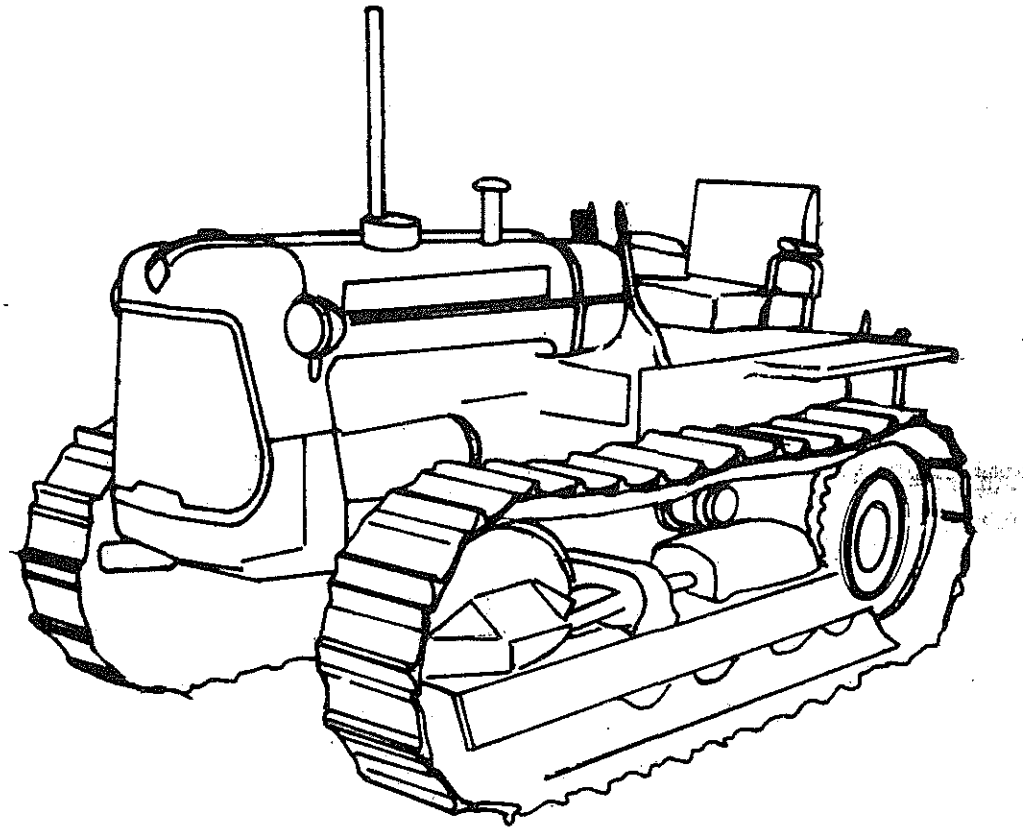
CDS

SERVICE SECTION

H-3 & HD-3 TRACTORS



Industrial Tractor Division

LITHO IN USA

No. 1013044
6/73

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149 GASOLINE ENGINE
H-3 CRAWLER TRACTOR

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H-3 CRAWLER TRACTOR
149 Gasoline Engine
Prior To S/N 6959
SPECIFICATIONS

ENGINE

No. of Cylinders	4
Firing Order	1-2-4-3
Bore	3-1/2
Stroke	3-7/8
Piston Displacement	149 cu. in.
Piston Travel @ (Rated Gov. Speed)	1066 F. P. M.
Compression Ratio	7. 5 - 1
Compression Pressure	
At Cranking Speed	160 - 165
R. P. M. (Low Idle)	550 - 575
R. P. M. (High Idle)	1850 - 1900
R. P. M. (Rated Load)	1650

CAMSHAFT

Drive	Gear
Timing	Marked Gear
Journal Diameter	1. 749" - 1. 750"
Bushing Diameter (Inside)	1. 752" - 1. 753"
Bushing Clearance	.002 - .004
End Thrust	Spring Loaded

CRANKSHAFT

Bearing Length	
Front and Center	1. 250"
Rear	1. 448" - 1. 500"
Journal Length	
Front and Center	1. 5626"
Rear	1. 504" - 1. 506"
End Thrust Clearance	.004" - .008"
Bearing Diameter	2. 751" - 2. 752"
Journal Diameter	2. 748" - 2. 749"
Bearing Clearance	.002" - .004"
Adjustment	Replaceable Inserts
Bearing Torque	90 - 95 ft. lbs.

CONNECTING ROD

Type	Offset
Bearing	Precision Inserts
Bearing Length	1. 219" - 1. 229"
Journal Length	1. 436" - 1. 439"
Rod Width	1. 428" - 1. 430"
Side Clearance	.006" - .011"
Bearing Diameter	1. 938" - 1. 939"
Journal Diameter	1. 936" - 1. 937"
Bearing Clearance	.001" - .003"
Adjustment	Replaceable Inserts
Rod Length (Center to Center)	6-1/2"
Nut Torque	35 to 40 ft. lbs.
Clamp Screw Torque	35 to 40 ft. lbs.
Pal Lock Nut Torque	40 to 60 in. lb.

CYLINDER LINERS

Liner Stand Out	.002" - .005"
Inside Diameter	3. 4995" - 3. 5005"

PISTON

Type	Cam Ground
Cam Ground	.0085" - .0095"
Material	Cast Aluminum
Skirt Dia. (Large)	3. 497"
Skirt Dia. (Small)	3. 485"
Ring Groove Width (3 Comp)	.1255" - .1256"
Ring Groove Width (1 Oil)	.1875" - .189"
Skirt Clearance (Large Dia.)	.0015" - .003"
Pin Bore	.8139" - .8141"

Measurements to be taken at bottom of Skirt

PISTON PIN

Pin Length	2-7/8"
Pin Diameter	.8133" - .8135"
Pin Clearance	.0004" - .0006"

Clearance With Piston and Pin at 70°F.

PISTON RINGS

Ring Gap (Comp.)	.010" - .020"
Ring Gap (Oil) (3 Piece)	.015" - .055"
Ring Width (Comp.)	.123" - .124"
Ring Width (Oil) (3 Piece)	.186" - .1865"
Ring Groove Clearance	.001" - .003"

Compression Rings have a Tapered Face, and Must be Installed With the Word "TOP" Toward Top of Piston.

VALVES

Exhaust Diameter	1. 313" - 1-5/16"
Intake Diameter	1. 438" - 1-7/16"
Stem Diameter	.3407" - .3417"
Guide Diameter Inside	.344" - .345"
Stem Clearance	.0023" - .0043"
Seat Angle	45°
Margin	1/16"
Seat Width	1/32"
Spring Length	2-31/64"
Exhaust Seat Insert Dia.	1. 4415"
Intake Seat Insert Dia.	1. 540"
Tappet Clearance Hot	
Intake	.008" - .010"
Exhaust	.014" - .016"

VALVE TIMING

Intake Opens	6° A. T. D. C.
Intake Closes	36° A. B. D. C.
Exhaust Opens	31° 15 min. B. B. D. C.
Exhaust Closes	8° 45 min. A. T. D. C.

CARBURETOR

Make	Marvel Schebler
Model	TSX 815
Float Valve (Hole Size)	.071"
Venturi (Inside Diameter)	3/4'
Main Jet Flow Per Min.	300 CC
Main Jet Adjustment	Approx. 2-7/16
Idler Jet (No. 71 Drill)	.026"
Economizer Jet (Hole Diameter)	.052"
Idler Jet Adj. approx.	1-9/16 turns open
Float Level	1/4" from gasket face to float

DISTRIBUTOR

Make	Delco-Remy
Model	1112607
Point Gap	.022"
Rotor Rotation	Clockwise
Advance	Automatic Centrifugal
Timing	25° B. T. D. C. at 1750 R. P. M.

SPARK PLUGS

Thread Size	14 M. M.
Thread R ach	3/8"
Point Gap	.025"
Heat Range - Heavy Loads	
A-C	45
Autolite	A-7
Champion	J-8
Medium to Light Loads	
A-C	47
Autolite	A-9
Champion	J-11

THERMOSTAT

Type	By-Pass Pallet

AIR CLEANER

Make	Donaldson

Fill to mark on cup
Use same viscosity oil as used in the engine at prevailing temperatures

FUEL PUMP

Make	A-C
Static Pressure	Min. 3 lb.
At 16" Above Outlet	Max. 4 lb.

Pump operated at 1800 R. P. M.

GENERATOR

Make	Delco-Remy
Model	1100305
Type	2 Brush
Volts	12 V
Capacity	25 Amperes
Charging Rate	Controlled by Volt. Reg.

REGULATOR

Make	Delco-Remy
Model	1118993
Volts	12 V
Regulator adjusted to	14.2 Amp. Max.

TORQUE SPECIFICATIONS - GASOLINE ENGINE

DESCRIPTION	SIZE	TORQUE FT. LBS.
Main Bearing Caps	1/2"	90-95 ft. lbs.
Con. rod bearing caps	3/8"	35-40 ft. lbs.
Con. rod to piston pin	3/8"	35-40 ft. lbs.
Cylinder head capscrews	7/16"	70-75 ft. lbs. Center 60-65 ft. lbs.
Cylinder head capscrews	1/2"	90-95 ft. lbs.
Flywheel to crankshaft	7/16"	70-75 ft. lbs.
Fan pulley to crankshaft	3/8"	20-25 ft. lbs.
Clutch to flywheel	5/16"	17-20 ft. lbs.
Oil sump to cylinder block	5/16"	15-20 ft. lbs.
Gear cover to cylinder block	5/16"	15-20 ft. lbs.
Gear cover to cylinder block	5/8"	80-85 ft. lbs.
Rear oil seal retainer	5/16"	15-20 ft. lbs.
Governor housing cover	5/16"	15-20 ft. lbs.
Vaive rocker arm cover	3/8"	10-15 ft. lbs.
Rocker arm shaft supports	3/8"	20-25 ft. lbs.
Carburetor to manifold	5/16"	15-20 ft. lbs.
Manifold to cylinder head	3/8"	25-30 ft. lbs.
Oil Pump to cylinder block	5/16"	15-20 ft. lbs.
Oil filter base to cylinder block	3/8"	25-30 ft. lbs.
Distributor drive housing to block	3/8"	25-30 ft. lbs.
Distributor to drive housing	3/8"	25-30 ft. lbs.
Water pump to cylinder block	3/8"	25-30 ft. lbs.
Fan hub	5/16"	15-20 ft. lbs.
Thermostat cover	5/16"	15-20 ft. lbs.
Air cleaner mounting	3/8"	25-30 ft. lbs.

H-3 CRAWLER TRACTOR
160 Gasoline Engine
Eff W/Tr S/N - 6959 - 8694
SPECIFICATIONS

ENGINE

No. of Cylinders	4
Firing Order	1-2-4-3
Bore	3-5/8
Stroke	3-7/8
Piston Displacement	160 Cu. In.
Compression Ratio	8 - 1
Compression Pressure	180 - 185
R. P. M. (Cranking Speed)	300
R. P. M. (Low Idle	550 - 575
R. P. M. (High Idle)	1850 - 1900
R. P. M. (Rated Load)	1650

H-3 CRAWLER TRACTOR
160 Gasoline Engine
Eff W/Tr S/N - 8694
SPECIFICATIONS

No. of Cylinders	4
Firing Order	1-2-4-3
Bore	3-5/8
Stroke	3-7/8
Piston Displacement	160 Cu. In.
Compression Ratio	8 - 1
Compression Pressure	180 - 185
R. P. M. (Cranking Speed)	300
R. P. M. (Low Idle)	600 - 650
R. P. M. (High Idle)	2030 - 2060
R. P. M. (Rated Load)	1800

VALVE TIMING

Intake Opens	T. D. C.
Intake Closes	40° A. B. D. C.
Exhaust Opens	40° B. B. D. C.
Exhaust Closes	10° A. T. D. C.

FITS AND TOLERANCES OF NEW PARTS
160 Engine

CYLINDER SLEEVE

1.	Type	Replaceable Wet
2.	Inside Diameter - 160 Engine	3.6245 ± .0010"
3.	Top Surface of Cylinder Sleeve Flange Above Cylinder Block w/Sleeve Installed	.002" - .005"

PISTON

NOTE: *Combustion Chamber is in Piston.*

1.	Material	Cast Aluminum
2.	Diameter at Bottom of Skirt Measured at Right Angle to Piston Pin - 160 Engine	3.6225
3.	Bore for Piston Pin	.99985 - .99987"
4.	Clearance of Piston Skirt With Sleeve	.0015" - .003"

PISTON PIN

1.	Type	Float
2.	Piston Pin Length	2.973"
3.	Diameter of Pin	.99975 - .99973"
4.	Fit of Pin in Piston at Room Temperature	.0004" to .0006" Loose

PISTON RINGS

1.	Number of Rings on Each Piston.	4
2.	Location of Rings	3 Compression & 1 Oil Control; All Above Piston Pin
3.	Only Standard Size Rings are Available. Compression Rings Have a Tapered Face and Must be Installed With the Word "TOP" Toward Top of Piston.	

CRANKSHAFT

1.	Journal Diameter for Connecting Rods	1.9365" - 1.9375"
2.	Journal Diameter for Main Bearings	2.748" - 2.749"
3.	Crankshaft End Clearance	.004" - .008"
4.	Fit of Crankshaft Gear on Crankshaft	.0015" - .0035" Tight

MAIN BEARINGS

1.	Number Used	3
2.	Type	Replaceable Precision
3.	Torque For Main Bearing Capscrews - 1/2-13 UNC-3A	90 to 100 Ft. Lbs.

CONNECTING ROD BEARINGS

1.	Type	Replaceable Precision
2.	Inside Diameter of Bearing (With Capscrews Tightened to Specified Torque)	1.938" - 1.9395"
3.	Diameter of Crankshaft Connecting Journals	1.9365" - 1.9375"
4.	Undersize Bearings Available For Service	.001" and .0025"

CONNECTING RODS

1.	Type - Non-Rifled Drilled,	Offset - Balance Forged
2.	Bolts Used Per Rod	2
3.	Connecting Rod Length (Center to Center)	6.500"
4.	Piston Pin Diameter	.99975" - .99973"
5.	Torque For Tightening Connecting Rod Bolt Nuts	35 to 40 Ft. Lbs.
6.	Torque For Tightening Connecting Rod Bolt Pal Locknuts	40 to 60 Inch Lbs.

EXHAUST VALVES

1.	Valve Lift (At Valve) Lash	.384"
2.	Valve Lift (At Cam)	.259"
3.	Seat Angle	45°
4.	Valve Seat Contact Width	1/16"
5.	Valve Lash (Cold)	.016" - .018"
6.	Valve Lash (Normal Operating Temperature)	.014" - .016"
7.	Head Diameter	1.308" - 1.318"
8.	Overall Length	4.901" - 4.911"
9.	Stem Diameter	.341" - .3417"

EXHAUST AND INTAKE VALVE SPRING

1.	Valve Spring Free Length	2-31/64"
2.	Valve Spring Length (Valve Closed)	1-55/64"
3.	Valve Spring Length (Valve Opened)	1-31/64"
4.	Spring Load at 1-55/64" Length	47 - 53 Lbs.
5.	Spring Load at 1-31/64" Length	75 - 85 lbs.
6.	Install New Spring When Old Spring is 5% Below the Low Limit or 5% Above the High Limit	

INTAKE VALVES

1.	Valve Lift (At Valve (w/.020" Lash)	.384"
2.	Valve Lift (At Cam)	.259"
3.	Seat Angle	45°
4.	Valve Seat Contact Width	1/16"
5.	Valve Lash (Cold)	.010" - .012"
6.	Valve Lash (Normal Operating Temperature)	.008" - .010"
7.	Head Diameter	1.433" - 1.443"
8.	Overall Length	4.8985" - 4.9185"
9.	Stem Diameter	.342" - .3427"

EXHAUST VALVE SEAT INSERT

1.	Seat Angle	45°
2.	Seat Contact Width	1/16"
3.	Seat Run-Out	.002"
4.	Insert Press Fit	.0025" - .0055"
5.	Insert O.D. Not Installed	1.3905"-1.3915"
6.	Bore in Cylinder Head for Insert	1.386" - 1.388"
7.	Depth of Counterbore in Cylinder Head for Insert (From Bottom Deck of Head)	.2235" - .2285"

INTAKE VALVE SEAT INSERT (Service Only) (See Note) - 220474

1.	Seat Angle	45°
2.	Seat Width	1/16"
3.	Seat Run Out	.002"
4.	Insert Press Fit	.003" - .005"
5.	Insert O.D. Not Installed	1.539" - 1.540"
6.	Bore in Cylinder Head for Insert	1.535" - 1.536"
7.	Depth of Counterbore in Cylinder Head for Insert (From Bottom Deck of Head)	.226" - .230"

NOTE: *Production Engines Do Not Have Intake Inserts*

EXHAUST AND INTAKE VALVE GUIDE

1.	Length	2.250"
2.	Inside Diameter After Assembly	.344" - .345"
3.	Stem-To-Guide Clearance - Exhaust	.0023" - .004"
	Intake	.0013" - .003"
4.	Press Guides in Cylinder Head Until Top of Guides Are Flush With Top Machined Surface of Head	

ROCKER ARMS - WITH NON-REPLACEABLE BUSHINGS

1.	I.D. of Rocker Arm	.868" - .8695"
2.	O.D. of Rocker Arm Shaft	.8645" - .8655"
3.	Rocker Arm Shaft-To-Rocker Arm Clearance	.0025" - .005"
4.	Rocker Arm Ratio	1.481" - 1"
5.	Oil Feed Restrictor Line	.070" - .073"

CAMSHAFT

1.	Number of Bearings Used	3
2.	I.D. of Camshaft Bearings	1.7515" - 1.7535"
3.	O.D. of Camshaft Journals	1.749" - 1.750"
4.	Camshaft Bearing-To-Journal Running Clearance	.0015" - .0045"
5.	O.D. of Camshaft Bearings	1.8825" - 1.883"
6.	Bore in Cylinder Block for Bearing	1.880" - 1.881"
7.	Fit of Camshaft Bearings in Bore of Cylinder Block	.001" - .003" Tight
8.	Overall Width of Camshaft Bearings	
	Front and Rear	1.125"
	Center	1.250"
9.	Camshaft End Play (Controlled by Thrust Spring and Plunger)	
10.	Camshaft Gear Width	.750"
11.	Fit of Camshaft Gear on Camshaft	.0015" - .003" Tight

VALVE TAPPET

1.	Bore in Cylinder Block for Valve Tappet	.5625" - .5635"
2.	O.D. of Valve Tappet Stem	.561" - .562"
3.	Fit of Valve Tappet in Bore of Cylinder Block - Clearance	.0005" - .0025"

CYLINDER HEAD

1.	Valve Sequence (Front to Rear)	
	No. 1 Cylinder	Exhaust-Intake
	No. 2 Cylinder	Intake-Exhaust
	No. 3 Cylinder	Exhaust-Intake
	No. 4 Cylinder	Intake-Exhaust

LUBRICATING OIL PUMP - BLADE TYPE

1.	Radial Clearance - Blades to Pump Body	Spring Loaded
2.	End Clearance - Pump Rotor	.001" - .004"
3.	I.D. in Pump Body For Oil Pump Rotor Shaft	.749" - .7495"
4.	O.D. of Rotor Shaft	.748" - .7485"
5.	Clearance - O.D. of Rotor Shaft to Bore in Oil Pump Body	.0005" - .0015"

WATER PUMP

1.	Clearance - Impeller to Cover Plate	.060" - .065"
2.	Bearing O.D.	1.1796" - 1.1811"
	Bore in Water Pump Body (For Bearing)	1.1795" - 1.1805"
	Fit-Bearing O.D. to Body	.0009" - .0016" Tight
3.	Impeller - Bore in Impeller For Shaft	.6235" - .6245"
	Shaft Diameter	.6262" - .6267"
	Fit - Shaft Diameter to Impeller Bore	.0017" - .0032" Tight
4.	Hub - For Water Pump Pulley; Bore in Hub For Shaft	.623" - .624"
	Shaft Diameter	.6262" - .6267"
	Fit - Shaft Diameter to Hub Bore	.0022" - .0037" Tight

GOVERNOR

1.	O.D. of Governor Gear Bushing	1.878" - 1.879"
2.	Bore in Block For Governor Gear Bushing	1.875" - 1.876"
3.	Press Fit of Bushing in Bore of Block	.002" - .004" Tight
4.	I.D. of Governor Gear Bushing	1.754" - 1.755"
5.	O.D. of Governor Gear Bearing Surface	1.748" - 1.749"
6.	Clearance of Gear Hub in Bushing	.005" - .007"
7.	O.D. of Governor Shaft	.4325" - .433"
8.	I.D. of Distributor Drive Gear	.4381" - .4391"
9.	Clearance of Drive Gear on Shaft	.0051" - .0066"
10.	O.D. at Front End of Governor Shaft	.375"
11.	I.D. of Bushing in Governor Housing	.441" - .442"
12.	Clearance of Front End of Shaft to Bushing	.066" - .067"

FUEL PUMP

Make	A-C
Static Pressure	Min. 3 lb.
At 16" Above Outlet	Max. 4 lb.
Pump operated at 1800 R P.M.	

ENGINE SPECIFICATIONS

CARBURETOR

Make	Marvel Schebler
Model	TSX 869
Idler Jet (No. 71 Drill)	.026"
Float Level	1/4" from gasket face to float

SPARK PLUG

Thread Size	14 M.M.
Thread Reach	3/8"
Point Gap	.025"
Heat Range - Heavy Loads	
A-C	45
Autolite	A-7
Champion	J-8
Medium to Light Loads	
A-C	47
Autolite	A-9
Champion	J-11

THERMOSTAT

Type	By-Pass Pallet
Air Cleaner	Dry

DISTRIBUTOR

Make	Delco-Remy
Model	1112609
Point Gap	.022"
Rotor Rotation	Clockwise
Advance	Automatic Centrifugal 25° B.T.D.C. at 1750 R.P.M.

GENERATOR

Make	Delco-Remy
Model	1100426
Type	2 Brush
Volts	12 V
Capacity	25 Amperes
Charging Rate	Controlled by Volt. Reg.

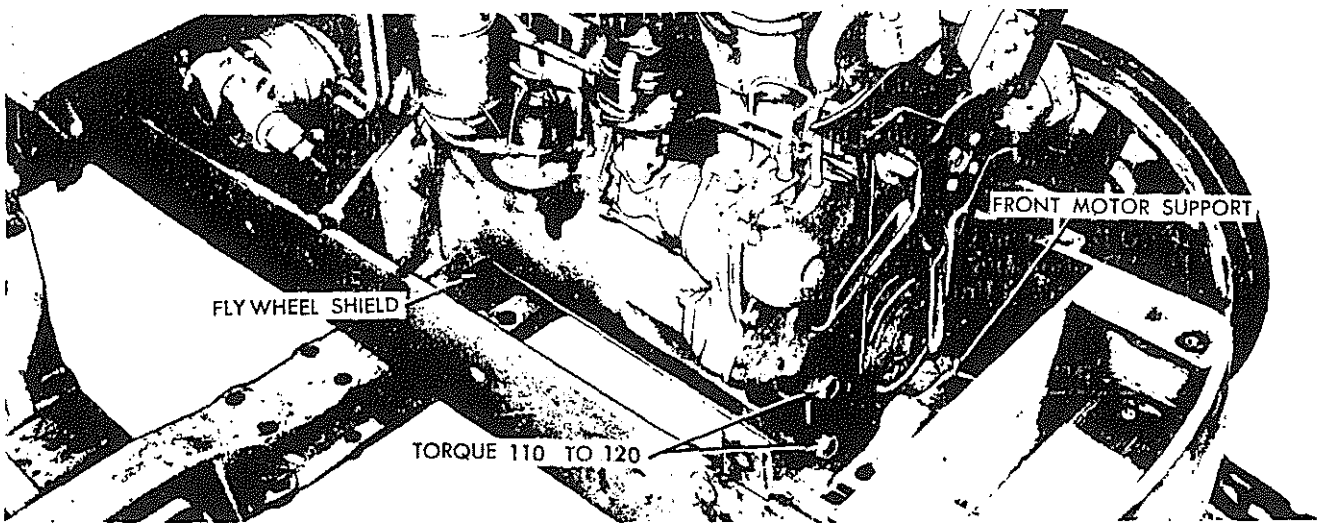
REGULATOR

Make	Delco-Remy
Model	1119191
Volts	12 V
Regulator Adjusted To	14.2 Volts Max.

STARTING MOTOR

Make	Delco-Remy

ENGINE REMOVAL AND ASSEMBLY



REMOVAL

Remove hood and radiator assemblies. Remove ignition coil. Disconnect fuel lines from carburetor and fuel pump. Disconnect choke rod from carburetor. Disconnect governor control rod at governor. Disconnect operation meter drive. Remove heat indicator pellet from cylinder head. Disconnect the air cleaner hose from the carburetor. Remove the wires from the generator. Remove oil gauge line from filter base.

Remove the two bolts attaching front engine support to frame. The front engine support is adjusted to properly position engine to main frame. The shims should be kept intact and not damaged. The same number of shims should be used at time of assembly.

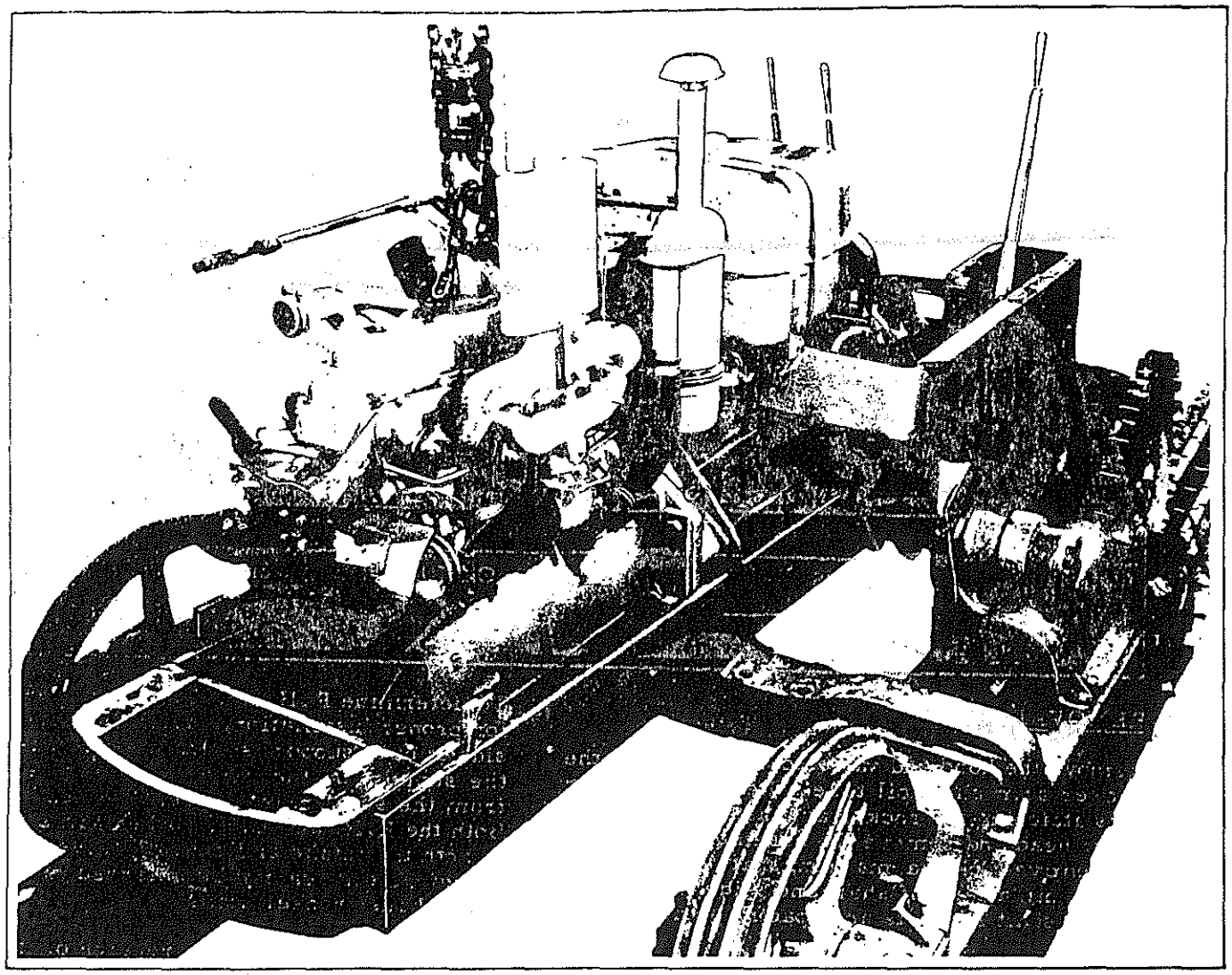
Remove the capscrews from lower flywheel shield. Support engine with a suitable sling on the first and third valve cover studs. Remove the four capscrews attaching engine to torque tube. Slip the engine forward and tip front of engine up until it will clear the front frame member. Continue to move engine forward and slightly up until flywheel and clutch clears clutch shaft and torque housing.

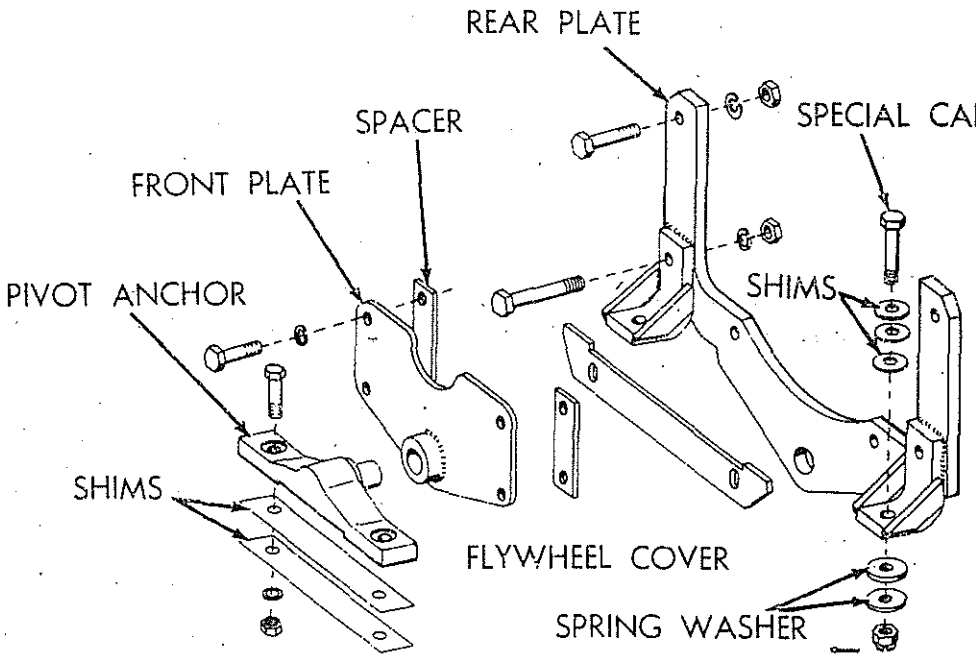
Place engine on bench or engine service stand-disassemble.

ASSEMBLY

For assembly, reverse the above instructions. When installing the engine, make certain the clutch is properly aligned for the clutch shaft.

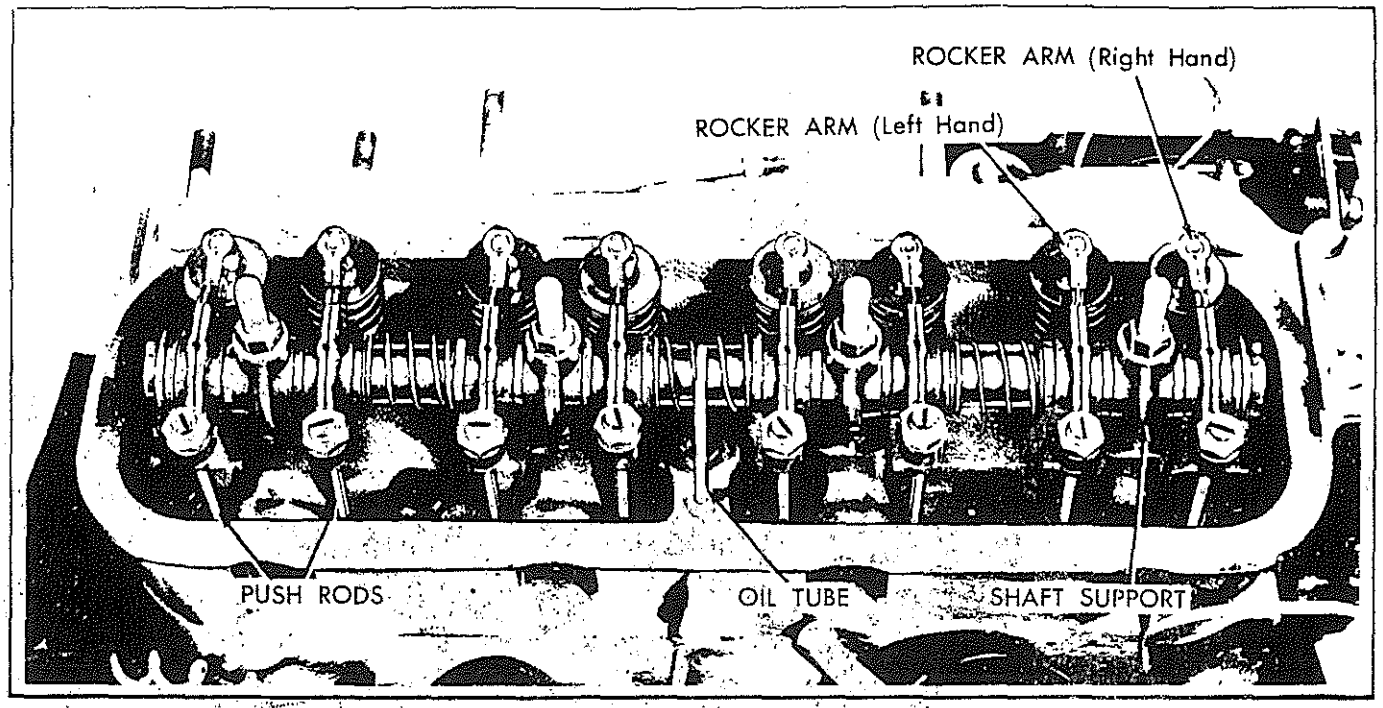
For alignment and assembly sequence of engine-see Torque Tube.





ENGINE MOUNTS

ROCKER ARMS & SHAFTS



REMOVAL

Remove the hood and valve cover. Remove the rocker arm shaft oil tube. Remove the four nuts attaching the rocker arm assembly to cylinder head and remove the assembly as a unit. To remove rocker arms from shaft, remove one cotter pin at end of shaft and slide the rocker arms, shaft supports and spacing springs from shaft.

The rocker arms and shaft are lubricated by an oil tube that delivers oil at the center of the hollow shaft. Oil is fed through support to rocker arm. Rocker arms are available as an assembly only including adjusting screw and locknut and if worn excessively and loose on shaft, it may be necessary to replace both shaft and arm assembly. Replace if total clearance exceeds .010" between rocker arm and shaft.

Check the valve stem contact surface on arms, and if worn flat they must be refaced with valve refacing equipment. Worn contact surface on rocker arm will cause excessive valve stem and guide wear. Check the cork stoppers in each end of shaft for tightness and install new stoppers, if necessary, to prevent oil leakage.

ASSEMBLY

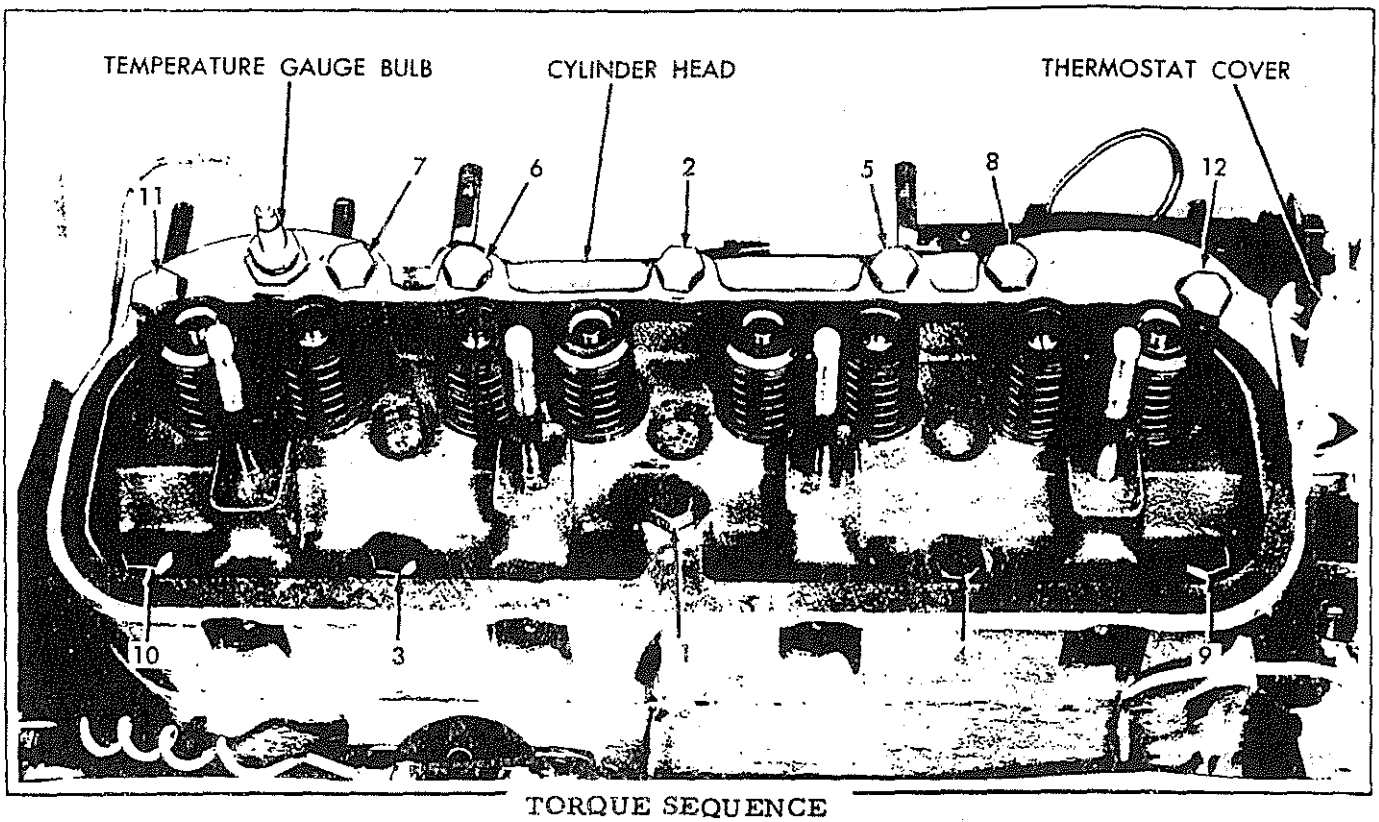
The rocker arms are right and left hand assemblies and cannot be interchanged. The R.H. arm is installed on the R.H. side of each shaft support, and the L.H. arm is installed on the L.H. side of each shaft support, as viewed from the push rod side.

To determine R.H. and L.H. arm assemblies for proper installation, install in pairs at each side of each support so that the offset is toward the support on the valve stem end, and away from the support on the push rod end of arm. Both the R.H. and L.H. rocker arms are used in both the intake and exhaust valve positions, therefore they cannot be referred to as intake and exhaust rocker arms.

The rocker arm bushings receive oil from the shaft through grooves in the shaft supports. The hole in shaft for the oil tube must be in an upward position when installing assembly to cylinder head. With washer and cotter pin in one end of shaft install a rocker arm, support and the second rocker arm. Install in pairs as described in above paragraph. Install a spacer spring between each pair of rocker arms and support. Repeat this procedure until assembly is complete and install the second washer and cotter pin.

Check push rods for straightness or damage, and replace any that are necessary. Install push rods in place in cylinder head being sure that they are seated in the valve tappets. Install rocker arm shaft assembly with hole for oil tube upward. Install washers at top of supports, and install retaining nuts and tighten 20 to 25 ft. lbs. torque. Install oil tube and check valve lash to make sure that none are to tight or too loose. Operate engine and bring temperature up to normal and adjust valve lash. Intake .008-.010, Exhaust .014-.016. Install valve cover using a new gasket and tighten retaining nuts 20 to 30 inch. lbs.

CYLINDER HEAD



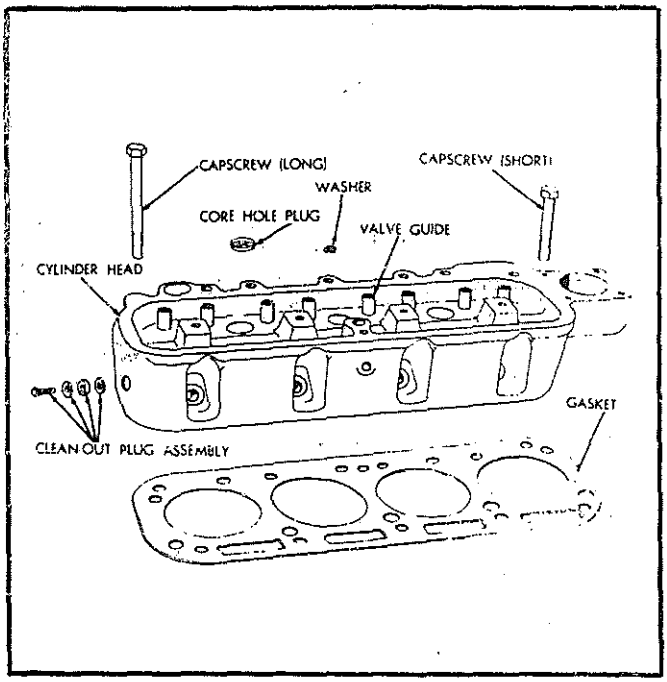
TORQUE SEQUENCE

REMOVAL

Remove radiator and cylinder block. Remove hood. Remove air cleaner. Shut off fuel and remove fuel line from carburetor. Remove the choke control rod. Remove the manifold, muffler and carburetor all in one assembly. Remove temperature gauge pellet from cylinder head. Remove the upper radiator hose, and thermostat by-pass hose. Remove valve cover, rocker arm shaft assembly and push rods. Remove capscrews attaching head to block and remove cylinder head.

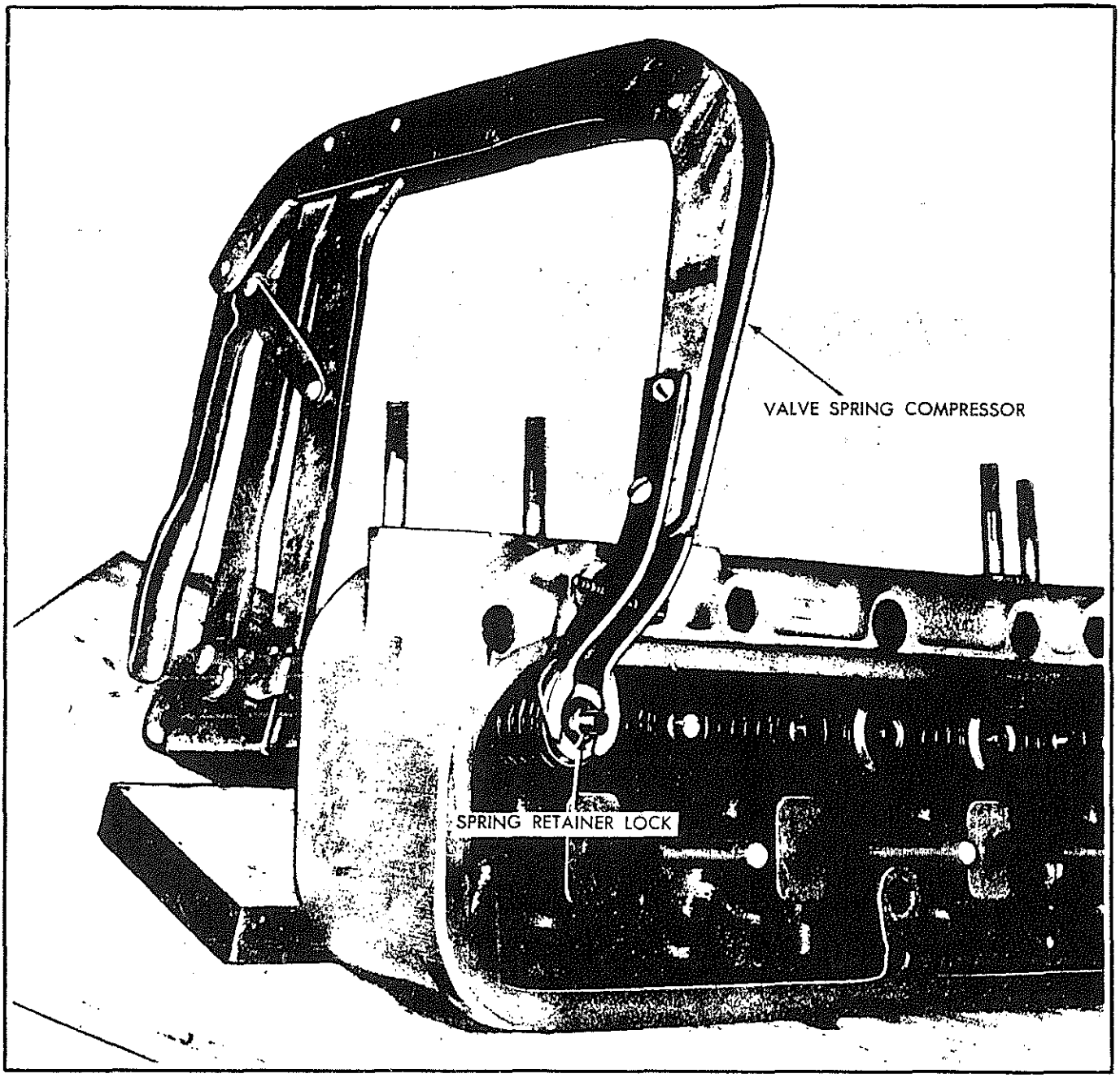
ASSEMBLY (149) Engine Prior To Tr S/N-6959

When reinstalling cylinder head, be sure gasket surface of head and block is perfectly clean. Install a new gasket using sealer on both sides of gasket. The gasket and head is easier to locate to block if two dowel studs are used. There are eight long and four short capscrews for attaching cylinder head to block. Install capscrews and tighten from 80 to 85 ft. lbs. torque. Start tightening at center of head and work back and forth toward each end of head.



ASSEMBLY (160) Engine - Eff W/Tr S/N-6959

When reinstalling cylinder head, be sure gasket surface of head and block is perfectly clean. The gasket and head are easier to locate to block if two dowel studs are used. There are eight long and four short



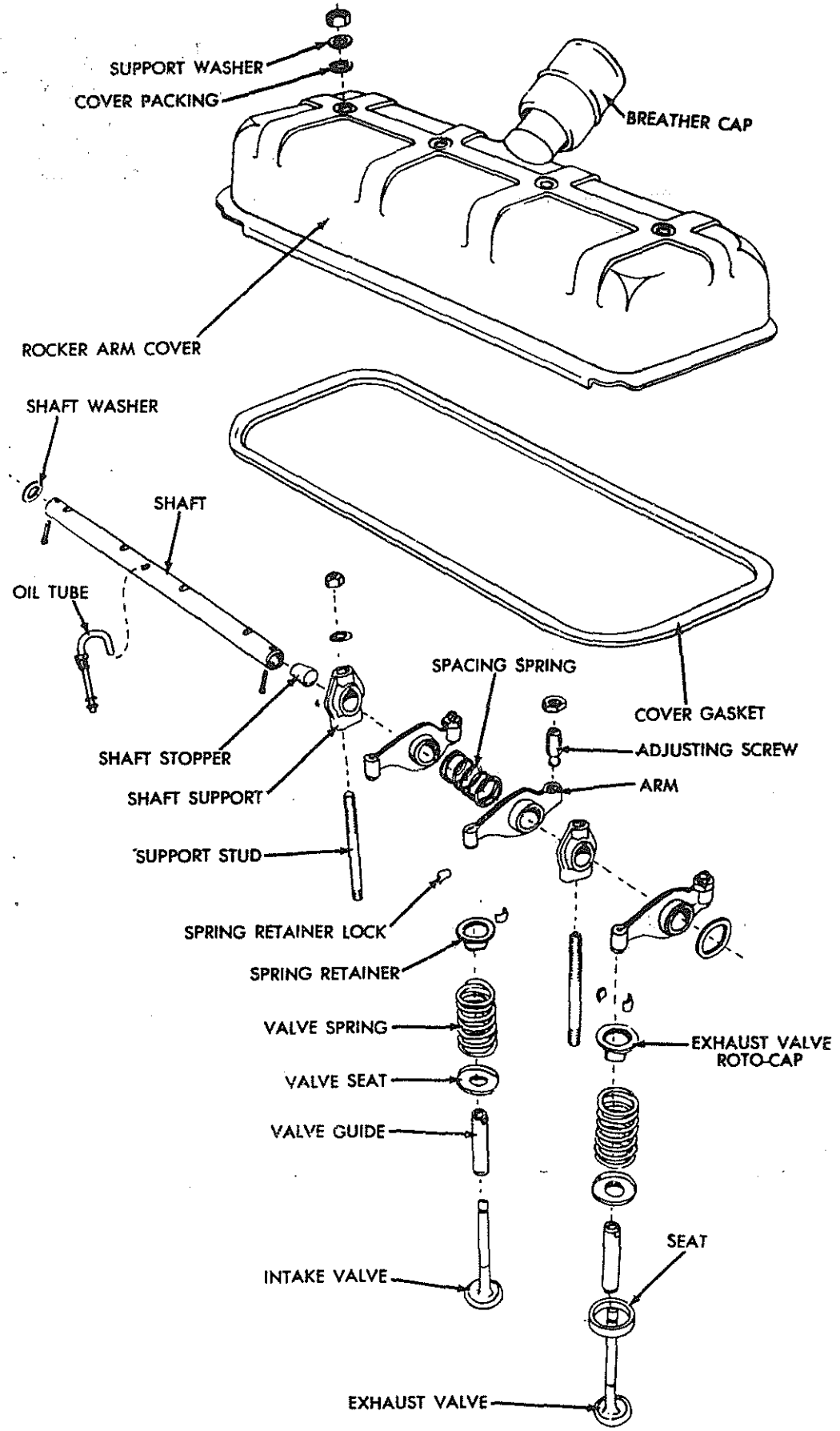
There are eight long and four short capscrews for attaching cylinder head to block. Install capscrews and torque the five 1/2" capscrews to 90 to 95 ft. lbs. and the seven 7/16" capscrews to 70 to 75 ft. lbs. except the center capscrew, it should torque to 60 to 65 ft. lbs. Start tightening at center of head and work back and forth toward each end of head.

VALVES (Intake & Exhaust)

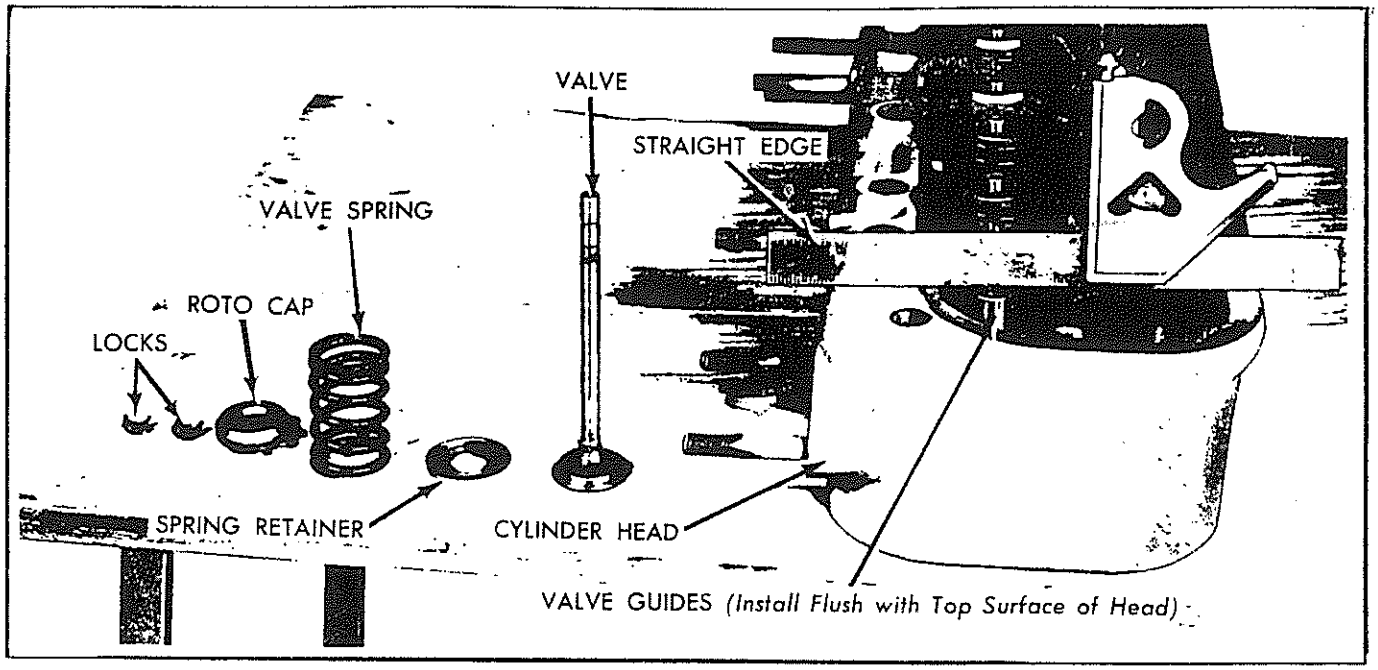
The exhaust valves have a stem diameter of .3417 to .3410" and a stem to guide clearance of .0020 to .0028". The intake valve has a stem diameter of .3420 to .3427" and a stem to guide clearance of .0020 to .0028". The valve faces are both 45° angles and the valve margin is 1/16". Valves must be refaced with high speed valve refacing equipment. This equipment must be maintained and kept in good working condition otherwise a good valve refacing job will not be obtained. Adjust intake valves .008-.010", exhaust valves .014 to .016" lash hot.

VALVE SEATS

The cylinder head has replaceable exhaust valve seat inserts. The valve seat angle is 45°and the seat width should be from 1/16" to 3/32". If seats become too wide they can be narrowed by using 30° and 60° reseating stones.



VALVES & ROCKER ARMS



VALVE GUIDES

The intake and exhaust valve guides are alike. The guide inside diameter is .344" to .345". The guide outside diameter is .566" to .567" and they have an interference fit of .0005" to .0025" in head. The guide bore in head is .5645" to .5655". To remove guides from head, drive guide through head in a downward direction. Worn valve guides cause excessive oil consumption; if worn excessively - they should be replaced. Install new guides into top of head until guide is flush with top gasket surface of head. Always use a special valve guide driver and they should be pressed into head, if at all possible. If press is not available they may be driven in with driver and heavy hammer. Check valve stem into guide and ream guide if necessary.

VALVE SPRINGS

The valve springs are all alike and have a free length of 2-31/64". When checking springs with a spring tester they should read 50 lbs. plus or minus 3 lbs. when compressed to a height of 1-55/64" and should rear 75 to 85 lbs. when compressed to a height of 1-31/64". Replace springs if they are found to be 1/16" or more short, or if tester indicates they are weak. Valve springs are removed by compressing spring and removing retainer locks. Each spring sets in a spring seat on top of cylinder head. The intake springs are retained to valve with a plain retainer cap. All exhaust valves use roto caps.

VALVE TAPPETS

Tappets are of the mushroom type and must be free to rotate in the block without excessive clearance. Check surfaces for scuffing. If necessary to remove tappets, the camshaft will have to be removed. Refer to camshaft removal.

VALVE TIMING

The valves are properly timed when the line mark on camshaft gear is in register with line mark on crankshaft gear. The intake valve starts to open at 6 degrees after top dead center and closes 36 degrees after bottom dead center. The exhaust valve opens 31 degrees 15 minutes before bottom dead center, and closes 8 degrees 45 minutes after top dead center.

TIMING GEAR COVER

REMOVAL

To remove the timing gear cover it will be necessary to remove the hood, radiator and shell, radiator support. Refer to removal instructions given under each of the above subject assemblies. Remove fan belt and fan blades. Remove the two Allen head setscrews from crankshaft pulley and remove pulley and woodruff key from end of shaft. Disconnect carburetor rod from governor cross shaft. Disconnect oil lines at top of governor housing. The governor housing may be removed with gear cover, or removed separately. Drain oil and remove oil sump. Remove capscrews attaching gear cover to cylinder block and remove cover. Drive oil seal from gear cover.

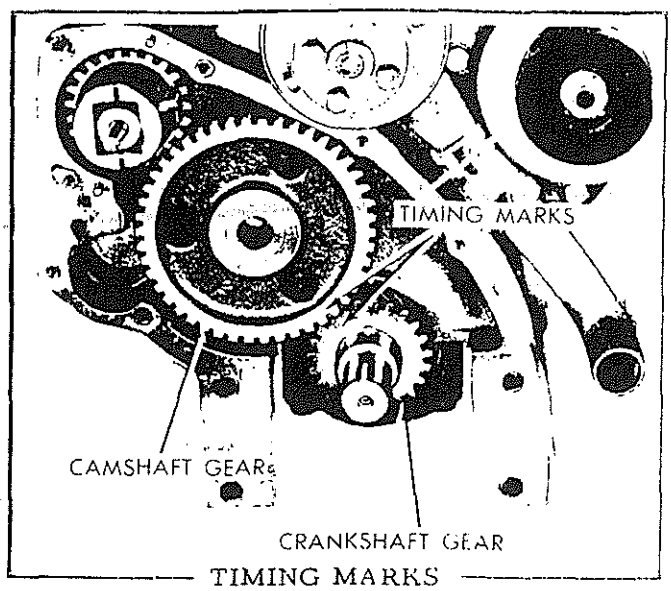
The timing gear train is now exposed and the timing marks may be checked for proper timing. Proper timing is obtained when the line mark on camshaft gear is in register with line mark on crankshaft gear. The governor and distributor drive gear has no timing marks. To replace the camshaft gear it will be necessary to remove the camshaft. Refer to camshaft removal. To replace the crankshaft gear it will be necessary to remove the crankshaft. Refer to crankshaft removal. The governor gear and shaft assembly can be removed by removing governor housing at front of timing gear cover.

ASSEMBLY

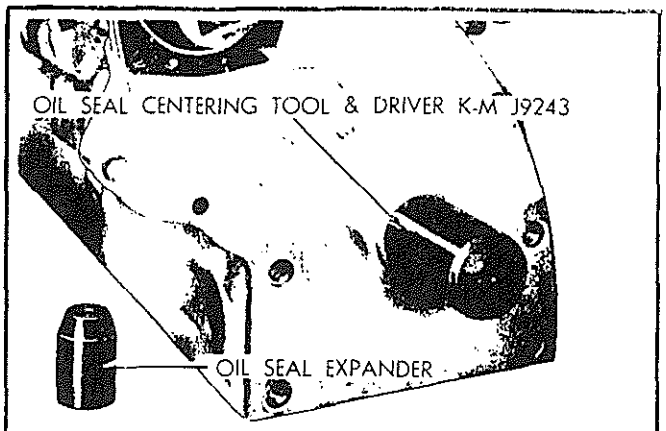
Clean off any old gasket or foreign matter from gasket surface of engine block or timing gear cover. Shellac new gasket and install to engine block. Install timing gear cover, leaving the capscrews loose. Place the oil seal centering tool K-M J-9243 over end of crankshaft and pilot into gear cover to center cover with crankshaft. Tighten capscrews and remove the centering tool. Torque all 5/16" capscrews in governor housing and timing gear cover 15 to 20 ft. lbs.

Place the oil seal expander in place over end of crankshaft. Lubricate lip of seal and seal expander. Place oil seal over seal expander, and apply a coat of sealer to outside surface of oil seal. Use the centering and driving tool K-M J-9243 for driving the seal into place in gear cover.

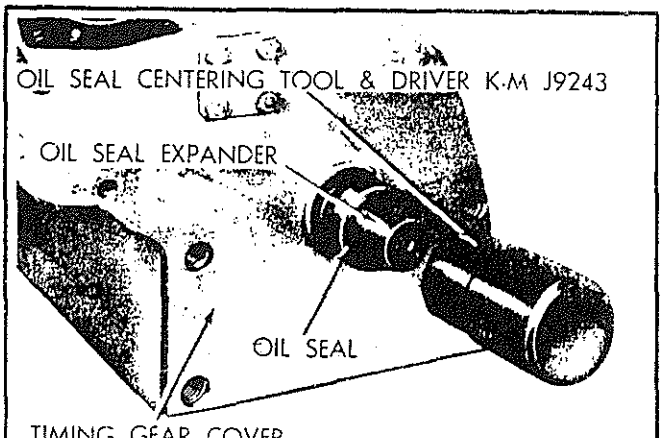
Install front engine support and tighten the 5/8" capscrews 80 to 85 ft. lbs. torque. Install crankshaft pulley and tighten the two Allen setscrews 20 to 25 ft. lbs. torque. Install governor housing and tighten capscrews 15 to 20 ft. lbs. torque. Install fan blades and tighten capscrews 15 to 20 ft. lbs. torque. Install fan belt and adjust.



TIMING MARKS



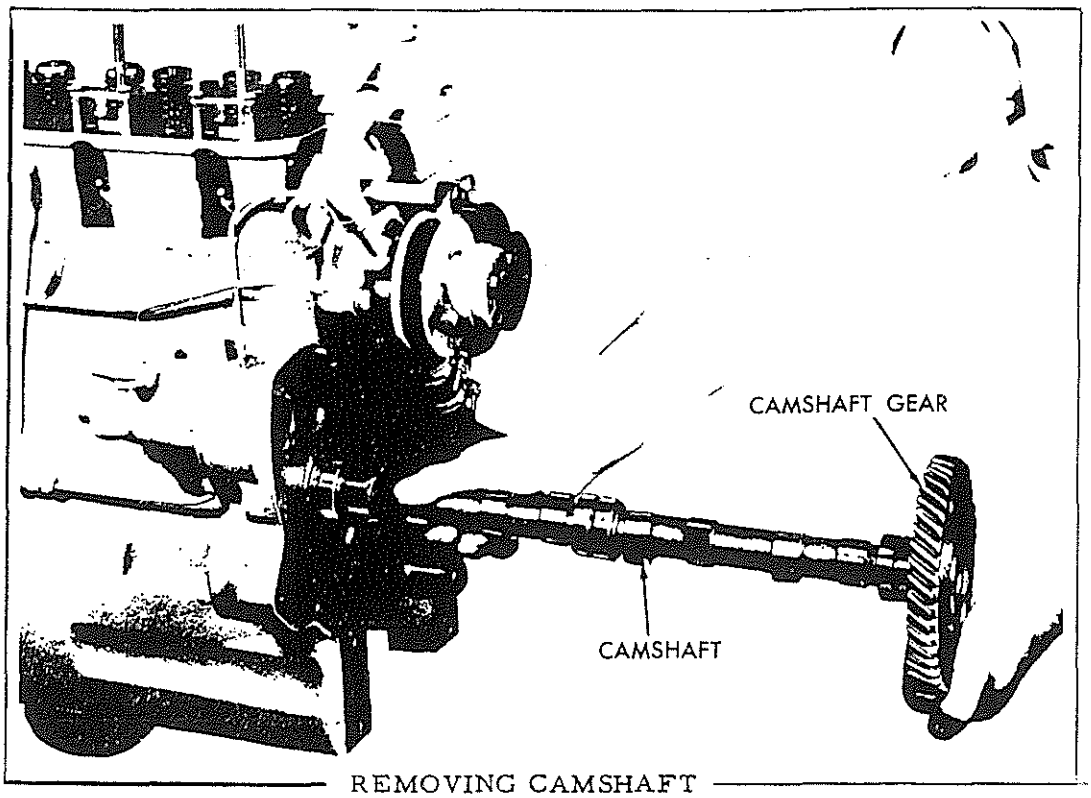
INSTALLING TIMING GEAR COVER



INSTALLING CRANKSHAFT OIL SEAL

Install the engine oil sump and replace engine oil. Install the front support assembly. Install radiator and shell. Refill cooling system. Connect oil lines and governor linkage. Replace hood.

CAMSHAFT



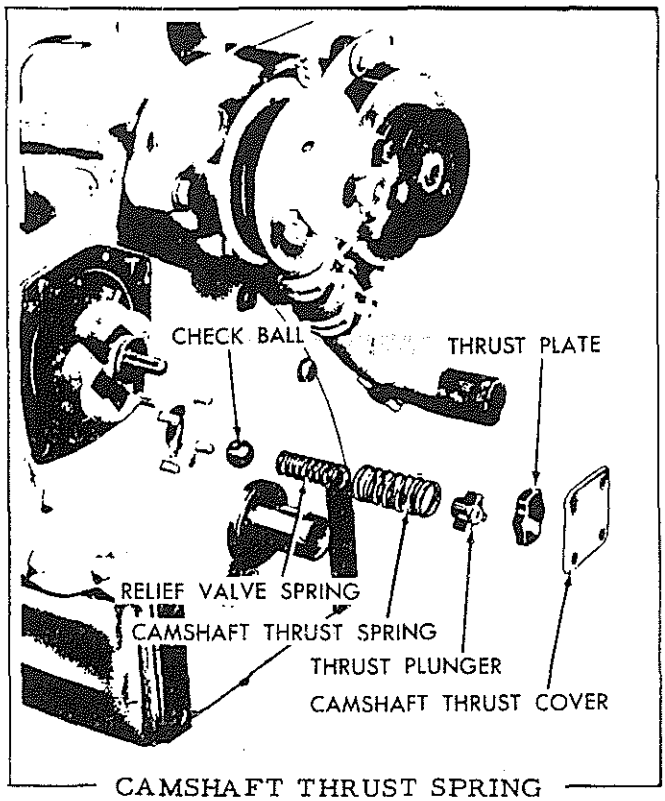
REMOVING CAMSHAFT

REMOVAL

To remove the camshaft gear, the camshaft and gear will have to be removed as an assembly, and the gear pressed from shaft and a new one pressed on. The camshaft may be removed from engine without removing engine from torque housing. If camshaft bushings are to be replaced, it will be necessary to separate engine from torque housing.

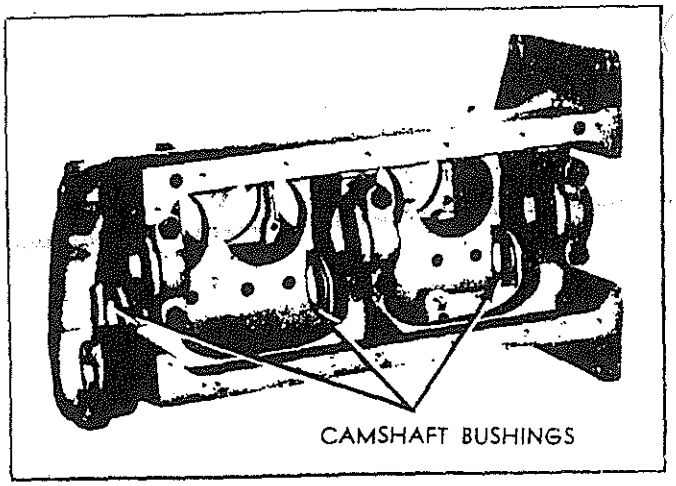
To remove camshaft without replacing camshaft bushings, proceed as follows: Remove timing gear cover as described under subject heading TIMING GEAR COVER - REMOVAL. Remove the valve cover rocker arm shaft assembly and push rods. Push the valve tappets upward in cylinder block, in most cases they will tighten into bore enough to hold them up out of way of cam lobes, if not they may be lifted by rotating camshaft as the shaft is removed. Remove tappets as they clear end of camshaft. The shaft may be pressed from gear.

The camshaft end thrust is controlled by a thrust spring and plunger located at front end of shaft. The oil pump pressure relief valve is also located in front end of camshaft, this relief valve consists of a 5/8" diameter chrome steel ball and a spring. The engine oil pump is driven by a pin through the rear end of camshaft. The hollow passage through center of camshaft is the engine oil gallery and delivers oil to the three camshaft bushings, main and connecting rod bearings.



CAMSHAFT THRUST SPRING
& OIL PRESSURE RELIEF VALVE

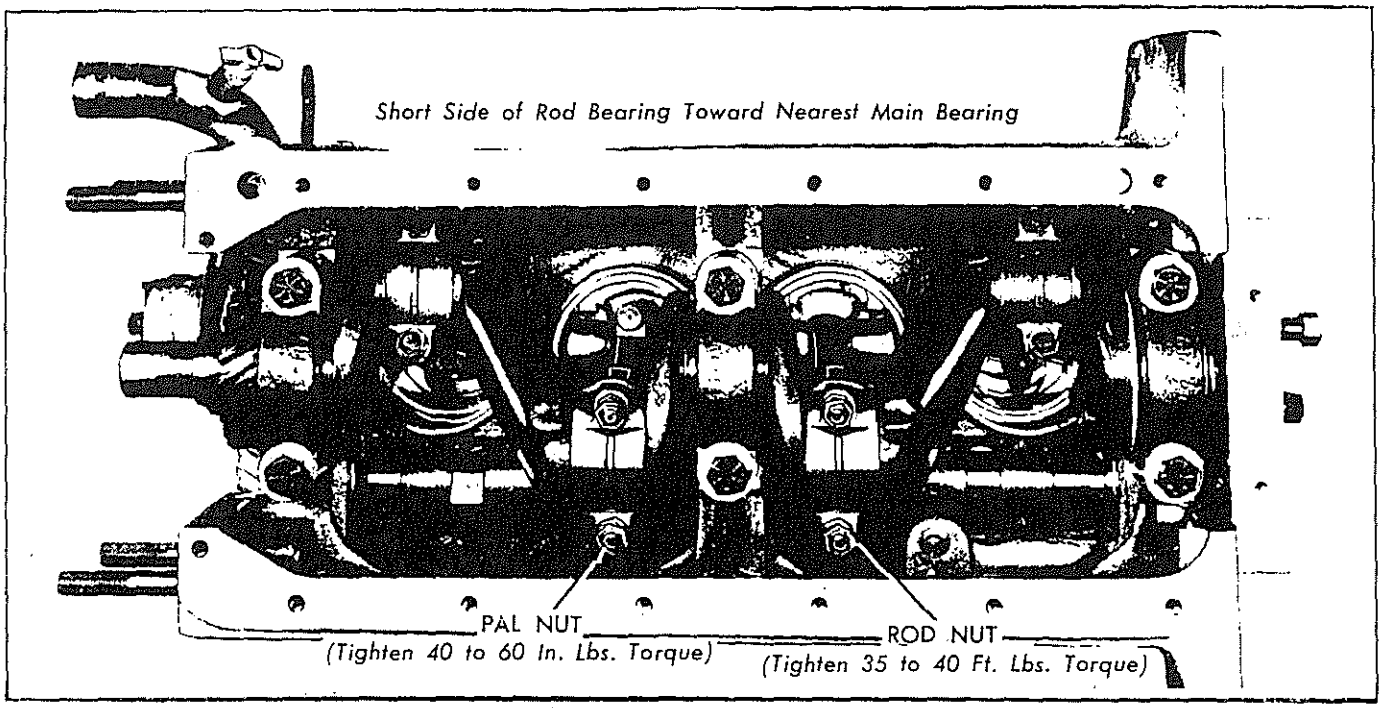
If the camshaft bushings are to be removed, it will be necessary to remove engine from torque housing, and remove the clutch, flywheel and oil pump. The camshaft bushings may be removed and replaced by using a special bushing driver. When installing bushings be sure and align the oil hole in bushing with oil hole in block. The front and rear bushings are alike and have one oil hole, the center bushing is different, having two oil holes. Both these holes must align with holes in block when installing bushing.


CAMSHAFT BUSHINGS

The camshaft journals are all the same diameter, and measure 1.749" to 1.750". The camshaft bushings have an inside diameter of 1.752" to 1.753", giving a shaft to bushing clearance of .002" to .004". The camshaft end play is controlled by a thrust spring and plunger, located at front end of shaft. This thrust plunger rides against a thrust plate located in the timing gear cover.

When installing new camshaft bushings, use caution not to damage bushings by using a special driver provided for this purpose. A camshaft bushing driver may be obtained through the Owatonna Tool Company, Owatonna, Minnesota. When installing camshaft it must rotate freely in bushings and the line mark on camshaft gear must be in align with line mark on camshaft gear.

CONNECTING RODS & PISTONS



REMOVAL

Remove hood, valve cover, rocker arm shaft assembly and push rods. Drain cooling system and remove radiator shell and radiator. Drain crankcase oil and remove oil sump. Instructions for removing the various items will be found under the subject headings for each item to be removed.

Remove any carbon on top of cylinder liner, so that piston and rings may slide out of liner. Remove the oil pump intake floating screen. Remove one rod bearing at a time and push rod and piston assembly upward from top of cylinder liner. Install the rod cap to rod with the bearing notches both on the same side of rod.

When installing connecting rod and piston assemblies, the piston pin must be centered in piston and the rod centered on piston pin. Tighten the pin clamp capscrew 35 to 40 ft. lbs. torque. Install connecting rods to crankshaft with short side of rod bearing toward the nearest main bearing. Tighten the connecting rod cap nuts 35 to 40 ft. lbs. torque. Tighten the pal nuts 40 to 60 inch lbs. torque.

PISTONS

To remove pistons, refer to removal of connecting rods and pistons. To remove piston from connecting rod, place a punch in vise, place piston pin over punch and loosen the piston pin clamp capscrew. Push or drive pin from rod and piston.

149 ENGINE PRIOR TO S/N 6959

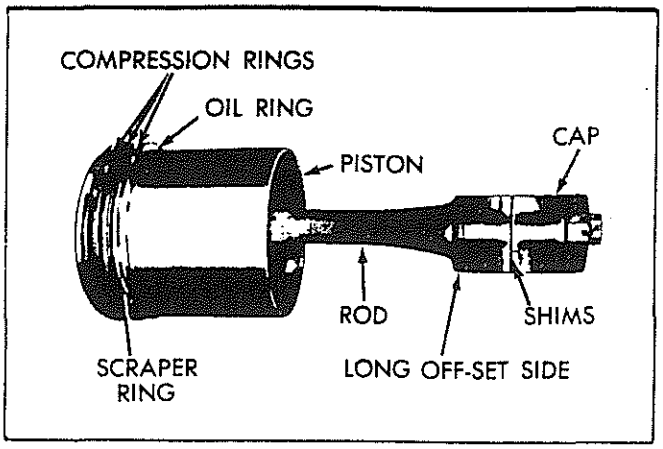
The piston is made from cast aluminum and is cam ground .0085" to .0095". The skirt large diameter is 3.497" at 90° of piston pin bore. The skirt diameter (small) is 3.485" at sides in line with piston pin bore. The piston skirt is tapered, and will measure .0005" to .0015" smaller at top than at bottom. All measurements must be taken at bottom of skirt. All dimensions are for new parts.

The three top compression ring grooves are .1255" to .1256" wide. The fourth oil ring groove is .1875" to .189" wide. The skirt clearance with cylinder liner is .0015" to .003". The piston pin bore is .8139" to .8141".

160 Engine Eff W/S/N-6959

The piston cam ground .0085" to .0095". The skirt large diameter is 3.622" at 90° of piston pin bore. The skirt diameter (small) is 3.613" at sides in line with piston pin bore. The piston skirt is tapered and will measure .0005" to .0015" smaller at top than at bottom. All measurements must be taken at bottom of skirt. All dimensions are for new parts.

The three top compression ring grooves are .0955" to .096" wide. The fourth oil ring groove is .1885" to .189" wide. The skirt clearance with cylinder liner is .0015" to .003". The piston pin bore is .99985" to .99987".



PISTON RINGS

The three top compression rings are alike and should have .009" to .014" end gap when installed in a new cylinder liner.

(149)-Engine Prior to Tr S/N-6959

The oil ring should have .007" to .017" end gap. The compression ring width is .123" to .124" and have a clearance of .0015" to .0035" in groove. The oil ring width is .186" to .1865" and has a clearance of .001" to .003" in groove. Compression rings have a .001" to .0015" tapered face and must be installed with the word "TOP" toward top of piston.

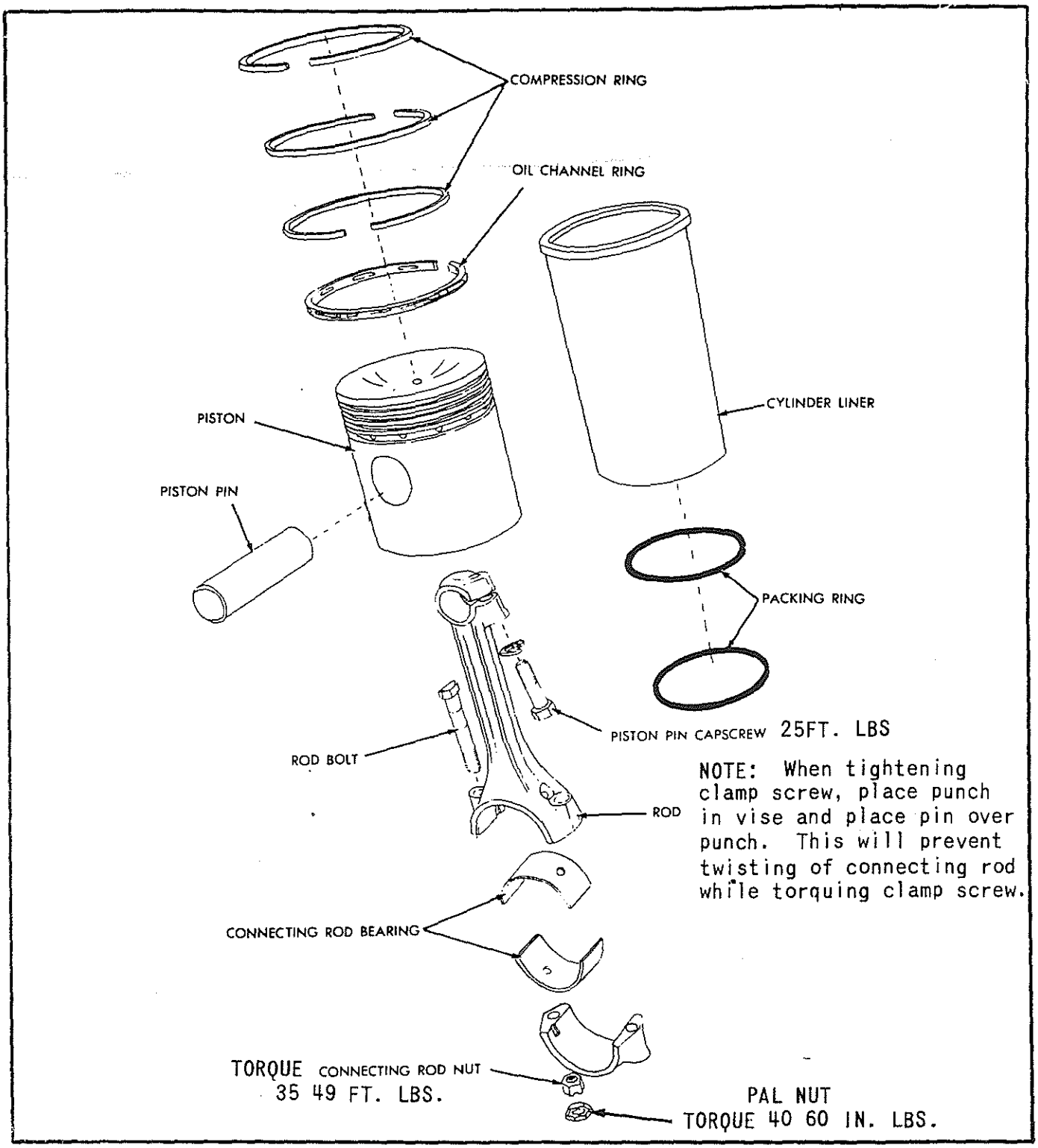
PISTON PIN

The piston pins may be removed after the connecting rods and pistons are removed. To remove piston pins, loosen the pin clamp capscrew in connecting rod and push or drive pin from piston. The piston pin is 2-7/8" in length and .8133" to .8135" in diameter. The pin clearance in piston is .0004" to .0006" with piston pin at room temperature of 70°F.

(160 Cu. in. Engine) Eff W/Tr S/N-6959

The oil ring should have .007" to .017" end gap. The compression ring width is .093" to .0925" and has a clearance of .0015" to .0035" in groove. Compression rings have a .001" to .0015" tapered face and must be installed with the word "TOP" toward top of piston.

PISTON PIN & CONNECTING ROD
149 Engine Prior To SN 6959

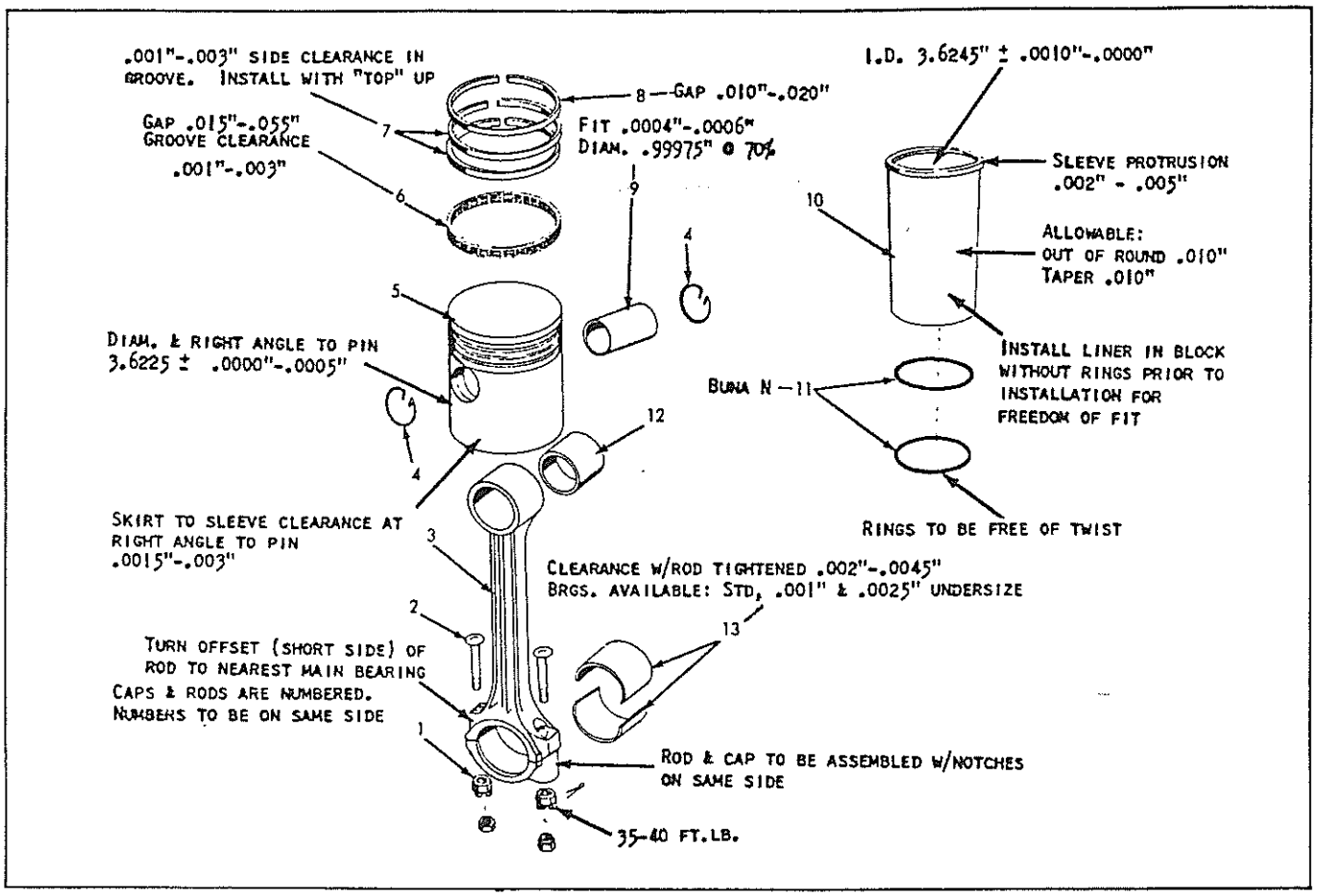


PISTON PIN

The piston pins may be removed after the connecting rods and pistons are removed. To remove piston pins, remove the two snap rings from ends of pin and push or drive pin from piston. The piston pin is 2.973" in length and .99975" to .99973" in diameter. The pin clearance in piston is .0001" to .00014" with piston pin at room temperature of 70°F.

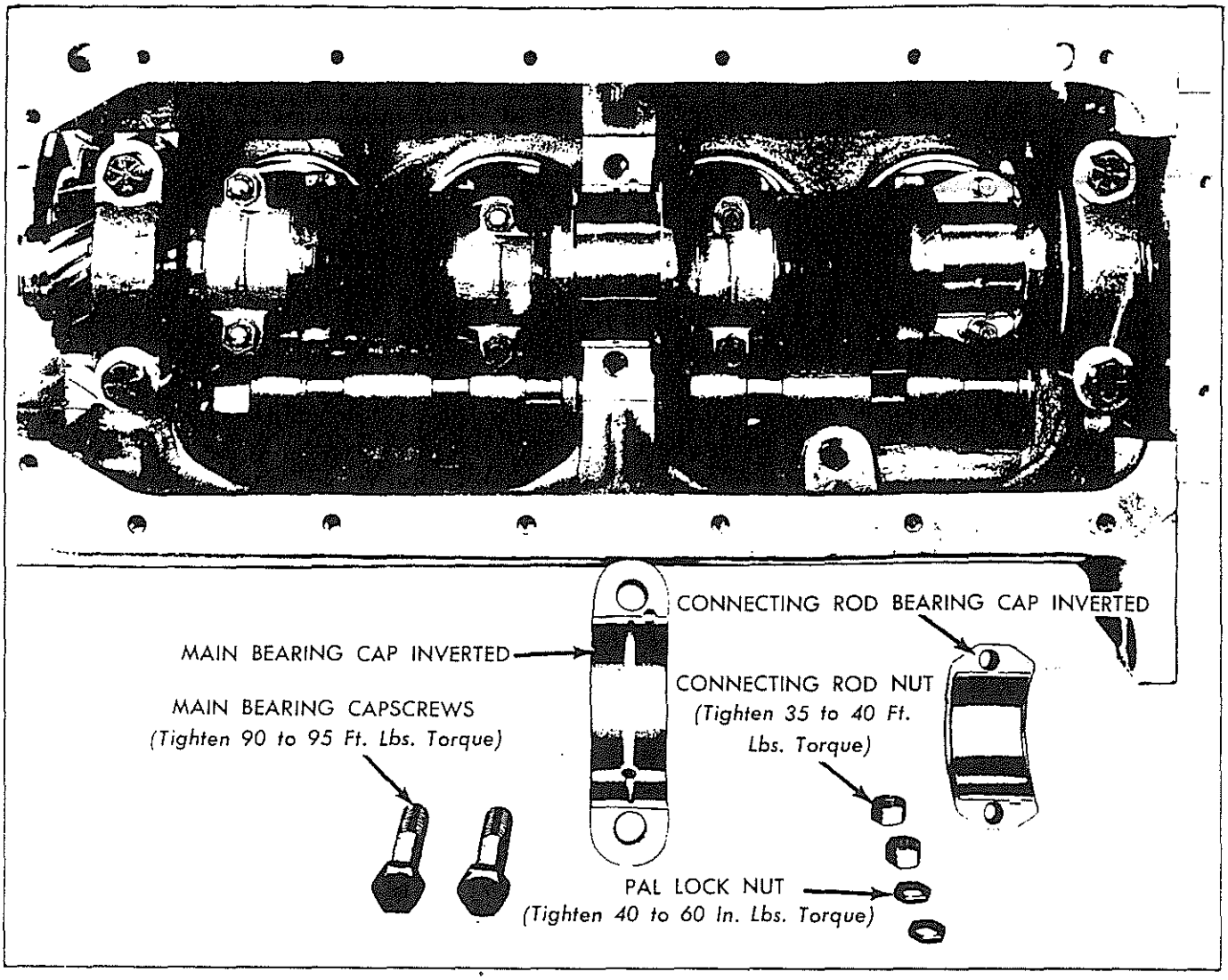
PISTON & CONNECTING ROD

(160 Cu. In. Engine Eff W/Tr S/N-6959



1. NUT, bearing cap bolt
2. BOLT, bearing cap
3. ROD ASSY, connecting
4. LOCK, piston pin
5. PISTON ASSY.
6. RING, channel oil, piston
7. RING, compression, 2nd &3rd
8. RING, compression, top
9. PIN, piston
10. LINER, cylinder
11. RING, packing, cylinder liner
12. BUSHING, piston pin
13. BEARING, connecting rod

CONNECTING ROD BEARINGS



CONNECTING ROD BEARINGS

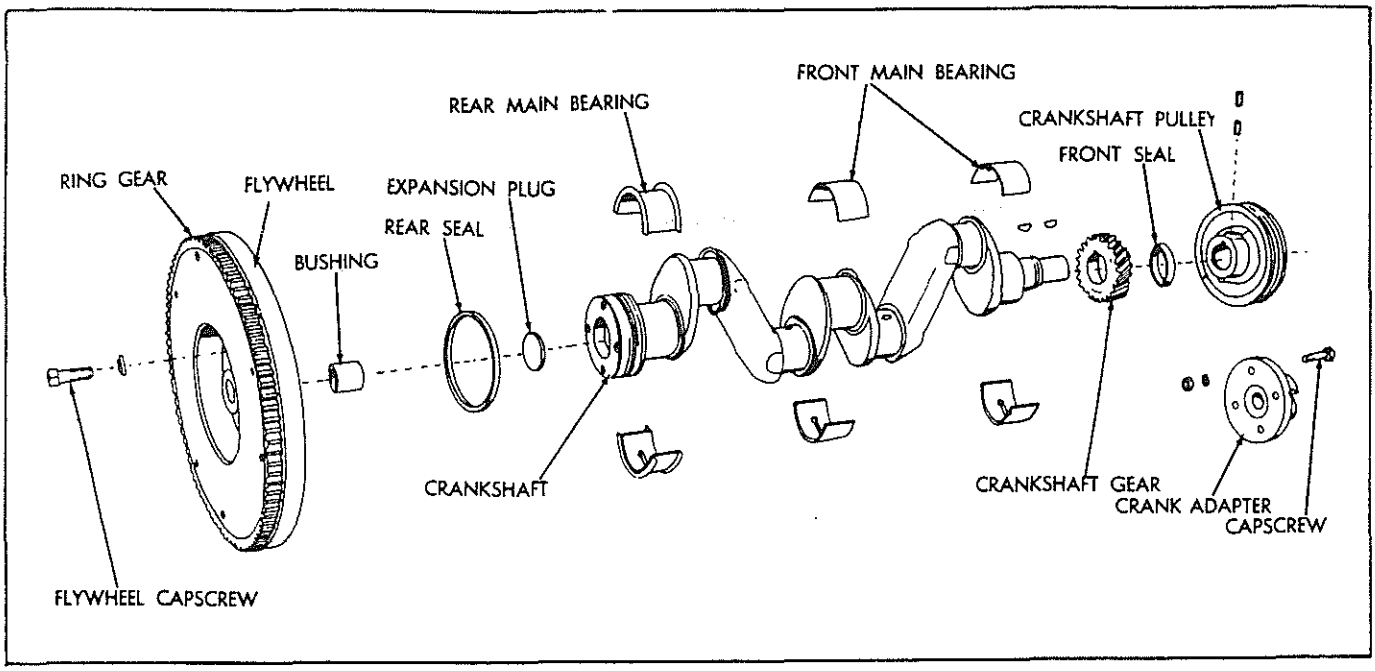
The connecting rod bearings are of the precision replaceable type, and may be replaced after removing the oil sump and connecting rod caps. The bearings are available for service in standard .001" and .0025" undersize, and may be used according to the amount of wear on crankshaft journals.

The connecting rods are offset and are not all positioned alike in the engine. Number one and number three connecting rods are positioned alike. Number two and number four connecting rods are positioned alike. ALL RODS ARE POSITIONED WITH THE SHORT SIDE OF BEARING TOWARD THE NEAREST MAIN BEARING.

The numbers on connecting rods and caps are for proper positioning of caps to rods and to prevent cap from being installed to other than its mating rod. The cap and rod numbers must both be on the same side, also the notches for the bearing inserts will be on the same side of rod.

When installing new connecting rod bearings it is advisable to check the journals for wear to determine if a standard or undersize bearing should be used. The journal diameter of a new crankshaft is 1.936" to 1.937", and the running clearance should be from .001" to .003". Use of PLASTIGAGE is a quick method of determining bearing clearances. Clean parts thoroughly and eliminate all possible dirt when installing bearings. Place a film of engine oil on the journal surface of bearings and

CRANKSHAFT AND MAIN BEARINGS



install them in place in rod and cap, being sure the projecting tank on bearings engages the notches in rod and cap. Tighten the bearing cap bolt nuts 35 to 40 ft. lbs. torque. Tighten the pal lock nut from 40 to 60 inch lbs. torque.

CRANKSHAFT AND MAIN BEARINGS

The main bearings may be replaced from below by removing the engine oil sump. Remove the main bearing caps one at a time, and replace bearings and tighten capscrew before removing the next bearing cap. Thin headed dowels are available for removing the upper half of bearing. These dowels have a tapered head and are inserted into oil hole in bearing journal. Rotate shaft and head of dowel will roll out bearing insert.

Main bearings are available for service in three sizes, which are standard, .001" and .0025" undersize. Use the size bearing that will give a running clearance from .002" to .004". The main bearing journals are 2.748" to 2.749" on a new shaft. The crankshaft end play is controlled by the rear flanged main bearing.

End clearance with new shaft and bearings should be from .004" to .008".

If the crankshaft is to be replaced, it will be necessary to remove engine from tractor and remove timing gear cover as explained under subject headings of ENGINE ASSEMBLY-REMOVAL, and TIMING GEAR COVER-REMOVAL. Remove clutch, flywheel and the rear seal retainer.

When installing new main bearing inserts, apply a film of oil on journal side of bearings. Install so that projecting tank on bearing engages with notch on cylinder block and bearing cap. Install bearing caps so that both notches are on the same side of bearing. Tighten the main bearing capscrews from 90 to 95 ft. lbs. torque.

CRANKSHAFT FRONT OIL SEAL

REMOVAL

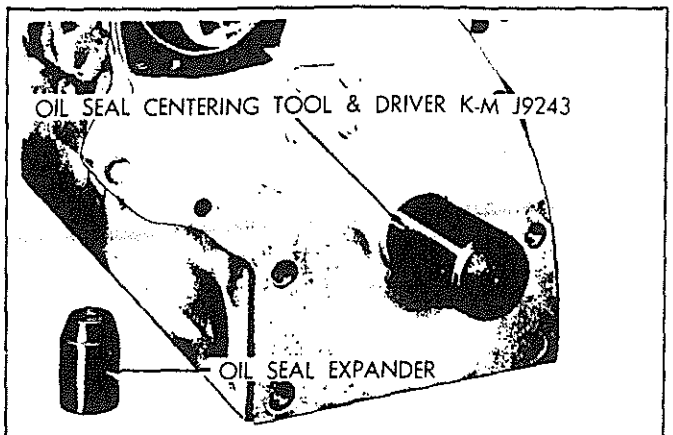
To replace the front crankshaft oil seal, it will be necessary to remove the timing gear cover. Drain engine oil and remove the oil sump. Drain cooling system and remove hood, radiator shell and radiator. Support tractor and remove the front support. Remove the front engine support. Remove the fan belt and fan blades.

Remove the two Allen head setscrews from crankshaft pulley hub, and remove pulley from crankshaft. Disconnect the governor control rod from lever at governor housing. Disconnect carburetor link rod from governor cross shaft. Disconnect the oil tubes at top of governor housing. The governor housing may be removed with timing gear cover, or removed separately. Remove timing gear cover from front of engine block. Drive oil seal from timing gear cover.

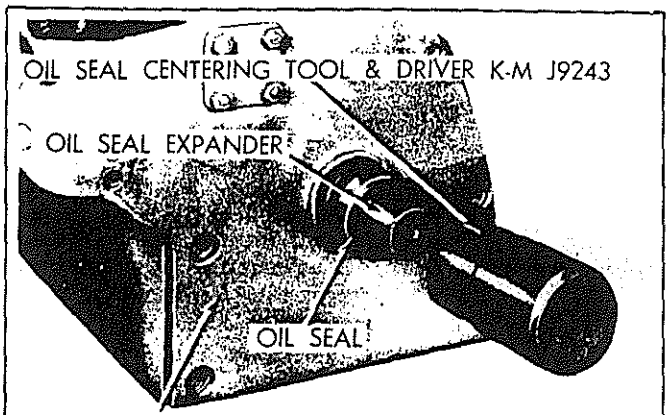
ASSEMBLY

Clean off any old gasket or foreign matter from gasket surface of engine block or timing gear cover. Shellac new gasket and install to engine block. Install timing gear cover, leaving the capscrews loose. Place the oil seal centering tool K-M J-9243 over end of crankshaft and pilot into gear cover to center cover with crankshaft. Tighten capscrews and remove the centering tool. Torque all 5/16" capscrews in governor housing and timing gear cover 15 to 20 ft. lbs.

Place the oil seal expander in place over end of crankshaft. Lubricate lip of seal and seal expander. Place oil seal over seal expander, and apply a coat of sealer to outside surface of oil seal. Use the centering and driving tool K-M J-9243 for driving the seal into place in gear cover.



INSTALLING TIMING GEAR COVER

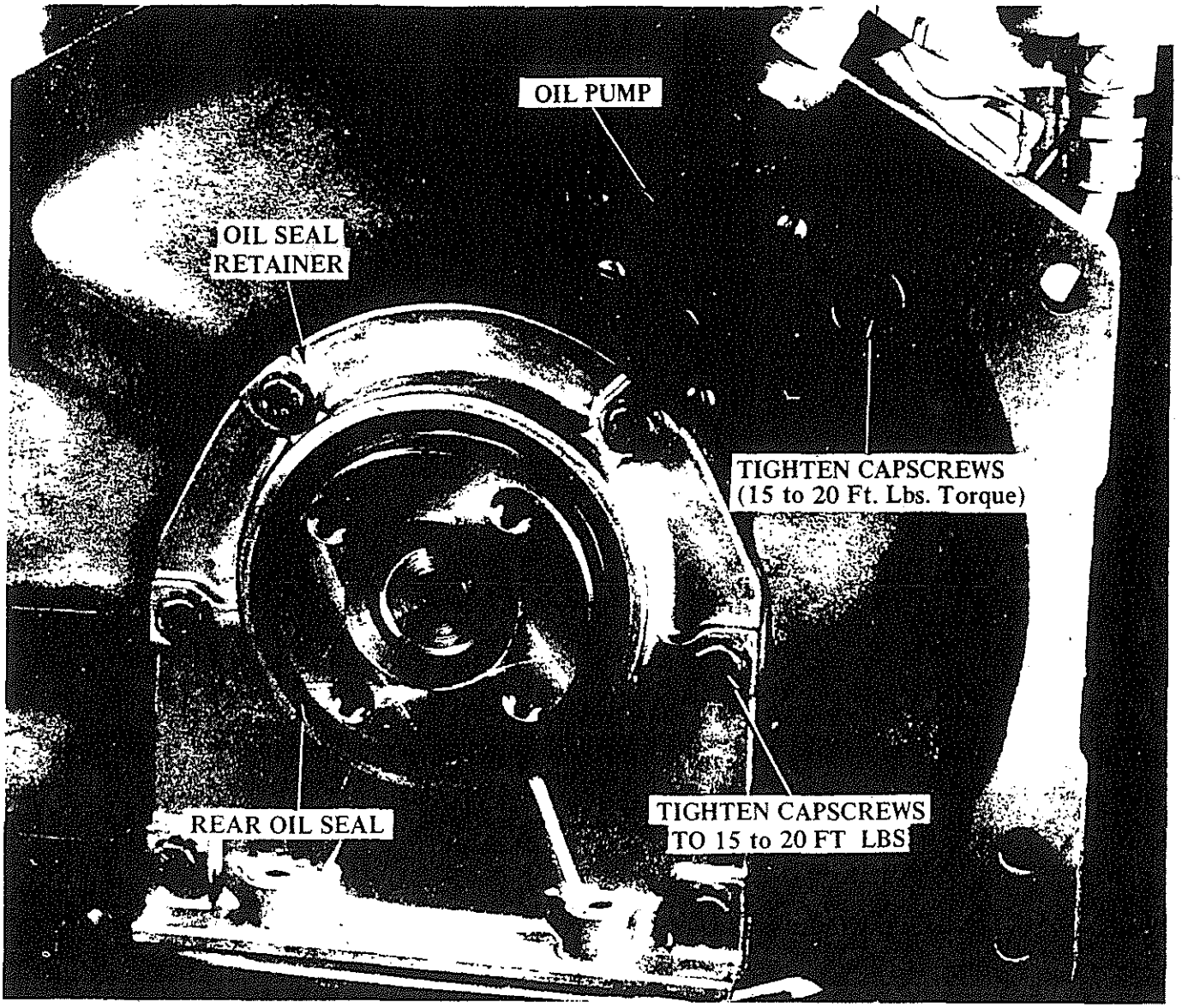


INSTALLING CRANKSHAFT OIL SEAL

Install front engine support and tighten the 5/8" capscrews 80 to 85 ft. lbs. torque. Install crankshaft pulley and tighten the two Allen setscrews 20 to 25 ft. lbs. torque. Install governor housing and tighten capscrews 15 to 20 ft. lbs. torque. Install fan blades and tighten capscrews 15 to 20 ft. lbs. torque. Install fan belt and adjust.

Install the engine oil sump and replace engine oil. Install the front support assembly. Install radiator and shell. Refill cooling system. Connect oil lines and governor linkage. Replace hood.

CRANKSHAFT REAR OIL SEAL



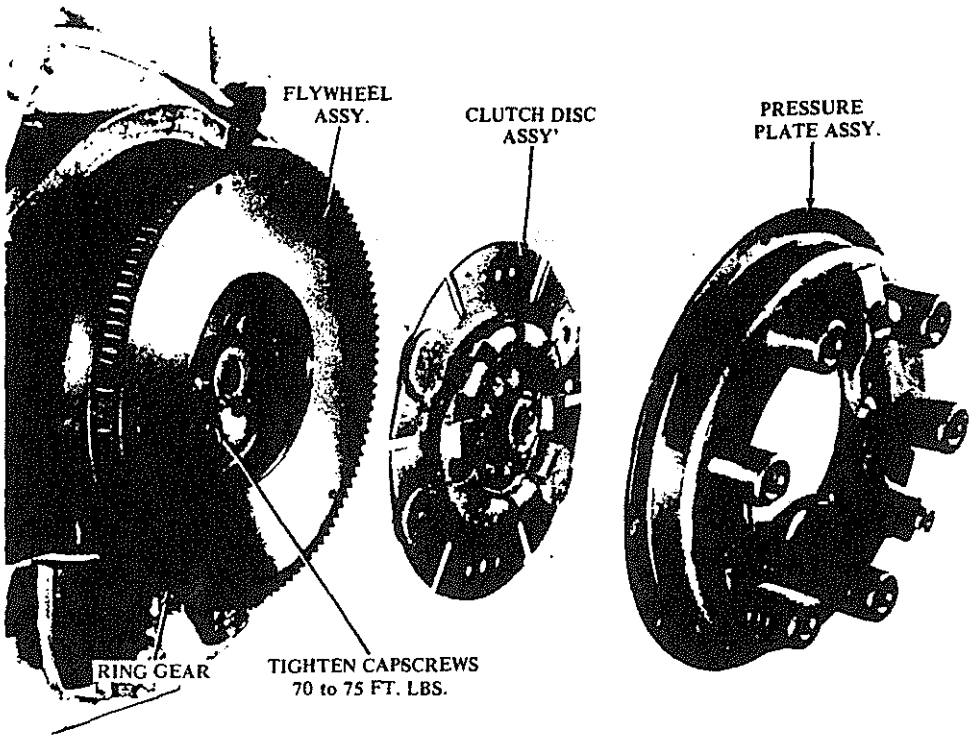
CRANKSHAFT REAR OIL SEAL

REMOVAL

To remove the rear oil seal it will be necessary to remove engine, remove clutch, flywheel and oil sump. The rear oil seal is located in a seal retainer attached to rear of cylinder block. Remove the seal retainer and press or drive seal from retainer. Clean retainer of all sealer. Apply sealer to outside diameter of seal and press into place in seal retainer. The seal has two lips; the shorter, outer lip, is sort of a wiper to prevent dirt from entering the inner lip. Install seal with the longer lip toward engine.

Apply sealer to seal retainer and cylinder block. Use a new gasket and install seal retainer. Apply lubriplate to inside diameter of seal and to the flange end of crankshaft. Center seal over end of crankshaft and press retainer into place on block. Install capscrews and tighten 15 to 20 ft. lbs. torque.

FLYWHEEL



FLYWHEEL & CLUTCH ASSEMBLIES SEPARATED

FLYWHEEL

REMOVAL

Remove engine as outlined under engine removal. Remove the six capscrews attaching the pressure plate assembly to the flywheel and remove the pressure plate assembly and clutch disc. Remove capscrews attaching the flywheel to the crankshaft flange and remove flywheel.

INSPECTION

Check the clutch shaft bushing in flywheel for wear, replace if worn.

Check fit to clutch shaft after installing bushing in flywheel. Check the clutch lining for wear. The flywheel assembly includes a bushing to pilot the end of clutch shaft, and is replaceable if excessive wear occurs. The flywheel ring gear has 116 teeth and is also replaceable if gear becomes damaged. The old ring gear may be driven from flywheel, but a new one must be heated and expanded until it can be positioned on flywheel without excessive driving. Shrinking the gear onto flywheel causes it to become tight and firmly fixed. Install ring gear with beveled edge of teeth rearward.

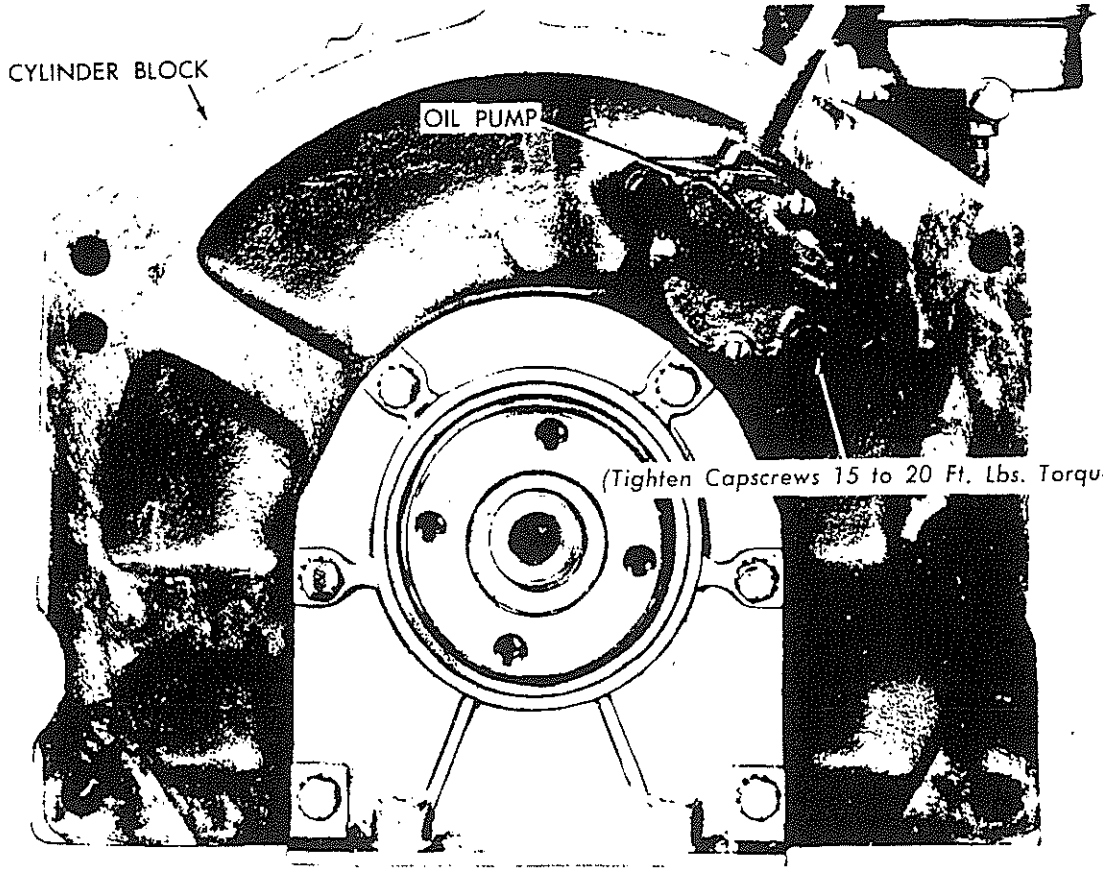
When installing flywheel to crankshaft, special positioning is not necessary, as the holes are not equally spaced and flywheel can be attached in only one position. Tighten the flywheel capscrews (7/16" diameter) 70 to 75 ft lbs. torque.

ASSEMBLY

Install the clutch disc assembly with the smooth side toward the flywheel, or the side with the longer hub and dampener springs toward the pressure plate, using tool for centering disc assembly to flywheel

Install the pressure plate assembly over disc assembly and tighten the retaining capscrews evenly Torque 17 to 20 ft. lbs.

OIL PUMP



OIL PUMP

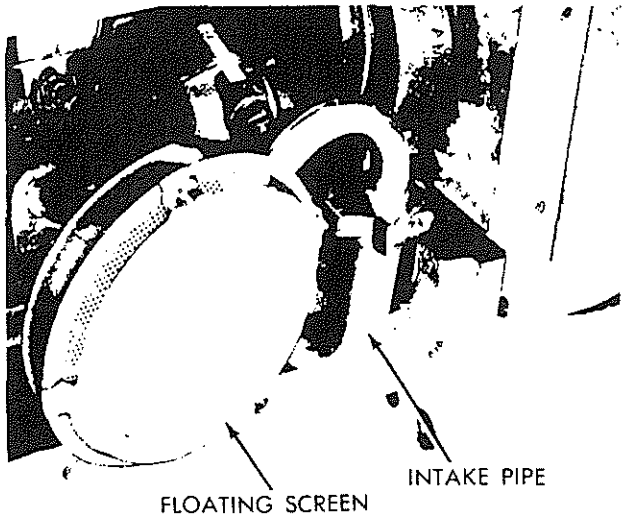
REMOVAL

To remove the oil pump it will be necessary to remove engine from tractor and remove the clutch and flywheel. Remove the three screws (5/16" x 1/2") attaching oil pump to cylinder block and remove pump.

Remove spring retaining pin, check valve spring and ball if used, check valve from hollow rotor shaft.

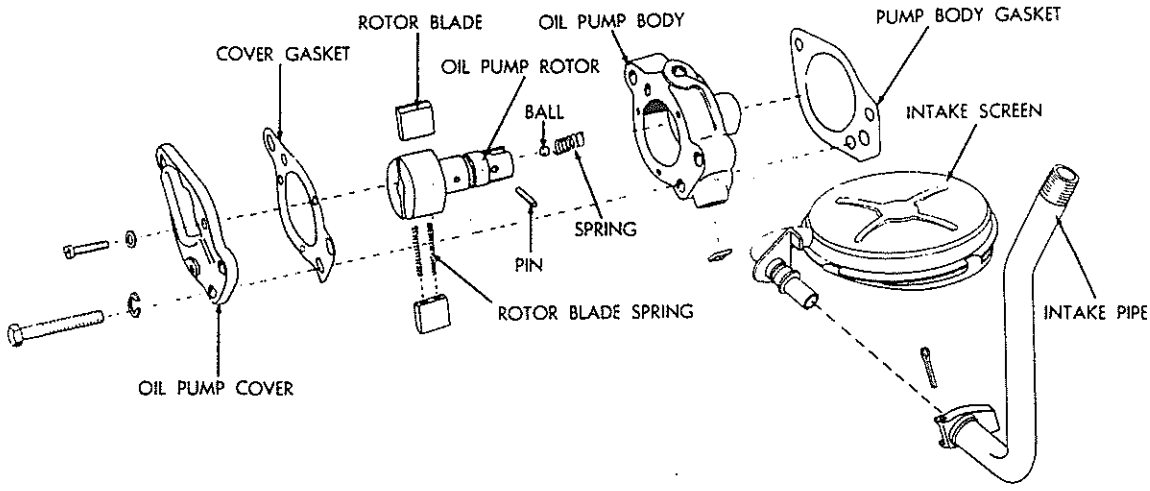
Remove cover at rear of pump body. Push rotor shaft rearward until rotor blades are partly out of pump body, then grasp rotor, with thumb and forefinger holding the blades into position, and pull rotor from body. Carefully remove the blades and springs from rotor.

Check the pump drive pin in end of camshaft for wear or looseness, and replace if necessary. If this drive pin must be replaced, it will be necessary to remove camshaft, refer to instructions under CAMSHAFT AND GEAR - REMOVAL. The rotor end clearance should not exceed .002".



OIL PUMP INTAKE SCREEN

Side clearance between rotor and body at tight side should not exceed .004". The blades should fit in slots of rotor snugly and yet free enough to slide freely. The blades should be exactly flush with rear surface of rotor when rotor and blades are in place in body. Check for air leaks between oil intake pipe and oil pump.



OIL PUMP

ASSEMBLY

Install the two springs and rotor blades in slot of rotor. Use caution and do not kink the springs when compressing the blades together. Install blades with the tapered edge leading in a counterclockwise direction when viewed from the drive end. Holding the blades compressed, and in position in rotor with the thumb and forefinger, install the rotor assembly into place in pump body.

Install gasket and cover. If the rotor end clearance exceeds .002", using only one gasket, dress the face of pump body with valve grinding compound or fine emery cloth, placed on a flat surface or face plate.

Install check valve ball, valve spring and spring retaining pin in hollow rotor shaft.

When installing pump to cylinder block, be sure to align the slot in end of rotor shaft with the drive pin in end of camshaft. Tighten the retaining capscrews 15 to 20 ft. lbs. torque.

OILING SYSTEM

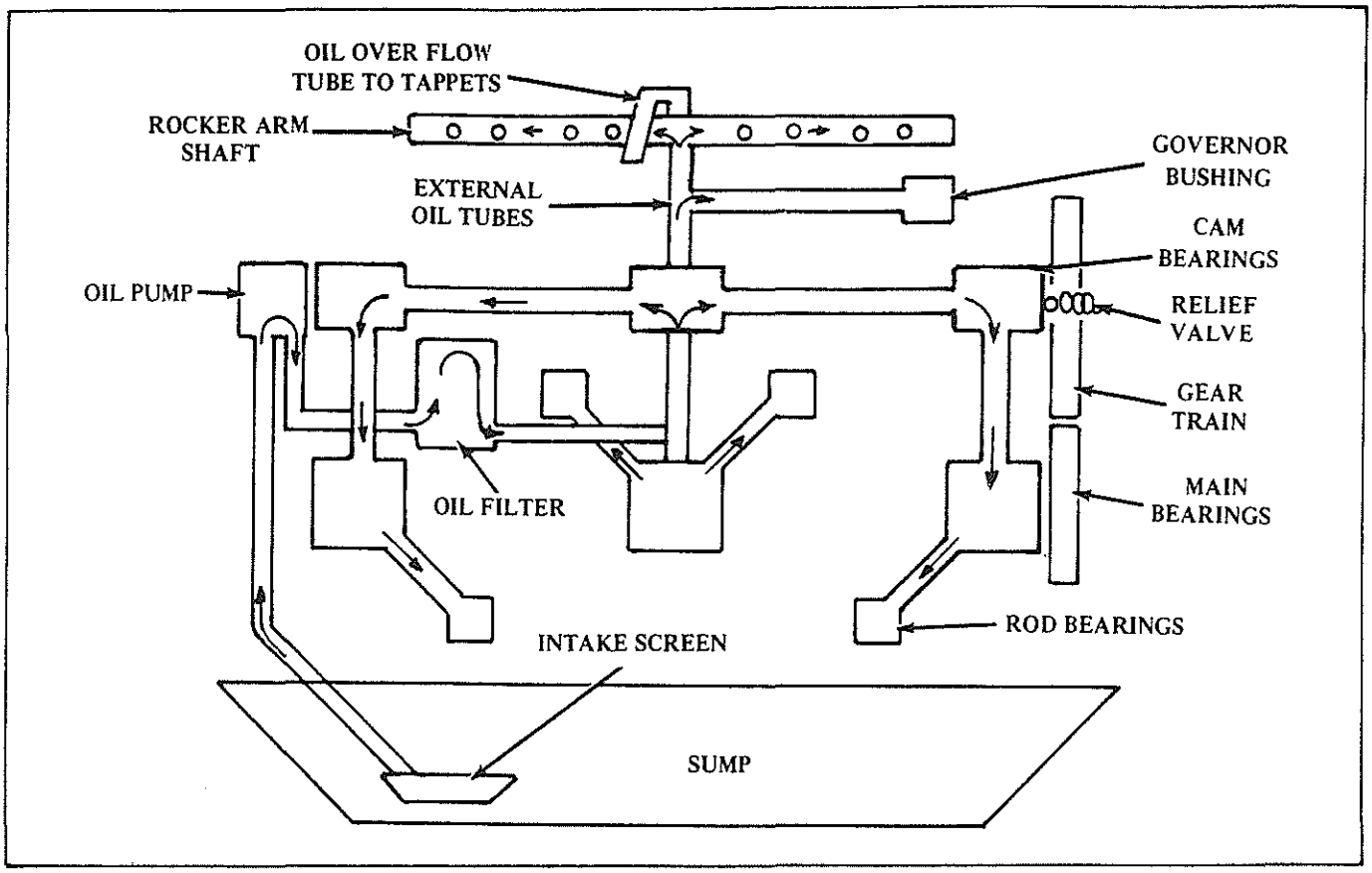
A vane type oil pump is mounted at rear of cylinder block, and is driven from rear end of camshaft. Oil is drawn from oil sump through a floating screen and intake pipe leading to a cored passage in cylinder block. This cored passage is connected to the inlet port of pump.

As the pump rotates, it pressurizes and discharges oil to inner connection of oil filter. As the oil passes through the filter, it flows through a tube leading from center of filter base to an oil passage at side of cylinder block This oil passage is connected to passage leading from center camshaft bushing to center main bearing.

At this point oil is free to flow under pressure to center camshaft bushing, through hollow camshaft to front and rear camshaft bushings. An oil groove in camshaft bearing journals permits oil to flow from holl shaft to passages in bushings leading to main bearings.

The oil pressure relief valve is located at front end of camshaft. Oil passing through this valve lubricates the timing gear train and returns to oil sump. The pump rotor shaft has a ball check valve with a light spring. The oil pressure in camshaft pushes against this check valve which helps to keep it closed, causing the volume of oil from pump to flow through oil filter before entering engine. On cold starts this check valve momentarily by-passes oil until pressure is established in camshaft.

OILING SYSTEM



Oil flow from front camshaft bushing passes through a passage to front main bearing. The crankshaft is drilled leading oil from front main bearing to number one connecting rod. An oil passage from center camshaft bushing feeds oil to center main bearing. The crankshaft is drilled so that oil is fed to number two and three connecting rods. An oil passage from rear camshaft bushing feeds oil to rear main bearing. The crankshaft is drilled feeding oil from rear main bearing to number four connecting rod. The cylinder liners and pistons are lubricated by splash.

An outside oil tube attached to cylinder block feeds oil from center camshft bushing to cylinder head, lubricating the rocker arms and valve mechanism. The overflow of oil returns down through the push rod openings and lubricates the valve tappets and cam lobes. Another outside oil tube feeds oil to the governor housing and distributor drive housing. This oil returns through the timing gear compartment to the oil sump. An oil tube is connected at rear of filter base to the oil pressure gauge.

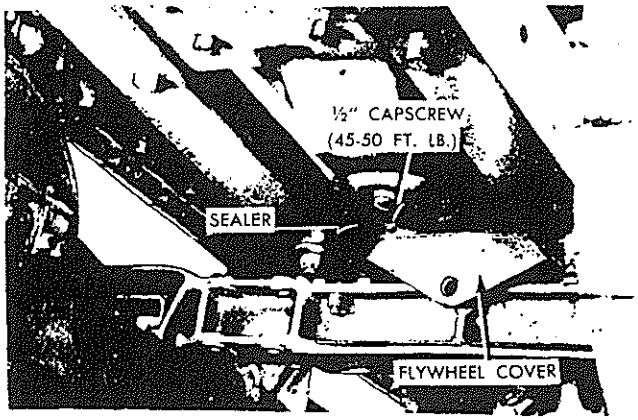
OIL SUMP

REMOVAL

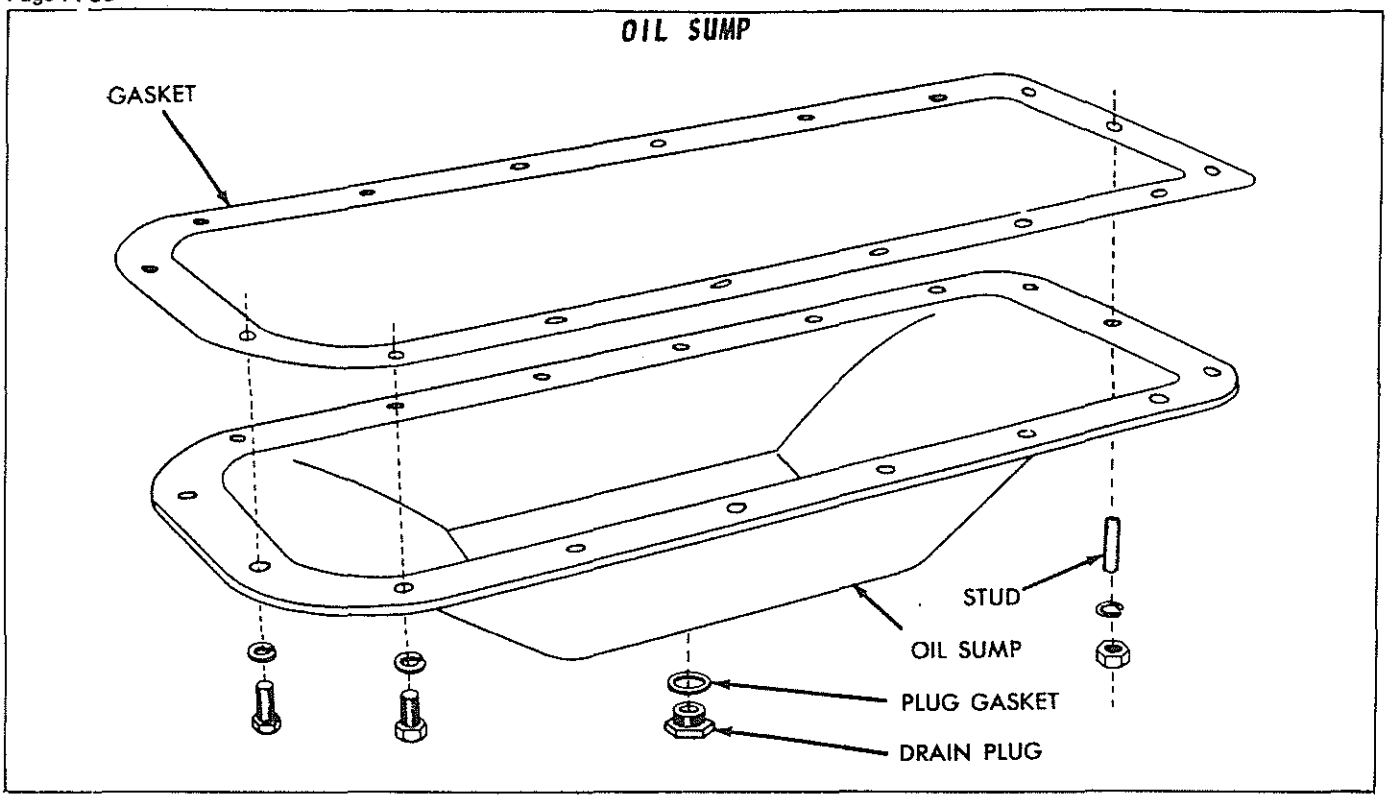
To remove the oil sump it is necessary to remove the lower flywheel cover. Remove the capscrews and nut retaining sump to cylinder block and remove the oil sump.

ASSEMBLY

When installing the oil sump, remove the old gasket and shellac a new gasket to the oil sump. Tighten capscrews and nut 15 to 20 ft. lb. torque. The flywheel cover has slotted holes for the capscrews. Use a sealer supplied by 3M-EC 1184 under part



OIL SUMP



921314 to seal the flywheel shield to the housing and to oil sump. Apply a reasonable amount of sealer to top edge of shield and around the ends and back edge. This must be done to prevent water, mud, and dust from entering clutch housing.

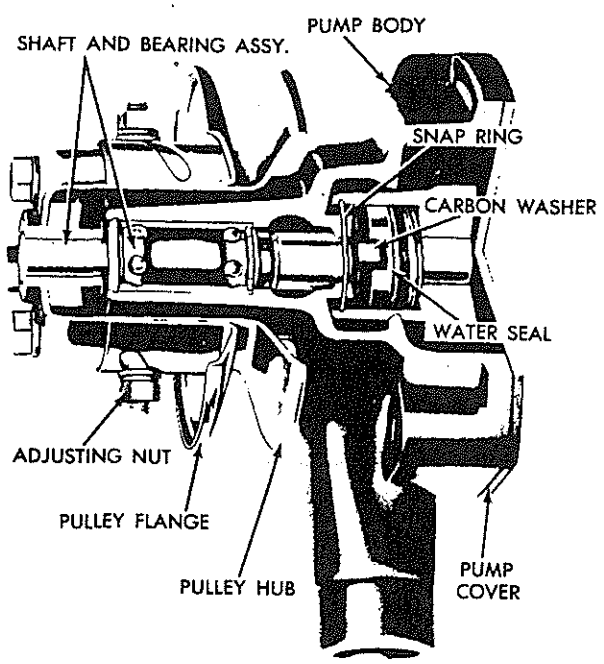
This sealer should be used anytime the flywheel cover is removed and replaced. The sealer is a special compound for sealing metal to metal seams throughout industry. After the sealer is applied, push the cover up as far as possible and tighten the capscrews 45 to 50 ft. lbs. torque.

WATER PUMP

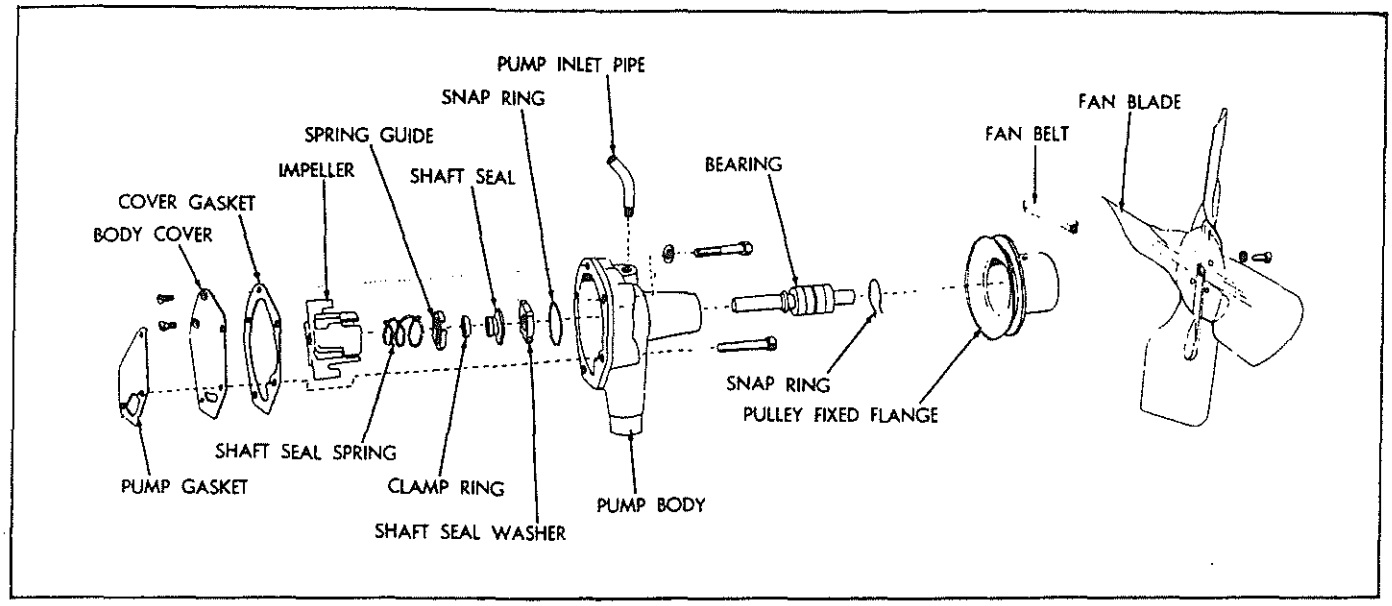
WATER PUMP - REMOVAL

Drain cooling system and remove hood, radiator shell and radiator. Refer to subject items for removal information. Remove the lower hose connection from water pump. Remove the by-pass hose from pump and thermostat housing. Loosen generator and remove fan belt. Remove the four capscrews attaching fan and pulley to fan hub and remove fan and pulley. Remove the three capscrews attaching water pump to cylinder block and remove water pump assembly.

To disassemble pump for inspection or replacement of parts, remove the cover plate from rear of pump body. Using a suitable puller, remove the impeller from rear of shaft. The water pump seal assembly is installed in the hub of impeller, and can be removed by removing the retaining snap ring. Remove all rust and corrosion from impeller or replace if damaged.



WATER PUMP



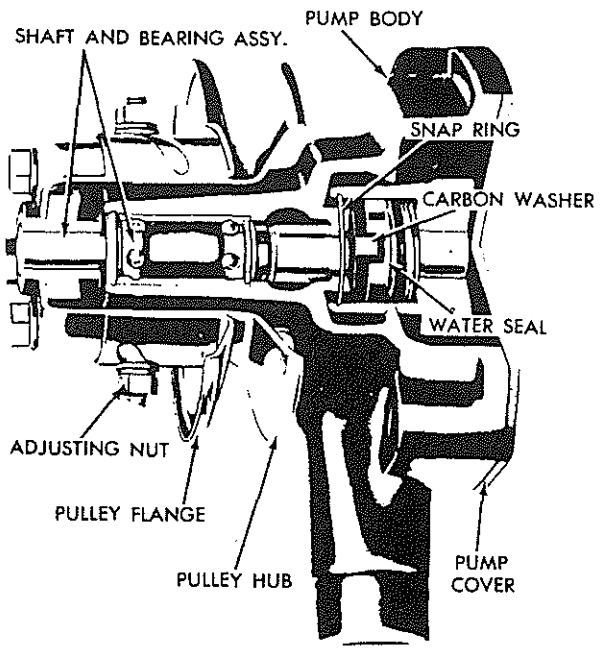
Using a suitable puller, remove the hub at front of pump shaft. Remove snap ring at front of pump body and press the shaft and bearing assembly from front of pump body. Check the seal surface in pump body. If rough or pitted this surface must be refaced with special grinding equipment or the pump body replaced. If this surface is rough the carbon seal will fail and leak and the repair job will be unsatisfactory.

All pump parts are serviced as individual items and may be ordered as required. A pump repair kit is also available. This kit contains all the seal parts including seal spring, all snap rings and gaskets. These are the parts most commonly needed when rebuilding a pump. If the shaft and bearing assembly is in need of replacement, it must be obtained separately as it is not included in the repair kit.

ASSEMBLY

Press the shaft and bearing assembly into pump body and install the retaining snap ring. Install the fan hub with the longest chamfered end forward, press on until flush with end of shaft.

Install the clamp ring over end of rubber seal. Install all seal parts into impeller, starting with the spring, spring guide, rubber seal and carbon washer. Press downward on carbon washer and install the retaining snap ring. Press impeller on shaft until rear surface of impeller is approximately 1/32" past flush of pump body at gasket surface. Use caution not to cock the impeller while installing as this could damage the carbon seal. Install gasket and cover plate.



Install pump assembly to cylinder block, using a new gasket and tighten the three retaining capscrews 25 to 30 ft. lbs. torque. Install pulley and fan to fan hub and tighten the four retaining capscrews 15 to 20 ft. lbs. torque. Install fan belt and adjust belt tension. Install the lower radiator hose connection, radiator and radiator shell. Fill cooling system and check for leaks.

THERMOSTAT

THERMOSTAT - REMOVAL

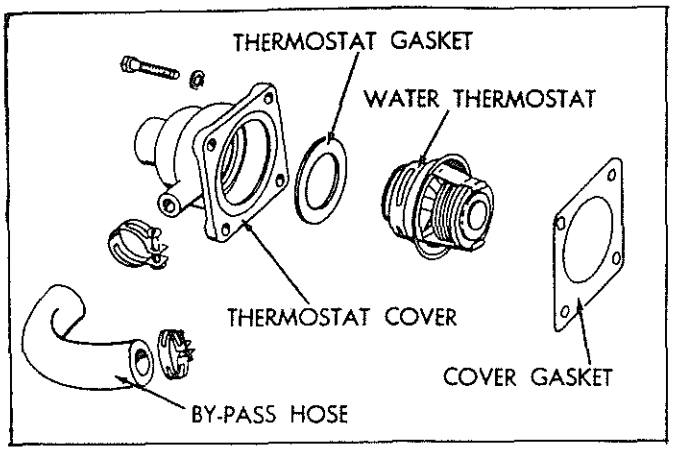
Drain the cooling system, engine block and radiator. Remove the hood side pieces. Remove the upper radiator hose and the thermostat by-pass hose. Remove the four capscrews attaching thermostat housing to cylinder head and remove the housing and thermostat.

The thermostat used in gasoline tractors should have an opening temperature of 160° F. Another thermostat is available and has an opening temperature of 180°F. and may be used for cold weather operation.

INSPECTION

In most cases a defective thermostat can be detected from a visual inspection, but if in doubt as to its operation, it may be checked by placing it in a container of water, in which the temperature of the water can be controlled.

Place the thermostat and a thermometer in the container of water on a small wood block. As the temperature of the water reaches the opening temperature stamped on the thermostat, the thermostat valve should start to open.



ASSEMBLY

Install the housing gasket in place on cylinder head. Place the gasket (thermostat to housing) at top of thermostat and place thermostat to cylinder head with the bellows end downward and one of the by-pass opening to the R.H. side of engine so as to align with the by-pass outlet on housing. Place the housing over thermostat with the by-pass connection toward R.H. side of engine and attach to cylinder head with the four capscrews. Tighten capscrews 15 to 20 ft. lbs. torque. Attach the by-pass hose and the upper radiator hose. Refill cooling system. Install hood side pieces.

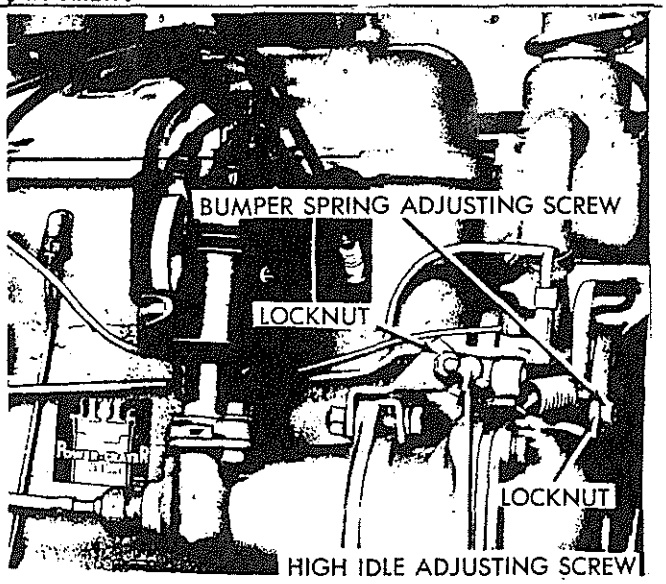
GOVERNOR ADJUSTMENT

GOVERNOR Eff W/ H-3-6959

ADJUSTMENT

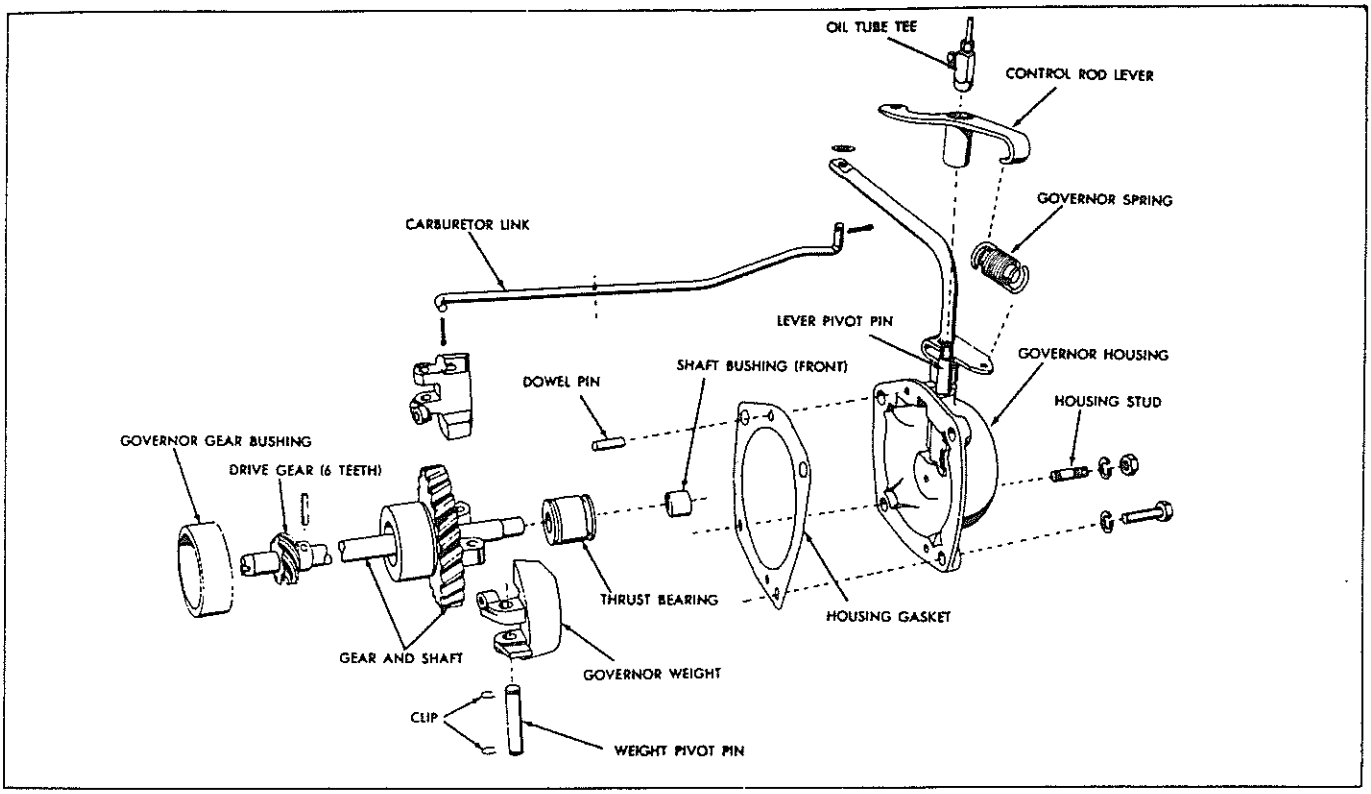
To obtain maximum performance from the engine it is necessary that the engine speed and governor linkage be properly adjusted and free of binding. Check the carburetor link rod and governor cross shaft for proper adjustment. Check for interference between governor spring lever and the bumper spring bracket.

With engine stopped, open throttle lever half way on quadrant and disconnect the carburetor link rod at governor cross shaft arm. Hold the link rod fully forward so that the throttle shaft on carburetor is in the wide open position. At this time the link rod should be 1/16" too short to connect with the governor cross shaft arm.



If the link rod and cross shaft adjustment is not as prescribed above, it will be necessary to bend the governor cross shaft to obtain this 1/16" dimension. A special tool

GOVERNOR

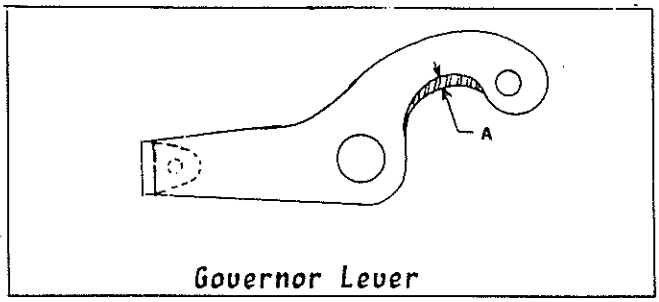


is available for adjusting the governor cross shaft arm. With linkage properly adjusted proceed with the engine speed adjustments.

To adjust the high and low idle speeds of engine proceed as follows: Loosen lock nut and remove the bumper spring screw. Start engine and adjust the high idle speed by properly setting the high idle stop screw located at rear of the control rod lever at side of engine. Use an electric tachometer for checking engine speeds. H-3 Crawler Tractors Eff with S/N-6959 to 8694, the high idle is 1850-1900 RPM's. Eff with S/N-8694 and up the high idle is 2030 to 2060 RPM's.

Close throttle and adjust the low idle speed from 500 to 575 R.P.M. by properly setting the throttle stop screw on carburetor. Stop engine and install the bumper spring screw and lock nut. With throttle closed, bring the bumper spring into contact with the stop on lever, then compress spring with approximately 1-1/2 turns of bumper spring screw and tighten lock nut. When the bumper spring screw is turned 1-1/2 turns after contact with the stop it should add approximately 35 R.P.M.'s to the high idle.

If speed is in excess of this figure repeat the adjusting procedure. If the bumper spring screw is turned in too far the speed will be too fast and a false high idle speed reading will be obtained. It is only necessary to turn the bumper spring in far enough to reduce surging. The speeds should be set after the engine is warmed up and the carburetor properly adjusted.



Governor Lever

If the above speeds cannot be obtained, grind approximately 1/8" from the governor lever as shown at area "A" in sketch. This will avoid interference with the governor lever (part of housing). Replace the high idle stop screw 1/4" x 1-1/4" with 1/4" x 3/4" placing the lock nut on the back side of bracket. This will give enough spring range to obtain the correct speeds.

GOVERNOR REMOVAL

GOVERNOR - REMOVAL

To remove the governor assembly, it will be necessary to retime the distributor, therefore remove the distributor assembly from the drive housing. Remove hood, radiator shell and radiator. Disconnect the carburetor link rod from governor cross shaft and disconnect governor control rod from lever at governor housing. Disconnect the oil tubes from governor housing. Remove capscrews and nut attaching governor housing to timing gear cover and remove governor housing. Remove the governor assembly, gear and shaft through opening in timing gear cover.

To remove the governor weights, remove spring clip from one end of weight pivot pin and remove pivot pin. The governor gear and shaft is furnished only in an assembly, therefore it is not necessary to remove gear from shaft. The distributor drive gear (6 tooth) is replaceable and is retained to shaft with a pin. The front shaft bushing located in the governor housing may be replaced if necessary. If the governor fork that contacts the thrust bearing is worn excessively, or any other part of the housing assembly is worn, the complete assembly should be replaced.

The rear shaft bushing is replaceable and is located in the distributor drive housing. The governor gear hub diameter is 1.748" to 1.749". The gear bushing inside diameter is 1.751" to 1.752", giving a running clearance of .002" to .004" with new parts. If clearance exceeds .006 replace bushing. Check thrust bearing for wear or binding; the thrust face must rotate freely on bearing assembly. Install thrust bearing with the thrust face forward.

GOVERNOR OPERATION

OPERATION

The purpose of the governor is to provide a mechanical means of controlling the engine speed under varying load conditions. Without a governor the engine speed would decrease as the load increased and would increase as the load decreased.

The governor has the ability to both open and close the throttle depending on load conditions. The limits of the governor are from low idle to high idle, or the maximum horsepower at rated speed. The rated horsepower of an engine is the maximum load it can pull and still maintain rated speed.

In this condition the throttle valve is wide open and the engine is receiving the maximum amount of air and fuel. From this it can be seen that the governor cannot provide more action or power once the engine reaches full load or the speed falls off due to an overload.

The governor consists of a pair of hinged weights which act against a thrust bearing and linkage to which a spring is attached. The linkage in turn is attached to the throttle valve of the carburetor.

The governor operates on the well known laws of physics.

1. For every force there is an equal or opposing force acting in the opposite direction. (Governor weights against governor spring.)

2. When two forces are equal, no movement takes place.

3. Centrifugal force. The force which tries to keep all objects moving outward from a center of rotation.

The governor makes use of these facts by combining the centrifugal force of the revolving weights to act against the force of the governor spring.

Movement of the governor is caused by increasing or decreasing the speed of the weights which is affected by increasing or decreasing loads on the engine. The movement of the governor is always in the direction of the greater force toward the smaller force.

The throttle is held in position in direct relation to the position of the weights. The two forces acting on the throttle working in opposite directions are the weights which are always trying to close the throttle and the spring which is always trying to open the throttle.

The hand control lever simply increases or decreases the tension on the governor spring.

The position of the control lever and the amount of tension on the governor spring is selected by the operator and determines the speed the governor will maintain.

The governor spring is fitted with a plunger which forces the governor cross shaft and weights to the idle position when the control lever is placed in the idle position.

TIMING THE ENGINE

TIMING BY FLYWHEEL

This indicates number one piston is coming up on its compression stroke and the dead center line mark on flywheel is approaching the timing hole. The first mark to appear will be the fire mark, identified by "F-25" and is 25° ahead of the dead center mark The dead center mark is identified by the word "center" above line mark.

With the dead center mark on flywheel in center of timing hole in L. H. side of torque housing, install distributor to the drive housing. With the point gap set at .022", position the distributor rotor toward number one plug wire position and enter distributor assembly into drive housing with the primary lead terminal rearward and slightly away from engine. With distributor in place, install the two clamps and capscrews. Rotate distributor until points have just separated and tighten the clamp capscrews to 25 ft. lbs. torque.

Install dust cover and distributor cap. Install number one plug wire in front position of cap. Proceed clockwise with number two, number four, and number three plug wires. Install coil wire at center of cap.

To check the distributor timing, the High Idle must be checked first (refer to Governor adjustment). After the High Idle has been established and Bumper Spring properly adjusted, proceed and check or adjust the distributor timing.

With a timing light (power timing light preferred) operate the engine at High Idle.

The fire mark "F-25" should appear in center of timing hole. If not, loosen clamps and rotate distributor right or left until the fire mark on flywheel is in center of timing hole.

FRONT CRANKSHAFT PULLEY TIMING

If tractor is equipped with loader or some equipment that covers the timing hole in front R. H. side of torque housing, it will be necessary to use the crankshaft pulley and arrow on front timing cover to time the engine properly.

To time the distributor assembly to engine, proceed as follows: Remove number one (front) spart plug and place thumb in spark plug opening, rotate engine until air is forced past thumb.

This indicates number one piston is coming up on its compression stroke and the timing mark on crankshaft pulley is approaching the timing pointer. This mark will be 25° ahead of the top dead center. Rotate crankshaft until setscrew in back side of crankshaft pulley is directly on top. When this setscrew is on top, the piston will be on top dead center.

With setscrew on top center install distributor to the drive housing. With the point gap set at .022", position the distributor rotor toward number one plug wire position and enter distributor assembly into drive housing with the primary lead terminal rearward and slightly away from engine. With distributor in place, install the two clamps and capscrews. Rotate distributor until points have just separated and tighten the clamp capscrews to 25 ft. lbs. torque.

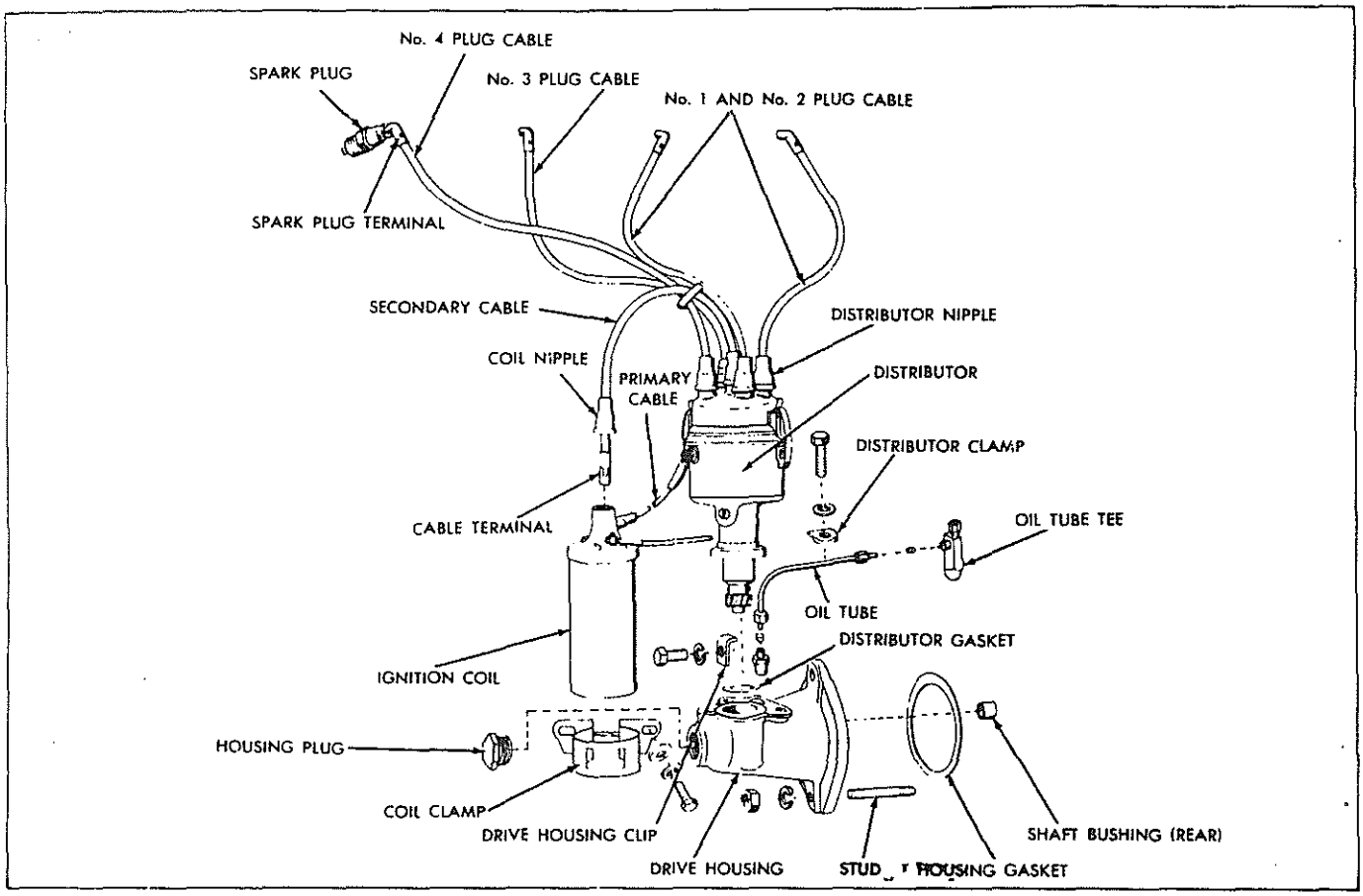
Install dust cover and distributor cap. Install number one plug wire in front position of cap. Proceed clockwise with number two, number four and number three plug wires. Install coil wire at center of cap.

TIMING BY FLYWHEEL

When checking and adjusting timing light (power light preferred) operate the engine at High Idle. The High Idle must be checked first (refer to Governor adjustment).

Observe timing mark on crankshaft pulley. If chalk is put in timing notch in pulley, this will aid in seeing the mark when the engine is running. If mark is not directly under arrow when observed from R.H. side, loosen clamps and rotate distributor until fire mark is directly under arrow and retighten clamps. Check timing mark again after tightening clamps.

DISTRIBUTOR



The distributor is a Delco-Remy Model 1112607 for 149 Cu. In. engine and Model 1112609 for 160 Cu. In. engine. The point gap setting is .022" and the rotor rotates in a clockwise rotation. The automatic advance is 25° at High Idle R.P.M.

To adjust or replace the point set, remove distributor cap, rotor and dust cover. Loosen nut from terminal screw and remove the breaker arm assembly. Remove the locking screw from the stationary contact assembly and remove the stationary contact. Replace with a new contact point set and adjust as follows: Rotate engine until the peak of cam lobe is contacting the breaker arm, and points are at their widest position. Loosen lock screw and rotate cam screw until the point gap is .022" measured with feeler gauge, tighten lock screw and recheck point gap. It is a good practice to replace the condenser when replacing a point set, unless testing proves it to be in perfect condition.

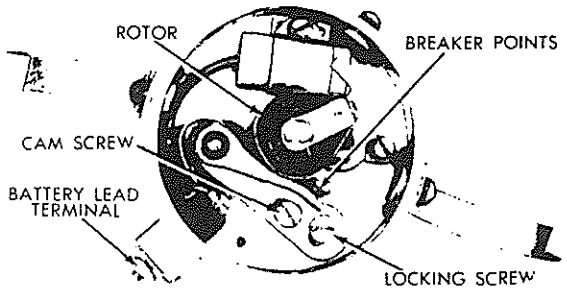
REMOVAL

Remove the coil wire from the distributor primary lead terminal. Remove the spark plug cables from distributor cap, or remove distributor cap, and cables from spark plugs and ignition coil and place out of way. Remove capscrews and clamps attaching distributor to drive housing and remove distributor.

To remove distributor drive housing from engine, remove oil line from distributor drive housing, capscrew and nut retaining housing to engine and remove housing by sliding rearward until it clears end of drive shaft.

If tractor is equipped with an operation meter, it will also be necessary to disconnect drive housing and cable from distributor drive housing.

The drive gear (6 tooth) may be replaced by filing off end of pin and driving pin from shaft. Support shaft while driving out pin to eliminate damage to shaft. If it becomes necessary to remove the governor gear and shaft assembly, remove the governor housing at front of timing gear cover, and remove governor gear and shaft through opening in timing gear cover. Refer to governor removal for instructions on removing governor assembly, gear and shaft. The rear shaft bushing is replaceable by removing the drive housing.



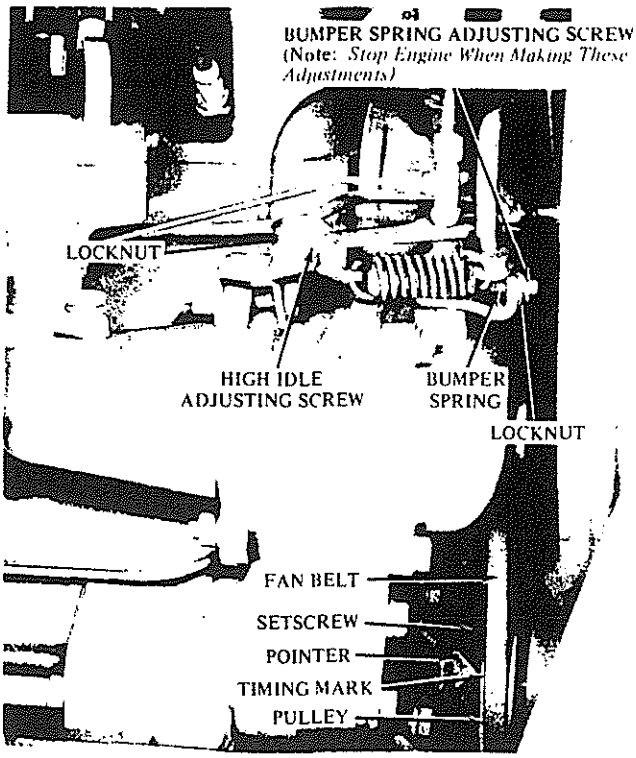
DISTRIBUTOR TIMING

DISTRIBUTOR TIMING

To time the distributor to engine, two important steps are necessary. First, the engine must be positioned on dead center on its number one compression stroke. Second, the distributor must be positioned to fire number one cylinder when installed to the engine. To time distributor to engine proceed as follows:

Rotate engine until number one piston is approaching top center on its compression stroke. This can be determined by removing number one spark plug (front plug) and placing thumb in plug opening, rotate engine slowly until air is forced past thumb.

This will indicate number one piston is on its compression stroke



DISTRIBUTOR TIMING WITH LOADER MOUNTED

If crawler tractor is equipped with loader or some equipment that covers the timing hole in front R. H. side of torque housing, it will be necessary to use the crankshaft pulley and arrow on front timing cover to time the engine properly.

FRONT CRANKSHAFT PULLEY TIMING

If tractor is equipped with loader or some equipment that covers the timing hole in front R. H. side of torque housing, it will be necessary to use the crankshaft pulley and arrow on front timing cover to time the engine properly.

To time the distributor assembly to engine, proceed as follows: Remove number one (front) spark plug and place thumb in spark plug opening, rotate engine until air is forced past thumb.

This indicates number one piston is coming up on its compression stroke and the timing mark on crankshaft pulley is approaching

the timing pointer. This mark will be 25° ahead of the top dead center. Rotate crankshaft until setscrew in back side of crankshaft pulley is directly on top. When this setscrew is on top the piston will be on top dead center.

With setscrew on top center, install distributor to the drive housing. With the point gap set at .022", position the distributor rotor toward number one plug wire position and enter distributor assembly into drive housing with the primary lead terminal rearward and slightly away from engine. With distributor in place, install the two clamps and capscrews. Rotate distributor until points have just separated and tighten the clamp capscrews to 25 ft. lbs. torque.

Install dust cover and distributor cap. Install number one plug wire in front position of cap. Proceed clockwise with number two, number four and number three plug wires. Install coil wire at center of cap.

When checking and adjusting timing (power light preferred) operate the engine at High Idle. The High Idle must be checked first (refer to Governor adjustment).

Observe timing mark on crankshaft pulley. If chalk is put in timing notch in pulley, this will aid in seeing the mark when the engine is running. If mark is not directly under arrow when observed from R.H. side, loosen clamps and rotate distributor until fire mark is directly under arrow and retighten clamps. Check timing mark again after tightening clamps.

TIMING BY FLYWHEEL

The first flywheel mark to appear will be the fire mark. This is a line mark with the letter "F-25" stamped into flywheel. The fire mark is 25° ahead of center mark. The center mark is a line mark with the word "CENTER" stamped into flywheel. Position engine with the center mark on flywheel in center of timing hole in torque housing.

With the distributor cap, rotor and dust cover removed, check and if necessary adjust the point gap to .022". Install rotor and rotate until rotor tip is pointing toward number one plug wire outlet, opposite the primary lead terminal. Install distributor assembly into drive housing with the primary lead terminal rearward and slightly away from engine. Rotate distributor body until points just separate, and clamp in this position. Recheck after tightening clamps.

To determine when points have just separated, a magnifying glass is very useful, also a piece of cellophane may be placed between points. The points will grip cellophane until they just separate then release the cellophane. Timing lamps are also available which attach from battery terminal to distributor terminal. As long as the points make contact the lamp will be lighted; when the points have just separated the lamp will go out.

Install dust cover, rotor and distributor cap. Install number one spark plug cable in the front position. Proceed clockwise and install number two, number four and number three plug cables. Install coil high tension cable at center of cap. The distributor lead wire must be attached to positive terminal of coil.

When checking timing with a timing light (power light preferred), operate the engine at 1750 R.P.M. with an accurate tachometer. If the engine speed is more than 1750 R.P.M. the distributor will advance more than 25°. If the engine speed is less, the distributor advance will be less than 25°. Observe fire mark in timing hole. If fire mark is not in center of timing hole, loosen clamps and rotate distributor until fire mark is in center of timing hole and retighten clamps. Check timing mark again after tightening clamps.

INDEX

CARBURETOR

B

PRINCIPLE OF OPERATION

To understand a carburetor it is necessary to realize that there is only one thing that a carburetor is designed to do and that is to mix fuel and air in the proper proportion so that the mixture will burn efficiently in an engine. It is the function of the engine to convert this mixture into power.

There are three major factors in an engine which control the change of fuel and air into power: 1--Compression. 2--Ignition. 3--Carburetion.

Carburetion has been listed last because it is absolutely necessary for the engine to have good compression and good ignition before it can have good carburetion.

When the average person thinks of "carburetion" they immediately think of the carburetor as a unit. Carburetion is the combined function of the carburetor, manifold, valves, piston and rings, combustion chamber, and camshaft.

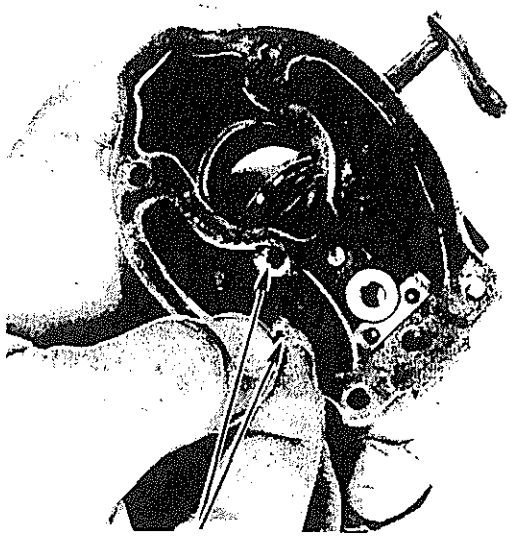
It can be readily seen that "carburetion" is a far deeper subject than consideration of the carburetor alone, and expecting the carburetor to cure faulty ignition, compression, valves, etc., will only result in wasted time and effort on the part of the service man and added expense to the customer.

It must be remembered that the function of the carburetor does not extend beyond delivering the proper mixture of fuel and air to the manifold and the other factors which affect power and economy cannot be changed or corrected by the carburetor. Inability to understand all the factors that affect engine operation is the reason many service mechanics change from factory standards and attempt to improve on the engine set-up by their own methods or "standards". All that any service mechanic should ever try to do is to make the particular engine he is working on as good as the manufacturer intended it to be, but he can make it a lot worse. Far too many engines are running below their standard of performance in service today.

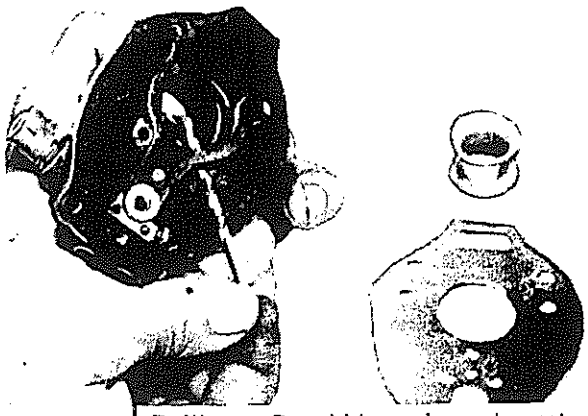
For the carburetor to accomplish its function it must be able to vary the mixture strength dependent upon the engine demands. It must supply a mixture strength that will allow the engine to give maximum horsepower, whenever the throttle is fully opened, while at part throttle conditions it must lean out the mixture so that maximum economy can be obtained. In addition, it must have flexibility throughout the entire range of operating speeds, from idle and part throttle to full power wide open throttle position. The carburetor must also have an accelerating "well" with enough fuel capacity to start handling sudden maximum loads. In other words, the carburetor not only varies in volume of fuel and air that enters the engine but also varies the amount of fuel that goes in with a given amount of air, in order to produce the proper mixture proportion for any condition under which the engine is operating at any time.

In order to understand the function and operation of this carburetor, it is well to consider the systems that make up each carburetor. These systems are: The Float System, The Idle System, The Power Fuel Feed System, The Back Suction System, and The Choke System.

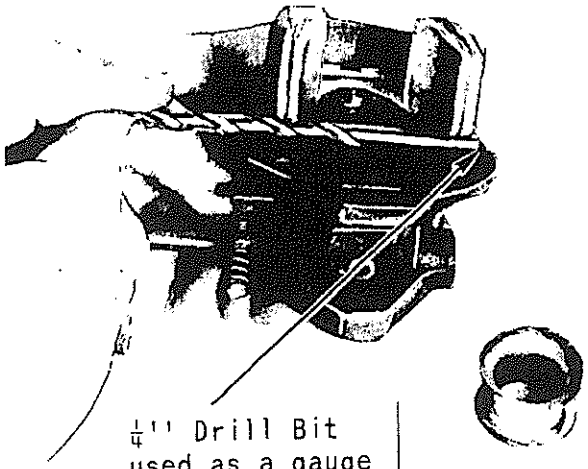
A thorough knowledge of each system will help the service mechanic to quickly locate and correct legitimate carburetor complaints as well as to inspect, repair, and put back to standard any carburetor that requires an overhaul.



Remove and plug Brass Economizer Jet.



Drill two Bowl Vents into throttle bore entering back of Venturi with No. 25 Drill 0.1495"

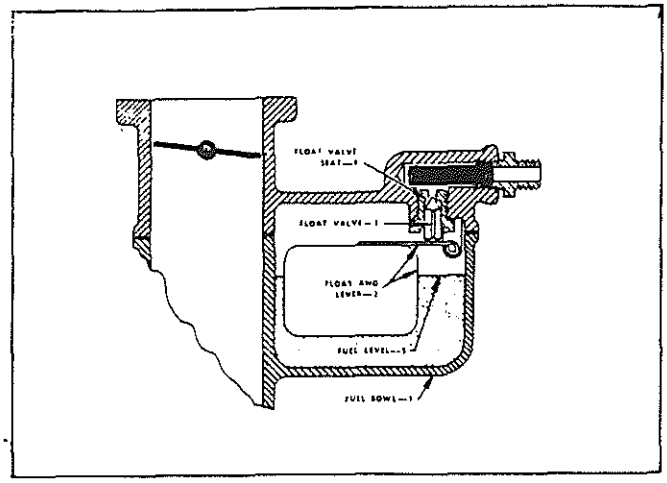


$\frac{1}{4}$" Drill Bit used as a gauge to set the float level.

FLOAT SYSTEM

The float system controls the level and supply of gasoline in the fuel bowl throughout the operating range of the engine.

When the fuel bowl (1) is empty the float and lever (2) and float valve (3) drop and fuel under pressure from the fuel pump (or gravity feed) is forced through the float valve seat (4) around the float valve (3) and into the fuel bowl (1). As the fuel in the bowl approaches the correct operating level it raises the float and lever (2) with enough force to raise the float valve and cut off the flow of fuel into the bowl. As fuel feeds through the carburetor jets into the engine, the fuel level (5) drops, allowing additional fuel to enter the fuel bowl.



Float System

Under actual operating conditions the fuel level (5) and float and lever (2) automatically position themselves so that the inward flow of gasoline to the carburetor is equal to the outward flow of gasoline to the engine.

As can readily be seen the float system under the most favorable of operating conditions is subjected to a certain amount of wear. Under severe conditions or conditions that result in excessive vibrations being transmitted to the carburetor, float valve seat wear is accelerated.

It should be an established policy that whenever the carburetor is disassembled for whatever cause the service man make the following checks:

1. Examine float valve for any signs of wear. If it is not absolutely true or is grooved and hasn't a perfect taper, a new float valve and also a new float valve seat must be used. These float valves and seats are supplied in matched sets and are tested at the factory for leaks. Always use a new float valve seat gasket to make sure of a perfect seal.

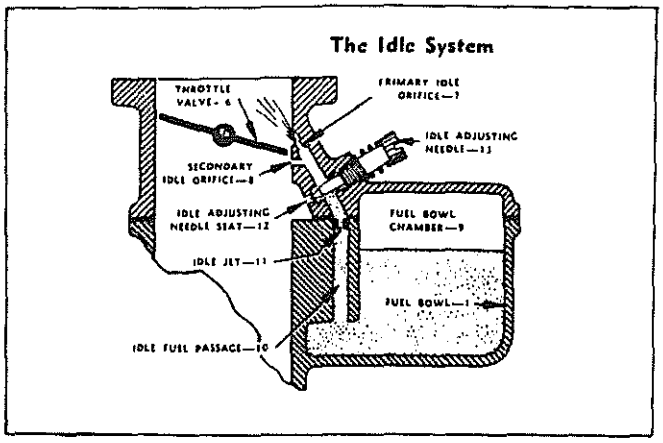
2. Examine float for any signs of failure. To test metal float submerge float in pan of hot water and if air bubbles are observed, replace with new float.

   Examine cork float for bare places or cracks in coating. If either are found, or if float shows evidence of having been soggy, replace with new one. (Do not attempt to recover float with shellac or varnish.)

THE IDLE SYSTEM

3. Set float height to the proper specification for the particular model carburetor being serviced. Make certain that the entire assembly works free and that there is no binding.

4. It has been proven, with few exceptions, that with a float system in good order, carburetor flooding only occurs when dirt or foreign matter becomes lodged between the float valve (3) and float valve seat (4).



THE IDLE SYSTEM

The idle system controls the flow of fuel at idle speed and at slow speeds until the throttle is opened wide enough to allow the power fuel feed system to function.

When the throttle valve (6) is in the idle position the edge of the valve is between the primary idle orifice (7) and the secondary idle orifice (8). With the valve in this position the air pressure (manifold vacuum) at the primary idle orifice (7) is lower than the air pressure in the fuel bowl chamber (9) and fuel is forced from the fuel bowl (1) into the idle fuel passage (10). As the fuel travels through the idle fuel passage (10) it passes through the metering orifice of the idle jet (11) to the point where it is combined with air entering through the idle adjusting needle seat (12) The mixing of air with gasoline helps to atomize the fuel and this process is repeated at the secondary idle orifice (8) as the fuel travels through the idle fuel passage (10). As this rich mixture of fuel and air emerges from the primary idle orifice (7) it is reduced to correct proportions by the air which passes around the throttle valve (6) since this valve must be slightly open to permit the engine to idle. The resultant mixture is correct for operating engine at idle speed, provided the idle adjusting needle (13) is properly adjusted.

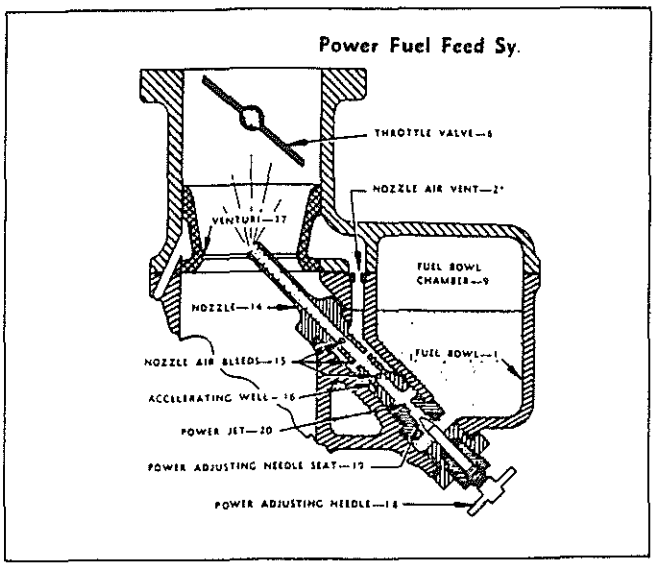
As the throttle valve (6) is slowly opened from the slow idle position it gradually subjects the secondary idle orifice (8) to intake manifold vacuum, and the secondary idle orifice (8) no longer bleeds air to the idle fuel passage (10) but feeds an additional quantity of fuel into the engine. This is proper since the throttle valve is now open wider and will admit a greater amount of air to blend with this additional fuel to maintain the correct proportions of fuel and air for the engine.

As the throttle valve (6) is opened still wider, the idle fuel delivery begins to fade out, however, the throttle valve at this point is far enough open for the power fuel feed system to begin functioning.

The idle system as described above is the most positive and satisfactory of idle systems, as it is working under very high suction and the mixture flows through the small passages and orifices at very high velocities. It is necessary to bear in mind, however, that there are times when these small holes may become plugged with particles of dirt or foreign matter and will require cleaning. At such times the passages, jets, and small drilled holes should only be cleaned with a cleaning fluid such as gasoline and air under pressure. Never use drills or wires as a change in size of these small openings will change the entire calibration of the carburetor.

POWER FUEL FEED SYSTEM

POWER FUEL FEED SYSTEM



With the throttle valve (6) in slow or just off slow idle position, fuel rises up through the nozzle (14) and out the nozzle air bleeds (15) to fill the accelerating well (16) to approximately the height of the fuel level in the fuel bowl (1).

As the engine speed is increased from the slow idle position the air flow through the venturi (17) is gradually increased, and, as the idle system begins to diminish. the velocity through the venturi (17) is high enough to create a pressure at the tip of the nozzle (14) slightly less than the pressure in the fuel bowl chamber (9) and the accelerating well (16) Fuel, therefore, feeds from the fuel bowl (1) through the opening between the power (load) adjusting needle (18) and the power adjusting needle seat (19), through the power jet (20) and out the nozzle (14) to be discharged into the air stream at the venturi (17). At the same time, the fuel that is stored in the accelerating well (16) is also forced through the nozzle air bleeds (15) into the nozzle (14). But, because the size of the power jet (20) and the position of the power adjusting needle (18) restrict the amount of fuel which can enter the nozzle (14), the fuel in the accelerating well (16) will soon be exhausted and air will then enter through the nozzle air bleeds (15) to mix with the fuel passing through the nozzle (14) is limited by the size of the nozzle air vent (21).

The result of air bleeding into the nozzle (14) is, to help atomize or break up the fuel into finer particles, to regulate the quantity and the rate of discharge of the fuel fed from the accelerating well (16), during acceleration, and to provide the correct mixture proportions for full throttle operation.

As the throttle valve is opened toward the wide open position the velocity through the venturi (17) continues to increase, lowering the air pressure at the nozzle (14) and resulting in additional fuel being supplied to the engine as the speed is increased.

When the throttle valve (6) is opened suddenly from slow or just off slow idle position, the fuel stored in the accelerating well (16) is forced out through the nozzle air bleeds (15) very rapidly and serves to provide the extra richness required by the engine to meet the sudden load. When the throttle valve (6) is closed, fuel again fills the accelerating well (16), ready for the next acceleration.

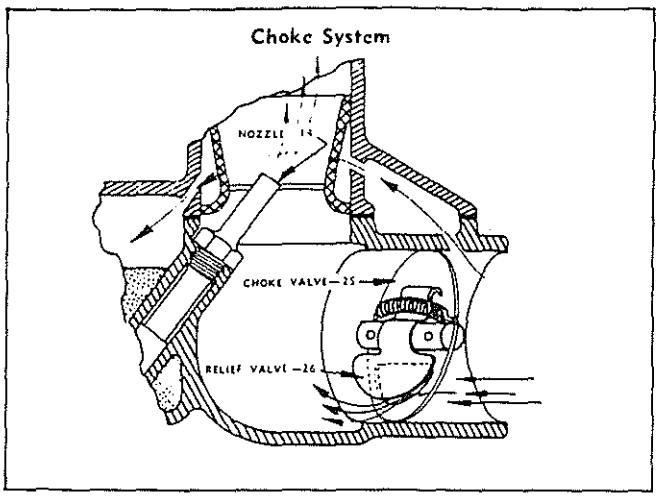
CHOKE SYSTEM

The choke system is used during cold starting and the warm-up period. Under these cold conditions it is necessary to supply an additional rich mixture of fuel and air, as only the "light ends" or more volatile portions of the fuel will vaporize with the manifold and air temperatures at these cold conditions. Consequently it is necessary that a large quantity of fuel be available so that there will be enough "light ends," to combine with the air to form a combustible mixture for starting the engine.

The function of the choke valve (25) is to restrict the amount of air that can enter the carburetor and to increase the suction on the nozzle (14) so that additional fuel will be drawn into the manifold. As soon as the engine fires and runs the rich mixture must be rapidly reduced to prevent stalling. This

change in mixture is accomplished by the operator positioning the choke valve to provide the proper mixture. However, a few degrees movement of the choke valve (25) will make a big change in the mixture strength and to help reduce the sensitivity of the choke valve (25) position use is made of a spring loaded relief valve (26) in many applications. This valve opens automatically with engine speed and load and eliminates a great deal of manipulation of the choke on the part of the operator.

When the engine has obtained normal operating temperature the choke valve (25) must be fully opened to assure maximum power and economy. In addition, extended use of the choke results in more gasoline being supplied to the engine than can be burned. A large percentage of the unburned gasoline is lost through the exhaust system. The remainder of the raw gasoline is forced between the pistons and cylinder walls, washing away the protective oil film and increasing engine wear, and enters the crankcase where it dilutes the engine oil.



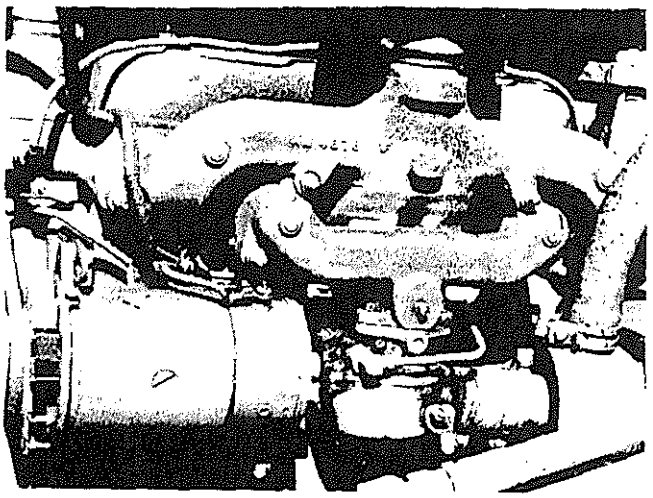
Any adjustments that are necessary on the carburetor should never be attempted until the engine has obtained its normal operating temperature and the choke valve (25) has been placed in the wide open position.

REMOVAL

Remove carburetor from engine. Shut off fuel and disconnect fuel line. Remove air cleaner hose. Disconnect choke control and carburetor link rod. Remove two capscrews attaching carburetor to intake manifold, and remove carburetor from engine. Clean the outside of carburetor thoroughly, and examine the throttle and choke shafts for wear.

Remove screws attaching throttle plate to shaft, and remove throttle plate and shaft assembly. Remove the seal retainer and seal. Remove screws attaching choke plate to choke shaft, and remove plate. Remove choke lever at end of shaft and remove choke shaft assembly Remove the choke shaft seal retainer and seal. Always install new seals and retainers on throttle and choke shafts upon reassembly.

Remove the main jet adjusting needle, spring and washer. Remove idle adjusting needle and spring. Remove the four screws and separate the throttle body from the fuel bowl. Remove the float, float valve, bowl gasket and venturi. Remove float valve seat and gasket. If float valve is worn or grooved it must be replaced during assembly.



Remove the economizer jet and idle jet. Remove main discharge nozzle and main jet. Remove the air intake drain strainer assembly and replace with new during assembly.

Thoroughly clean the throttle body, fuel bowl and all parts removed from carburetor in a suitable carburetor cleaning solution. Do not use a drill or wire to clean jets, as the possible enlargement of calibrated holes will affect operating balance of carburetor. Use clean, dry compressed air and blow the jets clear of cleaning fluid and all foreign matter.

The measurement of jets to determine the extent of wear is impractical and difficult; therefore, new parts are usually installed to assure satisfactory operation. Check wear on throttle and choke shafts and replace if necessary. Check fit of throttle and choke shafts in their respective bores, and if bores prove to be worn excessively, replace the throttle body or bowl assembly.

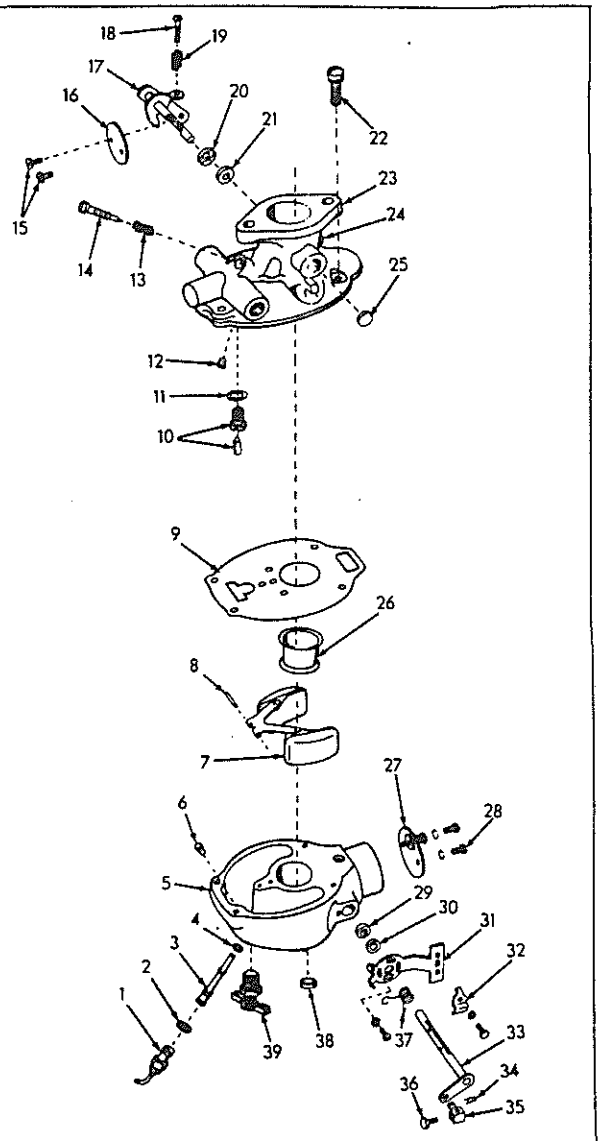
High vacuum occurs in the vicinity of the throttle and choke shafts; therefore excessive shaft to bore clearance and faulty shaft packing will permit dust and dirt to be drawn into the engine, resulting in rapid engine wear. Excessive shaft clearance also will cause improper throttle and choke plate seating and will upset carburetor calibration and contribute to uneven engine operation.

A carburetor gasket set is available for use in repairing of carburetors. This gasket set consists of a float valve seat gasket, a throttle body to bowl gasket, a power jet gasket, a high speed needle gasket and a flange gasket.

A carburetor repair kit is also available for complete carburetor overhaul. This kit consists of the complete gasket set plus a throttle shaft assembly, a throttle stop lever screw and spring, a throttle shaft seal and seal retainer, a throttle shaft bore cup, two choke shaft packings and one retainer. A choke lever spring, a float shaft a float valve assembly and gasket, an idle adjusting needle, idle jet, power jet and four screws for throttle and choke plates.

ASSEMBLY

1. NEEDLE & SEAT ASSY.
2. GASKET
3. NOZZLE
4. GASKET
5. BOWL
6. POWER JET NO. 65 DRILL
7. FLOAT
8. PIN
9. GASKET
10. VALVE NO. 50 DRILL
11. GASKET
12. IDLE JET NO. 71 DRILL
13. IDLE ADJUSTING SPRING
14. IDLE SCREW
16. THROTTLE PLATE
17. THROTTLE SHAFT
18. STOP SCREW
19. SPRING
20. RETAINER
21. SEAL
24. BODY
25. PLUG
26. VENTURI
27. CHOKE PLATE
31. BRACKET ASSY.
33. CHOKE SHAFT
34. RETAINER
35. SHAFT SWIVEL
38. STRAINER
39. DRAIN PLUG



ASSEMBLY

Install new throttle and choke shaft packing and retainers in shaft bores. Insert shaft through packing into bore and tap lightly until packing retainer is flush with surface of body. Use caution not to damage packing retainer to a point that would cause binding to throttle shaft.

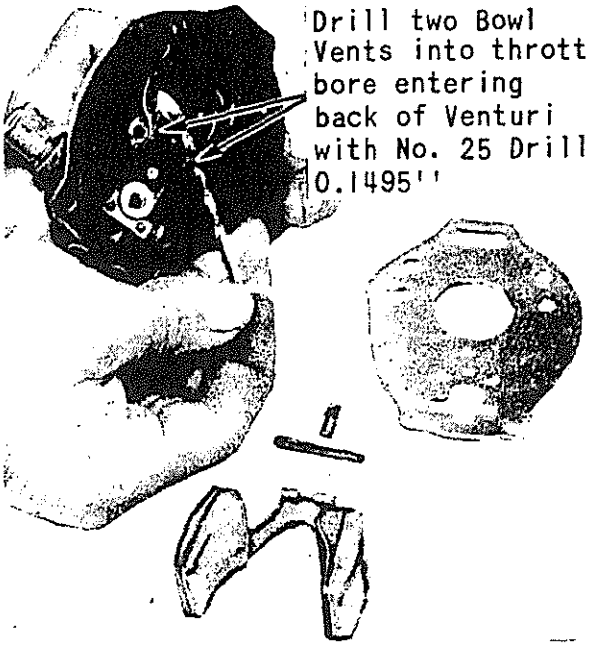
Install the throttle plate, being sure it is centered in bore and that angle at edge of plate is in the proper position. Install economizer jet, idle jet, adjusting needle and spring. Lightly seat the idle adjusting needle and back it out approximately one and one-half turns open.

Install float valve seat and gasket venturi and bowl gasket. Install float valve, float and float lever shaft. Adjust floats 1/4"

TSX 931 HIGH ANGLE CARBURETOR
TSX 879 & TSX 912

from gasket face to nearest edge of float. Install the power jet, power jet nozzle. Install gasket and needle and seat assembly. Install new drain strainer at bottom of fuel bowl.

Invert throttle body and lower fuel bowl over floats, making certain the venturi guides the two bodies into position. Install retaining screws and tighten gradually until completely tight.



Drill two Bowl Vents into throttle bore entering back of Venturi with No. 25 Drill 0.1495''

TSX-931 HIGH ANGLE CARBURETOR

A TSX-931 High Angle Carburetor has been released for service which will afford greater angle of side hill operations and reduce possibility of engine stall out and erratic operation.

The TSX-815, TSX-879 and TSX-912 can be reworked in the field by drilling two 0.1495" (#25 drill) bowl vent holes into the throttle bore entering back of venturi as shown.

Remove and plug the brass economizer jet.

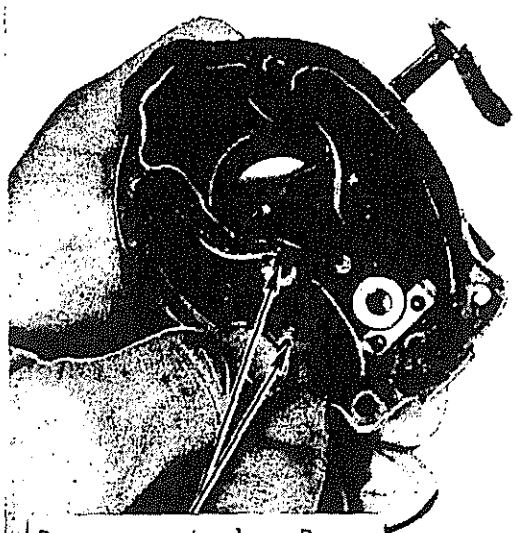
FOR THE TSX-879 & TSX-912

Replace the 202cc flow power jet, #219991, with 175cc flow power jet, #250314. (The 175 jet may not be stamped for identification but may be checked with a #57 drill.)

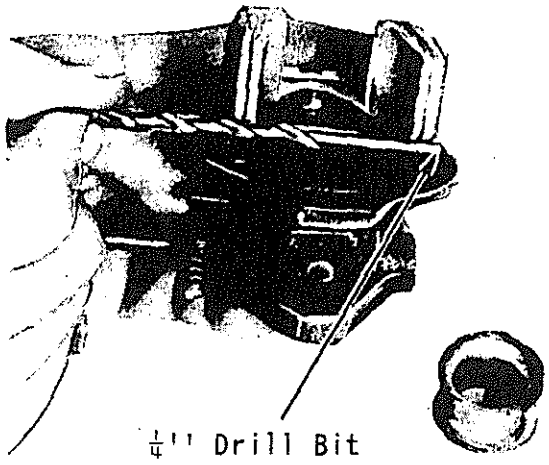
Remove and replace the needle float valve assembly with the #244912 which has a

VITON TIP. This valve assembly was made available to overcome the problem of carburetor flooding when operating on slopes or rough terrain.

Adjust the floats 1/4" from the gasket face to the nearest edge of float. Caution must be taken when adjusting the float so as not to push down on the float and damage the VITON TIP.



Remove and plug Brass Economizer Jet.



$\frac{1}{4}$'' Drill Bit used as a gauge to set the float level.

Preliminary Adjustments

Set throttle stop screw so that throttle valve is open slightly. Make certain that fuel supply to carburetor is open. Close choke valve. Start engine and partially release choke. After the engine has been run sufficiently to bring up to operating temperature throughout, see that choke is returned to wide open position.

Low Speed Or Idle Adjustment

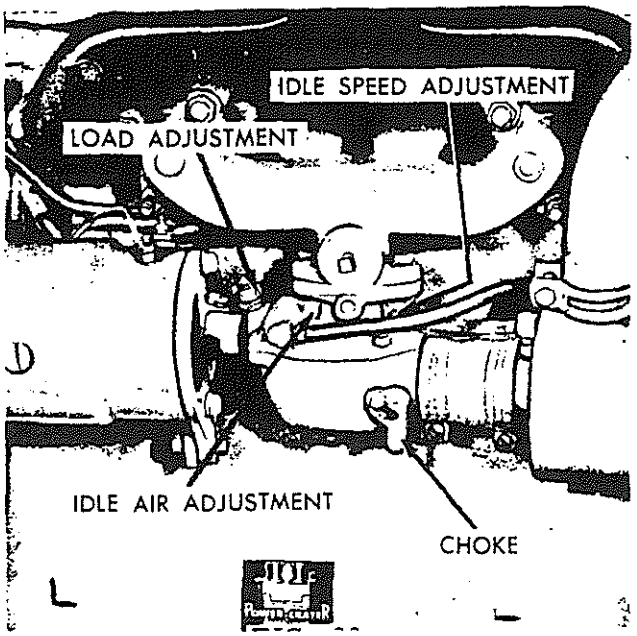
Set throttle or governor control lever in slow idle position and adjust throttle stop screw for the correct engine idle speed. (On a new, stiff engine this speed must be slightly higher than required for a thoroughly run-in engine.) Turn idle adjusting needle* until engine begins to falter or roll from richness, then turn needle in the opposite direction until the engine runs smoothly.

NOTE: It is better that this adjustment be slightly too rich than too lean.

*Idle Adjusting Needle - Air Adjusting

To richen the idle mixture, turn the idle adjusting needle to the right or clockwise.

*Idle Adjusting Needle - Fuel Adjusting



To richen the idle mixture turn the idle adjusting needle to the left or counterclockwise.

Power or Load Adjustment

With the engine running at governed speed under load, turn power adjusting needle to the right, or clockwise, a little at a time until the power drops appreciably. Then turn the needle to the left, or counterclockwise, until the engine picks up power and runs smoothly. This will give an economical part throttle mixture. Due to variations in temperature or fuels it may be necessary to richen up this mixture by backing out the power adjusting needle, a small amount at a time until good acceleration is obtained.

MEMO

INDEX

DIESEL ENGINE

C

HD-3 CRAWLER TRACTOR
D-175 DIESEL ENGINE
SPECIFICATIONS

ENGINE - Prior S/N-8694

Number of Cylinders	4
Firing Order	1-3-4-2
Bore	3-9/16
Stroke	4-3/8
Piston Displacement	175 Cu. In.
Compression Ratio	15.35-1
Compression Pressure	
At Cranking Speed	325 ± 20 lb.
At 600 R.P.M.	415 ± 20 lb.
All Cylinders within 20 lbs.	
R.P.M. (Low Idle)	600 - 650
R.P.M. (High Idle)	1865 - 1885
R.P.M. (Rated Load)	1650
Piston Travel	1167 F.P.M. at 1600

VALVE TIMING

Intake Opens	13° B.T.C.
Intake Closes	63° 30' A.B.C.
Exhaust Opens	31° B.B.C.
Exhaust Closes	16° A.T.C.
Valve Clearance	Set at .010" on intake, and .019" on exhaust (Hot)

ENGINE - Eff - S/N-8694 & Up

Number of Cylinders	4
Firing Order	1-3-4-2
Bore	3-9/16
Stroke	4-3/8
Piston Displacement	175 Cu. In.
Compression Ratio	15.35-1
Compression Pressure	
At Cranking Speed	325 ± 20 lb.
At 600 R.P.M.	415 ± 20 lb.
All Cylinders within 20 lbs.	
R.P.M. (Low Idle)	600 - 650
R.P.M. (High Idle)	2030 - 2060
R.P.M. (Rated Load)	1800

FUEL SYSTEM

Injection Pump Type & Model	Roosa Master Model "DB" DBFGC-429 - 3AF
Transfer Pump	Vane type Integral with Injection Pump

SPECIFICATIONS - Fuel System (Cont.)

Injection Timing	22° B.T.D.C.
Transfer Pump Pressure	
600 R.P.M.	39 P.S.I.
1875 R.P.M.	60 P.S.I.
Transfer Pump Vacuum (Inches of Mercury)	15" Hg. - 25" Hg.
Vacuum on Filters Max. (Inches of Mercury)	6" Hg.
Blade Length Min.	1.092"
One Piece Rotor Dia.	.920"
Roller to Roller Setting	1.9665" - or - .0005"

Bench Testing Data
- Pump 600 R.P.M. 48 - 50 CC per 500 strokes
- 50 P.S.I. Transfer Pump
- Pump 825 R.P.M. 49 - 51 CC per 500 strokes
- 60 P.S.I. Transfer Pump

Has discharge valve vent in Hydraulic Head to Pump Housing
Solid Metering Valve

FUEL INJECTION NOZZLES

Make	Allis-Chalmers
Model	45 11201
Type	Throttling Pintle
Opening Pressure	2000 P.S.I.

FUEL FILTERS

Type	Dual filters
Cartridge	Replaceable

GOVERNOR

Type	Positive Mechanical
Make	Roosa Master
Location	Integral with injection pump

FITS AND TOLERANCES OF NEW PARTS

CYLINDER SLEEVES

Type	Replaceable - Wet
Inside Diameter	3.5623" - 3.5638"
Replace sleeves when wear at top of ring travel exceeds	.007"
Diameter of sleeve at machined area just below flange	3.911" - 3.913"
Diameter of sleeve at packing ring location	3.838" - 3.840"
Sleeve flange - outside diameter	3.978" - 3.982"
Block to sleeve clearance at packing ring location	.001" - .005"
Block to sleeve clearance at machined area below flange	.0005" - 0045"
Block to sleeve clearance at sleeve flange	.003" - .012"
Piston skirt to sleeve clearance	.004" - .0065"
Sleeve stand-out above block	plus .002" minus .002"
Allowable taper	.0007"
Allowable out of round - installed	.001"

CYLINDER BLOCK

Block counterbore diameter for sleeve flange	3.985" - 3.990"
Depth of counterbore for sleeve flange	.249" - .251"
Block bore diameter for cylinder sleeve - top	3.9135" - 3.9155"
Block bore diameter for cylinder sleeve - bottom	3.841" - 3.843"
Cylinder block bore diameter for camshaft bushings -	
front and intermediate	2.124" - 2.125"
rear	1.374" - 1.375"
Cylinder block bore diameter for main bearings -	
Bearing caps in place and capscrews tightened to specified torque	2.6993" - 2.700"

PISTON

Material	Aluminum Alloy
Length	4.142" - 4.150"
Diameter between top and second ring groove	3.537" - 3.541"
Diameter at bottom of skirt measured at right angle to piston pin	3.5573" - 3.5583"
Piston pin bore diameter	.99985" - 1.00005"
Measurement from center of pin bore to top of piston	2.269" - 2.273"
Clearance of piston skirt with cylinder sleeve	.004" - .0065"

PISTON PIN

Type	Full Floating
Pin Length	2.963" - 2.973"
Pin diameter	.99955" - .99975"
Pin to piston clearance at room temperature	.0001" - .0005" loose
Inside diameter of connecting rod bushing - installed	1.0001" - 1.0006"
Piston pin to connecting rod bushing clearance	.00035" - .00105"

PISTON RINGS

Number of rings per piston	5
Location of oil rings	One above and one below piston pin

Ring end gaps - top compression	.022" - .037"
2nd and 3rd compression	.014" - .029"
4th oil control	.014" - .059"
5th oil control	.007" - .020"
Clearance of rings in grooves	
Top compression	.003" - .0045"
Top compression wear limit	.008"
2nd and 3rd compression	.002" - .004"
4th oil control	.0000" - .0055"
5th oil control	.0015" - .0035"

CRANKSHAFT

Connecting rod journal diameter	1.9975" - 1.9985"
Main bearing journal diameter	2.497" - 2.498"
Connecting rod journal width	1.500" - 1.504"
Main bearing journal width	
Front bearing	1.557" - 1.567"
Intermediate bearings	1.318" - 1.326"
Center bearing	1.875" - .1879"
Rear bearing	2.000"
Crankshaft end clearance	.003"
End clearance wear limit	.015"
Crankshaft journals may be ground to the following undersize	.010"- .020" - .040"
Fit of crankshaft gear on crankshaft	.001" - .003" tight

MAIN BEARINGS

Number used	5
Type	Replaceable precision
Inside diameter - with capscrews tightened to specified torque	2.4993" - 2.501"
Crankshaft main b earing journal diameter	2.497" - 2.498"
Bearing to journal clearance (with capscrews torqued to specifications)	.0015" - .004"
Replace parts when bearing clearance exceeds	.007"
Main bearing length - Front	1.245" - 1.255"
Intermediates	1.120" - 1.130"
Center	1.870" - 1.872"
Rear	1.745" - 1.755"
Undersize bearing available	.002" - .010" - .020" - .040"
Bearing wall thickness - standard	.0995" - .1000"
Bearing bore in cylinder block cap in place and capscrews tightened to specified torque	2.6993" - 2.7000"
Main bearing capscrew torque	120 - 130 ft. lbs.

CONNECTING ROD BEARINGS

Type	Replaceable precision
Inside diameter	1.9996" - 2.0011"
Journal diameter	1.9975" - 1.9985"
Bearing to journal clearance (with nuts tightened to specified torque) (Replace when clearance exceeds .006")	.0011" - .0036"
Bearing length	1.307" - 1.317"
Undersize bearings available	.002" - .010" - .020" - .040"
Bearing wall thickness - standard	.0797" - .0802"

CONNECTING RODS

Type	Balanced forging
Bolts per rod	2
Rod length - center to center	7.373" - 7.377"
Rod bushing inside diameter (finished bore)	1.0001" - 1.0006"
Rod bushing outside diameter	1.127"
Bearing bore (cap in place and nuts tightened to specified torque)	2.160" - 2.1605"
Rod bearing to journal clearance (with nuts tightened to specified torque)	.0011" - .0036"
Replace bearings when clearance exceeds	.006"
Connecting rod width	1.495" - 1.497"
Rod side clearance	.003" - .009"
Replace parts when clearance exceeds	.015"
Piston pin diameter	.99955" - .99975"
Piston pin bushing length	1-1/4"

EXHAUST VALVES

Valve lift (at valve)	.348"
Valve lift (at cam)	.260"
Seat angle	45°
Valve seat width (contact)	3/64"
Valve lash (cold)	.021"
Valve lash (at normal operating temperature)	.019"
Head diameter	1.370" - 1.381"
Overall length	4-9/16"
Stem diameter	.309" - .310"
Inside diameter of valve guide (installed)	.3125" - .3135"
Stem to guide clearance	.0025" - .0045"
Replace parts when clearance exceeds	.006"

INTAKE VALVES

Valve lift (at valve)	.357"
Valve lift (at cam)	.260"
Seat angle	30°
Valve seat width (contact)	5/64" - 3/32"
Valve lash (cold)	.012"
Valve lash (at normal operating temperature)	.010"
Head diameter	1.541" - 1.551"
Overall length	5.356"
Stem diameter	.309" - .310"
Inside diameter of valve guide (installed)	3.125" - 3.135"
Stem to guide clearance	.0025" - .0045"
Replace parts when clearance exceeds	.006"

VALVE SPRINGS - EXHAUST

Valve spring free length	2-3/32"
Spring length (valve closed)	1.756"
Spring length (valve open)	1.412"
Spring load at 1.756" length	40 - 45 lbs.
Spring load at 1.412" length	86 - 92 lbs.

VALVE SPRINGS - INTAKE

Valve spring free length	1-29/32"
Spring length (valve closed)	1.584"
Spring length (valve open)	1.240"
Spring load at 1.584" length	40 - 45 lbs.
Spring load at 1.240" length	86 - 92 lbs.

SPECIFICATIONS

INTAKE VALVE ROTATORS

Type	Positive rotation
Body must rotate counter clockwise when loaded from 35 lbs. starting load to 96 lbs. (viewed from top of engine).	

EXHAUST VALVE SEAT INSERTS

Seat angle	45°
Seat width (contact)	3/64"
Outside diameter	1.4715" - 1.4725"
Bore diameter for insert	1.468" - 1.469"
Shrink fit	.0025" - .0045" tight
Seat run-out	.002" T.I.R.
Oversize seat insert	.005" over standard O.D.

VALVE GUIDES

Exhaust valve guide length	2-1/4"
Intake valve guide length	2-11/16"
Inside diameter (installed)	.3125" - .3135"
Stem to guide clearance	.0025" - .0045"
Guide stand out above flat surface of cylinder head	5/16"

ROCKER ARMS

Inside diameter of rocker arm (finished bore)	.842" - .844" tight
Outside diameter of rocker arm and shaft	.8405" - .841"
Shaft to bushing clearance	.001" - .0035"
Rocker arm ratio	1.41 to 1
Concave expansion plug size	11/16"

CAMSHAFT

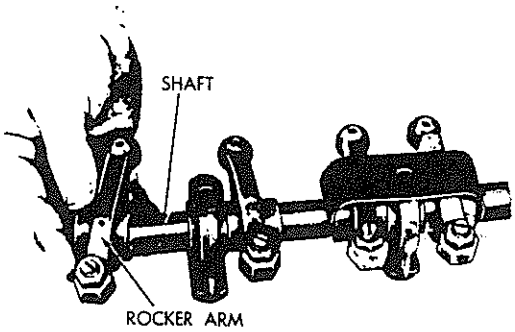
Number of bearings used	4
Inside diameter of camshaft bearings	
Front and intermediate (installed)	2.001" - 2.0026"
Rear	1.251" - 1.2526"
Outside diameter of camshaft journals	
Front and intermediate	1.998" - 1.999"
Rear	1.248" - 1.249"
Bearing to journal clearance	.002" - .0046"
Install new parts when clearance exceeds	.0065"
Outside diameter of camshaft bearings	
Front and intermediate	2.127" - 2.128"
Rear	1.376" - 1.377"
Bore diameter for camshaft bearings	
Front and intermediate	2.124" - 2.125"
Rear	1.374" - 1.375"
Fit of bearing in bore	
Front and intermediate	.002" - .004" tight
Rear	.001" - .003" tight
Camshaft bearing width	
Front	1-1/8"
Intermediates	7/8"
Rear	1"
Camshaft end clearance	.003" - .008"
Install new parts when clearance exceeds	.014"
Camshaft gear width	1"
Fit of gear on camshaft	.001" - .003" tight
End thrust collar thickness	.165" - .167"

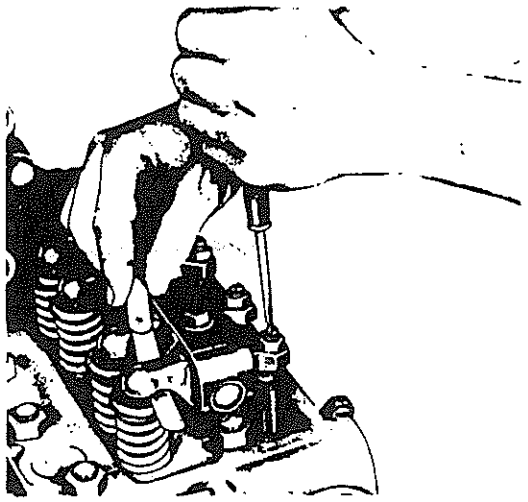
SPECIFICATIONS

VALVE LIFTER

Bore diameter in cylinder block	.5615" - .5625"
Outside diameter of lifter stem	.560" - .5605"
Lifter to bore clearance	.001" - .0025"

ROCKER ARMS AND SHAFT





REMOVAL

Remove the air cleaner stack cap. Release the hood fasteners and lift R.H. and L.H. hood assemblies from tractor. Remove capscrews attaching hood support channel to radiator shell. Remove capscrews and washers attaching support channel to battery tray and remove hood support channel from tractor.

Remove the valve cover. Remove the capscrews attaching the rocker arm shaft to the cylinder head and remove the shaft assembly. Remove the spring clips and slide the supports and rocker arms from shaft.

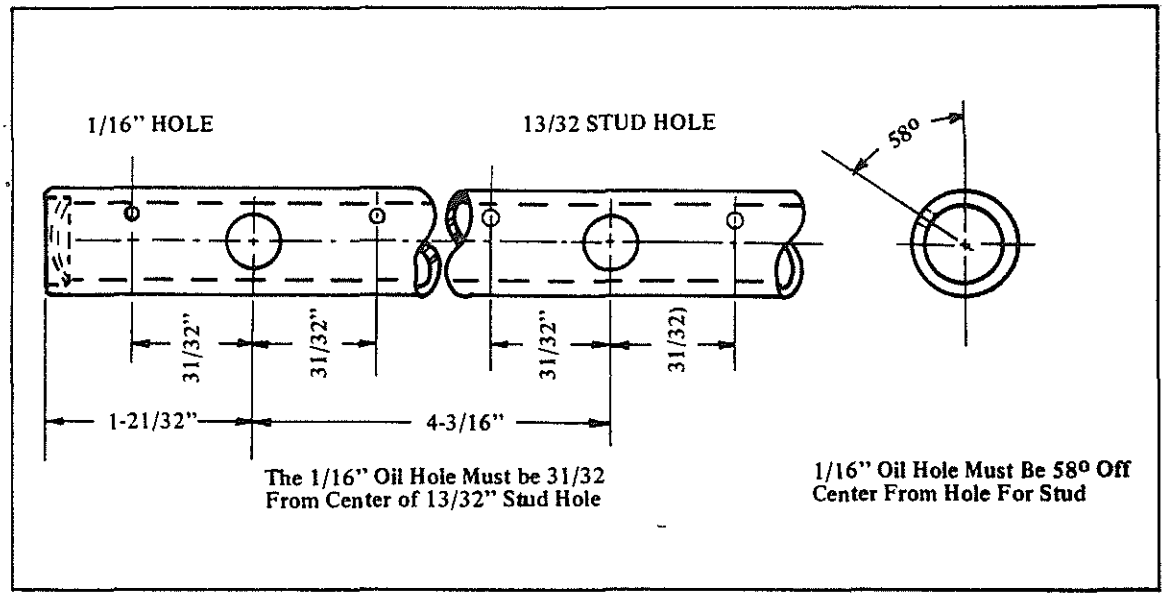
Check the shaft and rocker arm bushings for wear. If the clearance between shaft and bushing exceeds .005", the shaft or rocker arm bushing should be replaced. Shaft to bushing clearance should be .001" to .002" with new parts. Check the rocker arm valve contact button for wear, or looseness in socket and replace if necessary. Always replace oil wick if contact button is replaced.

Blow out all oil holes and passages with compressed air. Check the oil passage in the rear valve cover stud. This slotted stud provides oil from the cylinder head, through the shaft support to the rocker arm shaft. Remove the oil line fitting from head and blow through with compressed air to check oil passage through slot in stud.

If the stud is tight in head and end of stud is above the oil line below passage, it will not be necessary to align slot in stud with oil line passage as oil will flow through slot from end of stud.

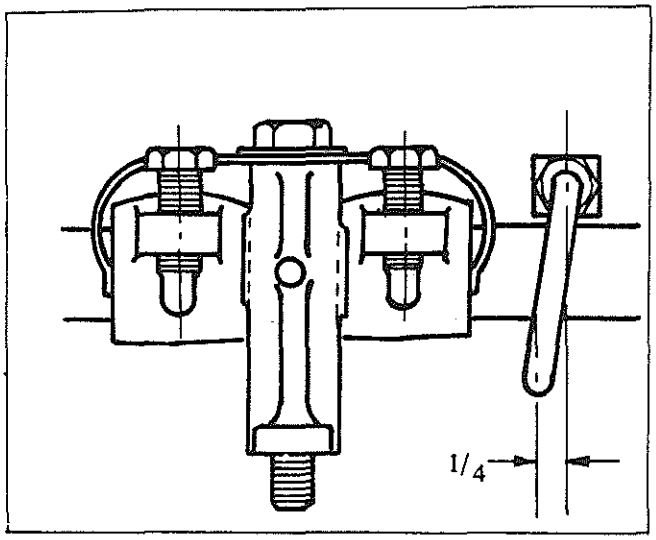
The rocker arms are all alike and are assembled on shaft in pairs, one on each side of support. Install the spring clip to retain rocker arms. The holes in shaft must be positioned so that they are toward the push rod side. Adjust rocker arms each time the head is torqued. Set the rocker arms clearance to .010" on intake and .019" on exhaust.

ROCKER ARM SHAFT SPECIFICATION

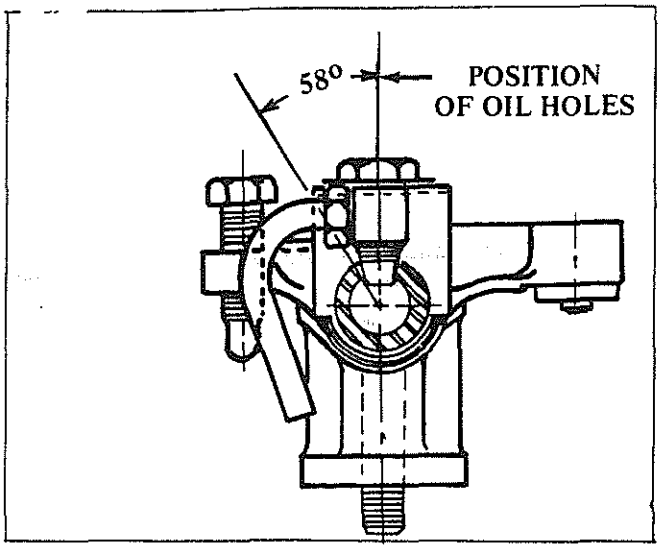


The 1/16" oil hole must be 31/32" from center of 13/32 stud hole.

1/16" oil hole must be 58° off center from hole for stud.

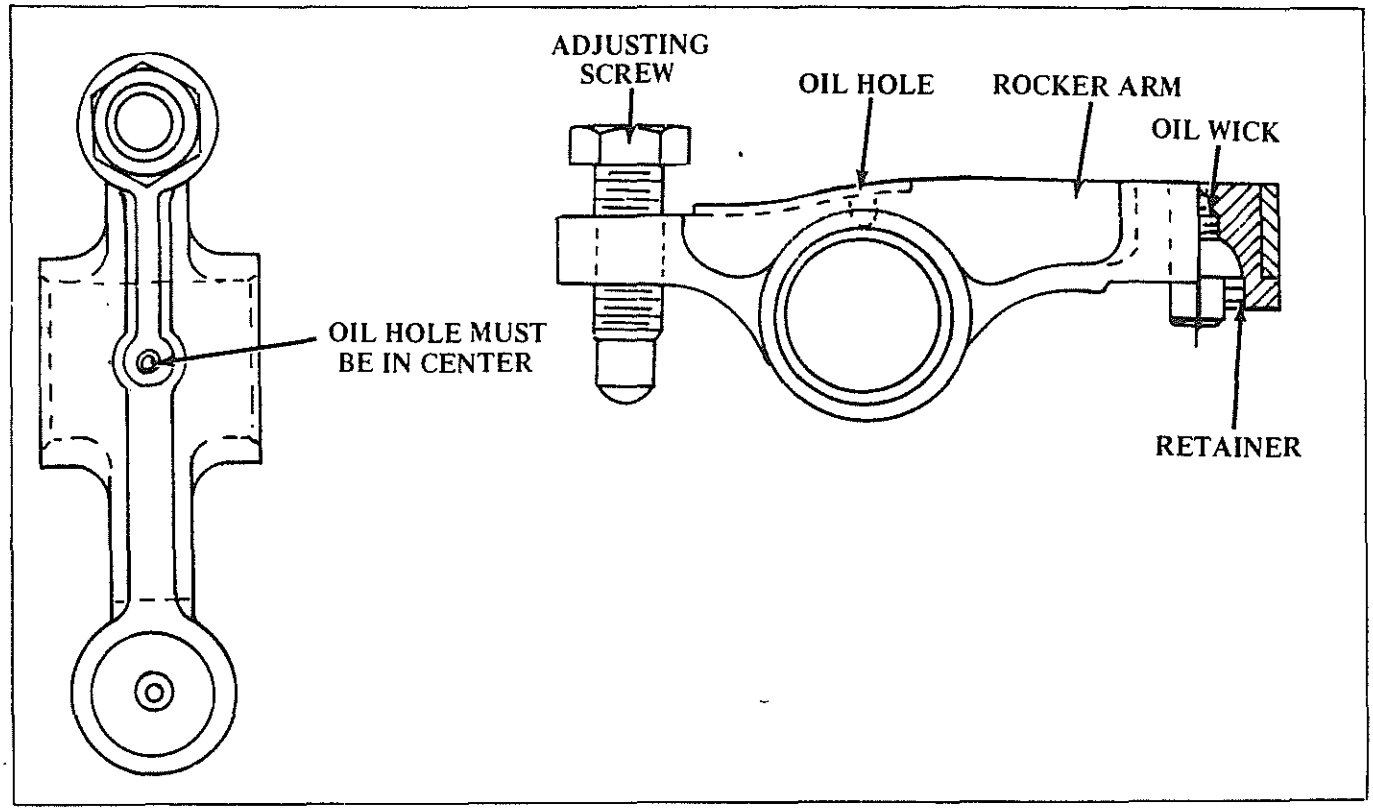


Overflow Tube Must Be Positioned Toward Front of Engine As Shown. The Oil Overflowing Through Tube Lubricates Drive Gear On Oil Pump.



1/16" Oil Hole in Rocker Arm Shaft Must be Turned to Adjusting Screw Side as Shown.

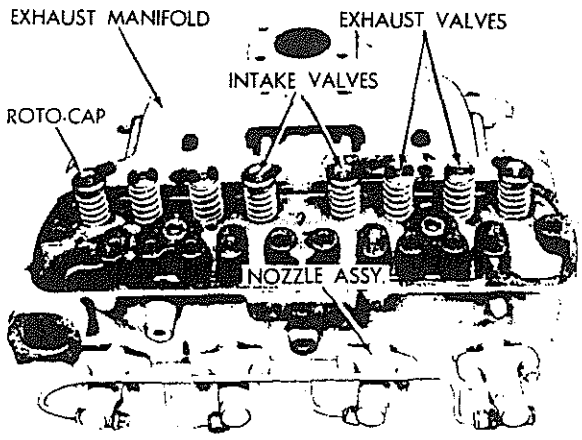
ROCKER ARM ASSY

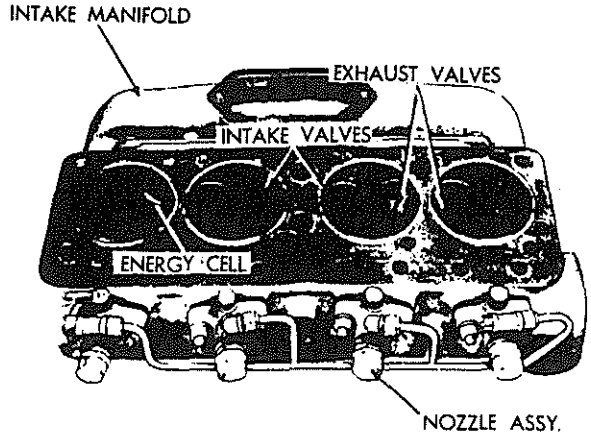


The rocker arm shaft is drilled to lubricate the rocker arm. The rocker arms are drilled to lubricate valves, valve guides, etc. The valve end of rocker arm has an oil wick in it to absorb oil and release it on valve and valve guide . When rebuilding an engine or if valve sticking is experienced the oil wick should be checked and replaced if necessary. The wick and ball is secured by a snap ring.

NOTE: *If valve sticking is experienced the rocker arm shaft should be checked for plugging and proper drilling. The rocker arm should be checked for drilling and oil wick. The valve guides should be checked for proper inside diameter.*

CYLINDER HEAD





REMOVAL

Remove the intake and exhaust manifolds. Remove the water pump, thermostat housing and water manifold. Remove all fuel lines. Cap all fuel line connections to prevent the entrance of dirt. Remove valve cover, rocker arm shaft and push rods. Disconnect oil tube to cylinder head. Remove all studs retaining cylinder head and remove head from engine block.

If the energy cells are to be removed, suitable pullers are necessary. An energy cell puller J-6306 may be obtained through the Kent-Moore Organization. This puller may be used with their slide hammer puller and adapter set number J-4671-02. New energy cells must be lapped to the cylinder head and the cap lapped to energy cell to form a pressure tight seal.

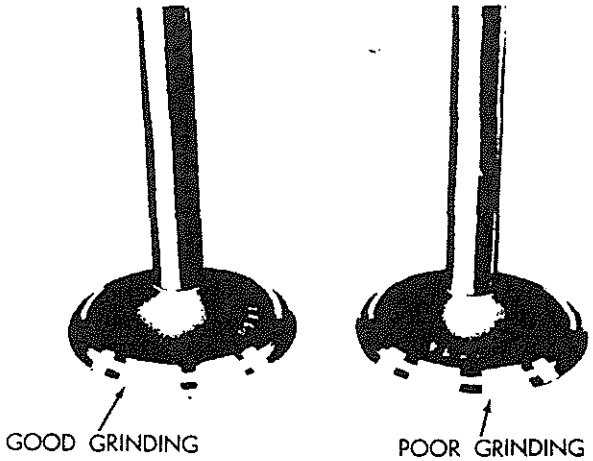
Compress the valve springs, remove the retainer locks and valves. Check the valve stems and guides for wear, the total clearance should not exceed .006". The exhaust valve guide is shorter than the intake guide. When installing guides, press them into the head until guide protrudes 5/16" above the valve cover gasket surface at top of head.

Clean and check the valve face and seats, reface with a high speed grinder to a 45 degree angle. Never allow the seats to become wider than 3/32". This can be controlled by the use of the proper angled cutters to cut down the edges of the seat. Replace valves if burnt or pitted excessively. Reface and re-use valves only where valves appear to be in good condition.

Valve seats may be installed if burnt, pitted or damaged in any way. Seats must also be replaced if ground or worn down until the seat cannot be held to the proper width or if they allow the valve to seat far below their original surface. If new valve seats are to be installed, always install new valve guides first. Special tools are provided for removing and installing valve seats.

New valve springs should measure 2-3/32" long. Replace spring if more than 1/8" short. Install new oil control deflectors on the intake valve stems. Install over valve stems and position so that the oil deflector is shielding the upper end of valve guide.

Valve equipment must be kept clean and in good repair if a good valve job is to be expected. Dial gauges should be used to check the run out of valve seats. Valve seat run out must be .002" or less if a satisfactory valve job is to be expected.



EXAMPLE OF VALVE GRINDING

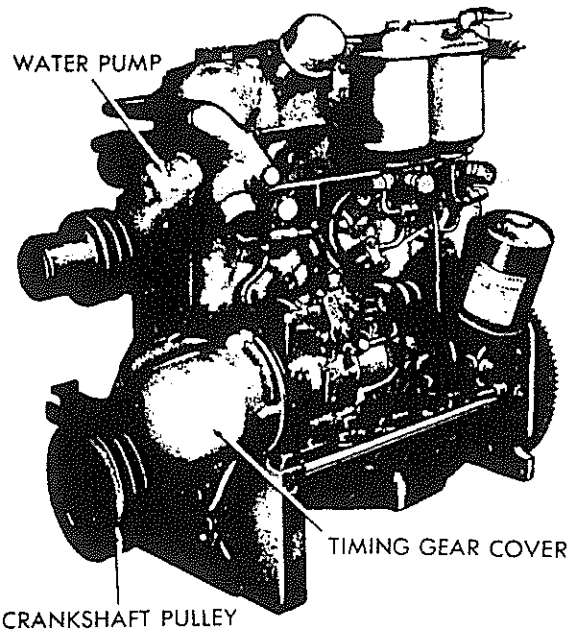
Valves must be lapped to seats using a medium compound. Lap valves only enough to get a good impression of the valve seat on the valve face. The valve face and seats should have a complete circle without waves. After checking valve seating with compound, be sure and clean all compound from valve and seat. Oil valve stems and seats before assembly.

TIMING GEAR COVER

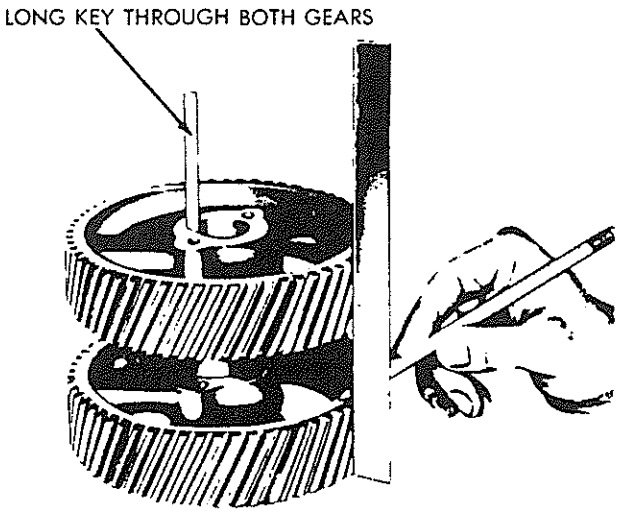
REMOVAL

Remove the nut from end of crankshaft, and pull the pulley from shaft. The clearance between pulley and shaft may be from .000" to .002" loose, making the use of a puller unnecessary.

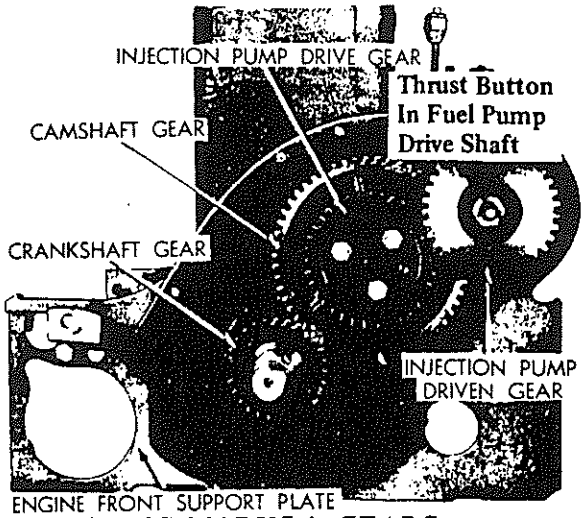
Remove the capscrews retaining the timing gear cover to engine block and remove cover. Replace the front crankshaft oil seal in place in gear cover. The gear cover is located to engine block by two dowel pins, therefore, the oil seal should be properly centered to crankshaft when the gear cover is installed. Tighten the capscrews from 18 to 21 ft. lbs. torque. Tighten the pulley nut at end of crankshaft from 250 ft. lbs. torque.



TIMING GEARS



The timing gears should be checked for backlash with a dial indicator. The gears should be replaced if backlash exceeds .008" or more. Backlash between mating gears should be .001" to .005" with new parts. The gears are a press fit to the shafts and may be replaced if necessary. The gears are marked. These marks must be aligned during assembly.



TIMING MARKS & GEARS

The fuel injection pump drive gear is attached to the camshaft gear hub with dowel pin and capscrews. This gear meshes with (and drives) the driven gear on the injection pump shaft. These two gears are of the same size, therefore, the pump drive shaft turns at engine camshaft speed which is one half engine speed.

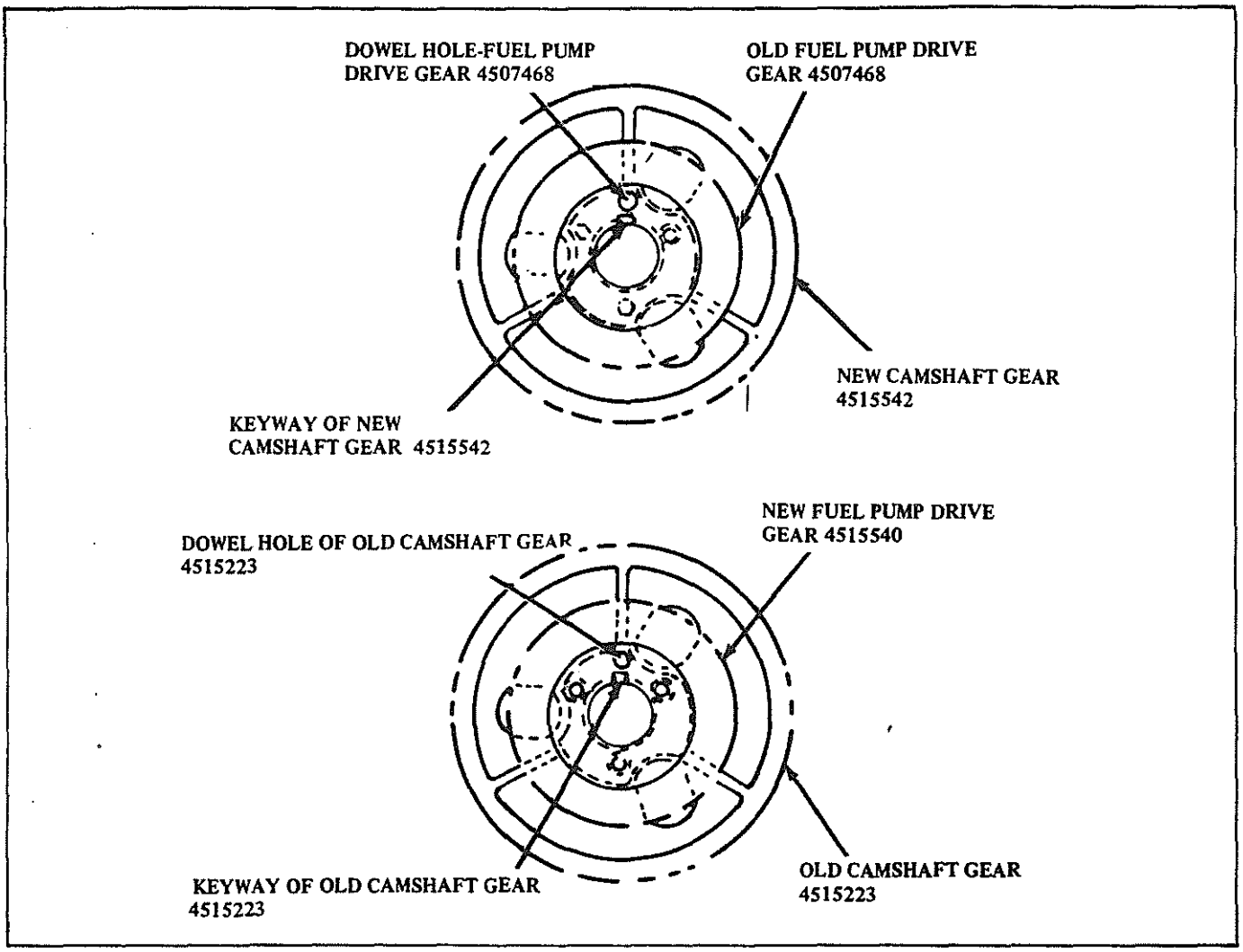
THRUST BUTTON

The thrust button must be installed in fuel injection drive shaft. This button controls the drive shaft end thrust.

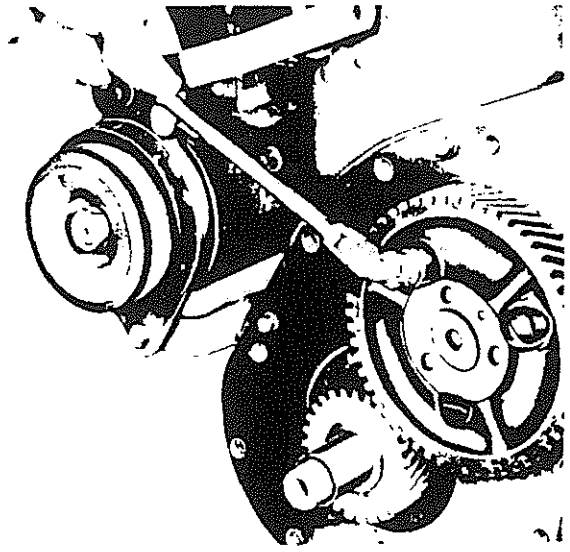
A change was made in the D-175 engine camshaft and fuel pump drive gears which eliminates the locating dowels for positioning the fuel pump gear to the camshaft gear in favor of an arrow on the fuel pump gear which is to be aligned with the keyway in the camshaft gear.

To service the old camshaft gear 4515223 that has been used with an old fuel pump drive gear 4507468 the dowel hole in the old fuel pump drive gear should align with the keyway of the new camshaft gear 4515542 as shown.

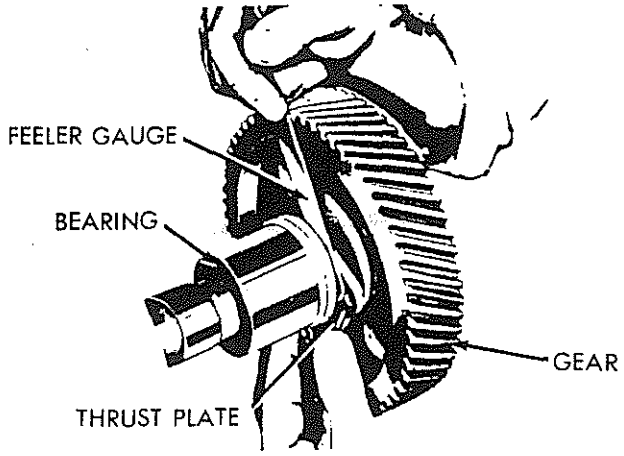
To service the old fuel pump drive gear 4507468 that has been used with the old camshaft gear 4515223, the dowel in the old camshaft gear must be removed and the new fuel pump drive gear 4515540 should be mounted with the arrow pointing to the keyway of the old camshaft gear as shown.



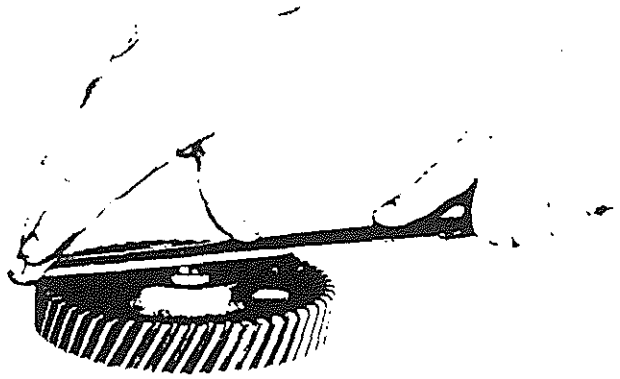
CAMSHAFT



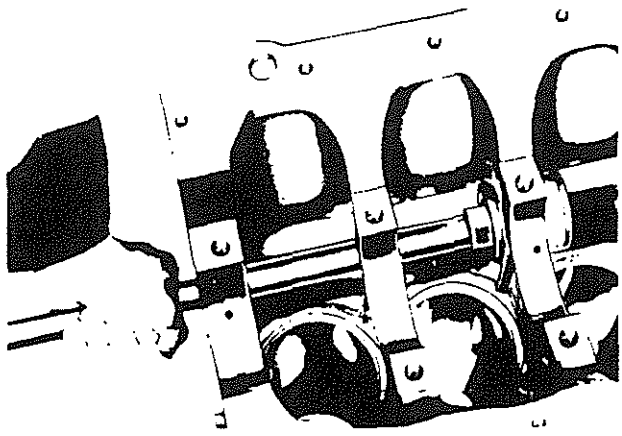
REMOVING CAMSHAFT THRUST PLATE



CHECKING THRUST CLEARANCE



CORRECTING THRUST CLEARANCE



INSTALLING CAMSHAFT BUSHING

REMOVAL

Remove the crankshaft pulley and timing gear cover. Remove the valve cover, rocker arm shaft assembly and push rods. Remove oil sump. Remove the two capscrews attaching the camshaft thrust plate to engine. These capscrews can be removed through the holes in camshaft gear. The gear must be rotated to align a hole with the capscrews.

The camshaft end thrust clearance should be from .003" to .008". The end thrust clearance may be checked by the use of a dial indicator, or by placing a feeler gauge between the thrust plate and the front shaft journal. Checking end clearance with a feeler gauge can best be done with the shaft removed. If the end clearance is excessive, remove gear from shaft and file (or machine) the back side of gear hub. This will permit pressing gear on shaft further, which will reduce the thrust plate clearance. Replace the thrust plate if worn excessively.

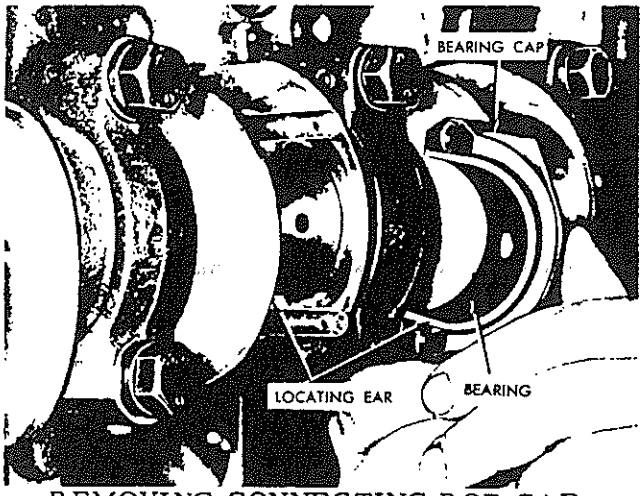
Check the cam lobes for wear or roughness. The cam lift should be .260 on exhaust cams and .260 on the intake cams. There are two different cams used in the D-175 engine. The newer cam shaft has a radius where cam gear goes on. The latest cam gear can be installed on the old cam shaft or new cam shaft. The old cam gear will only fit the earliest production cam shaft.

When installing the new camshaft gear, it is recommended that the gear be preheated to 350°-400°F. for ease of installation and prevention of galling during assembly. An approved method of preheating a gear is in oil, by putting the gear in oil and heating the oil to a boil and installing the gear.

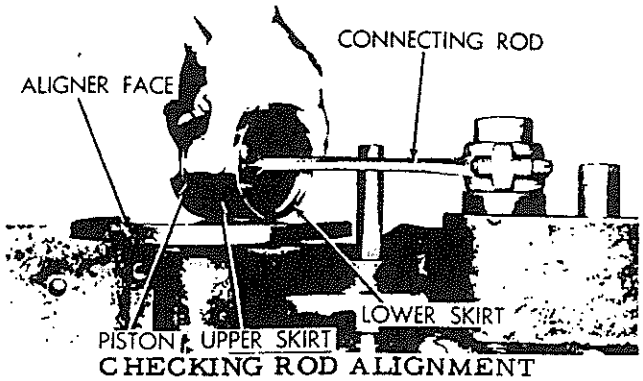
The cam followers should be installed in the same bore in cylinder block from which they were removed. They must be free to rotate in block, otherwise scuffing will result.

The camshaft bushings are removable and should be replaced if clearance exceeds .0065". Original clearance is from .002" to .0046". Bushing drivers are available for removing or replacing bushings. The two intermediate bushings are alike, the front and rear bushings are different. When installing new bushings, line up the oil holes in bushing with the oil holes in engine block. The engine front plate and support can be removed from engine block after the camshaft is removed.

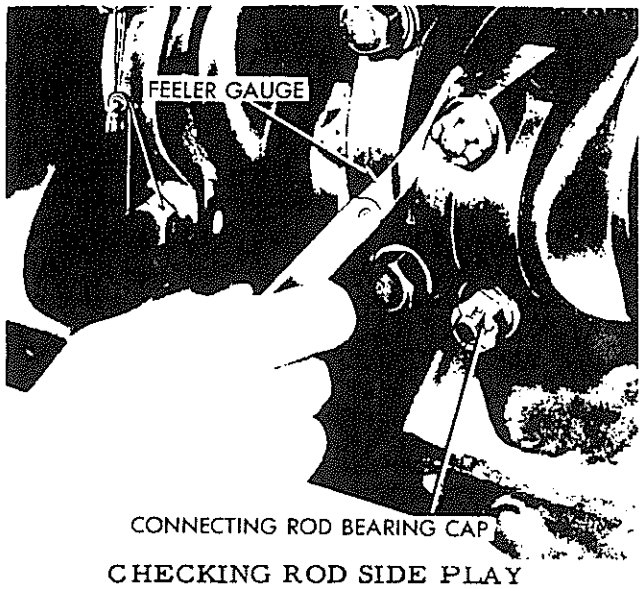
CONNECTING RODS



REMOVING CONNECTING ROD CAP



CHECKING ROD ALIGNMENT



CHECKING ROD SIDE PLAY

REMOVAL

Remove the cylinder head and oil sump. Remove the carbon at top of cylinder liner. Remove rod bearing cap and push rod and piston out of engine block. To remove the connecting rod from the piston, remove the piston pin retaining snap ring and slide pin from piston.

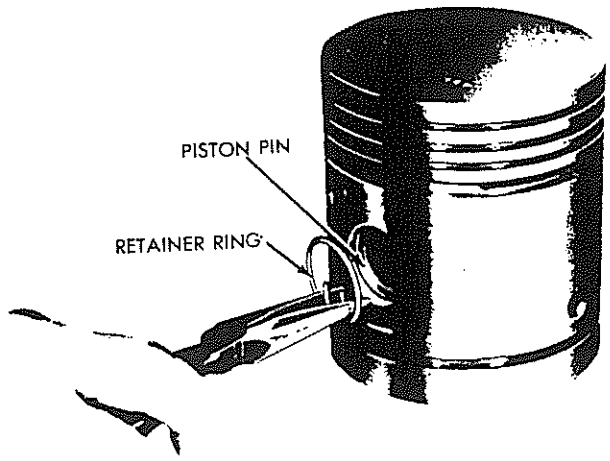
The connecting rods have a removable, precision bearing insert. The rod bearing clearance with new parts should be from .0011" to .0036". Bearings must be replaced if clearance exceeds .006". Bearing clearance can easily be checked with plastic gauge, as no measuring of the material is necessary.

The rod side clearance should be from .003" to .009" with new parts. If the side clearance exceeds .015" the rod or crankshaft must be replaced. Check with measurements listed under specifications. All connecting rods must be checked for alignment before installing in engine. Tighten the rod bolts from 40 to 50 ft. lbs. torque.

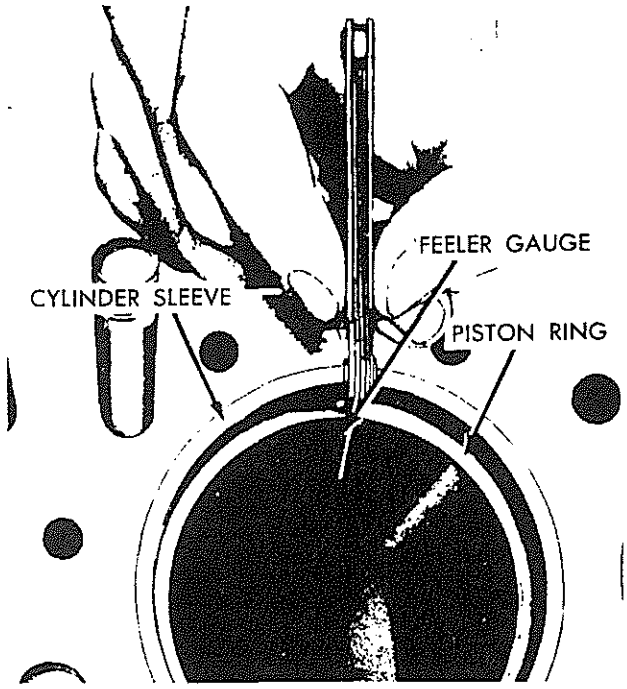
NOTE: There are two types of connecting rods used in the D-175 engines. However, the rods are interchangable with each other.

The piston pin bushing is replaceable in rod, and should be replaced if clearance is .002". When pressing bushing into place be sure the oil hole in bushing is in alignment with drilling in rod. The bushing must then be honed from 1.0001" to 1.0006". A new piston pin should measure from .99955" to .99975". Pin to bushing clearance of new parts should be .00005" to .00035" at 70°F. Reaming does not provide a good finish for these tolerances.

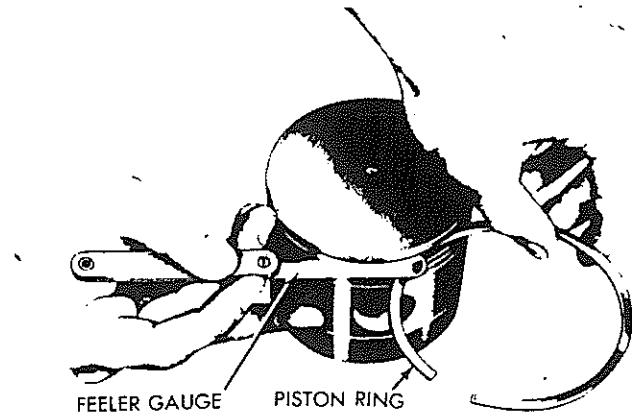
PISTON AND RINGS



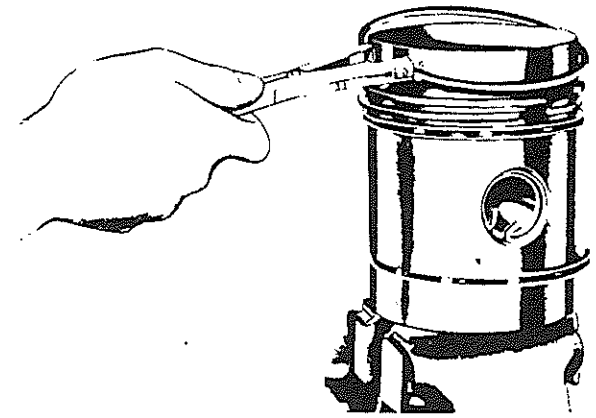
REMOVING RETAINING RING



FITTING PISTON RINGS



CHECKING LAND TO RING CLEARANCE



REMOVING RINGS

REMOVAL

Remove cylinder head and oil sump. Remove connecting rod bearing, caps and push connecting rod and piston assembly from engine. Remove the piston pin retaining snap rings and push the pin from piston. Remove piston from connecting rod.

The piston pin or piston should be replaced if the total wear exceeds .002". The piston pin bore is from .99985" to 1.00005", and the piston pin diameter from .99955" to .99975". The pin to piston clearance should be .0001" to .0005" with new parts at room temperature, 70°F. If the temperature is lower, it will be necessary to heat the piston evenly to assemble piston pin.

The piston has a .009" cam grind. The skirt diameter is 3.5573" to 3.5583" as measured at right angles with the piston pin at bottom of piston skirt. The cylinder liner inside diameter is 3.5623". Therefore, the piston skirt clearance is .004" to .0065" using new parts. Piston or cylinder liners should be replaced if wear exceeds .007".

The piston ring end gap should be checked in cylinder liner before assembling on piston. The top chrome compression ring should have from .007" min. The second and third compression rings are "granoseal processed" and should have from .014" min, end gap. The fourth and fifth oil rings should have from .007" min. end gap.

The first, second and third compression rings should measure .1235" to .124" in width. The fourth and fifth oil rings should measure .182" to .187" in width.

The top compression ring groove width should be .127" to .128" wide, giving the ring .003" to .0045" clearance in groove. The second and third ring groove width should be .126" to .127", giving the rings .002" to .004" clearance in grooves. The fourth and fifth oil ring groove width should be .188" to .1895", giving the oil rings .0015" to .0035" clearance in grooves.

Install the compression rings with the word "Top" upward, toward top of piston. Install the oil rings with the scraper edges downward, toward bottom skirt of piston.

CYLINDERS LINERS

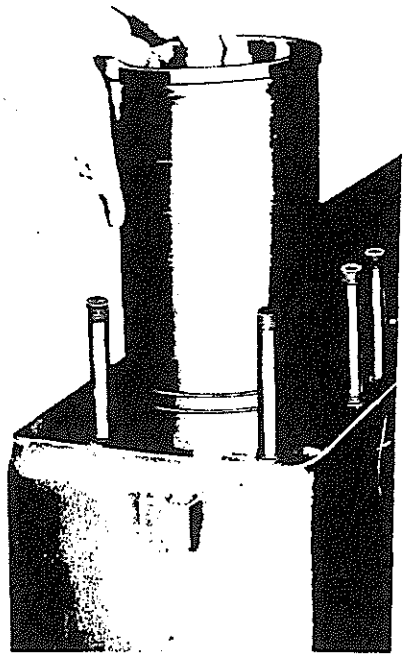
REMOVAL

Remove the cylinder head, oil sump, connecting rods and pistons. The cylinder liners may be pulled from cylinder block with a suitable puller. The liners may also be driven out with a hard wood block. After the liners are removed, the cylinder block should be thoroughly cleaned and all rust and scale removed from inside of block. Clean the surfaces where the liners contact the block thoroughly.

New liners should be thoroughly cleaned before installing. Install the liners in place in block without the liner packing rings. The liners should be free to rotate in cylinder block. Check the liner stand-out, it should be minus .00'' to plus .002".

The liner packing rings are installed in grooves in cylinder block. Be sure these grooves are clean. Use a soft white lead solution on packing rings and bottom end of liner that contacts packing rings. Thin the white lead down to a point where it will act as a lubricant instead of being in a heavy paste form. Install packing rings in grooves without twists. Install liner and push into place in block by hand, being sure no foreign material lodges between block and flange of liner.

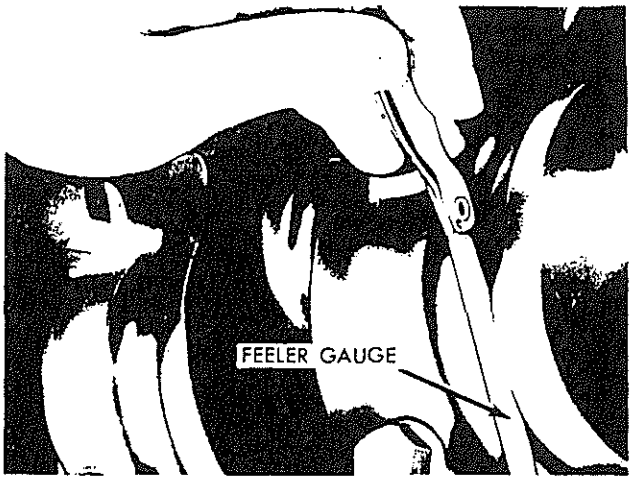
Try the fit of piston into liner without piston rings. The piston should have a free fit in liner



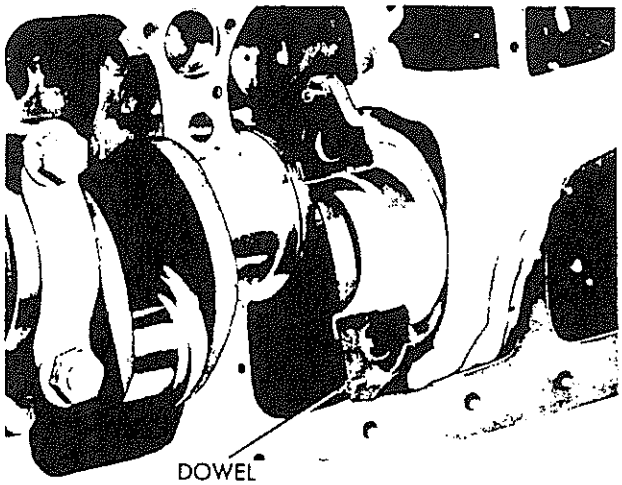
CYLINDER INSTALLATION

as it is moved up and down in all positions. The piston skirt clearance should be from .004" to .0065", and can be checked with a ribbon type feeler gauge. The measurement is checked at bottom of piston skirt at right angles to the piston pin.

CRANKSHAFT



CHECKING CRANKSHAFT END PLAY



REMOVING MAIN BEARINGS

REMOVAL

Remove the oil sump, clutch assembly, flywheel and the rear adapter plate. Remove timing gear cover, camshaft and gear, and the engine front plate and support. If the piston and rods are to be removed, remove the cylinder head. Remove the bearing caps and lift the crankshaft assembly from engine.

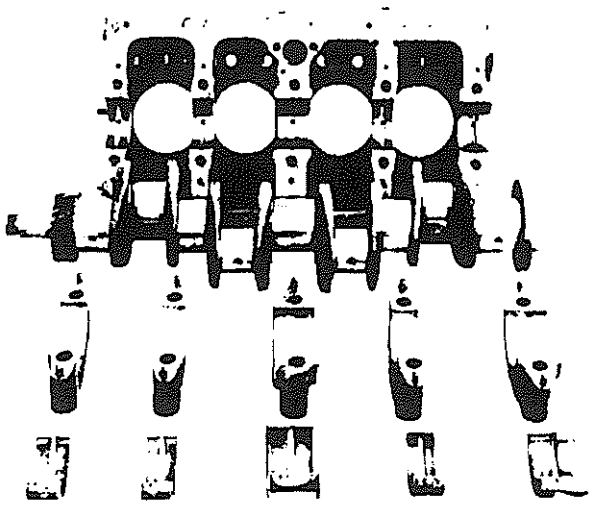
Before removing crankshaft, check the end thrust clearance. The end thrust is controlled by the center main bearing. If end clearance exceeds .011" the main bearing set should be replaced. Never replace one bearing if the rest of bearings are worn. The end clearance, when using new parts, should be from .002" to .007".

caps are numbered in order that they may be replaced exactly as removed.

Before installing crankshaft, be sure all oil passages in block are clean. The oil gallery may be cleaned by removing plugs at each end of block. When installing gallery plugs be sure they are past flush of block. Torque main bearing capscrews from 120 to 130 ft. lbs.

Check the crankshaft journals for wear or roughness, if worn out of round or tapered more than .002", the shaft should be replaced. Check the oil passages in shaft and clean them thoroughly.

The crankshaft bearings are of the precision type and no shims are used. The bearing clearance, when using new parts, should be from .0013" to .004". If clearance exceeds .0065" the bearings should be replaced. Bearing clearance is easily checked by the use of PLASTI-GAGE, as no micrometers are necessary. The main bearing



FRONT CRANKSHAFT OIL SEAL

REMOVAL

Remove hood assemblies. Drain coolant from cooling system. Remove grille and radiator assembly. Remove fan and fan belt. Remove large crankshaft nut securing crankshaft pulley to crankshaft. Pull the pulley from the shaft. The pulley is provided with two tapped holes, (1/4 x 20 N. C.) for removing pulley from shaft.

The clearance between pulley and shaft may be from .0001 to .002" loose, making the use of a puller unnecessary. With the proper tools seal may be pulled from front cover.

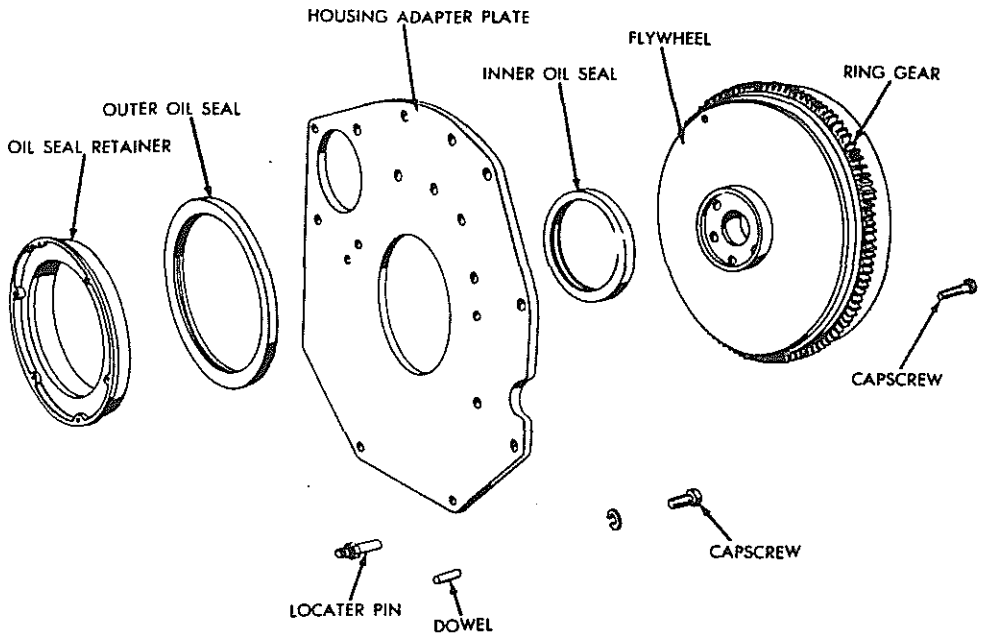
INSPECTION

Inspect seal surface on crankshaft pulley, making certain there are no nicks or burrs or unreasonable amount of wear. Replace pulley assembly if necessary. Clean front cover at seal contact area of any sealer.

INSTALLATION

Using sealer on outside diameter of seal, press or drive seal into position in front cover. Lubricate seal lip, and seal surface of crankshaft pulley with light grease or oil. Install crankshaft pulley, properly torquing crankshaft nut to 250 ft. lbs. Reverse removal procedure for assembly.

REAR OIL SEAL AND ADAPTOR PLATE



REMOVAL

Remove the radiator as outlined under radiator removel. Remove the engine as outlined under engine removal. Remove the engine clutch assembly and flywheel. Use caution when removing or installing the flywheel, as the rear oil seal seats against the hub of flywheel. Remove oil sump. Remove capscrews attaching adaptor to engine block and remove adaptor. This plate must be removed before removing crankshaft.

The rear oil seal is installed in the rear adaptor plate. The seal consists of three parts. A seal retainer, and an inner and outer seal. The seal retainer is pressed into the adaptor plate. Use sealer on outer surface of retainer and opening in adaptor plate. The inner seal is pressed into the seal retainer and seals against hub of flywheel. Use sealer on outer surface of seal. The outer seal seals against the engine block and oil sump. Use sealer on all surfaces of outer seal.

ASSEMBLY

Press the inner seal into seal retainer with the lip of seal towards seal retainer. Press the seal retainer into the adaptor plate from the front side (engine side) of plate. Install the outer seal over the seal retainer. It will be necessary to stretch the seal to fit it to retainer. Use sealer at all surfaces to prevent oil leakage.

Install the adaptor plate assembly to rear of engine block, the dowel pins will center and locate the plate and oil seal to engine. Install the flywheel to crankshaft with the dowel pins in the blind holes. The capscrew holes are not equally spaced, therefore, the holes will only line up in one position. Torque flywheel capscrews from 95 to 105 ft. lbs.

FLYWHEEL

REMOVAL

Remove the engine as outlined under engine removal. Remove the six capscrews attaching the pressure plate assembly to the flywheel and remove the pressure plate assembly and clutch disc. Remove capscrews attaching the flywheel to the crankshaft flange and remove flywheel.

INSPECTION

Check the clutch shaft bushing in flywheel for wear, replace if worn.

Check fit to clutch shaft after installing bushing in flywheel. Check the clutch lining for wear. The flywheel assembly includes a bushing to pilot the end of clutch shaft, and is replaceable if excessive wear occurs. The flywheel ring gear is also replaceable if gear becomes damaged. The old ring gear may be driven from flywheel, but a new one must be heated and expanded until it can be positioned on flywheel without excessive driving. Shrinking the gear onto flywheel causes it to become tight and firmly fixed. Install ring gear with beveled edge of teeth rearward.

When installing flywheel to crankshaft, special positioning is not necessary, as the holes are not equally spaced and flywheel can be attached in only one position. Tighten the flywheel capscrews 95 to 105 ft. lbs. torque.

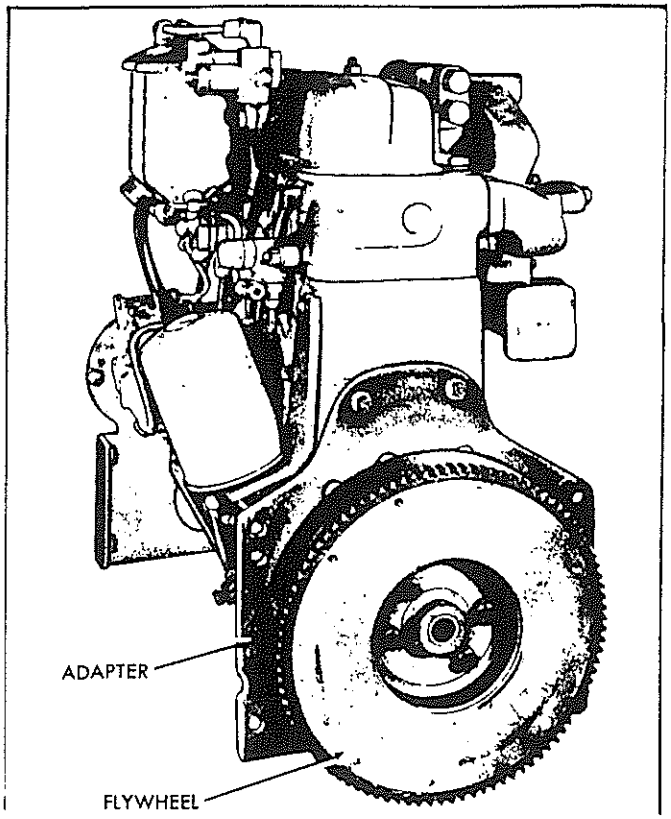
ASSEMBLY

Install the clutch disc assembly with the smooth side toward the flywheel, or the side with the longer hub and dampener springs toward the pressure plate, using tool for centering disc assembly to flywheel.

Install the pressure plate assembly over disc assembly and tighten the retaining capscrews evenly. Torque 17 to 20 ft. lbs.

To disassemble the pressure plate assembly, compress the pressure plate to the back plate, this can be done by using "C" clamps. Remove the pins from the release levers, and slide the levers toward center until the lever spring releases from back plate. Separate back plate from pressure plate and remove the six springs and spring caps.

New clutch springs have a free length of 2-9/16" approximately, and should be replaced if they become 3/32" short. When checking springs with spring compression tester, they should read 180 lbs., when compressed to a height of 1-13/16". Springs are painted lavender for identification purposes.



ASSEMBLY

Place pressure plate on a bench, flat side downward. Place springs over bosses on pressure plate. Place spring cups over springs. Place back plate in position over spring cups. Compress the back plate and pressure plate together, using "C" clamps. Install the release lever springs to release levers. Install the release levers in place, being sure the lever spring is hooked to back plate. Install the lever pin with a spring washer next to head of pin. Install pin so that head of pin will lead in the direction of rotation, and install cotter pin. Remove "C" clamps.

To set the release lever adjustment, it will be necessary to assemble pressure plate assembly to flywheel, using a new disc assembly or one with new lining. When making the release lever adjustment it is necessary that the pressure plate be positioned .336" from the surface of flywheel, this dimension is the thickness of a new disc assembly. Do not use a worn disc assembly when making the release lever adjustment. Install disc assembly with the long hub rearward, using a pilot shaft to line disc assembly to flywheel. Adjust the release levers evenly to a dimension of 1-5/16" from flat surface of spring retainer on clutch disc, to release bearing contact surface of release levers. Tighten pressure plate retaining capscrews 17 to 20 ft. lbs. torque.

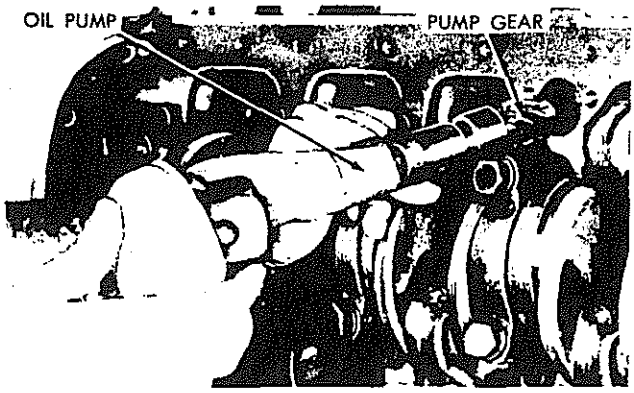
OIL PUMP

REMOVAL

Remove the oil sump. Remove the two capscrews retaining the pump to engine block, and remove pump. Remove the oil screen and cover plate at bottom of oil pump. Drive the pin from the pump drive gear and remove drive shaft from pump body. Remove gear from drive shaft. Remove idle gear and shaft. Idle gear may be pressed from shaft if necessary.

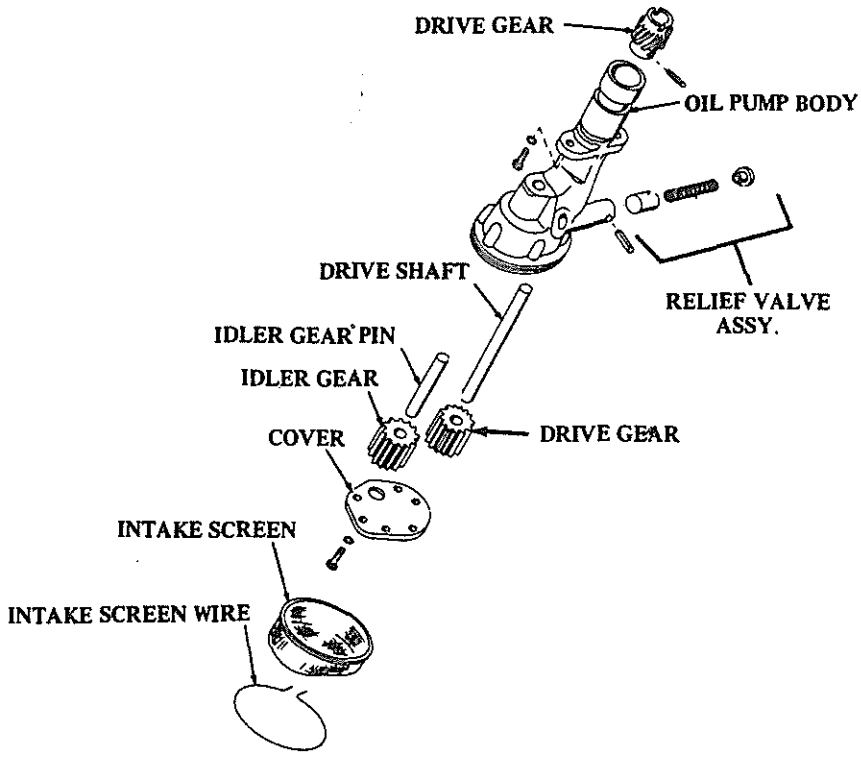
Check the shafts and gears for wear. Excess end play and gear tooth wear reduces the pressure and volume of the pump. The pump gear backlash should not exceed .020" or have more than .006" end clearance between gear and bottom cover plate. Increasing the spring pressure on the relief valve to compensate for low pressure caused by a worn pump, reduces the output volume of the oil pump.

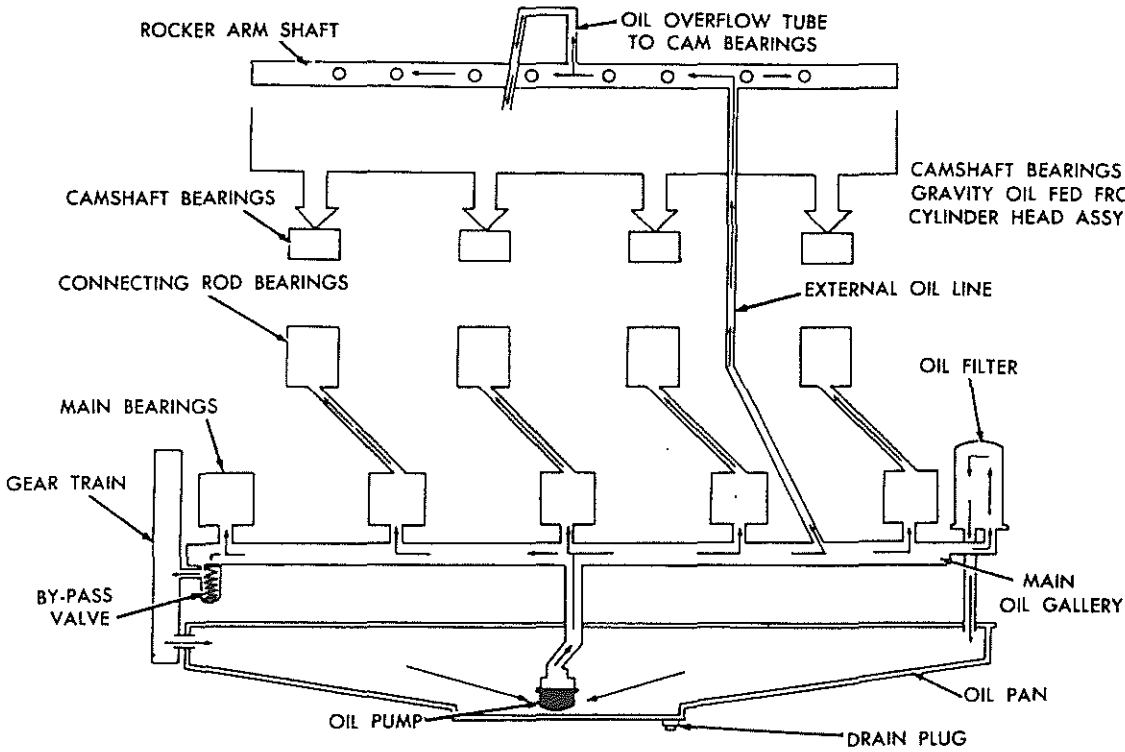
Use caution when removing or installing the pin in the pump drive gear so as to not damage the drive shaft. The pump must rotate freely after assembly, without any binding or tight spots.



REMOVING OIL PUMP

Use caution when tightening the pump mounting capscrews as the pump flange does not fit against the engine block. Tighten capscrews to 18 ft. lbs. torque.





SCHEMATIC OF ENGINE LUBRICATION

OILING SYSTEM

The engine oil pump is located in the bottom of the oil sump and is driven from the camshaft.

Oil from the gear pump is forced through a cored passage to the main distributing line located on left side of engine.

The main gallery supplies oil to each of the main bearings.

From the main bearings the shaft is drilled so that each connecting rod receives oil. Excess oil from bearings lubricates the cylinder walls and pistons by splash.

The by-pass valve is located in the front end of gallery and is set 25 to 40 P.S.I. Excess oil from the by-pass enters the timing gear cover and lubricates the timing gears.

The excess oil drains back to sump through the timing gears.

A line is attached to the outside of engine into the gallery and leads oil to the rocker arms.

Drain back from the rocker arms aids in lubricating the cam followers and camshaft bushings. Another line from the gallery leads to the oil gauge.

The oil filter receives oil from the oil gallery. After the oil is filtered it is returned to the sump.

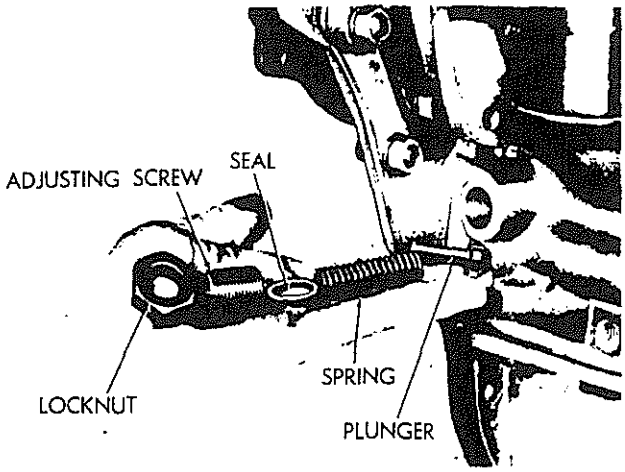
OIL PRESSURE RELIEF VALVE

REMOVAL

The oil pressure relief valve is a spring loaded piston, located at the front end of the engine oil gallery. The spring tension of this valve is adjustable by an adjusting screw. This valve regulates the oil pressure of the engine. This pressure is registered on the pressure gauge located on the instrument panel.

As oil pressure pushes the piston off its seat, the oil escapes through a drilled capscrew at front of engine block. This drilled capscrew is used in the bottom location of the camshaft end thrust plate. Both capscrews in the thrust plate are drilled, but the oil by-pass is through the bottom capscrew only. Oil from the relief valve dumps into the timing gear compartment and lubricates the timing gears.

The oil relief valve should be set at 35 P. S. I. on an engine that is in good mechanical condition, and the oil pump is in good condition. Never adjust oil pressure to compensate for low oil pressure due to a worn engine or oil pump.



PRESSURE RELIEF VALVE

Increasing the relief valve pressure on a worn engine increases the amount of oil through bearings which causes excess splash on inside of engine and generally causes increased oil consumption. Increasing pressure to compensate for a worn oil pump, decreases the pump volume or output.

OIL SUMP

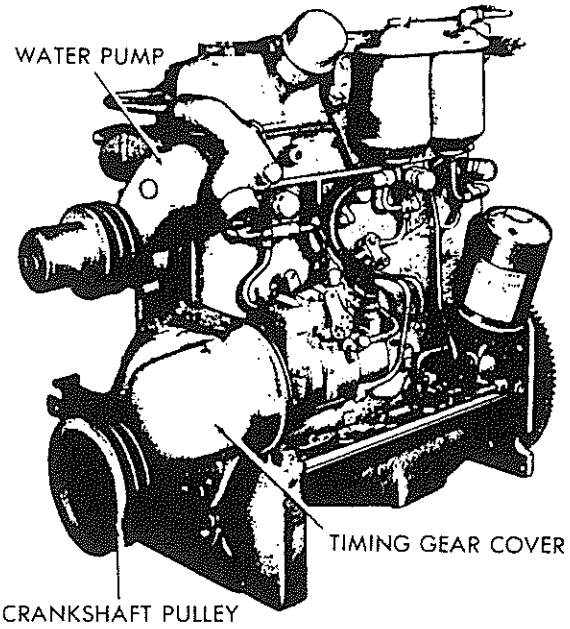
REMOVAL

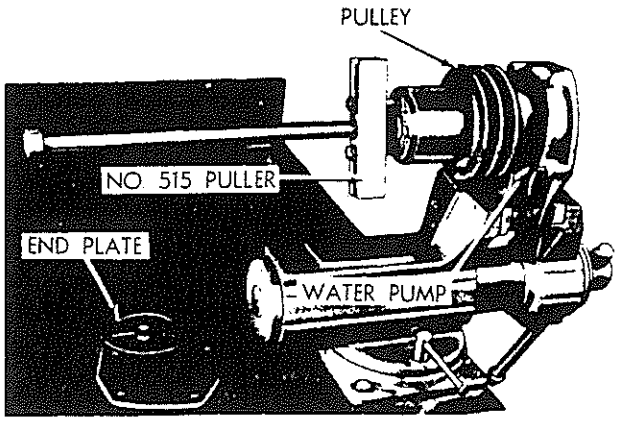
To remove and replace the oil sump it will be necessary to remove the engine from the tractor. Follow the necessary procedure under engine removal. With the engine removed and positioned in engine stand or on proper work bench, drain the oil sump. Remove the necessary capscrews from front timing gear cover attaching to oil sump. These capscrews use a copper sealing washer and should be replaced each time they are removed. Remove the capscrews attaching oil sump to engine block. Use caution in removing oil sump from engine block as the sump may be distorted or the rear arch spread making it difficult to seal at rear gasket.

ASSEMBLY

Properly clean engine block and sump of old gasket. If rear seal was not disturbed or replaced, use sealer around rear arch. Cut and fit the necessary portion of a new back plate gasket to seal front of oil sump. Use a heavy sealer at top corners. Position sump gaskets properly. Install oil sump cautiously into position using care in bringing front of sump into contact with back plate. Install capscrews with new copper gaskets through timing gear cover and back plate into sump. Do not tighten capscrews. Install oil sump capscrews to engine block. Properly torque front capscrews, sealing oil sump at front, and progressively work toward the rear torquing sump capscrews 15 to 20 ft. lbs.

WATER PUMP





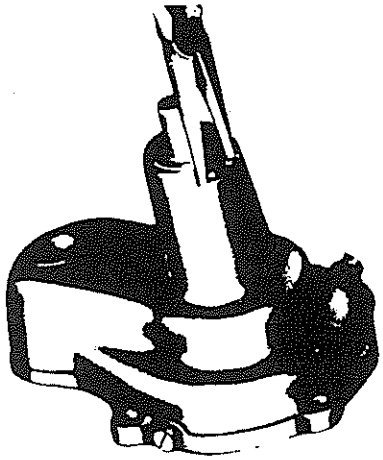
PULLING WATER PUMP PULLEY USING "O.T.C. NO. 515 PULLER

REMOVAL

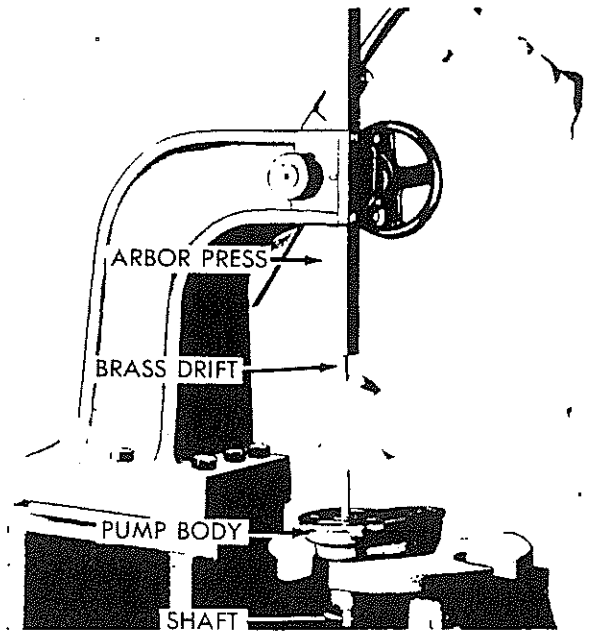
Drain and remove radiator. Remove the fan from pulley hub. Remove the two capscrews attaching the water pump to cylinder head and remove water pump.

Remove the fan pulley from water pump shaft. This can be done by pulling pulley from shaft with the "OTC" No. 515 puller, or by pressing the shaft from pulley.

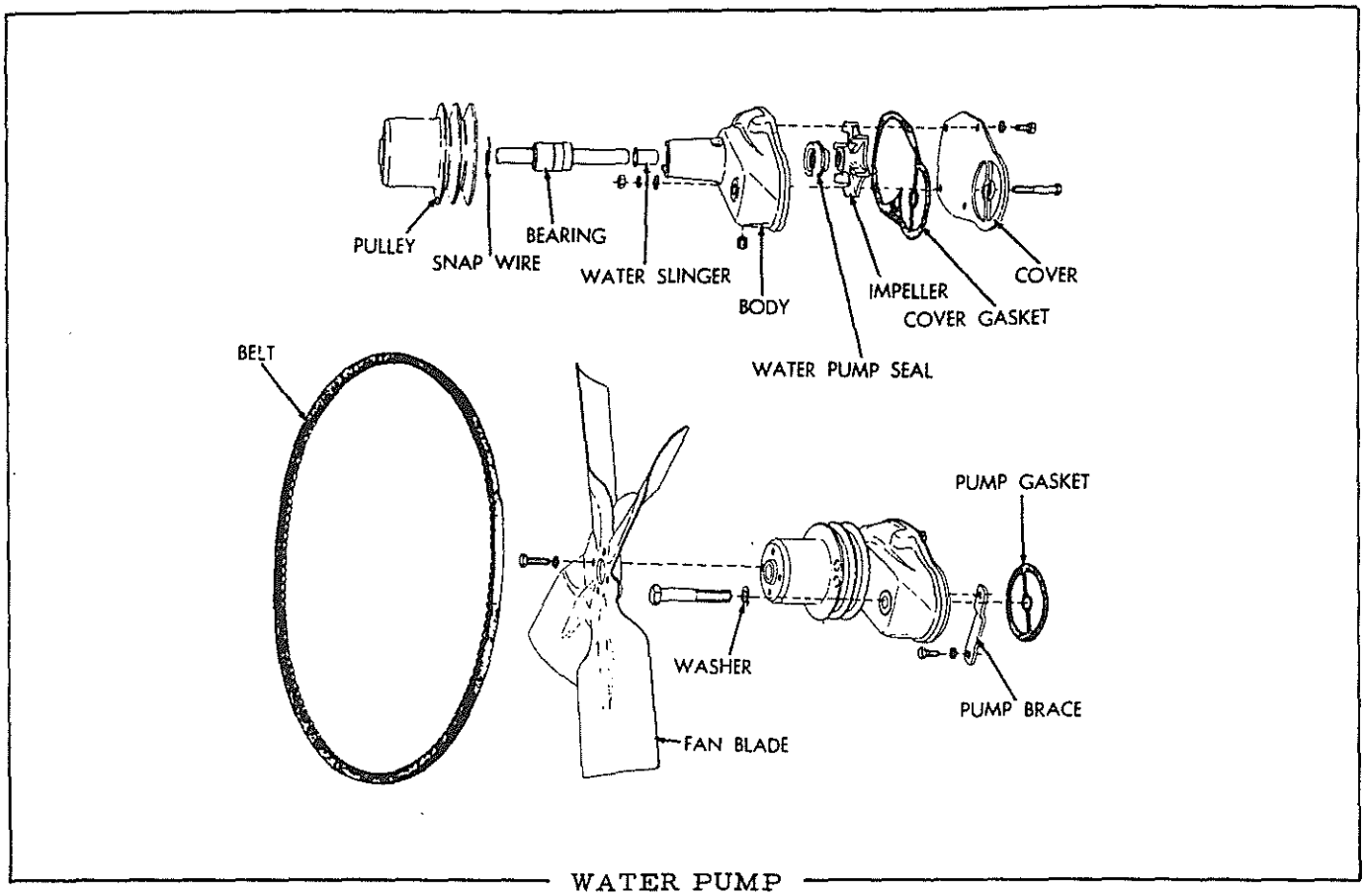
Remove the snap ring at front of pump body retaining the pump shaft and bearing assembly. Remove the cover plate at rear of pump body. Remove the pump impeller by pressing the pump shaft from impeller and pump body. Remove shaft at front of pump body. Remove pump impeller. The seal assembly may now be pressed from pump body, using the Kent-Moore seal removing and installing tool No. J-6902.



REMOVING RETAINING RING



REMOVING SHAFT & BEARINGS



WATER PUMP

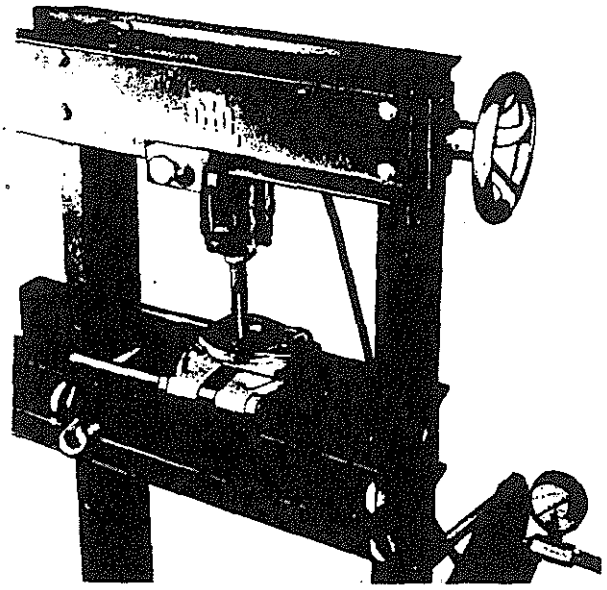
ASSEMBLY

Press the seal assembly into place in pump body, using the Kent-Moore water pump seal removing and installing tool No. J-6902. Apply sealer on outer diameter of seal. Note that the seal surface is not damaged in any way. Apply grease to seal surface.

Install the shaft and bearing assembly into pump body by pressing bearing against inner snap ring. Install the outer snap ring at front of body.

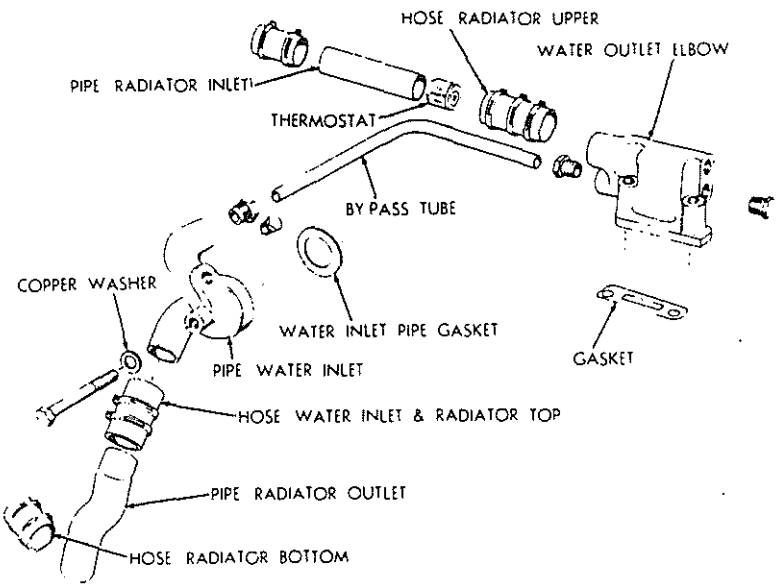
Check the ceramic seal surface on impeller for cracks, chipping or damage in any way. Press the impeller on shaft until the impeller is .030" to .040" below the face of the pump body. Use caution not to cock the impeller on shaft while installing, as this is liable to crack the ceramic seal surface.

Install the fan pulley on shaft until there is 11/16" from front end of shaft to front edge of pulley hub. Install the rear cover plate and capscrews, using a new gasket at rear of pump body. Install pump assembly to engine. Install the fan blade assembly. Install radiator, and fill with coolant.



INSTALLING WATER PUMP SEAL
USING KENT-MOORE J-6902 TOOL

THERMOSTAT



REMOVAL

The thermostat is of the pellet type and is located in the upper radiator hose nearest the water outlet elbow. Drain cooling system until coolant is at cylinder head level so that upper hose may be removed without loss of coolant.

Remove R.H. hood assembly. Loosen hose clamps and remove hose from water outlet elbow and radiator inlet pipe. Loosen the center hose clamp and push thermostat from hose.

In most cases a defective thermostat can be detected from a visual inspection, but if in doubt as to its operation, it may be tested by placing in a container of water where the temperature of water can be controlled.

Place the thermostat and a thermometer in the container of water and as the temperature of water reaches the opening temperature stamped on the thermostat, the thermostat valve should start to open. The opening temperature of thermostat is 180°F.

ASSEMBLY

Install thermostat into center of radiator hose with arrow pointing toward radiator, also the valve end of thermostat will be toward radiator. Tighten center hose clamp to hold thermostat in position.

Reinstall radiator hose, being sure to position hose so that thermostat will be positioned properly and tighten hose clamps. Refill cooling system and check for leaks. Replace the R.H. hood assembly.

TITLE

GENERAL

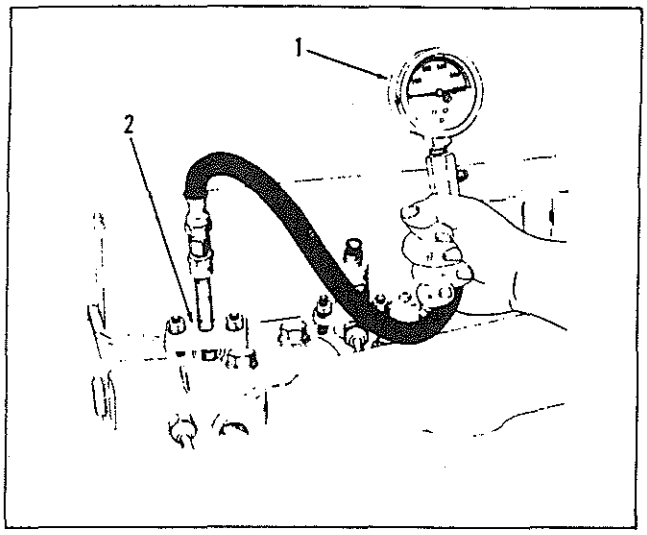
It has been proved that over 90% of the troubles that occur in engine operation are avoided when those responsible for maintenance adhere to an adequate program of lubrication, inspection, and maintenance. The time and expense involved in such programs is only a fraction of that incurred when poor maintenance practice results in a major malfunction or breakdown.

In most cases, when a trouble is detected and remedied immediately, a more expensive, time-consuming repair will be avoided. The following list of troubles , causes, and remedies is given to aid the operator in locating and correcting mechanical and electrical troubles as quickly as possible. For detailed inspection and service procedures for any given component, refer to that section or topic in the manual pertaining to the part, assembly, or system.

ENGINE

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine will not turn	1. Battery weak.	1. Recharge or replace battery.
	2. Starter or starter switch inoperative.	2. Repair or replace defective parts.
	3. Engine locked or seized.	3. This can be due to extended idle or storage periods, or to improper preparation of the engine for storage, in which case the parts may be rusted or corroded and seized. Broken piston rings, gears, etc., may also cause locking. Repair or replace defective parts.
	4. Hydro-static lock.	4. This can be due to rain water entering uncovered exhaust pipe, leaking cylinder head gasket, cracked block or cylinder head. Repair or replace defective parts.
Engine will not start	1. Slow cranking speed.	1. Specific gravity of battery too low. Charge battery. Starter not delivering maximum torque. Repair or replace defective parts. Use cold weather starting aids if applicable.
	2. Engine controls out of adjustment	2. Check all engine control linkages for proper adjustment.
	3. Insufficient supply of fuel to fuel injection nozzles.	3. Check fuel system and clean sediment bowl.

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine will not start (Cont)	4. Fuel injection nozzles not operating properly.	4. Test and repair or replace nozzles.
	5. Fuel injection pump improperly timed.	5. Time fuel injection pump.
Engine hard to start	1. Battery weak.	1. Recharge or replace battery.
	2. Insufficient fuel in fuel tank.	2. Check fuel level in tank. Fill with specified fuel if necessary.
	3. Incorrect grade of fuel.	3. Drain fuel system. Fill the tank with the specified fuel.
	4. Clogged filter/sediment bowl.	4. Replace filter, clean sediment bowl.
	5. Fuel injection nozzles not operating properly.	5. Test and repair or replace nozzles.
	6. Fuel transfer pump not operating properly.	6. Test and repair or replace fuel transfer pump.
	7. Air in fuel system.	7. Correct air leaks in suction side of fuel system. Vent fuel system.
	8. Insufficient air supply to cylinders.	8. Clean air system.
	9. Fuel injection pump improperly timed.	9. Time fuel injection pump.
	10. Valve lash incorrect.	10. Adjust valve lash.
	11. Piston rings or cylinder liners worn.	11. Replace affected parts.
	12. Valves warped or pitted.	12. Recondition or replace valves and/or valve guides.
Engine stops frequently	1. Idling speed too low.	1. Adjust low idling speed.
	2. Restricted fuel supply.	2. Check fuel system.
Engine stops suddenly	1. Out of fuel.	1. Fill fuel tank with specified fuel and vent the fuel system.
	2. Restricted fuel supply.	2. Check fuel system.
	3. Broken or loose fuel lines.	3. Correct or replace affected parts.
	4. Fuel transfer pump or fuel injection pump inoperative.	4. Replace inoperative parts.
Engine overheats	1. Leak in cooling system.	1. Correct all leaks and fill cooling system.
	2. Radiator core clogged.	2. Clean and flush radiator.
	3. Radiator air passages clogged.	3. Remove debris from radiator core.



1. Compression tester gauge assembly
2. Compression tester adaptor

Checking Compression Pressure

Compression pressure for a normal engine at normal operating temperature firing on five cylinders at 600 rpm and at sea level conditions is 500 psi.

When checking compression pressure, altitude at which engine is located must be taken into consideration for an accurate evaluation of test, because the density of air decreases as altitude increases. For each 1000 feet of altitude above sea level the specified sea level figure of 500 psi must be derated 3%.

It is common practice to consider a differential of 25 psi between one or more cylinders as an indication of possible trouble. This is not always true. Pressure readings taken at 600 rpm are not always representative of what is happening within the engine at 1800 or 2000 rpm, under load. If a spread between cylinders of 25 psi or more at 600 rpm is noted and there is no evidence of excessive oil consumption, intake or exhaust valve blow-by into the manifolds, or loss of engine power, it is safe to continue to operate the engine. However, if any of the above conditions exist, or if a difference of 50 psi or more is noted between cylinders, the cylinder head should be removed and a detailed inspection made of cylinder head, valves, pistons, rings, and cylinder sleeves, and necessary repairs should be made to eliminate cause of the low compression pressure.

NOTE In order to obtain an accurate pressure indication, make certain the compression tester gauge has been properly tested and calibrated. Do not rebuild an engine because of low compression readings obtained with a compression tester unless the gauge is known to be accurate.

To check compression pressure, proceed as follows:

a. Start engine and warm up to a minimum temperature of 160°F.

b. Shut off engine. Remove drip manifold from the nozzle holder assemblies. Either plug or connect a rubber hose to the upper end of the tube assembly that connects the drip manifold to the overflow tee at the injection pump. If hose is used, place lower end of hose in a container in order to collect fuel overflow from the injection pump.

CAUTION Do not plug return of fuel to tank.

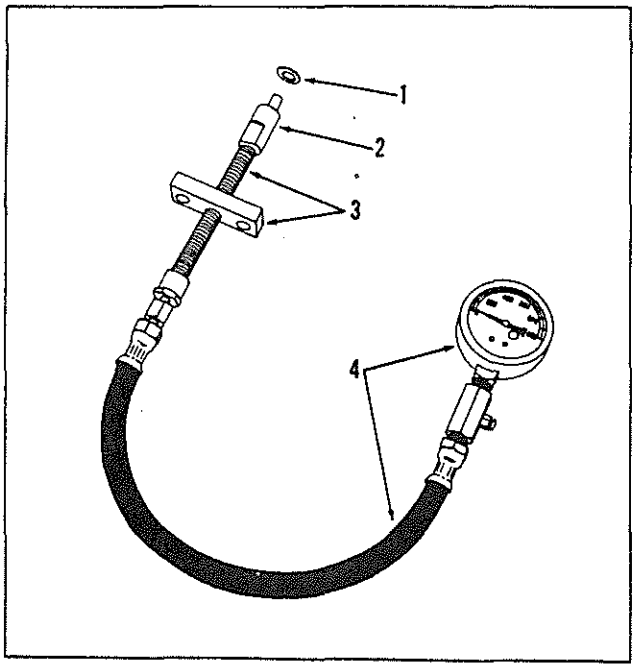
c. Start compression check on cylinder Number 1. Remove the fuel injection nozzle and install compression tester adapter and nozzle gasket in same manner the fuel injection nozzle was installed. Install the compression tester hose and gauge assembly. (See Figure 1.)

d. Start engine and run at approximately 600 rpm. Take several readings on gauge.

NOTE Do not check compression by cranking engine with starter.

e. Stop engine and remove the compression tester assembly. Install nozzle holder assembly. Connect fuel injection line.

f. Repeat procedure detailed above in Steps c, d, and e, to check compression of each of the remaining cylinders.



1. Nozzle gasket
2. Adaptor tip
3. Adaptor
4. Compression gauge assembly

Tools For Checking Compression

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine overheats (Cont)	4. Fan drive belt too loose.	4. Adjust fan drive belt to proper tension.
	5. Thermostat inoperative.	5. Replace thermostat.
	6. Engine oil cooler clogged.	6. Clean or replace the oil cooler core.
	7. Improper engine lubrication.	7. Check for proper operation of engine lubricating oil pump.
	8. Water pump malfunctioning.	8. Repair or replace the water pump.
	9. Fuel injection pump improperly timed.	9. Time fuel injection pump.
Engine shows loss of power	1. Insufficient supply of air to cylinders.	1. Clean air system.
	2. Insufficient supply of fuel to fuel injection nozzles.	2. Check fuel system.
	3. Governor not operating properly.	3. Inspect and adjust governor.
	4. Air in fuel system.	4. Vent fuel system. Check for air leaks on suction side of fuel transfer pump.
	5. Clogged fuel filter.	5. Change filter element.
	6. Improper valve lash.	6. Adjust valve lash.
	7. Fuel injection pump improperly timed.	7. Time fuel injection pump.
	8. Inoperative fuel injection pump or fuel injection nozzles.	8. Repair or replace affected parts.
	9. Cylinder cutting out.	9. Locate "missing" cylinder as follows: Run engine at low idle speed and cut out each fuel injection nozzle in turn by loosening the fuel injection line nut attaching line to fuel injection pump. A decrease in engine speed with line nut loosened indicates nozzle for that cylinder is functioning properly. If engine speed does not decrease, nozzle is malfunctioning and must be replaced.
	10. Loss of compression.	10. This may be due to leaking valves or to worn piston rings or cylinder sleeves. Use a suitable compression tester, Figure 2, and check each cylinder as detailed in following paragraphs.

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine runs unevenly and vibrates excessively	1. Governor not operating properly.	1. Adjust governor and linkage.
	2. Fuel supply erratic or insufficient.	2. Check fuel system.
	3. Engine operating temperature too low.	3. Check thermostats.
	4. Fuel injection pump malfunctions.	4. Check fuel injection pump.
	5. Valves in bad condition.	5. Recondition valves.
	6. Cylinder "cutting-out."	6. Correct cause.
	7. Fuel injection nozzle malfunctions.	7. Repair nozzle.
Engine emits black smoke from exhaust	1. Air system clogged.	1. Check engine air intake system.
	2. Fuel injection pump roller-to-roller dimension incorrect.	2. Correct roller-to-roller dimension.
	3. Improper fuel.	3. Drain fuel system and refill with specified fuel.
	4. Lack of good fuel injection nozzle spray pattern.	4. Clean and adjust nozzles.
Engine emits bluish-white smoke from exhaust	1. Engine operating temperature too low.	1. Check thermostat.
	2. Clogged fuel injection nozzles.	2. Clean and adjust nozzles.
	3. Low compression.	3. Make compression test and necessary repairs.
	4. Early fuel injection pump timing.	4. Test and adjust.
Engine detonates or knocks	1. Fuel pump improperly timed.	1. Check and adjust.
	2. Loose bearings.	2. Replace bearings.
	3. Loose piston.	3. Inspect piston assembly. Replace parts required.
	4. Loose flywheel.	4. Check tightness of flywheel bolts and dowel. Tighten/replace parts required.
	5. Improperly adjusted valve(s).	5. Check and adjust.
	6. Foreign material in cylinder(s).	6. Make necessary repairs.

STARTING SYSTEM

TROUBLE	POSSIBLE CAUSES	REMEDY
Starter will not crank engine	1. Battery weak.	1. Check battery.
	2. Cables and/or connections loose or corroded.	2. Tighten all loose connections and clean corrosion from all terminals.
	3. Starter switch inoperative.	3. Replace switch.
	4. Starter brushes worn or not contacting properly.	4. Install new brushes or fit brushes to conform to contour of commutator.
	5. Starter brush springs weak.	5. Check brush spring tension, replace springs if necessary.
	6. Starter commutator dirty or worn.	6. Polish commutator, machine commutator and under-cut mica if necessary.
	7. Starter armature shaft bushings worn (armature drags on fields).	7. Replace worn bushings and related items.
	8. Starter armature burned out.	8. Replace armature.
Starter pinion will not engage with flywheel ring gear	1. Grease and/or dirt in starter drive mechanism.	1. Disassemble and clean the drive assembly.
	2. Broken or excessively worn parts.	2. Replace broken or worn parts.

FUEL SYSTEM

TROUBLE	POSSIBLE CAUSES	REMEDY
Insufficient fuel supply to fuel injection nozzles	1. No fuel in fuel tank.	1. Fill fuel tank with specified fuel. Vent fuel system.
	2. Inoperative fuel transfer pump.	2. Repair or replace transfer pump.
	3. Fuel injection nozzle valve binding in valve body.	3. Replace valve assembly in nozzle holder body.
	4. Fuel lines/fuel filter/sediment bowl clogged.	4. Clean fuel system components, replace fuel filter.
	5. Fuel injection pump malfunctioning.	5. Replace fuel injection pump.
	6. Fuel injection nozzles improperly adjusted.	6. Adjust fuel injection nozzles.
Air in fuel system	1. Loose fuel line fitting or leak in fuel line on suction side of fuel transfer pump.	1. Tighten loose fitting or replace damaged line.
	2. Damaged gasket on fuel filter.	2. Replace fuel filter.

AIR INTAKE SYSTEM

TROUBLE	POSSIBLE CAUSES	REMEDY
Insufficient air supply to cylinders	1. Air cleaner clogged.	1. Replace air filter element.
Rapid wear on engine parts	1. Dirt admitted with intake air.	1. Inspect air cleaner body, pipe, connecting hoses, gaskets, etc., thoroughly for cracks or openings which would allow air to enter engine without passing through air cleaner. Make necessary repairs.
	2. Dirty lubricating oil.	2. Change engine oil and the lubricating oil filter element at the intervals recommended. Keep oil clean when filling engine.
	3. Improper fuel.	3. Use the proper fuel. It is important that the fuel be within the specified limits for ash, carbon, sulphur, etc., to prevent excessive wear on engine parts.

COOLING SYSTEM

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine operating temperature too high with ample coolant in system	1. Temperature gauge inoperative.	1. Check gauge. Replace if necessary.
	2. Radiator air passages restricted.	2. Clean exterior of radiator.
	3. Thermostat inoperative.	3. Replace thermostat.
	4. Loose or broken fan drive belt.	4. Adjust or replace fan drive belt.
	5. Lime deposits in water passages of radiator, cylinder head and/or cylinder block.	5. Thoroughly clean affected parts.
	6. Water passages in oil cooler restricted.	6. Remove and clean oil cooler core.

TROUBLE	POSSIBLE CAUSES	REMEDY
Engine operating temperature too high with ample coolant in system (Cont)	7. Water pump inoperative. 8. Engine pulling excessive load. 9. Engine speed set too high.	7. Repair or replace water pump. 8. Reduce load. 9. Adjust speed to within specified rpm limits.
Engine operating temperature too high due to loss of coolant	1. External leaks. 2. 3. Engine cylinder head gasket leaking. 4. Engine cylinder heads cracked. 5. Engine cylinder block cracked.	1. Repair affected parts. 2. 3. Replace gasket and torque cylinder head capscrews as specified. 4. Replace cylinder head. 5. Replace cylinder block.
Engine operating temperature too low	1. Thermostat stuck in open position. 2. Operating in extremely cold weather.	1. Replace thermostat. 2. Provide covers for radiator and engine side openings.

LUBRICATING SYSTEM

TROUBLE	POSSIBLE CAUSES	REMEDY
No lubricating oil pressure	1. Insufficient oil in crankcase. 2. Oil pressure gauge inoperative. 3. Lubricating oil pump screen clogged. 4. Lubricating oil pump inoperative. 5. Oil line loose or broken inside crankcase.	1. Fill crankcase to proper level. 2. Replace gauge. 3. Remove and clean the screen. 4. Repair or replace oil pump. 5. Repair or replace affected parts.
Low lubricating oil pressure with proper oil level in crankcase	1. Oil pressure gauge inaccurate. 2. Oil pressure relief valve or regulator valve stuck in open position. 3. Oil line in crankcase loose or broken. 4. Improper lubricant. 5. Main and/or connecting rod bearings worn.	1. Check gauge. Replace if necessary. 2. Clean, repair, or replace affected parts. 3. Repair or replace affected items. 4. Fill crankcase with specified lubricant. 5. Replace bearings.

TROUBLE	POSSIBLE CAUSES	REMEDY
Low lubricating oil pressure with proper oil level in crankcase (Cont)	6. Camshaft bearings worn. 7. Lubricating oil pump worn.	6. Replace bearings. 7. Repair or replace oil pump.
Excessive lubricating oil pressure	1. Oil pressure gauge inaccurate. 2. Oil pressure regulating valve improperly adjusted. 3. Improper lubricant.	1. Check gauge. Replace if necessary. 2. Adjust valve to obtain proper pressure. 3. Fill crankcase with specified lubricant.
Overheating of lubricating oil	1. Insufficient oil in crankcase. 2. Improper lubricant.	1. Fill crankcase to proper level. 2. Fill crankcase with specified lubricant.
Excessive oil consumption	1. External oil leakage (gaskets, etc.). 2. Engine oil seals worn or damaged. 3. Lubricating oil too light. 4. Pistons, rings, and/or cylinder sleeves worn. 5. Oil control rings stuck in piston ring grooves. 6. Valve guides worn.	1. Correct all external leaks. 2. Replace oil seals. 3. Fill crankcase with specified lubricant. 4. Replace affected parts. 5. Clean ring grooves and replace rings. 6. Replace valve guides. Check related parts.
Excessive oil consumption during first 250 hours of operation and no indication of improvement	1. Rings not seated properly. 2. Engine oil viscosity too light.	1. Allow more time for break-in. Make certain specified lube oil is used and engine is at operating temperature. 2. Use recommended viscosity.
Rapid wear on engine parts	1. Lubricating oil contaminated. 2. Improper engine lubricating oil being used.	1. Fill system with clean engine oil. Replace engine oil filter. 2. Fill system with engine lubricating oil of proper specifications.

ELECTRICAL SYSTEM

TROUBLE	POSSIBLE CAUSES	REMEDY
Alternator not charging	1. Alternator drive belt loose or broken.	1. Adjust or replace drive belt.
	2. Alternator regulator inoperative.	2. Remove regulator for repair or replacement.
	3. Alternator inoperative.	3. Remove alternator for repairs or replacement.
Alternator output low and/or unsteady	1. Alternator drive belt improperly adjusted.	1. Adjust drive belt.
	2. Brushes sticking in brush holders.	2. Free brushes in holders.
	3. Brush spring tension too low.	3. Replace brush springs.
	4. Slip ring dirty or worn.	4. Clean slip ring or remove alternator for repair or replacement.
	5. Voltage regulator operating improperly.	5. Remove regulator for repair or replacement.
Battery will not hold charge	1. Loose terminals or connections.	1. Tighten affected parts.
	2. Short in electrical system.	2. Correct short.
	3. Short circuit in battery.	3. Remove and repair or replace battery.
	4. Electrolyte level low (alternator output excessive or cracked battery case).	4. Reduce charging rate. Remove and repair or replace battery.
	5. Voltage regulator inoperative.	5. Remove regulator for repair or replacement.

INSTRUMENTS

If any of the instruments fail to register proper readings while the engine is in operation, the system to which the instrument applies should be thoroughly checked. If failure of the instrument is suspected, test by installing a new, tested instrument in its place. Replace any inoperative instruments.

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ROOSA MASTER MODEL "DB" PUMP

D

FUEL INJECTION

ROOSA MASTER MODEL "DB" PUMP

This section is expressly intended to provide sufficient information for qualified technicians experienced in diesel engines and diesel injection equipment to disassemble and assemble the Roosa Master Fuel Injection Pump and to make such adjustments and parts replacements as may be needed. It is recommended than an inexperienced person refrain from making adjustments and repairs, as such action may result in very extensive damage to the pump and possibly to the engine.

No services should be performed on the pump before making a careful study of this section and becoming familiar with the principles and instructions which follow.

This section completely describes the operating principles of the various mechanism of the pump itself as well as its accessories.

Only through a thorough knowledge of these principles of the various mechanisms of the pump itself as well as its accessories can the service man locate and correct possible operational faults.

FUEL SYSTEM

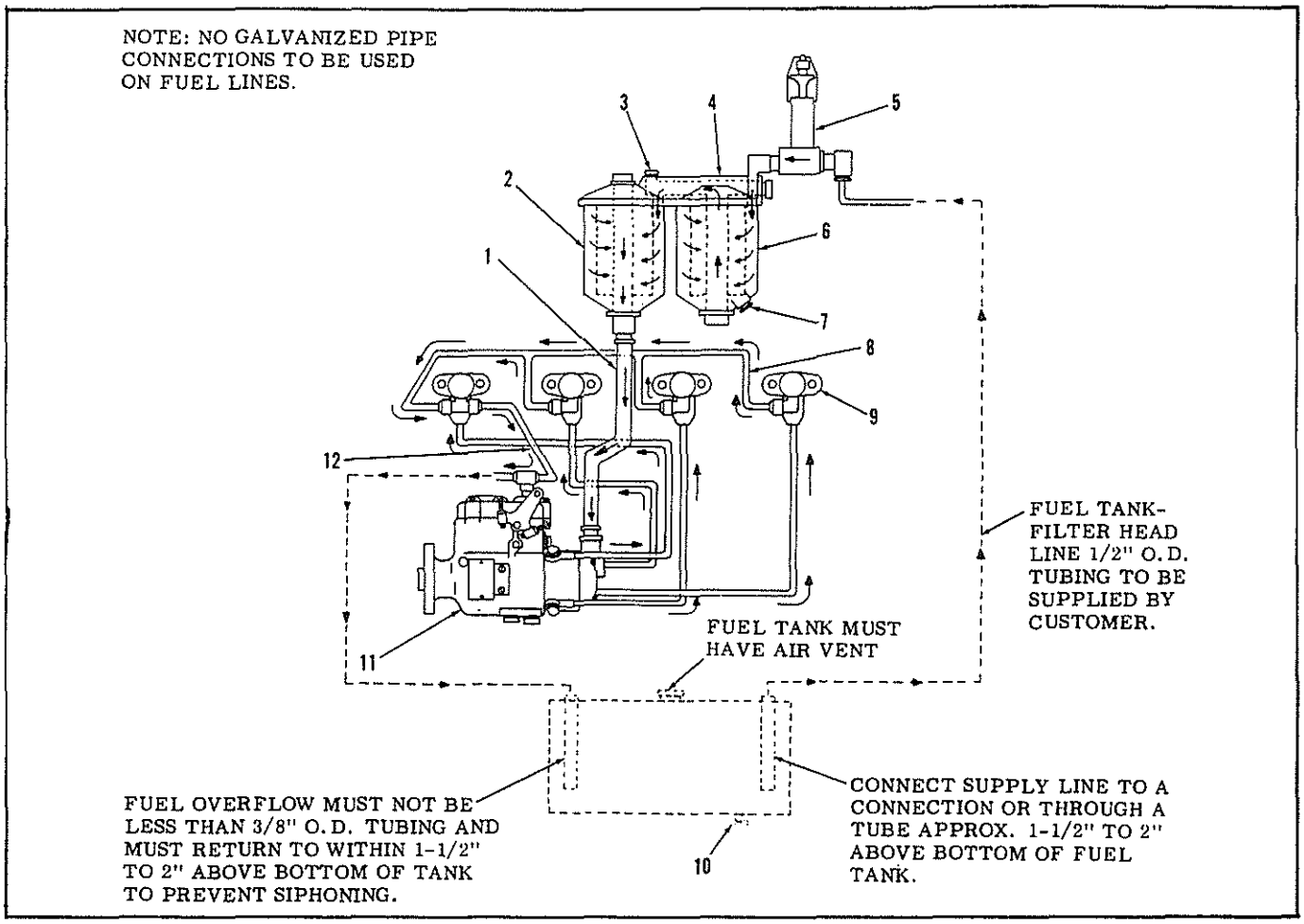
GENERAL

The fuel system consists of a fuel tank, hand primer pump (optional), primary and secondary fuel filters, transfer pump, fuel injection pump, fuel injection nozzles and fuel lines. There are two fuel pressure systems, low pressure and high pressure.

The low pressure system is comprised of the fuel tank, hand primer pump, primary and secondary fuel filters, transfer pump, fuel lines between the fuel tank and the fuel pump and leakage return lines.

The high pressure system begins in the fuel injection pump where the fuel is forced by the action of cam-actuated plungers into the outlet ports and through the high pressure fuel lines connected to the fuel injection nozzles.

The fuel is drawn from the fuel tank through the primary and secondary filters by the transfer pump located at the rear of the fuel injection pump. The fuel is then forced by the transfer pump to the cam-actuated plungers which force the fuel under high pressure through the fuel lines to the fuel injection nozzles from which the fuel enters the combustion chambers in the form of a fine, cone-shaped spray.



1. Fuel Inlet Line
2. Secondary Filter
3. Vent Plug
4. Filter Head
5. Hand Primer Pump (Optional)
6. Primary Filter
7. Drain Plug
8. Fuel Return Manifold
9. Nozzle Injector
10. Drain Cock
11. Fuel Injection Pump
12. Fuel Return Line

The fuel transfer pump delivers more fuel to the fuel sump of the fuel injection pump than is required for engine operation. A line extending from the top of the fuel injection pump to the fuel tank conveys the surplus fuel back to the fuel tank.

There is a certain amount of fuel seepage between the lapped surfaces of each fuel injection nozzle valve and its body, which is necessary for lubrication. This leakage of fuel accumulates around the spindle and in the spring compartment of each fuel injection nozzle holder and is returned through the fuel return manifold to the fuel return line, extending to the fuel tank. The excess fuel delivered to the fuel injection pump by the fuel supply pump is also returned to the fuel tank through the fuel return line.

A regulating valve in the pump end plate allows a large percentage of the fuel to be by-passed back to the inlet side. The fuel by-passed increases in proportion to speed, and the regulating valve is designed so the transfer pump pressure also increases with speed.

If necessary precautions are not taken in the storage of fuel, in the transfer of fuel to the fuel tank, and in keeping the fuel tank full to prevent condensation, foreign matter and water will enter the fuel system and damage the fuel injection pump and fuel injection nozzles. The fuel filters are installed in the fuel injection system to clean the fuel before it enters the fuel injection pump.

It is essential that personnel responsible for the care and operation of the engine adhere to the following maintenance recommendations:

1. Use only fuel meeting the specifications as outlined in Topic 7.

2. Store and handle fuel with utmost care to prevent water and foreign matter from entering the fuel system.

3. Properly maintain fuel oil filters.

4. Remove injection nozzle holder assemblies at the prescribed intervals; adjust the opening pressure and check the spray pattern.

5. Daily, drain the water from the primary filter.

6. Periodically check injection pump timing.

7. Keep all fuel line connections, filters, injection pump, and injection nozzle holder assemblies tightened securely to the engine (specified torque).

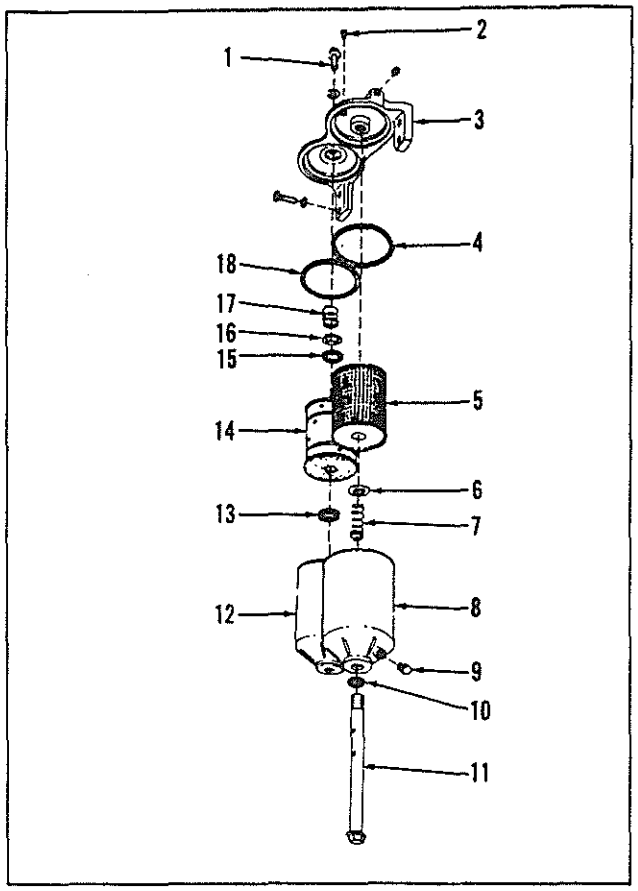
8. Before removing any part of the fuel injection system from the engine be sure to wash the part with cleaning solvent, also the surrounding area to prevent the entrance of abrasives into the system. Cover all openings immediately.

B. FUEL FILTERS

There are two filters in the fuel injection system, a primary filter and a secondary filter. Both filter shells are mounted in a common header and are located to the rear of the fuel pump. Necessary hoses are installed to connect the filters into the fuel system. Each filter shell contains a replaceable-type element. Any dirt, water or sediment which may pass through the primary filter will be trapped in the secondary filter and prevented from entering the fuel injection pump. A drain plug is provided in the bottom of the primary filter shell for the draining of water or sediment.

1. Filter Service

   At the beginning of each day's operation in warm weather and at the end of each day's operation in freezing weather, remove the drain plug in bottom of the primary filter and allow water and sediment to flow out. Replace drain plug as soon as clean fuel is evident. No daily service is normally required for the secondary filter. Remove and discard the element in each filter after every 500 hours of operation (more often if conditions warrant), or when the fuel filters become clogged. Clogged filter elements are usually indicated by irregular engine performance.



1. Retaining Capscrew
2. Vent Plug
3. Filter Head
4. Gasket
5. Primary Filter Element
6. Spring Washer
7. Spring
8. Primary Filter Shell
9. Drain Plug
10. Gasket Washer
11. Center Bolt
12. Secondary Filter Shell
13. Gasket
14. Secondary Filter Element
15. Gasket
16. Spring Washer
17. Spring
18. Gasket

Fuel Filter Details

2. Replacing Primary and Secondary Filter Elements

   If the fuel level in the tank is above the fuel filters, close the tank shutoff valve. If the fuel tank is located below the filters, it is not necessary to close the shutoff valve. Thoroughly clean the fuel filter head and surrounding area. Replace the elements as follows:

   a. Primary Filter Element

   (1) Loosen the vent plug in the filter head and the center bolt at the bottom of the filter and allow fuel to drain.

(2) Remove the filter from the head by turning the center bolt until it is free from the filter head.

(3) Discard the filter element and gasket. Thoroughly wash and dry the spring, washer, center bolt, and interior of the filter shell.

(4) Install the center bolt into the filter shell, making certain the washer is in good condition.

(5) Slip the element spring and spring washer onto the center bolt.

(6) Install new filter element (from element replacement kit) onto the center bolt.

(7) Install a new shell gasket (from the element replacement kit) in position in the filter head. Hold the filter shell in position under the filter head and engage the threads in the filter head and tighten the shell center bolt securely.

b. Secondary Filter Element

(1) Remove the shell-retaining capscrew located in the top of the filter head, and remove the filter shell and element as a unit.

(2) Remove and discard the filter element and the two element gaskets. Remove the shell gasket from the filter head and discard.

(3) Thoroughly wash and dry the interior of the filter shell.

(4) Install a new element gasket in position on the shell center tube. Install a new element in position in the filter shell and push it down firmly on the shell center tube. Install a new element gasket in position on the shell center tube and down on top of the filter element. Slip element spring washer and spring onto the center tube.

(5) Install a new shell gasket in position in the filter head.

(6) Hold the filter shell in position under the filter head and install the shell-retaining capscrew and retaining capscrew gasket. Tighten the shell-retaining capscrew securely.

(7) Open fuel tank shutoff valve and vent the low pressure system. Refer to Paragraph C, below.

CAUTION: Keep parts clean when replacing fuel filters.

C. VENTING FUEL SYSTEM

1. Venting Low Pressure Fuel System

a. If the fuel tank is located above the fuel filters, loosen the vent plug (Figure 3) on top of the filter head and open the fuel tank shutoff valve. Fuel, flowing by gravity, will force the air out of the filters. When the flow of fuel from around the vent plug is free of air bubbles, tighten the vent plug securely.

b. If the fuel tank or the fuel level in the tank is located below the fuel filters and a hand primer pump (optional equipment) is not provided, crank the engine with the starter to operate the transfer pump which will draw the fuel into the filters, transfer pump, injection pump cavity and expel the air through the fuel return line.

c. If the fuel system is equipped with a hand primer pump , remove the vent plug from top of the filter head. To operate the primer pump, loosen the locking screw on top of the plunger and move the clamp to one side. Moving the primer plunger up and down in a pumping motion will fill the filters with fuel and expel the air. When the flow of fuel from the vent hole is free of air bubbles, install and tighten the vent plug securely. Position the primer pump plunger clamp and tighten the lockscrew.

2. Venting High Pressure Fuel System

The high pressure fuel system is usually self-venting due to the fact that air trapped by the fuel injection pump is forced out through the injection nozzles and into the combustion chambers. However, if the engine has run out of fuel or has been shut down for an extended period of time, or if the fuel lines have been removed, it may be necessary to vent the high pressure system to facilitate engine starting. Proceed as follows:

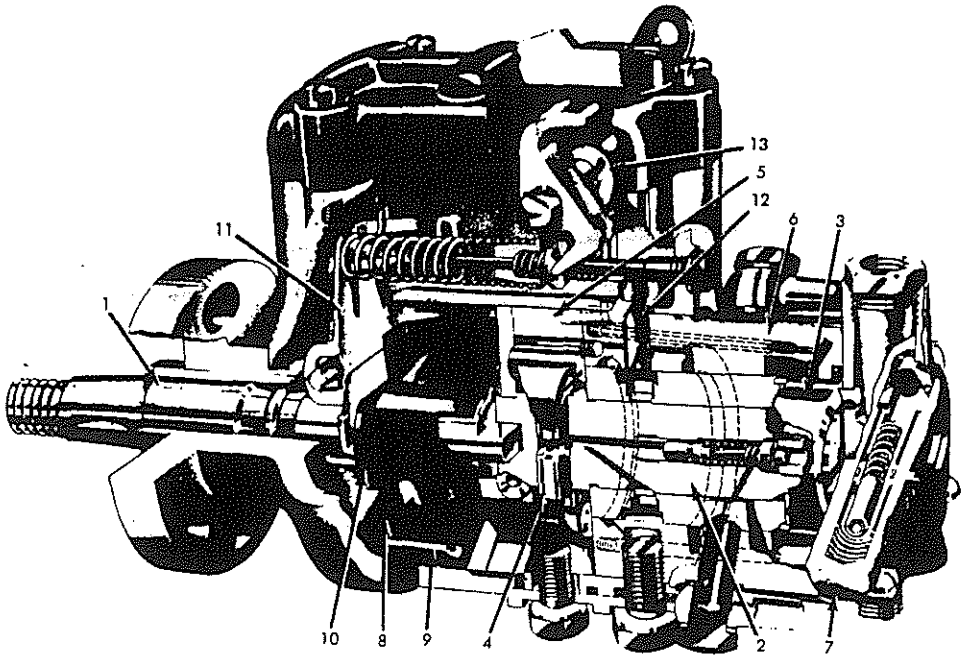
a. Loosen fuel line connection nut attaching each line to its corresponding fuel nozzle-holder.

b. Pull the throttle control outward to the high speed position and push the engine stop control all the way in to the run position.

c. Crank engine with starter until fuel flows from ends of all high pressure fuel lines. Connect fuel lines to nozzle holders and tighten connection nuts.

CAUTION: Do not operate starting motor continuously for more than 30 seconds at a time without a pause of two minutes to permit starter to cool.

CONSTRUCTION AND OPERATION



A. COMPONENTS AND FUNCTIONS

The Roosa Master Fuel Injection Pump is described as a single cylinder, opposed plunger, inlet metering, distributor type.

To readily understand the basic operating principles of the Roosa Master pump, it is necessary to become familiar with the function of the main components, some of which rotate. See the cutaway view in Fig. 1 for construction details.

These main components are:

1. Drive Shaft
2. Distributor Rotor
3. Transfer Pump
4. Pumping Plungers
5. Internal Cam Ring
6. Hydraulic Head
7. End Plate
8. Governor

The rotating members revolve on a common axis, and are:

1. Drive Shaft
2. Distributor Rotor (containing the plungers and mounting the governor)
3. Transfer Pump

With reference to Fig. 1, the drive shaft (1) engages the distributor rotor (2) in the hydraulic head (6). The drive end of the rotor has a diametric bore containing two plungers (4).

The plungers are actuated toward each other simultaneously by an internal cam ring (5) through rollers and shoes which are carried in guide slots in the flanged end of the rotor. Normally, there are as many lobes as there are cylinders to be served.

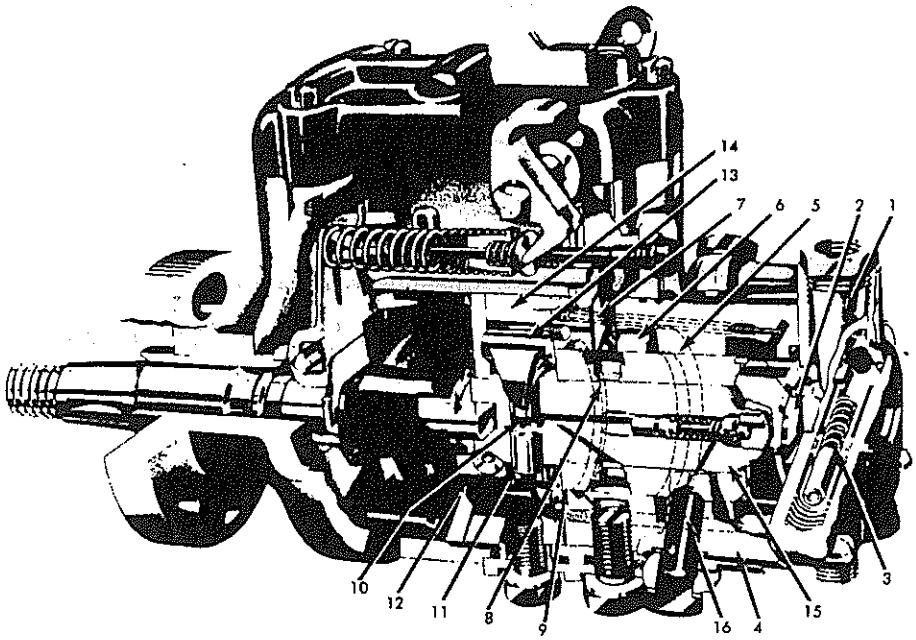
The transfer or supply pump (3) in the opposite end of the rotor from the pumping cylinder, is of the positive displacement, vane type and is covered by the end plate (7).

The "DB" Pump incorporates a single, angled passage for charging and an axial bore incorporating a delivery valve to serve all outlets for discharging. The hydraulic head contains the bore in which the rotor revolves, the metering valve bore, the charging ports and the head outlets, to which are connected through appropriate fuel line connectors, the injection pipes leading to the cylinders.

Covering the transfer pump, on the outer end of the hydraulic head, is the end plate. This assembly houses the fuel inlet connection, fuel strainer and transfer pump pressure regulating valve.

The Roosa Master Model "DB" Pump contains its own mechanical or flyweight type governor (8), capable of close speed regulation.

The action of the weights in their retainer (9) is transmitted through a sleeve (10) to the governor arm (11) and through a positive linkage to the metering valve (12). The metering valve is closed to shut off fuel through a solid linkage by an independently operated shut-off lever (13).



B. FUEL FLOW

The operating principles of the Roosa Master pump can be understood more readily by following the fuel circuit during a complete pump cycle. (See Fig. 2).

Fuel is drawn from the supply tank into the pump through the inlet strainer (1) by the vane type fuel transfer pump (2). Since transfer pump displacement greatly exceeds the injection requirements, a large percentage of fuel is by-passed through the regulating valve (3) back to the inlet side. The flow thus by-passed increases with speed, and the regulating valve is designed so transfer pump pressure also increases with speed.

Fuel, under transfer pump pressure, is forced through the drilled passage (4) in the hydraulic head into the annulus (5). It then flows around the annulus to the top of the sleeve and through a connecting passage (6) to the metering valve (7). The rotary position of the metering valve, controlled by the governor, regulates the flow of fuel into the charging ring (8) which incorporates the charging ports.

As the rotor revolves, its single charging hole (9) registers with one of the charging ports in the hydraulic head and fuel, at transfer pump pressure, flows through the angled passage to the pumping cylinder (10). The inflowing fuel forces the plungers (11) outward a distance proportionate to the quantity to be injected on the following stroke.

If only a small amount of fuel is admitted into the pumping cylinder, as at idling, the plungers move out very little. As additional fuel is admitted, the plunger stroke increases to the maximum quantity as limited by the leaf spring adjustment (12).

At this point (charging) of the cycle, the rollers (13) are in the "valley" or relieved part of the cam (14) between lobes. The fuel is trapped in the cylinder for a very slight interval after charging is complete.

This is caused by the fact that the rotor charging port (9) has passed out of registry with the head port and the rotor discharge port (15) has not yet come into registry with an outlet port (16) in the hydraulic head.

Further rotation of the rotor brings its discharge port into registry with an outlet port of the head at which point the rollers simultaneously contact the opposing cam lobes and the plungers are forced towards each other. The fuel trapped between the plungers is forced from the pump through one of the outlet ports to an injection line.

Lubrication of the pump is an inherent characteristic of the Roosa Master design. As fuel, at transfer pump pressure, reaches the charging ring, slots on the rotor shank allow fuel and any entrapped air to bleed to a reduced diameter on the shank. This fuel fills the pump housing cavity and acts as a coolant as well as a lubricant, since it is allowed to return to the supply tank via the oil return connection in the pump housing cover. This return line also permits any air entrained in the fuel or originally contained in the pump to be carried out.

In addition, an air bleed arrangement is incorporated in the hydraulic head which connects the outlet side of the transfer pump with the pump housing cavity. This allows air, which for any reason is carried into the end plate, to be bled back to the fuel tank via the return line.

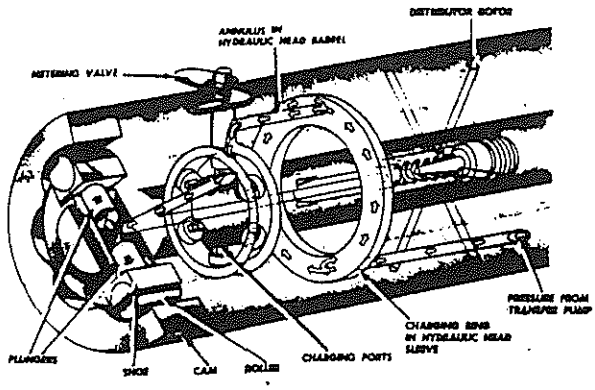


FIG. 3 (Charging)

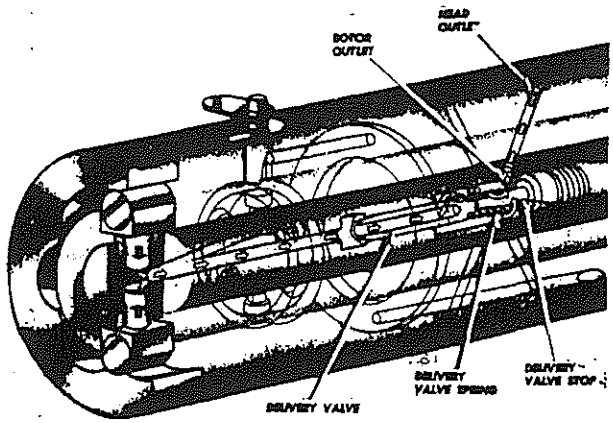


FIG. 4 (Discharging)

C. CHARGING AND DISCHARGING-DELIVERY VALVE TYPE ROTOR

Figs. 3 and 4 show the porting relationships during the charging and discharging cycles.

CHARGING CYCLE - As the rotor revolves, Fig. 3, the angled passage in the rotor registers with one of the charging ports in the charging ring. Fuel, at transfer pump pressure, then passes into the pumping cylinder, forcing the plungers apart a distance proportionate to the amount of fuel required for injection on the following stroke. Only at full load will the plungers move to the most outward position, controlled by the leaf spring setting (maximum fuel adjustment).

Note in Fig. 3 that while the angled passage in the rotor is in registry with one of the charging ports in the hydraulic head, the rotor outlet is out of registry with the head outlet. Note also that the rollers are between the cam lobes. Compare their relative position in Fig. 3 with that of Fig. 4.

DISCHARGE CYCLE - As the rotor continues to revolve Fig. 4, the angled passage passes out of registry with the charging port. For a brief interval the fuel is trapped until the rotor outlet registers with one of the head outlets. As this registration takes place both rollers contact the rise of the cam lobes and are forced together, Fig. 4. This is the discharge or injection stroke. The fuel trapped between the plungers is forced through the axial passage, through the delivery valve and out the rotor outlet.

D. DELIVERY VALVE FUNCTION

"Line Retraction", the most significant function of the delivery valve, is accomplished by rapidly decreasing the injection line pressure after injection to a predetermined point lower than that of the nozzle opening pressure. This reduction in pressure causes the nozzle valve to return rapidly to its seat, achieving sharp delivery cut-off and preventing dribble of fuel into the combustion chamber.

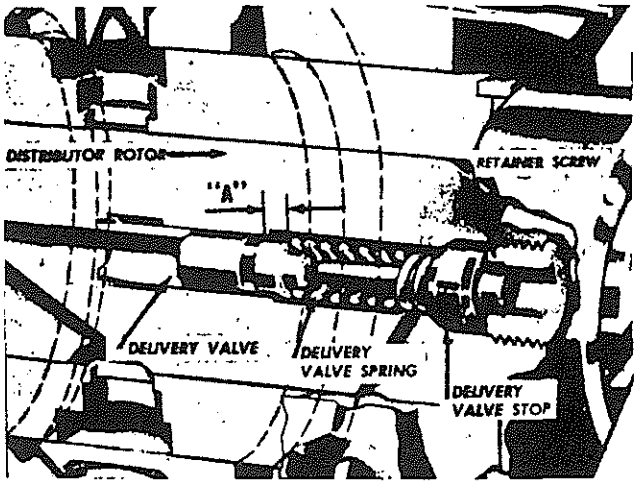


FIG. 5

The delivery valve, which is located and operates in a bore in the center of the distributor rotor, Fig. 5, is simply constructed. It requires no seat - only a shoulder to limit travel. Sealing is accomplished by the long, closely fitted bore into which it fits.

Since the same delivery valve performs the function of retraction for each line, the retracted amount will not vary from cylinder-to-cylinder. This results in an extremely smooth running engine at all loads and speeds.

When injection starts, fuel pressure moves the delivery valve slightly out of its bore and adds the volume of its displacement section (A) to the enlarged cavity of the rotor occupied by the delivery valve spring. This displaces a similar volume of fuel in the spring cavity before delivery through the valve ports starts.

At the end of the injection, the pressure on the plunger side of the delivery valve is quickly reduced by allowing the cam rollers to drop into the retraction step on the cam lobes. Cam

retraction value is always equal to or slightly more than delivery valve retraction value.

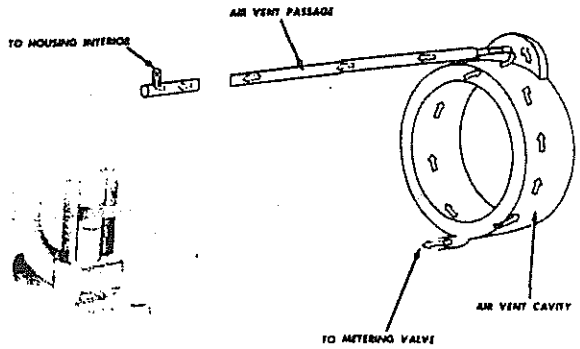
As the valve returns to its closed position, it removes its displacement section (A) from the spring cavity and, since the rotor discharge port is still partly in register, fuel rushes back out of the injection line (to fill the volume left by the retreating delivery valve).

Following this, the rotor ports close completely and the remaining injection line pressure is blocked off.

The delivery valve system of retraction is essential to some engine combustion chambers, injection line sizes and nozzle combinations. Other engines perform entirely satisfactorily with other retraction systems

E. RETURN OIL CIRCUIT

Fuel, under transfer pump pressure, is discharged out of the slot in the discharge area of the transfer pump liner into a cavity in the hydraulic head. See Fig. 6. The upper half of this cavity connects with a longitudinal passage, the volume of which is restricted by a vent wire to prevent undue pressure loss.



The vent passage passes around the metering valve bore and connects with a short vertical passage entering the governor linkage compartment.

Should air enter the transfer pump because of suction side leaks, it immediately passes to the air vent cavity and then to the vent passage as shown. Air and a small quantity of fuel then passes from the housing to the fuel tank via the return line.

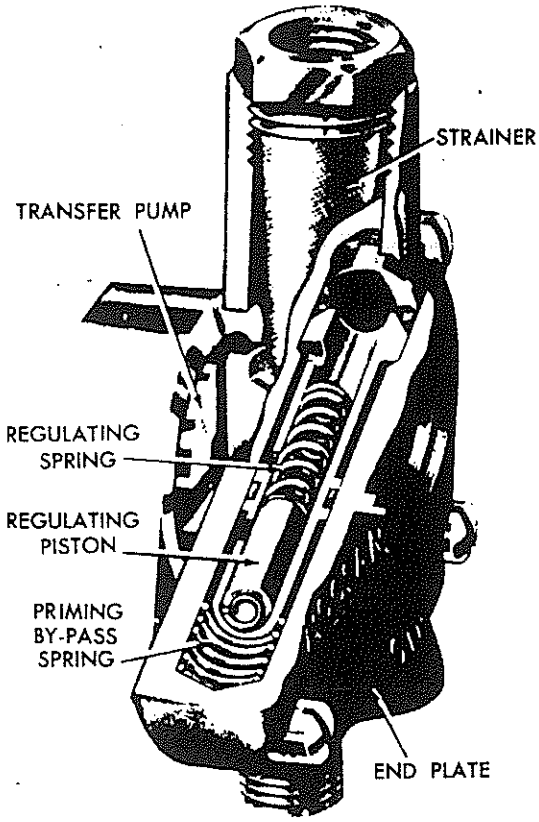


FIG. 7

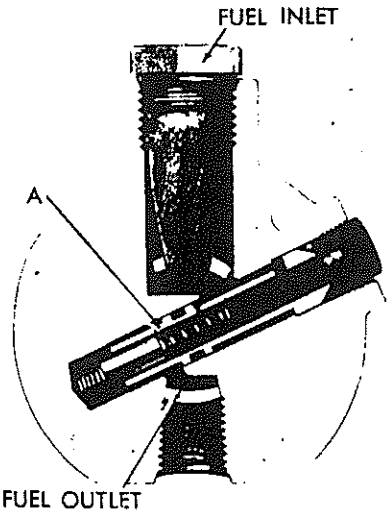


FIG. 9 (Hand Priming)

F. END PLATE OPERATION

The End Plate is common to all models of the pump and varies only slightly between applications. Its three basic functions are:

1. To provide passages for fuel, and cover and absorb end thrust of the transfer pump.
2. To house the pressure regulating valve.
3. To house the priming by-pass spring which permits fuel to by-pass the transfer pump during hand priming.

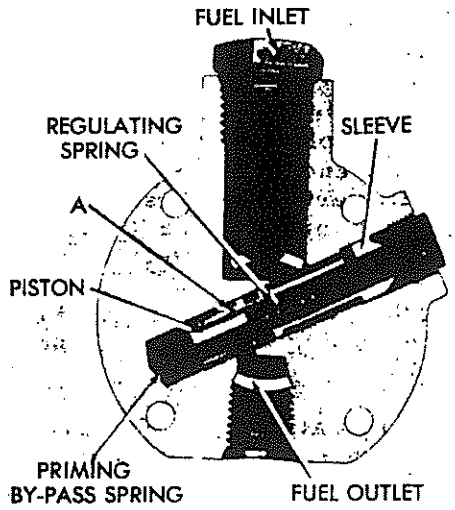


FIG. 8 (At Rest)

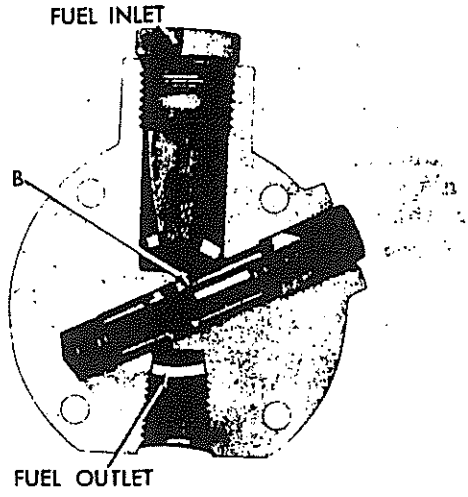


FIG. 10 (Pressure Regulating)

The end plate, pressure regulating valve, priming by-pass spring and strainer are shown in Fig. 7. Figs. 8, 9 and 10 show the regulating piston in three positions - at rest, during hand priming, and in operation.

Fig. 8 shows the piston covering the hand priming port (A) and resting against the priming by-pass spring.

During hand priming, Fig. 9, the pressure differential across the transfer pump, caused by the hand primer, forces the piston down, compressing the spring, until the priming port (A) is uncovered. Fuel then by-passes the stationary transfer pump to fill the system.

Fig. 10 shows the piston in operation. Fuel pressure forces the piston up the sleeve until the regulating port or ports (B) are uncovered. Since the pressure on the piston is opposed by the regulating spring, the delivery pressure of the transfer pump is controlled by the spring rate and size and number of regulating ports.

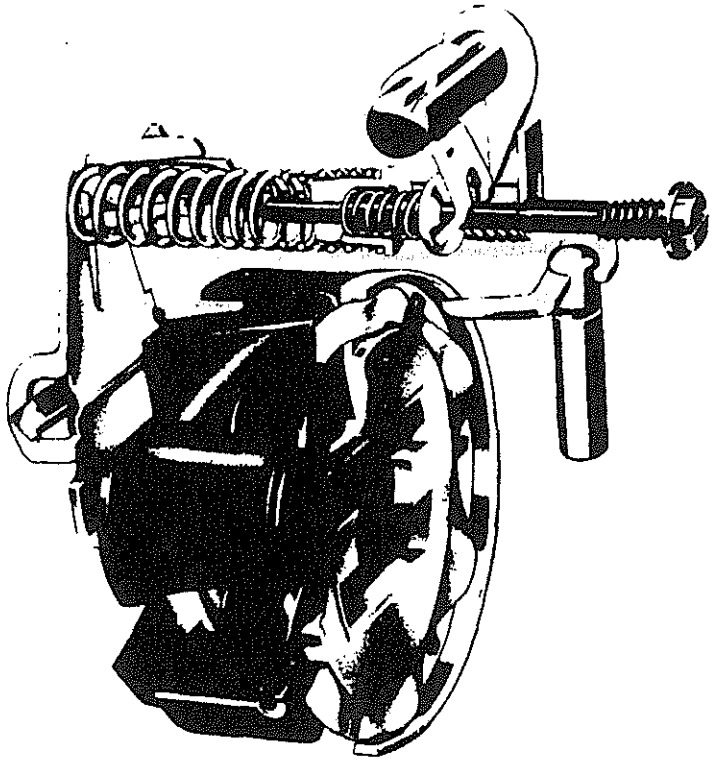


FIG. 11

G. CENTRIFUGAL GOVERNOR

In the centrifugal governor, Fig. 11, the movement of the flyweights against the governor thrust sleeve rotates the metering valve. This rotation varies the registry of the metering valve slot with the passage to the rotor, thus controlling the flow to the engine.

This type of governor derives its energy from the centrifugal action of the flyweights pivoting on their outer edge in the retainer. Centrifugal force tips them outward, moving the governor thrust sleeve against the governor arm, which pivots on the knife edge of the pivot shaft, and is connected through a simple positive linkage to the metering valve. The force on the governor arm caused by the centrifugal action of the flyweights is balanced by the compression type governor spring, which is manually controlled by the throttle shaft linkage in regulating engine speed. A light idle spring is provided for more sensitive regulation at the low speed range. The limits of throttle travel are set by adjusting screws for proper idling and high idle positions.

A light tension spring allows the stopping mechanism to close the metering valve without overcoming the governor spring force. Only a very light force is required to rotate the metering valve to the closed position.

TORQUE SPECIFICATIONS

Governor Pivot Shaft	20 inch lbs.
Fuel Lines	420 inch lbs.
Transfer Pump Screws	80 inch lbs.
Delivery Valve Retainer Screw	85 inch lbs.
Drive Shaft Nut	450 inch lbs.
Transfer Pump Relief Valve Sleeve Nut	50 inch lbs.
Pump Governor Cover	40 inch lbs.
Fuel Strainer	240 inch lbs.
Cam Locating Screw	420 inch lbs.
Bottom Cover Screw	450 inch lbs.
Head Locating Screws	360 inch lbs.
Timing Cover Windows	15 inch lbs.
Transfer Pump Outlet	300 inch lbs.
Torque Screw Lock Nut	25 inch lbs.
Shut Off & Throttle Lever Retaining Screws	35 inch lbs.
Governor Spring Stud	110 inch lbs.

Reduce values above 30% for cadmium plated screws tightened against blackened or die cast parts.

Reduce values 40% for cadmium plated screws tightened against cadmium plated parts.

REMOVAL FROM ENGINE

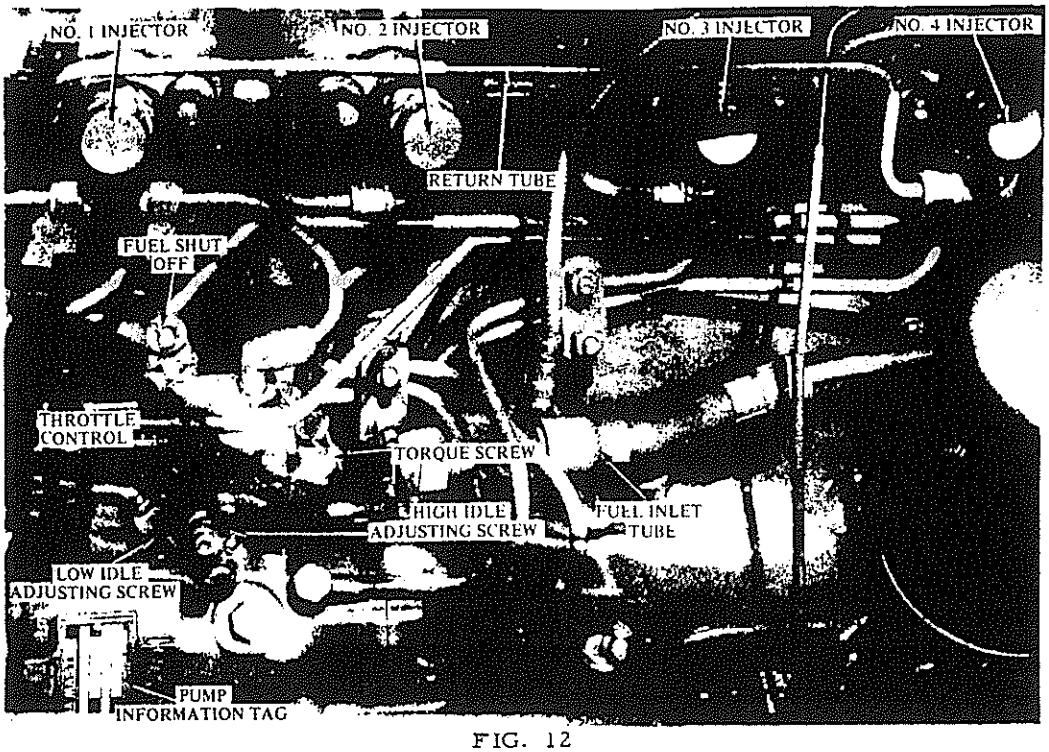


FIG. 12

The procedure described below for removal of the Roosa Master pump from the engine should be followed in detail to assure ease of pump reinstallation.

A. Clean and wash down pump, fittings and all connections to be broken, to eliminate any chance of dirt entering the system when lines are disconnected.

CAUTION: All openings should be temporarily plugged with masking tape as lines are dis connected.

B. Remove the timing hole cover (outboard side of pump), Fig. 12, and bar engine in the direction of rotation until the timing line on the governor weight retainer hub registers with timing line on the cam.

C. Disconnect the fuel supply, return, and nozzle leak-off lines and all high pressure lines. Plug all openings.

D. Disconnect throttle and shut-off linkage.

E. Remove mounting nuts on the pump flange.

F. Slide pump gently from location.

DISASSEMBLY

STUDY THE MANUAL FIRST

Before commencing the disassembly of the pump, remove all external grease and dirt by washing the unit with fuel oil and blowing it off with a blast of filtered air. It must be constantly kept in mind that dirt, dust and foreign matter are the greatest enemies of the fuel injection pump. As an added precaution, to prevent dirt from entering the fuel system while servicing the pump, it is recommended that A CLEAN WORK-SPACE, CLEAN TOOLS AND CLEAN HANDS BE USED.

A clean pan should be available in which the parts may be placed upon disassembly, and a pan of clean fuel oil should be available in which the parts may be flushed. It is recommended that these be deep drawn pans with rounded corners to lessen the chances of dirt pockets.

STEP 1. Mount the pump in Roosa Master fixture #13363 as shown. Remove all seals. Unscrew the three cover hold-down screws and remove the governor control cover and cover gasket.

STEP 2. Remove the shut-off cam by rotating

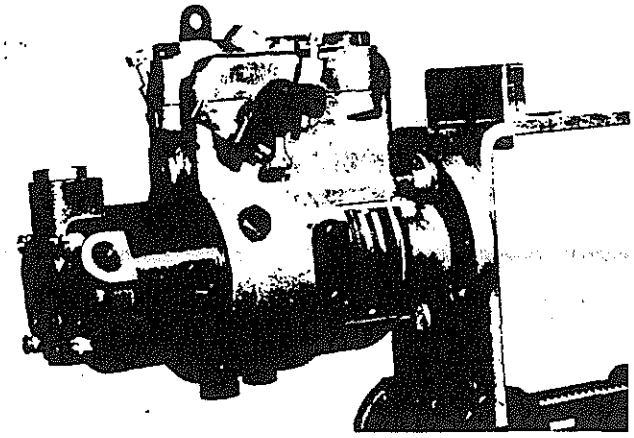


FIG. 13 (Step 1)

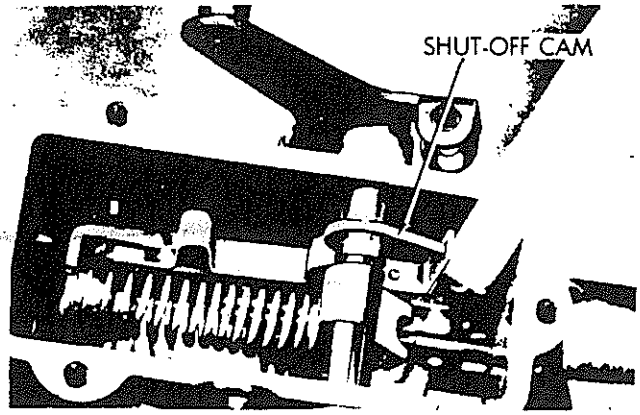


FIG. 14 (Step 2)

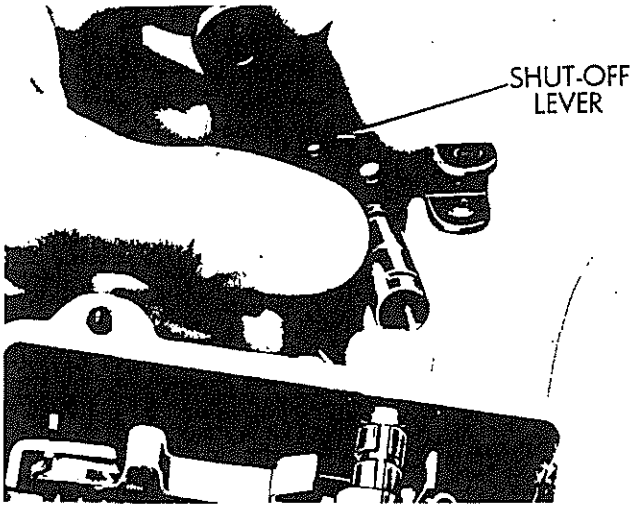


FIG. 15 (Step 3)

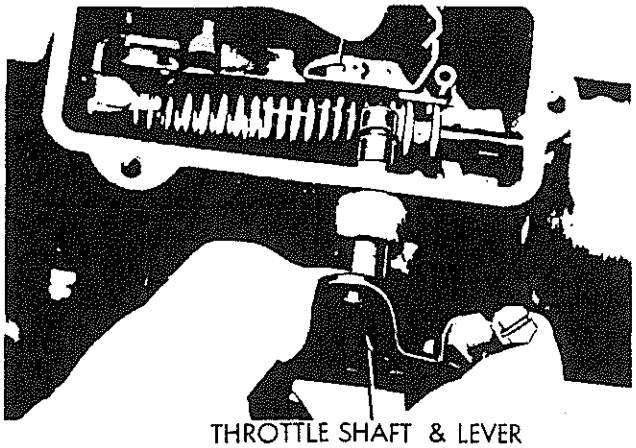


FIG. 16 (Step 4)

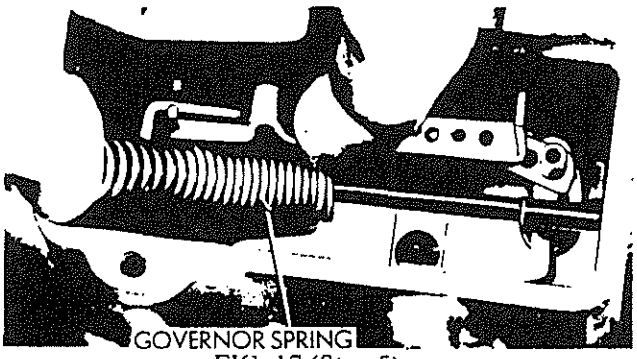


FIG. 17 (Step 5)

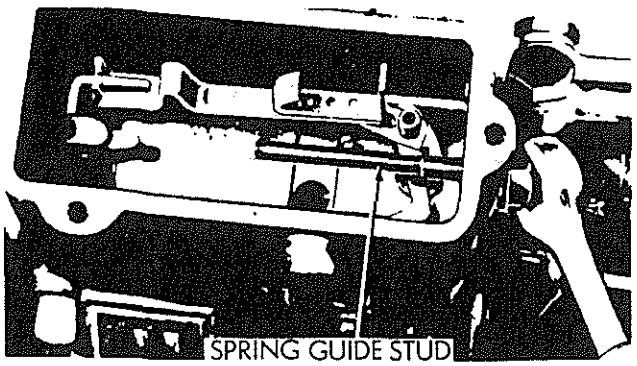
the shut-off lever to the full shut-off position (shut-off cam horizontal). Place Roosa Master tool No. 13339 between housing and governor linkage hook as shown and pry gently, sliding cam out of its groove and off the throttle shaft.

STEP 3. Withdraw the shut-off lever and shaft.

STEP 4. Slide the throttle shaft lever off the throttle shaft and withdraw the throttle shaft assembly from its position.

NOTE: *To aid in correct assembly, be sure to make a note of the side on which the throttle shaft is assembled.*

STEP 5. Hold the governor spring, idle spring guide, idle spring and spring retainer firmly between the thumb and forefinger. Loosen and remove the guide stud and its washer. Lift out the governor spring, idle spring guide, idle spring and spring retainer as a unit and set aside.



SPRING GUIDE STUD

TRANSFER PUMP-METERING VALVE

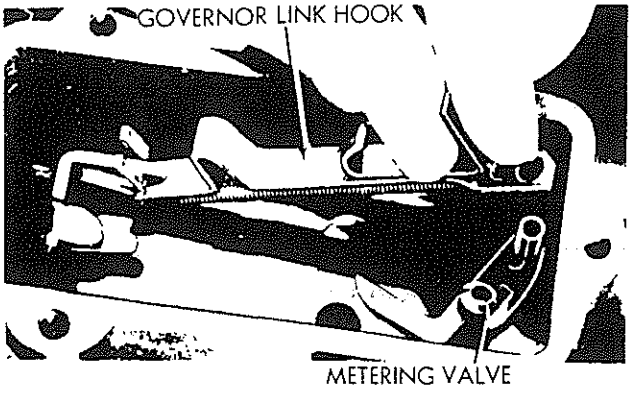


FIG. 18 (Step 6A)

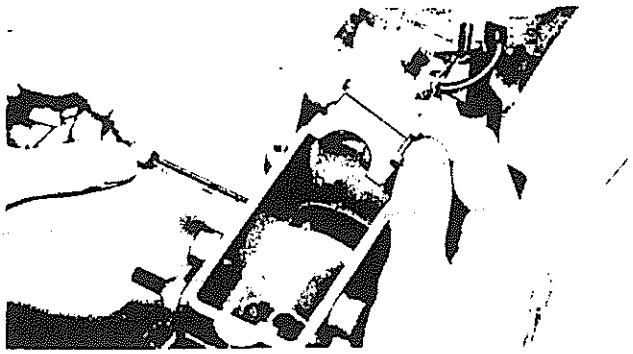


FIG. 19 (Step 6B)

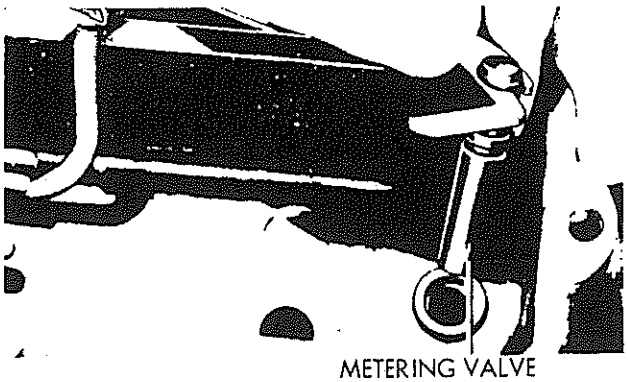


FIG. 20 (Step 7)

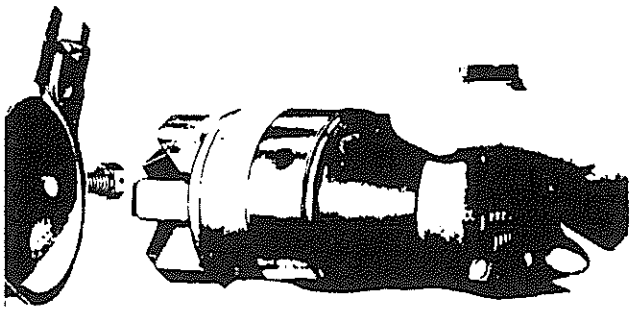


FIG. 21 (Step 8)

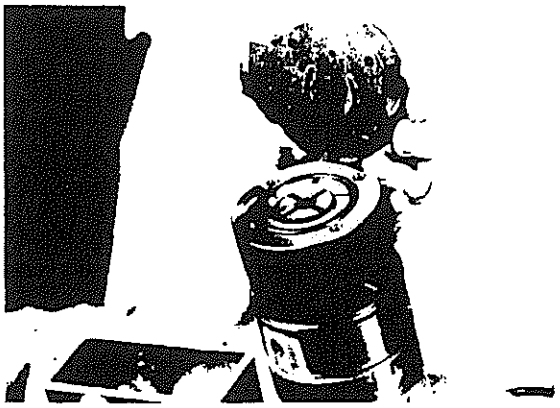


FIG. 22 (Steps 9 & 10)

STEP 6A. While depressing the metering valve and holding one finger over damper and spring, (if used), raise the governor linkage hook at the metering valve end to clear the metering valve arm pin. Remove the damper and spring (if used). Pull the linkage hook back slightly to disengage it from the governor arm and place it over the side.

STEP 6B. Remove one pivot shaft cap nut and seal and withdraw the pivot shaft from the housing. The governor arm and linkage hook may now be removed.

STEP 7. Remove the metering valve and spring. Remove the two head locking screws from the pump housing.

STEP 8. Invert the pump and holding fixture as a unit in the vise and remove the head and cam locating screws, cam hole cover and seals. Return the unit to an upright position. Grasp the hydraulic head assembly firmly in both hands and withdraw with a slight rotary motion. Use caution not to drop weights.

STEP 9 To disassemble the governor, invert the hydraulic head and let weights, governor thrust sleeve and governor thrust sleeve washer fall into hand. -

STEP 10. Place the hydraulic head assembly on the pump holding fixture so that the governor weight retainer engages the bar on the fixture as shown. Remove the four end plate screws and lift off the end plate assembly.

STEP 11. Remove the end plate plug and with a dull scribe. remove the seal located on the top of the end plate sleeve. Insert the end plate sleeve retractor tool in the 1/8" hole in the top of the sleeve and withdraw the sleeve carefully with a rotary motion. Remove the regulating piston and spring from the bore of the sleeve and withdraw the priming by-pass spring by hooking it with tool No. 13301. Place the end plate in a soft jawed vise and remove the filter assembly and seal from the inlet bore.

TRANSFER PUMP-DISASSEMBLY

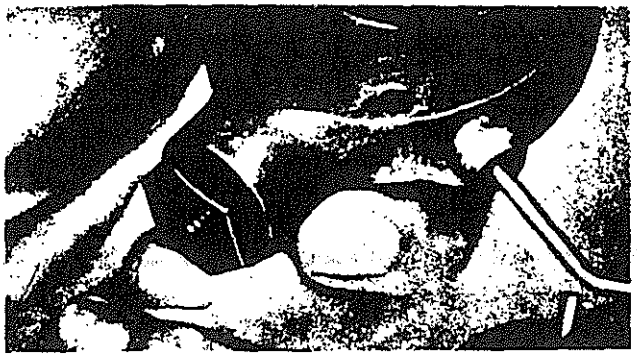


FIG. 23 (Step 11)

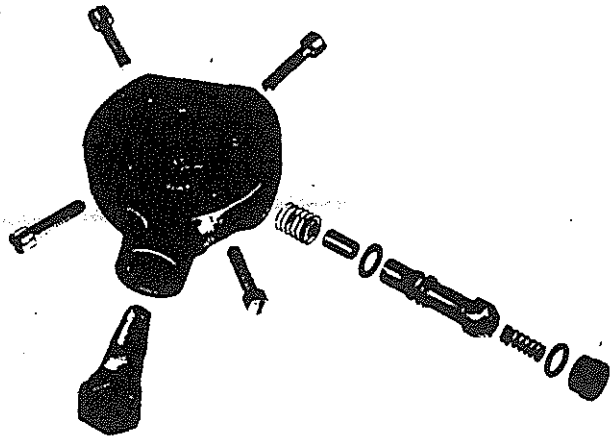


FIG. 24 (Step 11)

FIG. 25 (Step 12)

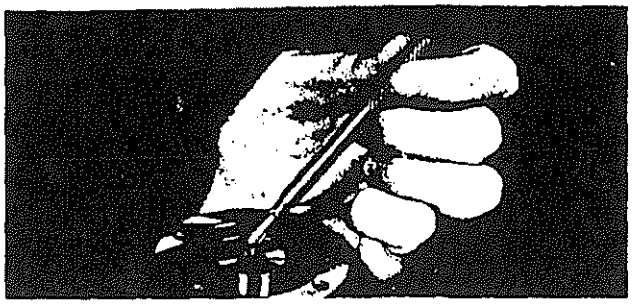


FIG. 26 (Step 13)

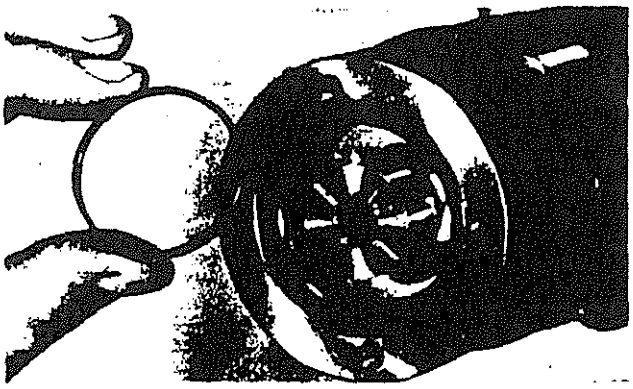


FIG. 27 (Step 14)

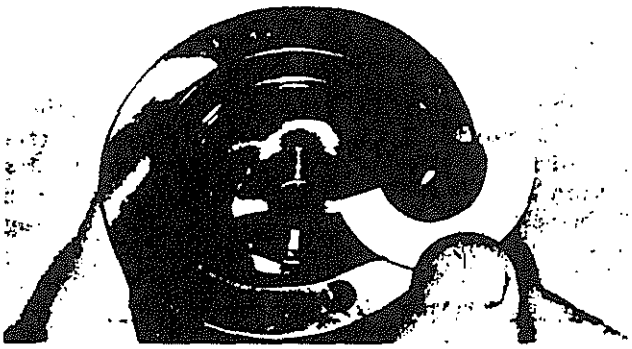


FIG. 28 (Step 14)

STEP 12. To disassemble the transfer pump, (revealed after end plate removal) remove the transfer pump seal. Lift out the transfer pump liner and blades.

STEP 13. With a socket setscrew wrench, loosen and remove delivery valve retainer screw. Lift head and rotor assembly and shake delivery valve stop, spring and delivery valve into the hand. If delivery valve sticks in its bore, remove it using delivery valve retractor tool as shown.

STEP 14. Using a small bladed screw driver or a dull scribe, disengage and remove the rotor retainer snap ring. This releases the rotor retainers which should now be moved outward as far as possible to clear the rotor.

Gently lift the hydraulic head so that the transfer pump rotor is flush with the inner face of the hydraulic head. The rotor retainers can be easily removed. Lower the head to its former position.

CAUTION: Rotor is no longer retained in the head. Do not let them slip apart when proceeding to Step 15.

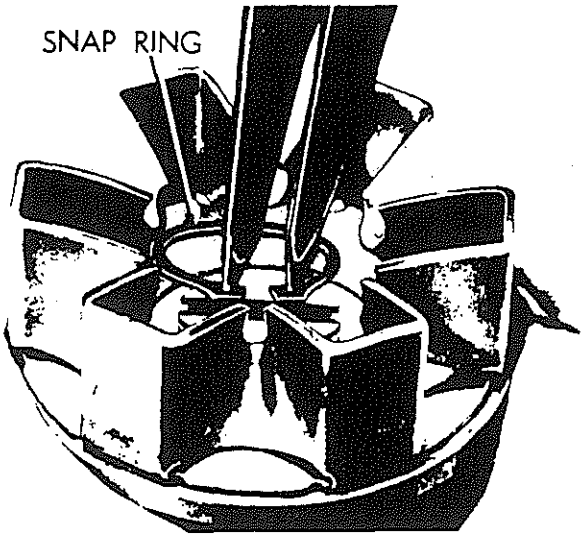


FIG. 29 (Step 15)

STEP 15. Place the hydraulic head assembly in the holding fixture as shown and remove the weight retainer snap ring with the assembly pliers. Lift off the governor weight retainer and internal cam ring.

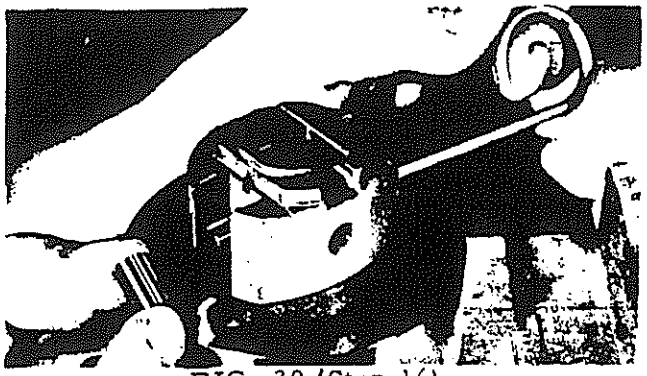


FIG. 30 (Step 16)

With reference to Step 6, Reassembly, check and record the roller-to-roller dimension. Compare this dimension with that called for on the pump specification.

STEP 16. Remove the leaf spring from the rotor and the rollers and shoes from their guide slots. Remove the two plungers, being careful not to drop or otherwise damage them. Withdraw the distributor rotor from its bore in the hydraulic head.

CAUTION: DO NOT HANDLE ROTOR SHANK.

PARTS INSPECTION

A. GENERAL INSPECTION

Discard all O-rings, seals and gaskets. Replace with appropriate Roosa Master gasket kits. Examine all springs for fretting, wear, distortion or breakage. Clean and carefully check all bores, grooves and seal seats for damage or wear of any kind.

B. SUPPLEMENTARY INSPECTION

1. Transfer Pump Blades - Inspect with the utmost care. Check for chipping on any of the edges, pitting, imbedded foreign particles or wear on the rounded ends. Determine wear by measuring the length (See Calibration Data) with a micrometer. Inspect flat surfaces visually for scores. If any discrepancies are noted, replace both blades.

2. Plungers - While holding the rotor under clean oil insert the plungers into their bore. With thumb and forefinger over the guide slots, tilt from side to side several times to insure complete freedom of movement. Interchanging or reversing their individual position may be necessary as these are matched parts. If the plungers were sticking, but not visibly damaged, clean both plungers and bore with a soft brush and lacquer-removing solvent such as lacquer thinner or acetone. (Do not force plungers into their bore and do not handle rotor shank).

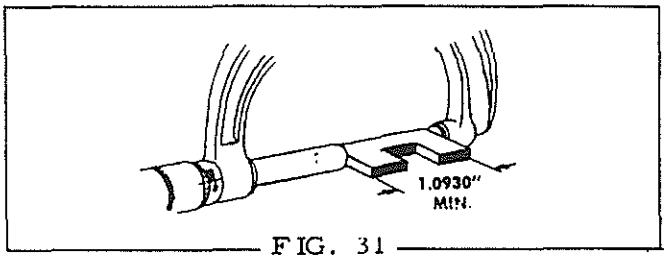


FIG. 31

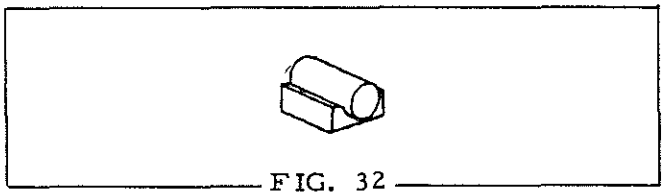


FIG. 32

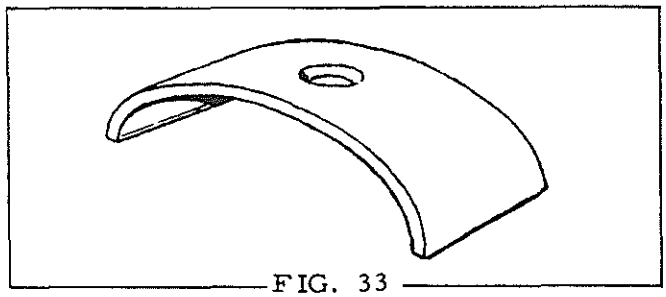


FIG. 33

3. Distributor Rotor - Examine the radii contacted by the leaf spring, the tank slot and the weight retainer drive on the large end for excessive wear. Check all slots, charging and

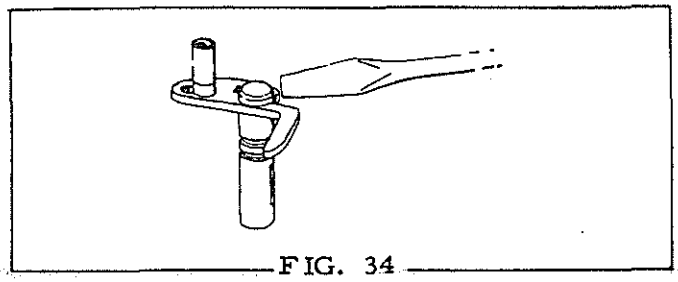


FIG. 34

discharged ports for chipping of edges or dirt, and the rotor shank for scratches. If damage or excessive wear is apparent, the head and rotor must be replaced as a mated unit.

4. Cam Rollers and Shoes - Check each roller in its shoe for freedom of rotation, and the top edge of each shoe, where retained by the leaf spring, for chipping or excessive wear. Improved roller surfaces will result from long, normal operation in clean fuel oil.

5. Leaf Spring - Check for wear at points where the spring contacts the radii on the rotor, and along the steps that retain the roller shoes.

6. Governor Weights and Retainer - Examine drive shaft pilot tabs in retainer hub, retainer sockets where weights pivot, and pivot points of all weights for wear. If equipped with the flexible spring type retainer, check springs for breakage or distortion. If damage is noted, the complete retainer must be replaced as a unit.

7. Governor Linkage - Inspect the pivot points of the governor control arm and pivot shaft. Examine the control arm fork where it contacts the thrust sleeve. If wear is in excess of .003, discard and replace. Examine the metering valve pin hole in the linkage hook, the spring retainer, throttle shaft lever, shut-off cam, and especially the throttle and shut-off shaft assemblies where joined, for looseness.

8. Metering Valve and Arm Assembly - Check the metering valve body for wear. Be sure the metering valve arm is well seated and that there is no radial movement of the arm on the valve. Check the metering valve spring for breakage or distortion, and the metering valve arm pin for wear at its point of contact with the linkage hook.

NOTE: If metering valve spring washer is not present on those pumps where it is listed on the

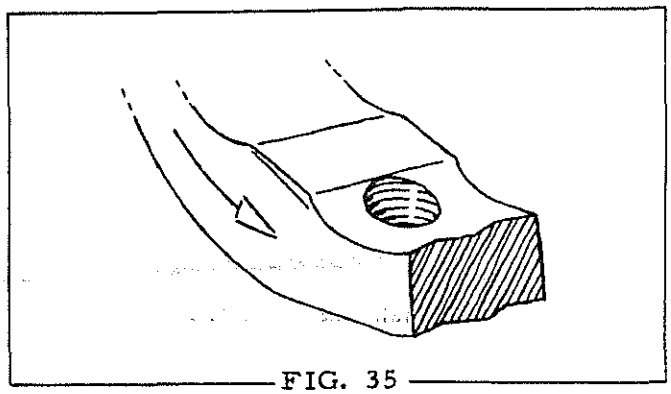


FIG. 35

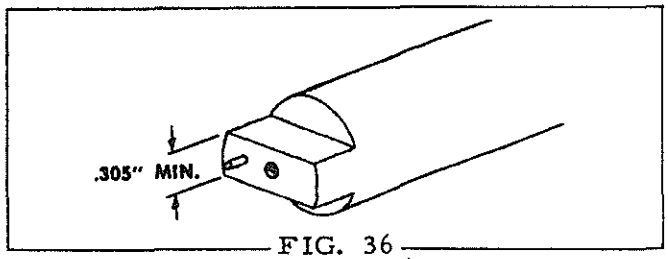


FIG. 36

Service Specification, install as follows: Clamp metering valve in a soft jawed vise. With a screwdriver blade placed as shown, tap arm from position. Assemble washer to end of valve and replace arm.

9. Cam - Since only the working portions of the lobes on the I. D. are ground, the tool marks between lobes should not be considered damage. The cam finish is mottled from heat treatment rather than operation. Carefully inspect the I. D. and edges of all flat surface . If there is evidence of spalling or flaking out, replace with new cam. Improved cam lobe finish will result from long, normal operation in clean fuel oil.

10. Drive Shaft - Inspect the tang, being sure that distance across flats is not less than .305". Check the shaft diameter where the governor thrust sleeve slides. The drive shaft seal grooves must be absolutely smooth for the seals to function properly.

11. End Plate - Check the regulating piston for freedom of movement in the sleeve. Check all threads for damage and the face of the end plate for excessive wear due to end thrust of the transfer pump rotor. The inlet screen must be inspected for damage. All dirt or rust must be removed from the assembly. DO NOT ATTEMPT TO REMOVE LINER LOCATING PIN UNLESS OBVIOUSLY DAMAGED.

FIG. 37 (Step 1)

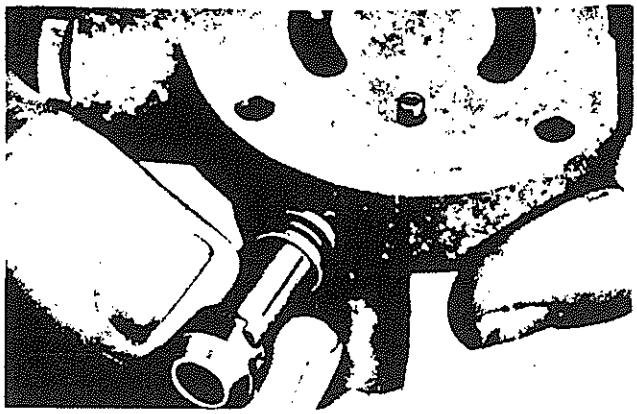


FIG. 39 (Step 3)

All parts must be thoroughly flushed in clean oil as they are being reassembled. Cleanliness will contribute to long life and trouble free operation. All seals and gaskets must be replaced, whether visibly damaged or not.
NOTE: Refer to Torque Value Chart before assembly.

STEP 1. Insert the priming by-pass spring in its bore in the end plate with the closed coil end upward as shown. Be sure this spring is seated correctly in bottom of the bore. Improper seating will make hand priming of the pump impossible.

STEP 2. Place the regulating piston in the end plate sleeve and, while holding between the thumb and forefinger as shown, shake slowly to ascertain complete freedom of the piston. The piston should slide freely by its own weight.

STEP 3. While holding the end plate in a horizontal position and sighting down the inlet bore to make certain the lower sleeve seal does not catch and tear on any sharp edges, carefully insert the sleeve, with regulating piston, into its bore with a slight rotary motion. The application of clean mineral grease to the seal will aid assembly. Wring into seat using the Sleeve Retractor Tool. If the sleeve has been removed for any reason while the pump is mounted on the engine, it is recommended that the regulating piston be inserted after the sleeve is installed to prevent it from falling out the lower end.

FIG. 38 (Step 2)

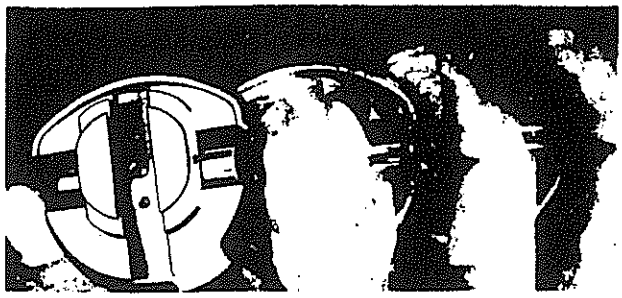


FIG. 40 (Steps 4 & 5)

Assemble the regulating spring and the top sleeve seal, which must be correctly seated on top of the end plate sleeve. Assemble and tighten the end plate plug and the strainer assembly.

STEP 4. The first part of the hydraulic unit to be assembled is the distributor rotor. With particular attention to "B" under parts inspection insert the pumping plungers into their bore.

STEP 5. Flush the hydraulic head and distributor rotor thoroughly in clean oil and assemble, under oil, with a slight rotary motion. Under no circumstances should any force be used. Do not handle the rotor shank with the fingers, but do hold fingers over the plungers so they will not drop out. This procedure will prevent possible damage and ease assembly.

STEP 6. Place the hydraulic head and rotor assembly in the holding fixture as shown and assemble the leaf spring. A little clean grease on the edges of the leaf spring hole before assembly will make adjustment easier. Insert the rollers and shoes and check for their freedom of movement. With reference to the pump specification, the roller-to-roller dimension (maximum fuel adjustment) should now be set.

Apply clean, dry air (30-100 P.S.I.) by means of a suitable fitting to any one of the head outlets. Rotate the rotor until the rollers are pushed to their extreme outward position by the air pressure. Using a 1" to 2" micrometer, measure the roller-to-roller dimension (outside of one roller to outside of other roller) now present. To set the roller-to-roller dimension to that called for in the pump specification, turn the

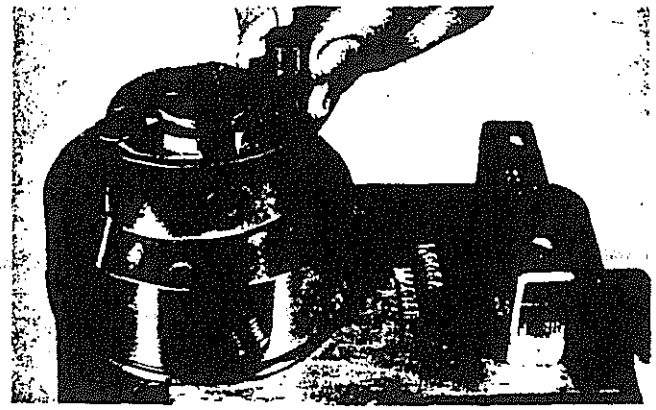


FIG. 41 (Step 6)

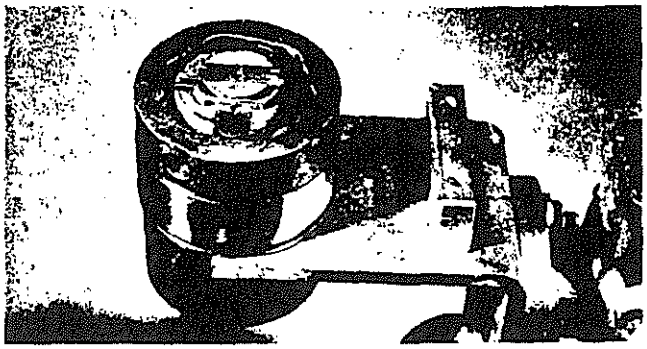
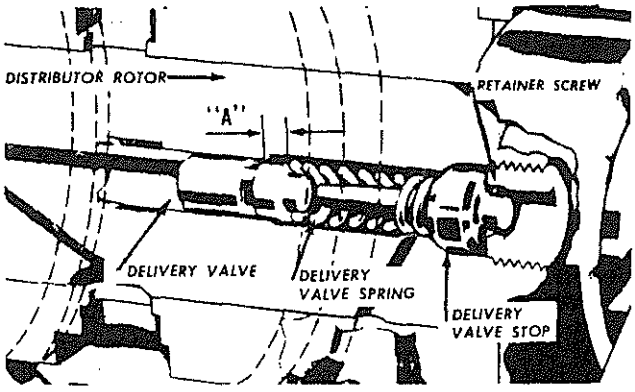


FIG. 43 (Step 7)



leaf spring adjusting screw inward (clockwise) to increase travel and outward (counter-clockwise) to reduce travel using the Socket Screwdriver Tool.
NOTE: This setting provides a completely accurate maximum fuel setting and it should not be altered from the specification.

STEP 7. Place the cam ring atop the hydraulic head with the directional arrow indicating the proper direction of pump rotation facing upward. Remember that pump rotation is always expressed as viewed from the drive end. The pump will not deliver fuel with incorrect assembly of the cam ring.

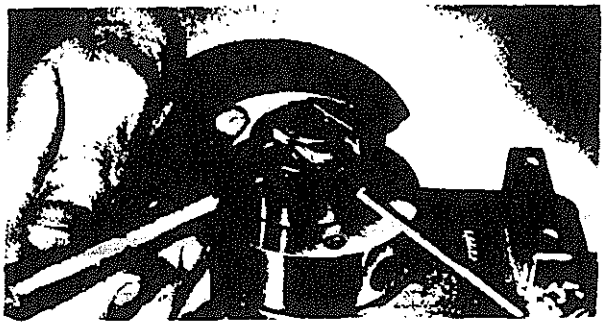


FIG. 42 (Step 6)

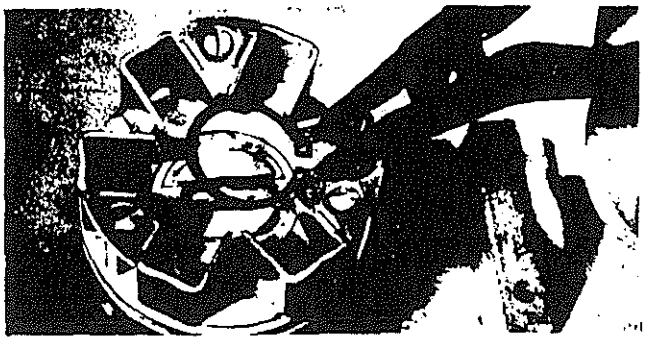
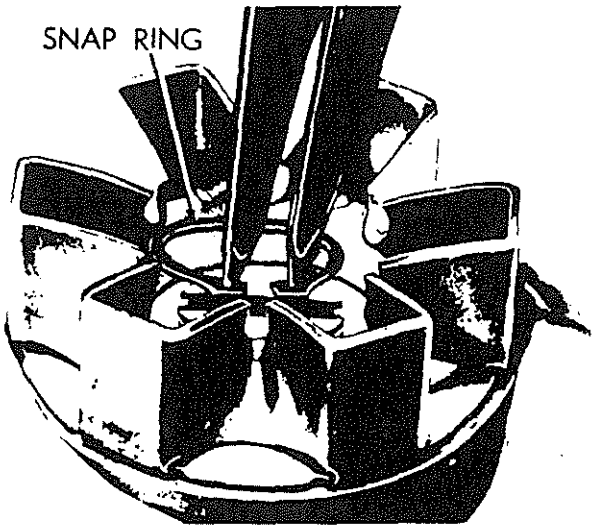


FIG. 44 (Step 8)



STEP 8. Place the governor weight retainer in position over the drive on the distributor rotor. Make sure the assembly marks on the weight retainer and the distributor rotor line up with each other. Assemble the snap ring to its groove with the Assembly Pliers.

FIG. 45

FIG. 46

FIG. 47

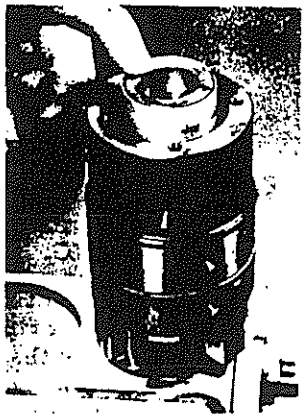


FIG. 48

STEP 9. While holding this assembly carefully together so the rotor will not fall out, invert the entire unit so that the governor weight retainer engages the bar on the holding fixture.

Install delivery valve making sure that it operates freely in its bore. Install delivery valve spring and delivery valve stop. The stop screw internal hex has one end which is slightly relieved to clear the delivery valve stop. Be sure it faces down. Start the stop screw using hex end of the delivery valve retractor tool (Fig. 45), and finish tightening with a torque wrench to 85-90 inch pounds.

STEP 10. Insert the two rotor retainers by lifting the head up slightly so that the inside face of the head is flush with the rotor end. Position the retainers with the outer sleeve of the Retainer Ring Installation Tool and install the retaining ring as shown in Figs. 46, 47 and 48.

STEP 11. Insert the transfer pump liner so that the large slot is in line with the head locating screw hole, and the letter signifying correct pump rotation faces up. This will correctly position the liner locating slot to accept the locating pin in the end plate.

Carefully place the transfer pump blades in

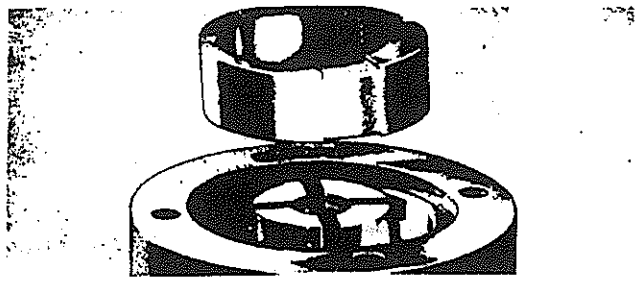


FIG. 49 (Step 11)

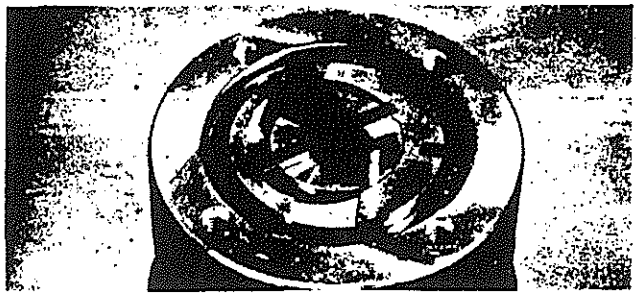


FIG. 50 (Step 11)

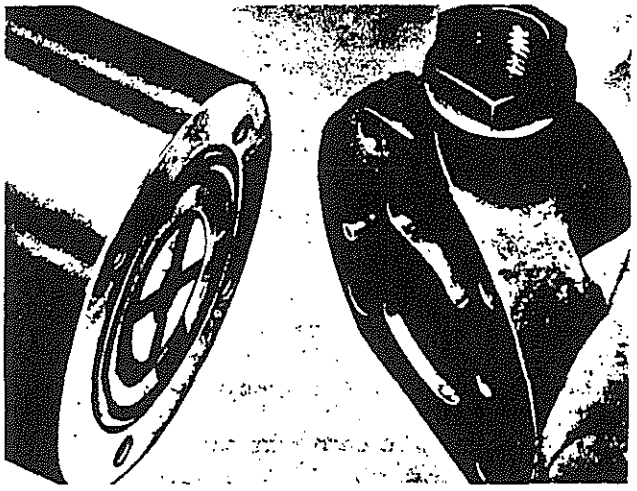


FIG. 51 (Step 12)

their slots in the transfer pump rotor. With one finger, rotate the liner several times to test for bind. Return the liner to correct position.

STEP 12. Insert the transfer pump seal and mount the end plate so that the inlet fitting is in line with the metering valve bore. The locating pin "B" will now line up with the locating slot "A" in the liner. If these are 180° out of alignment, check the end plate for correct location of the pin as to pump rotation (C and CC are marked on the outside of the end plate).

With reference to the Torque Value Chart, insert and tighten the four end plate screws.

STEP 13. Slip the head and rotor assembly, drive end up, into open end of holding fixture. Place the six governor weights in their sockets with the slots facing the bore of the assembly. Place the governor sleeve thrust washer against

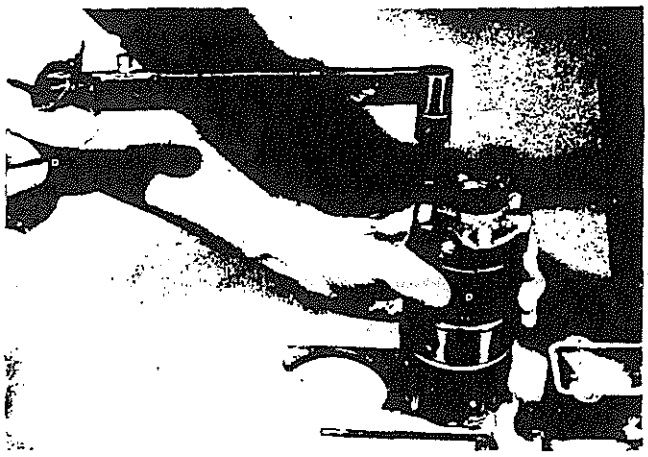


FIG. 52 (Step 12)

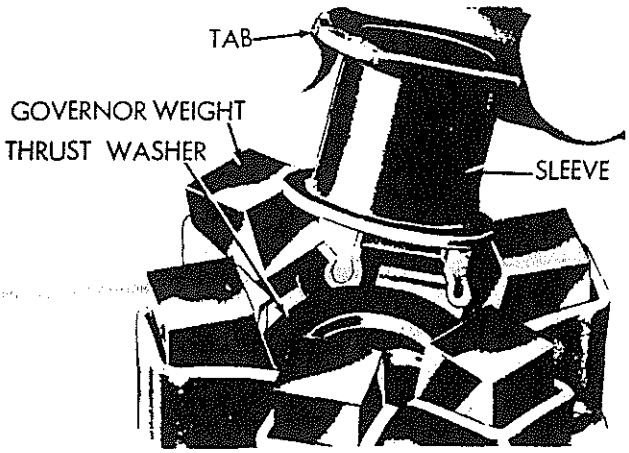


FIG. 53 (Step 13)

FIG. 54 (Step 14)

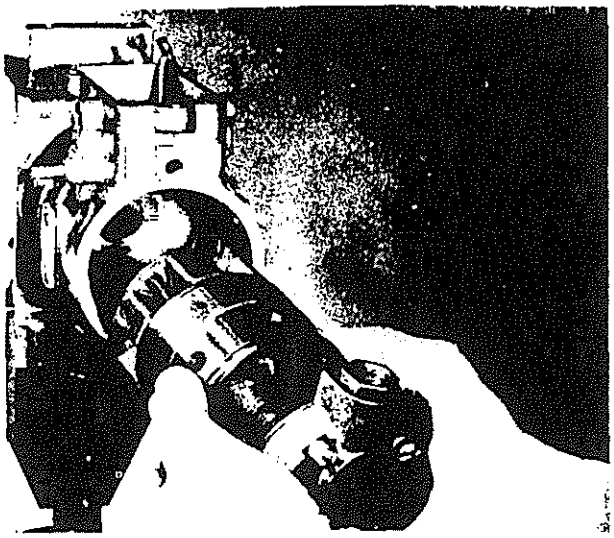


FIG. 55 (Step 15)

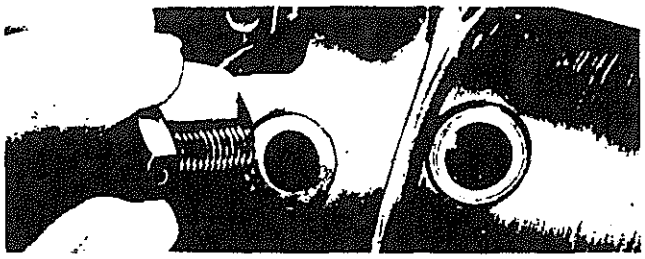


FIG. 56 (Step 15)

the governor thrust sleeve so that the chamfered edge faces the sleeve. Insert the forefinger into the bore of the sleeve and washer, holding them together, and insert them into the slots of the governor weights by tilting the weights slightly back. The tab on the thrust sleeve flange should face upward. Sight across the tops of the assembled weights to ascertain correct positioning. One weight higher than others indicates incorrect assembly of the thrust washer.

STEP 14. Place the governor arm in position with the fork for the governor linkage hook facing the end plate. Insert the pivot shaft (KNIFE EDGE FACING END PLATE) and assemble the two seals and cap nuts. Tighten the cap nuts simultaneously with reference to the Torque Value Chart.

STEP 15. The hydraulic head and rotor assembly including the transfer pump, cam ring, governor weight retainer, weights, governor thrust sleeve and washer should now be assembled into the housing.

Install a new seal on the hydraulic head. Rotate the cam ring so that the unthreaded hole is in line with the metering valve bore. This will insure proper position of the cam. Apply a light film of clean grease around the inside edge of the housing to aid in assembly.

Grasp the hydraulic head firmly in both hands and insert it into the housing bore with a slight rotary motion. Do not force.

If the assembly should cock during insertion, withdraw and start over. This is particularly important, as cocking can cause particles of metal to be shaved off the housing and left in the pump, causing serious damage in operation.

When inserting, make sure the assembly is wrung into position past the hydraulic head seal. Failure to do this might cause damage to the seal, resulting in leakage. When the head and rotor are finally assembled in their approximate location, rotate them until the head locking screw holes line up with their corresponding holes in the housing. Insert the head locking screws finger-tight.

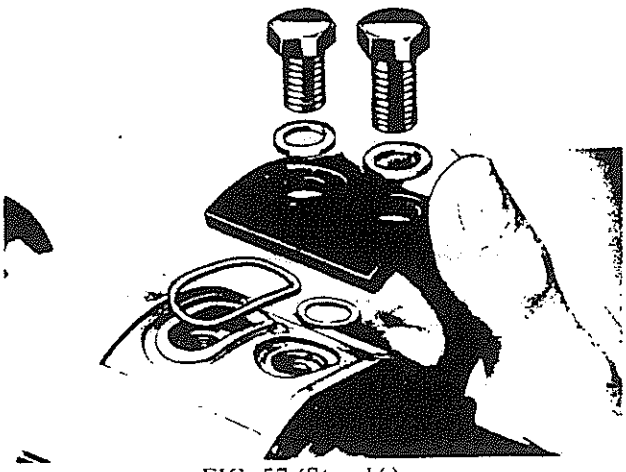


FIG. 57 (Step 16)

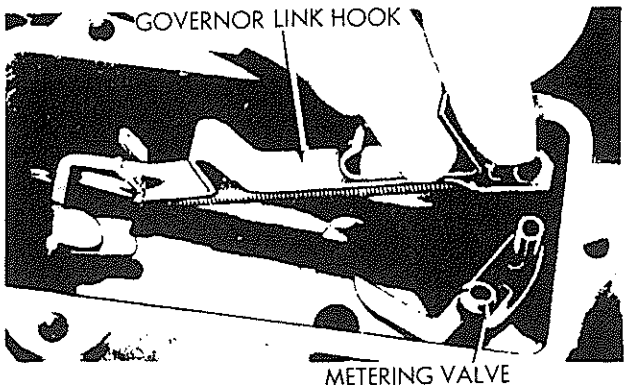


FIG. 59 (Step 18)

STEP 16. Invert the pump and fixture in the vise so the bottom faces upward. Place the cam hole seal in its groove (if used).
NOTE: *Place a small quantity of grease in each end of the seal groove and stretch the seal slightly to facilitate assembly (if used). Place head locating screw seal in its counterbore, and the cam hole cover in position.*

Before assembling the cam screw and head locating screw, make certain the holes in the hydraulic head and cam match with their corresponding holes in both the housing and cam hole cover. If necessary, the cam position may be adjusted to suit with the fingers.

Insert and tighten the cam holding and head locating screws with reference to Torque Value Chart.

Turn the pump back to its original position (top upward) in the vise. Tighten the two head locking screws. Refer to Torque Value Chart.

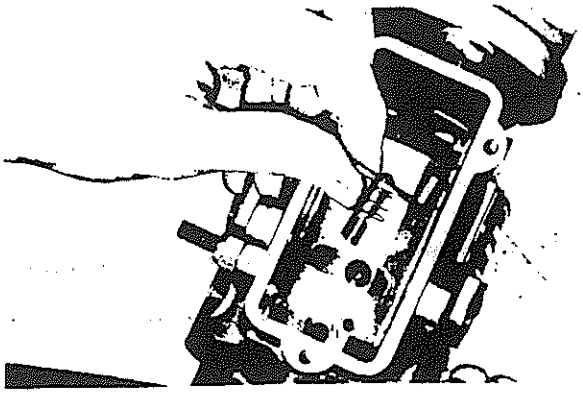


FIG. 58 (Step 17)

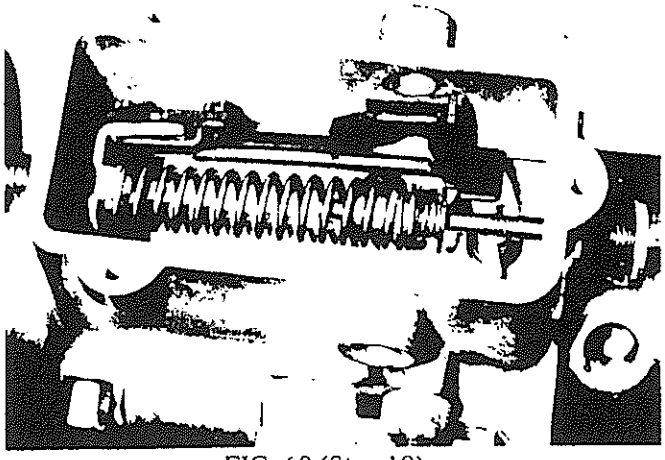


FIG. 60 (Step 19)

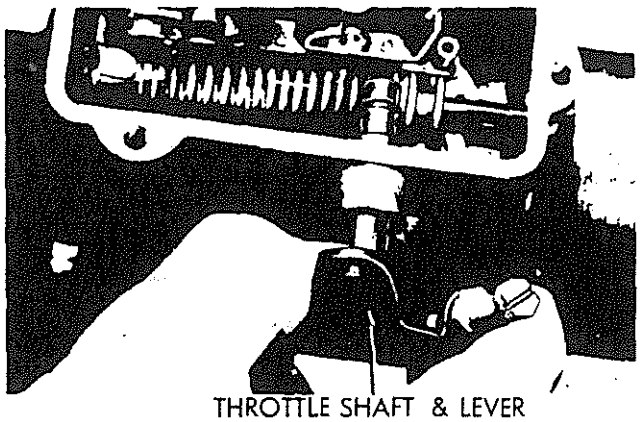
STEP 17. Place the metering valve spring on the metering valve and install the assembly into its bore. Depress and rotate the valve several times to insure freedom of movement If valve sticks, lap it in carefully with clean oil. Never sand. or polish off the special surface treatment provided.

STEP 18. Pull back on the governor linkage hook, stretching the spring just enough to assemble the hook correctly to the fork on the governor arm. Position the opposite end of the hook over the pin on the metering valve arm. Check all of the governor parts again for freedom or movement.

STEP 19. Assemble the governor spring, spring retainer, idle spring and idle guide on the bench. Pick up between thumb and forefinger and engage the governor spring over the formed tabs on the governor arm. Insert the guide stud, with washer, through the tapped hole in the rear of the housing and into the idle spring guide, idle spring, spring retainer and governor spring. Tighten guide stud to recommended torque.

NOTE: *The apparent looseness in the governor parts is normal.*

Lost motion is immediately taken up as soon as the pump rotates.



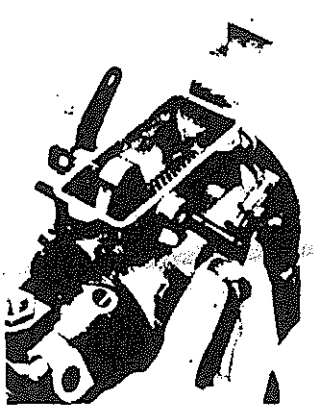


Fig. 62 (Step 20).

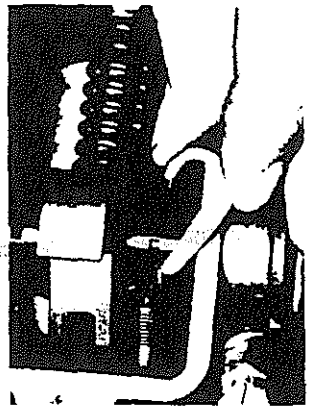


Fig. 63 (Step 20)

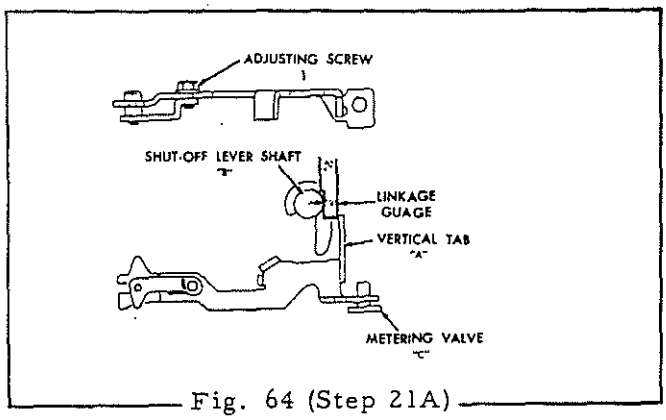


Fig. 64 (Step 21A)

STEP 20 Assemble the throttle shaft and lever assembly partially through its bore in the housing. Slide the spacer bushing (if used) and throttle shaft lever over the throttle shaft so that the projection on the throttle shaft lever bore engages the keyway on the shaft. Position the forked end of the throttle lever so that it straddles the guide stud. Apply a light coat of grease to the throttle and shut-off shaft seals. Assemble the shut-off lever assembly from the opposite side with a slight rotary motion, so as not to damage the seal, firmly seat the two levers. Locate and seat the shut-off cam.

STEP 21A. Linkage Adjustment - All pumps now in production employ a new style adjustable linkage. (See Fig. 64).

With the throttle lever in wide open position and the torque screw backed out, check the clearance between the rear of the shut-off shaft (B) and the vertical tab (A) on the linkage hook.

Adjustment of this clearance in the pump is made using Linkage Wrench #13379 by changing the effective length of Linkage Hook.

With adjusting screw (1) tight, apply a slight pressure to tab (A). At the same time rotate pump one or two complete revolutions to assure that linkage is in full forward position. Loosen adjusting screw (1) and slide linkage to maximum open length. Insert Linkage Gauge #13389 between vertical tab (A) and shut-off shaft (B) and

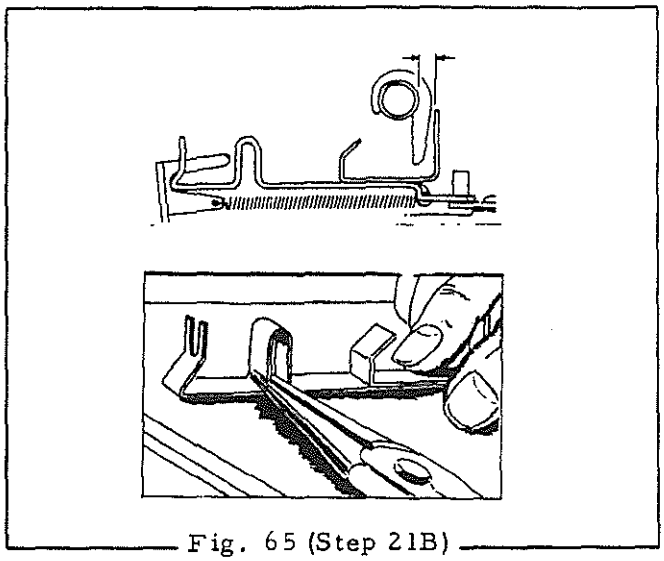


Fig. 65 (Step 21B)

slide linkage hook together from rear until face of tab is flush against gauge. Tighten adjusting screw (1). Check adjustment and reset if required.

STEP 21B. A limited number of Pumps incorporate the old style single piece linkage hook shown in Fig. 65. Adjustment may be made as follows:

With the throttle and shut-off levers in "run" position, check for clearance between rear of shut-off shaft and the vertical tab on the linkage hook. Refer to Service Specification for proper clearance.

CAUTION: During adjustment, the linkage hook must be removed from the pump and laid on a flat surface so the surfaces shown will remain parallel. Severe binding at the metering valve arm pin and erratic governing will result if this precaution is not observed.

To adjust clearance, open or close the formed hump in the linkage hook to increase or decrease its length, with needle nosed pliers. Reassemble linkage hook and recheck clearance between shut-off cam and linkage hook tab.

STEP 22. Check all governor parts for freedom of movement. Assemble a new seal to governor control cover, and install cover on pump tightening the three retaining screws securely.

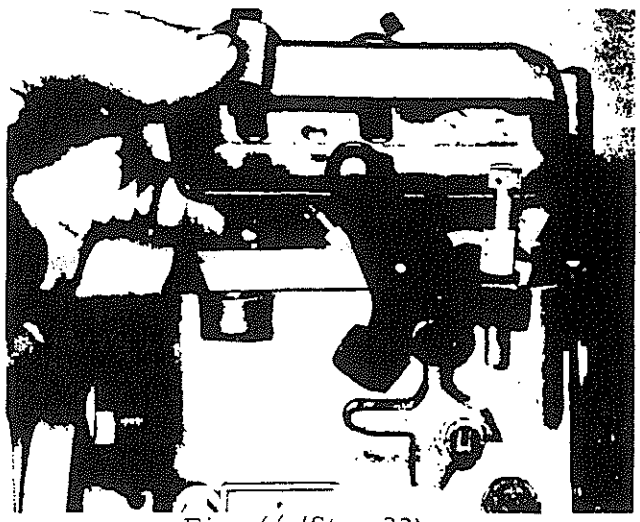


Fig. 66 (Step 22)

DRIVE SHAFT

Two molded cup shaped oil seals are retained in intermediate grooves in the drive shaft. The shaft tang has a small off center hole which coincides with a similar hole in the distributor rotor to indicate correct assembly.

Fig. 67

DISASSEMBLY

The shaft can be slid out without removing any other parts.

INSPECTION

Examine the tang end of the drive shaft, Fig. 67, for excessive wear, and the drive end for thread and key slot damage. The drive is a helical gear type; check for tooth wear, and the shaft pilot diameter for wear or scoring. Remove and discard drive shaft seals. Examine the seal grooves for smooth finish. Any roughness at these points will cause seal failure.

REASSEMBLY

Lubricate the shaft seals with light mineral grease and slide into grooves using seal installation tool. The seals MUST face in opposite directions to separate external lubricants from fuel oil in the pump. Apply mineral grease liberally around the shaft between the two seals.

While compressing the drive shaft seals with the drive shaft installation tool, start the drive shaft into the pilot tube. Push the drive shaft through.

CAUTION: Always align the hole in the tang of the drive shaft with the hole in the tang slot of the rotor.

TORQUE CONTROL

Torque is commonly defined as the turning moment or "lugging ability" of an engine. Maximum torque varies at each speed in the operating range for two reasons: (1) As engine speed increases, friction losses progressively increase and, (2) combustion chamber efficiency drops due to loss of volumetric efficiency, (breathing ability of an engine) and due to reduction of time necessary to completely and cleanly burn the fuel in the cylinder.

Since torque increases with overload conditions, a predetermined point at which maximum torque is desired may be selected for any engine. Thus, as engine RPM decreases, the torque increases toward this preselected point. This desirable feature is called "Torque Back-Up".

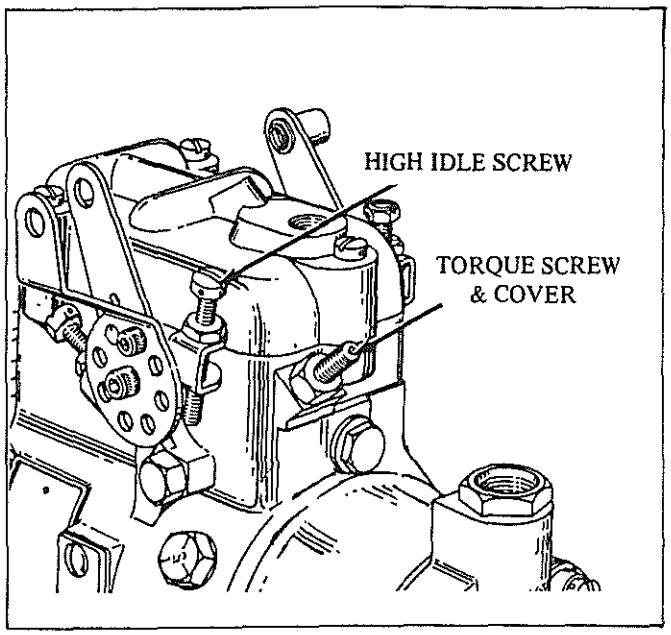
In the Roosa Master pump three basic factors affect Torque Back-Up. These are:

(1) Metering valve opening area, (2) time allowed for charging and (3) transfer pump pressure curve. Of these, the only control between engines for purposes of establishing a desired torque curve is the transfer pump pressure curve, since the other factors involved are common to all engines.

Torque control in the Roosa Master Fuel Injection Pump is accomplished in the following manner:
Engineering determines at what speed for a specific application they want the engine to develop its maximum torque. The maximum fuel setting is then adjusted for required delivery during dynamometer test. This delivery cannot exceed acceptable fuel economy.

The engine is then brought to full load governed speed. The fuel delivery is then reduced from that determined by the maximum fuel setting by turning in an adjustment or "torque screw", Fig. 68, which moves the metering valve toward the closed position. The engine is now running at part load since the pump plungers are not moving out to the limit determined by the maximum fuel adjustment (Roller to Roller Dimension).

When the engine is operating at high idle speed, no load, the quantity of fuel delivered is controlled only by governor action through the metering valve.
NOTE: At this point, the torque screw and maximum fuel adjustment have no effect.



As load is applied, the quantity of fuel delivered remains dependent on governor action and metering valve position until full load governed speed is reached. At this point, further opening of the metering valve is prevented by its contact with the previously adjusted torque screw. Thus, the amount of fuel delivered at full load governed speed is controlled by the torque screw and not by the Roller-To-Roller Dimension.

As additional load is applied and engine RPM decreases, a greater quantity of fuel is allowed to pass into the pumping cylinder due to the increased time of registration of the charging port. During this phase of operation the metering valve position remains unchanged, still being held from further rotation by the torque screw. As engine RPM continues to decrease, the quantity of fuel allowed into the pumping cylinder increases until the predetermined point of maximum torque is reached. At this point the quantity of fuel is controlled by the Roller-to-Roller Dimension.

It must be remembered that torque adjustment on the Roosa Master Pump may be properly carried out only during dynamometer or bench test. It should not be attempted on a unit in the field without means of determining actual fuel delivery.

HD-3 TRACTOR D-175 ENGINE (PRIOR TO NO. 117742)

A. C. Part No. - 4513092
Roosa No. - DBGFC429 3 AF
High Idle - 1865 - 1885 RPM
Rated Load - 1650 RPM
Low Idle - 650 RPM

Static Timing - 22°BTDC
Roller to Roller Setting @ 30 to 100 PSI = 1.966"
Transfer Blade Minimum Dimension - 1.093"
Shut-off lever overlap .135 to .155 from vertical lever tab to shut-off lever shaft

CALIBRATION DATA:
Dynamometer - PTO Speed Rated Load 538 RPM 32.5 HP
Taylor Reading - 73.5 Pounds Force - 32.5 Direct PTO HP

Test Stand -			
Fuel Pump RPM	Transfer pump pressure	c.c. per 1000 strokes	Remarks
600	50	47-51	Roller to roller setting 1.966
825	60	49-51	Torque screw setting
75	10 minimum	30.5 minimum	Minimum flow check

NOTE: Pump Turns 1/2 Engine Speed
Vacuum on Transfer Pump = 15 - 25 Inches
Vacuum on Transfer Pump thru Filters - 6 In.

HD-3 TRACTOR D-175 ENGINE (NO. 117742 thru D-08499)

A. C. Part No. - 4513635
Roosa No. - DBGFC429 6 AF
High Idle - 1865 - 1885 RPM
Rated Load - 1650 RPM
Low Idle - 650 RPM

Static Timing - 22° BTDC
Roller to Roller Setting @ 30 to 100 PSI = 1.966"
Transfer Blade Minimum Dimension - 1.093"
Shut-off lever overlap .135 to .155 from vertical lever tab to shut-off lever shaft

CALIBRATION DATA:
Dynamometer - PTO Speed Rated Load 538 RPM 32.5 HP
Taylor Reading - 73.5 Pounds Force - 32.5 Direct PTO HP

Test Stand -			
Fuel Pump RPM	Transfer pump pressure	c.c. per 1000 strokes	Remarks
600	50	47-51	Roller to roller setting 1.966"
825	60	49-51	Torque screw setting
75	10 minimum	30.5 minimum	Minimum flow check

NOTE: Pump turns 1/2 Engine Speed
Vacuum on Transfer Pump = 15-25 Inches
Vacuum on Transfer Pump thru Filters - 6 In.

HD-3 TRACTOR D-175 ENGINE

Engine No. D-08500 & Above
Tractor S/N 8694 & Up

A. C. Part No. - 4515366
Roosa No. - DBGFC429 26AF

High Idle - 2030 - 2060 RPM
Rated Load - 1800 RPM
Low Idle - 600-650 RPM

Static Timing - 24° BTDC
Roller to Roller Setting @ 30 to 100 PSI= 1.968"
Transfer Blade Minimum Dimension - 1.093"
Shut-off lever overlap .135 to .155 from vertical lever tab to shut-off lever shaft

CALIBRATION DATA:

Test Stand -

Fuel Pump RPM	Transfer Pump Pressure	C. C. Per 1000 Strokes	Remarks
600	48	47.5-51.5	Roller to Roller Setting 1.968"
900	65	49-51	Torque Screw Setting
75	8 Minimum	30.6 Minimum	Minimum Flow Check

NOTE: Pump Turns 1/2 Engine Speed
Vacuum on Transfer Pump = 15-25 Inches
Vacuum on Transfer Pump thru Filters = 6 Inches

BENCH TEST PROCEDURE

All tests must be conducted using heated calibrating oil (110° - 115°F.) and 12SD12 nozzles set to open at 2500 PSI. Fresh clean oil is all important for accurate testing and should be changed as often as excessive foam is noted.

A complete set of adapters for all models of the Roosa Master Pump are available for the following makes of commercial test benches.

1.	American Bosch	TSE7664 TSE4500 TSE4600
2.	Unitest	U-4500 U-4600
3.	Bacharach	GP-500C SP-600
4.	Hartridge	J L NU

GENERAL TEST PROCEDURE

A. Mount the pump securely with appropriate adapter. If pump employs a bronze pilot tube, the shaft supplied with the pump must be removed and the pump mounted on the stand using the shaft provided by the test stand manufacturer. (No support bearing is required). (See Fig.

Check intermediate coupling disc for freedom of movement. Connect supply and return lines securely.

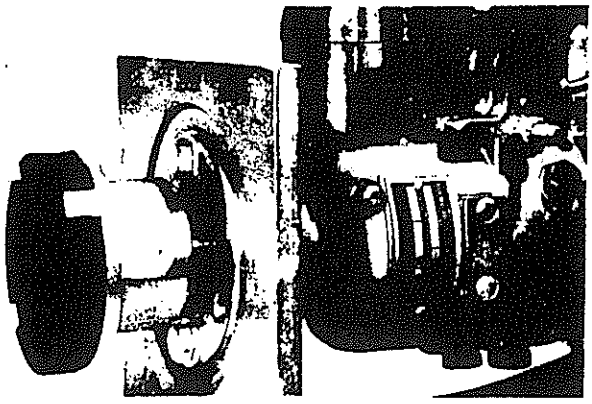
Install high pressure injection lines using new copper gaskets. Leave fuel line connector screws at pump, and injection line nuts and nozzles loose.

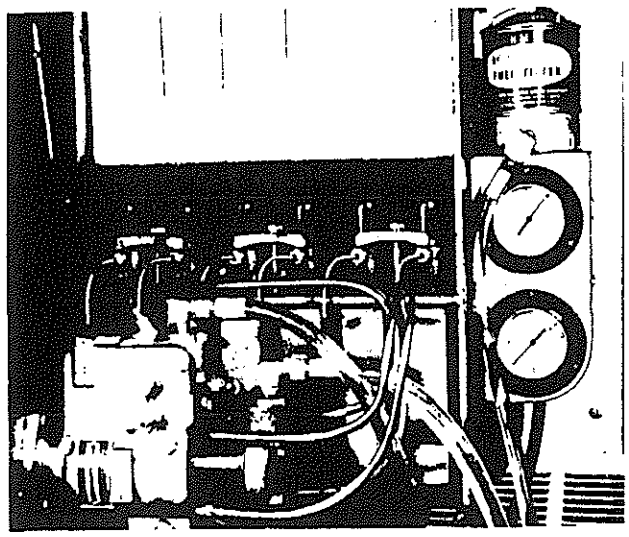
B. Determine proper direction of rotation from pump name plate ("C" - Clockwise). Rotation is determined as viewed from drive end of pump.

C. Start stand at lowest speed. Move throttle to "full load" position. When transfer pump picks up suction, allow fuel to bleed for several seconds from loosened connector screws. Likewise, allow fuel to bleed from loosened injection line nuts. Tighten securely.

D. Operate pump at full load rated speed for several minutes. Dry off completely with solvent and compressed air. Observe for leaks and correct as necessary.

E. Close valve in supply line. Transfer pump must pull at least 15" HG. If it does not, check for air leaks on suction side or malfunction of end plate and transfer pump parts.





F. Fill graduates to bleed air from test stand and to wet glass.

G. Observe return oil. Return should be at rate of 100-450 CC/Min. @ 35 PSI transfer pump pressure.

H. Operate test stand at full load speed (consult pump specification sheet). Set counter for 1000 revolutions. Divert fuel to graduates. Record reading. Difference between cylinders should not exceed 5%. Record transfer pump pressure.

I. Check and record full load fuel delivery and transfer pump pressure according to the Pump Specification.

J. While operating at full load governed speed, set torque screw (if employed) to specified delivery. (See Pump Specifications).

K. Check shut-off at low idle, full load and high idle speeds.

L. Adjust test stand speed to high idle speed and adjust high idle screw. (See Pump Specifications).

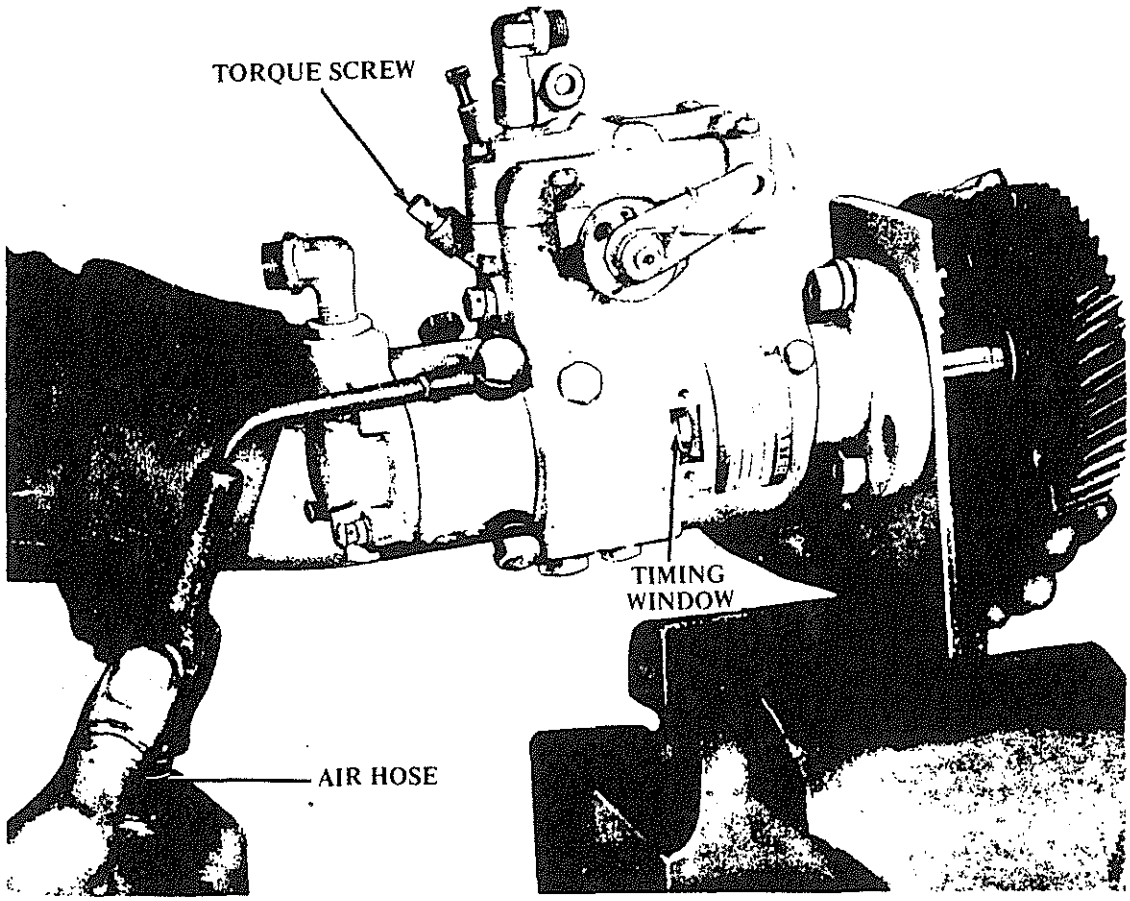
M. Set low idle with reference to Pump Specifications.

N. If automatic advance is employed, check cam movement and reset, if necessary, according to the Pump Specifications.

O. Assemble all sealing wires. Pump is now ready for installation to engine.

P. Wire throttle lever in "full fuel" position for shipment or until installed on engine.

AIR TIMING



Air-timing establishes the exact point at which the cam rollers contact the face of the cam lobe which is the start of injection. It is a far more accurate method of timing than the mechanical procedure. On all pump repairs involving replacement of the weight retainer cage, the new timing line must be established using the air-timing procedure.

The new timing line should be electro-etched on the weight retainer through the timing window.

Air-Timing Procedure

a. Connect air pressure (30 to 100 PSI) to fuel dishcarge port for No. 1 cylinder using 2 copper washers, one on each side of the banjo fitting.

b. Viewing the timing line on the cam through the timing window, name plate side, rotate the pump in direction of rotation.

c. When resistance is felt, the cam roliers are just contacting the cam.

d. The electro-etched timing line must be placed on the weight retainer, in line with the timing line on the cam. This should be first marked with a pencil and established, as in Step B, several times before the etched mark is applied.

e. If the electro-etched mark is placed in a mistaken position, it may be "stoned-off", with care, through the timing window. A new line can then be placed in the proper position following the above procedure.

NOTE: Enough air will leak by the delivery valve for this procedure as listed above. It is not necessary to remove the delivery valve.

INSTALLATION

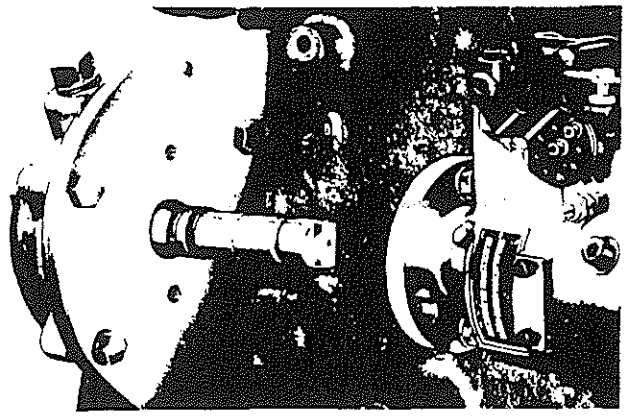


FIG. 84

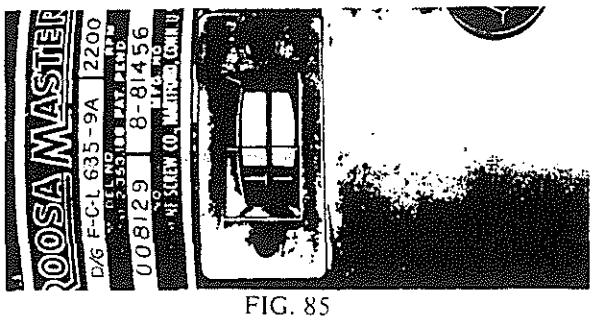
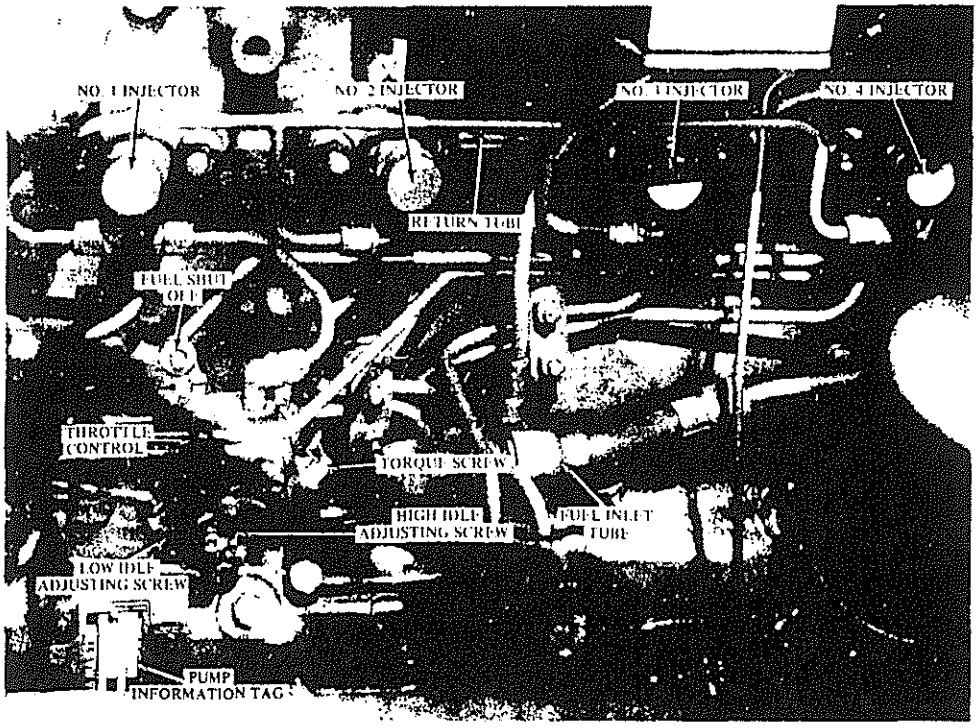


FIG. 85



TIMING (Engines w/Timing Strip)

Install pump to engine, with the engine positioned as specified before top center on number one cylinder and the injection pump positioned with the timing marks in alignment in timing window.

TIMING (Engines w/out Timing Strip)

Rotate engine until the number four cylinder exhaust valve is just closing. This will locate the number one cylinder on the compression stroke. Remove the stud from flywheel plate and reverse screw putting the stud end in hole. Gently rotate engine until pin enters hole in flywheel. This will locate engine for start of injection.

ATTACHING PUMP TO ENGINE

Remove outer timing window from pump and rotate until timing marks on governor spider and cam ring align. This locates the pump for beginning of injection. As a further check observe the end of the tang on drive shaft. It has a drilled hole to one side of center. Observe the end of rotor, it also has a drilled hole. When coupling pump these two holes should align. Fineness of adjustment may be made by the slotted holes in pump mounting flange. If the length of slot provided is not long enough it indicates the drive gear is not mated in the correct position.

Install new seals on the pump drive shaft, position front seal with lip forward and rear seal with lip rearward. Use the special tool to compress seals while sliding pump over shaft. Install new O-ring seal at front of pump.

Install fuel lines, using a washer at each side of the banjo connections. Tighten the banjo retaining screws to 420 in. lbs. torque.
CAUTION! *Tightening these screws without the gasket washers in place will cause rotor distortion and seizure.*

PRIMING PUMP

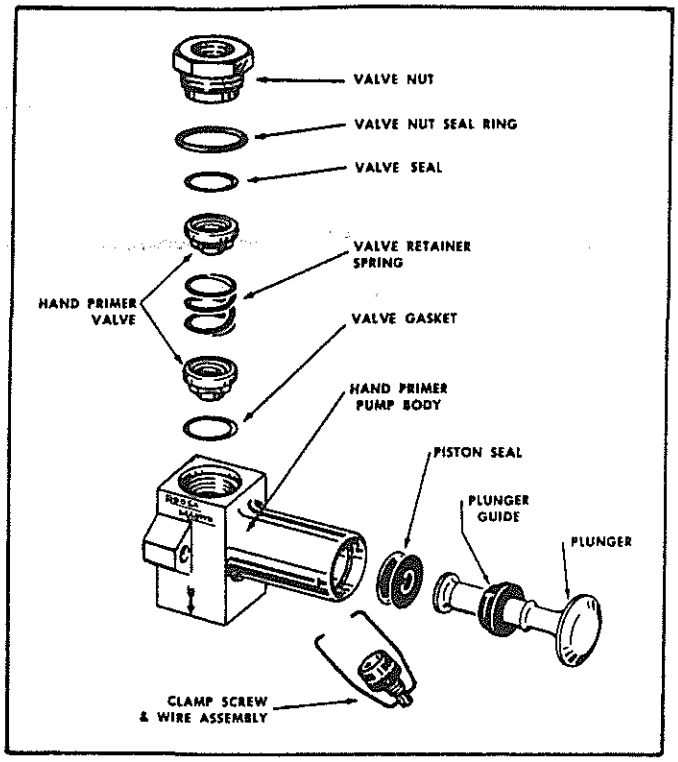
The priming pump consists of a body and two valves, a piston and locknut screw.

The valves are assembled in body so that fuel may flow through in the direction of arrow on body but not in the reverse direction.

When the piston is unlocked and drawn out oil is pulled through the upper valve. When the piston is pushed in the upper valve closes and the lower valve opens and fuel is discharged into the filter circuit.

To disassemble remove the valve nut and seal ring. Remove upper valve seal, valve, valve retainer spring, lower valve and seal.

The washer assembly contains a very light spring to seat the valve.



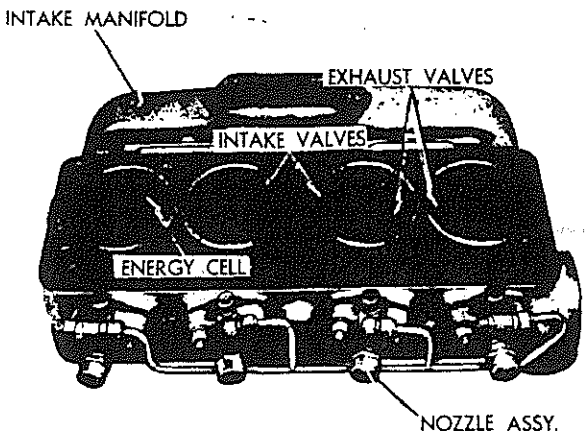
AIR OR ENERGY CELL

The energy cells may be removed from the cylinder head if replacement or inspection of the cells are necessary. It will be necessary to remove the intake manifold before the energy cells can be removed. To remove energy cells, suitable pullers are necessary. An energy cell puller J-6306 may be obtained through the Kent-Moore organization. This puller may be used with their slide hammer puller and adapter set number J-6471-02.

The only faults of the energy cell is plugging or burning. Plugging is caused by malfunction of the nozzle. Burning is the result of unburnt fuel. If eroded, they should be replaced.

When installing an energy cell, the seal surface at the head and at the cap must be lapped with fine compound to provide an air tight seal, as no gaskets are used. Leaking energy cell seats, or caps, causes a severe knocking sound.

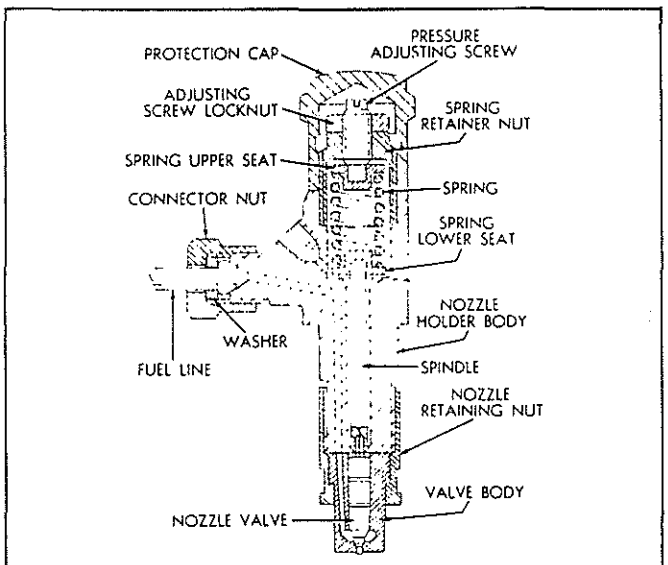
NOZZLE HOLDER AND NOZZLE



NOZZLE

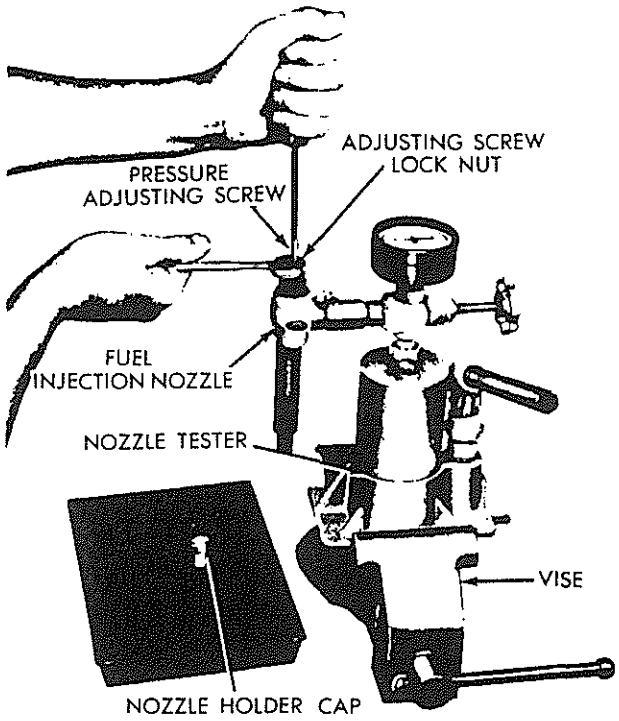
The nozzle holder is held to the cylinder head by two studs and nuts. The torquing of these nuts are very important for a nozzle to function properly. The maximum torque on these nuts is 12 to 15 ft. lbs. and no one nut should be tightened over 2 ft. lbs. before changing over to the other nut. If one side of the holder assembly is over tightened, it will force the nozzle against one side of the cylinder head bore. Then no matter how much the opposite nut is tightened, it will not center in nozzle bore.

Also a nozzle gasket which has been improperly torqued will again deflect the nozzle even with the correct torque application, so always use a new gasket and tighten the nuts evenly, about 2 ft. lbs. on each nut until 12 to 15 ft. lbs. is reached.



FUEL NOZZLE SECTIONAL VIEW

The nozzle assembly is of the throttling pintle type. The nozzle operates on the hydraulic principal of the pressure differential between fuel pressure and spring pressure. As fuel from the injection pump enters the nozzle holder, it flows under the pintle valve and when the pressure increases sufficiently to overcome the valve spring, the pintle is lifted from its seat and fuel enters the combustion chamber. A leak off line is attached to the holder to lead any leakage back to the fuel tank.



NOZZLE TESTER

It is permissible to set the nozzle popping pressure at 2100 P. S. I. when performing the predelivery check up as new springs usually take a slight set and show a reduction of pressure. When cleaning or adjusting nozzles at the 100 hour inspection, or there after, adjust the pressure to exactly 2000 P. S. I.

When checking the spray pattern of a nozzle, it should be observed 3" to 6" from the nozzle tip.

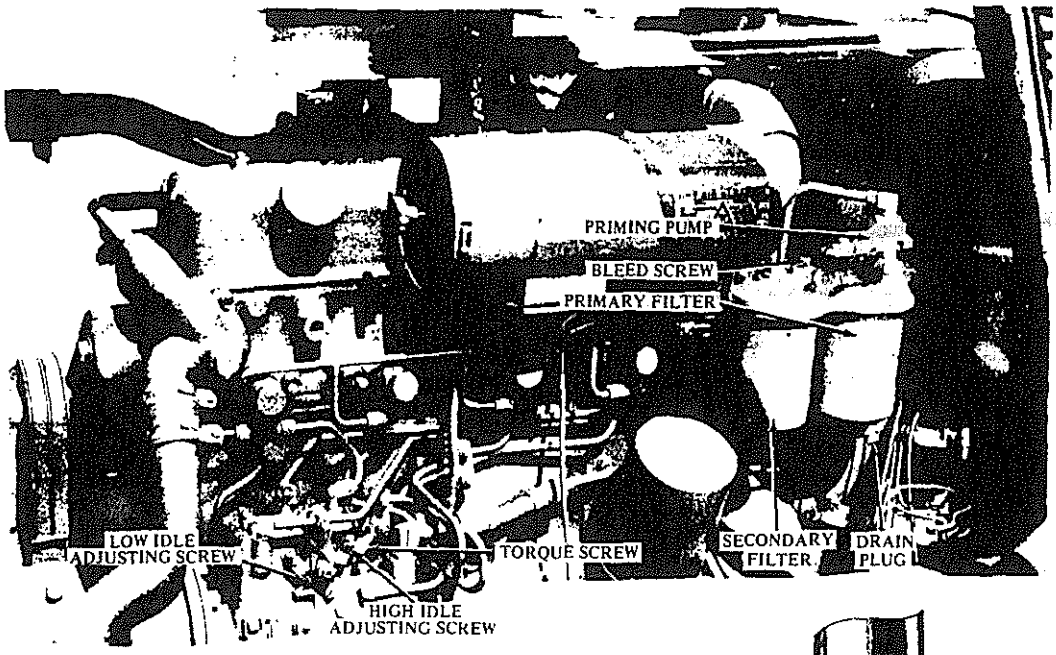
In the disassembly of a nozzle, remove the cap nut, loosen the adjusting screw lock nut and back out the pressure adjusting screw until the spring pressure is relieved. This will relieve the spring tension and avoid damage to pintle.

Remove the nozzle retaining cap nut and valve assembly.

Use only brass or wood tools for cleaning the pintle, pintle seat or pintle opening.

The nozzle test kit 4833865 was supplied with three adapters for attaching nozzles to the nozzles

NOZZLE HOLDER AND NOZZLE



to the nozzle tester. Each adapter has a number stamped into it. The J-1148 adapter nut has a 14 M. M. thread and is used for testing the American Bosch nozzles as used in the WD-45 diesel.

AC nozzle thread is 9/16 x 18 thread, use correct test stand adapter.

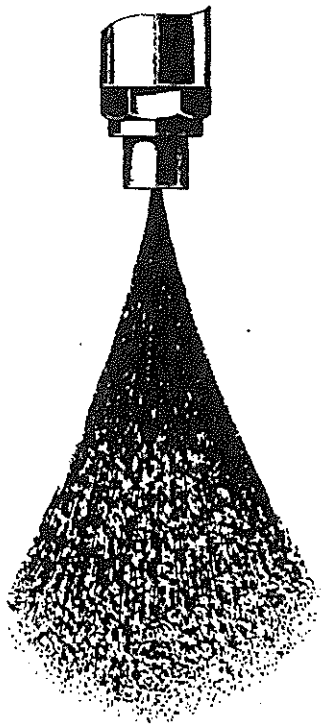
After the nozzle assembly is thoroughly cleaned and is free of any sticking, attach it to the nozzle holder, keeping all parts clean in clean diesel fuel. Leave the adjusting screw loose during assembly, and use the special centering tool for properly locating valve assembly to holder assembly.

First adjust the popping pressure to 2100 P. S. I. on new nozzles, and to 2000 P. S. I. at the 100 hour inspection or thereafter.

Next, bring the pressure up slowly to check for dribble. If the nozzle does not leak up to 1700 P. S. I., the seat is considered good.

Check the spray pattern at approximately 100 strokes per minute (short quick strokes). The pattern should be even and uniform. Also check for dribble and rapid closing using short quick strokes. Slower operating of tester may cause dribble.

Brass or wood tools must be used for removing carbon and cleaning nozzle parts. Mutton tallow is used for cleaning the pintle and valve assembly.



GOOD NOZZLE PATTERN

INDEX

ELECTRICAL SYSTEM

E

SPECIFICATIONS

GASOLINE UNIT

Quantity	1
Type	12 volt
Capacity	6 AMP Hour
Ground Terminal	Positive

DIESEL UNIT

Quantity	1
Type	6 volt
Capacity	135 AMP Hours(total)
Ground Terminal	Positive
Circuit	Series

BATTERY LOCATION

GASOLINE UNIT

The battery is located under the engine hood, immediately ahead of the fuel tank and is accessable through the removal of the R.H. Hood Section.

DIESEL UNIT

The batteries are located in a Compartment mounted on the L.H. Fender and are accessable through the hinged door on top of the Compartment.

THE BATTERY

A.

New batteries are normally "dry charged" and are stored and shipped without electrolyte (water diluted sulphuric acid) in order to avoid deterioration and to simplify shipment and storage. The battery is activated by filling each cell with electrolyte.

B. OPERATION

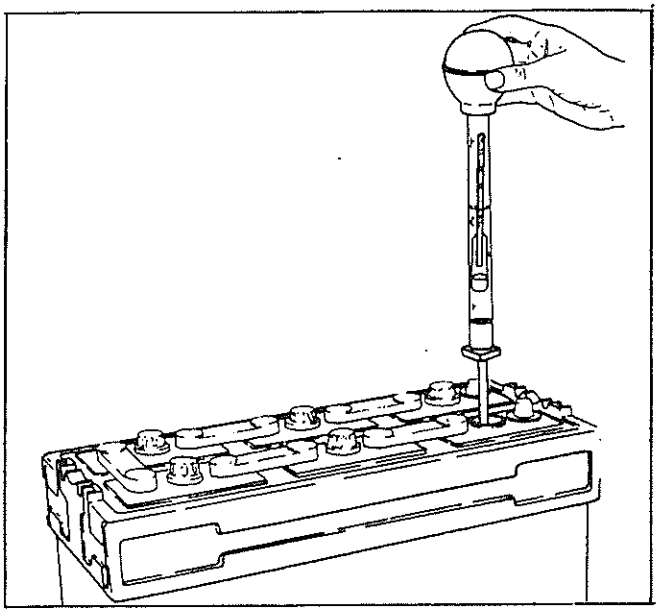
Hydrogen and oxygen gases are given off as the plates reach a fully charged condition due to decomposition of the water by the excess of charging current not utilized by the plates. Water is the only chemical, under normal conditions, which is lost by a battery in use.

Battery strength is measured by the specific gravity of the electrolyte. The specific gravity for a battery at a temperature of 80° F ranges from about 1.250 when fully charged to about 1.210 when discharged.

Since specific gravity is a comparison of the density of the electrolyte to that of water, this means the electrolyte solution of a fully charged battery weighs 27 per cent more than an equal volume of water and the electrolyte solution of a discharged battery weighs only 11 per cent more than an equal volume of water. If the temperature of the electrolyte is not approximately 80°F when the specific gravity is measured, the reading should be adjusted. For each 10° increment below 80°, .004 should be subtracted from the specific gravity reading. For each 10° increment about 80°, .004 should be added to the reading. For example, if the hydrometer reading is 1.230 and the temperature of the electrolyte is 100°F, .008 (.004 for each 10° above 80°) should be added to the hydrometer reading and the corrected reading would be 1.230 plus .008 or 1.238. If the temperature of the electrolyte had been 10°F, .028 (.004 for each 10° below 80°F) should be subtracted from the hydrometer reading and the corrected reading would be 1.230 minus .028 or 1.202.

C. MAINTENANCE AND SERVICE

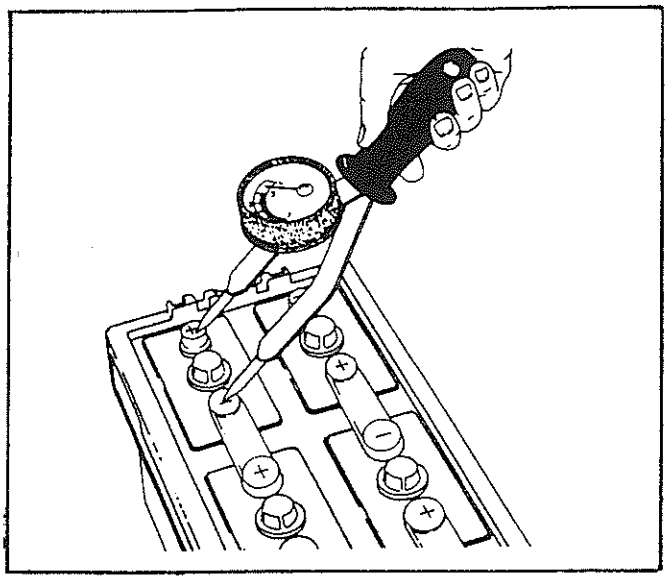
General - A battery is a perishable item requiring periodic servicing. Only when the battery has been properly maintained can long and trouble-free service be expected. To properly service a battery, observe the following:



1. Check the level of the electrolyte regularly as specified in the service and lubrication guide of the loader. Add water if necessary to maintain the prescribed level but do not overfill. Overfilling can cause loss of electrolyte. Excessive use of water indicates overcharging or possible leakage.

2. Keep the top of the battery clean. When necessary to rid the terminals and connections of corrosion, wash with baking soda solution and rinse with clear water. Clean additionally with a steel brush or steel wool. Coat the connections and terminals lightly with grease to retard additional corrosion.

3. Inspect cables, clamps and hold-down brackets. Clean and replace as necessary.



Temperature considerations -

1. An undercharged battery is susceptible to freezing when standing idle and exposed to cold weather. The electrolyte of the battery in various stages of discharge will start to freeze at temperature as follows:

Specific Gravity (Corrected to 80°F)	State of Charge	Freezing Temperature
1.110	Discharged	15° F
1.190	Half charged	- 10° F
1.270	Fully charged	80° F

2. High temperature operation may make an adjustment for tropical climate desireable. If the battery will not be exposed to freezing temperatures, the specific gravity for a fully charged battery may be altered by dilution to 1.225. This adjustment will reduce battery maintenance and increase battery life. The specific gravity alteration is accomplished by fully charging the battery and then removing a portion of the electrolyte and replacing it with distilled water until the gravity of all cells is 1.225. The various states of charge for a battery so adjusted would then be:

1.225	100%charged	1.135	50% charged
1.180	75%charged	1.045	Discharged

D. BATTERY STORAGE

If the loader is not expected to be used for two or more weeks, the battery should be removed and stored in a cool dry place. During extended storage it should be checked periodically and recharged as necessary.

NOTE

Batteries allowed to stand for long periods in a discharged condition are subject to crystallization of the lead sulfate on the plates. This deterioration will adversely affect future performance.

E. TESTING

In-vehicle testing

1. Make a visual inspection of the battery. Check the level of the electrolyte. Observe the outside of the battery for signs of damage or serious abuse such as excessive corrosion, cracked case, bulged or cracked cell covers.

2. Perform a "light-load" test as described below. This test, to be effective, should be made prior to charging the battery.

   a. If the electrolyte level is low, add water to bring to proper level.

   b. Place a load on the battery by engaging the starter for three seconds. If the engine starts, turn it off immediately. The purpose of the load is to remove the surface charge from the plates of the battery and to condition it for testing. Also voltage differences between good and poor cells will be amplified.

   c. Turn the loader lights on or subject to a comparable current drain. Leave the lights on for one minute prior to starting the light-load test and leave them on during the test. This allows the discharge current to reduce the cell voltages in proportion to the capacity of the cells. After one minute, read the individual cell voltages with an expanded scale voltmeter having .01 volt divisions. The difference in voltage readings between the cells can be interpreted as follows:

   (1) Uniform readings - If any cell reads 1.95 volt or more and there is a difference of .05 volt or more between the highest and lowest readings is less than .05 volt, the battery is good. If any cell reads less than 1.95 volt, the battery should be fully recharged for good performance.

   (2) Non-uniform readings - If any cell reads 1.95 volt or more and there is a difference of .05 volt or more between the highest and the lowest cell, the battery should be replaced.

   (3) Low readings - If all cells read less than 1.95 volts, the battery is too low to test properly. Failure of the meter to register on all cells does not, of itself, indicate a defective battery. Boost-charge the battery (60 ampere rate for 30 minutes) and repeat the light-load test.

Out-of-vehicle testing

1. "Light-load" test - Follow the procedure described for in-vehicle testing by substituting a 150 ampere load for three seconds in lieu of engaging the starter and a 10 ampere load in lieu of turning on the lights.

2. Full charge hydrometer test - Fully charge the battery at a rate of 7% of the 20 hour rating of the battery. Example: A battery with a 20 hour rating of 150 amperes should be slow charged at 10 or 11 amperes. Charging should be continued until cell gravite cease to show an increase when checked with a hydrometer at three intervals of one hour and all cells are gassing freely.

3. Measure the specific gravity of the electrolyte in each cell and compare readings with the following:

   a. If individual cell readings range between 1.230 and 1.310 specific gravity, the battery is ready for use. Any variation in the specific gravity within this range does not indicate a defective battery.

   b. If any cell reads less than 1.230 and the battery has been in use for more than three months, the battery at best will give very little useful service and should be replaced. If the battery has been in service for less than three months, it may have been improperly activated with electrolyte. To correct this condition, empty the electrolyte from any cell reading less than 1.230 and refill with 1.265 gravity battery grade electrolyte.

F. BATTERY CHARGING

Two methods are used for recharging batteries. They differ basically in the rate of charge together with duration. Before recharging a battery by either method, the electrolyte level should be checked and water added as necessary.

1. Slow charging - The slow charge method supplies the battery with a low amount of current for a relatively long period of time. As much as 24 hours may be needed to fully recharge a battery.

2. Fast charging - The fast charge method supplies the battery with a high amount of current for a relatively short period of time. The battery state of charge is brought up quickly before excessive battery temperatures are reached. Although a battery cannot be brought up to a fully charged condition during fast charge, it can be substantially recharged or "boosted". In order to bring the battery to a fully charged condition, the charging cycle must be finished by the slow charging method. If the electrolyte temperature reaches 125° F during charging, the recharging must be stopped or the charging rate reduced to avoid damage to the battery.

3. Recommended charging rates are as follows (12 volt batteries):

Amp Hour Capacity	Slow Charging	Fast Charging
100 or less	24 hrs 4 Amps	1-1/2 hrs 45 Amps
over 100	24 hrs 9 Amps	3 hrs 45 Amps

WARNING

Gases formed in battery during charging are explosive. It is good practice to remove vent plugs where performing any service of battery.

Do not smoke near batteries being charged or which have been charged very recently.

Do not break live circuits at the terminals of batteries which have been undergoing charging. The spark which usually occurs can cause an explosion.

G. INSTALLATION OF BATTERIES

To properly install a battery, the following precautions should be observed:

1. Clean the battery compartments.

2. Check polarity of the battery to ensure it is not reversed with respect to the generating system.

3. Be sure the battery sits level when installed in the compartment.

4. Tighten the hold-down clamps evenly until snug. Avoid over-tightening as it may distort or crack the battery case.

5. Check the battery cables to be sure they are in good condition. Make sure the connections to starter and ground are clean and tight.

6. Grease the battery terminals lightly to deter corrosion. When connecting the cable clamps to the battery, install the grounded clamp last to avoid short circuits which may damage the battery or other parts of the electrical system. Lightly grease the exteriors of the cable clamps to deter corrosion.

STARTING MOTORS
Gas and Diesel

OPERATION

When the switch is closed, the magnetic switch winding is energized, and the switch contacts close to connect the motor directly to the battery. As the armature begins to rotate, the drive pinion, being a loose fit on the drive sleeve located on the armature shaft, does not pick up speed as fast as the armature. Therefore, the drive pinion, having internally matched splines with respect to the splined drive sleeve, moves endwise on the shaft and into mesh with the flywheel. As the pinion hits the pinion stop it begins to rotate with the armature and cranks the engine. When the engine starts, the flywheel begins to spin the pinion faster than the armature. Again, because of the splined action of the pinion and drive sleeve assembly, the pinion backs out of mesh with the flywheel ring gear protecting the armature from excessive speeds.

Some Bendix drives incorporate a small anti-drift spring between the drive pinion and the pinion stop which prevents the pinion from drifting into mesh when the engine is running. Others use a small anti-drift pin and spring inside the pinion which provides enough friction to keep the pinion from drifting into mesh.

Never operate the motor for more than 30 seconds without pausing for two minutes to allow it to cool.

CRANKING MOTOR LUBRICATION

When the motor is disassembled for any reason, lubircate as follows:

1. Oil wicks, if present, should be resaturated.

2. Bushings, should be coated with a small amount of Delco-Remy Lubricant No. 1960954.

3. The armature shaft should be coated lightly with Delco-Remy Lubricant No. 1960954.

4. The drive assembly should be wiped clean and coated with light oil. Do not wash the drive assembly in solvent.

5. Avoid excessive lubrication.

TROUBLESHOOTING THE CRANKING CIRCUIT

Before removing any unit in a cranking circuit for repair, the following checks should be made:

BATTERY: To determine the condition of the battery, follow the testing procedure outlined in Service Bulletin 7D-100 or 7D-100E. Insure that the battery is fully charged.

WIRING: Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid or magnetic switch, ignition switch or any other control switch, and battery, including all ground connections. Clean and tighten all connections as required.

MAGNETIC SWITCH AND CONTROL SWITCHES:
Inspect all switches to determine their condition. Connect a jumper lead around any switch suspected of being defective. If the system functions properly using this method, repair or replace the bypassed switch.

MOTOR: If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the test procedures outlined below.

CRANKING MOTOR TESTS

With the cranking motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of operation by turning the pinion. Tight, dirty, or worn bearings, bent armature shaft, or a loose pole shoe screw will cause the armature to not turn freely. If the armature does not turn freely the motor should be disassembled immediately. However, if the armature does operate freely, the motor should be given electrical tests before disassembly.

NO-LOAD TEST

Connect a voltmeter from the motor terminal to the motor frame, and use an r.p.m. indicator to measure armature speed. Connect the motor, switch and an ammeter in series with a fully charged battery of the specified voltage and compare the r.p.m., current, and voltage readings with the specifications.

It is not necessary to obtain the exact voltage specified in these bulletins, as an accurate interpretation can be made by recognizing that if the voltage is slightly higher the r.p.m. will be proportionately higher, with the current remaining essentially unchanged. However, if the exact voltage is desired, a carbon pile connected across the battery can be used to reduce the voltage to the specified value. Interpret the test results as follows:

1. Rated current draw and no-load speed indicate normal condition of the cranking motor.

2. Low free speed and high current draw indicate:

   a. Too much friction -- tight, dirty, or worn bearings, bent armature shaft or loose pole shoes allowing armature to drag.
   b. Shorted armature. This can be further checked on a growler after disassembly.
   c. Grounded armature or fields. Check further after disassembly.

3. Failure to operate with high current draw indicates:

   a. A direct ground in the terminal or fields.
   b. "Frozen" bearings (this should have been determined by turning the armature by hand).

4. Failure to operate with no current draw indicates:

   a. Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.
   b. Open armature coils . Inspect the commutator for badly burned bars after disassembly.
   c. Broken brush springs , worn brushes, high insulation between the commutator

bars or other causes which would prevent good contact between the brushes and commutator.

5. Low no-load speed and low current draw indicate:

   a. High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under Number 4.

6. High free speed and high current draw indicate shorted fields. If shorted fields are suspected, replace the field coil assembly and check for improved performance.

DISASSEMBLY

If the motor does not perform in accordance with published specifications, it may need to be disassembled for further testing of the components. Normally the cranking motor should be disassembled only so far as is necessary to make repair or replacement of the defective parts. As a precaution, it is suggested that safety glasses be worn when disassembling or assembling the cranking motor. Following are general instructions for disassembling a typical Bendix drive cranking motor:

1. Remove the magnetic switch, if present.
2. Remove the cover band, if present, and detach the field coil leads from the brush holders.
3. Remove the bolts attaching the drive housing and commutator end frame to the field frame assembly. Discard the tang lock washers.
4. Separate the commutator end frame, armature assembly, field frame, and drive housing.
5. Remove and disassemble the drive from the armature shaft by first identifying the type Bendix drive and then following one of the guides below:

(GASOLINE)

a. Standard Bendix Drive,
   Remove the head spring screw and slip it off of the armature shaft.

(DIESEL)

b. Folo-Thru- Bendix Drive,
   Push in the outer anchor plate so the pilot screw or pin can be removed.

COMPONENT INSPECTION AND REPAIR

A. Brushes and Brush Holders - Inspect the brushes for wear. If they are excessively worn when compared with a new brush, they should be replaced. Make sure the brush holders are clean and the brushes are not binding in the holders. The full brush surface should ride on the commutator to give proper performance. Check by hand to insure that the brush springs are giving firm contact between the brushes and commutator. If the springs are distorted or discolored, they should be replaced.

B. Armature - If the commutator is excessively worn, dirty, out of round, or if it has high insulation, it should be turned down in a lathe adn the insulation undercut 1/32" wide and 1/32" deep.
   IMPORTANT: Do not undercut insulation on motors having commutators with the flat molded core construction in place of the metal V-ring core construction.

   The armature should be checked for short circuits, opens, and grounds:
   1. Short circuits are located by rotating the armature in a growler with a steel strip such as a hack-saw blade held on the armature. The steel strip will vibrate on the area of the short circuit. Shorts between bars are sometimes produced by brush dust or copper between the bars. Undercutting the insulation will eliminate these shorts.

2. Opens - Inspect the points where the conductors are joined to the commutator for for loose connections. Poor connections cause arcing and burning of the commutator. If the bars are not badly burned, leads originally soldered to the riser bars can be resoldered.
3. Grounds in the armature can be detected by the use of a test lamp and prods. If the lamp lights when one test prod is placed on the commutator and the other test prod on the armature core or shaft, the armature is grounded. If the commutator is worn, dirty, out of round, or has high insulation, the commutator should be turned down and undercut as previously described.

C. Field Coils - The field coils should be checked for grounds and opens using a test lamp. Typical circuits are shown in Figures 10 and 11.

1. Grounds - Disconnect field coil ground connections. Connect one test prod to the field frame and the other to the field connector. If the lamp lights, the field coils are grounded and must be repaired or replaced.
2. Opens - Connect test lamp prods to ends of field coils. If lamp does not light, the field coils are open.

If the field coils need to be removed for repair or replacement, a pole shoe spreader and pole shoe screwdriver should be used. Care should be exercised in replacing the field coils to prevent grounding or shortening them as they are tightened into place. Where the pole shoe has a long lip on one side, it should be assembled in the direction of armature rotation.

REASSEMBLY

To reassemble the motor follow the disassembly procedures in reverse. Install new tang lock washers where removed.

CAUTION: If Folo-Thru drive is manually rotated to locked position, do not attempt to force it in a reverse direction. Proceed to install with pinion meshing with flywheel. When engine starts, the drive will return to the demeshed position.

STARTING MOTOR - SPECIFICATIONS

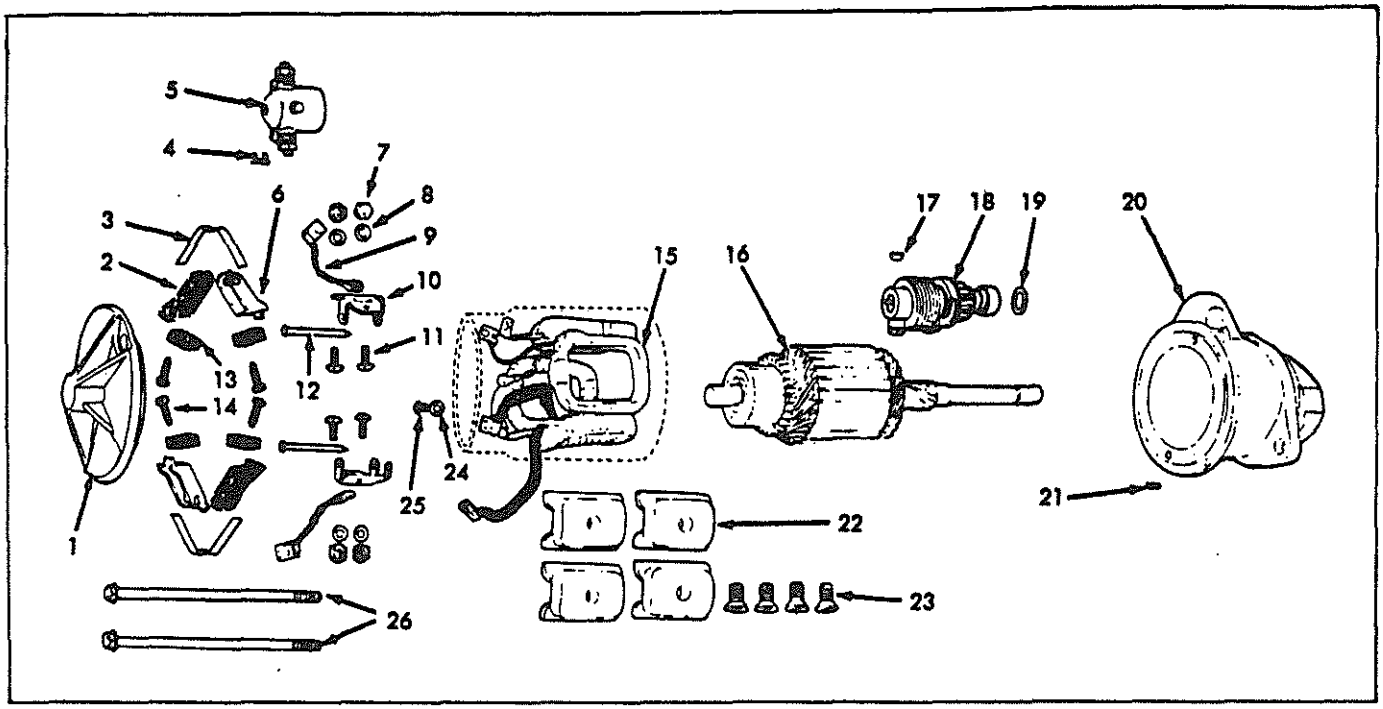
GASOLINE

	NO LOAD TEST			
VOLTS	MIN. AMPS.	MAX. AMPS.	MIN. RPM	MAX RPM
9	50	75	3500	6000

DIESEL

	NO LOAD TEST			
VOLTS	MIN. AMPS.	MAX. AMPS.	MIN. RPM	MAX RPM
9	50	80	5500	9000

STARTING MOTOR - GASOLINE

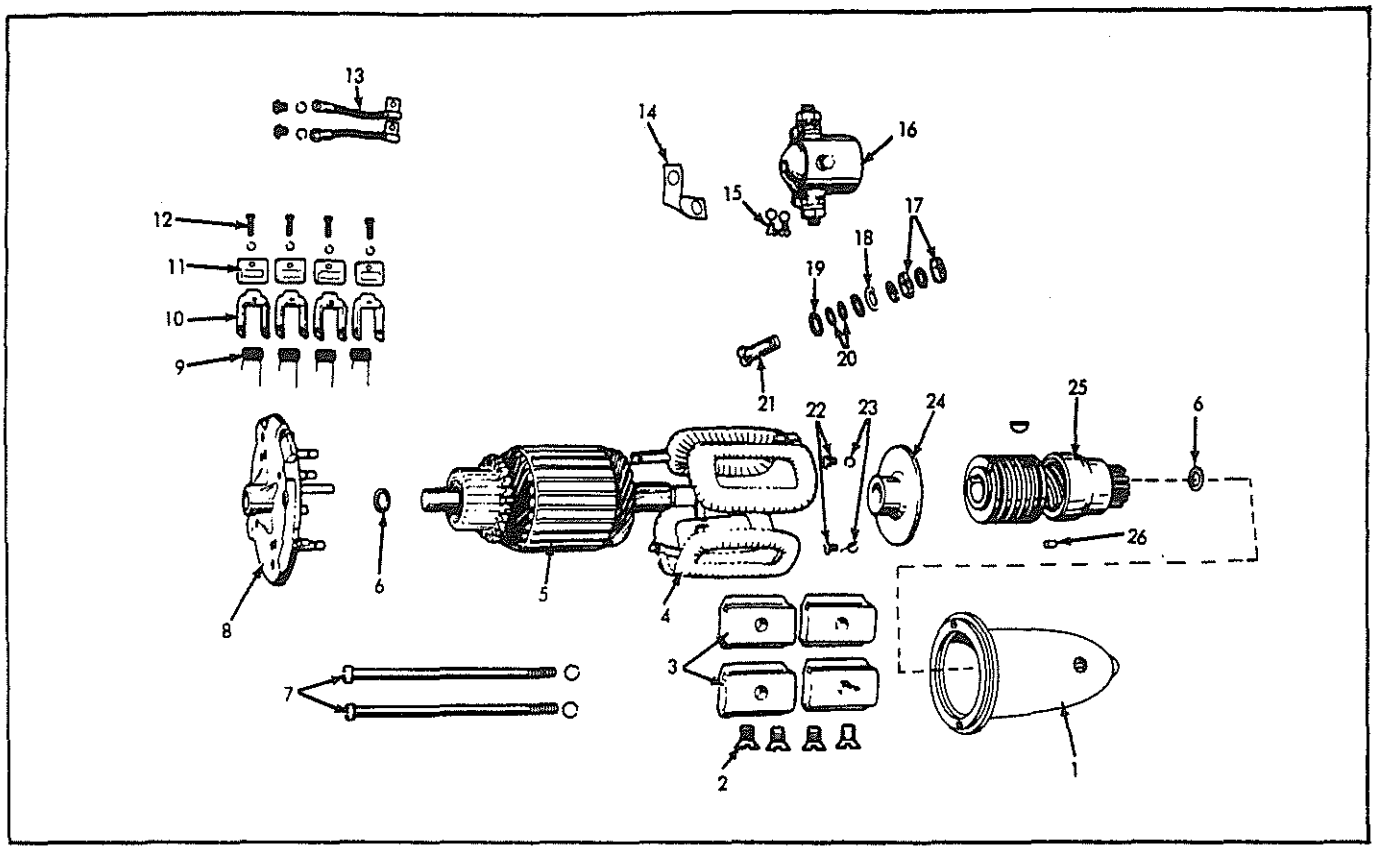


STARTING MOTOR
Gasoline

ITEM	QTY	DESCRIPTION
1	1	FRAME, (Commutator End) (Incl. BUSHING)
	1	BUSHING, center bearing
	1	WASHER, spacing
2	2	HOLDER, insulated brush
3	2	SPRING, brush
4	2	SCREW, switch attaching
5	1	SWITCH ASSY., starting motor (Solenoid) (Supersedes 233296)
	1	CONNECTOR, switch (Not Illustrated)
6	2	HOLDER, ground brush
7	4	NUT, support screw
8	4	LOCKWASHER, support screw
9	2	WIRE, brush ground
10	2	SUPPORT ASSY., brush holder (Incl. items 7, 8, 9, 11 & 12)
11	4	SCREW, brush holder support
12	2	PIN, support, brush holder
13	4	BRUSH, starting motor
14	4	SCREW, brush attaching
15	1	COIL ASSY., field
	1	COIL, field, short
16	1	ARMATURE, starting motor
17	1	KEY, drive (woodruff)
18	1	DRIVE ASSY.
19	1	WASHER, thrust

20	1	HOUSING, drive
	1	BUSHING
	1	PLATE, center bearing
	2	LOCKWASHER, center bearing screw
	2	SCREW, center bearing plate
21	1	PIN, dowel (Drive End)
22	4	SHOE, pole
	3	SHOE, pole (One open end)
23	4	SCREW, pole shoe
24	1	LOCKWASHER, field wire screw
25	1	SCREW, field wire attaching
26	2	BOLT, thru
--	1	STUD, terminal (Not Illustrated)
	2	WASHER, insulation(Terminal Stud)
	2	WASHER, insulation, 9/16" O. D. (Terminal Stud)
	1	WASHER, insulation (Terminal)
	2	WASHER, plain, 3/8" (Terminal Stud)
	2	NUT, 3/8" (Terminal Stud)
	2	LOCKWASHER, 3/8" (Terminal Stud)
--	4	INSULATION, field coil (Not Illustrated)
--	1	GROMMET, (Not Illustrated)
--	1	SCREW, switch

STARTING MOTOR - DIESEL



STARTING MOTOR- DIESEL

ITEM	DESCRIPTION
-	HOUSING ASSY., drive (Incl. BUSHING, OILER, WICK & PIPE PLUG)
1	BUSHING, drive housing
	WICK, oil
	PLUG, pipe
2	SCREW, pole shoe
3	SHOE, pole
4	COIL, field, lower
	COIL ASSY., field
5	COIL ASSY., top
6	ARMATURE
7	WASHER, space commutator & drive end
8	BOLT, thru
	2 916964 LOCKWASHER
	BOLT, thru
9	FRAME ASSY., commutator end (Incl. BUSHING, WICK, BRUSH PINS, DOWEL PIN & PLUG)
	FRAME ASSY., commutator end (Incl. BUSHING, WICK & PLUGS)
	WICK, oil
	PIN, brush holder hinge
	PIN, brush holder, stop

	PIN, brush holder hinge (w/installation)
	PIN, brush holder, stop (w/installation)
	PIN, dowel
	PLUG, expansion
	BUSHING
	PLUG, pipe
10	BAND, cover (Incl. SCREW & NUT)
	SCREW
	1 914172 NUT
11	SPRING, brush
	SPRING, brush
12	HOLDER, brush
	HOLDER, brush (insulated)
	HOLDER, brush, ground
13	BRUSH
	BRUSH
14	SCREW, brush attaching
	SCREW, brush attaching
15	LOCKWASHER, brush screw
16	WIRE, ground
	2 914684 SCREW
	WIRE, ground
	2 900551 SCREW
17	WIRE, brush connector
	2 903753 SCREW, mach
18	CONNECTOR, switch
	CONNECTOR, switch
19	SCREW, switch attaching
20	SWITCH, starting
	SWITCH, starting
21	NUT, terminal stud
	1 917356 LOCKWASHER
22	WASHER, terminal stud
	WASHER, terminal stud
23	WASHER, terminal stud (insulated)
	WASHER, terminal stud (insulated)
24	WASHER, terminal stud (insulated)
	WASHER, terminal stud (insulated)
25	STUD, terminal
	STUD, terminal
26	SCREW, center bearing plate
27	LOCKWASHER, plate screw
28	PLATE, center bearing (Incl. BUSHING)
	BUSHING
29	DRIVE ASSY., motor
	1 917408 Key, woodruff
30	PIN, dowel
31	SUPPORT ASSY., brush holder (Not Illustrated)
	(Incl. items 16, 32 and Hardware)
32	PIN, support, brush

MEMO

GENERATORS
INDRODUCTION, MAINTENANCE, LUBRICATION, & INSPECTION

INTRODUCTION

D.C generators are manufactured in a wide range of sizes and types, but the basic design of each generator is the same. Regardless of size, each generator has an armature mounted at both ends on bearings. The armature rotates between pole shoes over which are wound field coils. The voltage and current developed in the armature windings is supplied through brushes riding on a commutator to the generator terminals, and then to the battery and other electrical accessories in the circuit.

The extruded frame two-brush two-pole type of generator has a frame diameter size of 4-5/8 inches. Each end frame has hinge cap oilers for periodic lubrication, and the commutator end frame features a bronze bushing and an oil reservoir. Continuous lubrication to the bushing and shaft is provided by a wick which extends through a hole in the bushing to contact the shaft.

MAINTENANCE

Maintenance procedures may be divided into two sections--Lubrication and Inspection.

LUBRICATION

It is very important that proper lubrication procedures be followed in order to obtain maximum life from the generator.

All bearings used in generators use grease to retain the oil which bleeds to the bearing surfaces to provide proper lubrications. On some generator models hings cap oilers are used so that the oil supply in the grease can be replenished.

On generators having hinge cap oilers, a few drops of SAE No. 20 oil should be added at vehicle or engine lubrication periods.

INSPECTION

Inspection procedures are limited mostly to visual checks for loose mounting bolts, a loose drive belt, damaged wiring, and worn commutator brushes.

All mounting bolts should be kept tight, and the belt tension should be adjusted to conform with engine or vehicle manufacturer's recommendations.

Wiring with frayed insulation should be replaced, and all connections should be checked for tightness and cleanliness.

If the commutator is dirty, it may be cleaned with No. 00 sandpaper, or with a brush seating stone, with the generator in operation. Blow away all dust after the cleaning operation. If the commutator is rough, out of round, or has high mica, the armature must be removed so the commutator can be turned down in a lathe and the insulation between bars undercut. Remove only enough material to make the commutator smooth and round, and undercut the insulation 1/32 inch deep and .033 inch wide. Finish with No. 00 sandpaper, and blow away all dust, particularly between bars.

If the brushes are worn down to less than half their original length, they should be replaced. New brushes can be seated to make good contact with the commutator by holding a brush seating stone on the commutator with the generator in operation or by applying brush seating compound to the commutator. Blow away all dust after the seating operation.

A visual inspection will often reveal the condition of the brush springs. If the springs are corroded, or if they are blued and discolored from excessive heat, they should be replaced. If the brush arms move freely, and if the brush moves freely in the holder, with no spring corrosion or discoloration,

the springs most likely are satisfactory. If an additional check is desired, use a spring tension scale to measure the brush spring tension, and compare with specifications given. The method of checking the spring tension on generators is illustrated. The spring gauge should be hooked under the brush arm where it contacts the brush, and the reading taken when the brush arm first starts to move off the brush.

"A" CIRCUIT AND "B" CIRCUIT -- The generator circuits can be classified as either "A" circuit or "B" circuit. an "A" circuit is used in the H-3 and HD-3 tractor. In this type circuit, the field winding is connected to the insulated brush inside the generator and is connected to ground through the contact points in the regulator. In the "B" circuit generator (Fig. 19), the field winding is grounded inside the generator, and is connect ed to the armature circuit inside the regulator.

DISASSEMBLY

Generator disassembly can be accomplished first by removing the thru-bolts, or end frame assemblies from the field frame. On some models, it is necessary to detach leads from the brush holders before the commutator end frame can be removed.

When removing bearings from the armature shaft or end frame, care should be taken to avoid damage to the balls and raceways. If the bearing is a press fit over the shaft, use bearing pullers against the inner race only. If the inner race is inaccessible, and it is necessary to pull against the outer race, the balls will be loaded and may be damaged. Similarly, when removing a bearing whose outer race is a press fit into the end frame, use an arbor press against the outer race to avoid loading the balls.

After bearing removal, wash in a clean solvent, and carefully inspect for worn surfaces, looseness, broken separators, a cracked ring or race, and a rough or catchy feeling. Always replace any bearing if its condition is doubtful.

When remounting bearings, use an arbor press and press firmly and evenly against the proper race to avoid loading the balls. If the mounting surfaces are clean, and the bearing is started properly and is not cocked or mis-aligned, it can be mounted without undue pressure.

ELECTRICAL TESTS

After the generator has been disassembled, tests can be made of the armature and field coils to determine any electrical defects.

The armature should be checked for shorts, grounds, and opens. To check for shorts, place the armature in a growler, and slowly rotate with a metal blade held on the armature. If the metal blade vibrates, the windings are shorted.

To check the armature for grounds, touch one prod of a 110 volt test lamp to the commutator, and the other test lamp prod to the shaft or laminations. If the lamp lights, the windings are grounded.

To check the armature for opens, visually inspect the wiring connections to the commutator bars, and inspect the commutator for a burned or discolored commutator bar. An open circuit will cause one of the bars to burn and become discolored. Also, the armature may be checked for opens on a growler meter. If the meter reads low, the winding connected to the commutator bars to which the prods are connected is open.

The generator field windings should be checked for shorts, grounds and opens. To check for shorts, connect an ammeter and battery in series with the field windings, and refer to specifications. If the current reading is higher than specified, the windings are shorted.

REASSEMBLY & POLARIZING GENERATOR

To check the field windings for grounds, connect one prod of a 110 volt test lamp to the field terminal, and the other prod to the generator frame. If the lamp lights, the windings are grounded.

To check the field windings for opens, connect the 110 volt test lamp prods across the windings. If the lamp fails to light, the windings are open.

A shorted, grounded, or open field will result in abnormal generator output. A shorted field winding will cause excessive burning of the voltage regulator contact points, resulting in reduced generator output. A grounded field can cause excessive generator output on "A" circuit generators, if the ground is near the "F" terminal. If the ground is near the end of the winding connected to the insulated brush, reduced generator output will be obtained.

REASSEMBLY

Reassembly is the reverse of disassembly. Care should be taken to avoid damage to grease seals and oil seals during reassembly, and the brushes should be checked after reassembly to make sure they are free in their holders and the brush arms move freely.

POLARIZING GENERATOR

After a generator has been tested and repaired, and installed on the engine or vehicle, it must be polarized so it will have the correct polarity with respect to the battery polarity. Failure to polarize the generator may result in burned or stuck cutout relay contacts in the regulator, along with damage to the wiring and generator windings.

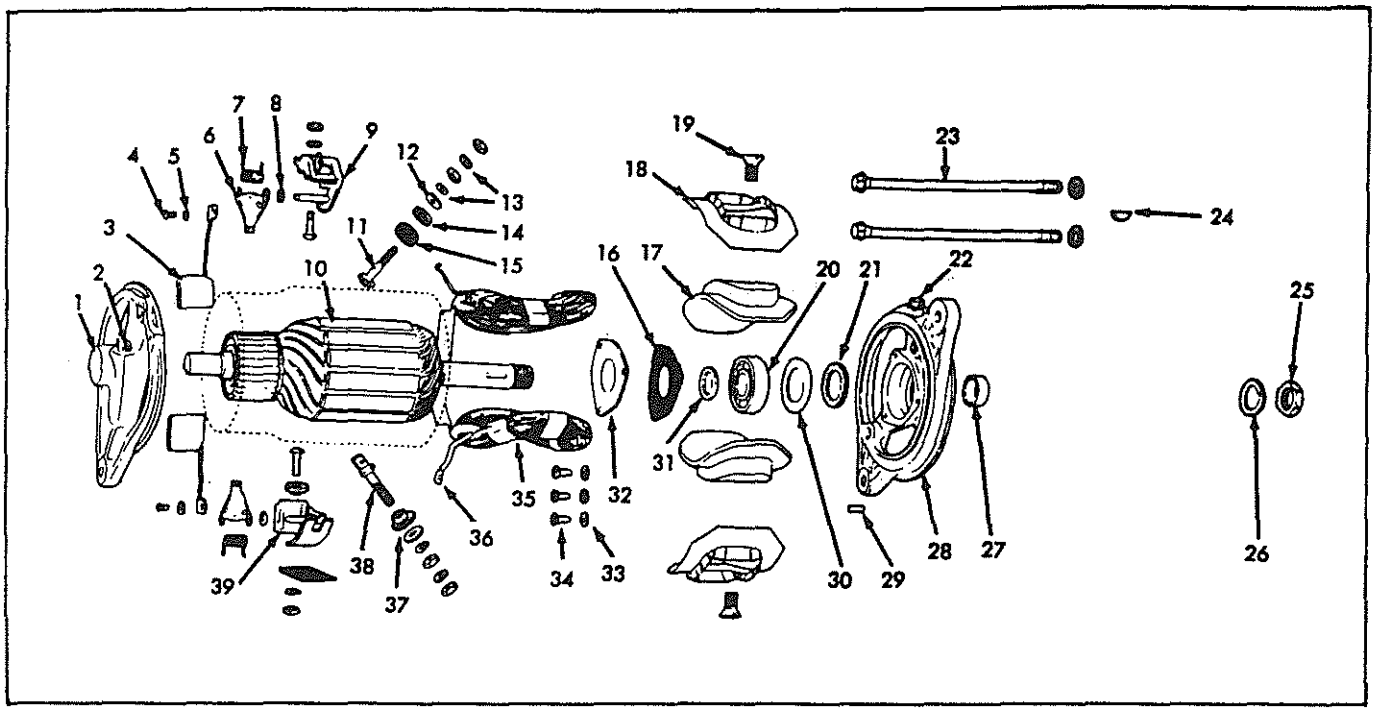
"A" CIRCUIT GENERATOR -- To polarize an "A" circuit generator, momentarily connect a jumper lead between the regulator BATTERY and ARMATURE terminals after all leads have been connected, but before the engine is started.

Polarizing the generator allows a surge of current to flow through the field windings, which insures that the polarity of the generator will match the polarity of the battery.

SPECIFICATIONS
H-3 and HD-3

ROTATION VIEWING DE	CIRCUIT	BRUSH SPRING TENSION (OZ)	FIELD CURRENT 80°F		COLD OUTPUT		
			AMPS	VOLTS	AMPS	VOLTS	RPM
C	A	28	1.58-1.67	12	20	14.0	2300

GENERATOR PARTS

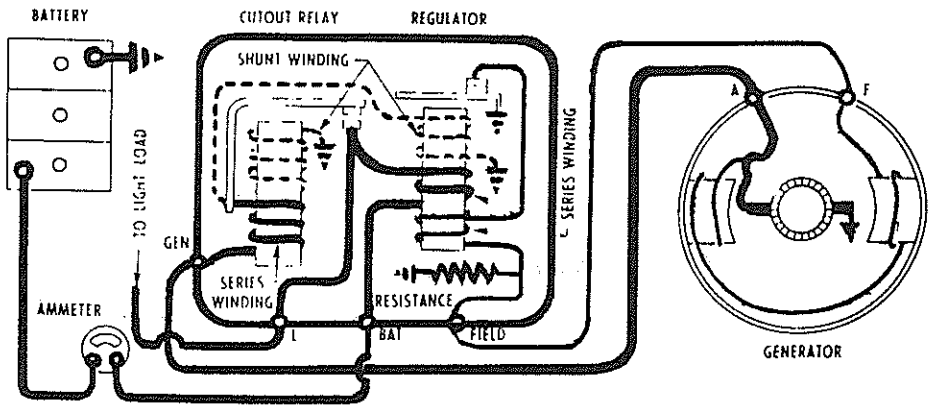


GENERATOR

ITEM	DESCRIPTION
1	FRAME(Commutator End) (Incl. Item 2, WICK, PIN, WASHER & CUP)
	WICK, oil
	PIN, dowel
	WASHER, felt
	CUP, felt washer
2	OILER (Commutator End)
3	BRUSH, generator
4	SCREW, brush wire
5	LOCKWASHER, brush wire screw
6	ARM, brush
7	SPRING, brush
8	WASHER, spacing, brush arm
9	HOLDER ASSY., ground brush (Incl. LOCKWASHER, NUT & SCREW)
10	ARMATURE, generator
11	STUD, (Terminal "F")
	2 917376 NUT
12	WASHER, plain, terminal stud
13	LOCKWASHER, terminal stud
14	WASHER, insulation (Terminal "F")
15	BUSHING, insulation (Terminal "F")
16	GASKET, bearing retainer
17	SHOE, pole
18	INSULATOR, field coil
19	SCREW, pole shoe

20	BEARING, ball (Drive End)
21	WASHER, felt
22	OILER, (Drive End)
23	BOLT, thru
	1 919311 LOCKWASHER
24	KEY, pulley & fan (Woodruff)
25	NUT, shaft
26	LOCKWASHER, shaft nut
27	COLLAR, spacing (Drive End)
28	FRAME (Drive End) (Incl. Item 22)
	WICK, oil
29	PIN, dowel (Drive End)
30	PLATE, felt washer
31	WASHER, spacing, inside (Drive End)
32	PLATE, bearing retainer
33	LOCKWASHER, bearing plate screw
34	SCREW, bearing, retainer plate
35	COIL ASSY., field
36	CLIP, terminal to brush
37	BUSHING, insulation (Terminal "A")
38	STUD, (Terminal "A")
	2 917376 NUT
39	HOLDER, insulated brush (Incl. NUT, LOCKWASHER, & SCREW)
	1 NUT
	1 LOCKWASHER
	1 SCREW, mach.

REGULATOR



Wiring circuit of Delco-Remy combined current-voltage regulator as shown. The shunt windings in the cutout relay and the current-voltage regulator unit are shown in dashed lines. The charging circuit series windings are shown in heavy line. The field circuit series winding is shown in narrow line.

CONSTRUCTION

The regulators consist of two units, a cutout relay and a combination current-voltage regulator. A heavy soft rubber gasket seals the junction between the cover and the regulator base to prevent the entrance of dust and moisture. The cover is crimped on during manufacture and should not be removed for repairs or adjustments except in emergencies. A special rubber shock mounting protects the regulator from shocks and vibration transmitted through the vehicle frame and engine. The wiring circuit of the combined current-voltage regulator is shown.

Wiring circuit of Delco-Remy combined current-voltage regulator as shown. The shunt windings in the cutout relay and the current-voltage regulator unit are shown in dashed lines. The charging circuit series windings are shown in heavy line. The field circuit series winding is shown in narrow lines.

CUTOUT RELAY

The cutout relay is a device which closes the circuit between the generator and the battery when the generator is operating at sufficient speed to charge the battery, and which opens this circuit, when the generator slows down or stops, to prevent the battery from discharging back through the generator. The relay has two windings assembled on one core, a series winding of a few turns of heavy wire (shown in heavy line) and a shunt winding of many turns of fine wire (shown in dashed line). The shunt winding is connected across the generator so that generator voltage is impressed upon at all times. The series winding is connected in series with the charging circuit so that generator output passes through it.

The relay core and windings are assembled into frame. A flat steel armature is attached to the frame by a flexible hinge so that it is centered just above the end of the core. The armature has one contact point which is located just above a similar stationary contact point. When the generator is not operating, the armature contact point is held away from the stationary contact point by the tension of a flat spring riveted on the side of the armature. When the generator operates the relay responds as described under Cutout Relay Action.

CURRENT-VOLTAGE REGULATOR

The combination current-voltage regulator is a device which provides control of the generator output and circuit voltage so as to meet various battery and operating requirements. The regulator has three windings assembled on one core, a series winding of

a few turns of heavy wire (shown in a heavy line) a shunt winding of many turns of fine wire (shown in dashed line), and a series winding of a few turns of relatively heavy wire (shown in narrow line). The heavy series winding (heavy line) is connected in series with the charging circuit, the shunt winding (dashed line) is connected across the generator so that generator voltage is impressed on it at all times, the series winding of fairly heavy wire (narrow line) is connected in series with the generator field circuit when the regulator contact points are closed.

The windings and core are assembled into a frame. A flat, L-shaped, steel armature is attached to the frame by a flexible hinge so that it is just above the end of the core. The armature contains a contact point which is just beneath a stationary contact point. When the voltage regulator is not operating, spring tension holds the armature away from the core so that the points are in contact and the generator field circuit is completed to ground through them. (When the contact points are open, the field circuit is completed to ground through a separate wire-wound resistor beneath the regulator base.

OPERATION

In order to appreciate the function of the combined current-voltage type regulator, some attention must be given to the kind of service for which it is designed. With tractors, the equipment is often operated for periods of days or weeks at a time with no electrical load other than occasional cranking. When such service occurs during hot weather or in installations where battery ventilation is poor, overheating of the battery may lead to serious overcharging by allowing the charge rate to increase. To prevent the charge rate from becoming unduly high under such conditions, the regulator must be able to control the current flowing to the battery at all times.

On first consideration, it seems that a standard type regulator could be used, provided it were set to function at a suitably low voltage. Actually, such a regulator would be unsatisfactory since the low voltage settings would result in insufficient charge to the battery during cool or cold weather operation when battery counter voltage is naturally higher. This condition is more pronounced with tractor batteries because their location usually allows them to become colder and also prevents them from being warmed by engine heat as most automobile batteries are. On the other hand, if the voltage setting were sufficiently to satisfactorily charge the battery in cool weather, the new setting would be too high to prevent serious overcharging when the battery became hot. Here, again, the tractor is likely to reach higher operating temperatures than an automobile battery because of longer periods of continuous operation in hot weather. Furthermore, the standard current regulator unit serves only to limit maximum output of the generator and is ineffective in preventing overcharging at lower rates.

The combination current-voltage regulator overcomes these objections by controlling both the battery charge rate and the circuit voltage at the same time so as to prevent battery overcharge in hot weather and still provide a satisfactory charging rate to the battery during cold weather.

CUTOUT RELAY ACTION

When the generator voltage builds up to a value great enough to charge the battery, the magnetism induced by the relay shunt winding is sufficient to overcome the armature spring tension and pull the armature toward the core so that the contact points close. This completes the circuit between the generator and battery. The current which flows from the generator to the battery passes through the series winding in the proper direction to add to the magnetism holding the armature down and the contact points closed.

When the generator slows down or stops, current begins to flow from the battery to the generator. This reverses the direction that the current flows through the series winding, thus causing a reversal of the magnetic field of the series winding. The magnetic field of the shunt winding does not reverse. Therefore, instead of helping each other, the two windings now magnetically oppose so that the resultant magnetic field becomes too weak to hold the armature down. The flat spring pulls the armature away from the core so that the points separate; this opens the circuit between the generator and battery.

CURRENT-VOLTAGE REGULATOR ACTION

The combination current-voltage regulator action depends on both the current flowing through the heavy series (load) winding and the voltage imposed on the shunt winding. The field current winding also has some effect on the action as will be explained later.

When the generator goes into operation, the voltage imposed on the shunt winding causes some current to flow thus creating a magnetic field. Closing of the cutout relay allows current to flow through the load winding creating an additional magnetic field. When these two magnetic fields add up to sufficient strength, they pull the regulator armature toward the core causing the contact points to open. This diverts the field current to ground through the wire-wound resistor. The additional resistance of this circuit causes the generator voltage and output to drop. This, in turn, causes a weakening of the combined magnetic field from the load and shunt windings, so that the armature spring tension pulls the armature away from the core and the contact points close. Generator voltage and output then immediately increase, strengthening the magnetic field and causing the points to open again. This cycle is rapidly and continuously repeated as long as the generator and regulator are in operation, thus accomplishing the required control of the generator voltage and output.

The field current winding, already mentioned, might be termed an accelerator winding that speeds the action of the regulator armature in closing and opening the points. When the contact points are closed, the field current flows through the winding creating a small magnetic field. The strength of this field adds to the magnetic field strength of the shunt winding and helps to attract the armature. As the points open, current stops flowing through the field current winding, and its magnetic field collapses. Since this causes an appreciable weakening of the total magnetic field holding the points open, armature spring tension causes the points to close quickly. The result is that the rate of armature vibration is increased.

Since the electrical resistance of the regulator windings is lower when they are cold than when they are thoroughly warmed up, the voltage required to force a given current through the windings also varies. This condition would cause the regulator to operate at a considerably higher voltage when hot than when cold if the regulator were not compensated for temperature. Therefore, the current-voltage regulator includes a temperature compensating device in the form of a bi-metal hinge on the regulator armature. The action of this hinge provides increased spring tension when the regulator is cold and reduced spring tension when warm, thus offsetting the effect of changes in the electrical resistance of the windings with temperature.

NOTE: For the first few minutes of regulator operation, during which the regulator warms up, the temperature compensation does not produce a uniform decrease in the charging rate or voltage. The voltage may go up slightly and then begin to decrease. This is due to the fact that the internal regulator parts heat up at

REGULATOR ACTION (LOAD) & CHECKS (GENERATOR & REGULATOR)

NOTE (Cont'd)

different rates--approximately 15 minutes being required for the internal parts to reach a stable operating temperature so that stable voltage and current readings can be obtained.

It is important to note that the combined current-voltage regulator characteristically functions so that the regulated voltage is reduced as the charge rate increases. That is, the higher the current to the battery, the lower the regulated voltage and vice versa. On a given 6-volt unit, for example, a charge rate of 3 amperes is accompanied by a regulated voltage of 7.2 volts, but with a charge rate of 6 amperes the regulated voltage is only 6.6 volts.

REGULATOR ACTION WITH LOAD

With an electrical load, such as lights, turned on, the generator output increases. The regulator has an extra terminal marked "L" which is connected with the lower contact point in the cutout relay. This extra terminal permits current from the generator to be diverted to the load without its passing through the current-voltage regulator. This current has no reducing effect on the operating voltage since the regulator is affected only by current going to or from the battery. Generator output, therefore, is allowed to increase to a value sufficient to handle the load and still supply a charging current to the battery, provided, of course, that the total current requirements do not exceed the maximum output of the generator as determined by third brush setting and speed. In the case of shunt generators the maximum output is controlled by generator speed.

NOTE: Do not operate a shunt generator above the maximum speed encountered on the engine. When the generator is not in operation, the electrical load is supplied with current from the battery. The current, in this case, flows through the regulator load winding and the "L" terminal to the load.

IMPORTANT

Lights, ignition (if battery ignition is used), and all other similar loads must be attached to the "L" or load terminal of the current-voltage regulator and will not interfere with regulation. Any load (such as a horn), however, which may individually exceed the total output of the generator, must be connected direct to the battery side of the ammeter. Heavy currents cannot be drawn from the battery through the series winding of the current-voltage regulator without considerable increase in operating voltage.

Care must be taken to prevent interchanging the leads at the "L" or load terminal and the "BATTERY" terminal of the regulator. Loads, such as lights, connected to the "BATTERY" terminal of the regulator will prevent proper operation. Only the battery should be connected to the "BATTERY" terminal of the combined current-voltage regulator (except for horns and similar loads as already described).

QUICK CHECKS OF GENERATOR AND REGULATOR

In analyzing complaints of generator-regulator operation, any of several basic conditions may be found.

(1) Battery Remains Charged with Low Water Usage -- This indicates normal generator-regulator operation. Regulator settings may be checked as outlined in the following sections.

(2) Battery Remains Charged with High Water Usage -- If the electrolyte level in the battery drops to the tops of the separators in less than 100 hours of normal operation, it indicates that the current-voltage regulator is not reducing the current flowing to the battery as it should. Excessive current flowing to a fully charged battery will cause serious damage in the battery. This operating condition may result from:

QUICK CHECKS OF GENERATOR & REGULATOR (Cont.)

(a) Improper setting of the current-voltage regulator unit.
(b) Defective current-voltage regulator unit.
(c) Grounded generator field circuit (in either generator, regulator, or wiring).
(d) The load and battery leads may be interchanged at the regulator terminals.

To determine the cause of trouble, first disconnect the lead from the regulator "F" terminal with the generator operating at medium speed. If the output remains high, the generator field is grounded either in the generator, or in the wiring harness. If the generator output stops, the regulator is probably at fault, and it should be checked for high current-voltage setting. To check the possibility of interchanged leads at the "L" and "B" terminals, reconnect field lead at regulator and then with generator operating at approximately 2500 r.p.m., turn on lights. With lights on, disconnect lead at "L" terminal. If lights go out, leads are properly connected. If lights stay on, leads are interchanged at "L" and "B" terminals of regulator and must be corrected.

(3) Battery Remains Low or Discharged -- This condition could be due to:

(a) Loose connections, frayed or damaged wires.
(b) Defective battery. (Battery should take charge and should crank engine.)
(c) High circuit resistance. (Check voltage drop between "BAT" terminal of regulator and battery. Drop should not exceed 0.15 volts with 3-4 amperes flowing.)
(d) Low regulator setting.
(e) Damage or defects within the regulator.
(f) Defects within the generator.
(g) Continuous loads in excess of generator capacity.

If the condition is not caused by loose connections, frayed, or damaged wires, defective battery, high circuit resistance, or excessive loads, the trouble will be found in the generator or regulator. To determine which is at fault proceed as follows:

If Generator Shows Some Output -- With generator operating at medium speed, a charge rate of 1 to 3 amperes is normal with fully charged battery at normal operating temperatures. If battery is in a discharged condition or is extremely hot, charge rate will be considerably higher. If condition of battery indicates that charge rate is too low, momentarily ground "FIELD" terminal of regulator. If output shows a strong increase, trouble is probably due to low setting of current-voltage regulator unit or to dirty contact points in regulator. If output does not increase, generator is probably at fault and should be checked.

If Generator Shows No Output -- With generator operating at medium speed, momentarily connect a jumper between "GENERATOR" and "BATTERY" terminals of regulator. If generator shows output, the relay is at fault. If generator does not show output, momentarily ground "FIELD" terminal of generator. If generator now shows output regulator is at fault. If generator still does not show output, the generator is at fault and should be checked.

(4) Damaged Resistor -- If the resistor attached beneath the regulator is broken or otherwise damaged, the contact points of the current-voltage regulator unit soon become burned. This condition results in a low generator output. Whenever a resistor is replaced it will usually be found necessary to clean the contact points in order to restore satisfactory operation.

(5) Damage Within the Regulator -- This may be due to reversed generator polarity. Generator polarity must be corrected as explained in POLARIZING GENERATOR after any checks of the regulator or generator, or after disconnecting and reconnecting leads.

REGULATOR ELECTRICAL CHECKS

The electrical settings of the cutout relay and the current-voltage regulator unit may be checked either on or off the installation without removing the regulator cover. When bench checks are made, the regulator must be connected only to a generator of the type for which it is designed. Results obtained with any other type of generator will be meaningless. When the regulator is checked on the installation, all loads (including ignition) connected to the "L" terminal must be switched off. To furnish ignition current during tests for electrical settings, use a jumper lead to connect free end of battery lead direct to primary terminal of ignition coil (switch side).

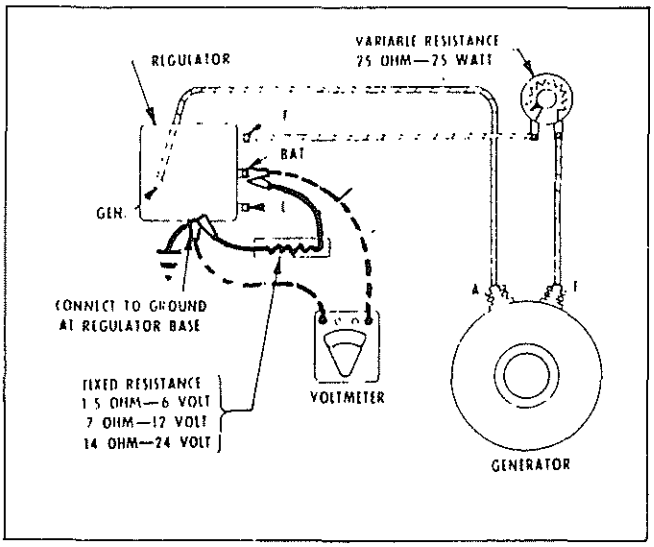


Figure 1 -- Fixed resistance, variable resistance, and voltmeter connections for checking current-voltage regulator unit electrical setting. Fixed resistance leads in solid line and voltmeter leads in broken line.

CURRENT-VOLTAGE REGULATOR UNIT SETTING

To check the electrical setting of the current-voltage regulator unit, desconnect the lead from the "BATTERY" terminal of the regulator, and connect a fixed resistor from the "BATTERY" terminal of the regulator to "GROUND" on the regulator base (Fig. 1)

Disconnect the lead from the "FIELD" terminal of the regulator, and connect a variable resistance (25-ohm-25-watt) in series between the lead and the "FIELD" terminal. The variable resistance must have an "open" position at the extreme left end of its travel (Fig. 1). Connect a low reading test voltmeter between the "BATTERY" terminal of the regulator and "GROUND" at the base of the regulator. For this check the regulator must be stabilized at operating temperature, otherwise the results are of no value. To stabilize the regulator, operate the generator at a speed of 2500 r.p.m. for at least 15 minutes with the fixed resistor connected and the knob of the variable resistance turned to the right so that the resistance is entirely cut out. With the generator operating at 2500 r.p.m. and all electrical load (including ignition) disconnected from the "L" terminal of the regulator, slowly turn the operating knob of the variable resistance to the left until the circuit is broken at the "open" position. Then turn the knob back to the right slowly until the resistance is entirely cut out. Note the voltage setting. If the check is repeated, the knob on the variable resistance must be turned to the "open" position each time before the voltage is again raised.

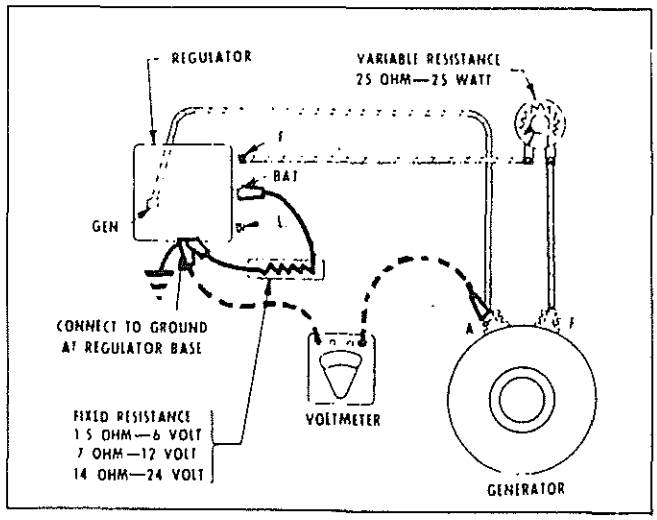


Figure 2 -- Fixed resistance, variable resistance, and voltmeter connections for checking cutout relay closing voltage. Fixed resistance leads in solid line and voltmeter leads in broken line.

CUTOUT RELAY CLOSING VOLTAGE CHECK

The cutout relay closing voltage check should be made immediately after the current-voltage regulator unit check while the regulator is stabilized at operating temperature. Electrical connections for this test are exactly like those for the current-voltage unit check except that the voltmeter is connected from the "A" terminal of the generator to "GROUND" as shown in Figure 2.

To check the cutout relay closing voltage, turn the knob of the variable resistance to the right until the resistance is entirely cut out, and start the generator. Adjust the generator speed to approximately 2500 r.p.m. Slowly turn the knob of the variable resistance to the left until the "open" position is reached and the field circuit is broken. Then turn the knob slowly to the right so that the generator voltage rises slowly until the relay closes. (Closing of the relay is indicated by a sharp drop in voltage). Note the closing voltage. If the check is repeated, the knob on the variable resistance must be turned to the "open" position each time (so that the field circuit is broken) before raising the voltage to the closing point of the relay. This is necessary to eliminate the effects of residual magnetism.

CLEANING CONTACT POINTS

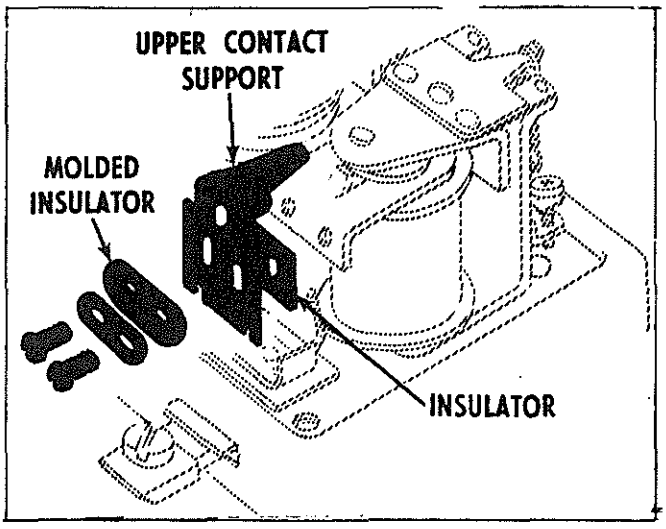


Figure 3. -- Disassembly of upper contact support for cleaning or replacement.

In many cases regulator trouble can be eliminated by a simple cleaning of the contact points, plus some possible readjustment. The flat points should be cleaned with a spoon or riffler file. On positive grounded regulators, the flat point is in the upper contact bracket so the bracket must be removed for cleaning the points (Fig. 3). A flat file cannot be used successfully to clean the flat contact points since it will not touch the center of the flat point where point wear is most likely to occur. NEVER USE EMERY CLOTH OR SANDPAPER TO CLEAN THE CONTACT POINTS.

CUTOUT RELAY CHECKS AND ADJUSTMENTS

The cutout relay requires three checks and adjustments: air gap, point opening, and closing voltage. The air gap and point opening adjustments are made with the battery disconnected.

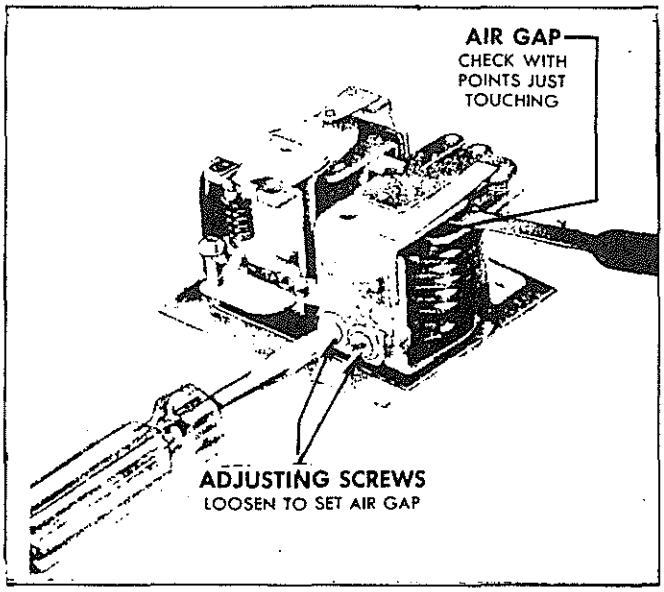


Figure 4. -- Cutout relay air gap check and adjustment (1118200 series). Battery must be disconnected when this check is made.

AIR GAP (1118200 Series) -- Place fingers on armature directly above core and move armature down until points just close, and then measure air gap between armature and then measure air gap between armature and center of core (Fig. 4). To adjust air gap, loos-

en two screws at back of relay and raise or lower armature as required. Tighten screws after adjustment.

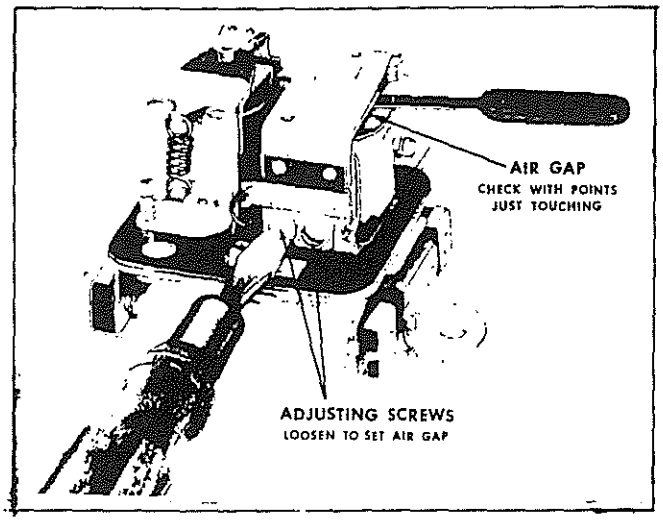


Figure 5. -- Cutout relay air gap check and adjustment (1118300 and 1118700 series). Battery must be disconnected when this check is made.

AIR GAP (1118300 and 1118700 Series) -- Check and adjust as in 1118200 Series (Fig. 5)

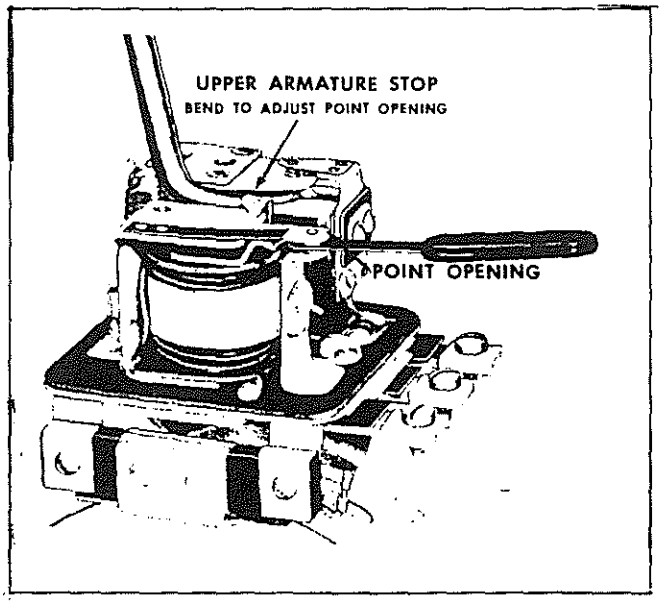


Figure 6. -- Cutout relay point opening check and adjustment (1118200 series). Battery must be disconnected when this check is made.

POINT OPENING (1118200 Series) -- Check point opening and adjust by bending the upper armature stop (Fig. 6).

POINT OPENING (1118300 and 1118700 Series) -- Check and adjust point opening as in 1118200 Series (Fig. 7).

CLOSING VOLTAGE (1118200 Series) -- Check closing voltage as described under Regulator Electrical Checks. Adjust closing voltage by bending the armature spring post (Fig. 8). Bend up to increase spring tension and closing voltage, and bend down to decrease closing voltage.

CLOSING VOLTAGE (1118300 and 1118700 Series) -- Check closing voltage as described under Regulator Electrical Checks. Adjust closing voltage by turning adjusting screw (Fig. 9). Turn screw clockwise to increase spring tension and closing voltage, and turn counterclockwise to decrease closing voltage.

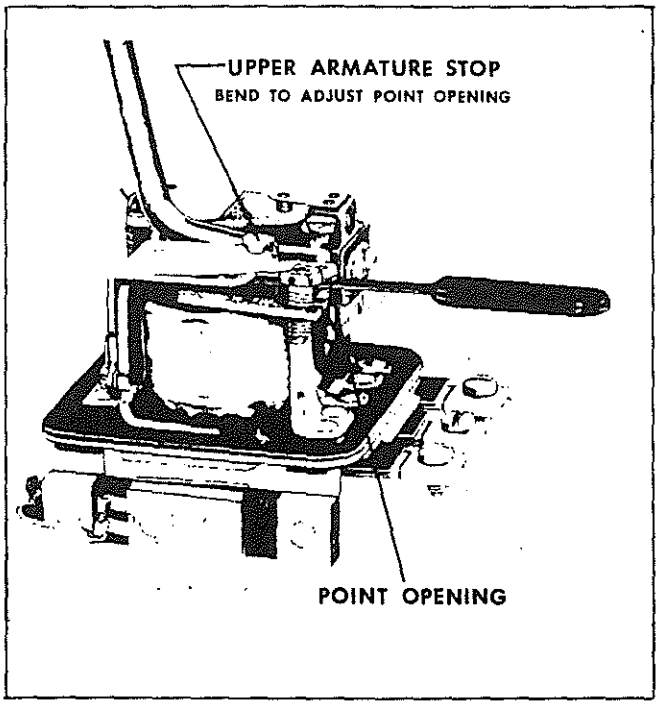


Figure 7. -- Cutout relay point opening check and adjustment (1118300 and 1118700 series). Battery must be disconnected when this check is made.

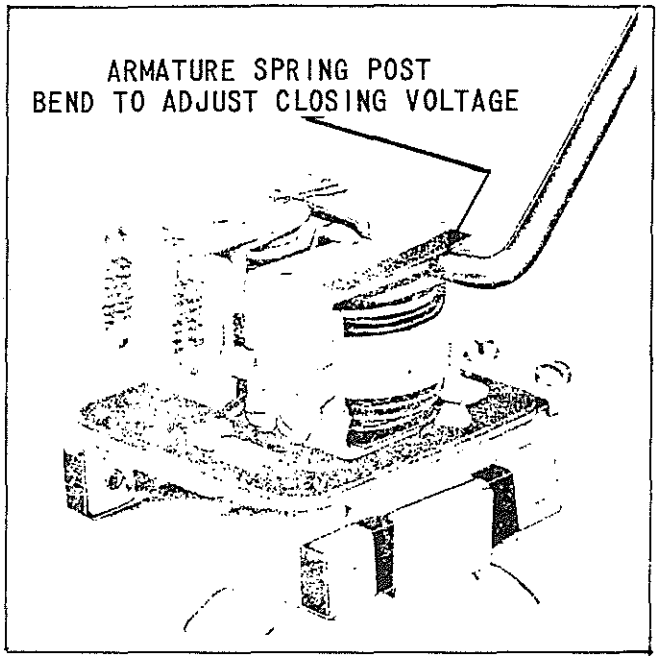


Figure 8. -- Adjustment of cutout relay closing voltage (1118200 series).

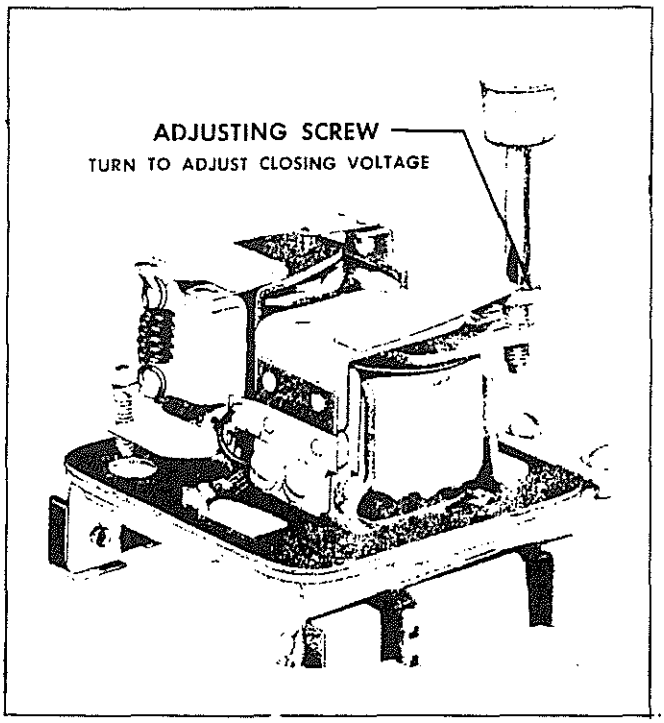


Figure 9. -- Adjustment of cutout relay closing voltage (1118300 and 1118700 series).

CURRENT-VOLTAGE UNIT CHECKS AND ADJUSTMENTS

The current-voltage unit requires two checks and adjustments, air gap and voltage setting.

AIR GAP (1118200 Series) -- To check air gap, push armature down until the contact points are just touching, and then measure air gap (Fig 10). Adjust by loosening contact mounting screws and raising or lowering contact bracket as required. Be sure points are lined up, and tighten screws after adjustment.

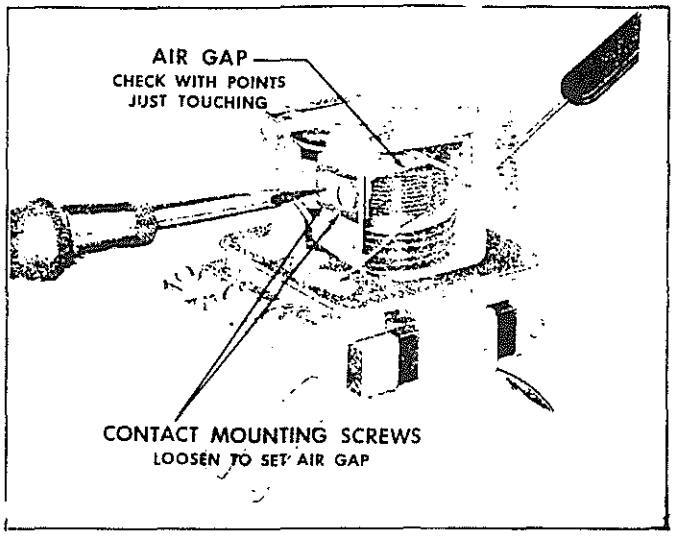


Figure 10. -- Current-voltage unit air gap check and adjustment (1118200 series).

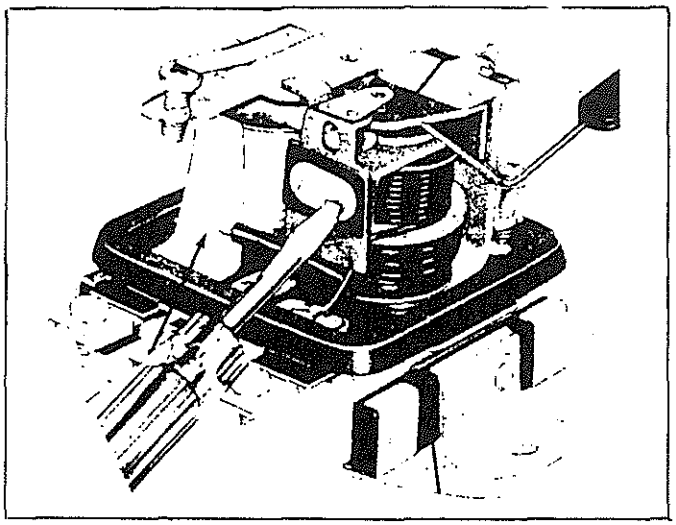


Figure 11. -- Current-voltage unit air gap check and adjustment (1118300 and 1118700 series).

AIR GAP (1118300 and 1118700 Series) -- Check and adjust air gap as in 1118200 Series (Fig. 11).

VOLTAGE SETTING (1118200 Series) -- Check voltage setting as described under Regulator Electrical Checks. Adjust by bending the lower spring hanger of one spring (Fig. 12). Bend down to increase the voltage setting, or bend up to lower the setting. After each adjustment, set cover in place before checking setting. Confine adjustment to one spring only. If the unit is badly out of adjustment, refer to section headed Regulator Spring Replacement.

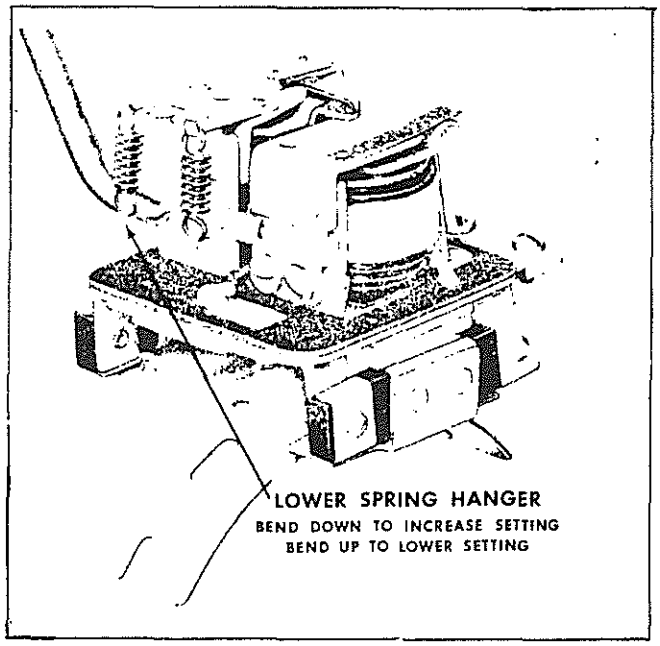


Figure 12. -- Adjusting voltage setting of current-voltage regualtor unit (1118200 series).

VOLTAGE SETTING (1118300 and 1118700 Series) -- Check voltage setting as described under Regulator Electrical Checks. Adjust voltage setting by turning adjusting screw. (Fig. 13.). Turn screw clockwise to increase voltage setting and counterclockwise to decrease voltage setting. After each adjustment, set cover in place before checking setting.

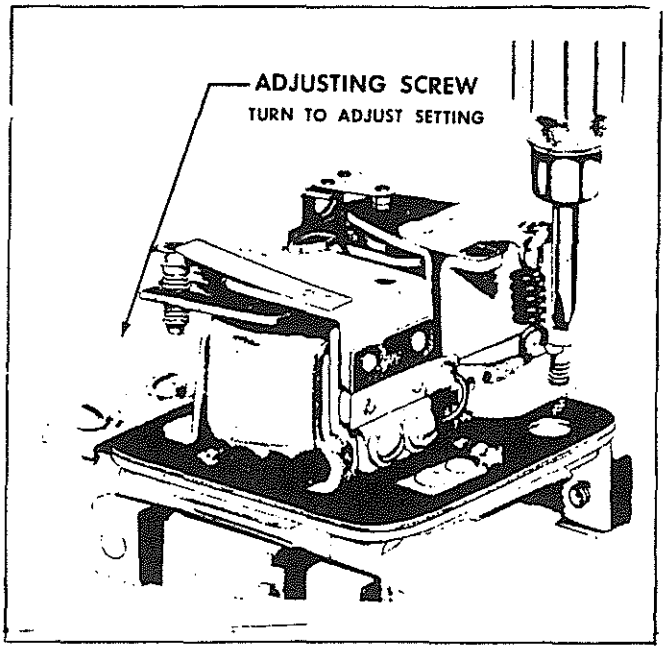


Figure 13. -- Adjusting voltage setting of current-voltage regulator unit (1118300 and 1118700 series).

CAUTION

If adjusting screw is turned down(clockwise) beyond normal range required for adjustment, spring support may fail to return when pressure is relieved. In such an instance, turn screw counterclockwise until sufficient clearance develops between screw head and spring support, then bend spring support upward carefully with small pliers until contact is made with screw head. Final setting of unit should always be approached by increasing spring tension, never by reducing it. In other words, if setting is found to be too high, unit should be adjusted below required value and then raised to exact setting by increasing spring tension. Be sure screw is exerting force on hanger.

REGULATOR SPRING REPLACEMENT

When the current-voltage unit is badly out of adjustment or requires spring replacement, the following procedures must be followed.

CURRENT-VOLTAGE Unit (1118200 Series)- Make connections as in Figure 2 for Cutout Relay Closing Voltage Check. Turn knob of variable resistance completely to right to cut out all resistance. Install one spring on current-voltage unit. Open contact points on current-voltage unit by hand. Start generator and slowly raise speed to approximately 2500 r.p,m. Maintain this speed, release armature and adjust spring hanger until voltmeter reads 4.0-4.5 volts (8.0-9.0 volts on 12 volt system). Install second spring, reconnect voltmeter as in Figure 4 and complete voltage adjustment on second spring as described under Voltage Setting of Current-Voltage Unit.

CURRENT-VOLTAGE Unit (1118300 and 111-8700 Series) -- When installing a new spring on units of this type, care must be taken to avoid bending or distorting spring supports or armature hinge. Spring should preferably be hooked at the lower end first and then stretched upward by means of a screw driver blade inserted between the turns, or by the use of any other suitable tool, until upper end of spring can be hooked. Do not try to pry up per end of spring over spring support. Make connections as in Figure 1 and adjust as described under Voltage Setting of Current-Voltage Unit.

REPLACING CONTACT SUPPORT BRACKET

The current-voltage unit contact support bracket can be replaced by following the relationship illustrated in Figure 3.

HIGH POINTS ON REGULATOR PERFOR MANCE AND CHECKS

1. The current-voltage unit by its action protects the distributor points, lights, and other accessories from high voltage, and prevents excessive charge rates to a fully charged battery.
2. The proper testing equipment in the hands of a qualified mechanic is necessary to assure proper and accurate regualtor settings. Any attempt on the part of untrained personnel to adjust regulators is likely to lead to serious damage to the electrical equipment and should be discouraged.
3. Never set the regulator outside specified limits.
4. Always make sure that the rubber gasket is in place and compressed when replacing cover. The gasket prevents entrance of moisture, dust, and oil vapors which might damage the regulator.
5. Many of the regulators are designed to be used with a positive grounded battery only, while others are designed to be used with negative grounded battery only. Never attempt to use the wrong polarity regulator on an application.
6. After any generator or regulator tests or adjustments, the generator should be polarized as explained in Generator Section.

REGULATOR SPECIFICATIONS

CIRCUIT	POLARITY	CUTOUT RELAY				VOLTAGE REGULATOR		
		Air Gap	Point Opening	Closing Range	Voltage Adjust	Air Gap	Voltage Range	Setting Adjust
A	D	.020	.020	11.8-19.0	12.8	.075	13.6-14.5	14.0

ALL ELECTRICAL CHECKS AND ADJUSTMENTS MUST BE MADE WITH THE REGULATOR AT OPERATING TEMPERATURE AND ON CLOSED CIRCUIT.

WIRING DIAGRAM- DIESEL

By following the diagram the wires may be successfully installed. The various wires are numbered, colors of the wires are given, and the terminals to which the wires are named. Always disconnect the battery ground strap when working on any of the electrical system. The electrical system uses two six volt batteries, connected in series with the positive terminal grounded.

1. Jumper cable connected from the negative terminal of first battery to the positive terminal of second battery.

2. Heavy cable from negative terminal of second battery to starting motor solenoid switch.

3. Heavy cable from starting motor solenoid switch to manifold heater solenoid switch.

4. Heavy cable from manifold heater solenoid switch to manifold heater.

5. Green wire from the small terminal of manifold heater solenoid switch to heater push button switch on instrument panel.

6. Green wire from heater push button switch to "IGN" terminal of starting switch.

7. White wire from push button starting switch to small terminal of starting motor solenoid switch.

8. Blue wire from starting motor solenoid switch to positive terminal (charge side) of ammeter.

9. Red wire from negative terminal (discharge side) of ammeter to "BAT" terminal of starting switch.

10. Red wire from negative terminal (discharge side) of ammeter to "BAT" terminal of voltage regulator.

11. Wire from field terminal "F" of voltage regulator to field terminal of generator.

12. Wire from "GEN" terminal of voltage regulator to armature terminal of generator.

13. Black wire from load terminal "L" on voltage regulator to fuse holder.

14. Black wire from fuse holder to light switch.

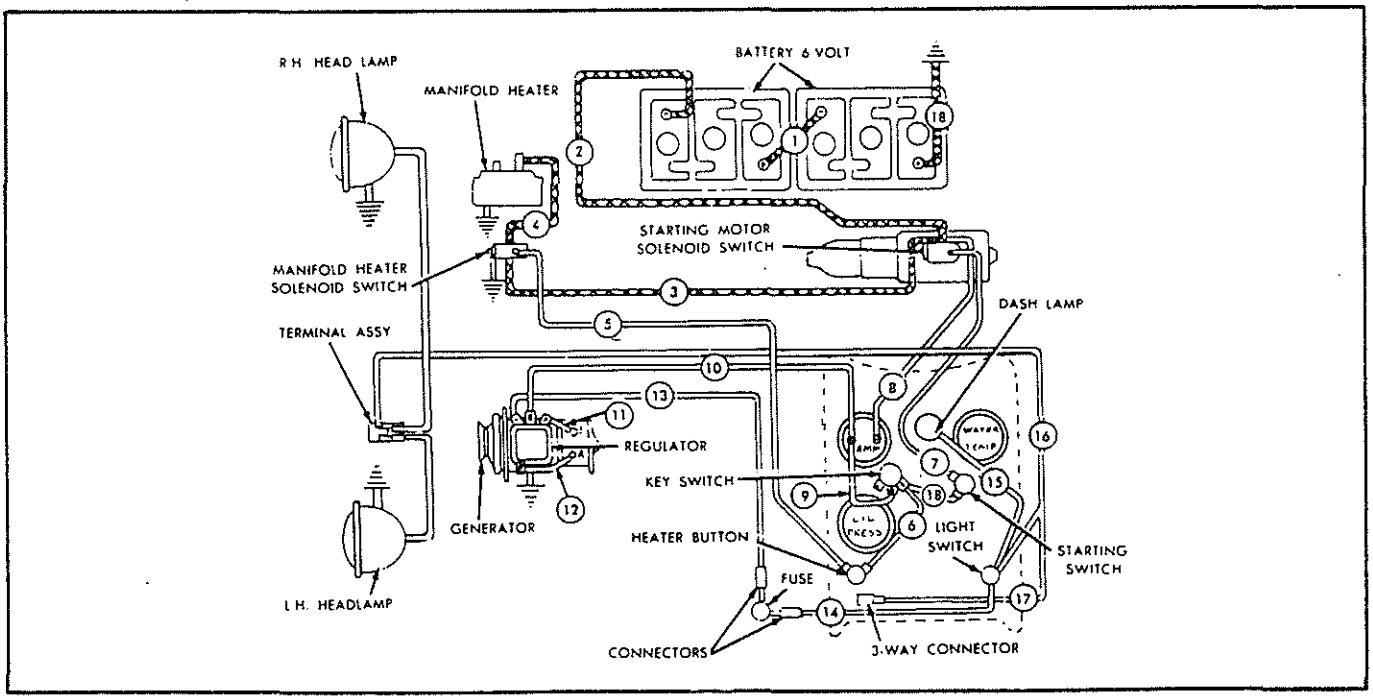
15. Wire from dash lamp to wire adaptor of light switch.

16. Orange wire from wire adaptor of light switch to headlamp terminal connector. The headlamp wires are connected to this terminal assembly.

17. Orange wire lead from light switch with a three-way connector, and is used for connecting wires when rear lamps are installed.

18. White jumper wire from ignition terminal of key switch to push button starting switch.

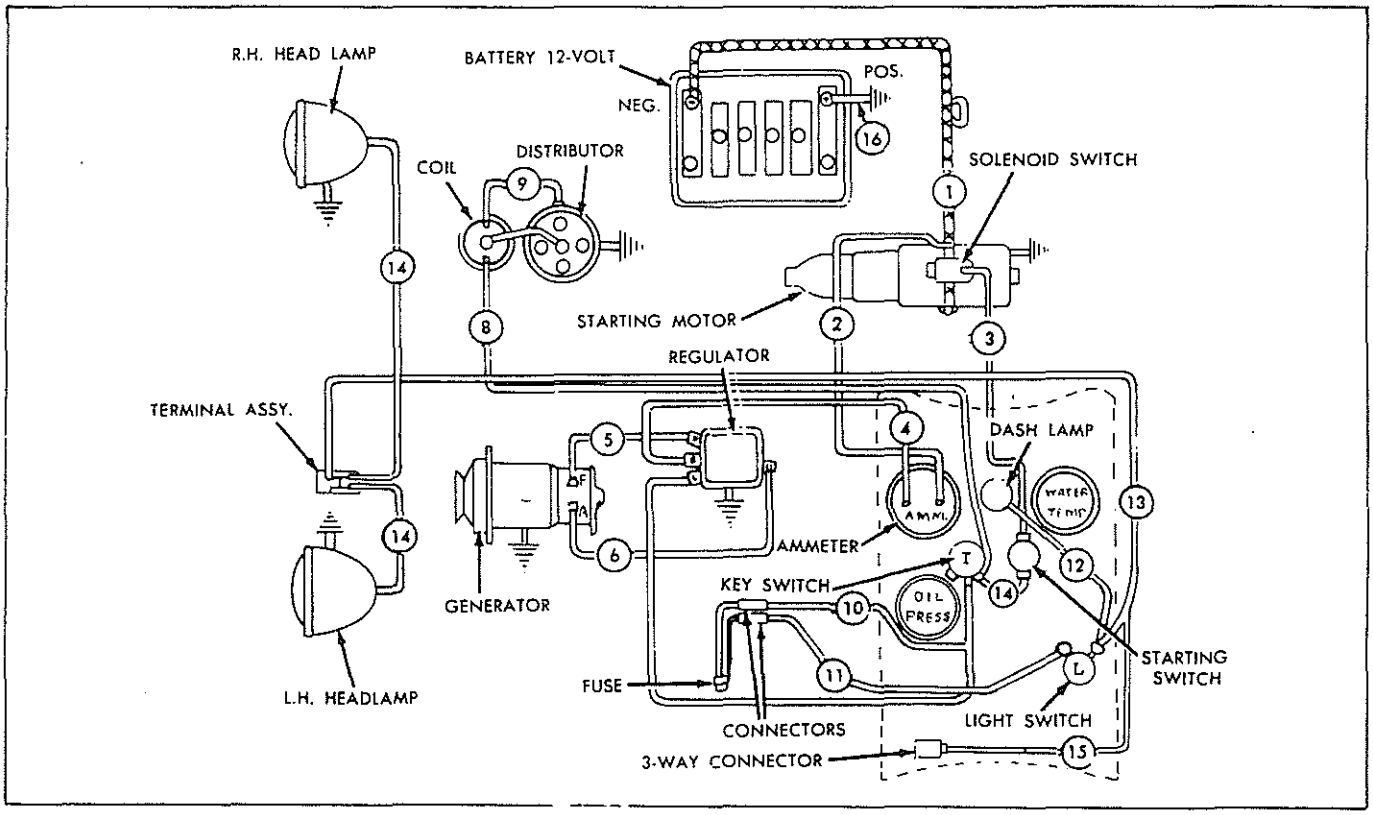
19. Ground strap from positive terminal of first battery to ground. Connect last to avoid danger of short circuits.



WIRING DIAGRAM-GASOLINE

By following the diagram the wires may be successfully installed. The various wires are numbered, colors of the wires are given, and the terminals to which the wires are connected are named. Always disconnect the battery ground strap when working on any of the electrical system to prevent short circuits. The electrical system uses a 12 volt battery with the positive terminal grounded.

1. Heavy cable from negative terminal of battery to starting motor solenoid switch.
2. Blue wire from starting motor solenoid, switch to positive terminal (charge side) of ammeter.
3. White wire from small terminal of starting motor solenoid switch to push button starting switch.
4. Red wire from negative terminal (discharge side) of ammeter to voltage regulator terminal marked "BAT".
5. Green wire from field terminal "F" of voltage regulator to field terminal "F" (inner terminal) of generator.
6. Brown wire from terminal "G" of voltage regulator to armature terminal "A" (outer terminal) of generator.
7. Black wire from load terminal "L" of voltage regulator to terminal "BAT" of ignition and starting switch.
8. Yellow wire from ignition terminal "IGN" of ignition and starting switch to negative terminal of ignition coil.
9. Wire from positive terminal of ignition coil to primary lead terminal of distributor.
10. Green wire from ignition and starting switch terminal "BAT" to light fuse holder.
11. Purple wire from fuse holder to light switch.
12. Wire from dash lamp to light switch terminal with wire adaptor.
13. Orange wire from adaptor terminal of light switch to head lamp terminal connector.
14. Jumper wire from ignition terminal of key switch to push button starting switch.
15. Orange wire from light switch terminal with wire adaptor to rear wiring harness connector. If rear lamps are installed, the wires will be connected to this three-way connector.
16. Battery ground strap from positive terminal of battery to ground. Connect last to avoid danger of short circuit.



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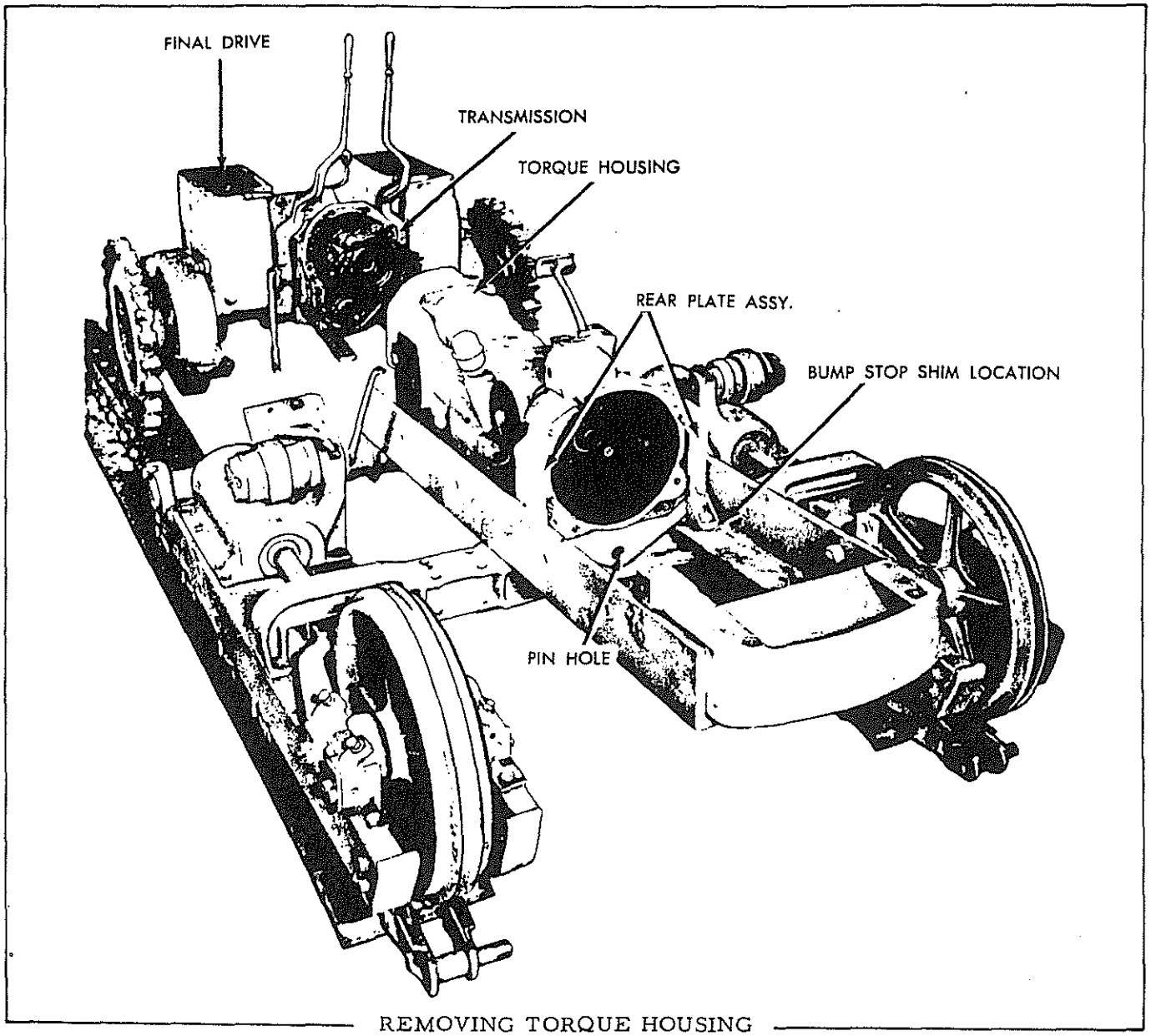


REMOVING TORQUE HOUSING

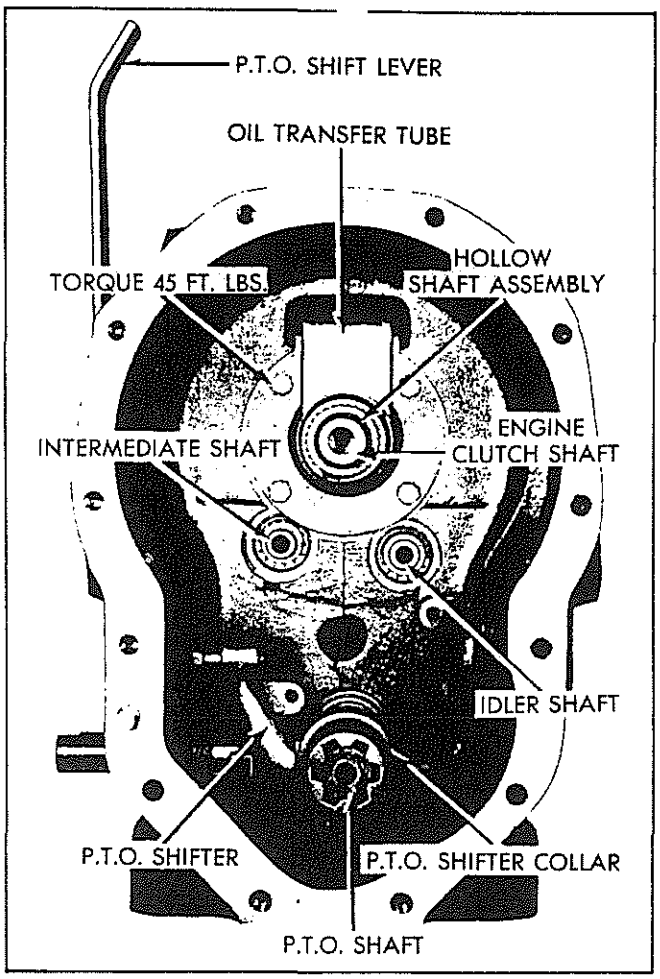
REMOVAL

Remove radiator and engine. Remove battery. Remove front portion of right and left fender assembly. Remove side sheets, fuel tank, instrment panel, etc., as an assembly.

Remove brake pedal rods. Drain oil from hydraulic pump reservoir and power director or shuttle clutch compartment. Remove cover from side of torque tube and remove shuttle clutch or power director shift lever, shaft and fork. Push shaft to left and remove L.H. "O" ring then move shaft to right far enough to remove the two woodruff keys. Push shaft out to right. Remove lines from hydraulic pump. Remove capscrew attaching torque tube to main frame and pivot shaft brackets. Support torque tube on hoist. Remove capscrews attaching torque tube to transmission. Move torque tube forward until clear of clutch. Shims under torque tube should be tied together so thay may be reinstalled in the same position and quantity for correct alignment of torque tube to main frame.

Remove hydraulic pump from side of torque housing. Remove the P.T.O coupling. Remove covers at bottom of torque housing. Place housing on bench or saw horses for disassembly.

HOLLOW SHAFT WITH GEAR



REMOVAL

The hollow shaft assembly may be removed by separating transmission housing from torque housing. Remove the four capscrews, oil transfer tube and bearing retainer from rear of torque housing. Pull the hollow shaft and bearing assembly from housing. Remove snap ring at rear end of shaft. Remove the oil impeller spring and bearing retaining snap ring from shaft and press shaft from bearing. Drive bushing from inside of shaft if replacement is necessary.

ASSEMBLY

Install bushing into hollow shaft by pressing it 1/2" past flush with end of shaft. If bushing is being installed it must be honed or diamond bored to a dimension of 1.255". The Engine Clutch Shaft must have an O.D. dimension of 1.251" for the bushing surface.

The bushing must have .003" to .005" clearance to engine clutch shaft.

Install snap ring in groove of the outer race of ball bearing, and press bearing on shaft with the snap ring rearward and install the bearing retaining snap ring. Install the oil impeller spring. For power director clutch use a spring that is coiled L.H. (similar to L.H. thread) and is dark in color. For shuttle clutch use a spring that is coiled R.H. (similar to a R.H. thread) and is cadmium plated. Do not mix springs. If in doubt, determine direction of rotation and install spring that will push oil rearward.

The hollow shaft for either the power director or shuttle has a 26 tooth gear, but the helix of teeth are opposite and cannot be interchanged.

Install snap ring in groove at rear of hollow shaft. Install hollow shaft in place in housing. Install bearing retainer, oil transfer tube and capscrews. Tighten capscrews to 45 ft. lbs. torque.

ENGINE CLUTCH SHAFT

REMOVAL

To remove the engine clutch shaft it is necessary to remove engine and separate torque housing from transmission housing. Remove the clutch shifter shaft retainer at front of torque housing and slide shaft from housing. Slide the shifter lever and clutch release bearing from shifter tube. Remove the four capscrews and the retainer assembly from housing. Remove the hydraulic pump assembly from side of torque housing. Remove the oil sump or housing cover at bottom of torque housing.

Remove the four capscrews, oil transfer tube and bearing retainer from rear of torque housing. Pull the hollow shaft and gear assembly from housing. Remove snap ring and thrust washer from rear of clutch shaft drive gear. The snap ring will be easier to remove if the gear is driven forward on shaft slightly. Remove 23 tooth gear from shaft through opening in housing if tractor is equipped with power director clutch. Shuttle clutch tractors use a 29 tooth gear that will not pass through this opening. The Engine clutch will have to be removed from the front of the torque tube housing.

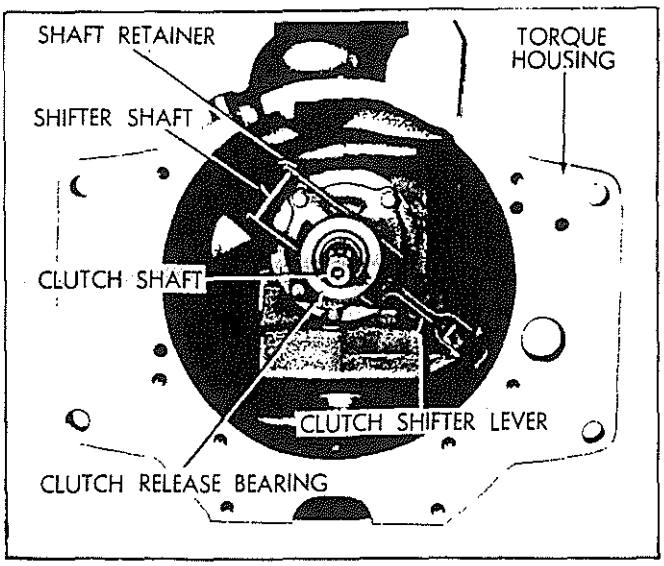
Install push puller as shown and push shaft forward to remove from housing. The clutch shaft may be removed for installing rear oil seals without removing the power take-off gear train. If it is necessary to remove P.T.O. gears or bearings in conjunction with removal of clutch shaft for replacement of parts, remove P.T.O. shaft first and clutch shaft last.

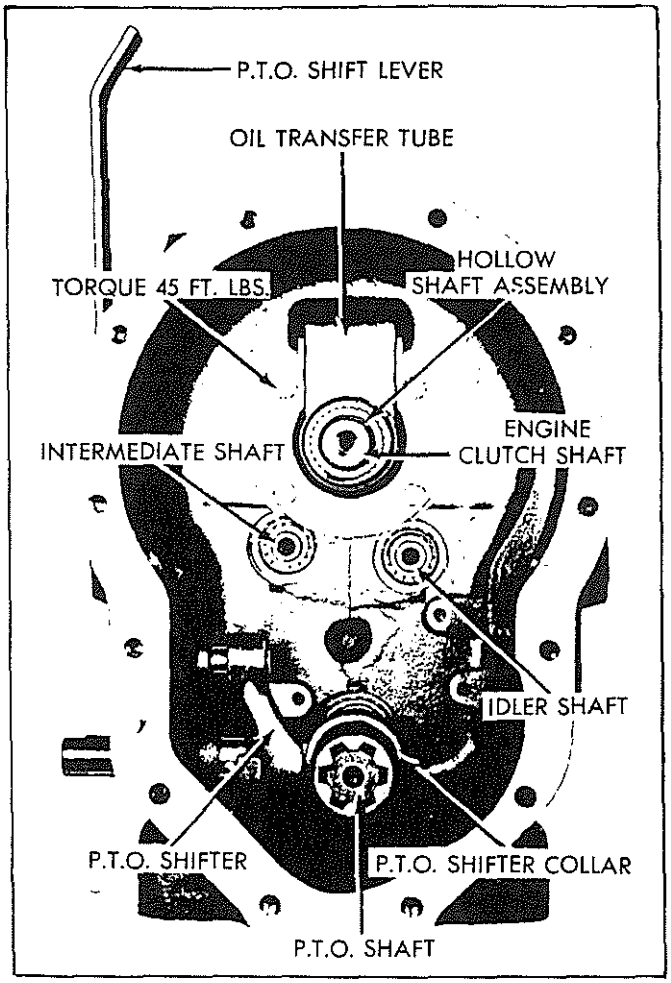
Remove snap ring from clutch shaft at front of hydraulic pump drive gear. The snap ring will be easier to remove by first pressing the gear and bearing cone rearward on shaft slightly. Drive the two rear oil seals forward to remove from housing. Drive bearing cups from housing if replacement is necessary.

ASSEMBLY

Install the snap rings and front and rear bearing cups in housing. Install front cup with larger inside diameter forward. Install rear cup with larger inside diameter rearward. Use K-M cup driver J-9276-2 and handle J-8592. If longer extension handle is desired use handle J-9236-2.

Install the two rear oil seals. Install first seal with the lip rearward, install second seal with lip forward. Do not drive first seal all the way back against snap ring, drive only far enough to start second seat, then drive second seal in until flush with housing, this will properly locate the first seal. If first seal is driven too far rearward the lip will be off the seal surface of shaft. Use K-M seal driver J-9276-12 and extension handles J-9236-2 for installing seals.





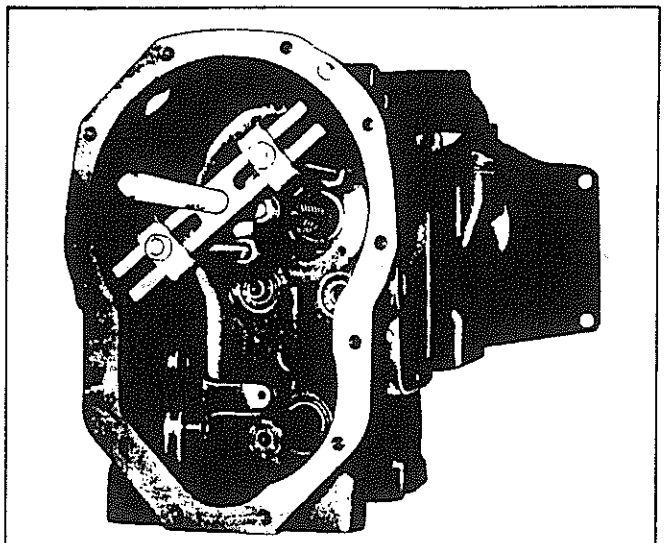
Install the front bearing cone over front of shaft with the small diameter rearward. Press on to shaft far enough to install the hydraulic pump drive gear and snap ring. Now press bearing cone forward, using K-M press plates J-9276-5 until drive gear is tight against snap ring.

Install clutch shaft into front of housing and use caution while entering shaft through rear oil seals. If shaft is being installed without the removal of power take-off shaft and gears, it will be necessary to place rear bearing cone into cup as the shaft is installed to eliminate interference with the 30 tooth intermediate gear as used with power director clutch. On tractors equipped with shuttle clutch, both the rear bearing cone and the 29 tooth drive gear must be placed in housing before installing clutch shaft, as the 29 tooth drive gear will not pass through bearing bore at rear of housing. Avoid letting the shaft lay on oil seals with out being supported until rear bearing cone is in place.

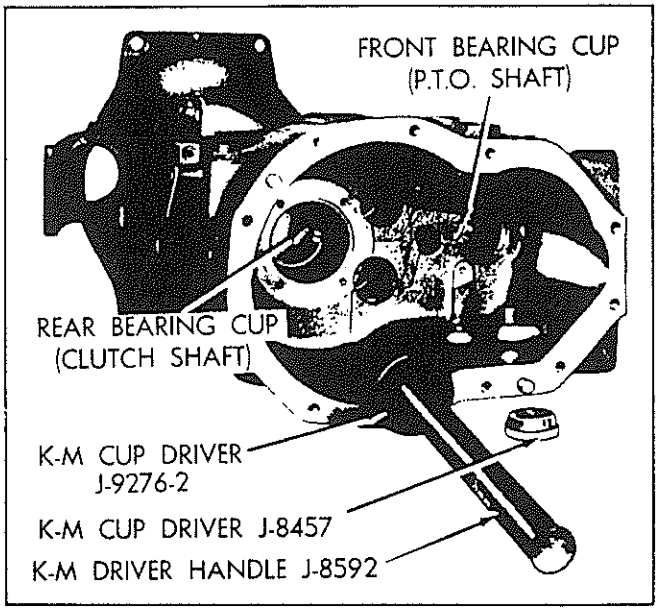
Stand torque housing upright on engine end for installing rear bearing cone and checking bearing adjustment, also for removing or installing power take-off shaft and gears. Place a block of wood under the end of clutch shaft to protect the pilot bushing surface, and of the correct thickness to hold front bearing cone tight against the bearing cup. Install the rear bearing cone and drive gear, using K-M driver J-9276-8 for driving rear bearing cone in place over shaft. Install thrust washer and snap ring. Use a snap ring of the proper thickness to give .0005" to .0045" bearing end clearance when measured with a dial indicator.

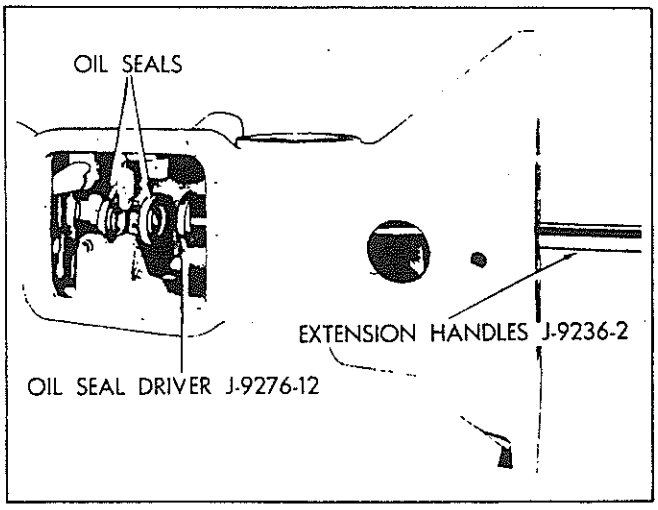
To prevent obtaining a false indicator reading of bearing clearance proceed as follows: Drive rear bearing forward until all end play is removed and install snap ring. Remove block of wood from front end of clutch shaft. Drive shaft forward in housing until thrust washer is tight against snap ring at rear of shaft. Also check to be sure drive gear is tight against snap ring at front end of shaft.

Install dial indicator to rear end of shaft and observe the first reading as shaft is pryed upward toward rear of housing. If the second reading is attempted the dial indicator will show nearly zero due to tapered bearings holding end movement of shaft. If the second reading is necessary, remove the dial indicator and drive the shaft downward. Reinstall indicator and observe the reading as the shaft is first pryed upward.



REMOVING CLUTCH SHAFT





POWER TAKE-OFF SHAFT-FRONT

REMOVAL

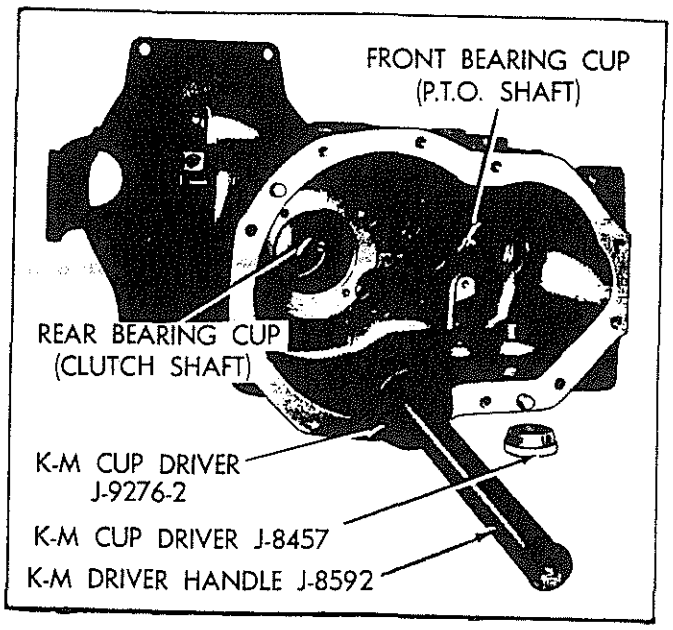
Remove cover at bottom of torque housing. Remove roll pin from the power take-off shifter, and remove P.T.O. shift lever. Remove the P.T.O. shifter being careful not to lose the detent ball and spring. Remove the P.T.O. shift collar. If tractor is equipped with shuttle clutch, or power director clutch with oil cooler, remove the oil cooler pump. The pump is attached to housing with two cap-screws on the right and one on the left side of pump.

Remove the snap ring retaining the rear bearing cup. Pull shaft and rear bearing from housing. Use the O.T.C. 14-M adapter and slide hammer to pull shaft. Remove gear, thrust washer and front bearing cone from opening at bottom of housing. The rear bearing cone may be pressed from shaft if replacement is necessary. The front bearing cup may be driven from housing if replacement is necessary. To remove front bearing cup, first remove the bearing bore plug by driving forward, then remove cup by driving it rearward.

ASSEMBLY

Stand torque housing on engine end for assembly of all shafts and gears. Install the front bearing bore plug with cup side rearward. Use sealer on surface of bearing bore, place plug inside housing and drive forward until plug is flush with front surface of housing. Install front bearing cup with larger inside diameter rearward, using K-MJ8457 cup driver and handle J8592.

Install snap ring in groove on shaft. Install the rear bearing cone over rear end of shaft with taper of bearing rearward. Press into place until tight against snap ring. Place the front bearing cone into cup in housing. Place the P.T.O. gear in housing with the long hub forward. Tractors equipped with power director use a 55 tooth gear, if equipped with

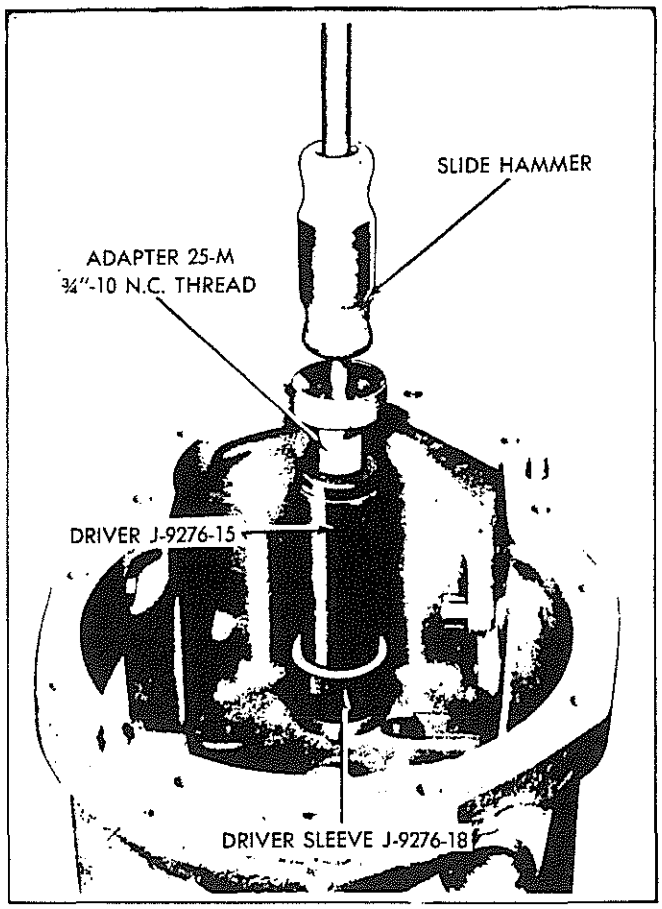


shuttle clutch use a 50 tooth gear, if equipped with shuttle clutch use a 50 tooth gear. Place the .189" thrust washer between bearing cone and gear hub. Install the shaft through gear, thrust washer and into front bearing cone. Drive shaft into place, using O.T.C. 14-M adapter (3/8" - 24 N.F. thread) and slide hammer.

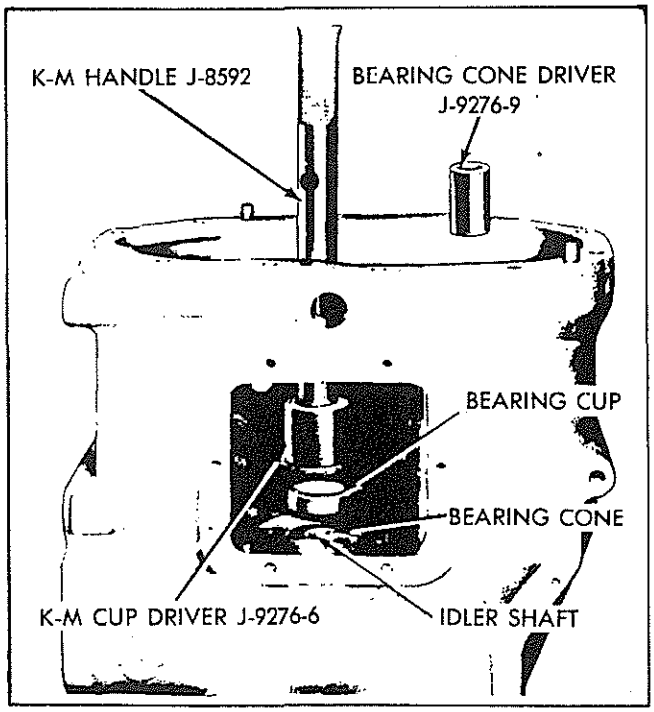
Install the rear bearing cup, using K-M bearing driver J9276-15, sleeve J9276-18 and slide hammer. Drive cup in tight until all end play is removed, and install a snap ring that will give .0005" to .0045" end play when check with a dial indicator. Use slide hammer and pull rear bearing cup back tight against snap ring. Use K-M bearing driver J9276-15, adapter 25M (3/4" - 10 N.C. thread) and slide hammer and drive inner race of bearing cone away from bearing cup. Do not slide hammer or drive against end of shaft. Mount dial indicator and check end clearance of bearings which should be .0005" to .0045".

If end movement is excessive, install a thicker snap ring. If end clearance is too tight install a thinner snap ring. Snap rings are furnished in eleven thicknesses from .070" in steps of .004". When removing snap rings always drive bearing cup away from snap ring

slightly for each removal. When installing snap rings, always pull cup back tight against snap ring and drive inner race of bearing cone away from bearing cup before checking end clearance with dial indicator. For correct indicator reading check as shaft or gear is first pried rearward, as the tapered bearings will grip shaft and the second reading will be false.



IDLER SHAFT AND GEAR

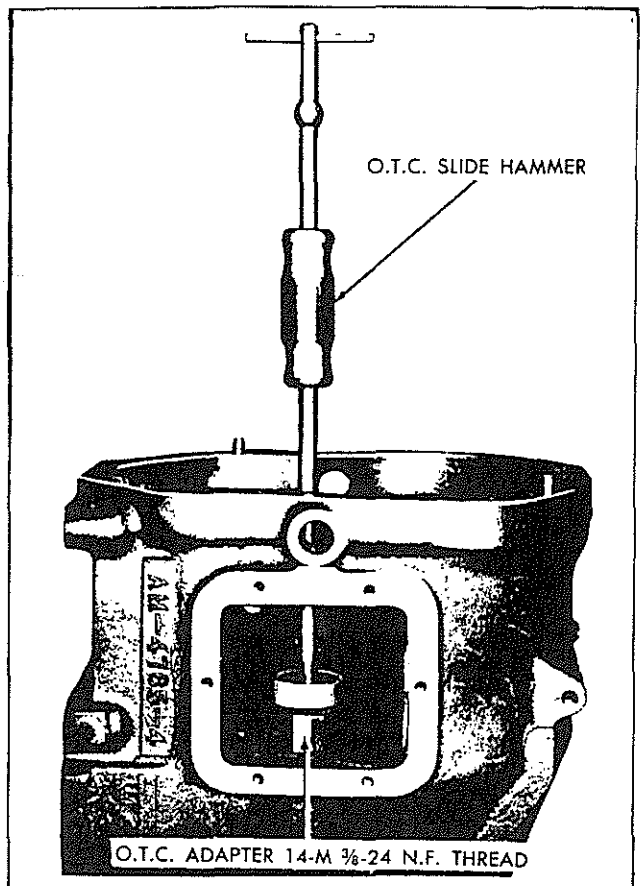


REMOVAL

Remove the snap ring retaining the rear bearing cup. Use the O.T.C. adapter 14-M 3/8" - 24 N.F. thread and slide hammer and pull the shaft, rear bearing cone and cup from housing. Press rear bearing cone from shaft if replacement is necessary. Remove the front bearing bore plug by driving it forward. Remove the front bearing cup by driving it rearward.

ASSEMBLY

Install the front bearing bore plug by driving it forward from rear of housing. Install with flat side forward, using sealer on outer diameter of plug. Drive plug flush with front surface of housing. Wipe out any sealer that may have gotten into area where front bearing cup seats. Drive front bearing cup into place with larger inside diameter rearward, using K-M cup driver J8457 and drive handle J8592.



REMOVING OR INSTALLING SHAFTS

Press the rear bearing cone on rear end of shaft with taper of bearing rearward. Place the front bearing cone into front bearing cup. Place .156" spacer next to front bearing cone, and place idler gear next to spacer. Tractors with Power director clutch use a 26 tooth idler gear; tractors equipped with shuttle clutch use a 30 tooth idler gear.

Install the idler shaft through gear, spacer and into front bearing cone. Use O.T.C. 14-M adapter, 3/8" - 24 N.F. thread and slide hammer to drive shaft into front bearing cone. Install the rear bearing cup, using K-M cup driver J-9276-6 and handle J-8592 for installing cup. Drive cup in until all end play is removed, and install snap ring.

Install a snap ring that will give a bearing end clearance of .0005" to .0045" when checked with a dial indicator. Snap rings are furnished in eleven thicknesses from .069" to .109" in steps of .004". If end play is excessive install a thicker snap ring that will compensate for the excessive end play. If end play is too tight install the next thinner snap ring and again check end play with dial indicator.

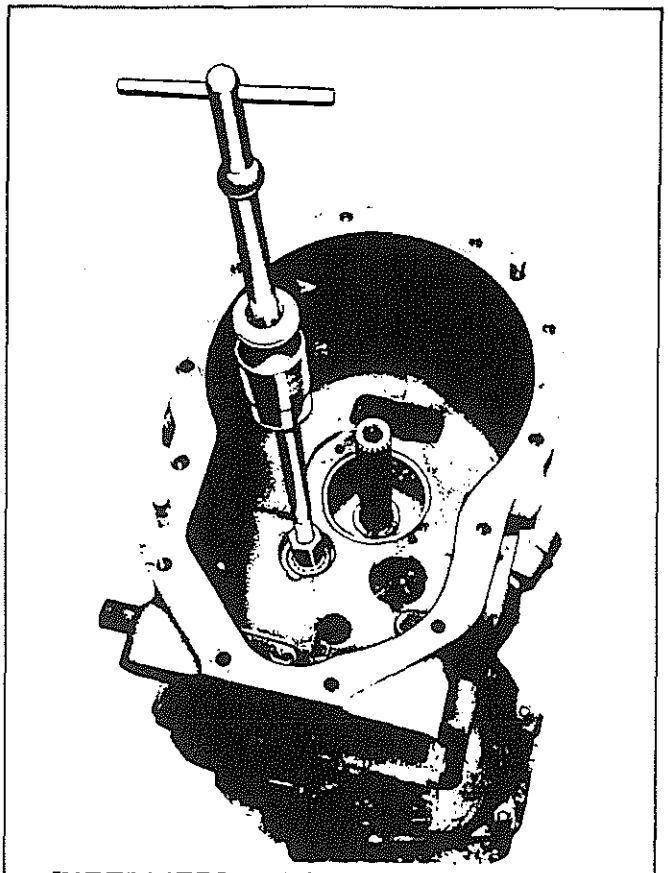
After installing snap ring, attach slide hammer to shaft and pull bearing cup back tight against snap ring. Use bearing cone driver J-9276-9 and handle J-8592 and drive inner race of bearing cone away from bearing cup. Install dial indicator to end of shaft and set on zero. Pry upward on shaft or gear (housing standing on engine end) and note the end movement on dial indicator which should be from .0005" to .0045".

Always note indicator reading as the shaft and gear is first pried upward, as the tapered bearings hold the shaft from moving back down and the second attempted reading will be near zero, and a false reading will be obtained. When changing snap rings, always drive cup away from snap ring for easy removal. After changing snap rings always pull bearing cup back tight against snap ring and drive bearing cone away from bearing cup before checking end play with dial indicator.

INTERMEDIATE SHAFT AND GEARS

REMOVAL

Remove the snap ring retaining the rear bearing cup. Remove plug from the front bearing bore through opening at bottom of housing. Remove nut from end of shaft. Attach slide hammer and O.T.C. adapter 14-M 3/8" - 24 N.F. thread to end of shaft and pull shaft, rear bearing cone and cup from housing. Remove gears and front bearing cone through opening in housing. Remove snap ring and press rear bearing cone from shaft if replacement is necessary. Remove front bearing cup by driving it rearward, or using the O. T. C. cup puller.

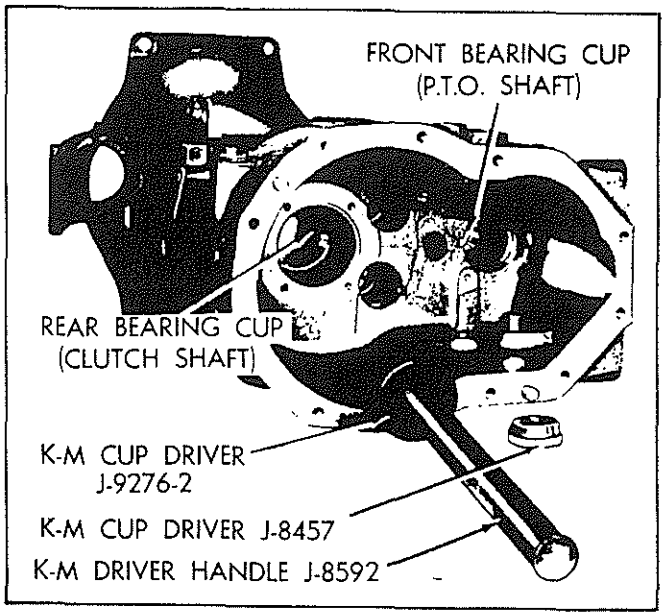


INTERMEDIATE SHAFT REMOVAL

ASSEMBLY

Install the front bearing cup with the larger inside diameter rearward, using K-M cup driver J-8457 and drive handle J-8592. Press the rear bearing cone on shaft with the taper rearward, and install the snap ring. Press bearing back tight against snap ring.

Install the front bearing cone into front bearing cup. Install the drive gear in housing with the smaller diameter hub forward next to front bearing cone. This gear has 30 teeth when used with power director clutch, and 24 teeth when used with shuttle clutch. Install the driven gear in the rear position with the flat side forward. The driven gear has 27 teeth when used with the power director clutch, and 22 teeth when used with shuttle clutch.



Install the intermediate shaft through both gears and into front bearing cone. Attach O.T.C. adapter 14-M (3/8" - 24 N.F. thread) and slide hammer to shaft and drive shaft into front bearing cone. Install a new nut at front end of shaft and tighten to 50-60 ft. lbs. torque. The shaft may be blocked from turning by wedging a wiping cloth between the gear teeth while tightening nut.

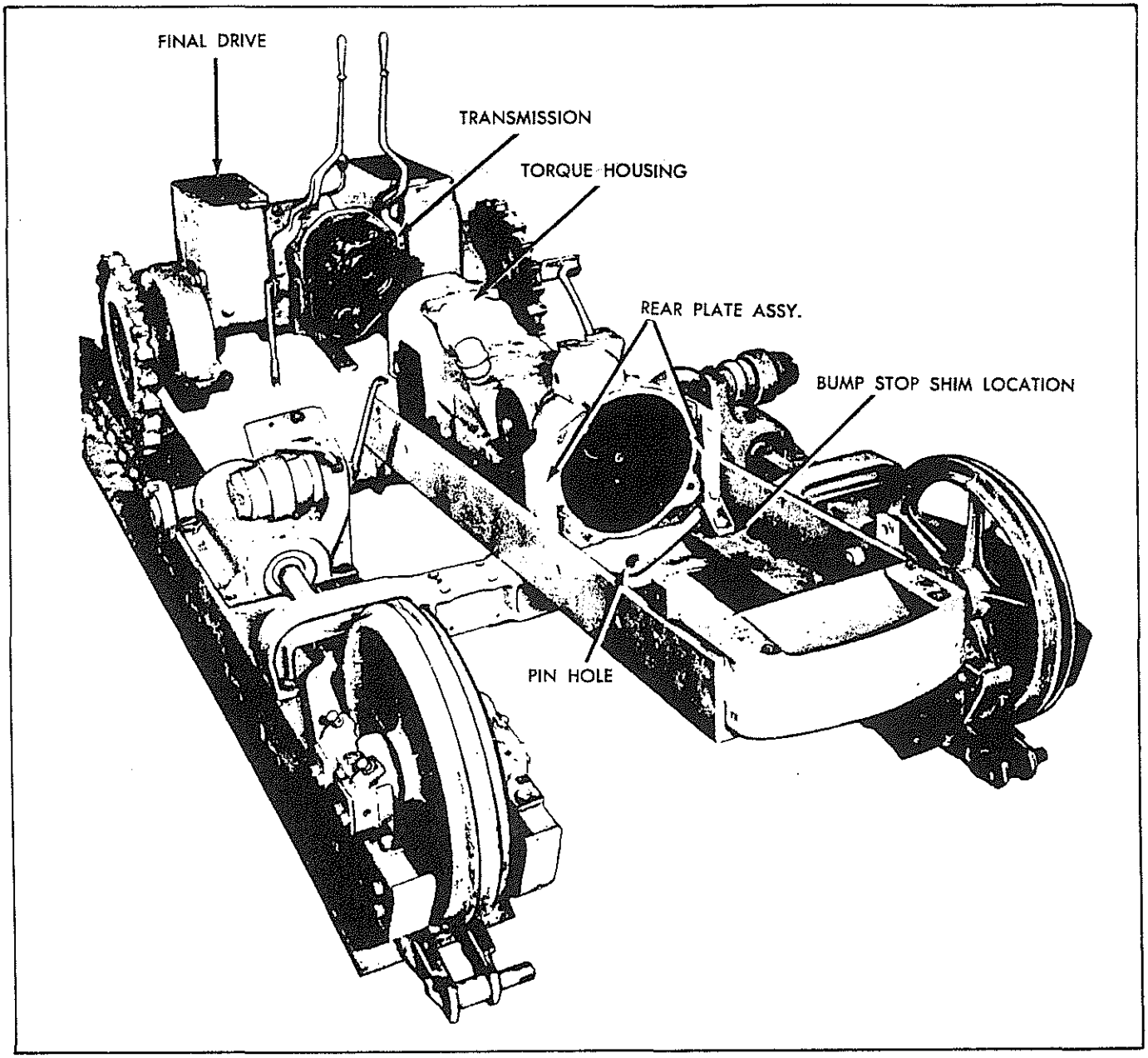
Install the rear bearing cup, using K-M cup driver J-9276-6 and driving handle J-8592. Drive cup in tight until all end play is removed, and install a snap ring that will give .0005" to .0045" bearing end clearance when checked with a dial indicator. Attach O.T.C. adapter 14-M (3/8"- 24 N.F. thread) and slide hammer and pull rear bearing cup back tight against snap ring. Use O.T.C. bearing

cone driver J-9296-9 and driving handle J-8592 and drive bearing cone away from bearing cup.

Attach dial indicator at end of shaft and set at zero. Observe the first reading as the shaft and gears are first pried upward toward rear of housing. After the shaft is once lifted, the tapered bearings will hold shaft in this position and the second attempted reading will be false. The first attempted indicator reading should be .0005" to .0045" end play. If not, remove snap ring and install one of the proper thickness.

Snap rings are furnished in eleven thicknesses from .069" to .109" in steps of .004". To remove snap rings, always drive the bearing cup away from snap ring for easier removal. After snap ring is installed always pull cup back tight against snap ring and drive bearing cone away from bearing cup before checking end play with dial indicator. If the second indicator reading becomes necessary, remove indicator and drive bearing cone away from bearing cup before attempting the second reading.

TORQUE HOUSING
ASSEMBLY AND ALIGNMENT PROCEDURE
OF MAIN FRAME TORQUE HOUSING & ENGINE

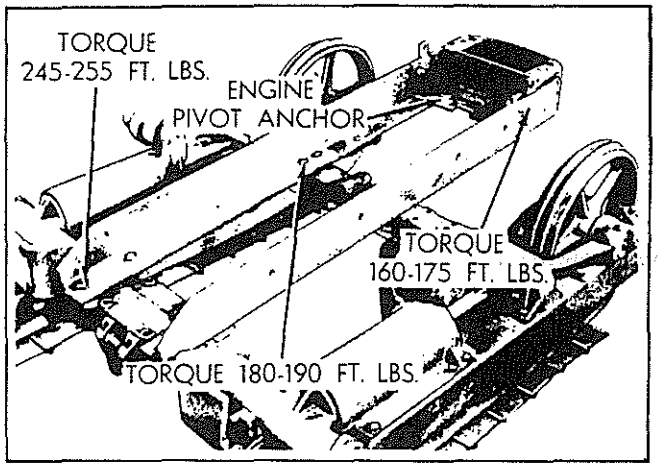


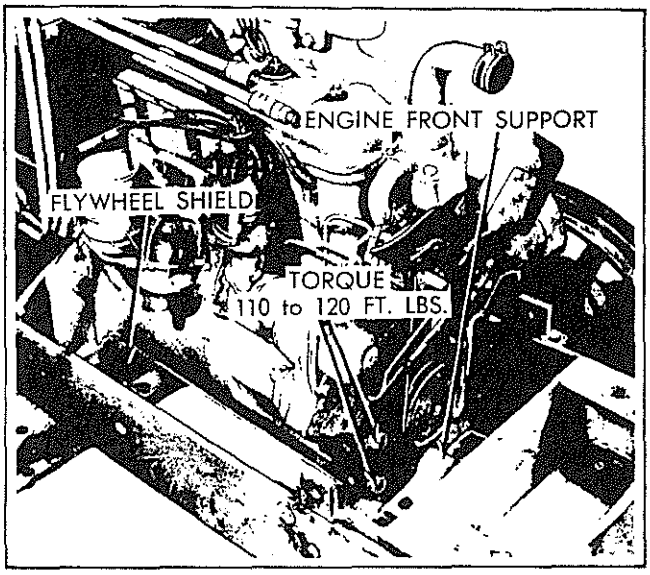
This procedure must be followed when replacing any of the main frame members, the torque housing, the rear plate assembly, and the engine cylinder block. Also, this procedure must be followed whenever any alignment problems are encountered with the power train drive line, or aligning engine to tractor and radiator. Proper alignment can be checked by installing an alignment pin (1.245" diameter pin) in the rear plate assembly and the front cross member beam hole. This pin should fit and align these holes and be removed easily when all parts are torqued to proper specifications.

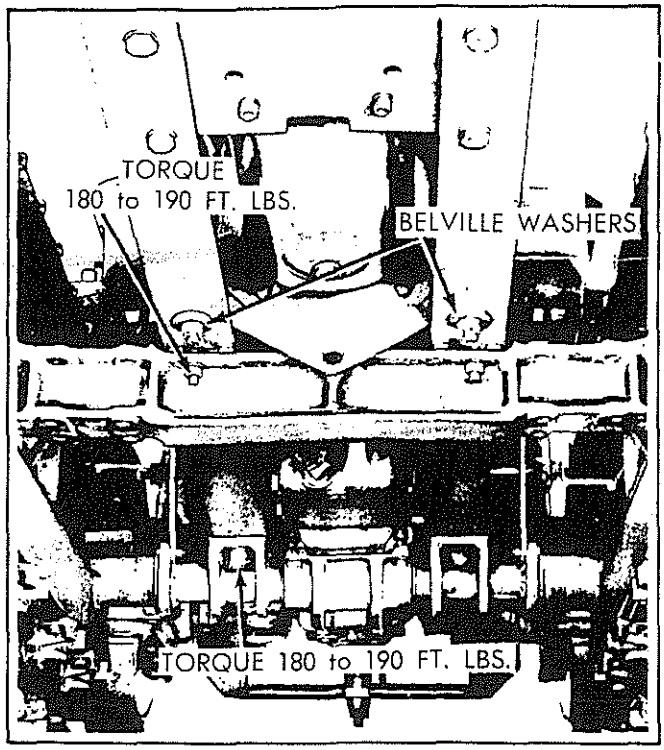
If unit is completely assembled, loosen the six capscrews attaching main frame to final drive housings. Loosen the four capscrews securing torque tube to rear pivot axle.

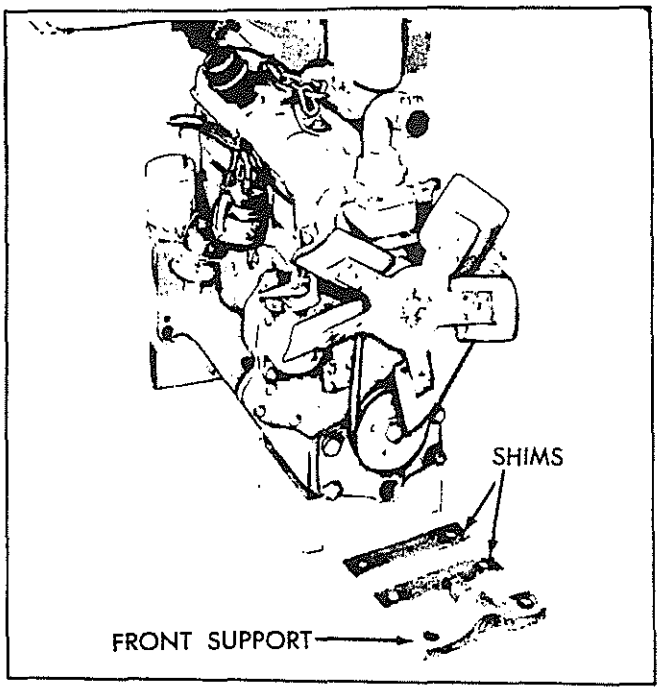
Remove the two bolts and shims securing rear plate assembly to main frame at front of torque tube. Loosen bolts securing rear plate assembly to torque tube. Remove the two bolts attaching front engine pivot anchor to front support. Follow assembly procedure and adjustment for retorquing these positions.

TORQUE HOUSING (Cont.)









1. Assemble torque housing to transmission housing, torquing capscrews 70 to 75 ft. lbs.

2. Install four capscrews attaching rear of torque tube to rear pivot plate leaving capscrews loose, final torque is 120 to 130 ft. lbs.

3. Attach rear plate assembly to front of torque housing leaving bolts loose, final torque is 180 to 190 ft. lbs.

4. At this time install alignment pin (1.245" + .000" - .004" diameter) through rear plate assembly and front beam hole.

5. Attach engine to torque housing, properly torque capscrews 70 to 75 ft. lbs.

6. Install front engine pivot anchor in position, less shims and bolts.

7. Assemble radiator on front support.

8. It will be necessary to raise or lower the complete assembly of engine and torque tube with a hoist or proper jack. With alignment pin installed in aligning holes the engine fan should be centered in the radiator shroud.

9. Properly torque the bolts attaching rear plate assembly to front of torque tube.

10. Properly torque the four 5/8" capscrews securing rear of torque tube to rear pivot axle, 130 to 140 ft. lbs.

11. Properly torque six capscrews attaching rear of main frame to final drive housing.

12. Install the necessary amounts of shims under front engine pivot anchor to center fan in radiator shroud, install pivot anchor bolts and torque 70 to 75 ft. lbs.

13. At bump stop, rear plate assembly at front of torque tube, measure the clearance between the main frame and bump stop bracket, attached to rear plate assembly. Using proper shims (.020", .062", .1196") obtain .010" to .030" clearance between bump stop and main frame. Install special capscrews. Assemble two bellview spring washers, large diameters together, under main frame member and install special nut. Tighten nut until it contacts washers, tighten to next castellation and install cotter pin.

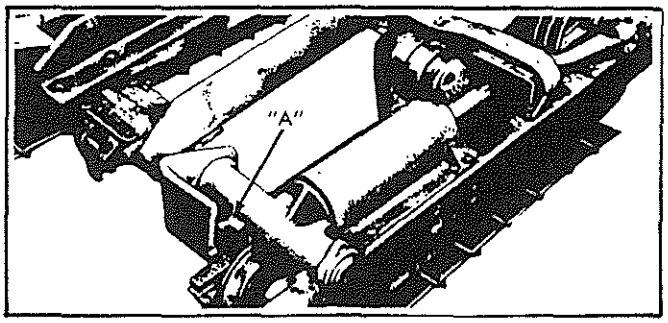
14. Using proper sealer (3M-EC 1185) (A-C part number 921314), properly caulk the flywheel cover plate to torque tube. Install capscrews and torque 40 to 45 ft. lbs.

At this time alignment pin should be removed easily with all bolts properly torqued. If alignment pin cannot be removed easily, follow procedure again and make necessary corrections for proper alignment.
CAUTION: Do not operate tractor with alignment pin in place.

PIVOT AXLE BRACKET & BUMP STOP BRACKET

H-3 AND HD-3 PIVOT AXLE BRACKET

In splitting the tractor between the torque tube and transmission on early tractors, a problem occurs during reassembly. If one of the clutch plates drops from the clutch hub and the bracket capscrews are used to draw the tractor together, the clutch will be ruined. To avoid this condition, the two housings should be brought fully together before the capscrews are entered between the bracket and final drive housing. When this procedure is followed, the lower outside capscrew cannot be entered. To install this capscrew, refer to photo and cut out the corner of the roller frame as shown at "A".



H-3 AND HD-3 TRACTOR BUMP STOP BRACKETS

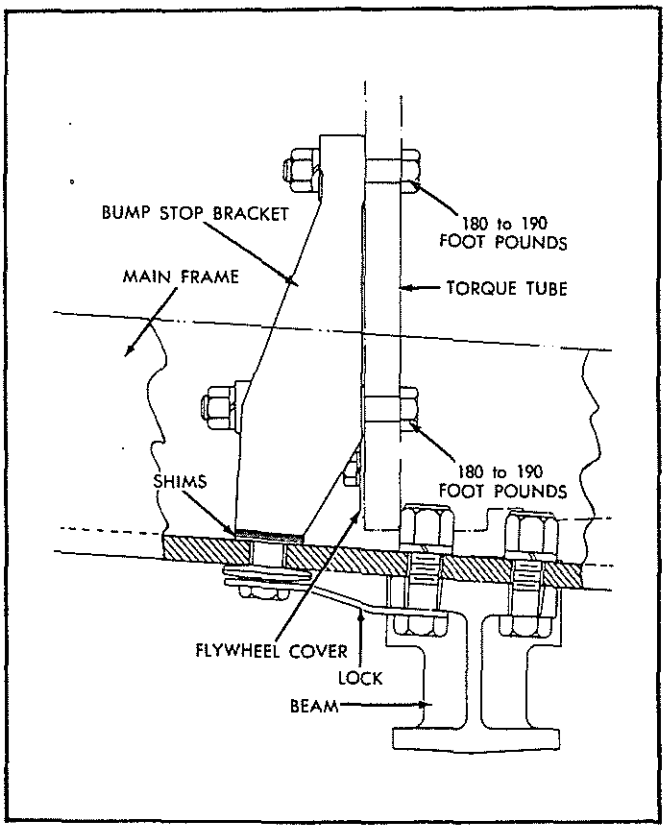
New design "Bump Stop Brackets" have been installed on production model H-3 and HD-3 Tractors effective with Tractor Serial Number 4153.

The new Bump Stop Brackets can be installed on all H-3 and HD-3 Tractors and should be used for field service.

INSTALLATION PROCEDURE
(Refer to Illustration)

The new cast Bump Stop Brackets, R.H. and L.H. replace the Rear Plate Assembly. New hardware is also used for installing the brackets.

To install brackets it is necessary to remove the Rear Plate Assembly and Flywheel Cover along with all attaching hardware. New flywheel covers should be used.



Attach Bump Stop Brackets to front of Torque Housing, using four capscrews, lockwashers, and nuts. Do not tighten. Hold Bump Stop Bracket in the raised position then tighten nuts to a torque of 180-190 ft. lbs.

For field installation of Bump Stop Brackets, it is necessary that the front Engine Pivot Anchor be located and adjusted with shims (if necessary) to position center of Fan Hub on H-3 8-5/8" and HD-3 10" from Radiator Pads on the Front Support. This is a vertical measurement. The Fan Hub must also be centered horizontally. This may require loosening the four capscrews attaching Pivot Axle to torque housing.

Attach the new flywheel cover (diesel) or (gasoline) to front of torque housing, using two capscrews and two lockwashers. Tighten capscrews 45 to 50 ft. lbs. torque. Calk between flywheel cover and torque housing with sealer. Be sure seal will keep dirt and moisture out of engine clutch housing.

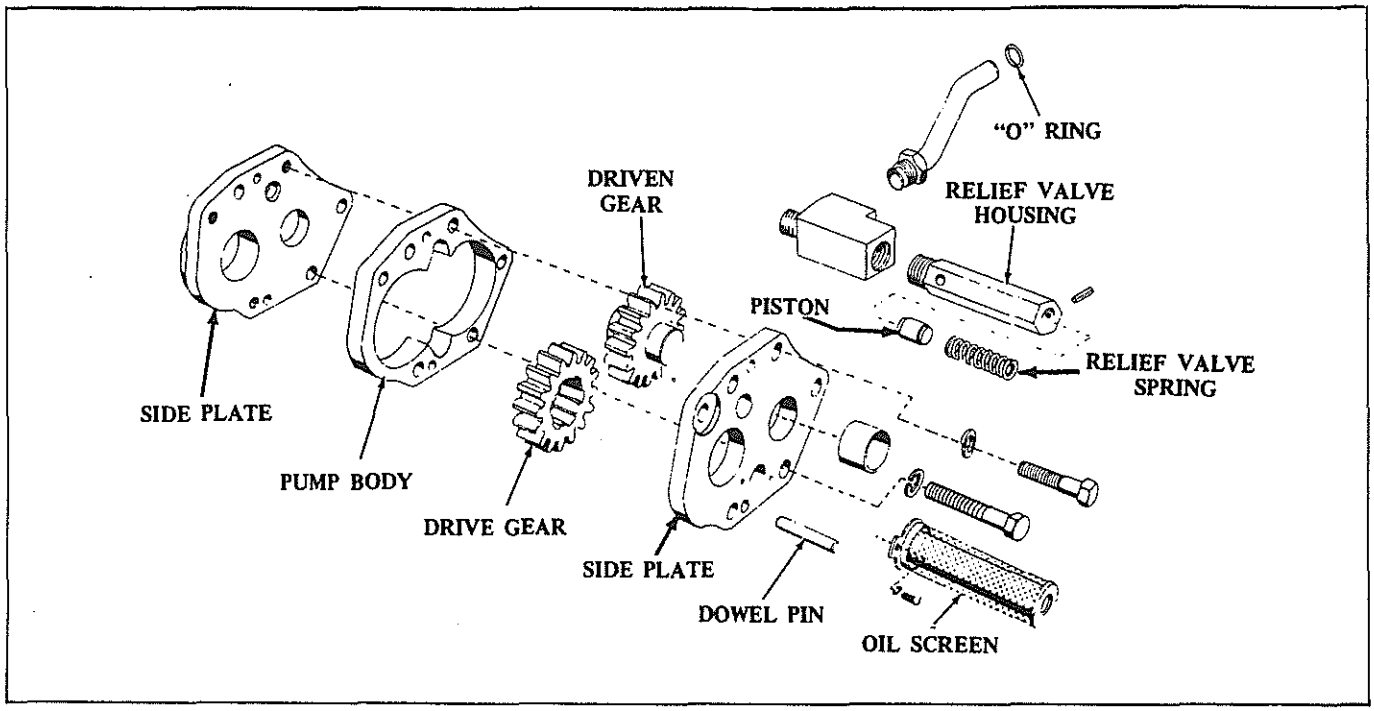
Determine space between Bump Stop Brackets and Frame Angle, and, if necessary, use shims (.062"), (.0897"), or (.1196") to obtain clearance of .010" to .040".

NOTE: If necessary, grind bottom area of Bump Stop Bracket to obtain proper clearance using caution not to destroy square of original surface.

Place two spring washers (concave surfaces together) over capscrew, and thread into the Bump Stop Bracket from the bottom until the spring washers come into contact with the frame angle. Lock this capscrew in this position by attaching lockplate to the front beam capscrew and over hex head of capscrew.

When installing new Bump Stop Brackets on HD-3 tractors, it will also be necessary to replace the oil pressure line adaptor and elbow with new adaptor and connector.

SHUTTLE CLUTCH OIL PUMP



SHUTTLE CLUTCH OIL PUMP

The shuttle clutch oil pump is located internally in the rear portion of torque housing. Its purpose is to circulate oil through the oil cooler and shuttle clutch to make clutch run cooler. If the clutch fails for any reason the pump should be checked for output and pressure. The pump should produce 2.5 G.P.M. at 30 P.S.I. at 550 pump R.P.M. The pump relief valve pressure should be set at 60 P.S.I. If pump is checked and found to be okay after a shuttle clutch failure the oil cooler radiator should be checked to see if it has become plugged.

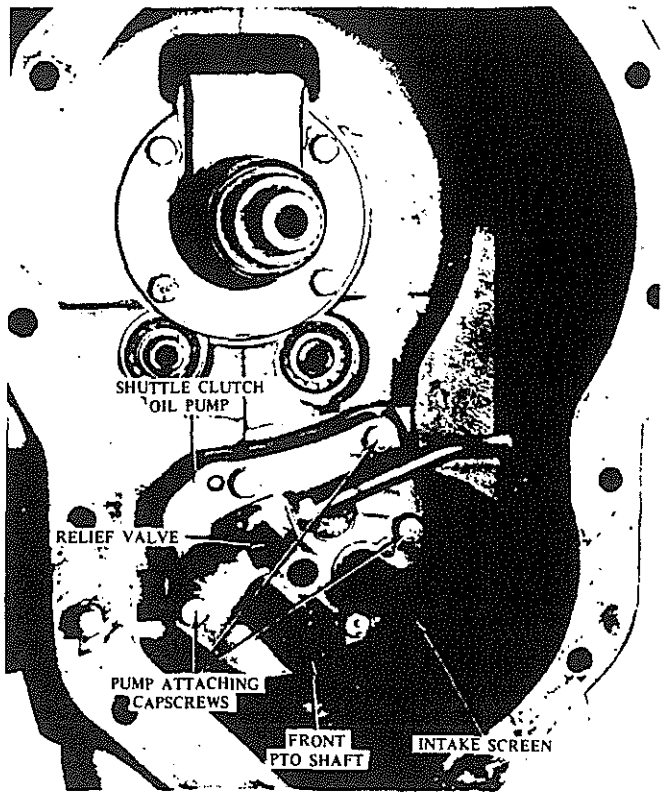
REMOVAL

To remove the oil pump drain the oil from the shuttle clutch compartment and remove the R.H. side cover at rear of torque housing. If tractor is equipped with P.T.O. shaft and shifter it will be necessary to remove the rear section of P.T.O. shaft and the P.T.O. shifter. Remove the intake screen and relief valve from pump and the three capscrews that attach pump to torque housing. The pump can now be moved rearward off of front P.T.O. shaft and removed through side opening.

Three short capscrews are used to hold the pump together. The sections of body and covers are also on dowel pins to provide accurate alignment. Parts of body and plates cannot be interchanged and must be serviced as an assembly.

Check end plates for wear or scoring. Check gears for excess backlash and idler gear bushings for wear. As the pump circulates oil at low pressure, considerable wear can be tolerated.

Install bushing in end covers. Be sure mating surfaced of end plates and body are clean and free from nicks or scratches. Assemble gears in body and install end plates. Start the dowel pins and the three short capscrews. Torque capscrews to 25 to 30 ft. lbs. Be



sure oil screen is clean and not damaged. Secure to body and tighten screws snugly. Rotate pump and see that it does not bind.

Assemble pump over the P.T.O. shaft and torque the 3 long capscrews to 25 to 30 ft. lbs.

The oil tube which leads to shuttle clutch side cover must be aligned to fit. It is sealed to cover with an "O" ring contained in cover fitting.

SHUTTLE OR POWER DIRECTOR CLUTCH

CLUTCH ADJUSTMENT

The clutch can be checked for adjustment, or adjusted without removing clutch from tractor. Although if the clutch plates are to be inspected, or the clutch disassembled, it will be necessary to remove it from tractor.

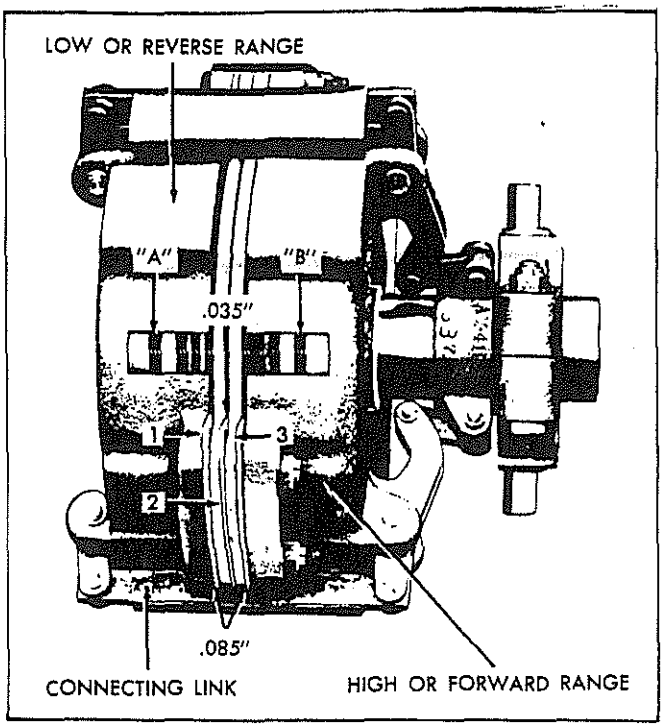
The clutch is built with an .085" stack of shims at 1 and 3, which are in the low and high, or reverse and forward ranges of the clutch. These shim stacks consists of five .015" and one .010" shims. There is a .035" shim stack at 2" which is between the two center plates, separating the two sections of the clutch. This shim stack consists of one .015" and two .010" shims. These shim stacks total .205" and an equal stack is located at each of the three ears. This amount of shim must always be in the clutch, otherwise the length of the connecting links between the front and rear levers will be affected.

To check the clutch for adjustment, measure the distance between the preload plate and the pressure plate at all three places located at "A" and "B" in picture. First, measure this distance with the clutch disengaged and record the measurements. Second, measure these three same measurements, with the clutch engaged, which will be the smaller dimension and record these measurements. These measurements may be made with a hole gauge and micrometer.

The object in taking these dimensions in both the disengaged and engaged positions of the clutch is to determine the amount of difference between the preload plate and the pressure plate in both the disengaged and engaged positions of the clutch. The pressure washer is installed between these two plates and you are merely determining the amount the pressure washer is compressed when the clutch is engaged.

After the measurements have been taken and recorded, add the three disengaged dimensions together and divide by three to obtain an average dimension. Now add the three engaged dimensions together and divide by three to obtain an average dimension. Then subtract the average engaged dimension from the average disengaged dimension. This will give the difference in the two average dimensions, or in other words how much the pressure washer is compressed when the clutch is engaged.

This average difference between the two dimensions must be from .042" to .046". If this difference is within the figure the clutch is properly adjusted and no shim changing is necessary. If the average difference is below the .042" figure or above the .046" figure then it will be necessary to change shims by removing or adding at the proper location.



If the measured average difference is below the .042" figure, remove from position "1" or "3" (which ever the case may be) and add this same amount to position "2". If the average difference is from .037" to .041" remove .005" from position "1" or "3" and add .005" to position "2". If the average difference is from .032" to .036" remove .010" from position "1" or "3" and add .010" to position "2". The third step of .005", remove and add .015" etc.

If the measured average difference proves to be above .046", the shim will be removed from position "2" (center position) and added to position "1" or "3" which ever the case may be. If the difference is from .047" to .051", remove .005" from position "2" and add .005" to position "1" or "3". If the difference is from .052" to .056" then remove .010" from position "2" and add .010" to position "1" or "3".

The shims used in position "1" or "3" are identical, and are furnished in .010" and .015" thickness. This provides adjusting steps of .005" by replacing a .015" shim with a .010" or vise versa. Shim at position "2" has a different shape. They are much longer than the shims at "1" or "3" and are used to back up the two center plates of clutch. Shim at position "2" is also furnished in .010" and .015" thicknesses and provide adjusting steps of .005".

With clutch in neutral, the minimum plate dearance must be .040" when measured between clutch housings and center plates.

EXAMPLE

Average Measured Difference at A or B	Remove Shims at "1" or "3"	Add Shims at "2"
.027" to .031"	.015"	.015"
.032" to .036"	.010"	.010"
.037" to .041"	.005"	.005"
Correct Adjustment		
.042" to .046"	.000"	.000"
	Add Shims at "1" or "3"	Remove Shims at "2"
.047" to .051"	.005"	.005"
.052" to .056"	.010"	.010"
.057" to .061"	.015"	.015"

SHUTTLE OR POWER DIRECTOR CLUTCH LUBRICATION

NOTE: The power take-off gear train picks up oil and carries it up to the oil transfer tube. Here the oil is carried back on the hollow shaft assembly. On the hollow shaft an oil impeller spring carries the oil back into the clutch.

CAUTION: Two springs are used, the spring used in the shuttle clutch is a right hand helix wound spring, and the power director clutch uses a left hand helix wound spring. These springs must be used in their proper places as the rotation of the hollow shaft and spring assembly, carries the oil rearward, into the clutch.

The power take-off driven pump in the shuttle clutch tractor, picks up oil through the intake screen and pumps it through the connection in the cover plate and to the heat exchanger core in front of the radiator. Here the oil is cooled and returned to the sump through the sump line connection in the cover plate.

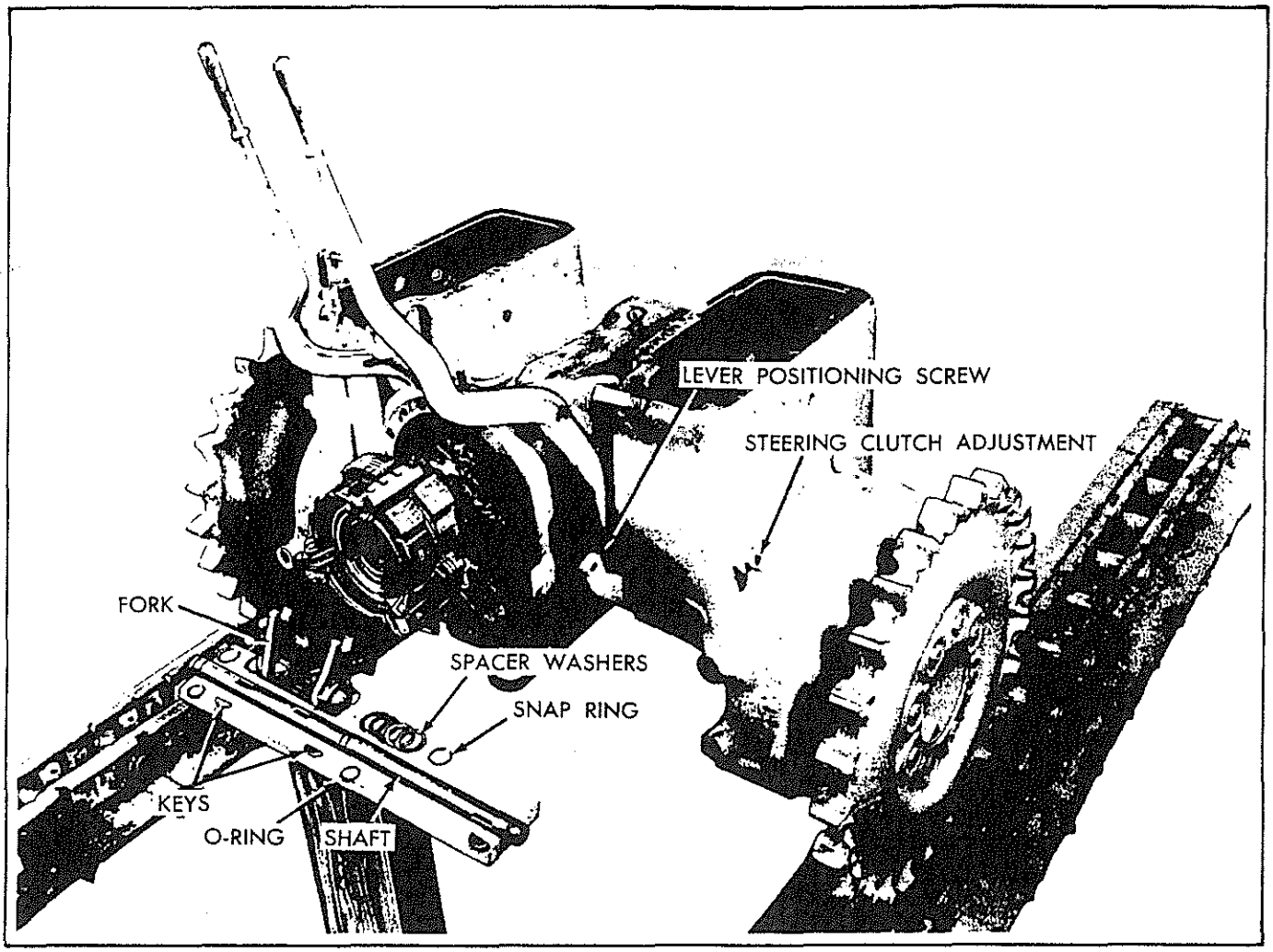
NOTE: If shuttle clutch failure is experienced the plugs from heat exchanger should be removed and heat exchanger cleaned out before tractor is operated again.

SHUTTLE OR POWER DIRECTION CLUTCH LEVER ADJUSTMENT

The clutch lever quadrant must be so that it will hold the clutch lever in the neutral position so that both ranges of clutch is released equally. This can be checked by holding the hand grip depressed and moving the lever slightly forward and rearward between the start of engagement of both ranges and adjust lever quadrant to hold lever exactly halfway between the two clutch engagements.

The holes in quadrant are slotted. To adjust, loosen two nuts and move quadrant forward or rearward to the desired position and retighten nuts.

SHUTTLE CLUTCH AND POWER DIRECTOR CLUTCH



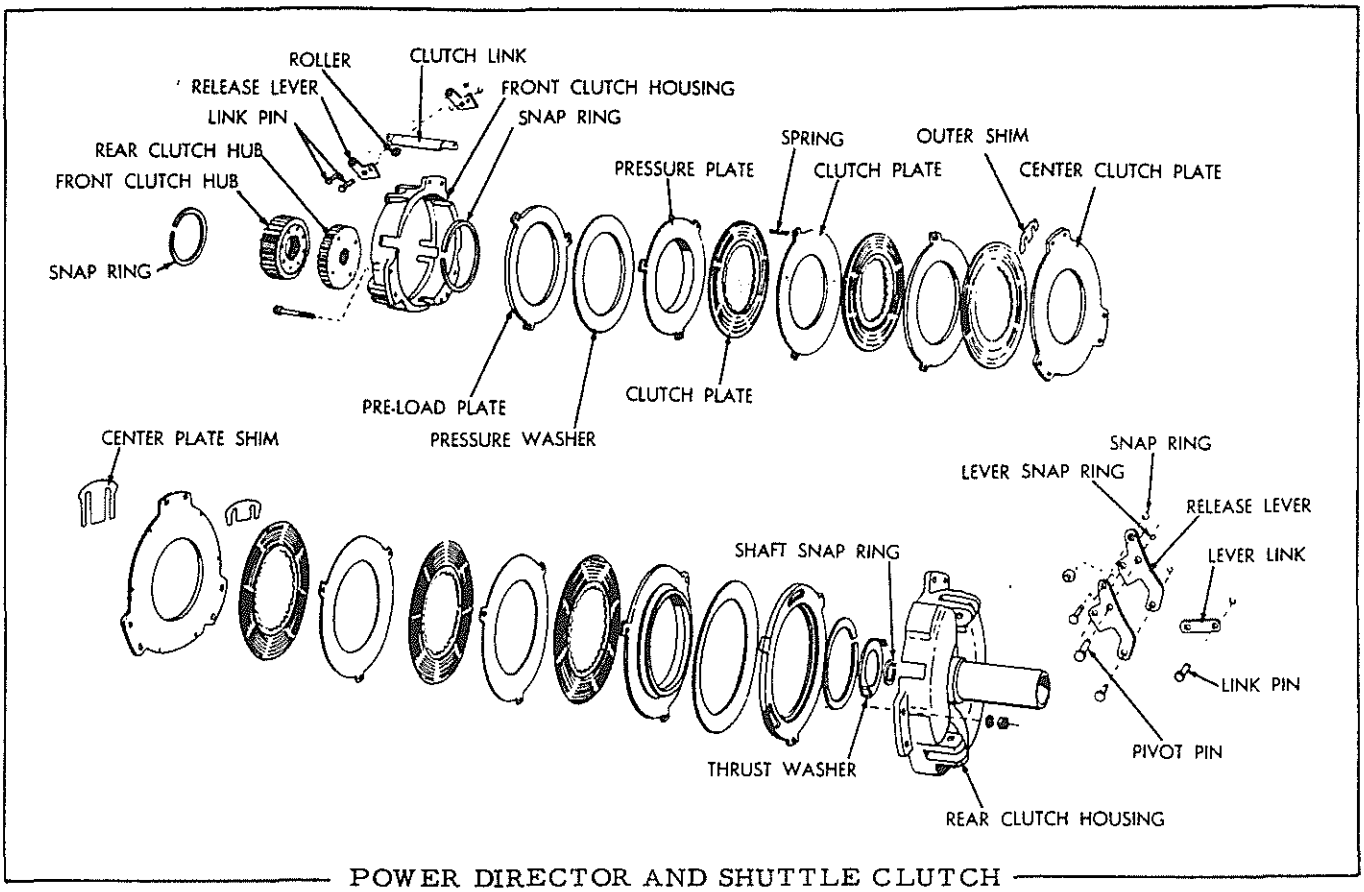
REMOVAL

Remove the track assemblies, refer to track removal. Leave ample room at rear of tractor to lay out track. This is necessary to permit transmission and final drive assemblies to be rolled away on drive sprocket. Drain oil from clutch compartment. Disconnect brake rods at rear pins. Disconnect hydraulic lines from pump to control valve. Remove front section of the fenders and floor plates, both right and left. Remove front drawbar pull pin. Remove cooler lines from cover and remove cover from side of torque housing. Remove shuttle clutch or power director shift lever and Woodruff key. Remove snap rings and washers to remove shaft, push shaft to left and remove left hand "O" ring, push shaft to right and remove in this manner. The shifter fork is positioned to shaft by two Woodruff keys. The keys must be removed before the shaft can be pulled from the housing. Holding the shifter fork, push the shaft to the right and remove both Woodruff keys. The right hand key can be removed between the fork and the housing; push the shaft on through the fork and remove second key. Remove the shifter fork. Remove oil filter breather and dipstick. Remove six capscrews attaching rear pivot axle to final drive housings. Remove capscrews attaching torque tube to front of transmission housing. Roll rear assembly away from tractor on track and block securely.

DISASSEMBLY

Remove the large snap ring at front of clutch. Remove both front and rear clutch hubs from front of clutch. Remove thrust washer from rear housing of clutch. Remove the snap ring at front end of clutch shaft and pull the clutch assembly from shaft. Place clutch assembly on bench for disassembly.

Clutches are balanced in manufacture, therefore, prior to disassembly the housings should be marked so that they may be reassembled in their original position. Remove the three links connecting the front and rear release levers. Remove the six capscrews attaching the front and rear housings together. Separate the two halves of the clutch at the center plates.



POWER DIRECTOR AND SHUTTLE CLUTCH

The two center plates are separated with a .035" shim stack (one .015" and two .010"). The center plates and the front and rear clutch housings are separated with a .085" shim stack (five .015" and one .010"). These latter shims are not alike. The shims used between the center plates have a different shape. Keep track of these shims stacks so that they may be installed in their original positions.

To disassemble either range of the clutch, remove the center plate. Remove the three release springs; these springs are longer in the low range section of clutch. Remove the clutch plates. There are three plates in the high section and four plates in the low range section of clutch, each separated by a plate attached to clutch housing.

Remove the preload plate assembly from housing. Compress the preload plate and remove the large snap ring retaining the preload and the pressure plates together. Remove the pressure washer. Remove pins, levers, rollers and linkage if worn excessively.

ASSEMBLY

Both sections of the clutch are assembled in the same manner. First assemble the pressure plate, pressure washer and preload plate together. Place the pressure plate on bench with the flat side down. Place the pressure washer over pressure plate with the small diameter downward. Install the preload plate over the pressure washer, with the lugs on both plates in line with each other. Compress this assembly and install the large retaining snap ring. This assembly could be assembled by compressing the plates in slots of housing to keep them in alignment.

The pressure washer should measure in thickness from .118" to .124" and is identified by a blue mark on edge of washer. The free height of a new pressure washer should be from .270" to .302".

Install the preload and pressure plate assembly in place in housing. Try the splined clutch plates over splined hubs to check for freedom of fit. Install a splined clutch plate and alternate with a clutch plate with the three lugs to separate each splined clutch plate. Assemble both sections of clutch in this manner, using three splined clutch plates in the rear of high section and four splined plates in the front or low range section of clutch. Install the three clutch retracting springs through the holes in lugs of clutch plates, being sure they are seated properly in preload plate and center plate. Install the longer springs 1-17/32" long in the front or low range section of clutch. Install center plates. Install the .085" shim stacks in their respective positions between the center plates and bushings or the shim stacks may be installed while bolting the two sections of clutch

together. Install the two housings together in the same position as which they were removed. Place the .035" shim stacks between the two center plates. Torque housing capscrews (with self lock nuts) from 25 to 30 ft. lbs.

With clutch in neutral, the minimum plate clearance must be .040" when measured between housing and center plate.

Install the clutch assembly over clutch shaft and install the retaining snap ring. Install the thrust washer in place in rear housing. Install the rear clutch hub with the flat side rearward. Install the front hub. The clutch hubs will have to be rotated and moved about in order to align with splines of clutch plates. Install the retaining snap ring at front of clutch hubs.

Install the transmission housing to the torque housing, torque the capscrews from 70 to 75 ft. lbs.

INDEX

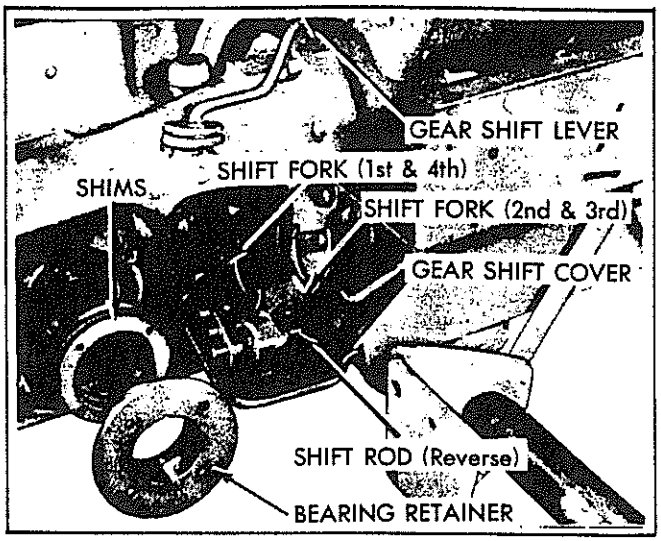
TRANSMISSION ASSEMBLY

GEAR SHIFT LEVER

All tractors equipped with shuttle clutch have the reverse gears and reverse shift fork omitted. This resulted in the end of gear shift lever disengaging from notches in the reverse shift lug in some instances.

To correct service complaints on tractors prior to serial number 1490, a new shift lever with a larger ball end was designed to replace original lever. On tractor from serial number 1490 to serial number 1813, the reverse shift rod was tack welded in position.

After serial number 1813, a new control cover assembly became effective. This new cover assembly has a new first and fourth shift fork, and the reverse shift rod and shifter lug has been omitted.



REMOVAL

Slide the dust cover upward on lever and remove the snap ring retaining the lever pivot washer. Lift lever assembly from transmission housing. Remove the two shift lever pivot pins, if replacement is necessary. The square head pivot pins may be removed from transmission housing through hole for gear shift lever.

ASSEMBLY

Install the shift lever pivot pins if they have been removed. Install the gear shift lever in place, being sure end of lever is engaged in shift lug on shifter forks, and the pivot pins are lined up to enter the grooves in lever. Place the lever pivot washer in housing and install the retaining snap ring. Install the dust cover in groove on transmission housing, making sure the cover is in good condition and seals tight around lever and housing. Try out shift lever to check its operation and proper assembly.

GEAR SHIFT COVER ASSEMBLY

On tractors starting with serial number 1490 to serial number 1813, the reverse shift rod was tack welded in position to prevent gear shift lever from disengaging shift lugs. Upon disassembly of cover it will not be necessary to remove reverse shift rod.

Starting with serial number 1813, a new cover assembly became effective. This new cover assembly has a new first and fourth shift fork, and the reverse shift rod and shifter lug has been omitted on tractors equipped with shuttle clutch.

REMOVAL

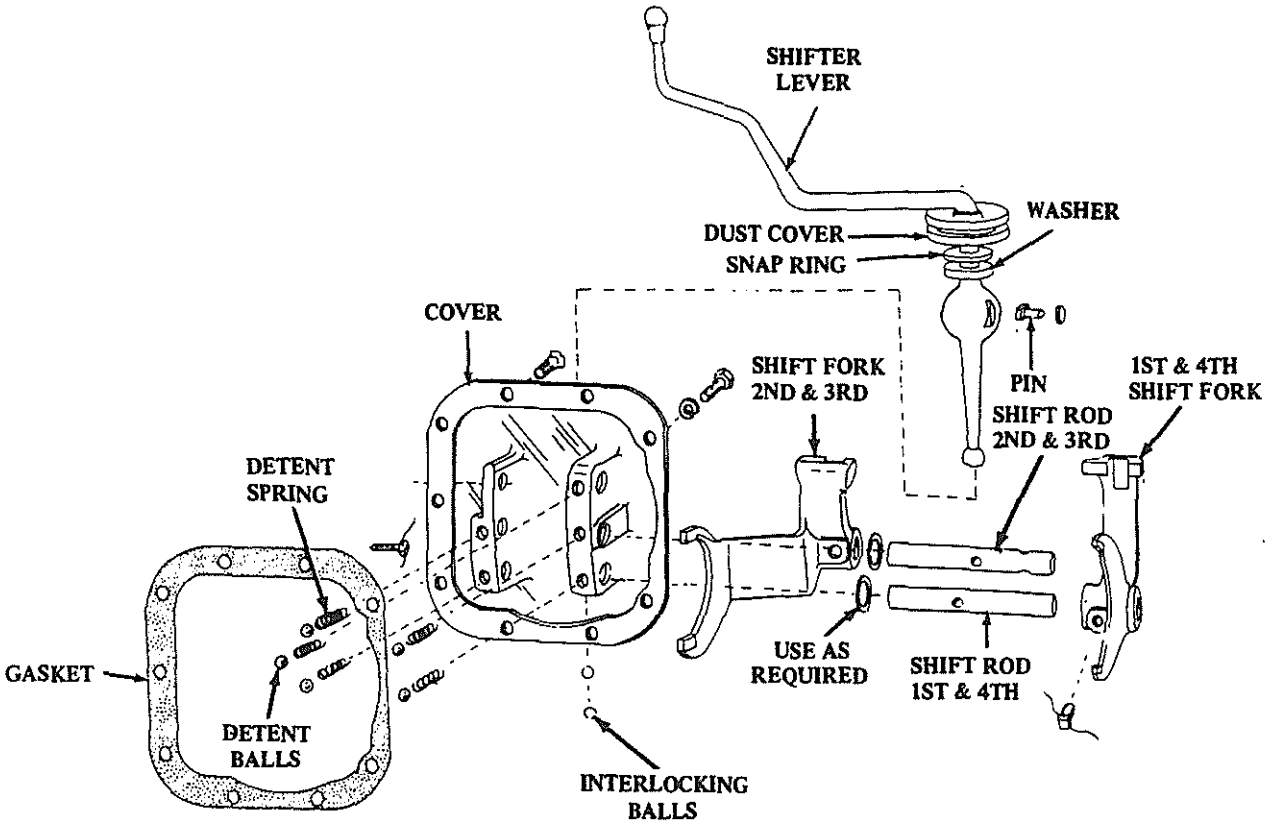
To remove the gear shift cover assembly, it will first be necessary to remove the R.H. final drive assembly. To remove final drive assembly will require the removal of brake, steering clutch, splitting the track and removing the track drive sprocket. Refer to removal instructions for each assembly.

Remove screws attaching cover assembly to transmission housing. On shuttle clutch equipped tractors the cover assembly may be removed without removing the gear shift lever. On tractors equipped with power director clutch, engage shift lever in the reverse gear position and remove shift lever before removing cover assembly.

ASSEMBLY

Clean off the gasket surfaces and shellac a new gasket to transmission housing. If tractor is equipped with shuttle clutch, the reverse gears

TRANSMISSION GEAR SHIFT COVER

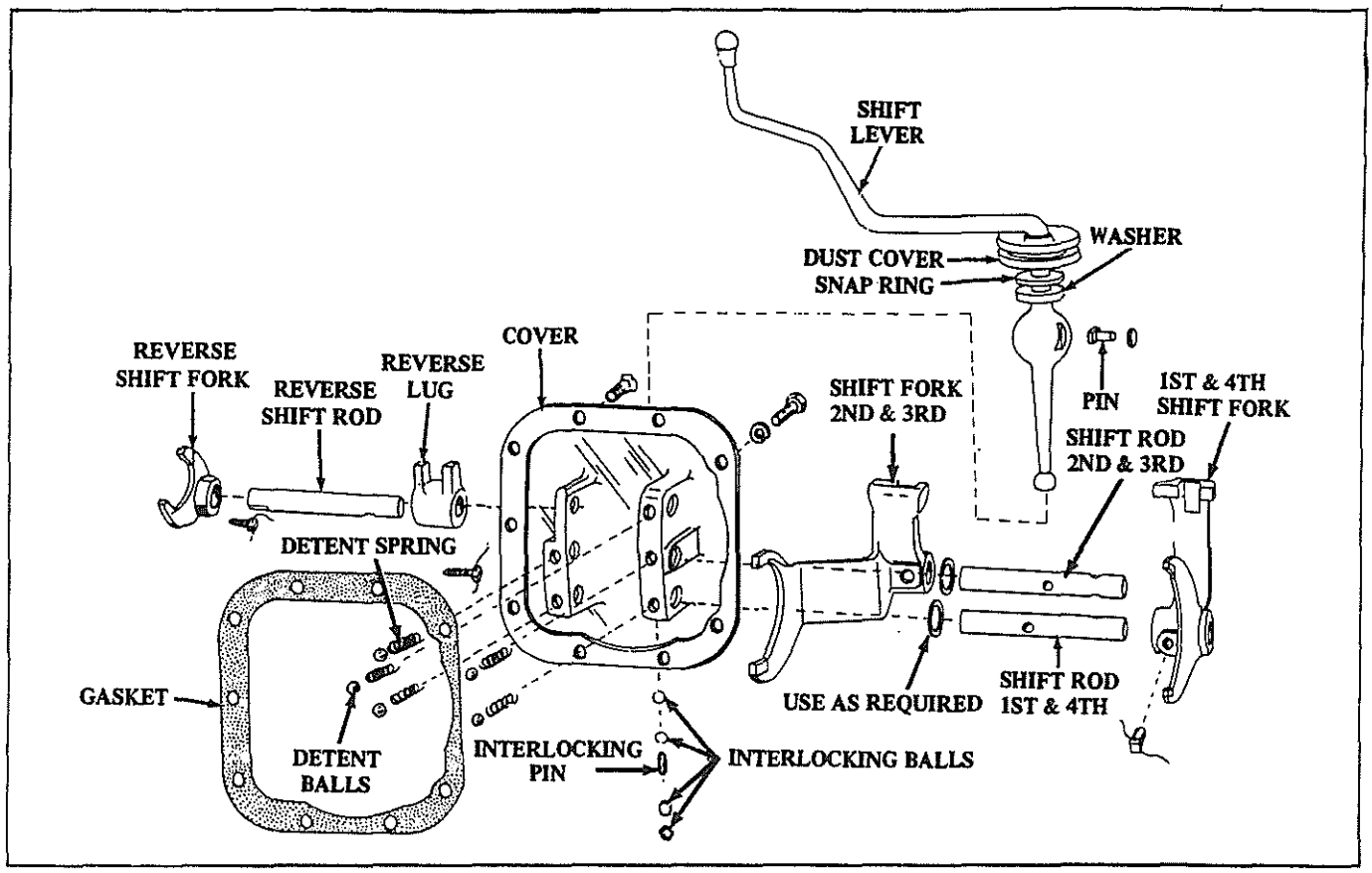


TRANSMISSION GEAR SHIFT (Forward and Reverse Transmission)

and shift fork are omitted and cover assembly may be installed without difficulty and with gear shift lever in place. Place shift rods and shifter couplings in the neutral positions.

If tractor is equipped with power director clutch, the reverse gears and shifter fork are in place. For easy assembly the gear shift lever must be removed. Place reverse sliding gear (idler gear) in the engaged or in gear position. Place reverse shifter rod in the in gear position and install cover, being careful the shifter forks all enter the shifter grooves. Install the screws and tighten from 15 to 20 ft. lbs. torque. Pry reverse shift rod rearward to neutral position before installing shift lever.

TRANSMISSION GEAR SHIFT COVER



TRANSMISSION GEAR SHIFT (Standard 4 Speed and Power Director Transmission)

FIRST AND FOURTH SHIFT ROD REMOVAL

With gear shift cover removed, clamp cover assembly in vise with bottom side upward. Remove setscrew from first and fourth shift fork. With all shift rods in the neutral position, push rearward on the first and fourth shift rod until the front detent ball is released. Hold hand over opening to prevent loss of ball. Push shift rod further rearward and remove washers and shift fork.

Move the shift rod further rearward until end of rod released the rear detent ball, holding hand over opening to prevent loss of ball. Remove both front and rear detent springs. Remove cover assembly from vise and dump out the two interlock balls, holding hand over opening to catch balls.

ASSEMBLY

Effective with serial number 1813 a new first and fourth shift fork 235630 was used with shuttle clutch equipped tractor. This shift fork is used when the reverse shift rod and shifter lug was omitted. If tractor is equipped with power director clutch, shift fork 225838 is used.

With second and third shift rod in place, clamp cover assembly in vise with the bottom side upward. Drop the two interlock balls in position between the shift rods. Install the rear detent spring and ball. Depress ball and spring with punch and enter end of shift rod past detent ball. A special tool is available for depressing detent ball while installing shift rod.

Install the shift fork over rod with longer boss or hub forward. Install the front detent spring and ball. Depress ball and spring and push rod into place. Tighten setscrew into fork and try shifting. If more than 1/16" clearance between shift fork and cover when in the in-gear position in either direction, install over shift washers 227195 as required. Install lock wire through setscrew and tie.

SECOND AND THIRD SHIFT ROD

REMOVAL

With the first and fourth shift rod removed, clamp cover assembly in vise with bottom side upward. Remove setscrew from second and third shift fork. Push shaft rearward until end of shaft releases the front detent ball, holding hand over opening to prevent loss of ball. Push shift rod further rearward and remove washers and shift fork.

Move shift rod further rearward until end of rod releases the rear detent ball, holding hand over opening to prevent loss of ball. Remove both front and rear detent springs. Remove cover assembly from vise and dump out the second pair of interlock balls, holding hand over opening to catch balls.

ASSEMBLY

The shift rod 234008 used in tractors equipped with shuttle clutch is similar to the shift rod 226027 used in tractors equipped with power director clutch except that it does not have the hole for the interlock pin, and the notch for the upper set of interlock balls was omitted.

Clamp cover assembly in vise with bottom side upward. The reverse shift rod must be installed prior to installing second and third shift rod on tractors equipped with power director clutch, or on tractors prior to serial number 1813 if equipped with shuttle clutch. Effective with serial number 1813 the reverse shift rod was omitted on shuttle clutch tractors.

Drop the two interlock balls into position between reverse shift rod and second and third shift rod. Install the rear detent spring and ball. Depress ball and spring using special tool, and enter end of shift rod past detent ball.

Install second and third shift fork with off-set of fork forward. Install over shift washers in positions on shift rods if any were removed on disassembly. Install front detent spring and ball. Depress ball and spring and push shift rod into position past detent ball. Tighten setscrew in shift fork and try shifting. Install over shift washers 227195 if necessary to prevent forcing shift rod more than 1/16" past the detent position. Tie setscrew with lock wire.

REVERSE SHIFT ROD

REMOVAL

The reverse shift rod was omitted on shuttle clutch equipped tractors effective with serial number 1813. With the first and fourth, and the second and third shift rods removed as outlined, remove setscrew from reverse shift lug. Remove reverse shift fork on power director equipped tractors. Push shift rod rearward and remove shift lug. Push shift rod further rearward until end of rod releases the detent ball (power director tractors only), holding hand over opening to prevent loosing ball.

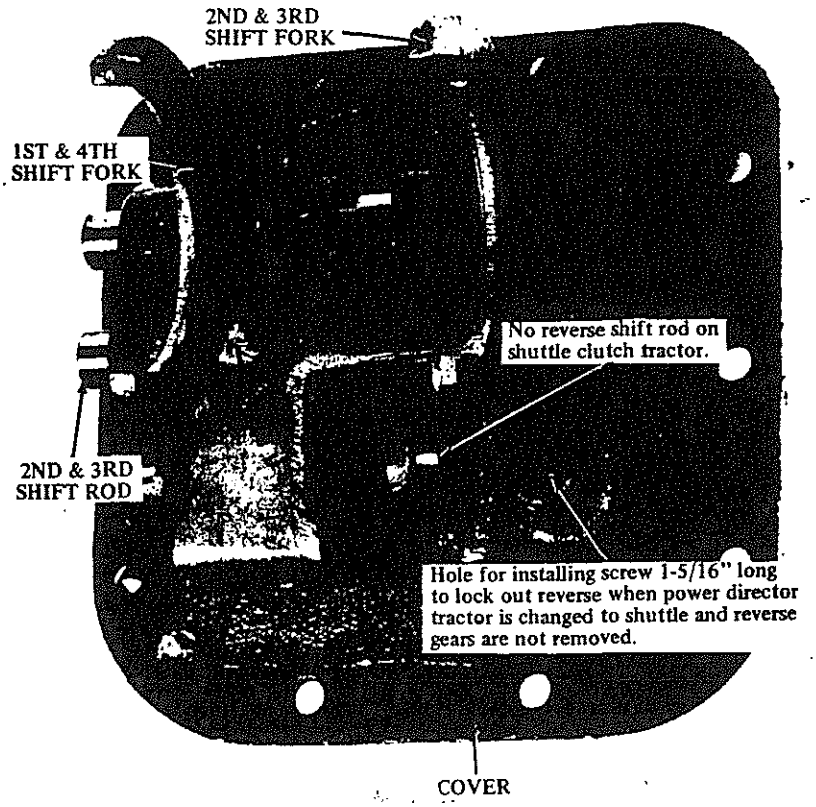
There are no detent ball or spring used in the reverse shift rod on tractors equipped with shuttle clutch. On shuttle clutch tractors serial number 1490 to 1813 the reverse shift rod was tack welded in place to hold shift lug in position.

ASSEMBLY

The reverse shift rod 225436 is 4-29/32" long, and is used in tractors equipped with power director clutch having the reverse gears installed.

The reverse shift rod 234009 is 3-1/2" long, and is used in tractors equipped with shuttle clutch where the reverse gears were omitted. This rod does not shift and has only one detent notch for the interlock balls, and no hole for attaching a reverse shift fork.

GEAR SHIFT COVER



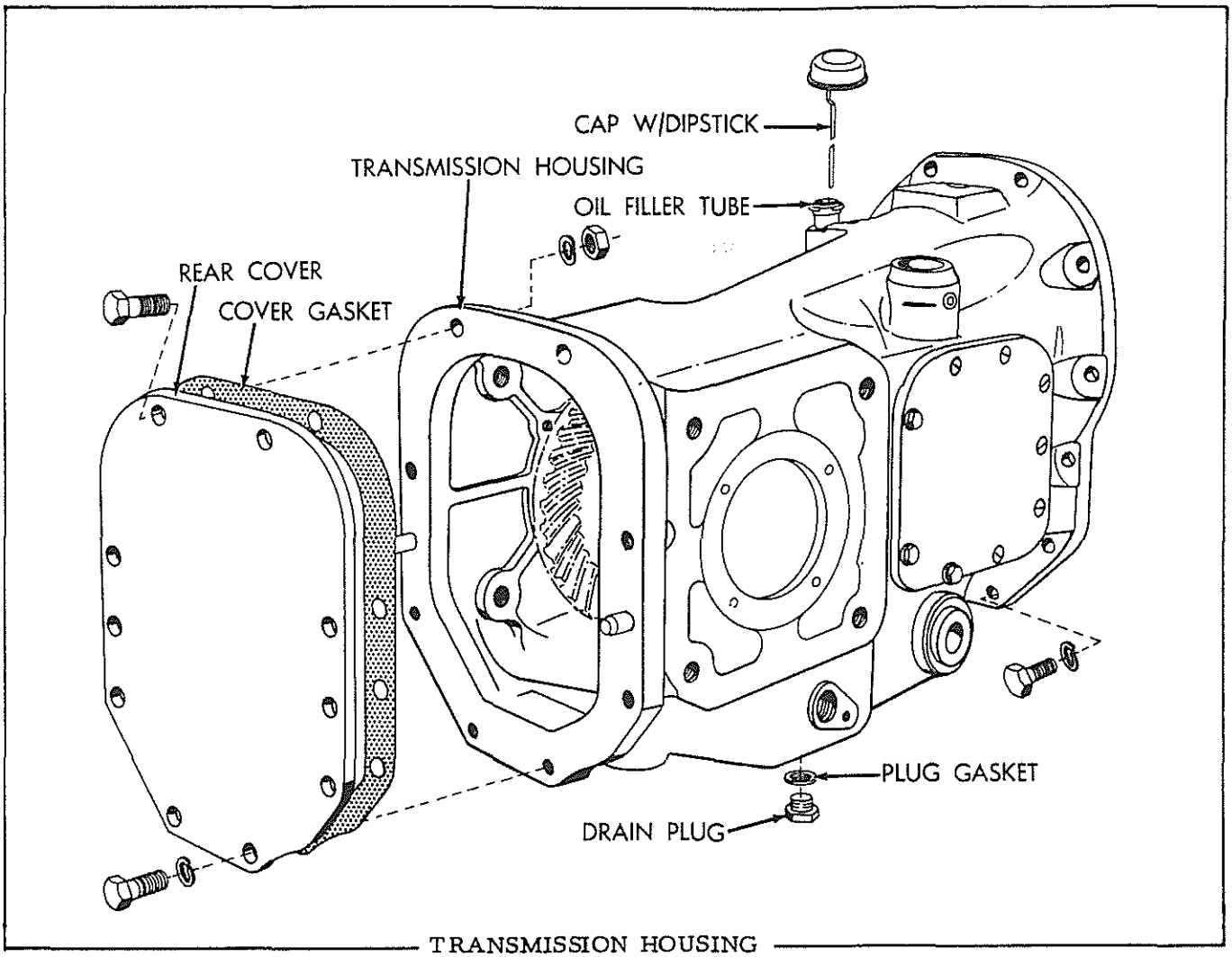
TRANSMISSION GEAR SHIFT COVER (FORWARD AND REVERSE)

shift fork to shaft. Move shaft further to right and remove the second hi-pro key. Remove shaft and shift fork from housing.

Remove the shuttle clutch oil gauge from torque housing. Support transmission housing assembly on hoist, and remove capscrews attaching transmission to torque housing. Move transmission rearward until shuttle clutch is clear of torque housing. Place transmission on bench for disassembly.

Remove snap ring at front of shuttle clutch, and remove the front and rear clutch hubs. Remove the thrust washer from front of rear clutch housing. Remove the snap ring retaining the clutch assembly to the transmission main shaft. Remove the clutch assembly and the second snap ring from shaft.

Remove the cover plate at rear of transmission housing, or if equipped with power take-off, remove the P.T.O. housing assembly. Remove the ring gear bearing and oil seal retainers at both sides of housing, keeping the shims with their respective bearing carrier and mark right and left for easier assembly. Remove gear shift lever and gear shift cover assembly.



TRANSMISSION HOUSING

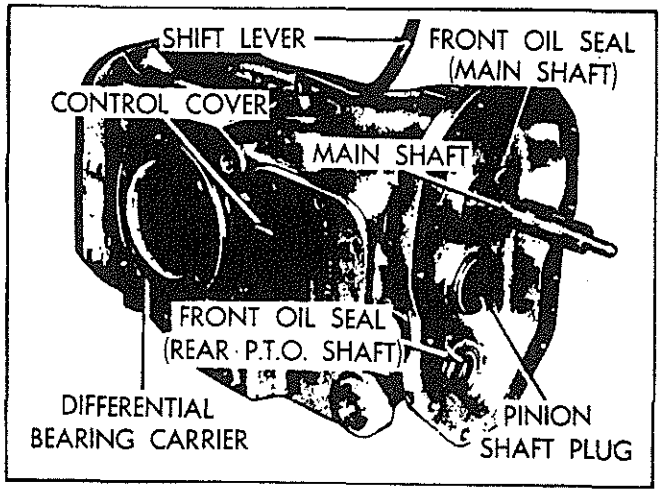
REMOVAL

Split both track assemblies as outlined under Track Removal. Place track at rear of tractor so that the track drive sprockets can be removed, and remove drive sprockets.

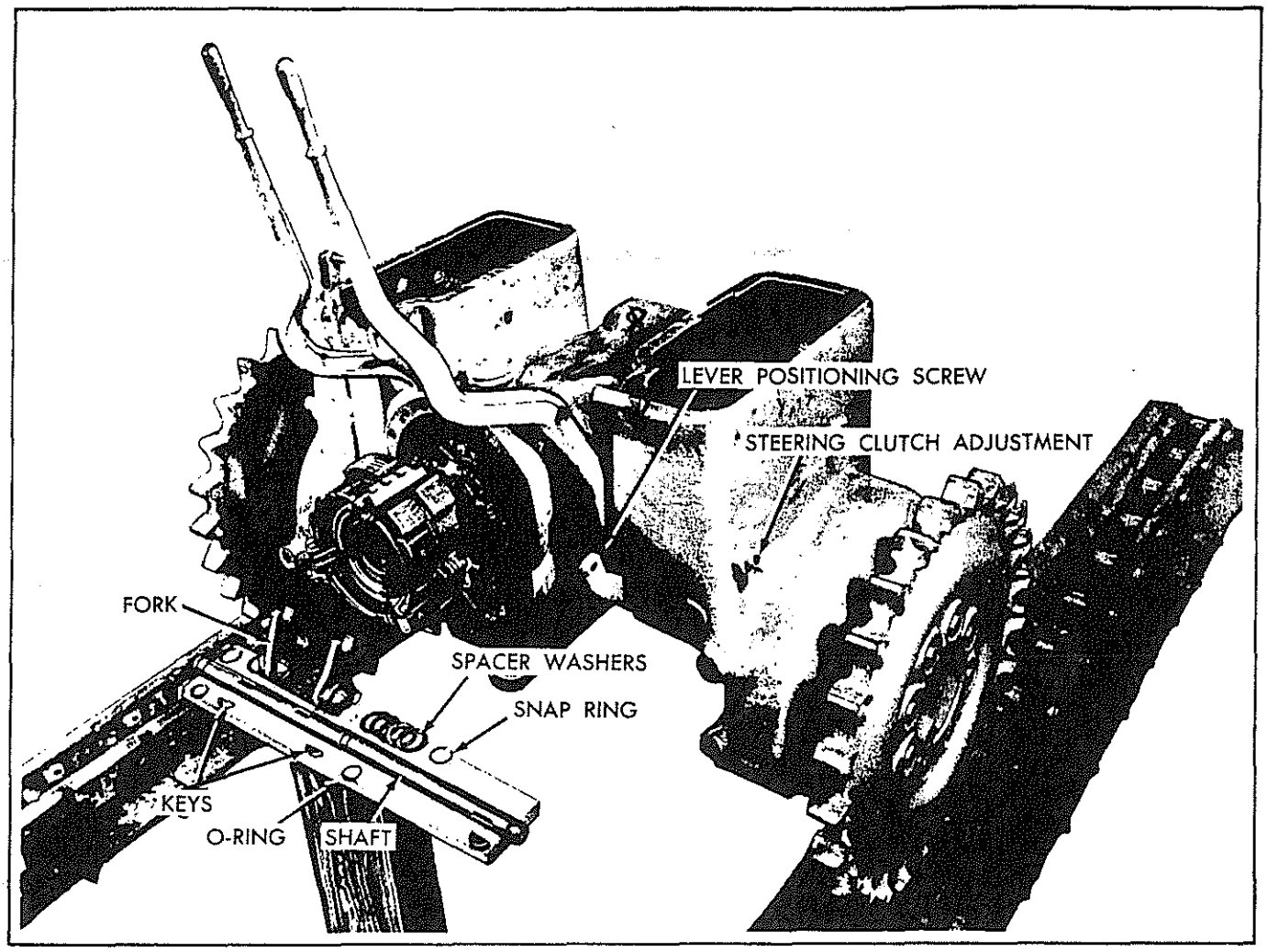
Remove the seat assembly, seat support, fenders and rear platforms. Remove both brake band assemblies and brake arms. Remove both steering clutch assemblies. Remove drawbar and both final drive assemblies.

Drain oil from transmission and shuttle clutch (or power director) compartments. Loosen clamp screw in shuttle clutch lever, and remove lever and hi-pro key from shaft. Remove the snap rings and washers from both ends of the shift fork shaft. Move shaft to left far enough to remove "O" ring seal from shaft.

Remove the side cover plate at R.H. side of transmission. Move shaft to R.H. side far enough to remove the first hi-pro key retaining



TRANSMISSION HOUSING

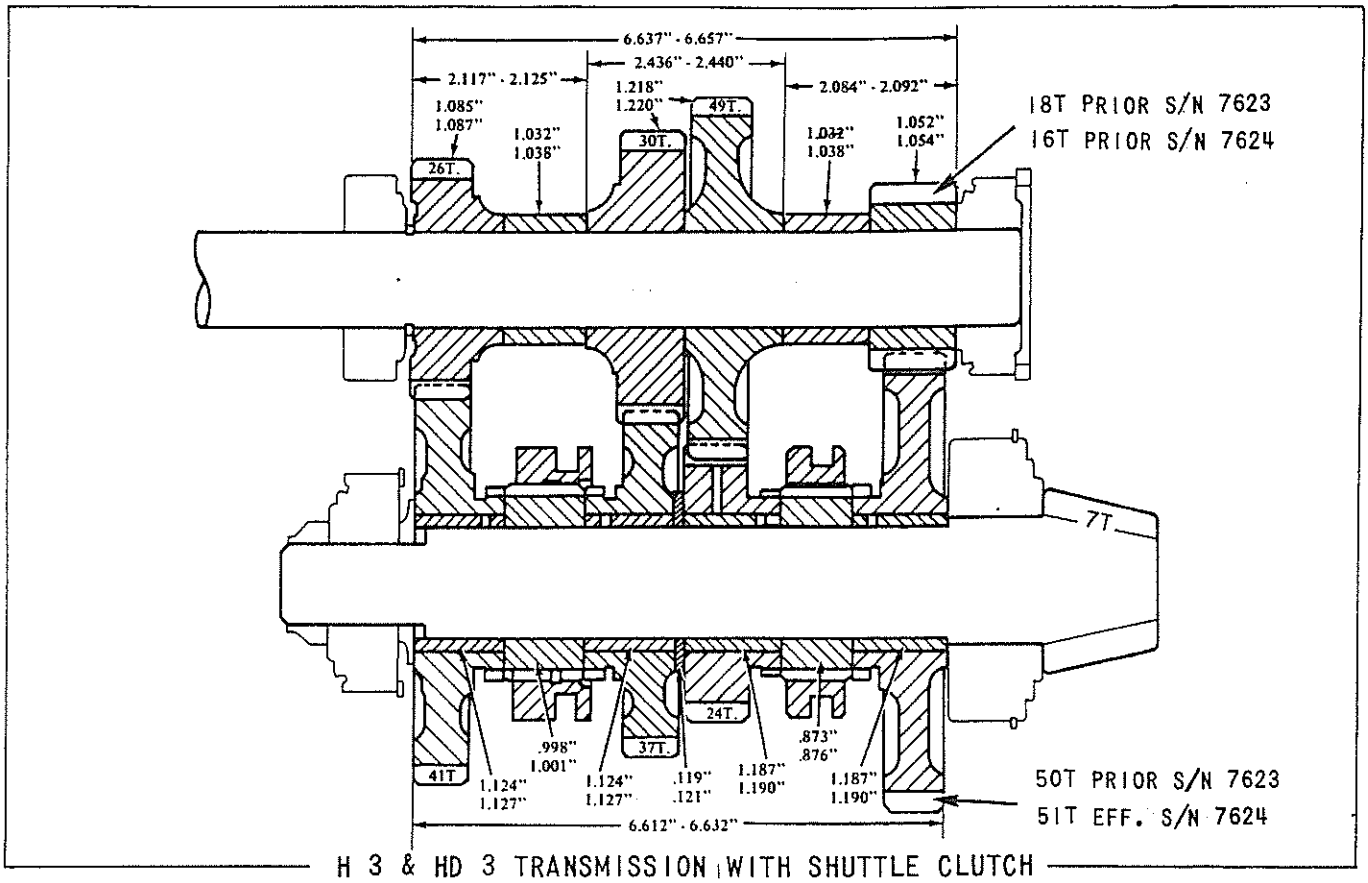


shift fork to shaft. Move shaft further to right and remove the second hi-pro key. Remove shaft and shift fork from housing.

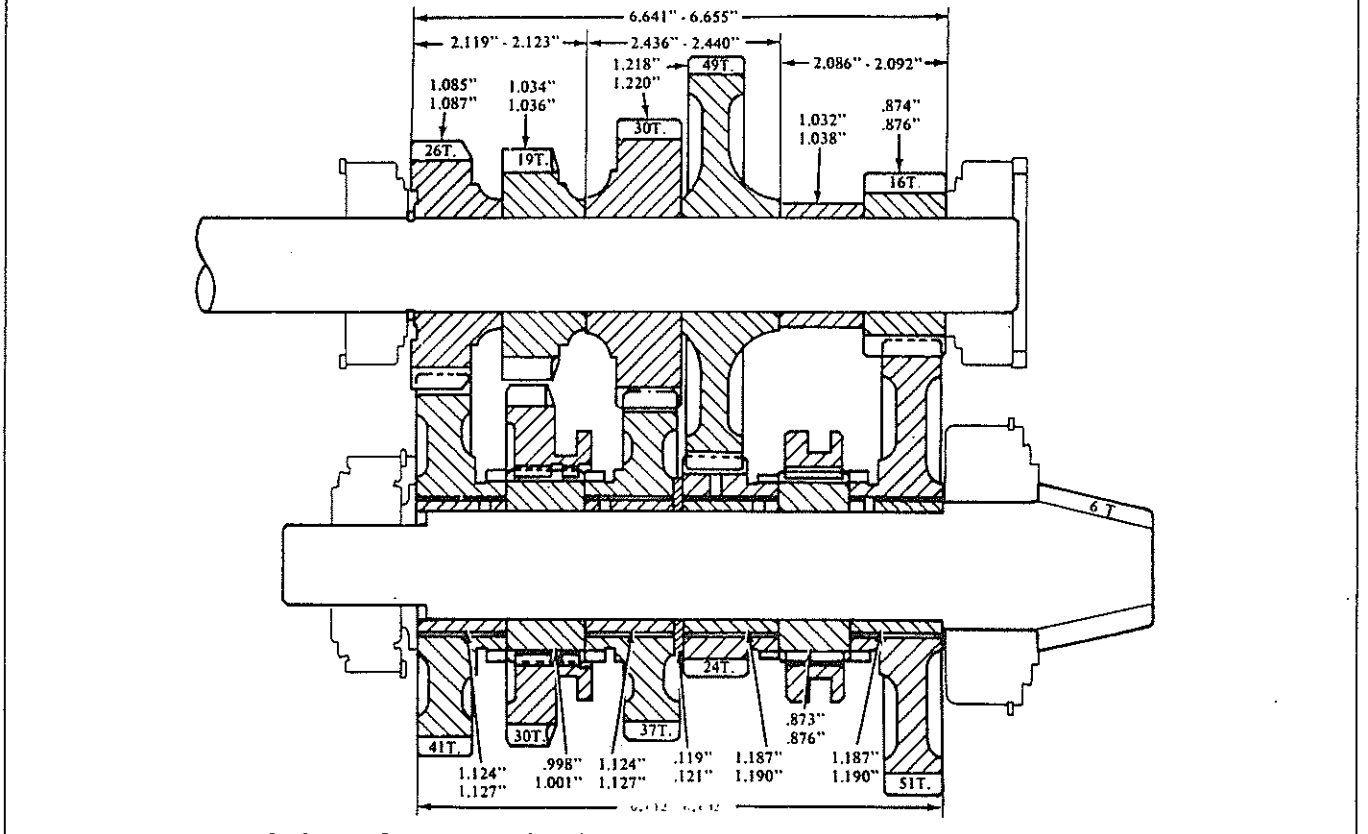
Remove the shuttle clutch oil gauge from torque housing. Support transmission housing assembly on hoist, and remove capscrews attaching transmission to torque housing. Move transmission rearward until shuttle clutch is clear of torque housing. Place transmission on bench for disassembly.

Remove snap ring at front of shuttle clutch, and remove the front and rear clutch hubs. Remove the thrust washer from front of rear clutch housing. Remove the snap ring retaining the clutch assembly to the transmission main shaft. Remove the clutch assembly and the second snap ring from shaft.

Remove the cover plate at rear of transmission housing, or if equipped with power take-off, remove the P.T.O. housing assembly. Remove the ring gear bearing and oil seal retainers at both sides of housing, keeping the shims with their respective bearing carrier and mark right and left for easier assembly. Remove gear shift lever and gear shift cover assembly.

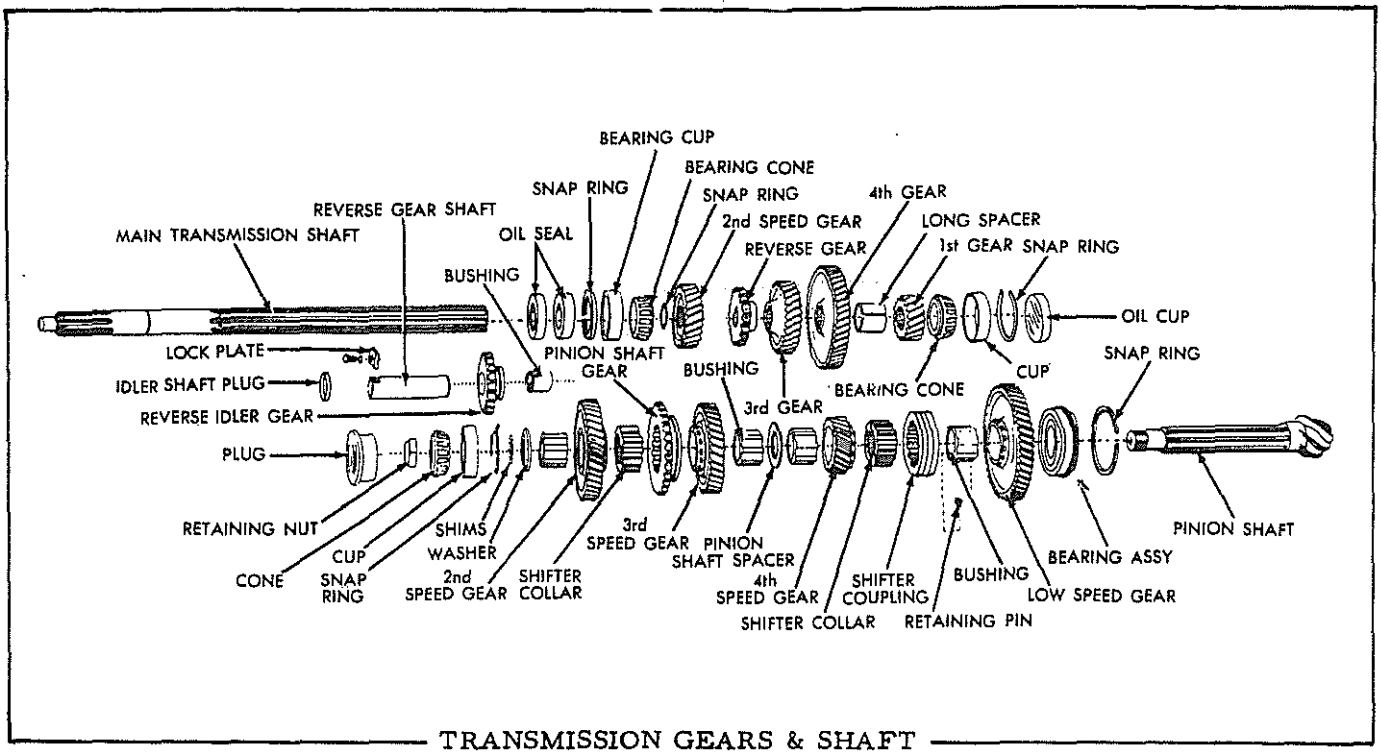


H 3 & HD 3 TRANSMISSION WITH SHUTTLE CLUTCH

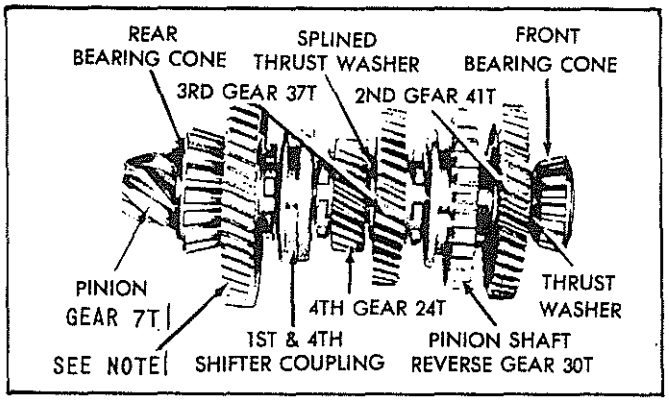


H 3 & HD 3 WITH STANDARD AND POWER DIRECTOR TRANSMISSIONS

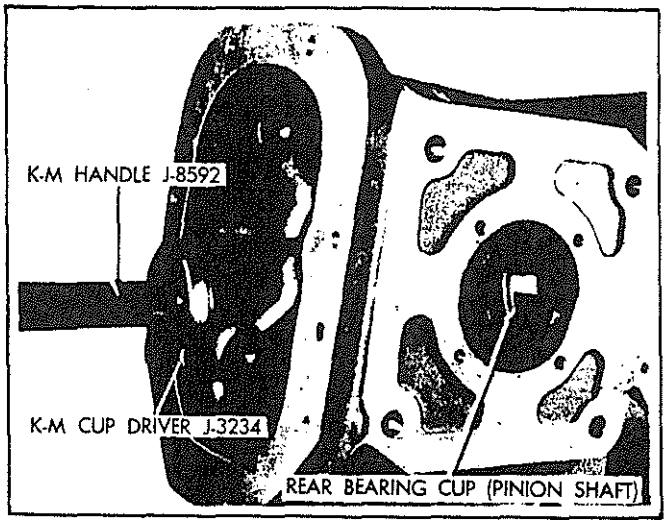
PINION SHAFT AND GEARS



TRANSMISSION GEARS & SHAFT



NOTE 1ST GEAR (SHUTTLE CLUTCH)
50T PRIOR TO 7623
51T EFF. WITH 7624
1ST GEAR (POWER DIRECTOR)
47T



REMOVAL

To disassemble the transmission the pinion shaft must be removed first. Remove the differential assembly, keeping the shims with their respective bearing retainers and mark right and left for easier assembly.

Remove transmission shifter cover. If power director shift transmission into the reverse gear position and remove shift lever. Remove screws attaching side cover and remove the shifter assembly. Remove plug at front of housing over pinion nut.

Remove nut at front of pinion shaft and drive or press shaft rearward until free of front bearing cone. The pinion shaft may now be removed by hand and the gears, bushings(etc) removed through opening at side of housing. Press bearing cone from shaft if necessary. Drive bearing cups from housing if replacement is necessary. Remove front bearing cup snap ring.

PINION SHAFT & GEARS

ASSEMBLY

Install pinion shaft and gears after the main shaft and gears have been installed. All pinion shaft gears rotate on bushings. These bushings use a pin to prevent bushing from rotating on splined shaft. The pins are installed from inside of bushing, and head of pin engages in one of the splines on shaft. To prevent pins from falling out of hole in bushing over a round shaft so that shaft supports against head of pin, with sharp center punch swell end of pin until tight in bushing. Install all bushings with pin end forward. If bushing for low speed gear is installed with pin end, rearward, it cannot be properly located on shaft.

Install the rear bearing cup in housing, using Kent-Moore cup driver J-3234 and handle J-8592. The snap ring for locating the rear bearing cup is available in variable thickness to adjust the pinion mesh to ring gear. Use the old snap ring or one of the same thickness if assembling the original housing. If a new housing is to be installed, use a snap ring that will give a centered tooth contact with the ring gear teeth.

This can be accomplished with the least effort if the pinion shaft and bearings are assembled in housing without gears. When making this check, the ring gear must be installed and shimmed to secure the correct bearing clearance and backlash. The tooth contact pattern may be secured by painting the gear teeth with a light coat of Prussion blue or any good marking ink.

Press the rear bearing cone on pinion shaft with the tapered end forward and bearing cone is tight against the 7-tooth pinion gear. Enter front end of pinion shaft through rear bearing cup and install a bushing 1-3/16" long with the pin end forward. Place the low gear over bushing with the jaw clutch forward. Shuttle clutch tractors prior to S/N-7623 used a 50-tooth low gear, Eff. with S/N-7624 used a 51-tooth. Tractors equiped with power director clutch the low gear has 47-teeth.

Install the splined shifter collar 7/8" wide over shaft and slide rearward next to low gear. Install the low and fourth speed shifter coupling over splined collar with the narrow shifter groove flange rearward. Install the second bushing 1-3/16" long over shaft with drive pin forward. Place fourth speed gear 31 tooth over bushing with the jaw clutch rearward. Install the .119"-.121" splined thrust washer.

Install the third bushing 1-1/8" long over pinion shaft with the pin end forward. Install third gear 37 tooth over bushing with jaw clutch forward. Place the second speed gear 43 tooth in the front position in housing with the jaw clutch rearward. Place the shifter coupling or reverse gear 30 tooth over the splined collar 1" wide with the shifter groove rearward, and place into housing between the second and third speed gears. Push the pinion shaft forward through this complete assembly. The reverse gears are omitted from tractors equipped with shuttle clutch and a second and third speed shifter coupling 31/32" wide replaces the 30 tooth reverse gear used in power director equipped tractors.

Install the fourth and last bushing 1-1/8" wide, pin end forward, through opening at front of housing and slide over shaft until it is positioned in hub of second speed gear. Install thrust washer with flat side rearward. Install the bearing cup retaining snap ring at front of housing. Install the front bearing cup with the larger inside diameter forward, using Kent-Moore cup installer J-8458. Install the proper number of shims between thrust washer and bearing cone to give a bearing clearance of .0005" to .0045". Torque nut to 140-150 ft. lbs. After bearing adjustment is completed, lock nut to shaft by staking the nut into Keyway in shaft. Check end movement of shaft with dial indicator.

Do not use the nut partially tight to achieve bearing adjustment; always tighten nut securely for checking bearing adjustment. If too many shims are used the bearing adjustment

will be too loose. If not enough shims are used the bearing adjustment will be too tight.

Install the proper number of various thickness shims to provide shaft end movement of .0005" to .0045" when checking with the dial indicator. Shims are furnished in .005" - .006" -.008" and .010" thicknesses.

If difficulty is encountered with transmission jumping out of gear, this bearing adjustment should be checked. If the shaft or gears have excessive end movement, it may cause the shifter couplings to work out of engagement. After bearings have been properly adjusted to .0005" to .0045" end movement, lock the nut to shaft by staking edge of nut into keyway in shaft. Apply sealer to outer surface of the bearing bore plug and drive into place, using a flat driver that will not bend or damage plug.

MAIN SHAFT AND GEARS

REMOVAL

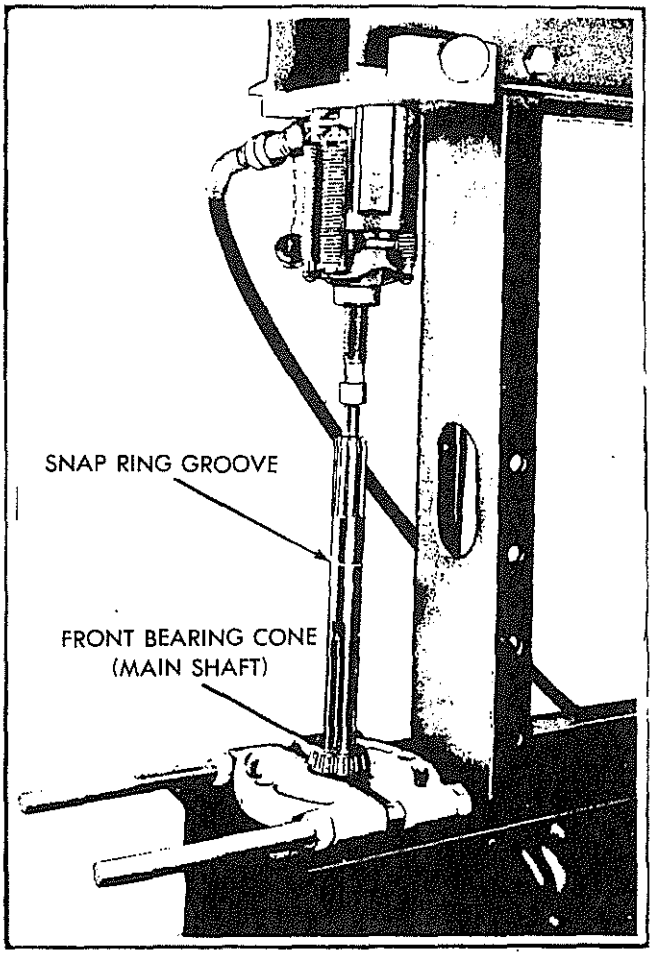
The main shaft and gears must be removed after the pinion shaft and gears have been removed to avoid interference. Remove the two oil seals at front of housing. To aid in removing seals, drill two small holes through seal opposite of each other. Turn a coarse threaded screw (metal screw or small lag screw) into these holes, this will provide a means for prying or pulling seals. With seals removed, remove snap ring retaining front bearing cup. Snap rings are easier to remove if bearing cup is driven away from snap ring slightly.

Remove the oil cup at rear of housing. This cup can easily be removed by driving a pointed punch through center of cup and prying from housing. Drive or press the shaft forward until the front bearing cup is free of housing and rear bearing cone is free of shaft. As the shaft is moved forward, remove the gears, spacers and rear bearing cone through opening at side of housing. To remove front bearing cone from shaft, remove snap rings and press bearing cone rearward over splines of shaft. Do not press bearing cone forward, as it will damage the oil seal surface. Remove the rear bearing cup if replacement is necessary.

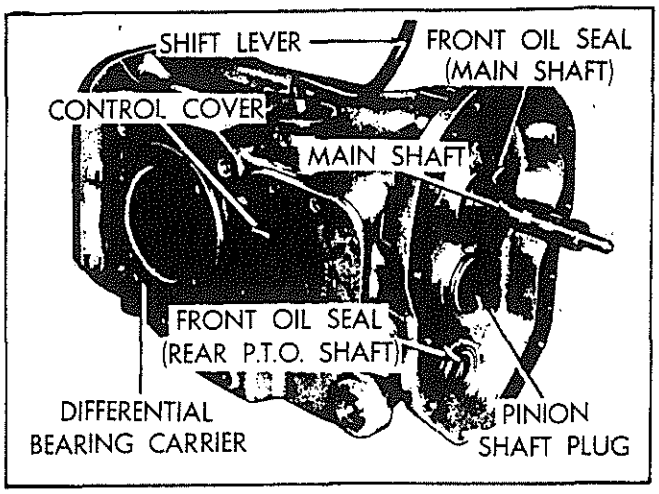
ASSEMBLY

Upon assembling the transmission the main shaft and gears must be installed before the pinion shaft. Install the front bearing cone from rear end of shaft, with the tapered of cone forward. Press bearing cone over long splines until just past snap ring groove at end of splines, install snap ring and press bearing cone back tight against snap ring. Do not press bearing cone over front oil seal surface as damage will result. The bearing cone fits the shaft very tight and installation may be aided by heating bearing in oil to a maximum of 250°F.

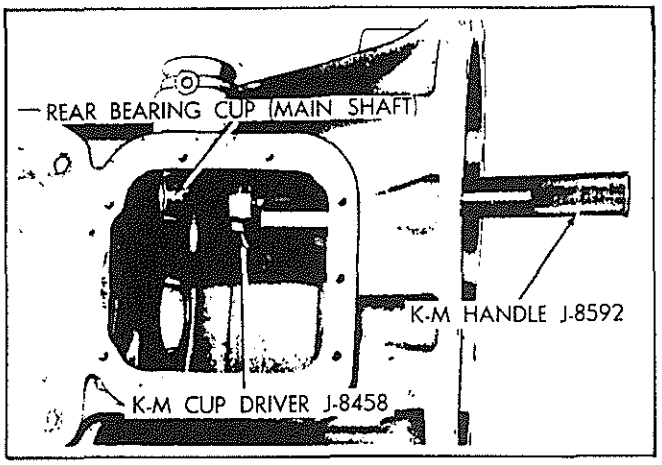
Install the snap ring and rear bearing cup in housing, with larger inside diameter of cup forward. Drive cup rearward until tight against snap ring, using K-M cup driver J-8458 and drive handle J-8592. Enter shaft at front of housing and install gears through opening at side of housing. Install second speed gear 24 tooth on shaft with long hub rearward. Install reverse gear 19 tooth on shaft with long hub rearward if equipped with power director clutch. If tractor is equipped with shuttle clutch, install spacer 1-1/32" wide in place of reverse gear.



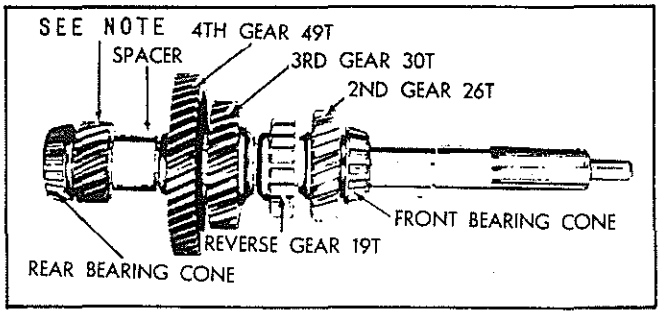
Install third speed gear 30 tooth on shaft with long hub forward. Install fourth speed gear 42 tooth on shaft with long hub rearward. Place rear bearing cone into rear bearing cup, place first speed gear next to rear bearing cone. Shuttle clutch tractors prior to S/N - 7623 used a 18 tooth and effective with S/N - 7624 a 16 tooth first speed gear. Power director tractor use a 20 tooth first speed gear. Place spacer 1-7/32" wide between first and fourth speed gears and slide shaft rearward through the remaining parts. Drive or press shaft into rear bearing cone.



Install the front bearing cup with the larger inside diameter rearward, and drive toward bearing cone until all end play of shaft is removed. Install a snap ring that will give. .0005" to .0045" end play of shaft when checked with a dial indicator.



Snap rings are furnished in thicknesses from .100" to .135" in steps of .005" for both the front or rear bearing cups. Before checking end play with dial indicator, drive shaft forward to locate front bearing cup tight against snap ring. Then drive front bearing cone inner rearward. This procedure will give the correct end play when checked with dial indicator. Do not drive on shafts or bearings while dial indicator is installed. If end clearance exceeds .0045" select thicker snap ring, if less than .0005" select thinner snap ring.



Reverse Idler Shaft and Gear - Used only in tractors equipped with power director clutch.

REVERSE IDLER GEAR REMOVAL

The reverse idler gear may be removed from shaft during the removal of the pinion and main shafts, but must be replaced on idler shaft before the main shaft and pinion shaft is installed, otherwise it will be necessary to remove idler shaft. The idler gear bushing is not serviced, if bushing or gear is worn, replace with gear assembly. To remove the idler gear shaft, remove the capscrew and lock plate and press the shaft rearward. Use press for removing or installing shaft, as driving will swell end of shaft.

NOTE

SHUTTLE CLUTCH
1ST GEAR
18T PRIOR TO SN 7623
16T EFF WITH SN 7624
POWER DIRECTOR
1ST GEAR 20T

NOTE: On shuttle clutch tractor there is no reverse idler shaft or gears. If power director tractor are changed to shuttle clutch and shaft and gears are removed, a plug mus must be driven in hole for shaft.

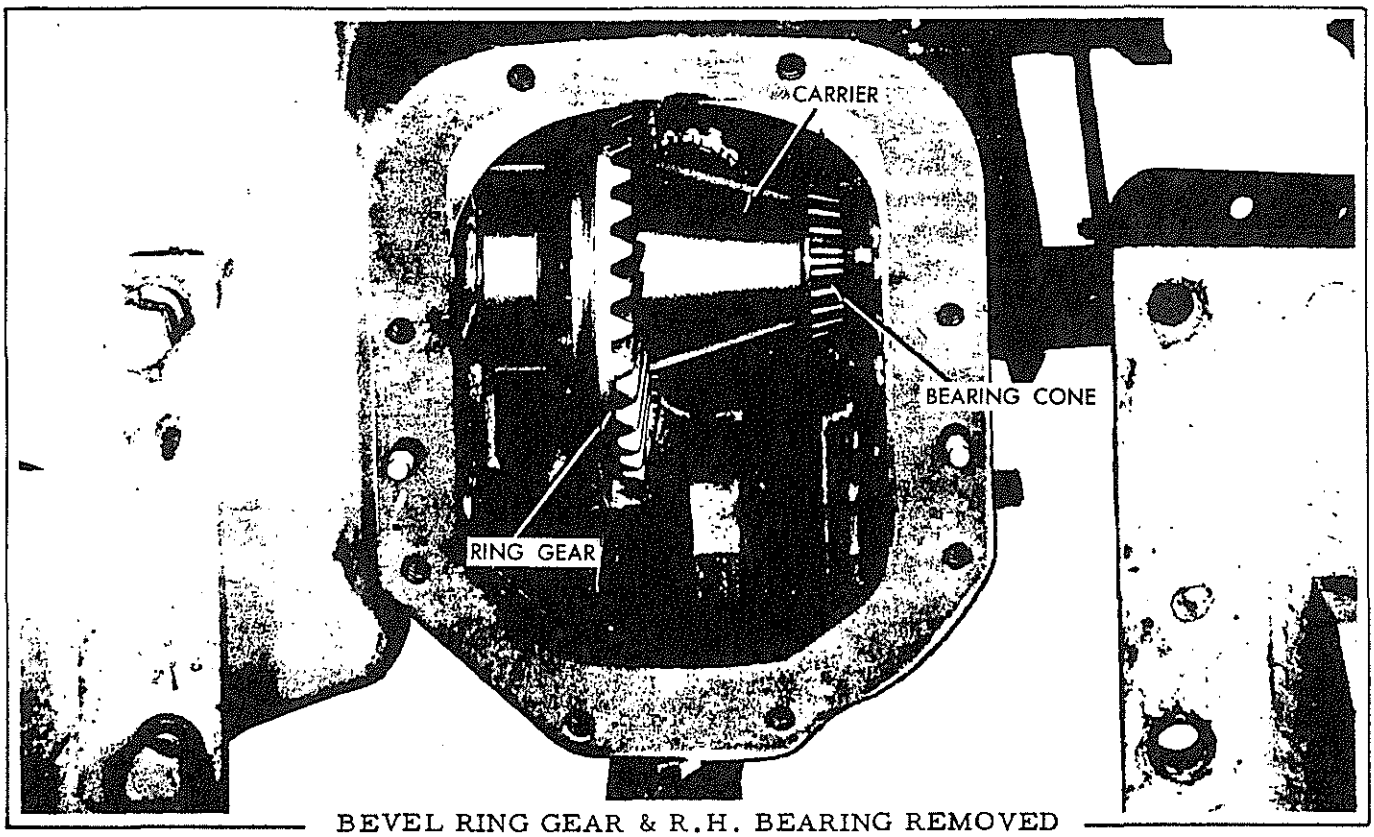
ASSEMBLY

Install idler gear 21 tooth in place on shaft before installing the main and pinion shaft. Install gear with the shifter groove rearward. To install idler shaft align the lock plate slot with the retaining capscrew hole and press into front of housing until the lock plate slot is flush with face of housing. Install lock plate and capscrew. Torque capscrew 25 ft. lbs.

REAR P.T.O. SHAFT OIL SEALS (Front)

REMOVAL

The oil seals and bushing for the front end of rear power take-off is located in the transmission housing. To replace bushing it will also be necessary to remove seals. To aid in removing seals, drill two small holes through seal opposite of each other. Turn a coarse thread screw (metal or lag screw) into holes in seal, this will provide a means for removing seal. The bushing may be driven from housing, using the Kent-Moore J-9276-4 bushing driver.



BEVEL RING GEAR & R.H. BEARING REMOVED

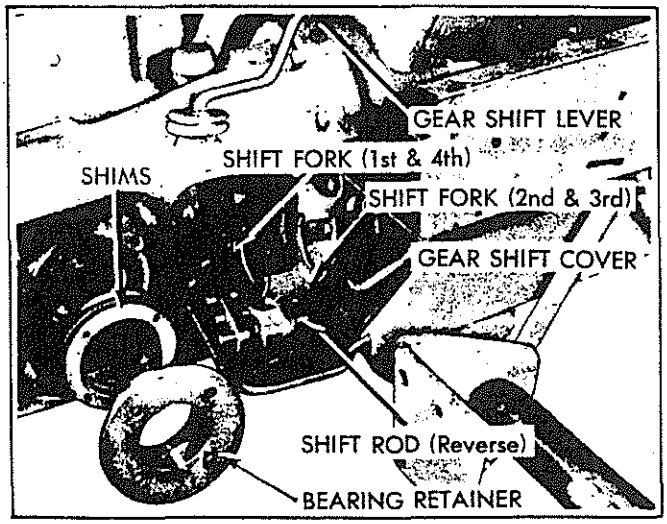
REMOVAL

Remove the tracks, sprockets, seat, steering clutches and drawbar. Drain oil from transmission and remove final drive housings.

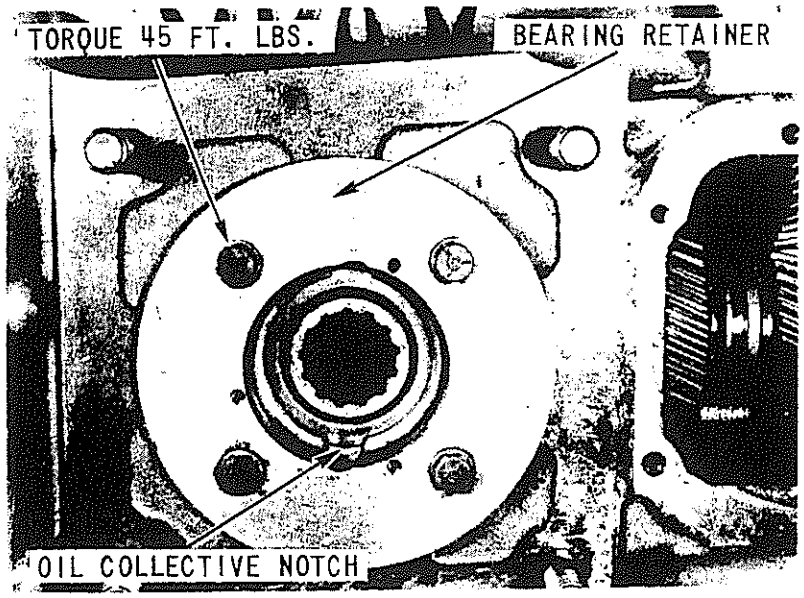
Remove rear cover plate. Remove ring gear side bearings carriers. Tie shims to each respective carrier and mark right and left for easier assembly. Remove ring gear and carrier.

ASSEMBLY

Install the bearing cones on the carrier with the tapered ends of cones out. Install assembly in tractor with gear on left side. Install the cups in the retainers. Use sealer on the shims and capscrews and install in housing.



MAIN SHAFT & GEARS



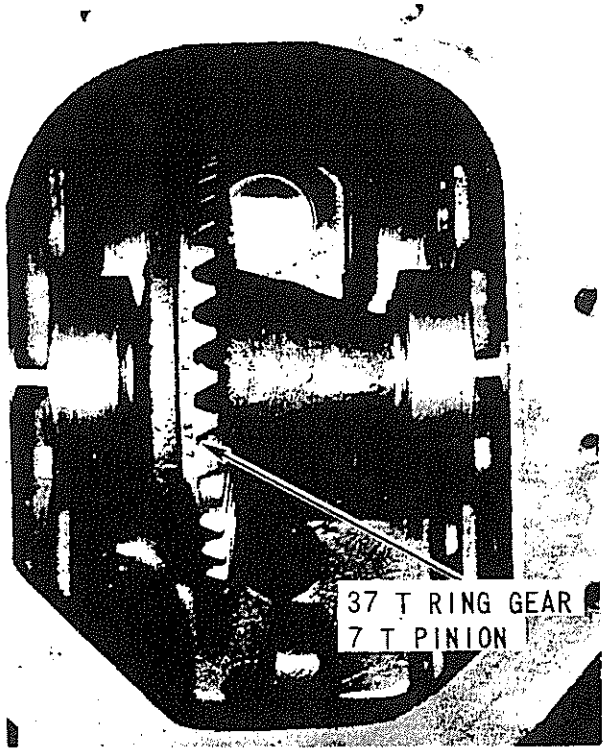
Install bearing Retainer into transmission as shown with oil collective notch on the bottom of transmission.

Tighten capscrews gently until bearing clearance and ring gear mesh is determined, applying full torque to capscrews may damage assembly if incorrect amount of shims are used.

Add or remove shims, keeping the most shims on R.H. side to provide excess backlash clearance, until bearing adjustment of .0005" to .0045" is obtained. After the bearing clearance is set with fully torque capscrews remove one .005" shim from R.H. side and install on L.H. side until backlash is .007" to .015".

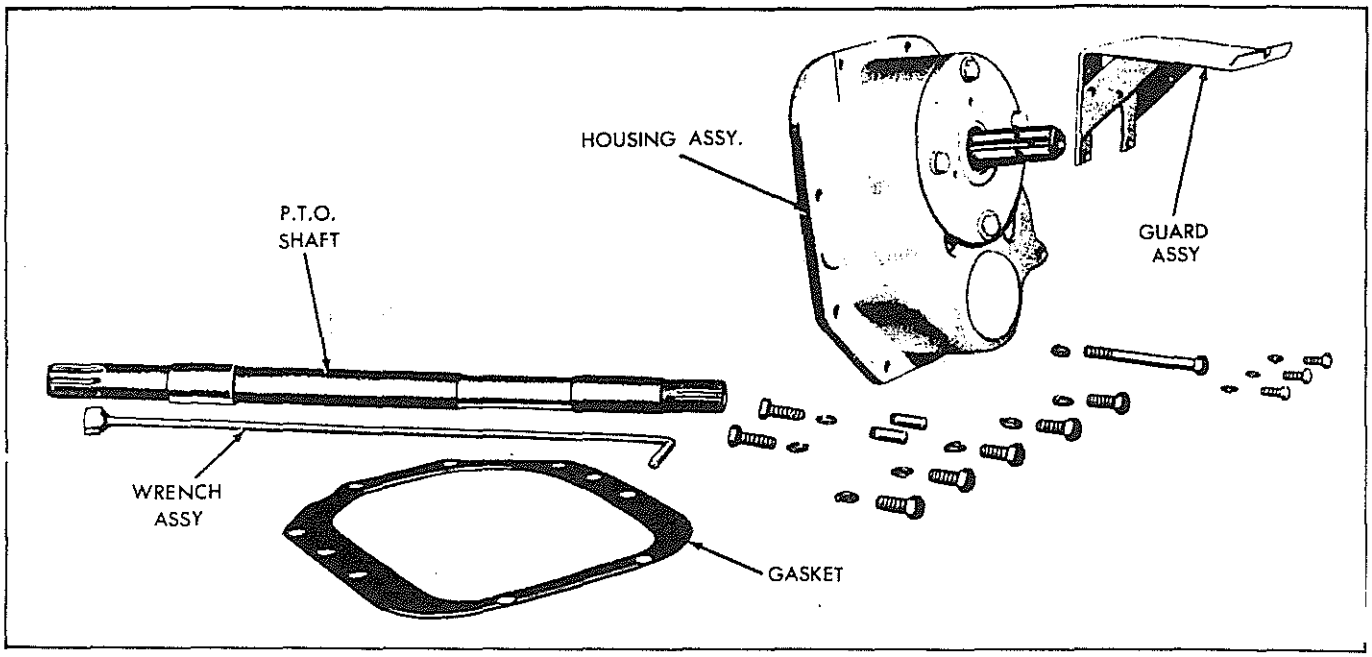
If the backlash is too small, remove shim from left side and install on right side. Measure backlash and bearing clearance with a dial indicator. Torque capscrews to 45 ft. lbs. on final assembly.

The H-3 and HD -3 uses 7 teeth in pinion and 37 teeth in ring gear. The rim of the ring gear has the ratio and mating pinion numbers stamped for identification. Do not mate incorrect gears, as the wheel tractor has a 37 tooth gear mating with a 6 tooth pinion. There is such a slight difference in gear teeth of ring gear they cannot be identified visually.



REAR VIEW TRANS. ASSY.

POWER TAKE-OFF



REMOVAL

Drain oil from transmission and shuttle clutch compartments. Remove capscrews attaching the power take-off housing to rear of transmission. Pry housing rearward, keeping housing square with transmission until free of dowel pin. The front extension shaft is splined to gear in P.T.O. housing, and should slide apart on removal.

Remove the front extension shaft if necessary. If replacement of the shaft front bushing or oil seals is necessary it will require removal of transmission housing as they are located in the front wall of transmission housing.

DRIVEN SHAFT WITH GEAR

REMOVAL

This shaft and bearings may be removed without removing P.T.O. housing from tractor. Remove the power take-off guard assembly. Remove capscrews attaching the rear bearing retainer to housing, and remove shaft and bearing retainer together. Remove retainer plate from shaft. Remove oil seal and bearing cup from retainer. Remove front bearing cap from housing. Remove bearing cones from shaft if replacement is necessary.

For complete disassembly of P.T.O. housing, the housing must be removed from tractor. The driven shaft with gear must be removed first, the idler gear and shaft removed second, and the drive gear removed last.

IDLER SHAFT AND GEAR

REMOVAL

To remove the idler shaft and gear, it is necessary to remove P.T.O. assembly from tractor, and the rear P.T.O. shaft with gear must be removed. Remove capscrew and lock from front end of shaft. Drive shaft rearward to remove. Remove gear and thrust washers through opening in housing.

The shaft is sealed to housing with an "O" ring seal and is retained in housing by the splined shaft bearing retainer. The capscrew and lock prevents the shaft from turning in housing. The needle bearings may be pressed from gear if replacement is necessary.

DRIVE GEAR

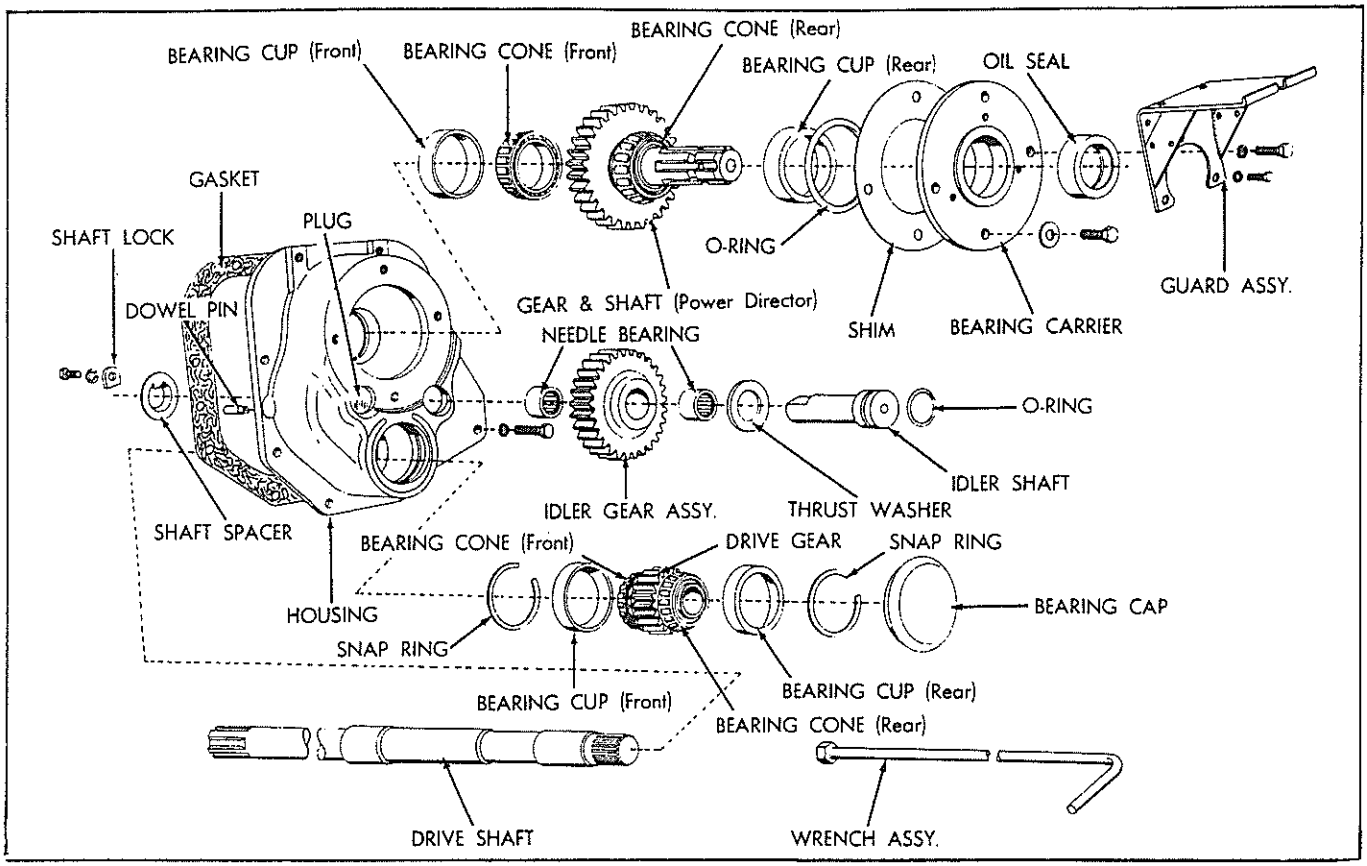
REMOVAL

Remove bearing cap at rear of drive gear. Remove snap ring at rear of housing. Press the gear and bearing assembly rearward until rear bearing cup is free of housing and remove drive gear. Remove front snap ring and drive bearing cup from housing. Press or pull bearing cones from drive gear.

ASSEMBLY

On complete assembly of P.T.O. housing, the drive gear must be installed first, the idler gear installed second, and the driven shaft with gear installed last to avoid interference.

POWER TAKE-OFF



Press the front bearing cone 234608 on one end of drive gear (19 tooth), and press the rear bearing cone 235439 onto other end of drive gear. Install bearing cones with the larger diameter toward gear.

Install the front bearing cup 234607 into housing with larger inside diameter rearward. Drive cup into housing until flush with snap ring groove. Do not install snap ring at this time.

Install the gear through rear opening of housing with the bearing cone 234608 forward. Install the rear bearing cup 235440 with larger inside diameter toward bearing. Drive cup into housing past the snap ring groove, and install the 227598 snap ring.

Turn housing over and press or drive the gear assembly rearward until the rear bearing cup is tight against snap ring. Drive the front bearing cup in until all end play of gear is removed. Install variable thickness snap ring that will give .0005" end play of bearing.

The variable thickness snap rings are used in the front position for bearing adjustment, as a notch is provided for easier removal. Snap rings are furnished in thicknesses from .061" to .097" in steps of .0045". Always press bearing cups tight against snap rings when checking bearing adjustment, using a dial indicator. Drive bearing cups away from snap ring slightly for easier removal of snap rings. Use shellac on rear bearing cap and drive into place in housing.

IDLER SHAFT AND GEAR ASSEMBLY

Install idler shaft and gear in R.H. position when used with shuttle clutch, and in L.H. position when used with power director clutch. Press the needle bearings into idler gear (29 tooth) until just past flush with surface of gear hub, with housing on bench front side downward. Place the idler shaft front spacer 224867 in position in housing with flat side upward, and flat area toward top of housing. Place idler gear in position on top of spacer, being careful not to dislocate spacer from counterbore in housing.

Place the washer 223734 on top of idler gear with oil grooves toward gear. Install the "O" ring seal in groove in idler shaft. Install shaft into housing with the flat side toward top of housing, being careful that the shaft enters through washer, gear and spacer. Press shaft into place until end of shaft is below surface of housing or until the stack of parts are solidly together. Install the lock and capscrew at front side of housing.

DRIVEN SHAFT WITH GEAR

ASSEMBLY

The driven shaft with gear used with shuttle clutch tractors has 31 teeth, and the shaft with gear used with power director equipped tractors has a 22 tooth gear. This is the only part that is different in the power take-off for power director or shuttle clutch tractors. In either case the splined shaft turns at 540 RPM at rated engine speed. The front extension shaft rotates at 621 RPM on power director tractors, and at 818 RPM on shuttle clutch tractors at rated engine speed.

Install the front bearing cup in housing with the larger inside diameter rearward. Install rear bearing carrier with the larger inside diameter forward. Press the front and rear bearing cones on shaft with the larger outside diameters toward gear. Install shaft with gear in position in housing.

Install the "O" ring seal in groove in bearing carrier. Install the proper amount of shims (.005" and .010" thickness) between bearing carrier and housing to give a bearing clearance of .0005" to .0045" end play when checked with a dial indicator. Torque retaining capscrews from 80 to 90 ft. lbs.

Install oil seal. Use caution and some method of seal protection to enter seal over spline shaft. Use sealer on outer diameter of seal. Use a seal driver for driving seal into place. Press seal 3/16" below surface of carrier. Install P.T.O. guard.

INSTALLATION

Drain oil from transmission and shuttle clutch (or power director) compartments. Remove cover from rear of transmission housing. Use the special wrench assembly (234612) furnished to remove the P.T.O. shaft bushing seal in transmission housing.

Thread the nut end of wrench onto end of capscrew until capscrew bottoms in nut end of the wrench. Continue to turn wrench clockwise will loosen nut on capscrew and relax the compression on the rubber plug seal. When capscrew is loosened, the bushing seal assembly may be removed by pulling on wrench. The oil seals and bushing are installed in transmission housing.

Shift the P.T.O. shift lever into the engaged or forward position. This will pilot the end of power take-off extension shaft. Install extension shaft through bushing and oil seals. Push shaft forward and rotate until end of shaft enters the splined shifter coupling. Install shaft with the proper end forward, check splines in drive gear in P.T.O. housing before installing.

FINAL DRIVE ASSEMBLY

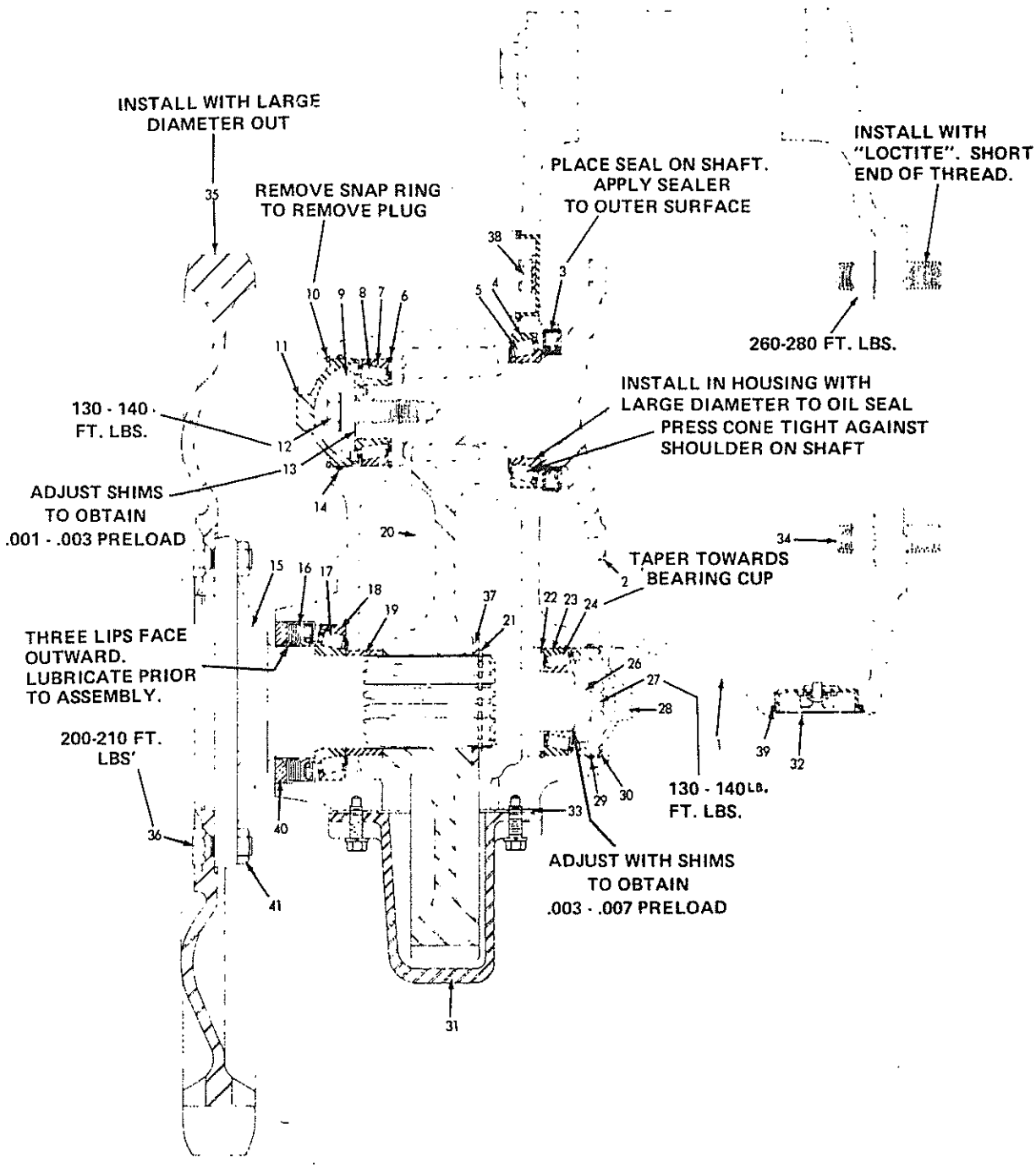
INDEX

FINAL DRIVE ASSEMBLY

STEERING CLUTCHES

BRAKES

FINAL DRIVE

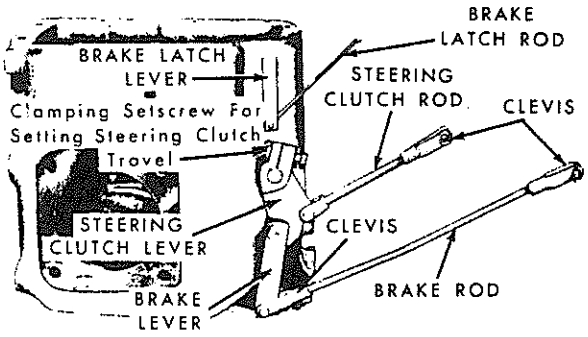


Sprocket And Final Drive

SPOCKET & FINAL DRIVE

1. Housing, final drive, R.H. or L.H.
2. Shaft, pinion
3. Seal, oil
4. Cup, bearing
5. Cone, bearing
6. Ring, snap, internal
7. Cup, bearing
8. Cone, bearing
9. Washer Assy.
10. Ring, snap, internal
11. Plug, final drive
12. Capscrew
13. Shim (Use as required)
14. O-Ring
15. Axle, rear
16. Seal, oil
17. Cone, bearing
18. Cup, bearing
19. Spacer, final drive gear
20. Gear, final drive
21. Ring, snap, external
22. Ring, snap, internal
23. Cup, bearing
24. Cone, bearing
25. Shim (Use as required)
26. Washer and Pin Assy.
27. Capscrew
28. Plug, final drive
29. O-Ring
30. Ring, snap, internal
31. Pan, final drive
32. Plug Assy., (Incl. RIVET)
33. Gasket, pan
34. Stud
35. Sprocket
36. Capscrew
37. Spacer
38. Plug, drain
39. Gasket, plug
40. Ring, seal protector
41. Nut, lock

FINAL DRIVE HOUSING



Inside Of Steering Housing

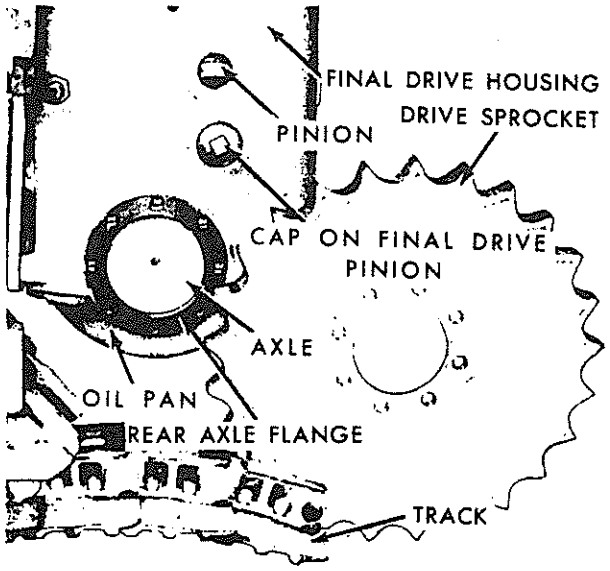
REMOVAL

Split the track and lay track at rear of tractor so that the track drive sprocket can be removed. Remove capscrews attaching sprocket to axle flange and remove sprocket. Remove drawbar support assembly. Remove seat assembly, batteries, battery support and platform assembly.

Remove brake arm and band assembly. Remove steering clutch assembly. Remove capscrews attaching the frame pivot axle to final drive housing. Attach hoist to final drive housing. Remove the nuts from studs inside torque housing that retain torque housing to transmission.

ASSEMBLY

Attach hoist to final drive housing and swing into position on tractor. Enter the housing over



the studs at side of transmission and install the four nuts. Tighten nuts 260 to 280 ft. lbs. torque.

Install capscrews attaching the frame pivot axle to torque housing and torque to 225. Install the steering clutch assembly and brake band. Install the drawbar support to final drive housings. Install the track drive sprocket and tighten capscrews 200 to 210 ft. lbs. torque.

Install platform assembly, battery support, batteries, seat support and seat. Install track assembly (Refer to Track Installation).

REMOVE FINAL DRIVE

The pinion shaft and bearings may be removed without removing final drive housing from tractor. Split the track and place track at rear of tractor and remove track drive sprocket from axle flange. Remove seat, seat support, batteries, battery support, tank assembly. Remove brake arm and band assembly. Remove the steering clutch assembly. Remove steering clutch release bearing and bearing carrier. Remove the clutch shifter sleeve assembly.

Remove snap ring retaining the plug at outer side of housing and remove plug. This plug is sealed to housing with an "O" ring seal in groove in housing. Remove O-ring seal from groove. Remove capscrew, washer and shims from end of pinion shaft. Press or drive pinion shaft inward until free of out bearing cone and remove from housing. Install a capscrew in end of pinion shaft that will screw down tight to protect end of shaft while removing.

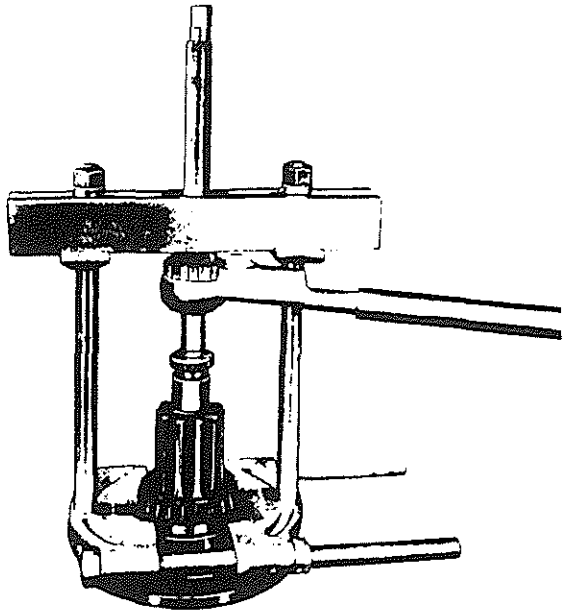
The inner bearing cone and oil seal will be removed with pinion shaft. Pull bearing from shaft and remove oil seal. The bearing cups may be pulled or driven from housing if replacement is necessary.

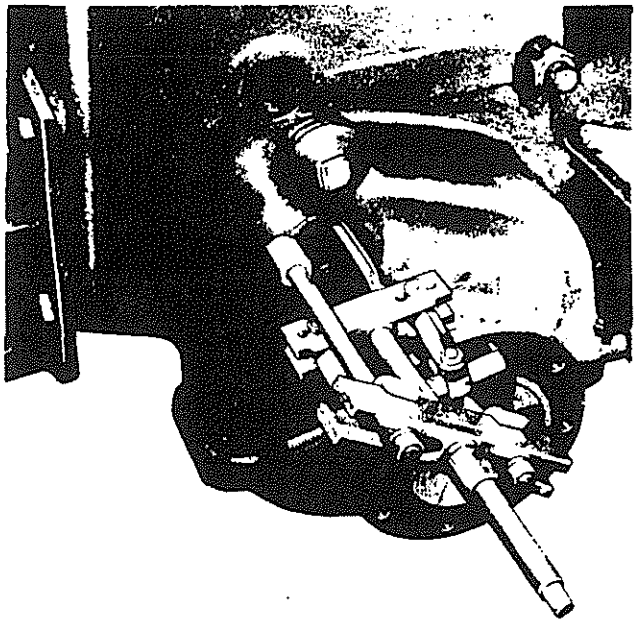
ASSEMBLY

Install the oil seal over surface of shaft, with lip of seal away from shaft flange, apply sealer to outer surface of seal. Press the inner bearing cone on shaft with larger diameter toward oil seal, press bearing cone tight against shoulder on shaft. Install bearing cups in housing, install inner cup with larger inside diameter toward steering clutch compartment. Install outer cup with larger inside diameter outward.

Install the pinion shaft in place in housing and start the outer bearing cone on shaft. Remove roll pin from washer and install washer and capscrew at end of shaft. Use two half moon spacers 1/8" thick between oil seal and shaft flange to press oil seal into place in housing. This spacer can be made from a washer 1/8" thick and with inside diameter approximately 3-1/4", then cutting washer through center line. A seal installing tool J9488-1 has been made available through the Kent-Moore Tool Company.

The oil seal will bottom in counterbore before flush with housing. Remove tool or spacer when oil seal is in place, before making bearing adjustment. Tightening capscrew will press oil seal in place and also press the outer bearing cone on shaft. When all end play of shaft is removed, remove capscrew and replace roll pin in washer. Install correct amount of shims between washer and shaft to give a bearing adjustment of .001- .003 preload.





PRELOAD

NOTE It is necessary to adjust pinion with end play before preload can be determined. Add shims untill end play is determined., and check with dial indicator.

Tighten Capscew 130 - 140 Ft. Lbs. Torque

FINAL DRIVE AXLE SHAFT

REMOVAL

The rear axle, bearings and final drive gear may be removed without removing final drive housing from tractor. Split the track and lay track at rear of tractor and remove track drive sprocket from axle flange.

Remove the snap ring retaining the plug at inner side of housing and remove plug. This plug is sealed to housing with an O-ring seal in groove in housing. Remove the O-ring seal from groove. Remove capscrew, washer and shims at end of axle shaft. Remove the oil pan at bottom of housing. Remove gear retaining snap ring from groove in axle shaft.

To pull the axle from housing, use the OTC938 push-puller with adapter 21P for mechanical use, or adapter 32R for hydraulic use. Pull axle until inner bearing cone is free and remove bearing cone. The outer bearing cone, spacer and oil seal will be removed with axle. Pull outer bearing cone from axle. Pull or drive bearing cups from housing. Support final drive gear while removing axle if housing has not been removed from tractor.

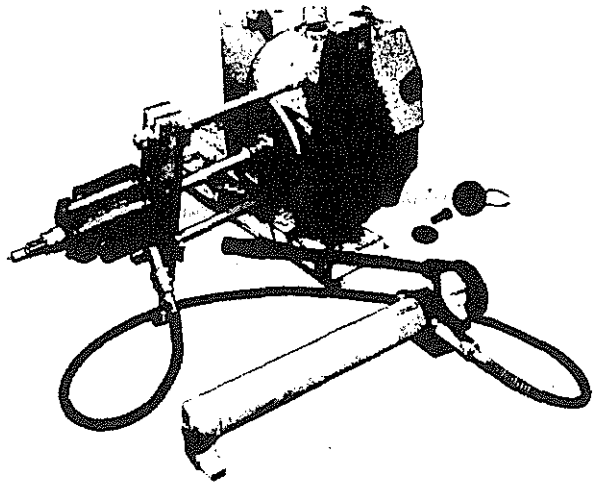
ASSEMBLY

Place seal protector ring over axle next to the flange. The large chamfer on the inside is located away from the axle flange and will be next to the seal lips when the parts are assembled. Apply sealer to outside diameter of seal protector ring before pulling into place.

The oil seal used on axle shaft has three thin outer lips and a heavier inner lip. When oil seal is installed on axle, the three outer lips must be facing outward toward axle flange and the inner lip must be facing inward. This seal requires a special technique for proper installation; therefore, a seal installing tool J9488-1 has been made available through the Kent-Moore Tool Company.

Place oil seal inner lip over sharp edge of seal expander. Lubricate lips of seal and expander before attempting installation. Work the inner lip of seal with fingers carefully over edge of expander, then push expander the rest of way through seal; this will turn the three outer lips facing outward. Place the seal and expander over axle and push seal from expander to seal surface of axle with a rotating motion, being sure seal surface of axle is well lubricated. Apply sealer to outer diameter of seal.

Install the two halves of the seal installing tool around axle between oil seal and axle flange. Use a rubber band or cylinder liner packing around the two halves of tool to hold them together. Press the seal back tight against installing tool. Install the outer bearing cone on axle with larger diameter toward oil seal, press bearing cone on until tight against shoulder on axle. Install spacer sleeve on axle next to bearing cone.



Pulling Axle Shaft

Install the inner and outer bearing cups in housing with the larger inside diameters outward. Use bearing cup drivers and drive outer cup in until tight against shoulder in housing, drive inner cup until tight against snap ring.

Place drive gear in position in housing with the long hub outward. Install axle assembly into housing and enter end of axle through splines of gear hub. As end of axle protrudes through gear hub, install the spacer washer and snap ring and push axle through until oil seal contacts housing. Install inner bearing cone on end of axle with taper toward bearing cup. Remove roll pin from washer and install washer and capscrew at end of axle. It may be necessary to start with a longer capscrew, as the capscrew is used to pull oil seal into housing and to press inner bearing cone on axle.

Remove seal installing tool from axle when oil seal is flush with housing. Tighten capscrew to press on bearing cone until all end play is removed. Remove capscrew and install roll pin in washer. Install the correct amount of shims between washer and axle to give a bearing adjustment of .003" to .007" preload.

NOTE It is necessary to adjust axle with end play before preload can be determined. Add shim until end play is obtained and check with dial indicator.

BEARING ADJUSTMENT PROCEDURE FOR PINION

Set bearing adjustment of .001 - .003 preload.

1. Addshims until pinion end play measures .003-.012".

2. If end play is .003, remove 2 - .003 shim.
" " " .004 " 2 - .003 "
" " " .005 " 2 - .003 "
" " " .006 " 3 - .003 "
" " " .007 " 1 - .010 "
" " " .008 " 1 - .010 "
" " " .009 " 1 - .010 "
" " " .010 " 1 - .003 " and 1 - .010 "
" " " .011 " 1 - .003 " and 1 - .010 "
" " " .012 " 1 - .003 " and 1 - .010 "

EXAMPLE : End play was .008", remove .013" of shim and preload would be .005",

When final adjustment is made, tighten capscrew to 130 - 140 ft. lbs. torque.

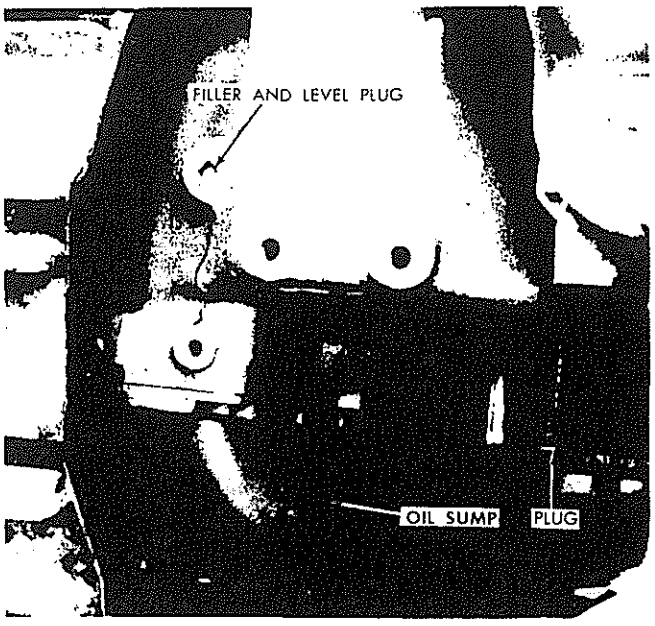
Install O-ring seal in groove in housing. Install the bearing bore plug and retaining snap ring. Install a new gasket and oil pan at bottom of housing.

BEARING ADJUSTMENT PROCEDURE FOR AXLE

Set bearing Adjustment of .003" to .007"preload.

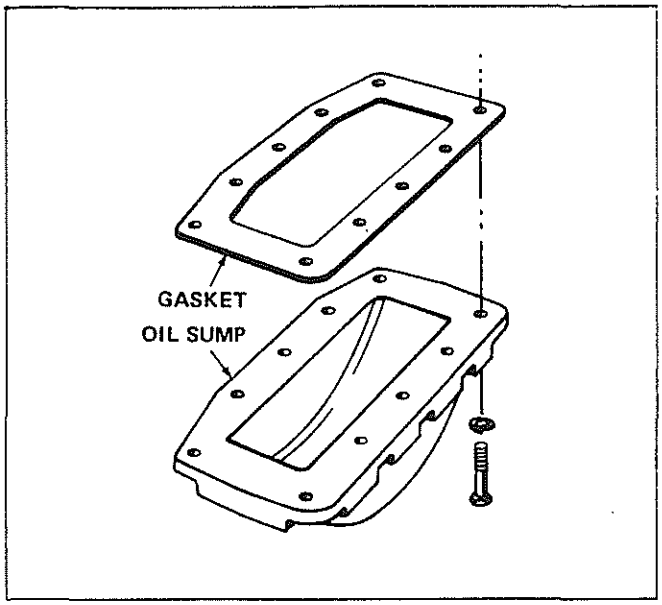
1. Add shim until axle end play measures .003 - .012.
2. If end play is .003, remove 1 - .010 shim.
" " " .004 " 1 - .010 "
" " " .005 " 1 - .010 "
" " " .006 1 - .010 "
" " " .007 1 - .010 "
" " " .008 " 1 - .010 " and 1 - .003
" " " .009 " 1 - .010 " and 1 - .003
" " " .010 " 1 - .010 " and 1 - .003
" " " .011 " 1 - .010 " and 2 - .003
" " " .012 " 1 - .010 " and 2 - .003

FINAL DRIVES - OIL LEVEL CHECK



FINAL DRIVES

Check oil level once a week, or after each 50 hours of operation. Keep filled to level of filler and filler plug, located at rear of final drive housing. Use 80 EP gear lubricant. Remove oil sump and change oil once a year.



There are two types of plugs used in the final drives. One is a solid plug to be used in conditions where mud and water are present. The other is a vented plug used in normal to dry conditions.

Improvements have been made in the final drive of the H-3 and HD-3 crawler tractors, effective Serial No. 3365 and up.

Field reports indicate when the tractor is used in extreme conditions, the bearing adjusting washer would bend and allow the axle bearings to become loose. When the tractor is operated with this condition, the bearings will become damaged to the point of failure. Also, the axle seal would become damaged and no longer effective. This could lead to complete destruction of component parts of the final drive.

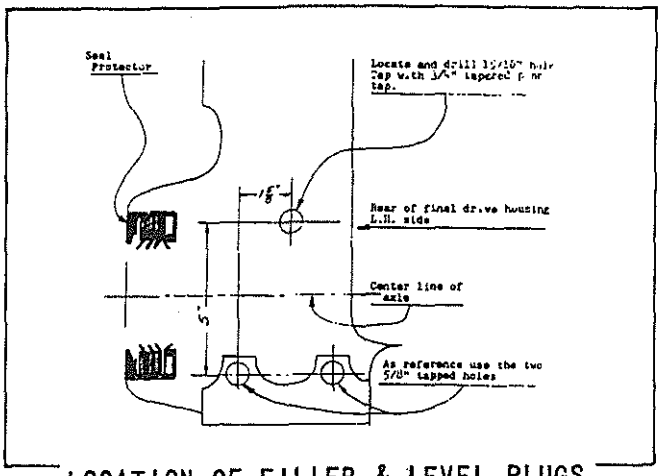
Changes made are: Hardening of washer, raising the oil level in the final drive housing, adding the seal protector ring to aid and protect the oil seal.

Where a tractor is required to operate in extreme conditions or with water and mud over the axle, it is highly advisable to rework the final drive housings and raise the oil level. In doing this, the higher oil level will aid the seal in keeping dirt and foreign material out of the final drive housing and component parts. The higher oil level will add static pressure and greatly aid and lubricate the oil seal.

It is relatively easy with a crowbar to check the final drive axle bearings for looseness. When this is detected, the necessary repair should be made incorporating these changes. Also, if seal failure occurs with the raised oil level, the loss of oil should be obvious to the operator, and repairs can be made before damage is done to other component parts.

All of the improved parts are available from Parts Stock for field service and repair. The final drive housings can be reworked in the field to relocate the filler and level plug for the raised oil level as per attached sketch. Calking compound should be used to seal dry housings, clutch housing when units are to work in wet conditions.

When there is evidence of failure of any parts in the final drive, the housing should be completely disassembled and all of the parts and the housing should be properly cleaned. All of the oil seals should be replaced at this time.



LOCATION OF FILLER & LEVEL PLUGS

1. Remove 1 or 2 track shoes.
2. Remove final drive pan and oil.
3. Locate as shown, drill and tap the hole perpendicular to the surface of the final drive housing so the plug will be square and flush with housing. It would be advisable to remove final drive axle and gear and reinstall with improved parts.
4. Assemble unit, replace pans and fill to level with proper oil (approximately 6 quarts).
5. Install plug (917686).
6. Check oil level periodically to keep housings filled to proper level.

HEAVY DUTY PAN

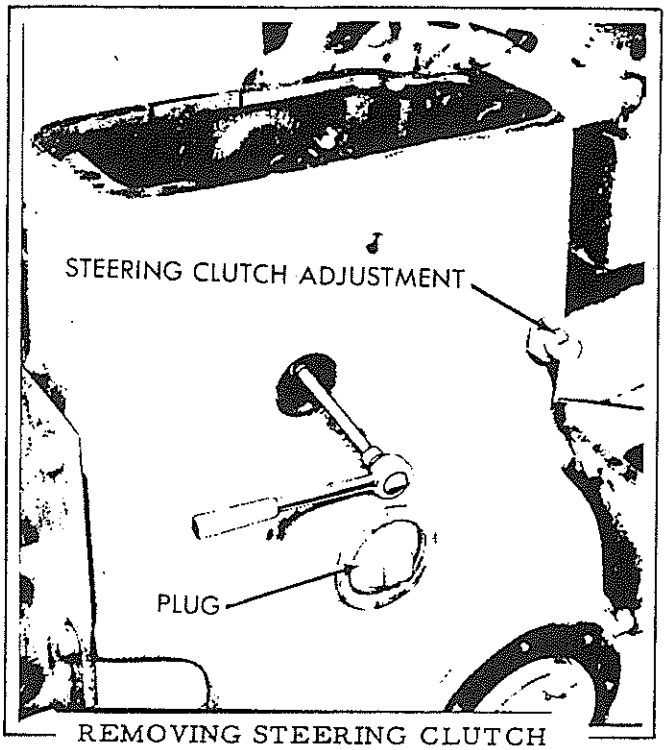
New heavy duty final drive pans are available for field service.

The new pans are cast malleable iron and a ductile material for strength. In all respects, the new heavy duty pan is completely interchangeable, using the same gasket and cap screws.

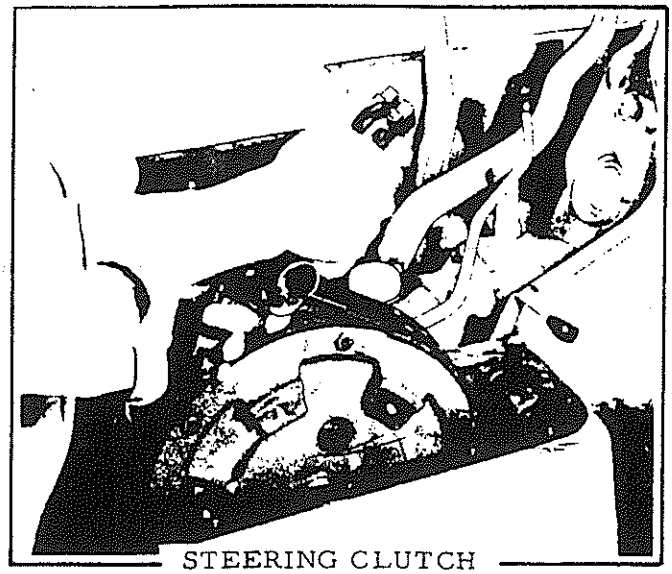
The new pan is designed without a drain plug. This was done to eliminate possible damage when operating in rocky terrain, etc.

In areas where a drain plug is desirable, the bottom of the pan can be drilled and tapped for a drain plug. The bottom section of the pan is 1/2" thick and can readily be threaded for a pipe plug.

STEERING CLUTCH



REMOVING STEERING CLUTCH ATTACHING CAPSCREWS



STEERING CLUTCH REMOVAL & INSTALLATION

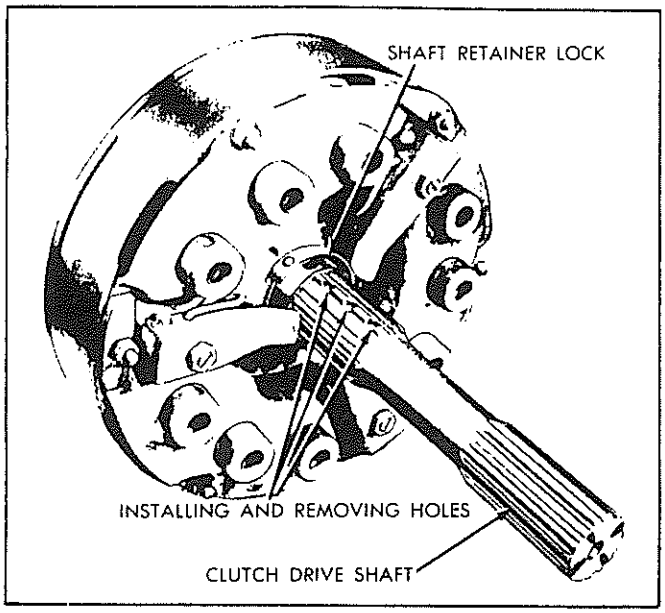
REMOVAL

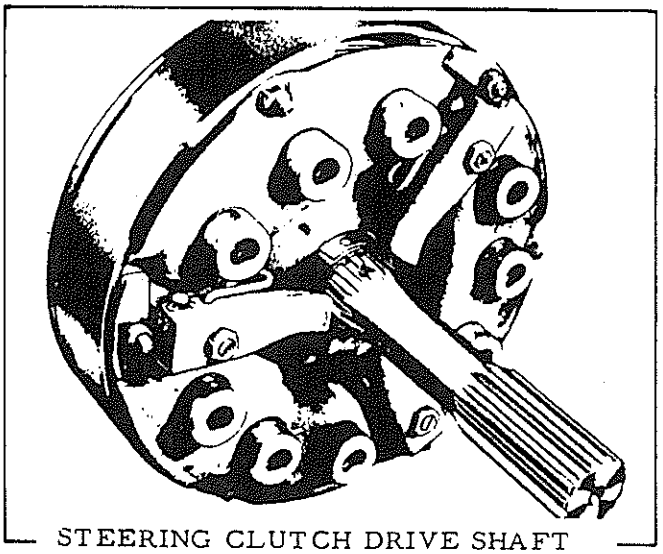
Remove the seat and the steering clutch cover. Remove the brake band. Remove plug on the outside of steering clutch housing. Rotate clutch until holes in steering clutch drive shaft is at top. (This is easily done when unit is assembled). Loosen the clutch adjustment until maximum free travel of steering lever is obtained. Lift the spring retainer until pin is released from hole in shaft. Use a bar inserted in one of the holes and slide shaft into ring gear carrier until free of clutch.

The stilt pin can be removed to allow more freedom of the fork. Unhook the stilt pin spring and use a bar behind the release fork to compress the clutch levers and allow the stilt pin to drop out. With the clutch adjustment completely loose, the pin can be easily removed and replaced in this manner.

Reach through the cover hole in outside of housing and remove the capscrews attaching clutch to the pinion shaft flange. If track is on, it is possible to remove from inside of housing. Lift clutch from housing. Calking compound should be used to seal when units are expected to work in wet conditions.

A rust preventive material can be purchased from Parts, and can be applied inside the housing on the parts. Use caution not to get rust preventive material on clutch plate facing or brake drum and lining.





STEERING CLUTCH DRIVE SHAFT W/LOCK IN POSITION IN CENTER HOLE INSTALLED POSITION

The pinion flange and shaft must be removed to remove the clutch drive shaft.

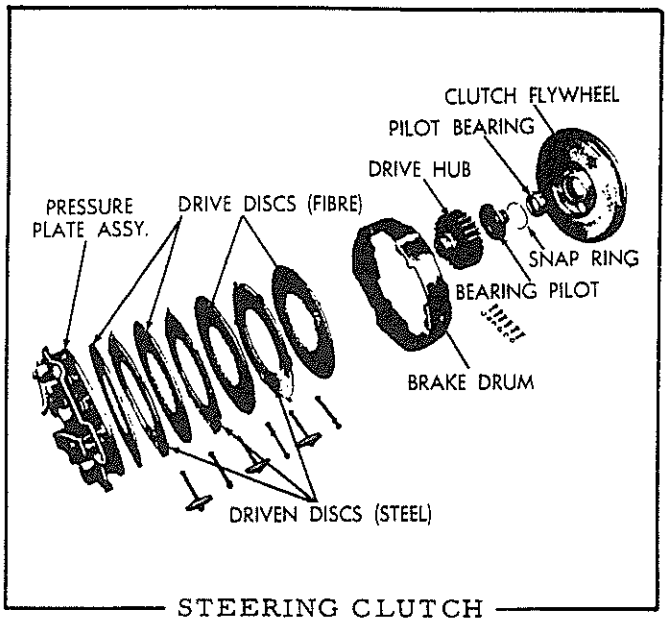
H-3 AND HD-3 STEERING CLUTCHES

Water can and does enter the steering clutch compartment of the H-3 and HD-3 tractors. Tractors equipped with solid drain plug must be drained occasionally to remove any collected water. This plug is primarily used when the tractor is used in a condition where tractor must be driven through deep water.

A self-draining type plug should be used in all conditions, except deep water.

Early tractors were shipped with the solid plug. Late tractors are shipped with the self-draining type. In either event, it may be necessary to change plugs according to type of operation. If using the solid plug, be sure to advise operator to drain daily or as required.

CLUTCH RELEASE BEARING AND FORK



STEERING CLUTCH

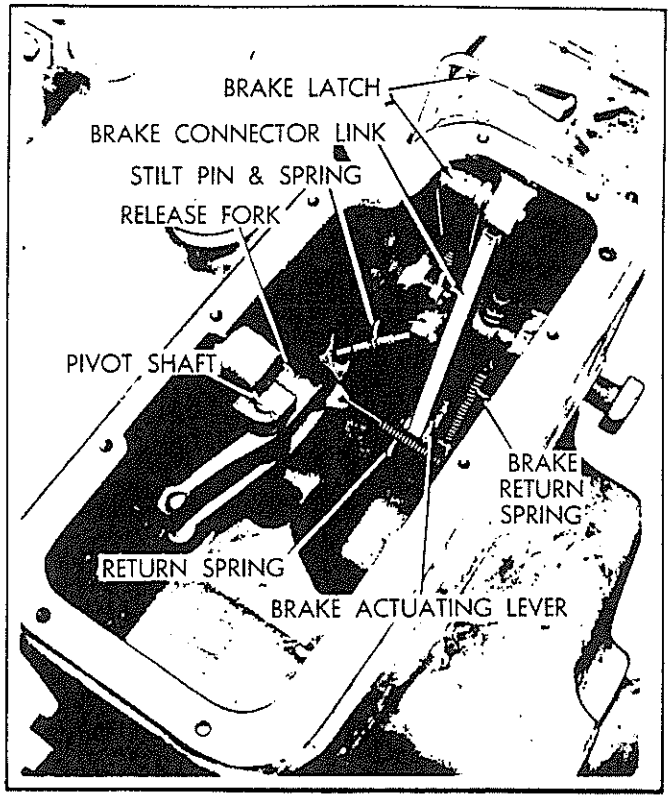
REMOVAL

Remove the quick hitch pin from the fork and bearing carrier. Slide assembly from sleeve. Press bearing from carrier.

Remove the stilt pin and spring from throwout fork. Remove fork return spring. Remove upper cotter pin from fork pivot shaft. Remove cover from bottom of housing directly under the pivot shaft. Drive shaft down and remove the fork. The fork may be removed without removing the steering clutch. The shifter tube and bearing carrier must be installed before the clutch is replaced.

DISASSEMBLE

With the clutch assembly removed from tractor, place on work bench and remove the six capscrews that hold the clutch assembly together. Lift the pressure plate assembly upward to remove. Lift brake drum upward over clutch disc and remove. Remove the driving and driven clutch discs.

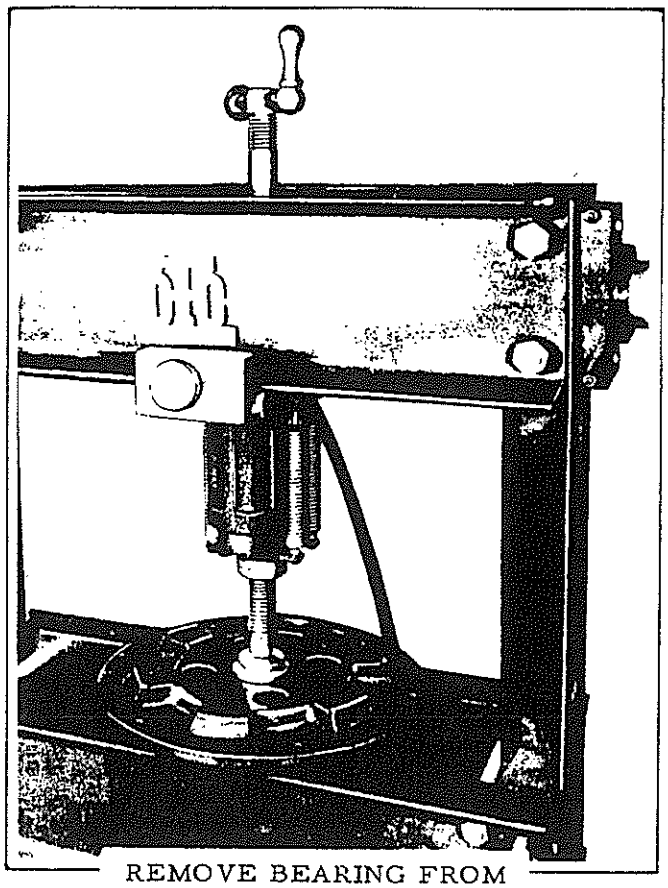


Remove snap ring at end of bearing pilot on back side of flywheel. Press the bearing pilot and driving disc hub from pilot bearing. Remove the pilot bearing retaining snap ring and press pilot bearing from flywheel. Remove capscrew and separate the bearing pilot from the clutch disc driving hub.

PRESSURE PLATE

REMOVAL

With pressure plate assembly removed from clutch, clamp in vise and use vise and "C" clamps to compress the pressure plate and back plate together. Remove the lever pins and spring washers, and remove the lever assemblies. Remove the lever return springs.



REMOVE BEARING FROM CLUTCH BACK PLATE

Release the vise and "C" clamps evenly until the assembly can be removed from vise (holding the back plate and pressure plate together) and place (pressure plate downward) on work bench. Remove back plate, pressure springs, and cups.

Check pressure plate for flatness, scoring, or cracks. Check pressure springs for free length by comparing with a new spring. The spring free length should be 2-3/8". When compressed to 1-23/32", it should have 245 to 265 lbs. pressure.

ASSEMBLE

Place pressure plate face downward on bench. Place the nine pressure springs in position on pressure plate. Place the spring cups over springs. Place the back plate over the spring cups. Attach "C" clamp to hold assembly together and place in vise, and compress the back plate and pressure plate together.

Install the lever springs on release levers, and install levers to pressure plate. Be sure lever springs are hooked under clips on back plate. Be sure to compress spring to the point the lever pins can be put in by hand. Install the lever pins with head of pin leading in the direction of rotation when tractor is moving forward. Install spring washer next to head of pin. Install new cotter pins. Release the vise and "C" clamps evenly.

ASSEMBLE

Attach the bearing pilot to the disc driving hub, tighten capscrews 15 to 20 ft. lbs. torque. Press the pilot bearing into clutch flywheel and install retaining snap ring. Press the hub and bearing pilot into pilot bearing and install retaining snap ring.

Place the clutch flywheel assembly on bench face upward. Place the brake drum over flywheel with the flange edge upward, aligning the holes for capscrews. Install a fiber driving disc with notches engaged with driving hub. Install a steel driven disc with lugs engaged in grooves of brake drum. Proceed with alternate fiber and steel discs until three steel and four fiber discs have been used.

Install the pressure plate assembly and align capscrew holes. Install the three longer capscrews (from flywheel side) in alternate positions, using the clamp bars next to pressure plate. Install the shorter capscrews in alternate positions with lockwashers and nuts next to back plate. Tighten nuts 17 to 21 ft. lbs. torque.

NOTE: Effective with S/N 9700 and up, the three 3/8" NC x 4-1/2", Gr. 8 and the three 3/8" NC x 3-1/2", Gr. 8 socket head capscrews with six huglock nuts are used in steering clutch assembly. Tighten huglock nuts 35 to 40 ft. lbs. torque (torque on nut). Models prior to S/N 9700, the steering clutch can be reworked by redrilling the holes with a 25/64" drill bit and order necessary parts, through your ALLIS-CHALMERS dealer.

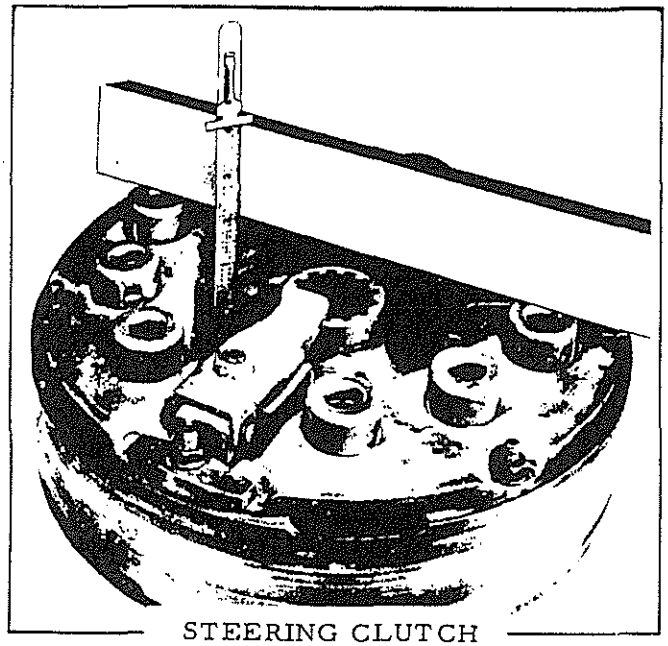
Adjust the clutch release levers evenly to a dimension of 2-1/8" from the face of the first fiber disc to the release bearing contact surface of release lever with clutch completely assembled. To adjust, loosen locknut and turn adjusting screw until the above dimension is obtained and tighten nut securely.

The fiber discs should be checked for thickness, a new fiber disc should be .141" plus or minus .005" thick. The steel discs should be checked for flatness. Any warping of the steel discs due to overheating by not fully releasing the clutch levers during operation will cause dragging of the clutch.

INSTALLATION

With the steering clutch properly assembled and the finger adjustment properly made, the assembly can be installed in the tractor.

Cradle the steering clutch assembly in the brake band as it was removed. Locate the retainer lock ring on the hub with the open part of the ring toward front of tractor and retainer pin forward of hole in hub. Position turn clutch so hole is up and lower clutch assembly into housing.



STEERING CLUTCH
FINGER ADJUSTMENT

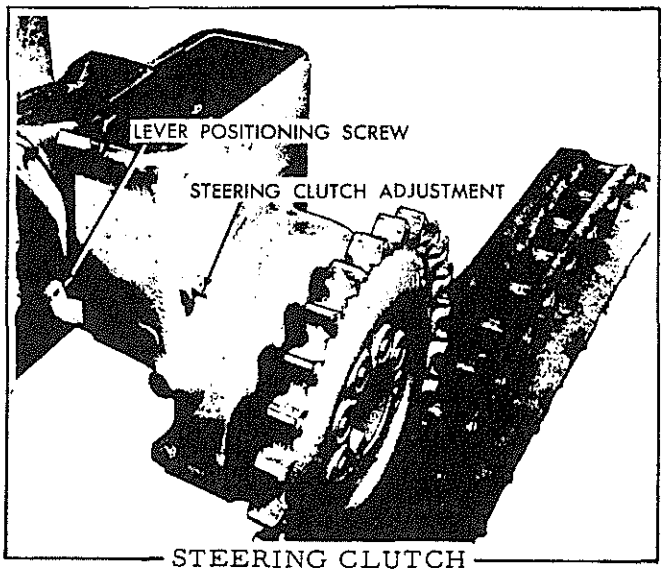
FIRST METHOD

The steering clutch drive axle must be pushed into the bearing carrier tube to install the clutch. A small 16 gauge soft wire can be used to pull the axle back out of the tube when the clutch is installed. Roll a loop on the end of the wire to fit into the first detent hole, and lay the loop in the hole with the wire running out of the nearest spline. Push axle into the shifter tube flush, and bend wire up and back over tube, to be out of the way. When the clutch is attached to the flange, pull the wire and axle out of shifter tube.

SECOND METHOD

Install the clutch assembly to the flange. Do not tighten the attaching capscrews. Use caution to have clutch indexed properly for splined hub and detent pin hole.

Attach the clutch assembly to the pinion flange, and do not tighten the capscrews completely. A small amount of freedom will allow ease of alignment of the drive axle and the clutch hub splines. With the retainer ring on the opposite side disengaged, use a pin bar in the detent hole and pry over clutch and use this axle as a hammer blow to bump axle out of carrier. Bump axle into view so pin bar can be used to engage axle into clutch. There are three detent holes in axle to be used to position axle in and out of clutch hubs. Relocate the axle into the steering clutch and engage detent pin in hub and center hole of axle. Tighten clutch to flange. Use bar and install stilt pin between push points and hook springs. Connect linkage and any clutch hand levers for proper travel.



STEERING CLUTCH

REMOVAL

Loosen the clamp bolt on the steering clutch lever. Slide lever from the shaft. Remove the clutch adjusting screw and remove shaft.

Installation, reverse procedure. The lever has a setscrew at the base which rests against the steering clutch housing. This setscrew should be adjusted so that the top of the lever is 1-1/2" to 1-3/4" from back rim of fuel tank.

The clutch is properly adjusted when the levers have 3-1/2" free movement measured from the rim of gas tank. As the clutch wears this clearance diminishes, and should be readjusted when free travel has decreased to 1-1/2" to 2".

BRAKE ADJUSTMENT

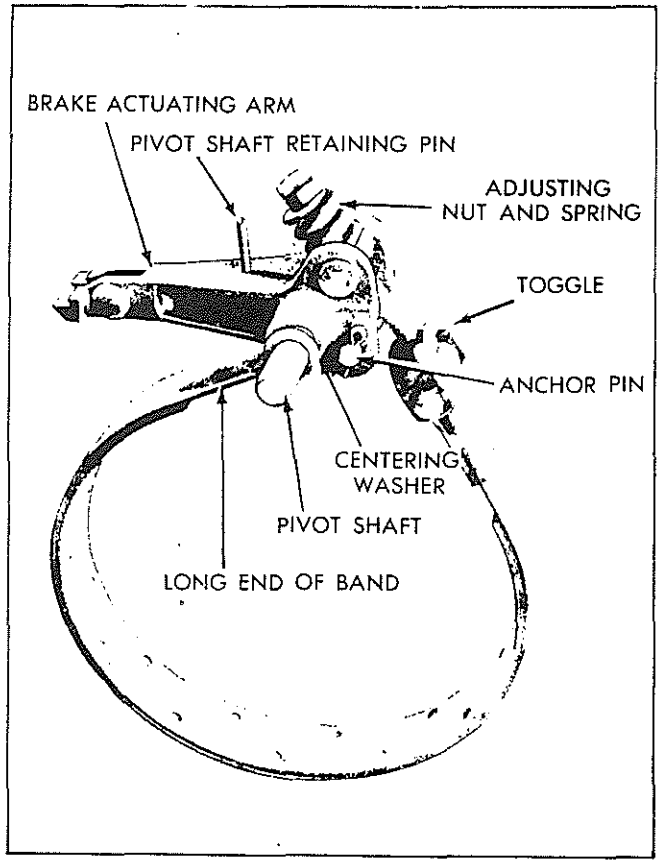
The brake rods are properly adjusted at factory, and should not need any further adjustment, unless replacement of rod is necessary.

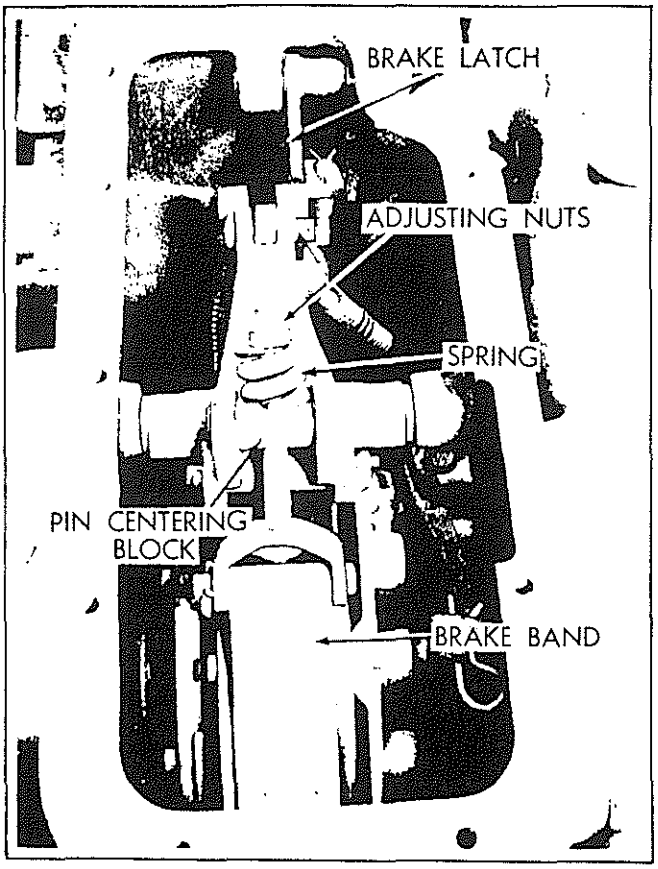
To adjust brake band, place the brake latch hand lever in the "up" or "off" position. Remove cover at top of brake compartment. Loosen the two adjusting nuts and if the brake pedal free travel is excessive, tighten brake by turning the adjusting nuts clockwise until the brake pedals have 2-1/2" of free travel.

If brake rods have broken and a new one has to be installed for any reason, it will be necessary to first determine the proper length for rod before adjusting brake. The approximate length of the brake rods when installed will be 13-1/4" from center of hole in yoke to center of bend at end of rod.

With cover removed, loosen brake band adjusting nuts, and with the brake latch handlever in the "down" or "on" position, place the brake arm in the upper most notch of the brake latch. Hold brake pedal in returned position (pedal arms contacting platform). Install and adjust brake rods into yokes until the rod lines up with holes in pedal arm and arm of shaft assembly, then tighten lock nut on rod. Adjust brake band as described above.

BRAKE BAND





REMOVAL

Remove seat and steering clutch cover. Remove the brake adjusting locknuts and spring. Drive the roll pin from the brake actuating arm and drive shaft from housing. Remove pins from ends of band. Turn band forward until open end of band is at bottom of housing. Tip the top end of band towards outside of housing and pull up. The ends of the band will pass upward around the throwout bearing. Do not spring band out of shape. If the band is deformed it will not clear drum when reinstalled. The long end of band is at the front when the band is reinstalled.

BRAKE LATCH - REMOVAL

Drive the roll pin from the lever and shaft. Remove cotter pin from lower end of spring stud. Remove shaft from actuating lever and remove the lever assembly. Remove the upper cotter pin from the spring stud and slide stud from the trunnion block.

BRAKE LEVER

The brake return spring is hooked onto the clutch lever shaft and must be removed. Remove the brake pedal rod. Loosen the clamp bolt on the inner lever. Slide the splined shaft from lever. A new two piece brake return spring is being used.

To install in R. H. brake and steering clutch; to install remove fender platform and seat support, three spool valve assembly, and hydraulic filter.

1. Remove the steering clutch lever.

2. Remove the hand lever shaft adjusting screw.

3. Remove the fork lever setscrew.

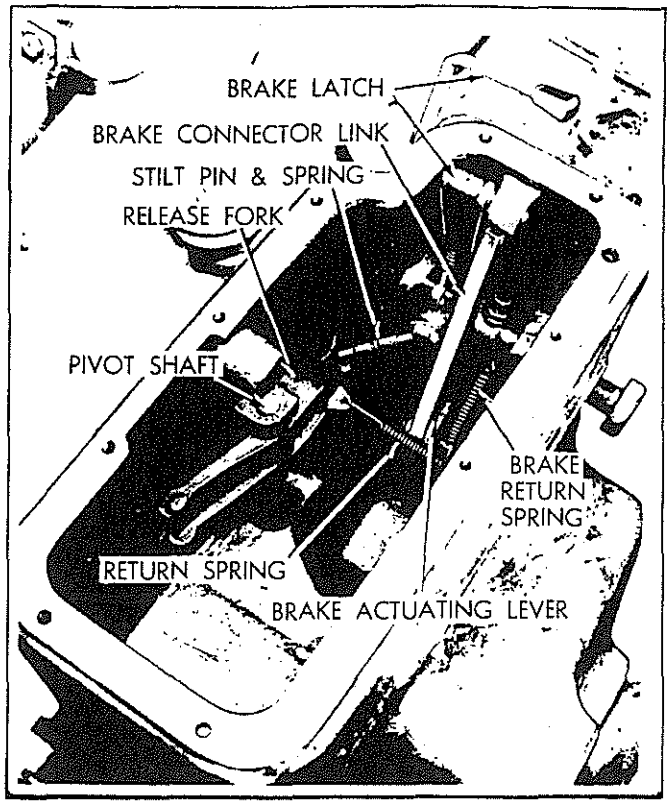
4. Drive the hand lever shaft toward the center of the tractor so that the woodruff key is all of the way out of the fork lever. The key cannot be removed as in Step No. 3 left hand installation, due to the end of the hand lever shaft striking the right hand side of the transmission. The control lever is on this side of the transmission, and, therefore, the hand lever shaft cannot be shifted far enough toward the center of the tractor to remove the woodruff key.

5. To remove the key, place a bar between the key and the inside of the final drive housing and drive the shaft towards the center of the tractor until the key is pushed out of its seat.

6. Then drive the hand lever shaft toward the outside of the tractor until the brake return spring comes off the end of the shaft and the fork lever drops out of place.

7. Unhook the lower end of the production spring (open hook).

8. Hook lower end of closed hook spring first, then with a loop of wire through the closed hook of the spring, stretch the spring into position and push the hand lever shaft back through the closed spring hook.



9. Push the hand lever shaft back through the fork lever until the full length of the woodruff key seat can be seen on the left hand end of the fork lever.

10. Reseat the woodruff key.

11. Pry the hand lever shaft back into place.

12. Reinstall the fork lever setscrew.

13. Reinstall the steering clutch lever.

14. Reinstall and adjust the hand lever adjusting screw.

15. Reinstall the platform, fender, seat support assembly, hydraulic filter, and the three spool valve assembly.

To install in L. H. brake and steering clutch; remove fender platform and seat support.

1. Remove the fork lever setscrew.

2. Remove the hand lever shaft adjusting screw.

3. Drive the hand lever shaft toward the center of the tractor and remove the woodruff key. This was accomplished by forcing the key end against the inside of the housing which pushed the key up partially out of its seat.

4. Shift hand lever shaft just far enough to allow the closed end of the spring to slip over the end of the shaft, but not far enough to force the woodruff key completely out of its seat.

5. Hook lower end of spring first, then with a loop of wire through the closed hook of the spring, stretch the spring into position and push the hand lever shaft back through the closed spring hook.

6. Reseat the woodruff key.

7. Push the hand lever shaft back into place.

8. Reinstall the fork lever setscrew.

9. Reinstall and adjust the hand lever adjusting screw.

10. Reinstall the platform, fender, and seat support assemblies.

BRAKE LEVER ASSEMBLY

Reverse removal procedure. The brake lever must be indexed on the spline. Holding the outside lever tight to the housing, the inner lever must be 13-9/16" from the top of housing at the top edge of link pin.

PLUG ASSEMBLY FOR STEERING CLUTCH HOUSINGS

A plug assembly and gasket is provided for the bottom of the steering clutch and brake housing on the H-3 and HD-3 crawler tractors. The plugs are removed from the housings when the tractor is shipped. This is done to allow any moisture to quickly drain from the housings when the unit is shipped or in storage. The plugs are shipped in the trim package with each tractor, and must be installed when the tractors are put into operation.

Periodic inspection must be made, the plugs should be removed and the housing checked for accumulation of foreign material. The self draining, vented plugs should also be checked to insure proper function of the pin to allow the vented plugs to drain.

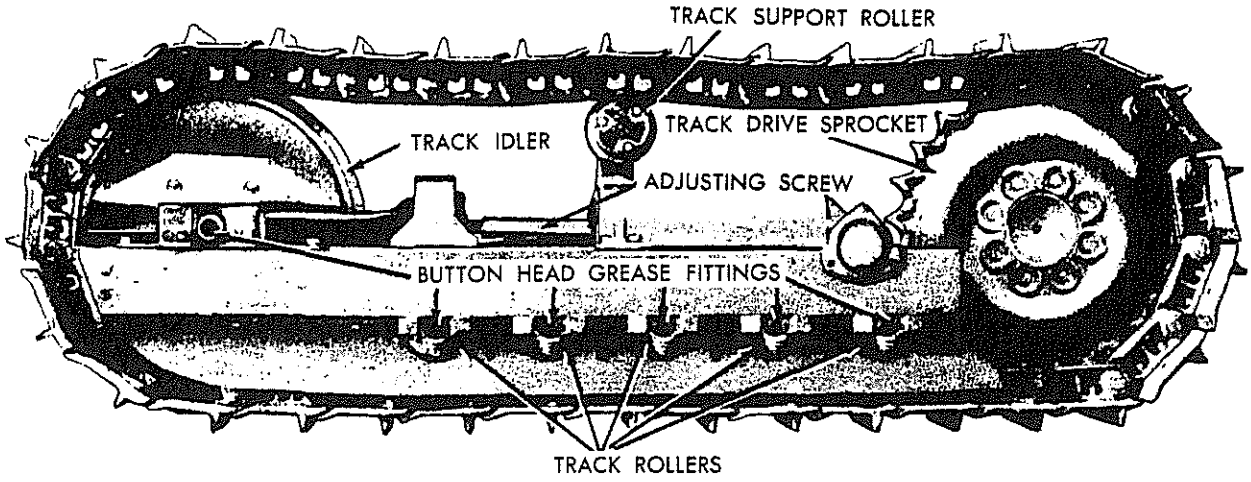
Also, from Parts Stock a solid plug is available using the same gasket. The solid plugs should be obtained and installed in tractors that are expected to operate in wet or swamp conditions.

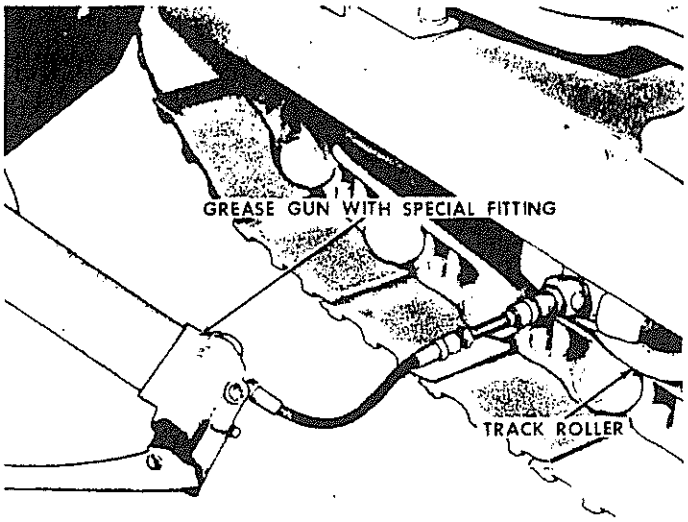
When using the solid plugs, the periodic inspection is most important to drain any moisture collected in the housing.

INDEX

TRACKS AND UNDERCARRIAGE

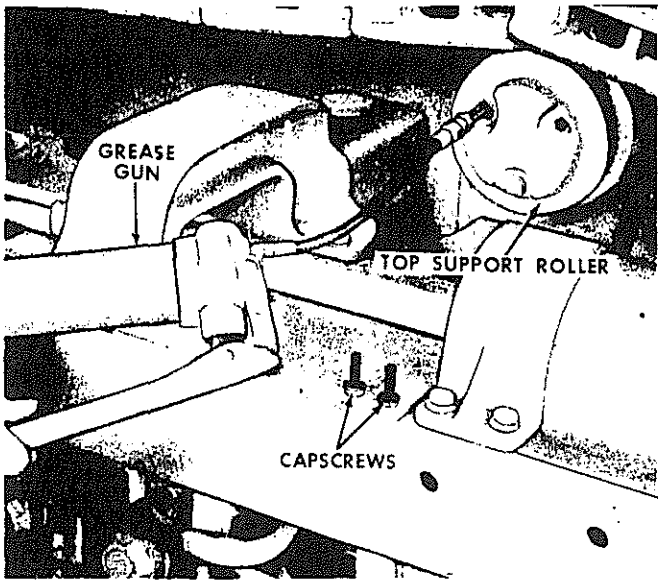
100 HOURS INTERVAL -





TRACK IDLER & ROLLERS (100 HOURS)

Lubricate every 100 hours of operation. Clean the button head grease fittings thoroughly before attaching grease gun. Pump a few strokes of SAE 90 transmission oil into bearings until a resistance is felt on grease gun. This is a slow process and time must be allowed for air trapped in the system to escape. Excess lubrication will allow grease past face type seals giving the appearance of seal leakage.



TRACK SUPPORT ROLLERS (100 HOURS)

Lubricate every 100 hours of operation. To lubricate, turn roller with one capscrew in cover plate downward. Remove the two upper capscrews. Insert tube of grease gun, forcing SAE 90 transmission oil through one capscrew hole and allowing air to escape from the other. When filled to level of capscrew holes, replace capscrews and tighten 25 to 30 ft. lbs. torque.

Severe operating conditions may necessitate this service at shorter intervals.

PROLONGING UNDERCARRAGE LIFE

Undercarriage life cannot be measured in hours of operation only. Ideal operating and soil conditions, proper operating technique, and proper maintenance can extend undercarriage life several times over life obtained under extremely severe conditions and poor maintenance. Operating conditions and terrain cannot be controlled,but "common sense"operating techniques and regular inspection along with an effective maintenance program can materially prolong undercarriage life. Following material is given to assist in setting up and carrying out program to prolong undercarriage life.

OPERATING TECHNIQUES

1. Speed

Unnecessary high speed operation causes rapid wear and damage, as entire undercarriage is subjected to extreme shock loading, spilling loads causing rough travel surfaces which increases shock loading. If speed is great enough, tracks will pound support rollers, track bushings will not enter or leave sprocket teeth smoothly and end result will be badly damaged track rollers, support rollers, and idlers. Operate crawler loader at a speed which will permit the use of full horsepower and load capacity without slipping tracks excessively or spilling load. It is more economical to operate unit at 1.81 mph with full load than 2.81 mph at half load, this also minimizes wear on components.

2. Loading Operation

While loading trucks or conveyor's, unnecessary turning and abrupt stops should be avoided. Turning and traveling should be alternated frequently to distribute wear on components. Abrupt stops tend to shift center of gravity forward; this imposes abnormal loads on idlers and front track rollers. This is also true when loadpickup area is not kept slightly inclined (upward). Spilling loads create rough travel area which has a tendency to twist the track, load the idlers and impose shock loads on all the components as well as sprockets.

3. Using Loader To Backfill

To prevent abnormal loads on idler and front rollers when dumping over edge of backfill, it is recommended that loads be dumped then pushed over edge of backfill, maintaining a level and smooth surface to work on.

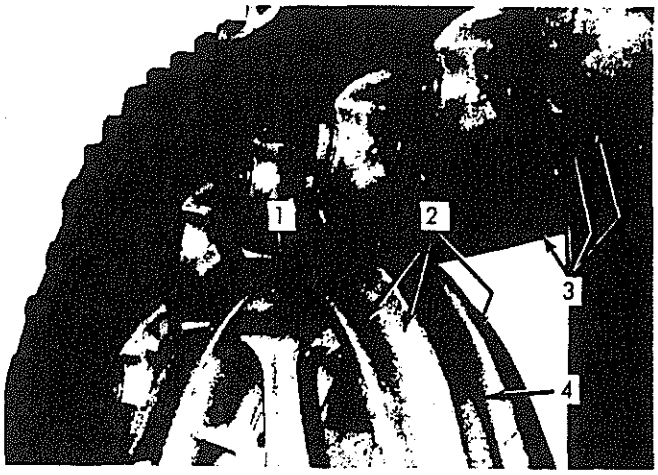
Operating crawer tractor with tracks too loose or too tight results in acceleratedwear on undercarriage components. Tracks too tight create excessive friction between pins and bushings as track links hinge over sprocket and idler also causing excessive wear on other component; excessive friction absorbs tractor power. Tracks too loose will cause track misalignment to idler, track rollers, excessive pounding of support rollers, and will in some situations permit track bushings to jump sprocket teeth causing severe damage.

TRACK IDLER WEAR PATTERN GUIDE

WEAR PATTERNS

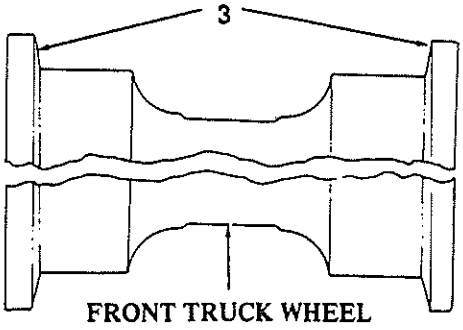
Wear patterns shown will occur when track and idler are misaligned. Track andidler wear patterns should be checked periodically: misalignment detected early may be corrected with minor adjustment; as wear increases, however, cause of wear becomes more difficult to determine and a complete alignment check may be required.

Proper alignment of undercarriage components in respect to each other and to the unit is essential; improper alignment will result in accelerated wear to ALL undercarriage components. Following illustrations and text show undercarriage wear patterns, causes of uneven wear patterns and methods to check undercarriage alignment both on and off the crawler loader.



WEAR SURFACES ON TRACK IDLER AND SIDE BARS

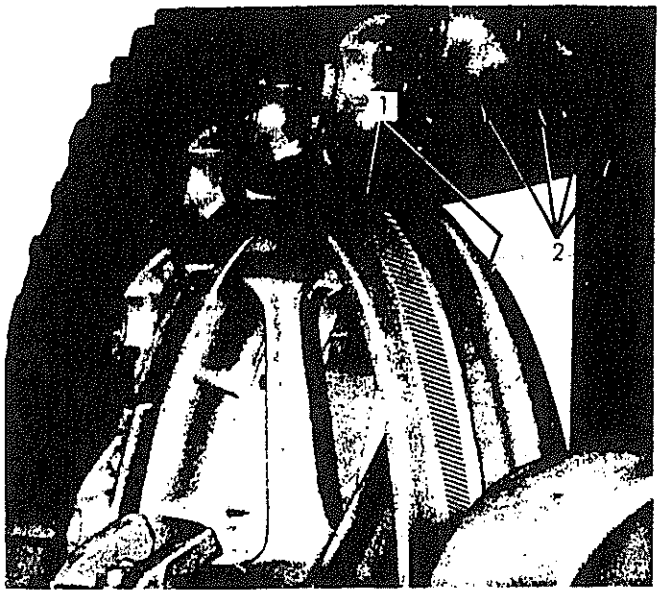
1. TRACK IDLER
2. IDLER WEAR SURFACES
3. SIDE BAR WEAR SURFACES
4. TRACK GUIDING FLANGE

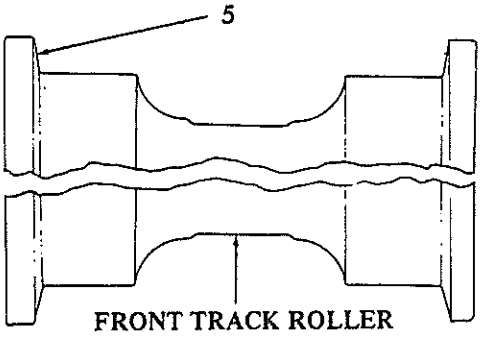


FRONT TRUCK WHEEL

Wear Pattern - Track and Idler Properly Aligned

1. Light even contact on each side of idler flange
2. Light even contact on both sides of side bars
3. Light even contact on both flanges of truck wheels

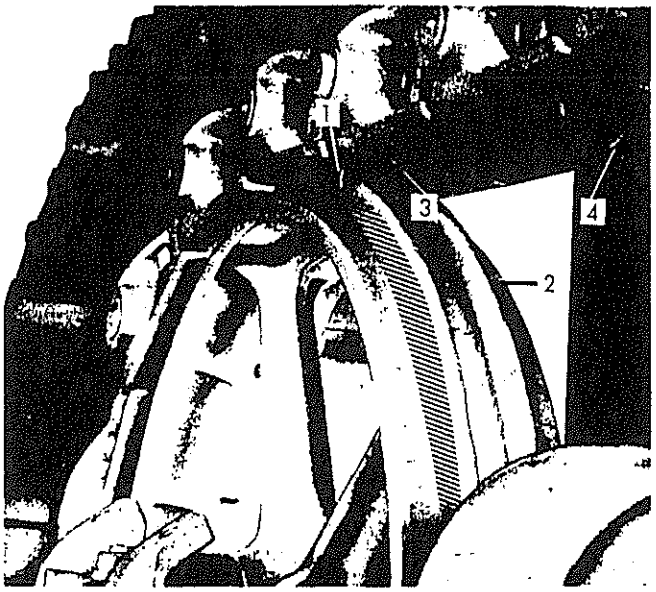


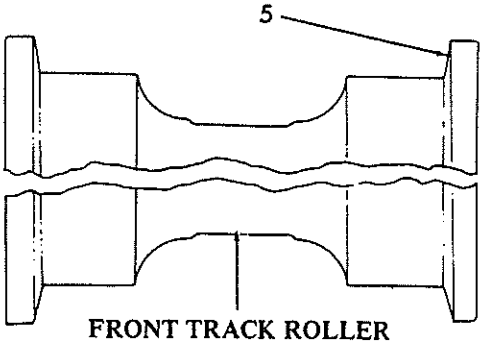


FRONT TRACK ROLLER

Wear Pattern - Idler Off Center Toward Outside

1. Heavy contact on idler outer flange
2. Light to no contact on idler inner flange
3. Heavy contact on inner side of outer side bars
4. Light to no contact on inner side of inner side bars
5. More contact on outer flange than inner flange

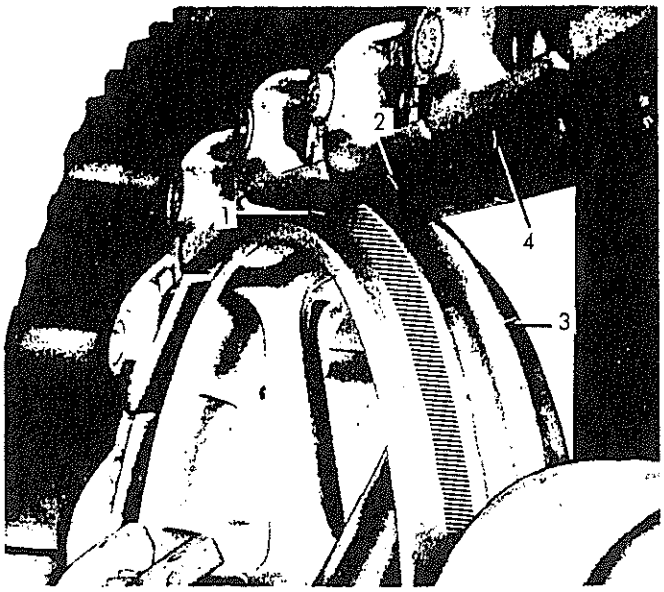


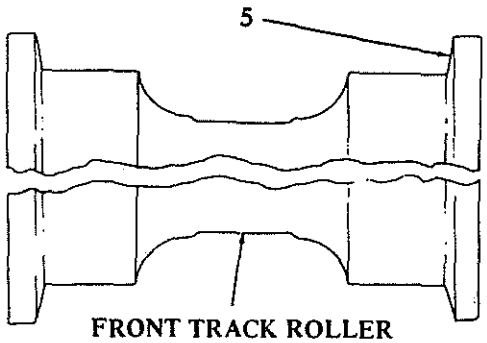


FRONT TRACK ROLLER

Wear Pattern - Idler Off Center Toward Inside

1. Light to no contact on idler outer flange.
2. Heavy contact on inner side of inner side bars.
3. Heavy contact on idler inner flange.
4. Light to no contact on inner side of outer side bars
5. More contact on inner flange than outer flange.

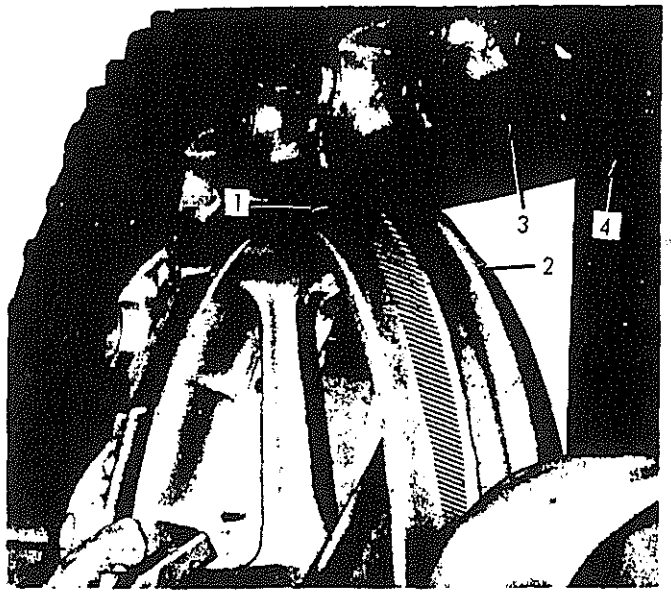


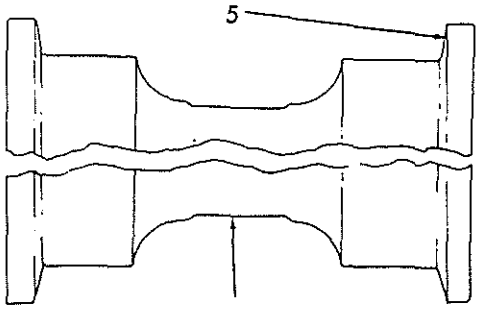


FRONT TRACK ROLLER

Wear Pattern - Idler Low Toward Outside

1. Heavy contact on idler outer flange
2. Light or no contact on idler inner flange
3. Heavy contact on inner side of outer side bars
4. Heavy contact on outer side of inner side bars
5. Heavy contact on inner flange

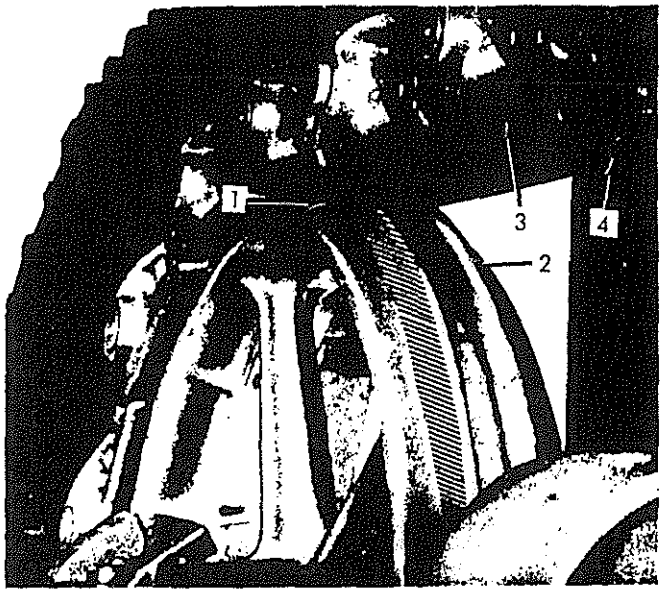


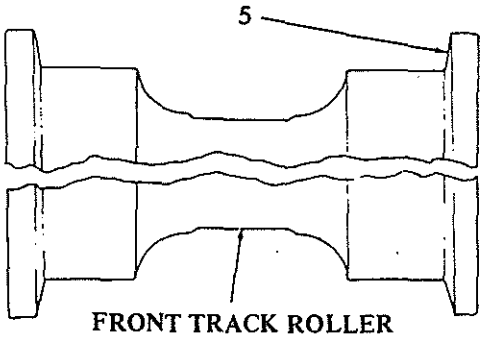


FRONT TRACK ROLLER

Wear Pattern - Idler Low Toward Outside

1. Heavy contact on idler outer flange
2. Light to no contact on idler inner flange
3. Heavy contact on inner side of outer side bars
4. Light to no contact on inner side of inner side bars
5. More contact on outer flange than inner flange

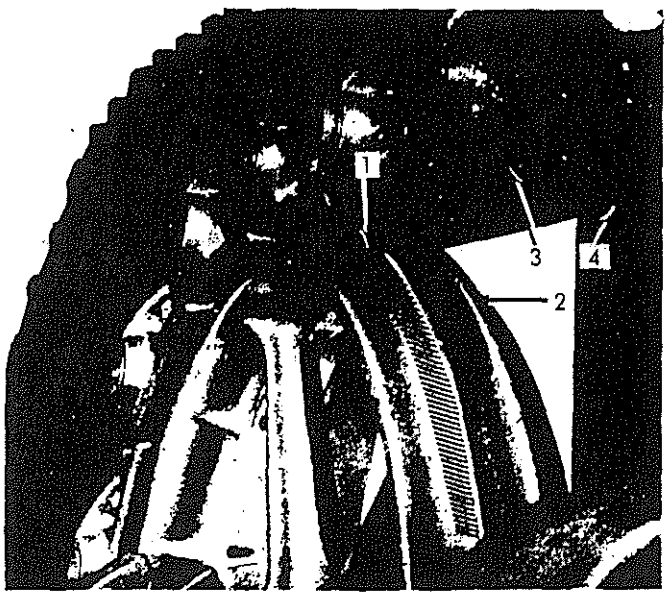


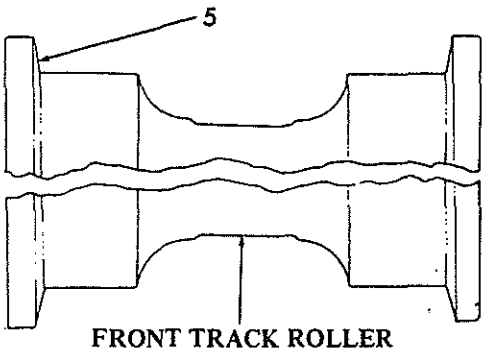


FRONT TRACK ROLLER

Wear Pattern - Idler "Toed In"

1. Heavy contact (cutting if toe-in is 1/4" or more) on idler outer flange
2. Moderate contact on idler inner flange
3. Heavy contact (cutting if toe-in is 1/4" or more) on inner side of outer side bars
4. Heavy contact on outer side of inner side bars
5. Heavy contact on inner flange

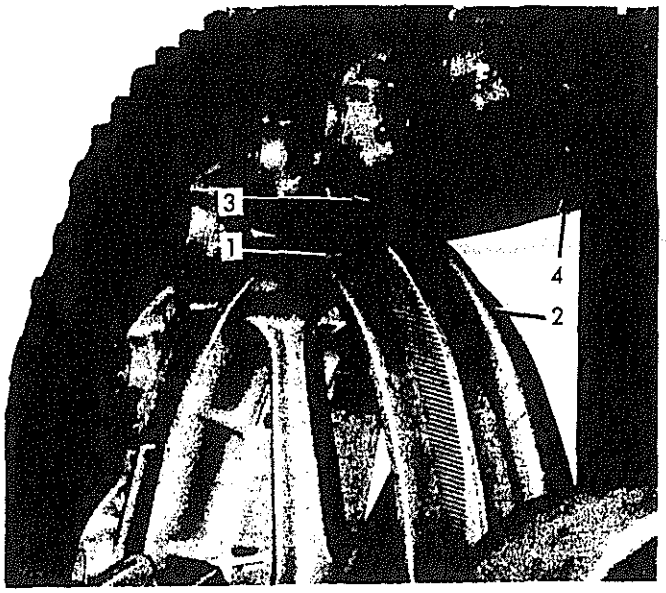


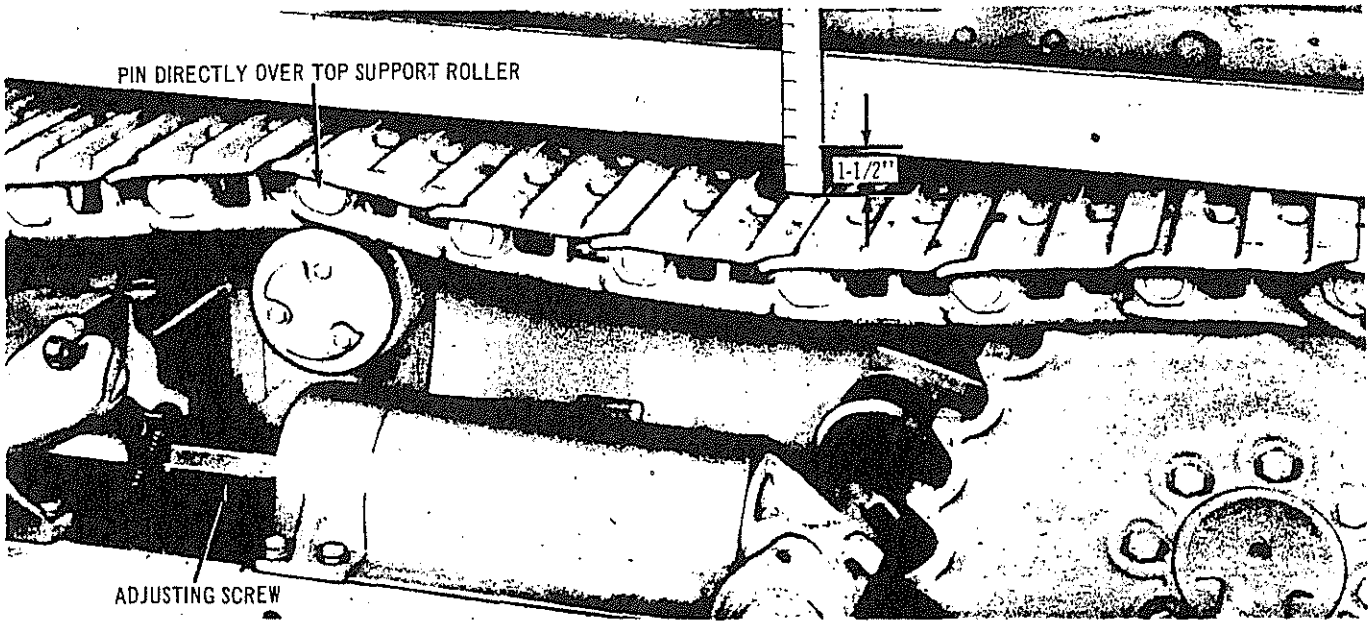


FRONT TRACK ROLLER

Wear Pattern - Idler "Toed - Out"

1. Moderate contact on idler outer flange.
2. Heavy contact (cutting if toe-out is 1/4" or more) on idler inner flange
3. Heavy contact on outer side of outer side bars.
4. Heavy contact (cutting if toe-out is 1/4" or more) on inner side of inner side bars
5. Heavy contact on outer flange.





TRACK ADJUSTMENT

Each track is properly adjusted when the track has a 1-1/2" to 2-1/2" sag when measured with a straight edge laid over the grousers midway between the sprocket and top support roller. If the track assembly is adjusted too tight, the pins and bushings will also cause loss of power. If the track assembly is adjusted too loose, it will jump off the track rollers and in doing so may cause damage to the final drive assembly.

When track adjustment is needed, remove any accumulation of dirt from around track idler yoke and track adjustment screw. Clean and lubricate adjusting screw threads. Loosen capscrews in lock plate and turn the adjusting screw out of the track, release yoke as necessary to tighten the track. Turn the adjusting screw into yoke to loosen the track.

Run the tractor backward and forward a few times without applying brakes before checking the adjustment of the track. The last movement of the tractor should always be forward. Measure the amount of sag in the track and adjust as required.

Conditions may arise such as in loader work where there is a packing condition in the tracks and sprockets, in sand, snow, mud and under certain soil condition; where the above adjustments is a good starting point; where this condition may arise the crawler should be equipped with a skeleton sprocket as shown in figure. Some conditions require the use of cut out grouser shoes with this type of sprocket as shown in figure.

TRACK ALIGNMENT

Wear on undercarriage components cannot be prevented, but a systematic inspection program can lead to longer component life and lessen down time. Proper track alignment can be determined by regular visual inspection.

TRACK SERVICE AND INSPECTION

The use of a track wear gauge (Available through your Allis-Chalmers Dealer) will properly indicate the remaining percentage of useful life of the track and track frame components. Usually it will be possible to turn pins and bushings in side bars before side bars are worn enough to require replacement.

CHECKING TRACK PIN AND BUSHING WEAR

The pins and bushings, their relation to each other and to the sprocket teeth, constitute the most important factor in track life. Since only external wear on bushings is apparent, a track wear gauge must be used (as shown) to determine amount of wear on O. D. of pins and inside bore of bushings. The internal wear of bushings and pins and the visible external wear of bushings will determine when pins and bushings should be turned in the side bars. Turning pins and bushings 180° in the side bars will renew the contact surface between the pins and bushings (load side) which will give you about 1/3 of the original life received before the pins and bushings were turned, thereby, returning close to original pitch length (distance between center of pins). Pitch length of new track is 6.000" and the maximum allowable pitch length for a used track is 6.120".

The practice of turning pins 180° provides additional life to the track assembly. As tracks wear and pitch length increases, the bushings are inclined to ride higher on the sprocket tooth and wear the tips of the teeth rapidly to the extent where the sprocket will eventually spin in the track assembly causing severe damage to entire unit.

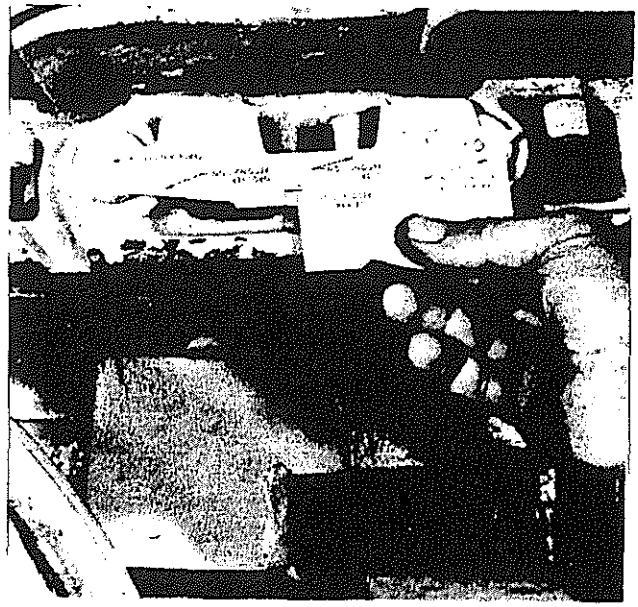
Distance between centers of adjacent track pins is track pitch; pitch in new track corresponds to pitch of sprocket teeth. As pins and bushings wear, track pitch increases, but pitch of sprocket teeth remains the same; therefore both sprocket and track bushing wear is accelerated.

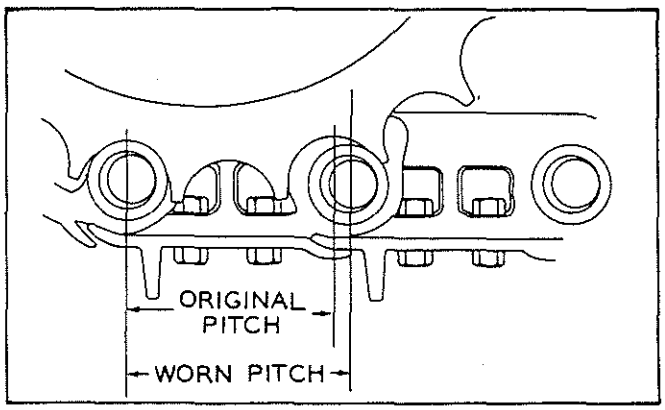
Increase in track pitch also loosens track; looseness may be taken up by adjusting track, but bushing-sprocket contact can only be changed by turning pins and bushings 180°. Turning exposes new wear surfaces on pins and bushings and restores track pitch to near new specifications. When to turn can be determined by measuring track pitch using wear gauge available through Allis-Chalmers Dealer. Measure pitch along top half of track, at least two links either side of master pin; tracks must be tight when measuring.

When it is preferred to operate pins, bushings and sprocket to end life rather than turn pins and bushings, wear gauge can be used to project estimated replacement time.

Master bushing does not extend into side bar bore; therefore less contact between pin and bushing exists, causing master pin and bushing to wear more rapidly than other pins and bushings. The two adjacent pins and bushings will also wear faster than others due to master pin and bushing wear. This wear can be reduced by periodically replacing master pin and bushing.

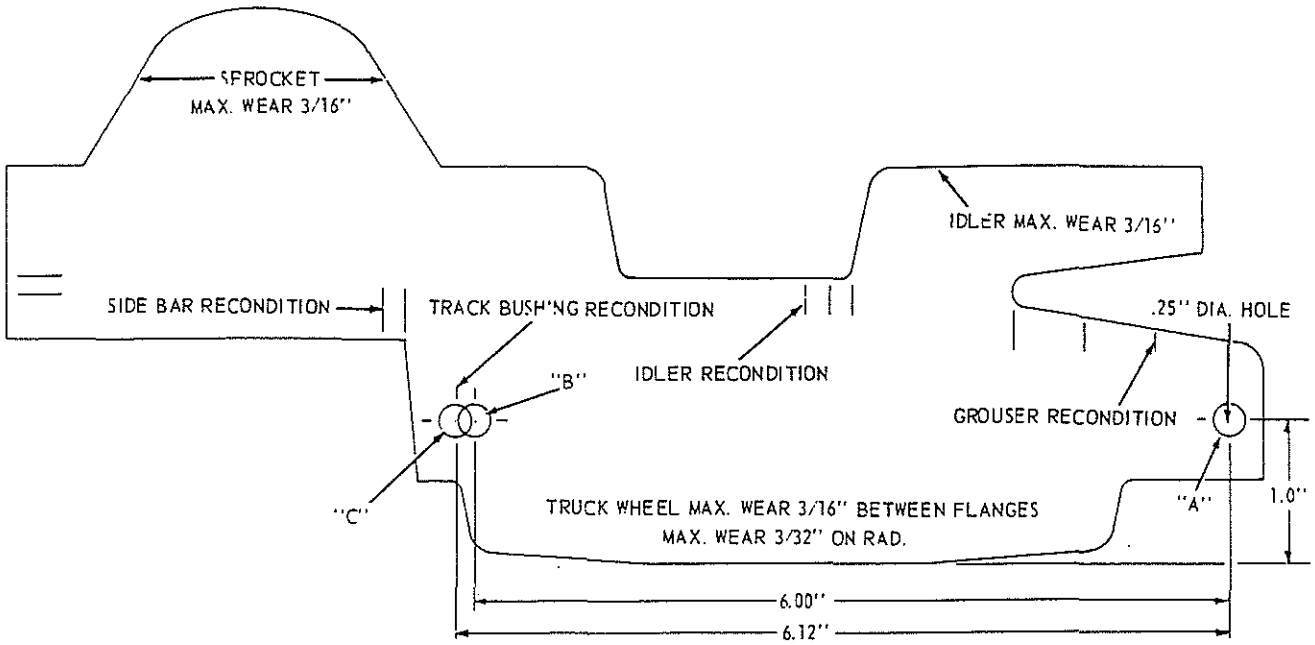
CAUTION Never attempt to remove a link from the track assembly to provide additional adjustments of track adjusting screw.





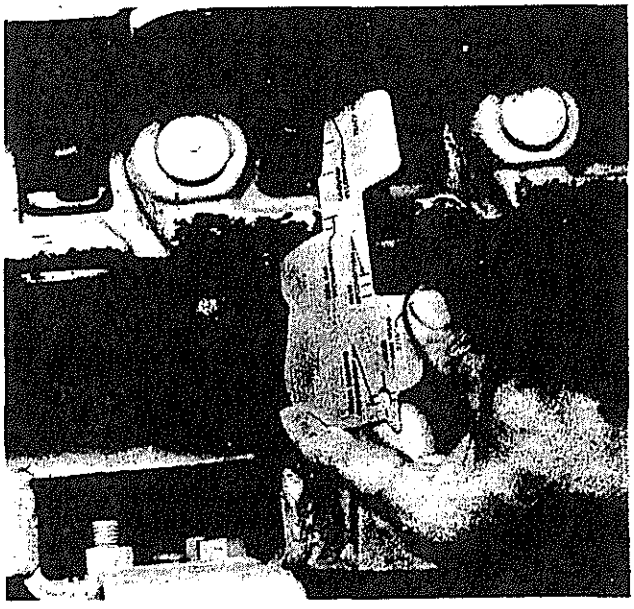
Sprocket and Bushing Wear

TRACK WEAR GAUGE

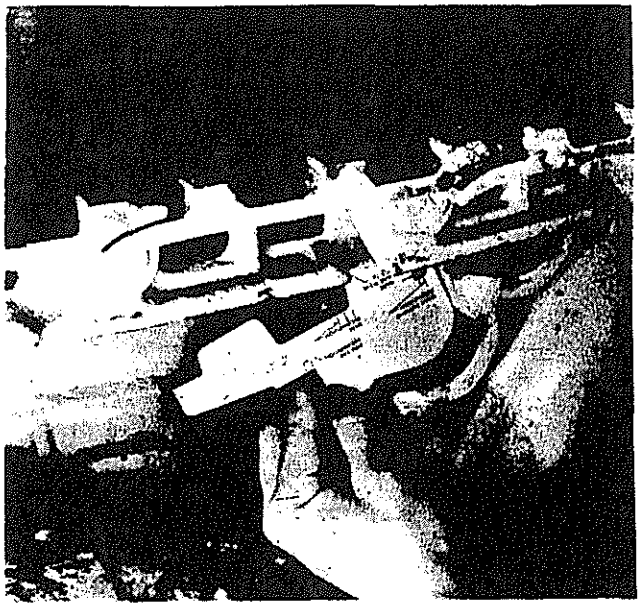


WEAR GAUGE (1ST. TYPE)

NOTE The track wear gauge in field service use does not show the track pitch length as shown. This can easily be added by drilling 1/4" hole (at point "A") in one end of gauge and by measuring out 6.000" from center of 1/4" hole and scribe a 1/2" line and drill a 1/4" hole (at point "B") on the center. Drill another 1/4" hole at (point "C") 6-1/4" along side slot the hole out and scribe another 1/2" line for 6.120" for the track bushing recondition mark. Later production track wear gauges will have these holes added.



Checking Side Bar Wear



Checking sprocket Teeth Wear

The rail links have only one wearing surface, that being the surface which contacts the track rollers, track idler and the support roller.

Rails of side bars wear as they pass over idler, support rollers, and track rollers; amount of wear and projected replacement time can be determined by use of wear gauge, available through Allis-Chalmers Dealer.

Sprocket teeth are index ground to insure proper contact between teeth and bushings; teeth are induction hardened to help revert wear. Odd number of sprocket teeth enables sprocket teeth to contact different bushings each revolution (commonly known as hunting tooth sprocket) there by increasing both bushings and sprocket life.

TRACK WEAR GAUGE

RAIL ASSEMBLY

1. BAR, side, L.H.
2. BAR, side, R.H.
3. BUSHING
4. PIN, track
5. PIN, master (Not Assembled)

If a track is worn to the point where the length of one link can be taken out, the track will be so far out of pitch that the increased wear on the sprocket will far more than offset the saving that may be obtained by further life of the track.

Occassionally, under extreme abrasive conditions the sprocket tooth may wear deep enough into the bushing to justify turning the pins and bushings before any appreciable wear shows on the inside of the bushings and on the pins. In other words, the pitch length of the track may only slightly exceed the pitch length when new. In any case, the remaining thickness of the bushings is the determining factor. Pins and bushings must be turned before the bushing wears through and the pin is destroyed, or before the bushing becomes thin enough to allow it to crack in service.

TURNING PINS AND BUSHINGS

To successfully assemble or disassemble track, a track press and necessary adapter is required; these can be obtained from various manufacturers, use the following sequence.

1. Uncouple and remove track.

2. Remove track shoes from track assembly.

3. Use a track press and proper adapters, remove pins and bushings from side bars.

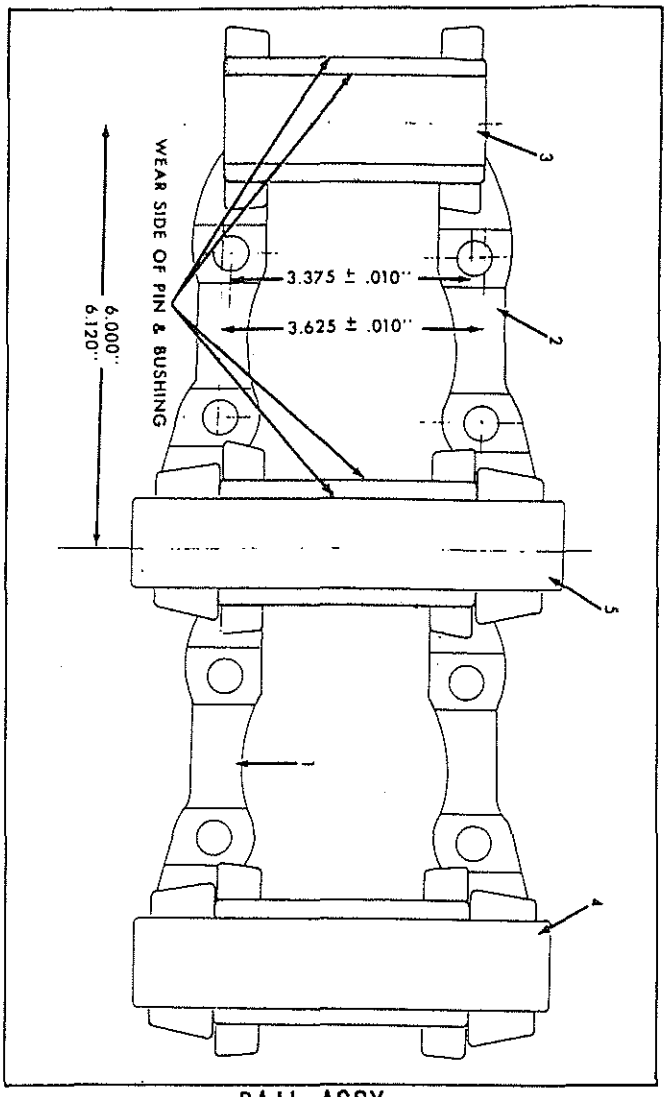
4. Thoroughly clean and inspect all pins, bushings and side bars for cracks. If any cracks are found, component must be replaced.

5. Assemble track components as shown (Fig. , turning pins and bushings 180° from their original position so new wear surfaces are exposed to the wear side as shown.

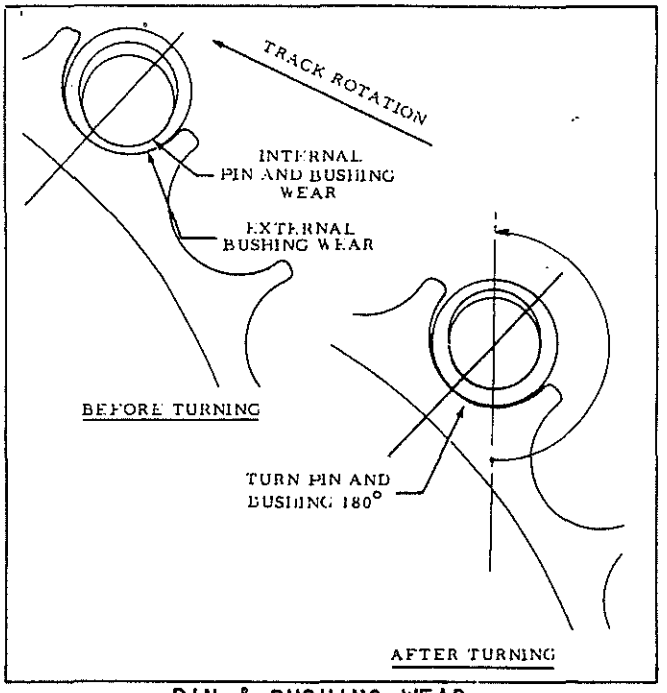
6. Install track shoes on track assembly and torque bolts 100 - 110 ft. lbs.

7. Install and adjust track.

In some cases it will be necessary to replace only one link or so in the track assembly. In such cases the tracks should be removed and the necessary pins and bushings removed by hand, either with a power press or a sledge hammer. In replacing, install master pins instead of the ordinary pins removed.



RAIL ASSY



PIN & BUSHING WEAR

TRACK WEAR GAUGE

CHECKING TRACK ROLLER FLANGE WEAR

To check the track roller flange wear it requires:

1. The removal of the outer rock guards.

2. Loosen the tracks by loosening the two cap-screws in the lock plate. Turn the track adjusting screw into the yoke to loosen tracks.

3. Jack the tractor up and place blocks under the grousers at the sprocket and the front track idler. This will allow track to sag (as shown).

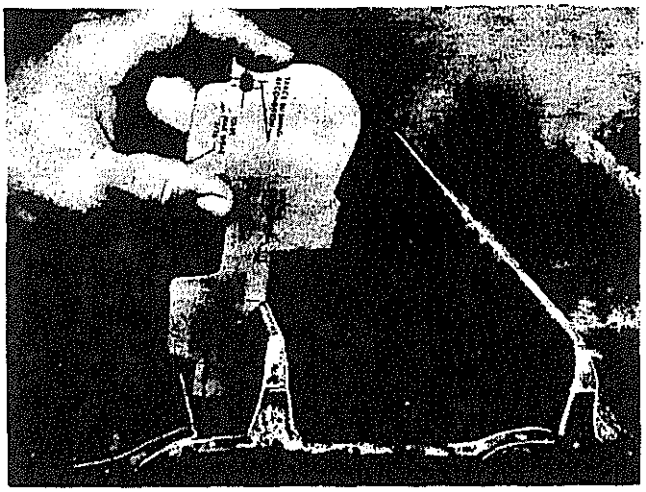
The track roller flange can now be checked. Take a bar and pry rollers up and down to check for loose rollers, bushings and shafts. Check for roller seals leaking.

Which roller will wear the most will depend on the type of work for which the crawler tractor is being used. To get more wear out of the track rollers you can switch the rollers around.

CHECKING TRACK ROLLER FLANGE WEAR

CHECKING GROUSER WEAR

When rebuilding track shoe grousers, use the wear gauge to check for proper height of grouser (as shown). This shows the amount of wear in the grouser height. Also, make a check on the track shoe bolts for their proper torque of 100-110 ft. lbs. If the bolts are loose it will allow the holes in the grousers to wallow out. It is then impossible to keep them tight. Wear on track shoes and grousers is determined by the type of material that it is worked in, amount of slippage and travel speed.



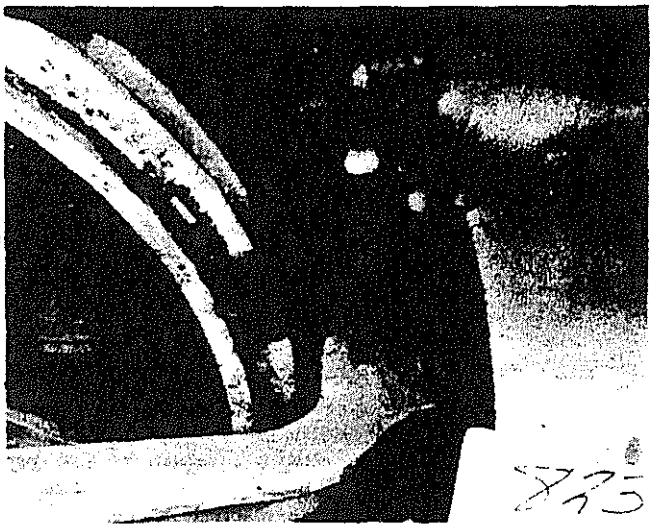
CHECKING GROUSE WEAR

CHECKING IDLER FLANGE WEAR

When checkingidler flange wear also check for proper alignment, this will show up as more wear on one side of the center flange then the other. This can be corrected by removing shims from under the retainer wear plates and adding shims to other side of the idler under the retainer plate.

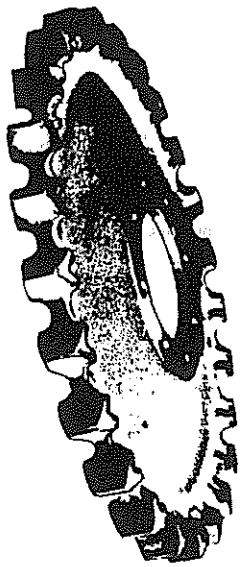
Misalignment of front idler can be caused by the track roller frame being bent. This can cause wear to all component parts in a tract assembly.

To check for loose idler bushings and shaft also check for seal leakage by taking a bar and pry the idler up and down.

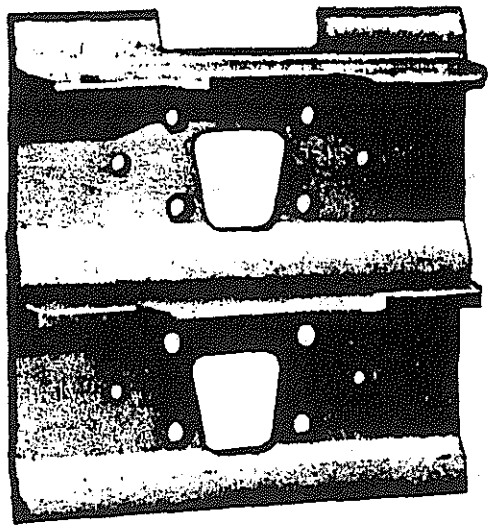


CHECKING FLANGE WEAR

SPOCKET



Skeleton Sprocket

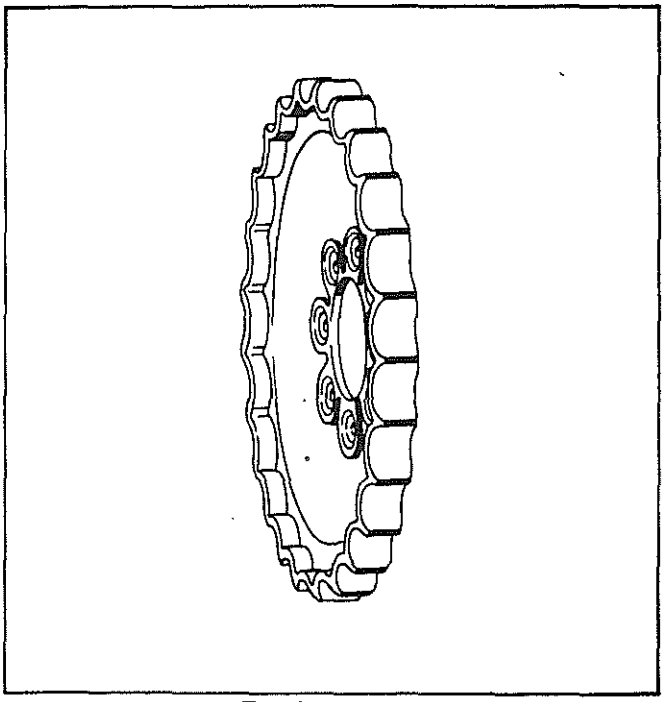


FULL SPROCKET

For each tractor application on a given soil condition, there is one track which best fits the operation. The full sprocket is the most commonly used, especially under abrasive, sandy and dry conditions where wear is more rapid, the full sprocket gives more tooth contact to the bushing area. Also, cut-out grousers would be of great value in this application to reduce possibilities of packing.

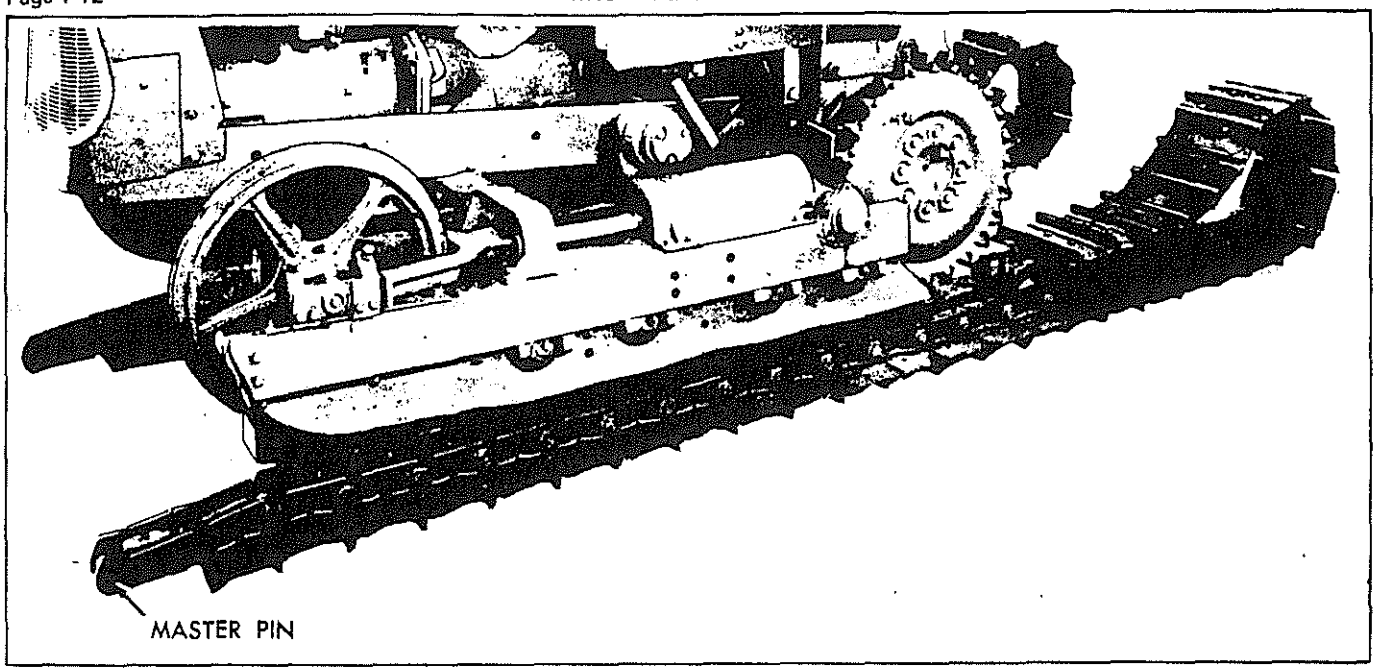
Both types of sprockets use the hunting tooth design which means that the sprockets have an odd number of teeth. With this design the tooth contacts a different track bushing every revolution thus lengthening the life of the sprocket teeth and track pins and bushings.

The drive sprocket is securely mounted over a flange on the hub and bolted on with eight heat treated capscrews. The flange rather than capscrew absorb any shock that may be applied to the sprocket as shown.



Full Sprocket

TRACK REMOVAL



Block tractor securely under the front cross member and the drawbar bail. Locate the master track pin. It may be identified because it is 5/16" longer than the regular track pins. Release the left steering clutch and apply brake. Roll track around until master pin is at front on right hand track. Release right hand steering clutch and apply brake. Roll left track until master pin is at front.

Remove the inner and outer front idler guards. Remove the track shoes (2) on either side of the master pin so that the OTC puller may be installed. Press master pin from track.

If the track pin is worn it may catch on the track rail. In this event when the pin is half way out, rotate pin 180° to put the unworn side against the track weight.

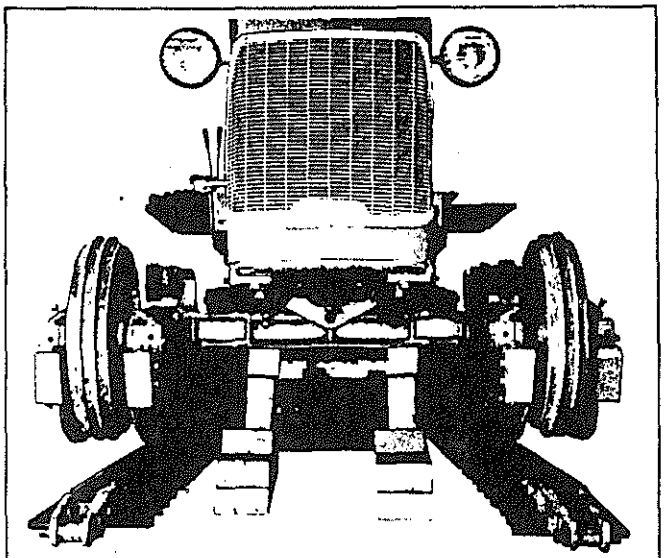
If the pin is to be removed with a sledge hammer and punch, turn the track adjusting screw back to give the track extra slack. Place a block under the grouser lug. (Do not remove track shoes). Use the power of the tractor and force the track against the block to remove all tension from the track pin.

Protect the eyes with safety goggles as the track pins are glass hard and there is danger of flying metal.

Back up the inside track rail with a heavy bar at least 110 lbs. weight. This is to prevent spreading of the rails. If the rails spread it will tighten the pin making it almost impossible to remove.

TRACK INSTALLATION

The track is usually replaced as a last operation

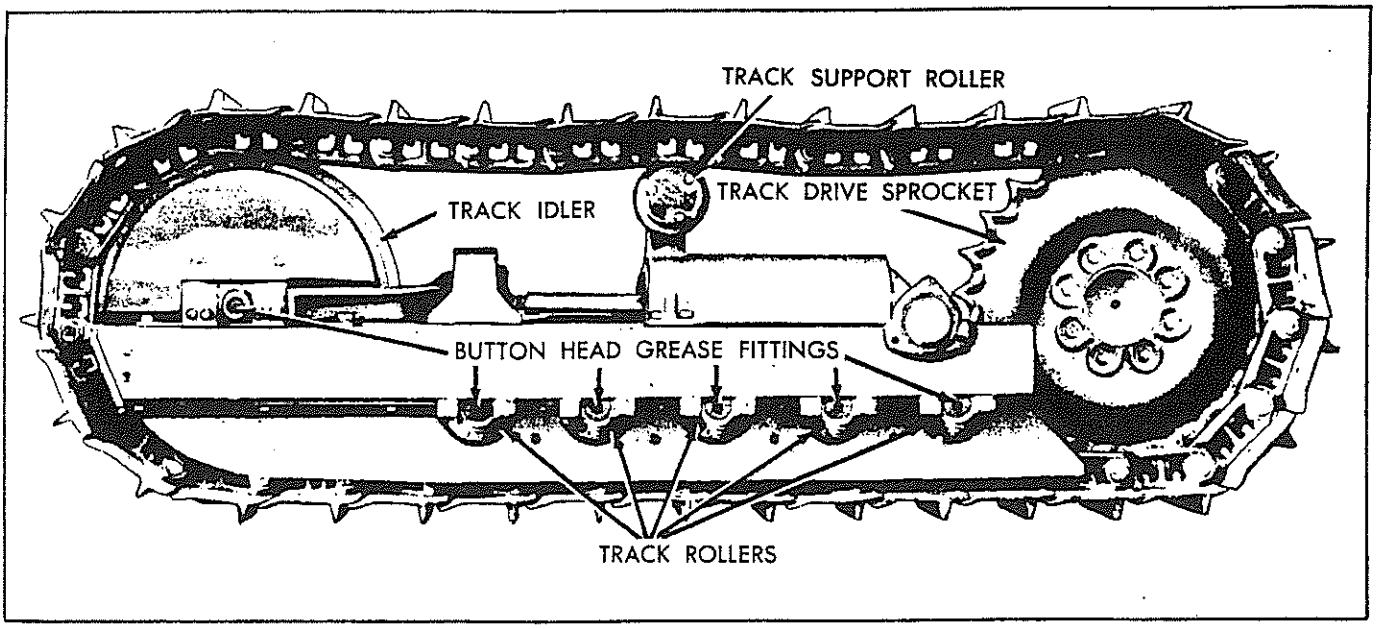


BLOCK TRACTOR SECURELY

when the tractor may be operated. Place the track under tractor with both tracks spaced evenly and with the bushing end to the front. The front idler must be back far enough to give track extra slack. Let tractor down on the tracks and back up to the end of track.

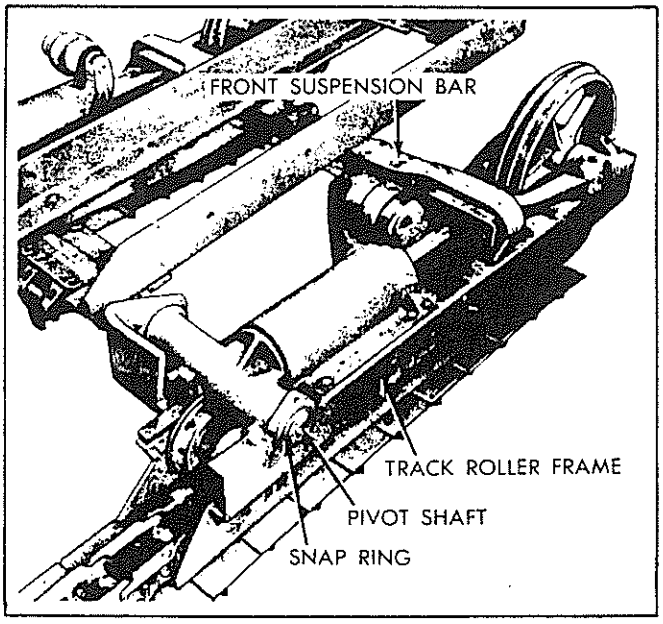
Insert a bar through the pin hole and pick track up and catch bar in rear sprocket tooth. Hold in this position and drive tractor forward. Feed track over support roller and front idler. Place a block under the front shoe grouser so that it is supported about 10 inches from floor. Drive tractor forward until all slack is in the top of the track. Lap the two ends and insert the master pin. If the pin hole does not align, place a chain through the track rail, and with a bar through the chain and under the first grouser pull the slack ends of the track together to align pin holes.

TRACK ADJUSTMENT

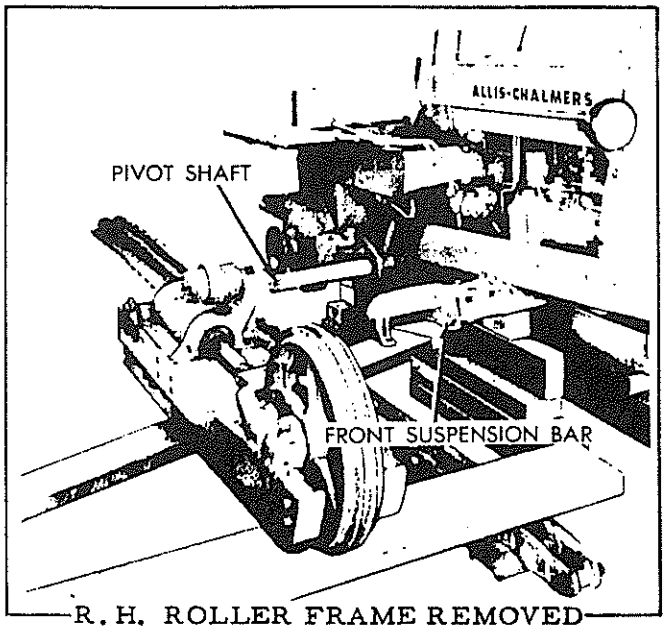


The track should have 1-1/2" of sag when measured with a straight edge laid over grousers. Readjust when sag increases to 2-1/2". Extreme tight or loose tracks cause excessive wear on the track pins and bushings.

TRACK ROLLER FRAME



Remove track, remove rear sprocket. Raise tractor and block securely. Remove snap ring from outer end of pivot shaft. Block under rollers with a long plank. Place two planks under the plank and under rollers, place two pieces of pipe between two lower plank and floor to act as rollers.



R. H. ROLLER FRAME REMOVED

Remove the four capscrews from end of front suspension bar. Slide entire frame outward from pivot shaft. To assemble, lubricate the pivot shaft thoroughly with lubriplate and slide assembly back into place.

TRACK ROLLER FRAME

A change has been made in the track roller frames to eliminate the 1/4" spacer part between the track roller and the frames on both 4 & 5 roller tractors.

Used on tractors prior Serial Number 2987	Used on tractors Serial Number H-3-3267 HD-3-3326 & up
5 Roller	
233752--LH	235553--LH
233753--RH	235554--RH
4 Roller	
233728--LH	235547--LH
233734--RH	235548--RH

On tractors 2987 and up to H-3-3267, HD-3-3326, an intermediate frame was used. The intermediate frames were not serviced and for replacement parts the new numbers must be used. The front cross beam also was changed effective 2987 to accommodate the new track frames. On early production units up to serial #2987, the old cross beam must be used when assembled on the old track frames. On units 2987 and up a new front cross beam is used.

For field service the new beam and new track roller frames can be used in combination on any tractor. The new track roller frame can be used on any units with the old beam by adding the 1/2" spacer, 4 per tractor and 8 capscrews. The spacers are located between the cross beam and track roller frames. The only combination that cannot be used is the new cross beam on the old track frames.

On units 2987 to H-3-3267 and HD-3-3326 using the intermediate track frames, both R.H. and L.H. track spring housing assemblies had to be reworked. The rear end of the cover had to be shortened 7/16". For field service on these tractors, the spring housing must be reworked in the field when replacement is necessary.

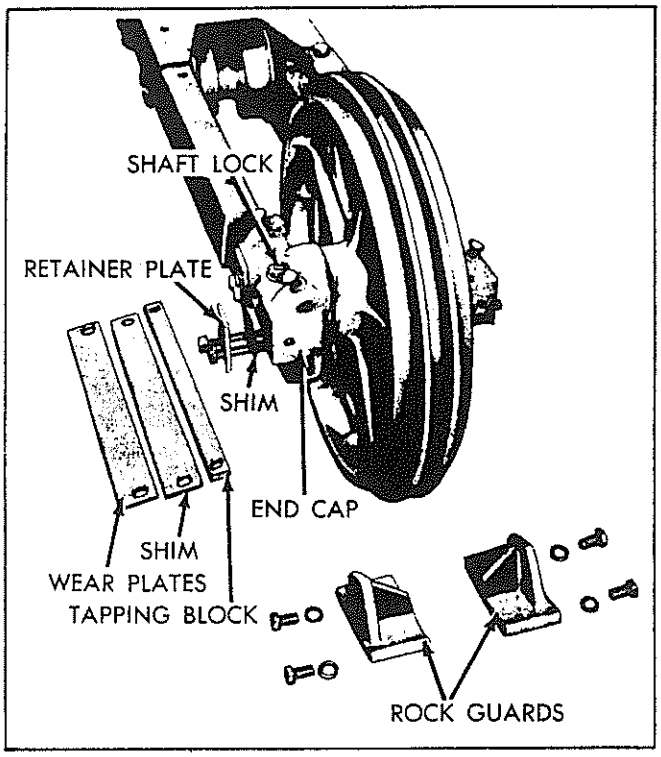
SHOULDER BOLT, MAIN FRAME

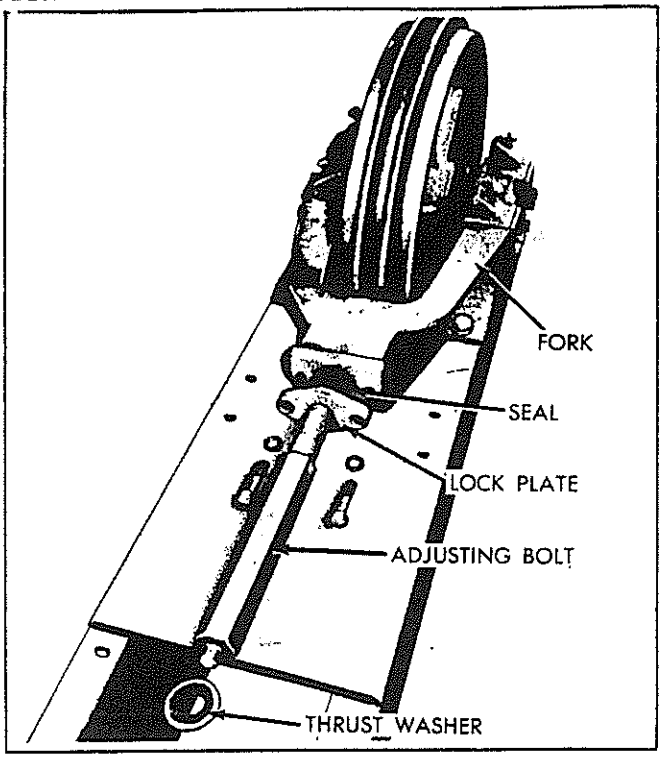
In tractor serial number approximately 3351 and up, a new shoulder bolt and nut is used to provide a dowel pin effect, to maintain position of the main frame side angle. The shoulder bolt is installed in reamed fit holes, in the rear most hole of side angles to pivot axle. This method is used in assembly on production units.

The early frames have 3/4" holes. The new frames are sized to be reamed on installation to 15/16" or .937 - .005 - .000. This must be done with a 15/16" reamer and not a drill bit. The pivot axle part number has been changed. The old axle had 3/4" hole. The new axle will have holes, sized also for reaming.

This improvement can be used in the field and is effective to correct the problem of frame member bolts coming loose and also breakage of engine mounts. For installation in early production units, the holes can be drilled and reamed for the bolts. Any time a new main frame angle is installed or a new pivot axle, the hole in the related part will have to be reworked to accommodate the new shoulder bolt. This bolt should be torqued 400 ft. lbs. to 425 ft. lbs. The bolt should be installed up from the bottom.

FRONT IDLER





Remove track. Remove brackets from each end of track roller frame and the stop bolts. Slide idler assembly forward until it clears the frame. The idler shaft construction is the same as the truck rollers. (
), except for the end caps which are drilled for setscrews to prevent the shaft from rotating.

On the outside of the end caps, guide plates are provided. Under these plates shims are used to center the idler between the frames and to remove excess end movement of assembly. The top and bottom of the roller frame are protected by wear plates which are replaceable; yet leaving it free to slide back when necessary.

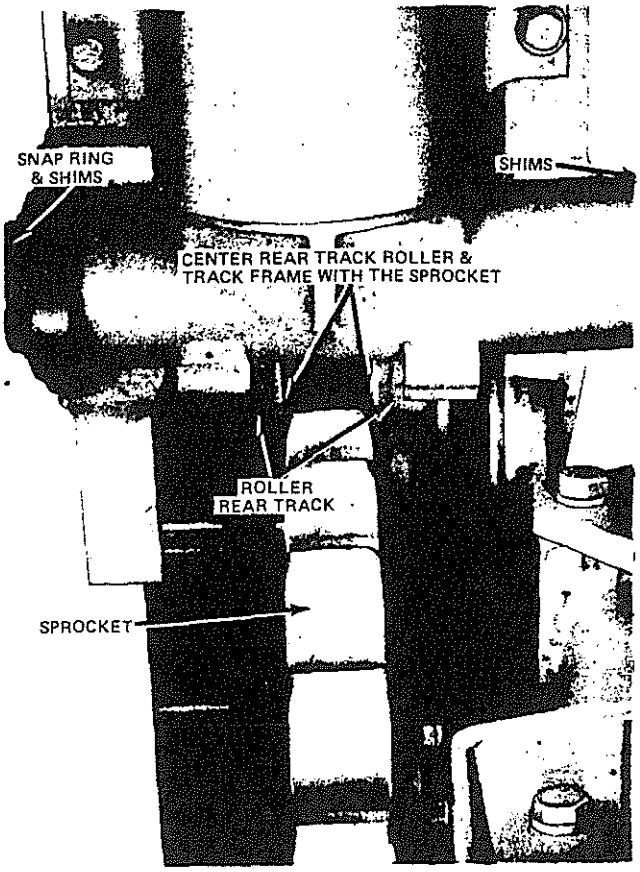
Worn parts which allow too much movement or twist of the idler should be replaced. Shims under the end plates of front idler should be divided equally for both ends and used in an amount to give .031" clearance. If necessary to align roller with track frame due to flange wear, shims may be used unequally.

Tighten plate capscrews to 45 to 50 ft. lbs. Tighten setscrews retaining end caps to axle shaft 80 to 90 ft. lbs.

Torque the wear plate capscrews to 88 to 95 ft. lbs. Shim to give a free sliding fit for entire length of travel.

The fork between front idler and track tension spring fits the idler brackets on dowel pins. The machining of this fork gives permanent idler alignment.

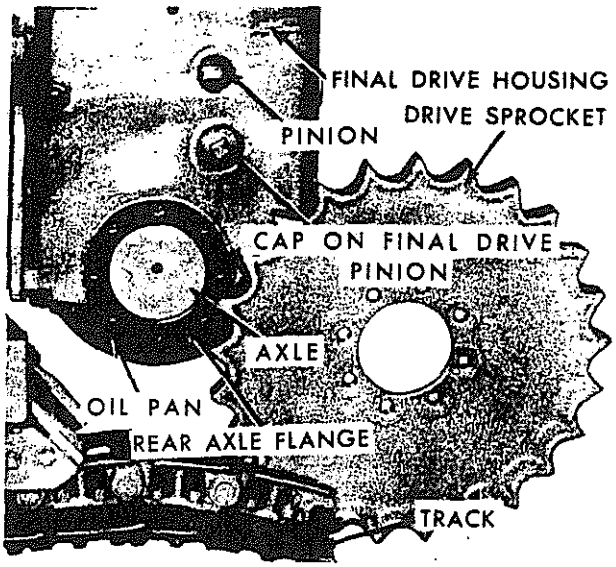
The track adjusting screw is clamped with a retainer lock and two capscrews to prevent wear on the threads of the adjusting screw. These capscrews must be loosened to turn adjusting screw. The front screw opening is sealed with a welsh plug and a rubber seal between lock plate and fork. When assembling, pack thread with grease and tighten lock plate capscrews to 10 to 15 ft. lbs. This arrangement prevents rusting of threads which would make adjustment difficult.



SPROCKET

Permissible sprocket runout is 1/8" total indicator reading. As the sprocket overlaps the rear track roller, this sometimes causes the sprocket to rub the inside edge of the rear roller.

A spacer was provided to place between track roller frame and pivot bracket. It is horseshoe shaped and may be installed without removing track roller frame. It is retained in place by a capscrew in lower end of R. H. and L. H. fender supports.



Drive Sprocket Removal

To install shim, loosen the four bolts at outer end of front beam. Move roller frame out far enough to install shim and retighten capscrews in front beam.

Production wtih serial #2987 uses shims as required to align track frame. These shims may be used when track roller frames are rebuilt.

Sprocket capscrews should be tightened 190 to 210 ft. lbs. torque.

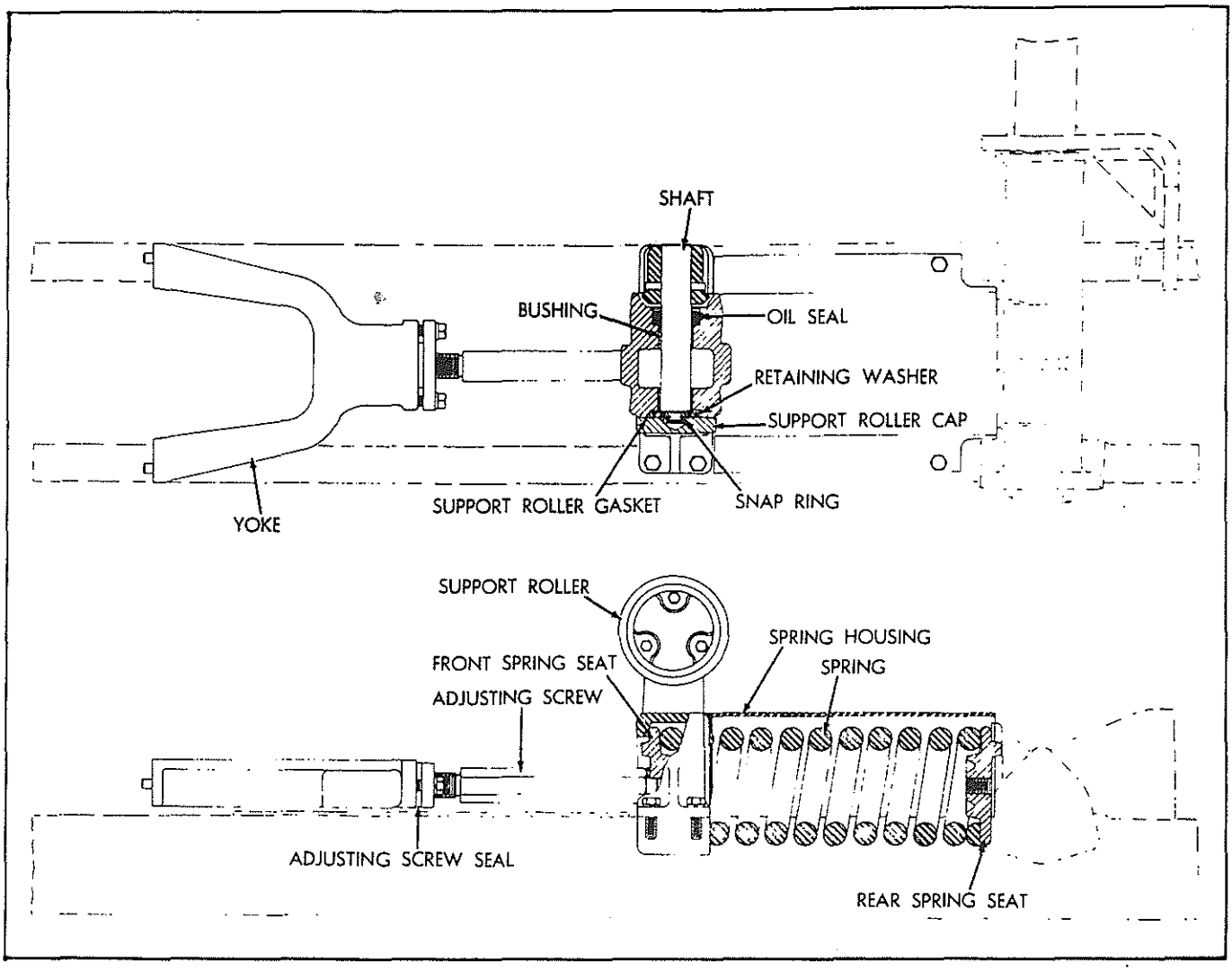
Special sprocket capscrews may be ordered with a locknut.

SPROCKET ATTACHING BOLT

A new bolt is used on the H-3 and HD-3 tractors. It is effective with serial number 2669.

The bolt has a larger head for a better grip with the wrench and is shorter so that it does not protrude through the flange. Threads protruding through the final drive axle flange were sometimes damaged by rocks, which made them difficult to remove. The new bolt will eliminate this problem.

TRACK TENSION SPRING

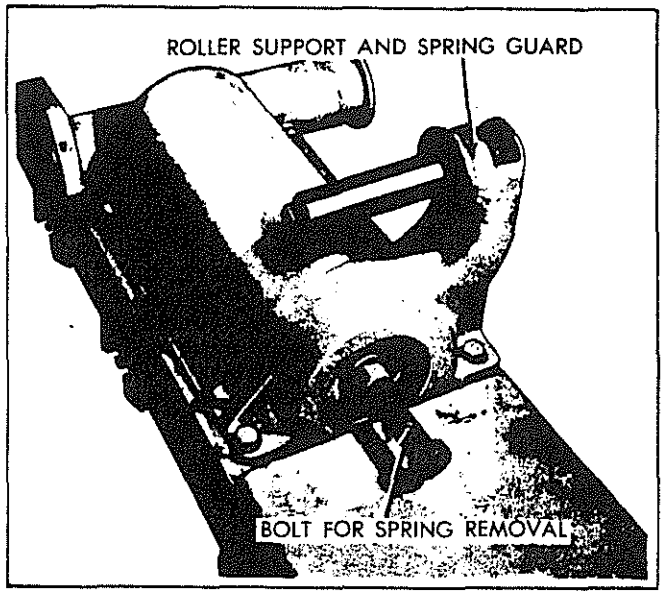


REMOVAL

A spring is provided for release of the front idler to allow front idler to slide back if a foreign object becomes lodged in the track. Effective Serial No. 3554, the track spring cover, is separate from the housing.

Remove track and the front idler fork and track adjusting screw. Install long bolt (special) and compress spring until free. This bolt must be turned into threaded rear plate at least eight turns, otherwise force of spring may strip threads. With spring compressed, remove bolts attaching spring cover and idler bracket to track frame.

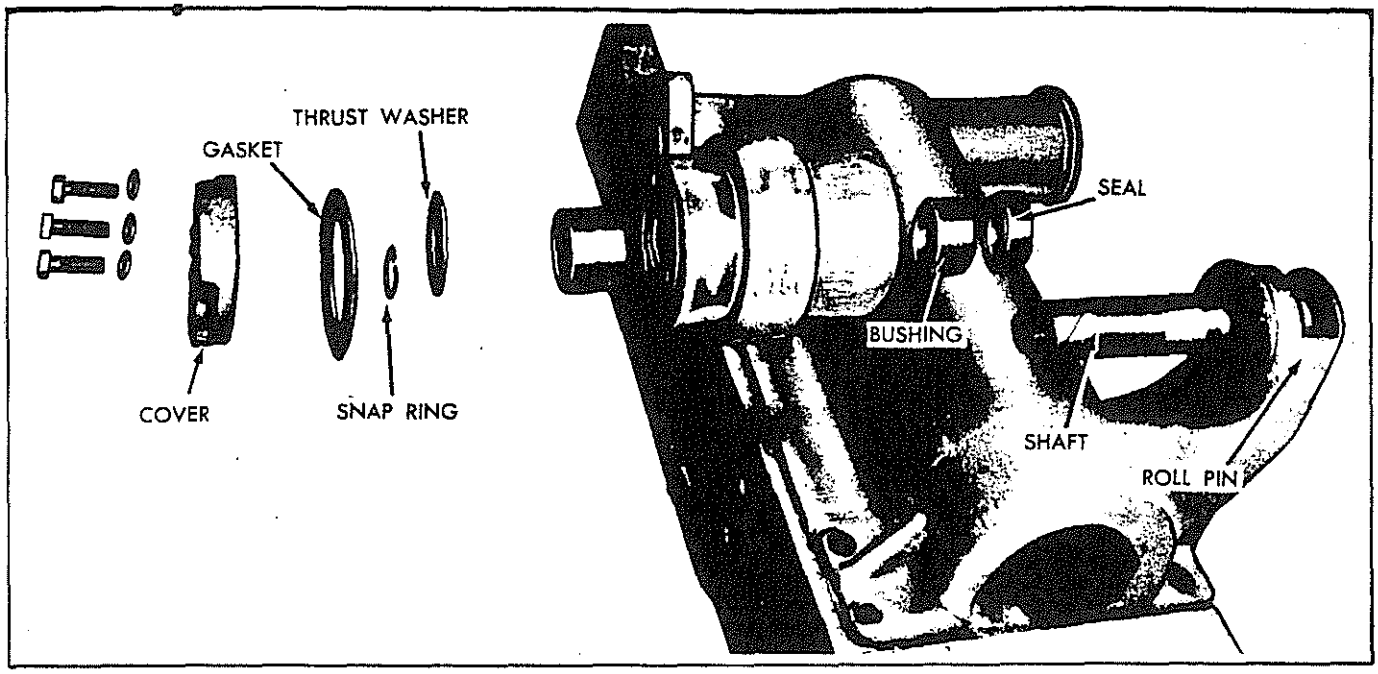
CAUTION: Do not try to remove spring cover without spring compression bolt; to do so may create a hazard as tremendous force is contained in compression spring.



Parts necessary for spring compressing tool:

1 - 234053 - Stud
1 - 910255 - Washer
1 - 915797 - Roll Pin
2 - 910923 - Nut

TRACK SUPPORT ROLLER



REMOVAL

Remove three capscrews attaching cover to roller and remove cover. Remove snap ring, and the "D" thrust washer. Remove roller assembly from shaft. Remove the two bushings and the oil seal.

Remove the roll pin retaining shaft, and drive the shaft from housing assembly.

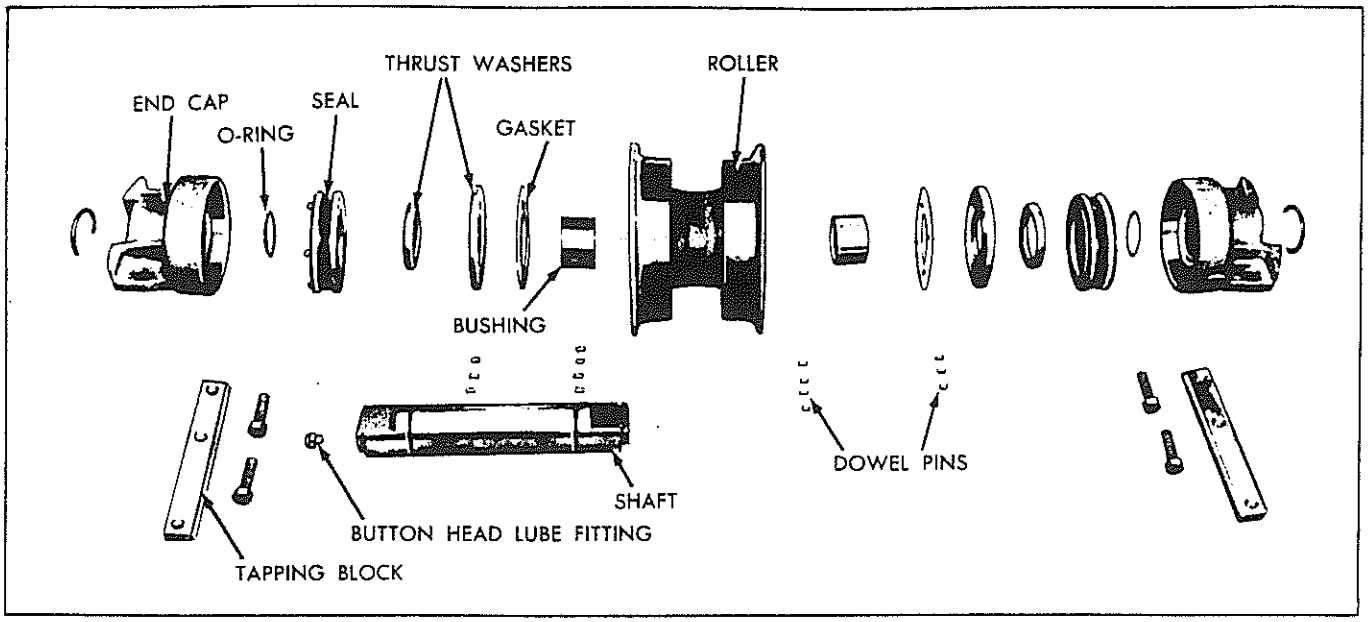
ASSEMBLY

Install bushings in support roller, pressing bushings flush with counter bore surface. Install oil seal with the larger lip toward bushing, and the three wiper lips toward outside of roller.

Install shaft through cap end of roller and enter through bushings and oil seal, being careful while entering shaft through oil seal. The inner lip must be turned inward, and the three outer lips must be turned outward. Install roller and shaft to housing assembly, and drive in the retaining roll pin. Install "D" washer, gasket and end cap.

To lubricate turn roller with one capscrew down in cover and remove the other two. Insert tube of grease gun forcing oil through capscrew hole, and allowing air to escape from opposite hole. When filled to level of capscrew holes, replace capscrews. Torque capscrews 25 to 30 ft. lbs.

TRACK ROLLER & FRONT IDLER PRIOR TO TRACTOR SN-8298

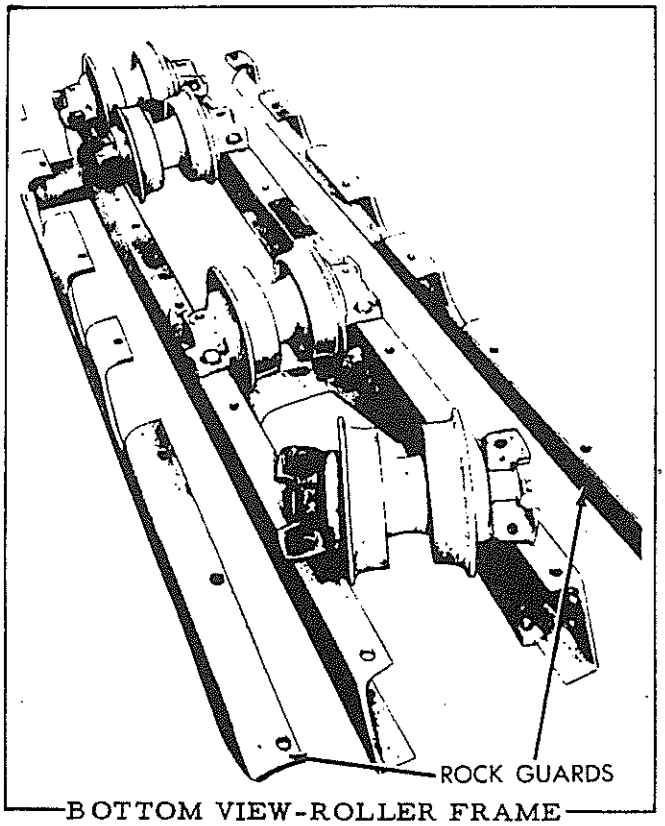


Remove rock guards and bolts attaching rollers to track frame. Raise tractor high enough to slide roller out. It may be necessary to loosen track adjustment to get enough space to remove roller.

Remove snap ring from ends of roller shaft and slide end caps, seals, washers etc. from shaft and roller.

Press the two bushings from the roller or idler.

Examine the parts and replace if worn. Pay particular attention to the wear surfaces of the thrust washers etc. always replace seal assembly. Replace worn dowel pins. Dowel pins may usually be pulled with a pair of vice grips. If not, weld on extension on the pin. As a last resort the pins may be cut off flush and new holes drilled.

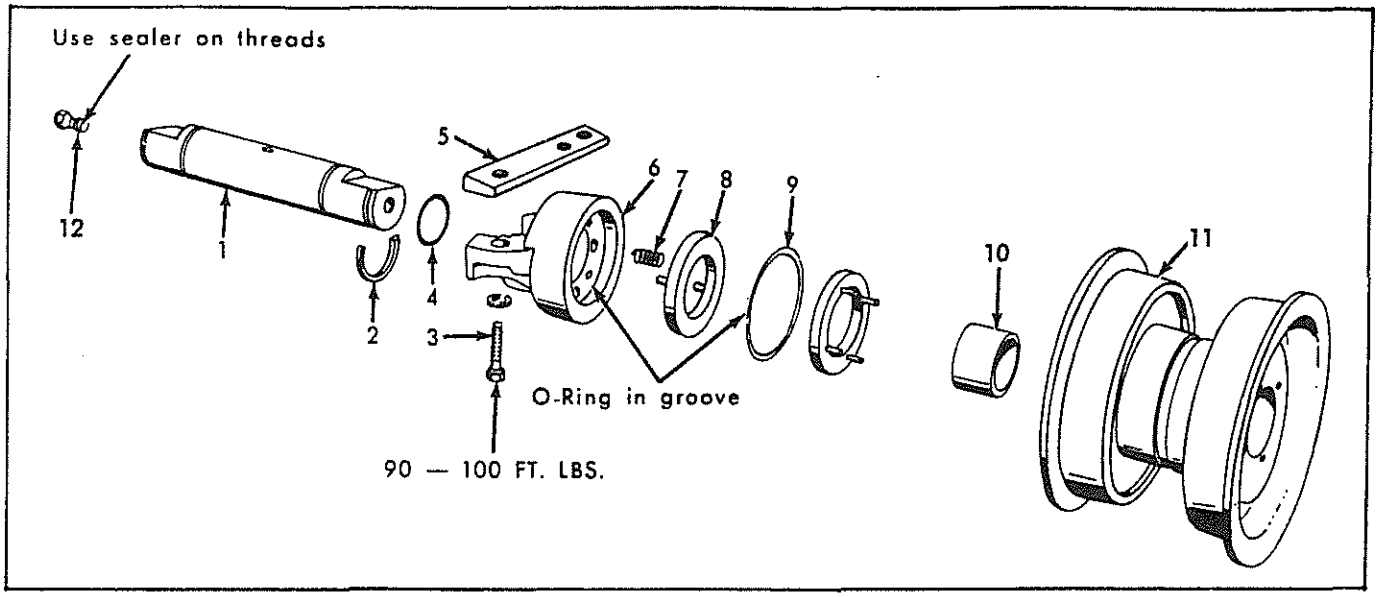


BOTTOM VIEW-ROLLER FRAME W/1 ROLLER REMOVED

ASSEMBLY

Press bushings into roller until flush with end of bore. Install the shaft. Place the gasket over roller dowel pins being sure parts are thoroughly clean. Install the large thrust washer on dowel pins. Install "O" ring on the shaft. Install the seal assembly in the end cap. Install the small thrust washer on the dowel pins in the end cap. Press the end cap on the shaft over the "O" ring with the flat on shaft matching the flat on cap. Install opposite end in similar manner. Lubricate all the thrust surface with vaseline prior to assembly. Lubricate the roller & idlers with 12 to 16 strokes of the grease gun. This is a slow process and must be done slowly allowing time for the air trapped in assembly to escape, otherwise the seal bellows will be ruptured.

TRACK ROLLERS
EFF. WITH H-3 SN-8298



Track Rollers

1. SHAFT, track roller
2. RING, snap (2 Qty.)
3. CAPSCREW (4 Qty.)
4. O-RING (2 Qty.)
5. BLOCK, tapping (1-L.H.) (1-R.H.)
6. BRACKET (2 Qty.)
7. SPRING (8 Qty.)
8. SEAL ASSY. (4 Qty.) w/roll pin 7/32 x 3/4
9. O-RING (2 Qty.)
10. GASKET (2 Qty.)
11. BUSHING (2 Qty.)
12. ROLLER ASSY., track
13. FITTING, lube, but-hd.

The track rollers can now be removed with the tractor placed on blocks as explained above:

1. Remove the inner and outer rock guards.

2. Remove the capscrews attaching track roller or rollers which need attention.

3. Remove track roller.

DISASSEMBLY OF TRACK ROLLERS

1. Thoroughly clean outside of track roller.

2. Remove the button head grease fitting.

3. To remove the snap ring from shaft, place the track roller in a press. Support the shaft on the bottom and press down on the end cap to compress the seal springs. Remove snap ring, remove track roller from press.

4. Slide end cap from shaft springs, seal assembly, gasket and remove O-ring from end cap.

5. Slide the end cap and shaft from the track roller; remove gasket, seal assembly, springs and O-ring from end cap.

6. Remove snap ring from shaft, slide end cap from shaft and remove two O-rings from shaft.

7. Press the two bushings from the track roller.

Thoroughly clean parts, examine the parts, replace if worn, (check for flat spots on roller from not turning). Always replace the steel seal washer assemblies, springs, gaskets, and all O-rings. Clean the drilled out passage in the center of the shaft, which feeds grease to the internal parts.

ASSEMBLY OF TRACK ROLLERS

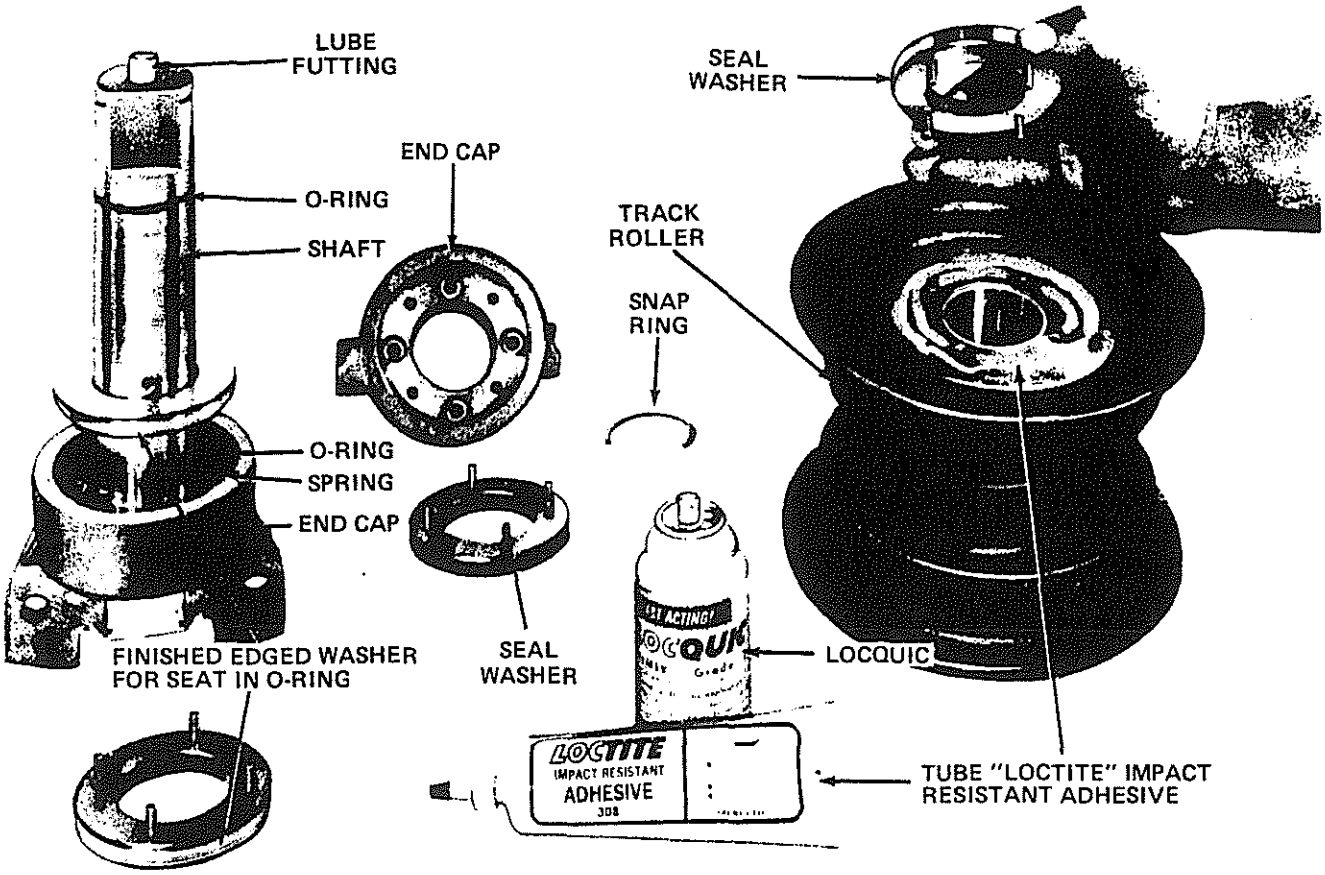
1. Press new bushings into track rollers until flush with end of bore; clean the face of the roller on any foreign material from pressing the bushings into the track rollers.

2. Clean each side of the roller face with LOCQUIC PRIMER, GRADE "T", thoroughly. Allow to dry a few minutes.

3. There are two types of seal washers used in the truck rollers, The two seal washers, installed next to the truck roller face, have outside diameter edges of a low machined finish. The two seal washers used, one in each end cap to aid in O-ring seal, have outside diameter edges displaying a fine machined finish.

   Clean thoroughly the two seal washers, roll pin side, that are to be installed on the truck roller face with LOCQUIC PRIMER, GRADE "T". A high degree of cleanliness is necessary on truck roller face and seal washer mating surfaces if a complete seal is to be attained. Allow LOCQUIC to dry a few minutes.

LOCTITE (SEAL WASHER)



Apply LOCTITE To Seal Washer

When LOCTITE impact resistant adhesive is ready to apply to mating surfaces, puncture a small hole of a 1/64" size in spout of LOCTITE impact resistant adhesive tube, then distribute sparingly a thin film of LOCTITE impact resistant adhesive.

The small hole punctured in tube will help in regulating flow so that a uniform flow can be applied and so that desired width of LOCTITE impact resistant adhesive on mating surface is obtained.

You will also notice the tube of LOCTITE impact resistant adhesive will not be full. This LOCTITE impact resistant adhesive will harden if no air is present. So that LOCTITE impact resistant adhesive will hold its fluid composition, a slight air space remains in each tube of LOCTITE impact resistant adhesive after it is sealed.

Apply LOCTITE impact resistant adhesive to face area of truck roller. LOCTITE is used to bond and seal seal washer to the truck roller face. Place LOCTITE in as near center of circumference of truck roller face as possible so, when seal washer is installed, the LOCTITE impact resistant adhesive is spread evenly to inside and outside of truck roller face area so that a complete seal can be attained.

Continue on and assemble truck roller completely. Allow from thirty minutes to three hours for LOCTITE to dry before full adhesive strength is reached. This will depend on temperature and condition of surface cleaned.

These seal washers can be used on H-3 and HD-3 crawler tractors prior to S/N 9700 to 8298. When repair of truck roller assemblies is undertaken, we recommend that the LOCTITE impact resistant adhesive replace the gasket in the truck roller assemblies on the tractor with serial number prior to S/N-9700 - 8298.

This special LOCQUIC and LOCTITE impact resistant adhesive can be purchased from your Allis-Chalmers Dealer through Parts.

4. Slide shaft into track roller and install two new O-rings on shaft (lubriplate O-rings).
5. Install new O-rings in grooves for O-rings in both end caps (lubriplate O-rings).
6. Insert four springs in large holes in each end cap.
7. Lubriplate the seal washer sealing surface.

TRACK

8. Install the end cap assembly over shaft on opposite end of shaft grease fitting; care must be taken not to lose the springs out of their holes.

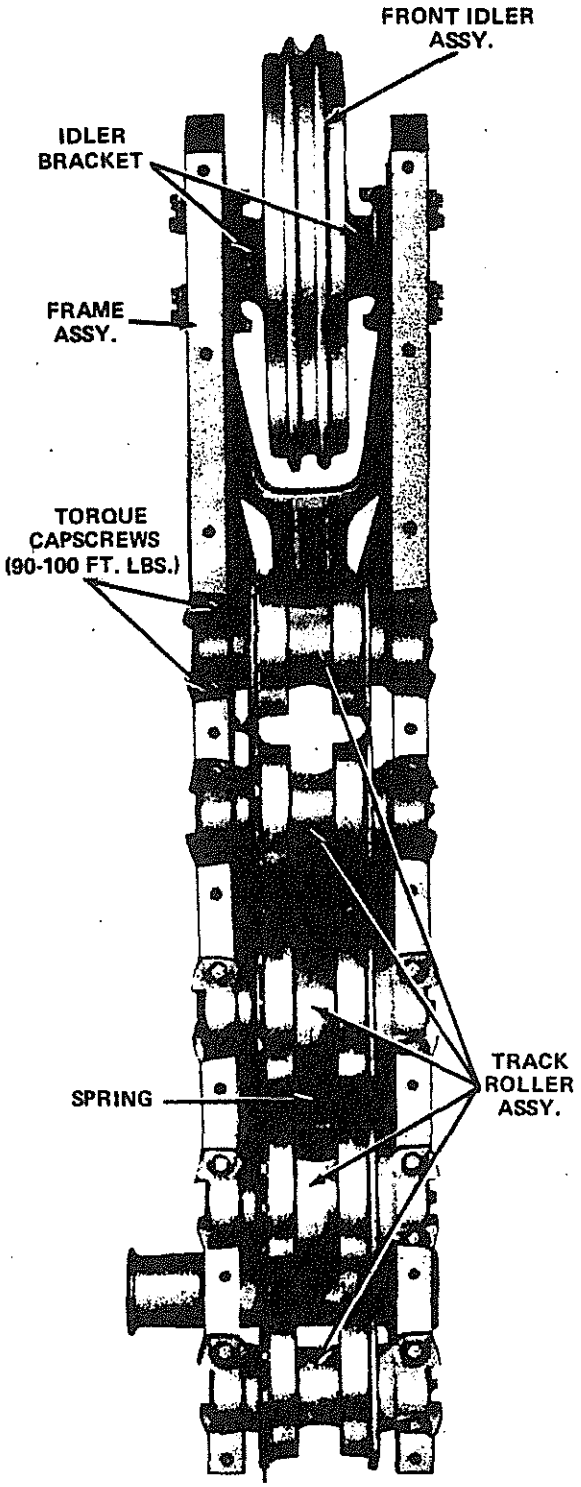
9. Install snap rings in groove.

10. Install the end cap assembly over shaft on grease fitting end; care must be taken not to lose the springs out of their holes.

11. Put the roller assembly in a press. Support the shaft on the bottom and press down on the end cap to compress the seal springs. Install snap ring. Remove from press.

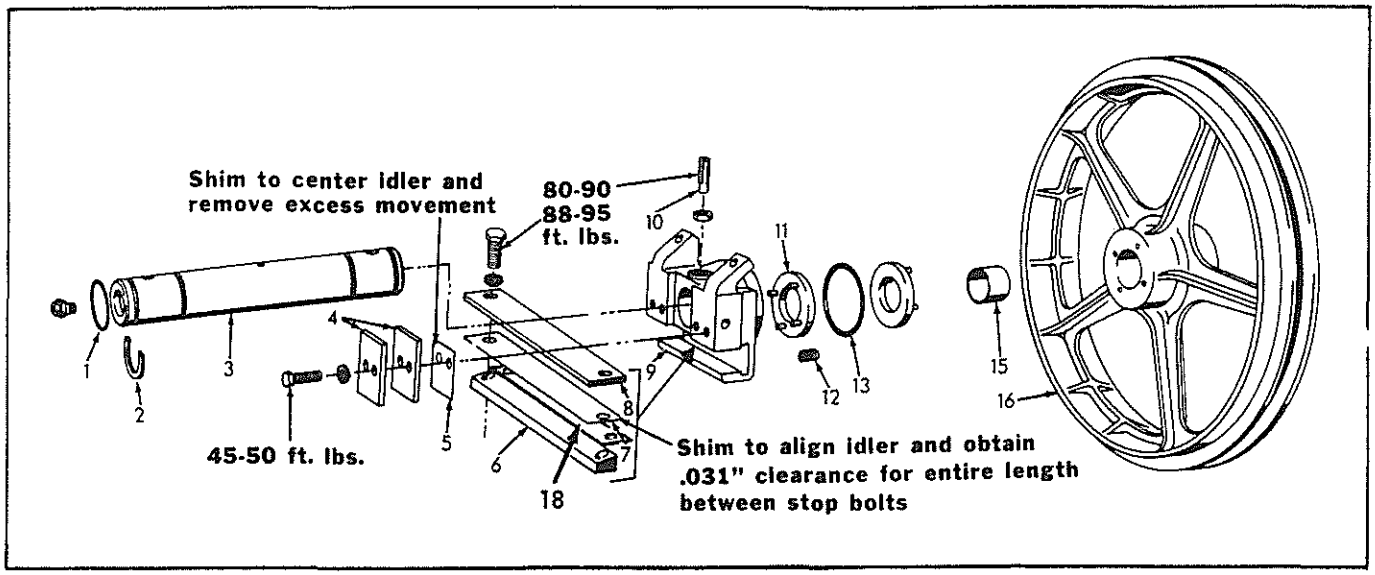
12. Install a new button head grease fitting in roller shaft using a sealer on the threads.

13. Lubricate the idler with SAE 90 transmission oil 12 to 16 strokes of the grease gun. This is a slow process and time must be allowed for air trapped in the system to escape. Excess lubrication will allow grease past face type seals giving the appearance of seal leakage. (It takes about 4 oz. of SAE 90 transmission oil per track roller). Place track roller in position, turn the flat surfaces on shaft and end caps against the bottom of track frame. Align track rollers on track frame as shown. Insert capscrews through end caps into tapped blocks and torque capscrew 90-100 ft. lbs.



View Of Track Frame Assembly From Underside Alignment Of Track Rollers On Track Frame Assy,

FRONT IDLER
EFF. WITH H-3 &HD-3 SN-8298



Front Idler

1. O-RING (2 Qty.)
2. RING, snap (2 Qty.)
3. SHAFT
4. PLATE (8 Qty.)
   2 - Capscrew
   2 - Lockwasher
5. SHIM (Use as req'd.)
6. BLOCK, tapping (2 Qty.)
7. SHIM, (Use as req'd.)
8. PLATE, wear
   2 - Capscrew
   2 - Lockwasher
9. BRACKET, idler
10. SCREW, special
    1 - Nut, 5/8NC
11. WASHER ASSY., seal (4 Qty.)
    4 - Pin, roll
12. SPRING (8 Qty.)
13. O-RINGS (2 Qty.)
15. BUSHING (2 Qty.)
16. IDLER ASSY.
17. FITTING, lube, but-hd.
18. SHIM (Use as req'd.)

FRONT IDLER

Maintenance of the track idlers consists of a periodic check of idler bracket wear plates, retainer guide plate wear and adjustments track alignment, bushings and shaft wear, shaft lock setscrews, grease leakage at the seals and damage to the button head grease fittings replace if missing.

To remove the front idler, umcouple the track. Move tractor rearward until track is off the front idler. Remove the rock guards from each end of the track roller frame and the two front stop bolts. Slide track idler and bracket assembly forward from idler yoke and track frame.

DISASSEMBLY OF FRONT IDLER

1. Thoroughly clean idler assembly.

2. Remove the button head grease fitting.

3. Remove the shaft lock setscrew from the idler bracket on the grease fitting side.

4. To remove the snap ring from shaft, place the idler in a press, with the grease fitting end up press down on the end cap and remove snap ring, remove idler from press.

5. Slide end cap from shaft, springs, seal assembly, and remove O-ring from end cap.

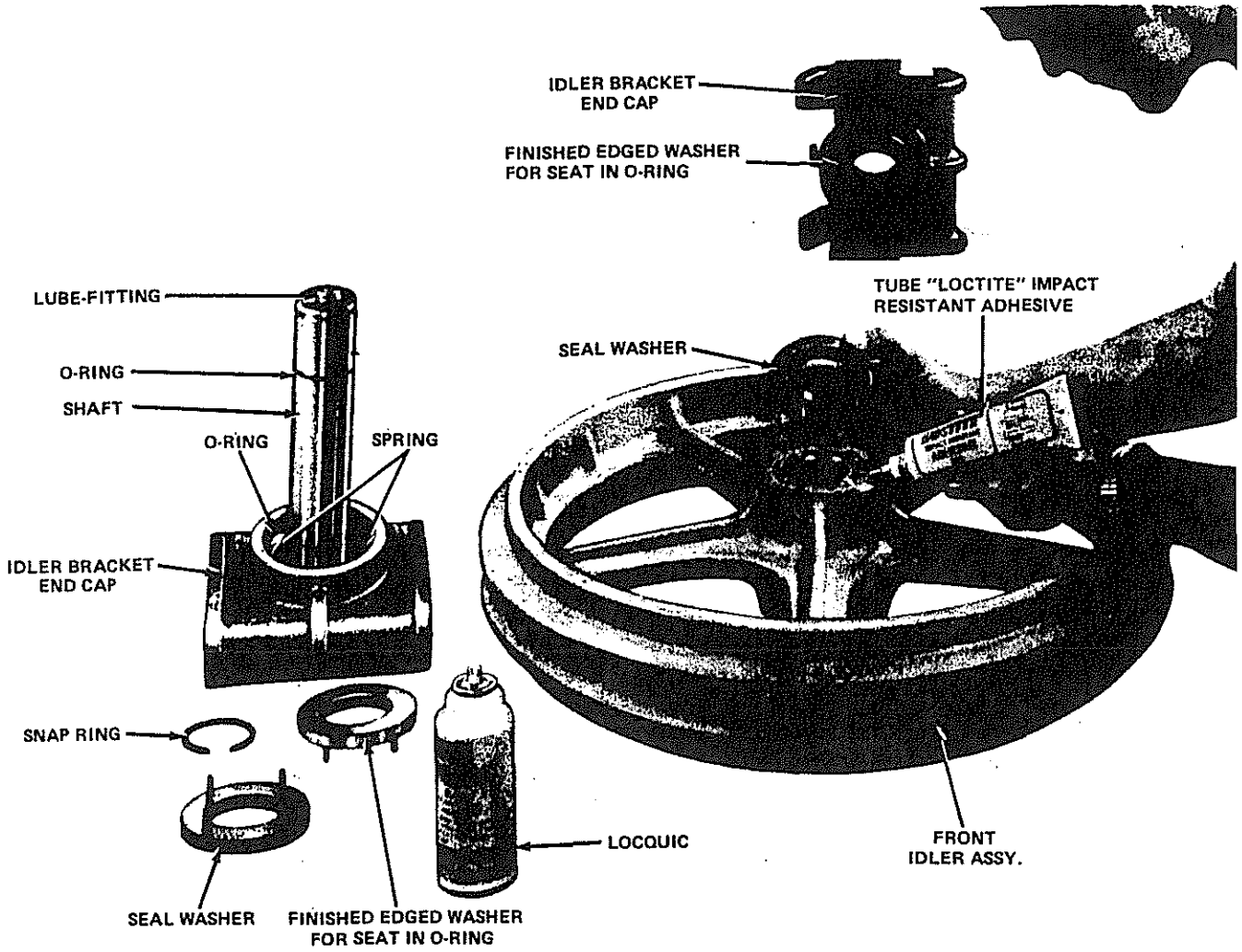
6. Slide the end cap and shaft from the idler, remove the gasket, seal assembly, springs and O-ring from end cap.

7. Remove the lock setscrew from the idler bracket and slide end cap from shaft, remove snap ring and remove two O-rings from shaft.

8. Press the two bushings from the idler.

Thoroughly clean parts, examine the parts and replace if worn. Always replace the steel seal washer assemblies, springs, and all O-rings. Clean the drilled out passage in the center of the shaft, which feeds grease to the internal parts.

FRONT IDLER



ASSEMBLY OF FRONT IDLER

1. Press new bushings into idler until flush with end of bore; clean the face of the idler of any foreign material from pressing the bushings into the idler.

2. Clean each side of idler face with LOCQUIC PRIMER, GRADE "T", thoroughly. Allow to dry a few minutes.

3. There are two types of seal washers used in the front idler, The two seal washers installed next to the front idler face have outside diameter edges of a low machined finish. The two seal washers used, one in each end cap to aid in O-ring seal, have outside diameter edges displaying a fine machined finish.

   Clean thoroughly the two seal washers, roll pin side, that are to be installed on the front idler face with LOCQUIC PRIMER, GRADE "T". A high degree of cleanliness is necessary on front idler face and seal washer mating surfaces, if a complete seal is to be attained. Allow LOCQUIC to dry a few minutes.

   When LOCTITE impact resistant adhesive is ready to apply to mating surfaces, puncture a small hole of a 1/64" size in spout of LOCTITE impact resistant adhesive tube, then distribute sparingly a thin film of LOCTITE impact resistant adhesive.

   The small hole punctured in tube will help in regulating flow so that a uniform flow can be applied and so that desired width of LOCTITE impact resistant adhesive on mating surface is obtained.

   You will also notice the tube of LOCTITE impact resistant adhesive will not be full. This LOCTITE impact resistant adhesive will harden if no air is present. So that LOCTITE impact resistant adhesive will hold its fluid composition, a slight air space remains in each tube of LOCTITE impact resistant adhesive after it is sealed.

   Apply LOCTITE impact resistant adhesive to face area of front idler. LOCTITE is used to bond and seal the seal washer to the front idler face. Place LOCTITE in as near center of circumference of front idler face as possible so, when seal washer is installed, the LOCTITE impact resistant adhesive is spread evenly to inside and outside of front idler face area so that a complete seal can be attained.

Continue on and assemble front idler completely. Allow from thirty minutes to three hours for LOCTITE to dry before full adhesive strength is reached. This will depend on temperature and condition of surface cleaned.

NOTE: These seal washers can be used on H-3 and HD-3 crawler tractors prior to 9700 - 8298. When repair of front idler is undertaken, we recommend that LOCTITE impact resistant adhesive be used to replace the gasket in the front idler assembly on the tractors with serial numbers prior to 9700-8298.

This special LOCQUIC PRIMER, GRADE "T", and LOCTITE impact resistant adhesive can be purchased from your Allis-Chalmers Dealer through Parts.

4. Slide shaft into idler and install two new O-rings on shaft (lubriplate O-rings).

5. Install new O-rings in grooves for O-rings in both end caps. (Lubriplate O-rings).

6. Insert four springs in large holes in each end caps.

7. Lubriplate the seal washer sealing surface.

8. Install the end cap assembly over shaft on opposite end of shaft grease fitting; care must be taken not to lose the springs out of their holes.

9. Install snap ring in groove.

10. Install lock setscrew into end cap, line the setscrew up with the hole in the shaft; this will hold the end cap in place next to the snap ring in shaft while pressing on the end cap on the grease fitting end of shaft to compress the spring to install snap ring.

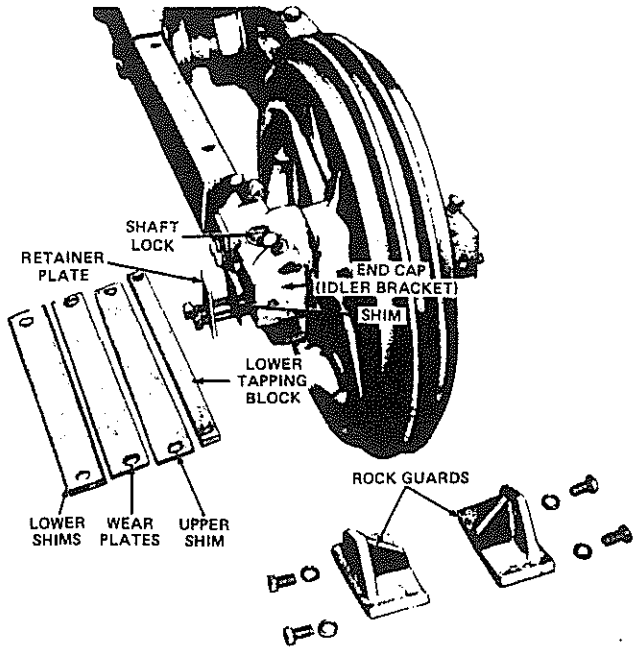
11. Install the end cap assembly over shaft on grease fitting end; care must be taken not to lose the springs out of their holes.

12. Put the idler assembly in a press and press down on the end cap assembly and install snap ring. Remove from press.

13. Install the lock setscrew into end cap, lining the setscrew up with hole in the shaft, torque setscrew 80 to 90 ft. lbs. and install jam nuts. The setscrews prevent the shaft from working and rotating in the end caps.

14. Install a new button head grease fitting in idler shaft, using a sealer on the threads.

15. Lubricate the idler with SAE 90 transmission oil 12 to 16 strokes of the grease gun. This is a slow process and time must be allowed for air trapped in the system to escape. Excess lubrication will allow grease past face type seals giving the appearance of seal leakage. (It takes about 4 oz. of 90 transmission oil per idler).



INSTALLATION AND ASSEMBLY OF FRONT IDLER

When track, track idler brackets and guide plates are properly aligned, an even wear pattern will be noted on each side of guiding flange of front idler. Light contact will be apparent on inner side of track side bars and both flanges of the track rollers.

The front idler must be centered with track rollers between track frame channels. This alignment is done by shims which are under the retainer guide plates on the outside of the end caps, they are also used to remove excess end movement of assembly.

Shims under the end retainer plates of front idler should be divided equally for both ends and used in an amount to give .031" clearance. If necessary to align roller with track frame due to flange wear, shims may be used unequally. Shims are also used beneath WEAR PLATES and LOWER TAPPING BLOCKS to align front idler.

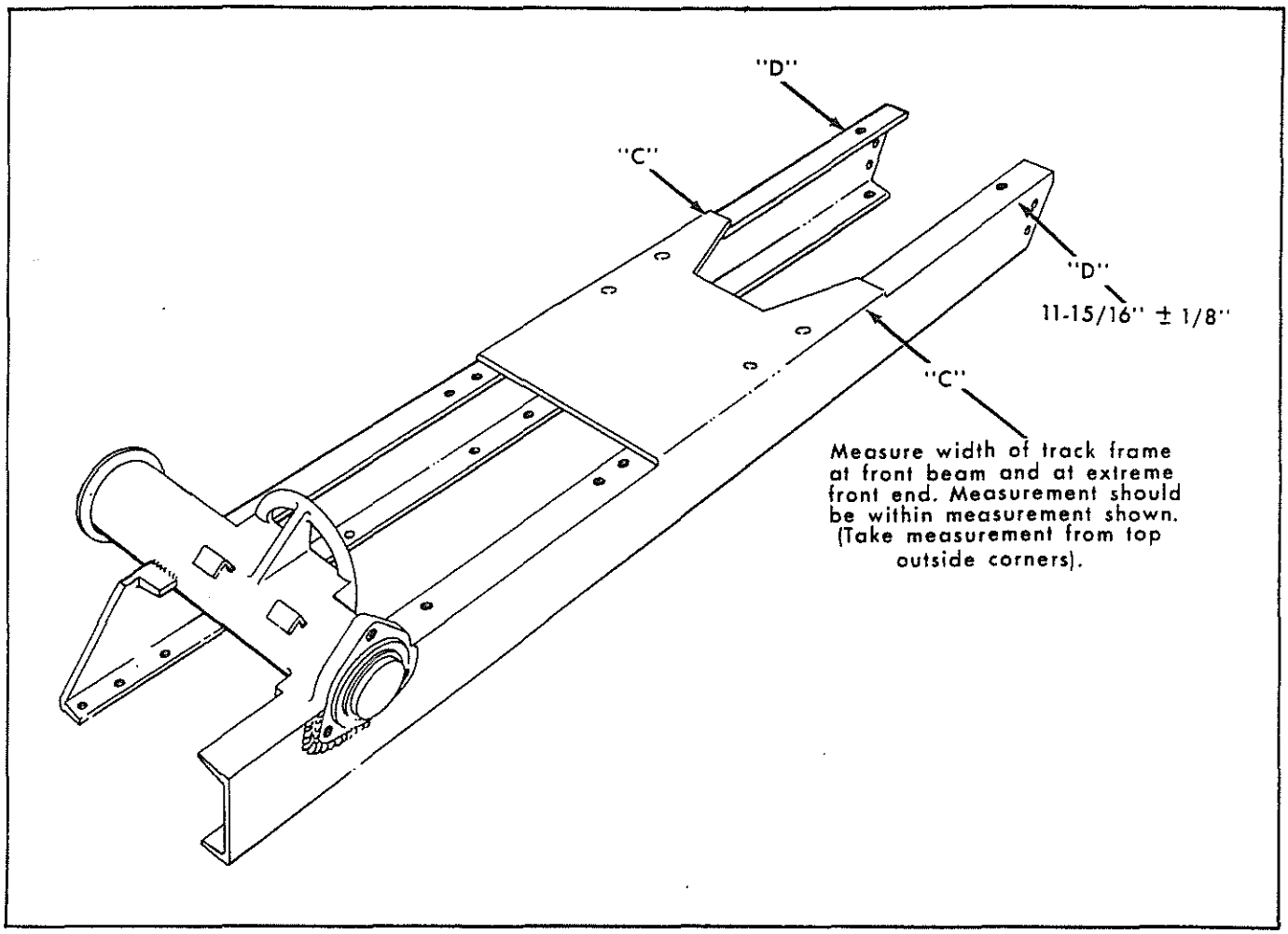
The top and bottom of the track roller frame are protected by wear plates which are replaceable, yet leaving it free to slide back when necessary. Worn parts which allow too much movement or twist of the idler should be replaced.

Tighten plate capscrews to 45 to 50 ft. lbs. Tighten setscrews retaining end caps to axle shaft 80 to 90 ft. lbs.

Torque the wear plate capscrews to 88 to 95 ft. lbs. Shim to give a free sliding fit for entire length of travel.

When track, track idler, brackets, and wear plates are properly aligned, an even contact (wear pattern) will be noted on each side of flange of front idler. Light contact will be

TRACK FRAME



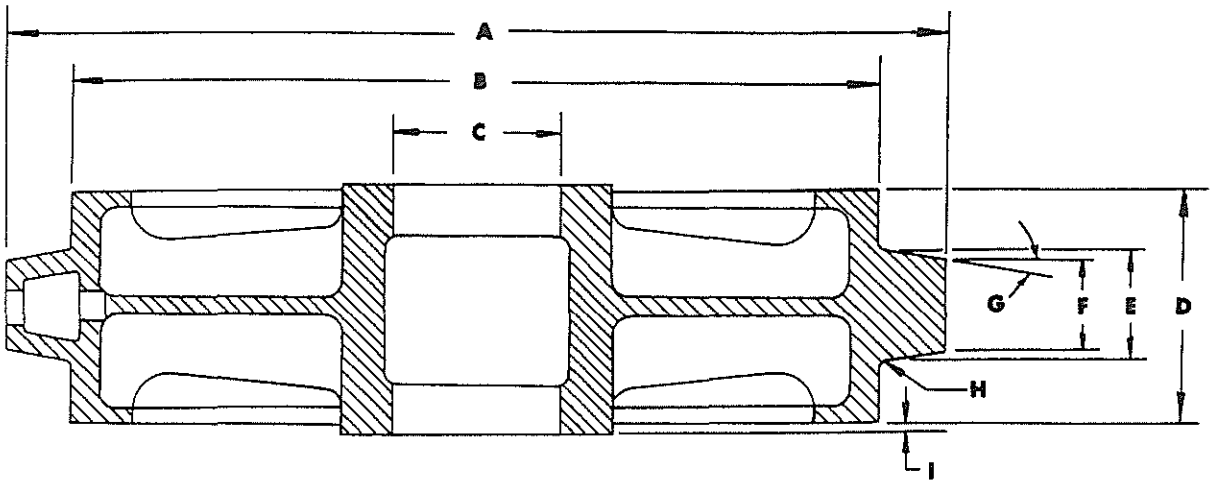
apparent on inner side of track side bars and both flanges of track rollers to assure proper alignment of tracks, idlers must be centered with track rollers between track frame channels. Idler brackets to wear plates clearances must be properly set and sprocket in center lined with track rollers and top support roller.

TRACK FRAME

If the dimension at point "B" is not within 3/16" at point "A" and there is track misalignment measure the width of track frames at front main beam and at extreme front end to find which track frame is sprung or twisted. Take measurement from top outside corners at point "C" and "D". The dimension at point "D" should fall within ± 1/8" at point "C".

Track frames "out of line" will contribute to rapid wear of the track rollers, track idlers support roller, track sprockets and track assemblies. A sprung or twisted track frame should be corrected immediately.

TRACK DIMENSIONS



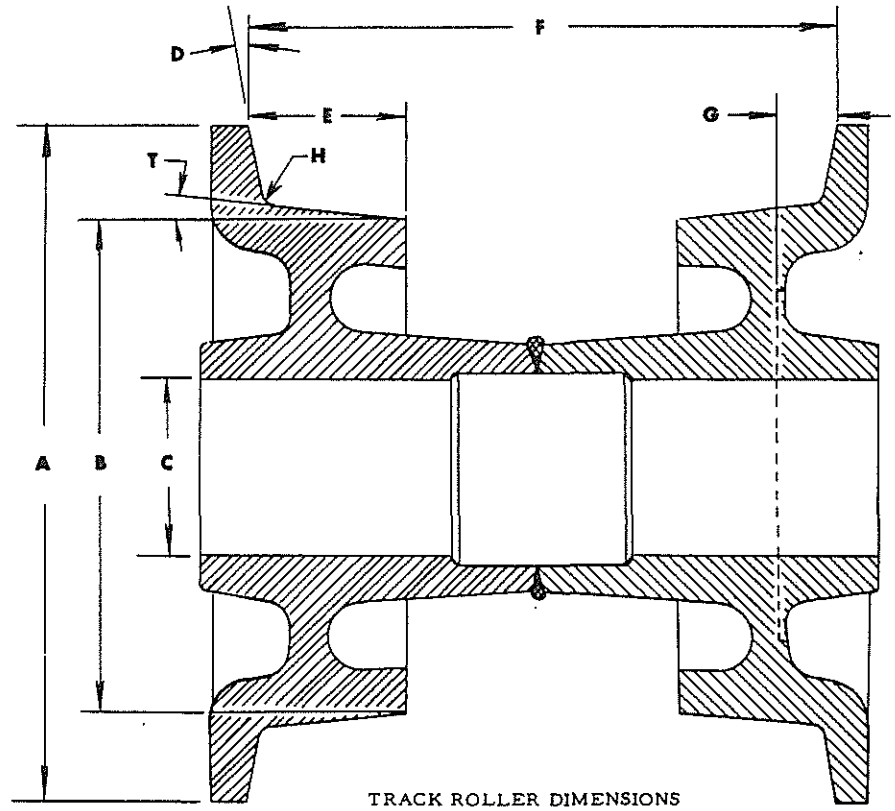
TRACK IDLER DIMENSIONS

A = 22-9/16"
B = 20-13/16"
C = 2.1620 to 2.1630"
D = 4"
E = 2-1/8"
F = 1-13/16"
G = 10°
H = 3/16" R
I = 7/32"

Note: Maximum misalignment of bores to be .003"
Maximum out-of-round of bores to be .001"

Dimension "A" & "B" are plus or minus 1/16"

Track Idler Dimensions



TRACK ROLLER DIMENSIONS

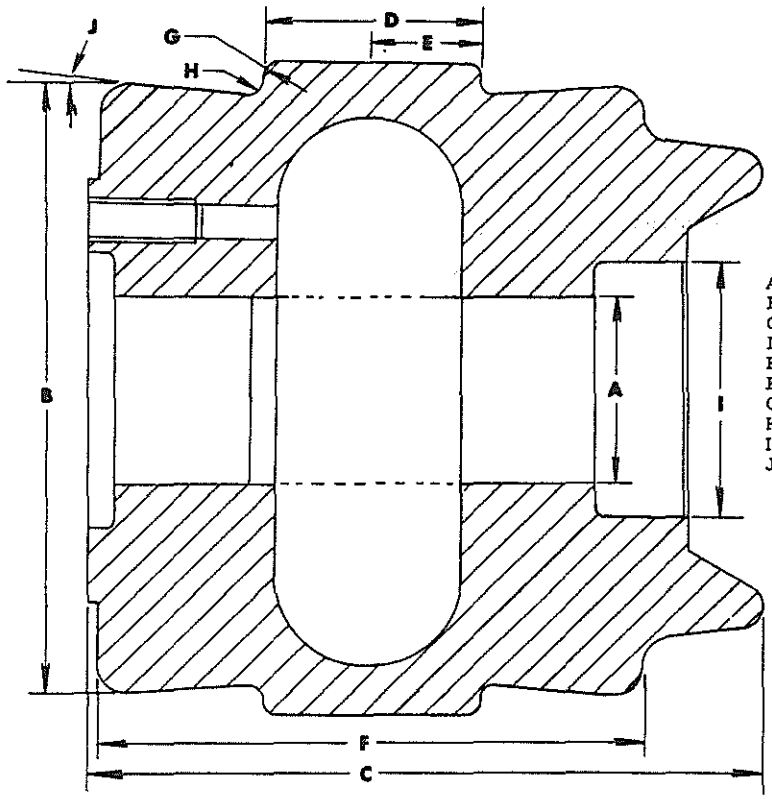
A = 8-1/4"
B = 6-15/16"
C = 2.1620 to 2.1630"
D = 10°
E = 1-1/2"
F = 5-9/32"
G = 11/32"
H = 1/4"R

Note: Maximum misalignment of bores to be .002"
Maximum out-of-round of bores to be .001"

4° Taper at Dimension T

Track Roller Dimensions

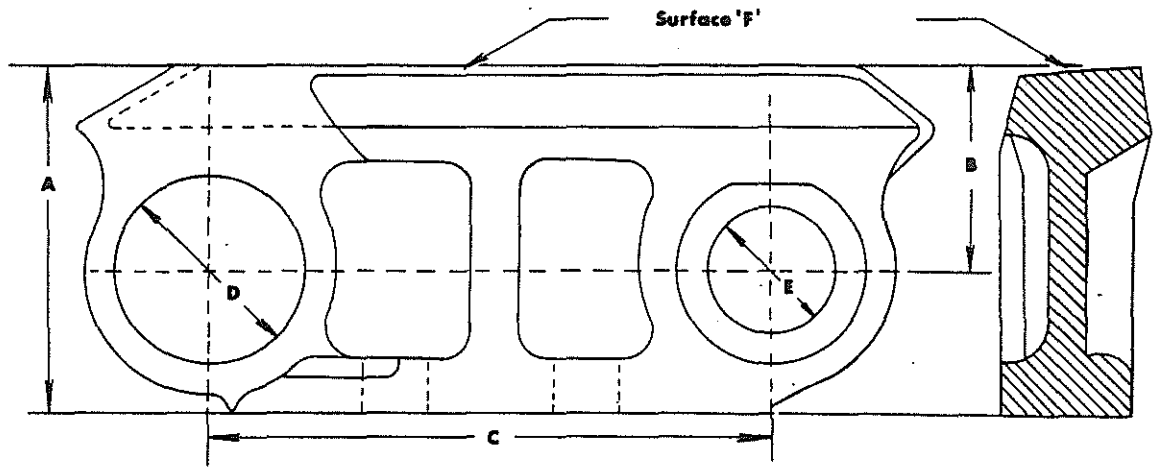
TRACK DIMENSIONS



A = 1.687 to 1.688"
B = 5-5/8"
C = 6-7/32"
D = 2"
E = 1"
F = 5"
G = 1/8" R
H = 1/8" R
I = 2.373 to 2.374
J = 4°

SUPPORT ROLLER DIMENSIONS

Support Roller Dimensions



TRACK SIDE BAR

A = 3-1/16"
B = 1-11/16"
C = Pitch:
Original Pitch (New Track) 6.000
Maximum Allowable (Worn Track) . . . 6.120

D = 1.744
E = 1.242

Note: Use Track Wear Gauges to determine when replacement or build-up is necessary.

Dimensions "D" & "E" are plus or minus .001".

4° Taper at Surface "F".

Track Side Bar Dimensions
(Prior to S/N 3001)

INDEX

HYDRAULIC PUMP

J

HYDRAULIC PUMP AND DRIVE

The pump is of the gear type with needle bearing construction. It is mounted at the side of torque housing and is driven by a 29 tooth gear on the clutch shaft. The pump drive shaft with gear is of the one piece type and has a 20 tooth gear.

The above gear combination was used prior to S/N 2926 and was a spur cut design. Effective with S/N 2926 to S/N 8694 the clutch shaft gear is a 28 tooth and the pump drive shaft with gear is a 19 tooth of a spiral bevel design.

The 29 tooth spur cut gear is no longer serviced as a parts item. When necessary it must be replaced with a 28 tooth spiral bevel gear and the drive shaft must be replaced with the 19 tooth spiral bevel gear.

Effective with S/N 8694 the Hydraulic Pumps feature a drive that is independent of the pump. The New Drive incorporates the same 19th spiral bevel design on the shaft, but this shaft is not interchangeable with the drive shaft used between S/N2926 and S/N 8694.

Three hydraulic pumps were available prior to S/N 8694, a 15 GPM, and a 25 GPM with a flow reducer valve.

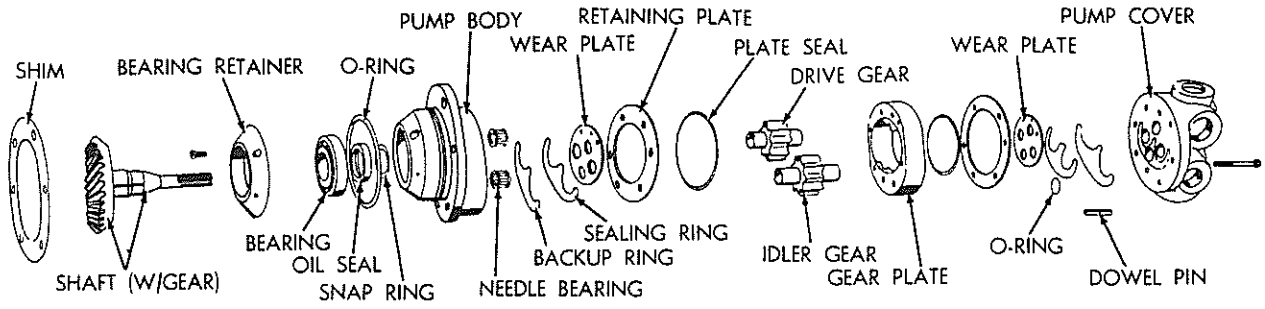
IDENTIFICATION REFERENCE		PART NUMBER	MODEL NUMBER
	15 GPM	234544	2JDS2-L
	25 GPM	234590	4JDS2-L
Variable	25 GPM	236748	4JDS3-L

Three hydraulic pumps used effective with 8694 and up are; 11.5 GPM, 2 stage 11.5-6 GPM and a 2 stage 11.5-13.5 GPM.

IDENTIFICATION REFERENCE	PART NUMBER	MODEL NUMBER
11.5 GPM	246411	1YDS6-1LB
11.5 GPM	247656	1YDS6/OYD6-LB
11.5 GPM	246412	1YD26/1Y1D6-LB

Part No. and model No. can be found on the mounting flange on the pumps.

Due to the gear ratio involved, the pump speed is approximately 1/3 faster than engine speed.



HYDRAULIC PUMP

REMOVAL

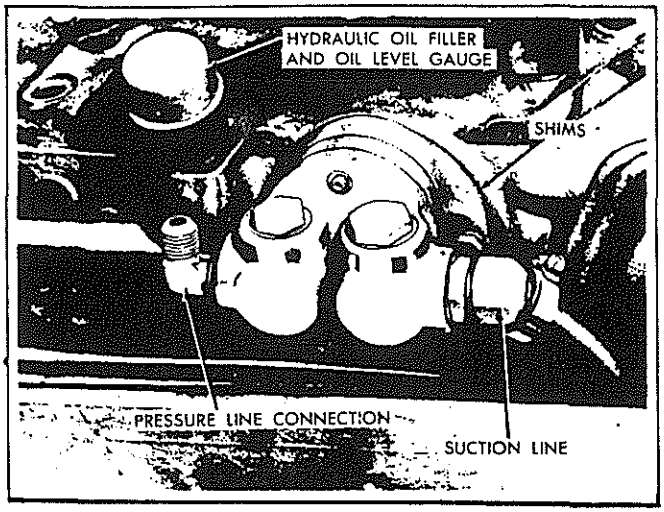
Wash pump and all surrounding parts thoroughly before removing pump from tractor. Drain the hydraulic oil from torque housing and oil reservoir if equipped with fender mounted oil supply. Remove the hoses from pump, and plug or cap hoses and pump connections. Remove capscrews attaching pump to torque housing, and remove pump.

INSTALLATION

Install the "O" ring seal at front of pump and insert in opening of torque housing. Hold in position squarely with zero backlash on gears, and determine the number of shims that fit between pump and torque housing. Remove pump and add six .005" or three .010" shims (total of .030") to the amount previously determined and install pump to torque housing. Tighten capscrews 45 to 55 ft. lbs. torque.

Do not attempt to operate pump until all hoses are connected and oil reservoir filled with oil. Operating without oil may score and damage pump. Operating pump with the outlet plugged will split pump body, as the pump does not have a relief valve. The relief valve is incorporated in the control valve.

Pumps that have been rebuilt or repaired should be checked out by breaking them in with the relief pressure set low before actually being used on regular operating conditions. Set the pressure relief valve approximately 200 P.S.I. and operate slowly for a period of time to properly position the wear plates to gears.



DISASSEMBLY

With the pump removed from tractor and thoroughly cleaned, it is ready for disassembly. Place all parts on a clean surface as they are being removed.

To remove the drive shaft with gear, remove the thru screws attaching bearing retainer to pump body, and remove shaft assembly. Remove snap ring retaining bearing to shaft and press or pull bearing from shaft. Remove the bearing retainer from shaft. Pull oil seal from body.

Remove the four socket head capscrews from body side of pump. Remove the four hex head capscrews from cover side of pump, with a soft hammer, gently tap the stack apart until the pump can be disassembled by hand. The mating surfaces are a lapped fit, do not pry between

these surfaces to disassemble. Any marring of these surfaces will cause oil leak and an unsatisfactory reassembly of pump. Mark the three main sections of pump (body, gear plate and end cover) before disassembly, this will aid in assembly.

Remove the end cover from dowel pins. Remove the wear plate and retaining plate. Remove the back up and seal ring from wear plate. Remove the plate seal. Remove pump gears. Remove the gear plate or center section. The second set of plates and seals are removed in the same manner as the first. Dowel pins hold the assembly in alignment.

Use a bearing puller attachment and pull needle bearings from body and end cover if replacement is necessary. Check all parts for wear or damage. Pay particular attention to the bronze faced wear plates and replace if worn excessively or scored.

ASSEMBLY

The wear plates are pressure balanced. Always use new sealing rings when assembling pump. Clean all parts thoroughly. Inspect all parts carefully before assembly. Lubricate each part prior to installing.

Press the needle bearings into body and end cover until slightly below flush with surface. Use a square tool and do not crush bearing retainer shell. Install the neoprene sealing ring in groove in body and cover with the flat surface downward in groove. Install the nylon back-up ring in groove with sealing ring in both body and cover. Install "O" ring seals in recess (counter bore) in both body and cover.

Install the dowel pins in place in cover. Install the retaining plate over dowel pins on cover. Install the retaining plate seal inside retaining plate with lip of seal toward cover. Install the wear plate with the entrapment relief grooves inside of the retaining plate seal, install with the pressure balance ports (1/8" diameter) toward the pressure balance rings, and the bronze side toward pump gears.

Install the gear plate (center section) over dowel pins, noting markings previously made so that it will be positioned properly. Install the pump gears, being sure the splined drive gear is in the correct location viewing end cover with gear side toward you, and outlet port (smallest opening) to your right, the drive gear must go in the lower position.

Install the second retaining plate over dowel pins. Install the second wear plate (without entrapment relief grooves) with bronze side toward gears, and the two pressure balance holes (1/8" diameter) toward the pressure balance rings in body. Install the retaining plate seal between retaining plate and wear plate with lip of seal toward body.

Place the body section over dowel pins being sure it is properly positioned, refer to marks made before disassembly. The opening for the pump drive shaft with gear must align with the splined hub of pump drive gear. Install the four socket head capscrews from body side of pump and tighten 32 to 37 ft. lbs. torque.

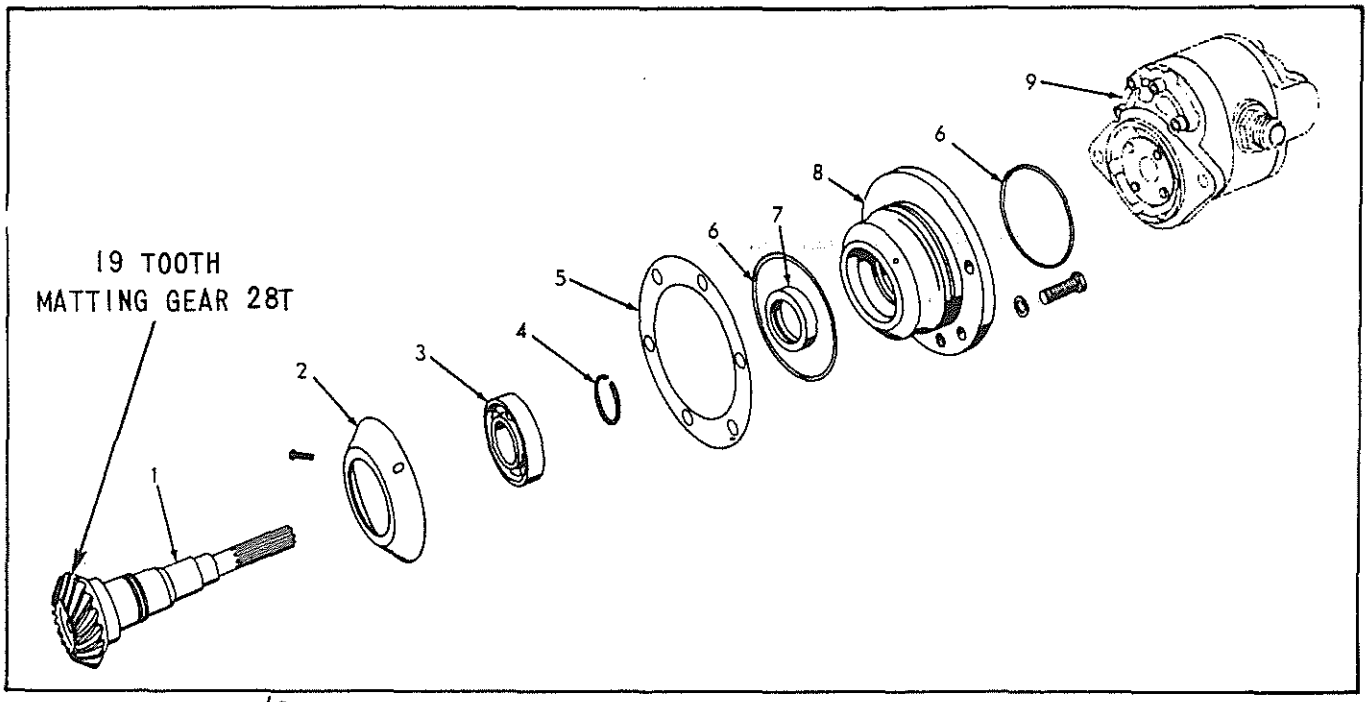
Install the two 5/16" hex head capscrews from cover side of pump and tighten 32 to 37 ft. lbs. torque. Install the two 1/4" hex head capscrews from cover side and tighten 18 to 22 ft. lbs. torque. Tighten all capscrews evenly and gently until final torque is achieved, rotating gears frequently to avoid binding.

Install drive shaft oil seal into pump body with lip of seal toward pump drive gear. Press seal just below champfer in counter bore of pump body.

Install the bearing retainer over drive shaft with cup side away from gear. Press the ball bearing on shaft and install the retaining snap ring. Install the drive shaft assembly into pump body, press in until bearing is seated against shoulder in body. Hold bearing retainer in place and install and tighten the three retaining screws.

Rotate pump by hand to see if all parts are free. The pump assembly is made with such close tolerance that any part of the pump may be replaced individually.

DRIVE & MOUNTING
EFF. WITH TRACTOR SN-8694 & UP



1. Drive Shaft w/Gear
2. Bearing Retainer
3. Shaft Bearing
4. Snap Ring
5. Shim, .005"
6. O-Ring
7. Oil Seal
8. Pump Adaptor
9. Pump Assy.

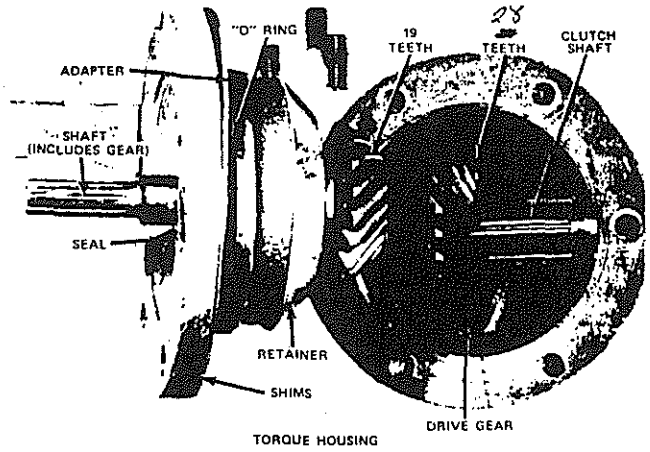
PUMP DRIVE SHAFT WITH GEAR

INSTALLATION

Place bearing retainer over shaft with flat side next to gear. Press ball bearing on the shaft and install its retaining snap ring. Press the bearing and shaft assembly into place in the drive adaptor. Install the hex head screws attaching bearing retainer to adaptor. Press oil seal into adaptor. Install with garter spring side toward bearing and press flush with surface of adaptor, use sealer on outside diameter and lubriplate on shaft and inside diameter of seal.

INSTALL PUMP DRIVE ASSEMBLY TO TORQUE HOUSING

To adjust gear mesh, install pump drive adaptor and shaft assembly into torque housing. With gears in mesh and touching with no backlash, measure gap between surface of torque housing and flange of drive adaptor. Insert a shim pack .030" thicker than measures gap.



TORQUE HOUSING

Remove drive adaptor and install O-ring seal in groove of adaptor. Lubricate O-ring seal and place shim pack next to adaptor flange. Reinstall adaptor assembly to torque housing; torque capscrews 45-50 ft. lbs. Attach hydraulic pump to pump adaptor.

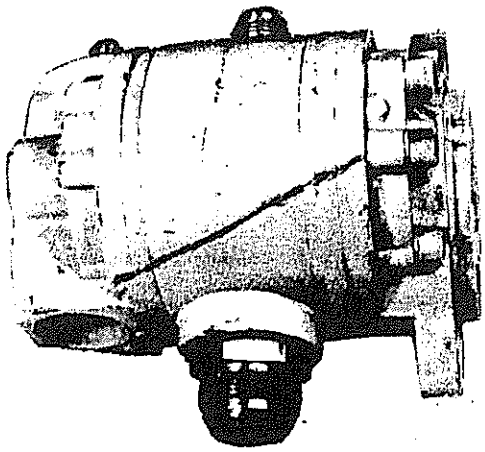
SERVICE INFORMATION
2 Stage 11.5-6 GPM Pump.
Part No. 247656, Mfg. No. 1YD56/0YD6-LB

PUMP REMOVAL

Disconnect suction and pressure lines. Remove the two capscrews from the pump mounting flange. Pull the pump directly out from the torque housing until it clears the end of the splined drive shaft. It is necessary to loosen the track adjustment and raise the track with a jack to facilatate removal of a two stage pump.

PUMP DISASSEMBLY

Scratch a diagonal line across the entire pump body to assure correct assembly. Clean the pump thoroughly.



REASSEMBLY AID

Remove the shaft seal retainer plate and the socket head capscrews. Separate each section. It may be necessary to tap the sections lightly with a plastic hammer to loosen them. CAUTION: Do not pry between the sections. Scratches on the mating surfaces will render a part useless.

INSPECTION

Details on inspection are given at the end of this section.

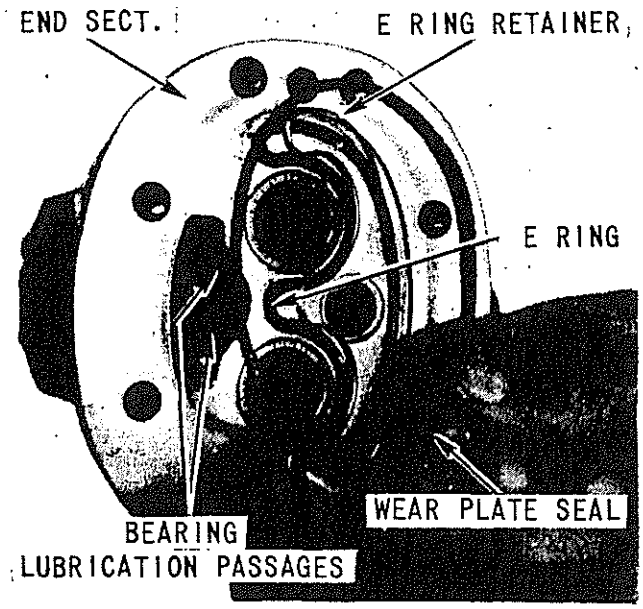
ASSEMBLY

Clean all parts thoroughly. Polish dowel pins and all dowel pin holes until pins slide smoothly into holes. Clean all mating surfaces of any sealer or dirt and be sure they are not scratched or marred in any way.

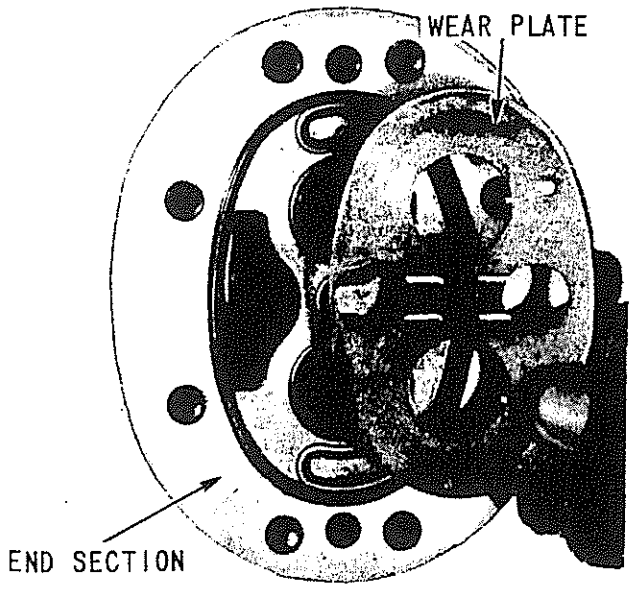
Early style wear plates utilized two small pressure balance holes and a round suction port. The pressure balance holes have been eliminated and the suction port. The pressure balance holes have been eliminated and the suction ports are now diamond shaped to allow better suction. O-rings used at the pressure port of the wear plate are no longer used and should be omitted upon rebuilding a early model pump.

A band of loctite gasket sealer no wider than 1/16" and inside the bolt hole pattern should be used on the gear plate mating surfaces.

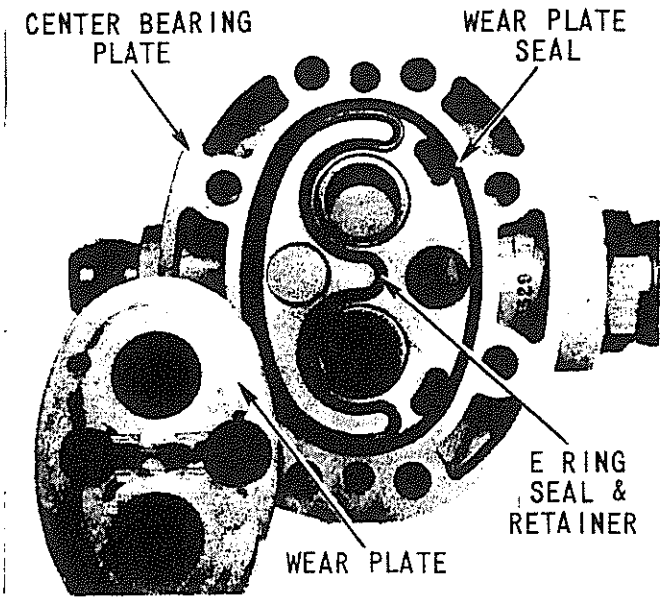
Install the E-ring, E-ring retainer, wear plate seal and wear plate in the end section in that order.



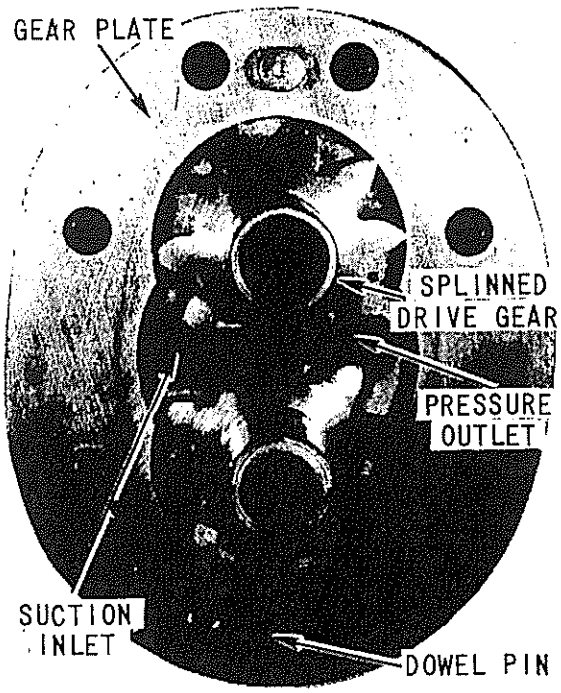
INSTALLING SEALS - END SECTION



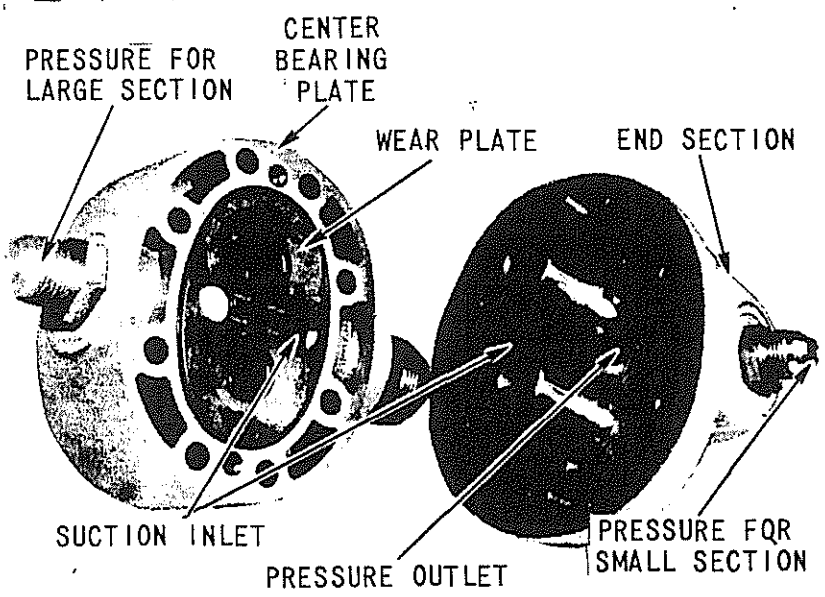
WEAR PLATE INSTALLATION



SEAL AND WEAR PLATE INSTALLATION



GEAR INSTALLATION

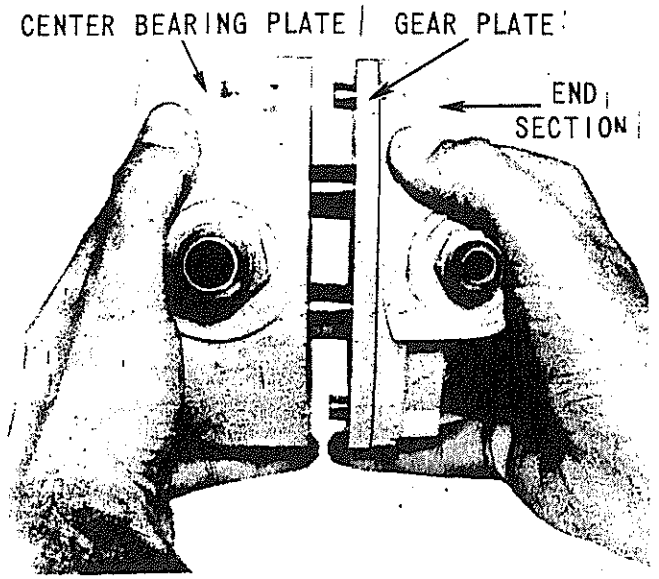


BEARING PLATE AND END SECTION PREPARED FOR ASSEMBLY

INSTALLING SEALS - END SECTION

Insert the dowel pins in their holes and install the small gear section. Install the gears as shown.

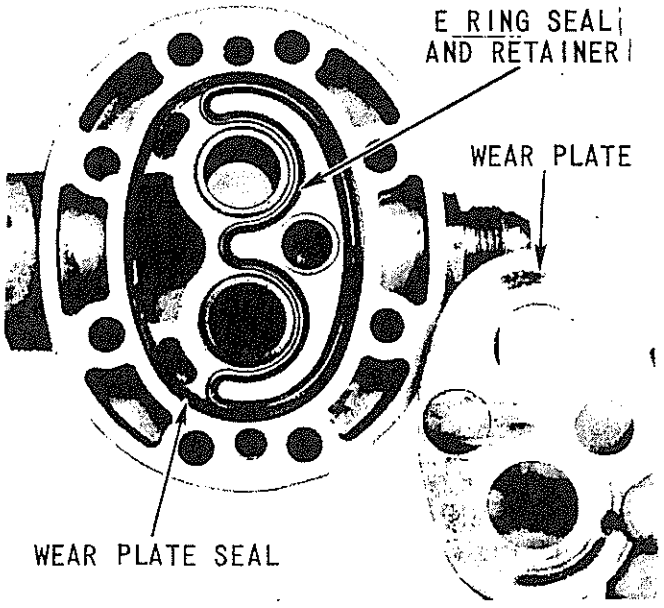
Install the E-ring, E-ring retainer, wear plate seal, and wear plate on the side of the bearing plate that mates with the smaller volume section.



ASSEMBLY OF BEARING PLATE AND END SECTION

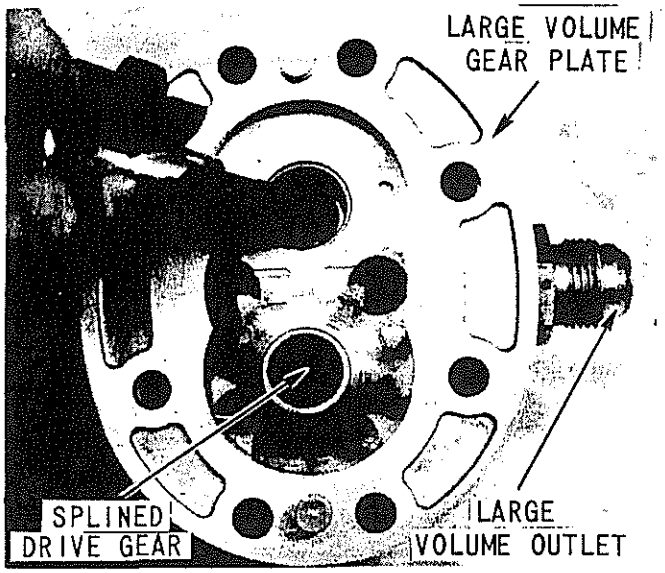
Lubricate gears, wear plates, and bearings, then holding each part as shown assemble them being sure the wear plate does not fall from it's proper location.

Install the E-ring, E-ring retainer, wear plate seal and wear plate on the large volume side of the bearing plate, then install the dowel pins, gear plate and gears as shown.

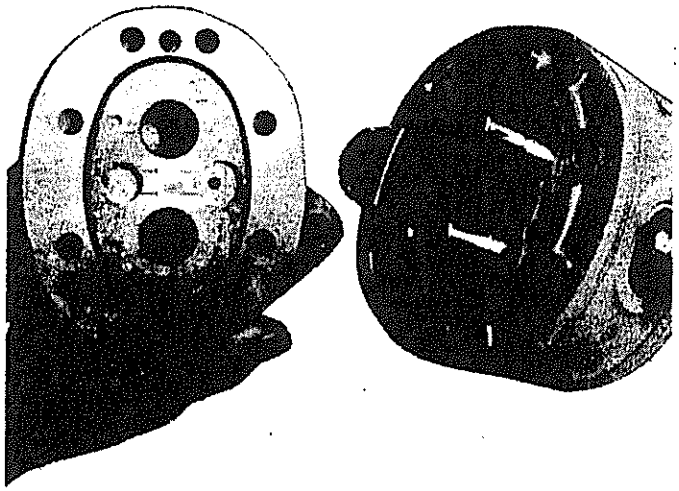


WEAR PLATE INSTALLATION

NOTE: The gear plate is cut away partially in the radius between the gears. The plate should always be assembled with the cut-away side next to the suction and pressure ports of the wear plate.

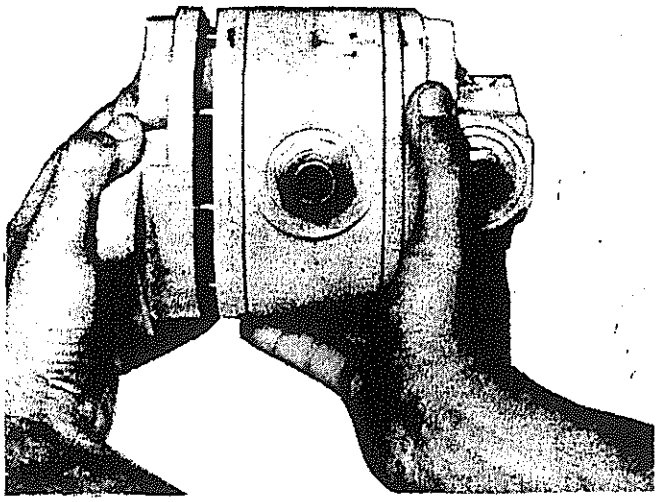


GEAR INSTALLATION



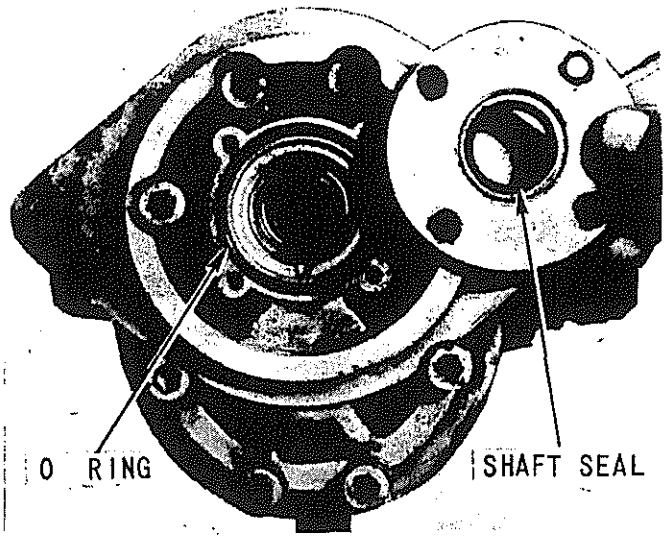
BODY SECTION SEALS AND WEAR PLATE INSTALLED

Install the E-ring, E-ring retainer, wear plate seal and wear plate in the body assembly.



INSTALLING BODY SECTION

Again, holding the assemblies in each hand, join them together. Install the hex head capscrews and torque evenly 33 to 37 ft. lbs.



INSTALLING O RING AND SHAFT SEAL

Install the seal retainer assembly at front of body section, using new O-ring seal. Install with flat side away from pump. Lubricate shaft and lip of seal prior to installation. Install and tighten the four No. 10-24 x 3/8" retaining screws.

SERVICE INFORMATION FOR THE SINGLE STAGE 11.5 GPM PUMP. PART NO. 246411 MFG. NO. 1YD56-1LB

PUMP REMOVAL

Disconnect suction and pressure lines. Remove the two capscrews from the pump mounting flange. Pull the pump directly out from the torque housing until it clears the end of the splined drive shaft.

PUMP DISASSEMBLY

Scratch a diagonal line across the entire pump body to assure correct assembly. Clean the pump thoroughly. Remove the shaft seal retainer plate and the socket head capscrews. Separate each section. It may be necessary to tap the sections lightly with a plastic hammer to loosen them.

CAUTION: Do not pry between the sections. Scratches on the mating surfaces will render a part useless.

INSPECTION

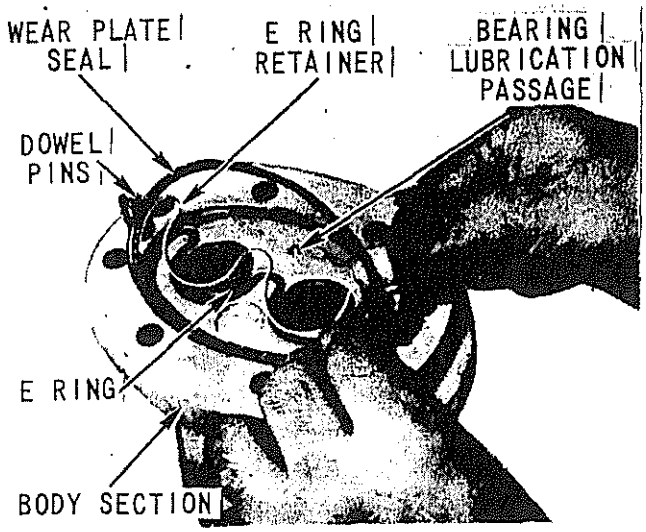
Details of inspection are given at the end of this section.

ASSEMBLY

Clean all parts thoroughly. Polish dowel pins and all dowel pin holes until pins slide smoothly into holes. Clean all mating surfaces of any sealer or dirt and be sure they are not scratched or marred in any way.

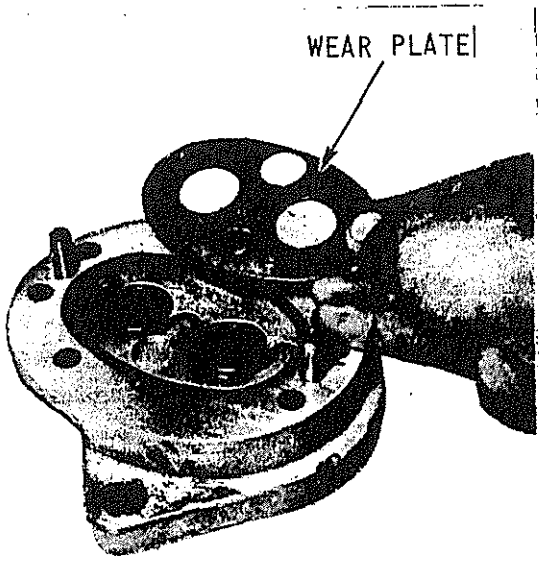
Early style wear plates utilized two small pressure balance holes and a round suction port. The pressure balance holes have been eliminated and the suction ports are now diamond shaped to allow better suction. O-rings used at the pressure port of the wear plate are no longer used and should be omitted upon rebuilding a early model pump.

A band of loctite gasket sealer no wider than 1/16" and inside the bolt hole pattern should be used on the gear plate mating surfaces.

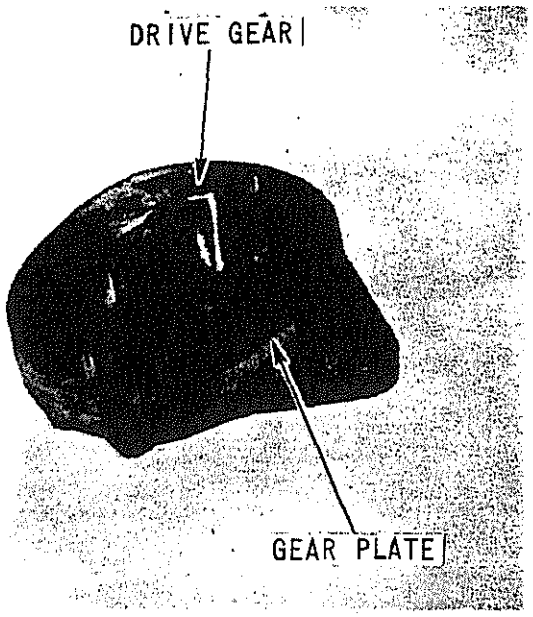


INSTALLING SEALS BODY SECTION.

Install the E-ring, E-ring retainer, wear plate seal and wear plate in the body section in that order.

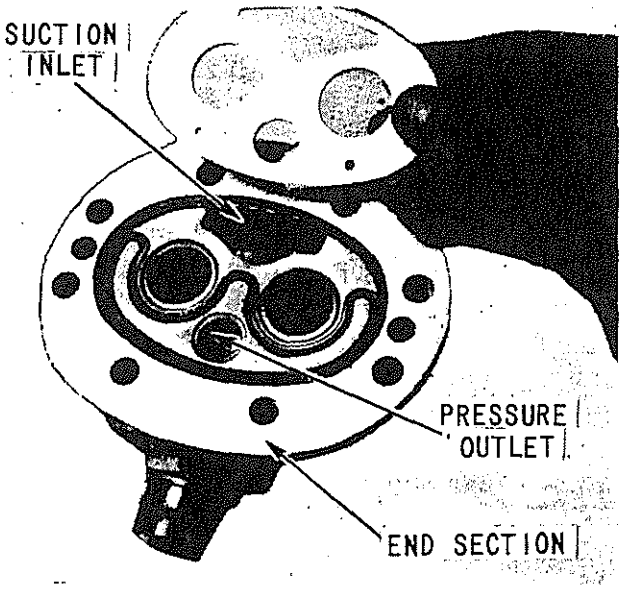


INSTALLING WEAR PLATE BODY SECTION



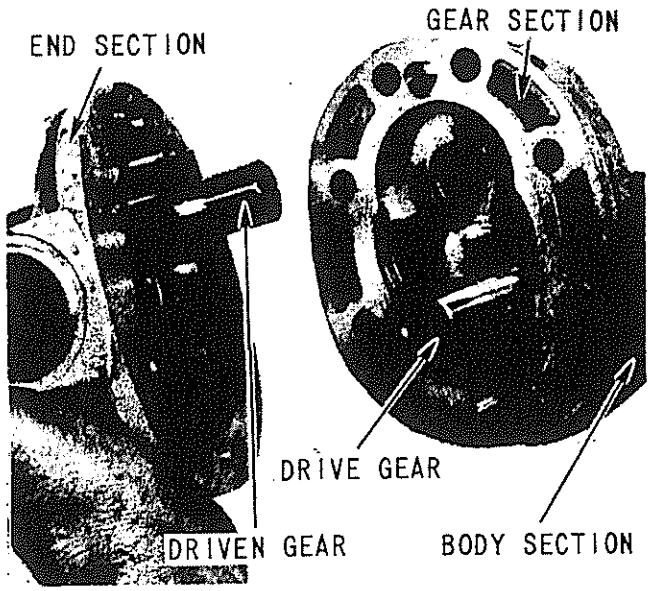
GEAR PLATE AND GEAR INSTALLATION

Insert the dowel pins in their holes and install the gear plate. Install the drive gear as shown.



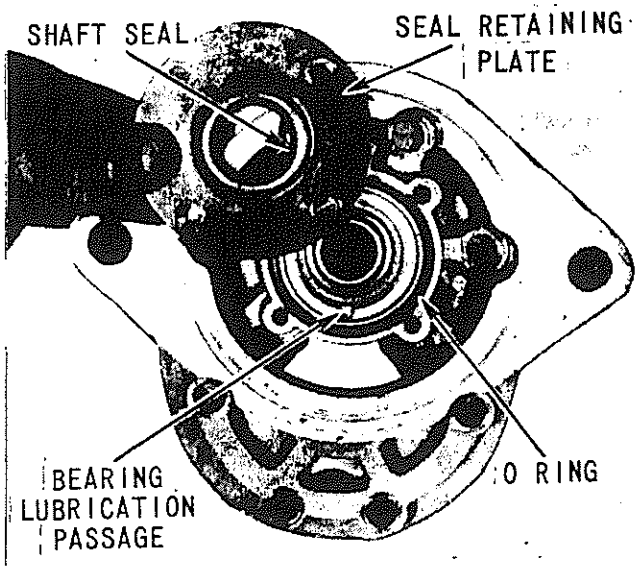
SEAL AND WEAR PLATE INSTALLATION

Install the E-ring, E-ring retainer, wear plate seal and wear plate in the end section as shown. Install the drive gear in bearing of end section. Hold one assembly in each hand and join them together. The gear in the end section will aid in retaining the wear plate in it's proper location.



BODY AND END SECTION PREPARED FOR ASSY

Install the hex head capscrews and torque 33 to 37 ft. lbs.



O RING AND SHAFT SEAL INSTALLATION

Install the seal retainer at front of body section using a new O-ring seal. Install the flat side away from pump. Lubricate shaft and lip of seal prior to installation. Install and tighten the four No. 10-24 x 3/8" retaining screws.

PUMP INSPECTION

ALIGNMENT

The tolerances and allowances on all parts of this pump are held very close, making alignment very important. All machining references are made from the dowel pin holes. The dowel pin fit should be a heavy wringing fit to a loose slip fit and the dowel pin should extend equidistant into the body and cover on reassembly of the pump. Since your pump has operated a considerable number of hours, before rebuilding, it can be assumed that the bearing bores are in proper alignment.

BEARINGS

Needle Bearings -- Close visual inspection will generally indicate the condition of the bearings. The needles, or shell, should not be spalled or have case failure. The shaft and bearing shell should not contact and the needles should be held in securely by the shell. If a faulty bearing is found the assembly containing it should be replaced.

All bearing components must be checked for cleanliness before rebuilding the pump. All bearing components must turn smoothly when assembled. If the components turn erratically after all possible foreign matter has been removed, the bearing must be considered defective and replaced.

SHAFT SEALS

The lips of synthetic seals should be checked to insure there are no cuts or nicks. The rubbing surfaces of seals must be smooth and free from nicks, scratches and ridges. If a ridge can be felt with a finger-nail on any rubbing surfaces of the seal, it must be considered defective. All rubber sealing components of seals must be pliable and free from cuts and excessive wear. A defective seal will sometimes be indicated by air bubbles in the reservoir.

PUMP INSPECTION

DRIVE SHAFTS

If the wear of the seal can be felt with the finger-nail, the shaft should be polished or replaced. As an expedient, a seal seat with a smooth groove no more than a few thousandths deep will probably function without the shafts being altered. If wear has roughened the seat, it is possible to polish with crocus cloth to a satisfactory finish if wear is not too deep. If the drive gear spline shows a considerable amount of wear, it should be replaced.

GEARS

Gears that are to be used over should be free from burrs, scores, gouges and pickup. The tooth tips should be lightly stoned to remove any burrs or pickup. The face of the gear should be sharp and square with the gear teeth. This edge should be free from burrs but never rounded. The bearing surfaces should be free from scores, pits and spalling.

GEARS AND GEAR PLATES IN GENERAL

Always insure that there is no interference between the gears and gear plate before tightening up a pump. They should always be replaced in sets, never in components unless the other components can be restored to a like new condition. The damage done by the original components in seating themselves is generally so severe that it cannot be tolerated by new parts. Always try for the median clearance between the gears and gear plate of .0005" in thickness and .0015" on the diameter. Always insure that the drive shaft fits freely in the drive gear since end loading of the drive gear will upset the balanced loading of the pump.

WEAR PLATES

Wear plates should be flat, parallel and free from scores and gouges. Never remove more than .010" from a wear plate.

SEALING RINGS

Sealing rings should remain close to their original shape, heat will cause them to take a set. They should also be free, from cuts and abrasions.

LOADING RINGS

Loading rings should be free from cuts, nicks and erosion. This ring can be easily removed by directing a compressed air stream at it.

BACK-UP RINGS

Back-up rings should be free from breaks, cuts, nicks and extrusion.

BODY AND COVER

The pump side of the body and cover should be free from nicks, scratches and cracks.

GENERAL INFORMATION

Cleanliness is of the utmost importance when working on any hydraulic equipment. A supply of cleaning solvent for cleaning is required with power cleaning equipment preferred. In general, all parts should be free from burrs, nicks, scratches, cuts, abrasions and sharp cutting edges. This is important in areas where seals, O-rings, and alignment are concerned. Any part in contact with an O-ring or seal should have a surface finish of 40 RMS or better.

The reworking of parts in a machine shop should be done with caution. The removal of .010" from any parts to clean it up would not affect the part strengthwise, but the interference caused by its removal could lead to early failures of the pump. It is suggested new parts be used rather than attempt any extensive rework.

In reassembling the pump there should be no interference between the loading ring and se-

aling ring. Any extrusion from the flange or the sealing ring should be removed. O-rings and seals that can become dislocated during assembly should be secured with a temporary adhesive (heavy grease for example).

Before tightening a pump after assembly always turn the gears a sufficient amount to assure removal of any foreign particles from between the gears and wear plates and also that there is no interference between any of the parts. This is necessary, because when the pump is tightened the rubber parts will not be properly seated and the pump will in all probability turn with difficulty making it impossible to tell whether it is normal or a malfunction.

Always torque all bolts evenly to avoid any distortion of the parts--this is important on the body and cover.

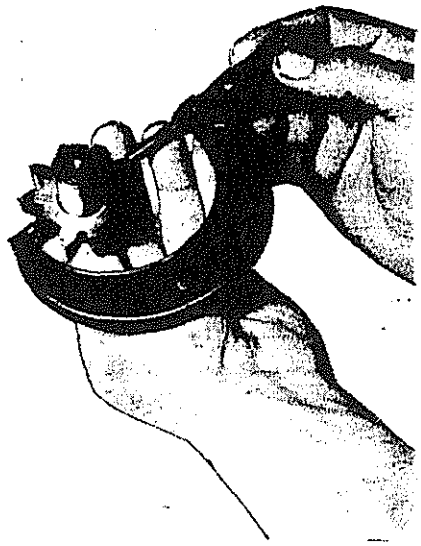
Lubricate the pump well before starting it, break it in slowly and apply about 200 P.S.I. of pressure to force the wear plates away from the gears for initial lubrication.

The following chart provides specifications for each part of the pump. For best performance use the dimensions provided to insure that all parts are the proper limitations of the specifications within.

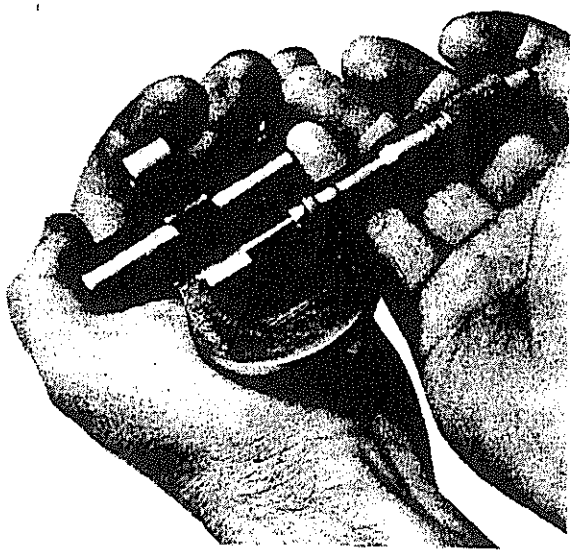
PUMP GEAR & GEAR PLATE SPECIFICATIONS

MFG. IDENT. PUMP MODEL NO.	PUMP VOLUME	GEAR PLATE WIDTH	GEAR WIDTH	GEAR O.D.	GEAR CLEARANCE
234544 2JDS2-L	15 GPM @ RPM Engine & 1500 PSI@ 120° F oil	.7011 - 7016	.7005 - .7010	2.1740-2.1745	.0003-.0011
236748 4JDS3-L	25 GPM @ RPM Engine & 1500PSI @ 120° F oil	1.1011 - 1.1016	1.1005-1.1010	2.1740-2.1745	.0003-.0011
234590 4JDS2-L	25 GPM @ RPM Engine & 1500PSI @ 120° F oil	1.1011-1.1016	1.1005-1.1010	2.1740-2.1745	.0003-.0011
246411 16DS6-1 LB	11.5 GPM @RPM Engine & 1500PSI @ 120° F oil	.5011-.5016	.5005 - .5010	2.1740-2.1745	.0003-.0011
247656 1yDS6/OyD6-LB	Dual Pump 11.5 & 6 GPM @ RPM Engine & 1500PSI @ 120° F oil	.3011-.3016 .5011-.5016	.3005-.3010 .5005-.5010	2.1740-2.1745 2.1740-2.1745	.0003-.0011
246412 1yDS6/1y1D6-LB	Dual Pump 11.5 & 13.5 GPM @ RPM Engine & 1500PSI @ 120° F oil	.6011-.6016 .5011-.5016	.6005-.6008 .5005-.5010	2.1740-2.1745 2.1740-2.1745	.0003-.0011 .0003-.0011

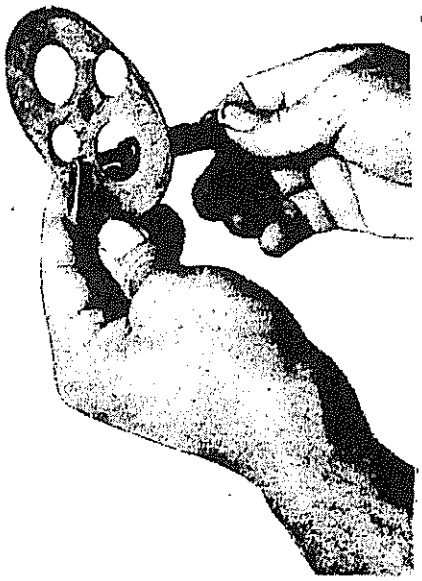
PUMP INSPECTION FOR PROPER DIMENSIONS



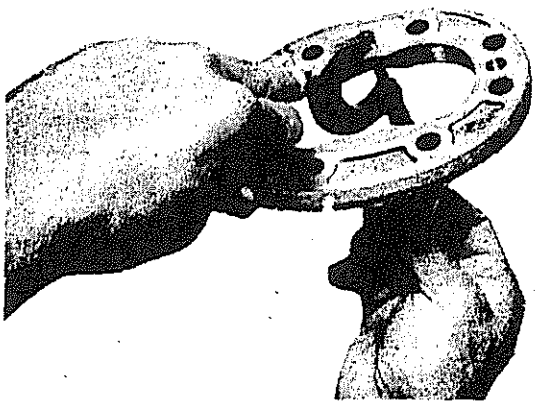
CHECKING GEAR O.D.



CHECKING GEAR WIDTH

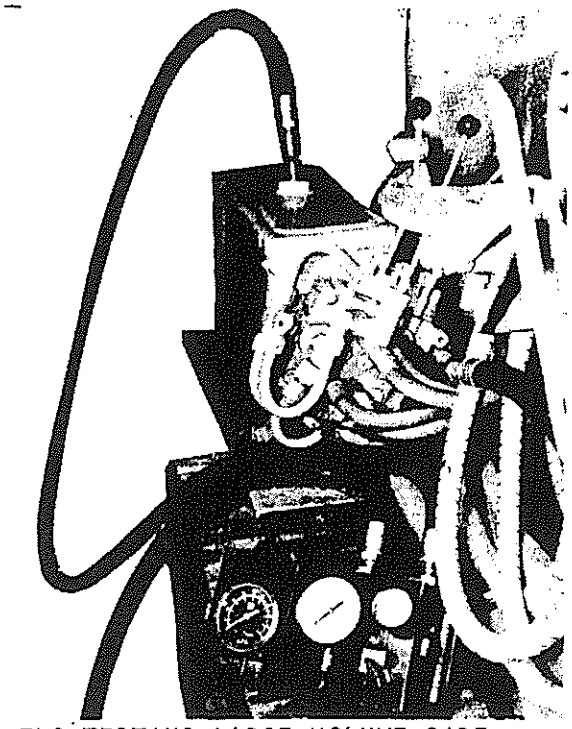


CHECKING WEAR PLATE WIDTH



CHECKING GEAR PLATE WIDTH

FLO-RATING (2 STAGE PUMP)



FLO TESTING LARGE VOLUME SIDE

FLO-RATING 2 STAGE PUMP USED WITH LOADER

Plumb the inlet hose of flo-rator into a work port of valve as shown or tee into the pressure inlet line of the valve. Place the flo-rator return hose into the fender mounted reservoir in a manner that will direct the suction port off the reservoir. Oil directed at the suction port of reservoir will create a turbulance and disturb the efficiency of the pump.

OPEN FLO-RATOR VALVE

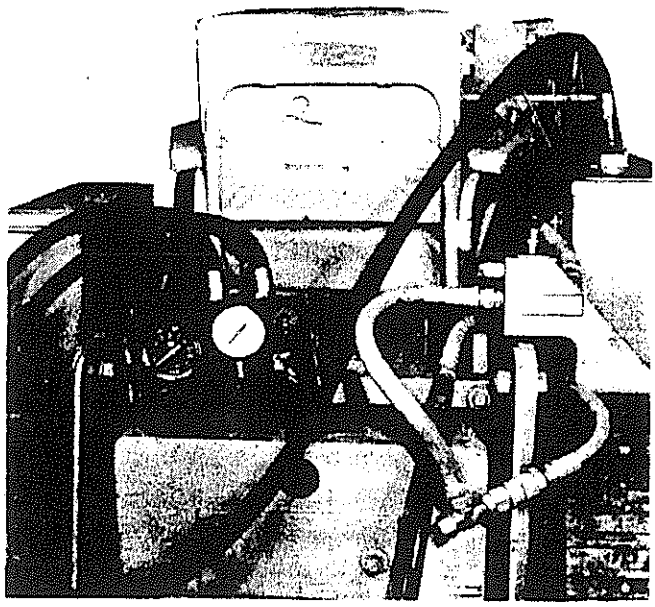
Start engine, release clutch, operate engine at high idle and bring oil temperature to 120°.

Close off flow through flo-rator slowly. Pressure should be 1500 to 1550 P.S.I. (1700 P.S.I. on later valves).

Note on units having a backhoe application and using power beyond from the 3 spool valve to operate the backhoe rather than a diverter valve, the main relief is adjusted to 1700 P.S.I. Open flo-rator valve and slowly close again to a pressure valve at least 200 P.S.I. below main relief pressure.

Volume should be with 1 YDS 6 pump - 11.5 G.P.M., with 4 JDS 3L pump - 25 G.P.M. (reducer valve set for full volume) and with 4 JDS 2-L pump - 25 G.P.M. A sudden drop in volume while approaching relief pressure could indicate a faulty relief valve.

A low volume reading at 200 P.S.I. under main relief, either indicates a faulty pump, faulty relief valve, or leakage past the relief valve body.



FLOW TESTING SMALL VOLUME SIDE

CHECKING SMALL VOLUME SECTION

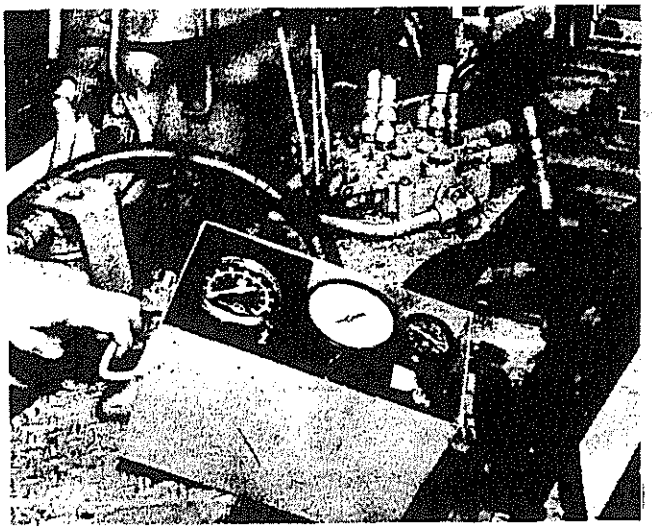
Plumb inlet hose of flo-rator directly into small volume pressure line as shown. Insert return hose into reservoir.

CAUTION: Extreme care must be exercised in flo-rating a pump in this manner as there is no relief valve between the pump and flo-rator. Do not exceed 2000 P.S.I., and do not attempt to close off flow completely or the pump can be seriously damaged. Open valve in flo-rator. Start engine, release clutch, and operate at high idle.

Close carefully and adjust flo-rator to 2000 P.S.I.

FLO- RATING (2 STAGE PUMP)

With oil temperature at 120° with OYD 6-LB Pump - volume should be 6 G.P.M., or with 1Y1 D6-LB volume should be 13.5 G.P.M.



FLO TESTING DOZER PUMP

FLOW RATING HYDRAULIC PUMP WITH DOZER

Plumb the inlet hose of the flo-rator into a working port as shown or tee into the pressure inlet line of the valve. The flo-rator return hose should be placed in the torque tube as shown in the fender mounted reservoir if used.

Make sure the flo-rator valve is full open. Start the engine, release the clutch, operate at high idle and actuate the control spool to direct oil into the flo-rator. Close off flow through flo-rator slowly. With oil temperature at 120° the pressure reading should be 1500 to 1550 P.S.I. (1700 P.S.I. on later valves)

Open flo-rator again and close slowly to a pressure of 200 P.S.I. below main relief setting. The GPM reading should be 11.5 GPM for a 1 YD 56 pump and 14 GPM for a 2JDS2-C pump.

A sudden drop in volume while approaching relief pressure could indicate a faulty relief valve.

A low GPM reading at 1200 P.S.I. either indicates a faulty pump, faulty relief valve, or leakage past the relief valve body.

ENGINE SPEED IN RELATION TO PUMP VOLUME

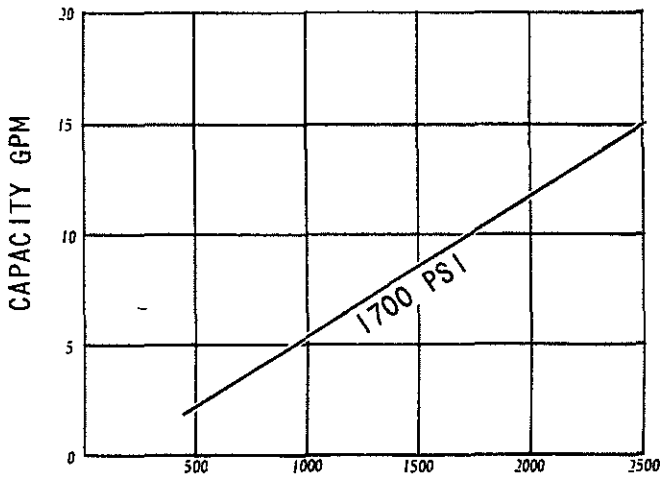
Engine Speeds Prior to 8694
High Idle 1900 RPM
Governed Load 1650 RPM

Effective w/8694 & up
High Idle 2000 RPM
Governed Load 1800 RPM

When flo-testing it must be kept in mind that pump volume depends directly on pump speed and pump speed depend directly upon engine RPM.

As the pump is loaded by means of the flo-tester engine RPM will decrease thereby decreasing pump speed and ultimately pump volume.
Compare flo-tester readings with engine speeds as indicated under each performance curve for accurate pump evaluation.

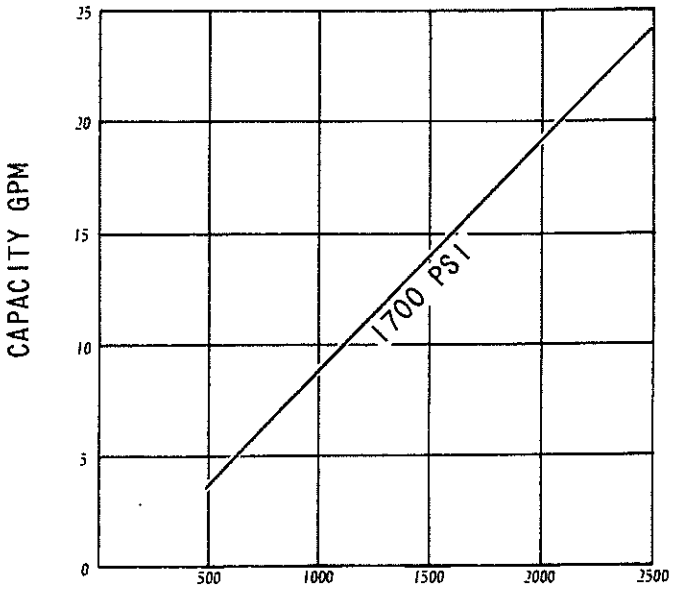
TYPICAL PERFORMANCE CURVE FOR 2JDS2-L PUMP



Pump Speed	500	1000	1500	2000	2500
Engine Speed	339	678	1017	1357	1697

SPEED RPM

TYPICAL PERFORMANCE CURVE FOR 4JDS PUMP

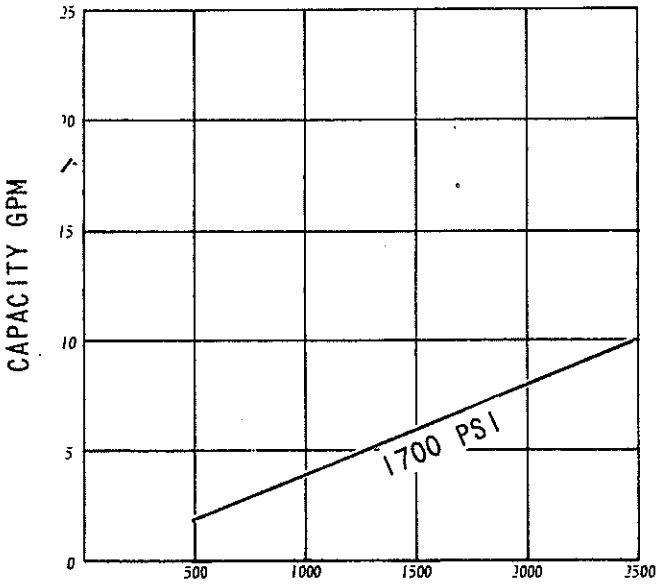


Pump Speed	500	1000	1500	2000	2500
Engine Speed	339	678	1017	1357	1697

SPEED RPM

TYPICAL PERFORMANCE CURVE FOR 1YDS6/1YID6-LB

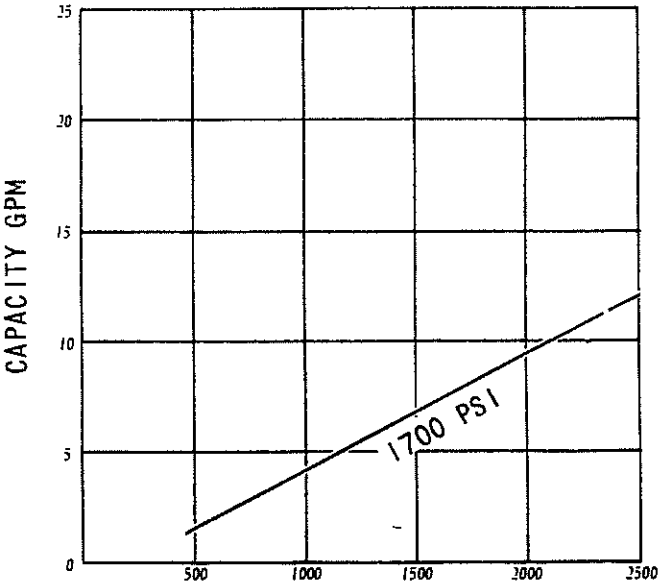
1YDS6



Pump Speed	500	1000	1500	2000	2500
Engine Speed	339	678	1017	1357	1697

SPEED RPM

1YID6 LB

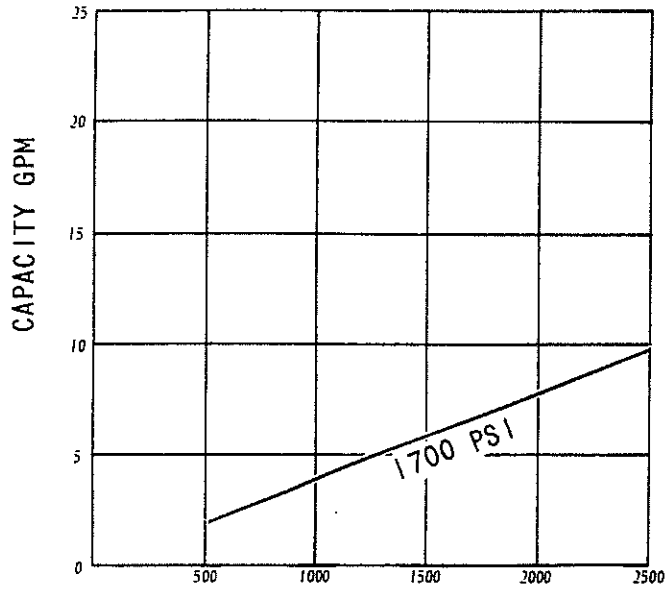


Pump Speed	500	1000	1500	2000	2500
Engine Speed	339	678	1017	1357	1697

SPEED RPM

TYPICAL PERFORMANCE CURVE FOR 1YDS6 /0YD6-LB

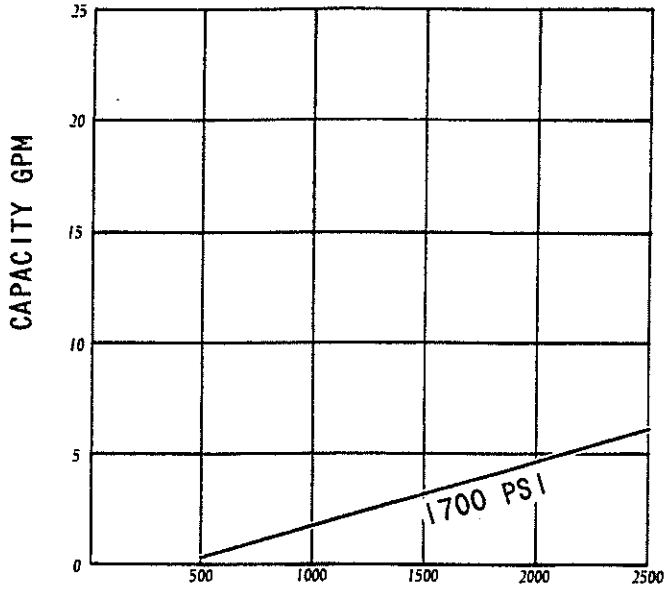
1YDS6



Pump Speed	500	1000	1500	2000	2500
Engine Speed	339	678	1017	1357	1697

SPEED RPM

0YD6-LB



Pump Speed	500	1000	1500	2000	2500
Engine Speed	339	678	1017	1357	1697

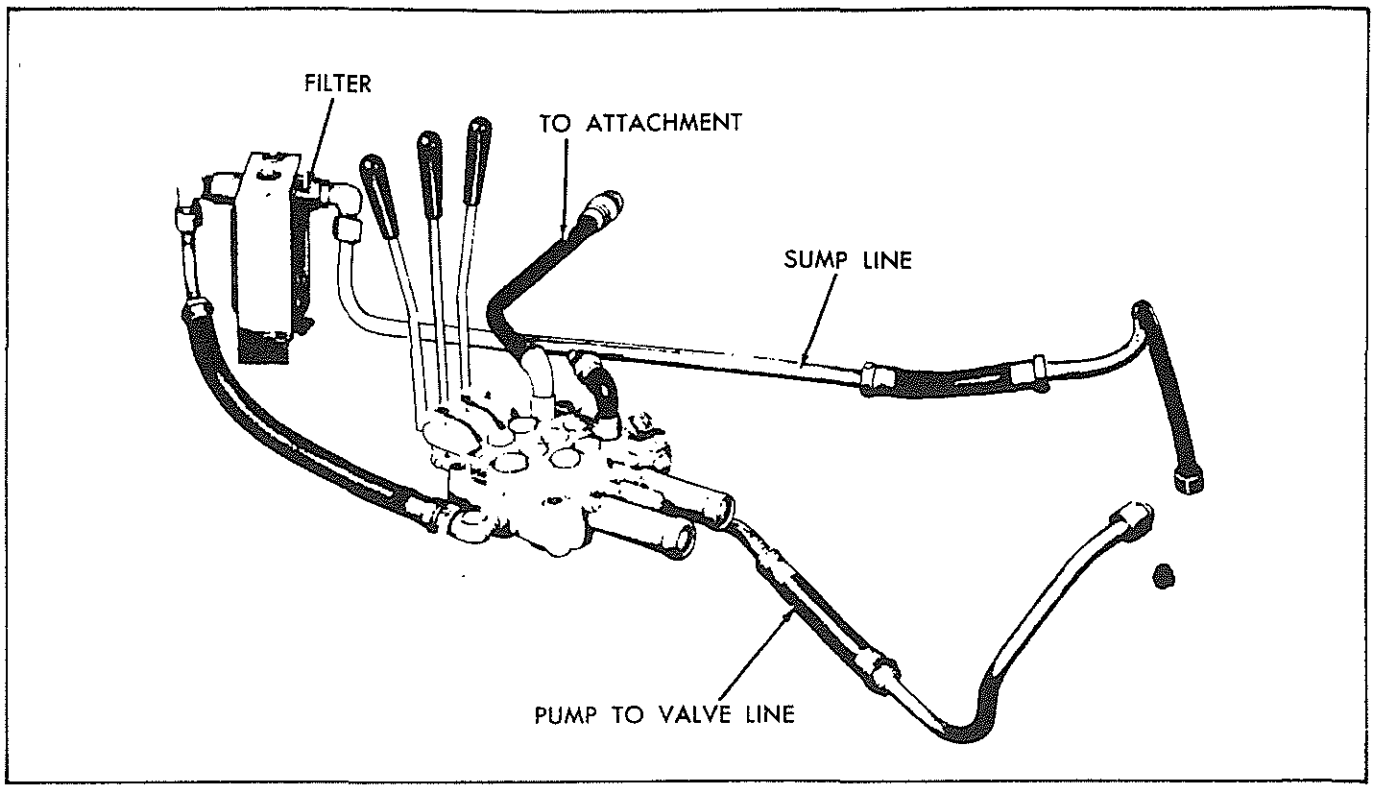
SPEED RPM

CONTROL VALVE

INDEX

CONTROL VALVE

CONTROL VALVES- 1 or 3 SPOOL



The hydraulic system is available with a one or three spool control valve, and a torque housing or fender mounted oil reservoir. All control valves use the pilot operated relief valve. The three spool valves are set up for loader, or for dozer operation. Extra valve equipment is available to connect two control valves in series for types of operation where more than three rams are used.

The one spool control valve is used in conjunction with the 15 GPM pump and torque housing oil reservoir. This valve is used where only one double acting ram is used. This valve has one double acting spool with a float position. It is spring returned from lift or lower to hold position, and is detented in the float position, with a detent feel when passing from lower to float. The pilot operated relief valve is set at 1500 to 1550 P.S.I.

The three spool dozer valve is available with the 15 GPM pump and torque housing oil reservoir. This valve will operate three double acting rams.

The number one spool (next to relief valve) has a float position with a detent feel when passing from lower to float. All spools have a lift, lower and hold position with a spring return back to hold position. The number two spool (center spool) has no detent or float position. The number three spool (furthest from relief valve) is set up exactly like the number one spool with a detent in float position. The pilot operated relief valve is set at 1500 to 1550 PSI.

HYDRAULIC PRESSURE

Factory setting on all H-3 and HD-3 crawler tractor hydraulic systems are 1500 PSI plus or minus 50 PSI.

In field conditions where it is necessary, the hydraulic relief valve may be adjusted to 1700 PSI plus 0 or minus 25 PSI. When using a 1066 front end loader or a combination with a Mark V backhoe, the raise in pressure will increase the digging ability of the backhoe and also increase the breakout and lift of the 1066 front end loader.

It is recommended to increase the relief valve pressure only where it is necessary.

CAUTION: An accurate pressure gauge must be used and properly plumbed into the system when making the adjustment.

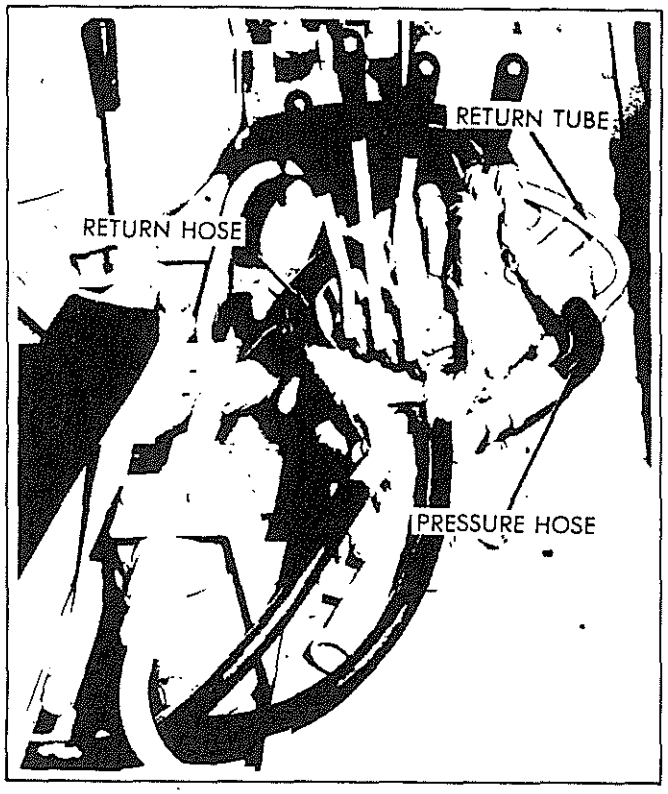
The hydraulic fluid must be up to normal operating temperatures and the engine at rated RPM.

The relief valve is an overloaded protection to the entire unit and hydraulic system. Therefore, extreme high pressures will cause damage to the unit or shorten the life of the hydraulic system.

When the tractor is used for dozer only operation, the relief valve setting should be 1500 PSI plus or minus 50 PSI.

K

1 or 3 SPOOL VALVES



The three spool loader valve is available only with the fender mounted reservoir, This valve is similar to a dozer valve, except that it has a detent in the lift position on number three spool where the dozer valve detents only in the float position.

The number three spool operates the loader boom, and while the boom is raising the operator's hands are free for operating other controls. All spools have a spring return from lift or lower back to hold position. Number one and three spools have a float position, with a detent feel when passing from lower to float. Number two spool does not have a float or detent position. Number three spool has a detent in the raised position. The pilot operated relief valve is set at 1500 to 1550 PSI.

When extra valve equipment is installed and two control valves are used in series, the countersunk (Allen Head) pipe plug must be installed in the small threaded section above "L" in the oil flow diagram of the first valve, and the pressure outlet taken from opening on top of valve body. The elbow is removed from "L" and installed at top of valve; this elbow is replaced with a tee fitting and return lines to sump from both valves are connected to this tee fitting.

ANTI-CAVITATION LINE

In some types of operation where the bucket is carried high before dumping, the tilt rams may have a tendency to cavitate. This cavitation, or motion in the ram, will cause excess movement in the bucket linkage resulting in material spillage.

The cavitation, or lack of oil in the base end of tilt ram, occurs when the hydraulic oil is transferred from rod end to base end of tilt ram when booms are raised to extreme height with the bucket rolled back.

An anti-cavitation or oil make-up line is now available, and may be installed on any 1066 Loader in the field. Units shipped from the factory, or mounted at the West Allis mounting station, will be equipped with the assembly.

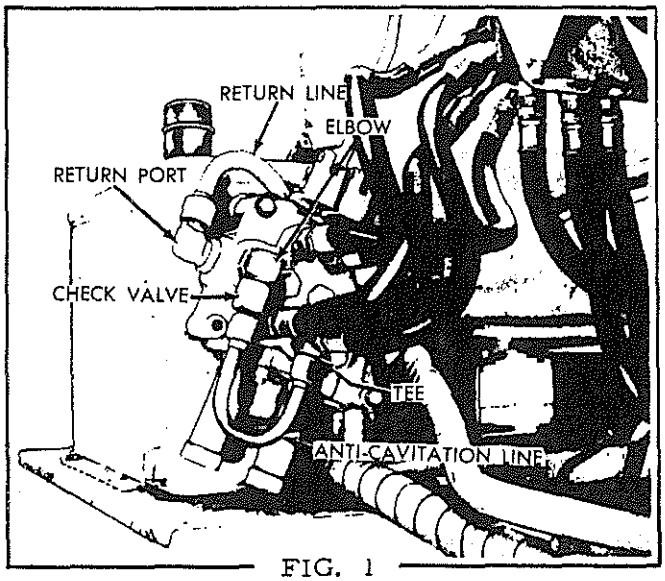


FIG. 1

INSTALLATION INSTRUCTIONS

Remove plug from R. H. side of 3 Spool Valve, and install elbow and check valve. (Fig. 1)

CAUTION: Be certain check valve is installed in proper sequence or oil will bleed back to sump and lose bucket control. Refer to Fig. 2 for correct sequence of parts in installation.

Remove hose from lower end of second control valve. Remove connector and install tee connector provided. Place hose in end of tee connector and install steel tube between tee connector and check valve.

Installation of anti-cavitation line for loaders with backhoe combination.

1 or 3 SPOOL VALVES

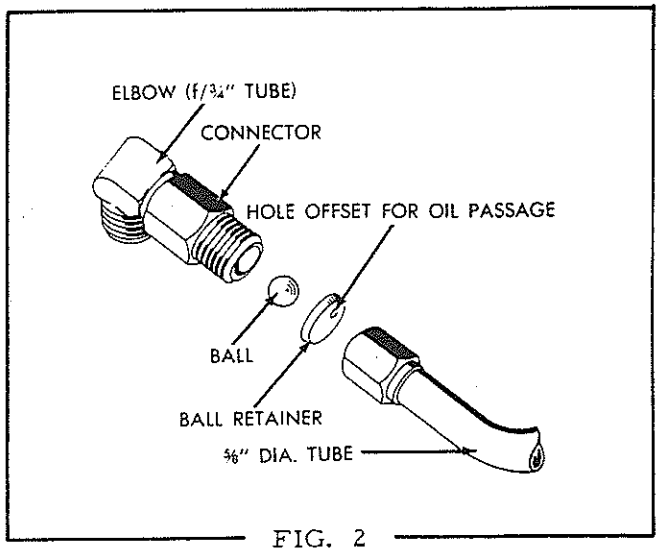


FIG. 2

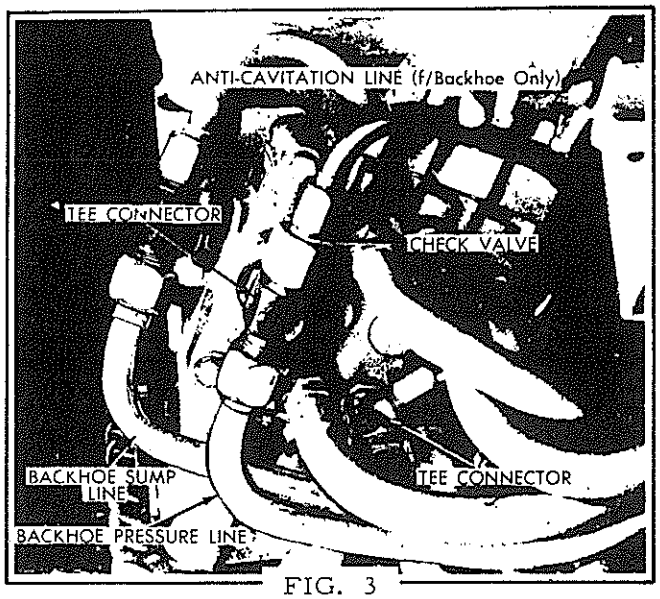


FIG. 3

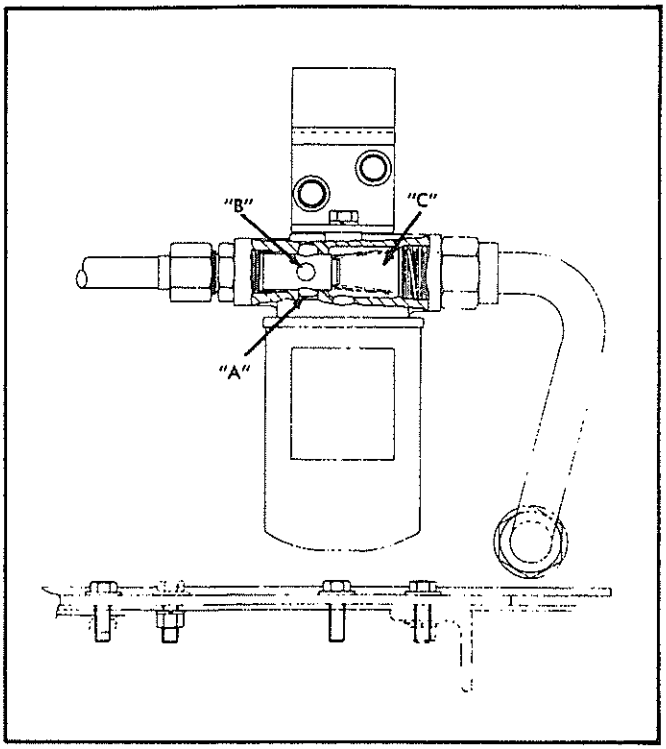
Refer to Fig. 3. When a backhoe is to be mounted or used in combination with a 1066 loader, a tee connector must be ordered from Parts Stock. This tee will replace the 3/4" elbow in right hand side of valve and connect the backhoe pressure line and the anti-cavitation tube. The anti-cavitation line must be ordered from Parts Stock. The original line will be scrapped. The tee connector to the valve spool must be turned up to connect special line. Hose and connector must be removed from lower spool ports to install fittings.

CAUTION: The unit must be properly plumbed up as per Operator's Manual. If hydraulic lines have been changed or a different spool has been used for the bucket circuit, this line will have to be modified.

HYDRAULIC SYSTEM OIL FILTER

Some instances of filter gaskets or filter cans blowing up have been received. This can be caused by high pressure due to the relief valve sticking or being assembled incorrectly. In the event of filter failure, be sure to check the relief valve.

The relief valve is designed with small threads at the pressure inlet and large threads at the outlet to prevent reversal in the circuit.



Refer to sketch: When assembled correctly, oil enters valve piston (which is installed with shoulder end toward oil source) and flows through hole in piston at "B" which matches port "A" in body. Oil passes through the filter and out the opposite port to the return line. When surge pressures occur, the piston moves toward the pressure spring, shutting off oil flow from "B" to "A" through the filter and piston port "B" moves far enough to open into spring cavity "C", and dumping oil directly to the sump line without passing through the filter.

The relief valve piston must be installed through the small thread pressure opening with the shoulder end toward the oil flow.

In the event of filter failure, check for correct assembly and freedom of movement.

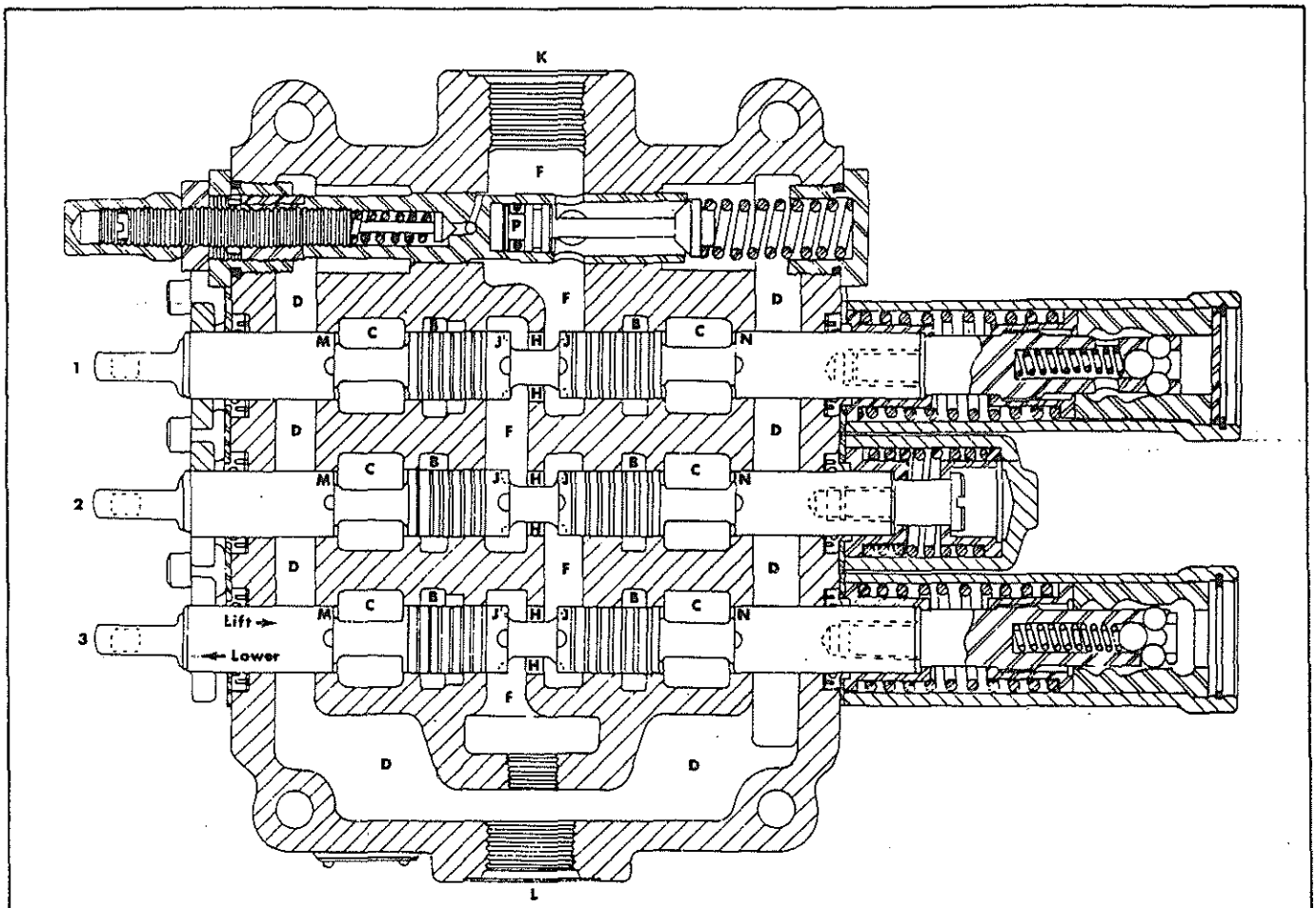
In the event of continued failure after thoroughly checking the above, one coil may be cut from the large end of the regulating spring.

The filter has a static pressure test of: 160 PSI and can withstand 90 PSI working pressure.

The normal working pressure varies from 25 to 50 PSI depending on pump size and engine speed. The relief valve should operate at 60 PSI.

Surge pressures will be developed above 60 PSI when a heavily loaded loader bucket is dropped rapidly. In this event the relief valve must be operative to avoid high pressure in the filter.

THREE SPOOL CONTROL VALVE



THREE SPOOL VALVE

OIL FLOW-LIFT POSITION

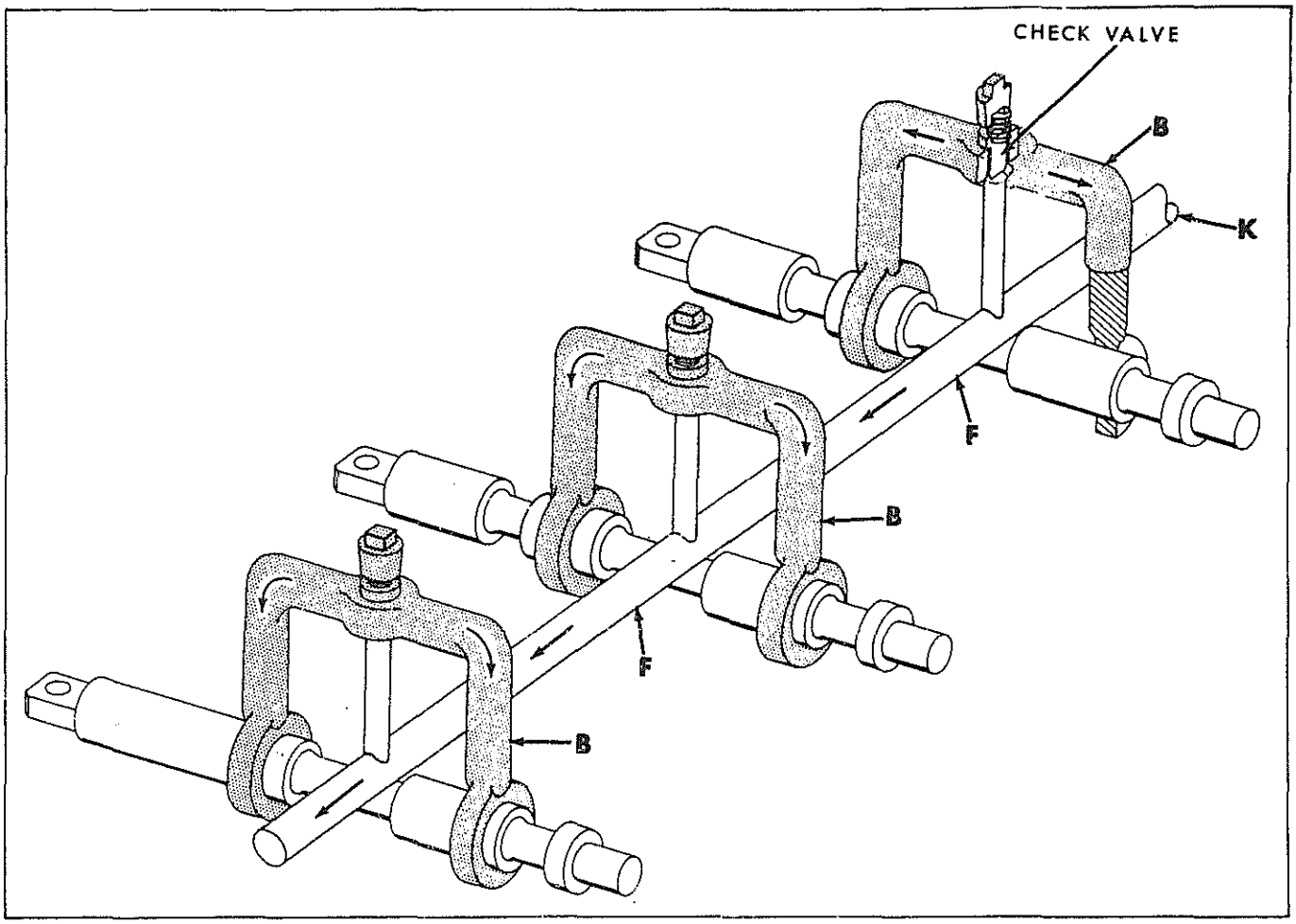
Oil flow from the pump enters control valve at port "K", and flows through passage "F" through the valve body, and returns through port "L" to the sump. Whenever a valve spool is moved into lift position (spool moves to right, or away from lever end of housing) shoulder "J" on spool moves into port "H", blocking off the oil flow through passage "F", therefore the oil flow will be from passage "F" through a lift check valve into left hand passage "B" which is open to ram hose connection "C" at lever end of spool. At this time the oil flow is under pressure to operate the ram.

At this same time shoulder "N" on spool has moved and connected ram hose "C" at spring end of spool to sump passage "D". Therefore the oil returning from opposite end of ram to sump through ram hose connection "C" into sump passage "D" to sump line connection at "L".

OIL FLOW-LOWER POSITION

When a valve spool is moved in the opposite direction to lower position (spool moves to left, or toward lever end of housing), the opposite shoulder "J" on spool moves into port "H", blocking off oil flow through passage "F", and pressurizing passage "B" which is connected to

THREE SPOOL CONTROL VALVE



ram hose connection "C" at spring end of spool. Therefore oil pressure to ram will cause ram to lower.

At this same time shoulder "M" on lever end of spool has moved and connected ram hose connection "C" (lever end of spool) to sump passage "D", allowing oil to return from the opposite end of ram to sump through ram hose connection "C" into sump passage "D" and to sump line connection at "L".

OIL FLOW - FLOAT POSITION

When the valve spool is in float position, both ram hoses are connected to sump passages in a somewhat different manner, also the oil flow through valve to sump is somewhat different as neither ram hose is pressurized.

When the spool is moved to float position, beyond lower position toward the lever end of valve, the spool has a detent arrangement that will hold it in this position until manually removed.

With spool in float position, shoulder "J" at spring end of spool has closed port "H", blocking off oil flow through passage "F" beyond spool. At this same time shoulder "J" at lever end of spool has moved and connected with passage "B" counter bore (at lever end of valve) to passage "F". Therefore the oil flow will be from pump at "K" into passage "F" to point where spool has passage "F" closed off. From this point the oil will flow through the check valve into passage "B", and from passage "B" which is connected back to passage "F" and on to sump line connection at "L".

Ram hose connection "C" at lever end is connected to sump passage "D" through shoulder "M" on spool. Also ram hose connection "C" at spring end of valve is connected to passage "B", and other end of passage "B" (lever end) is connected to passage "F" which leads to sump line connection at "L". This allows free float, and the ram can receive or discharge oil at will.

RELIEF VALVE - OIL FLOW

The type of relief valve used is referred to as a pilot operated relief valve, and is set to by-pass

at 1500 to 1550 P.S.I. The relief valve is incorporated to eliminate high pressures on the system when the ram reaches the end of its stroke in either direction, and control valve in the lift or lowered position, or when the load to be lifted requires more than 1500 P.S.I. of oil pressure.

When the oil pressure builds up in the area of the relief valve in excess of 1500 P.S.I., the oil enters a small hole (1/8" diameter) in the relief valve sleeve and acts against the pilot valve, as the pilot valve is forced from its seat, the oil then enters another drilled passage (3/32" diameter) and acts against the piston end of the main relief valve and hydraulically forces it open, compressing the relief valve spring.

At this time the oil flow from pump entering valve at port "K" and passage "F" surrounding the relief valve sleeve, through the four large holes in the sleeve and out the open relief valve into passage "D", then back to the sump at port "L".

As the oil pressure in the area of the relief valve drops below 1500 P.S.I. the pilot valve will close, due to spring pressure overcoming the oil pressure. When the pilot valve closes, the oil pressure against the main relief valve piston ceases, and the spring forces it back on its seat. The main relief valve is also hydraulically controlled as it reseats, the oil trapped at piston end of valve is forced through a 1/32" hole in the relief valve sleeve to the sump passage "D" and back to sump through port "L".

RELIEF VALVE

REMOVAL

Remove the castle nut and locknut from the pressure adjusting screw. Remove the hollow hex plug from adjusting screw end of valve housing. The adjusting sleeve will be removed with the hollow hex plug. Grasp the adjusting screw and slide the relief valve assembly from valve housing. Remove the plug at spring end of housing, and remove the main relief valve spring.

Remove the adjusting screw from the relief valve sleeve, and remove the pilot valve and valve spring. Pull the main relief valve from sleeve by hand. The piston end of the main relief valve is sealed to sleeve with an "O" ring seal and nylon back-up ring. Check "O" ring seal, and replace any parts that are necessary.

ASSEMBLY

Install a new "O" ring seal and nylon back-up ring on piston end of the main relief valve, and install valve in place in sleeve. Lubricate all parts on assembly. Clean all parts thoroughly before assembly. Install the pilot valve, valve spring and adjusting screw into valve sleeve.

Install the sleeve assembly into bore in housing in the same position from which it was removed. Install sleeve with adjusting screw toward lever end of control valve housing.

Thread the adjusting sleeve into the hollow plug until the notched end of sleeve is 3/8" past flush with the hex face of plug. Install "O" ring seal on plug and thread into valve housing and tighten. Recheck the 3/8" dimension of adjusting sleeve. Install the main relief valve spring and plug at opposite end (spring end) of valve housing, using a new "O" ring seal on plug.

Install the copper washer and locknut on the adjusting screw without tightening. With a pressure gauge connected to a ram hose connection, adjust the pilot valve until it will by-pass at 1500 to 1550 P.S.I. and tighten locknut. Install the second copper washer and castle nut on adjusting screw and tighten.

This type of pilot operated relief valve gives nearly a flat pressure curve at all engine speeds, and provides for longer life of the main relief valve. The relief pressure must be adjusted at full pump capacity. Therefore, operate engine at high idle and adjust pressure to by-pass at 1500 to 1550 P.S.I. The main relief valve is pressure balanced and will not open to by-pass oil until after the pilot valve has been unseated.

VALVE SPOOLS (PLUNGERS)

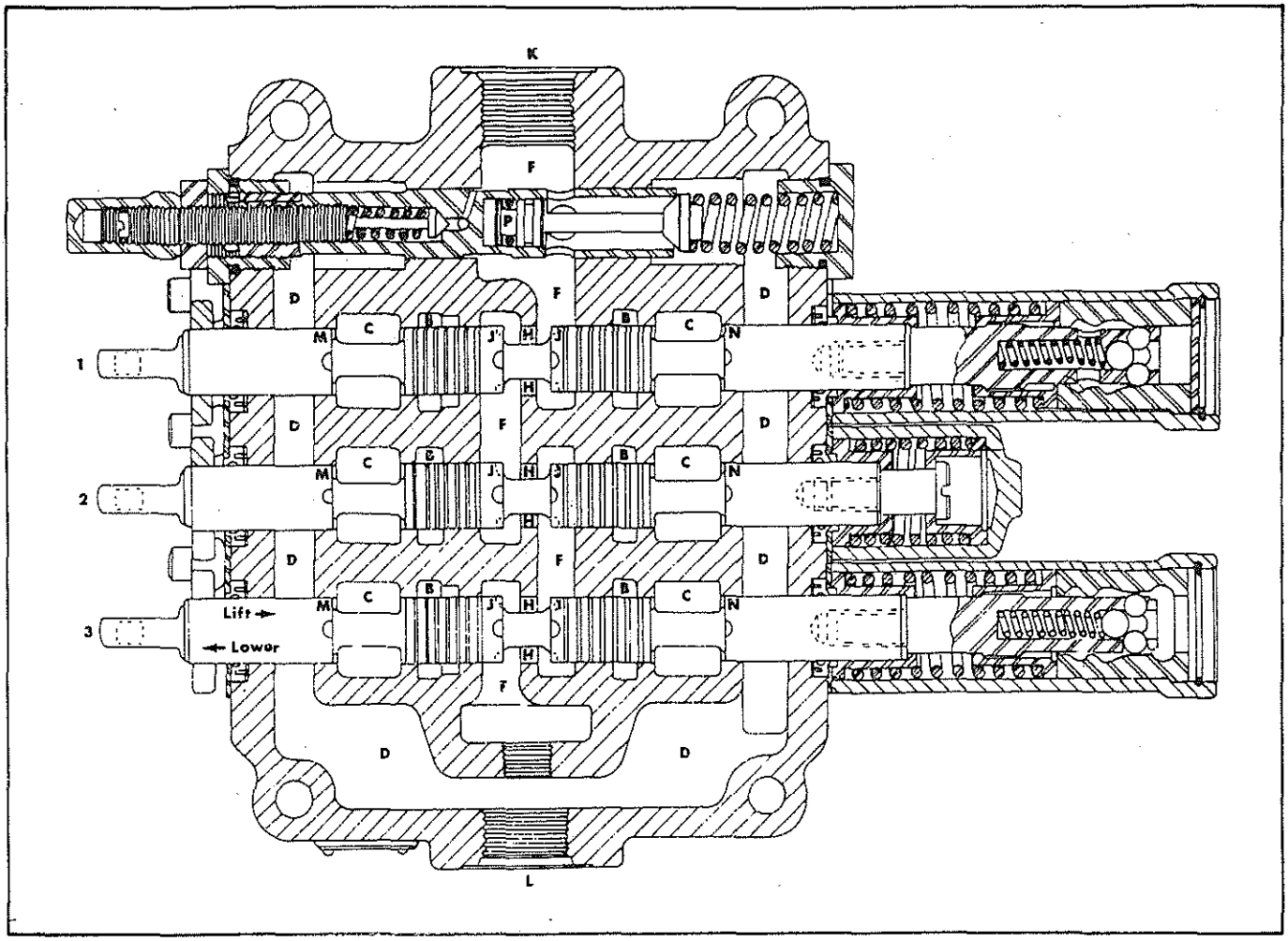
REMOVAL

The plunger in the one spool control valve, and the number one and number three plungers in the three spool control valve are all alike, and will be removed or installed in the same manner. The number two plunger (center spool) of the three spool valve does not have a float position and the detent balls and sleeve are omitted, making the removal and assembly of spool more simplified. Mark position of the number one and three spools so that they can be installed in the same bore in valve housing. Clean valve thoroughly before disassembly.

Remove the control levers from valve assembly. Remove any paint, rust (etc.) from lever end of plunger. Remove the Allen head screws attaching the lever mounting brackets to valve housing, and remove brackets, seal plates, wiper seals and seal support rings. Remove the Allen head screws attaching detent caps to valve housing, and pull plunger assemblies from valve housing.

Clamp the lever end of spool (plunger) in vise with the spring end upward. On number two spool, remove the special capscrew, spring seats, spring, seal plate, wiper seal and seal

THREE SPOOL CONTROL VALVE



support ring. Use caution when removing capscrew and hold spring compressed until screw is out of plunger.

On all detent spools, remove snap ring retaining detent plug at end of detent cap and remove plug. Remove the spool from vise, and remove the wiper seal, seal support ring, seal plate and detent cap from lever end of spool (plunger).

Replace the lever end of spool in vise with spring end upward, and remove the detent sleeve as follows. Use a small diameter punch and depress the center detent ball against the detent spring until a small screw driver can be inserted through hole in detent pin and hold spring depressed. Lift detent sleeve from spool. Holding spring compressed, remove the four 1/4" diameter detent balls. Hold hand with glove over opening in detent pin while releasing the detent spring. Hold centering spring compressed and remove the detent pin from spool.

ASSEMBLY

With the control valve completely disassembled, it is difficult to determine the lever end from the spring end. To properly assemble the spools into valve housing, position the housing with the relief valve bore away from you, with ram hose outlets upward and the sump return opening toward you. Install lever end of spool into housing at R.H. side, so that lever end is to the L.H. side when installed. The increased counter bore in housing for float position at "B" in oil flow diagram is the lever end of housing. Thoroughly clean housing and all parts before reassembly.

Clamp lever end of spool in vise with spring end upward. Place a spring seat at each end of centering spring, and place over end of spool. On number two spool, hold spring compressed and install the special capscrew. Be sure capscrew is threaded into spool before releasing spring, then tighten capscrew.

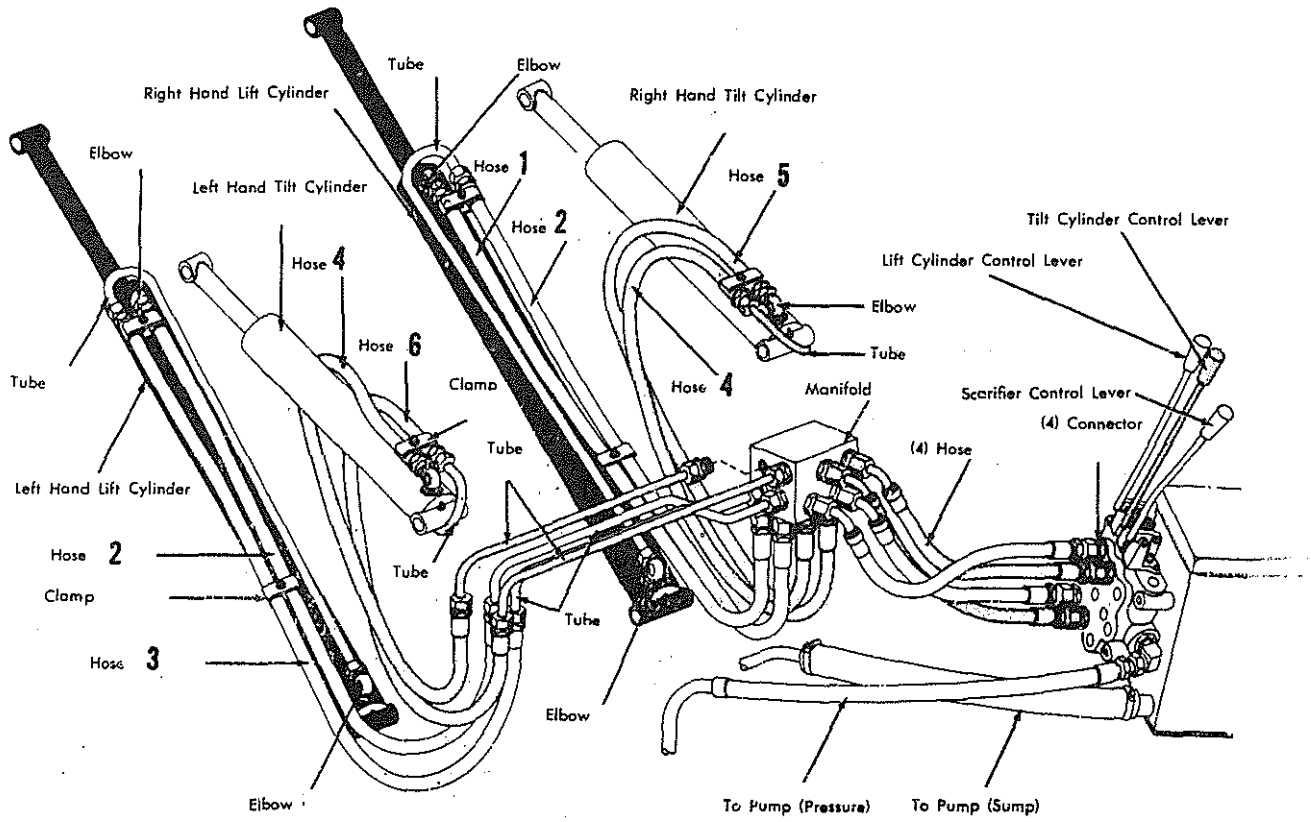
On all detent spools, hold spring compressed and install the detent pin. Insert punch through hole in detent spring and tighten, using caution not to distort or bend spool. Install detent spring into hole in pin. Use punch and depress spring until a small screw driver can be inserted through hole in hold spring depressed. Install the 11/32"

diameter detent ball at top of spring. Place the four 1/4" diameter detent balls in holes provided, using Lubri-plate (or grease) to hold the balls in place. Place the detent sleeve (with flange edge upward) over the detent balls and pin, then release the detent spring by removing the small screw driver.

Remove spool assembly from vise and install the detent cap over lever end of spool. Install detent plug and retaining ring in end of cap. Install the seal retaining plate, wiper seal and seal support ring over lever end of spool and position next to detent cap. Use caution while installing wiper seal over shoulders on spool to prevent damage to seal lips. With all parts clean, install the spool assembly into position in valve housing, using the method previously explained for proper assembly.

Install the Allen head screws retaining the detent caps to valve housing. Install the wiper seals with seal support rings in place over lever end of spools, with shoulder of seal forward and press into place in housing. Install the seal retaining plates and lever mounting brackets. Install the Allen head retaining screws and tighten. Install the levers and links, using the pins and "E" rings.

1066 LOADER HYD. CIRCUIT



Hose Legend

1	Lift Cylinder - Female Both Ends	52" Lg.
2	Lift Cylinder - Female One End, Male Other	52" Lg.
3	Lift Cylinder - Male Both Ends	52" Lg.
4	Tilt Cylinder - Female One End, Male Other	43" Lg.
5	Tilt Cylinder - Female Both Ends	44" Lg.
6	Tilt Cylinder - Male Both Ends	43" Lg.

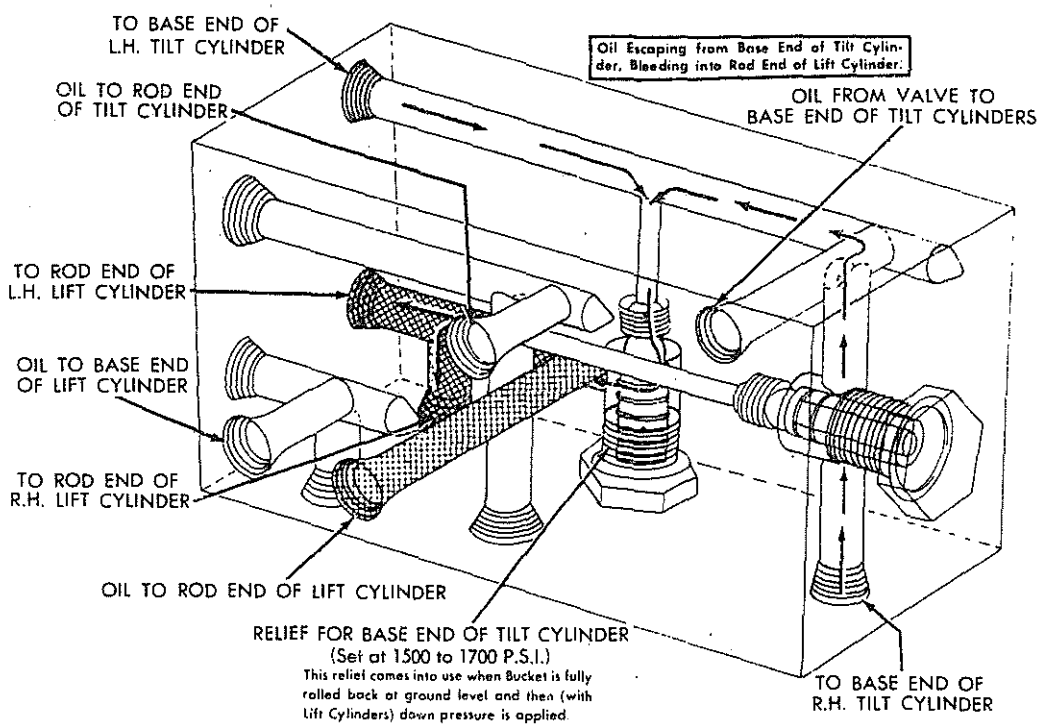


FIG. 1

HYDRAULIC RELIEF VALVES

The manifold provides a junction for installing all hydraulic lines between tilt and lift cylinders and the control valve.

There are two relief valves in the manifold. These valves provide the necessary protection for the tilt cylinders when raising the boom to full height with the bucket dumped; also when lowering the boom from carrying height with the bucket rolled back all the way.

With bucket in complete rolled back position, the tilt cylinders are extended. When bucket is lowered all the way, pressure must be relieved from the base end of the tilt cylinders.

This pressure is relieved through the valve in bottom of manifold allowing oil to transfer to rod end of lift cylinder. (See Fig. 1).

When bucket is in dumped position, tilt rams are collapsed. When bucket is raised, oil must be relieved from rod end of tilt cylinder. The valve on R. H. end of manifold relieves this pressure allowing oil to transfer from rod end of tilt cylinder to base of tilt cylinder. (See Fig. 2).

These valves are pre-set at the factory to open between 1700 and 1900 P. S. I., and should be kept within this range for best operation of the loader.

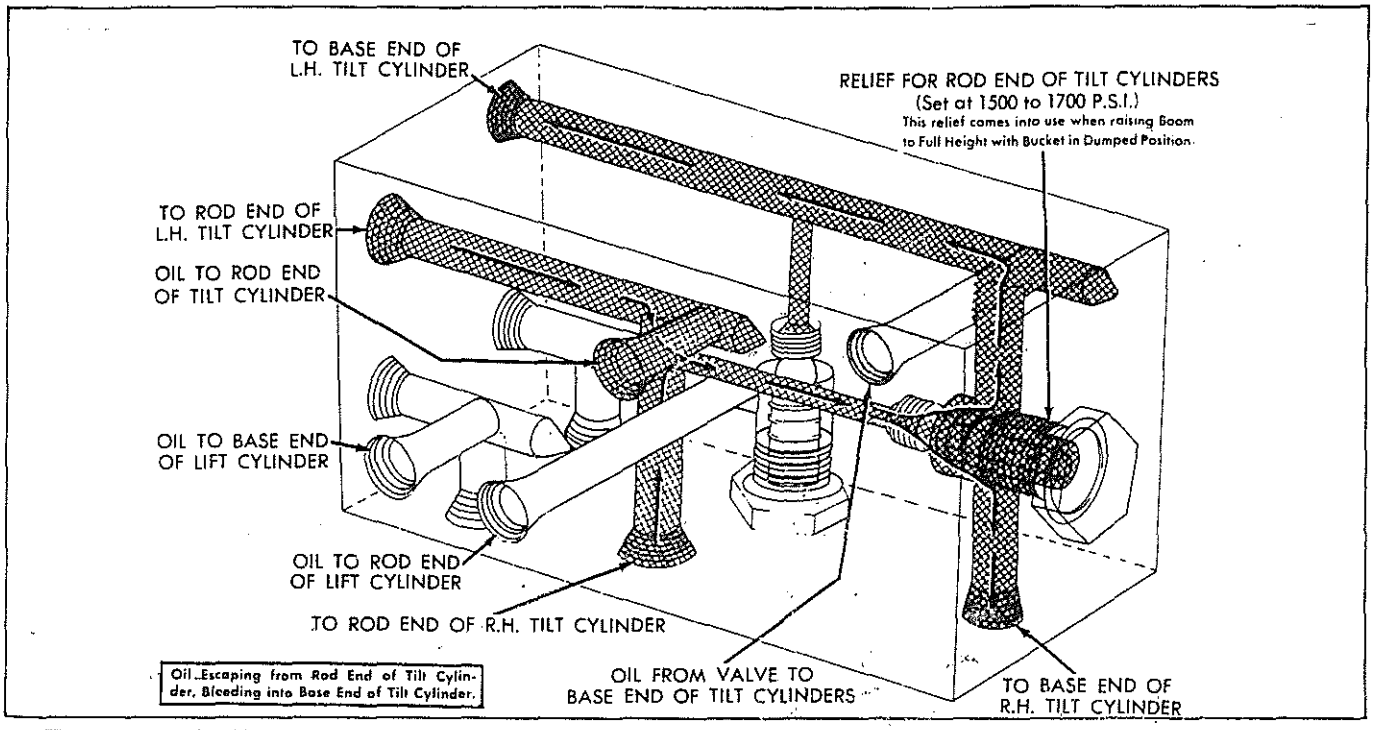
To test the valve in end of manifold, install pressure gauge in hose at rod end of tilt cylinder. Rotate bucket to full dumped position. Raise bucket to full height. As rod end of tilt rams start to pull out, the gauge should read between 1700 and 1900 P. S. I.

To check valve in under side of manifold, install gauge in base end of tilt cylinder. Roll bucket all the way back, then lower bucket. Gauge should read at 1700-1900 P. S. I. Bucket should be lowered to ground level only. DO NOT APPLY DOWN PRESSURE.

CAUTION: Valves are pre-set and should never be adjusted by adding shims. IF PRESSURE IS LOW, REPLACE THE VALVE SPRING.

The addition of more than two shims cuts down clearance between ball and end of the 1/4" diameter rod. If this clearance is diminished too much by adding more than two shims, the ball will not rise sufficiently off the seat to allow oil to escape. This would cause damage to hydraulic cylinders, hoses, etc.

HYD. CIRCUIT



OPERATION (3 POINT HITCH)

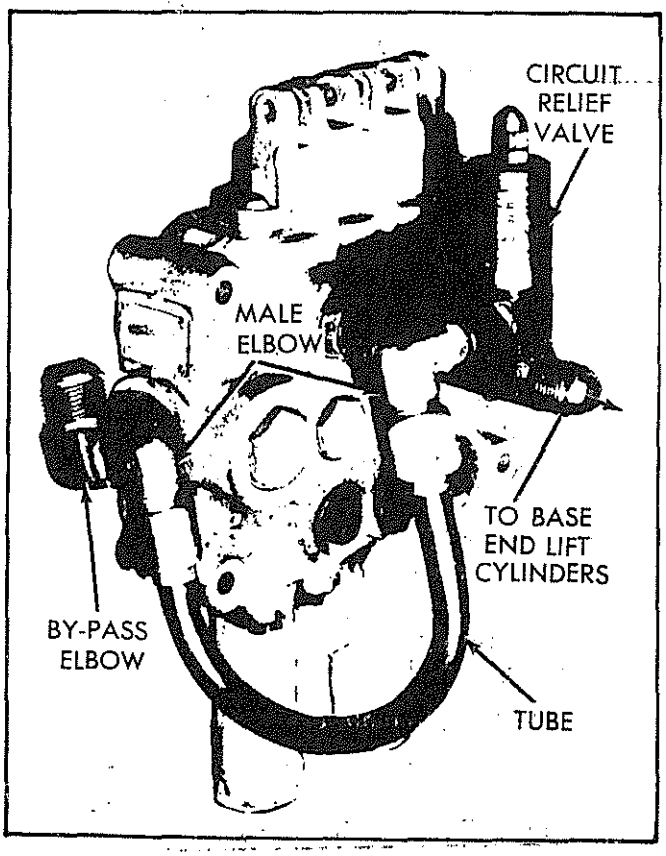
To obtain float position of hydraulics, it is necessary to move control lever into Detent position which is past full lower position.

A circuit relief valve is being added to the tractor control valve on units H3-7286 and up. This circuit relief is available for older units to provide protection for the loader lift cylinder and frame structure of the loader.

The circuit relief is to be set at 2000 P.S.I. If static loads in the lift circuit exceed this pressure, oil from the base end of the lift cylinder will be allowed to flow to sump there-by relieving undue strain on the loader.

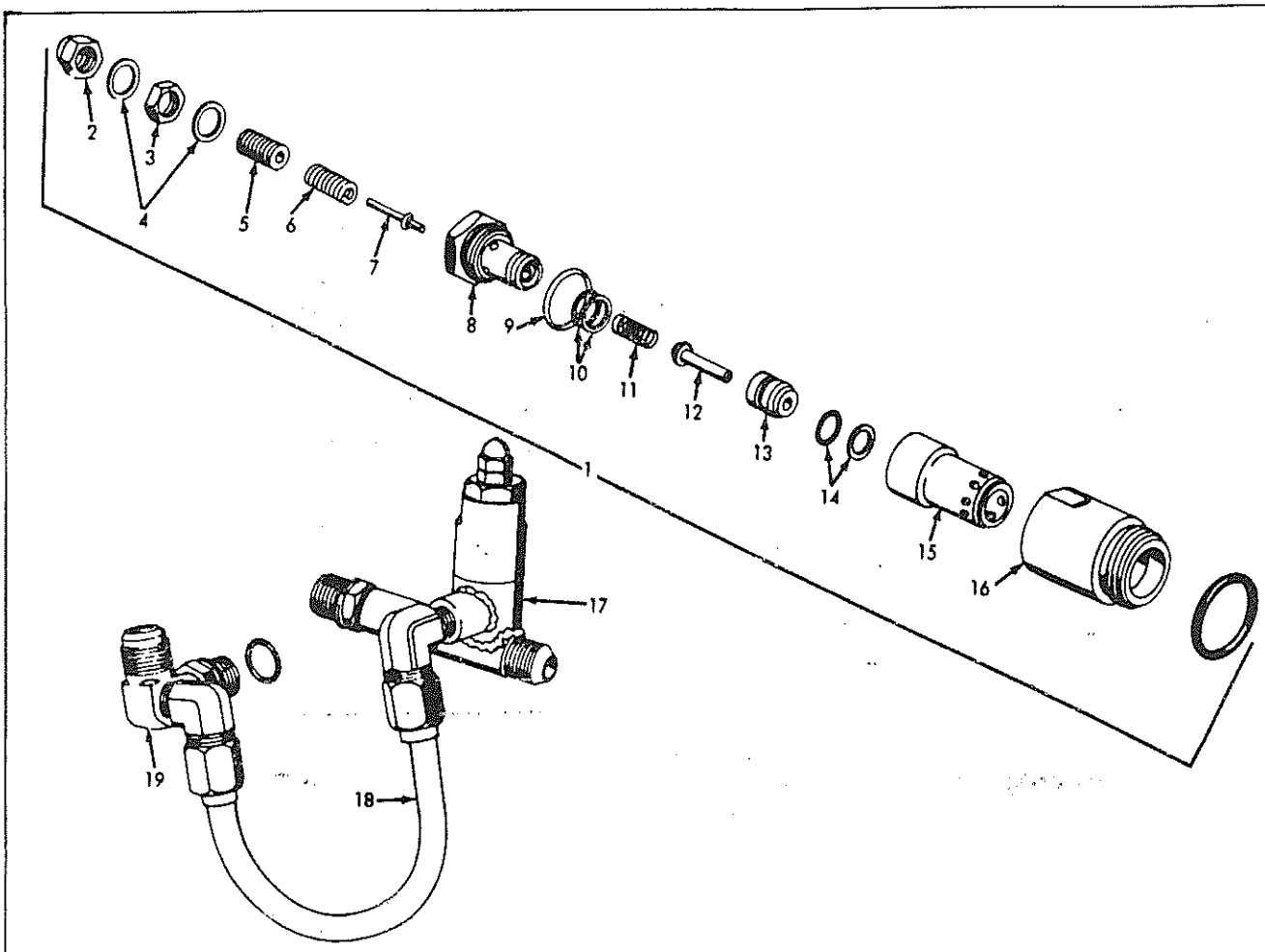
INSTALLATION

1. Remove the 21-1/4" hose from the upper R.H. port of loader valve and hose connector.
2. Disconnect sump line from R.H. side of loader valve and remove elbow and connector.
3. Mount relief valve assembly into upper R.H. pressure port in control valve and index as shown.
4. Mount 5/8 tube x 3/8 male elbow into circuit relief valve and index as shown.
5. Mount by-pass elbow into sump port on R.H. side of control valve and index as shown.



6. Mount tube assembly and tighten locknuts on relief valve assembly and by-pass elbow.

CIRCUIT RELIEF VALVE
Used with 1066 Loader



1. Circuit Relief valve
2. Nut
3. Jam nut
4. Copper Washer
5. Adjusting screw
6. Pilot poppet Spring
7. Pilot poppet
8. Plug
9. O-Ring (2)
10. Backup Ring & O-Ring
11. Pilot poppet Spring
12. Poppet piston
13. Inner poppet
14. O-Ring &.back-up ring
15. Outer Poppet
16. Relief Valve Cap
17. Tee Assy.
18. Tube Assy w/elbow
19. By-pass elbow w/O-Ring

NOTE: When backhoe is installed by-pass elbow is replaced with tee.

LIFT CIRCUIT RELIEF VALVE

DISASSEMBLE RELIEF VALVE

Thoroughly clean the area of dirt around the relief valve prior to removing relief valve from section. The relief valve for the lift circuit is 2000 P.S.I.

Remove the acorn nut, copper washer, jam nut, second copper washer, adjusting screw, valve spring and the pilot poppet valve. Remove the hex plug section from the relief valve cap section. Separate the hex plug from the relief valve poppet (Item #15) and remove the spring and piston.

RELIEF VALVE

Remove the poppet valve with seals from inside of the valve poppet sleeve. Remove all O-ring seals and back-up rings, as new seals must be used. Inspect all parts and replace those that are necessary.

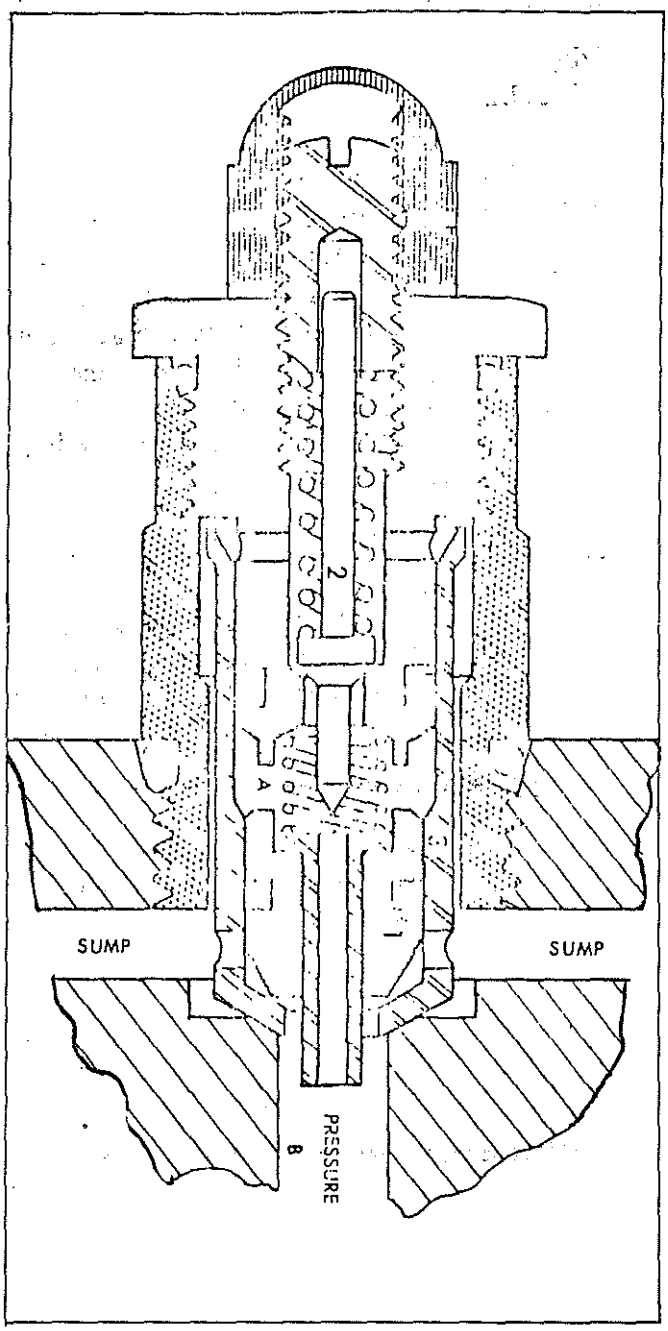
ASSEMBLE RELIEF VALVE

Install O-ring and back-up ring on the valve poppet (Iten #13). The flat back-up ring seats in the groove nearest the seating end of the poppet. The O-ring seats in groove next to back-up ring, but on the spring end of poppet.

Place the piston through poppet valve. Lubricate O-Ring and insert poppet valve assembly into the poppet valve sleeve.

Install O-ring and back-up ring in groove of valve plug. Place back-up ring inside of the groove nearest hex end of plug. Lubricate O-ring seals. Place poppet sleeve assembly inside of the valve cap. Place spring in counterbore of poppet valve. Install valve plug with O-rings. Enter seal end into poppet sleeve and thread into valve cap.

Install pilot poppet valve (Item #7), spring (Iten #6) and adjusting screw (Item #5). Tighten adjusting screw against spring only slightly during assembly. Set relief pressure after valve is installed and using a pressure gauge in the system, install copper washer and jam nut, second copper washer and the acorn nut. When installing a new relief valve assembly, always set the relief valve pressure. Set at 2000 P.S.I. for lift system.



RELIEF VALVE

OPERATION OF RELIEF VALVE

1. In normal operation the oil pressure exerts a greater force on the side "A" of the poppet, due to a larger area which keeps the poppet seated.

2. If a surge pressure is realized in the system, Item #1 could be unseated before the higher pressure in encountered at "A". This would reduce (relieve) the high surge of pressure without relieving pressure of the whole system.

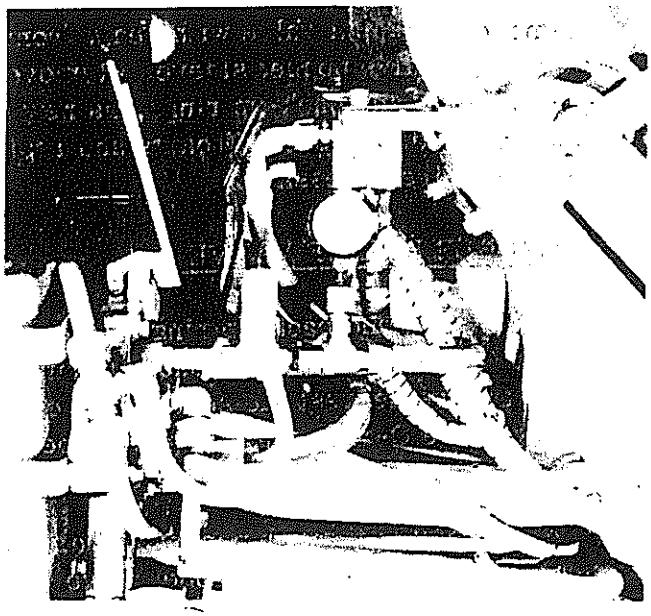
3. Should the pressure become high enough and for a duration of time long enough to equalize pressure at "A" and "B" which then allows Items #1 and #3 to move simultaneously off the seat, dumping the system oil to sump.

RELIEF VALVE

CHECKING LOADER LIFT CIRCUIT RELIEF

Plumb a 3000 P.S.I. gauge into base end of lift cylinder as shown.

Place the bucket cutting edge under a stationery immovable object. Raise loader until oil bypasses through main relief. Bucket should clear ground by at least 12". Roll bucket back. Forces generated in this manner will create down pressure on lift arms and cause lift cylinder rods to retract thereby actuating the circuit relief valve. Observe reading on gauge. It should be 2000 P.S.I.



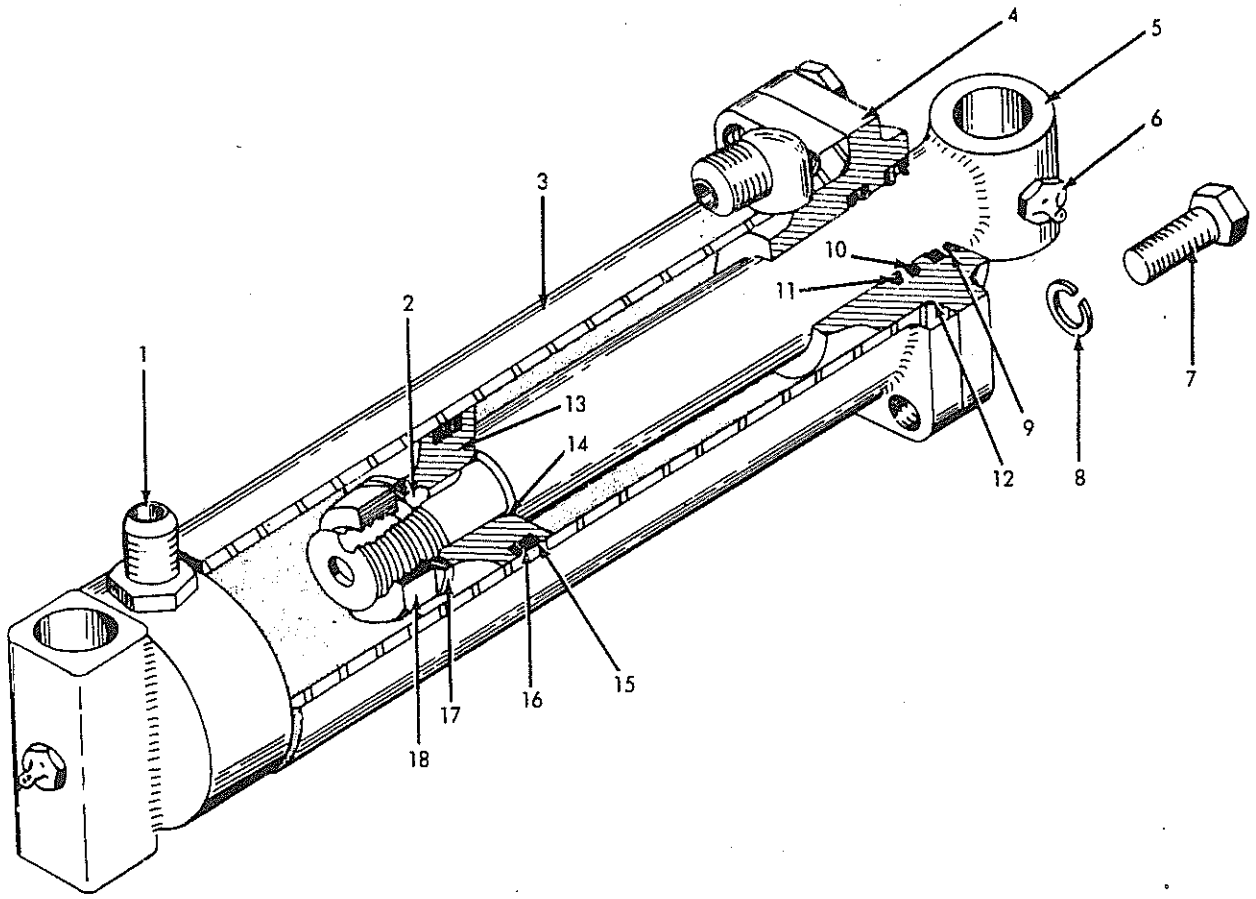
PRESSURE TESTING CIRCUIT RELIEF VALVE

ADJUSTING VALVE SETTING

Remove acorn nut (Item 2) and loosen jam nut (Item 3), then turn screw in to increase pressure and out to decrease. Tighten jam nut and replace acorn nut after attaining 2000 P.S.I. adjustment.

The (Loquic primer) 344054 in 4 oz. quantities must be used to treat plated parts and also aides the (Loc Tite) sealer (310481) to set up fast. The (locquic primer) will cut grease or oil and also eliminate need for a curing period.

Lubricate inside of cylinder tube and piston assembly and install piston and rod assembly. Install retaining nut and tighten with spanner wrench. Cylinder is now ready for installation on unit and operation.



1080, 1081 & 1090 DOZER CYLINDER

1. Connector
2. O-Ring
3. Cylinder Tube
4. End Cap
5. Rod
6. Fitting
7. Capscrew
8. Lockwasher
9. Seal
10. O-Ring
11. O-Ring
12. O-Ring
13. Piston
14. O-Ring
15. Backup Washer
16. O-Ring
17. Lockwasher
18. Nut