

SHOP MANUAL

JOHN DEERE

SERIES 6030

Tractor serial number located on rear of transmission case. Engine serial number located on front right side of engine block.

INDEX (By Starting Paragraph)

<p>BRAKES106</p> <p>CLUTCH</p> <p> Engine Clutch78</p> <p> PTO Clutch79</p> <p>COOLING SYSTEM</p> <p> Radiator68</p> <p> Water Pump69</p> <p> Thermostat71</p> <p>DIESEL SYSTEM</p> <p> Bleeding43</p> <p> Filters42</p> <p> Injection Nozzles45</p> <p>INJECTION PUMP</p> <p> Naturally Aspirated59</p> <p> Turbocharged62</p> <p>TIMING</p> <p> Naturally Aspirated60</p> <p> Turbocharged63</p> <p>DIFFERENTIAL97</p> <p>DIFFERENTIAL LOCK100</p>	<p>ELECTRICAL SYSTEM</p> <p> Alternator72 & 74</p> <p> Circuit Description77</p> <p> Starting Motor76</p> <p>ENGINE</p> <p> Assembly R&R14</p> <p> Camshaft24</p> <p> Connecting Rods & Bearings28</p> <p> Crankshaft29</p> <p> Cylinder Head15</p> <p> Flywheel31</p> <p> Oil Pan32</p> <p> Tappet Adjustment17</p> <p> Timing Gears23</p> <p> Valves16</p> <p>FINAL DRIVE104</p> <p>FRONT SYSTEM1</p> <p>HYDRAULIC SYSTEM116</p> <p>POWER TAKE-OFF111</p> <p>STEERING SYSTEM6</p> <p>TRANSMISSION84</p> <p>TURBOCHARGER38</p>
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CONDENSED SERVICE DATA

GENERAL

Engine Make	Own
No. of Cylinders	6
Bore, Inches	4 ³ / ₄
Stroke, Inches	5
Displacement, Cu. In.	531
Compression Ratio	15.4:1
Induction	*NA. & Turbocharged
Cylinder sleeves	Wet
Forward Speeds	8

TUNE-UP

Firing Order	1-5-3-6-2-4
Compression Pressure	
Cranking Speed	325-395
Valve Tappet Gap	
Intake	0.018
Exhaust	0.028
Injection Pump Timing	27° BTDC
Injector Opening Pressure	3100 psi
Engine Rated Speeds	
Slow Idle	800 rpm
Working Range	1500-2100 rpm
Maximum Transport Speed	2300 rpm

TUNE-UP Cont.

Horsepower @ 2100 rpm	
PTO *(N.A.)	145
PTO (Turbo)	175

SIZES—CAPACITIES—

CLEARANCES

Cooling System (Quarts)	*N.A.33-Turbo. 40
Crankcase Oil (Quarts with filter) ...	*N.A.20-Turbo. 26
Transmission & Hydraulic System	
(Gallons) (Refill)	16
Fuel Tank (Gallons)	*N.A.68-Turbo. 73
Crankshaft Journal Diameter	3.748-3.749
Crankpin Diameter	3.498-3.499
Piston Pin Diameter	1.8739-1.8745
Crankshaft End Play	0.004-0.010
Main Bearing Clearance	0.0019-0.0049
Connecting Rod Bearing Clearance ..	0.0024-0.0054

TIGHTENING TORQUES—Ft.-Lbs.

Cylinder Head	175-185
Main Bearings	205-215
Connecting Rods	155-165

*Naturally aspirated

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CONDENSED SERVICE DATA

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Bore, Inches4¾

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Displacement, Cu. In.531

Compression Ratio15.4:1

Induction*NA. & Turbocharged

Cylinder sleevesWet

Forward Speeds8

TUNE-UP

Firing Order1-5-3-6-2-4

Compression Pressure

 Cranking Speed325-395

 Valve Tappet Gap

 Intake0.018

 Exhaust0.028

Injection Pump Timing27° BTDC

Injector Opening Pressure3100 psi

Engine Rated Speeds

 Slow Idle800 rpm

 Working Range1500-2100 rpm

 Maximum Transport Speed2300 rpm

TUNE-UP Cont.

Horsepower @ 2100 rpm

 PTO *(N.A.)145

 PTO (Turbo)175

SIZES—CAPACITIES—

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Cooling System (Quarts)*N.A.33-Turbo. 40

Crankcase Oil (Quarts with filter) ...*N.A.20-Turbo. 26

Transmission & Hydraulic System

 (Gallons) (Refill)16

Fuel Tank (Gallons)*N.A.68-Turbo. 73

Crankshaft Journal Diameter3.748-3.749

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Piston Pin Diameter1.8739-1.8745

Crankshaft End Play0.004-0.010

Main Bearing Clearance0.0019-0.0049

Connecting Rod Bearing Clearance ..0.0024-0.0054

TIGHTENING TORQUES—Ft.-Lbs.

Cylinder Head175-185

Main Bearings205-215

Connecting Rods155-165

*Naturally aspirated

FRONT SYSTEM

All models are equipped with either a wide fixed axle, or a wide adjustable axle. Two tie rods are attached to a bell crank mounted on a center axle unit. The bell crank is actuated by hydrostatic steering and two single acting hydraulic cylinders.

AXLE AND SUPPORT

Fixed Axle Models

1. HOUSING AND PIVOT BRACKET. The front axle attaches to tractor frame by pivot bracket (1-Fig. 1). Pivot pin bushing (5) installed I.D. should be 2.004-2.018 inches, with 2.011 nominal. Tighten pivot bracket to frame cap screws to 300 ft. lbs. torque, and pivot pin to housing cap screws to 85 ft. lbs.

2. SPINDLES AND BUSHINGS. Knuckle pin bushings (8-Fig. 1) should have an installed I.D. of 1.237-1.241 inches. The bushing hole must line up with grease fitting hole. Thrust washers (10) control the knuckle end play, which should be 0.005-0.045 inch.

Adjustable Axle Models.

3. HOUSING AND PIVOT BRACKET. The pivot pin bushings (5-Fig. 2) should have an installed I.D. of 2.004-2.018 inches, with 2.011 in. nominal. Tighten pivot bracket to frame cap screws to 300 ft. lbs. torque, and pivot pin to housing cap screws to 85 ft. lbs.

4. SPINDLE AND BUSHINGS. The O.D. of knee bushing (7-Fig. 2) should be 2.189-2.190 inches. Check bore I.D. before installing bushing to make sure that it is not worn. Bore should measure 2.185 inches. Align grease fitting hole as bushing is installed, and installed I.D. of bushing should be 2.001-2.004 inches. End play of knuckle (10) is adjusted by thrust washers (9) and should be 0.005-0.045 inch. Spring pins prevent thrust washers from turning.

Fig. 1—Exploded view of fixed front axle and pivot bracket assembly.

1. Pivot bracket
2. Expansion plug
3. Hollow dowel
4. Pivot pin
5. Bushing
6. Axle housing
7. Knuckle pin
8. Bushing
9. Knuckle
10. Thrust washers

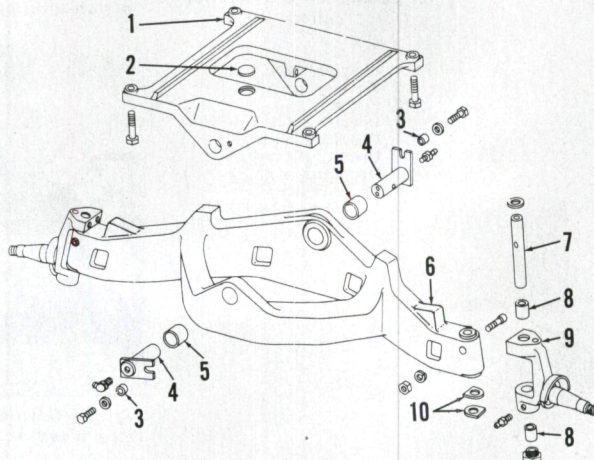


Fig. 2—Exploded view of adjustable front axle and pivot bracket assembly.

1. Pivot bracket
2. Expansion plug
3. Hollow dowel
4. Pivot pin
5. Bushing
6. Axle housing
7. Knee bushing
8. Knee
9. Thrust washers
10. Knuckle

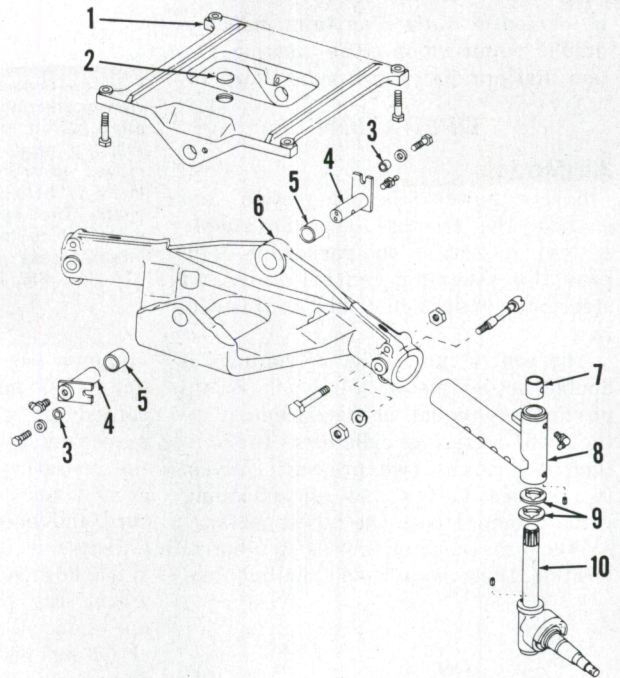
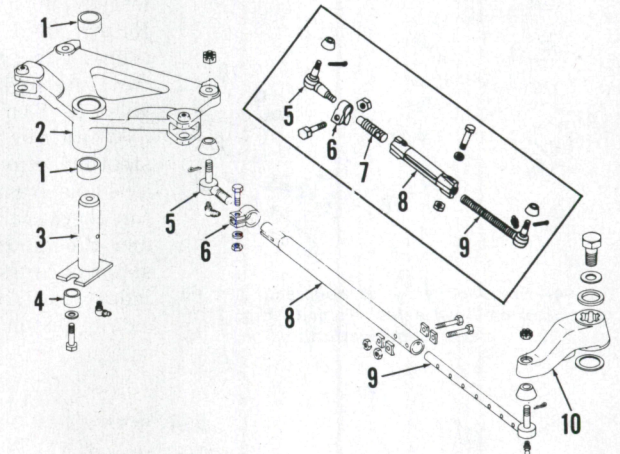


Fig. 3—Exploded view of bellcrank and tie rods used on adjustable axles. Inset shows parts used on tractors to serial no. 034597.

1. Bushing
2. Bellcrank
3. Pivot pin
4. Hollow dowel
5. Inner tie rod end
6. Clamp
7. Inner tie rod
8. Tie rod
9. Outer tie rod end
10. Steering arm



TIE RODS AND TOE IN

All Models

5. Tractors with adjustable axles were equipped with threaded tie rods and ends (inset Fig. 3) up to serial number 034597. After that serial num-

ber, outer tie rod ends were provided with holes and cap screws for easier adjustment. Toe in (all models) should be 1/8-3/8 inch measured at wheel center height, and both tie rods must be equal length so tractor will steer as far to the right as to the left. Tighten clamps in the downward position to 35 ft. lbs. torque.

POWER STEERING SYSTEM

All models are equipped with a full power steering system. No mechanical linkage exists between steering wheel and steering cylinders; however, steering can be manually accomplished by hydraulic pressure when tractor hydraulic unit is inoperative. Power is supplied by the same hydraulic pump which powers the lift and brake systems. A pressure control (priority) valve

FRONT SYSTEM

All models are equipped with either a wide fixed axle, or a wide adjustable axle. Two tie rods are attached to a bell crank mounted on a center axle unit. The bell crank is actuated by hydrostatic steering and two single acting hydraulic cylinders.

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Fig. 2—Exploded view of adjustable front axle and pivot bracket assembly.

1. Pivot bracket
2. Expansion plug
3. Hollow dowel
4. Pivot pin
5. Bushing
6. Axle housing
7. Knee bushing
8. Knee
9. Thrust washers
10. Knuckle

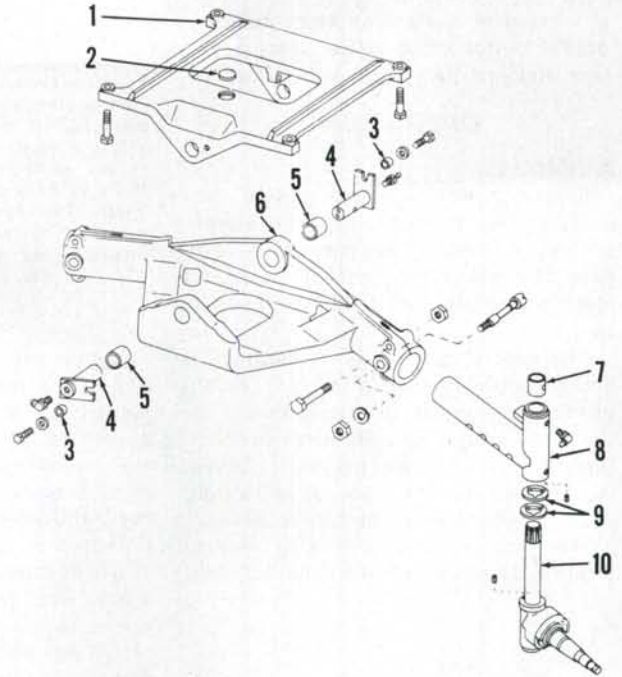
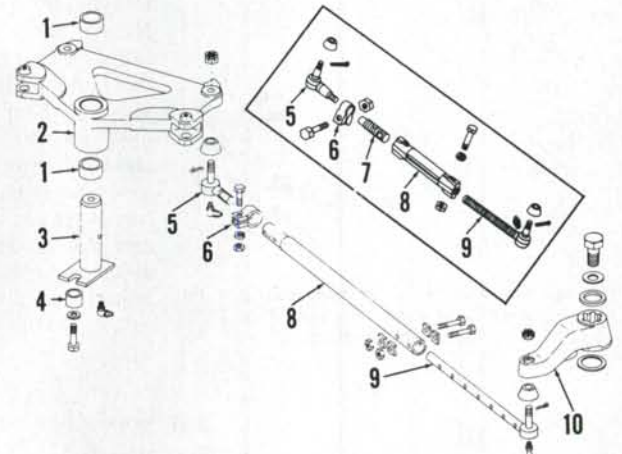


Fig. 3—Exploded view of bellcrank and tie rods used on adjustable axles. Inset shows parts used on tractors to serial no. 034597.

1. Bushing
2. Bellcrank
3. Pivot pin
4. Hollow dowel
5. Inner tie rod end
6. Clamp
7. Inner tie rod
8. Tie rod
9. Outer tie rod end
10. Steering arm



TIE RODS AND TOE IN

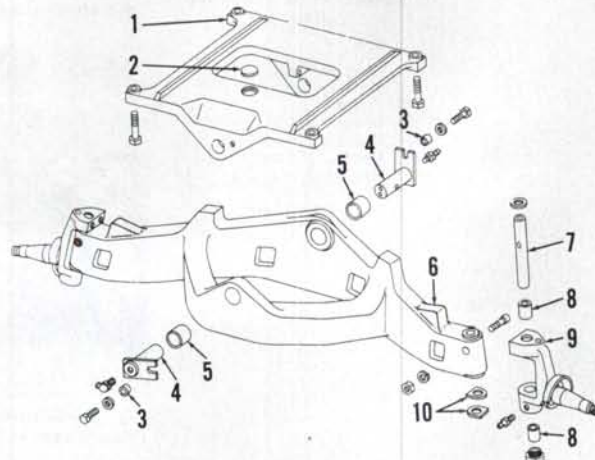
All Models

5. Tractors with adjustable axles were equipped with threaded tie rods and ends (inset Fig. 3) up to serial number 034597. After that serial num-

ber, outer tie rod ends were provided with holes and cap screws for easier adjustment. Toe in (all models) should be 1/8-3/8 inch measured at wheel center height, and both tie rods must be equal length so tractor will steer as far to the right as to the left. Tighten clamps in the downward position to 35 ft. lbs. torque.

Fig. 1—Exploded view of fixed front axle and pivot bracket assembly.

1. Pivot bracket
2. Expansion plug
3. Hollow dowel
4. Pivot pin
5. Bushing
6. Axle housing
7. Knuckle pin
8. Bushing
9. Knuckle
10. Thrust washers



POWER STEERING SYSTEM

All models are equipped with a full power steering system. No mechanical linkage exists between steering wheel and steering cylinders; however, steering can be manually accomplished by hydraulic pressure when tractor hydraulic unit is inoperative. Power is supplied by the same hydraulic pump which powers the lift and brake systems. A pressure control (priority) valve

Paragraphs 6-7

is located in outlet line from main hydraulic pump which gives steering system first priority on hydraulic flow.

OPERATION

All Models

6. The power steering system consists of the tractor hydraulic supply system described in paragraph 116, plus the steering control unit and steering cylinders described in this section.

The control unit (Fig. 5) contains a double acting piston (3) which is approximately equal in displacement to the two operating cylinders. In addition, it contains two pressure valves, two return valves and an unloading valve which actuate the power assist.

When the control unit is in neutral position, there is no fluid flow but fluid

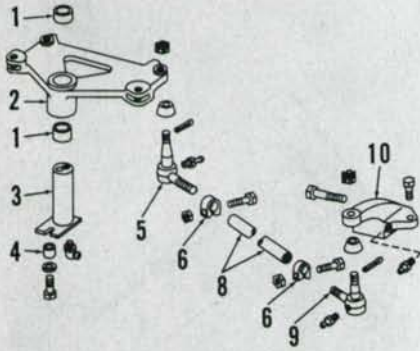


Fig. 4—Exploded view of bellcrank and tie rods used on fixed axles. Refer to Fig. 3 for parts identification.

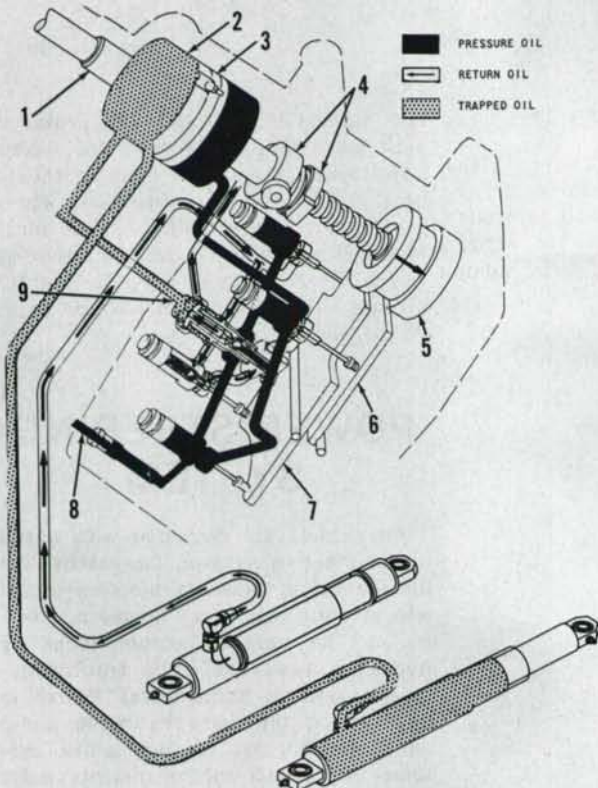
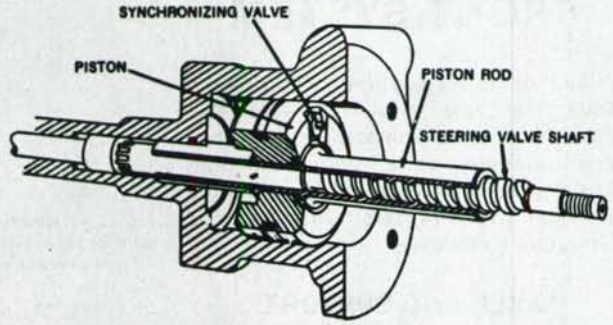


Fig. 5—Schematic view of power steering gear showing operating parts. Refer to paragraph 6 for operation.

1. Steering shaft
2. Slave cylinder
3. Piston
4. Operating nut
5. Operating collar
6. Operating lever
7. Operating valve
8. Pressure line
9. Unloading valve

Fig. 6—Cross sectional view of steering valve operating piston, cylinder and steering shaft. Piston is moved up or down in cylinder by helix on steering shaft. The synchronizing valve which corrects for internal leaks is shown in Fig. 7.



at pump pressure is available at inlet line (8). When the steering wheel is turned for a right or left turn, first movement of steering wheel reacts on the operating collar (5) and one operating lever (6 or 7) to open one pressure and one return valve leading to either end of metering cylinder (2). With continued turning of steering wheel, the pressurized fluid entering one side of metering cylinder moves actuating piston (3) toward opposite end of cylinder and the trapped fluid is forced out line to operating cylinder. Return fluid from the opposite operating cylinder passes through the return metering valve and unloading valve (9) back to the reservoir.

When the pressure required for steering effort exceeds the pressure available from hydraulic system pump, the check valve in inlet line (8) closes and the metering piston (3) manually supplies pressure to the operating cylinders and return fluid flows to back side of piston (3).

Refer also to Figs. 6 and 7 for operating principles regarding the synchronizing valve and associated parts.

BLEEDING

All Models

7. To bleed the steering system, first remove the cowling and attach a small transparent hose from bleed screw (Fig. 8) on left side of steering valve housing. Bleed hose should be long

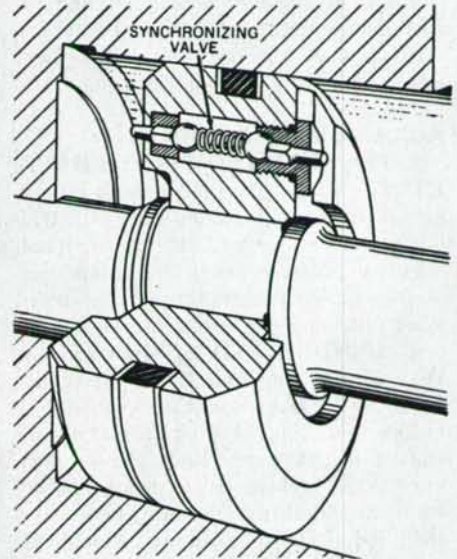


Fig. 7—Steering valve piston must be synchronized with steering cylinders for full turning action. Synchronization is automatically accomplished. When control valve piston reaches end of its stroke, the extended rod unseats the ball check valve, allowing pressurized fluid to flow through piston until cylinders complete their travel.

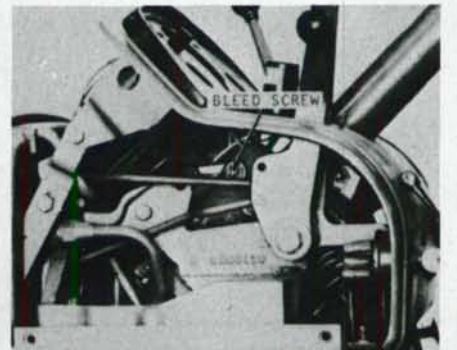


Fig. 8—Cowling removed to show steering valve bleed screw. Refer to paragraph 7 for procedure.

enough to reach transmission filler opening or alternately, to a clean container.

Have tractor sitting on front wheels. Start engine and run at slow idle speed. Turn wheels to full left turn position then open bleed valve. With bleed valve open, **slowly** turn steering wheel to full right without moving front wheels. Close bleed valve and allow wheels to turn to full right. Turn wheels to full left with bleed valve closed; and repeat the operation as necessary until air-free fluid flows from bleed hose.

PRESSURE CONTROL (PRIORITY) VALVE

All Models

8. OPERATION. The Pressure Control (Priority) valve cuts off hydraulic flow to main hydraulic system whenever system pressure drops below 1600-1700 psi, thus, giving priority to steering and brake units on all tractors. Refer to Fig. 9 for a sectional view of valve and to Fig. 10 for an exploded view.

9. R&R AND OVERHAUL. To remove the priority valve, first remove cowl. Disconnect inlet, bleed and outlet lines and unbolt and remove valve assembly.

Examine valve and housing bore for scoring or other damage and housing for cracks. Spring (5-Fig. 10) should have a free length of approximately 4-5/8 inches and test 45-55 lbs. when compressed to a height of 3 1/2 inches. Shims (4) may be added or removed to adjust valve operating pressure. Maximum leakage through bleed line should not exceed 100 cc per minute at stand-by pressure of 2250 psi.

STEERING CONTROL UNIT

All Models

10. REMOVE AND REINSTALL. To remove the steering control unit, first remove steering wheel using a suitable puller; then remove cowling, hand

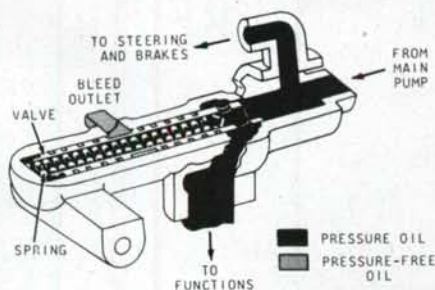
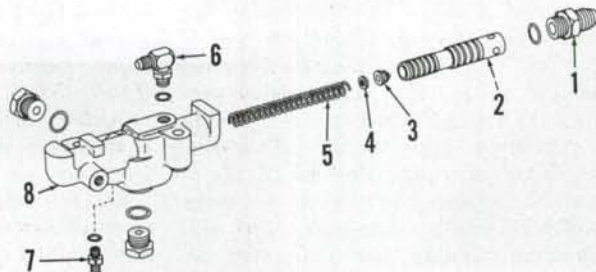


Fig. 9—Cross sectional view of steering priority valve showing fluid flow. Pressurized fluid from main hydraulic pump enters valve. Steering line is always open to pump pressure; hydraulic systems line to functions is closed off when system pressure drops below 1650-1700 psi.

Fig. 10—Exploded view of steering priority valve showing component parts.

1. Inlet
2. Valve spool
3. Orifice
4. Shims
5. Spring
6. Steering outlet
7. Systems outlet
8. Body



throttle, hub, and instrument panel. Remove selective control valve levers, control support, speed control rod, tube and arm.

Disconnect steering fluid lines, being sure to cap all exposed connections, then unbolt and remove the complete steering unit.

When installing, bleed steering system as outlined in paragraph 7 and adjust throttle linkage as in paragraph 65. Tighten steering wheel nut to a torque of 50 ft.-lbs. Tighten 3/8" cap screws to 35 ft. lbs. and 1/2" cap screws to 85 ft. lbs.

11. OVERHAUL. To disassemble the removed steering control units, first remove lower cover (1—Fig. 11), cotter pin and nut (7); then unbolt and re-

move control valve housing (9) and associated parts from cylinder housing (22) and cover (17). Remove operating collar (8) with housing (9), and be careful not to drop steering check valve stop and spring (Fig. 12), as housing is removed.

Remove operating shaft nut (13—Fig. 11) and slide spring (14) and piston rod collar (15) from shaft. Turn steering wheel shaft to the left to force off cylinder cover (17). Steering shaft (21) is retained in steering column by snap ring (24). Remove shaft if service on oil seal and bushing (23), shaft or housing is indicated.

When reassembling, make sure synchronizing valves in piston are at one o'clock position and rod holes horizontal

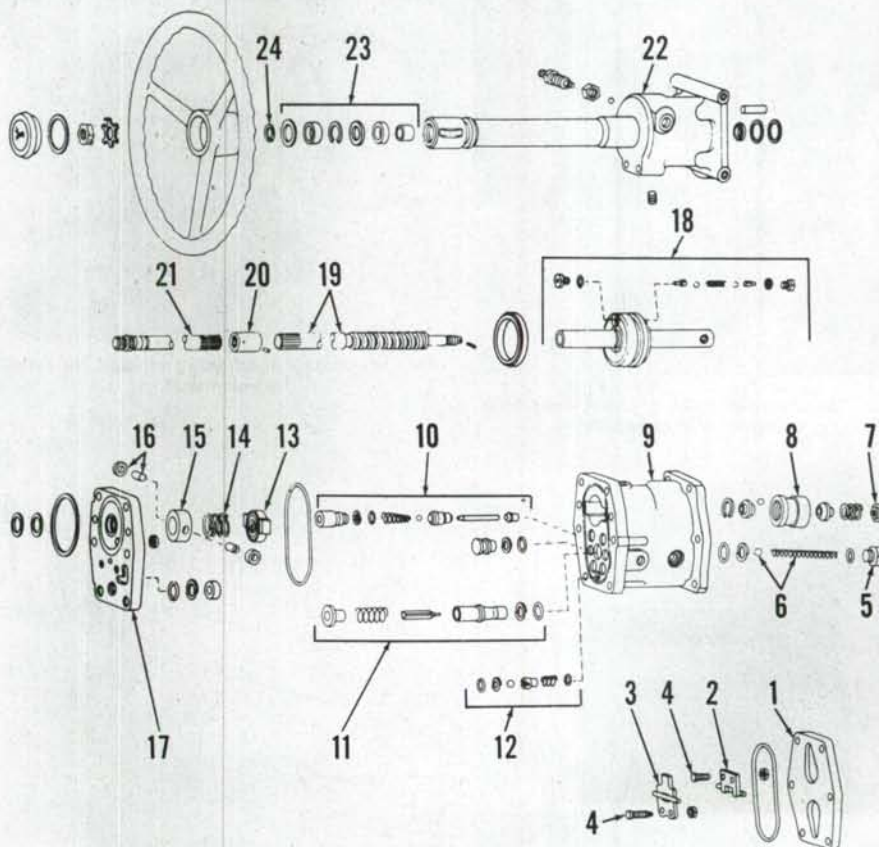


Fig. 11—Exploded view of steering valve assembly showing component parts. No mechanical linkage exists between steering valve and steering bellcrank.

- | | | | |
|--------------------|---------------------|--------------------|----------------------|
| 1. Cover | 7. Nut | 13. Nut | 19. Steering shaft |
| 2. Operating lever | 8. Operating Collar | 14. Spring | 20. Coupling |
| 3. Operating lever | 9. Housing | 15. Collar | 21. Steering shaft |
| 4. Adjusting screw | 10. Unloading valve | 16. Guide roller | 22. Cylinder housing |
| 5. Plug | 11. Check valve | 17. Cylinder cover | 23. Seal and bushing |
| 6. Check valve | 12. Ball check | 18. Piston | 24. Snap ring. |

as shown in Fig. 13. Tighten spring loaded nut (13—Fig. 11) until a gap of approximately 5/16 inch exists between nut and collar (15). This tension provides the friction which gives a feeling of stability to the steering effort. End plugs for operating levers (2 & 3) should be adjusted to provide not more than 0.003 end play, but so levers will not bind. Tighten jam nuts securely when adjustment is correct. Tighten nut (7) to a torque of 5 ft.-lbs., loosen to nearest castellation and install cotter pin. Collar (8) must turn freely by hand but must have no end play.

With steering control unit completely assembled except for lower cover, temporarily install steering wheel and mount unit in a vise as shown in Fig. 14. Install special positioning clamps JDH-3C as shown. Use the side marked "3000-4000-5000". This will hold the valve operating collar 0.030 inch from inside edge of housing face (neutral position). Turn steering wheel fully to right and hold in position by attaching a weight to rim of steering wheel. Loosen the jam nuts and four adjusting

screws (4—Fig. 11); then using a dial indicator, adjust upper left and lower right adjusting screws to a clearance of 0.0025-0.0035. With the first screws adjusted, turn remaining two screws to a clearance 0.001-0.002 less than first clearance.

NOTE: Adjustment can be made more accurately if lever is pulled outward slightly using a stiff wire hook, as adjustment is being made.

Tighten 1/2-inch cap screws to 85 ft.-lbs. and 3/8-inch cap screws to 35 ft.-lbs. Install the assembled unit as in paragraph 10 and bleed as in paragraph 7.

STEERING CYLINDER

12. REMOVE AND REINSTALL To remove either steering cylinder, first disconnect the pressure hose at cylinder. Remove the cap screws (C—Fig. 15) which retain pins (1) to frame bracket and steering bellcrank; then remove pins using a suitable puller.

NOTE: ID of pin has screw threads for attaching puller.

When reinstalling, make sure step washers (2) are properly installed as shown. Draw the pins into position using longer bolts in place of cap

screws (C). Tighten cap screws in frame bracket and steering bellcrank and secure by bending locking plate (L).

13. OVERHAUL. Refer to Fig. 15 for an exploded view of steering cylinder and attaching parts. To disassemble the removed steering cylinder, unscrew extension (10) using a suitable spanner. Remove snap ring (6) and washer (7) from piston rod (14) and withdraw extension (10) from piston. Bushings (9), packing (11) and seal (13) can be renewed at this time. Renew piston rod (14) if scored or otherwise damaged.

Assemble by reversing the disassembly procedure and install as outlined in paragraph 12.

ENGINE AND COMPONENTS

All tractors are equipped with either a naturally aspirated, or a turbocharged, six cylinder diesel engine having a bore of 4 3/4 inches, a stroke of 5 inches and a piston displacement of 531 cubic inches.

REMOVE AND REINSTALL

All Models

14. To remove the engine and clutch assembly as a unit, first drain cooling system and, if engine is to be disassembled, drain oil pan. Remove air stack, cab center panel if so equipped, and cowl; then remove hood, grille screens, engine side panels and muffler.

Make a clutch split by disconnecting air conditioning compressor, if so equipped, and placing unit with hoses inside cab. Disconnect cab mounting



Fig. 12—Remove steering check valve stop and spring as unit is separated.

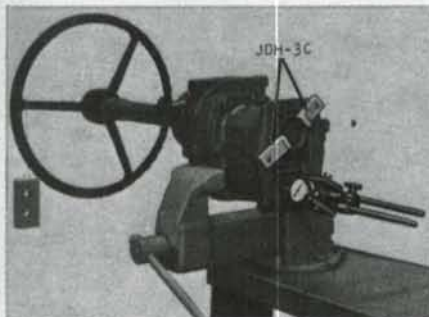


Fig. 14—Install positioning clamps for valve adjustment.

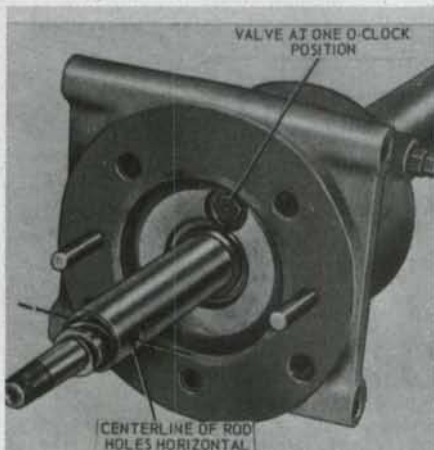


Fig. 13—Assemble piston with synchronizing valve at one o'clock and rod holes horizontal as shown.

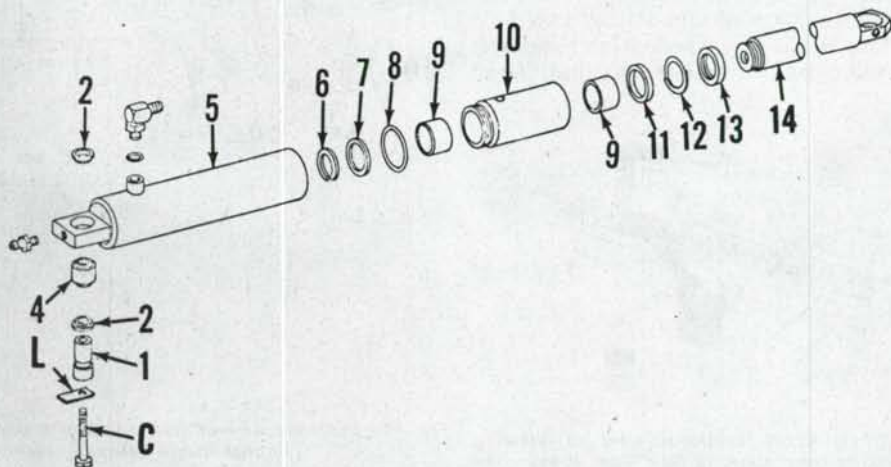


Fig. 15—Exploded view of steering cylinder and associated parts.

- C. Cap screw
- L. Lock plate
- 1. Pin

- 2. Step washer
- 4. Bushing
- 5. Cylinder
- 6. Snap ring
- 7. Washer
- 8. "O" ring
- 9. Bushing
- 10. Extension

- 11. Packing
- 12. Backup ring
- 13. Oil seal
- 14. Piston

as shown in Fig. 13. Tighten spring loaded nut (13—Fig. 11) until a gap of approximately 5/16 inch exists between nut and collar (15). This tension provides the friction which gives a feeling of stability to the steering effort. End plugs for operating levers (2 & 3) should be adjusted to provide not more than 0.003 end play, but so levers will not bind. Tighten jam nuts securely when adjustment is correct. Tighten nut (7) to a torque of 5 ft.-lbs., loosen to nearest castellation and install cotter pin. Collar (8) must turn freely by hand but must have no end play.

With steering control unit completely assembled except for lower cover, temporarily install steering wheel and mount unit in a vise as shown in Fig. 14. Install special positioning clamps JDH-3C as shown. Use the side marked "3000-4000-5000". This will hold the valve operating collar 0.030 inch from inside edge of housing face (neutral position). Turn steering wheel fully to right and hold in position by attaching a weight to rim of steering wheel. Loosen the jam nuts and four adjusting

screws (4—Fig. 11); then using a dial indicator, adjust upper left and lower right adjusting screws to a clearance of 0.0025-0.0035. With the first screws adjusted, turn remaining two screws to a clearance 0.001-0.002 less than first clearance.

NOTE: Adjustment can be made more accurately if lever is pulled outward slightly using a stiff wire hook, as adjustment is being made.

Tighten 1/2-inch cap screws to 85 ft.-lbs. and 3/8-inch cap screws to 35 ft.-lbs. Install the assembled unit as in paragraph 10 and bleed as in paragraph 7.

STEERING CYLINDER

12. REMOVE AND REINSTALL To remove either steering cylinder, first disconnect the pressure hose at cylinder. Remove the cap screws (C—Fig. 15) which retain pins (1) to frame bracket and steering bellcrank; then remove pins using a suitable puller.

NOTE: ID of pin has screw threads for attaching puller.

When reinstalling, make sure step washers (2) are properly installed as shown. Draw the pins into position using longer bolts in place of cap

screws (C). Tighten cap screws in frame bracket and steering bellcrank and secure by bending locking plate (L).

13. OVERHAUL. Refer to Fig. 15 for an exploded view of steering cylinder and attaching parts. To disassemble the removed steering cylinder, unscrew extension (10) using a suitable spanner. Remove snap ring (6) and washer (7) from piston rod (14) and withdraw extension (10) from piston. Bushings (9), packing (11) and seal (13) can be renewed at this time. Renew piston rod (14) if scored or otherwise damaged.

Assemble by reversing the disassembly procedure and install as outlined in paragraph 12.

ENGINE AND COMPONENTS

All tractors are equipped with either a naturally aspirated, or a turbocharged, six cylinder diesel engine having a bore of 4 3/4 inches, a stroke of 5 inches and a piston displacement of 531 cubic inches.

REMOVE AND REINSTALL

All Models

14. To remove the engine and clutch assembly as a unit, first drain cooling system and, if engine is to be disassembled, drain oil pan. Remove air stack, cab center panel if so equipped, and cowl; then remove hood, grille screens, engine side panels and muffler.

Make a clutch split by disconnecting air conditioning compressor, if so equipped, and placing unit with hoses inside cab. Disconnect cab mounting



Fig. 12—Remove steering check valve stop and spring as unit is separated.

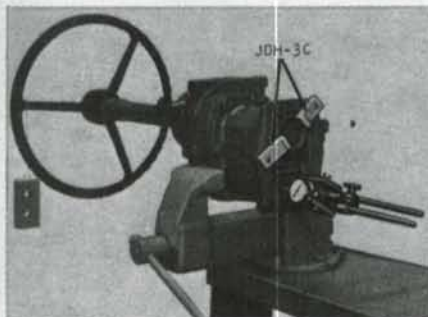


Fig. 14—Install positioning clamps for valve adjustment.

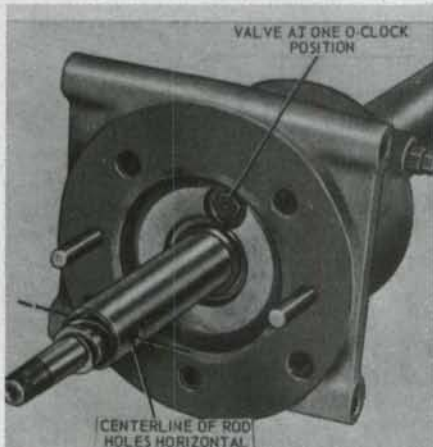


Fig. 13—Assemble piston with synchronizing valve at one o'clock and rod holes horizontal as shown.

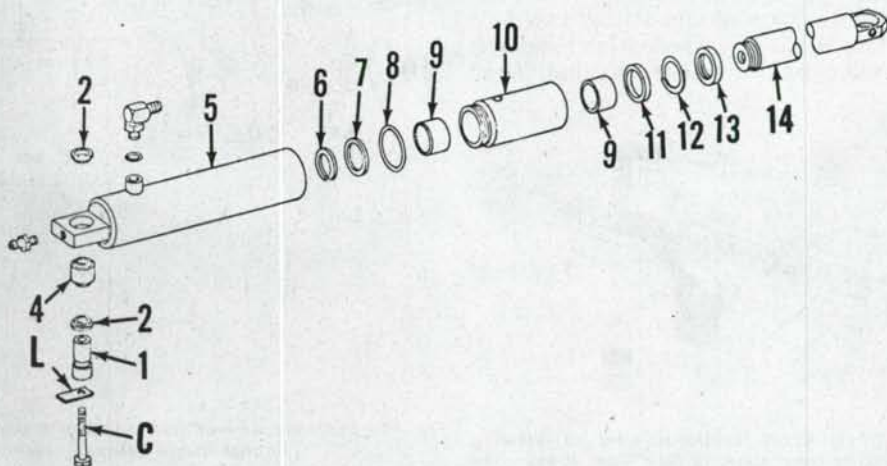


Fig. 15—Exploded view of steering cylinder and associated parts.

- C. Cap screw
- L. Lock plate
- 1. Pin

- 2. Step washer
- 4. Bushing
- 5. Cylinder
- 6. Snap ring
- 7. Washer
- 8. "O" ring
- 9. Bushing
- 10. Extension

- 11. Packing
- 12. Backup ring
- 13. Oil seal
- 14. Piston

bracket from right frame rail. Disconnect heater hoses, fuel shut-off cable, right hand steering pipe and clamp, temperature gage sensing bulb, tachometer cable, throttle linkage, electric wiring and hydraulic lines on right side of engine. Remove cold starting unit, step and bracket, turbocharger inlet elbow and air cleaner, battery cables, wiring and hydraulic lines on left side. Suitably support both halves of tractor separately, remove cap screws securing engine to clutch housing and side rails to housings. Place wood blocks between front axle and frame rails to prevent tipping. Remove drawbar and support, and install JDG-2M, or other suitable support under transmission case and roll front half of tractor away.

NOTE: When engine is removed, front unit may be heavy in front therefore unstable. Remove front end weights, if used, and securely support front frame before attempting to remove engine.

Shut off fuel valve and remove hydraulic pump drive coupler. Place a wood block under pump for support. Disconnect fuel inlet pipe from fuel pump and hydraulic pump support from engine. Remove upper and lower radiator hoses. Disconnect both steering cylinders from rear brackets. Remove right hand steering pipe and rear portion of left hand steering pipe. Disconnect fuel gage sender wire at connector and remove hydraulic pump discharge pipe. Disconnect fuel leak-off pipe. Swing engine from a hoist and remove cap screws securing engine to side of frames, make sure front section is well supported, then slide engine rearward out of frame unit.

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

Hydraulic pump drive 30 ft.-lbs.
Hydraulic pump support 85 ft.-lbs.
Cylinder block to
clutch housing 300 ft.-lbs.

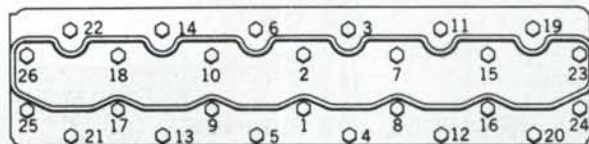
Bleed steering as outlined in paragraph 7.

CYLINDER HEAD

All Models

15. To remove the cylinder head, drain cooling system and remove air stack, hood, side panels, grille screens and muffler. Remove water manifold, by-pass pipe and upper water hose. On naturally aspirated models, remove intake and exhaust manifolds. Disconnect turbocharger oil pipes and remove inter-cooler for access to cap screws to intake manifold. Unbolt and remove

Fig. 16—Use the indicated sequence and tighten cylinder head cap screws to a torque of 100 then 175 ft.-lbs. in two steps.



exhaust manifold and turbocharger as a unit.

Remove alternator and fan blades then unbolt and remove water pump. Remove injector lines and injectors. Remove ventilator tube, rocker arm cover, rocker arm assembly and push rods, then unbolt and remove cylinder head.

NOTE: Make sure cylinder liners are held down with cap screws and washers if engine is to be turned.

Install cylinder head gasket dry and dip cylinder head cap screw threads in oil prior to installation. Make sure hardened flat washers are installed on all cap screws and tighten to a torque of 100 ft.-lbs. using the sequence shown in Fig. 16. Retighten to a torque of 170-180 ft.-lbs. using same sequence. Tighten rocker arm clamp bolts to a torque of 65 ft.-lbs. Retorque cylinder head and readjust tappets after tractor has been warmed to operating temperature. Refer to paragraph 17 for tappet gap adjustment procedure.

NOTE: NEVER run engine with turbocharger oil lines disconnected.

VALVES AND SEATS

All Models

16. Hardened steel valve seat inserts are used for both intake and exhaust valves. Valve face angle on exhaust valves is 44½ degrees and seat angle is 45 degrees. Intake valve face angle is 29½ degrees and seat angle is 30 degrees. Recommended seat width is 0.115 inch. Runout of seat should not exceed 0.004. Seats can be narrowed using 15 and 70 degree stones. If

necessary to renew seats, use JDE-77 Seat Puller to remove them, being careful not to damage head. Use JDE-72 and 73 to install new seats and chill both seats and driver in dry ice before installation.

Intake and exhaust valve stem diameter is 0.4335-0.4345 with a recommended clearance of 0.002-0.004 in guide bores. Valves should be renewed if clearance in a new guide exceeds 0.006. Valve tappet gap should be adjusted using the procedure outlined in paragraph 17.

17. TAPPET GAP ADJUSTMENT.

The two-position method of valve tappet gap adjustment is recommended. Refer to Fig. 17 and proceed as follows:

Turn engine crankshaft by hand until "TDC" mark on pulley is aligned with reference mark on timing gear housing, then check the valves to determine whether front or rear cylinder is at top of compression stroke. (Exhaust valve on adjacent cylinder will be partly open). Use the appropriate diagram (Fig. 17) and adjust the indicated valves; then turn crankshaft one complete turn until "TDC" timing mark is again aligned. Adjust remainder of valves using the other diagram. Recommended valve tappet gap is 0.018 for intake valves and 0.028 for exhaust valves (hot or cold).

VALVE ROTATORS

All Models

18. Positive type valve rotators are used on intake and exhaust valves on turbocharged models and only on exhaust valves on naturally aspirated models. Normal service consists of renewing the complete unit. Rotators can

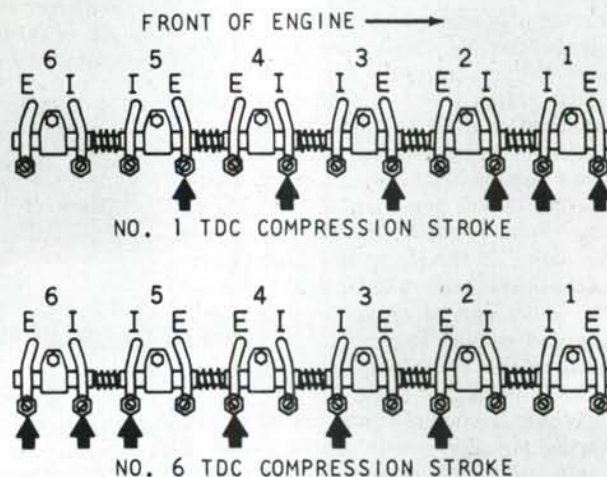


Fig. 17—Adjust valves indicated by arrows when no. 1 or no. 6 piston is at TDC on compression stroke. Engine may be hot or cold. Tappet gap should be 0.018 for intake valves and 0.028 for exhaust valves.

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be considered satisfactory if the valve turns a slight amount each time it opens.

VALVE GUIDES AND SPRINGS

All Models

19. Valve guides are renewable in the cylinder head. Valves with oversize stems are not available for service replacement. The manufacturer recommends knurling as a means of resizing the guide to accept the standard stem if wear does not exceed 0.008 inch. Renew any guide that is worn beyond that figure. Use JDE-75 driver to install new guide 1.875 inches from head gasket surface of head. New guides can be knurled to compensate for valve stem wear up to 0.006 inch. Standard valve guide bore diameter is 0.4365-0.4375 inch and normal stem clearance is 0.002-0.004.

Turbocharged models are equipped with inner and outer valve springs, while other models use single springs. Intake and exhaust valve springs are interchangeable and may be installed either end up. Renew any spring which is distorted, rusted or discolored, or does not meet the test specifications which follow:

Free Length (approx.)	
Outer	2.46 in.
Inner	2.32 in.
Lbs. test @ length (inches)	
Closed	
Outer	70-78 @ 2.01
Inner	42-46 @ 1.77
Open	
Outer	162-188 @ 1.48
Inner	84-98 @ 1.24

ROCKER ARMS

All Models

20. The rocker arm shaft attaches to bosses which are cast into cylinder head and is held in place by clamps. Turbocharged engines use two double clamps and two single clamps to retain rocker arm shaft. Other models use six single clamps. Shaft rotation is prevented by a spring pin in cylinder head which enters a hole in shaft for positive positioning of lubrication passages.

Rocker arms are right hand and left hand assemblies. Recommended clearance of rocker arms is 0.0005-0.0035 on the 3/4-inch shaft. Bushings are not available; if clearance is excessive, renew rocker arms and/or shaft. If only the valve end of rocker arm is worn, the end can be reground and arm reused. Make sure lubrication holes are clear in arms and shaft.

When reassembling, make sure spring pin aligns with locating hole in shaft, tighten clamp screws to a torque

of 65 ft.-lbs. and adjust tappet gap as outlined in paragraph 17.

CAM FOLLOWERS (TAPPETS)

All Models

21. The cam followers can be removed from above without removing camshaft. The cam followers operate in unbushed bores in engine block and are available in standard size only.

If camshaft and/or followers are giving indications of wear, use a dial indicator on valve spring retainer to measure valve lift, which should be 0.517 inch for intake and 0.453 inch for exhaust. New followers should be installed whenever camshaft is renewed.

TIMING GEAR COVER AND CRANKSHAFT FRONT OIL SEAL

All Models

22. To remove the timing gear cover, first drain cooling system and remove hood, grille screens and engine side panels. Remove radiator and fan shroud from left side after disconnecting oil cooler from radiator.

Remove pressure and return lines from hydraulic pump, disconnect pump drive shaft and coupler and remove pump and support. Loosen fan belts, remove crankshaft damper pulley using a suitable puller, remove cover retaining cap screws and lift off the cover. The lip type front oil seal is supplied in a kit which also includes a steel wear sleeve which is pressed on crankshaft in front of gear as shown in Fig. 18. Score old sleeve lightly with a blunt chisel and pry sleeve from shaft. Coat inner surface of new sleeve with a non-hardening sealant and install with a suitable screw-type installer such as JDE-3, or a tube which will just slip over snout of crankshaft. Install oil seal in cover, with sealing lip 0.010 inch the rear and seal 0.010 inch from inner edge of bore.

When installing timing gear cover, tighten retaining cap screws to a torque of 30 ft.-lbs. and damper pulley retaining cap screw to 170 ft.-lbs. Com-



Fig. 18—Score oil seal wear sleeve as shown using blunt chisel, then pry from shaft when renewal is indicated.

plete the assembly by reversing the disassembly procedure.

TIMING GEARS

All Models

23. The timing gear train consists of crankshaft gear and camshaft gear as shown in Fig. 19. Gears are available in standard size only. If backlash is excessive, renew the parts concerned.

The engine is properly timed when "V" mark on camshaft and crankshaft gears are aligned as shown. The timing of the injection pump gear should be checked at this time. Pump is properly timed when the "V" mark on pump gear aligns with mark on camshaft gear.

The combination camshaft/injection pump drive gear can be renewed after removing camshaft as outlined in paragraph 24. To renew crankshaft gear, remove wear sleeve as outlined in paragraph 22, and use a suitable puller to remove gear. When installing crankshaft gear, heat gear to approximately 350 degrees F. using a hot plate or oven and install with a press or JDH-7 driver, with timing mark to front.

CAMSHAFT AND BEARINGS

All Models

24. To remove the camshaft, first remove timing gear cover as outlined in paragraph 22, and oil pump as in paragraph 33. Remove rocker arm cover, rocker arms assembly and push rods. Raise and secure cam followers just far enough to clear camshaft, using magnetic holders or other suitable means. If cylinder head is off, and followers are removed, be sure they are marked for reinstallation into the same bores. Before camshaft is removed, use a dial indicator to check camshaft end play, which should be 0.004-0.010, but not more than 0.015 inch. Excessive end play indicates a worn thrust plate. Thickness of plate should be 0.1185-0.1215, with a minimum of 0.1135 inch. Working through openings provided in camshaft gear, remove the four cap screws securing camshaft thrust plate



Fig. 19—Timing gears with cover removed, showing timing marks on turbocharged model. Other models are similar.

to front face of engine block, then withdraw camshaft and gear assembly forward out of engine.

The 2.3745-2.3755 camshaft journals should have a clearance of 0.002-0.005 in bushings. The pre-sized copper lead camshaft bushings are interchangeable, but only the two front bushings can be renewed without separating engine from clutch housing.

To install the two rear bushings after camshaft is out, detach cylinder block from clutch housing, remove clutch, flywheel and camshaft bore plug, then pull bushings into block bores using a piloted puller. Make sure oil supply holes in block are aligned with holes in bushings.

Camshaft/injector pump drive gear can be removed with a press when camshaft is out, after removing the retaining cap screw and washer. Align key slot in gear with Woodruff key in shaft, make sure thrust plate and spacer are installed and press gear on shaft until it bottoms. Tighten gear retaining cap screw to a torque of 85 ft.-lbs. and thrust plate retaining cap screws to a torque of 20 ft.-lbs.

ROD AND PISTON UNITS

All Models

25. Connecting rod and piston units are removed from above after removing cylinder head, oil pan and rod bearing caps. When reinstalling, correlation numbers, small and large slots and tangs on rod and cap must be in register. Rods and head of piston are stamped "FRONT" for proper installation. Tighten connecting rod cap screws to a torque of 155-165 ft.-lbs.

NOTE: Do not rotate crankshaft with head removed nor attempt to remove rod and piston units without first bolting liners down using washers and short cap screws.

PISTONS, RINGS AND SLEEVES

All Models

26. The aluminum alloy, cam ground pistons are fitted with two compression rings and one oil control ring. The top two compression rings are of keystone

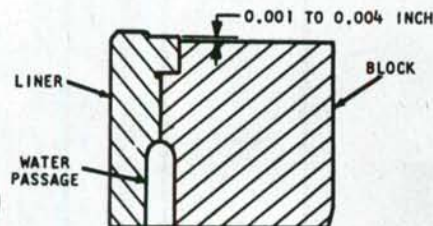


Fig. 20—Cylinder sleeves should stand out 0.001-0.004 inch when properly installed. Refer to paragraph 26.

design and their ring grooves contain cast iron inserts.

The wet cylinder sleeves have square rubber packing rings which seal at a shoulder on sleeve at bottom edge of water jacket in cylinder block. Backup rings fit in block grooves below the shoulder to aid in sealing. Top of sleeve extends above top gasket face of block a slight amount as shown in Fig. 20 and is sealed by cylinder head and head gasket.

When installing sleeves, make sure that seal ring grooves are clean. Lubricate sealing rings with liquid soap or other suitable lubricant and make sure rings are not twisted. Work sleeves gently into place by hand as far as possible, then seat the sleeve using a wooden block and hammer.

The manufacturer recommends cleaning pistons using Immersion Solvent "D-PART" and Hydra-Jet Rinse Gun or Glass Bead Blasting Machine. A wear gage (JDE-55) is provided for checking keystone ring groove wear. Measure sleeves in a front-to-rear, and side-to-side direction, at the top and bottom. Renew sleeve if taper is excessive. Other specifications are as follows:

Sleeve inside diameter ... 4.7493-4.7507
Piston skirt clearance ... 0.0058-0.0082
(bottom of skirt)

PISTON PINS

All Models

27. The full floating type piston pins are retained in piston bosses by snap rings. Pins are available in 0.003 oversize (marked yellow) and 0.005 oversize (marked red) as well as standard. Always renew snap rings when reinstalling pins.

The recommended fit of piston pins is a hand push fit in piston bores and a slip fit in connecting rod bushings. Standard diameter and clearances are as follows:

Piston pin diameter ... 1.8739-1.8745
Clearance (rod) ... 0.0007-0.0023
Clearance (piston) ... 0.0003-0.0011

CONNECTING RODS AND BEARINGS

All Models

28. Connecting rod bearings are steel-backed aluminum inserts. Bearings are available in standard size as well as undersizes of 0.002, 0.010, 0.020 and 0.030.

Mating surfaces of rod and cap have milled tongues and grooves which positively locate cap and prevent it from being reversed during installation. Check drilled hole to pin bushing for

cleanliness. Connecting rods are marked "FRONT" for proper installation. Check the connecting rods, bearings and crankpin journals for excessive taper and against the values which follow:

Crankpin diameter ... 3.4980-3.4990
Regrind if out-of-round ... 0.004
Crankpin diametral clearance ... 0.0024-0.0054
Rod bolt tightening torque ... 155-165 ft.-lbs.

CRANKSHAFT AND BEARINGS

All Models

29. The crankshaft is supported in seven main bearings. Crankshaft end play of 0.004-0.010 is controlled by the flanged fifth main bearing. Upper and lower bearing shells of flanged bearing ONLY are not interchangeable, the upper half containing an oil hole.

All main bearing caps can be removed from below after removing oil pan and oil pump. When renewing bearings, make sure that locating lug on bearing shell is aligned with milled slot in cap and block bore. After caps are loosely installed, bump crankshaft forward and rearward to align thrust flanges; then tighten main bearing cap screws to a torque of 205-215 ft.-lbs. Main bearings are available in undersizes of 0.002, 0.010, 0.020 and 0.030. The fifth (thrust) bearing is available in all undersizes with standard flange width; and in 0.010 undersize and 0.007 oversize flange width.

To remove the crankshaft, first remove engine as outlined in paragraph 14 and proceed as follows: Remove flywheel and crankshaft rear oil seal retainer. Remove crankshaft pulley, timing gear cover, oil pan and oil pump. Remove rod and main bearing caps and lift out crankshaft. The hardened crankshaft rear wear sleeve is a press fit on flywheel flange and is renewable. To remove score lightly with a blunt chisel. When installing, place JDE-34 GUIDE on crankshaft, drive wear sleeve on shaft with JDE-68 driver until rear edge is flush with guide. Make sure the chamfer on the O.D. of wear sleeve is to the rear of engine. Refer to paragraph 30 for procedures to renew rear oil seal. Check crankshaft and bearings against the values which follow:

Crankpin diameter ... 3.498-3.499
Main journal diameter ... 3.748-3.749
Regrind if out-of-round ... 0.004
Main bearing diametral clearance ... 0.0019-0.0049
Cap screw torque ... 210 ft.-lbs.