DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL FOR

TRUCK, LIFT, FORK, GASOLINE ENGINE DRIVEN,

SOLID RUBBER TIRES, 127 INCH LIFT,

2000 POUND CAPACITY

(ARMY MODEL MHE-229)

(CLARK EQUIPMENT MODEL 2329397)

NSN 3930-00-315-9699

This copy is a reprint which includes current pages from Change 1.

HEADQUARTERS, DEPARTMENT OF THE ARMY

30 APRIL 1975

WARNING

DANGEROUS GASES

When servicing battery, do not smoke or use flame in the vicinity. Batteries generate hydrogen, a highly explosive gas.

Do not fill fuel tank while engine is running. Provide metallic contact between the fuel container and fuel tank to prevent a static spark from igniting fuel. Wipe or flush any spillage.

Make sure fire extinguisher (Class B) is on the truck.

Use caution when approaching doorways, aisles, intersections or other workers.

Avoid sudden starting and stopping. Reduce speed on turns.

Know the rated capacity of the truck arid do not overload it.

Do not operate vehicle for prolonged periods in an unventilated area. All gasoline engines produce poisonous carbon monoxide gas which is extremely toxic if allowed to accumulate in a closed area.

Immediately remove from service any vehicle evidencing a defect or malfunction which might prove hazardous to operating personnel, or cause further damage to equipment. Such defects must be corrected immediately, regardless of scheduled maintenance actions.

Do not remove the radiator cap from an overheated radiator; stop engine and allow radiator to cool before removing cap to avoid injury by scalding.

Make sure forks are lowered to the ground and hand brake is engaged firmly.

If the truck is parked on an incline, set brakes and block at least two wheels in the event of hand brake failure.

Immediately remove from service any vehicle showing a defect or malfunction which might prove hazardous to operating personnel or cause further damage to equipment.

Do not remove radiator cap from an overheated radiator. Stop engine and allow radiator to cool before removing cap to avoid injury by scalding.

If vehicle is parked on an incline, set brakes and block at least 2 wheels as a precaution against hand brake failure.

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F.- 138° F. (39° C. - 59° C.).

CHANGE
NO. 1 }

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *22 October 1984*

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

TRUCK, LIFT, FORK, GASOLINE

ENGINE DRIVEN, SOLID RUBBER TIRES,

127 INCH LIFT, 2000 POUND CAPACITY

(ARMY MODEL MHE-229)

(CLARK EQUIPMENT MODEL 2329397)

NSN 3930-00-315-9699

TM 10-3930-632-34, 30 April 1975, is changed as follows:

1. Remove old pages and insert new pages as indicated below.
2. New or changed material is indicated by a vertical bar in the margin of the page.
3. Added or revised illustrations are indicated by a vertical bar adjacent to the illustration identification number.

Remove Pages	*Insert Pages*	*Remove Pages*	*Insert Pages*
i through iv	i through iv	11-5 through 11-8	11-5 through 11-8
1-1 and 1-2	1-1 and 1-2	12-1 through 12-3	12-1 through 12-4
4-9 through 4-12	4-9 through 4-12	13-1 through 13-3	13-1 through 13-3
9-3 through 9-6	9-3 through 9-6	A-1	A-1 /(A-2 blank)
none	**9-10.1 and 9-10.2**	Index 1-1 through 1-8	I-1 through I-8
9-17 through 9-20	9-17 through 9-20		
9-23 through 9-26	9-23 through 9-26		

4. File this change sheet in front of the publication for reference purposes.

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

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To be distributed in accordance with DA Form, 12-25A, Direct and General Support Maintenance for Warehouse Equipment.

TECHNICAL MANUAL

No. 10-3930-632-34

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *30 April 1975*

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

TRUCK, LIFT, FORK, GASOLINE

ENGINE DRIVEN, SOLID RUBBER TIRES,

127 INCH LIFT, 2000 POUND CAPACITY

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LIST OF ILLUSTRATIONS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual is for your use in maintaining the Army Model MHE-229 Fork Lift Truck.

1-2. Maintenance Forms and Records

Maintenance forms and records that you are required to use: DA Form 2408 (Equipment Log Assembly-Records), DA Form 2408-1 (Equipment Daily and Monthly Log), DA Form 2408-5 (Equipment Modification Record), DA Form 2408-9 (Equipment Control Record), DA Form 2408-10 (Equipment Component Register), and DA Form 2408-14 (Uncorrected Fault Record).

1-3. Reporting of Errors

You can help improve this manual. If you find any mistakes or if you know of a way to improve the procedures, please let us know. Mail your letter, DA Form 2028 (Recommended Changes to Publications and Blank Forms), or DA Form 2028-2 located in the back of this manual direct to: Commander, US Army Tank-Automotive Command, Warren, MI 48090, Attn: DRST-MB. A reply will be furnished to you.

1-4. Destruction of Army Material to Prevent Enemy Use

a. General. Do not destroy the truck except on order of proper authority, and demolish it only to prevent capture and use of the truck by the enemy. Destroy the same parts on all similar equipment to prevent enemy use through cannibalization.

b. Methods.

(1) Controls. Smash all controls, including steering wheel.

(2) Gasoline Engine. Pierce or smash cylinder block. Damage crankshaft and camshaft.

(3) Transmission and Differential. Pierce or smash transmission and differential case.

(4) Steering Gear. Pierce or smash steering gear housing.

(5) Wires, Cables, and Lines. Cut, rip out, or otherwise destroy all wires, electrical cables, and fuel, oil, or water lines.

(6) Carburetor and Manifolds. Smash these assemblies.

(7) Alternator, Distributor, ignition Coil, and Spark Plugs. Destroy these components by smashing.

(8) Radiator. Drive large holes through core and tank. Break off drain cock.

(9) Battery. Break cam and plates of battery.

1-5. Administrative Storage

a. Select the best available site for administrative storage. Separate stored equipment from equipment is use. Conspicuously mark the are "Administrative Storage".

b. Covered space is preferred. When sufficient covered space for all items to be stored is not available, priority should be given to items which are most susceptible to deterioration from the elements. SB 38-8-1 should be used s a guide for establishing the items most susceptible to deterioration.

c. Open sites should be improved hardstand, if available. Unimproved sites should be firm, well-drained, and kept free of excessive vegetation.

d. Trucks, vans, CONEX containers, and other containers may be used if they provide the best available protection.

Section II. DESCRIPTION AND DATA

1-6. Description

a. general The fork lift truck (fig. 1-1 and 1-2) is a four cylinder gasoline engine driven, torque converter coupled, solid rubber tire-mounted unit. The fork lift truck utility hydraulic power for its lift and tilt functions. The truck has a rated capacity of 2000 pounds, and is designed for high maneuverability and operation in confined areas. The maintenance paragraphs of this manual contain detailed descriptions of the various components of the truck.

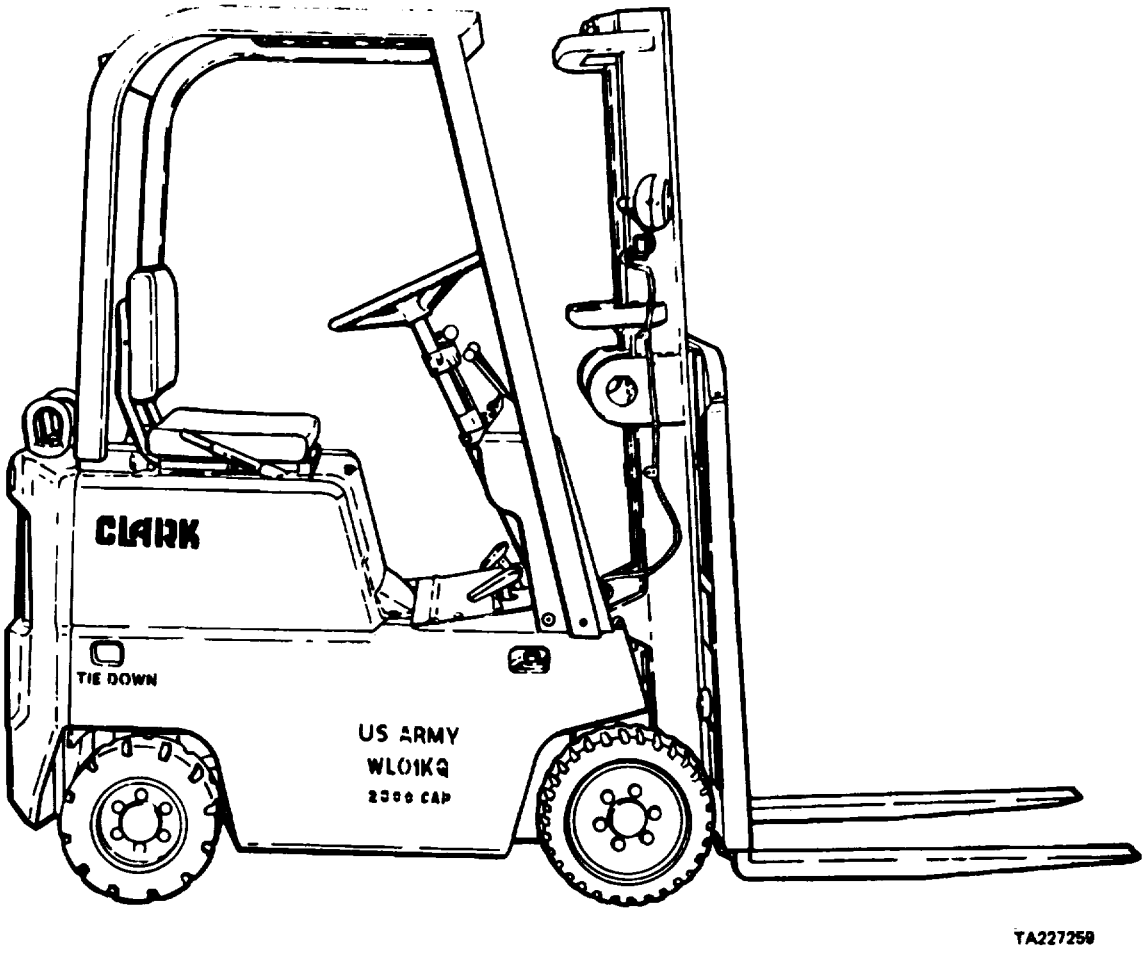


Figure 1-1. Fork Lift Truck, Right side View.

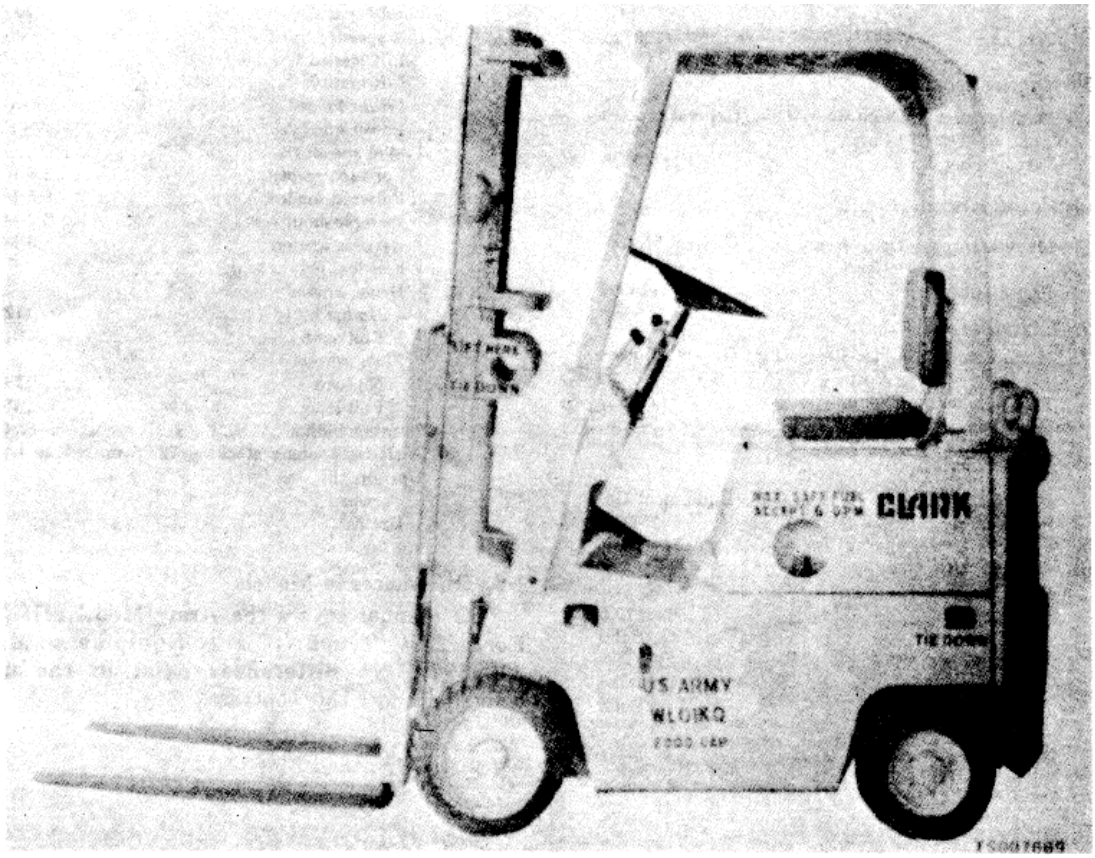


Figure 1-2. Fork Lift Truck, Left Side View

1-7. Tabulated Data

a. Identification. The fork lift truck has one identification plate, located on a panel in front of the driver's compartment. It specifies model, serial number, registration number, Federal stock number, engine serial number, warranty data, shipping and inspection dates, contract number, capacity, gross vehicle weight and dimensional information.

b. Tabulated Data.

(1) Identification plate.

Model	C500-20
Serial number	1 thru 519
Registration number	- - - - -
Federal stock number	3930-00-315-9699
Contract number	DSA700-73-C-9423
Capacity	2000 lb
G.V.W.	47301b
Length	69.5 in.
Height	81.5 in.
Shipping weight	- - - - -
Width	33.5 in.

(2) Fork lift truck.

Manufacturer	Clark Equipment Co.
Model	2329397
Serial number range	1 thru 519

(3) Engine.

Manufacturer	Teledyne Continental Motors
Model	Y112-8061
Cylinders	4-in line
Bore and storke	3-3/16 x 3 1/2 in.
Displacement (cu. in.)	112
Compression ratio	6.07:1
Max. oil pressure	30-40 PSI
Min. oil pressure (idling)	7 PSI
Firing order	1-3-4-2
Spark plug gap	030 in.
Main bearing, front	1 3/4 x 1-7/32 in.
Main bearing, center	1 3/4 x 1-7/16 in.
Main bearing, rear	1 3/4 x 1-7/16 in.
Crankcase oil capacity	3 1/2qt
Oil filter capacity	1/2 qt
Total oil capacity	4 qt
Intake valve clearance	012 in.
Exhaust valve-clearance	020 in.
Engine water capacity	3 3/4 qt
Engine and radiator water capacity	15 qt
Weight (bare engine)	290 lb

(4) Engine alternator.

Manufacturer ... Delco-Remy Div. General Motors Corp.
Part number 1100720

(5) Engine starter.

Manufacturer .. Delco-Remy Div.. General Motors Corp.
Part number 1107378

(6) Voltage regulator.

Manufacturer ... Delco-Remy Div., General Motors Corp.
Part number 1119507

(7) Distributor.

Manufacturer ... Delco-Remy Div. General Motors Corp.
Part number 1112637
Point gap..... 022 in.

(8) Transmission.

Manufacturer .....Clark Equipment Co.
Part number 284427

(9) Wheels and tires.

Drive wheels:
- Tire size.....16x6x10.5
- Type ..... Solid

Steer wheels:
- Tire size.....14x4.5x8
- Type ..... Solid

(10) Performance.

Lift height max. .....128.25 in.
Load capacity .....2000 lb
Lift speed:
- Lift loaded .....69 FPM
- Lift empty .....79 FPM
- Lower loaded .....80 FPM
- Lower empty .....76 FPM

Travel speed:
- Forward empty.....8.6 MPH
- Forward loaded.....8.5 MPH
- Reverse empty.....8.7 MPH
- Reverse loaded.....8.6 MPH

Wheel loadings (each):
Drive wheels:
- No load.....1123 lb
- Full load .....2912 lb

Steer wheels:
- No load.....1243 lb
- Full load .....453 lb

Turning radius .....62.0 in.
Aisle-right angle stacking 72.75 in. +load length
Upright tilt:
- Forward..... 3°
- Back..... 10°

1-8. Differences in Models

This manual covers the Army Model MHE-229 Fork Lift Truck (Clark Equipment Model 2329397). No differences exist in the units delivered under this contract.

CHAPTER 2

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

2-1. General

a. Special Tools. No special tools are required to perform the direct support and general support maintenance procedures outlined in this manual.

b. Repair Parts. Repair parts, special tools, and equipment are listed in the Repair Parts and Special Tools List for Direct Support, General Support and Depot Maintenance for this equipment, TM 10-3930-632-34P.

Section II. TROUBLESHOOTING

2-2. General

a. This section contains troubleshooting information for locating and correcting most of the troubles which may develop in the fork lift truck. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help to determine probable causes and corrective actions to take. Perform the tests/inspections and corrective actions in the order listed.

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections or corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor. See Table 2-1

Table 2-1. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE
1. ENGINE STARTER OPERATES, BUT FAILS TO CRANK ENGINE WHEN SWITCH IS ENGAGED.
Step 1. Test starter motor (TM 10-3930-632-12), and inspect drive gear. Repair starter motor (para 5-8).
2. ENGINE CRANKS BUT WILL NOT START.
Step 1. Check carburetor for sticking float. Disassemble and clean carburetor (para 6-2).
Step 2. Test engine compression TM 10-3930-632-12). Adjust engine valves and replace cylinder head gasket (TM 10-3930-632-12). Replace valve spring (para 9-10). Replace valves (para 9-10). Replace piston rings (para 9-26).
3. ENGINE OPERATES, BUT BACKFIRES AND SPITS.
Step 1. Check carburetor float level. Disassemble carburetor and set float level (para 6-6d).
Step 2. Check Timing (TM 10-3930-632-12).
Step 3. Check for sticking, improperly seated, burned or pitted valve. Grind or replace valves (para 9-10).
Step 4. Inspect cylinders for excessive carbon build-up. Remove carbon from cylinders (para 9-40).
Step 5. Test valve springs. Replace weak or broken springs (para 9-10).
4. ENGINE MISFIRES ON ONE OR MORE CYLINDERS.
Step 1. Check for valve sticking open. Replace defective tappet (para 9-10).
Step 2. Test engine compression (TM 10-3930-632-12). Refer to "ENGINE CRANKS BUT WILL NOT START" above.
Step 3. Inspect for cracked cylinder block or broken valve tappet or tappet screw. Replace defective parts (para 9-10).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

5. ENGINE DOES NOT IDLE PROPERLY.
   - Step 1. Test for uneven cylinder compression (TM 10-3930-632-12). See "ENGINE CRANKS BUT WILL NOT START" above.
   - Step 2. Check carburetor accelerator pump system. Inspect for dirt in metering jets, or incorrect float level. Disassemble, clean, and overhaul carburetor (para 6-2).
6. ENGINE BACKFIRES.
   - Step 1. Check for sticking valve. Repair or replace defective parts (para 9-10).
7. ENGINE STALLS ON IDLE.
   - Step 1. Carburetor choke valve sticking in closed position. Free and lubricate valve. Overhaul carburetor (para 6-2).
   - Step 2. Check engine compression (TM 10-3930-632-12). Refer to "ENGINE CRANKS BUT WILL NOT START" above.
8. ENGINE MISSES AT HIGH SPEEDS.
   - Step 1. Check for sticking valves and weak or broken valve springs. Replace defective parts (pare 9-10).
   - Step 2. Check engine compression (TM 10-3930-632-12). See "ENGINE CRANKS BUT WILL NOT START" above.
   - Step 3. Inspect for dirty or defective carburetor. Overhaul and clean carburetor (para 6-2).
9. ENGINE LACKS POWER.
   - Step 1. Check engine compression (TM 10-3930-632-12). Inspect valves and springs. See "ENGINE CRANKS BUT WILL NOT START" above.
10. ENGINE OVERHEATS.
   - Step 1. Check engine compression (TM 10-3930 632-12). See "ENGINE CRANKS BUT WILL NOT START" above.
   - Step 2. Inspect for leaking cylinder block or head. Replace defective parts (para 9-41 and TM 10-3930-632-12).
11. HIGH FUEL CONSUMPTION.
   - Step 1. Inspect carburetor for worn or broken parts. Overhaul carburetor (para 6-2).
   - Step 2. Carburetor float level too high; accelerator pump not properly adjusted. Adjust carburetor float (para 6-6*d*).
   - Step 3. Check engine compression (TM 10-3930-632-12). See "ENGINE CRANKS BUT WILL NOT START" above.
12. ENGINE OIL CONSUMPTION IS HIGH.
   - Step 1. Inspect pistons and rings. Check side clearance of intake valves in guide and worn cylinder bores. Inspect for excessive bearing clearance or misaligned connecting rod. Replace defective parts (paras 9-10 and 9-33).
13. ENGINE OIL PRESSURE IS LOW.
   - Step 1. Check for clogged oil pump screen. Remove oil pan and clean pump screen (para 9-16).
   - Step 2. Check for oil leaks. Repair or replace defective parts.
   - Step 3. Test oil pump. Check for sticking or improperly adjusted pressure regulator. Repair or replace defective parts (para 9-15).
14. A HEAVY DULL KNOCK SOUNDS IN ENGINE WHEN ACCELERATING UNDER LOAD.
   - Step 1. Check for worn or damaged main bearings. Replace main bearings (para 9-30).
15. ENGINE KNOCKS WHEN LOADED OR UNLOADED.
   - Step 1. Check for excessive crankshaft end play. Adjust crankshaft end play (para 9-33*j)*.
16. A LIGHT METALLIC KNOCK OCCURS WHEN ENGINE IS AT ABOUT TWO-THIRDS MAXIMUM SPEED.
   - Step 1. Check for worn or damaged connecting rod bearings. Replace bearings (para 9-26).
17. A PERSISTENT SHARP CLICKING NOISE OCCURS AT ANY ENGINE SPEED.
   - Step 1. Check for broken piston ring or pin. Replace defective parts (para 9-26).
18. ENGINE VIBRATES AT ALL SPEEDS.
   - Step 1. Check flywheel for proper balance. Repair or replace defective parts (para 9-22).
19. FUEL REACHES CARBURETOR BUT DOES NOT REACH CYLINDER.
   - Step 1. Check carburetor for clogged fuel passage. Overhaul carburetor (para 6-2).
   - Step 2. Check carburetor for stuck float. Overhaul carburetor (para 6-2).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

COOLING SYSTEM

1. COOLING SOLUTION IS LOW.
   - Step 1. Check radiator for leaks.
     Repair radiator (para 7-3).

ELECTRICAL SYSTEM

1. STARTER MOTOR CRANKS ENGINE SLOWLY.
   - Step 1. Inspect for dirty commutator.
     Clean commutator (para 5-10).
   - Step 2. Check wear condition of brushes.
     Replace brushes (para 5-9).
   - Step 3. Test starter motor (TM 10-3930-632-12).
     Overhaul starter motor if defective (para 5-7).
2. STARTER MOTOR DOES NOT CRANK ENGINE.
   - Step 1. Check for faulty drive mechanism.
     Overhaul drive mechanism (para 5-7).
   - Step 2. Check for faulty solenoid switch.
     Replace switch (para 5-7).
3. LOW OR FLUCTUATING ALTERNATOR OUTPUT.
   - Step 1. Inspect brushes for wear.
     Replace brushes (para 5-4).
4. ALTERNATOR IS NOISY.
   - Step 1. Inspect for defective bearings or bent armature.
     Replace defective parts (para 5-4).
   - Step 2. Check brushes for alignment.
     Align or seat brushes.

DRIVE AXLE

1. CONTINUOUS DRIVE AXLE NOISE.
   - Step 1. Check for badly worn parts.
     Replace worn parts (para 12-2).
2. COMPLETE FAILURE OF DRIVE AXLE TO FUNCTION.
   - Step 1. Check for broken teeth on ring gear or pinion gear.
     Replace ring gear, pinion, and other parts as necessary (para 12-2).
3. DRIVE AXLE NOISE OCCURS ON DRIVE OR COAST ONLY.
   - Step 1. Differential, pinion gear and ring gear out of adjustment or worn.
     Adjust, repair or replace unit (para 12-2).
4. EXCESSIVE BACKLASH IN DRIVE AXLE.
   - Step 1. Check for loose axle shaft drive flange capscrews.
     Tighten capscrews.
   - Step 2. Check for maladjusted or worn differential drive pinion gear and ring gear.
     Adjust or replace (para 12-2).

STEERING SYSTEM

1. STEERING IS DIFFICULT.
   - Step 1. Check for tight steering system connections.
     Adjust linkage (TM 10-3930-632-12).
   - Step 2. Check for tight steering gear and misaligned wheels.
     Align and adjust steering gear and axle (paras 2-7 and 13-2).
   - Step 3. Inspect for bent pitman arm.
     Replace pitman arm (para 13-2).
2. TRUCK WANDERING OR WEAVING.
   - Step 1. Check for proper toe-in, camber, or caster (axle twisted).
     Repair and adjust axle (para 12-2).
   - Step 2. Check for worn or maladjusted steering gear.
     Repair, replace, or adjust steering gear (para 2-7).
3. SHIMMY OR WOBBLE OCCURS AT LOW SPEED.
   - Step 1. Check for loose steering connections.
     Adjust and tighten linkage (TM 10-3930-632-12).
   - Step 2. Check for worn or loose adjustment on steering gear.
     Repair, replace, or adjust steering gear (para 2-7).
4. VEHICLE PULLS TO ONE SIDE.
   - Step 1. Inspect for bent steering knuckle.
     Straighten or replace bent linkage (para 13-4).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

BRAKES

1. BRAKES DRAG.
   - Step 1. Inspect for broken or weak brake pedal return spring.
     Replace spring (para 11-3).
   - Step 2. Check for broken brake shoe return spring.
     Replace spring (para 11-20).
   - Step 3. Inspect brake drum for scored or rough condition.
     Replace drum and brake shoe assemblies (TM 10-3930-632-12).

HYDRAULIC SYSTEM

1. MAIN HYDRAULIC PUMP DOES NOT DELIVER OIL.
   - Step 1. Check for broken pump shaft.
     Overhaul pump (para 4-9).
2. MAIN HYDRAULIC PUMP DOES NOT DEVELOP PRESSURE.
   - Step 1. Check relief valve for stuck open condition.
     Overhaul and clean pump (para 4-9).
3. HYDRAULIC CYLINDERS WORK SLOWLY AT RATED ENGINE RPM.
   - Step 1. Check for defective main control valve.
     Overhaul control valve (para 4-15).
4. HYDRAULIC CYLINDERS CHATTER WHEN OPERATING.
   - Step 1. Inspect for defective cylinder.
     Overhaul cylinder (para 4-2).
   - Step 2. Check for defective hydraulic pump.
     Overhaul pump (para 4-9).
5. MAIN HYDRAULIC PUMP MAKES NOISE.
   - Step 1. Check for air leak at pump shaft packing.
     Replace shaft packing (para 4-9).
   - Step 2. Inspect shaft packing for wear.
     Replace shaft packing (para 4-9).
6. LIFT AND TILT ACTION FAILS.
   - Step 1. Check for low oil pressure.
     Overhaul main hydraulic pump (para 4-9).
7. OIL LEAK AT TOP OF LIFT CYLINDER.
   - Step 1. Inspect lift piston seal for wear.
     Replace cylinder seal (para 4-3).
   - Step 2. Inspect cylinder wall for scored condition.
     Overhaul cylinder (para 4-2).
8. OIL LEAK AROUND TILT CYLINDER PISTON ROD.
   - Step 1. Inspect seal for wear.
     Replace cylinder seal (TM 10-3930-632-12).
   - Step 2. Inspect piston rod for scored condition.
     Overhaul cylinder (TM 10-3930-632-12).

TRANSMISSION

1. TRUCK WILL NOT MOVE IN EITHER DIRECTION.
   - Step 1. Check for lack of transmission oil pressure.
     Clean transmission intake lines. Replace transmission oil pump (para 14-8).
2. TRUCK WILL MOVE ONLY IN ONE DIRECTION.
   - Step 1. Test for lack of pressure to directional selector (seals and preformed packings in directional selector possibly defective).
     Overhaul transmission (para 14-6).
   - Step 2. Directional selector discs not releasing, discs defective, or relief hob in drum clogged.
     Overhaul transmission (para 14-6).
3. TRUCK MOVES SLOWLY IN BOTH DIRECTIONS AT WIDE OPEN THROTTLE.
   - Step 1. Check for low oil pressure (faulty inching valves, faulty relief valve, or faulty pump).
     Repair or replace defective parts (para 14-6).
   - Step 2. Check for clogged sump screen.
     Clean sump screen (para 14-9).
4. TRANSMISSION OVERHEATS.
   - Step 1. Check for low directional selector pressure. Inching valve not functioning properly.
     Overhaul transmission (para 14-6).
   - Step 2. Inspect for defective selector seals.
     Overhaul transmission (para 14-6).
   - Step 3. Check for clogged sump screen.
     Clean screen (para 14-9).

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION	
Step 4.	Check for sufficient oil supply to torque converter and cooler. Clean transmission cooling lines (TM 10-3930-632-12).
Step 5.	Inspect cooler for clogged condition, stopping oil flow. Clean oil cooler (TM 10-3930-632-12).
Step 6.	Inspect bushing in torque converter impeller hub for wear. Replace torque converter (para 14-6).
Step 7.	Check for slipping stator. Replace torque converter (para 14-6).

Section III. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ACCESSORIES

2-3. General

The instructions in the following paragraphs are provided to aid in the removal and installation of those major components which are replaceable only at the Direct Support or higher level of maintenance. Refer to TM 10-3930-632-12 for removal and replacement instructions for those assemblies replaceable at organizational levels.

2-4. Special Precautions

a. Before attempting removal of any electrical component, make certain that the system is not energized. Disconnect battery ground strap.

b. Insure that adequate clearance is available for removal of the component. Disassemble the truck to the extent necessary to provide adequate working clearance.

c. Use a chain hoist, jack or other aid when lifting the heavier components. The lifting device should be positioned and attached to the component to remove all strain from the mounting hardware before the last of the hardware is removed.

d. To facilitate reassembly and installation, apply identifying tags to mating ends of electric or hydraulic lines as they are disconnected. Identify parts of similar configuration to insure correct reassembly.

e. To prevent moisture and foreign matter from entering open housings, lines, and other openings, apply protective covers as soon as practicable after disassembly.

2-5. Engine

a. Removal.

(1) Refer to TM 10-3930-632-12 and perform the following:

(a) Disconnect parking brake lever from stub shaft.

(b) Tag and disconnect electrical leads at voltage regulator.

(c) Remove overhead guard; lift-off side panels, floor plate, and hood parts.

(d) Tag and disconnect electrical leads shown in the wiring diagram in TM 10-3930-632-12 at ignition coil (fig. 2-1), alternator (fig. 2-2), starter solenoid, and starter relay.

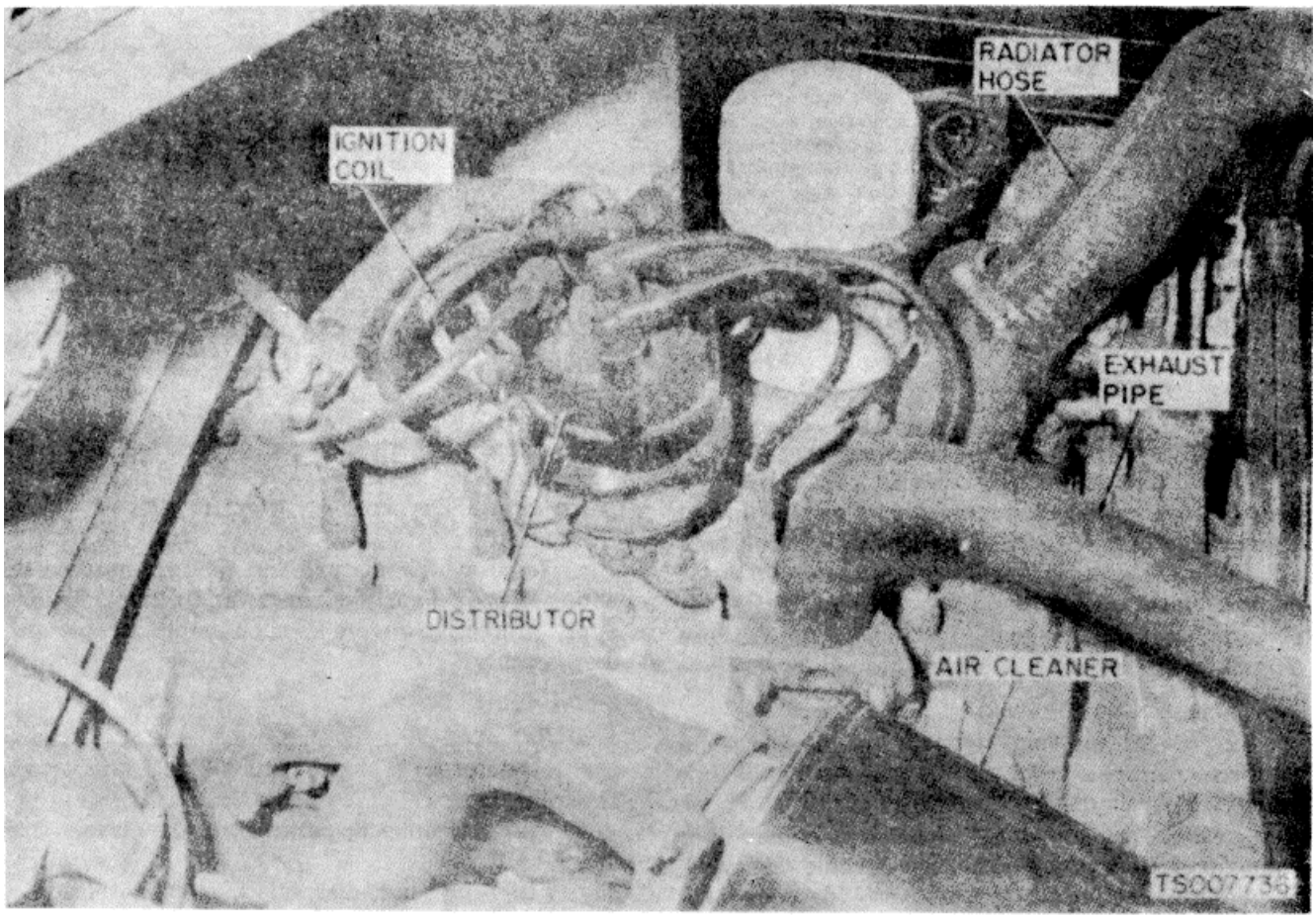


Figure 2-1. Top Front View of Engine.

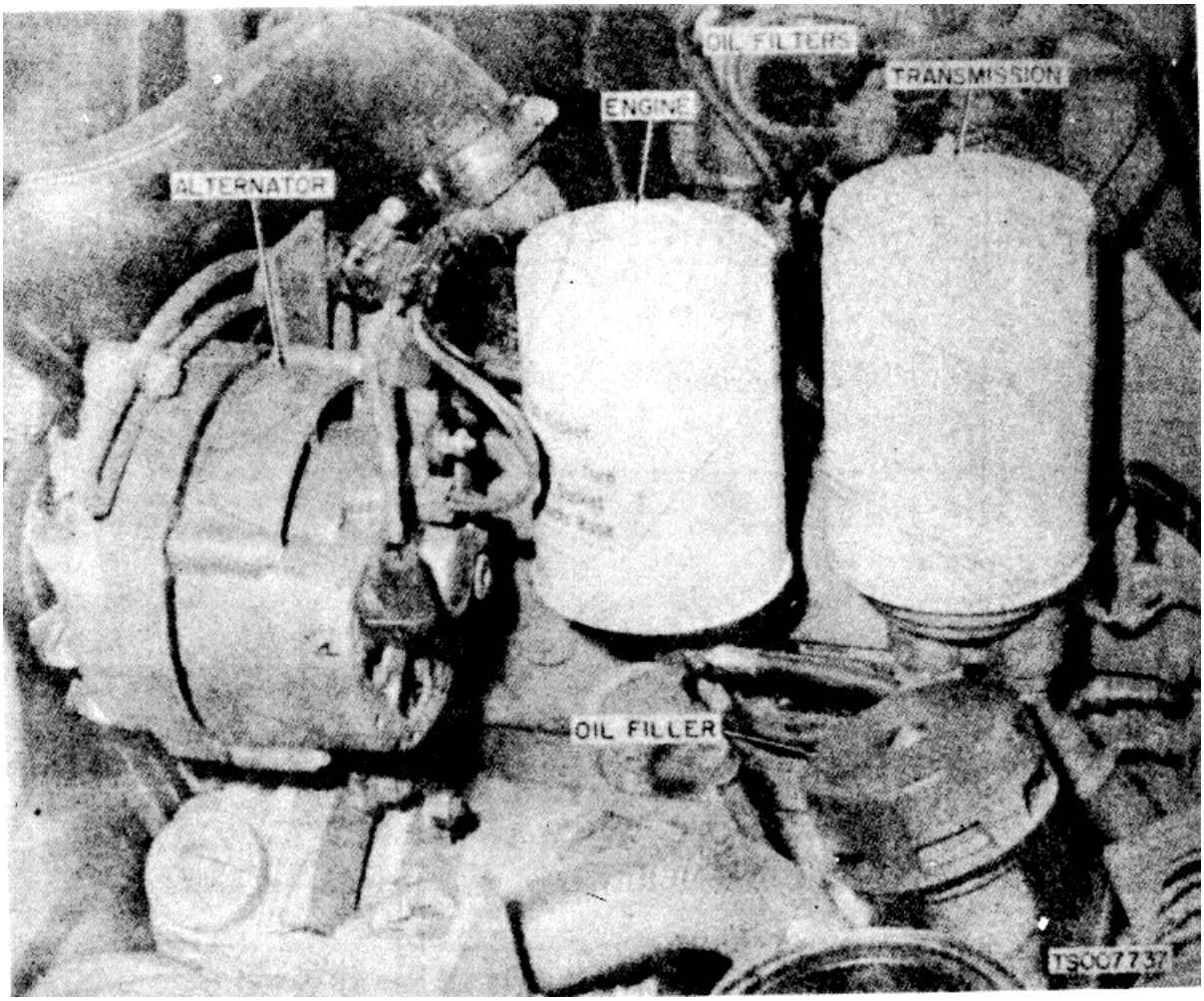


Figure 2-2. Right Hand View of Engine

(e) Remove air cleaner and mounting bracket.

(f) Disconnect fuel lines from fuel pump.

(g) Disconnect accelerator linkage from governor control lever.

(h) Disconnect choke cable from carburetor.

(I) Remove battery cables.

(j) Drain engine oil, transmission oil, and engine coolant.

(k) Remove engine oil filter and mounting bracket.

(l) Disconnect hydraulic lines from transmission oil filter and drain lines into suitable container.

(m) Disconnect hydraulic lines from hydraulic pump and drain lines into suitable container.

(n) Remove counterweight, muffler, and radiator.

(2) Block up securely underside of transmission. Support weight of engine with hoist attached to lifting eyes on engine.

(3) Remove hex locknuts (fig. 2-3) and lower support pads.

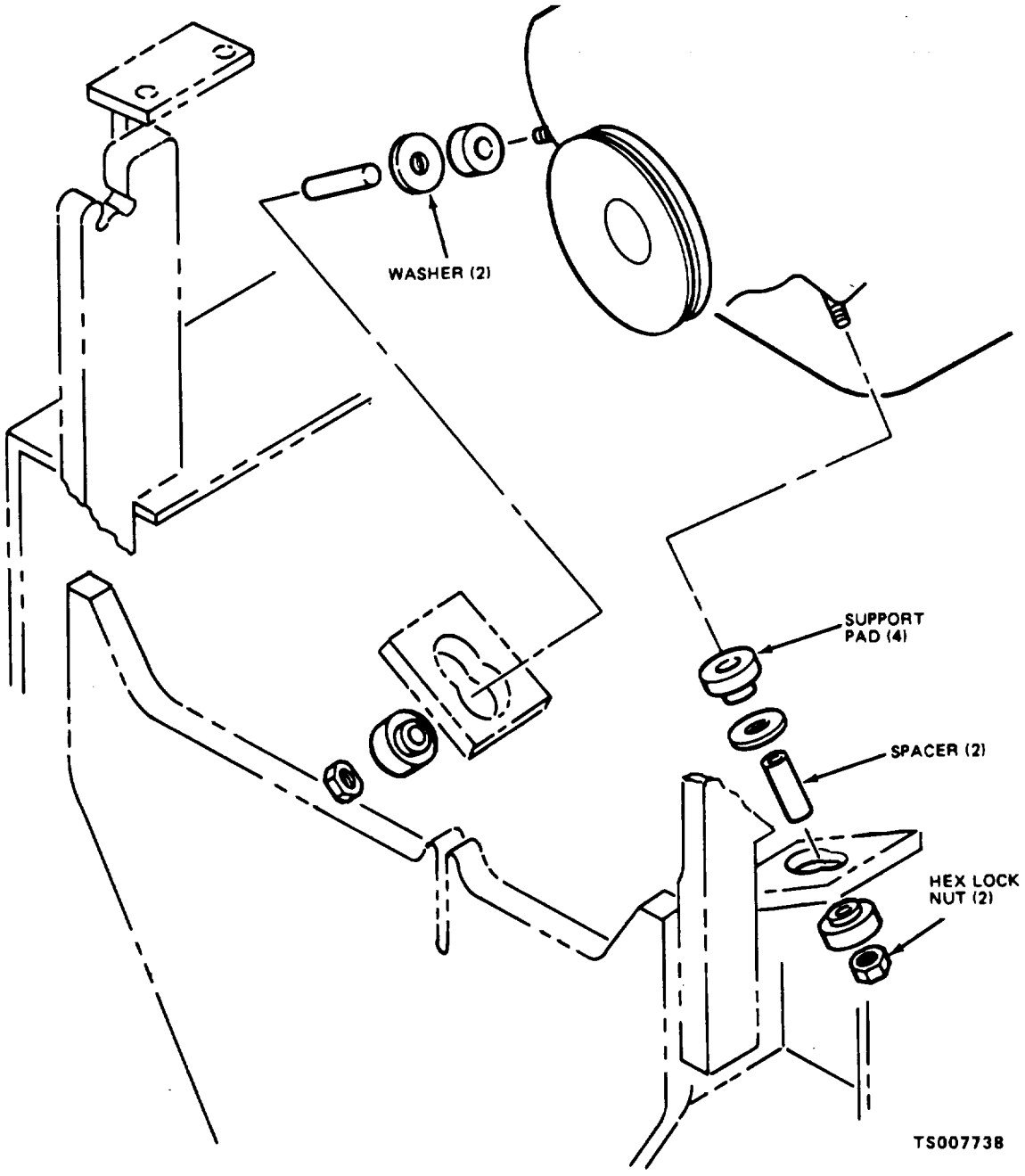


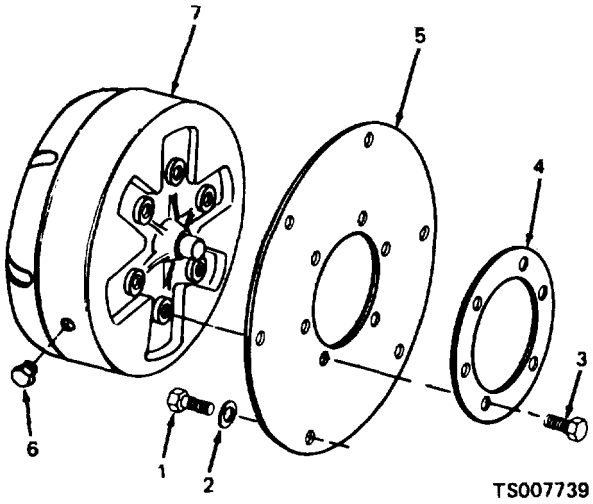
Figure 2-3. Engine Mount, Exploded View

NOTE

Remaining support pads, spacers and washers may be removed after engine is removed from truck.

(4) Remove engine-to-torque converter housing mounting screws from flange of engine flywheel housing. Remove engine and assembled torque converter by pulling out toward rear of truck.

(5) Remove six bolts (1, fig. 2-4) and lockwashers (2) that secure flywheel drive plate (5) to flywheel; remove plate and torque converter (7).



1. Bolt
2. Lockwasher
3. Bolt
4. Converter drive and reinforcing plate
5. Flywheel drive plate
6. Plug
7. Torque converter

Figure 2-4. Torque Converter and Drive Plates, Exploded View.

(6) Remove six bolts (3) that secure torque converter (7) and converter drive and reinforcing plate (4) to flywheel drive plate (5); remove torque converter and reinforcing plate.

b. Installation.

(1) Position converter drive and reinforcing plate (4, fig. 2-4) and flywheel drive plate (5) on the torque converter (7); secure with six bolts (3).

(2) Position the assembled torque converter and flywheel drive on the engine flywheel; secure with six bolts (1) and lockwashers (2).

(3) Place one support pad (fig. 2-3), one washer and spacer on each engine mounting stud.

(4) Position assembled engine and torque converter on truck so that splined shaft of transmission engages splined hole of converter. Align engine flywheel housing with torque converter housing and secure with twelve capscrews and lockwashers.

(5) Install remaining support pads on studs of engine assembly; secure engine assembly to truck frame with hex locknuts.

(6) Refer to TM 10-3930-632-12 and perform the following:

(a) Install counterweight, muffler, and radiator.

(b) Connect hydraulic lines to main hydraulic pump.

(c) Connect hydraulic lines to transmission oil filter.

(d) Install engine oil filter and mounting bracket.

(e) Fill engine crankcase, transmission, and radiator to proper levels.

(f) Install battery cables.

(g) Connect and adjust choke linkage to carburetor.

(h) Connect and adjust accelerator linkage to governor control lever.

(I) Connect fuel lines to fuel pump and hoses to water pump.

(j) Install air cleaner and mounting bracket.

(k) Connect electrical leads to ignition coil, generator, starter solenoid, and starter relay.

(l) Install overhead guard, lift-off side panels, floor plate, and hood parts.

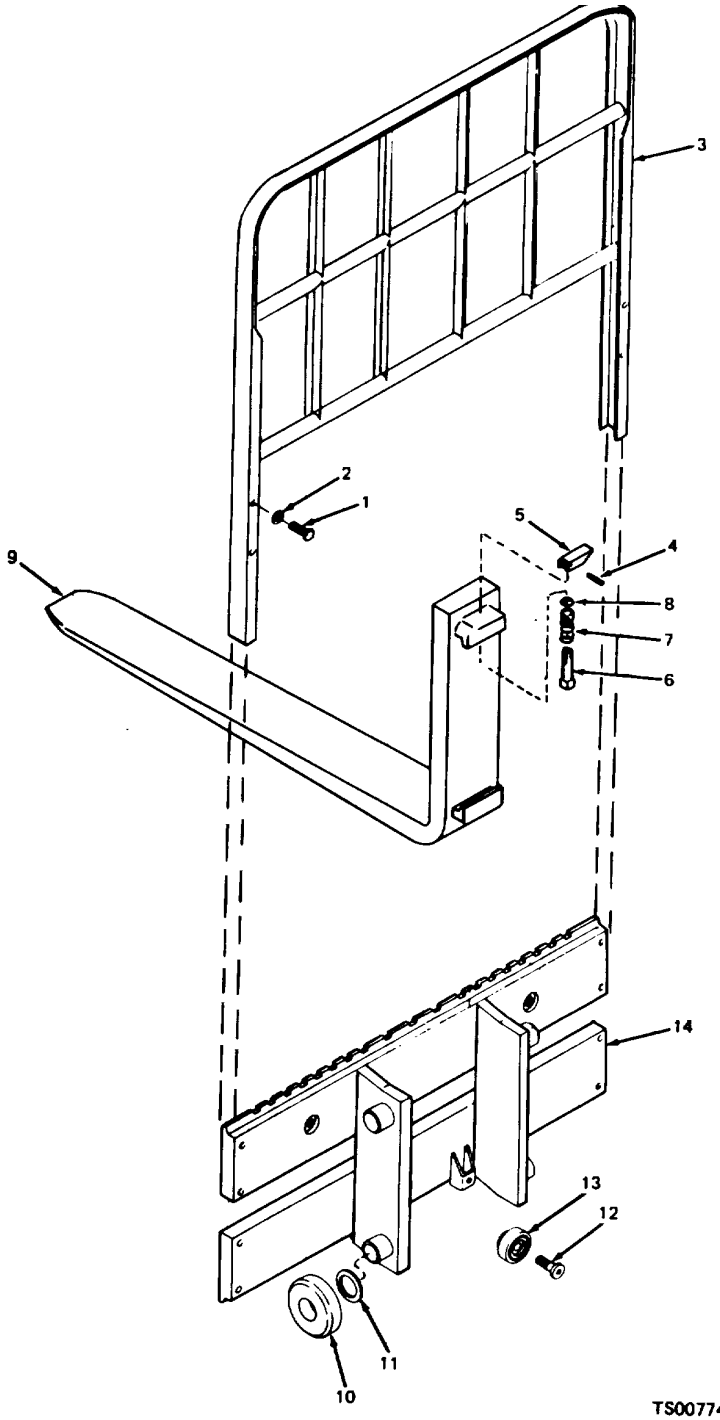
(m) Connect electrical leads to voltage regulator.

(n) Connect parking brake lever to stub shaft.

2-6. Carriage, Mast, and Lift Cylinder

a. Removal.

(1) Remove the capscrews (1, fig. 2-5) and lockwashers (2) and lift the load backrest (3) from the carriage (14). Operate the fork stop lever (5) and slide the forks (9) from the carriage.

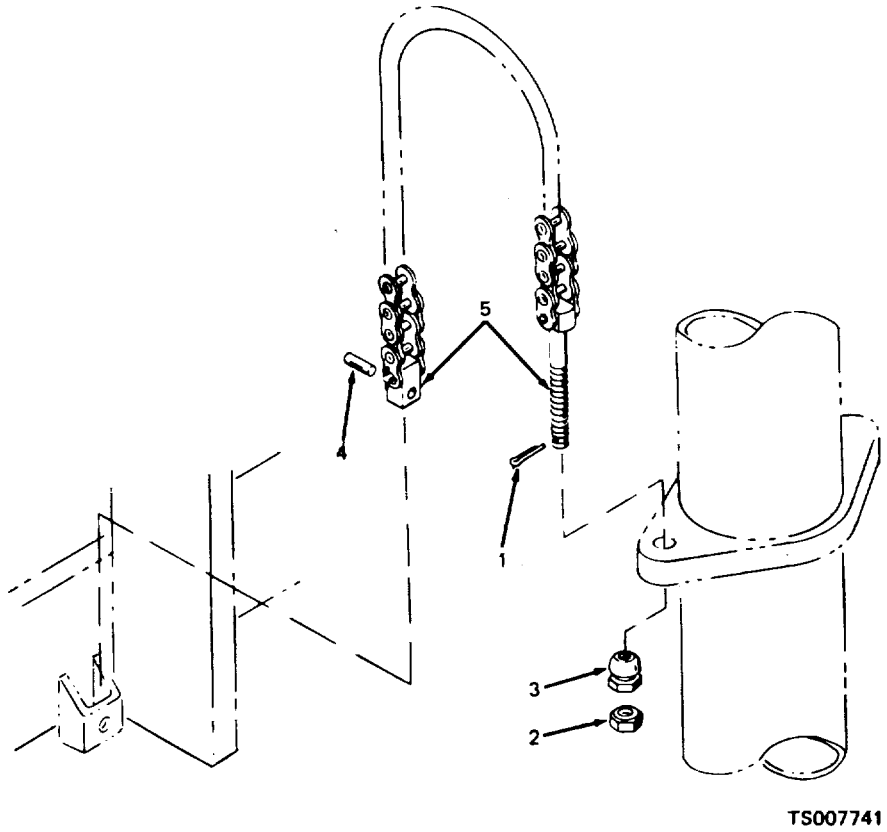


1. Capscrew
2. Lockwasher
3. Backrest
4. Roll pin
5. Fork stop lever
6. Pin
7. Spring
7 Springrest and Forks, Exploded View.
9. Fork
10. Roller
11. Shim
12. Screw
13. Roller
14. Carriage

Figure 2-5. Carriage Load Backrest and Forks, Exploded View.

(2) Position blocks under the carriage assembly and lower the carriage assembly until it rests firmly on the blocks.

(3) Remove the cotter pins (1, fig. 2-6) and nuts (2 and 3) that secure the lift chain assemblies (5) to the hydraulic lift cylinder; remove lift chain assemblies from the hydraulic lift cylinder and lay them over the carriage assembly.



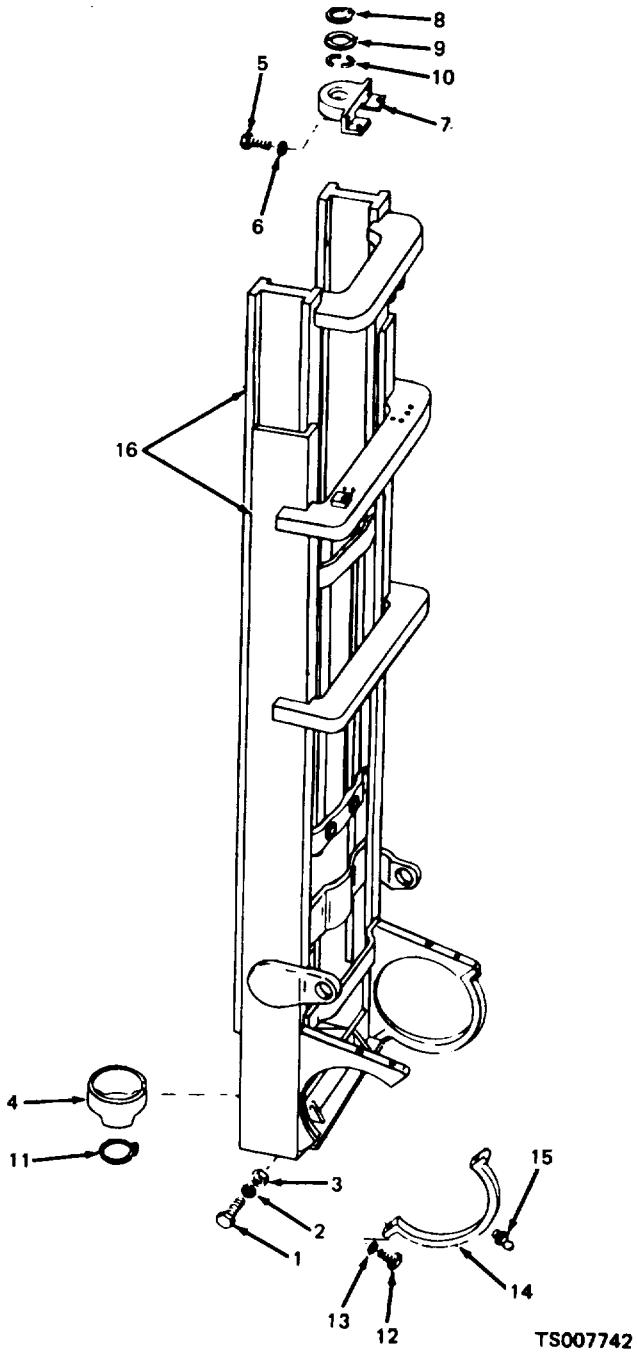
1. Cotter pin
2. Locknut
3. Adjusting nut
4. Pin
5. Chain assembly

Figure 2-6. Chain Anchors, Removal and Installation.

(4) Start the engine; using the hydraulic control valve, raise the mast assembly until the carriage assembly, is clear of the mast assembly. Remove the carriage assembly from the fork lift truck.

(5) Provide a container to catch the hydraulic oil as the hydraulic connection to the inlet elbow is broken. Disconnect the cylinder hose assembly from the elbow.

(6) Support the hydraulic lift cylinder with a hoist, using a sling wrapped around the cylinder under the chain bracket. Remove the two capscrews (1, fig. 2-7), nuts (3), and lockwashers (2) that hold the adapter (4) into the bracket on the mast.



1. Capscrew
2. Lockwasher
3. Nut
4. Adapter
5. Capscrew
6. Lockwasher
7. Bracket
8. Retaining ring
9. Ring retainer
10. Segment ring
11. Retaining ring
12. Capscrew
13. Lockwasher
14. Trunnion cap
15. Lubrication fitting
16. Mast

Figure 2-7. Mast Assembly, Removal and Installation.

(7) Remove the six capscrews (5) and lockwashers (6) that secure the bracket (7) at the top of the cylinder to the mast. Hoist the assembled cylinder, bracket, and adapter (4) from the mast. Remove the retaining ring (8) that secures the bracket (7) to the top of the cylinder. Remove the retaining ring (11) that secures the adapter (4) to the base of the cylinder.

(8) Remove headlight (TM 10-3930-632-12).

(9) Block the rear wheels of the fork lift truck so that it will not roll when the front end is jacked up. Jack up the front end of the truck and install blocks under it. Wrap a sling around one of the cross bars of the mast assembly (16, fig. 2-7) and support the weight of the mast with a hoist.

(10) Disconnect the tilt cylinders from the mast (TM 10-3930-632-12). Swing the tilt cylinders clear of the outer rail brackets and tie them back for safety.

(11) Remove the four capscrews (12, fig. 2-7) and lockwashers (13) that secure the trunnion caps (14) to the outer rail trunnion brackets; remove the caps. Lift the mast off the fork lift truck. Lower the tilt cylinders until they rest An the drive axle housing.

b. Installation.

(1) Raise the tilt cylinders and tie them back for safety. Wrap a sling around the upper cross bar of the mast assembly (16, fig. 2-7) and use a hoist to lift the mast assembly into position on the fork lift truck. Position the mast assembly on the fork lift truck; attach the trunnion caps (14) with capscrews (12) and lockwashers (13).

(2) Swing the tilt cylinders down and position the rod eye in the bracket provided on the outer rail; secure the tilt cylinder to the mast assembly (TM 10-3930-632-12).

(3) Position the adapter (4, fig. 2-7) on the base of the lift cylinder; secure with a retaining ring (11). Position the bracket (7) on the top of the cylinder; secure with a segment ring (10), ring retainer (9), and retaining ring (8).

(4) Wrap a sling around the cylinder assembly under the chain brackets and raise the cylinder with a hoist. Insert the adapter at the base into the bracket on the mast. Position the bracket (7) at the top of the cylinder on the mast; secure with six capscrews (5) and lockwashers (6). Install the two capscrews (1), nuts (3), and lockwashers (2) in the bracket to retain the adapter (4).

(5) Position the preformed packing (fig. 4-1) on the inlet tube assembly; connect the tube assembly into the piston rod assembly (6) and tighten securely. Connect the elbow to the tube assembly. Connect the hydraulic hose to the elbow.

(6) Fill the hydraulic tank with hydraulic oil. Start the engine of the fork lift truck, open the two setscrews (22) and raise the mast assembly. Close the bleeder valves when the hydraulic oil flows out. Tighten the gland nuts until a thin film of hydraulic oil is left on the piston rods. Operate the hydraulic lift cylinder until all air is removed from the system.

(7) Position the assembled carriage on the ground directly in front of the fork lift truck. Start the engine and raise the mast assembly until the carriage assembly rollers (13, fig. 2-5) clear the inner rail of the mast assembly. Slide the carriage assembly under the mast assembly and lower the mast to engage the rollers of the carriage.

(8) Pass the chain assemblies over the bearings on the piston head and pass the anchors of the chain assemblies (5, fig. 2-6) through the brackets provided on the hydraulic lift cylinder. Secure the chains with the adjusting nuts (3). Turn the nut up until there is no slack in the chain. Turn the locknut (2) on the anchor, but allow it to remain loose. Insert the cotter pin (1) into the anchor.

(9) Install the headlight on the outer rail (TM 10-3930-632-12).

(10) Position the fork lift truck on level ground and, with the mast vertical, lower the mast assembly completely. The upper cross bar of the inner rail must contact both stop pads. If not, add or remove shims under the pads as necessary. Install the safety catches.

(11) Raise the mast assembly to full height and lower slowly. No binding or dragging is allowable when the mast is raised or lowered.

c. Adjustment.

(1) Adjust the carriage assembly chain as described in TM 10-3930-632-12.

(2) There is no adjustment on the rollers (13, fig. 2-5). Check for clearance of 1/32-inch on each side. If clearance is greater than this, replace the rollers.

(3) Check the rollers (10) for clearance of not more than 1/32-inch between the roller side and the inner rail of the mast assembly on each side. If clearance is greater than 1/32-inch, remove the carriage assembly and place shims (11) under the roller until the prescribed clearance is attained.

2-7. Steering Gear

a. Removal.

(1) Remove the instrument panel (TM 10-3930-632-12).

(2) Remove the transmission control lever from the steering column (para 14-2).

(3) Disconnect the drag link from the pitman arm of the steering gear (TM 10-3930-632-12). Swing the drag link free of the pitman arm.

(4) Refer to figure 2-8 and remove steering gear.

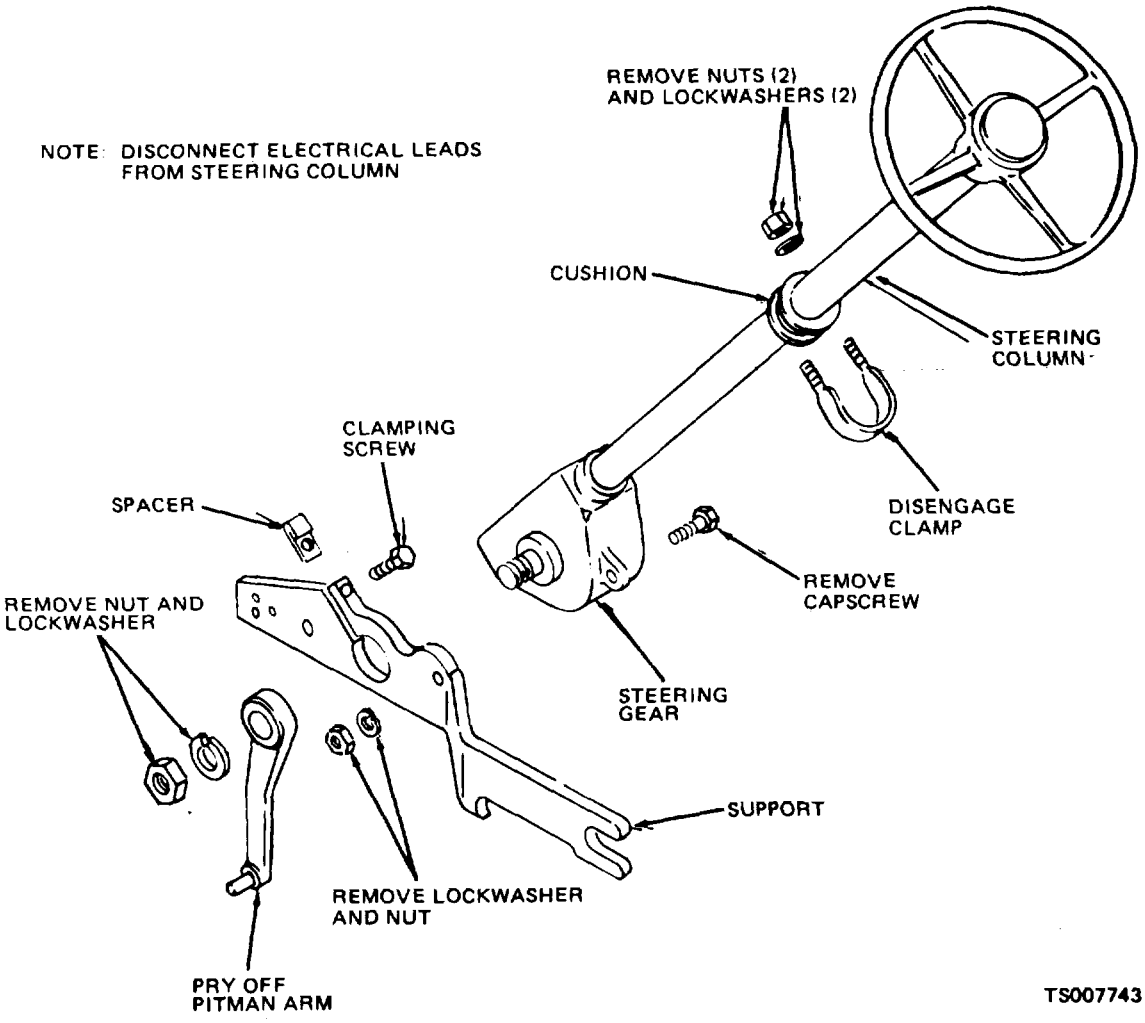


Figure 2-8. Steering Gear, Removal and Installation.

b. Installation.

(1) Refer to figure 2-8 and install the steering gear.

(2) Adjust the steering gear as directed in subparagraph c below.

(3) Install and adjust the drag link (TM 10-3930-632-12).

(4) Install the transmission control lever on the steering gear (para 14-2).

(5) Install the instrument panel (TM 10-3930-632-12).

c. Adjustment.

(1) *Centering the steering wheel.*

(a) Disconnect the drag link from the pitman arm. Note the relative position of drag link parts when disconnecting the link so the parts may be reassembled correctly.

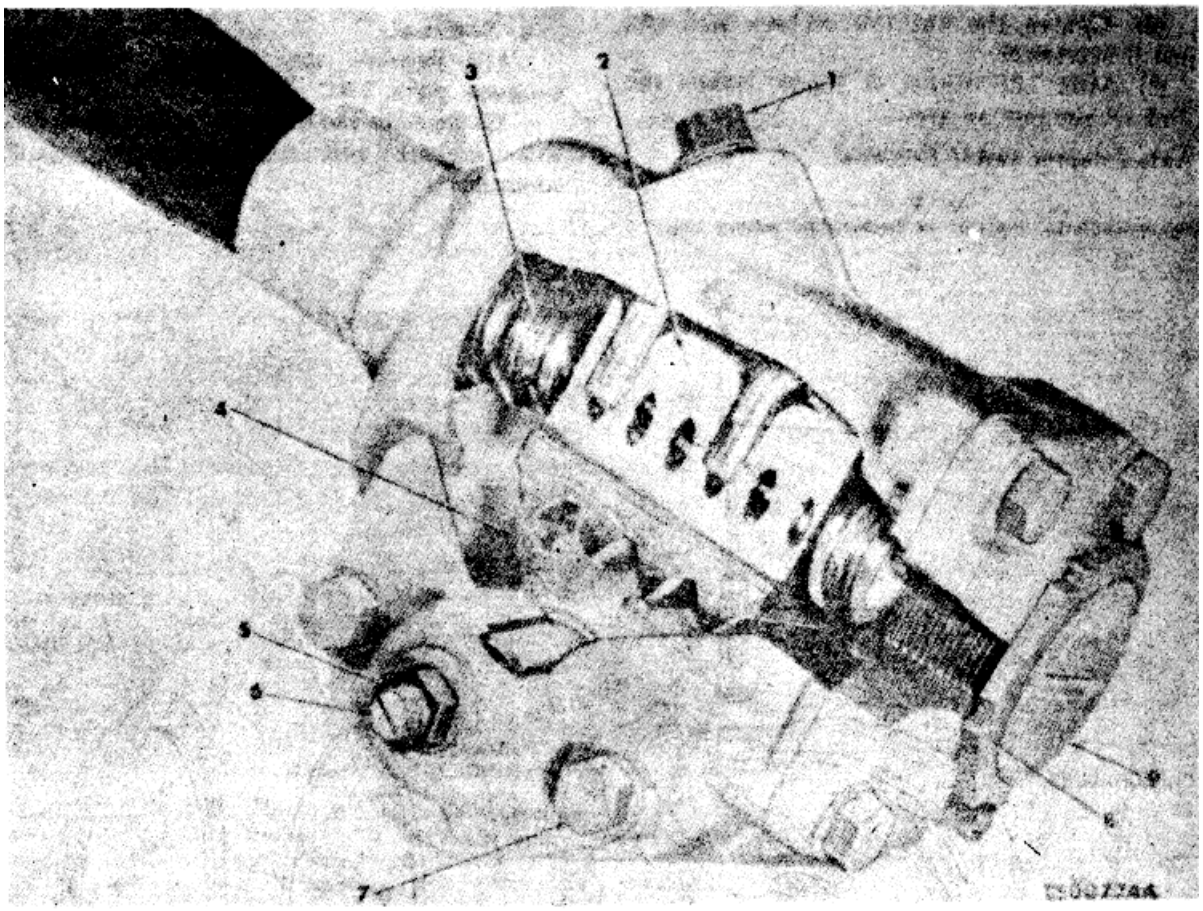
(b) Check the lubricant level in the steering gear housing. If low, add enough lubricant to bring the level up to the plug (LO 10-3930-632-12).

(c) Tighten the housing assembly bolts.

(d) Determine the straight-ahead position of the steering mechanism by turning the steering wheel to the extreme right. Then turn to the extreme left, counting the exact number of turns from the right to the left end. Turn the steering wheel back one-half the number of wheel turns. Mark the steering wheel with respect to the steering column so the center position may readily be found during adjustment procedures.

CAUTION

Approach the extreme ends cautiously; the ball nut (2, fig. 2-9) must not strike the ends of the steering shaft (3) with any degree of force.



1. Fill and level plug
2. Ball nut
3. Steering shaft
4. Shaft and gear assembly
5. Nut
6. Lash adjuster
7. Cover bolt
8. Nut
9. Thrust adjuster

Figure 2-9. Steering Gear Showing Adjustment Points.

(2) Thrust adjustment.

(a) Check the tightness of all cover bolts (7, fig. 2-9.) If necessary, loosen the nut (5) and turn the lash adjuster (6) counterclockwise a few turns to provide the clearance between the shaft and gear assembly (4) and the ball nut (2).

(b) Turn the steering wheel gently to one extreme end. Turn the steering wheel back one full turn. With the spring scale on a spoke of the steering wheel, measure the pull required to keep the steering wheel moving. The pull on the scale should be made at right angles to the spoke. If the pull is within 1/2 to 2 pounds, proceed to the lash adjustment in (3) below. If the pull is not within 1/2 to 2 pounds, loosen the nut (8) and then turn the thrust adjuster (9) clockwise until all end play is removed. Using a spring scale as directed above, check the pull and readjust as necessary; then tighten the nut (8) securely.

(3) Lash adjustment.

NOTE

Always make the thrust adjustment as directed in (2) above before making the lash adjustment.

(a) Position the steering gear mechanism in straight-ahead position as described in (1) above.

(b) Turn the lash adjuster (6, fig. 2-9) clockwise to remove all lash between the gear teeth of the ball nut (2) and shaft and gear assembly (4). Tighten the nut. Position the spring scale on the steering wheel so that pull may be made at right angles to a wheel spoke.

(c) Measure the pull while the steering wheel is turned through the center position. Rotate the

lash adjuster (6) to provide reading between 21/2 to 3 pounds.

(d) Tighten the nut (5); recheck pull and readjust if necessary.

(e) After adjustment is made, install the drag link on the pitman arm.

2-8. Axle/adapter and Differential

NOTE

Transmission trouble can be isolated by testing the transmission prior to removal. Refer to paragraph 2-9a for testing instructions.

a. Removal.

(1) Remove the carriage, mast, and lift cylinder (para. 2-6).

(2) Remove the drain plug (fig. 2-10) Drain the axle adapter and differential into a suitable container.

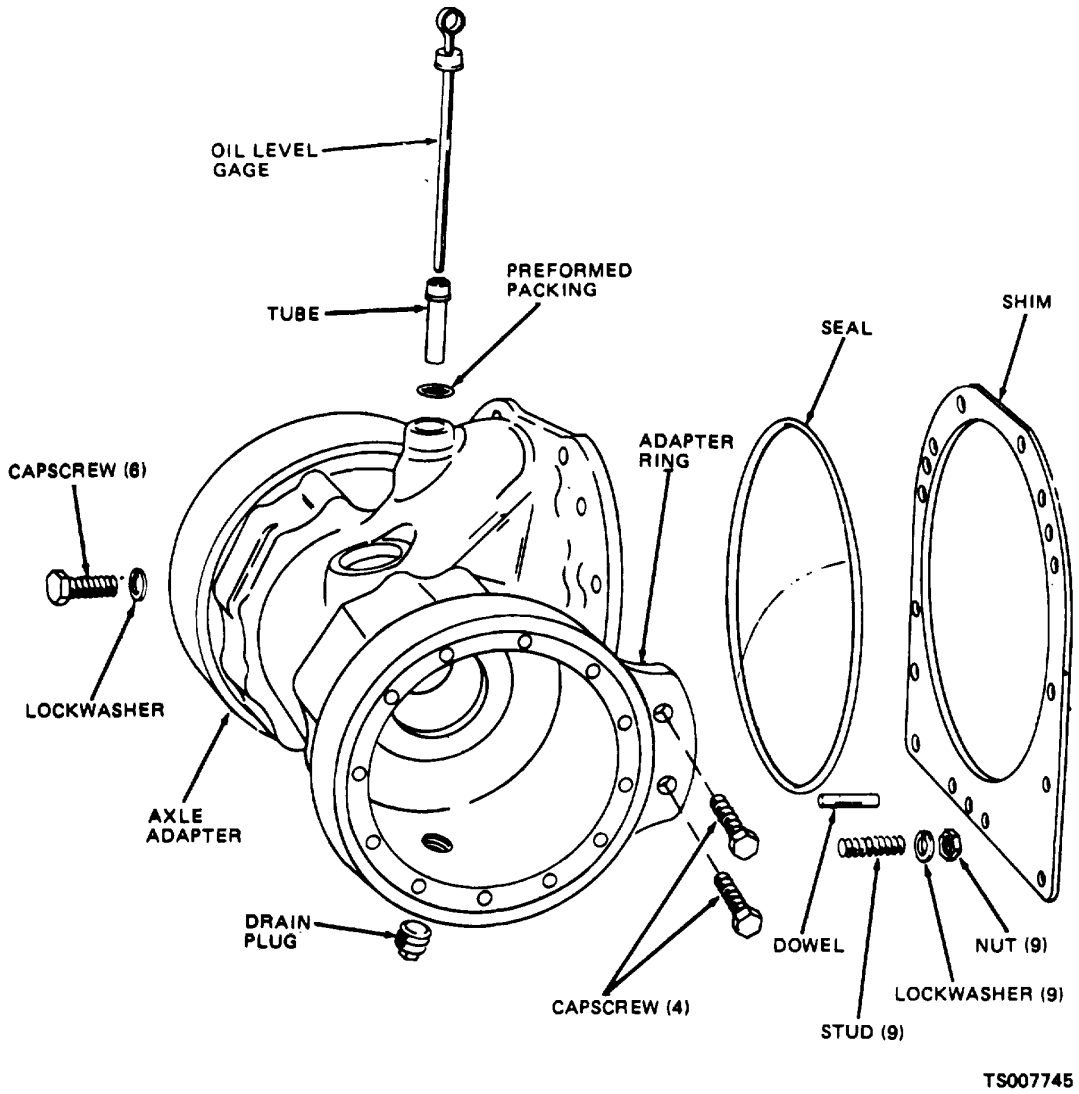


Figure 2-10. Axle Adapter, Removal and Installation

(3) Disconnect the brake lines from the axle (TM 10-3930-632-12).

(4) Jack up the fork lift truck and block it in position. Support the engine and transmission with blocks.

(5) Remove the wheels and axle ends (TM 10-3930-632-12).

(6) Refer to figure 2-10 and remove the axle adapter with the assembled differential.

b. Installation.

(1) Install the assembled axle adapter and differential on the truck as shown in figure 2-10. Tighten the mounting bolts to 40 to 60 ft/lbs.

(2) Paint three or four teeth of the gear of the pinion drive shaft with red lead or mechanic's blue. Rotate the pinion drive gear until the ring gear makes one complete revolution. Remove the axle adapter, note the area of tooth contact on the ring gear and compare it with that shown in figure 2-11. Make adjustments as indicated in the illustration to correct faulty gear wear patterns.

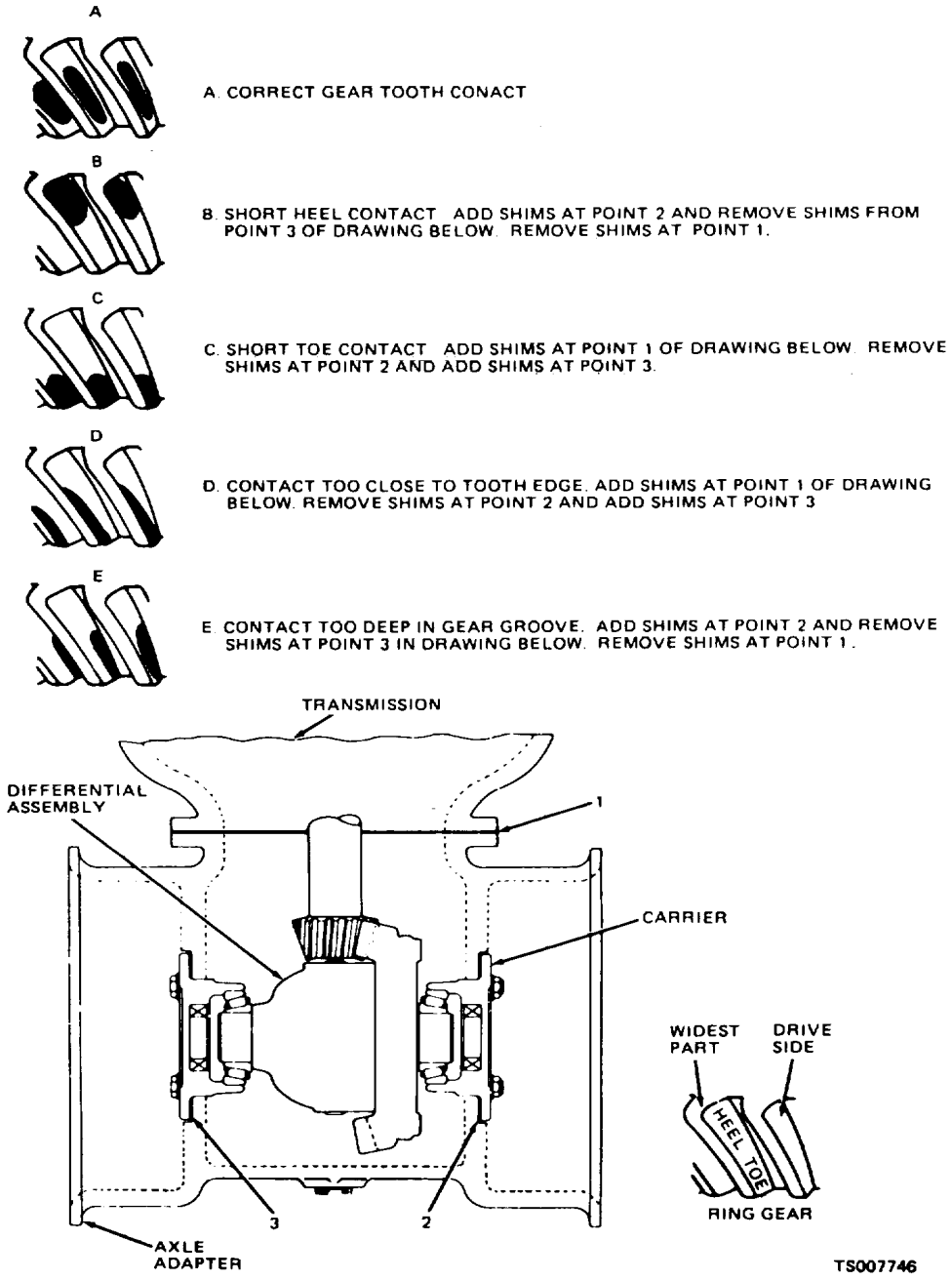


Figure 2-11. Ring Gear and Pinion Tooth Contact Patterns.

(3) Install the wheel and axle ends (TM 10-3930-632-12).

(4) Remove the engine and transmission supports; lower the fork lift truck to the floor.

(5) Replace brake line tee and brake lines removed during disassembly (TM 10-3930-632-12).

(6) Fill the differential and transmission (LO 10-3930-632-12).

(7) Install the carriage, mast, and lift cylinder (para 2-6).

2-9. Transmission

a. Testing. If the transmission and engine are operative and there is no obvious damage, it is a good practice to check the operation of the transmission to localize and identify troubles. This is easily done prior to transmission removal. This practice will help to determine the areas of the transmission which will require particular attention at overhaul. Proceed as follows:

(1) Steam-clean the entire fork lift truck before testing the transmission. Clean the radiator (TM 10-3930-632-12).

(2) Remove the drain plugs from the axle adapter and transmission to drain transmission and axle.

(3) Refer to figure 14-2 and remove items (30) through (35); clean and reinstall.

(4) Replace the transmission oil filter and fill the transmission and axle to the required level with oil (LO 10-3930-632-12).

(5) Run the fork lift truck in forward and reverse for a total of 3 minutes. Stop the engine and check the fluid level with the dipstick. Add transmission fluid until the level reaches the full mark on the dipstick.

(6) Check, and adjust if necessary, the brake pedal free travel (TM 10-3930-632-12).

(7) Adjust the engine speed for prescribed no-load RPM (TM 10-3930-632-12).

(8) Check the engine for normal engine stall by positioning the truck against an immovable object and with the engine in gear, accelerating to full throttle position. Normal engine stall is between 1210 and 1300 RPM. If the engine stalls between 1000 and 1210 RPM, the engine is losing power.

(9) If the engine stalls between 650 and 900 RPM, the torque converter stator is slipping and the torque converter must be replaced (para 2-5).

(10) Check the transmission oil pump pressure as follows:

(a) Remove the pipe plug and install a pressure gage that will indicate between 0 and 200 PSI at the converter housing outlet (fig. 2-12).

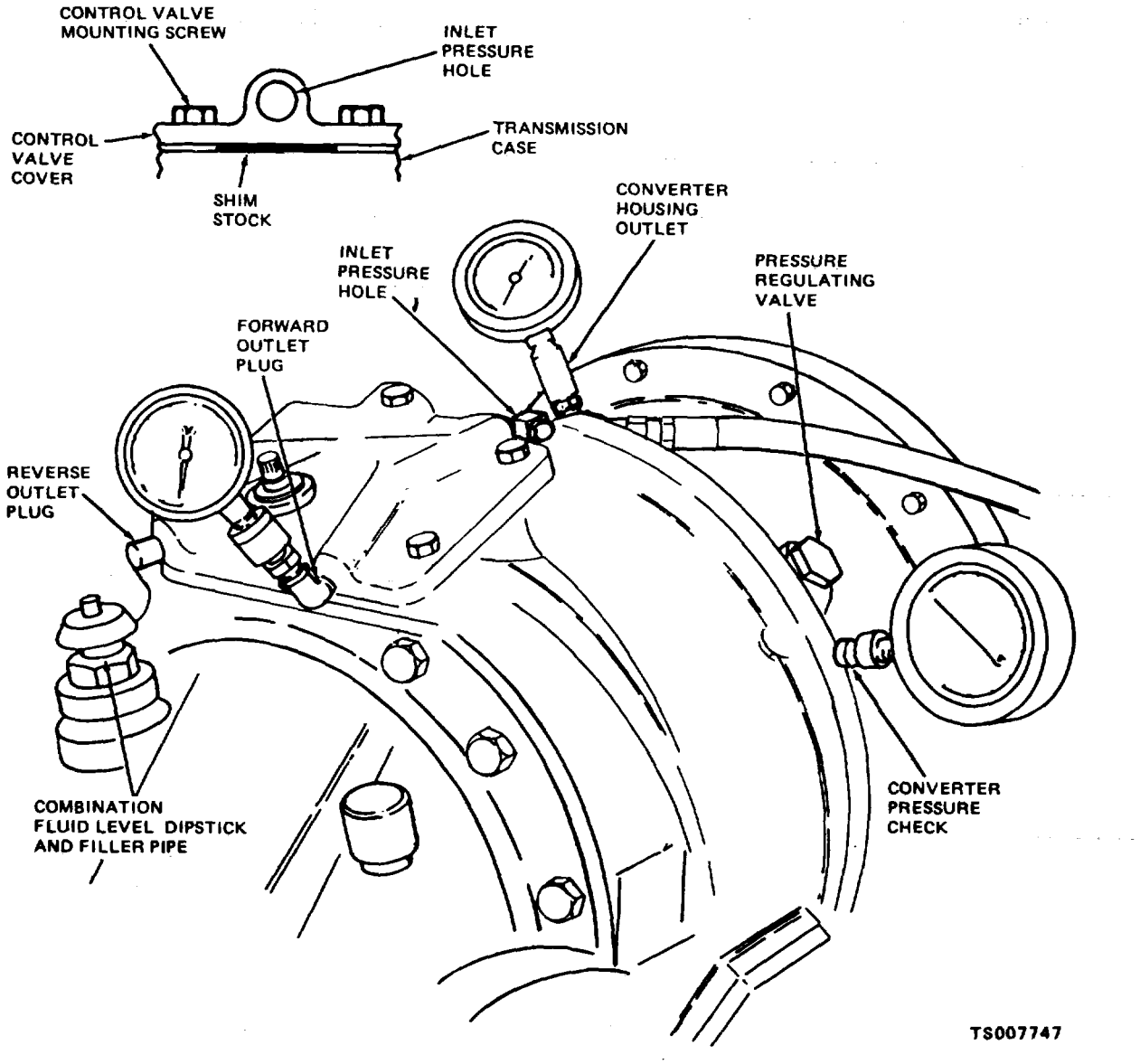


Figure 2-12. Transmission Test Setup.

(b) Run the engine at 2000 RPM with the transmission in neutral. The pressure gage should indicate between 110 and 125 PSI. If the pressure is low, loosen the control valve mounting screws and place shim stock (0.001 inch to 0.002 inch thick by 11/s inches wide) between the inlet pressure hole of the control valve cover and the transmission case (fig. 2-12). Tighten the mounting screws.

(c) Recheck the pressure as described in (a) and (b) above. If the pressure is still low, overhaul the control valve pressure regulating valve or replace the transmission oil pump. Determine which is defective as described in (11) below.

(d) Remove gage from the converter housing outlet and replace the plug.

(11) Check the transmission control valve and transmission directional assemblies as follows:

(a) Securely block the fork lift truck so that it cannot move.

(b) Install a pressure gage that indicates between 0 and 200 PSI at either the forward or reverse outlet plug positions (fig. 2-12).

(c) Run the engine at 2000 RPM and place the transmission control lever in the position that corresponds to the outlet at which the pressure gage has been placed (forward or reverse). The

pressure gage should indicate between 110 and 125 PSI.

(d) If the pressure is low, loosen the control valve mounting screws and insert shim stock (0.001 inch to 0.002 inch thick by 11/2 inches wide) between the outlet hole of the control valve cover used for the pressure check and the transmission case. Tighten the mounting screws.

(e) Recheck the pressure. If the pressure is still low, the trouble is in the transmission control valve. Overhaul the transmission control valve (para 14-8).

(f) If shimming brings the pressure up to the prescribed limits, the transmission is defective. Remove the shim and overhaul the transmission as described in paragraph 14-6. Remove the gage and insert the plug.

(12) Check the torque converter pressure as follows:

(a) Install a pressure gage that indicates between 0 and 200 PSI in the converter pressure check hole (fig. 2-12) in the torque converter housing.

(b) Run the engine at 2000 RPM with the transmission in neutral. The pressure gage should indicate between 65 and 75 PSI.

(c) If the pressure is not within the prescribed limits, overhaul the pressure regulating valve (items 9 through 17, fig. 14-5).

b. Removal.

(1) Remove the drain plugs from the axle adapter and transmission to drain the transmission and axle.

(2) Remove the steering gear (para 2-7a). Remove the instrument panel (TM 10-3930-632-12).

(3) Remove the tilt cylinders (TM 10-3930-632-12).

(4) Remove the brake pedal (TM 10-3930-632-12).

(5) Remove the brake hydraulic lines (TM 10-3930-632-12).

(6) Remove the overhead guard (TM 10-3930-632-12).

(7) Remove the carriage, mast, and lift cylinder (para 2-6).

(8) Disconnect the oil cooler hoses from the transmission. Disconnect and tag all electrical leads. Disconnect all piping and tubing (TM 10-3930-632-12).

(9) Disconnect the parking brake linkage from the transmission (TM 10-3930-632-12).

(10) Jack up the fork lift truck and block securely under the frame. Block up under the flywheel housing of the engine.

(11) Wrap a sling around the transmission housing. Make sure the position of the cable will not interfere with the removal of the bolts that secure the axle adapter to the transmission. Support the weight of the transmission with a hoist. Remove the wheels and axle shafts (TM 10-3930-632-12). Remove the axle adapter and differential (para 2-10).

(12) Remove the bolts and lockwashers that secure the transmission assembly to the engine. Maintain support of the transmission with the hoist. Pry the transmission from the engine. Pull straight back to disengage the shaft of the input gear from the torque converter. When the shaft is disengaged, lower the transmission onto a dolly and roll it from the front of the truck.

(13) Remove the torque converter from the engine (para 2-5a).

c. Installation.

(1) Install the torque converter on the engine flywheel (para 2-5).

(2) Position the transmission assembly on the engine bell housing with a hoist; secure using the bolts and lockwashers.

(3) Install the axle adapter and differential (para 2-10).

(4) Install the wheel and axle ends (TM 10-3930-632-12).

(5) Remove the engine blocks and lower the fork lift truck to the ground.

(6) Install the carriage, mast, and lift cylinder (para 2-6).

(7) Connect the handbrake linkage (TM 10-3930-632-12). Connect the transmission control linkage (TM 10-3930-632-12).

(8) Position, reclamp, and reconnect all hoses, wires, and tubes to the transmission assembly and wheel and axle ends (TM 10-3930-632-12).

(9) Replace the tilt cylinders (TM 10-3930-632-12).

(10) Install the dash panel and install the instrument panels (TM 10-3930-632-12).

(11) Install the steering gear (para 2-7).

(12) Fill the transmission and axle adapter and differential (LO 10-3930-632-12).

(13) Test the transmission as described in a above.

2-10. Rear Axle

a. Removal.

(1) Remove the counterweight (TM 10-3930-632-12).

(2) Block the drive wheels of the fork lift truck and jack the steering wheels clear of the floor. Remove the wheels and bearings from the fork lift truck (TM 10-3930-632-12).

(3) Disconnect the rear drag link from the ball stud (TM 10-3930-632-12). Swing the rear drag link clear of the steering axle assembly.

(4) Support the steering axle assembly with a

jack and remove the four bolts and lockwashers that secure the steering axle assembly to the axle mounting blocks. Lower the steering axle assembly to the floor. Remove the two cotter pins, washers, and nuts that secure the axle mounting blocks to the frame; remove the blocks.

b. Installation.

(1) Position the axle mounting blocks (14, fig. 13-1) into the holes provided in the fork lift truck frame and secure with the nut (11) and cotter pin (10). Raise the steering axle assembly so that the brackets provided on it are in line with the axle mounting blocks. Secure the steering axle assembly to the axle mounting blocks with the four screws (12) and lockwashers (13). Torque to 130 to 140 ft/lbs.

(2) Connect the rear drag link to the ball stud (TM 10-3930-632-12).

(3) Replace the wheel assemblies (TM 10-3930-632-12).

c. Steering Axle Linkage Adjustment.

(1) Remove the counterweight (TM 10-3930-632-12).

(2) Install a jack under the center rear of the frame or use a hoist and sling with spreader bars hooked in the lifting recesses of the rear wheel well. Raise the rear of the fork lift truck and install wooden blocks ahead of the rear wheels under the sides of the frame.

(3) Remove the rear drag link from the steering axle spider ball stud.

(4) Check the steering wheels for correct turning geometry, by turning the wheels all the way to the left. This should allow the righthand steering wheel to attain an angle of 75 degrees to the frame. If adjustment is necessary, the axle stop screw (fig. 2-13) on the front side of the steering knuckle should be turned in or out, whichever is necessary to achieve the correct angle. Repeat this procedure with the left wheel.

Figure 2-13. Steering Axle and Linkage Adjustment.

(5) After adjusting the stop screws, check steering wheel alignment. Place the steering wheels in the straight-ahead position. The steering wheels should track squarely with the drive wheels with no toe-in or toe-out. If adjustment is necessary, adjust the alignment of the steering wheels by

running one tie rod end from the spider, loosening the locknuts (fig. 2-13), and turning the tie rods until the wheels are in alignment.

NOTE

Tie rods should be adjusted the same length. Adjust both tie rods until the wheels are in alignment; then tighten the locknuts to secure adjustment.

(6) With the steering wheels in full left-turn position, attach the end of the drag link to the spider ball stud and tighten.

(7) Turn the steering wheel all the way to the left. Turn the steering wheel one-quarter turn clockwise, loosen the nut on the adjustable end of the drag link (TM 10-3930-632-12) and turn the rod end until the grease fitting on the rod end lines up with the ball on the pitman arm. Install and tighten the nuts on the clamp bolts.

(8) Turn the steering wheel until the steering wheels are in a straight-ahead position. Remove the steering wheel and replace on the steering column with the center spoke aligned, plus or minus 10 degrees, with the centerline of the truck.

CHAPTER 3

REPAIR OF MAST ASSEMBLY

Section I. GENERAL DESCRIPTION

3-1. General

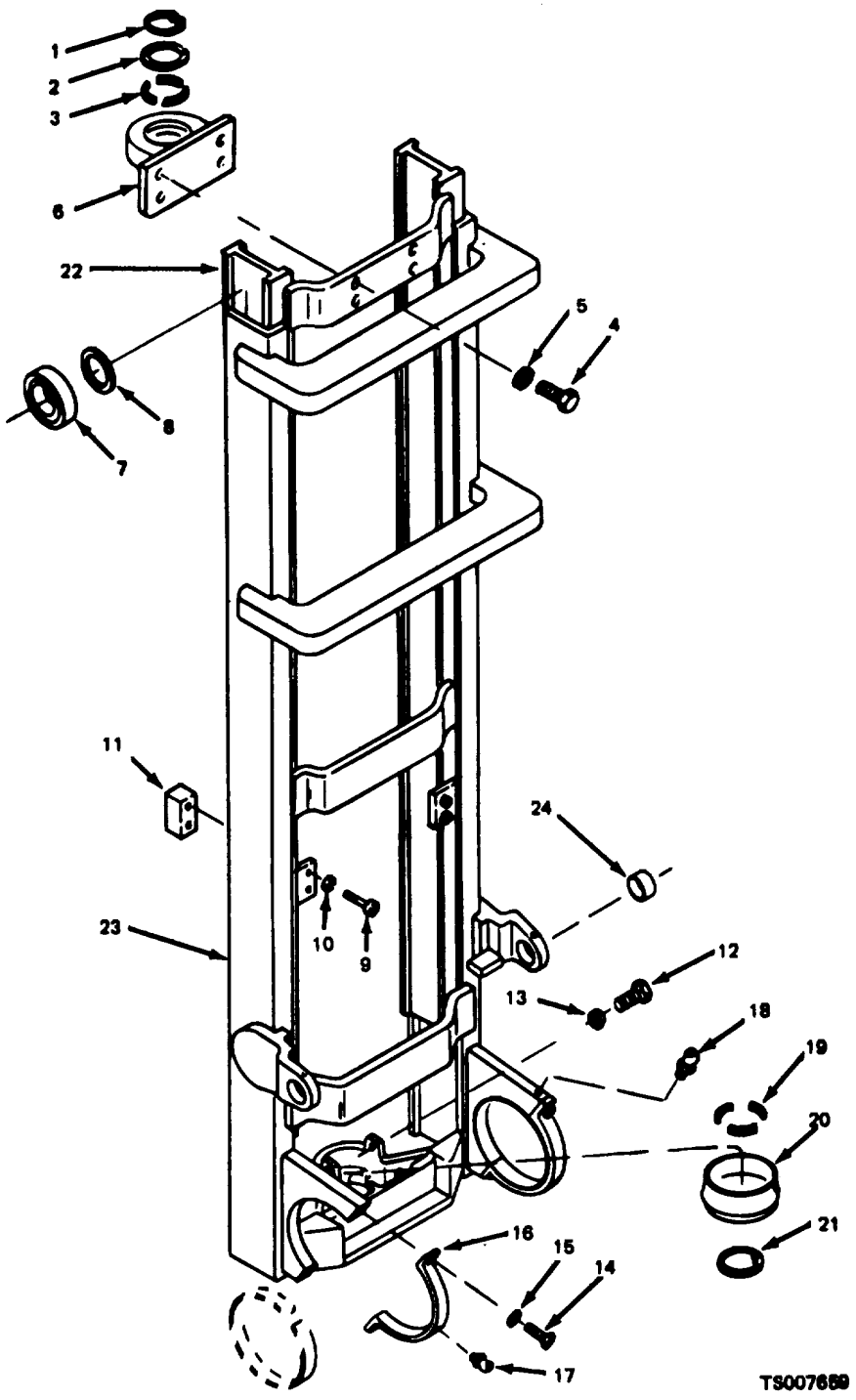
The mast assembly is trunnion mounted to the drive axle adapter at the front of the lift truck so that it can pivot on bushings installed on the adapter. The mast assembly includes an inner rail which is roller mounted in the outer rail, permitting free up and down movement of the inner rail within the outer rail. Brackets are provided on the mast assembly to mount the lift cylinder. Sleeve bearings are installed in the tilt cylinder brackets.

3-2. Removal

Remove the mast assembly (para 2-6a).

3-3. Disassembly

Refer to figure 3-1 and disassemble the mast assembly. To disassemble, lay the mast assembly flat so that it rests on the inner rail. Roll the outer rail along the inner rail until the rollers stop its movement. Wrap a sling around the outer rail cross bars and lift it from the inner rail with a hoist.



1. Retaining ring
2. Cylinder retainer
3. Segment ring
4. Screw
5. Lockwasher
6. Upper anchor
7. Roller
8. Shim
9. Screw
10. Lockwasher
11. Carriage retainer
12. Screw
13. Nut
14. Screw
15. Lockwasher
16. Trunnion cap
17. Lubrication fitting
18. Lubrication fitting
19. Segment ring
20. Support adapter
21. Retaining ring
22. Inner-rail
23. Outer rail
24. Anchor bushing

Figure 3-1. Mast Assembly, Exploded View.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59° C.).

3-4. Cleaning and Inspection

a. Clean all metal parts of the mast assembly, except the rollers, with cleaning solvent P-D-680. Wipe off dirt, dust, and grease and oil deposits.

b. Clean the rollers by wiping with a cloth dampened in cleaning solvent P-D-680.

c. Inspect all metal parts for wear, distortion, or other damage; replace defective parts.

d. Inspect the trunnion bushings for wear, scoring, distortion, or other damage; replace bushings if damaged.

e. Inspect stop pads for wear, cracks, distortion, or other damage; replace damaged stop pads.

f. Inspect inner and outer rail assemblies for cracks, breaks or distortion; repair inner and outer rails by welding or straightening. Replace rails if they cannot be repaired.

3-5. Reassembly

Refer to figure 3-1 and reassemble the mast assembly. Note the following:

a. Place the shims (8) and two rollers (7) on the inner rail (22) and outer rail (23). Position the outer rail on the inner rail so that the inner rail rollers slide in the outer rail track. Move the outer rail along until it contacts the stop pads. It must move freely, without binding or drag. If binding or dragging is present, check welds or bends made during repair; correct the cause of drag or bind.

b. Turn the inner and outer rail assembly over and block the outer rail so that it is level and the trunnion brackets are clear of the ground. Slide the outer rail down until the rollers stop it; support the outer rail so that it is level. Use a pry bar to move the inner rail fully to one side. Maximum clearance between rails and rollers on the side forced apart is 1/32 inch. Check for this clearance on the full length of the inner rail for the outer rail roller, and down to 20 inches below the outer rail rollers for the inner rail rollers. Add or remove shims behind the rollers to maintain this maximum clearance. Check again for clearance; readjust if necessary.

NOTE

The inner rail is made with a slight taper so that the bottom is wider than the top. Make the outer rail roller adjustments with the inner rail in the fully extended position or the rail will bind when reassembled.

3-6. Installation

Install the mast assembly (para 2-6b).

CHAPTER 4

REPAIR OF HYDRAULIC SYSTEM

Section I. GENERAL DESCRIPTION

4-1. General

The main hydraulic system uses a hydraulic lift cylinder mounted on the mast assembly to raise the loads being handled by the lift truck. Two hydraulic tilt cylinders, mounted between the mast and the truck frame, tilt the mast to the required attitude. Hydraulic power is supplied by a vane-type hydraulic pump which is mounted on a plate at the fan end of the engine and which is gear-driven by the engine. The reservoir, from which the hydraulic fluid is supplied, is built into the truck frame. The flow of hydraulic fluid is controlled by a lever operated hydraulic control valve. A brief description of each component is provided as an introduction to the paragraph covering that component.

Section II. LIFT CYLINDER

4-2. General

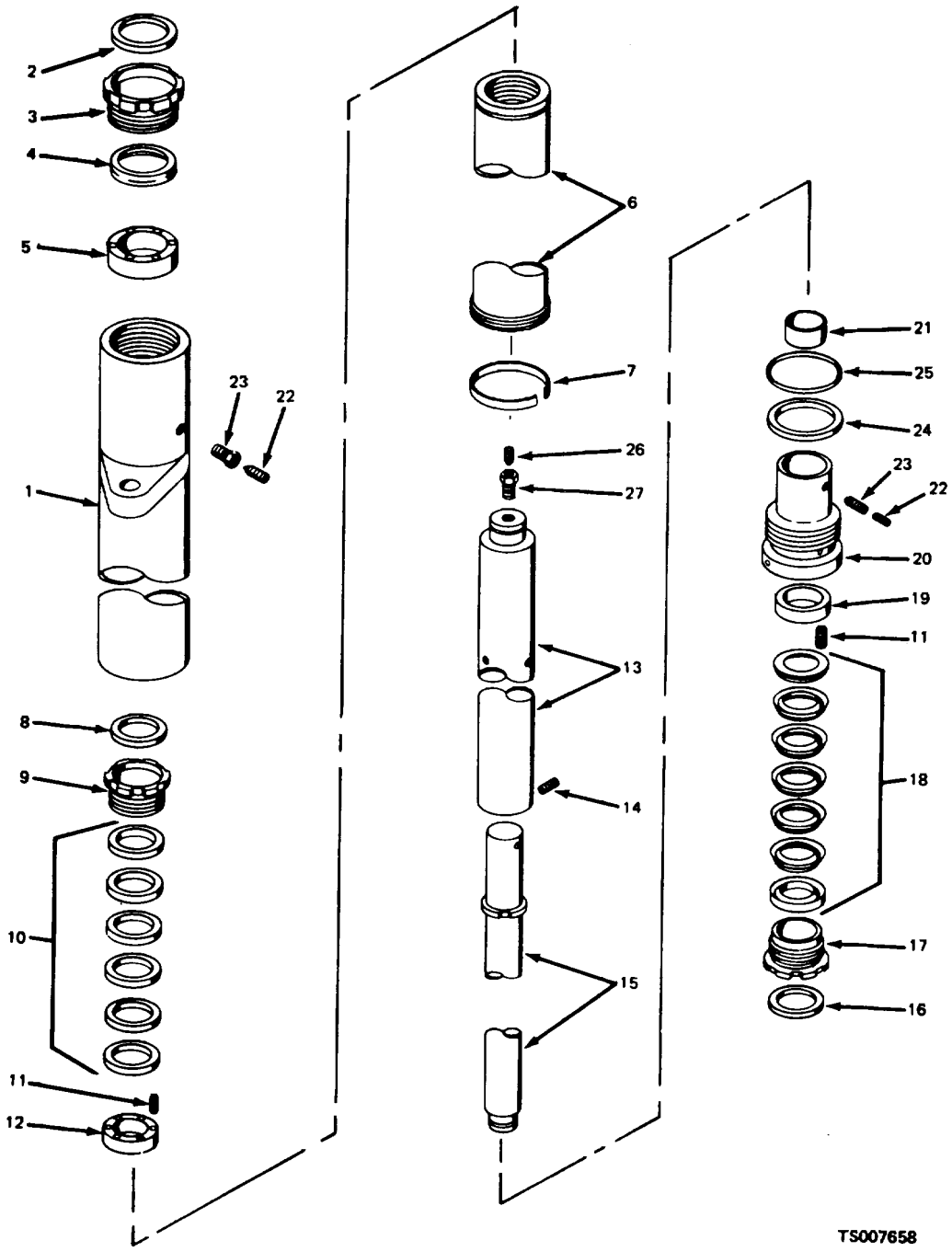
The lift cylinder is a single-acting, two-stage hydraulic cylinder. It provides power to lift. It is lowered by the weight of the carriage or mast. When the limit of the first stage of the hydraulic cylinder is reached, the second stage operates to continue the lifting effort.

4-3. Removal

Remove the lift cylinder (para 2-6).

4-4. Disassembly

Refer to figure 4-1 and disassemble the lift cylinder. Note the following:



1. Cylinder barrel
2. Rod wiper
3. Gland nut
4. V-packing
5. Cylinder retainer
6. Primary rod
7. Wear ring
8. Rod wiper
9. Gland nut
10. V-packing set
11. Packing spring
12. Spring retainer
13. Stationary tube
14. Nylon plug
15. Secondary rod
16. Rod wiper
17. Gland nut
18. V-packing set
19. Spring retainer
20. Gland cap
21. Cap bushing
22. Setscrew
23. Lock screw
24. Back-up ring
25. Preformed packing
26. Setscrew
27. Bleeder valve

Figure 4-1. Lift Cylinder, Exploded View.

a. Unscrew gland nut (3); slide the nut off over the primary rod (6) and remove the wiper (2) from the gland nut. Hold the stationary tube assembly (13) and loosen the gland cap (20). Slide the barrel (1) off the assembled primary piston, secondary rod assembly (15), and stationary tube assembly (13). Remove the packing assembly (10), retainer (12) and packing (4) from the body; remove the back-up ring (24) and preformed packing (25) from the cylinder head.

b. Unscrew the gland nut (17) from the cylinder head and slide it off the secondary rod assembly (15). Unscrew the gland nut (3) and slide the assembled secondary rod assembly (15) and stationary tube assembly (13) out of the primary piston.

c. Remove lock screw (23) and setscrew (22) from gland cap (20). Hold the stationary tube assembly (13) and remove the cylinder head. Remove the stationary tube from the piston rod assembly. Slide the cylinder head off the piston rod assembly.

NOTE

Do not remove the plug (14) unless obviously damaged. Remove the packing assembly (18), retainer (19) and packing springs (11) from The cylinder head. Remove the two setscrews (26) and bleeder valves (27) from the body and stationary tube assembly.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59° C.).

4-5. Cleaning and Inspection

a. Replace all seals, wipers, and other unserviceable parts.

b. Clean all metal parts thoroughly in cleaning solvent P-D-680. Dry thoroughly with compressed air.

CAUTION

Do not allow dirt to get on disassembled parts after cleaning.

c. Check all metal parts for cracks, burrs, rust, distortion, scores, or other damage. Remove burns rust, with a fine stone. Replace damaged parts.

4-6. Reassembly

Refer to figure 4-1 and reassemble the lift cylinder. Note the following:

a. Immerse all parts of the hydraulic lift cylinder in clean hydraulic oil to lubricate them before Reassembly.

b. Slide the piston rod assembly (15) into the stationary tube assembly (13). Position the gland cap (20) on the piston rod assembly and turn the cylinder head onto the stationary tube assembly (13). Install setscrew (22) and lock screw (23) in gland cap (20) and secure. Torque the cylinder head to a minimum of 300 ft/lbs. Position the packing springs (11) in the retainer (19) and slide the assembled retainer and adapter into the cylinder head over the end of the piston rod assembly.

c. Position packing assembly (18) into gland cap (20) and tap into place. Position wiper (16) into the gland nut (17); slide the assembled gland nut over the piston rod assembly and into the cylinder head. Tighten the gland nut into the cylinder head.

d. Slide the primary rod (6) over the assembled stationary tube and piston rod assembly. Position the packing springs (11) in the retainer (12); slide the assembled retainer and adapter into the primary piston over the stationary tube assembly. Position wiper (2) in the gland nut (3). Slide the gland nut over the stationary tube assembly and tighten the gland nut in the primary piston.

e. Position the back-up ring (24) and preformed packing (25) on the cylinder head. Slide the barrel (1) over the assembled primary piston, stationary tube assembly and piston rod assembly; turn the body onto the cylinder head and torque to a minimum of 300 ft/lbs. Tap packing assembly (4) into position in barrel (1). Position wiper (2) in gland nut (3); slide gland nut over the primary piston assembly and tighten in body. Turn the set-screws (22) into the lock screws (23); turn the two assembled bleeder valves into the hydraulic lift cylinder.

4-7. Installation

Install and bleed the lift cylinder (para 2-6b).

Section III. HYDRAULIC PUMP

4-8. General

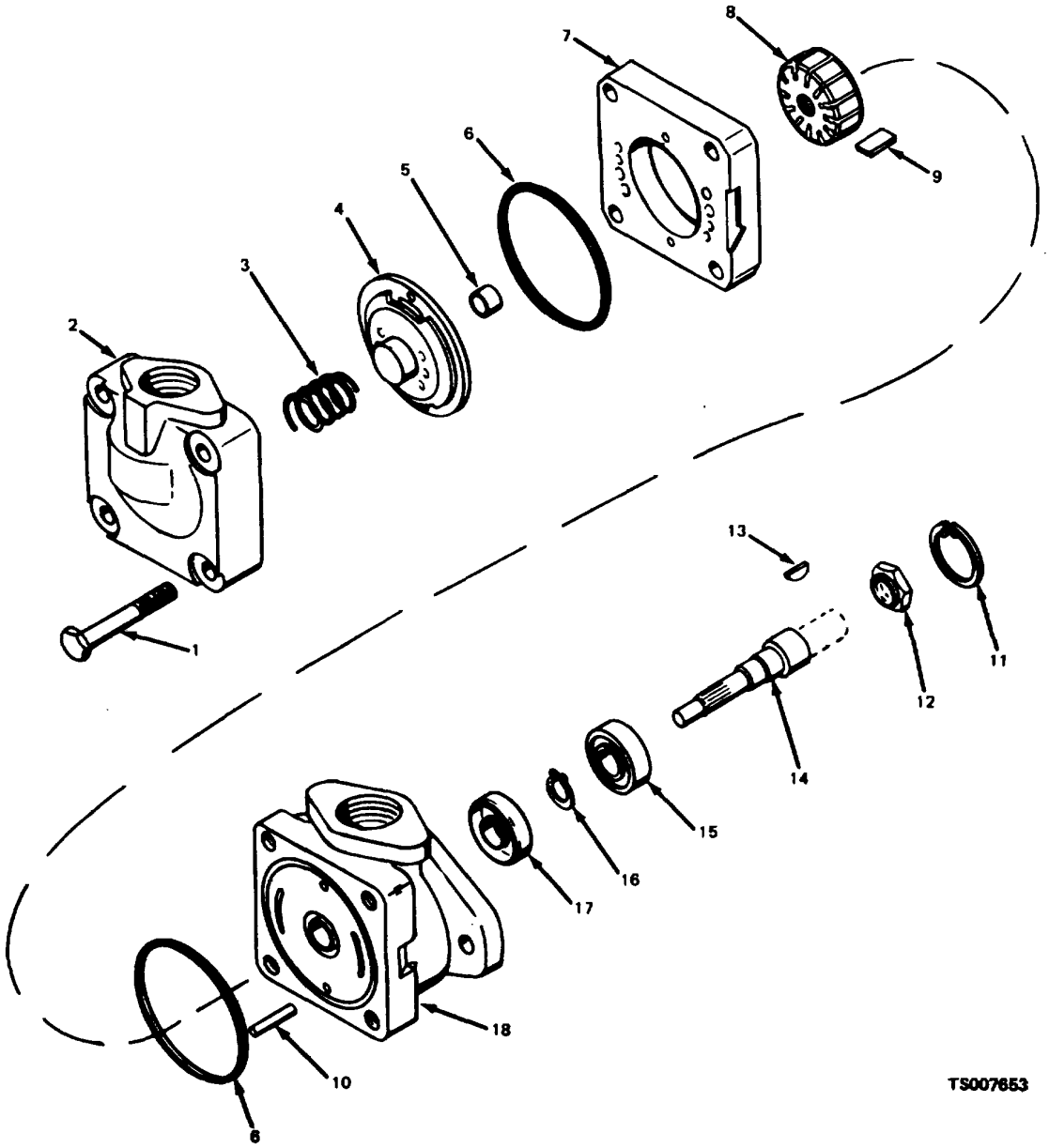
The main hydraulic pump is a vane-type rotary pump in which vanes are installed in slots of a close-fitting rotor which rotates in an eccentrically positioned ring. The oil is drawn into the low-pressure side of the unit and is trapped in the compartments between the vanes and ring until it is transferred to the high-pressure side of the pump where it is discharged. The rotor is mounted on a ball bearing-mounted drive shaft to assure free rotation.

4-9. Removal

Remove the gear cover and the hydraulic pump with its assembled adapter and gasket from the engine (para 9-19).

4-10. Disassembly

Refer to figure 4-2 and disassemble the main hydraulic pump. Note the following:



1. screw
2. Pump cover
3. Spring
4. Pressure plate
5. Bushing
6. Preformed packing
7. rump ring
8. Rotor
9. Vane
10. Pin
11. Retaining ring
12. Nut
13. Woodruff key
14. Pump shaft
15. Bearing
16. Retaining ring
17. Shaft seal
18. Pump body

Figure 4-2. Hydraulic Pump, Exploded View.

a. Match-mark the cover, ring, and body to assure proper Reassembly.

b. Clamp the drive gear lightly in a soft-jawed vise to prevent the shaft from rotating while removing the nut (12).

c. After removing the cover (2), ring (7), and rotor (8), remove the retaining ring (11) and press on the splined end of the shaft (14) to remove the assembled shaft and bearing (15) from the body (18).

d. Pry the seal (17) from the body (18) with a thin, hooked tool.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F (39° C. - 59° C.).

4-11. Cleaning and Inspection

a. Discard the seal and preformed packings.

b. Thoroughly clean all parts of the pump assembly, except the bearings, in cleaning solvent P-D-680, and shake excess solvent from the parts and dry with compressed air.

c. Clean the bearings by placing them in a wire basket and agitating them in clean solvent. Dry with compressed air taking care not to spin the dry bearings. Dip in engine oil to lubricate the bearings.

CAUTION

Do not use a cloth to wipe the pump parts because lint trapped in the parts can enter the hydraulic system at Reassembly.

d. Inspect the ring, rotor, and vanes for wear, scoring, distortion, or other damage. Replace the ring, rotor, and vanes in complete sets only, if damaged.

NOTE

No side play is allowable in vane movement in the rotor slots.

e. Inspect the face of the pressure plate that rides on the vanes for scoring. Lap out scores with crocus cloth. Replace the pressure plate if scores cannot be removed.

f. Inspect the bearings for wear, pitting, and looseness; replace damaged bearings.

g. Inspect the shaft for distortion, worn or damaged splines, and damaged threads. Check the keyway for burrs. Remove any burrs with a fine stone.

h. Inspect all other parts for cracks, distortion, worn or damaged threads, and other damage; replace damaged parts.

4-12. Reassembly

Refer to figure 4-2 and reassemble the main hydraulic pump. Note the following:

a. Lubricate all parts with clean engine oil at Reassembly.

b. Install the seal (17) with the lip facing inward in the body.

c. Align the match-marks made on the cover (2), ring (7), and body (18) during disassembly.

d. When installing the splined end of the shaft (14) through the seal (17), apply a thin layer of cellophane tape over the splines to prevent cutting the seal.

e. Torque the screws (1) evenly and alternately to a torque of 65 to 75 ft/lbs.

f. Install gear and nut on pump shaft. Stake nut in place.

4-13. Installation

a. Install the assembled pump and adapter and the gasket on the engine backing plate (para 9-21).

b. Connect the hydraulic lines to the hydraulic pump (TM 10-3930-632-12).

4-14. Testing

Refer to figure 4-3 and test the hydraulic pump as follows:

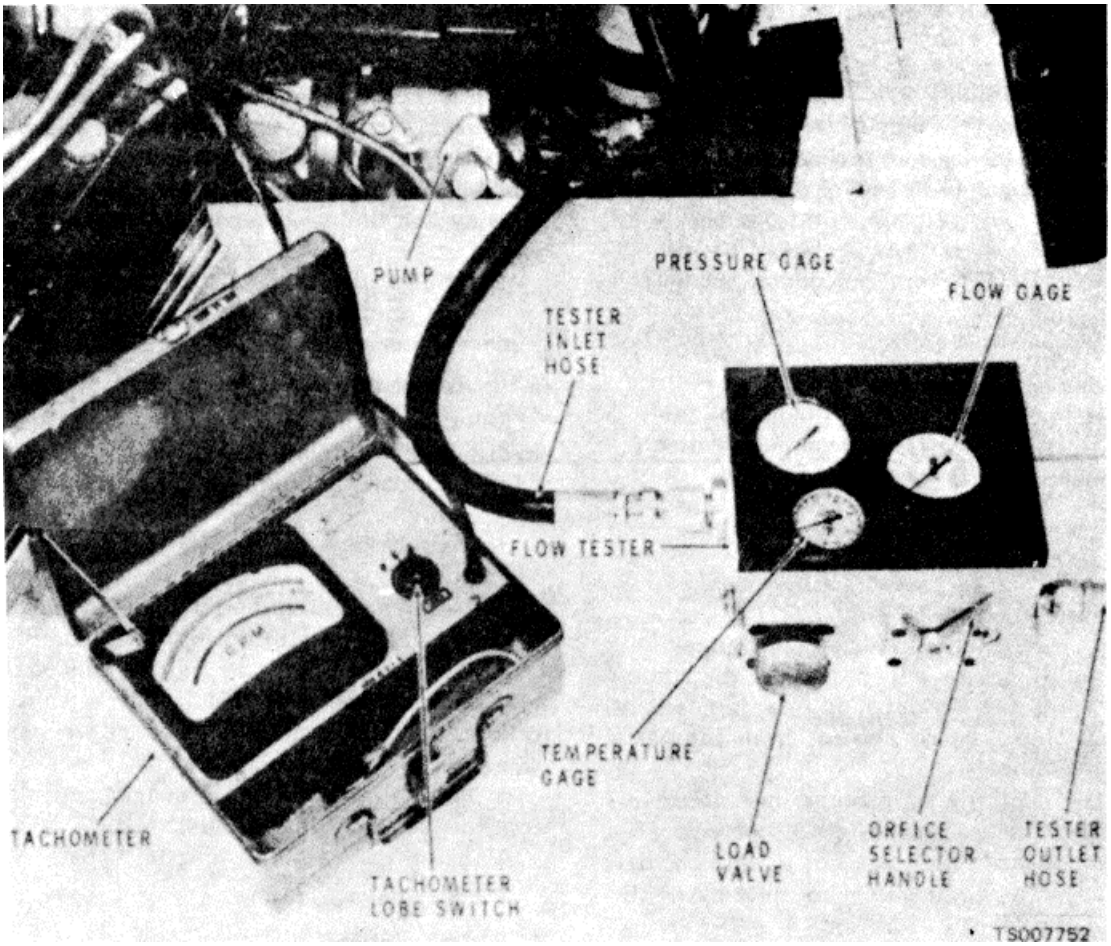


Figure 4-3. Hydraulic Pump Test Setup.

a. Connect tachometer. Set lobe switch to 4-lobe position.

b. Disconnect pressure hose from hydraulic pump and plug hose end. Connect one end of test hydraulic pressure hose to hydraulic pump and other end to inlet side of flow tester. Be sure all connections are tight.

c. Disconnect reservoir return line hose at the hydraulic control valve and plug the valve opening. Connect one end of the test return hose to the reservoir return hose and the other end to the outlet side of the flow tester. Be sure all connections are tight.

d. Set flow tester orifice selector handle on 0-30 GPM position (maximum clockwise).

e. Turn tester load valve to fully open position by turning all the way to the left (maximum counterclockwise).

CAUTION

Load valve is capable of extremely high pressure and must be in the fully open position before starting test. Do not exceed prescribed test pressures when conducting test.

f. Start the vehicle engine and set the engine speed at 1450 RPM.

g. Bring the hydraulic oil to the test temperature of 130°F by gradually applying the load valve (turning clockwise) until the fluid pressure reaches 1000 PSI.

CAUTION

Apply load valve pressure gradually as rapid application of valve can result in "blowing out" the tester relief plug.

h. After the hydraulic oil is brought to test temperature and the flow gage needle is stabilized, gradually reduce pressure at tester to 100 PSI by turning load valve to the left (counterclockwise). Turn orifice selector handle to the left (10 gal scale), stabilize flow gage needle and record flow reading at 100 PSI tester pressure. Flow reading should be 6 to 6.5 GPM.

NOTE

It will be necessary to maintain engine speed of 1450 RPM when testing-pump under load.

l. After recording flow reading at 100 PSI, gradually apply load valve (turning clockwise) until pressure stabilizes at 1000 PSI. With flow gage needle stabilized, record flow reading at 1000 PSI. Flow reading should be 5 GPM or slightly higher.

j. Pump output should be reasonably close to specifications at rated test pressure. Allow t 10 percent flow gage tester tolerance when comparing recorded readings to specifications. Recorded readings that are consistently below specifications indicate that pump is worn and should be repaired or replaced.

k. Disconnect test lines and tachometer. Connect hydraulic pump pressure line to pump and reservoir return line to hydraulic control valve.

Section IV. HYDRAULIC CONTROL VALVE

4-15. General

The hydraulic control valve includes two separate valve sections joined together with bolts and nuts. One section controls the operation of the lift cylinder while the other controls the operation of the tilt cylinders. Each section consists of a close-fitting spool which is installed in the bore of the body. The lands and grooves on the spool direct the flow of the pressurized hydraulic fluid to operate the associated cylinder. Check valves are installed to prevent reverse flow of fluid. A relief valve is installed to relieve excess system pressure.

4-16. Removal

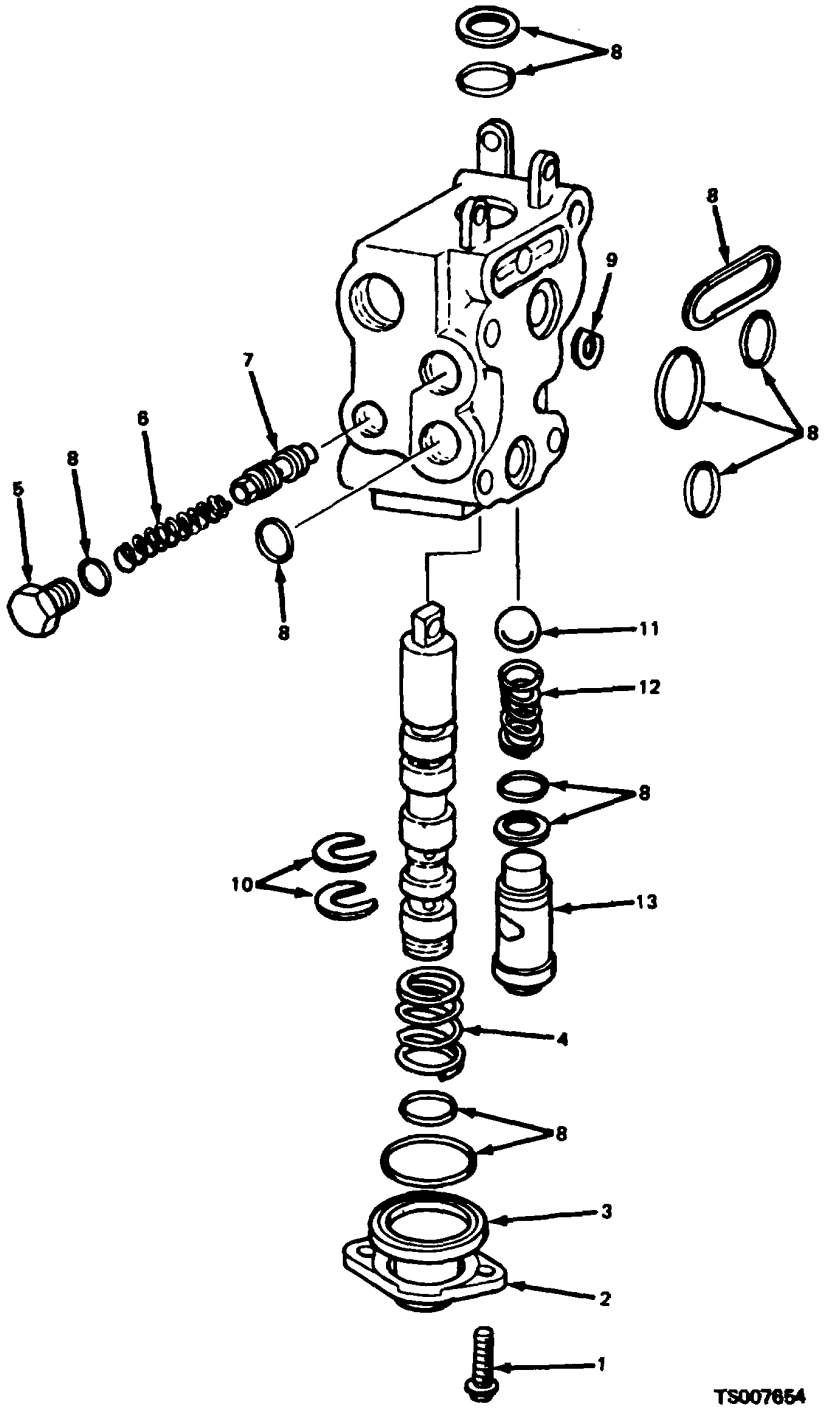
a. Disconnect the hydraulic lines from the hydraulic control valve (TM 10-3930-632-12). Plug all open ports to prevent the entry of dirt.

b. Remove the control linkage.

c. Remove the capscrews, nuts and lockwashers that secure the hydraulic control valve to the lift truck; remove the hydraulic control valve.

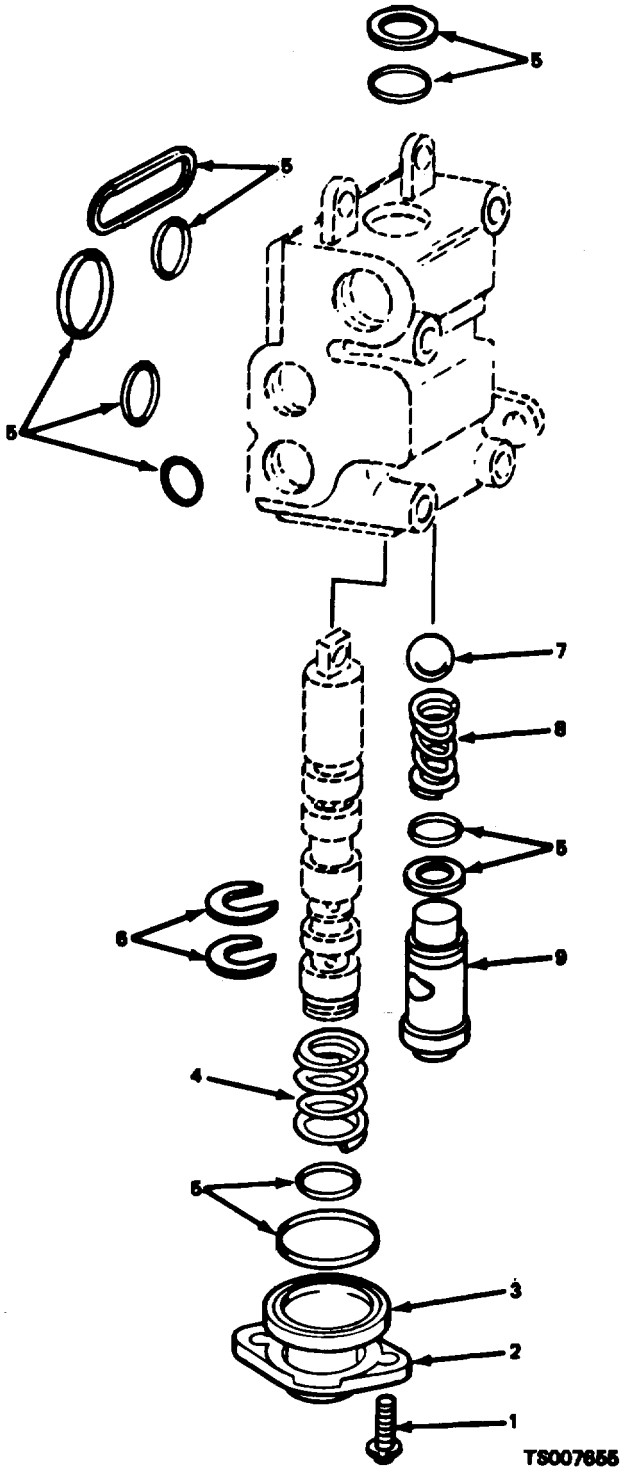
4-17. Disassembly

Refer to figures 4-4 and 4-5 and disassemble the hydraulic control valve sections. Note the following:



1. Machine screw
2. Spool retainer
3. Spool sleeve
4. Return spring
5. Pipe plug
6. Valve spring
7. Relief valve
8. Seal kit
9. Valve shim
10. C-washer
11. Detent ball
12. Detent spring
13. Detent plug

Figure 4-4. Inlet Value Section, Exploded View.



1. Machine screw
2. Spool retainer
3. Spool sleeve
4. Return spring
5. Seal kit
6. C-washer
7. Detent ball
8. Detent spring
9. Detent plug

Figure 4-5. Outlet Valve Section, Exploded View.

a. Tag the spools to assure that each will be reassembled in the body from which it was removed. Do not interchange the spools in the bodies.

b. To remove the check valve assemblies, grip the stem of the check valve with a pliers and pull out the plug to release the spring and ball.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F - 138°F. (38°C -59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

4-18. Cleaning and Inspection

a. Discard all seals and preformed packings; replace with new parts.

b. Clean all metal parts in cleaning solvent P-D-680 and dry thoroughly with compressed air.

c. Inspect the two spools of the control valve for distortion, cracks, wear, or scoring. Coat the spool lightly with clean oil and check the fit of the spool in the body. The parts must provide a close-tolerance fit. If any side play of the spool is perceptible, or if the spool is damaged, or sticks in the body, replace the entire valve section.

d. Inspect all parts of the hydraulic control valve for burrs; remove burrs by lapping with crocus cloth.

e. Inspect the valve bores for burrs and scoring; if scores and burrs are not deep, remove them with crocus cloth. If burrs and scores are deep, replace valve assembly.

f. Inspect the C-washers (10, fig. 4-4 and 6, fig. 4-5) and spring (4) for distortion, cracks, breaks, or other damage; if parts are damaged, remove the C-washers from the spool and replace with four new C-washers.

g. Coat parts lightly with engine oil. Check the relief valve and check valve balls for freedom of movement in their bores. If the relief valve or ball is not free to move, replace the relief valve or ball.

4-19. Reassembly

Refer to figure 4-4 and 4-5 and reassemble the hydraulic control valve. Note the following:

a. Lubricate all parts with clean engine oil prior to Reassembly.

b. Make sure that spools are installed into the bores of the bodies from which they were removed.

c. Install one C-washer (10 and 6) on the spool and position the spring (4) on the spool. Compress the spring and install the second C-washer to retain the spring.

d. When joining the valve bodies together, tighten the nuts on the bolts evenly and alternately to 15 ft/lbs torque.

4-20. Installation

a. Position the hydraulic control valve on the truck; secure with three capscrews, nuts, and lockwashers.

b. Install the control linkage on the control valve.

c. Connect the hydraulic lines to the hydraulic control valve (TM 10-3930-632-12).

Section V. TILT LOCK VALVE

Paragraphs 4-21, 4-22, 4-24, 4-25 and 4-26 deleted.

4-23. Removal

Remove the tilt block valve (TM 10-3930-632-12).

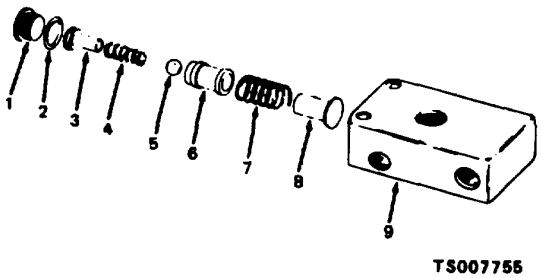


Figure 4-6. Tilt Lock Valve, Exploded View.

4-27. Installation

Install the tilt lock valve'(TM 10-3930-632-12).

Section VI. CARRIAGE, LIFT CHAINS, AND ROLLERS

4-28. General

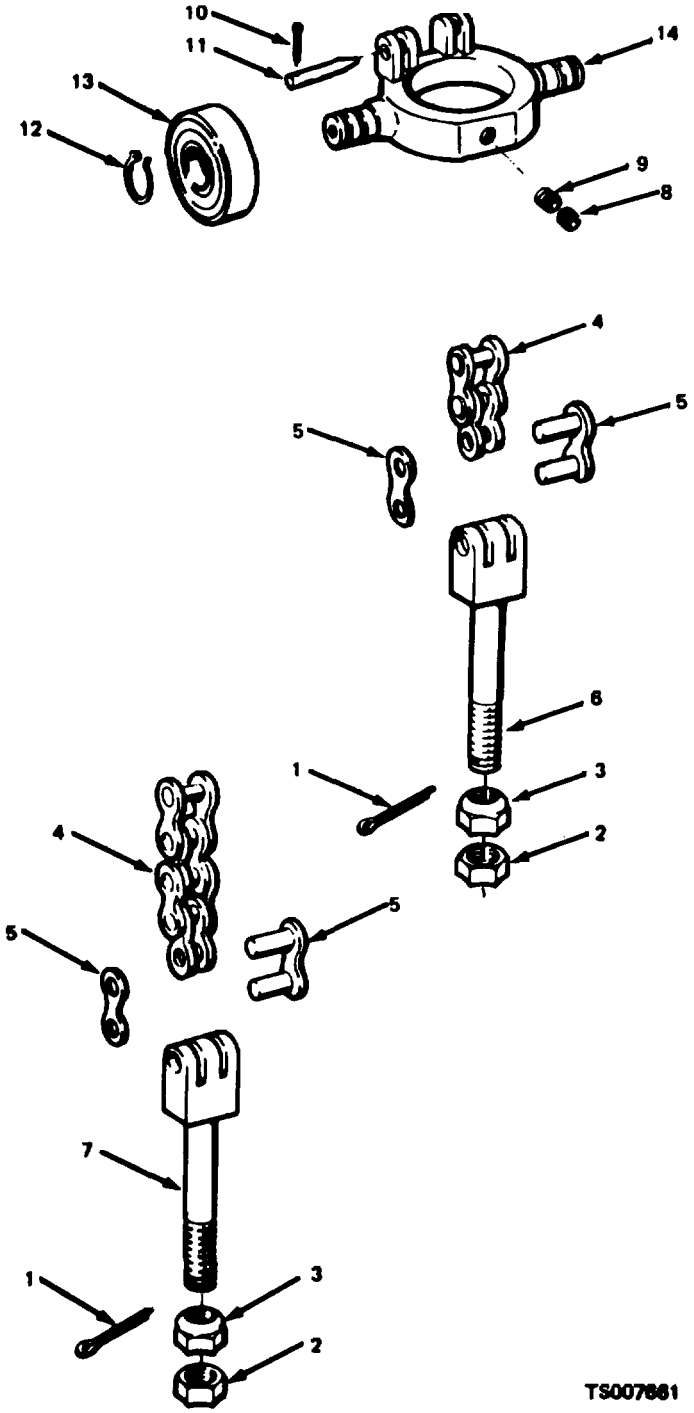
The carriage rollers ride within the inner channels of the beams that form the uprights of the inner mast, providing smooth up and down movement of the carriage. Smaller rollers, mounted perpendicular to the lamp rollers, also ride against the inner rail and prevent side to side movement of the carriage. The chains also ride on ball bearing rollers which are installed on short shafts on the piston head of the lift cylinder.

4.29. Removal

Remove the carriage and chains (para 2-6a).

4-30. Disassembly

Refer to figure 4-7 and disassemble the carriage, lift chains, and rollers.



1. Cotter pin
2. Jam nut
3. Nut
4. Chain pitch
5. Link
6. Chain anchor
7. Chain anchor
8. Setscrew
9. Lock screw
10. Cotter pin
11. Retainer pin
12. Retaining ring
13. Chain sheave
14. Piston heed

Figure 4-7. Lift Chains and Rollers, Exploded View.

WARNING

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4-31. Cleaning and Inspection

a. Wipe the rollers with a cloth dampened with cleaning solvent P-D-680. Clean all other parts with cleaning solvent P-D-680. Lubricate the chains thoroughly with light engine oil.

b. Inspect all parts of the carriage assembly for distortion, cracks, breaks, or other damage. Weld cracks or broken weldments. Replace damaged parts.

c. Inspect all parts of the carriage assembly for rust, chipped paint, or other damage; remove any rust and paint the entire assembly.

d. Check the rollers for binding operating, cracks in the seals, or other damage; replace damaged rollers.

e. Discard any damaged cotter pins or other pins.

4-32. Reassembly

Refer to figure 4-7 and reassemble the carriage, lift chains, and rollers.

4-33. Installation

Install the carriage and chains (para 2-6a).

Section VII. HYDRAULIC OIL TANK

4-34. General

The hydraulic system oil supply tank is integral with the fork lift frame. The tank therefore cannot be removed as a unit for repair.

4-35. Inspection

Check the hydraulic oil tank for cracks and damages.

4-36. Repair

a. Repair cracks or other minor damage by first draining all fuel and hydraulic oil from the fork lift truck.

b. Weld cracks or damaged areas to restore original finish.

CHAPTER 5

REPAIR OF ELECTRICAL SYSTEM

Section I. ALTERNATOR

5-1. General

The engine alternator is driven by the fan and alternator drive belts to provide power necessary to recharge the storage batteries and to maintain electrical power during engine operation. Output of the alternator is controlled by the voltage regulator which senses power requirements and increases or decreases the strength of current as necessary to meet output requirements.

5-2. Removal

Remove the alternator as outlined in TM 10-3930-632-12.

5-3. Disassembly

Disassemble the alternator in the order of indexing depicted in figure 5-1. The following special notes should be observed:

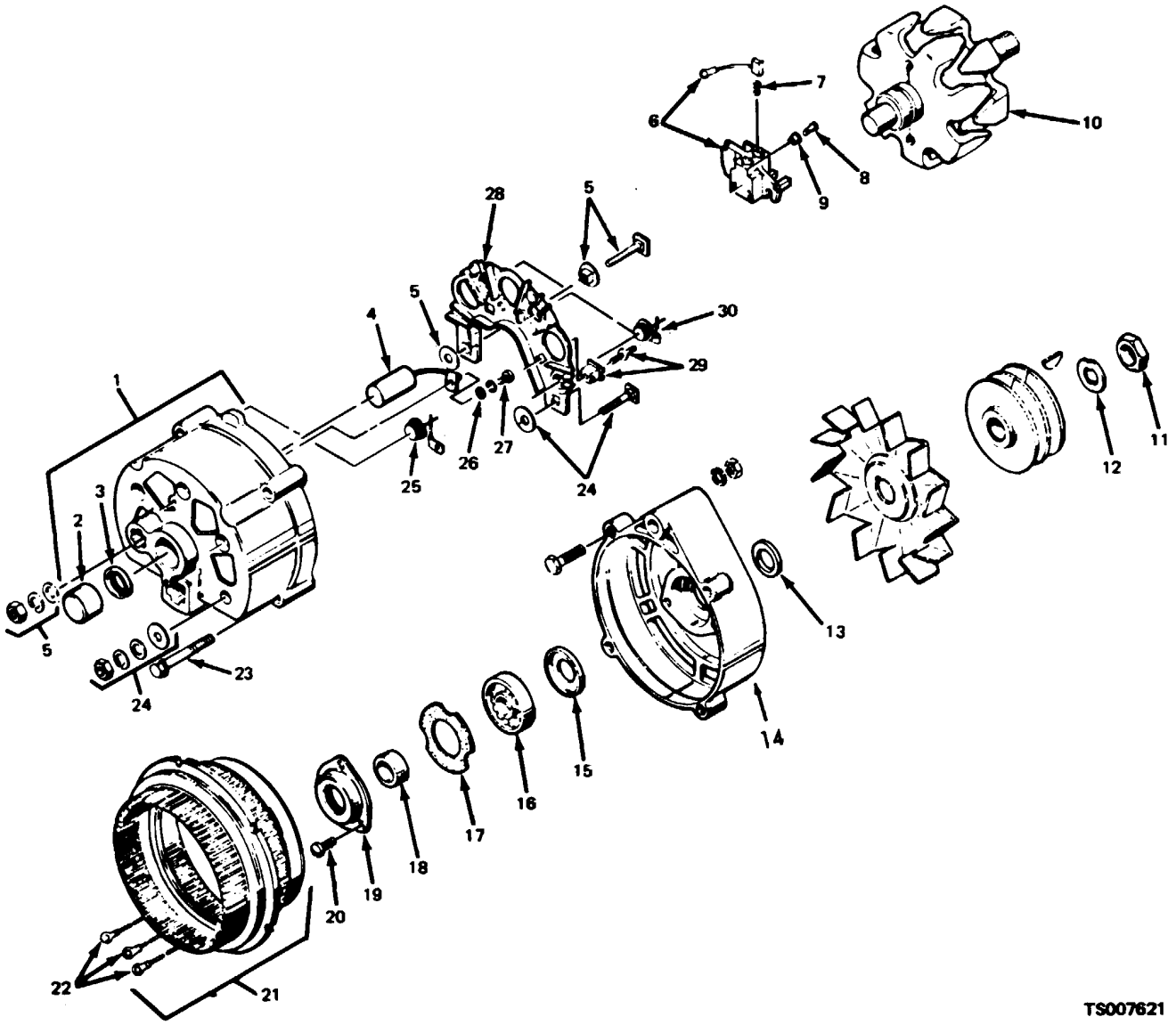


Figure 5-1. Alternator, Exploded View.

KEY to figure 5-1:

1. End frame
2. Bearing
3. Bearing retainer
4. Capacitor
5. Ground terminal package
6. Brush kit
7. Brush spring
8. Screw
9. Heat sink
10. Rotor
11. Nut
12. Lockwasher
13. Drive end collar
14. End frame
15. Oil slinger
16. Bearing
17. Retainer gasket
18. Collar
19. Retainer plate
20. Screw
21. Stator
22. Terminal
23. Thru bolt
24. Terminal package
25. Diode
26. Washer
27. Screw
28. Heat sink
29. Terminal package
30. Diode

a. Separate the drive end frame (14, fig. 5-1) and roter assembly (10) from the stator assembly (21) by prying apart with a screwdriver at the stator slot. A scribe mark will help locate parts in the same position during Reassembly.

b. Following disassembly, place a piece of tape over the slipring end frame bearing (2) to prevent entry of dirt. Place a piece of tape over the shaft on the slipring end.

c. To remove the drive end frame (14) from rotor (10), place the rotor in a vise and tighten only enough to permit removal of the shaft nut.

CAUTION

Avoid excessive tightening as this may cause distortion of the rotor.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59° C.).

5-4. Cleaning and Inspection

a. Wipe all parts of the alternator, except the brushes, with a cloth dampened in cleaning solvent P-D-680. Dry thoroughly with low pressure, dry, compressed air. Wipe the brushes with a clean, dry cloth.

b. Inspect ball bearing (16, fig. 5-1) for cracked, pitted balls and wear.

c. Check the size of the brushes. Replace if less than one-half size of new brushes.

d. The rotor may be checked electrically for grounded, open, or short circuited field coils. To check for grounds, connect a 110-volt test lamp or an ohmmeter from either slipring to the rotor shaft or to the rotor poles. If the lamp lights, or if the ohmmeter reading is low, the field winding is grounded. To check for opens, connect the test lamp or ohmmeter to each slipring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open. The winding is checked for short circuits by connecting a battery and ammeter in series with the two sliprings. Note the ammeter reading (2.2 amps). An ammeter reading above the specified value indicates shorted windings. An alternate method is to check the resistance of the field by connecting an ohmmeter to the two sliprings. If the resistance reading is below the specified value, the winding is shorted. The specified resistance value can be determined by dividing the voltage by the current (14 + 2.2 5 to 7 ohms).

e. To check the stator windings, remove all three stator lead attaching nuts and then separate the stator assembly from the end frame. The fit between stator frame and end frame is not tight, and the two can be separated easily. The stator windings may be checked with a 110-volt test lamp or an ohmmeter. If the lamp lights, or if the meter reading is low when connected from any stator lead to the frame, the windings are grounded. If the lamp fails to light, or if meter reading is high when successively connected between each pair of stator leads, the windings are open. A short circuit in the stator windings is difficult to locate without laboratory test equipment due to the low resistance of the windings. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated.

5-5. Repair

Repair consists of replacement of all parts found to be unserviceable during inspection or testing.

5-6. Reassembly and Installation

a. Reassemble the alternator as shown in figure 5-1. Reverse order of indexing depicted therein for Reassembly sequence.

b. Install the alternator (TM 10-3930-632-12).

Section II. STARTER MOTOR

5-7. General

A 12-volt battery provides the power necessary to operate the engine starter. When the starting switch is turned to the start position, and the transmission is in neutral, the circuit to the starting relay closes. The relay closes a circuit through the solenoid switch, which, when energized, engages the pinion on the starter drive

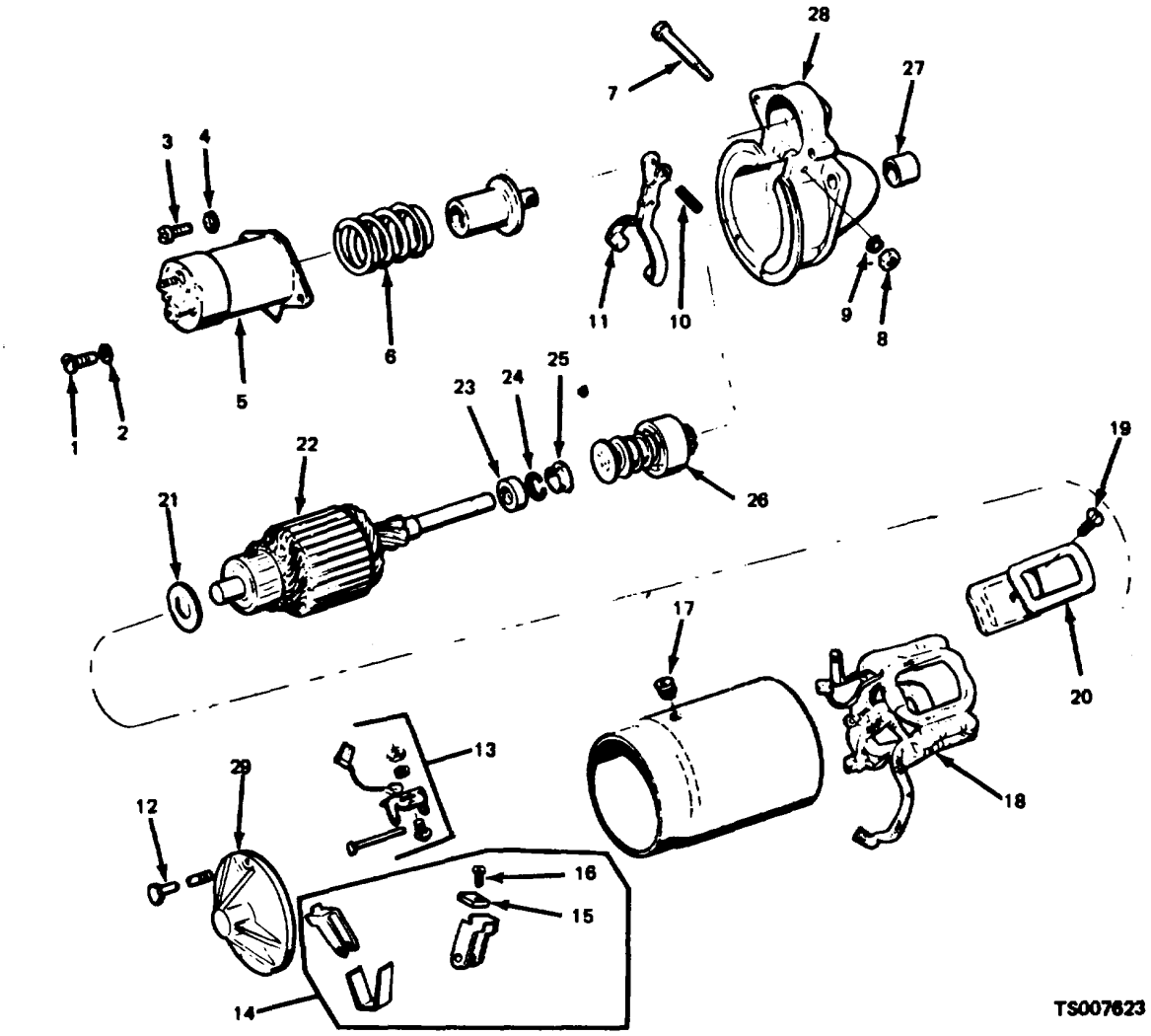
with the engine ring gear and then closes the circuit to the engine starter to crank the engine.

5-8. Removal

Remove the engine starter (TM 10-3930-632-12).

5-9. Disassembly

Refer to figure 5-2 and disassemble the engine starter. Note the following:



1. Screw
2. Lockwasher
3. Screw
4. Lockwasher
5. Solenoid switch
6. Plunger spring
7. Stud
8. Nut
9. Lockwasher
10. Spring pin
11. Shift fork lever
12. Thru bolt
13. Brush holder support
14. Brush holder
15. Brush set
16. Machine screw
17. Grommet
18. Field coil set
19. Pole shoe screw
20. Insulator
21. Thrust washer
22. Motor armature
23. Collar
24. Retainer ring
25. Thrust collar
26. Drive assembly
27. Bushing
28. Drive end housing
29. Commutator end frame

Figure 5-2. Starter Motor, Exploded View.

a. Match-mark the drive housing (28), field frame and winding assembly and commutator end frame (29) to assure that the engine starter components will be assembled in the same positions from which they were removed.

b. Remove thru bolts (12). Separate the end frame (29) and field frame from the drive housing (28) by tapping them off with a plastic hammer.

c. Do not remove the bushing (27) from the drive housing unless it is damaged and requires replacement. If defective, drive or press it from the housing.

d. Before disassembling the brush holders (14) and springs, check brush spring tension with a spring scale. Spring tension shall be 35 ounces minimum. If it is less than 35 ounces, disassemble the brush holders and springs.

e. To remove drive assembly (26) from the armature shaft, install l/2 inch pipe coupling on the end of the armature shaft so that it engages the outer collar (25). Rest the opposite end of the armature shaft on a wooden block and tap the end of the pipe coupling so that it disengages the retaining ring (24) from the groove in the armature shaft. Remove the collar (25) and remove the retaining ring from the shaft with a pliers. Slide the collar (23) and drive assembly (26) from the shaft.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid prolonged and repeated skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59° C.).

5-10. Cleaning, Inspection, and Repair

a. Clean the armature, field frame assembly, and solenoid switch assembly with a cloth lightly dampened in cleaning solvent P-D-680.

b. Clean all other parts of the engine starter, except the brushes, in cleaning solvent P-D-680 and dry thoroughly with compressed air.

c. Check the size of the brushes; replace them if they are less than one-half the length of a new brush.

d. Inspect the armature commutator for roughness, out-of-round, or high mica. If any of these conditions exist, turn the commutator down on a lathe and undercut the mica 1/32 inch. Remove only enough stock to make the commutator smooth and round. After undercutting, finish the commutator with No. 00 sandpaper. Clean all particles off the commutator using compressed air.

CAUTION

Always blow particles off the commutator In the direction away from the armature windings.

e. Check the brush holders for distortion, cracks, breaks, or other damage.

f. Inspect the drive assembly for cracks, damaged pinion teeth, breaks, clutching action, or other damage: replace the drive assembly if any parts are damaged.

g. If removed, replace the bushing in the drive housing. Replace the brush springs if brush tension is not to specification.

5-11. Reassembly

Refer to figure 5-2 and reassemble the engine starter. Note the following:

a. To install the drive assembly (26), coat the armature shaft with light engine oil and install the drive assembly on the shaft. Position the collar (23) on the shaft. With the armature shaft in a vertical position and the end resting on a wooden block, place the retaining ring on the end of the shaft and force it onto the shaft by placing a wooden block on it and pounding on the wooden block. Force the retaining ring into the ring groove in the shaft.

b. Position the second collar (25) on the shaft. Use two pairs of pliers to squeeze the collars together, forcing the collar (23) over the retaining ring.

c. Make sure the fork (11) of the solenoid assembly (5) engages the grooved portion of the drive assembly (26).

d. Lubricate the bushings in the drive end housing and the commutator end frame with engine oil prior to installation.

CAUTION

When installing the armature in the field frame, lift the brushes so that they pass over the end of the commutator.

NOTE

If brushes have been replaced, seat them using No. 00 sandpaper before assembling the end frame. Blow the brush particles off the commutator so that they will not cause a short circuit during operation.

e. Align the match-marks made during disassembly to assure that the drive housing, field frame and winding assembly, and commutator end frame will be installed in the same positions from which they were removed.

f. Check the pinion clearance after Reassembly by connecting the starting motor and a battery in the circuit (fig. 5-3). Disconnect the motor field lead from the solenoid motor terminal.

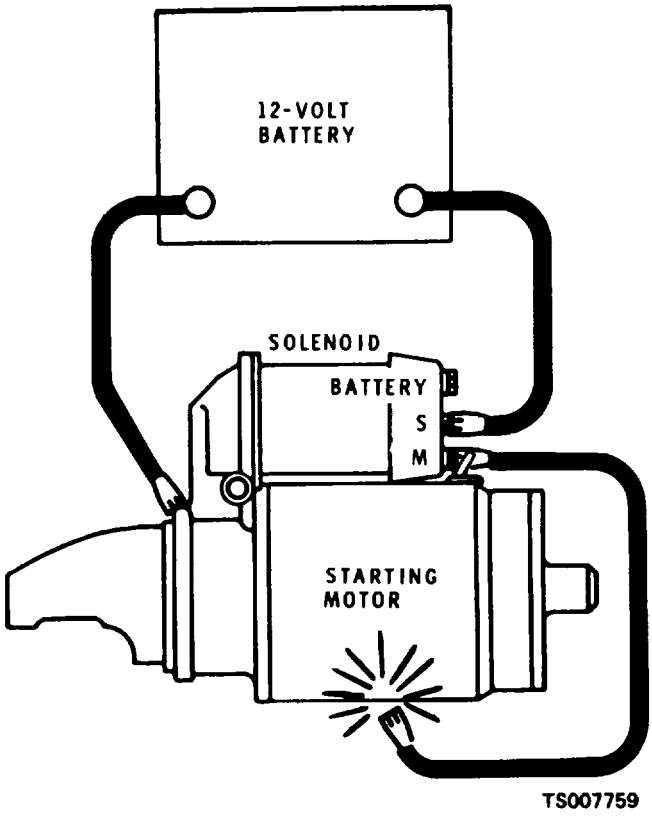


Figure 5-3. Circuit for Checking Pinion Clearance.

CAUTION

Insulate the motor field lead carefully to avoid arcing during the checking procedure.

g. Momentarily touch the jumper lead from the solenoid motor terminal to the motor frame. This will shift the pinion into cranking position. It will stay in this position until the battery is disconnected.

h. Push the pinion back toward the commutator end to eliminate all slack movement. Measure the distance between the pinion gear of the drive assembly (26, fig. 5-2) and the collar (23). If clearance is not between 0.010 and 0.140 inch, disassemble the starting motor as described in paragraph 5-9 above and check alignment of the collar (23) on the retaining ring (24).

I. Before installation, test the engine starter as directed in paragraph 5-12, below.

5-12. Testing

To assure that the engine starter is fully restored to operating condition after overhaul, test it as follows:

a. Connect the engine starter, a 12-volt battery, an ammeter, a variable resistor, and a voltmeter in a circuit (fig. 5-4). Close the switch to drive the starter. Vary the resistance until the voltmeter reads 9 volts. The ammeter must read between 50 and 80 amperes and the armature speed must be between 5500 and 10,500 RPM as indicated on a tachometer held against the shaft.

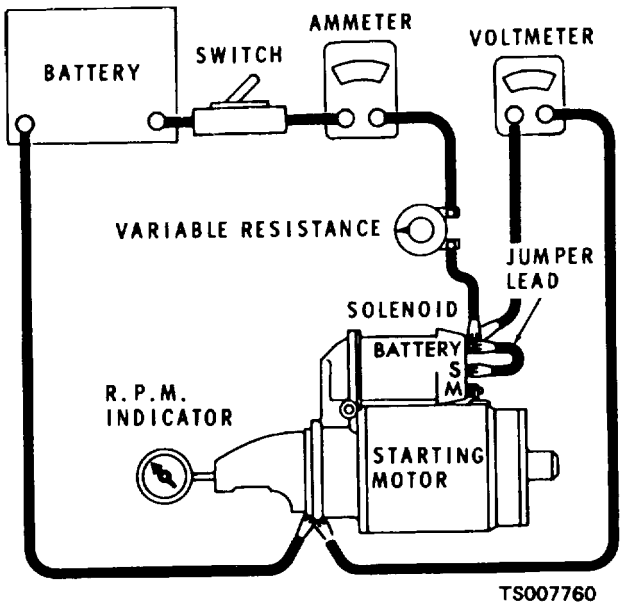


Figure 5-4. Engine Starter No-load Test Setup.

CAUTION

Do not operate the engine starter for more than 30 seconds at a time without pausing for 2 minutes to allow it to cool.

b. If the engine starter fails to pass either of the above tests, disassemble and reinspect and test the components to determine the cause of faulty operation.

5-13. Installation

Install the engine starter (TM 10-3930-632-12).

CHAPTER 6

REPAIR OF FUEL SYSTEM

Section I. DESCRIPTION

6-1. General

The fuel system consists of a fuel tank, fuel pump, supply line, carburetor, and a governor. All components of the fuel system are covered in TM 10-3930-632-12 with the exception of the carburetor, governor, and fuel tank. The fuel is drawn from the fuel tank, through the supply line, by the fuel pump. The pump then delivers the fuel to the carburetor where it is mixed with the proper amount of air and vaporized. The fuel-air mixture leaves the carburetor and enters the intake manifold of the engine where it is drawn into the engine cylinders.

Section II. CARBURETOR

6-2. General

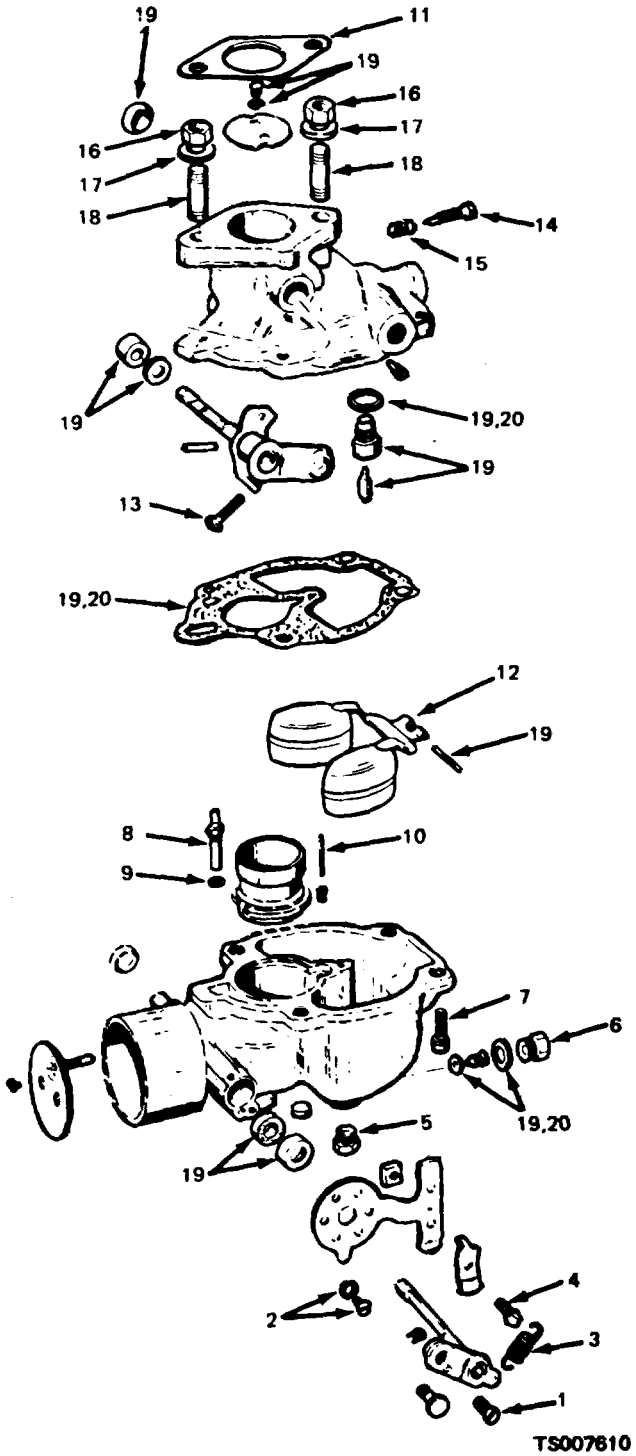
The carburetor is of updraft, single-barrel design with a manual choke. The level of the fuel in the fuel chamber is regulated by a float which controls the fuel valve. The fuel valve does not close and open alternately, but assumes an opening regulated by the float, sufficient to maintain a proper fuel level in the fuel chamber that is equal to the demand of the engine according to its speed and load.

6-3. Removal

Remove the carburetor as outlined in TM 10-3930-632-12.

6-4. Disassembly

Disassemble the carburetor as shown in figure 6- 1. The index numbers assigned to the parts indicate the order of disassembly. Note the following:



1.	Choke lever screw	6.	Main jet plug	11.	Carburetor gasket	16.	nut
2.	Machine screw	7.	Screw	12.	Float	17.	Lockwasher
3.	Return spring	8.	Main jet	13.	Stop screw	18.	Mounting stud
4.	Clamping screw	9.	Fiber washer	14.	Idle adjust screw	19.	Repair kit
5.	Drain plug	10.	Idle filler tube	15.	Idle adjust spring	20.	Gasket kit

Figure 6-1. Carburetor, Exploded View.

a. To remove the float axle, press a screwdriver against the float axle at the slotted side of the float hinge bracket. Remove the axle from the opposite side and remove the float (12).

b. After the float is removed, take care that the fuel valve does not drop from the valve seat.

c. Use a file to match-mark the throttle lever on the throttle shaft and the throttle body. These marks will serve as a guide to assure that the parts will be reassembled in the proper manner.

d. Use a file to match-mark the choke bracket, choke lever, and the boss on the fuel bowl. These marks will serve as a guide to assure proper reassembly.

e. To remove the plug, insert a 1/4 inch rod, 6 inches long, through the opposite side of the fuel bowl and drive out the plug.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59° C.).

6-5. Cleaning and Inspection

a. Discard all washers and gaskets. Replace these parts with new ones from the repair kit.

b. Clean all parts in cleaning solvent P-D-680 and dry thoroughly with compressed air.

c. Blow out all passages in the air intake, fuel bowl, and throttle body with compressed air.

CAUTION

Do not clean by inserting a wire or drill into any openings or passages as this will destroy their fine calibration.

d. Inspect all parts of the carburetor for wear, distortion, cracks, breaks, or other damage.

6-6. Reassembly

Refer to figure 6-1 to reassemble the carburetor. Reassembly is the reverse of disassembly. Note the following:

a. During reassembly, align the match-marks made during disassembly on the fuel bowl, choke bracket, and choke shaft and lever.

b. Align the match-marks made at disassembly on the throttle body and throttle shaft and lever.

c. Note that the screw holes in the throttle plate are off-centered. Start the side of the throttle plate with the shortest distance between the screw holes and beveled edge in to place first. The plates are 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 discharge holes when the plate is closed.

d. After installing the float (12) and axle, check the position of the float. With the throttle body in an inverted position and viewed from the free end of the float, the float bodies must be centered and at right angles to the machined surface (fig. 6-2). The distance from the machined surface of the throttle body to the top side of the highest point of the float bodies must be 1-5/32 + 3/64 inches. To increase or decrease the distance between the float body and machined surface, use long-nosed pliers and bend the lever close to the float body.

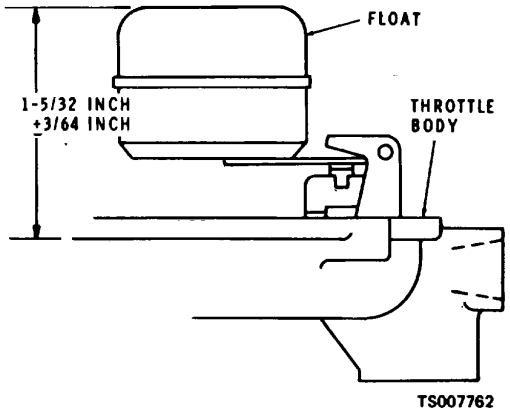


Figure 6-2. Float Level Adjustment.

NOTE

Replace carburetor if float position is off more than 1/16 inch.

Install and adjust the carburetor (TM 10-3930-632-12).

6-7. Installation

Section III. GOVERNOR

6-8. General

The governor is a sealed built-in unit, driven by the timing gears and lubricated from the engine oil supply. The governor is the centrifugal, variable speed, flyball type that controls speed by adjusting the amount of travel of the control rod to the carburetor. As the camshaft timing gear rotates, the drive assembly balls are pressed against the outer slant of the race assembly to push the race outward. The race assembly in turn presses against the lever and shaft assembly which is connected to the carburetor throttle control through a direct linkage. The throttle plate is closed by this action, slowing the engine to governed speed. As the engine slows, less pressure is exerted by the balls, and the race assembly moves inward. This movement is transferred through the linkage to the carburetor throttle control to increase fuel flow to the engine and increase engine speed. In this manner, the engine speed is regulated.

6-9. Removal and Disassembly

a. Remove the counterweight, muffler, and radiator (TM 10-3930-632-12).

b. Remove the fan and generator drive belts (TM 10-3930-632-12).

c. Remove crankshaft pulley (para 9-19).

d. Disconnect the linkage from the governor arm (TM 10-3930-632-12). Disconnect the spring (1, fig. 6-3) and remove the nuts (2), lockwashers (3), and adjusting bolt (4) from the bracket (6).

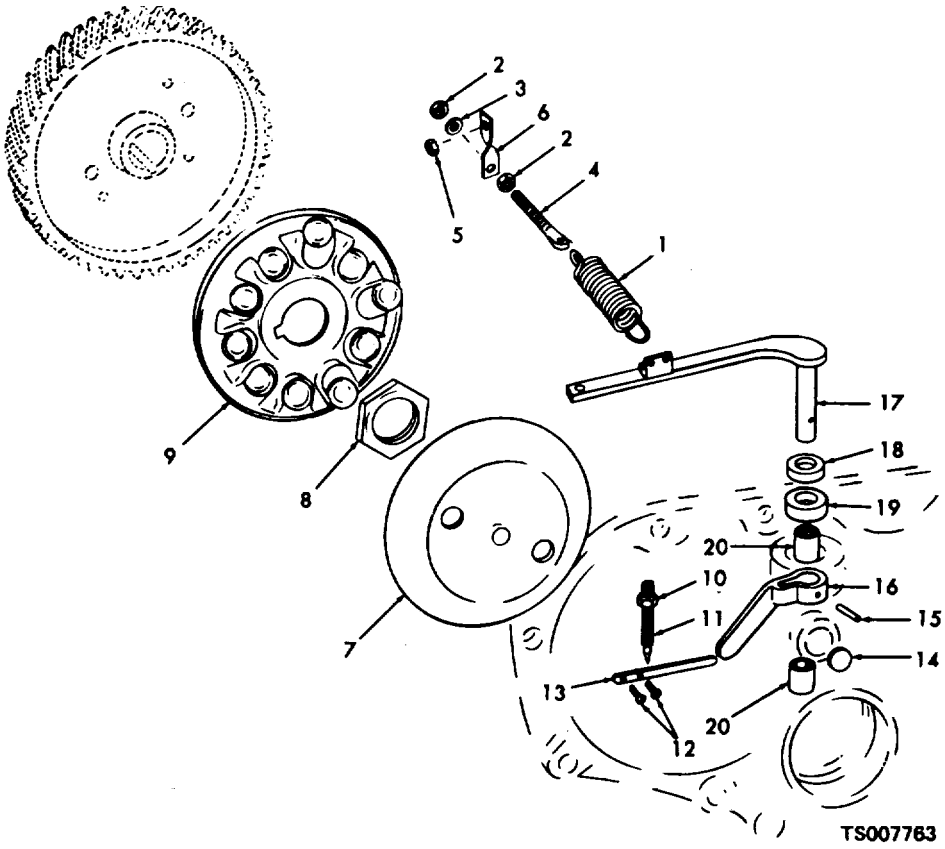


Figure 6-3. Governor Assembly. Exploded View.

KEY to figure 6-3:

1.	Spring	11.	Surge screw
2.	Nut	12.	Screw
3.	Lockwasher	13.	Spring
4.	Adjusting bolt	14.	Plug
5.	Nut	15.	Pin
6.	Bracket	16.	Lever
7.	Race assembly	17.	Governor arm
8.	Nut	18.	Dust seal
9.	Drive assembly	19.	Oil seal
10.	Nut	20.	Needle bearing

e. Disconnect the hose to the engine oil filter from the gear cover. Drain the oil from the filter and crankcase.

f. Remove the hex locknuts (fig. 2-3) and lower support pads from the stud of the engine assembly. Hoist the engine just enough to raise the upper support pad off the frame. Block the engine in this position.

g. Remove the hydraulic pump and mounting plate (para 9-19).

h. Remove the gear cover from the engine block (para 9-19).

I. Refer to figure 6-3 and remove and disassemble the governor assembly.

NOTE

Do not remove the drive screws (12) and spring (13) unless obviously damaged.

j. If the needle bearings (20) are damaged, use a rod of slightly smaller diameter than the gear housing hole and drive the dust seal (18), oil seal (19!, and needle bearings (20) out of the gear cover.

WARNING

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6-10. Cleaning, Inspection and Repair

a. Discard the seals.

b. Clean all parts of the governor in cleaning solvent P-D-680 and dry with compressed air. Dip the needle bearings and drive assembly in engine oil.

c. Inspect the race assembly for wear, scoring, distortion, cracks, breaks, or other damage; replace damaged parts Remove burrs and scoring by lapping with crocus cloth. If the burrs or scores are too deep to remove in this manner, replace the part.

d. Inspect the drive assembly for a cracked ball retainer; worn, pitted or scored balls; distortion; or other damage. Replace a damaged drive assembly.

e. Check the needle bearings for smooth operation; replace sticking or rough operating bearings.

f. Inspect the shaft for wear, scoring, and distortion; replace if damaged.

g. Inspect all other governor parts for cracks, scoring, wear or distortion; replace damaged parts.

6-11. Reassembly and Installation

a. Refer to figure 6-3 and reassemble and install the governor assembly. Install the rotating parts (7 through 9) on the timing gear and camshaft. Install the governor arm and lever and associated parts (14 through 20) on the gear cover.

b. When installing the needle bearings (20) in the bore of the gear cover, tap them into position with a driver and light hammer until there is clearance for the oil seal (19) and dust seal (18). Install the oil seal and dust seal.

c. When installing the surge screw (11), turn it into the cover about one-fourth of its length as a preliminary adjustment.

d. Install the adjusting bolt (4), nuts (2) and lockwasher (3) on the bracket (6) so that an equal amount of threads are visible on each side of the nuts. This is a preliminary adjustment. Install the spring (1) between the adjusting bolt and governor arm (17).

e. Install the hydraulic pump and pump mounting plate (para 9-19).

f. Lower the fan end of the engine so that it is resting on the truck frame. Install the bottom support pads and nuts.

g. Connect the hose from the engine oil filter to the gear cover. Fill the engine crankcase (LO 10-3930-632-12).

h. Install the crankshaft pulley (para 9-21, e).

I. Install the fan and generator V-belts (TM 10-3930-632-12).

j. Connect the governor linkage clevises to the governor adjusting arm (TM 10-3930-632-12).

k. Install the muffler, radiator, and counterweight (TM 10-3930-632-12).

l. Adjust the governor linkage (TM 10-3930-632-12).

Section IV. FUEL TANK

6-12. General

The fuel tank is built into the frame at the left side of the truck. It is not removable.

6-13. Repair

The fuel tank is built into the left frame member of the lift truck. If fuel tank leaks or other damage

require welding or straightening repairs that necessitate the use of heat or open flame, be sure to steam clean or use other cleaning methods which will remove all fuel fumes from the tank prior to repairing.

WARNING

Failure to remove all traces of fuel from the fuel tank prior to the application of heat or flame may result in a violent explosion.

CHAPTER 7

REPAIR OF COOLING SYSTEM

Section I. RADIATOR

7-1. General

The radiator consists of a series of tubes through which the coolant is circulated. Fins are attached to the tubes to give a more extended surface through which heat can be dissipated. For most effective use, these fins must be kept clean and free from accumulated dirt.

7-2. Radiator Testing

a. Remove the radiator (TM 10-3930-632-X2).

b. Place the cap tightly on the radiator and close the drain cock. Block off the upper hose connection; connect an air line to the lower hose connection with an air pressure gage in the line.

c. Submerge the radiator in a tank of water. Open the air line to the radiator and apply a pressure of not more than 8 to 10 PSI.

d. Watch the radiator for signs of bubbles coming from the core during this pressure test. The pressure cap should rise at approximately this pressure. Shut off the air to the radiator and allow the air to escape until the safety cap seats. Hold the pressure for 5 minutes. If no bubbles appear from the core, the radiator is good. If bubbles appear, mark the origins of the bubbles and remove the radiator from the tank.

7-3. Radiator Repair

a. Replace a defective drain cock.

b. Solder any holes found in the radiator.

c. Solder all tubing connections that leak underpressure.

d. Repair a badly damaged radiator. If radiator is still defective, replace it with a new radiator.

e. Install the radiator (TM 10-3930-632-12).

CHAPTER 8

REPAIR OF STEERING GEAR

Section I. GENERAL DESCRIPTION

8-1. General

The steering gear consists primarily of a shaft nut, and gear and shaft assembly. The nut mounted on the steering gear shaft moves up and down on the shaft as the shaft is rotated. Recirculating bearing balls engage the threaded outside diameter of the shaft and the threaded inside diameter of the nut to assure easy shaft rotation. A toothed portion of the nut provides a rack which engages the shaft and gear assembly, rotating the shaft and gear assembly as the nut moves up and down. A pitman arm mounted on the splined end of the gear shaft provides the external movement to turn the steering axle through a drag link.

Section II. REPAIR

8-2. Removal

Remove the steering gear (para 2-7a).

8-3. Disassembly

Refer to figure 8-1 and disassemble the steering gear. Note the following:

a. Remove the cover (1) from the horn button (2) by pulling up on the cover. Remove the horn button by pressing down and turning it out of the retainer (7). Remove the cup (3), spring (4) and cap (5). Remove the three screws (6) that hold the retainer to the steering handwheel (9); remove the retainer. Remove the nut (8) that secures the steering handwheel (9) to the shaft assembly (28); pull the steering handwheel off the shaft assembly.

b. To remove the shaft and gear assembly (23), tap the end of the shaft with a soft hammer, taking care not to damage the threads.

c. If necessary to remove the shaft assembly (28), tap the upper end of the shaft with a soft hammer, taking care not to damage the threads.

d. Do not remove the sleeve bearing (22) from the cover (18) or the sleeve bearing (43) from the housing assembly (45) unless inspection indicates the need for replacement.

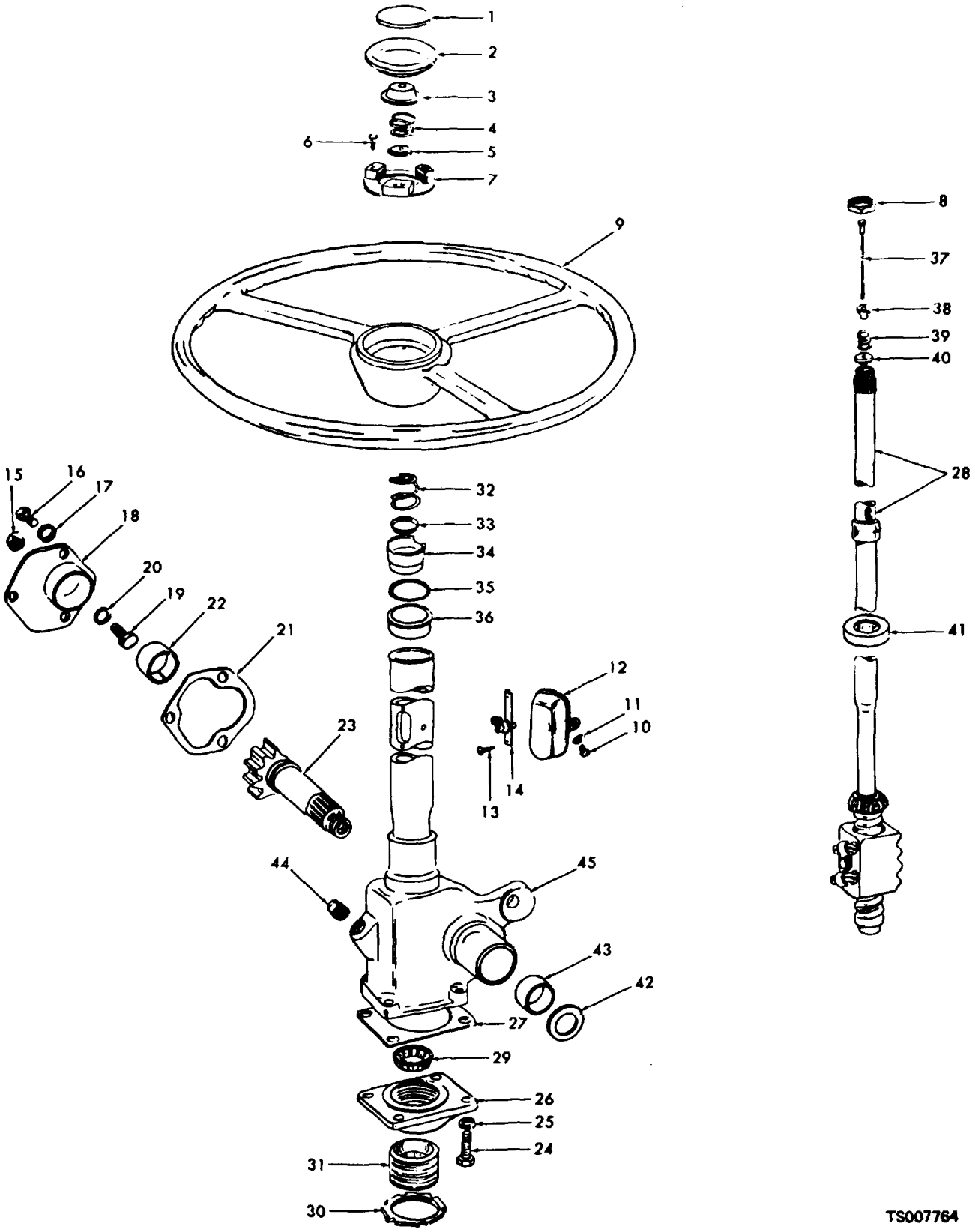

Figure 8-1. Steering Gear, Exploded View.

KEY to figure 8-1:

1. Cover
2. Horn button
3. Cup
4. Spring
5. Cap
6. Screw
7. Retainer
8. Nut
9. Steering handwheel
10. Screw
11. Lockwasher
12. Cover
13. Screw
14. Connector assembly
15. Nut
16. Bolt
17. Lockwasher
18. Side cover
19. Lash adjuster
20. Shim
21. Gasket
22. Sleeve bearing
23. Shaft and gear assembly
24. Bolt
25. Lockwasher
26. End cover
27. Gasket
28. Shaft assembly
29. Bearing cone
30. Nut
31. Adjuster
32. Spring
33. Retainer
34. Bearing assembly
35. Retaining washer
36. Adapter
37. Cable assembly
38. Ferrule
39. Spring
40. Washer
41. Bearing cup
42. Retainer
43. Sleeve bearing
44. Plug
45. Housing assembly

WARNING

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8-4. Cleaning and Inspection

a. Clean all parts of the steering gear in solvent, Federal Specification P-D-680; dry with compressed air.

b. Inspect all bearings for cracks, binding, rough operation, flat spots, wear, or other damage; replace damaged bearings.

c. Inspect the housing for cracks, breaks, distortion, stripped threads, or other defects; retap threads as necessary. Replace housing if damaged.

d. Inspect the sleeve bearing (22) in the cover (18) for wear, burrs, or scoring; replace if the bearing is damaged.

e. Turn the ball nut slowly up and down the full length of the worm gear on the shaft assembly and check for flat spots, rough operation, binding, wear or other damage; replace a damaged shaft assembly.

f. Inspect the shaft and gear assembly for scoring, nicks, or worn teeth; replace the shaft and gear assembly if damaged.

g. Inspect the springs for distortion, loss of tension, or other damage; replace the springs if damaged.

h. Discard all gaskets, preformed packings, and unserviceable parts.

8-5. Reassembly

Refer to figure 8-1 and reassemble the steering gear. Note the following:

a. If the sleeve bearing (43) was removed, position the new bearing on the housing and tap into place using a light hammer and a soft wooden block. Install the retainer (42).

b. Insert the ferrule (38) into the shaft assembly (28); pass the cable assembly (37) down through the ferrule and out the opening provided in the side of the shaft assembly. Solder the cable assembly end to the collar on the shaft. Press the bearing cup (41) into the housing assembly 445). Insert the shaft assembly into the housing assembly. Make sure the nut on the threads of the shaft is centered before installing the shaft.

c. Turn the adjuster (31) loosely into the cover (26); turn the nut (30) loosely onto the adjuster. Lubricate the bearing cone (29) with light oil. Position the bearing cone in the adjuster. Position the new gasket (27) and assembled cover on the housing; secure in place using the bolts (24) and lockwashers (25).

d. Insert the lash adjuster (19) into the end of the shaft and gear assembly (23) using a shim (20) that allows it to turn, but does not allow any end play. Position the cover (18), with bearing (22) installed, on the lash adjuster; with a screwdriver inserted through the threaded hole in the cover, turn the lash adjuster into the cover as far as possible.

e. Lightly oil the gear teeth on the shaft and gear assembly (23). Place a new gasket (21) on the cover and position the cover on the housing, being careful to engage the teeth on the shaft and gear assembly (23) with those of the nut on the shaft assembly (28). Secure with three bolts (16) and lockwashers (17). Turn the nut (15) onto the lash adjuster.

f. Position the adapter (36), bearing assembly (34), retaining washer (35), spring retainer (33) and spring (32) over the shaft assembly and into the housing assembly. Position the steering handwheel (9) on the shaft assembly and secure with the nut (8).

g. Position the retainer (7) in the steering handwheel and under the horn contact; secure with the three screws (6). Place the cap (5) over the horn contact, and position the spring (4) and cup (3) on the retainer over the cap. Place the horn button (2) into the steering handwheel so that its locking devices are alongside the retainer locking devices. Insert two small screw-drivers into opposite slots in the horn button; press down and turn the horn button clockwise until it is engaged.

Press lip of cover (1) into hole in horn button (2) until cover is seated on button.

h. Lubricate the steering gear (LO 10-3930-632-12).

8-6. Installation

Install and adjust the steering gear (para 2-7b and c).

CHAPTER 9

REPAIR OF ENGINE

Section I. DESCRIPTION

9-1. General

The engine is a four-cylinder, four stroke-cycle, water-cooled, valve in block, pressure-lubricated, gasoline engine. The engine is equipped with a 12-volt electrical system, including a coil and distributor type ignition system, starting system, and battery charging system with an alternator. Detailed descriptions of the various components of the engine are presented in applicable paragraphs through this chapter.

Section II. ENGINE WEAR LIMITS

9-2. General

Table 9-1 lists allowable wear limits of engine parts. Refer to this table to determine if parts can be reinstalled or if replacement of parts is necessary.

Table 9-1. Engine Wear Limits

Engine Part	Point of Measurement	Limit Wear
Valve Guides	Length	2-9/32
(intake and exhaust)	Outside Dia.	5645/5635
	Stem Hole Dia.	3167/.3157
	Wear Limits-Max. Dia	3182
	Distance, Cyl. Block Contact Face to Guide	7/8
Intake Valves	Stem Dia.	3149/.3141
	Wear Limits-Min. Dia	.3121
	Seat Angle	30°
	Stem Clearance Limits	001/.0006
	Wear Limits-Max. Cl	.003
	Desired Stem Clear	.0008
Exhaust Valves	Stem Dia.	3132/.3124
	Wear Limits-Min. Dia.	.3104
	Seat Angle	45°
	Stem Clearance-Limits	.0047/.0043
	Wear Limits-Max. Cl.	.0063
	Desired Stem Cl.	.0035
Valve Springs	Outside Dia.	31/32
	Length-Valve Closed	1-45/64
	Load-Valve Closed	47-53#
	Wear Limits-Min. Wgt.	42#
	Length-Valve Open	1-27/64
	Load-Valve Open	96-104#
	Wear Limits-Min. Wgt.	86#
Camshaft	Brg. Journal Dia. #1	1.8095/1.8085
	#2	1.7465/1.7457
	#3	1.2475/1.2465
	Bushing-Inside Dia. #1	1.8125/1.8115
	#2	1.7502/1.7495
	#3	1.2505/1.2495
	Bushing-Clearance Limits	004/.002
	End Play	007/.003

Engine Part	Point of Measurement	Wear Limit
Connecting Rods	Bush. Hole Dia	7632/.7622
	Brg. Hole Dia	1.6245/1.6240
	Brg. Thickness	0617/.0614
	Wear Limits-Min. Thk.	.0609
	Dia.-Crank Pin	1.500-1.499
	Wear Limits-Min. Dia.	1.498
	Clearance Limits	.0006/.0027
	Desired Clearance	.0015
	Wear Limits-Max. C1	.0037
	Side Play	.0105/.006
	Desired Side Play	0065
Main Bearings	Dia of Brg Bore in Block	1.8747/1.8740
	Brg. Thickness	.0625/.0622
	Wear Limits-Min. Thk	.0617
	Dia. of Main Brg. Jr.	1.7485/1.7475
	Wear Limits-Min. Dia.	1.7465
	Clearance Limits	.0005/.0028
	Desired Clearance	.0015
	C/S End Play	003/.008
Piston Pin	Length	2.7553/2.7543
	Diameter	7085/.7083
	Wear Limits-Min. Dia.	.7080
	Desired Fit	Light Push
	Bush. Hole Dia.-Fin	.7089/.7087
	Wear Limits-Max. Dia	.7099
	Pin Cl. in Bushing	.0006/.0002
	Desired Pin Fit	.0004
Pistons	Cylinder Dia.	3.1875/3.1895
	Wear Limits-Cyl. Bore	.008
	Piston Pin Hole Dia.	.7086/.7084
	Ring Groove Width-#1	.0955/.0945
	Max. Wear Limit Width	.0975
	Ring Groove Width-#2	.0955/.094
	#3	251/.250
	Max. Wear Limit Width-12	.0975
	#3	.253
	Piston Fit-Feeler Gage	.002
	Lbs. Pull	5-10#
Piston Rings	Ring Width-#1	0935/.0925
	Wear Limits-Min. Width	.0905
	Ring Width- #2	.0935/.0925
	#2	.249/.2485
	Wear Limits-Min. Width-#2	.0905
	#3	.2465
	Ring Gap Clear.-#1	.013/.008
	Ring Gap Clear.-#2 & #3	#2-.013/.008
	#3-	.016/.008
	Ring Side Clar.-#1	.003/.001
	#2	.003/.001
	#3	.0025/.001

Section III. TORQUE SPECIFICATIONS

9-3. General

Due to the many various sizes of fasteners used in the engine, the following table 9-2 should be consulted during engine/component reassembly. The torque values are listed in foot-pounds and must be strictly observed.

Table 9-2. Torque Specifications

Size-Diameter	5/16"	3/8"	7/16"	1/2"	9/16"	5/8"
Cylinder Heads		35-40	70-75	100-110	130-140	145-155
Main Bearing Caps		35-40	70-75	85-95	110-120	140-150
Connecting Rods	20-25	40-45	55-60	90-100	110-120	
Flywheels	20-25	35-40	70-75	85-95	100-110	145-155
Manifolds	15-20	25-30	40-50	50-60	50-60	60-70
Gear Covers, Water Pumps, Front and Rear End Plates	15-20	25-30	50-55	80-90		
Oil Pans	12-16	12-16				
Flywheel Housings	15-20	25-30	50-55	80-90	115-125	

Camshaft Nut

Thread Size	3/4"	7/8"	1"	11/8"	11/4"	
C. I. Shafts	65-70#	70-80#	95-100#	125-130#	145-150#	
Forged Steel Shafts		*120-125#	*175-180#			
Elastic Stop Nut w/C.I. or Forged Steel Shaft		65-70#				

* When Cam Gear Governor is used with a steel camshaft, torque cam nut to 85-90

Section IV. ENGINE OVERHAUL

9-4. General

Engine overhaul is the complete disassembly, cleaning, inspection and repair of the basic engine and its components. Performance of all procedures in this chapter constitutes an engine overhaul and should be carried out at prescribed intervals or as engine operation/performance dictates. While overhaul does not necessarily return the engine to a like new condition, the procedure will result in a completely serviceable engine.

Section V. CYLINDER HEAD

9-5. General

The cylinder head serves as the combustion chamber as well as mounting for spark plugs. The combustion chamber design is tailored for the required turbulence, charge flow and burning characteristics to provide the most efficient and economical operation.

9-6. Removal

a. Drain coolant from the engine and radiator (TM 10-3930-632-12).

b. Tag and remove ignition cable and primary distributor wire from ignition coil.

c. Remove the nuts and lockwashers that secure the engine oil filter and bracket to the cylinder head; position the filter and bracket to provide clearance to remove the cylinder head.

d. Remove nuts and lockwashers that secure transmission oil filter, ignition coil, and crankcase breather bracket to the head and block. Position bracket to provide clearance to remove cylinder head.

e. Remove belts from alternator pulley.

f Remove alternator adjusting strap bolt, washer, and lockwasher. Remove nuts and washers securing alternator to cylinder head.

g. Remove intake and exhaust manifold (TM 10-3930-632-12).

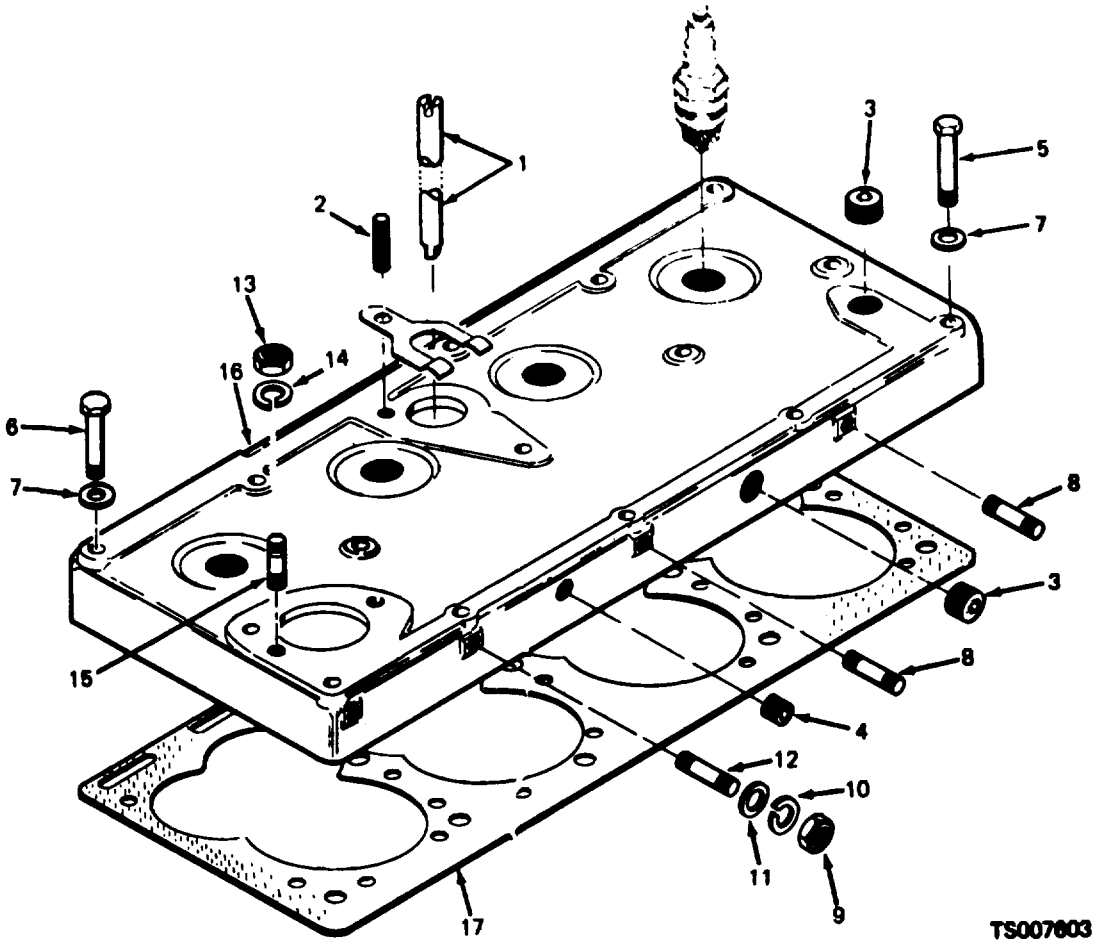
h. Remove nuts and washer securing thermostat housing to cylinder head.

I. Remove the bypass elbow from the water pump and thermostat elbow; remove the thermostat housing (TM 10-3930-632-12).

j. Remove distributor (TM 10-3930-632-12).

k. Tag and disconnect the lead from the water temperature sending unit. Remove the sending unit.

l. Remove the capscrews, nuts, and washers securing the cylinder head. Remove the cylinder head and gasket. (Figure 9-1).



1. Distributor shaft
2. Stud
3. Plug
4. Plug
5. Bolt
6. Bolt
7. Washer
8. Stud
9. Nut
10. Lockwasher
11. Washer
12. Stud
13. Nut
14. Lockwasher
15. Stud
16. Cylinder head
17. Head gasket

Figure 9-1. Cylinder Head, Exploded View.

9-7. Cleaning and Inspection

a. Remove all carbon from combustion arm using a scraper and wire brush (fig. 9-2).

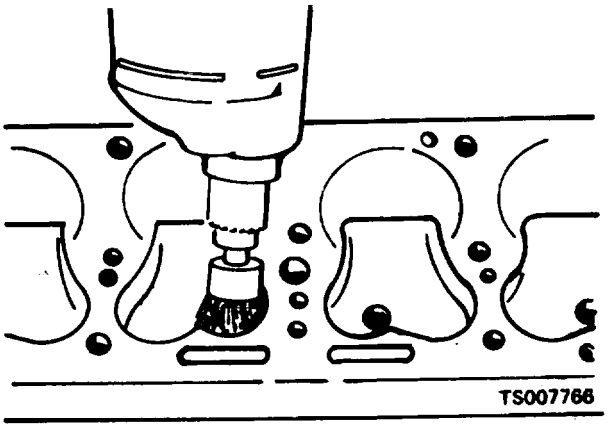


Figure 9-2. Cleaning Carbon From Combustion Chamber.

b. Clean the cylinder head thoroughly with a solvent or degreasing solution and blow it off with air pressure.

c. Make sure that gasket contact surfaces on the head and block are clean, smooth and flat. See figure 9-3.

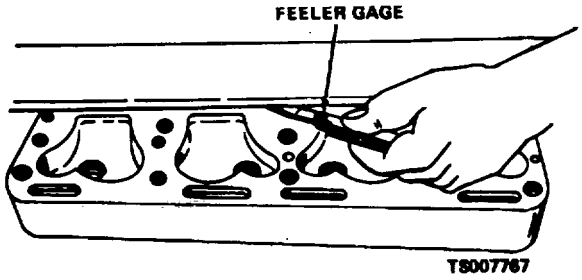


Figure 9-3. Checking Cylinder Head Flatness Lengthwise.

d. Check out-of-flatness with straightedge and feeler gage; maximum permissible is .00075 inches per inch of width or length. Thus, for a cylinder head 16" long, maximum permissible lengthwise out-of-flatness is .012". Out-of-flatness should vary gradually and uniformly from end to end and side to side. Localized depressions or high spots should not exceed .003 See figure 9-4.

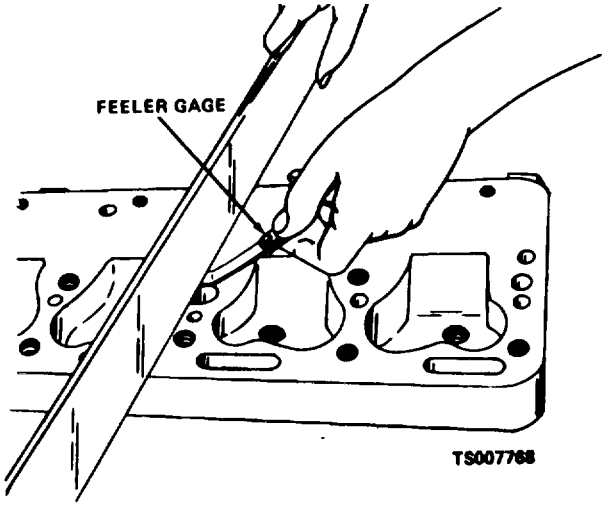


Figure 9-4. Checking Cylinder Head Flatness Crosswise.

9-8. Repair

Repair consists of replacement of a defective or, otherwise unserviceable cylinder head.

9-9. Installation

Reverse the procedures outlined in paragraph 9-6 for cylinder head installation.

a. Refer to table 9-2 for fasteners torque specifications.

b. Refer to figure 9-6 for cylinder head bolt tightening sequence.

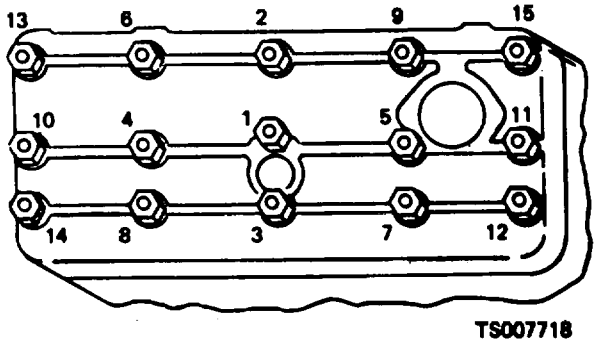


Figure 9-5. Cylinder Head Bolt Tightening Sequence.

Section VI. INTAKE AND EXHAUST VALVES

9-10. General

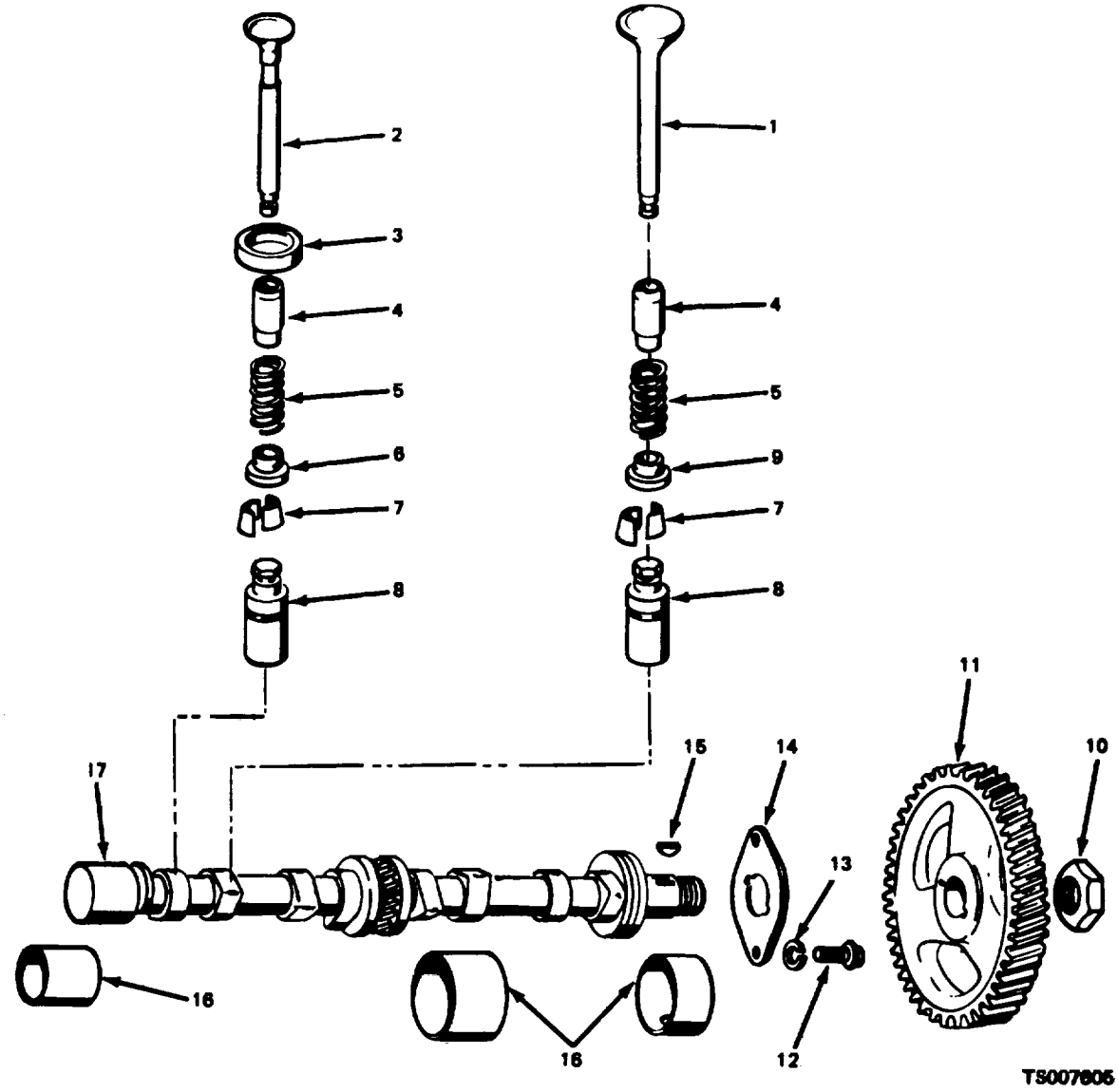
The intake and exhaust valves of this L-head engine are mounted in the cylinder block. They are opened by operation of the camshaft through adjustable valve tappets. They are closed by the valve springs. The valve stems ride in valve guides which are pressed into the block. The intake valves seat directly in the block. The exhaust valves seat in shrink-fit valve seat inserts in the block.

9-11. Removal

a. Remove the cylinder head (para 9-6).

b. Remove the valve tappet cover (para 9-13.1).

c. Using a spring lifter, compress the valve spring (5, fig. 9-6) at each valve (1l and 2) and remove the valve locks (7) from each valve that is in the closed position. Rotate the engine crankshaft to close the remaining valves and remove the remaining locks.



1. Intake valve
2. Exhaust valve
3. Exhaust valve seat
4. Valve guide
5. Valve spring
6. Spring seat
7. Valve lock
8. Valve tappet
9. Spring seat
10. Hex nut
11. Timing gear
12. Bolt
13. Lockwasher
14. Thrust plate
15. Woodruff key
16. Bearing set
17. Camshaft

Figure 9-6. Valves and Camshaft, Exploded View.

d. Lift each valve from the top of the block. Place them in order in a rack to assure that each will be reassembled in the same valve guide from which it was removed.

e. Remove the valve spring retainer seats (6) and valve springs (5). Remove the valve tappet assemblies (8).

f. Do not remove the valve guides (4) or valve seat inserts (3) unless inspection indicates that they are faulty.

WARNING

Dry cleaning solvent, PD4-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F.-138° F. (39° C.-59 ° C.).

9-12. Cleaning, Inspection, and Repair

a. Clean the valves, valve springs, valve tappet assemblies and valve stem caps with cleaning solvent P-D-680 and dry thoroughly. Remove carbon deposits with a wire brush.

b. Clean the valve guides installed in the block with a valve guide cleaner or wire brush. Remove all lacquer and other deposits.

c. Clean the valve seats with a wire brush.

d. Inspect the valves for cracks, bent stems, distortion, and wear (table 9-1). If the valves are not seriously damaged, regrind them. After grinding, the valve head thickness must be at least 50 percent the thickness of a new valve. Replace the valves if they are ground to less than this amount. Check the reground valves on V-blocks with an indicator. The contact face must be true with the stem to within 0.002 inch. Repeat refacing operation if necessary.

e. Check for loose or worn valve guides. Check the internal diameter of the valve guide with a telescope gage and a micrometer. Replace guides that are worn to a bell-mouthed shape or guides that have a maximum diameter of more than 0.3133 (intake) and 0.3150 (exhaust).

f. If the valve guides are worn or damaged, drive out the guides from the combustion side, using a driver that is slightly smaller than the external diameter of the guide (fig. 9-7). With the driver, drive in new guides from the combustion side. When properly seated, valve guide tops will be 7/8 inches from the top of the block (fig. 9-8).

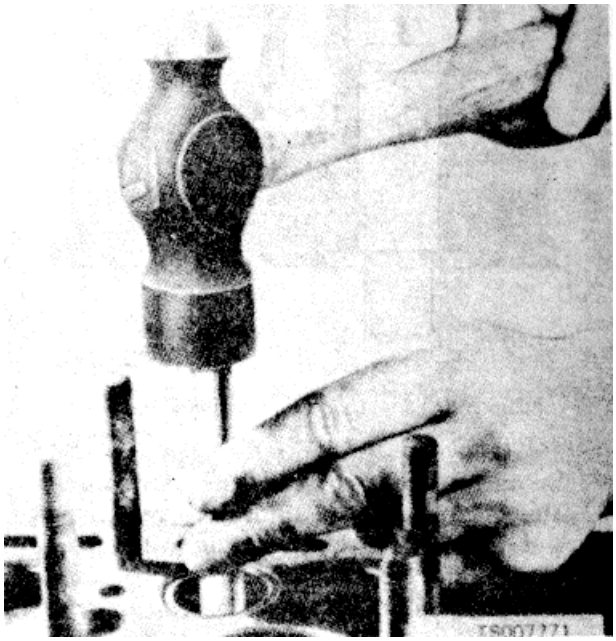


Figure 9-7. Removing Valve Guides.

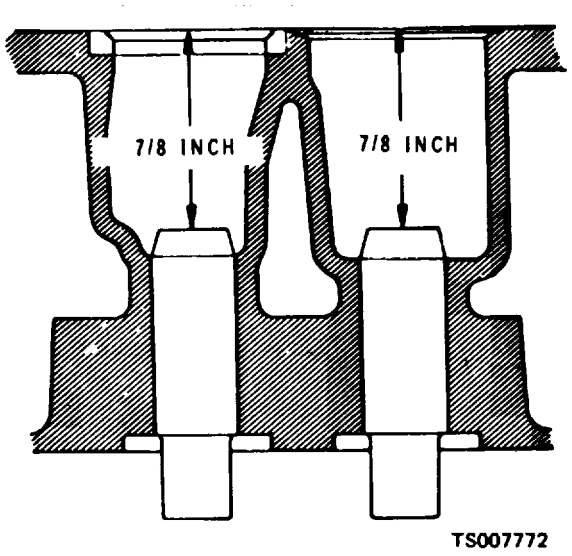


Figure 9-8. Valve Guide Installation Dimensions.

CAUTION

Do not attempt to ream the valve guides after seating them. Guides are pre-reamed and coated. Further reaming will remove the coating.

g. Check the exhaust seat inserts for cracks or loose mounting. Pull out faulty valve seat inserts (fig. 9-9). Replace valve seats with new 0.010 inch oversized valve seats. Counterbore the valve seats to a diameter of 1.1255 to 1.1245 inches. This will provide the required press fit. Counterbore deeply enough so that the boring tool will clean up the bottom of the bore to assure proper heat conduction from the valve insert. Chill the valve seats in dry ice for 20 minutes. Install the valve seat in place with a piloted driver using an arbor press or by applying light blows with a hammer until the valve seat is resting against the bottom of the bore. Roll or peen the valve seat in-place.

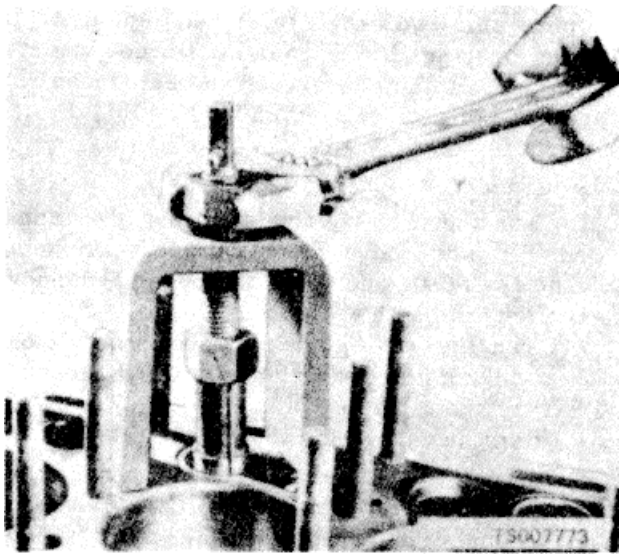


Figure 9-9. Pulling Valve Seat Insert.

h. Check the valve springs for cracks and distortion. Test compression strength with a spring tester. Compression, strength must be as follows:

Length	*Load (minimum)*
1-33/64 in. (closed	42 pounds
1-15/64 in. (open)	86 pounds

I. Grind the valve seats {fig. 9-10). The seat angle of the intake valves in 45°. The seat angle of the exhaust valve is 45°. Use a dial indicator (fig. 9-11) to check the valve seat for runout. The total indicator reading must not exceed 0.002 inch. Clean the valve seat and exceed 0.002 surrounding area thoroughly after grinding.

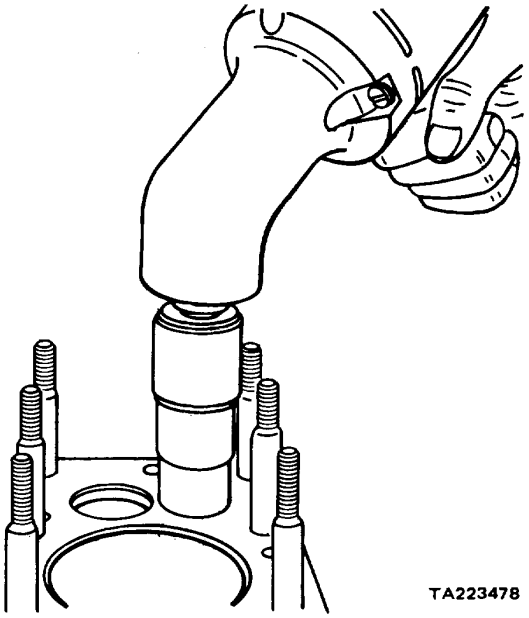


Figure 9-10. Grinding Value Seat.

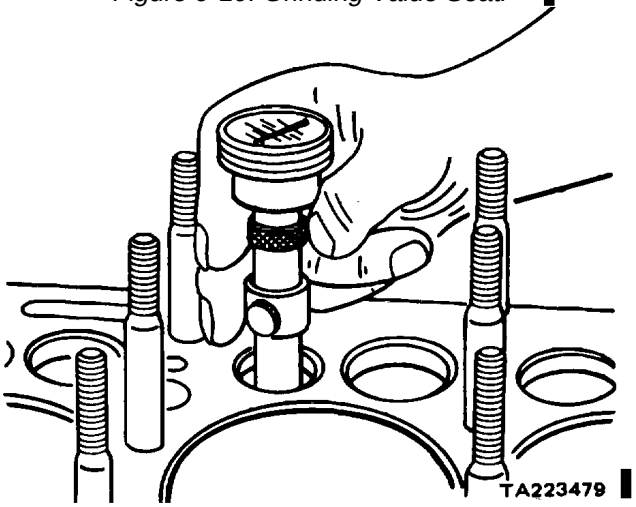


Figure 9-11. Checking Valve Seat turnout.

j. After the valves and seats have been refaced and reground, coat the seat lightly with Prussian blue and drop the valve into place oscillating it slightly to transfer the blue pattern to the valve face. This should show a contact width of 1/16 to 3/32 inch, and should fall well within the width of the valve face, leaving at least 1/64 inch on either side of the contact area. If the contact area is greater than 3/32 inch, narrow the contact area by grinding the outside diameter of the seat with a 15° stone or by grinding the inside diameter of the seat with a 60° or 76° stone (fig. 9-12). After the seat area is corrected, touch the seat lightly with the original grinding stone to remove the burred or feathered edge.

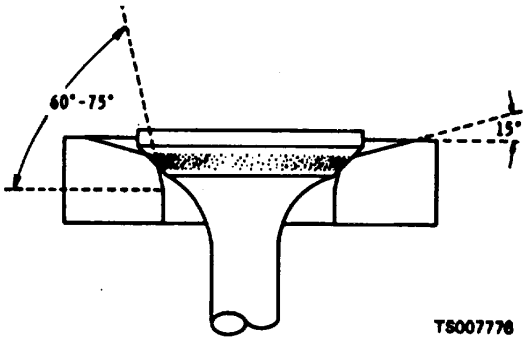


Figure 9-12. Narrowing Valve Seat.

k. Inspect the spring retainer seat, spring retaining locks, valve stem caps, and valve tappet assemblies for cracks, scoring, overheating, and wear. Replace damaged parts.

9-13. Installation

a. Position the valve tappet assemblies (8, fig. 9-6) in the engine block.

b. Assemble the valves (1 and 2), valve springs (5), spring retainer seats (9), and valve locks (7). Compress the valve springs with a spring compressor to install the valve locks. Turn the engine over as necessary to allow each valve to move to the closed position before attempting to install the valve parts. Make sure each valve is installed in the guide from which it was removed.

c. Temporarily set valve tappet clearance.

d. Install the cylinder head (para 9-9).

e. Operate the engine until it reaches operating temperature. Adjust valve tappet clearance (para 9-13.1).

f. Install the valve tappet cover (para 9-13.1).

9-13.1. Valve Adjustment

a. Operate engine until it reaches operating temperature.

b. Remove the nuts and washers that secure the valve tappet cover to the cylinder block. Remove the valve tappet cover and gasket.

c. With the engine at operating temperature and running at idle speed, set the valves for 0.012-inch clearance as follows:

(1) Check for proper 0.012-inch intake valve clearance by alternately passing an 0.011-inch and an 0.013-inch flat feeler gage between the head of the adjusting screw and intake valve stem (figure 9-12.1).

(2) If an 0.011-inch feeler gage moves freely back and forth in the gap when the valve is not being lifted and an 0.013-inch feeler gage binds at

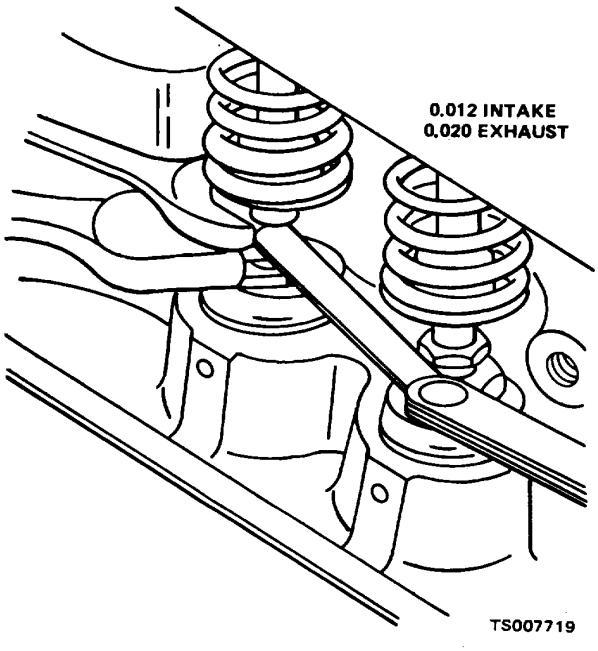


Figure 9-12.1. Valve Adjustment

all times, the clearance requires no adjustment.

(3) If an 0.011-inch feeler gage is gripped at all times, the clearance is insufficient.

(4) Hold valve lifter with an open end wrench while using a second wrench to turn adjusting screw one-quarter to one-half turn clockwise. Repeat clearance check and adjustment until proper clearance is obtained. The adjustable-type valve lifters have self-locking adjusting screws that require no locknuts.

(5) If an 0.013-inch feeler gage moves freely when valve is not being lifted, the clearance is too great. Hold valve lifter with an open end wrench while using a second wrench to turn valve lifter adjusting screw counterclockwise one-quarter to one-half turn. Repeat the clearance check and adjustment until proper clearance is obtained.

(6) Repeat clearance check and adjustment for remaining intake valves.

(7) Check exhaust valve clearance for proper 0.020-inch clearance by alternately passing an 0.019-inch and an 0.02-inch flat feeler gage between the head of the adjusting screw and the valve stem cap.

(8) If necessary, adjust the exhaust valve clearance in the same manner as the intake valves described in (1) through (5) above.

(9) Install the valve tappet cover using a new gasket. Secure with two cover nuts and gaskets.

Section VII. OIL PAN, OIL PUMP, AND FILLER BLOCKS

9-14. General

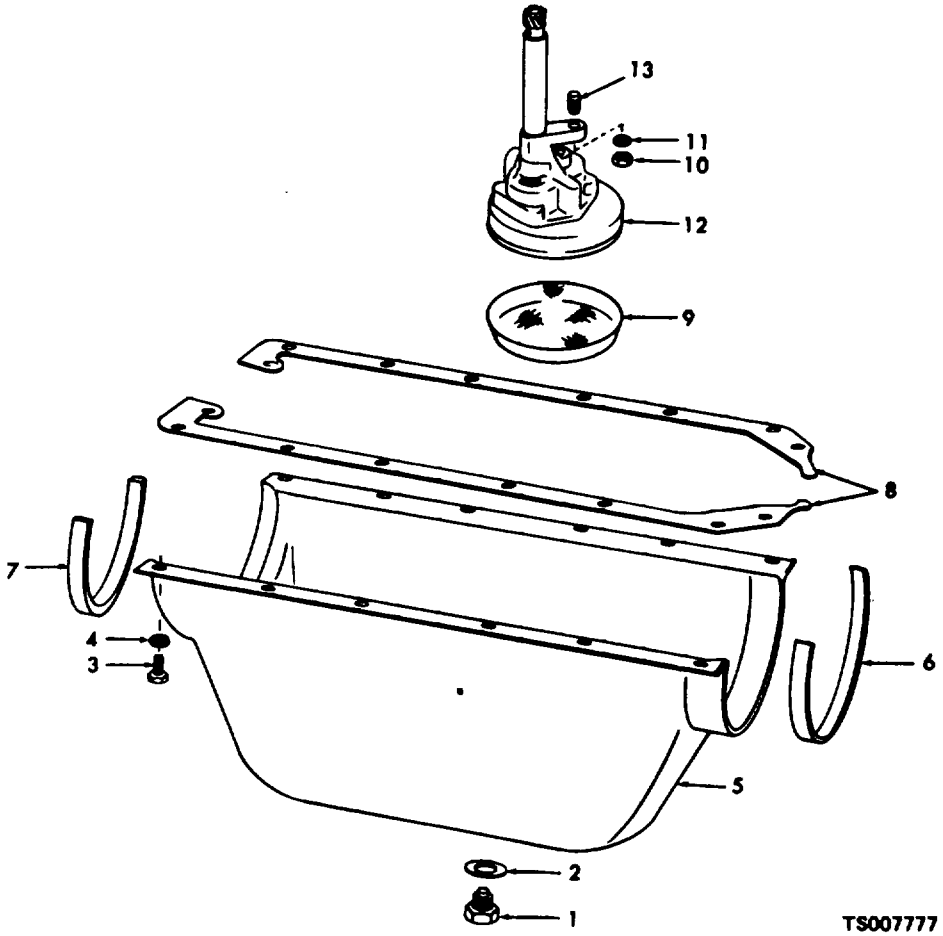
The oil pan is mounted at the bottom of the cylinder block to provide a sump for the engine oil as it drains from the operating parts of the engine.

The filler blocks provide mountings for the seals that retain the oil at the front and rear of the engine. They are mounted between the oil pan and cylinder block. The oil pump is secured to the engine crankcase and is driven by a gear that is integral with the camshaft. The oil pump provides pressure necessary to pump the engine oil to the operating parts of the engine.

9-15. Removal

a. Remove the drain plug from the oil pan to drain the engine oil.

b. Remove the twelve screws (3, fig. 9-13) and lockwashers (4) that secure the oil pan (5) to the block; remove the oil pan and gaskets (6, 7 and 8).



1. Plug
2. Gasket
3. Capscrew
4. Lockwasher
5. Oil pan
6. Gasket
7. Gasket
8. Gasket
9. Screen
10. Nut
11. Lockwasher
12. Oil pump
13. Stud

Figure 9-13. Oil Pan and Oil Pump, Exploded View.

c. Remove the nut (10) and lockwasher (11) that secure the oil pump assembly (12) to the engine; remove the oil pump assembly. Remove the oil screen (9) from the oil pump assembly.

d. Remove the two screws (29, fig. 9-26) and lockwashers (30) that secure the rear filler block (28) to the engine block; remove the filler block and seal (26).

e. Remove the two screws (32) and lockwashers (33) that secure the front filler block (31) to the block; remove the filler block.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use

near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59° C.).

9-16. Cleaning and Inspection

a. Discard and replace gaskets and seals.

b. Clean all remaining parts with cleaning solvent P-D-680 and dry thoroughly.

c. Inspect the oil pan for cracks, severe dents, holes, damaged threads, and other damage; replace a damaged oil pan.

d. Inspect the oil pump for visible damage. Rotate the oil pump shaft and check for rough, binding, or catching operation. Replace the oil pump if faulty operation is noted.

e. Inspect the oil pump screen for clogging, distortion, and damage; replace a damaged screen.

f. Inspect the filler blocks for cracks, distortion, and other damage; replace damaged filler blocks.

9-17. Installation

a. Install the gasket (6, fig. 9-13) on the rear filler block (28, fig. 9-26) by placing a drop of nonhardening cement in the middle of the gasket and pressing the gasket into the groove in the filler block (fig. 9-14).

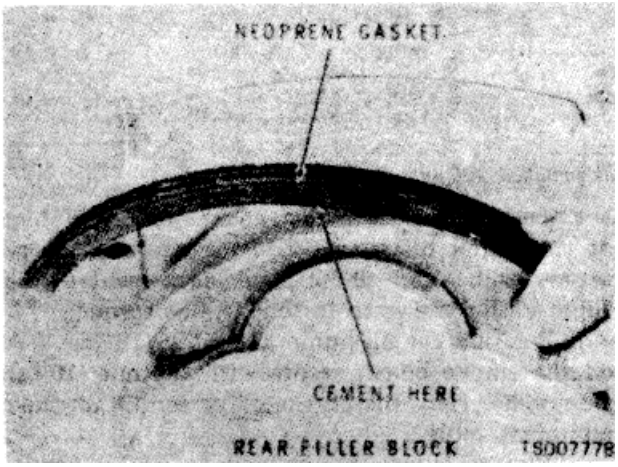


Figure 9-14. Installing Neoprene Gasket on Rear Filler Block.

b. Install the seal (26, fig. 9-26) in the rear filler block as follows:

(1) Flatten the seal in a vise or with a hammer until the seal fits into the groove in the filler block.

(2) Roll the seal into the filler block groove with a round object (fig. 9-15).

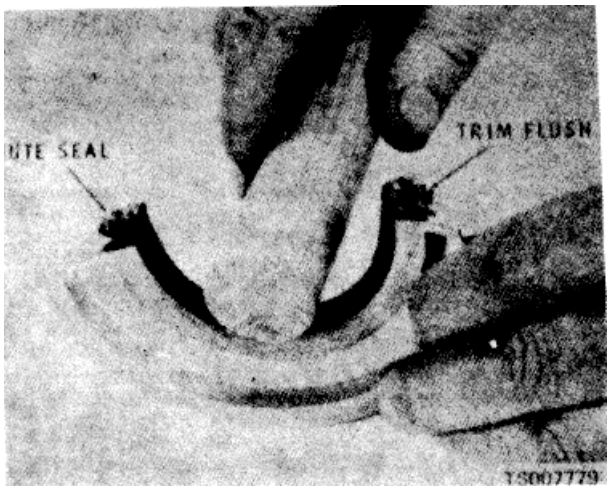


Figure 9-15. Rolling Seal into Filler Block.

(3) Trim the seal flush with the filler block (fig. 9-16).

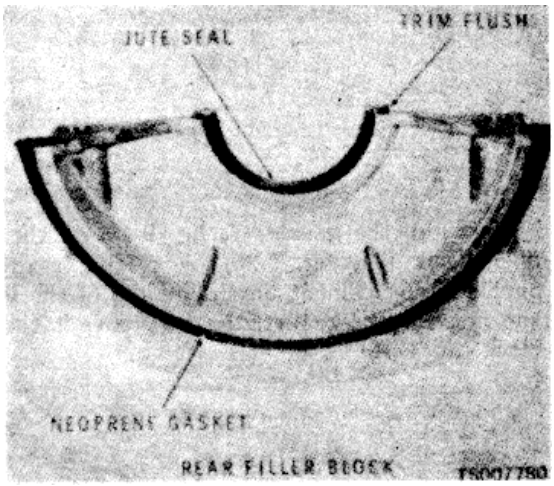


Figure 9-16. Lower Half of Ring Seal Installed in Rear Filler Block

c. Lubricate the seal with engine oil. Position the assembled filler block, gasket, and seal on the engine block (fig. 9-17); secure with the two screws

(29, fig. 9-26) and lockwashers (30). Tighten the screws to 15 to 20 ft/lbs torque.

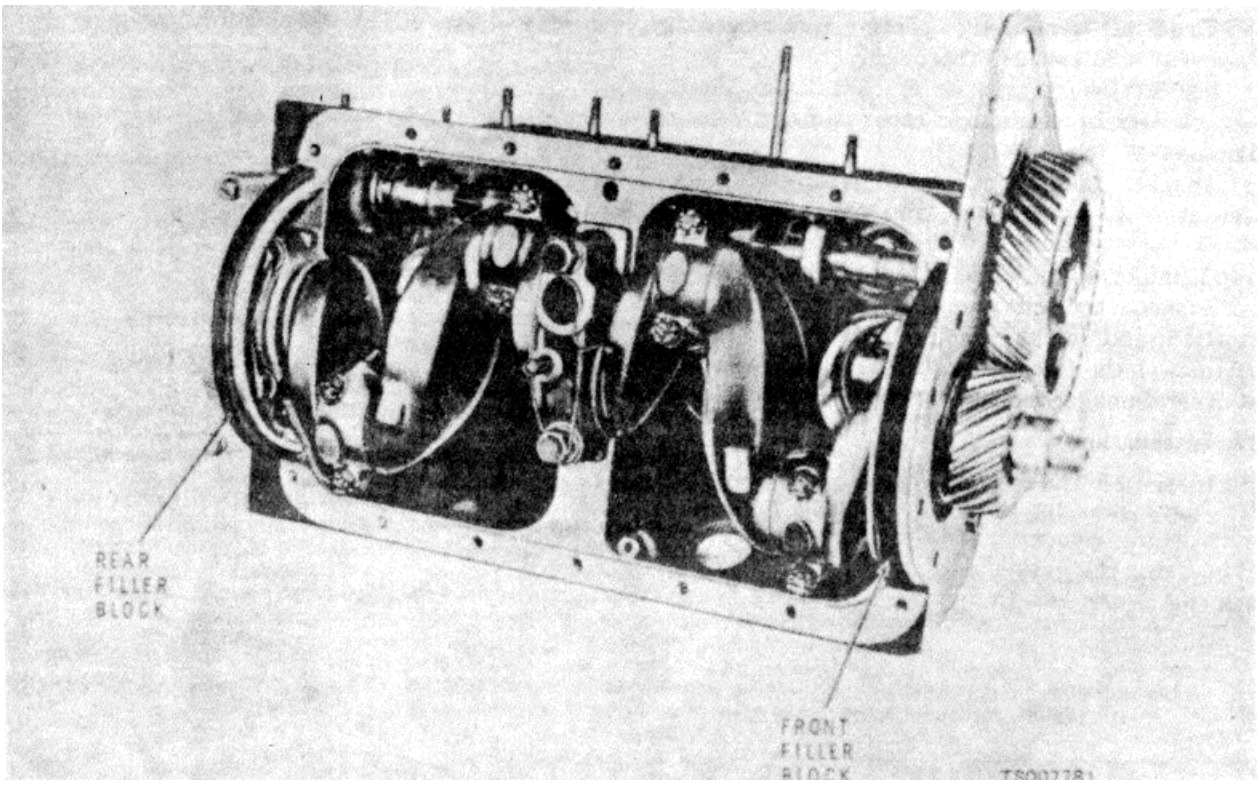


Figure 9-17. Filler Blocks Installed on Engine.

d. Install the gasket (7, fig. 9-13) on the front filler block (31, fig. 9-26) by placing a drop of nonhardening cement on the middle of the gasket and pressing the gasket into the groove in the filler block (fig. 9-18).

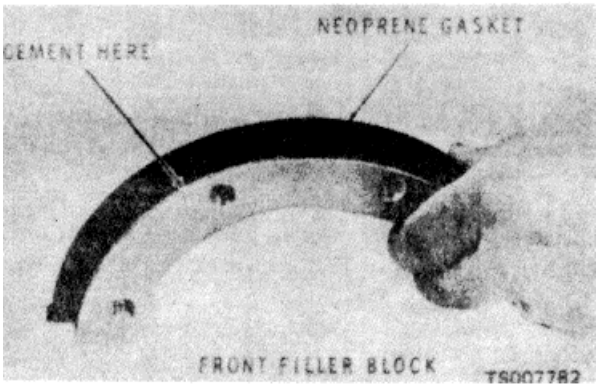


Figure 9-18. Installing Neoprene Gasket on Front Filler Block.

e. Install the assembled gasket and filler block on the engine block (fig. 9-17); secure with the two screws (32, fig. 9-26) and lockwashers (33). Tighten the screws to 15 to 20 ft/lbs torque.

f. Position the oil pump assembly (12, fig. 9-13) on the engine block; secure with the nut (10) and lockwasher (11). Install the oil screen (9) on the oil pump assembly.

g. Flatten oil pan gasket surfaces with a block of wood and a hammer. Position the gaskets (8) on the oil pan (5). Install the oil pan and gaskets on the engine block; secure with the twelve screws (3) and lockwashers (4). Tighten the screws to 15 to 20 ft/lbs torque.

Section VIII. GEAR COVER AND IDLER GEAR

9-18. General

The gear cover is mounted at the front of the engine where it provides a housing for the timing gears. The gear cover also provides a mounting for the governor lever parts and for the idler gear bearing support. The idler gear is mounted at the front of the engine within the gear cover. It transfers rotational force to the hydraulic pump. The hydraulic pump mounts on an adapter which is secured to the rear of the backing plate which is secured to the fan end of the engine. See figure 9-19.

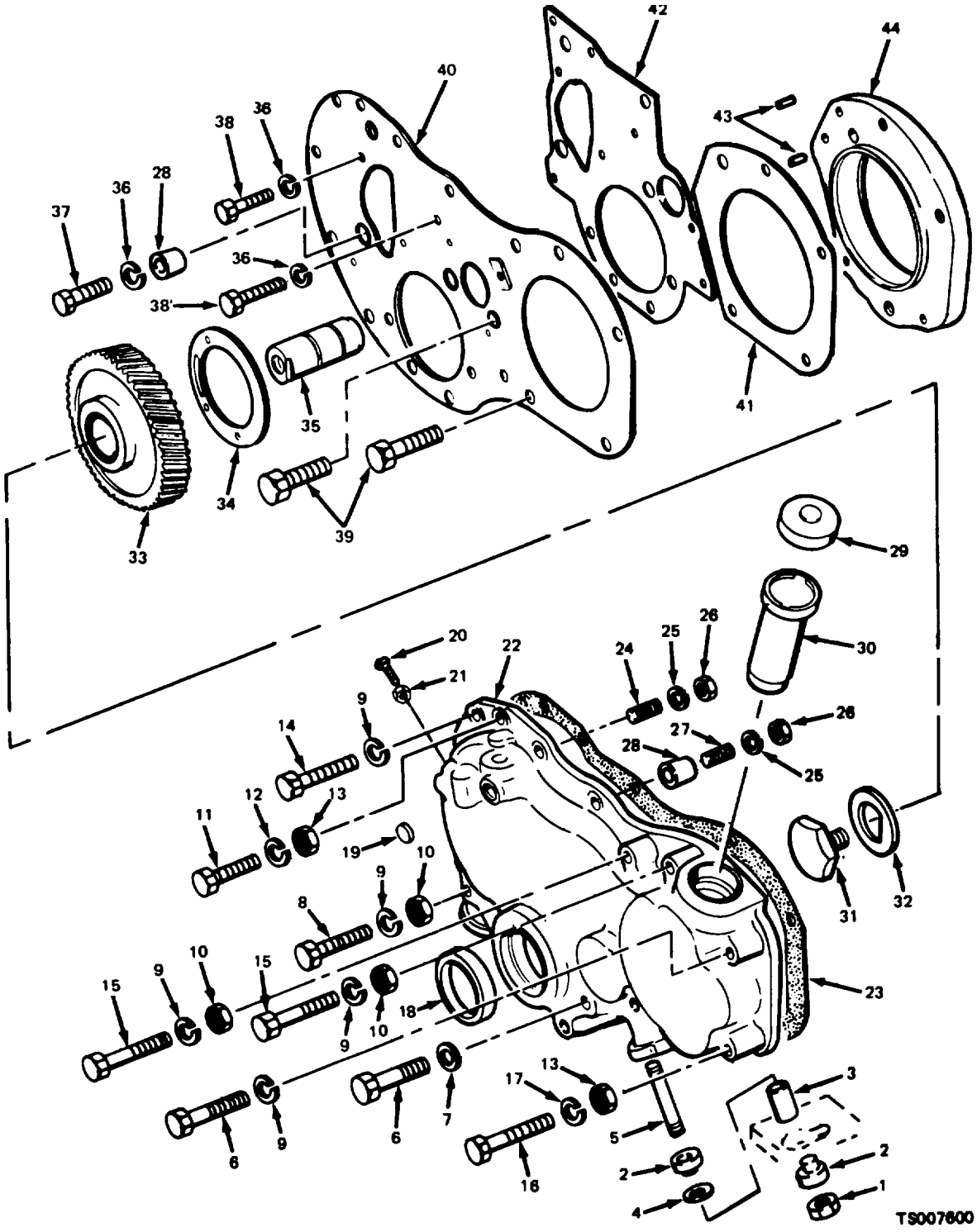


Figure 9-19. Gear Cover and Idler Gear, Exploded View.

KEY to figure 9-19:

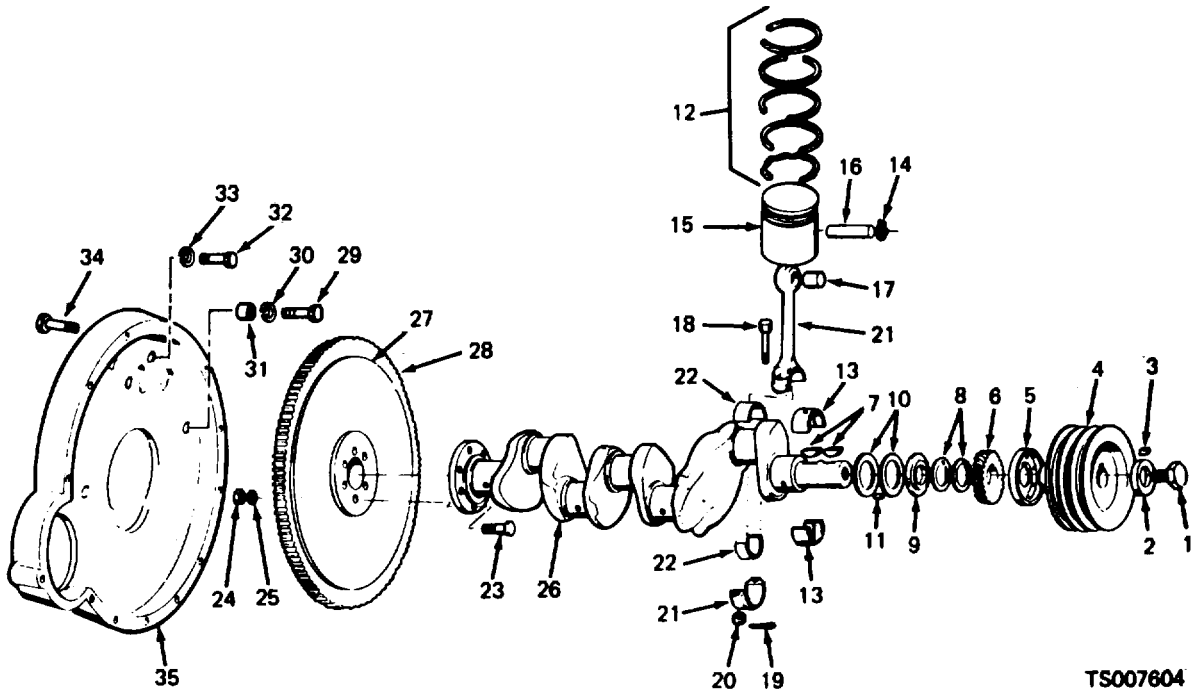
1. Nut
2. Engine mount
3. Spacer
4. Washer
5. Stud
6. Bolt
7. Washer
8. Bolt
9. Lockwasher
10. Nut
11. Bolt
12. Lockwasher
13. Nut
14. Bolt
15. Bolt
16. Bolt
17. Lockwasher
18. Seal
19. Plug
20. Bumper screw
21. Nut
22. Cover
23. Cover gasket
24. Stud
25. Lockwasher
26. Nut
27. Stud
28. Dowel
29. Filler cap
30. Filler neck
31. Screw
32. Thrust washer
33. Idler gear
34. Thrust washer
35. Spindle
36. Lockwasher
37. Bolt
38. Bolt
39. Bolt
40. Backing plate
41. Gasket
42. Gasket
43. Pin
44. Pump mounting plate

9-19. Removal and Disassembly

a. Remove the counterweight, muffler and radiator (TM 10-3930-632-12).

b. Remove the fan and generator drive belts (TM 10-3930-632-12).

c. Remove the bolt (1, fig. 9-20) and washer (2) that secure the pulley (4); remove the pulley from the crankshaft.



1. Pulley bolt
2. Pulley washer
3. Keyway plug
4. Pulley
5. Oil slinger
6. Timing gear
7. Woodruff key
8. Shim
9. Thrust plate
10. Thrust washer
11. Pin
12. Piston ring set
13. Main bearing
14. Retaining ring
15. Piston
16. Piston pin
17. Pin bushing
18. Rod cap bolt
19. Cotter pin
20. Nut
21. Connecting rod
22. Rod bearing
23. Flywheel bolt
24. Nut
26. Lock washer
26. Crankshaft
27. Flywheel
28. Ring gear
29. Screw
30. Lockwasher
31. Dowel
32. Screw
33. Lockwasher
34. Screw
35. Flywheel housing

Figure 9-20. Piston, Connecting Rod, Crankshaft and Flywheel, Exploded View.

d. Disconnect the linkage from the governor lever (TM 10-3930-632-12).

e. Disconnect the hose to the engine oil filter from the gear cover. Drain the oil from the filter and crankcase.

f. Remove the hex locknuts (fig. 2-3) and lower support pads from the stud of the engine assembly. Hoist the engine just enough to raise the upper support pad off the frame. Block the engine in this position.

g. Disconnect the hydraulic lines from the hydraulic pump (TM 10-3930-632-12).

h. Remove the capscrews and bolts (fig. 9-19), nuts, lockwashers and copper washers that secure the gear cover to the engine block; remove the gear cover from the engine block.

I. Remove the governor lever and related parts from the gear cover (para 9-6).

j. Remove the idler gear (33, fig. 9-19) and spindle (35). Remove the gear screw (31) and thrust washer (32) from the shaft.

k. Press the seal (18) from the gear cover.

l. Remove the bearing from the shaft of the idler gear only if necessary for replacement.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138°F. (39° C. - 59° C.).

9-20. Cleaning and Inspection

a. Discard and replace all gaskets and seals.

b. Clean the bearings and all remaining parts with cleaning solvent P-D-680 and dry thoroughly. Dip the bearings in clean engine oil and wrap them in paper to protect them from dust and dirt.

c. Inspect the gear cover for cracks, distortion, damaged sealing surfaces, and other damage; replace a damaged gear cover.

d. Inspect the idler gear and shaft for worn or chipped gear teeth and a scored or worn shaft; replace if damaged.

e. Inspect all other parts for cracks, distortion, worn or damaged threads, and other damage; replace damaged parts.

9-21. Reassembly and Installation

a. Refer to figure 9-19 and reassemble and install the idler gear and gear cover.

b. Connect the hydraulic lines to the main hydraulic pump (TM 10-3930-632-12).

c. Lower the engine so that the support pad is resting on the truck frame; install the bottom support pads, spacer and nuts (fig. 2-3).

d. Connect the hose from the engine oil filter to the gear cover; fill the crankcase (LO 10-3930-632-12).

e. Secure the crankshaft pulley (4, fig. 9-20) to the crankshaft, using the bolt (1) and washer (2).

f. Position the fan and generator drive V-belts on the pulleys (TM 10-3930-632-12). Connect the linkage devises to the lever.

g. Install the muffler, radiator, and counterweight (TM 10-3930-632-12).

Section IX. FLYWHEEL AND FLYWHEEL HOUSING

9-22. General

The flywheel is connected to the rear of the crankshaft to help smooth the rotational force produced by the engine. It is provided with a ring gear around its exterior. The pinion of the engine starter engages this ring gear to turn over the engine when starting. The flywheel housing houses the flywheel and provides a mounting from the equipment driven by the engine.

9-23. Removal

With the engine removed from the truck, remove the flywheel and flywheel housing as follows:

a. Remove the six nuts (24, fig. 9-20) and lockwashers (25) that secure the flywheel (27) to the crankshaft (26); remove the flywheel.

b. Remove the screws (29 and 32, fig. 9-26) and washers (30 and 33) that secure the flywheel housing (35, fig. 9-20) to the block; remove the flywheel housing.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138°F. (39° C. - 59° C.).

9-24. Cleaning, Inspection, and Repair

a. Clean the flywheel and flywheel housing with cleaning solvent P-D-680 and dry thoroughly.

b. Inspect the flywheel housing for cracks, distortion, and damaged threads; replace a damaged flywheel housing.

c. Inspect the flywheel for chipped, cracked, or

broken teeth on the ring gear, distortion, worn or out-of-round bolt holes, and other damage. If the ring gear is damaged, replace as follows:

(1) Cut the ring gear with a torch or hack saw and remove the ring gear from the flywheel 127).

CAUTION

When cutting the ring gear, be extremely careful not to damage the flywheel.

(2) Heat the replacement ring gear in an oven and cool the flywheel in water or in a refrigerator.

(3) Position the replacement ring gear on the flywheel. As the ring gear and flywheel approach the same temperature, the ring gear will contact to a tight fit on the flywheel.

9-25. Installation

a. Position the flywheel housing (35) on the engine block. Secure with screws (29 and 32, fig. 9-26) and washers (30 and 33).

b. Position the flywheel (27, fig. 9-20) on the crankshaft (26); secure with six bolts (23), lockwashers (25), and nuts (24). Tighten the nuts to 35 to 40 ft/lbs torque.

c. Check flywheel runout by mounting a dial indicator (fig. 9-21) and rotating the crankshaft through one full revolution. Hold pressure against the flywheel to eliminate crankshaft end play. If flywheel runout exceeds 0.008 inch, remove the flywheel and clean the crankshaft flange and flywheel seat. Install the flywheel and recheck runout. If runout still exceeds 0.008 inch, replace the flywheel.

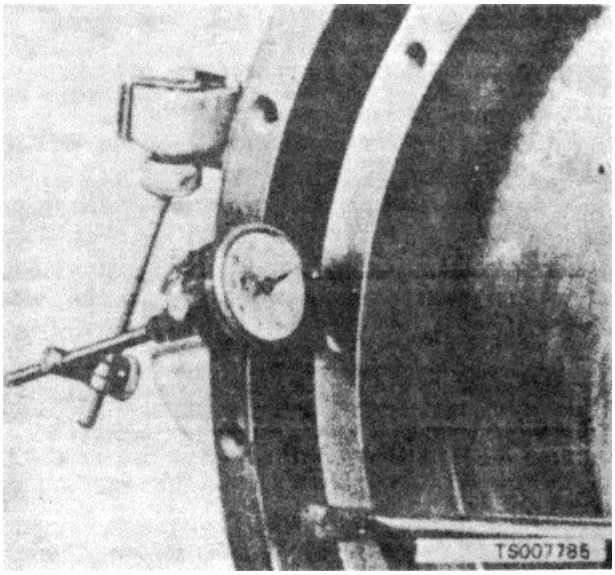


Figure 9-21. Checking Flywheel Runout.

d. Check flywheel eccentricity by mounting a dial indicator (fig. 9-22) and rotating the crankshaft through one revolution. If the flywheel is eccentric more than 0.008 inch, loosen and TM 10-3930432-34 retighten the flywheel mounting bolts and recheck eccentricity. If eccentricity still exceeds 0.008 inch, replace the flywheel.

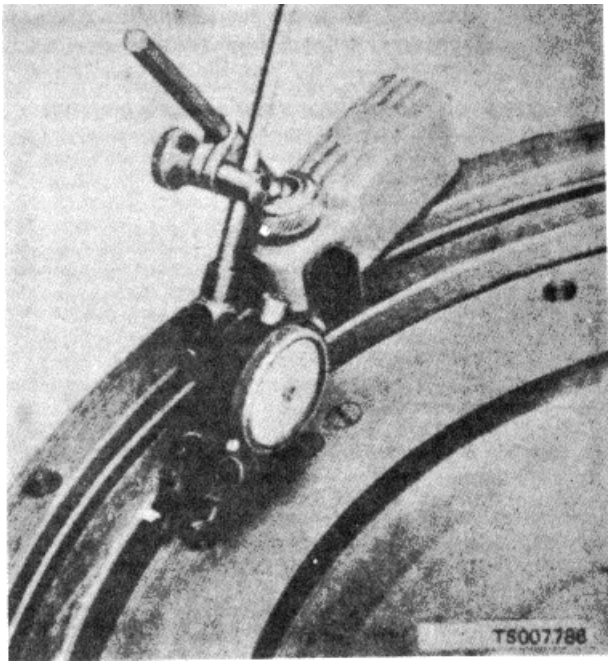


Figure 9-22. Checking Flywheel Eccentricity.

e. Check runout of the flywheel housing face by mounting a dial indicator (fig. 9-23) and rotating the crankshaft through one revolution. Hold pressure against the flywheel to eliminate end play. If runout exceeds 0.008 inch, clean the mounting surfaces of the flywheel housing and the block. Recheck flywheel housing runout. If the runout is still not within limits, replace the flywheel housing.

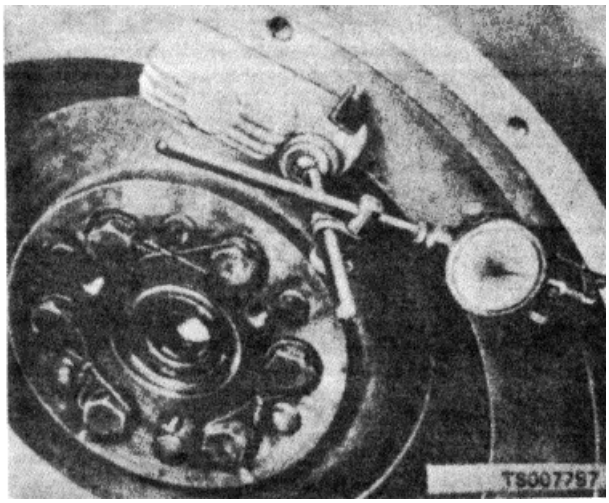


Figure 9-23. Checking Flywheel Housing Runout.

f. Check eccentricity of the flywheel housing bore by mounting a dial indicator (fig. 9-24) and rotating the engine through one revolution. If the housing bore is eccentric more than 0.008 inch, loosen the flywheel housing mounting bolts and tap the housing into its proper position with a soft hammer. Tighten the bolts and recheck eccentricity of the housing bore. If the housing cannot be brought into true position, replace the housing.

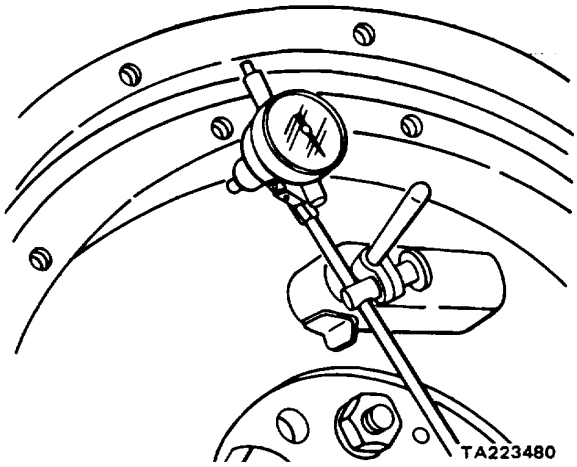


Figure 9-24. Checking Flywheel Housing Eccentricity.

Section X. PISTONS AND CONNECTING RODS

9-26. General

The engine uses aluminum pistons, each of which is fitted with three compression rings and one oil control ring. The forged steel connecting rods transfer the force from the pistons to the crankshaft. Close-fitting bearing shells are installed between the connecting rod and the crankshaft journals.

9-27. Removal and Disassembly

With the engine mounted on an engine overhaul stand, proceed as follows:

a. Remove the cylinder head (para 9-6).

b. Remove the engine oil pan and oil pump (para 9-15).

c. Ream the ridge of the top of each cylinder bore with a standard ridge reamer. Blow metal fragments from the cylinder with compressed air.

d. Remove the two cotter pins (19, fig. 9-20) and nuts (20) that secure a bearing cap to a connecting rod (21); remove the cap and rod bearing (22).

e. Push assembled piston (15) and connecting rod (21) up through the top of the block.

CAUTION

While pushing the piston and rod from the block, be very careful the connecting rod does not scratch the cylinder wall.

f. Refer to figure 9-20 (items 12 through 21) and disassemble the piston and connecting rod.

NOTE

Disassemble the pistons and piston rods in sets, and keep the sets together. Also, be sure each piston and piston rod set is installed In the cylinder from which it was removed.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F - 138°F. (38°C - 59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

9-28. Cleaning and Inspection

a. Discard and replace the piston rings.

b. Clean all parts with cleaning solvent P-D-680 and dry thoroughly.

c. Inspect the pistons for cracks, distortion, broken ring lands and distorted grooves, loose piston pin-to-piston fit and other damage; replace damaged pistons. Refer to table 9-1 for wear limits.

NOTE

Pistons and bearings are individually checked and fitted to the cylinders at reassembly. Before reassembly. the cylinder bores must be checked as directed in paragraph 9-41.

d. Inspect the connecting rods for cracks, distortion, and other damage; replace damaged connecting rods. Refer to table 9-1 for wear limits,

e. Inspect the bearing shells for scoring, wear, cracks, and other damage.

NOTE

New bearing shells are smooth and highly polished. After a few hours of operation, the bearing surface becomes a leaden grey and develops minute craters so

that the bearing surface has an almost cellular appearance. This is normal, and is not an indication of impending bearing failure

f. Inspect all other parts for cracks, scoring, damaged threads, and other damage; replace damaged parts.

9-29. Reassembly and Installation

a. Check piston fit in the cylinder bore (fig. 9-25) using a piece of 0.0015-inch feeler stock cut 1/2 inch wide. Dress the edges of the feeler stock with a stone to remove burrs and feathered edges. The block and pistons must be at room temperature when piston fit is tested. Position the feeler stock midway between the piston pin bosses. With the piston inserted about 2 inches into the block, the feeler stock must pull from the block with 5 to 10 pounds pull. If the feeler stock does not offer enough resistance, perform the same test with a new standard size piston. If sufficient resistance is still not obtained, rebore the cylinders (para 9-41) and install oversize pistons.

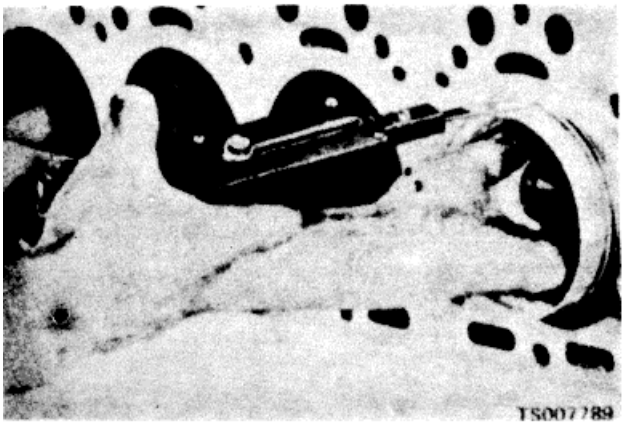


Figure 9-25. Checking Piston Fit in Cylinder Bore.

b. If new pistons (15, fig. 9-20) and piston pins (16) are being used, press a new pin bushing (17) into each connecting rod (21). Ream and hone the sleeve bearings to 0.8596 to 0.8593-inch diameter.

c. If the pistons and pins are not being replaced, check the clearance between the piston pins and the sleeve bearings. Clearance must be between 0.0000 and 0.005 inch. If clearance is not within this tolerance, press new sleeve bearings into the connecting rods and ream and hone to provide the proper clearance. After honing, 75 percent of the sleeve bearing surface must contact the piston pin.

d. When pins, bushings, and pistons of the proper size have been found, assemble the pistons to the connecting rods as follows:

(1) Heat the pistons and connecting rods in an oven or in water to a minimum of 160° F.

(2) Position a connecting rod in its piston. Install the piston pin; secure with the piston pin retainer ring (14, fig. 9-20).

e. Slide the piston rings (12) squarely into the cylinders in which they will be used. Check the ring gap with feeler gage. If the ring gap is not at least 0.010 inch, file the rings to provide a larger gap. If the ring gap exceeds 0.020 inch, rebore the cylinders (para 9-41) and install oversize pistons and rings.

f. Install a piston ring expander on the bottom ring groove of a piston. Install the piston rings on the piston with a standard ring expander tool.

g. Assemble the remaining pistons, connecting rods, and piston rings.

h. Install the assembled pistons and connecting rods in the same cylinders from which they were originally removed. Use a ring compressor to compress the piston rings. Lubricate the pistons and cylinder walls with engine oil before installing the pistons. Wrap the bottom end of the connecting rods with a cloth to prevent damage to the cylinder walls during installation.

I. Check the crank pin bearing journal-to-connecting rod bearing clearance with plastigage. Lay a piece of plastigage material on the crankshaft journal and install the connecting rod bearing cap. Torque the nuts to 35 to 40 ft. lbs. Remove the bearing cap and compare the width of the flattened plastigage material with the scale markings on the plastigage package to determine the clearance. The bearing-to-journal clearance shall be 0.0007 to 0.0031 inch. If clearance is beyond these limits replace the bearing and/or the crankshaft as required.

j. As an alternate method of checking crank pin bearing journal-to-connecting rod bearing clearance, install a piece of 0.0030-inch thick feeler stock between the bearing and journal, and install the bearing cap. Tighten the connecting rod cap bolts to 35 to 40 ft/lbs torque. Rotate the crankshaft to detect drag. If clearance is within tolerance, a definite drag will be felt. Disassemble the rod cap and remove the shim stock. If clearance is not within tolerance, replace the connecting rod bearings and recheck the clearance. If clearance is still not within tolerance, replace the crankshaft.

k. Lubricate the crank pin bearing journals and the sleeve bearings with engine oil. Install the cap on its connecting rod (21, fig. 9-20) and crank pin bearing journal; secure with the two bolts (18) and nuts (20). Tighten the nuts to 35 to 40 ft/lbs torque. Install the cotter pins (19).

l. Secure the remaining connecting rods to the crank pin bearing journals.

m. Install the engine oil pan (para 9-17).
n. Install the cylinder head (para 9-9).

Section XI. MAIN BEARINGS AND CRANKSHAFT

9-30. General

Three main bearings support the crankshaft in the cylinder block. The crankshaft provides a mounting for the flywheel at the rear of the engine. The front of the crankshaft mounts the gear which drives the camshaft gear. The generator and fan drive pulley is also mounted on the front of the crankshaft.

9-31. Removal and Disassembly

With the engine removed from the truck and mounted on an engine overhaul stand, proceed as follows:

a. Remove the cylinder head (para 9-6).
b. Remove the oil pan and oil pump (para 9-19).
c. Remove the gear cover (para 9-19).
d. Remove the flywheel and flywheel housing (para 9-23).
e. Remove the pistons and connecting rods (para 9-27).
f. Remove the capscrews (29, fig. 9-26) and lock washers (30) that secure the main bearing caps to the cylinder block. Loosen the bearing caps by tapping them with a plastic hammer. Remove the bearing caps and lower bearing shells.

KEY to figure 9-26:

1.	Vent tube	19.	Gasket
2.	Elbow	20.	Adjusting washer
3.	Valve cover	21.	Regulating spring
4.	Gasket	22.	Regulating platon
5.	Nut	23.	Stud
6.	Washer	24.	Plug
7.	Stud	25.	Plug
8.	Coupling	26.	Seal
9.	Cover	27.	Oil guard
10.	Gasket	28.	Filler block
11.	Screw	29.	Screw
12.	Washer	30.	Lockwasher
13.	Plug	31.	Filler block
14.	Plug	32.	Screw
15.	Plug	33.	Lockwasher
16.	Dipstick	34.	Plug
17.	Dipstick tube	35.	Plug
18.	Plug	36.	Drain cock

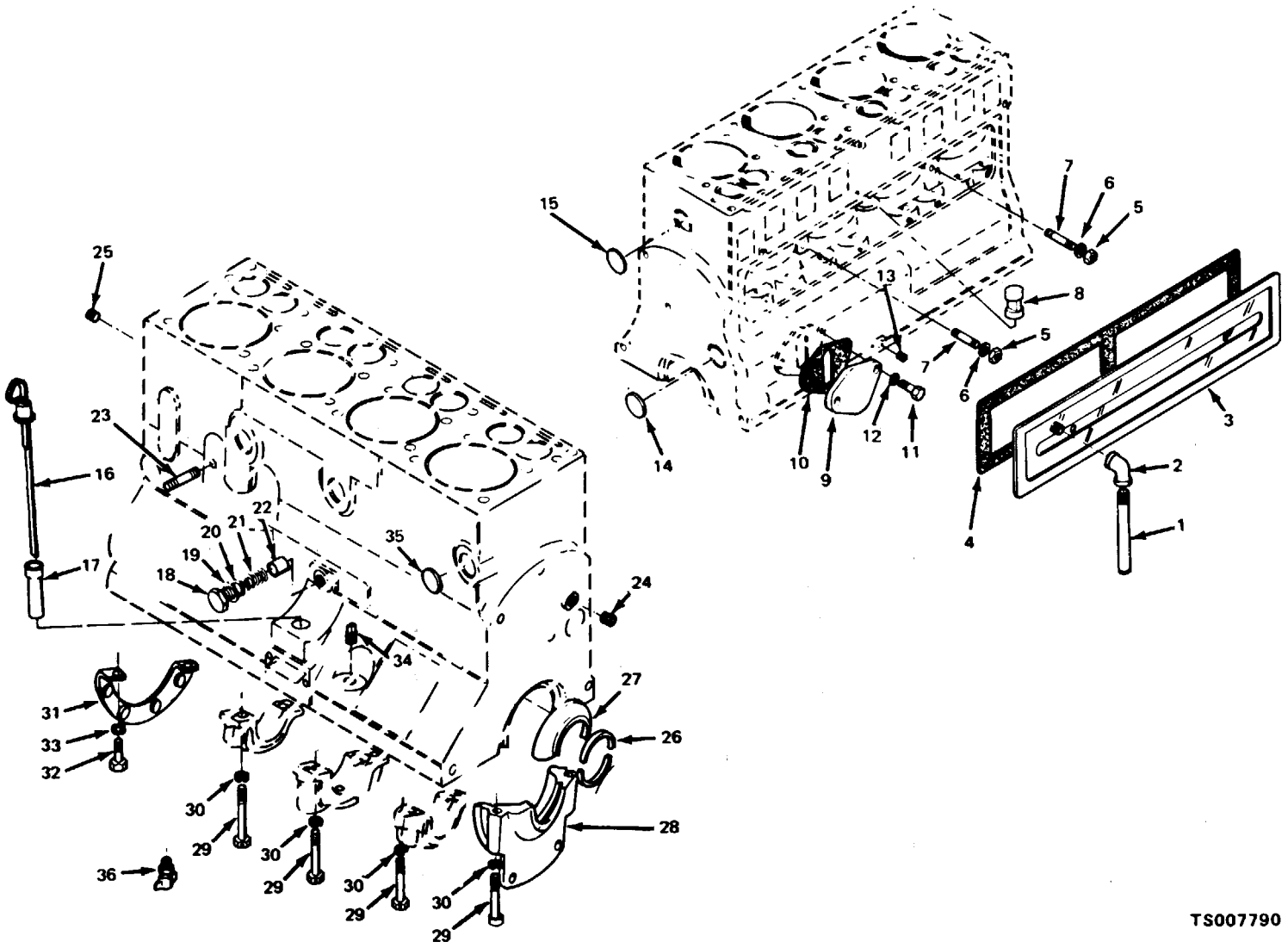


Figure 9-26. Cylinder Block and Related Parts, Exploded View.

NOTE

Upper main bearing shells can be removed without removing the crankshaft. To remove the upper shell, remove the main bearing cap at the defective bearing and remove the lower bearing shell. Insert a pin with an angular head in the oil hole of the crankshaft as shown in figure 9-27. Rotate the crankshaft and roll the bearing shell from the cylinder block.

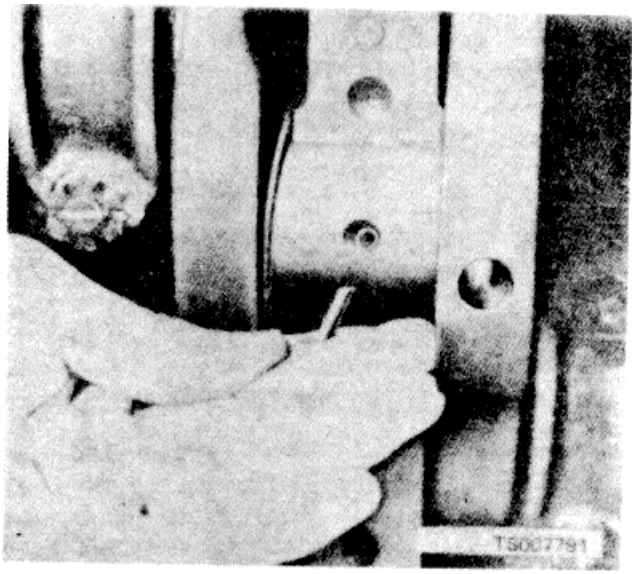


Figure 9-27. Removing Upper Bearing Shell with Angular Pin.

g. Pull the slinger (5, fig. 9-20), gear (6), and thrust plate (9) from the crankshaft (26). Remove the keys (7).

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F - 138° F. (39° C. - 59° C.).

9-32. Cleaning and Inspection

a. Clean all parts with cleaning solvent P-D-680. Clean oil passages in the crankshaft with a rifle cleaning brush. Make sure all passages are open.

b. Inspect the crankshaft for cracks, worn or scored journals, damaged threads, and burred keyways. Refer to table 9-1 for wear limits. If magnetic particle inspection equipment is available, use it to check the crankshaft for hidden flaws. Replace a damaged crankshaft.

c. Inspect the gear for cracked, chipped and broken teeth; replace a damaged gear.

d. Inspect the bearing shells for cracks and scoring. New bearings are smooth and highly polished. After a few hours of operation, the bearing surfaces become leaden grey in color and develop minute craters which give the bearing surfaces an almost cellular appearance. This is a natural characteristic of the bearing and does not indicate bearing failure. Replace bearings if they are scored or damaged.

e. Inspect the bearing caps for cracks and distortion and for burrs and gouges of the seating surfaces. Clean up any burrs with a fine stone to assure proper seating of the bearing cap on the block.

9-33. Reassembly and Installation

a. Flatten the seal (26, fig. 9-26) with a hammer or vise; install in the rear guard (fig. 9-15). Trim the seal flush with the guard. Install the felt and the assembled seal and guard in the engine block. Lubricate the seal with engine oil.

b. Install the keys (7, fig. 9-20) in the keyways of the crankshaft, after making sure that the keyways are free of burrs. Press the thrust plate (9) and gear (6) onto the crankshaft. Install the slinger (5).

c. Position the upper main bearing shells (13) in the seats in the crankcase. Position the crankshaft in the bearing shells.

CAUTION

When installing the crankshaft, make sure the timing marks on the crankshaft gear are aligned with the timing marks on the camshaft gear. See paragraph 9-37.

d. Install the lower half of the bearing shells in the bearing caps.

e. Check the clearance between the crankshaft bearing journals and bearing as follows:

(1) Place a piece of plastigage near the oil hole of the bearing cap.

(2) Position the cap on the block and secure with the two screws and lockwashers. Tighten the screws to 85 to 95 ft/lbs torque.

(3) Remove the bearing and bearing cap. Check the bearing journal-to-bearing clearance indicated by the plastigage (fig. 9-28)

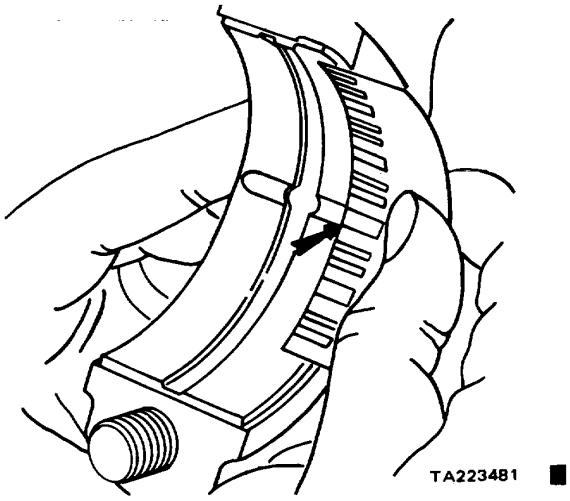


Figure 9-28. Checking Bearing Clearance with Plastigage.

f. Clearance must be between 0.0006 and 0.0032 inch. If the clearance is not within these limits, replace the bearings and recheck the clearance.

g. Remove and replace the bearings as follows:

(1) Remove the bearing cap; remove the bearing from the cap.

(2) Install a pin with an angular head in the oil hole in the crankshaft bearing journal (fig. 9-27).

(3) Rotate the crankshaft by hand. The pin will force the top bearing half out of its seat.

(4) Position the replacement bearing on the crankshaft bearing journal. Rotate the crankshaft by hand. The pin will force the bearing half into position.

(5) Install the replacement bearing half in the cap. Install the cap.

h. Check the remaining bearing-to-bearing journal clearances and replace bearings as necessary.

I. An alternate method of checking bearing clearance is as follows:

(1) Oil the bearing and bearing journal with engine oil.

(2) Position a strip of 0.003-inch feeler gage, 1/2 inch long, on the bearing cap (fig. 9-29).

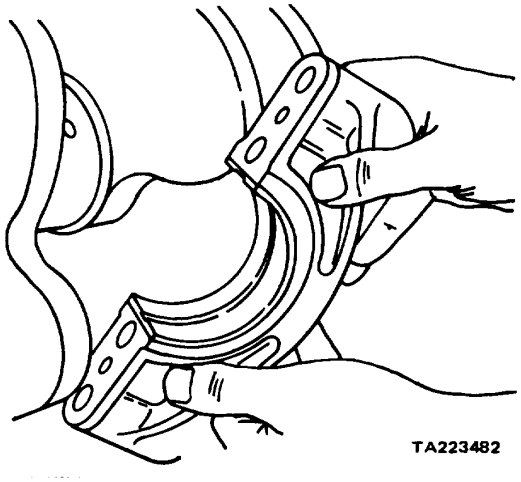


Figure 9-29. Checking Bearing Clearance with Shim Stock.

(3) Install the cap on the block; secure with the screws and lockwashers. Tighten the screws to 85 to 95 ft/lbs torque.

(4) Try to turn the crankshaft by hand. If the crankshaft will not turn or a definite drag is felt, bearing-to-bearing journal clearance is within tolerance. Remove the shim stock and reinstall the bearing caps.

j. After all main bearings have been installed, check crankshaft end play using a dial indicator. If end play is not between 0.002 and 0.006 inch, replace the thrust plate (9, fig. 9-20) as follows:

(1) Pull the gear (6) from the crankshaft. Remove the thrust plate (9).

(2) Position a new thrust plate and one key (7) on the crankshaft; drive the gear onto the shaft.

(3) Press the gear into final position by installing the oil slinger (5), pulley (4), washer (2) and bolt (1).

(4) Remove the nut, washer, pulley, and slinger after the gear is fully seated.

k. Install the pistons and connecting rods (para 9-29).

l. Install the flywheel housing and flywheel (para 9-25).

m. Install the gear cover (para 9-21).

n. Install the oil pan and oil pump (para 9-17).

o. Install the cylinder head (para 9-9).

Section XII. CAMSHAFT

9-34. General

The camshaft is driven by the timing gears, one of which is installed on the crankshaft and the other on the camshaft. The camshaft gear has

twice the number of teeth as the crankshaft gear so that the camshaft rotates at one-half the speed of the crankshaft. The camshaft has eight cam lobes, two for each set of valves. The cam lobes are positioned to provide the correct valve opening and closing characteristics for each valve. The camshaft is provided with an integral gear which drives the engine oil pump. The camshaft rides in sleeve bearings which are seated in the cylinder block.

9-35. Removal

With the engine removed from the truck and mounted on an engine stand, proceed as follows:

a. Remove the cylinder head (para 9-6).

b. Remove the valves and valve tappets (para 9-11).

c. Remove the gear cover (para 9-19).

d. Remove the governor parts.

e. Pull the gear (11, fig. 9-6) from the camshaft (17).

f. Remove the two bolts (12) and lockwashers (13) that secure the thrust plate (14) to the block; remove the thrust plate.

g. Pull the camshaft (17) from the block.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F - 138°F. (38°C - 59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

9-36. Cleaning and Inspection

a. Clean all parts with cleaning solvent P-D-680 and dry thoroughly.

b. Inspect the camshaft for cracks, worn or scored cams, worn or scored bearing surfaces, chipped, cracked, or broken gear teeth, and clogged oil passages. Refer to table 9-1 for wear limits. Replace a damaged camshaft.

c. Inspect the' thrust washer for scoring and wear. Replace the thrust washer if any signs of wear are evident.

d. Inspect the cam gear for cracked, chipped or broken gear teeth, damaged shaft bore, or worn thrust surface. The cam gear and the mating gear on the crankshaft must be replaced as a pair. Do not attempt to replace these gears singly.

e. Inspect the camshaft end plug in the cylinder block. Replace if any leaking is evident from the circumference of the plug.

f. Inspect the camshaft bearings in the cylinder block for scoring or visible damage; replace damaged bearings if necessary. Check the camshaft-to-bearing clearance, and, if necessary, replace bearings as follows:

(1) Temporarily insert the camshaft in the block. Check the clearance between the camshaft bearing journals and camshaft bearings with feeler stock cut in strips ¼s inch wide. Dress the feeler stock with a stone to eliminate burrs or feathered edges. Clearance between the fan end and drive end bearings and journals must be between 0.002 and 0.004 inch and the center journal must be between 0.003 and 0.0047.

CAUTION

Do not insert the camshaft too far into the block. If the camshaft bumps the expansion plug on the drive end of the engine, an oil leak could result.

(2) If clearance exceeds tolerances, remove the camshaft and remove the camshaft bearings. New bearings are pre-reamed. Install new bearings, taking care to align the oil holes with the passages in the block. Use caution to prevent damage to the bearings during installation.

9-37. Installation

a. Lubricate the camshaft bearings with engine oil and install the camshaft in the block. Position the thrust plate (14, fig. 9-6) on the camshaft; secure with the two bolts (12) and lockwashers (13).

b. Hold the camshaft toward the front of the engine with a bar inserted into the fuel pump hole. Align the timing marks on the camshaft and crankshaft gears (fig. 9-30) and drive the gear (11, fig. 9-6) onto the camshaft. Position the governor drive assembly against the camshaft gear and secure with nut (10, fig. 9-6). Tighten the nut to 85 to 90 ft/lbs torque.

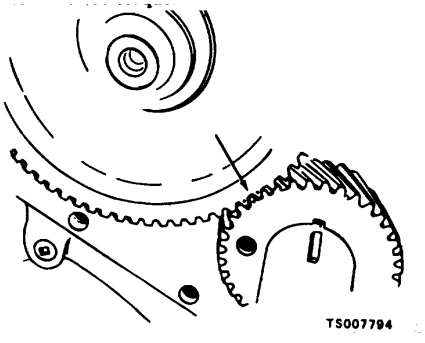


Figure 9-30. Timing Gears Showing Alignment Marks.

c. Check camshaft end play with a dial indicator. If end play is not between 0.003 and 0.007 inch, remove the camshaft timing gear and replace the thrust plate (14).

d. Check the clearance between the camshaft and crankshaft gears as follows:

(1) Force the teeth of the gears apart with a screwdriver. Attempt to insert an 0.0015 inch feeler gage into the gap between the gears (fig. 9-31). If the gage will enter, the clearance is excessive.

(2) If the gage will not enter, place a finger at the junction of the two gears and tap the camshaft gear with a hammer. If vibrations can be felt in the large gear, the clearance is sufficient.

e. If gear clearance is too great or too small, the gears must be replaced. Replace the gears only in sets.

f. Install the gear cover (para 9-21).

g. Install the valves and valve tappets (para 9-13).

h. Install the cylinder head (para 9-9).

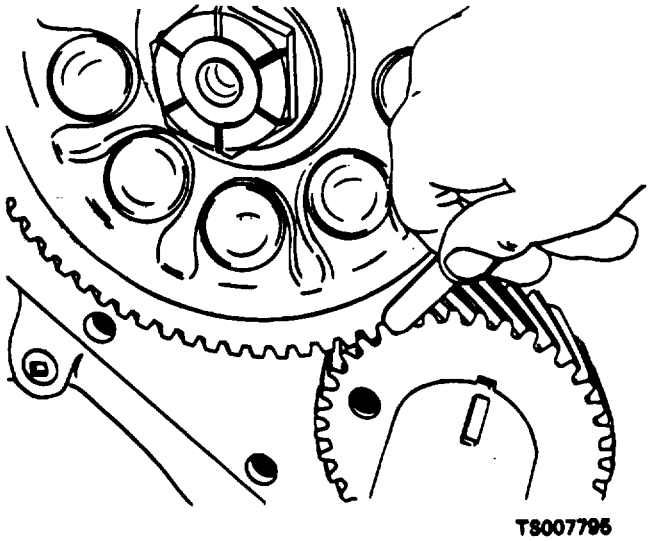


Figure 9-31. Checking Timing Gear Clearance.

Section XIII. CYLINDER BLOCK

9-38. General

The cast iron cylinder block provides the four highly machined cylinder bores in which the pistons ride. The cylinder walls are surrounded by water passages to enable the engine coolant to circulate and remove the heat of combustion from the cylinders, thereby maintaining the engine at proper operating temperatures. The cylinder block provides seats for the upper main bearing shells and main bearing caps, as well as for the camshaft bearings. Oil passages are also provided in the cylinder block. These passages direct lubricating oil to the operating components of the engine. An oil pressure regulator is installed in the cylinder block to maintain the lubricant pressure at the required level. A rigid backing plate is secured to the front of the cylinder block. This provides a mounting for the hydraulic pump.

9-39. Removal and Disassembly

With the engine mounted on an engine overhaul stand, proceed as follows:

a. Remove the cylinder head (para 9-6).

b. Remove the intake and exhaust valves (para 9-11).

c. Remove the oil pan and oil pump (para 9-15).

d. Remove the gear cover and idler gear (para 9-19).

e. Remove the flywheel and flywheel housing (para 9-23).

f. Remove the pistons and connecting rods (para 9-27).

g. Remove the crankshaft and main bearings (para 9-31).

h. Remove the camshaft (para 9-35).

I. Remove the bolts and lockwashers that secure the backing plate (40, fig. 9-19) to the cylinder block; remove the backing plate and gasket.

j. Remove the plug (18, fig. 9-26) and gasket (19) and remove the spring (21) and oil pressure regulating valve.

k. Remove the capscrews (11) and lockwashers

(12) that secure the cover (9) to the cylinder block; remove the cover and gasket (10).

WARNING

Dry cleaning solvent, P-D-680, used to clan parts Is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent Is 100° F. - 138° F. (39° C. - 59° C.).

9-40. Cleaning

a. Remove dirt and grease deposits from the block with a putty knife. Steam-clean the block. Remove greasy or gummy deposits with a cloth dampened in cleaning solvent P-D-680. Clean the oil and water passages in the block with compressed air. Remove varnish deposits with a wire brush.

b. Clean the mounting plate and all other metal parts with cleaning solvent P-D-680 and dry thoroughly.

9-41. Inspection

a. Inspect the block for cracks, damaged sealing surfaces, scored or damaged bearing seats, scored or scratched cylinder walls, damaged threads, loose or damaged studs, corrosion in the water jacket or other defects.

b. Check piston fit in the cylinder bores (para 9-29).

c. Check cylinder bore wear with an inside micrometer. Measure the cylinder bore at 45° intervals below the travel of the lowest piston ring where the cylinder is not worn. Compare this measurement with a measurement taken about 1/4 inch below the top of the cylinder. The maximum allowable cylinder wear (the difference between these two measurements) is 0.008 inch.

d. Replace the engine assembly if the block is cracked, or if defects cannot be repaired. Replace loose or damaged studs. Retap damaged threads. If a proper piston fit cannot be attained (para 9-29), the cylinders are scratched or scored, or cylinder wear exceeds 0.008 inch, rebore the cylinders as directed in paragraph 9-42 below.

e. Inspect the backing plate for cracks and distortion. Remove any burrs with a fine stone.

f. Inspect the oil pressure regulating valve for scoring, wear, and other damage. Inspect the Spring for cracks and misaligned coils. Replace damaged oil pressure regulator parts.

9-42. Reboring

Rebore the cylinders to 3.2700 to 3.2720 inch diameter (0.020 inch oversize). If this is not sufficient to eliminate cylinder wear or damage, rebore the cylinders to 3.2900 to 3.2920 inch diameter (0.040 inch oversize). Maximum allowable overbore is 0.040 inch.

9-43. Reassembly and Installation

a. Reassembly and installation is the reverse of removal and disassembly. Refer to figure 9-26.

CHAPTER 10

WHEELS AND TIRES

Section I. DESCRIPTION

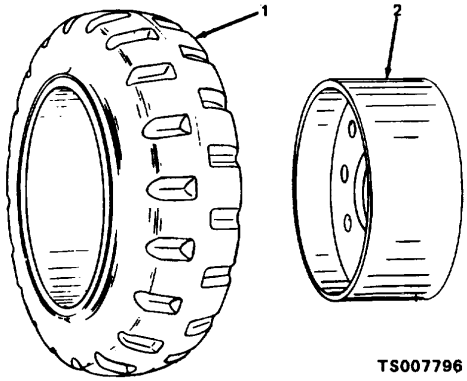
10-1. General

The solid rubber tires are molded on steel rims. The tire assembly is pressed onto the wheel which is secured to the axle hub.

10-2. Removal and Disassembly

a. Remove the assembled wheels and tires (TM 10-3930-632-12).

b. Refer to figure 10-1 and press the tires (1) from the wheels (2).



1. Tire
2. Wheel

Figure 10-1. Wheel and Tire, Exploded View.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59° C.).

10-3. Cleaning and Inspection.

a. Clean drive wheel and metal base of tire assembly with cleaning solvent P-D-680 and dry with compressed air.

b. Inspect drive wheel tires for wear, cracks and separation from metal base.

c. Inspect drive wheels for cracks, breaks, and elongated mounting holes.

d. Discard damaged parts.

10-4. Reassembly and Installation

a. Refer to figure 10-1 and press the tire (1) onto the wheel (2).

b. Install the tire and wheel assembly (TM 10-3930-632-12).

CHAPTER 11

REPAIR OF BRAKES

Section I. DESCRIPTION

11-1. General

The brake system includes a hydraulic service brake system and a manually operated parking brake system. The service brake system includes the break pedal, master cylinder, and the wheel cylinders. The parking brake is mounted on the transmission. A brief description of each component is provided as an introduction to the paragraph covering that component.

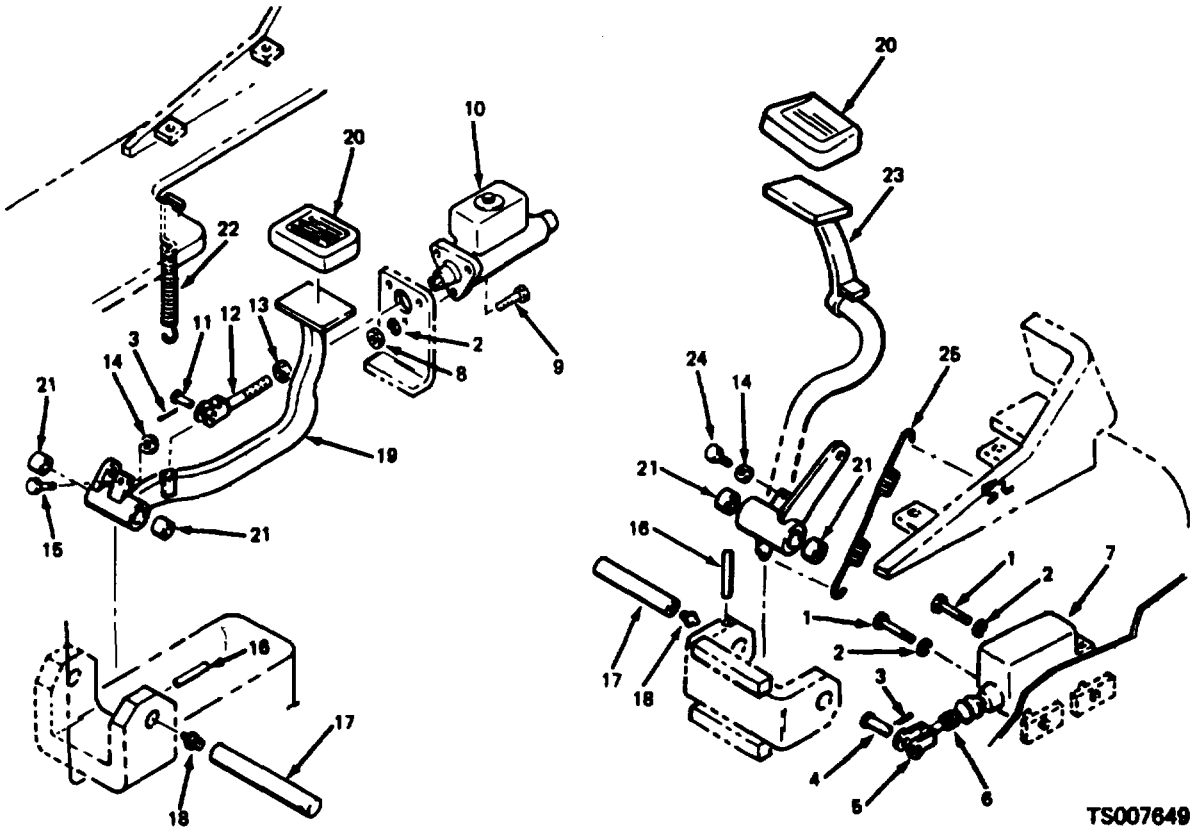
Section II. BRAKE PEDAL AND LINKAGE

11-2. General

Two brake pedals are provided on the lift truck and are mounted on either side of the steering column on the truck floor. The right hand brake pedal controls the truck service brake functions. The left hand brake pedal provides truck inching capability. Slight pedal pressure allows creeping; to obtain precise load pickup/deposit position.

11-3. Removal and Disassembly

Refer to figure 11-1 and disassemble the brake pedal and linkage as required by following the order of indexing depicted therein.



2. Lockwasher
3. Cotter pin
4. Clevis pin
5. Clevis rod end
6. Jam nut
7. Service master cylinder
8. Nut
9. Bolt
10. Inching master cylinder
11. Clevis pin
12. Clevis rod end
13. Jam nut
15. Stop bolt
16. Spring pin
17. Pivot shaft
18. Lubrication fitting
19. Inching brake pedal
20. Pedal pad
21. Needle bearing
22. Return spring
23. Service brake pedal
24. Stop bolt
25. Return spring

Figure 11-1. Brake Pedal and Linkage. Exploded View.

WARNING

Dry cleaning solvent, P.D480, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° F. - 90° C.).

11-4. Cleaning and Inspection

a. Clean all metal parts with a cloth dampened in solvent, Federal Specification P.D.680.

b. Wipe all grease or oil deposits from brake pedal pads with a dry cloth.

c. Inspect the brake pedals (23 and 19) for cracks or evidence of bending or stress.

d. Check pivot bushings and shafts carefully for wear or damage.

e. Inspect springs (25 and 22) for broken or cracked coils and signs of fatigue.

11-5. Reassembly and Installation

Reassembly and installation is essentially the reverse of removal and disassembly and may be accomplished by reversing the order of indexing depicted in figure 11-1.

Section III. BRAKE MASTER CYLINDERS

11-6. General

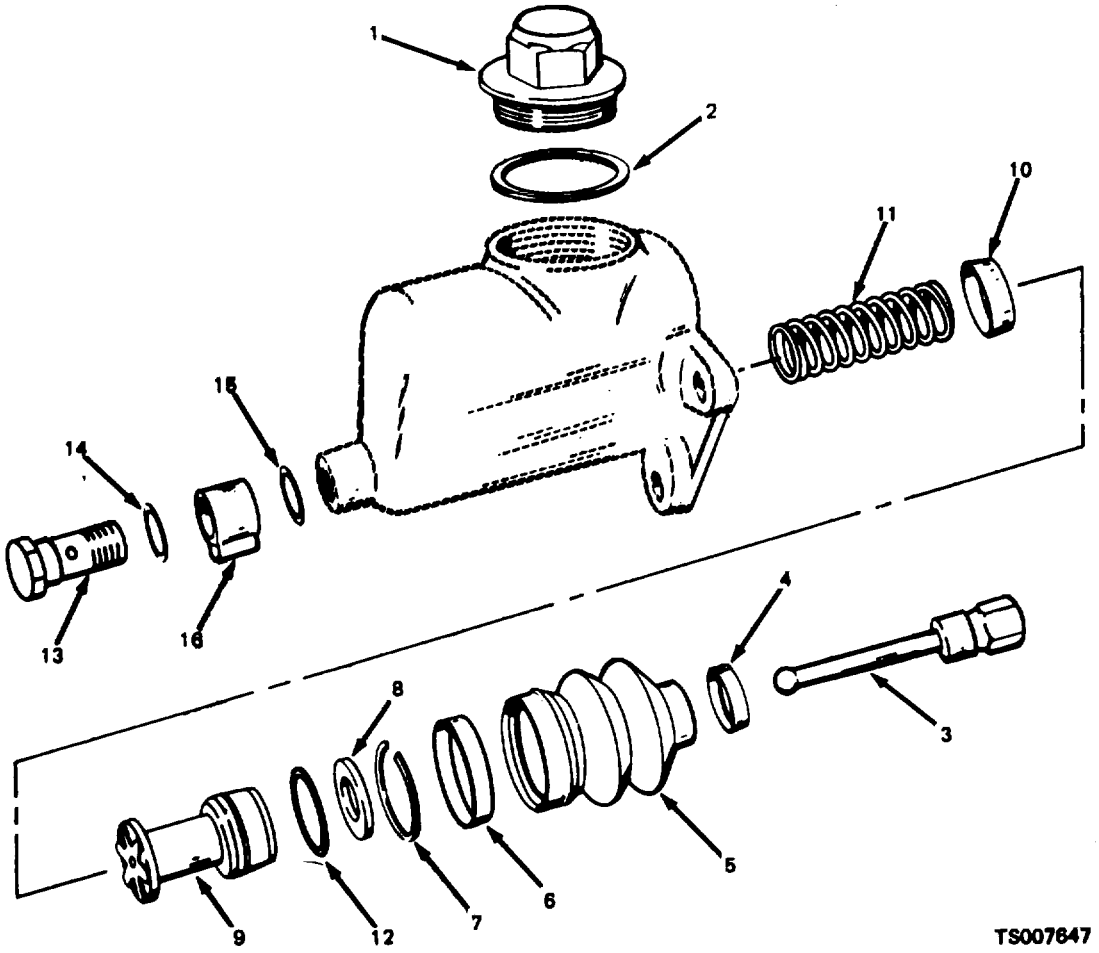
The brake master cylinders are conventional automotive-type units. When the brake pedal is pushed, it forces a piston to move in a close-fitting cylinder. This, in turn, causes brake fluid in the cylinder to be forced out of the cylinder into the brake lines. The service brake fluid is directed to the wheel cylinders. The inching brake fluid is directed to an inching valve and to the wheel cylinders. Slight inching pedal pressure produces an inching or creeping motion. Complete pedal depression will stop the truck.

11-7. Removal

Remove the brake master cylinders (TM 10-3930-632-12).

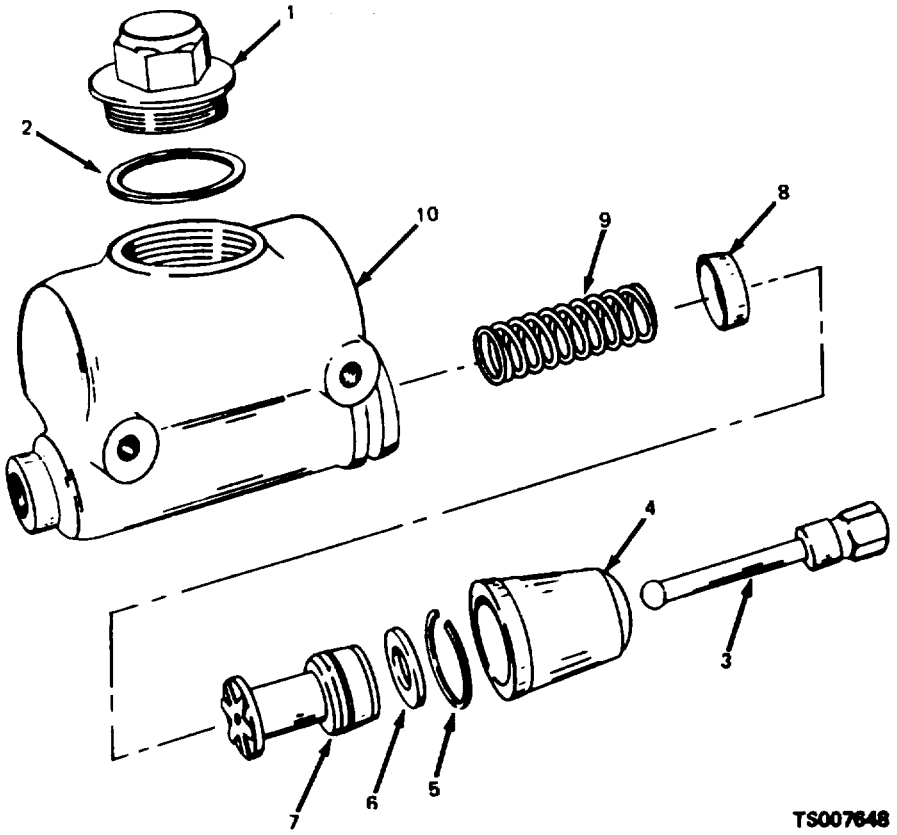
11-8. Disassembly

Refer to figure 11-2 and disassemble the service brake master cylinder. Refer to figure 11-3 and disassemble the inching brake master cylinder.



1. Filler cap
2. Gasket
3. Pushrod
4. Boot clamp
5. Piston boot
6. Boot clamp
7. Piston retainer
8. Piston stop plate
9. Cylinder piston
10. Primary cup
11. Cylinder spring and retainer
12. Preformed packing
13. Shoulder bolt
14. Bolt gasket
15. Cylinder gasket
16. Outlet fitting

Figure 11-2. Service Brake Master Cylinder. Exploded View.



1. Filler cap
2. Gasket
3. Cylinder pushrod
4. Pushrod boot
5. Lockwire
6. Stop plate
7. Cylinder piston
8. Primary cup
9. Return spring
10. Cylinder housing

Figure 11-3. Inching Brake Master Cylinder, Exploded View.

11-9. Cleaning and Inspection

a. Discard the primary cups (10, fig. 11-2, and 8, fig. 11-3). Discard boots (5, fig. 11-2, and 4, fig. 11-3).

b. Clean all other metal parts of the brake master cylinder in denatured alcohol; dry thoroughly with compressed air.

c. Inspect the tank for cracks, distortion, and damaged threads. Check the bore of the tank for pitting or scoring. Replace if damaged.

d. Inspect all other parts for cracks, damaged threads, distortion, and other damage; replace damaged parts.

11-10. Reassembly

a. Refer to figures 11-2 and 11-3 and reassemble the service and inching brake master cylinders. Note the following:

b. After installing the spring (11, fig. 11-2, and 9, fig. 11-3), cup (10 and 8), and piston (9 and 7) in the tank, lock them in place with the stop plate and lockwire retainer.

11-11. Installation

Install the brake master cylinders, bleed the brake system and adjust the brake linkage (TM 10-3930-632-12).

Section IV. WHEEL CYLINDERS

11-12. General

The wheel cylinders are mounted on the brake backing plate, positioned between the brake shoes. When brake fluid under pressure is applied to the wheel cylinder, both pistons are pushed outward in the cylinder, forcing the brake shoes apart. This

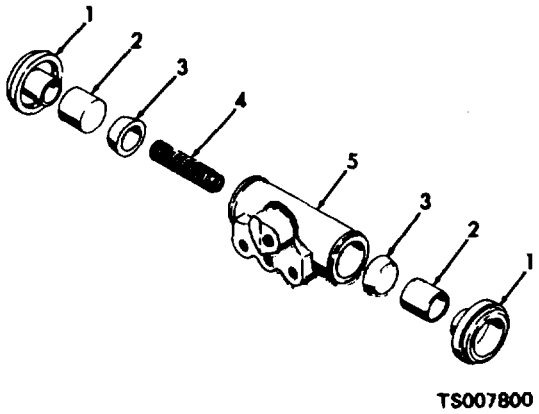
pushes the brake linings into contact with the brake drums to slow and stop the vehicle.

11-13. Removal

Remove the wheel cylinders (para 11-22).

11-14. Disassembly

Refer to figure 11-4 and disassemble the wheel cylinder.



1. Boot
2. Piston
3. Cup
4. Spring
5. Cylinder

Figure 11-4. Wheel Cylinder, Exploded View.

11-15. Cleaning and Inspection

a. Discard the boots and cups.

b. Clean all parts of the wheel cylinder with denatured alcohol; dry thoroughly.

c. Inspect the cylinder for scoring, pits, burrs, or wear by holding the cylinder up to a strong light and looking through it; replace the cylinder if damaged.

d. Inspect all other parts of the wheel cylinder for cracks, breaks, distortion, burrs, scoring, or other damage: replace damaged parts.

e. Remove any cleaning residue with crocus cloth or jeweler's rouge.

f. Check for proper clearance between the piston and cylinder by sliding the piston into the cylinder and checking with a feeler gage. Replace the cylinder assembly if clearance exceeds 0.005 inch.

11-16. Reassembly

Refer to figure 11-4 and reassemble the wheel cylinder. Lubricate internal parts of the wheel cylinder with hydraulic brake fluid during reassembly.

11-17. Installation

a. Install the wheel cylinder (para 11-24).

b. Bleed the brake system and adjust the brakes (TM 10-3930-632-12).

Section V. HAND BRAKE SHOES

11-18. General

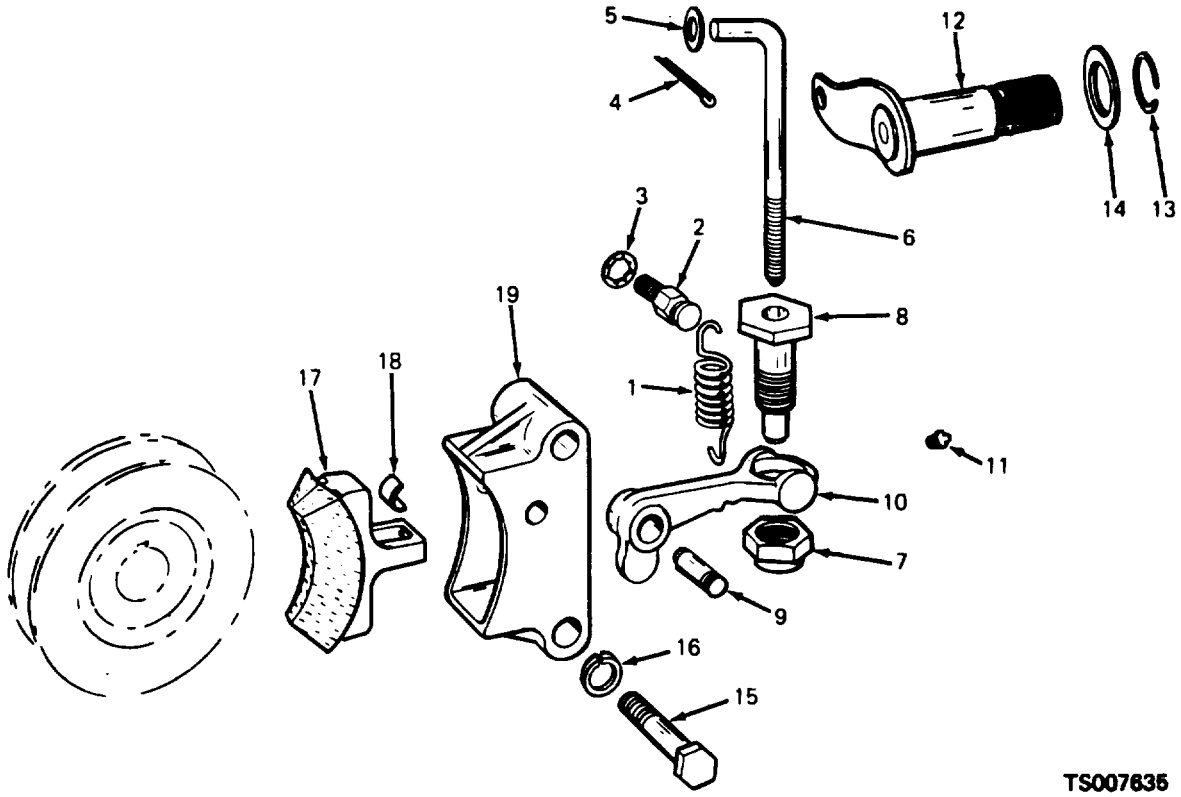
The parking brake drum is a V-pulley keyed to the driven end of the pinion shaft of the transmission. The brake shoe is a V-shaped block which is pressed into the V of the pulley as the brake is applied. This prevents rotation of the transmission pinion shaft, preventing movement of the vehicle. The lever that operates the brake shoe is designed to multiply the application force of the brake by a leverage factor.

11-19. Removal and Disassembly

a. Remove right side tilt cylinder (TM 10-3930-632-12).

b. Disconnect the hand brake linkage from the arm and shaft assembly (TM 10-3930-632-12).

c. Refer to figure 11-5 and remove and disassemble the parking brake assembly from the torque converter housing.



1. Spring
2. Spring screw
3. Lockwasher
4. Cotter pin
5. Washer
6. Draw rod
7. Locknut
8. Lock sleeve
9. Lever pin
10. Cam lever
11. Lubrication fitting
12. Arm and shaft
13. Retaining ring
14. Washer
15. Screw
16. Lockwasher
17. Brake shoe
18. Spring
19. Brake housing

Figure 11-5. Parking Brake Assembly,. Exploded View.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59 °C.).

11-20. Cleaning and Inspection

a. Clean all parts of the hand brake mechanism in cleaning solvent P-D-680 and dry thoroughly with compressed air.

b. Inspect the brake shoe for overheating, scoring, wear, incorrect alignment, or other damage; replace a damaged brake shoe.

c. Inspect all metal parts for burrs, cracks, breaks, distortion, or other damage; replace damaged parts.

d. Inspect the splines on the arm and shaft assembly for damage; replace the arm and shaft assembly if damaged.

e. Inspect all other parts for cracks, distortion, damaged threads, and other damage; replace damaged parts.

11-21. Reassembly and Installation

Refer to figure 11-5 and reassemble the parking brake. Note the following:

a. Position the retaining spring (18) in the bracket of the brake shoe (17). Position the cam of the lever (10) on the bracket and force it down into the bracket. Place the assembled brake shoe and lever into the housing (19) and drive the pin (9)

through the hole in the housing and lever to secure the brake shoe and lever assembly.

b. When installing the sleeve (8) in the lever sleeve hole, install the nut (7) to allow some free play of the sleeve.

c. Install right side tilt cylinder (TM 10-3930-632-12).

d. Connect and adjust the hand brake b-handle assembly and linkage (TM 10-3930-632-12).

Section VI. SERVICE BRAKES

11-22. Removal and Disassembly

a. Remove the brake assembly from the front drive wheel (para 12-2).

b. Disassemble the brake assembly as shown in figure 11-6. Do not disassemble the brake assembly farther than is necessary to determine if the condition of the parts warrants further disassembly,

c. Use brake spring pliers to disengage the brake return springs from the brake shoes.

WARNING

Dry cleaning solvent P-D-80 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated Area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F - 138°F. (38°C - 59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid, If contact with eyes is mild, wash your eyes with water and get medical aid immediately.

11-33. Cleaning and Inspection

a. Clean the brake shoes with a wire brush. Remove greasy or gummy deposits with a cloth dampened with dry cleaning solvent P-D-680.

b. Wipe the exterior of the wheel cylinder with a cloth dampened with dry cleaning solvent P-D-680.

c. Clean all metallic parts with dry cleaning solvent P-D680; dry thoroughly.

d. Inspect the brake shoes for wear, cracks, oil saturation, signs of overheating, or other damage. If the linings are damaged or worn to less than 1/16 inch thickness, replace the brake shoes.

e. Inspect the wheel cylinders for cracks, deterioration of rubber parts, signs of leaking, or other damage; replace damaged wheel cylinders.

f. Inspect the brake return springs for cracks, worn or damaged end hooks, or elongation. If the springs are damaged or if they are elongated so that spaces exist between loops of the springs, replace the springs.

g. Inspect the backing plate for cracks, distortion, and other damage; replace the brake assembly if damaged.

11-24. Reassembly and Installation

a. Reassemble the brake assembly as shown in figure 11.6. Use a brake spring pliers to install the brake return springs between the brake shoes.

b. Install the brake assembly (para 12-4).

c. Connect the brake lines to the fittings on the brake assemblies. Bleed the brake system (TM 10-3930-632-12).

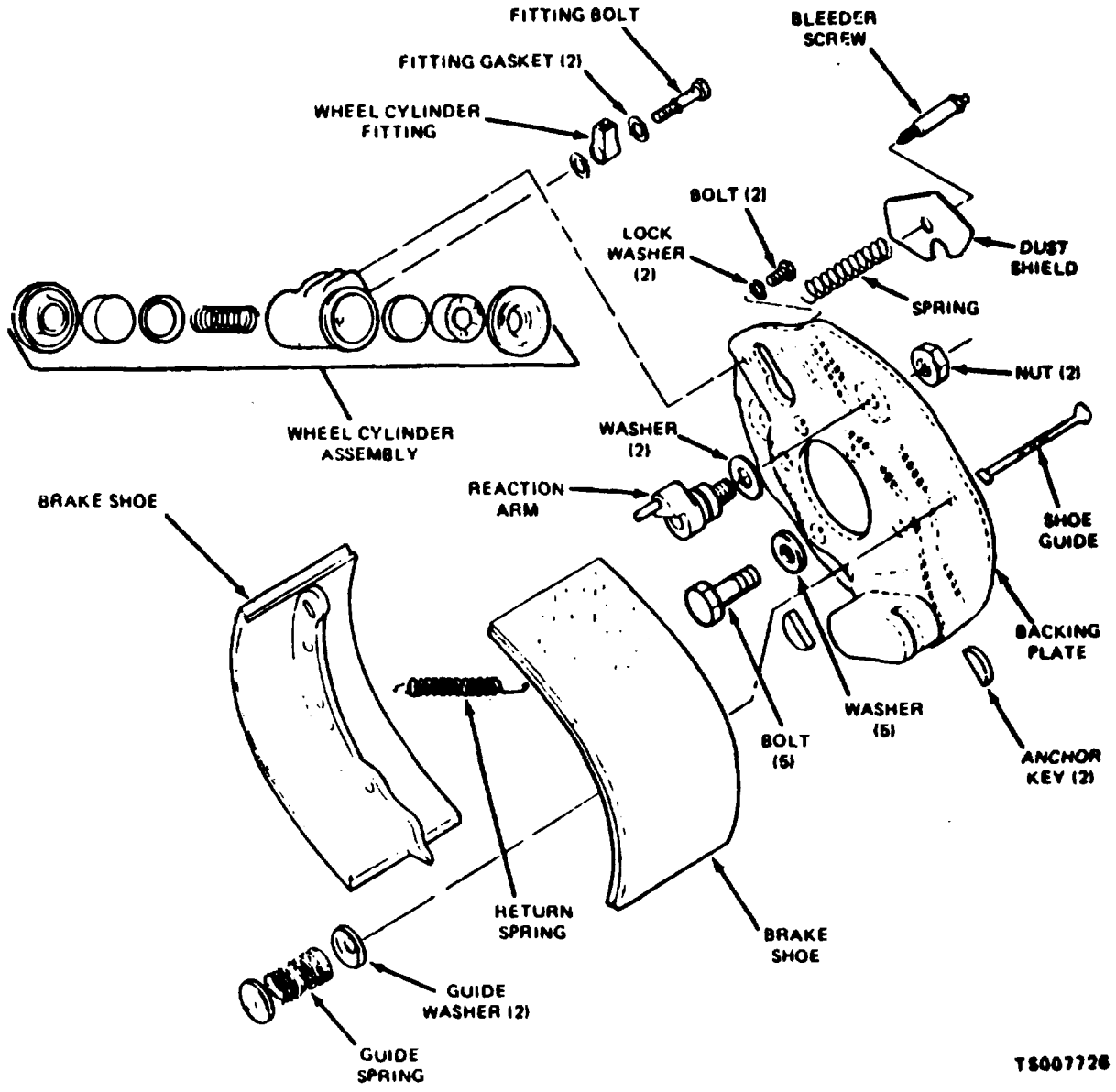


Figure 11-6. Service Brake Assembly, Removal and Disassembly.

CHAPTER 12

REPAIR OF FRONT AXLE

Section I. GENERAL DESCRIPTION

12-1. General

The front axle adapter mounts directly on the transmission housing. The axle adapter houses and mounts the differential assembly. The differential case rides in tapered roller bearings in the axle adapter housing. Transmission pinion-to-differential ring gar engagement is adjusted by varying the shims between the differential carriers and axle adapter and between the axle adapter and transmission housing.

Section II. DRIVE AXLE ENDS

12-2. Removal and Disassembly

a. Remove the wheel bearings and hubs (TM 10-3930-632-12).

b. Disconnect the brake lines from the fittings on the brake assemblies.

c. Remove and disassemble the axle end as shown in figure 12-1.

d. If the brake assembly is damaged, disassemble (Figure 11-6).

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F - 138°F. (38°C - 59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

12-3. Cleaning and Inspection

a. Discard and replace the seals.

b. Clean the ball bearing by flushing it up and down in dry cleaning solvent P-D-680. Use a soft-bristled brush to remove hardened lubricant. Blow dry with compressed air, taking care not to spin the bearing. Dip the bearing in light oil and wrap it in lint-free paper until it is ready for use.

NOTE

If either a bearing cone or bearing cup is damaged, replace both parts of the bearing set. Do not replace parts singly.

c. Scrape or wipe all old grease from the ring gear and pinion. Clean all metallic parts with dry cleaning solvent P-D-680.

d. Inspect the spindle for cracks, worn or damaged threads, scoring or burring of the bearing seats, and other damage. Remove any light burrs or nicks with a fine stone.

e. Inspect the ring gear and pinion shaft for cracked or broken gear teeth. Inspect the splines of the pinion shaft for damage or wear. Make sure the retaining ring grooves are free of nicks and burrs.

f. Inspect the spindle support for cracks, damaged seal and bearing seats, worn or damaged threads, distortion, and other damage. Make sure the 'vent in the spindle support is open. Replace if necessary.

g. Inspect the brake drum for cracks, checking and scoring of the braking surface, signs of over-heating, and other damage.

h. Replace parts that are damaged beyond repair.

12-4. Reassembly and Installation

a. Reassemble the axle end as shown in figure 12-1.

b. Torque the brake assembly-to-spindle support capscrews to 52-57 foot-pounds.

c. Torque the spindle-to-spindle support bolts to 115-127 foot-pounds.

d. Pack the ring gear and pinion shaft bearing with the lubricant recommended in the lubrication chart. Total amount of grease used to pack the hub, bearings, ring gear, and pinion shall be about one. pound per wheel.

e. Before installing the ring gear and hub, make sure the vent on the spindle support is not blocked.

f. Install the wheel bearings and hubs (TM 10-3930-632-12).

g. Bleed the brake system (TM 10-3930-632-12).

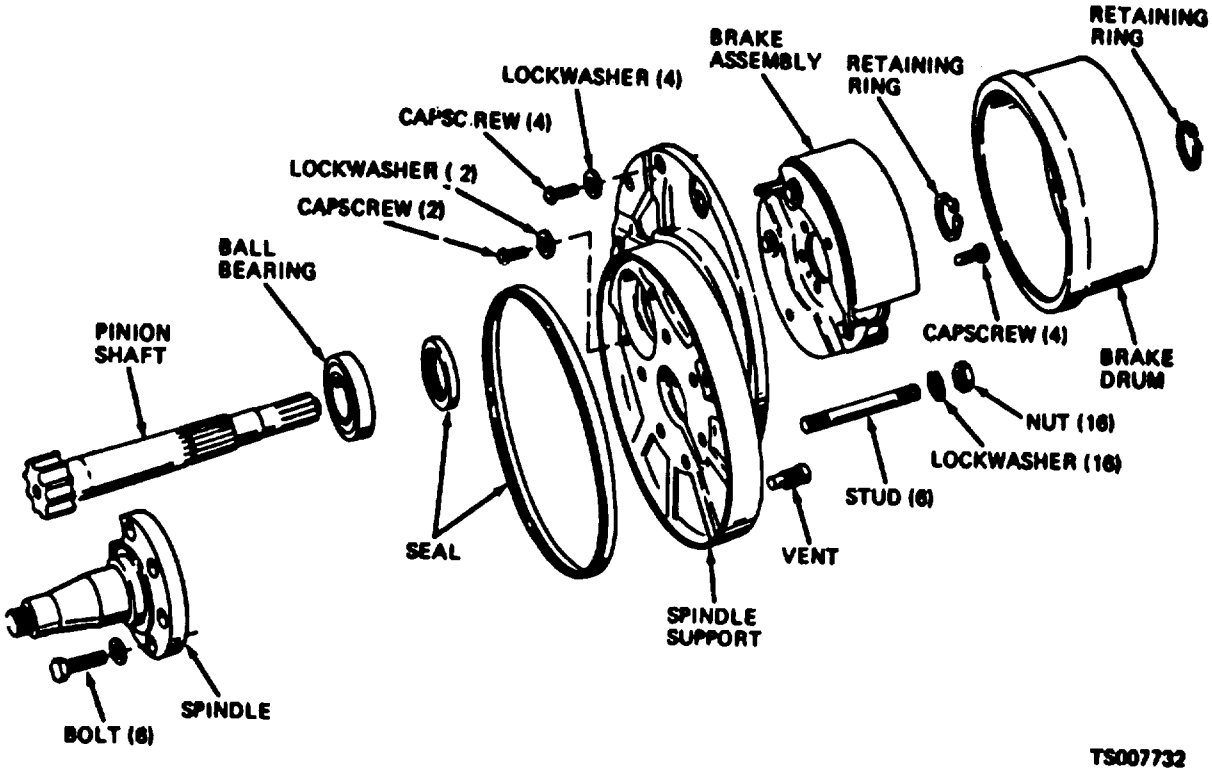


Figure 12-1. Axle End, Disassembly and Reassembly

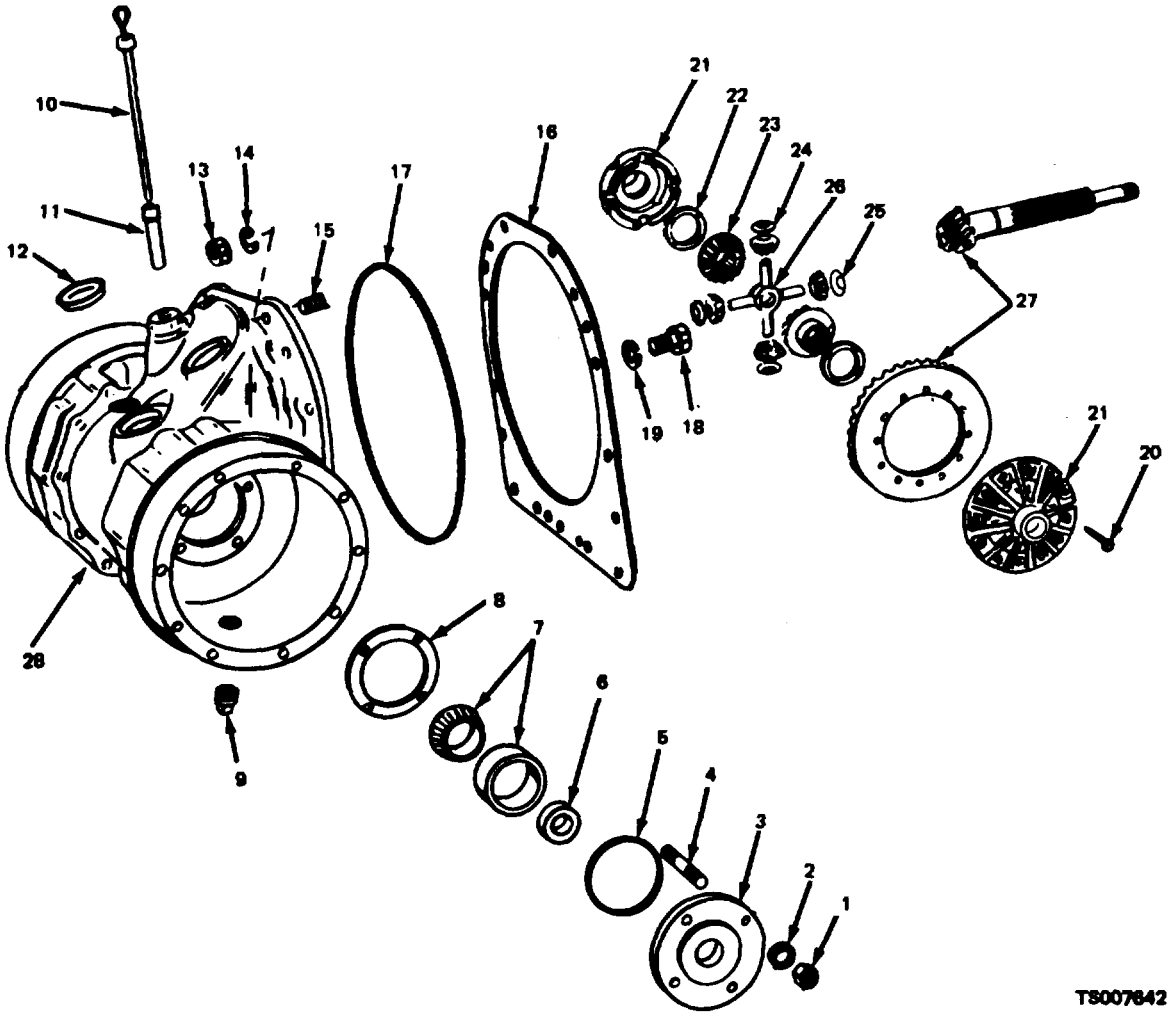
Section III. AXLE ADAPTER AND DIFFERENTIAL

12-5. Removal

Remove the axle adapter and differential (para 2-8a).

12-6. Disassembly

Refer to figure 12-1.1 and disassemble the axle adapter and differential.



1. Nut
2. Lockwasher
3. Bearing carrier
4. Stud
5. Preformed packing
6. Oil seal
7. Differential bearing
8. Carrier shim
9. Drain plug
10. Oil dipstick
11. Dipstick tube
12. Inspection plug
13. Nut
14. Lockwasher
15. Stud
16. Adapter shim
17. Sealing ring
18. Screw
19. Lockwasher
20. Screw
21. Differential case
22. Thrust washer
23. Side gear
24. Thrust washer
25. Pinion gear
26. Differential spider
27. Gear and pinion set
28. Axle adapter

Figure 12-1.1. Axle Adapter and Differential

NOTE

Identify the shims (8) so that they can be reinstalled on the same side of the axle adapter at reassembly.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F - 138°F. (38°C - 59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

12-7. Cleaning and Inspection

a. Discard all seals, and other unserviceable parts.

b. Clean all other parts of the axle adapter and differential assembly in cleaning solvent P-D-680 and dry thoroughly with compressed air. Coat all parts with clean lubricating oil.

c. Inspect the bearing cones and cups for cracks, nicks, looseness, or rough or binding operation; replace the complete bearing assembly if either part is damaged.

d. Inspect the gears for cracked, chipped, or worn teeth, or scored or worn bore holes; replace all differential gears (four pinion and two side gears), differential spider, and thrust washers if any gear is damaged.

e. Inspect the differential housings for cracks, breaks, scoring or other damage; replace a damaged differential housing.

NOTE

The ring gear and pinion shaft of the transmission are replaced as a matched set only. To replace the pinion shaft. refer to Chapter 14.

f. Inspect the axle adapter, bushings, studs, and rings for cracks, or damage; replace damaged parts.

12-8. Reassembly and Installation

Refer to figure 12-1.1 and reassemble the axle adapter and differential. Note the following:

a. When installing the ring gear (27) on the flanged case half (21), torque the screws (20) to 20 to 25 ft/lbs.

b. After assembling the differential parts (21 through 27), make sure the side gears rotate in mesh with the pinion gears before tightening the bolts. Torque the bolts to 20 to 25 ft/lbs. Rotate the side gears while tightening to assure that the operating parts of the differential remain free.

c. Install the same thicknesses of shims (8) that were removed from each side when installing the carriers (3). Tighten the carrier nuts (1) evenly and alternately in small increments to a torque of 24 to 28 ft/lbs.

CHAPTER 13

REPAIR OF REAR AXLE

Section I. GENERAL DESCRIPTION

13-1. General

The steering axle is mounted at the rear of the lift truck. The steering axle is secured to the frame with axle mounting blocks which are free to pivot as required as the wheels are turned. The drag link from the steering gear pitman arm connects to a ball stud on the spider of the steering axle. The movement of the spider is transferred through tie rods to the steering knuckles on which the wheels are mounted to provide steering for the truck.

Section II. TIE RODS

13-2. Removal and Disassembly

a. Remove the tie rods from the spider and steering knuckles of the steering axle. Disassemble as shown in figure 13-1.

WARNING

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13-3. Cleaning and Inspection

a. Wipe the tie rod ends with a cloth dampened with dry cleaning solvent P-D-680. Clean all remaining parts with dry cleaning solvent P-D-680 and air dry.

b. Inspect the tie rod ends for damaged threads, binding or seizing of the studs, scoring or corrosion of the stud shaft. Replace damaged tie rods.

c. Inspect the tie rod for cracks, distortion, and damaged threads; replace damaged tie rods.

13-4. Reassembly, Installation and Adjustment

a. Reassemble the locknuts and tie rod ends on the tie rods as shown in figure 13-1. Do not tighten the locknuts until the tie rod length is adjusted.

b. Install the tie rods between the steering knuckles and the steer axle spider.

c. Adjust the tie rods (TM 10-3930-632-12).

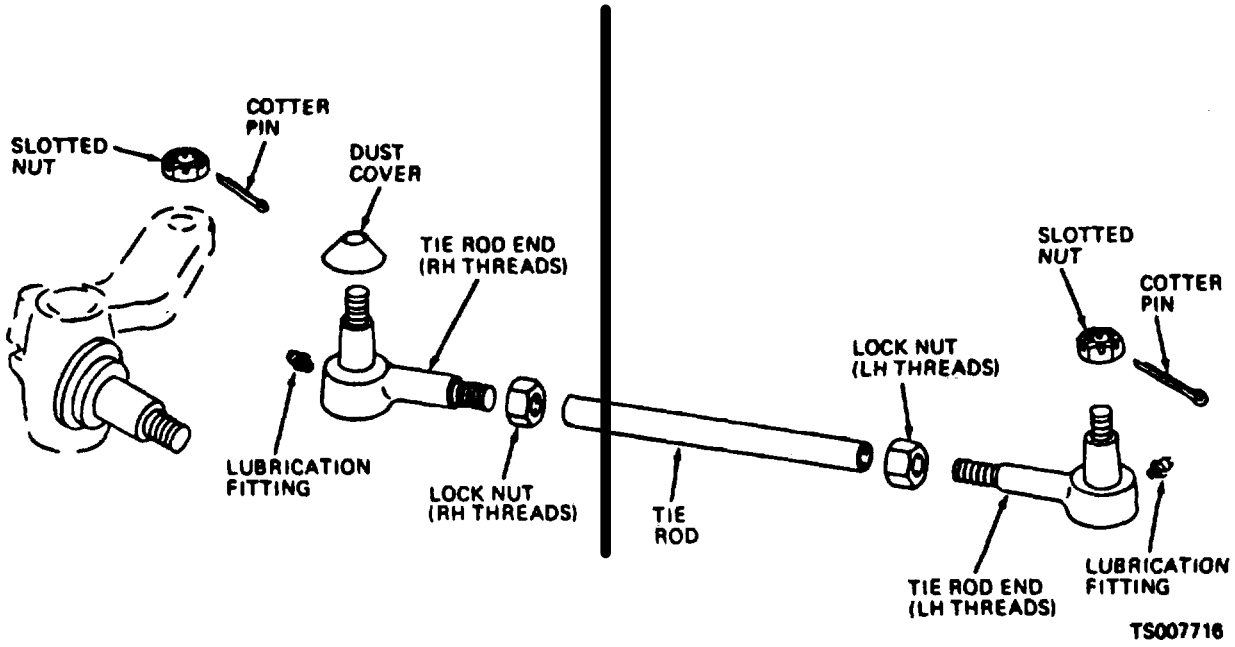


Figure 13-1. Tie Rod, Disassembly and Reassembly.

Section III. REAR (STEER) AXLE

13-5. Removal

Remove the steering axle (para 2-10*a*).

13-6. Disassembly

Refer to figure 13-1.1 and disassemble the steering axle.

WARNING

Dry cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well ventilated area. Avoid contact with skin, eyes, and clothes and don't breathe vapors. Do not use near open flame or excessive heat. The flash point is 100°F - 138°F. (38°C - 59°C). If you become dizzy while using cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.

13-7. Cleaning and Inspection

a. Clean all metal parts of the steering axle assembly, except the bearings, in solvent, Federal Specification P-D-680; dry thoroughly with compressed air.

13-8. Reassembly

Refer to figure 13-1.1 and reassemble the steering axle. Note the following:

a. If the clearance between the steering knuckle (47 or 50) and the bracket of the axle center assembly exceeds 0.015 inch, add one shim (44) between the parts.

b. When installing the knuckle pins (39), align the hole in the pin with the hole in the steering knuckle. Drive in the draw key (41 or 42) and stake it into place.

b. Clean the bearings by placing them in a wire basket and agitating them in cleaning solvent P-D-680. Dry thoroughly with compressed air, taking care that the air pressure does not spin the dry bearings.

c. Inspect all parts for cracks, breaks, distortion, or other damage; replace damaged parts.

d. Inspect the bearings for scoring or wear; replace damaged bearings.

e. Inspect the knuckle pins (39, fig. 13-1) for wear, scoring, or distortion; replace damaged pins.

f. Inspect the axle mounting blocks for cracks, distortion, worn pivot shafts, and damaged threads; replace damaged blocks.

g. Clean the grease fittings with a fine wire to dislodge any hardened grease accumulations.

c. When installing the expansion plugs (48), position them in the bores with the convex side out and tap the center of the plug to expand it. Stake the plugs into place.

d. Adjustment of the stop screw (45) is made after the axle is installed on the vehicle.

13-9. Installation

Install and adjust the steering axle (pares 2-10*b* and *c*).

KEY to figure 13-1:

1.	Tie rod	18.	Retaining ring	35.	Bearing cup
2.	Tie rod end	19.	Spider shim	36.	Bearing cone
3.	Nut	20.	Thrust washer	37.	Lubrication seal
4.	Dust cover	21.	Bearing seal	38.	Cotter pin
5.	Tie rod end	22.	Bearing	39.	Knuckle pin
6.	Nut	23.	Axle spider	40.	Pin bearing
7.	Tie rod	24.	Lubrication fitting	41.	Draw key
8.	Nut	25.	Tire	42.	Draw key
9.	Lubrication fitting	26.	Wheel bolt	43.	Pin bearing
10.	Cotter pin	27.	Rear wheel	44.	Knuckle shim
11.	Nut	28.	Hub cap	45.	Axle stop screw
12.	Capscrew	29.	Cotter pin	46.	Nut
13.	Lockwasher	30.	Nut	47.	RH steering knuckle
14.	Mounting block	31.	Flat washer	48.	Expansion plug
15.	Cotter pin	32.	Bearing cone	49.	Lubrication fitting
16.	Hex nut	33.	Bearing cup	50.	LH steering knuckle
17.	Ball stud	34.	Hub and cap	51.	Axle

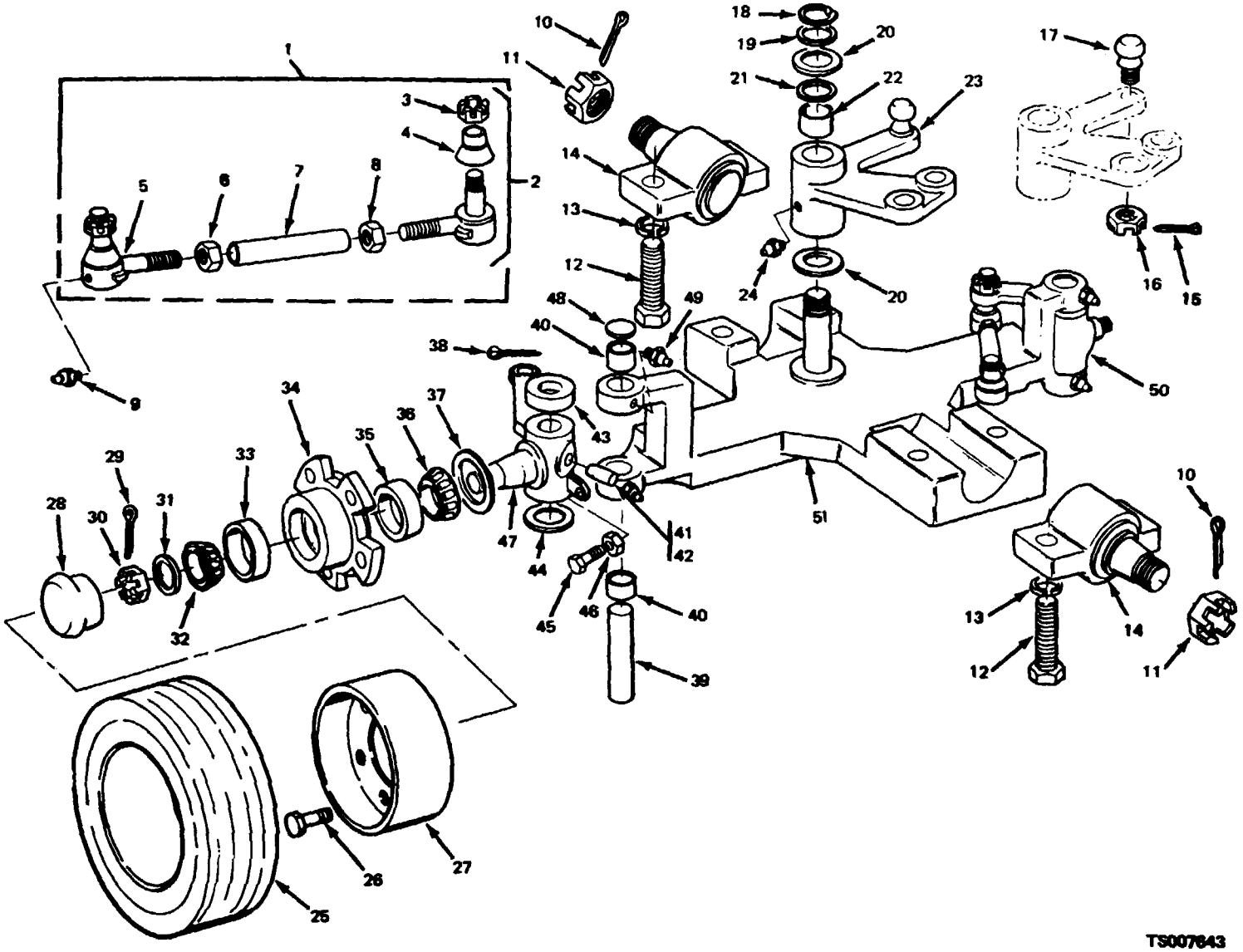


Figure 13-1.1. Rear Steering Axle Assembly, Exploded View.

CHAPTER 14

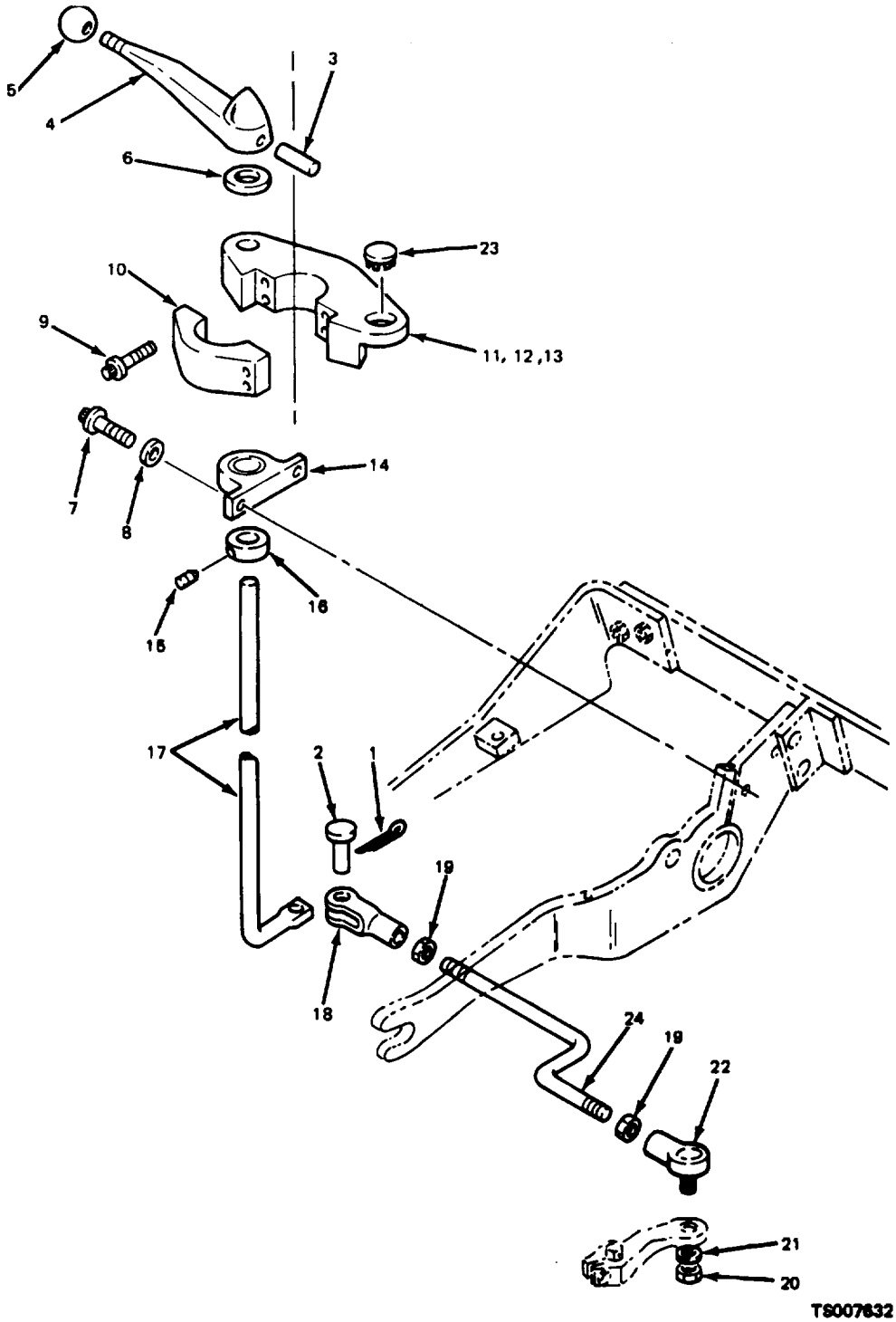
REPAIR OF TRANSMISSION

Section I. CONTROL LEVER AND LINKAGE

14-1. Genera

The transmission control lever and linkage (fig. 14-1) is mounted to the fork lift steering column.

The control lever (4) is within convenient reach of the operator's left hand.



1.	Cotter pin	7.	Capscrew	13.	Bracket bushing	19.	Nut
2.	Clevis pin	8.	Lockwasher	14.	Lower bearing	20.	Nut
3.	Spring pin	9.	Capscrew	15.	Setscrew	21.	Lockwasher
4.	Control lever	10.	Bracket cap	16.	Control rod collar	22.	Ball joint
5.	Lever ball	11.	Lever bracket	17.	Control rod	23.	Button plug
6.	Washer	12.	Bracket bushing	18.	Rod clevis	24.	Control rod

Figure 14-1. Transmission Control Lever and Linkage, Exploded View.

14-2. Removal and Disassembly

Remove and disassemble the control lever and linkage by referring to figure 14-1 and following the order of indexing depicted therein.

WARNING

Dry cleaning solvent, P-D-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100° F. - 138° F. (39° C. - 59° C.).

14-3. Cleaning, Inspection, and Repair

a. Clean all parts with cleaning solvent P-D-680 and dry thoroughly.

b. Inspect the shift lever and shift rod for cracks, distortion, and other damage; replace damaged parts.

c. Inspect the pillow block for a cracked mounting bracket, and for rough, catching, or sticking operation; replace a damaged pillow block.

d. Inspect the control rod for bends and for damaged threads; replace a damaged control rod.

e. Inspect the bracket for cracks, worn or damaged threads, and for worn or scored bushings. If the bushings are damaged, drive them out and drive in new bushings.

14-4. Reassembly and Installation

Refer to figure 14-1 and reassemble and install the transmission control lever and linkage.

14-5. Adjustment

Adjust the transmission control linkage (TM 10-3930-632-12).

Section II. TRANSMISSION OVERHAUL

14-6. General

The torque converter, mounted on the engine flywheel, is directly coupled to the transmission main drive gear. Power flows through the transmission directional selectors and gears to provide driving torque for the front drive wheels.

14-7. Removal

Remove transmission as outlined in paragraph 2-9*b*.

14-8. Disassembly

a. Remove the transmission control valve (29, fig. 14-2).

b. Remove cotter pins (1). Remove nut (2) and woodruff key (33). Pull brake drum (3) and oil seal (4) from shaft. Remove and discard preformed packing (5).

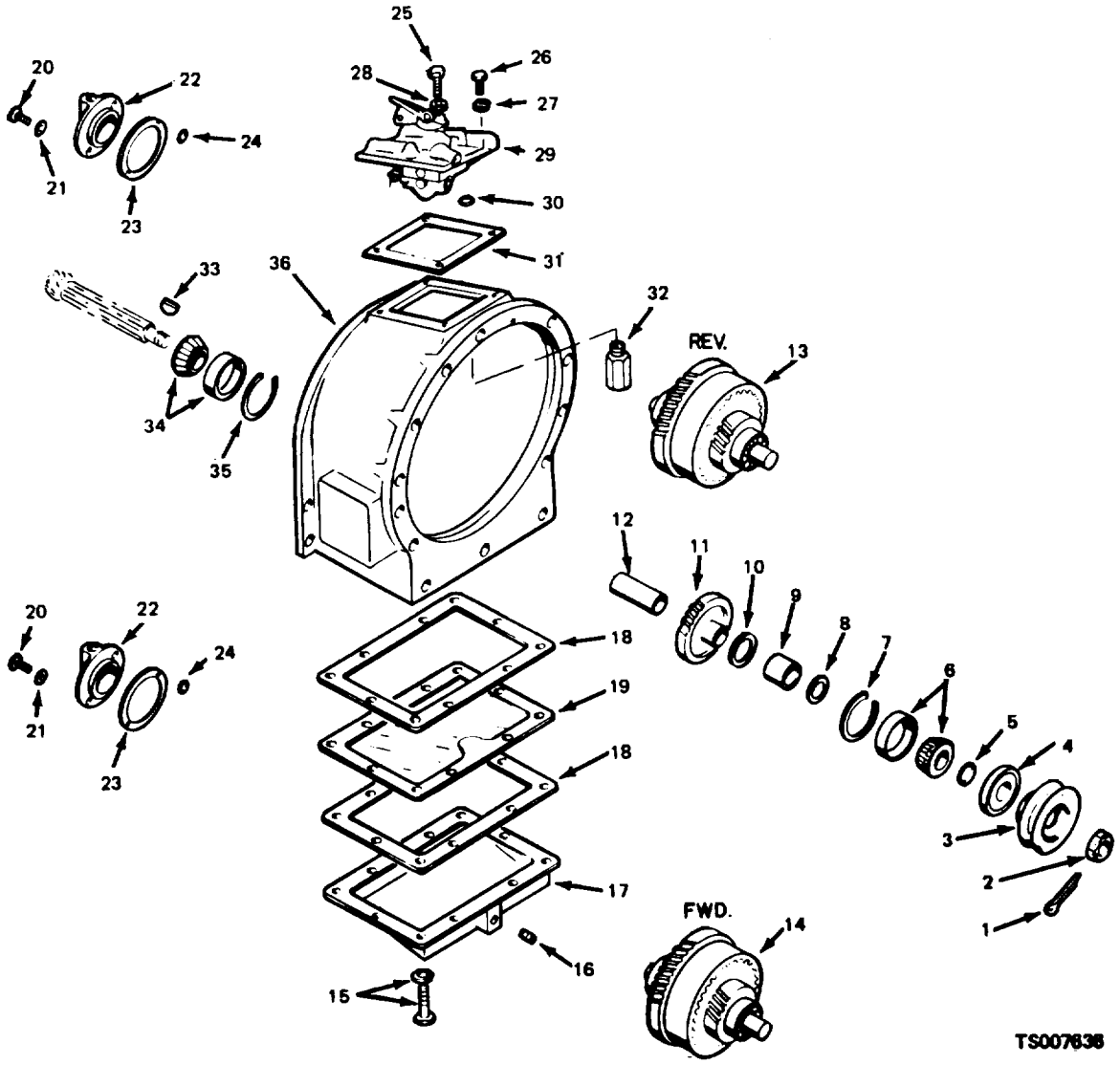
c. Attach a suitable puller and pull front bearing (6) from shaft. Remove retainer ring (7) and shim (8).

d. Slide gear spacer (9) and thrust washer (10) from shaft. Pull gear (11) and bearing spacer (12).

e. Remove reverse clutch pack (13) and forward clutch pack (14). Lay aside for disassembly.

f. Remove locating ring (35) and rear bearing (34).

g. Remove capscrews (20) and lockwashers (21). Pull bearing caps (22) from housing. Remove and discard gaskets (23) and sealing rings (24).



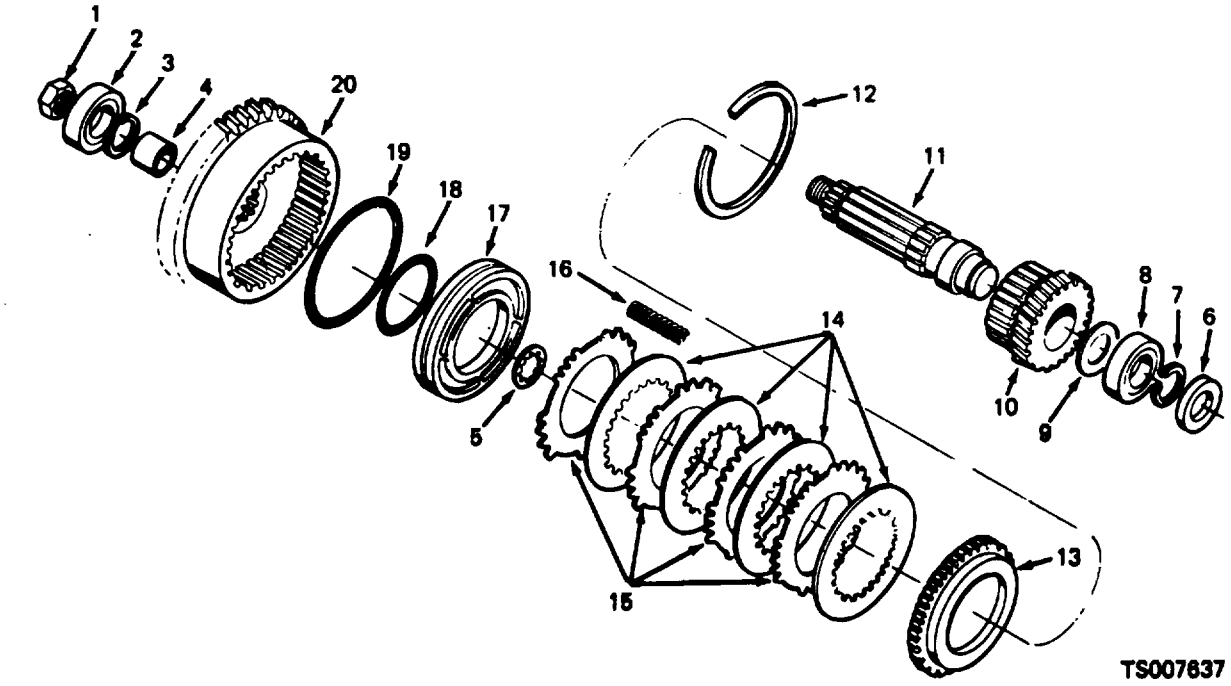
2.	Nut	20.	Capscrew
3.	Brake drum	21.	Lockwasher
4.	Oil seal	22.	Bearing cap
5.	Preformed packing	23.	Bearing cap gasket
6.	Front bearing	24.	Sealing ring
7.	Retainer ring	25.	Capscrew
8.	Bearing shim	26.	Capscrew
9.	Gear spacer	27.	Lockwasher
10.	Thrust washer	28.	Lockwasher
11.	Pinion shaft gear	29.	Control valve
12.	Bearing spacer	30.	Preformed packing
13.	Reverse clutch pack	31.	Cover gasket
14.	Forward clutch pack	32.	Pressure relief valve
15.	Capscrew	33.	Woodruff key
16.	Drain plug	34.	Rear bearing
17.	Oil pump cover	35.	Locating ring
18.	Cover gasket	36.	Transmission housing

Figure 14-2. Transmission Assembly, Exploded View.

h. Remove capscrews (15) and pull oil pump cover (17), gaskets (18) and screen (19) from bottom of housing. Remove drain plug (16).

I. Disassemble the reverse clutch pack (13) as follows:

(1) Remove nut (1, fig. 14-3), outer bearing (2) and retainer ring (3). Slide shaft spacer (4) from shaft. Remove thrust washer (5).



1. Nut
2. Outer bearing
3. Retainer ring
4. Shaft spacer
5. Thrust washer
6. Inner seal
7. Retainer ring
8. Inner bearing
9. Bearing spacer
10. Gear and bushing
11. Drive shaft
12. Retainer ring
13. End plate
14. Internal tooth clutch disc
15. External tooth clutch disc
16. Release spring
17. Clutch piston
18. Inner seal
19. Outer seal
20. Drum and hub

Figure 14-3. Reverse Clutch Pack, Exploded View.

(2) Pull inner seal (6), retainer ring (7) and inner bearing (8) from end of shaft (11). Remove bearing spacer (9).

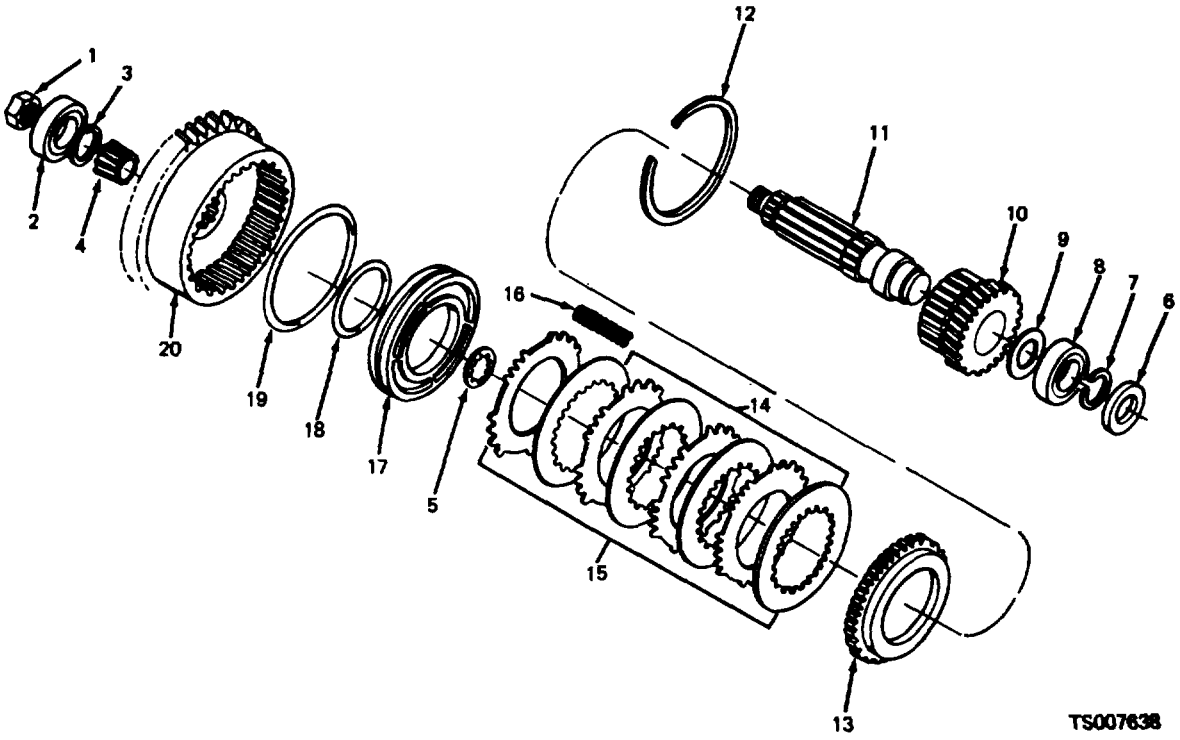
(3) Slide gear and bushing (10) and shaft (11) from assembly.

(4) Compress and remove retainer ring (12). Slide end plate (13) from drum and hub (20). Remove all internal and external tooth clutch discs (14 and 15). Remove release springs (16)

(5) Pull clutch piston (17) from drum and hub (20). Remove inner and outer seals (18 and 19).

j. Disassemble the forward clutch pack as follows:

Refer to figure 14-4. Note that the parts are very similar to those of the reverse clutch pack. Follow the same procedure to disassemble the forward clutch pack as outlined for reverse clutch pack.



1.	Nut	11.	Drive shaft
2.	Shaft bearing	12.	Retainer ring
3.	Retainer ring	13.	End plate
4.	Gear	14.	Inner disc
5.	Thrust washer	15.	Outer disc
6.	Oil seal	16.	Release spring
7.	Retainer ring	17.	Clutch piston
8.	Shaft bearing	18.	Inner seal
9.	Bearing spacer	19.	Outer seal
10.	Gear and bushing	20.	Drum and hub

Figure 14-4. Forward Clutch Pack, Exploded View.

k. Pull torque converter (1, fig. 14-5) out of housing. Remove seal (2).

KEY to figure 14-5:

1.	Torque converter	18.	Valve spring	35.	Oil pump
2.	Seal	19.	Regulator piston	36.	Capscrew
3.	Screw	20.	Valve stop	37.	Capscrew
4.	Capscrew	21.	Valve body	38.	Lockwasher
5.	Washer	22.	Retaining pin	39.	Lockwasher
6.	Cover plate	23.	Washer	40.	Retainer plate
7.	Plug	24.	Seal	41.	Main gear and shaft
8.	Plug	25.	Drive gear	42.	Outer seal
9.	Plug seal	26.	Capscrew	43.	Inner seal
10.	Valve spring	27.	Stator support	44.	Oil seal
11.	Valve ball	28.	Oil seal	45.	Drain plug
12.	Gasket	29.	Bearing shim	46.	Capscrew
13.	Preformed packing	30.	Locating ring	47.	Lockwasher
14.	Preformed packing	31.	Bearing	48.	Capscrew
15.	Regulator valve	32.	Retainer ring	49.	Dowel pin
16.	Plug	33.	Shaft washer	50.	Converter housing
17.	Plug washer	34.	Driven gear		

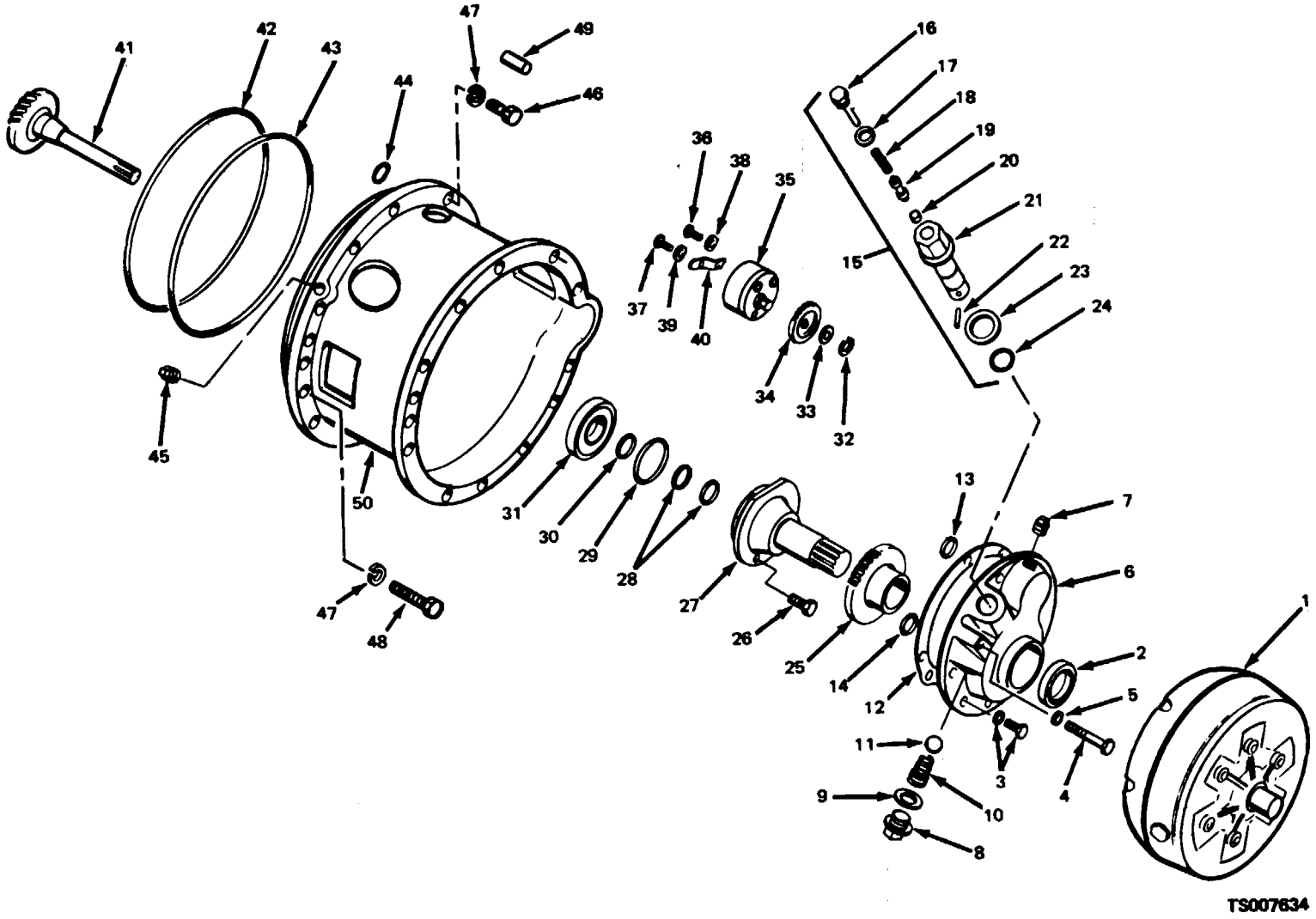


Figure 14-5. Transmission Torque Converter Housing and Related Parts, Exploded View.

l. Remove plug (8). Remove plug seal (9) and pull valve spring (10) and ball (11) out of hole.

m. Disassemble and remove regulator valve (15) by removing plug (16), washer (17), valve spring (18), regulator piston (19) and valve stop (20). Drive pin (22) out of hole and pull valve body (21) out. Remove washer (23) and seal (24).

n. Remove screws (4 and 3) and remove cover plate (6). Remove and discard gasket (12) and preformed packings (13 and 14).

o. Attach a suitable puller and remove drive gear (25). Remove screws (26) and pull stator support (27) from position.

p. Expand and remove retaining ring (32). Remove shaft washer (33) and driven gear (34) from shaft of oil pump (35). Remove capscrews (36 and 37) and lockwashers (38 and 39). Remove retainer plate (40) and oil pump (35).

q. Remove seals (44, 42 and 43) from converter housing (50).

r. Remove oil seals (28), shims (29), locating ring (30) and bearing (31) from main gear and shaft (41).

s. Disassemble the control valve (29, fig. 14-2) as follows:

(1) Remove capscrew (1, figure 14-6) and lockwasher (2). Pry selector arm (3) off of shaft (29).

(2) Remove cotter pin (7) and clevis pin (8). Remove screw (4), nut (5), and lockwasher (6). Pry arm (9) off of shaft (25).

KEY to figure 14-6:

1. Capscrew
2. Lockwasher
3. Selector arm
4. Capscrew
5. Nut
6. Lockwasher
7. Cotter pin
8. Clevis pin
9. Valve arm
10. Retaining ring
11. Washer
12. Oil seal
13. Neutral start switch
14. Washer
15. Actuator pin
16. Bleeder valve
17. Pipe plug
18. Reducer bushing
19. Bushing seal
20. Balance spring
21. Expander cup
22. Sealing cup
23. Valve piston
24. Return spring
25. Arm and shaft
26. Spacer
27. Cotter pin
28. Clevis pin
29. Arm and shaft
30. Control cover
31. Bushing

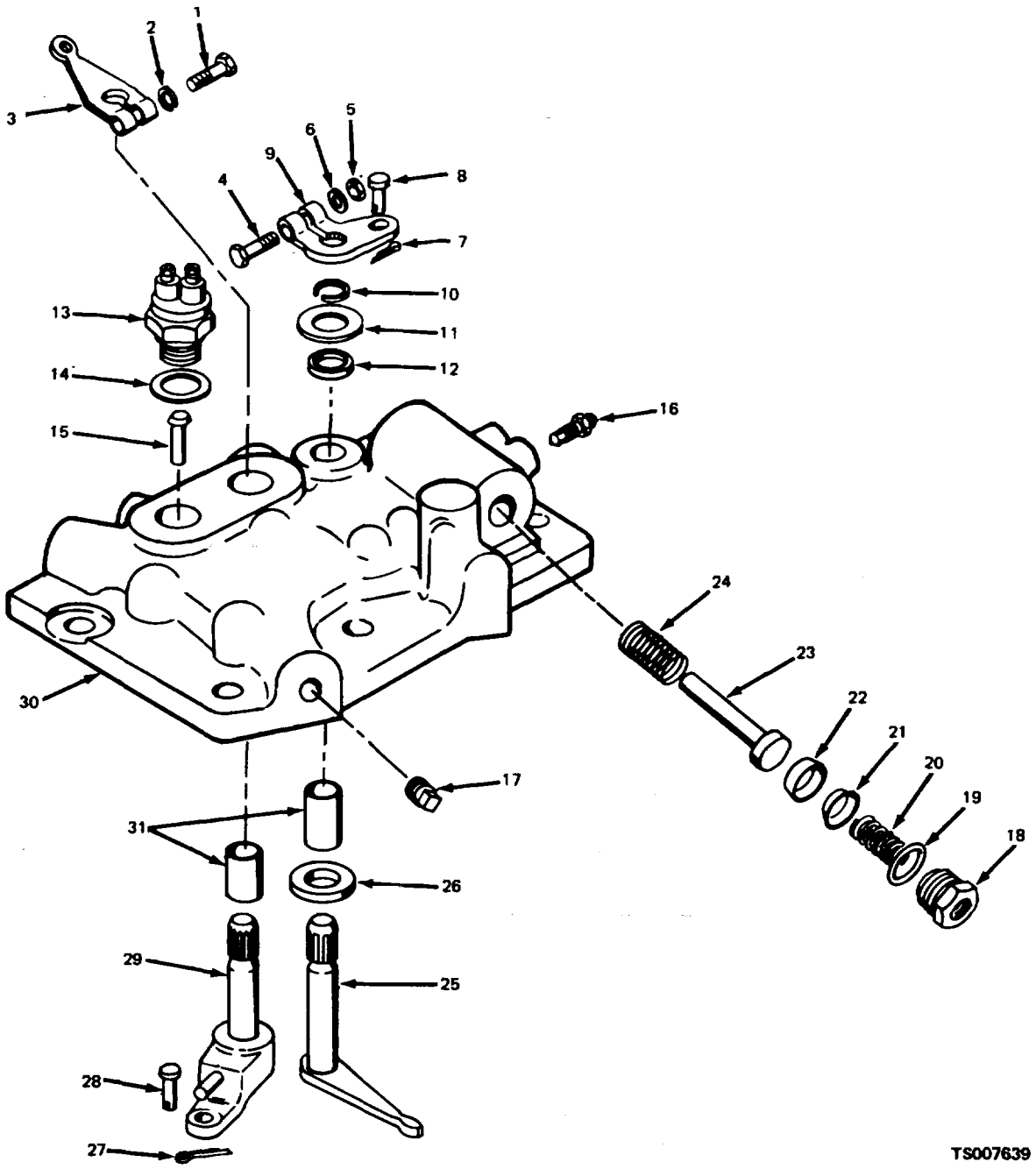


Figure 14-6. Control Valve, Exploded View.

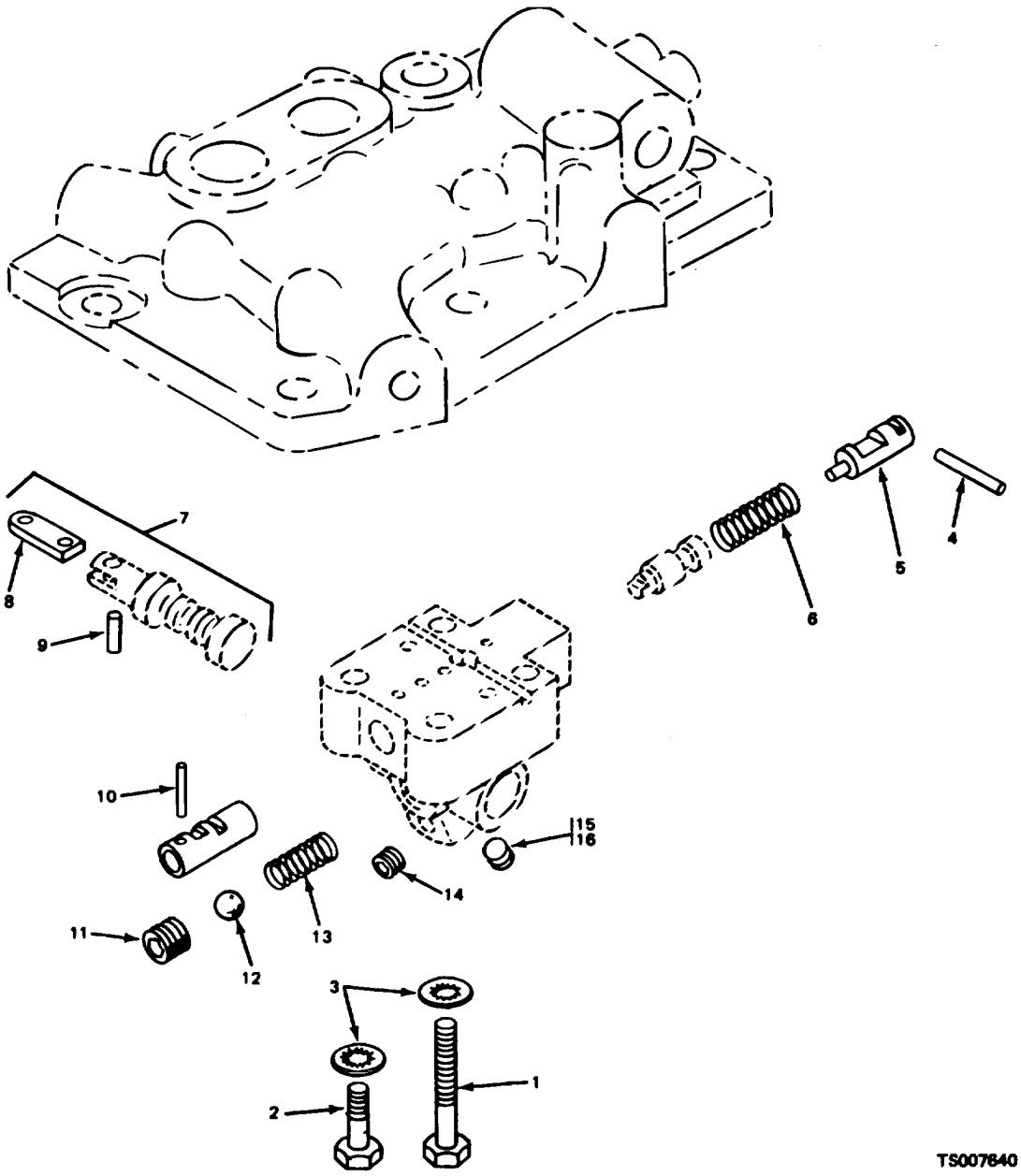
(3) Expand and remove retaining ring (10). Remove washer (11) and seal (12).

(4) Unscrew and remove neutral start switch (13), washer (14). Pull out actuator pin (15). Remove bleeder valve (16) and pipe plug (17).

(5) Remove reducer bushing (18), seal (19), balance spring (20), expander cup (21), sealing cup (22), valve piston (23) and return spring (24).

(6) Pull arm and shaft (25) out of cover (30). Remove spacer 126). Remove clevis pin (28) and cotter pin (27). Pull arm and shaft (29) from cover (30). Remove bushings (31) only if necessary for replacement.

(7) Refer to figure 14-7 and remove capscrews (1 and 2) and lockwashers (3). Press out stop pin (4). Pull inching valve rod (5) and valve spring (6) out of cover.



1.	Capscrew	2.	Link Pin
2.	Capscrew	10.	Retainer pan
3.	Lockwasher	11.	Plug
4.	Stop pin	12.	Detent ball
5.	Inching valve rod	13.	Spring
6.	Valve spring	14.	Plug
7.	Selector valve	15.	Plug
8.	Link	16.	Preformed packing

Figure 14-7. Control Valve Associated Parts, Exploded View.

(8) Remove link pin (9) and link (8).
(9) Remove retainer pin (10), plug (11), detent ball (12) and spring (13). Remove plugs (14 and 15) and preformed packing (16).

WARNING

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14-9. Cleaning and Inspection

a. Discard the seals and preformed packings.

b. Clean the bearings by placing them in a wire basket and immersing them in a container of solvent. Agitate the basket in the solvent to thoroughly clean the bearings. Dry with clean, dry, compressed air, taking care not to spin the bearings. Lubricate with light oil after cleaning.

c. Clean all other parts of the transmission assembly in cleaning solvent P-D-680 and dry with compressed air.

d. Lubricate all metal parts of the assembly with transmission fluid.

e. Inspect all bearings for cracks, nicks, wear, scoring, overheating, or other damage; replace damaged bearings.

f. Inspect the gears for chips, cracks, breaks, worn teeth, worn splines, or other damage; replace damaged gears.

g. Inspect the case, housing, and all covers for cracks, breaks, distortion, nicked seal seats, or other damage; replace parts if damage makes them unserviceable.

h. Inspect discs for cracks, wear, overheating, or other damage; replace the complete disc assembly if any are defective.

I. Inspect all springs for wear. Check tension of the springs. Replace if the springs do not meet requirements as shown in table 14-1.

14-10. Reassembly

a. Reassemble the control valve by referring to figures 14-6 and 14-7, and procedural step s (1) thru (9), paragraph 14-8, and reversing order of disassembly.

b. Place spacer (9, figs. 14-3 and 14-4) and bearing (8) on shaft (11); secure with retaining ring (7). Slide gear and bushing (10) on the shaft, and discs (14 and 15) onto the gear assembly. Place thrust washer (5) on the shaft.

c. Install seal (18) on the hub of the hub and drum. Install seal (19) on piston (17). Install the piston in the hub and drum.

d. Install discs (14 and 15) and springs (16) in the hub and drum, making sure that the first disc inserted has splines which engage the hub and drum and the second disc has splines which engage the gear assembly. Alternate discs until all eight are installed. Figure 14-8 shows clutch assembly. Install end plate (13, figs. 14-3 and 14-4) in the hub and drum and secure the assembly with retaining ring (12).

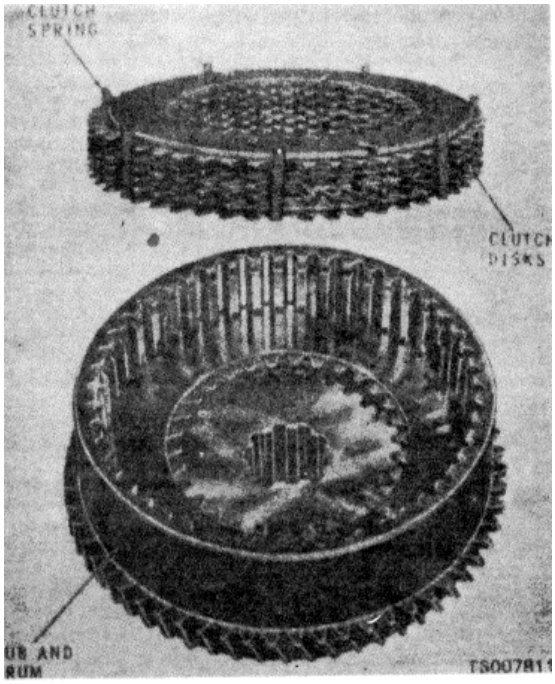

Figure 14-8. Assembling Forward and Reverse Clutches

Table 14-1. Transmission Spring Inspection

Name	Fig. No.	Index No.	Compressed Length	Pounds load
Pressure regulator spring	14-5	18	2 1/2	21-24
Relief valve spring	14-5	10	0.763	5 1/2-7 1/2
Clutch spring	14-4	16		

e. Align the discs that engage the gear assembly and install the clutch assembly on the assembled shaft (11) and gear (10). Install the gear or spacer (4) on the shaft and secure with the retaining ring (3).

f. Assemble the second clutch assembly as directed in a through e above.

g. Press the bearings (2) into the housing (36, fig. 14-2) so that the retaining ring on the bearing

is firmly seated against the case. Install the clutch pack (13 and 14) in the case so that the threaded ends of the shafts enter the bearings; secure with the nuts (1. figs. 14-3 and fig. 14-4).

h. Install the retaining ring (35, fig. 14-2) in the case (36). Press the bearing cup (34) into the case so that it is firmly seated against the locating ring (35). Install the retaining ring (7) and press the bearing (6) firmly against the ring in the housing (50, fig. 14-5).

I. Press the bearing (31) into the housing until it rests firmly against its integral retaining ring. Install the input shaft (14) in the bearing, and secure with the locating ring (30). Make sure the two oil seals (28) are installed on the shaft as shown in figure 14-9. Install the stator (27, fig. 14-5), using shims (29) to take up play of the shaft (41). Secure the stator with capscrews (26) and lockwire.

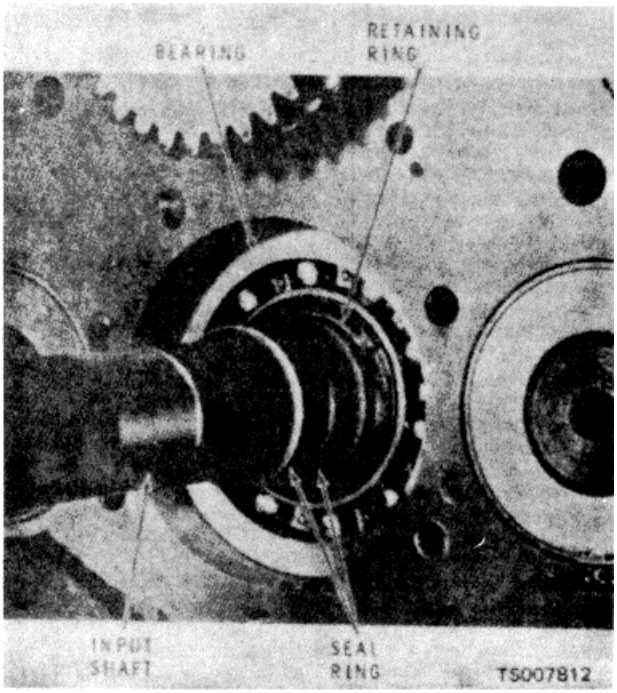

Figure 14-9. Input Shaft Installation

j. Position the gear (34) on the drive shaft of the converter oil pump (35) and press the gear over the shaft. Place the washer (33) on the shaft and secure in place using the retaining ring (32).

k. Position the converter pump assembly on the plate (40) and secure them together using the screws (36) and lockwashers (38). Torque bolts to 20 to 25 ft/lbs. Insert the pump into the housing and secure the plate in position using the screw (37) and lockwasher (39).

I. Position new seals (42 and 43) and preformed packing (44) on the housing as shown in figure 14-10. Position the housing (50, fig. 14-5) on the housing (36, fig. 14-2). Align the gears so that they mesh by turning the input shaft. Secure the housing to the case using the screws (46 and 48, fig. 14-5) and lockwashers (47). Torque bolts to 35 to 45 ft/lbs.

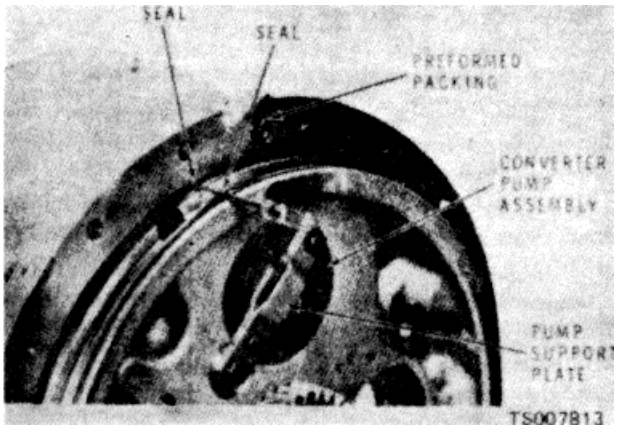

Figure 14-10. Torque Converter Housing Showing Pump and Seals

m. Position the rear bearing (34, fig. 14-2) on the pinion shaft and insert the pinion shaft part way into the housing (36). Install the spacer (12), gear (11), and spacer (9) on the pinion drive shaft. Seat the shaft and install the front bearing (6), preformed packing (5), and brake drum (3); secure with the nut (2) torqued to 150 to 200 ft/lbs. When the nut is tightened, check the rotation of the pinion shaft. If the shaft binds, add washer (10). If the shaft has any end play, remove washer (10). When the proper washer thickness is obtained, the shaft shall have a preload of 8 to 10 inch-pounds. Add shims to decrease preload, subtract to increase preload. After proper adjustment, install the seal (4) in the housing and reinstall the brake drum (3) and nut (2). Secure the nut to 150 to 200 ft/lbs and lock with the cotter pin (1).

n. Position the gear (25, fig. 14-5) on the stator so that the teeth of the gear mesh with those of the converter pump drive gear (34).

o. Insert the ball (11), spring (10) and seal (9) into the cover plate (6); secure in place with the plug (8). Insert the stop (20), regulator piston (19), pin (22), and spring (18) into the body (21); position the washer (17) on the plug (16) and turn the plug into the body.

p. Position the washer (23) and seals (24) on the body; turn the body into the cover.

q. Position seal (2) and preformed packings (13 and 14) in the cover. Coat both sides of gasket (12) with gasket sealer and place the gasket (12) on the

cover. Position the cover on the housing. Secure the cover with the screws (3). Torque to 20 to 25 ft/lbs.

r. Position the gaskets (23, fig. 14-2) and sealing rings (24) on the caps (22). Coat the screws (20) with Permatex No. 2. Secure caps (22) with screws (20) and lockwashers (21). Torque to 20 to 25 ft/lbs.

s. Coat the gaskets (18) with Permatex No. 3. Position two gaskets and screen (19) on the oil pump cover (17); position the oil pump cover on the transmission case and secure with the screws (15). Coat the plug (16) with sealer and insert the plug into the oil pan.

t. Install the parking brake parts (para 11-21).

u. Install the transmission control valve (para 14-10).

14-11. Installation

Install the transmission on the lift truck (para 2-9*c*).

APPENDIX A

REFERENCES

A-1. Fire Protection

TB 6.4200-200-10	Hand Portable Fire Extinguishers Approved, for Army Users

A-2. Lubrication

C9100IL	Fuels, Lubricants, Oils and Waxes
LO 10-3930-632-12	Lubrication Order for Truck, Lift, Fork, Army Model MHE-229, Clark Model 2329397

A-3. Painting

TM 43-0139	Painting Instructions for Field Use

A-4. Radio Suppression

TM 11-483	Radio Interference Suppression

A-5. Maintenance

TB ORD 651	Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling Systems
DA PAM 738750	The Army Maintenance Management System (TAMMS)
TM 10-3930-632-12	Operator and Organizational Maintenance Manual for Truck, Lift, Fork, Army Model MHE-229, Clark Model 2329397
DMWR 10-3930-632	Depot Maintenance Work Requirement for Truck, Lift, Fork, Army Model MHE-229, Clark Model 2329397
TM 10-3930-632-20P	Organizational Maintenance Repair Parts Manual for Truck, Lift, Fork, Army Model MHE-229, Clark Model 2329397
TM 10-3930-6832-4P	DS, GS, and Depot Maintenance Repair Parts List for Truck, Lift, Fork, Army Model MHE-229, Clark Model 2329397
TM 96140-200-14	Operation and Organizational Field and Depot Maintenance Storage Batteries, Lead Acid Type
TM 5-764	Electric Motor and Generator Repair
TB 385-101	Safety Use of Cranes, Crane-Shovel Dragline, and Similar Equipment near Electric Power Lines

A-6. Shipment end Storage

TB 740-97-2	Preservation of USAMEC Mechanical Equipment for Shipment and Storage
TM 740-90-1	Administrative Storage of Equipment

A-7. Destruction of Army Materiel to Prevent Enemy Use

TM 750-244-3	Procedures for Destruction of Equipment to Prevent Enemy Use (Mobility Equipment Command)

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