TM 5-4320-273-14

TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, GED, 350 GPM CAPACITY, 275 FEET TOTAL HEAD, WHEEL MOUNTED (GORMAN-RUPP MODEL 04A12C-MVG4D)

NSN 4320-00-600-7590

This copy is a reprint which includes current pages from Changes 1,2and 3

HEADQUARTERS, DEPARTMENT OF THE ARMY

OCTOBER 1975

WARNING
FIRE AND EXPLOSION HAZARDS

The equipment operates on gasoline and is used to pump flammable liquids. The danger of severe burns or death from fire/explosion necessitates that:

Rules prohibiting “smoking” be established and enforced.

The fuel tanks be filled when the engine is stopped.

All gasoline fumes be purged before making repairs involving heat or flame to the fuel tank or other components.

The battery be serviced in a well ventilated area because of the generation of flammable gas. Keep fire or flame away while servicing the battery.

Liquid spills be cleaned up or neutralized immediately.

POISONOUS GASES

Exhaust fumes expelled from this equipment can cause serious illness or death if not properly purged from enclosed areas.

CLEANING SOLVENTS

Cleaning solvents can cause irritation and burning of the skin and illness or death if the fumes are inhaled. Use cleaning solvents in a well ventilated area and wash skin thoroughly if exposed to solvent.

WARNING

Operation of this equipment presents a noise hazard to personnel in the area. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs or ear plugs which were fitted by a trained professional.

CHANGE

NO. 4

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., 10 October 1990

Operator, Organizational, Direct Support
and General Support Maintenance Manual

PUMPING ASSEMBLY, FLAMMABLE LIQUID,
BULK TRANSFER, GED, 350 GPM CAPACITY,
275 FEET TOTAL HEAD, WHEEL MOUNTED
(GORMAN-RUPP MODEL 04A12C-MVG4D)
NSN 4320-00-600-7590

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TM 54320-273-14, dated 20 October 1975, is changed as follows:

1. Remove and insert pages as indicated below. New or changed text material is indicated by a vertical bar in the margin. An illustration change is indicated by a miniature pointing hand.

Remove pages	Insert pages
2-5 and 2-6	2-5 and 2-6
3-4.1 and 3-.2	3-4.1 and 3-4.2
3-5 and 3-6	3–5 and 3-6
3–1 1 and 3-12	3-11 and 3-12
4-1 through 4-4	4–1 through 4-4
4-33 and 4-34	4-33 and 4–34

2. Retain this sheet in front of manual for reference purposes,

By Order of the Secretary of the Army:

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Chief of Staff

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CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 4 November 1986

Operator's, Organizational, Direct Support and
General Support Maintenance Manual

PUMPING ASSEMBLY, FLAMMABLE LIQUID,
BULK TRANSFER GED, 350 GPM CAPACITY,
275 FEET TOTAL HEAD, WHEEL MOUNTED
(GORMAN-RUPP MODEL 04A12C-MVG4D)
NSN 4320-00-600-7590

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3-3 and 3-4	3-3 and 3-4
----	3-4.1 and 3-4.2

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DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Operator, Organizational, Direct Support and General Support Maintenance Requirements for Pump Assembly, Flammable Liquid, Bulk Transfer, Gas Driven, Wheel Mounted, 350GPM/275 FT Head (04A12C-MVG4D).

CHANGE NO. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 30 December 1983

Operator's, Organizational, Direct Support and
General Support Maintenance Manual

PUMPING ASSEMBLY, FLAMMABLE LIQUID,
BULK TRANSFER GED, 350 GPM CAPACITY,
275 FEET TOTAL HEAD, WHEEL MOUNTED
(GORMAN-RUPP MODEL 04A12C-MVG4D)
NSN 4320-00-600-7590

TM 5-4320-273-14, 20 October 1975, is changed as follows:

1. Remove and insert pages as indicated below.

	Remove pages	Insert pages
Chapter 1	1-3 and 1-4	1-3 and 1-4
Chapter 3	3-3 and 3-4	3-3 and 3-4
Chapter 8	8-3 and 8-4	8-3 and 8-4

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CHANGE
No. 1

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *30 December 1980*

Operator's, Organizational, Direct Support and General Support Maintenance Manual

PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, GED, 350 GPM CAPACITY, 275 FEET TOTAL HEAD, WHEEL MOUNTED (GORMAN-RUPP MODEL 04A12C-MVG4D) NSN 4320-00-600-7590

TM 5-4320-273-14, 20 October 1975, is changed as follows:

1. Remove and insert pages as indicated below.

Remove Pages	Insert Pages
	2-2.1/2-2.2
2-3 and 2-4	2-3 and 2-4
3-9 and 3-10	3-9 and 3-10
4-1 and 4-2	4-1 thru 4-2.1/4-2.2
5-5 thru 5-7/5-8	5-5 thru 5-7/5-8

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Technical Manual
No. 5-4320-273-14

HEADQUARTERS,
DEPARTMENT OF THE ARMY
Washington, D.C., 20 *October 1975*

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, GED, 350 GPM CAPACITY, 275 FEET TOTAL HEAD, WHEEL MOUNTED (GORMAN-RUPP MODEL 04A12C-MVG4D) NSN 4320-00-600-7590

LIST OF ILLUSTRATIONS

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope
This manual is for your use in operating and maintaining the Pumping Assembly, Flammable Liquid, Bulk Transfer, GED, 350 GPM Capacity, 275 Feet Total Head Wheel Mounted (German-Rupp Model 04A12C-MVG4D).

1-2. Reporting of Errors
You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter, DA Form 2028 (Recommended Changes to Publications), and DA Form 2028-2 (Recommended Changes to Equipment Technical Manuals) may be used. Copies of DA Form 2028-2 are attached in the back of the manual for your use. Please mail your recommended changes directly to Commander, U.S. Army Troop Support Command, ATTN. AMSTS-MPP, 4300 Goodfellow Blvd., St. Louis, Mo. 63120. A reply will be furnished directly to you.

1-3. Maintenance Forms and Records
Maintenance forms, records, and reports that you are required to use are listed in TM 38-750.

1-4. Equipment Serviceability Criteria (ESC)
This pumping assembly is not covered by an ESC.

1-5. Destruction of Army Materiel to Prevent Enemy Use
a. Using an axe, pick, mattock, sledge, or any other heavy implement, damage all vital elements such as controls, engine fuel pump, switches or any other major assemblies.

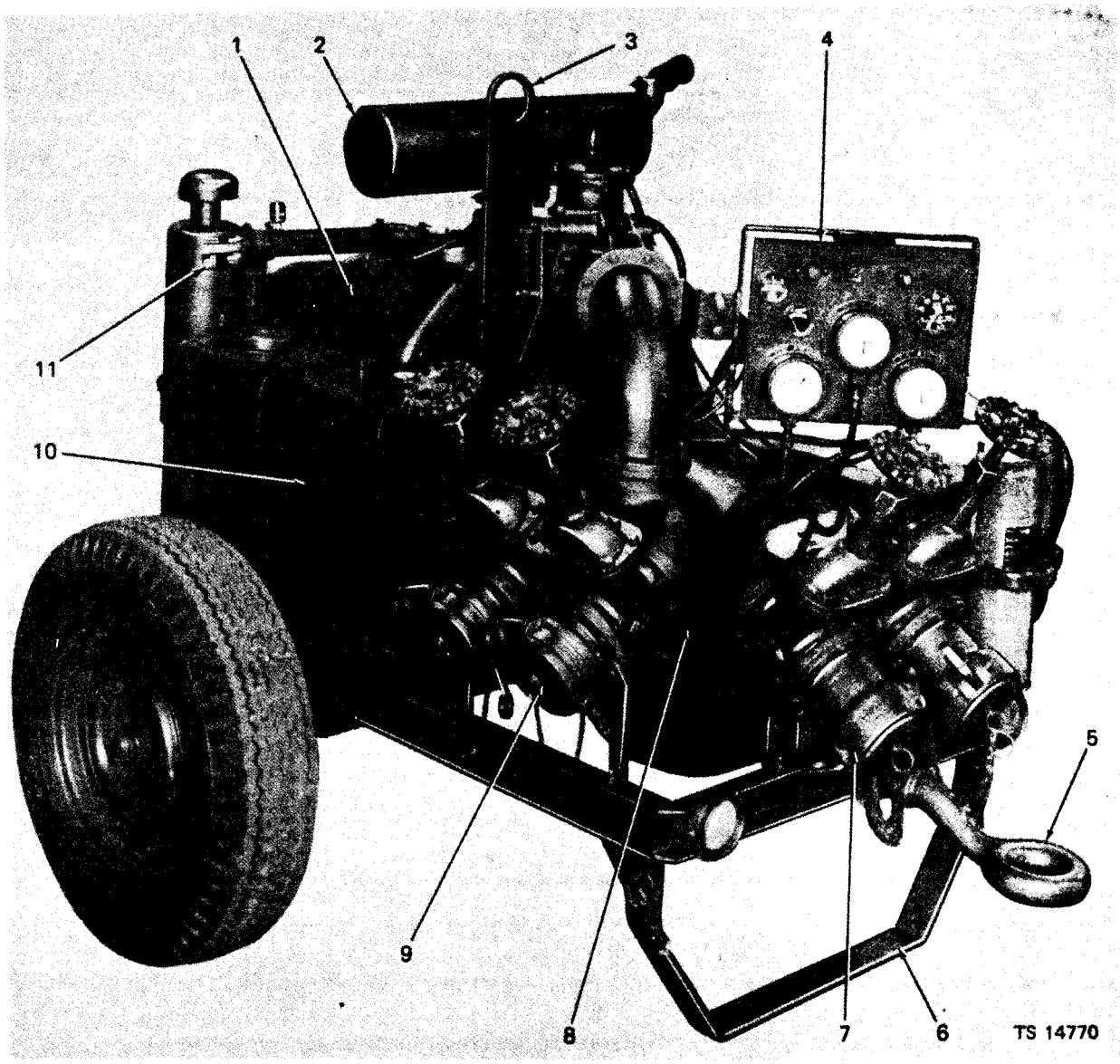
b. Add sand to oil in engine crankcase, and drop nuts and bolts into pump case. Run engine until pump fails.

c. Demolition with explosives. Place as many charges as time permits. Place charges in vital areas such as under the engine, control box, under and around the pumps. Use a suitable detonator to blow all charges simultaneously.

1-6. Administrative Storage
This pumping assembly is prepared for administrative storage according to instructions provided in TM 740-90-1.

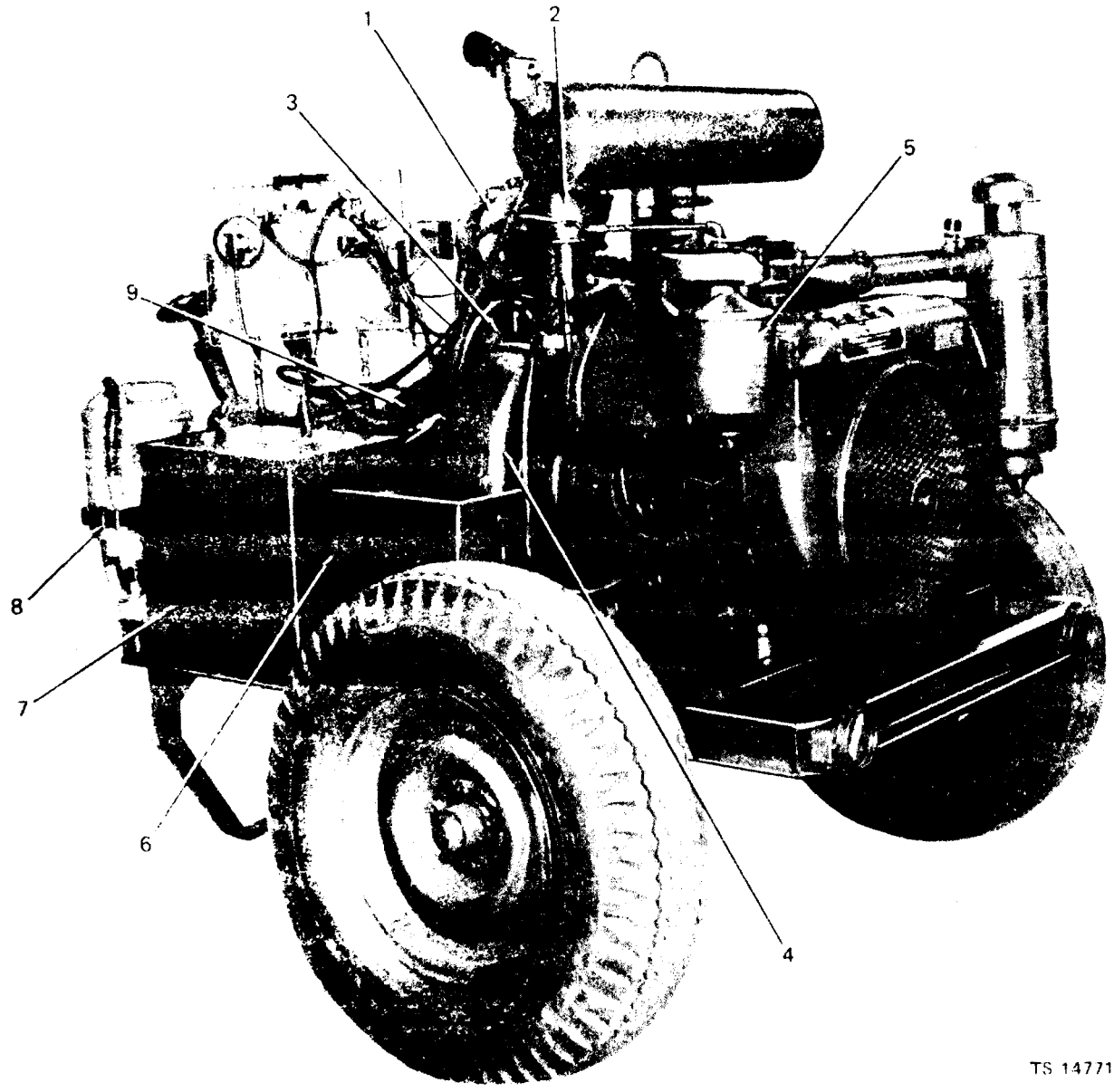
Section II. DESCRIPTION AND DATA

1-7. Description
a. *General*. The pumping assembly is a self-contained unit consisting primarily of a centrifugal pump powered by a gasoline engine directly coupled to the pump. The pump and engine are secured to a wheel-mounted welded frame. The unit is designed for pumping gasolines, jet fuels, light liquid petroleum fuels, and water. A right front, three-quarter view and a left rear, three-quarter view of the pumping assembly are shown in figures 1-1 and 1-2, respectively.



1. Engine
2. Muffler
3. Lifting bail
4. Control panel
5. Drawbar
6. Front stand
7. Suction pipe assembly
8. Pump drain valve
9. Discharge pipe assembly
10. Fuel tank
11. Air cleaner

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



1. Check valve assembly
2. Oil filler cap
3. Primer fill cap
4. Pump
5. Oil filter
6. Battery box
7. Tool box
8. Fire extinguisher
9. Strainer

Figure 1-2. Pumping assembly Left rear, three-quarter view.

b. Pump. The centrifugal pump is a conventional type, self-priming unit designed to deliver 350 gallons per minute (gpm) with a 270-foot dynamic head. The pump impeller is threaded onto the engine crankshaft. The piping arrangement includes a 4-inch (10-cm) suction assembly consisting primarily of a strainer, manifold, and two gate valves and a 4-inch (lo-cm) discharge assembly consisting primarily of an air eliminator, check valve, manifold, and two gate valves. Female couplers secured to the gate valves in the suction assembly and male adapters secured to the gate valves in the discharge assembly provide for quick-connecting/disconnecting of hose assemblies.

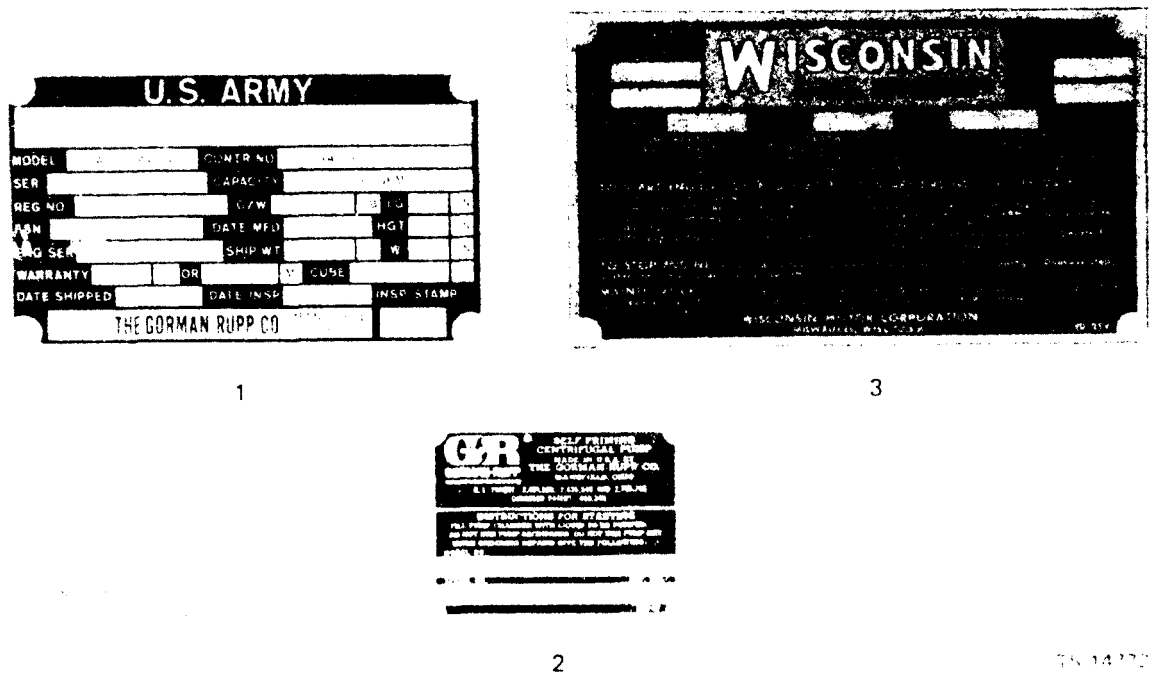
c. Engine. The engine is a V-type, four-cylinder, four-cycle unit with an L-head. It is pressure-lubricated and is cooled by a flow of air which is circulated over the cylinders and heads of the engine by a combination fan-flywheel encased in a sheet metal shroud. The engine uses an electrical starting motor and has magneto ignition. Engine speed is controlled

by a centrifugal flyball-type governor which responds to the load imposed on the engine. A flywheel alternator maintains the charge of the lead-acid battery.

d. Frame Assembly. The frame assembly is constructed of welded steel members and is equipped with a fixed axle, two wheels, and pneumatic tires. It has a removable drawbar for towing and a collapsible stand at the front end to support the unit during operation. Reflectors are attached to the front and rear of the frame as a safety feature during periods of poor visibility.

1-8. Identification and Tabulated Data

a. *Identification.* The pumping assembly has three primary identification plates (fig. 1-3) for ready reference.



1. Military data plate
2. Pump data plate
3. Engine data plate

Figure 1-3. Identification plates.

(1) Military *data plate.* The military data plate is located on the tool box cover. It identifies the assembly and provides dimensions, weight, and shipping information.

(2) *Pump data plate.* The pump data plate is located on the pump casing behind the battery box. It identifies the pump and provides dimensions, weight, and shipping information.

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

b. Tabulated Data. Table 1-1 provides tabulated data on the pumping assembly and its components.

Table 1-1 Data on Pumping Assembly and Components

component	Data
Pumping assembly	
Manufacturer	Gorman-Rupp
Model number	04A12C-MVG4D
Specification	MIL1l-275D
Length overall	119in. (297.5 cm)
Length (drawbar retracted)	75 in. (187.5 cm)
Width	57 in. (1425 cm)
Height	56 in. (140 cm)
Overall weight	13501b(612kg)
Shipping weight	1497 lb(679 kg)
Shipping volume	152.21 ft^3(4.3m8)
Tire size	7.00 x16
Tire pressure	25 to 30 psi
Engine	
Manufacturer	Teledyne Wisconsin Motor
Model	MVG4D
Specification,	
Type	Four stroke cycle
Number of cylinders	4
Displacement	l48.5 cu in.
Horsepower at full load (2400 rpm)	36.0
Cooling	Air
Fuel tank capacity	20 gal (761iters)
Crankcase oil capacity (including filter)	6 qt (5.71iters)
Low oil pressure switch cutout	l psi

Table 1-1. Data on Pumping Assembly and Components — Continued

Component	Data
Valve clearance (cold)	
Intake	0.008 in. (0.02cm)
Exhaust	0.016 in. (0.04 cm)
Spark plugs	
Gap	0.030 in. (0.075 cm)
Torque	25 to 30 ft-lb (3.45 to 4.14 kg-m)
Breaker point gap	0.015in. (0.03 cm)
Firing order	1-3-4-2
Governor speed at full load	2350 rpm
Alternator	
Manufacturer	Teledyne Wisconsin Motor
Type	Flywheel mounted
voltage	24
Amperage output	12
Starting motor	
Manufacturer	Prestolite
Part number	MBP-4018T
Voltage	24
Magneto	
Manufacturer	Fairbanks-Morse
Part number	FM-XZE4B7
Carburetor	
Manufacturer	Zenith
Part number	11532
Fuel pump	
Manufacturer	Teledyne Wisconsin Motor
Part number	LA46A
Fuel strainer	
Manufacturer	Tillotson
Part number	OW476T

Table 1-1. Data on Pumping Assembly and Components — Continued

Component	Data
Air cleaner	
Manufacturer	Teledyne Wisconsin Motor
Part number	L0176
Oil filter	
Manufacturer	FRAM
Part number	F2lP
Tachometer-hourmeter	
Manufacturer	Stewart-Warner
Part number	567AAC
Governor assembly	
Manufacturer	Teledyne Wisconsin Motor
Part number	T84H1
Type	Flyweight
Pump	
Manufacturer	Gorman-Rupp
Part number	8561
Type	Centrifugal
Stages	1
Volume flow	350 gpm
Total dynamic head	275 ft
Suction size	4 in. (10 cm)
Discharge size	4 in. (10 cm)
Gate valves	
Manufacturer	OPW
Part number	676FR41NAL

c. Wiring Diagram. A wiring diagram of the starting system, magneto ignition system, and the flywheel alternator system is shown in figure 1-4.

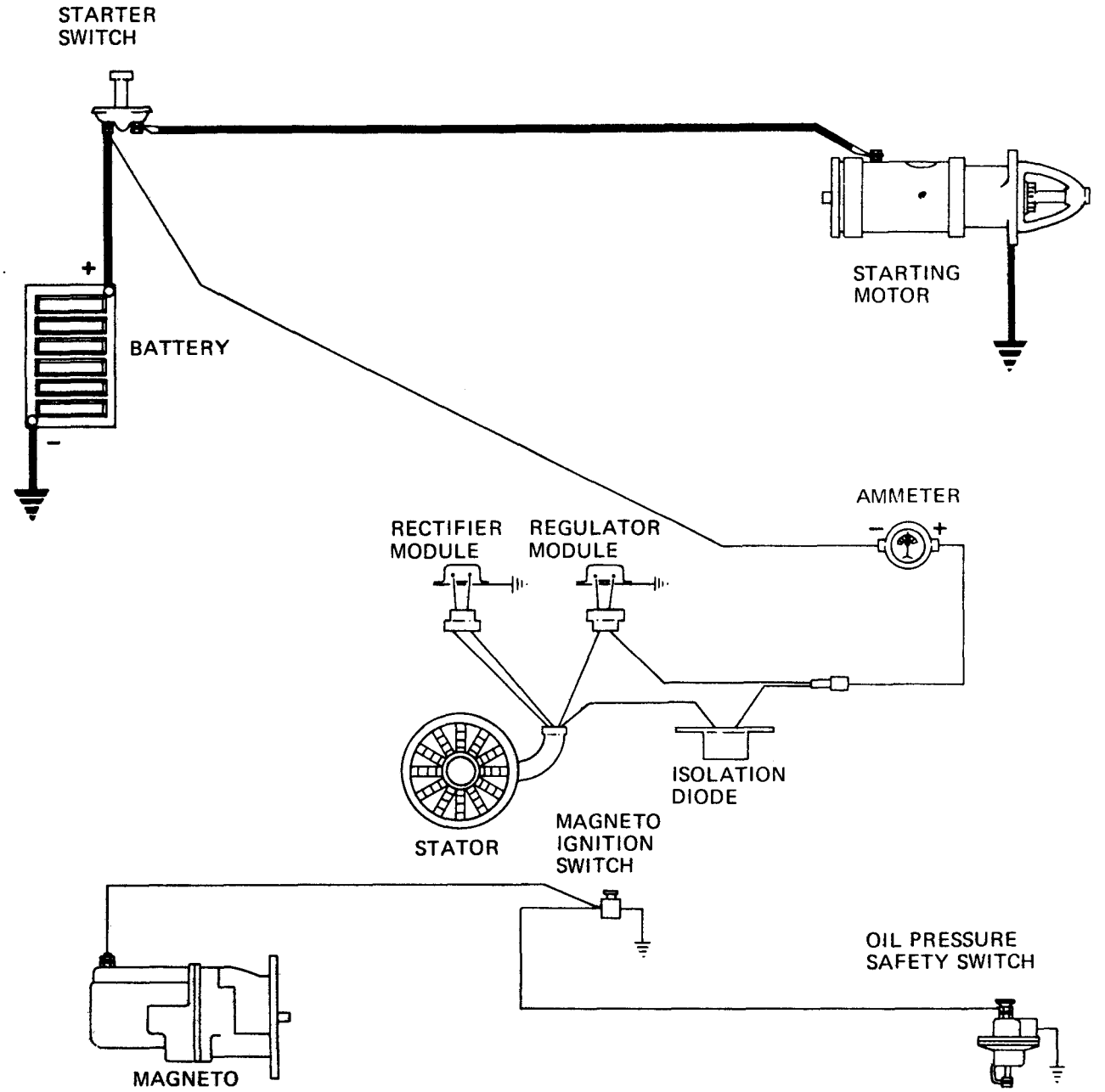


Figure 1-4. *Wiring diagram.*

1-9. Difference in Models

This manual covers only the German-Rupp pumping assembly, Model 04A12C-MVG4D. No known differences exist among the model covered by this manual.

CHAPTER 2
OPERATING INSTRUCTIONS

WARNING

If equipment fails to operate, refer to troubleshooting procedures in Chapter 3.

Section I. OPERATING PROCEDURES

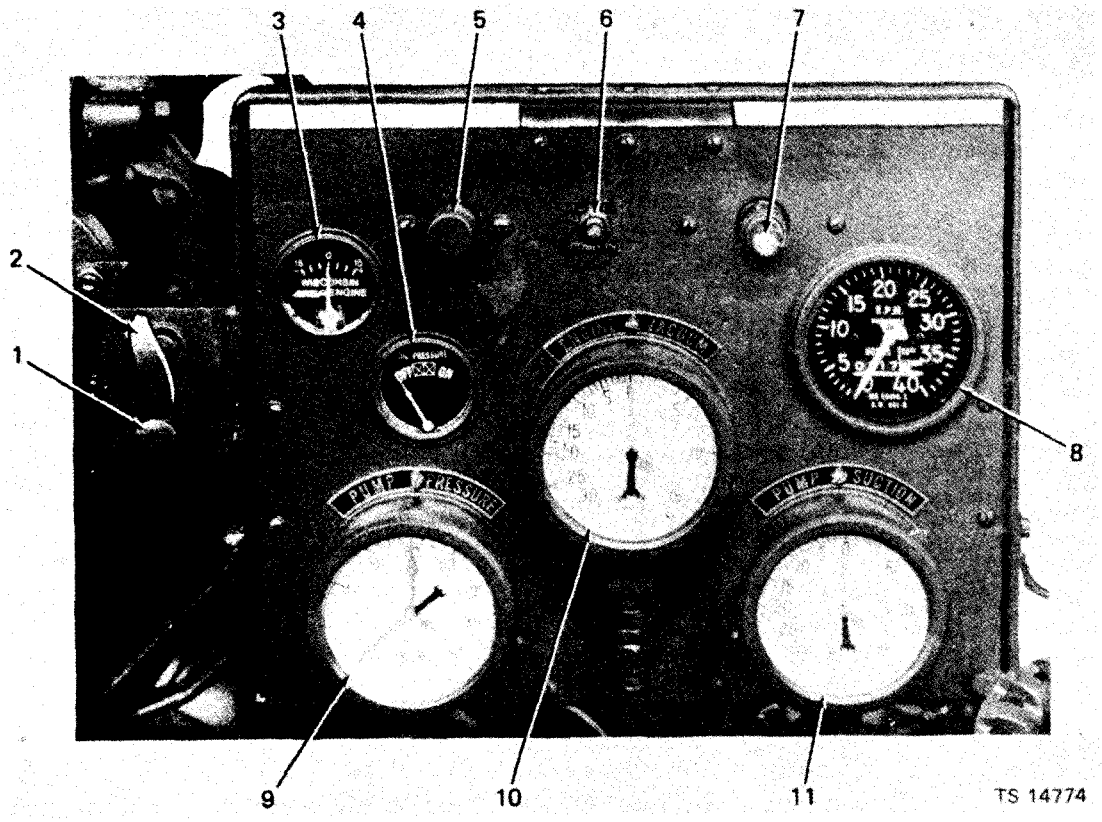
2-1. General.

This section contains information and guidance for personnel responsible for the operation of the pumping assembly. It provides a description of the controls and instruments necessary for safe and efficient operation of the unit and gives instructions on starting, stopping, and operating the unit.

2-2. Controls and Instruments.

Before attempting to operate the pumping assembly, you must become familiar with all controls and instruments provided on the unit, The controls and instruments are illustrated in figures 2-1 through 2-3.

a. Choke Control. The choke control (1, fig. 2-1) provides a means of regulating the amount of air entering the carburetor. Pulling the choke out reduces the proportion of air in the fuel-air mixture; pushing it fully in provides a balanced fuel-air mixture for normal operation.



1. Engine choke control
2. Throttle control
3. Ammeter
4. Oi1 pressure
5. Starter switch
64 Ignition switch
7. Low oil pressure safety switch
8. Engine tachometer-hourmeter
9. Pump discharge pressure gage
10. Engine vacuum gage
11. Pump suction gage

Figure 2.1. Instrument and control panel.

b. Engine Throttle Control. The engine throttle control (2) provides a means of controlling the engine speed, Pushing the throttle fully in reduces the engine speed to idling; pulling it fully out permits

the engine to operate at the governed speed.

c. Starter Switch. The starter switch (5) when pressed permits current to flow from the battery to the starting motor to crank the engine for starting.

d. Ignition Switch. The ignition switch (6) controls the ignition circuit. When in the ON position, it permits a high-tension current to be transmitted from the magneto to the spark plugs. When in the OFF position, it shorts out the magneto coil and stops the engine.

e. Ammeter. The ammeter (3) indicates if the battery is being charged or discharged while the engine is in operation. The ammeter should show a high charge rate to restore battery energy immediately after starting and then taper off to zero with continued operation.

f. Tachometer-Hourmeter. The tachometer-hourmeter (8) registers the rpm of the engine and maintains a running total of the engine operating hours and tenths of hours.

g. *Engine Vacuum Gage.* The engine vacuum gage (10) is a measure of the engine horsepower output. The horsepower required to drive the pump varies with the weight of the liquid being pumped and the capacity or rate of pumping. For example, jet fuel having a specific gravity of 0.8 requires only eight-tenths as much horsepower at a given flow rate as does water having a specific gravity of LO. The vacuum reading on the engine vacuum gage is indicative of the horsepower being generated - the higher the vacuum, the less the horsepower.

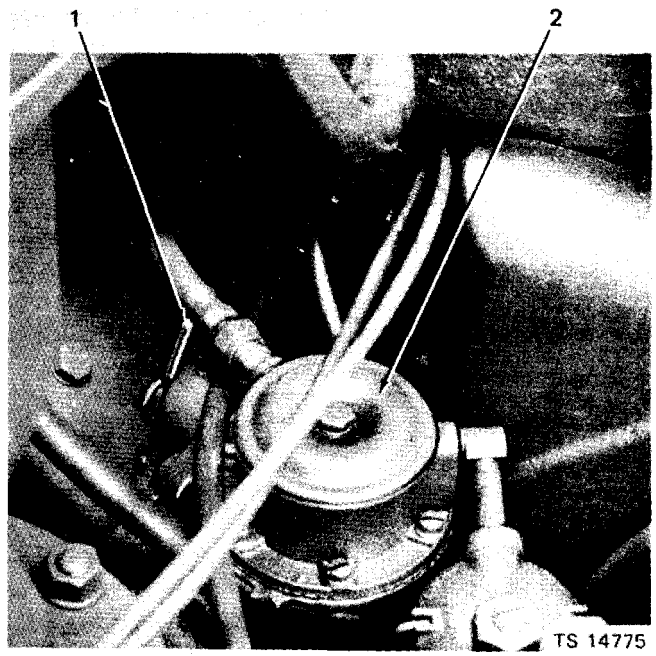
h. Pump Suction Gage. The pump suction gage (11) indcates either a vacuum or pressure at the pump inlet, depending on pump application.

i. Pump Discharge Pressure Cage. The pump pressure gage (9) indicates discharge pressure at the pump outlet.

j. Oil *Pressure Cage.* The oil pressure gage (4) indicates the oil pressure within the lubricating system. At normal operating temperature, the oil pressure must be 4 to 5 pounds per square inch. When the oil is cold, pressure will be higher.

k. Low Oil Pressure Safety Switch. The low oil pressure safety switch plunger (7) stops the engine by closing the ground circuit to the magneto when the lubricating oil pressure falls below 1 pound per square inch. It must be manually set each time the engine is started.

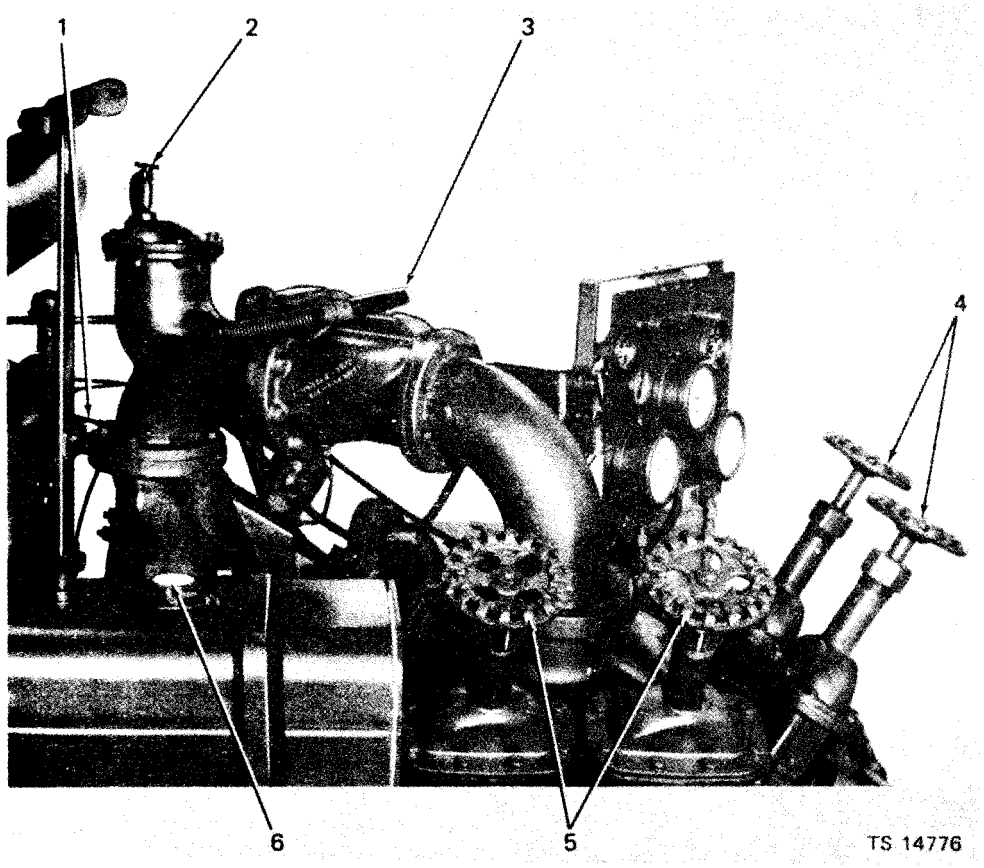
1. Fuel Hand Primer Lever. The fuel hand primer lever (1, fig. 2-2) is operated in a back-and-forth motion to pump fuel to prime the fuel lines at initial starting or after the engine has been idle for an extended period of time.



1. Hand primer lever
2. Fuel pump

Figure 2-2. *Fuel hand* primer lever.

m. Fuel Cage. The fuel gage (6, fig. 2-3) indicates the level of fuel in the fuel tank.



1. Fuel source selector valve
2. Air eliminator vent valve
3. Check valve override handle
4. Suction gate valve
5. Discharge gate valve
6. Fuel gage

Figure 2-3. Right side view of pumping assembly showing controls.

n. Fuel Source Selector Valve. The selector valve (1) controls the source of fuel to the engine. In the OFF position it shuts off the fuel source. In the TANK position it connects the engine fuel system to the fuel supply in the fuel tank. In the AUX position it connects the engine fuel system to an auxiliary external fuel supply, if connected.

o. *Air Eliminator Vent Valve.* The vent valve (2) serves to vent off entrapped air during the priming cycle and is normally left open during operation.

p. Check Valve Override Handle. The check valve override handle (3) adjusts to the opening and closing of the check valve. Normally, the check valve closes automatically when the pumping operation is discontinued; this retains enough fuel in the pump and suction hose for priming the pump in subsequent operations. The check valve throttle can be manually opened to drain the liquid back through the pump and the suction hoses when required.

q. Suction and Discharge Gate Valves. The suction and discharge gate valves (4 and 5), located on the suction and discharge manifolds, are designed to control the flow of fuel in the system.

2-3. Before Operation Services

Before operating the pump assembly, you must ensure that installation instructions have been followed and that inspection and servicing has been performed. In addition, inspect all the suction and discharge hoses. Ensure that each connection is properly secured and that the hoses are independently supported near the pump. Arrange the hoses as straight as possible. Required bends should be made with a long radius.

2-4. Starting

CAUTION

Starting a dry pump may damage the pump shaft seal.

a. Prime the pump with the liquid to be pumped by closing the suction valves, removing the primer fill cap (3, fig. 1-2), and filling the pump housing to the level of the cap. Make sure the drain valve at the bottom of the housing is closed,

WARNING

After removing the priming cap and filling the pump casing with the product to be pumped, check the snap-in gasket in the cap to be sure that it is present and that it is serviceable (no dents; cuts, abrasions). Remove and replace as necessary.

When the casing has been filled, place the cap on the male quick disconnect adapter and raise the cam levers on the cap to the fully locked (vertical) position.

Bind the cap cam levers together in the locked position with soft wire or heavy twine in order to eliminate any possibility of their release due to vibration. This procedure must be followed each time the pumping assembly is primed.

b. Open the air eliminator valve (2, fig. 1-2).

C. Although electric start engines do not require hand priming, it is a good practice to prime the fuel system if the engine is being started for the first

time, or if the unit has been standing idle for a considerable length of time. Using the hand primer lever (1, fig. 2-2), fill the fuel lines and the carburetor float bowl and the strainer bowl. When priming, a distinct resistance to movement of the hand primer should be felt, If you do not feel this resistance, turn the engine crankshaft one revolution so that the fuel pump lobe on the camshaft is rotated out of engagement with the fuel pump cam follower to permit movement of the fuel pump diaphragm with the lever. Assuming the gasoline strainer is empty, about 26 strokes of the primer lever are required to fill the bowl. After the strainer bowl is full, an additional 5 to 10 strokes are required to fill the carburetor bowl. When this bowl is full, the primer lever will operate with less resistance.

d. Pull out the throttle control (2, fig. 2-1) halfway and place the ignition switch (6) in ON position.

e. Pull out the choke control (1) all the way.

f. Pull out the oil pressure safety switch plunger (7) about 1/16 inch and engage the spring clip into the recessed underside of the housing to hold the switch contacts open for starting. You must reset this switch each time you start the pump.

g. Depress the starter switch (5). After several revolutions of the crankshaft, push in the choke control (1) half way. If the engine should fail to start after a few revolutions of the crankshaft, do not continue to crank with the starter. Use short, intermittent starting cycles to prevent overheating of, and possible damage to, the starting motor.

h. After the engine starts, adjust the choke so that the engine runs smoothly. Run the engine for a few minutes to allow it to warm up and then push the choke in all the way.

2-5. Operation.

a. To start product flow, open the suction and discharge valves and adjust the engine throttle (2, fig, 2-1) so that the tachometer indicates no less than 1400 revolutions per minute. Fluid flow should be indicated by the movement of the check valve override handle as the check valve is pushed open.

b. Open the discharge valves and increase the engine speed to achieve the desired flow rate,

2-6. During Operation Services.

You must remain alert in order to correct or report any deficiency in performance or other signs of unusual operation.

a. Unusual Operation and Noises. Inspect for any unusual operation, such as engine overheating or running at below-governed speed or failure of the pump to deliver desired volume or to respond to controls. Stop operation immediately if any unusual noise is noticed.

b. Gage Readings. Check all gage readings frequently; watch particularly to see that there is no unusual drop in engine oil pressure and that the ammeter is operating within its normal range.

c. Leaks. Inspect the entire unit for leaks, paying particular attention to the suction hose fittings.

2-7. Stopping.

a. Reduce the engine speed by means of the throttle lever and remove the load by shutting off the suction valves, Allow the engine to idle from 3 to 5 minutes to cool evenly and prevent warping of the valves.

b. Press and hold the ignition switch in the OFF position until the engine stops,

2-8. Temporary Stop Services.

When the unit is stopped, even for short periods, you should make a general inspection of the equipment. If time permits, minor deficiencies should be corrected during temporary stops.

2-9. After Operation Services.

To ensure that the equipment is ready to operate at any time, the daily services indicated on the preventive maintenance services check-list (table 3-1) must be performed by the operator or crew immediately after every operating period.

2-10. Breaking in a New Engine.

Careful breaking in of a new engine will greatly increase its life and result in trouble-free operation. After inspecting and servicing the unit, follow the starting procedures and, if possible, proceed as follows:

a. Operate for one-half hour at 1,000 to 1,200 revolutions per minute without load.

b. Increase to engine operating speed for an additional 2 hours without load.

c. If possible, operate at light loads for about 8 hours before maximum load is applied.

2-11. Performance Curve.

A composite pump performance curve (fig. 24) for this pumping assembly is located under the tool box cover. It indicates the pump capacities in relation to revolutions per minute and dynamic head

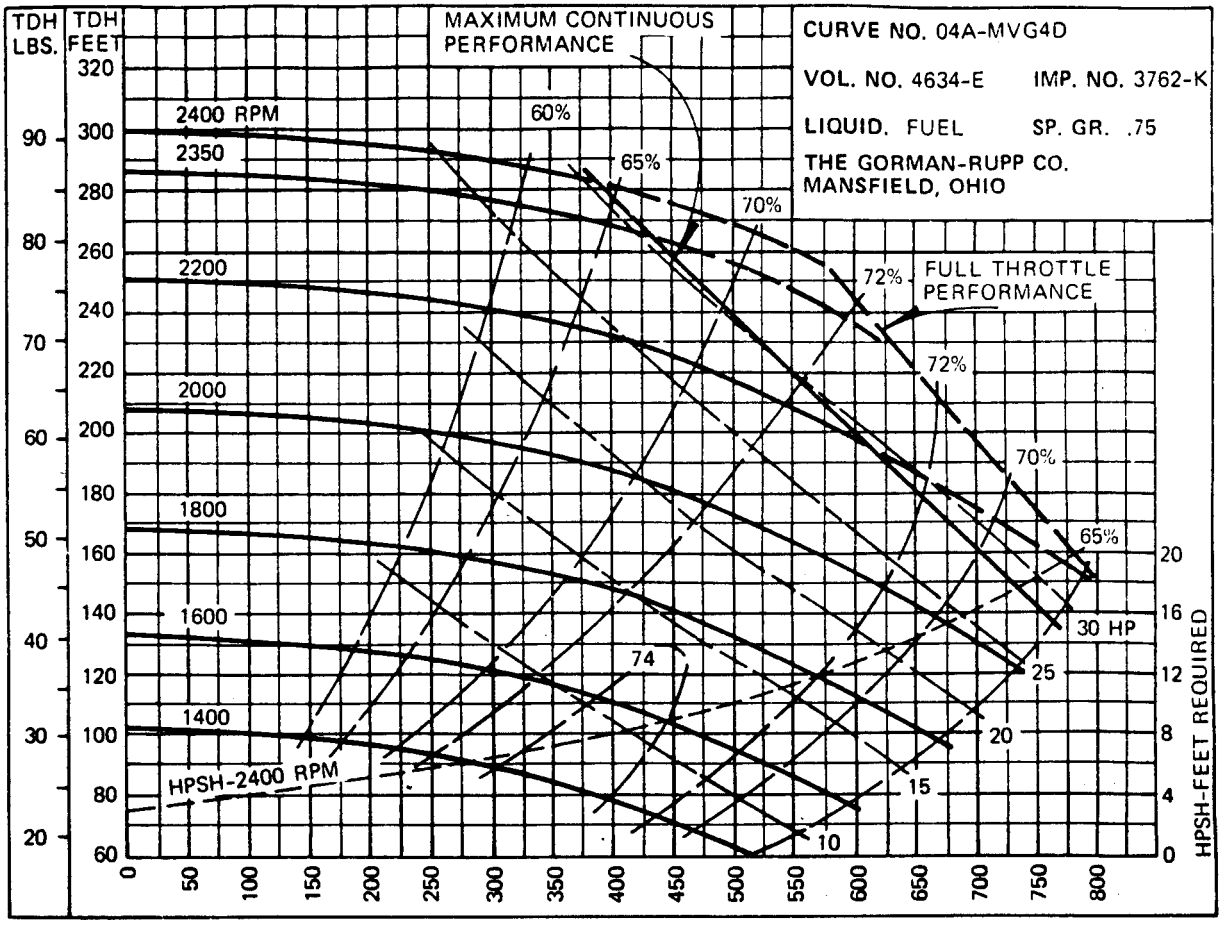


Figure 2-4. Performance of pump unit pumping fuel at 0.75 specific gravity.

a. Pump capacities are shown in gallons per minute. Pump discharge pressures are shown in pounds per square inch and in feet of head of the liquid pumped.

b. For various operations of the pump unit, that is, transfer, dispensing, and receiving, it is most desirable that you maintain the engine speed at a constant level. This may be accomplished simply by adjusting the engine throttle control.

Section II. OPERATION UNDER UNUSUAL CONDITIONS

2-12. Extreme Heat.

Under conditions of extreme heat, you should locate the pump in a well–ventilated area which will allow a maximum amount of cool air for cooling the engine.

a. Cooling System Protection. Be sure that all shrouding is installed and in good condition. Keep cylinder head and cylinder fins free from any oil an-or dirt.

b. Lubrication. Make sure the lubricants used are in accordance with the expected air temperatures and are in accordance with LO 54320–273–12.

c. *Fuel System Protection.* Fill the fuel tank at the end of each day's operations to prevent an accumulation of vapor in the fuel tank.

d. Battery. Increase battery PMCS frequency. Use distilled water or a good grade of drinking water (excluding mineral water).

2-13. Extreme Cold.

Under conditions of extreme cold, you should, if possible, locate the unit so as to provide shelter from the elements, using a building, a snowdrift, canvas, or a hill as a windbreak. Cover the unit when not in use. You must observe special precautions to obtain satisfactory performance of the equipment in sub zero temperatures. To help prevent malfunctioning and to assure continuous operation, observe the following procedures.

a. *Fuel System.*

(1) Keep the area surrounding the fuel tank fill cap free of ice, snow, or other moisture.

(2) Thoroughly clean containers before using for fuel storage.

(3) Keep the fuel tank full when the pump is not in use to prevent an excessive amount of water condensation in the fuel system of the engine.

(4) Service the fuel filter frequently to remove any moisture from the bowl.

b. Engine Ignition System. Keep the starter, magneto, and other electrical fixtures free of moisture,

c. Lubrication. Refer to LO 5-4320-273-12 to assure that engine lubricant is the proper grade for the coldest conditions likely to be encountered.

2-14. Sandy or Dusty Conditions.

You must protect the unit from dust or sand as much as possible to ensure proper cooling and operation.

a, Lubrication. When adding oil to the crankcase, remove any dirt or sand from around the filler neck. Keep the crankcase breather cap clean. Lubricate in accordance with LO 5-4320-273-12.

b. Air Cleaner. Service the air cleaner as often as necessary.

c. Protection of Stores of Oil and Fuel. Keep stores of oil and fuel tightly closed to protect them from dust or sand. If possible, store the supplies in a shed or storage room or cover them with a tarpaulin.

2-15. Salt Water Areas.

Salt air causes a rapid deterioration of unpainted surfaces. You should remove rust formations immediately and protect the exposed surfaces with paint, if available, or with a light coat of oil. Check all electrical contacts daily and replace corroded part.

2-16. Movement to a New Location.

Before moving the pumping assembly to a new location, you should observe the following procedures.

a. Close all gate valves.

b. Seal the suction and discharge openings with the appropriate dust caps/plugs issued with the equipment.

c. Disconnect and stow the grounding wire and grounding rod.

d. If the pump is being towed, secure the front stand support in the “up” position after the drawbar is secured to the towing vehicle.

CHAPTER 3
OPERATOR'S MAINTENANCE INSTRUCTIONS

Section I. LUBRICATION INSTRUCTIONS

3-1. General.

This section contains information and instructions that the operator must follow to ensure proper lubrication of the pumping assembly. The required lubrication points, intervals, and detailed instructions are indicated on Lubrication Order LO 5-4320-273-12 (fig. 3-l). Strict adherence to this information will ensure longer periods of trouble-free operation.

LUBRICATION ORDER
15 MAY 1975

LO5-4320-273-12

PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER GED, 350 GPM CAPACITY, 275 TOTAL HEAD, WHEEL MOUNTED (GORMAN-RUPP MODEL 04A12C-MVG4D) W/WISCONSIN ENGINE MODEL MVG4D

Reference: FEDERAL SUPPLY CATALOG C9100-IL

Intervals are based on normal hours of operation. Adjust to compensate for abnormal operations and severe conditions or contaminated lubricants. During inactive periods sufficient lubrication must be performed for adequate preservation.

Clean lubricating points before lubricating.

Relubricate after washing or fording.

Clean parts with SOLVENT, dry-cleaning, or with OIL, fuel, Diesel. Dry before lubricating.

Drain crankcase when hot; replenish and check level when cool.

Lubricate points indicated by dotted arrow shafts on both sides of the equipment.

-KEY-

LUBRICANTS	CAPACITY	EXPECTED TEMPERATURES			INTERVALS
		Above +32°F Above 0°C	+40°F to -10°F +5°C to -23°C	0°F to -65°F -18°C to -50°C	
OE/HDO-OIL, Engine, Heavy Duty					
Crankcase	5qt(4.75L)	OE/HDO 30	OE/HDO 10	OEA	Intervals given are in hours of normal operation
Oil Filter	1qt(0.95L)				
Oil Can Points					
OEA-OIL, Engine, Subzero					
GAA-GREASE, Automotive and Artillery		ALL TEMPERATURES			

FOLD FOLD

LUBRICANT • INTERVAL

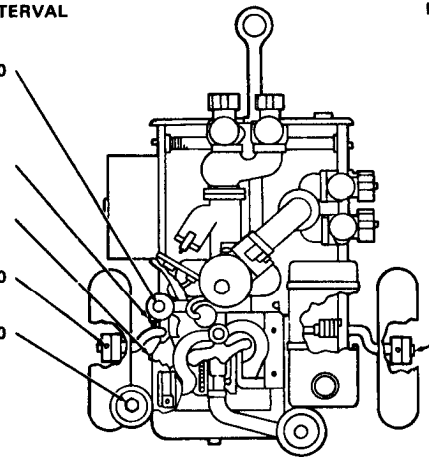
Crankcase Fill and Breather Cap (Clean and re-oil) (See key) — OE 100

Crankcase Oil Level Gage (Check level) — 10

Crankcase Drain Plug (Drain and refill) — 50

Magneto Cam Wick (Sparingly) — OE 500

Oil Filter (Disassemble, clean housing, renew element and reassemble) (See note 2.) — 100



INTERVAL • LUBRICANT

1000 GAA Wheel Bearing (Remove wheel, clean, inspect and lubricate bearings and reassemble)

NOTES:

1. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW - 10 F. (23C). Remove lubricants prescribed in the key for temperatures above - 10 F, (23C). Clean parts with SOLVENT, dry-cleaning. Relubricate with lubricants specified in the key for temperatures below - 10 F. (23C).

2. OIL FILTER. Every second time crankcase is drained, or 100 hours, remove and discard oil filter. Install new filter.

3. OIL CAN POINTS. Every 250 hours clean and lightly coat the governor and carburetor linkage, axle mounts, all clevis pins and hinges with OE.

4. LUBRICANTS. The following is a list of lubricants with the military symbols and applicable specification numbers.
OE/HDO MIL-M-2104C
OEA MIL-M-46167
GAA MIL-G-10924

A copy of this Lubrication Order will remain with the equipment at all times; instructions contained herein are mandatory.

BY ORDER OF THE SECRETARY OF THE ARMY:

FRED C. WEYAND,
General, United States Army,
Chief of Staff

OFFICIAL:
VERNE L. BOWERS,
Major General, United States Army,
The Adjutant General.

TS 14778

Figure 3-1. Lubrication order.

3-2. Detailed Lubrication Information.

a. Keep lubricants in closed containers and store in a clean, dry place away from external heat. Allow no dust, dirt or other foreign material to mix with the lubricants.

6. Store lubrication equipment in a place where it will be safe from damage. Clean the equipment before and after use.

c. Keep all external parts not requiring lubrication free of lubricants. Wipe all lubrication points free of dirt and grease before lubricating, and clean all lubrication points after you lubricate them to prevent accumulation of dirt.

d. Check the crankcase oil level frequently when operating under unusual conditions. You generally have to change the oil more frequently than normal under cold weather operation conditions because contamination by fuel dilution and sludge formation will increase under dusty and sandy conditions because contamination by foreign matter increases.

3-3. Engine Lubrication.

Engine crankcase lubrication consists mainly of changing the oil in the crankcase and servicing the oil filter (LO 5-4320-273-12). Proceed as follows:

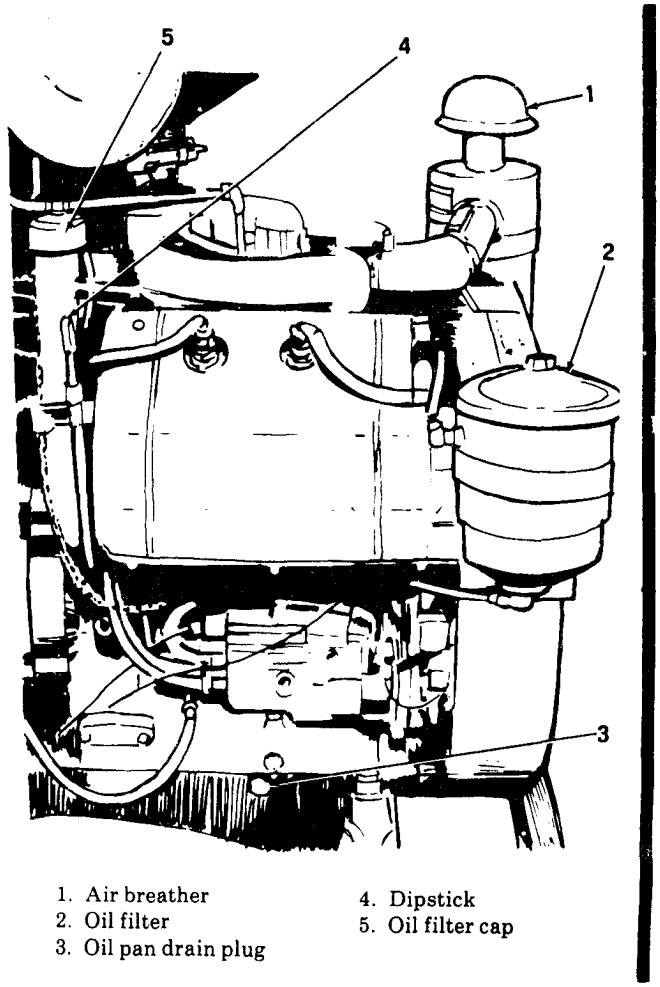
a. Run the engine long enough to heat it to operating temperature. The warm oil will drain from the internal engine parts much more rapidly than cold oil and also will carry more dirt and sludge with it as it drains.

6. Place a suitable container under the engine drain port before you remove the oil pan drain plug (3, fig. 3-2). Allow the oil to drain fully.

c. If engine is operated under extreme dusty or sandy conditions, you should replace the filter element at every oil change.

d. Install the plug in the drain port.

e. Remove the oil filler cap (5, fig. 3-2) from the engine oil filler tube and pour 6 quarts (5.7 1) of engine oil into the engine, 5 quarts (4,7 1) for the crankcase and 1 quart (0.95 1) for the oil filter. You must use the engine oil required for the particular temperature range which will be encountered, Refer to LO 5-4320-273-12.



1. Air breather
2. Oil filter
3. Oil pan drain plug
4. Dipstick
5. Oil filter cap

Figure 3-2 Engine lubrication.

f. Check the oil level on the oil level dipstick (4, fig. 3-2). It must be up to the full mark. If you find the oil level to be low, add enough oil through the oil filler tube to bring the oil up to the proper level, Take care not to overfill.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

3-4. General.

Preventive maintenance checks and services are necessary to ensure that the pumping assembly is ready for operation at all times. You must inspect the assembly systematically so that any defects may be discovered and corrected before they result in serious damage or failure.

3-5. Checks and Services.

a. The preventive maintenance services to be performed by you are listed in table 3-1 Defects discovered during operation of the unit shall be noted for correction and shall be made as soon as operation has ceased. If a deficiency is noted during operation which would damage the equipment if operation were continued, stop operation immediately. You shall record all deficiencies together with the corrective action taken on DA Form 2404 (Equipment Inspection and Maintenance Worksheet),

b. Table 3-1 lists the checks and services that you should perform before, during, and after operation of the pumping assembly and the approximate work time required in tenths of man-hours.

c. Leakage definitions for operator/crew PMCS shall be classified as follows:

Class I Seepage offluid (as indicated by wetness ordiscoloration) not great enough to form drops.

Class II Leakage of fluid great enough to form drops but not enough to cause drops to drip from item being checked/inspected.

Class Ill Leakage of fluid great enough to form drops that fall from the item being checked/inspected.

CAUTION

Equipment operation is allowable with minor leakages (Class I or II). Of course, you must consider the fluid capacity in the item/system being checked/inspected. When in doubt, notify your supervisor.

When operating with Class I or Class II leaks, continue to check fluid levels as required in your PMCS.

Class Ill leaks should be reported to your supervisor or organizational maintenance.

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services

NOTE

Within designated interval, these checks are to be performed in the order listed.

B-Before D-During A-After Q-Quarterly

Item No.	Interval B	D	A	Q	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	Equipment is Not Ready/ Available if:
						NOTE Perform lubrication prior to or in conjunction with before PMCS . Refer to LO 5-4320-273-12. Keep the pumping assembly free of dirt and oil on all external surfaces.	
1	●				Pumping Assembly	Make the following walk around checks:	
						a. Check for leaks (oil or fuel) on, around, or under pumping assembly.	Class III oil leak or any fuel leakage is found.
						b. Check for loose, missing, or damaged parts or equipment such as the fire extinguisher, ground rod, or shrouding. Check tires for inflation.	Fire extinguisher, ground rod, or shrouding missing.

Table 3-1. Operator/Crew Preventive Maintenance Checks and Services (cont)

B-Before D-During A-After Q-Quarterly

Item No.	Interval B	D	A	Q	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	Equipment is Not Ready/ Available if:
						c. Check air cleaner restriction indicator. If indicator shows Fully RED, replace filter element. Squeeze rubber vacuator valve. d. Visually check fuel strainer for dirt or moisture. Service as required. NOTE During starting and operation, check restriction indicator. Check for leaks. Check for missing, loose, or cracked parts. Check for unusual noise, rough-running, excessive vibration, lack of power, or any indication of a failing or defective component. If suspected, notify organizational maintenance.	Indicator shows RED.
2		●			Control Panel	Check instruments for proper function.	
					a. Ammeter	Indicates positive charge at start and tapers to zero with continued operation.	
					b. Tachometer Hourmeter	Indicates rpm of engine and maintains running time of engine in hours and tenths.	
					c. Vacuum Gage	Vacuum indicates amount of horsepower. The higher the vacuum the less the horsepower.	
					d. Pump Suction Gage	Indicates either a vacuum or pressure, depending on pump application.	
					e. Pump Discharge Pressure Gage	Indicates pressure at the pump outlet depending on pump application.	

Table 3–1. Operator/Crew Preventive Maintenance Checks and Services (cont)

B – Before D –During A – After Q-Quarterly

Item No.	Interval B	Interval D	Interval A	Interval Q	Item to be Inspected	Procedures Check for and have repaired or adjusted as necessary	Equipment is Not Ready/ Available If
					f. Oil pressure Gage	Indicates 4 to 5 lbs/sq in. at idle. WARNING Do not fill tank while engine is running.	Pressure drops below 1 lb/sq in.
3			●		Fuel System	Fill fuel tank. WARNING Do not smoke or use an open flame in the vicinity when servicing the battery. Batteries generate hydrogen gas, which is highly explosive. NOTE Use distilled water or a good grade drinking water (excluding mineral water).	
4				●	Battery	Check level of electrolyte. If low, fill with clean water (distilled if possible) to the split ring. In freezing weather, charge battery at least 1 hour after adding water.	

Section III. TROUBLESHOOTING

3-8. 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, of a 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 and corrective

actions. If you experience a malfunction which is not listed or is not corrected by listed corrective actions, notify your supervisor.

3-7. Operator/Crew Maintenance Troubleshooting

Refer to table 3-2 for troubleshooting which is allocated to operator/crew maintenance levels.

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

ENGINE

1. ENGINE FAILS TO CRANK WHEN STARTER BUTTON IS DEPRESSED.

NOTE

Use distilled drinking water or a good grade drinking water (excluding mineral water).

Step . Check to ensure electrolyte level in battery cells is 3ffl inch (0.99 cm) above the top of the plates. If electrolyte level is below top of plates, add distilled water.

WARNING

Do not smoke or use an open flame In the vicinity when servicing the battery. Batteries generate hydrogen gas, which is highly explosive.

Recharge batteries.

Charge the battery using a constant current charger. Check the speclflc gravity of the electrolyte every 30 minutes. The battery is fully charged when you get a constant specific gravity (1.250) reading for three 90 minute intervals.

CAUTION

Constant current battery charging is always preferred. If you must use a constant-potential charger, battery temperatures must be maintained at less than 130xF (64.44xC) by interrupting the charging procedures as this temperature is approached.

Step 2. Inspect for broken or damaged battery cables and for loose or corroded connections.
Clean battery posts and connections. Tighten loose connections at battery, ground, and starter. If cables are damaged, notify organizational maintenance.

2. **ENGINE CRANKS BUT FAILS TO START.**

Step 1. Check ignition switch for "ON' position.
Turn on switch.

Step 2. Check to ensure oil pressure safety switch was reset.
Reset oil pressure safety switch.

Step 3. Check for insufficiently choked carburetor, especially when engine is cold.
Pull out choke.

Step 4. Check for empty fuel tank.

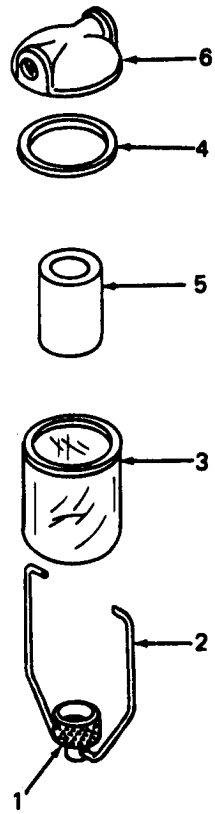
WARNING

Do not fill fuel tank while engine is running.

Refill empty or low fuel tank.

Step 5.. Check for improper setting on fuel source valve.
Set fuel source selector valve on T&NK or aux as required.

Step 6. Check for water or dirt in fuel bowl.
Service the fuel strainer.
Turn the fuel selector valve to the OFF position.
Loosen the nut (1, fig. 3–3) on the bail assembly (2) and swing the bail aside.
Remove the fuel bowl (3), gasket (-) and empty the fuel bowl contents. Wipe the fuel bowl out with a clean cloth.
Remove the strainer element (6) and inspect it for contamination. Replace a contaminated strainer elemenL
Install strainer element (5) in fuel strainer head (8).
Install gasket (4) and fuel bowl (3) in fuel strainer head (8).
Swing bail (2) under the fuel bowl and tighten the nut (l).
Turn the fuel selector valve to the ON position.



1. Nut
2. Bail assembly
9. Fuel bowl
4. Gasket
5. Strainer element
6. Fuel stpiner head

Figure 3-3. *Fuel strainer.*

Table 3-2. Troubleshooting — Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE — Continued

Step 7. Operate hand primer lever on fuel pump.
Crank engine. Engine should start if trouble due due to empty fuel lines cause by extended period of idleness,

3. ENGINE STARTS BUT THEN STOPS.

Step 1. Check for insufficient fuel supply.
Refill empty or low fuel tank.

Step 2. Check for water or dirt in fuel bowl.
Service the fuel strainer.
Turn the fuel selector valve to the OFF position.
Loosen the nut (1, fig. 3-3) on the bail asseembly (9) and l wiag the bail l eide.
Remove the fuel bowl (9), gasket (4) and empty the fuel bowl contents. Wipe the fuel bowl out with a clean cloth.
Remove the strainer element (6) and inspect it for contamination. Replace i contaminated strainer element.
Install l trainer element (5) in fuel l trainer head (6).
Install gacket (4) and fuel bowl (9) in fuel strainer head.
Swing bail (9) under the fuel bowl and tighten the nut (1).
Turn the fuel selector valve to the ON position.

Table 3.2. Trouble shooting — Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE — Continued

Step 3. Check for pulled out choke.
Push in choke control.

Step 4. Check for tripped oil pressure safety switch.
If switch has been tripped, check oil level in crankcase.
If low, fill to proper level with recommended oil. If oil level is not the cause, notify organizational maintenance.

Step 5. Check for clogged fuel line.
Loosen slightly the fuel line nut at carburetor.
If line is open, fuel should drip out at loosened nut.
Report clogged fuel line to organizational maintenance.

4. ENGINE RUNS BUT CONTINUALLY MISFIRES.

Step 1. **Check for water in fuel.**
Drain fuel tank and lines. Refill with clean fuel.

Step 2. Check for clogged fuel strainer.
Service the fuel strainer.
Turn the fuel selector valve to the OFF **position,**
Loosen the nut (1, fig. 3-3) on the bail assembly (2) and owing the bail aside.
Remove the fuel bowl (3), gasket (4), and empty the fuel bowl contents. Wipe the fuel bowl out with a clean cloth.
Remove the strainer element (5) and inspect it for contamination. Replace a contaminated strainer element.
Install strainer element (5) in fuel strainer head (6).
Install gasket (4) and fuel bowl (3) in fuel strainer head (6).
Swing bail (2) under the fuel bowl and tighten the bail nut (l).
Turn the fuel selector valve to the ON position.

5. ENGINE OVERHEATS.

Step 1. Check oil level.
If oil level is low, fill to the proper level with recommended oil. Refer to LO 5-4320-273-12 (fig. 3-l).

Step 2. Check that all air shrouding is unclogged undamaged, and in place.
Remove foreign matter from air shrouding. Tighten loose shrouding, Notify organizational maintenance of other damage.

6. ENGINE RUNS BUT LACKS POWER

Step 1. Check to ensure throttle control is in full speed position.
If throttle control is not in full speed position, pull out throttle control to provide full speed operation,

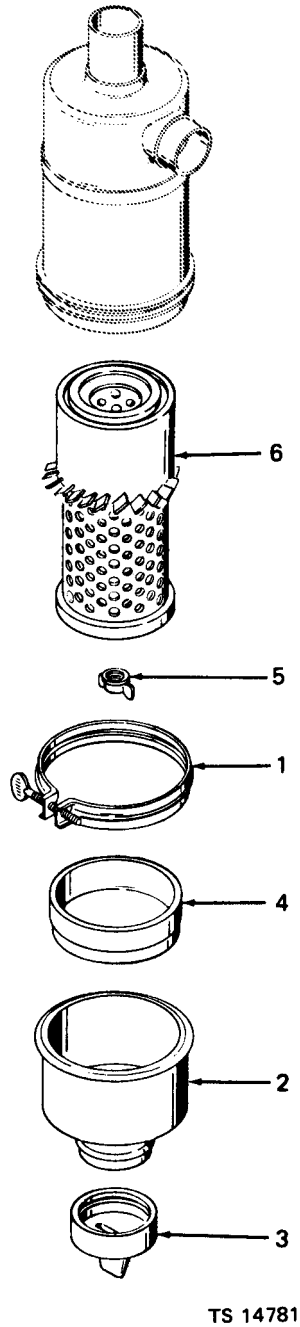
Step 2. Check for dirty **or** incorrect grade of oil.
Service the engine.
Place a suitable container under the engine drain port before you remove the oil pan drain plug. Allow the oil to drain fully.
Install the oil pan drain plug. Remove the oil filler cap and pour five (5) quarts of oil into the engine. (One extra quart if the oil filter element was changed.)

Step 3. Check that all air shrouding is unclogged undamaged and **in place.**
Remove foreign matter from air shrouding. Tighten loose shrouding. Notify organizational maintenance of other damage.

7. ENGINE RUNS BUT LACKS POWER.

Step 1. Check to ensure throttle control is in full speed position.
If throttle control is not in full speed position, pull out throttle control to provide full speed operation.

Step 2. **Check for a dirty air cleaner element.**
Service the air cleaner any time the air restriction indicator shows red in the sight area.
Loosen clamp assembly (1, fig. 3-4) and remove the dust cap (2) and vacuator valve (3). Remove the baffle (4) and empty the dust cap. Remove the wing nut (5), filter element (6) and clean with compressed air, directing the air stream from the inside out.



1. Clamp assembly
2. Dust cap
3. Vacuator valve
4. Baffle
5. Wing nut
6. Filter element

Figure 3-4. Air cleaner.

Table 3-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
Step 2. **Check for a dirty air cleaner element — continued.**
CAUTION **Do not use gasoline, kerosene or solvent to clean element; do not oil the element.**
Install the filter element (6) in air cleaner body and secure with wing nut (5). Install baffle (4) in dust cap. Install vacuator valve (3) on dust cap. Install dust cap (2) on air cleaner body and secure with clamp assembly (l).
PUMP ASSEMBLY
1. PUMP FAILS TO PRIME.
Step 1. **Check for inefficient priming liquid in pump.**
Remove the primer fill cup and check for sufficient priming liquid. If priming liquid level is low, do the followinng:
Make sure the drain valve at the bottom of the housing is closed.
Fill the pump housing to the level of the cap. Install primer fill cap.
WARNING **After removing the priming cap and filling the pump casing with the product to be pumped, check the snap-in gasket in the cap to be sure that it is present and that it is serviceable (no dents; cuts, abrasions). Remove and replace as necessary.** **When the casing has been filled, place the cap on the male quick disconnect adapter and raise the cam levers on the cap to the fully locked (vertical) position.** **Bind the cap cam levers together in the locked position with soft wire or heavy twine in order to eliminate any possibility of their release due to vibration. This procedure must be followed each time the pumping assembly is primed.**
Step **2. Check for loose connection on suction side of pump.**
Check gaskets in suction hoses.
Remove suction hoses from the pump assembly by disconnecting the quick-disconnect fittings.
Remove gaskets from hose couplings and inspect them for cracks or any sign of wear. If gaskets are found to be bad, replace them.
Step 3. **Check for clogged suction strainer.**
Service auction strainer.
Step 4. **Check pump for air or vapor block.**
Make sure the air vent discharge line is open.

Section IV. MAINTENANCE PROCEDURES

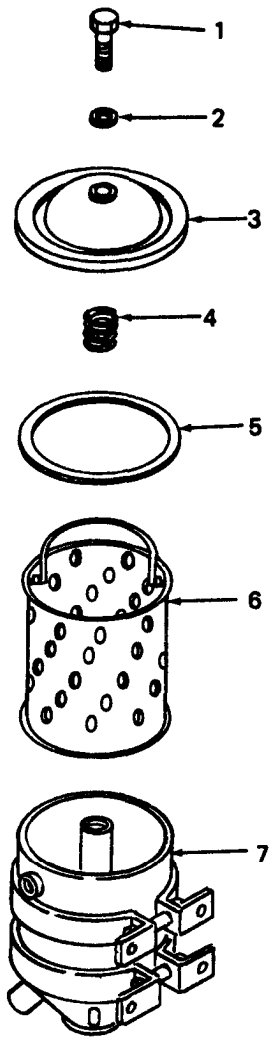
3-8. Engine.

Operator/crew maintenance of the engine consists primarily of the following procedures:

a. Changing Engine Oil. You must change the oil at least every 100 hours of engine operation.

b. Servicing Oil Filter. You should change the oil filter element every 100 hours under normal operating conditions. U rider extreme dusty conditions, replace oil filter element at every oil change. To change the filter element, the filter assembly does not have to be removed, proceed as follows:

(1) Remove shoulder bolt (1, fig. 3-5) and remove the flat washer (2), filter cover (3), spring (4), and gasket (5).



1. Shoulder bolt
2. Flat washer
3. Cover
4. Spring
5. Gasket
6. Filter element
7. Body

Figure 3-5. *Oil filter.*

(2) You can now lift the filter element (6) from the filter body (7). Discard the filter element.

(3) Wipe the interior of the filter body with a clean, dry cloth and position a new filter element (6) in the filter body (7).

(4) Install the gasket (5), spring (4), and cover (3) on the filter body (7). Position the flat washer (2) on the shoulder bolt (l). Tighten the shoulder bolt to secure the cover.

(5) After installing a new filter element, check the oil level dipstick. Add oil if you find the level below the full mark, but do not overfill. Refer to LO 5-4320-273-12 for recommended oil.

3-9. Fuel System.

Operator/crew maintenance of the fuel system consists primarily of the following procedures:

a. Servicing the Air Cleaner.

(1) You should service the air cleaner any time the air restriction indicator shows red in the sight area.

(2) Loosen the clamp assembly (1, fig. 3-4) and remove the dust cap (2) and vacuator valve (3). Remove the baffle (4) and empty the dust cap and vacuator valve.

(3) Remove the wing nut (5), and remove the filter element (6). The element can be dry-cleaned with compressed air, directing the air stream from the inside out. If time permits, you can also wash the element with water and, upon completion, air-dry it.

CAUTION

Do not use gasoline, kerosene, or solvent to clean element; do not oil element.

(4) Replace the element if it is damaged.

(a) Install filter element (6, fig. 3-4) in body and secure with wing nut (5). Install baffle (4) and vacuator valve (3) on dust cap (2).

(b) Install dust cap (2) on air cleaner body and secure with clamp assembly (l).

b. Servicing Fuel Tank, Lines, and Fittings. Maintenance of the fuel tank, lines, and fittings is normally confined to such services as filling the tank with fuel and tightening loose fittings.

(1) Drain the fuel tank by removing the plug and draining the fuel into a suitable container. Clean the strainer with a soft-bristled brush to remove embedded material.

(2) Inspect the fuel tank and lines for leaks, cracks, dents, damaged threads, and broken weldments. You should report any damage to organisational maintenance.

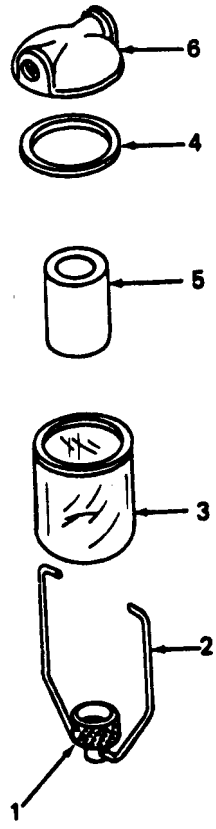
(3) Check for clogged fuel lines by loosening the nut connecting the fuel line to the carburetor. If the line is open, fuel will drip out at the loosened nut. If the fuel line is clogged, you should report it to organizational maintenance.

(4) Insert the drain plug and fill the fuel tank to the proper level.

c. Servicing the Fuel Strainer. If *you* observe moisture or other contaminants in the glass bowl of the fuel strainer, service the strainer as follows

(1) Turn the fuel source selector valve to OFF position.

(2) Loosen the nut (1, fig. 3-6) on the bail assembly (2) and swing the bail aside to remove the glass fuel bowl (3) and gasket (4). Empty the contents of the bowl and wipe it dry with a clean cloth.



1. Nut
2. Bail assembly
3. Fuel bowl
4. Gasket
5. Strainer element
6. Fuel strainer head

Figure 3–6. Fuel Strainer

(3) Visually inspect the strainer element (6) for contamination. Replace a contaminated strainer element.

(4) Install strainer element (5) in fuel strainer head (6). Install gasket (4) and fuel bowl (3) on the fuel strainer head (6), swinging the bail assembly (2) into position, and tightening the bail assembly nut (1) to hold the bowl in place.

(5) After you have serviced the fuel strainer, open the fuel selector valve and check for leaks after engine is in operation. Correct any leaks by tightening bail assembly nut or by replacing a damaged fuel bowl gasket.

3-10. Electrical System

NOTE

Use distilled water or a good grade of drinking water (excluding mineral water).

Operator/crew maintenance of the electrical system consists primarily of servicing the battery. You should keep battery filled to 3/8 inch (0.93 cm) above plates, with distilled water. Keep the battery posts and the cable terminals clean. You can protect the terminals from corrosion by coating them with a light application of GAA lubricant.

3–11. Wheels

Operator/crew maintenance of wheels consists primarily of servicing the tires, as follows:

a. Inspect wheels and rims for damage and inspect tires for cracks or deep cuts.

b. Remove foreign material embedded between the tire threads. If you remove a nail or other penetrating object, check tire pressure frequently to ensure the tube is not punctured. If pressure drops, the tube must be inspected for a puncture and may need patching or replacing.

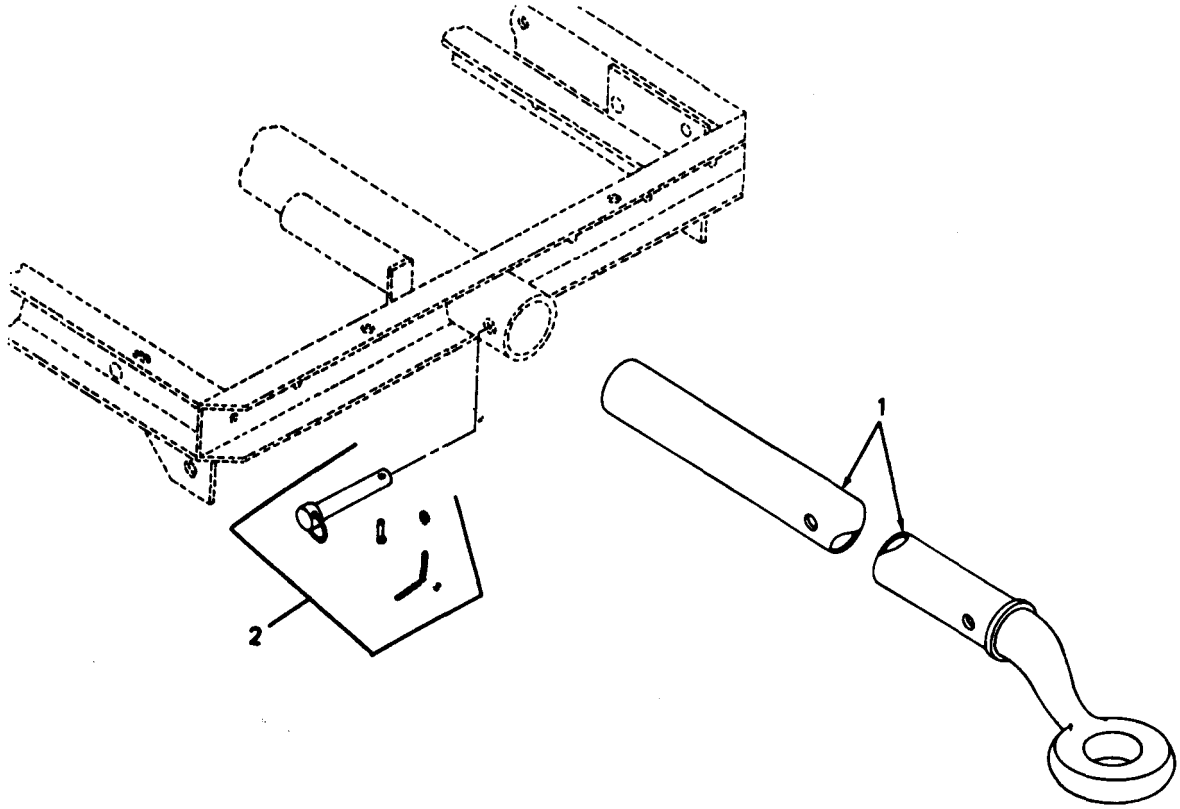
c. Keep tires inflated to 35 psi.

d. Report any defects or damage to organizational maintenance personnel.

3-12. Frame Assembly.

Operator/crew maintenance of the frame assembly consists primarily of inspecting the frame for broken weldments or other damage.

a. You should particularly examine the towing tongue (1, fig. 3–7) for cracks or other damage.



1. Towing tongue
2. Anchor pin assembly

Figure 3-7. Towing *attachment.*

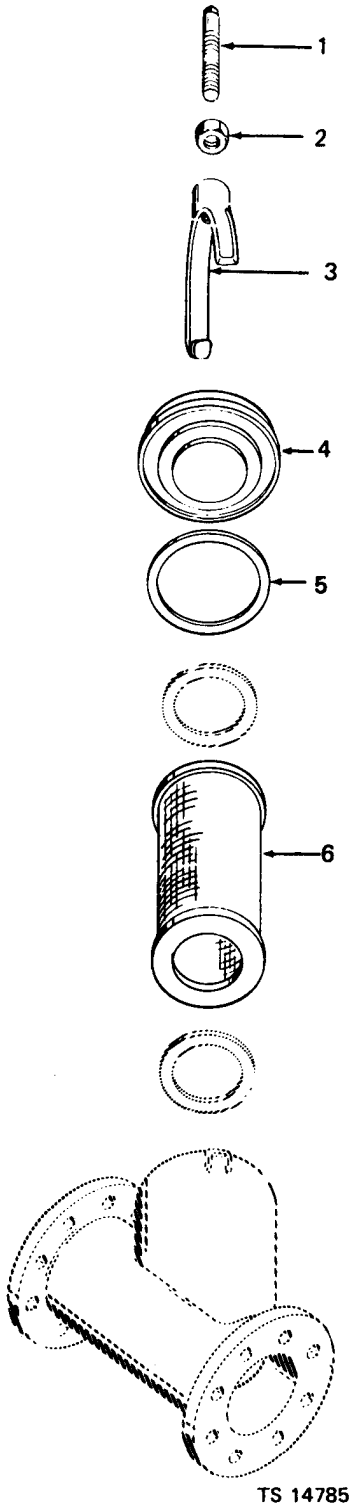
b. Make sure the anchor pin assembly(2) is properly secured to the frame.

c. You should report any defects to organizational maintenance.

3-13. Suction Strainer.

Service the suction strainer as follows

a. Loosen the lock nut (2, fig. 3-8) and loosen the setscrew (1) to release the clamp (3). Disengage the clamp from the housing and remove the cover (4), gasket (5) and basket (6).



1. Setscrew
2 Lock nut
3. Clamp
4. Cover
5. Gasket
6. Basket

Figure 3-8. ***Suction strainer.***

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S-661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

b. You should thoroughly clean the basket with cleaning solvent (fed. spec. P-D-680) and a soft-bristled brush. Inspect the basket for holes and tears; replace if damaged.

c. Inspect the gasket and replace if defective. Install basket (6), gasket (5), and cover (4) on the housing. Install clamp (3), setscrew (l), and lock nut (2). Tighten setscrew (1) and lock nut (2) to secure cover to housing.

CHAPTER 4
ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section 1. SERVICE UPON RECEIPT OF MATERIAL

4-1. Inspecting and Servicing the Equipment.

a. Before you operate the pumping assembly, inspect the equipment as follows:

(1) Inspect for damage that may have recurred during shipment.

(2) Inspect for loose or missing hardware. Tighten all loose hardware.

(3) Remove any preservatives or tapes which may have been used to protect components or seal openings.

(4) Inspect the controls, instruments, gages, and valves for damage and loose mountings; free levers and linkage of any binding.

(5.) Inspect all accessible wiring for loose connections, cuts, burns, frayed insulation and damaged terminals and shielding. Replace damaged wiring or terminals.

(6) Inspect the fire extinguisher to be sure that it is fully charged and in operating condition.

(7) Ensure the oil in the crankcase is at the proper level and then turn over the engine using the engine crank. The engine and pump should turn freely without binding or scraping or other signs of faulty operation.

NOTE

Occurrence of a clicking noise while handcranking engine indicates an engaged starting motor Bendix. This is usually caused by weak battery. The battery should have a specific gravity reading of 1.250 or above. Use a fully charged battery and start the engine. The starter Bendix will disengage when the engine speed reaches 900 rpm or above.

(8) Report any damage or malfunctioning to your supervisor.

b. Servicing the pumping assembly primarily consists of the following:

NOTE

Use an electrolyte with a specific gravity of 1.280. Do not use tropical electrolyte which will reduce battery reserve capacity.

(1) If you are preparing the pumping assembly for initial use, fill battery with electrolyte to a level of 3/8 inch (0.93 cm) above plates. Check specific gravity with a hydrometer; it should be at least 1.250 or higher at 75°F (23.8°C). It is good practice to charge the battery for 10 or 15 minutes before applying the starting leads. Charge the battery using a constant current charger. Check the specific gravity of the electrolyte every 30 minutes. The battery is fully charged when you get a constant specific gravity reading for three 30 minute intervals.

CAUTION

Constant current battery charging is always preferred. If you must use a constant–potential charger, battery temperatures must be maintained at less than 130°F (54.4°C) by interrupting the charging procedure as this temperature is approached.

NOTE

Use distilled water or a good grade drinking water (excluding mineral water).

(2) During charging, check the electrolyte level frequently. Add distilled water when necessary to maintain the battery electrolyte level. Continue charging after adding water to assure proper mixing of solution.

WARNING

Take precautions against spilling electrolyte on clothing or allowing it to come in contact with skin as burns may occur. Use rubber gloves when filling battery. Do **not smoke or use open flame in the vicinity when servicing the batteries, since they generate hydrogen gas which is highly explosive.** Fill **the fuel tank with gasoline. Fuel tank capacity is 20 gallons (76 liters).**

4–2. Installation.

a. Locate the unit as close as possible to the liquid source and maintain the suction lift as low as practical with the line sloping up to the pump to eliminate air pockets. Locate the unit on level terrain and, if conditions permit, avoid muddy, sandy, or dusty sites. Before the pumping assembly is disengaged from the towing vehicle, pull down and lock front stand in position and block the wheels securely. If it is necessary to compensate for unlevel terrain or soft undergrounding, arrange a foundation of planking logs or concrete that is capable of withstanding the weight of the unit when filled with liquid and secure enough to minimize vibration. You should allow ample room around the pump to support the suction and discharge hoses and to service the pump as required.

b. Make sure that your connections in the suction line are air tight. Even a small leak will greatly reduce pumping efficiency and may cause difficulty in priming, especially when the pump is operating with a high suction lift.

c. Connect the discharge hose to one of the couplings of the discharge pipe assembly. If fluid is to be supplied to alternate locations, connect a discharge hose to the second discharge coupling.

d. Close the suction valves. Check to be sure that the drain valve at the bottom of the pump housing is closed. To prime the pump, remove the primer fill cap

and fill the pump housing to the level of the port with the fluid to be pumped.

WARNING

After removing the priming cap and filling the pump casing with the product to be pumped, check the snap-in gasket in the cap to be sure that it is present and that it is serviceable (no dents; cuts, abrasions). Remove and replace as necessary.

When the casing has been filled, place the cap on the male quick disconnect adapter and raise the cam levers on the cap to the fully locked (vertical) position.

Bind the cap cam levers together in the locked position with soft wire or heavy twine in order to eliminate any possibility of their release due to vibration. This procedure must be followed each time the pumping assembly is primed.

e. If fuel for the engine is to be provided from an alternate, external source, connect the external line to the port on the fuel source selector valve. Turn the fuel valve to AUX position.

WARNING

Do not operate the pumping unit in an enclosed area unless exhaust gases are piped to the outside. Inhalation of exhaust fumes will result in serious illness or death. Make sure the exhaust piping is large enough to prevent excessive back pressure in the engine.

f. You must ground the pump prior to operation. Remove the ground rods from the ground rod carrier on the frame and drive the rods in to the ground approximately two (2) feet (60 cm). Connect the ground wire assembly securely to the ground rod and the frame.

Section II. MOVEMENT TO A NEW WORKSITE

4-3. Dismantling for Movement.

You should prepare the pumping assembly for movement to a new worksite as follows

a. Disconnect grounding wire and retrieve grounding rod; stow rod in holders on frame and place wire assembly in tool box.

b. Drain the suction and discharge hoses and disconnect them from the pump. Manually operating the check valve override handle opens the check valve and allows fluid to siphon from hoses if source is lower than delivery point. Drain the hoses into a suitable container.

c. You must install dust plugs and caps on the couplings to keep foreign matter from entering the pump suction and discharge piping.

d. If you were operating the pump from an auxiliary fuel source, turn the fuel selector valve to OFF position and disconnect the fuel line,

e. Secure the towing tongue to the towing vehicle. If necessary you can extend it to provide a greater turning clearance with the towing vehicle. Lift the front stand and secure it under frame using pins provided. Unblock the wheels.

Section III. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

4-4. Tools and Equipment.

No tools, equipment or repair parts are issued with the pumping assembly.

4-5. Special Tools and Equipment.

No special tools or equipment is required for organizational maintenance of the pumping assembly.

4-6. Maintenance Repair Parts.

Repair parts and equipment are listed and illustrated in the repair parts and special tools list covering organizational maintenance for this equipment. Refer to TM 5-4320-273-24P.

Section IV. LUBRICATION INSTRUCTIONS

4-7. General.

This section contains supplemental information and lubrication instructions that must be followed for the pumping assembly at the organizational maintenance level. Refer to LO 5-4320-273-12 (fig. 3-1) for your lubrication points, intervals, and detailed instructions.

4-8. Wheel Lubrication.

Lubrication at the organizational maintenance level consists primarily of lubricating the wheel bearings.

Table 4-1. Organizational Preventive Maintenance Checks and Services

Q – Quarterly
Total man-hour required; 10.0

Sequence no.	Item to be inspected procedure	Work time (M/H)
1	**LUBRICATING OIL** Check to ensure that the crankcase oil and the filter element have been changed at the required interval. Check breather cap for cleanliness.	0.2
2	FUEL SYSTEM Check for leaks and for contamination of the fuel. Replace defective parts and clean system.	0.2
3	AIR CLEANER Check condition of air element. Clean or replace element and replace any other damaged parts.	0.5
4	BATTERY **WARNING** **Do not smoke or use an open flame in the vicinity when servicing the battery. Batteries generate hydrogen gas, which is highly explosive.** Test the specific gravity of the electrolyte in the battery with a hydrometer. Replace battery if it fails to take and maintain a charge.	0.3
5	EXHAUST SYSTEM Check exhaust system for damage and leaks. Replace muffler or any other parts if damaged or if leaks are noticed.	0.2
6	CRANKCASE, BLOCK, AND CYLINDER HEAD Check for leaks and for cracks or other damage. Tighten or replace loose or missing hardware. Replace defective cylinder head gasket.	0.4
7	FUEL STRAINER Check for dirt or water in fuel bowl. Service fuel bowl. Replace strainer element if clogged.	0.5
8	FUEL PUMP Check fuel pump for leaks or damage. Replace fuel pump if defective.	0.5
9	CONTROL PANEL Inspect for inoperative or illegible gages, defective switches or damaged controls. Replace as required.	0.2
10	SUCTION STRAINER Check condition of suction strainer. Clean if necessary. Replace damaged strainer and gasket.	0.4
11	SUCTION AND DISCHARGE PIPING Check for leaks, cracks, or damage to piping parts and for missing dust plugs or. aps. Repair or replace as necessary.	0.2
12	GATE VALVES Check all gate valves by operating them. Repair or replace valves which leak, are difficult to operate or are otherwise damaged.	0.2
13	GROUND ROD ASSEMBLY Inspect the ground rod and wire assembly. Clean corrosion from clamps and other parts. Replace any damaged parts.	0.2
14	ENGINE SHROUDING Check for loose, missing or damaged engine shrouding. Repair or replace shrouding as necessary.	0.4
15	TIRES Inspect tires for proper inflation and condition. Replace worn or damaged tires and damaged tubes as necessary.	0.4
16	CARBURETOR Make a visual inspection of carburetor. Check operation of throttle lever and choke lever. Adjust as necessary. Replace a damaged carburetor.	0.3
17	GOVERNOR AND CONTROLS Check governor operation and inspect for damage. Adjust the governor if full load speed is not between 2300 and 2350 rpm.	0.2
18	BATTERY CHARGING SYSTEM Check ammeter with engine running. After the initial high charging rate when starting, rate should slowly reduce to near zero. Notify direct support maintenance of faulty operation.	0.2
19	TACHOMETER-HOURMETER Check for secure mounting, tight fittings, and for proper operation.	0.3
20	STARTING MOTOR Check starting motor operation. Inspect brushes and replace if worn. Replace damaged starting motor.	0.5
21	SPARK PLUGS Check for cleanliness and proper gap. Clean and regap if necessary. Replace defective plugs.	0.8

Table 4–1. Organizational Preventive Maintenance Checks and Services – Continued

Q - Quarterly
Total man–hours required: 10.0

SEQUENCE NUMBER	ITEM TO BE INSPECTED PROCEDURE	NUMBER	U/M
22	MAGNETO Check breaker point opening. It must be -015 inch (0.03 cm). Replace burned points and adjust point gap.		0.5
23	OIL PRESSURE SWITCH Check for damage. Make sure switch spring clip disengages at engine startup and that switch trips at engine shutdown. Replace faulty switch.		0.3
24	FIRE EXTINGUISHER Inspect for full charge, proper working condition, and secure mounting. Replace if gage indicates low charge.		0.2
25	FRAME ASSEMBLY Check condition of frame and stowage boxes and for missing reflectors and data plates.		0.4
26	WHEEL ASSEMBLY Clean and check for damage. Ensure that wheel bearings have been lubricated in accordance with LO 5-4320-272-12. Adjust the wheel bearings.		0.5
27	ENGINE COMPRESSION Check the engine compression.		1.0

Section VI. TROUBLESHOOTING

4-ll. General

a. This section contains troubleshooting information which are the responsibility of organizational maintenance. 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 and corrective actions. If a malfunction is not listed or is not corrected by listed corrective actions, notify your supervisor.

c. Only those functions within the scope of organizational maintenance are listed– For trouble– shooting procedure within the scope of operator/crew maintenance, refer to table 3–2.

4-12. Organizational Maintenance Troubleshooting Chart.

Refer to table 4–2 for troubleshooting which is allocated to the organizational maintenance level

NOTE

Before you use this table, be sure you have performed all applicable operating checks.

Table 4-2. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

ENGINE

1. ENGINE FAILS TO CRANK WHEN STARTING BUTTON IS DEPRESSED.

NOTE

Use distilled water or a good grade drinking water (excluding mineral water).

Step 1. Check for weak or dead battery with a hydrometer. Hydrometer reading should be at least 1.250 or higher at 75° F (23.8°C). Service battery by removing caps and checking the electrolyte level in each cell. If low, fill to level of 3/8 inch (0.93 cm) above plates with distilled water.

WARNING

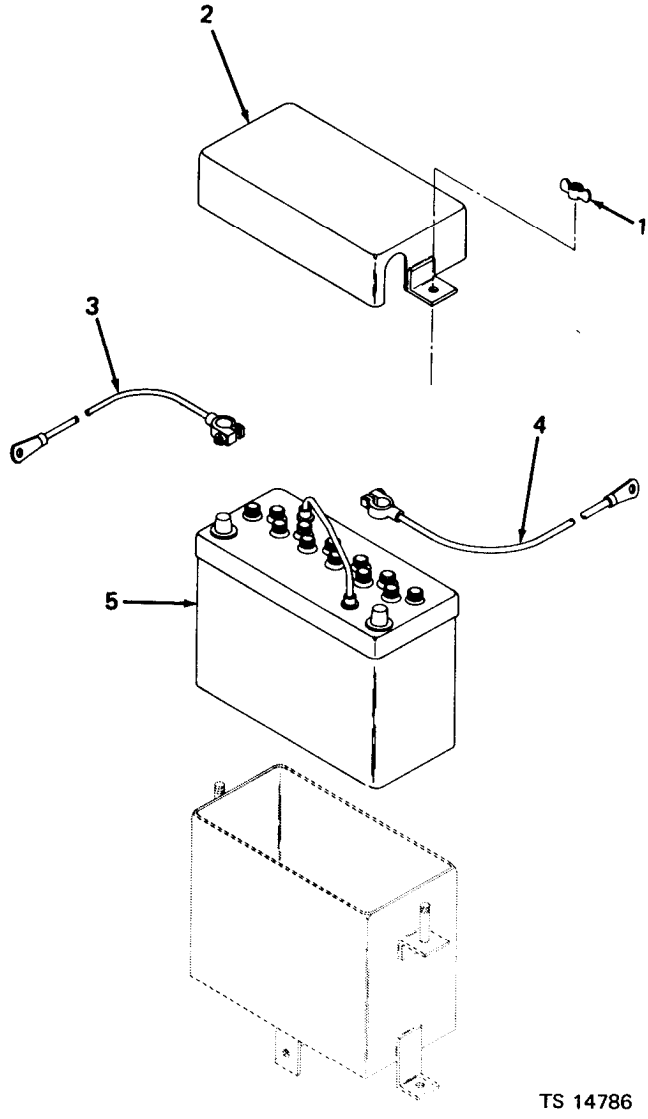
Do not smoke or use an open flame in the vicinity when servicing the battery. Batteries generate hydrogen gas, which is highly explosive. Charge the battery using a constant current charger. Check the specific gravity of the electrolyte every 30 minutes. The battery is fully charged when you get a constant reading for three 30 minute intervals.

CAUTION

Constant current battery charging is always preferred. If you must use a constant-potential charger, battery temperatures must be maintained at less than 130°F (54.4°C) by interrupting the charging procedure as this temperature is approached.

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
During charging, check the electrolyte level frequently. Add distilled water as necessary to maintain the battery electrolyte level. Continue charging after adding water to assure proper mixing of solution. **WARNING** **Take precautions against spilling electrolyte on clothing or allowing it to come in contact with skin as burns may occur. Use rubber gloves when filling battery.** **If battery is bad and will not hold charge replace as follows:** **Remove the two (2) wing nuts (1. fig. 4-1) and remove the battery box cover (2).** **Disconnect the cables (3 and 4) from the battery (5). Using the lift strap, lift the battery from the battery box and replace with a serviceable battery. Connect cables (3 and 4) to battery. Be sure negative post is connected to cable leading to ground and positive post is connected to cable leading to starter switch.** **Install battery box cover (2) and secure with wing nuts (1).**



1. Wing nut
2. Cover
3. Cable assembly
4. Cable assembly
5. Battery

Figure 4.1. Battery and battery box.

Table 4-2. Troubleshooting — Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE — Continued

Step 2. Visually inspect for loose or corroded terminals or broken battery cables.

Clean the battery posts and cable ends with a solution of water and baking soda. Replace cables (3 and 4, fig. 4-1) if damaged. After installation apply light coat of GM lubricant to battery posts and terminals to prevent corrosion.

Step **3.** Check for faulty starter switch or damaged wiring.

Use an ohmmeter or test lamp to check continuity of switch. Continuity should not exist when the switch is in the RUN position, but it should exist when switch is depressed.

CAUTION

Disconnect the battery cable from the positive battery terminal before disconnecting any other electrical leads from the engine components. This will prevent shorts which could damage the alternator, voltage regulator and other parts.

To replace bad starter switch, tag and disconnect the electrical wires from switch.

Remove nuts, lockwashers, and machine screws which secure switch to instrument panel. Remove bad switch.

Install serviceable starter switch through instrument panel and secure with machine screws, lockwashers, and nuts.

Replace defective wiring if insulation is damaged or wire is broken by removing nuts and lockwashers from each end. Remove bad wire.

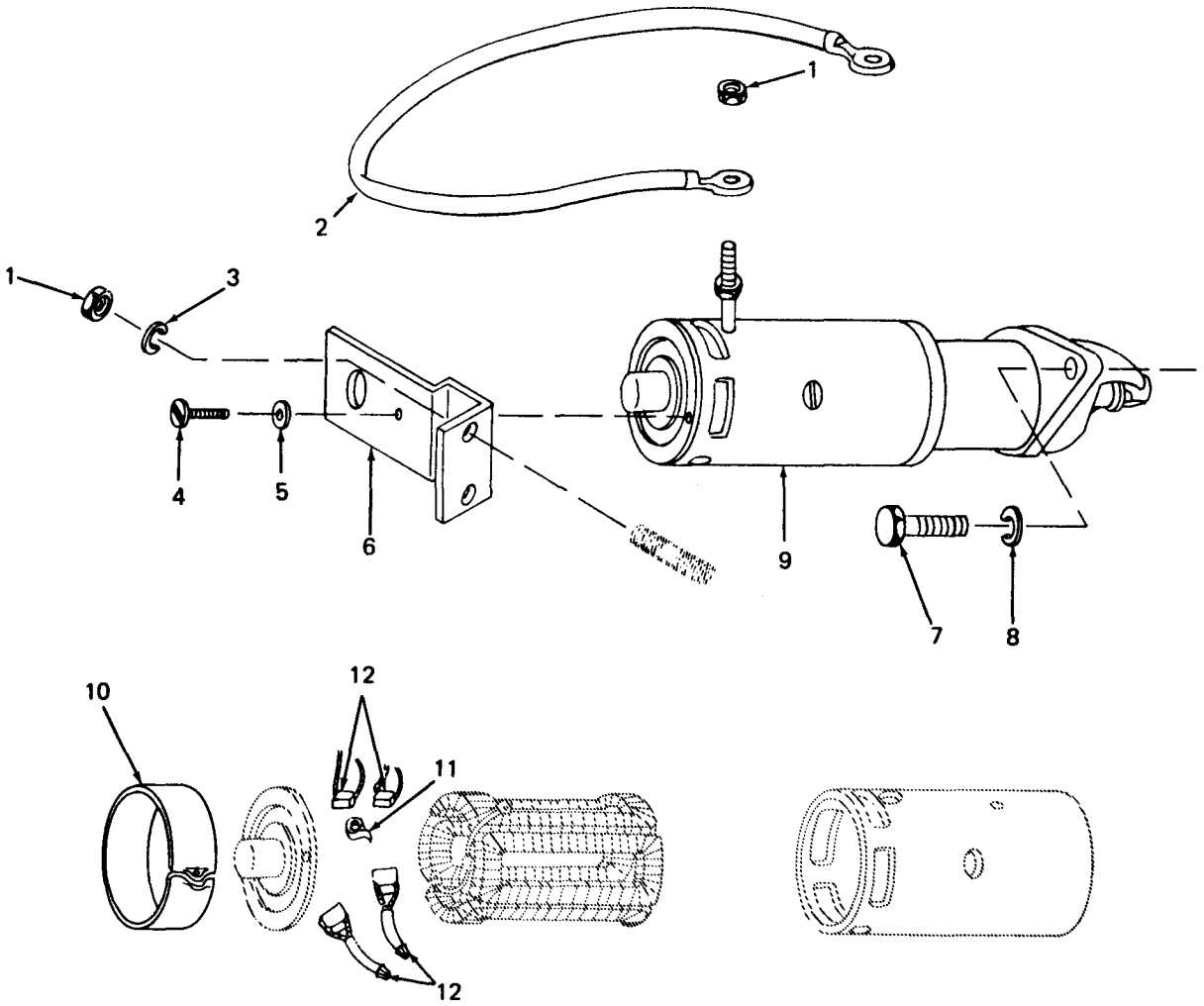
Install serviceable wire and secure by replacing lockwashers and nuts to each end.

Step 4. Check for defective starting motor.

CAUTION

Disconnect the battery cable from the positive battery terminal before disconnecting any other electrical leads from the engine components. This will prevent shorts which could damage the alternator, voltage regulator, and other parts.

Disconnect electrical cable (2, fig. 4-2) from starting motor by removing nut (1).



1. Nut
2. Cable
3. Lockwasher
4. Machine screw
5. Flat washer
6. Support bracket
7. Capscrew
8. Lockwasher
9. Starting motor
10. Cover band
11. Brush spring set
12. Brush set

Figure 4-2. Starting motor.

Table 4-2. Troubleshooting — *Continued*

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
Remove the nuts (1) and lockwashers *(3)* that secure the support bracket (6) to the engine. Remove the machine screw *(4)* and the flat washer *(5)* that mount the starting motor to the support bracket (6). Remove the support bracket. **Remove the three capscrews (7) and lockwashers (8) that secure the starting motor (9) to the flywheel housing.** **Pull the starting motor straight out to remove from engine. Inspect starter Bendix for operation and starter for worn brushes.** **Replace brushes if they are worn more than 3/8 inch (0.95 cm) as follows:** **Loosen cover band screw and slide the cover band (10) from the brush accees openings *in* the starter frame. Unhook the spring set (11) retaining each brush and hold it out of the way of the brush. Holding the brush set (12) by the leads carefully remove brush through the access opening. Remove brush only far enough to disconnect brush leads from field leads. Repeat this procedure for each brush.**

Table 4-2. Troubleshooting — Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE — Continued

NOTE

Before you install new brushes, check the commutator on the armature shaft. It must be smooth and concentric, free of burrs, scoring, high segments, or other damage. If the commutator is damaged, replace starting motor.

Install new brushes by connecting brush leads to field leads. Reposition brushes through access openings and secure by hooking spring sets (11). Slide cover band (10) over access openings and secure with cover band screw.

Replace starting motor by pushing straight into engine and secure with three capscrewe (7) and lockwashers (8) to flywheel housing.

Secure the support bracket (6) to the starting motor by replacing machine screws (4) and flat washer (5).

Install the support bracket to the engine by replacing lockwashers (9) and nuts (l).

Connect electrical cables (2) to starting motor by replacing nut (l).

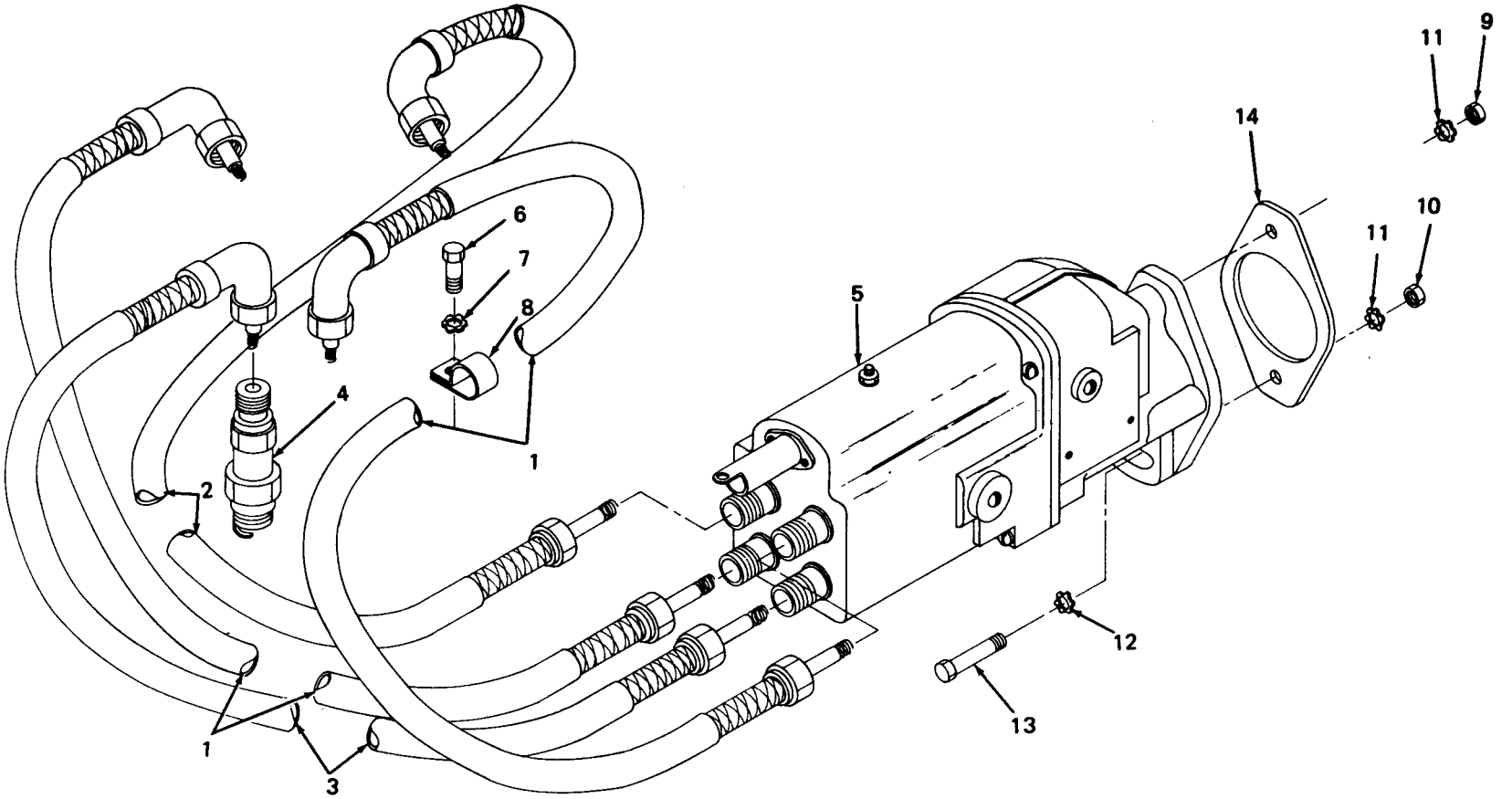
Step 4. Check for internal seizure of the engine or pump.

If the unit cannot be cranked manually, report seized engine or pump to direct support maintenance.

2. **ENGINE CRANKS BUT FAILS TO START (NO SPARK).**

Step 1. Cheek ignition wiring assemblies.

Tighten loose connections or replace damaged spark plug cables (1, 2, and 3, fig. 4-3).



1. Spark plug cable
2. Spark plug cable
3. Spark plug cable
4. Spark plug
5. Magneto
6. Screw
7. Washer
8. Cable clip
9. Nut
10. Nut
11. Lockwasher
12. Lockwasher
13. Screw
14. Gasket

Figure 4-3. Ignition system.

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
Replace spark plug cables as follows: **Disconnect connections to spark plugs (4) and magneto (5). Remove screw (6), washer (7), and cable clip (8) from each cable to be replaced. Install serviceable shielded spark plug cables to magneto and spark plugs. Make sure leads are not interchanged. Refer to figure 4-4 to assure proper magneto-to-spark plug *wiring*. Secure cables by installing cable clip (8, fig. 4-3), washer (7), and screw (6).**

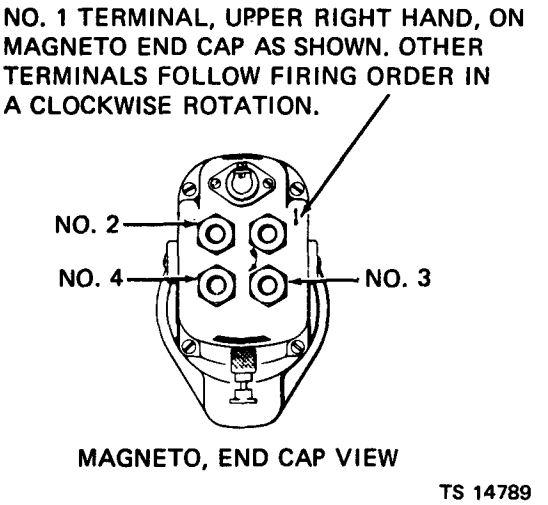
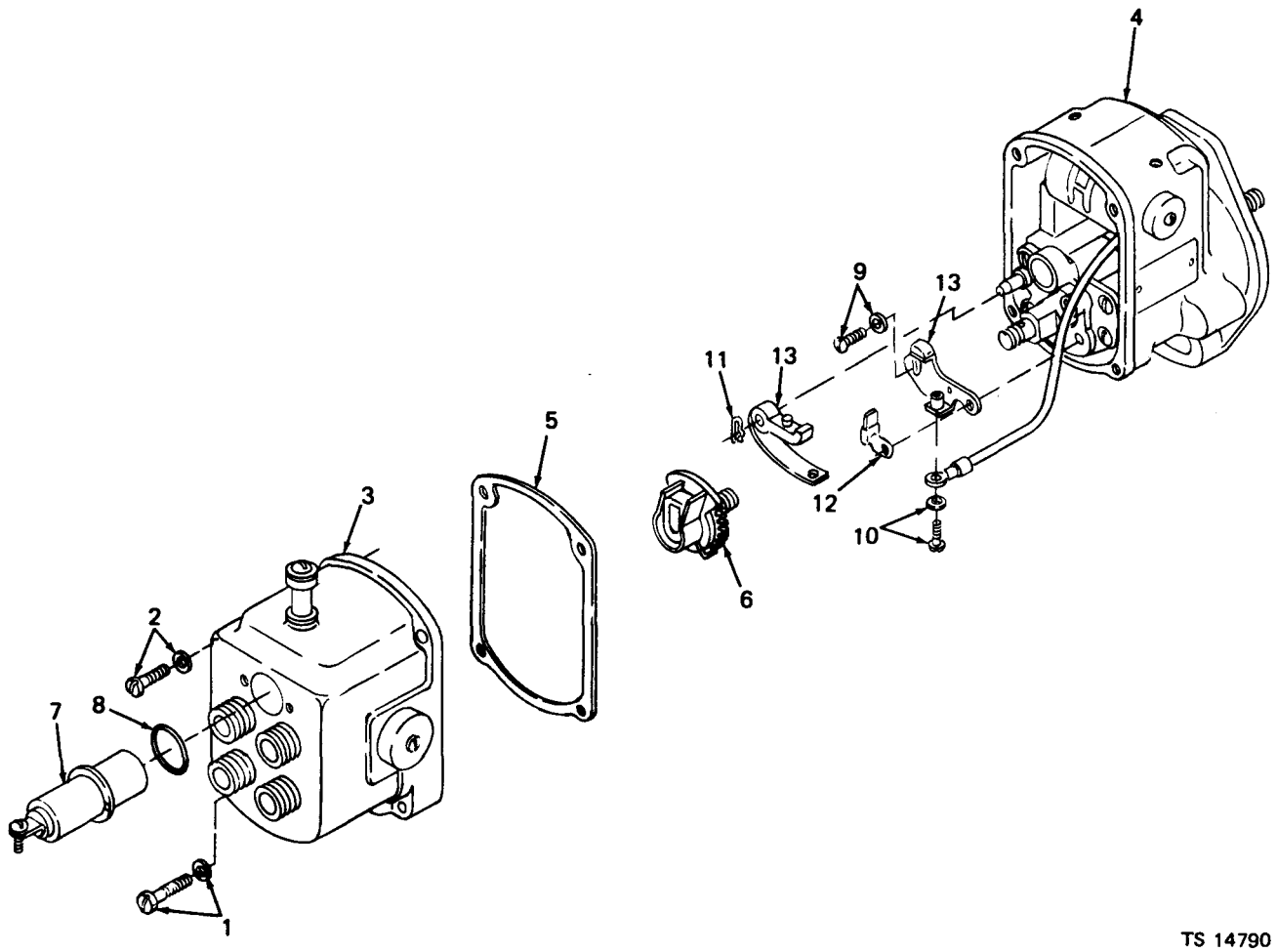


Figure 44. Magneto-to-spark plug connections.

Step 2. Check magneto points for proper gap clearance and defective capacitor.

Remove screws and assembled washers (1 and 2, fig. 4-5) that secure the end cap assembly (2) to the housing (4). Remove the end cap from the housing without disconnecting the spark plug cables.



1. Screw, assembled washer
2. Screw, assembled washer
3. End cap assembly
4. Housing assembly
5. Gasket
6. Distributor rotor
7. Capacitor
8. Preformed packing
9. Screw, assembled washer
10. Screw, assembled washer
11. Retaining ring
12. Cam wick
13. Breaker point assembly

Figure 4-.5. Magneto.

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
Remove end cap assembly (3). Remove and discard end cap gasket (5). Remove distributor rotor (6). Use a feeler gage to check breaker point gap after rotating the crankshaft with handcrank until points are wide open. Gap should be 0.015 inch (0.03 cm). Resurface burnt or pitted points with small tungsten file. Badly worked or pitted points must be replaced as follows: Disconnect ground switch lead from the capacitor (7). Remove the capacitor and preformed packing (8) from the end cap assembly. Discard both the capacitor and preformed packing. Remove screws and assembled washers (9 and 10) and retaining ring (11) that secure the breaker point assembly and cam wick (12) to the bearing support. Remove breaker point assembly (13) and discard. Install serviceable breaker point assembly (13) and cam wick (12) on bearing support using screws and assembled washers (9) and retaining ring (11). Leave screws loose enough to permit adjustment.

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
Rotate engine by hand to locate the breaker arm on the high point of the cam. Using a feeler gage set the point gap at a maximum of 0.015 inch (0.03 cm). Make the adjustment by inserting a screwdriver into the adjusting slot and pivot between the two small bosses on the bearing support. **Hold parts in position while tightening mounting screws.** **Check point gap after tightening to assure correct adjustment has been maintained.** **If cam is dry, apply light coat of grease.** **Install distributor rotor (6).** **Clean contact surfaces of end cap assembly (3) and housing (4) and instill new gasket (5). Secure cap to housing with screws and assembled washers (1 and 2). Be sure ground strap is connected.** **Install new capacitor (7) and preformed packing (8),**
***Step* 3.** Check for shorted or grounded magneto by checking the oil pressure safety switch to ensure that the switch plunger is pulled out. Test magneto ignition spark by disconnecting a spark plug cable from a spark plug and hold the terminal 1/8 inch (0.32 cm) away from any metal part of the engine. Use the hand crank to slowly turn the engine over two complete revolutions. Watch for the spark discharge which should occur the instant the impulse coupling on the magneto snaps. Repeat this check with each of the ignition wires. **If no spark occurs, replace magneto as follows:** **Tag and disconnect spark plug cables, ground switch lead and ground strap.** **Remove the nuts (9 and 10, fig. 4-3) lockwashers (11) and screw *(13)* with lockwasher (12).** **Withdraw magneto (5) and gasket (14) from gear housing.** **Before installing new magneto you must time the magneto to engine,** **Remove flywheel screen and locate timing marks on flywheel and shroud. Refer to figure 4-6.**

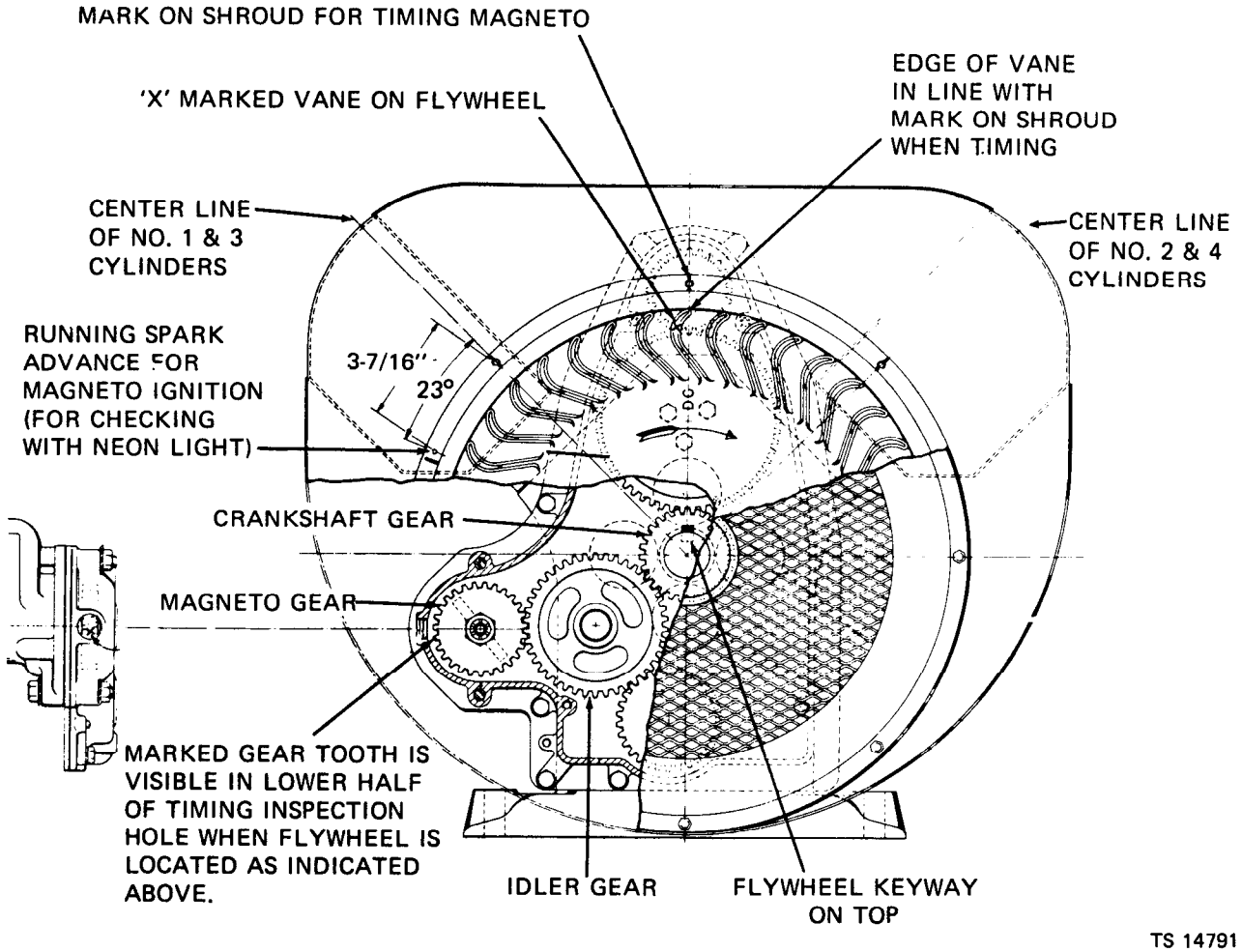


Figure 4-6. ***Magneto*** **timing.**

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
Remove spark plug from number 1 cylinder. Place finger over bole and crank engine over until compressed air can be felt against finger as piston rises. **Continue cranking until the DC mark on the flywheel is aligned with the timing mark on the shroud. The engine should be held at this dead center setting.** **Disconnect the oil line and remove pipe elbow from gear cover at magneto mounting flange. This will provide an inspection hole.** **Determine the number 1 cylinder firing position of the magneto by inserting an ignition cable into the number 1 terminal on the end cap.** **Mount magneto in vise thoroughly lined with protective cloth. Hold spark plug terminal at other end abc 1/8 inch (0.32 cm) from magneto body and turn magneto gear in clockwise rotation until terminal spa' Hold gear in this position.** **Remove magneto from vise and mount magneto (5, fig. 4-3) and gasket (14) to engine. Mesh gears so magneto is in place. The gear tooth marked with an "X" will be visible through *lower* half of inspection hole.** **Secure magneto by installing screw (13) and lockwasher (12). Install lockwashers (11) and nuts (9 and 10).** **Connect spark plug cables and ground switch lead.** **Adjust breaker point assembly on new magneto as follows:**

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

ENGINE — Continued

Remove screws and assembled washers (1 and 2, fig. 4-5) that secure the end cap assembly (3) to the housing (4). Remove the end cap from the housing without disconnecting the spark plug cables.
Remove end cap assembly (4).
Remove distributor rotor (6).
Use a feeler gage to check the breaker point gap after rotating crankshaft with handcrank until points are wide open. Gap should be 0.015 inch (0.03 cm).
Loosen screws and assembled washers (9) just enough to permit adjustment.
Rotate engine by hand to locate breaker arm on high point of cam. Adjust gap to maximum of 0.015 inch (0.03 cm).
Hold parts in position while tightening mounting screws.
Check point gap after tightening to assure correct adjustment has been maintained.
If cam is dry apply light coat of grease.
Install distributor rotor (6).
Reinstall end cap assembly and secure with screws and assembled washers (1 and 2). Be sure ground strap is connected.
"X" marked vane of flywheel should be marked with white chalk or paint.
Connect timing light to number 1 spark plug. Start engine and run at 1400 rpm to check that the white mark is aligned with the spark advance mark which is a 1/8 inch (0.32 cm) hole 23° before the vertical center line on the number 1 and 3 cylinders.
If not exactly aligned, rotate magneto slightly until correct alignment is attained. Shut off engine and install flywheel screen.

Step 4. Check spark plugs for corrosion and proper gap as follows:
Clean area surrounding spark plugs with compressed air.
Disconnect shielded spark plug cables (1, 2, and 3, fig. 4-3) from plugs (4) and remove.

WARNING

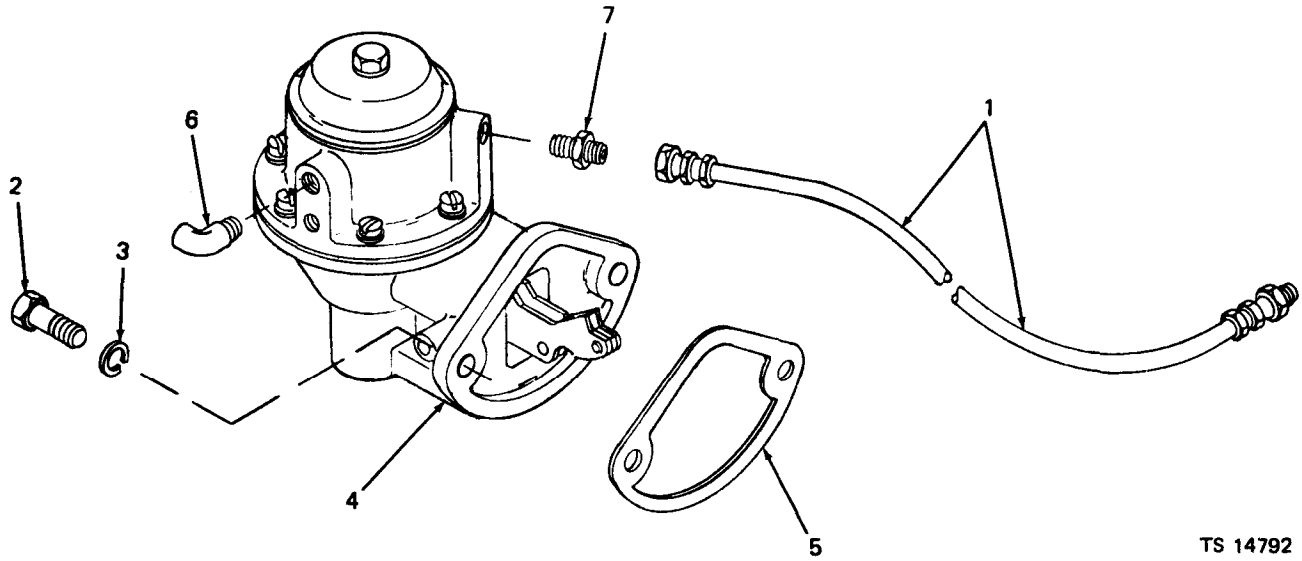
DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

If necessary to use old plugs, clean exterior with cloth dampened with cleaning solvent (fed. spec. P-D-680). Dry thoroughly.
Remove scale and other deposits with contact file.
Correct contact gap to 0.030 inch (0.07 cm) on new or used plugs.
Install and torque spark plugs to 25 to 30 foot-pounds (3.45 to 4.14 kg-m).
Connect shielded spark plug cables. Make sure they are not interchanged by referring to figure 4-4.

3. ENGINE CRANKS BUT FAILS TO START (GOOD SPARK)

Step 1. Check for plugged vent in fuel tank cap by removing and inspecting for obstruction.
Unplug fuel tank cap vent and reinstall.

Step 2. Check for bad fuel pump as follows:
Be sure ignition switch is off and the oil safety switch has been tripped.
Disconnect fuel line from carburetor.
Crank engine with starter. If fuel pump is operating properly, fuel will spurt out the fuel line.
Replace bad pump by removing fuel strainer from pipe elbow (6, fig. 4-7).



1. Hose assembly
2. Capscrew
3. Lockwasher
4. Fuel pump assembly
5. Gasket
6. Pipe elbow
7. Hose adapter

Figure 4-7. Fuel pump.

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
Disconnect hose assembly (1, fig. 4-7) to carburetor and remove capscrews (2) and lockwashers (3) which secure fuel pump to adapter. **Lift out fuel pump (4) and remove and discard gasket (5).** **Remove pipe elbow (6) and hose adapter (7).** **Install pipe elbow and adapter on fuel pump.** **Replace gasket (5) and secure fuel pump (4) with lockwashers (3) and capscrews (2).** **Connect hose assembly (1) and install fuel strainer to pipe elbow (6).** **Operate engine and check for leaks. Correct any leaks.**
4. ENGINE RUNS BUT CONTINUALLY MISFIRES
Step 1. Check for defective spark plug cable or loose connections. **Tighten loose connections. Replace damaged spark plug cables (1, 2, and 3, fig. 4-3) as follows: Disconnect connections to spark plugs (4) and magneto (5).** **Remove screw (6), washer (7), and cable clip (8) from each cable to be replaced.** **Install new shielded spark plug cables to magneto and spark plugs. Be sure wires are not interchanged. Refer to figure 4-4 for proper magneto-to-spark plug wiring.** **Secure cables by installing cable clips (8) with washer (7) and screw (6).**
Step 2. Inspect for fouled or bad spark plugs as follows: **Clean area surrounding spark plugs with compressed air.** **Disconnect shielded spark plug cables (1, 2, and 3, fig. 4-3) from plugs (4) and remove.**
WARNING **Dry cleaning solvent, P-D-680 or P-S-661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100 to 138 F. (38 to 60 C).**
If necessary to use old plugs, clean exterior with cloth dampened with cleaning solvent (Fed. Spec. P-D-680). Dry thoroughly. **Remove scale and other deposits with contact file.** **Correct contact gap 0.030 inch (0.07 cm) on new or used plugs.**

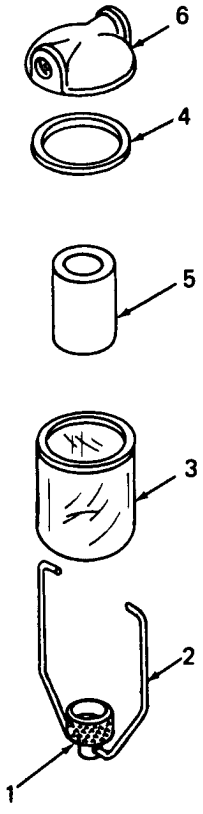
Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued

Install and torque spark plugs to 25 to 30 foot-pounds (3.45 to 4.14 kg-m).
Connect shielded spark plug cables. Make sure they are not interchanged by referring to figure 4-4.

Step 3. Check for water or dirt in fuel strainer bowl.

Service the fuel strainer.
Turn the fuel selector valve to the OFF position.
Loosen the nut (1, fig. 4-8) on the bail assembly (2) and swing the bail aside.



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1. Nut
2. Bail assembly
3. Fuel bowl
4. Gasket
5. Strainer element
6. Fuel strainer head

Figure 4-3. Fuel strainer.

Remove the fuel bowl (3), gasket (4) and empty fuel bowl contents. Wipe the fuel bowl out with a clean cloth. Remove the strainer element (5) and inspect it for contamination. Replace a contaminated strainer element. Install strainer element (5) in fuel strainer head (6). Install gasket (4) and fuel bowl (3) in fuel strainer head. Swing bail (2) under the fuel bowl and tighten the bail nut (1). Turn the fuel selector valve to the ON position.

5. ENGINE OVERHEATS.

Step 1. Check for low oil level in crankcase.

Check oil level on oil dipstick. It must be up to the full mark.

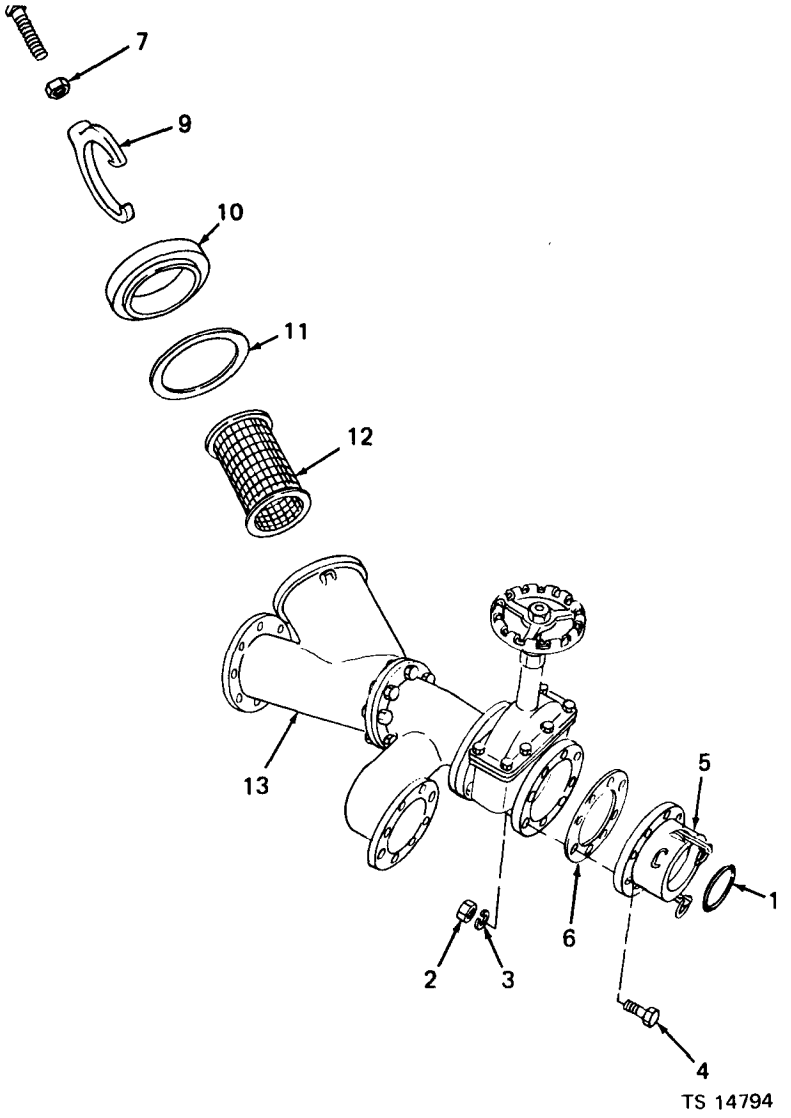
If oil level is low, remove oil filler cap and add enough oil through the filler tube to bring the oil up to the proper level. Refer to lubrication order LO 5-4320-273-12 for proper grade oil.

Step 2. Check for late ignition timing.

Retime magneto as follows:
Remove flywheel screen and locate timing marks on flywheel and shroud, refer to figure 4-6.

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE — Continued
Remove spark plug from number 1 cylinder, place finger over hole and crank engine over until compressed air can be felt against finger as piston rises. Continue cranking until the DC mark on the flywheel is aligned with the timing mark on the shroud. Hole engine at this top dead center setting. **Disconnect the oil line and remove the pipe elbow from gear cover at the magneto mounting flange. This will provide an inspection hole.** **Apply white chalk or paint to "X" marked vane of flywheel.** **Connect timing light to number 1 spark plug. Find the spark advance mark indicated on the shroud by a 1/8 inch (0.32 cm) hole 23° before the vertical centerline on the number 1 and 3 cylinders.** **Start the engine and run at 1400 rpm. Using the timing light, check that the white mark is aligned with the spark advance mark. If not exactly aligned, rotate magneto slightly until correct alignment is attained. Shut off engine and install flywheel screen.**
6. ENGINE RUNS BUT LACKS POWER.
Step 1. Check for incorrect ignition timing.
Retime magneto as follows: **Remove flywheel screen and locate timing marks on flywheel and shroud, refer to figure 4-6.** **Remove spark plug from number 1 cylinder. Place finger over hole and crank engine over until compressed air can be felt against finger as piston rises. Continue cranking until the DC mark on the flywheel is aligned with the timing mark on the shroud. Hold engine at this top dead center setting. Disconnect the oil line and remove the pipe elbow from gear cover at the magneto mounting flange. This will provide an inspection hole.** **Apply white chalk or paint to "X" marked vane of flywheel.** **Connect timing light to number 1 spark plug. Find the spark advance mark indicated on the shroud by a 1/8 inch (0.32 cm) hole 23° before the vertical center line on the number 1 and 3 cylinders.** **Start the engine and run at 1400 rpm. Using the timing light, check that the white mark is aligned with the spark advance mark.** **If not exactly aligned, rotate magneto slightly until correct alignment is attained. Shut off engine.** **Reinstall number 1 spark plug.** **Install flywheel screen.**
7. PUMP FAILS TO PRIME.
Step 1. Check for leaks in suction piping assembly by inspecting all parts of suction piping assembly for cracks and other damage.
Check studs or bolts in area of leak, tighten loose hardware. **Replace broken suction hoses or leaking gaskets (1, fig. 4-9) in quick-disconnect adapter (5).**



1. Gasket
2. Nut
3. Lockwasher
4. Capscrew
5. Adapter
6. Gasket
7. Lock nut
8. Setscrew
9. Clamp
10. Cover
11. Gasket
12. Screen
13. Suction strainer assembly

Figure 4-9. Suction piping assembly.

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP — Continued
Replaced damaged quick-disconnect adapter by removing nuts (2) and lockwashers (3) from capscrews (4). Remove adapter and discard gasket (6). **Install new gasket and adapter by securing it with capscrews (4), lockwashers (3), and nuts (2).**
Step 2. Check for clogged hoses or strainer. **Disconnect hoses and inspect for obstructions. Loosen lock nut (7, fig. 4-9) and setscrew (8) to release clamp (9) on suction strainer assembly (13).**

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION

PUMP — Continued

Disengage the clamp from housing and remove cover (10) and gasket (11).

WARNING

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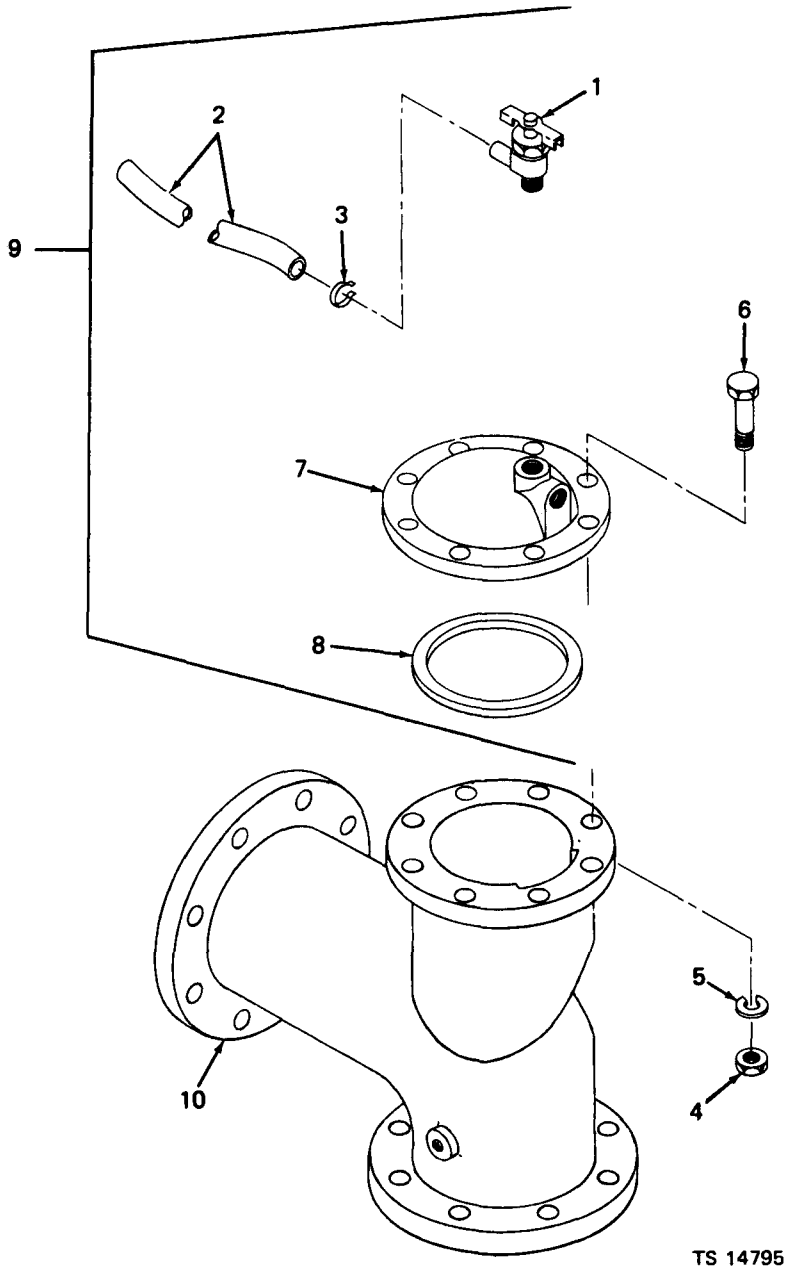
Remove screen (12) and clean with cleaning solvent (fed. spec. P-D-680) and soft bristled brush.
Reinstall screen (12) and gasket (11).
Position cover (10) on housing and install clamp (9), setscrew (8), and lock nut (7). Secure by tightening setscrew, then lock nut.

Step 3. Check pump for air or vapor lock.
Ensure drain cock (1, fig. 4-10) is open.



1. Drain cock
2. Hose
3. Clamp
4. Nut
5. Lockwasher
6. Capscrew
7. Cover
8. Gasket
9. Air eliminator assembly
10. Discharge elbow

Figure 4-10. Air eliminator assembly.

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP — Continued
Remove air eliminator assembly (9) and clean or replace parts as follows: **Disconnect hose (2, fig. 4-10) and clamp (3) from drain cock (1).** **Remove cover (7) and gasket (8) by removing nut (4), lockwasher (5), and capscrew (6). Remove air eliminator assembly (9) from cover (7).**

Table 4-2. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP — Continued
WARNING **DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).**
Thoroughly clean all parts in assembly with cleaning solvent (fed. spec. P-D-680) and blow dry with compressed air. **Install gasket (8) and cover (7) on discharge elbow (10); secure by tightening capscrews (6), lockwashers (5), and nuts (4). Install air eliminator assembly (9) in cover (7). Connect hose (2) and clamp (3) to drain cock (1).**
8. PUMP FAILS TO DELIVER CAPACITY.
Step 1. Check for closed discharge valves. **Open valves as necessary.**
Step 2. Check for too much discharge head by consulting the pump performance curve which is located under the tool box cover. **Reposition discharge hoses or reposition pumping assembly as recommended by performance curve.**
Step 3. Check engine speed by consulting the pump performance curve which is located under the tool box cover. **Increase engine speed as recommended.**
9. PUMP OVERHEATS.
Step 1. Check for closed discharge valve. **Open valves as necessary.**

Section VII. RADIO INTERFERENCE SUPPRESSION

4-13. General.

a. Definition of Radio Suppression. Radio suppression is the effective elimination of electrical disturbances within the equipment. These disturbances interfere with radio reception and disclose the location of the unit to sensitive electrical detectors.

b. Sources of Interference. Common sources of electrical interference are the spark plugs, ignition wires from the magneto to the spark plugs, the starting motor, the flywheel alternator, and poor electrical grounds between mounted electrical components and the frame.

c. Methods Used to Suppress Interference. 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, grounding the frame with bonding straps, and using capacitors and resistors.

(1) Bonding is necessary to provide an easy path for ground static charges. The better the connection between metal parts, the greater the effect in preventing interfering waves from being thrown off to affect radio reception.

(2) Shielding does not reduce the intensity of the interfering surges, but it prevents radiation.

4-14. 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.

b. Replace the magneto ground strap.

Section VIII. MAINTENANCE OF CYLINDER HEAD

4-15. Description.

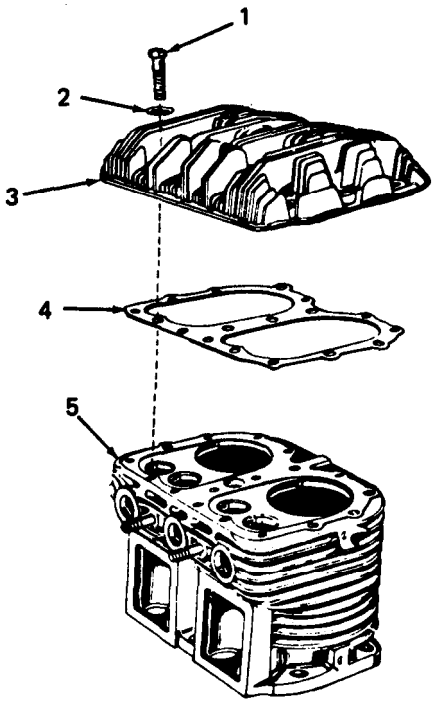
Each of the L-type cylinder heads is secured to the cylinder blocks (5, fig. 4-11) with capscrews and flat washers.

4-16. Cylinder Head.

a. Removal.

(1) Remove the muffler, manifold and carburetor. Remove the cylinder head air shrouding. Disconnect spark plug cables and remove spark plugs.

(2) Remove capscrews (1, fig. 4-11) and flat washers (2); remove cylinder head (3) and gasket (4) from cylinder block (5).



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1. Capscrew
2. Flat washer
3. Cylinder head
4. Gasket
5. Cylinder block

Figure 4-11. Cylinder head.

b. Cleaning and Inspection.

WARNING

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(1) Clean the cylinder head with cleaning solvent (Fed. Spec. P-D-680) and dry thoroughly with clean, dry compressed air.

(2) Remove all carbon and lead deposits with a wire brush.

(3) Inspect the cylinder head for cracks, broken cooling fins, and damaged threads in spark plug parts. Replace a damaged cylinder head.

c. Installation.

(1) Position gasket (4) and cylinder head (3) on cylinder block (5). Secure cylinder head to cylinder block with flatwashers (2) and capscrews (1).

(2) Install spark plugs and cables. Install cylinder head air shrouding carburetor, manifold and muffler.

Section IX. MAINTENANCE OF MUFFLER AND MANIFOLD

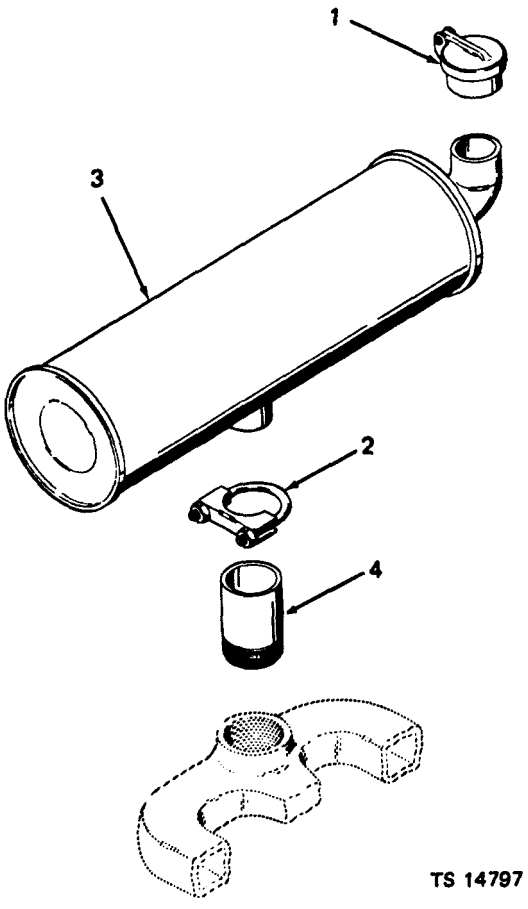
4-17. Description.

The muffler is a hollow cylinder that contains internal baffles which break up the flow of exhaust gases. It is mounted on top of the engine and is connected to the manifold. The manifold assembly is a single casting and is a combination exhaust and intake manifold. The manifold is on the cylinder block.

4-18. Muffler and Manifold.

a. Removal.

(1) Remove weather cap (1, fig. 4-12) from the muffler.

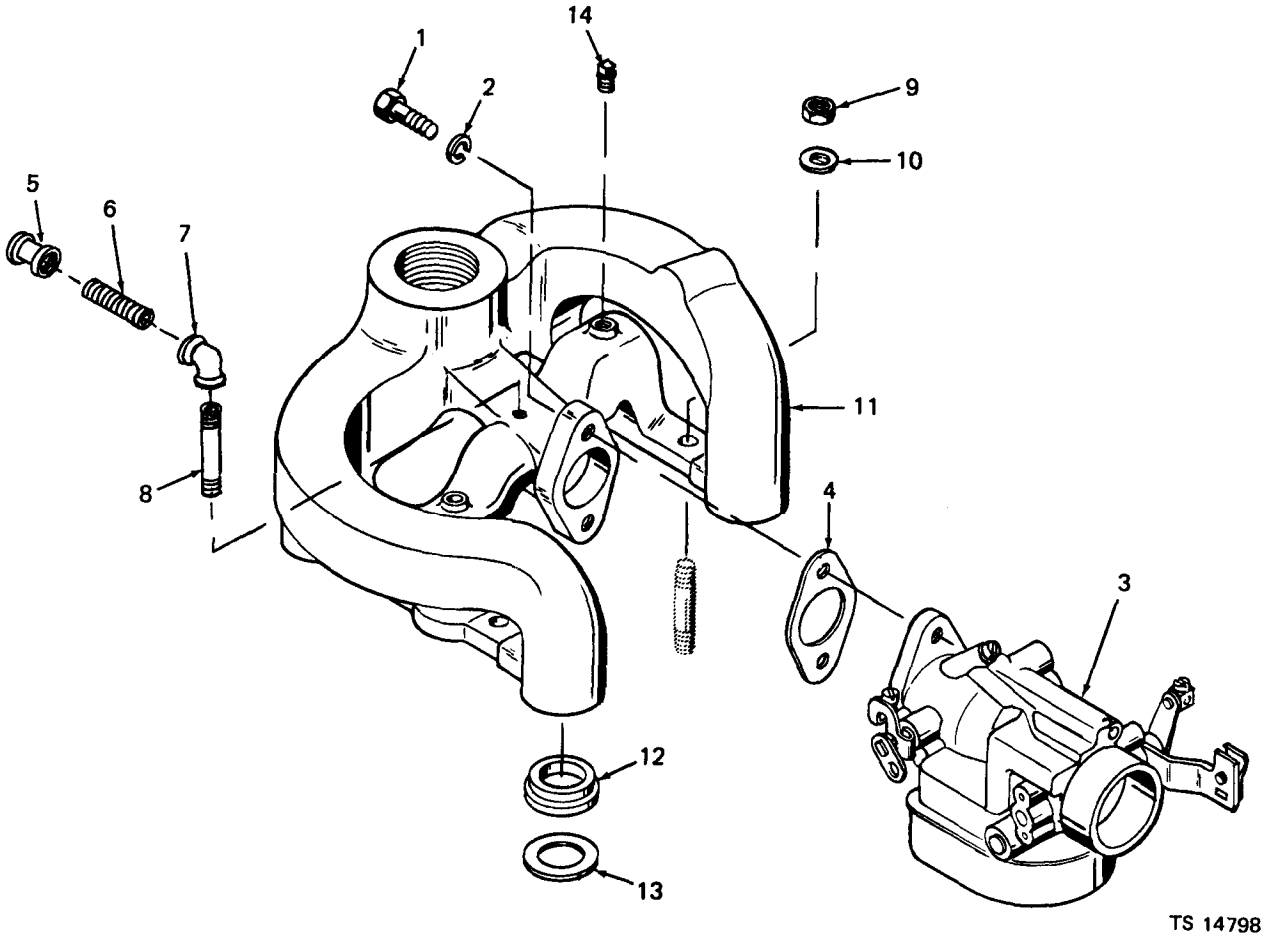


1. Weather cap
2. Clamp
3. Muffler
4. Pipe nipple

Figure 4-12. *Muffler.*

(2) Loosen clamp (2) and remove muffler (3) and clamp (2). Remove pipe nipple (4) from manifold.

(3) Disconnect carburetor linkage, choke control, and fuel line. Remove screw (1, fig. 4-13), lockwasher (2), and remove carburetor (3) and gasket (4) from the manifold.



1. Screw
2. Lockwasher
3. Carburetor
4. Gasket
5. Pipe coupling
6. Nipple
7. Elbow
8. Nipple
9. Nut
10. Flat washer
11. Manifold
12. Insert
13. Gasket
14. Pipe plug

Figure 4-13. Manifold assembly and carburetor.

(4) Remove pipe coupling (5), nipples (6 and 8), and elbow (7) from the manifold (11).

(5) Remove nuts (9), flat washer (10), and remove the manifold (11) from the cylinder block.

(6) Remove insert (12) and gasket (13). Remove pipe plug (14) from the manifold (11).

b. Cleaning and Inspection.

WARNING

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(1) Clean the manifold with cleaning solvent (fed. spec. P-D-680).

(2) Inspect the muffler for cracks, holes, or severe corrosion. Replace a bad muffler.

(3) Check manifold for cracks or breaks; replace a bad manifold.

c. Installation.

(1) Install pipe plug (14, fig. 4-13) and insert (12) in manifold (11). Position gasket (13) on cylinder block and install manifold (11). Secure manifold to cylinder block with flat washer (10) and nuts (9).

NOTE

Manifold nuts should be torqued to 35 foot-pounds (4.84 kg-m).

(2) Install nipple (8) in manifold and install elbow (7), nipple (6), and pipe coupling (5).

(3) Position gasket (4) on manifold and install the carburetor (3). Secure carburetor to manifold

with lockwasher (2) and screw (1). Connect fuel line, choke control, and carburetor linkage.

(4) Install pipe nipples (4, fig. 4-12) into manifold. Position clamp (2) and muffler (3) on pipe nipple. Position the clamp on muffler and tighten clamp nuts.

(5) Install weather cap (1) on muffler.

Section X. MAINTENANCE OF FUEL SYSTEM

4-19. Description.

a. Air Cleaner. The air cleaner is secured by a bracket to the left side of the flywheel housing. It is a dry-type unit which uses a porous paper element to screen the particles of dust and dirt from the air before it enters the carburetor. A system of hoses and tubing, secured together by clamps, connects the air cleaner to the carburetor. An air restriction indicator mounted on the tube indicates any restriction to air passing through the paper element.

b. Fuel Tank, Lines, and Fittings. The fuel system consists of the fuel tank, fuel line, three-way fuel source selector valve, and associated fittings. The tank is mounted on the frame on the left side of the engine. The three-way fuel source selector valve permits you to line up the fuel pump with the fuel tank or an auxiliary source of fuel.

c. Fuel Pump. The fuel pump contains a flexible diaphragm which acts to pump fuel from the fuel tank through a strainer to the carburetor. The diaphragm is pulled down by a rocker arm and link which is actuated by the plunger in the fuel-pump adapter. A spring forces the diaphragm back up to force fuel to the carburetor. The adapter contains a plunger that rides on an eccentric of the camshaft and has a built-in lever for hand priming the carburetor.

d. Fuel Strainer. The fuel strainer is mounted between the line from the fuel tank and the fuel pump. Its purpose is to prevent sediment, dirt, and water from entering the carburetor.

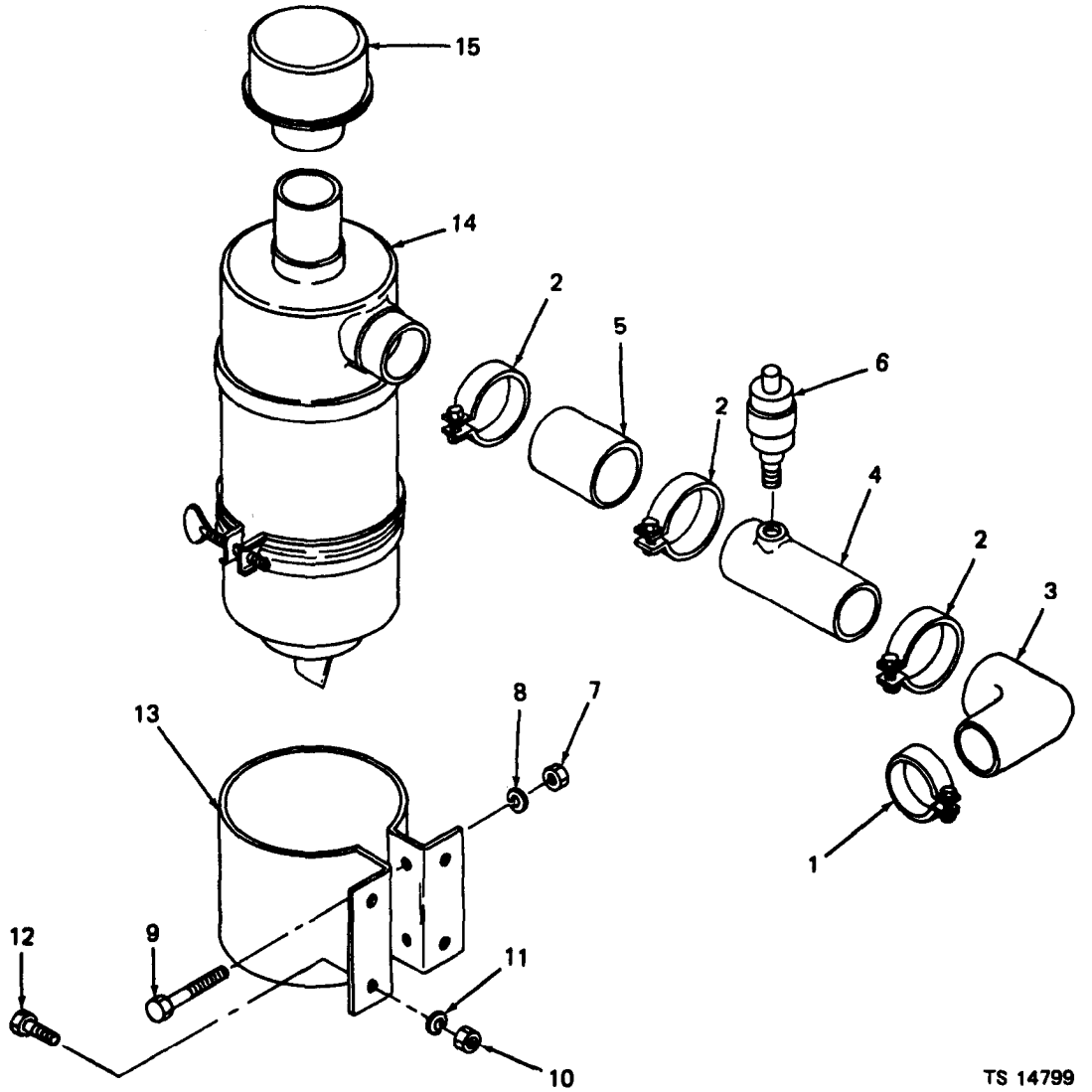
e. Carburetor. The carburetor is a horizontal, single-venturi type with a straight-through air intake. It regulates the fuel-air mixture which is fed to the engine to meet the needs of the engine power requirements. A float system controls the level of the fuel in the carburetor float bowl. Adjustment screws are provided to regulate the fuel mixture for high-speed operation, normal speed, and idling speed. Choking is controlled manually.

f. Governor. Engine speed is controlled by the inter-operation of the governor and carburetor. The centrifugal flyball governor rotates on a ball bearing supported shaft in the upper part of the timing gear cover and is driven off the camshaft gear. As the engine speed increases or decreases, the governor transfers the centrifugal forces acting on the flyweights to the axial movement of a sliding sleeve and a thrust bearing which operates the governor control lever. The control lever is connected to the throttle control on the carburetor and as the engine speed tends to increase, the throttle is closed slightly, resulting in a decrease in engine speed. This decrease in speed causes a decrease in centrifugal forces, which causes the governor to operate the control lever in the opposite direction. The governor lever then opens the carburetor throttle, tending to speed up the engine. In this manner, a balanced condition is reached, and the engine speed remains constant under varying load conditions, as determined by the throttle control setting. The governor can be adjusted by changing the tension of the spring which applies tension to the governor control lever. By hooking the spring in various holes in the governor lever, tension can be increased to raise engine speed or decreased to lower the speed at any particular throttle control setting.

4-20. Air Cleaner and Piping.

a. Removal.

(1) Remove the air cleaner discharge piping by loosening clamps (1 and 2, fig. 4-14) that join parts: elbow (3), air tube (4), and hose (5); unscrew restriction indicator (6).



1. Clamp
2. Clamp
3. Elbow
4. Air tube
5. Hose
6. Restriction indicator
7. Nut
8. Lockwasher
9. Screw
10. Nut
11. Lockwasher
12. Screw
13. Strap
14. Air cleaner
15. Breather cap

Figure 4-14. Air cleaner and piping.

(2) Remove air cleaner strap (13) by removing nuts (7), lockwashers (8), and screw (9).

(3) Remove air cleaner assembly (14) by removing nuts (10), lockwashers (11), and screws (12).

(4) Remove breather cap (15).

b. Cleaning and Inspection.

WARNING

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(1) Clean the exterior of the air cleaner and the piping by wiping with a cloth dampened lightly with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

c. Reassembly. Reassemble air cleaner and piping as follows:

(1) Install breather cap (15).

(2) Secure strap (13) to engine with screws (12), lockwashers (11), and nuts (10).

(3) Slide air cleaner (14) into strap (13) and in-

stall screws (9), lockwashers (8), and nuts (7).

(4) Install restriction indicator (6) and connect air cleaner discharge piping by connecting elbow (3), air tube (4), hose (5), and clamps (1 and 2).

4-21. Fuel Tank, Lines, and Fittings.

a. Removal.

(1) Turn the three-way valve (5, fig. 4-15) to OFF, and disconnect the auxiliary fuel line if used.

(2) Remove the fuel line assembly (1), elbows (2), nipple (3), bushing (4), and three-way valve (5).

(3) Remove the drain cock (6) from the bottom of the fuel tank and drain the fuel into a clean container that is large enough to hold the fuel.

(4) Remove the four nuts (7), lockwashers (8), and capscrews (9) that secure the upper retaining straps (10) to their corresponding straps welded to the frame. Remove the felt strips (11 and 12) and lift off the fuel tank (13).

(5) Remove the fuel tank cap (14), gasket (15), and strainer (16).

(6) Remove fuel level gage (17) by turning counterclockwise.

b. Cleaning and Inspection.

WARNING

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(1) Steam-clean the inside and outside of the fuel tank. Thoroughly flush with cleaning solvent (fed. spec. P-D-680).

(2) Inspect the fuel tank for cracks, dents, damaged threads, and broken weldments. Replace a damaged fuel tank.

(3) Use a soft-bristled brush to remove embedded material from the strainer.

(4) Clean all fuel lines and fittings with cleaning solvent (fed. spec. P-D-680). Blow through the lines with compressed air to make sure they are clear.

c. Reassembly.

(1) Install fuel level gage (17), strainer (16), gasket (15), and cap (14) into tank (13).

(2) Mount fuel tank (13) by positioning felt strips (11 and 12) and securing with retaining straps (10), capscrews (9), lockwashers (8), and nuts (7).

(3) Install drain cock (6).

(4) Install three-way valve (5), bushing (4), nipple (3), elbows (2), and fuel line assembly (1).

(5) Be sure drain cock (6) is closed and all fittings are tight before filling tank with fuel.

(6) After tank is filled, prime the system with hand primer and check for leaks.

1. Fuel line assembly
2. Pipe elbow
3. Pipe nipple
4. Bushing
5. Three-way valve
6. Drain cock
7. Nut
8. Lockwasher
9. Capscrew
10. Strap
11. Felt strip
12. Felt strip
13. Tank
14. Cap
15. Gasket
16. Strainer
17. Fuel level gage

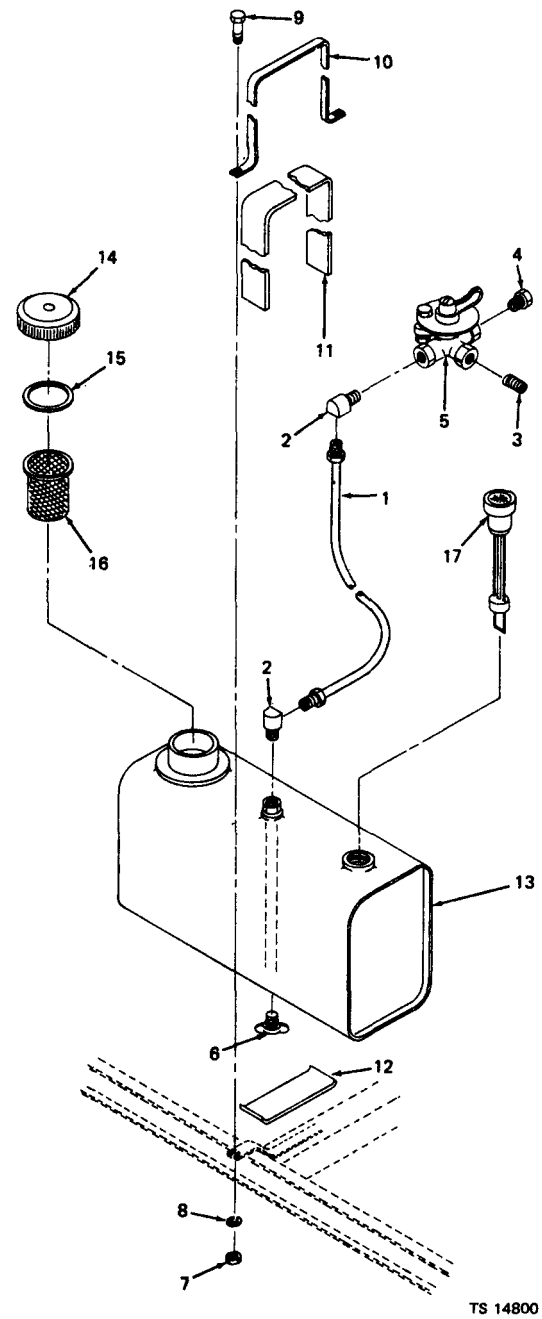
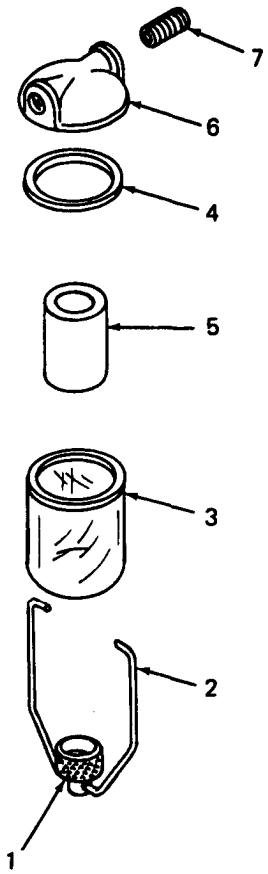


Figure 4-15. Fuel tank, lines, and fittings.

4-22. Fuel Strainer.

a. Removal.

(1) Loosen nut (1, fig. 4-16) on bail assembly (1) and swing bail aside to remove the glass bowl (3) and gasket (4). Empty bowl.



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1. Nut
2. Bail assembly
3. Glass bowl
4. Gasket
5. Strainer element
6. Fuel strainer head
7. Pipe nipple

Figure 4-16. Fuel strainer.

(2) Remove strainer element (5).

(3) Remove fuel line to three-way valve. Plug line with clean cloth.

(4) Remove three-way valve and pipe nipple assembly from fuel strainer head (6).

(5) Remove fuel strainer head (6) from pipe nipple (7).

b. Cleaning and Inspection.

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

(1) Thoroughly clean all parts with cleaning solvent (fed. spec. P-D-680).

(2) Inspect for damaged threads or cracks.

c. Reassembly.

(1) Install fuel strainer head (6) to pipe nipple (7).

(2) Install three-way valve and pipe nipple assembly to fuel strainer head (6).

(3) Unplug and install fuel line to three-way valve.

(4) Install strainer element (5).

(5) Position gasket (4) and glass bowl (3) on fuel strainer head (6). Swing bail assembly (2) into position and tighten nut (1).

(6) Open three-way valve and prime system with hand primer to check for leaks.

4-23. Fuel Pump.

a. Testing. Test the fuel pump for faulty operation as follows:

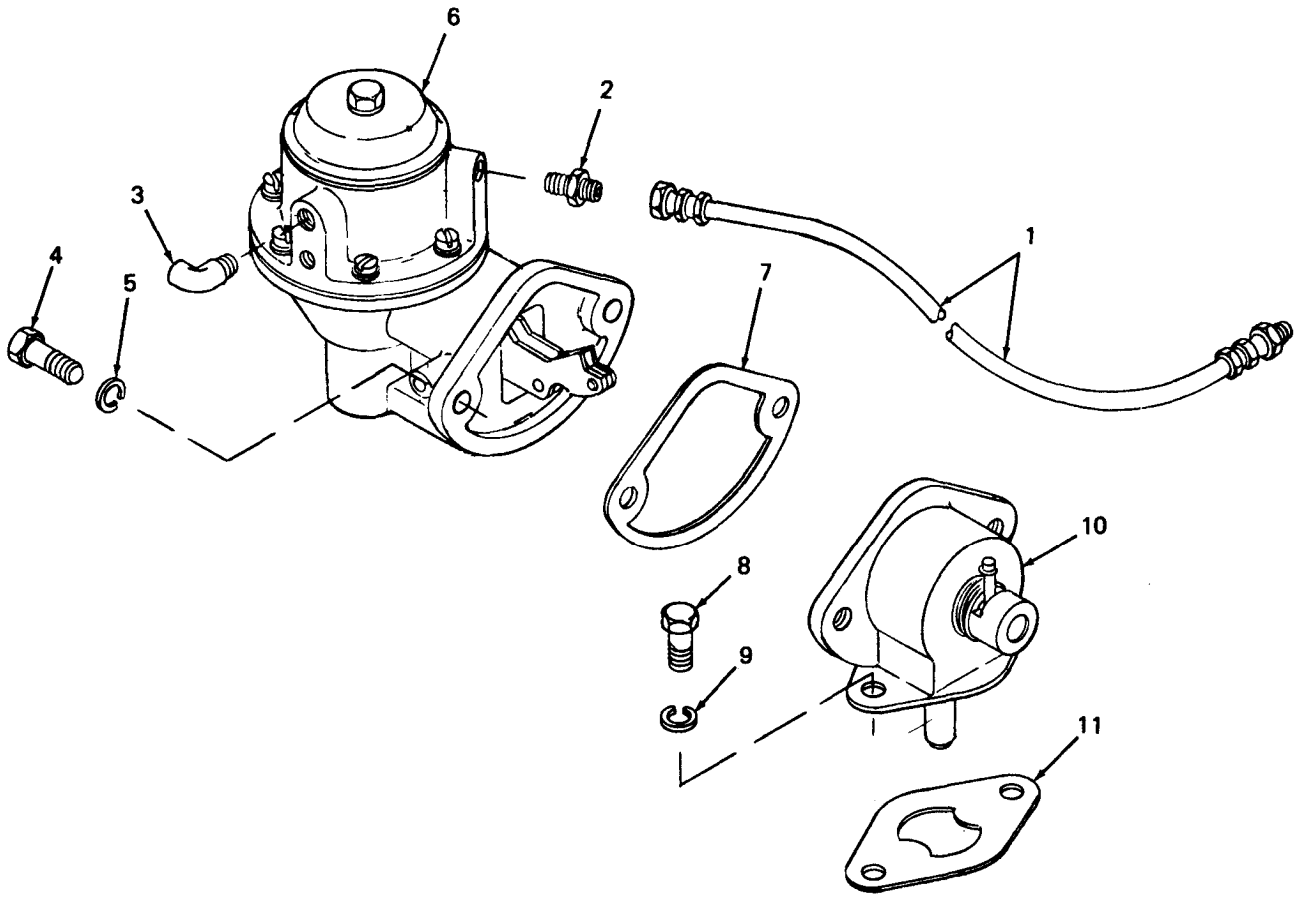
(1) Make sure that the ignition switch is on OFF and the oil pressure safety switch has been tripped. Then disconnect the fuel line at the carburetor.

(2) Crank the engine with the starter. If the fuel pump is operating properly, fuel will squirt out of the fuel line. Replace a faulty operating or damaged fuel pump.

b. Removal.

(1) Remove fuel strainer.

(2) Disconnect fuel line (1, fig. 4-17) to carburetor, and remove hose adapter (2) and elbow (3).



1. Fuel line
2. Hose adapter
3. Elbow
4. Screw
5. Lockwasher
6. Fuel pump assembly
7. Gasket
8. Screw
9. Lockwasher
10. Fuel pump adapter
11. Gasket

Figure 4-17. Fuel pump.

(3) Remove screws (4) and lockwashers (5).

(4) Remove fuel pump (6) and gasket (7).

(5) Remove screws (8) and lockwashers (9) to remove fuel pump adapter (10) and gasket (11).

c. Cleaning and Inspection.

WARNING

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(1) Clean the fuel pump and adapter with a cloth dampened with cleaning solvent (fed. spec. P-D-680); wipe dry.

(2) Clean all fuel lines and fittings with cleaning solvent and blow through them with compressed air to ensure all are clear.

(3) Inspect the fuel pump and adapter for cracks, damaged threads, and other obvious damage. If you remove the fuel pump to replace the gaskets (7 and 11, fig. 4-17), operate the rocker arm to check for free movement. Replace the fuel pump if defective.

(4) Inspect the fuel line and fittings for damage; replace any damaged parts.

d. Reassembly.

(1) Position gasket (11) and adapter (10). Secure with lockwashers (9) and screws (8).

(2) Install fuel pump (6) and gasket (7). Secure with lockwashers (5) and screws (4) to adapter (10).

(3) Install elbow (3) and hose adapter (2).

(4) Connect fuel line (1) leading to carburetor.

(5) Install fuel strainer.

(6) Operate engine and check for leaks.

4-24. Carburetor.

a. Adjustment. If troubleshooting indicates that the carburetor is responsible for faulty engine operation, you can adjust the carburetor as follows:

(1) Start the engine and allow it to warm up to operating temperature.

(2) Adjust the main adjusting screw (fig. 4-18) for high-speed operation as follows:

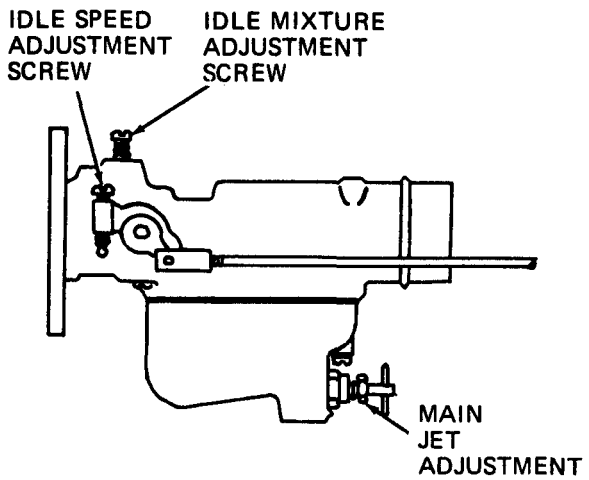


Figure 4-18. Carburetor adjustments.

(*a*) Adjust the throttle control of the pump to set the carburetor throttle at about one-fourth open.

NOTE

Better engine performance and fuel economy is obtained if the mixture is not too lean.

(*b*) Turn the main adjusting screw clockwise to reduce the fuel to the engine until the engine begins to miss due to a lean fuel mixture.

(*c*) Turn the main adjusting screw counterclockwise until the engine runs smoothly without missing.

(3) Adjust the idle mixture adjustment screw (fig. 4-18) to control the amount of air admitted to the idling system which functions only at low speeds. You should adjust as follows:

(*a*) With the engine at idle speed, turn the idle mixture adjustment screw counterclockwise to cut off air, making the fuel mixture richer until the engine starts to run roughly due to the excessively rich mixture.

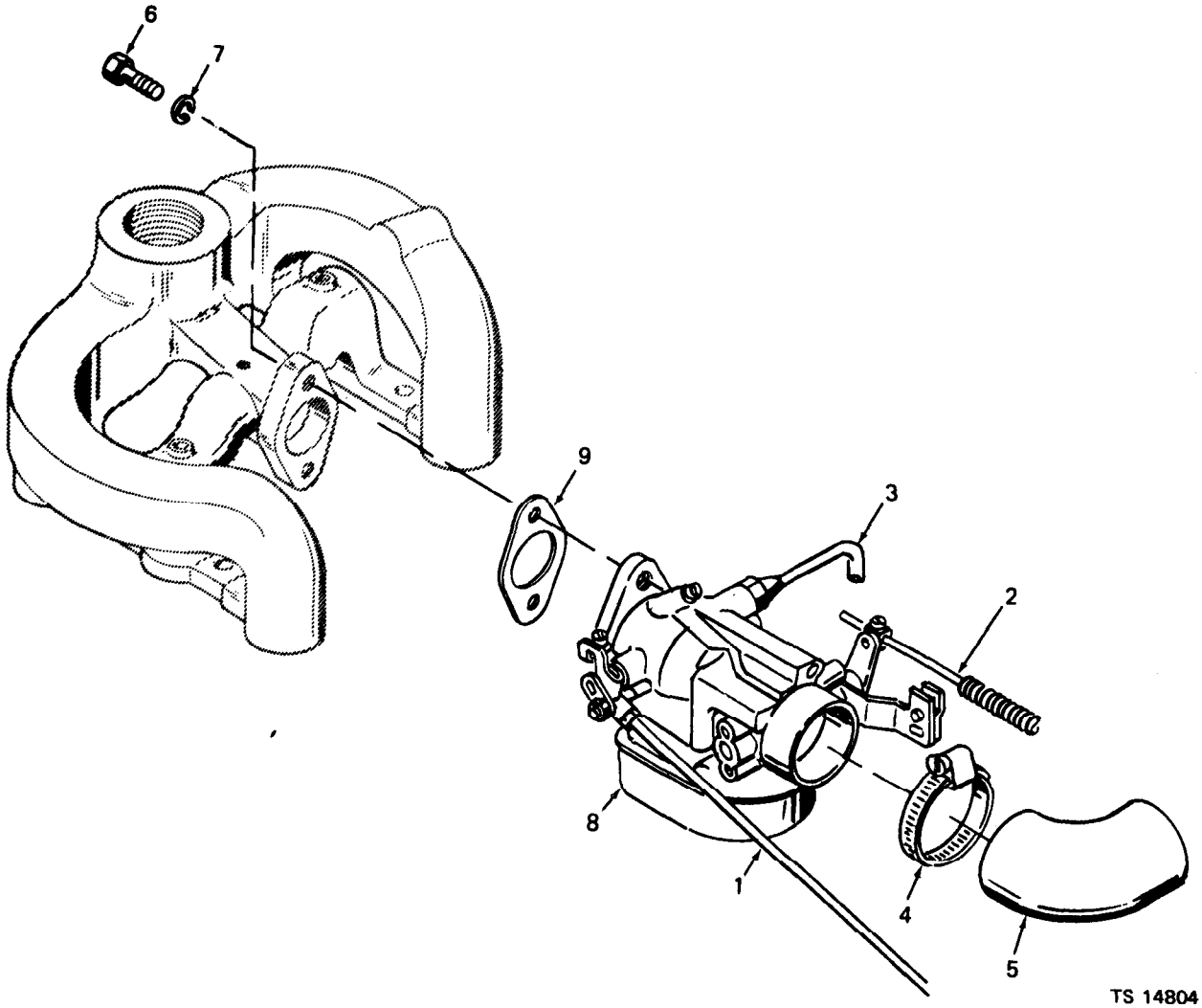
(*b*) Turn the adjustment screw clockwise to make the mixture more lean and to obtain the smoothest idle operation possible.

(*c*) By observing the engine vacuum gage on the control panel, you can adjust the screw for the highest engine vacuum.

(4) Adjust the idle speed adjustment screw (fig. 4-18) by turning the screw clockwise or counterclockwise as necessary to provide 1400 ±50 rpm idling speed when the pump throttle control is set to idle.

b. Removal.

(1) Disconnect the throttle lever (1, fig. 4-19) from the governor control rod linkage.



1. Throttle lever
2. Choke control wire
3. Fuel line
4. Clam
5. Air cleaner hose
6. Screw
7. Lockwaeher
8. Carburetor
9. Gasket

Figure 4-19. *Carburetor removal.*

(2) Disconnect choke control wire (2) from the carburetor.

(3) Disconnect fuel line (3) from carburetor.

(4) Loosen clamp (4) and remove air cleaner hose (5) from carburetor.

(5) Remove screws (6) and lockwashers (7).

(6) Lift carburetor (8) out and remove gasket (9).

c. Cleaning and Inspection.

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

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

(2) Inspect the carburetor for cracks and other obvious damage. Check the operation of the throttle lever and choke lever to ensure free movement. Replace the carburetor if you determine it is defective.

d. Installation.

(1) Hold carburetor (8) and gasket (9) in place and secure with lockwashers (7) and screws (6).

(2) Install air cleaner hose (5) and tighten clamp (4).

(3) Connect fuel line (3) to carburetor.

(4) Connect choke control wire (2) and adjust wire so that the choke lever can move through its full operating range as the choke control on the in-

strument panel is operated.

(5) Install the throttle lever (1) from governor control rod linkage.

4-25. Governor Adjustment.

NOTE

Before you adjust the throttle linkage, start engine and allow to warm up, and be sure the idle speed adjusting screw is set for the proper idle speed (1400 rpm).

a. Disconnect the control rod ball joint from the governor lever.

b. Push the control rod toward the carburetor as far as it will go, causing the throttle to open fully.

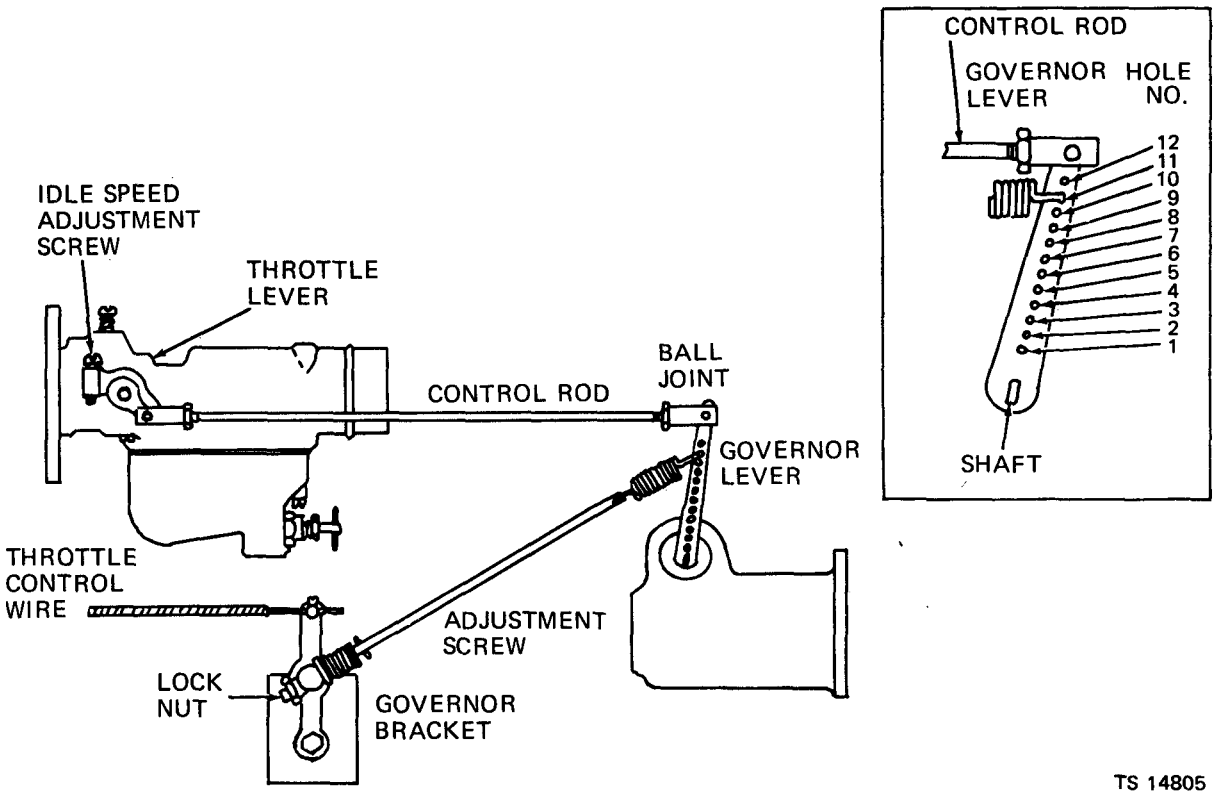


Figure 4-20. Governor and carburetor linkage.

c. Move the governor lever as far as possible in the same direction. Holding the control rod and governor lever in these positions, screw the joint on or off the control rod until you can align the right angle stud on the ball joint fitting with the top hole on the governor lever, then screw fitting in two additional turns.

d. Insert ball joint stud into the top hole in the governor lever; install and tighten lock nuts.

e. With the governor lever pushed toward the carburetor as far as it will go, be sure you have approximately 1/16-inch (0.15-cm) clearance between the throttle lever and the stop pin on the carburetor. If the clearance is not correct, you can adjust it by turning the control lever ball joint farther on or off the control rod; refer to subparagraph *c* above.

f. To adjust the maximum operating speed of the engine, you must be sure the spring is hooked into the proper hole in the governor lever. Hook the spring in hole No. 11 (fig. 4-20). There are 12 spring mounting holes. With engine operating and throttle fully open, the full-load speed will be approximately 2350 rpm.

Section XI. MAINTENANCE OF ELECTRICAL SYSTEM

4-26. Description.

a. Battery. A 24-volt, lead-acid type storage battery is used to power the 24-volt, negative ground electrical system. The electrical output is used to energize the electrical starting motor to start the engine. The battery charge is partially depleted as the engine is started, but during operation the charge is restored by action of the flywheel alternator.

b. Magneto. The magneto is driven by the idler gear and is timed to the engine. The magneto distributor rotor turns at half-engine speed. The distributor rotor applies voltage induced by the magneto coils to the spark plug of the appropriate cylinder at the required instant. At this time, the

breaker points open at the correct instant to ensure a hot spark to the spark plug. The magneto also contains provisions for automatic spark advance so that the spark will occur sooner to provide for smooth engine performance during high speed operation.

c. Spark Plugs. Four radio–shielded spark plugs receive the spark from the magneto and ignite the fuel–air mixture in the appropriate cylinder. The firing order of the cylinders is 1–3–4–2. When you view the engine from the flywheel end, the number 1 cylinder is nearest the flywheel on the left bank of cylinders and the number 3 cylinder is the other cylinder in this bank. The number 2 cylinder is nearest the flywheel in the right bank of cylinders and the number 4 is the other cylinder in this bank.

d. Starting Motor. The starting motor has a Bendix drive gear which engages the flywheel ring gear when the starter switch pushbutton is depressed The Bendix drive gear disengages by centrifugal force when the engine starts.

e. Oil Pressure Safety Switch. The oil pressure safety switch is mounted on the control panel and is connected by tubing to the oil pressure gage. The operating oil pressure is 4 to 5 psi. When the oil pressure drops to 1 psi, the oil pressure safety switch is tripped, closing the ground circuit to the magneto to stop the engine. This protects the engine from overheating and wear due to lack of proper lubrication. You must reset the switch plunger after each engine shutdown before you can restart the engine. The spring reset clip will kick out after the engine starts and sufficient oil pressure builds up. The switch will then be operative.

f. Control Panel. The engine controls and instruments are mounted on the control panel which is located on the pump piping assemblies. Refer to figure 1–4 for the wiring diagram showing the electrical connections between the engine and controls.

g. Starter Switch. The starter switch is mounted on the control panel. When the pushbutton is depressed, it closes the circuit to energize the starting motor.

h. Magneto Switch. The magneto switch is on the control panel. When you depress the switch, it will ground the magneto and stop the engine. This switch is in the same circuit as the oil pressure safety switch.

4–27. Battery, Battery Box, and Leads.

a. Service. To service battery, proceed as follows:

NOTE

Use distilled water or a good grade drinking water (excluding mineral water).

(1) Remove caps and check the electrolyte level in each cell. If any are low, fill to 3/8 inch (0.93 cm) above plates with distilled water.

WARNING

Do not smoke or use an open flame in the vicinity when servicing the battery. Batteries generate hydrogen gas, which is highly explosive.

(2) Start engine and allow it to run for 10 to 15 minutes. Stop the engine and check the battery with a hydrometer. A fully charged battery shall have a minimum specific gravity of 1.275 at 75°F (23.8°C).

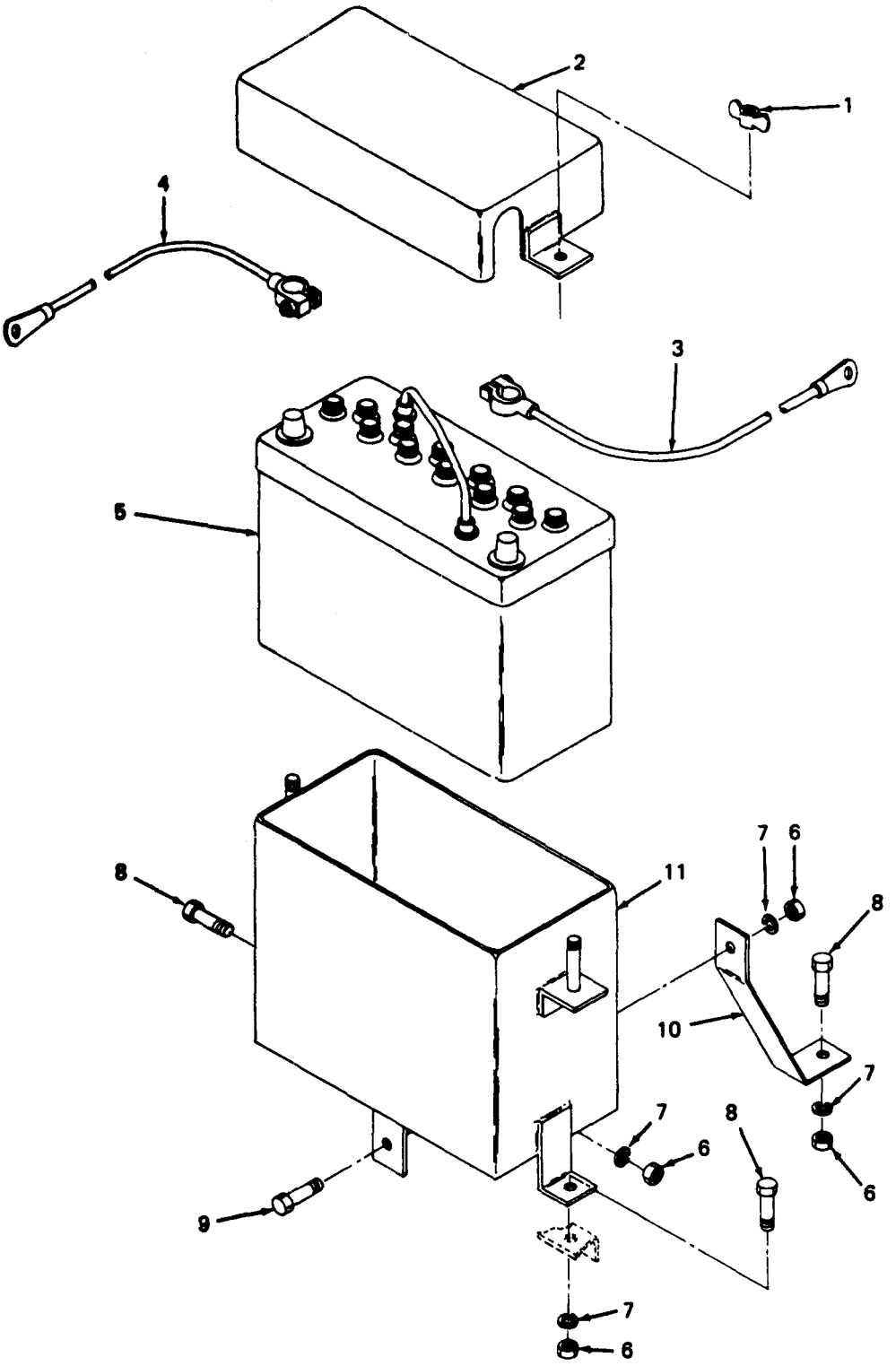
(3) If the specific gravity of the electrolyte is less than 1.250, the battery must be charged before use. When you charge the battery, use a constant current charger. Check the specific gravity of the electrolyte every 30 minutes. The battery is fully charged when you get a constant specific gravity reading for three 30–minute intervals.

CAUTION

Constant–current battery charging is always preferred. If you must use a constant–potential charger, battery temperatures must be maintained at less than 130°F (54.4°C) by interrupting the charging procedure as this temperature is approached.

b. Removal.

(1) Remove wing nuts (1, fig. 4–21) and remove battery box cover (2).



1. Wing nut
2. Cover
3. Cable assembly
4. Cable assembly
5. Battery
6. Nut
7. Lockwasher
8. Screw
9. Screw
10. Bracket
11. Battery box

Figure 4–21. Battery and battery box

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(2) Disconnect and remove cable assemblies (3 and 4) from battery (5). Use the lifting strap attached to the battery, lift battery (5) from battery box (11).

(3) Remove nuts (6), lockwashers (7), and screws (8 and 9). Remove bracket (10) and battery box (11) from frame.

c. Cleaning and Inspection.

(1) Clean the top surface and posts of the battery and the cable ends with a solution of water and baking soda to neutralize any acid on the parts. You should not permit the solution to enter the battery.

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100°to 138°F (38° to 60°C).

(2) Remove any greasy or gummy deposits with a cloth dampened with cleaning solvent (fed. spec. P-D-680).

(3) Inspect the battery for cracks and loose posts. Inspect the cables for damaged insulation, breaks in the wiring, and loose ends. Replace damaged parts.

(4) Inspect the battery box for corrosion, damaged threads, and other damage. Remove corrosion and paint as necessary. Replace battery box if not serviceable.

d. Installation.

(1) Install battery box (11, fig. 4-21) and bracket (10) on frame. Secure battery box and bracket with screws (9 and 8), lockwashers (7), and nuts (6).

(2) Install battery (5) in battery box and connect cable assemblies (4 and 3).

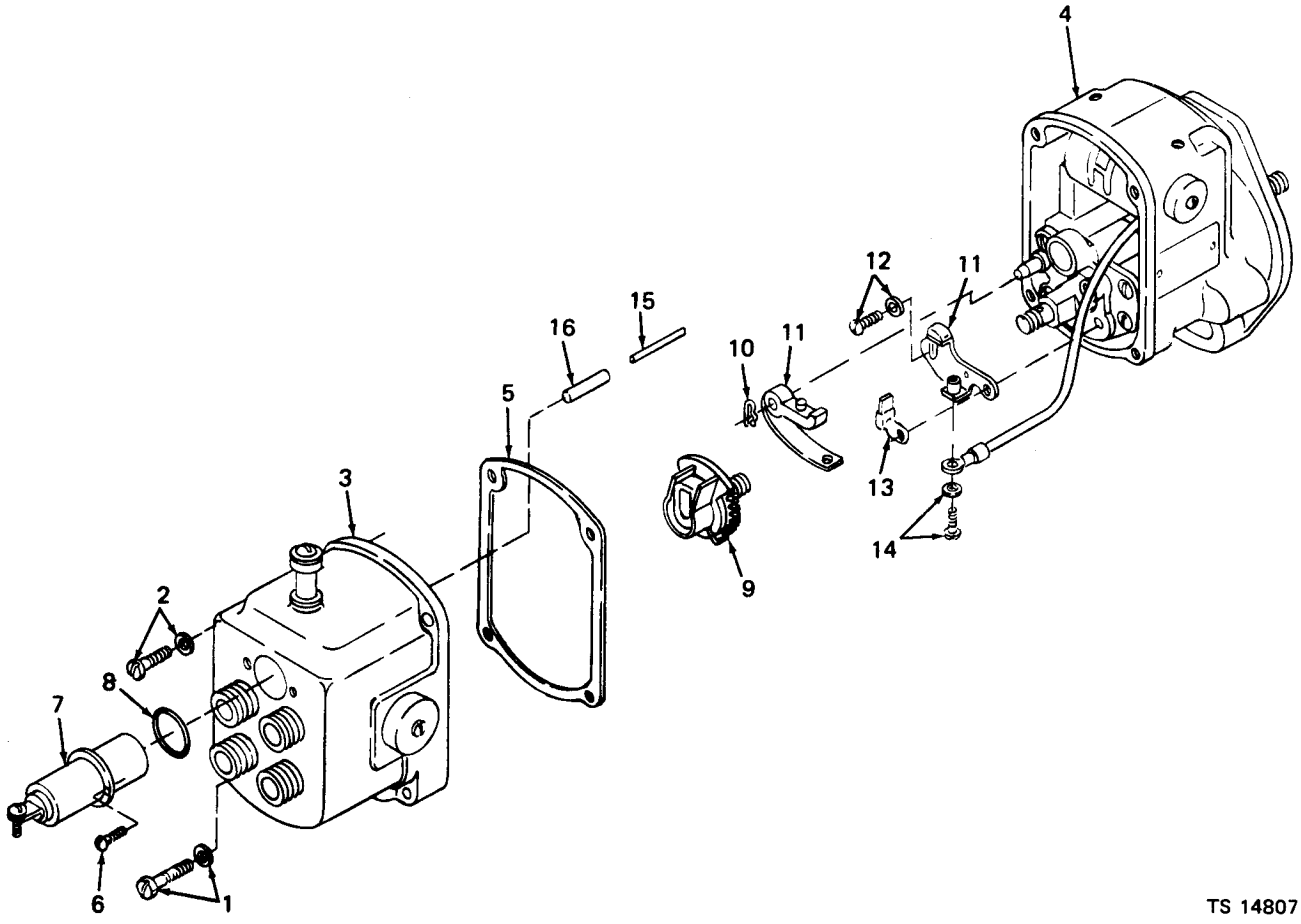
(3) Install cover (2) on battery box and secure with wing nut (1).

4-28. Magneto, Spark Plugs, and Cables.

a. Checking Magneto Spark. You can test the strength of the magneto ignition spark by disconnecting the spark plug cable from the spark plug and holding the terminal 1/8 inch (0.31 cm) away from the air shroud or any other metal part of the engine. Using the starting crank, slowly turn the engine over two complete revolutions and watch for the spark discharge which should occur during the cycle, at the instant the impulse coupling on the magneto snaps. Repeat this check with each of the other ignition wires.

b. Replacing and Adjusting Breaker Point Assembly.

(1) Remove the screws and assembled washers (1 and 2, fig. 4-22) that secure the end cap assembly (3) to the housing (4). You can remove the end cap from the magneto without disconnecting the spark plug cables. Remove the end cap assembly. Remove and discard the end cap gasket (5).



1. Screw, assembled washer
2. Screw, assembled washer
3. End cap
4. Housing
5. Gasket
6. Screw
7. Capacitor
8. Preformed packing
9. Rotor
10. Retaining ring
11. Breaker point assembly
12. Screw, assembled washer
13. Cam wick
14. Screw, assembled washer
15. Suppressor assembly
16. Suppressor insulator

Figure 4-22. Magneto breaker point removal.

(2) Disconnect the ground switch lead from the capacitor (7). Remove screw (6) and the capacitor (7) and preformed packing (8) from the end cap assembly. Discard both the capacitor and preformed packing.

(3) Remove rotor (9) and the screws and assembled washers (12 and 14) and retaining ring (10) that secure the breaker point assembly (11) and cam wick (13) to the bearing support. Remove the breaker point assembly.

(4) Inspect the breaker points for evidence of pitting or pyramiding. You can use a small tungsten file or fine stone to resurface the points. You must replace badly worn or pitted points.

(5) Install new or resurfaced breaker point assembly on the bearing support, using the screws and assembled washers (12 and 14) and retaining ring (10). Leave the mounting screws just loose enough to permit adjustment. Be sure you install the cam wick (13).

(6) Rotate the engine by hand to locate the breaker arm on the high point of the cam. Using a feeler gage, set the breaker point at maximum opening of 0.015 inch (0.03 cm). Make the adjustment with a screwdriver inserted into the slot at the bot - tom of the contact plate, and pivoting between the two small bosses on the bearing support. Hold the parts in place while you tighten the mounting screws. Take a final measurement of the breaker point gap after the screws are tightened to be sure you have maintained the correct adjustment.

(7) If the cam is dry, you should coat it with a light coat of grease. Install rotor (9) on shaft.

(8) Clean the contact surfaces between the cap and the housing and, using a new gasket (5), mount the end cap (3) on the housing (4). Make sure the sup-

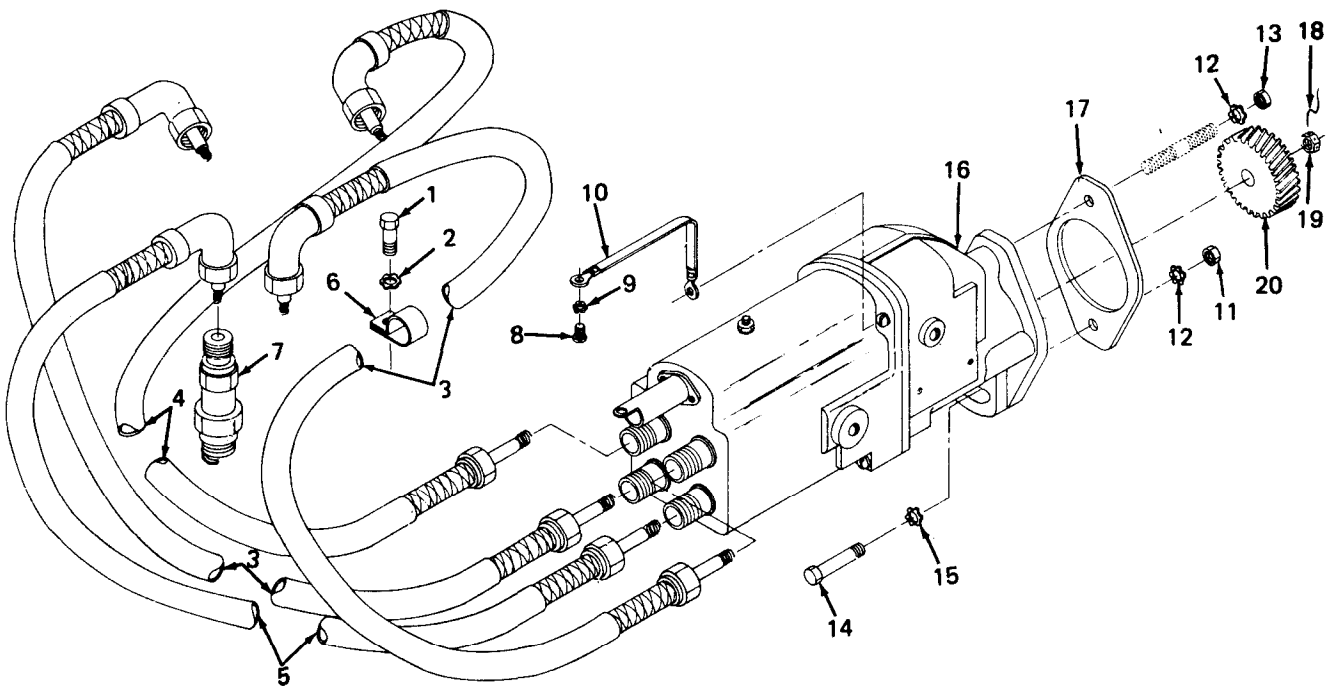
pressor assembly (15) and suppressor insulator (16) are properly installed before securing cap. Secure end cap to housing with screws and assembled washers (1 and 2).

(9) Install a new capacitor (7) and preformed packing (8). Secure capacitor to magneto with screw (6).

(10) Make sure the ground strap is mounted to the magneto.

c. Removal.

(1) Remove screw (1, fig. 4-23) and lockwasher (2) that attach clamp (6) to air shroud.



1. Screw	6. Clamp	11. Nut	16. Magneto
2. Lockwasher	7. Spark plug	12. Lockwasher	17. Gasket
3. Cable	8. Screw	13. Nut	18. Lockwire
4. Cable	9. Lockwasher	14. Screw	19. Nut
5. Cable	10. Ground strap	15. Lockwasher	20. Gear

Figure 4-23. Magneto removal.

(2) Tag and disconnect shielded spark plug cables (3, 4, and 5) from the magneto (16) and spark plugs (7). Remove spark plugs (7) from the cylinder head.

(3) Remove screw (8), lockwasher (9), and magneto end cap screw; remove ground strap (10).

(4) Remove nuts (11 and 13), lockwashers (12), screw (14), and lockwasher (15) that secure the magneto to the engine.

(5) Remove the magneto (16) and gasket (17) from the engine.

d. Disassembly. Disassemble the magneto only far enough for you to install the breaker points, following the sequence indicated in figure 4-22.

e. Cleaning and Inspection.

WARNING

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

(2) Inspect the end cap for cracks or damaged terminal threads.

(3) Rotate the rotor shaft and check for binding or rough operation. Check for play between the shaft and bearings. Replace the magneto if play is excessive.

(4) Inspect the magneto gear for worn, cracked, or broken teeth.

(5) Check the spark plug ceramic insulators for cracks, porosity and other damage.

(6) If the electrodes of the spark plugs are not too badly burned, you can remove the scale and deposits with a contact file or a spark cleaning and test machine. Gap all spark plugs, new or used, to 0.030 inch (0.07 cm).

(7) Inspect all spark plug cables for fraying, damaged threads and insulators. Replace a bad cable.

f. Installation and Magneto Timing. A critical step in the installation of the magneto is timing the magneto to the engine. Install and time the magneto as follows:

(1) Install gear (20, fig. 4-23) on magneto shaft and secure with nut (19) and lockwire (18).

(2) Remove the screen that protects the flywheel by removing the screws that attach the screen to the flywheel shroud. This will expose the timing marks on the flywheel and shroud. Refer to figure 4-24.

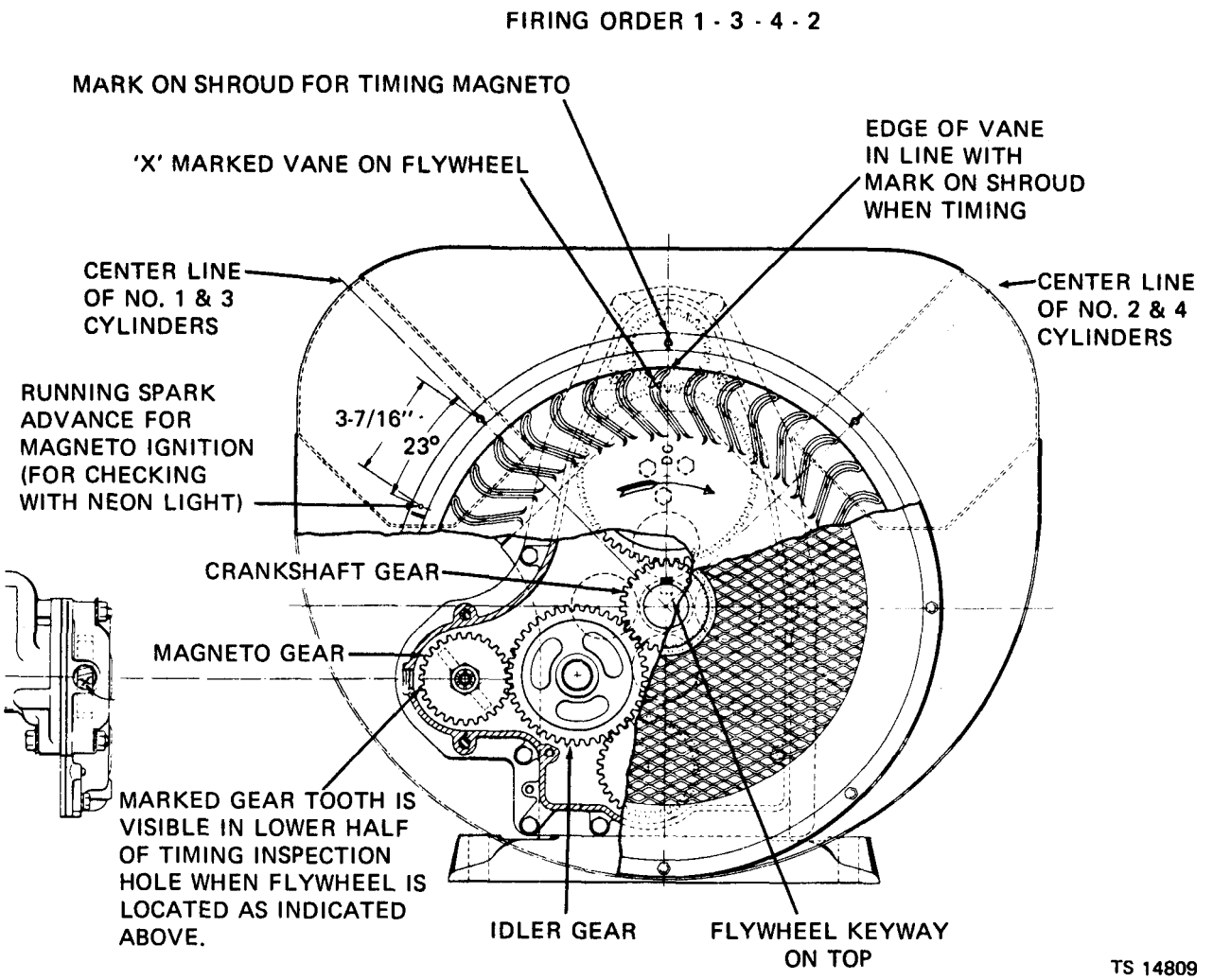


Figure 4-24. Magneto timing.

(3) Remove the spark plug from the number 1 cylinder. The firing order is marked on the shrouding. Place your thumb over the spark plug hole and crank the engine until air is being compressed against your thumb as the piston rises in the cylinder. This indicates the compression stroke.

(4) Continue cranking the engine until the DC mark on the flywheel is aligned with the timing mark on the shroud. The edge of the "X"-marked vane will also be aligned with the timing mark. The piston is now on dead center, and the engine should be held at this setting.

(5) Disconnect the oil line and remove the pipe elbow from the gear cover at the magneto mounting flange; this will provide an inspection hole.

(6) With the magneto still removed from the engine, you must now determine the number 1 cylinder firing position of the magneto. Insert the ignition cable into the number 1 lower terminal on the magneto end cap. Mount the magneto in a vise

thoroughly lined with soft protective cloths. Hold the spark plug terminal at the other end about 1/8 inch (0.31 cm) from the magneto body, and turn the magneto gear in a clockwise rotation, tripping the impulse coupling, until the number 1 terminal sparks. Then hold the gear in this position.

(7) Remove the magneto from the vise and mount the magneto (16, fig. 4-23) and gasket (17) on the engine, meshing the gears so that when the magneto is in place, the gear tooth marked with an "X" will be visible through the lower half of the inspection hole in the gear cover (fig. 4-24). Secure the magneto using screw (14, fig. 4-23), lockwashers (15 and 12), and nuts (11 and 13). Connect the leads from the magneto to the spark plugs of corresponding numbers.

(8) Install ground strap on magneto and secure to magneto with end cap screw. Secure other end to frame with lockwasher (9) and screw (8).

(9) Install spark plug (7) into cylinder head. Install clamp (6) on spark plug cables; install and connect spark plug cables (5, 4, and 3). Secure clamp (6) to air shroud with lockwasher (2) and screw (1). Refer to figure 4-25 for magneto-to-spark plug connections.

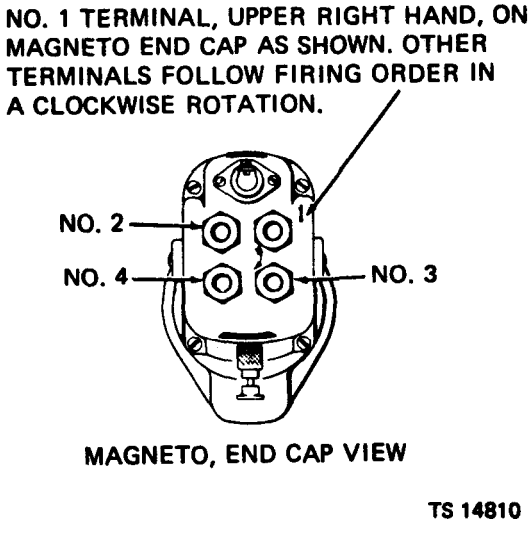


Figure 4-25. Magneto-to-spark plug connections.

(10) Start the engine and idle it at about 1400 rpm. If the engine fails to start, the probable cause is faulty ignition timing. You should retrace the timing procedures previously outlined above.

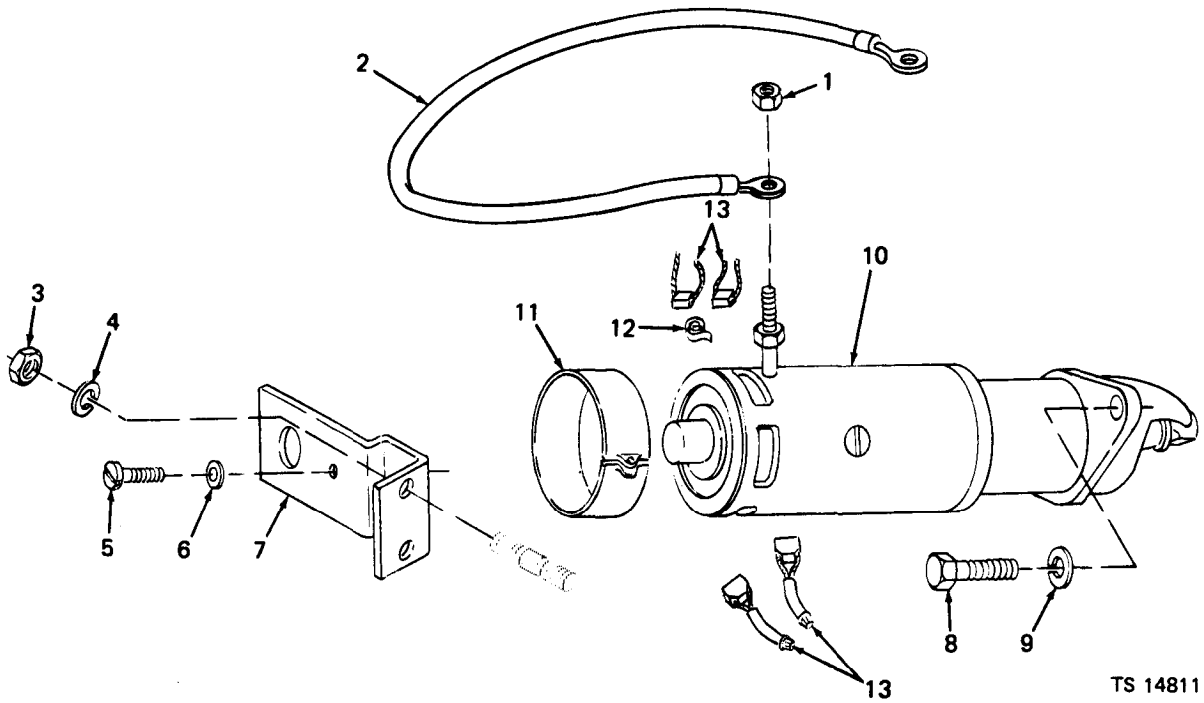
4-29. Starting Motor.

a. Removal. Remove the starting motor for replacement as follows:

CAUTION

Disconnect the battery cable from the positive battery terminal before disconnecting any other electrical leads from the engine components. This will prevent shorts which could damage the alternator, voltage regulator, and other parts.

(1) Disconnect the electrical cable (2, fig. 4-26) from the starter switch to the starting motor (10) by removing nut (1).



1. Nut
2. Cable
3. Nut
4. Lockwasher
5. Screw
6. Lockwasher
7. Support bracket
8. Screw
9. Lockwasher
10. Starting motor
11. Cover band
12. Brush spring
13. Brush

Figure 4-26. Starting motor and brush removal.

(2) Remove the nuts (3) and lockwashers (4) that secure the support bracket (7) to the engine block.

(3) Remove the screw (5) and lockwasher (6) that mount the starting motor to the support bracket (7); remove the support bracket.

(4) Remove the three screws (8) and lockwashers (9) that secure the starting motor (10) to the flywheel housing. Pull the starting motor straight out to remove it from the engine.

b. Cleaning and Inspection.

WARNING

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(1) Clean the exterior of the starting motor with a cloth dampened with cleaning solvent (fed. spec. P-D-680). You should take care to prevent the solvent from entering the starting motor.

(2) Inspect the starting motor for cracks, signs of overheating, and other damage.

(3) Inspect the starting motor drive for worn, chipped, and broken gear teeth and other broken parts.

(4) Remove the brush cover band (11, fig. 4-26) and inspect the starting motor brushes; replace if necessary.

(5) Replace the starting motor if it is damaged or nonserviceable.

c. Starter Brush Replacement. You should replace the brushes if they are less than 3/8 inch (0.93 cm).

(1) Disconnect the electrical cable (2, fig. 4-26) to the starting motor from the starter switch.

(2) Loosen the cover band screw and slide the cover band (11) from over the brush access openings in the starter frame.

(3) Unhook the spring (12) retaining each brush and hold it out of the way of the brush. Holding the brush by the leads, carefully remove brush (13) through access opening. Remove brush only far enough to disconnect brush leads from field leads. Repeat this procedure with each brush.

NOTE

Before you install the new brushes, check the commutator on the armature shaft. It must be smooth and concentric, free from burrs, scoring, high segments, or

other damage. If the commutator is damaged, replace the starting motor.

(4) Install the new brushes (13) and spring (12). Connect each brush lead.

(5) Install the cover band (11) and connect the electrical cable (2) to the starting motor and switch.

d. Installation.

(1) Install starting motor (10, fig. 4-26) on engine and secure with lockwashers (9) and screws (8).

(2) Install support bracket (7) on stud and secure with lockwashers (6), screw (5), and nut (3).

(3) Connect electrical cable (2) to starter and secure with nut (1).

4-30. Control Panel and Instruments.

a. Removal.

CAUTION

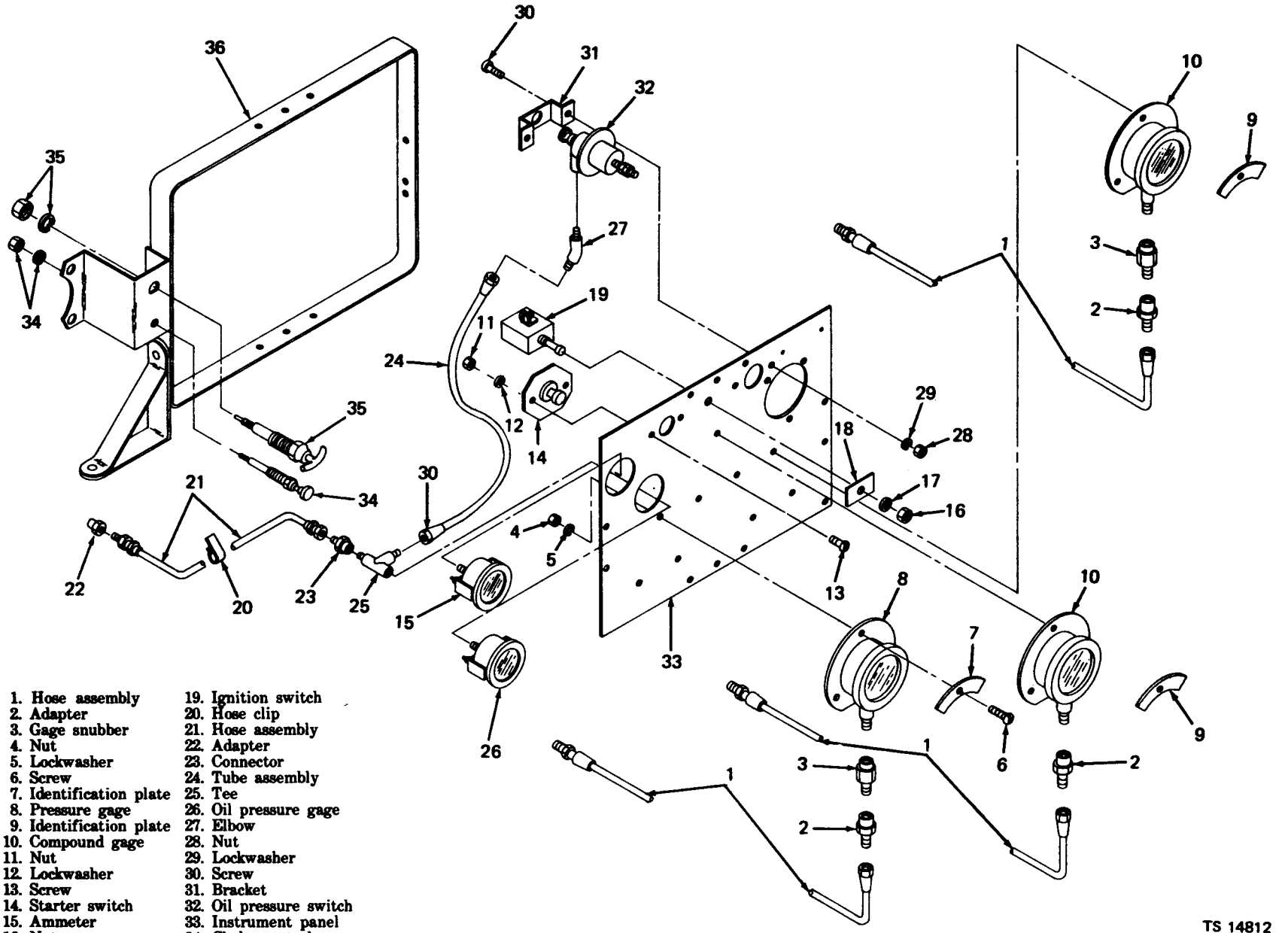
Disconnect the battery cable from the positive battery terminal before disconnecting any leads to the engine controls and instruments. This will prevent shorts which could damage the alternator and other parts.

(1) Disconnect and tag the electrical leads from the engine controls and instruments on the control panel.

(2) Remove nuts and lockwashers on the discharge piping that secure the instrument panel frame and remove.

b. Disassembly.

(1) Remove nut (11, fig. 4-27), lockwasher (12), screw (13), and starter switch (14) from instrument panel. Remove ammeter (15) from instrument panel.



1. Hose assembly
2. Adapter
3. Gage snubber
4. Nut
5. Lockwasher
6. Screw
7. Identification plate
8. Pressure gage
9. Identification plate
10. Compound gage
11. Nut
12. Lockwasher
13. Screw
14. Starter switch
15. Ammeter
16. Nut
17. Flat washer
18. Instruction plate
19. Ignition switch
20. Hose clip
21. Hose assembly
22. Adapter
23. Connector
24. Tube assembly
25. Tee
26. Oil pressure gage
27. Elbow
28. Nut
29. Lockwasher
30. Screw
31. Bracket
32. Oil pressure switch
33. Instrument panel
34. Choke control
35. Throttle control
36. Frame

Figure 4-27. Instrument panel and gages.

(2) Remove nut (16), flat washer (17), instruction plate (18), and ignition switch (19) from instrument panel.

(3) Remove hose clip (20), hose assembly (21), adapter (22), connector (23), tube assembly (24), tee (25), and remove oil pressure gage (26) from instrument panel.

(4) Remove elbow (27), nuts (28), lockwashers (29), screws (30), and remove bracket (31) and oil pressure switch (32) from instrument panel (33).

(5) Remove nuts and lockwashers from choke control (34) and throttle control (35) and remove them from instrument panel frame (36).

c. Cleaning and Inspection.

WARNING

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(1) Clean all parts by wiping them with a cloth dampened lightly with cleaning solvent (fed. spec. P-D-680). You must be careful to prevent the solvent from entering the interior of the components.

(2) Inspect all meters and gages for cracked dial glass, defaced or illegible dial marking, sticking or binding dial pointers, damaged terminals, evidence of entry of moisture, and other damage. Replace damaged gages and meters.

(3) Check all switches for damaged cases, difficult operation, lack of positive switch action, and other damage. When you check the switches for continuity, use an ohmmeter or test lamp. Replace defective switches.

(4) Inspect the magneto ignition switch for loose or damaged terminals and other damage. Continuity should not exist when the switch is in the run position, but it should exist when the switch is in the stop position. Replace a damaged or inoperative magneto ignition switch.

(5) Inspect hoses for cuts, abrasions, leaks, damaged threads on fittings, and other damage. Replace damaged hoses.

(6) Check the operation of the oil pressure safety switch by checking continuity across the terminals while you apply air pressure to the inlet port. Start with the switch in the reset position (with the spring clip inserted under the recess in the housing). No continuity must exist at this time. Slowly apply air pressure. When approximately 1-1/2 psi pressure is applied, the spring clip must disengage from the housing, with no continuity being maintained through the switch. Increase pressure to a maximum of 5 psi, then reduce pressure. When you lower the pressure to approximately 1 psi, continuity must be established and must remain when the pressure is further reduced to zero. Replace the switch if it fails to perform as indicated.

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

d. Reassembly.

(1) Install throttle control (35, fig. 4-27) and choke control (34) in instrument panel frame (36) and secure with nuts and lockwasher on the back side of the frame.

(2) Install instrument panel (33) on frame and secure with nuts, lockwashers, and screws.

(3) Install oil pressure switch (32) in instrument panel and secure with bracket (31), screws (30), lockwashers (29) and nuts (28).

(4) Install and connect elbow (27) to oil pressure switch. Install oil pressure gage (26), tee (25), tube assembly (24), connector (23), adapter (22), hose assembly (21), and clip (20).

(5) Install ignition switch (19), instruction plate (18) and secure with flat washer (17) and nut (16). Install ammeter (15) in instrument panel.

(6) Install starter switch (14) in instrument panel and secure with screws (13), lockwashers (12), and nuts (11). Connect all electrical leads.

e. Installation.

(1) Position assembled instrument panel on the discharge piping and secure with nuts and lockwashers.

(2) Connect all electrical leads to the engine.

Section XII. MAINTENANCE OF NON-ELECTRICAL GAGES

4-31. Description.

a. Three non-electrical gages are mounted on the control panel to keep you informed of the pump suction and discharge pressures and the engine vacuum. They are connected to their related system by hoses and fittings. The pump gages, which are subject to momentary pressure surges, are protected from internal damage by snubbers installed just ahead of the gage inlet ports.

b. The tachometer-hourmeter mounted on the control panel is driven by a flexible drive shaft which is connected to a drive adapter on the governor. The drive adapter transmits the rotational force necessary to operate the tachometer-hourmeter.

4-32. Pump Suction and Discharge and Engine Vacuum Gages, Lines, and Fittings.

a. Removal.

(1) Remove the hose assemblies (1, fig. 4-27), adapters (2), and snubbers (3) from the gages and disconnect the hoses from the pump.

(2) Remove the nuts (4), lockwashers (5), and screws (6) that secure the gages (8 and 10) and identification plates (7 and 9) to the control panel; remove the gages.

b. Cleaning and Inspection.

WARNING

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(1) Clean all lines and fittings by washing in cleaning solvent (fed. spec. P-D-680). Wipe external surfaces dry and blow through the lines with compressed air to make sure they are clear.

(2) Inspect hoses for cuts, evidence of dry rot, leaks, damaged threads, and other damage; replace damaged hoses.

(3) Inspect fittings for cracks, distortion, damaged threads, and other damage; replace damaged fittings.

(4) Clean the pump suction and discharge gages and the engine vacuum gage with a cloth dampened with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(5) Inspect the gages for cracked gage glasses, binding or sticking of the indicator needles, illegible dial markings, evidence of moisture, and other damage. Replace damaged gages.

c. Installation.

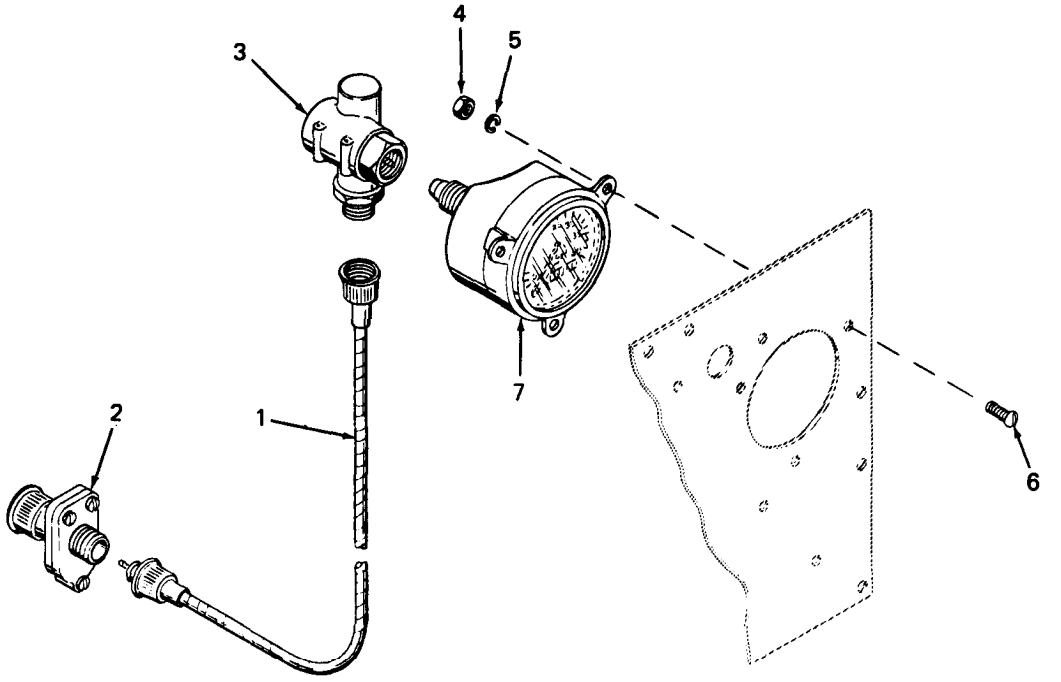
(1) Install compound gage (10, fig. 4-27), pressure gage (8), identification plates (9 and 7) and secure them in the instrument panel with screws (6), lockwashers (5), and nuts (4).

(2) Install gage snubber (3), adapter (2), and connect hose assemblies (1) to gages and pump assembly.

4-33. Tachometer-Hourmeter.

a. Removal.

(1) Disconnect and remove flexible drive shaft (1, fig. 4-28). Remove reversing adapter (3) and drive adapter (2).



1. Flexible drive shaft
2. Drive adapter
3. Reversing adapter
4. Nut
5. Lockwasher
6. Screw
7. Tachometer-hourmeter

Figure 4-28. Tachometer-hourmeter.

(2) Remove nuts (4), lockwashers (5), and screws (6). Remove tachometer-hourmeter (7) from instrument panel.

b. Cleaning and Inspection.

WARNING

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(1) Wipe the exterior of the tachometer-hourmeter and the flexible shaft with a cloth dampened with cleaning solvent (fed. spec. P-D-680).

(2) Inspect the tachometer for a broken dial glass, illegible dial markings, binding of the indicator pointer, binding of the digital hour counter, and evidence of entry of moisture. Replace a damaged tachometer-hourmeter.

(3) Inspect the tachometer shaft for kinks, broken sheathing, binding of the internal shaft when rotated, and damaged threads on the coupling nuts. Replace a damaged tachometer shaft.

(4) Inspect the adapters for damaged threads and other damage; replace if damaged.

c. Installation.

(1) Install tachometer-hourmeter (7, fig. 4-28) in instrument panel and secure with screws (6), lockwasher (5), and nuts (4).

(2) Install reversing adapter (3), drive adapter (2), and flexible drive shaft (1).

Section XIII. MAINTENANCE OF ENGINE COOLING SYSTEM

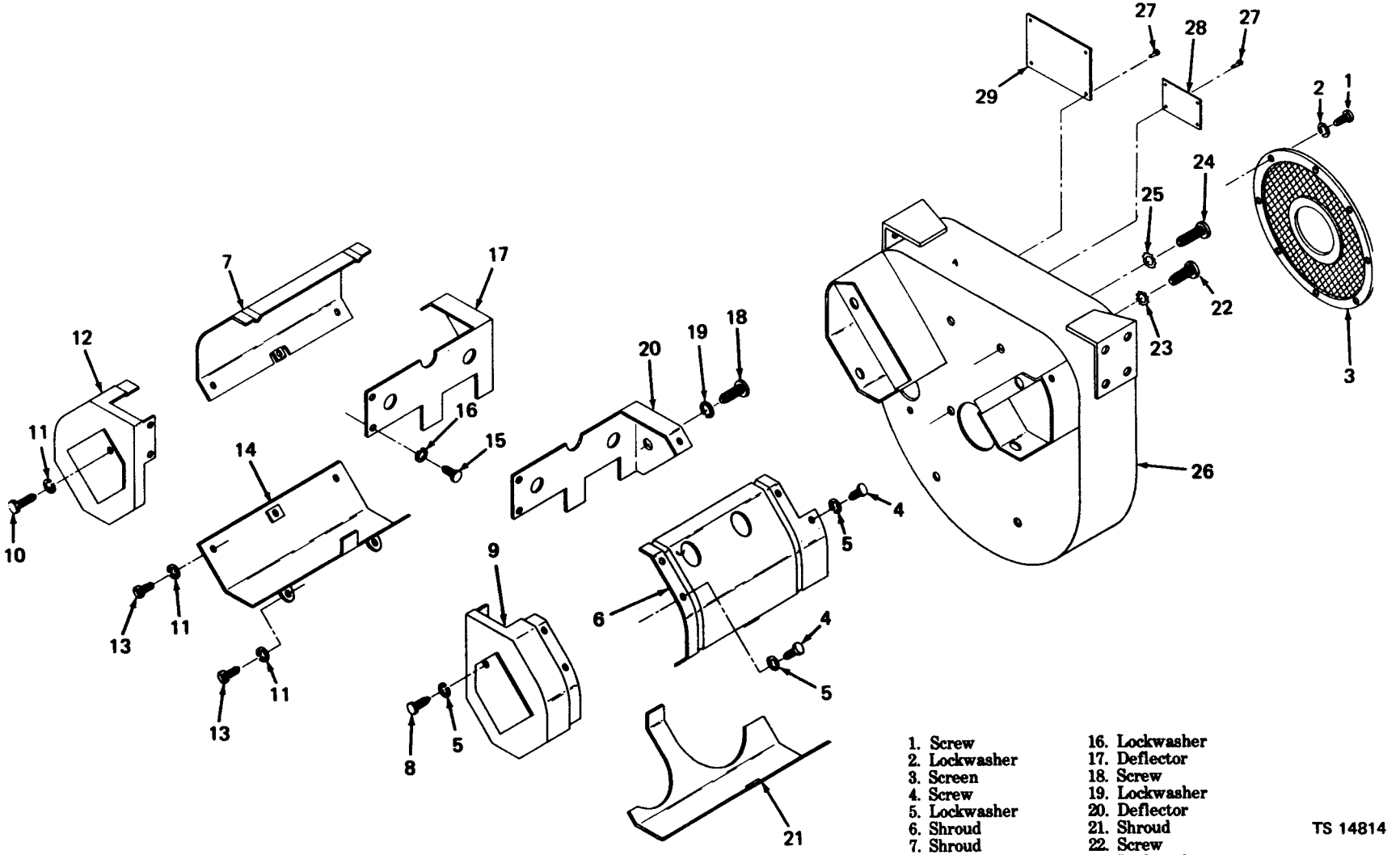
4-34. Air Shrouding.

a. Removal.

(1) Obtain the services of direct support personnel to remove the flywheel and alternator assembly.

(2) Remove muffler, manifold, and carburetor. Disconnect spark plug cables.

(3) Remove screws (1, fig. 4-29), lockwashers (2), and flywheel screen (3).



1. Screw
2. Lockwasher
3. Screen
4. Screw
5. Lockwasher
6. Shroud
7. Shroud
8. Screw
9. Cover
10. Screw
11. Lockwasher
12. Cover
13. Screw
14. Shroud
15. Screw
16. Lockwasher
17. Deflector
18. Screw
19. Lockwasher
20. Deflector
21. Shroud
22. Screw
23. Lockwasher
24. Screw
25. Lockwasher
26. Shroud
27. Rivet
28. Identification plate
29. Identification plate

Figure 4-29. Engine air shroud.

(4) Remove screws (4), lockwashers, (5), and cylinder head shrouds (6 and 7). Remove screws (8), lockwashers (5), and cylinder head cover (9).

(5) Remove screws (10), lockwashers (11), and cylinder head cover (12). Remove screws (13), lockwashers (11), and shroud (14).

(6) Remove screws (15), lockwashers (16) and remove cylinder head deflector (17).

(7) Remove screws (18), lockwashers (19), deflector (20), and shroud (21). Remove screws (22 and 24), lockwashers (23 and 25), and flywheel shroud (26). Remove rivet (27) and remove identification plates (28 and 29).

b. Cleaning and Inspection.

WARNING

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

(2) Inspect the parts for corrosion, cracks, dents, and distortion. Straighten dented and distorted panels and reuse them. If damage is too severe to correct, you must replace the shrouding. Remove rust and corrosion using sandpaper or wire brush. Prime and paint the cleaned areas and shrouding as necessary.

c. Installation.

(1) Install identification plates (29 and 28, fig. 4-29) and secure them to the flywheel shroud with rivets (27).

(2) Install flywheel shroud (26) on the engine and secure with lockwashers (25 and 23) and screws (24 and 22). Install shroud (21), deflector (20), and secure with lockwasher (19) and screw (18).

(3) Install cylinder head deflector (17) and secure with lockwashers (16) and screws (15).

(4) Install shroud (14) and secure with lockwashers (11) and screws (13). Install cylinder head cover (12) and secure with lockwashers (11) and screws (10).

(5) Install cylinder head cover (9) and secure with lockwashers (5) and screws (8). Install cylinder head shrouds (7 and 6) and secure with lockwashers (5) and screws (4).

(6) Install alternator and flywheel. Install screen (3) and secure with lockwashers (2) and screws (1).

(7) Install carburetor, manifold and muffler. Connect all spark plug cables.

Section XIV. MAINTENANCE OF WHEELS AND HUBS

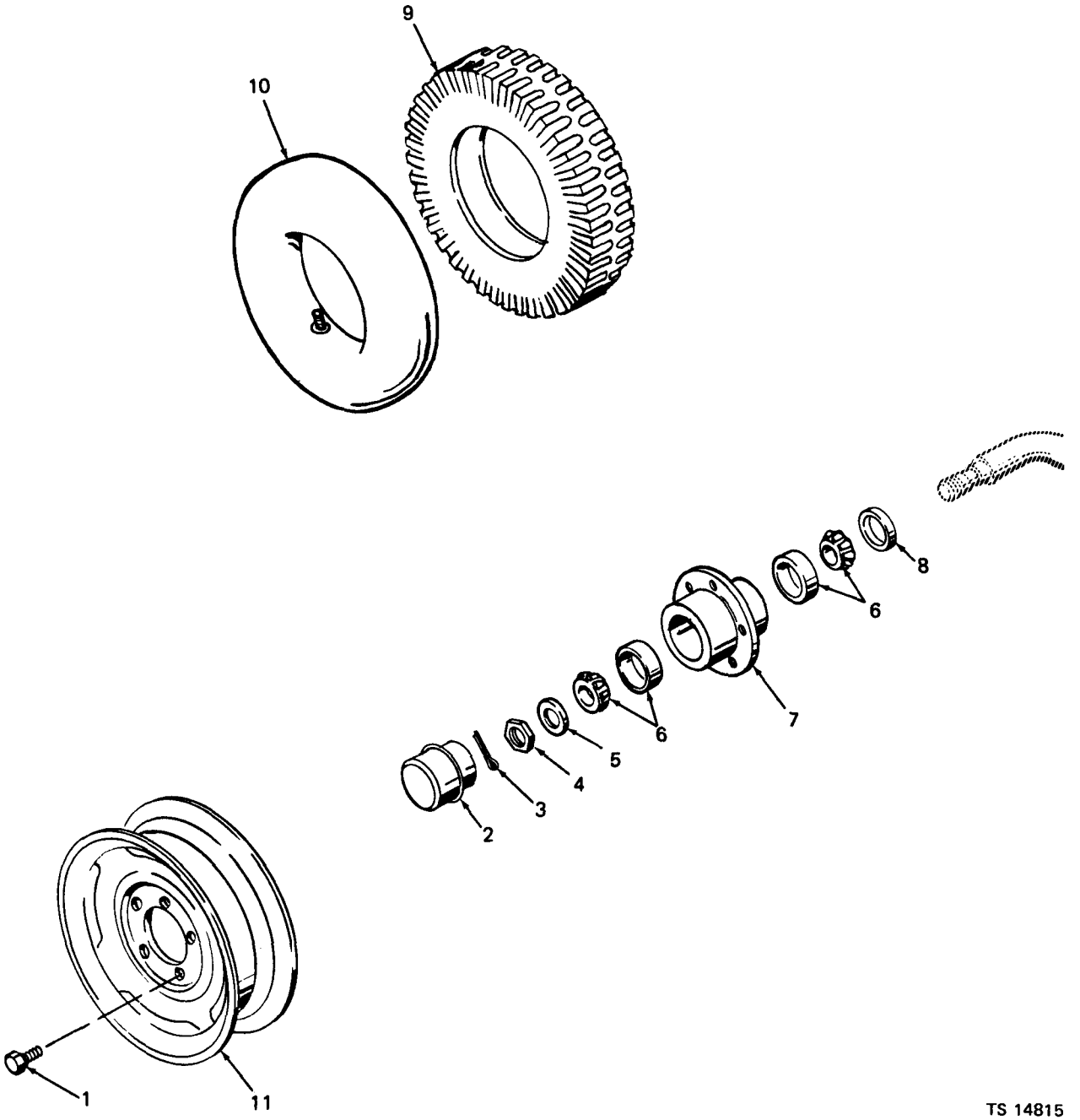
4-35. Description.

a. The tire assembly consists of a separate tire and inner tube. The tire size is 7.00-15, 8-ply rating, with a regular tread. The tires must be inflated to 35 psi.

b. The wheel assemblies consist of steel wheels which are bolted to the hub assemblies. The hub assemblies are mounted on the axle and rotate on tapered roller bearings. They are secured to the axle by castellated nuts that are locked in place by cotter pins.

c. Removal

(1) Remove bolts (1, fig. 4-30) and remove wheel assembly from the hub.



1. Bolt
2. Grease cup
3. Cotter pin
4. Nut
5. Washer
6. Bearing
7. Hub
8. Seal
9. Tire
10. Inner tube
11. Wheel

Figure 4-30. Wheel assembly and hub.

(2) Remove grease cup (2), cotter pin (3), nut (4), and washer (5). Remove bearing (6) and hub (7) from the axle. Remove bearing (6) and seal (8) from the hub.

(3) Deflate the inner tube and depress the outer sealing surface of the tire to free it from the wheel.

(4) Using a tire iron or other tool, pry the sealing surface of the tire out over the wheel (11) and remove tire (9) and inner tube (10).

d. Cleaning and Inspection.

WARNING

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(1) Inspect the tires for cuts, punctures, worn treads, imbedded stones, and severe abrasions. Inspect the inside of the tires for broken cords and punctured walls. Replace tires which are damaged beyond repair or excessively worn.

(2) You can check the inner tube for leaks by inflating it and immersing it in water. Any sign of bubbles indicates a leak. Place a patch over any leaks. Check the tube for dry rot and other signs of deterioration. Replace nonserviceable tubes.

(3) Clean the bearing cones in a container of cleaning solvent (fed. spec. P-D-680). After cleaning, dip them in light oil and wrap in lint-free paper to prevent entry of dirt and grit.

(4) Clean all other parts with the cleaning solvent and dry thoroughly.

(5) Inspect the wheel for cracks, distortion, burrs on the sealing rim, and other damage. Remove all burrs with a file or fine stone. Replace damaged wheels.

(6) Inspect the bearing cones for rough, scored, or brinnelled rollers, scored races, and bent cages. Inspect the bearing cups for wear and scoring. If either the cone or cup of a bearing set is damaged, you must replace both parts.

e. Reassembly.

(1) Install tire (9, fig. 4-30) on wheel (11) and install the inner tube (10), making sure the valve stem extends in the required direction.

(2) Pry the outer surface of the tire over the rim and inflate to 35 psi.

f. Installation.

(1) Install bearing (6) and seal (8) in hub (7). Position hub (7) on the axle and install bearings (6). Secure hub to axle with washer (5), nut (4), and cotter pin (3).

(2) Install grease cup (2) on axle. Install wheel assembly onto the hub and secure with bolts (1).

Section XV. MAINTENANCE OF PUMP

4-36. Description

a. Suction Piping and Strainer. The pump suction piping system consists of two 4-inch gate valves attached to a suction manifold and strainer connected between the suction manifold and the pump to remove solid materials from the fluid being pumped. Attached to the gate valves are female quick-disconnect fittings to facilitate the connection of hoses. A dust plug is provided for each fitting to prevent the entry of foreign matter when that particular fitting is not in use.

b. Discharge Piping. The discharge piping system consists of two 4-inch gate valves attached to a discharge manifold, a lever-operated check valve between the discharge manifold and the pump, and an air eliminator. The check valve automatically prevents reverse flow of fluid through the pump, and if desired, you can manually override the normal check valve operation. The air eliminator expels air from the pump during the priming cycle and as the need arises.

c. Gate Valve. The gate valves are identical. When you rotate the valve handwheel counterclockwise, the valve disc assembly is raised from the valve seat to allow fluid flow. When you rotate the handwheel clockwise, the stem lowers the disc assembly into alignment with the valve seat and expands the parts of the disc assembly outward to seal the fluid flow through the valve.

d. Check Valve. The check valve is mounted in the discharge line to prevent the reverse flow of fluid through the pump by closing automatically at shutdown. It can be manually opened to drain the discharge lines back to the fuel source, but the discharge lines must be higher than the pump inlet. You can adjust the valve to remain open.

e. Air Eliminator. The air eliminator assembly is mounted on the highest section of the discharge line to expel air during the priming cycle. It consists primarily of a float-operated valve that remains open until all air is vented and the rising liquid raises the float and closes the valve.

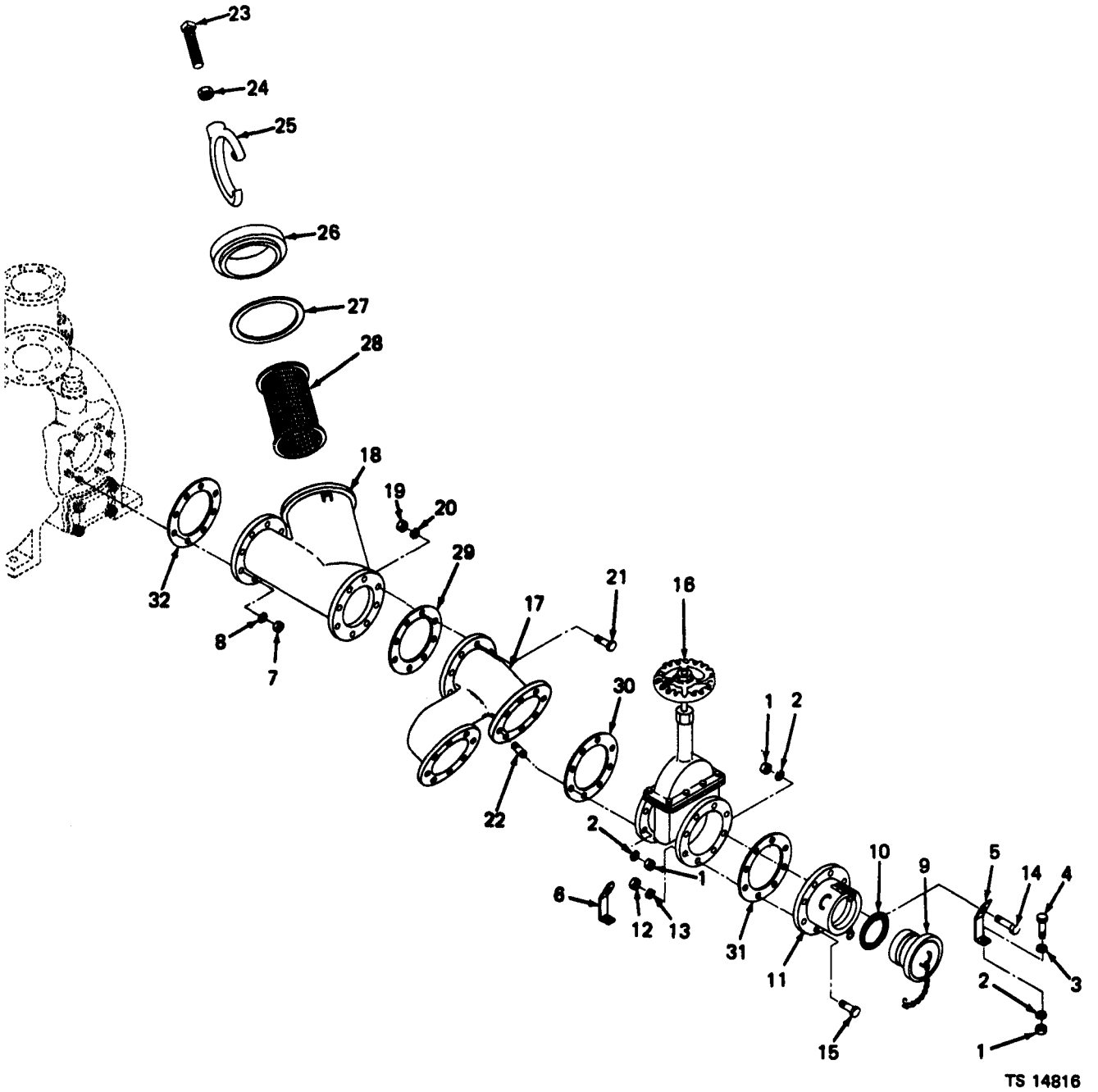
4-37. Suction Piping and Strainer.

a. Removal.

(1) Drain all fluid from the piping and disconnect suction hoses before you begin to remove the suction piping.

(2) Disconnect the pump suction gage hose assembly from the elbow on the strainer housing.

(3) Remove nuts (1, fig. 4-31), washers (2 and 3), and screws (4) that fasten support brackets (5 and 6) to frame. Remove nuts (7), and washers (8) that fasten strainer to pump. Remove suction piping.



1. Nut	9. Dust plug	17. Suction manifold	25. Yoke
2. Washer	10. Gasket	18. Y strainer	26. Cover
3. Washer	11. Adapter	19. Nut	27. Gasket
4. Screw	12. Nut	20. Washer	28. Screen
5. Support bracket	13. Washer	21. Screw	29. Gasket
6. Support bracket	14. Screw	22. Stud	30. Gasket
7. Nut	15. Screw	23. Setscrew	31. Gasket
8. Washer	16. Gate valve	24. Nut	32. Gasket

Figure 4-31. Suction piping and Y strainer.

b. Disassembly.

(1) Quick-disconnect fittings consisting of dust plug (9), gasket (10), and adapter (11) can be taken off by removing nuts (12), washers (13), and screws (14 and 15).

(2) Gate valves (16) can be taken off by removing nuts (1), and washers (2) that secure valves to suction manifold (17).

(3) Suction manifold (17) can be separated from Y strainer (18) by removing nuts (19), washers (20), and screws (21).

(4) Disassemble Y strainer by removing setscrew

(23), nut (24), yoke (25), cover (26), gasket (27), and screen (28).

c. Cleaning and Inspection.

WARNING

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

(2) Inspect quick-disconnect fittings, parts (9, 10, and 11), for cracks, distortion, or cam lever damage. Replace if damaged.

(3) Inspect the gate valves (16) for cracks and damaged flanges, operate the valve handwheel to check for free operation. Replace if damaged.

(4) Inspect the suction manifold (17) for cracks or damaged flanges. Replace studs (22) as required. If stud mounting holes are damaged, replace the entire manifold.

(5) Inspect the Y strainer (18) for cracks or damaged flanges. Use a soft bristled brush to remove foreign matter from strainer screen.

(6) Touch up or repaint all areas requiring it.

d. Reassembly.

(1) Slide screen (28) into Y strainer (18). Secure with gasket (27), cover (26), yoke (25), nut (24), and setscrew (23). Secure Y strainer (18) and gasket (29) to suction manifold (17) using nuts (19), washers (20) and screws (21).

(2) Fasten valves (16) and gaskets (30) to suction manifold (17) using nuts (1) and washers (2).

(3) Quick-disconnect fittings, dust plug (9), gasket (10), adapter (11) and support brackets (5 and 6) and gasket (31) are secured to valves (16) using nuts (1 and 12), washers (2 and 13), and screws (14 and 15).

e. Installation.

(1) Install suction piping, with gasket (32) onto pump using nuts (7) and washers (8).

(2) Secure support brackets (5 and 6) to frame using nuts (1), washers (2 and 3), and screws (4).

(3) Connect the pump suction gage hose assembly to the elbow on the strainer housing.

4-38. Discharge Piping.

a. Removal.

(1) Before you disassemble the discharge piping, drain the piping of all fluid and disconnect discharge hose.

(2) Disconnect the pump discharge pressure gage hose assembly from the elbow on the air eliminator housing.

NOTE

Make sure you provide proper support for the control panel if gages and instruments are to remain intact.

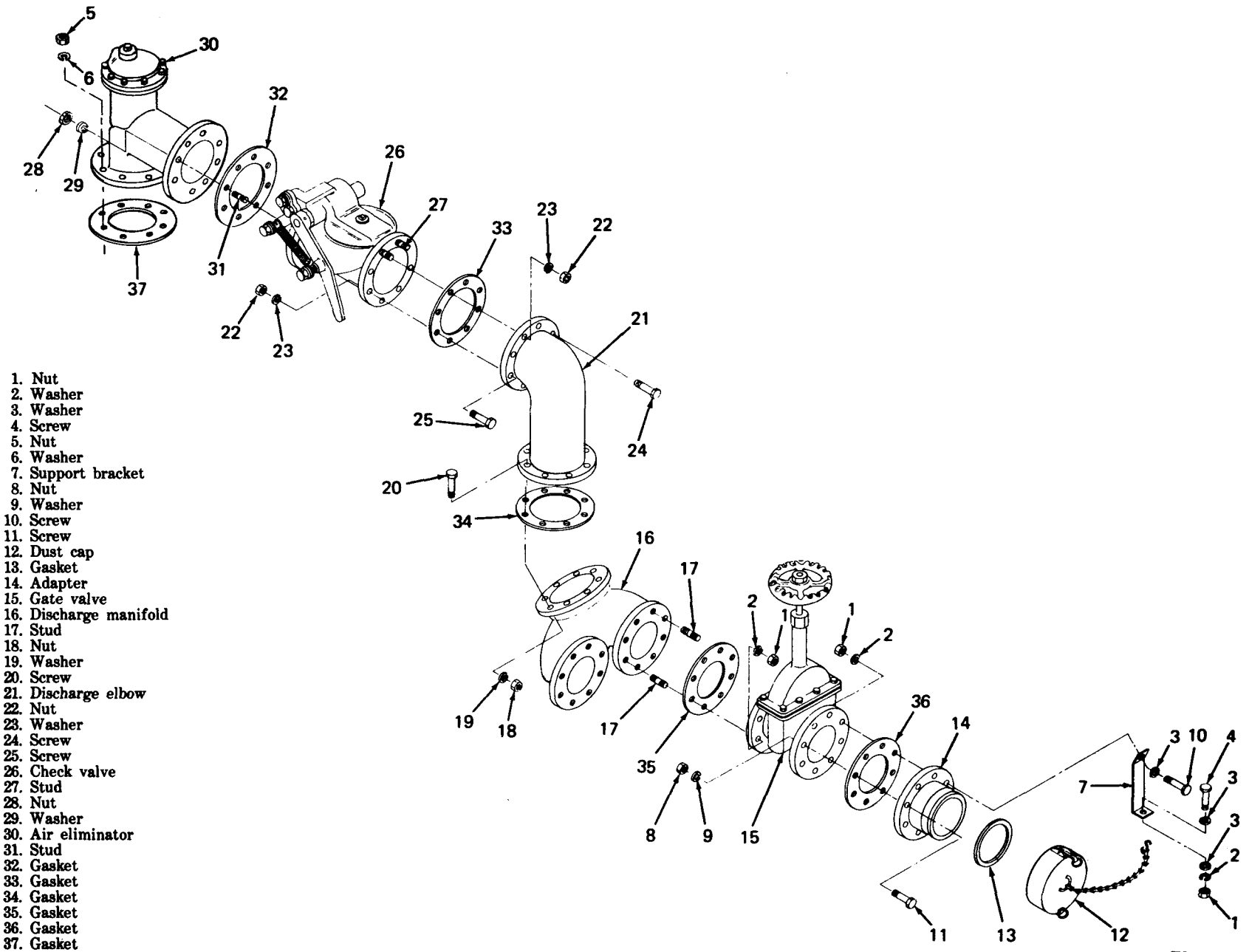
(3) Remove nuts (1, fig. 4-32), washers (2 and 3), and screws (4) that fasten support brackets (7) to frame. Remove nuts (5), and washers (6) that fasten air eliminator (30) to pump. Remove discharge piping.

b. Disassembly.

(1) Quick-disconnect fittings consisting of dust cap (12), gasket (13), and adapter (14) can be taken off by removing nuts (1 and 8), washers (2, 3, and 9), and screws (10 and 11).

(2) Gate valves (15) can be taken off by removing nuts (1), and washers (2) that secure valves to discharge manifold (16).

(3) Detach discharge manifold (16) from discharge elbow (21) by removing nuts (18), washers (19), and screws (20).



1. Nut
2. Washer
3. Washer
4. Screw
5. Nut
6. Washer
7. Support bracket
8. Nut
9. Washer
10. Screw
11. Screw
12. Dust cap
13. Gasket
14. Adapter
15. Gate valve
16. Discharge manifold
17. Stud
18. Nut
19. Washer
20. Screw
21. Discharge elbow
22. Nut
23. Washer
24. Screw
25. Screw
26. Check valve
27. Stud
28. Nut
29. Washer
30. Air eliminator
31. Stud
32. Gasket
33. Gasket
34. Gasket
35. Gasket
36. Gasket
37. Gasket

Figure 4-32. Discharge piping.

(4) Detach discharge elbow (21) from check valve (26) by removing nuts (22), washers (23), and screws (24 and 25).

(5) Separate check valve (26) from air eliminator (30) by removing nuts (28) and washers (29).

c. Cleaning and Inspection.

WARNING

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

(2) Inspect quick-disconnect fittings, parts (12, 13, and 14), for cracks, distortion, or cam lever damage. Replace if damaged.

(3) Inspect the gate valves (15) for cracks and damaged flanges. Operate the valve handwheel to check for free operation. Replace if damaged.

(4) Inspect the discharge manifold (16) for cracks or damaged flanges. Replace studs (17) as required. If stud mounting holes are damaged, replace the entire manifold.

(5) Inspect the discharge elbow for cracks, distortion, or damaged flanges. Replace if damaged.

(6) Inspect the check valve (26) for cracks or damaged flanges. Replace studs (27 and 31) as required. Operate lever to check for free movement. If stud mounting holes are damaged, replace check valve.

(7) Inspect air eliminator for cracks, distortion or damaged flanges. Replace if damaged.

d. Reassembly.

(1) Attach check valve (26, fig. 4-32) and gasket (32) to air eliminator (30) using nuts (28) and washers (29).

(2) Fasten discharge elbow (21) and gasket (34) to check valve (26) using nuts (22), washers (23), and screws (24 and 25).

(3) Attach discharge manifold (16) and gasket (34) to discharge elbow (21) using nuts (18), washers (19), and screws (20).

(4) Attach gate valves (15) and gaskets (35) to discharge manifold (16) using nuts (1) and washers (2).

(5) Attach quick-disconnect fittings, dust cap (12), gasket (13), adapter (14), with support bracket (7) and gasket (36) using nuts (1 and 8), washers (2, 3, and 9), and screws (10 and 11).

e. Installation.

(1) Install discharge piping with gasket (37) on to pump using nuts (5) and washers (6).

(2) Secure support brackets (7) to frame using nuts (1), washers (2 and 3), and screws (4).

(3) Connect the pump discharge pressure gage hose assembly to the elbow on the air eliminator housing.

Section XVI. MAINTENANCE OF ACCESSORY ITEMS

4-39 Description.

a. The fire extinguisher is installed in a bracket at the left front of the unit. The bracket is attached to the front side of the tool box.

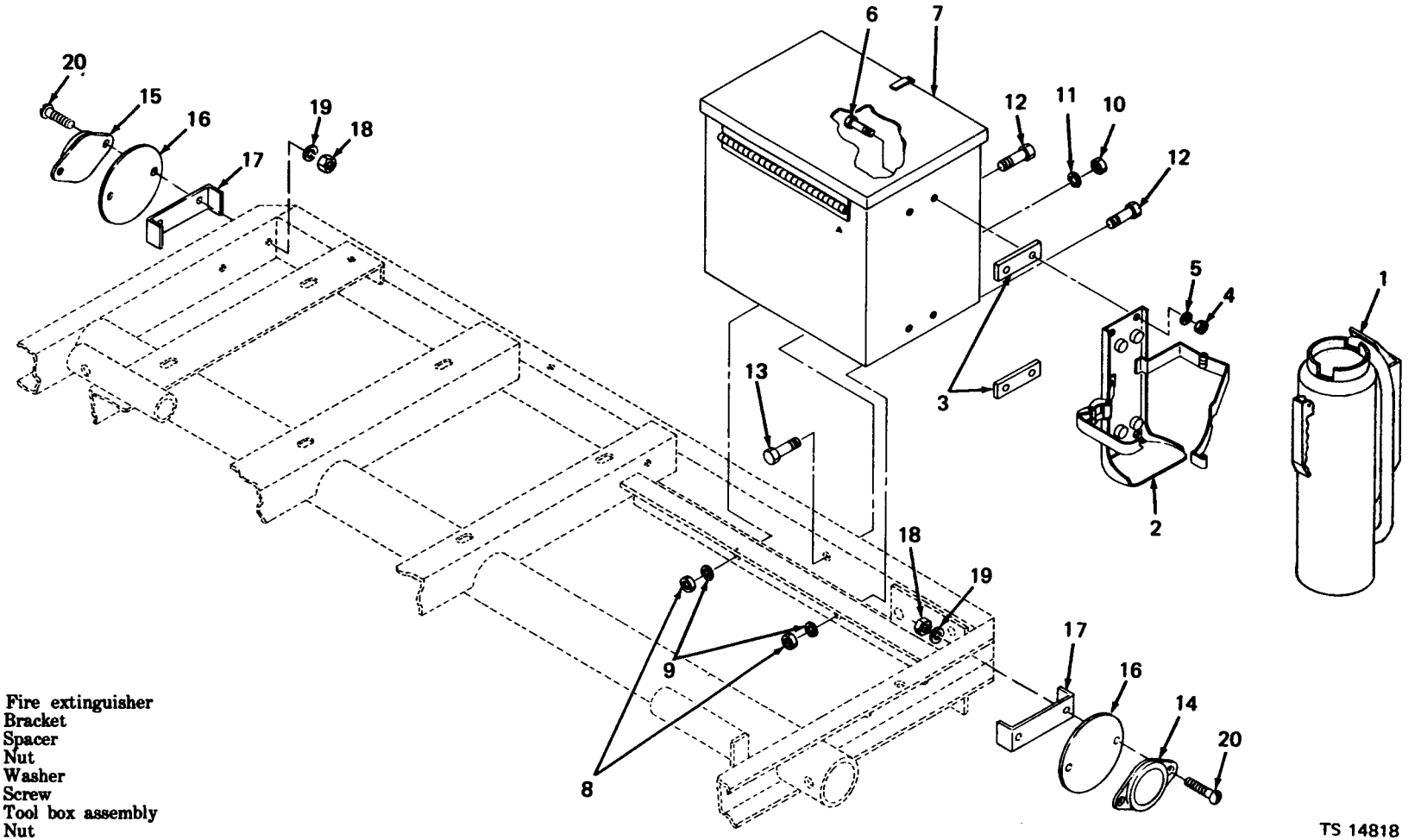
b. The tool box is mounted on the left front of the frame.

c. Two amber reflectors are mounted at the front end of the frame, and two red reflectors are mounted at the rear end.

4-40. Accessory Items.

a. Removal.

(1) Remove the fire extinguisher (1, fig. 4-33) from its bracket and detach the bracket (2) and spacers (3) from the side of the tool box by removing nuts (4), washers (5), and screws (6).



1. Fire extinguisher
2. Bracket
3. Spacer
4. Nut
5. Washer
6. Screw
7. Tool box assembly
8. Nut
9. Washer
10. Nut
11. Washer
12. Screw
13. Screw
14. Amber reflector
15. Red reflector
16. Reflector mounting plate
17. Bracket
18. Nut
19. Washer
20. Screw

Figure 4-33. Tool box and reflector.

(2) Remove the tool box (7) from the frame by removing nuts (8 and 10), washers (9 and 11), and screws (12 and 13).

(3) Detach the reflectors (14 and 15) from their mounting plates (16) and brackets (17) by removing nuts (18), washers (19), and screws (20).

b. Cleaning and Inspection.

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

(1) Clean the fire extinguisher, tool box, and reflectors with a damp cloth. Remove grease or gummy deposits with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(2) Inspect the fire extinguisher for illegible instruction plate and for damaged operating parts. Make sure it is fully charged. Replace the extinguisher if it is damaged or is lacking a full charge.

(3) Inspect the tool box for dents, rust, and other damage. You can use sandpaper or a wire brush to remove the rust; repaint as needed.

(4) Inspect the reflectors for cracks and other damage.

(5) Replace items that are damaged beyond repair.

c. Reassembly.

(1) Attach brackets (17, fig. 4-33), mounting plates (16), and reflectors (14 and 15) by using nuts (18), washers (19), and screws (20).

(2) Mount tool box (7) to frame by using nuts (8 and 10), washers (9 and 11), and screws (12 and 13).

(3) Attach spacers (3), extinguisher bracket (2) to tool box using nuts (4), washers (5), and screws (6). Place fire extinguisher in bracket and close clamp.

CHAPTER 5
DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

Section I. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

5-1. Special Tools and Equipment.

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

5-2. 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 pumping unit. Refer to TM 5-4320-273-24P for information on the replacement of parts.

Section II. TROUBLESHOOTING

5-3. 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. You should perform the tests or 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 inspector.

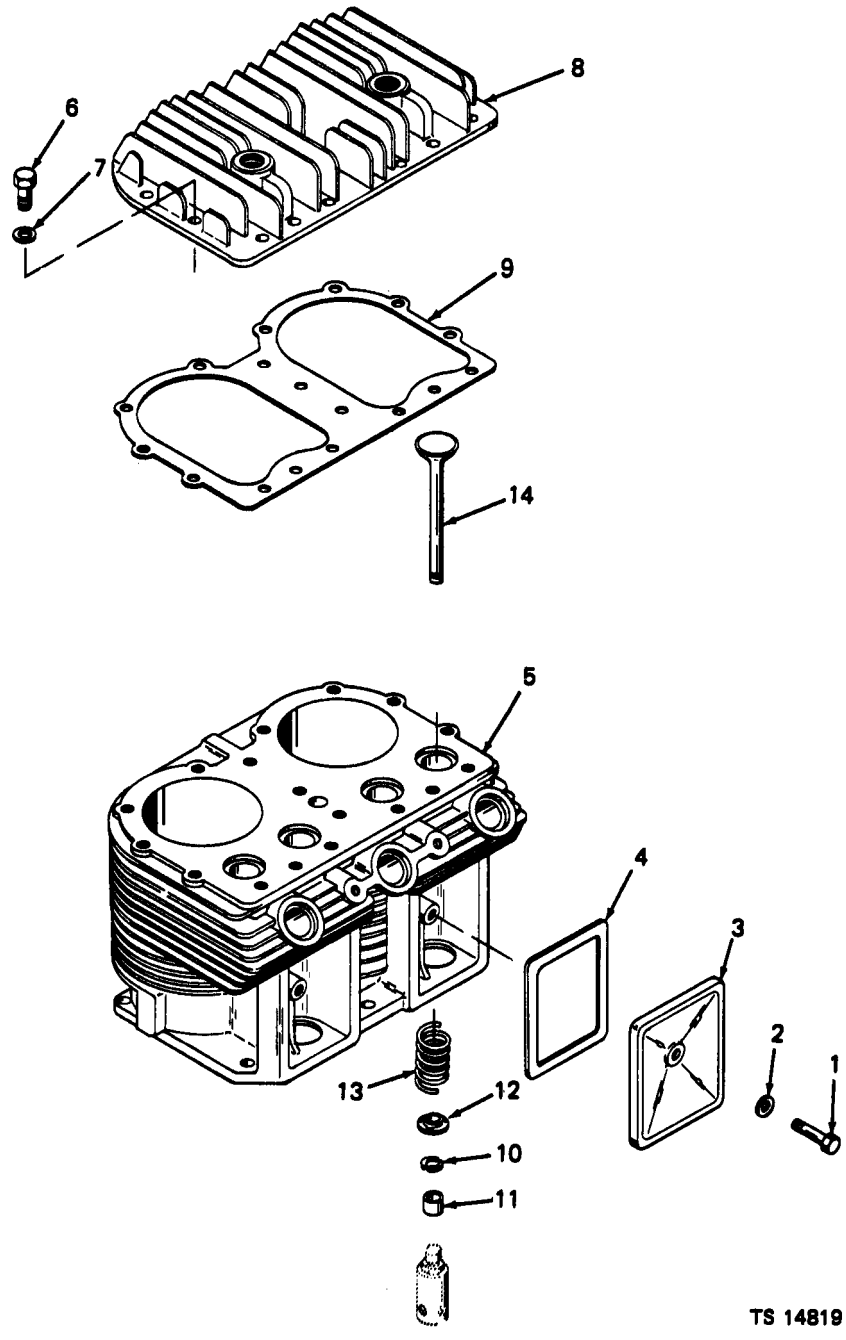
c. Only those functions which are solel y within the scope of direct and general support maintenance are listed. For troubleshooting procedures which are within the scope of operator/crew and organizational maintenance, you should refer to Chapters 3 and 4 of this manual.

5-4. Direct Support and General Support Maintenance Troubleshooting.

Refer to table 5-1 for troubleshooting which is allocated to direct support and general support maintenance levels.

Table 5.1. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE
1. ENGINE LACKS POWER
Step 1. Check for bad piston rings.
Use compressed air and blow dirt out of spark plug wells. Remove spark plug lead and spark plug. Insert compression gage in spark plug hole and crank engine over with starter. Compression readings should be between 90 to 120 psi.
Repeat compression check for all remaining cylinders. Record readings for each cylinder.
Another method of checking compression to find out if piston rings or valves are bad, is to squirt a small amount of oil through the spark plug hole.
Turn the engine over several times with the starter. Insert compression gage in spark plug hole and crank engine over with starter.
If compression reading is higher than previous reading, this indicates the piston rings are bad. If the compression reading does not rise, this indicates the valves are bad.
Replace piston rings or valves as indicated by compression check (Ref. to para 6-8).
Step 2. Check for bad valves or weak valve springs.
Remove cylinder head outside air shrouding.
Remove muffler, carburetor and manifold as an assembly.
Remove capscrew (1, fig. 5-1), flat washer (2), inspection plate (3), and gasket (4) from cylinder block (5).



1. Capscrew
2. Flat washer
3. Inspection plate
4. Gasket
5. Cylinder block
6. Capscrew
7. Flat washer
8. Cylinder head
9. Gasket
10. Valve spring seat lock
11. Valve stem cap
12. Valve spring seat
13. Valve spring
14. Valve

Figure 5-1. Cylinder head and valve removal.

Table 5-1. Troubleshooting — Continued

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE — Continued

Remove capscrew (6), flat washer (7), cylinder head (8), and gasket (9) from cylinder block.
Using a standard automotive type valve spring compressor, compress the valve spring and remove the valve spring seat locks (10) and valve stem cap (11). Release the valve spring compressor and remove the valve spring seat (12), valve spring (13), and valve (14). You should tag the valves so that in reassembly each valve will be mounted in the same valve guide from which it was removed.

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

Clean the valves and springs with cleaning solvent (fed. spec. P-D-680); dry thoroughly.
Inspect the valve springs for breaks or signs of wear.
Inspect the valves for burned, pitted, or cracked faces.
If valves are bad and cannot be cleaned up by grinding, replace them. Replace a bad valve spring.
Insert new valves (14) in cylinder block (5) and assemble valve springs (13), valve spring seat (12), and valve stem cap (11).
Using the valve spring compressor, compress the valve and install valve spring seat locks (10).
Install gasket (9) and cylinder head (8) on cylinder block. Secure the cylinder with flat washer (7) and capscrew (6).
Tighten the cylinder screws in the sequence shown in figure 5-2 to ensure proper seating of the cylinder head. The final torque applied to the cylinder head screws should be 25 to 32 foot-pounds (3.45 to 4.42 kg-m).

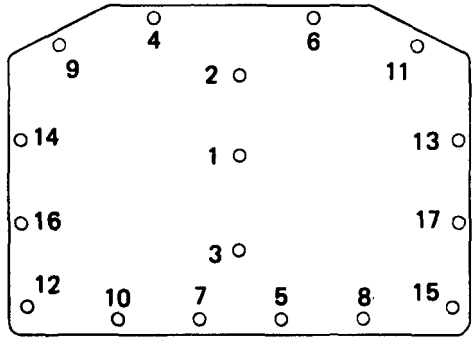


Figure 5-2. Cylinder head tightening sequence.

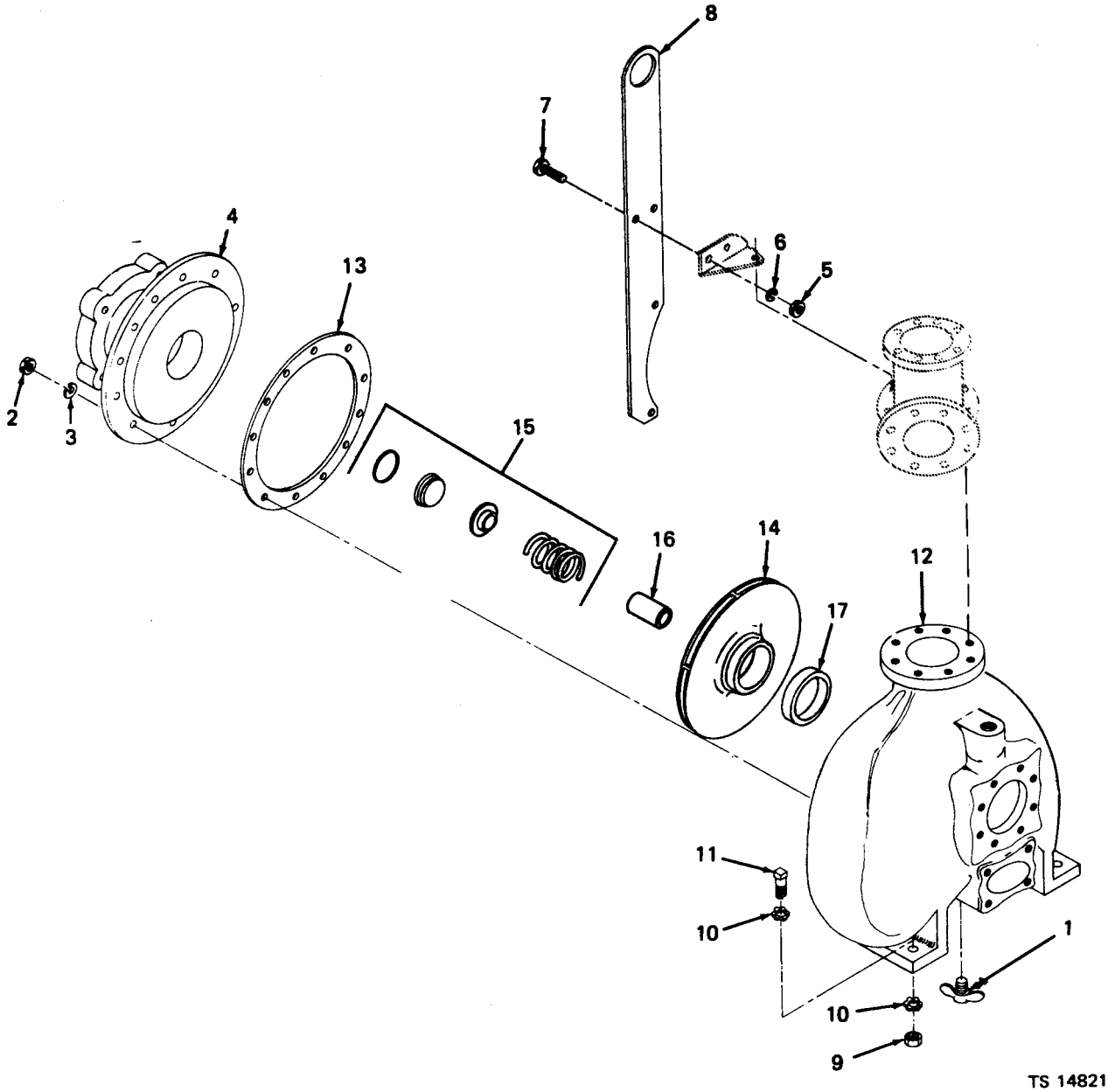
Install gasket (4) and inspection plate (3) on cylinder block. Secure inspection plate with flat washer (2) and capscrew (1). Install manifold, carburetor and muffler.
Install cylinder head outside air shroud.

PUMP

1. PUMP FAILS TO DELIVER CAPACITY OR MAKES EXCESSIVE NOISE.

Step 1. Check for damaged impeller, worn wear rings, or worn shaft seal.

Remove the suction and discharge piping assembly and the instrument control panel.
Remove the pump air eliminator.
Drain the pump by opening the drain cock (1, fig. 5-3). After pump is drained, remove the drain cock to prevent damage during disassembly.



1. Drain cock
2. Nut
3. Lockwasher
4. Intermediate housing
5. Nut
6. Lockwasher
7. Screw
8. Lifting bail
9. Nut
10. Lockwasher
11. Capscrew
12. Volute
13. Gasket
14. Impeller
15. Seal assembly
16. Shaft sleeve
17. Impeller wear ring

Figure 5-3. Pump assembly.

Table 5-1. Troubleshooting — Continued

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
PUMP — Continued
Remove nuts (2) and lockwashers (3) that secure pump volute to the intermediate housing (4). Remove nut (5), lockwasher (6), screw (7), and lifting bail (8). Remove nuts (9), lockwasher (10), and capscrew (11) that secure pump volute (12) to the frame. Insert a lifting hook in pump volute. Attach a sling or wire rope and using a suitable lifting device, slide the pump away from the engine and remove from the frame. Remove gaskets (13) from intermediate housing. Place a pipe wrench on the flywheel end of the engine crankshaft. Insert a rod in the impeller and strike sharply to rotate the impeller (14) counterclockwise to loosen it from the end of the engine crankshaft. Unscrew the impeller from the engine crankshaft. Remove seal assembly (15), shaft sleeve (16), and impeller wear ring (17). **WARNING** **DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).** Clean all parts with cleaning solvent (fed. spec. P-D-680); dry thoroughly. Inspect the impeller for cracks, wear, chips, broken vanes, distortion, and damaged threads. Inspect the wear ring for wear, cracks, and other damage. If during inspection any parts are found to be bad, replace them. Install impeller wear ring (17) in pump volute. Coat the end of the engine crankshaft sparingly with engine oil. Install shaft sleeve (16) on the shaft. Coat the shaft seal (15) with engine oil. Install the stationary seal parts in the bore of intermediate housing. Install the rotating seal members on the shaft. Install the impeller (14) on the engine without shims. You will note that the impeller has a right hand thread. With the impeller firmly seated on the shaft, measure the distance from the mounting flange of the intermediate housing to the near side of the impeller discharge slot. Measure the distance from the machined mounting surface of pump body to the slot in the inside diameter of the pump body. Subtract dimension B from dimension A. The remainder must be at least 0.187 inch (0.46 cm). If it is not, remove the impeller and add shims to increase the difference to 0.187 inch (0.46 cm) when the impeller is reinstalled. Insert a new gasket (13) on the intermediate housing (4). Support the pump volute (12) with a hoist and slide it into position on the intermediate coupling. Install lifting bail (8) onto intermediate housing studs and secure intermediate housing to volute with lockwashers (3) and nuts (2). Install capscrew (11), lockwashers (10), and nuts (9) to secure pump volute to frame. Install screw (7), lockwasher (6), and nut (5) to secure lifting bail to support. Install drain cock (1) into pump volute. Without resetting the oil pressure safety switch to prevent the engine from starting, crank the engine to ensure that the pump turns freely without scraping or binding. If the pump rotates freely, reassemble suction and discharge piping removed to enable pump disassembly. Prime the pump and check to ensure that it operates properly and at the required capacity.

WARNING

After removing the priming cap and filling the pump casing with the product to be pumped, check the snap-in gasket in the cap to be sure that it is present and that it is serviceable (no dents; cuts, abrasions). Remove and replace as necessary.

When the casing has been filled, place the cap on the male quick disconnect adapter and raise the cam levers on the cap to the fully locked (vertical) position.

Bind the cap cam levers together in the locked position with soft wire or heavy twine in order to eliminate any possibility of their release due to vibration. This procedure must be followed each time the pumping assembly is primed.

Section III. GENERAL MAINTENANCE

5-5. General.

This section contains general maintenance instructions which are the responsibility of direct support and general support maintenance personnel. You will find that these instructions apply to several assemblies or components. They would otherwise have to be repeated throughout the chapter.

5-6. Work Guidelines.

a. Make sure the work area is clean before you disassemble the pump or engine.

b. Make sure that materials needed for the maintenance task are at hand. These may include cleaning solvents, lubricants, buckets, or other containers for cleaning or keeping components separated, clean wiping cloths, and, of utmost importance, the proper tools.

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S-661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

c. Clean the exterior of the engine and pump before disassembly to keep foreign matter from bearings, gears, and other machine-surfaced parts which are subject to scoring and other such damage. Use a cloth dampened with cleaning solvent (fed. spec. P-D-680).

d. If compressed air is used to clean parts, you should make sure it is free of dirt and other contaminants.

e. Protect disassembled parts from dust, blowing sand, and moisture which can cause rapid wear and deterioration of bearings, gears, and other machine-surfaced parts.

5-7. Seals and Gaskets.

You should replace seals and gaskets of all components you disassemble. This will greatly reduce the possibility of leaking and will help prevent the entry of dust and dirt after reassembly.

5-8. 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 you clean the bearings, dry them with clean 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 protect them from dust and other foreign matter.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS AND ASSEMBLIES

5-9. Engine and Pump.

Whenever it becomes necessary to remove the engine and pump assembly from its mounting on the frame for overhaul purposes, the engine and pump assembly are removed as a unit. The pump is directly connected to the engine. The crankshaft extends into the pump and serves as an impeller shaft for the pump.

a. Removal.

(1) Disconnect instrument wiring assemblies and gage lines leading to the control panel and remove control panel.

(2) Disconnect fuel line from the engine fuel pump to the fuel tank.

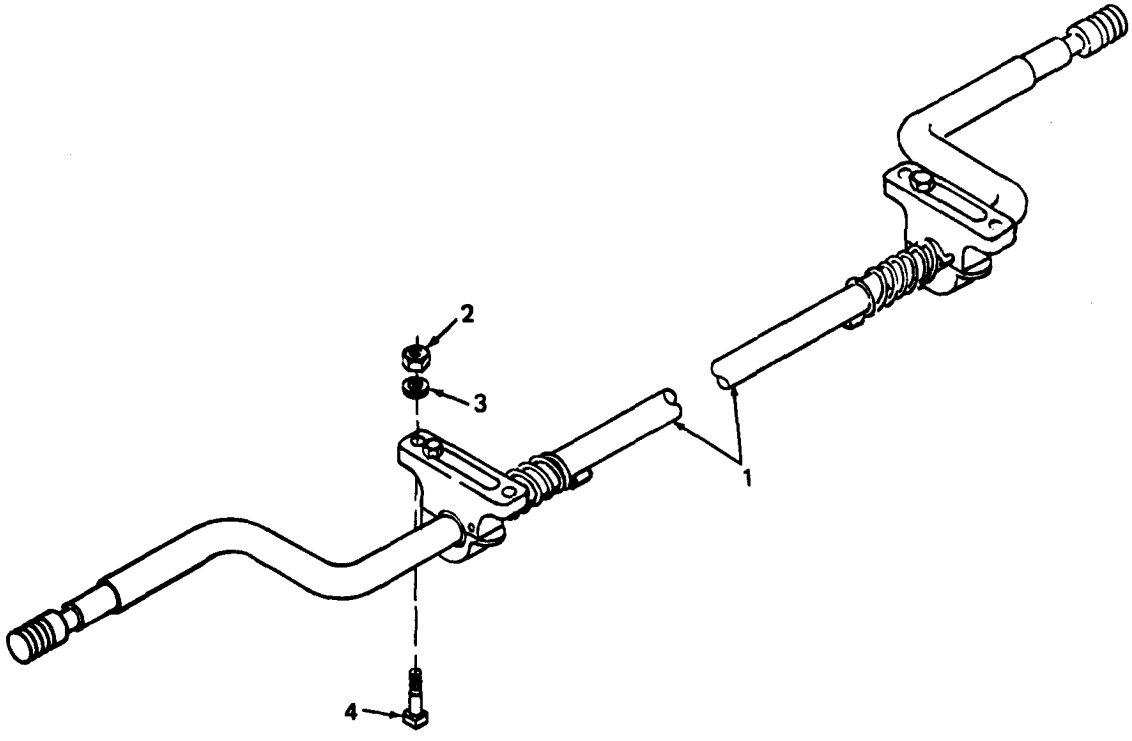
(3) Disconnect and remove the battery cables.

(4) Drain the pump and pump lines and drain the crankcase oil.

(5) Remove the pump suction and discharge assemblies.

(6) Remove the nuts, bolts, and lockwashers securing the pump and engine to the frame.

(7) Use a lifting device, such as a crane, and lift off the engine and pump as an integral unit from the frame. The unit is lifted by means of the lifting eye located in the center of the unit.



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1. Axle
2. Nut
3. Lockwasher
4. Capscrew

Figure 5-4. Axle assembly.

b. Installation. The engine and pump assembly can be either installed as a unit, or each assembly can be installed separately.

(1) Position each component and secure it with the attaching parts.

(2) Install suction and discharge piping assemblies. Install instrument panel and connect all electrical leads, hoses, and lines.

(3) Connect and tighten battery cables.

NOTE

If the components are installed separately, do not attach them firmly to the frame until the crankshaft is threaded fully into the impeller of the pump.

5-10. 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.

(3) Support the weight of the axle (1, fig. 5-4) with a floor jack. Remove the four nuts (2), lockwashers (3), and capscrews (4) that secure the top brackets to the frame; remove the assembled axle, brackets, and springs.

b. Installation.

(1) Using a floor jack, position the assembled axle (1) into place under the frame.

(2) Secure axle assembly to frame with capscrews (4), lockwashers (3), and nuts (2).

(3) Install wheel and hub assemblies on the axle.

CHAPTER 6
REPAIR OF ENGINE

Section I. GENERAL

6-1. Introduction.

This chapter provides you with instructions for disassembly, repair and overhaul, and reassembly of the engine. It provides instructions for the inspection of parts to determine if there continued serviceability is possible or if they should be replaced. It also provides clearances, tolerances, and other information relating to engine overhaul.

6-2. Description of Engine and Components.

a. The engine is a four-cylinder, V-type, four-stroke-cycle unit with an L-type head. It 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. The crankshaft has a counterclockwise rotation when you view it from the pump end of the engine. It drives the pump and also the magneto, oil pump, camshaft, and governor. The gear train is en-

necting 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 oil to the oil filter, to the governor and gear train, and also to an oil pressure safety switch which will shut off the engine when oil pressure falls below 1 pound per square inch. At normal operating temperatures, the oil pressure is from 4 to 5 pounds per square inch (1.81 to 2.23 kg), and a pressure relief valve is provided in the oil pump which limits the maximum oil pressure to 15 pounds per square inch (6.81 kg).

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. The alternator assembly also includes a regulator module and a rectifier module. The center-tap rectifier arrangement prevents damage to the alternator system, in the event of incorrect battery connection or from arc welding. Two ground rods with their related wiring assemblies are provided to ensure proper grounding of the welded frame.

d. The engine is cooled by 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 ensure uniform cooling of all parts.

e. The inter-operation of a fixed speed governor and the carburetor controls the speed of the engine. A spring and lever arrangement permits adjustment of the governor to provide a practically constant engine speed under varying load conditions.

6-3. Tolerances and Wear Limits.

Engine tolerances and wear limits listed in table 6-1 will help you determine if parts are serviceable or need replacement.

Table 6-1. Engine Tolerances and Wear Limits

Component points of measurement	Normal clearances (inches)	Maximum allowable clearance (inches)
Piston to cylinder at piston skirt thrust faces	0.0052 to 0.0062 (0.013 to 0.015 cm)	0.0112 (0.028 cm)
Piston ring gap		
Top ring	0.0020 to 0.0040 (0.005 to 0.01 cm)	
2nd ring	0.0015 to 0.0035 (0.003 to 0.008 cm)	
3rd and 4th groove oil rings	0.0010 to 0.0030 (0.002 to 0.007 cm)	
Connecting rod to crankpin side clearance	0.0080 to 0.0150 (0.02 to 0.03 cm)	
Connecting rod shell bearing to crankpin bearing journal	0.0015 to 0.0030 (0.003 to 0.007 cm)	

Table 6-1. Engine Tolerances and Wear Limits — Continued

Component points of measurement	Normal clearances (inches)	Maximum allowable clearance (inches)
Piston pin to piston	0.0000 to 0.0003 (0.0007 cm)	
Piston pin to connecting rod sleeve bearings	0.0002 to 0.0007 (0.0005 to 0.0017 cm)	
Valve stems to guides	0.0025 to 0.0045 (0.006 to 0.011 cm)	0.0080 (0.02 cm)
Crankshaft end play	0.0020 to 0.0040 (0.005 to 0.01 cm)	
Idler gear to shaft shoulder	0.0030 to 0.0040 (0.007 to 0.01 cm)	

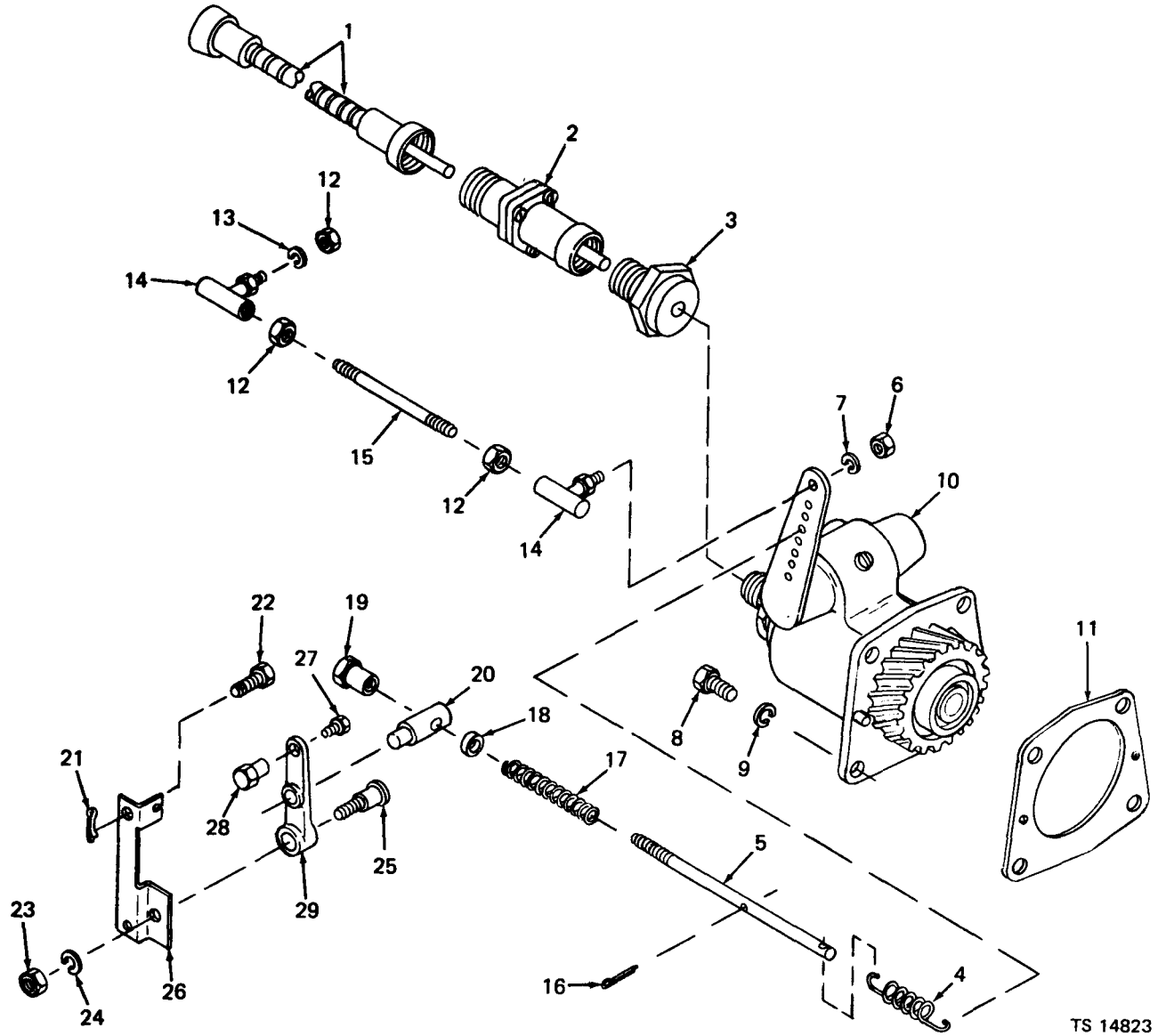
Section II. ENGINE OVERHAUL AND REPAIR

6-4. Governor and Controls.

a. Removal.

(1) Remove the muffler, manifold, and carburetor.

(2) Disconnect tachometer-hourmeter drive shaft assembly (1, fig. 6-1) and shaft adapter (2) from adapter (3).



1. Drive shaft assembly
2. Adapter
3. Adapter
4. Spring
5. Rod
6. Nut
7. Lockwasher
8. Screw
9. Lockwasher
10. Governor assembly
11. Gasket
12. Nut
13. Lockwasher
14. Ball joint
15. Control rod
16. Cotter pin
17. Spring
18. Spring retainer
19. Sleeve nut
20. Shoulder pin
21. Cotter pin
22. Screw
23. Nut
24. Lockwasher
25. Screw
26. Bracket
27. Screw
28. Swivel block
29. Control lever

Figure 6-1. Governor assembly.

(3) Unhook the governor spring (4) from rod (5) and governor lever.

(4) Disconnect the governor control rod linkage from the carburetor throttle lever by removing nuts (6) and lockwashers (7).

(5) Remove screws (8) and lockwashers (9) that secure governor assembly (10) to the engine. Remove the governor (10) and gasket (11) from the engine.

(6) Remove nut (12), lockwasher (13), and ball joint (14) from control rod (15).

(7) Remove cotter pin (16), spring (17), spring retainer (18) and sleeve nut (19) from rod (5). Remove

shoulder pin (20) from control lever.

(8) Remove cotter pin (21), screw (22), nut (23), lockwasher (24), and screw (25). Remove support bracket (26).

(9) Remove screw (27) and swivel block (28) from control lever (29). Remove control lever (29).

b. Cleaning and Inspection.

WARNING

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(1) Clean the governor with a cloth dampened with cleaning solvent (fed. spec. P-D-680); wipe dry.

(2) Inspect the drive gear for chipped or missing teeth.

(3) Inspect the governor housing for cracks and other damage. Check the movement of governor lever shaft. It must pivot freely without catching or binding and without excessive play.

(4) Rotate the governor gear and check main shaft for free movement. It must move freely without catching or binding.

(5) Replace a damaged or bad governor.

c. Installation.

(1) Install swivel block (28, fig. 6-1) and screw (27) on control lever (29).

(2) Install control lever (29) on support bracket (26) and secure with screw (25), lockwasher (24), and nut (23). Install screw (22) on support bracket and secure with cotter pin (21).

(3) Install shoulder pin (20) on control lever and install sleeve nut (19), spring retainer (18), spring (17), rod (5), and cotter pin (16).

(4) Install nut (12) and ball joint (14) on control rod (15). Install assembled control rod on governor lever and secure with lockwashers (13 and 7) and nuts (12 and 6).

(5) Using a new gasket (11), install governor assembly (10) on engine. Secure governor assembly to engine with lockwasher (9) and screws (8).

(6) Install and hook governor spring (4) to rod (5) and governor lever.

(7) Install adapter (3), shaft adapter (2), and connect tachometer-hourmeter drive shaft assembly (1).

(8) Install the muffler, manifold, and carburetor.

d. Governor Adjustment.

(1) After you have installed a new governor, start the engine and check governor for proper adjustment. If the governor needs adjustment, proceed as follows. See figure 6-2.

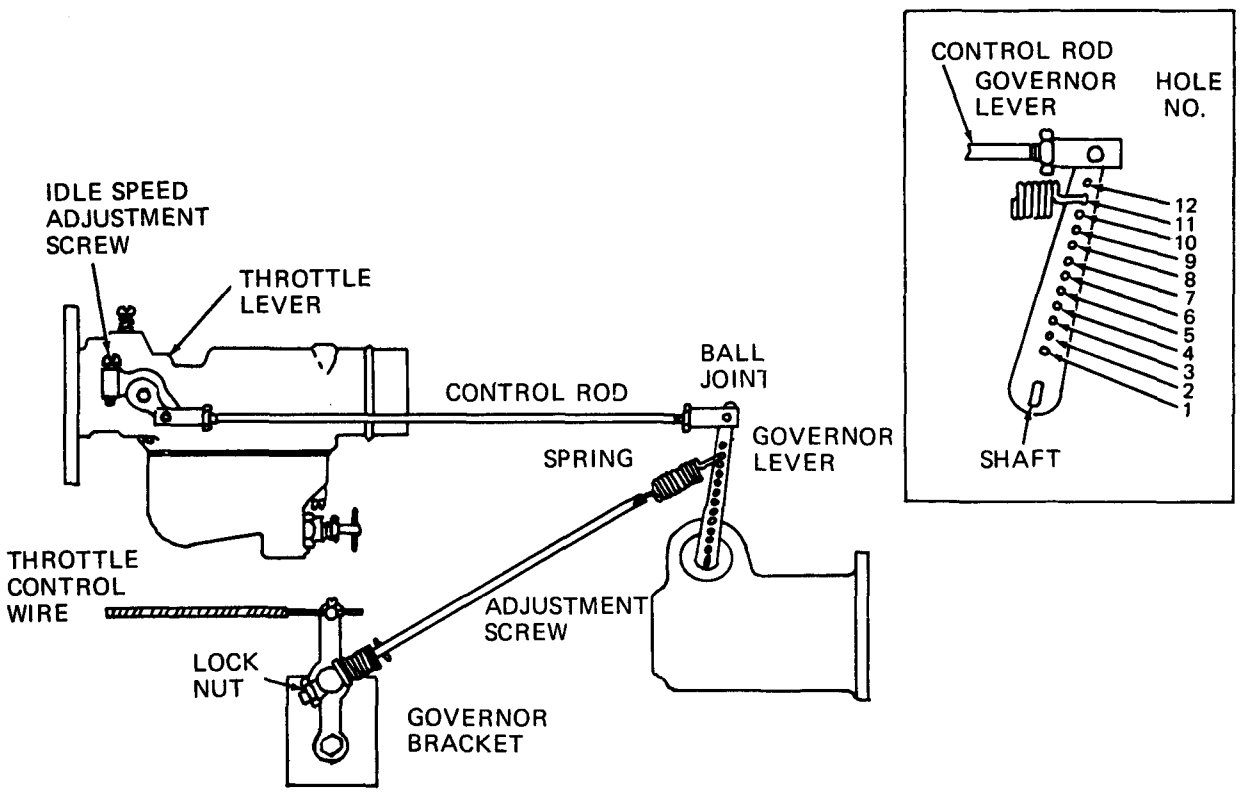

Figure 6-2. Governor adjustment.

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NOTE

Before you adjust the throttle linkage, you must make sure the idle speed adjusting screw is set for proper idle speed.

(2) Disconnect the control rod ball joint from the governor lever.

(3) Push the control rod toward the carburetor as far as it will go, causing the throttle to open fully.

(4) Move the governor lever as far as possible in the same direction. Holding the control rod and governor lever in these positions, screw the ball joint on or off the control rod until you can align the right angle stud on the ball joint fitting with the top hole on the governor lever, then screw fitting in two additional turns.

(5) Insert ball joint stud into the top hole in the governor lever; install and tighten lock nuts.

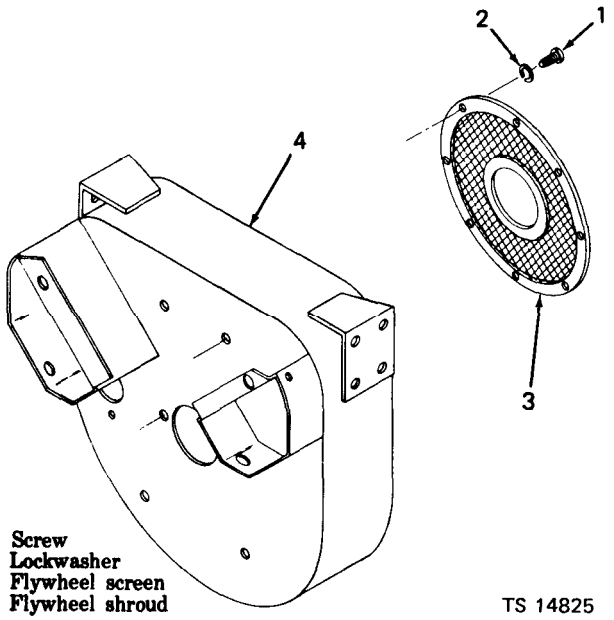
(6) With the governor lever pushed toward the carburetor as far as it will go, be sure you have approximately 1/16-inch clearance between the throttle lever and the stop pin on the carburetor. If the clearance is not correct, you can adjust it by turning the control lever ball joint farther on or off the control rod; refer to subparagraph *c* above.

(7) To adjust the maximum operating speed of the engine, you must be sure the spring is hooked into the proper hole in the governor lever. Hook the spring in hole No. 11. There are 12 spring mounting holes. With engine operating and throttle fully open, the full-load speed will be approximately 2350 rpm.

6-5. Flywheel.

a. Removal.

(1) Remove screws (1, fig. 6-3), lockwashers (2) and flywheel screen (3) from the flywheel shroud (4).

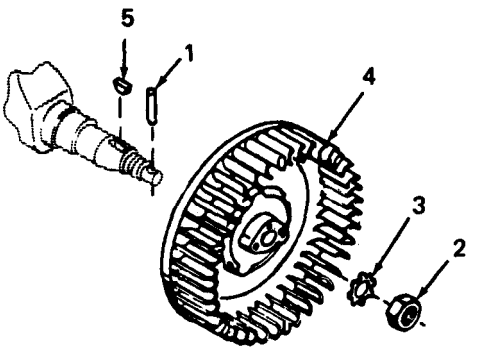


1. Screw
2. Lockwasher
3. Flywheel screen
4. Flywheel shroud

TS 14825

Figure 6-3. Flywheel shroud.

(2) Using a punch, drive pin (1, fig. 6-4) from crankshaft. Remove nut (2) and lockwasher (3) that secure the flywheel to the crankshaft.



1. Pin
2. Nut
3. Lockwasher
4. Flywheel
5. Woodruff key

TS 14826

Figure 6-4. Flywheel.

CAUTION

Take care when you remove the flywheel; it weighs about 50 pounds (22.68 kg). Do not damage the stator of the alternator which is mounted on the gear cover and recesses within the magnetic rotor of the flywheel.

(3) Remove the flywheel (4) by pulling outward on the flywheel fins while you strike the end of the crankshaft with a brass drift or aluminum 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. Remove Woodruff key (5).

b. Cleaning and Inspection.

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S 661, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

(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.

(3) Inspect the magnetic rotor insert for damage or signs of contact with the stator.

(4) Replace the flywheel assembly if damage is not repairable or if it causes unbalance when operating.

c. Installation.

(1) Install the Woodruff key (5, fig. 6-4) in the crankshaft keyway. Position the flywheel (4) on the crankshaft so that the keyway aligns with the Woodruff key in the shaft keyway. Tap the flywheel onto the shaft with a soft hammer.

(2) Secure the flywheel to the crankshaft with nut (2) and lockwasher (3).

(3) Drive in pin (1) so that ends protrude evenly.

(4) Replace the flywheel screen (3, fig. 6-3) with screws (1) and lockwashers (2).

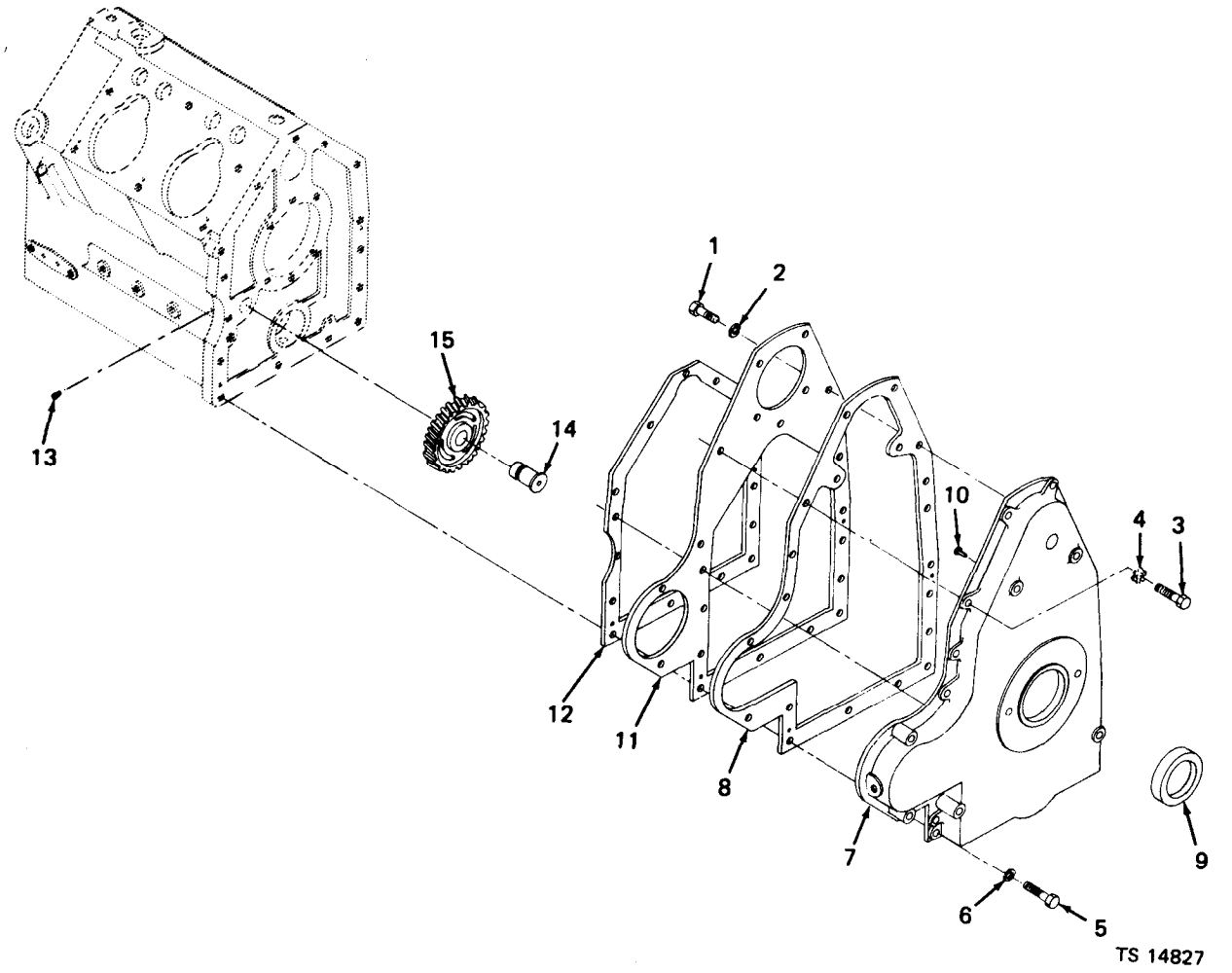
6-6. Gear Cover and Idler Gear.

a. Removal.

(1) Remove the magneto, governor, and air shrouding.

(2) Remove the flywheel and alternator.

(3) Remove screws (1, fig. 6-5) and lockwashers (2) that secure the gear cover spacer (11) to the gear cover (7).



1. Screw
2. Lockwasher
3. Screw
4. Lockwasher
5. Screw
6. Lockwasher
7. Gear cover
8. Gasket
9. Oil seal
10. Thrust button plunger
11. Spacer
12. Gasket
13. Setscrew
14. Shaft
15. Gear

Figure 6-5. Gear cover and idler shaft.

(4) Remove screws (3 and 5) and lockwashers (4 and 6) that secure the gear cover to the crankcase.

(5) Remove the gear cover (7) and gasket (8) by sliding them off the crankshaft. Press the front oil seal (9) from the gear cover and remove the thrust button plunger (10).

(6) Remove gear cover spacer (11) and gasket (12) from the crankcase.

(7) Remove setscrew (13) which locks the idler gear shaft in the crankcase.

(8) You can remove the shaft (14) and idler gear (15) using a puller as shown in figure 6-6. The idler shaft has a hole tapped in the end to receive the 3/8"-16 bolt of the puller.

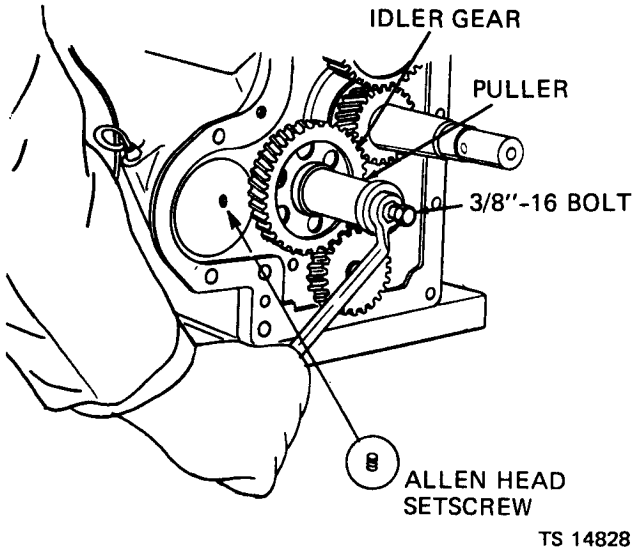


Figure 6-6. Idler gear and shaft removal.

b. Cleaning and Inspection.

WARNING

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

(2) Inspect the gear cover for cracks, distortion, damaged or scored sealing surfaces, and other damage; replace if damaged.

(3) Inspect the camshaft thrust plunger button for distortion, wear, or other damage; replace if damaged.

(4) Inspect the idler gear for distortion and chipped, cracked, or broken teeth; replace if damaged.

(5) Check the idler gear shaft for distortion or excessive wear of the shaft or shoulder. Replace a worn or damaged shaft.

c. Installation.

(1) Place the idler gear (15, fig. 6-6) on the shaft (14) before you drive the shaft into the crankcase. The oil groove in the shaft must be facing up. Use a plastic or soft metal hammer and drive gear and shaft into the crankcase.

(2) Maintain a 0.003 to 0.004-inch (0.007 to 0.01-cm) clearance between idler gear and shoulder of the shaft. Lock shaft in crankcase by installing setscrew (13).

(3) Install thrust plunger button (10) and oil seal (9) in gear cover.

(4) Install gasket (12), gear cover spacer (11), gasket (8), and gear cover (7) on crankcase. Secure gear cover to crankcase with lockwashers (4 and 6) and screws (3 and 5).

(5) Install lockwashers (2) and screws (1) that secure the gear cover spacer to the gear cover.

NOTE

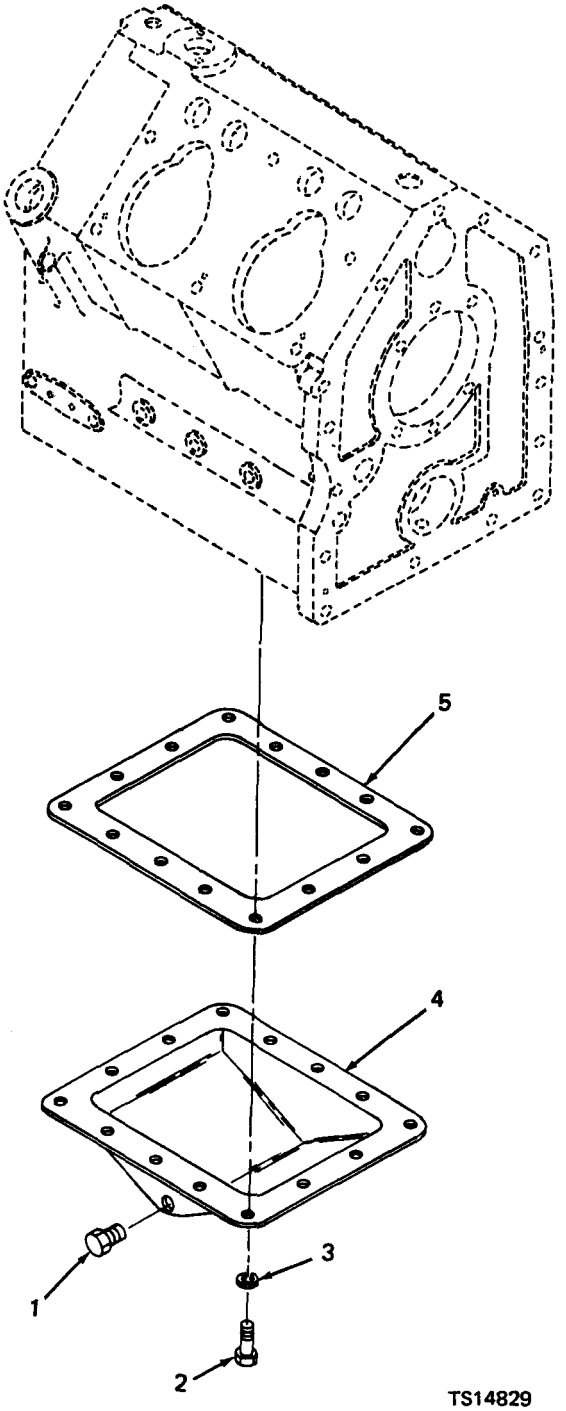
You should alternately tighten the gear cover screws to 14 to 18 foot-pounds (6.35 to 8.14 kg-m).

(6) Install the alternator and flywheel. Install the magneto, governor, and air shrouding.

6-7. Oil Pan and Oil Pump.

a. Removal.

(1) Remove the drain plug (1, fig. 6-7) and drain the oil into a suitable container.



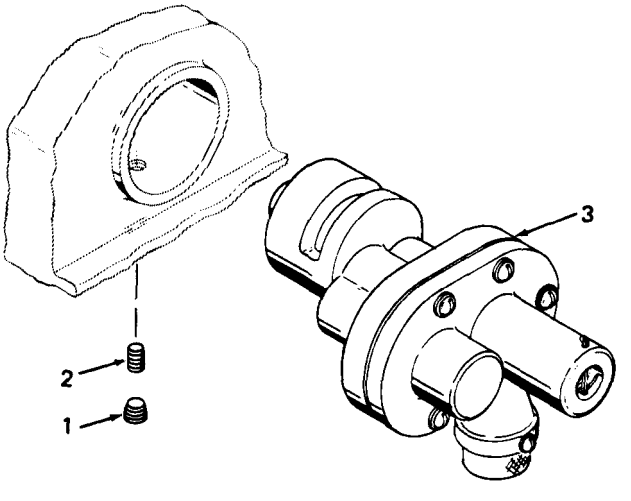
1. Drain plug
2. Screw
3. Lockwasher
4. Oil pan
5. Gasket

Figure 6-7. *Oil pan removal.*

(2) Remove the engine gear cover.

(3) Remove screw (2), lockwasher (3), and remove oil pan (4) and gasket (5) from crankcase.

(4) Remove slotted pipe plug (1, fig. 6-8) and, using a 5/32-inch Allen wrench, remove setscrew (2) that locks the oil pump (3) in position.



1. Pipe plug
2. Setscrew
3. Oil pump

Figure 6-8. Oil pump removal.

(5) Remove oil pump drive gear locknut and, using a soft brass rod, drive the oil pump shaft through the drive gear. Remove the oil pump by pulling it toward the center of the crankcase.

b. Cleaning and Inspection.

WARNING

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

(2) Inspect the oil pan for cracks, severe dents, holes, damaged threads, and other damage. Inspect the drain plug for damaged threads. Replace the oil pan and plug if damaged.

(3) Inspect the oil pump drive gear for chipped or missing teeth.

(4) Turn the drive gear and check pump shaft for free movement and excessive shaft play. Replace a bad oil pump.

c. Installation.

(1) Install the oil pump (3, fig. 6-8) in the crankcase with the screen facing toward the oil pan. Secure the oil pump in the crankcase with setscrew (2) and pipe plug (1).

(2) Install oil pump drive gear on shaft and secure with lock nut.

(3) Install gasket (5, fig. 6-7) and oil pan (4) on crankcase. Secure oil pan to crankcase with lockwashers (3) and screws (2). Install drain plug (1).

NOTE

Install the oil pan with the deep end toward the oil pump. Alternately tighten the oil pan mounting screws to 6 to 9 foot-pounds (2.71 to 4.27 kg-m) torque.

(4) Install the engine gear cover.

6-8. Crankshaft, Piston, and Connecting Rods.

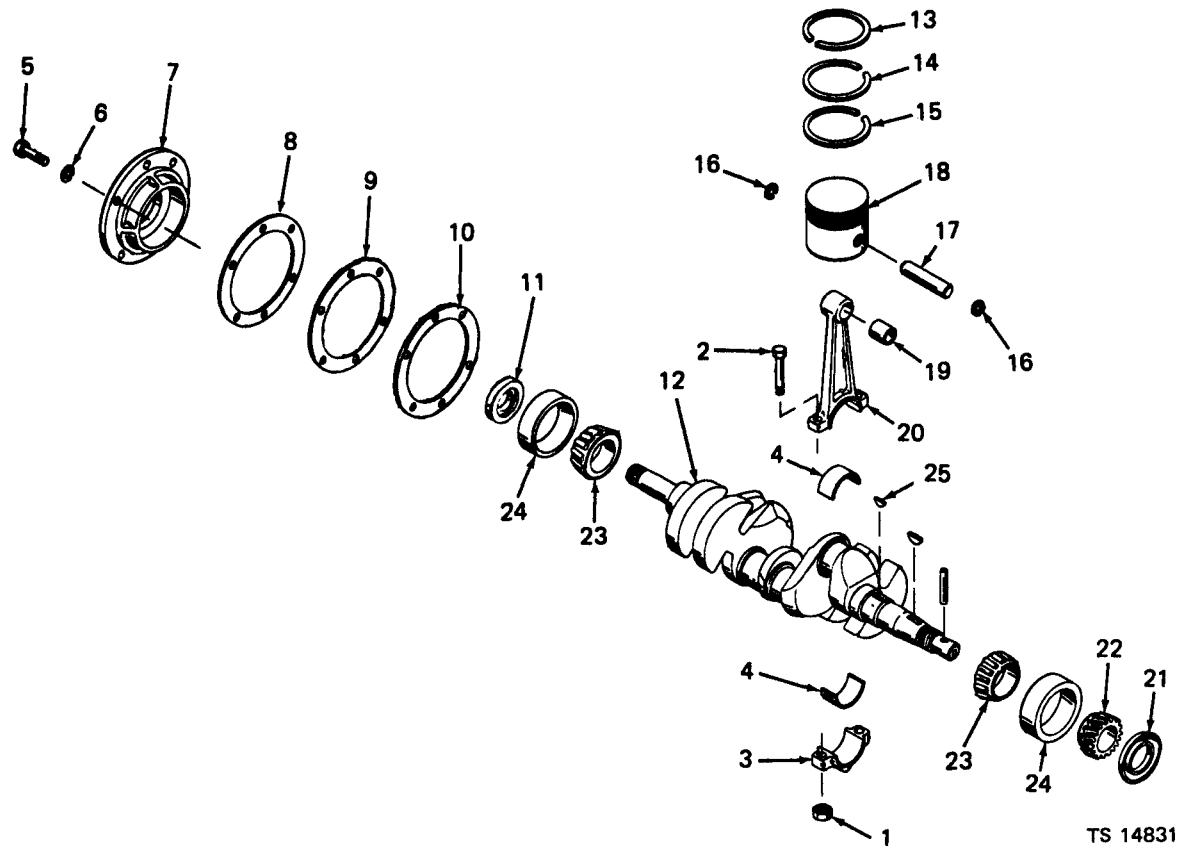
a. Removal.

(1) Remove air shrouding, manifolds, carburetor, governor, magneto, oil pan, gear cover, cylinder head, and oil pump.

(2) Remove flywheel and alternator.

(3) Remove the carbon ridge at the top of the cylinder bore with a standard ridge reamer.

(4) Remove the nuts (1, fig. 6-9) and, by tapping the ends of the bolts (2) lightly, remove them, being careful not to mar the threads.



1. Nut
2. Bolt
3. Bearing cap
4. Bearing shell
5. Screw
6. Lockwasher
7. Bearing plate
8. Gasket
9. Shim
10. Gasket
11. Oil seal
12. Crankshaft assembly
13. Piston ring
14. Piston ring
15. Piston ring
16. Retaining ring
17. Piston pin
18. Piston
19. Bushing
20. Connecting rod
21. Oil deflector
22. Gear
23. Roller bearing
24. Bearing cup
25. Key

Figure 6-9. Crankshaft and piston.

(5) Remove the connecting rod bearing cap (3) and bearing shell (4) from the connecting rod.

CAUTION

When removing the piston assembly and connecting rod from the cylinder, be careful the connecting rod does not scratch or scrape the crankshaft journals or cylinder walls.

(6) You can now remove the assembled piston and connecting rod by pushing piston assembly and rod up through the cylinder.

(7) Remove screws (5), lockwashers (6), bearing plate (7), gaskets (8 and 10) and shims (9). Remove oil seal (11) from the bearing plate.

(8) Pull the crankshaft assembly (12) through the open end of the engine block.

b. Disassembly.

(1) Remove piston rings (13, 14, and 15) from the piston.

(2) Remove retaining rings (16) and push piston pin (17) from piston (18) and connecting rod (20). Place the connecting rod in a press and press out piston pin bushing (19).

(3) Remove oil deflector (21) from the crankshaft. Using an arbor press, remove gear (22) and key (25). Remove roller bearings (23) from the crankshaft and remove bearing cups (24) from the crankcase.

c. Cleaning and Inspection.

WARNING

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

(2) Inspect the pistons for wear (table 6-1), cracks, distortion, broken ring bands, and distorted grooves, loose piston pin-to-piston fit, and other damage; replace if damaged.

(3) Using new piston rings, check the piston ring groove side clearance. If clearance exceeds the limits given in table 6-1, replace the piston.

(4) Inspect the connecting rods for cracks, distortion, and other damage; replace if damaged. Refer to table 6-1 for wear limits.

(5) Inspect the bearing shells (4, fig. 6-9) for scoring, wear, cracks, and other damage; replace damaged bearings. If bearing shells need replacing, you must replace both halves.

NOTE

The smooth and highly polished surface of the bearing shells normally becomes a leaden gray and develops minute craters after a few hours of operation. It is not a sign of impending bearing failure.

(6) Inspect the crankshaft for cracks, damaged threads, burred keyways and worn or scored journals (see table 6-1).

(7) Inspect the crankshaft gear for cracked, chipped, or missing teeth. Replace all parts that are found to be bad.

d. Reassembly and Installation.

(1) Press bearing cups (24, fig. 6-9) into the crankcase and bearing plate (7). Press roller bearings (23) onto the crankshaft. Press gear (22) onto crankshaft and install oil deflector (21).

(2) Check the clearance between the piston pins (17) and sleeve bushings (19). If clearance is not between 0.0002 and 0.0007 inch (0.0005 to 0.0017 cm), press new sleeve bushings into the connecting rods. Ream and hone until at least 75 percent of the sleeve bushing surface makes contact with the piston pin.

(3) Press bushing (19) into connecting rod (20). Insert piston (18) on the connecting rod (20) and install piston pin (17); secure piston pin with retaining ring (16).

(4) Using a feeler gage, refer to clearances in table 6-1 and check the piston fit in the cylinder bore. You must measure the clearance between the piston and cylinder at the center of the piston skirt thrust faces which are 90° from the axis of the piston pin 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.

(5) To measure the piston-ring gap, place the ring into the cylinder bore in the approximate operating position and measure the gap with a feeler gage (see table 6-1). If the ring is too small, use an oversized ring. If the gap is too small, clamp a file in a vise; lightly squeeze the ring together and move it back and forth to file both ends at one time. Measure the gap frequently to keep from filing off too much stock.

(6) Install the bottom oil ring first, as shown in figure 6-10. Spread ring only wide enough to slip over piston and into correct ring groove, taking care that you do not distort the ring. Install the remaining rings in the same manner, working up from the bottom. When you install the second compression ring from the top, make sure you install it with the scraper edge down; otherwise, oil pumping and excessive oil consumption will result (fig. 6-10). After you install each ring, check its side clearance, using table 6-1 as a reference. The ring must be free to move in the piston groove.

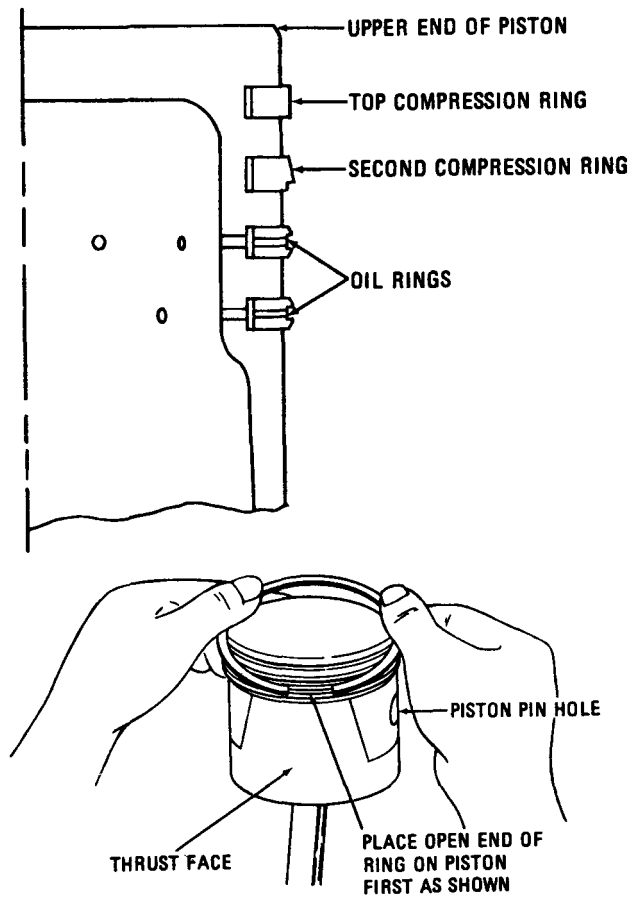


Figure 6-10. Piston ring placement.

(7) Install the bearing retainer plate on the flywheel end of the crankcase.

(8) Lubricate the main bearings and connecting rod journals with a light coat of engine oil and apply a coat of grease (GAA) to the roller bearings and cups.

(9) Carefully insert the crankshaft into the crankcase through the rear opening of the crankcase. Engage the crankshaft gear in the gear train so that the punched timing mark on the camshaft gear aligns with the timing mark on the crankshaft gear.

CAUTION

You must mount the main bearing plate so that the word "Top", which is cast on the outside of the plate, is correctly positioned; otherwise, the main bearing will not be properly lubricated.

(10) Using new gaskets (8 and 10, fig. 6-9), install the bearing plate (7) and shims (9) on the crankcase; secure them with the six screws (5) and lockwashers (6). Tighten the screws to 25 to 30 foot-pounds (3.45 to 4.14 kg-m) torque.

(11) Use a dial indicator and set its contact point against the end of the crankshaft. With a screwdriver, pry the crankshaft back and forth, being careful not to damage the connecting rod journals. If the end play of the crankshaft exceeds 0.002 inch (0.005 cm), remove the shims (9) to adjust. Add shims if there is not at least 0.002-inch (0.005-cm) end play.

NOTE

Before installation, you should lubricate the cylinder walls, pistons, rings, and rod bearings with engine oil. The ring gaps on the pistons should be staggered.

(12) Turn the crankshaft so that the crankshaft journal to which the rod is to be attached is at top dead center.

(13) Compress the piston rings with a ring compressor and lower the piston into the cylinder from which it was removed. The arrows on the top of the piston must point in the direction of the crankcase rotation.

NOTE

The slits in pistons Nos. 1 and 3 should face toward the center of the engine. The slits in pistons Nos. 2 and 4 should face away from the center of the engine.

(14) Using the end of a hammer handle, carefully push the piston and connecting rod into the cylinder until the connecting rod rests on the crankshaft. Assemble the lower bearing half to the cap (3) so that the oil holes are aligned. Push the piston down while rotating the crankshaft to bottom dead center.

NOTE

You should match the number stamped on the cap with its corresponding number stamped on the rod. The numbers must be on identical sides of the rod in reassembly.

(15) To check the crankpin bearing journal-to-connecting rod bearing clearance, lay a piece of Plastigage material on the crankshaft journal and position the cap on the rod so that its oil hole faces the oil-spray nozzle of the oil header in the crankcase. Tighten the connecting rod nuts to 28 to 32 foot-pounds (3.87 to 4.42 kg-m) 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. If the bearing-to-journal clearance is not within the specified clearance of 0.015 to 0.0030 inch (0.0006 to 0.0075 cm), replace the bearing and/or the crankshaft as required.

(16) Lubricate the crankpin bearing journals and the rod bearings with engine oil and install the bearing cap (3) on its connecting rod and crankpin journal. Secure it with the two bolts (2) and nuts (1). Torque the nuts to 28 to 32 foot-pounds (3.87 to 4.42 kg-m). Using a feeler gage, check the side clearance between connecting rod and crankpin (see table 6-1).

(17) Check the clearance and secure the remaining connecting rods to the crankpin journals.

(18) Install alternator and flywheel. Install the

cylinder head, gear cover, and oil pan.

(19) Install the magneto, governor, carburetor, manifolds, and air shrouding.

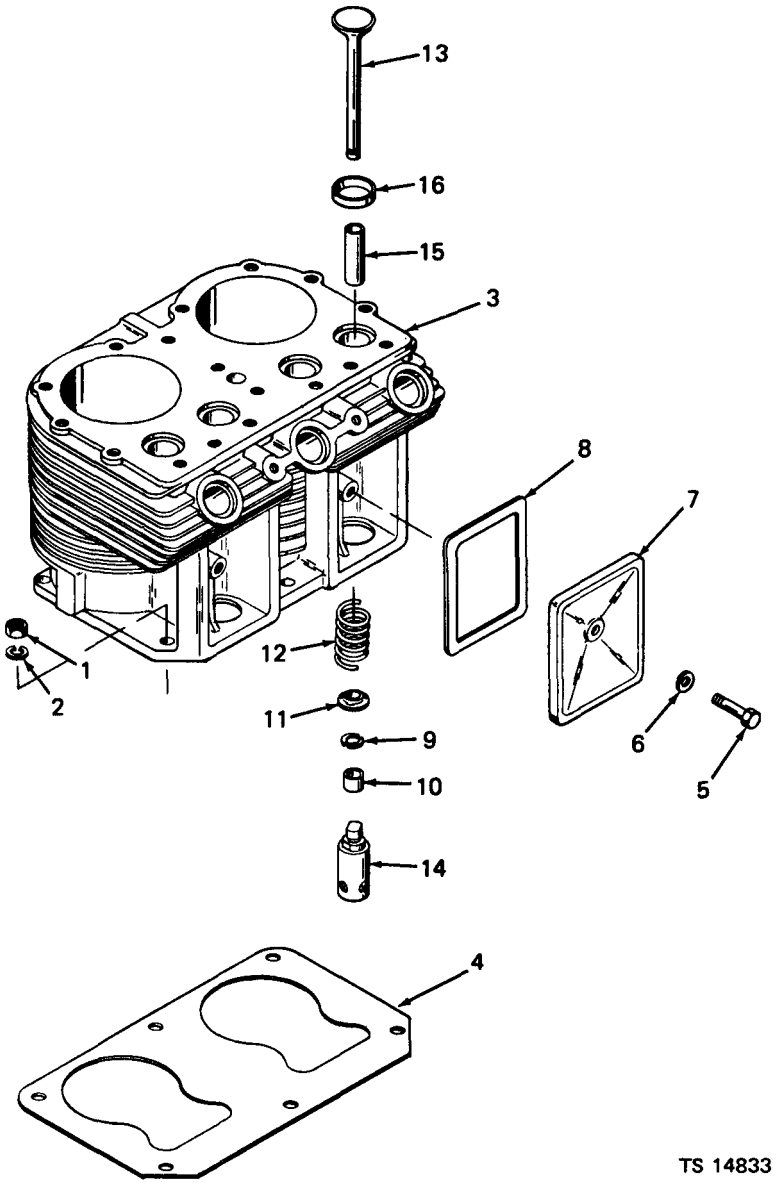
6-9. Cylinder Block and Valves.

a. Removal.

(1) Remove air shrouding, manifolds, carburetor, governor, magneto, oil pan, gear cover, cylinder head, and oil pump.

(2) Remove flywheel, alternator, pistons, and connecting rods.

(3) Remove nuts (1, fig. 6-11), lockwashers (2), and remove cylinder block assembly (3) and gasket (4) from the engine crankcase.



1. Nut
2. Lockwasher
3. Cylinder block assembly
4. Gasket
5. Screw
6. Washer
7. Inspection plate
8. Gasket
9. Valve spring seat lock
10. Valve stem cap
11. Valve spring seat
12. Valve spring
13. Valve
14. Valve tappet
15. Valve guide
16. Valve seat insert

Figure 6-11. Cylinder block and valves.

b. Disassembly.

(1) Remove screw (5, fig. 6-11), washer (6), and remove inspection plate (7) and gasket (8) from the cylinder block.

(2) Use a standard automotive type valve spring compressor, compress the valve spring, and remove

valve spring seat locks (9) and valve stem cap (10).

(3) Release the valve spring compressor and remove valve spring seat (11), valve spring (12), and valve (3).

(4) Remove the valve tappets (14) from the crankcase. Do not remove valve guides (15) and valve seat inserts (16) unless they are damaged.

c. Cleaning and Inspection,

WARNING

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(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.

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

(3) Inspect the cylinder block for cracks, scored or scratched cylinder walls, or other damage. Replace the block if damage cannot be corrected.

(4) Check the cylinder bores for wear. Measure the cylinder bores with an inside micrometer. Measure the bore lengthwise and crosswise above the ring travels; repeat the measurement at the top of the cylinder bore. The difference in these measurements will determine the amount of wear in the cylinder bore, the taper, and the out-of-round condition. If cylinder bores are worn more than 0.005 inch (0.012 cm), rebore the cylinder with conventional reboring equipment and hone until the bores are not more than 0.001-inch (0.002-cm) out-of-round and are not tapered more than 0.001 inch (0.002 cm). Normally reboring to a 0.020-inch (0.05-cm) oversize is sufficient. Maximum allowable oversize is 0.040 inch (0.1 cm).

(5) Clean the valves with a wire wheel brush to remove carbon from the valve faces and gum deposits from the stems. Wash the springs with cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(6) Clean the valve seat insert and the top of the cylinder block. Inspect the valve-seat inserts for looseness and excessive wear replace as necessary.

(7) Inspect the valve springs for breaks and wear. Compare with a new spring and replace if weak or damaged.

(8) Inspect the valves for burned, pitted, or cracked faces; replace if defective or if grinding is not plausible.

d. Valve and Valve Seat Refacing.

(1) Replace valves and valve seats only when there is evidence of warping or deep pits. A good method of detecting warping is to check each valve stem in a valve face grinder, and slowly rotate the valve while the grinding wheel is brought near the rotating valve face.

(2) Using a valve face grinder, reface the valves to an angle of 45 degrees. Replace any valve that measures less than 0.0625 inch (0.355 cm) from the top of head to the edge of the refaced outer circle.

(3) Install a pilot in the valve stem bore of the cylinder block. Set the stone on the valve reseating machine to the angle of 45 degrees and dress the stone with the dresser. Place the grinder and stone assembly over the pilot in the valve stem bore, and grind inserts just enough to make a smooth seat.

(4) After grinding, valves and inserts should be lapped with a suitable lapping compound or they will leak due to improper seating within the first few hours of operation.

(5) Apply lapping compound to the valve face and put the valves back into their guides. Lap the valves by rotating them back and forth with a reciprocating advancing tool.

(6) Occasionally lift the valves and reseat them in a different position to ensure a uniform seat which will show entirely around the valves, After valves have been lapped in evenly, remove them from the block and clean the valves and block.

(7) When the grinding is completed, check the seat for concentricity, using a dial indicator.

(8) With the valve stems inserted in the guide, the stems shall have a clearance of 0.0025 to 0.0045 inch (0.006 to 0.011 cm). When the clearance becomes 0.008 inch (0.02 cm), you should replace the guides by pressing them out with a driver that is slightly smaller than the external diameter of the guide. The driver is also used to press in the new valve guides.

e. Reassembly and Installation.

(1) Install valve tappets (14, fig. 6-11) in the engine block.

(2) Place the valve springs (12) in their respective valve chambers.

(3) Insert the valves (13) into the same bores from which they were removed. Assemble the valve stem cap (10) and valve spring seat (11) on the valve.

(4) Using a valve spring compressor, compress the valve spring and install valve spring seat locks (9).

(5) Position gasket (4) on crankcase and install cylinder block assembly (3). Secure cylinder block assembly to crankcase with Lockwasher (2) and nut (l).

NOTE

Tight.en cylinder block mounting nuts to 62 to 78 foot-pounds (8.57 to 10.78 kg-m) torque.

(6) With the tappets in their lowest position on

the camshaft, engine cold, set the intake valve tappet clearance to 0.008 inch (0,02 cm) and the exhaust valve tappet clearance to 0,016 inch (0,04 cm).

(7) Position gasket (8) and inspection plate (7) on cylinder block and secure with washer (6) and screw (6).

(8) Install pistons and connecting rods, alternator, and flywheel.

(9) Install oil pump, oil pan, gear cover, magneto, governor, carburetor, manifolds, and air shrouding.

6-10. Camshaft and Crankcase.

a. Removal and Disassembly.

(1) Remove air shrouding, manifolds, carburetor, governor, magneto, oil pan, gear cover, cylinder head, and oil pump.

(2) Remove flywheel, alternator, pistons, and connecting rods, and cylinder block assembly.

(3) Remove all valve tappets. Remove camshaft (1, fig. 6-12) from engine crankcase.

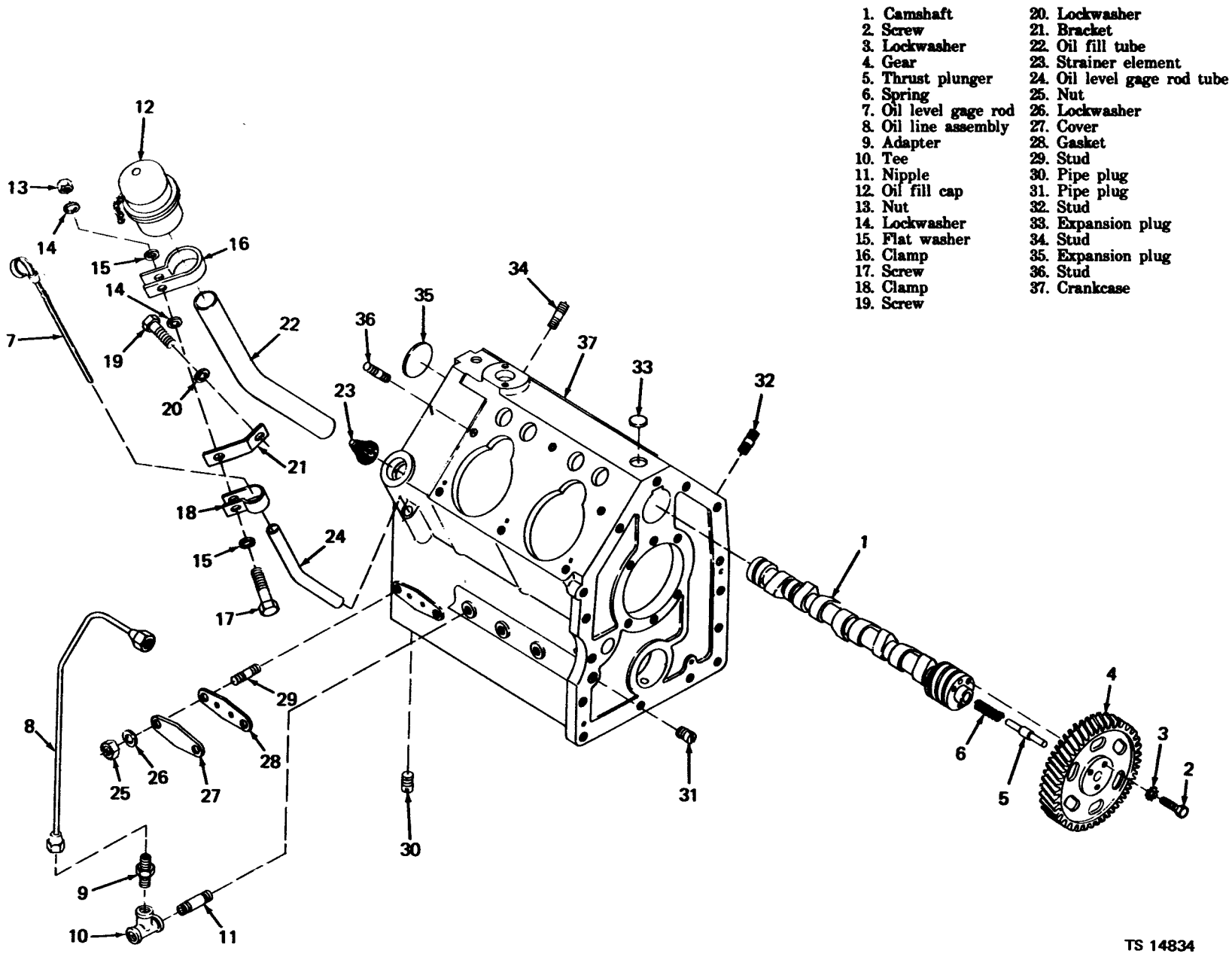


Figure 6-12. Crankcase and camshaft.

NOTE

Use a standard gear puller to remove the camshaft gear.

(4) Remove screws (2) and lockwashers (3) that secure gear (4) to the camshaft. Remove thrust plunger (5) and spring (6) from the camshaft.

(5) Remove oil level gage rod (7), oil line assembly (8), adapter (9), tee (10), and nipple (11) from crankcase (37).

(6) Remove oil fill cap (12). Remove nut (13), lockwasher (14), flat washer (15), and clamp (16). Remove screw (17) and clamp (18).

(7) Remove screw (19), lockwasher (20), and bracket (21). Remove oil fill tube (22), strainer element (23), and oil level gage rod tube (24) from the crankcase (37).

(8) Remove nut (25), lockwasher (26), cover (27), and gasket (2$) from the crankcase (37).

(9) Remove stud (29), pipe plugs (30 and 31), studs (32, 34, and 36) and expansion plugs (33 and 35) from the crankcase (37).

b. Cleaning and Inspection.

WARNING

DRY CLEANING SOLVENT, P-D-680 or P-S-661, wed to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. DO NOT use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 60°C).

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

(2) Inspect the camshaft plunger and spring for wear, scoring, and distortion; inspect the spring for resiliency. Replace if worn or damaged,

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

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

(5) You can clean the oil passages in the crankcase using compressed air.

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

(7) Discard all gaskets.

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

c Reassembly.

(1) Install expansion plugs (33 and 35, fig. 6-12), studs (29, 32,34, and 36), and pipe plugs (30 and 31) in crankcase (37).

(2) Install gasket (28) and cover (27) on crankcase; secure cover to crankcase with lockwasher (26) and nut (25).

(3) Install oil level gage rod tube (24), strainer element (23), and oil fill tube (22) in crankcase. Install bracket (21) and secure with lockwasher (20) and screw (19).

(4) Install clamps (18 and 16) and secure with screw (17), flat washer (15), lockwasher (14), and nut (13). Install oil fill cap (12).

(5) Install nipple (11), tee (10), adapter (9), and connect oil line assembly (8). Install oil level gage rod (7) in tube.

NOTE

The timing gear has offset mounting holes and can only be installed with the timing mark matching that of the crankshaft gear.

(6) Press gear (4) onto the camshaft and secure with lockwashers (3) and screws (2). Install spring (6) and thrust plunger (5) in camshaft (l).

(7) Lubricate the camshaft journals with engine oil and insert the camshaft into the crankcase (37), making sure you do not ram the camshaft against the expansion plug (35).

(8) Install all valve tappets, cylinder block assembly, piston and connecting rods, alternator and flywheel.

(9) Install oil pump, oil pan, gear cover, cylinder head, magneto, governor, carburetor, manifolds, and air shrouding.

6-11. Flywheel Alternator.

Before you test the alternator and its components, check the operation of the battery charging system by observing the ammeter. The ammeter should indicate a high charging rate immediately after starting. After a few minutes the ammeter should return to near zero. If the ammeter does not operate in this manner or if it indicates a discharge rate, perform checks and tests as indicated in the following subparagraphs.

a. Testing.

(1) Test the alternator and components while the parts are mounted on the engine. The rectifier and regulator modules and the isolation diode are grounded to the engine and therefore cannot be tested while mounted at a remote location. Check to ensure that you have good continuity between the modules and the engines. 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.

(2) To check for stator continuity, use an ohmmeter with R X 1 scale (minimum sensitivity of 20,000 ohm/volts). If the ohmmeter indicates a short (no resistance) or open (infinite resistance) circuit,

replace the stator.

(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.

(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) Any connection between a lead and engine ground should indicate infinite resistance. Any other reading indicates that a short circuit exists and the stator must be replaced.

(3) To check the rectifier module, which you can distinguish from the regulator by the two black leads, use an ohmmeter and static check continuity. Replace the rectifier module if tests indicate malfunctioning.

(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 ohm resistance.

(b) 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.

(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 a short circuit exists.

(4) Check the regulator module, which you can distinguish from the rectifier module by the red and black leads. Using an ohmmeter, all continuity checks shall indicate infinite resistance. Any other reading indicates that a short circuit exists and the regulator must be replaced. The ohmmeter 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 screws (1, fig. 6-3), lockwashers (2) and flywheel screen (3) from the flywheel shroud (4).

(2) Using a punch, drive pin (1, fig. 6-4) from crankshaft. Remove nut (2) and lockwasher (3) that secure the flywheel (4) to the crankshaft.

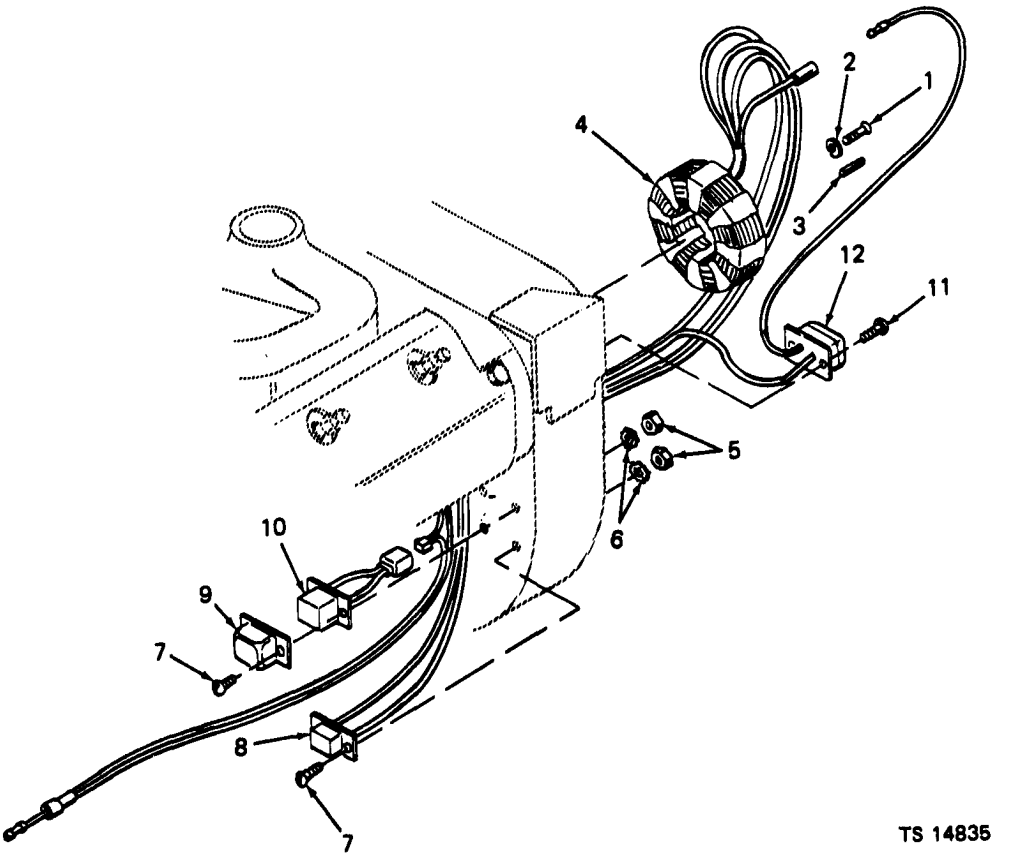
CAUTION

Take care when you remove the flywheel; it weighs about 50 pounds (22.68 kg). Do not damage the stator of the alternator which is mounted on the gear cover and recesses within the magnetic rotor of the flywheel.

(3) Remove the flywheel (4) by pulling outward on the flywheel fins while you strike the end of the crankshaft with a brass drift or aluminum 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. Remove Woodruff key (5).

(4) Remove stator assembly (4, fig, 6-13) by removing screws (l), lockwashers (2), and pins (3) that secure the stator to the flywheel shroud and engine gear cover.

(5) Remove the nuts (5), lockwashers (6), and screws (7) that secure the rectifier module (8), regulator module shield (9), and regulator module (10). Remove the screws (11) that secure the isolation diode (12).



1. Screw
2. Lockwasher
3. Pin
4. Stator assembly
5. Nut
6. Lockwasher
7. Screw
8. Rectifier module
9. Regulator module shield
10. Regulator module
11. Screw
12. Isolation diode

Figure 6-13. Flywheel alternator.

c. Cleaning and Inspection.

WARNING

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

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

(8) Inspect the stator assembly (4) for damaged insulation, gouges, or other damage. Replace a damaged stator.

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

d. Installation.

(1) Install isolation diode (12) using screws (11).

(2) Be sure mounting surfaces of modules and engine are clean. Hold regulator module (10), regulator module shield (9), and rectifier module (8) in place and secure with screws (7), lockwashers (6), and nuts (5),

(8) Install stator assembly (4) to flywheel shroud and engine gear cover by installing pins (3), lockwasher (2), and screw (l).

(4) Install the Woodruff key (5, fig, 6-4) in the crankshaft keyway. Position the flywheel (4) on the crankshaft so that the keyway aligns with the Woodruff key in the shaft keyway. Tap the flywheel onto the shaft with a soft hammer.

(5) Secure the flywheel to the crankshaft with nut (2) and lockwasher (3).

(6) Drive in hand crank pin (1) so that ends protrude evenly.

(7) Replace the flywheel screen (3, fig, 6-3) with screws (1) and lockwashers (2).

CHAPTER 7
REPAIR OF CENTRIFUGAL PUMP

7-1. Description.

This self-priming pump is designed to pump flammable liquids at relatively high discharge heads. It has a closed-type impeller which is mounted directly on the extended crankshaft and contains no bearings since the crankshaft is adequately supported by the engine bearings. Leakage around the shaft is prevented by a face seal which primarily consists of a ni-resist stationary seat and a spring-loaded carbon rotating member. The highly finished mating surfaces are in constant contact to stop seepage of fluid through the seal.

7-2. Pump Tolerances and Wear Limits.

Pump tolerances and wear limits which will help you determine if parts replacement is required are shown in figure 7-2,

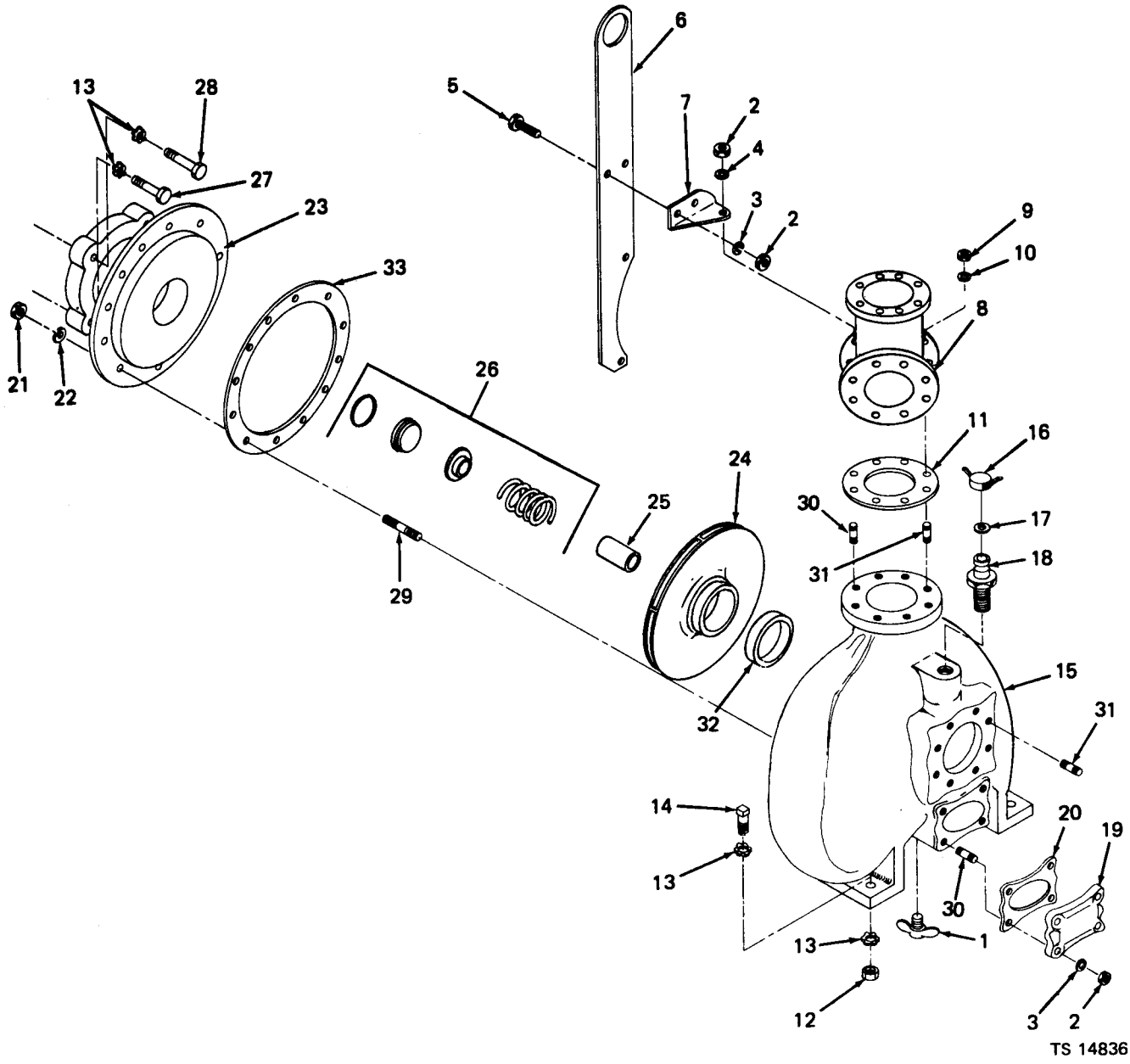
7-3. Pump removal.

a. Removal.

(1) Remove the suction piping assembly, discharge piping assembly, and the instrument control panel.

(2) Remove the pump air eliminator.

(3) Referring to figure 7-1, drain the pump by opening the drain cock (1). Remove the drain cock to prevent damage during further disassembly.



1. Drain cock
2. Nut
3. Washer
4. Washer
5. Screw
6. Lifting bail
7. Support
8. Discharge elbow
9. Nut
10. Lockwasher
11. Gasket
12. Nut
13. Lockwasher
14. Screw
15. Casing
16. Dust cap
17. Gasket
18. Adapter
19. Cleanout cover
20. Gasket
21. Nut
22. Lockwasher
23. Intermediate bracket
24. Impeller
25. Shaft sleeve
26. Seal
27. Screw
28. Screw
29. Stud
30. Stud
31. Stud
32. Wear ring
33. Gasket

Figure 7-1. Pump assembly.

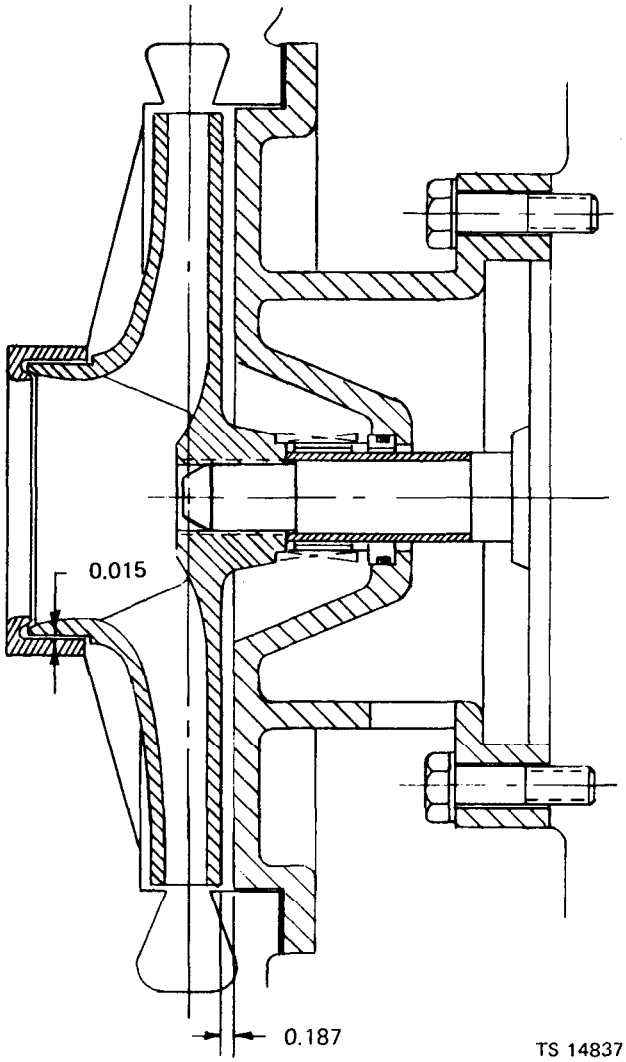


Figure 7-2. Pump tolerances and wear limits.

(4) Remove the nuts (2), washers (3 and 4), and screws (5) that secure the lifting bail (6) and support (7) to the discharge elbow (8).

(5) Remove the nuts (9) and lockwasher (10) and remove discharge elbow (8) and gasket (11).

(6) Remove the nuts (12), lockwashers (13), and screws (14) securing the base of the pump casing (15) to the frame.

(7) Remove O.P.W. dust cap (16), gasket (17), and adapter (18) from pump casing.

(8) Remove the nuts (2) and washers (3) that secure the cleanout cover (19) and gasket (20) to the pump casing (15).

(9) Remove the nuts (21) and lockwashers (22) that secure the intermediate bracket (23) and the pump casing (15).

(10) Insert hook of a hoist device into discharge of pump casing (15) and slide pump away from the engine, Remove from frame.

b. Disassembly.

(1) Remove impeller (24) by inserting a rod into each side of impeller. Remove flywheel screen from engine and hold crankshaft with a pipe wrench. Impeller can now be loosened by turning counterclockwise. If impeller cannot be loosened by hand tap rods with a plastic hammer.

(2) Remove the shaft sleeve (25) and seal (26). Retain the shims as a set. You will want to reinsert the same shim thickness at reassembly unless related parts are replaced.

(3) Remove the screws (27 and 28) and lockwashers (13), and remove the intermediate bracket (23).

(4) You should not remove the studs (29, 30, and 31) from the pump casing unless they are damaged and require replacement.

c. Cleaning and Inspection.

(1) You should replace the pump seal (26) at each overhaul. Always replace the complete seal assembly, not individual parts.

WARNING

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

(3) Inspect the impeller (24) for cracks, wear, broken vanes, chips, distortion, and damaged threads.

(4) Inspect the wear ring (32) in the pump casing for wear, cracks, and other damage. If the inspection indicates wear or damage, you must replace the wear ring.

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

(6) Inspect the intermediate bracket (23) for cracks, distortion, scoring, and other damage; replace a damaged intermediate bracket.

(7) Inspect the O.P.W. fitting (16, 17, and 18) for cracks, damaged threads, distortion, or other damage. Replace damaged parts. Always replace gasket (17).

(8) Inspect cleanout cover (19) for cracks, distortion, or other damage. Replace if damaged. Always replace gasket (20).

d. Reassembly and Installation.

(1) Install the wear ring (32) if you had removed it.

(2) Coat the stationary members of the pump seal (26) sparingly with light engine oil. Install the stationary seal parts in the bore of the intermediate

bracket (23) and install the intermediate bracket on the engine, taking care not to dislodge the stationary seal members. Secure the bracket to the engine with screws (27 and 28) and lockwasher (13).

CAUTION

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

(3) Coat the face of the rotating seal member and the shaft sleeve with light engine oil. Install the rotating parts of the seal on the shaft sleeve. Coat the end of the engine crankshaft sparingly with light engine oil and install the shaft sleeve (25), with rotating seal parts, onto the crankshaft. Push until sleeve is firm against shoulder on crankshaft.

(4) Install the impeller (24) on the engine crankshaft without shims, Note that the impeller has a right hand thread.

(5) With the impeller firmly seated on the shaft, measure the space between the back of the impeller and the face of the intermediate (fig. 7-2). If the space is leas than required, remove the impeller and add shims to desired width when impeller is reinstalled.

(6) Install a new gasket (33) on the intermediate bracket. Using a hoist, slide pump casing (15) into position on the intermediate bracket. Install lifting bail (6). Secure the casing with nuts (21) and lockwashers (22).

(7) Without resetting the oil pressure safety switch to prevent the engine from starting, crank the engine to ensure that the pump turns freely without scraping or binding.

(8) Install cleanout cover (19) and gasket (20) using nut (2) and washer (8).

(9) Install O.P.W. fitting, adapter (18), gasket (17), and dust cap (16).

(10) Install discharge elbow (8) and gasket (11) using nuts (9) and lockwashers (10).

(11) Secure lifting bail (6) and support (7) to discharge elbow using nuts (2) and washers (3 and 4).

(12) Reassemble the components and piping removed to enable pump disassembly, Replace pump suction piping assembly, discharge piping assembly, and the instrument control panel. Replace air eliminator.

CHAPTER 8
REPAIR OF FRAME ASSEMBLY

8-1. Description.

The frame assembly consists of a wheel-mounted welded frame that provides support for mounting the pump, engine, fuel tank, suction and discharge assemblies, and other components and accessories of the pumping assembly.

a. The welded frame consists primarily of two longitudinal structural members, five horizontal members, and a series of angles and channels at both ends. A frame stand is at the front (towing) end of the frame. It is secured to the frame by screws and nuts and can be locked in a position by two anchor pins. The towing tongue can be retracted for compactness or extended to provide a greater turning clearance when the vehicle is being towed.

b. The axle assembly is mounted to the underside of the frame. It consists primarily of the axle and its mounting brackets. It serves as a mounting base for the hubs, wheels, and tires.

8-2. Axle Assembly.

a. Removal.

(1) Support the frame securely on four stands or on blocks.

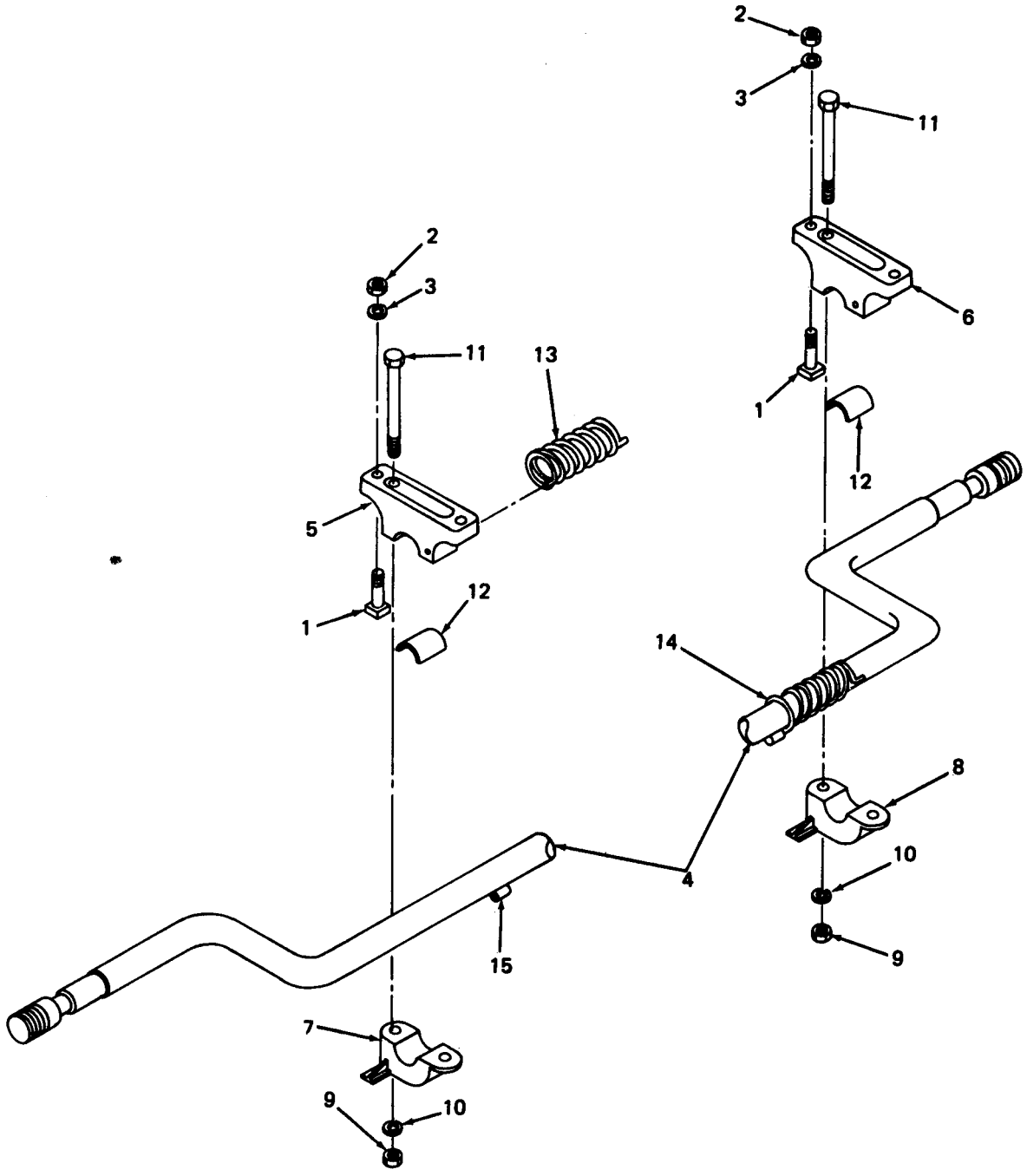
(2) Remove wheels and tires.

(3) Remove hub and bearing assemblies.

WARNING

You must support the axle properly before detaching the mounting brackets from the frame or injury to personnel may result.

(4) Remove four screws (1, fig. 8-l), nuts (2), and lockwashers (3) that secure the axle (4) to the fram; remove the axle assembly.



1. Screw
2. Nut
3. Lockwasher
4. Axle
5. Top bracket, rh
6. Top bracket, lh
7. Base bracket, rh
8. Base bracket, lh
9. Nut
10. Lockwasher
11. Screw
12. Insert
13. Torsion spring
14. Torsion spring
15. Spring clip

Figure 8-1. Axle assembly.

b. Disassembly.

(1) You can now remove the top and base brackets (5, 6, 7, and 8) by removing nuts (9), lockwashers (10), and screws (11).

(2) Remove bearing insert (12).,

(3) Remove torsion springs (13 and 14) from top

brackets (5 and 6), and spring clips (15) on the axle (4).

c. *Cleaning and Inspection.*

WARNING

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

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

(3) Inspect the bearing insert (12) for wear or other damage. Replace if damaged.

(4) Inspect for cracked, distorted, or weak springs. Axle assembly must be replaced if springs are weak are damaged.

(5) Inspect all parts for rust, corrosion, chipped paint, and distortion. Remove rust and corrosion with a wire brush or scraper. Touch up and paint as necessary.

d. Reassembly.

(1) Rotate each spring until the end is held by its axle clip.

(2) Hold the springs (13 and 14) against the clips and position the top brackets (5 and 6) on the opposite end of the springs.

(3) Install bearing inserts (12) between the top brackets and the axle.

(4) Attach the base brackets (7 and 8) to the top brackets and secure with screws (11), lockwashers (10), and nuts (9).

e. Installation.

(1) Attach the axle assembly to the underside of the frame with screws (l), lockwashers (3), and nuts (2).

(2) Install bearings, hubs, wheels, and tires.

8-3. Frame.

a. Removal and Disassembly.

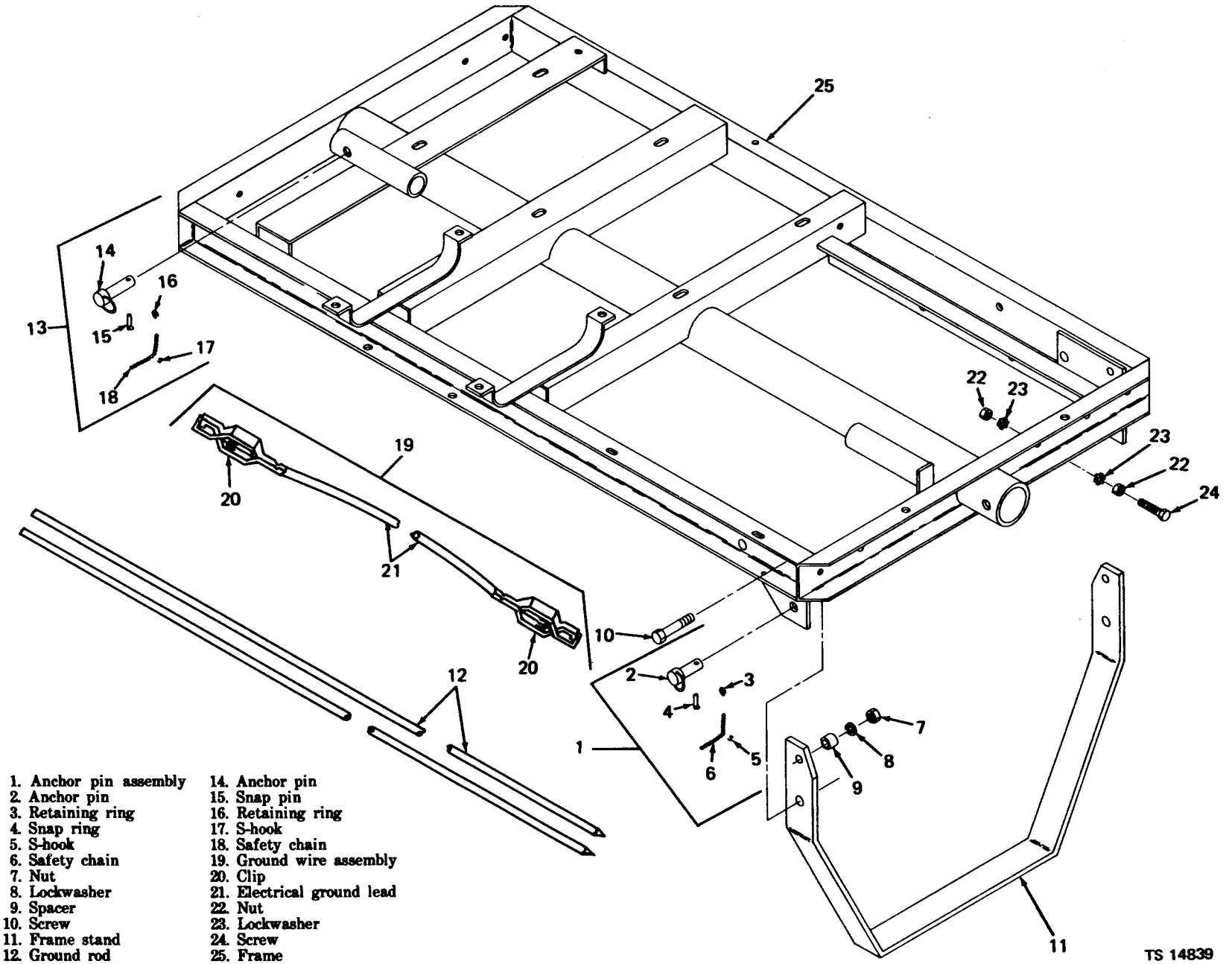
(1) Remove the pump and engine assemblies.

(2) Remove the wheel and axle assemblies.

(3) Remove the tool box.

(4) Remove the towing tongue pin and withdraw the tongue from the tube.

(5) Remove stand, anchor pin assemblies (1, fig. 8-2), nuts (7), lockwashers (8), spacers (9), and screws (10) that secure the front stand (11) to the frame: remove stand from frame.



1. Anchor pin assembly
2. Anchor pin
3. Retaining ring
4. Snap ring
5. S-hook
6. Safety chain
7. Nut
8. Lockwasher
9. Spacer
10. Screw
11. Frame stand
12. Ground rod
13. Anchor pin assembly
14. Anchor pin
15. Snap pin
16. Retaining ring
17. S-hook
18. Safety chain
19. Ground wire assembly
20. Clip
21. Electrical ground lead
22. Nut
23. Lockwasher
24. Screw
25. Frame

Figure 8-2. Frame assembly.

(6) Remove the ground rods (12) by removing the anchor pin assembly (13) from the rear rod tube. The ground wire assembly (19) is stowed in the tool box which was removed previously.

(7) Remove the nuts (22), lockwashers (23), and screw (24) that secure the bonding strap to the frame (25).

b. Cleaning and Inspection.

WARNING

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

(2) Inspect all parts for rust, corrosion, cracks, and distortion. You can remove rust or other corrosion by using sandpaper, a metal scraper, or a wire brush. Prime and paint bare surfaces as necessary. Straighten distorted or bent structural members or towing tongue,

(3) Inspect for bent or damaged ground rods (12) and ground wire assemblies (19). If you cannot straighten or repair ground rods or repair the ground wire assemblies, replace them.

(4) Check the wear of the spacer (9) which enables raising or lowering of the front stand; replace if excessively worn.

(5) Replace other damaged or missing parts.

c. Reassembly and Installation,

(1) Install bonding strap to frame (25) rising nuts (22), lockwashers (23), and screw (24).

(2) Install ground rods in rod tube and secure with anchor pin assembly (13).

(3) Replace front stand. Secure with anchor pin assembly (l), nuts (7), lockwashers (8), spacers (9), and screws (10).

(4) Install tongue, secure with tongue pin.

(5) Install tool box. Stow ground wire assembly (19) in tool box.

(6) Install wheel and axle assemblies.

(7) Install pump and engine assemblies.

APPENDIX A
REFERENCES

A-1 Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguishers for Army Users

A-2 Lubrication

LO 5-4320-273-12	Engine Lubrication Order

A-3 Painting

TM 9-213	Painting Instructions for Field Use

A-4 Radio Suppression

TM 11-483	Radio Interference Suppression

A-5 Maintenance

TM 5-4320-273-24P	Organizational, Direct Support, General Support Maintenance Repair Parts and Special Tools List, Pumping Assembly
TM 38-750	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

APPENDIX B
MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1. General.

a. This section provides a general explanation of all maintenance and repair functions authorized at various maintenance levels.

b. Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component and the work measurement time required to perform the functions by the designated maintenance level, The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the tools and test equipment required for each maintenance function as referenced from section II.

B-2. Explanation of Columns in Section II.

a. Column (1) Group Number. Column 1 lists group numbers to identify related components, assemblies, subassemblies, and modules with their next higher assembly. The applicable groups are list - ed in the MAC in disassembly sequence beginning with the first group removed.

b. Column (2) Component/Assembly. This column contains the noun names of components, assemblies, subassemblies and modules for which maintenance is authorized.

c. Column (3) Maintenance Functions. This column lists the functions to be performed on the item listed in column 2. The maintenance functions are defined as follows

(1) ***Inspect.*** To determine serviceability of an item by comparing its physical, mechanical, and/or electrical characteristic with established standards through examination,

(2) Test. To verify serviceability and detect incipient failure by measuring the mechanical or electrical characteristic of an item and comparing those characteristic with prescribed standards,

(8) Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean (decontaminated), to preserve, to drain, to paint, or to replenish fuel, lubricants, hydraulic fluids, or compressed air supplies.

(4) Adjust. To maintain within prescribed limits, by bringing into proper or exact position, or by setting the operating characteristics to specified parameters,

(5) Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

(6) Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipments used in precision measurement, Consists of comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared.

(7) Install. The act of emplacing, seating, or fixing into position an item, part or module (component or assembly) in a manner to allow the proper functioning of an equipment or system.

(8) Replace. The act of substituting a serviceable like type part, subassembly, or module (component or assembly) for an unserviceable counterpart.

(9) Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, or replace) or other maintenance actions (welding, grinding, riveting, straightening, facing; remachining, or resurfacing) to restore serviceability to an item by correcting specific damage, fault, malfunction, or failure in a part, subassembly, module (component or assembly), end item, or system.

(10) Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (i.e., DMWR) in appropriate technical publications, Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to a like new condition,

(11) ***Rebuild.*** Consists of those services/actions necessary for the restoration of unserviceable equipment to a like new condition in accordance with original manufacturing standards. Rebuild is the highest degree of materiel maintenance applied to Army equipment. The rebuild operation includes the act of returning to zero those age measurement (hours, miles, etc.) considered in classifying Army equipment/components,

d. Column (4) Maintenance Category. This column is made up of subcolumns for each category of maintenance. Work time figures are listed in these subcolumns for the lowest level of maintenance authorized to perform the function listed in column 8, These figures indicate the average active time required to perform the maintenance function at the indicated category of maintenance under typical field operating conditions,

e, Column (5) Tools and Equipment. This column is provided for referencing by code, the common tool sets (not individual tools), special tools, test and sup-

port equipment required to perform the designated function.

B-3. Explanation of Columns in Section III.

a. Column (1) Reference Code. This column consists of an arabic number listed in sequence from column 5 of section II. The number references the common tool sets, special tools and test equipment requirements.

b. Column (2) Maintenance Category. This column shows the lowest category of maintenance authorized to use the special tools or test equipment

c. *Column (3) Nomenclature.* This column lists the name or identification of the common tool sets, special tools or teat equipment.

d. Column (4) National/Nato Stock No. (NSN). This column is provided for the NSN or common tool sets, special tools and test equipment listed in the nomenclature column.

e. *Column (5) Tool Number.* This column lists the manufacturer's code and part number of tools and test equipment.

Section II. MAINTENANCE ALLOCATION CHART

(1)	(2)	(3)	(4)					(5)
Group number	Component/assembly	Maintenance function	Maintenance category* C	O	F	H	D	Tools and equipment
01	ENGINE							
0100	Engine Assembly	Inspect	0.1					
		Test		1.0				
		Service	1.0					
		Replace			8.0			
		Repair			16.0			
		Overhaul				24.0		
0101	Crankcase, Block and Cylinder Head							
	Crankcase, block	Replace			10.0			
		Overhaul				16.0		
	Cylinder head	Replace		5.0				
0102	Crankshaft	Replace				8.0		
0103	Flywheel Assembly	Replace			6.0			
0104	Pistons, Connecting Rods	Replace				8.0		
0105	Valve, Camshafts and Timing System	Replace				6.0		
		Repair			8.0			
0106	Lubricating System							
	Oil filter	Inspect	0.1					
		Service	0.1					
		Replace		0.2				
	Oil pump	Inspect	0.1					
		Replace				4.0		
0107	Manifolds, Intake and Exhaust	Inspect	0.1					
		Replace		2.0				
02	FUEL SYSTEM							
0200	Carburetor	Inspect	0.1					
		Adjust		0.5				
		Replace		1.0				
0201	Fuel Pump	Inspect	0.1					
		Replace		0.5				
0202	Air Cleaner	Inspect	0.1					
		Service	0.2					
		Replace		0.5				
0203	Tanks, Lines and Fittings	Inspect	0.2					
		Service	0.2					
		Replace		1.5				
0204	Governor and Controls	Inspect	0.1					
		Adjust		0.5				
		Replace			3.0			
0205	Fuel Filter	Inspect	0.1					
		Service	0.2					
		Replace		1.3				

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** INDICATES WT/MH REQUIRED

Section II. MAINTENANCE ALLOCATION CHART (Cont'd)

(1)	(2)	(3)	(4)					(5)
Group number	Component/assembly	Maintenance function	Maintenance category* C	O	F	H	D	Tools and equipment
02	FUEL SYSTEM CONTINUED							
0206	Throttle and Choke Controls	Inspect	0.1					
		Adjust		0.5				
		Replace		0.5				
03	EXHAUST SYSTEM							
0300	Muffler and Pipes	Inspect	0.1					
		Replace		1.0				
04	COOLING SYSTEM							
0400	Cowling, Deflectors, Air Ducts, Shrouds, Etc.	Inspect	0.1					
		Replace		2.0				
		Repair		3.0				
05	ELECTRICAL SYSTEM							
0500	Generator, Alternator	Inspect	0.1					
		Test		0.5				
		Replace		4.0				
0501	Generator Regulator	Inspect	0.1					
		Test		0.5				
		Adjust		0.5				
		Replace		0.5				
0502	Starting Motor	Inspect	0.1					
		Replace		0.5				
	Brushes	Replace		0.5				
0503	Ignition Components	Inspect	0.2					
		Test		0.5				
		Adjust		0.5				
	Breaker points, capacitor, coil	Replace		0.5				
0504	Engine Safety Controls	Inspect	0.1					
		Adjust		0.5				
		Replace		0.5				
0505	Control Panel	Inspect	0.2					
		Replace		2.0				
0506	Miscellaneous Items	Inspect	0.1					
		Test		0.2				
		Service	0.3					
		Replace		0.5				
0508	Radio Interference Suppression	Inspect				1.0		
		Test				1.0		
		Replace				0.5		
06	AXLE							
0600	Axle Assembly	Inspect	0.2					
		Replace			8.0			
07	WHEELS							
0700	Wheel Assembly	Inspect	0.1					
		Adjust		0.5				
		Replace		0.5				
0701	Tires, Tubes	Inspect	0.1					
		Service	0.2					
		Replace		0.5				
		Repair		0.5				
08	FRAME							
0800	Frame Assembly	Inspect	0.2					
		Replace				8.0		
0801	Pintles and Towing Attachments	Inspect	0.1					
		Service	0.1					
		Replace		0.5				

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** INDICATES WT/MH REQUIRED

Section II. MAINTENANCE ALLOCATION CHART (Cont'd)

(1)	(2)	(3)	(4)					(5)
Group number	Compone t/assemb	Maintenance function	Maintenance category* C	O	F	H	D	Tools and equipment
09	BODY, CAB, HOOD AND HULL							
0900	Stowage Boxes	nspect	0.1					
		Replace		0.5				
10	ACCESSORY ITEMS							
1000	Reflectors	nspect	0.1					
		Replace		0.2				
1001	Data Plates	nspect		0.1				
		Replace				0.5		
11	GAGES, NON-ELECTRICAL							
1100	Tachometer	nspect	0.1					
		Replace		0.3				
1101	Gages, Pressure and Vacuum	nspect	0.1					
		Replace		0.3				
12	PUMPS							
1200	Pump Assembly	nspect	0.1					
		Test				16.0		
		Replace			8.0			
		Repair				12.0		
		Overhaul				24.0		
201	Shaft, Impeller, Seals, and Bearings	nspect	0.1					
		Replace			4.0			
		Repair				8.0		
	Suction and Discharge Assemblies	nspect	0.1					
		Replace		2.0				

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Section III TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) Reference code	(2) Maintenance category	(3) Nomenclature	(4) National stock number (NSN)	(5) Tool number
		NO SPECIAL TOOLS REQUIRED.		

INDEX

By Order of the Secretary of the Army:

FRED C. WEYAND
General, United States Army
Chief of Staff

Official:

PAUL T. SMITH
Major General, United States Army
The Adjutant General

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* U. S . GOVERNMENT PRINTING OFFICE : 1987 0 - 181-421 (70903)

RECOMMENDED ~~CHANGES TO EQUIPMENT~~ TECHNICAL MANUALS

SOMETHING WRONG WITH THIS MANUAL?

THEN. . .JOT DOWN THE DOPE ABOUT IT ON THIS FORM, TEAR IT OUT, FOLD IT AND DROP IT IN THE MAIL!

FROM: (YOUR UNIT'S COMPLETE ADDRESS)
PFC JOHN DOE
CoA, 3d ENGINEER BN
FT. LEONARD WOOD MO 63108

DATE 16 DEC 74

PUBLICATION NUMBER	DATE	TITLE
TM5-6115-200-20 AND P	1 APR 72	GENERATOR SET 10 KW NSN 6115-00-231-7286

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.
6	2-1 a		
81		4-3	
125	line 20		

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

In line 6 of paragraph 2-1a the manual states the engine has 6 cylinders. The engine on my set only has 4 cylinders. Change the manual to show 4 cylinders

Callout 16 on figure 4-3 is pointing at a bolt. In the key to fig. 4-3, item 16 is called a shim. Please correct one or the other.

I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered so the NSN is wrong. Please give me a good NSN

SAMPLE

TYPED NAME, GRADE OR TITLE, AND TELEPHONE NUMBER
JOHN DOE, PFC (268) 317-7111

SIGN HERE: John Doe

DA FORM 1 AUG 74 2028-2 (TEST)

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