DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

TRUCK, LIFT, FORK; GASOLINE ENGINE DRIVEN;

PNEUMATIC-TIRED WHEELS; 6000 LB CAPACITY;

168 INCH LIFT; ALLIS-CHALMERS MODEL FP60-24PS;

ARMY MODEL MHE213 FSN 3930-935-7979

This copy is a reprint which includes current pages from Changes 2 and 3.

HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1971

CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington D.C., *26 August 1991*

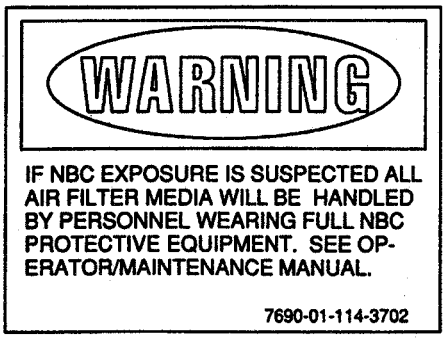
Direct Support and General Support
Maintenance Manual

TRUCK, LIFT, FORK; GASOLINE ENGINE DRIVEN; PNEUMATIC-TIRED WHEELS; 6000 LB CAPACITY; 168-INCH LIFT; ALLIS-CHALMERS MODEL FP60-24PS, ARMY MODEL MHE-213, NSN 3930-00-935-7979

TM 10-3930-618-34, 12 May 1971, is changed as follows:

Page 1-1, the following paragraph is added after **Section II. "DESCRIPTION AND DATA."**

A decal has been developed that warns of NBC exposure. It is to be positioned in a noticeable place on or near the air cleaner or air filter housing. You may order the decal using part number 12296626, CAGEC 19207. Refer to TB 43-0219 for further information. Add the decal the air cleaner.



Page 1-1, add the following. WARNING preceding paragraph 1-5*b.* "Air cleaner."

WARNING

If NBC exposure is suspected, all air filter media should be handled by personnel wearing protective equipment. Consult your unit NBC Officer or NBC NCO for appropriate handling or disposal instructions.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

PATRICIA P. HICKERSON
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25E (Block 2214) Direct and General Support maintenance requirements for TM 10-3930618-34.

CHANGE
NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *29 .Nov 1984*

Direct Support and General Support
Maintenance Manual
TRUCK, LIFT FORK; GASOLINE ENGINE DRIVEN; PNEUMATIC-TIRED WHEELS; 6000 LB. CAPACITY; 168-INCH LIFT; ALLIS-CHALMERS MODEL FP60-24PS, ARMY MODEL MHE-213, NSN 393000-935-7979

TM 10-3930-61834, 12 May 1971, is changed as follows:
Cover. Change "FSN 3930-935-7979" to read "NSN 3930-00-935-7979".
Inside Front Cover. Add safety precautions as follows:

WARNING

DANGEROUS GASES
are generated as a result of operation of this equipment.

ASPHYXIATION
may occur if truck is operated in a closed building without providing adequate ventilation.

DEATH
or severe injury may result if personnel fail to observe safety precautions. Utilize extreme caution, do not smoke, or use flame in vicinity when servicing batteries. Batteries generate explosive gas during charging. Always maintain metal-to-metal contact when filling the fuel tank. Do not smoke or use open flame in vicinity when filling the fuel tank. Do not fill fuel tank when truck is operating.

LOSS OF HAND OR FINGERS
may occur if adjustments are made on engine while in operation, except for designated adjustments.

Page i. Change "FSN 3930-935-7979" to read "NSN 3930-00-935-7979".
Page 1-1. Chapter 1. Section I. Paragraph 1-3 is superseded as follows:

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS
You can improve this manual by recommending improvements using DA Form 2028 (Recommended Changes to Publications and Blank Forms) or DA Form 2028-2 located in the back of this manual and mail the form direct to Commander, US Army Tank-Automotive Command, ATTN: DRSTA-MB, Warren, MI 48090. A reply will be furnished to you.

Page 1-1. Paragraph 1-5b(8). After Table 1-2, before Chapter 2 add the following:
(9) Fits, Tolerances, and Wear Limits. Fits, tolerances and wear limits for the engine, transmission, and miscellaneous items are contained in tables 1-3 (Engine), 1-4 (transmission) and 1-5 (Miscellaneous).

*This Change Supersedes Change 1 dated 6 March 1972.

After Page 1-2, in, front of Page 2-1 add the following:

Table 1-3. Engine Fits, Tolerances, and Wear Limits.

Component	*Manufacturer's Dimensions and Tolerances in Inches* Min	Max	*desired Clearance in Inches* Min	Max	*Maximum Allowable Wear and Clearance*
CYLINDER SLEEVE					
Inside diameter	3.4379	3.4385			
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, lower diameter			0.001	0.005	
Block to sleeve clearance at machined area Just below flange			0.0005	0.0045	
Block to sleeve clearance at sleeve flange			0.003	0.012	
Clearance of piston skirt with sleeve			0.006 tight	0.002 loose	
Top surface of cylinder sleeve flange relative to cylinder block with sleeve installed					± 0.002 in.
Allowable taper					0.0007 in.
Allowable out-of-round (when installed)					0.001 in.
CYLINDER BLOCK					
Counterbore diameter in block for sleeve flange	3.985	3.990			
Counterbore depth for sleeve flange	0.249	0.251			
Bore in block for sleeve					
Top	3.9136	3.9155			
Bottom	3.841	3.843			
Bore in block for camshaft bearings					
Front and intermediate	2.124	2.125			
Rear	1.374	1.375			
Bore in block for main bearings (without baring, cap in place, and capscrews tightened to 120-130 lb ft)	2.6913	2.6920			
PISTON					
Diameter between top and second ring groove	3.4045	3.4095			
Diameter at bottom of skirt measured at right angle to piston pin	3.4365	3.4385			
Bore for piston pin.	0.8693	0.8696			
Measurement from center of piston pin bore to top piston	1.995	2.000			
Clearance of piston skirt with sleeve			0.0006 tight	0.002 loose	

Table 1-3. Engine Fits, Tolerances, and Wear Limits-Continued.

Component	*Manufacturer's Dimensions and Tolerances in Inches* Min	Max	*desired Clearance in Inches* Min	Max	*Maximum Allowable Wear and Clearance*
PISTON PIN					
Length	2.738	2.753			
Diameter of pin	0.8591	0.8593			
Fit at pin in piston, room temperature			0.0001	0.0005 loose	
Inside diameter of connecting rod bushing installed	0.8593	0.8596			
Piston pin to connecting rod bushing clearance			0.0000	0.0006 loose	
PISTON RINGS					
Gap between end--fitted			0.011		
Clearance of rings in grooves:					
Top compression			0.002	0.004	
2nd compression (intermediate)			0.0015	0.0035	
3rd oil control			0.0015	0.0035	
4th oil control			0.001	0.003	
CRANKSHAFT					
Journal diameter for connecting rods	2.1214	2.1224			
Journal diameter for main hearings	2.4984	2.4994			
Width between connecting rod journal checks	1.500	1.504			
Width of main hearing journals:					
Front bearing	1.557	1.567			
Intermediate hearings	1.308	1.316			
Center hearing	1.878	1.882			
Rear bearing		2.000			
Crankshaft end clearance			0.002	0.008	0.014
Fit of crankshaft gear on crankshaft (tight)			0.001	0.003	
MAIN BEARING					
Inside diameter (with capscrews tightened to 120-130 lb ft)	2.5007	2.5024			
Diameter of crankshaft main hearing journals	2.4984	2.4994			
Bearing to journal (with capscrews tightened to 120-130 lb ft)			0.0013	0.0040	0.007
Overall length of main bearing					
Front	1.057	1.067			
Intermediate	1.057	1.067			
Center	1.874	1.876			
Rear	1.708	1.718			
Bearing wall thickness (standard bearing)	0.0948	0.0953			
Bore in cylinder block (without bear ing, cap In place, and capscrews tightened to 120-130 lb ft)	2.691	2.69 20			

Table 1-3. Engine Fits, Tolerances, and Wear Limits-Continued.

Component	*Manufacturer's Dimensions and Tolerances in Inches* Min	Max	*desired Clearance in Inches* Min	Max	*Maximum Allowable Wear and Clearance*
CONNECTING ROD BEARINGS					
Inside diameter of bearing (with nuts tightened to 40-50 lb ft)	2.1239	2.1264			
Diameter of crankshaft connecting rod journals	2.1214	2.1224			
Connecting rod bearing to journal clearance (with nuts tightened to 40-50 lb ft)			0.0015	0.0040	
Overall length of connecting rod bearings	1.180	1.190			
Bearing wall thickness (standard bearing)	0.0623	0.0628			
CONNECTING RODS					
Length (center to center)	7.748	7.762			
Inside diameter of bushing (finished bore)	0.8593	0.8596			
Outside bore of bushing	0.9175	0.9195			
Bearing bore (without bearing, caps in place and nuts tightened to 40-50 lb ft)	2.2495	2.2600			
Connecting rod bearing to crankshaft journal clearance (with nuts tightened to 40-50 Ib ft)			0.0015	0.0040	
Connecting rod width at lower end	1.495	1.497			
Side clearance to crankshaft cheek	0.003	0.009			
Piston pin diameter	0.8591	0.8593			
Piston pin to connecting rod bushing clearance (loose)			0.0000	0.0005	
Bore in connecting rod for piston pin bushing	0.913	0.914			
EXHAUST VALVE					
Valve lift (at valves)					0.428 in.
Valve lift (at cam)					0.312 in.
Seat angle					45 degrees
Seat width (contact)					31/2 in.
Valve clearance (cold)					0.014 in.
Valve clearance (engine coolant at normal operating temperature)					0.012 in.
Overall length					4-3/8 in.
Head diameter	1.307	1.317			
Stem diameter	0.3405	0.3415			
Inside diameter of valve guide (finish room after assembly)	0.343	0.344			
Stem to guide clearance			0.0015	0.0035	

Table 1-3. Engine Fits, Tolerances, and Wear Limits-Continued.

Component	*Manufacturer's Dimensions and Tolerances in Inches* Min	Max	*desired Clearance in Inches* Min	Max	*Maximum Allowable Wear and Clearance*
INTAKE VALVE					
Valve lift (at valve)					0.430 in.
Valve lift (at cam)					0.312 in.
Seat angle					45 degrees
Valve seat width (contact)					1/16 in.
Valve clearance (cold)					0.012 in.
Valve clearance (engine coolant at normal operating temperature)					0.010 in.
Head diameter	1.496	1.606			
Overall length					4-3/8 in.
Stem diameter	0.3406	0.8416			
Inside diameter of valve guide (finish room after assembly)	0.843	0.S44			
Stem to guide clearance	0.0016	0.0035			
VALVE SPRING					
Free length					2-3/32 in.
Load (small)	42 lb	47 lb			1-27/32 in.
Load (large)	122 lb	131 lb			1-13132 in.
VALVE SEAT INSERTS					
Seat angle (intake & exhaust)					46 degree
Seat width (intake)					1/16 in.
Seat width (exhaust)					3/32 in.
Outside diameter not installed (intake)	1.597	1.598			
Outside diameter not installed (exhaust)	1.378	1.379			
Bore in cylinder for insert (intake)	1.5935	1.5945			
Bore In cylinder for insert (exhaust)	1.3745	1.7655			
Press fit (intake & exhaust) (tight)	0.0026	0.0046			0.002 in.
Runout (intake & exhaust)					TIR
VALVE GUIDES					
Length			2-11/32 in.		
Inside diameter (finish ream after assembly)	0.343	0.844			
Stem to guide clearance			0.0015	0.0035	
Guide standout (top of guide is positioned above the head cover gasket surface)					7/32 in.
ROCKER ARMS					
Inside diameter of rocker arm (finished bore)	0.842	0.844			

Table 1-3. Engine Fits, Tolerances, and Wear Limits-Continued.

Component	*Manufacturer's Dimensions and Tolerances in Inches* Min	Max	*desired Clearance in Inches* Min	Max	*Maximum Allowable Wear and Clearance*
Outside diameter of rocker arm shaft	0.8405	0.8410			
Clearance rocker arm shaft to rocker arm			0.001	0.0035	0.007
Rocker arm ratio					1.41:1
CAMSHAFT					
Inside diameter of camshaft bearings (when installed)					
Front and Intermediate	2.001	2.004			
Rear	1.251	1.254			
Outside diameter of camshaft journals					
Front and intermediate	1.998	1.999			
Rear	1.248	1.249			
Bearing-to-journal-running clearance			0.0020	0.0060	0.0065
Outside diameter of camshaft bearings					
Front and intermediate	2.1285	2.1305			
Rear	1.3790	1.3805			
Bore in block for camshaft bearings					
Front and intermediate	2.124	2.125			
Rear	1.374	1.375			
Fit of camshaft bearings in bore of cylinder block					
Front and intermediate (tight)			0.002	0.006	
Rear (tight)			0.004	0.0055	
Overall width of camshaft bearings					
Front					1-1/8 in.
Intermediate					7/8 in.
Rear					1 in.
Camshaft end clearance			0.003	0.008	0.014
Camshaft gear width					1 in.
Specified thickness of thrust collar	0.165	0.167			
Fit of camshaft gear on camshaft (tight)			0.001	0.003	
VALVE LIFTER					
Bore in cylinder block for lifter	0.5615	0.5625			
Outside diameter of valve lifter stem	0.5600	0.5605			
Fit of lift- in bore			0.0010	0.0025	0.0035
GEAR TRAIN					
Backlash between mating gears			0.001	0.005	
LUBRICATING OIL PUMP					
Radial clearance gears to pump housing			0.001	0.002	
End clearance-pump gears			0.002	0.004	0.006
Bore in oil pump housing for driveshaft	0.5006	0.5015			

Table 1-3. Engine Fits, Tolerances, and Wear Limits-Continued.

Component	Manufacturer's Dimensions and Tolerances in Inches Min	Max	desired Clearance in Inches Min	Max	Maximum Allowable Wear and Clearance
Bore in oil pump housing for idler shaft	0.500	0.501			
Diameter of drive and idler gear shaft	0.4990	0.4995			
Clearance-driveshaft to housing bore			0.0010	0.0025	
Clearance-idler shaft to housing bore			0.0020	0.0025	
Backlash-pump gears			0.004	0.010	0.0020
DISTRIBUTOR					
Point gap			0.022	0.022	0.016 in. (min)'
SPARK PLUGS					
Point gap					0.025 in.
TIMING GEARS					
Clearance camshaft end			0.003	0.008	
Maximum permissible end clearance					0.008
STARTING MOTOR					
Brush spring tension		35.0 oz			
Bushing clearances					
Commutator-end frame	0.009	0.0013			
Center plate and drive housing	0.005	0.0015			
ALTERNATOR					
Belt adjustment (amount deflection)					112 in. inward
Test force					10 lb
GOVERNOR					
Spring					
Length	2.25				
Test force	25 psi	30 psi			
Outside diameter	15/16				
Max load	100 lb				
Number of coils	10-1/2				

Table 1-4. Transmission Fits, Tolerances, and Wear Limits.

Component	Manufacturer's Dimensions and Tolerances in Inches Min	Max	desired Clearance in Inches Min	Max	Maximum Allowable Wear and Clearance
TRANSMISSION					
Forward and reverse gear diameter					
OD	4.148	4.164	0.005	0.009	0.005
ID	1.834	1.839	0.005	0.009	0.005
Idler gear diameter	4.594	4.600			

Table 1-4. Transmission Fits, Tolerances, and Wear Limits-Continued.

Component	*Manufacturer's Dimensions and Tolerances in Inches* Min	Max	*desired Clearance in Inches* Min	Max	*Maximum Allowable Wear and Clearance*
Output gear diameter					
ID	1.126	1.130			
OD	1.995	2.000			
TORQUE CONVERTER					
Backlash-input shaft to pump	0.002	0.004			
Major diameter	1.486	1.489			
Root diameter	1.380	1.390			
Backlash-input shaft to flywheel	0.004	0.008			
Major diameter	0.886	0.889			
Root diameter	0.780	0.790			
CLUTCH					
Maximum allowable dish or warp					
Retractor spring					
Free length		1.865			
Outside diameter	0.355	0.375			
TRANSMISSION CONTROL VALVE					
Bypass valve-relieves	50 pi	70 psi			
Bypass valve spring					
Free length	2.043				
Length test force applied		1.386			
Outside diameter		0.417			
Pressure regulating valve					
external (500 rpm)	22-1/2	27-1/2			
relieves	psi	psi			
Swing, pressure regulating valve					
Free length	2-1/16	2-1/8			
Outside diameter		0.523			
Regulator valve-relieves	80 psi	100 psi			
inching valve-relieves	O psi	100 psi			
Inching valve spring					
Free length	2.052	2.072			
Test force	13.5 lb				
Length-test force	1-25/64				
applied	in.				
Dump valve-relieves		3 psi			
Dump valve spring					
Free length		1.047			
Selector valve-pressure					
(500 rpm)	15 psi	27 psi			
Selector valve-pressure					
(200 rpm)	70 psi	87 psi			
Pump pressure (500 rpm)	15 psi	30 psi			
Pump pressure (2000 rpm)	140 psi	60 psi			

Table 1-4. Transmission Fits, Tolerances, and Wear Limits-Continued.

Component	*Manufacturer's Dimensions and Tolerances in Inches* Min	Max	*desired Clearance in Inches* Min	Max	*Maximum Allowable Wear and Clearance*
DOUBLE REDUCTION GEAR TRAIN					
Bevel gear to pinion backlash	0.0060	0.0100			0.0040
STEERING CYLINDER					
Diameter of rod	0.875				
Length-cylinder closed	15.65				
Length-rod extended	23.65				

Table 1-5. Miscellaneous Fits, Tolerances and Wear Limits.

Component	*Manufacturer's Dimensions and Tolerances in Inches* Min	Max	*desired Clearance in Inches* Min	Max	*Maximum Allowable Wear and Clearance*
BRAKE DRUM					
Diameter	12.495	12.505		12.465	
TILT CYLINDER					
Rod diameter	1.243	1.247			
LIFT CYLINDER					
Rod diameter	3.194	3.202			

Page 2-1. Chapter 2. Section II. *Table 2-1.* Malfunction 1. Change Corrective action from "Valves not seating properly. Either adjust (TM 10-3930618-20) or grind valves (para 3-23)" to read "Valves not seating properly. Either adjust (para 3-20.1*b*) or grind valves (para 3-23).".

Page 2-6. Paragraph 2-9a(3) is superseded as follows:

(3) Drain engine cooling system and remove radiator and hose connections (para 3-6.1).

Page 2-9. Paragraph 2-9e(8) is superseded as follows:

(8) Install radiator and hoses. Pour coolant into engine cooling system and check for leaks. Refer to Cooling System section, (para 3-6.1).

Page 2-9. Paragraph 2-9e(9) is superseded as follows:

(9) Install counterweight (para 3-6.1) *Page 2-9* Paragraph 2-10b(l) is superseded as follows:

(1) Remove radiator grille (para 3-6.1b).

Page 2-12. Paragraph 2-12 is rescinded.

Page 2-12. Figure 2-6 is rescinded.

Page 3-7. Paragraph 3-6*b* is superseded as follows:

b. Removal and Installation. Refer to para 3-6.1 and para 3-6.1

Page 3-7. Paragraph 3-6*c* is superseded as follows:

c. Cleaning and Inspection. Refer to paragraph 3-6.1

Page 3-7. After paragraph 3-6, before Section III add the following:

3-6.1. Radiator

a. Inspection and External Cleaning.

(1) Remove the counterweight. Refer to figure 3-6.1.

WARNING

Use lifting device, with a 4000 lb capacity, for removing counterweight from truck.

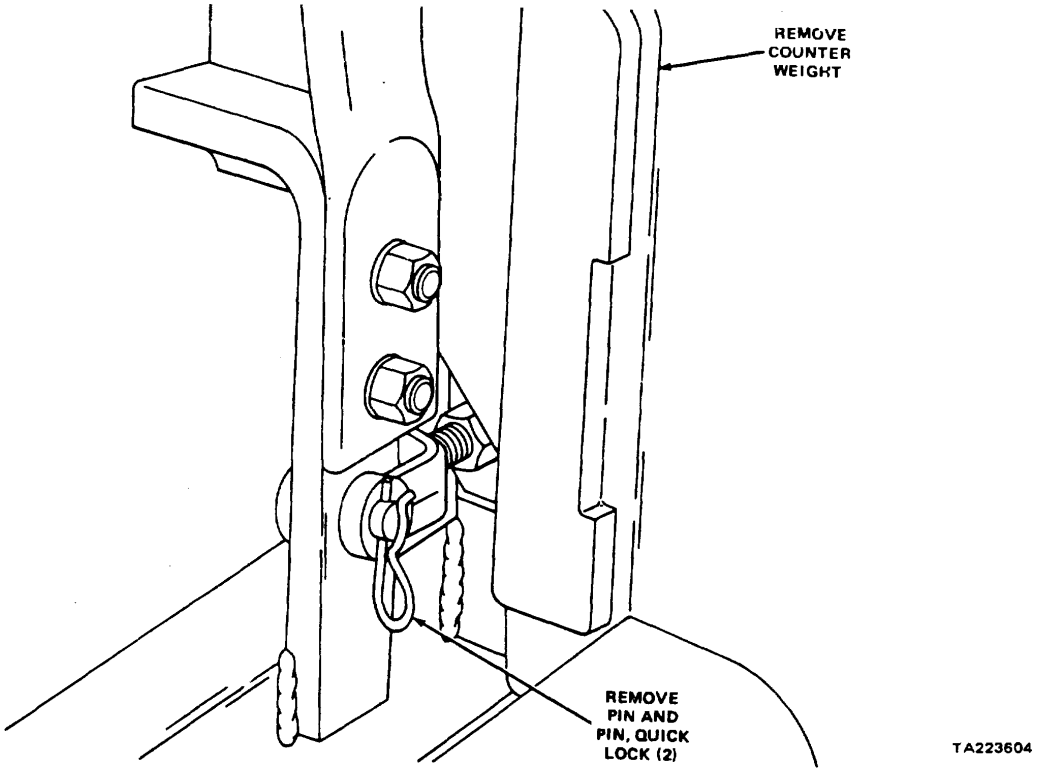


Figure 3-6.1. Counterweight, installed view.

WARNING

HIGH VELOCITY AIR

Compressed air, used for cleaning purposes, will not exceed 30 psi. Safety glasses must be used when cleaning parts with compressed air. Failure to do so could cause SERIOUS INJURY to your EYES and possible BLINDNESS. If you hurt your eyes or if a foreign object is blown into your eyes, seek medical attention immediately.

(2) Remove dirt, insects, and other obstructions lodged in the fins by directing compressed a or a stream of pressurized water at the core from the front (engine side). Do not use steam, gasoline fuel oil, or kerosene.

(3) Straighten bent fins using a piece of wood or a blunt instrument. Be careful not to puncture the tubes.

(4) Inspect radiator mounts and tighten necessary.

(5) Tighten hose clamps.

(6) Inspect radiator core and hoses for leaks.

(7) Inspect hoses for cracks or deterioration.

b. Removal. Refer to figure 3-6.2 and remove the radiator as follows:

(1) Remove the side panels and raise the seat.

(2) Remove the radiator cap, open the drain cocks and drain the cooling system.

(3) Disconnect upper and lower hoses from the radiator.

(4) Disconnect the converter oil cooler lines at the radiator.

(5) Remove the radiator grille and panel.

(6) Remove the four screws (two on each side of the radiator) that secure the radiator to the mounting bars.

(7) Remove radiator.

c. Installation. Reverse procedures in b above. Make sure that all lines and hoses are tight.

d. Draining and Refilling.

(1) To drain the cooling system remove the radiator cap and open the drain cocks (fig. 3-6.3) and (fig. 3-6.4). If the cooling system is not to be

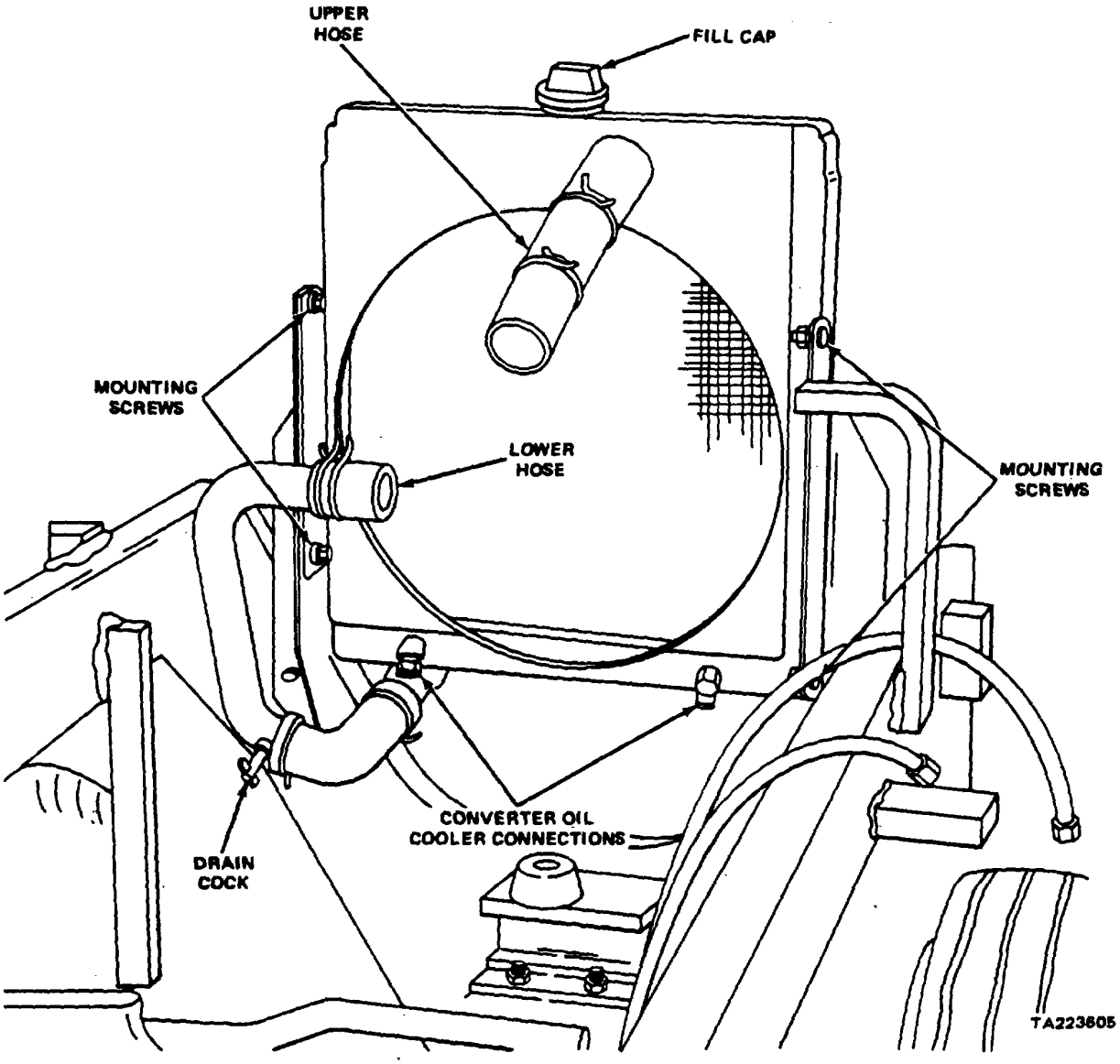


Figure 3-6.2. Radiator, installed view.

refilled immediately, attach a notice to the steering wheel to warn personnel that the cooling system has been drained.

(2) After draining and before refilling, clear and flush the cooling system (TM 10-3930-618-20). Pressure flush the radiator (TM 10-3930-618-20) if overheating cannot be corrected by normal cleaning and flushing.

(3) Use soft water in the cooling system wherever possible. Add antifreeze or corrosion inhibitor to the water as applicable.

(4) To fill the cooling system, close the drain cocks and pour coolant into the radiator filler opening until the coolant reaches the bottom of the filler neck. Then start the engine and let it idle until the thermostat opens.

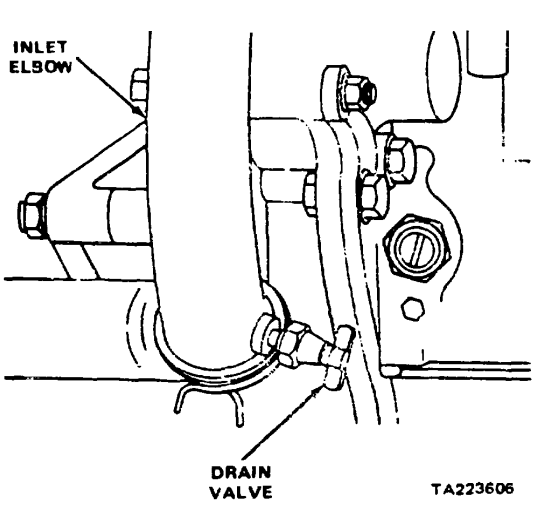


Figure 3-6.3. Drain valve, radiator.

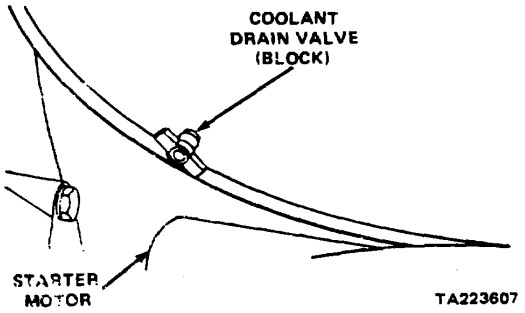


Figure 3-6.4. Drain valve, block.

Page 3-12. Paragraph 3-9d(1). Change "P-S-661" to read “P-D-680".
Page 3-15. Paragraph 3-12a(3). Change "(ref. TM 10-3930-618-20)'" to read "(para 3-6.1)".
Page 3-26. Paragraph 3-16(4)(b). Change "P-S-661" to read "P-D-680".
Page 3-35. Paragraph 3-20(2)(a)1. Change "(TM 10-3930-i8-"20)" to read "(para 3-20.1)".
Page 3-25. After Paragraph 3-20, before Paragraph 3-21 add the following:

3-20.1. Valves

a. General. The valves are of the overhead type: and adjustment may be made after removing the rocker arm cover on top of engine. Maintaining correct valve clearance is very important. Insufficient valve clearance will cause burning of the valves and valve seats if allowed to continue. Excessive valve wear will result in faulty engine operation and valve and lifter wear will cause rapid wear of the valve operating mechanism.

b. Adjustment.. Adjust the valve clearance as follows:

(1) Operate the engine until it reactors normal operating temperature.

(2) Stop the engine and disconnect the high tension wire from the ignition coil to prevent accidental starting.

(3) Thoroughly clean the valve cover and surrounding area and remove the valve cover.

(4) Crank the engine with the starter motor until both valves of No. 1 cylinder are closed and the push rods are at the lowest position on their respective cams.

(5) Using a flat feeler gage (fig. 3-20.1) of 0.012 inch thickness, check the clearance between the exhaust valve stems (engine hot) and their respective rocker arms. The feeler gage should pass through with a slight drag. Repeat this process on the intake valves using feeler gage thickness of 0.010.

(6) If adjustment is necessary, loosen the locknut and obtain proper clearance by turning the adjusting screw. Turning the adjusting screw clockwise will decrease the clearance; counterclockwise will increase the clearance.

(7) Tighten the locknut and then recheck the clearance to make certain no change occurred.

(8) Repeat the above procedure on the remaining cylinders following the firing order of the engine (1-5-3-6-4) .

(9) Connect the high tension wire to the ignition coil and start the engine.

(10) Run the engine at operating temperature, pass the feeler gage back and forth between the exhaust rocker arms and valve stems and check for 0.012-inch thickness. A slight drag will be felt, followed by a tightening which will momentarily pre vent moving the feeler gage. Repeat this process for the intake valves and check for 0.010-inch thickness. Stop the engine and correct any improperly adjusted clearances. Repeat step (10) above

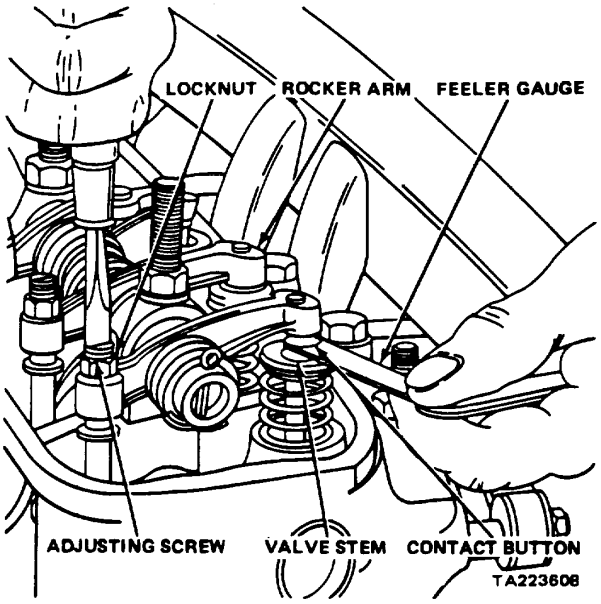


Figure 3-20.1. Adjusting valve clearance.

(11) Install the valve cover, making certain that the cover gasket is in good condition and positioned properly to prevent oil leakage.

Page 3-40. Paragraph 3-21(2)c. Change "(Spec P.S-661)" to read "(Spec P-D-680)".

Page 3-45. Paragraph 3-23b(1)a. Change "(TM 10-3930-618-20)" to read "(para 3-20.1)".

Page 3-47. Paragraph 3-23d(7). Change "(TM 10-3930-618-20)" to read "(para -3-20.1)".

Page 3-49. Paragraph 3-24b(1)(a). Change "(TM 10-3930-618-20)" to read "(para 3-6.1)".

Page 3-50.- Paragraph 3-25a(1). Change "(TM 10-3930618-20)" to read "(para 3-6.1)".

Page 4-1. Chapter 4. Section I. After the title "Section I. HYDRAULIC SYSTEM", before paragraph 4-1 add the following:

WARNING

Hydraulic oil under pressure. 2500 PSI pressure is used to operate this equipment. Never disconnect any hydraulic lines or fittings without dropping the pressure to zero. Operate all hydraulic levers with vehicle turned off to release any pressure.

Failure to follow this procedure could cause serious injury. Should you be struck by a high pressure oil stream, seek medical help immediately.

Page 5-10. Paragraph 5-7*b*. Change "Refer to TM 10-3930-618-20 for removal procedure" to read "Refer to paragraph 5-7.2 for removal procedure."

Page 5-10. After Paragraph 5-7, before Paragraph 5-8 add the following:

5-7.1. General

The steering system consists of the power steering unit, power steer cylinder, and the steering axle assembly. The steering axle is located beneath the engine at the rear of the truck. The steering unit is mounted in the truck chassis in front of the operator.

5-7.2. Power Steering Cylinder

a. Inspection. Inspect the steering cylinder, for leaks or damaged condition. Replace power steer cylinder if damaged.

b. Removal. Refer to figure 5-8.1 and remove the power steering cylinder.

(1) Disconnect hydraulic lines at the cylinder. Plug lines to keep out foreign matter.

(2) Remove bolt, cotter pin, and pin and remove cylinder from bracket.

(3) Loosen locknut.

(4) Rotate the cylinder to remove it from fitting on steering axle pivot arm.

c. Installation.

(1) Reverse procedure as outlined in above.

(2) Refill and bleed hydraulic cylinder before tightening hydraulic lines.

(3) Operate the cylinder through several cycles and check for leaks before final installation of pin and cotter pin.

Paragraph 5-9. Steer Wheel Bearings is deleted.

Page 5-13. After Paragraph 5-10, before Section II add the following:

5-10.1. Tie Rods

a. Removal.

(1) Loosen the adjusting plug and disconnect the tie rod from the pivot arm.

(2) Remove the nuts from the ball socket on the opposite end of the rods and remove the tie rods from the truck.

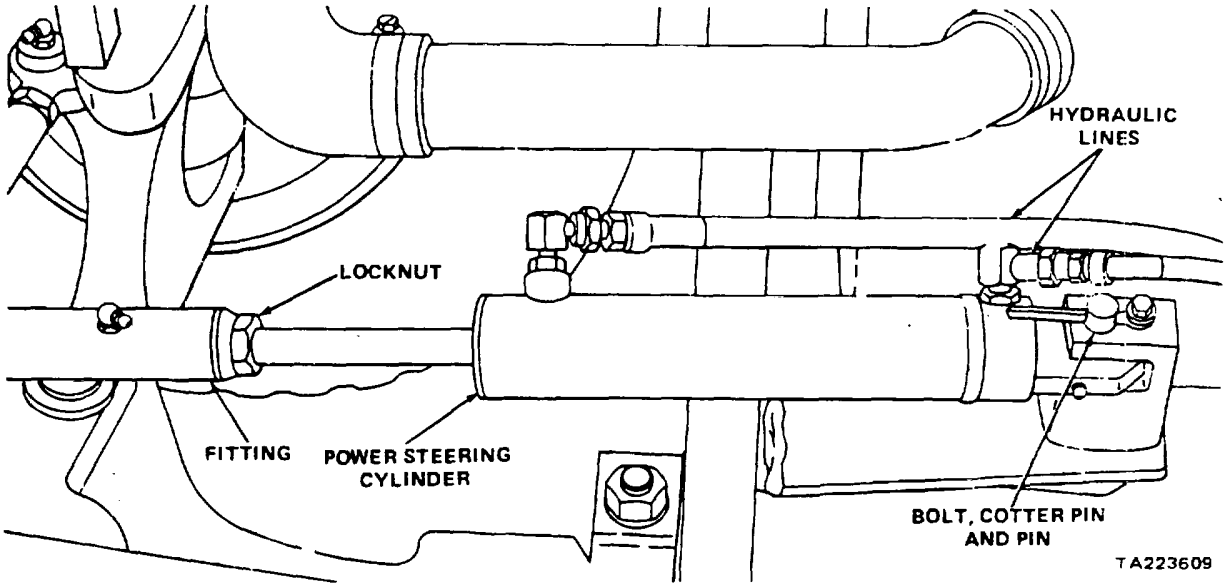
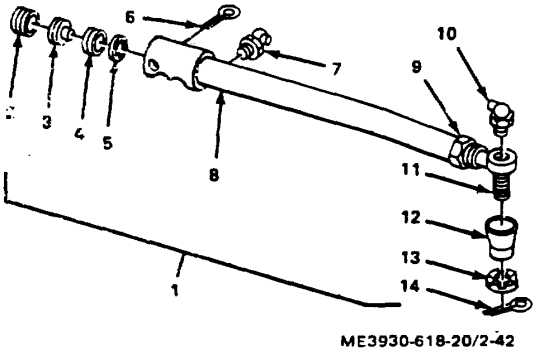


Figure 5-8.1. Power steering cylinder, installed view.

b. Disassembly. To disassemble tie rods, remove the adjusting plugs and withdraw the internal parts (fig. 5-10.1 If desired, unscrew the ball sockets. Note the position of each part to assure proper assembly.



1 Tie rod
2 Plug
J Seat
4 Sprint
5 Washer
6 Pin, cotter
7 Fitting, lubrication
8 Tube assembly
9 Nut
10 Fitting, lubrication
11 Socket
12 Cover
13 Nut
14 Pin, cotter

Figure 5-10.1. Tic rod, exploded view.

WARNING

Dry cleaning solvent, SD-2 used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 59° C (138° F).

c. Cleaning and Inspection. Wash all parts in SD-2 and dry with compressed air. Inspect for damaged springs and ball seats. Inspect for defective threads.

d. Repair and Replacement. Replace defective parts and lubricate.

e. Reassembly. Reverse procedures in b above.

f. Installation. Reverse procedure in a above.

Page 5-16. After para 5-11. General" title add the following:

WARNING

During asbestos fiber pad removal use wet process only. Sander, dry brush and compressed air create dangerous dust hazards to your health. Inhaled asbestos dust remains permanently in your breathing system.

Page 5-16. Paragraph 5-12a. Change "*a*. Removal. Refer to TM 10-3930-618-20" to read "a. Removal. Refer to paragraph 5-12.1".
Page 5-16. After Para. 5-12 before Para. 5-13 add the following:

5-12.1. Hand Brake Lever, Cable and Linkage

a. Removal

(1) *Level assembly*. Refer to figure 5-12.1 and remove the lever assembly as follows:

(a) Disengage the handbrake.

(b) Remove the 2 screws and lockwashers from the cover and remove the cover.

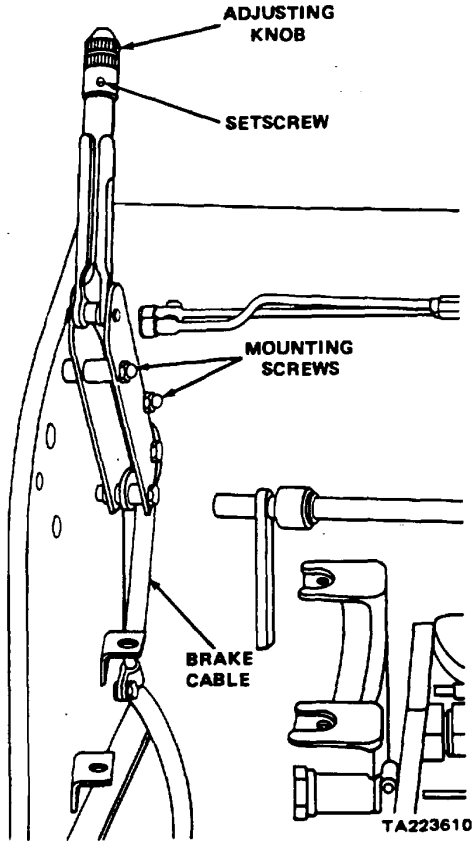


Figure 5-12.1. Handbrake lever, installed view.

(c) Remove the small setscrew from the adjusting knob on the lever and turn the knob counterclockwise to disengage the brake cable.

(d) Remove the 2 capscrews securing the lever assembly to the truck.

(2) *Brake cable.*

(a) Perform (1) (a) and (b) above.

(b) Remove the pin and detach the cable clevis from the lever assembly.

(c) Remove the floor plate to expose the brake assembly.

(d) Remove the yoke pin and detach the yoke from the brakeshoe actuating lever (fig. 5-12.2).

(*e)* Remove the two cable clamps and remove the cable.

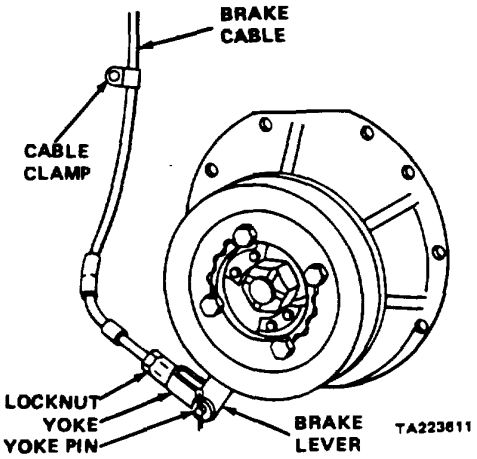


Figure 5-12.2. Handbrake lower cable yoke adjustment.

b. Installation.' Reverse procedure in a above. Make final adjustment as instructed in *c* below. Yoke adjustment should be such as to allow approximately 5 turns on the adjusting knob for future periodic adjustment.

c. Adjustment. Up to a point, the adjusting knob on the handbrake lever can be used to compensate for brake lining wear. When the adjusting knob will no longer provide the necessary brake adjustment, and sufficient brake lining still remains, further adjustment can be made at the lower cable yoke.

(1) Adjustment using the hand brake lever adjusting knob:

(a) Set the lever in fully released position.

(b) Remove the setscrew from the adjusting knob.

(c) Turn the adjusting knob one or two turns clockwise, check adjustment by engaging the brake.

(d) Repeat step (*c*) if necessary and reinstall the setscrew in the adjusting knob.

(2) Adjustment of lower cable yoke.

(a) Disengage the brake and remove the setscrew from the adjusting knob. Turn the adjusting knob 4 or 5 turns counterclockwise.

(b) Remove the floor plate and remove the pin from the lower cable yoke. Loosen the yoke locknut figure 5-12.2.

(c) Turn the yoke 3 or 4 turns clockwise to shorten the cable length.

(d) Install the yoke on the brake lever and check adjustment by engaging the brake. Readjust as necessary to prevent the brakeshoes from dragging when disengaged.

(e) Tighten the yoke locknut and install the pin.

(f) Install and tighten the setscrew in the adjusting knob.

512.3. Brake Master Cylinder

a. Removal. Refer to figure 5-12.3 and remove the master cylinder assembly as follows:

(1) Remove the floor plate.

(2) Disconnect the electrical wires at the stoplight switch.

(3) Remove the power booster (TM 10-3930-618-20).

(4) Remove the clevis pin holding the pushrod to the brake pedal.

(5) Remove the screws holding the master cylinder assembly to the inside of the frame and remove the cylinder.

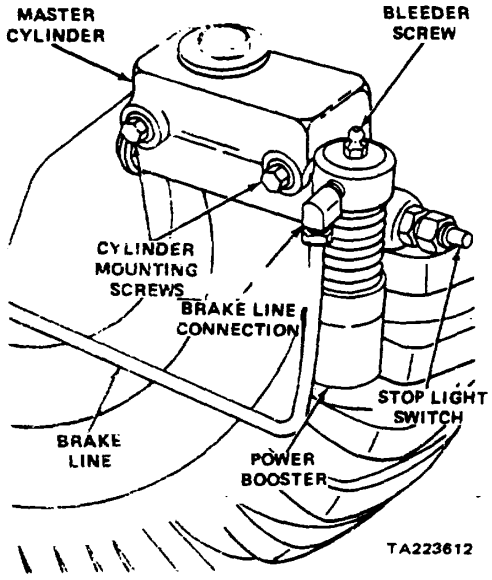


Figure 5-12.3. Brake master cylinder and brake power booster, installed view.

b. Installation. Reverse procedures in a above. Bleed the brake hydraulic system as instructed in *c* below.

c. Bleeding the Brake Hydraulic System. The fluid in the brake hydraulic system must form a "solid" column. To do this, the system must be bled of all air or other gases. Bleeding of the brake system is required each time the system is drained and refilled with new fluid; if some part of the system has been disconnected for any reason; if the fluid level in the master cylinder is allowed to decrease to a point where air enters the system; if the air has entered the system due to a defective master cylinder or wheel cylinders; or if the brake pedal feels spongy. There is a bleeder screw on each wheel cylinder and on the power hooster. To bleed the system, proceed as follows:

(1) Fill the master cylinder to the proper level (3/8- to 1/2-in. from the reservoir top).

(2) If a refiller or pressure bleeder is used, place the proper adapter in the master cylinder fillercap opening and install the refiller or pressure bleeder.

(3) Install a bleeder hose on the bleeder screw of either wheel cylinder. Submerge the loose end of the hose in brake fluid in a glass jar.

(4) Open the bleeder screw one turn.

(5) If a pressure bleeder is used, permit the fluid to drain from the bleeder hose until no bubbles appear in the fluid. Then close the bleeder screw.

(6) If manual bleeding is being employed, slowly depress the brake pedal to the stroke limit, close the bleeder screw, and then release. Repeat until no bubbles escape from the bleeder hose. Keep the pedal depressed after the final stroke and quickly close the bleeder screw so that no air enters the system.

NOTE

Manual bleeding quickly depletes the fluid supply in the reservoir. Continually check the fluid level and keep the reservoir at least 1/2 full at all times or air will enter system.

(7) Repeat the bleeding procedure at the remaining wheel cylinder and then at the power booster.

(8) When the bleeder operation is complete re-fill the master cylinder reservoir to the proper level.

CAUTION

Fluid salvaged from the system during the bleeding operation is aerated and is no longer suitable for use in this system.

Page 5-24. Paragraph 5-20a(3). Change "(TM 10-3930-618-20)" to read "(para 5-12.1)".
Page A-1. Paragraph A-2 is superseded as follows:

A-2. Painting

TM 43-0139 Painting Instructions for Field Use FM 5-20 Camouflage

Page A-1. Paragraph A-3. Line 3. Change '"TM 10-3920-618-34P" to read '"TM 10-3930-61834P".
Page A-1. Paragraph A-3, TM 38750 to read DA PAM 738-750.
Page A-1. Paragraph A-4. Change "TB 740-93-2" to read "TB 740-97-2".
Page A-1. After Paragraph A-5, before Index page add the following:
Page I-1, Index page, is superseded as follows:

A-6. NonAeronautical Equipment

TB 43-0210	Army Oil Analysis Program

A-7. Tires

TM 9-2610-200-20	Organizational Care, Main tenance and Repair of Pneumatic Tires and Inner Tubes.

A-8. Decontamination

FM 2140	Chemical, Biological, Radiological, and Nuclear Defense (NBC)

A-9. Military Publication Indexes

DA PAM 310-1	Index of Military Publications

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By Order of the Secretary of the Army:

JOHN A. WICKHAM, JR.
General United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Major General, United States Army
The Adjutant General

Distribution:

To be distributed in accordance with DA Form 12-25A direct and general support maintenance requirements for Warehouse Equipment.

TECHNICAL MANUAL
No. 10-3930-618-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *12 May 1971*

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

TRUCK, LIFT, FORK; GASOLINE ENGINE DRIVEN;
PNEUMATIC - TIRED WHEELS;
6000 LB CAPACITY; 168 INCH LIFT; ALLIS-CHALMERS
MODEL FP60-24PS;
ARMY MODEL MHE213 FSN 3930-93S-7979

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS - Continued

CHAPTER I
INTRODUCTION

Section I. GENERAL

1-1. Scope
This manual contains instructions for the use of direct support and general support maintenance personnel maintaining the fork lift truck (Allis-Chalmers Model FP60-24PS) as allocated by the Maintenance Allocation Chart. It provides information on equipment maintenance which is beyond the scope of the tools, equipment, personnel, or supplies normally available at organizational maintenance.

1-2. Forms and Records
Maintenance forms, records and reports which are to be used by maintenance personnel at all maintenance levels are listed in, and prescribed by, TM 38-750.

1-3. Reporting of Errors
Report of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, (Recommended Changes to Publications) and forwarded direct to Commanding General, U.S. Army Mobility Equipment Command, ATTN: AMSME-MPP, 4300 Goodfellow Boulevard, St. Louis, Mo. 63120.

Section II. DESCRIPTION AND DATA

1-4. Description
A general description of the fork lift truck is contained in TM 10-3930-618-10. A more detailed description of specific components and assemblies is contained in the applicable sections of this manual. Detailed description of components and assemblies are provided in the applicable maintenance paragraphs of this manual.

1-5. Tabulated Data
a. Identification. The major identification plates of the fork lift truck are located and described in TM 10-3930-618-20.

b. Tabulated Data.

(1) *Engine assembly.*

Manufacturer ..... Allis-Chalmers
Model 6MB230
Type ..... OHV (overhead valve)
Number of cylinders 6
Piston stroke ..... 4 1 / 8 inches
Bore ..... 3 7/16 inches
Compression 7.3:1
Piston displacement ..... 230 cubic inches
Firing order 1-5-3-6-2-4
Governed speed ..... 2200 rpm (revolutions per minute) under load
Idle speed ..... 500 rpm
S.A.E. rated horsepower (HP)
- Maximum @ 2200 rpm ..... 55.0 hp
- Intermittent @ 2200 rpm .. 49.5 hp
- Continuous @ 1800 rpm .. 36 hp

Lubrication ..... Forced feed main and connecting rod bearings with oil filter
Cooling system ..... Pressure-type radiator, with fan and water pump
Electrical system ..... 12 V dc (volts, direct current)
Fuel feed ..... Mechanical pump is a camshaft operated valve and diaphragm type
Air cleaner ..... Oil bath type
Ignition ..... Battery and distributor. distributor gap 0.022 in.
Oil pump:
Type ..... Gear
Pressure ..... 70-90 psi (pound per square inch) relief valve bypass
Valves ..... Rotator type
Valve clearance:
- Intake (cold) ..... 0.012 in.
- Exhaust (cold) ..... 0.014 in.
- Intake (hot) ..... 0.010 in.
- Exhaust (hot) ..... 0.012 in.

Hydraulic Pump Specifications:
- Primary flow ..... 2 to 3 GPM (gallons per minute)

Secondary flow ..... 18 to 19 GPM
RPM (Revolutions per minute) 2200
PSI (Pounds per square inch) 2000
Primary flow relief:
- Valve set at ..... 1600 ±100 PSI

(2) *Torque converter and transmission.*

Manufacturer ..... Allis-Chalmers

(3) *Clutch assembly.*

Manufacturer ..... Allis-Chalmers

(4) *Generator.*

Manufacturer ..... Delco-Remy

(5) *Starter motor.*

Manufacturer ..... Delco-Remy

(6) Distributor.

Manufacturer ..... Delco-Remy

(7) *Fuel pump.*

Manufacturer ..... AC Spark Plug Div of General Motors Corp

(8) *Torque valves.* See table 1-1 for special torque values for stated applications See table 1-2 for general torque values, to be used on nuts and bolts where specific valves are not stated.

Table 1-1. Special Torque Values

Application	*Ft-Lb. Torque*	*Thread Size*
Engine cylinder mounting	110-120	1/2-13
Cylinder head lifting	110-120	1/2-20
Thermostat housing and cylinder head	110-120	1/2-13
Water outlet	18-21	3/8-16
Manifold, intake and exhaust	32-35	7/ 16-20
Main bearing mounting	120-130	9/16-12
Connecting rod	45-50	3/8-24
Crankshaft pulley retaining	240-260	1-16
Pressure regulating screw	125-135	3/4-16
Lube oil filter mounting	45-50	1/2-13
Spark plugs	25-30	14MM

Table 1-2. General Torque Values (Foot-pounds torque)

Capscrew	*Grade 2*		*Grade 5*		*Grade 8*	
Size	NC	*NF*	*NC*	*NF*	*NC*	*NF*
1/4	5-7	6-8	9-11	11-13	12-14	14-16
5/ 16	11-13	13-15	18-20	21-23	25-27	28-30
3/8	18-21	19-22	28-33	30-35	50-55	69-74
7/ 16	30-33	32-35	44-49	50-55	69-74	72-77
1/2	45-50	45-50	68-73	68-73	95-105	95-105
9/ 16	60-65	60-65	95-105	95-105	130-140	130-140
5/8	75-85	75-85	125-135	125-135	170-190	170-190
3/4	105-115	105-115	210-230	210-230	290-310	290-310
7/8	105-115	105-115	290-310	290-310	450-500	450-500
1	140-150	450-475	380410			

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE

INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS AND EQUIPMENT

2-1. Tools and Equipment
Tools, equipment, and repair parts issued with or authorized for the fork lift truck are listed in TM 10-3930-618-20.

2-2. Special Tools and Equipment
No special tools or equipment are required to perform direct and general support maintenance of the fork lift truck.

2-3. Maintenance Repair Parts
Repair parts required to perform direct and general support maintenance is listed and illustrated in TM 10-3930-618-34P.

Section II. TROUBLESHOOTING

2-4. General
This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the fork lift and its components.

2-5. Troubleshooting
Malfunctions which may occur are listed in table 2-1. Each malfunction stated is followed by a list of probable causes of the trouble. The corrective action recommended is described opposite the probable cause. Refer to TM 10-3930-618-20 for initial troubleshooting information.

Table 2-1. Troubleshooting

Malfunction	Probable cause	Corrective action
1. Engine hard to start	No compression	Valves not seating properly. Either adjust (TM 10-3930-618-20) or grind valves (para 3-23).
2. Engine misses	*a.* Leaks at cylinder head gaskets	*a.* Tighten head or replace gasket (para 3-20).
	b. Engine overheats, causing valves to stick	*b.* Free the valves by cleaning the valve stems (para 3-23).
	c. Warped valves	*c.* Replace (para 3-23).
	d. Stuck valve	*d.* Remove valve cover and with screwdriver, free the sticking valve. Valve stem and guide will have to be cleaned to restore proper clearance. If condition continues, valves need regrinding (paras 3-23).
3. Engine knocks	a. Carbon in combustion chamber ("piping" knock in cylinder)	a. Remove cylinder head; scrape and clean out carbon (para 3-20).
	b. Loose connecting rod bearing, (Sharp knock, low oil pressure.)	*b.* Replace bearings (para 3-22).
	c. Loose main bearing. (Heavy knock-low oil pressure.	c. Replace main bearings (para 3-21)
	d. Loose piston pins (Sharp double knock 3-22).	*d.* Replace pins, or bushings (para
	e. Piston and cylinder wear	e. Replace sleeve (para 3-20), piston and rings (para 3-22).
4. Engine overheats	Leaky radiator.	Repair. Do not use quick-stop lead solders, as these tend to clog the circulation. Lead solder must be used (para 3-6).

Table 2-1. Troubleshooting (Continued)

Malfunction	Probable cause	Corrective action
5. Loss of power	*a.* Lower oil pressure, due to (1) external oil leaks, (2) thin oil or (3) sticking of oil pressure relief valve.	*a.* (1) Repair leaks by lightening the connections, or replacing the line; (2) Drain and fill with fresh oil; (3) Remove oil pressure relief valve and clean (para 3-14). Do not stretch spring.
	b. Leaky valves.	*b.* If the leaky valve is caused by its improper adjustment, adjust or grind valve (para 3-23).
	c. Worn piston rings	*c.* Replace rings (Para 3-22).
	d. Blown cylinder head gasket	*d.* Replace cylinder head gasket (para 3-20).
6. Explosion in exhaust	Partially open exhaust valve.	Remove gum from valve stem. or adjust tappet clearance or replace broken spring (para 3-23).
7. Engine runs irregularly (sputters)	*a.* Warped exhaust valve.	*a.* Replace valve (para 3-23).
	b. Leaky valves.	*b.* Adjust tappet clearance regrind. or replace (para 3-23).
	c. Loose jets in the carburetor.	*c.* Remove carburetor and tighten (para 3-8).
8. Smoky exhaust	*a.* Carburetor float sticking (black smoke)	*a.* Tap carburetor lightly with hammer handle. If this does not correct the situation carburetor must be cleaned (para 3-8).
	b. Worn piston rings, and out-of-round and tapered cylinders (blue smoke)	*b.* Replace rings (para 3-22) and cylinder sleeves (para 3-20).
	c. Thin lubrication oil (blue smoke)	*c.* Use oil correct viscosity (LO 10-3930-618-12).
9. Ammeter does not register	Slip-rings dirty.	Clean slip-rings (para 3-2).
10. Alternator does not generate current	*a.* Shorted rotor.	*a.* Replace or repair (para 3-2).
	b. Shorted stator.	*b.* Replace or repair (para 3-2).
11. Starting motor failure	a. Faulty switches.	*a.* Check ignition switch or magnetic starting switch.
	b. Commutator dirty.	*b.* Clean with No. 00 sandpaper; do not use emery cloth (para 3-3).
	c. Worn brushes.	*c.* Replace (para 3-3).
	d. Bad teeth on flywheel.	*d.* Replace ring gear (para 3-26).
12. No gasoline at the carburetor	Float stuck (dirty needle valve).	Tap the carburetor bowl gently. or remove the carburetor, and (lean the needle valve and float chamber (para 3-8).
13. Carburetor leaks gasoline when idling.	*a.* Float stuck (dirty needle valve)	*a.* Tap carburetor gently to dislodge dirt in fuel valve, or remove carburetor and clean valve (para 3-8).
	b. Float level incorrect	*b.* Adjust (para 3-8).
	c. Drain plug not tight.	*c.* Tighten (para 3-8).
14. Radiator boils.	*a.* Frozen radiator.	*a.* Run engine for 3 minutes with blanket covering radiator. Stop for 5 minutes. Run for 3 minutes and stop for 5 minutes. Continue this operation until radiator is thawed. Check for leaks. ***CAUTION:*** Do not run continuously) to thaw. Water will boil away and overheat seriously damaging engine.
	b. Leaky radiator.	*b.* Repair radiator. Do not use liquid solder, as it tends to clog the system (para 3-6).
15. Unable to lift or tilt load.	*a.* Air leak at suction line.	*a.* Tighten connections.
	b. Damaged or worn pump.	*b.* Remove and repair (para 4-2).
	c. Relief valve binding open	*c.* Remove and repair (para 4-3).
	d. Damaged lift cylinder.	*d.* Check for binding or any cause to make plunger inoperative(para 4-6)

Table 2-1. Troubleshooting (Continued)

Malfunction	Probable cause	Corrective action
	e. Control valve inoperative.	*e.* Inspect for internal leakage or damaged parts, and repair (para 4-3).
16. Lift and till too slow.	*a.* Internal leakage at pump.	*a.* Inspect for worn or damaged parts (para 4-2).
	b. Excessive leakage at cylinder packing.	*b.* Repair or replace packing (para 4-8 & 4-6).
	c. Air leaks in system.	*c.* Tighten all connections.
	d. Misalignment.	*d.* Check mast (para 4-8) or tilt linkage (TM 10-3930-618-20) for cause of binding.
	e. Faulty relief valve.	*e.* Check for worn or damaged parts. Repair or replace (para 4-3).
17. Load creeps when tilting or lowering.	*a.* Internal leakage in cylinders.	*a.* Repair or replace packing (para 4-5) and para 4-6).
	b. Oil leak at packing glands.	*b.* Repair or replace packing (para 4-5 and 4-6).
	c. Leak in control valve.	*c.* Check for worn or damaged plungers (para 4-3).
	d. Leaks in oil lines. damaged lines.	*d.* Tighten all connections or replace
18. Noisy hydraulic pump.	a. Insufficient or no oil.	*a.* Check tank for proper oil level or restricted suction line (para 4-4).
	b. Air leaks.	*b.* Tighten intake connections.
	c. Oil bubbles in intake oil.	*c.* Use hydraulic oil with antifoaming characteristics. (LO 10-3930-618-12).
	d. Coupling misalignment	*d.* Realign.
	e. Pump mounting flange I loose	*e.* Tighten (para 4-2).
	f. Worn or broken parts.	*f.* Replace (para 4-2).
19. Oil overheating.	*a.* Internal oil leakage.	*a.* Repair or replace pump (para 4-2).
	b. Pump too tight after overhaul.	*b.* Remove and repair (para 4-2).
	c. Restricted lines.	*c.* Check and repair.
20. Failure to operate.	*a.* Broken axle shaft.	*a.* Replace axle (para 5-19).
	b. Teeth broken on axle shaft planetary gears.	*b.* Replace axle shaft or planetary gears. (para 5-19).
	c. Broken teeth on ring gear or pinion.	*c.* Replace ring gear and pinion (para 5-20).
	d. Worn disc in transmission	*d.* Replace disc (para 3-16).
	e. Worn transmission oil	e. Replace pump (para 3-15).
	f. Stripped gears and worn bearings in transmission.	*f.* Replace worn parts (para 3-16).
	g. Valve plunger stuck in transmission control valve.	*g.* Disassemble valve clean, and replace worn parts (para 3-16).
21. Truck moves in one direction but not in other.	*a.* Worn disc in transmission.	*a.* Replace disc (para 3-16).
	b. Binding valve plunger in transmission control valve.	*b.* Disassemble valve clean, and replace worn parts (para 3-16).
22. Axle noise drive or coast.	*a.* Excessive wear at ring gear and pinion.	*a.* Replace (para 5-20).
	b. Worn pinion gears or side gears in differential case.	*b.* Replace worn gears (para 5-21).
23. Continuous axle noise.	*a.* Excessive wear in gear train.	*a.* Replace worn part (para 5-19 and 5-20).
	b. Lack of lubrication.	*b.* Lubricate according to LO 10-3930-618-12.
	c. Worn or damaged drive wheel bearing.	*c.* Replace bearings (para 5-20).
24. Excessive backlash in unit.	*a.* Worn splines on axle shafts.	a. Replace axle shafts (para 5-19).
	b. Worn ring gear, pinion or differential case pinions.	*b.* Replace gear and pinions (para 5-20).
	c. Loose or worn universal joints.	*c.* Tighten or replace (para 5-21).
25. Pedal goes to toe board.	External leak in brake system or leak past master cylinder piston cup.	Check master cylinder for leak and repair (par 5-14).
26. Both brakes drag.	*a.* Mineral oil in brake system.	*a.* Clean out system, replace cups in brake cylinders and refill with

Table 2-1. Troubleshooting (Continued)

Malfunction	Probable cause	Corrective action
		brake fluid TM 10-3930-618-20.
	b. Breather port in master cylinder clogged.	*b.* Clean out breather port (para 5-14).
27. One wheel drags.	a. Weak or broken brakeshoe return springs.	*a.* Replace broken or weak springs para 5-13).
	b. Loose wheel bearings.	*b.* Readjust (TM 10-3930-618-20).
	c. Swollen wheel cylinder piston cups or piston binding.	*c.* Replace defective or damaged parts (para .5-15).
28. Truck pulls to one side.	a. Grease or brake fluid on brake lining.	*a.* Replace with new lining (para 5-13).
	b. Loose wheel bearings.	*b.* Readjust (TM 10-3930-618-20).
	c. Different brakes of brake lining. used at each wheel.	*c.* Make sure same type ,of lining is
	d. Lining charred or drum scored.	*d.* Replace lining (para 5-13) or repair or place drum (para 5-13).
29. Spongy brakes.	Shoe surface not square with drum.	Repair (para 5-13).
30. Excessive pedal pressure	*a.* Incorrect brake lining.	*a.* Install specified lining (para 5-13).
	b. Oil or fluid soaked lining.	*b.* Replace lining (para 5-13).
31. Light pedal pressure-brakes too severe.	*a.* Small amount of grease or brake fluid on lining.	*a.* Correct cause and replace lining (para 5-13).
	b. Incorrect lining.	*b.* Install specified lining (para 5-13).
	c. Defective power booster.	*c.* Replace or repair (para 5-13).
32. Brakes squeak.	*a.* Brake shoes twisted.	*a.* Replace(para 5-13).
	b. Particles of metal or dust im-bedded in lining.	*b.* Remove foreign material, and sand lining and drum (para 5-13).
33. Loss of coolant.	*a.* Cracked engine block or head.	*a.* Replace damaged part (para 3-20)
	b. Defective head gasket.	*b.* Replace (para 3-20).
	c. Leaky radiator.	*c.* Repair or replace (para 3-6).
34. Rapid wear or breakage of fan belt.	Excessive drag from alternator.	Check alternator bearings (para 3-2).
35. Ammeter does not show charge.	*a.* Worn alternator brushes.	*a.* Replace brushes (para 3-2).
	b. Shorted alternator armature.	*b.* Test alternator (para 3-2).
	c. Shorted alternator fields.	*c.* Test alternator (para 3-2).
36. Ammeter shows discharge during engine operation.	Inoperative alternator.	Test alternator (para 3-2) determine cause.
37. Ammeter show heavy discharge with engine stopped.	Defective alternator regulator.	Inspect for closed contacts. Adjust or replace regulator (TM 10-3930-618-20).
38. Ammeter shows rapid fluc-tuation.	*a.* Dirty, loose or worn alternator brushes.	*a.* Clean and tighten brushes. Replace if worn (para 3-2).
	b. Defective alternator.	*b.* Repair or replace (para 3-2).
39. Starting motor failure.	*a.* Commutator dirty.	*a.* Clean (para 3-3).
	b. Worn brushes.	*b.* Replace (para 3-3).
	c. Broken drive mechanism.	*c.* Replace (para 3-3).
	d. Bad teeth on flywheel.	*d.* Replace ring gear {para 3-26).
40. Hard steering.	*a.* Failure of hydraulic pump.	*a.* Replace or recondition (para 4-2).
	b. Badly worn pump.	*b.* Recondition pump (para 4-2).
	c. Broken or weak relief valve spring.	*c.* Replace spring (para 4-2).
	d. Binding relief valve.	*d.* Free up valve (para 4-2).
	e. Low pump pressure.	*e.* Replace worn or faulty parts (para 4-2).
	f. Line leakage.	*f.* Tighten connections.
	g. Leakage in steering cylinder.	*g.* Repair (para 5-7).
	h. Faulty regulator valve.	*h.* Recondition valve (para 4-2).
	i. Binding steering gear.	*i.* Repair (or adjust (para 5-7).
41. Steering too sensitive.	*a.* Pump pressure too high.	*a.* Check for binding relief valve (para 4-2).
	b. Faulty flow control valve.	*b.* Recondition-free tip any binding parts (para 4-2).
42. Loose steering.	Loose kingpins.	Repair or recondition (para 5-10).

Table 2-1. Troubleshooting (Continued)

Malfunction	Probable cause	Corrective action
43. Low, oil pressure.	*d.* Low oil level.	*a.* Fill reservoir to correct level (LO 10-3930-618-12).
	b. 'Worn hydraulic pump.	*b.* Recondition or replace (para 4-2).
	c. Weak relief valve spring.	*c.* Replace spring (para 4-2).
	d. Relief valve stuck open.	*d.* Remove and free up valve (para 4-2).
	e. Flow control valve stuck open.	*e.* Free up flow control valve (para 4-2).
	f. External leakage.	*f.* Tighten or replace fittings hoses, or seals (para 4-2).
	g. Internal leakage.	*g.* Replace seals in pump (para 4-2) or cylinder (para 4-2).

Section III. GENERAL MAINTENANCE

2-6. General

This section contains general maintenance information that would otherwise have to be repeated throughout this manual.

2-7. Maintenance Requirements

a. Hardware and Threaded Parts. Inspect hardware for damaged threads, rounded corners, and damaged slots. Threaded holes and parts should accept their mating parts without requiring excessive torque. Threads may be chased with a tap or die. Replace any threaded parts which cannot be repaired.

b. Gaskets. Replace all gaskets .which are disturbed during repair operation or which show evidence of leakage. When installing gaskets, insure all gasket surfaces are clean and free from nicks and burs. Use grease or gasket cement to retain gasket in position during assembly procedure.

c. Oil Seals and Packings. Thoroughly lubricate the sealing lip of spring loaded seals with grease or other suitable lubricant when installing. Apply nonhardening sealer to the outer circumference of encased seals or to the mating bores to prevent possible leakage. Immerse preformed packings in the liquid or lubricant with which they will be in contact.

d. Ball and Roller Bearings. After removing antifriction bearings, cover them immediately to keep out dirt and abrasives. Flush thoroughly with solvent, tap them against a wooden block to remove packed lubricant, and air-dry. Coat cleaned bearings with oil and wrap in clean paper. Replace any bearings that are scored, pitted, discolored from overheating, or otherwise damaged. When installing bearings against shoulders, be sure the chamfered side faces the shoulder. Lubricate the bearing and its mating surface when pressing a bearing into place. Press bearings only on the race adjacent to the mating part. Use drivers which contact as much of the race as possible.

e. Repair of Damaged Machined and Polished Surfaces. Remove rough spots, scores, burs, galling, gouges, and other surface damage from machined and polished surfaces. Use a suitable honing stone, crocus or emery cloth, file, or any other method that will permit the part to function efficiently. The finish of the part must approximate that of the original finish. Do not alter critical dimensions beyond acceptable limits. Build up shafts, rods, and other worn parts by metallizing, chrome plating, or welding. Grind built up parts to original size.

f. Welding Repair. Welding must be performed by a qualified welder. Welds must provide complete fusion and penetration and comply with governing specifications. Inspect all welds using a radiographic or magnetic particle process. Grind all new welds flat and smooth whenever possible.

g. Part Replacement. Replace parts which are worn or defective with new parts. Consider such factors as age, mileage, operating hours, usage, and part availability to determine the necessity of part replacement.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND AUXILIARIES

2-8. General

The major components of the fork lift truck are; the power plant (engine, torque converter, and transmission; drive axle (differential, brakes and wheels); hydraulic lift assembly (mast, carriage, and cylinders); steering axle; and hydraulic system. This section covers direct and general support maintenance instructions for the removal,

installation, and where necessary the adjustment of these components as authorized by the maintenance allocation chart (TM 10-3930-618-20).

2-9. Power Plant

a. Removal.

(1) Refer to TM 10-3930-618-20 and perform the following:

(a) Remove the overhead guard.

(b) Remove the operators seat and engine hood.

(c) Remove toe plate and floor plate.

(2) Remove counterweight (TM 10-3930-618-20).

(3) Drain engine cooling system and remove radiator and hose connections. (TM 10-3930-618-20).

(4) Disconnect hydraulic noses at pump and remove hose clamps on each side of oil pan holding hoses in position. Lines, should then be tied out of the way.

(5) Disconnect wiring harness terminals from engine, being careful not to damage leads. For convenience in reinstallation, tag all terminals showing where wires should be installed.

(6) Disconnect fuel lines (TM 10-3930-618-20).

(7) Disconnect all throttle (TM 10-3930-618-20) and shift linkage (para 5-6).

(8) Disconnect exhaust pipe from manifold (TM 10-3930-618-20).

(9) Disconnect carburetor air inlet hose from carburetor.

(10) Disconnect the propeller shaft (para 5-21).

(11) Remove nuts, washers, and capscrews securing front and rear engine mounts to truck frame.

(12) Attach a suitable lifting sling and hoist to the two lifting studs provided on engine head.

(13) Raise engine, high enough to clear engine supports. Move engine toward rear to free transmission from drive shaft slip joint. Then raise and remove engine from truck.

CAUTION

Use care when removing engine; make certain that no parts are damaged by careless handling.

(14) After engine assemble with transmission has been removed from truck, it is recommended that all accessories be removed for ease of engine disassembly. Enough pans or boxes should be available so that components removes from the engine can be placed in them and kept separated, making reinstallation easier and quicker. For specific instructions on removal and installation of accessories, refer to the appropriate sections of T.M 10-3930-618-20, and of this manual.

b. Separating Engine From Converter and Transmission.

(1) Attach sling and hoist to transmission case and then take up slack until there is no weight on slings, but slings are straight.

(2) Remove capscrews and lockwashers securing the converter housing to the flywheel (fig. 2-1).

(3) Disconnect the cooler lines at bottom right side of sump.

(4) Drain oil from transmission by removing drain plug from sump.

(5) Carefully work transmission away from engine and flywheel housing.

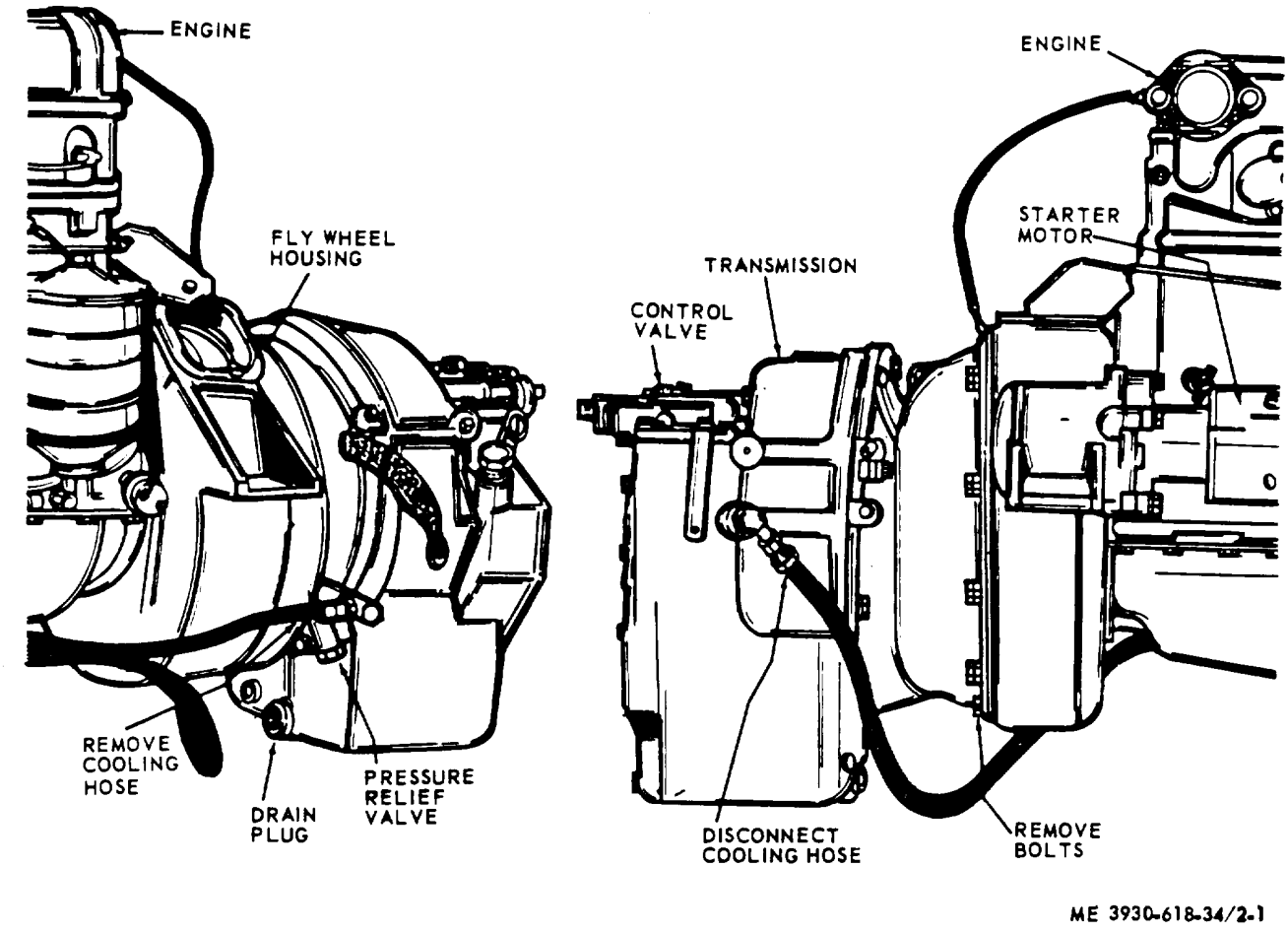


Figure 2-1. Transmission assembly removal and installation.

c. Separating Torque Converter From the Flywheel.

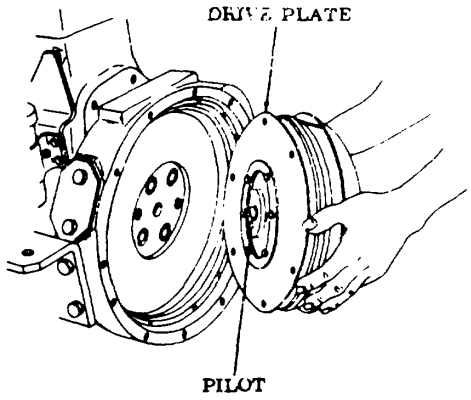
(1) Refer figure 2-2 and remove 6 capscrews and lockwashers that secure the torque converter to the flywheel.

(2) Slide torque converter off the flywheel.

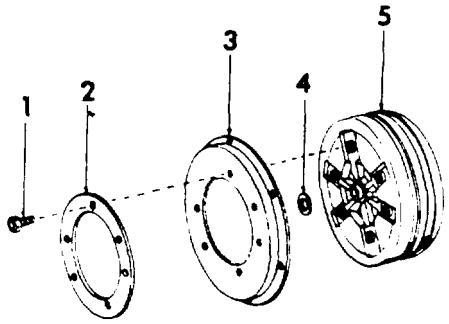
Note how many shims are on the converter pilot (fig. 2-2

NOTE

When torque converter and transmission are separated, proceed to paragraphs 3-15. for repairs. To install replacement torque converter and/or transmission, proceed as follows:



A. SEPARATING CONVERTER FROM FLYWHEEL



B. CONVERTER PILOT AND SHIM
ME 3930-618-34/2-2

B. Converter pilot and shim
1 Bolt
2 Plate. reinforcing
3 Plate, drive
4 Shim
5 Converter

Figure 2-2. Torque converter removal and installation.

d. Assembly of Power Plant.

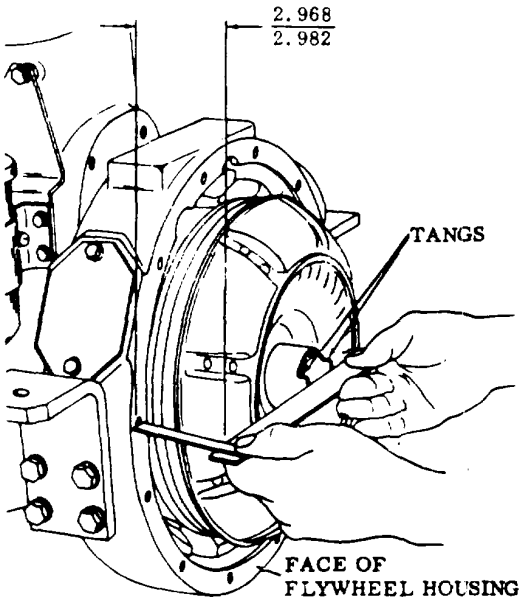
(1) Torque converter installation.

(a) Without shims (fig. 2-2) on pilot, install converter on flywheel. Tighten capscrews.

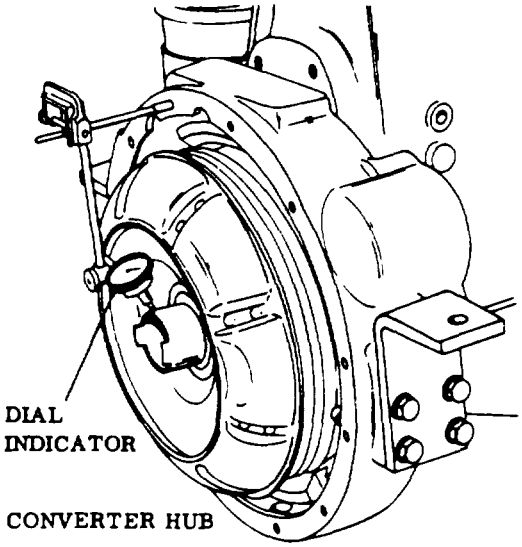
NOTE

When installing converter it is important that tongs of converter extend to a proper depth into pump.

(b) Place scale across tangs of converter and another scale front flyweel housing face to the first scale (fig. 2-3).



A. CHECKING CONVERTER TANG DEPTH



B. CHECKING CONVERTER ALIGNMENT
ME 3930-618-34/2-3

Figure 2-3. Converter installation.

(c) Record measurement from face of tangs to housing face.

(d) If measurement is less than 2 31/ 32 inches (2.968 inches) remove converter and add shims at converter pilot to obtain specified dimension.

(e) If measurement is greater than 2 63 / 64 inches (2.982 inches) insert a suitable gasket between the converter housing and flywheel housing to obtain the specified dimension.

(f) Mount a dial indicator, (fig. 2-3) on the flywheel housing. Rotate converter and note dial indicator readings. Hub runout should not exceed 0.005 inch (0.01 inch T.I.R) (Total Inches Runout).

(g) Bend converter plate to adjust to specified dial reading. Do not use shims between plate and flywheel.

(h) After correct alignment is obtained, recheck tang depth as outlined above.

(2) *Transmission Installation*.

(a) Mark one mounting strap and flywheel for identification and remove converter from flywheel being careful not to damage or lose shims, if any, on converter pilot.

(b) Position converter in pump at back of transmission making sure converter hub tangs properly engage pump driven gear.

(c) Reinstall transmission on flywheel bell housing as follows:

1. Mount converter on flywheel by installing capscrews and lockwashers trough timing mark inspection plate in flywheel housing.

2. After converter has been securely installed, rotate until filler hole appears and add 1 quart of oil.

3. After assembly has been installed in truck, add 10 quarts of oil to transmission.

e. Power Plant Installation. The installation of engine assembly with transmission is practically a reversal of the procedures in paragraph 2-9a.

(1) Using an engine lifting sling attached on the lifting studs on the cylinder head, and with a suitable hoist, slowly lower engine into truck frame. Have an assistant line up drive shaft slip joint so that it will enter output shaft of transmission without damage during installation.

(2) With engine correctly aligned in truck frame and positioned on the rubber mounts, install the mounting capscrews, washers, and nuts. Torque nuts to 60 foot-pounds and remove hoist and sling.

(3) Connect exhaust pipe, using a new gasket.

(4) Connect throttle and shaft linkage, and make initial adjustments to linkage at this time (TM 10-3930-618-20). Final adjustment can be made after installation is complete.

(5) Connect fuel supply line and open shutoff valve (TM 10-3930-618-20).

(6) Install wiring harness. If ends of leads have not been tagged, refer to Electrical System section (TM 10-3930-618-201.

(7) Clamp hydraulic hoses along oil pan and connect hose to hydraulic pump.

(8) Install radiator and hoses. Pour coolant into engine cooling system and check for leaks. Refer to Cooling System section, (TM 10-3930618-20).

(9) Install counterweight (TM 10-3930-61820).

2-10. Hydraulic Pump Assembly

a. Description. The hydraulic pump is a gear type unit, driven directly through a flexible coupling from the engine crankshaft. With this type of installation the pump is always driven at engine speed.

b. Removal.

(1) Remove radiator grille (TM 10-3930-61820).

(2) Refer to figure 2-4 and disconnect the hydraulic pump from the engine drive coupling.

NOTE

It is not necessary to drain hydraulic reservoir since oil level is below that of pump fittings.

(3) Remove capscrews (3), and lockwashers (2), attaching flange to the timing gear cover.

(4) Remove the pump and flange by pulling straight away from engine.

(5) Remove capscrews (4), lockwashers (5), and coupling (1), from crankshaft pulley.

c. Installation.

(1) Install the hydraulic pump on the engine by reversing the procedure in b above.

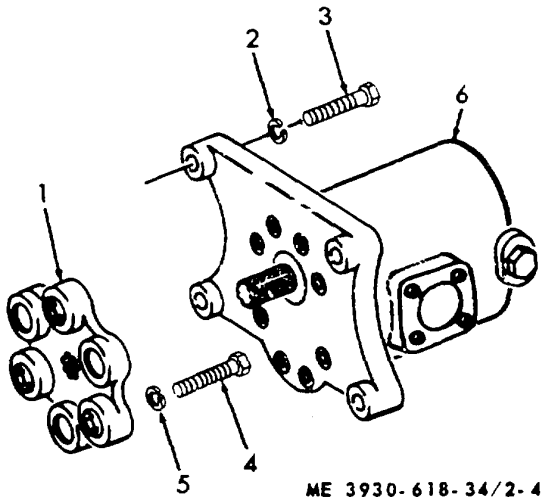
(2) Pump shaft splines should slide easily into the coupling. Do not force engagement.

(3) Install top-left and bottom-right mounting screws first, and tighten securely.

(4) Make sure all line connections are tight.

(5) Operate the pump after installing and check operation of lift and steering systems.

(6) Install a pressure gage (2000 psi) in pressure line between pump and control valve and check pressure with engine running at maximum throttle and with steer wheel held in either extreme right or left position. Observe gage for a reading of 1200- to 1400-psi.



1 Coupling
2 Lockwasher
3 Screw
4 Screw
5 Lockwasher
6 Pump

Figure 2-4. Hydraulic pump removal and installation.

2-11. Hydraulic Lift Assembly

a. Description. The hydraulic lift assembly consists of hydraulic cylinder, carriage and inner and outer masts with wear plate in the sliding channels to provide maximum ease of movement.

b. Removal. Refer to figure 2-5 and remove as follows:

(1) Remove lift forks (TM 10-3930-618-20).

(2) Detach tilt cylinders from mast. brackets (para 2-12).

(3) Attach chain hoist to lifting eyes on the back of outer mast and raise mast assembly enough to take weight off pivot pins.

(4) Remove lock wires from capscrews. Remove capscrews, lockwashers, and remove pivot pins.

(5) Lift mast assembly free of truck.

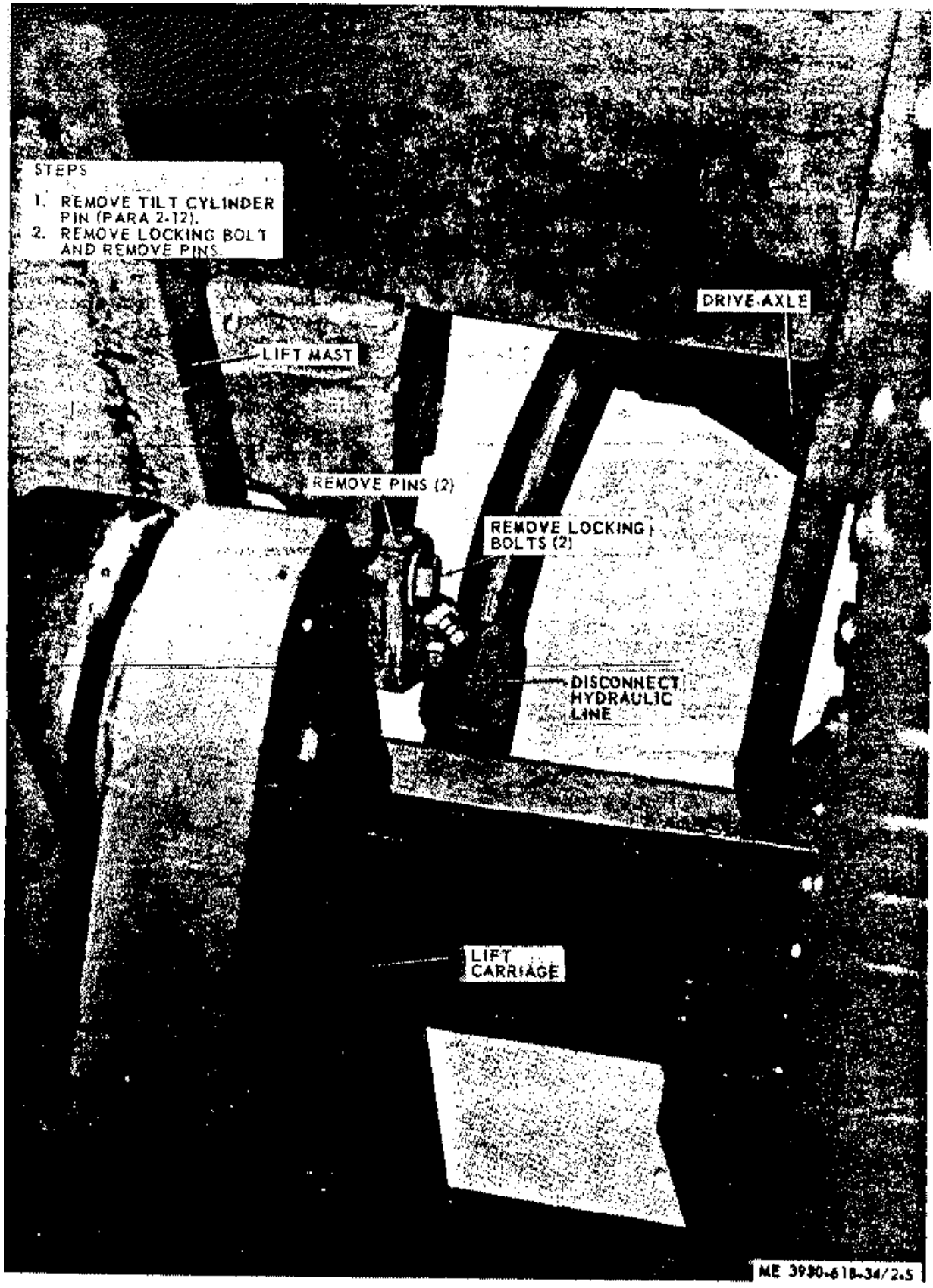


Figure 2-5. Hydraulic lift assembly removal and installation.

c. Installation. Install hydraulic lift mast by reversing procedures in *b* above.

2-12. Tilt Cylinders

a. Removal. Refer to figure 2-6 and remove tilt cylinder assemblies as follows:

(1) Operate the tilt control lever to put the mast in forward position. Hold the mast in forward position with a chain hoist.

(2) Remove the cotter pin and pull out the pin attaching the cylinder yoke to the carriage.

(3) Disconnect the hydraulic lines at the tilt cylinder.

(4) Remove the screw and pin retainer from the tilt cylinder rear mounting bracket and pivot shaft.

(5) Insert a drift in the hole (provided in the pivot shaft) and remove the pivot shaft. Lift the cylinder from the truck.

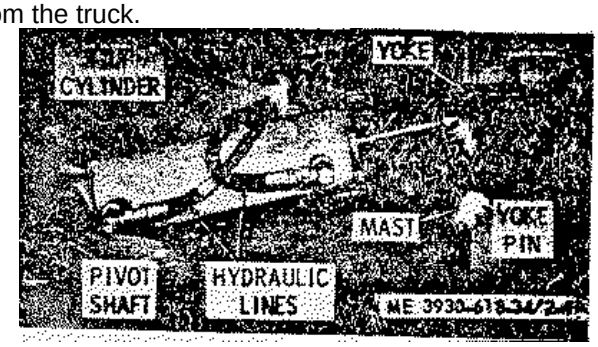


Figure 2-6. Tilt cylinder removal and installation.

b. Installation.

(1) Reverse procedures in a above.

(2) Make sure the rear pin retainer is positioned properly so the screw can be easily installed.

(3) Make sure that hydraulic line connections are tight.

(4) Refill hydraulic tank.

(5) Operate the cylinders and check carefully for leaks before installing the cowls.

(6) Check to be sure both cylinders bottom simultaneously.

c. The correct degree of tilt is 3° forward and 10° backward for correct adjustment procedures, refer to TM 10-3930-618-20.

2-13. Hydraulic Control Valve and Levers

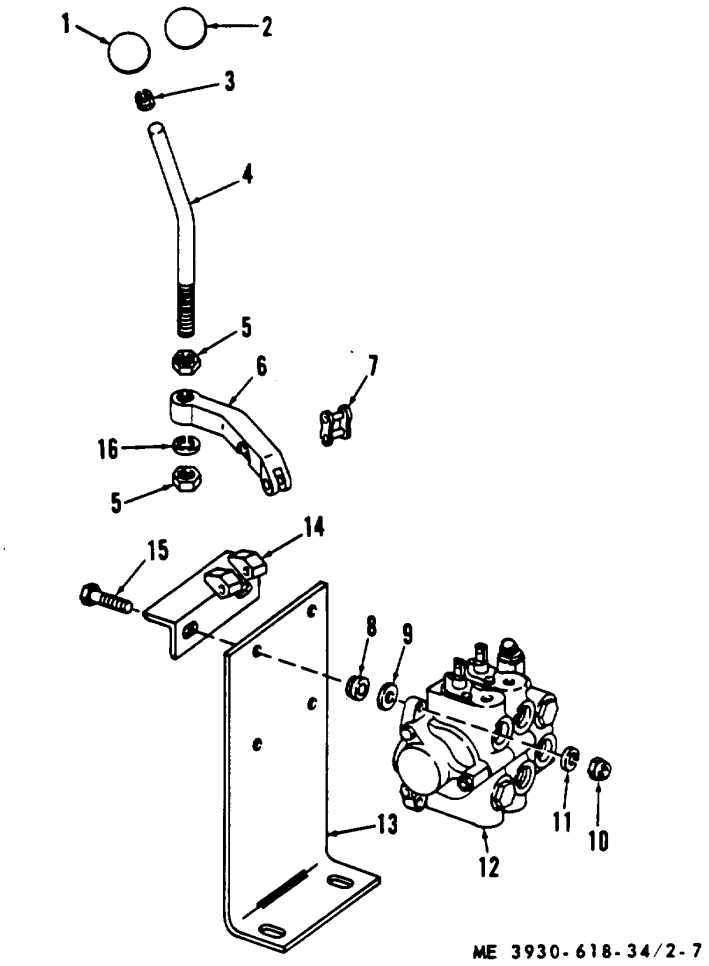
a. Removal. Refer to figure 2-7 and remove the hydraulic control valve as follows:

(1) Remove seat and right-hand side panel.

(2) Remove pins attaching levers (6) to valve plungers.

(3) Disconnect all hydraulic lines at control valve.

(4) Remove nuts (10) and washers (11) and remove control valve assembly from bracket (13).



1 Knob	9 Flat washer
2 Knob	10 Nut
3 Bushing	11 Lockwasher
4 Handle	12 Control valve
5 Nut	13 Bracket
6 Lever	14 Bracket
7 Link	15 Screw
8 Bushing	16 Lockwasher

Figure 2-7. Hydraulic control valve removal and installation.

(5) Replace nuts (10) and washers (11) or screws 115) to hold bracket (14) in place.

b. Removal (Control levers)

(1) Remove links (7) attaching levers (6) to bracket (14).

(2) Remove lower nuts (5) and lockwashers (16) from handles (4). Loosen upper nuts (5) and screw handles from levers.

(3) Remove knobs (1 and 2) from handles.

c. Installation. Install hydraulic control valve by reversing the procedure in a & b above.

2-14. Steering Axle Assembly

a. Removal. Refer to figure 2-8 and proceed a follows:

(1) Raise rear end of truck with chain hoist to a workable height and support in this position with blocks or other authorized safe means.

(2) Place a suitable jack under the steering axle to raise it slightly. This removes weight stress from the trunnion supports and supports axle during removal.

(3) Detach steering yoke from ball stud on pivot arm.

(4) Remove from capscrews attaching the trunnion support assemblies.

(5) Lower axle assembly to ground.

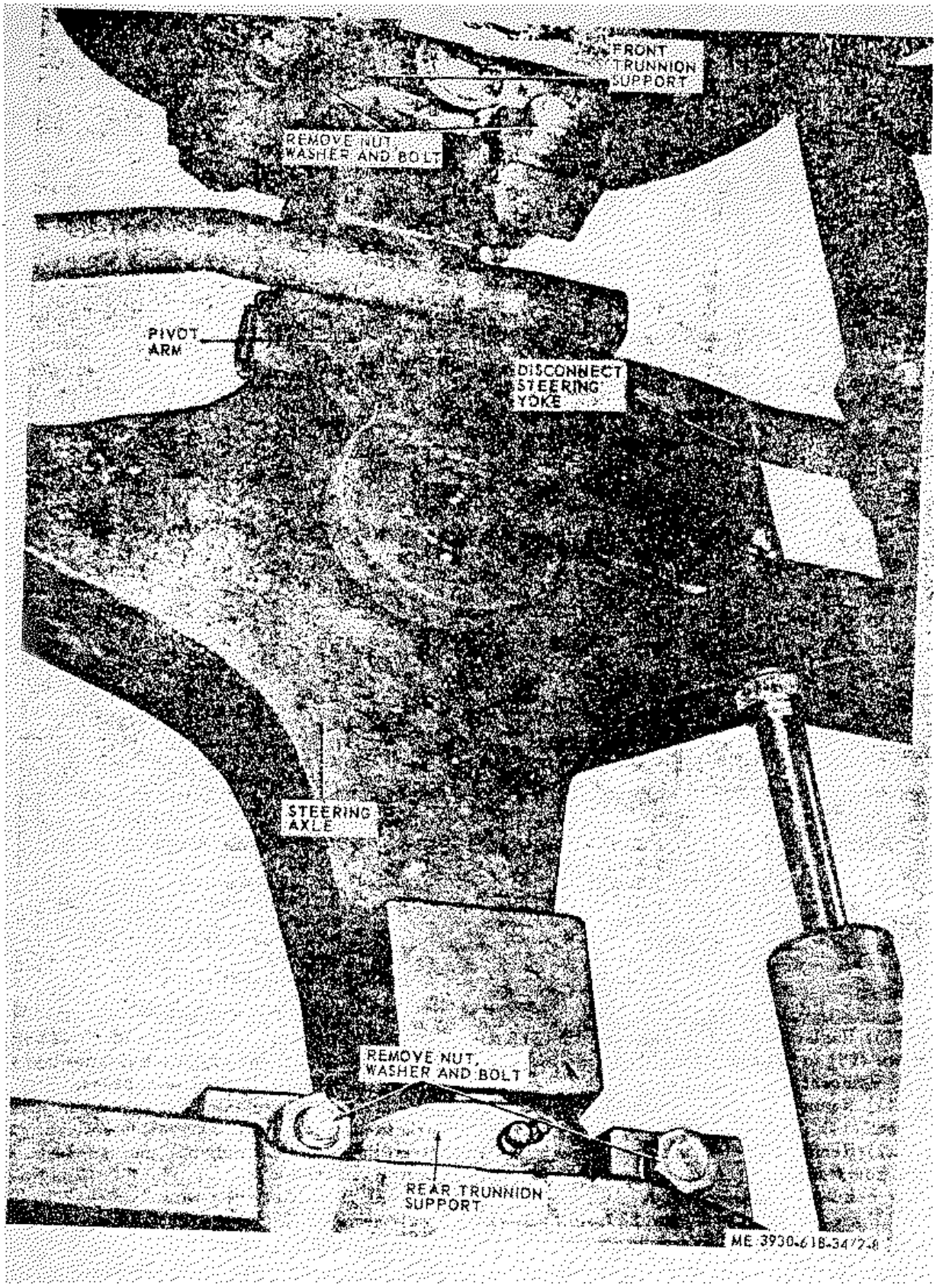


Figure 2-8. Steering axle assembly, removal and installation.

b. Installation. Install the steering axle assembly by reversing the procedure in a above.

2-15. Drive Axle Assembly

a. Removal The complete drive unit, including wheels and tires, can be removed as a unit. Proceed as follows:

(1) Remove hydraulic lift assembly (para 2-11)

(2) Remove propeller shaft (para 5-21).

(3) Remove hand brake assembly (para 5-12)

NOTE

If desired, detach universal joint from pinion flange and leave handbrake assembly installed.

(4) Disconnect hydraulic brake line at tee on right-hand axle mounting support.

(5) Attach hoist to front of truck and raise trucks just enough to take weight off of axle housings.

(6) Remove (2) bolts and nuts that attach the differential housing to the truck frame.

(7) Remove nuts and lockwashers from U-bolts. Pull U-bolts from axle supports.

(8) Raise front of truck until supports clear axle housings and roll drive unit from beneath truck.

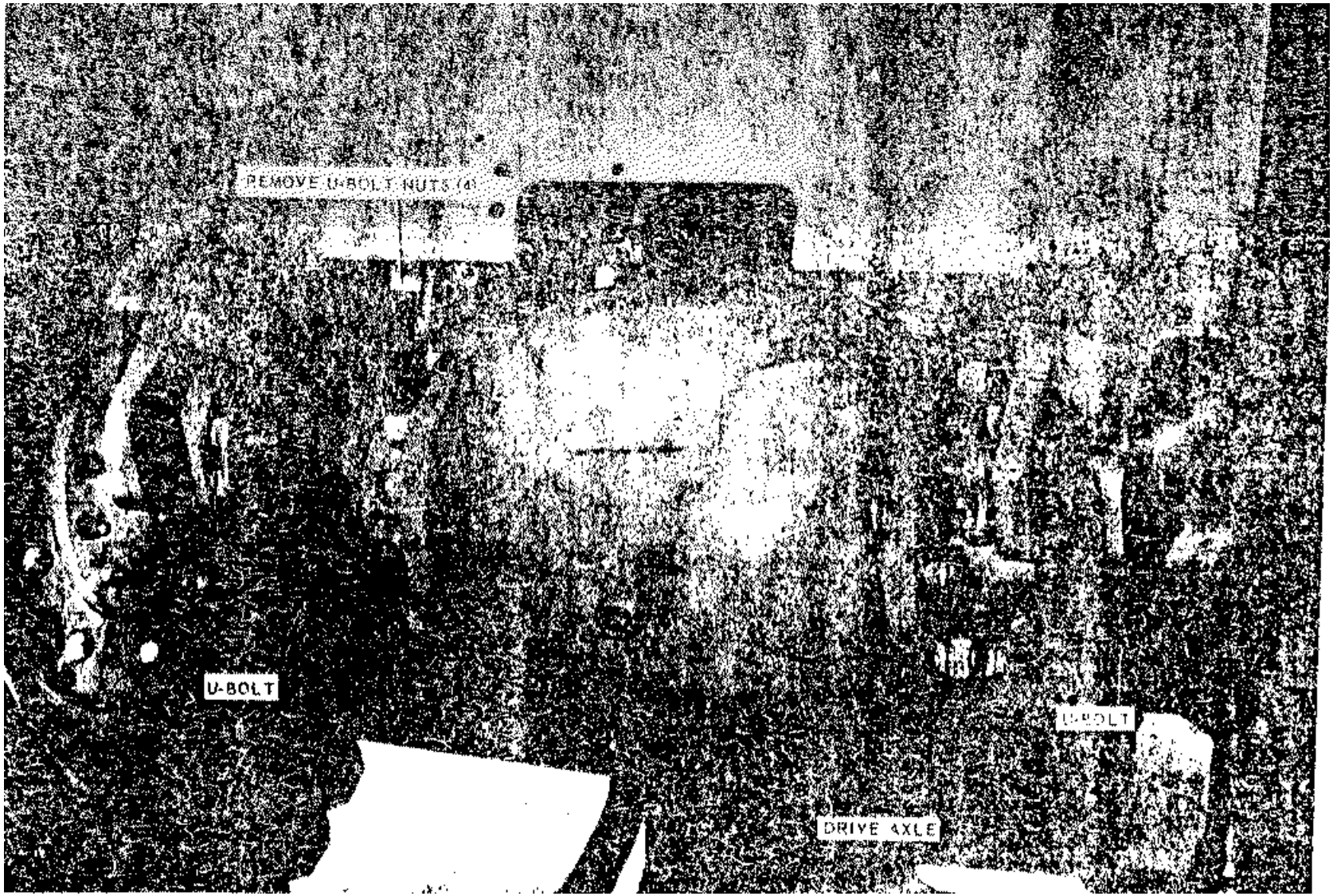


Figure 2-9. Drive axle assembly removal and installation.

b. Installation. Install the drive axle assembly on the truck frame by reversing procedure in a above.

CHAPTER 3

REPAIR OF POWER PLANT

Section I. REPAIR OF ENGINE ELECTRICAL SYSTEM

3-1. General

This section contains information useful to direct and general support maintenance personnel in their performance of maintenance of the engine electrical system.

3-2. Alternator

a. Removal and Installation. Remove or install the alternator as directed in TM 10-3930-618-20.

b. Disassembly. Refer to figure 3-1.

(1) Remove the four thru-bolts from the alternator assembly

NOTE

Place a scribe mark on the stator and end frames to aid in locating the parts in the same position during reassembly.

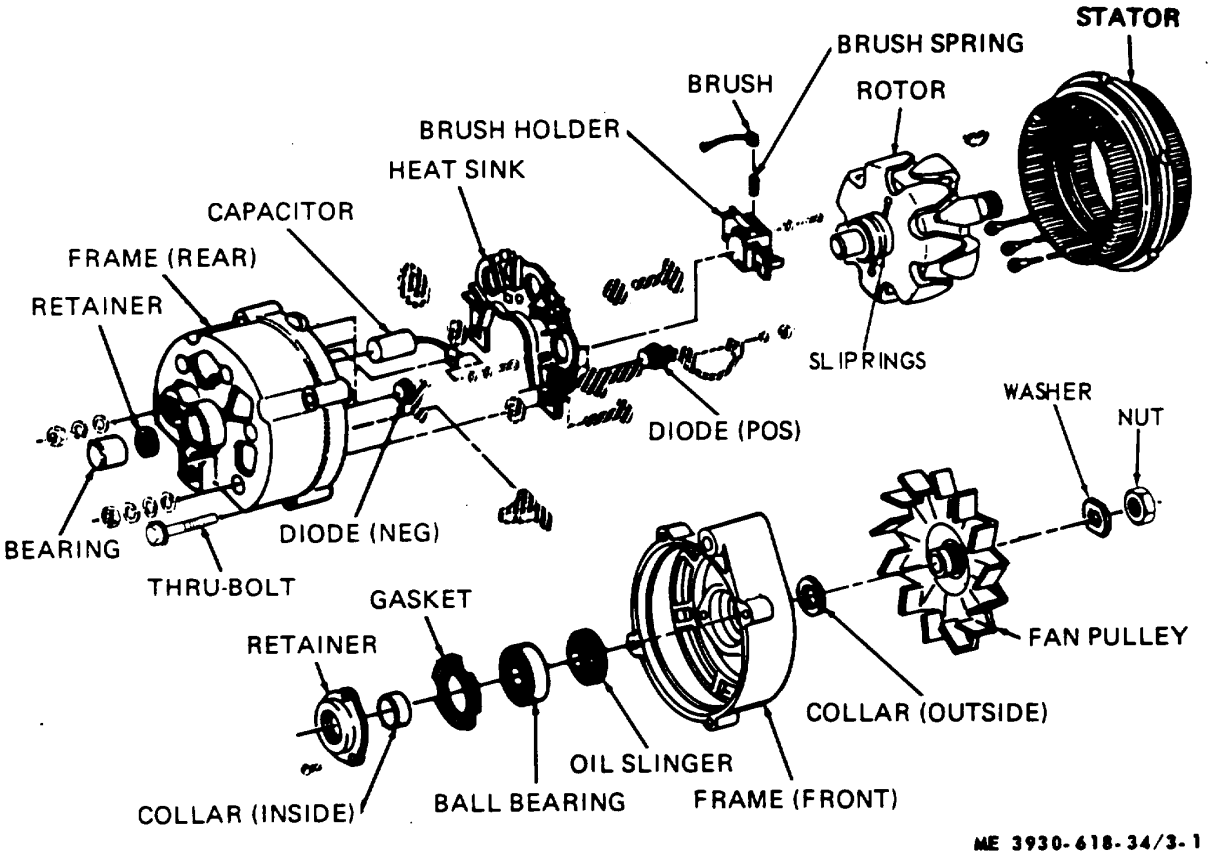


Figure 3-1. Alternator, exploded view.

(2) Separate the front end frame and the rotor assembly from the stator assembly. Pry them apart at the stator slot with a screw driver.

(3) Place the rotor in a vise and tighten just enough to permit removal of the shaft nut. Remove the shaft nut, washer, pulley, fan and collar.

(4) Separate the rotor from the front end frame, removing key.

(5) Remove retainer, collar, gasket and bearing from end frame.

(6) Remove stator from rear end frame.

(7) Remove rear end frame bearing and

retainer from end frame. Place a piece of tape over the bearing and over the slip ring assembly on the rotor shaft.

(8) Remove brushholder, brushes and springs.

(9) Remove capacitor, diodes, and heat sink from end frame.

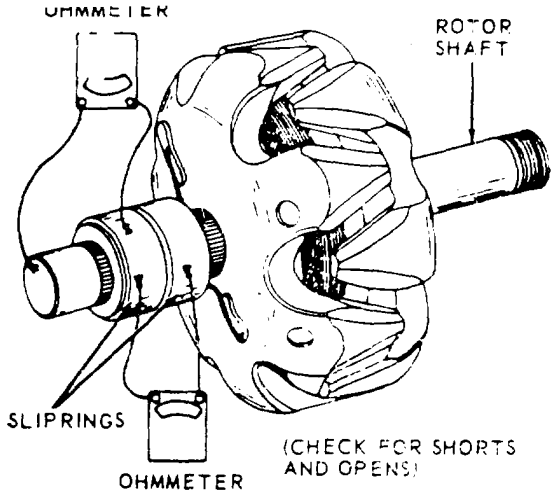
NOTE

Do not wash alternator parts in a cleaning solvent.

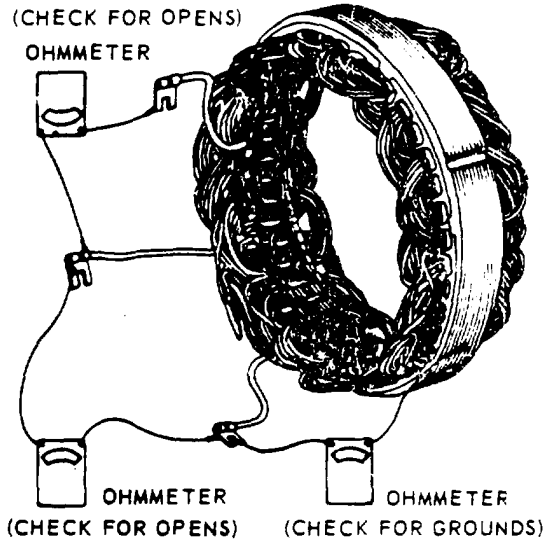
c. Cleaning. Clean all parts with a dry, lint-i/ce cloth. Use filtered compressed air to blow dust dirt from end frames.

d. Inspect and Repair.

(CHECK FOR GROUNDS)



A. ROTOR



B. STATOR

ME 3930-618-34/3- 2

Figure 3-2. Checking rotor and stator for shorts, grounds, and open circuits.

CAUTION

Do not touch test probes to polished mating surfaces.

(1) *Rotor.* Refer to figure 3-2 and perform the following checks:

(a) Grounds. Connect 1 10-volt test lamp or an ohmmeter from either slipring to the rotor shaft or to the rotor poles. If the lamp lights, or if ohmmeter reading is low, it indicates the field is grounded.

(b) Open windings. Connect test lamp or ohmmeter to each slipring and if lamp fails to light or if ohmmeter reading is high (infinite), winding is open.

(c) Short-circuits. Connect a battery and ohmmeter in series with two sliprings. Note the ammeter reading. If reading is above 1.9-to 2.3ohms, it indicates shorted windings.

(d) Field resistance. Connect an ohmmeter to the two sliprings and check the resistance of the field. If the resistance reading is below 1.9-to 2.3ohms, the winding is shorted. Replace a defective rotor as required.

(2) *Stator.* Refer to figure 3-2 and perform following checks:

(a) Ground. Check stator windings with a 110-volt test lamp or an ohmmeter. If the test lamp lights, or if the meter reading is low when connected from any stator lead and to the frame, the windings are grounded.

(b) Open windings. Connect test lamp or ohmmeter to any stator lead and to the frame. The windings are open if the lamp fails to light or if the meter reading is high when successively connected between each pair of stator leads. Replace stator having grounded or open windings.

NOTE

Due to low resistance of the stator windings, it is difficult to locate a short circuit in the windings, without the use of laboratory test equipment. Shorted Stator windings are indicated if all other electrical checks are normal but alternator does not supply rated output.

(3) *Diodes.* Refer to figure 3-3 and check each diode electrically for a shorted or open condition by any one of the following methods:

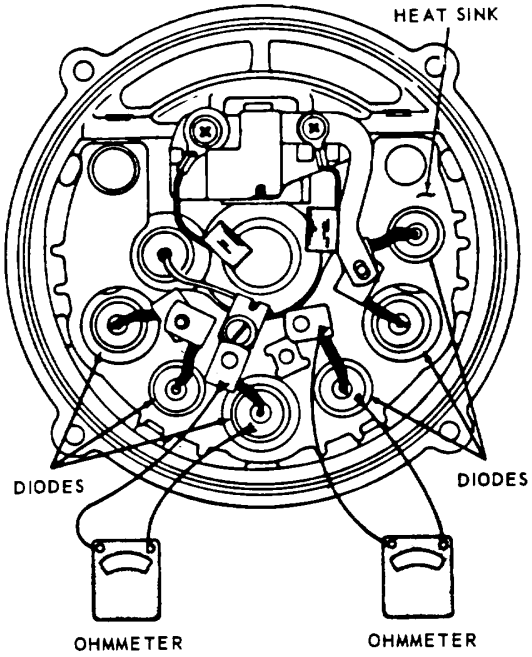


Figure 3-3. Checking heat sink diodes.

(a) Ohmmeter method. Use an ohmmeter with a 11/2-volt cell and use the lowest range scale.

Disconnect stator from the heat sink diodes.

1. Connect one ohmmeter lead to the heat sink and the other one to the diode lead and note the reading. Reverse the ohmmeter lead connections and check the reading.

2. If both readings are either very low or very high, the diode is defective. A good diode is indicated by one low reading and one high reading. Check the two remaining heat sink diodes in same manner.

3. Check the end frame diodes in the same manner as the heat sink diodes. However, connect

one ohmmeter lead to the end frame and one to the diode lead. Check all three diodes in the way previously described.

(b) Test lamp method. Test lamp of not more than 12-volts is required. Disconnect stator from the heat sink diodes.

CAUTION

Do not use 110-volt test lamp to check diodes.

1. Connect the test lamp in the same manner as the ohmmeter. If lamp lights in both checks or fails to light in both checks, diode is defective. When diode is not defective, the test lamp will light in only one of two checks.

2. Check all diodes and replace defective ones as required.

(4) *Diode replacement*. When a diode requires replacement. proceed as follows:

CAUTION

Do not hammer diodes into position as the shock will damage them.

(a) Support the end frame or head sink in a suitable tool and push out the old diode with an arbor press or vise.

(b) Press the diode in with a suitable tool which fits over the outer edge of the diode while supporting the heat sink or end frame.

(5) *Slipring.*

(a) Clean. To clean sliprings, use 400-grain or finer polishing cloth. Spin the rotor in a lathe or by other means and hold the polishing cloth against the sliprings until they are clean.

(b) Repair. Out of round or rough sliprings should be trued to 0.002-inch maximum indicator readings in a lathe. Remove just enough material to make the rings smooth and round. Polish with 400grain or finer polishing cloth and blow away all dust.

(6) *Bearing* (drive bearing).

(a) The drive bearing can be removed by detaching the retainer plate screws and then pressing the bearing from the front frame.

(b) Check the bearing; if it is in satisfactory condition, it can be reused. It should be cleaned in an approved cleaning solvent and lubricated ¼ full with MILG-18709.

CAUTION

Do not overfill with lubricant as this could cause the bearing to overheat.

(c) If a new bearing is required, press it in with a tube or collar that just fits over the outer race. If the felt seal is worn excessively or hardened, it is recommended that a new retainer plate be in stalled.

(7) *Bearing* (Rear Frame).

(a) The slipring rear frame bearing should be replaced if its grease supply ;is exhausted. Never attempt to relubricate and reuse the bearing.

(b) Press the bearing out from the slipring rear frame with a tube or collar that fits just inside the rear frame housing. Press the bearing out from outside the housing toward the inside.

(c) Press in the new bearing with a flat plate. Press in from outside of the rear frame until the bearing is flush with the outside of the rear frame.

To prevent breakage of the rear frame, support it on the inside with a hollow cylinder. When installing the new bearing, use extreme care to avoid misalignment or other undue stress on the bearing. Saturate the felt seal in OE 10 oil (MIL-L-21041, then reassemble felt seal and steel retainer.

(8) *Brush Replacement.*

(a) When separating the slipring rear frame from the rotor and front end frame assembly, the brushes will drop down onto the shaft and come into contact with the lubricant. If brushes are to be reused, they must be thoroughly cleaned with a soft dry cloth. Also. clean the shaft thoroughly before beginning reassembly.

(b) Inspect the brush springs for evidence of any damage or corrosion. Be sure to replace the brush springs if there is any doubt as to their condition.

(c) When new brushes are required. install them as follows: First, remove the two brush holder screws, then remove the brush holder assembly from the rear frame. After installing the springs and brushes in the brush holder, insert a piece of straight wire or pin into holes at the bottom of the holder to retain brushes. Then install the brush holder assembly onto the rear frame, noting carefully the proper alignment of parts as shown in

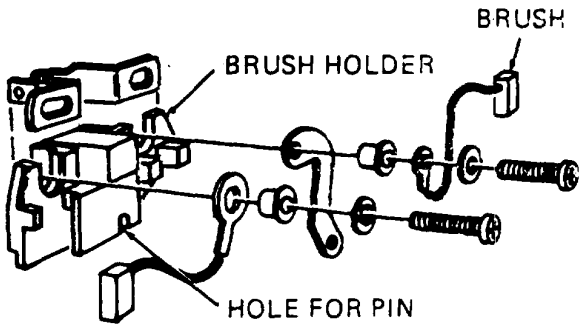


Figure 3-4. Brush holder assembly.

(9) *Heat sink replacement.*

(a) To replace the heat sink, remove the "BAT" and "GRO" terminals from the end frame and the screw attaching the condenser lead to heat sink.

(b) During reassembly, carefully note the alignment of parts as shown in figure 3-1.

e. Alternator reassembly.

(1) The reassembly of the alternator is a reverse of the disassembly (fig. 3-1).

(2) Avoid excessively tightening the rotor in a vise as this could distort the entire rotor assembly. After installing the pulley assembly, tighten the shaft nut to 50-60 ft. lbs. Before installing the slipring end frame assembly, remove the protective tape from the bearing end shaft, making sure shaft is completely clean after tape is removed.

(3) When alternator is assembled, withdraw the brush retaining wire through the hole in the end frame, allowing the brushes to contact the sliprings.

f. Alternator test.

(1) To check the alternator on a test bench, make an electrical hook-up as shown in figure 3-5, operate at specified speed and check for rated output. See table 3-1.

(2) Adjust the load rheostat, if necessary, to obtain, the desired output.

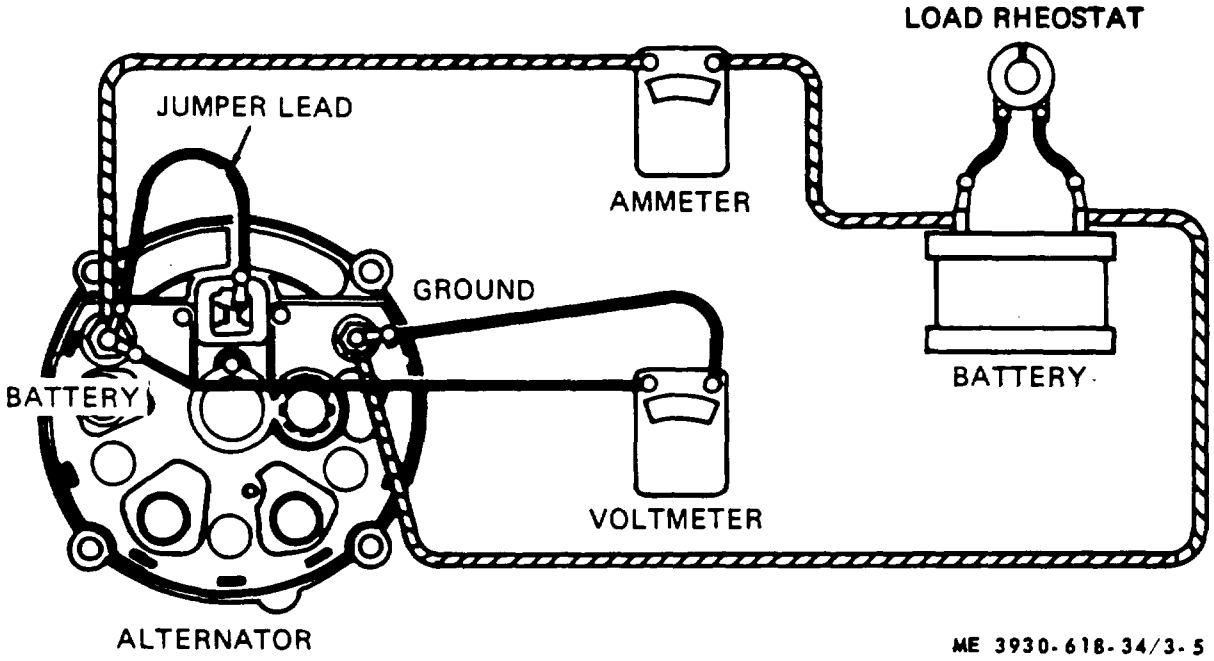


Figure 3-5. Checking alternator output.

Table 3-1. Alternator Specifications

Rotation viewing D.E.	Field current (80F)				Cold output at specified voltage				
	Grd	Amps	Volts	Spec volts	Amp	Approx. R.P.M.	Amp	Approx. R.P.M.	Rated hot output amp
CW	Neg	1.9-2.3	12	14.0	12	1100	42	6500	42

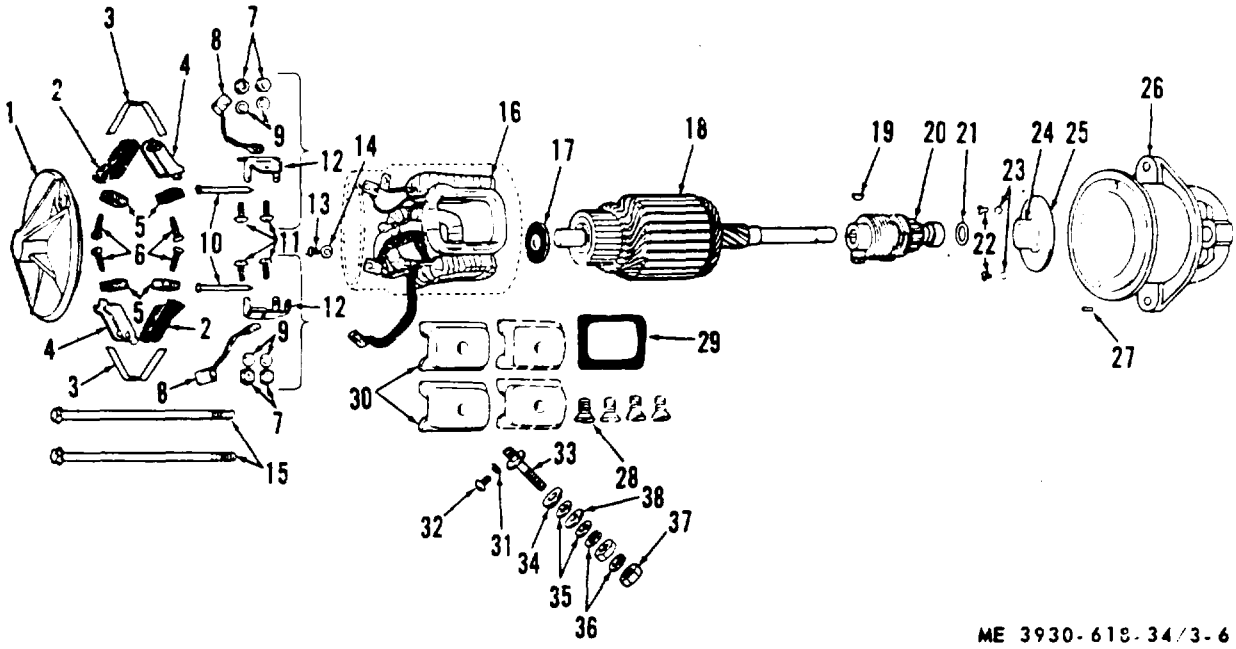
3-3. Starter Motor

a. Removal and Installation. Refer to TM 10-3930-618-20 and remove or install the starter motor.

b. Disassembly. Disassembly should proceed only so far as is necessary to make repairs or replace defective parts.

(1) Secure starter motor in bench vise at drive end of unit. Be careful not to damage drive end housing.

(2) Remove the two through bolts (15, fig. 3-6) and slide commutator end frame (1) and field frame from armature.



1 End frame
2 Brush holder
3 Spring
4 Brush holder
5 Brush
6 Screw
7 Nut
8 Lead
9 Washer
10 Shaft
11 Screw
12 Holder
13 Screw
14 Washer
15 Through bolts
16 Field coil
17 Spacer
18 Armature
19 Ken
20 Drive mechanism
21 Washer
22 Screw
23 Washer
24 Bushing
25 Bearing assembly
26 End frame (drive housing)
27 Pin
28 Screw
29 Insulator
30 Pole shoe
31 Washer
32 Screw
33 Stud
34 Grommet
35 Washer
36 Washer
37 Nut
38 Washer

Figure 3-6. Starter motor, disassembly and reassembly/

(3) Disconnect field lead from brush holders (2 and 4) and remove commutator end frame (1) from field frame.

(4) Brushes (5) brush holders 12 and 4) and springs (3) can now be removed from commutator end frame.

(5) Do not remove field coils. If tests indicate coils are defective, replace starting motor.

(6) Remove terminal stud from field frame by removing nuts (37), washers (35, 36, and 38) and rubber grommet (34).

(7) Remove capscrews (22) which mount center bushing (24) on drive end housing (26) and remove housing from armature.

(8) Drive mechanism (20) is keyed onto armature shaft and is removed by pressing off or using a puller.

c. Cleaning, *Inspection and Repair*. Clean, inspect and repair as directed in TM 5-764.

d. Reassembly.

(1) Install field frame terminal stud (33) and then connect heavy field lead to stud (33).

(2) Install brush holders (2 and 4), brushes (5), and springs (3) on commutator end frame (1). Place end frame on field frame and connect undergrounded brush leads to field coil terminals.

(3) Install center bearing (25) on armature shaft with long side toward commutator end of armature.

(4) Install key (19) in armature shaft (18) and

press on drive mechanism (20). Apply thin coating of grease before pressing on drive assembly.

NOTE

If drive mechanism is rotated to full extended lock position on crew shaft during replacement or during overhaul of cranking motor, do not attempt to force it in the reverse direction. Proceed to install drive even though it is fully extended. After starter motor is installed on engine and the engine starts. centrifugal force will demesh drive pinion from flywheel ring gear in the usual manner.

(5) Place drive end housing (26) on armature shaft after placing a few drops of oil on bushing (24). Then fasten center bearing (25) on drive housing (26).

(6) Place spacer (17) on commutator end of armature shaft and install armature (18) complete with drive housing (26) in field frame assembly.

While installing armature, pull commutator end frame away from field frame and make certain brushes are seated correctly on commutator.

(7) Replace end frame and position drive end housing on field frame. Make certain both commutator end frame and drive housing are correctly positioned on field frame dowels (27). Then insert the through bolts (15) and tighten securely.

3-4. Ignition Coil

Test the coil for grounded or open circuits by using a test lamp as follows:

a. Primary Circuit Continuity Test.

(1) Check the primary circuit by placing the test probes of a test light on the two primary terminals.

(2) If the lamp does not light the primary circuit is open and the coil must be replaced.

b. Secondary Circuit Continuity Test.

(1) Check the secondary circuit by placing one test probe of a test light on the high tension terminal and the other test probe on one of the primary terminals.

(2) The lamp will not light but sparks will be noted as the test probe is rubbed over the terminal.

If no sparks occur, the secondary circuit is open and the coil must be replaced.

Section II. REPAIR OF COOLING SYSTEM

3-5. Description

The cooling system carries off excess heat from the engine and holds engine at an efficient operating temperature. System includes radiator, water pump, engine temperature gauge and sending unit, thermostat, cooling fan, and coolant passages in the cylinder block and cylinder head. Centrifugal water pump, which is driven by "V" belt from crankshaft pulley, draws coolant from bottom of radiator to top of cylinder block, from where there is forced circulation of coolant through cylinder block and cylinder head. Coolant is discharged from cylinder head into coolant outlet manifold and passes through thermostat and tubing to upper tank of radiator. Heat is removed from coolant as it passes from top to bottom of radiator by air forced through radiator core by pusher type cooling fan.

Engine has a pressure type cooling system which permits higher coolant operating temperatures. It is necessary to keep radiator cap turned on tightly at all times to prevent loss of pressure. A thermostat, located in the thermostat housing operates automatically to maintain a minimum coolant operating temperature of 1650F. This section covers direct and general support maintenance procedures authorized by the Maintenance Allocation Chart.

3-6. Radiator

a. Description. Fin and tube type radiator is supported in truck frame and protected from damage by a heavy grille mounted in the counterweight. In order for cooling fan to provide positive full airflow through radiator core, a fan shroud is provided. An overflow tube connected to filler neck leads to bottom of radiator. Radiator incorporates a transmission oil cooler in bottom tank. A double acting valve is provided in radiator cap for relieving pressure due to expansion (from heating of coolant) and allows atmospheric pressure to enter when contraction (due to cooling of coolant) occurs.

b. Removal and Installation. Refer to TM 103930-618-20.

c. Cleaning and Inspection. Refer to TM 1039 30-618-20.

d. Repair.

(1) *Radiator core*. Use standard operating procedures for repair of radiator core.

(2) *Heat exchangers*.

(a) Sweat heat exchanger loose from bottom of radiator core.

(b) Plug one port of heat exchanger, then apply controlled air pressure to remaining port.

NOTE

Place heat exchanger under water as air pressure is applied to expedite leak location.

(c) Mark leak (s), remove air pressure, and dry surface of heat exchanger.

(d) Prepare surface of heat exchanger to

receive silver solder, solder leaks, then solder heat exchanger to bottom of radiator core.

(3) *Test.*

(*a)* Use controlled air pressure.

(b) Plug one port of heat exchanger, apply air pressure to the remaining port, then gradually increase pressure to 30 psi.

(c) When leak is evident, repair heat exchanger as in d(2) above.

(d) Install radiator cap, then test radiator core. Do not exceed 10 psi of controlled air pressure.

(e) When leak is evident in radiator, repair radiator as in d(1) above. Replace a radiator, when heat exchanger or radiator core is beyond repair.

Section III. REPAIR OF ENGINE FUEL SYSTEM

3-7. General

This section will cover direct and general support maintenance of the engine fuel system authorized by the maintenance allocation chart, and includes the carburetor, governor, and fuel tank.

3-8. Carburetor

a. Description. The carburetor is mounted directly) to the intake manifold on the left side of the engine. The throttle valve is controlled by the action of the accelerator controls and the action of a variable speed governor. It is of the single venturi, updraft type which mixes the correct proportions of air and fuel to produce a highly combustible mixture, which is then drawn into the intake manifold. All mixture adjustments, except idle, are controlled by fixed jets. The idle fuel adjusting screw controls the fuel mixture for the idle system.

The idle throttle stop screw controls low engine rpm.

The air intake of the carburetor is provided with a choke valve as an aid in starting a cold engine.

b. Removal. Refer to TM 10-3930-618-20.

c. Disassembly.

(1) Separate carburetor bodies as follows:

(a) Remove the four screws (15, fig. 3-7) and lockwashers which attach throttle body (11 to fuel bowl (30).

(b) Separate throttle body from fuel body and remove gasket.

(2) Disassemble throttle body as follows:

(a) Press screwdriver against the float axle (21) at slotted side of float hinge bracket and force axle through hinge bracket.

(b) Pull float axle out from opposite side and remove float (20).

(c) Remote float valve and seat (17), and waster , (16) from throttle body.

(d) Remove venturi 1191.

(e) Remove idle jet (44) from its passage near float valve seat.

(f) Remove idle adjusting needle (13) and spring (12) from front of throttle body.

(g) Unscrew throttle stop screw (54) until threaded end is flush with the lever (51).

(h) Remove the two screws (57) attaching throttle plate (56) to throttle shaft and remove plate.

(i) From governor end of throttle shaft, remove cotter pin (2) and retainer (3); slide governor lever (5) and spring (4) off shaft (48). Note position of spring and lever to insure correct reassembly.

(j) Drive roll pins (55) from shaft.

(k) Pull throttle shaft with lever from throttle body. If is not necessary to remove throttle lever from shaft unless the parts must be replaced.

(l) Remove both throttle shaft seals (9 and 46) and retainers (8 and 47) using end of a small screwdriver to lift out parts.

(3) Disassembly fuel bowl body as follows:

(*a)* Remove drain plug (35) from bottom of fuel bowl body.

(b) Remove passage plug (33) and fibre washer (34) from bottom of fuel bowl body.

(c) Remove discharge jet (32) and fibre washer (31) from passage in bottom of fuel bowl body.

(d) With a small screwdriver, remove well vent jet (42) from center of large opening in machined surface of fuel bowl.

(e) Remove main jet (28) and fibre washer (29) from inside fuel bowl.

(f) Note position of choke bracket (27) and choke shaft (24) to insure correct reassembly.

(g) Remove choke plate screws (39) and lockwashers.

(h) Remove choke plate (38), choke shaft (24) and lever.

(i) choke bracket by removing the two capscrews (26).

(j) Drive out choke shaft hole plug (37) by using a short length of ¼-inch rod inserted through opposite shaft hole.

(k) Remove shaft seals (40) by using end of a small screwdriver to lift out parts.

d. Cleaning and Inspection.

(1) Clean all metal parts thoroughly in an approved cleaning solution, then rinse in cleaning solvent (Spec. P-S-661).

(2) Blow out all passages with compressed air and make certain that all carbon deposits have been removed from the throttle bore and idle ports.

(3) Inspect for float leaks and other damage.

(4) Inspect float axle bearings for excessive wear.

(5) Inspect top side of float lever for wear where it contacts the fuel valve needle.

(6) Inspect float axle for wear on bearing surfaces.

(7) Inspect idle adjusting needle and spring for wear or ridges on needle point, weak or bent spring, and other damage.

(8) Inspect throttle plate for burred or damaged edges.

CAUTION

Never clean a throttle plate with a buffing wheel or sharp instrument.

(9) Inspect choke plate for bends, burrs or damaged edges.

(10) Inspect choke shaft for bends and wear at bearing surfaces.

(11) Inspect throttle shaft for wear at the bearing surfaces.

(12) Check the jets for specified sizes

Idle jet .....No. 15
Fuel valve.....No. 40
Main jet.....No. 26
26 Discharge jet.....No. 65
Well vent jet.....No. 26
Idle air bleed.....No. 25
Venturi.....No. 20

(13) Replace defective parts as authorized.

e. Assembly. Before assembling the carburetor, make certain all the above inspections and checks have been completed. Check for correct location of parts (fig. 3-7).

(1) Assemble fuel bowl body as follows:

(a) Press the choke shaft (24) and retainer (41) into the bowl bore until the retainer is flush with the machined surface.

(b) In the opposite hole, install the shaft hole plug (37) with a hammer.

(c) Install the choke bracket (27), keeping in mind its position when removed.

(d) Insert the choke plate (38), poppet valve first and stem down, into the air intake.

(e) Hold the choke plate up and insert the choke shaft into place with the cutout section facing up.

(f) Rotate the shaft to the closed position, place the choke plate in the cutout section and install the screws (39). Be sure the plate is properly centered before tightening the screws.

(g) Install the main jet (28) and fibre washer (29) in the fuel bowl.

(*h)* Install the well vent jet (42).

(i) Install the discharge jet (32) and fibre washer (31) in the large threaded passage beneath the fuel bowl; then install the fibre washer (34) and passage plug (33).

(j) Install the drain plug (35) in the bottom of the fuel bowl.

(2) Assemble throttle body as follows:

(a) Install throttle shaft seals (9 and 46), open side out, followed by the retainers. Retainers must be flush with throttle body.

(b) Insert the throttle shaft (48) with the throttle lever into the throttle body.

(c) With the throttle shaft positioned with the throttle lever down, install the roll pins (55) in the governor end of the shaft until the bottom of the pin is flush with the shaft.

(d) Install the governor lever up. Install the coil spring in the same position as when it was removed.

(e) Install the retainer (31 and the cotter pin (2).

(f) Rotate the throttle shaft to closed position, insert the throttle plate in the cutout section of the shaft, holding the plate in position with the fingers.

(g) Start the throttle plate screws (57) and tighten, being sure that the throttle plate is properly centered in the throttle body bore.

NOTE

The screw holes in the throttle plate are off center. Start the side of the throttle plate with the shortest distance between the screw holes and beveled edge into place first. The throttle plate is made with two opposite edges beveled to fit the throttle body bore when the plate is closed. The throttle plate will not close tightly if installed upside down. Pressure on the plate must be maintained with the finger until the screws are tightened. When properly installed, the side of the throttle plate farthest away from the mounting flange will be aligned with the idle port when the plate is closed.

(h) Install the idle adjusting needle (13) and friction spring (12) in the threaded passage in the front of the throttle body. Seat the needle lightly and then back out 1 1/4 full turns as a preliminary adjustment.

(i) Install the idle jet (44) in its counterbored passage in the machined surface.

(i) Install the fuel valve and seat (17) and the fibre washer (16).

(*k)* Install the fuel valve needle in the seat, then install the float (20) and the float axle (21). Make certain the float is free and is centered on the throttle body.

(l) Check for correct level by inverting the throttle body and measuring from the machined surface of the body to the top side of the float bodies at the highest point. The dimension should be 1.5/32 inch ±1/32 inch. To increase or decrease the distance between the float body and the

machine surface, use longnosed pliers and bend the lever close to the float body.

(m) Insert the venturi (19) in the fuel bowl bore, with the small opening down. The flat side of the venturi must be toward the well vent jet.

(3) Assemble carburetor bodies as follows: *(a)* Place a new gasket on the throttle body.

(b) Place the fuel bowl on the throttle body, install the four capscrews (15) and tighten them evenly and firmly.

(c) Hold the throttle lever in a closed position and turn the throttle stop screw (54) in until it just contacts the stop pin, then turn the screw in 1 ½ additional turns as a preliminary adjustment of the idle speed.

f. Adjustment and Installation. Refer to TM 10-3930-618-20.

Key to figure 3-7

1 Lever and shaft assembly
2 Cotter pin
3 Retainer
4 Spring
5 Clamp lever
6 Screw
7 Spacer
8 Seal retainer
9 Shaft seal
10 Bearing
11 Body
12 Spring
13 Needle
14 Plug
15 Screw
16 Washer
17 Valve and seat
18 Gasket
19 Venturi
20 Float
21 Axle
22 Nut
23 Screw
24 Choke shaft
25 Screw
26 Screw
27 Choke bracket
28 Main jet
29 Washer
30 Bowl
31 Washer
32 Discharge jet
33 Plug
34 Washer
35 Drain plug
36 Plug
37 Plug
38 Choke plate
39 Screw
40 Packing washer
41 Retainer
42 Well vent jet
43 Clip
44 Idle jet
45 Bearing
46 Shaft seal
47 Seal retainer
48 Throttle shaft
49 Bushing
50 Screw
51 Throttle lever
52 Retainer
53 Cotter pin
54 Throttle stop screw
55 Pin
56 Throttle plate
57 Screw
58 Gasket

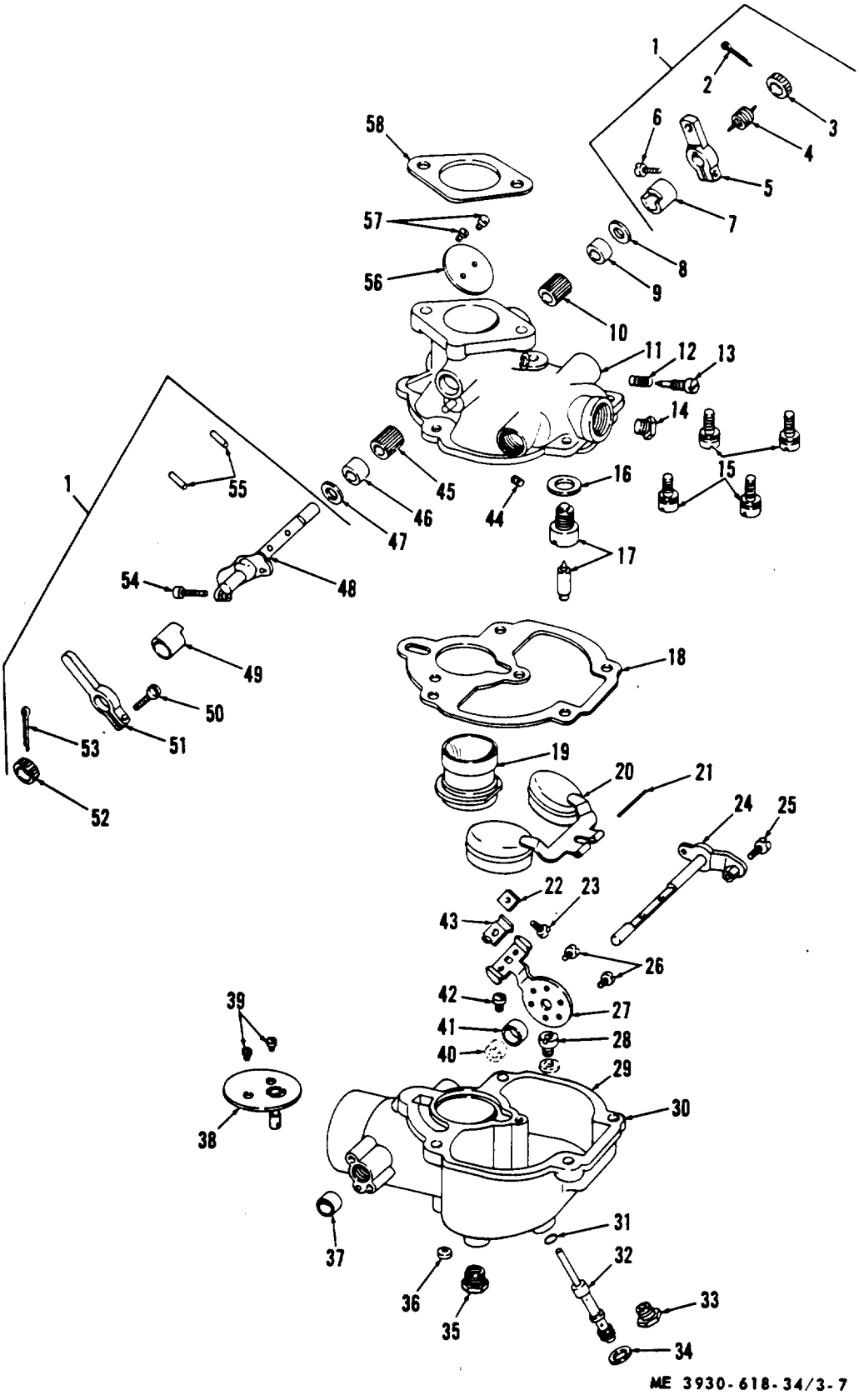


Figure 3-7. Carburetor disassembly.

3-9. Governor

a. Description. The engine governor is a mechanical spring loaded device installed on the engine to prevent overspeeding. It consists of a drive gear and a set of weights arranged around a shaft in a spider assembly. The unit is mounted on the timing gear cover and is driven by a gear meshing with the camshaft gear. Centrifugal force created by rotation causes the governor weights to pivot outward on their retaining pins. The outward movement of the weights pushes a thrust sleeve against a yoke, which in turn, transfers this movement through the governor control rod to the throttle valve in the carburetor. The governor weights move outward until the pressure on the thrust sleeve is strong enough to overcome the spring tension on the throttle lever. When this condition occurs, governor force, through the control rod to the throttle valve, prevents the entrance of more fuel to the manifold, thus preventing the engine from exceeding its maximum governed speed of 2200 rpm.

b. Removal.

(1) Clean outside of the governor housing and the surrounding area to be certain that no loose dirt will enter the governor assembly.

(2) Remove the ignition coil from the adapter cover (TM 10-3930-618-20).

(3) Remove the governor spring (17, fig. 3-8) from the adjusting screw (18) and disconnect the throttle lever (23) from the control rod 13).

(4) Remove the two capscrews from the adapter assembly (11) mounting flange. Lift the governor body away from the timing gear housing.

(5) Slide the thrust bearing and sleeve (38) off the weight assembly shaft (40) and then work the drive gear (43) free of the adapter.

(6) Remove the two capscrews (13) and lockwashers (12) attaching adapter (11) to body (30) and timing gear housing, and remove the adapter and thrust washer t 10).

c. Disassembly.

(1) Remove the adapter cover to remove the adapter bearing 19i.

(2) To remove the governor weights (39) from the spider assembly (40). slip the pin clips (42) from the governor weight pivot pins, drive out the pins and remove the weight from the spider.

(3) Press the drive gear (43) from the spider shaft (40).

(4) Remove the two fasteners (37) which secure the yoke (36) to the lever shaft (20).

(5) Pull the lever shaft out of the governor body along with the bearing (28), seal (26), and retainer (27). Remove the yoke from the governor bode.

(6) Drive the pin (24) out of the lever shaft and throttle lever (23) and press the shaft out of the lever.

(7) Press the bearing, seal, and retainer off the lever shaft.

(8) Remove the spider shaft bushing (35) from the governor body.

(9) Press the lever shaft bottom bushing (31) out of the governor body.

d. Cleaning and Inspection.

(1) Wash all parts in cleaning solvent (Spec. P-S-661) and thoroughly dry with compressed air.

(2) Check lever shaft and bearing for worn areas and score marks. Replace if lever shaft does not rotate freely in the governor body.

(3) Replace the lever shaft oil seal.

(4) Slide thrust sleeve and bearing on the spider shaft and check for freeness.

(5) Check the drive gear (43) for worn or chipped teeth. Check the gear bearing surface for score marks. Replace the gear if necessary.

(6) If the governor weights (39) are too loose or bind on the pivot pins, make the necessary repairs, or replace the assembly.

(7) Check the drive gear bearing and the thrust washer for worn spots or score marks. I' the bearing is loose, install a new bearing in the adapter.

(8) Replace the governor spring (17) if it is worn or weak.

(9) Install new gasket.

e. Assembly.

(1) To replace the adapter bearing (9), locate the bearing with the oil hole up and press into place to the same position as the bearing which was removed.

(2) Press bearing (28) on the lever shaft (20) until it seats on the snapring (29) and then follow with the oil seal (26) and retainer (27).

(3) Install the throttle lever (23) on the lever shaft (20) and secure both parts with the roll pin (24).

(4) Press the spider shaft bushing (35), into the governor housing flush with the open end of the bore. Normal clearance between the bushing and the shaft is 0.002 inch to 0.004 inch.

(5) Press the lever shaft bushing (31) into the governor housing; but, do not press all the way in at this time.

(6) Hold the yoke (36) in the governor housing, install the lever (23) and shaft (20), sliding the shaft through the yoke.

(7) Position the yoke on the shaft. install and tighten the fasteners (37).

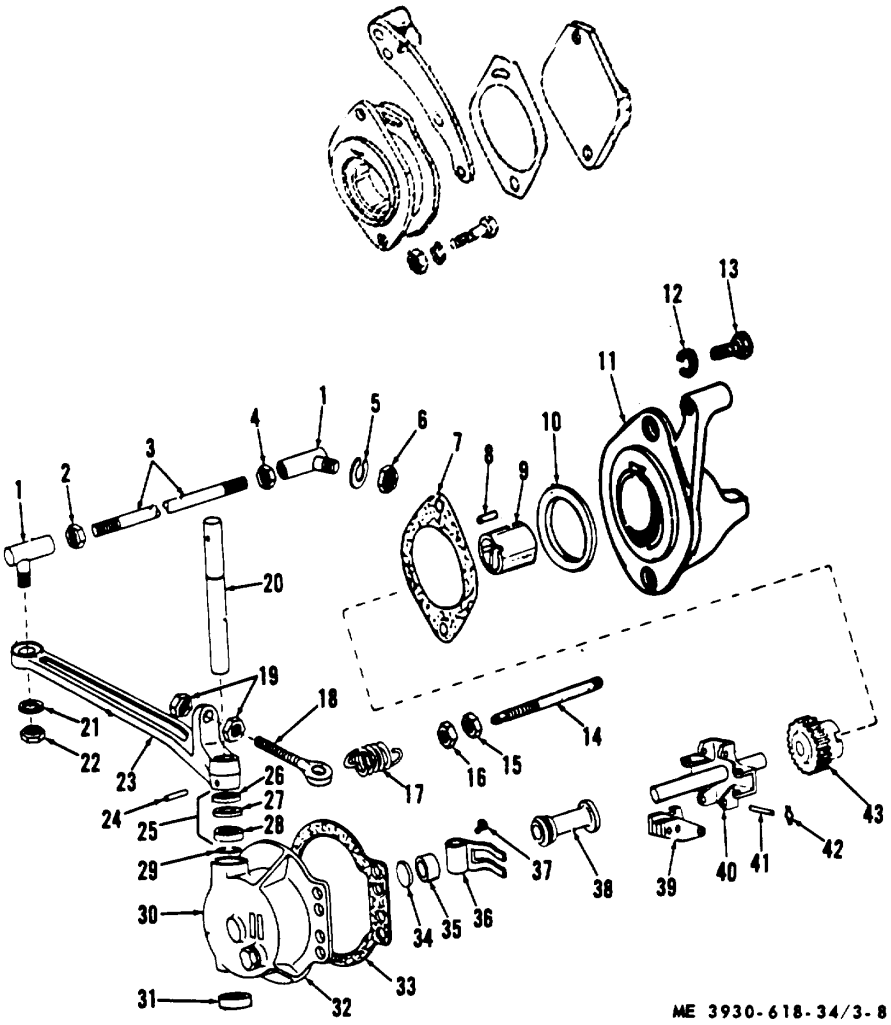
(8) Continue pressing the lever shaft bushing into the governor housing until there is between 0.005-inch and 0.015-inch end plan. Then paint over the bushing with a sealing compound.

f. Installation.

(1) Install the governor on the engine by a direct reversal of the procedures in *b* above. Be sure to use new gasket.

(2) Install the throttle control rod on the throttle lever.

(3) After installation, refer to TM 10-3930-618-20 for adjustment instructions.



1 Ball joint
2 Nut
3 Control rod
4 Nut
5 Lockwasher
6 Nut
7 Gasket
8 Dowel pin
9 Bearing
10 Thrust washer
11 Adapter assembly
12 Lockwasher
13 Capscrew
14 Shaft
15 Nut
16 Nut
17 Spring
18 Adjusting screw
19 Nut
20 Shaft
21 Lockwasher
22 Nut
23 Throttle lever
24 Roll pin
25 Seal and retainer kit
26 Seal
27 Retainer
28 Bearing
29 Snapring
30 Body
31 Bushing
32 Washer, copper
33 Gasket
34 Disc
35 Bushing
36 Yoke
37 Fastener
38 Sleeve and bearing assembly
39 Weight
40 Spider and shaft assembly
41 Pin
42 Clip
43 Drive gear

Figure 3-8. Governor disassembly.

3-10. Fuel Tank

a. Removal and Installation. See TM 10-3930-618-20.

b. Disassembly.

(1) Remove drain plug (16, fig. 3-9).

(2) Remove filler cap (10) assembly by unscrewing from top of tank.

(3) Remove five screws (23) and lockwashers which mount fuel gauge sending unit (18) in fuel tank, and carefully lift unit out of tank. Be careful not to bend the float arm during removal or installation.

c. Cleaning and Inspection.

(1) Flush tank with solvent and dry with compressed air.

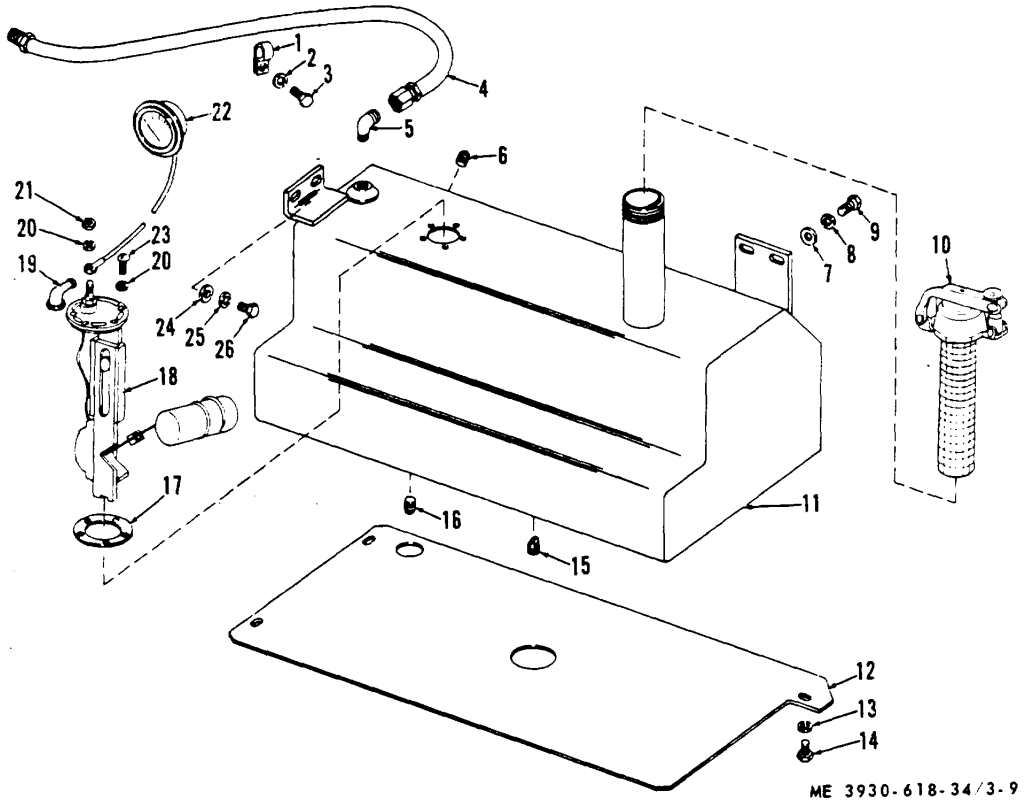
(2) Inspect tank for rust, cracked seams, or damaged threads.

(3) Inspect accessories for damage or corrosion.

d. Repair.

(1) I damage is such that welding can be used to repair the tank, be sure to flush tank thoroughly to remove all traces of explosive solvents and fuel, both liquid and vapor.

(2) If damage is beyond reasonable welding repair, replace tank and accessories as authorized.



1 Clamp
2 Lockwasher
3 Capscrew
4 Fuel line
5 Elbow
6 Plug
7 Washer
8 Lockwasher
9 Capscrew
10 Filler cap and screen
11 Fuel tank
12 Guard
13 Lockwasher
14 Capscrew
15 Drain plug
16 Drain plug
17 Gasket
18 Fuel sender
19 Boot
20 Lockwasher
21 Nut
22 Fuel gage
23 Screw
24 Washer
25 Lockwasher
26 Capscrew

Figure 3-9. Fuel tank.

Section IV. REPAIR OF ENGINE LUBRICATION SYSTEM

3-11. General

This section will cover direct support maintenance of the engine lubrication system authorized by the maintenance allocation chart, and includes the oil pan, oil pressure relief valve, and oil pump. The oil pressure relief valve has an external adjustment that direct support may use to assist in making determination of internal bearing failure (low oil pressure), or clogged passages (high pressure).

3-12. Oil Pan

a. Removal and Inspection.

NOTE

Oil pan can be removed from engine with engine-either installed in truck or out of truck. If engine has already been removed from truck, disregard (1) through (4) below.

(1) Run engine until normal operating temperature is reached.

(2) Remove drain plug (10, fig. 3-10) and allow all engine oil to drain.

(3) Remove radiator grille from counterweight (ref. TM 10-3930-618-20).

(4) Raise back of truck and remove steering axle assembly (para 2-14) to allow sufficient room for removal of oil pan.

NOTE

It will be necessary to work through the grille opening in the counterweight in order to remove the front oil pan capscrews.

(5) Remove capscrews (8) from front of oil pan and pan side flanges. Remove oil pan.

(6) Wash oil pan with cleaning solvent (Spec. P-S-661) to remove all dirt and sludge.

(7) Inspect drain plug boss for evidence of leakage.

(8) Repair by welding or hard soldering.

WARNING

Be certain that all traces of oil and cleaning solvents have been removed from the oil pan and the surrounding area before any heat or flame is used.

c. Installation.

(1) Cement new gaskets (1, fig. 3-10) to oil pan side rails.

(2) Outer oil seal at rear of engine should be replaced when engine is overhauled. If engine has not been overhauled, inspect lower portion to make certain it is in good condition. If outer seal has be to replaced, it will be necessary to remove flywheel housing (para 3-26).

(3) Oil pan front gasket is lower portion of cylinder block to front plate assembly gasket. When engine is overhauled, new gasket should be cemented to rear of front plate assembly before it is secured to front of cylinder block. If engine has not been overhauled and oil pan portion of gasket is damaged, scrape away gasket as far as cylinder block rails. Cut lower portion from new gasket and cement in position on front plate assembly.

(4) Before installing oil pan, place a small quantity of nonhardening sealing compound in corners formed by flywheel housing and cylinder block rails, and front plate assembly and cylinder block rails, to eliminate possibility of oil leaks at these points.

(5) Position oil pan on cylinder block and secure in place with capscrews and lockwashers. Torque capscrews to 18-21 ft-lbs.

CAUTION

Be sure to use copper washers on lower three capscrews in front of oil pan. These three capscrews extend into oil pan and copper washers prevent oil leakage past capscrew threads.

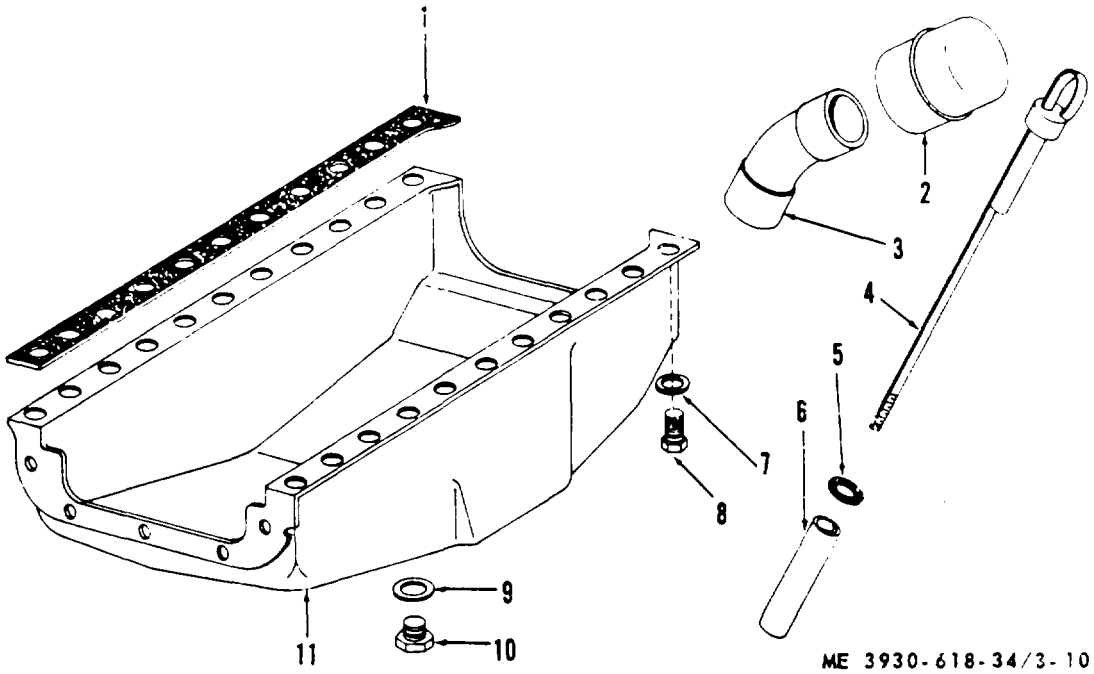
(6) Install drain plug in oil pan.

(7) If engine has not been removed from truck, install steering axle assembly by a direct reversal of removal procedure.

(8) Install rear grille in counterweight.

(9) Replace oil filter element and fill crankcase to correct oil level.

(10) Run engine and check for oil leaks oil pan and at filter.



1 Gasket
2 Breather cap
3 Filler tube
4 Oil level gauge
5 Oil seal
6 Adapter
7 Lockwasher
8 Capscrew
9 Gasket
10 Drain plug
11 Oil pan

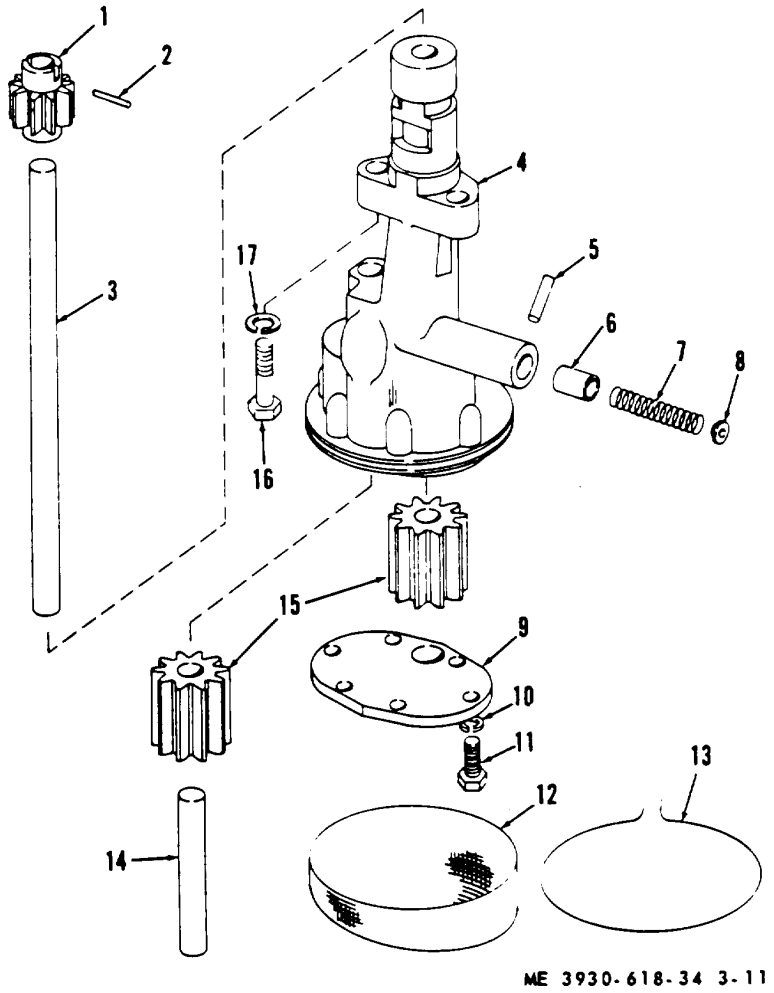
Figure 3-10. Oil pan removal and installation.

3-13. Oil Pump

a. Description. Lubricating oil pump is the positive drive gear type consisting of a single cast pump housing and mounting extension with a precision cavity to receive the two pump gears, and attached to the crankcase flange by two capscrews. Oil pump drive gear meshes with and is driven by an integral helical gear on engine camshaft. Oil pump driving gear is pinned to the upper end of pump driving shaft and pump drive gear is pressed onto lower end of driving shaft. Pump idler gear is pressed onto idler gear shaft which rotates in pump body. Idler gear is retained in pump body by bottom cover in which is located entrance for oil from oil pan. Oil is picked up by the pump gears and is forced into a tube assembly which conducts it to a passage in the filter base. Connected to the oil discharge passage of the oil pump body, is a sleevetype relief valve which will bypass oil back to oil pan when discharge pressure exceeds 70-90 psi, thus eliminating undue wear on pump gears caused by excessively high discharge pressure which occurs when starting a cold engine. Surrounding lower part of oil pump is a fine mesh screen to keep any large foreign object from entering oil inlet opening and damaging pump.

b. Removal. Oil pump can be removed from engine without removing engine from truck. Follow procedure outlined below. If engine has already been removed, disregard (1) and (2).

(1) Distributor is driven by means of an offset slot at upper end of oil pump driven gear (1, fig. 3-11). Because of offset, distributor can be mounted in only one position. Therefore, it is recommended that distributor rotor be positioned to fire on No. 1 cylinder before removing oil pump from cylinder block. This can be accomplished by positioning No. 1 piston on compression stroke with timing mark "IGN" in center of timing hole in flywheel housing. In this position, piston is before top dead center. Mark side of distributor housing to indicate position of rotor.



1 Drive gear
2 Pin
3 Drive shaft
4 Body
5 Roll pin
6 Valve piston
Valve spring
8 Spring retainer
9 Cover
10 Lockwasher
11 Capscrew
12 Screen
13 Lockwire
14 Idler shaft
15 Pump gears
16 Capscrew
17 Lockwasher

Figure 3-11. Oil pump.

NOTE

If both oil pump and distributor are removed, as at engine overhaul. refer to g below for installation procedure.

(2) Remove oil pan (para 3-12).

(3) Remove the two capscrews (16) and lockwashers (17) which secure oil pump to cylinder block. Withdraw pump from cylinder block.

c. Disassembly. Disassembly of oil pump advisable whenever the engine is overhauled or drop in oil pressure can be attributed to pump. To disassemble pump, proceed as follows:

(1) Remove suction screen retainer wire (13) and remove screen (12).

(2) Remove capscrews (11) and lockwashers (10) securing pump cover (9) to pump body (4), and remove cover.

(3) Remove pump gears (15) and idler shaft (14) from pump body.

(4) Place pump assembly in position on a press

from pump driving gear and pump body. *d. Cleaning and Inspection*. If dirt and sludge are allowed to accumulate in engine lubricating system, oil pump wear may be rather pronounced in a comparatively short time. When oil is kept clean and oil filter has been properly serviced wear on these parts should be very slight. Wash all oil pump components in clean solvent, and thoroughly inspect and check parts as follows:

(1) Inspect pump gear teeth, inside of pump body, and inner face of cover for wear and scoring. Gear teeth, inside of pump body, and inner face of cover must be smooth with no scratches, score marks, or rough spots. Also, inspect pump shafts and shaft bores in pump body for excessive radial clearance (fig. 3-12) between pump gears and pump body (0.001-inch to 0.002-inch). End clearance (between pump gears and pump cover) of gears in pump body is 0.002-inch - 0. 004-inch, and must not exceed 0.006-inch. To check clearance, lay pump cover across pump body. Insert a feeler gage between pump cover plate and pump gears. Backlash between pump gears can be checked with a feeler gage and should not exceed 0.020-inch.

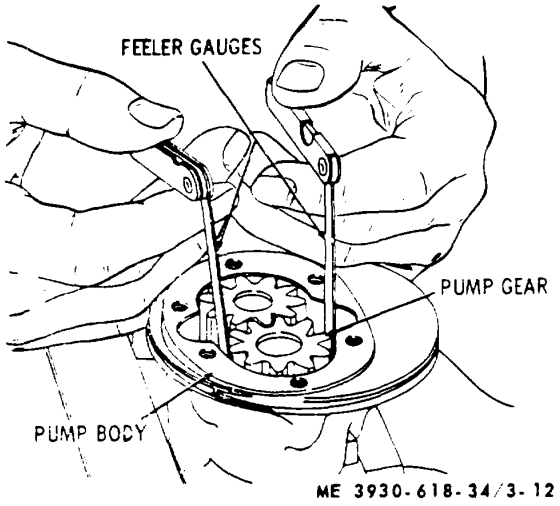


Figure 3-12. Checking oil pump radial clearance.

(2) Inspect pump shafts for wear with a micrometer and pump body wear with a feeler gage. Inspect for excessive wear or scoring and replace if necessary. Specified clearance between pump drive shaft and pump housing bore is 0.0010-inch - 0.0025-inch and must not exceed 0.004 - 0.006-inch. Specified clearance between idler gear shaft and pump housing bore is 0.0005 inch - 0.0029-inch, and must not exceed 0.004inch. Specified diameter of both pump drive shaft and idler gear shaft is 0.4990-inch - 0.4995-inch. Pump housing bore is 0.5005-inch - 0.5015 -inch; idler shaft bore is 0.500-inch - 0.501-inch. If parts are worn or damaged, replace pump.

(3) Thoroughly clean oil pump suction screen.

e. Assembly. Refer to figure 3-11 for relative position of parts and assemble pump as follows:

(1) When installing gears on idler shaft (14) or drive shaft (3), press shaft gear into gear until end is approximately flush with end of gear.

CAUTION

Shaft must not protrude past oil pump cover end of gear.

(2) Lubricate pump drive shaft and insert (with drive gear in position) into bore in pump body.

(3) Place pump body in position in a press, supporting assembly on drive gear end of shaft. Place pump driving gear in position! or: upper end of shaft, aligning pinhole in gear ,with hole in shaft. Press gear onto shaft until pinhole in gear and shaft are aligned. Install new roll pin.

(4) Lubricate idler gear shaft (4) and install pump gears (15) and shaft in position in pump body. Check dimension between gears and bottom face of pump body. End clearance of gears should be 0.002-inch - 0.004-inch.

(5) Place pump cover (9) in position on pump body (4) and secure with the capscrews (11) and lockwashers (10).

NOTE

No gasket is required between cover and pump body.

(6) Place pump suction screen (12) in position on bottom of pump body and secure with screen retaining wire (13).

(7) After pump is completely assembled, it must turn freely when rotating drive gear (1) by hand.

f. Installation. The following installation instructions apply when engine has not been disassembled for complete overhaul or when oil pump has been removed with engine in truck. For pump installation instructions at engine overhaul. refer to *g* below.

(1) Make certain distributor rotor is aligned with reference mark made on side of distributor housing as instructed in *b* (1) above.

(2) Before installing oil pump in cylinder block, use dial as illustrated in figure 3-13 to position offset of pump drive gear to the right and toward the rear of cylinder block so that slot will be at an angle of 5: 30-to 11: 30-o'clock.

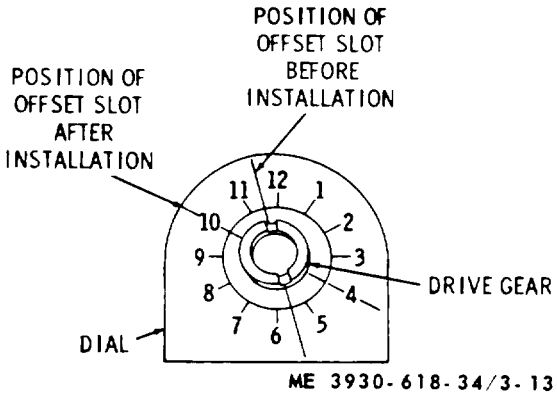


Figure 3-13. Positioning drive gear offset slot.

(3) Insert oil pump in cylinder block with drive gear positioned as indicated in (2) above and mesh it with gear on camshaft. Install one oil pump retaining capscrew and lockwasher and tighten only enough to hold pump in place.

CAUTION

It is possible oil pump drive gear engaged gear on camshaft one tooth one way or the other from correct position and tang on distributor drive did not engage drive slot in pump gear; therefore, if pump retaining capscrews are tightened securely at this time, undue strain will be placed on distributor and advance arm assembly.

(4) After oil pump is in mesh with gear on camshaft, check to make certain distributor drive has engaged slot in pump drive gear and rotor is pointing to reference mark made on side of distributor housing.

(5) Install cap on distributor.

CAUTION

Overtightening may break mounting flange. Note that flange is not flush with cylinder block.

(6) Install second pump retaining capscrew and lockwasher and tighten both capscrews to 1821 ft.-lbs. torque.

(7) After pump is secured in position, check gear backlash between pump drive gear and gear on camshaft. Gear backlash is 0.004-inch -0.010inch, and can be checked through opening at fuel pump mounting pad.

(8) Assemble oil relief valve mounting flange, relief valve, and oil tube assembly as follows:

(a) Place lockwasher on relief valve and screw it into flange. Torque valve to 40-50 ft.-lbs. and lock in position by bending one tab against relief valve and a second tab against flange.

(b) Position oil tube assembly (straight section) in flange and screw nut into flange to a point where tube can still be turned.

(*c)* Cement a new gasket on flange.

(9) Position assembled flange, relief valve, and tube b, inserting rear end of tube in cylinder block at No. 6 main bearing cap and placing flange against oil pump with relief valve down.

(10) Start rear tube nut and tighten securely. Install and tighten the two flanges to oil pump retaining capscrews and lockwashers. Torque to 11-13 ft.-lbs. Securely tighten front tube nut.

(11) Install oil pan (para 3-12).

g. Installation After Engine Overhaul. During engine overhaul, distributor and oil pump are removed from cylinder block. In order to mesh oil pump drive gear with gear on camshaft in original factory location, so rotor in distributor will point to No. 1 cylinder spark plug wire, proceed as follows:

(1) Rotate crankshaft in direction of engine rotation until No. 1 cylinder exhaust valve lobe on camshaft points horizontally to side of cylinder block. Whenever No. 1 cylinder exhaust valve camshaft lobe is in this position, piston is on compression stroke near or at top dead center and timing mark stamped on flywheel should be in timing hole in flywheel housing.

NOTE

Number 1 cylinder exhaust valve camshaft lobe is first lobe from front of engine.

(2) Position offset slot of oil pump drive gear. Refer to *f* (2) above.

(3) Insert oil pump in cylinder block with drive gear position as indicated in *f* (2) above and mesh it with gear on camshaft. Note that as pump drive gear meshes with camshaft gear, it will rotate slightly because gears are helical type. When pump gear is fully engaged with cam gear, slot will be positioned at an angle of 4: 00 - 10: 00-o'clock (fig. 3-13). This is correct position for slot in pump drive gear to drive distributor. Install capscrew finger tight to hold pump in position.

(4) Insert distributor into cylinder block and rotate until offset tang on distributor drive engages slot in pump drive gear. In this position rotor will be pointing to No. 1 cylinder spark plug wire in distributor cap.

(5) Complete installation of oil pump as outlined in *f* above.

3-14. Oil Pressure Relief Valve

a. Description. Stabilized oil pressure is maintained in engine lubrication system by an adjustable oil pressure regulating valve located in main oil gallery at front left corner of cylinder block. This valve is factory set to open at 35 to 40 psi. When oil pressure at relief valve exceeds its regulated pressure setting, plunger opens and excess oil bypasses through lower drilled capscrew.

The drilled capscrew secures camshaft thrust plate to front of cylinder block, and serves to lubricate gear train. Pressure relief valve should require very little attention under normal conditions. If engine lubricating system allowed to sludge, valve may not work properly. If plunger binds in open position, a sharp drop in engine oil pressure will occur; or, if plunger binds in closed position, a sharp rise in engine oil pressure will occur. If oil pressure should rise or drop sharply, relief valve must be disassembled and checked for damage or sludge. Whenever oil pump or engine is disassembled. all components of oil pressure relief valve assembly should also be removed, thoroughly cleaned, and inspected.

NOTE

A gasket between adjusting screw locknut and cylinder block is not required because of nylon plug located in side of adjusting screw which prevents oil leakage past threads.

b. Removal and Inspection.

(1) Loosen locknut (fig. 3-14) and remove adjusting screw from cylinder block. While removing adjusting screw, count number of turns required for removal.

(2) Remove valve spring and plunger from cylinder block.

(3) Wash all parts thoroughly in (Spec. P-D680) and inspect. Replace any worn or damaged parts.

(4) Inspect valve seat in cylinder block and clean if necessary.

c. Installation and Adjustment.

(1) Lubricate plunger with clean oil and install plunger and plunger spring in position in cylinder block.

(2) Install pressure regulating valve adjusting screw and locknut. Make certain valve adjusting screw is turned into cylinder block same number of turns required for removal.

(3) Start engine and operate at about one-half throttle. Observe engine oil pressure gauge, and adjust oil pressure regulating valve to obtain a reading of approximately 15-psi on gauge. After engine reaches normal operating temperature. operate engine at high idle speed, adjust pressure regulating valve to obtain a reading of 35-40 psi on oil pressure gauge, and tighten locknut. No further adjustment of valve should be necessary.

(4) After engine has been run-in, oil pressure operating range (with stabilized engine temperature) is 25- to 35-psi at rated engine speed.

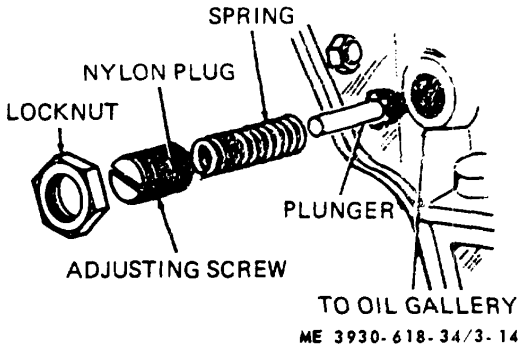


Figure 3-14. Oil pressure relief valve.

Section V. REPAIR OF TORQUE CONVERTER AND PUMP

3-15. Torque Converter and Pump

a. General. The "Power Shift" is dependent upon correct operating pressures for efficient operation. If in doubt, the pressures should be checked. for the following: Pump pressure, converter pressure, clutch pack pressure, and clutch cooling oil pressure.

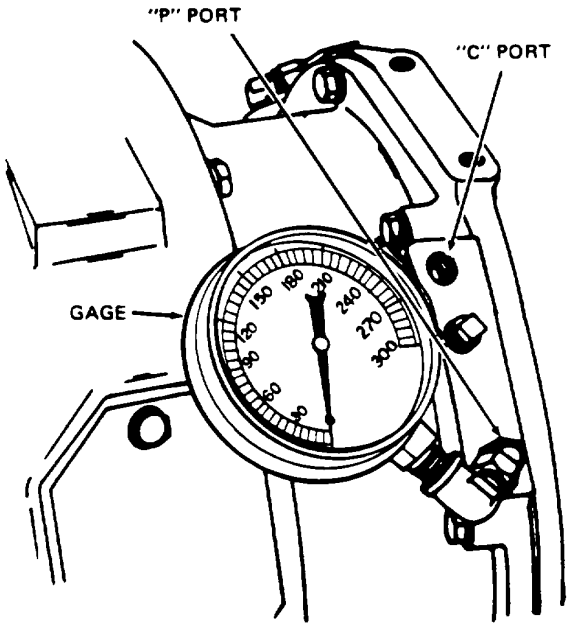
NOTE

Oil temperature should be 80° to 100° F, when checking pressure at idle speed.

b. Test.

(1) *Pump pressure.*

(a) To check pump pressure. install a pressure gauge calibrated to 300-psi, in the port marked "P" on the right side of the transmission. Leave the transmission in neutral and start the engine. Accelerate the engine to full governed speed and note the pressure indicated on the pressure gauge (fig. 3-15).



ME 3930-618-34/3-15

Figure 3-15. Checking pump and converter pressure.

(b) If the pump pressure is between 100-psi and 140-psi, the pump is in normal operating condition.

(c) If the pump pressure is over 150-psi, check the regulator valve spring and spool; check the cooler by-pass and check for restricted lines and passages.

(d) If the pump pressure is below 100-psi, check for low oil level, a faulty pump, excessive line leakage, a faulty directional valve, or clogged inlet filter.

(2) *Torque converter pressure.*

(a) To check converter pressure, install a pressure gauge calibrated to 300-psi, in the port marked "C" on the right side of the transmission (fig. 3-15). Leave the transmission in neutral and start the engine. Accelerate the engine to full governed speed of 2200-rpm and note the pressure indicated on the pressure gauge.

(b) If the converter pressure is 65-psi to 100-psi maximum, the converter is in normal operating condition. With the engine idling at 500rpm, converter pressure will be 15-psi to 60-psi.

(c) If the pressure is above 100-psi at 2200rpm, check for cause of excessive pump pressure; enlarged metering orifice, restricted converter return passages, or maladjustment of cooling circuit resistor valve.

(d) If the pressure is below 65-psi, check for low oil level, restricted intake screen, faulty pump, clogged converter orifice in pump collector ring or a faulty cooler by-pass valve.

(3) *Clutch pressure (at stall).*

(a) To check clutch pressures; install a pressure gauge in the front port on top of the

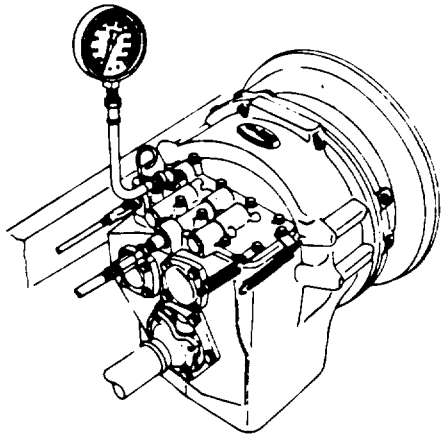


Figure 3-16. Checking clutch pressure.

(b) Check clutch pressure in forward and reverse direction by the following method. Position truck against wall and apply both the parking and the foot brake-drive wheels must be locked. Accelerate engine momentarily to wide open throttle with truck in a stalled condition. Note the pressure indicated on the pressure gauge. Engine rpm should not exceed 1500.

(c) If the reading is not below 65-psi, or does not go above normal pump pressure, the pressure in the clutch circuit is normal. Pressure should never be below 65-psi.

(d) If the pressure is below 65-psi, check for low oil level, restricted lines or passages, damaged collector rings, faulty or incorrectly adjusted selector valve, faulty pump or excessive leaks in the clutch drum assembly. (4) Clutch pressure(Free running). To check the clutch pressure with the drive wheels free running, the following instructions are to be used.

(a) Raise both drive wheels off floor and block securely with both wheels free to rotate.

(b) Hold inching pedal up so inching valve plunger cannot move.

(c) Run engine at full governed speed with shift lever in either forward or reverse position. Check pressure in both directions.

(d) If pressure is abnormal, check

paragraph (3) *(d)* above for causes. Table 3-2 indicates the normal pressures at various rpm's.

NOTE

The pressures are to be obtained with oil at 200° F. and at indicated engine speeds. (All pressures in pounds per square inch).

Table 3-2. Clutch Oil Pressures (Free Running)

Engine RPM	Main Line Pump press		Converter in.		Forward clutch		Reverse clutch	
	minimum	maximum	minimum	maximum	minimum	maximum	minimum	maximum
500	18	30	15	2 5	1	2	15	27
1000	..	..	..	..	..	..	..	..
1500	..	..	..	..	..	..	..	..
2000	90	115	65	80	70	87	70	87

(5) *Cooler circuit.* To check cooler circuit, circuit must be open and relief valve setting must be within the proper range of 65- to 100-psi.

(*a)* The cooler hoses must not be crimped, crushed, bent, or deteriorated in any way which might restrict the flow of oil.

(b) The cooler in the bottom of the radiator must not be restricted in the flow of oil nor should the passages in the radiator be coated with lime deposits which will restrict transfer of heat from transmission oil to cooling system.

(c) Disconnect the cooler return hose at the return port on the left side of the converter housing adapter. Plug the cooler return port. Install a 200psi pressure gauge in the cooler hose. With the clutch engaged and the oil pump temperature at 120° to 170°F., run the engine at governed speed. The relief valve which protects the cooling oil circuit is preset and opens at 65-psi to 100-psi. It should open near 100-psi, and never under 65-psi. If pressure is below 65-psi or above 100-psi replace spring and copper washer.

(6) *Overheating.* When a transmission has overheated and become sludged, the following procedure for cleaning is recommended:

(a) Drain two quarts of oil from the transmission.

(b) Add two quarts of OE-10 oil and operate unit for 50 hours before drain and flush.

(c) At 50 hours, drain the transmission oil while the transmission is warm.

(*d)* Fill transmission with OE-10 oil and operate 10 minutes at high idle. DO NOT STALL. Operate in both directions and drain.

(e) Clean oil screen with a small brush or an air hose.

(f) Flush with one gallon of OE-10 oil. Make certain all internal parts are thoroughly drained by removing the 1/8" pipe plug from the converter and turning the engine by hand until the opening is straight down. This will allow the fluid to drain from the converter and out through the hole in the bottom of the flywheel housing.

(g) Replace the drain plugs and fill transmission with OE-10.

c. Removal.

(1) Remove floor plates, seat deck (para 2-9), front grille and seat support, battery case and battery and one corner post (TM 10-3930-618-20).

(2) Drain oil from transmission by removing drain plug at rear of sump.

(3) Disconnect cooler lines at the right and left sides of the transmission housing.

(4) Remove all control linkage from transmission (para 2-9).

(5) Remove drive shaft from universal joints (para 5-21).

(6) Attach sling and hoist to transmission case (fig. 3-17). Remove 12 capscrews and lockwashers holding converter housing to flywheel housing.

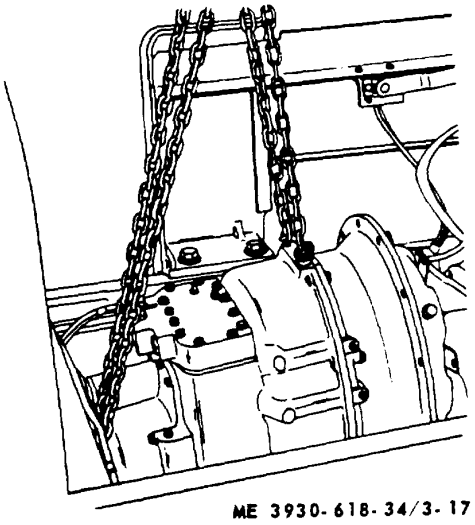


Figure 3-17. Transmission removal and installation.

(7) Carefully work transmission assembly forward until transmission case clears torque converter, and remove from truck.

NOTE

Jacking screws may be used in the two tapped holes in the transmission case to aid in removal.

(8) To remove torque converter from engine flywheel, refer to paragraph 2-9 c.

(9) To remove pump from turbine shaft, mark pump and converter housing to insure proper reinstallation. Remove capscrews holding pump and collector ring to converter housing. (fig. 3-18).

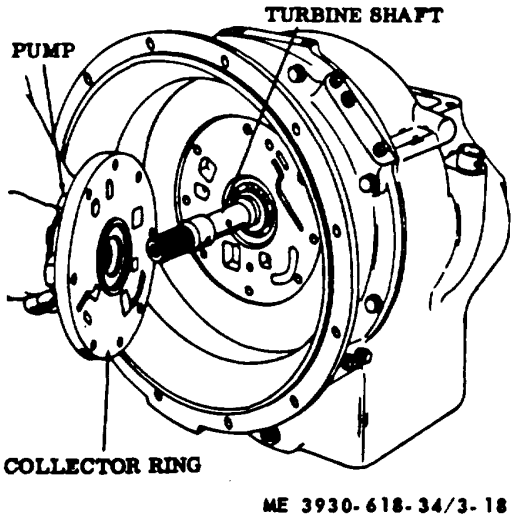
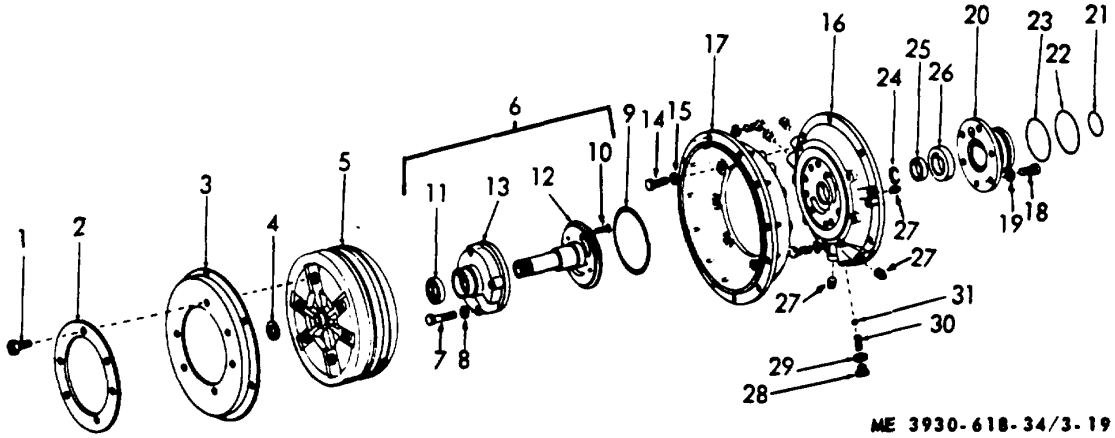


Figure 3-18. Pump removal and installation.

d. Disassembly.

(1) Refer to figure 3-19 and disassemble the torque converter from the flywheel drive plate.



1 Bolt
2 Plate
3 Capscrew
4 Lockwasher
5 Converter
6 Pump assembly
7 Bolt
8 Lockwasher
9 Preformed packing
10 Capscrew
11 Oil seal
12 Shaft
13 Housing
14 Bolt
15 Lockwasher
16 Plate
17 Housing
18 Bolt
19 Lockwasher
20 Support
21 Preformed packing
22 Preformed packing
23 Preformed packing
24 Snap ring
25 Seal
26 Seal
27 Plug
28 Plug
29 Seal
30 Spring
31 Ball

Figure 3-19. Torque converter and pump assembly, disassembly, and reassembly.

(2) Remove the bolts (7) and lockwasher (8) and remove pump. Remove the preformed packing (9) from the pump. Remove the capscrews (10) and separate the oil seal (11) from the housing (13). Remove the pump shaft (12).

(3) Remove the bolts (14) and lockwashers (15) and remove the plate (16) from the converter housing (17).

(4) Remove the bolts (18) and lockwashers (19) and remove the support (20). Remove the preformed packings (21, 22 and 23), snap ring (24) and seals (25 and 26).

(5) Remove the plugs (27) from the plate. Remove the plug (28) and (29) spring (30) and ball (31).

e. Inspection, Cleaning and Repair.

(1) Inspect the dirt or sludge for abrasive matter (metal fillings). If it has metal particles, investigate possible source of wear, or failure that caused accumulation. Replace defective part or parts, then use extreme care in cleaning the components.

CAUTION

Parts cleaned by steam must be protected with an even coating of OE 10 oil applied immediately after drying with filtered compressed air. Never dry bearings with compressed air.

NOTE

All metallic parts, except bearings, may be cleaned in dry cleaning solvent (Fed. P-D-680), in diesel fuel (Fed VV-F-800), or may be cleaned by the steam l cleaning method. Wash bearings. only in dry cleaning solvent (Fed P-D-680). When grease has hardened in used bearings, always soak them in the solvent for several hours, for ease in cleaning.

CAUTION

Protect all parts from contamination after cleaning, and before inspection or reassembly, by an even coating of the oil to be used in the converter (LO 5-3930-618-12). Keep oiled parts covered with clean paper or cloth, and handle carefully during inspection to avoid leaving finger prints on machined surfaces.

(2) Inspect pump and if gears, bushings, or housing show wear, pump will have to be replaced.

(3) Check face of pump collector ring for score marks caused by tangs of converter. If marks are present, it indicates converter is not properly shimmed at flywheel. (para 2-9*d)*.

f. Reassembly.

(1) Install new preformed packings and oil seals.

(2) Lubricate all parts with light oil.

(3) Install pump on collector ring. Make sure holes are properly aligned.

(4) Install pump assembly, on converter housing adapter, using new gasket.

Section VI. REPAIR OF TRANSMISSION

3-16. Transmission Assembly

a. Disassembly.

(1) Place transmission assembly on a suitable work area, and proceed as follows for complete disassembly (refer to fig. 3-20 for detail).

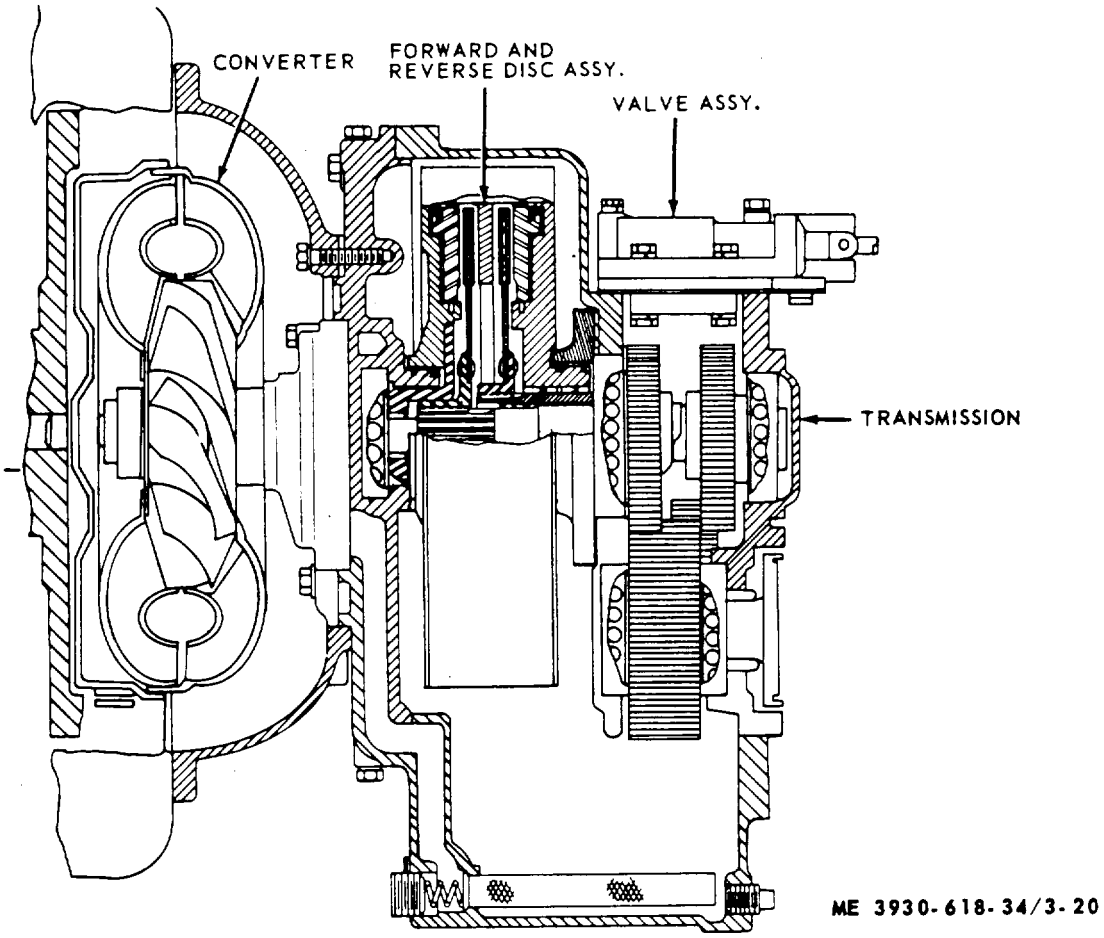


Figure 3-20. Transmission.

(2) *Pump.* To remove the pump assembly, refer to paragraph 3-15 c.

(3) *Converter housing and drum.* Lay transmission on gear case (fig. 3-21). Remove capscrews which mount converter housing adapter to gear case. Attach chain to housing and remove housing and disc drum assembly as a unit, taking care not to damage seal rings in collector ring on gear case.

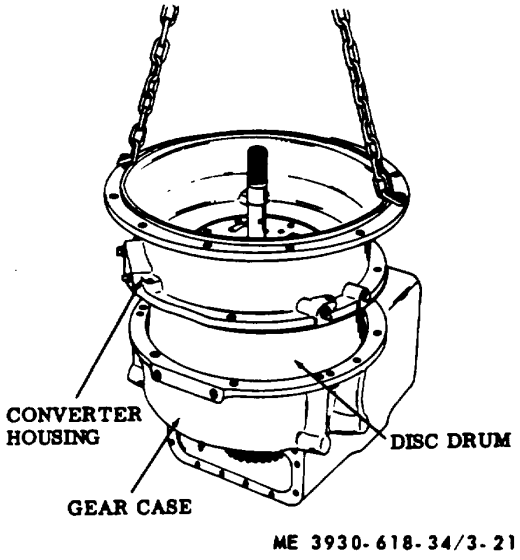
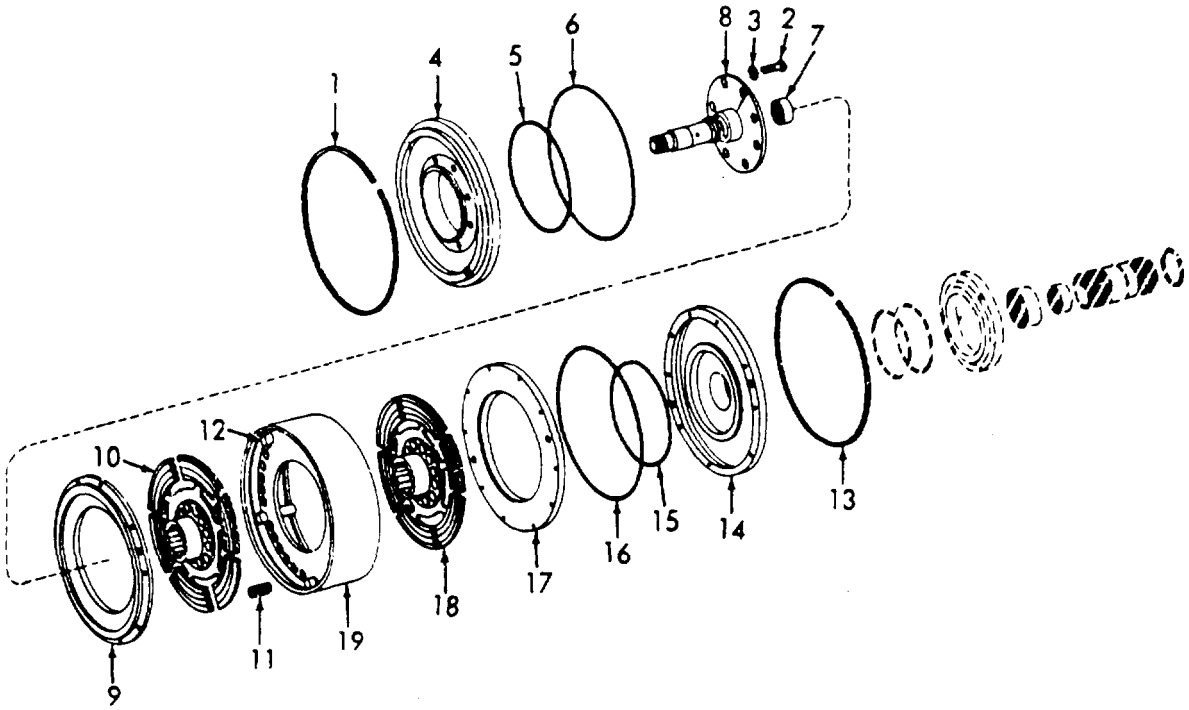


Figure 3-21. Housing and drum assembly removal and installation.

(a) Place drum and disc assembly in arbor press. Apply pressure on turbine shaft until cylinder is depressed enough to remove large snapring (1, fig. 3-22).



1 Snap ring
2 Capscrew
3 Lockwasher
4 Cylinder
5 Seal ring
6 Seal ring
7 Needle bearing
8 Turbine shaft
9 Piston
10 Disc
11 Spring
12 Pin
13 Snap ring
14 Cylinder
15 Seal ring
16 Seal ring
17 Piston
18 Disc
19 Drum

Figure 3-22. Forward reverse disc assembly.

(b) Remove the capscrews (2) and lockwashers (3) and remove the cylinder (4) from the turbine shaft (8). Remove seal rings (5 and 6). Remove the needle bearing (7) from the turbine shaft (8).

(c) Remove the piston (9), forward drive disc 10), spring (11) and pins (12) from the drum.

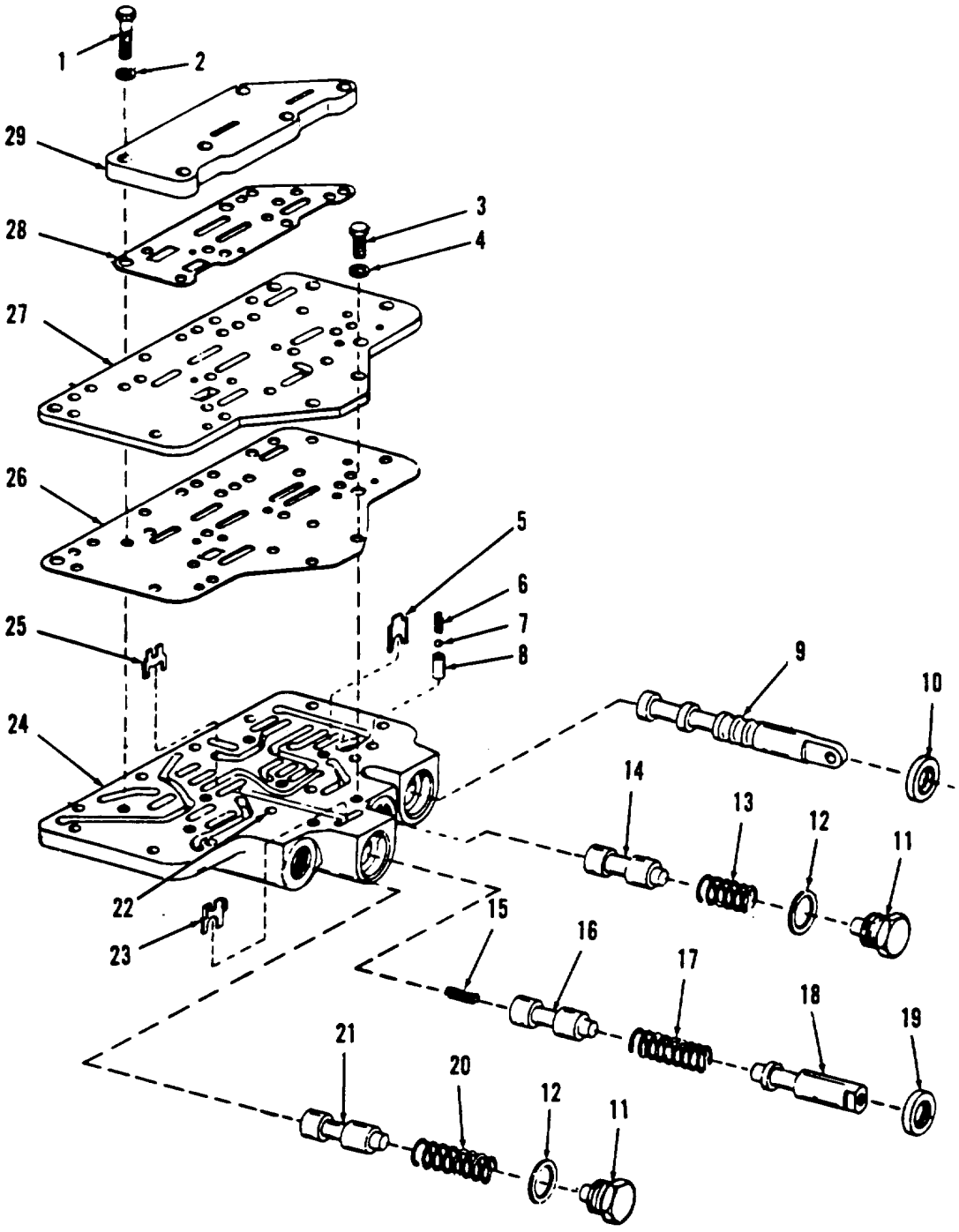
(d) Remove snap ring (13), cylinder (14), seal rings (15 and 16), piston (17) and reverse disc (18) from drum (19).

(4) *Transmission control valve*.

(a) Remove bolts and washers attaching transmission control valve to transmission case.

(b) Clean valve exterior with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

(c) Remove valve cover bolts (1, fig. 3-23) and lockwashers (2), valve cover (29), and gasket (28). Discard gasket.



1 Bolt
2 Lockwasher
3 Bolt
4 Lockwasher
5 Selector stop
6 Selector spring
7 Selector ball
8 Selector bushing
9 Selector spool
10 Oil seal
11 Retaining screw
12 Gasket
13 Drum spring
14 Drum spool
15 Inching spool spring
16 Inching spool
17 Inching plunger spring
18 Inching plunger
19 Oil seal
20 Regulator spring
21 Regulator spool
22 Gasket
23 Plunger stop
24 Body
25 Inching stop
26 Gasket
27 Separator plate
28 Gasket
29 Cover

Figure 3-23. Transmission control valve.

(d) Remove separator plate bolts (3) and lockwashers (4), separate plate (27), and gasket (26), and valve body gasket (22). Discard gaskets.

(e) Remove selector valve ball (7), spring (6), and bushing (8).

(f) Remove selector valve stop (5), and slide selector spool (9) from valve body (24).

(g) Remove and discard oil seal (10).

(h) Remove inching valve plunger stop (23) and slide plunger (18) and spring (17) from valve body (24).

(i) Remove and discard oil seal /(19).

(j) Remove inching valve spool stop (25), spool (16), and spring (15) from inside spool.

(k) Slowly remove regulator and dump valve retaining screws (11) and gaskets (12). Discard gaskets.

(l) Remove regulator valve spring (201 and spool (21), and dump valve, spring (13) and spool (14).

(5) *Forward gear and shaft.*

(a) Remove bolts (15, fig. 3-24) and lockwasher (16) holding bearing retainer (14) and gasket (13) to case and remove retainer with gasket Discard gasket.

(b) Remove bearing retaining ring (17), depress retaining ring on bearing, and slide bearing (12) from forward shaft (11).

(*c)* Reach through valve control opening, remove forward gear retaining rings (1U).

(d) Using a rawhide hammer and holding forward gear (9) in place, tap forward shaft (11) out through bearing retainer opening. Remove

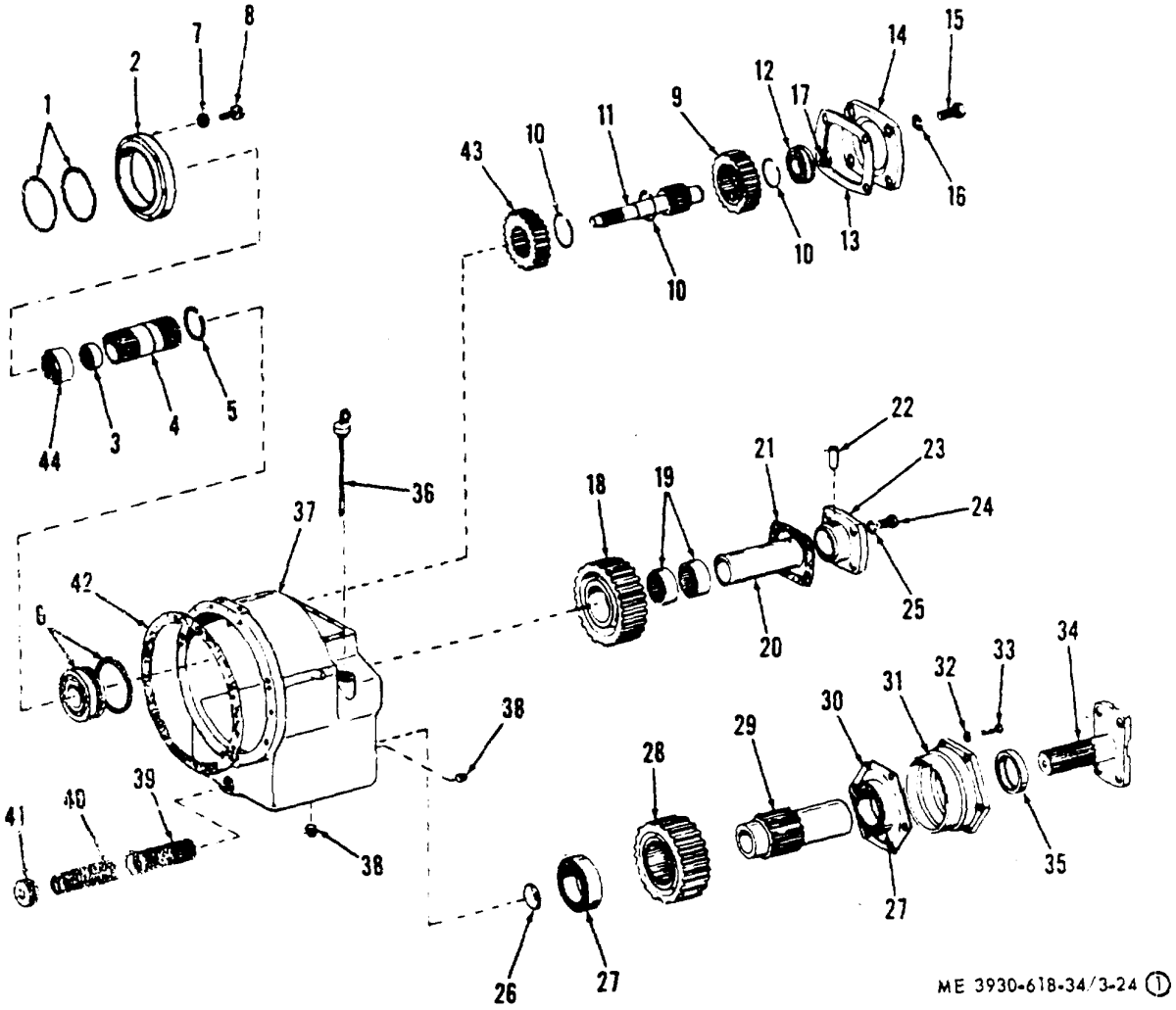


Figure 3-24. Single speed transmission disassembly (sheet 1 of 2)

Key to figure 3-24

1 Packing
2 Collector ring
3 Needle bearings
4 Reverse shaft
5 Retaining ring
6 Ball bearing
7 Lockwasher
8 Bolt
9 Forward gear
10 Retaining ring
11 Forward shaft
12 Bearing
13 Gasket
14 Retainer
15 Bolt
16 lockwasher
17 Retaining ring
18 Idling gear
19 Needle bearings
20 Idler shaft
21 Gasket
22 Pin
23 Retainer
24 Bolt
25 Lockwasher
26 Plug
27 Ball bearing
28 Output gear
29 Output shaft
30 Gasket
31 Retainer
32 Lockwasher
33 Bolt
34 Flange
35 Oil seal
36 Gage
37 Case
38 Drain plug
39 Screen
40 Spring
41 Plug
42 Gasket
43 Reverse gear
44 Needle bearing

Figure 3-24. Single speed transmission disassembly (sheet 2 of 2).

(6) *Remove reverse gear and shaft.*

(a) Match mark collector ring (2) and remove collector ring attaching lockwashers (7) and bolts (8) and collector ring.

(b) Remove packings (1) from collector ring.

(c) Remove needle bearings (3 and 44) from reverse shaft (4).

(d) Remove retaining ring (10) and reverse gear (43) from reverse shaft (4) (see fig. 3-25).

(*e)* Tap shaft (4, fig. 3-24) out disc and drum assembly side of transmission and remove bearing retaining ring (5).

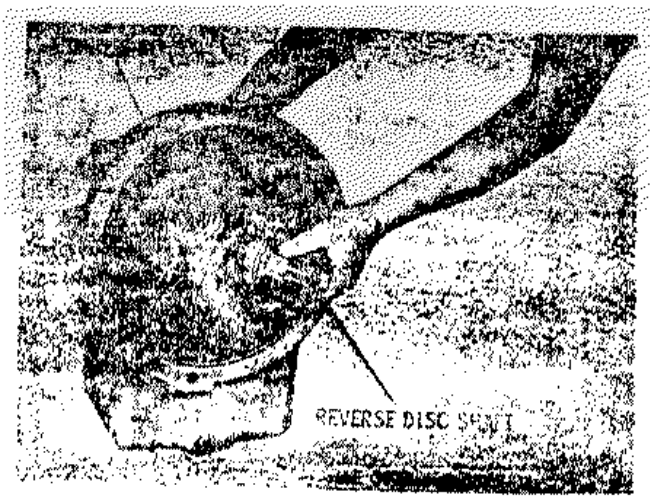


Figure 3-25. Reverse gear and shaft, removal and installation.

(f) Remove hearing (6) with retaining ring.

(7) *Idler gear shaft.*

(a) Remove retainer (23) by removing attaching bolts (24) and lockwashers (25). Discard gasket (21).

(b) Mark position of pin (22) holding shaft in retainer (23) to insure proper assembly and remove pin.

(c) Remove idler shaft (20) and idler gear assembly (fig. 3-26).

NOTE

Idler gear assembly consists of two needle bearings (19, fig. 3-24) and a gear (18).

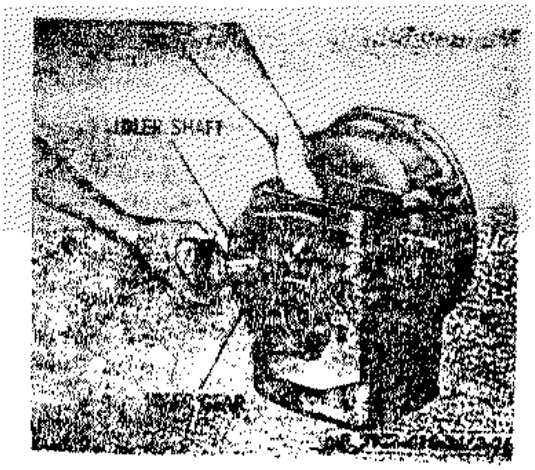


Figure 3-26. Idler gear shaft, removal and installation.

(8) *Output gear and shaft.*

(a) Remove output flange (34) and oil seal (35).

(b) Remove retainer (31) by removing attaching bolts (33) and lockwashers (32). Discard gasket (30).

(c) While holding output gear (28) in gear box, remove output shaft (29) (fig. 3-27).

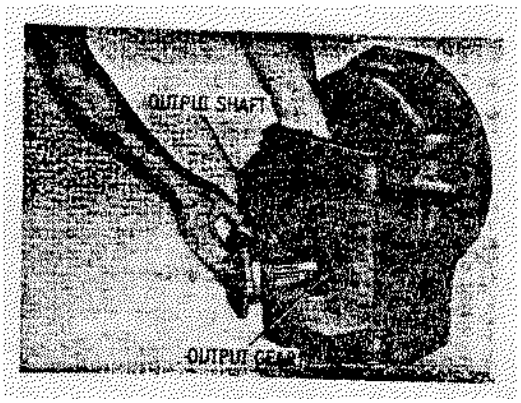


Figure 3-27. Output gear and shaft, removal and installation.

(d) Remove gear (28, fig. 3-24) and both ball bearings (27).

(e) Remove expansion plug (26).

(9) Remove plug (41, fig. 3-24), spring (40), and screen (39), from bottom portion of transmission case (37).

b. *Cleaning, Inspection, and Repair.* Assure that none of the dirt or sludge contains abrasive matter (metal filings). If it has metal particles investigate possible source of wear, or failure that caused accumulation. Replace defective part or parts, then use extreme care in cleaning the components.

CAUTION

Parts cleaned by steam must be protected with an even coating of OE 10 oil applied immediately after drying with filtered compressed air. Never dry bearings with compressed air.

NOTE

All metallic parts, except bearings, may be cleaned in dry cleaning solvent (Fed P-D-680), in diesel fuel (Fed VV-F-8001, or may be cleaned by the steam cleaning method. Wash bearings only in dry cleaning solvent (Fed P-D-6801. When grease has hardened in used bearings. always soak them in the solvent for several hours, for ease in cleaning.

CAUTION

Protect all parts from contamination after cleaning, and before inspection or reassembly, by an even coating of the oil to be used in the converter (LO 53930-618-12). Keep oiled parts covered with clean paper or cloth, and handle carefully during inspection to avoid leaving fingerprints on machined surfaces.

(1) Clean all metallic parts carefully, paying particular attention to oil passages by running a clean wire back and forth through the passage, blow dry with filtered compressed air, then coat all parts with an even coating of oil. (See caution above).

(2) Inspect all parts for the following:

(a) Bores for wear, burs, scratches, or grooves. Remove minor burs and scratches with crocus cloth. Replace parts that are deeply grooved or scratched.

(b) Mounting faces for nicks, burs, or scratches. Remove such defects with crocus cloth or a soft stone.

(c) Threaded openings for damaged threads. Chase a damaged thread with correct size tap.

(d) Castings for cracks or other damage. Replace a cracked casting.

(e) Sleeve bearings and thrust washers for scoring, sharp edges, roundness, burs, or discoloration from overheating. Remove scoring with crocus cloth. Burs and sharp edges may be removed with a scraper. Excessive wear, out-of-round, or overheated items require replacement.

(f) seals and gaskets for wear, cuts, and deterioration. Replace defective seals and rings. Replace all composition gaskets.

(g) teeth for wear, nicks, or burs. Gear thrust face for scores, nicks, or burs, and gears for cracks, or breaks. When burs, scores or nicks cannot be removed with a soft stone, replace the defective gear. When teeth are worn out of shape, or gear is cracked, replace the gear.

(h) rings for spring tension, wear, nick, or bur. Replace a defective ring.

(i) Springs for discoloration from heat, permanent set, or wear. Replace a defective spring.

(j) Mounting hardware for burs or other damage. Chase a burred external thread with proper size die. Chase a burred internal thread with proper size tap. Replace defective mounting hardware.

(k) for burs, twist, or chip, and wear that affects tightness of fit. When bur or chip cannot be removed with a soft stone, or wear is excessive, replace the defective part.

(l) Inspect sump screen for clogged or damaged screen.

NOTE

Thoroughly clean the intake screen and spring. In addition to soaking and washing, air streams should be directed from the outside toward the inside to remove material clogged in the screen and spring.

(m) Inspect drive discs, pistons and drum for wear or damage, Should any of these parts show evidence of excessive wear or scored marks, they should be replaced.

(n) Inspect control valve plungers and spools for score marks - clean up with crocus cloth or replace as required. Check spring for damage. Replace oil seals, seal rings and gaskets.

c. Reassembly. To reassemble the transmission, reverse the disassembly procedure. During reassembly, note the following:

(1) *Control valve assembly*. Reverse disassembly procedure making sure plungers and spools operate freely and retainer at both forward - reverse plunger and inching valve plunger are installed with angled edges facing back of valve body.

(2) *Drum and disc assembly*.

(a) Install reverse drive disc, piston, and cylinder. Make sure cylinder and piston does not bind in drum or on dowel pins. Install large snapring holding cylinder in place.

(b) Turn drum over and install springs, drive disc, piston and cylinder.

(c) Place assembly in arbor press. Apply pressure on turbine shaft, making sure cylinder does not bind in drum or on dowel pins. Install large snapring holding cylinder in place and release pressure in arbor press.

(d) should be exercised when installing converter housing on turbine shaft of disc drum, so that misalignment does not occur during assembly. Make sure snapring holding converter housing .to turbine shaft is properly seated.

(3) *Transmission gear train*.

(a) Make sure spring is in place when installing oil strainer in housing.

(b) sure output shaft is installed with internal splines to outside of gear case.

(c) sure machined reliefs in idler shaft cap are positioned down so that oil in cap will drain in housing.

(d) As gears and bearings are being installed, coat with lubricant and make sure they rotate freely.

(e) When installing forward and reverse drive disc shafts and gears, check to make sure snaprings holding gears on shaft are properly installed and seated.

(4) *Converter housing and disc drum and transmission housing*. When installing converter housing and disc drum (as a unit) into the transmission housing, care should be exercised so as not to damage collector rings fitting into disc drum, as damage to these rings will cause the reverse piston and disc to be inoperative.

(5) *Control valve assembly and transmission*.

(a) new gaskets when replacing control valve.

(b) capscrews evenly to 5-to 10-foot pounds.

(6) *Pump assembly and turbine shaft*.

(a) When installing pump assembly on turbine shaft, collector ring aligning marks must match marks made in disassembly.

(b) Make sure rings rotate free on collector ring and that rings are properly hooked together at ring ends.

(c) Use new gaskets and make sure mounting holes are properly aligned.

d. Installation.

NOTE

For proper reinstallation of transmission and torque converter, refer to Converter Replacement (para 2-9*d*). After correct alignment has been obtained, the following procedure is recommended:

(1) Mark one mounting strap and flywheel for identification and remove converter from flywheel being careful not to damage or loose shims, if any, on converter pilot.

(2) Position converter in pump at back of transmission, making sure converter hub tangs properly engage pump driven gear.

(3) Reinstall transmission on flywheel bell housing as follows:

(a) Mount converter to flywheel by installing capscrews and lockwashers through' inspection plate in flywheel bell housing.

(b) After converter has been securely installed, rotate until filler hole appears and add one quart of oil.

(c) After assembly has been installed in truck, add 10 quarts of oil to transmission. See LO 10-3930-618-12 for lubrication requirement.

(d) Test the operation of the transmission, use the procedure outlined in paragraph 3-15b.

3-17. Inching Pedal and Brake Pedal

a. Description. The inching pedal is installed on the same shaft as the brake pedal, and cannot be removed without removing the brake pedal. The inching pedal controls operation of the inching valve, which is part of the transmission control valve assembly and also actuates the brakes to provide simultaneous transmission disengagement and position braking.

b. Removal.

(1) Remove floor plates (TM 10-3930-61820).

(2) Disconnect master cylinder clevis pin (fig. 3-28, sheet 1 of 2) from the brake pedal, and the inching pedal pivot shaft (8, fig. 3-28, sheet 2 of 2).

(3) Remove pedal springs (15) and brake pedal bumper (14).

(4) Remove pin (6) through brake pedal (4) and shaft (8).

(5) Remove shaft support bearing (9) on steering shaft bracket.

(6) Pull shaft through bracket far enough to slide brake pedal off shaft.

(7) Push shaft back through bracket, but drop the free end below the support bearing on the right frame member until shaft drops free.

(8) Slide inching pedal (9, fig. 3-29) off shaft.

c. Cleaning and Inspection.

(1) Clean all parts with cleaning solvent and dry with compressed air.

(2) Inspect bushings (16) and shaft for excessive wear.

(3) Inspect treadle pad (8) for cracks, deformation, or other damage.

(4) Replace damaged or worn parts.

d. Installation.

(1) Reverse removal procedures.

(2) Do not attempt to drive roll pin (6, fig. 3-28) home until holes in brake pedal (4) and shaft (8) are properly aligned.

e. Adjustment of Inching Pedal Linkage. Because the inching pedal (9, fig. 3-29) stroke is limited by the inching valve stroke, the adjustment between-the pedal adjusting screw (14) and the plunger rod (4) must be set so the pedal (9) is fully released when the inching valve bottoms. Adjust as follows:

(1) Remove the floor plate.

(2) Depress the inching pedal down to the toe plate. The inching valve plunger rod (4) should move M6 the end of its stroke.

(3) Slowly release the pedal and observe the action. When the pedal is fully released and resting on the stop, the inching valve plunger rod (4) should just bottom.

CAUTION

Do not attempt to stop the pedal travel with the valve plunger rod alone.

(4) If the valve plunger rod (4) bottoms before the pedal (9) is fully released, and resting on its stop, turn the pedal stop adjusting screw (14) in or out until correct adjustment is obtained.

f. Service Brake Pedal Adjustment. The ideal pedal free play is h inch. Too little free travel will prevent the master cylinder piston from returning to full OFF position and the brakes will begin to drag after several applications. Excessive free travel will reduce the usable stroke of the master cylinder.

Refer to figure 3-28 and adjust as follows:

(1) Remove the floor plates.

(2) Slowly depress the brake pedal and check for 1/2 inch free travel. Also observe push rod action.

(3) To obtain the proper free travel, loosen the locknut on the clevis and then turn the adjusting nut.

(4) Tighten the locknut and reinstall the floor plates.

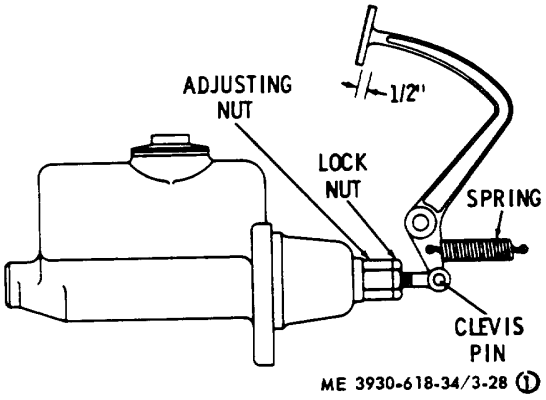
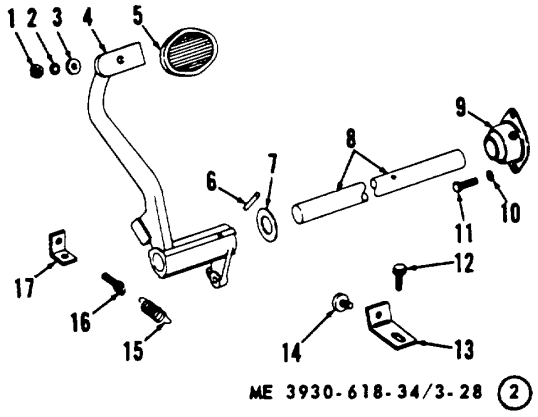
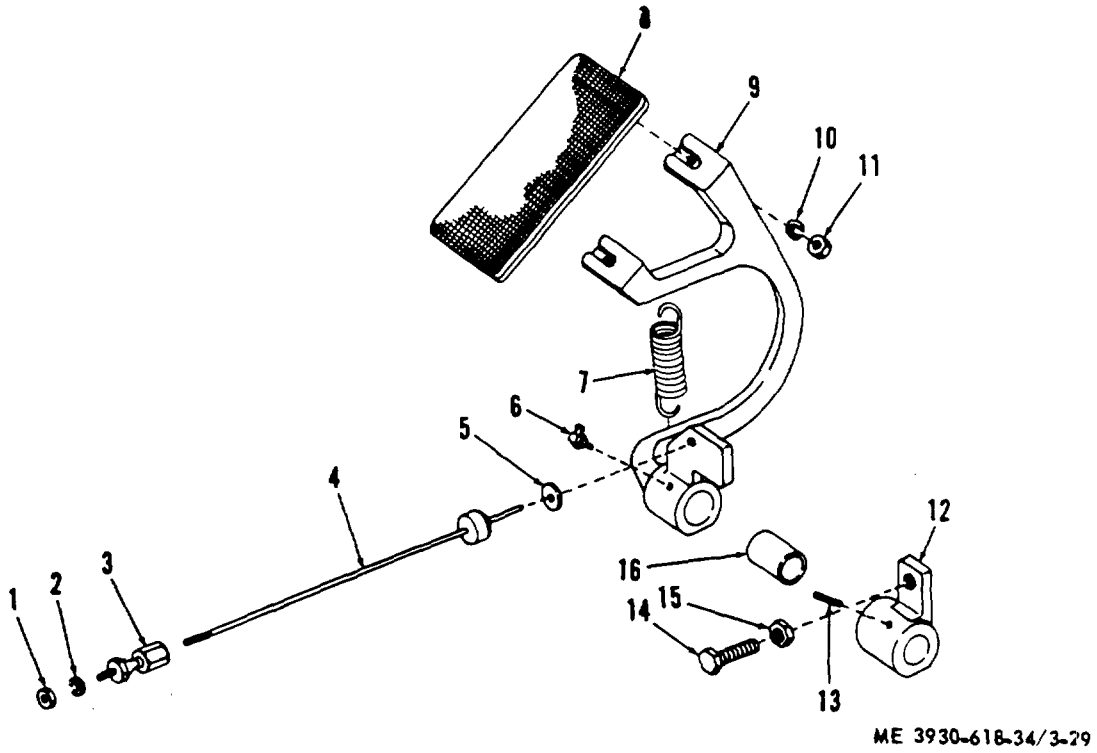


Figure 3-28. Brake pedal (sheet 1 of 2)



1 Nut	10 Loekwasher
2 Lockwasher	11 Capicrew
3 Washer	12 Capscrew
4 Pedal	13 Bracket
5 Pedal pad	14 Bumper
6 Pin	15 Spring
7 Washer	16 Adjusting screw
8 Pivot shaft	17 Clip
9 Support bearing	

Figure 3-28. Brake pedal (sheet 2 of 2).



1 Nut
2 Lockwasher
3 Ball joint
4 Rod
5 Washer
6 Fitting
7 Spring
8 Pad
9 Pedal
10 Lockwasher
11 Nut
12 Bellcrank
13 Pin
14 Screw
15 Nut
16 Bushing

Figure 3-29. Inching pedal

Section VII. REPAIR OF ENGINE

3-18. General

This section describes direct and general support maintenance of the Allis-Chalmers engine Model 6MB230 used in the forklift truck. Internal repairs to the engine, except valve grinding, will require its removal from the truck.

3-19. Engine Removal and Disassembly

a. Removal. Remove the power plant from the truck and separate the transmission, torque converter and hydraulic pump from the engine (para 2-9 and 2-10}.

b. Disassembly.

(1) Refer to TM 10-3930-618-20 and remove the following accessories and components:

(a) Fan and water pump.
(b) Alternator and starter motor.
(c) Carburetor
(d) Fuel pump.
(e) Manifold.
(f) Distributor
(g) Thermostat

(2) Remove speed limiting governor (para 3-9).

(3) Remove oil pan (para 3-12).

(4) Remove oil pump (para 3-13).

3-20. Cylinder Head, Block, and Sleeves

a. Cylinder Head.

(1) Description. The cylinder head is a one-piece, alloy iron, casting which is attached to the top of the cylinder block by special capscrews. Cored passages in cylinder head provide for intake of fuel-air mixture and expulsion of exhaust gage Cored passages are provided for circulation of coolant. To seal compression, a head gasket and fire rings are installed between cylinder head and block. Located in the cylinder head above each cylinder is an intake valve, an exhaust valve, replaceable valve seat inserts, two valve guides, a spark plug, and two rocker arms. The valves are operated by rocker

arms. Valve guides, pressed into the cylinder head, hold valves in accurate alignment with valve seats. Top of cylinder head, with the valve and rocker arm assembly, is inclosed by a cover.

(2) *Cylinder head service*. Service on some parts contained in the head can be accomplished with the head installed on engine. Other service operations require head removal.

(a) Operations not requiring head removal.

1. Adjustment of valve clearance (TM 10-3930-618-20).

2. Replacement of rocker arms, rocker arm shafts, or springs (para 3-23).

3. Replace of push rods (para 3-23).

4. Replacement of valve springs (para 3-23).

5. Removal of spark plugs (TM 10-3930-618-20).

(b) Operations requiring head removal.

1. Grinding, reseating or replacement of valves (para 3-23).

2. Replacement of valve guides (para 3-23).

3. Replacement of exhaust "salve seat inserts (para 3-23).

(3) *Removal of cylinder head.*

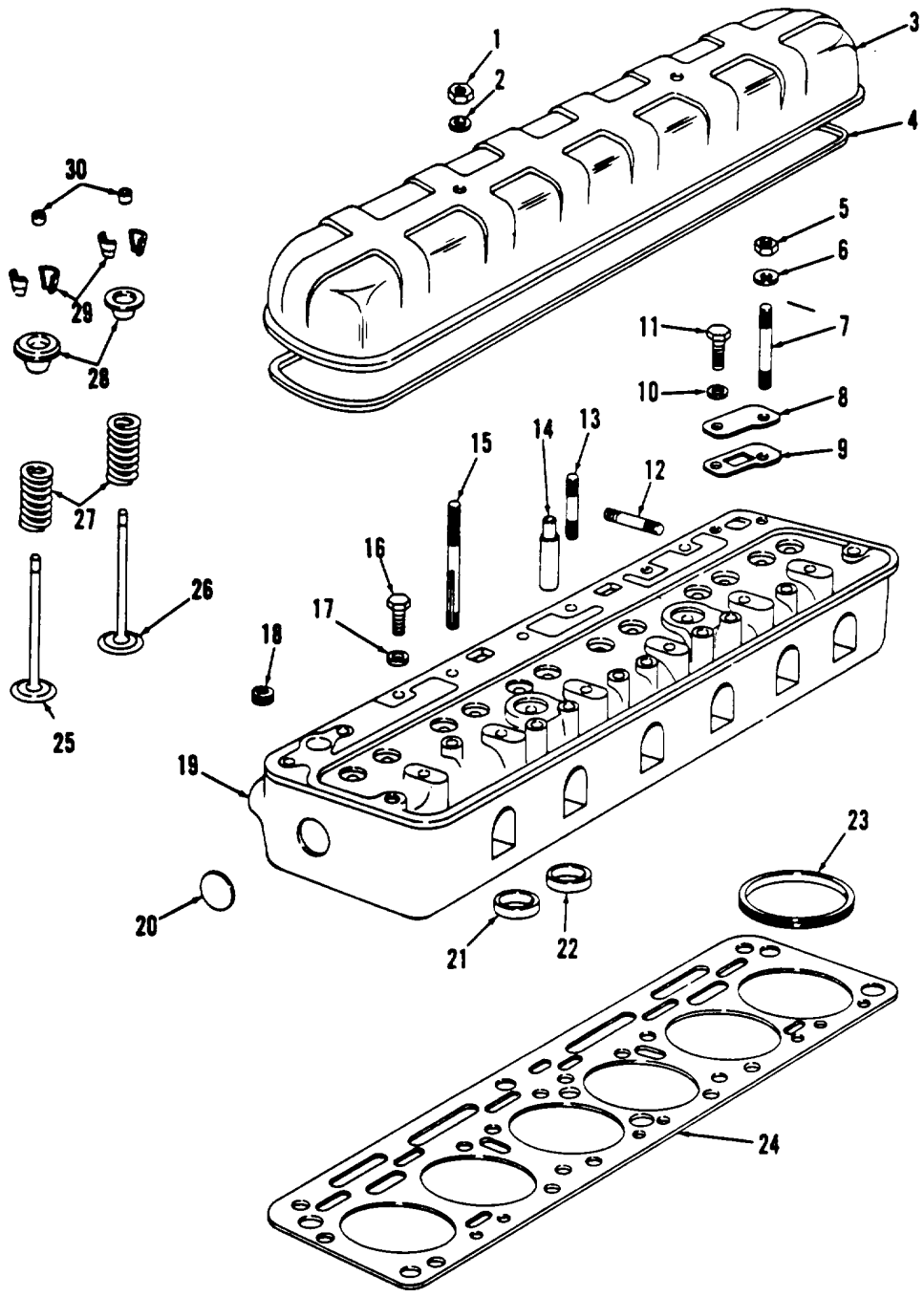
(a) Remove side panels, seat deck and supports, battery, and battery tray (TM 10-3930-618-20).

(b) Drain radiator and block.

(c) Remove vent hose from rocker arm cover.

(d) Remove nut (1, fig. 3-30) and washers

(2) from stud (15). Then remove cover (3) and rocker arm assembly (para 3-23).



1 Nut	11 Capscrew	21 Exhaust valve insert
2 Washer	12 Stud	22 Intake valve insert
3 Cover	13 Stud	23 Fire ring
4 Gasket	14 Valve guide	24 Head Gasket
5 Nut	15 Stud	25 Exhaust valve
6 Washer	16 Capscrew	26 Intake valve
7 Stud	17 Washer	27 Salve spring
8 Cover	18 Pipe plug	28 Valve retainer
9 Gasket	19 Cylinder head assembly	29 Lock
10 Washer	20 Expansion plug	30 Rotor cap

Figure 3-30. Cylinder head and valves.

(e) Remove spark plug cables.

(f) Remove radiator connections to engine and transmission (TM 10-3930-618-20).

(g) Disconnect rocker arm oil feed line from head and move out of way.

(h) Remove cylinder head capscrews (11 and 16, fig. 3-30), nuts (5) and washers (6, 10, and 17). Lift cylinder head assembly (19) from block with a sling. Discard fire rings (23) and head gasket (24).

(4) Inspection of cylinder head.

(a) Clean cylinder head, removing all carbon deposits, and inspect for wear or other damage.

(b) Before removing valves (para 3-23) check them for seating.

(c) Replace defective parts.

NOTE

If cylinder head is to be replaced, parts from the defective head must be thoroughly inspected before installing them in a new head. For inspection procedures for valves and rocker arm assembly (para 3-23) and for spark plugs, see TM 10-3930-618-20.

(5) *Installation of cylinder head.*

(a) Thoroughly clean the top deck of the cylinder block and the underside of the cylinder head.

(b) Do not use any sealer or gasket dope on any part of the cylinder head gasket assembly.

(c) Install guide studs in holes (19 and 20. fig. 3-31).

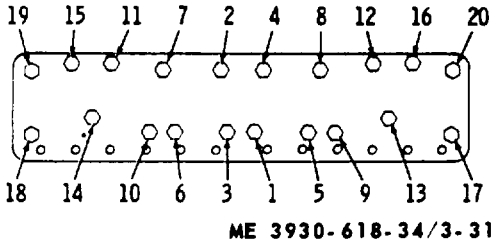


Figure 3-31. Sequence for cylinder head Capscrew tightening.

(d) Position the head gasket on the cylinder block guide studs. Position the fire rings inside the cylinder bores of the gasket and be sure no overlapping of the fire rings by the gasket occurs.

(e) Carefully install the head, being sure not to displace the positioned fire rings. Head is to be located by the guide studs. Install capscrews in all locations except those occupied by guide studs.

(f) Torque the capscrews to a final torque of 110 ft-lbs. in the following manner (fig. 3-31).

1. Tighten capscrews in numerical sequence to 1/2, final torque. Remove guide studs and install lifting studs when reaching these locations.

2. Tighten capscrews in numerical sequence to full recommended torque.

3. Retighten capscrews in numerical sequence to full recommended torque.

4. Run engine until coolant temperature reaches minimum of 160°F, (approx. 1 hour), then retorque capscrews to the full recommended torque in the specified numerical sequence.

(g) Reset the valve tappet clearance.

b. Cylinder Block and Cylinder Sleeves.

(1) *Description.* The cylinder block is a one-piece iron casting. Integral transverse members provide rigidity and strength, assuring accurate alignment of crankshaft bearings and cylinder sleeves. Block is bored to receive removable cylinder sleeves which are completely surrounded by full-length water jackets for maximum cooling. The main oil gallery extends lengthwise through the cylinder block, below and parallel to the camshaft. Oil passages direct oil from main oil gallery to main bearings. A horizontal oil passage leads to the outside of the cylinder block and is connected by tubing to lubricate rocker arm assembly. The removable cylinder sleeves are made of alloy cast iron. Two silicone rubber packing rings, fitted into grooves in lower bore of cylinder block, prevent water leakage into crankcase. Sleeve is seated at top by a flange which fits into a machined recess in block. Cylinder head gasket and fire rings are compressed between this flange and cylinder head, holding sleeve in place.

(2) *Removal of cylinder sleeve.*

NOTE

When removing sleeves and pistons. do not interchange parts. If any sleeves are to be reused, they should be reinstalled in the same sleeve bore from which the)y were removed. Pistons must be reinstalled in the same sleeves from which they were removed.

If engine has already been removed from truck, disregard *(a)* below.

(a) Remove engine from truck (para 2-9).

(b) Remove cylinder head assembly (para *a* above).

(c) Remove pistons and connecting rods (para 3-22).

(d) Rotate crankshaft to gain access for installation of cylinder sleeve puller.

(3) *Cylinder sleeve tool.* Install puller tool to remove cylinder sleeve from top of cylinder block.

NOTE

If sleeve puller is not available, sleeves may be loosened by placing end of hardwood block against bottom of sleeve and striking block sharply with a hammer. Be careful not to hit cylinder block.

(4) Cleaning and inspection of cylinder sleeves.

(a) Remove all carbon, dirt, and oil from cylinder sleeves and machine recess bore in cylinder block. Replace cylinder sleeves if scored or worn beyond allowable limits of 0.008 inch. Slightly scuffed cylinder sleeves, if not worn, may sometimes be made usable by polishing or lapping to remove surface irregularities.

(b) Check cylinder sleeves for roundness by means of a cylinder diameter checking gauge. Allowable out-of-round when installed is 0.001 inch. Using an inside micrometer, measure cylinder sleeve for taper and wear. Inside diameter of new cylinder sleeve is 3.4379 inch to 3.4385 inch. Cylinder sleeve should be round to within 0.001 inch, and have no more than 0.0007-inch taper. Cylinder sleeves that are more that 0.001 inch out- of-round or have more than 0.0007-inch taper when installed, must be replaced. These measurements should be taken at several locations within the area of piston ring travel.

(c) If cylinder sleeves are within allowable wear limits and are to be used again, there may be a slight ring travel ridge near top of the sleeve which should be removed with a ridge reamer. Follow the instructions of the manufacturer of the specific ridge reamer.

(d) Refer to paragraph 3-22 for instructions on the fitting of pistons in cylinder sleeves.

(5) *Installation of cylinder sleeve.*

(a) Thoroughly clean cylinder sleeve (2, fig. 3-32) and the bore in cylinder blocks (3). Be sure bottom surface of flange on cylinder sleeve and counterbore in cylinder block are clean and free from nicks or burs.

(b) Before installing silicone rubber seal rings (1) insert sleeve (2) into bore to make certain sleeve can be pushed down into place by hand pressure. Withdraw sleeve from block. If sleeve cannot be inserted in above manner, more cleaning is necessary or sleeves are distorted.

(c) Install silicone rubber seal rings as follows:

1. Thoroughly clean the cylinder sleeves and wipe or blow them dry. Thoroughly clean the sleeve bores and O-ring grooves in the cylinder block. Check the sleeve flange counterbores in the block to be sure the sleeve flange seats are true and square with the upper and lower deck sleeve bores in the block. Check the depth of the flange counterbores in the block to be sure the specified sleeve protrusion above the top deck of the block is maintained.

2. Install the dry silicone cylinder sleeve packing rings in both grooves in the cylinder block. 3. Brush a light coat of light engine lubricating oil in the lower sleeve bores and on the sleeve rubbers in the cylinder block and on the sleeve immediately prior to installation of the sleeve in the cylinder block.

CAUTION

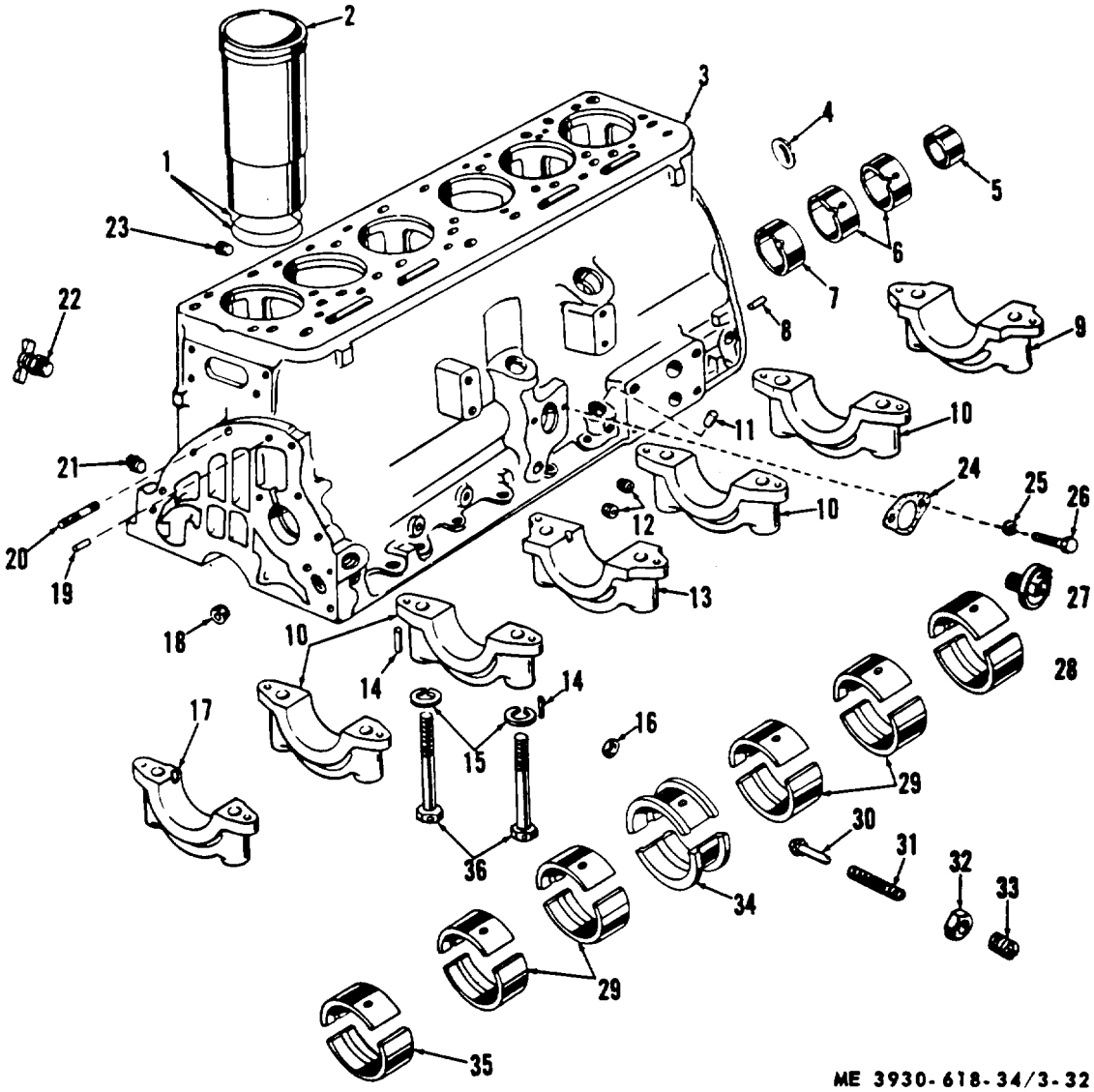
Use only a light engine lubricating oil as a lubricant for the cylinder sleeve packing rings when installing cylinder sleeves in a cylinder block.

(d) With silicone rubber seal rings installed, install sleeve in position in cylinder block, being careful not to cut or scratch seal rings. When sleeve is nearly in place, apply pressure to opposite sides of sleeve with hands and press into place with a sudden, quick application of pressure. Be careful not to get dirt under flange of sleeve, which would prevent it from properly seating.

(e) With flange of cylinder sleeve firmly seated in counterbore of cylinder block, top surface of cylinder sleeve must be -0.002 inch to +0.002 inch above top flat surface of the cylinder block. Hold a straightedge across cylinder sleeve and use a feeler gauge to measure standout of sleeve flange above block.

c. Cleaning and Inspection of Cylinder Block. The cylinder block is the main structural part of the engine, therefore, whenever engine is overhauled, thoroughly inspect block for any damage which may render it unfit for further use. Make inspection of block after all parts have been removed and it has been thoroughly cleaned with steam or cleaning solvent (Spec P-S-661) and dried with compressed air. All oil passages in cylinder block must be cleaned before assembling engine. Effective cleaning of these passages can be accomplished only with the use of high steam pressure with a solvent used in the water to dissolve the sludge and foreign material that has collected. Open all passages before flushing.

(1) Remove expansion plugs (4, fig. 3-32) at front and rear of engine.



1 Packing ring
2 Sleeve
3 Block assembly
4 Expansion plug
5 Camshaft bearing, rear
6 Camshaft bearing, interm
7 Camshaft bearing, front
8 Dowel pin
9 Bearing cap, rear
10 Bearing cap, interm
11 Plug
12 Pipe plug
13 Bearing cap, center
14 Dowel pin
15 Lockwasher
16 Insert
17 Bearing cap, front
18 Pipe plug
19 Dowel pin
20 Stud
21 Pipe plug
22 Drain cock
23 Pipe plug
24 Gasket
25 Lockwasher
26 Capscrew
27 Oil pressure sender
28 Main bearing, rear
29 Main bearing, interm
30 Piston
31 Spring
32 Nut
33 Adjusting screw
34 Main bearing, center
35 Main bearing, front
36 Capscrew

Figure 3-32. Cylinder block.

jackets, apply high pressure steam and water through all block openings. Turn block in various positions while this is being done so that loose scale will be washed out. After oil and water passages have been cleaned and block has been inspected, install expansion plugs (4, fig. 3-32) and oil pressure relief valve (para 3-14). Oil gallery plugs should be coated with a sealing compound and installed flush with, or below the surface, so that they will not interfere with fit of attached parts.

3-21. Crankshaft, Main Bearings, Gear, and Pulley

a. Description.

(1) *Crankshaft*. The crankshaft is a counterbalanced, heat-treated, steel drop forging drilled for pressure lubrication to main and connecting rod bearings. It is balanced both statically and dynamically and is supported by seven main bearings. Crankshaft end thrust is taken by thrust flanges on each side of center main bearings.

(2) *Main bearings*. Main bearings are replaceable without machining. The front main bearing is 1 1/16 inch long; the center main bearing is 1 7/8 inch long, and the rear main bearing is 1 23/32 inch long. All intermediate bearings have an inside diameter of 2.5007 inches to 2.5024 inches with bearing caps tightened to specified torque (table 1-1). The main bearing caps are attached to the cylinder block and line bored in position to receive the bearing shells. Each bearing cap is numbered and when removed should always be reinstalled in respective position and corresponding to the numbers stamped on the bottom of the cylinder block. The upper halves of the main bearing shells are seated in the lower part of the cylinder block. The lower halves are held in place by the main bearing caps, each of which is attached to the cylinder block by capscrews and lockwashers. Each half of the bearing shell is prevented from radial movement by a tang at the parting line on one side of the bearing shell. A spring loaded, lip-type oil seal is used at the rear of the crankshaft to seal the crankcase oil from the flywheel compartment. A spring loaded, lip-type oil seal, pressed into the timing gear cover located on the front of the engine, is used to seal the crankcase oil from leaking out at the front end of the crankshaft.

(3) *Gear and pulley*. The gear and pulley are installed, in that order, on the front end (threaded end) of the crankshaft.

b. Removal. Inspection can be made of crankshaft main bearings and journals by removing oil pan and removing bearing caps one at a time. If crankshaft has been damaged, removal of engine is necessary for shaft replacement.

(1) Remove engine (para 2-9).

(2) Drain lubricating oil by removing drain plug from bottom of oil pan.

(3) Remove transmission (para 3-16).

(4) Remove starter motor (TM 10-3930-618-20).

(5) Remove flywheel and flywheel housing (para 3-26).

(6) Remove crankshaft pulley as follows:

(a) Remove locknut (1, fig. 3-33).

(b) Using appropriate puller, remove pulley (2).

(c) Remove key (6).

(7) Remove oil pan (para 3-12).

(8) Remove timing gear cover from front plate (para 3-25).

(9) Remove lubricating oil pump (para 3-13).

(10) Remove connecting rod bearing caps and bearing shells (para 3-22).

(11) Remove main bearing caps and bearing shells as follows:

(a) Remove capscrews (36, fig. 3-32) and lockwashers (15).

(b) Remove main bearing caps (9, 10, 13, and 17) and bearing shells (28, 29, 34, and 35).

(12) Remove crankshaft (fig. 3-34).

(13) Use gear puller and remove crankshaft timing drive gear (3, fig. 3-33) and key (5).

c. Cleaning, Inspection, and Repair.

(1) Clean all parts in cleaning solvent (Spec P-S-661) and dry with compressed air.

(2) Be sure to clean out the crankshaft oil passages.

(3) Inspect crankshaft journals for scoring, chipping, cracking, signs of overheating, or other damage. If crankshaft has been overheated (usually indicated by discolored or blue bearing journal surfaces), is scored, or excessively worn, then reconditioning or replacement will be necessary.

(4) Recheck crankshaft journals for fine cracks if signs of overheating are observed.

(5) Measure crankshaft main bearing and connecting rod journals at several points on their diameter to check for out-of-roundness. The specified diameter of the main bearing journals is 2.4984 inches to 2.4994 inches; the specified diameter of the connecting rod journals is 2.1214 inches to 2.1224 inches.

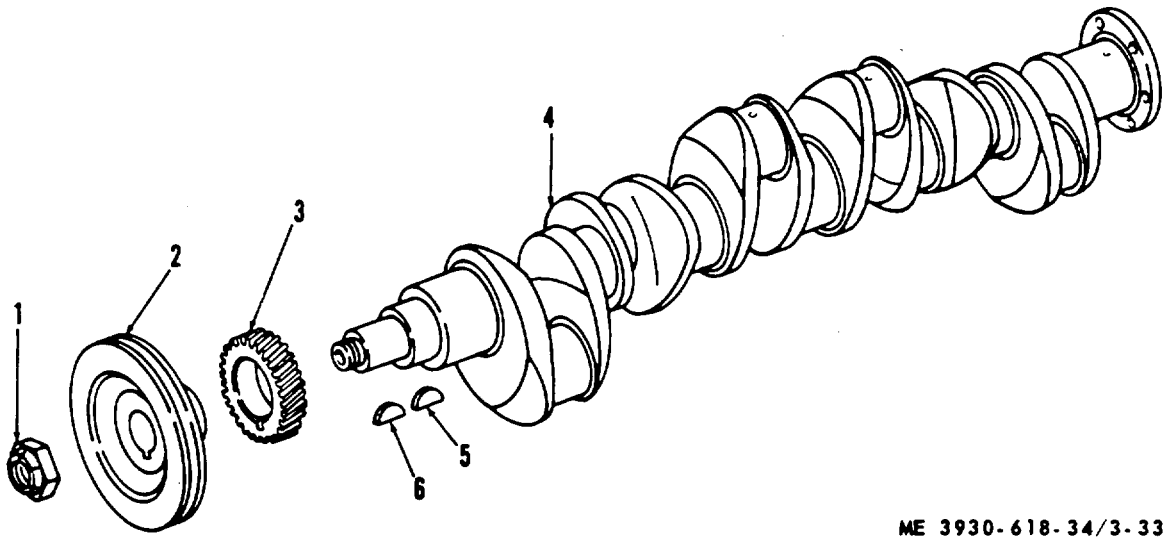
(6) All main and connecting rod bearings surfaces of the crankshaft are hardened to a depth of 0.070 inch.

d. Installation. Install crankshaft in reverse order of procedure of b above, except -

(1) Inset key (15, fig. 3-33 into shaft.

(2) Heat crankshaft timing drive gear (3) in boiling oil for at least 15 minutes to expand gear ID.

(3) Pick up gear with tongs or pliers and slide onto crankshaft. Aline “C” marks on crankshaft and camshaft gears and mesh gears. It may be necessary to tap gear with a wooden block and hammer to seat it over key and against crankshaft shoulder.



1 Locknut
2 Pulley
3 Gear
4 Crankshaft
5 Key, gear
6 Key, pulley

Figure 3-33. crankshaft gear and pulley.

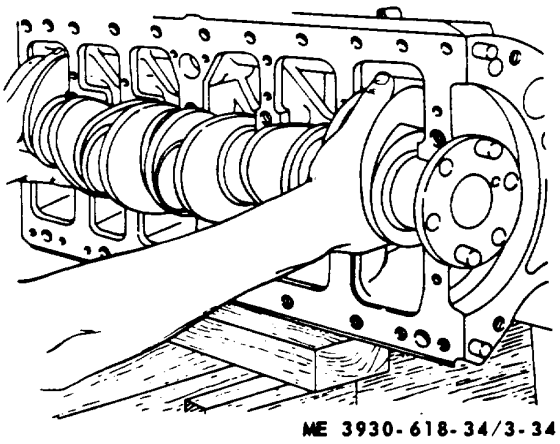


Figure 3-34. Removing crankshaft.

3-22. Pistons and Connecting Rods

a. Description.

(1) *Pistons*. The precision-machined, balanced, cast aluminum alloy, cam ground, and tip-plated pistons are fitted with two compression and two oil control rings, all located above piston pin. Behind oil control ring, holes drilled through piston allow excess oil in groove to return to crankcase. Piston pins are full-floating type held in piston by two retainer rings fitted into grooves in pin boss of piston. Pins are full-floating, but normal movement is between pin and bushing in the connecting rod.

(2) *Connecting rods*. Each connecting rod, made of drop-forged, heat-treated steel, is forged to an "I" section with closed hub at upper end and integral cap at lower end and is dynamically and electronically balanced. Connecting rod bearings are replaceable without machining. Each half of bearing shell is prevented from radial movement by a tang at parting line on one side of bearing shell. Bearing shells are held in place by a cap which is attached to the connecting rod with two special capscrews and castellated nuts. Upper end of connecting rod contains a bushing which is pressure lubricated.

b. Removal. Connecting rods and pistons may be replaced without removing engine from truck. (If engine has already been removed from truck, disregard (1), (2), and (3) below).

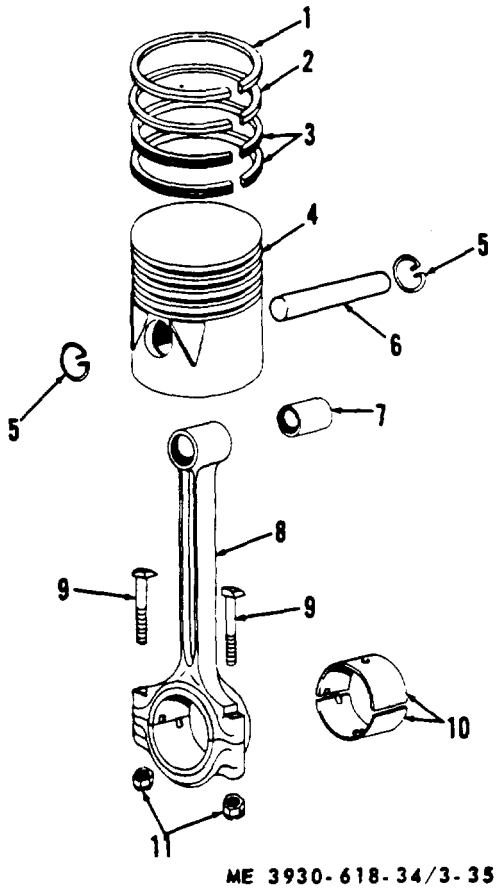
(1) Remove cylinder head (para 3-20).

(2) Remove steering axle assembly (para 2-14).

(3) Drain oil from crankcase and remove oil pan (para 3-12).

(4) If cylinder sleeves (2, fig. 3-32) are worn so there is a ridge at the upper end of ring travel, remove ridge with a ridge reamer before piston is removed. This prevents damage to rings during removal and installation.

(5) Remove nuts (11, fig. 3-35) and bearing cap from each connecting rod (8) in turn and push piston and connecting rod assembly out through top of cylinder block. Reassemble bearing caps on their respective connecting rods as they are removed.



1 Top ring
2 Second ring
3 Third and fourth ring
4 Piston
5 Pin retainer
6 Piston pin
7 Bushing
8 Connecting rod
9 Bolt
10 Rod bearing
11 Nut

Figure 3-35. Piston and connecting rod.

(6) Inspect, disassemble, and reassemble pistons and connecting rods as required.

(7) Inspect crankshaft 14, fig. 3-33) bearing journals at connecting rod throws for scoring, checking, or signs of overheating. If any of these conditions exist, crankshaft will require reconditioning or replacing.

c. Disassembly.

(1) Using suitable tool. remove piston pin retainer ring (5, fig. 3-35) at each end of piston pin (6).

(2) To avoid breaking piston rings, the use of a ring remover and installer is recommended. Care must be taken not to over-stress piston rings by spreading ends more than is necessary to remove them from piston. Before removing rings, inspect for wear and side clearance in grooves. However, removal will be necessary in order to clean carbon from grooves.

(3) Using a driving tool, drive piston pin (6) from piston. Use a wooden block or brass drift as a driver. In some instances it may not be necessary to drive piston pin from piston. Specified clearance between piston and pin at room temperature is 0.0001 inch to 0.0005 inch loose.

d. Piston and Piston Ring Inspection.

(1) As gummy deposits are not always removed from piston walls and ring grooves with fuel, these parts may be cleaned with Cleaning Solvent (Spec P-S-661) and then blown off with dry compressed air. After cleaning, piston skirt, piston rings, and ring grooves should be thoroughly inspected.

CAUTION

Some types of solvents contain chemicals injurious to aluminum alloy. Do not use a cleaning agent containing such chemicals.

(2) Piston skirt should be carefully inspected for score marks or other indications of improper piston clearance. Any scored pistons should be replaced.

(3) Inspect inside of piston for cracks, any of which make it unfit for further use. Make certain that drilled holes in piston walls are open and clean.

(4) Check piston for wear by inserting it into cylinder sleeve and measuring clearance between piston and sleeve. Maximum tolerance is from 0.0006 inch tight to 0.002 inch loose, measured at bottom of piston skirt and at right angles to piston pin.

NOTE

When measuring clearance between a piston and a used sleeve. make certain that piston is inserted into the sleeve far enough so measurement is taken in area of piston ring travel within sleeve.

(5) Piston skirt diameter of a new piston is 3.4365 inches to 3.4385 inches, measured at right angles to the piston pin; inside diameter of a new cylinder sleeve is 3.4379 inches to 3.4385 inches. Deviation from these measurements will indicate amount of wear on piston or cylinder sleeve. The piston or cylinder sleeve, or both, must be replaced if the clearance exceeds 0.008 inch.

(6) New piston rings must always be used with new pistons. If engine has been in service for some time, even though the same pistons are used again, it is advisable to use new rings when the engine is reassembled.

e. Connecting Rod Inspection.

(1) Wash connecting rod assembly with SD.

(2) Measure outside diameter (OD) of piston pin to determine wear. Specified diameter of a new piston pin is 0.8591 inch to 0.8591 inch.

(3) Specified inside diameter of connecting rod bushing is 0.8593 inch to 0.8596 inch. These pin and bushing dimensions provide a clearance of 0.0001 inch to 0.0005 inch; clearances of up to 0.002 inch are permissible. If clearance is close to or beyond this limit, replace connecting rod bushing.

(4) Inspect connecting rod bearings (10, fig. 3-35) for scoring, chipping, corrosion, cracking, or signs of overheating; discard bearing shells if any of these conditions are apparent.

(5) Back of rod bearings should be inspected for bright spots and discarded if any are found, as this condition indicates they have been moving in their supports. Inspect rod bearings for wear. Specified inside diameter of rod bearings when installed with bearing cap retaining bolts tightened to specified torque is 2.1239 inches to 2.1254 inches. This provides a running clearance of 0.0015 inch to 0.0030 inch; new bearings must be installed when this clearance exceeds 0. 006 inch. Refer to paragraph 3-21 and measure the connecting rod bearings for wear and clearance with the crankshaft in a similar manner. If crankshaft is worn or damaged it must be replaced.

f. Piston Rod Alignment Inspection.

(1) If wear on rod bushings or bearings indicates rod may be out of alignment, place rod and piston on aligning fixture for checking.

(2) With piston and connecting rod assembly clamped onto aligning fixture, swing rod into a horizontal position parallel to floor. With piston held diagonally to rod (piston head pointing to floor), observe space between aligner face and skirt of piston. If this space is not equal distance, rod is twisted out of line.

NOTE

Ring lands at top of piston are smaller than skirt: therefore, check alignment of rod along full length of skirt only.

(3) Twist rod with bending bar until space between aligner face and piston skirt is even.

(4) Check for twist in the opposite diagonal line to piston rod (piston head pointing up). Observe space between aligner face and piston skirt. If space is uneven, twist rod with bending bar until true alignment is obtained.

(5) Check for bent rod by moving piston into parallel position with connecting rod and observe space between aligner face and piston skirt. If space is not even, straighten rod carefully with bending bar.

g. Fitting Pistons to Cylinder Sleeves.

CAUTION

Measurement of pistons and cylinder sleeves (2, fig. 3-32), and running clearances between them should be taken at room temperatures. Pistons are cam ground and can be from 0.0006 inch tight to 0.002 inch loose when fitted to their respective cylinder sleeves before piston rings are installed. Insufficient clearance will result in premature failure of these parts.

(1) Measure cylinder sleeves (para 3-20).

(2) Measure pistons (para d above).

NOTE

Pistons and cylinder sleeves are available in standard size. 0.020 inch, and 0.040 inch oversize.

h. Fitting Piston Rings.

(1) Gap between ends of piston rings should be measured before rings are installed on piston. Select rings to be installed on each piston, oil and insert them one at a time into cylinder sleeve in which they are to operate. Use a piston to push ring squarely into cylinder sleeve so that it is parallel with top of cylinder block.

(2) Push ring far enough down in bore of cylinder sleeve to be on ring travel area. Measure ring gap with a feeler gauge.

(3) Minimum ring gap on all rings is 0.011 inch. If necessary, file ring ends with a fine cut file to obtain correct clearance.

(4) Measure ring-to-groove clearance (top of ring to top of groove in piston). Specified clearances are as follows: top compression ring, 0.002 inch to 0.004 inch; second compression ring, 0.0015 inch to 0.0035 inch; and oil control rings, 0.001 inch to 0.003 inch.

(5) After rings have been properly fitted,

install them on piston, using a piston ring remover and installer. Take care not to spread rings more than necessary. Stagger ring gaps evenly around piston so that no two are in line.

NOTE

Oil all rings and pistons before installing them in cylinder sleeve.

i. Replacement of Connecting Rod Bushing and Pin.

(1) connecting rod bushing (7, fig. 3-35) is worn, old bushing may be pressed out and a new bushing pressed in. Specified inside diameter of connecting rod bushing is 0.8593 inch to 0.8596 inch and diameter of piston pin is 0.8591 inch to 0.8593 inch; this provides a clearance of 0.0000 inch to 0.0005 inch between pin and bushing. Maximum clearance or fit of 0.002 inch is allowable before replacement.

(2) When there is no wear between piston and pin, but wear exists between bushing and pin, install a new bushing and ream to fit a standard size pin. If there is wear on both the piston and bushing, an oversize pin of 0.005 inch or 0.010 inch may be used which will require reaming of piston and connecting rod bushing to fit.

(3) bushing is loose in the connecting rod, it is recommended that rod be replace as even a new bushing would fit loosely.

j. Assembly.

(1) Install one of the piston pin retainer rings (5, fig. 3-35) in one end of the piston pin hole in piston.

(2) Immerse piston in boiling water for about 5 minutes. Then insert upper end of connecting rod into piston and insert piston pin (6). Pin to connecting rod is a very light push fit.

(3) Install other piston pin retainer at opposite end of piston pin.

k. Installation.

(1) When installing pistons and connecting rods, be sure to place them in their respective cylinders with number on bearing cap opposite camshaft side of engine.

(2) Place ring compressor over piston rings making certain that rings are wholly in their grooves before tightening compressor. Tighten compressor gradually, pausing to move it sideways to be sure the rings are free. Compress rings as much as possible.

(3) Place piston connecting rod in cylinder sleeve with lower end of connecting rod aligned with crankshaft. Using the wooden handle of hammer, tap on upper end of piston to push it out of compressor and into sleeve.

(4) Place upper half of bearing in position on connecting rod and install bearing cap and lower half of bearing, making certain identifying marks are aligned.

(5) Install connecting rod nuts; torque to 45 50 ft-lbs.

(6) Check connecting rod side play at bearing journal. Specified clearance is 0.003 inch to 0.009 inch.

(7) Replace items which were removed in order to remove pistons and connecting rods.

3-23. Valves and Rocker Arm Assembly

a. Description. Intake and exhaust valves (fig. 3-36) are high tensile alloy steel carefully heattreated to develop special properties required for valve service. Each valve stem is accurately ground to size and hardened. Hardened intake and exhaust valve seat inserts are installed in the cylinder head. Valve guides, made of high tensile iron, are pressed into the cylinder head. Valve springs are held in place by a regular spring retainer on the valve and tapered valve spring retainer locks. Release type cap allows valve to rotate slightly each time valve is opened and repositioned on its seat. The rocker arm assembly, consisting of two rocker arms for each cylinder, is mounted on a common rocker arm shaft supported by rocker shaft brackets attached to the cylinder head. The push rods extend down through the cylinder head, cylinder block, and into valve lifters which are held in place by the camshaft. Upper ends of push rods are concave to receive ends of valve lash adjustment screws threaded into one end of rocker arm. Other end of rocker arm actuates valves through push rods. When push rods are forced upward by camshaft lobes, rocker arm forces valve open. Tension of valve spring closes valve when push rods move downward. An oil feed line from the engine oil gallery, connected to the side of the cylinder head, leads to an oil feed in line tube. Both ends of shaft are blocked, forcing oil out holes at each rocker arm location and into a drilled passage in each rocker arm, providing lubrication for the assembly. Oil spilled down over push rods and valve springs drains back to oil pan through overflow tube.

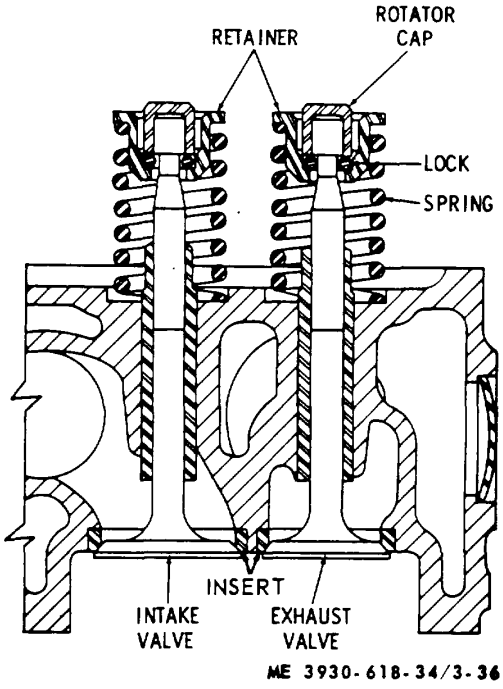


Figure 3-36. Intake and exhaust valve assembly.

b. Valve Mechanism Service.

(1) Operations not requiring cylinder head removal:

(a) Adjustment of valve clearance (TM 10-3930-618-20).

(b) Replacement of valve push rods.

(c) Replacement of valve lifters.

(d) Replacement of valve springs.

(e) Replacement of any part of rocker arm assembly.

(2) Cylinder head must be removed to perform the following operations:

(a) Replacement of valves.

(b) Replacement of valve guides.

(c) Grinding or reseating valves.

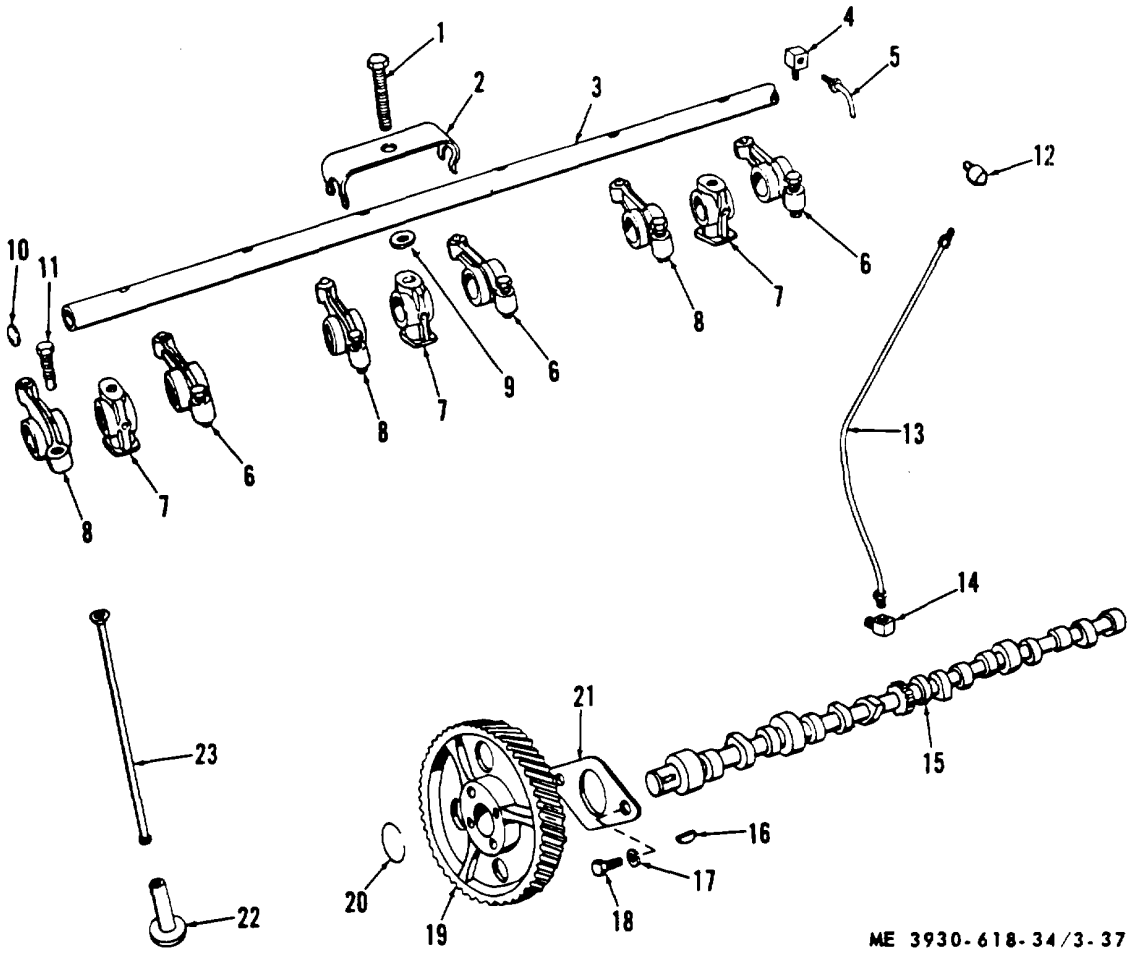
(d) Replacement of valve seat inserts.

c. Rocker Arm Removal and Inspection. The following operations may be performed without removing the engine from truck, and if performed in the truck disregard (1) below.

(1) Remove engine from truck (para 3-19).

(2) Remove rocker arm cover (3, fig. 3-30).

(3) Remove line assembly (5, fig. 3-37) from cylinder head and rocker arm shaft (3).



1 Capscrew
2 Clip
3 Shaft
4 Elbow
5 Line assembly
6 Rocker arm
7 Bracket
8 Rocker arm
9 Washer
10 Expansion plug
11 Adjusting screw
12 Elbow
13 Line assembly
14 Elbow
15 Camshaft
16 Key
17 Lockwasher
18 Capscrew
19 Gear
20 Retainer
21 Thrust plate
22 Valve lifter
23 Push rod

Figure 3-37. Valve operating mechanism and camshaft.

(4) Remove capscrews (1) and washers (9) attaching rocker arm shaft brackets (7) to cylinder head, and lift rocker arm assembly from cylinder head.

(5) Remove elbow (12) and line assembly (13) from collar at center of rocker arm shaft.

(6) Remove rocker arm brackets and collar from shaft.

(7) Inspect rocker arm bore for wear. Specified clearance between shaft and bore is 0.001 to 0.0035 inch, and must not exceed 0.007 inch. If clearance is greater than allowable limit, rocker arm must be replaced. Inspect machined ends (valve stem end) of rocker arms for signs of wear. If not excessively worn, contact surfaces may be refaced on a valve lathe.

(8) Inspect the rocker arm shaft for wear. Remove expansion plugs (10), and clean oil holes with cleaning solvent (Spec. P-S-661), and dry with compressed air.

d. Rocker Arm Installation.

CAUTION

The rocker arms are not designed to contact the valve stems at the center, but 1/16 inch off center. Do not bend rocker arms to make them line up center-to-center with valve stems.

(1) Make certain plugs are tight in ends of shaft.

(2) Install exhaust rocker arms (7, fig. 3-37), shaft support, and intake rocker arm (6) in order shown. Assemble last half in same manner, then install second washer and cotter pin.

(3) Install oil tube elbow (12) and line assembly (13) in collar at center of shaft. Make certain elbow enters hole in shaft.

(4) Install rocker arm assembly on cylinder head, making certain that shaft supports are positioned with longer section down.

(5) With valve lash adjusting screws (11) correctly seated in push rods, tighten shaft support stud nuts and capscrews. Torque to 18 to 22 ft-lbs.

(6) Install oil line assembly (5) between rocker arm shaft and cylinder head.

(7) Adjust valves for correct clearance (TM 10-3930-618-201.

(8) Install rocker arm cover making certain gasket is in good condition and properly positioned, then install vent hose.

e. Removal and Inspection of Lifters and Push Rods.

(1) Remove rocker arm assembly (*d* above).

(2) Withdraw push rods (23). Inspect ball and cup ends for signs of wear; polish out any nicks or score marks. If push rods are bent, twisted, or damaged they must be replaced.

(3) If inspection indicates valve lifters (22) should be removed, refer to paragraph 3-24.

f. Installation of Lifters and Push Rods.

(1) Install lifters, reversing procedures in e above.

(2) Install push rods with cup end to top of cylinder head.

(3) Recheck to make sure that push rods are firmly seated in lifters.

(4) Install rocker arm assembly and rocker arm cover (*d* above).

g. Removal, Inspection, and Installation of Valve Springs.

(1) With cylinder head removed from block.

(a) Remove cylinder head (para 3-20).

(b) Place cylinder head on end, depress valve springs (27, fig. 3-30) with a spring depressing tool and remove spring retainer locks (29). Release valve spring depressing tool and remove valve spring retainer and valve spring.

(c) Inspect valve springs for cracks. Both intake and exhaust valve springs should have a load of 42- to 47-pounds when compressed to length of 1 27 / 32 inch. When compressed to a length of 1 13/32 inch, they should have a load of 122- to 131-pounds. Spring free length is 23 / 32 inches. Replace any springs that are found to be weak or cracked.

(*d)* Install valve spring by a direct reversal of (*b*) above. Make certain that the release type rotors (30, fig. 3-30) are installed on exhaust valve stems only.

(*e)* Install cylinder head (para 3-20).

(2) Cylinder head not removed from engine.

(a) Remove rocker arm cover and rocker arm assembly (c) above.

(b) Crank engine to make certain that piston in cylinder from which valve springs are to be removed, is at top dead center. Using two heavy screwdrivers, or suitable pry bars, and using the manifold as a fulcrum, pry down on valve spring retainer (28) until valve spring retainer locks (29) can be removed. Remove valve spring retainer locks and carefully release tension on valve spring. Remove valve spring retainer and valve spring.

(c) Perform procedures in (1) (*c*) and (*d*) above.

(d) Install rocker arm assembly and rocker arm cover (*d* above).

h. Removal and Inspection of Valves, Guides, and Seat Inserts.

(1) Remove rocker arm assembly. Refer to (*c* above).

(2) Remove cylinder head from cylinder block. Refer to paragraph 3-20.

(3) Remove valve springs. (Refer to (*g* above).

(4) Remove valves from cylinder head. Place valves in a rack as they are removed from cylinder head so they can be identified and reinstalled in their original positions.

(5) Clean carbon from valves and valve inserts (21 and 22). Clean carbon from valve guides (14) using a valve guide cleaning tool.

(6) Replace valves if they are cracked, bent, or worn beyond allowable limits. Specified diameter of valve stems is 0.3405 inch to 0.3415 inch. Specified clearance of valve stems in valve guide is 0.0015 inch to 0.0035 inch. If clearances exceed specified limits, valve, guide, or both should be replaced.

(7) Valve guides (14) are removed by pressing them out through bottom of cylinder head, using a valve guide removing tool.

(8) New valve guides are installed by inserting upper (chamfered) end of guide on guide installing tool and pressing into cylinder head until top of guide is 7 / 32 inch above top surface of cylinder head. Both intake and exhaust valve guides are positioned to the same depth in head.

(9) After valve guides have been installed, insert valve stems into guides to check for proper clearances between valve stems and valve guides. Specified clearance if 0.0015 inch to 0.0035 inch.

If clearance is less than specified minimum, guides must be reamed to obtain proper clearance. Inside diameter of valve guide is 0.343 inch to 0.344 inch.

(10) Valve seat inserts (21 and 22) are replaceable. Standard seats are available for service. Inspect valve seat inserts. If loose, cracked, or pitted new inserts must be installed. Inserts are a shrink fit in cylinder head. Remove insert shown in figure 3-36 by electric welding a bead around inside circumference of insert on beveled portion. Allow insert to cool, then lift out.

CAUTION

Protect machined surfaces from arc splatter.

(11) Care must be exercised when installing new valve seat inserts. Inserts are installed into cylinder head with a 0.0025 inch to 0.0045 inch shrink fit and must be started in place "true" with counterbore in cylinder head.

(a) Be sure insert counterbores in cylinder head are clean and free of burs.

(b) Thoroughly chill insert with dry ice.

(c) Clean counterbore with compressed air and start insert into counterbore (valve seat side up).

(d) Using a valve seat installer tool, drive insert down tight into counterbore. This operation must be done quickly, while insert is cold. After installation, stake valve seat in position with a center punch at two or three points around edge of seat..

(e) It will be necessary to refinish valve seat inserts with a grinder (*i* below).

i. Valve and Valve Seat Grinding.

(1) Before installing new valves or valves previously used, valve seats in cylinder head should be inspected for proper valve seating. If previously used valves are to be reinstalled, valve stems should be cleaned and valve faces ground to an angle of 45°. When refacing valves, remove just enough to clean up seat, removing all evidence of pitting and grooving.

(2) Valve guide should be cleaned with a valve guide cleaning tool. If bore of valve guide is worn oblong, or if valve head is warped relative to valve stem, damaged parts must be replaced.

(3) When new valve seat inserts are installed, or previously used inserts refaced, refinishing must be done with a valve grinder set because of very hard valve seat material.

NOTE

It is very important that valve grinder set be used according to manufacturer's directions.

(4) The usual equipment furnished with the valve seat grinder set includes the following items:

(a) Valve seat grinder.

(b) Dial gauge.

(c) Tool pilot.

(d) Grinding wheels of 30°, 45°, and 60°.

(5) Install tool pilot in position in valve guide. Use a 45° grinding wheel for refacing valve seat and use the 30° to 60° grinding wheels for narrowing the seat width to the specified 1 / 16 inch for intake and 3 / 32 inch for exhaust valve seats.

(6) After a grinding wheel has been used several times, cutting angle of stone must be reground and made true to obtain proper seat angle.

(7) After valve seats have been ground, use dial gauge to check concentricity of valve seats relative to valve guides. Total runout of valve should not exceed 0.002 inch.

(8) After valve seats have been ground, valves may be inserted in position in cylinder head and lapped in place, using fine grain valve lapping compound. After lapping, contact between valves and seats may be checked by wiping a thin film of Prussian Blue on each valve seat, setting valve in place, and bouncing each valve once on its seat.

NOTE

Do not revolve valve when checking seat.

(9) If valve seats are properly ground, a continuous thin blue line will be evident around face of valve.

(10) Clean valves and block and install valves *h* above.

(11) Install cylinder head (para 3-20).

3-24. Camshaft, Bearings, and Valve Lifters

a. Description. The camshaft is manufactured of drop forged, open hearth steel. case hardened at the cams and journals, and is located in the rightside of the engine block (as mounted in truck). Rigidly supported by four replaceable bronze bearings, the camshaft's end play is controlled by an end thrust plate at the timing gear end. The valve lifters ride on precision ground cams of the shaft and provide the timing link between the camshaft and valves through the push rods and rocker arm assembly. The camshaft bearings seldom need replacement or repair, and since it is necessary to disassemble the entire crankcase to effectively check bearing to camshaft clearances, it is recommended that camshaft bearings be checked every time crankcase disassembly allows access to the camshaft and bearings.

b. Removal.

NOTE

It is recommended that camshaft be replaced only when engine is removed from truck. However. in an emergency it is possible to replace it without engine removal. Instructions below apply to both methods. however. if engine has already been removed from truck. disregard (a) and (e).

(c) Remove distributor (TM 10-3930-61820).

(d) Remove steering axle assembly (para 2-14).

(e) Remove timing gear cover (para 3-25).

(f) Remove lubricating oil pump (para 3-13).

(g) Rotate crankshaft until openings in camshaft gear align with thrust plate capscrews (18, fig. 3-37), then remove capscrews.

(h) If engine is in truck, push valve lifters (22, fig. 3-37) upward in cylinder block. In most cases. they fit tight enough in the lifter bore to stay out of the way of the cam lobes. If they do not stay out of the way voluntarily, they may be lifted separately by rotating the camshaft while removing it.

(i) If the engine has been removed from truck, turn engine on its side, push the lifters up into their bores and they will stay out of the way of the camshaft lobes during removal.

(j) Remove camshaft by drawing it out of the cylinder block at the gear end. Be careful to keep it aligned with bore so that the camshaft bearings will not bind on the camshaft journals.

(k) Remove valve lifters from the cylinder block by withdrawing them from their bores.

(2) *Camshaft bearings*.

(a) Remove camshaft as described in (11 above.

(b) Remove flywheel housing (para 3-26).

(c) Remove camshaft hole plug (4, fig. 3-32) from flywheel end of camshaft bore.

(d) If removing and installing tool is not available, carefully cut through gear end bearing (5) with a hacksaw blade, being careful not to cut into crankcase.

(e) Break bearing with hammer and chisel and remove it.

(f) Remaining bearings (6 and 7) can be removed as outlined in (*d*) and (*e*) above, or with installing tool (fig. 3-38).

c. Inspection and Repair.

(1) *Camshaft and lifters.*

(a) Check camshaft thrust clearance (fig. 3-39) by inserting feeler gauge between thrust plate and camshaft bearing surface (fig. 3-39). Specified thrust clearance is 0.003 inch to 0.008 inch.

(b) If end clearance exceeds maximum wear limit of 0.014 inch, remove gear from camshaft and

1. Remove gear retaining ring (20, fig. 3-37.

2. Install gear puller and remove gear (19) and key (16) from shaft.

3. File back of gear hub (side facing cylinder block). This permits pressing gear further onto shaft, reducing thrust plate clearance.

(c) Check camshaft journals for out-of round and deviations from design diameters.

Specified diameters of camshaft journals are-

1. 1.248 inch to 1.249 inch for the flywheel end.

2. 1.998 inch to 1.999 inch for the intermediate and gear end journals.

(d) Check valve lifters for wear. Valve lifters fit in their bores is 0.0010 inch to 0.0025 inch. If wear exceeds 0.0035 inch, lifters should be replaced. Lifters must be free to rotate in their bores, otherwise scuffing will result.

(2) *Camshaft bearings.*

(a) Check camshaft bearings for excessive looseness, wear, or other damage.

(b) Check inside diameter of bearings for roundness and conformance to specifications, which are -

1. 1.2510 inch to 1.254 inch for the bearing at the flywheel end of engine.

2. 2.0010 inches to 2.004 inches for the intermediate and gear end camshaft bearings.

(c) If clearance between camshaft journals and bearings exceeds 0.0065 inch, new camshaft bearings must be installed.

d. Installation.

(1) *Camshaft bearings.*

(a) Install camshaft bearings with camshaft bearing installing tool (fig. 3-38).

NOTE

The bearing nearest the flywheel end of block is 1**.**0 inch wide, intermediate is 7 / 8 inch wide, and the gear end bearing is 1 1/8, inch wide.

(b) Drive bearings into place with a driving bar. They do not require reaming after installation.

(c) Install new camshaft hole plug in open end of bore in the flywheel housing mounting face of the cylinder block.

(2) *Camshaft and valve lifters*. Install by direct reversal of procedures in *b* above.

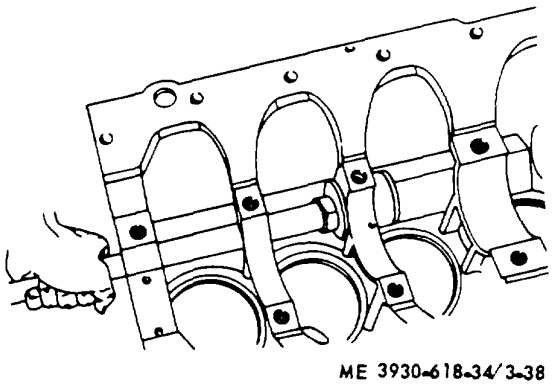


Figure 3-38. Camshaft bearing installation.

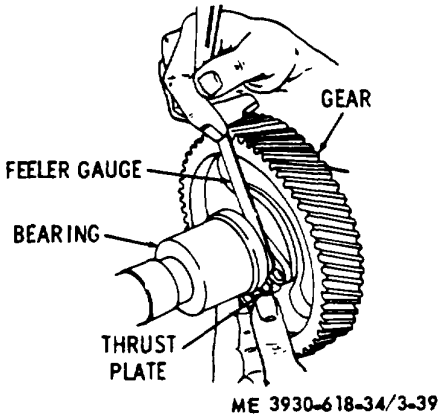


Figure 3-39. Checking camshaft thrust clearance.

3-25. Timing Gears and Cover

The timing gear housing at the rear end of the engine contains a train of three helical gears; a crankshaft gear which is pressed and keyed on the crankshaft, a camshaft gear, and a governor gear driven by the camshaft gear. Gear train is splash lubricated by excess oil from engine oil system relief valve. The rear engine mount is located in the lower portion of the timing gear cover casting.

a. Removal and Installation of Timing Gear Cover.

NOTE

The following procedures apply to removal of cover with engine mounted in truck. if engine is out of truck, disregard (1) and (5) below.

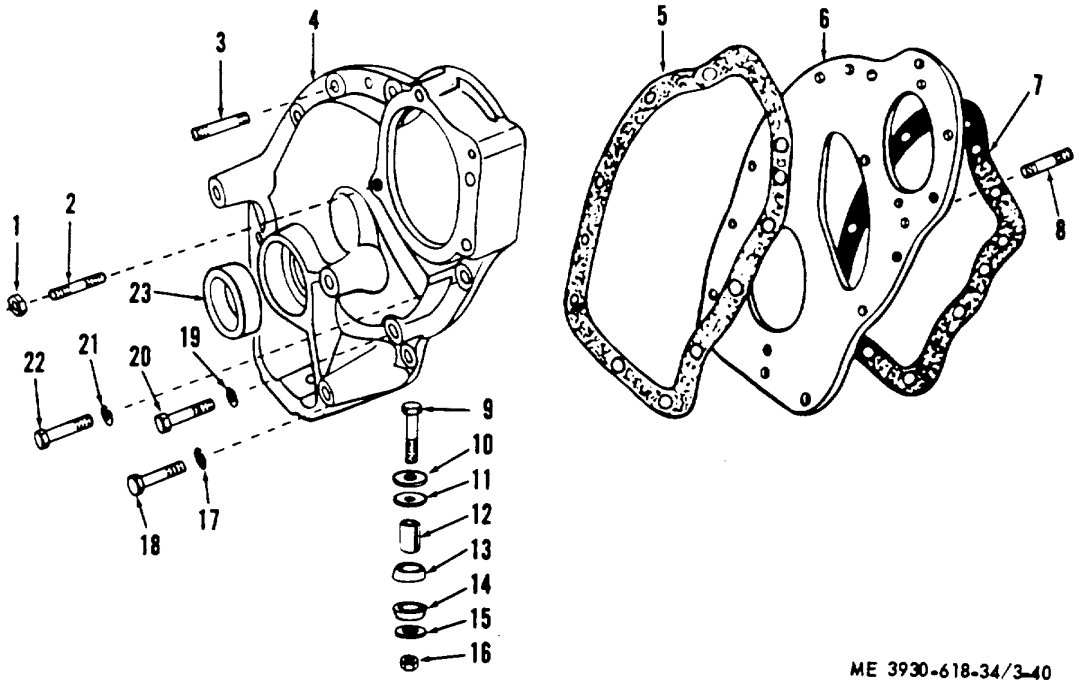
(1) Remove radiator (TM 10-3930-618-201.
(2) Remove cooling fan (TM 10-3930-618-20).
(3) Remove crankshaft pulley (para 3-21).
(4) Remove governor (para 3-9).
(5) Remove support capscrews (9, fig. 3-40) and raise rear end of engine approximately 2.0 inches, and block the engine in this position. This takes weight of engine off mounting pad on timing gear cover.
(6) Remove capscrews (18, 20, and 22) nuts (1) and lockwashers (17, 19, and 21) attaching timing gear cover (4) to front plate (6) and oil pan.
Do not attempt to pry cover off. Tap cover lightly with wood or plastic mallet to remove.
(7) To install, reverse removal instructions above.

b. Inspection and Repair.

(1) Inspect timing gear cover for cracks, dents, breaks, or other damage which could prevent a secure seal of the timing gear cover.
(2) Replace gaskets.
(3) Replace defective parts.

c. Timing Gears.

(1) Refer to paragraphs 3-21 and 3-24 for crankshaft and camshaft timing gears.
(2) Refer to paragraph 3-9 for governor timing gear.
(3) Check backlash of timing gears with a dial indicator. One or more of the mating gears should be replaced if backlash exceeds 0.007 inch.



1 Nut
2 Stud
3 Stud
4 Timing gear cover
5 Gasket
6 Plate assembly
7 Gasket
8 Stud
9 Capscrew
10 Washer
11 Washer
12 Sleeve
13 Insulator
14 Insulator
15 Washer
16 Nut
17 Lockwasher
18 Capscrew
19 Lockwasher
20 Capscrew
21 Lockwasher
22 Capscrew
23 Oil seal

Figure 3-40. Timing gear cover and rear support.

3-26. Flywheel, Ring Gear, and Housing

a. Removal.

(1) Remove transmission (para 3-16).

(2) Remove two of the flywheel mounting capscrews (10, fig. 3-41), which are opposite each other, and install a pair of guide studs.

(3) Remove remaining mounting capscrews, and slide flywheel (11) off over guide studs.

(4) If inspection indicates necessity of removing ring gear proceed as follows:

(a) Grind notch through gear (8) at route of one of the teeth.

CAUTION

Be certain not to notch flywheel.

(b) Expand ring gear and drive from flywheel (11).

CAUTION

Do not attempt to drive notched ring gear from flywheel without first expanding it.

(5) Loosen capscrews on oil pan (para 3-12) to relieve pressure on pan section of oil seal in flywheel housing.

(6) Remove two flywheel capscrews (7) opposite each other, and install a pair of guide studs.

(7) Remove remaining housing capscrews and slide flywheel housing off over guide studs.

(8) If necessary, remove oil seal (1).

b. Inspection and Repair.

(1) Inspect oil seals for cracks, tears, deterioration, deformation, or other damage.

(2) Inspect oil seal flange on engine side of flywheel for nicks or burs. If defective, smooth with a fine stone or crocus cloth.

(3) Remove all burs and nicks from mating surfaces of the flywheel and crankshaft flange.

CAUTION

It is extremely important that all burs and nicks be removed from mating surfaces of flywheel and crankshaft flange. If surfaces are not smooth and true, the flywheel may wobble. Flywheel wobble would result in improper torque converter operation, engine vibration, and shortening of the life of crankshaft bearings and other parts.

(4) Inspect flywheel housing for cracks, bends, nicks, holes, stripped threads, corrosion, and other damage which would interfere with its proper operation.

(5) Replace defective parts as authorized.

c. Installation.

(1) Install flywheel and housing by reversing procedures in *a* above.

(2) Install new inner and outer oil seals whenever any signs of leakage appear, and whenever engine is overhauled.

NOTE

Flywheel can be installed in only one position on the crankshaft flange because on of the capscrews is offset slightly. Any time a new flywheel is installed. be certain to check the timing marks of the old and new flywheels.

(3) To install a new ring gear -

(a) Heat ring gear to approximately 400 degrees Fahrenheit (400°F.). The desired temperature produces a dull red heat visible in the dark.

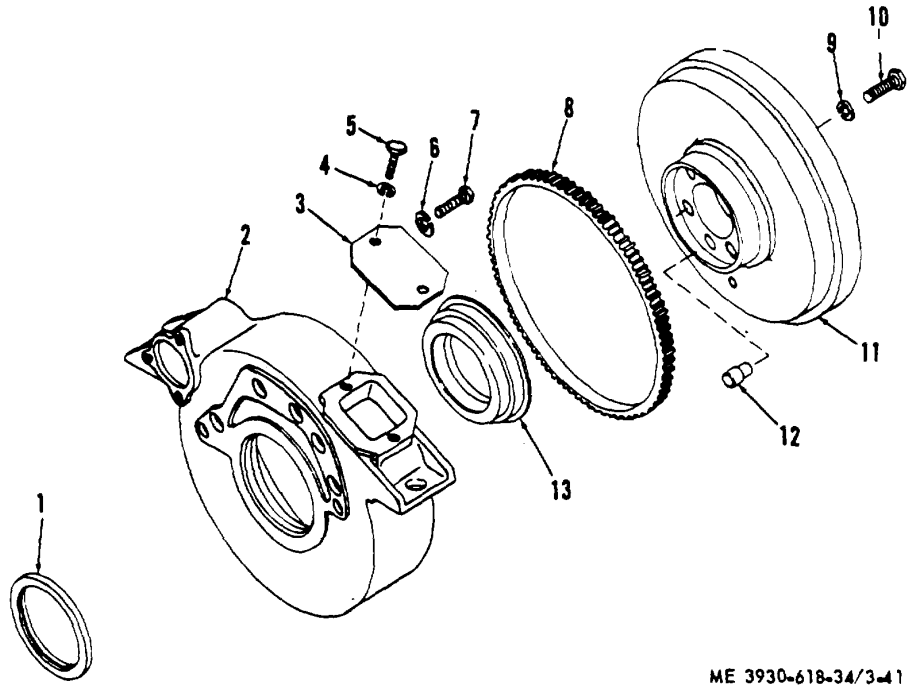
(b) Place heated ring gear on flywheel with chamfered ends of gear teeth away from flywheel shoulder, and toward the oil seal flange. The flywheel should be at room temperature.

(c) Drive ring gear down tight against shoulder of flywheel.

(d) After the installation of housing, flywheel, and ring gear, and before installation of starting motor and transmission, dial indicate both flywheel and housing as follows:

1. Attach a dial indicator to housing, at one of the transmission mounting holes, and check flywheel for runout. Runout should not exceed 0.005 inch.

2. Attach dial indicator to center of flywheel, and check flywheel housing for runout, which should never exceed 0.010 inch.



1 Outer oil seal
2 Housing
3 Cover
4 Lockwasher
5 Capscrew
6 Lockwasher
7 Capscrew
8 Ring gear
9 Lockwasher
10 Capscrew
11 Flywheel
12 Dowel
13 Inner oil seal

Figure 3-41. Flywheel, ring gear, and housing.

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and
PAGE 3-54

CHAPTER 4

REPAIR OF HYDRAULIC SYSTEM

Section I. HYDRAULIC SYSTEM

4-1. General

In this equipment all lifting, tilting, and steering units are operated by means of hydraulic pressure. Service and adjustment of the hydraulic system is described in TM 10-3930-618-20. This section will cover direct and general support maintenance of the hydraulic system components.

4-2. Pump Assembly

a. Removal. Refer to paragraph 2-10 for hydraulic pump removal.

NOTE

Clean outside of pump prior to starting disassembly.

b. Disassembly.

(1) Remove screws and separate flange from pump body (fig. 4-1).

NOTE

To prevent chance of leakage at reassembly, avoid scoring or nicking of mating cover, housing, and adapter machined surfaces. Do not use a screwdriver to pry components apart. Use a loft hammer and tap gently to loosen the sections on dowel pins.

(2) Remove screws and separate flange (3) from body (18).

(3) Remove seals (1 and 2).

(4) Remove packing (5) and front O -rings (4) and O -rings (6).

(5) Tip pump to front and allow bushings (7) to slide out into hand. If bushings do not slide out, jar them loose by tapping side of pump body with a soft hammer.

NOTE

Identify bushings as "front" to insure proper assembly. Interchanging front and rear bushings will greatly reduce pump efficiency.

(6) Tip pump body to rear and lift out gears (25 and 26).

(7) Remove bushings (24) in same manner as bushing (7) (5 above). Remove rear packings and rings.

(8) Normally, plug (23) will be forced out by spring (20) when flange (3) is removed. If not, turn a 1/4 inch screw into plug and pull out the plug.
Then remove spool (21) and spring (20).

(9) Remove plug (15) and remove relief valve parts (10 through 14).

c. Cleaning and Inspection.

NOTE

All parts should be thoroughly cleaned in cleaning solvent (Spec. P-S-661) and dried with compressed air before inspection. After inspecting, reclean serviceable parts, apply a coating of oil and wrap the parts in clean, lint-free cloths until the pump is reassembled.

(1) Clean in accordance with above note.

(2) Using a 2-inch inside micrometer, measure bore in body (18) near the front. The bore diameters should not exceed 1.770 inch.

(3) It is normal for gears to cut shallow grooves with tips of teeth on the inlet side. Measure depth of groove cut by idler gear (26), which will be slightly deeper than groove cut by drive gear (25).
Discard body if groove depth exceeds 0. inch.

(4) Normal grooves (tracks) have a smooth texture radially and are of slightly darker color than rest of body.

(5) If grooves have a sandpaper like texture and are light gray or silver in color (when dry), oil in the system is either dirty or foamy. Check for dirty oil, clogged filters, and leaks in pump suction line.

(6) Check seals (1 and 2) for nicked or frayed lips or signs of leakage. Replace seals if conditions exist.

(7) Inspect gear journals on both shafts for general condition. Small radial scratches left by particles in the oil are normal. If journal surfaces are blackened and can be easily scratched, they have lost their hardening, and gear assemblies must be replaced. Polish journals with 400 grit sandpaper or finer.

(8) Measure gear assemblies for following dimensions: *(a)* Journal diameter-0.872 inch minimum.

(b) Gear length-1.319 inch minimum.

(c) Gear diameter (outside)-1.754 inch minimum.

(9) Inspect gears for burs which could cut faces of bushings. Remove burs with fine hone.

(10) Inspect bushings (7 and 24) for dents, deformations, and for grooves cut in faces by foreign particles.

(11) Hone front and rear faces of bushings with an extra fine stone, moving stone in circular motion.

NOTE

Do not attempt to remove all cuts as the face Will probably become out-of square with the outside diameter.

CAUTION

Use care when honing to avoid breaking sharp edge between face of bushing and outside diameter.

(12) Measure entire bore of each bushing. Bores will be slightly oval due to wear but must not exceed 0. inch at any point or bushing must be replaced.

(13) Measure length of bushings at a number of points. Shortest length must not be less than 1.055 inch or bushing must be replaced.

(14) Gears will sometimes make small cuts in rectangular land near flat of bushings. Depth of these cuts must not exceed 0.002 inch or bushing must be replaced.

(15) Inspect for erosion on bushing faces near rectangular lands and in lube oil slots. Erosion at these points is caused by air in oil. Replace bushings having erosion at these points. Slight erosion on outside diameters and on flats is normal.

(16) Visually inspect spool (21) for erosion and scratches. Insert spool in bore and check that it slides freely in bore.

(17) Measure diameters of spool lands. Replace spool if any land diameter is less than 0.748 inch.

(18) Clean deposits from balance orifice in spool using a fine, soft wire. Also check slow orifices and clean as necessary using fine, soft wire.

(19) Check both springs (20 and 14) for bent or deformed condition. Spring (20) should have a free length of 3 1/2 inches. Spring (14) should have a free length of 7/8 inch. Replace springs if bent, deformed, or stretched.

d. Assembly

(1) Reverse procedures in c above.

(2) Do not reuse packings and backup rings.

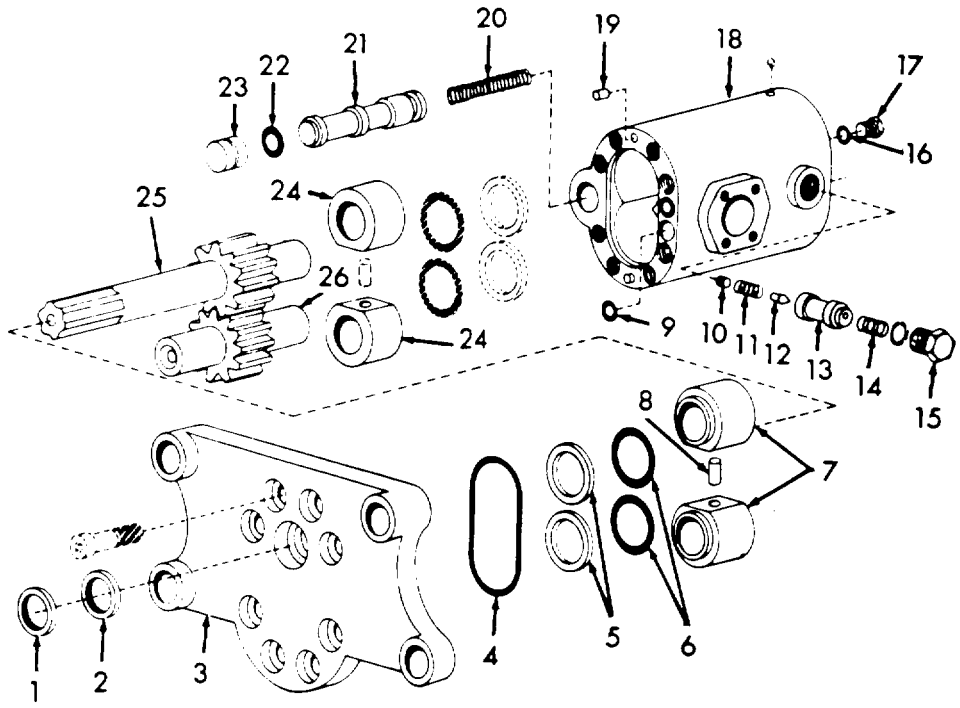
(3) Apply small amount of heavy grease to packings (6) and backup rings (5) to hold them in position on bushings (7). Slide bushings into bores, do not tap or force them in any way. Make sure packings and backup rings remain in place. Apply a coat of light oil to bushing surfaces for ease of installation.

(4) Apply coat of light oil to gear faces and to shaft journals before installing.

(5) Insert spring (20) in spool (21) and insert spool in body bore. Assemble O -ring (22) to plug (23), coat with light oil, and press plug into bore until flush with face of body. Then install flange (3) on body (18). Make sure O -ring (4) is in place.

(6) Install relief valve parts (10 through 14) in order shown and tighten plug (15) until ii: bottoms.

e. Installation. Refer to paragraph 2-10 for pump installation.



1 Seal
2 Seal
3 Mounting flange
4 O-ring
5 Packing
6 O-ring
7 Bushing
8 Bushing dowel
9 O-ring
10 Setscrew
11 Spring
12 Relief valve cone
13 Spool
14 Relief spring
15 Relief port plug
16 O-ring
17 Plug
18 Body
19 Body dowel
20 Valve spool spring
21 Spool
22 O-ring
23 Plug
24 Bushing
25 Drive gear
26 Idler gear

Figure 4-1. Hydraulic pump disassembly and reassembly.

4-3. Hydraulic Control Valve

a. Description. The hydraulic system control valve contains two plunger sections; an inlet section, and an outlet section. Each of the sections may be replaced separately. All parts of the sections may be replaced individually except the plunger section housings and their selectively-fit plungers, which must be replaced as units.

b. Removal. Refer to paragraph 2-12 for hydraulic control valve removal.

c. Disassembly. Refer to figure 4-2 and disassemble as follows:

CAUTION

It is extremely important that all parts be kept clean at all times, and that all machined surfaces be protected from nicks, scoring, gouging, and other damage. Disassemble valve assembly only as far as is necessary.

(1) Separate the control valve into its major sections by removing nuts (19) from tie rods (44) and slip the sections off of tie rods.

(2) Disassemble defective sections using figure 4-2 as a guide.

d. Cleaning and Inspection.

(1) Clean all parts in (SPEC. P-S-661).

(2) Inspect springs for cracks, wear, deformation, or signs of weakness.

(3) Inspect all seals for cracks, cuts, or other damage.

(4) Inspect all machined surfaces for nicks, scratches, gouges, or other damage which could cause internal or external leakage.

(5) Inspect all housings for cracks, stripped

threads, or other damage which could affect operation.

(6) Inspect plungers and plunger bores for scoring, chips, nicks, cracks, or other damage which could result in internal or external leaks.

(7) Replace seals and defective parts.

e. Refer to figure 4-2 as a guide to assembly.

NOTE

Recheck each part before assembly for dirt or damage.

(1) Reverse procedures in *c* above.

(2) Coat all seals with approved hydraulic coil before installing.

(3) Use new packings.

(4) Tighten nuts (19 and 45) to 18 ft-lbs torque.

f. Installation. Refer to paragraph 2-13 for control valve installation.

g. Relief Valve Adjustment. Refer to figure 4-2 and adjust as follows:

(1) Remove the plug from the inlet port elbow and install a pressure gage. The gage must be calibrated to at lease 2,000 psi.

(2) Remove the capnut (1) from the adjusting screw (41 and loosen the locknut (3).

(3) Start the engine and accelerate to high speed.

(4) With the engine running at high speed, operate the tilt control lever to run the tilt cylinders to the end of their stroke. Hold the tilt control lever in operate position through step (5 below.

(5) Adjust the adjusting screw to obtain a gage reading of 1,950±50 psi.

(6) Hold the screw in position and tighten the locknut.

(7) Check the setting with a capacity load on the forks before removing the gage. Readjust as necessary.

(8) Shut off the engine.

(9) Install the capnut over the adjusting screw, remove the pressure gage, and install the plug.

Key to figure 4-2

1 Capnut
2 Washer
3 Locknut
4 Adjusting screw
5 Spring
6 Poppet
7 Plug
8 Packing
9 Backup ring
10 Packing
11 Spring
12 Piston
13 Poppet
14 Packing
15 Backup ring
16 Poppet
17 Cup
18 Packing
19 Nut
20 Plug
21 Packing
22 Inlet section
23 Packing
24 Screw
25 Plate
26 Wiper
27 Packing
28 Tilt plunger
29 Tilt plunger housing
30 Capscrew
31 Cap
32 Capscrew
33 Spring seat
34 Spring
35 Spring seal
36 Plate
37 Wiper
38 Packing
39 Packing
40 Outlet section
41 Spring
42 Poppet
43 Packing
44 Tie rod

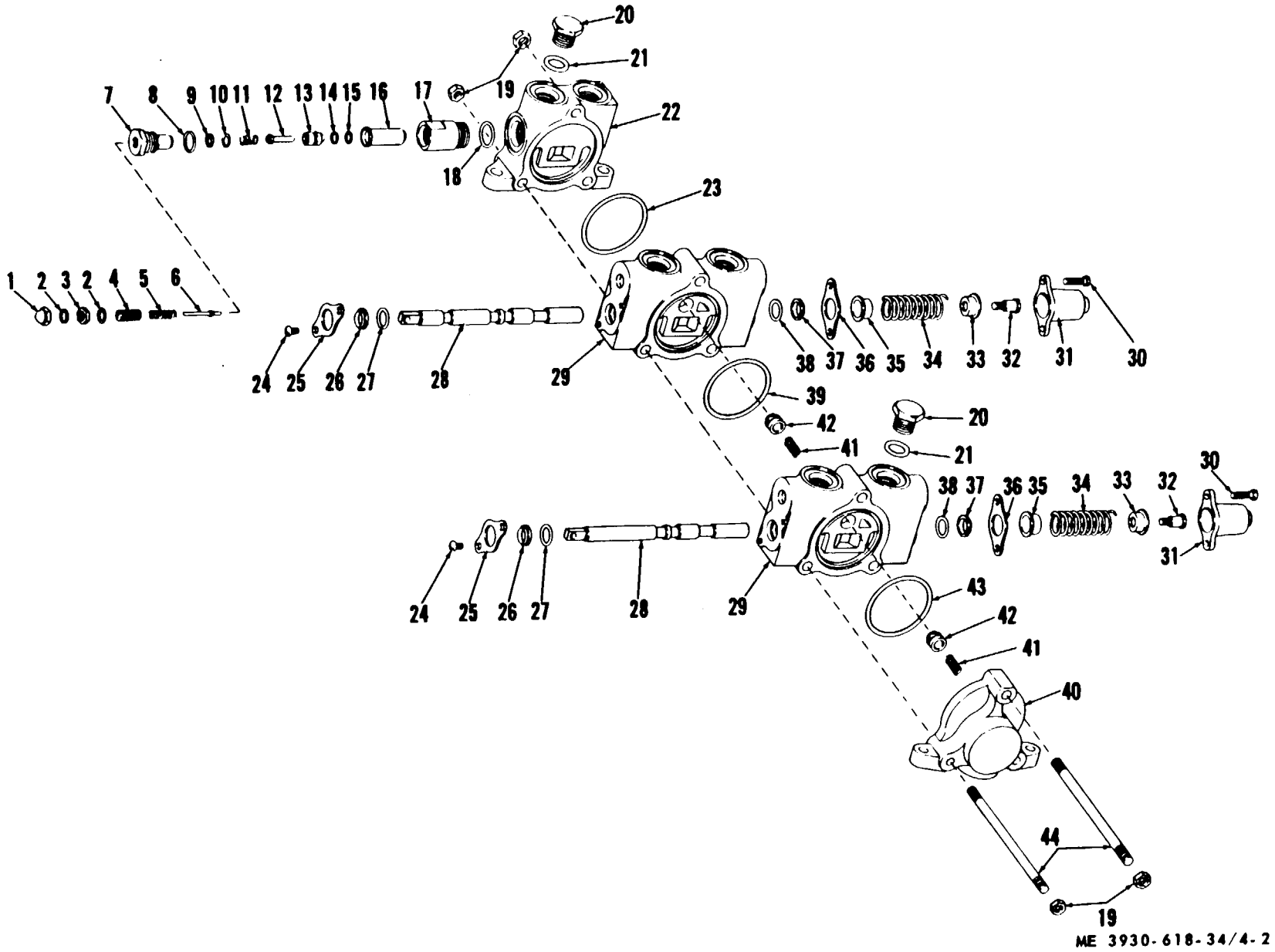


Figure 4-2. Hydraulic control valve.

4-4. Hydraulic Reservoir

a. Description. The purpose of the hydraulic reservoir is to hold sufficient oil for the entire hydraulic system. It consists of a 7.2 gallon tank, combination filler and plug and dipstick, and a washable breather cap. It is attached to the frame on the left side of the truck. The suction line on one end of the tank is located near the bottom to prevent air from being drawn into the pump, causing pump noise and erratic operation of the system. The return line is connected to the opposite end of the tank, also near the bottom. This is to help prevent foaming of the oil. A magnetic drain plug is provided on the bottom of the tank to drain out all the oil when necessary. A screen is located in the, auction line between the reservoir and pump at the junction midway of the line.

CAUTION

Always refer to LO 10-3930-618-12. NEVER USE BRAKE FLUID. Make sure containers and surrounding parts are clean when filling tank, to prevent dirt from contaminating the oil.

b. Removal. Refer to TM 10-3930-618-20 for hydraulic tank removal.

c. Disassembly. Refer to figure 4-3 and disassemble the tank as follows:

(1) Remove all plugs, fittings, breather cap and dipstick from the reservoir.

(2) Clean outside of reservoir with cleaning solvent.

(3) Thoroughly flush reservoir with solvent to remove dirt or other sediments.

(4) Inspect reservoir for bad dents, cracks, and leaks. Replace reservoir if cracked or badly dented.

(5) Inspect for damaged or worn threads in openings. Repair damaged threads by chasing if practical, otherwise replace the reservoir.

(6) Check filler screen for clogging or damage.

Clean screen with cleaning solvent and dry with compressed air. If filler screen cannot be cleaned, replace with new filler screen.

d. Reassembly. Reverse the procedure as outlined in *c* above.

e. Installation. Refer to TM 10-3930-618-20 for hydraulic tank installation.

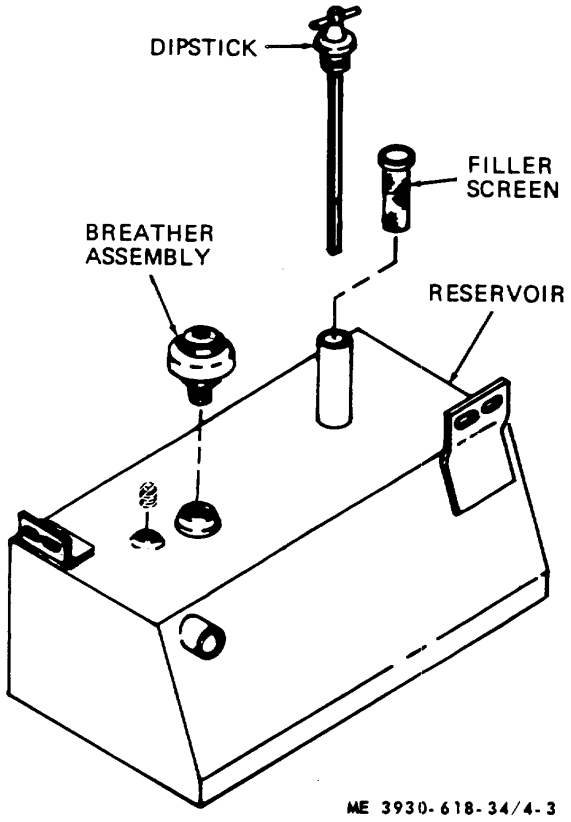


Figure 4-3. Hydraulic reservoir.

Section II. REPAIR OF HYDRAULIC LIFT CYLINDERS

4-5. Tilt Cylinders

a. Description. The two double acting till cylinders provide the means for tilting the mast assembly 30 forward and 100 back. They are located under cowls on each fender. Action of the tilt cylinder is a straight line motion. Any misalignment between the cylinder and piston will cause binding, rapid wear of packing and packing gland, rapid wear of piston rod and packing, and tend to break the weld on the cylinder case. The welded section is designed to hold hydraulic pressure and should not be called upon to hold any bending action due to misalignment.

b. Removal. Refer to paragraph 2-12 for tilt cylinder removal and installation.

c. Disassembly. Refer to figure 4-4 and disassemble the tilt cylinder as follows:

(1) Secure tilt cylinder in bench vise. Be careful not to deform cylinder.

(2) Loosen capscrew in yoke (27) and unscrew yoke from plunger rod (16).

(3) Unscrew packing nut (24) from retainer (22).

(4) Remove screw (23) from retainer (22) and unscrew retainer from tube assembly.

(5) Grasp rod (16) and pull all internal parts (assembled) from tube assembly.

(6) Remove cotter pin (4) and nut (3) from rod (16).

(7) Disassemble remainder of parts in order shown.

d. Cleaning and Inspection.

(1) Clean all metal parts with solvent and dry thoroughly.

(2) Check cylinder tube bore for scores or nicks.

(3) Check sliding surfaces of guide ring (5) and follower (12) for scores, nicks, or other irregularities which could damage cylinder tube bore.

(4) Check bores of guide ring (5), follower (12), and packing nut (24) and mating surfaces of plunger rod (16) for damage which could cause faulty seating, leaks, or damage to other parts.

(5) Check all backup rings and hardware for cracks, bends, deformation, stripped threads, and other damage.

(6) If mating or sliding surfaces are damaged the parts must be replaced.

(7) Replace all packings, guard rings, and wiper rings.

e. Reassembly.

(1) Assemble tilt cylinder in reverse order of procedures in disassembly (*c* above), with the addition of the following:

(a) Dip all packings, gaskets, and wiper rings in hydraulic oil before assembly.

(b) Oil piston parts, plunger rod, and packing nut before installation.

(c) When installing packing (6) on guide ring (15), do not stretch packing any more than absolutely necessary.

(d) Do not expand backup washers any more than necessary.

CAUTION

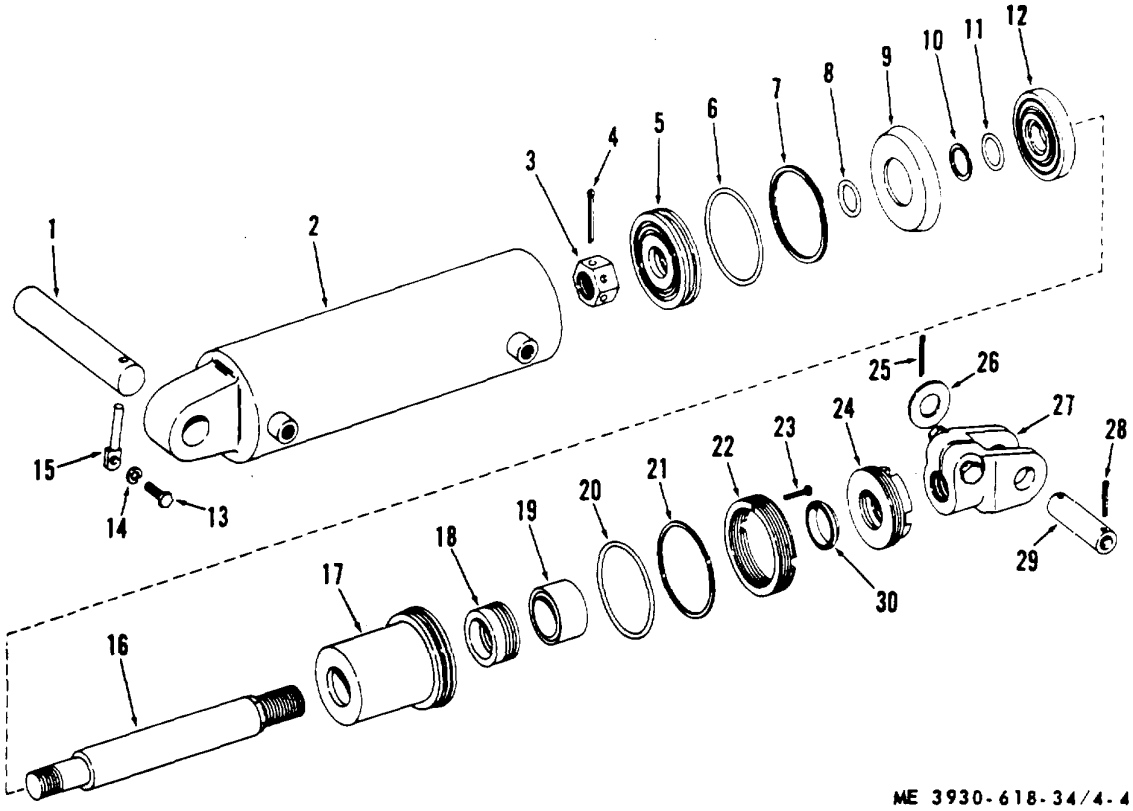
Never use sharp tools or instruments when installing rings, packings, or backup washers.

(e) Torque nut (3) to 300 foot-pounds, and install cotter pin (4).

(f) Tighten packing nut securely, then back off approximately 1/8 turn.

(2) Be certain that all parts are kept clean during installation and that no dirt or water is allowed to enter the cylinder before the hydraulic lines are connected.

f. Installation. Install the tilt cylinder by reversing the procedure in paragraph 2-12.



1 Pivot shaft
2 Tube assembly
3 Nut
4 Cotter pin
5 Guide ring
6 Packing
7 Backup ring
8 Packing
9 Packing cup
10 Backup ring
11 Packing
12 Follower
13 Screw
14 Lockwasher
15 Retainer
16 Plunger rod
17 Stuffing box
18 Packing set
19 Adapter
20 Ring
21 Packing
22 Retainer
23 Screw
24 Packing nut
25 Cotter pin
26 Flat washer
27 Yoke
28 Cotter pin
29 yoke pin
30 Wiper

Figure 4-4. Tilt cylinder.

4-6. Lift Cylinder

a. Description. The lift cylinder is a piston type cylinder assembly. The plunger is bolted to the roller support in the inner mast. The chain sprockets are also mounted on this roller support.

In operation, the plunger is moved upward by force of hydraulic pressure at the plunger base, raising the inner mast and carriage.

b. Removal.

(1) Lower fork carriage, and remove carriage backrest (para 4-8).

(2) Detach chains from cylinder TM 10-3930618-20.

(3) Remove bleeder screw from cylinder case, and insert airhose. With lift control valve held in down (forward) position, blow oil out of cylinder back into reservoir.

(4) Disconnect hydraulic lines at lift cylinder.

(5) Wrap chain securely around outer case of cylinder assembly below lift chain anchor flanges. Attach hoist to chain and take up slack.

(6) Remove 2 screws attaching plunger to roller support on inner mast.

(7) Lift cylinder assembly gently, to clear both upper and lower ends of cylinder from mast assembly, and remove.

CAUTION

Be careful not to damage cylinder assembly when removing it from mast assembly.

c. Disassembly. Refer to figure 4-5 and disassemble as follows:

(1) Using a spanner wrench, remove gland nut (2) and wiper (11).

(2) Close off bleeder port, insert airhose in 1/2inch port and use compressed air to force packing (3) and packing set (10) from tube assembly (5).

(3) Remove tube assembly (13) (plunger) with bearing (4), spacer (12), and stop ring (11).

(4) Remove snapring (9) and restrictor parts (6, 7, and 8).

d. Cleaning and Inspection.

(1) Clean all metal parts in SD.

(2) Examine wearing surfaces of tube assemblies (5 and 13) for damage and evidence of misalignment.

(3) Examine packings and wiper (1) for scores, folded edges, and worn or torn sections. Existence of these conditions indicates excessive pressure or a loose gland nut (2)

(4) Inspect spring (7) for bent or stretched condition.

(5) Replace parts as necessary.

e. Assembly. Reverse procedures in *c* above.

f. Installation.

(1) Reverse procedures in *b* above.

CAUTION

Be certain that all parts are clean and that there is no foreign matter in the cylinder tube.

(2) When cylinder has been installed, run lift to extreme upper limit then open bleeder screw one or two turns. Allow trapped air and foamy oil to run out. When a clear stream of oil appears, tighten bleeder screw.

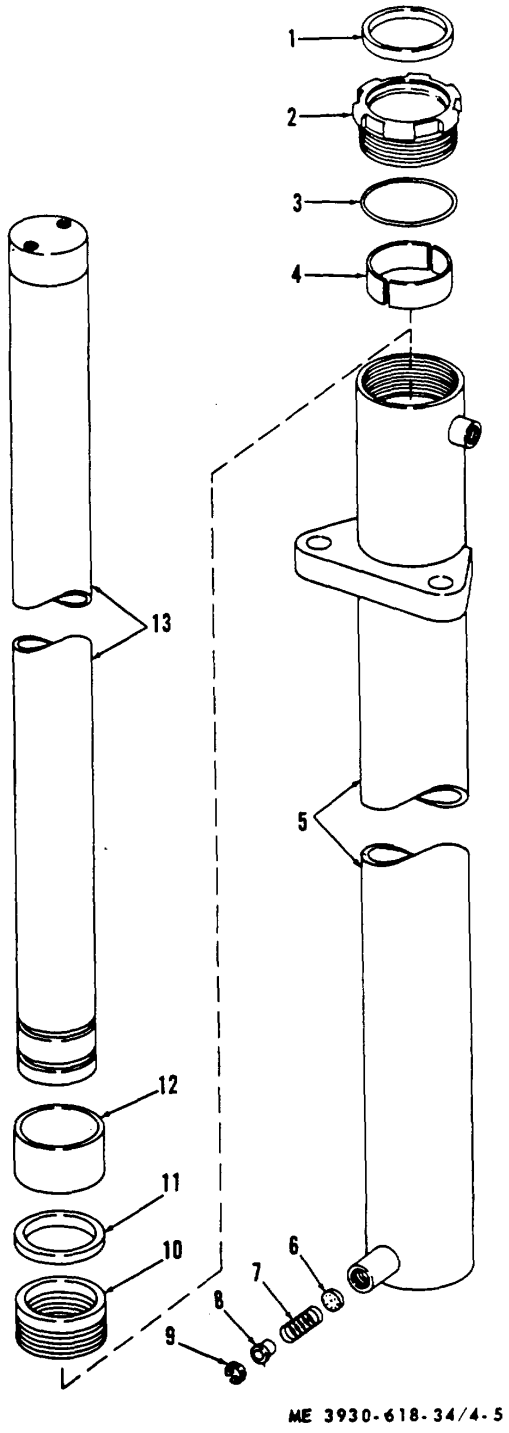


Figure 4-5. Hydraulic lift cylinder.

1 Wiper
2 Gland nut
3 Packing
4 Bearing
5 Tube assembly
6 Washer
7 Spring
8 Spacer
9 Snapring
10 Packing set
11 Stop ring
12 Spacer
13 Tube assembly

Section III. REPAIR OF LIFT MAST

4-7. Hydraulic Lift Mast

a. Description. The hydraulic lift mass, consists of inner and outer masts with wear plates in the sliding channels to provide maximum ease of movement.

b. Removal. Refer to figure 4-6 and remove as follows:

(1) Remove lift forks (TM 10-3930-618-20).

(2) Remove hydraulic lift cylinder (para 4-7).

(3) Detach tilt cylinders from mast brackets and remove lift chains (TM 10-3930-618-20).

(4) Attach chain hoist to lifting eyes on back of outer mast and raise mast assembly enough to take weight off pivot pins (34).

(5) Remove lock wires capscrews (37). Remove capscrews, lockwashers (38) and remove pivot pins.

(6) Lift mast assembly free of truck.

c. Disassembly.

(1) Lay mast assembly on suitable support.

(2) Slide inner mast out of outer mast.

(3) Remove carriage assembly by sliding out of mast channel.

(4) Remove wear strips (3 and 20) as necessary.

(5) Remove retaining rings (18) and remove bearings (17) from inner masts.

(6) Remove retainer (9) and remove roller(8) from roller support (7).

d. Inspection.

(1) Inspect mast channels for misalignment, broken welds, excessive wear, worn or damaged wear plates.

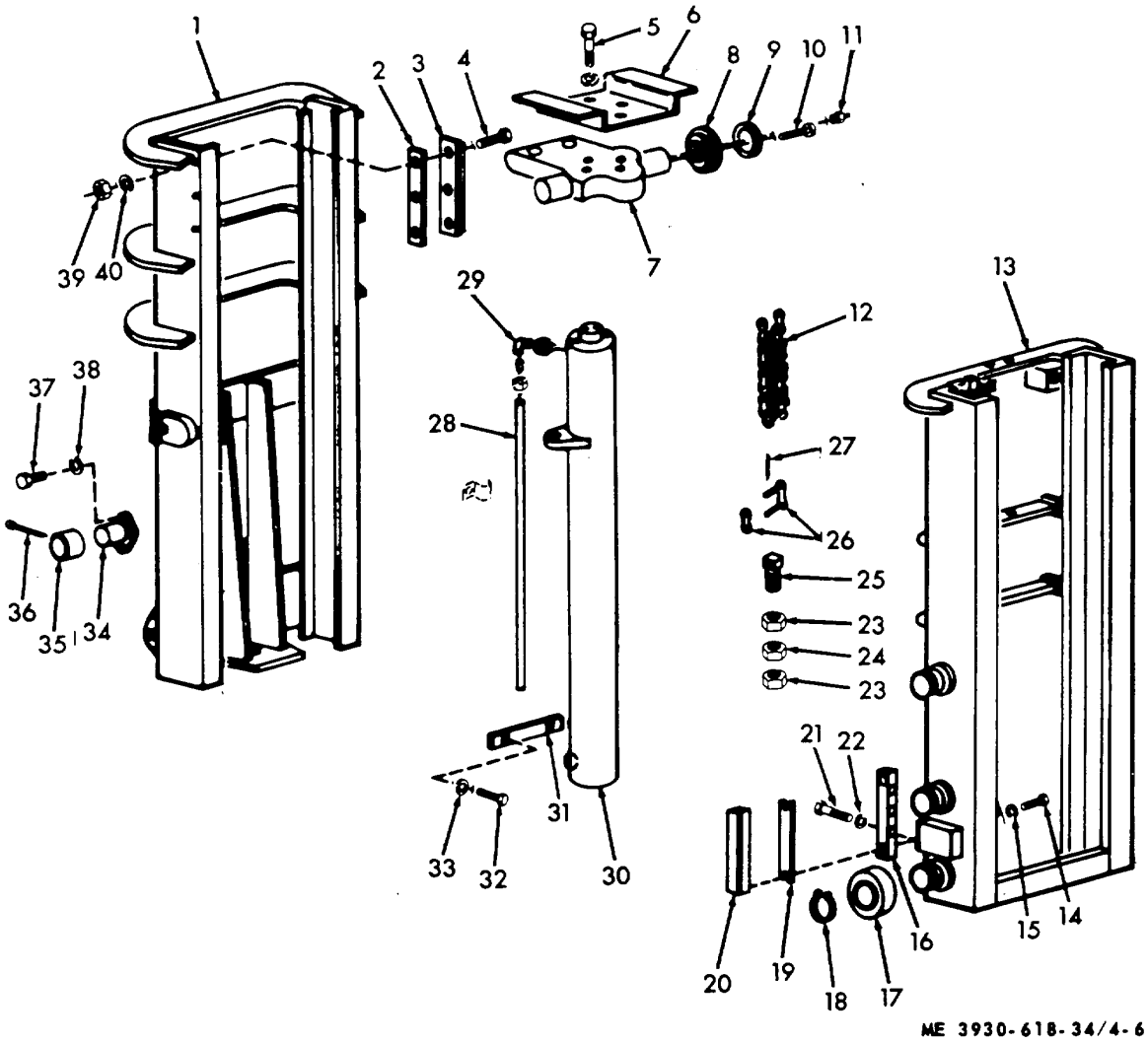
(2) Inspect bearings for excessive or uneven wear. Check the pivot bushing (35).

(3) Repair cracks and minor breaks in mast frames by welding if practical, and provided heat distortion is avoided.

(4) Replace defective parts.

e. Assembly. Reverse procedures in *c* above.

f. Installation. Reverse procedures in *b* above.



1 Outer mast
2 Shim
3 Wear strip
4 Capscrew
5 Capscrew
6 Chain guard
7 Roller support
8 Roller
9 Retainer
10 Screw
11 Lubrication fitting
12 Chain assembly
13 Inner mast
14 Capscrew
15 Lockwasher
16 Block
17 Bearing
18 Retaining ring
19 Shim
20 Wear strip
21 Capscrew
22 Lockwasher
23 Locknut
24 Adjusting nut
25 Chain anchor
26 Connecting link
27 Cotter pin
28 Tube
29 Elbow assembly
30 Lift cylinder
31 Retainer bar
32 Capscrew
33 Lockwasher
34 Pivot pin
35 Bushing
36 Cotter pin
37 Capscrew
38 Lockwasher
39 Nut
40 Lockwasher

Figure 4-6. Hydraulic lift mast.

4-8. Carriage and Backrest

a. Description. The fork lift carriage is a welded assembly having horizontal upper and lower fork support bars and a pair of vertical carriage support bars (fig. 4-7). The vertical bars each carry upper and lower stud and bearing assemblies which ride in the channel of the inner mast. The backrest is a welded metal frame, which is attached to the upper fork support bar of the carriage and serves to prevent loads from resting against the mast when the mast is tilted back.

b. Removal.

(1) Support backrest with hoist, remove capscrews (1) and lift backrest free of carriage.

(2) Disconnect lift chain at connecting link at back of carriage.

(3) Remove carriage from mast by raising out of mast channel.

c. Disassembly.

(1) Remove plugs (6) and screws (5).

(2) Remove retaining rings (7) and bearings (8) from studs.

(3) If necessary, studs may be removed and replaced by welding.

d. Inspection.

(1) Inspect backrest for cracked or broken welds, and any wear or bends which could interfere with heavy use.

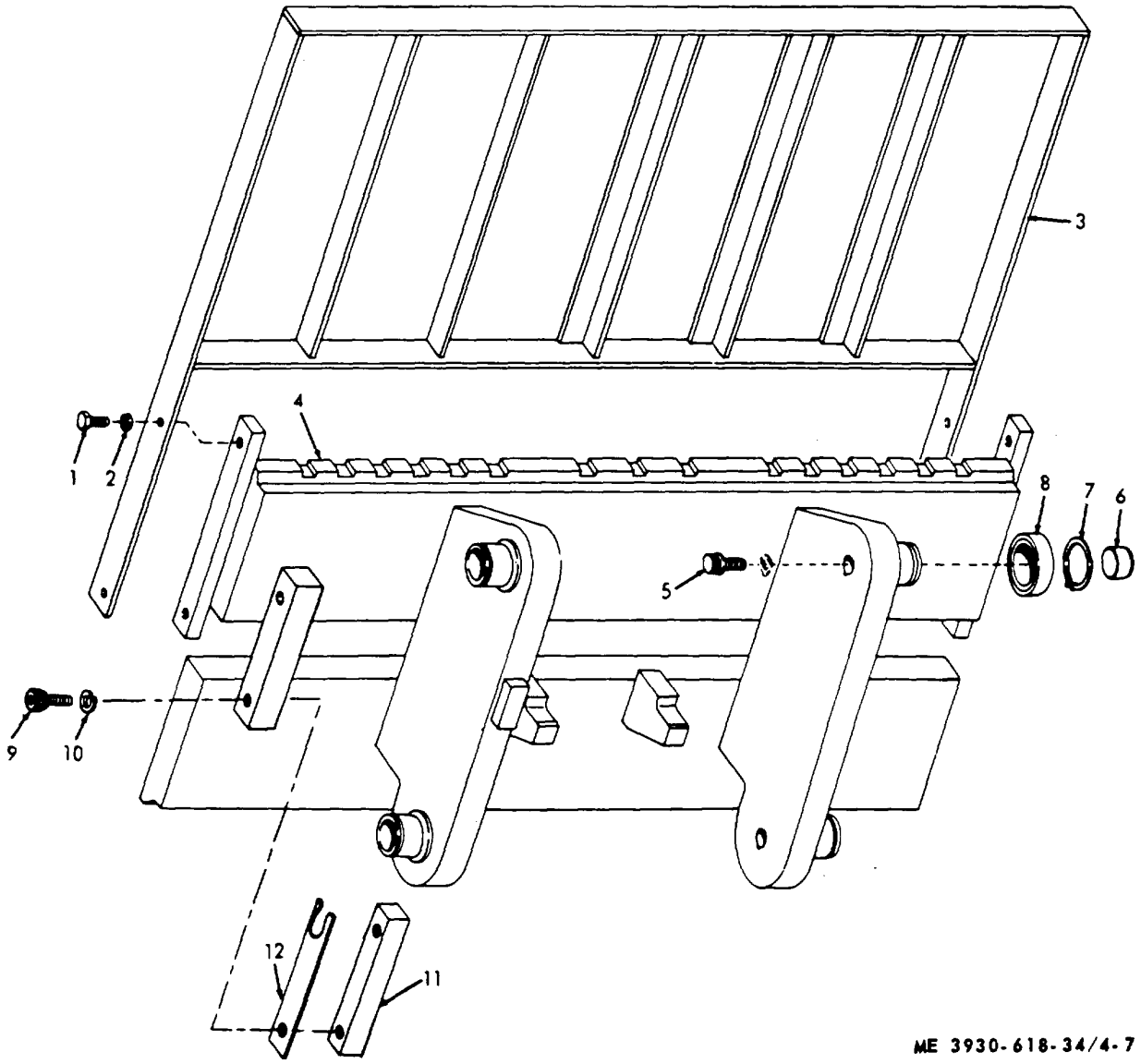
(2) Inspect carriage far cracked or broken welds, wear, bends, misalignment of the vertical bars, or other damage.

(3) Inspect stud, bearing, and plug assembly for misalignment, cracks or breaks, and excess wear.

(4) Repair damaged parts by welding if practical.

(5) Replace defective parts.

e. Assembly. Assembly and installation are the reverse of the procedures for disassembly and removal in *b* and *c.*



1 Capscrew
2 Lockwasher
3 Backrest
4 Carriage frame
5 12-point screw
6 Plug
7 Retaining ring
8 Roller bearing
9 Screw, socket hd.
10 Lockwasher
11 Block
12 Shim

Figure 4-7. Hydraulic lift carriage and backrest.

CHAPTER 5

REPAIR OF FRONT AND REAR AXLE ASSEMBLIES

Section I. REPAIR OF STEERING SYSTEM

5-1. Description

The power steering system consists of a steering gear assembly, power steering cylinder, and a steering axle assembly. Major components of the steering gear assembly are a wheel and shaft and control unit. When the steering wheel and shaft are turned, hydraulic fluid is ported from the control assembly, through hoses, to either the front or rear of the power steering cylinder.

5-2. Steering Gear Assembly

a. Removal and Installation. Refer to figure 5-1 to remove or install steering column, bracket, and steering unit as an assembly.

(1) Remove floor and toe plates (TM 10-3930618-20).

(2) Disconnect shift linkage.

(3) Disconnect neutral switch and horn wires.

(4) Remove bolts that secure steering gear mounting bracket to truck frame.

(5) Remove bolts securing upper steering column support to truck frame.

(6) Disconnect hydraulic lines to steering unit.

NOTE

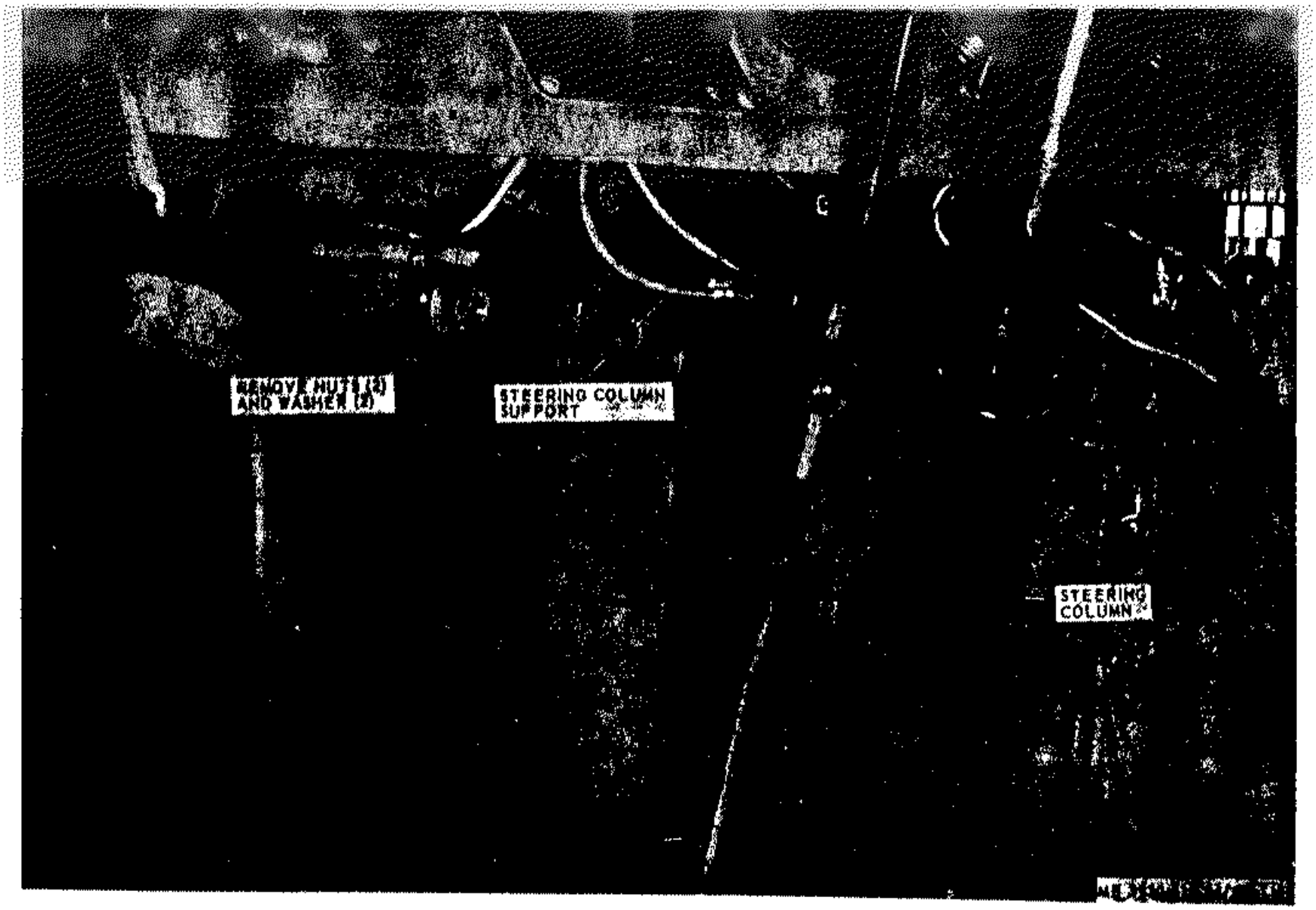
Tag hydraulic lines and steering unit fitting for identification. Plug hydraulic lines immediately to prevent loss of fluid or entrance of foreign material.

(7) Lift steering gear assembly with mounting support up and out of truck and place it in a clean work area for disassembly. Clean all paint and surface contamination from unit at points of separation.

b. Disassembly and Reassembly.

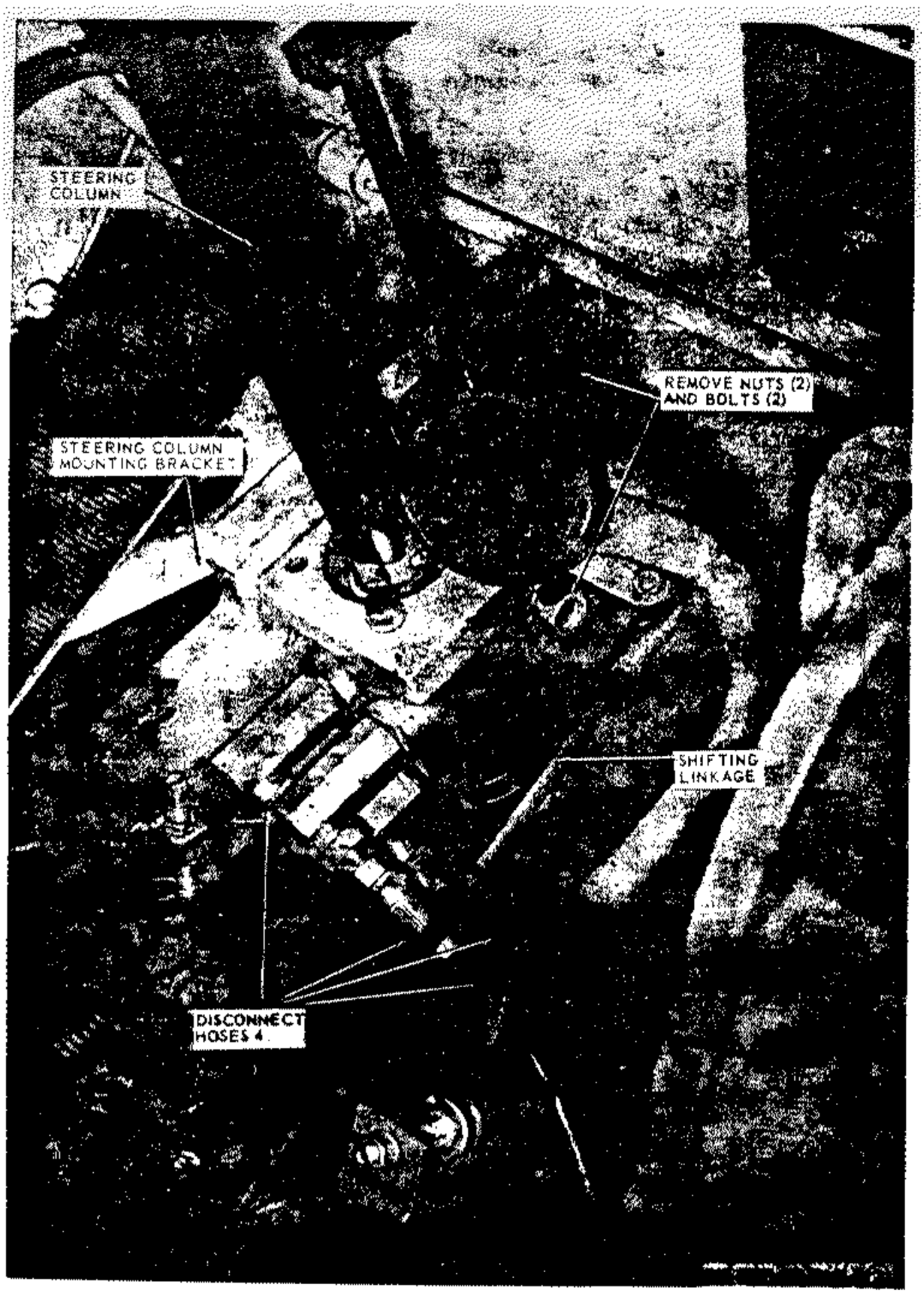
(1) Refer to paragraph 5-6 for removal and installation of the shifting lever mechanism.

(2) Refer to figure 5-2 and disassemble the steering assembly to the degree required for repair. Reassemble in the reverse order.



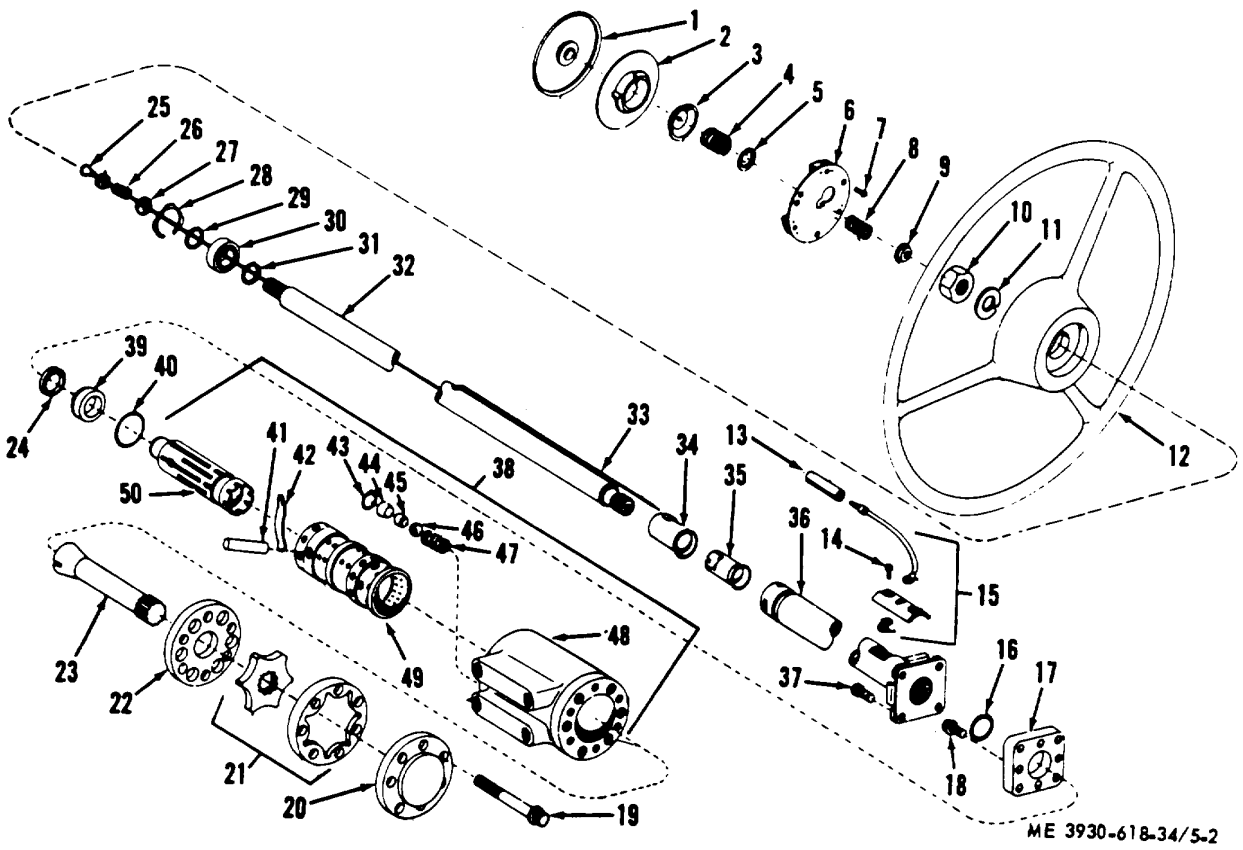
A. Steering column support.

Figure 5-1. Steering gear assembly removal and installation (sheet 1 of 2).



B. Steering unit bracket.

Figure 5-1. Steering gear assembly removal and installation (sheet 2 of 2).



1 Horn cover
2 Horn button
3 Contact cup
4 Spring
5 Contact cap
6 Base plate
7 Screw
8 Spring
9 Contact washer
10 Nut
11 Lockwasher
12 Steering wheel
13 Connector
14 Screw
15 Brush assembly
16 Oil seal
17 Plate
18 Bolt
19 Screw
20 End cap
21 Rotor
22 End plate
23 Drive
24 Seal
25 Ferrule
26 Contact spring
27 Contact washer
28 Retaining ring
29 Retaining ring
30 Bearing
31 Retaining ring
32 Shaft
33 Wire assembly
34 Contact ring
35 Insulator
36 Column
37 Bolt
38 Control assembly
39 Bushing
40 Packing
41 Pin
42 Spring
43 Packing
44 Plug
45 Seat
46 Ball
47 Spring
48 Housing
49 Control sleeve
50 Control spool

Figure 5-2. Steering gear assembly.

5-3. Horn Button and Steering Wheel

a. Removal.

(1) Push down on horn button cover (1, fig. 5-2) and turn to right.

(2) Remove horn button cover (1), button (2), contact cup (3), spring (4), and contact cap (5).

(3) Separate horn button wire (33) from base plate (6).

(4) Remove screws (7) from base plate (6) and remove base plate, contact spring (8) and contact washer (9).

(5) Remove steering wheel nut (10) and lockwasher (11) from steering shaft (32).

(6) Using wheel puller, remove steering wheel (12) from shaft (32).

(7) Remove two screws (37) and lockwashers attaching steering gear support bracket to steering gear assembly.

b. Installation.

(1) Thread horn wire (33, fig. 5-2) through steering wheel (12), lockwasher (11), nut (10), washer (91, and spring 18) and attach wire to base plate (6).

(2) Press steering wheel (12) on shaft and secure with lockwasher (11) and nut (10).

(3) Install base plate (6) and secure with screws (7) making sure horn wire (33) is securely attached to plate.

(4) Install cap (5), spring (4), cup (3) and button (2) on base plate (6).

(5) Install horn button cover (1) by pressing down on cover and turning right.

5-4. Column *a. Removal.*

(1) Refer to paragraph 5-2 for steering gear assembly removal and installation.

(2) Refer to paragraph 5-3 for steering wheel and horn button removal.

b. Disassembly.

(1) Remove screws (14, fig. 5-2), brush assembly (15), and contactor (13) from column (36).

(2) Working through brush plate opening, disconnect horn wire (33) from contact ring (34).

(3) Remove horn wire (33), ferrule (25), spring (26), and washer (27) by slowly pulling wire from shaft (32).

(4) Remove retaining ring (28) from column (36) and slide shaft and bearing from column (36).

(5) Remove bearing retaining ring (29), press off bearing (30), and remove other bearing retaining ring (31) from shaft (32).

(6) Mark two bolt hole locations on column, so that ports will be correctly referenced when unit is reassembled.

(7) Remove column bolts (37) and column (36) from mounting plate (17).

c. Reassembly.

(1) Note match-marks on column (36) and secure column to mounting plate (17) with bolts (37). Torque bolts to 280 inch-pounds.

(2) Install retaining ring (31), bearing (30), and retaining ring (26) on shaft (32).

(3) Insert horn wire (33) through washer (27), spring, ferrule (25), and partially through shaft (32). Bring wire out from shaft and attach to contact ring (34).

(4) Insert insulator (35) in contact ring (34) and slide both, gradually pulling back on horn wire, on shaft (32).

(5) Insert shaft (32) in column (36) and secure with retaining ring (28). Rotate shaft to engage shaft and spool splines.

(6) Install brush assembly (15) on column (36) securing with screws (14).

(7) Install connector (13) on brush wire.

(8) Install steering gear support bracket on steering column and secure it to steering gear with two screws (37) and lockwashers.

5-5. Steering Unit *a. Removal.*

(1) Refer to paragraph 5-2 for steering gear assembly removal.

(2) Refer to paragraph 5-4 a (7) for separation of steering unit from steering column.

b. Disassembly.

(1) Clamp end plate (17) of steering unit assembly in vise with end cap (20) up and remove screws (19).

(2) Remove end cap (20), rotor (21), plate (22) and drive (23) from control assembly housing (48).

c. Control Spool Rotation Check. Remove control assembly (38) from vise and check for free rotation of control spool (50) and sleeve (49) using shaft (32) (fig. 5-3 3).

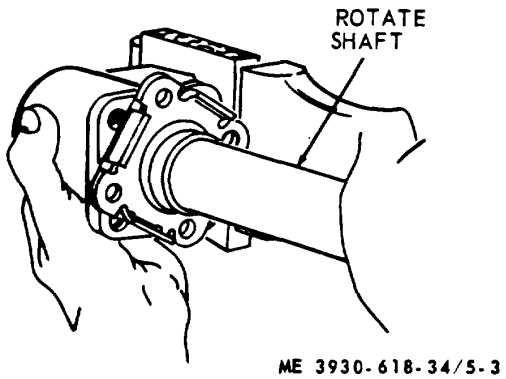


Figure 5-3. Checking control spool rotation.

d. Mounting Plate.

(1) Place wooden block across vise throat to support spool parts.

(2) Clamp control assembly (38, fig. 5-2) across port face with control end up and remove mounting plate attaching bolts (18).

(3) Hold spool assembly down against wooden block and lift off mounting plate (17).(4)Inspect mating surfaces for obvious leakage path and wear. Remove and discard quad ring shaft seal (24) and oil seal (16) in mounting plate (17).

e. Control Assembly.

(1) Remove cap locator bushing (39) and packing (40) Discard packing.

CAUTION

Use extreme care when removing control spool and sleeve, as they are very closely fitted and must be rotated slightly as they are withdrawn.

(2) Place port face of housing (48) on a solid surface and remove control spool and sleeve from 14-hole end of housing.

CAUTION

Do not pry against edge of hole in housing bore.

(3) Using a small bent tool or wire, remove check valve seal plug (44) from housing (48) by reaching it through "out" port and pushing upwards (fig. 5-4). Remove and discard packing (43, fig. 5-2).

(4) With housing in vise control end up, unscrew check seat (45) with 3/ 16 inch hex wrench.

(5) Remove housing from vise and up end it. Tapping it lightly with palm of hand, allow check valve seat (45) ball (46) and spring (47) to fall into other hand.

(6) Remove centering pin (41) from control spool and sleeve.

(7) Push inside lower edge of spool (50) so that spool moves toward splined end and remove spool carefully from sleeves (49).

(8) Push the centering spring set (42) out of spring slot in spool (50).

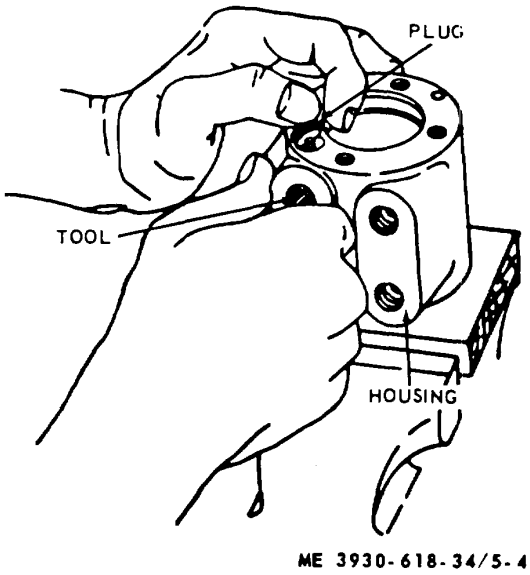


Figure 5-4. Removing check valve seal plug.

f. Cleaning, Inspection, and Repair.

(1) Clean all parts with cleaning compound, solvent (P-S-661). Cleaning may be done during disassembly and parts set to dry on clean paper towel.

(2) Inspect all moving parts to make sure they have not been scored or damaged by dirt particles. Smooth burnished surfaces are normal in many areas. Any slightly scored parts may be cleaned by hand rubbing with 600-grit abrasive paper.

(3) Prepare all surfaces of control assembly for assembly as follows:

(a) Place a piece of 600-grit abrasive paper face up on a piece of plate glass or similar material.

(b) Clean the ends of the star gear first to remove any sharp grit from the paper which could produce scratches.

(c) Clean both sides of the ring gear, both sides of the plate, the 14-hole end of the housing, and the flat side of the end cap.

(d) Stroke each surface across the abrasive several times and check the results. Any small bright areas indicate a burr which must be removed. When polishing the parts, hold them as flat as possible against the abrasive. After 6-to-10 strokes across the abrasive, check the part to see if it is polished. After each part is polished, rinse clean in solvent', blow dry with air, and place it where it can remain absolutely clean until assembly.

(4) Replace all packing and oil seals. Replace all other parts as authorized.

g. Assembly and Adjustment.

(1) *General.* Refer to figures 5-2 thru 5-6 when assembling and adjusting.

(2) *Control assembly.*

(a) Install clean wooden block in vise to provide platform for assembly operations.

(b) Place housing (48) on wood platform and drop check valve spring (47) into check hole with large end down.

(c) Drop check ball (46) into check hole making sure it rests on top of small end of spring (47).

(d) Place check valve seat (45) on 3/16inch hex wrench and screw into a check hole so machined counterbore of seat is towards ball (46).

(e) Lower wood platform in vise and place housing (48) on platform control end up. Clamp vise jaws lightly across housing port surface.

(f) Torque seat (45) to 150 inch-pounds and test ball (46) action by pushing against it with small, clean pin.

NOTE

Ball need not be snug against seat to function properly.

(g) Carefully install the spool (50) into the sleeve (49). Be sure that spring slots of both spool and sleeve are at the same end. Rotate spool carefully while sliding parts together. Test for free rotation.

CAUTION

Spool must rotate smoothly in sleeve with finger tip force applied at splined end.

(h) Clamp wooden platform in jaws, set control spool and sleeve on platform and aline spring slots of both.

(i) Stand control spool and sleeve on end and insert a flat tool through slots or both parts.

(j) Position three pairs of centering springs (42), or two sets of three each, on bench so extended edge is down and center section is together.

(k) Install one end of positioned spring set (42) on flat tool. Compress extended end of spring set and push it into control spool and sleeve, withdrawing flat tool at same time. See figure 5-5.

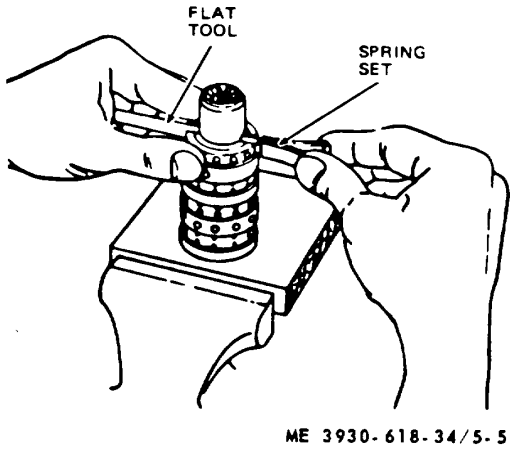


Figure 5-5. Installing centering spring set.

(l) Center spring set (42), alining each spring so the entire set is flush with upper surface of control spool and sleeve.

(m) Install the cross pin (41) through the spool and sleeve and push into place until pin is flush or slightly below the sleeve diameter at both ends.

(n) Place the housing (48) on a solid surface with the port face down. Install the spool assembly with the splined end of the spool (50) entering the 14-hole end of the housing first. Push parts gently into place with a slight rotating motion.

CAUTION

Use extreme care so control assembly (38) does not lose alinement when entering housing (48).

(o) Install control assembly (38) in housing bore until flush with 14-hole end of housing.

CAUTION

Do not pull control assembly beyond flush position or cross pin (41)will drop into housing discharge groove.

(p) Turn splined end of control assembly (38), checking for free rotation.

(q) Install new packing (43) and check plug (44) in check plug hole. Use steady pressure on plug and rock it slightly so packing feeds in smoothly without cutting.

(r) Install new packing (40) and seal (24) on spool (50).

(s) Seat cap locator bushing (39), large outside diameter up, against spool (50) evenly.

h. Mounting Plate.

(1) Check mounting plate seal grooves for cleanliness and smooth condition.

(2) Install and smooth down new quad ring shaft seal (24) and oil seal (16) into mounting plate (17) seal grooves.

NOTE

Oil seal (16) lip must face away from unit

(3) Place the mounting plate subassembly over the spool shaft and slide it down smoothly in place over the cap locator bushing (39) so that seals will not be damaged.

(4) Aline the bolt holes in the cover (17) with the tapped holes in the housing 1481. Be sure the mounting plate' rests fairly flush against end of housing assembly so that the cap locator bushing is not cocked.

(5) Install mounting plate attaching bolts (18) and torque each to 150 inch-pounds.

i. End Plate.

(1) Reposition control housing (48) in vise, clamping the mounting plate with 14-hole surface up.

(2) Check that control spool and sleeve are flush or slightly below 14-hole surface and that surface is clean.

(3) Place end plate (22) over control spool and sleeve, alining bolt holes in plate with tapped holes in housing 1481.

(4) Place rotor ring (21) on assembly and aline bolt holes.

(5) Place splined end of drive (23) in rotor gear star so slot at control end of drive is alined with outside diameter valleys of gear. See figure 5-6.

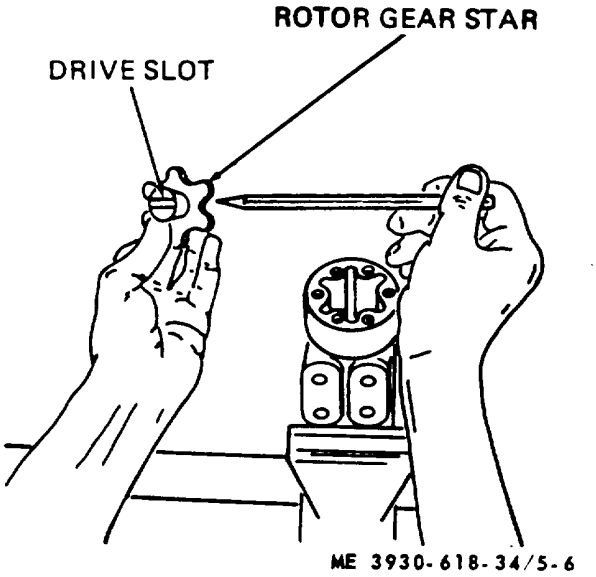


Figure 5-6. Drive-gear alinement.

(6) Push splined end of drive (23) through the gear until spline extends about one-half its length beyond gear star. Hold it in this position while installing it in the unit. Note position or direction of cross pin (41) within the unit.

(7) Install gear-drive assembly into rotor ring (21), drive (23) first, and slowly rotate it to engage cross slot in drive (23) with cross pin (41). Splined end of drive will drop down against rotor ring (21) when slot engages.

CAUTION

Alinement of the cross slot in the drive with the valleys between the teeth of the gear star determines the proper valve timing of the unit. There are 12 teeth on the spline and 6 on the star. Alinement will be right in 6 positions and wrong in 6 positions. Should the parts slip out of position during this part of the assembly, make certain that proper alinement is obtained.

(8) Place end cap (20) over assembly and install screws (19) finger tight, to maintain alinement of parts.

(9) Secure assembly in vise and torque screws to 150 inch-pounds.

j. Installation.

(1) Install steering gear and secure steering gear support (22, fig. 5-2) in place on truck bracket with flat washers (23), lockwashers (24), and screws (25).

(2) Install clip on upper part of column (36, fig. 5-2).

(3) Connect brush assembly connector (13).

(4) Note identification marks on hydraulic hoses and attach hoses to proper ports in control housing (48).

(5) Install floor and toe plates (TM 10-3930618-20).

5-6. Shifting Mechanism

a. Removal.

(1) Remove floor plate (TM 10-3920-618-20) and steering wheel (para 5-3).

(2) Remove roll pin (4, fig. 5-7) holding indicator (3) in position and move indicator up shaft.

(3) Remove capscrews (1) holding cover (5) in place and move out of way.

(4) Remove capscrews from steering column support (19) and the two mounting brackets (8 and 27).

(5) Loosen actuating lever capscrew (40).
(6) Detach shifting rod ball joint (31) from shift lever (30).
(7) Lift mechanism out of truck.
(8) Shift lever can now be removed by removing pin (29).

b. Cleaning and Inspection.

(1) Clean all parts in SD and dry.
(2) Inspect all parts for excess wear, deformation, cracks, stripped threads, and other damage.
(3) Replace defective parts as authorized.

c. Installation. Install in reverse order of removal.

d. Adjustment.

(1) If shifting mechanism binds, check alignment at mounting bracket (8) on steering column and mounting bracket (27).

(2) To obtain proper operation of the shifting mechanism it is important that the detent in the indicator plate be synchronized with the detents in the selector valve plunger. Correct synchronization of the detents can be obtained by adjusting the rod assembly (36) between the selector valve plunger and the lever (30).

(3) After shifting detents are correctly adjusted, the neutral switch (21) and lever (24) should be adjusted for correct operation.

(4) To adjust, loosen capscrew (40) holding lever (24) to shifting rod (11) and, with the shifting mechanism in neutral, move cam so that switch lever is at lowest point on cam, making sure switch is in OFF position.

(5) Tighten capscrew in switch lever. Move shifting lever (15) to either forward or reverse position, turn ignition key to start. If engine does not start, adjustment is correctly made.

(5) Loosen actuating lever capscrew (40).

(6) Detach shifting rod ball joint (31) from shift lever (30).

(7) Lift mechanism out of truck.

(8) Shift lever can now be removed by removing pin (29).

b. Cleaning and Inspection.

(1) Clean all parts in SD and dry.

(2) Inspect all parts for excess wear, deformation, cracks, stripped threads, and other damage.

(3) Replace defective parts as authorized.

c. Installation. Install in reverse order of removal.

d. Adjustment.

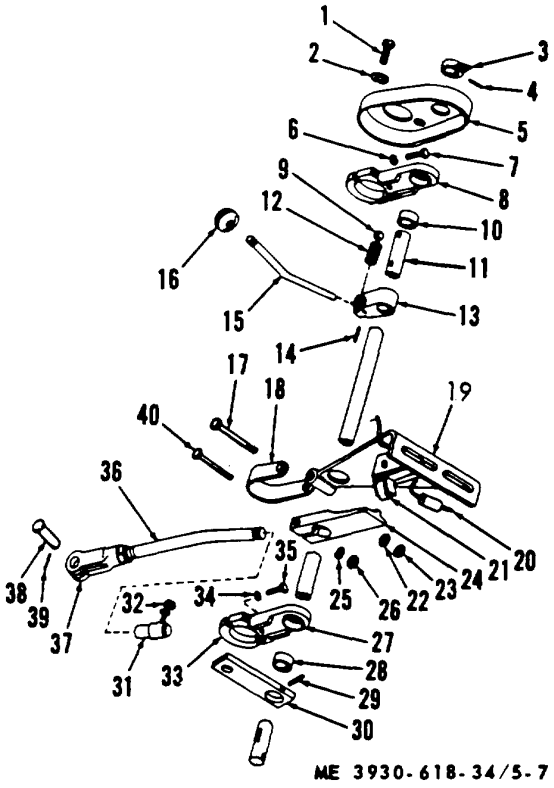
(1) If shifting mechanism binds, check alignment at mounting bracket (8) on steering column and mounting bracket (27).

(2) To obtain proper operation of the shifting mechanism it is important that the detent in the indicator plate be synchronized with the detents in the selector valve plunger. Correct synchronization of the detents can be obtained by adjusting the rod assembly (36) between the selector valve plunger and the lever (30).

(3) After shifting detents are correctly adjusted, the neutral switch (21) and lever (24) should be adjusted for correct operation.

(4) To adjust, loosen capscrew (40) holding lever (24) to shifting rod (11) and, with the shifting mechanism in neutral, move cam so that switch lever is at lowest point on cam, making sure switch is in OFF position.

(5) Tighten capscrew in switch lever. Move shifting lever (15) to either forward or reverse position, turn ignition key to start. If engine does not start, adjustment is correctly made.



1 Screw	21 Switch
2 Lockwasher	22 Lockwasher
3 Indicator	23 Nut
4 Pin	24 Lever
5 Cover	25 Lockwasher
6 Lockwasher	26 Nut
7 Screw	27 Bracket assembly
8 Bracket	28 Bushing
9 Ball	29 Pin
10 Bushing	30 Lever
11 Rod	31 Joint
12 Spring	32 Nut
13 Stop	33 Bracket assembly
14 Pin	34 Washer
15 Shifting lever	35 Screw
16 Knob	36 Rod
17 Screw	37 Yoke
18 Clip	38 Pin
19 Support assembly	39 Cotter pin
20 Wire	40 Screw

Figure 5-7. Forward-reverse assembly.

5-7. Power Steering Cylinder

a. Description. When hydraulic oil is under regulated pressure from the steering gear and enters the power steering cylinder, the piston moves forward or back within a tube, depending on which side of the piston hydraulic fluid is forced. The movement of the piston rod, with attached yoke, moves the steering axle pivot arm and attached tie rods.

b. Removal.

Refer to TM 10-3930-618-20 for removal procedure.

c. Disassembly.

(1) Refer to figure 5-8 and disassemble as follows:

(2) Remove cotter pin (1) and adjusting plug (30) from end of steering link (3).

(3) Remove lubrication fitting (2) and plug (31) from steering link and remove link and nut (4) from rod (12).

(4) Tap out seat (29) and spring (28) from link. Remove elbows (5) from tube assembly (10).

(5) Remove lockring (14) holding spacer (15) in position and remove spacer.

(6) Compress lockring (16) holding head (19) cylinder assembly (10) and remove actuating rod (12) with remaining components attached from cylinder assembly (10).

(7) Carefully slide head (19) off rod (12) end and remove head seal (20), wiper (13), backup washer (17), and packing (18) from head. Discard packing.

(8) Remove nut (21) securing piston (24) to rod end and slide piston off rod.

(9) Remove two backup washers (22) and packing (23) from piston (24). Discard packing.

(10) Remove rod seal (25) from rod (12).

(11) Check bearing (27) and lubrication fitting (26) at tube end. If damaged, replace parts. Press bearing from cylinder to remove.

Key to figure 5-8.

1 Cotter pin
2 Lubrication fitting
3 Link
4 Nut
5 Elbow
6 Pin
7 Lockwasher
8 Screw
9 Spacer
10 Cylinder assembly
11 Cylinder
12 Rod
13 Wiper
14 Lockring
15 Spacer
16 Lockring
17 Backup washer
18 Packing
19 Head
20 Head seal
21 Nut
22 Backup washer
23 Packing
24 Piston
25 Seal
26 Lubrication fitting
27 Bearing
28 Spring
29 Ball seat
30 Plug
31 Plug

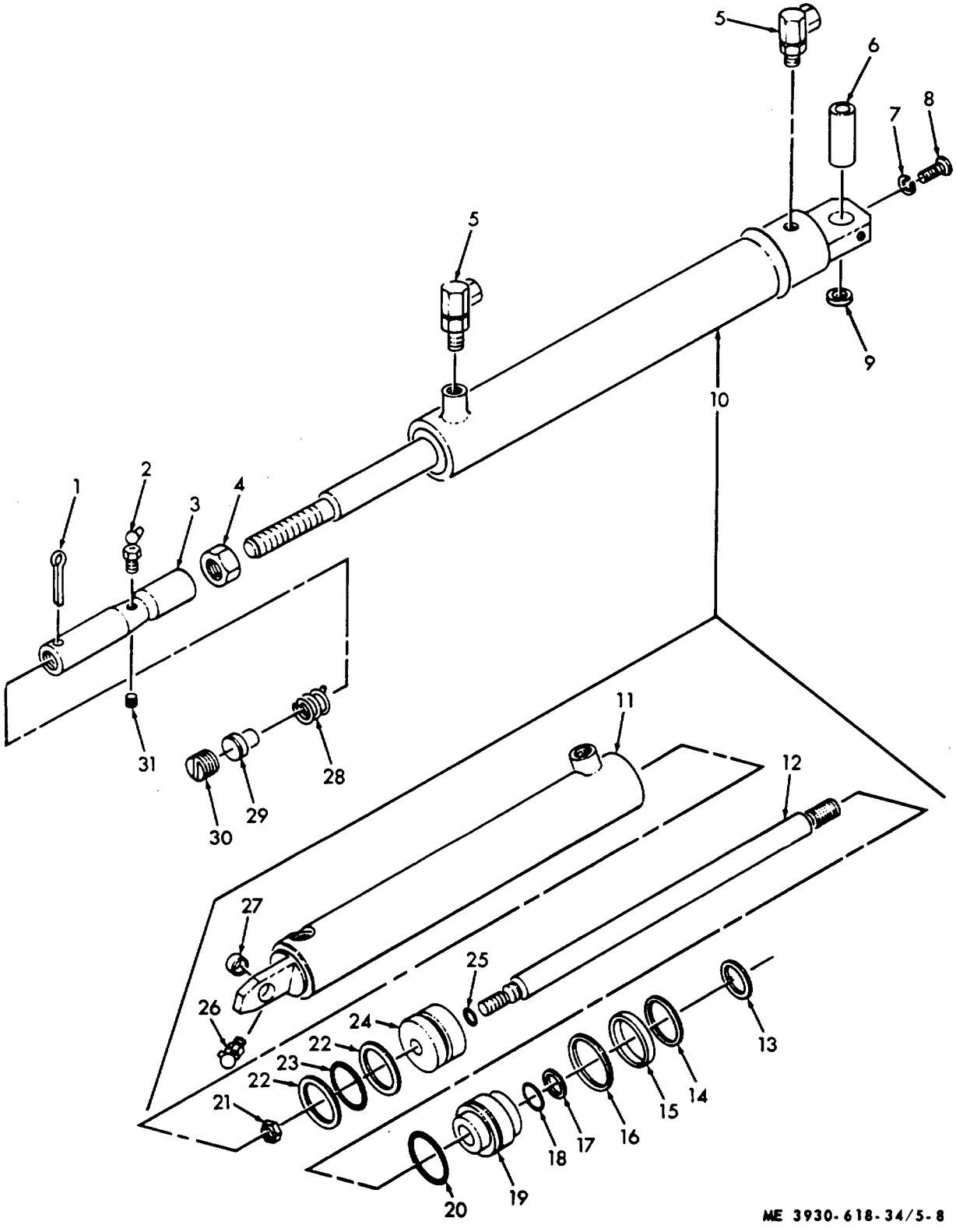


Figure 5-8. Power steering cylinder with yoke.

d. Cleaning and Inspection.

(1) Clean all parts with cleaning compound, solvent (Spec. P-S-661).

(2) Inspect tube bore, rod head, and piston for cracks, scratches, scoring, and other damage. Repair or replace damaged components.

(3) Prior to assembly, coat all components with clean hydraulic oil to aid in installation and provide initial lubrication.

(4) Replace all seals and packing.

e. Assembly.

(1) Refer to figure 5-8 and assemble as follows:

CAUTION

Be careful not to damage seals and packing during assembly.

(2) Install rod seal (25) on rod (12).

(3) Position backup washers (22) and packing (23) on piston (24).

(4) Install piston (24) on rod (12) and secure with nut (21).

(5) Install packing (18), backup washer (17), and wiper (13) in head (19).

(6) Position head seal (20), lockring (16), spacer (151, and lockring (14) on head (19).

(7) Carefully slide piston and rod assembly into cylinder (11).

(8) Position head assembly over rod (12) and compress lockring (16).

(9) With lockring (16) compressed, head assembly into cylinder until lockring snaps into tube groove.

(10) Install elbows (5) in cylinder.

(11) Install spring (28), seat (29), and adjusting plug (30) in link (3).

(12) Install nut (4) and link (3) on rod (12).

(13) Install lubrication fitting (2), plug (31), and cotter pin (1) in link (3).

(14) If bearing (27) was removed, press new bearing into bore at end of cylinder (11).

f. Installation and Adjustment. Refer to TM 10-3930-618-20 for installation and adjustment procedure.

5-8. Steering Axle and Wheels

a. Description. The cruciform - trunnion mounted steering axle is mounted in lubricated self-aligning sleeve bearings. A hydraulic operated control unit pivots an arm that moves tie rods connected to the spindles on which the steering wheels are mounted.

b. Removal. Refer to paragraph 2-14 for removal of the steering axle and wheels from the truck.

5-9. Steer Wheel Bearings

a. Removal. If steering axle has not been removed from the truck proceed as follows:

(1) Raise the rear of the truck until the wheels clear the floor. Block front wheels securely to prevent truck from rolling.

(2) Remove the hubcaps (3, fig. 5-9).

(3) Remove the cotter pin (4); from the bearing adjusting nut (5) and remove the nuts and washers.

(4) Remove the outer bearing cone (7).

(5) Slide the hub assembly (9) from the steering axle spindle.

(6) Remove the inner bearing cone (11) and grease retainer (12) from the hub assembly.

(7) Carefully tap both bearing cups (8, 1.0) from the hub assembly.

b. Cleaning, Inspection and Repair.

(1) Clean all parts with cleaning compound, solvent (Spec. P-S-661). Dry thoroughly with compressed air.

(2) Inspect bearing cones and cups and wheels for damage and excessive or uneven wear.

(3) Replace all parts as authorized.

(4) Repack bearings (TM 10-3930-618-20).

c. Installation and Adjustment.

(1) Install bearing cups with the taper to the inside. Tap into place using a brass drift pin. Tap evenly around the edge of the cup. Use care to prevent the cup from binding.

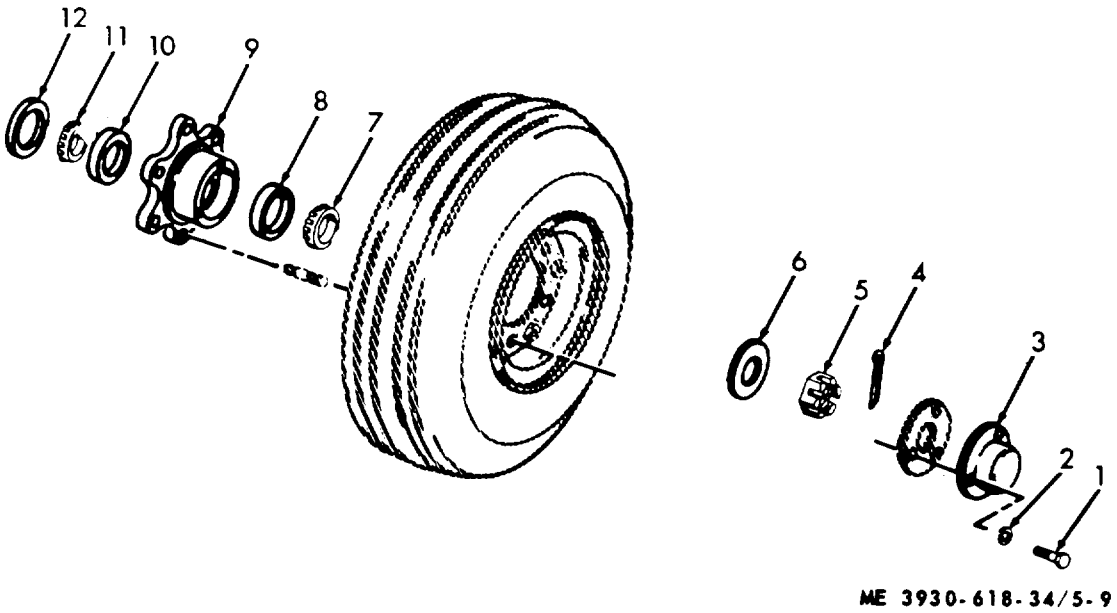
(2) Install the bearing cones and hub assemblies in reverse order of removal. Hold the hub assemblies in position while installing the outer bearings.

(3) Install the adjusting nut(s) and washer.

(4) Tighten the adjusting nut and, at the same time, rotate the wheel until a heavy drag is felt.

(5) Loosen the nut to the point where the wheel rotates freely but no bearing end play is apparent.

(6) Install cotter pin (4) in the wheel nut and reinstall the hubcap (3).



1 Screw
2 Washer
3 Cap
4 Pin
5 Nut
6 Washer
7 Cone-rollers
8 Cup
9 Hub
10 Cup
11 Cone-rollers
12 Seal

Figure 5-9. Steer wheel and bearings, removal and installation.

5-10. Steering Axle and Tie Rods

a. Removal. Refer to paragraph 2-14 for removal of the steering axle from the truck.

b. Disassembly. Refer to figure 5-10 and disassemble the axle as follows:

c. Remove and disassemble the tie rods as follows:

(1) Remove cotter pin, nut, and flat washer from bottom of tie rod end (24).

(2) Remove cotter pin and loosen adjusting plug (30).

(3) Remove tie rod (2 and 26).

(4) Remove adjusting plug (30), ball seat (29), and spring (28) from tie rods.

(5) Slip cover (23) from tie rod end (24).

(6) Loosen jam nut on tie rod end (24) and remove tie rod end from tie rods.

(7) Remove lubrication fittings from rods and rod end (24).

d. Disassemble bearing housing (6) as follows:

(1) Remove screws, lockwashers, flat washers and shims (5) from bearing housing (6). Tag and count number of shims for correct installation.

(2) Remove spacers (4) and self-aligning bearings (3) from housings.

(3) Remove lubrication fittings from top of housing.

e. Remove pivot arm (22) from steering axle (8) as follows:

(1) Remove nut (13),washer (12) and bearing cone (11).

(2) Remove pivot arm (22) from axle and bearing cup (20) and bearing cone (21) from pivot arm (22).

(3) Remove bearing cups (10 and 20) and retaining ring (9) from axle if replacement is necessary.

(4) Remove lubrication fitting.

f. Remove king pins (18) and spindles (1 and 15) as follows:

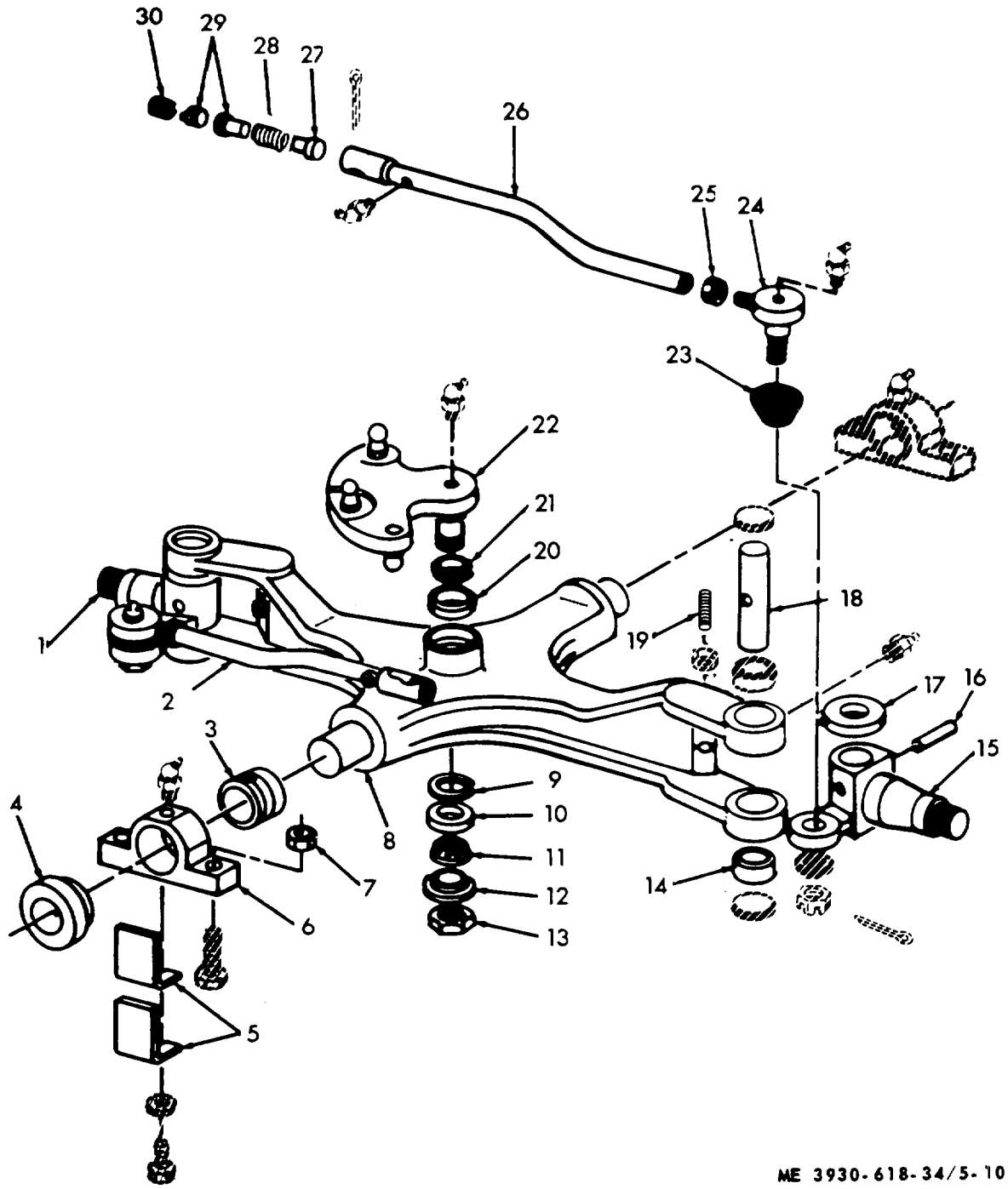
(1) Remove expansion plugs.

(2) Remove pins (16) and tap pins (18) from spindles (1 and 15).

(3) Remove spindles (1 and 15) from axle. Remove four thrust washers (17).

(4) Press out needle bearings (14) from axle.

(5) Remove lubrication fittings.



1 Left spindle
2 Left tie rod
3 Self-aligning bearing
4 Spacer
5 Shim
6 Housing
7 Locknut
8 Axle
9 Retaining ring
10 Bearing cup
11 Bearing cone
12 Washer
13 Nut
14 Needle bearing
15 Right spindle
16 Spring pin
17 Thrust washer
18 King pin
19 Setscrew
20 Bearing cup
21 Bearing cone
22 Pivot arm
23 Cover
24 Tie rod end
25 Jam nut
26 Right tie rod
27 Safety plug
28 Spring
29 Seat
30 Adjusting plug

Figure 5-10. String axle and tie rods.

g. Cleaning and Inspection.

(1) Clean all parts with cleaning compound, solvent (Spec. P-S-661).

(2) Inspect all moving parts, bearings, and attaching parts for wear, corrosion, or other damage.

(3) Worn or deteriorated parts must be replaced as authorized.

h. Assembly.

(1) Refer to figure 5-10 and assemble and install as follows:

(2) Install king pins (18) and spindles (1 and 15) as follows:

(a) Install lubrication fittings and needle bearings (14) in axle (8).

(b) Aline spindles (1 and 15) and thrust washers (17) in axle and tap in king pins (18).

(c) Aline king pins (18) in spindle (1 and 15) and tap in pins (16) to secure king pins.

(d) Install expansion plugs.

(e) Lubricate assembly (TM 10-3930-618-20).

i. Install pivot arm (22) in axle (8) as follows:

(1) Install lubrication fittings and pack bearing cones (11 and 21) with grease (GAA).

(2) Install retaining ring (9) and bearing cups (10 and 20) in axle (8), if they are removed.

(3) Press bearing cone (21) on pivot arm (22).

(4) Install pivot arm (22) in axle (8), firmly seating bearing cone (21) in bearing cup (20).

(5) Press bearing cone (11) into bearing cup (10) at bottom of axle.

(6) Slide washer (12) on pivot arm (22) and secure assembly with nut (13). To preload bearings, torque nut to 20-30 foot pounds. Stake nut to hold in position.

(7) Lubricate cavity with grease (TM 10-3930-618-20).

(8) Install lubrication fitting, self-aligning bearings (3), and spacer (4) in housing (6).

(9) Lubricate housing (6) (TM 10-3930-618-20).

j. Assemble and Install Tie Rods (2 and 26) as follows:

(1) Install lubrication fittings on rods (2 and 26) and tie rod ends (24).

(2) Install tie rod ends in rods and tighten jam nuts (25).

(3) Install covers (23) on tie rod ends.

(4) Install adjusting springs (28), ball seats (29), and plugs (30) in tie rods.

(5) Install tie rods on spindles (1 and 15) and pivot arm (22).

(6) Tighten adjusting plugs (30), then back off enough so there is some end play. Then secure plugs with cotter pins.

(7) Secure tie rod ends to axle with flat washer, nuts, and cotter pins.

(8) Lubricate tie rod ends and rods (TM 10-3930-618-20).

k. Installation. Refer to paragraph 2-14 for steering axle installation.

l. Adjustment. If the steering system should require adjustment, the following procedure should be followed:

(1) Raise the rear end of the truck so that the steer wheels clear the floor. Block in position.

(2) Disconnect the steer cylinder from the pivot arm.

(3) Turn the steer wheels full right and full left. Measure the distance between the wheel and the axle at both wheels. Clearance should be at least 1/2 inch. While holding this distance, adjust the spindle stops to allow approximately 0.030 inch clearance between the stop and the spindle (fig. 5-11).

(4) Center the steering gear. Count the number of turns of the steering wheel from extreme right to extreme left, or vice-versa. Turn the steering wheel back half this number of turns to its mid-position of travel.

(5) Set the steer wheels straight ahead, parallel with the sides of the truck frame. It may be necessary to adjust the tie rods to obtain this position, as zero degrees toe-in must be maintained at all times.

(6) With the steering gear centered and the steer wheel correctly positioned, loosen the clamp bolt at the plunger end of the steer cylinder and with an open end wrench turn the plunger in or out of the clamp so that the socket at the pivot arm end of the steering unit will be correctly aligned with the ball on the pivot arm. Screw in the plug and install the cotter pin. The steering cylinder plunger will be half-way out of the cylinder.

(7) Start the engine and check the steering system. With all adjustments correctly made, the wheel spindles should contact the stop screws on the axle to prevent the piston from bottoming in the steering cylinder. This prevents excessive thrust and cramping of the steering linkage and excessive relief valve operation.

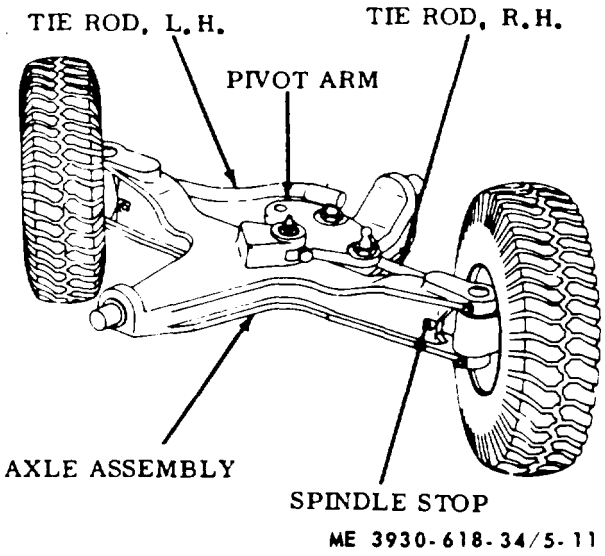


Figure 5-11. Stop adjustment.

Section II. REPAIR OF BRAKE SYSTEM

5-11. General

The handbrake is a dual-shoe, mechanical-type and is mounted to the differential pinion flange. The brakeshoes are actuated through a cable by an adjustable, over-center type lever. The service brake system contains a mechanically actuated hydraulic master cylinder with an attached power booster. A heavy duty brake line transmits hydraulic pressure from the power booster to double-end type cylinders in each drive wheel. The brakeshoes are the free floating type, and are provided with major and minor adjustment cams, accessible at the rear of the backing plates.

5-12. Handbrake Assembly

a. Removal. Refer to TM 10-3930-618-20.

b. Disassembly. Refer to figure 5-12 and proceed as follows:

(1) Remove universal joint.

(2) Detach lower cable yoke from actuating lever (5).

(3) Remove cotter pin (37, fig. 5-19) and remove nut (38) from drive pinion shaft.

(4) Remove brakedrum (8, fig. 5-12).

(5) Remove springs (7) from brakeshoe assemblies (6) and slide shoes from actuating pawls.

(6) Remove actuating lever (5) and rollers (4).

(7) Remove screws (3) and lockwashers (2) and remove backing plate (1) from pinion bearing cap.

b. Inspection.

(1) Check backing plate for distortion, loose or sheared rivets, and worn pawls.

(2) Check brake lining for abnormal wear or grease saturation.

(3) Check brakeshoes for worn pawl holes, lever contact areas or wear pads and cracks or distortion.

(4) Check brakedrum for cracks, scoring, or other damage.

(5) Replace drum if defective. If serviceable, use fine emery cloth to remove discolorations and lining residue from interior surfaces.

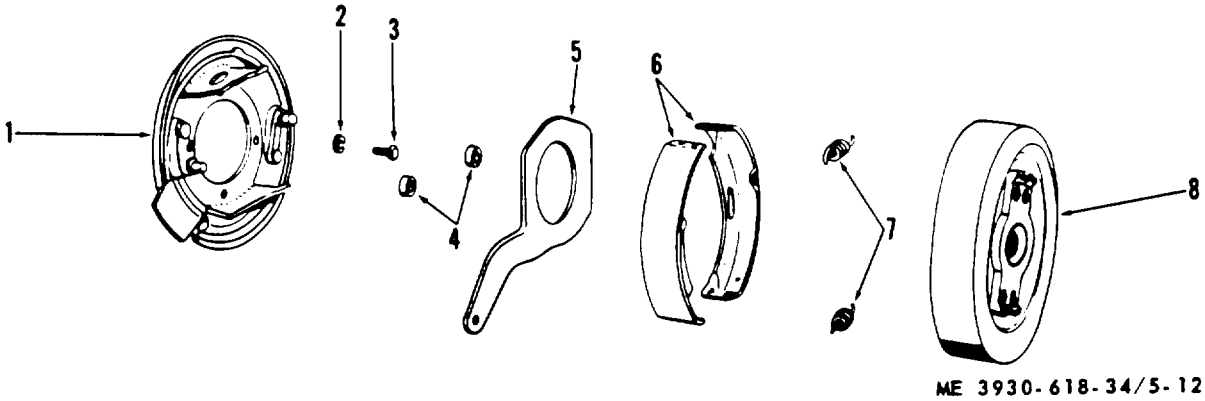
(6) Replace other defective parts as authorized.

c. Reassembly and Installation.

(1) Reverse procedures in *a* above.

(2) Apply light coat of brake lubricant to wear pads and pawls on backing plate and wear surfaces of actuating lever and shoes.

(3) Refer to TM 10-3930-618-20 for adjustment.



1 Backing plate
2 Lockwasher
3 Capscrew
4 Roller
5 Actuating lever
6 Shoe assembly
7 Spring
8 Brake drum

Figure 5-12. Hand brake assembly.

5-13. Wheel Brake Assembly

a. Removal and Disassembly.

(1) Remove drive wheels (TM 10-3930-618-20).

(2) Remove planetary gears, axle shafts, hubs, and brakedrums (para 5-19).

(3) Remove shoe retaining spring (1, fig. 5-13, sheet 1 of 2).

(4) Remove the brake shoe return spring (2).

(5) Remove the brake shoe anti-rattle components (3, 4, 5, and 7).

(6) Remove the brake shoes (6).

(7) Replace adjusting pawl assembly if spring tension test is less than 107 lbs. (see fig. 5-13, sheet 2 of 2).

(8) Remove adjusting pawl (14) from backing plate.

NOTE

It will be necessary to break tack weld to remove adjusting pawl nut.

b. Inspection and Repair.

(1) Examine brake drums for scoring, heat checks, or out-of-round condition.

(2) Resurface drums if scored, cracked from heat checks, or out-of-round. Do not resurface previously turned drums or turn in excess of 0.030 inch.

(3) If resurfacing drums is not required, polish surface with fine emery cloth to remove discoloration and lining residue.

(4) Inspect linings for abnormal wear and brake fluid or grease saturation.

(5) Replace linings if worn to less than 1/8 inch or if saturated with brake fluid or grease.

(6) Inspect shoes for distortion and cracks.

(7) Inspect for weak or broken return springs.

c. Reassembly and Installation.

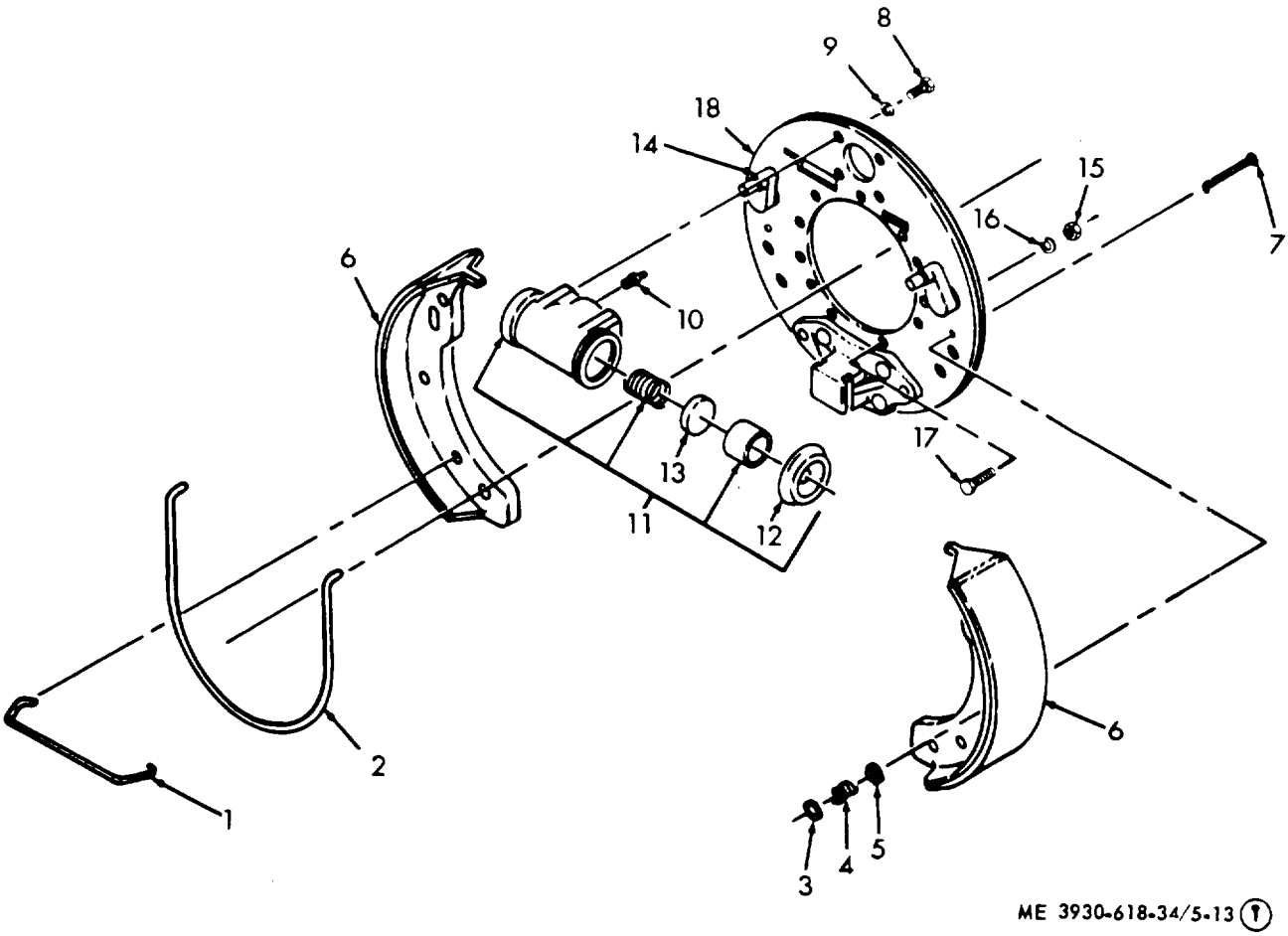
(1) Reverse procedures in *a* above.

(2) Refer to figure 5-13 for installation instructions for the adjusting pawl.

CAUTION

Do not attempt to adjust this system manually by using a wrench to turn tack welded pawl nut.

(3) Brakes are self-adjusting and will maintain a predetermined lining to drum clearance. Minimum lining to drum clearance is established by width of the adjusting pawl slots in the shoe webs. Lining to drum clearance will be established with the first pedal application.



1 Retaining spring
2 Return spring
3 Rod retainer
4 Spring
5 Rod retainer
6 Brake shoe
7 Anti-rattle rod
8 Capscrew
9 Lockwasher
10 Bleeder valve
11 Brake cylinder assy
12 Cylinder boot
13 Cup
14 Adjusting pawl
15 Nut
16 Lockwasher
17 Screw
18 Backing plate

Figure 5-13. Wheel brake assembly (sheet 1 of 2).

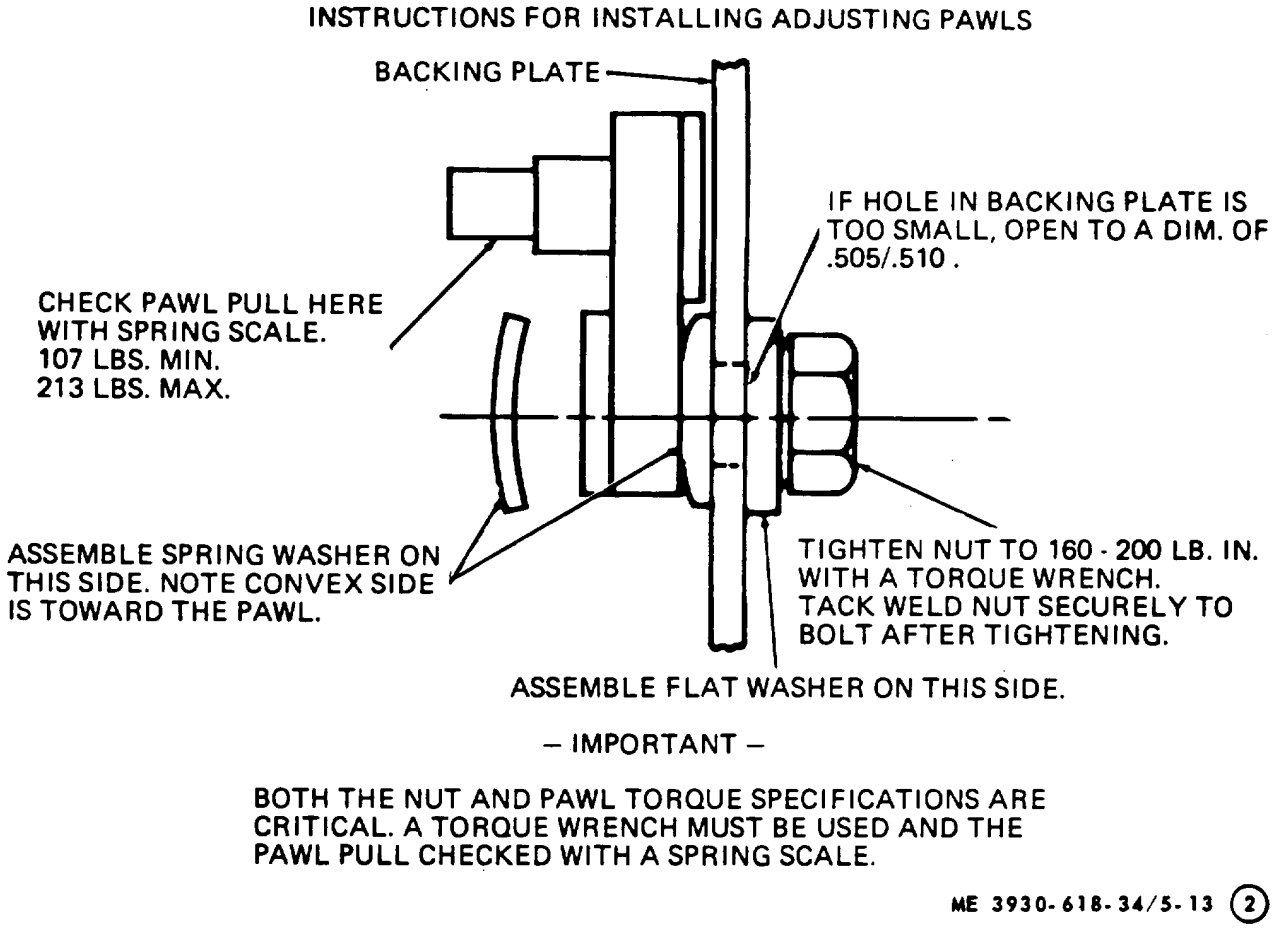


Figure 5-13. Wheel brake assembly (sheet 2 of 2).

5-14. Master Cylinder

a. Description. The brake master cylinder and fluid reservoir are combined in one casting and are joined by intake and bypass ports in the cylinder wall. Internal parts are removable at the push rod end.

b. Removal. Refer to figure 5-14 and remove the master cylinder assembly as follows:

(1) Remove the floor plate.

(2) Disconnect the electrical wires at the stoplight switch.

(3) Remove the power booster (para 5-17).

(4) Remove the clevis pin holding the push rod to the brake pedal.

(5) Remove the screws holding the master cylinder assembly to the inside of the frame and remove the cylinder.

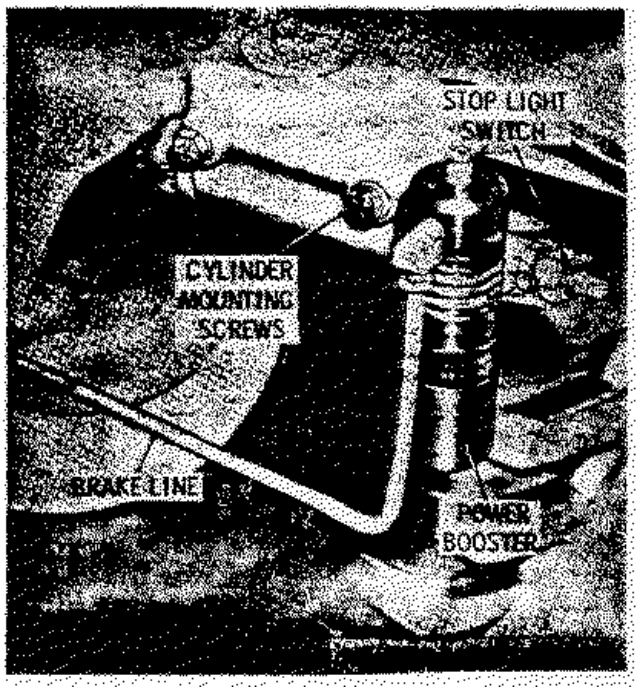


Figure 5-14. Brake master cylinder installed view.

(1) Secure master cylinder in a vise, using care not to crack or distort cylinder housing.

(2) Remove boot (2, fig. 5-15) and piston rod (1).

(3) Hold piston in cylinder and remove lock wire (3) by gentle prying.

CAUTION

When lock wire is removed, the entire piston assembly will spring out if not held in place.

(4) Carefully remove copper stop plate (4), piston (5), piston cup (6), spring (7), and valve (8).

(5) Working from the other end of cylinder, remove outlet fitting bolt (15), gasket (14), outlet fitting (13), and gasket (12).

(6) Remove filler cap (11) and gasket (10).

d. Cleaning and Inspection.

(1) Clean all parts with denatured alcohol or brake fluid, and keep clean in all following operations.

require honing to resurface the cylinder wall. Pressure marks may be polished out with crocus cloth.

CAUTION

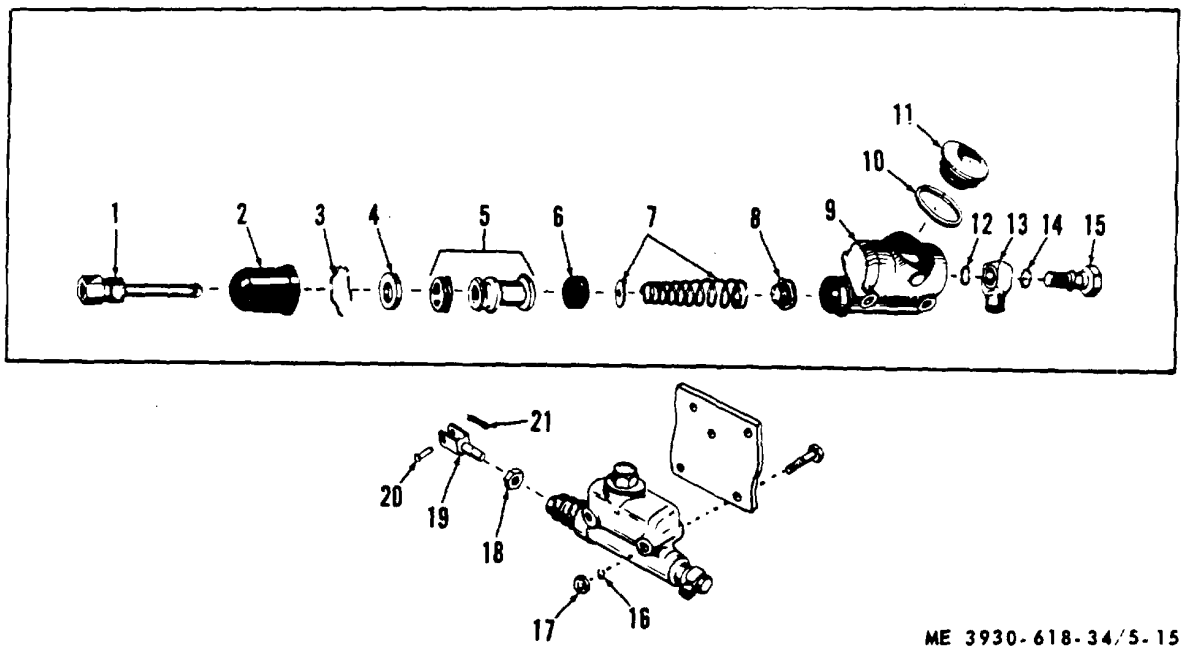
Do not use emery cloth or sandpaper.

(3) Make sure intake and bypass ports are open. Bypass ports may e probed with soft iron wire.

(4) If it is necessary to resurface the cylinder wall, follow the honing equipment manufacturers recommendations. Do not hone cylinder oversize.

(5) Before assembly, inspect parts for corrosion, scratched or pitted piston bearing surfaces, rubber deterioration, and defective spring action. Replace worn, damaged, corroded, or deteriorated parts as authorized.

e. Assembly and Installation. Reverse procedures in *b* and *c* above. Refer to TM 10-3930-618-20 for hydraulic brake bleeding.



1 Piston rod
2 Boot
3 Lock wire
4 Stop plate
5 Piston assembly
6 Piston cup
7 Spring and retainer
8 Check valve
9 Cylinder and tank
10 Gasket
11 Filler plug
12 Gasket
13 Outlet fitting
14 Gasket
15 Fitting bolt
16 Lockwasher
17 Capscrew
18 Jamnut
19 Yoke
20 Yoke pin
21 Cotter pin

Figure 5-15. Master cylinder.

5-15. Wheel Cylinders

a. Description. The hydraulic wheel cylinder houses two opposed pistons which actuate two opposed brakeshoes. Pistons, rubber cups, and springs are held in the cylinder by pressure from the brakeshoes. Open ends of the cylinder are protected by rubber boots.

b. Removal.

(1) Remove brake assemblies (para 5-13).

(2) Disconnect brake line at cylinder fitting.

(3) Remove capscrew (8, fig. 5-13) and lockwashers (9) and remove cylinder from backing plate (18).

c. Disassembly.

(1) Remove rubber boots (12) from cylinder ends.

(2) Push out internal parts.

d. Cleaning and Inspection. Use the same procedures for cleaning and inspection as those used for the master cylinder (para 5-14). Replace defective parts as authorized.

e. Assembly and Installation.

(1) Reverse procedures in *b* and *c* above.

(2) Refer to TM 10-3930-618-20 for bleeding of brake system.

5-16. Brake Pedal

Refer to paragraph 3-17.

5-17. Power Booster

a. Description. The power booster is connected to the master cylinder outlet through a pipe nipple and is operated by pressure developed by the master cylinder. The power booster multiplies this pressure and applies the increased pressure to the wheel cylinders, resulting in more positive braking.

b. Removal. Refer to figure 5-16 and remove the power booster as follows:

(1) Remove the floor plate.

(2) Disconnect the brake line at the power booster.

(3) Using an open-end wrench of the proper size, turn the connecting nipple clockwise, into the master cylinder, while holding the power booster. The nipple will turn out of the power booster.

c. Disassembly.

(1) Remove nipple (2, fig. 5-17), bleeder screw (1), and elbow (13).

(2) Clamp top end of booster in padded vise.

(3) Carefully unscrew lower part of housing from upper part, using a pipe wrench.

(4) Grasp end of poppet (9) and carefully withdraw poppet, sleeve (8), spring (4), and lower cup washer (11) from lower part of housing.

(5) Remove spacer (6), cup washers (7 and 11), piston (10), and spring (12) from upper part of housing.

d. Inspection and Repair.

(1) Inspect springs (4) and (2) for distortion or stretching.

(2) Check poppet (9), sleeve (8), and piston (10) for scratches, burs, and improper sliding fit.

(3) Inspect piston bore in upper housing for scratches or out-of-round condition.

(4) Remove and discard packing (5).

e. Assembly. Reverse procedures in *c* above. Make sure springs seat properly and no damage occurs to housing. Replace packing (5).

f. Installation.

(1) Reverse procedures in *b* above.

(2) Use a suitable thread compound on thread connections and make sure connections are tight.

(3) Bleed the brake system (TM 10-3930-618-20).

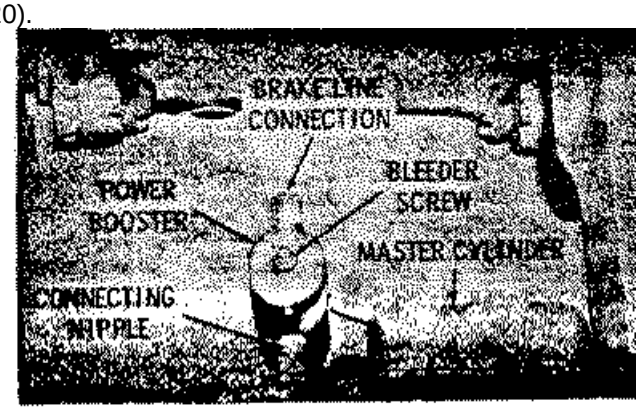
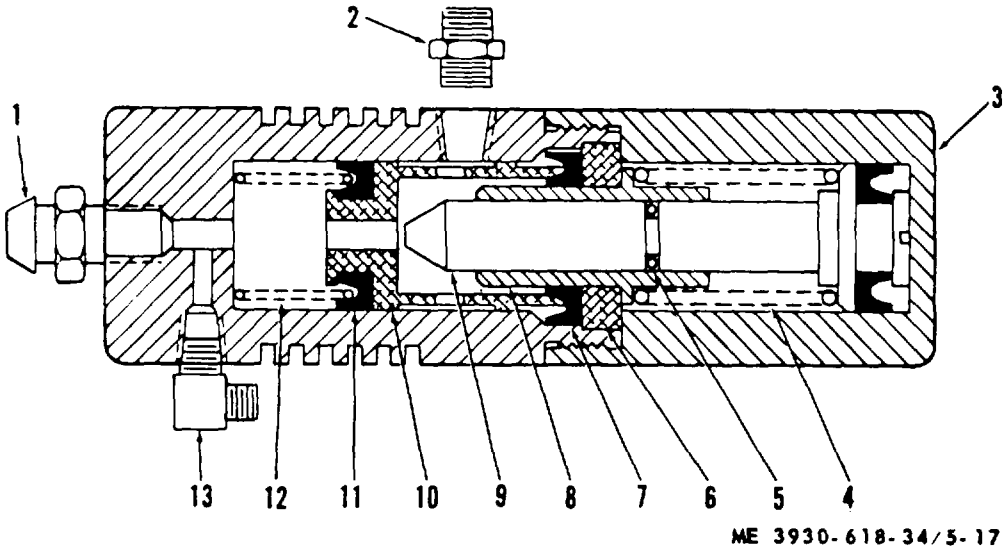


Figure 5-16. Brake power booster, installed valve.



1 Bleeder screw
2 Nipple
3 Booster assembly
4 Spring
5 Packing
6 Spacer
7 Cup washer
8 Sleeve
9 Poppet
10 Piston
11 Cup washer
12 Spring
13 Elbow

Figure 5-17. Power booster components.

Section III. REPAIR OF DRIVE AXLE

5-18. Drive Axle Assembly

a. Description. The drive axle group consists of the differential and carrier, axle shafts, and planetary gear-type final drive. The drive wheel, bevel drive pinion, and differential assembly are supported by tapered roller bearings. The differential carrier is mounted at the center of the drive axle housing. The differential consists of two parts, the carrier assembly and case assembly. The bevel ring gear is bolted to the differential case which houses the spider and side gears. The pinion gear is mounted in the differential carrier. Double reduction is obtained by means of internal tooth planetary gears mounted on the wheel hubs which are driven through idler gears by pinion gears mounted at the wheel ends of the axle shafts.

b. Removal. The complete drive unit, including wheels and tires, can be removed as a unit (para 2-15).

5-19. Planetary Gears, Axle Shafts, Wheel Hubs, and Brakedrums

a. Tire and Wheel Removal.

(1) Refer to TM 10-3930-618-20 for removal of drive tires and wheels.

(2) Refer to paragraph 5-13 for service brake removal.

(3) Refer to paragraph 5-12 for hand brake removal.

b. Disassembly.

(1) Rotate hubs until plug (18, fig. 5-18) in cover (15) is at low point. Then remove plug and drain oil from cover.

(2) Remove nuts (17) and lockwashers (16) and pull cover (15), gear (11), and gaskets (10) from studs in hub (25).

(3) Remove screws (14) and remove retainer (12) from spider (1).

(4) Slide gears (9) and thrust washers (8) from shafts (7).

(5) Insert threaded puller into tapped hole in axle shaft (6) and carefully pull axle shaft from axle housing tube (33).

(6) Remove nuts (4), lock (5), and washer (3) from axle housing tube.

(7) Pull spider (1) from splines on axle housing tube.

(8) Remove outer bearing cone (22) from hub (25).

(9) Slide hub (25) and brakedrum (30) from axle housing tube.

(10) Remove inner bearing cone (28) and oil seal (29) from axle housing tube.

(11) Remove nuts (32) and lockwashers (31) and separate hub from brakedrum.

(12) Remove bearing cups (21 and 27) from hub only if replacement is necessary.

c. Inspection and Repair.

(1) Wash all metal parts in cleaning solvent (P-S-661) and dry thoroughly.

(2) Inspect all gear teeth and splines for excessive or uneven wear and damage.

(3) Inspect wheel bearings for defective rollers, excessive radial play, and restricted rotation.

(4) Examine brake drums for scoring, heat checks, or out of-round condition.

(5) Resurface drums if scored, cracked from heat checks, or out-of-round. Do not resurface previously turned drums or turn in excess of 0.030 inch.

(6) If resurfacing drums is not required, polish surface with fine emery cloth to remove discolorations and lining residue.

(7) Inspect oil seal (29) for warping, damage, or signs of leakage.

(8) Replace defective parts as authorized.

d. Reassembly and Installation.

NOTE

Do not reuse gaskets.

(1) Install wheel bearings, hub (25), brakedrum (30), and spider (1) on axle housing tube (33).

(2) Install nuts (4), washer (3), and lock bearings as follows:

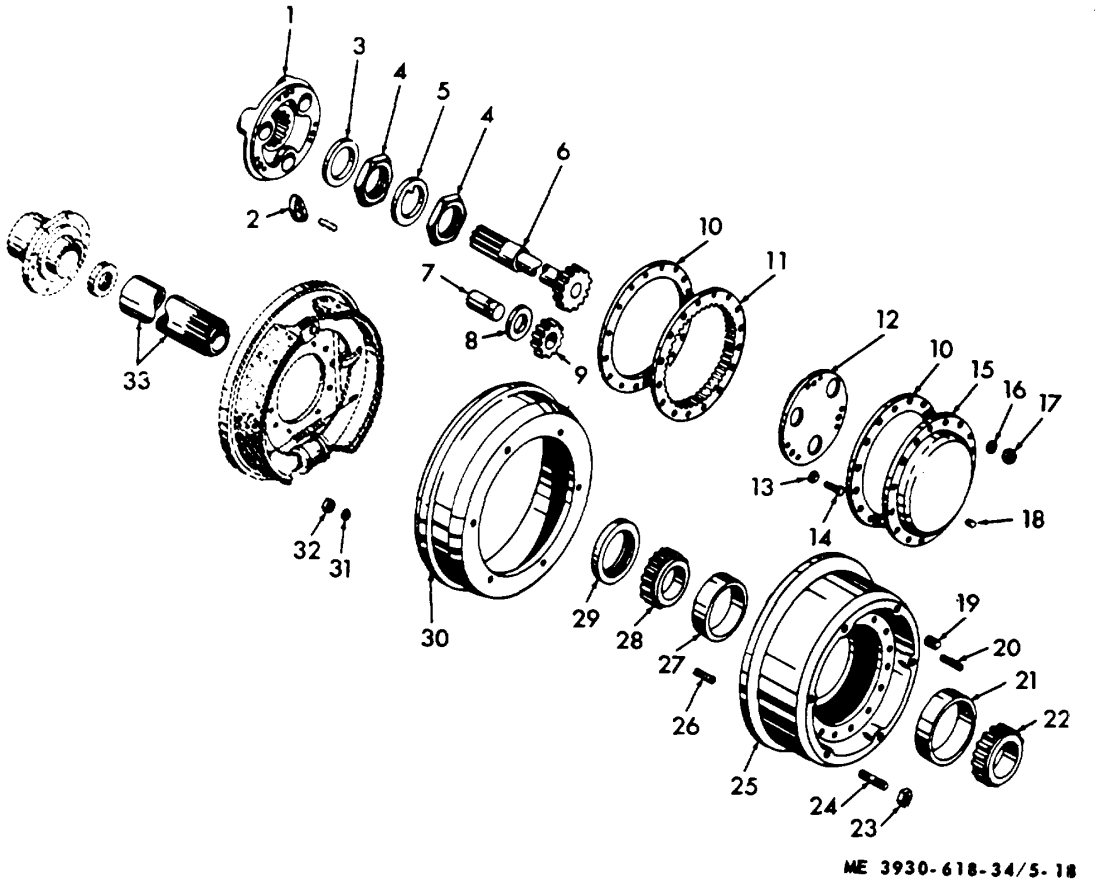
(a) Rotate wheel in forward direction and at the same time, tighten inner nut (4) until a definite drag is felt in wheel rotation.

(b) Back nut off just to the point where wheel rotates freely, then tighten outer nut against inner nut without disturbing position of inner nut.

(3) Continue reassembly in reverse order of disassembly (*b* above). Use wooden or plastic mallet to drive axle shaft in.

(4) Install wheel assemblies (TM 10-3930-618-20).

(5) Lubricate in accordance with LO 10-3930-618-12.



1 Spider
2 Spacer
3 Washer
4 Nut
5 Lock
6 Axle shaft
7 Shaft
8 Thrust washer
9 Pinion gear
10 Gasket
11 Internal gear
12 Retainer
13 Lockwasher
14 Screw
15 Cover
16 Lockwasher
17 Nut
18 Drain plug
19 Pipe plug
20 Stud
21 Bearing cup
22 Bearing cone, outer
23 Nut
24 Stud
25 Hub
26 Stud
27 Bearing cup, inner
28 Bearing cone, inner
29 Oil seal
30 Brakedrum
31 Lockwasher
32 Nut
33 Axle tube assembly

Figure 5-18. Drive axle assembly.

5-20. Drive Axle Housing and Differential

a. Removal and Disassembly.

(1) Remove drive axle assembly from truck para 2-15).

(2) Remove wheels (TM 10-3930-618-20), axle shafts (paras 5-19 *b*(1) through (5), and wheel rake assemblies (para 5-13).

(3) Remove handbrake assembly if applicable (TM 10-3930-618-20).

(4) Remove drain plug (15, fig. 5-19) and drain oil from housing.

(5) Remove screws (34 and 39) and lockwashers (33 and 40) and slide bearing cap (31) and gasket (29) off of pinion shaft, away from pinion cage (28).

(6) Remove snapring (46) and remove bearing (47) from bearing cap (31).

(7) Pull pinion shaft from differential housing.

(8) Remove screws (32 and 41), lockwashers (5 and 30), and nut (6) and lift pinion cage (28) and gasket (16) away from housing (7).

(9) Remove nuts (10) and lockwashers (11) and pull axle housings (1 and 9) and gaskets (4) from studs on drive housing (7).

(10) Support differential assembly and ring gear in drive housing (7) and remove bearing cones (26) and cups (25) from sides of housing.

(11) Carefully remove differential assembly and ring gear from drive housing.

(12) Remove screws (43) and separate ring gear from differential case (27).

(13) Remove lock wire (52) from screws (51); remove screws and separate two parts of differential case (27).

(14) Disassemble differential assembly (53) as shown.

b. Inspection and Repair.

(1) Clean all metal parts in cleaning solvent P-S-661 and dry thoroughly.

(2) Inspect bearings for worn rollers, excessive radial play, and restricted rotation.

(3) Inspect gears for chipped, cracked, or excessively worn teeth.

c. Reassembly and Installation.

(1) Reverse procedures in a above.

(2) Do not reuse gaskets.

(3) Lubricate in accordance with LO 10-3930-618-12.

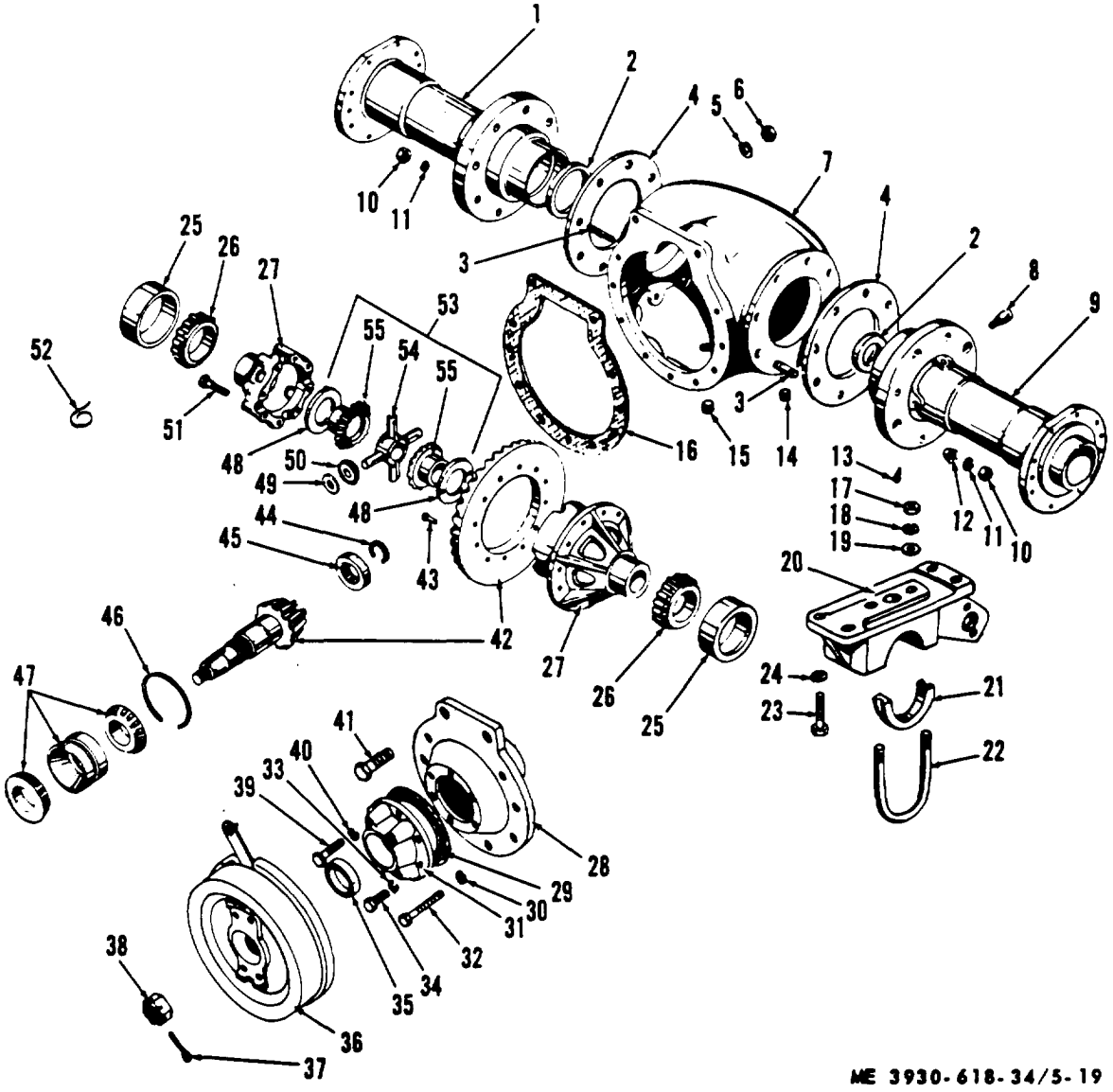


Figure 5-19. Drive axle housing and differential.

Key to figure 5-19.

1 Axle housing, rh
2 Oil seal
3 Stud
4 Gasket
5 Lockwasher
6 Nut
7 Final drive housing
8 Breather
9 Axle housing, rh
10 Nut
11 Lockwasher
12 Dowel pin
13 Screw
14 Level plug
15 Drain plug
16 Gasket
17 Nut
18 Lockwasher
19 Flat washer
20 Axle support
21 Saddle
22 U-bolt
23 Screw
24 Lockwasher
25 Bearing cup
26 Bearing cone
27 Differential case
28 Pinion cage
29 Gasket
30 Lockwasher
31 Bearing cap
32 Screw
33 Lockwasher
34 Screw
35 Oil seal
36 Hand brake assembly
37 Cotter pin
38 Nut
39 Screw
40 Lockwasher
41 Screw
42 Ring gear and pinion set
43 Screw
44 Lockring
45 Pinion bearing, rear
46 Snapring
47 Pinion bearing, front
48 Thrust washer
49 Thrust washer
50 Differential pinion gear
51 Screw
52 Lock wire
53 Differential assembly
54 Differential spider
55 Differential side gear

Section IV. REPAIR OF UNIVERSAL JOINT

5-21. Universal Joint

a. Description. The universal joint assembly is of a heavy duty industrial type consisting of two trunnion bearing assemblies, a tube assembly (propeller shaft), and an output flange. Very little service is normally required of this assembly other than periodic repacking of the bearings.

b. Removal. Refer to figure 5-20 and remove as follows:

(1) Remove wires and capscrews (3) holding cross assemblies (2) to the pinion shaft flange and transmission output flange (1).

(2) Slide the output flange into transmission and remove universal joint.

c. Disassembly.

(1) Bend back tabs on lock plates (6) and remove screws (5) to separate cross assemblies (2) from tube assembly (4).

(2) Break connecting plates tying trunnion bearings together and remove trunnion bearings from crosses.

d. Cleaning and Inspection.

(1) Clean all parts in cleaning solvent (Spec. P-S-661) and dry thoroughly.

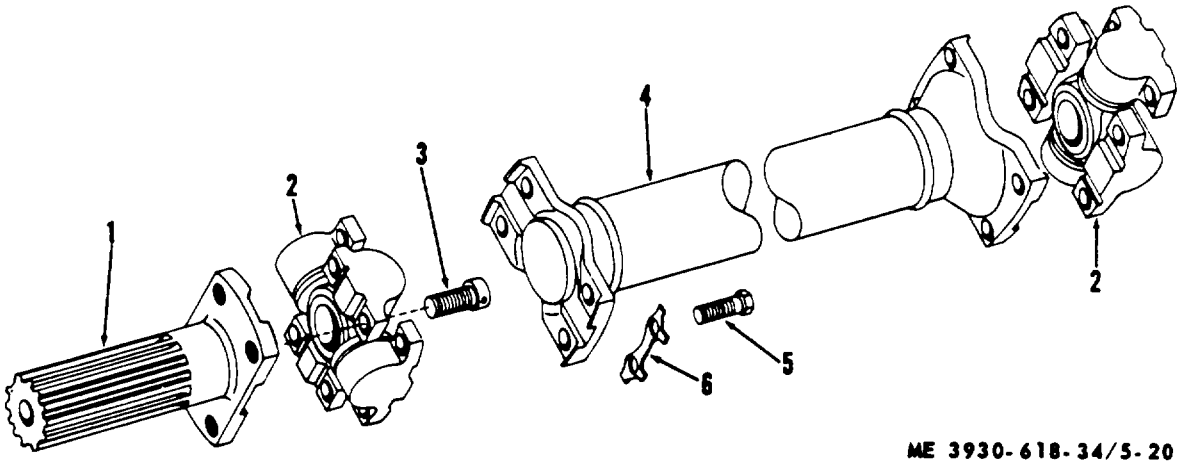
(2) Inspect bearing assemblies for freedom of movement, and for excess wear or damage.

(3) Check cross assemblies, output flange, and all capscrews for stripped threads and other dam age.

(4) Replace defective parts as authorized.

e. Assembly. Reverse procedures in *c* above.

f. Installation. Reverse procedures in *b* above.



1 Output flange
2 Crow assembly
3 Capscrew
4 Tube assembly
5 Screw
6 Lock plate

Figure 5-20. Universal joints.

APPENDIX A

REFERENCES

A-1. Lubrication

C9100IL	Fuels, Lubricants, Oils and Waxes
LO 10-3930-618-12	Lubrication Order for Truck, Lift, Fork, Allis-Chalmers Model FP60-24PS

A-2. Painting

TM 9-213	Painting Instructions for Field Use

A-3. Maintenance

TB 750-651	Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling Systems
TM 38-750	The Army Maintenance Management System (TAMMS)
TM 10-3920-618-34P	DS and GS and Depot Maintenance Repair Parts and Special Tools List
TM 10-3930-618-20	Organizational Maintenance Manual
TM 10-3930-618-20P	Organizational Maintenance Repair Parts and Special Tools List
TM 5-764	Electric Motor and Generator Repair

A-4. Shipment and Storage

TB 740-93-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-90-1	Administrative Storage of Equipment

A-5. Demolition

TM 750-244-3	Destruction of Materiel to Prevent Enemy Use

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