DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TECHNICAL MANUAL

OPERATOR AND ORGANIZATIONAL

MAINTENANCE MANUAL

PUMP, CENTRIFUGAL, SELF-PRIMING,

GASOLINE ENGINE DRIVEN, WHEEL MOUNTED,

6-INCH, 1500 GPM CAPACITY AT 60 FOOT HEAD

(PEABODY BARNES, INC: MODEL US90CCG-1)

NSN 4320-00-490-1859

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

HEADQUARTERS, DEPARTMENT OF THE AR MY

MARCH 1975

WARNING

POISONOUS GASES

are contained in the exhaust fumes expelled by this equipment.

DEATH

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

FLAMMABLE GAS

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

FIRE HAZARD

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

EXPLOSION HAZARD

exists when welding repairs are attempted on fuel tank.

DEATH

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

SEVERE INJURY

may result from contact with the rotating cooling fan. When it is necessary to make governor adjustments or any other adjustments in the fan area, remove the cooling fan drive belt before making the adjustment.

HEALTH AND SAFETY HAZARD

exists when cleaning solvents are used. Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning and solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59°C).

NOISE HAZARD

exists during operation of this equipment. The noise level exceeds the allowable limits for unprotected personnel. Wear ear muffs, or wear ear plugs fitted by a trained professional.

CHANGE

NO. 1

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

Operator and Organizational Maintenance Manual

**PUMP, CENTRIFUGAL, SELF-PRIMING, GASOLINE ENGINE DRIVEN
WHEEL MOUNTED, 6-INCH, 1500 GPM CAPACITY AT 60 FOOT HEAD
(PEABODY BARNES, INC.: MODEL US90CCG-1
NSN 4320-00-490-1859**

Approved for public release; distribution is unlimited

TM 5-4320234-12, 21 March 1975 is changed as follows:

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Remove pages	Insert pages
2-7/(2-8 blank)	2-7/(2-8 blank)
3-7 and 3-8	3-7 and 3-8
4-1 and 4-2	4-1 and 4-2
4-5 and 4-6	4-5 and 4-6
4-39 and 4-40	4-39 and 4-40

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TECHNICAL MANUAL
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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON,D.C., *21 March 1975*

OPERATOR AND ORGANIZATIONAL MAINTENANCE MANUAL

PUMP, CENTRIFUGAL, SELF-PRIMING,

GASOLINE ENGINE DRIVEN, WHEEL MOUNTED,

6-INCH, 1500 GPM CAPACITY AT 60 FOOT HEAD

(PEABODY BARNES, INC. MODEL US90CCG-1)

NSN 4320-00-490-1859

LIST OF ILLUSTRATIONS

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope
This manual is for your use in operating and maintaining the Pump, Centrifugal, Self-priming, Gasoline Engine Driven, Wheel Mounted, 6-Inch, 1500 GPM Capacity at 60 Foot Head (Peabody Barnes, Inc. Model US9OCCG-1).

1-2. Maintenance Forms and Records
Maintenance forms, records, and reports that you are required to use are DA Form 2400, 2401, 2402, 2404 and 314 (see TM 38-750).

1-3. 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/or 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.

1-4. Equipment Serviceability Criteria
This equipment is not covered by an ESC.

1-5. Destruction of Army Materiel to Prevent Enemy Use
For instructions regarding destruction of equipment to prevent enemy use, refer to TM 750244-3.

1-6. Administrative Storage
You must prepare the pump assembly for storage according to procedures given in TM 740-90-1.

SECTION II. DESCRIPTION AND DATA

1-7. Description
a. Centrifugal Pump, Model US9OCCG-1, consists primarily of a gasoline engine and a wheel mounted centrifugal pump. The torque from the engine is transferred to the pump through an intermediate shaft and flexible coupling.

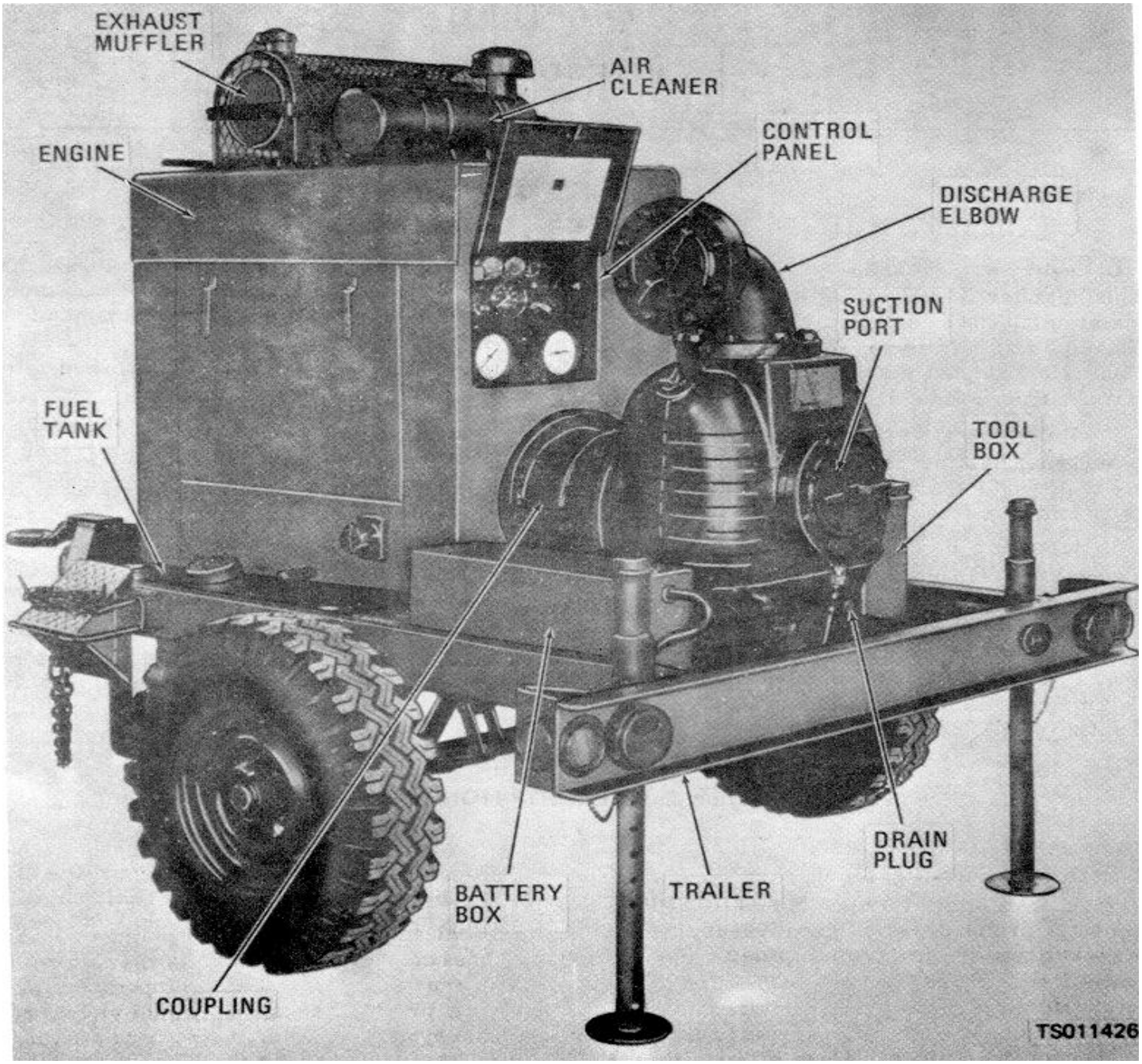


Figure 1-1. Centrifugal pump, left rear view.

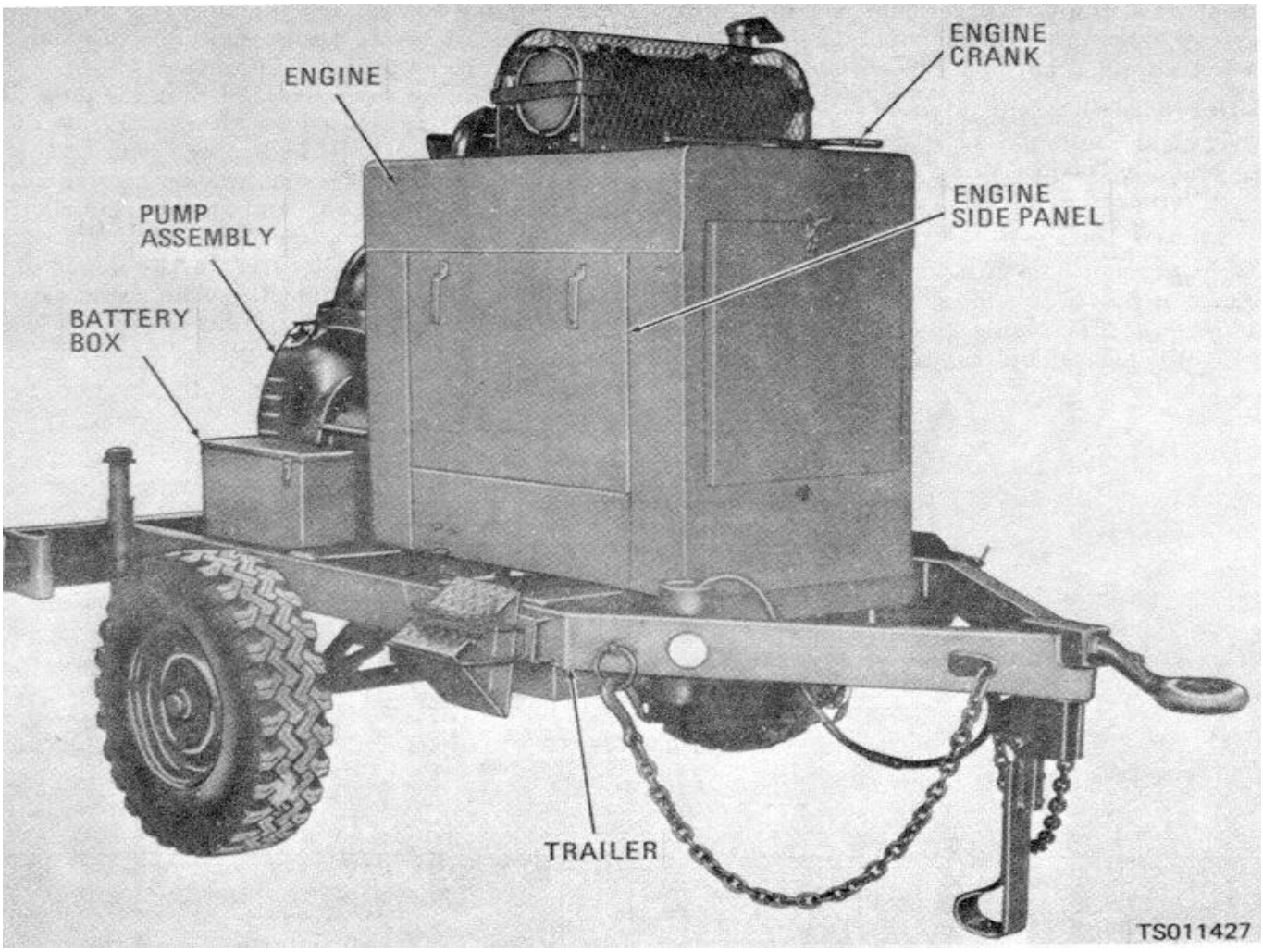


Figure 1-2. Centrifugal pump, right front view.

b. The centrifugal pump has a 6-inch suction flange secured to the front of the pump body and a 6-inch discharge elbow secured to the top of the pump body. The bearing housing joins the flywheel housing of the engine with the pump body, providing correct spacing and proper alinement of the parts. The bearing housing also provides the bearing seats for the ball bearings that support the impeller shaft. The impeller is keyed to the end of the impeller shaft and is secured with a locking cone. The impeller is enclosed in a close-fitting volute to provide efficient pumping operation. A replaceable wear plate at the front of the impeller takes most of the internal pump wear.

c. The engine is a six-cylinder, water-cooled, pressure-lubricated, four-stroke-cycle, L-head type. Engine speed is governed by a flyball-type governor. The engine is enclosed in a housing that has coolant and oil drains ported to the outside of the housing for easy access. The engine uses an electrical starting motor, has magneto ignition, and uses an alternator to restore the charge of the battery as it is depleted by operation of the starting motor. The conventional radiator-type cooling system uses a pusher-type cooling fan which forces cooling air through the radiator from the inside out. The fan also maintains a flow of air around the engine to provide proper cooling.

d. The engine and pump are protected by three safety controls. The overspeed governor shuts off the engine when speed exceeds a preset maximum. The oil pressure safety switch shuts off the engine when oil pressure drops below a preset minimum. The temperature safety switch shuts off the engine when coolant temperature exceeds a preset maximum.

e. The engine and pump are secured to a two-wheeled chassis. The chassis consists primarily of hub assemblies, pneumatic tires, welded frame, and axle. Two retractable stands are provided at the rear of the chassis and one folding leg is installed at the front.

These help to maintain rigidity of the unit during operation. Chock blocks are supplied to lock the wheels.

1-8. Differences Between Models

This technical manual covers only Centrifugal Pump, Peabody Barnes Model US9OCCCG-1. No known differences exist for this model number.

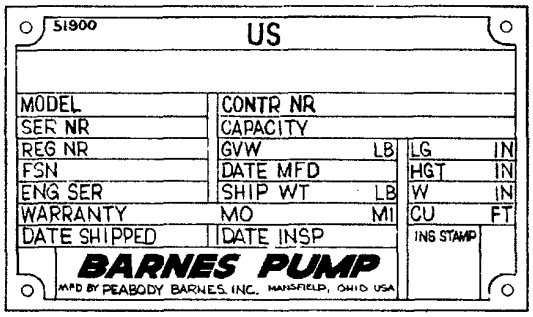
1-9. Tabulated Data

a. Identification. The pump assembly has three identification plates, as follows:

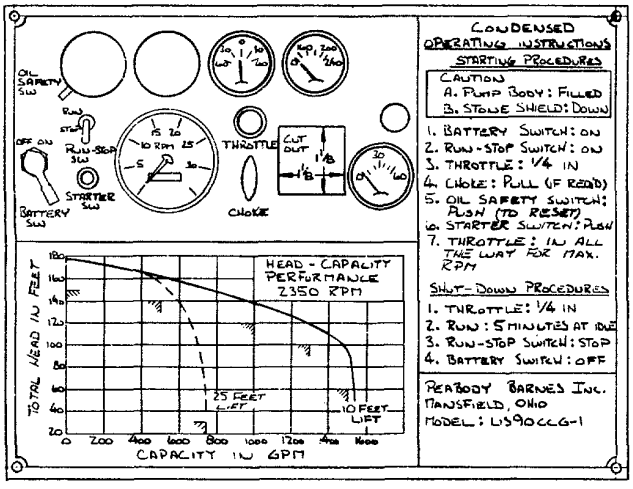
(1) *Pump data plate*. The pump data plate (A, fig. 1-3) is located on front of the pump above the suction flange. It indicates the pump identification number, serial number, dimensions, weight, and shipping information.

(2) Engine data plate. The engine data plate (B, fig. 1-3) is located on alternator side of the engine block. It indicates engine identification numbers, serial number, valve tappet clearance information, and patent information.

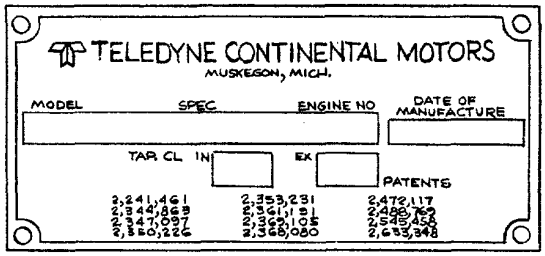
(3) Instruction plate. The pump instruction plate (C, fig. 1-3) is located in the cover of the control panel. It identifies the controls and provides basic operating instructions.



A PUMP DATA PLATE



C INSTRUCTION PLATE



B ENGINE DATA PLATE

TS011428

Figure 1-3. Data plates.

b. Tabulated Data. Tabulated data applicable to the centrifugal pump and its components is given in table 1-1.

Table 1-1. Tabulated Data

OPERATOR CREW TABULATED DATA

Manufacturer	Peabody Barnes, Inc.
Model number	US90CCG-1
Serial number range	56751-001 thru -024
Type	Self-priming, centrifugal
Output (at maximum rated speed)	1500 gpm at 60 feet head
Rated driven speed	2450 rpm
Suction port size	6 in., No.6-8 NPT
Discharge port size	6 in., No.6-8 NPT

ORGANIZATIONAL MAINTENANCE TABULATED DATA

Engine	
Manufacturer	Continental Motors Corp.
Model	FS244-6100P
Type	Four stroke cycle
Number of cylinders	6
Displacement	244 cu in.
Compression ratio	6.9:1
Coolant	Water
Cooling system capacity	18 qt
Crankcase oil capacity	5-1/2 qt
Valve clearance (warm)	
Intake	0.014 in.
Exhaust	0.016 in.
Spark plug gap	0.025 in.
Breaker point gap	0.015 in.
Firing order	1-5-3-6-2-4
Governed speed	2450 rpm
Overspeed cutout	2700 rpm
Alternator	
Manufacturer	Motorola
Part number	MA24-900G
Voltage	24
Amperage output	35
Voltage regulator	
Manufacturer	Motorola
Part number	7
Starting motor	
Manufacturer	Delco-Remy
Part number	1108271
Voltage	24
Magneto	
Manufacturer	Fairbanks-Morse
Part number	FMZE6BI6P
Fuel pump	
Manufacturer	AC Spark Plug
Part number	6440314
Carburetor	
Manufacturer	Zenith
Part number	12334
Air cleaner	
Manufacturer	Donaldson
Part number	FWG06-6032
Oil filter	
Manufacturer	Fram
Part number	C7407
Military standard number	MS35343-1
Overall dimensions and weight	
Overall length	119 in.
Overall width	68.5 in.
Overall height	71 in.
Overall weight	2630 lbs.
Shipping weight	2630 lbs.
Shipping volume	343 cu ft.
Ground clearance	13.25 in.
Approach angle	15 degrees
Departure angle	30 degrees

ORGANIZATIONAL MAINTENANCE TABULATED DATA--Continued

Engine torque specifications	
Spark plugs	30 to 35 ft-lb
Cylinder head cap screws	35 to 40 ft-lb

c. *Wiring Diagram*. Refer to figure 1-4 for the wiring diagram.

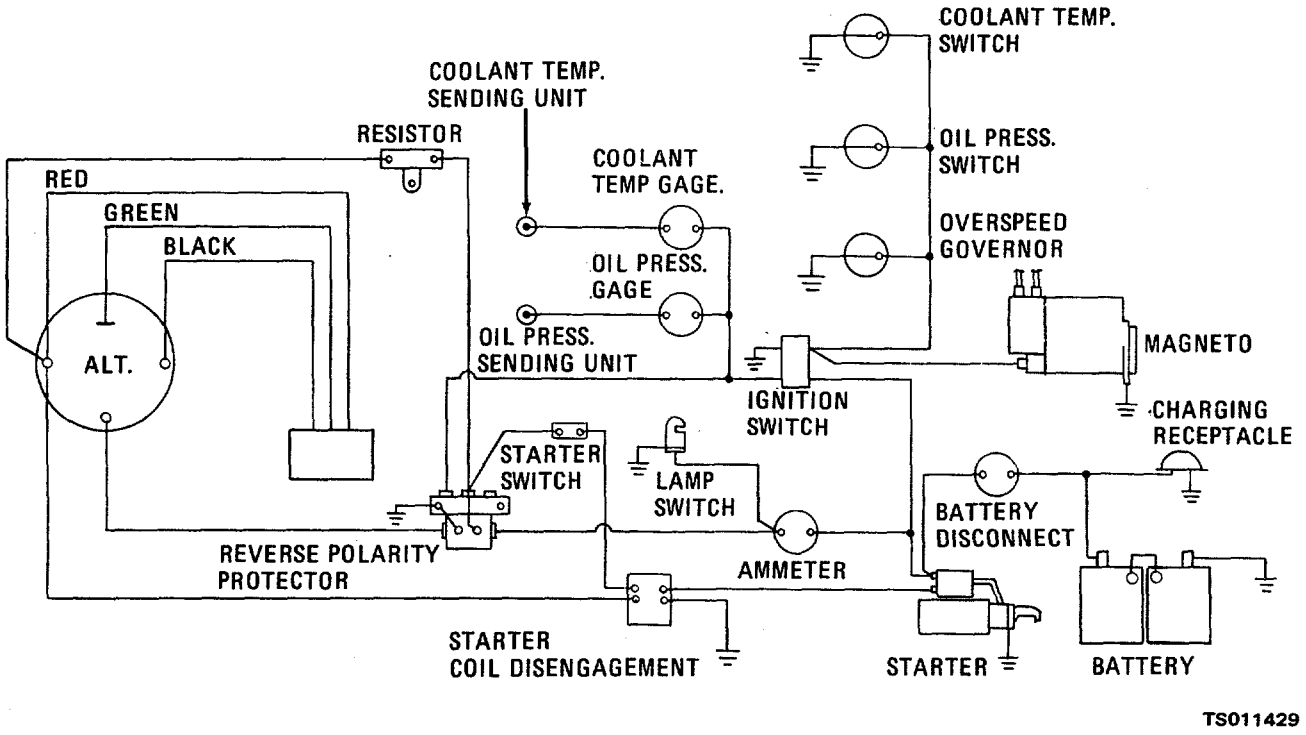


Figure 1-4. Wiring diagram.

CHAPTER 2

OPERATING INSTRUCTIONS

WARNING

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

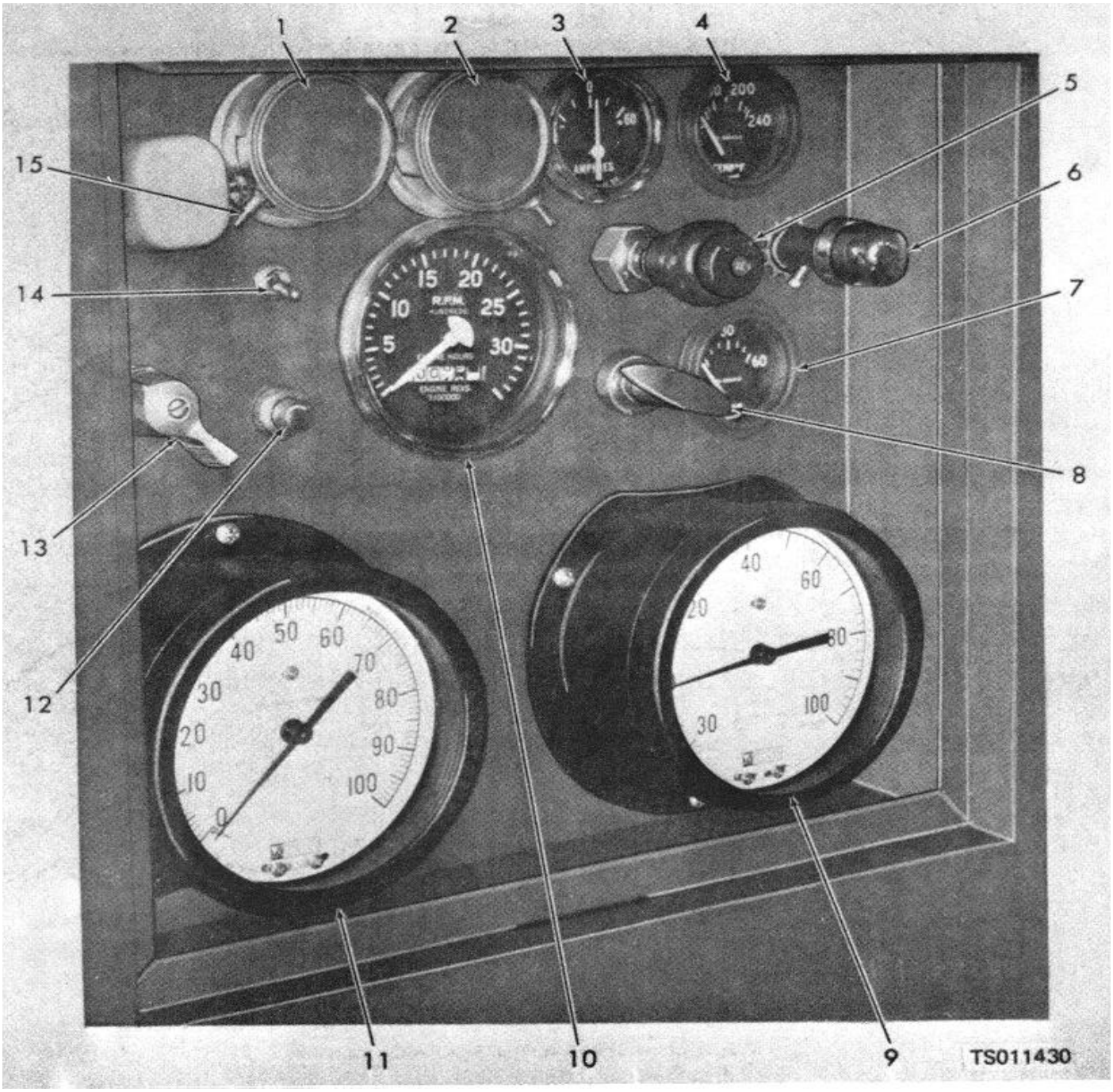
Section I. OPERATING PROCEDURES

2-1. General

This section contains information and guidance for the personnel responsible for operation of the pump assembly. This section gives instructions on starting and stopping the pump and basic operations of the unit.

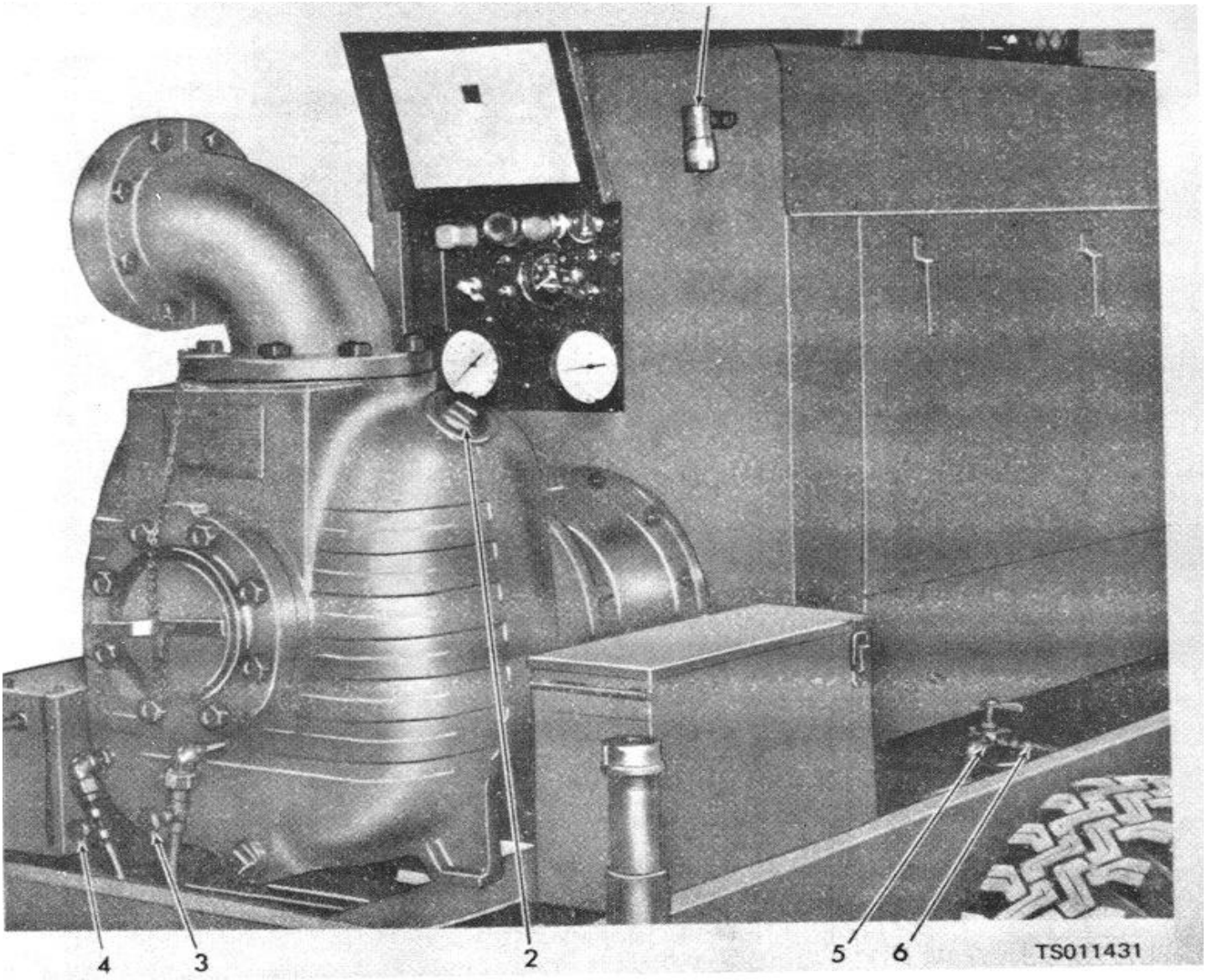
2-2. Controls and Instruments

Before attempting to operate the pump assembly, you must become familiar with all controls and instruments provided on the unit. Refer to table 2-1 for a complete description and identification of all controls and instruments used on the pump assembly. The controls and instruments are illustrated in figures 2-1 through 2-3.



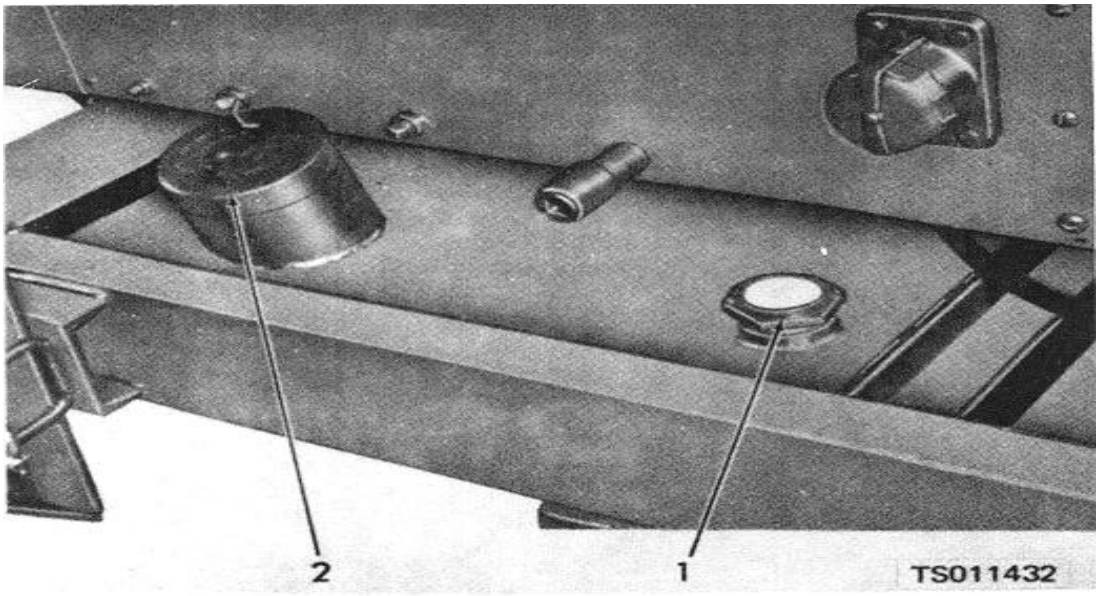
1. Engine oil pressure safety switch
2. Coolant temperature safety switch
3. Ammeter
4. Engine coolant temperature gage
5. Throttle control
6. Control panel lamp
7. Engine oil pressure gage
8. Choke control
9. Suction gage
10. Tachometer-hourmeter
11. Discharge pressure gage
12. Engine starter pushbutton
13. Battery disconnect switch
14. Ignition switch
15. Safety bypass switch

Figure 2-1. Control panel controls and instruments.



1. Air cleaner restriction indicator
2. Fill plug
3. Suction gage valve
4. Discharge pressure gage valve
5. Fuel source selector valve
6. Auxiliary fuel line connector

Figure 2-2. Miscellaneous controls and indicators.



1. Fuel tank level gage
2. Fuel tank filler cap

Figure 2-3. Fuel tank and related parts.

Table 2-1. Controls and Instruments

Fig. & index No.	Name	Operation and use
2-1 1	Engine oil pressure safety switch	Automatically shuts down the unit when engine oil pressure falls below preset level of the switch. Correct cause of trouble before restarting operation.
2-1 2	Coolant temperature safety switch	Automatically shuts down the unit when engine coolant temperature increases above preset setting of the switch. Correct cause of trouble before restarting operation.
2-1 3	Ammeter	Indicates rate of battery charge or discharge. Charging rate may be higher immediately after starting but should taper off to near zero with continued operation. Immediately check cause of discharge indication that occurs during operation.
2-1 4	Coolant temperature gage	Indicates the temperature of engine coolant during operation. Normal operating temperature reading is 180° to 200°F.
2-1 5	Throttle control	Controls engine speed between idle and governed speed. When pulled out, it causes the engine to operate at idle speed. When pushed in fully, it causes engine to run at full governed speed. Intermediate settings provide intermediate engine speeds.
2-1 6	Control panel lamp	Provides illumination for control panel when operating during hours of darkness.
2-1 7	Engine oil pressure gage	Indicates engine oil pressure. At idle, oil pressure must exceed 7 psi. At governed speed, oil pressure must be 20 to 30 psi.
2-1 8	Choke control	When pulled out, the choke control supplies an extra-rich fuel mixture to the engine to facilitate engine starting and warmup. When pushed in fully, it restores normal fuel mixture for running the engine.
2-1 9	Suction gage	Compound gage indicates either vacuum or pressure condition at suction port when suction gage valve is open. Indication depends upon specific operating conditions.
2-1 10	Tachometer-hourmeter	Indicates the engine speed in hundreds of rpms. Normal governed speed rating is 2450 rpm. Engine speed at full load should not go beyond this level.. Hourmeter indicates engine running time based on operating speed (engine revolutions x 100,000).
2-1 11	Discharge pressure gage	Indicates pump discharge pressure when discharge pressure gage valve is open. High pressure indicates high discharge head or discharge line restriction. Normal discharge pressure varies with operating conditions.
2-1 12	Starter pushbutton	When the battery disconnect switch and ignition switch are ON, pressing the starter pushbutton energizes the engine starting motor to turn over the engine for starting.

Fig. & index No.	Name	Operation and use
2-1 13	Battery disconnect switch	In the ON position, the battery disconnect switch closes circuits to the starting system and ignition switch. In the OFF position, it interrupts these circuits.
2-1 14	Ignition switch	In the ON position, the ignition switch energizes the oil pressure and water temperature gage circuits and removes the ground from the ignition circuit to permit engine ignition. Battery disconnect switch must be in ON position to make this switch operative. When moved to OFF, ignition switch stops the engine by grounding the magneto, regardless of the position of battery disconnect switch.
2-1 15	Safety bypass switch	When reset, the safety bypass switch causes an electrical bypass of the oil pressure safety switch to allow normal starting.
2-2 1	Air cleaner restriction indicator	Indicates red when air cleaner is clogged, preventing free air passage. Requires reset after air cleaner service.
2-2 2	Fill plug	Allows pump body to be filled with fluid during priming. Replace plug before starting.
2-2 3	Suction gage valve	When open, the suction gage valve applies suction port pressure to suction gage.
2-2 4	Discharge pressure gage valve	When open, the discharge pressure gage valve applies discharge pressure to discharge pressure gage.
2-2 5	3-way fuel source selector valve	This valve has three positions as follows: OFF position shuts off fuel supply to engine. TANK position opens tank-to-engine fuel supply line. AUX position opens the line between the auxiliary fuel supply and engine.
2-2 6	Auxiliary fuel line connector	Provides connection for fuel line when engine fuel is supplied from auxiliary source of supply.
2-3 1	Fuel tank level gage	Indicates level of fuel in fuel tank.
2-3 2	Fuel tank filler cap	Remove filler cap to fill fuel tank.

2-3. Starting

a. Preparation for Starting.

(1) Perform the necessary daily preventive maintenance procedures (para 3-6).

(2) If the pump is being started for the first time, or if it has been drained since its last use, remove the fill plug (2, fig. 2-2) and fill the pump body with the fluid to be pumped. Replace the fill plug.

CAUTION

Be sure the pump has fluid in it before you attempt to start it. Starting the pump when it is completely dry may damage the shaft seal.

Unlatch and pull down the stone shield to provide adequate air flow through the radiator.

(3) Remove side panels from the engine.

NOTE

During operation, it may be necessary to reinstall the engine side panels, depending upon the ambient temperature, to maintain engine operation within the 180° to 200°F range.

b. Fuel Supply.

(1) Check the fuel level on the fuel tank level gage (1, fig. 2-3) mounted in the top of the tank. Refill if the gage reads low or empty unless auxiliary fuel supply is to be used.

(2) Move the fuel source selector valve (5, fig. 2-2) to TANK or AUX, whichever is applicable.

c. Starting Procedures.

(1) Push in throttle control (5, fig. 2-1) half way.

(2) Pull out choke control (8) all the way.

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 wear ear plugs fitted by a trained professional.

(3) Turn battery disconnect switch (13) to ON. Turn ignition switch (14) to ON.

CAUTION

Excessive cranking will cause the starting motor to overheat. If engine fails to start after 30 seconds of cranking, release the starter button and wait 2 minutes for the starting motor to cool before attempting to start the engine again.

(4) Press to reset the safety bypass switch (15). Press and hold the starter pushbutton (12). The engine should start after a few revolutions of the crankshaft. If it does not start within 30 seconds, release the pushbutton to stop cranking.

(5) When engine starts, release starter push button and watch the oil pressure gage (7). If normal operating range is not achieved within 10 seconds, shut down the engine.

(6) Push in the choke control (8) as necessary

to provide smooth engine operation. When the engine is warmed up, you must push the choke control all the way in.

(7) Adjust the throttle control (5) to run the engine at high idle speed (1200 to 1400 rpm as indicated on the tachometer-hourmeter) for a few minutes to allow the engine to warm up before applying the pump load.

2-4. Operation.

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 fitted by a trained professional.

a. Open the suction gage valve (3, fig. 2-2) and the discharge pressure gage valve (4) to operate the gages.

b. Push in the throttle control (5, fig. 2-1) all the way and operate the pump at maximum governed speed. Depending on pumping conditions, the pump may not start pumping immediately, since it is necessary for the suction line to fill with water. If after a reasonable time the pump fails to pump, check the suction line carefully for leaks. A small air leak will greatly reduce pumping efficiency under any conditions and especially when operating under a high suction lift.

c. After the pump starts pumping, as indicated by a reading on the discharge pressure gage, adjust the flow by operating the throttle control on the control panel to obtain the desired pumping rate.

d. Check the pump for any unusual or excessive vibration. If excessive vibration is noticed, stop the pump immediately. Correct or refer the problem to the next higher level of maintenance. Vibration usually occurs when the pump or connecting lines are not properly supported, alined, or secured.

e. While the pump is in operation, do not completely close off the discharge line. Although no serious harm can be done to the pump, the churning of liquid by rotating impeller can generate enough heat to cause the liquid to boil in the pump. Make sure that some passage of liquid continues through the pump during operation.

f. If the suction vacuum increases, or the pumping rate or pressure drops off for no apparent reason, check the suction line for blockage or closed valves.

g. If the engine stops due to an engine over speed condition, correct the cause of the overspeed and press the reset button on top the engine overspeed governor (4, fig. 3-3) to reset the overspeed circuit before attempting to restart the engine.

h. During operation, check the fuel level gage (1, fig. 2-3) at intervals. When necessary, shut off the engine, remove the filler cap (2) and add gasoline to fill the tank.

i. Check the air cleaner restriction indicator (1, fig. 2-2) at intervals during operation. If the restriction indicator shows red, the air cleaner requires servicing.

2-5. Stopping

CAUTION

Do not stop the engine by pulling out the choke. This floods the cylinders with raw gasoline, which washes away the lubricants and makes the engine susceptible to wear.

a. If the engine has been running hard, do not stop it abruptly. Reduce the engine speed to a high idle for several minutes before stopping. This will distribute engine heat, minimizing the danger of valve warpage and other internal damage.

b. Turn ignition switch OFF. Engine should stop immediately.

c. Turn battery disconnect switch (13, fig. 2-1) OFF. Turn fuel source selector valve (5, fig. 2-2) OFF.

Section II. OPERATION UNDER UNUSUAL CONDITIONS

2-6. Operation in Extreme Cold

a. Drain the pump. Keep free of ice and snow at all times when not in use. Cover it when not in use and, if possible, provide some shelter from the weather.

b. Use a hydrometer to ensure that the engine coolant has sufficient antifreeze to prevent freezing at the lowest temperature expected.

c. Refer to the current lubrication order (fig. 3 1) to determine the proper grade of engine lubricant for the coldest conditions likely to be encountered.

d. Keep the fuel tank filled when the pump is not in use. This will prevent moisture from condensing in the fuel system. Moisture in the fuel system can freeze and clog lines, filters, and carburetor jets, preventing fuel from reaching the engine.

e. Check the specific gravity of the batteries and make sure that they remain fully charged.

The specific gravity of a fully charged battery should be 1.250.

f. Service the fuel filter frequently to remove any moisture which may have collected in the fuel bowl.

2-7. Operation in extreme heat

a. Protect the pump assembly from direct rays of the sun if possible.

b. Allow adequate space for ventilation.

c. Keep the engine and radiator clean to provide proper heat transfer to the air.

d. Check that the lubricants used in the engine comply with the recommendations of the current lubrication order, figure 3-1.

e. Increase battery PMCS frequency.

2-8. Operation in High Altitudes

The operating efficiency of the engine diminishes at high altitudes. Make sure that the engine is operating at peak efficiency to provide the highest possible pump output.

2-9. Operation in Sandy or Dusty Areas

a. The frequency of air cleaner service must be increased when you are operating the pump assembly under conditions of extreme sand or dust.

b. While filling the fuel tank, take care to prevent the entry of sand and dust into the fuel system. Watch the fuel strainer bowl for accumulations of dirt.

2-10. Operation Under Rainy or Humid Conditions

a. Take care to prevent the entry of moisture into the fuel system. You should fill the fuel tank immediately after every operating period to prevent moisture in the air from condensing and entering the fuel system. Maintain a careful check of the fuel strainer bowl for collection of moisture.

b. Take special care to prevent rust and corrosion of exposed metal surfaces.

2-11. Operation in Salt Water Areas

a. Because of the corrosive action of salt water, use fresh water to wash off any salt water that comes in contact with the equipment. This will help you prevent the formation of rust and corrosion.

b. Take special care to prevent rust and corrosion of exposed metal surfaces.

CHAPTER 3

OPERATOR / CREW MAINTENANCE INSTRUCTIONS

Section I. LUBRICATION INSTRUCTIONS

3-1. General

This section contains supplemental information and lubrication instructions applicable to the pump assembly. Lubrication Order LO 5-4320-234-12 (fig. 3-1) will indicate to you the required lubrication points, intervals, and detailed instructions.

PUMP, CENTRIFUGAL, SELF-PRIMING, GASOLINE ENGINE DRIVEN,

WHEEL MOUNTED, 6-INCH, 1500 GPM CAPACITY AT 60 FOOT

HEAD (PEABODY-BARNES MODEL US90CCG-1) W/ENGINE

CONTINENTAL MODEL FS244-6100P

Reference: FEDERAL SUPPLY CATALOG C9100-IL and TM 5-4320-234-12

Intervals are based on normal hours of operation. Adjust to compensate for abnormal operations and severe conditions or contaminated lubricants. During Inactive periods, intervals may be extended commensurate with adequate preservation.

Relubricate after washing or fording.

Clean parts with dry cleaning solvent, Type II (SD-2). Dry before lubricating.

Lubrication points indicated by dotted arrow shafts ore located on both sides of the equipment.

* The time specified Is the time required to perform all services at the particular interval.

* TOTAL MAN-HR		* TOTAL MAN-HR	
INTERVAL	MAN-HR	INTERVAL	MAN-HR
10	0.1	150	0.5
50	0.3	2000	2.0

FOLD **FOLD**

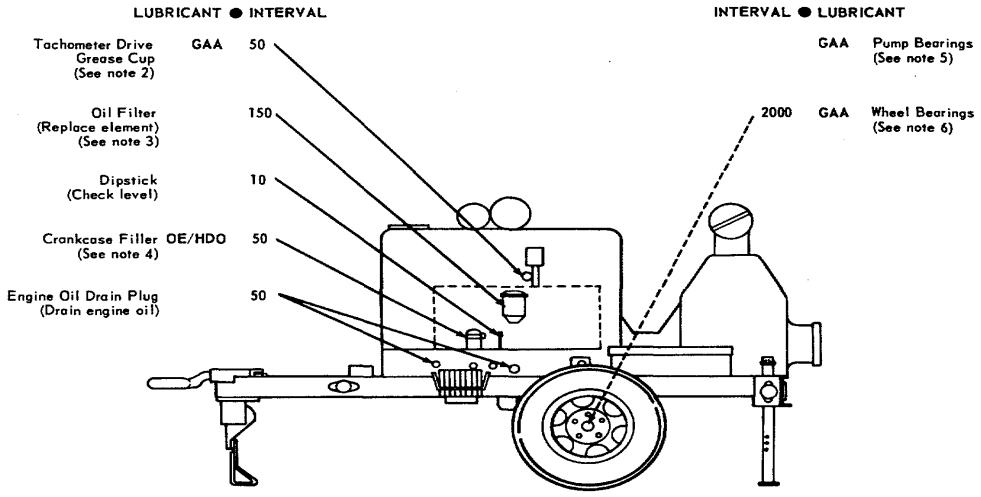


Figure 3-1. Lubrication order.

-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-LUBRICATING OIL, Engine		OE/HDO 30	OE/HDO 10	OEA	Intervals given are In hours of normal operation
Crankcase (See note 3)	4.5 qt (4.2L)				
Oil can points					
OEA-LUBRICATING OIL, Arctic					
GAA-GREASE, Auto & Artillery		ALL TEMPERATURES			

NOTES:

1. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW-10°F.(-18°C). Remove lubricants prescribed In the key for temperatures above-10°F.(-18°C). Relubricate with lubricants specified In the key for temperatures helow-10°F. (-18°C).

2. TACHOMETER DRIVE GREASE CUP. Give cup one full turn every 50 hours. When cup Is turned down fully, the grease is depleted; refill the cup.

3. ENGINE OIL FILTER. Replace filter to coincide with every third oil change. Remove filter while crankcase Is drained, clean filter housing with clean cloth, and install new filter element before replenishing engine oil. Crankcase requires extra quart of oil at intervals In which filter Is changed.

4. CRANKCASE FILLER. Check oil level every 10 hours. Add oil through filler if dipstick level is low. Remove both engine drain plugs to drain crankcase at oil change Interval. Drain oil while engine is hot.

5. PUMP BEARINGS. Pump bearings ore lubricated by the manufacturer at assembly and require no subsequent lubrication except oat scheduled overhaul periods.

6. WHEEL BEARINGS. Remove wheels and hubs, clean and inspect bearings, and repack with grease oat reassembly. Refer to TM 5-4320-234-12 for required wheel nut adjustment.

7. OIL CAN POINTS. Every 250 hours, using an oil can filled with OE/HDO, lubricate carburetor and governor linkages. trailer front leg, and hinged panels.

8. LUBRICANTS. The following is a list of lubricants with the military symbols and the applicable specification numbers.

OE/HDO-MIL-L-2104C OEA MIL-L-46167
GAA-MIL-G-10924

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
OFFICIAL: Chief of Staff

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

FOLD **FOLD**

Figure 3-1. Lubrication order-Continued

3-2. Detailed Lubrication Information

a. Keep all 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. Keep all lubrication equipment clean and ready to use.

b. All external parts that do not require lubrication must be kept free of lubricants. Before lubricating the equipment, wipe dirt and grease from all lubrication points. To prevent accumulation of dirt, clean all lubrication points after you lubricate them.

c. You must take the following precautions when using a sub-zero engine oil:

(1) The crankcase oil level must be checked frequently, as oil consumption may increase.

(2) The oil may require changing more frequently than usual because contamination by fuel dilution and sludge formation will increase under cold weather operation conditions.

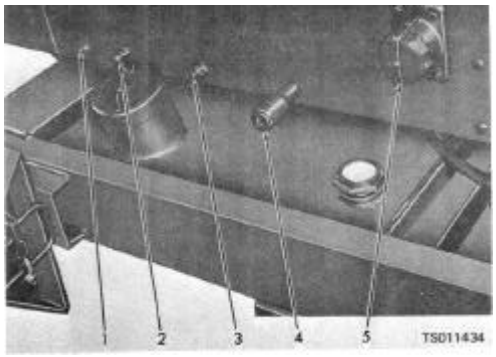
d. Change oil and service the oil filter as described in paragraph 3-3.

3-3. Engine Lubrication

a. Engine crankcase lubrication consists primarily of changing the oil in the crankcase and servicing the oil filter. Change oil every 50 operating hours and change the oil filter every 150 operating hours. Proceed as follows:

(1) Run the engine long enough to warm it to operating temperature. This is important since warm oil will drain from the internal engine parts much more rapidly than cold oil. The warm oil will carry more dirt and sludge with it as it drains.

(2) Place suitable containers under the engine drain ports and remove the oil pan drain plug (4, fig. 3-2) and oil cooler drain plug (1). Allow the oil to drain fully.



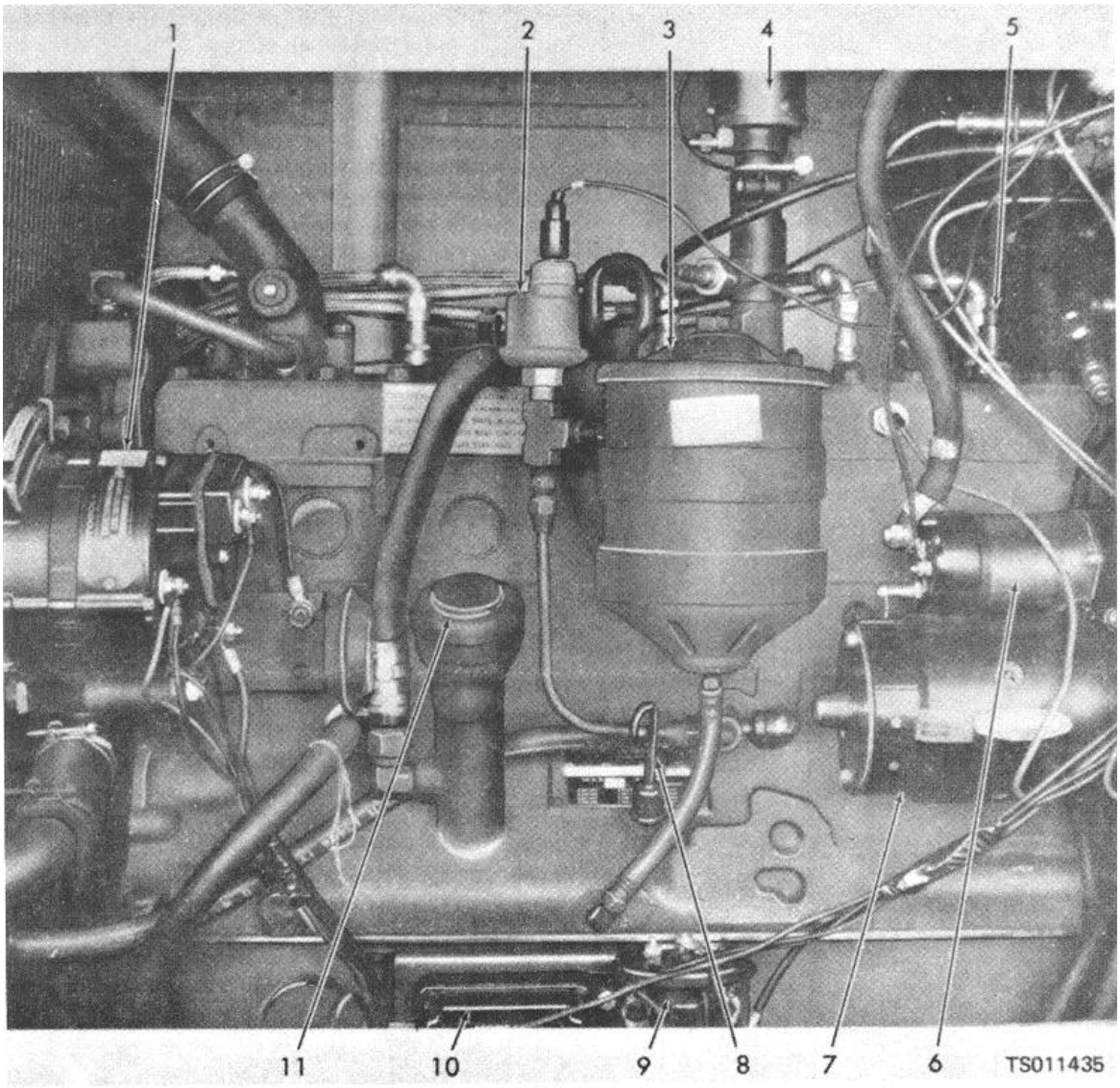
1. Oil cooler drain plug
2. Radiator coolant drain plug
3. Block coolant drain plug
4. Oil pan drain plug
5. Battery charging receptacle

Figure 3-2. Left side of engine housing showing drains and battery charging receptacle.

(3) Install plugs in the drain ports.

(4) Remove the filler cap (11, fig. 3-3) from the engine oil filler pipe and pour 4/2 quarts of engine oil into the engine. Use the engine oil required for the particular temperature range which will be encountered. Required grades of engine oils are as follows:

Below O°F	0 to 32°F	32 to 75°F	Above 75°F
5W-20	10W	SAE20W	SAE30



1. Alternator
2. Oil pressure sender
3. Oil filter
4. Engine overspeed governor
5. Water temperature sender
6. Starter solenoid switch
7. Engine starting motor
8. Oil level dipstick
9. Reverse polarity protector
10. Voltage regulator
11. Engine oil filler cap

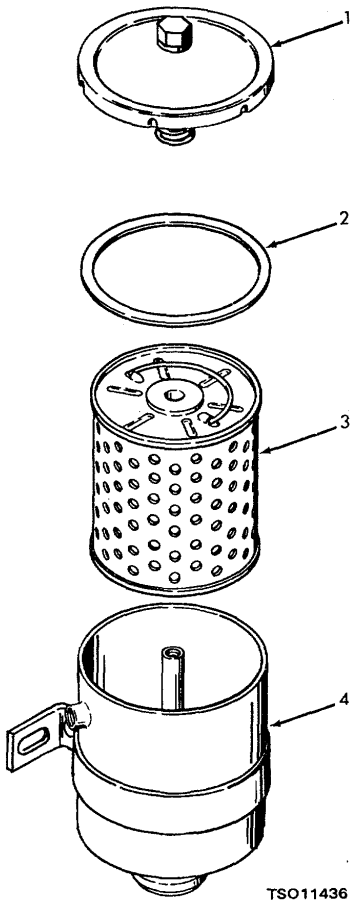
Figure 3-3. Left side of engine showing components.

(5) Check the oil level on the oil level dipstick (8, fig. 3-3). Oil must be up to the full mark. Add oil if necessary, but do not overfill.

b. Every third oil change (150 operation hours maximum), replace the oil filter as follows:

(1) Drain oil and replace plugs (para 3-3a).

(2) Remove the screw in the oil filter cover (1, fig. 3-4), and remove the cover and gasket (2).



1. Oil filter cover
2. Cover gasket
3. Filter element
4. Oil filter housing

Figure 3-4. Oil filter, exploded view.

(3) Remove the oil filter element (3) by lifting up the handle provided. Use a clean cloth to remove excess oil from the filter housing (4).

CAUTION

Do not use solvent of any kind to clean the oil filter housing. If solvent gets into the lubricating system, it can thin the oil so that it no longer protects the engine from wear.

(4) Wipe the interior of the filter housing with a clean, dry cloth.

(5) Install a new filter element in the filter housing.

(6) Replace gasket and cap. Before you tighten the attaching screw, carefully check the position of the gasket. If the cap is slightly tilted, the gasket probably is not seated. Loosen the screw and recheck it. When you are sure that the gasket is in its correct position, tighten the screw on the cover. It is not necessary to tighten the screw with all your strength, but it must be tight enough so that it will not loosen up during operation.

(7) Add 51/2 quarts of the proper grade oil (see para 3-3 a) through the oil filler. Wipe off oil filter housing and filler tube.

(8) Start engine and watch the oil filter closely. If the gasket is not properly seated, a large amount of oil can be lost in a very short time. No leakage is permitted. If you see any leakage, stop the engine immediately and repeat step (6) above to stop the leak.

(9) Shut off the engine after 3 to 5 minutes. Wait 5 to 10 minutes for the engine oil to drain back into the crankcase, and check the oil level on the dipstick (8, fig. 3-3). Add oil if necessary.

3-4. Pump Lubrication

The pump shaft bearings were packed with grease by the manufacturer at assembly and require no subsequent lubrication except at overhaul periods. No other pump lubrication is required.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

3-5. General

To ensure that the centrifugal pump is ready for operation at all times, it must be inspected systematically so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance checks and services to be performed are listed and described in paragraph 3-6. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit will be noted for future correction to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noted during operation which would damage the equipment if operation were continued. All deficiencies and shortcomings will be recorded together with the corrective action taken on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) at the earliest possible opportunity.

3-6. Preventive Maintenance Checks and Services

Refer to table 3-1 for a listing of operator's preventive maintenance checks and services.

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

D—Daily W—Weekly

Interval and Sequence No. D	Interval and Sequence No. W	ITEM TO BE INSPECTED PROCEDURE
1		ENGINE OIL Before operation, check level of oil in the crankcase. If the oil level is below the specified mark on the dipstick, remove the oil filler cap and add oil to bring the level to the specified mark. **NOTE** If it takes more than two quarts of oil to bring the level up to specifications, report this condition immediately to organizational maintenance.
2		AIR CLEANER Check restriction indicator mounted next to the control panel. If it indicates that the air cleaner must be serviced, proceed as described in paragraph 3-10. Remove the precleaner and clean out any accumulated dirt or debris
3		FUEL LEVEL **WARNING** Do not fill the fuel tank while the engine is running. Flammable vapors are released while the tank is being filled, and a spark from the engine could ignite them. Check fuel level on gage mounted on the fuel tank. Fill if necessary.
4		BATTERY If the battery electrolyte level is low, fill to the proper level with distilled water or a good grade drinking water (excluding mineral water) (para 3-12).
5		EXHAUST SYSTEM Check muffler, pipes and manifold for damage and leaks. Check weather cap for proper operation. Report damage to organizational maintenance.
6		GENERAL Walk around the pump unit and visually inspect for loose or missing bolts, screws, hoses, fittings, or other parts. Be sure the wheels are properly blocked. Check tires for 40-psi inflation and fill them if necessary.
7		SUCTION AND DISCHARGE LINES Check that all line connections are tight and that lines are free from severe abrasions, cracks, flatted areas, and obstructions.
8		UNUSUAL OPERATIONS During operation, check for leaking, low pumping rate, excessive noise or vibration, overheating, or other abnormal operation.
	9	FUEL STRAINER Check for dirt or water in the fuel bowl. Service if necessary (para 3-11).
	10	COOLING SYSTEM With the engine cold, open the radiator access cover on top the engine housing, and remove the radiator cap. If the coolant level is more than 11/2 inches below the filler neck, refer the unit to organizational maintenance for service.
	11	FAN BELT Inspect the fan belt for glazing, cracks, or other wear. The belt must deflect 3/4 to 1 inch with thumb pressure at midpoint of the longest belt span. Report a loose or worn belt to organizational maintenance.
	12	HOSES AND PIPING Inspect fuel lines, fuel pump, coolant hoses, water pump, and pump gage lines for leakage. Tighten fuel line fittings if necessary. Report all other trouble to organizational maintenance.
	13	PUMP Inspect the pump suction and discharge assemblies for loose mounting or damage. Check that the pump is firmly mounted to the chassis. The pump must be aligned carefully with the engine. Report an insecurely mounted pump to organizational maintenance for alignment and tightening.
	14	CHASSIS Inspect engine shrouds and chassis frame for cracks or damage. Refer the unit to organizational maintenance for necessary repairs.
	15	TIRES Fill tires to 40-psi inflation and inspect them for cuts, bruises, or blisters. Tire service is described in paragraph 3-13.
	16	TACHOMETER DRIVE Turn grease cup on tachometer drive clockwise two full turns to provide Tease to the gear teeth. When the grease cup is turned down all the way, refill it with automotive grease and reinstall it. Refer to LO 5-4320-234-12 (fig. 3-1).

Section III. TROUBLESHOOTING

3-7. General

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

b. This manual cannot list all malfunctions that may occur, nor all tests or inspections and corrective actions. If you experience a malfunction which is not listed or is not corrected by listed corrective actions, notify your supervisor.

3-8. Operator/ Crew Maintenance Troubleshooting Chart

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.

Table 3-2. Troubleshooting

MALFUNCTION TEST OR INSPECTION CORRECTIVE ACTION
ENGINE
1. ENGINE FAILS TO TURN OVER WHEN STARTING BUTTON IS DEPRESSED.
Step 1. Check that battery disconnect switch in ON. Turn battery switch on.
Step 2. Inspect for loose, corroded, or broken battery cables. Clean corroded cables. Tighten loose connections at battery, ground, and starter. If cables are broken, notify organizational maintenance.
2. ENGINE TURNS OVER BUT FAILS TO START.
Step 1. Check overspeed governor reset button. Reset by pushing the reset button on top the engine overspeed governor.
Step 2. If engine is cold, check for proper choke operation. Be sure choke control is out all the way, and is not binding, or only partially closed. If choke control is binding, report to organizational maintenance.
Step 3. If engine is hot, check for flooded carburetor. Open the flood relief drain cock on the underside of the carburetor, near the air inlet hose. Drain excess fuel. Restart with both throttle control and choke control in all the way.
Step 4. Check for dirt or water in fuel filter bowl. a. Close the shutoff valve on the fuel strainer. b. Loosen the bail nut and swing the bail aside and remove the glass fuel bowl and gasket. Empty the contents of the bowl and wipe it dry with a clean cloth. c. Remove the filter element and inspect it for contamination If filter element is found to be contaminated, replace it with a new one. d. Position the filter element, gasket and fuel bowl on the strainer housing. Swing bail into position and tighten the bail nut.
Step 5. Check for restricted fuel line. Inspect fuel lines for breaks, kinks, or pinched sections. Remove kinks and relocate pinched sections. Report other fuel line defects to organizational maintenance.
3. ENGINE STARTS BUT THEN STOPS.
Step 1. Check for open choke control when engine is warm. Push in choke control.
Step 2. Check for adequate fuel supply. Refill fuel tank
Step 3. Check for dirt or water in fuel filter bowl. a. Close the shutoff valve on the fuel strainer. b. Loosen the bail nut and swing the bail aside and remove the glass fuel bowl and gasket. Empty the contents of the bowl and wipe it dry with a clean cloth. c. Remove the filter element and inspect it for contamination. If filter element is found to be contaminated, replace it with a new one. d. Position the filter element, gasket and fuel bowl on the strainer housing. Swing bail into position and tighten the bail nut.
Step 4. Check temperature gage to determine if overheating has tripped temperature safety switch. Fill radiator to required level. Report broken fan belt or defective radiator hoses to organizational maintenance. Add oil if engine oil level is low. Open the radiator stone shield if it is closed.
Step 5. Check oil pressure safety switch reset. Add oil to crankcase to bring level to specified mark. Reset oil pressure safety switch. If safety switch trips when oil level is not low, report to organizational maintenance.

MALFUNCTION

TEST OR INSPECTION

CORRECTIVE ACTION

ENGINE-Continued

Step 6. Check overspeed governor reset.
Push reset button on top of overspeed governor. Restart and watch tachometer. If engine speed rises above 2700 rpm, report to organizational maintenance.

4. ENGINE RUNS BUT CONTINUALLY MISFIRES.
Step 1. Check for water in fuel.
Drain fuel tank and lines. Refill with fresh fuel.
Step 2. Check for clogged fuel strainer.
a. Close the shutoff valve on the fuel strainer.
b. Loosen the bail nut and swing the bail aside and remove the glass bowl and gasket.
Empty the contents of the bowl and wipe it dry with a clean cloth.
Step 3. If engine continues to misfire, report problem to organizational maintenance.

5. ENGINE OVERHEATS.
Step 1. Check radiator water level.
If low, fill radiator to proper level.
Step 2. Check for broken or worn fan belt.
Report damaged fan belt to organizational maintenance.
Step 3. Check for broken radiator hoses.
Report broken hoses to organizational maintenance.
Step 4. Check oil level.
If oil level is low, fill to the proper level with recommended oil.
Step 5. Check that radiator stone shield is open and that radiator is clear of foreign matter.
Remove foreign matter from radiator. Make sure that stone shield is open before operating engine.

6. ENGINE RUNS BUT LACKS POWER.
Step 1. Check that throttle control is in full speed position.
If throttle control is not in full speed position, push in throttle control to provide full speed operation.
Step 2. Check that choke control is fully in when engine is warm.
Push in choke control.
Step 3. Check for restriction in air cleaner.
a. Loosen the wing belt on the clamp assembly and remove the dust cover.
b. Remove the wing nut and remove the element.

CAUTION

Do not use gasoline or other solvents for cleaning the air element.

c. To clean the element, use a 1/8 inch air nozzle with 100 psi maximum compressed air, blowing from the inside toward the outside until all dust is removed.
d. An alternate method of cleaning the element is to wash it with a nonsudsing detergent in a container large enough to immerse the element. Allow it to soak for 10 minutes minimum and agitate it for 2 minutes to dislodge all dirt. Rinse with clean water, using water pressure from a tap with pressure of less than 40 psi. Air dry thoroughly before reinstallation.
e. Insert a light bulb in the cleaned element and carefully check for holes, cracks, or ruptures. Any hole in the element will necessitate element replacement.
f. Install element and secure with wing nut. Install dust cover and tighten clamp assembly wing bolt.
Step 4. Check for stuck weather cap on muffler.
Free weather cap.
Step 5. If engine continues to run, but lacks power, report problem to organizational maintenance.

PUMP ASSEMBLY

1. PUMP FAILS TO PRIME.
Step 1. Check for insufficient fluid in pump body.
Shut off engine. Remove fill plug on top of pump and fill with fluid to be pumped. Replace fill plug.
Step 2. Check for closed suction valve, if used.
Open valve.
Step 3. Check for air leak or loose fitting on suction side of pump.
Repair leak or tighten fitting.

2. PUMP FAILS TO DEVELOP HEAD.
Step 1. Check for leak in suction line.
If leak is detected, notify organizational maintenance.
Step 2. Check for low engine speed.
Operate throttle control to increase engine speed.

Section IV. MAINTENANCE PROCEDURES

3-9. General

This section describes the maintenance procedures assigned to the operator/crew level. Follow instructions given herein when performing the required maintenance procedures.

3-10. Air Cleaner Service

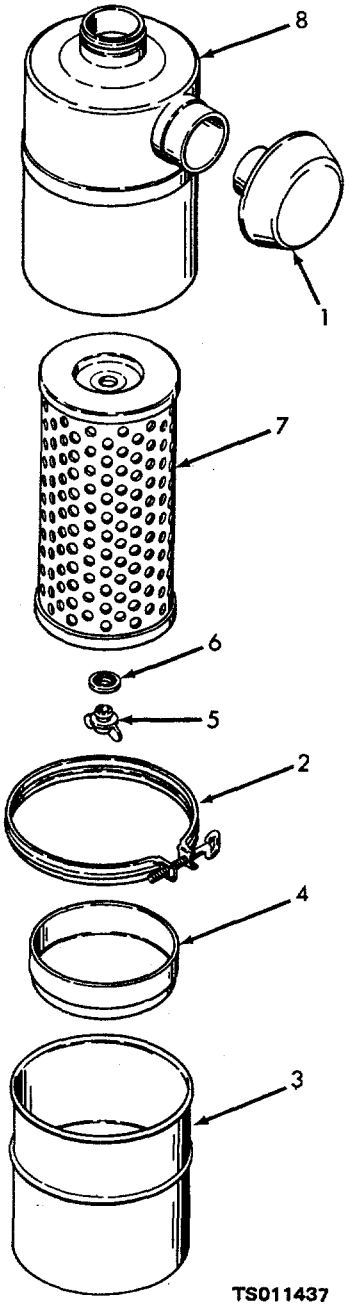
NOTE

The air cleaner element must be replaced after one year of service or after it has been cleaned six times, whichever comes first.

a. Removal.

(1) Stop the engine (para 2-5).

(2) Loosen the wing bolt on the clamp assembly (2, fig. 3-5) and remove the assembled dust cup (3) and flexible baffle (4). Remove the baffle from the dust cup and empty the dust from the dust cup.



1. Precleaner
2. Clamp assembly
3. Dust cup
4. Flexible baffle
5. Wing nut
6. Washer gasket
7. Air cleaner element
8. Air cleaner body

Figure 3-5. Air cleaner, exploded view.

(3) Remove the wing nut (5) with its assembled washer gasket (6) and remove the element (7) from the air cleaner body (8).

b. Cleaning and Inspection.

CAUTION

Do not use gasoline or other solvents for cleaning the air cleaner element.

CAUTION

Mechanical drying methods can be used to dry a washed element providing that the heated air does not exceed a temperature of 180 F with the air under constant circulation. Do not attempt to use light bulbs to dry element.

(1) To clean the air cleaner element, use a 1/8-inch air nozzle with 100 psi maximum compressed air, blowing from the inside toward the outside until all dust is removed.

(2) An alternate method of cleaning the element is to wash it with a non-sudsing detergent in a container large enough to immerse the element. Allow it to soak for 10 minutes minimum and agitate it for 2 minutes to dislodge all dirt. Rinse with clean water, using a pressure hose from a tap with pressure of less than 40 psi. Air dry thoroughly before reinstallation.

(3) Insert a light bulb in the cleaned element and carefully check for holes, cracks, or ruptures. Any hole in the element will necessitate element replacement. A hole, no matter how small, will cause unnecessary engine wear.

c. Installation.

(1) Install the element (7, fig. 3-5) in the air cleaner body (8). Check that the washer gasket (6) on the wing nut (5) is in good condition; secure the element to the body with the wing nut.

(2) Install the flexible baffle (4) in the cleaned dust cup (3), and install the parts on the body. Secure by tightening the wing screw on the clamp assembly (2).

3-11. Maintenance of Fuel System

a. Lines and Fittings. Normal operation of the pump and engine requires no lines and fittings maintenance other than tightening loose connections.

b. Tank.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 ° to 138 °F (38 ° to 59 'C).

(1) If the fuel inlet strainer becomes clogged, remove the filler cap and pull the strainer out of the filler neck. Clean it with a soft brush and dry cleaning solvent (fed. spec. P-D-680). Allow strainer to dry thoroughly before installing it in the fuel tank.

(2) If the fuel becomes contaminated with dirt or water, drain the tank as follows:

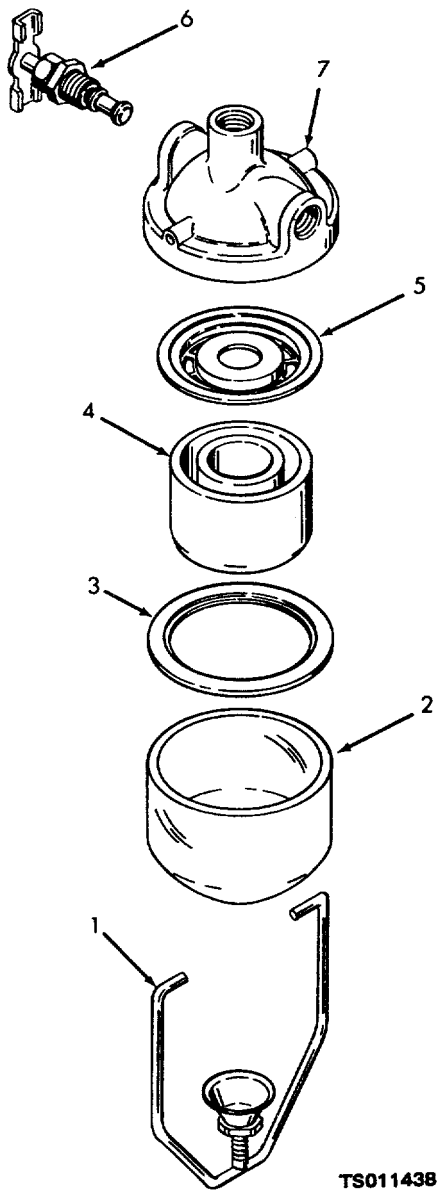
(a) Open the filler cap.

(b) Place a container of suitable size under the drain plug on the bottom rear of the tank. Remove the plug and drain the contaminated fuel. Flush the tank with a small amount of clean fuel.

(c) Replace the plug, refill the tank with fresh fuel, and replace the filler cap. Dispose of the contaminated fuel.

c. Fuel Strainer Service. If moisture or other contaminants are visible through the glass bowl of the fuel strainer, service the fuel strainer as follows:

(1) Close the shutoff valve (6, fig. 3-6) on the fuel strainer.



1. Bail
2. Fuel bowl
3. Bowl gasket
4. Filter element
5. Filter gasket
6. Fuel shutoff valve
7. Fuel strainer housing

Figure 3-6. Fuel strainer, exploded view.

(2) Loosen the nut on the bail (1) and swing the bail aside to release the glass fuel bowl (2). Remove the bowl and gasket (3). Empty the contents of the bowl and wipe it dry with a clean cloth.

(3) If engine operation indicates that the filter element (4) is contaminated, replace it with a new one.

(4) Position the gasket (3) and fuel bowl (2) on the fuel strainer housing (7). Swing bail (1) into position and tighten the bail nut to hold the bowl in place.

(5) Open the fuel shutoff valve (6) and check for leaks. Correct any leaks.

3-12. Maintenance of Electrical System

Operator/crew maintenance of the electrical system consists primarily of servicing the battery. Keep battery filled to the top of plates with distilled water. Keep the top of the battery and the battery terminals clean. To protect the terminals from corrosion, you can coat them with a light application of GAA lubricant.

3-13. Maintenance of Wheels

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

a. Clean tires and wheels with fresh, clean water.

b. Remove foreign material embedded in the tires. If you remove nails or other penetrating objects, be sure to inspect for punctures of the tubes.

c. Inspect wheels and rims for damage. Inspect tires for cracks, deep cuts, or separated tread.

d. Keep tires inflated to 40 psi.

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

3-14. Maintenance of Chassis

a. Using light engine oil as required, lubricate the front leg and lock pin, the rear leg supports and lock pins, and the tool storage box hinges.

b. Clean reflectors and tail light assembly lenses with a damp cloth as required. Replace tail light and stop/turn bulbs as required by removing the lens attaching screws to provide access to the bulbs.

CHAPTER 4

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATERIEL

4-1. Inspecting and Servicing the Equipment

a. Inspect the unpacked pump assembly as follows:

(1) Inspect for cracks, dents, and other damage that may have occurred during shipment.

(2) Inspect for loose or missing hardware.

(3) Check the engine for leaking.

(4) Inspect the suction and discharge ports for damaged ends and butted threads.

(5) Using the crank, turn over the engine with the battery disconnect switch and ignition switch in the OFF positions. The engine and pump must turn freely without binding or scraping or other signs of faulty operation.

(6) Inspect the control panel (fig. 1-1) for damaged controls and instruments.

(7) Remove the engine side panels (fig. 1-2). Inspect all hoses for abrasions, cracks, fraying, and other damage. Check tubing for kinks, flatted areas or other damage.

(8) Tighten all loose hardware. Report any other damage to the required authority.

b. Service the pump assembly as follows:

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 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 pump assembly for initial use, open the container of electrolyte and fill the dry charge battery in the battery box (fig. 1-1) so that the electrolyte is up to the required level. If possible, charge the battery for 10 or 15 minutes before connecting and applying the starting load. Refer to paragraph 4-37 for battery charging instructions. Make sure you have securely connected the battery. Note that the electrical system has a negative ground.

(2) Fill the fuel tank (fig. 1-1) with gasoline. Fuel tank capacity is 22.8 gallons.

(3) Check the engine coolant. Make sure the radiator is filled to the required level and that there is sufficient antifreeze for the required operating conditions. Normally, water that is suitable for drinking is suitable for use in the radiator.

(4) Check the oil level in the engine crank- case, using the dipstick (8, fig. 3-3). Add oil if the level is near the low mark on the dipstick.

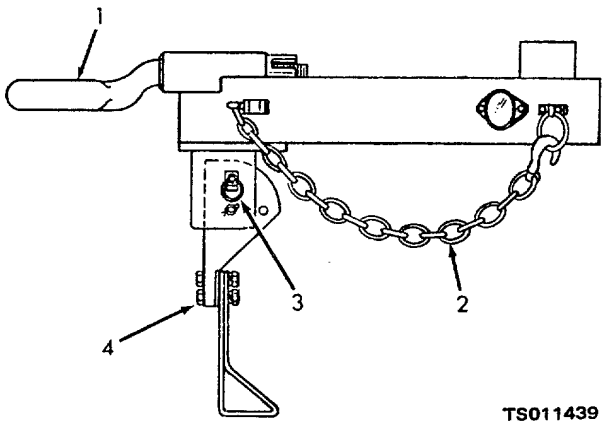
4-2. Installation

a. Locate the pump assembly on a solid, flat surface as close as possible to the source of supply. Allow ample room around the pump to support the suction and discharge lines and to enable you to service the pump as required.

CAUTION

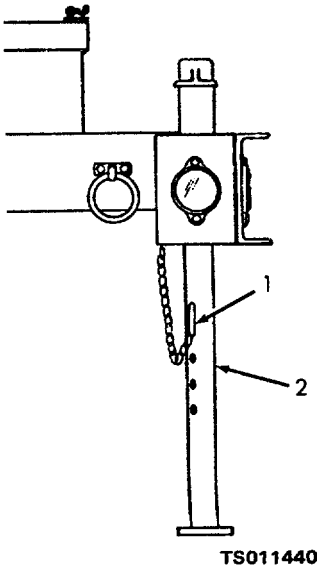
The tilt of the pump when spotted for operation shall not exceed 15 degrees from horizontal. An angle of more than 15 degrees will result in inefficient operation of the engine lubrication system and may cause severe damage to the engine or automatic shutoff due to low oil pressure.

b. Before the pump is disengaged from the towing vehicle, remove the lock pin (3, fig. 4-1) that holds the front leg assembly (4) in the raised position and lower the leg. Reinsert the pin to lock the leg. Install the chock blocks under the wheels to prevent the unit from rolling. Disconnect the electrical plug and the safety chains (2), then disengage the tow bar (1) from the towing vehicle. Pull out the pin (1, fig. 4-2) that holds the leg (2) of each rear stand and pull down the leg so that it is in firm engagement with the ground. Reinsert the pin to lock the position of the leg. The pump should now be firmly positioned so that it will not rock or wobble.



1. Tow bar
2. Safety chain
3. Lock pin
4. Front leg assembly

Figure 4-1. Front chassis leg.



1. Lock pin
2. Rear leg

Figure 4-2. Rear chassis stand.

c. Connect the suction line to the suction port (fig. 1-1), as follows:

(1) Remove the threaded cap (fig. 1-1) from the suction port. The suction port has a 6-inch NPT female thread. Connect it to a suction line with a matching 6-inch NPT thread.

(2) Keep the suction line as short as possible and the suction lift as low as possible. Reduction in pumping capacity becomes noticeable at suction lifts in excess of 15 feet and is very pronounced at 25 feet. You should not attempt to operate the pump with a suction lift in excess of 25 feet.

(3) The suction line should be as large a diameter and as short as practical, and should be installed with as few bends as possible. Use no fittings of less than a 6-inch diameter.

(4) The highest point in the suction line should be at the pump, and the line should be laid in a decline from the pump to the source. Avoid high points which will form air pockets.

(5) Make sure that connections in the suction line are air tight. Even a small leak will greatly reduce pumping efficiency and may cause difficulty in priming.

(6) Support the suction line at or near the pump to prevent strain.

d. Install the discharge line on the discharge elbow (fig. 1-1) as follows:

(1) Remove the threaded cap from the discharge port. The discharge port has a 6-inch NPT female thread. Connect it to a discharge line with a matching 6-inch thread.

(2) Avoid unnecessary fittings in the discharge line. When necessary to use elbows, use long radius type to reduce friction loss.

(3) Support the discharge line at or near the pump to prevent strain.

WARNING

Do not operate the pump unit in an enclosed area unless exhaust gases are piped to the outside. Inhalation of exhaust fumes will result in serious illness or death.

e. If the centrifugal pump is operated indoors, you must provide piping to carry exhaust gases to the outside of the building. Make sure that the diameter of the exhaust piping is large enough to prevent excessive back pressure in the engine.

f. If an auxiliary fuel supply is to be used, connect a fuel line between the source of supply, the auxiliary fuel line connector (6, fig. 2-2), and the 3-way fuel source selector valve (5) on the fuel tank. Operate the fuel valve to the AUX position.

NOTE

Due to the engine heat and vibration, engine cylinder head bolts have a tendency to loosen at initial operation. After the first 50 hours of engine use, retighten the cylinder head bolts to a torque of 35 to 40 foot-pounds. Follow the tightening sequence shown in figure 4-3.

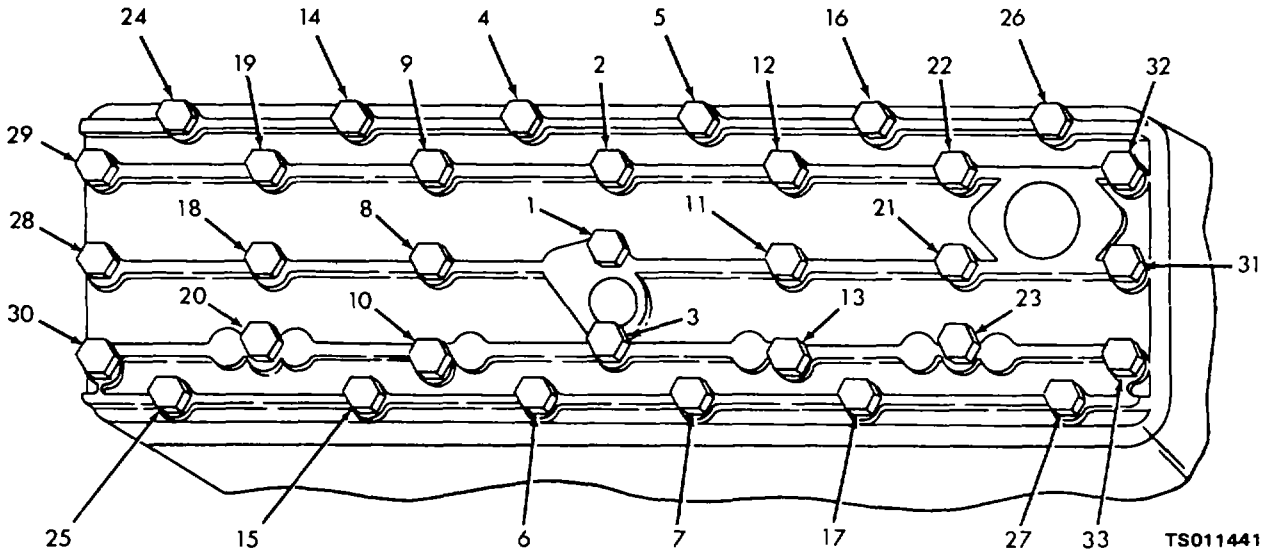


Figure 4-3. Cylinder head bolt tightening sequence.

Section II. MOVEMENT TO A NEW WORKSITE

4-3. Dismantling for Movement

Dismantle the pump for movement to a new worksite as follows:

a. Disconnect the suction line and discharge line from the pump. If possible, drain the lines before disconnecting them from the pump.

b. Remove the drain plug (fig. 1-1) from the bottom of the pump to drain the pump housing. Catch the fluid in a suitable container.

c. Cover the pump suction and discharge openings by installing the caps provided.

d. If installed, disconnect the fuel line from the 3-way fuel source selector valve (5, fig. 2-2) on the fuel tank.

e. Disconnect any exhaust piping from the pump.

f. Remove the pin from each rear stand and slide the leg up to its highest position. Reinsert the pin to secure it in the raised position. Hitch the tow bar (1, fig. 4-1) to the towing vehicle, making sure that it is properly secured. Connect the electrical cable to the receptacle on the towing vehicle and connect the safety chains (2). Remove the pin (3) and raise the front leg (4). Reinsert the pin to secure the leg. Remove the chock blocks from under the chassis wheels.

g. Before moving the unit, check that the stop, tail, and directional lights all light in response to operation of controls on the towing vehicle.

4-4. Reinstallation after Movement

Refer to paragraph 4-2 for installation instructions.

Section III. REPAIR PARTS, SPECIAL TOOLS, AND EQUIPMENT

4-5. Tools and Equipment

There are no tools, equipment, or repair parts issued with the pump assembly.

4-6. Special Tools and Equipment

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

4-7. Maintenance Repair Parts

Repair parts and equipment are listed in the repair parts and special tools list covering organizational maintenance for this equipment. Refer to TM 5-4320-234-20P.

Section IV. LUBRICATION INSTRUCTIONS

4-8. General

This section contains supplemental information and lubrication instructions that must be followed for the pump assembly at the organizational maintenance level. Refer to LO 5-4320-234-12 (fig. 3-1) for lubrication points, intervals, and detailed instructions. Also, reference to paragraphs 3-2 thru 3-4 of this manual will provide you with additional lubrication information.

4-9. Chassis Lubrication

Lubrication at organizational maintenance consists primarily of annual lubrication of wheel bearings. Refer to paragraph 4-52 for wheel bearing maintenance and lubrication instructions.

Section V. PREVENTIVE MAINTENANCE CHECKS AND SERVICES (MONTHLY AND QUARTERLY)

4-10. General

This section lists the preventive maintenance checks and services which shall be performed on a monthly or quarterly basis by organizational maintenance personnel. It includes and expands upon the preventive maintenance services performed by operator/crew maintenance and includes additional services which are allocated to organizational maintenance.

4-11. Preventive Maintenance Checks and Services

Refer to table 4-1 for a listing of the preventive maintenance checks and services which are allocated to organizational maintenance.

Table 4-1. Organizational Preventive Maintenance Checks and Services

M—Monthly Q—Quarterly

Interval and Sequence No.		ITEM TO BE INSPECTED PROCEDURE
M	**Q**	
1		ENGINE OIL Check that engine oil has been changed at the required intervals and that the oil filter element has been replaced as scheduled. Check crankcase oil level and, if necessary, add oil to bring the level to the specified mark.
2		AIR CLEANER Check restriction indicator mounted next to the control panel. If it indicates that the air cleaner must be serviced, proceed as described in paragraph 3-10. Remove the precleaner and clean out any accumulated dirt or debris.
3		FUEL LEVEL **WARNING** Do not fill the fuel tank while the engine is running. Flammable vapors are released while the tank is being filled, and a park from the engine could ignite them. Check fuel level on gage mounted on fuel tank. Check that the fuel in the tank is free of moisture and contamination.
4		BATTERY Check battery condition with a hydrometer. A fully charged battery has a temperature correct specific gravity reading of 1.275 at 750F. Charge the battery if the specific gravity is 1.250 or less. See paragraph 4-37 for procedures.
5		EXHAUST SYSTEM Check muffler, pipes and manifold for damage and leaks. Check weather cap for proper operation. Repair as necessary.
6		GENERAL Walk around the pump unit and visually inspect for loose or missing bolts, screws, hoses, fittings or other parts. Tighten or repair as necessary. Check tires for 40-psi inflation and fill them if necessary.
7		SUCTION AND DISCHARGE LINES Check that all line connections are tight and that lines are free from severe abrasions, cracks, flatted areas, and obstructions.
8		FUEL STRAINER Check for dirt or water in the fuel bowl. Service if necessary (para 3-11). If moisture or dirt in the fuel bowl is evident, check fuel supply for contamination.

Interval and Sequence No. M	Interval and Sequence No. Q	ITEM TO BE INSPECTED PROCEDURE
9		COOLING SYSTEM With the engine cold, open the radiator access cover on top the engine housing and remove the radiator cap. If the coolant level is low, check for coolant leaks. Some leaks are evident only when the engine is hot, and the coolant system is fully pressurized.
10		FAN BELT Inspect the fan belt for glazing, cracks, or other wear. The belt must deflect 3/4 to 1 inch with thumb pressure at midpoint of the longest belt span. Adjust belt as described in paragraph 4-31.
11		HOSES AND PIPING Inspect fuel lines, fuel pump, coolant hoses, water pump, and pump gage lines for leakage, Tighten fuel line fittings as necessary. Replace leaking parts.
12		PUMP Inspect pump suction and discharge assemblies for loose mounting or damage. Check that the pump is firmly mounted to the chassis. The pump must be aligned carefully with the engine. Align and tighten a loose pump.
13		CHASSIS Inspect engine shrouds and chassis frame for cracks or damage. If damage is extensive, refer to direct support maintenance for repair.
14		TIRES Fill tires to 40-psi air pressure and inspect them for cuts, bruises or blisters. Tire repair is described in paragraph 4-51.
15		TACHOMETER DRIVE Turn grease cup on tachometer drive clockwise two full turns to provide grease to the gear teeth. When the grease cup is turned down all the way, refill it with automotive grease and reinstall it. Add grease at grease fitting.
	16	RADIO SUPPRESSION EQUIPMENT. Inspect spark plug cable shields for wear or breaks. Replace if necessary. Tighten engine ground straps as required.
	17	MAGNETO ADJUSTMENT Check magneto breaker point gap. Adjust magneto breaker point gap to 0.015 inch (para 4-35).
	18	STARTING MOTOR OPERATION Follow starting procedure described in paragraph 2-3. While starting motor is engaged, listen for unusual noises or sluggish operation. Replace if defective (para 4-42).
	19	ALTERNATOR OPERATION Note the alternator charging rate indicated on the ammeter. For the first few minutes after the engine is started, the charging rate should be high, but it should level off to a lower value within 10 minutes, if batteries were properly charged at startup. If the alternator or regulator is visibly damaged. replace as required (para 4-38 and 4-39).
	20	GOVERNOR TEST Clean governor linkage and lubricate with light engine oil. With the engine running at operating temperature, push throttle control all the way in and note engine speed on tachometer. Maximum no-load governed speed must not exceed 2450 rpm. Governor adjustment is described in paragraph 4-27.

Section VI. TROUBLESHOOTING

4-12. General

a. This section contains troubleshooting or malfunction information and tests for locating and correcting most of the troubles which may develop in the Pump, Centrifugal. Each malfunction or trouble symptom for an individual component, unit, or system is followed by a list of tests or inspections necessary for you to determine probable causes and suggested corrective actions for you to remedy the malfunction.

b. This manual cannot list all possible malfunctions that may occur or all tests or inspections, and corrective actions. If a malfunction is not listed, or is not corrected by listed corrective actions, you should notify higher level maintenance.

c. Table 4-2 lists the common malfunctions that you may find during the operation or maintenance of Pump, Centrifugal or its components. You should perform the tests/inspections and corrective actions in the order listed.

4-13. Organizational Maintenance Troubleshooting Chart

Refer to table 4-2 for troubleshooting which is allocated to organizational maintenance levels.

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 TURN OVER WHEN STARTING BUTTON IS DEPRESSED.

Step 1. Check to see if battery disconnect switch is on.
Turn battery switch on.

Step 2. Inspect for loose or broken battery cables.
Tighten or replace broken battery cables.

Step 3. Check for a weak or dead battery.
a. Check the batteries with a hydrometer. Fully charged batteries shall have a minimum specific gravity of 1.275 at 75 F (23.89C).

CAUTION

Constant-current battery charging is always preferred. If you must use a constant-potential charger, battery temperatures must be maintained at less than 130F (54.44C) by interrupting the charging procedure as this temperature is approached.

b. If the specific gravity of the electrolyte is less than 1.250, the batteries must be charged before use. Remove the caps and check the electrolyte level in each cell. If any are low, fill with distilled water or good grade drinking water (excluding mineral water).
c. A battery charging receptacle is located at the lower left rear of the engine housing. Connect battery charger in to this receptacle. When you charge the batteries, use a constant current charger.
Check the specific gravity of the electrolyte every 30 minutes. The batteries are fully charged when you get a constant specific gravity reading for three 30 minute intervals.
d. During charging, check the electrolyte level frequently. Add distilled water when necessary to maintain the battery electrolyte level. Continue charging after adding distilled water to ensure proper mixing of the solution.

NOTE

Military batteries and maintenance free batteries cannot be mixed. Undercharge or overcharge of one will result.

e. If the battery fails to take or maintain a charge replace it.

Step 4. Check for a faulty starter push button switch.
a. Check the starter push button switch for a cracked case, lack of positive switch action, and other damage.
b. Check the switch for continuity, using a multimeter or test lamp. Replace a defective switch.
c. Disconnect the electrical leads from the starter push button switch. Remove nut from switch and remove switch from the control panel.
d. Insert a new starter push button switch in the control panel and secure with nut. Connect all electrical leads.

Step 5. Check for a defective starting motor.
a. Disconnect the electrical leads to the starter solenoid switch.
b. Remove three capscrews and lock washers that secure the starting motor to the flywheel housing.
Pull straight forward on the starting motor and remove it from the engine.
c. Check the armature for free rotation by turning with hand. There must be no catching, binding, or scraping as the armature is rotated.
d. To check the starter solenoid, apply 24 vdc between the BAT terminal of the solenoid and the switch(s) terminal. This will advance the starter drive to the engage position. With the drive advanced and power still applied, using a multimeter check continuity between the BAT and motor (m) terminals. continuity must exist. Break the circuit to the terminals. The drive must retract fully, and the circuit between the (BAT) and motor (m) terminals must break.
e. Replace a damaged, worn, or inoperative starter.
f. Place starter on the flywheel housing and secure with capscrews and lockwasher. Connect all electrical leads.

2. ENGINE TURNS OVER BUT FAILS TO START (NO SPARK OR WEAK SPARK).

Step 1. Check for a defective ignition switch.
a. Check the ignition switch for a cracked case, lack of positive switch action, and other damage.
b. Check the switch for continuity, using a multimeter or test lamp. Replace a defective switch.
c. Disconnect the electrical leads from the switch. Remove nut from switch and remove switch from control panel.
d. Install switch in the control panel and secure with nut. Connect all electrical leads.

Step 2. Check overspeed governor reset.
a. Reset by pushing reset button on top of engine overspeed governor.
b. If the engine starts, and the tachometer indicates over 2750 rpm, stop the engine and adjust the overspeed governor. If the engine stopped before the tachometer indicated 2650 rpm, you must adjust the overspeed governor.
c. Restart the engine and have an assistant watch the tachometer. To adjust the engine overspeed governor, loosen the lockscrew that secures the cap in position. To decrease the engine shutoff speed, rotate the cap clockwise. To raise the engine shutoff speed, turn the cap counterclockwise. After the desired speed 2750 rpm is obtained, tighten the lock screw. Replace the overspeed governor if it cannot be adjusted.
d. Disconnect and tag the electrical leads. Remove capscrew that secures the overspeed governor to governor arm and remove the overspeed governor.
e. Install overspeed governor on the governor arm and secure with capscrew. Connect all electrical leads.

ENGINE-Continued

Step 3. Check magneto breaker points for proper gap.
a. Remove four screws and lockwashers that secure the end cover on the magneto; remove the cover and gasket.
b. Tag and disconnect the shielded spark plug cables from the magneto end cap, by unscrewing the shield connectors.
c. Using the hand crank, turn the engine over until the movable contact is on the high portion of the cam. Insert a feeler gage between the contact points. The required contact gap is 0.015 inch. Loosen the stationary contact mounting screw and adjust the position of the stationary contact to provide the required gap when the cam holds the contacts fully open. Tighten the stationary contact screw to secure the adjustment.
d. To replace the breaker points, remove four screws and lockwashers that secure the end cover on the magneto; remove the cover and gasket. Remove four screws that secure the end cap and gasket to the magneto; remove the end cap and gasket. Remove retaining ring and remove the movable contact from the pivot. Remove screws and washers that secure the stationary contact and cam wick to the magneto, remove the stationary contact and cam wick.
e. Apply a light coat of grease on the magneto cam. Position the new stationary contact set on the magneto bearing support; secure by installing the cam wick, screws and lockwashers, do not tighten screws. Position the movable contact on the pivot of the bearing support; secure with the retaining ring. Refer to step 3, para c for contact set adjustment.

Step 4. Check for a defective magneto capacitor.
a. Remove two screws and lockwashers that secure the capacitor to the lower front of the magneto; remove the capacitor and packing.
b. Using a multimeter or ohmmeter test capacitor for continuity. Replace a defective capacitor.
c. Position capacitor and packing in the magneto; secure with screws and lockwashers.

Step 5. Check for defective spark plugs.
a. Tag and disconnect the shielded spark plug cables from the spark plugs. Using a spark plug wrench, remove the spark plugs.

WARNING

Dry cleaning solvent, PD 680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100F-138F (38C-59C).

b. Wipe the exterior of the spark plugs with a cloth dampened with dry cleaning solvent (fed spec. PD 680) dry thoroughly.
c. Check the ceramic insulator for cracks, porosity, and other damage.
d. If the electrodes of the spark plugs are not too badly burned, remove the scale and other deposits from them. This can be done by a sand blast type cleaner or with a contact file.
e. Inspect the electrodes for severe burning, cracks, and other damage. Replace any spark plugs whose condition is doubtful.
f. Make sure all spark plugs are gapped to 0.025 inch before installation. Install and torque the spark plugs to 35 foot-pounds.

3. ENGINE TURNS OVER BUT FAILS TO START (GOOD SPARK).

NOTE

Before proceeding, carefully review the step-by-step starting procedures detailed in paragraph 2-3. Omission of one or more steps can prevent the engine from starting.

Step 1. If engine is cold, check for proper choke control Operation.
Be sure choke control is all the way out, and is not binding or stuck only part-way closed.

Step 2. If engine is hot, check for flooded carburetor.
Open the flood relief drain cock on the underside of the carburetor, near the air cleaner inlet hose and allow excess fuel to drain. Restart with both throttle control and choke control in all the way.

Step 3. Check for dirt or water in fuel filter bowl.
a. Close the shutoff valve on the fuel strainer.
b. Loosen the bail nut and swing the bail aside. Remove the glass bowl and gasket. Empty the contents of the bowl and wipe it dry with a clean dry cloth.
c. If engine operation indicates that the filter element is contaminated, replace it with a new one.
d. Install filter element in strainer housing and install gasket and glass bowl. Swing bail into position and tighten the bail nut.

Step 4. Check for restricted fuel line.
Inspect fuel lines for breaks, kinks, or pinched sections. Repair or replace as necessary.

Step 5. Check fuel pump for operation.
a. Disconnect fuel hose at carburetor. Push and hold starter button for a few seconds. Gas should be ejected from the fuel line. Replace a defective fuel pump.
b. Disconnect fuel hose at fuel strainer. Remove fuel strainer from the fuel pump. Remove two capscrews and lockwashers and remove the fuel pump and gasket.
c. Position a new fuel pump and gasket on the engine and secure with capscrews and lockwashers. Install fuel strainer on the fuel pump and connect fuel hose to fuel strainer. Connect fuel hose to carburetor.

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE-Continued

Step 6. Check magneto breaker points for proper gap.
a. Remove four screws and lockwashers that secure the end cover on the magneto; remove the cover and gasket.
b. Tag and disconnect the shielded spark plug cables from the magneto end cap, by unscrewing the shield connectors.
c. Using the hand crank, turn the engine over until the moveable contact is on the high portion of the cam. Insert a feeler gage between the contact points. The required contact gap is 0.015 inch. Loosen the stationary contact mounting screw and adjust the position of the stationary contact to provide the required gap when the cam holds the contacts fully open. Tighten the stationary contact screw, to secure the adjustment.

Step 7. Check carburetor fuel filter.

WARNING

Dry cleaning solvent, PD-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100F-138F (38C-59C).

a. The carburetor fuel filter is located in top of the carburetor near the fuel inlet.
b. Remove the fuel filter from the carburetor.
c. Clean fuel filter with a soft bristle brush and dry cleaning solvent (fed. spec PD-680). Allow filter to dry thoroughly before reinstalling.

Step 8. Check for defective spark plugs.
a. Tag and disconnect the shielded spark plug cables from the spark plugs. Using a spark plug wrench, Remove the spark plugs.

WARNING

Dry cleaning solvent, PD-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100F-138F (38C-59C).

b. Wipe the exterior of the spark plugs with a cloth dampened with dry cleaning solvent (fed. Spec. PD-680) dry thoroughly.
c. Check the ceramic insulator cracks, porosity, and other damage.
d. If the electrodes of the spark plugs are not too badly burned, remove the scale and other deposits from them. This can be done by a sand blast type cleaner or with a contact file.
e. Inspect the electrodes for severe burning cracks, and other damage. Replace any spark plugs whose condition is doubtful.
f. Make sure all spark plugs are gapped to 0.025 inch before installation. Install and torque the spark plugs to 35 foot pounds.

Step 9. Check for incorrect ignition timing.
a. Start the engine and idle at 600 rpm.
b. Use a timing light, connected to the rear spark plug and check that the IGN-M indication on the flywheel is aligned with the timing pointer. If it is not aligned, loosen the magneto mounting hardware and rotate the magneto slightly until the IGN-M indication on the flywheel is obtained.

4. ENGINE RUNS BUT CONTINUALLY MISFIRES.

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

Step 2. Check for clogged fuel strainer.
a. Close the shutoff valve on fuel strainer.
b. Loosen the bail nut and swing the bail aside. Remove the glass bowl and gasket. Empty the contents of the bowl and wipe it dry with a clean dry cloth.
c. If engine operation indicates that the filter element is contaminated, replace it with a new one.
d. Install filter element in strainer housing, and install gasket and glass bowl. Swing bail into position and tighten the bail nut.

Step 3. Check carburetor fuel filter.

WARNING

Dry cleaning solvent, PD-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100F-138F (38C-59C).

a. The carburetor fuel filter is located in top of the carburetor near the fuel inlet.
b. Remove the fuel filter from the carburetor.
c. Clean fuel filter with a soft bristle brush and dry cleaning solvent (fed spec PD-680). Allow filter to dry thoroughly before reinstalling.

Step 4. Check for defective spark plugs.
a. Tag and disconnect the shielded spark plug cables from the spark plugs. Using a spark plug wrench, remove the spark plugs.

WARNING

Dry cleaning solvent, PD-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100F-138F (38C-59C).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE--Continued

b. Wipe the exterior of the spark plugs with a cloth dampened with dry cleaning solvent (fed. spec PD-680), dry thoroughly.
c. Check the ceramic insulator for cracks, porosity, and other damage.
d. If the electrodes of the spark plugs are not too badly burned, remove the scale and other deposits from them. This can be done by a sand-blast-type cleaner or with a contact file.
e. Inspect the electrodes for severe burning, cracks, and other damage. Replace any spark plug whose condition is doubtful.
f. Make sure all spark plugs are gapped to 0.025 inch before installation. Install and torque the spark plugs to 35 foot pounds.

5. ENGINE OVERHEATS

Step 1. Check oil level.
If oil level is low, fill to the proper level with recommended oil.

Step 2. Check that radiator stone shield is open and that radiator is clear of foreign matter.
Always open stone shield before operating engine. Remove foreign matter from radiator.

Step 3. Check for low coolant level.
Refill with approved coolant as required.

Step 4. Check for loose or damaged fan belt.
a. Inspect the fan belt for cracks, brittleness, and severe glazing. Replace a damaged fan belt.
b. Loosen the adjusting screw on the alternator adjusting strap and push the alternator toward the engine to loosen fan belt tension. Slip the fan belt off the alternator drive pulley and remove it from the fan and drive pulley.
c. Position a new fan belt on the fan and drive pulley and alternator drive pulley.
d. Pull the alternator away from the engine with hand pressure to tighten the fan belt.
e. Hold the alternator away from the engine and tighten the adjusting screw. The fan belt should be tensioned so that it can be deflected approximately 3/4 inch with thumb pressure at a point midway between pulleys at the longest belt span.

Step 5. Check for a clogged radiator.
a. Cover the engine with a piece of plastic film to prevent saturating the components before attempting to flush the exterior of the radiator.
b. Clean the exterior of the radiator by flushing a steam of water through it in a direction opposite that of the cooling fan. Since this engine uses a pusher type fan, it is necessary to squirt the water from the outside of the radiator inward toward the engine.
c. Disconnect the hoses connecting the engine and radiator. With the radiator cap closed tightly, use a flushing gun to reverse-flush the radiator. Fill the radiator with water, then blow out the water with compressed air, applying pressure slowly to prevent radiator damage. Repeat several times until the expelled flushing stream is clear.

Step 6. Check for a defective water pump.
a. Loosen the adjusting screw on the alternator adjusting the strap and push the alternator toward the engine to loosen fan belt tension.
b. Check the rotation of the water pump shaft by turning the fan by hand. It must turn easily without catching or binding. Replace a leaking or damaged water pump.
c. Remove the fan belt from the fan and drive pulley. Remove the four capscrews that secure the fan to the water pump pulley; remove the fan.
d. Drain the coolant from the radiator and cylinder block. Disconnect coolant hoses and bypass tube from the water pump. Remove the elbow and adapter. Remove three capscrews and lockwashers that secure the water pump to the cylinder block; remove the water pump and gasket.
e. Position water pump and gasket on the cylinder block and secure with screws and lockwashers.
Install the elbow and adapter. Connect coolant hoses and bypass tube to the water pump. Add coolant to the radiator and cylinder block.
f. Install the fan on the water pump pulley and secure with capscrews. Install fan belt on the fan and drive pulley and alternator drive pulley.
g. Pull the alternator away from the engine with hand pressure to tighten the fan belt.
h. Hold the alternator away from the engine and tighten the adjusting screw. The fan belt should be tensioned so that it can be deflected approximately 3/ inch with thumb pressure at a point midway between pulleys at the longest belt span.

Step 7. Check for a defective thermostat.
a. Drain coolant from the radiator. Remove radiator top hose and water pump bypass tube.
b. Remove two nuts and lockwashers and remove water outlet elbow, gasket, and thermostat.
c. Inspect the thermostat for obvious defects, including ruptured bellows and distortion. If the valve, when cold, can be pushed off its seat with only slight effort, the thermostat is defective and must be replaced.
d. Check the thermostat operation as follows:
(1) Hang the thermostat by its frame in a container of water so that it does not touch the container. Hang a thermometer in the container to maintain a check of water temperature.
(2) Heat the water slowly while watching the thermometer and thermostat. The thermostat must start to open before the thermometer indicates 180 F. (82.22 C.). Replace the thermostat if it fails to open at 180 F (82.22 C) or if it starts to open before 160 F. (71.11 C).

MALFUNCTION
TEST OR INSPECTION
CORRECTIVE ACTION

ENGINE--Continued

e. Install the thermostat, water outlet elbow and gasket on the engine. Secure the water outlet elbow with nuts and lockwashers.
f. Connect the water pump bypass tube and radiator top hose. Service the engine coolant system.
Start the engine and run it until it reaches operating temperature, and check for leaks.
Correct any leaks noted.

Step 8. Check for incorrect ignition timing.
a. Start the engine and idle at 600 rpm.
b. Use a timing light, connected to the rear spark plug and check that the IGN-M indication on the flywheel is aligned with the timing pointer. If it is not aligned, loosen the magneto mounting hardware and rotate the magneto slightly until the IGN-M indication on the flywheel is obtained.

6. ENGINE RUNS BUT LACKS POWER

Step 1. Check that throttle control is in full speed position.
a. If throttle control is not in full speed position push in throttle control to provide full speed operation. Adjust throttle control if necessary.
b. To adjust the throttle control rod, loosen nut at ball joint and adjust throttle rod length until operating range of 2750 rpm is obtained. Tighten throttle rod ball joint locknut.

Step 2. Check for restriction in air cleaner.
a. Loosen the wing bolt on the clamp assembly and remove the dust cover.
b. Remove wing nut and remove the element.

CAUTION

Do not use gasoline or other solvents for cleaning the air cleaner element.

c. To clean the element, use a 1/8 inch air nozzle with 100 psi maximum compressed air, blowing from the inside toward the outside until all dust is removed.
d. An alternate method of cleaning the element is to wash it with a nonsudsing detergent in a container large enough to immerse the element. Allow it to soak for 10 minutes minimum and agitate it for 2 minutes to dislodge all dirt. Rinse with clean water, using water pressure from a tap with pressure of less than 40 psi. Air dry thoroughly before reinstallation.
e. Insert a light bulb in the cleaned element and carefully check for holes, cracks, or ruptures. Any hole in the element will necessitate element replacement.
f. Install element and secure with wing nut. Install dust cover and tighten clamp assembly wing bolt.

Step 3. Check for stuck weather cap on muffler.
Free weather cap, squirting oil on swivel and tapping lightly with a hammer.

Step 4. Check for incorrect ignition timing.
a. Start the engine and idle at 600 rpm.
b. Using a timing light, connected to the rear spark plug and check that the IGN-M indication on the flywheel is aligned with the timing pointer. If it is not aligned, loosen the magneto mounting hardware and rotate the magneto slightly until the IGN-M indication on the flywheel is obtained.

7. ENGINE BACKFIRES

Step 1. Check for incorrect ignition timing.
a. Start the engine and idle at 600 rpm.
b. Use a timing light, connected to the rear spark plug and check that the IGN-M indication on the flywheel is aligned with the timing pointer. If it is not aligned, loosen the magneto mounting hardware and rotate the magneto slightly until the IGN-M indication on the flywheel is obtained.

8. ENGINE OPERATED ERRATICALLY

Step 1. Check for improper fuel mixture.
a. Turn the carburetor main adjusting screw clockwise to reduce the fuel to the engine until the engine begins to miss due to a lean fuel mixture.
b. Turn the adjusting screw counterclockwise until the engine runs smoothly without missing.
c. With the engine at idle, turn the carburetor idle mixture adjustment screw clockwise to cut off air. making the fuel mixture richer, until the engine starts to run roughly due to excessively rich mixture.
d. Turn the idle mixture adjustment screw counterclockwise to obtain the smoothest idle operation possible.

Step 2. Check for defective spark plugs.
a. Tag and disconnect the shielded spark plug cables from the spark plugs. Using a spark plug wrench, remove the spark plugs.

WARNING

Dry cleaning solvent PD-680, used to clean parts is potentially dangerous to personnel and property. Avoid repeated and prolonged skin contact. Do not use near open flame or excessive heat. Flash point of solvent is 100 F.-138 F. (38 C.-59 C).

b. Wipe the exterior of the spark plugs with a cloth dampened with dry cleaning solvent (Fed Spec. PD-680), dry thoroughly.
c. Check the ceramic insulator for cracks, porosity, and other damage.
d. If the electrodes of spark plugs are not too badly burned, remove the scale and other deposits from them. This can be done by a sand-blast type cleaner or with a contact file.
e. Inspect the electrodes for severe burning cracks, and other damage. Replace any spark plug whose condition is doubtful.
f. Make sure all spark plugs are gapped to 0.025 inch before installation. Install and torque the spark plugs to 35 foot pounds.

Section VII. RADIO INTERFERENCE SUPPRESSION

4-14. General Methods Used to Attain Proper Suppression

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

4-15. Replacement of Suppression Components

This equipment uses no primary radio suppression components. Replace the shielded spark plug cables and ground strap as directed in paragraph 4-35.

Section VIII. MAINTENANCE OF AIR CLEANER, EXHAUST SYSTEM, AND ENGINE HOUSING

4-16. Description

a. Air Cleaner. The air cleaner (fig. 1-1) is mounted on the end of the engine housing opposite the radiator. It is a dry-type unit which uses a porous paper element to screen the particles of dust and dirt from the air before the air enters the carburetor. A flexible hose connects the air cleaner and carburetor. Proper maintenance requires cleaning or replacement of the air cleaner element when the restriction indicator shows a restricted condition. This occurs when the engine is running and the clogged condition of the air cleaner prevents sufficient air from entering the engine. The partial vacuum in the air lines trips the restriction indicator, indicating the need for servicing or replacement of the air cleaner element.

b. Muffler. The muffler (fig. 1-1) is a hollow cylinder containing internal baffles which break up the flow pattern of the exhaust gases expelled by the engine to provide quiet engine operation. It is mounted on top the engine housing and is connected to the exhaust manifold of the engine by a pipe nipple. A heat shield is mounted between the muffler and housing to minimize heat transfer to the housing.

c. Engine Housing. The engine housing protects the engine from the weather, aids cooling by directing the air flow around the engine, and provides a mounting for the air cleaner and muffler.

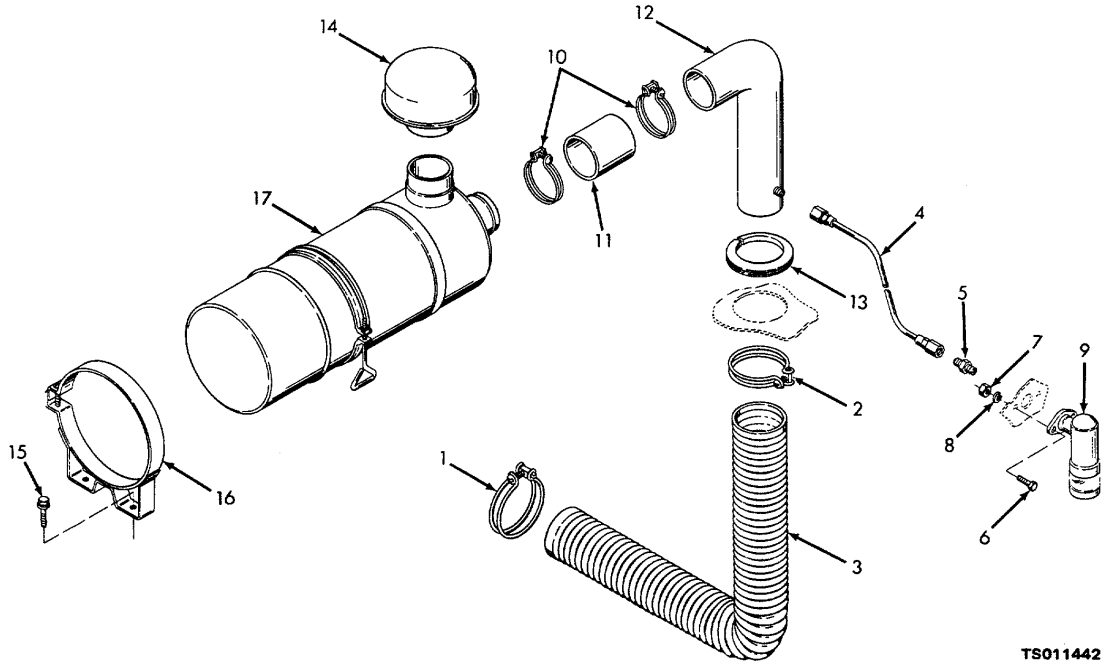
4-17. Air Cleaner and Piping

NOTE

The air cleaner element must be replaced after one year of service or after it has been cleaned six times, whichever comes first.

a. Removal and Disassembly.

(1) Remove the air cleaner and related piping, following the sequence shown in figure 4-4.



1. Hose clamp
2. Hose clamp
3. Hose
4. Tube assembly
5. Adapter
6. Cap screw
7. Nut
8. Lock washer
9. Restriction indicator
10. Hose clamp
11. Hose
12. Elbow
13. Grommet
14. Precleaner
15. Assembled washer screw
16. Air cleaner clamp
17. Air cleaner assembly

Figure 4-4. Air cleaner and piping, exploded view.

(2) Service the air cleaner as directed in paragraph 3-10.

b.Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area.

Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 1000 to 138 o F (38 ° to 59 Q C).

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

(2) Inspect the air cleaner piping for cracks or holes which could allow unfiltered air to enter the engine; replace any damaged parts.

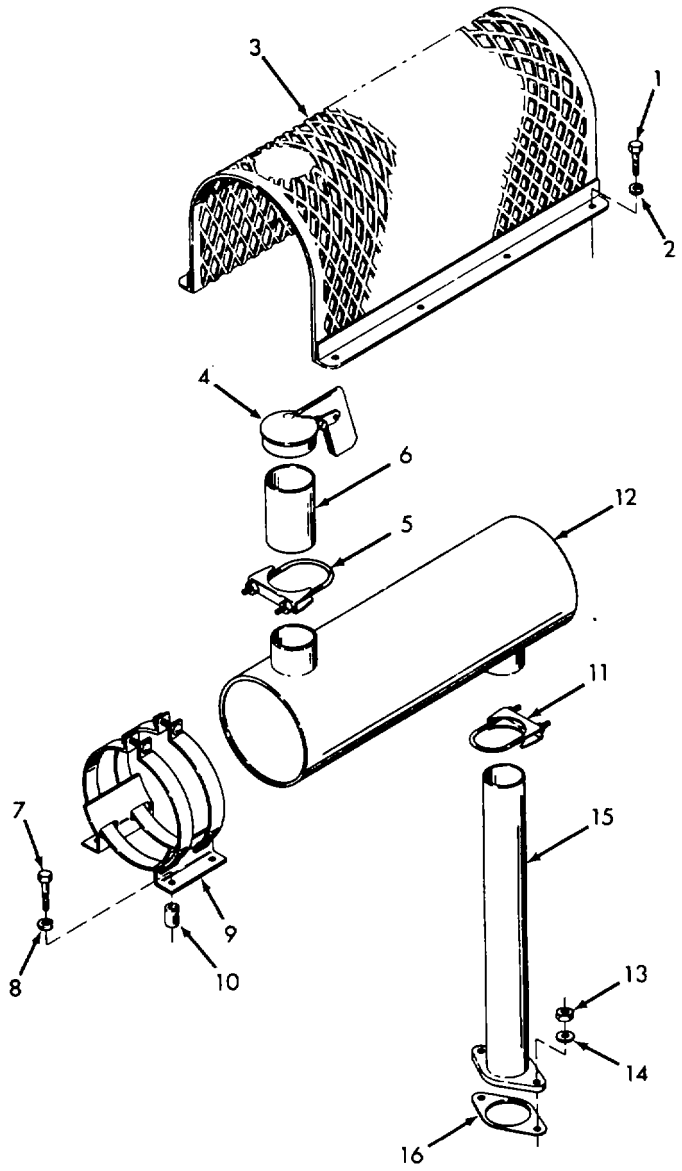
(3) Inspect the air cleaner for dents, cracks, and leakage; replace the air cleaner if the housing is damaged.

(4) Inspect the air cleaner mounting parts for cracks, distortion, and other damage; replace damaged parts.

c.Installation. Installation of the air cleaner and piping is the reverse of removal and disassembly. Refer to figure 4-4.

4-18. Muffler and Piping

a.Disassembly. Disassemble the muffler and related parts from the engine by following the sequence indicated in figure 4-5.



1. Cap screw
2. Lock washer
3. Muffler guard
4. Weather cap
5. Clamp
6. Pipe
7. Cap screw
8. Lock washer
9. Muffler clamp
10. Spacer
11. Clamp
12. Muffler
13. Nut
14. Lock washer
15. Exhaust pipe
16. Gasket

Figure 4-5. Muffler and related parts, exploded view.

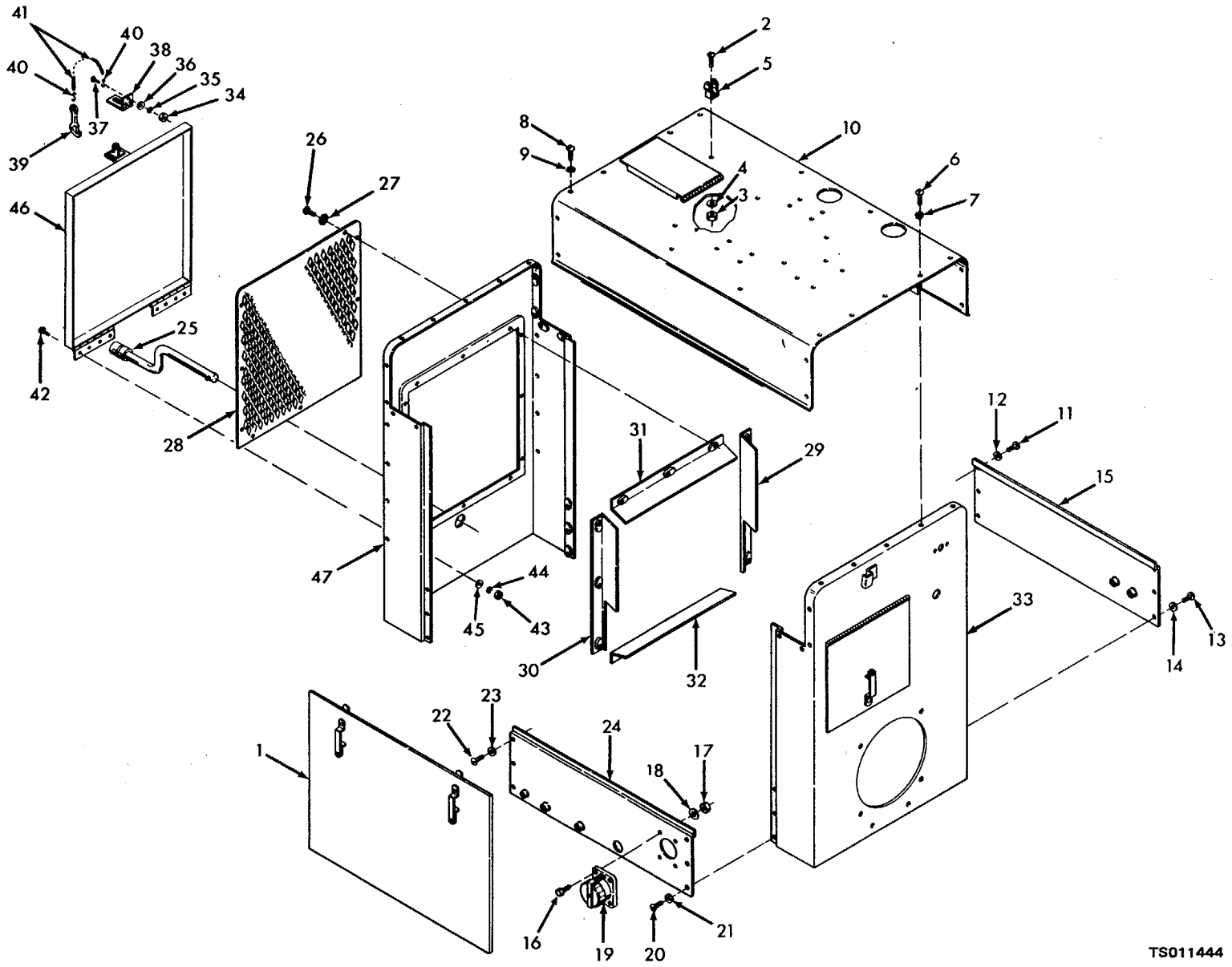


Figure 4-6. Engine housing, exploded view.

KEY to fig. 4-6:

1. Engine side panel
2. Screw
3. Nut
4. lock washer
5. Crank clip
6. Screw
7. Flat washer
8. Screw
9. Flat washer
10. Top hood
11. Screw
12. Flat washer
13. Screw
14. Flat washer
15. Lower left panel
16. Cap screw
17. Nut
18. Lock washer
19. Battery charging receptacle
20. Screw
21. Flat washer
22. Screw
23. Flat washer
24. Lower right panel
25. Engine crank
26. Screw
27. lock washer
28. Radiator grille
29. Baffle
30. Baffle
31. Baffle
32. Baffle
33. Rear panel
34. Nut
35. Lock washer
36. Flat washer
37. Cap screw
38. Hasp
39. Snap
40. S-hook
41. Chain
42. Cap screw
43. Nut
44. Lock washer
45. Flat washer
46. Stone shield
47. Radiator shell

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59° C).

(1) Clean the muffler and exhaust piping with a wire brush. Wipe with a cloth dampened with dry cleaning solvent (fed. spec. P-D-680).

(2) Clean all remaining parts with an approved cleaning solvent.

(3) Inspect the muffler for cracks, holes, severe rust, and other damage; replace a damaged muffler.

(4) Inspect the remaining parts for cracks, distortion, and other damage; replace damaged parts.

c. Reassembly. Reassembly of the muffler and piping is the reverse of disassembly. Refer to figure 4-5.

4-19. Engine Housing

a.Removal

(1) Remove the air cleaner (para 4-17).

(2) Remove the muffler and exhaust system (para 4-18).

(3) To remove the lower left and lower right side panels (15 and 24, fig. 4-6), disconnect the drain lines from the connections on the panels.

(4) Disassemble the engine housing following the sequence of index numbers in figure 4-6.

b.Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 o to 138 F (38 to 59 C).

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

(2) Inspect all parts for rust, corrosion, cracks, chipped paint, dents, and distortion. Straighten dented and distorted panels. Remove rust and corrosion with sandpaper, rubbing until the surface is clean and bright. Prime and paint the bare surfaces.

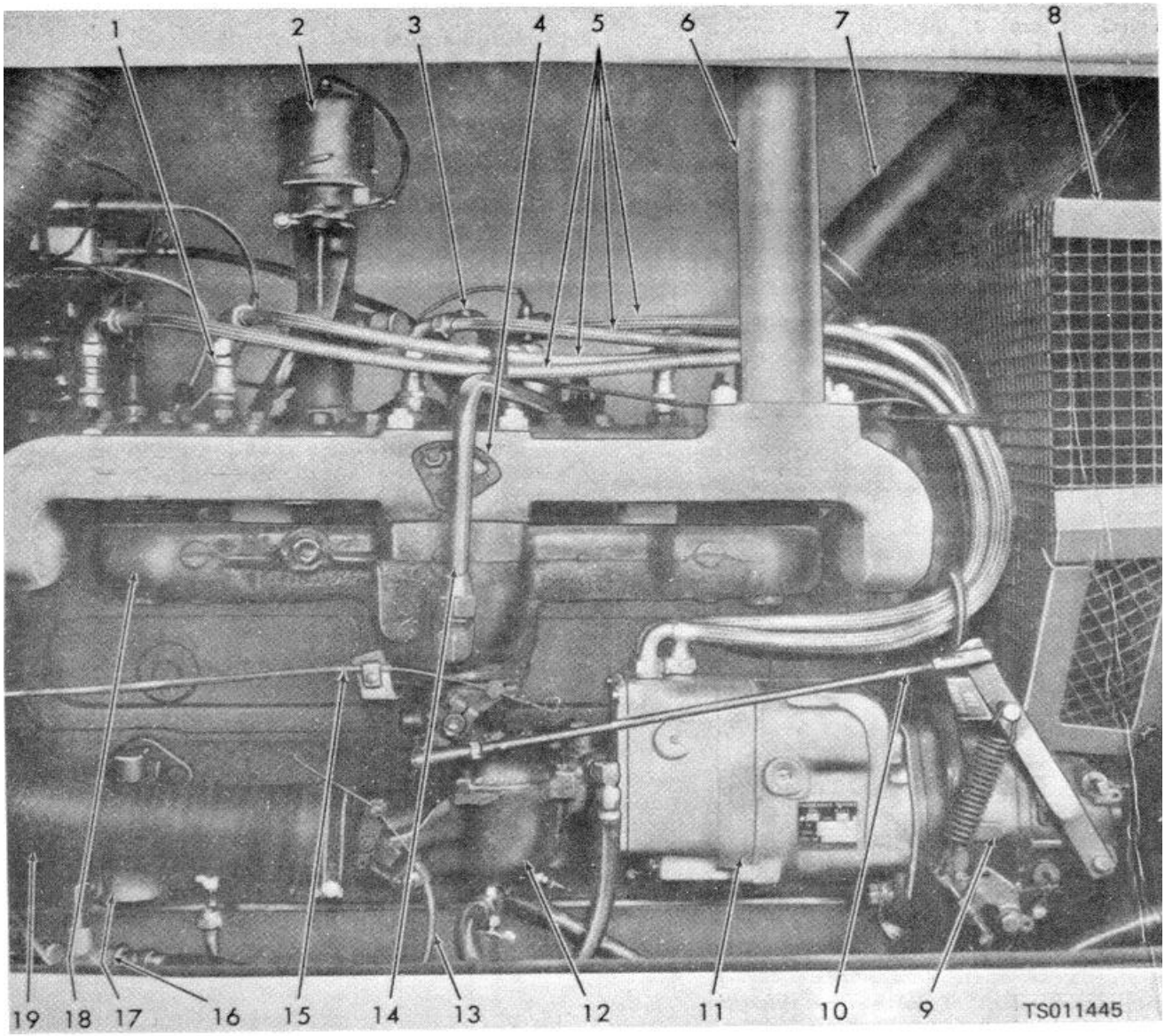
c.Installation. Installation is the reverse of removal. Refer to figure 4-6.

Section IX. MAINTENANCE OF FUEL SYSTEM

4-20. Description

a. The fuel tank (fig. 1-2) is mounted between the longitudinal members of the chassis frame at the fan end of the engine. It incorporates a 3-way fuel source selector valve (5, fig. 2-2) to permit the engine to use the fuel from the fuel tank or from an auxiliary source, depending upon the valve position. A fuel line connects the 3-way valve with the fuel pump.

b. The diaphragm-type, engine-driven fuel pump (17, fig. 4-7) is operated by a lobe on the camshaft. It is mounted on the side of the engine. Fuel is pumped through a strainer (16) to the carburetor (12), which is mounted on the intake manifold. The carburetor provides a fuel-air mixture to the engine, and has several adjustments for smooth engine operation.



1. Spark plug
2. Overspeed governor
3. Engine lifting eye
4. Exhaust manifold
5. Shielded spark plug cables
6. Exhaust pipe
7. Radiator hose
8. Fan guard
9. Engine speed governor
10. Governor-to-throttle rod
11. Magneto
12. Carburetor
13. Choke control cable
14. Emission control tube
15. Throttle control cable
16. Fuel strainer
17. Fuel pump
18. Intake manifold
19. Air intake hose

Figure 4-7. Right side of engine, identifying components.

c. The fuel strainer (16) contains a filter for removing dirt from the fuel. It is encased in a removable glass bowl which permits quick visual inspection of the fuel for the presence of water or dirt. Another fuel line connects the fuel strainer to the fuel inlet of the carburetor.

d. The carburetor (12) is a single-barrel, updraft design which is secured to the intake manifold. It contains its own filter mounted near the fuel inlet. The carburetor fuel bowl has a drain plug to permit removal of contaminated fuel, and a drain cock to remove excess fuel if the engine becomes flooded.

e. The governor (9, fig. 4-7) operates the throttle control of the carburetor (12) to provide the required engine speed, depending upon the setting of the manual throttle control. The engine will maintain the set speed regardless of load, provided the load applied does not exceed the horsepower rating of the engine. Several adjustment points are provided to ensure proper engine governor control.

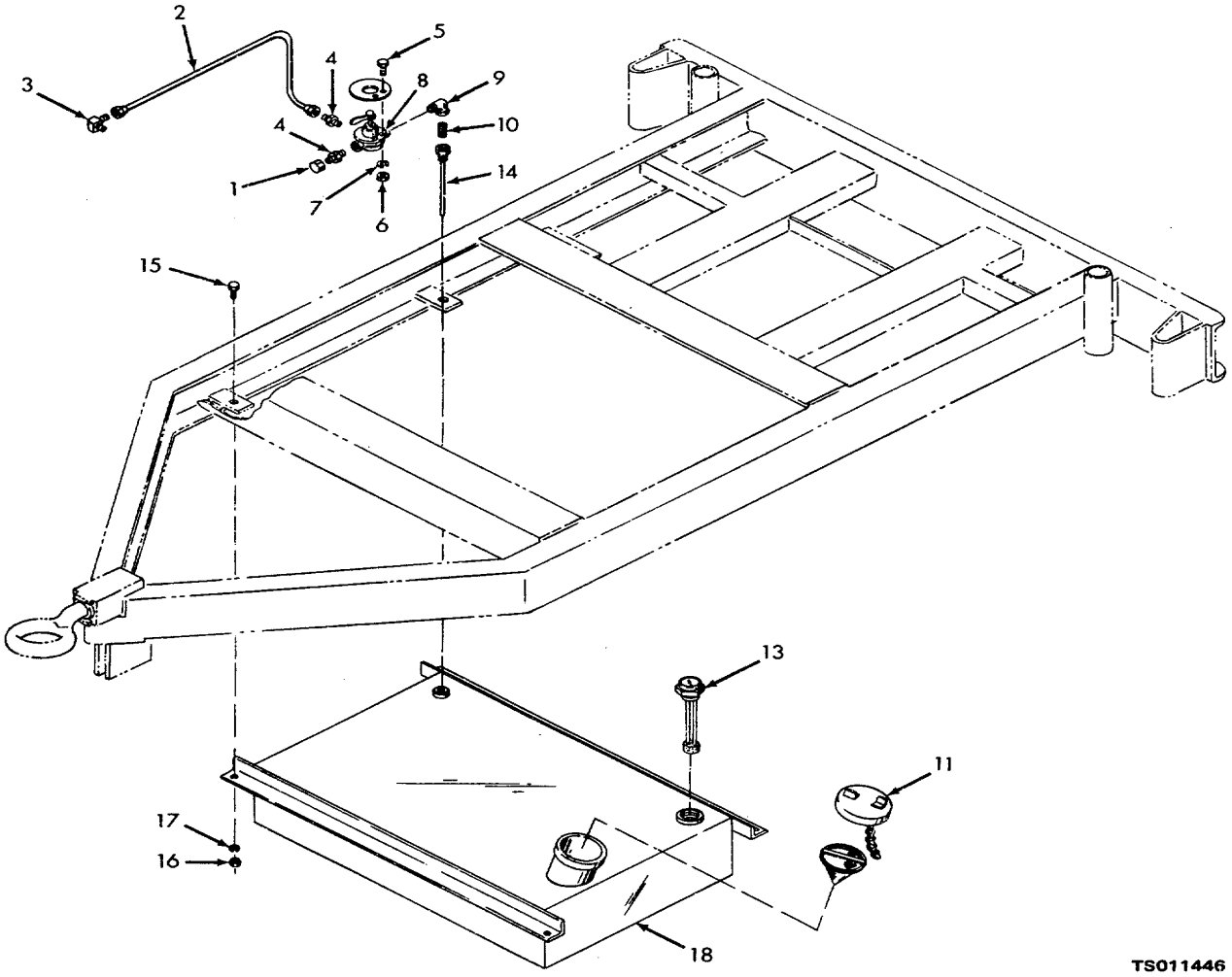
f. The intake manifold (18) and exhaust manifold (4) are bolted directly to the cylinder head and are sealed with a gasket. The intake manifold provides mounting for the carburetor and directs the fuel and air mixture to the cylinders. The exhaust manifold routes the exhaust gases through the muffler. It includes a thermostatically controlled heat valve to direct exhaust gases through passages in the intake manifold to provide faster engine warmup.

g. The emission control system recirculates combustion gases which blow past the pistons, so that these gases are burned in the engine. The flow is controlled by an emission control valve which diverts the gases from the crankcase through a tube and into the intake manifold. Crankcase pressure is regulated by a pressure control chamber which is part of the emission control valve. The emission control system helps to prevent engine blow-by gases from polluting the atmosphere.

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

a. Fuel Strainer Service. If moisture or other contaminants are visible through the glass bowl of the fuel strainer, service the fuel strainer as directed in paragraph 3-11.

b. Removal. Remove the fuel strainer and the fuel lines and fittings as shown in items 1 through 10 of figure 4-8 and items 1 through 10 to figure 4-9.



1. Cap
2. Fuel tube
3. Tube elbow
4. Tube adapters
5. Cap screw
6. Nut
7. Lock washer
8. Fuel selector valve
9. Street elbow
10. Nipple
11. Fuel tank cap
12. Fuel strainer screen
13. Fuel level gage
14. Suction tube
15. Cap screw
16. Nut
17. Lock washer
18 Fuel tank

Figure 4-8. Fuel tank valve, exploded view.

KEY to fig. 4-9:
1. Fuel supply hose
2. Elbow
3. Elbow
4. Pipe plug
5. Carburetor bowl drain hose
6. Adapter
7. Carburetor drain cock
8. Fuel strainer
9. Elbow
10. Nipple
11. Cap screw
12. Lock washer
13. Fuel pump
14. Gasket
15. Nut
16. Ball joint
17. Lock nut
18. Governor-to-carburetor control rod
19. Ball joint
20. Lock washer
21. Screw
22. Nut
23. Lock washer
24. Clamp
25. Nut
26. Lock washer
27. Throttle cable bracket
28. Carburetor
29. Gasket
30. Stud
31. Governor spring
32. Cotter pin
33. Nut
34. Flat washer
35. Governor adjusting assembly
36. Stud
37. Assembled washer screw
38. Bolt
39. Flat washer
40. Gasket plate
41. Gasket
42. Governor
43. Gasket
44. Cap screw
45. Lock washer
46. Clamp
47. Nut
48. Lock washer
49. Choke control cable
50. Throttle control cable

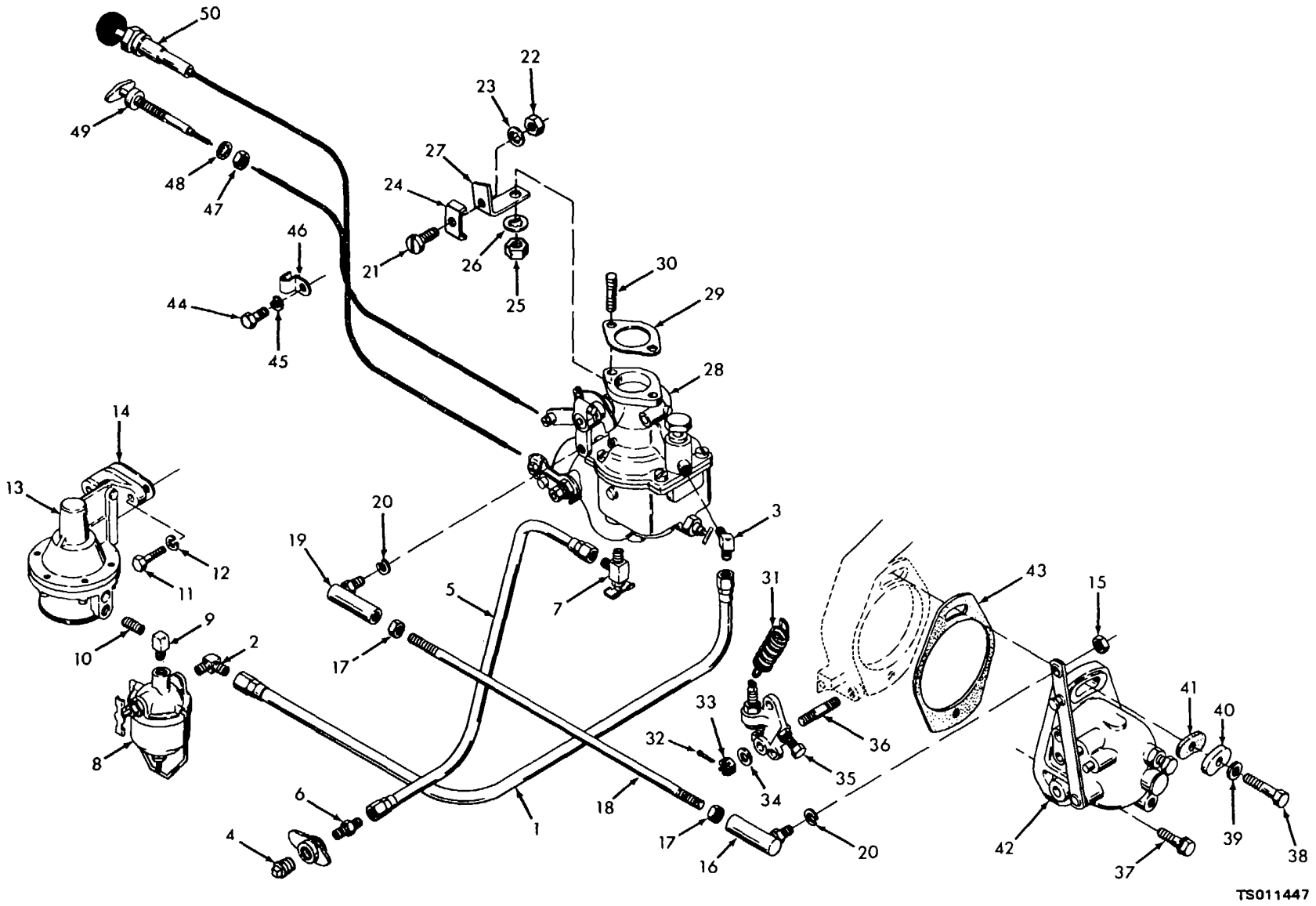


Figure 4-9. Fuel system components, exploded view.

c. Cleaning and Inspection.

(1) Inspect the fuel strainer parts for cracks and damage. Replace defective parts.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 to 138°F (38° to 59°C).

(2) Clean all fuel lines and fittings with dry cleaning solvent (fed. spec. P-D-680). Blow through them with compressed air to ensure all are clear.

(3) Inspect the hoses for cracks, fraying, and damaged threads; replace damaged hoses.

(4) Inspect the 3-way fuel selector valve for difficult operation and for cracked or damaged threads; replace a damaged valve.

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

d. Reassembly and Installation. Reassemble and install the fuel lines and fittings as shown in items 1 through 10 of figure 4-8 and items 1 through 10 of figure 4-9. After assembly, check for leaks. Correct any leaks noted.

4-22. Fuel Tank (Fig. 4-8)

a. Removal.

(1) Drain the fuel tank. Disconnect the fuel lines, fittings, and fuel selector valve from the fuel tank.

(2) Remove the fuel level gage (13) and the suction tube (14) from the fuel tank (18).

(3) Block up under the fuel tank and remove the four cap screws (15), nuts (16), and lock washers (17) that secure the fuel tank to the frame; lower the fuel tank to the ground.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 to 138°F (38°to 59°C).

(1) Flush the interior of the fuel tank with dry cleaning solvent (fed. spec. P-D-680); drain completely.

(2) Inspect the fuel tank for cracks, distortion, dents, damaged threads, and other damage. Replace a damaged fuel tank.

WARNING

No repairs of the fuel tank are authorized. Replace if defective. Any repairs involving heat or flame can result in a severe explosion due to the gasoline fumes within the tank.

c. Installation.

(1) Installation is the reverse of removal. Refer to figure 4-8.

(2) Fill the fuel tank with fuel and start the engine. Check carefully for leaks noted.

4-23. Fuel Pump (Fig. 4-9)

a. Removal.

(1) Remove the fuel lines and fuel strainer from the fuel pump (para 4-21 b).

(2) Remove the two cap screws (11) and lock washers (12) that secure the fuel pump (13) to the cylinder block. Pull straight out on the fuel pump to remove it. Remove the gasket (14).

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 l to 138 OF (38 ° to 59 ° C).

(1) Clean the fuel pump with a cloth dampened with a dry cleaning solvent (fed. spec. P-D680) and wipe dry.

(2) Inspect the fuel pump for cracks, damaged threads, and other obvious damage. Operate the cam follower lever of the fuel pump to check for faulty movement. Replace the fuel pump if defective.

(3) Make sure that you completely remove the old gasket from the cylinder block. Use a gasket scraper or knife to remove all traces of the old gasket.

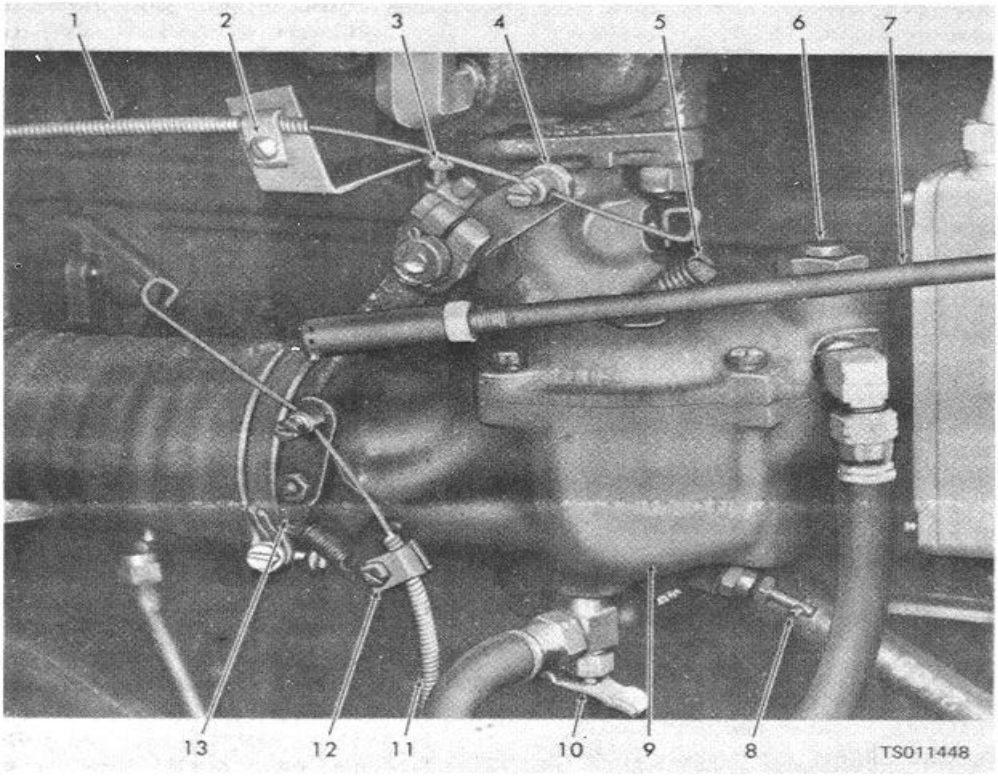
c. Installation.

(1) Use the crank or starting motor to turn over the engine so that the cam follower engages the low portion of the cam. This will facilitate installation of the fuel pump. Position the fuel pump (13, fig. 4-9) and gasket (14) on the engine and secure it with two cap screws (11) and lock washers (12).

(2) Install the fuel strainer, lines, and fittings (para 4-21d).

4-24. Carburetor (Fig. 4-10)

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



1. Throttle cable
2. Throttle cable clamp
3. Idle speed adjustment screw
4. Carburetor throttle lever
5. Idle mixture adjustment needle
6. Carburetor inlet filter
7. Throttle rod
8. Main adjusting screw
9. Carburetor float bowl
10. Flood relief drain cock
11. Choke control cable
12. Choke cable clamp
13. Carburetor choke lever

Figure 4-10. Carburetor, showing adjustment points.

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

(2) Adjust the main adjusting screw (8, fig. 4-10). This adjustment determines the amount of fuel available for high-speed operation. Adjust as follows: (a) Adjust the throttle control of the pump to open the carburetor throttle about one-fourth.

(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 adjusting screw counterclockwise until the engine runs smoothly without missing.

(3) Adjust the idle mixture adjustment needle (5, fig. 4-10). This adjustment controls the amount of air admitted to the idling system which functions only at low speeds. Adjust as follows:

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

(b) Turn the adjustment needle counterclockwise to obtain the smoothest idle operation possible.

(c) If a vacuum gage is available, use a vacuum gage attached to the intake manifold and adjust the needle for highest engine vacuum.

(4) Adjust the idle speed adjustment screw (3, fig. 4-10). Turn the screw clockwise or counterclockwise as necessary to provide 400 to 600

rpm idle speed when the pump throttle control is set to idle.

b. Removal.

(1) Disconnect the fuel lines and fittings from the carburetor (para 4-22).

(2) Remove the air cleaner hose from the carburetor (para 4-17).

(3) Disconnect the governor-to-carburetor control rod (18, fig. 4-9) by unscrewing the ball joint (19) and removing the lock washer (20).

(4) Disconnect the ends of the throttle control cable (50) and choke control cable (49) from their respective levers on the carburetor.

(5) Remove the nuts (25) and lock washers (26) that secure the carburetor to the intake manifold. Remove the throttle cable bracket (27) and carburetor (28).

c. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 to 138 F (38 to 59 C).

(1) Clean the exterior of the carburetor with a cloth dampened with dry 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. They must operate freely, without binding. Refer a damaged carburetor to direct support maintenance.

(3) If you are going to install a new carburetor, remove the old gasket (29, fig. 4-9) from the mating surface of the intake manifold. Use a gasket scraper or knife to remove all traces of the old gasket.

d. Installation. Install the carburetor by reversing the removal procedure. Note the following:

(1) Make sure there are no air lea. between the carburetor and air cleaner. Air leaks 'ill Allow dust and dirt to enter the engine, causing rapid engine wear.

(2) Adjust choke control cable connection to carburetor so that the choke lever can move through its full operating range as the choke control on the instrument panel is operated.

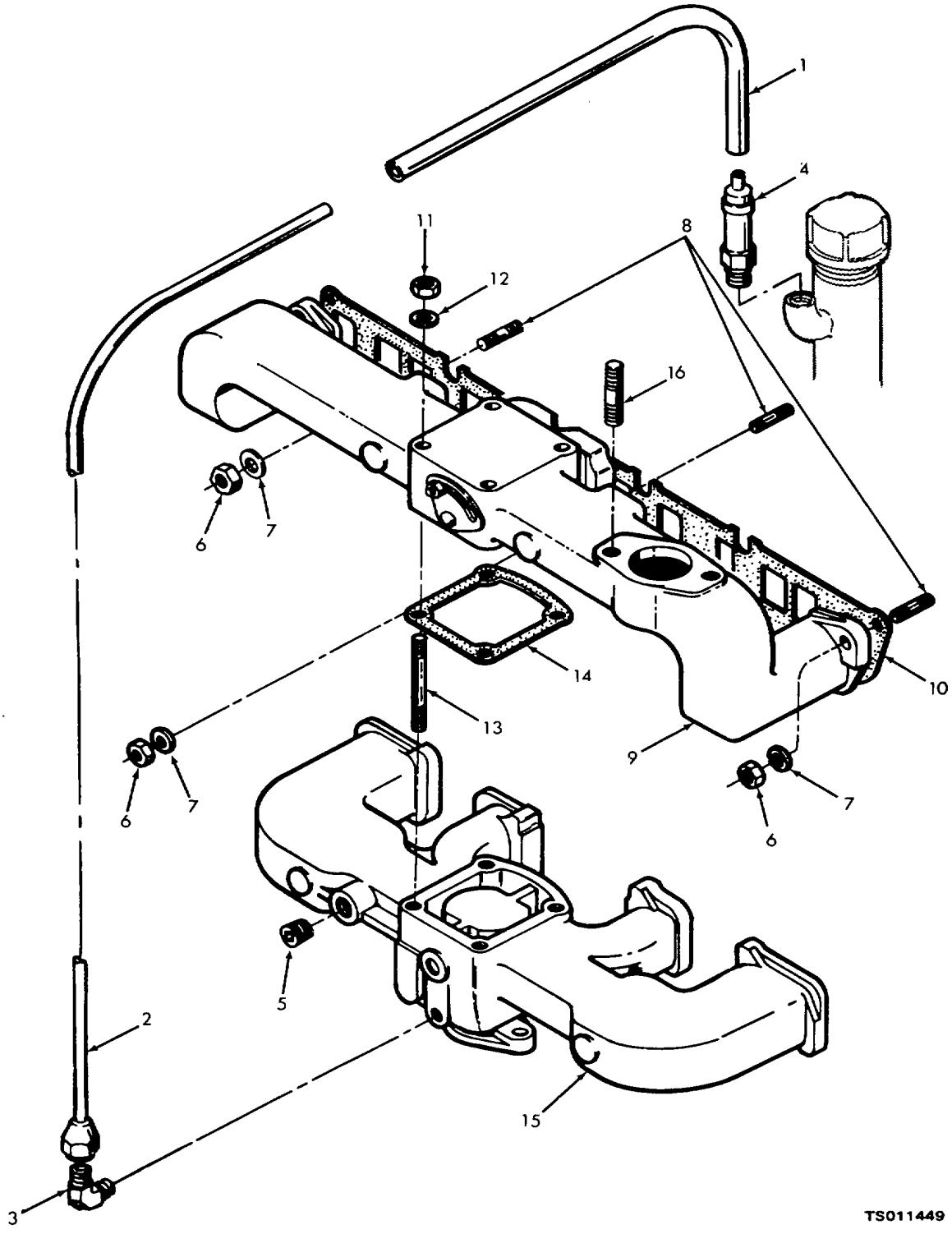
(3) Adjust the throttle linkage from the governor as directed in paragraph 4-27.

4-25. Crankcase Emission Control System

a. Removal.

(1) Remove the hose (1, fig. 4-11) and remove the tube assembly (2). Remove the elbow (3).

(2) Unscrew the emission control valve (4) from the elbow on the oil filler tube.



1. Hose
2. Tube assembly
3. Elbow
4. Emission control valve
5. Plug
6. Nut
7. Washer
8. Stud
9. Exhaust manifold
10. Gasket
11. Nut
12. Washer
13. Stud
14. Gasket
15. Intake manifold
16. Stud

Figure 4-11. Intake and exhaust manifolds and emission controls, exploded view.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 o to 138 ° F (38 ° to 59 ° C).

(1) Wipe the exterior of the emission control valve with a cloth dampened with dry cleaning solvent (fed. spec. P-D-680). Do not soak the valve in solvent.

(2) Clean the remaining parts with solvent; dry thoroughly.

(3 Inspect the hose for cracks, clogging, and deterioration; replace a defective hose.

(4) Inspect the emission control valve for cracks, dents, distortion, and other damage.
Make sure the inside element is free. Replace if defective.

c. Installation. Installation of the emission control parts is the reverse of removal. Refer to items 1 through 4 of figure 4-11.

4-26. Intake and Exhaust Manifolds

a. Removal.

(1) Remove carburetor (para 4-24).

(2) Remove muffler and piping (para 4-18).

(3) Remove crankcase emission tube (2, fig. 4-11) from elbow (3). Remove 11 nuts (6) and washers (7) from studs (8) in cylinder head. Remove manifolds. If they are stuck, you can loosen them by rapping lightly on them with a soft-faced hammer.

(4) With the manifold off the engine, separate items 9 and 15 by removing nuts (11) and washers (12).

(5) Remove gaskets (10 and 14) and studs (13).

b. Cleaning and Inspection.

(1) Clean the exteriors of the manifolds with a wire brush. Check that the intake, exhaust, heat control, and emission control passages are clear.

(2) Inspect the manifolds for cracks, severe corrosion, or other damage. Replace as necessary.

(3) Check operation of heat control valve and free it if stuck. Lubricate shaft with colloidal graphite (MIL-G-17745A). If thermostatic spring, valve, or shaft is damaged, replace the exhaust manifold.

(4) Check for loose or damaged studs. Replace if necessary.

(5) Remove old gaskets. Use a gasket scraper or knife to remove all traces of old gaskets from mating surfaces.

c. Installation.

(1) Assemble intake manifold to exhaust manifold and tighten nuts to 25 to 30 foot-pounds. Locate gasket (10, fig. 4-11) over studs on cylinder head and install manifolds (9 and 15). Torque nuts (6)to 25 to 30 foot-pounds.

(2) Install crankcase emission tube (2) on elbow (3).

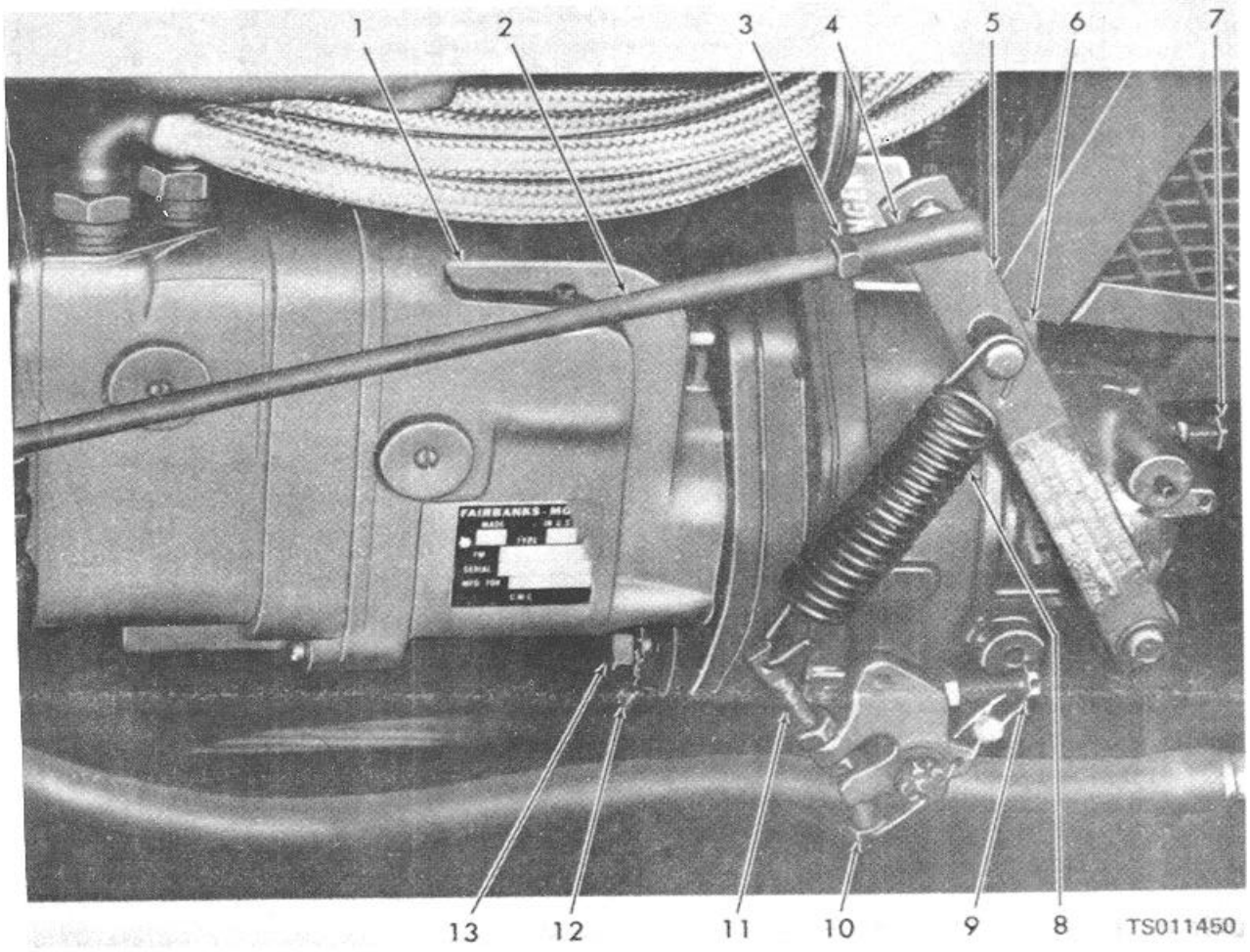
(3) Install muffler and piping (para 4-18).

(4) Install carburetor (para 4-24).

4-27. Engine Speed Governor Adjustment

Adjust the engine speed governor as follows:

a. Start the engine and allow it to warm to operating temperature. While it is warming up, back out the surge adjusting screw (7, fig. 4-12) so that it will not influence the governor setting.



1. Magneto
2. Throttle rod
3. Nut
4. Ball joint
5. Throttle operating lever
6. Mounting screw
7. Surge adjusting screw
8. Governor spring
9. Speed adjusting lock screw
10. Speed adjusting screw
11. Sensitivity adjusting screw
12. Ground strap
13. Mounting screw

Figure 4-12. Magneto and governor installation.

b. With the engine warmed up and with the pump not under load, adjust the engine idle speed to approximately 150 rpm higher than the required idle speed under load. Make this adjustment by turning the speed adjusting screw (10). Back out speed adjusting lock screw (9) so that it will not influence the adjustment.

c. The governor's range of action is the differential between the engine speed under load and the engine speed without load. To broaden the range of action, use the sensitivity adjusting screw (11). Lengthen the sensitivity adjusting screw to broaden the range of action of the engine. Compensate for speed Changes by readjusting the speed adjusting screw (10). To narrow the range of action, shorten the sensitivity

adjusting screw (11) and compensate for speed change with the speed adjusting screw (10).

d. When the governor range of action is properly adjusted, allow the engine to run at governed speed, no load, and check for surging. If surging is noted, turn in the surge adjusting screw (7) just far enough to eliminate the surging.

e. The surge adjustment can also be made by using the tachometer. With the engine running at governed speed, no load, turn in the surge adjusting screw (7) until the engine speed increases 10 to 20 rpm and tighten the locking nut. If the carburetor and linkage are properly adjusted, surge will disappear.

f. If the governor cannot operate the throttle lever on the carburetor through the full operating range, it will be necessary to adjust the length of the throttle rod (2) by loosening the nut (3) and adjusting the position of the ball joint (4).

g. When the governor adjustment is completed, tighten the speed adjusting lock screw (9) to lock the cam in position. Make sure all locking nuts are tightened.

h. If the governor cannot be adjusted, refer problem to direct support maintenance.

Section X. MAINTENANCE OF COOLING SYSTEM

4-28. Description

a. The engine cooling system is a conventional automotive type in which coolant is circulated through the cylinder block to remove the combustion heat from the operating parts of the engine. The water is then passed through the radiator, which acts as a large heat exchanger to dissipate the heat to the atmosphere. The water pump maintains the flow of coolant through the engine.

b. A thermostat is installed in the engine to prevent the flow of coolant into the radiator when the engine is cold. Instead, the coolant is bypassed directly to the water pump and recirculated into the block without being cooled in the radiator. In this way, the engine heats more rapidly, providing efficient operation more quickly. When the coolant in the cylinder block reaches operating temperature, the thermostat opens and the coolant is forced to flow through the radiator.

c. To ensure efficient operation of the cooling system, it is important to keep the exterior of the radiator clean and free from bugs, dirt, and debris. It is also necessary to keep the interior of the radiator and the engine block flushed out to prevent accumulations of rust and scale which can prevent proper heat transfer.

4-29. Cleaning and Flushing the Cooling System

a. Clean the exterior of the radiator by flushing a stream of water through it in a direction opposite that of the cooling fan flow. Since this engine uses a pusher type fan, it is necessary to squirt the water from the outside of the radiator inward toward the engine. Cover the engine with a piece of plastic film to prevent saturating the components before attempting to flush the exterior of the radiator.

b. Disconnect the hoses connecting the engine and radiator. With the radiator cap closed tightly, use a flushing gun as shown in figure 4-13 to reverse-flush the radiator. Fill the radiator with water, then blow out the water with compressed air, applying pressure slowly to prevent radiator damage. Repeat several times until the expelled flushing stream is clear.

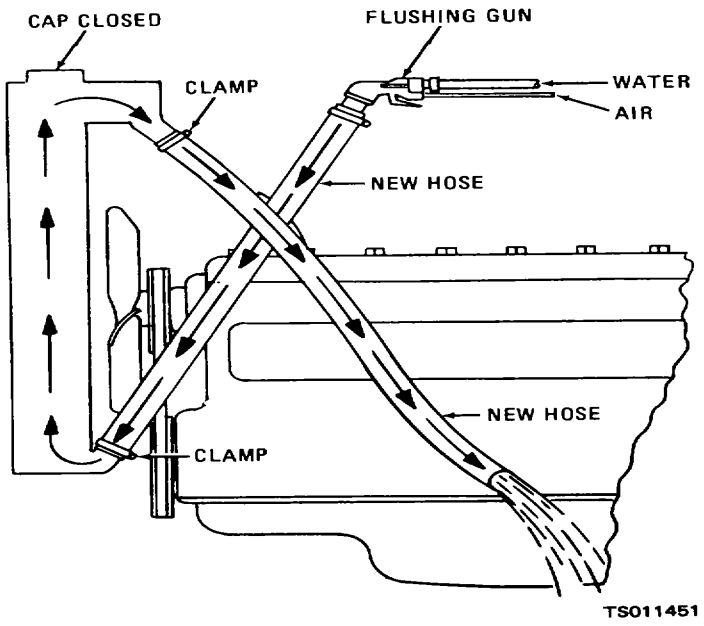


Figure 4-13. Reverse-flushing the radiator.

c. Remove the thermostat (para 4-30) from the engine and use a flushing gun as shown in figure 4-14. Fill the cylinder block with water before applying air pressure. When the block is filled, expel the water with an 80 psi air stream. Repeat until the expelled flushing stream is clear.

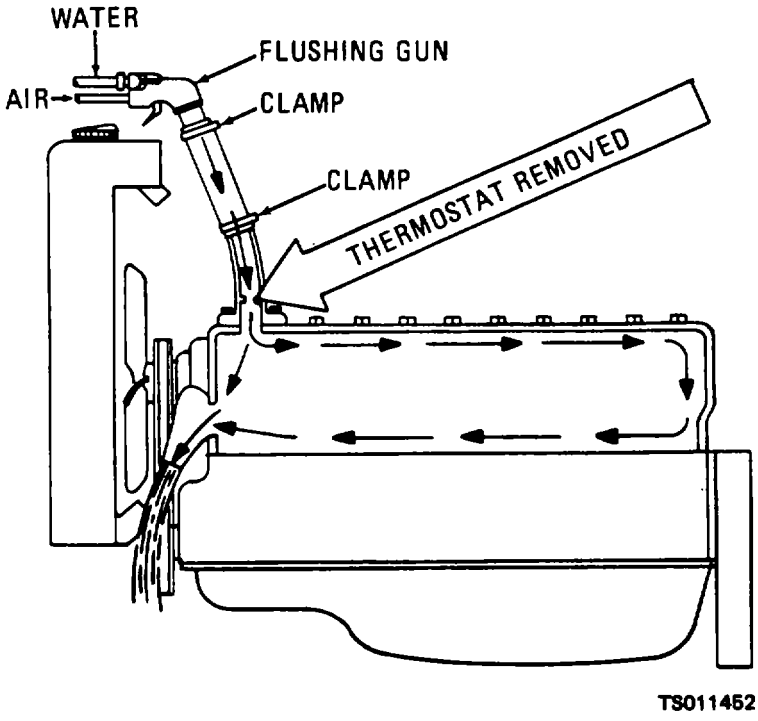


Figure 4-14. Reverse-flushing the engine block.

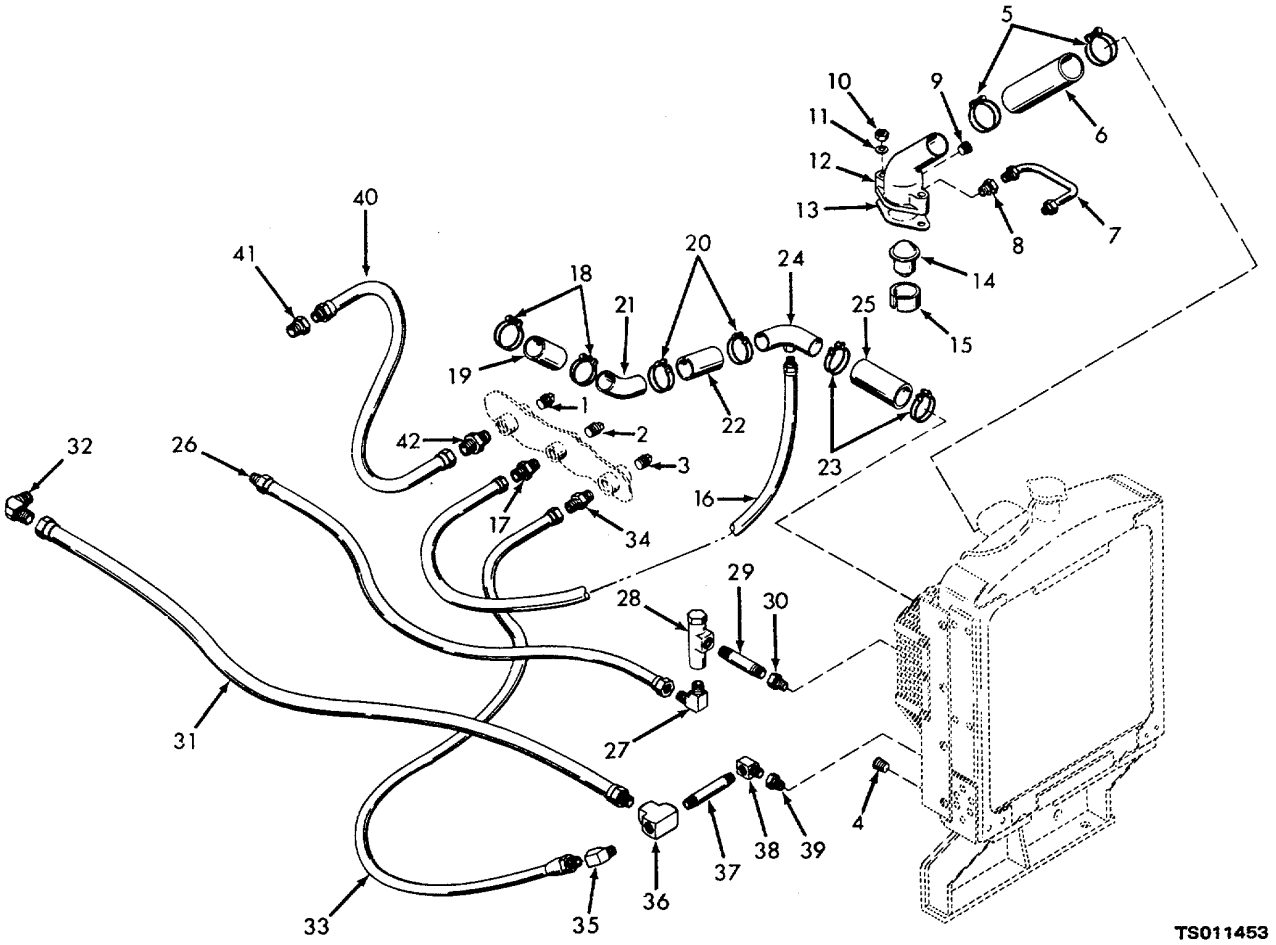
d. Install the thermostat and connect the hoses between the engine and radiator (para 4-30). Start the engine and allow it to run until the coolant reaches operating temperature. Check for coolant leaks and correct if any are noted.

4-30. Thermostat, Outlet Elbow, Lines, and Fittings

a. Removal.

(1) Drain the radiator and block by removing plugs (2 and 3, fig. 3-1).

(2)Remove and disassemble the thermostat, of elbow, lines, and fittings as shown in figure 4-15.



1. Drain plug
2. Drain plug
3. Drain plug
4. Drain plug
5. Hose clamp
6. Hose
7. Bypass tube
8. Connector
9. Plug
10. Nut
11. Lock washer
12. Water outlet elbow
13. Gasket
14. Thermostat
15. Thermostat ring
16. Radiator drain tube
17. Connector
18. Hose clamp
19. Hose
20. Hose clamp
21. Elbow
22. Hose
23. Hose clamp
24. Drain elbow
25. Hose
26. Crankcase-to-cooler hose
27. Elbow
28. Bypass valve
29. Nipple
30. Bushing
31. Cooler-to-crankcase hose
32. Elbow
33. Oil cooler drain hose
34. Connector
35. Elbow
36. Tee
37. Nipple
38. Elbow
39. Bushing
40. Crankcase coolant drain hose
41. Bushing
42. Connector

Figure 4-15. Thermostat, outlet elbow, coolant and oil cooler lines and fittings, exploded view.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. Spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59°C.

(1) Clean all parts by washing in warm, soapy water. Remove any greasy or gummy deposits with a cloth dampened with dry cleaning solvent (fed. Spec. P-D-680); dry thoroughly.

(2) Inspect the thermostat for obvious defects, including ruptured bellows and distortion. If the valve, when cold, can be pushed off its seat with only slight effort, the thermostat is defective and must be replaced.

(3) Check the thermostat operation as follows:

(a) Hang the thermostat by its frame in a container of water so that it does not touch the container. Hang a thermometer in the container to maintain a check of water temperature.

(b) Heat the water slowly while watching the thermometer and thermostat. The thermostat must start to open before the thermometer indicates 180° F. Replace the thermostat if it fails to open at 180°F or if starts to open before 160° F.

(4) Inspect the water outlet elbow for cracks, damaged threads, and distortion; replace a damaged elbow.

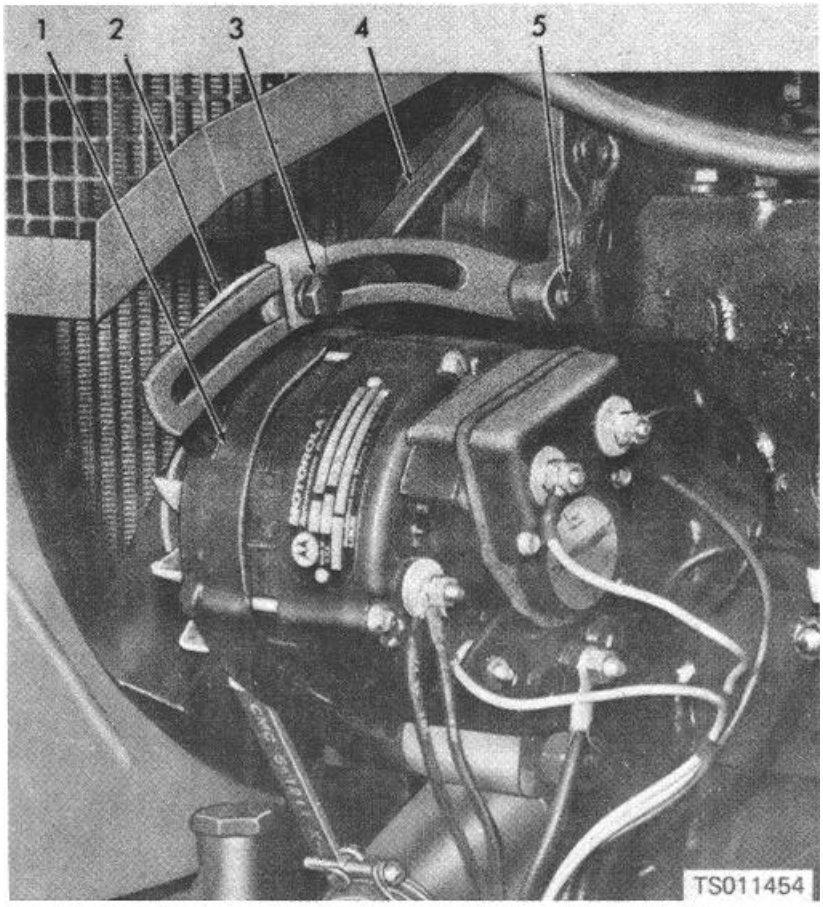
(5) Inspect the hoses for cracks, cuts, deterioration, brittleness, and other damage; replace damaged hoses.

c. Installation. Installation of the thermostat, outlet elbow, hoses, and fittings is the reverse of removal. Refer to figure 4-15. Service the coolant and engine lubrication systems. After installation, run the engine until it reaches operating temperature, and check for leaks. Correct any leaks noted.

4-31. Water Pump, Cooling Fan, and Fan Belt

a. Fan Belt Adjustment. The fan belt should be tensioned so that it can be deflected approximately 3/4 inch with thumb pressure at a point midway between pulleys at the longest belt span. Adjust belt tension as follows:

(1) Loosen the alternator strap mounting screw (5, fig. 4-16).



1. Alternator
2. Adjusting strap
3. Adjusting screw
4. Fan belt
5. Strap mounting screw

Figure 4-16. Alternator mounting.

(2) Loosen the adjusting screw (3) on the adjusting strap (2) and pull the alternator (1) away from the engine with hand pressure to tighten the fan belt (4).

(3) Hold the alternator away from the engine and tighten the adjusting screw (3). Recheck fan belt tension and readjust if necessary. Tighten the strap mounting screw (5) after proper adjustment is made.

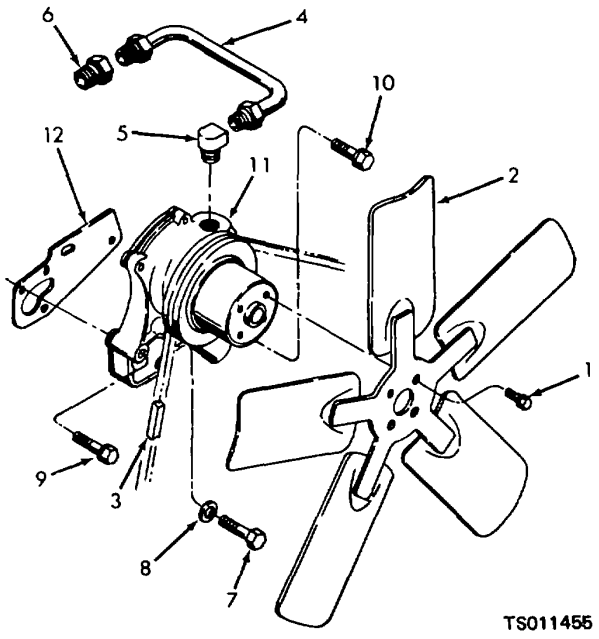
b. Removal.

(1) Remove the cap screws (1, fig. 4-18) and washers (2) that secure the fan guard (3) to the fan shroud (11); remove the fan guard.

.

(2) Loosen the adjusting screw (3, fig. 4-16) on the alternator adjusting strap and push the alternator toward the engine to loosen fan belt tension. Slip the fan belt (4) off the alternator drive pulley and disengage it from the fan and pulley.

(3) Remove the four cap screws (1, fig. 4-17) that secure the cooling fan (2) to the pulley on the water pump; remove the cooling fan.



1. Cap screw
2. Cooling fan
3. Fan belt
4. Bypass tube
5. Elbow
6. Adapter
7. Cap screw
8. Lock washer
9. Cap screw
10. Cap screw
11. Water pump
12. Gasket

Figure 4-17. Water pump and cooling fan, exploded view.

(4) Drain the coolant from the radiator and cylinder block. Disconnect coolant hoses (para 4- 30) and bypass tube (4, fig. 4-17) from the water pump. Remove the elbow (5) and adapter (6). Remove the three cap screws (7, 9, and 10), and lock washer (8) that secure the water pump (11) to the cylinder block; remove the water pump and gasket (12).

c. Cleaning and Inspection.

(1) Wipe the fan belt with a clean, dry cloth.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138 °F (38° to 59° C).

(2) Clean the cooling fan and water pump with a cloth dampened with a dry cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(3) Inspect the fan belt for cracks, brittleness, severe glazing, and other damage; replace a damaged fan belt.

(4) Inspect the cooling fan for cracked, bent, loose, or severely nicked fan blades, damaged or elongated mounting holes, or other damage; replace a damaged cooling fan.

(5) Inspect the water pump for a cracked or distorted housing, damaged mounting flanges, and other damage. Check the rotation of the water pump shaft. It must rotate easily without catching or binding. Replace a leaking or damaged water pump.

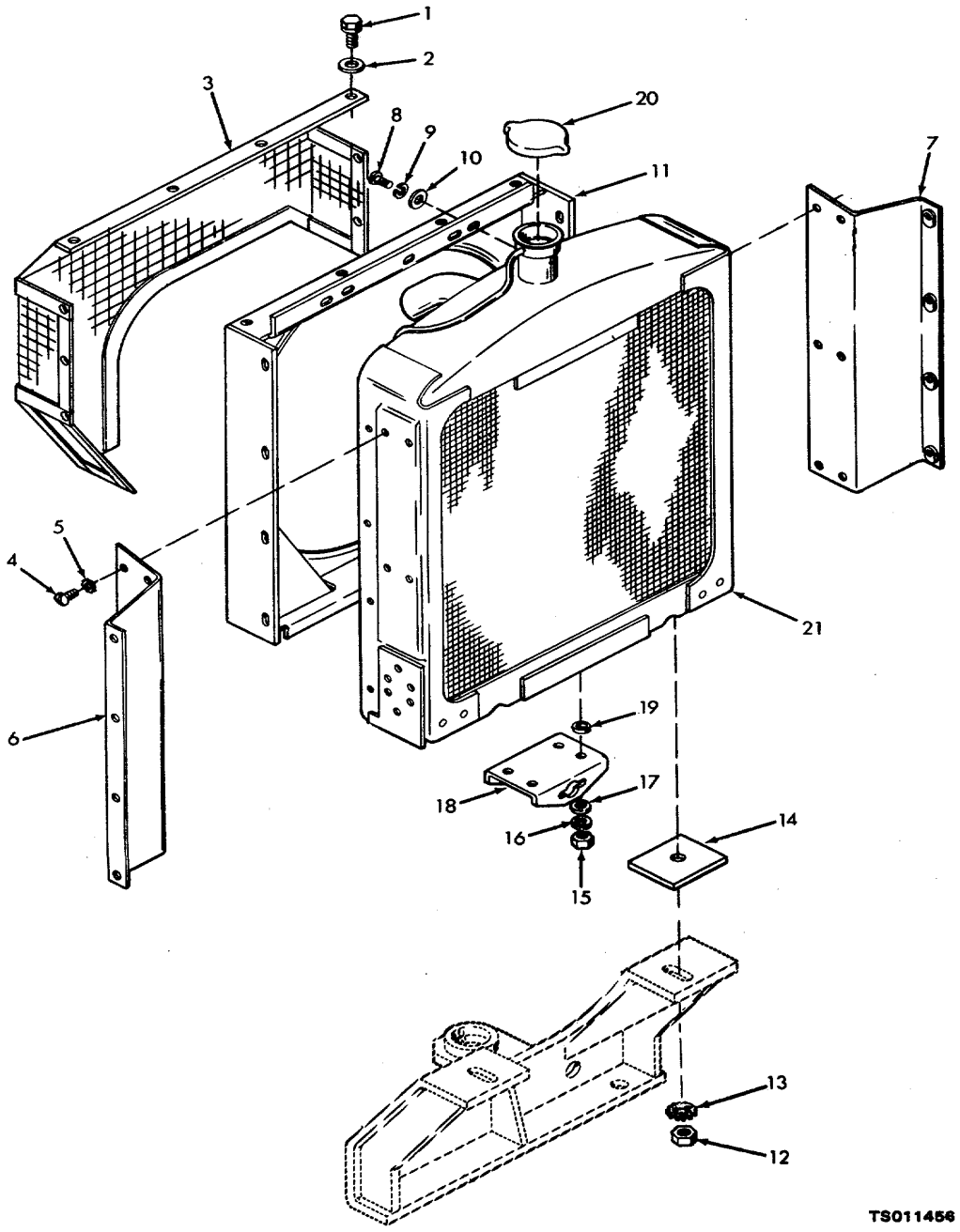
d. Installation.

(1) Installation of the water pump and cooling fan is the reverse of removal. Refer to figure 4-17.

(2) Install the fan belt on the pulleys and

tighten to the required tension (subparagraph a above).

(3) Install the fan guard (3, fig. 4-18) with cap screws (1) and flat washers (2).



1. Cap screw
2. Flat washer
3. Fan guard
4. Machine screw
5. Lock washer
6. Radiator support
7. Radiator support
'8. Machine screw
9. Lock washer
10. Flat washer
11. Fan shroud
12. Nut
13. Lock washer
14. Liner
15. Nut
16. Lock washer
17. Flat washer
18. Crank support
19. Spacer
20. Radiator cap
21. Radiator

Figure 4-18. Radiator and related parts, exploded view.

4-32. Radiator

a. Removal.

(1) Drain the radiator and oil cooler, and remove the coolant and oil cooler lines from the radiator (para 4-30).

(2) Remove the engine housing as necessary to provide access to the radiator for removal. Refer to paragraph 4-19a.

(3) Remove the fan guard (3, fig. 4-18). Remove the machine screws (4) and lock washers (5) and remove the supports (6 and 7). Remove the machine screws (8), lock washers (9) and flat washers (10), and remove the fan shroud (11).

(4) Use a rope sling and a hoist to support the weight of the radiator before removing the nuts (12) and lock washers (13) that secure the radiator (21) to the engine support; remove the radiator and liners (14).

(5) Remove the nuts (15), lock washers (16) and flat washers (17), and remove the crank support (18) and spacer (19) from the radiator. Remove the radiator cap (20).

b. Cleaning and Inspection.

(1) Thoroughly flush the radiator with water, both inside and out. Make sure all bugs and debris are removed from the external cooling fins.

(2) Inspect the radiator for cracks, damaged cooling fins, leaking tubes, leaks around the top bonnet, and other damage. Refer a damaged radiator to direct support maintenance for repair.

(3) Inspect the fan guard and fan shroud for cracks, broken weldments, distortion, and other damage. Replace damaged parts.

c. Installation.

(1) Installation is the reverse of the removal procedure. Refer to figure 4-20.

(2) Install the coolant and oil cooler lines and fittings (para 4-30).

(3) Install the engine housing panels that were removed to provide access to the radiator (para 4-19c).

(4) Service the engine coolant system and the engine oil system. Start the engine and check for leaks. Correct any deficiencies

Section XI. MAINTENANCE OF IGNITION SYSTEM

4-33. Description

a. The ignition system includes the magneto (11, fig. 4-7) and radio-suppressed spark plugs (1) which have shielded cables (5). The system is completely independent of the battery- and alternator-powered electrical system.

b. The magneto is timed to the engine and is driven by the camshaft gear through the governor drive gear which is engaged by the drive lugs on the magneto drive coupling. There is a critical timing relationship between these driving parts since it determines the instant at which the spark from the magneto will be delivered to each spark plug. An improperly timed magneto will make engine operation impossible.

c. The magneto consists of a magnetic rotor which is rotated in a laminated frame to set up magnetic flux in the laminated frame. This induces a current in the primary winding each time the magnetic flux rises and falls. The primary winding acts as the primary winding of a step-up transformer, surrounded by the secondary coil. Breaker point opening occurs at the instant of maximum primary current, causing an immediate collapse of the magnetic field. This collapsing magnetic field induces an extremely high voltage surge through the secondary circuit. The capacitor in the primary circuit speeds the collapse of the circuit, increasing the secondary voltage and also reducing contact point burning.

d. The voltage induced in the secondary coil is applied to the spark plug of the required cylinder at precisely the correct instant by the distributor rotor in the magneto. The breaker points open at the required instant to ensure a hot spark to the spark plug at this time. The spark at the spark plug causes the ignition of the fuel-air mixture in the cylinder.

e. At starting, an impulse coupling on the magneto causes a snapping action of the magneto rotor, producing the rapid rotation necessary to energize the electrical windings. This retards the rotation of the magneto rotor at slow speeds until top-dead-center is reached. Spring action then snaps the rotor forward to produce the required high rotational speed.

f. The magneto also contains automatic spark advance provisions so that the spark will occur sooner during high speed operation. This is necessary for smooth engine performance. The automatic spark advance rotor has pawls which are thrown outward as engine speed increases to change the relationship of the distributor rotor in the magneto.

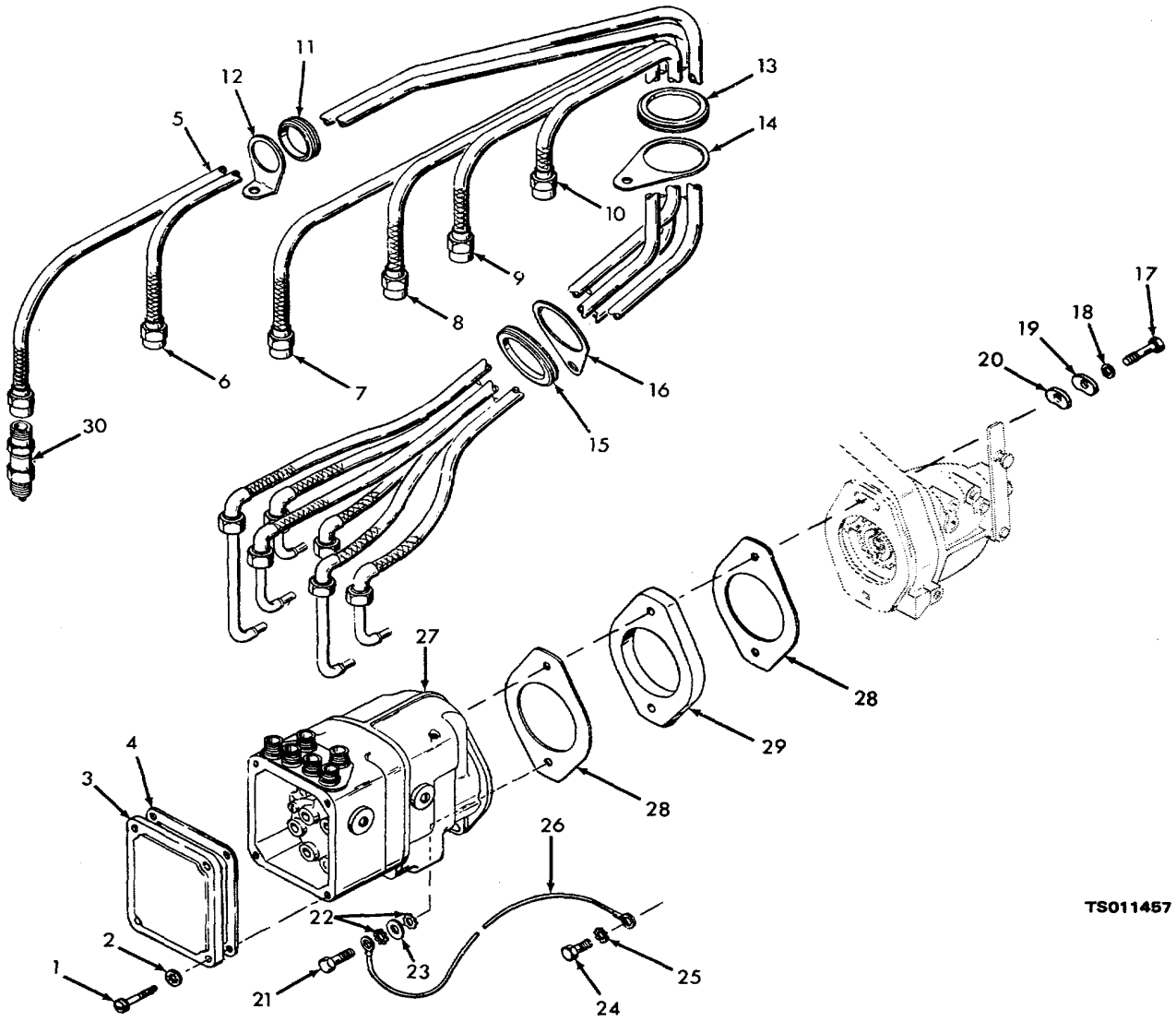
g. The connections to the distributor block of the magneto are shielded by a cover through which the high-tension spark plug cables pass. The cable shields are secured to the cover, but the electrical conductors pass through and connect to the distributor block.

4-34. Spark Plugs

a. Removal.

(1) Use compressed air to blow dirt away from the spark plugs before removing them. This will prevent the dirt from entering the cylinder as the spark plug is removed.

(2) Tag and disconnect the shielded spark plug cables (5 through 10, fig. 4-19) from the spark plugs (30) and remove the spark plugs, using a spark plug wrench.



1. Screw
2. Lock washer
3. Magneto cover
4. Cover gasket
5. No. 6 spark plug cable
6. No. 5 spark plug cable
7. No. 4 spark plug cable
8. No. 3 spark plug cable
9. No. 2 spark plug cable
10. No. 1 spark plug cable
11.
11. Grommet
12. Bracket
13. Grommet
14. Bracket
15. Grommet
16. Bracket
17. Bolt
18. Flat washer
19. Gasket plate
20. Gasket
21. Cap screw
22. Lock washer
23. Flat washer
24. Cap screw
25. Lock washer
26. Ground strap
27. Magneto
28. Gasket
29. Magneto spacer
30. Spark plug

Figure 4-19. Ignition system, exploded view.

NOTE

It is normally more economical to replace the spark plugs than to clean and regap them. It also provides greater assurance that there are no hidden cracks in the ceramic insulators which could cause engine misfiring at high engine speeds. Cleaning and inspection instructions are given here in case it is necessary to reuse the removed plugs.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 ° to 138 ° F (38 ° to 59 ° C).

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

(2) Check the ceramic insulator for cracks, porosity, and other damage.

(3) If the electrodes of the spark plugs are not too badly burned, remove the scale and other deposits from them. This can be done by a sand- blast-type cleaner or with a contact file.

(4) Inspect the electrodes for severe burning, cracks, and other damage. If it is necessary to reuse the plugs, correct the contact gap to 0.025 inch.

(5) Replace any spark plugs whose condition is doubtful.

c. Installation.

(1) Make sure all spark plugs are gapped to 0.025 inch before installation.

(2) Install the spark plugs, using a socket and torque wrench. Tighten the spark plugs to 35 foot-pounds torque.

(3) Install the shielded spark plug cables on the spark plugs. Make sure the leads are not interchanged. Refer to figure 4-20 to ensure proper magneto-to-spark plug wiring if spark plug connection is doubtful.

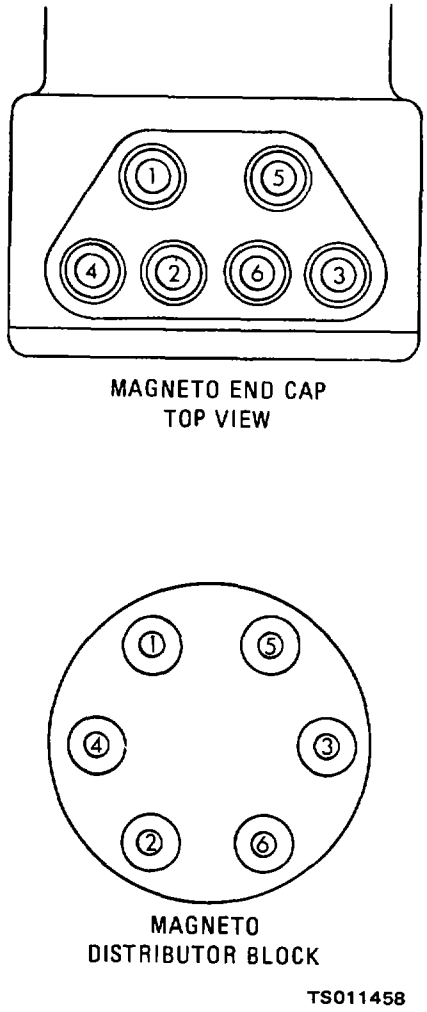


Figure 4-20. Magneto-to-spark plug connections.

4-35. Magneto and Spark Plug Cables

a. Removal.

(1) Refer to paragraph 4-24 for removal of carburetor. Refer to paragraph 4-19 for removal of the lower panel.

(2) Remove the four screws (1, fig. 4-19) and lock washers (2) that secure the cover (3) on the magneto; remove the cover and gasket (4).

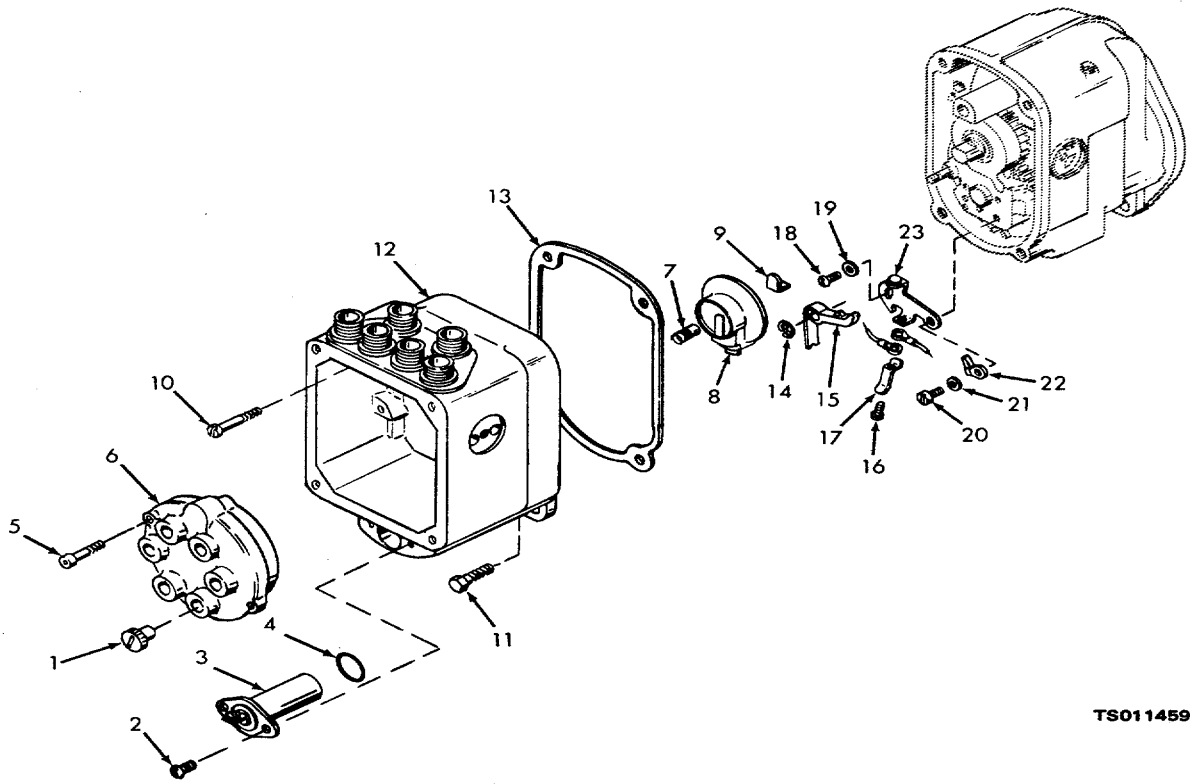
(3) Disconnect the shielded spark plug cables from the magneto end cap by unscrewing

the shield connectors. Disconnect the ends of the leads from the distributor cap in the magneto end cap. Tag and disconnect spark plug cables from spark plugs if cable replacement is necessary.

(4) Remove the lower cap screw (21), lock washers (22), and flat washer (23) that secure the bottom of the magneto and the ground lead (26) to the engine front end plate. Remove the bolt (17), flat washer (18), gasket plate (19), and the top of the engine speed governor to the gear cover; remove the magneto (27), gaskets (28), and spacer (29).

b. Replacing and Adjusting Breaker Point Assembly.

(1) Remove the screws (2, fig. 4-21) that secure the capacitor (3) to the lower front of the magneto; remove the capacitor and preformed packing (4).



1. Cable outlet knob
2. Screw
3. Capacitor
4. Preformed packing
5. Screw
6. Distributor block
7. Brush and spring
8. Distributor rotor
9. Rotor spring clip
10. Screw
11. Screw
12. End cap
13. Gasket
14. Retaining ring
15. Movable contact
16. Terminal screw
17. Primary ground spring
18. Screw
19. Washer
20. Screw
21. Washer
22. Cam wick
23. Stationary contact

Figure 4-21. Magneto breaker points, exploded view.

(2) Remove the screws (5) that secure the distributor block (6) to the magneto and remove cable outlet knobs(1). Remove the distributor (3) Remove the four screws (10 and 11); block and brush and spring (7). Pull off the distributor rotor (8) and remove the rotor spring clip (9).

remove the end cap (12) and gasket (13) to provide easy access to the breaker points.

(4) Remove the retaining ring (14) and remove the movable contact (15) from the pivot.

(5) Remove the terminal screw (16), and disconnect the leads and the primary ground spring (17).

(6) Remove the screw (18) and washer (19) that secure the one end of the stationary contact (23) to the magneto. Remove the screw (20), washer (21), and cam wick (22). Remove the stationary contact from the magneto.

(7) Apply a light coat of grease on the magneto cam. Position the stationary contact of the new breaker point set on the magneto bearing support; secure by installing the cam wick (22), screw (20), and washer (21). Install the screw (18) and washer (19), but do not tighten.

(8) Position the movable contact (15) of the new breaker point set on the pivot on the bearing support; secure with the retaining ring.

(9) Install the primary ground spring (17) and the leads with the terminal screw (16).

(10) Crank the engine so that the cam follower of the movable contact is on the high portion of the cam. Insert a feeler gage between the contact points. The required contact gap is 0.015 inch. Adjust the position of the stationary contact (23) to provide the required point gap when the cam holds the contacts fully open. Tighten the screw (18) to secure the adjustment. Check that screw (20) is also tight.

(11) Rotate the magneto shaft to check that the breaker points open and close properly as the magneto cam rotates.

(12) Position the gasket (13) and end cap (12) on the magneto case and secure with four screws (10 and 11).

(13) Check the distributor rotor (8) for cracks, worn mounting hole, and burned contacts. If defective, use a new rotor. Install the rotor spring slip (9) and rotor.

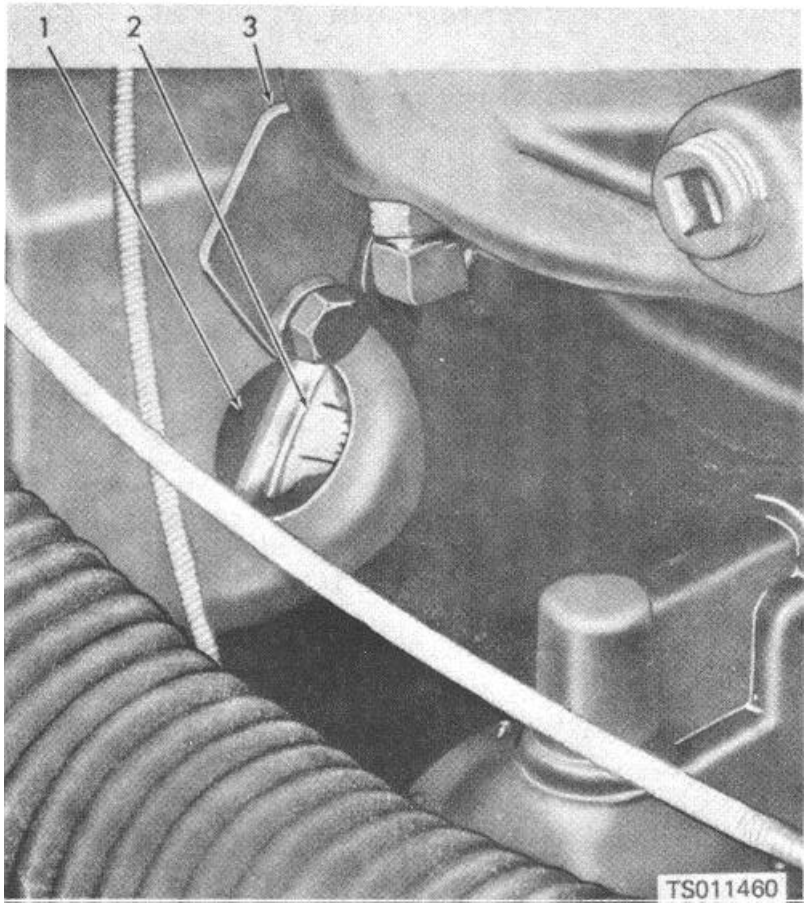
(14) Inspect the distributor block (6) and cable outlet knobs (1) for cracks, arc paths, burned terminals, and other damage. Replace if defective. Install a new brush and spring (7) and the distributor block on the magneto with four screws (5).

(15) Install a new preformed packing (4) on a new capacitor (3) and secure with two screws (2). The rear terminal of the capacitor must contact the primary ground spring (17).

c. Installation. Timing the magneto to the engine is a critical procedure. Install the magneto as follows:

(1) Remove the rear spark plug from the engine. Put your thumb over the spark plug hole and crank the engine until No. 6 cylinder starts on the compression stroke. This is indicated by air being compressed against your thumb as the piston rises in the cylinder.

(2) Set the piston on top-dead-center by slowly cranking until the DC mark on the flywheel (2, fig. 4-22), visible through the timing hole (1) in the housing, is aligned with the timing mark pointer. Hold the engine at this setting



1. Flywheel timing hole
2. Flywheel
3. Timing hole cover

Figure 4-22. Engine timing marks.

(3) Mount the removed magneto in a vise thoroughly lined with soft cloths. Insert a spark plug cable into distributor block hole for spark plug No. 6. Refer to figure 4-20. Turn the drive lugs clockwise while holding the high tension cable for No. 6 cylinder close to the magneto frame so that a spark will arc when the No. 6 cable is energized. When No. 6 cable arcs, the magneto is at the No. 6 firing position. Hold the magneto drive shaft at this position.

(4) Check the governor drive gear to make sure that the punch-marked tooth in the cam gear is engaged between the two punch-marked teeth on the governor drive gear. Refer to figure 4-22.

(5) Remove the magneto from the vise. Turn the magneto drive lugs of the impulse coupling counterclockwise about one-quarter turn so that the lugs will mesh with the drive members of the governor drive gear. Position the magneto (25,fig. 4-19), spacer (27) , and gasket (26) on the engine with the magneto lugs engaged. Tighten the mounting bolts moderately. Install and connect the spark plug cables.

(6) Start the engine and idle it at 600 rpm. If the engine fails to start, it is probably due to faulty ignition timing. Recheck as directed above.

(7) With the engine running at 600 rpm, use a timing light connected to the rear spark plug and check that the IGN-M indication on the flywheel is aligned with the timing pointer. If it is not exactly aligned, loosen the magneto mounting hardware slightly and rotate the magneto slightly until the correct indication is attained. Tighten the mounting hardware firmly.

(8) Install the cover (3, fig. 4-19) on the magneto with four screws (1) and lock washers (2).

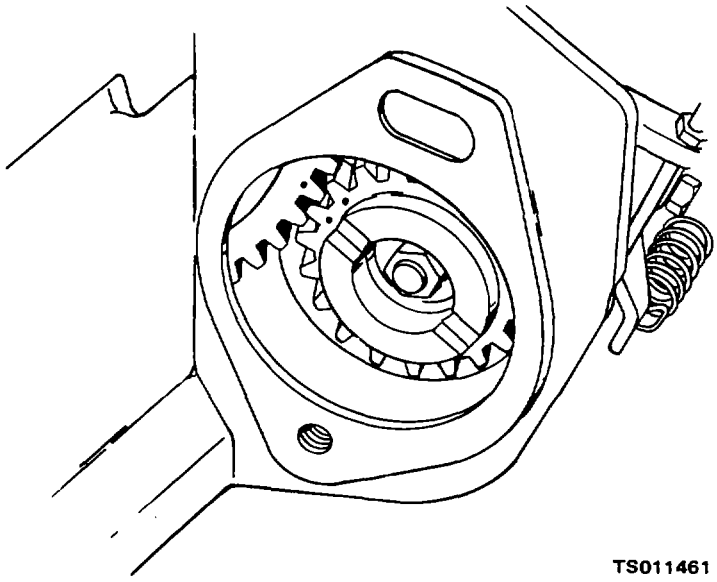


Figure 4-23. Timing marks on timing gear and governor drive gear.

Section XII. MAINTENANCE OF ELECTRICAL SYSTEM

4-36. Description

a. The electrical system includes two 12-volt, lead-acid-type storage batteries connected in series to power the 24-volt electrical system. Battery output is used to energize the electrical starting motor (7, fig. 3-3) to start the engine. The battery charge is partially depleted as the engine is started and is restored by the battery charging system consisting of the alternator (1) and voltage regulator (10).

b. The alternator and regulator are typical automotive types in which the alternator output is controlled through the voltage regulator, depending upon the state of charge of the batteries. When the battery charge is low, the voltage regulator increases the strength of the alternator field to increase the output of the alternator. When the battery charge is normal, the output of the alternator decreases to near zero.

CAUTION

Though this engine is equipped with a reverse polarity protector to protect the alternator against damage due to reverse polarity connections, it is good practice to take special precautions when connecting and disconnecting electrical leads and cables. Do not ground the field terminal between the alternator and regulator. Do not operate the alternator in an open circuit with the rotor winding energized. Do not ground the alternator output circuit. Take care to prevent reversing polarity of the electrical system. When using a battery booster or fast charger, make sure the leads are connected with proper polarity. Failure to follow these instructions may damage the alternator rectifiers, voltage regulator, and wiring.

c. Reverse polarity connections to an alternator can severely damage the alternator. To prevent this damage, the system is protected by a reverse polarity protector (9, fig. 3-3) which is mounted on the panel next to the voltage regulator.

d. The engine starting motor (7, fig. 3-3) is a solenoid-operated type in which the solenoid switch (6) is mounted on top the starting motor. The solenoid switch uses electrical energy to pull the starting motor drive into engagement with the fly-wheel ring gear and to make the electrical circuit which energizes the starting motor after the drive is engaged. When the engine starts, the starting motor drive is disengaged, preventing the engine from driving the starting motor which could be severely damaged by engine operating speeds. Reengagement of the starting motor while the engine is running is prohibited by the starting motor disengage relay.

e. The battery cables are automotive type, with a large cross section of copper wires to transmit the heavy current required when starting the engine. The terminals are molded onto the cables.

f. The engine controls and instruments are

mounted on the control panel which is located on the pumping assemblies. Refer to figure 1-4 for the wiring diagram showing the electrical connections between the engine and controls. The function of the controls and instruments is described in table 2-1

g. The starter switch, mounted on the control panel, closes the circuit to energize the starting motor. When the push-button is released, the starting motor deenergizes.

h. The ignition switch, mounted on the control panel, grounds the magneto and stops the engine. This switch is in the same circuit as the oil pressure safety switch.

4-37. Batteries and Cables

a. Service. To charge batteries, proceed as follows:

WARNING

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

(1) Remove caps and check the electrolyte level in each cell. If any are low, fill to proper level with distilled water or good grade drinking water (excluding mineral water).

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

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 by interrupting the charging procedure as this temperature is approached.

(3) If the specific gravity of the electrolyte is less than 1.250, the batteries must be charged before use. A battery-charging receptacle (5, fig. 3-2) is provided at the lower left rear of the engine housing. Connect the charger into this receptacle. When you charge the batteries, use a constant current charger. Check the specific gravity of the electrolyte every 30 minutes. The batteries are fully charged when you get a constant specific gravity reading for three 30-minute intervals.

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

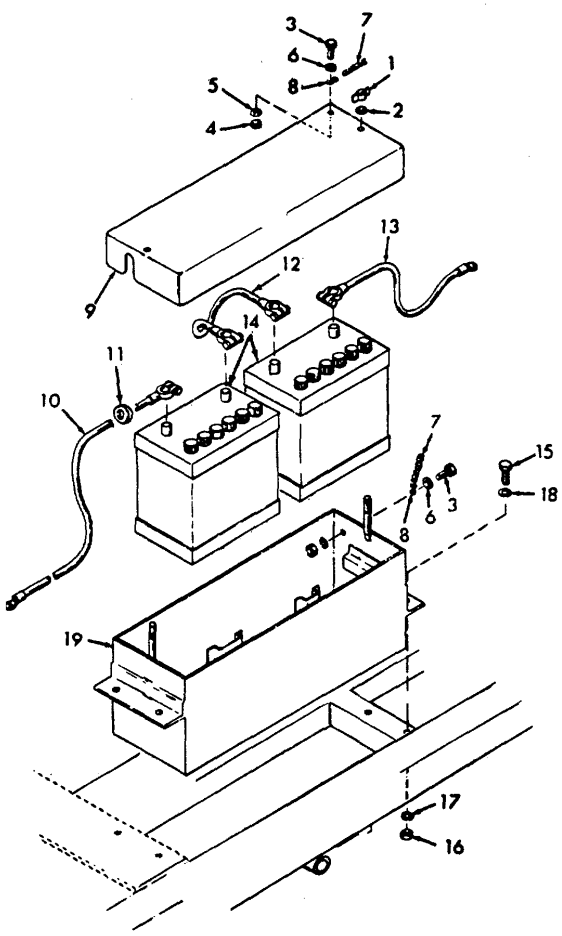
NOTE

Military batteries and maintenance free batteries cannot be mixed.

(5) Charge the battery a minimum of once each month when the battery is not in service. If the battery fails to take or maintain a charge, replace it.

b Removal and Disassembly.

(1) Remove the wing nut (1, fig. 4-24) and flat washer (2), and remove the battery box cover (9). If any of the parts are damaged, remove the cap screws (3), nuts (4), lock washers (5), and flat washers (6), and remove the chain (7) and S-hooks (8).



1. Wing nut
2. Flat washer
3. Cap screw
4. Nut
5. Lock washer
6. Flat washer
7. Chain
8. 5-hook
9. Battery box cover
10. Battery cable
11. Insulating grommet
12. Jumper cable
13. Ground cable
14. Battery
15. Cap screw
16. Nut
17. Lock washer
18. Lock washer
19. Battery box

Figure 4-24. Batteries, battery box, and cables, exploded view.

(2) Disconnect the cables (10, 12, and 13, fig. 4-24) from the batteries (14).

(3) Lift the batteries (14) from the battery box 19).

(4) If the battery box is damaged, remove the cap screws (15), nuts (16), lock washers (17), and lock washers (18) that secure the battery box (19) to the chassis frame; remove the battery box.

c. Cleaning and Inspection.

(1) Clean the battery tops and the cable ends with a solution of water and baking soda to neutralize any acid on the parts. Prevent the solution from entering the batteries.

WARNING I

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of the skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138 ° F (38 ° to 59 °C).

(2) Flush the metallic parts with a solution of water and baking soda to neutralize any spilled acid. Remove any greasy or gummy deposits with a cloth dampened with cleaning solvent (fed. spec. P-D-680).

(3) Inspect all parts for cracks, corrosion, damaged paint, stripped threads, and other damage. Touch up damaged paint. Replace damaged parts.

(4) If necessary, service the batteries as directed in subparagraph a above. d. Reassembly and Installation. Refer to figure 4-24 and install the batteries, battery box, and cables in the reverse order of removal. After installation, be sure that you coat battery terminals with GAA lubricant to prevent corrosion.

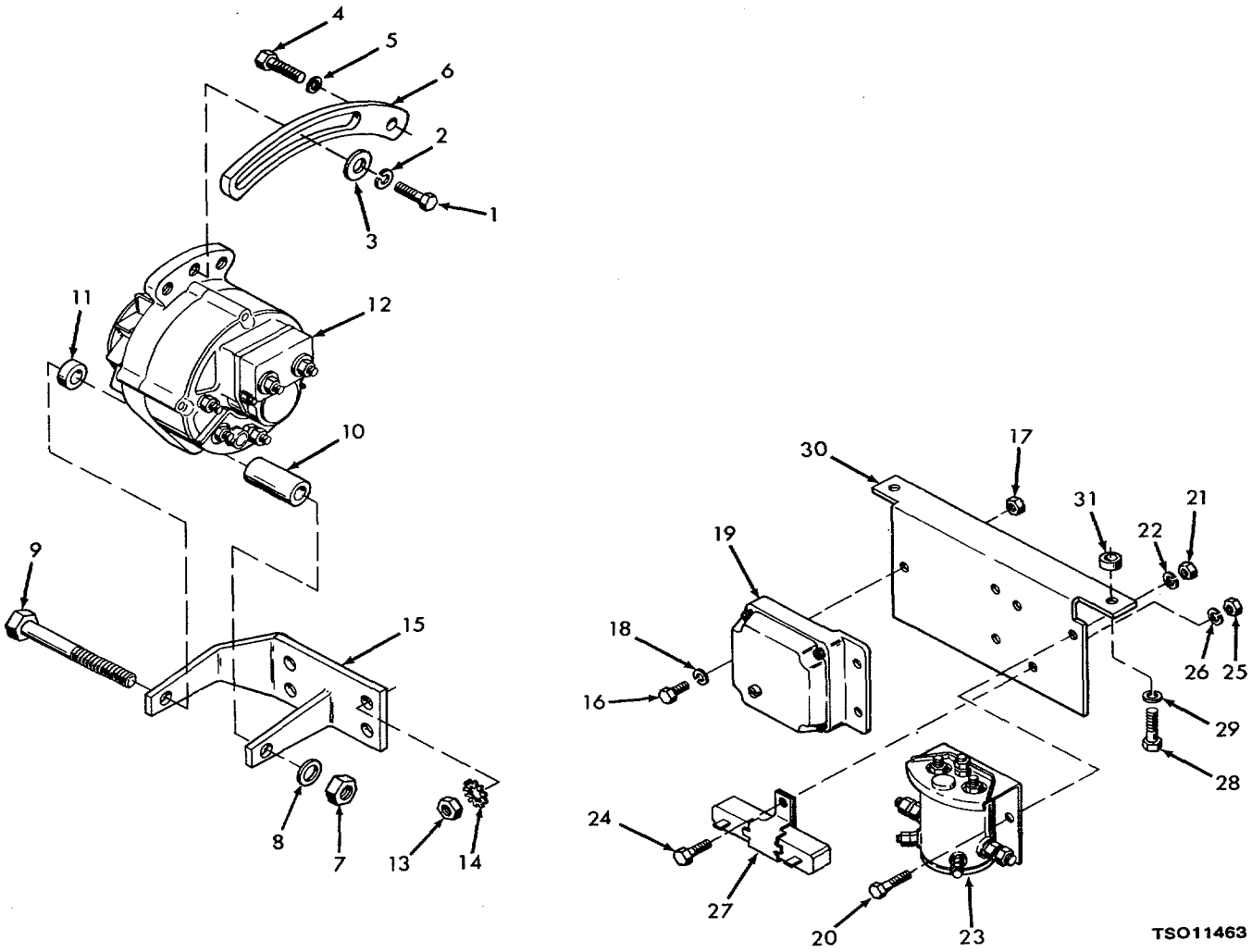
4-38. Alternator

CAUTION

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

a. Removal.

(1) Loosen the adjusting screw (1, fig. 4-25) and push the alternator toward the engine to loosen the fan belt. Disengage the fan belt from the alternator drive pulley.



1. Adjusting screw
2. Lock washer
3. Flat washer
4. Strap mounting screw
5. Lock washer
6. Adjusting strap
7. Nut
8. Flat washer
9. Bolt
10. Spacer
11. Spacer
12. Alternator
13. Nut
14. Lock washer
15. Alternator mounting bracket
16. Cap screw
17. Nut
18. Lock washer
19. Voltage regulator
20. Cap screw
21. Nut
22. Lock washer
23. Reverse polarity protector
24. Cap screw
25. Nut
26. Lock washer
27. Excitation resistor
28. Cap screw
29. Lock washer
30. Mounting bracket
31. Spacer

Figure 4-25. Battery charging system, exploded view.

(2) Disconnect the electrical leads from the alternator. Tag leads to facilitate reassembly.

(3) Remove the alternator from the engine, .following the sequence of index numbers 1 through 15 in figure 4-25.

b. Cleaning and Inspection

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138 ° F (38 0 to 59 o C).

(1) Clean the exterior of the alternator with a cloth dampened with dry cleaning solvent (fed. spec. P-D-680). Take care to prevent the solvent from entering the interior of the alternator. Wipe the alternator dry.

(2) Inspect the alternator for cracks, signs of overheating, damaged terminals, and damaged internal wiring.

(3) Check the alternator rotor shaft for free rotation. The shaft must turn freely and smoothly without catching or binding. Replace the alternator if it is damaged.

c. Installation.

(1) Installation is the reverse of removal. Refer to items 1 through 15 in figure 4-25.

(2) Connect the electrical leads to the alternator. If necessary, refer to the wiring diagram in figure 1-4.

(3) Engage the fan belt on the alternator pulley and tighten the belt (para 4-31a).

4-39. Voltage Regulator

CAUTION

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

a. Removal.

(1) Disconnect the electrical leads from the voltage regulator. Tag leads to facilitate reassembly.

(2) Remove the three cap screws (16, fig. 4-25), nuts (17), and lock washers (18) that secure the voltage regulator to the mounting bracket; remove the voltage regulator.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 ° to 138 ° F (38 ° to 59 ° C).

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

(2) Inspect the voltage regulator for cracks, signs of overheating, loose or damaged terminals, and other damage; replace a damaged voltage regulator.

c. Installation. Installation of the voltage regulator is the reverse of removal. Refer to items 16 through 19 of figure 4-25. If necessary, refer to the wiring diagram in figure 1-4 for connection requirements.

4-40. Reverse Polarity Protector

a. Removal.

CAUTION

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

(1) Disconnect the electrical leads from the reverse polarity protector (23, fig. 4-25). Tag leads to facilitate reassembly.

(2) Remove the two cap screws (20), nuts (21), and lock washers (22) that secure the reverse polarity protector (23) to the mounting bracket (30); remove the reverse polarity protector.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 ° to 138 ° F (38 ° to 59 ° C).

(1) Wipe the exterior of the reverse polarity protector with a cloth dampened with dry cleaning solvent (fed. spec. P-D-680); dry thoroughly.

(2) Inspect the reverse polarity protector for cracks, signs of overheating, loose or damaged terminals, and other damage; replace a damaged polarity protector.

(3) Check the operation of the reverse polarity protector. When positive (+) 24 vdc is applied to the IGNITION terminal of the unit with a negative (-) ground, continuity must exist across the main terminals. When negative (-) 24 vdc is applied to the IGNITION terminal with a positive (+) ground, no continuity must

exist across the main terminals. Replace the unit if it fails to operate as indicated.

c. Installation. Installation of the reverse polarity protector is the reverse of removal. Refer to items 20 through 23 in figure 4-25. If necessary, refer to figure 1-4 for connection requirements.

4-41. Excitation Resistor

a. Removal.

CAUTION

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

(1) Disconnect the electrical leads from the excitation resistor (27, fig. 4-25). Tag leads to facilitate reassembly.

(2) Remove the cap screw (24), nut (25), and lock washer (26) that secure the excitation resistor (27) to the mounting bracket (30). Remove the cap screws (28) and lock washers (29), and remove the bracket (30) and spacer (31).

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 o to 138 ° F (38° to 59 C).

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

(2) Inspect the excitation resistor for cracks, signs of overheating, loose or damaged terminals, and other damage. Use a multimeter to check the resistance of the unit. Resistance must be 33 ohms. Replace the resistor if it is damaged or if resistance is incorrect.

c. Installation. Installation of the excitation resistor is the reverse of removal. Refer to items 24 through 31 in figure 4-25. If necessary, refer to figure 1-4 for connection requirements.

4-42. Engine Starting Motor

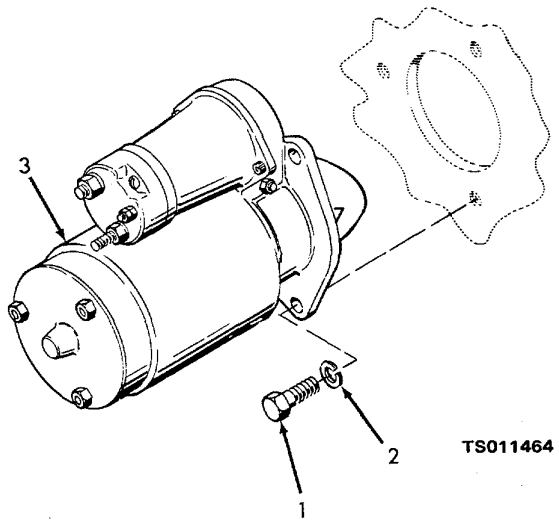
a. Removal.

CAUTION

Disconnect the battery cables from the positive battery terminals 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 leads to the starter solenoid switch (6, fig. 3-3).

(2) Remove the three cap screws (1, fig. 4-26) and lock washers (2) that secure the starting- motor (3) to the engine side of the flywheel housing; pull straight forward on the starting motor to remove the assembled starter solenoid switch and starting motor from the engine.



1. Cap screw
2. Lock washer
3. Starting motor

Figure 4-26. Starting motor mounting, exploded view.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 O to 138 O F (38 ° to 59° C).

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

(2) Inspect the starting motor for cracks, signs of overheating, loose solenoid switch mounting, damaged pinion teeth on the drive, and other damage.

(3) Check the armature for free rotation. There must be no catching, binding, or scraping as the armature is rotated.

(4) To check the starting motor solenoid, apply 24 vdc between the BAT terminal of the solenoid and the switch (S) terminal. This will advance the starter drive to the engaged position. With the drive advanced and power still applied, check continuity between the BAT and motor (M) terminals Continuity must exist. Break the circuit to the terminals. The drive must retract fully, and the circuit between the BAT and motor (M) terminals must break.

(5) Replace the starting motor if it is worn, damaged, or inoperative.

c. Installation.

(1) Position the starting motor (3, fig. 4-26) with its assembled solenoid switch on the flywheel housing of the engine; secure with three cap screws (1) and lock washers (2).

(2) If necessary, refer to figure 1-4 for connection information.

(3) Attempt to start the engine as directed in paragraph 2-3. The starting motor must crank the engine freely and easily.

Section XIII. MAINTENANCE OF CONTROLS AND INSTRUMENTS

4-43. Description

a. The engine controls and instruments are mounted on the control panel which is part of the dash assembly of the engine. Refer to figure 1-4 for the wiring diagram showing the electrical connections between the engine and controls. The function of the controls and instruments is described in table 2-1.

b. The engine has three protective devices which will shut down the engine under certain conditions which could damage the engine. These conditions are high coolant temperature, low oil pressure, and engine overspeed. In each of these emergency conditions, the engine shutdown is accomplished by grounding the primary of the magneto to prevent the engine ignition system from operating.

c. Two large gages on the engine control panel indicate the suction and discharge pressures of their related systems. They are connected to the pump by lines and fittings, and each system incorporates a valve to disconnect the gage from the system if desired. A dampener in the system at each gage prevents momentary pressure surges from damaging the related gage.

d. The tachometer-hourmeter mounted on the control panel is driven by a flexible drive shaft which connects to a drive adapter on the overspeed governor arm. The drive adapter meshes with a threaded portion of the overspeed governor drive shaft, providing the rotational force necessary to operate the tachometer-hourmeter.

e. The starter disengage relay, mounted on the control panel, opens the circuit to the starter solenoid switch to deenergize the start circuit immediately when the engine starts, and prevents the operation of the starting motor at any time while the engine is running. This protects the starting motor from damage which could be caused by accidental operation of the starter push-button while the engine is running. The operating coil of the relay is connected to alternator output so that the start circuit is held open whenever there is alternator output.

4-44. Control Panel Engine Controls and Instruments

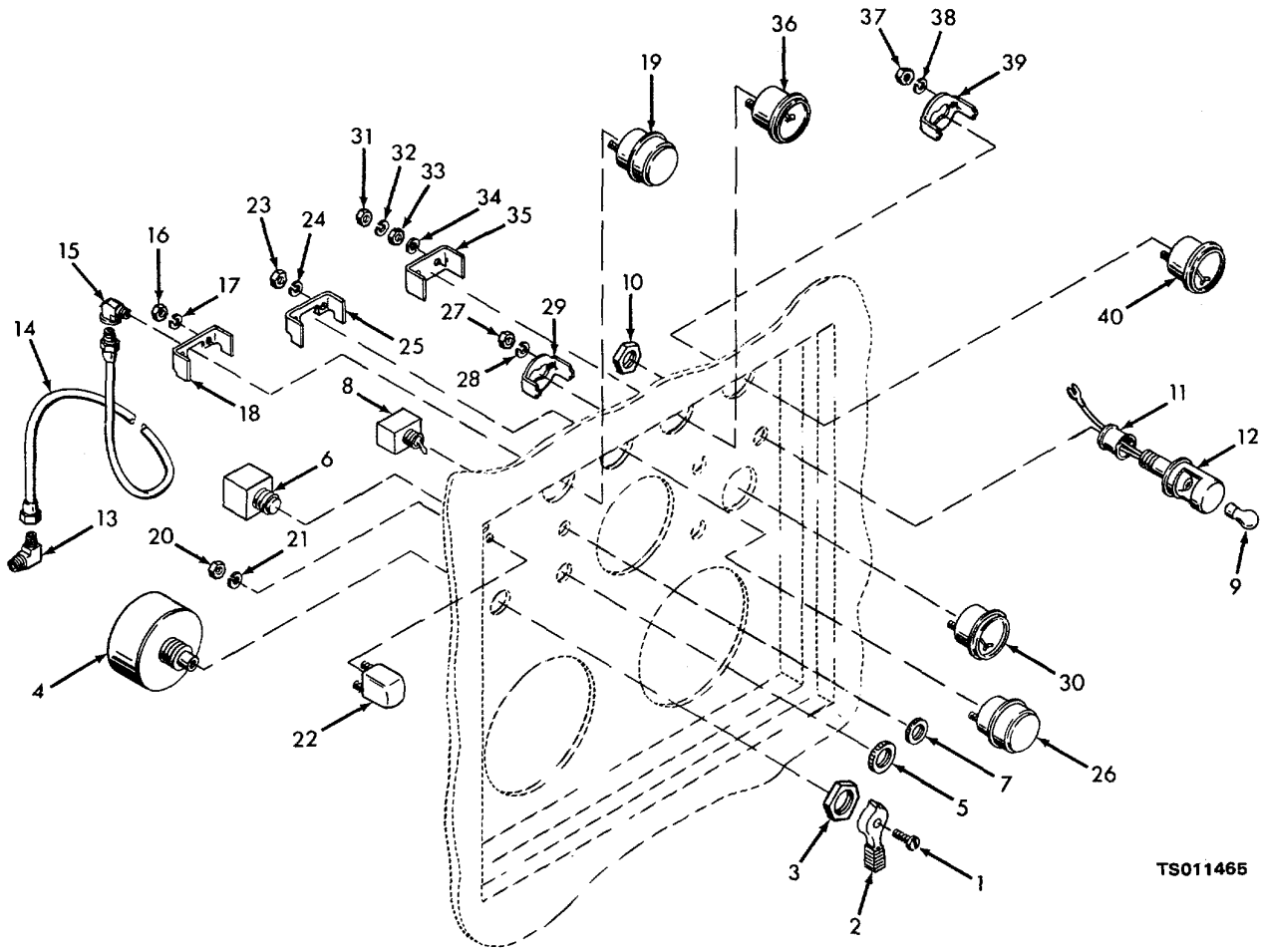
a. Removal and Disassembly.

CAUTION

Disconnect the battery cables from the positive battery terminals before disconnecting any leads to the engine controls and instruments. This will prevent shorts which could damage the alternator, voltage regulator, and other parts.

(1) Disconnect the electrical leads from the engine controls and instruments on the control panel. Tag leads to facilitate reassembly.

(2) Remove and disassemble the engine controls and instruments from the control panel as shown in figure 4-27.



1. Screw
2. Switch handle
3. Nut
4. Battery disconnect switch
5. Nut
6. Starter push-button switch
7. Nut
8. Ignition switch
9. Panel lamp
10. Nut
11. Spacer
12. Panel lamp holder
13. Elbow
14. Hose assembly
15. Elbow
16. Nut
17. Lock washer
18. Clamp
19. Oil pressure safety switch
20. Nut
21. Lock washer
22. Starter disengage relay
23. Nut
24. Lock washer
25. Clamp
26. Water temperature safety switch
27. Nut
28. Lock washer
29. Clamp
30. Oil pressure gage
31. Nut
32. Lock washer
33. Nut
34. Lock washer
35. Clamp
36. Ammeter
37. Nut
38. Lock washer
39. Clamp
40. Water temperature gage

Figure 4-27. Control panel engine controls and instruments, exploded view.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138 °F (38° to 59 C).

(1) Clean all parts by wiping them with a cloth dampened lightly with dry cleaning solvent (fed. spec. P-D-680); take care 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 cracked cases, difficult operation, lack of positive switch action, and other damage. Check the switches for continuity, using a multimeter or test lamp. Replace defective switches.

(4) Inspect the starter disengage relay for cracks, dented housing, loose or damaged terminals, and other damage. The relay is a normally closed switching device. Apply 24 volts across the coil terminals and check for continuity across the contact terminals. No continuity should exist while power is applied. Disconnect the 24-volt input to the coil terminals. There should now be continuity across the contact terminals when the coil is deenergized. Replace a damaged or inoperative relay.

c. Reassembly and Installation.

(1) Reassemble and install the controls and indicators on the control panel as shown in figure 4-27.

(2) Connect the electrical leads to the components as shown in figure 1-4.

4-45. Tachometer-Hourmeter Adapter

a. Removal.

(1) Disconnect the tachometer shaft (1, fig. 4-28) from both the tachometer-hourmeter (2) and from the adapter (3) on the overspeed governor drive mechanism

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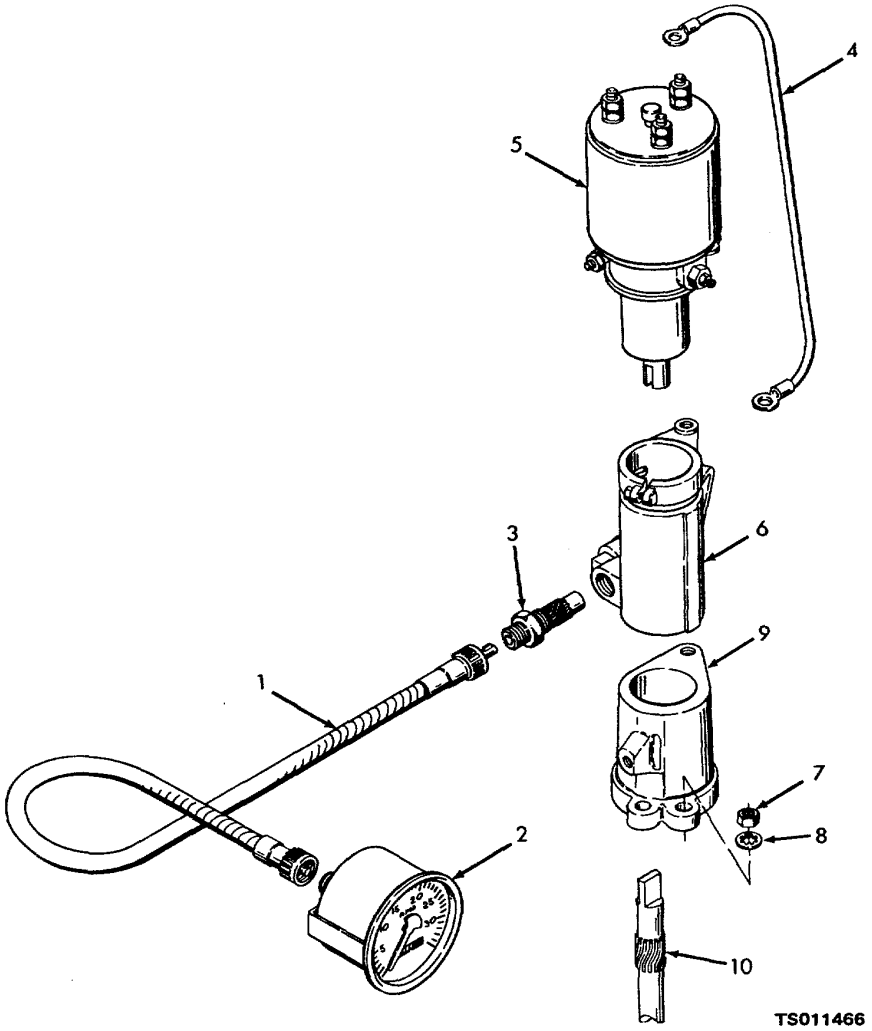


1. Tachometer shaft
2. Tachometer-hourmeter
3. Adapter
4. Ground lead
5. Overspeed governor
6. Governor arm
7. Nut
8. Lock washer
9. Adapter
10. Governor drive shaft

Figure 4-28. Engine overspeed governor related parts, exploded view.

(2) Remove the tachometer-hourmeter (2) from the control panel.

(3) Use an open-end wrench to remove the adapter (3) from the overspeed governor drive mechanism.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100 o to 138 ° F (38 ° to 59 0 C).

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

(2) Wash the adapter with cleaning solvent. Dislodge all hardened and caked grease from the adapter.

(3) Inspect the tachometer-hourmeter for broken dial glass, defaced or illegible dial

markings, binding or sticking pointer, jammed digital hour counter, or evidence of entry of moisture. Replace a damaged tachometer-hourmeter.

(4) Inspect the adapter for cracks, chipped or broken gear teeth, rough or catching operation, and damaged threads; replace a damaged adapter.

(5) Inspect the tachometer shaft for kinks, broken sheathing, binding or catching rotation of the internal shaft, and damaged threads on the coupling nuts. Replace a damaged tachometer shaft.

c. Installation. Installation is the reverse of removal; refer to figure 4-28. After installation, start the engine and check the tachometer-hourmeter for proper operation.

4-46. Engine Overspeed Governor

a. Testing and Adjustment. The engine overspeed governor must shut off the engine when engine speed reaches or exceeds 2700 rpm. Test and adjust as follows:

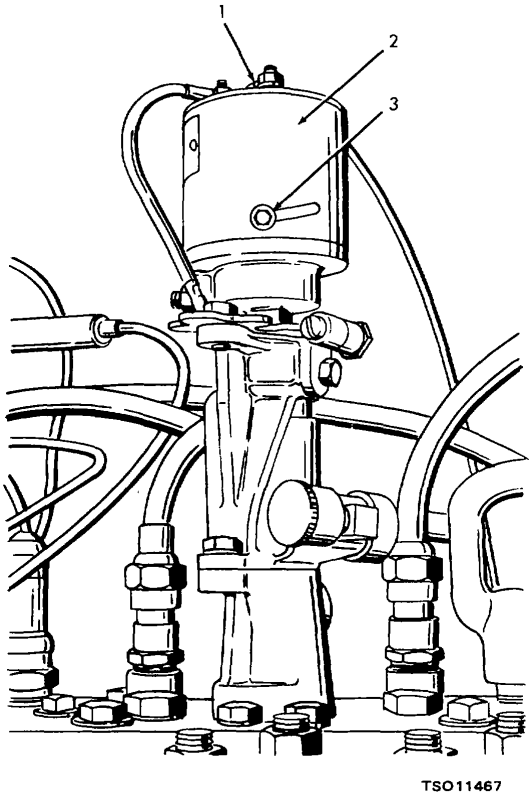
(1) Start the engine and allow it to warm to operating temperature, then shut it off.

(2) Disconnect the linkage from the engine speed governor so that the engine speed can be controlled by manually manipulating the carburetor throttle lever.

(3) Restart the engine and have an assistant watch the tachometer. Slowly increase engine speed with no load until the engine stops as the result of the operation of the overspeed governor or until the tachometer indicates 2750 rpm.

(4) If the engine did not shut off as the result of the tripping of the overspeed governor, you must adjust the overspeed governor. If the engine stopped before the tachometer indicated 2650 rpm, you must adjust the overspeed governor.

(5) To adjust the engine overspeed governor, loosen the lock screw (3, fig. 4-29) that secures the cap (2) in position. To decrease the engine shutoff speed, rotate the cap clockwise. To raise the engine shutoff speed, turn the cap counterclockwise. Tighten the lock screw.



1. Reset button
2. Cap
3. Lock screw

Figure 4-29. Engine overspeed governor, showing adjusting points.

(6) Recheck the speed at which the overspeed governor stops the engine as directed in steps (1) through (3) above. Readjust until the engine

shuts off at 2700 rpm. Replace the engine overspeed governor if it cannot be adjusted.

(7) Reconnect the engine overspeed governor.

b. Removal.

(1) Remove the tachometer drive from the governor arm (para 4-45).

(2) Disconnect the electrical leads, including the ground lead (4, fig. 4-28), from the terminals at the top of engine overspeed governor. Tag leads to facilitate reassembly.

(3) Remove and disassemble the overspeed governor and related parts as shown in figure 4-28.

c. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59°C).

(1) Wipe the exterior of the engine overspeed governor with a cloth dampened with cleaning solvent (fed. spec. P-D-680); dry thoroughly. Take care to prevent solvent from entering the interior of the unit.

(2) Wash all remaining parts with cleaning solvent. Remove the grease cup from the governor arm and carefully remove all grease from the cup and from the interior of the arm.

(3) Remove all grease from the toothed portion of the governor drive shaft. Use a soft-bristled brush, if necessary, to remove the grease.

(4) Inspect the engine overspeed governor for cracks, loose or damaged terminals, and damaged coupling at the end of the shaft. Rotate the shaft to check for rough, catching, or binding operation. Replace a damaged overspeed governor.

(5) Inspect the governor drive shaft for cracks, damaged teeth, distortion and other damage; replace a damaged drive shaft.

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

d. Reassembly and Installation.

(1) Reassemble and install the engine overspeed governor and related parts as shown in figure 4-28.

(2) Reconnect the electrical leads to the terminals at the top of the overspeed governor. Refer to the wiring diagram (fig. 1-4).

(3) Reconnect the tachometer drive and tachometer shaft to the governor arm, and lubricate the tachometer drive and overspeed governor. Refer to lubrication order LO 5-4320234-12 (fig. 3-1).

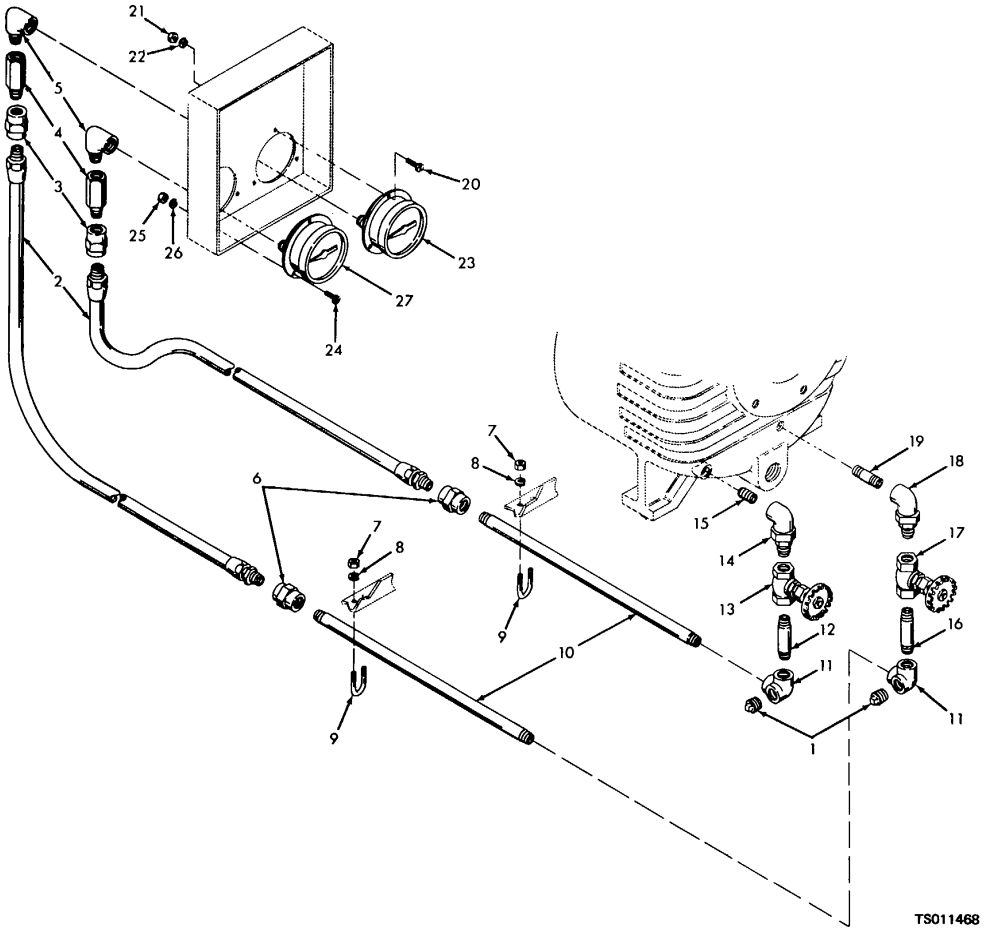
(4) Check and, if necessary, adjust the engine overspeed governor (subparagraph *a* above).

4-47. Suction and Discharge Gages, Lines, and Fittings

a. Removal and Disassembly.

(1) Remove and disassemble the lines and fittings from the suction and discharge gages and from the pump as shown in figure 4-30.

(2) Remove the cap screws (20 and 24, fig. 430), nuts (21 and 25), and lock washers (22 and 26) that secure the suction and discharge gages (23 and 27) to the control panel; remove the gages.



1. Drain plug
2. Hose assembly
3. Coupling
4. Dampener
5. Elbow
6. Coupling
7. Nut
8. Lock washer
9. U-bolt
10. Pipe nipple
11. Side outlet elbow
12. Pipe nipple
13. Discharge gage valve
14. Elbow
15. Pipe nipple
16. Pipe nipple
17. Suction gage valve
18. Elbow
19. Pipe nipple
20. Cap screw
21. Nut
22. Lock washer
23. Suction gage
24. Cap screw
25. Nut
26. Lock washer
27. Discharge gage

Figure 4-30. Suction and discharge gages, lines, and fittings, exploded view.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59°C).

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

(2) Clean all lines and fittings by washing in cleaning solvent. Shake off excessive solvent.

(3) Inspect the suction and pressure gages for cracked dial glass, binding or sticking needle movement, illegible dial faces, evidence of water entry, and other damage. If possible, check the operation against master gages to ensure the accuracy of the indication. Replace damaged gages.

(4) Inspect the lines for cuts, abrasions, leaks, damaged threads, and other damage. Blow through lines with compressed air to ensure that they are open. Replace damaged lines.

(5) Inspect the valves for cracks, damaged threads, and for catching or binding of the valve stem. Replace damaged valves.

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

c. Reassembly and Installation. Install the suction and discharge gages, lines, and fittings as shown in figure 4-30. After assembly, start the pump and check for leaks. Correct any leaks noted.

Section XIV. MAINTENANCE OF PUMP

4-48. Description

a. The centrifugal pump has a discharge elbow secured to the top of the pump housing with studs and nuts. The straight suction inlet is in the front center of the pump housing. Both suction and discharge ports are provided with threaded flanges having 6-inch female NPT threads. The suction inlet incorporates a flapper-type check valve which prevents reverse flow of fluid through the pump when the unit is shut down. The check valve also helps retain fluid in the pump housing to facilitate the self-priming action.

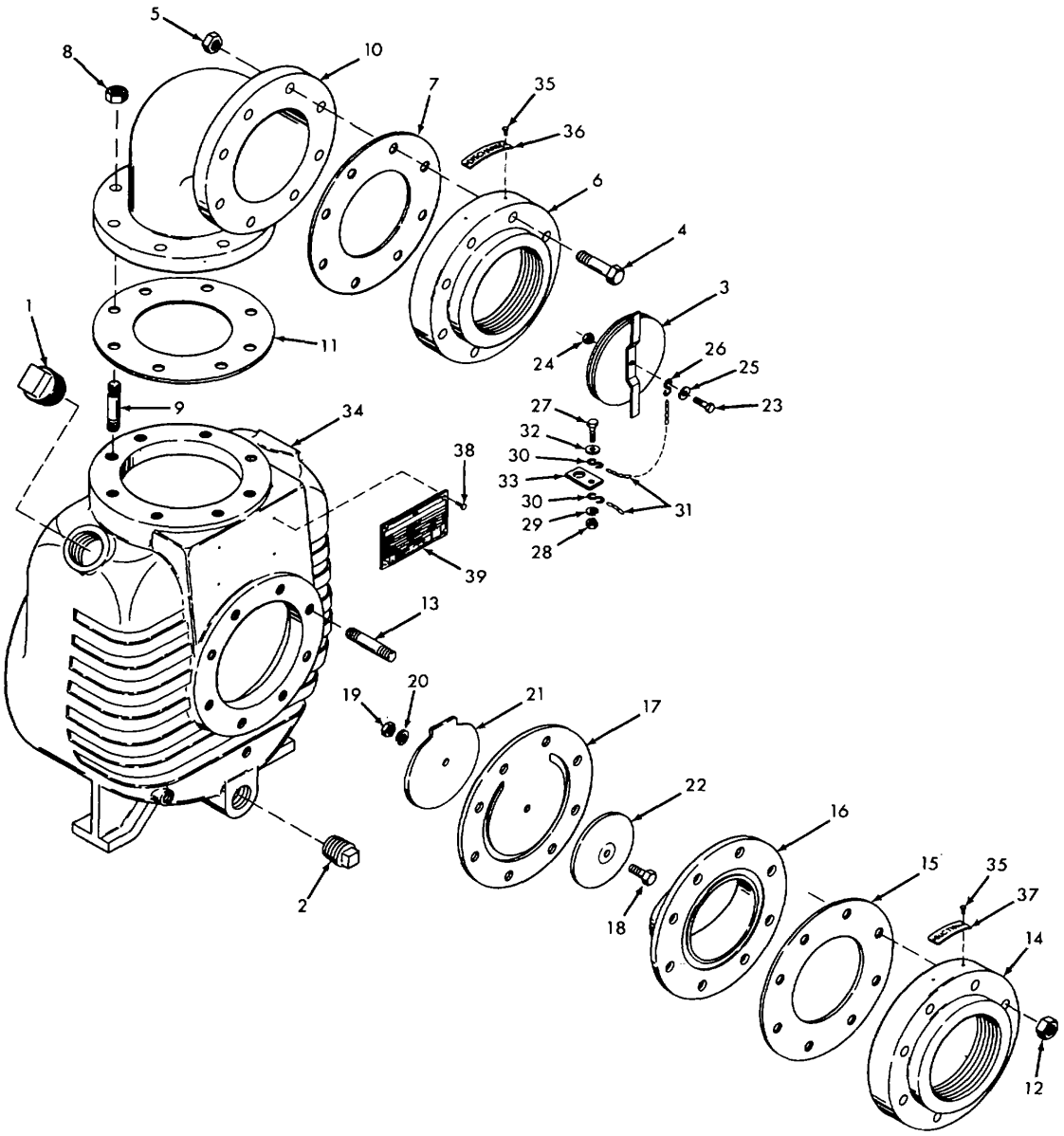
b. This self-priming pump requires manual priming only at initial startup or after the pump has lost its priming fluid through evaporation or draining. Otherwise, it will self-prime using the fluid which is retained in the pump body.

c. Both suction and discharge ports have screw-in caps which protect the pump from the entry of foreign matter when the suction and/or discharge lines are disconnected.

4-49. Suction and Discharge Assemblies

a. Removal.

(1) Remove the two primer plugs (1, fig. 4-31) and the drain plug (2) from the pump casting.



1. Primer plug
2. Drain plug
3. Cap
4. Screw
5. Nut
6. Coupling flange
7. Gasket
8. Nut
9. Stud
10. Elbow
11. Gasket
12. Nut
13. Stud
14. Coupling flange
15. Gasket
16. Check valve seat
17. Check valve
18. Screw
19. Nut
20. Lock washer
21. Weight
22. Weight
23. Screw
24. Nut
25. Flat washer
26. Hook
27. Screw
28. Nut
29. Lock washer
30. Hook
31. Chain
32. Flat washer
33. Bracket
34. Pump casting
35. Screw
36. Nomenclature plate
37. Nomenclature plate
38. Screw
39. Identification plate

Figure 4-31. Suction and discharge assemblies, exploded view.

(2) Remove the suction and discharge gage piping from the pump (para 4-47).

(3) Disassemble the suction and discharge assemblies as shown in figure 4-31.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59°C).

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

(2) Inspect the pump for a cracked or dented housing, suction coupling flange or discharge elbow. Inspect the inside of the pump for signs of damage or wear on the internal parts. Refer the pump to direct or general support maintenance for repair or replacement.

(3) Inspect the check valve for cracks, tears, or other damage. The center flap must seat against the valve seat, and must be smooth to form a proper seal. Replace the valve if it is worn or damaged.

(4) Inspect the valve seat for chips or cracks. Replace it if it is defective. You may reuse a valve seat, but if there are any scratches or burrs on the face which contacts the valve, remove them with fine sandpaper before reassembly.

(5) Remove all old gaskets from the pump casting, elbow valve seat and coupling flanges. Clean the mating surfaces of these parts with a scraper or knife to ensure a tight seal.

(6) Inspect studs, nuts, plugs, and coupling flanges. Replace any parts that have stripped or damaged threads.

c. Installation.

(1) Use all new gaskets when reassembling the suction and discharge assemblies.

(2) Install the assemblies as shown in figure 4-31.

(3) Reconnect the suction and discharge gage piping (para 4-47).

(4) After assembly, start the pump, and check for leaks. Correct any leaks noted.

Section XV. MAINTENANCE OF WHEELS

4-50. Description

a. The tire assembly includes the tire, inner tube, and flap. The tire size is 7.00-15, 6-ply rating, with a mud and snow tread. The tires are mounted on single-piece wheels, and must be inflated to 40 psi.

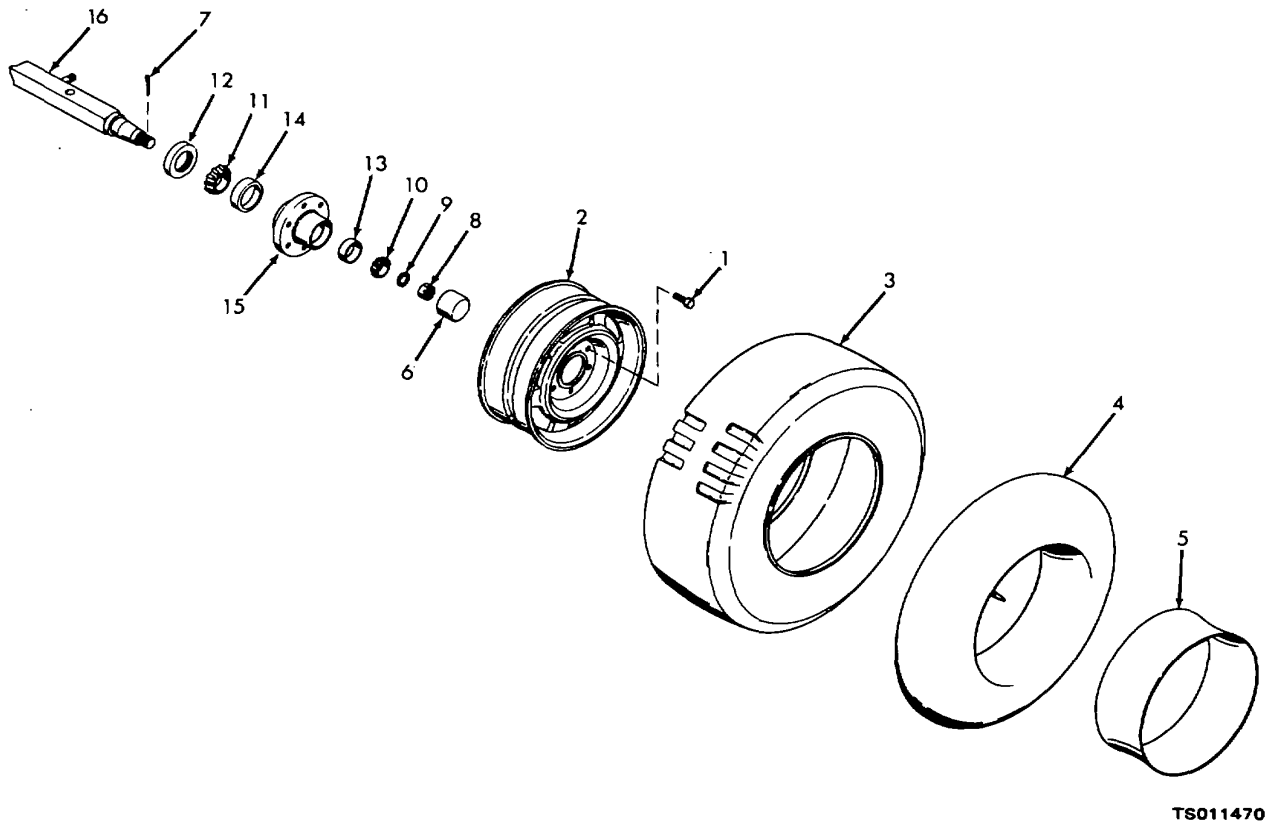
b. The wheel assemblies consist of pressed steel wheels which are bolted to the hub assemblies. The hub assemblies ride on tapered roller bearings on axle spindles.

4-51. Tires and Tubes

a. Removal.

(1) Jack up and block under the frame to raise the wheel from the ground. Remove the cap screws (1, fig. 4-32) that secure the assembled wheel, tire, and tube to the hub (15); remove the assembled parts.

(2) Deflate the inner tube. Use proper tire removal tools to remove the tire (3), tube (4), and flap (5) from the wheel (2), as indicated in figure 4-32.



1. Cap screw
2. Wheel
3. Tire
4. Inner tube
4. Inner tube
5. Flap
6. Grease cup
7. Cotter pin
8. Nut
9. Washer
10. Bearing cone
11. Bearing cone
12. Grease seal
13. Bearing cup
14. Bearing cup
15. Hub
16. Axle

Figure 4-32. Wheel assembly, exploded view.

b. Cleaning and Inspection.

(1) Clean the tires with a high-pressure water hose.

(2) Inspect the tire for cuts, bruises, punctures, worn treads, imbedded stones, and severe abrasions. Skive around cuts and imbedded stones with a sharp knife to remove all edges which could catch against sharp rocks and result in further tearing. Inspect the inside of the tire for broken cords and punctured walls. Replace tires which are damaged beyond repair.

(3) You can check the inner tube by filling it with air and immersing it in water to locate any leaks. Patch the leaks. Check the tube for cracks, brittleness, and signs of deterioration. Replace defective tubes or tubes with more than four patches.

c. Installation. Using proper tire mounting tools, install the tires and tubes on the wheel as shown in figure 4-32. Note the following:

(1) Position the inner tube (4) and flap (5) in the tire (3).

(2) Position the assembled tire and tube on the wheel (2), making sure the valve stem extends in the required direction.

(3) After you have properly mounted the tire on the wheel, inflate the tire to 40 psi.

(4) Install the assembled wheel, tire, and tube on the hub (15); secure with cap screws (1).

4-52. Wheel and Hub Assembly

a. Removal and Disassembly. Remove and disassemble the wheel and hub assembly as shown in figure 4-32. Note the following:

(1) Pry off the grease cup (6) to provide access to cotter pin (7) and nut (8).

(2) If the tires leak or if they are damaged, you should service them as directed above. If tires do not require servicing, they can remain on the wheels.

(3) Do not remove the bearing cups (13 and 14) from the hub (15) unless they are damaged or unless you plan to replace the bearing cones (10 and 11). The bearing cups (13 and 14) and bearing cones (10 and 11) must be replaced as sets.

b. Cleaning and Inspection.

(1) Discard all gaskets and seals.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59°C).

(2) Clean the bearing sets by placing them in a wire basket and agitating them in a container of cleaning solvent (fed. spec. P-D-680). After you clean the bearings, dip them in light oil and wrap in lint-free paper to prevent entry of dirt and grit.

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

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

(5) 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. To replace bearing cups, drive them out of the hub using a hammer and soft drift. Take care to prevent damage to the bearing seats in the hub. Press new cups into the hub so that they are fully seated.

(6) Discard and replace the grease seal (12).

c. Reassembly and Installation. Reassembly and installation is essentially the reverse of disassembly sequence; refer to figure 4-32. Use new seals for reassembly. When installing the wheel bearings, you should service and adjust them as follows:

(1) Pack wheel bearings with grease before installing them in the hub. Refer to LO 5-4320-234-12 (fig. 3-1).

(2) Take care to prevent damage to the lips of the grease seal (12, fig. 4-32) when installing the assembled hub.

(3) As you install the hub assembly, adjust the wheel bearings as follows:

(a) With the wheel and tire installed on the hub, tighten the nut (8) while rotating the wheel and tire until a distinct drag is felt.

(b) Continue to rotate the wheel and tire and back off the nut just enough to release the drag on the wheel. Insert the cotter pin (7) and bend it over to lock the nut (8) in position.

(c) Drive the grease cup (6) onto the hub.

Section XVI. MAINTENANCE OF CHASSIS COMPONENTS

4-53. Description

a. The tool storage box is installed on the right rear of the chassis frame.

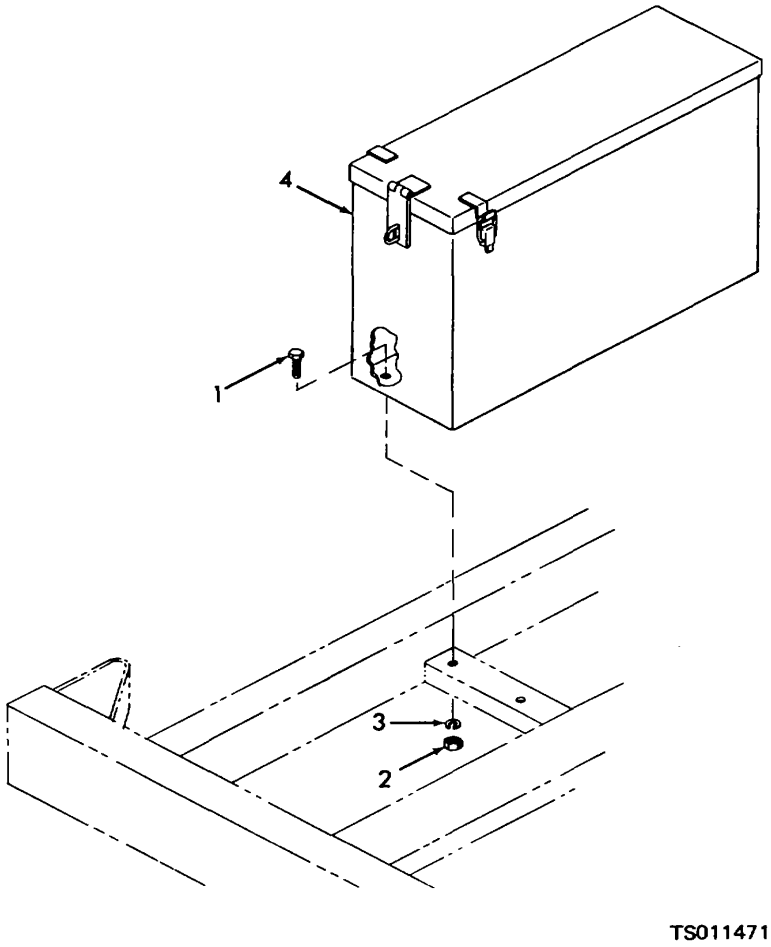
b. The tow bar is installed in a tube at the front of the chassis frame.

c. Four reflectors are mounted on the chassis frame. Red reflectors are mounted at the rear and amber reflectors are mounted at the front.

d. The interconnecting cable terminates with a plug that is inserted into a connector on the towing vehicle. This cable connects to the chassis wiring harness. In this manner, the towing vehicle controls and powers the lighting system of the chassis. The chassis lighting consists of two stop, tail, and directional lights and one blackout stop light.

4-54. Tool Box

a. Removal. To remove the tool box (4, fig. 433), open the tool box cover, and remove the four cap screws (1), lock washers (3), and nuts (2). Lift the tool box from the frame.



1. Cap screw
2. Nut
3. Lock washer
4. Tool box

Figure 4-33. Tool box, exploded view.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59°C).

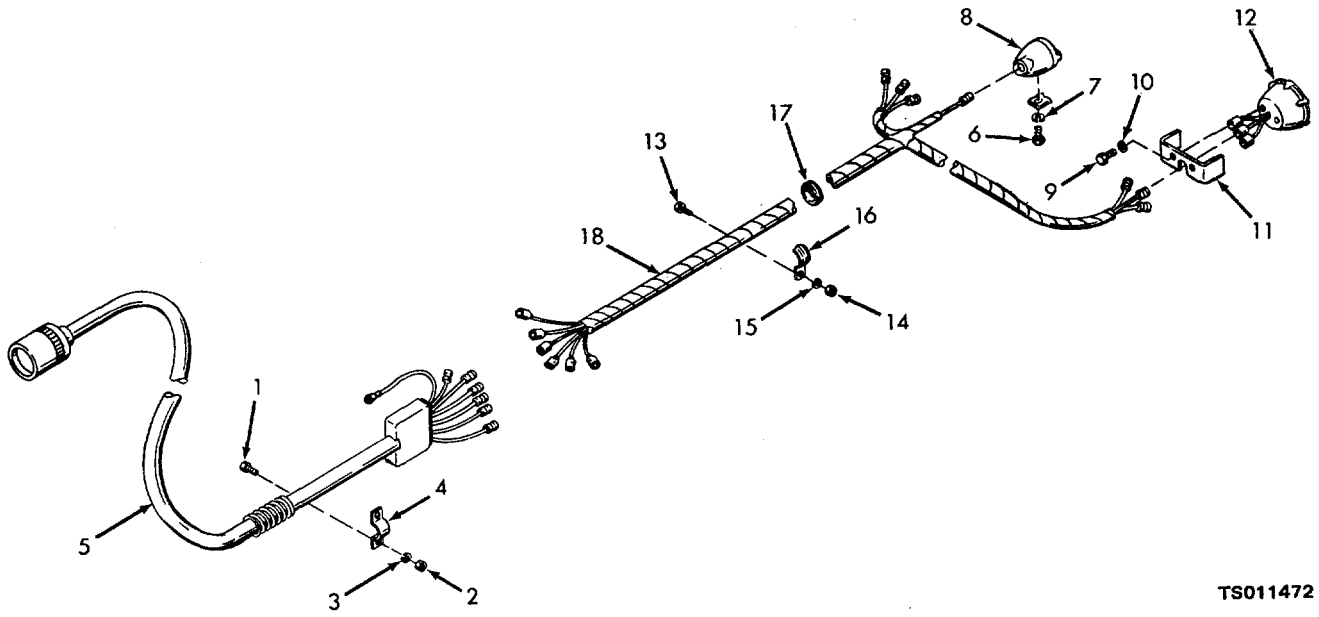
(1) Clean the tool box with a cloth dampened with dry cleaning solvent (fed. spec. P-D-680). Remove rust with fine sandpaper.

(2) Inspect the tool box for loose or damaged hinge, latches, or catches, and for cracks and distortion. Repair or touch up damaged painted areas. Repair or replace a damaged tool box.

c. Installation. Installation is the reverse of removal. Refer to figure 4-33.

4-55. Lights and Wiring Harness

a. Removal. Remove the lights and wiring harness as shown in figure 4-34.



1. Cap screw
2. Nut
3. Lock washer
4. Clamp
5. Cable assembly
6. Cap screw
7. Lock washer
8. Stoplight assembly
9. Cap screw
10. Lockwasher
11. Bracket
12. Stop, turn, and tail light
13. Cap screw
14. Nut
15. Lock washer
16. Clamp
17. Grommet
18. Wiring harness

Figure 4-34. Lights and wiring harness, exploded view.

b. Cleaning and Inspection.

(1) Wipe cable and wiring harness with a clean, dry cloth. Clean light assemblies with a damp cloth.

(2) Inspect light assemblies for dented or damaged housings and cracked or broken lenses. Replace the complete light assembly if any part of it is damaged, since individual replacement parts are not available.

(3) Inspect cable and wiring harness for broken wires and worn or damaged insulation. In an emergency, worn insulation can be repaired by wrapping the damaged spot with several layers of electrical insulating tape (MIL-T-50886).

(4) Inspect cable-to-harness and harness-to-light assembly connectors. Clean corroded or dirty terminals with fine sandpaper or scrape them with a knife.

c. Installation.

(1) Install lights and wiring harness as shown in figure 4-34. Route the cables inside the right side of the chassis frame, and fasten securely with clamps (4 and 16).

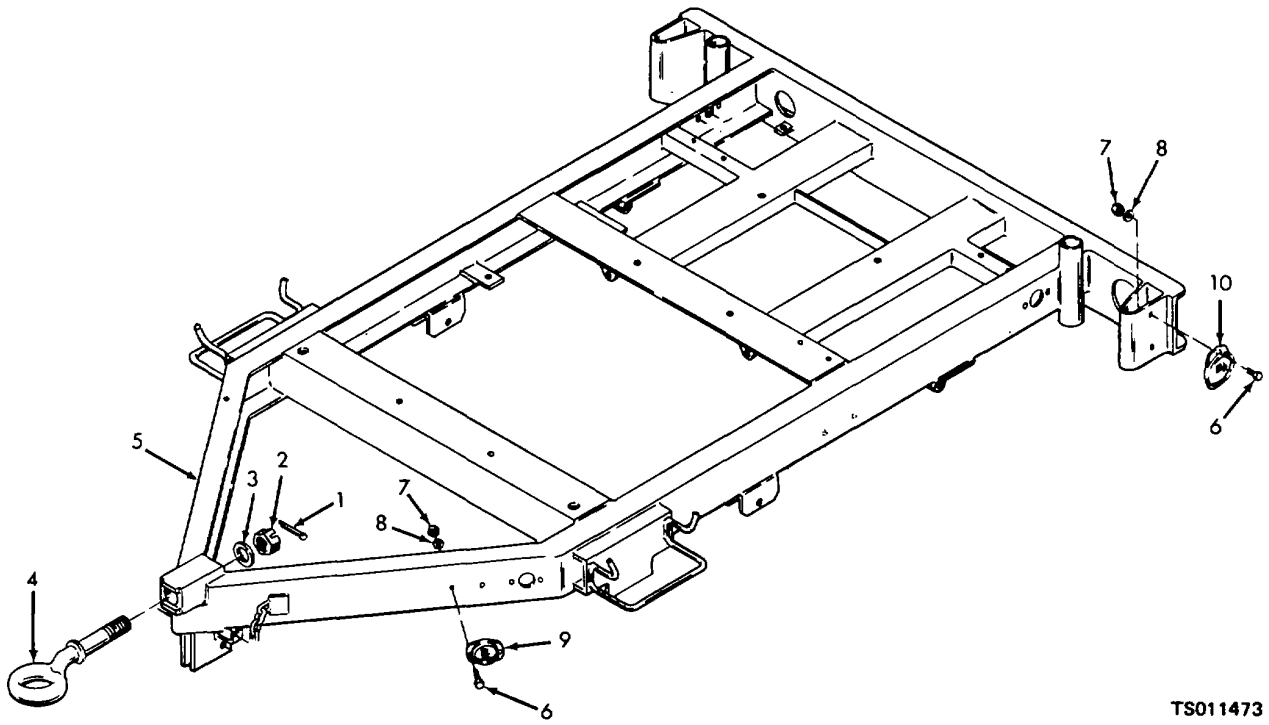
(2) After installation, recheck the tightness of all connectors, and check the operation of the lights by connecting the chassis to the system of a towing vehicle.

4-56. Chassis Miscellaneous Parts

a. Removal.

(1) Remove the cotter pin (1, fig. 4-35) castellated nut (2), and flat washer (3). Pull the tow bar (4) from the front of the chassis frame (5).

(2) Remove the cap screws (6), nuts (7), and lock washers (8) that secure the reflectors (9 and 10) to the chassis frame; remove the reflectors.



1. Cotter pin
2. Castellated nut
3. Flat washer
4. Tow bar
5. Chassis frame
6. Cap screw
7. Nut
8. Lock washer
9. Amber reflector
10. Red reflector

Figure 4-35. Chassis frame miscellaneous parts.

b. Cleaning and Inspection.

WARNING

Clean all parts in a well-ventilated area. Avoid inhalation of solvent fumes and prolonged exposure of skin to cleaning solvent. Wash exposed skin thoroughly. Dry cleaning solvent (fed. spec. P-D-680) used to clean parts is potentially dangerous to personnel and property. Do not use near open flame or excessive heat. Flash point of solvent is 100° to 138°F (38° to 59°C).

(1) Clean the tow bar with a cloth dampened with dry cleaning solvent (fed. spec. P-D-680).

(2) Wipe the reflectors with a damp cloth.

(3) Inspect the eye of the tow bar for wear or distortion. Replace a damaged or weakened tow bar.

(4) Inspect reflectors for cracks, loss of reflective characteristics, and damage. Replace any that are damaged.

c. Reassembly.

(1) At installation, apply a light coat of grease to the shaft of tow bar (4, fig. 4-35).

(2) When installing reflectors (9 and 10), place amber ones at the front and red ones at the rear.

APPENDIX A

REFERENCES

A-1	**Fire Protection**	
	TM 5-4200-200-10	Hand Portable Fire Extinguishers for Army Users
A-2	**Lubrication**	
	C91001L	Fuel, Lubricants, Oils and Waxes
	LO 5-4320-234-12	Pumping Assembly and Engine Lubrication Order
A-3	**Painting**	
	TM 9-913	Painting Instructions for Field Use
A-4	**Radio Suppression**	
	TM 11-483	Radio Interference Suppression
A-5	**Maintenance**	
	TM 9-1870-1	Care and Maintenance of Pneumatic Tires
	TM 5-4320-234-20P	Organizational Maintenance Repair Parts and Special Tools List, Centrifugal Pump
	TM 5-4320-234-34	Direct Support and General Support Maintenance Manual, Centrifugal Pump
	TM 5-4320-234-34P	Direct Support and General Support Maintenance Repair Parts and Special Tools List, Centrifugal Pump
	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. The implementation of the maintenance functions upon the identified end item or component will be consistent with the assigned maintenance functions.

B-2. Maintenance Functions

Maintenance functions are defined as follows:

a. Adjust. Maintain within prescribed limits by bringing into proper or exact position, or by setting the operating characteristics to the specified parameters.

b. Align. To adjust specified variable elements of an item to bring about optimum or desired performance.

c. Calibrate. To determine and cause corrections to be made or to be adjusted on instruments or test measuring and diagnostic equipment used in precision measurement. Consists of comparisons 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.

d. Inspect. To determine the serviceability of an item by comparing its physical, mechanical, and/or electrical characteristics with established standards through examination.

e. Install. The act of emplacing, seating, or fixing into position an item, part, module (component or assembly) in a manner to allow the proper functioning of the equipment/system.

f. Overhaul. That maintenance effort (service/action) necessary to restore an item to a completely serviceable/operational condition as prescribed by maintenance standards (e.g., DMWR) in pertinent technical publications. Overhaul is normally the highest degree of maintenance performed by the Army. Overhaul does not normally return an item to like-new condition.

g. 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 measurements (hours, miles, etc.) considered in classifying Army equipment/components.

h. Repair. The application of maintenance services (inspect, test, service, adjust, align, calibrate, 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/assembly, end item, or system.

i. Replace. The act of substituting a serviceable like-type part, subassembly, module (component or assembly) in a manner to allow the proper functioning of an equipment/system.

j. Service. Operations required periodically to keep an item in proper operating condition, i.e., to clean, preserve, drain, paint, or to replenish fuel/lubricants/hydraulic fluids or compressed air supplies.

k. Test. To verify serviceability and to detect incipient failure by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

l. Symbols. The uppercase letter placed in the appropriate column indicates the lowest level at which that particular maintenance function is to be performed.

B-3. Explanation of Format

Purpose and use of the format are as follows, and shall be explained in the introductory portion of the MAC.

a. Column (1)*, Group number*. Column 1 lists group numbers, the purpose of which is to match components, assemblies, subassemblies and modules with the next higher assembly.

b. Column (2)*, Functional group.* Column 2 lists the next higher assembly group and the item names of components, assemblies, subassemblies and modules within the group for which maintenance is authorized.

c. Column (3)*, Maintenance function*. Column 3 lists the twelve maintenance functions defined in B-2 above. Each maintenance function required for an item shall be specified by the symbol among those listed in *d* below which indicates the level responsible for the required maintenance. Under this symbol there shall be listed an appropriate work measurement time value determined as indicated in *e* below.

d. Use of symbols. The following symbols shall be used to prescribe work function responsibility:

C--Operator/Crew
O--Organization
F--Direct Support
H--General Support
D--Depot

e. Work measurement time. The active repair time required to perform the maintenance function shall be included directly below the symbol identifying the category of maintenance.

f. Column (4)*, Tools and equipment*. This column shall be used to specify, by code, those tools and test equipment required to perform the designated function.

NOTE

No special tools, test or support equipment is required for the repair and maintenance of the lubricating and servicing unit.

g. Column (5), *Remarks*. Self-explanatory.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Functional Group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild		
	01 ENGINE													
0100	Engine Assembly	C	0	C					F	F	H			A-B
	...	0.2	1.0	1.0					8.0	16.0	40.0			
0101	Crankcase, Block and Cylinder Head								H		H			
	...								16.0		20.0			
0102	Crankshaft								H					
	...								12.0					
0103	Flywheel Assembly								F					
	...								8.0					
0104	Pistons, Connecting Rods								H					
	...								12.0					
0105	Valve, Camshafts, and Timing System								H	F				B-I
	...								10.0	8.0				
0106	Lubricating System	C		C					H					
	...	0.1		1.0					4.0					
0107	Manifolds, Intake and Exhaust	C							O					
	...	0.1							2.0					
	02 FUEL SYSTEM													
0200	Carburetor	C			O				O					
	...	0.1			0.5				1.0					
0201	Fuel Pump	C							O					
	...	0.1							0.5					
0202	Air Cleaner	C		C					O					
	...	0.1		0.2					0.2					
0203	Tanks, Lines and Fittings	C		C					O					
	...	0.2		0.3					1.5					
0204	Governor and Controls	C			O				F					
	...	0.1			0.5				1.0					
0205	Fuel Filter	C		C					O					
	...	0.1		0.2					0.3					
0206	Throttle and Choke Control	C			O				O					
	...	0.1			0.5				0.5					
	03 EXHAUST SYSTEM													
0300	Muffler and Pipes	C							O					
	...	0.1							1.0					

Section II. MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Functional Group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A Inspect	B Test	C Service	D Adjust	E Align	F Calibrate	G Install	H Replace	I Repair	J Overhaul	K Rebuild		
	04 COOLING SYSTEM													
0400	Radiator	C	F	O					O	F				
	...	0.1	1.0	2.0					2.0	4.0				CB, CC
0401	Cowling, Deflectors, Air Ducts, Shrouds, etc.	C							O	O				
	...	0.1							2.0	3.0				D-I
0402	Thermostat		O						O					
	...		1.0						1.0					E-B
0403	Water Pump	C							O					
	...	0.1							1.0					
0404	Fan Assembly	C			O				O					
	...	0.1			0.1				0.4					
	05 ELECTRICAL SYSTEM													
0500	Generator, Alternator	C							O	F				
	...	0.1							0.5	2.0				
0501	Generator Regulator	C			F				O					
	...	0.1			0.5				0.5					
0502	Starting Motor	C							O	F				
	...	0.1							0.5	2.0				
0503	Ignition Components	C	O		O				O	O				
	...	0.1	0.5		0.5				0.5	1.0				F-B
0504	Engine Safety Controls	C	O		O				O					
	...	0.1	0.5		0.5				0.5					G-B
0505	Control Panel	C							O					
	...	0.1							2.0					
0506	Miscellaneous Items	C						O						
	...	0.2						1.0						
0507	Batteries, Storage	C	O	C					O					
	...	0.1	0.2	0.3					0.5					H-B
0508	Radio, Interference, Suppression	O	H						H					
	...	0.2	2.0						0.5					I-B
	06 AXLE													
0600	Axle Assembly	C							F					
	...	0.2							8.0					
	07 WHEELS													
0700	Wheel Assembly	C			O				O					
	...	0.1			0.5				0.5					
0701	Tires, Tubes	C		C					O	O				
	...	0.1		0.2					0.5	0.5				
	08 FRAME													
0800	Frame Assembly	C							H					
	...	0.2							8.0					
0801	Pintles and Towing Attachments	C		C					O					
	...	0.1		0.1					0.5					
	09 BODY, CAB, HOOD AND HULL													
0900	Stowage Boxes	C							O	O				
	...	0.1							0.5	1.0				
	10 ACCESSORY ITEMS													
1000	Reflectors	C							O					
	...	0.1							0.2					
1001	Data Plates	O							H					
	...	0.1							0.5					
	11 GAGES, NON-ELECTRICAL													
1100	Tachometer	C							O					
	...	0.1							0.3					

Section II. MAINTENANCE ALLOCATION CHART

(1) Group No.	(2) Functional Group	(3) Maintenance functions											(4) Tools and equipment	(5) Remarks
		A	B	C	D	E	F	G	H	I	J	K		
		Inspect	Test	Service	Adjust	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild		
1101	Gages, Pressure and Vacuum	C	F						O					J-B
	...	0.1	0.5						0.3					
	12 PUMPS													
1200	Pump Assembly	C	H						F	H	H			
	...	0.1	16.0						8.0	12.0	4.0			K-B
1201	Shaft, Impeller, Seals and Bearings	C							F	H				
	...	0.1							4.0	8.0				L-H
1202	Suction and Discharge Assemblies	C							O					
	...	0.1							2.0					

Section III. SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS

Reference code	Maintenance level	Nomenclature	Tool number
No Special Tools or Test Equipment Required.			

Section IV. REMARKS

Reference code	Remarks
A-B	Compression
B-I	Reface valves and seats
C-B	Air Test for leaks
C-C	Drain and Flush at seasonal changes
D-I	Straighten and weld
E-B	Before installing
F-B, G-B	Test for proper operation
H-B	Test to assure that the proper specific gravity is maintained
I-B	Test for and correct, interference emission
J-B	Test for improper readings
K-B	Performance: After initially filling the case the pump operating at 2600 RPM shall: a. Prime in not more than 1 minute when subjected to a static suction lift equivalent to 10 feet using 15 feet of suction line and one elbow. b. Deliver not less than 980-1000 GPM 6 60 feet total head. c. After conducting tests (a and b) above, test the pump check valve-shut off the pump and allow it to set for not less than 30 minutes. Restart the pump and determine if the pump immediately primes. Immediate prime is an indication that the valve prevents siphoning of water from the pump case.
L-H	Replace seals and gaskets.

INDEX

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.

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