft.-Lbs. on late D-17; 110-120 Ft.-Lbs. on D-15 diesel engines.

Complete reassembly by reversing removal procedure. Operate engine until normal operating temperature is reached, recheck cylinder head cap screw torque and readjust valve tappet gap (hot) to 0.010 on intake valves and 0.019 on exhaust valves.

VALVES, SEATS AND ROTATORS

Non-Diesel

38. Inlet valves for D-14 and D-15 non-diesel engines have a face and seat angle of 45 degrees. Seat width can be narrowed using 30 and 60 degree stones to obtain the desired seat width of 1/16 to 3/32 inch. Valve stem diameter is 0.3407-0.3417 for D-14 and D-15 models.

Inlet valves for D-17 non-diesel engines have a face and seat angle of 30 degrees. The seat width can be narrowed by using 15 and 70 degree stones to obtain the desired seat width of 1/16 to 3/32-inch. Valve stem diameter is 0.371-0.372.

The exhaust valves for all non-diesel engines have a face and seat angle of 45 degrees. The seat width can be narrowed by using 30 and 60 degree stones to obtain the desired seat width of 1/16 to 3/32-inch. The exhaust valves seat in renewable ring type inserts which are available for serv-

Photos Courtesy of Perfect Circle Corp.

Fig. 31 — Views A through E illustrate method of installing valve stem seals on late production diesel models.

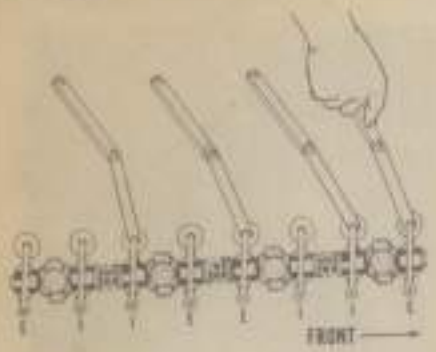


Fig. 32 — All non-diesel models. With number 1 piston at TDC on compression stroke, valve clearances (tappet gap) can be set on the four valves indicated. Refer to text for recommended clearances. Refer to Fig. 32A and adjust remainder of valves.

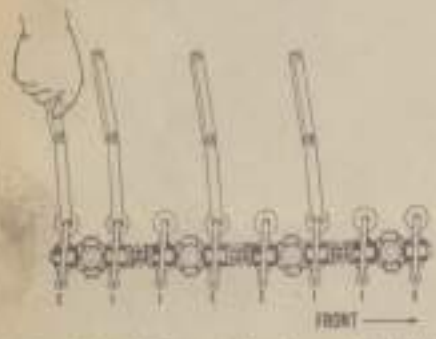


Fig. 32A—All non-diesel models. With number 4 piston at TDC on compression stroke, valve clearances (tappet gap) can be set on the four valves indicated. Refer also to Fig. 32.

ice in standard size and one oversize. Exhaust valve stem diameter is 0.3407-0.3417 for D-14 and D-15 models; 0.371-0.372 for D-17 models.

The positive type exhaust valve rotators require no maintenance, but the valve should be observed while engine is running to be sure that it rotates slightly. Renew the rotator on any exhaust valve that fails to turn.

Refer to paragraph 40 for setting tappet gap.

D-15 and D-17 Diesel

39. The inlet valves seat directly in the cylinder head and exhaust valves seat on renewable ring type inserts. Inlet valve seat and face angle is 45 degrees on D-15 diesel tractors and most D-17 diesel tractors prior to engine Serial Number 119938. Inlet valve face and seat angle is 30 degrees for D-17 diesel after engine Serial Number 119937. Exhaust valve face and seat angle is 45 degrees for all models.

Inlet valve seats having a 30 degree angle, can be narrowed by using 10 and 70-degree stones to obtain the desired seat width of 5/64 to 3/32-inch. Inlet and exhaust valve seats having a 45 degree angle, can be narrowed using 30 and 60 degree stones to obtain the desired seat width of 3/64 to 1/16 inch. Inlet and exhaust valve stem diameter is 0.309-0.310 inch.

Some D-15 and D-17 diesel models are equipped with inlet valve stem seals and seals should be renewed whenever the intake valves are removed for service. Remove old seals from intake valve guides. When reinstalling valves, refer to Fig. 31 and install new intake valve seals as follows: Install intake valve in guide and place plastic sleeve (contained in seal kit) over stem as shown in view A. If sleeve extends over 1/16-inch below groove of valve stem, cut off excess length of sleeve. Lubricate the sleeve and, while holding against head of valve, push seal assembly down over sleeve and valve stem as shown in view B and view C. Rubber sleeve of seal should be pushed down over intake valve guide with two screw drivers as shown in view D, making sure that seal is tight against top of valve guide. Remove plastic sleeve from valve stem and when installing valve rotator, compress spring only far enough to install keepers. Compressing spring too far may damage seal.

Intake valves are equipped with positive type rotators. No maintenance of rotators is required, but valves should be observed while engine is running to be sure that each is rotating slightly in a counter-clockwise direction. Renew the rotator of any intake valve that fails to turn.

Refer to paragraph 40 for setting tappet gap.

TAPPET GAP ADJUSTMENT

All Models

40. Tappet gap should be set hot to the following clearances.

D-14	
Inlet and exhaust	0.012-0.014
D-15 Non-Diesel	
Inlet	0.008-0.010
Exhaust	0.014-0.016
D-15 Diesel	
Inlet	0.010
Exhaust	0.019
D-17 Non-Diesel	
Inlet and exhaust	0.012-0.014

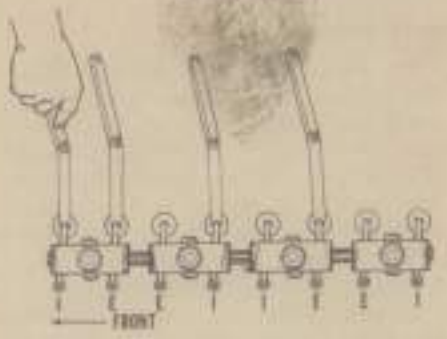


Fig. 33 — D-15 diesel. With number 1 piston at TDC on compression stroke, valve clearances (tappet gap) can be set on the four valves indicated. clearance for inlet valves (I) should be 0.010 inch hot; 0.019 inch hot for exhaust valves (E). Refer to Fig. 33A and adjust remainder of valves.

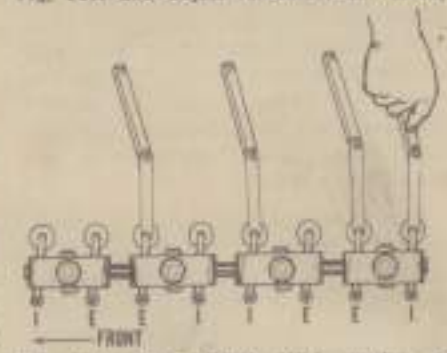


Fig. 33A—D-15 diesel. With number 4 piston at TDC on compression stroke, valve clearances (tappet gap) can be set on the four valves indicated. Refer also to Fig. 33.

D-17 Diesel	
Inlet	0.010
Exhaust	0.019

Two-position adjustment of all valves is possible as shown in Figs. 32, 32A, 33, 33A, 34 and 34A. To make the adjustment, turn crankshaft to No. 1 cylinder TDC (non-diesel marked on flywheel; diesel marked on crankshaft pulley). If No. 1 piston is on compression stroke, both front rocker arms will be loose and both rear arms will be tight; adjust the valves indicated in Fig. 32 for all non-diesel models, Fig. 33 for D-15 diesel engines or Fig. 34 for D-17 Diesel models. If rear piston is on compression stroke, both front rocker arms will be tight and both rear rocker arms will be loose; adjust the valves indicated in Fig. 32A for all non-diesel models, Fig. 33A for D-15 diesel engines or Fig. 34A for D-17 diesel models. After adjusting four valves (six valves for D-17 diesel), turn the crankshaft one complete revolution until TDC marks are again aligned and adjust the remaining valves.

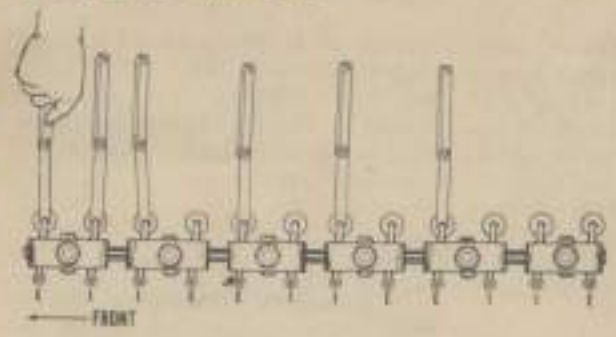


Fig. 34 — D-17 diesel. With number 1 piston at TDC on compression stroke, valve clearances (tapper gap) can be set on the six valves indicated. Clearance for inlet valves (I) should be 0.010 inch hot; 0.019 inch hot for exhaust valves (E). Refer to Fig. 34A and adjust remainder of valves.

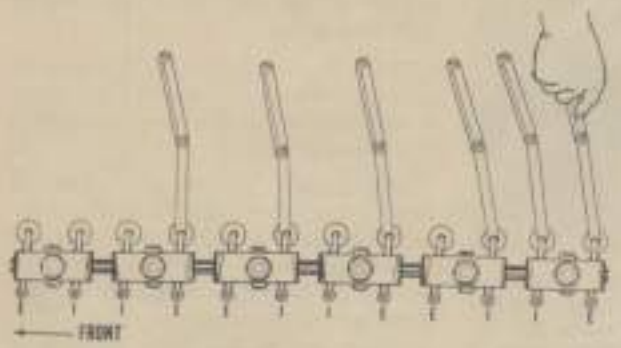


Fig. 34A — D-17 diesel. With number 6 piston at TDC on compression stroke, valve clearances (tapper gap) can be set on the six valves indicated. Refer also to Fig. 34.

VALVE GUIDES

D-14 and D-15 Non-Diesel

41. Intake and exhaust valve guides should be renewed if valve stem to guide clearance exceeds 0.008. Press new guides into cylinder head until top ends of guides are flush with machined rocker arm cover gasket surface. Check fit of valves in guides and ream guides, if necessary to provide 0.0023-0.004 clearance between guides and intake valve stems and 0.0023-0.0043 clearance between guides and exhaust valve stems. New valve guide inside diameter should be 0.344-0.345.

D-17 Non-Diesel

42. Valve guides should be renewed if clearance between stems and guides exceeds 0.008. Intake and exhaust valve guides are not interchangeable. New exhaust valve guides should be pressed into head until top of guide is flush with the machined rocker cover gasket surface of the cylinder head. Top of inlet valve guide should be ⅛-inch below the machined rocker cover gasket surface. Both intake and exhaust valve guides should be reamed to an inside diameter of 0.3745-0.3755 which should provide 0.0025-0.0045 clearance between valve stem and guide.

Diesel

43. Valve guides should be renewed if clearance between valve stems and guides exceeds 0.006. Intake and exhaust valve guides are not interchangeable. New intake and exhaust valve guides should be pressed into cylinder head until top of guides are 5/16-inch above the machined rocker cover gasket surface. The inlet valve guides are longer than guides for exhaust valves. Both intake and exhaust valve guides should be reamed to provide 0.0025-0.0045 clearance between the guides and the 0.3090-0.3100 diameter valve stems. Note: Late production intake valve guides are machined for valve stem seals.

VALVE SPRINGS

Non-Diesel

44. The interchangeable intake and exhaust valve springs should be renewed if they are rusted, distorted or fail to meet the following test specifications:

D-14 and D-17 Non-Diesel

Spring free length	2 7/16 inches
Renew if less than	2⅜ inches
Pounds pressure @ 1¾ inches	33-39
Pounds pressure @ 1 7/16 inches	55-65

D-15 Non-Diesel

Spring free length (new)	2-31/64 inches
Renew if free length is less than	2-27/64 inches
Pounds pressure @ 1-55/64 inches	47-53
Pounds pressure @ 1-31/64 inches	75-85

D-17 Diesel (Prior to Engine Serial No. 119938 Except Serial No. 117087 through 117104)

45. The interchangeable intake and exhaust valve springs should be renewed if they are rusted, distorted or fail to meet the following test specifications:

Pounds pressure @ 1.756 in.	40-45
Pounds pressure @ 1.412 in.	86-92
Spring free length	2 7/16 inches

D-15 Diesel and Late D-17 Diesel

46. Intake and exhaust valve springs are not interchangeable. Install stamped steel valve spring dampener with flange between spring and cylinder head. Renew valve springs if they are rusted, distorted, or fail to meet the following test specifications:

INTAKE VALVE SPRINGS

Pounds pressure @ 1.584 in.	40-45
Pounds pressure @ 1.240 in.	86-92
Spring free length	1 11/16 in.
Renew if free length is less than	1-17/32 inches

EXHAUST VALVE SPRINGS

Pounds pressure @ 1.756 in.	40-45
Pounds pressure @ 1.412 in.	86-92
Spring free length	2 7/16 in.
Renew if free length is less than	1-31/32 inches

CAM FOLLOWERS

Non-Diesel

47. The mushroom type cam followers (tappets) ride directly in unbushed cylinder block bores and can be removed after removing the camshaft as outlined in paragraph 65 or 66. Cam followers are available in standard size only and followers and/or block should be renewed if clearance between fololwers and bores is excessive.

Diesel

48. The 0.5600-0.5605 diameter mushroom type cam followers (tappets) operate directly in unbushed

cylinder block bores with a suggested clearance of 0.0010-0.0025. Maximum allowable clearance is 0.0035.

The cam followers may be removed after removing the camshaft as outlined in paragraph 68. Cam followers are available in standard size only.

ROCKER ARMS

D-14 and D-15 Non-Diesel

49. **R&R AND OVERHAUL.** Rocker arms and shaft assembly can be removed after removing the right hood, rocker arm cover, oil line from head to shaft and the four retaining nuts.

Maximum allowable clearance between rocker arms and shaft is 0.010. If clearance exceeds 0.010, renew the worn part. Rocker arms are offset and must be installed with valve stem end of arm offset toward the nearest shaft support.

Renew corks in each end of rocker arm shaft if the corks are loose or damaged. Refer to paragraph 40 for adjusting valve clearance (tappet gap).

D-17 Non-Diesel

50. **R&R AND OVERHAUL.** Rocker arms and shaft assembly can be removed after removing the right hood panel, rocker arm cover, oil line to rocker arm shaft and the four retaining nuts.

To disassemble the rocker arm assembly, remove the cotter pin and washer from each end of shaft; then slide rocker arms, shaft supports and springs from shaft.

The valve stem contact surface of the rocker arms can be resurfaced, but the surface must be kept parallel to rocker arm shaft and original radius maintained. Desired clearance between rocker arm and shaft is 0.002-0.003. If clearance exceeds 0.008, renew the rocker arm and/or shaft. Rocker arm bushings are not available separately from rocker arm. The intake valve rocker arms can be identified by a milled notch located on the arm upper surface between the shaft and valve stem end. Reinstall rocker arm shaft with the oiling holes toward the cylinder head. Renew cork plugs in each end of rocker arm shaft if loose or damaged.

Refer to paragraph 40 for adjusting valve tappet gap.

51. **ROCKER ARM BAFFLE.** Non-diesel D-17 engines are fitted with a baffle over the rocker arms to prevent oil from splashing against the intake valve stems. At tractor Serial No. D17-24001, six ¼-inch holes were incorporated in the baffle to prevent loss of oil at the breather. It is suggested that these holes be drilled in the baffle on prior serial numbered tractors if oil leakage at the breather is encountered. Refer to Fig. 35 for hole locations. Lip of baffle should be straight and contact rocker arm cover firmly when both are in position on engine.

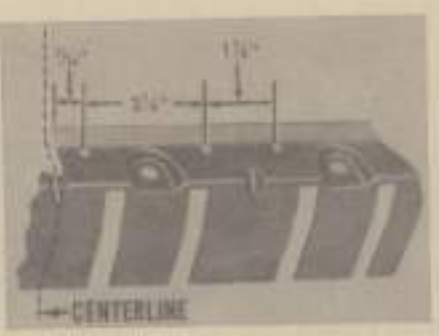


Fig. 35 — Rocker arm baffle is used on non-diesel D-17 engines to keep excessive amount of oil from valve stems. Six ¼-inch holes should be drilled as shown in early production baffles to prevent oil from being splashed out of breather. Top of baffle must contact rocker arm cover.

Fig. 36—Diesel engine rocker arms assembly is lubricated via the slotted stud (S). An early D-17 model is shown.

Diesel

52. **R&R AND OVERHAUL.** Rocker arms and shaft assembly can be removed after removing the right hood side panel and rocker arm cover; then removing the retaining cap screws and stud nuts.

NOTE: On Late models, it will be necessary to remove the dry type air cleaner assembly to gain clearance for removal of rocker arm cover.

The hollow rocker arm shaft is drilled for lubrication to each rocker arm bushing. Lubricating oil to the drilled cylinder head passage and slotted oil stud (S—Fig. 36) is supplied by an external oil line which is connected to the main oil gallery on left side of engine. If the slotted stud is tight in the cylinder head and the end of stud is above the drilled passage, it is not necessary that the slot be in line with the passageway. However, this should checked and if the end of the stud is lower than the passageway, be sure that the slot in the stud is in line with the drilled passage. If oil does not flow from the hole in the top of each rocker arm, check for foreign material in the external oil line or in the cylinder head passage.

The procedure for disassembling and reassembling the rocker arms and shaft unit is evident. Check the rocker arm shaft and bushings in rocker arms for excessive wear. Maximum allowable clearance between the shaft and rocker arm bush-

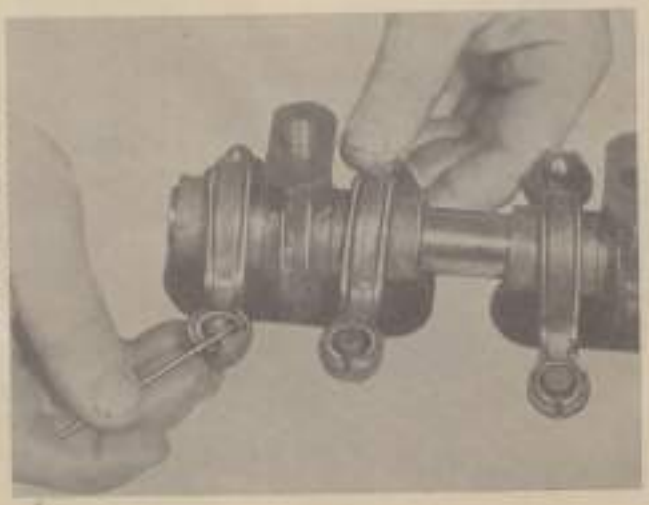


Fig. 37 — On the diesel engines, the rocker arms are fitted with renewable type valve stem contact buttons which can be removed after extracting the retaining snap rings as shown.

ings is 0.005. When installing new bushings, be sure that hole in bushing is aligned with hole in rocker arm and ream the bushings to provide a clearance of 0.001-0.002 between bushing and rocker arm shaft. Install rocker arm shaft with oil metering holes toward push rods.

NOTE: Rocker arm bushings are not available separately from rocker arm after D-15 engine Serial Number 119737 and D-17 engine Serial Number 119937. Renew complete rocker arm assembly if bushing is worn excessively.

Inspect the valve stem contact button in the end of each rocker arm for being mutilated or excessively loose. If either condition is found, renew the contact button. Extract the button retaining snap ring as shown in Fig. 37 and remove the button and oil wick. Install new oil wick and button and test the button for a free fit in the rocker arm socket. If button tends to bind in the socket, use a fine lapping compound and hand lap the mating surfaces.

Fig. 38 — Camshaft thrust cover removed for installation of relief valve assembly and camshaft thrust assembly (Fig. 39).

TIMING GEAR COVER AND CRANKSHAFT FRONT OIL SEAL

D-14 and D-15 Non-Diesel

53. **REMOVE AND REINSTALL.** To remove the timing gear cover, first perform a front split as outlined in paragraph 13, and proceed as follows: Remove fan, governor housing and oil pan (sump). After removing the two Allen head set screws; use a suitable puller and remove crankshaft pulley. Remove the camshaft thrust cover and withdraw the camshaft thrust assembly and the engine oil pressure relief valve assembly. Refer to Fig. 39. Remove the engine front support, then unbolt and remove the timing gear cover.

To renew crankshaft front oil seal, proceed as follows: After removing timing gear cover, remove old seal from cover and reinstall timing gear cover loosely without seal. Center timing gear cover on crankshaft with tool as shown in Fig. 40; then, tighten timing gear cover cap screws while centering tool is in place. Remove centering tool, place seal expander over end of crankshaft as shown in Fig. 41 and slide seal on shaft with lip of seal to rear. Then, drive seal into timing gear cover with centering tool which is also a seal driver. As no dowel pins are used to properly locate timing gear cover, care must be taken in centering cover to crankshaft as described to prevent oil leakage.

D-17 Non-Diesel

54. **R&R TIMING GEAR COVER.** To remove the timing gear cover, first perform a front split as outlined in paragraph 13; then, proceed as follows: Disconnect wires from generator and remove the generator adjusting strap and fan belt. Remove the crankshaft pulley; then, unbolt and remove the engine front support and generator as a unit. Disconnect the carburetor link (1—Fig. 85) from the cross shaft (20) and the control rod from the governor control shaft (2). Remove the oil pan as outlined in paragraph 91. To gain clearance, unbolt and remove the water pump; then, unbolt and remove timing gear cover. Note: An alternate method is to remove the stud bolts extending through timing gear cover and turn cover to clear water pump rather than to remove water pump for clearance.

The governor linkage can be overhauled or renewed as necessary and the crankshaft front oil seal may be renewed at this time.

Reinstall the cover by reversing removal procedure. Adjust camshaft end play to 0.007-0.010, after timing gear cover is installed, as follows: Loosen the adjusting screw lock nut located on front of timing gear cover and turn the adjusting screw in until it solidly contacts end of camshaft; then, back screw out ⅛-turn and tighten lock nut while holding adjusting screw in this position.

55. **CRANKSHAFT FRONT OIL SEAL.** The crankshaft front oil seal can be renewed in a conventional manner after first removing the timing gear cover as outlined in paragraph 54. Sealer should be applied to the outer rim of seal.

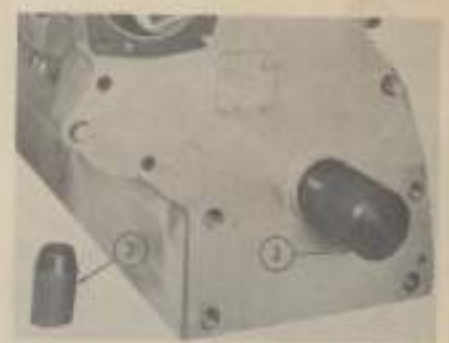


Fig. 40—Timing gear cover on D-14 and D-15 non-diesel engines is not located with dowel pins. Alignment tool (3) must be used to properly position timing gear cover to crankshaft before retaining cap screws are tightened. Seal is then installed as shown in Fig. 41.

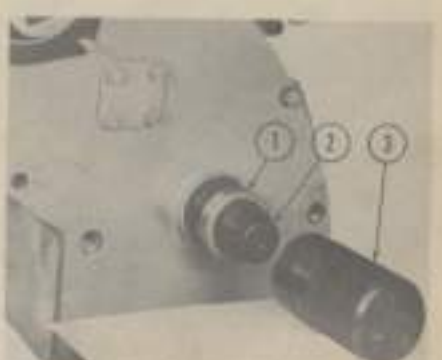


Fig. 41 — After timing gear cover on D-14 and D-15 non-diesel engines is installed (See Fig. 40), place seal protector (2) over end of crankshaft and drive seal (1) into cover with lip to inside using alignment tool (3) as a seal driver.

Fig. 39 — Removed oil pressure relief valve and camshaft thrust assembly. See Fig. 52 for legend.

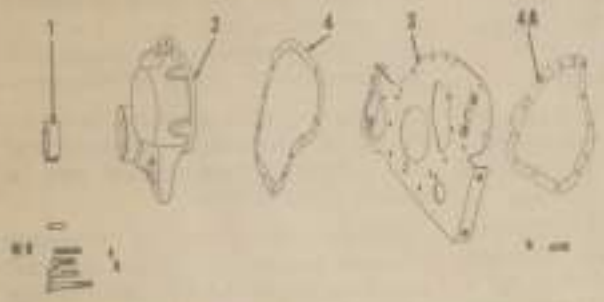


Fig. 42 — Diesel timing gear cover (2) and associated parts.

1. Crankshaft front oil seal
2. Timing gear cover
3. Engine front support plate
4. Gasket
4A. Gasket

D-15 and D-17 Diesel

56. **R&R TIMING GEAR COVER.** To remove the timing gear cover, first perform a front split as outlined in paragraph 13; then, remove the fan belt, power steering pump drive belt if so equipped, and the crankshaft pulley retaining nut and pulley. The timing gear cover can now be unbolted and removed.

The crankshaft front oil seal (1—Fig. 42) should be installed with the lip facing rear. Apply gasket sealer to outside rim of seal before installing same in timing gear cover.

Reinstall cover by reversing the removal procedure taking care to install the four cover to oil pan cap screws and copper washers in the proper places.

NOTE: Copper sealing washers are not used on late production engines. On these engines, be sure to apply gasket sealer to the threads of the cap screws that extend through the engine oil pan.

57. **CRANKSHAFT FRONT OIL SEAL.** The crankshaft front oil seal can be renewed in a conventional manner after first removing the timing gear cover as outlined in paragraph 56. Gasket sealer should be applied to outer rim of seal.

TIMING GEARS

Non-Diesel

58. **TIMING GEAR MARKS AND GEAR BACKLASH.** Timing gears are properly meshed when the scribed lines on the camshaft gear and crankshaft gear are in register as shown in Fig. 43.

Check timing gear backlash while holding all end play from camshaft. Desired backlash is 0.002-0.006. Renew timing gears if backlash exceeds 0.010.

59. **CAMSHAFT GEAR.** The camshaft gear is keyed and press fitted to the camshaft and can be removed with a suitable puller after first removing the timing gear cover as outlined in paragraph 53 or 54.

Before installing, heat gear in hot oil or boiling water for 15 minutes; then, back-up camshaft with heavy bar while drifting heated gear on shaft. The gear should butt up against front camshaft journal. Make certain that timing marks are aligned as shown in Fig. 43.

NOTE: Some mechanics may prefer to remove the camshaft as outlined in paragraph 65 or 66; then, remove the gear from the shaft and install new gear in a press.

60. **CRANKSHAFT GEAR.** The crankshaft gear is keyed and press fitted to the crankshaft and can be removed by using a suitable puller after first removing the timing gear cover as outlined in paragraph 53 or 54.

Before installing, heat gear; then, back-up crankshaft with a heavy bar while drifting heated gear on shaft. Make certain that timing marks are aligned as shown in Fig 43.

Fig. 43—D-14 and D-15 non-diesel timing marks on camshaft gear and crankshaft gear. The governor and distributor drive gear, also shown, may be meshed in any position; ignition timing being made at distributor. Timing marks for D-17 non-diesel engines are similar.

Diesel

61. **TIMING GEAR MARKS AND GEAR BACKLASH.** Timing gears are properly meshed when the punch marked tooth of the crankshaft gear is in register with the punch marked space between teeth on the camshaft gear and the punch marked space between teeth on the injection pump drive gear is in register with the punch marked tooth on the pump driven gear as shown in Fig. 44.

Desired backlash between camshaft gear and crankshaft gear is 0.001-0.005. Camshaft gear and/or crankshaft gear should be renewed if backlash exceeds 0.008. Gears are available in standard size only. Note: While checking gear backlash, be sure to hold all end play out of camshaft.

62. **CAMSHAFT GEAR.** It is recommended that the camshaft be removed from engine to remove and install

Fig. 44 — Diesel engine timing gears consist of camshaft and crankshaft gears and injection pump drive and driven gears. Timing marks should be aligned as shown.

Fig. 45 — Removing the camshaft thrust plate retaining cap screws. (Although a WD45 diesel engine is shown the method is the same for D-15 and D-17 diesel models.)

camshaft gear. After timing gear cover is removed as outlined in paragraph 56, proceed as follows: Remove rocker arm shaft assembly and push rods as outlined in paragraph 52. Unbolt and remove oil pan and oil pump. Pull injection pump driven gear and shaft from injection pump. Note: Fuel will flow from pump unless shut off valve has been closed and pump drained through timing window opening. Unbolt and remove the injection pump drive gear from front of camshaft gear. Pull each cam follower up against cylinder block with wooden dowel pins driven into the hollow followers and hold in that position with pincher type clothes pins. Working through the holes in the camshaft gear, remove the two cap screws retaining the camshaft thrust plate to cylinder block; then withdraw camshaft and gear assembly from front of engine.

Remove snap ring from in front of camshaft gear, then remove gear from shaft in a press or by using a suitable puller. Gear is keyed and press fitted to shaft.

Camshaft end play is controlled by the thrust plate that retains the camshaft assembly in the cylinder block. End play should be 0.003-0.008 and can be measured with a dial indicator, or when camshaft assembly is removed, end play can be measured with a feeler gage as shown in Fig. 46. If end play exceeds 0.014, worn thrust plate should be renewed or end play can be reduced by filing off the rear face of the camshaft gear as shown in Fig. 47.

Install thrust plate, Woodruff key, camshaft gear and snap ring on camshaft and reinstall the assembly by reversing removal procedures.

CAUTION: Both camshaft thrust plate retaining cap screws should be drilled through length of cap screw. Never substitute solid cap screws for this installation as lubricating oil for the timing gears must pass through the hollow cap screw in lower position. Be sure that timing marks are aligned as shown in Fig. 44 before installing camshaft thrust plate retaining cap screws.

63. **CRANKSHAFT GEAR.** The crankshaft gear is keyed and press fitted to the crankshaft. The gear can be removed by using a suitable puller after first removing the timing gear cover as outlined in paragraph 56.

New gear can be installed by heating it in oil for fifteen minutes prior to installation and drifting the heated gear on the crankshaft or by pressing gear on shaft using crankshaft pulley retaining nut and suitable washers and spacers. Be sure timing marks are aligned as shown in Fig. 44.

DIESEL INJECTION PUMP DRIVE AND DRIVEN GEARS

64. The diesel fuel injection pump drive and driven gears can be removed and reinstalled after the timing gear cover is removed as outlined in paragraph 56. The pump driven gear and shaft assembly is removed by pulling it from the fuel injection pump. Note: Fuel in the pump will drain out through the shaft opening unless fuel has been shut off and the pump drained by removing timing inspection cover on side of pump prior to removal of gear and shaft. The pump drive gear is retained to the camshaft gear by three wired cap screws and one dowel pin.

Fig. 46—To check the diesel engine camshaft end play, insert a feeler gage as shown between shaft journal and the thrust plate. The amount of end play is equal to the thickness of the maximum size feeler gage that can be inserted.

Fig. 47—Excessive diesel engine camshaft end play can be corrected by filing the required amount of metal from rear face of the camshaft gear hub. Refer to text.

Fig. 48—Partially exploded view of the injection pump drive assembly used on diesel engines.

92. Thrust plunger
93. Spring
94. Nut
95. Pump drive gear
96. "O" ring
97. Shaft
98. Off-center hole
99. Seals
100. Pump timing cover

The injection pump driven gear can be removed from the pump shaft by removing the retaining nut and pressing shaft from gear. The two lip seals on the shaft should be renewed whenever the shaft is removed from the pump. Lip of each seal should be towards end of shaft (opposed).

To install pump driven gear and shaft unit, lubricate seals with Lubriplate or similar lubricant and insert shaft in pump with off-center hole on drive tang of shaft and off-center hole in pump rotor slot aligned. Carefully work the shaft into pump to avoid rolling lip of rear seal back. Note: If lip of seal is rolled back during installation, remove shaft and renew seal before proceeding further. The seal will have been damaged and early failure of seal will occur. Be sure drive tang of shaft enters drive slot in pump rotor. Place spring and plunger in front end of shaft.

To install pump drive gear, turn engine until timing marks on camshaft gear and crankshaft gear are aligned and secure pump drive gear with dowel pin and cap screws. Wire the cap screws as shown in Fig. 44. Be sure that the punch marked tooth of injection pump driven gear is in register with the punch mark between two teeth of the drive gear as shown in Fig. 44.

CAMSHAFT AND BUSHINGS

D-14 and D-15 Non-Diesel

The camshaft is carried by three 1.749-1.750 diameter bearing journals which have a normal clearance of 0.002-0.004 in the 1.752-1.753 diameter bushings. Shaft end play is automatically maintained by a spring loaded thrust plunger in front end of shaft and a thrust plate interposed between camshaft (8—Fig. 52) and the thrust cover (1).

65. **R&R AND OVERHAUL.** To remove the camshaft, first remove the timing gear cover as outlined in paragraph 53 and the rocker arms and

shaft assembly as outlined in paragraph 49; then remove the push rods. Before removing the camshaft, check the backlash of the timing gears and if more than 0.008 renew the gears as necessary. Raise the cam followers (tappets) from below and worm the camshaft out front of engine.

Check the oil pump driving pin (9—Fig. 52) and renew same if damaged or worn. The 1.749-1.750 diameter camshaft bearing journals have a normal clearance of 0.002-0.004 in the 1.752-1.753 diameter bushings. If bushing diameter exceeds 1.759, renew the bushings. If camshaft journals are worn, 0.0025 undersize bushings are available.

To renew bushings, the additional work of removing the engine oil pump as outlined in paragraph 93 is necessary. Drive out old bushings and install new ones with a piloted drift as follows: Drive rear bushing in ⅛-inch past flush with rear face of block, making certain oil hole in bushing is aligned with passage in block. The center bushing should be installed with ⅛-inch hole aligned with oil passage to center main bearing and ⅛-inch hole aligned with the passage toward right side of block. The front bushing should be installed flush with front face of block with oil hole aligned with oil passage. When installing camshaft, be sure pin in rear end of shaft engages slot in oil pump rotor and align timing marks as shown in Fig. 43.

D-17 Non-Diesel

66. **CAMSHAFT.** To remove the camshaft, first remove the timing gear cover as outlined in paragraph 54, the rocker arm shaft assembly as outlined in paragraph 50 and remove the push rods. Remove the oil pan and oil pump, hold tappets (cam followers) up to clear cams and withdraw camshaft from engine. The mushroom type cam followers can be removed at this time.

Clearance between the camshaft and the three split type camshaft bushings should be 0.002-0.004. Renew camshaft bushings and/or camshaft if clearance exceeds 0.006. Bushings are available in standard size and in 0.0025 undersize. Camshaft journal diameter is 1.874-1.875.

When reinstalling camshaft, make certain that all oil passages are clean. Reverse removal procedure to reinstall. Be sure to adjust camshaft end play as outlined in paragraph 54 after reinstalling timing gear cover.

NOTE: At engine Serial No. 17-19978, the oil pump driving gear on the camshaft was changed from 11 teeth to 14 teeth to increase oil pump capacity. Prior to this change, a ⅜-inch pipe plug was used to seal the oil passage at rear end of camshaft. After this change, the passage is sealed with a ⅞-inch steel ball pressed into rear end of shaft. Service camshafts have this steel ball packaged in a bag that is attached to the camshaft. Prior to installing new shaft, clean out the oil passageway and press the steel ball into passageway until flush with rear end of camshaft. CAUTION: Oil pump drive gear having 10 teeth must be used with camshaft having 11 tooth oil pump driving gear and an oil pump drive gear having 9 teeth must be used with camshaft having a 14-tooth oil pump driving gear.

67. **CAMSHAFT BUSHINGS.** To renew the camshaft bushings after removal of camshaft, it is necessary to remove flywheel which requires removal of engine from tractor. After removing the clutch and flywheel, drive the rear bushing out towards rear, forcing the expansion plug at rear of bore out with bushing.

Bushings are pre-sized and should be installed with a piloted driver. Make sure that oil holes in bushings are aligned with oil passages in the cylinder block bores. Minimum (standard) bushing diameter after installation should be 1.877. Bushings are also available in 0.0025 undersize for fitting with worn shafts. It will probably be necessary to finish grind the camshaft journals to use the 0.0025 undersize bushings. When installing the expansion plug in rear of block, be sure the drilled hole at rear of bushing is open, apply sealer to rim of plug and be sure that it seats tightly in the cylinder block.

NOTE: Prior to engine Serial No. 17-19978, center camshaft bushing had two oil holes and the end bushings had only one hole. On engine Serial No. 17-19978 and up, all three camshaft bushings are alike and have only one oil hole in each bushing. When servicing engines prior to Serial No. 17-19978, be sure that the bushing having two oil holes is used in center camshaft bearing bore and that both oil holes are aligned with the oil passages in the cylinder block.

Diesel

68. **CAMSHAFT AND BEARINGS.** The camshaft is supported in four precision steel backed babbit lined bearings. The shaft journals have a normal operating clearance of 0.002-0.0046 in the bushings. If journal clearance exceeds 0.0065, the bushings and/or the camshaft should be renewed.

To remove the camshaft, follow procedure outlined in paragraph 62 for removal of camshaft gear.

To renew the camshaft bushings after removal of camshaft, the engine must be removed from the tractor and the flywheel, engine rear adapter plate and the soft plug behind the rear bushing must be removed.

New rear bushing should have 0.001-0.003 interference fit in bore of block and the three front bushings should have 0.002-0.004 interference fit. Although front bushing has the same diametrical dimensions as the two intermediate bushings, it is wider and the oil holes are spaced differently. Be sure that the oil holes in all bushings line up with the oil passages in the cylinder block.

Inside diameter of camshaft bearings after installation should be as follows:

Front, second & third . . 2.0010-2.0026
No. 4 (rear) 1.2510-1.2526

Although camshaft bearings are pre-sized, it is highly recommended that bearings be checked after installation for localized high spots. Camshaft bearing journals should have a normal operating clearance in bearings of 0.002-0.0046.

Use Permatex or other suitable sealer when installing plug at rear of camshaft bushing bore in rear face of cylinder block.

ROD AND PISTON UNITS

D-14 and D-15 Non-Diesel

69. Connecting rod and piston units are removed from above after removing the cylinder head as outlined in paragraph 35 and the oil pan. Connecting rods are offset; numbers 1 and 3 having long part of bearing towards flywheel; numbers 2 and 4 having long part of bearing toward timing gears. Tighten connecting rod nuts to 35-40 Ft.-Lbs. of torque and install pal nuts. Tighten pal nuts finger tight plus ⅛ turn.

D-17 Non-Diesel

70. Connecting rod and piston assemblies are removed from above after removing the cylinder head, oil pan and connecting rod caps.

Rods should be installed with piston pin clamping screw on camshaft side of engine and cylinder numbers on rod and cap aligned (tangs of bearing inserts must be to same side of rod and cap assembly). Rods are offset in pistons; refer to paragraph 75 and to Fig. 49. Tighten the connecting rod nuts to a torque of 45-55 Ft.-Lbs.

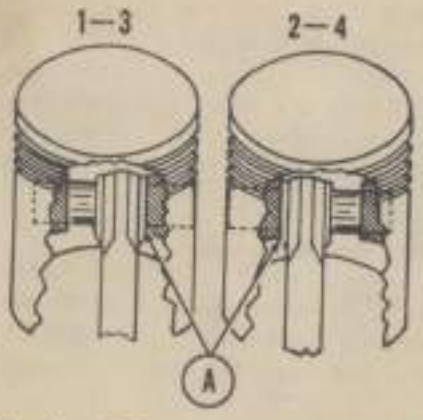


Fig. 49 — D-17 non-diesel piston pins are of the locked-in rod type. Numbers 1 and 3 units are assembled as shown at the left. Numbers 2 and 4 units are assembled as shown at the right.

Diesel

71. Piston and connecting rod units are removed from above after removing cylinder head, oil pan and connecting rod caps.

Cylinder numbers are stamped on the connecting rod and cap. When reinstalling rod and piston units, make certain that the cylinder identifying numbers are in register and face away from the camshaft side of engine. (Both bearing insert tangs must be towards same side of rod and cap assembly.)

Tighten the connecting rod nuts to a torque of 40-50 Ft.-Lbs. and install new cotter pins.

PISTONS, LINERS (SLEEVES) AND PISTON RINGS

Non-Diesel

72. The cam ground aluminum pistons are fitted with three compression rings and one segment type oil control ring. Pistons and rings are available in standard size only.

When assembling the pistons to connecting rods, refer to paragraph 74 or 75.

Compression rings should be installed with the side of ring marked "T" or "TOP" towards top of piston. To install the segment type oil ring, proceed as follows: Install expander in ring groove with ends butted together above either end of piston pin. Install top steel rail with end gap 90 degrees away from expander joint. Install lower steel rail with end gap 180 degrees away from top rail end gap. Be sure that ends of expander are butted together and not overlapped.

After removing piston and connecting rod assembly, use suitable pullers to remove the wet type cylinder liners (sleeves) from cylinder block. Clean all sealing and mating surfaces of block prior to installing new sleeve. Lubricate the sealing rings with thinned white lead or a soap lubricant and carefully push sleeves into place. Top of sleeve should stand out 0.002-0.005 above top of cylinder block on D-14 and D-15 models; 0.000-0.003 above top of block on D-17 models. Excessive stand out will cause leakage at head gasket.

Check pistons, rings and sleeves against the following specifications:

MODEL D-14

Ring end gap	0.007-0.017
Ring land clearance	0.0015
Cylinder liner ID	3.4995-3.5005
Wear limit	3.5115
Piston skirt clearance (bottom of skirt-right angles to piston pin)	0.0025-0.0035

MODEL D-15

Ring end gap—	
Compression	0.009-0.014
Oil ring	0.007-0.017
Ring land clearance	
Compression	0.0015-0.0035
Oil ring	0.001-0.003
Cylinder liner ID	3.4995-3.5005
wear limit	3.5105
Piston skirt clearance (bottom of skirt-right angles to piston pin)	0.0015-0.003

SERIES II D-15

Ring end gap—	
Compression	0.009-0.014
Oil ring	0.007-0.017
Ring land clearance—	
Compression	0.0015-0.0035
Oil ring	0.001-0.003
Cylinder liner ID	3.6245-3.6255
Wear limit	3.6355
Piston skirt clearance (bottom of skirt-right angles to piston pin)	0.0015-0.003

MODEL D-17

Ring end gap	
Compression rings	0.009-0.017
Oil ring (steel rails)	0.015-0.055
Ring side clearance	
Compression rings	0.0015-0.0035
Oil ring (segment type)	0-0.065
Cylinder liner I.D., new	4.000-4.001
Liner stand-out	0-0.003
Renew if wear at top of liner exceeds	0.011
Piston skirt diameter	
Parallel to pin	3.989
At right angle to pin	3.998
Piston skirt to liner clearance	
At right angle to piston pin	0.002-0.003

Diesel

73. The cam ground aluminum pistons are fitted with three compression rings, one segment type oil ring above the piston pin and one scraper type oil control ring below the piston pin. Pistons and rings are available in standard size only.

NOTE: Early production models were equipped with two scraper type oil rings instead of one scraper type and one segment type ring; however, when servicing these tractors, a segment type ring can be used in the fourth ring groove as on later production models.

Install compression rings with side marked "TOP" towards top of piston. To install the three piece segment type oil ring, place expander in groove with ends butted together above either end of piston pin. While holding expander in position, install top steel rail with end gap 90 degrees away from ends of expander. Then, install the bottom steel rail with end gap 180 degrees away from end of top rail. Be sure that the ends of the expander remain butted together and do not overlap. Install the scraper type oil ring in the bottom ring groove with scraper edge of ring down.

With the piston and connecting rod assembly removed from the block, use a suitable puller to remove the wet type cylinder sleeve. Clean and lubricate all sealing and mating surfaces of sleeve and block and renew sealing "O" rings. Use soap or thinned white lead as lubricant. Top of cylinder sleeve should be from 0.002 below to 0.002 above top surface of cylinder block when sleeves are installed. If top of sleeve is more than 0.002 below top of block, sleeves with flange 0.020 thicker than standard are available for service and may be installed by machining counterbore in block out to proper depth to provide proper standout of —0.002 to +0.002.

Check pistons, rings and sleeves against the following specifications:

D-15 Diesel

Piston Ring Side Clearance—	
Top	0.003-0.0045
Wear limit	0.008
2nd and 3rd	0.002-0.004
4th and 5th	0.0015-0.0035
Ring End Gap—	
Top	0.007-Minimum
2nd and 3rd	0.014 Minimum
4th and 5th	0.007 Minimum
Piston Skirt to Sleeve (liner) Clearance	Desired 0.004-0.0063 (Maximum 0.007)

D-17 Diesel

Piston Ring Side Clearance:
Top ring ..... Desired 0.003-0.005
Maximum 0.007
2nd & 3rd, desired 0.002-0.004
4th (segment type), desired 0-0.0055
5th, desired 0.0015-0.0035
Ring End Gap:
Top compression 0.008-0.016
2nd & 3rd compression .. 0.015-0.023
4th (side rails only) (min.) ... 0.014
5th oil 0.008-0.016
Piston skirt to sleeve clearance:
Desired 0.004-0.0065
Maximum allowable 0.009

Renew cylinder sleeve if wear at top of ring travel (taper) exceeds 0.007. Inside diameter of new sleeve is 3.5623-3.5638.

PISTON PINS

D-14 and D-15 Non-Diesel

74. The 0.8133-0.8135 diameter piston pins are available in standard size only and have a clearance of 0.0004-0.0006 (at 70° F.) in the 0.8129 piston pin bosses. Piston pins are locked in the connecting rod by a clamping cap screw. Be sure rod and piston pin are centered in piston before tightening the clamp screw to 35-40 Ft.-Lbs. of torque.

D-17 Non-Diesel

75. The 0.9893-0.9895 diameter piston pins are available in standard size only. Desired clearance between piston pin and piston pin bores in piston is 0.0005-0.0007 at 70° F. Pins are retained by the clamp type connecting rods.

Pistons and rods should be assembled with the rods offset away from the nearest main bearing journal. Assemble connecting rod and piston units as follows: On all four units, the connecting rod clamp screw should be towards the camshaft side of engine. Refer to Fig. 49. On the number one and three units, hold connecting rod against the rear piston pin boss (A) and the rear end of the piston pin slightly below flush with piston skirt while tightening rod clamp screw. On the number two and four units, hold connecting rod against the front piston pin boss (A) and the front end of piston pin slightly below flush with piston skirt while tightening rod clamp screw. Tighten all rod clamp screws to a torque of 25 Ft.-Lbs.

NOTE: Piston and connecting rod unit should be held by a pin or rod inserted through piston pin while tightening rod clamp screw to avoid possible twisting of connecting rod.

Diesel

76. The full floating type piston pins are retained in piston pin bosses by snap rings and are available in standard size only. Check piston pin fit against values which follow:

D-15

Piston pin bore in rod bushing 1.0001-1.0006
Piston pin bore in piston 0.99985-1.00005
Piston pin diameter .. 0.99955-0.99975
Desired clearance between pin and rod bushing at 70 degrees F. 0.00035-0.00105
Desired clearance between pin and bore in piston at 70 degrees F. 0.0001-0.0005

D-17

Piston pin bore in rod bushing 0.9999-1.00004
Piston pin bore in piston 0.99985-1.00005
Piston pin diameter 0.99955-0.99975
Desired clearance between pin and rod bushing at 70 degrees F. 0.00015-0.00085
Desired clearance between pin and bore in piston at 70 degrees F. 0.0001-0.0005

Maximum allowable clearance between piston pin and rod bushing and/or bore in piston is 0.002 for both D-15 and D-17 diesel models.

CONNECTING RODS AND BEARINGS

Non-Diesel

77. Connecting rod bearings are of the non-adjustable precision insert type and are renewable from below after removing the oil pan and rod bearing caps.

When renewing bearing inserts, be sure that the tangs on the inserts engage the milled notches in connecting rod and cap and that rod and cap are assembled so that the insert tangs are both on the same side of the assembly. Bearing inserts are available in undersizes of 0.001 and 0.0025 as well as standard.

Check the bearing inserts and crankshaft connecting rod journals against the following specifications:

D-14

Rod journal diameter (std.) 1.9365-1.9375
Rod side clearance 0.006-0.011
Rod bearing clearance .. 0.0006-0.0027
Rod nut torque (Ft.-Lbs.) ... 35-40

D-15

Rod journal diameter (std.) 1.936-1.937
Rod side clearance 0.006-0.011
Rod bearing clearance 0.001-0.003
Rod nut torque (Ft.-Lbs.) 35-40

D-17

Rod journal diameter (std.) 2.374-2.375
Rod side clearance 0.004-0.008
Bearing clearance 0.001-0.003
Rod nut torque (Ft.-Lbs.) 45-55

Diesel

78. Connecting rod bearings are of the non-adjustable precision insert type and are renewable from below after removing the oil pan and connecting rod caps.

When renewing bearing inserts, be sure that the tangs on the inserts engage the milled notches in connecting rod and cap and that rod and cap are assembled so that the insert tangs are both on the same side of the assembly. Inserts are available in undersizes of 0.002, 0.010, 0.020 and 0.040 as well as standard.

Check the bearing inserts and crankshaft connecting rod journals against the following specifications:

Rod journal diameter (std.) 1.9975-1.9985
Rod side clearance (desired) 0.003-0.009
Max. allowable 0.015
Bearing clearance (desired) 0.0011-0.0036
Max. allowable 0.006
Rod bolt torque (Ft.-Lbs.) 40-50

CRANKSHAFT AND BEARINGS

D-14 and D-15 Non-Diesel

79. The crankshaft is supported in three non-adjustable, slip-in, precision type bearing inserts which can be renewed after removing oil pan and main bearing caps. Crankshaft end play of 0.004-0.008 is controlled by the flanged rear main bearing inserts. Check the 2.748-2.749 main journals for wear, out-of-round or taper and if any of these conditions exceed 0.004, renew crankshaft. Main bearing oil clearance is 0.002-0.004. Install inserts with projections engaging the machined slots and with slots in cap and block on the same side of engine. Bearing cap retaining cap screws should be tightened to 90-95 Ft.-Lbs. of torque.

D-17 Non-Diesel

80. The crankshaft is supported in three non-adjustable precision insert type bearings.

To renew the main bearing inserts, proceed as follows: Remove engine as outlined in paragraph 33. Unbolt and remove the starting motor, oil pan, clutch assembly, flywheel and engine rear adapter plate. All main bearing caps may now be removed.

To remove the crankshaft, first remove the engine as outlined in paragraph 33. Then, proceed as follows: Unbolt and remove starting motor, oil pan, oil pump and tube, clutch assembly, flywheel, engine rear adapter plate and timing gear cover. After removing the connecting rod bearing caps and main bearing caps, the crankshaft can be removed.

Crankshaft end play is controlled by the center main bearing inserts. Desired end play is 0.0045-0.013. Desired main bearing running clearance is 0.0014-0.0035. Main journal standard diameter is 2.9995-3.000. Bearing inserts are available in undersizes of 0.001 and 0.0025 as well as standard. Renew main bearing inserts if end play exceeds 0.013 or bearing running clearance is excessive. When installing bearing inserts, be sure that tangs on each insert engage milled notch in block or cap and that caps are installed so that both bearing insert tangs are on same side of engine. Tighten the main bearing cap screws to a torque of 130-140 Ft.-Lbs.

Diesel

81. The crankshaft is supported in precision insert type main bearings. The main bearing inserts can be renewed after removing the oil pan, oil pump, oil tube and main bearing caps. Five main bearings are used on D-15 engines and seven are used in D-17 engines.

Crankshaft end play is controlled by the flanges on the center main bearing inserts. Desired end play is 0.003-0.009. Desired main bearing running clearance is 0.0013-0.004. Renew all main bearing inserts if crankshaft end play exceeds 0.015 or bearing clearance exceeds 0.007. Inserts are available in undersizes of 0.002, 0.010, 0.020 and 0.040 as well as standard. Main bearing journal standard diameter is 2.4970-2.4980. When renewing bearing inserts, be sure that tangs on inserts engage the milled notches in block and cap and that cap is installed so that both bearing insert tangs are on same side of engine. Center main bearing cap is dowelled to block. Tighten the main bearing cap screws to a torque of 120-130 Ft.-Lbs.

To remove crankshaft, first remove engine as outlined in paragraph 34. Remove clutch, flywheel and engine rear adapter plate. Remove valve cover, rocker arm shaft assembly and push rods. Remove oil pan, oil pump, oil tube and rod and main bearing caps. Remove timing gear cover and injection pump drive and driven gears. Unbolt camshaft thrust plate, withdraw camshaft and remove the engine front plate. Lift crankshaft from engine.

CRANKSHAFT OIL SEALS

D-14 and D-15 Non-Diesel

82. **FRONT SEAL.** The crankshaft front oil seal is located in the timing gear cover and can be renewed after removing the timing gear cover as outlined in paragraph 53.

Fig. 50 — On D-14 and D-15 non-diesel models, the crankshaft rear oil seal is contained in the seal retainer (SR). Oil pump (OP) can be removed after removing the flywheel.

83. **REAR SEAL.** The crankshaft rear oil seal is contained in the seal retainer bolted to rear face of engine block. To renew seal, first remove the flywheel as outlined in paragraph 89. Remove the two cap screws retaining oil pan to seal retainer and loosen the remaining oil pan cap screws. Then unbolt and remove retainer from rear of engine. See Fig. 50.

Apply sealer to outside diameter of the seal; then press seal in retainer with lip toward front of engine.

D-17 Non-Diesel

84. **FRONT SEAL.** The crankshaft front oil seal is located in the timing gear cover and can be renewed as outlined in paragraph 55.

85. **REAR SEAL.** Lower half of oil seal is located in the rear main bearing cap and upper half is located in seal retainer that is attached to rear face of cylinder block. Renewal of rear seal requires removal of engine from tractor. Then, remove clutch, flywheel, engine rear adapter plate and oil pan. Unbolt and remove rear main bearing cap and seal retainer.

Do not trim ends of seal as the seal will compress when bearing cap is tightened. Be sure that oil seal contact surface on crankshaft is smooth and true. Apply gasket sealer to back of seal and seal groove; be careful to avoid getting gasket sealer on face of seal. Lubricate seal and reassemble by reversing removal procedure.

Diesel

86. **FRONT SEAL.** The crankshaft front oil seal is located in the timing gear cover and can be renewed as outlined in paragraph 57.

87. **REAR SEAL.** The crankshaft rear oil seal is installed in the adapter plate at rear of engine. The latest seal available for service consists of two parts; a seal retainer with an integral lip type inner seal and a

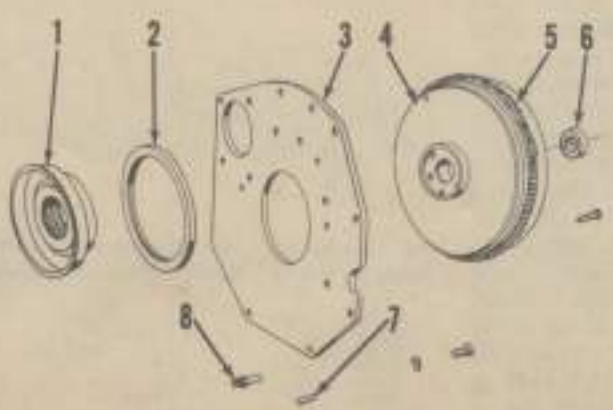


Fig. 51 — Exploded view of D-17 diesel rear oil seal, plate and flywheel. Two-piece rear oil seal used on earlier production is serviced by one-piece seal (1) shown. D-15 diesel models are similar.

1. Rear oil seal
2. Seal ring
3. Adapter plate
4. Flywheel
5. Ring gear
6. Pilot bearing
7. Dowel pins (2)
8. Timing pin

separate outer sealing ring. The seal assembly (1—Fig. 51) is pressed into the front side of the engine rear adapter plate. The outer sealing ring fits around the seal retainer and forms the rear seal for the oil pan.

To renew the rear seal, first remove engine from tractor, then remove the clutch, flywheel, oil pan and engine rear adapter plate. Drive old seal out of adapter plate. Apply gasket sealer to rim of retainer and drive retainer into adapter plate. Apply sealer to exposed rim of retainer and install outer sealing ring; then apply gasket sealer to sealing ring. Complete the reassembly of tractor by reversing removal procedure.

CYLINDER BLOCK

Due to installation procedure for the distributor drive housing or power steering pump dowel pin and also to a production change in the D-17 non-diesel engine which also affects service parts, service procedure information on renewal of the cylinder block was considered necessary. Renewal of the cylinder block on other models does not present any special service problem.

D-17 Non-Diesel

88. When renewing the cylinder block in non-diesel engines prior to engine Serial No. 17-19978, it will be necessary to convert the engine from a by-pass type oil filtering system to a full flow type system. A kit available from Allis-Chalmers parts departments contains a new cylinder block, a high capacity oil pump and a full flow oil filter installation kit. When installing this kit, it is recommended that a new camshaft having a 14-tooth oil pump driving gear and mating 9-tooth oil pump drive gear also be installed. See note after paragraph 90.

When renewing any D-17 non-diesel cylinder block, the following procedure is required: Prior to installing the timing gear cover, install the distributor drive housing assembly (or the power steering pump on power steering equipped models prior to tractor Serial No. D17-42001) and check the backlash of the governor drive gear. If backlash is not within 0.002-0.006, loosen the drive housing or pump mounting bolts and shift the unit until the desired backlash is obtained and re-tighten the mounting bolts. Then, using the drive housing or the pump as a template, use a ¼-inch drill to drill a hole ⅜-inch deep in the cylinder block. Insert dowel pin and peen edge of hole to secure dowel pin. Then, proceed with reassembly of tractor.

FLYWHEEL

All Engines

89. **REMOVE AND REINSTALL.** The flywheel can be unbolted and removed after first removing the engine clutch as outlined in paragraph 151 or 152. The non-diesel flywheel is attached to the engine crankshaft with four unequally spaced cap screws and two dowel pins.

Inspect the sealed clutch shaft pilot bearing and renew bearing if rough or noisy. When reinstalling flywheel, tighten the retaining cap screws to a torque of 75 Ft.-Lbs. on non-diesel models and 95-105 Ft.-Lbs. on diesel models.

On D-14 and D-15 models, the starter ring gear can be renewed after detaching (splitting) torque tube from the engine, without removing flywheel from crankshaft. Beveled side of ring gear teeth face toward rear (torque tube).

On D-17 models, the starter ring gear can be removed after removing the flywheel. Beveled side of ring gear teeth face toward front.

OIL PAN (SUMP)

D-14 and D-15 Non-Diesel

90. **REMOVE AND REINSTALL.** The method of removal is self-evident; however, the two oil pan rear retaining cap screws are slightly longer and should be reinstalled in the proper holes.

D-17 Non-Diesel

91. **REMOVE AND REINSTALL.** To remove the oil pan, it is necessary to first remove the starting motor and, on models equipped with power steering, remove the front support unit as outlined in paragraph 13. Then, unbolt and remove the pan from engine. Note: On power steering models, the right front corner of the oil pan may be secured with an Allen head screw located on the top of the cylinder block flange.

When reinstalling pan, thoroughly clean all gasket surfaces, be sure that the pan surface is smooth and true and that the pan arches are 47⅞ inches across. Use gasket sealer on both sides of gasket and stick gasket to cylinder block. Apply sealer on both sides of arch sealing strips and attach strips to pan arches with metal clips provided in gasket kit. Note: Do not cut off any excess length of gasket end strips, but place strips so that ends extend equally. Push pan straight up against cylinder block, install retaining bolts and tighten to a torque of 12-15 Ft.-Lbs.

Diesel

92. **REMOVE AND REINSTALL.** To remove the pan on all diesel models, it is first necessary to remove the front support as outlined in paragraph 13. Front end of pan is retained by cap screws extending through bottom of timing gear cover from front. Unbolt and carefully pry oil pan from engine to avoid damaging gasket flanges on pan.

Be sure that pan gasket surfaces are clean, smooth and true; straighten pan gasket flange if not flat. If gasket between engine front plate and pan was damaged when removing pan, cut lower part of new engine front cover gasket to fit pan. Apply heavy gasket sealer to cut ends of gasket and regular gasket sealer to both sides; stick gasket to engine front plate. Apply gasket sealer to both sides of pan gasket and to seal-

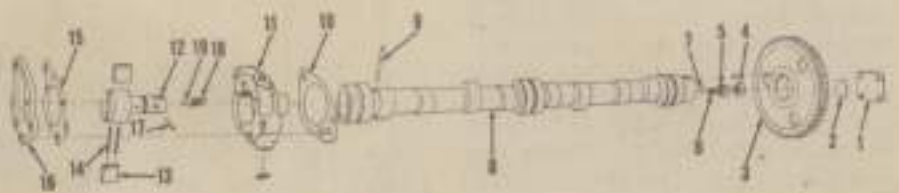


Fig. 52—Exploded view of D-14 and D-15 non-diesel camshaft and oil pump. The pump is driven by pin (9). Some engines are not equipped with check valve parts 17, 18 and 19.

1. Camshaft thrust cover
2. Thrust plate
3. Camshaft gear
4. Thrust plunger
5. Thrust spring
6. Relief valve spring
7. Relief valve ball
8. Camshaft
9. Oil pump drive pin
10. Gasket
11. Pump body
12. Rotor
13. Rotor blade
14. Rotor blade spring
15. Gasket
16. Pump cover
17. Pin
18. Spring
19. Check valve ball

ing ring at rear plate. Stick gasket to pan, place pan in position on cylinder block and install pan retaining cap screws finger tight. Install the four cap screws through front of timing gear cover and tighten to a torque of 18-21 Ft.-Lbs., then tighten pan retaining cap screws to same torque.

NOTE: Early production D-15 and D-17 diesel engines, require use of copper sealing washers on the four cap screws extending through front of timing gear cover into pan. On late production engines, sealing washers are not used, but a sealer such as Permatex should be used on threads of cap screws.

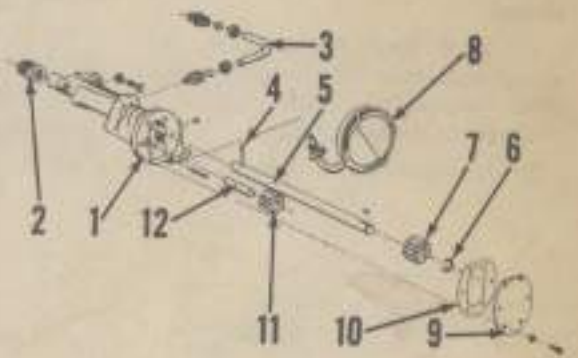


Fig. 53 — Exploded view of D-17 non-diesel engine oil pump used prior to engine serial No. D17-19978.

1. Oil pump body
2. Drive gear
3. Oil tube
4. Pin
5. Drive shaft
6. Snap ring
7. Driven gear
8. Oil intake
9. Pump cover
10. Gasket
11. Idler gear
12. Idler shaft

OIL PUMP AND RELIEF VALVE

D-14 and D-15 Non-Diesel

The vane type, camshaft driven engine oil pump is mounted on rear face of block. On some engines, a check valve is located in the rotor shaft of pump. The pressure relief valve is located in forward end of camshaft. Refer to Fig. 52.

93. **R&R AND OVERHAUL PUMP.** To remove the engine oil pump, remove flywheel as in paragraph 89; then, remove the three pump retaining cap screws.

Free length of rotor blade springs (14—Fig. 52) should be 1 1/2-inches, and each should exert a pressure of 8-10 ounces when compressed to a length of 3/4-inch. Clearance between rotor and body, at tight side, should not exceed 0.004. Rotor blades must be installed with beveled edge of blade toward direction of travel. Add or deduct gaskets (15) between oil pump cover and oil pump body to obtain 0.002 end play of rotor. If excessive end play is present with only one gasket installed, lap rear surface of pump body (11). The check valve located in the rotor shaft on some engines can be removed after driving out the retaining pin (17).

When reinstalling, tighten pump retaining cap screws to 15-20 Ft.-Lbs. of torque.

94. **OIL PRESSURE RELIEF VALVE.** To remove the oil pressure relief valve, which is located in the forward end of camshaft, first remove radiator. Camshaft thrust cover (1—Fig. 52) can be removed, exposing the camshaft thrust assembly and relief valve ball and spring. Insufficient oil pressure is corrected by renewing spring and ball.

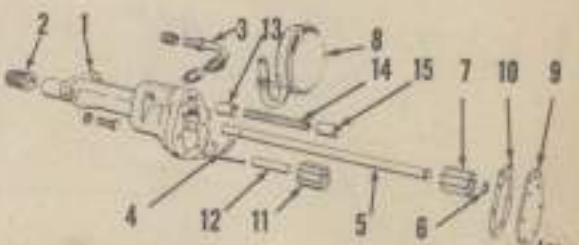


Fig. 54 — Exploded view of D-17 non-diesel engine oil pump used after engine serial No. D17-19978 with full flow oil filtering system.

1. Oil pump body
2. Drive gear
3. Oil tube
4. Pin
5. Drive shaft
6. Snap ring
7. Driven gear
8. Oil intake
9. Pump cover
10. Gasket
11. Idler gear
12. Idler shaft
13. Relief valve
14. Relief spring
15. Spring sleeve

D-17 Non-Diesel

95. **R&R AND OVERHAUL PUMP.** To remove the engine oil pump, it is first necessary to remove the oil pan as outlined in paragraph 91. Then, disconnect the oil pump discharge tube (3—Fig. 53 or 54), remove the oil pump and withdraw pump from engine.

To disassemble pump, remove cotter pin from pump body and withdraw tube and floating intake screen (8). Remove cover retaining screws, cover (9) and gasket. Note: On pumps used after engine Serial No. 17-19978, relief valve (13 — Fig. 54), spring (14) and spring sleeve (15) can be removed at this time.

Remove idler gear (11—Fig. 53 or Fig. 54). Remove pin (4) from pump drive gear (2); then, pull drive gear from shaft (5) and remove shaft and driven gear from bottom end of pump. Press driven gear (7) up on shaft until snap ring (6) can be removed, then press shaft out of gear. A Woodruff key is used in addition to the snap ring to retain gear on shaft. The idler shaft can be removed from the oil pump body.

Check the pump parts for damage or wear and renew parts or complete pump assembly as necessary. Desired gear backlash between driven and idler gear is 0.008-0.010; maximum allowable backlash is 0.015. The gears should have approximately 0.002 end play; pump body and/or cover may be lapped to reduce end play if excessive. Drive shaft to body diametrical clearance should not exceed 0.008 or loss in pumping pressure may occur. Reassemble and reinstall pump by reversing removal and disassembly procedure.

CAUTION: If renewing oil pump drive gear or complete oil pump assembly, refer to note after paragraph 96.

96. **ADJUST RELIEF VALVE.** On early production non-diesel engines (prior to engine Serial No. 17-19978), the piston type oil relief valve is located externally on right side of engine in the vicinity of the oil level dip stick. Oil pressure can be varied by adding or removing shim washers between spring and retaining plug. Normal oil pressure is approximately 12 psi with the prior by-pass type oil filtering system.

Relief valve used with the full-flow oil filtering system after engine Serial No. 17-19978 is located in the oil pump body and is non-adjustable. Normal relief pressure is 30-35 psi.

Diesel

97. **R&R AND OVERHAUL.** Removal procedure will be self-evident after removal of oil pan (sump) as outlined in paragraph 92.

To disassemble the removed pump, remove screen (2—Fig. 55 or 56) and cover (3). Extract pin from drive gear (8), then press shaft (7) out of drive gear and body. To remove either pump gear (4 or 5), press the drive shaft or idler shaft out of gear.

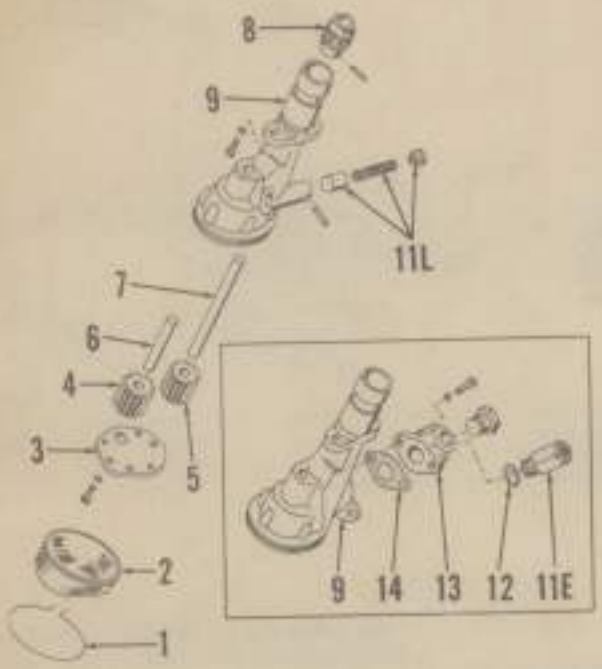


Fig. 55—Exploded view of D-15 diesel engine oil pump. Relief valve (11E) is early type, (11L) is late type. Refer to Fig. 56 for legend.

Renew any parts which are excessively worn, scored or are in any way questionable. Pump gears (4 and 5) should not have more than 0.020 backlash or more than 0.006 end play. Pump body and/or shafts should be renewed if shaft to body clearance exceeds 0.004. Reassemble and reinstall pump by reversing disassembly and removal procedures. Tighten pump retaining cap screws to a torque of 18-21 Ft.-Lbs. On D-17 models, bolt flanges **do not** fit against cylinder block. Make sure that connection on oil tube is secure before installing oil pan.

NOTE: Relief valve (11E or 11L—Fig. 55 or 11—Fig. 56) operating pressure is approximately 80 psi. Valve was incorporated to relieve surge pressures in system when engine oil is cold and does not affect normal engine oil pressure. This surge pressure relief valve may be installed in early production D-17 models if trouble is encountered in holding oil filter gaskets. Related parts must be used with installation.

98. **ADJUST RELIEF VALVE.** Normal oil pressure of 35 psi is controlled by a spring loaded oil pressure relief valve. The pressure is adjusted by the slotted screw (26—Fig. 57) on the left front side of crankcase. **Do not** increase spring pressure on oil pressure relief valve as a substitute for overhauling a worn pump. This valve must by-pass a certain amount of oil to lubricate the engine timing and fuel injection pump drive gears.

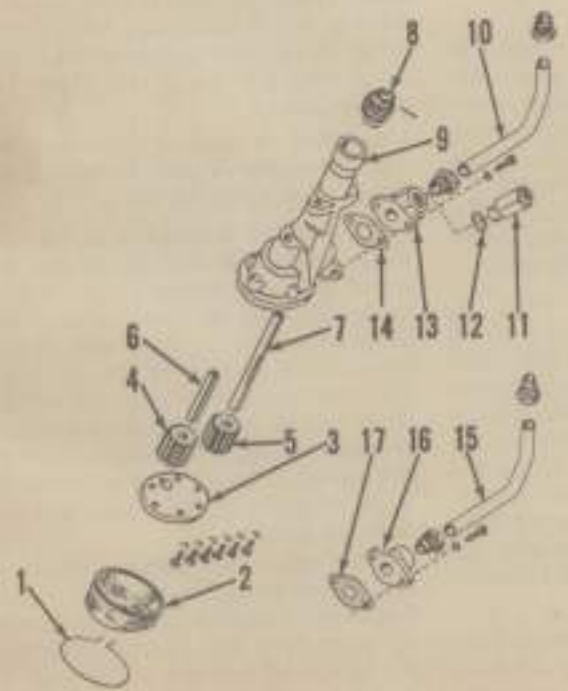


Fig. 56 — Exploded view of D-17 diesel engine oil pump. Oil tube with relief valve assembly (items 10 through 14) are used after engine serial No. 108899 and may be installed in earlier production units instead of items 15 and 16 to prevent surge pressures due to cold oil from blowing oil filter gasket.

1. Retainer ring
2. Filter screen
3. Pump cover
4. Idler gear
5. Driven gear
6. Idler shaft
7. Drive shaft
8. Drive gear
9. Pump body
10. Oil tube
11. Relief valve
12. Star washer
13. Adapter flange
14. Gasket
15. Oil tube
16. Flange
17. Gasket

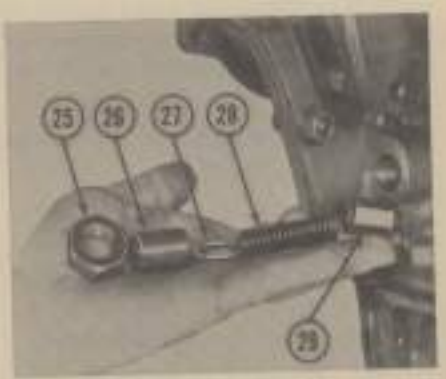


Fig. 57 — Oil pressure relief valve exploded from left front side of the diesel engine cylinder block.

25. Nut
26. Adjusting screw
27. Gasket
28. Spring
29. Regulator piston

CARBURETOR

Gasoline

99. D-14 tractors were equipped with either a Marvel-Schebler TSX-670 or TSX-701 carburetor similar to the type shown in Fig. 58. Float setting should be ¼ inch from nearest face of float to gasket surface of throttle body (14) with needle (10) closed.

D-15 tractors have been equipped with Marvel-Schebler carburetors TSX-815 (Fig. 58); TSX-844 (Fig. 58) and TSX-869 (Fig. 59). Float setting should be ¼ inch from nearest face of float to gasket surface of throttle body (14) with needle (10) closed.

D-17 tractors have been equipped with Zenith model 267J8 outline 0-12217 carburetor (Fig. 60) and Marvel-Schebler TSX-464 (Fig. 59); TSX-561 (Fig. 59); TSX-773 (Fig. 59) and TSX-871 (Fig. 59). Float setting for the Zenith carburetor is 1-5/32; setting for all Marvel-Schebler models is ¼-inch.

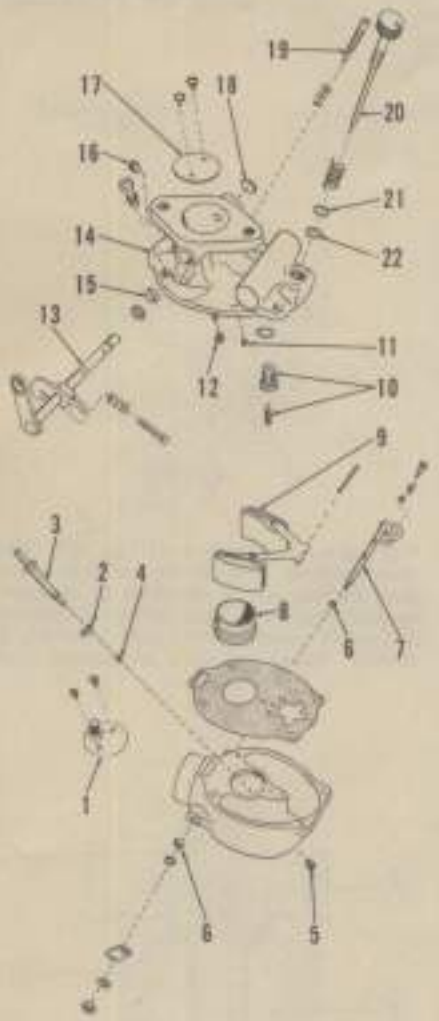


Fig. 58—Exploded view of Marvel-Schebler carburetor typical of TSX-670, TSX-701, TSX-815 and TSX-844 models.

1. Choke plate
2. Gasket
3. Main jet nozzle
4. Main jet
5. Plug
6. Packing
7. Choke shaft
8. Venturi
9. Float
10. Inlet needle and seat
11. Idle jet
12. Economizer jet
13. Throttle shaft
14. Throttle body
15. Packing
16. Plug
17. Throttle plate
18. Plug
19. Idle mixture needle
20. High speed mixture needle
21. Washer
22. Gasket

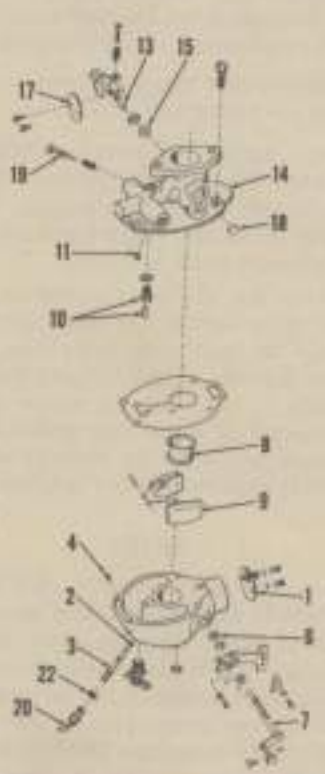


Fig. 59—Exploded view of Marvel-Schebler carburetor typical of TSX-464, TSX-561, TSX-773, TSX-869 and TSX-871 models. Refer to Fig. 58 for legend.

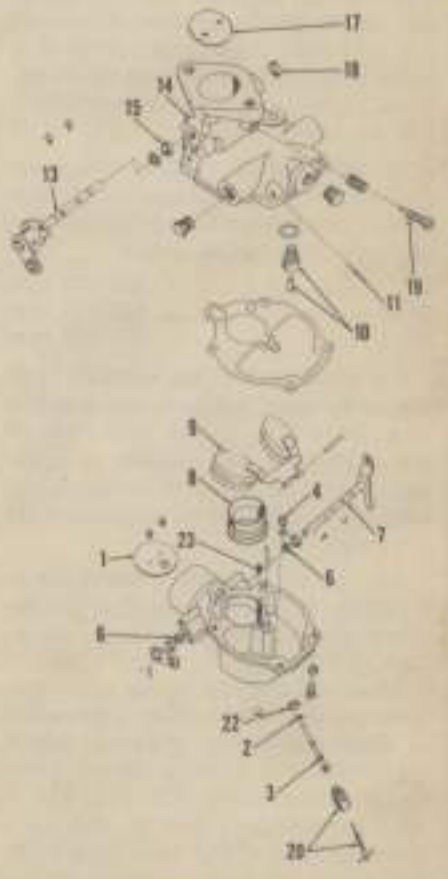


Fig. 60 — Exploded view of Zenith carburetor used on some D-17 models. Refer to Fig. 58 for legend. Well vent jet is shown at (23).

LP-GAS SYSTEM

The LP-Gas system available is designed and built by Ensign Carburetor Co. Like other LP-Gas systems, this system is designed to operate with the fuel tank not more than 80% filled.

The Ensign model Mg 1 carburetor and model W regulator have three points of mixture adjustment, plus an idle stop screw.

ADJUSTMENTS

100. **STARTING SCREW.** Immediately after the engine is started, bring the throttle to the fully **open** position and with the choke in the fully **closed** position, rotate the starting screw (N—Fig. 61) until the highest engine speed is obtained. A slightly richer adjustment (counter-clockwise until speed drops slightly) may be desirable for a particular fuel or operating condition. Average adjustment is ¼-turn open. Place the controls in operating position by completely opening the choke.

101. **IDLE STOP SCREW.** Idle speed stop screw on the carburetor throttle should be adjusted to provide the correct low idle engine speed.

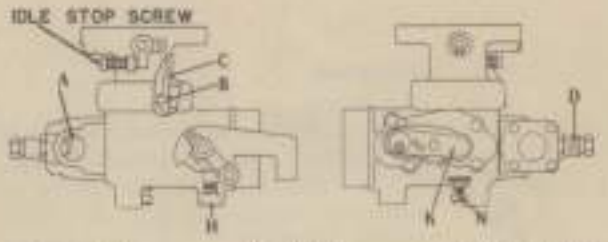
D-14	525-575 rpm
D-15	550-575 rpm
D-17	375-425 rpm

102. **IDLE MIXTURE SCREW.** With the choke **open**, engine warm and idle stop screw set, adjust idle mixture screw (K—Fig. 64), located on regulator, until best idle is obtained. An average adjustment is approximately 1¼-turns open.

103. **LOAD SCREW (WITH ANALYZER).** It is important that the exhaust gas analyzer operating instruction be followed.

Move the throttle to the fully open position and load engine until speed is kept below any governor action (until throttle remains open); then, set the load screw (D—Fig. 61) to give a reading of 13.4 to 14.0, on a gasoline scale, or 14.0 to 14.7, on a LP-Gas scale. An average adjustment is approximately 1½-turns open.

Recheck idle adjustment as outlined in paragraph 102.



A. Gas inlet
B. Nozzles
C. Venturi
D. Load adjusting screw
H. Balance line connection
K. Valve
N. Starting adjustment screw

Fig. 61 — The correct low idle engine rpm is obtained by adjusting the idle stop screw shown for Ensign MG 1 carburetor.

104. **LOAD SCREW (WITHOUT ANALYZER).** Move the throttle to the fully open position and load engine until speed is kept below any governor action (until throttle remains open); then, find the two load screw settings where the engine speed begins to drop, when going richer and leaner and set the adjusting screw at the mid-point. An average adjustment is approximately 1½-turns open.

Recheck the idle adjustment as outlined in paragraph 102.

105. **LOAD SCREW (WITHOUT LOAD).** The idle adjustment (paragraph 102) must be carefully made before using the following method as it influences the mixture.

With the engine running at high idle rpm, adjust the load screw to obtain the maximum rpm; then, carefully turn the screw in until the rpm begins to fall. Set the screw at the mid-point of these two positions and tighten lock nut. An average adjustment is approximately 1½-turns open.

FILTER

106. The filter (Fig. 63) used in this system is subjected to and should be able to stand high pressures without leakage. When major engine work is being performed, it is advisable to remove the lower part of the filter, thoroughly clean the interior and renew the felt cartridge if same is not in good condition.

NOTE: A partially clogged filter element will cause a pressure drop across the ele-

Fig. 62 — A fixed orifice (O) type economizer is built in the carburetor gas inlet casting and is operated by manifold vacuum applied in back of the diaphragm (P) which actuates valve (Q), resulting in slightly leaner mixtures at partial load ranges.

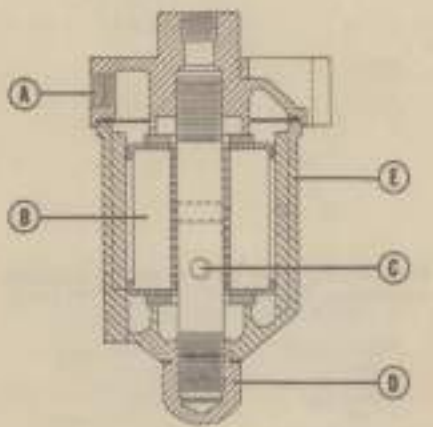


Fig. 63 — Cross sectional view of the LP-Gas filter.

A. Fuel inlet
B. Filter element
C. Fuel outlet
D. Cap nut
E. Filter bowl

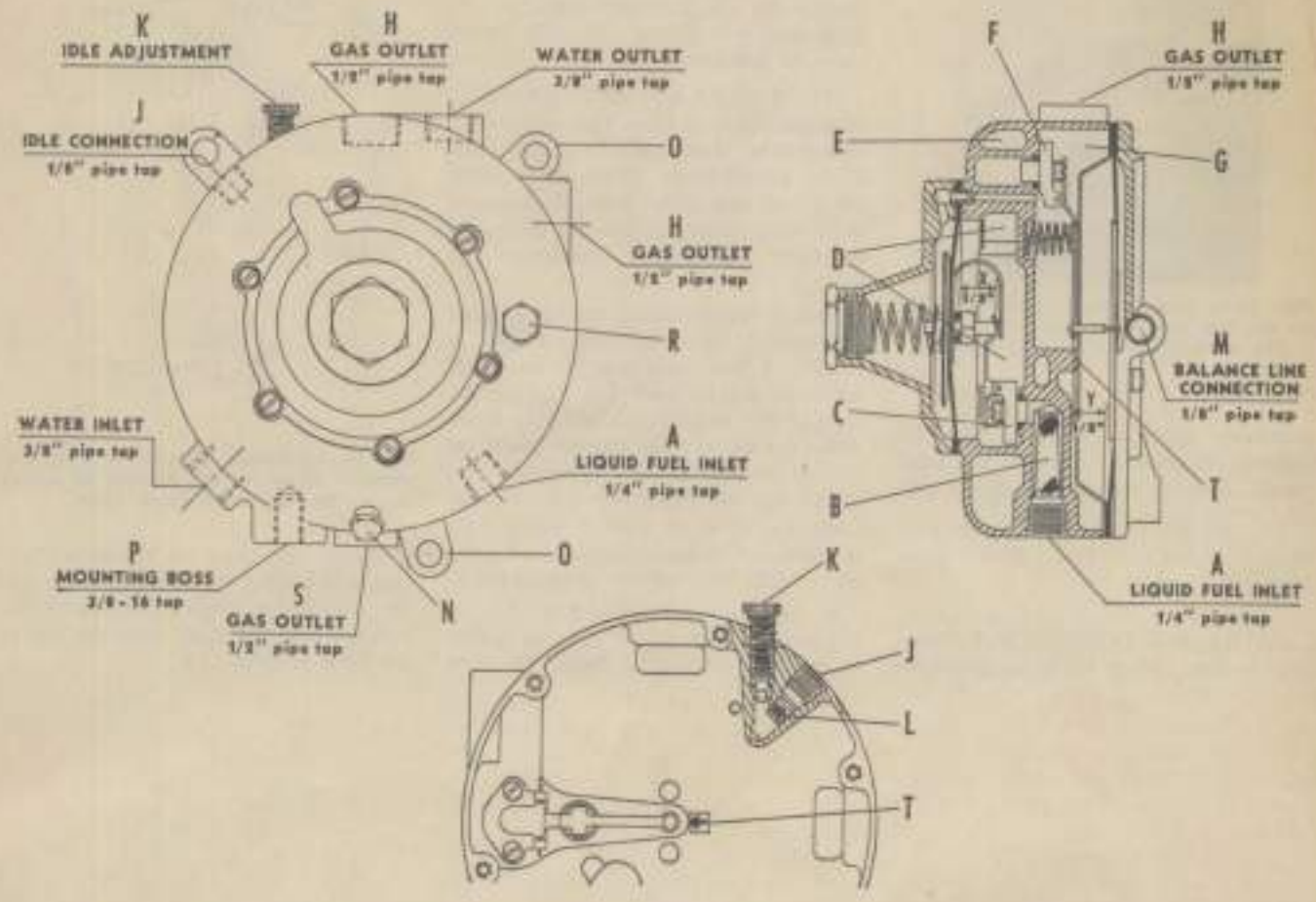


Fig. 64—Model W Ensign LP-Gas regulator of similar construction to that used. For exploded view refer to Fig. 67.

A. Fuel inlet
B. Strainer
C. Inlet valve
D. Vaporizing chamber
E. Water jacket
F. Outlet valve
G. Low pressure chamber
H. Gas outlet
J. Idle connection
L. Orifice (idling)
M. Balance line connection
T. Stem or post

ment which will in turn cause the fuel to partially vaporize. If too much vaporization occurs, there will be insufficient fuel to operate the engine and the outside of the filter will become extremely cold.

REGULATOR

107. **HOW IT OPERATES:** In the Ensign model W regulator, fuel from the supply tank enters the regulating unit (A—Fig. 64) at a tank pressure of 25-80 psi and is reduced from tank pressure to approximately 4 psi at the inlet valve (C) after passing through the strainer (B). Flow through the inlet valve is controlled by the adjacent spring and diaphragm. When the liquid fuel enters the vaporizing chamber (D) via the valve (C) it expands rapidly and is converted from a liquid to a gas by heat from the water jacket (E) which is connected to the coolant system of the engine. The vaporized gas then passes at a pressure slightly below atmospheric pressure via the outlet valve (F) into the low pressure chamber (G) where it is drawn off to the carburetor via outlet (H). The outlet valve is controlled by the larger diaphragm and small spring.

Fuel for the idling range of the engine is supplied from a separate outlet (J) which is connected by tubing to a separate idle fuel connection on the carburetor. Adjustment of the carburetor idle mixture is controlled by the idle fuel screw (K) and the calibrated orifice (L) in the regulator. The balance line (M) is connected to the air inlet horn of the carburetor so as to reduce the flow of fuel and thus prevent over-richening of the mixture which would otherwise result when the air cleaner or air inlet system becomes restricted.

108. **TROUBLE SHOOTING.** The following data should be helpful in trouble shooting LP-Gas equipped tractors.

109. SYMPTOM. Engine will not idle with idle mixture adjustment screw in any position.

CAUSE AND CORRECTION. A leaking valve or gasket is the cause of the trouble. Look for a leaking outlet valve caused by deposits on valve or seat. To correct the trouble, wash the valve and seat in gasoline or other petroleum solvent.

If the foregoing remedy does not correct the trouble check for a leak at the inlet valve by connecting a low reading (0-20 psi) pressure gage at point (R—Fig. 64). If the pressure

Fig. 65 — Using Ensign gage 8276 to set the fuel inlet valve lever to the dimension as indicated at "X" in Fig. 64.

increases after a warm engine is stopped, it proves a leak in the inlet valve. Normal pressure is 3½-5 psi.

110. SYMPTOM. Cold regulator shows moisture and frost after standing.

CAUSE AND CORRECTION. Trouble is due either to leaking valves as per paragraph 109, or the valve levers are not properly set. For information on setting of valve lever, refer to paragraph 111.

111. **REGULATOR OVERHAUL.** Remove the unit from the engine and completely disassemble, using Fig. 67 as a reference. Thoroughly wash all parts and blow out all passages with compressed air. Inspect each part carefully and discard any which are worn.

Before reassembling the unit, note dimension (X—Fig. 64) which is measured from the face on the high pressure side of the casting to the inside of the groove in the valve lever when valve is held firmly shut as shown in Fig. 65. If dimension (X) which can be measured with Ensign gage No. 8276 or with a depth rule is more or less than ½-inch, bend the lever until this setting is obtained.

A boss or post (T—Fig. 66) is machined and marked with an arrow to assist in setting the lever. Be sure

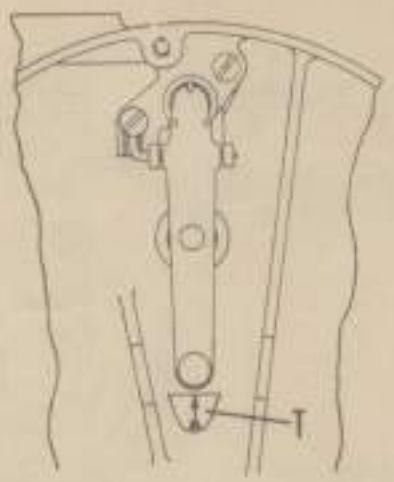


Fig. 66 — Location of post or boss with stamped arrow for the purpose of setting the fuel inlet valve lever.

to center the lever on the arrow before tightening the screws which retain the valve block. The top of the lever should be flush with the top of the boss or post (T).

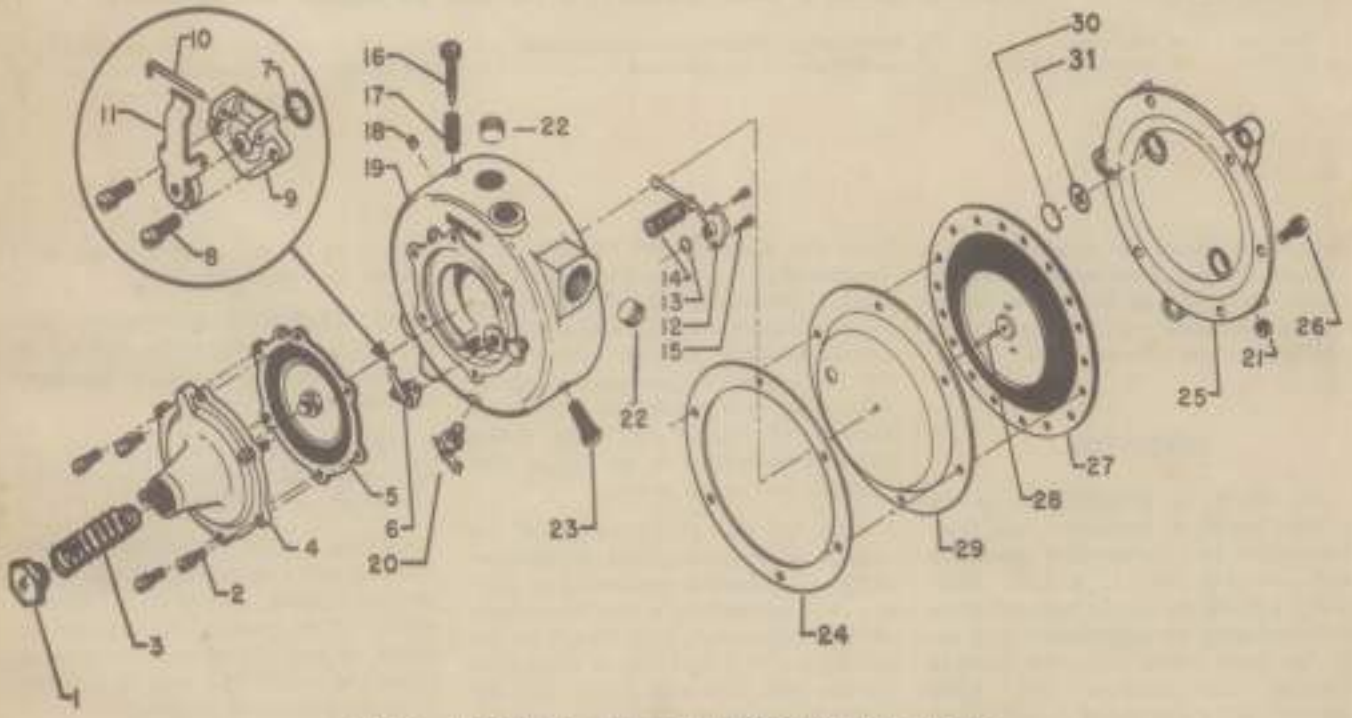


Fig. 67 — Exploded view of the Ensign Model W LP-Gas regulator.

1. Spring retainer
2. Inlet diaphragm spring
4. Regulator cover
5. Inlet pressure diaphragm
6. Inlet valve assembly
7. "O" ring
8. Valve seat
10. Pivot pin
11. Inlet diaphragm lever
12. Outlet valve assembly
13. "O" ring
14. Outlet diaphragm spring
16. Idle adjusting screw
17. Idle screw spring
18. Bleed screw
19. Regulator body
20. Drain cock
22. Strainer
24. Gasket
25. Back cover plate
27. Outlet pressure diaphragm
28. Push pin
29. Partition plate
30. Retainer ring
31. Compensator

DIESEL FUEL SYSTEM

The diesel fuel system consists of three basic units: 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 servicing 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. This last precaution is based on the fact that all diesel fuels contain some sulphur. When water is mixed with sulphur, sulphuric acid is formed and the acid will quickly erode the closely fitting parts of the injection pump and nozzles.

112. **QUICK CHECKS—UNITS ON TRACTOR.** If the diesel engine does not start or does not run properly, and the diesel fuel system is suspected as the source of trouble, refer to the Diesel System Trouble Shooting Chart and locate points which require further checking. Many of the chart items are self-explanatory; however, if the difficulty points to the fuel filters, injection nozzles and/or injection pump, refer to the appropriate paragraphs which follow.

FILTERS AND BLEEDING

The fuel filtering system consists of a fuel filter and sediment bowl which incorporates the fuel shut-off valve, first stage filter (of the replaceable element type) and a second stage filter (of the replaceable element type).

113. **BLEEDING.** Each time the filter elements are renewed or if fuel lines are disconnected, it will be necessary to bleed air from the system.

To bleed the fuel filters remove the air bleed plug (P—Fig. 68) at the top of the filter head assembly and open the fuel shut-off valve. On D-15 models operate hand primer pump (PP). As soon as all air has escaped and a solid flow of fuel is escaping from the air bleed hole, reinstall the plug.

Normally the injection pump is self bleeding; however, in some cases it may be necessary to proceed as follows:

Loosen the pump inlet line, turn the fuel on at the tank shut-off valve and allow fuel to flow from the connection until the stream is free from air bubbles; then, tighten the connection.

Loosen the high pressure fuel line connections at the injectors and crank engine with the starting motor until fuel appears. Tighten the fuel line connections and start engine.

114. **FILTERS.** The first and second stage fuel filtering elements should be renewed every 500 hours of operation. Poor fuel handling and storage facilities will decrease the effective life of the filter elements; conversely, clean fuel will increase the life of the filters. Filter elements should never remain in the fuel filtering system until a decrease in engine speed or power is noticed, because some dirt may enter the pump and/or nozzles and result in severe damage.

INJECTION NOZZLES

WARNING: Fuel leaves the injection nozzles with sufficient force to penetrate the skin. When testing nozzles, keep your person clear of the nozzle spray.

115. **TESTING AND LOCATING FAULTY NOZZLE.** If the engine does not run properly and the quick checks outlined in paragraph 112 point to a faulty injection nozzle, or if one cylinder is misfiring, locate the faulty nozzle as follows:

Loosen the high pressure line fitting on each nozzle holder in turn, thereby allowing a fuel to escape at

DIESEL SYSTEM TROUBLE SHOOTING CHART

	Sudden Stopping of Engine	Lack of Power	Engine Hard to Start	Irregular Engine Operation	Engine Knocks	Engine Smoking	Excessive Fuel Consumption
Lack of fuel	*		*				
Water or dirt in fuel	*	*	*	*			
Clogged fuel lines	*	*	*	*			
Inferior fuel	*	*	*	*			*
Faulty transfer pump	*	*	*	*			
Faulty injection pump timing		*	*	*	*	*	*
Air traps in system	*	*	*	*			
Clogged fuel filters	*	*	*	*			
Deteriorated fuel lines	*	*	*	*			*
Air leak in suction line	*	*	*	*			
Faulty nozzle	*	*	*	*		*	*
Sticking pump plunger	*		*				
Weak or broken governor spring	*	*	*	*			
Faulty governor and/or linkage adjustment		*		*		*	

the union rather than enter the cylinder. As in checking spark plugs in a spark ignition engine, the faulty nozzle is the one which, when its line is loosened, least affects the running of the engine.

116. Remove the suspected nozzle from the engine as outlined in paragraph 121. If a suitable tester is available, check nozzle, as in paragraphs 117, 118, 119 and 120. If a nozzle tester is not available, reconnect the fuel line and with the nozzle tip directed where it will do no harm, crank the engine with the starting motor and observe the nozzle spray pattern as shown in Fig. 70.

If the spray pattern is ragged, as shown in the left hand view, the nozzle valve is not seating properly and should be reconditioned as outlined in paragraph 122. If cleaning and/or renewal of nozzle and tip does not restore the unit and a nozzle tester is not available for further checking, send the complete nozzle and holder assembly to an official diesel service station for overhaul.

117. **NOZZLE TESTER.** A complete job of testing and adjusting the nozzle requires the use of a special tester such as that shown in Fig. 71. The nozzle should be tested for leakage, spray pattern and opening pressure. Operate the tester lever until oil flows and attach the nozzle and holder assembly.

NOTE: Only clean, approved testing oil should be used in the tester tank.

Close the tester valve and apply a few quick strokes to the lever. If undue pressure is required to operate the lever, the nozzle valve is plugged and should be serviced as in paragraph 122.

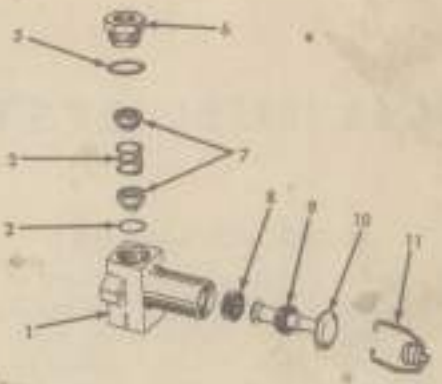


Fig. 69 — Exploded view of the Roosa-Master fuel primer pump used on D-15 diesel tractors. Location of primer pump may be different than PP-Fig. 68.

1. Pump body
2. Gasket
3. Spring
4. Seal ring
5. Retainer nut
7. Valves
8. Plunger plates
9. Plunger guide
10. Plunger
11. Cam assembly

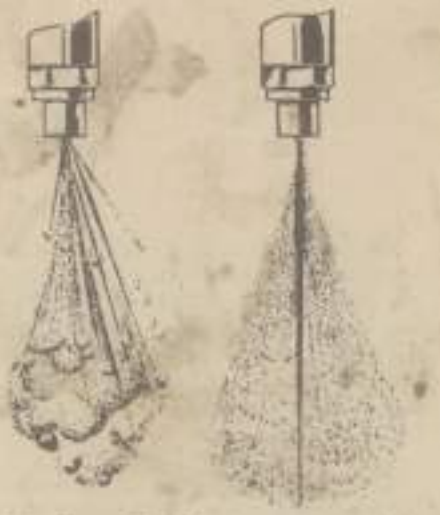


Fig. 70 — Typical spray patterns of a throttling type pintle nozzle. Left: Poor spray pattern. Right: Ideal spray pattern.

118. OPENING PRESSURE. While operating the tester handle, observe the gage pressure at which the spray occurs. The gage pressure should be 2000 psi. If the pressure is not as specified, remove the nozzle protecting cap, exposing the pressure adjusting screw and lock nut. Loosen the lock nut and turn the adjusting screw as shown in Fig. 71 either way as required to obtain an opening pressure of 2000 psi. Note: If a new pressure spring has been installed in the nozzle holder, adjust the opening pressure to 2100 psi. Tighten the lock nut and install the protecting cap when adjustment is complete.

119. LEAKAGE. The nozzle valve should not leak at a pressure less than 1700 psi. To check for leakage, actuate the tester handle slowly and as the gage needle approaches 1700 psi, observe the nozzle tip for drops of fuel. If drops of fuel collect at pressures less than 1700 psi, the nozzle valve is not seating properly and same should be serviced as in paragraph 122.

120. SPRAY PATTERN. Prior to testing for spray pattern, check opening pressure as outlined in paragraph 118. Close the valve to the tester gage; then, operate lever at about 100 strokes per minute while observing nozzle spray pattern. As the tester pump cannot duplicate the injection velocity necessary to obtain the operating spray pattern of throttling pintle nozzles, very little or no atomization may be noted. However, the solid core of fuel from the nozzle

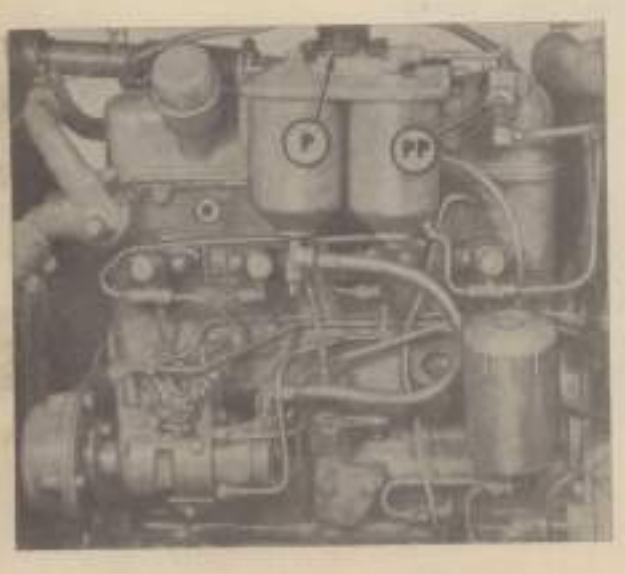


Fig. 68 — Air bleed plug (P) is located at same position on filters for all models; however, location of the filter assembly may be different than shown. D-15 models are equipped with a hand primer pump (PP).

Fig. 71 — Adjusting nozzle opening pressure, using a nozzle tester.

30. Nut
31. Adjusting screw
32. Screw driver
33. Nozzle tester

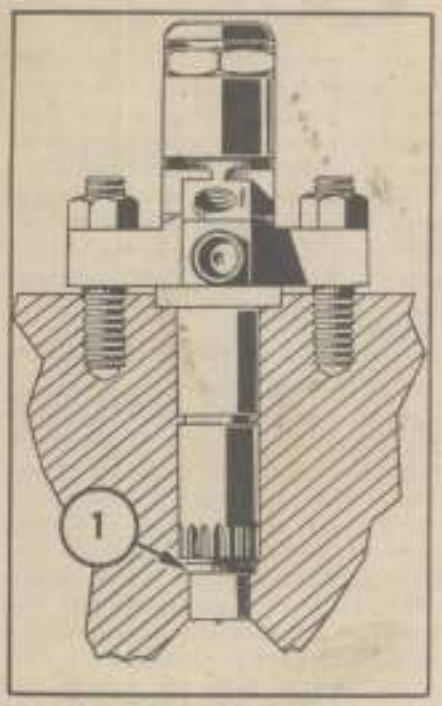


Fig. 72 — Sectional view showing the injection nozzle installation. Whenever the nozzle has been removed, always renew the copper gasket (1).

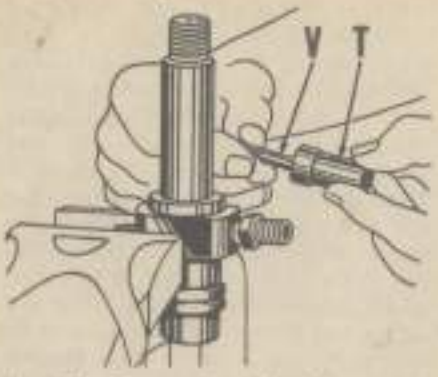


Fig. 73 — Removing injection nozzle valve (V) from tip (T). If the valve is difficult to remove, soak the assembly in a suitable carbon solvent.

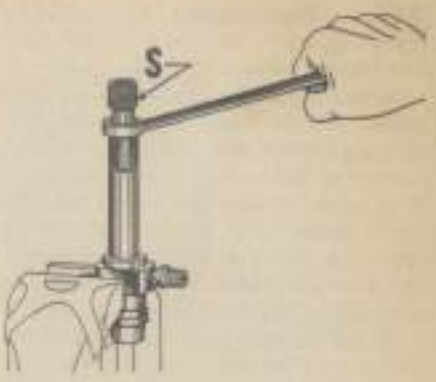


Fig. 74 — Using Bosch tool (S) to center the nozzle tip while tightening the cap nut. Late production nozzles do not require the use of a centering sleeve.

opening should be in a straight line with the injector body, with no branches, splits or dribbling. NOTE: Slow operation of tester pump may cause some dribble. Also, throttling pintle nozzles do not usually "chatter" or make a popping sound when operated on a tester pump as some nozzles do.

Under operating velocities, the solid core of fuel from the nozzle will cross the combustion chamber and enter the energy cell. In addition, a fine conical mist surrounding the core will ignite in the combustion chamber area above the piston. The solid core cannot vary more than 7½ degrees in any direction and enter the energy cell. While the core is the only spray characteristic which can be observed on the tester, it is of utmost importance that the core be absent of any deviations.

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

Thoroughly clean the nozzle recess in the cylinder head before reinserting the nozzle and holder assembly. No hard or sharp tools should be used for cleaning. A piece of wood dowel or brass stock properly shaped is very effective. It is important that the seating surfaces of recess be free of even the smallest particle of carbon which could cause the unit to be cocked and result in blowby of hot gases.

When reinstalling the nozzle, always renew copper ring gasket (1—Fig. 72). Torque each of the two nozzle holder stud nuts in 2 Ft.-Lbs. progressions until each reaches the final torque of 12-15 Ft.-Lbs. This method of tightening will prevent the holder being cocked in the bore.

122. **MINOR OVERHAUL OF NOZZLE VALVE AND BODY.** Hard or sharp tools, emery cloth, crocus cloth, grinding compounds or abrasives of any kind should NEVER be used in the cleaning of nozzles. A nozzle cleaning and maintenance kit is available through any diesel service agency.

Wipe all dirt and loose carbon from the nozzle and holder assembly with a clean, lint free cloth. Carefully clamp nozzle holder assembly in a soft jawed vise and remove the nozzle holder nut and spray nozzle. Reinstall the holder nut to protect the lapped end of the holder body. Normally, the nozzle valve (Fig. 73) can be easily withdrawn from the nozzle body. If the valve cannot be easily withdrawn, 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.

Clean the nozzle valve with mutton tallow used on a soft, lint free cloth or pad. The valve may be held by its stem in a revolving chuck during this cleaning operation. A piece of soft wood well soaked in oil will be helpful in removing carbon deposits from the valve.

The inside of the nozzle body (tip) can be cleaned by forming a piece of soft wood to a point which will correspond to the angle of the nozzle valve seat. The wood should be well soaked in oil. The orifice of the tip can be cleaned with a wood splinter. The outer surfaces of the nozzle body should be cleaned with a brass wire brush and a soft, lint free cloth soaked in a suitable carbon solvent.

Thoroughly wash the nozzle valve and body in clean diesel fuel and clean the pintle and its seat as follows: Hold the valve at the stem end only and using light oil as a lubricant, rotate the valve back and forth in the body. Some time may be required in removing the particles of dirt from the pintle valve; however, abrasive materials should never be used in the cleaning process.

Test the fit of the nozzle valve in the nozzle body as follows: Hold the body at a 45 degree angle and start the valve in the body. The valve should slide slowly into the body under its own weight. Note: Dirt particles, too small to be seen by the naked eye, will restrict the valve action. If the valve sticks, and it is known to be clean, free-up the valve by working the valve in the body with mutton tallow.

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 body and holder nut, making certain that the valve stem is located in the hole of the holder body. It is essential that the nozzle be perfectly centered in the holder nut. A centering sleeve is supplied in American Beach kit TSE 7779 for this purpose. Slide the sleeve over the nozzle with the tapered end centering in the holder nut. Refer to Fig. 74. Late production nozzles are self-centering and do not require the use of a centering sleeve. Tighten the holder nut, making certain that the sleeve is free while tightening.

Test the nozzle for leakage and spray pattern as in paragraph 119 and 120. If the nozzle does not leak under 1700 psi, and if the spray pattern is symmetrical as shown in right hand view of Fig. 70, the nozzle is ready for use. If the nozzle will not pass the leakage and spray pattern tests, renew the nozzle valve and seat, which are available only in a matched set or, send the nozzle and holder assembly to an official diesel service station for a complete overhaul which includes reseating the nozzle valve pintle and seat.

Fig. 75—Injection nozzle sectional view.

1. Cap nut
2. Jam nut
3. Adjusting screw
4. Spring retainer
5. Spindle
6. Spring

123. **OVERHAUL OF NOZZLE HOLDER.** Refer to Fig. 75. Remove cap nut (1) and gasket. Loosen jam nut (2) and adjusting screw (3). Remove the spring retaining nut (4) and withdraw the spindle (5) and spring (6). Thoroughly wash all parts in clean diesel fuel and examine the end of the spindle which contacts the nozzle valve stem for any irregularities. If the contact surface is pitted or rough, renew the spindle. Examine spring seat (7) for tightness to spindle and for cracks or worn spots. Renew the spring seat and spindle unit if the condition of either is questionable. Renew any other questionable parts.

Reassemble the nozzle holder and leave the adjusting screw lock nut loose until after the nozzle opening pressure has been adjusted as outlined in paragraph 118.

Fig. 76 — The injection marks as seen when pump timing hole cover is removed.

Fig. 77 — View showing timing strip on crankshaft front pulley with 20° BTDC mark aligned with pointer on timing gear cover. Exact static timing depends upon model of Roosa-Master pump used. Refer to paragraph 125 for timing specifications.

INJECTION PUMP TIMING

Early production D-15 and D-17 diesel tractors were equipped with a timing pin located on the engine rear adapter plate and a corresponding hole in the flywheel. Later production models are provided with a timing strip on the crankshaft pulley as shown in Fig. 77. Refer to the appropriate following paragraph for timing procedure.

Models With Flywheel Timing Pin

124. To time the injection pump, shut off fuel supply, remove the timing hole cover (TC—Fig. 78) and turn crankshaft in normal direction of rotation until the number one piston is coming up on compression stroke. Remove the timing pin from the engine rear adapter plate and insert the pin end through the hole in the plate. While applying light pressure on the pin, continue to rotate the flywheel slowly until the timing pin slides into a hole in the flywheel. Check to be sure that the timing lines on cam and governor drive plate are aligned as shown in Fig. 76.

If the pump timing marks are not aligned, loosen the two pump mounting nuts and turn pump housing in either direction as required to align the marks, then tighten the mounting nuts.

Models With Timing Strip on Crankshaft Pulley

125. Refer to following chart for correct injection pump timing according to fuel injection pump part number.

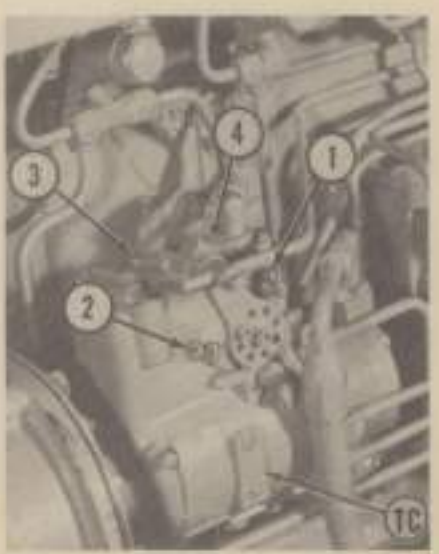


Fig. 78 — View of injection pump showing the governed speed adjusting screws and timing hole cover (TC). Screw (1) adjusts the high idle speed, screw (2) determines the low idle speed.

Injection Pump Part No.		
A.C.	RoosaMaster	BTDC
4512325	DBGFC429-1AF	22
4513634	DBGFC429-5AF	22
4508945	DGFCL629-12A	23
4513839	DBGFC637-12AJ	16
4513839	DBGFC637-14AJ	16
4514022	DBGFC637-17AJ	16
4514812	DBGFC637-32AJ	16

Turn engine in normal direction of rotation until the number one piston is coming up on compression stroke. Continue to turn engine slowly until the correct timing mark located on timing strip attached to crankshaft pulley (See Fig. 77) is aligned with the pointer on timing gear cover. Shut off fuel supply and remove the timing hole cover (TC—Fig. 78). If timing marks on cam and governor drive plate are not aligned as shown in Fig. 76, loosen pump mounting bolts and turn pump in either direction as required so that marks are aligned. Retighten pump mounting bolts.

R&R INJECTION PUMP

All Engines

126. To remove the fuel injection pump, first shut off fuel supply and thoroughly clean dirt from pump, fuel lines and connections. Turn engine in normal direction of rotation until timing marks are aligned as described in paragraph 124 or 125. Disconnect fuel supply line, throttle rod and shut off rod from pump. Disconnect the high pressure (nozzle) lines at injectors and the excess fuel line from pump. Remove the fuel filter assembly. Unbolt pump from engine and slide pump off of drive shaft.

The injection pump drive shaft seals should be renewed whenever the pump is removed. Lip of each seal must be towards end of shaft (opposed).

Before reinstalling the pump, remove timing hole cover from outer side of pump and be sure the timing marks are aligned as shown in Fig. 76. Also, be sure that engine is still on number one compression stroke and that pin is aligned with hole in flywheel or timing marks on crankshaft pulley are aligned. Lubricate shaft seals with Lubriplate or similar grease; then, carefully work pump over seals to avoid rolling lip of rear seal. Note: If lip of seal is rolled back while installing pump, remove pump and renew seal before proceeding further. Seal will have been damaged and early failure could occur. After mounting pump on engine with timing marks aligned, connect the pump control rods and fuel supply line. Turn on fuel supply and bleed air from filters. Turn engine with starter until fuel is flowing from fuel return line and high pressure lines; then, reconnect lines and start engine.

ENGINE SPEED ADJUSTMENTS

127. To adjust the engine governed speeds, first start engine and bring to normal operating temperature. Move the speed control lever to wide open throttle position. Refer to the following for correct engine speeds.

High Idle Speed—
D-15 ..... 2190-2210 rpm
D-17 ..... 1975-2000 rpm
Full Load Speed—
D-15 ..... 2000 rpm
D-17 ..... 1650 rpm
Low Idle Speed—
All models ..... 600-650 rpm

If the engine high idle no load speed is incorrect, loosen the jam nut on high speed adjusting screw (1—Fig. 78) and turn screw either way as required to obtain correct speed, then retighten jam nut.

Move the speed control lever to low idle speed position. If engine low idle speed is not approximately 650 RPM, loosen the jam nut on low idle speed adjusting screw (2) and turn screw either way as required to obtain correct low idle speed. Then, retighten jam nut.

Screws (3 and 4) are provided to set the limits of shut off arm travel and normally should not require readjustment. Adjustment of either screw requires removal of pump cover and should be done only by experienced diesel pump service personnel.

Fig. 79 — Installing the energy cell. If the surfaces (S) are rough or pitted, they can be reconditioned by lapping.

ENERGY CELLS

128. **R&R AND CLEAN.** The necessity for cleaning the energy cells is usually indicated by excessive exhaust smoking, or when fuel economy drops. To remove the energy cells it is necessary to remove the intake and exhaust manifolds. Remove the energy cell clamp and tap the energy cell cap with a hammer to break loose any carbon deposits. Using a pair of pliers remove the energy cell cap. A ¼-inch tapped hole is also provided in the cap to facilitate removal.

The outer end of the energy cell body is tapped to permit the use of a screw type puller when removing the cell body. The cell body can also be removed by first removing the respective nozzle, and using a brass drift inserted through the nozzle hole, bump the cell out of the cylinder head.

Fig. 80 — Exploded view of early type diesel intake pre-heater unit.

1. Element retainer screw (2 used)
2. Washer (4 used)
3. Gasket (4 used)
4. Heater element
5. Terminal post
6. Ground post
7. Insulator washer (2 used)
8. Insulating bushing
9. Connection screws (2 used)

Fig. 81 — Exploded view of diesel intake pre-heater unit used on late production models.

1. Adapter
2. Gasket
3. Glow plug
4. Gasket

NOTE: Energy cells for number 1 and number 6 cylinders on D-17 diesel engines can be removed without removing the manifolds.

The removed parts can be cleaned in an approved carbon solvent. After parts are cleaned, visually inspect them for cracks and other damage. Renew any damaged parts. Inspect the seating surfaces between the cell body and the cell cap for being rough and pitted. The surfaces (S—Fig. 79) can be reconditioned by lapping with valve grinding compound. Make certain that the energy cell seating surface in cylinder head is clean and free from carbon deposits.

When installing the energy cell, tighten the clamp nuts to 18-21 Ft.-Lbs. of torque.

NON-DIESEL GOVERNOR

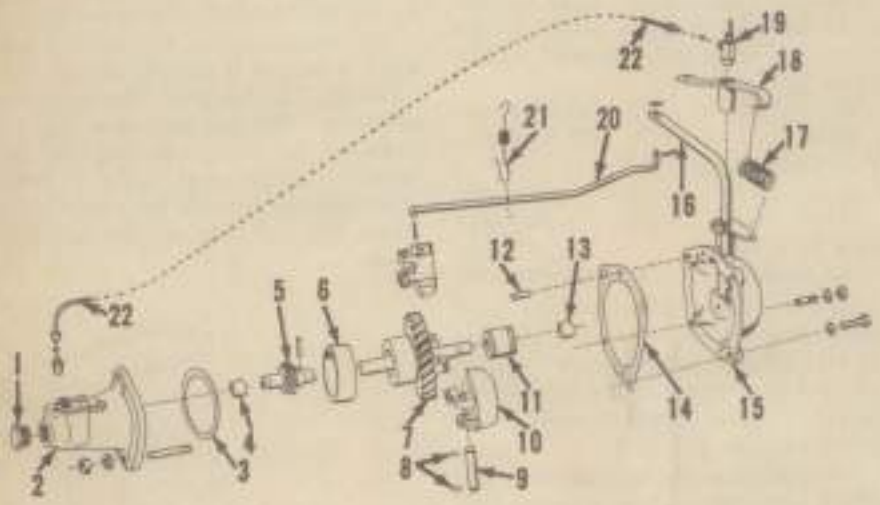


Fig. 82—Exploded view of D-14 governor and ignition distributor drive assembly. The drive shaft rides in three bushings (4, 6 and 13). D-15 non-diesel governor is similar.

1. Plug
2. Distributor drive housing
3. Gasket
4. Rear bushing
5. Distributor drive gear
6. Gear bushing
7. Governor and distributor drive gear
8. Clips
9. Weight pivot pin
10. Governor weight
11. Thrust bearing
12. Dowel pin
13. Front bushing
14. Gasket
15. Governor housing
16. Cross shaft arm
17. Governor spring
18. Control rod lever
19. Oil tube tee
20. Carburetor link
21. Link spring
22. Oil tube

D-14 and D-15 Non-Diesel

129. **CARBURETOR LINKAGE.** Before attempting to adjust the governed engine speed, be sure that carburetor link rod is approximately 1/16-inch too short when link rod and carburetor are in the wide open position. Bend cross shaft arm (16—Fig. 82) slightly, if necessary, to obtain the 1/16-inch preload.

130. D-14 SPEED ADJUSTMENTS. With the right side sheet (panel) removed and the governor hand lever in the high idle position, vary the length of the governor front control rod by loosening the set screw (Fig. 84) and moving the rod through the pin until a high idle no load speed of 1975-2075 rpm is obtained. Adjust the engine low idle speed to 400-500 rpm at the carburetor throttle stop screw. Full load speed should be 1650 rpm.

131. D-15 SPEED ADJUSTMENTS. Refer to Fig. 83. Loosen locknut (3) and remove bumper spring adjusting screw. Then, loosen locknut (1) and

Fig. 83—D-15 non-diesel engine high idle no-load speed is adjusted by loosening lock nut (1) and turning stop screw (2) in or out. Bumper spring adjusting screw which is retained by lock nut (3) must be removed while making speed adjustments.

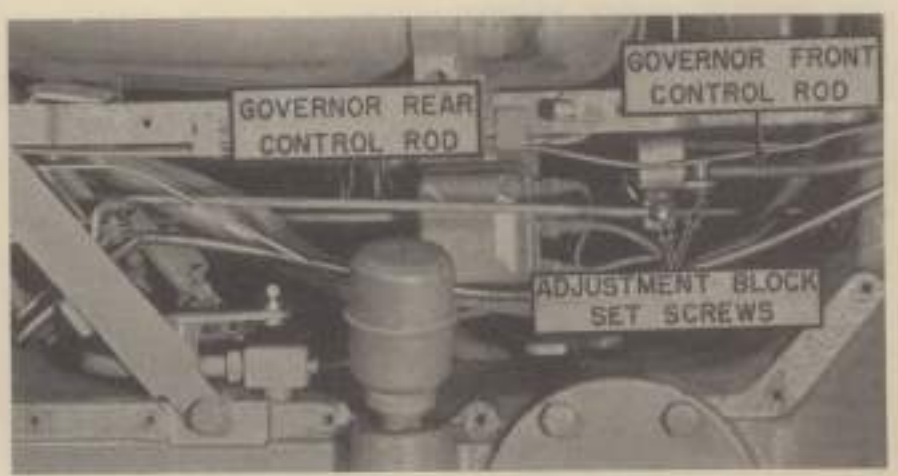


Fig. 84 — The D-17 non-diesel engine high idle speed is controlled by varying the lengths of the governor front and rear control rods. The rods can be moved either way, in their adjustment blocks, as required after the set screws are loosened. Control rods are similar on D-14 models.

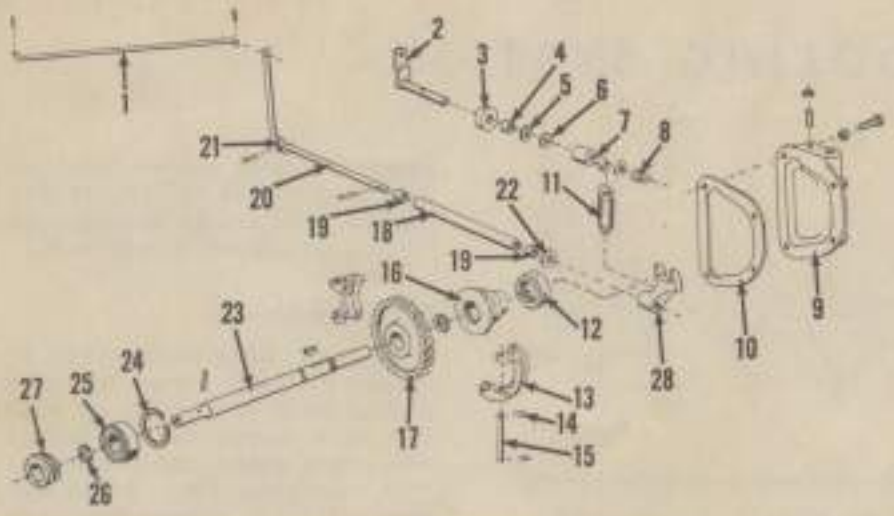


Fig. 85 — Exploded view of D-17 non-diesel governor and linkage. For non-diesel tractors prior to tractor Serial No. D17-42001 equipped with power steering refer to Fig. 15.

adjust engine high idle no-load speed to 2175-2225 RPM with high idle adjusting screw (2). Adjust low idle speed to 525-575 RPM with stop screw on carburetor. Stop engine and close throttle (low idle position). Then, reinstall bumper spring adjusting screw. Turn screw in until spring contacts the stop plus 1½ turns. Tighten bumper spring and adjusting screw locknut.

132. **R&R AND OVERHAUL.** To remove the governor, first remove the ignition distributor, then disconnect the carburetor link, speed control rod and oil tubes. Unbolt and remove the governor housing (15—Fig. 82). Withdraw the governor and distributor drive assembly.

Check all parts for excessive wear or binding. If shaft clearance in bushings (4 and 13) exceeds 0.006, renew the bushings. Normal running clearance in these bushings is 0.002-0.004. Thrust face of thrust bearing (11) should be installed facing forward.

While reinstalling, retime the ignition as outlined in paragraph 145 or 146.

D-17 Non-Diesel

133. **SPEED ADJUSTMENT.** With the engine at normal operating temperature, the high idle no load speed should be 1950-2000 RPM. If not within this speed range, remove the right side sheet (panel) from below fuel tank and vary the length of the governor control rods (Fig. 84) as necessary to obtain the correct speed. If the correct high idle speed cannot be obtained by adjusting the linkage as described, loosen the jam nut and back off the set screw located on top of governor cover (9—Fig. 85), retighten jam nut and then adjust governor control rod.

The low idle speed of 375-425 RPM is controlled by adjustment of the throttle stop screw on the carburetor.

134. **R&R AND OVERHAUL.** On power steering equipped models prior to tractor Serial No. D17-42001, refer to paragraph 23 for procedure to remove the power steering pump and governor unit.

On power steering equipped tractors after tractor serial No. D17-42001 and all models not equipped with power steering, remove the governor unit as follows: Remove the ignition distributor; then, unbolt and remove the distributor drive housing and governor weight unit.

On all models, it will be necessary to remove the timing gear cover as outlined in paragraph 54 if the governor throttle shaft and cross shaft are to be overhauled. With cover removed, check cross shaft bushings (19—Fig. 85) located in the timing gear cover and, if necessary, renew the bushings. Check governor lever spring eye holes and contact surfaces. Renew governor levers (7 and 28) if the spring holes are elongated and/or contact surfaces are worn flat. Steel washer type shims (22) inserted between governor fork (28) and cross shaft tube (18) control cross shaft end play. Desired end play is 0.003-0.005. When reinstalling timing gear cover, do not install governor front cover (9) until the governor weight unit has been installed. If fork (28) is not centered with shaft (23), drive cross shaft tube (18) in or out until fork is centered on shaft. Then, install governor front cover.

The governor weights (13) may be removed from gear by removing clips (14) and pins (15). Governor gear (17) may be removed from shaft (23) after removing the snap ring located in front of the gear. Shaft may be removed from distributor drive gear (27) after driving out pin from gear and shaft. Bearing (25) can be removed after removing snap ring (26). Renew the governor shaft bushing located in distributor drive housing if bushing is worn or clearance between shaft and bushing is excessive. Reassemble and reinstall governor by reversing disassembly and removal procedures. Retime the ignition distributor as outlined in paragraph 147.

NOTE: Governor gear to camshaft gear backlash should be 0.002-0.006. Other than renewing gears, backlash is adjusted by positioning the distributor drive housing (or power steering pump on models so equipped prior to tractor Serial No. D17-42001) to the cylinder block. This adjustment has been made at the factory and a dowel pin placed through distributor drive housing or power steering pump into cylinder block. This adjustment should be assumed correct unless renewing the cylinder block; in which case the dowel pin hole must be drilled in the cylinder block. Refer to paragraph 98.

COOLING SYSTEM

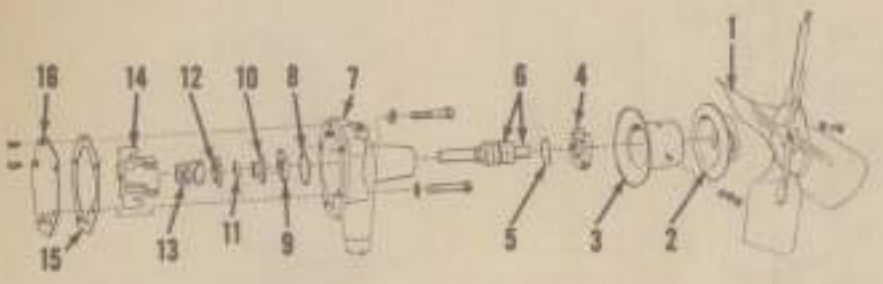


Fig. 86—Exploded view of D-14 and D-15 non-diesel water pump and fan assembly.

1. Fan blade
2. Adjustable pulley flange
3. Fixed pulley flange
4. Fan hub
5. Snap ring
6. Bearing and shaft assembly
7. Pump body
8. Snap ring
9. Carbon thrust washer
10. Shaft seal
11. Clamp ring
12. Spring guide
13. Shaft seal spring
14. Impeller
15. Gasket
16. Cover

RADIATOR

All Models

135. To remove the radiator, proceed as follows: Remove grille and drain cooling system. Then, remove both hood side panels and, on shuttle clutch equipped models, disconnect oil cooler tubes. Remove radiator shell, disconnect radiator hoses and unbolt and remove radiator from front support. Note: Radiator and radiator shell may be removed as a unit if so desired.

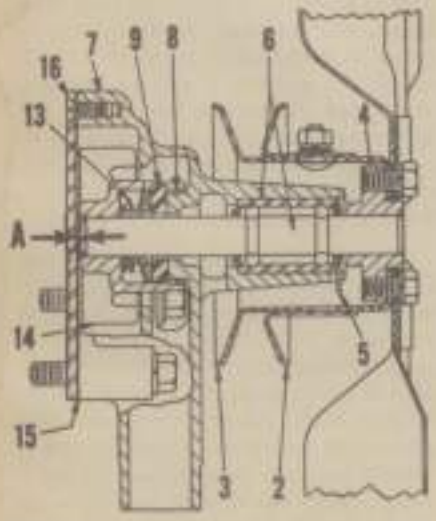


Fig. 87 — Cut-away drawing of water pump showing 1/32-inch clearance (A) between impeller and pump body. See Fig. 86 for legend.

WATER PUMP

D-14 and D-15 Non-Diesel

136. **REMOVE AND REINSTALL.** To remove the water pump, first remove both hoods, generator and fan belt. Disconnect lower radiator and thermostat by-pass hoses from pump. Remove the fan and pulley assembly. Unbolt and remove water pump.

137. **OVERHAUL.** To overhaul the removed water pump, first remove the cover (16—Fig. 86); then, using a suitable puller, remove impeller from rear end of shaft. Carbon thrust washer (9) and seal assembly can be removed from impeller after removing snap ring (8). Shaft and bearing assembly (6) can be pressed out front of body after removing snap ring (5) from behind fan hub (4). Hub can be pressed from shaft.

Surface of pump body contacted by the carbon thrust washer must be smooth and true. When pressing impeller on shaft, use caution not to collapse seal. Press impeller on shaft until rear face of impeller is $\frac{1}{64}$-inch below the cover gasket surface of body as shown at "A" Fig. 87. Fan hub should be pressed on shaft until fan hub is flush with end of shaft.

D-17 Non-Diesel

138. **R&R AND OVERHAUL.** To remove the water pump, first drain cooling system and remove left hood side panel. Loosen fan belt adjustment, then unbolt and remove fan from water pump. Disconnect by-pass hose and lower radiator hose from pump and unbolt and remove pump from engine.

To overhaul pump, refer to Fig. 88 and proceed as follows: Remove the fan pulley (9) using a suitable puller. Remove snap ring (8) and rear cover (2); then press the drive shaft and bearing unit forward out of impeller and pump housing. Seal (5) is available separately or in kit that includes all necessary gaskets and snap ring (8). Renew shaft and bearing assembly (7) if bearing is rough or dry. Renew all other questionable parts and reassemble pump in reverse of disassembly procedure. Press impeller onto shaft until rear face of impeller is 1/64 to 1/32-inch below gasket surface of body. Be sure to use copper washers under heads of the four cap screws that extend into the pump body.

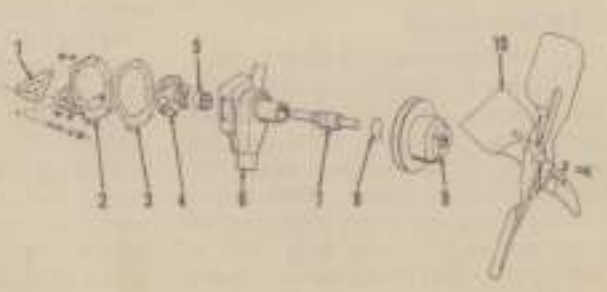
D-15 Diesel and Early D-17 Diesel

Refer to the following for all D-15 diesel models and D-17 diesel models prior to engine Serial No. 119038 (except Serial Nos. 117087 through 117104).

139. **R&R AND OVERHAUL.** To remove the water pump, first remove radiator and radiator shell as a unit as outlined in paragraph 135. Loosen the fan belt adjustment and remove fan blades and fan belt. Disconnect

Fig. 88 — Exploded view of the non-diesel D-17 fan and water pump assembly.

1. Gasket
2. Body cover
3. Gasket
4. Impeller
5. Seal
6. Pump body
7. Bearing and shaft
8. Snap ring
9. Fan pulley
10. Fan



the water pump drain tube, then unbolt and remove water pump assembly.

To disassemble pump, remove pulley and hub assembly. Remove snap ring (2—Fig. 89) and rear cover (10). Press shaft and bearing (3) out towards front from housing and impeller. Press seal assembly (7) from housing. Apply gasket sealer to outer rim of new seal and press the seal into housing with Kent-Moore seal installing Tool No. J-6902 or equivalent. Press shaft and bearing assembly, with water slinger installed, into housing from front until bearing contacts the rear snap ring and install front snap ring. Lubricate the seal contact surfaces and press impeller onto shaft until rear face of impeller is flush with rear end of shaft. Press pulley onto front end of shaft and reinstall pump assembly by reversing removal procedure.

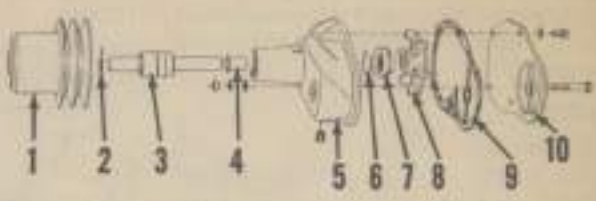


Fig. 89 — Exploded view of the water pump used on D-15 diesel and early D-17 diesel models

1. Fan pulley
2. Snap ring
3. Bearing and shaft
4. Water slinger
5. Pump body
6. Snap ring
7. Seal
8. Impeller
9. Gasket
10. Cover

Late D-17 Diesel

Refer to the following for D-17 diesel models after engine Serial No. 119930 and Serial Nos. 117087 through 117104.

140. **R&R AND OVERHAUL.** To remove the water pump, first remove radiator and radiator shell as a unit as outlined in paragraph 135. Loosen the fan belt adjustment and remove fan blades, pulley and fan belt. Disconnect the lower radiator hose from water pump and the metal tube from water pump and water manifold. Then, unbolt and remove the water pump assembly.

To disassemble pump, remove pulley hub (1—Fig. 90), snap ring (2) and rear cover (9). Press shaft and bearing assembly out towards front from housing and impeller. Drive old seal out of housing. Apply gasket sealer to outer rim or seal and press seal into housing using Kent-Moore seal installing Tool No. J-6902 or equivalent. Press shaft and bearing assembly into housing from front until snap ring (2) can be installed. Lubricate seal contact surfaces and press impeller onto rear of shaft until rear face of impeller is 0.030 to 0.040 below gasket surface of pump body. Install rear cover plate and tighten retaining screws to 11-13 Ft.-Lbs. Reinstall pump by reversing removal procedure.

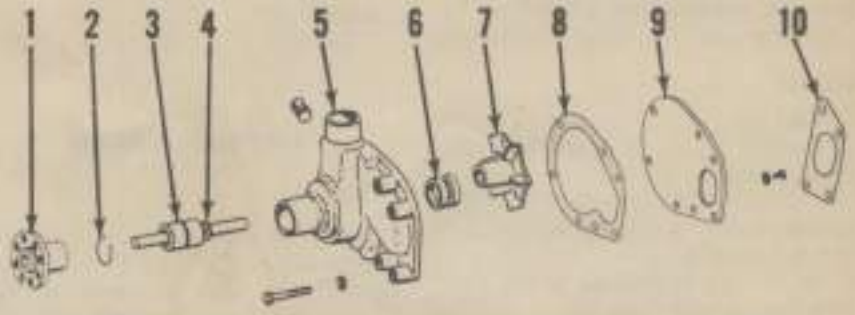


Fig. 90 — Exploded view of water pump used on late D-17 diesel models.

1. Fan pulley hub
2. Snap ring
3. Bearing and shaft
4. Slinger
5. Pump body
6. Seal assembly
7. Impeller
8. Gasket
9. Cover
10. Gasket

IGNITION AND ELECTRICAL SYSTEM

(Refer to Pages 88 through 93 for Wiring Diagrams)

SPARK PLUGS

Non-Diesel

141. Spark plug electrode gap should be 0.030 for D-14 models; 0.020 for D-15 and D-17 LP-Gas models; 0.025 for D-15 and D-17 gasoline models. Prior to engine Serial No. 17-17293, D-17 non-diesel models are equipped with 14 mm., ⅜-inch reach spark plugs. After engine Serial No. 17-17292, 14 mm., ¾-inch reach spark plugs are used. Refer to following chart for recommended spark plug usage.

GASOLINE (Heavy Leads)	Recommended Spark Plug
D-14 and D-15	A.C. 45 Autolite A-7 Champion J-8
Series II D-15	A.C. 45 Comm. Autolite A-5 Champion J-7
D-17 (⅜" reach)	A.C. 45 Comm. Autolite A-7 Champion J-8
D-17 (¾" reach)	A.C. 45XL Autolite AG-5 Champion N-8

GASOLINE (Light Leads)	Recommended Spark Plugs
D-14 and D-15	A.C. 47 Autolite A-9 Champion J-11
Series II D-15	A.C. 45 Comm. Autolite A-7 Champion J-8
D-17 (⅜" reach)	A.C. 47 Comm. Autolite A-9 Champion J-11
D-17 (¾" reach)	A.C. 47XL Champion N-18

LP-GAS	Recommended Spark Plug
D-14 and D-15	Champion J-3
Series II D-15	Champion J-3
D-17 (All Engines)	Champion N-3

DISTRIBUTOR

D-14

142. D-14 tractors prior to serial number D14-19001 are equipped with a Delco-Remy 1111745 distributor. Later tractors are equipped with a Delco-Remy 1113593 distributor. Specification data follows.

Advance data for both distributors is in distributor RPM and distributor degrees.

1111745

Contact gap 0.020
Cam angle ..... 25-34 degrees
Start advance
0.5-3.5 degrees @ 225 RPM
Intermediate 6-9 degrees @ 375 RPM
Maximum advance
14-16 degrees @ 550 RPM
Rotation, viewed from
driving end ..... counter-clockwise

1112593

Contact gap 0.022
Cam angle ..... 25-34 degrees
Start advance
0-2 degrees @ 250 RPM
Intermediate 5-7 degrees @ 500 RPM
Maximum advance
11-13 degrees @ 800 RPM
Rotation, viewed from
driving end ..... counter-clockwise

D-15 Non-Diesel

143. D-15 non-diesel tractors are equipped with a Delco-Remy 1112607 distributor. Specification data follows:

1112607

Breaker contact gap 0.022
Breaker arm spring
pressure (measured at
center of contact) ..... 17-21 oz.
Cam angle, degrees 25-34
Advance data is in distributor degrees and distributor rpm.
Start advance ..... 0°-2° @ 250 rpm
Intermediate
advance ..... 8.5°-10.5° @ 700 rpm
Maximum
advance ..... 18°- 20° @ 1200 rpm

D-17 Non-Diesel

144. D-17 non-diesel models, prior to engine Serial No. 17-19979, are equipped with a Delco-Remy 1112584 distributor. A Delco Remy 1112593 distributor is used on engines at engine Serial No. 17-19978 and up. Specification data follows:

1112584

Breaker contact gap 0.022
Breaker arm spring pressure
(measured at center of
contact) ..... 17-21 oz.
Cam angle ..... 25-34 degrees
Advance data (distributor
degrees and RPM)
Start advance ..... 0-2° @ 250 RPM
Intermediate
advance ..... 6-8° @ 500 RPM
Maximum
advance ..... 14-16° @ 850 RPM

1112593

Breaker contact gap 0.022
Breaker arm spring pressure
(measured at center of
contact) ..... 17-21 oz.
Cam angle ..... 25-34 degrees
Advance data (distributor
degrees and RPM)
Start advance ..... 0-2° @ 250 RPM
Intermediate
advance ..... 5-7° @ 500 RPM
Maximum
advance ..... 11-13° @ 800 RPM

IGNITION TIMING

D-14

145. With breaker point gap properly adjusted, breaker contact points should just start to open at TDC ("DC" mark on flywheel). At high idle speed, "FIRE" mark (30° B.T.D.C. on tractors prior to serial No. D14-19001; 25° B.T.D.C. on later production) should appear in center of timing hole in torque housing when using a power timing light.

D-15 Non-Diesel

146. With breaker point gap properly adjusted, breaker contact points should just start to open at TDC (line marked "CENTER" on flywheel positioned in center of timing hole in torque housing). To check advanced timing, adjust engine speed to 1750 RPM with tachometer; then, line marked "F-25" should appear in center of timing hole in torque housing when using a timing light. NOTE: Distributor advance will be greater than 25° BTDC at engine speeds above 1750 RPM.

D-17 Non-Diesel

147. Ignition timing on D-17 non-diesel engines with Serial No. 17-19978 and up is 25 degrees BTDC in fully advanced position. Experience has shown that engines prior to engine Serial No. 17-19978 also perform better with the advanced timing set at 25 degrees BTDC; therefore, this specification should be used instead of the previously recommended timing of 30 degrees BTDC. To properly set ignition timing on all non-diesel engines, proceed as follows: Using a power timing light, and with engine running at high idle speed, the advance timing mark "F" on engine flywheel should appear at center of timing hole on tractors with engine Serial No. 17-19978 and up; or mark "F" should appear at top of timing hole on tractors prior to engine Serial No. 17-19978. If not, loosen distributor mounting bolts and turn distributor in either direction as required to obtain proper timing.

When distributor has been removed, reinstall as follows: Turn engine until the number one piston is coming up on compression stroke; then, continue to turn engine slowly until the TDC mark on flywheel is at the center of the timing hole on engines with Serial No. 17-19978 and up, or at top of hole on engines prior to engine Serial No. 17-19978. Adjust distributor point gap to 0.022, turn distributor shaft so that rotor is pointing to number one spark plug terminal and ignition points are just breaking; then, install distributor with shaft in this position. After engine has been started, readjust timing using timing light as described in previous paragraph.

GENERATOR, VOLTAGE REGULATOR AND STARTING MOTOR

All Models

148. D-14, D-15 and D-17 tractors are equipped with Delco-Remy electrical units. Refer to the actual unit for model number. Specification data for generator, voltage regulator and starting motor used are as follows:

GENERATORS

1100025

Brush spring tension ..... 28 oz.
Field Draw
Volts 6.0
Amperes 1.85-2.03
Cold output
Volts 8.0
Amperes 35
RPM 2650

1100305, 1100345 & 1100440

Brush spring tension ..... 28 oz.
Field draw
Volts 12.0
Amperes 1.50-1.67
Output (cold)
Max. amperes 20
Volts 14.0
Max. RPM 2300

1100327 & 110426

Brush spring tension ..... 28 oz.
Field draw
Volts 12.0
Amperes 1.5-1.62
Output (cold)
Max. amperes 25.0
Volts 14.0
Max. RPM 2710

VOLTAGE REGULATORS

1118780

Cut-out relay	
Air gap	0.020
Point gap	0.020
Closing voltage-range	5.9-7.0
Adjust to	6.4
Voltage regulator	
Air gap	0.075
Setting volts-range	6.6-7.2
Adjust to	6.9

1118779, 1118792, 1118993 & 1119191

Cut-out relay	
Air gap	0.020
Point gap	0.020
Closing voltage	
Range	11.8-14.0
Adjust to	12.8
Voltage regulator	
Air gap	0.075
Voltage range	13.6-14.5
Adjust to	14.0
Ground polarity	Positive

STARTING MOTOR

1107466

Brush spring tension—min.	24 oz.
No Load test	
Volts	5.0
Amperes (max.)	65
RPM (min.)	5000
Lock test	
Volts (approx.)	3.2
Amperes	570
Torque—minimum	15 ft.-lbs.

1107502

Brush spring tension—min.	24 oz.
No load test	
Volts	11.8
Amperes, min.	40
Max.	70
RPM, min.	6800
Max.	9200
Lock test	
Volts (approx.)	5.9
Amperes	615
Min. torque, Ft.-Lbs.	29

1113082

Brush spring tension	48 oz.
No load test	
Volts	11.5
Amperes	57-70
RPM	5000-7400
Lock test	
Volts	approx. 3.4
Amperes	500
Torque, Ft.-Lbs.	22

1113152

Brush spring tension	80 oz.
No load test	
Volts	11.5
Amperes	37-50
RPM	5000-7400
Lock test	
Volts	approx. 3.4
Amperes	500
Torque, Ft.-Lbs.	22

1107758

Brush spring tension	35 oz.
No load test	
Volt	10.6
Amperes (max.)	94
RPM, min.	3240
Resistance test	
Volts	3.5
Amperes	325-390

1107695 & X-11969

Brush spring tension	40 oz.
No load test	
Volts	11.8
Amperes (max.)	72
RPM (min.)	6025
Resistance test	
Volts	3.5
Amperes	295-365

1107548

Brush spring tension	35 oz.
No load test	
Volts	10.6
Amperes	75-100
RPM	6450-8750
Resistance test	
Volts	5.0
Amperes	720-870

ENGINE CLUTCH

D-14 and D15 tractors are equipped with a single plate, 9-inch, dry disc, spring loaded engine clutch. Disengaging the engine clutch stops the hydraulic pump and pto; however, the "Power Director" or shuttle clutch can be shifted to neutral if live pto and/or hydraulic requirements are needed.

D-17 tractors are equipped with a single plate, 11-inch, dry disc, spring loaded engine clutch. D-17 models prior to tractor Serial No. D17-75001 are equipped with a plunger type hydraulic pump which is driven by the engine clutch shaft. If the engine clutch is disengaged, the pto and hydraulic pump are stopped. The "Power Director" or shuttle clutch can be shifted to neutral if live pto or hydraulic pump are needed. On Series IV D-17 models (after tractor Serial No. D17-75000), the hydraulic pump is driven by a hollow drive shaft (10—Fig. 97) which is splined into the clutch cover (5—Fig. 92). The bevel gear on rear end of the hollow drive shaft drives the hydraulic pump all the time the engine is running.

ADJUSTMENT

D-14 and D-15 Models

149. There should be ¼-inch clearance between the clutch throw-out (release) bearing and the release fingers on the pressure plate. Clearance may be checked by removing the inspection hole cover from bottom of the torque housing and using a piece of ¼-inch key stock as a gage. To adjust clearance, disconnect rear end of clutch rod from pedal and screw rod in or out of clutch release fork as required.

Do not adjust clutch release fingers to obtain throw-out bearing clearance. Clutch finders should be adjusted evenly when overhauling clutch assembly.

D-17 Models

150. Clutch pedal adjustment does not affect release bearing clearance but merely positions the clutch pedal closer to or further from the operator. To adjust clutch pedal position, disconnect link rod from pedal and turn rod in or out of clutch release lever trunnion to adjust pedal to desired position.

CLUTCH COVER AND DISC

D-14 and D-15 Models

151. **REMOVE AND REINSTALL.** To remove the engine clutch, remove both hoods and center channel. Support engine and torque tube; then on models with an adjustable axle, disconnect radius rod from pivot bracket. On all models, disconnect oil pressure gage line, fuel line and wiring harness from engine and engine accessories. On non-diesels, disconnect governor control rod and choke rod. On diesels remove fuel return tube and disconnect injection pump control rod and fuel shut-off rod from pump. On all models, drain cooling system and dis-

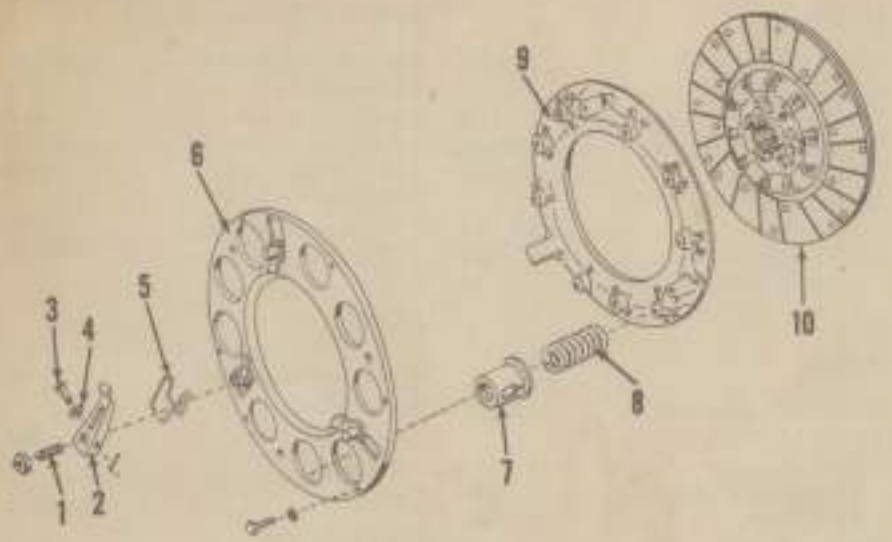


Fig. 91 — Exploded view of the clutch assembly used on D-17 tractors prior to Serial No. D17-75001. Clutch used on D-14 and D-15 models is similar.

1. Adjusting screw
2. Clutch fingers
3. Pivot pin
4. Spring washer
5. Lever spring
6. Back plate
7. Pressure spring cup
8. Pressure spring
9. Pressure plate
10. Clutch lined disc

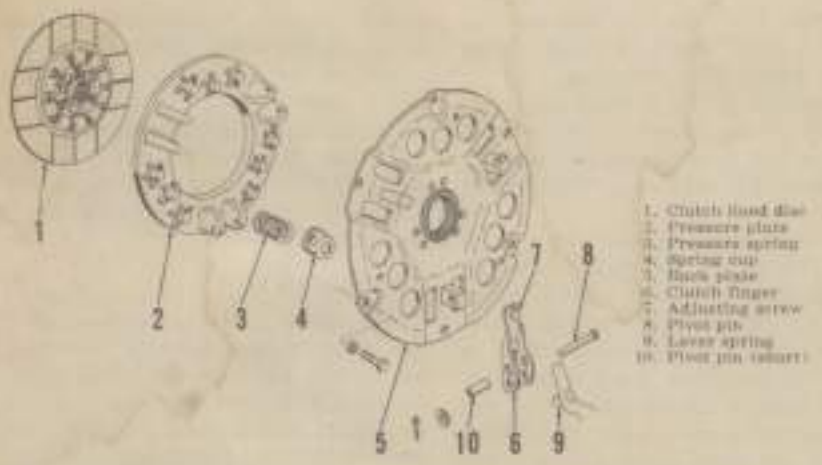


Fig. 92 — Exploded view of clutch assembly used on Series IV D-17 tractors. The center of the back plate (5) is splined and drives the side mounted, live hydraulic pump via hollow shaft shown in Fig. 97.

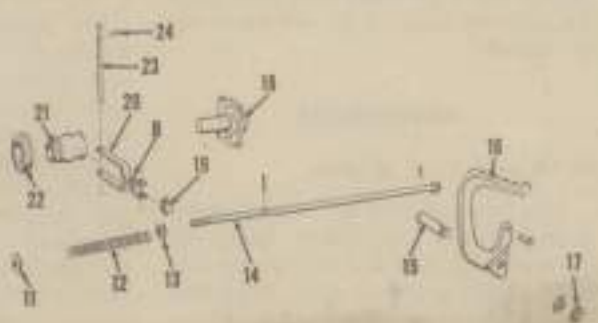


Fig. 93 — Exploded view of typical clutch throwout (release) bearing, linkage and associated parts.

11. Bolt
12. Washer
13. Pedal return spring
14. Washer
14. Pedal rod
15. Pedal shaft
16. Pedal
17. Snap ring
18. Retainer
19. Shifter fork
20. Shifter lever
21. Clutch shifter
22. Throw-out (release) bearing
23. Shift lever pivot
24. Clip

connect temperature bulb from cylinder head. Remove cap screws attaching side rails and engine to torque tube; then roll front system and engine forward. Clutch can be removed by removing cap screws retaining clutch cover to flywheel.

Reinstall in reverse of removal procedure with longer hub and springs of the lined disc (10—Fig. 91) facing toward rear. Align driven plate with a clutch pilot tool or spare clutch shaft.

D-17 Models

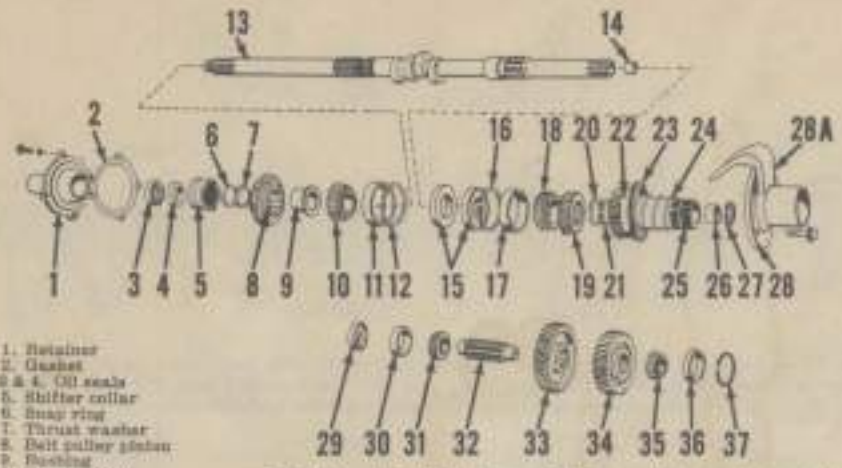
152. **REMOVE AND REINSTALL.** The clutch cover and disc assembly may be removed from the engine flywheel after splitting tractor between engine and torque housing as follows: Remove both hood side panels. Disconnect the battery ground cable and, on diesel models, remove starting motor. Disconnect air cleaner hoses on all non-diesel models; on diesel models with dry type air cleaner, disconnect air cleaner hoses and wiring to voltage regulator. On all models, unbolt and remove hood center channel with any accessories that are attached to channel.

Partially drain the cooling system and remove the temperature gage bulb from engine. Unhook tachometer cable. Remove left side sheet (panel) from below fuel tank after removing diesel fuel shut off knob or non-diesel choke knob if so located. Disconnect oil pressure gage line at rear of engine. If equipped with oil cooler for shuttle clutch or "Power-Director", disconnect cooler tubes at filter base.

On non-diesel models, disconnect wiring to generator, ignition coil and, if so equipped, to front mounted lights. Remove governor control rod and rod or wire to carburetor choke lever. Remove fuel supply line to carburetor.

On diesel models, remove control rods from bell-crank to fuel injection pump and from joint in shut off rod to fuel injection pump. Disconnect fuel return line at rear of engine and remove fuel supply line from tank to fuel filter unit. Disconnect wire to intake manifold heater and wiring to generator.

Support tractor under torque housing and support engine securely in a hoist. Unbolt engine rear adapter plate and side rails from torque housing and move front unit away from torque housing. Note: It will be necessary to support rear end of wide front axle center member on diesel models as front unit is moved away.



1. Retainer
2. Gasket
3 & 4. Oil seals
5. Shifter collar
6. Snap ring
7. Thrust washer
8. Belt pulley pinion
9. Bushing
10. Bearing cone
11. Bearing cup
12. Snap ring
13. Clutch shaft
14. Pilot bushing
15. Oil seals (2)
16. Snap ring
17. Bearing cup
18. Bearing cone
19. Drive gear
20. Thrust washer
21. Snap ring
22. Bearing
23. Snap ring
24. Pump spring
25. Clutch outer shaft
26. Bushing
27. Snap ring
28. Retainer
28A. Oil transfer tube
29. Plug
30. Bearing cup
31. Bearing cone
32. Intermediate shaft
33. Driven gear
34. Intermediate drive gear
35. Bearing cone
36. Bearing cup
37. Snap ring

Fig. 94 — Exploded view of D-14 and D-15 clutch shaft and associated parts. Lip seals (3&4) face toward rear.

After splitting tractor, unbolt and remove clutch cover assembly and clutch disc from engine flywheel. The clutch shaft pilot bearing in flywheel may be renewed at this time.

A heavy duty clutch driven disc is available as a factory option or as a service installation. Linings are available separately from the clutch driven disc assembly.

Reverse removal procedures to reinstall clutch assembly. Use suitable pilot in clutch disc and pilot bearing to align clutch for easy reassembly of tractor. Install clutch disc with dampener spring assembly rearward.

On Series IV D-17 models, the hydraulic pump hollow drive shaft (10—Fig. 97) must be aligned with splines in clutch cover before tractor will slide together.

OVERHAUL

D-14, D-15 and Early D-17 Models (Prior to D-17 Tractor Serial No. D17-75001)

153. Repair parts are available for the presure plate assembly. Disassembly is accomplished as follows: Compress presure plate (9—Fig. 91) into back plate (6) and remove pivot pins (3). Slide release fingers (2) toward center to free the springs (5) from the back plate. Refer to Fig. 91 and the following specifications:

D-14 and D-15

Pressure springs (8)—
Color ..... Red
Free length ..... 3 3/8 in.
Minimum ..... 3 1/8 in.
Pressure at 1 1/4 inches .... 130 lbs.
Disc (10) thickness (new) .. 0.220 in.
Release lever (2) height (refer to following text for adjustment) 1 1/8 in.

D-17 (Except Series IV)

Pressure spring (8)—
Color ..... Lavender
Free length ..... 2 1/8 in.
Minimum ..... 2 1/4 in.
Disc (10) thickness (new) ..... 0.340-0.357 in.
Release lever (2) height (refer to following text for adjustment) 2 1/8 in.

To adjust clutch release fingers, install clutch cover on flywheel with a new lined disc; then, measure distance between release bearing contact surface of fingers to the spring retainer disc on the clutch hub. The correct release finger height is listed in the specifications above. Make measurements between rivets on hub. **Do not** attempt to make adjustments using a worn friction disc. If measured distance is incorrect, loosen jam nut and turn finger adjusting screw either way as required until correct adjustment is obtained, then securely tighten jam nut.

Series IV D-17 (After Tractor Serial No. D17-75000)

154. Repair parts are available for the pressure plate assembly. Disassembly procedure is conventional. Refer to Fig. 92 and the following specifications:

Pressure springs (3)—
Color ..... Brown
Free length ..... 2 1/4 in.
Pressure at 1 1/4 inches .... 140 lbs.
Disc (1) thickness new ..... 0.281-0.301 in.

RELEASE BEARING

All Models

155. After engine is detached from torque housing as outlined in paragraph 151 or 152, release bearing may be renewed as follows: Remove the bolt (B—Fig. 93) joining the two halves of the shifter lever. Spread the shifter lever (yoke) halves and withdraw the release bearing and shifter assembly. Shifter (21) can then be pressed out of bearing.

ENGINE CLUTCH SHAFT

D-14 and D-15 Models

156. **REMOVE AND REINSTALL.** To remove the clutch shaft proceed as follows: Remove both hoods, center channel and both side sheets. Remove the battery and battery carrier; then disconnect all wires, tubes and linkage from the torque tube and engine that will interfere and remove the fuel tank, instrument panel and steering wheel assembly as a unit. Drain the "Power Director" clutch compartment and the transmission. Remove the "Power Director" filler cap and both platforms; then disconnect the brake rods. Remove the "Snap-Coupler" assembly from the underside of tractor and the hydraulic tube and tail light wire from left side. Support the engine and torque tube, remove the cap screws retaining the side rails and the engine to the torque tube; then move front system and engine forward. Support the transmission housing and torque tube separately, remove the power (pto) shaft, the "Power Director" clutch control lever and cover from side of torque tube. Remove the snap ring from the left

Fig. 95 — After the snap ring (27) and transfer tube (28A) are removed, the outer shaft can be removed.

end of the "Power Director" clutch shifter fork shaft and the fork retaining set screw. Then withdraw the shifter fork and shaft. After removing the retaining cap screws, separate the torque tube from the transmission housing. Remove the hydraulic pump as outlined in paragraph 233 or 268. After removing snap ring (27—Fig. 95) and transfer tube (28A), withdraw the clutch outer (hollow) shaft assembly (25—Fig. 94). Remove snap ring (21), thrust washer (20) and drive gear (19). Remove the belt pulley assembly (or pulley opening plate) and the retainer (1). Remove the belt pulley shifter yoke and shaft, and the detent ball and spring. Bump clutch shaft (13) forward out of bearing (18) and withdraw shaft from the front.

Bearing cups (11 & 17) and seals (15) can now be removed. Lip seals (15) are installed with the lip of the front seal facing towards the front and the lip of the rear seal towards the rear. Oil seals (3 & 4), which are pressed in the retainer (1), are both of the lip type and both lips face toward the rear.

In some cases, if outer shaft bushing (26) is renewed, it may require reaming after installation in the outer shaft to provide a free fit on the engine clutch shaft bearing surface.

When reinstalling, reverse the removal procedure. Position shaft (13) in torque tube and drift bearing (18) on shaft until shaft has the recommended end play of 0.0005-0.0045. Install drive gear (19) and thrust washer (20); then install correct thickness of snap ring (21) to maintain the correct end play. This snap ring is available in thicknesses from 0.089 to 0.127 in graduations of 0.004. When reinstalling the belt pulley shifter fork, press or drive the detent spring retaining plug up enough to allow the detent ball to be installed after the fork has been installed.

D-17 (Prior to Tractor Serial No. D17-75001)

157. **REMOVE AND REINSTALL.** To remove the engine clutch shaft, proceed as follows: Drain the hydraulic and "Power-Director" or shuttle clutch oil compartment. Split tractor between engine and torque housing as outlined in paragraph 152. If equipped with a "Power-Director" or shuttle clutch oil filter, detach oil tubes from fittings on clutch cover, unbolt filter base from fuel tank support and remove filter and lines as an assembly.

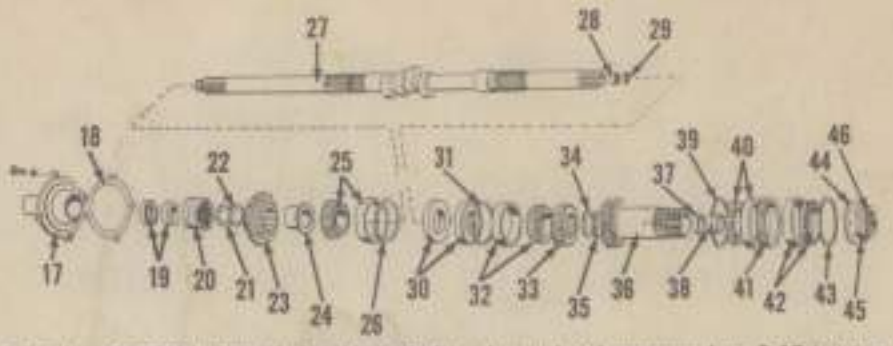


Fig. 96 — Exploded view of the clutch shaft and associated parts used on D-17 tractors prior to tractor serial No. D17-75001. Lip seals (19) face toward rear. Oil seals (30) are not used after tractor serial number 38896. Refer to text.

17. Retainer
18. Gasket
19. Oil seal (2)
20. Shifter collar
21. Snap ring
22. Thrust washer
23. Belt puller pinion
24. Bushing
25. Bearing
26. Snap ring
27. Clutch shaft
28. Needle bearing
29. Bearing sleeve
30. Oil seals (2)
31. Snap ring
32. Bearing
33. Drive gear
34. Thrust washer
35. Snap ring
36. Clutch outer (hollow) shaft
37. Bushing (⅛-inch)
38. Bushing (1-inch)
39. Snap ring
40. Bearing
41. Spacer
42. Bearing
43. Snap ring
44. Lockwasher
45. Nut
46. Snap ring

Remove right side sheet (panel) from below fuel tank and disconnect U-joint couplings on the hydraulic control lever shafts. Disconnect the "Traction - Booster" gage line from gage and disconnect wiring to fender mounted lights. Unbolt fuel tank and battery support frame from torque housing and secure steering shaft and instrument panel to support frame. Place a rope sling so that fuel tank, battery and support frame unit will be balanced and lift the unit from tractor.

If equipped with a shuttle clutch or "Power-Director" oil filter, refer to Fig. 100 and remove the two cap screws (8) from clutch cover. On models having a right hand clutch lever, unscrew the quadrant retaining nuts (3) and remove quadrant from clutch cover. Then, on all models, unbolt and remove cover assembly (7).

If clutch shifter fork has a retaining set screw, loosen lock nut and remove set screw. Remove set screw from control lever; then remove lever, Woodruff key and washers from shaft. Remove snap ring and washer from opposite end of shaft. Slide shaft to right and remove "O" ring from end of shaft. If shifter fork did not have a retaining set screw, remove Woodruff key from shaft at right side of fork. Slide the shaft to left and remove Woodruff key from shaft at left side of shifter fork. Remove "O" ring from left end of shaft; then, remove shaft and shifter fork.

Remove the lift ram pressure tube from left side of torque housing. Unbolt and remove the snap coupler linkage guard, disconnect link from pump and remove the snap coupler spring housing from bottom of torque tube, leaving snap coupler bell attached to transmission. Disconnect brake rods and remove both step plates. Remove belt pulley assembly if so equipped. Support rear unit under transmission and attach hoist to the torque housing so unit will be balanced. Unbolt and remove torque housing from transmission.

Remove the hydraulic pump following general procedure outlined in paragraph 233 and remove "Power-Director" or shuttle clutch outer (hollow) shaft as outlined in paragraph 164. Working through the belt pulley opening (remove cover if not equipped with belt pulley), remove the lock screw and set screw (7—Fig. 141) from the belt pulley shifter fork and remove shifter arm (2) from top of housing and fork (8), detent ball and spring (6) and insert (9) from belt pulley opening.

Remove the engine clutch release bearing shifter fork, release bearing and seal retainer (17—Fig. 96); then remove snap ring (35) and thrust washer (34) at rear end of shaft and bump shaft forward out of housing. Remove gear (33) and bearing cone (32) from rear. It is possible to pry seals (30) or compartment separator out and remove snap ring (31) by working through pump compartment; then, drive bearing cup (32) out to front. However, most mechanics prefer to remove the intermediate shaft and gears as outlined in paragraph 166 or 167, then remove bearing cup from rear due to usual difficulty encountered in trying to remove snap ring (31) from front.

Remove shifter collar (20) and press gear (23), bushing (24) and bearing

cone (25) to rear to allow removal of snap ring (21) and thrust washer (22). Then, remove gear (23), bushing (24) and bearing cone (25) from front end of shaft. Bearing cup (25) may be removed from torque housing at this time. Bearing (28) and sleeve (29) may be removed from rear end of shaft.

Prior to installing engine clutch shaft, check clearance between shaft and outer (hollow) shaft bushings and renew bushings, if necessary, as outlined in paragraph 164. Be sure that the rear bearing cup (32) is seated against snap ring (31). Install seals (30) in models prior to tractor Serial No. D17-38897 as follows: Lubricate seals prior to installation. Place one seal in bore with lip facing towards rear and drive it rearward until second seal can be started. Place second seal in bore with lip forward and drive both seals rearward until front seal is flush with wall of hydraulic pump compartment. On models after Serial No. D17-38896; place the steel compartment separator in bore with cup to rear and drive separator rearward until flat side is flush with wall in pump compartment.

Reinstall bearing cone (25), bushing (24), gear (23) and thrust washer (22), driving parts far enough to rear to install snap ring (21); then, drive bearing cone forward on shaft until thrust washer and bushing are held tightly against snap ring. Gear (23) should then turn freely on bushing.

Make certain that bearing cup (25) is seated against snap ring (26) and insert clutch shaft from front while holding rear bearing cone (32) in cup and gear (33) in position. Install thrust washer (34) and snap ring (35); then, drive shaft back and forth to seat bearings against snap rings and check end play of shaft in bearings. If end play is not within recommended limits of 0.0005 - 0.0045, install a different snap ring (35) of thickness necessary to bring end play within limits. Snap rings are available in thicknesses of 0.093 to 0.137 in steps of 0.004.

When reinstalling belt pulley shifter fork, drive detent retainer plug (5—Fig. 141) up enough to allow installation of detent ball after fork (6) is installed; then, drive plug back down in place. Complete reassembly of unit by reversing disassembly procedure.

Fig. 97 — Exploded view of the hydraulic pump drive used on Series IV D-17 tractors. Parts (17, 18, 19, 20 and 24—Fig. 96) are not used and plunger hydraulic pump drive cams on shaft (27) are omitted on Series IV D-17 models.

Series IV D-17 (After Tractor Serial No. D17-75000)

158. The general procedure outlined in paragraph 157 can be followed after noting these differences. Remove the side mounted hydraulic pump as outlined in paragraph 270. The hydraulic pump drive shaft (10—Fig. 97) can be removed after the torque tube is detached (split) from the engine. When reassembling, make certain that splines in the hollow shaft (10—Fig. 97) are aligned with clutch cover before sliding tractor together.

"POWER-DIRECTOR"

The "Power-Director" consists of two multiple disc wet type clutch packs contained in a common housing. The housing is mounted on and drives the transmission input shaft. A reduction gear drive in front of the clutch unit drives the discs of the front clutch pack through a hollow shaft. The engine clutch shaft turns inside this hollow shaft and drives the discs of the rear clutch pack at engine speed. Both clutch packs are controlled by a single lever with over-center type linkage. When the lever is in center position on its quadrant, both clutch packs are disengaged. When the lever is moved to the forward position, the rear clutch pack is engaged (front pack remains disengaged) and the transmission input shaft is driven at engine speed. When the lever is moved to the rear position on quadrant, the front clutch pack is engaged, rear pack is disengaged, and the transmission input shaft is driven at a reduced speed.

The center position of the "Power-Director" shift lever discontinues power to the transmission without stopping power to the P.T.O., belt pulley or hydraulic pump.

LUBRICATION

159. Recommended oil for D-14 and D-15 was SAE 20W/20. For D-17 models, SAE 20W/20, 80EP and automatic transmission oil Type "A" have been recommended. Due to several types of oil having been recommended, it would be advisable to check with the tractor owner or operator on type of oil being used before adding oil. On all models, the oil should be drained and refilled with new oil after 6 months of use. On models equipped with "Power-Director" oil filter, filter should be renewed after 50 hours of operation. The oil level on D-14 and D-15 tractors is checked with dipstick attached to the filler cap located at left front corner of transmission housing. On D-17 models (prior to tractor Serial No. D-17-38897), oil level is checked with the dipstick attached to filler cap without running engine. On D-17 tractors after Serial No. D17-38896 check the "Power-Director" and hydraulic oil supply level as follows: Retract any remote hydraulic cylinders, lower tractor lift arms and run the tractor for three minutes at high idle speed. Shut off

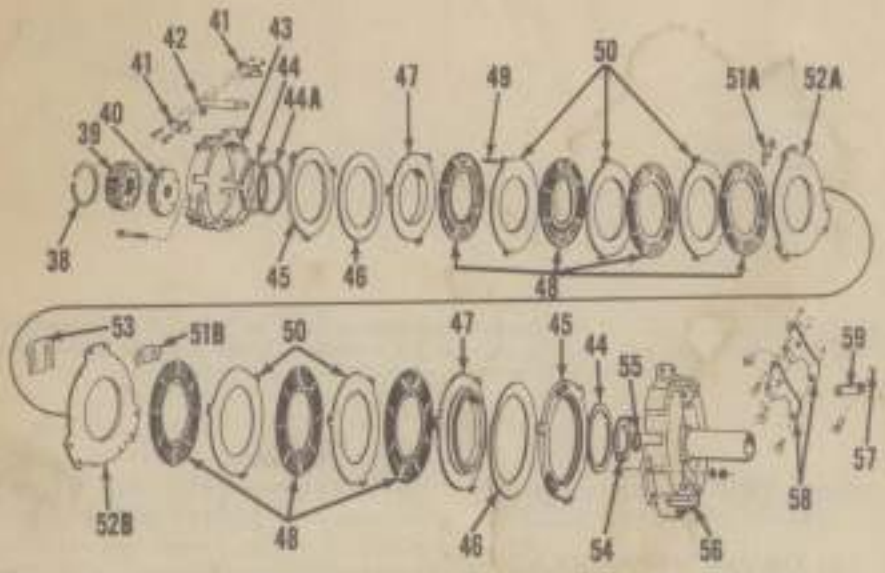


Fig. 98—Exploded view of D-17 "Power-Director" clutch assembly. D-14 and D-15 models are similar except spacer (44A) is omitted.

38. Snap ring
39. Front hub
40. Rear hub
41. Release lever (front)
42. Clutch link
43. Front housing
44. Snap ring
44A. Pressure plate spacer
45. Pre-load plate
46. Pressure washer
47. Pressure plate
48. Clutch splined disc
49. Clutch releasing spring
50. Clutch plate
51A. & 51B. Outer shims (0.010 & 0.005)
52A. & 52B. Center plate
53. Center shims (0.010 & 0.015)
54. Thrust washer
55. Snap ring
56. Rear housing
57. Snap ring
58. Release lever (rear)
59. Release lever link

engine and immediately check oil level with dip stick attached to filler cap. (Filler cap is located at left front corner of transmission housing.)

CLUTCH

All Models

160. **CLUTCH ADJUSTMENT.** Refer to Fig. 98. Clutch plate pressure is applied through a spring (Belleville) washer (46) that is located between the pre-load plate (45) and the pressure plate (47) of each clutch pack. The spring washer must be compressed 0.042-0.046 when clutch pack is engaged. If compression is less, slippage of clutch will result. If compression of spring washer is greater than 0.046, clutch pack will not release properly. Adjustment is provided with shim packs (51A, 51B and 53) placed between the clutch housings and adjoining center plates and between the two center plates.

On early production tractors, clutch assemblies were provided with three 0.085 stacks of shims at (51A), three 0.035 stacks of shims at (53) and three 0.085 stacks of shims at (51B).

On later tractors, clutch assemblies are provided with three 0.090 stacks of shims at (51A), three 0.025 stacks of shims at (53) and three 0.090 stacks of shims at (51B).

Thus, on all models, the total thickness of the shim packs is 0.205 and this total thickness must be maintained when adjusting the clutch to avoid changing clutch housing dimensions. For any thickness of shims added or removed from the three shim stacks (51A or 51B) between the housing and center plate of either clutch pack, a like thickness must be removed or added to the shim stacks (53) between the two center plates.

To gain access to the clutch packs to check adjustment, proceed as follows:

On models without an external filter, remove the quadrant (4—Fig. 100) after removing retaining nuts (3) and washers. Then, remove cap screws retaining cover (7) to housing and remove cover.

On models with external filter, first disconnect tubes (5 & 6) from fittings on clutch cover, unbolt filter base from fuel tank support and remove filter and lines as a unit. Remove the two cap screws (8), quadrant retaining nuts (3), washers and quadrant; then, remove cover retaining cap screws and remove cover (7) from housing. Pull the relief valve body (See Fig. 101) from oil tubes.

Using a hole gage of 2/10 to 3/10-inch capacity and a micrometer, measure clearance between the pre-load plate and the pressure plate (at A & B —Fig. 99) of each clutch pack; first with the clutch pack engaged, then with the clutch pack disengaged. Measurements should be made at each of the three openings around the clutch housings and an average of these dimensions used. Subtract the average engaged dimension from the average disengaged dimension. If the difference between the two average dimensions of a clutch pack is between 0.042 and 0.046, no adjustment is necessary. If the difference is less than 0.042, remove sufficient shim thickness from between the clutch pack housing and center plate (at 51A or 51B) to increase spring compression to 0.042-0.046 and add this same thickness between the center

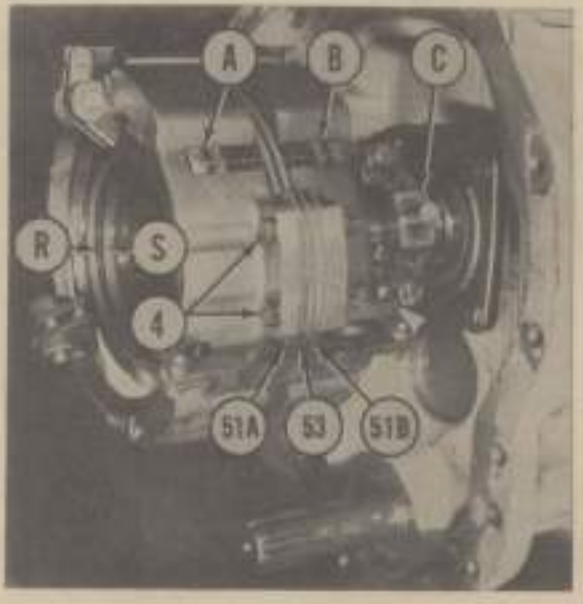


Fig. 99 — View of "Power-Director" clutch unit showing adjustment points. Refer to text for adjustment procedure.

A. Adjustment dimension
B. Adjustment dimension
C. Clutch collar
R. Snap ring
S. Spacer
4. Bolts
51A. Shims
51B. Shims
53. Shims

plates (at 53). For example, if the difference between the average engaged and disengaged dimension (A) of the front clutch pack was 0.035, removing 0.010 thickness of shims from each of the three stacks at (51A) and adding 0.010 thickness at each of the three stacks at (53) would increase compression of the spring washer to 0.045.

If the difference between the average engaged and disengaged dimensions is more than 0.046, add sufficient shim thickness between clutch pack housing and center plate to decrease spring compression to 0.042-0.046 and remove this same thickness from between the two center plates. For example, if the difference between the average engaged and disengaged dimension (A) of the front clutch pack was 0.050, adding 0.005 thickness of shims at (51A) and removing 0.005 thickness of shims at (53) would decrease compression of the spring washer to 0.045.

NOTE: As 0.005 shims are not provided for use between the clutch housing and center plate (at 51A and 51B), add a 0.010 shim and remove a 0.015 shim at each of the three shim stacks to reduce the shim stack thickness by 0.005; or add a 0.015 shim and remove a 0.010 shim to each of the three stacks to add 0.005 to the shim stack thickness. Shims of 0.005 thickness are provided for service use between the two center plates (at 53); however, 0.005 shims are not used in original assembly of the clutch unit.

161. **LEVER ADJUSTMENT.** To adjust lever quadrant (4—Fig. 100), place lever in center detent position (1) and loosen the two quadrant retaining stud nuts (3). Start the engine, shift transmission into gear and release engine clutch. Move lever to position where tractor has least tendency to creep and tighten quadrant stud nuts.

After the lever neutral position is located, adjust the forward stop position by varying the number of washers (2) until the control lever strikes the head of the stop bolt just as the clutch links snap over center.

162. **R&R AND OVERHAUL.** To remove the "Power-Director" clutch assembly, it is first necessary to split the torque housing from the transmission as outlined in paragraph 172 or 180; then proceed as follows: Remove the snap ring (R—Fig. 99) and spacer (S); then, withdraw the two clutch hubs and thrust washer. Remove the snap ring (SR—Fig. 102) that retains the clutch assembly to transmission input shaft and pull clutch assembly from shaft. To reinstall, reverse procedures making certain that the tabs on the clutch hub thrust washer enter the holes (H) in clutch housing.

The clutch assembly is a balanced unit; therefore, the front and rear housings should be marked prior to disassembly in order to maintain the balance when clutch is reassembled. Refer to Fig. 98 and proceed as follows: Disconnect the three clutch links from the release levers, loosen the six bolts through the housings (43 and 56) and remove the three shim stacks at each bolting point. Unbolt and separate the clutch housings, discs and center plates. Compress the pre-load plate (45), spring washer (46) and pressure plate (47) assembly to remove snap rings (44).

Inspect the clutch discs and renew any that are excessively worn or have damaged notches for the clutch hub splines. Inspect all other parts and renew any that are questionable. The free height of the spring washer in each clutch pack should be 0.270-0.302. Clutch plates with internal notches for clutch hub splines should measure 0.117-0.123 in thickness. Steel plates should be renewed if scored or showing signs of being overheated. All plates should be flat within 0.009.

To reassemble pre-load plate, spring washer and pressure plate, place parts in clutch housing to keep drive tangs aligned, compress spring and install snap ring. Reassemble clutch packs and install 0.090 shim stacks at each of the three positions (51A and 51B) between the clutch housings and center plates and install 0.025 shim stacks between the two center plates. All pins should be installed with heads in direction of clutch rotation to prevent failure of snap rings that retain pins in linkage.

Clutch can be adjusted following procedure outlined in paragraph 160

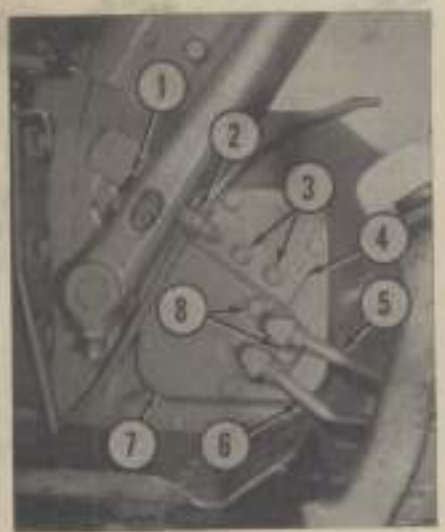


Fig. 100 — View of right hand side of torque housing showing "Power-Director" clutch lever, clutch cover and related parts. Shuttle clutch equipped tractors may have control lever on the opposite side of torque housing. Adjustment procedures remain the same, however.

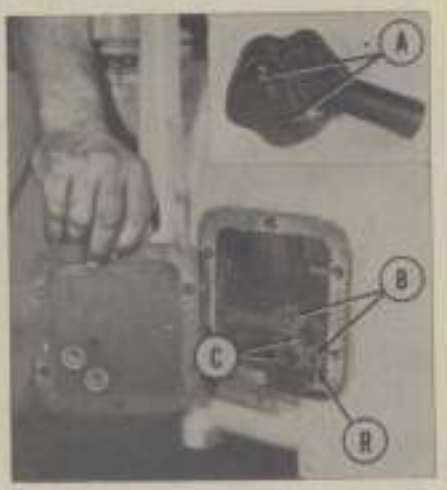


Fig. 101 — View showing late production D-17 "Power-Director" clutch cover removed from torque housing. Inset shows reverse side of relief valve assembly (R). D-15 Models equipped with a "Power-Director" or shuttle clutch oil cooler are similar.

A. "O" rings
B. Cap screw holes
C. "O" rings
R. Relief valve assembly

Fig. 102 — View of "Power-Director" clutch unit with drive hubs removed. Remove snap ring (SR) to remove unit from transmission input shaft. Be sure that tangs of thrust washer enter holes (H) when reinstalling unit.

either prior to or after reassembling tractor. Engage and disengage clutch using pry-bar against clutch collar (C—Fig. 99) if adjusting clutch prior to reassembly of tractor.

CLUTCH OUTER (HOLLOW) SHAFT

D-14 and D-15 Models

163. **REMOVE AND REINSTALL.** To remove the "Power Director" outer clutch shaft, it is necessary to split the torque tube from the transmission housing as outlined in paragraph 172; then proceed as follows: Remove snap ring (27—Fig. 103), unbolt and remove retainer (28) and oil transfer tube (28A). Outer shaft (25) can be withdrawn as the transfer tube is removed. After snap ring (21—Fig. 104) is removed, thrust washer (20) and drive gear (19) can be removed.

In some cases, outer shaft bushing (26) may need to be honed after installing same in the outer shaft to provide a free fit between bushing and engine clutch shaft.

When reinstalling, reverse the removal procedure.

D-17 Models

164. **REMOVE AND REINSTALL.** To remove the outer clutch shaft, it is necessary to first split the tractor between transmission and torque housing as outlined in paragraph 180; then, proceed as follows: Remove snap rings (43 and 46—Fig. 105), then bend tabs on lockwasher away from nut (45) and remove the nut and lockwasher. Using a tool similar to that shown in Fig. 106, screw tool onto outer shaft (36—Fig. 107) and bump shaft, bearings (40 and 42) and spacer (41) out toward rear.

Bushings (37 and 38) are pressed into the outer shaft. In renewing bushings, press the ½-inch wide front bushing (37) into hollow shaft bore until bushing is 3¾ inches from rear end of shaft. Press the 1-inch wide rear bushing (38) into hollow shaft so that bushing is 21/32-inch from rear of shaft. Ream or hone new bushings, if necessary, to provide 0.001-0.003 clearance between bushings and engine clutch shaft.

To reassemble, install snap ring (39) in the front groove in housing. Assemble front bearing cone and cup (40), spacer (41), rear bearing cone and cup (42), lock-tab washer (44) and nut (45) on hollow shaft, but do not tighten nut at this time. Apply grease to bushings in hollow shaft and install the assembly in bore of housing using the same tool that was used in removal. Adjust nut to provide 0.0005-0.0045 end play of shaft in bearings and bend tangs of lock-tab washer over nut. Install as thick a snap ring (43) as possible in the rear groove in bore of housing. Snap rings are available in thicknesses of 0.094 to 0.109 in steps of 0.003. Install snap ring (46).

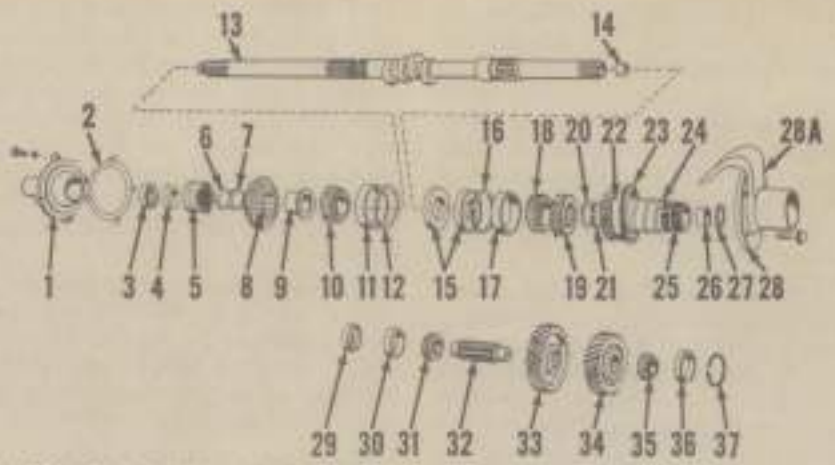


Fig. 104—Exploded view of D-14 and D-15 clutch shaft and associated parts. Lip seals (3 & 4) face toward rear.

1. Retainer
2. Gasket
3. & 4. Oil seal
5. Shifter collar
6. Snap ring
7. Thrust washer
8. Belt puller pinion
9. Bushing
10. Bearing cone
11. Bearing cup
12. Snap ring
13. Clutch shaft
14. Pilot bushing
15. Oil seals (2)
16. Snap ring
17. Bearing cup
18. Bearing cone
19. Drive gear
20. Thrust washer
21. Snap ring
22. Bearing
23. Snap ring
24. Pump spring
25. Clutch outer shaft
26. Bushing
27. Snap ring
28. Retainer
28A. Oil transfer tube
29. Plug
30. Bearing cup
31. Bearing cone
32. Intermediate shaft
33. Driven gear
34. Intermediate drive gear
35. Bearing cone
36. Bearing cup
37. Snap ring

Fig. 103—View of D-14 and D-15 "Power-Director" compartment. After the snap ring (27) and the transfer tube (28A) retaining cup screws are removed; the outer (hollow) "Power Director" clutch shaft (25), oil transfer tube (28A) and retainer (28) can be lifted out.

Fig. 105 — View into D-17 "Power-Director" compartment showing the inner clutch shaft (27) and the outer (hollow) shaft (36).

INTERMEDIATE SHAFT AND GEARS

D-14 and D-15 Models

165. To remove the intermediate gears and shaft, it is first necessary to remove the PTO driven gear as outlined in paragraph 224; then proceed as follows: Remove snap ring (27—Fig. 103), then unbolt and remove retainer (28) and oil transfer tube (28A). Remove the plug (29—Fig. 104), then remove snap ring (37). As the shaft (32) is pressed or bumped

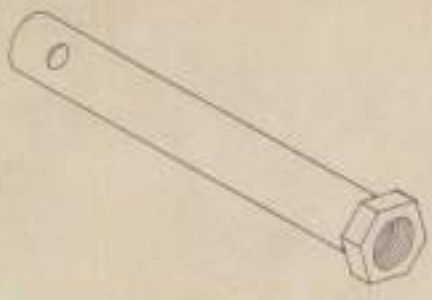


Fig. 106 — Suggested tool for removing the "Power Director" clutch outer (hollow) shaft from D-17 models can be made by welding a pipe to a nut (Allis-Chalmers part No. 229428). This tool can be screwed on the shaft in-place-of the standard nut and the pipe can be bumped rearward withdrawing the bearing cones, cups, spacer and the outer shaft.

to the rear, withdraw gears (33 & 34) from bottom and bearing cup (36) from rear.

Reinstall in the reverse of the removal procedure, using sealer on plug (29) to prevent leakage. Press bearings (31 & 35) on shaft and bearing cup (36) in bore. End play of shaft (32) should be 0.0005-0.0045 and should be maintained with a snap ring (37) of the proper thickness to maintain correct end play. This snap ring is available in thicknesses from 0.069 to 0.109 in graduations of 0.004.

For information concerning the PTO idler gear and drive gear, refer to paragraph 224 and 226.

D-17 (Prior to Tractor Serial No. D17-24001)

166. To remove the intermediate shaft and gears, it is first necessary to remove the PTO driven gear as outlined in paragraph 225, then remove snap ring (54—Fig. 107) at rear of intermediate shaft bore. Rear end of shaft has a threaded hole to facilitate removal. Screw slide hammer adapter into threaded hole in shaft and bump shaft out towards rear of torque housing. Rear bearing cone and cup will be pulled with intermediate shaft and gears and front bearing cone can be removed from bottom opening in housing. If necessary to renew front bearing cup, pull cup out to rear with slide hammer and bearing cup puller attachment.

NOTE: If intermediate shaft has a snap ring in a groove on the shaft at rear face of rear bearing cone, a later production intermediate shaft, with retaining nut on front end of shaft, has been installed. In this case, it will be necessary to disregard preceding instructions and remove the intermediate shaft as outlined in paragraph 167. Refer to 56—Fig. 108.

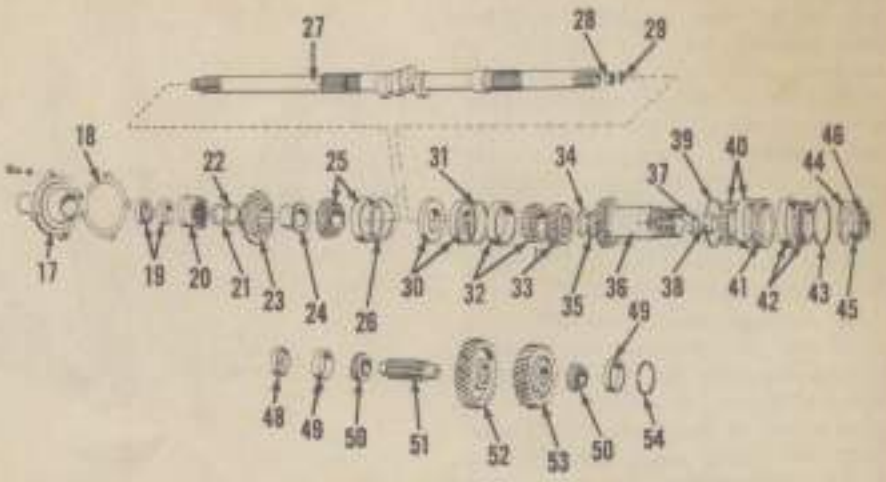


Fig. 107 — Exploded view of the clutch shaft and intermediate shaft and gears used on D-17 models prior to tractor Serial No. D17-24001.

17. Retainer
18. Gasket
19. Oil seals (2)
20. Shifter collar
21. Snap ring
22. Thrust washer
23. Belt pulley pinion
24. Bushing
25. Bearing
26. Snap ring
27. Clutch shaft
28. Needle bearing
29. Bearing sleeve
30. Oil seals (2)
31. Snap ring
32. Bearing
33. Drive gear
34. Thrust washer
35. Snap ring
36. Clutch outer (hollow) shaft
37. Bushing (⅛-inch)
38. Bushing (1-inch)
39. Snap ring
40. Bearing
41. Spacer
42. Bearing
43. Snap ring
44. Lockwasher
45. Nut
46. Snap ring
48. Plug
49. Bearing cup
50. Bearing cone
51. Intermediate shaft
52. Driven gear
53. Intermediate drive gear
54. Snap ring

Fig. 108 — Exploded view of intermediate shaft and gears used on D-17 tractors after tractor Serial No. D17-24001.

48. Plug
49. Bearing cup
50. Bearing cone
51A. Intermediate shaft
53A. Driven gear
53A. Intermediate drive gear
54. Snap ring
55. Nut
56. Snap ring

To reinstall shaft, drive front bearing cup in tight against shoulder in bore, taking care not to dislodge plug (48). Drive rear bearing cone tight against shoulder on rear (threaded hole) end of intermediate shaft. Place the 27-tooth (rear) gear in housing and insert shaft through rear bearing bore into splines in gear. Place front bearing cone in cup and position the 31-tooth (front) gear in housing. Slide shaft forward through splines of front gear and drive or bump the shaft forward through front bearing cone. Drive rear bearing cup into place and insert snap ring (54). Use slide hammer to seat rear bearing cup against snap ring, remove slide hammer adapter from shaft and remove all end play from shaft, gears and bearing cone assembly by driving rear bearing cone forward. A hollow driver that will contact only the inner race of bearing cone should be used. Measure end play of the shaft assembly in the bearing cups with a dial indicator. If end play is not within the recommended limits of 0.0005-0.0045, remove the snap ring and install new snap ring of sufficient thickness to bring shaft end play within limits. Snap rings are available in thicknesses of 0.069 to 0.109 in steps of 0.004 inch.

D-17 (After Tractor Serial No. D17-24000)

167. To remove the intermediate shaft and gears, it is first necessary to remove the PTO driven gear as outlined in paragraph 225. On models with the plunger type hydraulic pump, remove the pump as outlined in paragraph 233. Remove the plug (48—Fig. 108) and carefully unstake nut (55) from intermediate shaft (51A). Hold shaft from turning and remove nut. Remove snap ring (54) and screw slide hammer adapter into threaded

hole in rear end of shaft. Bump shaft out toward rear of torque housing. Rear bearing cone and cup will be removed with shaft; gears and front bearing cone can be removed from bottom opening of the torque housing. If necessary to renew front bearing cup, pull cup with bearing puller attachment on slide hammer or drive cup out towards rear. To remove rear bearing cone from the intermediate shaft, first remove snap ring (56).

To reinstall shaft assembly, first drive the front bearing cup in tight against shoulder in bore of torque housing. Drive rear bearing cone on to rear end of shaft and install snap ring (56). Place front bearing cone in cup and position the gears (52A and 53A) in housing. Insert shaft through rear bearing bore into splines of gears and then drive the shaft forward through front bearing cone. Install the rear bearing cup and snap ring (54); then, install nut (55) on front end of shaft and tighten the nut to a torque of 50-60 Ft.-Lbs. Check to see that rear bearing cone is tight against snap ring (56) and that the gears are pulled together. Stake nut to keyway in shaft. Install slide hammer adapter in rear end of shaft and bump shaft both to front and to rear to be sure bearing cups are seated; then, remove slide hammer and check end play of shaft assembly in bearing cups with dial indicator. If end play is not within recommended limits of 0.0005-0.0045, remove snap ring (54) and install new snap ring of correct thickness to bring end play within recommended limits. Snap rings are available in thicknesses of 0.069 to 0.109 in steps of 0.004 inch.

Fig. 109 — After removing the "Power Director" oil pump from early production D-17 models, check oil passage (OP) to make certain that it is not restricted.

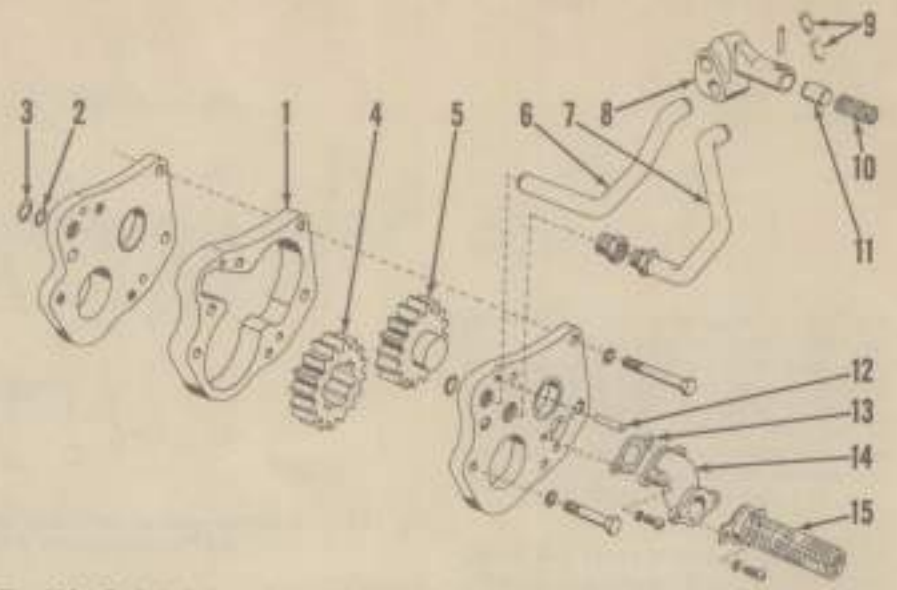


Fig. 110—Exploded view of late production D-17 "Power-Director" oil pump. Early type is similar.

1. Gear plate
2. "O" ring
3. "O" ring
4. Drive gear
5. Driven gear
6. Oil return tube
7. Oil pressure tube
8. Relief valve body
9. "O" rings
10. Spring
11. Relief valve
12. Dowel pin
13. Gasket
14. Manifold
15. Inlet screen

"POWER-DIRECTOR" OIL PUMP

D-15 and D-17 Models

168. The "Power-Director" oil pump is located in the bottom of the torque housing and is driven by the front power take-off shaft.

An exploded view of the gear type pump is shown in Figs. 110 and 111. On early production D-17 models, an external filter was not used and the oil was pumped directly to the intermediate shaft bearings and "Power-Director" clutch through the passage (OP—Fig. 109). On later production D-17 models, lubricating oil is pumped to an external filter (See Fig. 112) via the pressure tube (8—Fig. 110) and is returned to the oil passage in the torque housing via the return tube (6). The early and late production pumps are similar except for the holes for oil tube connections in the front cover on late pumps.

169. **R&R AND OVERHAUL.** To remove the "Power-Director" oil pump, it is first necessary to split the tractor between transmission and torque housing as outlined in paragraph 172 or 180 and remove the PTO shifter assembly. If equipped with an external oil filter, remove the oil tubes (6 and 7—Fig. 110) and the inlet manifold (14). The oil pump assembly can then be unbolted and removed from the torque housing. Note: Short cap screws holding pump assembly together should be left installed until pump assembly is removed.

Disassemble pump and renew any parts which are excessively worn or deeply scored. As pump operates at a relatively low pressure, some wear can be tolerated. Renew "O" rings and inlet adapter gasket when reassembling pump. Reverse removal procedures to reinstall pump. Note: Oil passage (OP—Fig. 109) should be checked to be sure it is open before reinstalling pump.

Fig. 111—Exploded view of "Power-Director" oil pump used on late production D-15 models.

1. Inlet screen
2. Dowel pin
3. Cover
4. Drive gear
5. Pump body
6. Cover
7. Idler gear
8. Adapter
9. Oil pressure tube
10. Relief valve body
11. Relief valve
12. Relief valve spring
13. Bushing (2 used)

SHUTTLE CLUTCH

A shuttle clutch (direction reverser clutch) is available as optional equipment. The shuttle clutch unit is similar to the "Power-Director" clutch except that the gearing ahead of the clutch unit (intermediate gears) provides a forward and a reverse rotation instead of a direct and a reduced speed drive. In addition, the shuttle clutch is provided with an oil cooler unit (See Fig. 113).

All service procedures and specifications for the late production "Power-Director" clutch and intermediate gears will also apply to the shuttle clutch unit and gears. For removal of the oil cooler (not used on "Power-Director" equipped D-17 models), refer to the following paragraph.

170. **R&R SHUTTLE CLUTCH OIL COOLER.** Remove both hood side panels and unbolt hood center channel from radiator shell. Disconnect oil cooler tubes at rear of radiator shell. Remove radiator cap. Unbolt radiator shell from side rails and radiator. Lift radiator shell and oil cooler from tractor as a unit. Remove oil cooler from radiator shell.

Reverse removal procedures to reinstall unit. Check oil cooler tube connections for leakage after completing reassembly and starting tractor engine.

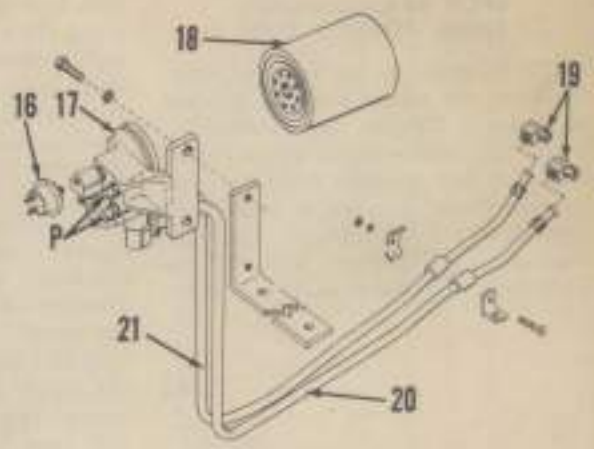


Fig. 112—View of external oil filter unit used on some models. If oil cooler is also used, lines attach to oil filter base at ports (P).

P. Oil cooler ports
16. Pressure switch
17. Filter base
18. Filter element
19. Elbow fittings
20. Pressure tube
21. Return tube

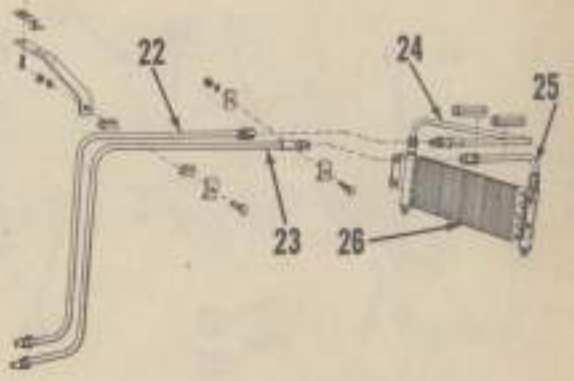


Fig. 113—Exploded view of oil cooler unit used on some models.

22. Pressure tube (rear)
23. Return tube (rear)
24. Pressure tube (front)
25. Return tube (front)
26. Oil cooler assembly

TRANSMISSION
D-14 AND D-15 MODELS

SIDE COVER

171. **R&R AND OVERHAUL.** The transmission shifter assembly is removed with the transmission cover as follows: Move the shifter lever to the neutral position, remove snap ring (46—Fig. 114) and withdraw shift lever. Using a screw driver or similar tool, shift the transmission into reverse. The transmission cover can then be removed after removing the attaching cap screws.

NOTE: The transmission cover (59—Fig. 114) has a screw located in the upper right hand corner of outer face of cover. On shuttle clutch equipped models, this screw is approximately 1-5/16 inches long and is used to lock the reverse gear in neutral position. On tractors equipped with "Power-Director," the hole in the cover is plugged with a short screw.

Disassembly and overhaul procedures for the removed unit are evident after an examination of the unit and reference to Fig. 114.

When reinstalling, reverse the removal procedure.

NOTE: Washers may be placed on the shift rails to prevent excessive overshift. Be sure the washers, if present, are reinstalled in the same location. If the shifter cover or forks are renewed, it may be necessary to change location of the washers, or add or remove washers to obtain proper overshift.

SPLIT TRANSMISSION FROM TORQUE TUBE

172. To split the transmission housing from the torque housing, proceed as follows: Remove the "Power-Director" or shuttle clutch compartment filler cap and dipstick, drain the compartment and, if work is to be performed on the transmission, drain the transmission lubricant. Remove the platforms and disconnect the brake rods. Remove the "Snap Coupler" pivot pin by driving the pin out with another pin of the same diameter, but short enough to disconnect the pivot joint while holding the snap coupler latch in position. Remove the hydraulic tube or tubes and tail light wire from the left side of tractor. If equipped with a shuttle clutch oil cooler, disconnect the cooler tubes at the clutch cover. Remove the "Power Director" or shuttle clutch lever and the clutch cover. Remove the snap ring and washers from the left end of the clutch shaft and remove the fork (yoke) retaining set screw or Woodruff keys. The shifter fork and shaft can then be removed. Support the torque housing and transmission separately, remove the retaining cap screws; then, separate the torque housing from the transmission housing.

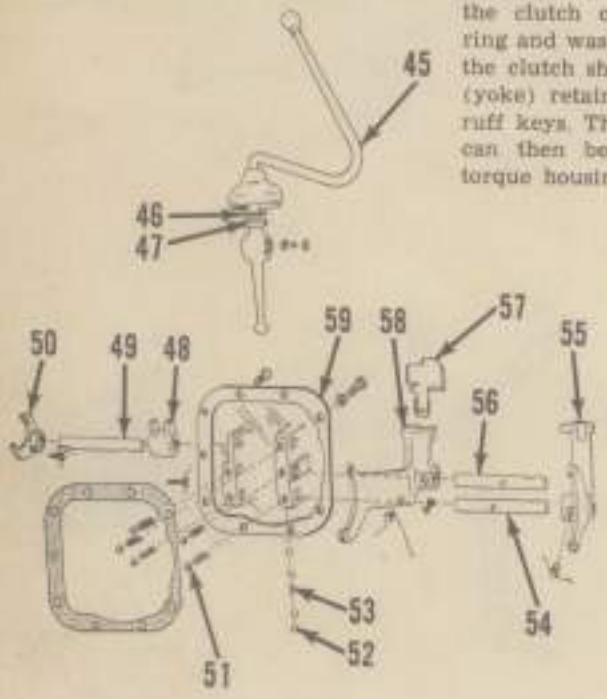


Fig. 114—Exploded view of the D-14 and D-15 transmission shifter assembly and associated parts.

45. Shift lever
46. Snap ring
47. Washer
48. Reverse lug
49. Shift rail (reverse)
50. Shift fork (reverse)
51. Detent ball
52. Interlock ball
53. Interlock pin
54. Shift rail (1st & 4th)
55. Shift fork (1st & 4th)
56. Shift rail (2nd & 3rd)
57. Oil baffle
58. Shift fork (2nd & 3rd)
59. Transmission cover

OVERHAUL

Data on overhauling the various components which make up the transmission are outlined in the following paragraphs.

173. **SHIFTER RAILS.** Rails and forks can be removed after removing transmission cover. Refer to paragraph 171.

174. **MAIN SHAFT.** On Model D-15 tractors refer to paragraph 175 and remove the bevel pinion shaft (18—Fig. 115) before attempting to remove the transmission main shaft (1). On Model D-14 tractors, the transmission main shaft may be removed as follows: Remove the rockshaft housing. Refer to paragraph 172 and split the transmission from the torque tube, then remove the shifter assembly as outlined in paragraph 171. On D-14 and D-15 Models, remove the large snap ring retaining the "Power Director" clutch hubs in the clutch assembly; then, withdraw the two hubs and thrust washer. After the small snap ring retaining the clutch assembly on the main shaft is removed; remove the "Power Director" clutch assembly. Remove the snap ring restricting rearward movement of the "Power Director" clutch assembly on the main shaft and remove the two opposed lip seals (2—Fig. 115).

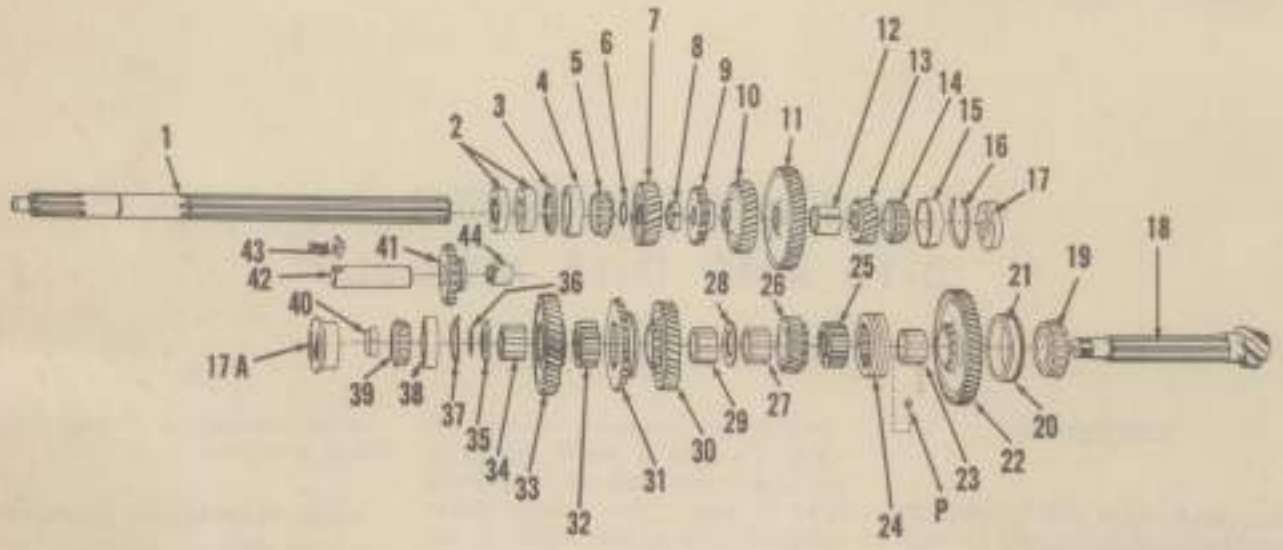


Fig. 115—Exploded view of the D-14 and D-15 transmission shafts, gears and related parts. Snap ring (16) controls the end play of the main shaft; snap ring (20) and shims (36) control the pinion shaft end play.

1. Main shaft
2. Oil seals (opposed)
3. Snap ring
4. Bearing cup
5. Bearing cone
6. Snap ring
7. 2nd speed gear
8. Spacer
9. Reverse gear
10. 3rd speed gear
11. 4th speed gear
12. Spacer
13. 1st speed gear
14. Bearing cone
15. Bearing cup
16. Snap ring
17. Oil cup
17A. Bearing bore plug
18. Pinion shaft
19. Bearing cone
20. Snap ring
21. Bearing cup
22. 1st speed gear
23. Bushing
P. Bushing pin
24. Shifter coupling
25. Shifter collar
26. 4th speed gear
27. Bushing
28. Pinion shaft spacer
29. Bushing
30. 3rd speed gear
31. Reverse shifter gear
32. Shifter collar
33. 2nd speed gear
34. Bushing
35. Washer
36. Shims
37. Snap ring
38. Bearing cup
39. Bearing cone
40. Retaining nut
41. Reverse idler gear
42. Idler gear shaft
43. Lock plate
44. Bushing

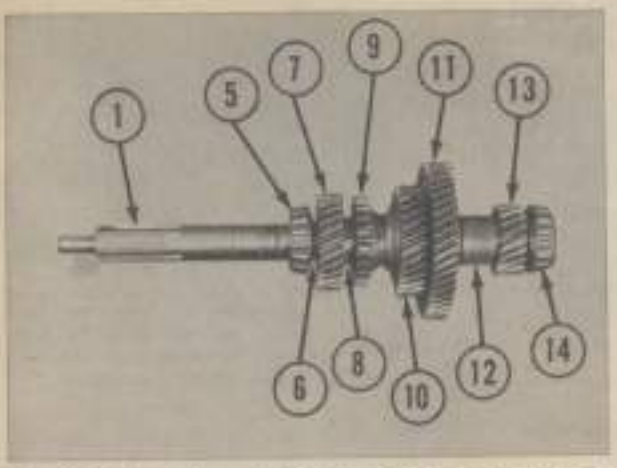


Fig. 116—The D-14 and D-15 transmission main shaft removed, showing gears, bearings and spacers. Refer to Fig. 115 for legend.

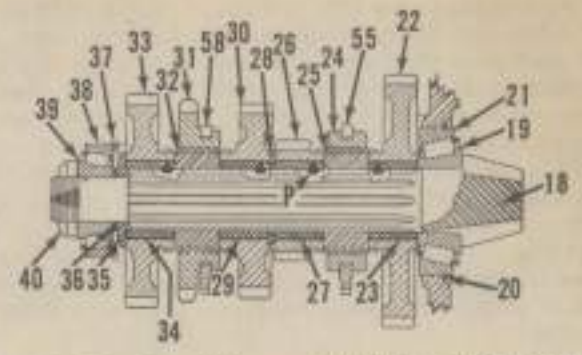


Fig. 117—Drawing of the assembled D-14 and D-15 bevel pinion shaft showing pins (P) in their positions in the bushings. Refer to Fig. 115 for legend.

Note: Most mechanics prefer to drill, tap and screw cap screws into oil seals (2) to aid in their removal.

Remove snap ring (3) retaining the main shaft front bearing cup (4); then remove oil cup (17), at rear. Bump the main shaft forward and extract the bearings, gears and spacers through opening in right side of housing.

Inspect all parts for visible damage and renew any that are questionable.

Reassembly is reverse of disassembly. Install second speed gear (26 teeth) (7) with flat side rearward; next, install short spacer (8), reverse gear (19 teeth) (9) with long part of hub facing rearward, third speed gear (30 teeth) (10) with long part of hub facing forward, fourth speed gear (49 teeth) (11) with long part of hub facing rearward, long spacer (12) and 1st speed gear (18 teeth) (13). Main shaft end play of 0.0005 to 0.0045 is controlled by the thickness of snap ring (16) located behind rear bearing cup (15). This snap ring is available in thicknesses from 0.100 to 0.135 in graduations of 0.005. Coat outer diameter of seals (2) with sealer; then install with lip of the front seal facing forward and lip of rear seal facing rearward.

175. **BEVEL PINION SHAFT.** To remove the bevel pinion shaft, proceed as follows: Split the transmission from the torque housing as outlined in paragraph 172. Remove the shifter cover as outlined in paragraph 171 and the differential as outlined in paragraph 190. Remove the bearing bore plug (17A—Fig. 115), unstake the retaining nut (40) and bump the bevel pinion shaft rearward withdrawing gears through the opening in right side of transmission housing.

Inspect all parts for excessive wear or other visible damage. Renew pins (P—Fig. 117) if damaged in any way and rivet the pins in the bushings to prevent their falling out during the reassembly of the pinion shaft.

NOTE: If the pinion shaft and/or bearings are renewed, the pinion shaft and bearings should be assembled in the transmission housing without gears and the bevel gear backlash and pinion mesh position be adjusted as outlined in paragraph 186, 187, 188, and 189 before proceeding further.

176. To reinstall the bevel pinion shaft, proceed as follows: Install rear bearing cup (21) tightly against snap ring (20). Install rear bearing cone (19) tightly against pinion gear and place 1 3/16-inch wide bushing (23) on pinion shaft (18). Insert shaft through rear bearing cup and place low gear (22) (50 teeth) on shaft with gear clutch jaws forward. Install ⅞-inch wide splined collar (25) and place shifter coupling (24) over collar with narrow flange of coupling to rear. Install 1 3/16-inch wide bushing (27) on shaft with pin end of bushing to rear. Place fourth gear (26) (24 teeth) over bushing with clutch jaws of gear rearward. Install splined thrust washer (28). Install 1⅛-inch wide bushing (29) with pin end of bushing to rear. Install third gear (30) (37 teeth) over bushing with clutch jaws of gear forward. Place second gear (33) (41 teeth) in housing with clutch jaws of gear to rear; then, place 1-inch wide splined collar in reverse gear (31) (30 teeth) and place gear, with shifter groove to rear, and collar in between third gear (30) and second gear (33). Push pinion shaft through the two gears. Install 1⅛-inch wide bushing (34) with pin end to rear through front bearing bore into position in hub of second gear (33). Place thrust washer (35) on shaft. Install snap ring (37) and drive the front bearing cup in tight against snap ring. Install shims

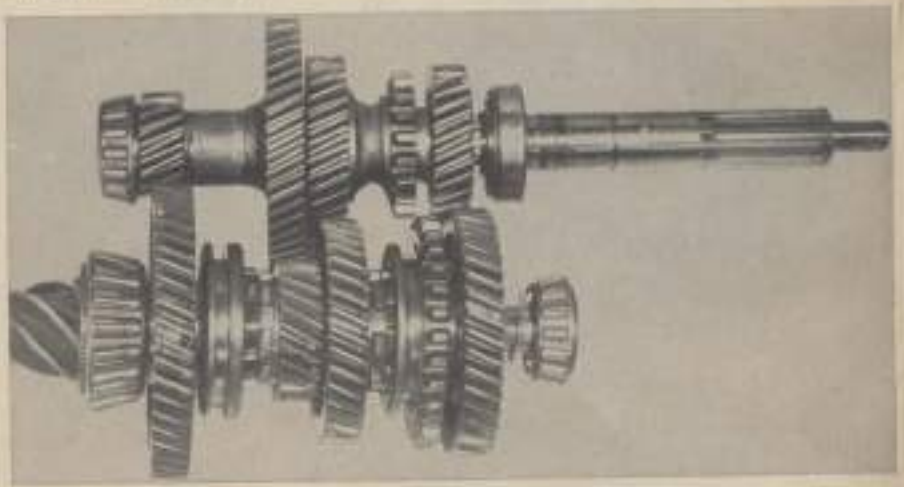


Fig. 118—View of removed D-14 and D-15 pinion shaft, main shaft and respective gears.

(36), front bearing cone (39) and nut (40). After nut is tightened, bump pinion shaft back and forth to be sure that bearings are seated and check end play of shaft with dial indicator. End play should be 0.0005-0.0045. If not within these limits, add or remove shims (36) as necessary to provide correct end play. When end play is correct and nut is tight, stake nut to keyway in pinion shaft. Apply sealer to rim of plug (17A) and drive plug into place.

177. **REVERSE IDLER AND SHAFT.** Reverse idler gear (41—Fig. 115) and shaft (42) can be removed after the transmission is detached from the torque tube and the side cover removed. Remove the lock plate (43) and bump the shaft out forward.

The reverse idler gear rotates on a bronze bushing (44). Worn bushings are serviced by renewing the gear and bushing as an assembly. Install reverse gear with shifter collar facing rearward.

Fig. 120—View of D-17 transmission cover and shifter assembly. Washers (W) are used as required on shift rails to limit overshift. Be sure to reinstall washers in same location during reassembly.

TRANSMISSION
D-17 MODELS

LUBRICATION

178. Transmission and differential have a common lubricating oil supply. Check oil level with dip stick that is attached to filler cap in transmission cover at right side of gear shift lever. Capacity is approximately 24 quarts of SAE 80 EP transmission lubricant.

SHIFTER ASSEMBLY

179. **R&R AND OVERHAUL.** The transmission shifter assembly is removed with the transmission cover by shifting transmission to neutral position; then, unbolting and removing the cover and shifter assembly.

To remove gear shift lever, remove snap ring (78—Fig. 119) and oil shield (80); then, remove dust cover (59), snap ring (55) and pivot washer (56). The two lever pivot pins in cover are renewable. To reinstall shift lever, reverse removal procedures.

To remove the shift rails, proceed as follows: Remove lock screw from reverse shifter fork, rotate shift rail ¼-turn, and catch detent ball and spring while sliding rail forward out of cover. With the reverse shift rail removed, long interlock plunger (60—Fig. 121) and interlock pin (77) can be removed from cover assembly. Then, remove lock screw from first and second gear shifter fork, turn rail ¼-turn and catch detent ball and spring while sliding rail forward out of cover. Rotate third and fourth gear shift rail ¼-turn and catch detent ball and spring while sliding rail forward out of cover. Be careful not to lose the short interlock plunger (79).

NOTE: Washers (W—Fig. 120) are used on shift rails as required to prevent excessive overshift. Be sure that if such washers are present, they are reinstalled in the same position when reassembling shifter cover. Check overshift before reinstalling cover; it is possible that if shifter components are renewed, washers may have to be added, re-positioned or removed from shift rails.

To reassemble cover, reverse disassembly procedure. Place shift lever and rails in neutral position and be certain that all gears are disengaged to reinstall cover on transmission.

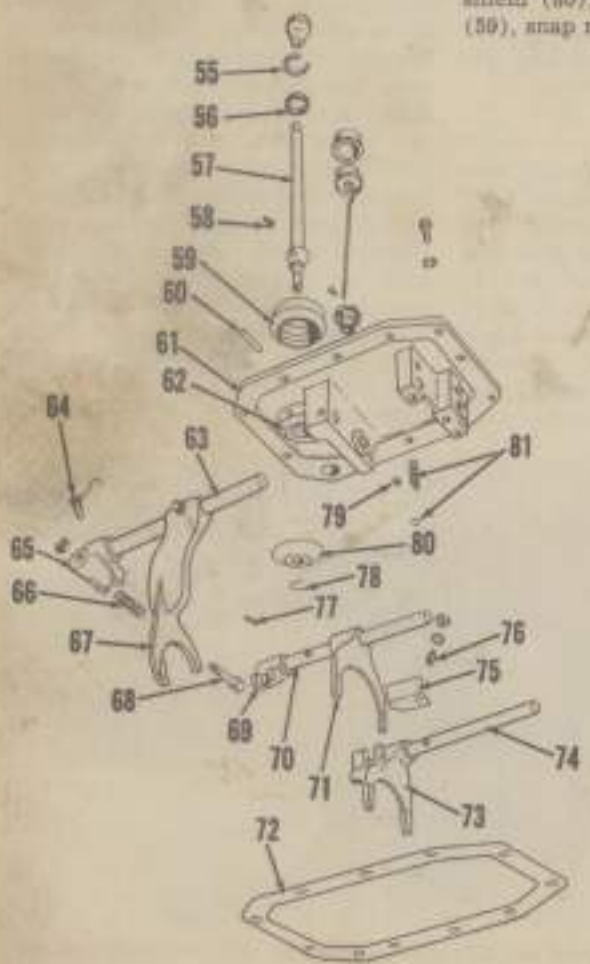


Fig. 119—Exploded view of the Allis-Chalmers D-17 transmission shifter assembly.

55. Snap ring
56. Pivot washer
57. Shift lever
58. Pivot pin
59. Dust cover
60. Long plunger
61. Cover
62. Insert
63. Reverse shift rail
64. Lock screw
65. Reverse fork
66. Spring
67. Shift fork (reverse)
68. Reverse latch plunger
69. First and second fork
70. First and second shift rail
71. Shift fork (1st & 2nd)
72. Gasket
73. Shift fork (3rd & 4th)
74. Third and fourth shift rail
75. Oil shield
76. Lock screw
77. Interlock pin
78. Snap ring
79. Short plunger
80. Oil shield
81. Detent spring and ball

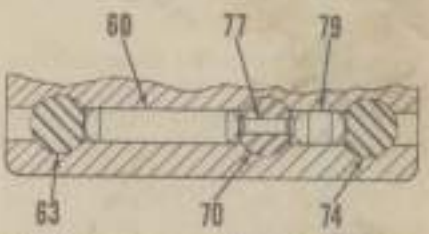


Fig. 121—Cut-away view of D-17 transmission cover showing location of interlock plungers and pin.

60. Long interlock plunger (1.081)
63. Reverse shift rail
70. 1st & 2nd shift rail
74. 3rd & 4th shift rail
77. Interlock pin (0.561)
79. Short interlock plunger (0.584)

SPLIT TRANSMISSION FROM TORQUE TUBE

180. To split the transmission housing from the torque housing, proceed as follows: Remove the "Power-Director" compartment filler cap and dipstick, drain the compartment and, if work is to be performed on the transmission, drain transmission lubricant. Disconnect the brake rods and remove both step plates. Remove the "snap coupler" pin by removing cotter pin and driving pivot pin out with another pin of same diameter, but short enough to disconnect the pivot joint while holding the snap coupler latch in position. Remove the hydraulic tube or tubes and tail light wire from left side of tractor. If equipped with shuttle clutch, disconnect the cooler tubes at filter base. Disconnect the filter tubes, if so equipped, at fittings on clutch cover and remove the filter unit and tubes as an assembly. On models with filter, remove the two cap screws (8—Fig. 100) from clutch cover. On models having a right hand control lever, remove the quadrant retaining nuts (3) and quadrant (4) from clutch cover. Then, unbolt and remove the clutch cover assembly.

If clutch shifter fork has a retaining set screw, loosen lock nut and remove set screw. Remove set screw from control lever; then remove lever, Woodruff key and washers from shaft. Remove snap ring and washer from opposite end of shaft. Slide shaft to right and remove "O" ring from end of shaft. If shifter fork did not have a retaining set screw, remove Woodruff key from shaft at right side of fork. Slide the shaft to left and remove Woodruff key from shaft at left side of shifter fork. Remove "O" ring from left end of shaft; then, remove shaft and shifter fork.

On wide front axle models, place wedges between front axle and front axle support. Place floor jack under torque housing and support rear unit under transmission. Unbolt torque housing from transmission and roll front unit away.

On tricycle models, unless suitable front end bracing is available, most mechanics prefer to adequately block up and support the front unit, unbolt torque housing from transmission and roll rear unit away.

OVERHAUL TRANSMISSION

Data on overhauling the various components which make up the transmission are outlined in the following paragraphs.

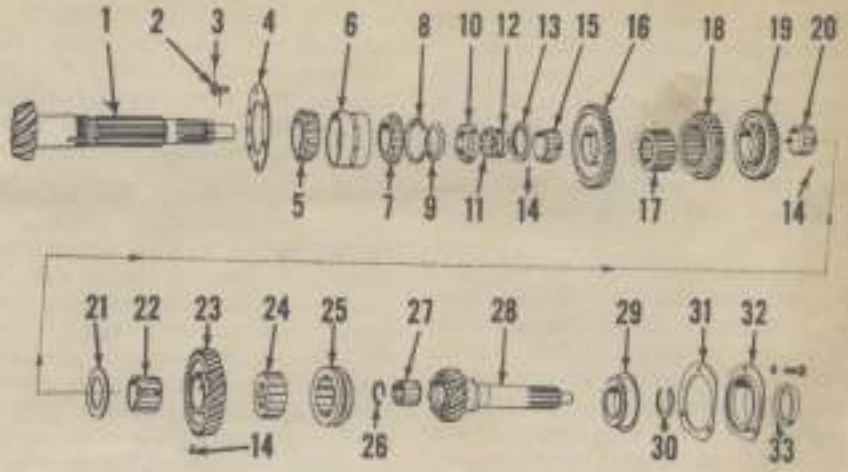


Fig. 122 — Exploded view of the D-17 transmission main drive (input) shaft (28), bevel pinion shaft (1) and associated parts.

1. Bevel pinion
2. Drilled cap screws
3. Wire
4. Retainer
5. Wide bearing cone
6. Double bearing cup
7. Narrow bearing cone
8. Snap ring (selective)
9. Locking washer
10. Lock nut
11. Split collar
12. Retainer
13. Thrust washer
14. Pins
15. Bushing
16. Gear (1st) (40T)
17. Collar
18. Gear (1st & 2nd) (34T)
19. Gear (2nd) (33T)
20. Bushing
21. Thrust washer
22. Bushing
23. Gear (3rd) (31T)
24. Collar
25. Coupling
26. Snap ring
27. Pilot bearing
28. Main (input) shaft
29. Bearing assembly
30. Snap ring
31. Gasket
32. Retainer
33. Seal

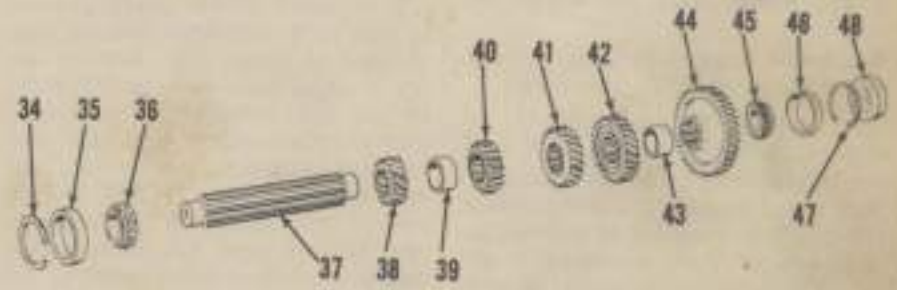


Fig. 123 — Exploded view of the D-17 transmission countershaft (37) and related parts.

34. Snap ring
35. Bearing cup
36. Bearing cone
37. Countershaft
38. Gear (1st) (19T)
39. Spacer
40. Gear (R) (18T)
41. Gear (2nd) (22T)
42. Gear (3rd) (28T)
43. Spacer
44. Gear (driven) (37T)
45. Bearing cone
46. Bearing cup
47. Snap ring (selective)
48. Plug

181. **SHIFTER RAILS.** Rails and forks can be removed and overhauled as outlined in paragraph 179.

182. **MAIN DRIVE (INPUT) SHAFT.** To remove and overhaul this shaft, proceed as follows: Split the transmission housing from torque housing as outlined in paragraph 180. Remove the large snap ring retaining the "Power-Director" clutch hubs in the clutch assembly; then, withdraw the spacer, the two clutch hubs and the thrust washer. Remove the small snap ring that retains clutch assembly to transmission shaft and pull clutch from shaft. Remove the transmission cover as outlined in paragraph 179. Remove the cap screws attaching the bearing retainer (32—Fig. 122) to the transmission housing; then, working through the top cover opening, bump the main drive shaft (28) forward out of transmission housing.

NOTE: Rather than remove transmission cover, some mechanics prefer the following procedure: After removing cap screws attaching the bearing retainer to front of transmission, turn the transmission input shaft so that the shifter collar splines are out of alignment. Then, while holding the input shaft in this position, bump the shaft and retainer forward by attempting to shift the transmission lever into fourth gear.

Transmission bevel pinion pilot bearing (27) is contained in gear end of main drive shaft and bearing can be renewed at this time. Transmission main drive shaft pilot bearing (28—Fig. 107) located in rear end of engine clutch shaft can also be renewed at this time.

Prior to tractor Serial No. D17-38899, two single lip type seals were used in the mainshaft bearing retainer. Front seal should be installed with lip forward and rear seal with lip to rear. On tractor Serial No. D17-38899 and up, a double lip type seal (33—Fig. 125) is used; install this later type seal with spring loaded lip to rear.

At tractor Serial No. D17-13075, a new bearing (29—Fig. 122) was used in production. It is recommended that this bearing (Allis-Chalmers Part No. 231175) be used to renew bearing on prior production tractors. Install this later type bearing with shielded side to rear. Also, discard undrilled retainer cap screws on the early models and install cap screws with drilled heads. Tighten the retainer cap screws to a torque of 10-15 Ft.-Lbs. and securely tie wire through drilled heads.

At tractor Serial No. D17-38899, a heavier bearing retainer (32) was used in production, and cap screws are retained by lock washers instead of lock wire; tighten cap screws securely.

Reinstall transmission input shaft by reversing removal procedure.

183. **BEVEL PINION SHAFT.** To remove the bevel pinion shaft, the input shaft must be removed as outlined in paragraph 182 and the differential unit be removed as outlined in paragraph 197. Then, working through the differential compartment, remove the locking wire (3—Fig. 122 or 125), cap screws (2) and bearing retainer (4). Remove snap ring (26) from front end of pinion shaft and withdraw the splined coupling (25) and splined collar (24). Then, bump or push bevel pinion shaft (1) to rear removing gears, collars, bushings, washers, retainer (12) and split collar (11) as the shaft is moved to rear. Bearing assembly (5, 6 and 7), locking washer (9) and retaining nut (10) will be removed with pinion shaft.

NOTE: The first, second and third gears turn on bushings (15, 20 and 22). Each bushing is prevented from turning on the pinion shaft by small pins (14) which are inserted in holes in the bushings from the inside and engage splines in the pinion shaft.

For tractors prior to Serial No. D17-38899, the bevel pinion can be purchased separately from bevel ring gear. Snap ring (8), which is available in thicknesses of 0.177 to 0.191 in steps of 0.002, controls the bevel gear mesh position for a particular transmission housing. If necessary to renew the snap ring on tractors prior to tractor Serial No. D17-38899, be sure that replacement is of exact same thickness as snap ring removed from housing. If a new transmission housing is being installed, it will contain a snap ring of correct thickness.

For tractor Serial No. D17-38899 and up, the bevel pinion shaft can be purchased only in a set with matched bevel ring gear. If bevel gear set, pinion bearings or transmission housing is renewed, a new snap ring must be selected according to procedure outlined in paragraph 193 for correct bevel gear mesh position. If only the snap ring is being renewed, be sure to obtain replacement snap ring of exact same thickness.

To remove bearings from pinion shaft, bend tab of locking washer (9) back out of slot in nut (10) and remove nut from shaft. The bearings and locking washer can then be removed. Bearing cones (5 and 7) are not serviced separately from bearing cup (6).

To reinstall pinion shaft, proceed as follows: Install wide bearing cone (5) next to pinion gear. Bearing cup (6) is reversible; however, if reinstalling cup, examine for wear pattern and place side of cup with widest wear pattern to rear. Install narrow bearing cone (7) and locking washer (9). Install nut (10) and adjust nut so that 5-8 inch-pounds torque is required to turn shaft in the bearing assembly. Be sure that snap ring (8) is installed in groove at front of bearing bore in transmission housing and insert shaft and bearing in bore from rear. Apply heavy grease to split collar (11) and retainer (12) to hold them in place; install split collar in groove on pinion shaft and install retainer over split collar. Bump or push pinion shaft assembly forward while installing components in following order: Install first gear bushing (15) with pins forward. (Note: Heads of lock pins are placed to inside of bushing. Peen or rivet pins into bushings to hold them in place during reassembly.) Install first gear (16) (40 teeth) with clutch jaws forward. Install splined collar (17) and sliding gear (18) (34 teeth) with shift fork groove to rear. Install second gear bushing with lock pins forward. Install second gear (19) (35 teeth) with clutch jaws to rear. Install thrust washer (21). Install third gear bushing (22) with lock pins forward. Install third gear (23) with clutch jaws forward. At this time, bevel pinion shaft bearing cup should be tight against the snap ring in transmission housing. Install splined collar (24); then, install thickest snap ring (26) that can be installed in groove on front end of pinion shaft. Snap ring is available in thicknesses of 0.085 to 0.109 in steps of 0.006. Install shifter coupling (25) over splined collar with beveled edge of coupling to front. Install bevel pinion shaft bearing retainer (4), insert cap screws (2) and tighten cap screws to a torque of 45-50 Ft.-Lbs. and secure with locking wire (3) placed through drilled heads of cap screws.

Reinstall main drive (input) shaft and retainer assembly as outlined in paragraph 182. Reassemble tractor in reverse of disassembly procedure.

184. **COUNTERSHAFT.** To remove countershaft and gears, the bevel pinion shaft must first be removed as outlined in preceding paragraph 183. Then, remove plug (48—Fig. 123 or 125) and snap ring (47) from front face of transmission housing. Thread slide hammer adapter into front end of shaft and bump shaft forward out of housing; or, drive shaft out to front with a soft drift punch. Gears (38, 40, 41, 42 and 44), spacers (39 and 43) and rear bearing cone (36) can be removed out top opening. Front bearing cone (45) and cup (46) will be pulled with shaft. If necessary to renew rear bearing cup (35), drive cup out to front.

End play of countershaft in bearings is controlled by varying the thickness of the snap ring (47) at front end of shaft. This snap ring is available in thicknesses of 0.069 to 0.109 in steps of 0.004. If use of the thickest snap ring (0.109) is not sufficient to control end play, the rear snap ring (34) may be removed and a 0.109 snap ring installed in that position; then, readjust end play with front snap ring. As the bearing cones fit against the gear and spacer stack instead of against shoulders on countershaft, end play can be checked only

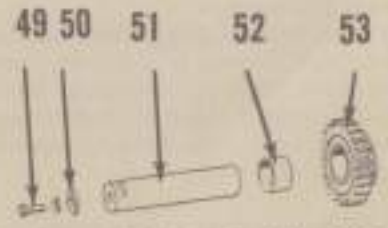


Fig. 124 — Exploded view of the D-17 reverse idler gear and shaft. Bushing (52) is renewable.

48. Cap screw
50. Lock plate
51. Shaft
52. Bushing
53. Idler gear

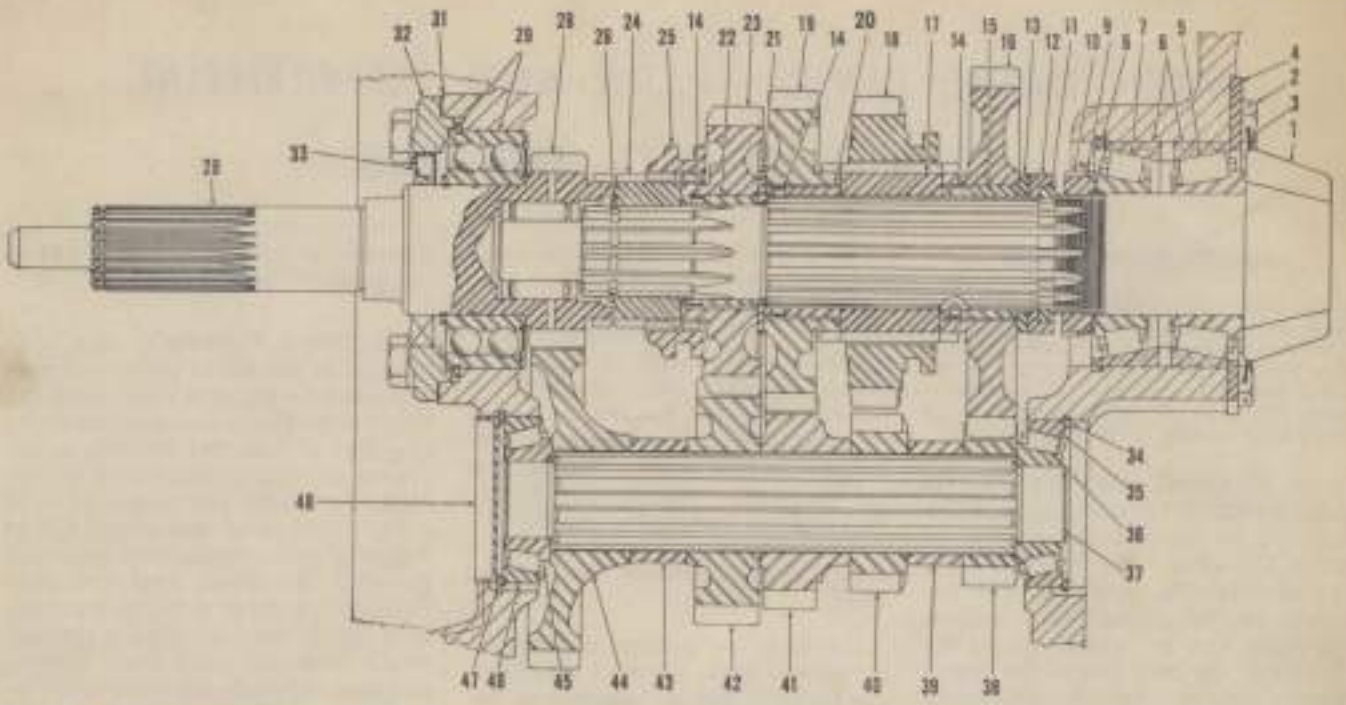


Fig. 125—Cross-section view of the D-17 transmission showing assembly of transmission input shaft, bevel pinion shaft, countershaft and related parts. Exploded views of component parts are shown in Fig. 122 and Fig. 123.

1. Bevel pinion
2. Drilled cap screws
3. Wire
4. Retainer
5. Wide bearing cone
6. Double bearing cup
7. Narrow bearing cone
8. Snap ring (selective)
9. Locking washer
10. Lock nut
11. Split collar
12. Retainer
13. Thrust washer
14. Pins
15. Bushing
16. Gear (1st) (40T)
17. Collar
18. Gear (1st & 2nd) (34T)
19. Gear (2nd) (35T)
20. Bushing
21. Thrust washer
22. Bushing
23. Gear (3rd) (31T)
24. Collar
25. Coupling
26. Snap ring
28. Main (input) shaft
29. Bearing assembly
31. Gasket
32. Retainer
33. Seal
34. Snap ring
35. Bearing cup
36. Bearing cone
37. Countershaft
38. Gear (1st) (16T)
39. Spacer
40. Gear (R) (18T)
41. Gear (2nd) (22T)
42. Gear (3rd) (26T)
43. Spacer
44. Gear (driven) (37T)
45. Bearing cone
46. Bearing cup
47. Snap ring (selective)
48. Plug

when the shaft is installed with all gears and spacers in place and all end play removed from gears and spacers.

To reinstall countershaft, proceed as follows: Drive front bearing cone onto end of countershaft having threaded hole. Install rear snap ring (normally 0.093 thick) and drive rear bearing cup in tightly against snap ring. Insert shaft through front bearing bore and install gears, spacers and rear bearing cone in following order: Install driven gear (44) (37 teeth) with long hub to rear; spacer (43) (0.996 wide); third gear (42) (26 teeth) with long hub to front; second gear (41) (22 teeth) with long hub to rear; reverse gear (40) (18 teeth) with beveled edge of teeth to rear; spacer (39) (0.868 wide); place rear bearing cone in cup and then install first gear (38) (16 teeth). Note: First gear is reversible but should be reinstalled in same position from which it was removed due to developed wear pattern.

Drive or push the countershaft through the rear bearing cone and install the front bearing cup and snap ring. Seat front bearing cup by bumping shaft assembly forward; then, remove all end play from countershaft gears and spacers by driving against inner race of front bearing cone with a hollow driver. Note: Tightness of bearing cones on shaft will retain gears and spacers in this "no end play" position. Then, check end play of the complete shaft, gears and spacer assembly with a dial indicator while moving the assembly back and forth between the front and rear bearing cups. If end play is not within 0.0005-0.0045, remove snap ring (47) and install snap ring of proper thickness to bring end play within recommended limits.

Apply sealer to rim of plug (48) and drive plug into bearing bore (flat side in) until rim of plug is flush with transmission housing. Reassemble tractor in reverse of disassembly procedure.

185. **REVERSE IDLER.** The reverse idler gear and shaft can be removed after tractor is split between transmission and torque housing and with the transmission cover and lift rockshaft cover removed; however, in most instances it will be removed only when bevel pinion shaft and countershaft are being serviced as outlined in paragraphs 183 and 184.

To remove the reverse idler shaft, proceed as follows: Remove cap screw (49—Fig. 124) and lockplate (50) from differential compartment. Thread slide hammer adapter into rear end of shaft, pull shaft from housing and remove gear out top opening of transmission.

Reverse idler rotates on a renewable bronze bushing (52). When renewing bushing, press new bushing in flush with flat side of gear and hone bushing to 1.2375-1.2385. Service shaft (51) may have lock notch in each end; rear end of this type shaft is 0.002 oversize. Clearance of shaft in bushing should be 0.002-0.004.

Install shaft with end having threaded hole to rear and reverse gear with shifter groove to front. Install lockplate, cap screw and lockwasher at rear end of shaft.

MAIN DRIVE BEVEL GEARS AND DIFFERENTIAL
D-14 AND D-15 MODELS

ADJUST BEVEL GEARS

The tooth contact (mesh position) of the main drive bevel pinion and ring gear is controlled by varying the thickness of snap ring (20—Fig. 117). The backlash of the bevel gears is controlled by transferring shims (61—Fig. 126) from one side of the differential housing to the other.

186. **BEARING AND BACKLASH ADJUSTMENT.** Carrier bearings are adjusted by varying the number of shims (61—Fig. 126) located under the carriers (60). Although shim removal can be accomplished without removing the rockshaft housing (bolted to the rear face of the transmission housing), there is no sure way of checking the bearing adjustment or the pinion to ring gear backlash without doing so.

187. To adjust the differential carrier bearings, first remove both final drive assemblies as outlined in paragraph 201, the brake shoes from their brackets and the rockshaft housing from rear face of transmission housing. Vary the number of 0.004 thick shims (61—Fig. 126), located between carriers and housing, to remove all bearing play but permitting differential to turn without binding. Removing shims reduces bearing play. NOTE: When making the bearings adjustment, make certain that there is some backlash between gears at all times.

188. After the bearings are adjusted as outlined in the previous paragraph, the backlash can be adjusted as follows: Transfer shims from under one bearing carrier to the other to provide 0.007-0.012 backlash between teeth of the main drive bevel pinion and ring gear. To increase backlash, remove shim or shims from carrier on ring gear side of housing and install same under carrier on opposite side.

189. **MESH POSITION.** The mesh position of the bevel pinion and ring gear must be adjusted when renewing either bevel pinion and bearings or the ring gear or both. The first step in adjusting the mesh position is to remove all gears, spacers and shims (22 to 36 —Fig. 115) using paragraph 175 as a general guide during this operation. Reinstall the pinion shaft with only bearings (19, 21, 38 & 39) on the shaft; then tighten the retaining nut (40) until the shaft (18) turns freely with no end play. Reinstall the differential assembly and adjust the bearings and backlash referring to paragraphs 187 and 188. Using mechanics (Prussian) blue, check the mesh position of the gears. If there is not a central mesh position, remove the differential, loosen nut (40), and install a different thickness snap ring (20). Then recheck the mesh position. Snap ring (20) is available in thicknesses from 0.060 to 0.072 in graduations of 0.003. A thicker snap ring will move the bevel pinion toward the rear. Refer to paragraph 176 when reinstalling the bevel pinion shaft.

190. **R&R AND OVERHAUL DIFFERENTIAL.** To remove the differential unit from the transmission housing. Remove both final drive units as outlined in paragraph 201, the brake shoes from their brackets, the rockshaft housing from rear face of transmission housing and the differential carrier from each side of transmission

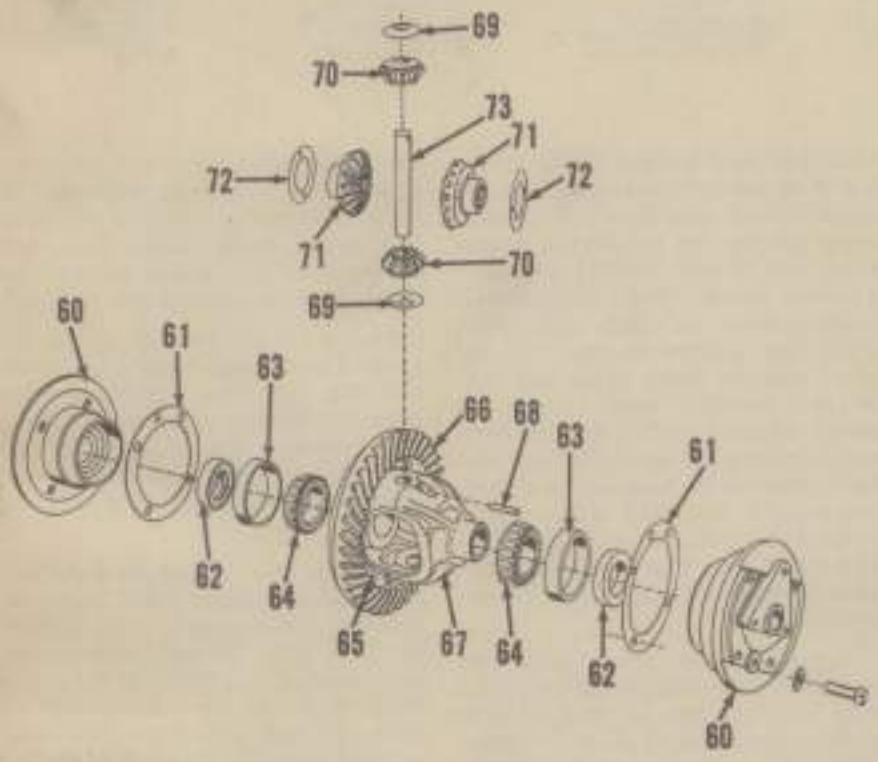


Fig. 126—Exploded view of the D-14 and D-15 differential unit including the bearing carriers (60). The main drive bevel gear backlash adjustment is accomplished by transferring shims (61) from under one bearing carrier (60) to the other as required to obtain the desired backlash of 0.007-0.012.

60. Bearing carriers
61. Shims (0.004)
62. Oil seal
63. Bearing cup
64. Bearing cone
65. Sliver
66. Sling gear
67. Differential case
68. Lock pin
69. Thrust washers
70. Differential pinions
71. Side gears
72. Thrust washers
73. Pinion shaft

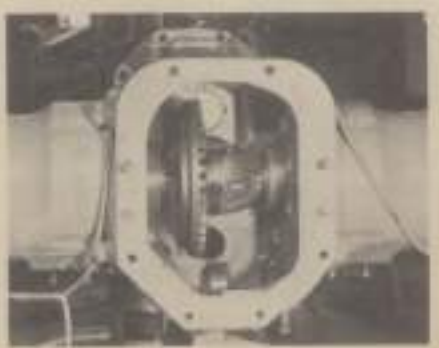


Fig. 127 — View showing the D-14 and D-15 differential unit installed.

housing. Make certain shims (61—Fig. 126), located under each bearing carrier, are not mixed, lost or damaged.

191. To disassemble the differential, drive out the lock pin (68—Fig. 126) and remove pinion shaft (73). Differential pinions (70), side gears (71), and thrust washers (69 & 72) can then be removed from the case.

If backlash between teeth of side gears and teeth of pinions is excessive, renew side gear thrust washers (72) and/or the pinion thrust washers (69). If backlash is still excessive after renewing thrust washers, it may be necessary to renew bevel pinions and/or side gears.

The bevel ring gear, which is available separately from the bevel pinion, is riveted to the differential case. The ring gear can be removed after first removing the attaching rivets. Special bolts are available for service from Allis-Chalmers dealers. Don't use ordinary bolts. After ring gear is attached, check trueness at ring gear back face with a dial indicator with unit in its carriers or between centers of a lathe. Total run-out should not exceed 0.003.

After unit is reinstalled in transmission housing, adjust bearings and backlash as outlined in paragraphs 187 and 188. If the ring gear was renewed adjust the mesh position as outlined in paragraph 189.

MAIN DRIVE BEVEL GEARS AND DIFFERENTIAL

D-17 MODELS

BEVEL GEAR MESH POSITION

Prior to Tractor Serial No. D17-38899

192. The fore and aft (mesh) position of the bevel pinion is controlled by the snap ring (8—Fig. 125) which is fitted to the transmission housing at the factory. Unless the transmission housing is renewed, there is no need to change the snap ring thickness. If necessary to renew snap ring, make certain that replacement snap ring is of exact same thickness. If the transmission housing is being renewed, the new housing will contain a snap ring of correct thickness.

Fig. 128—View showing bearing assembled on D-17 transmission bevel pinion shaft. Dimension "D" is used in determining thickness of snap ring (8—Fig. 125) in late production tractors. Refer to text.

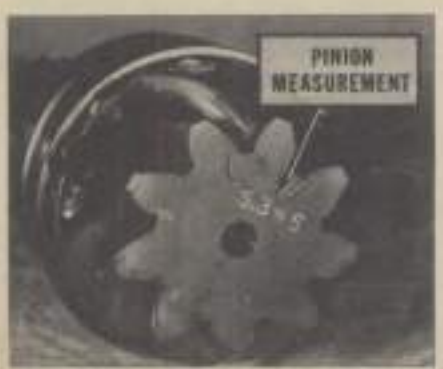


Fig. 129 — Cone measurement etched on rear face of D-17 pinion gear is used in determining thickness of snap ring (8—Fig. 125) in late production tractors. Refer to text.

Tractor Serial No. D17-38899 and Up

193. Mesh position of bevel pinion to ring gear is controlled by thickness of snap ring (8—Fig. 125) which is selected for a particular assembly of transmission housing, pinion bearing assembly (5, 6 and 7) and matched ring gear and bevel pinion set. The following procedure should be observed in selecting a new snap ring thickness if transmission housing, pinion bearings and/or ring gear and bevel pinion set are renewed:

Assemble bearings on bevel pinion shaft as follows: Install wide roller bearing cone firmly against shoulder on bevel pinion shaft. Place bearing cup on cone (cup is reversible, but match wide roller wear pattern to rear cone if same cup is being used) and install narrow front roller bearing cone. Install locking washer (9) and nut (10). Tighten nut to obtain 5-8 inch-pounds pre-load on bearings and bend tab of locking washer into notch on nut.

Measure distance (D—Fig. 128) from front edge of pinion bearing cup to rear face of rear bearing cone. Add this measurement to dimension etched on rear face of bevel pinion gear (See Fig. 129). Subtract the sum of these two dimensions from the measurement stamped at top center on rear face of transmission housing at a location directly below the transmission serial number. The remainder will be the thickness of the snap ring required for correct pinion mesh adjustment. Snap rings are available in thicknesses of 0.177 to 0.191 in steps of 0.002.

As an example of this procedure, let the measurement "D" (See Fig. 128) be 2.310. Add this dimension to dimension etched on rear face of pinion gear, which on gear shown in Fig. 129 is 5.345. This gives a sum of 7.655. If the dimension stamped below the transmission serial number on rear face of transmission housing is 7.840, subtracting 7.655 from 7.840 would indicate the desired snap ring thickness of 0.185. As this example would indicate, extreme care must be taken in making measurement "D" as shown in Fig. 128.

BEVEL GEAR BACKLASH

194. To adjust the backlash between bevel pinion and the bevel ring gear, follow procedure outlined in paragraph 196 for adjustment of the differential carrier bearings.

RENEW BEVEL GEARS

195. As the bevel pinion is an integral part of the transmission output shaft, refer to paragraph 183 for service procedures.

The bevel ring gear is renewable when the differential assembly is removed as outlined in paragraph 197. On factory assembled differential units, the ring gear is riveted to the differential housing. Special bolts and nuts are available for service installa-

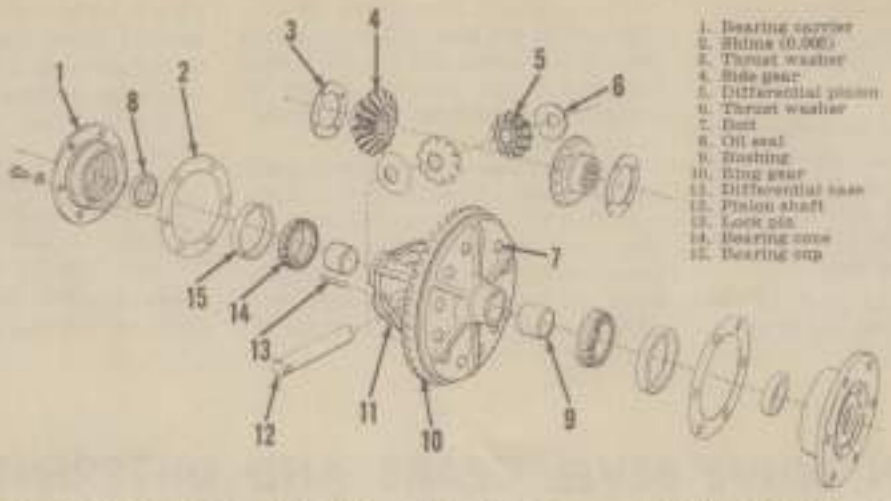


Fig. 130—Exploded view of the differential unit. On tractor Serial No. D17-38899 and up, bearing carriers (1) are equipped with an "O" ring seal to transmission housings. On tractor Serial No. D17-42001 and up, outer face of bearing carriers are machined for inner friction plate surface of the Bendix band/disc type brakes.

tion of ring gear. Cut rivets to remove original ring gear from housing. Install bolts with heads on ring gear side of assembly and tighten nuts securely. Install cotter pins through castellated nuts and drilled bolts.

NOTE: Prior to tractor Serial No. D17-38899, bevel pinion and bevel ring gear are available separately for service. On tractor Serial No. D17-38899 and up, bevel pinion and bevel ring gear are available and should be installed as a matched set only; also, bevel gear mesh position should be readjusted as outlined in paragraph 193.

DIFFERENTIAL

196. **CARRIER BEARING & BEVEL GEAR BACKLASH ADJUSTMENT.** To adjust the differential carrier bearings, first remove both final drive assemblies as outlined in paragraph 207, the lift rockshaft housing as outlined in paragraph 247 and, on tractor Serial No. D17-42001 and up, remove the band/disc type brakes as outlined in paragraph 216. Vary the number of steel shims (2—Fig. 130) located between the bearing carriers (1) and the transmission housing to remove all bearing play, but permitting differential to turn without binding. Removing shims reduces bearing play. Shims are available in thicknesses of 0.005, 0.007 and 0.020. Note: When adjusting bearing play, make certain that there is some backlash between the bevel pinion and ring gear at all times.

After the bearing play is adjusted, the backlash between bevel pinion and ring gear must be checked and/or adjusted as follows: Transfer shims (2) from under one bearing carrier to under the opposite bearing carrier to provide 0.005-0.014 backlash between teeth of pinion and ring gear. To increase backlash, remove shims from under carrier on right side of housing and install the shims under carrier on left side of housing. Note: Right and left as viewed from rear of tractor.

After adjusting bearing play and bevel gear backlash on tractor Serial No. D17-42001 and up, distance between brake friction surface on bearing carriers and surface on brake outer friction plates should be adjusted as outlined in paragraph 216.

197. **R&R AND OVERHAUL.** To remove the differential unit from transmission housing, first remove both final drive units as outlined in paragraph 207, the lift rockshaft housing as outlined in paragraph 247, and, on tractor Serial No. D17-42001 and up, remove the band/disc type brakes as outlined in paragraph 216. The differential unit can then be removed from rear opening in transmission housing after removing the differential bearing carriers. Make certain that shims (2—Fig. 130) located between the bearing carriers and transmission housing are not mixed, lost or damaged.

To disassemble the differential unit, drive out the lock pin (13), then remove differential pinion shaft (12). Differential pinions (5), side gears (4), and thrust washers (3 and 6) can then be removed from the case.

If backlash between teeth of side gears and pinion gears is excessive, renew the side gear thrust washers (3) and/or the pinion thrust washers (6). If backlash is still excessive after renewing thrust washers, it may be necessary to renew the pinion gears and/or side gears. New oil seals should be installed in bearing carriers with the lip facing inward.

Factory installed ring gear is riveted to the differential case. Special bolts and nuts are available for service installation of ring gear to case. Install bolts with heads on ring gear side of assembly. Tighten the nuts securely and install cotter pins through the castellated nuts and drilled bolts. On tractor Serial No. D17-38899 and up, ring gear is available only in a set with matched bevel pinion; renewal of the matched ring gear and bevel pinion also requires adjustment of the bevel pinion mesh position as outlined in paragraph 193.

Inspect final drive pinion shaft bushings (9) in each side of differential case and renew bushings if excessively worn or scored.

When reinstalling differential unit in tractors prior to tractor Serial No. D17-38899, apply No. 3 Permatex or equivalent to pilot surface of differential bearing carriers and to threads of retaining cap screws. Tighten the retaining cap screws to a torque of 45-50 Ft.-Lbs.

On tractor Serial No. D17-38899 and up, install new "O" rings on differential bearing carriers and lubricate "O" rings with Lubriplate or equivalent grease. Install the bearing carriers, apply No. 3 Permatex or equivalent to threads of retaining cap screws and tighten the cap screws to a torque of 90-100 Ft.-Lbs.

Check backlash of bevel pinion to ring gear and readjust if necessary as outlined in paragraph 196.

FINAL DRIVE

D-14 and D-15 Models

198. **ADJUST WHEEL AXLE SHAFT BEARINGS.** Adjust bearings to a free rolling fit with no end play by varying the number of shims (6—Fig. 131) interposed between wheel axle shaft retaining cap screw washer (5) and inner end of shaft.

199. **RENEW WHEEL AXLE, BEARINGS AND/OR BULL GEAR.** To renew either the wheel axle shaft (18—Fig. 131), bull gear (13) and/or wheel axle shaft oil seal (17) or bearings (7 & 16), proceed as follows: Drain bull gear housing; then remove housing pan and rear wheel and tire unit. Remove wheel axle shaft bearing dust cap, cap screw, washer (5) and shims (6). Working through bull gear housing opening remove bull gear positioning snap ring (12). Support bull gear and bump wheel axle shaft out of bull gear and housing.

The oil seal (17) (lip facing bull gear) and/or bearings can be renewed at this time. Long hub of gear should face toward wheel. Adjust wheel axle shaft bearings to a free rolling fit with no end play by varying the number of shims (6) located on inner end of shaft.

200. **ADJUST BULL PINION BEARINGS.** Remove rear wheel and tire as a unit. Adjust bull pinion shaft bearings to a free rolling fit with zero end play by varying the number of shims (20 & 21—Fig. 131) interposed between bull gear housing (2) and bull pinion bearing retainer (19).

201. **R & R FINAL DRIVE UNIT.** Support rear portion of tractor and remove rear wheel and fender. Detach platform from the final drive housing; then, remove the cap screws which retain final drive housing to transmission case and withdraw the final drive unit from the tractor.

202. **RENEW BULL PINION, BEARINGS AND/OR BRAKE DRUM.** To renew either the bull pinion (integral with shaft), pinion bearings, oil seals, and/or brake drum, remove final drive from the tractor as in paragraph 201; then proceed as follows: Using a suitable puller, remove the brake drum; then remove Woodruff key (25—Fig. 131) and brake drum positioning snap ring (10—Fig. 135). Remove outer bearing retainer and shims (20 & 21—Fig. 131). Then bump bull pinion shaft on inner end and remove from housing.

Adjust bull pinion shaft bearings to provide zero end play and a free-rolling fit by varying the number of shims (20 & 21).

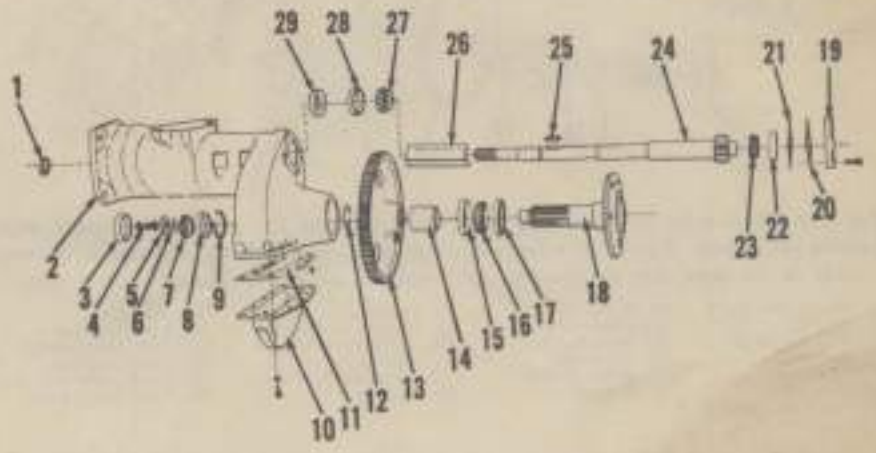


Fig. 131—Exploded view of D-14 and D-15 final drive assembly.

1. Oil seal
2. Final drive housing
3. Dust cap
4. Cap screw
5. Washer
6. Shims (0.005)
7. Bearing cone
8. Bearing cup
9. Snap ring
10. Pan
11. Gasket
12. Snap ring
13. Final drive (bull) gear
14. Spacer
15. Bearing cup
16. Bearing cone
17. Oil seal
18. Wheel axle shaft
19. Bearing retainer
20. Shims (0.005) paper
21. Shims (0.010) steel
22. Bearing cup
23. Bearing cone
24. Bull pinion shaft
25. Woodruff key
26. Pinion oil tube
27. Bearing cone
28. Bearing cup
29. Oil seal

D-17 Models

203. **ADJUST WHEEL AXLE BEARINGS.** When adjusting wheel axle shaft bearings with bull pinion removed from final drive housing, add or remove shims (27—Figs. 132 and 133) between end of wheel axle shaft and the pinned washer (28) to obtain proper bearing adjustment. Bearing adjustment is correct when a torque of 60-80 inch-pounds is required to turn the wheel axle shaft (with outer seal installed).

If making adjustment with final drive installed on tractor, proceed as follows: Adjust bearings by adding or removing shims (27) between the inner end of wheel axle shaft and pinned washer to remove all noticeable end play without creating any noticeable binding condition.

204. **RENEW WHEEL AXLE BEARINGS, SEAL AND/OR BULL GEAR.** Support rear end of tractor and remove rear wheel and tire unit. Remove lower cover (23—Figs. 132 and 133) from final drive housing. Note: No drain plug is provided; remove cover with oil it contains. Disengage the snap ring (21) holding bull gear (20) in position on axle shaft (16). Remove the cap (29) from inner end of axle shaft and remove the retaining cap screw (26), lockwasher, pinned washer (28) and shims (27). Then, while supporting bull gear, bump the axle shaft out of bull gear and final drive housing.

If not removed with axle shaft, remove the axle seal (17) and outer bearing cone (18) from housing. If necessary to renew bearing cups, drive cups from housing.

To reinstall removed parts, proceed as follows: Drive outer bearing cup (18) in tightly against shoulder in housing and inner bearing cup (25) in tight against snap ring (24). Lubricate outer bearing cone and place cone in cup. Soak new seal (17) in oil, wipe off excess oil and apply gasket sealer to outer rim of seal. Install the seal with lip to inside of housing. In-

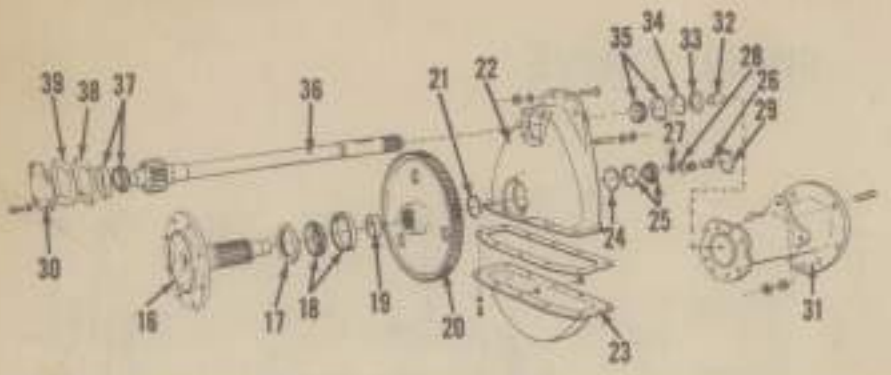


Fig. 132—Final drive and rear axle unit. Shims (38 and 39) control bull pinion shaft bearing adjustment. Shims (27) control wheel axle shaft bearing adjustment. Bushing (32) is the same part as (9—Fig. 130) which is pressed in the differential case.

16. Wheel axle shaft
17. Oil seal
18. Outer bearing
19. Spacer
20. Bull gear
21. Snap ring
22. Bull gear housing
23. Pan
24. Snap ring
25. Inner bearing
26. Cap screw
27. Shims (0.006)
28. Washer
29. Dust cap
30. Bearing retainer
31. Bull pinion shaft housing
32. Pinion shaft bushing
33. Oil seal
34. Snap ring
35. Inner bearing
36. Bull pinion shaft
37. Outer bearing
38. Shim (0.006 vellum)
39. Shim (0.015 steel)

sert axle shaft through seal and outer bearing cone until spacer (19) can be placed on end of shaft, then position bull gear in housing with long hub to outside and push shaft on through spacer and bull gear until snap ring (21) can be placed over end of shaft. Press axle shaft inward until shoulder of shaft is against outer bearing cone and snap ring (21) can be installed in groove against inner side of bull gear hub. Install inner bearing cone (25), shims (27), pinned washer (28), lockwasher and retaining cap screw (26). Check adjustment of axle bearings as outlined in paragraph 169 and adjust bearings if necessary. Apply sealer to rim of cap and drive the cap into place. Fill housing lower cover with 1¼ quarts of SAE 80 EP transmission lubricant and install cover using new gasket. Tighten cover retaining cap screws to a torque of 10-14 Ft.-Lbs.

205. **ADJUST BULL PINION BEARINGS.** Bull pinion shaft should have 0-0.005 end play. To adjust bull pinion bearings, proceed as follows: Remove rear wheel and tire as a unit. Remove bearing retainer cap (30—Figs. 132 and 133) from final drive housing (22) and remove all shims (38 and 39) from between cap and housing. Reinstall retainer without any shims and draw retaining cap screws and stud nuts up evenly and snugly. Check clearance between bearing retainer and final drive housing with feeler gage. Remove the bearing retainer and install shims of total thickness equal to the clearance measured with feeler gage plus zero to 0.005. Alternately place paper and steel shims for proper sealing. (A paper shim should be placed on each side of shim stack.) Paper (vellum) shims are 0.006 thick and steel shims are 0.015 thick.

206. **RENEW BULL PINION, BEARINGS AND/OR OIL SEAL.** On models prior to tractor Serial No. D17-42001, first remove brake shoes as outlined in paragraph 213. Then, on all models, proceed as follows:

Support rear end of tractor and remove rear wheel and tire unit and rear fender. Support the final drive assembly and unbolt final drive sleeve from transmission housing. Carefully withdraw the final drive and pinion shaft from transmission housing and differential unit.

Remove the brake drum or splined brake hub from inner end of pinion shaft and then remove Woodruff key and snap ring from shaft. Normally, brake drum or splined hub can be removed with suitable pullers. However, if drum or hub is seized to pinion shaft and resists efforts to remove same, some mechanics prefer to break the drum or hub from shaft rather than to expend excessive time in pulling hub or drum.

After removing the bearing retainer (30—Figs. 132 and 133), the final drive pinion shaft (36) can be bumped out towards outside end of unit. Be careful not to catch inner bearing cone (35) on teeth of bull gear. If inner bearing cup or seal (33) is to be renewed, pinion shaft sleeve (31) must be unbolted and removed from final drive housing. Then remove seal, snap ring (34) and bearing cup. Bearing cones can now be renewed on pinion shaft.

To reassemble, proceed as follows: Drive inner bearing cup (35) in far enough to install snap ring (34); then, drive bearing cup back against snap ring. Drive bearing cones tightly against shoulders on pinion shaft and insert shaft into final drive housing. Note: If seal (33) was not removed, tape inner end of shaft at Woodruff key and snap ring grooves to prevent damage to seal. Install outer bearing cup, shims and bearing retainer. Pinion shaft end play should be zero to 0.005. Add or remove shims (38 and 39) if end play is not within recommended limits. Alternate paper (vellum) shims (0.006 thick) and steel shims (0.015 thick) for proper sealing and use paper shim on each side of shim stack. Soak new seal (33) in oil, wipe off excess oil and apply gasket sealer to outer rim of seal. Install seal over pinion shaft with lip towards pinion gear and drive seal into final drive housing flush with end of bore.

Apply shellac or equivalent setting sealer to contact surfaces of final drive housing and pinion sleeve. Tighten the retaining nuts to a torque of 130-140 Ft.-Lbs. on models prior to tractor Serial No. D17-24001; on tractor Serial No. D17-24001 and up, tighten the nuts to a torque of 200-210 Ft.-Lbs.

Install snap ring, Woodruff key and brake drum or brake hub on pinion shaft and reinstall final drive unit to transmission, taking care not to damage seal in differential bearing carrier. Tighten the retaining nuts to a torque of 130-140 Ft.-Lbs. on models prior to tractor Serial No. D17-24001; tighten retaining nuts to a torque of 200-210 Ft.-Lbs on tractor Serial No. D17-24001 and up. Reinstall brake shoes on models prior to tractor Serial No. D17-42001. Reinstall wheel and tire unit and rear fender.

207. **R&R FINAL DRIVE UNIT.** On models prior to tractor Serial No. D17-42001, first remove the brake shoes as outlined in paragraph 213. Then, on all models, proceed as follows: Support rear end of tractor and remove rear wheel and tire unit and rear fender. Support final drive unit and unbolt pinion shaft sleeve from transmission. Carefully withdraw the final drive and pinion shaft from transmission housing and differential unit.

Reverse removal procedure to reinstall final drive unit taking care not to damage seal in the differential bearing carrier. On models prior to tractor Serial No. D17-24001, tighten

the retaining nuts to a torque of 130-140 Ft.-Lbs.; on tractor Serial No. D17-24001 and up, tighten the retaining nuts to a torque of 200-210 Ft.-Lbs.

208. **RENEW FINAL DRIVE PINION SHAFT SLEEVE.** On tractors prior to tractor Serial No. D17-42001, remove the brake shoes as outlined in paragraph 213. Then, on all models, remove the final drive unit as outlined in paragraph 207. Remove the brake drum (on models prior to tractor Serial No. D17-42001) using suitable pullers. On tractor Serial No. D17-42001 and up, remove the brake outer friction plate from inner end of pinion shaft sleeve. Be careful not to lose or damage shims between the and sleeve.

The pinion shaft sleeve (31—Fig. 132 or 133) may now be unbolted and removed from the final drive housing. Install the new sleeve as follows: Apply shellac or equivalent setting sealer to contact surfaces of sleeve and final drive housing. Install sleeve to housing leaving out the two cap screws (X—Fig. 134). Ream the two cap screw holes to 0.623-0.625 using holes in final drive housing as guides. Then, install the two cap screws (X). Prior to tractor Serial No. D17-24001, tighten the retaining cap screws and stud nuts to a torque of 130-140 Ft.-Lbs.; on tractor Serial No. D17-24001 and up, tighten to a torque of 200-210 Ft.-Lbs.

On tractor Serial No. D17-42001 and up, install the brake outer friction plate on inner end of sleeve using same number of shims as removed during disassembly; then, check clearance between brake inner and outer friction plates as outlined in paragraph 216.

Reinstall final drive unit as outlined in paragraph 207.

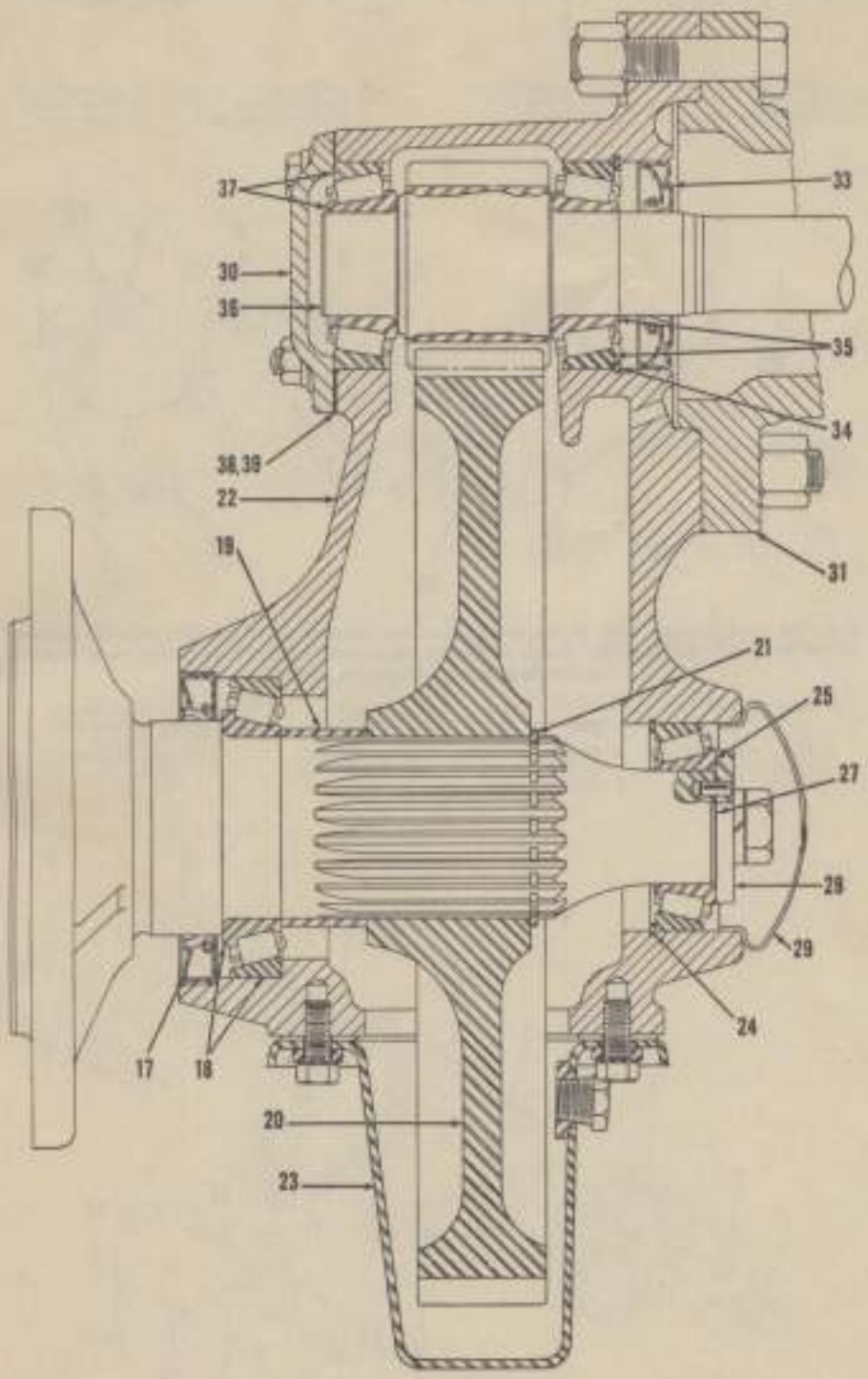


Fig. 133—Cross-sectional view of the D-17 final drive unit. Refer to Fig. 132 for legend.

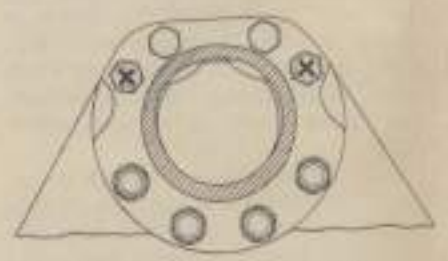


Fig. 134 — On D-17 when installing new ball pinion shaft housing (31—Figs. 132 and 133), holes indicated by "X" in new housing must be reamed to 0.623-0.625 after pinion shaft housing is bolted to final drive housing. Use holes in final drive housing as guide for reamer.

BRAKES

D-14 and D-15 Models

Brakes, shown in Fig. 135 are of the internal expanding type, bolted to the differential bearing carrier (1). The brake drums are pressed and keyed directly to the bull pinion shafts.

209. **ADJUSTMENT.** Each pedal should have approximately 2 inches free travel before lining contacts the brake drum. To adjust, disconnect the brake rod yoke from the actuating lever (2—Fig. 135). To reduce free travel (tighten brake), turn brake rod yoke further on brake rod. Both brakes should be adjusted equally.

210. **REMOVE AND REINSTALL.** To remove brake shoes, first remove final drive assembly as outlined in paragraph 201. The shoes can then be detached from their anchorages on the differential carriers. Brake shoes are interchangeable and the bottom of the shoe may be identified by the cutout section in the cam surface. Install new linings on shoes so that lining ends are flush with upper end of shoe.

211. To remove brake drum, first remove final drive assembly as outlined in paragraph 201; then pull drum from inner end of bull pinion shaft. It may be necessary to apply heat to the brake drum in order to remove and reinstall same. Be sure brake drum seats against snap ring on pinion shaft when installing.

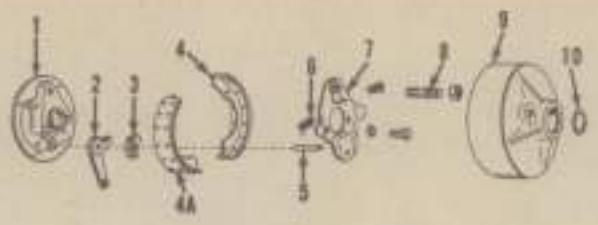


Fig. 135—Exploded view of the D-14 & D-15 brake assembly. Brake adjustment is accomplished by adjusting the length of the brake rods.

1. Differential bearing carrier
2. Actuating lever
3. Actuating cam
4. Brake shoe
4A. Lining
5. Pivot pin
6. Return spring
7. Support plate
8. Support stud
9. Brake drum
10. Snap ring

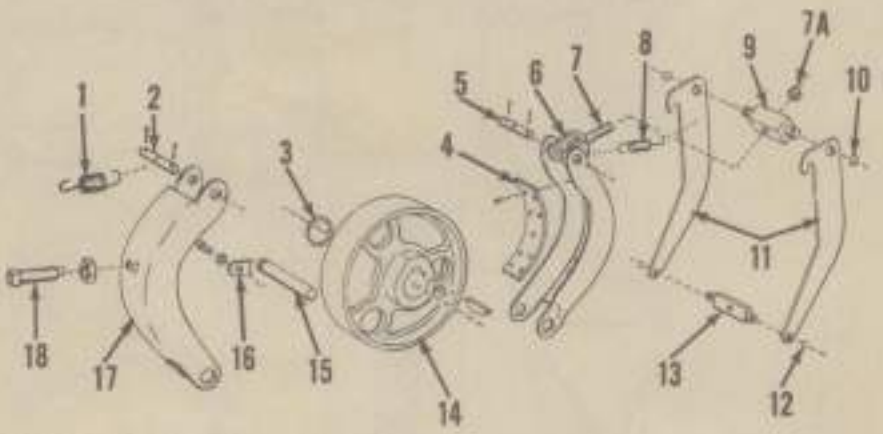


Fig. 136 — Exploded view of the brake assembly used on D-17 tractors prior to tractor Serial No. D17-42001. Brake drums (14) are keyed and press fitted to the inner end of each final drive bull pinion shaft.

1. Shoe return spring (rear)
2. Pin
3. Drum snap ring
4. Brake lining
5. Pin
6. Clevis
7. Adjusting bolt
7A. Adjusting nut
8. Shoe return spring (front)
9. Adjusting toggle pin
10. Snap ring
11. Toggles
12. Snap ring
13. Toggle pin
14. Brake drum
15. Shoe anchor pin
16. Anchor pin lock
17. Brake shoe
18. Shoe centralizing screw

D-17 Models
(Prior to Tractor Serial No. D17-42001)

The brakes used prior to tractor Serial No. D17-42001 are of the external contracting shoe type (See Fig. 136) with the brake drum keyed and press fitted to the inner end of the final drive pinion shaft.

212. **ADJUSTMENT.** To adjust either brake unit, turn screw (18—Fig. 136) in tight. Then, adjust nut (7A) until brake pedal free travel is limited to about 2 inches, or so that brake lock can just be engaged when pedal is depressed. Release brakes and center brake shoes with screw (18).

Each brake pull rod should measure 21 inches from center line of hole in brake pedal to front face of toggle (13). This setting provides best pedal leverage.

213. **R&R BRAKE SHOES.** To remove brake shoes, first remove the brake compartment covers from top of transmission housing. Disconnect

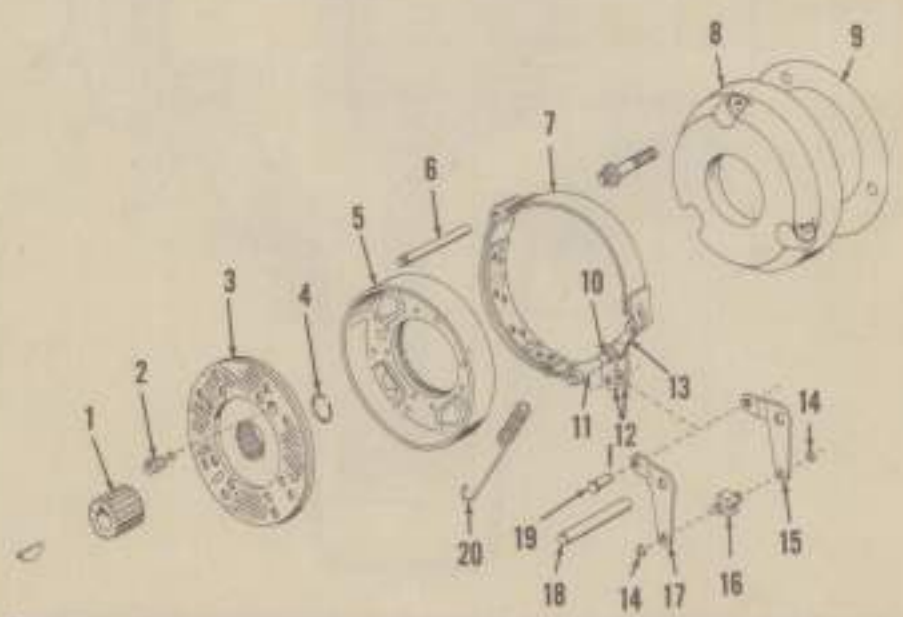


Fig. 137 — Exploded view of band/disc type brakes used on tractor Serial No. D17-42001 and up. Outer friction plate (8) is attached to inner end of bull pinion shaft housing. Differential bearing carriers are machined for brake inner friction surface. See Fig. 139 for cross-sectional view.

1. Splined hub
2. Retraction springs
3. Brake disc
4. Snap ring
5. Brake drum
6. Upper pin
7. Brake band
8. Outer friction plate
9. Shims
10. Clevis pin
11. Inner link
12. Link
13. Outer link
14. Snap ring
15. Outer lever
16. Pivot pin
17. Inner lever
18. Lower pin
19. Clevis pin
20. Band return springs (2)

and remove front and rear brake shoe return springs (1 and 8—Fig. 136). Remove brake shoe anchor pin lock (16) and anchor pin (15) from lower side of transmission housing. In the event that the brake anchor pin cannot be pried from housing, drill and tap pin so that a slide hammer may be used to remove pin. Remove adjusting nut (7A) from adjusting screw (7) and withdraw the front shoe. Then, remove rear shoe out top opening of transmission housing.

The brake shoes and linings are interchangeable. Reinstall the front shoe as an assembly made up of brake shoe, toggle levers, toggle pin and adjusting clevis and pin. The large brake shoe return spring (1) is for the rear shoe and the smaller spring (8) is used for front shoe.

214. **R&R BRAKE DRUM.** To remove the brake drum, first remove the brake shoes as outlined in preceding paragraph 213 and remove final drive unit as outlined in paragraph 207. The brake drum can then be removed from the end of the final drive pinion shaft by using suitable pullers. Note: In the event that the brake drum is seized to the shaft, it is usually expedient to remove the drum by breaking it, especially if the drum is to be renewed.

D-17 Models (Tractor Serial No. D17-42001 and Up)

Bendix band/disc type brakes are used on Series III and Series IV D-17 tractors. The brake disc and drum assembly is carried on a splined hub that is keyed and press fitted to the inner end of the final drive pinion shaft. See Fig. 137.

215. **ADJUSTMENT.** To adjust the band/disc type brakes, detach brake rods from brake pedals and turn rods in or out to obtain 2½ inches free travel of pedal pads. Reattach rods to pedals.

216. **R&R BRAKE BANDS AND DRUM AND DISC ASSEMBLY.** Brake drum and disc assembly can be withdrawn from brake bands after removing final drive unit as outlined in paragraph 207.

Detach brake rods from brake pedals and unscrew rods from pivot pins (16—Fig. 137). Unhook the

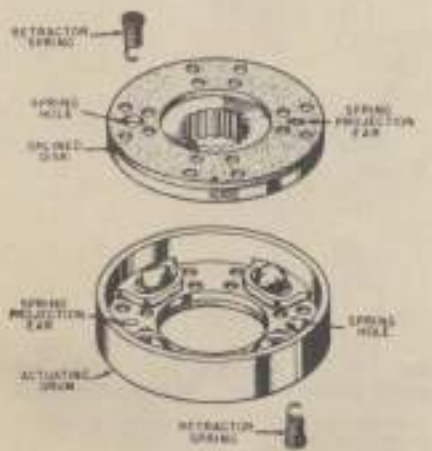


Fig 138—Exploded view of late D-17 brake drum and disc assembly.

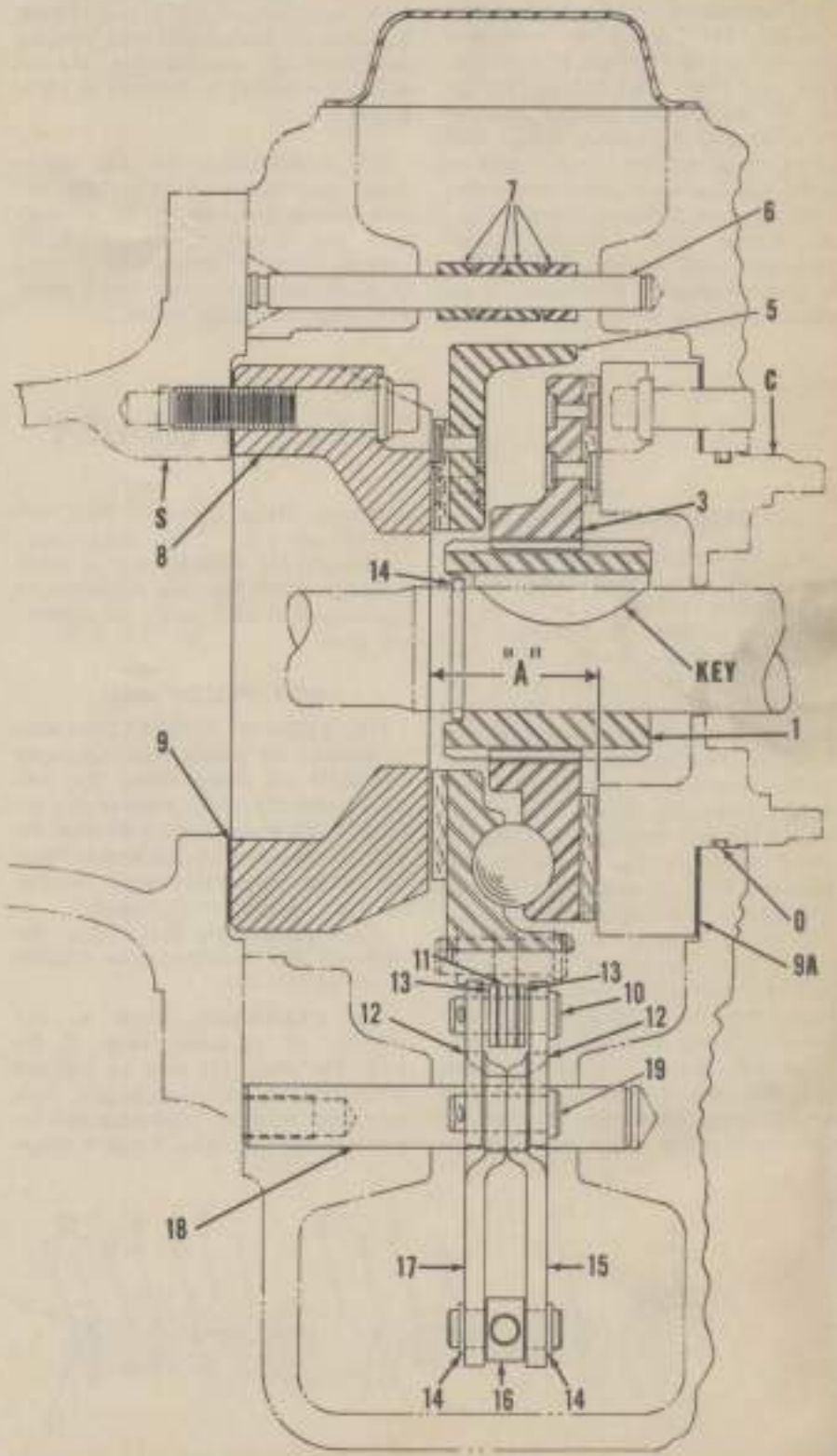


Fig. 139—Cross-sectional view of the Bendix band/disc type brakes used on D-17 tractor Serial No. D17-42001 and up. Dimension "A" should be maintained at 2.034-2.044 inches. Refer to Fig. 137 for legend.

A. Carrier to friction plate dimension
C. Differential bearing carrier
O. "O" ring seal
S. Pinion shaft housing

band return springs (20) from front and rear bands (7) and transmission housing. Thread slide hammer adapter into lower pin (18) and pull pin from housing. Pry upper pins (6) from transmission housing and remove brake bands.

A dimension of 2.034-2.044 inches (A—Fig. 139) should be maintained between the outer brake friction surface and the brake friction surface on the differential bearing carriers. To check this dimension, install final drive units **without** brake band or drum and disc units and measure distance between friction plate and bearing carrier brake friction surfaces with an inside micrometer or other accurate measuring instrument. If dimension is not within the limits of 2.034-2.044, vary number of shims (9) between the outer friction plate and the final drive pinion shaft sleeve to obtain the recommended dimension.

Remove final drive unit and install brake bands and the drum and disc unit in reverse of removal procedure. Disc part of drum and disc unit must be towards the differential bearing carrier. After reassembling tractor, adjust the brakes as outlined in paragraph 215.

217. **OVERHAUL.** To disassemble drum and disc unit (Fig. 138), insert slotted screwdriver tip through open end of springs and stretch the springs only far enough to unhook them. Remove disc and steel brake actuating balls from drum.

Linings are available separately from disc and drum. Renew band if linings are not reusable. Inspect friction surfaces of outer friction plate (8—Fig. 139) and differential bearing carrier (C) and renew friction plate or bearing carrier if friction surfaces are ot suitable for further use.

Condition of the return springs (2 and 20—Fig. 137) is of utmost importance when servicing band/disc brakes. Renew any spring if coils of spring do not fit tightly together and be careful not to stretch springs any farther than necessary when reassembling brakes. Insufficient spring tension will allow brakes to drag.

BELT PULLEY

GEAR ADJUSTMENT

218. To adjust the backlash of the belt pulley drive gears (10—Fig. 140 and 8—Fig. 142) first remove the pulley as outlined in paragraph 219. Remove all shims (8—Fig. 140), then reinstall belt pulley with the threaded hole in housing (6) toward bottom. Install a cap screw in the front bolt hole and another cap screw in the rear hole of the housing and tighten these cap screws finger tight while holding belt pulley unit in place. Install a cap screw in the threaded hole at bottom of housing and tighten this cap screw until the belt pulley housing flange is evenly spaced from the torque housing. Insert as many shims in the space between the pulley housing flange and torque housing as possible; then, remove belt pulley unit and reinstall unit with this amount of shims plus an additional 0.030 shim thickness to give belt pulley drive gears proper backlash. Shims provided with belt pulley are 0.010 thick; shims normally used for service are 0.005 thick, although shims are also available in thicknesses of 0.007 and 0.012 as service parts.

BELT PULLEY UNIT

219. **REMOVE AND REINSTALL.** To remove the pulley assembly, drain hydraulic oil down below the belt pulley opening; then, remove the retaining cap screws and withdraw the belt pulley unit from the torque housing. Make certain that shims (8—Fig. 140) are not lost or damaged.

When reinstalling belt pulley, the backlash may be adjusted as outlined in paragraph 218.

220. **OVERHAUL.** Refer to Fig. 140 for an exploded view of the unit. The shaft (2) may be bumped or pressed out of bearings and drive gear after carefully unstaking and removing the nut (12). Further disassembly procedure is evident from inspection of unit and reference to Fig. 140.

To reassemble unit, reverse disassembly procedure. Use as many 0.042 thick shims (9) as required so that washer (11) will contact face of gear (10) instead of shoulder of shaft. Tighten the retaining nut (12) so that 4 to 10 inch-pounds torque is required to turn shaft in bearings and stake the nut in that position.

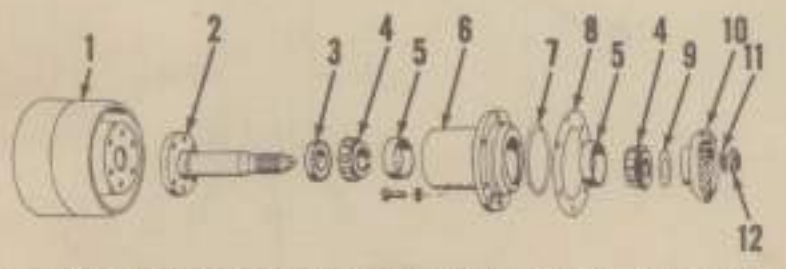


Fig. 140 — Exploded view of the belt pulley assembly. The pulley drive gear and shifter collar are shown in Fig. 142.

1. Pulley
2. Pulley shaft
3. Oil seal
4. Bearing cone
5. Bearing cup
6. Pulley housing
7. "O" ring
8. Shims (0.010)
9. Shims (0.042)
10. Pulley gear
11. Washers
12. Nut

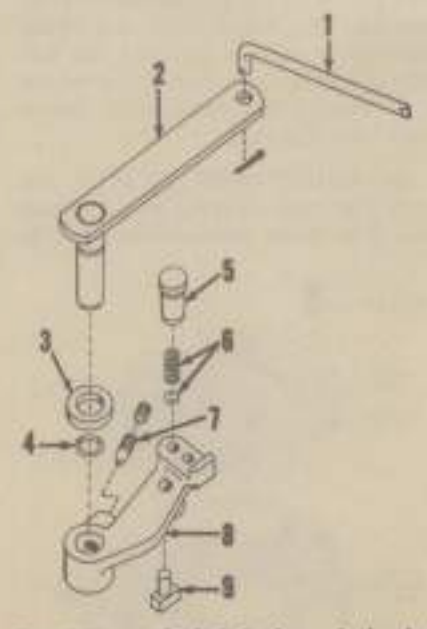


Fig. 141 — Exploded view of the belt pulley shifter (8) and the associated parts.

1. Shifter rod
2. Shifter lever
3. Spacer
4. "O" ring
5. Spring retainer
6. Detent spring and ball
7. Set screw
8. Shifter
9. Insert

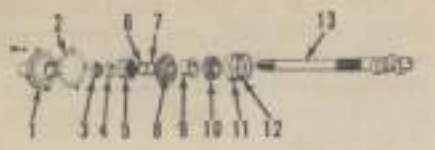


Fig. 142 — Exploded view of the parts located on front part of the engine clutch shaft (13) including the shifter collar (5). Lips of both oil seals (3 and 4) should be towards rear.

1. Seal retainer
2. Gasket
3. Oil seal
4. Oil seal
5. Shifter collar
6. Snap ring
7. Spacer
8. Belt pulley drive gear
9. Gear bushing
10. Bearing cone
11. Bearing cup
12. Snap ring
13. Clutch shaft

BELT PULLEY DRIVE GEAR

221. The belt pulley drive gear (8—Fig. 142) is located on the engine clutch shaft. If necessary to renew the gear, proceed as follows: Remove belt pulley unit as outlined in paragraph 219, split the tractor between engine and torque housing as outlined in paragraph 151 or 152, and remove the clutch release fork and bearing. Remove the left side sheet (panel) from below fuel tank, disconnect the belt pulley shifter rod (1—Fig. 141) and remove locking screw and set screw (7), shifter lever (2) and shifter (8). Remove the seal retainer (1—Fig. 142) and withdraw shift collar (5). Extract snap ring (6); then withdraw the spacer (7), gear (8) and bushing (9) through opening in front of torque tube.

When reinstalling the shifter (8—Fig. 141), the spring retainer (5) can be driven up to allow the detent ball (6) to be installed after the shifter is installed. Then, drive retainer back in place.

NOTE: It is usually difficult to remove the snap ring (6—Fig. 142). The bearing cone (10) has been found to be a very tight press fit on the clutch shaft and, in assembly, is pressed forward to hold the bushing (9) and spacer (7) tightly against the snap ring to prevent the bushing from turning. If difficulty is encountered, it will probably be necessary to follow the procedure outlined in paragraph 156 or 157 to renew the belt pulley drive gear.

POWER TAKE-OFF

OUTPUT SHAFT

All Models

222. To remove the PTO shaft assembly (items 21 through 28—Fig. 144) first drain oil from transmission and "Power-Director" compartments. Then, remove the cap screws retaining the bearing retainer (27) to the lift rockshaft housing and withdraw the shaft assembly from tractor. Take care not to damage the seals (19) which are located in the front end of the transmission housing.

PTO SHIFTER

All Models

223. To remove the PTO shift coupler (18—Fig. 144) and/or shifter arm (31—Fig. 143), it is first necessary to split the tractor between the transmission and torque housing as outlined in paragraph 172 or 180. Then, remove pin (32), withdraw lever and shaft (35) and remove shifter arm (31) and insert (30). Slide shifter collar from end of PTO front shaft.

Reverse removal procedure to reinstall. Be sure to insert a safety wire through hollow pin (32) and twist wire securely before reattaching transmission to torque housing.

PTO DRIVEN GEAR

D-14 and D-15 Models

224. To remove the PTO driven gear (12—Fig. 144), proceed as follows: Detach (split) the transmission from the torque tube as outlined in paragraph 172 and remove the hydraulic pump as outlined in paragraph 233. Remove the PTO shifter assembly and snap ring (17). Unbolt and remove the bottom cover from torque tube. Remove plug (8), bump shaft forward rear and extract bearing (10), spacer (11) and gear (12) through bottom opening.

When reinstalling, reverse the removal procedure pressing shaft in bearings and gears; then, install a snap ring (17) of the correct thickness to maintain 0.0005-0.0045 end play. This snap ring is available in thicknesses from 0.070 to 0.110 in graduations of 0.004.

D-17 Models

225. To remove the PTO driven gear (12—Fig. 144), proceed as follows: Split the tractor between transmission and torque housing as outlined in paragraph 160; then, remove the PTO shifter collar, the "Power-Director" pump and the bottom cover from torque housing. Remove snap ring (17), thread slide hammer adapter into threaded hole in rear end of shaft and bump the shaft out toward rear of torque housing. The driven gear, spacer (11) and front bearing cone (10) can be removed out bottom opening of torque housing. Remove rear bearing cone (15) and snap ring (14) from shaft. If necessary to renew front bearing cup, drive plug (8) forward out of housing and drive bearing cup out to rear.

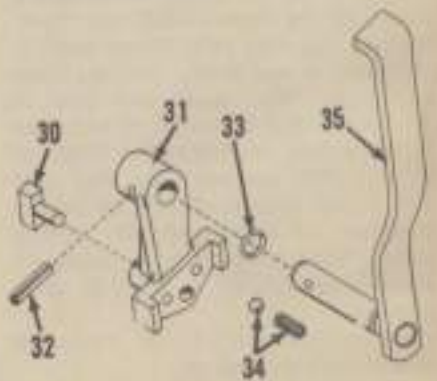


Fig. 143 — Exploded view of the pto shifter assembly. The shifter collar is shown at 18 in Fig. 144.

30. Insert
31. PTO shifter arm
32. Hole pin
33. "O" ring
34. Detent spring and ball
35. PTO shift lever

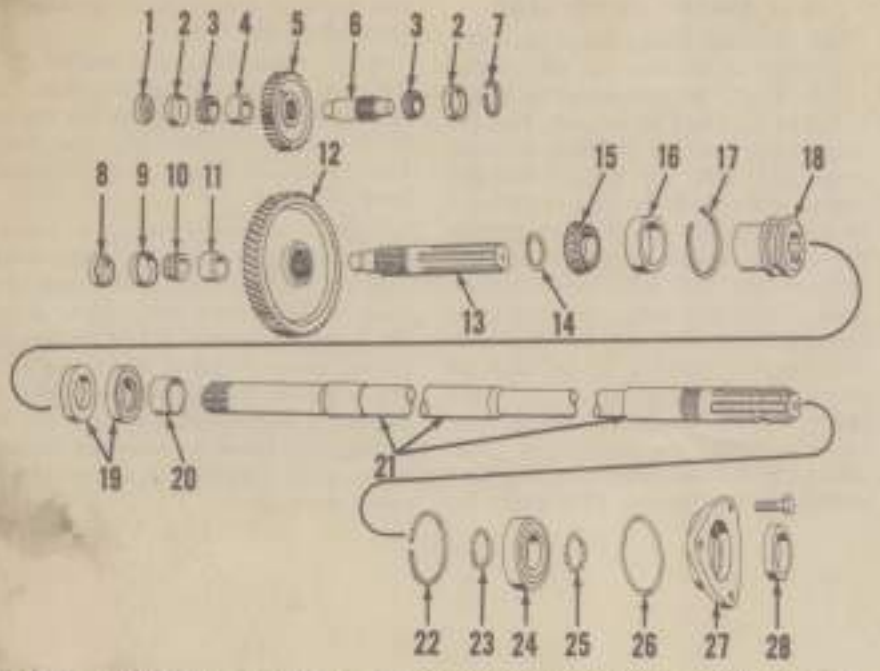


Fig. 144 — Exploded view of the Power Take-Off assembly. Adjustment of bearings (10 and 15) is controlled by the thickness of snap ring (17); the adjustment of bearings (2) is controlled by thickness of snap ring (7).

1. Plug
2. Bearing cup
3. Bearing cone
4. Spacer
5. Idler gear
6. Idler shaft
7. Snap ring
8. Plug
9. Bearing cup
10. Bearing cone
11. Spacer
12. PTO driven gear
13. PTO coupler shaft
14. Snap ring
15. Bearing cone
16. Bearing cup
17. Snap ring
18. Coupler
19. Oil seals (opposed)
20. Bushing
21. PTO shaft
22. Snap ring
23. Snap ring
24. Bearing
25. Snap ring
26. "O" ring
27. Rear bearing retainer
28. Oil seal

To reinstall, proceed as follows: Apply sealer to rim of plug and drive the plug, cupped side to rear, into torque housing until flat side is flush. Drive front bearing cup in tight against shoulder in bore of housing and drive rear bearing cone against snap ring on shaft. Place front bearing cone in cup and position the gear in housing. Insert shaft through rear bearing bore into splines of gear, place spacer between gear and bearing cone, and push shaft on through gear and spacer. Drive the shaft forward until shoulder on shaft contacts front bearing cone. Install rear bearing cup and snap ring. Bump shaft to front and to rear to seat bearing cones and cups; then, check end play of shaft with dial indicator. If end play is not within recommended limits of 0.0005-0.0045, remove snap ring (17) and install new snap ring of proper thickness to bring end play within limits. Snap rings are available in thicknesses of 0.061 to 0.105 in steps of 0.004.

Reassemble tractor by reversing disassembly procedure.

PTO IDLER GEAR

D-14 and D-15 Models

226. To remove the PTO idler gear (5—Fig. 144), first remove the PTO driven gear as outlined in paragraph 224; then proceed as follows: Remove snap ring (SR—Fig. 145), then unbolt and remove the oil transfer tube and retainer. Remove plug (1—Fig. 144) and snap ring (7); then while driving or pressing shaft (6) toward rear, withdraw bearing (3), spacer (4) and gear (5) through opening in bottom.

When reinstalling the idler shaft, press bearings (3) on shaft and bearing cup (2) in bore. Install a snap ring (7) of the proper thickness to maintain the recommended shaft end play of 0.0005-0.0045. This snap ring is available in thicknesses from 0.069 to 0.109 in graduations of 0.004.

D-17 Models

227. To remove the PTO idler gear (5—Fig. 144), first remove the PTO driven gear as outlined in paragraph 225; then, proceed as follows: Remove the snap ring (7) and install slide hammer adapter into threaded hole in rear end of idler shaft. Bump shaft and rear bearing cone and cup out towards rear end of torque housing. Remove gear (5), spacer (4) and front bearing cone (3) out bottom opening of torque housing. If necessary to renew front bearing cup (2), pull cup with slide hammer and bearing cup adapter; or, remove the hydraulic pump, drive plug (1) out to front and drive the cup out to rear.

NOTE: Prior to tractor Serial No. D17-24001, the PTO idler gear and shaft were splined. After this serial number, shaft is cross-drilled and a pin inserted through hole in shaft engages a milled slot in the bore of the gear.

To reinstall, proceed as follows: Apply sealer to outer rim of plug (1) and insert plug in bore from rear with flat side of cup to front. Drive plug forward until flat side is flush with front of casting. Drive front bearing cup in tightly against shoulder in bore. Drive rear bearing cone on shaft and insert gear drive pin in shaft if so equipped. Place front bearing cone in cup and idler gear in housing. Insert shaft through rear bearing bore into gear, mating splines or pin and milled slot. Place spacer between gear and front bearing cone, then bump shaft forward until shoulder on shaft is seated against front bearing cone. Install rear bearing cup and snap ring (7). Bump shaft to front and to rear to be sure bearings are seated; then, check end play of shaft with a dial indicator. If end play is not within the recommended limits of 0.0005-0.0045, remove snap ring (7) and install new snap ring of proper thickness to bring end play within limits. Snap rings are available in thicknesses of 0.069 to 0.109 in steps of 0.004.

NOTE: After tractor Serial No. D17-24001, the PTO idler and driven gears are thicker than gears used in prior production. The later type PTO idler gear and shaft and driven gear may be used as a set to renew the gears and shaft in models prior to tractor Serial No. D17-24001; however, it may be necessary to enlarge the bottom opening in the torque housing by grinding enough material from edge of opening to admit the thicker PTO driven gear.

Fig. 145—View into rear end of D-14 and D-15 tube showing the snap ring (7) which must be removed in order to remove the PTO idler gear.

HYDRAULIC POWER LIFT SYSTEM

(PLUNGER PUMPS)

228. Plunger type hydraulic pumps are available for all D-14 and D-15 tractors and for D-17 tractors prior to tractor Serial No. D17-75001. The plunger type pump is mounted in the torque housing and is driven by 4 cams on the engine clutch shaft. Refer also to paragraph 250 and following for side mounted, gear type hydraulic pump and controls.

HYDRAULIC PUMP

The hydraulic pump is of the constant displacement plunger (piston) type having three 11/16-inch diameter plungers and one 5/16-inch diameter plunger. The pump is mounted in the center section of the torque housing and the plungers are actuated by four cams on the engine clutch shaft. Except for the hold position valve (20—Fig. 146) which is contained in a separate housing that is bolted to the hydraulic pump, the hydraulic system control valves are located within the pump housing. Pump and valve operation is described in the following paragraphs.

229. **OIL FLOW—LIFTING.** As the control valve stack (Fig. 146) is moved to lift position by the lift-lower lever, oil that was by-passing the control valves from the 11/16-inch plungers (64) is directed through the discharge valves (10), and then through the oil gallery and master check valve (35) to the hold position valve (20). Oil from the 5/16-inch plunger is directed through the check valve (28) into the passage to the hold position valve. Oil under pressure then opens the hold position valve and flows into the hydraulic pressure line. When the hydraulic pressure reaches approximately 2100 psi, the relief valve (40) for the 5/16-inch plunger opens and the check valve (28) closes. When the hydraulic pressure reaches approximately 3600 psi, the unloading valve (50) for the 11/16-inch plungers opens, oil is by-passed into the sump, and the master check valve (35) and the hold position valve (20) closes. The unloading valve is of the differential area type and requires only 50 psi to be held open. Oil pressure from the 5/16-inch plunger will remain at 2100 psi and will flow through the relief valve to the sump unless pressure in the hydraulic pressure line drops below the relief pressure; in that event, the check valve (28) and hold position valve (20) will open and oil from the 5/16-inch plunger will flow into the hydraulic pressure line.

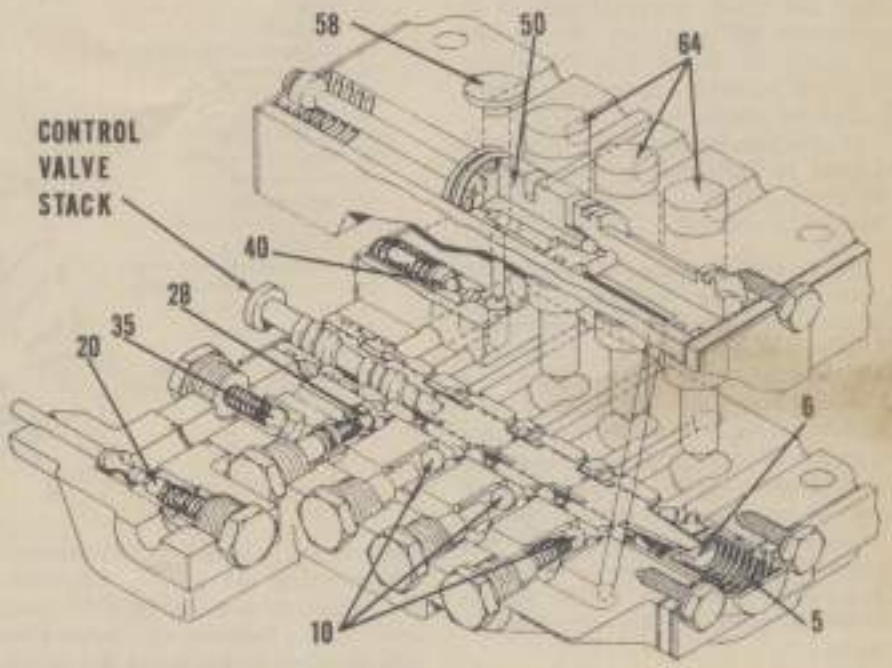


Fig. 146 — Cut-away view of the plunger type hydraulic pump assembly. Early production pump is shown; refer to differences between Figs. 149 and 150 for production changes. Spring behind hold position valve (20) should be discarded.

6. Dampener piston
10. 11/16-inch plunger check valves
20. Hold position valve
28. 5/16-inch plunger check valve
35. Master check valve
40. 5/16-inch plunger relief valve
50. Unloading valve plunger
58. 5/16-inch plunger
64. 11/16-inch plungers

230. **OIL FLOW-HOLD POSITION.** Moving the lift-lower lever to center (hold) position will allow the control valve stack to move rearward permitting oil from all four plungers to by-pass into the sump. The hold position valve remains seated which "holds" oil in the hydraulic pressure line.

231. **OIL FLOW-LOWERING POSITION.** Moving the lift-lower lever to bottom (lowering) position operates a plunger that pushes the hold position valve (20—Fig. 146) off of its seat. Oil in the pressure line can then return to the sump through the open valve.

232. **TESTS AND ADJUSTMENTS.** To check the unloading valve and the relief valve opening pressures, proceed as follows: Install a pressure gage of sufficient capacity (5000 psi) at the remote ram connection. Start engine and move the control lever (lift-lower lever) to the full lift position. As the tractor lift arms reach the fully raised position, the gage should, for an instant, read approximately 3600 psi and then drop to approximately 2100 psi and hold steady at that point.

If the opening pressure is not between 3500-3700 psi, overhaul the unloading valve assembly as outlined in paragraph 240 and add or deduct shims (48—Fig. 149 or 48A—Fig. 150) to obtain the correct pressure. Note: Unloading valve was changed to the later type shown in Fig. 150 at D-15 tractor Serial No. D15-6750 and D-17 tractor Serial No. D17-38500.

If the pressure reading, after the lift arms have raised, falls below 2100 psi or remains above 2200 psi, overhaul the relief valve as outlined in paragraph 238 and vary the number of shims (37—Fig. 149 or Fig. 150 as required to obtain approximately 2100 psi relief pressure.

If the specified opening pressures cannot be obtained by the addition of shims, overhaul the pump as outlined in paragraph 234 through 241.

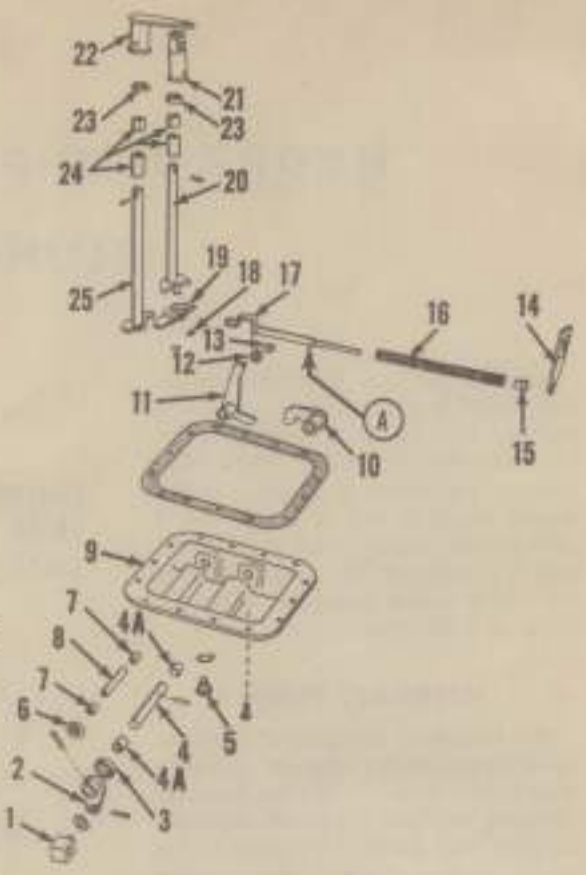
NOTE: If the unloading valve ball seat orifice is restricted, the pressure after the lift arms are raised may remain higher than 2100 psi; in this event, the plunger, ball and/or body should be reconditioned or renewed. The $\frac{7}{16}$-inch plunger relief valve operating pressure on early production tractors was 1500 psi. If one of these units is encountered and the hydraulic pump is removed for service, it is recommended that the spring (36—Fig. 149) be renewed using the later type stronger spring and that the proper number of shims (37) be used to provide the 2100 psi relief valve operating pressure.

233. **R&R HYDRAULIC PUMP.** The hydraulic pump can be removed as follows: Remove the linkage guard (See Fig. 147) and "Traction-Booster" link rod. Drain the hydraulic reservoir; then, unbolt and remove the pump cover and linkage housing (9—Fig. 148) from bottom of torque housing. Compress the linkage return spring (16) by moving the "Traction-Booster" lever to top of quadrant and by prying pivot bearing (15) forward until a nail can be inserted in the hole (A) in spring guide (17). Remove retainer ring (18); then, disconnect the return spring guide (17) from lever (19). Remove the lubrication tube attached to the pump and torque tube. Remove the three pump retaining cap screws, then lower pump from torque tube.

To reinstall, reverse the removal procedure. Before reinstalling the return spring (16), guide (17) and pivot bearing (15), compress the spring on the guide, install pivot bearing and insert nail in hole "A" in guide to hold pivot bearing and spring compressed. The nail head must be towards the bottom of the assembly. After assembly is installed, remove the nail.

Fig. 148—Exploded view of hydraulic pump linkage housing (9) and associated parts. Control valve cover (14) is same as item 3 in Figs. 149 and 150.

A. Hole (See text)
1. Adjusting block
2. Linkage lever
3. Seal
4. Pivot pin
4A. Bushing
5. Drain plug
6. Plug
7. Bushing
8. Lever pin
9. Linkage housing
10. Linkage cam
11. Roller lever
12. Roller
13. Retaining ring
14. Control valve cover
15. Pivot bearing
16. Return spring
17. Return spring guide
18. Retaining ring
19. "Traction Booster" lever
20. "Traction Booster" shaft
21. "U" joint hub
22. Cross-over lever
23. Oil seal
24. Bushings
25. Lift lever



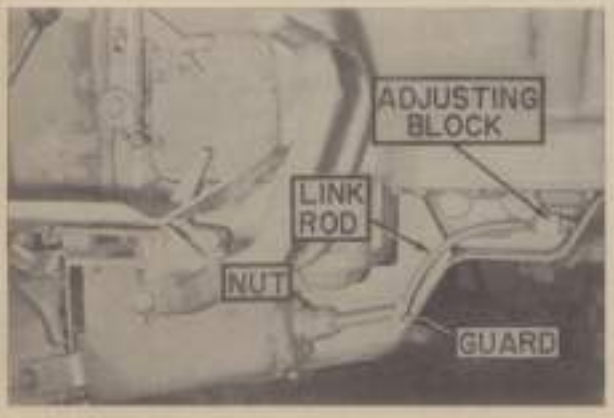


Fig. 147 — Hydraulic pump control linkage and adjustments. See text.

When reinstalling the pump cover and linkage assembly, be sure that roller (12) is in the relief of the spring guide (17). If not in the correct position, the linkage will be damaged when cover retaining cap screws are tightened. After reinstallation is complete, refill the system with oil and operate the system to bleed air from lines. Recheck oil level and add oil if necessary.

234. **OVERHAUL PUMP.** As overhaul of only an individual section of the pump may be required, refer to the appropriate following paragraphs.

235. CONTROL ASSEMBLY (PUMP COVER). Overhaul of this assembly will be evident after an examination of the unit and reference to the exploded view in Fig. 148. Lever pin (8) is tapped for a puller screw, and can be removed after prying out plug (6). Control shafts (20 and 25) can be removed from bottom opening in torque housing after removing roll pins attaching cross-over lever (22) and "U" joint (21) to the top ends of the shafts.

236. HOLD POSITION VALVE. The hold position valve can be withdrawn after removing plug (17—Fig. 151). To remove the plunger (22—Fig. 149

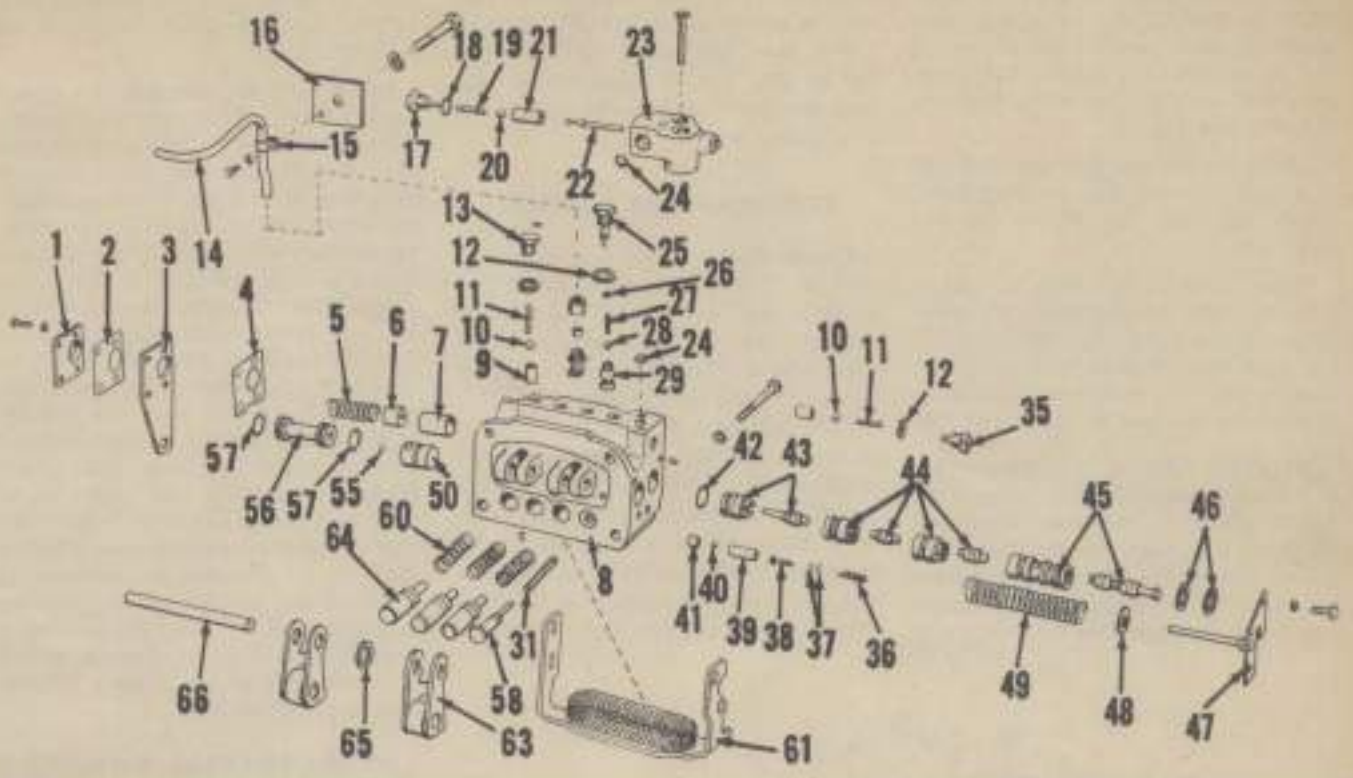


Fig. 149 — Exploded view of prior production hydraulic pump. Later production pump is shown in Fig. 150. Spring (19) has been deleted.

1. Spring retainer
2. Gasket
3. Cover
4. Gasket
5. Dampener spring
6. Dampener piston
7. Dampener sleeve
8. Pump body
9. Check valve seat
10. Check valve
11. Check valve spring
12. "O" rings
13. Plug
14. Lubrication tube
15. Tube clamp
16. Pump support
17. Plug
18. "O" ring
19. Spring (Do not use)
20. Hold position valve
21. Hold position valve seat
22. Hold position valve plunger
23. Hold position valve body
24. "O" ring
25. Check valve plug
26. "O" ring
27. Check valve spring
28. Check valve
29. Check valve seat
31. 5/16 plunger return spring
32. Plug, master check valve
36. Relief valve spring
37. Shims
38. Plunger
39. Sleeve
40. Relief valve
41. Relief valve seat
42. "O" ring
43. Control valve & sleeve, 11/16-inch plungers
44. Control valves & sleeves (2), 11/16-inch plungers
45. Control valve & sleeve, 5/16-inch plunger
46. "O" rings
47. Cover & stud assembly
48. Shims
49. Unloading valve spring
50. Unloading valve plunger
55. Unloading valve ball
56. Unloading valve seat
57. "O" rings
58. 5/16-inch plunger
60. Plunger return springs
61. Intake manifold screen
63. Cam followers
64. 11/16-inch plungers
65. Washers (2)
66. Cam follower shaft

or Fig. 150), it is necessary to first remove the seat (21) by tapping seat to accommodate a puller screw. Valve ball (20) may be seated by using a soft punch and tapping punch with small hammer. Discard spring (19) if present; spring is no longer used.

237. CAM FOLLOWERS AND PUMP PLUNGERS. Refer to Fig. 152 and withdraw pin (66) to release the cam followers. A washer (65) is located on the pin between each set of two cam followers. Renew the complete cam follower if rollers are loose or worn or if follower arm is bent.

To remove the plungers, first remove the cam followers and withdraw springs and plungers from pump body. Renew plungers if excessively worn or scored, or if they stick in bores after bores and plungers are cleaned. Check the springs for breakage, rust, corrosion and free length; renew springs if free length is not same as new spring.

At D-15 tractor Serial No. D15-9001 and D-17 tractor Serial No. D17-42001, the three 11/16-inch diameter pump plungers (64A—Fig. 150) were provided with intake check valves (62) which are held in the hollow plungers with retainers (61) placed between the plunger and plunger return spring (60A). Spring guides (59) set against bottom of plunger bores. On D-15 tractor Serial No. D-15-6750 and D-17 tractor Serial No. D17-38500 and up, the 5/16-inch diameter plunger return spring (31A) is removed from bottom of pump body after removing plug (34) and spring guide (32).

238. RELIEF VALVE. The relief valve spring (36—Fig. 149 or Fig. 150), shims (37), plunger (38) and ball (40) can be removed after unbolting and removing cover (47 or 47A). If valve is leaking, the ball can be seated using a soft punch and tapping punch with small hammer. If seat (41) must be removed, it will be necessary to tap seat to accommodate a puller screw.

Test and adjust the system operating pressure as outlined in paragraph 232.

239. CONTROL VALVES. To remove the control valves, first remove cover (47—Fig. 149 or 47A—Fig. 150) and retainer (1). Withdraw the dampener piston (6—Fig. 154), sleeve (7) and spring (5) from pump body; then, extract the control valves and sleeves (43 to 45—Fig. 155). When disassembling, keep valves and their respective sleeves together as they are mated parts.

Check the valves and sleeves making certain that the valves can turn and slide freely in the sleeves. Renew any valves and sleeves that are scored or show wear.

Reinstall in reverse of removal procedure using Figs. 154 and 155 as reference. Always renew the "O" rings (46).

240. UNLOADING VALVE ASSEMBLY. To remove the unloading valve assembly, first remove the covers (3 and 47 or 47A—Fig. 149 or Fig. 150), then withdraw the assembly. Refer to Fig. 156 and Fig. 157.

Check for leakage between ball and seat and between plunger and bore. Check the ball seat orifice for restrictions.

When reinstalling, renew "O" rings (57—Fig. 157) and assemble in order shown in Fig. 149 or Fig. 150, depending upon type of unloading valve assembly. Test the system for operating pressure as outlined in paragraph 232.

241. DISCHARGE VALVES. The check (discharge) valves shown in Fig. 158 can be removed after removing plugs. Seats for the discharge valves should not be removed unless known to be defective. A leaky valve can often be corrected by seating a new ball to seat by tapping the ball using a soft drift and a light hammer. Valve seat inserts (9 and 29—Fig. 149 or 150) can be removed by tapping the insert orifice to permit use of a puller screw.

CONTROLS AND LINKAGE

The hydraulic system is equipped with a "Traction-Booster" lever and a "lift-lower" lever on a quadrant at the left side of the steering wheel shaft and a "Traction-Booster" gage located on the instrument panel. The "Traction-Booster" lever has a series of detent positions for the full range of the quadrant. The "lift-lower" lever has three control positions: Lift positions: Lift position is at the top of the quadrant; hold position is at the center; and lowering position a the bottom of the quadrant. The "Traction-Booster" gage is an oil pressure gage hooked into the pressure line of the ram cylinder.

Implements are attached to a spring loaded hitch which is a part of the "Traction-Booster" linkage. In operation, the "Traction-Booster" lever is placed at the bottom of the quadrant; the implement is lowered into working position with the "lift-lower" lever which is then returned to "hold" position. The "Traction-Booster" lever is then raised until the "Traction-Booster" gage is registering in the first half of the dial. Changes in implement draft will vary the linkage to the pump control valve and hold position valve through the spring loaded hitch point and cause oil to flow to the ram cylinder or from the ram cylinder depending upon whether there is an increase or decrease in draft on the implement. As pressure is maintained on the lift cylinder, a certain amount of implement weight is transferred to the tractor ("Traction-Booster" action).

242. **HYDRAULIC CONTROL LINKAGE ADJUSTMENT.** To check and adjust the hydraulic control linkage, refer to the following paragraphs:

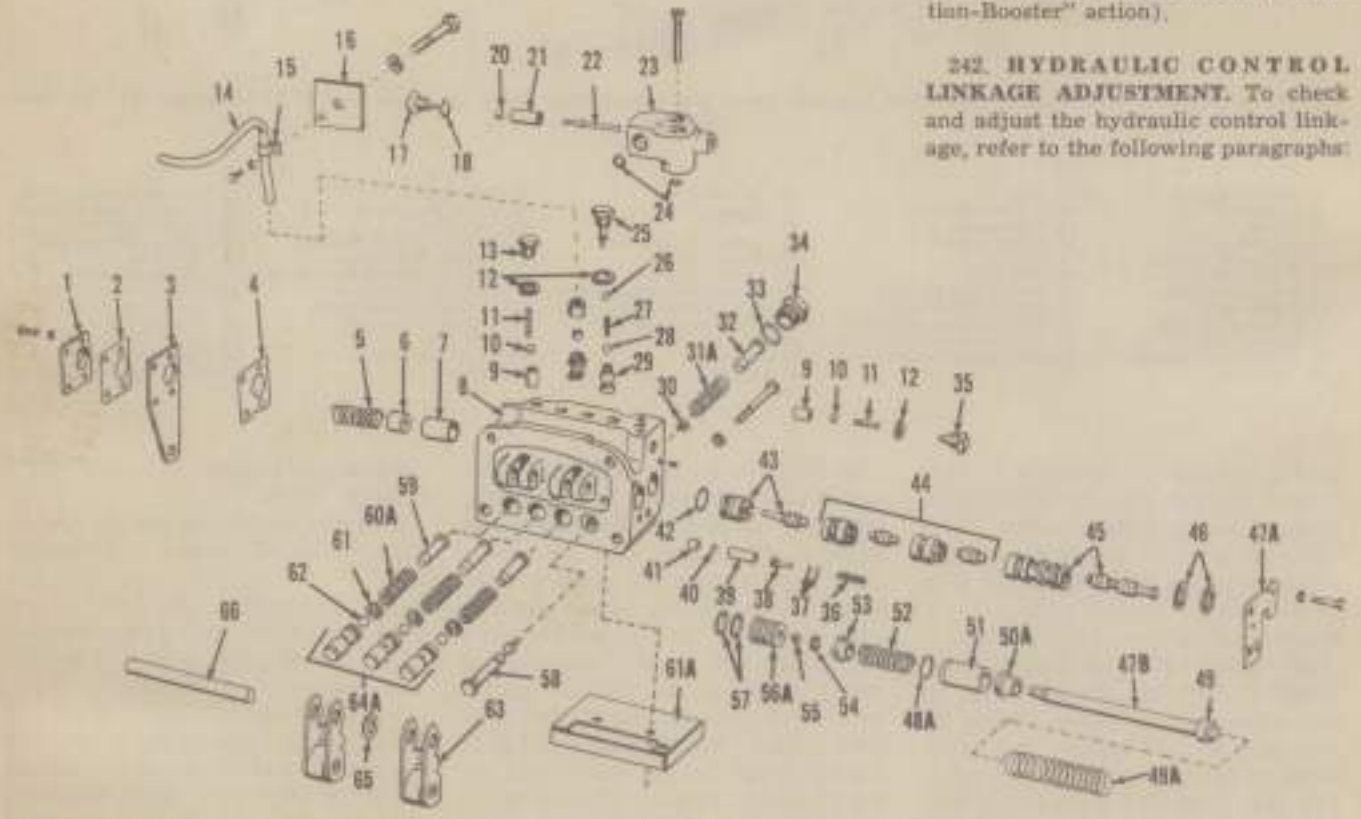


Fig. 150—Exploded view of hydraulic pump used on late production tractors. Some differences between this pump and earlier production pump are running production changes.

1. Spring retainer
2. Gasket
3. Cover
4. Gasket
5. Dampener spring
6. Dampener piston
7. Dampener sleeve
8. Pump body
9. Check valve seat
10. Check valve
11. Check valve spring
12. "O" rings
13. Plug
14. Lubrication tube
15. Tube clamp
16. Pump support
17. Plug
18. "O" ring
20. Hold position valve
21. Hold position valve seat
22. Hold position valve plunger
23. Hold position valve housing
24. "O" rings
25. Plug
26. "O" ring
27. Check valve spring
28. Check valve
29. Check valve seat
30. Flat washer
31A. 5/16 plunger return spring
32. Spring guide
33. "O" ring
34. Plug
35. Plug, master check valve
36. Relief valve spring
37. Shims
38. Plunger
39. Sleeve
40. Relief valve
41. Relief valve seat
42. "O" ring
43. Control valve & sleeve, 11/16 plunger
44. Control valves & sleeves (2), 11/16 plunger
45. Control valve & sleeve, 5/16 plunger
46. "O" rings
47A. Cover
47B. Rod & stop collar
48A. Shims
49A. Plunger return spring
50A. Unloading valve plunger
51. Spring retainer
52. Unloading valve spring
53. Spring guide
54. Snap rings (2)
55. Unloading valve ball
56A. Unloading valve seat
57. "O" rings
58. 5/16 plunger
59. 11/16 plunger spring guides
60A. Plunger return springs
61. Intake valve retainers
62. Intake valves
63. Cam followers
64A. 11/16 plungers
65. Washers (2)
66. Cam follower shaft

243. "LIFT-LOWER" LINKAGE (Early type linkage). Adjust length of crossover rod and/or position of ball joint connection in slotted hole of crossover lever (See Fig. 159) so that when the "lift-lower" lever is in lowering detent position, the detent pin is tight against the top of the detent window in quadrant and when lever is in lift detent position, the detent pin is tight to 1/16-inch loose against bottom of detent window. Securely tighten the adjusting points.

244. "LIFT-LOWER" LINKAGE (Late Type Linkage). Place both the "lift-lower" lever and the "Traction Booster" lever at bottom of the quadrant. Start engine and place "lift-lower" lever in lift position. After pump unloads, oil pressure trapped in ram cylinder by hold position valve will be indicated on "Traction-Booster" gage. Slowly lower the "lift-lower" lever until contact with hold position valve plunger can be felt, but do not force lever to cause pressure drop. If lever is not already in the lowering detent position, turn adjusting screw (See Fig. 180) counter-clockwise until lever can be placed in lowering detent position without causing pressure drop on "Traction-

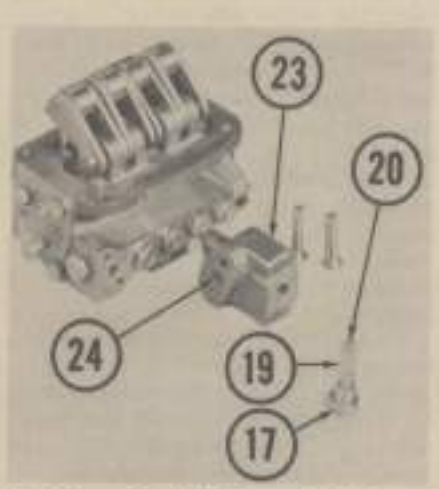


Fig. 151 — Partially disassembled view of the hold position valve. Refer to Fig. 149 or 150 for legend.

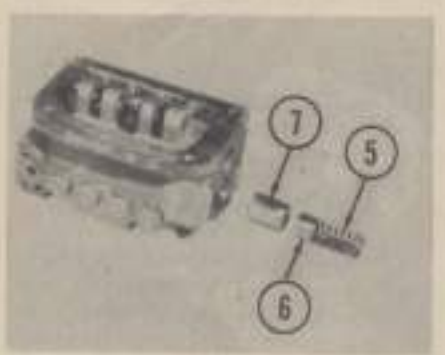


Fig. 154 — Dampener piston (6), sleeve (7) and spring (5) removed from pump body.

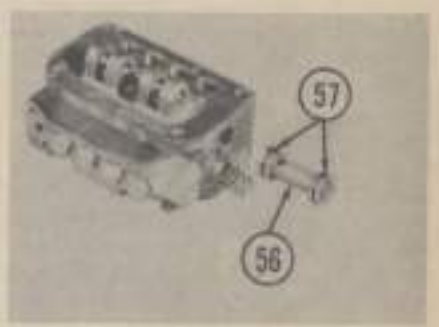


Fig. 157 — Unloading valve body removed from pump. Always renew "O" rings (57).

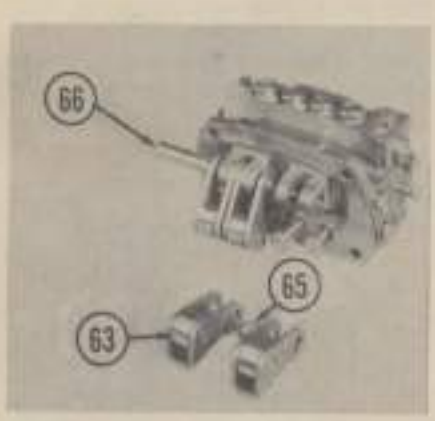


Fig. 152 — Washer (65) is placed between each set of cam followers (63) on pin (66).

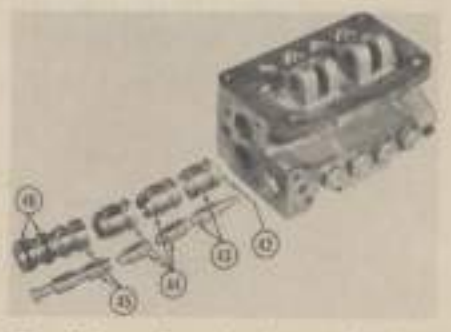


Fig. 155 — Control valves and sleeves (43, 44 and 45) removed from pump body. Always renew the "O" rings (46).

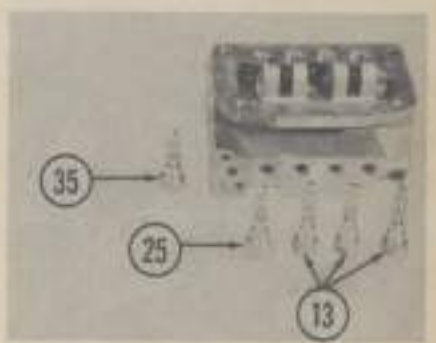


Fig. 158—Pump check (discharge) valves. Seat inserts can be removed by tapping to accomodate a puller screw.

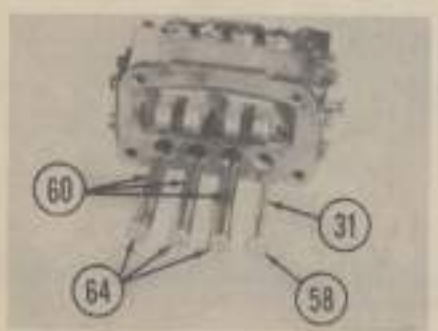


Fig. 153 — View of pump plungers and return springs removed from pump body. Refer to Fig. 149 for legend.

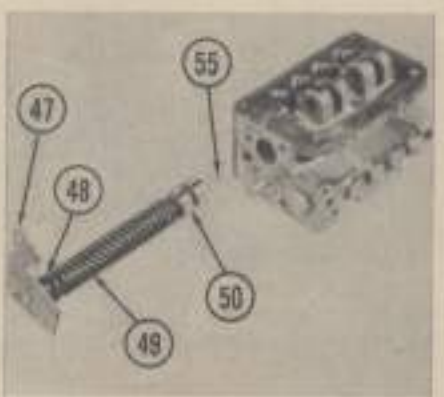


Fig. 156 — Unloading valve assembly removed. Tension of spring (49) is controlled by shims (48).

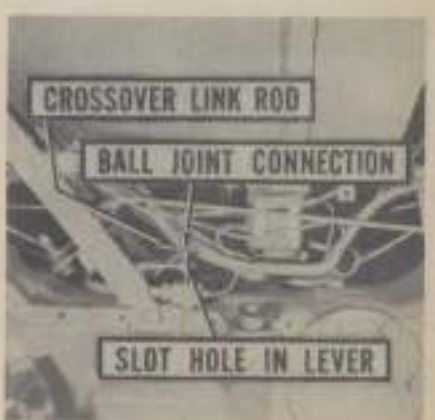


Fig. 159—View of adjustment points for early type "lift-lever" linkage. Refer to paragraph 243.

Booster" gage. Then, slowly turn adjusting screw clockwise until pressure on "Traction-Booster" gage drops.

When the "lift-lower" lever linkage is properly adjusted, an implement will be lowered slowly when lever is placed at lowering detent position. To increase the lowering rate, pull "lift-lower" lever down past detent position.

245. "TRACTION-BOOSTER" LEVER LINKAGE. Place both the "lift-lower" lever and the "Traction-Booster" lever at bottom of quadrant. When the "Traction-Booster" lever is moved up the quadrant, linkage contact with the pump control valve should be felt within the last $\frac{1}{16}$-inch movement from the extreme top detent position of the lever. If the contact point is not felt within $\frac{1}{16}$-inch from top of quadrant, refer to Fig. 161 and adjust linkage as follows: Loosen adjusting jam nuts (2 & 4) at front and rear of adjusting block (3) and reposition adjusting block on link rod with jam nuts until the control valve contact point is felt at the described lever position. Moving adjusting block forward on link rod will move the control valve contact point to a higher position on the quadrant.

When the "Traction-Booster" linkage is properly adjusted, the hydraulic lift arms should not raise with the engine at slow idle speed and with lever in its highest position on quadrant.

246. DRAWBAR SPRING ADJUSTMENT. Place the "Traction-Booster" lever at top of quadrant. Loosen rear jam nut (2—Fig. 161) at adjusting block (3) and back off nut ¼-inch from adjusting block. If drawbar is installed, loosen drawbar clamp. Remove cotter pin (CP) from spring adjusting nut (1) and loosen nut until spring is free. Re-tighten nut until spring free play is taken up; then, tighten nut ⅛-turn further. Turn nut to nearest castellation and install cotter pin. Readjust jam nut on link rod as outlined in paragraph 245.

LIFT ARMS, HOUSING AND RAM CYLINDER

247. **R&R HOUSING ASSEMBLY.** Drain oil from transmission and "Power-Director" compartment. Unbolt and remove pto shaft assembly from rear face of housing. Remove drawbar brackets. Remove oil lines from oil distribution housing or transport valve. On D-14 and D-15 tractors, remove the retaining screw from ram cylinder pivot pin (1—Fig. 162) and pull pin from housing. On D-17 tractors, remove jam nut and set screw from bottom of R.H. brake compartment, thread bolt into ram cylinder pivot pin (19—Fig. 163) and pull pin from housing. On all models, attach hoist to lift shaft housing; then, unbolt and remove housing from rear face of transmission.

To reinstall the assembly, position the lift shaft housing to rear of transmission with hoist, leaving hand space between the two housings. Using a bolt threaded into end of pivot pin as a handle, insert pivot pin in bore, align front end of ram cylinder with pin and push pin into place. Secure pivot pin with set screw. On D-17 models, make certain that set screw seats in groove in pin before tightening the jam nut. Locate lift shaft housing on dowel pins, install retaining cap screws and tighten the cap screws to a torque of 70-75 Ft.-Lbs. Reinstall PTO shaft assembly, hydraulic lines, drawbar brackets and drawbar clamp. Refill transmission and "Power-Director" compartments.

248. **OVERHAUL RAM CYLINDER.** After removing the lift shaft housing as outlined in paragraph 247, remove snap rings and pivot pin (23—Fig. 163) to remove ram assembly. Pull ram piston (17) from cylinder (20). Renew piston and/or cylinder if they are pitted or scored. To renew seals,

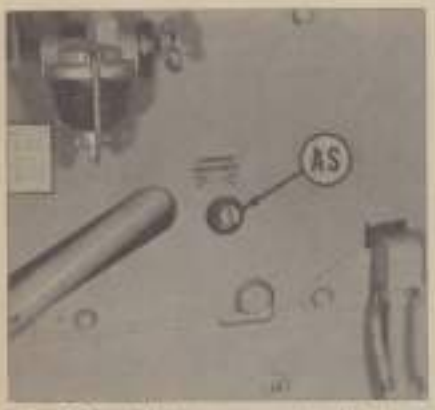


Fig. 160—Adjusting screw for late type "lift-lower" linkage. Refer to paragraph 244.

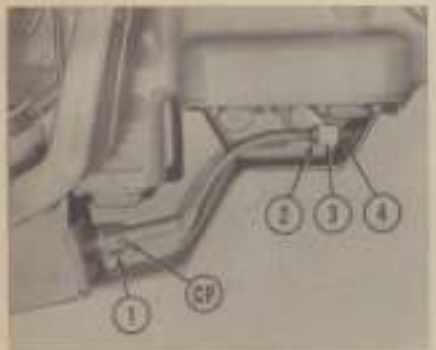


Fig. 161 — View of "Traction-Booster" control linkage and adjustment points. See text.

CP. Cotter pin
1. Spring adjustment nut
2. Jam nut
3. Adjusting block
4. Jam nut

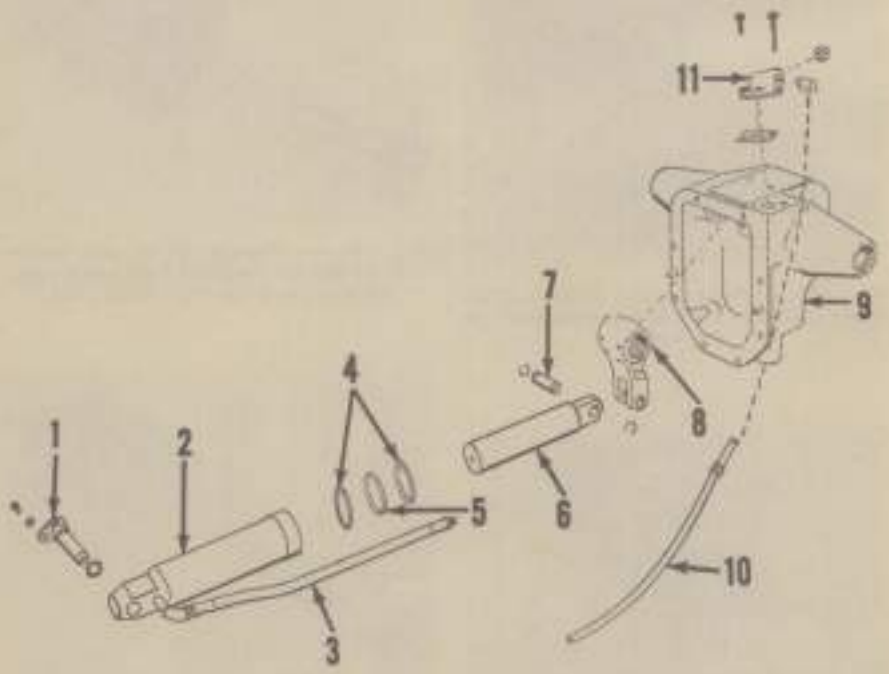


Fig. 162 — Exploded view of the lift (rockshaft) ram and associated parts for D-14 and D-15 tractors.

1. Pivot pin
2. Ram cylinder
3. Ram hose
4. Piston rings
5. "O" ring
6. Ram piston
7. Lift crank pin
8. Lift crank
9. Lift crank (rockshaft) housing
10. Pressure tube
11. Oil distribution housing

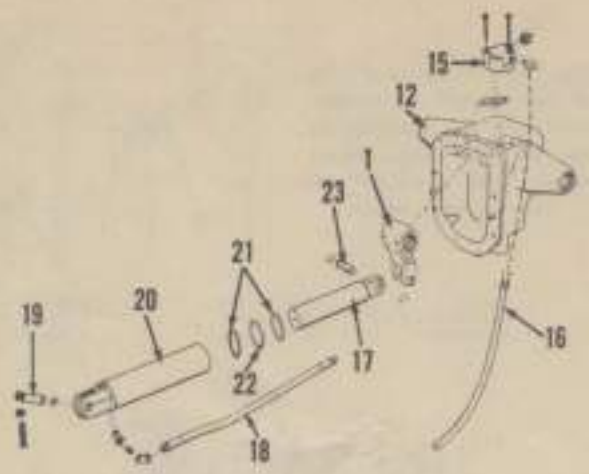


Fig. 163 — Exploded view of the lift (rockshaft) ram and related parts for D-17 tractors.

1. Lift crank
12. Lift (rockshaft) housing
15. Oil distribution housing
16. Pressure tube
17. Ram piston
18. Ram hose
19. Pivot pin
20. Ram cylinder
21. Backup rings
22. "O" ring
23. Lift crank pin

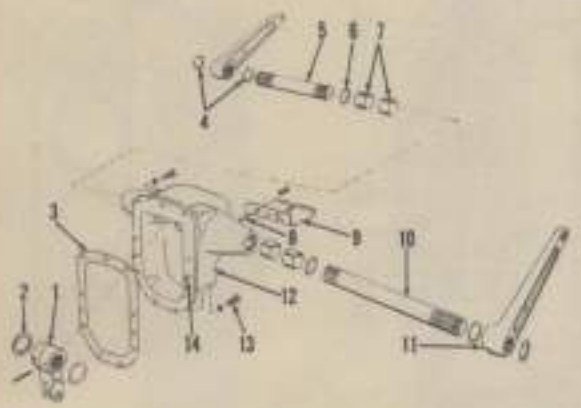


Fig. 164 — Exploded view of lift arms, lift shaft (rockshaft) and housing.

1. Lift crank
2. Spacer washers
3. Gasket
4. Snap rings
5. Lift shaft (RH)
6. "O" rings
7. Bushings
8. Stud bolts
9. PTO guard
10. Lift shaft (Lft)
11. Lift arm
12. Lift (rockshaft) housing
13. Capscrews
14. Dowel pins

install two new backup rings (21) in the groove in cylinder and install new "O" ring (22) between the backup rings. Lubricate piston and seals; then, push piston into cylinder. Apply sealer to threads of ram cylinder hose fittings and tighten fittings securely. Test ram cylinder for leaks prior to reassembly of tractor by blocking ends of cylinder and applying hydraulic pressure to hose; or by partly filling ram cylinder with oil, plugging the outer end of hose and applying mechanical pressure to ends of ram cylinder in a press. CAUTION: Be sure that ends of ram cylinder are secure when making leakage tests.

Leakage of ram cylinder or hose fittings will result in transfer of oil from the hydraulic compartment to the transmission.

249. **OVERHAUL LIFT SHAFT AND HOUSING.** Remove assembly from tractor as outlined in paragraph 247. Drive roll pins from lift crank (1—Fig. 164) and pull lift arms and shafts from housing. Install new inner bushings flush with lift crank thrust surfaces in housing. Install new outer bushings flush with inner edge of "O" ring grooves in outer ends of bore. Thrust washers (2) are available in thicknesses of $\frac{1}{32}$, $\frac{1}{16}$ and $\frac{1}{8}$-inch to eliminate lift shaft end play.

Lift arms are retained on the lift shafts by snap rings (4). Install lift arm on shaft with longer hubs of arms to inside. Align the centerline of lift arm with punch mark on outer end of shaft. Install new "O" ring at outer ends of bore in housing and install lift arms and shafts with the short shaft in R.H. side of housing. Install lift crank with the largest relief for ram piston to front and with the correct thickness of washers (2) to eliminate end play without binding. Align shafts with lift arms towards rear and with hole in shafts matching holes in lift crank. Install roll pins through lift crank and shafts.

OPTIONAL HYDRAULIC EQUIPMENT

250. **SELECTOR VALVE.** Selector valve (See exploded view in Fig. 165) is used on tractors equipped with or without a transport valve to permit use of single acting remote cylinder with regular tractor hydraulic lift-lower lever. When the selector valve lever is raised, oil is diverted from the tractor lift arm to operate a remote cylinder. Spool valve (5) and body (3) are serviced only as a complete valve assembly. Seals (4) and other parts are renewable.

251. **TRANSPORT VALVE.** Transport valve (See exploded view in Fig. 166) is used on tractors in place of the oil distribution housing (11—Fig. 162 or 15—Fig. 163) to permit use of "Traction-Booster" action when pulling certain large pull type implements that are equipped with single acting remote lift cylinder and transport wheels. With knob (7—Fig. 166)

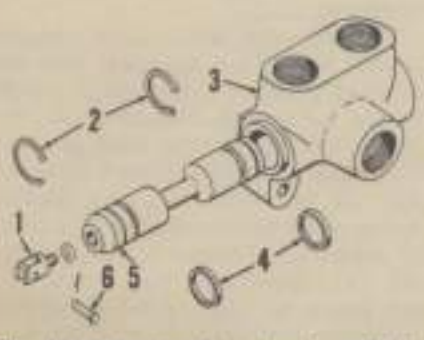


Fig. 165—Selector valve shown is available as optional equipment. See paragraph 250.

1. Lever adapter
2. Snap rings
3. Housing
4. "O" rings
5. Valve spool
6. Pin

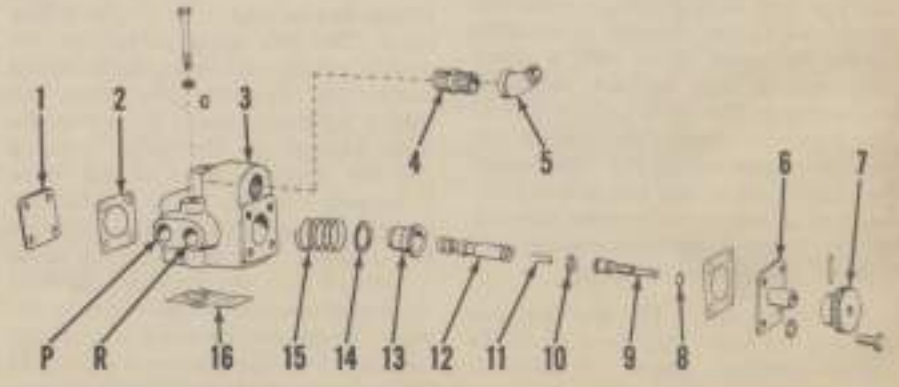


Fig. 166—Expanded view of transport valve available as optional equipment. See paragraph 251.

P. Pressure line port
R. Return (sump) port
1. Front cover
2. Gasket
3. Valve body
4. Pipe nipple
5. Pipe elbow
6. Rear cover
7. Adjusting knob
8. "O" ring
9. Adjusting screw
10. Snap ring
11. Spool plunger
12. Spool valve
13. Spring cup
14. Shim
15. Spring
16. Gasket

turned all the way out, oil flow is to tractor lift ram only which provides "Traction-Booster" action as long as the hydraulic pressure remains below 1000 psi. When the pressure exceeds 1000 psi, the spool valve (12) will shift, opening the pressure line to the remote cylinder. Except when "Traction-Booster" action is desired with pull type implements, the transport valve knob should be turned all the way in, holding the valve spool in position so the passage to lift cylinder ram and remote ram are both open.

Normal internal leakage to sump return line through the transport valve is 2 cubic inches of oil per minute at 1500 psi. To overcome this loss, it is necessary to keep the "lift-lower" lever in lift position when tractor is equipped with transport valve to hold implements in lift position. The $\frac{1}{4}$-inch pump plunger will then maintain approximately 2100 psi in the hydraulic pressure line.

To check the shifting pressure of transport valve spool, place a gage in the pressure line to valve and hook remote ram cylinder to outlet. Turn valve knob all the way out and place the "lift-lower" lever in lift position. Valve should automatically shift and start operating the remote ram when line pressure reaches 1000 psi. Use 0.015 shims (14) as required behind spring (15) to raise pressure at which the valve spool will shift.

252. **FOUR-WAY SINGLE SPOOL REMOTE CONTROL VALVE.** The four-way single spool valve (See exploded view in Fig. 167) is used to operate large diameter, low pressure, double acting remote ram cylinders from the high pressure system. The valve is equipped with an internal pressure relief valve set at 1000-1200 psi. The inlet of this valve is generally connected to the remote ram outlet of the transport valve with a quick coupler and the by-pass outlet is connected to the sump return line of the transport valve. To operate the remote control valve, the "lift-lower" lever must be in the lift detent position; thus, while the remote valve is in use, there is no independent control of the tractor lift arms.

The valve spool (9) and housing (5) are serviced only as a complete valve assembly. Seals (4) and all other parts are renewable.

253. **TWO OR THREE-SPOOL REMOTE CONTROL VALVES.** Cross-sectional view of the three spool valve is shown in Fig. 168 and Fig. 169.

Fig. 167 — Exploded view of single-spool four-way control valve for operation of low-pressure double acting remote ram (available as optional equipment).

1. Bonnet
2. Centering spring
3. Spool collar
4. Cup seal
5. Housing
6. "O" ring
7. Relief seat
8. Relief spring
9. Spool valve
10. Pin
11. Lever
12. Bracket

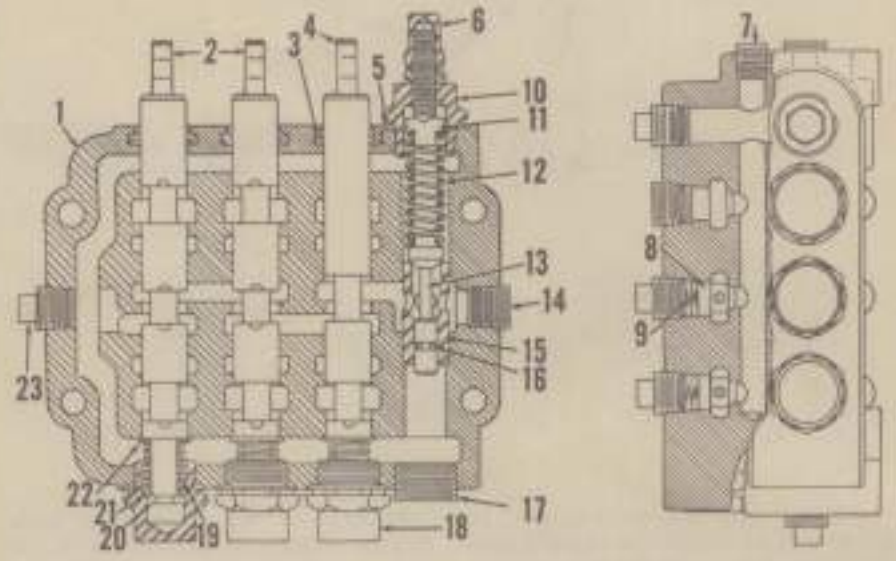


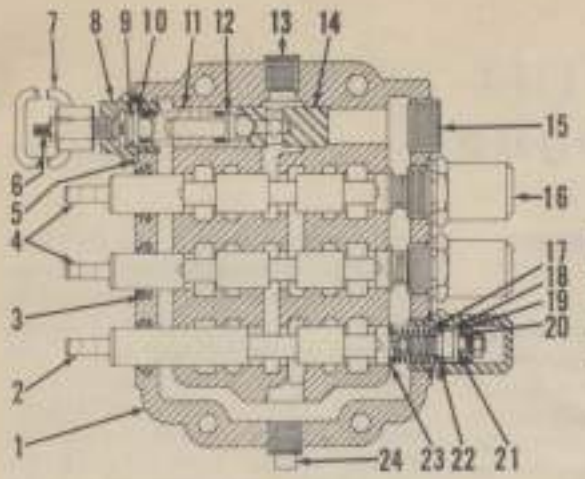
Fig. 168 — Cut-away view of early production 3-spool remote control valve (optional equipment). Single acting spool (4) is used in operation of tractor lift cylinder (See text). Note that check valve (8) is not used with single acting spool. Two-spool valve is similar.

1. Valve housing
2. Two-way spools
3. Spool seals
4. Single acting spool
5. Seal washer
6. Cap nut
7. Plug
8. Check valve poppet
9. Check valve spring
10. Retainer
11. Cap
12. Spring
13. Relief valve
14. Plug
15. Valve sleeve
16. Seal
17. Plug
18. Cap
19. Spring
20. Capscrew
21. Spring retainer
22. Washer
23. Plug

The two spool valve is similar. The three spool valve has two double acting spools and one single acting spool. The two spool valve has one double acting and one single acting spool. The pressure line from the tractor hydraulic pump leads into the inlet passage of the valve housing and the by-pass outlet of the valve is tapped into the sump return line of the transport valve. The pressure outlet port of the single acting spool is hooked into the pressure inlet of the transport valve. Therefore, to operate the tractor lift arms or a remote cylinder from the transport valve, the single acting spool of the remote control valve must be latched in the raised position to operate the system with the "lift-lower" lever on the steering wheel quadrant. An alternate method is to place the "lift-lower" lever in lift position and operate the tractor lift arms with the single acting spool lever of the remote valve. Note: The first method of operation must be used if "Traction-Booster" action is desired.

The two and three spool remote control valves are equipped with an internal pressure relief valve which should be set at 2200-2400 psi. To check relief pressure on early production valves (Fig. 168), place a pressure gage in the outlet port of a double acting spool and pressurize this port. to adjust relief pressure, remove cap nut (6), loosen jam nut and adjust the screw to bring pressure within recommended limits. Tighten jam nut and reinstall cap nut.

Later production valves are equipped with a different type relief valve incorporating a relief valve



1. Housing
2. Single-acting spool
3. Spool seal
4. Two-way spools
5. Sealing washer
6. Relief adjusting screw
7. Relief lock-out ball
8. Relief screw retainer
9. "O" ring
10. Spring seat
11. Relief valve spring
12. Guide
13. Plug
14. Relief valve seat
15. Plug
16. Cap
17. Centering spring
18. Spool retainer
19. "O" ring
20. Spool seal
21. "O" ring
22. Washer
23. Washer
24. Plug

Fig. 169 — Cut-away view of later production 3-spool remote control valve (optional equipment). A similar 2-spool valve is also available.

lockout. See Fig. 169. To adjust the relief valve in this type remote control valve, connect a pressure gage to a remote spool port and pressurize the port. To adjust relief pressure, loosen jam nut on pressure adjusting screw (6) and adjust screw to obtain 2200-2400 psi on gage; then retighten jam nut. When not using remote ram cylinders, the relief valve lockout ball (7) may be turned all the way in. This will provide a maximum of 3600 psi for operation of the tractor lift arm ram cylinder, as the unloading valve in the tractor pump will act as system relief valve. CAUTION: The relief valve ball should be turned all the way out whenever operating remote cylinders.

254. OVERHAUL REMOTE CONTROL VALVE. Spools (2&4—Figs. 168 and 169) and valve housing (1) are not serviced except as a complete valve assembly. All other parts are renewable.

To renew spool seals (3), unhook control lever from spool and clean all paint, rust, etc., from exposed end of spool. Remove cap (18—Fig. 168 or 16—Fig. 169) and withdraw spool assembly from valve housing. Seal in housing can then be renewed. Carefully reinstall spool through housing and seal. Reinstall cap and control lever. The valve centering spring assembly can be inspected and renewed without removing valve spool from housing.

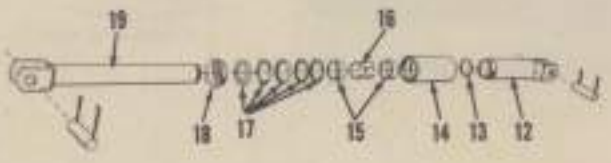
Note that centering spring retainer (20—Fig. 169) in late production valve incorporates a seal (21) between the retainer and cap. The seal is used to prevent pressure build up in cap that would cause a valve spool to shift without the control lever being actuated. This feature may be installed in early production valves (Fig. 168) by using parts supplied through Allis-Chalmers parts departments.

To inspect or renew pressure relief valve or spring, or renew "O" ring seals, loosen jam nut on relief valve adjusting screw and back screw out. Then, loosen and remove adjusting screw retainer (10—Fig. 168 or 8—Fig. 169). Spring, spring guide and valve ball or plunger can then be removed. To remove seat, first remove plug (17—Fig. 168 or 15—Fig. 169) and drive the seat from housing. Reverse disassembly procedures to reassemble valve. Note: Install relief valve spring with out-of-square end towards valve.

255. **1¾ OR 2-INCH REMOTE RAM.** Both the 1¾ inch and the 2-inch remote ram are single acting only. Refer to Fig. 170 for exploded view of ram. Ram piston is retained in cylinder by snap ring (13) in groove on inner end of piston striking plunger guide (14) when piston is in extreme extended position. Disassembly and overhaul procedure is evident after inspection of unit and reference to Fig. 170.

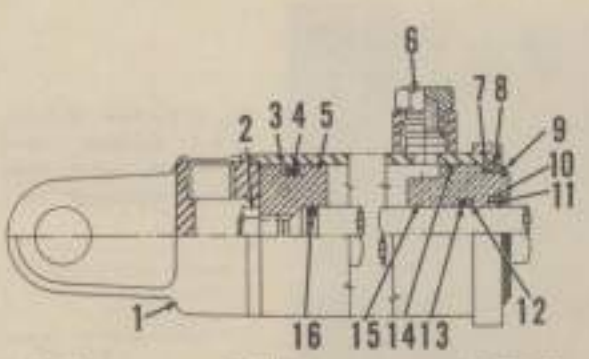
256. **2½ INCH REMOTE RAM.** Refer to Fig. 171 for cross-sectional view of this unit. The 2½ inch ram may be used for single acting applications when equipped with vent (6) as shown, or may be used for double acting applications by removing the vent and installing a hose in that port.

To disassemble ram, remove snap ring (9), spacer (8), snap ring (7) and withdraw piston rod, piston and piston rod support assembly from cylinder. To renew piston seals, install one backup ring (3) at each side of "O" ring (4). Further disassembly and overhaul procedure is evident from inspection of unit and reference to Fig. 171.



12. Cylinder
13. Snap ring
14. Plunger guide
15. Bushings
16. Bushing spacer
17. Gland packing
18. Gland nut
19. Plunger

Fig. 170—Exploded view of 1¾ and 2 inch remote (cylinder) ram.



1. Cylinder
2. Nut
3. Backup rings (2)
4. "O" ring
5. Piston
6. Breather vent
7. Snap ring
8. Spacer
9. Snap ring
10. Snap ring
11. Wiper
12. Backup ring
13. "O" ring
14. "O" ring
15. Support
16. "O" ring

Fig. 171 — Cut-away view of the 2½ inch remote ram which is available.

HYDRAULIC POWER LIFT SYSTEMS (GEAR TYPE PUMPS)

258. Gear type hydraulic pumps are available for D-15 and D-17 Series IV (tractor Serial No. D17-75001 and up). The gear type pump is mounted on the right side of the torque housing in place of the belt pulley. On D-15 tractors, the pump is driven by the bevel gear (8—Fig. 142) on the engine clutch shaft. On D-17 Series IV tractors, the pump is driven by the bevel gear on the pump drive shaft (10—Fig. 97). Refer to paragraph 228 for the plunger type pump used on other models.

CHECKS AND ADJUSTMENTS

Series IV D-17 Models

259. **TORSION BAR ADJUSTMENT.** Remove any weight or implement attached to the three point hitch. Loosen lock nut and back the preload adjusting screw (Fig. 172) out until torsion bar tube (3) is free to turn in the support brackets. Then, turn adjusting screw in just far enough to eliminate all free movement of the torsion bar tube and tighten the lock nut while holding the screw in this position.

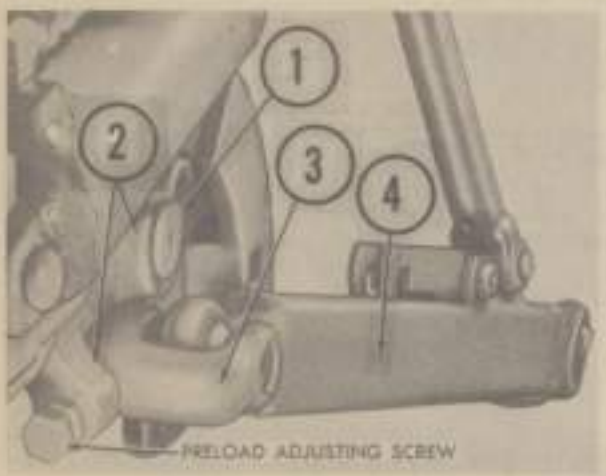


Fig. 172 — View of the torsion bar preload adjusting screw and locknut for Series IV D-17 tractors. Refer to paragraph 259 for adjustment procedure.

1. Torsion bar
2. Left hand torsion bar support
3. Torsion bar tube
4. Left hand draft arm

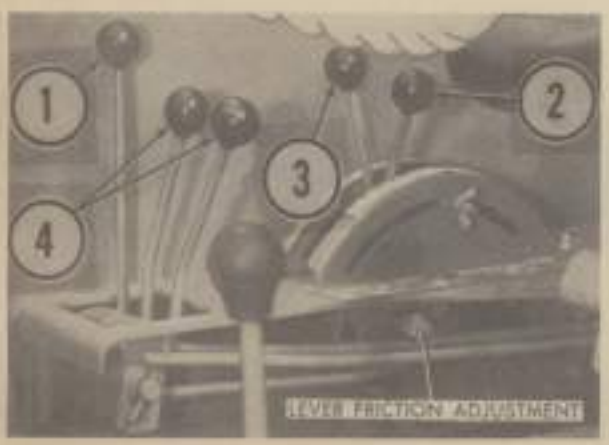


Fig. 173—View of Series IV D-17 hydraulic control levers and control lever friction adjustment nut.

1. Lift arm control lever
2. Position control lever
3. "Traction Booster" control lever
4. Remote ram control levers

260. **"TRACTION BOOSTER" (DRAFT) ADJUSTMENT.** Remove any weight or implement attached to the 3 point hitch and/or drawbar. With the engine running at low idle speed, move the lift arm control lever (1—Fig. 173) to the "Traction Booster" detent position, move the position control lever (2) all the way forward and move "Traction Booster" control lever (3) all the way to the rear. Loosen locknut (L—Fig. 174) and turn the "Traction Booster" link rod into yoke (Y). Attach a 200 lbs weight to the lift arms and back the link rod out of the yoke (Y) until lift arms begin to lower with the attached 200 lbs. Make certain that lift arms move to the fully lowered position with 200 lbs of weight, then tighten locknut (L).

261. **POSITION CONTROL ADJUSTMENT.** With the engine running at low idle speed, move the lift arm control lever (1—Fig. 173) in the "Traction Booster" detent position, move the "Traction Booster" control lever (3) all the way forward, move the position control lever (2) all the way to the rear. Turn the position control adjustment nut (Fig. 175) out until lift arms raise, then with lift arms at top of travel, turn the adjusting nut (Fig. 175) onto rod until pressure is below ½ of scale on the "Traction Booster" gage.

262. **LEVER FRICTION ADJUSTMENT.** With the engine stopped, completely lower the lift arms. Move the "Traction Booster" control lever (3—Fig. 173) and the position control lever (2) to full rearward position. If the levers will not stay in this position, tighten the friction adjusting nut (See Fig. 173).

263. **LOWERING RATE ADJUSTMENT.** The rate of lowering can be adjusted by turning the adjusting screw (56—Fig. 177) in to slow the lowering rate or out to increase the speed of lowering. Normal setting is accomplished by turning needle in until it seats, then backing screw out ⅝-turn. The adjusting needle is located at bottom of lift arm valve body, just ahead of the lift arm ram outlet connection. **NOTE:** The high volume

bleed-off adjustment screw (34—Fig. 177) should **NOT** be mistaken for the rate of lowering adjustment screw (56). Normal setting for the high volume bleed-off screw (34) is 4 turns open.

264. **SYSTEM RELIEF PRESSURE.** The hydraulic system relief pressure can be checked at a remote cylinder connection as follows: Install a 3000 psi gage in a remote cylinder (ram) connection and presurize that port.

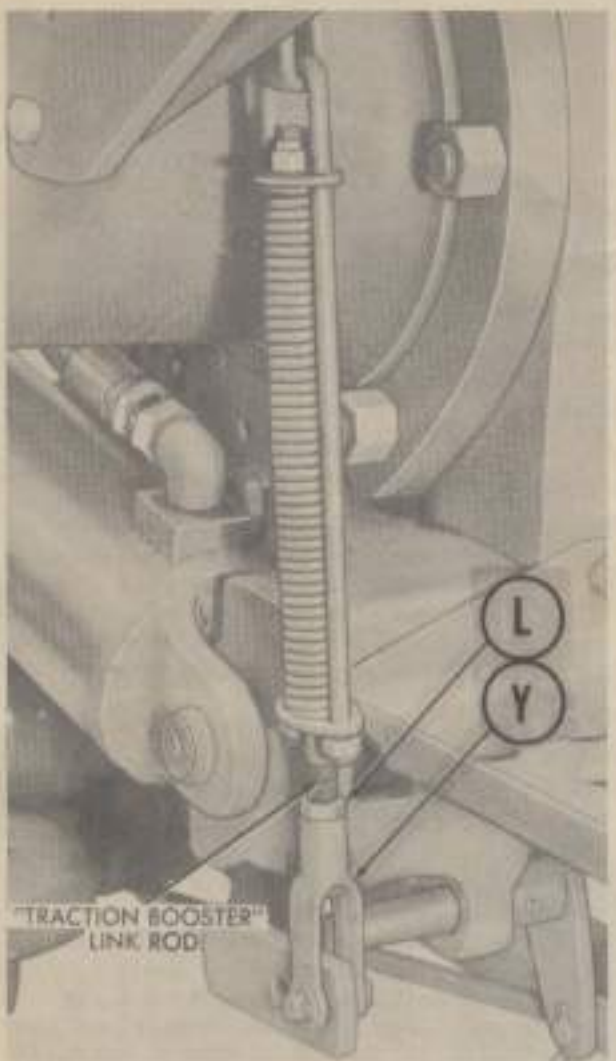


Fig. 174—Series IV D-17 "Traction Booster" linkage adjustment points. Refer to paragraph 260 for adjustment procedure.

Fig. 175 — View of position control linkage adjustment nut. Refer to paragraph 261 for adjustment procedure. Nut is self locking.

NOTE: Control valve must be held in position when checking pressure. Gage pressure should be 2250-2350 psi with engine running at 1650 rpm. If pressure is incorrect, remove cap nut (93—Fig. 177), loosen lock nut (92) and turn the adjusting screw (90) as required to obtain 2300 psi. Refer to paragraph 267 for complete system check.

265. **"TRACTION BOOSTER" RELIEF VALVE.** Pressure in the "Traction Booster" system is controlled by the relief valve (15 through 32—Fig. 177). To check the system pressure, disconnect one of the tractor lift arm ram (cylinder) lines from the "Tee" fitting on bottom rear of the valve assembly and connect a gage to the fitting connection. With engine running at 1650 rpm, actuate the "Traction Booster" sensing valve. Gage pressure should be 2100 psi. If pressure is incorrect, remove cap nut (15—Fig. 177), loosen lock nut (17) and turn adjusting screw (18) as required to obtain 2100 psi. Refer to paragraph 267 for complete "Traction Booster" and lift system check.

266. **CONTROL LEVER RELEASE PRESSURE.** When engine is running at normal operating speeds, the remote cylinder control levers should automatically return to neutral position when remote cylinder reaches end of stroke or the lift arm control lever should return to hold position from raising position when lift arms reach fully raised position. If the controls do not return to neutral or hold position, remove the rubber cap (53 or 74—Fig. 177) and turn adjusting screw (51 or 72) out just enough to allow valve to release. If controls release too soon, turn adjusting screw in.

267. **COMPLETE SYSTEM CHECK.** An OTC Y 81-21 or equivalent hydraulic tester can be used to check the complete "Traction Booster" and power lift hydraulic system. To connect the hydraulic tester, remove the tractor seat, remove the four capscrews from the brake housing cover and slide cover forward. Refer to Fig. 176. Disconnect center line from "Tee" fitting (921472) on lift ram pressure line, turn the "Tee" upward and connect the inlet hose to tester to the "Tee". Remove the union from the sump return line and install a "Tee" fitting (922741). Connect the outlet hose from the tester to the "Tee" (922741) in sump return line.

To check the power lift system, first remove the rubber plug (53—Fig. 177) and turn the adjusting screw (51) in until the spool will not automatically return to hold position. Open the hydraulic tester valve fully, move the lift arm control lever (Fig. 176) to the rear, move the position control lever and "Traction Booster" control levers toward front. Operate the engine at 1000 rpm and close the tester valve until pressure is 1500 psi. When hydraulic fluid temperature reaches 100° F., set engine speed at 1650 rpm and turn tester valve in to set pressure at 2000 psi. Volume of flow should be 10.5 GPM for new pump. To check the lift system relief pressure, close the tester valve completely. If relief pressure is not 2250-2350, remove cap nut (93—Fig. 177), loosen lock nut (92) and turn the adjusting screw (90) as required to obtain 2300 psi. Reset the control lever release pressure as outlined in paragraph 266.

To check the "Traction Booster" system, it is necessary to back-out the high volume bleed screw (34—Fig. 177) six turns from seated (closed) position. Shorten the "Traction Booster" linkage (Fig. 174) until sensing valve (9—Fig. 177) is pushed into the valve housing. Position the lift arm control lever in "Traction Booster" detent and move "Traction Booster" control lever (Fig. 176) all the way to the rear. Open the tester valve and operate engine at 1650 rpm. Tester will show false reading (increased volume) due to partial flow of lift pump until pressure is increased. Close the valve on tester until pressure is 1800 psi and observe "Traction Booster" pump volume which should be 1.5 GPM. If volume is less than 1.0 GPM, "Traction Booster" pump should be overhauled. To check "Traction Booster" relief pressure, completely close valve on hydraulic tester. If relief pressure is not 2050-2150 psi, remove cap nut (15—Fig. 177), loosen lock nut (17) and turn adjusting screw (18) as required to obtain 2100 psi. After checks are completed, turn the high volume bleed-off adjusting screw (34—Fig. 177) in until it seats, then back screw out 4 turns. Adjust the "Traction Booster" linkage as outlined in paragraph 260.

HYDRAULIC PUMP

D-15 Models

A high volume (25 GPM), side mounted, gear type pump is available on D-15 tractors. The high volume pump should be used only with control valves specified for use with high volume systems.

268. **REMOVE AND REINSTALL.** Before removing the pump, thoroughly clean exterior of pump, hydraulic lines and connections. Drain the hydraulic reservoir (Fig. 179) and disconnect hydraulic lines (1 & 2) from pump. All oil lines and ports should be capped or plugged. Remove the two pump mounting screws and remove pump from torque housing.

Shims (1—Fig. 178) are used to adjust backlash between pump gear (1) and drive pinion (8—Fig. 94) on the engine clutch shaft.

When reinstalling, first remove all shims (1—Fig. 178) and install "O" ring (5) on pump body (6). Hold pump squarely in torque housing with zero backlash on bevel gears and measure distance between pump mounting flange and torque housing.

Withdraw the pump from torque housing and install same thickness of shims as measured clearance plus an additional 0.030 inch thickness to give bevel gears the proper backlash. Shims are available in thicknesses of 0.005 and 0.010. Tighten pump mounting screws to 45-55 Ft.-Lbs. of torque.

269. **OVERHAUL.** To remove the pump drive shaft (2—Fig. 178), bearing (4) and/or seal (6); remove the three screws attaching bearing retainer (3) to pump body (8) and bump shaft (2) and bearing out of pump body. Remove snap ring (7) from shaft if bearing (4) is to be removed. Oil seal (6) can be removed from pump body.

Before disassembling the pump, scribe a mark across the pump body (8), gear plate (17) and cover (21) to facilitate reassembly. Remove the four socket head screws from pump body (8) and four capscrews from cover (21), then carefully separate pump sections. NOTE: Do not pry sections apart as this will damage sealing surfaces.

Check wear plates (12 & 18), gear plate (17), gears (15 & 16) and bearing surfaces for wear or scoring. Renew needle bearings (9) if needles are loose or scored. If damage is excessive, renewal of the complete pump may be more practical than renewing individual parts. Drive or press only on lettered end of needle bearing cages (9). Be careful to keep bearing assemblies clean. Install "E" shaped neoprene sealing rings (10) in grooves with flat side toward body (8) or cover (21). Install "E" shaped backup rings (11) with flat side toward wear plate (12 or 18). Install small "O" rings (19) in in grooves in body (8) and cover (21). Wear plate (12) has relief grooves and should be installed with pressure balance ports (⅛ inch) toward seal rings (10) and bronze face toward gears (15 & 16). Install "O" rings (14) with lip toward gear plate (17). Wear plate (18) does

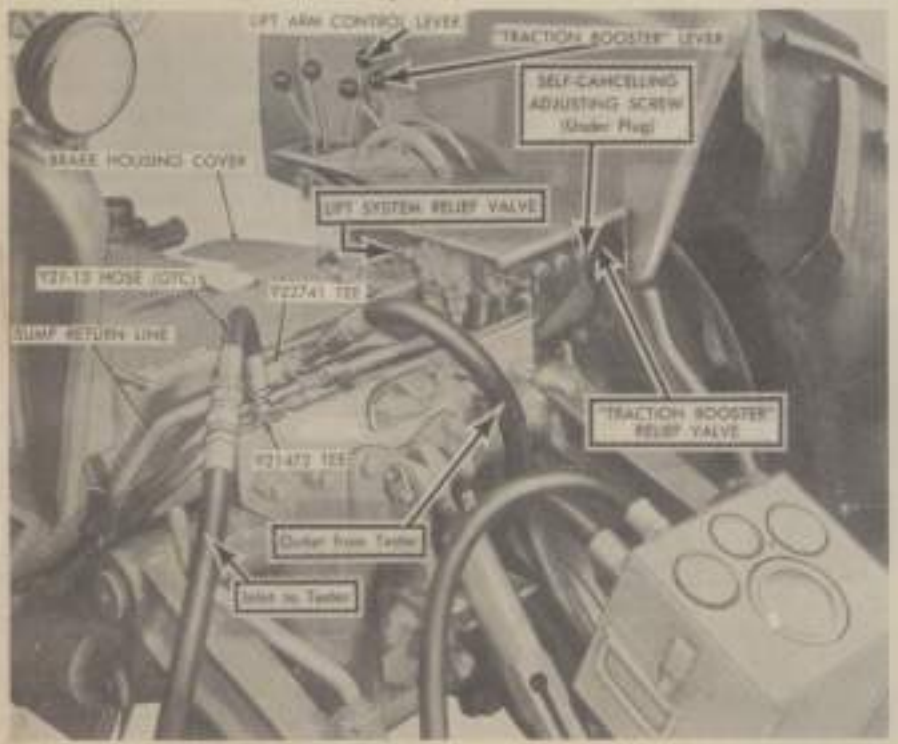


Fig. 176—View of Series IV D-17 tractor with hydraulic tester connected. Inlet hose to tester is connected to the lift arm cylinder pressure line, outlet hose from tester is connected to the sump return line.

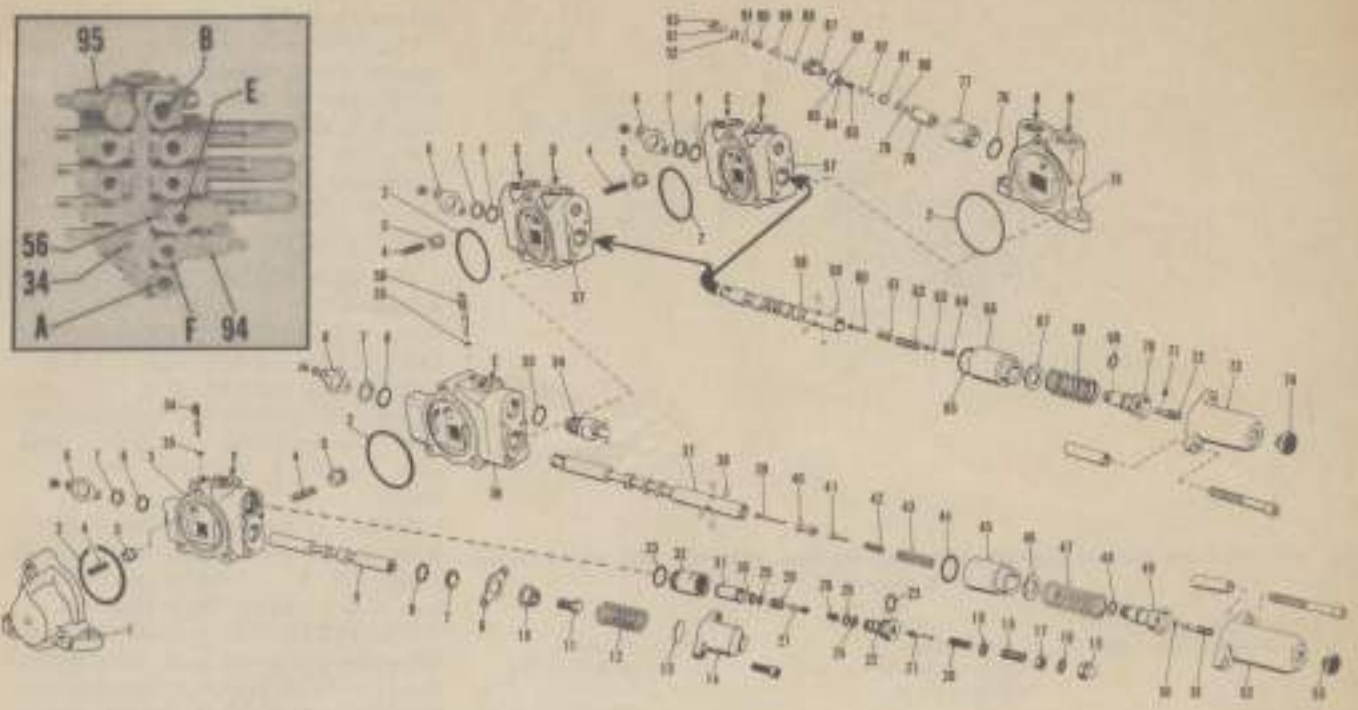


Fig. 177—Exploded view of "Traction Booster" and hydraulic power lift valves used on Series IV D-17 tractors. Later production units may have outlet port (A) in the outlet housing (1) as shown at inset.

A. Outlet port to sump
B. Inlet from lift pump
C & D. Double acting remote cylinder ports
E. Port to lift arm ram
F. Inlet from "Traction Booster" pump

1. Outlet housing
2. "O" rings
3. "Traction Booster" valve housing
4. Check valve springs
5. Check valves
6. Seal plates
7. Seal wiper rings
8. "O" rings
9. "Traction Booster" sensing valve
10. Spring seat
11. Socket head screw
12. Valve spring
13. Spacer
14. Cover
15. Cap nut
16. Copper washer
17. Lock nut
18. Adjusting screw ("Traction Booster" relief valve)
19. Copper washer
20. Spring
21. Plunger
22. Plug
23. "O" ring
24. "O" ring
25. Back-up ring
26. Spring
27. Relief valve ("Traction Booster")
28. Piston
29. "O" ring
30. Back-up ring
31. Valve sleeve
32. "Traction Booster" relief valve cap
33. "O" ring
34. High volume bleed-off adjusting screw
35. "O" rings
36. "Traction Booster"—lift arm valve housing
37. Valve spool
38. Steel balls
39. Poppet
40. Cam
41. Spring guide
42. Spring
43. Detent spring
44. "O" ring
45. Sleeve
46. Washer
47. Plunger spring
48. "O" ring
49. Spring seat
50. "O" ring
51. Adjusting screw (for self-cancelling)
52. Cover
53. Rubber plug
54. Shut-off valve
55. "O" ring
56. Lift arm rate of lowering adjusting screw
57. Remote cylinder control housing
58. Valve spool
59. Steel balls
60. Poppet
61. Cam
62. Detent spring
63. Spring guide
64. Spring
65. "O" ring
66. Sleeve
67. Washer
68. Plunger spring
69. "O" ring
70. Spring seat
71. "O" ring
72. Adjusting screw (for self-cancelling)
73. Cover
74. Rubber plug
75. Inlet housing
76. "O" ring
77. Lift system relief valve cap
78. Valve sleeve
79. Back-up ring
80. "O" ring
81. Piston
82. Relief valve (hydraulic lift system)
83. Spring
84. Back-up washer
85. "O" ring
86. "O" ring
87. Plug
88. Plunger
89. Spring
90. Adjusting screw (hydraulic lift system relief valve)
91. Copper washers
92. Lock nut
93. Cap nut

not have relief grooves and should be installed with balance ports (⅛ inch holes) toward same side as first plate (12). Bronze face of wear plate (18) should face toward gears (15 & 16).

When tightening the retaining screws, tighten all screws evenly and rotate gears frequently to avoid binding. The four socket head screws in pump body (8) and the two 5/16 inch cap screws in cover (21) should be torqued to 32-37 Ft.-Lbs. The two ¼ inch cap screws in cover (21) should be torqued to 18-22 Ft.-Lbs.

New and rebuilt pumps should be allowed to break-in for a short time with relief valve set at 200 psi. Make certain that all lines are connected and reservoir is filled before operating pump.

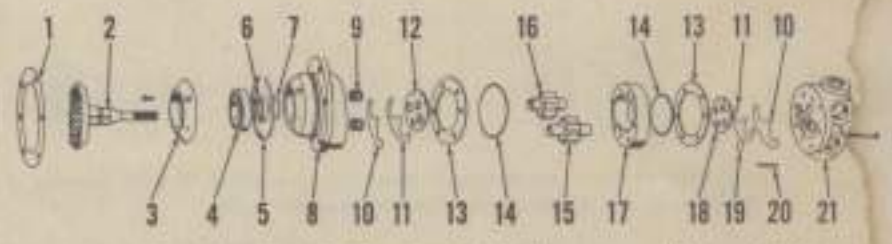


Fig. 178 — Exploded view of high volume hydraulic pump available on D-15 tractors. Unit is mounted and driven the same as belt pulley unit.

1. Shims
2. Pump drive gear and shaft
3. Bearing retainer
4. Bearing
5. "O" ring
6. Oil seal
7. Snap ring
8. Body
9. Needle bearings (4 used)
10. Neoprene seal rings (2 used)
11. Back-up rings (2 used)
12. Wear plate
13. Retaining plates (2 used)
14. Seals (2 used)
15. Idler gear
16. Drive gear
17. Gear plates
18. Wear plate
19. "O" ring (2 used)
20. Dowel pin (2 used)
21. Pump cover

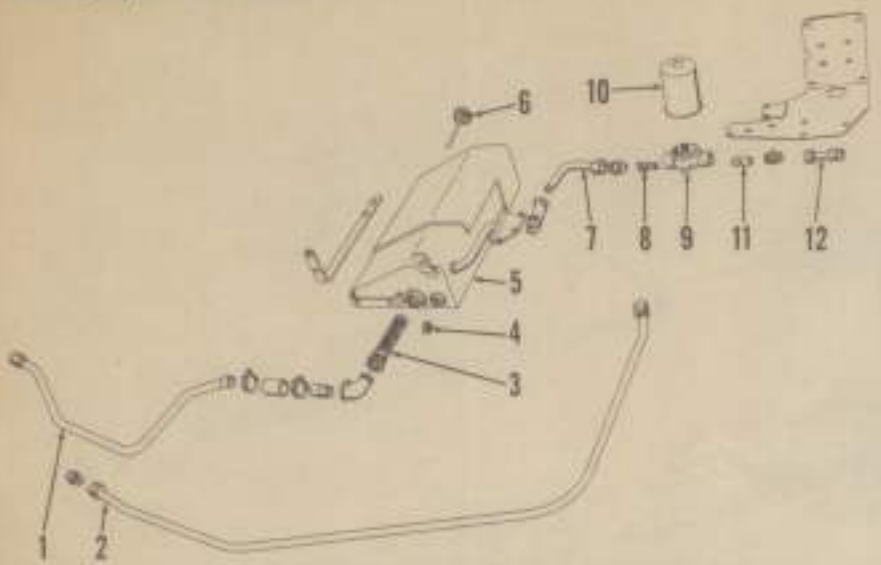


Fig. 179—Exploded view of reservoir, filter and oil lines used with high volume pump on D-15 tractors.

1. Inlet line to pump
2. Pressure line from pump
3. Screen
4. Drain plug
5. Reservoir
6. Filter cap and dipstick
7. Return line
8. Filter relief valve spring
9. Filter adapter
10. Filter
11. Relief valve piston
12. Return line from control valve

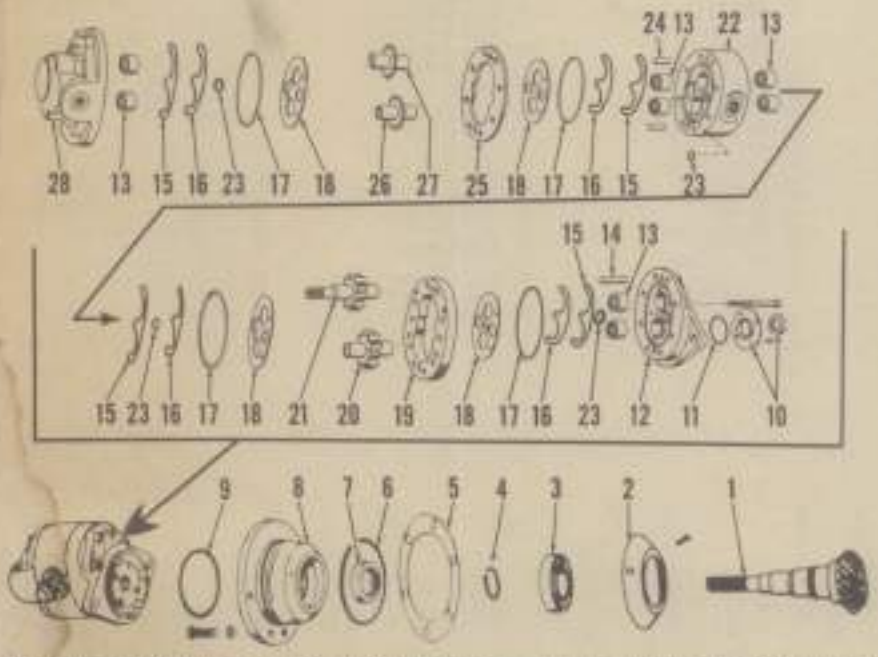


Fig. 180—Exploded view of gear type hydraulic pump used on Series IV D-17 tractors. Small gears (26 & 27) are for "Traction Booster" system.

1. Drive gear and shaft
2. Bearing retainer
3. Bearing
4. Snap ring
5. Shim (0.005)
6. "O" ring
7. Oil seal
8. Adapter
9. "O" ring
10. Oil seal and plate
11. "O" ring
12. Body
13. Needle bearings (8 used)
14. Dowel pins
15. Neoprene sealing rings (4 used)
16. Back-up rings (4 used)
17. Seal ring (4 used)
18. Wear plates (4 used)
19. Gear plate
20. Drive gear
21. Drive shaft and gear
22. Gear plate
23. "O" rings (4 used)
24. Dowel pins
25. Gear plate
26. "Traction Booster" gear
27. Drive gear
28. Pump cover

Series IV D-17

The side mounted, gear type hydraulic pump shown in Fig. 180 is driven by the bevel gear on end of hollow shaft (10—Fig. 97). The hollow pump drive shaft is splined into the engine clutch cover (5—Fig. 92) and drives the pump all the time engine is running.

270. **REMOVE AND REINSTALL.** Before removing the hydraulic pump, clean the pump and all connecting hydraulic lines and fittings. The pump unit (10 through 28—Fig. 180) can be removed from the drive assembly after disconnecting hydraulic lines and removing the two mounting screws.

Shims (5) are used to adjust bevel drive gear backlash. Refer to paragraph 268 for adjusting gear backlash if drive assembly is removed.

271. **OVERHAUL.** Before disassembling the pump, scribe a mark across the outside of pump to facilitate reassembly. Remove the eight socket head screws from pump base (12—Fig. 180), then carefully separate the pump sections. NOTE: Do not pry the pump apart as this will damage sealing surfaces.

Check wear plates (18), gear plates (19 & 25), gears (20, 21, 26 & 27) and bearing surfaces for wear or scoring. Renew needle bearings (13) if needles are loose or scored. If damage is excessive, renewal of the complete pump may be more practical than renewing individual parts. Drive or press only on lettered end of needle bearing cages (13). Be careful to keep bearing assemblies clean. Install "E" shaped neoprene sealing rings (15) in grooves with flat side toward body (12), plate (22) or cover (28). Install "E" shaped back-up rings (16) with flat side toward wear plates (18). Install small "O" rings (23) in grooves in body, plate and cover (12, 22 & 28). Install large "O" rings (17) with lip toward gear plate (19 and 25). Wear plates (18) should be installed with bronze face toward gears and balance ports (⅛ inch holes) toward sealing rings (16). Tighten the eight socket head retaining screws evening to 32-37 Ft.-Lbs. torque.

CONTROL VALVES

D-15 High Volume

272. The three spool remote control valve used on D-15 tractors equipped with the optional high volume pump is shown in Fig. 181. The center control valve (30) is not provided with float position. Number one and three

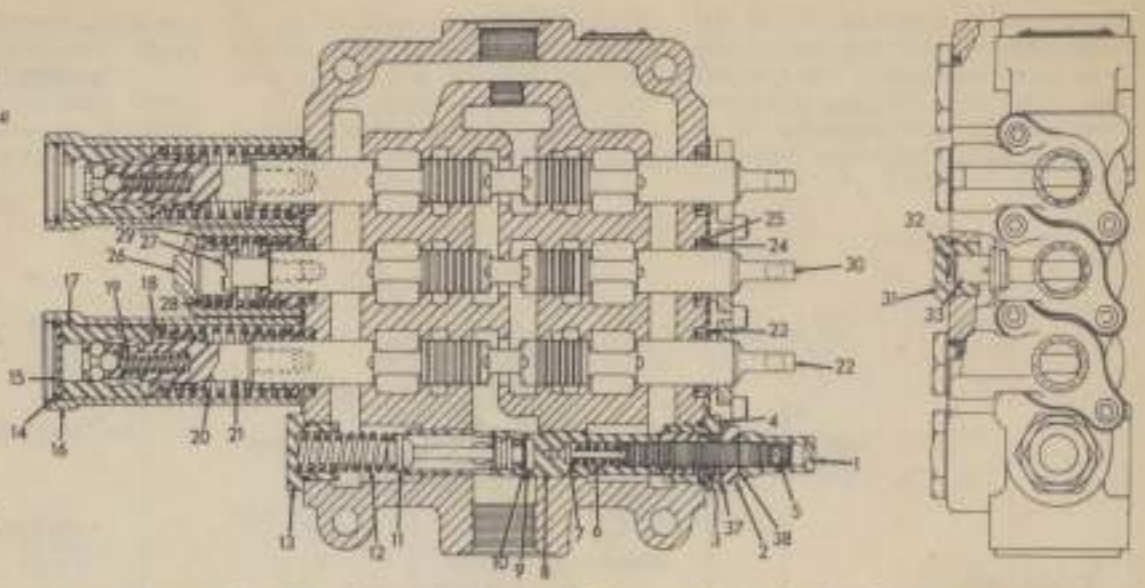


Fig. 181—Cross sectional view of three spool control valve for use with high volume (25GPM) pump available on D-15 tractors.

control valves are identical; however, spools should always be reinstalled in same valve housing bore.

System relief pressure should be 1500-1550 psi and is changed by turning the adjusting screw (5). After setting relief valve pressure, make certain lock nut (2) is tight and install cap nut (1).

Series IV D-17

273. Individual sections of the control valve assembly (Fig. 177) can be overhauled. Valve spools and housings are not available separately and if either is damaged, the complete section of valve must be renewed. Refer to paragraph 259 and following for system checks and adjustments.

3-POINT HYDRAULIC LIFT SYSTEM

Series IV D-17 Models

274. **SYSTEM ADJUSTMENTS.** For satisfactory operation of the 3-point hydraulic lift system, the control linkage and valves should be checked and adjusted as outlined in paragraphs 259 through 267.

275. **R&R LIFT CYLINDERS (RAMS).** To remove the 3-point hitch lift cylinders, first move the hitch to fully lowered position and block up under rear ends of lower (draft) links to take weight off of the lift cylinders. Disconnect hydraulic lines from cylinders and remove the cylinder attaching pins. Pin in lift arm is retained by snap rings.

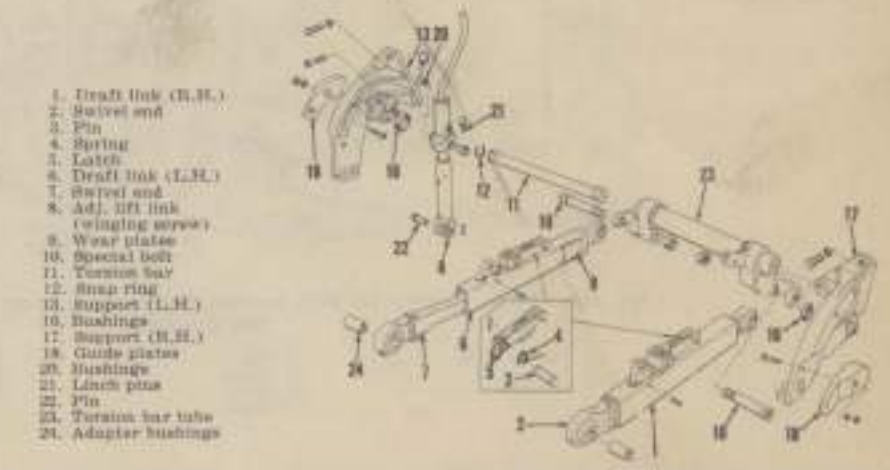


Fig. 183 — Exploded view of three point hitch draft links and torsion bar unit. Wear plates (9) on draft links (1 & 6) are renewable. Side sway of draft links is controlled by renewable guide plates (18 & 19) attached to torsion bar supports (13 & 17). Bushings (24) are used to convert the Category II hitch to use Category I implements.

276. **OVERHAUL LIFT CYLINDERS.** After unscrewing piston rod bearing retaining nut (8—Fig. 182) with pin type spanner wrench, the piston rod, nut, bearing and piston assembly can be removed from cylinder tube.

Using two pin type spanner wrenches, hold rear side (5) of piston and unscrew head end (2) from piston rod (10). Remove "O" ring (1) from piston rod and unscrew remaining part of piston from rod. Withdraw piston rod from bearing (7) and retaining nut.

Inspect cylinder tube (6) for wear or scoring and hone or renew cylinder tube if necessary. Clean the breather screen (11) in vent hole near open end of cylinder tube.

Install new seal (9) in piston rod bearing retaining nut. Lip of seal is towards outer side of nut (8). Install retaining nut on piston rod, outer side

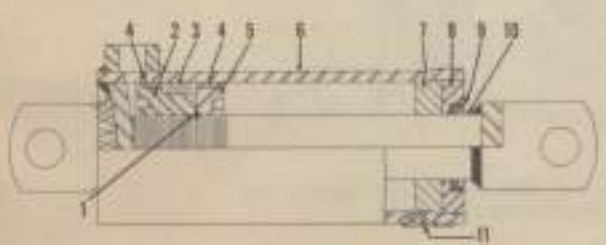


Fig. 182—Cross sectional view of lift arm cylinder used on Series IV D-17 tractors.

1. "O" ring
2. Piston head
3. "V" ring packing
4. Wearstrips
5. Piston retainer nut
6. Cylinder
7. Bearing
8. Retainer nut
9. Seal
10. Rod
11. Breather

first, and slide bearing (7) on rod with ridge on outer diameter towards nut. Screw rear part of piston on rod and install new "O" ring (1). Install new seals (3) and wearstrips (4) on piston. Lips of the chevron type seals (3) must be towards head end (2) of piston. Install and securely tighten head end of piston and stake end of piston rod with center punch.

Lubricate cylinder tube and piston, then carefully install piston and rod assembly. Securely tighten bearing retaining nut with spanner wrench.

REMOTE CYLINDER

277. Refer to paragraph 256 for overhaul of remote cylinder (ram) used on Series IV D-17 tractors.

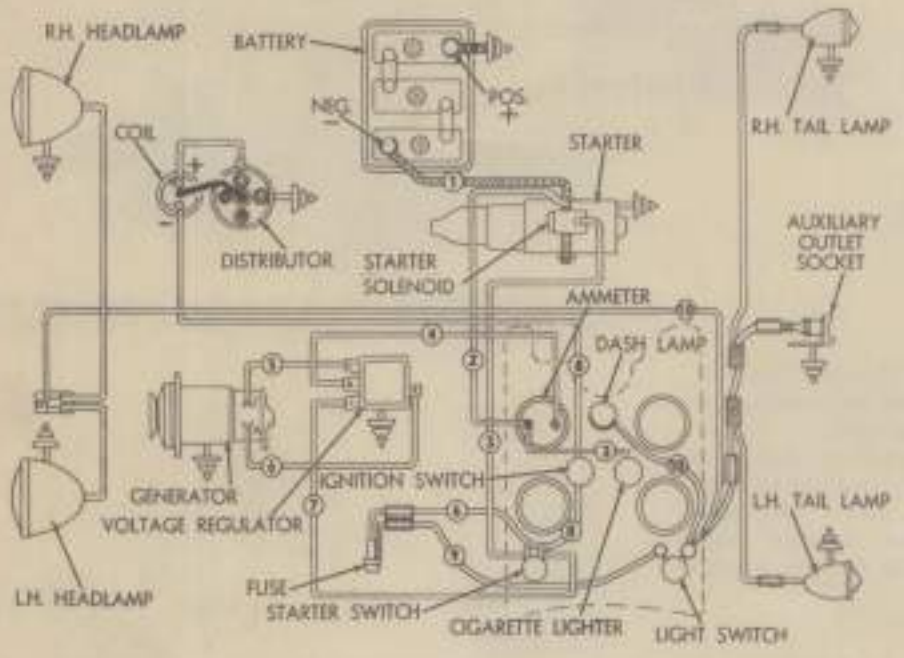


Fig. 184—Wiring diagram for D-14 tractors. The six volt battery has positive (+) terminal grounded.

1. Battery cable
2. Blue
3. White
4. Red
5. Brown
6. Green
7. Black
8. Yellow
9. Purple
10. Orange

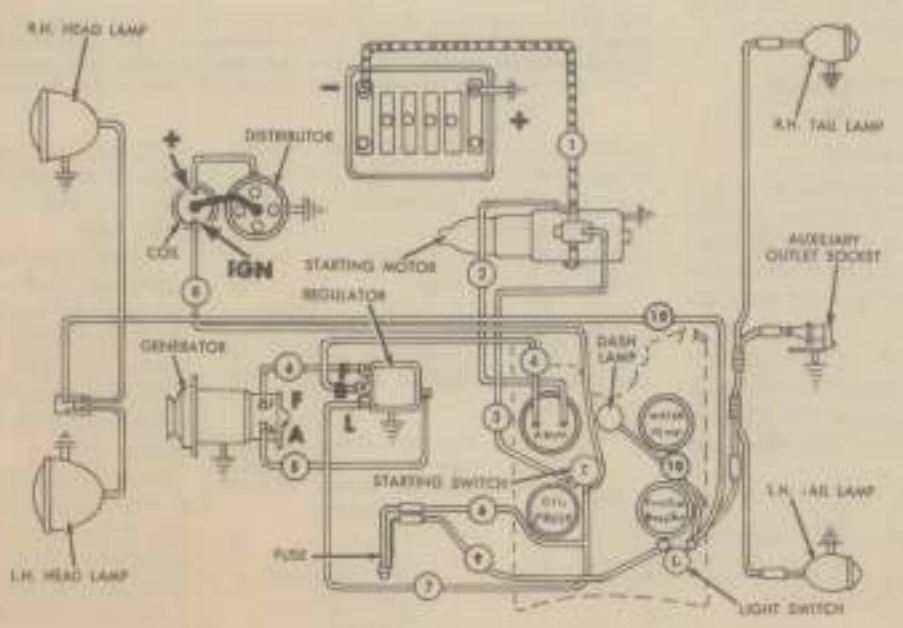


Fig. 185—Wiring diagram for D-15 non-diesel tractors. The twelve volt battery has positive (+) terminal grounded. Refer to Fig. 184 for color code.

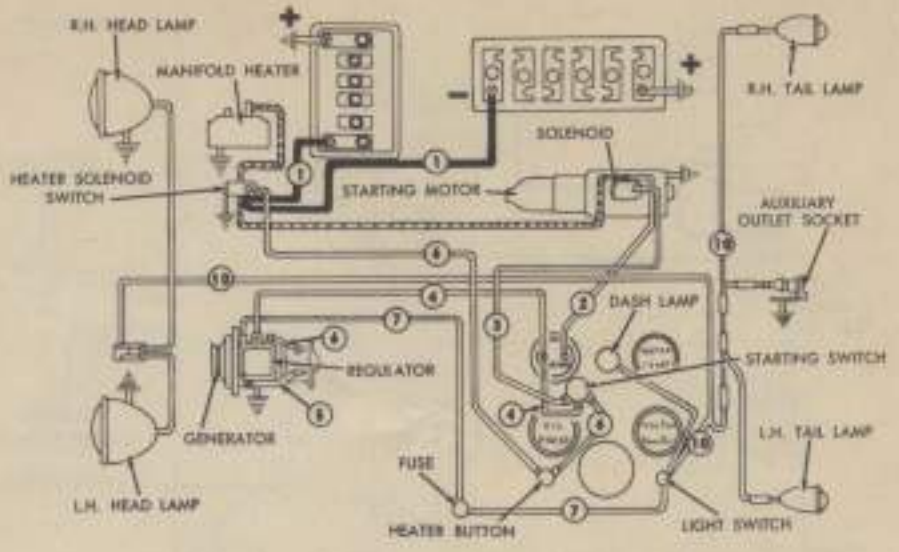


Fig. 186—Wiring diagram for D-15 diesel tractors. The two, twelve volt batteries have positive (+) terminal grounded. Refer to Fig. 184 for color code.

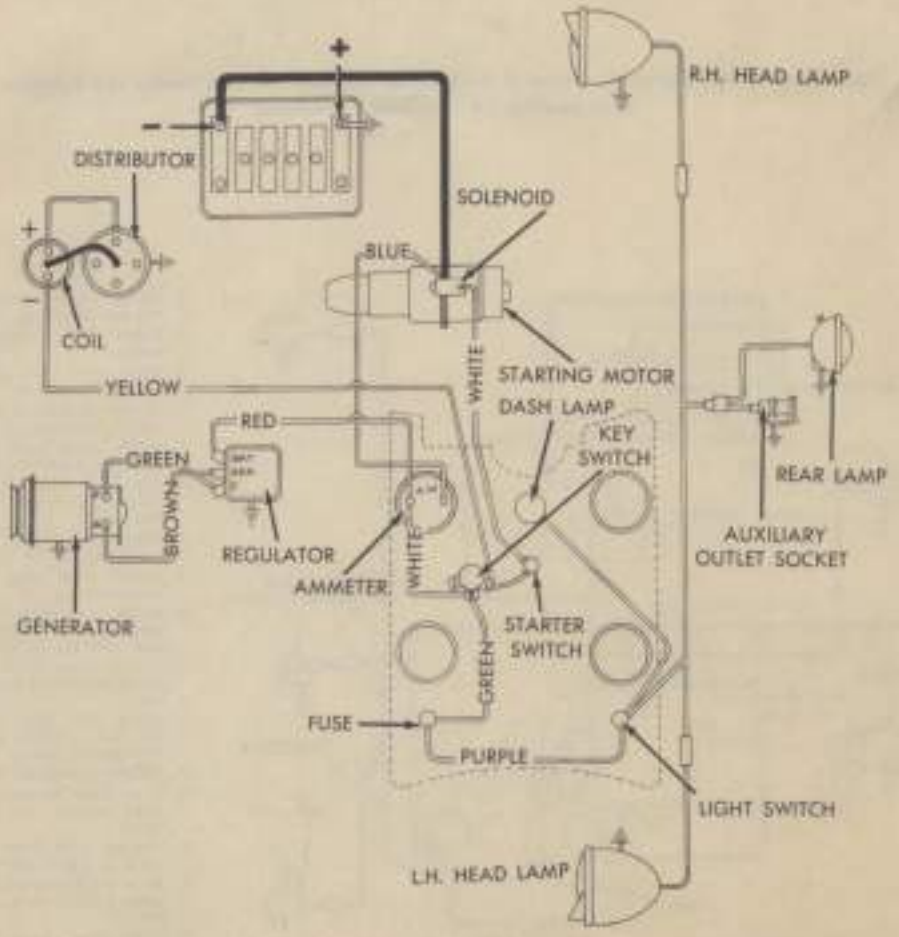


Fig. 187—Wiring diagram for Series II D-15 non-diesel tractors. The twelve volt battery has positive (+) terminal grounded.

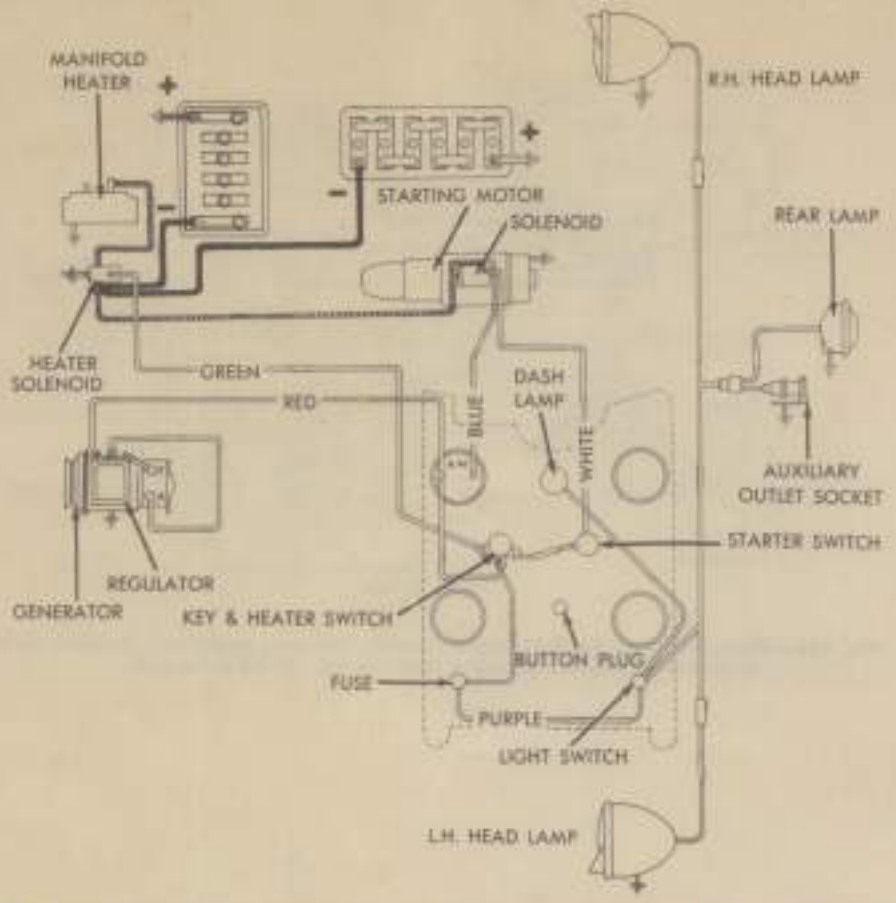


Fig. 188—Wiring diagram for Series II D-15 diesel tractors. The two, twelve volt batteries have positive (+) terminals grounded.

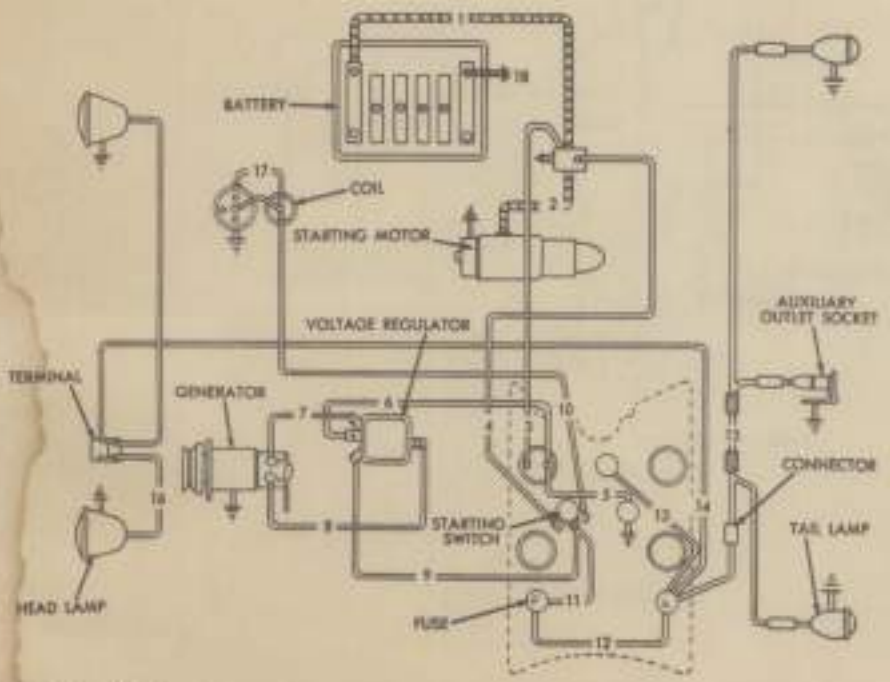
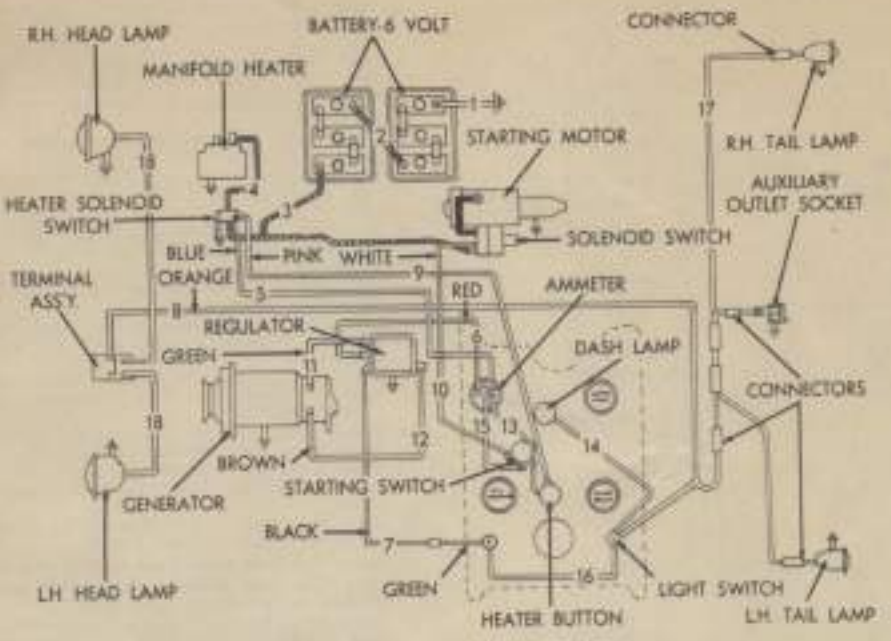


Fig. 189—Wiring diagram for early production Model D-17 non-diesel tractors having headlamps mounted on radiator shell.

1. Cable from negative battery terminal to starter solenoid.
2. Cable from starter solenoid to starting motor.
3. Blue wire from starter solenoid to charge side of ammeter.
4. White wire from solenoid small terminal to "ST" terminal on starting switch.
5. White wire from positive terminal (charge side) of ammeter to cigarette lighter.
6. Red wire from negative terminal (discharge side) of ammeter to "B" terminal on voltage regulator.
7. Green wire from "F" terminal on voltage regulator to "F" terminal on generator.
8. Brown wire from "G" terminal on voltage regulator to "A" terminal on generator.
9. Black wire from "L" terminal on voltage regulator to "BAT" terminal on ignition and starting switch.
10. Yellow wire from "IGN" terminal on ignition switch to negative terminal on ignition coil.
11. Green wire from "BAT" terminal on starting and ignition switch to fuse holder on instrument panel.
12. Purple wire from fuse holder to light switch.
13. Wire from terminal opposite purple wire on light switch to dash (instrument) panel light.
14. Orange wire from terminal opposite purple wire on light switch to headlamp connector.
15. Wire from terminal opposite purple wire on light switch to tail lights and remote outlet.
16. Wire from head lamp connector to head lamps.
17. Wire from distributor to positive terminal on ignition coil.
18. Cable from battery positive terminal to ground.



1. Cable from positive terminal of battery to ground.
2. Cable from negative terminal of grounded battery to positive terminal of second battery.
3. Cable from negative terminal of second battery to manifold heater solenoid and starting motor solenoid.
4. Cable from manifold heater solenoid to manifold heater.
5. Blue wire from manifold heater solenoid to positive terminal (charge side) of ammeter.
6. Red wire from negative terminal (discharge side) of ammeter to battery terminal of voltage regulator.
7. Black wire from load terminal of voltage regulator to fuse holder.
8. Orange wire from light switch to headlamp connector.
9. Pink wire from manifold heater push button to heater solenoid.
10. White wire from starter switch to starting motor solenoid.
11. Green wire from field terminal of voltage regulator to field terminal of generator.
12. Brown wire from generator terminal of voltage regulator to armature terminal of generator.
13. Wire from discharge side of ammeter to manifold heater push button.
14. Wire from light switch to instrument panel light.
15. Wire from discharge side of ammeter to starter switch.
16. Black wire from fuse holder to light switch.
17. Wire from light switch connector to tail light and remote socket.
18. Wire from headlamp connector to headlamps.

Fig. 190 — Wiring diagram for early production Model D-17 diesel tractors having headlamps mounted on radiator shell.

1. Cable from battery negative terminal to starting motor solenoid.
2. Cable from starting motor solenoid to starting motor.
3. Blue wire from starting motor solenoid to positive terminal (charge side) of ammeter.
4. White wire from small terminal of starting motor solenoid to "SOL" terminal of ignition and starter switch.
5. Red wire from negative terminal (discharge side) of ammeter to "BAT" terminal of voltage regulator.
6. White wire from "F" terminal of voltage regulator to "F" terminal of generator.
7. Black wire from "G" terminal of voltage regulator to "A" terminal of generator.
8. Yellow wire from "IGN" terminal of ignition and starter switch to negative terminal of ignition coil.
9. Wire from positive terminal of ignition coil to primary terminal of distributor.
10. Green wire from ignition and starting switch "BAT" terminal to fuse holder.
11. Purple wire from fuse holder to light switch.
12. Wire from light switch terminal with wire adaptor to instrument panel light.
13. Orange wire from light switch terminal with wire adaptor to headlamp connector, tail light and remote socket.
14. Wire from headlamp connector to headlamps.
15. Black wire from "IGN" terminal of ignition and starter switch to "Power-Director" oil pressure indicator switch and light.
16. Cable from battery positive terminal to ground.

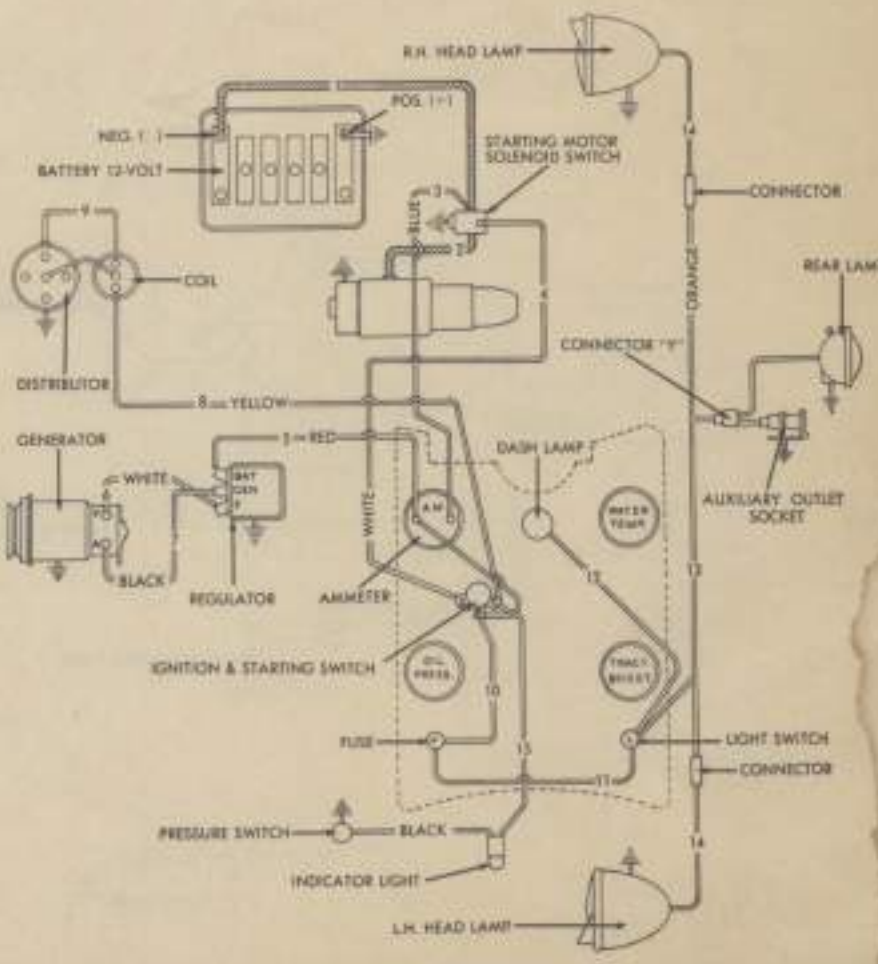
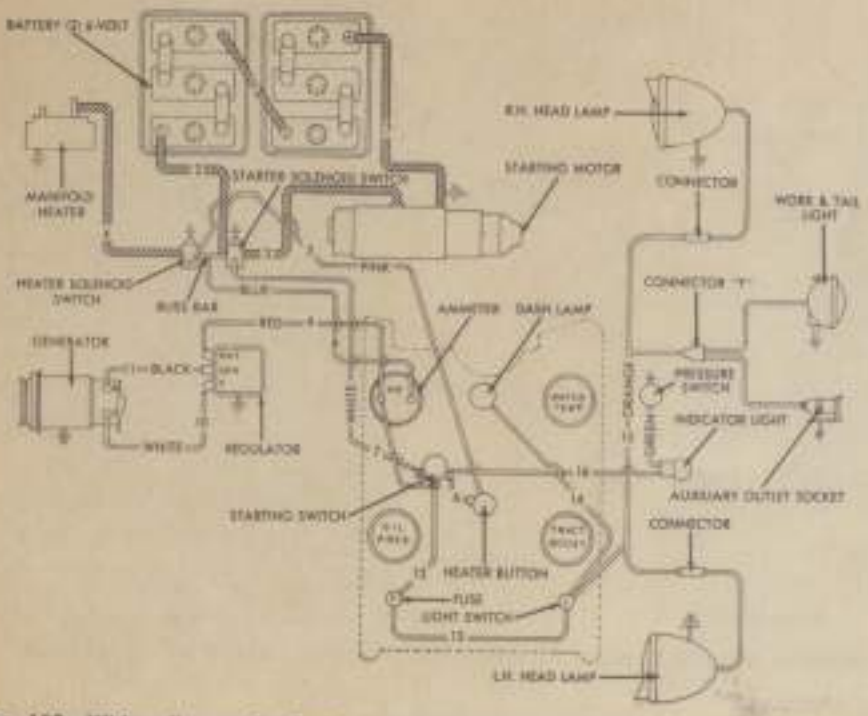


Fig. 191—Wiring diagram for Series III D-17 non-diesel tractors (headlamps mounted on rear wheel fenders).



1. Cable from negative terminal of grounded battery to positive terminal of second battery.
2. Cable from negative terminal of second battery to starting motor solenoid.
3. Cable from starting motor solenoid to starting motor.
4. Cable from manifold heater solenoid to manifold heater.
5. Pink wire from small terminal of manifold heater switch to heater push button switch.
6. Pink wire from heater push button switch to "IGN" terminal of starting switch.
7. White wire from "BAT." terminal of starting motor switch to small terminal of starting motor solenoid.
8. Blue wire from starting motor solenoid to positive terminal (charge side) of ammeter.
9. Red wire from negative terminal (discharge side) of ammeter to "BAT" terminal of voltage regulator.
10. White wire from "F" terminal of voltage regulator to field terminal of generator.
11. Black wire from "GEN" terminal on voltage regulator to "ARM" terminal of generator.
12. Black wire from "BAT" terminal of starting motor switch to fuse holder.
13. Black wire from fuse holder to light switch.
14. Wire from light switch terminal with wire adaptor to instrument panel light.
15. Orange wire from light switch terminal with wire adaptor to headlamps, tail light and remote (auxiliary) socket.
16. Green wire from "IGN" terminal of starting switch to "Power-Director" oil pressure indicating light and switch.
17. Cable from positive terminal of first battery to ground.

Fig. 192—Wiring diagram for Series III D-17 diesel tractors (with headlamps mounted on rear wheel fenders).

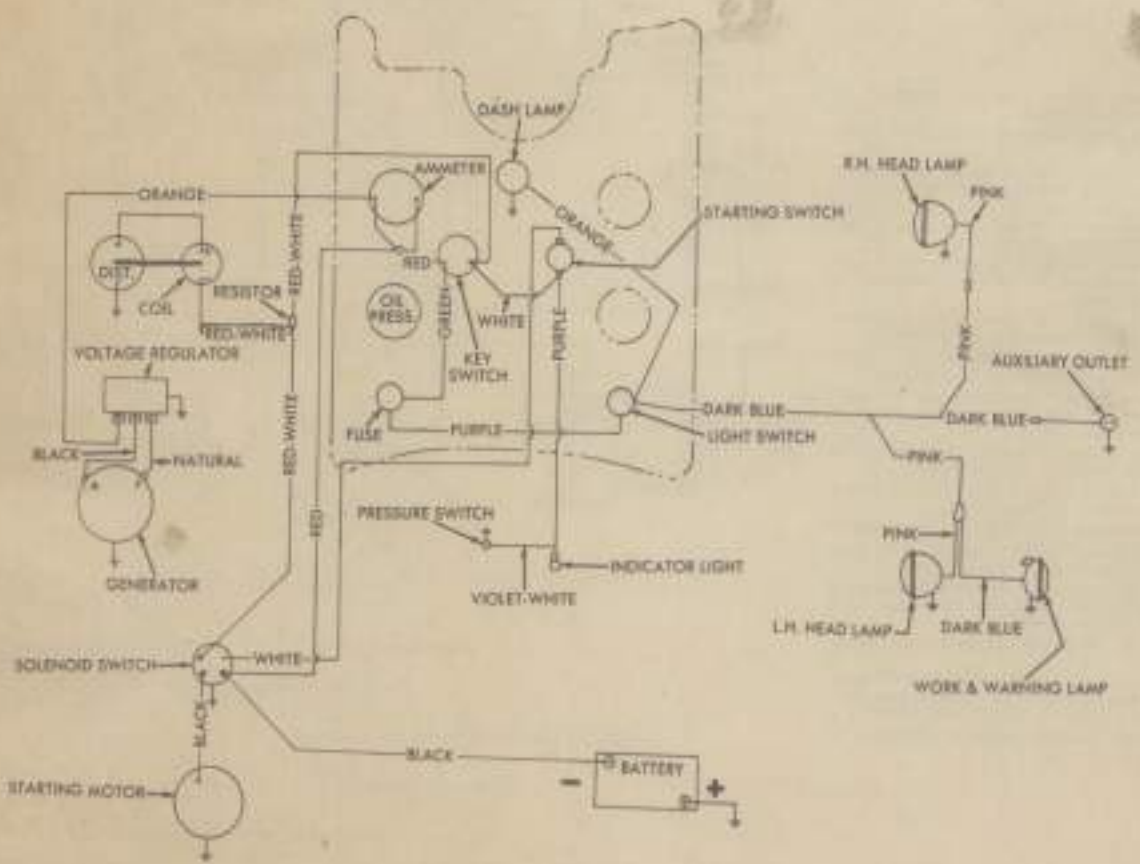


Fig. 193—Wiring diagram for Series IV D-17 non-diesel tractors. The twelve volt battery has positive (+) terminal grounded.

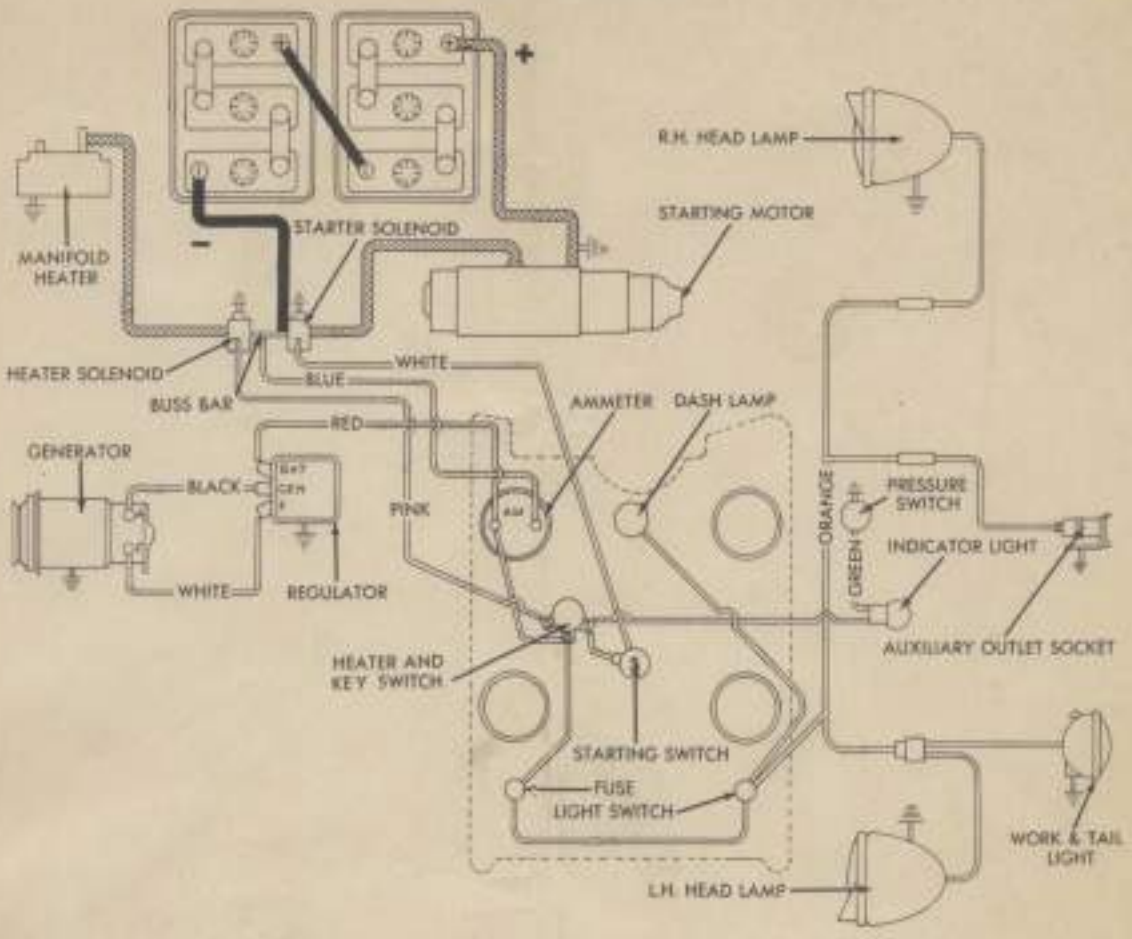


Fig. 194—Wiring diagram for Series IV D-17 diesel tractors. The two, six volt batteries are connected in series. Positive (+) ground is used.

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