

TECHNICAL MANUAL

DIRECT SUPPORT AND GENERAL SUPPORT

MAINTENANCE MANUAL

PUMPING ASSEMBLY, FLAMMABLE LIQUID,
BULK TRANSFER, GASOLINE ENGINE DRIVEN,

350 GPM CAPACITY, 275 FEET TOTAL

DYNAMIC HEAD,

WHEEL MOUNTED (PEABODY BARNES, INC.

MODEL US37ACG)

FSN 4320-195-4914

HEADQUARTERS, DEPARTMENT OF THE ARMY

FEBRUARY 1974

WARNING

POISONOUS GASES

are contained in the exhaust fumes expelled by this equipment.

DEATH

or serious illness may result if exhaust fumes are not properly expelled from enclosed areas.

FLAMMABLE GAS

is generated in the battery of this equipment while the battery is being charged. Keep fire or flame away while servicing battery or explosion may result.

FIRE HAZARD

is created by filling fuel tank while engine is running. Shut off engine before servicing fuel tank.

EXPLOSION HAZARD

exists when welding repairs are attempted on fuel tank.

DEATH

may result unless all gasoline fumes are purged from tank before making any repairs involving heat or flame.



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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual is for your use while providing direct and general support maintenance of the Pumping Assembly. Flammable Liquid, Bulk Transfer, Gasoline Engine Driven, 350 GPM Capacity, 275 Feet Total Dynamic Head, Wheel Mounted, (Peabody Barnes, Inc. Model US37ACG). You are instructed to perform the maintenance allocated by the Maintenance Allocation Chart.

1-2. Maintenance Forms and Records

Maintenance forms, records, and reports that you are required to use are explained in TM 38-750.

1-3. Reporting of Errors

You can improve this manual by calling attention to errors and by recommending improvements, using DA Form 2028 (Recommended Changes to Publica-

tions), or by a letter, and mail directly to Commander, U.S. Army Troop Support Command, ATTN: AMSTS-MPP, 4300 Goodfellow Boulevard, St. Louis, Missouri 63120. A reply will be furnished directly to you.

1-4. Equipment Serviceability Criteria

This equipment is not covered by an ESC.

1-5. Destruction of Army Materiel to Prevent Enemy Use

For instructions regarding destruction of equipment to prevent enemy use, refer to TM 750-244-3.

1-6. Administrative Storage

You must prepare the pumping assembly for storage according to procedures given in TM 740-90-1.

Section II. DESCRIPTION AND DATA

1-7. Description

a. Model US37ACG Two-Wheel Mounted Pumping Assembly consists primarily of gasoline engine,

centrifugal pump, and welded frame. The pump is coupled directly to the engine and the pump impeller is mounted on the extended engine crankshaft.

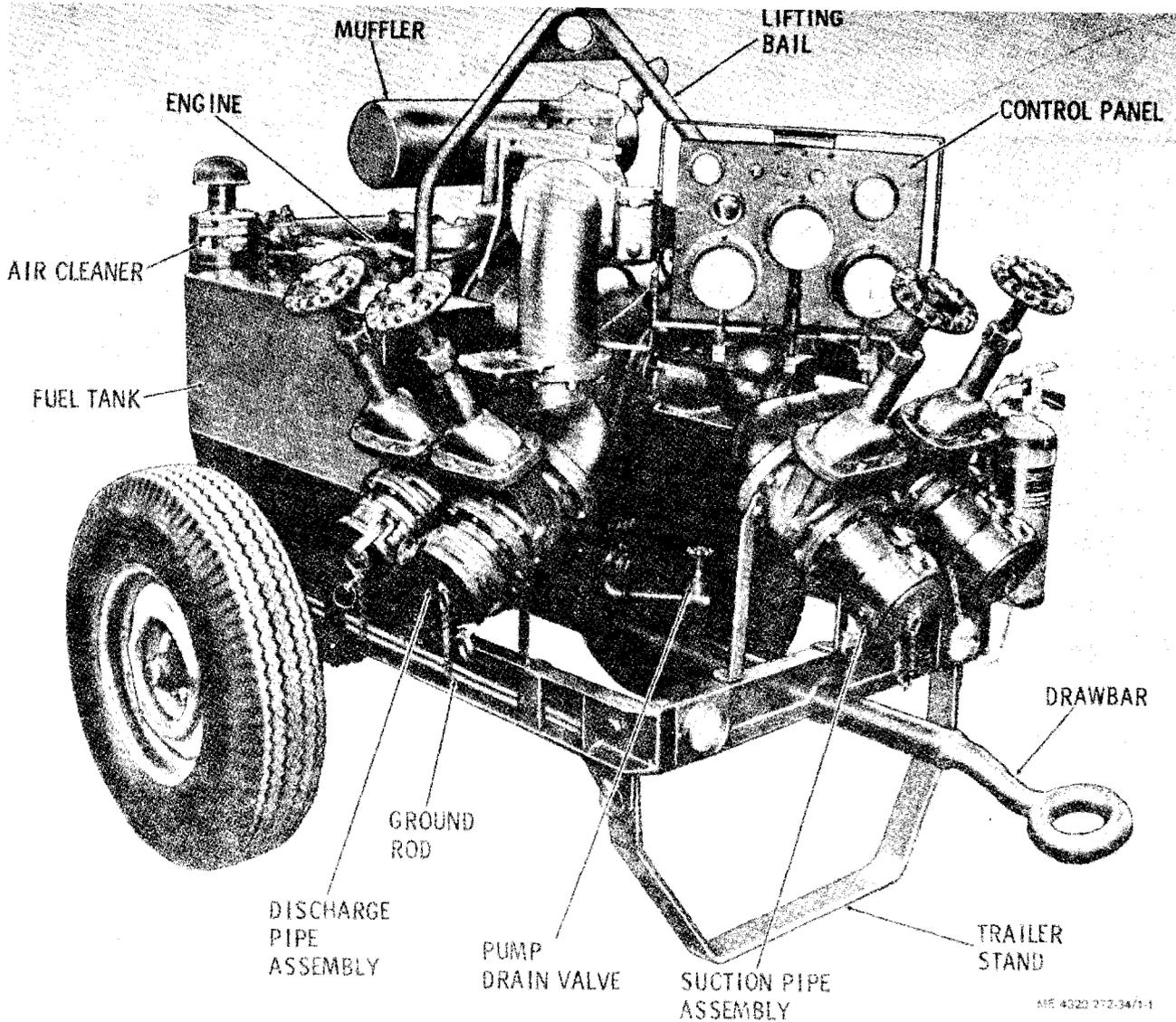
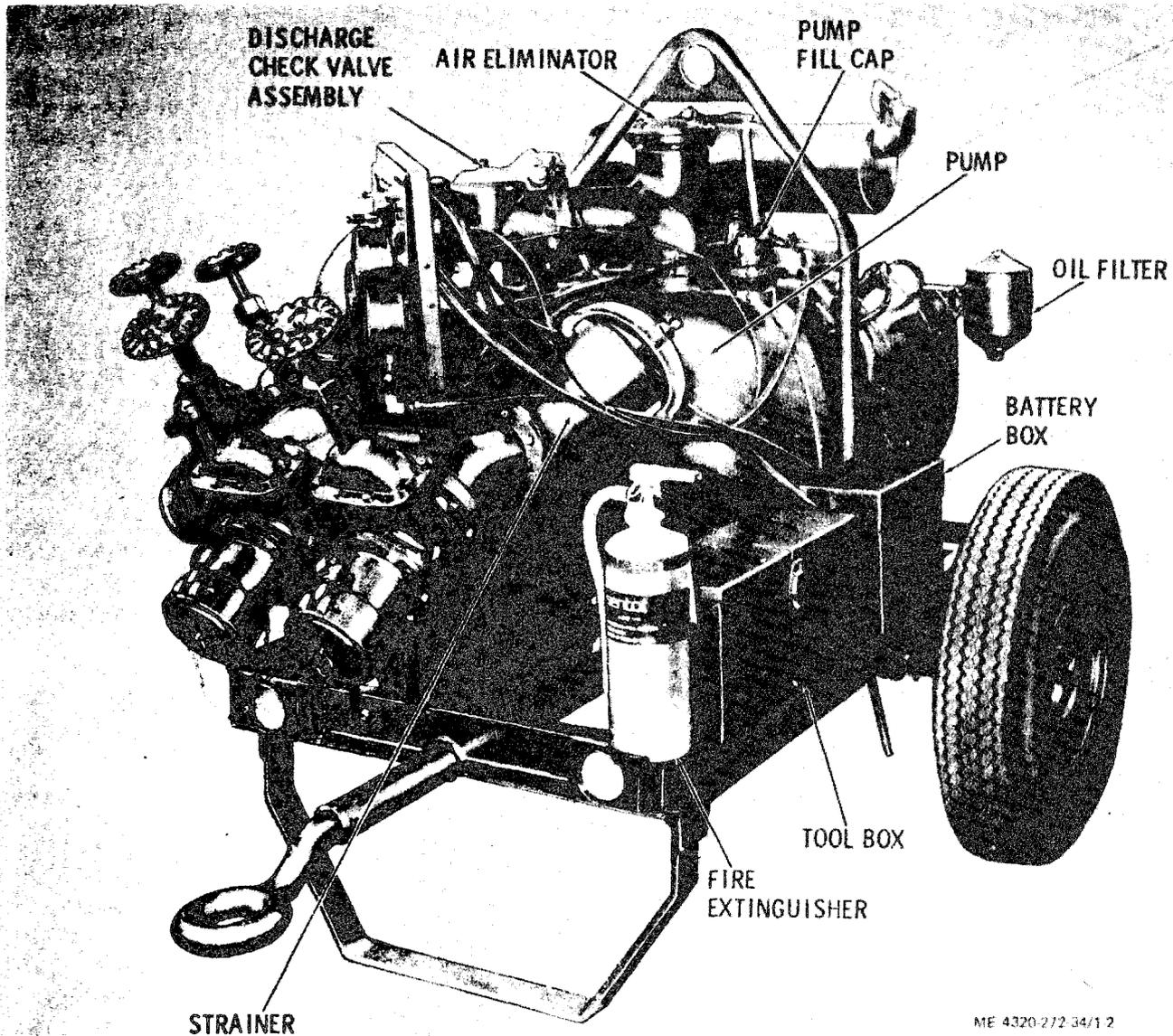


Figure 1-1. Pumping assembly, right three-quarter front view.



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Figure 1-2. Pumping assembly, left three-quarter front view.

b. The engine is a V-type, four-cylinder, air-cooled, pressure-lubricated, four-stroke-cycle unit with an L-head. Engine speed is controlled by the inter-operation of a governor and carburetor. The engine is cooled by a flow of air, circulated over the heads by a combination fan-flywheel enclosed in a sheet metal shroud. The engine uses an electrical starting motor, has magneto ignition, and uses a flywheel alternator to maintain the charge of the battery.

c. The engine and pump are secured to a two-wheeled welded frame. The frame weldment consists primarily of a drawbar, fixed axle, hub assemblies, and pneumatic tires.

d. The repair paragraphs of this manual contain detailed descriptions of centrifugal pump components.

1-8. Differences Between Models

This technical manual covers only Pumping Assembly, Peabody Barnes, Inc. Model US37ACG. No known differences exist for this model number.

1-9. Tabulated Data

a. *Identification.* The pumping assembly has four identification plates, as follows:

(1) *Pump data plate.* The pump data plate is located on a bracket mounted to the discharge piping. It indicates the pump identification number, serial number, dimensions, weight, and shipping information.

(2) *Pump performance plate.* The pump performance plate is located on the inside of the tool box cover. It indicates the pump capacities and performances.

(3) *Engine data plate.* The engine data plate is located on top of the flywheel shroud. It indicates the engine identification numbers, oil and gasoline specifications, operating and maintenance instructions.

(4) *Military data plate.* The military data plate is located on the engine flywheel shroud. It indi-

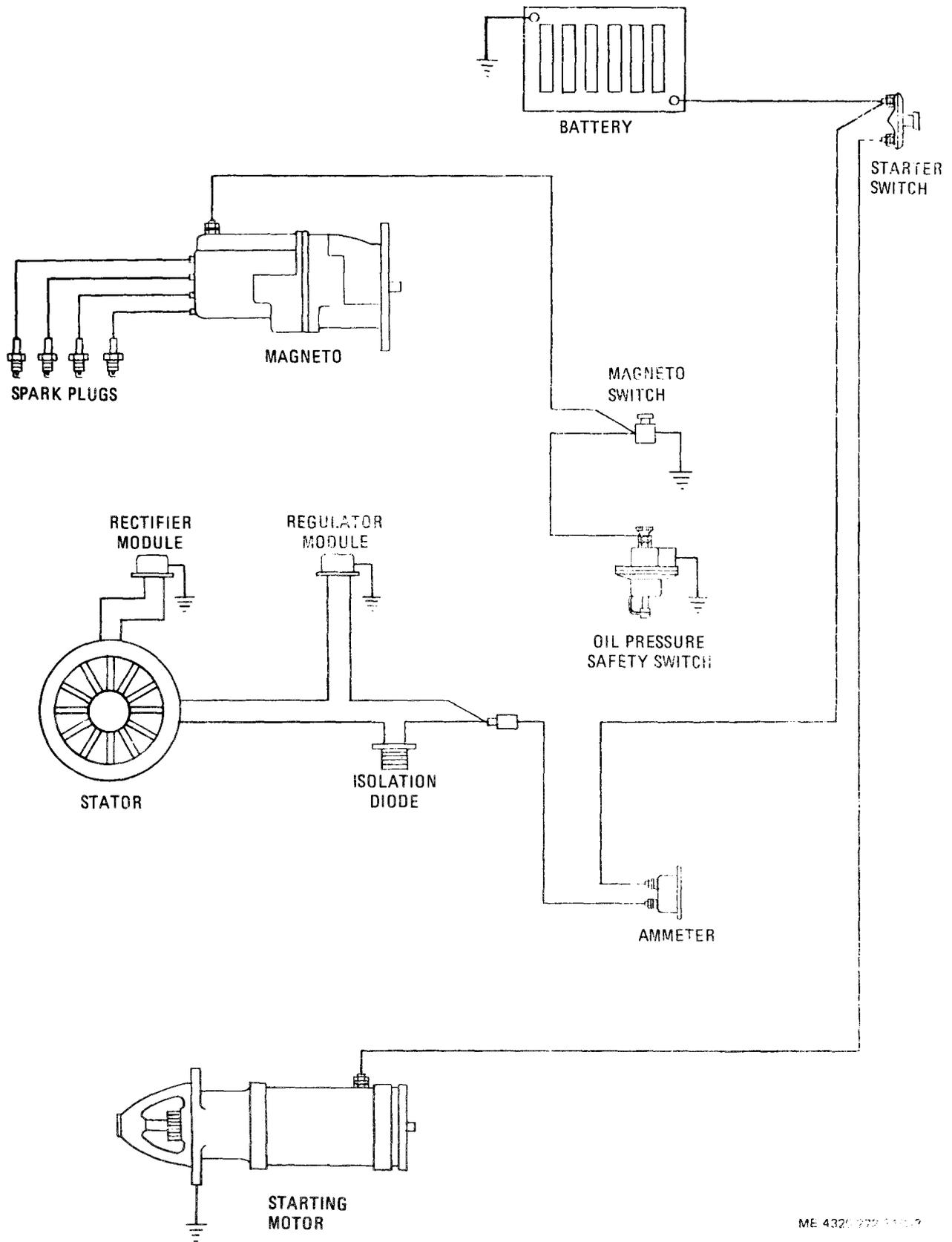
cates the military specification number and issue number.

b. *Tabulated Data.* Tabulated data applicable to the pumping assembly and its components is given in table 1-1.

Table 1-1. Tabulated Data

Manufacturer	Peabody Barnes, Inc.	Fuel strainer	
Model number	US37ACG	Manufacturer	Tillotson
Specification	52549	Part number	OW-444
Serial number range	52549-001 and up	Carburetor	
Type	Self-priming, centrifugal	Manufacturer	Wisconsin
Pumping medium	Flammable liquids	Part number	L57-2S1
Output (at maximum		Air cleaner	
rated speed)	350 gpm	Manufacturer	Donaldson
Total dynamic head	275 feet	Part number	FWA05-2527
Rated driven speed	2350 rpm	Oil filter	
Suction port size	4 in.	Manufacturer	Fram
Discharge port size	4 in.	Part number	F21-P
Engine		Hourmeter-tachometer	
Manufacturer	Teledyne Wisconsin Motor	Manufacturer	Stewart-Warner
Model	MVG4D	Part number	567AAC 2350 rpm
Specification	364739	Gate valve	
Type	Four stroke cycle	Manufacturer	OPW
Number of cylinders	4	Part number	676
Displacement	148.5 cu in.	Size	4 in.
Cooling	Air	Air eliminator	
Crankcase oil capacity		Manufacturer	PeabodyBarnes
(including oil filter)	6 qt	Part number	37458SA
Oil pressure switch cutout	1 psi	Overall dimensions and weight	
Valve clearance (cold)		Overall length	
Intake	0.008 in.	Extended	109 1/2 in.
Exhaust	0.016 in.	Retracted	68 1/2 in.
Spark plug gap	0.030 in.	Overall width	57 1/2 in.
Breaker point gap	0.015 in.	Overall height	62 in.
Firing order	1-3-4-2	Overall weight	1320 lbs.
Governed speed		Shipping weight	1470 lbs.
Full load	2350 rpm	Shipping volume	162 cu ft
Alternator		Engine torque specifications	
Manufacturer	Wisconsin	Torque (ft-lb)
Type	Flywheel mounted	Spark plugs	25-30
Voltage	24	Main bearing plate cap screws	25-30
Amperage output	12	Connecting rod nuts	28-32
Starting motor		Cylinder block mounting nuts	62-78
Manufacturer	Prestolite	Cylinder head cap screws	25-32
Part number	MBP-4018T	Gear cover screws	14-18
Voltage	24	Manifold nuts	30-35
Magneto		Oil pan screws	6-9
Manufacturer	Fairbanks-Morse	Starter mounting screws	20-25
Part number	FM-XZE4B7	Governor mounting nuts	15-20
		Magneto mounting nuts	20-25

c. *Wiring diagram.* Refer to figure 1-3.



ME 4326 278 11012

Figure 1-3. Wiring diagram.

CHAPTER 2
DIRECT SUPPORT AND GENERAL SUPPORT
MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

2-1. Special Tools and Equipment

You do not require any special tools or equipment for the repair and maintenance of the pumping assembly.

2-2. Maintenance Repair Parts

Repair parts and equipment are listed and illustrated

in the repair parts and special tools list covering direct support and general support maintenance for this centrifugal pump. Refer to TM 5-4320-272-34P when you need replacement parts information.

Section II. TROUBLESHOOTING

2-3. General

a. This section contains troubleshooting information for locating and correcting most of the operating troubles which may develop in the pumping assembly. Each malfunction for an individual component, unit, or system is followed by a list of tests or inspections which will help you 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 you experience a malfunction which is not

listed or is not corrected by listed corrective actions, notify your supervisor.

c. Only those functions which are solely within the scope of direct and general support maintenance are listed. For troubleshooting procedures which are within the scope of operator/crew and organizational maintenance, you should refer to TM 5-4320-272-12.

2-4. Direct Support and General Support Maintenance Troubleshooting

Refer to table 2-1 for troubleshooting which is allocated to direct support and general support maintenance levels.

Table 2-1. Troubleshooting

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

ENGINE

1. ENGINE FAILS TO TURN OVER WHEN STARTER BUTTON IS DEPRESSED.

Step 1. Check to see if impeller is binding involute.

Disassemble the pump and free impeller (para 4-3).

Step 2. Check for seized engine.

Remove engine (para 2-10). Repair engine as necessary (refer to chap.3).

2. ENGINE TURNS OVER BUT DOES NOT START.

Test for low engine compression.

Refer to malfunction 3 for corrective action.

3. LOW OR UNEVEN COMPRESSION.

Step 1. Check for damaged cylinder head gasket or loose cylinder head by listening for hissing noise or compression stroke.

Replace head gasket and tighten cylinder head bolts to proper torque.

Step 2. Check for sticking or improperly seating valve.

Free stuck valves. Clean, regrind, or replace burned valves as necessary (para 3-17).

Figure 2-1. Troubleshooting---Continued

MAJFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

ENGINE—Continued

- Step 3. Check for improperly adjusted valve tappets.
Adjust valve tappet clearance (para 3-17).
- Step 4. Check for weak valve springs.
Replace valve springs (para 3-17).
- Step 5. Check for worn piston rings or rings stuck in piston due to carbon accumulation.
Replace piston rings (para 3-15).
- Step 6. Check for scored cylinders.
Rebore the cylinders and fit with oversize pistons and rings. If you find that the cylinders are severely scored, replace the cylinder block (para 3-16).
- Step 7. Check for defective piston or connecting rod.
Replace as necessary (para 3-15).
4. ENGINE RUNS BUT CONTINUOUSLY MISFIRES.
Step 1. Test for uneven compression (TM 5-4320-272-12).
Refer to malfunction 3 for corrective action.
5. ENGINE OVERHEATS.
Step 1. Check for damaged or missing air shrouding.
Repair or replace damaged or missing air shrouding (para 3-7).
Step 2. Check for buildup of carbon on the cylinder head.
Remove carbon and lead deposits with a wire brush and metal scraper (para 3-8).
6. ENGINE LACKS POWER, SMOKES, OR OPERATES ERRATICALLY.
Step 1. Check for sticking valves.
Free stuck valves. Replace or regrind if burned (para 3-17).
Step 2. Check for weak valve springs.
Replace valve springs (para 3-17).
Step 3. Check for worn piston rings.
Replace piston rings (para 3-15).
7. ENGINE MAKES EXCESSIVE NOISE.
Step 1. Check for a buildup of carbon and lead on the cylinder head.
Remove with a wire brush and metal scraper (para 3-8).
Step 2. Check for loose flywheel mounting.
Tighten flywheel mounting nut (para 3-5).
Step 3. Check for loose, burned, or otherwise defective connecting rod bearings.
Replace defective bearings (para 3-15).
Step 4. Check for worn or loose piston pin and bushing.
Replace worn pin and bushing (para 3-15).
Step 5. Check for worn piston.
Replace worn piston (para 3-15).

FUEL SYSTEM

ENGINE SPEED VARIES OR ENGINE SURGES.

- Check for defective governor.
Replace defective governor (para 3-9).

PUMP ASSEMBLY

1. PUMP RUNS WITH NO DISCHARGE OR WITH LOW DISCHARGE
Step 1. Check for a broken, worn, or damaged impeller.
Replace impeller (para 4-3).
Step 2. Check for excessively worn wear rings.
Replace worn wear rings (para 4-3).
Step 3. Check for worn wear plates.
Replace worn wear plates (para 4-3).
2. PUMP MAKES EXCESSIVE NOISE.
Check for loose impeller or wear plates.
Tighten impeller or replace wear plates (para 4-3).

Section III. GENERAL MAINTENANCE

2-5. General

This section contains general maintenance procedures which are the responsibility of direct support and general support maintenance personnel. The paragraphs contained herein describe general practices you will find applicable to several assemblies or components of the pumping assembly which would otherwise have to be repeated in each section of the manual assigned to those assemblies and components.

2-6. Cleanliness

a. Take care to assure that your work area is clean before starting to disassemble the engine or pump parts.

b. Clean the exterior of the engine or pump before starting disassembly to prevent the dirt from entering the bearings. Clean the exterior of engine components with a cloth dampened with cleaning solvent (fed. spec. P-D-680).

c. If you clean the parts with compressed air, make sure it is free from dirt and contaminants.

d. Protect disassembled parts from blowing sand and dust which could later cause rapid wear of the gears, bearings, and machined surfaces.

2-7. Care of Bearings

a. You can clean ball and roller bearings by placing them in a wire basket and immersing in a container of fresh cleaning solvent. Agitate the bearings in the solvent to remove all traces of old lubricant.

b. After the bearings are cleaned, dry them with clean, filtered compressed air. Take care to prevent spinning the bearings when you use a compressed air jet.

c. Dip the cleaned bearings in clean engine oil and immediately wrap them in lint-free paper to prevent the entry of dust and dirt.

2-8. Seals and Gaskets

Replace seals and gaskets of all components you disassemble. The use of new gaskets and seals will greatly reduce the possibility of leaking and will help prevent the entry of dust and dirt after reassembly.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ASSEMBLIES

2-9. Centrifugal Pump.

a. Removal. Remove the centrifugal pump from the engine and trailer as follows:

(1) Disconnect and remove the instrument panel (TM 5-4320-272-12).

(2) Remove the plug (11, fig. 4-1), to drain the pump.

(3) Remove suction and discharge pipe assemblies (TM 5-4320-272-12).

(4) Further removal procedure requires that you disassemble the pump completely. Refer to paragraph 4-3 *a.*

b. Installation. Refer to paragraph 4-3 *c.*

2-10. Engine.

a. Removal. Remove the engine from the centrifugal pump and welded frame as follows:

(1) Remove the centrifugal pump (para 4-3 *a.*)

(2) Disconnect the battery leads at the battery. This will prevent your accidental shorting, grounding, or reverse-polarizing of the electrical system.

(3) Remove drain plug (1, fig. 3-13) and drain engine oil into suitable container.

(4) Disconnect and remove oil tube (2, fig. 3-13) from engine block to oil pressure switch and pressure gage.

(5) Disconnect the fuel lines connecting the engine to the fuel tank.

(6) Remove the cap screws (5), flat washers (6), nuts (3), and lock washers (4) that secure the engine to the trailer frame. Use a suitable lift to lift the engine from the welded frame. Take care that you support engine under structural members only.

b. Installation.

(1) Use a lift to position the engine on the welded frame. Take care that you support the engine under structural members only. Secure the engine to the welded frame with cap screws (5, fig. 3-13), flat washers (6), nuts (3), and lock washer (4).

(2) Install the fuel lines connecting the engine to the fuel tank.

(3) Install and connect the oil tube (2) from the engine block to the oil pressure switch and pressure gage.

(4) With drain plug in place, you can refill the crankcase with oil; refer to TM 5-4320-272-12.

(5) Connect the battery leads.

(6) Install the centrifugal pump (para 4-3 *c.*)

2-11. Axle Assembly

a. Removal.

(1) Hoist each end of the frame and install blocking under it so that the wheels just clear the ground.

(2) Remove tires, wheels, and hubs from the axle (TM 5-4320-272-12).

(3) Support the weight of the axle (13, fig. 5-1) with a floor jack. Remove four nuts (1), lock washers (2), cap screws (3), and bevel washers (4) that secure the top brackets (8) to the frame; remove the assembled axle, brackets, and springs.

b. Installation.

(1) With the pump frame securely and solidly

blocked, use a floor jack to position the assembled axle (13, fig. 5-1) brackets (8 and 9), and springs (11 and 12) so that the mounting holes in the upper bracket are aligned with the holes in the frame. Secure the brackets to the frame with four screws (3), lock washers (2), nuts (1), and bevel washers (4).

(2) Install the hubs, wheels, and tires (TM 5-4320-272-12).

(3) Remove blocking from under frame.

CHAPTER 3

REPAIR OF ENGINE

Section I. GENERAL

3-1. Introduction

This chapter provides you with instructions relating to engine repair and overhaul. It includes information regarding disassembly, inspection of parts to determine if their continued serviceability is possible or if they should be replaced, instructions covering repair techniques such as valve grinding and cylinder honing, reassembly and tolerance checking to assure proper fits and clearances, and other information relating to engine overhaul.

3-2. Description of Engine and Components

a. The engine is a four-cylinder, V-type, air-cooled, pressure-lubricated, four-stroke-cycle unit with an L-type head. The engine has a displacement of 148.5 cubic inches and develops 36.0 horsepower at 2400 rpm. It uses an electrical starting motor, has magneto ignition, and a flywheel alternator to maintain the charge of the battery. When you view the pump end of the engine, the crankshaft has a counterclockwise rotation. The rotating crankshaft not only drives the pump but also drives the magneto, oil pump, and camshaft. The gear train is enclosed by a gear cover and lubricated with oil from the crankshaft.

b. A gear-driven oil pump supplies oil to four nozzles which direct oil streams against the connecting rod caps. Part of the oil lubricates the rod bearing through holes in the rods, and the balance of the oil forms a spray or mist which lubricates the cylinders and all other internal parts of the engine. An external oil line from the oil header tube in the engine block supplies the oil to the oil filter and also to lubricate the governor and gear train. At normal operating temperatures, the oil pressure is from 4 to 5 pounds per square inch. A pressure relief valve is provided in the oil pump which limits the maximum oil pressure to 15 pounds per square inch. An oil pressure safety switch

will shut off the engine when oil pressure falls below 1 pound per square inch.

c. The engine electrical system has a negative ground. A flywheel alternator is used to maintain a proper battery charge. The flywheel alternator is a permanent magnet type and has no brushes, commutator, or adjustments. The stator, comprised of a series of coils, is mounted on the engine gear cover the magnetic flux is provided by a permanent magnet in the flywheel which rotates around these stationary coils. A center-tap rectifier arrangement prevents damage to the alternator system, in the event of incorrect battery connection. Two ground rods are provided to insure proper grounding of the welded frame.

d. The cooling of the engine is accomplished by a flow of air, circulated over the cylinder blocks by a combination fan-flywheel encased in a sheet metal shroud. The air is divided and directed by additional shrouding and baffle plates to insure uniform cooling of all parts.

e. The speed of the engine is controlled by the inter-operation of a fixed speed governor and the carburetor. A governor variable speed control regulates the governed speed of the engine. The centrifugal flyball-type governor rotates on a ball-bearing supported shaft and is driven off the camshaft gear. As the engine speed increases, the governor converts the centrifugal force to an axial motion which acts against the governor lever and spring this closes the throttle to a point where engine speed will be maintained practically constant under varying load conditions.

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

Table 3-1 lists engine fits, tolerances, and wear limits. Refer to the table to help you determine if parts replacement is required or if continued serviceability of the parts is possible.

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

Component points of measurement	Normal clearances (in inches)		Maximum allowable clearance
	Minimum	Maximum	
Piston to cylinder (at piston skirt thrust faces)	0.0052	0.0062	0.0112
Piston ring gap			
Top ring	0.0020	0.0040	
2nd ring	0.0015	0.0035	
3rd and 4th groove oil rings	0.0010	0.0030	
Connecting rod to crankpin side clearance	0.0080	0.0150	
Connecting rod shell bearing to crankpin bearing journal	0.0015	0.0030	
Piston pin to piston	0.0000	0.0003	
Piston pin to connecting rod sleeve bearings	0.0002	0.0007	0.0080
Valve stems to guides	0.0025	0.0045	
Crankshaft end play	0.0020	0.0050	
Idle gear to shaft shoulder	0.0030	0.0040	

Section II. ENGINE OVERHAUL AND REPAIR

NOTE

Major repair or overhaul requires that the engine be mounted on an engine overhaul stand. You will find it convenient to remove all engine accessories first. Refer to TM 5-4320-272-12.

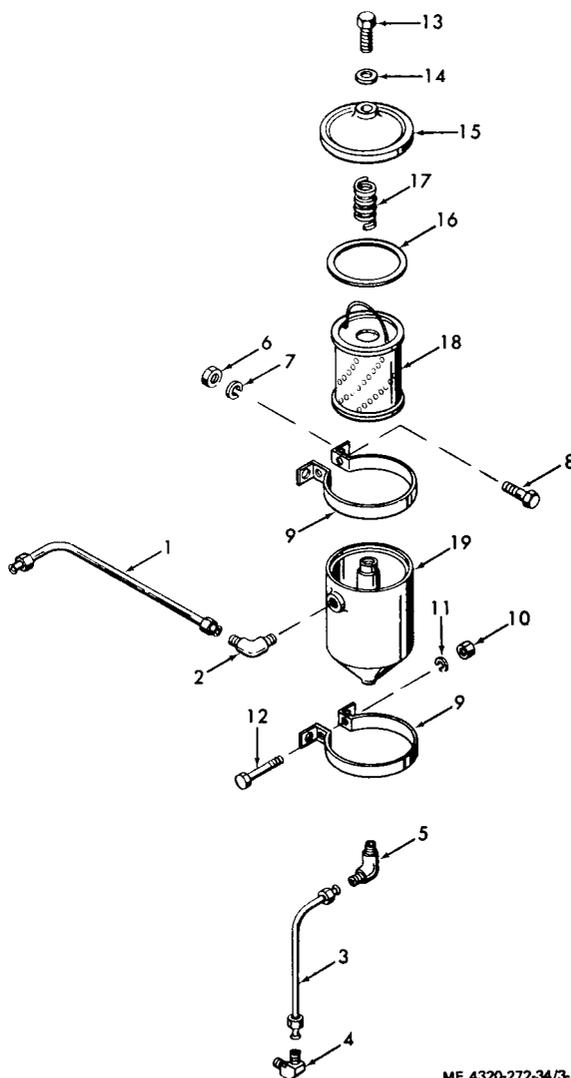
3-4. Oil Filter

a. Removal and Disassembly.

(1) Remove the drain plug (1, fig. 3-13) and drain the engine oil into a suitable container.

(2) Disconnect the oil tube from the governor.

(3) Remove and disassemble the oil filter and lines as shown in figure 3-1.



KEY to fig. 3-1:

- | | |
|---------------------|---------------------|
| 1. Tube | 11. Lock washer |
| 2. Elbow | 12. Screw |
| 3. Tube | 13. Cover screw |
| 4. Elbow | 14. Screw gasket |
| 5. Elbow | 15. Cover |
| 6. Nut | 16. Cover gasket |
| 7. Lock washer | 17. Spring |
| 8. Screw | 18. Filter element |
| 9. Oil filter clamp | 19. Oil filter body |
| 10. Nut | |

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Figure 3-1. Engine oil filter, exploded view.

b. Cleaning and Inspection.

(1) Discard and replace the oil filter element and gaskets.

(2) Clean all remaining parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly. Blow out tubes with compressed air.

(3) Inspect the tubes for dents, cracks, damaged tube nuts, and collapsed walls; replace damaged tubes.

(4) Inspect the filter body and cover for cracks, distortion, dents, damaged threads, and other damage; replace a damaged body or cover.

(5) Inspect all other parts for cracks, distortion, and damaged threads. Replace damaged parts.

c. Reassembly and Installation. Reassembly and installation are the reverse of removal and disassembly. Refer to figure 3-1. With drain plug in place, refill crankcase with engine oil; refer to LO 5-4320-272-12. After you install the oil filter, start the engine and check for oil leaks. Correct any leaks.

3-5. Flywheel

a. Removal.

(1) Remove the eight screws (1, fig 3-3) and lock washers (2) securing the flywheel screen (3) to the flywheel shroud (12).

(2) After you remove the screen, take off the drive pulley (4, fig. 3-11) by removing the cap screws (2) and lock washers (3) that secure it to the flywheel (8).

(3) Drive out pin (5) and remove nut (6) and lock washer (7) that secure the flywheel to the crankshaft (30).

CAUTION

The flywheel weighs approximately 50 lbs. Take care when you remove it.

(4) Remove the flywheel (8) by taking a firm hold on the flywheel fins, pulling outward while you strike the end of the crankshaft with a plastic hammer. Do not use a hard hammer as you may damage the crankshaft and bearings. The flywheel will slide off the taper of the crankshaft. Take care when you remove the flywheel that no damage occurs to the alternator stator which is mounted behind the flywheel. Remove woodruff key (9).

b. Cleaning and Inspection.

(1) Clean the flywheel with cleaning solvent (fed. spec. P-D-680) and dry thoroughly.

(2) Inspect the flywheel for bent or broken fins, chipped, cracked, or broken teeth on the ring gear, damaged or worn bore, distortion, or other damage. Inspect the magnetic rotor insert for damage or signs of contact with the stator.

(3) Replace the flywheel assembly if inspection indicates damage.

c. Installation.

(1) Install the woodruff key (9, fig. 3-11) in the crankshaft keyway. Position the flywheel (8) on the crankshaft so that the keyway dines with the woodruff key in the shaft keyway. Tap onto shaft with soft hammer.

(2) Secure the flywheel to the crankshaft with nut (6) and lock washer (7).

(3) Drive in hand crank pin (5) so that ends protrude evenly.

(4) Install the drive pulley (4) and secure it to the flywheel with cap screws (2) and lock washers (3).

(5) Secure the flywheel screen (3, fig. 3-3) with cap screws (1) and lock washers (2).

3-6. Flywheel Alternator

a. Testing. Testing of the alternator and components shall be done while the parts are mounted on the engine. Test before disassembling the parts. The rectifier and regulator modules and the isolation diode are grounded to the engine so that they cannot be tested while mounted at a remote location. Before conducting the following tests to determine the condition of the components, check to insure that you have good continuity between the modules and the engine. These are static tests which do not require that you run the engine. Disconnect battery leads and uncouple the connectors that connect the modules to the stator leads.

(1) To check for stator continuity, use a multimeter with R x 1 scale (minimum sensitivity of 20,000 ohm/volts), and check as follows:

(a) With positive meter probe connected to black wire No. 1 and negative probe connected to black wire No. 2, the multimeter should indicate approximately 1.00 ohm resistance. Replace stator if multimeter indicates a short (no resistance) or open (infinite resistance) circuit.

(b) With positive meter probe connected to black wire No. 1 and negative probe connected to the dark blue wire (center tap), the resistance should be approximately 0.50 ohm.

(c) With positive meter probe connected to black wire No. 2 and negative probe connected to the dark blue wire (center tap), the resistance should be approximately 0.50 ohm.

(d) With the positive meter probe connected to black lead No. 1 and negative probe connected to the red lead, the resistance should be 2.75 ohms.

(e) With the positive meter probe connected to black lead No. 2 and negative probe connected to the red lead, the resistance should be 1.75 ohms.

(f) If any of these tests indicate a short or open circuit, you must replace the stator.

(g) Any connection between a lead and

engine ground should indicate infinite resistance. Any other reading indicates that a short circuit exists and you must replace the stator.

(2) To check the rectifier module, which you can distinguish from the regulator by the two black leads, use a multi meter and static check continuity as follows:

(a) With the positive meter probe connected to the engine ground and the negative probe connected to black lead No. 1, the meter should indicate 5 to 15 ohms resistance.

(h) With the positive meter probe connected to black lead No. 1 and the negative probe connected to the engine ground, the resistance shall be infinite. Any other reading indicates that a short circuit exists and you must replace the rectifier.

(c) With the positive meter probe connected to the engine ground and the negative probe connected to black lead No 2, the resistance shall be 5 to 15 ohms.

(d) With the positive meter probe connected to black lead No. 2 and the negative probe connected to the engine ground, the resistance shall be infinite. Any other reading indicates that a short circuit exists and you must replace the rectifier.

(3) Check the regulator module, which you can distinguish from the rectifier module by the red and black leads. Using a multimeter, all continuity checks shall indicate infinite resistance. Any other reading indicates that a short circuit exists and that you must replace the regulator module. The multimeter probe connections shall be as follows:

(a) Positive probe connected to red lead. Negative probe connected to engine ground.

(b) Positive probe connected to engine ground. Negative probe connected to red lead.

(c) Positive probe connected to red lead. Negative probe connected to black lead.

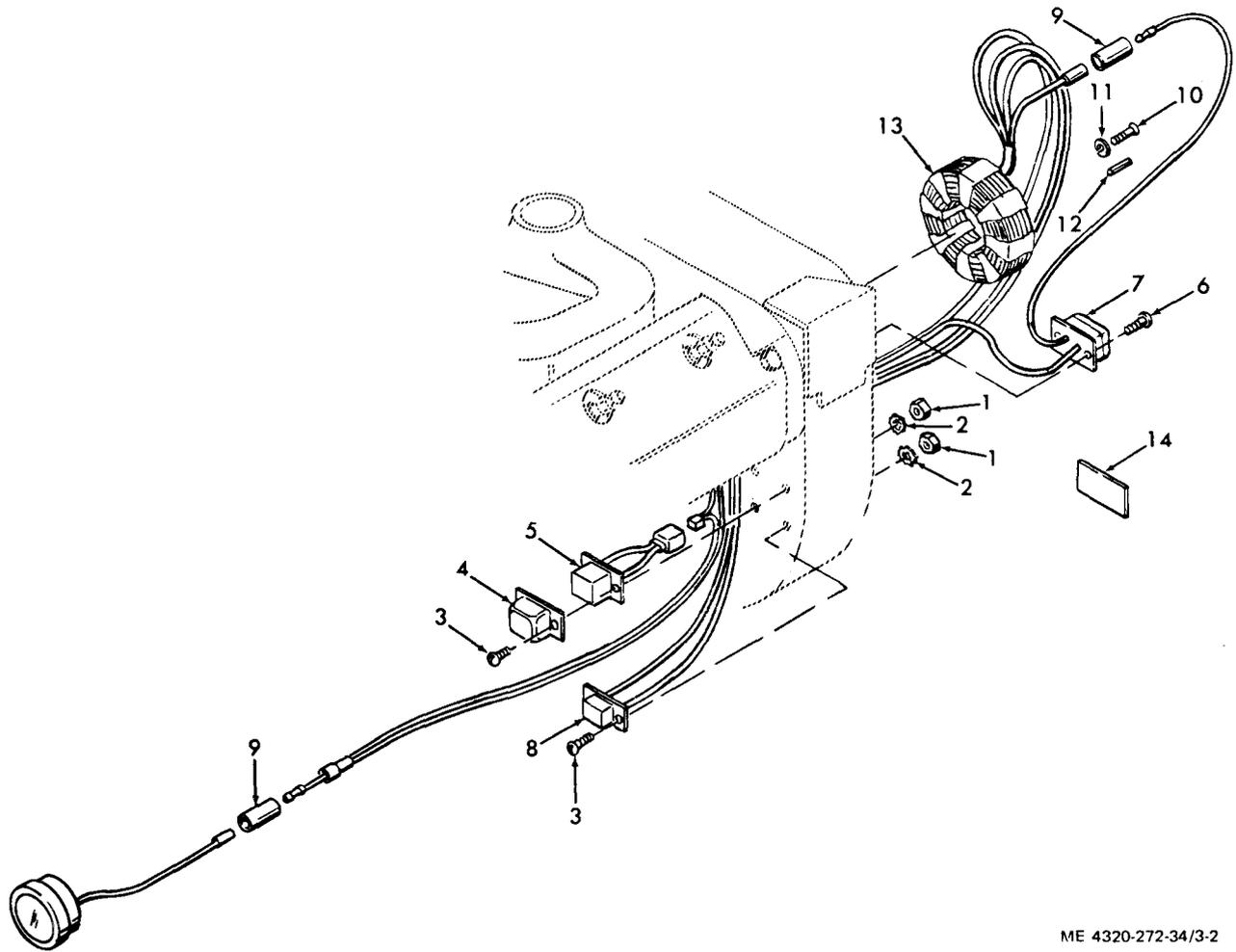
(d) Positive probe connected to black lead. Negative probe connected to red lead.

(e) Positive probe connected to black lead. Negative probe connected to engine ground.

b. Removal.

(1) Remove the flywheel from the engine (para 3-5).

(2) Remove the screws (3, fig. 3-2), lock washers (2), and nuts (1) securing the rectifier module (8), regulator module (5), and shield (4). Remove the screws (6) securing the isolation diode (7).



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- | | |
|---------------------|---------------------|
| 1. Nut | 8. Rectifier module |
| 2. Lock washer | 9. Insulator |
| 3. Screw | 10. Screw |
| 4. Regulator shield | 11. Lock washer |
| 5. Regulator module | 12. Pin |
| 6. Screw | 13. Stator assembly |
| 7. Isolation diode | 14. Decal |

Figure 3-2. Flywheel alternator, exploded view.

(3) You can now remove the stator (13) by removing screws (10), lock washers (1) , and pins (12) that secure the stator to the flywheel shroud and engine gear cover.

c. Cleaning and Inspection.

(1) Clean metal parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly. Clean all non-metallic parts with a cloth dampened lightly with cleaning solvent. Take care to prevent saturating the stator coils when you clean these parts.

(2) Inspect all leads for frayed wires, or loose connections; replace all damaged leads.

(3) Inspect the stator for damaged insulation, gouges, and other damage. Replace a damaged stator.

(4) Inspect inserts in flywheel for loss of magnetism.

d. Installation. Refer to figure 3-2 and install alternator components in the reverse order of removal. When installing the modules, you must make sure the bases of the modules make contact with a clean mounting surface on the engine, free of paint, dirt, oil, rust, and grease. This will provide the necessary ground contact for the modules, as well as a means of dissipating heat.

3-7. Air Shrouding

CAUTION

Do not operate the engine with any part of the air shrouding removed. This will retard the air cooling and cause overheating.

a. Removal.

(1) Remove the oil filter (para 3-4.)

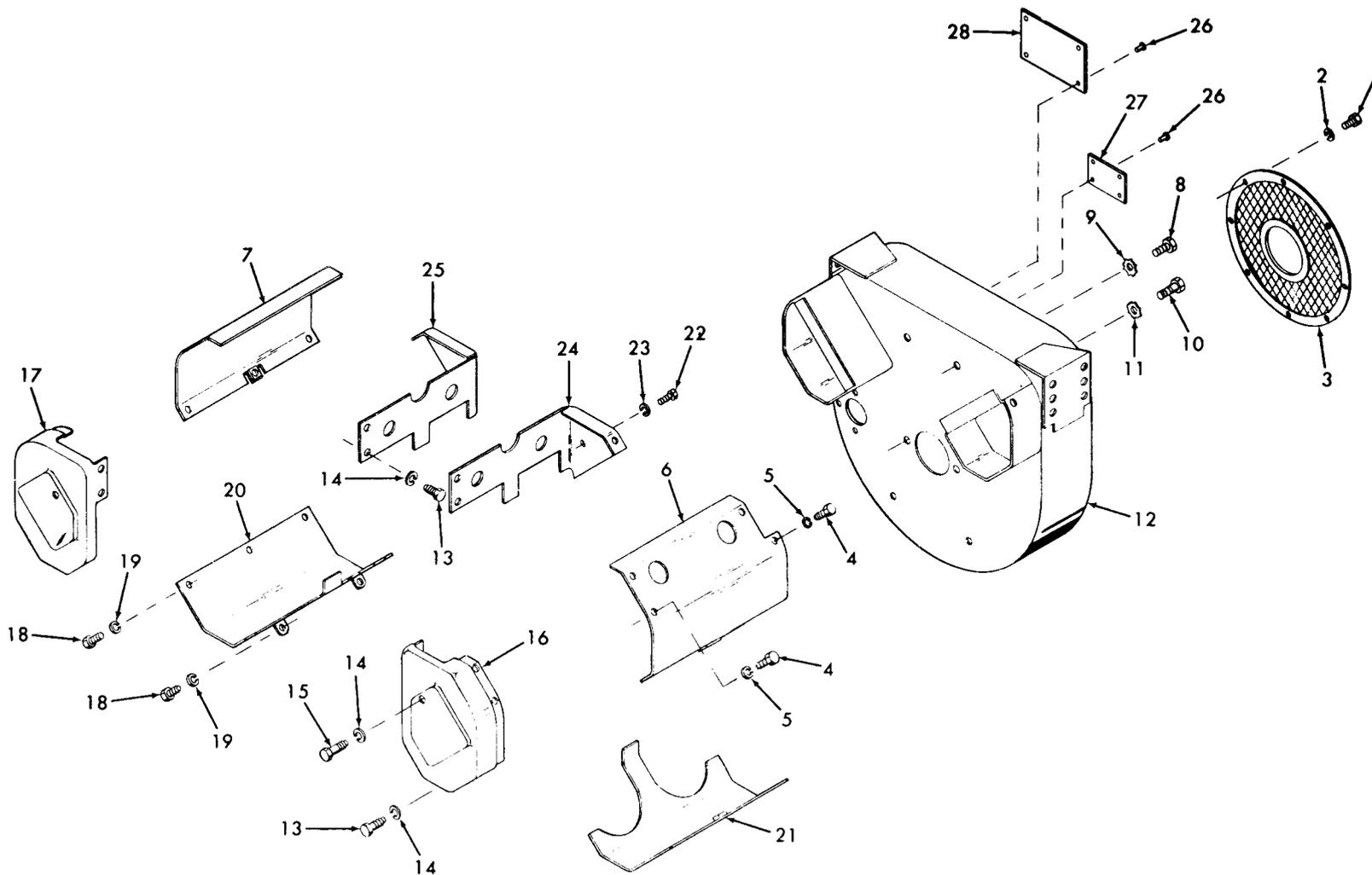
(2) Remove the flywheel assembly from the engine (para 3-5).

(3) Remove the flywheel alternator from the engine (para 3-6).

(4) Remove the cylinder head shrouds (6 and 7, fig. 3-3) by removing screws (4) and lock washers (5).

KEY to fig. 3-3:

1. Screw
2. Lock washer
3. Flywheel screen
4. Screw
5. Lock washer
6. Left hand cylinder head shroud
7. Right hand cylinder head shroud
8. Screw
9. Lock washer
10. Screw
11. Lock washer
12. Flywheel shroud
13. Screw
14. Lock washer
15. Screw
16. Left hand rear shroud cover
17. Right hand rear shroud cover
18. Screw
19. Lock washer
20. Right hand lower cylinder shroud
21. Left hand lower cylinder shroud
22. Cap screw
23. Lock washer
24. Left hand cylinder heat deflector
25. Right hand cylinder heat deflector
26. Rivet
27. MS plate
- 28i. Instruction plate



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Figure 3-3. Air shrouding, exploded view.

(5) Remove the screws (18) and lock washers (19) mounting the flywheel shroud (12) to the lower cylinder shrouds (20 and 21) and cylinder heat deflectors (24 and 25).

(6) Remove the flywheel shroud (12) by removing screws (8 and 10) and lock washers (9 and 11) securing it to the engine gear cover.

(7) Remove rear shroud covers (16 and 17) by removing screws (13 and 15) and lock washers (14).

(8) Remove the lower cylinder shrouds (20 and 21) by removing the screws (18) and lock washers (19).

(9) Before you can remove the cylinder heat deflectors (24 and 25), you will have to remove the carburetor and manifolds (TM 5-4320 -272-12). You will also have to remove the governor bracket mounting screws (14 and 15, fig. 3-5).

b. Cleaning and Inspection.

(1) Clean the parts of the air shrouding with a cloth dampened with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(2) Inspect all parts for rust, corrosion, cracks, chipped paint, dents, and distortion before you reinstall them. Straighten dented and distorted panels enough to reuse them. If the distortion is severe, you must replace the shrouding. Remove rust and corrosion with sandpaper, rubbing until the surface is clean and bright. Prime and paint the bare surfaces.

c. *Installation.* Installation of the air shrouding is the reverse of removal. Refer to figure 3-3.

3-8. Cylinder Head

a. Removal.

(1) Remove the oil filter from the flywheel shrouding (para 3-4).

(2) Remove the flywheel assembly from the engine (para 3-5).

(3) Remove the flywheel alternator (para 3-6).

(4) Remove the carburetor and manifolds (TM 5-4320-272-12).

(5) Remove the air shrouding (para 3-7).

(6) Remove 17 cap screws (1, fig. 3-10) and flat washers (2) securing cylinder head (3) to cylinder block (8); remove cylinder head and gasket (4).

b. Cleaning and Inspection.

(1) Remove all carbon and lead deposits from combustion areas with a wire brush and scraper. Clean the cylinder head with cleaning solvent (fed. spec. P-D-680). Dry thoroughly with clean, dry compressed air.

(2) Clean the top of the cylinder block (8, fig. 3-10) while the head is removed. You can do this with a scraper and a cloth dampened in cleaning solvent (fed. spec. P-D-680). You must be very careful not to get dirt in the cylinders.

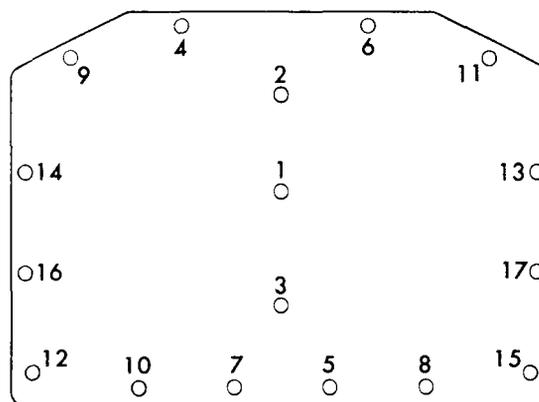
(3) Inspect the cylinder head for cracks. broken cooling fins, corrosion, damaged threads in spark plug ports, or other defects.

(4) Replace cylinder head gasket (4) and any defective parts.

c. Installation.

(1) Use a new gasket (4, fig. 3-10) when you install the cylinder head (3). Installation is the reverse of removal. Refer to items 1 through 4 of figure 3-10.

(2) Tighten the cylinder head screws (1) in the sequence shown in figure 3-4 to help insure proper seating of the cylinder head. First install all screws so that they are just snug, then tighten them in increments in the required sequence to prevent undue stress on any part of the cylinder head. When you tighten them the last increment, torque the screws to 25 to 32 foot-pounds.



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Figure 3-4. Cylinder head cap screw tightening sequence.

NOTE

After you have completed the engine reassembly and have run in the engine, retighten the cylinder head screws in the required sequence to the torque indicated above.

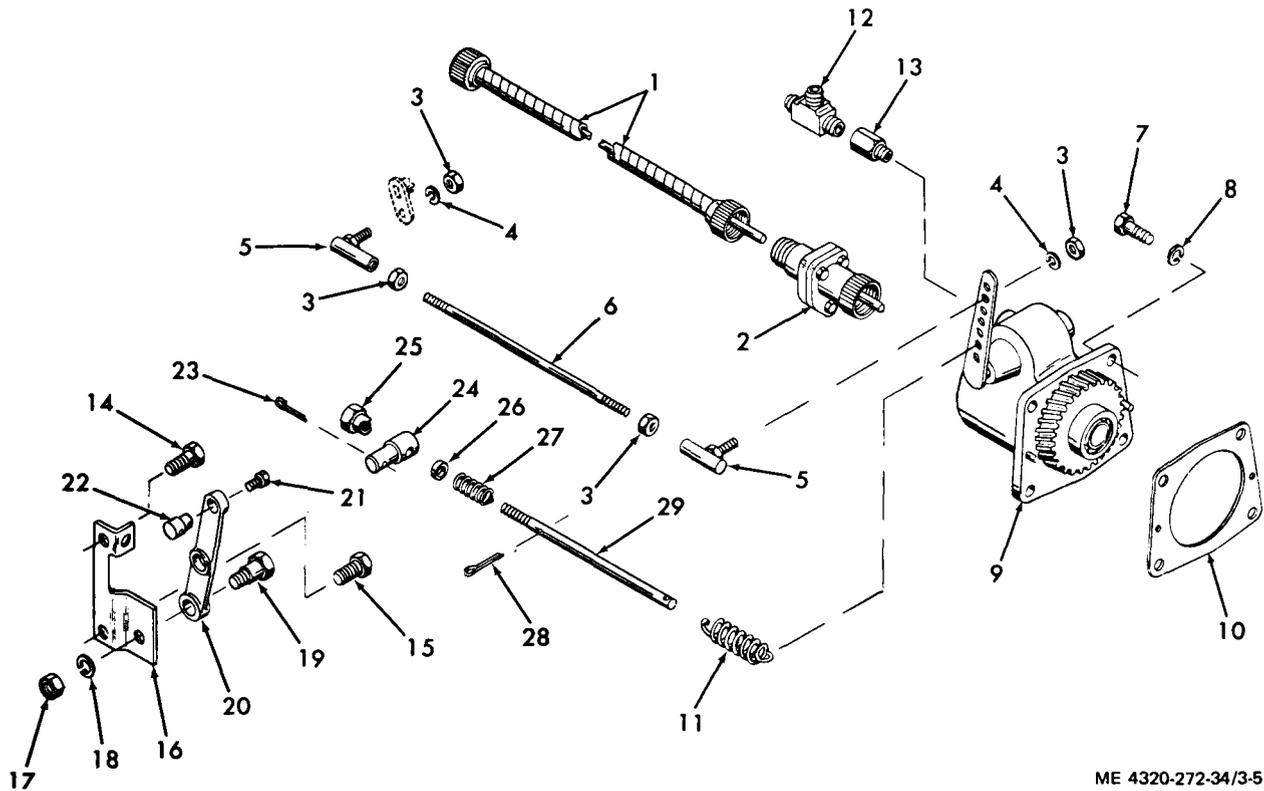
3-9. Governor and Controls

NOTE

For an operational description and instructions for adjustment of the governor, you can refer to TM 5-4320-272-12. The governor can be removed with the engine mounted on the pumping assembly.

a. Removal.

(1) Disconnect the oil tube (2, fig. 3-13) from the governor (9, fig 3-5) to the crankcase. Disconnect the oil tube (1, fig. 3-1) to the oil filter.



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- | | |
|-------------------|-----------------------|
| 1. Flexible shaft | 16. Bracket |
| 2. Drive adapter | 17. Nut |
| 3. Nut | 18. Lock washer |
| 4. Lock washer | 19. Lever fulcrum pin |
| 5. Ball joint | 20. Control lever |
| 6. Control rod | 21. Screw |
| 7. Screw | 22. Wire Connector |
| 8. Lock washer | 23. Cotter pin |
| 9. Governor | 24. Pin |
| 10. Gasket | 25. Lock nut |
| 11. Spring | 26. Retainer |
| 12. Tee | 27. Spring |
| 13. Adapter | 28. Cotter pin |
| 14. Screw | 29. Adjusting screw |
| 15. Screw | |

Figure 3-5. Governor and controls, exploded view,

(2) Remove carburetor and manifolds. Refer to TM 5-4320-272-12.

(3) Disconnect hourmeter-tachometer drive adapter (2, fig. 3-5) from governor (9). Take care that you do not kink or otherwise damage the flexible shaft (1).

(4) Unhook governor spring (11) from the governor lever and adjusting screw (29).

(5) Disconnect the governor control rod linkage from the carburetor throttle lever by removing nuts (3) and lock washers (4).

(6) Disassemble the control rod linkage by removing ball joints (5) and nuts (3) from the control rod (6).

(7) Remove four screws (7) and lock washers (8) securing governor assembly (9) to gear cover.

(8) You can now withdraw the entire governor assembly from the gear cover. Remove governor housing gasket (10).

(9) Disconnect speed control from governor control by loosening wire connector screw (21); withdraw speed control wire from connector (22).

(10) Remove the governor control assembly by removing screws (14 and 15) securing it to the cylinder block and heat deflector.

b. Governor Control Disassembly.

(1) After you have removed governor control, disassemble by removing lever fulcrum pin (19, fig.

3-5), lock washer (18), and nut (17) securing control lever (20) to bracket (16).

(2) Remove screw (21) and control wire connector (22) from lever.

(3) Remove cotter pin (23) that secures adjusting screw pin (24) in control lever; withdraw pin.

(4) Remove adjusting screw lock nut (25); remove adjusting screw pin (24), spring retainer (26), spring (27) and cotter pin (28) from adjusting screw (29).

c. Cleaning and Inspection.

(1) Clean the exterior of the governor with a cloth dampened with cleaning solvent (fed. spec. P-D-680). Wipe dry. With the bearing exposed on the end of the governor shaft, you should take care against the entry of dust and dirt.

(2) Clean the governor control parts with cleaning solvent; dry thoroughly.

(3) Inspect the governor shaft bearing for rough, catching or binding operation. Check the balls for scoring and check the races for damage. If you find the bearing is damaged replace the governor assembly.

(4) Inspect the drive gear for damaged gear teeth. If gear is damaged, replace governor.

(5) Inspect the governor for cracks, wear, and other obvious damage. By rotating the drive gear, you can check the governor drive shaft. It must turn freely without catching or binding. Check the movement of the lever governing shaft in its needle bearings. It must pivot freely without catching or binding and without excessive play. Replace a damaged governor.

(6) Discard and replace the governor housing gasket (10, fig. 3-5).

(7) Inspect the control lever (20) for wear and distortion. Insert the lever fulcrum pin (19) into the pivot of the lever to check the parts for wear. There should be no more than just perceptible clearance. Replace parts if worn.

(8) Inspect all remaining parts for cracks, distortion, wear, or other damage. Replace all damaged parts.

d. Assembly and Installation.

(1) Using a new governor housing gasket, assemble and install the governor and controls in the reverse order of removal and disassembly. Refer to figure 3-5. When you install the governor mounting screws (7), tighten them to 15 to 20 foot-pounds torque.

(2) Adjust the governor as directed in TM 5-4320-272-12.

3-10. Gear Cover

NOTE

Th gear cover cannot be removed without first removing the magneto. You should have removed this and other engine accessories before starting a

major repair or overhaul. For removal of engine accessories, refer to TM 5-4320-272-12.

a. Removal.

(1) Remove the oil filter from flywheel shrouding (para3-4).

(2) Remove the flywheel assembly from the engine (para 3-5).

(3) Remove the flywheel alternator (para 3-6).

(4) Remove the carburetor and manifolds (TM 5-4320-272-12).

(5) Remove the air shrouding (para 3-7).

(6) Remove the governor assembly (para 3-9).

(7) Using a drift, drive the two pins (10, fig. 3-13) from the gear cover (15) and engine block (54).

(8) Remove the four screws (11) and lock washers (12) that secure the gear cover spacer (40) to the gear cover (15).

(9) Remove the screws (13) and lock washers (14) securing the gear cover (15) to the engine block. You can now remove the gear cover (15) and gasket (16) by sliding them off the crankshaft.

(10) With the gear cover removed, the timing gears are exposed. You should now remove the crankshaft oil deflector (10, fig. 3-11) and the camshaft thrust plunger (1, fig. 3-12) and spring (2) to prevent them from being lost during further overhaul.

(11) Press the front oil seal (17, fig. 3-13) from the gear cover.

b. Cleaning and Inspection.

(1) Discard and replace all gaskets and seals.

(2) Clean the gear cover with cleaning solvent (fed. sec. P-D-680) and dry thoroughly.

(3) Inspect the gear cover for cracks, distortion, damaged or marred sealing surfaces, and other damage; replace a damaged gear cover.

(4) Inspect the camshaft thrust plunger button (18, fig. 3-13) for cracks, distortion, wear or other damage; replace if damaged.

c. Installation. Using new gasket and oil seal, install the gear cover in the reverse order of removal. Tighten the gear cover screws to 14 to 18 foot-pounds torque. Tighten the screws evenly and alternately in sequence to prevent undue strain on the gear cover.

3-11. Idler Gear and Shaft

a. Removal.

(1) Remove gear cover as directed in paragraph 3-10 *a.*

(2) Remove the setscrew (19, fig. 3-13) which locks the idler gear shaft (20) in position on the magneto side of the crankcase.

(3) You can remove the idler gear shaft (20) and idler gear (21) by using a puller as shown in figure 3-6.

NOTE

The hole in the end of the idler shaft is tapped 3/8"-16.

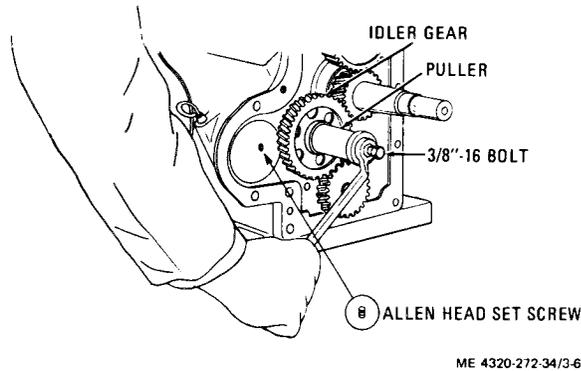


Figure 3-6. Idler gear and shaft removal.

c. Cleaning and Inspection.

(1) Clean the idler gear and shaft with cleaning solvent (fed. spec. P-D-680) and dry thoroughly.

(2) Inspect the idler gear for cracks, distortion, chipped, cracked, or broken teeth. Replace idler gear if damaged.

(3) Check the idler gear shaft for cracks, distortion, or excessive wear of shaft or shoulder. Replace worn or damaged shaft.

c. Installation.

(1) In installing the idler gear shaft, you must be sure the oil groove in the shaft is facing up. Place the idler gear on shaft before you drive shaft into crankcase. Use a plastic hammer. Take care to maintain a 0.003- to 0.004-inch clearance between idler gear hub and shoulder to shaft. Retain shaft by installing the setscrew (19, fig. 3-13).

(2) Install the gear cover (para 3-10).

(3) Install the governor assembly (para 3-9).

(4) Install the air shrouding (para 3-7).

(5) Install the carburetor and manifolds (TM 5-4320-272-12).

(6) Install the flywheel alternator (para 3-6).

(7) Install the flywheel assembly to the engine (para 3-5).

(8) Install the oil filter to the flywheel shrouding (para 3-4).

3-12. Oil Pan

a. Removal.

(1) If you have not already drained oil for engine overhaul, remove the drain plug (1, fig. 3-13) and drain the engine oil into a suitable container.

(2) Remove the 14 screws (22) and lock washers (23) that secure the oil pan (24) to the crankcase; remove the oil pan and gasket (25).

b. Cleaning and Inspection.

(1) Discard and replace oil pan gasket (25, fig. 3-13).

(2) Clean oil pan (24) and drain plug (1) with cleaning solvent (fed. spec. P-D-680; dry thoroughly).

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

c. *Installation.* Use new gasket (25, fig. 3-13) when you install oil pan (24). Install in reverse order of removal. Be sure to note the following

(1) Install the oil pan with the deep end toward the oil pump.

(2) Tighten the oil pan mounting screws (22) to 6 to 9 foot-pounds torque. Tighten the screws evenly and alternately in increments to prevent undue stress on the oil pan.

(3) Refill crankcase with oil before restoring the engine to service. Refer to LO 5-4320-272-12.

3-13. Oil Filler and Level Gage

a. Removal.

(1) To remove oil filler and breather cap (29, fig. 3-13), hold filler tube (30) securely. Rotate cap and pull at the same time.

(2) To remove oil filler tube, rotate and pull from engine block. Remove oil strainer (31).

(3) Remove oil level gage rod (32); remove adapter tube (33) if it is damaged.

b. Cleaning and Inspection.

(1) Clean all parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(2) Inspect the oil strainer (31, fig. 3-13) for distortion, damaged sealing surfaces, holes in the screen, clogging, or other damage. Replace a damaged strainer.

(3) Inspect the oil level gage rod (32), making sure it is straight and in good condition.

(4) Check all parts for cracks, dents, distortions, or other damage; replace damaged parts.

c. *Installation.* Install oil filler and level gage in the reverse order of removal. Use Loctite to secure adapter tube (33, fig. 3-13) in engine block. The filler tube (30) is a push fit in the block. If necessary, rotate the tube back and forth to seat it fully.

3-14. Engine Oil Pump

a. Removal and Disassembly.

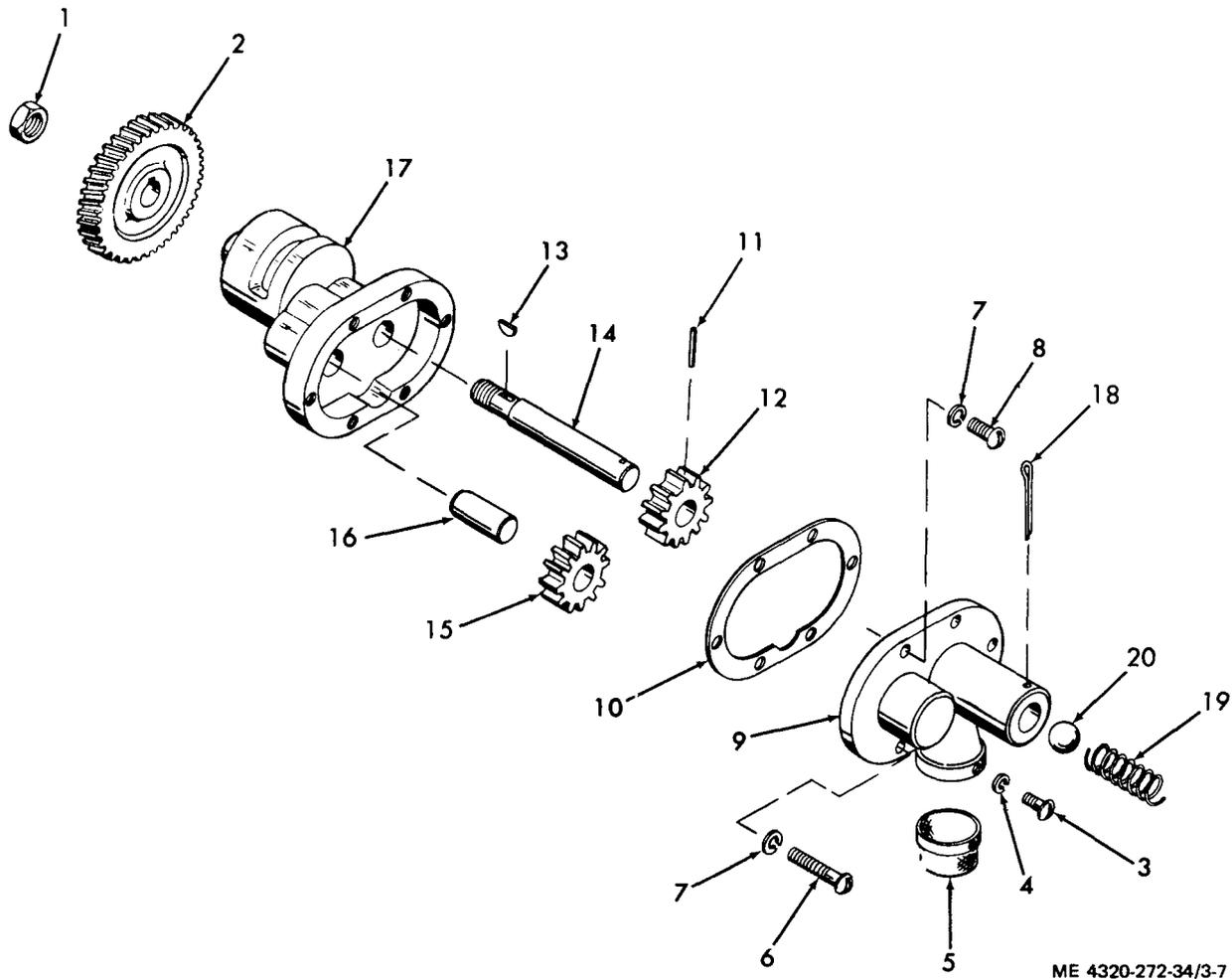
(1) Remove the engine oil pan (para 3-12).

NOTE

The engine support (7, fig. 3-13) is mounted over the pipe plug and setcrew which must be removed for oil pump removal. You must remove the support first, if you have not done so already.

(2) Remove slotted pipe plug (26, fig. 3-13); with a 5/32-inch Allen wrench, remove the setscrew (27) locking the oil pump in position.

(3) Remove the lock nut (1, fig. 3-7) holding the oil pump drive gear (2) to the shaft (14).



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- | | |
|------------------|-----------------|
| 1. Lock nut | 11. Pin |
| 2. Drive gear | 12. Gear |
| 3. Screw | 13. Key |
| 4. Lock washer | 14. Drive shaft |
| 5. Screen | 15. Gear |
| 6. Screw | 16. Shaft |
| 7. Lock washer | 17. Body |
| 8. Screw | 18. Cotter pin |
| 9. Cover | 19. Spring |
| 10. Cover gasket | 20. Ball |

Figure 3-7. Engine oil pump, exploded view.

(4) Using a soft drift, drive the oil pump shaft (14) through the drive gear (2). You can now remove the oil pump by pulling it toward the center of the crankcase. Remove key (13).

(5) Disassemble the oil pump as shown in figure 3-7, taking note of the following:

(a) You may need to tap the oil pump cover (9) with a plastic hammer to free it from the pump body (17).

(b) Take care when removing the cotter pin (18); it retains the pressure relief valve spring (19).

(6) Do not remove the gear (12) from the drive shaft unless it is worn or damaged.

b. Cleaning and Inspection.

(1) Discard and replace all gaskets.

(2) Clean all parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(3) Inspect the strainer screen (5, fig. 3-7) for

holes, clogging, and distortion; replace a damaged screen.

(4) Inspect the gears for chipped or broken teeth, scoring, and wear. Replace any damaged gears.

(5) Inspect the gear pockets of the body. If you find them scored or excessively worn, replace the pump.

(6) With the gears (12 and 15) and shafts (14 and 16) position in the body, check for excessive play of the shafts and for contact of the gears with the pump body. If you find these indications of wear, replace the pump.

(7) Inspect all parts for cracks, distortion, damaged threads, wear, and other damage; replace damaged parts.

c. Reassembly and Installation.

(1) Refer to figure 3-7 and reassemble the oil pump. Check that the drive shaft turns easily without binding when assembled.

(2) Install the oil pump in the reverse order of removal. To secure the pump firmly in place, align the locking setscrew (27, fig. 3-13) with the hole in the pump body. After installing the setscrew, also install the slotted head pipe plug (26). You may need to tap the pump into position with a plastic hammer.

(3) Install the key (13, fig. 3-7) in the keyway of the drive shaft (14). Align the keyway of the drive gear (2) with the key (13) before securing the gear to the shaft with the lock nut (1).

3-15. Pistons and Connecting Rods

a. Removal and Disassembly. With the engine mounted on an engine overhaul stand, proceed as follows:

(1) Remove oil filter from flywheel shrouding (para 3-4).

(2) Remove the flywheel assembly from the engine (para 3-5).

(3) Remove the flywheel alternator (para 3-6).

(4) Remove the carburetor and manifolds (TM 5-4320-272-12).

(5) Remove the air shrouding (para 3-7).

(6) Remove the governor assembly (para 3-9).

(7) Remove the gear cover (para 3-10).

(8) Remove the idler gear and shaft (para 3-11).

(9) Remove the oil pan (para 3-12), oil filler (para 3-13), and oil pump (para 3-14).

(10) To ream the ridge of the top of each cylinder bore you will need a standard ridge reamer. Blow metal fragments from the cylinder with compressed air.

(11) Remove hexagon nuts (11, fig. 3-1 1). Tap the ends of the cap screws (12) with a plastic hammer to remove them. Take care not to mar the threads. Remove the connecting rod bearing cap (13) and bearing shell (14) from the connecting rod.

CAUTION

When you push the piston and rod from the block, be very careful the connecting rod does not scratch or mar the crankshaft journals or cylinder walls.

(12) You can now remove the assembled piston (18), rings (20, 21, and 22), and connecting rod (15) by pushing piston assembly up through the top of the cylinder block.

NOTE

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

(13) Refer to figure 3-11 (items 11 thru 22) and disassemble the piston and connecting rod.

b. Cleaning and Inspection.

(1) Discard and replace the piston rings.

(2) Clean all parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(3) Inspect the pistons for wear, cracks, distortion, broken ring bands and distorted grooves, loose piston pin-to-piston fit, and other damage; replace damaged pistons. Refer to table 3-1 for wear limits.

(4) Check the piston ring groove side clearance, using new piston rings. If side clearance exceeds the limits given in table 3-1, replace the piston.

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 *c* (1) below.

(5) Inspect the connecting rods for cracks, distortion, and other damage; replace damaged connecting rods. Refer to table 3-1 for wear limits.

(6) Inspect the bearing shells (14, fig. 3-11) for scoring, wear, cracks, and other damage; replace damaged bearings. When replacing the bearing shells, you must replace a complete bearing consisting of two halves.

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

(7) Inspect all other parts for cracks, distortion, damaged threads, wear, and other damage; replace damaged parts.

c. Reassembly and Installation.

(1) Use a feeler gage to check the piston fit in the cylinder bore. Refer to table 3-1 for proper clearance. The block and pistons must be at room temperature when piston fit is checked. You must measure the clearance between the piston and cylinder at the center of the piston skirt thrust faces. The thrust faces are 90° from the axis of the piston in hole. Check the fit of the piston when it is approximately 2 inches down in the cylinder bore in an inverted position. If the clearance is too great, check the fit of a new standard size piston in the cylinder bore.

(2) Check the clearance between the piston pins (17, fig. 3-11) and sleeve bearings (19). Clearance must be between 0.0002 and 0.0007 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.

(3) If new pistons and piston pins are being used, press a new sleeve bearing (19) into each connecting rod (15). Ream and hone the sleeve bearing to provide proper clearance between bearing and piston pin; refer to table 3-1.

(4) When pins, bushings, and pistons of the proper size have been matched, assemble the pistons to the connecting rods. The specified pin clearance should permit a hand push fit in the piston at room temperatures. Position a connecting rod in its piston. Install the piston pin; secure with the new piston pin retaining ring (16).

(5) To check the piston ring gap, slide the piston rings squarely into the cylinders in which they will be used. You can insure squareness by pushing the piston rings in the cylinder bore with an inverted piston. Remove the piston and check the ring gap with feeler gage. If the ring gap is not at least 0.025 inch, carefully file the rings to provide a larger gap.

(6) Install the bottom oil ring first by placing the open end of the ring on piston, as shown in figure 3-8. Spread ring only wide enough to slip over piston and into correct ring groove. You must take care not to distort the ring. Install the remaining rings in the same manner, working up from the bottom and installing the top compression ring last. When you install the compression ring that is second from the top, be sure you install it on the piston with the scraper edge down, otherwise oil pumping and excessive oil consumption will result. See figure 3-9. Rings must be free to move in the groove. Check side clearance of each ring after you install it; refer to table 3-1 for clearances.

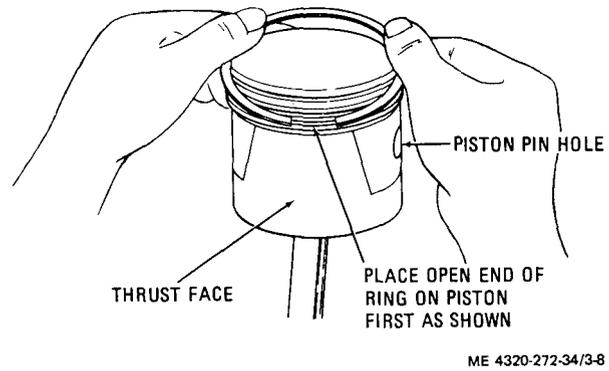


Figure 3-8. Piston ring installation.

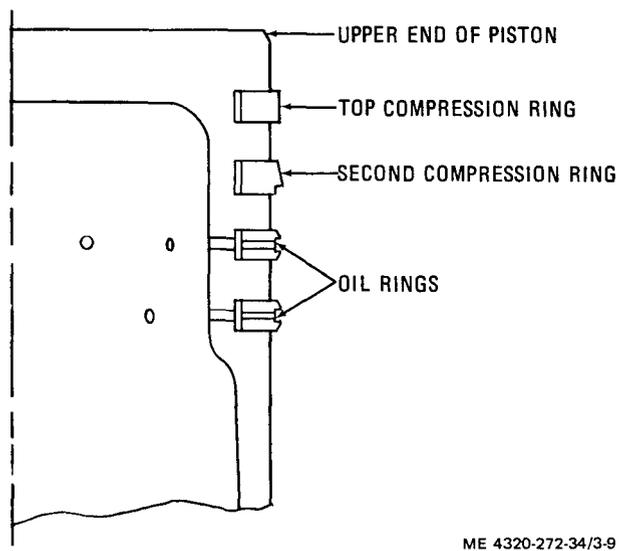


Figure 3-9. Piston ring placement.

(7) Assemble the remaining pistons, piston pins, connecting rods, and piston rings.

(8) Lubricate the pistons, rings, rod bearings, and cylinder walls with engine oil before installing the pistons. Stagger the piston ring gaps approximately 90° apart around the piston.

(9) Use a suitable ring compressor to compress the piston rings and install the assembled pistons and connecting rods in the same cylinders from which they were originally removed. The arrow on the top of the piston must point in the direction of crankshaft rotation. Wrap the bottom end of the connecting rods with a cloth so that you do not damage the cylinder walls during installation.

(10) Check the crankpin bearing journal-to-connecting rod bearing clearance with Plastigage. Lay a piece of Plastigage material on the crankshaft journal and install the connecting rod. You will notice a number is stamped on the side of the rod and cap. Match each connecting rod with its corresponding cap. These numbers must be on the same sides of the rod in reassembly. Tighten the connecting rod nuts to 28 to 32 foot-pounds torque. 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 0.0015 to 0.003 inch. If clearance is beyond these limits, replace the bearing and/or the crankshaft as required.

(11) Lubricate the crankpin bearing journals and the sleeve bearings with engine oil. When you install the cap (13, fig. 3-11) on its connecting rod (15) and crankpin journal, secure it with the two cap screws (12) and nuts (11). Torque the nuts to 28 to 32 foot-pounds. With feeler gage, check side clearance between connecting rod and crankpin. Refer to table 3-1 for tolerances.

(12) Secure the remaining connecting rods to the crankpin journals.

(13) Install the oil pump (para 3-14) and the oil filler (para 3-13), and the oil pan (para 3-12).

(14) Install the idler gear and shaft (para 3-11).

(15) Install the gear cover (para 3-10).

(16) Install the governor assembly (para 3-9).

(17) Install the air shrouding (para 3-7).

(18) Install the carburetor and manifolds (TM 5-4320-272-12).

(19) Install the flywheel alternator (para 3-6).

(20) Install the flywheel assembly to the engine (para 3-5).

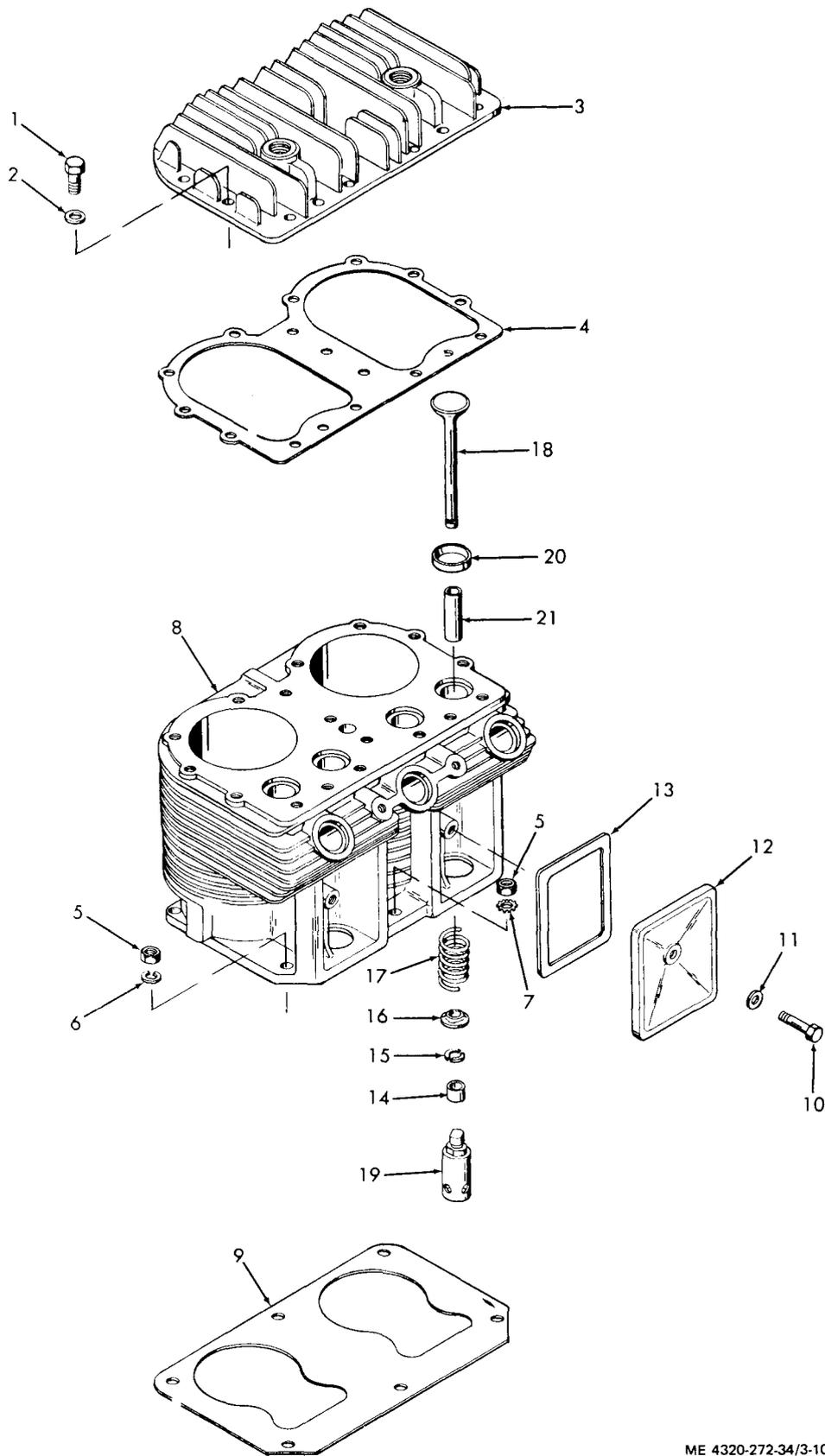
(21) Install the oil filter to the flywheel shrouding (para 3-4).

3-16. Cylinder Blocks

a. Removal.

(1) Remove the pistons and connecting rods as directed in paragraph 3-15 *a*.

(2) Remove the six nuts (5, fig. 3-10) and lock washers (6 and 7) securing each cylinder block to the engine block.



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Figure 3-10. Cylinder block, exploded view.

KEY to fig. 3-10:

- | | |
|-------------------|----------------------------|
| 1. Cap screw | 12. Valve inspection cover |
| 2. Flat washer | 13. Gasket |
| 3. Cylinder head | 14. Rotators |
| 4. Gasket | 15. Lock |
| 5. Nut | 16. Valve spring seat |
| 6. Lock washer | 11. Valve spring |
| 7. Lock washer | 18. Valve |
| 8. Cylinder block | 19. Valve tappet |
| 9. Gasket | 20. Valve seat insert |
| 10. Screw | 21. Valve guide |
| 11. Flat washer | |

(3) Remove the cylinder block (8) and gasket (9).

(4) Do not remove studs (28, fig. 3-13) unless inspection indicates damaged threads, or bent or otherwise damaged studs.

b. Cleaning and Inspection.

(1) Clean the top of the cylinder block with a scraper and cloth dampened in cleaning solvent (fed. spec. P-D-680). Clean all dirt and deposits from the cooling fins with a scraper or putty knife. You will be able to perform a more thorough cleaning when the valves have been removed (para 3-17).

(2) Clean all other parts with cleaning solvent; dry thoroughly.

(3) Inspect the cylinder block for cracks, scored or scratched cylinder walls, or other defects.

(4) Check piston fit in the cylinder bores (para 3-15 c).

(5) Check cylinder bore wear with an inside micrometer. Measure the cylinder bore at 450 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 0.005 inch.

(6) Replace the block if it is cracked, or if defects cannot be repaired. If proper piston fit (para 3-15 c) cannot be attained, the cylinders are scratched or scored, or cylinder wear exceeds 0.005 inch, rebore the cylinders as directed in subparagraph c below.

(7) Replace the cylinder block gaskets (9, fig. 3-10).

c. Reboring. Rebore the cylinders to 3.4575 to 3.4595 inch diameter (0.020 inch oversize). If this is not sufficient to eliminate cylinder wear or damage, rebore the cylinders to 3.4775 to 3.4795 inch diameter (0.040 inch oversize). Maximum allowable overbore is 0.040 inch.

d. Installation. Using new gaskets, install the cylinder blocks in reverse order of removal. Install each block on the same side of the crankcase from which it was removed. Tighten cylinder block mounting nuts (5, fig. 3-10) to 62 to 78 foot-pounds torque. Refer to paragraph 3-17 c for tappet adjustment.

3-17. Intake and Exhaust Valves

a. Removal.

(1) Remove the cylinder head as directed in paragraph 3-8 a.

(2) Remove the screws (10, fig. 3-10) and washers (11) securing the valve tappet inspection covers (12); remove inspection cover and gasket (13).

(3) Using a standard type valve spring lifter, compress the valve spring (17), remove the valve rotator (14) and valve spring seat retaining locks (15). After you release the valve lifter, remove the spring seat (16) and valve spring (17), and lift the valve (18) from the top of the cylinder block. As the valves are removed, tag them or place them in order in a rack to insure that you will reassemble each in the same valve guide from which is was removed.

(4) Do not remove the valve guides (21) or valve seat inserts (20) unless inspection indicates that they are faulty.

(5) Lift the valve tappets (19) from the engine block.

(6) Remove the remaining valves.

b. Cleaning, Inspection, and Repair.

(1) Discard and replace all gaskets.

(2) Clean the valves, valve springs, spring seats, spring seat retaining locks, and valve rotators with cleaning solvent (fed. spec. P-D-680); dry thoroughly. Remove carbon deposits with wire brush.

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

(4) Clean the valve seats with a wire brush.

(5) Check valve seat inserts for cracks or loose mounting. Replace faulty valve seat inserts.

(6) Inspect the valves for deep pitting, cracks, bent stems, distortion, and wear. If the valve faces are not seriously damaged or marred, you can regrind them. The valve face shall be ground at 45° to the vertical center line of the valve stem. The valve seat insert shall also be ground at a 45° angle. After grinding, clean the valve and valve seat insert. Apply a suitable lapping compound to the valve face and place the valve back into its proper guide. Using a reciprocating advancing tool, lap each valve by rotating it back and forth. Occasionally, you should lift the valve and reseal it in a different position to insure a uniform seat. After valves have been lapped in evenly, remove them from the block and clean them with cleaning solvent.

(7) Check for loose or worn valve guides. Using a dial indicator, check the side movement of valve stem in guide. The valve stems shall have a new clearance in the guides of 0.0025 to 0.0045 inch. When the clearance becomes 0.008 inch, the guides must be replaced. If you need to replace the guides, press them out with a driver that is slightly smaller than the external diameter of the guide. Use the driver to press in the new valve guides.

(8) Check the valve springs for cracks, distortion, and other damage. Replace weak or damaged springs.

(9) Inspect the spring retainer seats, spring seat retaining locks, valve rotators, and valve tappet assemblies for cracks, scoring, overheating, and wear. Replace damaged parts.

c Installation.

(1) Position the valve tappet assemblies (19, fig. 3-10) in the engine block.

(2) With the valves (18) installed in cylinder block, assemble valve springs (17), spring retainer seats (16), valve rotators (14), and valve spring seat retaining locks (15). Compress the valve springs with a valve spring lifter to install the valve locks. Make sure you install each valve in the guide from which it was removed.

(3) After the valve assemblies have been mounted in the cylinder blocks, you can adjust the tappets. With the tappets in their lowest position on the camshaft, engine cold, set the intake valve-to-tappet clearance to 0.008 inch and the exhaust valve-to-tappet clearance to 0.016 inch. Rotate the camshaft to locate low positions.

(4) Using a new gasket (13), install valve tappet inspection cover (12); secure with screw (10) and flat washer (11).

(5) Install cylinder head (para 3-8).

3-18. Main Bearings and Crankshaft

a. Removal.

(1) Remove the oil filter from the flywheel shrouding (para 3-4).

(2) Remove the flywheel assembly from the engine (para 3-5).

(3) Remove the flywheel alternator (para 3-6).

(4) Remove the carburetor and manifolds (TM 5-4320-272-12).

(5) Remove the air shrouding (para 3-7).

(6) Remove the governor assembly (para 3-9).

(7) Remove the gear cover (para 3-10).

(8) Remove the idler gear and shaft (para 3-11).

(9) Remove the oil pan (para 3-12), oil filler (para 3-13), and oil pump (para 3-14).

(10) Remove the pistons and connecting rods (para 3-15).

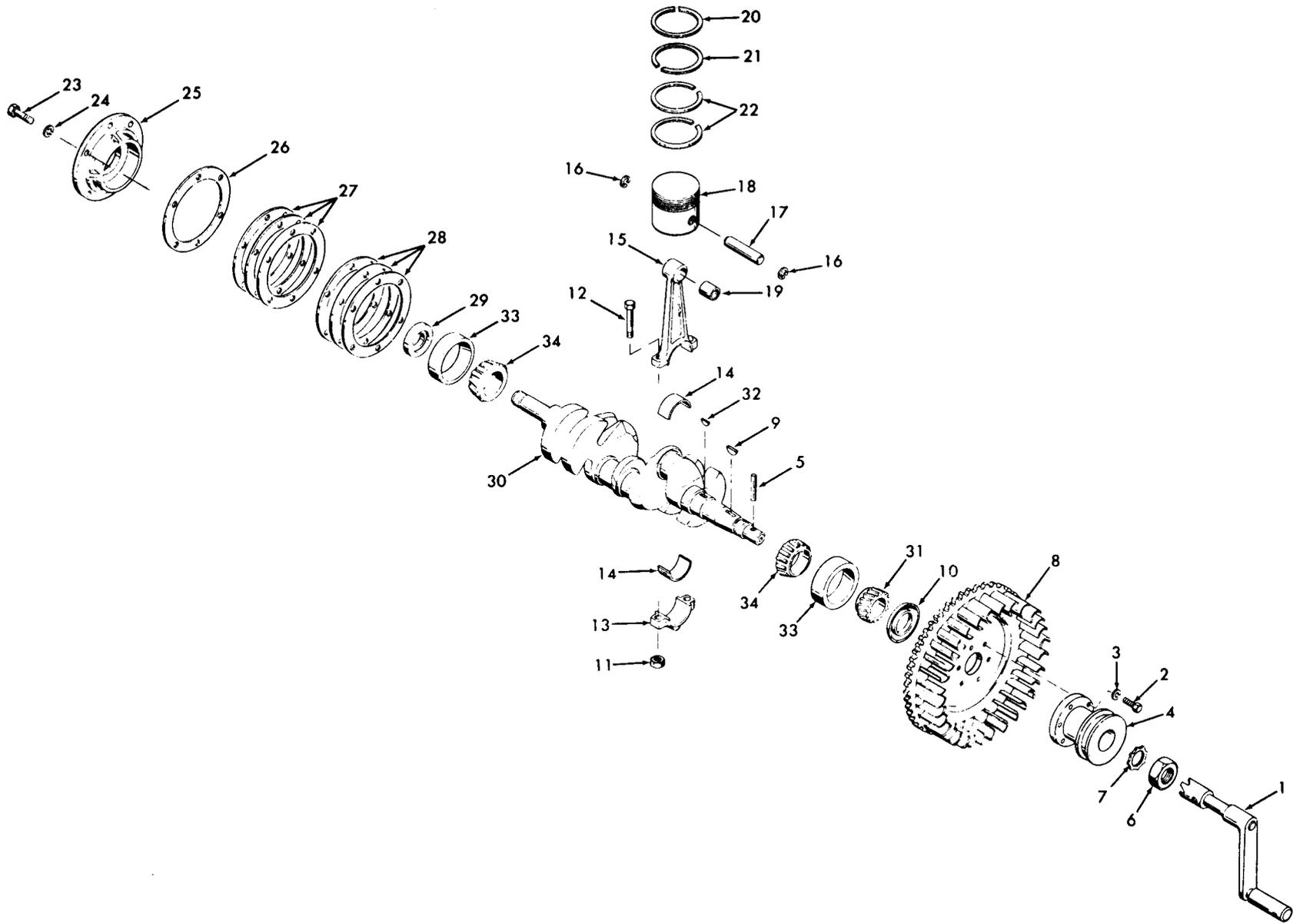
(11) Remove the cylinder blocks (para 3-16).

(12) Remove the valve tappets (19, fig. 3-10) from the engine block.

(13) Remove the six cap screws (23, fig. 3-11) and lock washers (24) that secure the main bearing plate (25) to the engine block; using a puller, remove the bearing plate, gaskets (27 and 28), and shim (26).

KEY to fig. 3-11:

- | | |
|----------------------|----------------------------|
| 1. Crank | 18. Piston |
| 2. Capscrew | 19. Sleeve bearing |
| 3. Lock washer | 20. Piston ring |
| 4. Drive pulley | 21. Piston ring |
| 5. Pin | 22. Piston ring |
| 6. Nut | 23. Cap screw |
| 7. Lock washer | 24. Lock washer |
| 8. Flywheel assembly | 25. Bearing retainer plate |
| 9. Key | 26. Shim |
| 10. Oil deflector | 27. Gasket |
| 11. Nut | 28. Gasket |
| 12. Cap screw | 29. Oil seal |
| 13. Bearing cap | 30. Crankshaft |
| 14. Bearing shell | 31. Gear |
| 15. Connecting rod | 32. Key |
| 16. Retaining ring | 33. Main bearing cap |
| 17. Piston pin | 34. Main bearing cone |



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Figure 3-11. Crankshaft and piston, exploded view

(14) Remove the oil seal (29).

(15) Remove the crankshaft (30) and crankshaft gear (31) by pulling them through the open end of the engine block.

(16) Remove the bearing retainer plate (36, fig. 3-13) from the flywheel end by removing the six cap screws (34) and lock washers (35) that secure it to the engine block.

b. Cleaning and Inspection.

(1) Discard and replace all gaskets and seals.

(2) Clean all parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly. Clean oil passages in the crankshaft with a rifle cleaning brush. Make sure all passages are open.

(3) Inspect the crankshaft for cracks, worn or scored journals, damaged threads, and burred keyways. Refer to table 3-1 for wear limits. If magnetic particle inspection equipment is available, use it to check the crankshaft for hidden flaws. Replace a damaged crankshaft.

(4) Inspect the crankshaft gear for cracked, chipped, or broken teeth. If you have to replace a damaged gear, use a gear puller to remove gear from the crankshaft.

(5) There is very little wear in the main bearings so you should not remove the bearing cones (34, fig. 3-11) or the bearing cups (33) unless it is absolutely necessary. If the bearings are damaged and must be removed, use pullers to remove bearing cones and press or drive out the cups.

c. Installation.

(1) If you had to remove the main bearings because they were damaged, install new bearings by pressing one bearing cup (33, fig. 3-11) into engine block and the other bearing cup into bearing retainer plate (25). Carefully press bearing cones (34) onto crankshaft. You must make certain that bearing cups and cones are seated squarely.

(2) Aline gear keyway to key (32) placed in crankshaft keyway and press gear (31) on crankshaft (30).

(3) Install the bearing retainer plate (36, fig. 3-13) on the flywheel end; secure with cap screw (34) and lock washer (35).

(4) Lubricate the main bearings and crankpin journals with a light coat of engine oil.

(5) Position the crankshaft assembly in the engine block.

CAUTION

When installing the crankshaft, you must make sure the timing marks on the crankshaft gear are alined with the timing marks on the camshaft gear.

(6) You will notice the word TOP cast on the outside of the bearing retainer plate (25, fig. 3-11); the plate must be mounted in this position. Secure the bearing retainer plate (25), new gaskets (27 and 28),

and shim (26) with cap screws (23) and lock washers (24). Tighten main bearing plate cap screws to 25 to 30 foot-pounds torque.

(7) When you get the engine reassembled to this extent, check crankshaft end play with a dial indicator. The end play shall be 0.002 to 0.005 inch, engine cold. If end play is not within limits, remove bearing plate and add shim gaskets (27 and 28) as necessary. Gaskets come in thicknesses of 0.003 and 0.006 inch.

(8) Install the valve tappets (29, fig. 3-10) in the engine block.

(9) Mount the cylinder blocks on the engine block (para 3-16).

(10) Install the pistons and connecting rods (para 3-15).

(11) Install the oil pump (para 3-14), oil filler (para 3-13), and oil pan (para 3-12).

(12) Install the idler gear and shaft (para 3-11).

(13) Install the gear cover (para 3-10).

(14) Install the governor assembly (para 3-9).

(15) Install the air shrouding (para 3-7).

(16) Install the carburetor and manifolds (TM 5-4320-272-12).

(17) Install the flywheel alternator (para 3-6).

(18) Install the flywheel assembly on the engine (para 3-5).

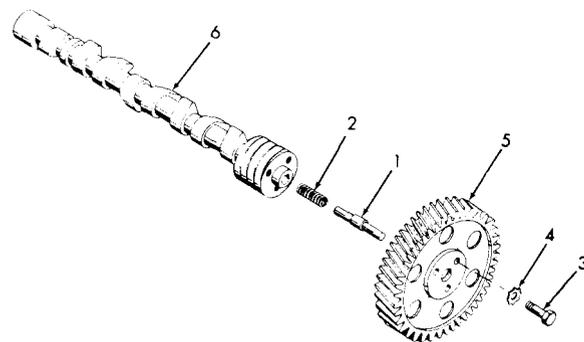
(19) Install the oil filter to flywheel shrouding (para 3-4).

3-19. Camshaft

a. Removal.

(1) Remove the main bearing and crankshaft as directed in paragraph 3-18 *a*.

(2) With all the valve tappets (19, fig. 3-10) removed, you can withdraw the camshaft (6, fig. 3-12) and gear (5) from the engine block.



ME 4320-272-34/3-12

- | | |
|-------------------|---------------|
| 1. Thrust plunger | 4. Lockwasher |
| 2. Spring | 5. Gear |
| 3. Screw | 6. Camshaft |

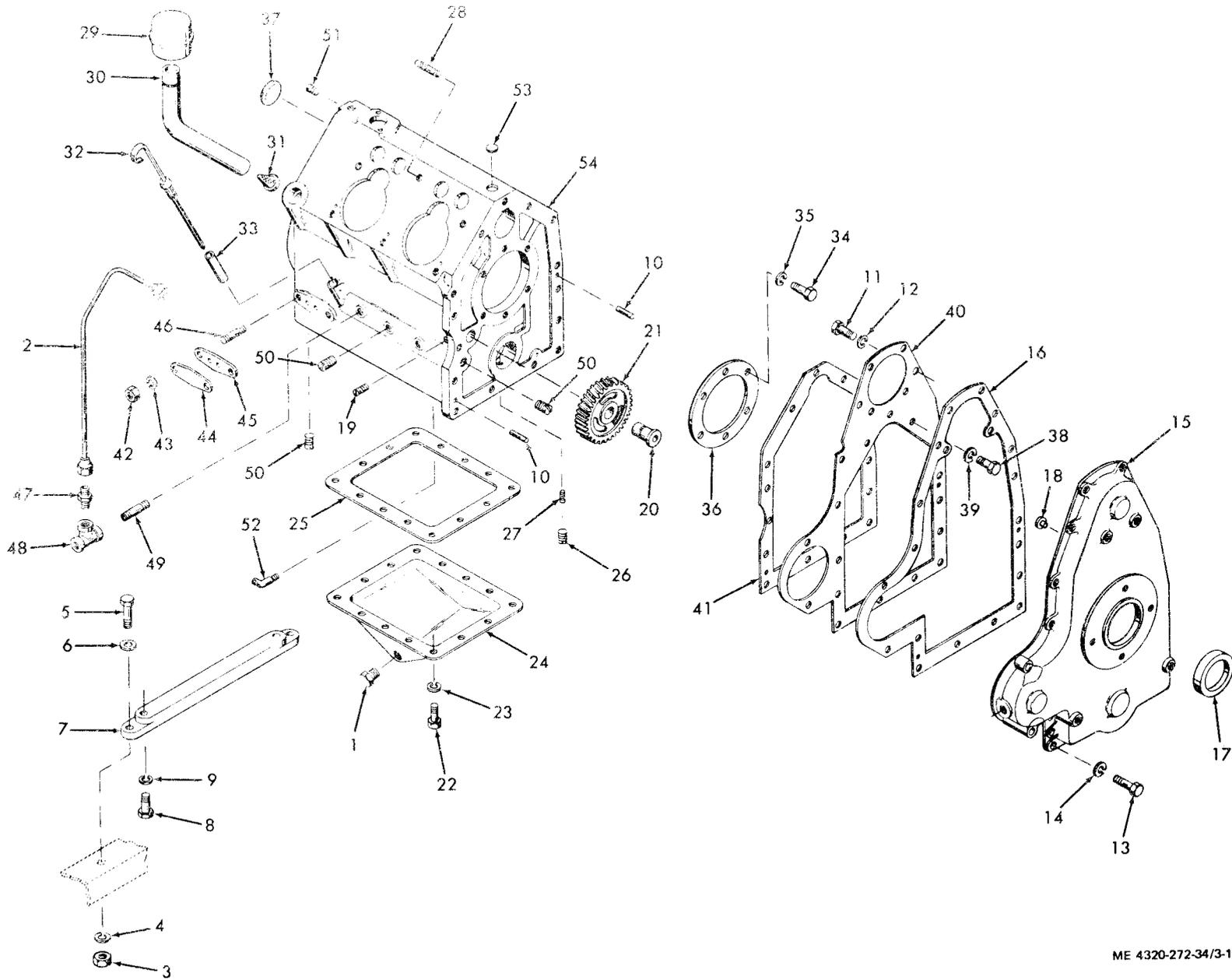
Figure 3-12. Camshaft, exploded view.

(3) Remove the three screws (3) and lock washers (4) securing the camshaft gear to the shaft. Use gear puller to remove gear from shaft.

(4) Remove and replace plug (37, fig. 3-13) in engine block if damaged or if leaking is evident.

KEY to fig. 3-13:

- | | |
|------------------------------------|----------------------------|
| 1. Drain plug | 28. Stud |
| 2. Oil tube | 29. Oil filler cap |
| 3. Nut | 30. Filler tube |
| 4. Lock washer | 31. Strainer |
| 5. Cap screw | 32. Oil level gage rod |
| 6. Flat washer | 33. Adapter tube |
| 7. Engine support | 34. Cap screw |
| 8. Bolt | 35. Lock washer |
| 9. Lock washer | 36. Bearing retainer plate |
| 10. Pin | 37. Expansion plug |
| 11. Screw | 38. Screw |
| 12. Lock washer | 39. Lock washer |
| 13. Screw | 40. Gear cover spacer |
| 14. Lock washer | 41. Gasket |
| 15. Gear cover | 42. Nut |
| 16. Gasket | 43. Lock washer |
| 17. Oil seal | 44. Cover plate |
| 18. Camshaft thrust plunger button | 45. Gasket |
| 19. Setscrew | 46. Stud |
| 20. Idler gear shaft | 47. Straight adapter |
| 21. Idler gear | 48. Tee |
| 22. Screw | 49. Nipple |
| 23. Lock washer | 50. Pipe plug |
| 24. Oil pan | 51. Pipe plug |
| 25. Gasket | 52. Oil spray nozzle |
| 26. Pipe plug | 53. Expansion plug |
| 27. Setscrew | 54. Engine block |



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Figure 3-13. Engine block and related parts, exploded view.

NOTE

the thrust plunger (1, fig. 3-12) and spring (2) were removed when the gear cover was removed to prevent their loss during engine overhaul.

b. Cleaning and Inspection.

(1) Clean all parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(2) Inspect the camshaft of cracks, worn or scored cams, worn or scored bearing surfaces, and clogged oil passages. Replace a damaged or worn camshaft.

(3) Inspect the plunger and spring for wear, scoring and distortion; replace if worn or damaged.

(4) Inspect the cam gear for cracked, chipped, or broken gear teeth, damaged shaft bore. Replace a damaged or worn cam gear.

c. Installation.

(1) You will notice the cam gear has offset mounting holes to insure accurate assembly. The gear can only be installed in the correct position for matching the timing mark with that of the crankshaft gear. Secure the gear to the shaft with screw (3, fig. 3-12) and lock washer (4).

(2) Install new expansion plug (37, fig. 3-13) in engine block.

(3) Lubricate the camshaft journals with engine oil and insert the camshaft in the block.

CAUTION

Do not insert the camshaft too far into the block. If you bump the camshaft against the expansion plug, an oil leak could result.

(4) Before installing gear cover (15, fig. 3-13), make sure the spring (2, fig. 3-12) and plunger (1) are in place in the end of the camshaft.

(5) Install the main bearings and crankshaft as instructed in paragraph 3-18 c.

3-20. Engine Block

a. Removal and Disassembly. With the engine mounted on an engine overhaul stand, proceed as follows:

(1) Remove oil filter from flywheel shrouding (para 3-4).

(2) Remove the flywheel assembly from the engine (para 3-5).

(3) Remove the flywheel alternator (para 3-6).

(4) Remove the carburetor and manifolds (TM 5-4320-272-12).

(5) Remove the air shrouding (para 3-7).

(6) Remove the governor assembly (para 3-9).

(7) Remove the gear cover (para 3-10).

(8) Remove the oiler gear and shaft (para 3-11).

(9) Remove the oil pan (para 3-12) and filler (para 3-13), and oil pump (para 3-14).

(10) Remove the pistons and connecting rods (para 3-15).

(11) Remove the cylinder blocks (para 3-16).

(12) Remove the main bearings and crankshaft (para 3-18).

(13) Remove the camshaft (para 3-19).

NOTE

Do not remove parts from the crankcase unless inspection indicates damage and that you must replace them.

(14) Remove four screws (38, fig. 3-13) and lock washer (39) that secure the gear cover spacer (40) to the engine block (54); remove gear cover spacer (40) and gasket (41).

(15) Remove the nuts (42) and lock washers (43) which secure cover plate (44) and gasket (45) to the engine block; remove the cover plate and gasket.

(16) Remove the straight adapter (47), pipe tee (48) and pipe nipple (49) from the block.

(17) Remove the pipe plugs (50 and 51).

(18) Remove the oil spray nozzles (52).

(19) Remove expansion plug (53) if damage or leaking is evident.

b. Cleaning and Inspection.

(1) Remove dirt and grease deposits from the engine block with a putty knife. Steam-clean the block. Remove greasy or gummy deposits with a cloth dampened in cleaning solvent (fed. spec. P-D-680). Use compressed air when you clean the oil passages in the block. Remove varnish deposits with a wire brush.

(2) Clean all other parts with cleaning solvent; dry thoroughly.

(3) Discard and replace all gaskets.

(4) Inspect the block for cracks, damaged sealing surfaces, damaged threads, loose or damaged studs, or other defects. Replace the block if it is cracked, or if you notice other defects which cannot be repaired. Replace loose or damaged studs. Retap damaged threads.

(5) Inspect the gear cover spacer for cracks, distortion, or damage. Replace spacer if not repairable.

(6) Inspect all remaining parts for damage; replace any damaged parts.

c. Installation.

(1) Install the pipe plugs (50 and 51, fig. 3-13) and expansion plug (53).

(2) Install the oil spray nozzles (52).

(3) Install the straight adapter (47), pipe tee (48), and pipe nipple (49).

(4) Use a new gasket (45) when you install cover plate (44); secure to block with nuts (42) and lock washers (43).

- (5) Install gear cover spacer (40) and new gasket (41); secure to engine block with screws (38) and lock washers (39).
- (6) Install the camshaft (para 3-19).
- (7) Install the main bearings and crankshaft (para 3-18).
- (8) Install the cylinder block (para 3-16).
- (9) Install the pistons and connecting rods (para 3-15).
- (10) Install the oil pump (para 3-14), oil filler (para 3-13) and oil pan (para 3-12).

- (13) Install the governor assembly (para 3-9).
- (14) Install the air shrouding (para 3-7).
- (15) Install the carburetor and manifolds (TM 5-4320-272-12).
- (16) Install the flywheel alternator (para 3-6).
- (17) Install the flywheel assembly for the engine (para 3-5).
- (18) Install the oil filter to flywheel shrouding (para 3-4).
- (11) Install the idler gear and shaft (para 3-11).
- (12) Install the gear cover (para 3-10).

Section III. RADIO INTERFERENCE SUPPRESSION

3-21. General Methods Used to Attain Proper Suppression

Essentially, suppression is attained by providing a low resistance path to ground for stray currents. The methods used include shielding the ignition and high frequency wires and grounding the frame with bonding straps.

3-22. Replacement of Suppression Components

This equipment uses no primary radio suppression components. Replace the secondary radio suppression components as follows:

- a.* Replace the shielded spark plug cables as directed in TM 5-4320-272-12.
- b.* Replace the magneto ground strap as directed in TM 5-4320-272-12.

CHAPTER 4

REPAIR OF CENTRIFUGAL PUMP

4-1. Description

This self-priming centrifugal pump is designed to pump flammable liquids at relatively high discharge heads. It uses a closed-type impeller which is mounted directly on the extended engine crankshaft. It contains no bearings since the crankshaft is adequately supported by the engine bearings. A face seal prevents leakage around the shaft. The seal consists of a Ni-Resist stationary member and a spring-loaded carbon rotating member. The highly finished mating surfaces

are in constant contact to stop seepage of fluid through the seal. Both parts are sealed to their associated parts with petroleum-resistant Buna N rubber parts.

4-2. Pump Fits, Tolerances and Wear Limits

Table 4-1 lists pump fits, tolerances, and wear limits. Refer to the table to help you determine if parts replacement is required or if continued serviceability of the parts is possible.

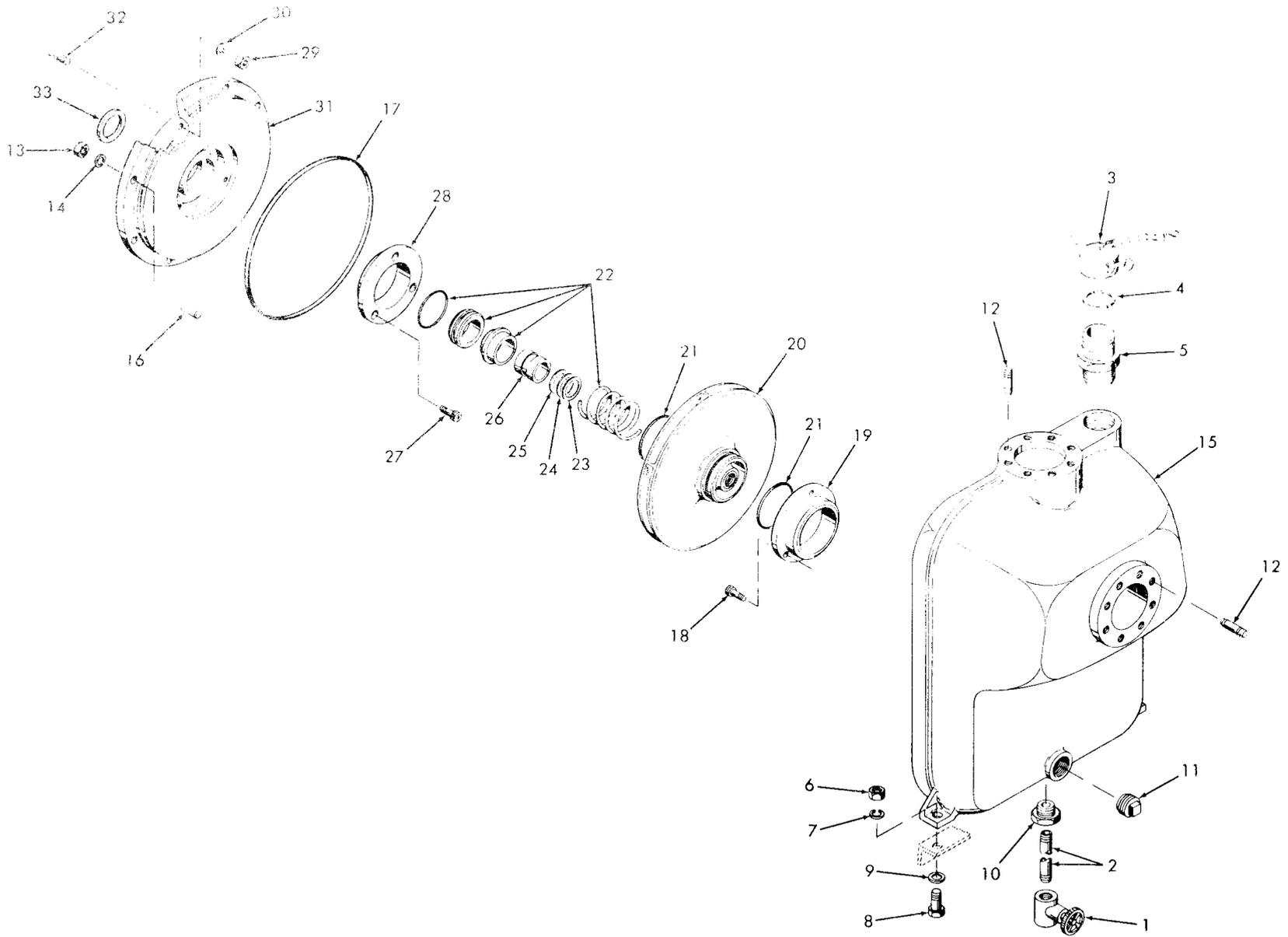
Table 4-1. Pump Fits, Tolerances, and Wear Limits

Component points of measurement	Normal clearances (in inches)		Maximum allowable clearance
	Minimum	Maximum	
Impeller-to-wear ring clearance	0.042	0.052	0.092
Wear ring internal diameter			5.107
Impeller external diameter at wear ring surface			5.015

4-3. Pump Repair

a. Removal and Disassembly. Remove the suction piping assembly, discharge piping assembly, and the instrument control panel. Refer to TM 5-4320-272-12

for instructions. Disassemble the centrifugal pump as shown in figure 4-1.



ME 4320-272-34/4-1

Figure 4-1. Centrifugal pump, exploded view.

KEY to fig. 4-1:

- | | |
|-------------------|---------------------------|
| 1. Gate valve | 18. Screw |
| 2. Pipe nipple | 19. Wear ring |
| 3. Cap and chain | 20. Impeller |
| 4. Gasket | 21. O-ring seal |
| 5. Coupling | 22. Shaft seal |
| 6. Nut | 23. Shim |
| 7. Lock washer | 24. Shim |
| 8. Cap screw | 25. Shim |
| 9. Flat washer | 26. Sleeve |
| 10. Bushing | 27. Screw |
| 11. Pipe plug | 28. Wear ring |
| 12. Stud | 29. Nut |
| 13. Nut | 30. Lock washer |
| 14. Lock washer | 31. Intermediate coupling |
| 15. Pump body | 32. Stud |
| 16. Stud | 33. Slinger |
| 17. O-ring gasket | |

(1) Remove the cap screws (8), flat washer (9), nuts (6), and lock washers (7) that secure the pump body to the trailer frame. Remove the nuts (13) and lock washers (14) that secure the pump body to the intermediate coupling (31) mounted on the engine. Support the weight of the pump body with a hoist and pull straight forward to disengage the body from the pump. Remove the O-ring gasket (17).

(2) Place a wooden block against one of the impeller blades and strike sharply on the end of the wooden block to rotate the impeller (20) counterclockwise to enable you to loosen it from the end of the engine crankshaft. You may find it necessary to block the rotation of the engine flywheel to facilitate impeller removal.

(3) When the impeller is removed, remove the O-ring seals (21) from the impeller. Slide the rotating seal members (part of item 22) from the shaft. Remove the shims (23, 24 and 25) and shaft sleeve (26). Retain the shims as a set. You will want to reinsert the same shim thickness at reassembly unless related parts are replaced.

(4) Remove the nuts (29) and lock washers (30) that secure the intermediate coupling (31) to the engine. Remove the intermediate coupling by pulling it straight away from the engine. Push the assembled stationary seal member (part of item 22) and O-ring gasket (17) from the intermediate coupling.

(5) Remove the slinger (33) from the engine crankshaft.

(6) You should not remove the studs (12 and 16) from the pump body unless they are damaged and require replacement. Removal of wear rings (19 and 28) is not required unless your inspection indicates that they require replacement.

b. Cleaning and Installation.

(1) Replace the O-ring gasket (17) and (O-ring seals (21). You should replace the shaft seal (22) at each overhaul to minimize the possibility of prema-

ture failure. Any scratching or scoring of the seal faces makes seal replacement mandatory. Always replace the complete seal assembly, not individual parts.

(2) Clean all remaining parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(3) Inspect the impeller for cracks, wear, broken vanes, chips, distortion and damaged threads. Replace wear rings (19 and 28) if scored or damaged.

(4) Inspect the wear rings in the pump body and in the intermediate coupling for scoring, wear, cracks, and other damage. If inspection indicates wear or damage, you must replace the wear rings.

(5) Inspect the pump body for cracks, distortion, damaged threads, or other damage. If studs are damaged, replace them.

(6) Inspect the intermediate coupling (31) for cracks, distortion, scoring, and other damaged; replace a damaged intermediate coupling.

c. Reassembly and Installation.

(1) Install the wear rings (19 and 28) if you had removed them.

(2) Sparingly coat the end of the engine crankshaft with light engine oil. Install the shaft sleeve (26) on the shaft and position the slinger (33) on the shaft.

(3) Sparingly coat the O-ring and stationary member of the shaft seal (22) with light engine oil. Install the stationary seal parts in the bore of the intermediate coupling (31). Install the intermediate coupling on the engine, taking care you do not dislodge the stationary seal members. Secure with nuts (29) and lock washers (30).

CAUTION

The mating faces of the shaft seal are highly machined and are easily damaged by rough handling and careless installation. Take care when you install seal parts or premature pump failure may result.

(4) Coat the face of the rotating seal member with light engine oil. Install the rotating seal members on the shaft.

(5) Install the O-ring seals (21) on the impeller (20). Install the impeller on the engine crankshaft without shims (23, 24) and (25). You will note that the impeller has a right hand thread.

(6) With the impeller (20) firmly seated on the shaft, measure the distance from the mounting flange of the intermediate coupling (31) to the near side of the impeller discharge slot (dimension A, fig. 4-2). Measure the distance from the machined mounting surface of pump body to the slot in the inside diameter of the pump body (dimension B). Subtract dimension B from dimension A. The remainder must be at least 0.125 inch. If it is not, remove the impeller and add shims (23, 24, and 25) (fig. 4-1) to increase the difference to 0.125 inch when the impeller is reinstalled.

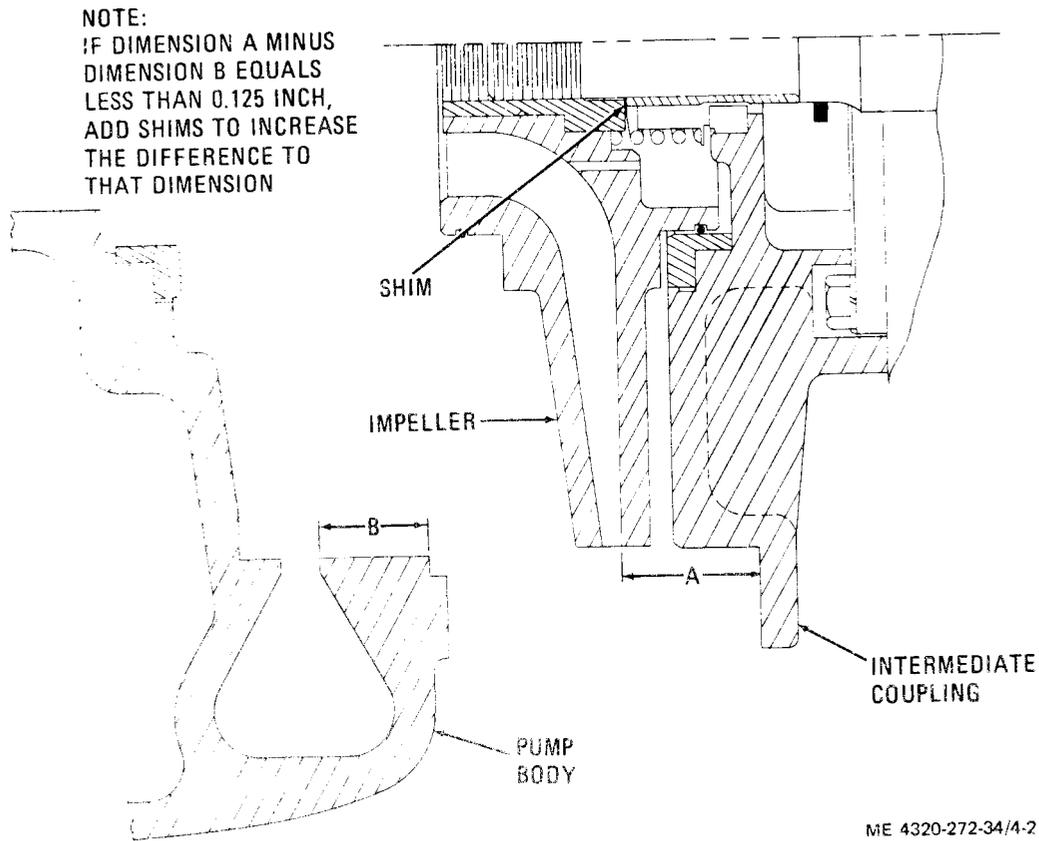


Figure 4-2. Internal pump tolerance.

(7) Coat the O-ring gasket (17, fig. 4-11) with light engine oil and install it in the groove of the intermediate coupling. Support the pump body (15) with a hoist and slide it into position on the intermediate coupling, taking care not to damage or dislodge the O-ring gasket. Secure the pump body with nuts (13) and lock washers (14).

(8) Crank the engine without resetting the oil pressure safety switch to prevent the engine from starting. Check that the pump turns freely without scraping or binding. After free rotation is assured, prime the pump and check to insure that it operates properly and at the required capacity.

CHAPTER 5

REPAIR OF TRAILER

5-1. Description

a. The trailer assembly is primarily a welded frame consisting of two longitudinal channels separated by a series of angles and channels at both ends. A trailer stand located at the draw bar end of the trailer is held in a raised or lowered position by two pins. The draw-bar can be extended to provide a greater turning clearance with the towing vehicle.

b. The axle assembly is mounted to the underside of the trailer frame. The axle assembly consists primarily of the axle, hub assembly, wheel, and tire. The tool box is mounted on the right side of the trailer. The trailer assembly provides support for mounting the pump, engine, fuel tank, suction and discharge assemblies, ground rods, and remaining components of the pumping assembly.

5-2. Axle

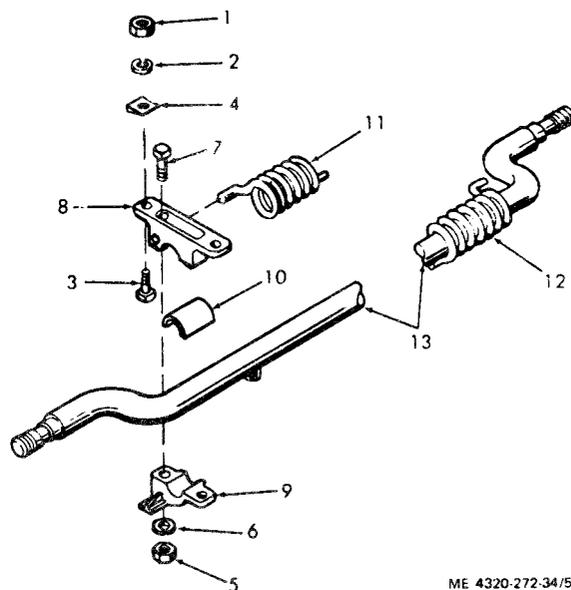
a. Removal and Disassembly.

- (1) Support the trailer frame securely in four stands.
- (2) Remove wheels and tires (TM 5-4320-272-12).
- (3) Remove hub assemblies (TM 5-4320-272-12).

WARNING

Make sure that you support the axle properly before removing the securing hardware or injury to personnel may result.

- (4) Remove four screws (3, fig. 5-1), beveled washers (4), lock washers (2), and nuts (1) that secure the axle (13) to the trailer frame; remove axle assembly.



ME 4320-272-34/5-1

- | | |
|-------------------|--------------------|
| 1. Nut | 8. Top bracket |
| 2. Lock washer | 9. Base bracket |
| 3. Screw | 10. Bearing insert |
| 4. Beveled washer | 11. Spring |
| 5. Nut | 12. Spring |
| 6. Lock washer | 13. Axle |
| 7. Screw | |

Figure 5-1. Axle, exploded view.

(5) With the axle assembly removed from the trailer, you can remove brackets (8 and 9) by removing screws (7), lock washers (6) and nuts (5).

(6) Remove bearing insert (10).

(7) Remove springs (11 and 12) from top bracket (8) and clip on axle (13).

b. Cleaning and Inspection.

(1) Use cleaning solvent (fed. spec. P-D-680) when you clean axle parts. Dry thoroughly.

(2) Inspect all parts for rust, corrosion, chipped paint, and distortion. Remove rust and corrosion with a metal scraper and wire brush. Prime and paint bare surfaces.

(3) Inspect the axle for cracks, distortions, or damaged threads. The spindle ends of the axle must be on the same axis. Check for damaged spring retaining clips. Replace a damaged axle.

(4) Inspect the bearing insert (10) for cracks, distortions, or signs of wear. Replace worn bearing insert.

(5) Inspect for cracked, distorted, or weak springs. Replace damaged or weak springs.

c. Reassembly and Installation.

(1) Install springs (11 and 12, fig. 5-1) on axle, if they were removed. Rotate the spring on the axle until the end is held by the axle chip.

(2) While you are holding the spring against the clip, position the top bracket (8) on the opposite end of the spring. The bracket will be mounted to the axle in this position.

(3) Install bearing insert (10) between the top bracket and the axle; it must be seated squarely.

(4) Install the base bracket (9) and secure with screw (7), lock washer (6), and nut (5).

(5) Support the trailer on stands high enough to permit installation of hub assemblies and wheels. Secure axle to underside of trailer with screws (3), beveled washers (4), lock washers (2), and nuts (1).

(6) Install hub assembly (TM 5-4320-272-12).

(7) Install wheel and tire (TM 5-4320-272-12).

5-3. Trailer Frame

a. Removal and Disassembly.

(1) Remove the pump assembly (para 4-3).

(2) Remove the engine (para 2-10).

(3) Remove the wheel and axle assemblies (para 2-11).

(4) Remove the tool box (TM 5-4320-272-12).

(5) Remove the lifting bail (3, fig. 5-2) by removing securing nuts (1 and 4) and lock washers (2).

KEY to fig. 5-2:

1. Nut	11. Cap screw
2. Lock washer	12. Spacer
3. Lifting bail	13. Stand
4. Nut	14. Cotter pin
5. Pin assembly	15. Wing nut
6. Drawbar	16. Clamp
7. Pin assembly	17. Ground rod
8. Nut	18. Cable and clip assembly
9. Lock washer	19. Frame
10. Washer	

(6) Remove the drawbar pin (5). You can now withdraw the drawbar (6) from the drawbar tube

(7) Remove stand pin (7). Remove screw (11), nut (8), lock washer (9), flat washer (10), and spacer (12) securing trailer stand (13); remove stand from trailer.

(8) Remove the ground rods (17) by removing cotter pin (14), wing nut (15), and clamp (16) from stud on frame channel.

b. Cleaning and Inspection.

(1) Clean all parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(2) Inspect all parts for rust, corrosion, cracks, chipped paint, and distortion. Straighten bent or distorted frame members. To remove rust and corrosion

you can use sandpaper, metal scraper, or wire brush, Prime and paint bare surfaces.

(3) To inspect the spacer (12) for wear, you can place it in the mounting hole in the trailer stand. With one edge of the spacer flush against the side of the stand, the opposite edge of a new spacer will extend approximately 1/8 inch beyond the stand. Replace the spacer if it is worn more than 1/16 inch.

(4) Inspect for bent or damaged ground rods (17) and clip and cable assemblies (18). If you cannot straighten or repair ground rods or repair the clip and cable assemblies, replace them.

(5) Replace other damaged or missing parts.

c. Reassembly and Installation. Assemble the trailer in the reverse order of disassembly and removal. Refer to figure 5-2.

APPENDIX A

REFERENCES

- | | |
|---|---|
| A-1 Fire Protection
TB 5-4200-200-10 | Hand Portable Fire Extinguishers for Army Users |
| A-2 Lubrication
C9100IL
LO 5-4320-272-12 | Fuel, Lubricants, Oils and Waxes Pumping Assembly and Engine Lubrication Order |
| A-3 Painting
TM 9-913 | Painting Instructions for Field Use |
| A-4 Radio Suppression
TM 11-483 | Painting Interference Suppression |
| A-5 Maintenance
TM 9-1870-1
TM 5-4320-272-20P
TM 5-4320-272-12
TM 5-4320-272-34P
TM38-750 | Care and Maintenance of Pneumatic Tires
Organizational Maintenance Repair Parts and Special Tools List. Pumping Assembly
Operator and Organizational Maintenance Manual, Pumping Assembly
Direct Support and General Support Maintenance Repair Parts and Special Tools List. Pumping Assembly
Army Equipment Record Procedures |
| A-6 Shipment and Storage
TM 740-90-1 | Administrative Storage |
| A-7 Destruction to Prevent Enemy Use
TM 750-244-3 | Procedures for Destruction of Equipment to Prevent Enemy Use |

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