DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT, GENERAL SUPPORT, AND DEPOT MAINTENANCE MANUAL

PUMP, CETRIFUGAL, G.E.D., SKID MOUNTED, 6 IN., 1120 GPM

(CARVER MODEL K906MP)
FSN 4320-929-0681

This copy is a reprint which includes current pages from Changes 1 through 4.

HEADQUARTERS, DEPARTMENT OF THE ARMY
AUGUST 1968

SAFETY PRECAUTIONS

BEFORE OPERATION

Do not operate the engines in an enclosed area unless the exhaust is piped to an open area. The exhaust contains carbon monoxide, a colorless, ordorless, deadly poisonous gas.

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

When filling the fuel tank, always maintain metal-to-metal contact between filling apparatus and fuel tank to prevent a spark from being caused by static electricity.

DURING OPERATION

Do not fill fuel tank while engine is running.

Do not attempt to perform maintenance on pumping unit while it is in operation.

AFTER OPERATION

Exercise caution when removing radiator cap while engine is hot. Quick removal will allow hot engine coolant to escape and may cause serious injury to personnel.

When filling the fuel tank, always maintain metal-to-metal contact between filling apparatus and fuel tank to prevent spark being caused by static electricity.

If the battery box cover or battery cables are removed, exercise caution in replacing to assure that the cable terminals do not come in contact with the cover. Make sure there is insulation between cover and terminals.

Changes in Force: C 2, C 3, and C 4

CHANGE
NO. 4

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

Operator, Organizational, Direct Support, General Support,
and Depot Maintenance Manual

PUMP, CENTRIFUGAL; G.E.D.,

SKID MOUNTED, 6 IN., 1120 GPM

(CARVER MODEL K906MP)

NSN 4320-00-929-0681

Approved for public release; distribution is unlimited

TM 5-4320-24015, 5 August 1968, is changed as follows:

Page 2-1, paragraph 2-4b, add the following note:

NOTE

Tropical electrolyte is no longer used due to lowered reserve capacity of batteries. Use only electrolyte with a specific gravity of 1.280.

Page 2-11, paragraph 2-15, add the following subparagraph:

e. Batteries. Increase battery PMCS. Use only distilled water or a good grade of drinking water (excluding mineral water) to bring electrolyte to proper levels.

Page 3-17, paragraph 3-42, add the following note:

NOTE

The 6TN and 6TL batteries can be mixed or matched. However, maintenance-free batteries cannot be mixed or matched with military batteries. The 6TN and or the 6TL batteries will perform properly in hot weather as long as electrolyte levels are carefully monitored. If the electrolyte expands and causes the level to rise, some fluid must be removed. If the level becomes too low due to evaporation, distilled water may be used to obtain the proper level. A good grade of drinking water (excluding mineral waters) may be used if distilled water is not available.

Electrolyte (NSNs 6810-00-249-9354 and 6810-00-843-1640) has a specific gravity of 1.280 and should be used in these batteries. Do NOT adjust the electrolyte in wet batteries to a lower specific gravity.

By Order of the Secretary of the Army:

CARL E. VUONO
General, United States Army
Chief of Staff

Official:

THOMAS F. SIKORA
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25E, (qty rqr block no. 1393).

TM 5-4320-240-15
***C3**

CHANGE

NO. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY,
WASHINGTON, D C, 10 November 1977

Operator, Organizational, Direct Support,
General Support, and Depot Maintenance
Manual

PUMP, CENTRIFUGAL, G. E. D., SKID

MOUNTED, 6 IN., 1120 GPM

(CARVER MODEL K906MP)

NSN 4320-00-929-0681

TM 5-4330-215-12, 5 August 1968, is changed as follows:

Title page and table of contents page are changed as shown above.

Page i. The appendixes in the table of contents are superseded as follows:

APPENDIX A. REFERENCES
B. COMPONENTS OF END ITEMS LIST
C. ADDITIONAL AUTHORIZATION LIST (NOT USED)
D. MAINTENANCE ALLOCATION CHART
E. EXPENDABLE SUPPLIES AND MATERIALS LIST

Page 1-1. Paragraph 1-1 b is superseded as follows:

b. Appendix A contains a list of publications applicable to this manual. Appendix B lists integral components of and basic issue items for the pump. Appendix C is not used. Appendix D contains the maintenance allocation chart. Appendix E lists expendable supplies and materials you will need to operate and maintain the pump. Organizational, direct and general support and depot maintenance repair parts and special tools are listed in TM 5-4320240-25P.

Paragraph 1-ld is superseded as follows:

d. You can help improve this manual. If you find any mistake or if you know of a way to improve the procedure, please let us know. Mail your letter. DA Form 2028 (Recommended Changes to Publication and Blank Forms), or DA Form 2028-2 located in the back of this manual directly to: Commander, US Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MTPS, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished to you.

Page B-1. Appendix B is superseded as follows:

APPENDIX B

COMPONENTS OF END ITEMS LIST

Section I. INTRODUCTION

B-1. Scope
This Appendix lists integral components of and basic issue items for the pump to help you inventory items required for safe and efficient operation.

B-2. General
The Components of End Item List is divided into the following sections:

This change supersedes C1, 7 July 1972.

a. Section II. Integral Components of the End Item. These items, when assembled, comprise the pump and must accompany it whenever it is transferred or turned in. These illustrations will help you identify these items.

b. Section III. Basic Issue Items. These are minimum essential items required to place the pump in operation, to operate it, and to perform emergency repairs. Although shipped separately packed they must accompany the pump during operation and whenever it is transferred between accountable officers. The illustrations will assist you with hard-to-identify items. This manual is your authority to requisition replacement BII, based on Table(s) of Organization and Equipment (TOE)/Modification Table of Organization and Equipment (MTOE) authorization of the end item.

B-3. Explanation of Columns

a. Illustration. This column is divided as follows: (l)Figure Number. Indicates the figure number of the illustration on which the item is shown (if applicable).

(2) Item Number. The number used to identify item called out in the illustration.

b. National Stock Number (NSN). Indicates the National stock number assigned to the item and which will be used for requisitioning.

c. Part Number (P/N). Indicates the primary number used by the manufacturer, which controls the design and characteristics of the item by means of its engineering drawings, specifications, standards, and inspection requirements to identify an item or range of items.

d. Description. Indicates the Federal item name and, if required, a minimum description to identify the item.

e. Location. The physical location of each item listed is given in this column. The lists are designed to inventory all items in one area of the major item before moving on to an adjacent area.

f. Usable on Code. "USABLE ON" codes are included to help you identify which component items are used on the different models (if applicable).

g. Quantity Required (Qty Reqd). This column lists the quantity of each item required for a complete major item.

h. Quantity. This column is left blank for use during inventory. Under the Rcv'd column, list the quantity you actually receive on your major item: The Date columns are for use when you inventory the major item at a later date; such as for shipment to another site.

Section II. INTEGRAL COMPONENTS OF END ITEM

(1) ILLUSTRATION a) FIGURE NO.	(b) ITEM NO.	(2) NATIONAL STOCK NO.	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY RCVD	DATE	DATE	DATE
38		6140-00-057-2554	1890326(16746)	Battery, 12V			2				
1	7	4320-01-036-9264	117229F(64104)	Crank, hano			1				

Section III. BASIC ISSUE ITEMS

(1) ILLUSTRATION a) FIGURE NO.	(b) ITEM NO.	(2) NATIONAL STOCK NO.	(3) PART NO. & FSCM	(4) DESCRIPTION	(5) LOCATION	(6) USABLE ON CODE	(7) QTY REQD	(8) QUANTITY RCVD	DATE	DATE
				LO 5-4320-240-12			1			
				TM 5-4320 240-15			1			
		5120 00 900-6103		Hammer Hand			1			
		5120-00-449-8083		Wrench, Open End, Adjustable			1			

Page C-I. Change "APPENDIX C MAINTENANCE ALLOCATION CHART" to read "APPENDIX D MAINTENANCE ALLOCTION CHART". Following Appendix D, add Appendix E as follows:

APPENDIX E

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

E-1. Scope

This appendix lists expendable supplies and materials you will need to operate and maintain the pump. These items are authorized to you by CTA50-970, Expendable Items (except Medical, Class V, Repair Parts, and Heraldic Items).

E-2. Explanation of Columns

a. Column I Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use cleaning compound, Item 5, App. D").

b. Column 2 Level. This column identifies the lowest level of maintenance that requires the listed item.

C - Operator/Crew O Organizational Maintenance

c. Column 3 National Stock Number. This is the National stock number assigned to the item; use it to request or requisition the item.

d. Column 4 Description. Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parenthesis, if applicable.

e. Column 5 Unit of Measure (U/M). Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea, in, pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS LIST

(1) ITEM NUMBER	(2) LEVEL.	(3) NATIONAL, STOCK NUMBER	(4) DESCRIPTION	(5) UIM
1	C	6850-00-281-1985	Solvent, Cleaning	GL
2	C	9150-00-402-4478	Oil, Engine, Subzero	QT
3	C	9150-00-186-6681	Oil, Engine, OE-30	QT
4	C	9150-00-160-1818	Gasoline, Combat	BK
5	0	6850-00-664-1403	Anti-freeze	GL

By Order of the Secretary of the Army:

BERNARD W. ROGERS
GENERAL, United States Army
Chief of Staff

Official:

J. C. PENNINGTON
Brigadier General, United States Army
The Adjutant General

Distribution:
To be distributed in accordance with DA Form 12-25A, Operator's maintenance requirements for Petroleum Distribution.

TM 5-4320-240-15
C2

Change 1

No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, *24 April 1974*

Operator, Organizational, Direct Support,
General Support, and Depot Maintenance Manual

PUMP, CENTRIFUGAL, G.E.D., SKID MOUNTED, 6 IN., 1120 GPM
(CARVER MODEL K906MP)
FSN 4320-929-0681

TM 5-4320-240-15, 5 August 1968, is changed as follows:

Inside Front Cover. Add the following warnings to the list of safety precautions:

WARNING

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

WARNING

Drycleaning solvent, 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°F. - 138°F.

Page 1-1. Paragraph 1-id is superseded as follows:

d. You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to: Commander, ATTN: AMSTS-MPP, 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished direct to you.
Page 2-7. Immediately after Section IV title, add the following warning:

WARNING

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

Page 3-1. Immediately after Chapter 3 title, add the following warning:

WARNING

Dry cleaning solvent, 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°F. - 138°F.

Page A-1, paragraph A-5. Appendix A, References, add the following: "TB MED 251, Noise and Conservation of Hearing".

By Order of the Secretary of the Army:

CREIGHTON W. ABRAMS
General, United States Army
Chief of Staff

Official:

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

Distribution:

To be distributed in accordance with DA Form 12-25A (qty rqr block No. 154), Organizational maintenance requirements for Petroleum Distribution.

TECHNICAL MANUAL

No. 6-4320-240-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *5 August 1968*

OPERATOR, ORGANIZATIONAL, DIRECT SUPPORT,

GENERAL SUPPORT AND DEPOT MAINTENANCE MANUAL

PUMP CENTRIFUGAL, GED, SKID

MOUNTED, 6 IN., 1120 GPM

(CARVER MODEL K906MP)

FSN 4320-929-0681

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

a. These instructions are published for use by personnel to whom the pumping unit, Carver Model K906MP, is issued. Chapters 1 through 3 provide information on operation, preventive maintenance services, and organizational maintenance of equipment, accessories, components, and attachments. Remaining chapters provide information for direct and general support and depot maintenance. Also included are descriptions of main units and their functions in relationship to other components.

b. Appendix A contains a list of publications applicable to this manual. Appendix B contains the list of basic issue items authorized the operator of this equipment and the list of maintenance and operating supplies required for initial operation. Appendix C contains the maintenance allocation chart. Organizational, direct and general support and depot maintenance repair parts and special tools will be listed in TM 5-4320-240-25P when printed.

c. Numbers in parentheses following nomenclature callouts on illustrations indicate quantity; number preceding nomenclature callouts indicate preferred sequence.

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

1-2. Record and Report Forms

a. DA Form 2258 (Depreservation Guide for Vehicles and Equipment).

b. For other record and report forms applicable to operator, crew, and organizational maintenance, refer to TM38-750.

Note. Applicable forms, excluding Standard Form 46 (United States Government Motor Vehicles Operators Identification Card) which is carried by the operator, shall be kept in a canvas bag mounted on equipment.

Section II. DESCRIPTION AND TABULATED DATA

1-3. Description

a. Engine. The Waukesha engine Model 190GLCU is a 265 Cubic inch displacement engine which is governed at a speed of 2250 RPM (revolutions per minute) when centrifugal pump is producing 1120 GPM (gallons per minute) at 100 feet.

b. Centrifugal Pump. The Carver Model K906MP-01 centrifugal pump is driven directly from the engine flywheel. It is a 6 inch, self-priming, centrifugal, petroleum pump. The pumping unit (fig. 1-1 and 1-2) is skid mounted and equipped with hose connections on suction and discharge.

c. Front of Unit. The radiator is designated as the front of the pumping unit. Any reference to left or right hand views shall be taken facing radiator end.

1-4. Identification and Tabulated Data

a. Identification. The centrifugal pump, model K906MP, has two major identification plates. The information contained on the plates is listed below.

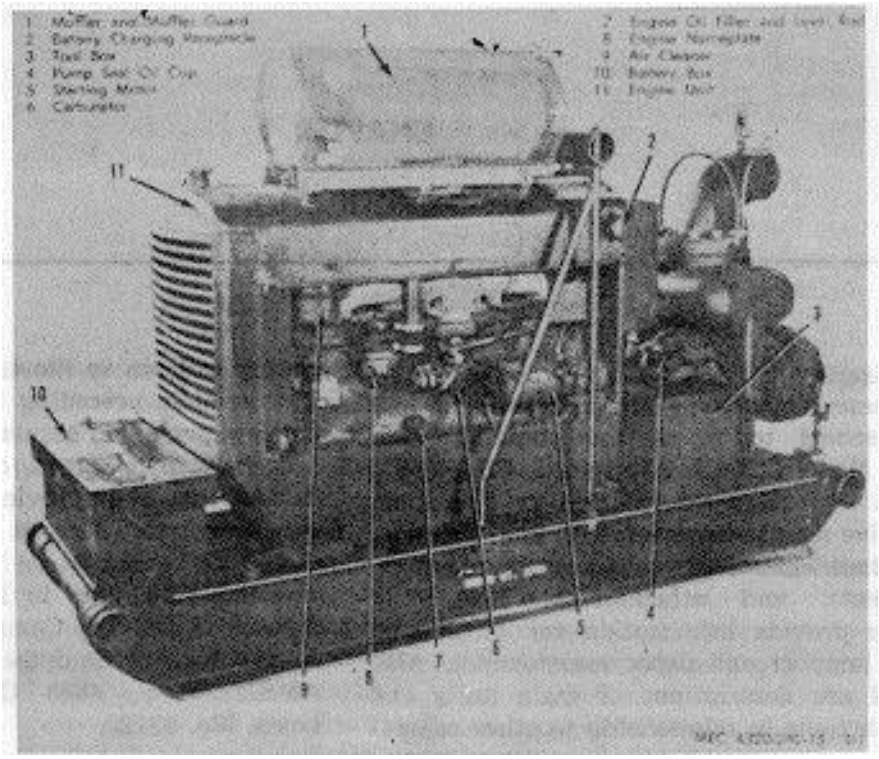


Figure 1-1. Centrifugal pump, right front view, wit panels off.

(1) *The U.S. Army nameplate.* The U.S. Army nameplate is mounted on top of the instrument panel and contains information including stock number, manufacturer, shipping dimensions and weights, capacity, etc.

(2) *Engine nameplate*. The engine nameplate is mounted on the right hand side of the engine block and contains the engine model number, serial number and governed speed.

b. Tabulated Data.

(1) Pump.

Manufacturer .....Carver Pump Company
Model K906MP-01
Type .....Self Priming Centrifugal
Serial number . .....66723 through 66784
.....69360 through 69888
.....91313 through 71818
Number of stages -.....One
Method of priming . .....Integral self-priming
Specification (military).....MIL-P-14321B

(2) Engine.

Manufacturer .....Waukesha Motor Co.
Model .....190 GLCU
Type .....Water-cooled
Bore .....3.75 inch
Stroke .....4.00 inch
Fuel .....Gasoline
Piston displacement.....265 cu.in.
Specification (military).....MIL-E-11276D
Firing order 1-5-3-6-2-4
Rated horsepower.....52 (continuous)
RPM (revolutions per minute) 2250
Number of cylinders.....Six
Specification (mfg.).....G15852

(3) Engine accessories.

(a) Magneto.

Manufacturer.....Fairbanks Morse
Model FME6B-8M

(b) Carburetor.

Manufacturer .....Marvel Schebler
Model TSX482
Part number 10-8186
Type .....Updraft

(c) Fuel strainer.

Manufacturer .....A.C.Spark Plug
Model - 5650470

(d) Air cleaner.

Manufacturer .....Donaldson
Model A-6222
Type .....Wet

(e) Fuel pump.

Manufacturer .....A.C.Spark Plug
Model 5656680

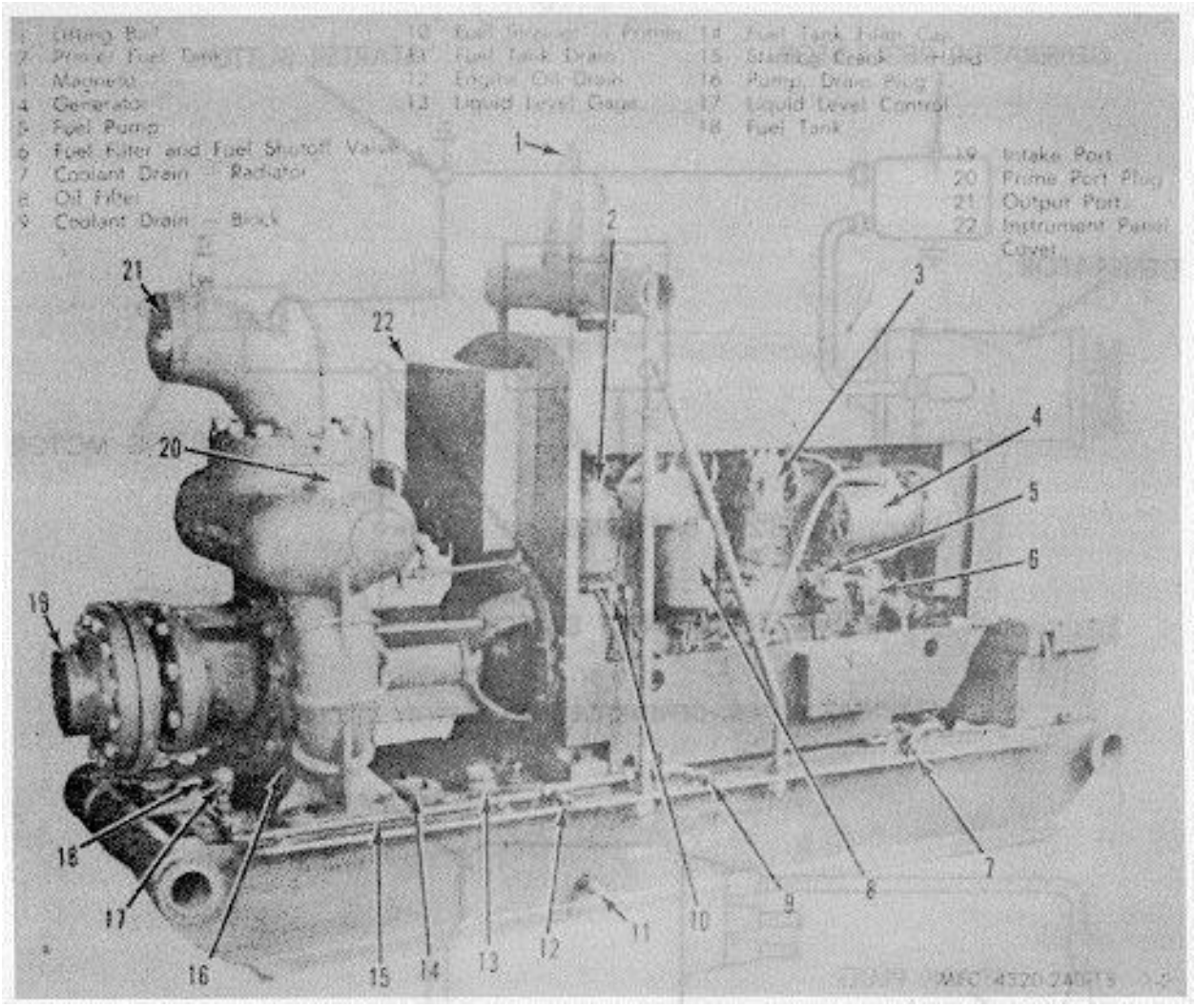


Figure 1-2. Centrifugal pump, left rear view, with panels off

(f) Oil pump.

Manufacturer .-.....Waukesha Motor Co.
Type .....Vane

(g) Oil filter.

Manufacturer .....Fram
Model F31-PL

(h) Batteries.

Manufacturer .....Delco-Remy
Type 6TN23D
Specification MIL-B-55166

(i) Governor.

Manufacturer.....Waukesha
Model CN180244A

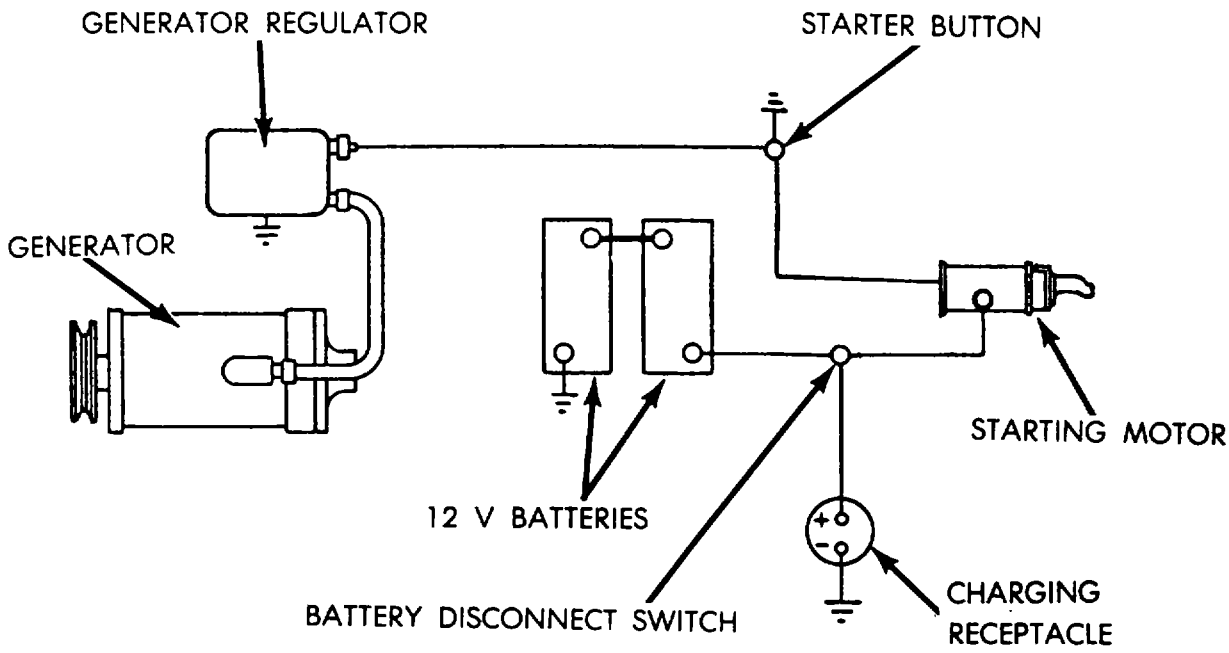
(j) Generator.

Manufacturer.....Delco-Remy
Model 1105993

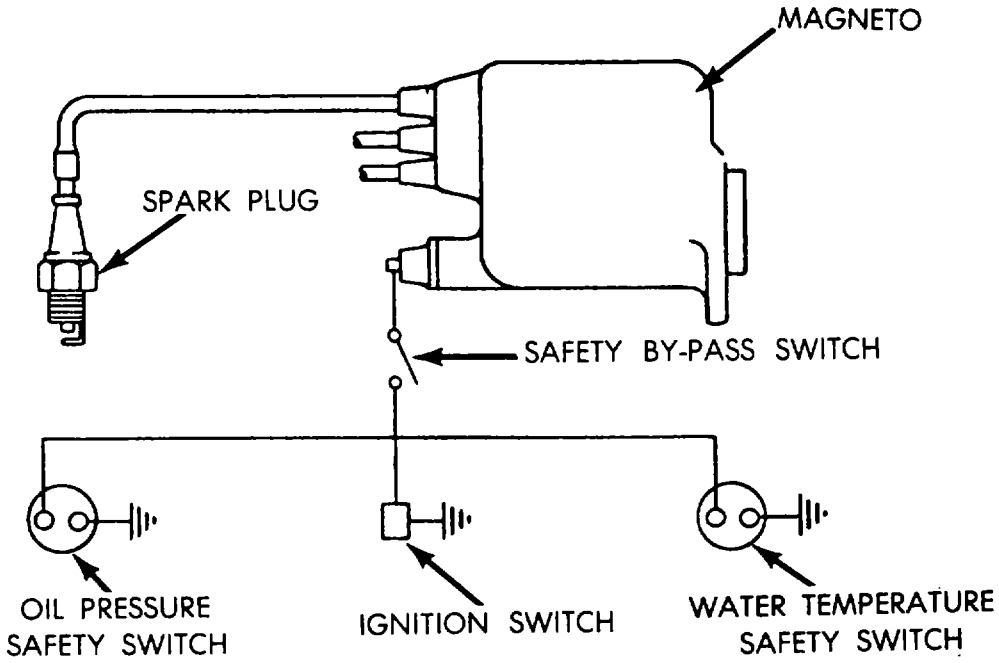
(k) Starting motor.

Manufacturer.....Delco-Remy
Model 1113032

(l) Voltage regulator.



STARTING MOTOR, GENERATOR AND BATTERY CIRCUIT



IGNITION CIRCUIT MEC 4320-240-15/ 1-3

Figure 1-3. Wiring diagram.

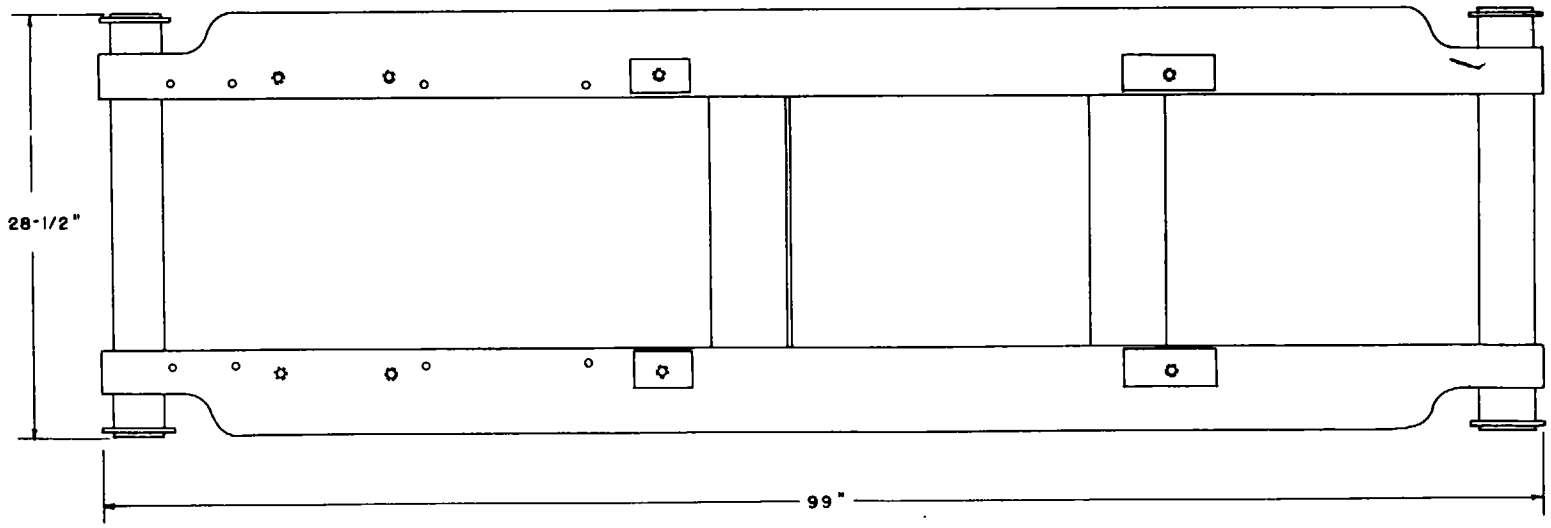


Figure 1-4. Base plan.

Manufacturer ..... Delco-Remy
Model 1118644

(4) Capacities.

Fuel tank ..... 20 gallon
Oil filter ..... 1 quart
Engine crankcase..... 7 quart
Cooling system ..... 5 gallon
Air cleaner -1 quart

(5) Adjustment data.

Spark plug gap 025
Magneto breaker point separation 014-.016
Valve lifters (engine cold):
Intake 007-.009
Exhaust 021-.023

(6) Dimensions and weight (shipping).

Length ..... 108 inches
Width35% inches
Height ..... 70 inches
Weight ..... 4080 lbs.
Volume ..... 170 cube ft.

(7) Wiring diagram.

Pump wiring diagram ..... figure 1-

(8) Base plan.

Pump base dimensions..... figure 1-4

(9) Performance data.

Speed . ..... 2250 RPM
Rated capacity..... 1120 gpm @ 100 feet

1-5. Difference in Models

This manual covers only the Carver pumping unit, model K906MP. No known unit differences exist for the model covered by this manual.

CHAPTER 2

INSTALLATION AND OPERATION INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

2-1. Unloading Equipment

a. Remove all tiedown straps and blocks that secure the pumping unit to the bed of the carrier.

b. Remove the pumping unit from the bed of the carrier with a crane or fork truck.

Warning

When lifting the pumping unit, be sure the lifting device has a capacity of at least 5,000 pounds. Do not allow the pumping unit to swing while suspended. Failure to observe this warning may result in damage to the' unit and severe injury to personnel.

2-2. Unpacking Equipment Position the pumping unit as near as possible to the source of supply. Remove the outside crate and all protective packing material from areas shown in figure 2-1.

2-3. Inspecting and Servicing Equipment

a. When a DA Form 2258 (Depreservation Guide) is furnished, accomplish depreservation as outlined in this guide. Inspect the pumping unit for secure mounting of parts, paying particular attention to areas shown in figure 2-2. Open the fuel tank shutoff valve installed in the fuel piping (fig. 1-2). Examine the oil drain plug and coolant drain plugs (fig. 1-2) to make certain that they are tightly closed. Perform all the servicing recommendations in figure 2-3 and in the lubrication section (para 3-4) except that for the first 50 hours of operation use SAE 10w30 in the engine crankcase. After 50 hours operation, drain and fill the crankcase in accordance with the lubrication order. Fill the radiator with specified coolant.

b. Perform services required by paragraph 3-6 for daily preventive maintenance services.

c. Inspect the equipment to be sure all parts are received intact.

d. Fill batteries with electrolyte to the level indicated.

2-4. Installation of Separately Packed Components

a. Suction Flange. Bolt the suction flange (19, fig. 1-2) and gasket to the pump, using twelve capscrews and lockwashers.

b. Electrolyte. Fill batteries with electrolyte to the level indicated.

2-5. Installation or Setting-up Instructions

a. Suction Line.

(1) Capacity. Install the pump to keep the suction lift as low as possible and the suction line as short as possible. Reduction in the capacity of self-priming pumps becomes noticeable at lifts, in excess of 15 feet, and is very pronounced at 25 feet. Do not use a centrifugal pump for suction lifts in excess of 25 feet.

(2) Air pockets. The highest point in the suction line should be at the pump, and the line should be laid on a gradual decline, not even on the level. Avoid. high points which will form air pockets. If the pump is operated at a high suction lift, use extra care to see that the hose connections and pipe joints in the suction line are air tight. A small air leak in the suction line may prevent pump priming.

b. Discharge Line. Friction loss should be given careful consideration. If the fluid is pumped a long distance, increase the size of the pipe to prevent pipe friction from becoming excessive.

Warning:

Do not operate the centrifugal pump in an enclosed area without venting the exhaust gases to the outside. Exhaust fumes contain carbon monoxide, an odorless, colorless deadly poison. Make sure that the exhaust

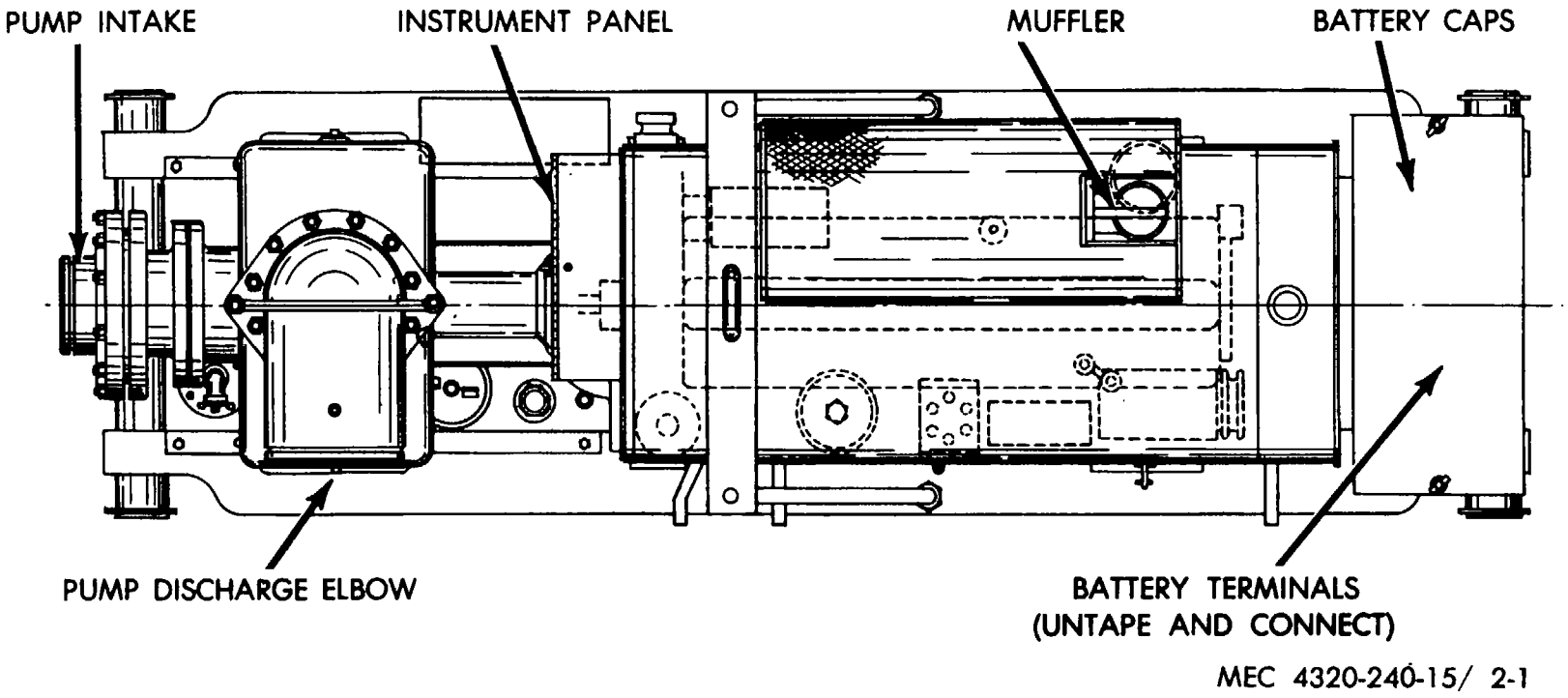


Figure 2-1. Areas of pump from which packing must be removed.

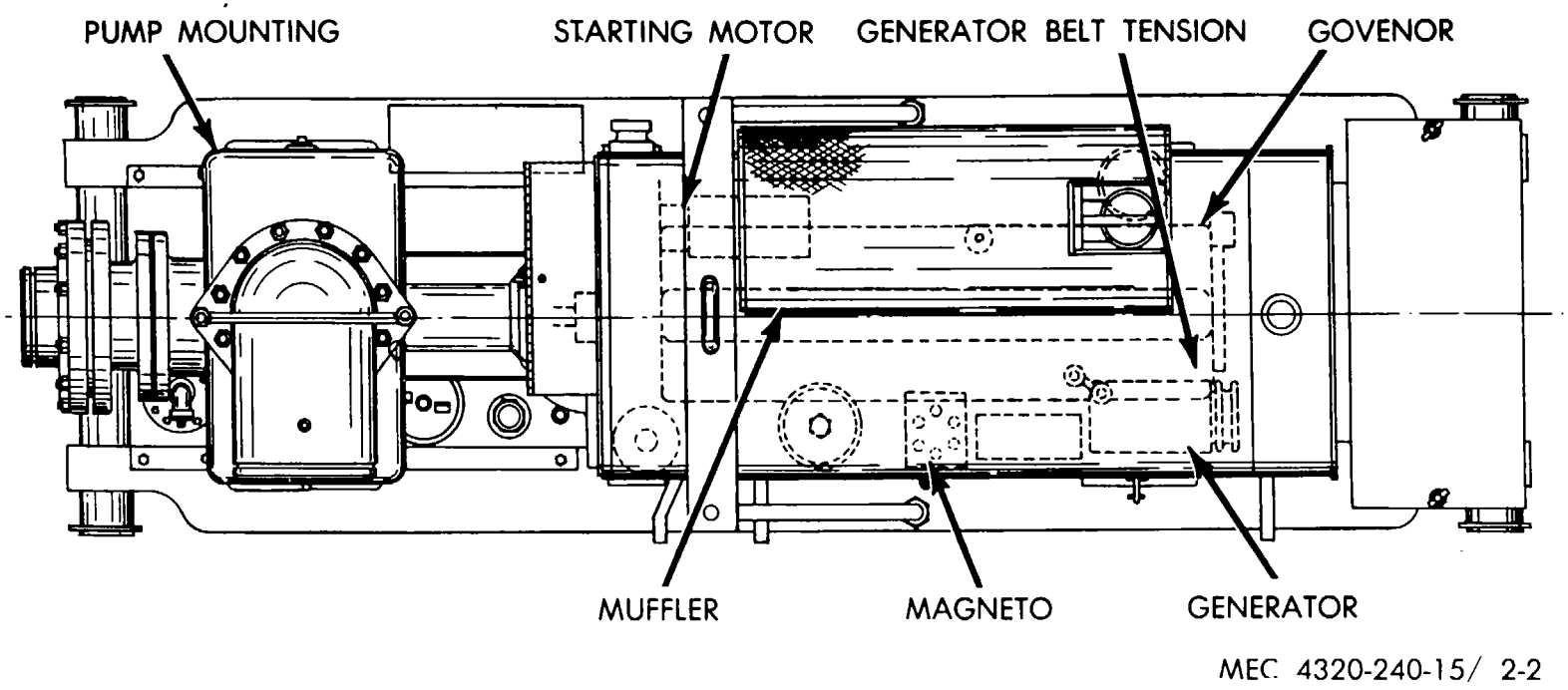


Figure 2-2. Areas of pump requiring inspection.

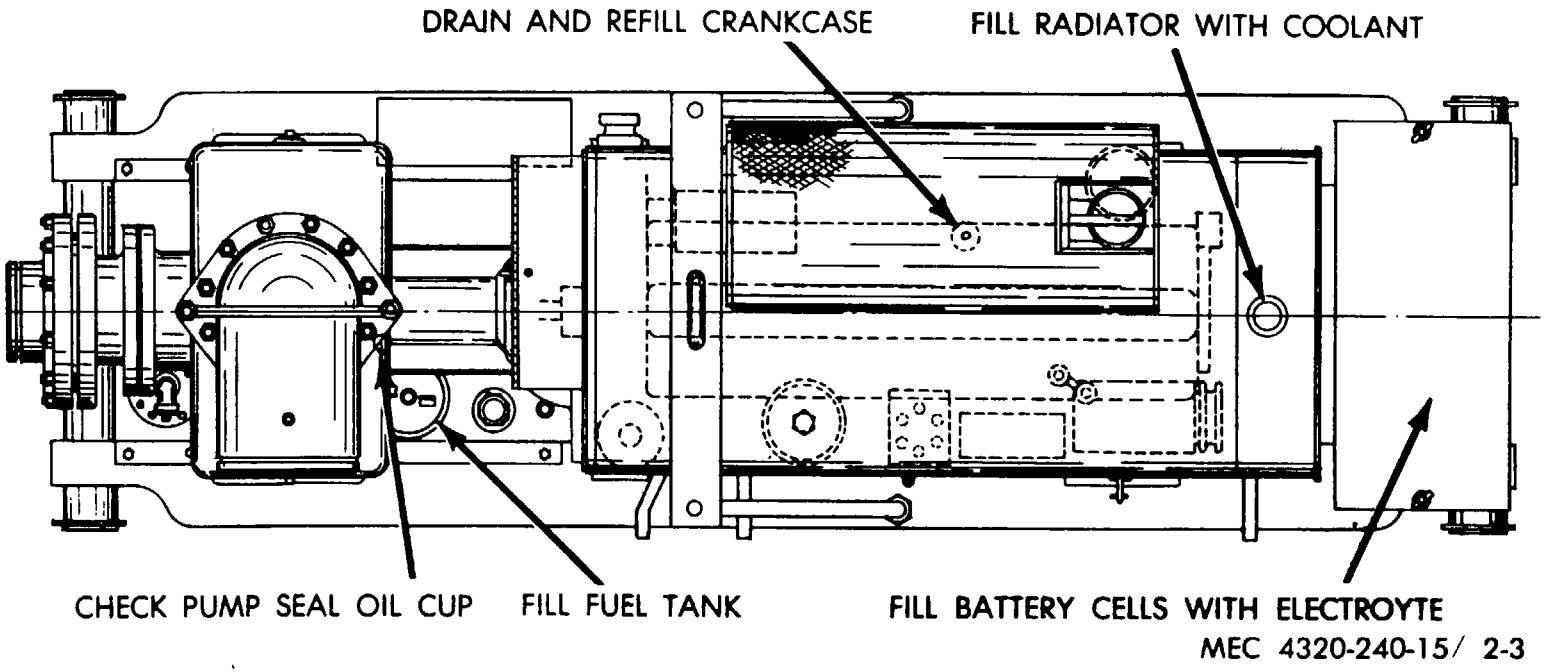


Figure 2-3. Areas of pump requiring service.

piping has a large enough diameter to prevent excessive exhaust back pressure in the engine.

Section II. MOVEMENT TO NEW WORKSITE

2-6. Dismantling for Movement

a. Short Distance Move.

(1) Disconnect the suction and discharge hoses or piping from the pump. Remove the pump drain plug (16, fig. 1-2) to drain the pump; replace the plug.

(2) Perform the daily preventive maintenance services (para 3-6).

(3) Close the engine and instrument panels.

(4) Make sure all on-equipment tools are present, clean, and properly stowed.

(5) Connect a cable or chain from the towing vehicle to the round bar at the front of the skid base; tow the pump to the new location.

b. Long Distance Move.

(1) Disconnect the suction and discharge lines from the pump. Remove the pump drain plug (16, fig. 1-2) to drain the pump; replace the plug.

(2) Drain the radiator and coolant lines (7 & 9, fig. 1-2), engine oil pan (12, fig. 1-2) and fuel tank (11, fig. 1-2).

(3) Thoroughly clean exterior of pump.

(4) Make sure that the fuel tank cap, radiator cap, oil drain plug, coolant drain plugs, and all pump plugs are securely tightened.

(5) Disconnect battery cables. Tape cable terminals and lay cables in the battery box to prevent shorting and electrical contact.

(6) Secure the engine and instrument panels.

2-7. Reinstallation After Movement

For reinstallation instructions, refer to paragraph 2-5.

Section III. CONTROLS AND INSTRUMENTS

2-8. General

This section describes, locates, illustrates, and furnishes operator, crew, or organization maintenance personnel sufficient information about various controls and instruments for proper operation of the centrifugal pump.

2-9. Controls and Instruments

The purpose of controls and instruments and their normal and maximum readings are illustrated in figure 2-4 and in the following paragraphs 2-9a through 2-9o.

a. Tachometer and Hourmeter. The tachometer and hourmeter (7, fig. 2-4) indicates the engine speed in rpm, and the total number of engine hours. Normal engine operating speed is 2,250 rpm. The tachometer is geared to register one hour when the engine has turned over, 135,000 rpm (2,250 rpm X 60 minutes). By keeping track of the hourmeter readings, it is easy to determine the correct service and lubrication intervals.

b. Engine Water Temperature Gage and Safety Switch.

(1) The engine water temperature gage and safety switch '(6, fig. 2-4) indicates the temperature of the cooling fluid in the engine. When the engine is at its normal operating temperature, the needle should indicate between 150° and 185°F.

(2) The gage incorporates a temperature safety switch designed to shut the engine down if the temperature of the coolant exceeds 190° The switch will permit starting of the engine when the temperature of the coolant drops to a safe level.

c. Ammeter. The ammeter (2, fig. 2-4) indicates the rate of charge or discharge of the batteries. The pointer on the ammeter deflects to the right to indicate charge and to the left to indicate discharge. After starting the ammeter will indicate a high rate of charge until the batteries are restored to full charge. After the unit has been inoperative for an extended period of time, the high charging time will be considerably longer after starting. During normal operation, the ammeter should indicate a slight charge rate.

d. Engine Oil Pressure Gage and Safety Switch.

(1) The engine oil pressure gage and

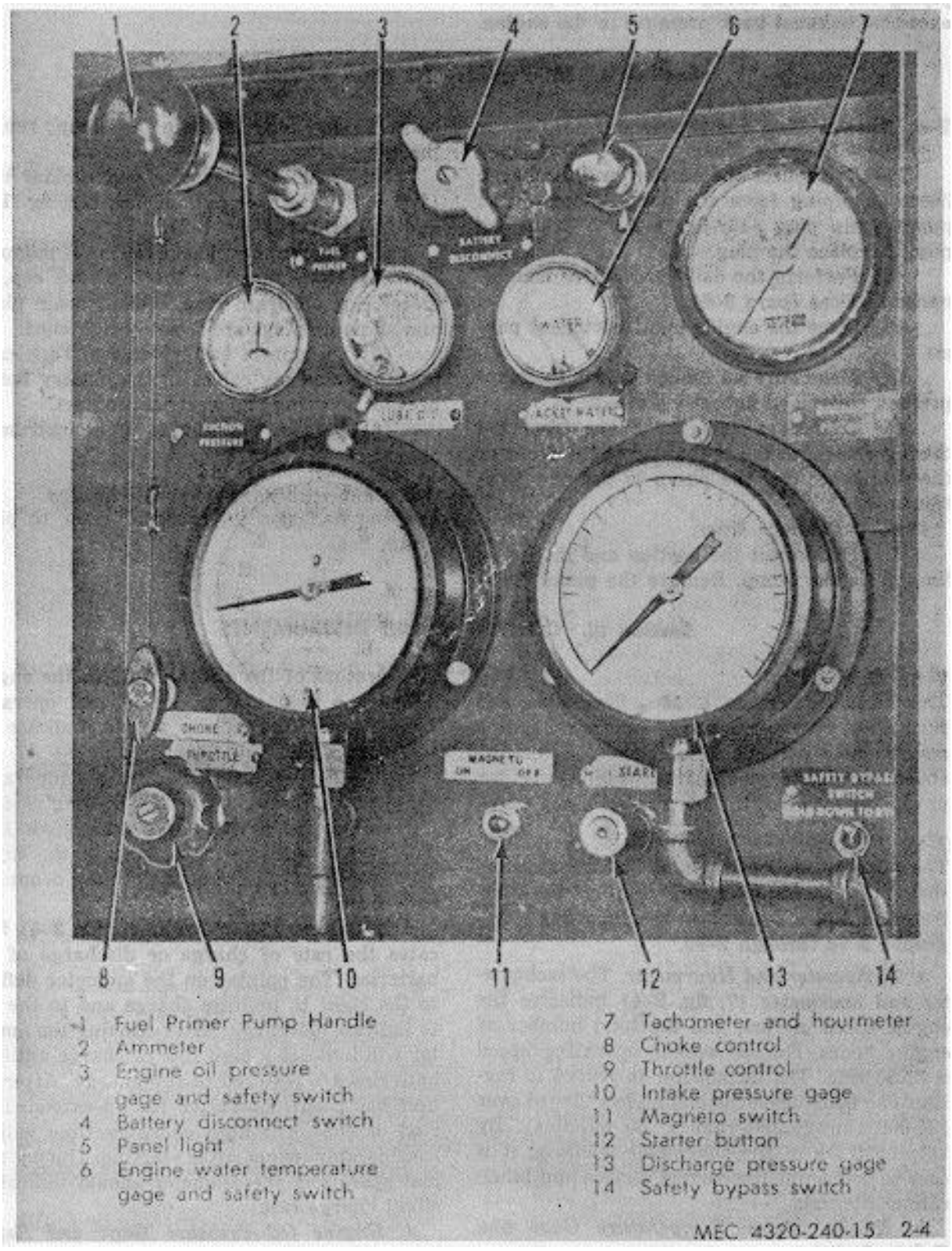


Figure 2-4. Controls and instruments.

safety switch (3, fig. 2-4) indicates the oil pressure of the engine lubrication system. The normal oil pressure reading when the engine is running at 2,250 rpm and at normal operating temperature is between 40 and 50 psi (pounds per square inch). The normal oil pressure reading at idle speed (400 to 600 rpm) is over 7 psi.

(2) The engine oil pressure gage includes an integral oil pressure safety switch which automatically shuts off the engine if oil pressure drops below 7 psi. It includes a reset button at the bottom of the gage. To start the engine after low pressure shutdown, first determine and correct the cause of the failure; press the reset button before starting the engine, following the normal starting procedures.

e. Throttle Control. The throttle control (9, fig. 2-4) provides a means of adjusting engine speed. Pulling the lever to the fullout position produces full speed (2,250 rpm). Pushing the lever to the full-in position produces idle speed. f. Fuel Primer Pump Handle. The fuel primer pump handle (1, fig. 2-4) operates the primer pump used to pump gasoline into the intake manifold for cold weather starting. When ambient temperatures are below freezing, pump the handle five or six times before starting. Leave the handle in full-in position while the pumping unit is operating.

g. Discharge Pressure Gage. The discharge pressure gage (13, fig. 2-4) indicates pressures on the discharge side of the pump. Normal gage readings are from 0 to 300 psi.

h. Magneto Switch. The magneto switch (11, fig. 2-4) when pulled out, closes the magneto circuit. Pull out before starting the engine. Push to shut off the engine.

i. Starter Button. The starter button (12, fig. 2-4) when depressed, completes a circuit that actuates the starting motor. When the starter button is pushed in, a circuit from the batteries to the starting motor is completed, and the starting motor cranks the engine. The starting motor circuit is broken when the starter button is released.

j. Intake Pressure Gage. The intake pressure gage (10, fig. 2-4) indicates the pressure or vacuum at the intake side of the pump. Normal readings are from 30 inches of mercury vacuum to 100 psi pressure.

k. Choke Control. The choke control (8, fig. 2-4) is mechanically connected to the carburetor choke lever. The choke is fully closed when the choke control knob is pulled out as far as it will go; the choke is open when the knob is pushed in as far as it will go. Close the choke to facilitate starting a cold engine. As the engine temperature rises, operate the choke to the open position until it is fully opened when engine temperature rises to normal.

l. Battery Disconnect Switch. The battery disconnect switch (4, fig. 2-4) when opened, breaks the circuit between the batteries and the starting motor. The switch must be in the ON position when the pumping unit is being started or is operating.

m. Safety Bypass Switch. The safety bypass switch (14, fig. 2-4) provides a means of overriding the control that automatically shuts down the engine if conditions of excessive water temperature or low oil pressure are encountered.

n. Liquid Level Gage. The liquid level gage (13, fig. 1-2) is located in the fuel tank (6, fig. 1-2). It indicates the level of the fuel in the tank.

o. Liquid Level Control. The liquid level control (17, fig. 1-2) is located in the fuel tank (18, fig. 1-2). It controls the level of fuel in the tank when an auxiliary fuel supply is connected.

Section IV. OPERATION OF EQUIPMENT

2-10. General

a. Instructions in this section are published for information and guidance of personnel responsible for operation of the pumping unit.

b. The operator must know how to perform every operation of which the pumping unit is capable. This section gives instructions on starting and stopping the pumping unit, basic motions of the pumping unit, and on coordinating basic motions to perform specific tasks for which the equipment is designed. Since nearly every job presents a different problem, the operator may have to vary given procedures to fit the individual job.

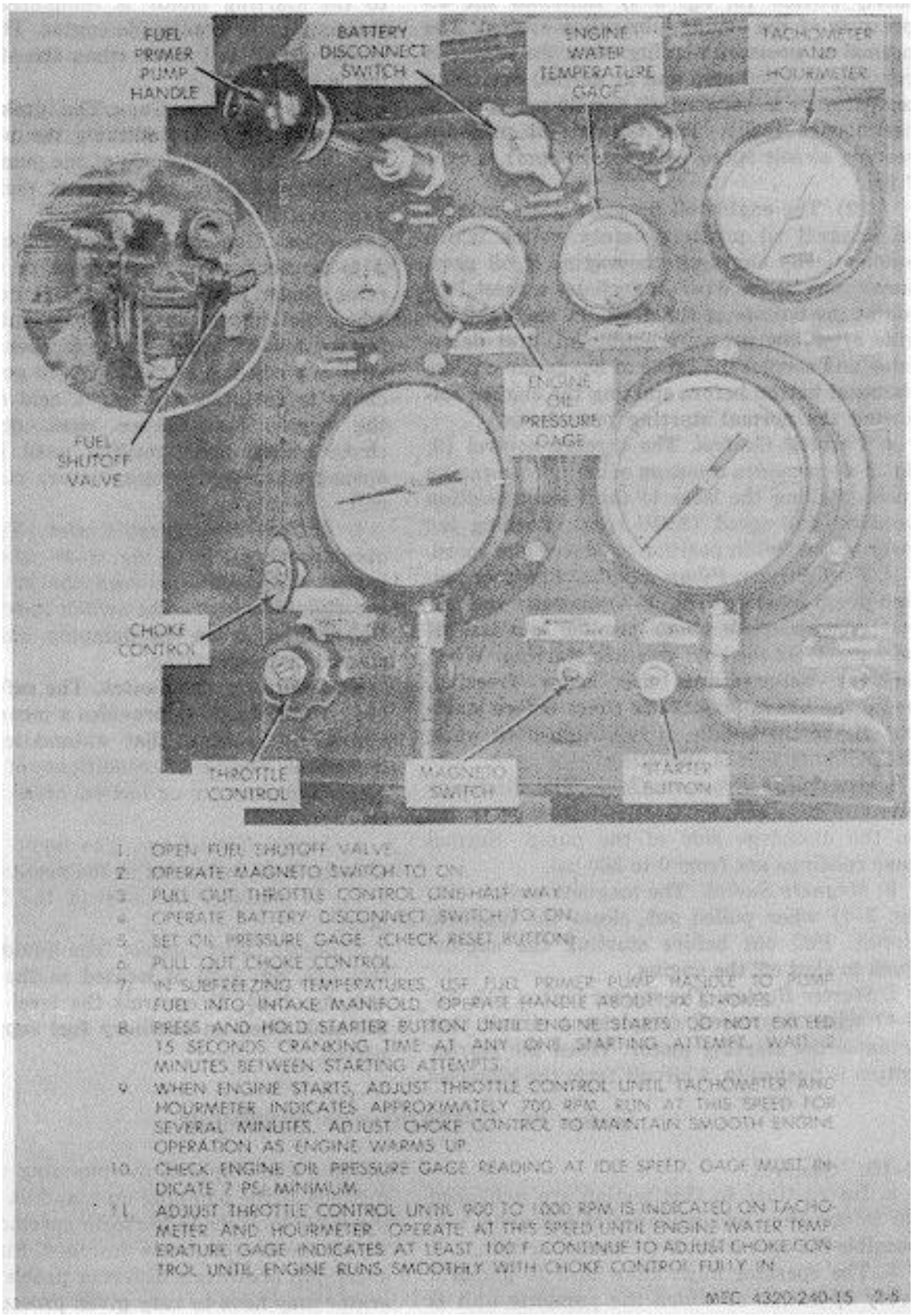


Figure 2-5. Starting procedure.

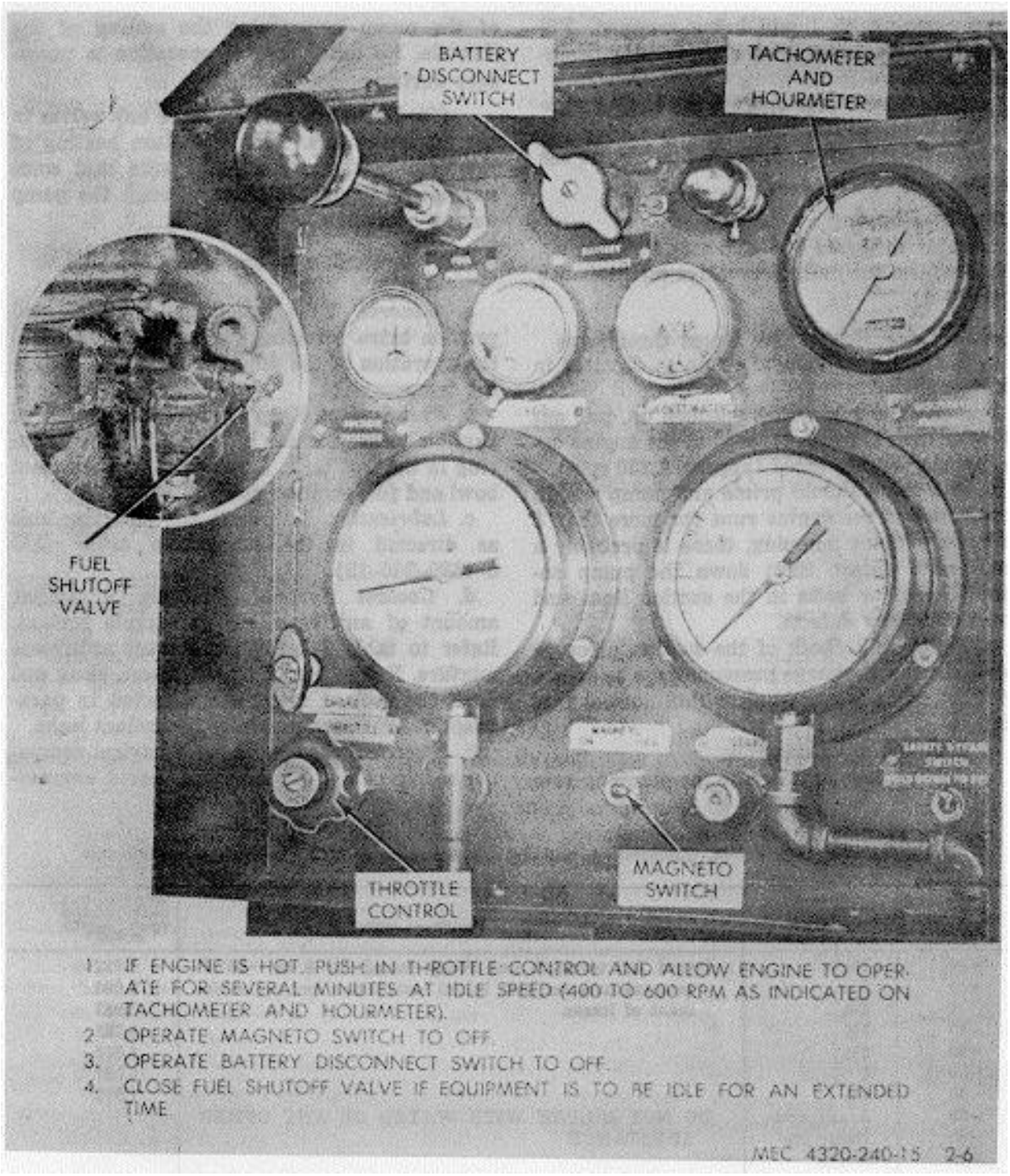


Figure 2-6. Stopping procedure.

2-11. Starting

a. Preparation for starting.

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

(2) Make sure the valves in both the suction and discharge lines are open.

(3) Prime the pump by removing the priming plug (20, fig. 1-2) and filling the 2-9

pump casing with liquid being pumped. Fill until liquid reaches the top of the casing. Reinstall the plug.

***Caution*. Never operate the engine without first priming the pump.**

b. Starting. Refer to figure 2-5 and start the engine.

2-12. Stopping

a. Refer to figure 2-6 and stop the engine.

b. Perform the daily preventive maintenance (para 36).

2-13. Operation Under Usual Conditions

a. Start the centrifugal pump as directed in paragraph 2-11.

b. After the engine has warmed up, pull out the throttle (9, fig. 2-4), so that the engine operates at governed speed (approx. 2,250 rpm).

c. The pump should prime and pump within 5 minutes. If the engine runs for more than 5 minutes without pumping, there is probably a mechanical defect. Shut down the pump engine; check for leaks in the suction lines and check for other defects.

d. Maintain a check of the suction pressure gage and the discharge pressure gage to assure that the pump is operating within normal capabilities.

e. Positioning of controls.

(1) Increase or decrease the pumping rate of the pump by varying the setting of the throttle. No other control operation is necessary during operation.

(2) Do not completely close any valves in the discharge line. This will cause heating of the fluid in the pump. Make sure that some passage of liquid continues through the pump during operation.

2-14. Operation in Extreme Cold (Below 0 °F)

a. General. Take special precautions and provide extra servicing necessary to maintain the operation of the pumping unit in subfreezing temperatures.

b. Fuel System. Keep the fuel tank as full as possible to keep water in the air from condensing in the fuel tank. Service the fuel sediment bowl and fuel strainer daily (fig. 86).

c. Lubrication. Lubricate the pumping unit as directed in the lubrication order (LO 5-4820-240-12).

d. Coolant System. Maintain a proper amount of antifreeze in the engine coolant. Refer to table 2-1 for the correct antifreeze mixture. Before installing antifreeze, clean and flush the coolant system as directed in paragraph 8-52. Check carefully for coolant leaks.

e. Electrical System. Keep electrical components free of ice and moisture. Avoid unnecessary

Table 2-1. Freezing Points, Composition, and Specific Gravities of Military Antifreeze Materials

Lowest expected ambient temp. °F	Pints of inhibited glycol per gal. Of coolant[1]	Compound antifreeze arctic[2]	Ethylene glycol coolant solution specific gravity at 68°F[3]
+20	1½	Issued full strength and ready mixed for 0 to -65°F	1.022
+10	2	temperatures for both initial installation and replenish-	1.086
0	2¾	ment of losses.	1.047
-10	3¼		1.055
-20	3½		1.062
-30	4		1.067
-40	4¼		1.078
-50	Arctic anti-	DO NOT DILUTE WITH WATER OR ANY OTHER	
-60	freeze pre-	SUBSTANCE	
-75	ferred		

[1]Maximum protection is obtained at 60 percent by volume (4.8 pints of ethylene glycol per gallon of solution).

[2]Military Specifications MIL-C-11755 Arctic type, nonvolatile antifreeze compound is intended for use in the cooling system of liquid-cooled internal combustion engines. It is used for protection against freezing primarily in Arctic regions where the ambient temperature remains for extended periods close to -40°F or drops below, to as low as -90°F.

[3]Use an accurate hydrometer. To test hydrometer, use 1 part ethylene glycol antifreeze to 2 parts water. This should produce a hydrometer reading of 0°F.

***Note*. Fasten a tag near the radiator filler cap indicating the type antifreeze.**

handling of electrical wiring during extreme cold. Wiring becomes brittle and is easily damaged and cracked. Maintain the batteries at full charge to increase their efficiency and lessen the possibility of damage due to extreme cold.

***Caution*: Run the engine for at least one hour after adding water to battery electrolyte. This will allow water and electrolyte to mix thoroughly and prevent freezing.**

2-15. Operation in Extreme Heat

a. General. Provide special servicing and take necessary precautions when operating the pumping unit in extremely high temperatures. Provide adequate ventilation when operating the unit indoors.

b. Fuel System. Do not fill the fuel tank completely to the top. Allow room for expansion of fuel as it heats to ambient temperatures.

c. Lubrication. Lubricate the pumping units as directed in the lubrication order (LO 5-4320-240-12).

d. Coolant System. Maintain a sufficient supply of coolant in the radiator at all times. Keep the cooling system free of rust and scale by using an approved rust inhibitor. Make sure that the thermostat is providing proper temperature control of the engine coolant. Check the fan belts for proper adjustment. Make sure that the radiator fins are free from dirt, corrosion, insects, and other matter that could reduce cooling efficiency. Adjust the fan belts (para 3-11).

2-16. Operation in Dusty or Sandy Areas

a. General. If the pumping unit is permanently installed, provide a protective shelter if possible. For temporary installation, take advantage of natural barriers to protect the unit as much as possible. Keep side panels and the instrument panel cover closed. Keep the unit free of sand and dirt,' taking special care to keep radiator cores clean.

b. Lubrication. In sandy and dusty areas, service the oil filter more frequently than directed in the lubrication order. Clean all lubrication points before and after lubrication. Keep lubrication containers tightly sealed and stored in a dust-free area.

c. Fuel System. Take care to prevent the entry of dust and grit into the fuel system. Clean the fuel strainer and sediment bowl frequently. Take special precautions to keep the air cleaner properly serviced. Experience will dictate the servicing interval required.

2-17. Operation Under Rainy or Humid Conditions

If the pumping unit is installed outdoors in conditions of high humidity, erect a shelter, if possible, to protect the unit. If the erection of a shelter is not possible, cover the unit with a tarpaulin or other vapor-barrier material when the pumping unit is inoperative. During dry periods, remove side panels to allow engine components to dry. Maintain a full fuel level in the fuel tank to prevent the formation of condensation.

2-18. Operation in Salt-Water Areas

a. Salt water has a highly corrosive effect on metals. Prevent contact of salt water with the unit whenever possible. If unit is exposed to salt water, wash with fresh water after every exposure.

***Caution*: Never use salt water in the coolant system of the engine. This will cause extreme corrosion and will greatly limit life of engine.**

b. Take special precautions to keep the unit painted properly. Paint all exposed metal surfaces. Coat all exposed polished metal surfaces with standard issue rust proofing materials, if available, or apply a light coat of grease. Refer to TM 9-213 for preservation and painting instructions.

2-19. Operation at High Altitudes

a. General. As altitudes increase, the thinning of the air decreases engine efficiency so that power output drops approximately 31/2 percent for each 1,000 feet of elevation. Because of the reduced external pressures, suction lifts decrease and pumping efficiency is also greatly reduced. Refer to table 2-2. For these reasons, it is highly important to maintain all other systems at the peak of efficiency to assure that all available power is applied to the pump.

b. Carburetor. Decreased air pressure at high altitudes upsets the calibration of the carburetor, causing an excessively rich fuel-air mixture. Adjust the carburetor as directed in paragraph 3-32.

c. Air Cleaner. Take care that the air cleaner is operating at its optimum efficiency to allow the engine to take in as much of the available air as possible. Service the air cleaner as necessary (fig. 8-2).

d. Ventilation. Provide an adequate fresh air supply to keep the engine of the pumping unit from overheating.

Table 2-2. Pump Efficiency at Varying Elevations

Altitude (ft.)	Percentage of sea level discharge	Percentage of sea level head
Sea level	100	100
2000 ft.	97	95
4000 ft.	95	91
6000 ft.	93	87
8000 ft.	91	83
10,000 ft.	88	18

CHAPTER 3

OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. OPERATOR AND ORGANIZATIONAL MAINTENANCE TOOLS AND EQUIPMENT

3-1. Special Tools and Equipment

No special tools or equipment are required by operator or organizational maintenance personnel for maintenance of the centrifugal pumping unit.

3-2. Basic Issue Tools and Equipment

Tools and repair parts issued with or authorized for use with the centrifugal pump are listed in the Basic Issue Items List, appendix B of this manual.

Section II. LUBRICATION

3-3. General Lubrication Information

a. This section contains general lubrication instruction.

b. For the current lubrication order refer to DA Pamphlet 810-4.

3-4. Detailed Lubrication Information

a. General. 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 for use.

b. Cleaning. Keep all external parts not requiring lubrication clean of lubricants. Before lubricating the equipment, wipe all lubrication points free of dirt and grease. Clean all lubrication points after lubricating to prevent accumulation of foreign matter.

c. Operation Immediately after Lubrication. Operate the engine immediately after lubrication. Inspect the oil filter, oil lines, and other connections which might cause oil leakage. If the crankcase oil has been changed, operate the engine for approximately 5 minutes before checking the oil level.

d. Oil Filter. Refer to figure 3-1 and service the oil filter.

e. Air Cleaner. Refer to figure 3-2 and service the air cleaner.

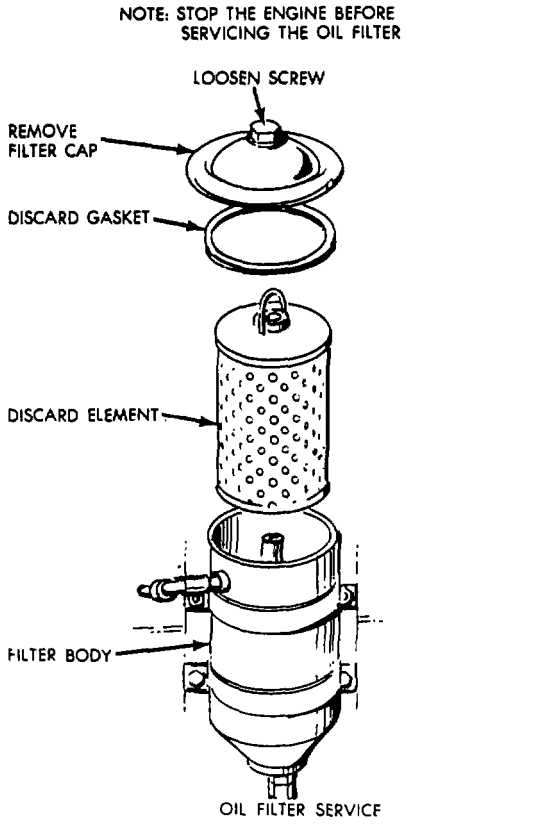


Figure 3-1. Oil filter service.

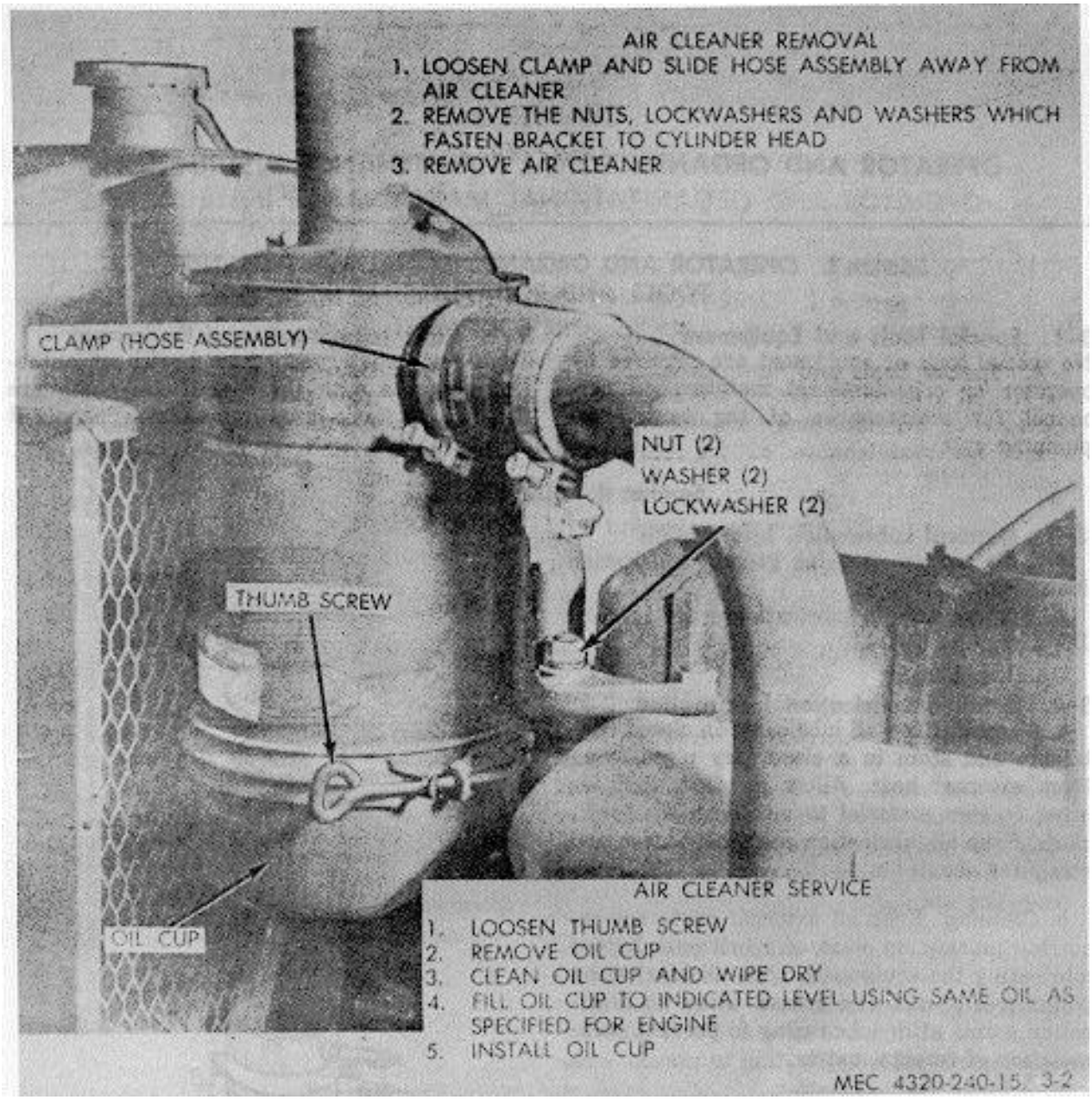


Figure 3-2. Air cleaner service, removal and installation.

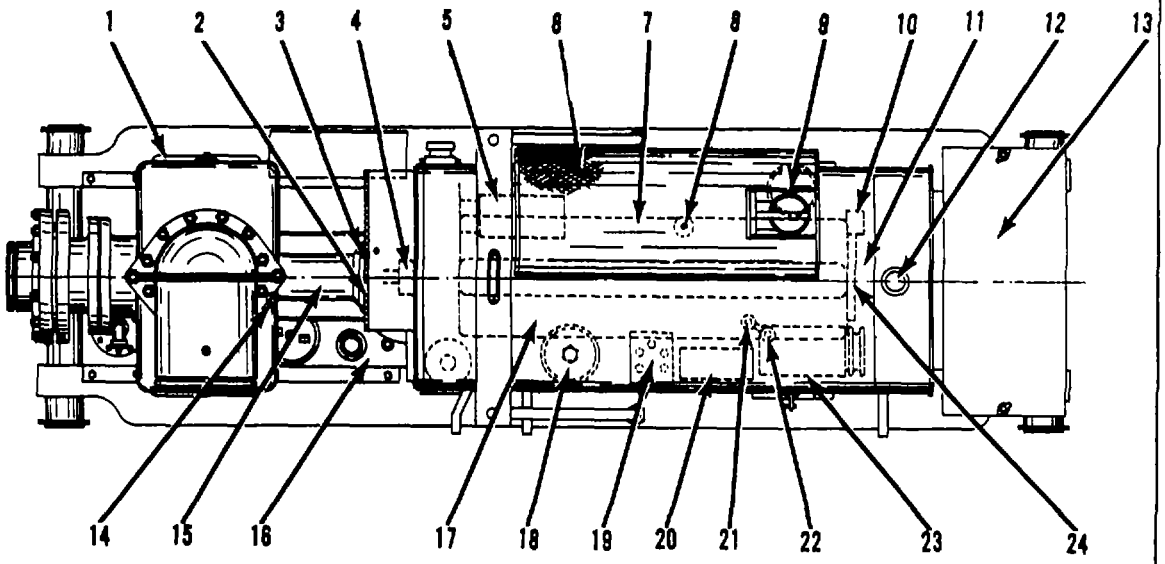
Section III. PREVENTIVE MAINTENANCE SERVICES

3-5. General

To insure 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 services to be performed are listed and described in paragraphs 36 and 3-7. Defects discovered during operation of the unit shall be noted for future corrections, to be

PREVENTIVE MAINTENANCE SERVICES
DAILY

CARVER MODEL K 906 MP PUMPING UNIT



ITEM	LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER	PAR. REF.
1.	PUMP ASSEMBLY. Inspect for insecure mounting, leaks, noisy operation, failure to prime easily and vibration.	3-61-b
2.	CONTROLS AND SWITCHES: Check all control and switch operations. Controls and switches must operate freely and positively.	
3.	INSTRUMENTS. Inspect for improper mounting, broken glass, and damaged dials. With engine operating at normal temperatures, check for erratic operation and erraneous readings. Readings must be as follows: Engine water temperature gage, 150°F to 180°F; Ammeter, high at start, declining to near zero; Engine oil pressure gage, over 7 psi at idle speed and between 40 and 50 psi at governed speed. Check discharge pressure gage and intake pressure gage for normal readings. (Check against Performance Curve) (during operation)	
4.	COUPLING. Check for loose coupling bolts. Check for vibration during operation.	
5.	STARTING MOTOR. Check for insecure mountings, loosely attached leads, improper drive engagement, and signs of overheating.	3-45-e
6.	MUFFLER AND PIPING. Check for cracks and holes in muffler and exhaust system parts. Check for exhaust leaks.	3-78-b
7.	CYLINDER HEAD MANIFOLDS AND GASKETS. Check for coolant and manifold leaks.	3-80-b
8.	ENGINE OIL LEVEL. Check dipstick for proper oil level. Check that oil has been changed in the interval dictated by the current lubrication order.	
9.	AIR CLEANER, HOSES AND PARTS. Check for insecure mounting, air leaks, dents, and damage. Check for presence of air intake cap. Check that air cleaner bowl is filled to the proper level with clean oil.	
10.	GOVERNOR. Check for insecure mounting and for loosely mounted linkage.	
11.	COOLING FAN AND GUARD. Check for bent, cracked, or missing cooling fan blades. Check for insecure guard mounting and fan belt adjustment.	

MEC 4320-240-15/ 3-3 (1)

Figure 3-3 (1). Daily preventive maintenance services.

ITEM		PAR. REF.
12.	RADIATOR. Inspect for leaks, insecure mounting, and obstructions in the core air passages. Check coolant level. Proper coolant level is 1 inch below filler neck.	3-52 - b
13.	BATTERIES. Inspect batteries for cracks, leaks or damage. Check for loose or missing mounting hardware. Check battery cables and terminals for corrosion and loose connections. Check electrolyte level	
14.	PUMP SEAL LUBRICATION CUP. Check that lubrication cup is filled to the required level.	
15.	PUMP BEARING HOUSING. Check bearing housing for leaks, excessive vibration during operation, and for unusual noises.	
16.	FUEL TANK. Check fuel tank and lines for damage and leaks. Check that fuel tank is full.	3-36-b
17.	HOOD AND SIDE PANELS. Inspect for insecure mounting, missing hardware and damage.	
18.	LUBRICATING OIL FILTERS AND LINES. Check for leaks, insecure mounting and damaged parts.	
19.	MAGNETO. Check for insecure mounting and for worn or frayed high tension leads.	3-46-e
20.	VOLTAGE REGULATOR. Check voltage regulator for insecure mounting, insecure connections, broken leads, and signs of overheating.	3-44-b
21.	FUEL PUMP. Check for insecure mounting and for leaks.	
22.	FUEL STRAINER. Check for sediment in sediment bowl.	
23.	GENERATOR. Check generator drive belt tension. Proper deflection midway between pulleys is 3/4 inch.	3-43-e
24.	WATER PUMP. Check water pump for signs of leaking.	

MEC 4320-240-15/ 3-3 (2)

Figure 3-3 (2) -Continued.

made as soon as operation has ceased. Stop operation immediately if a deficiency is noticed 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. Daily Preventive Maintenance Services

This paragraph contains an illustrated tabulated listing of preventive maintenance services which must be performed by the operator. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to figure -8 and perform the daily preventive maintenance services.

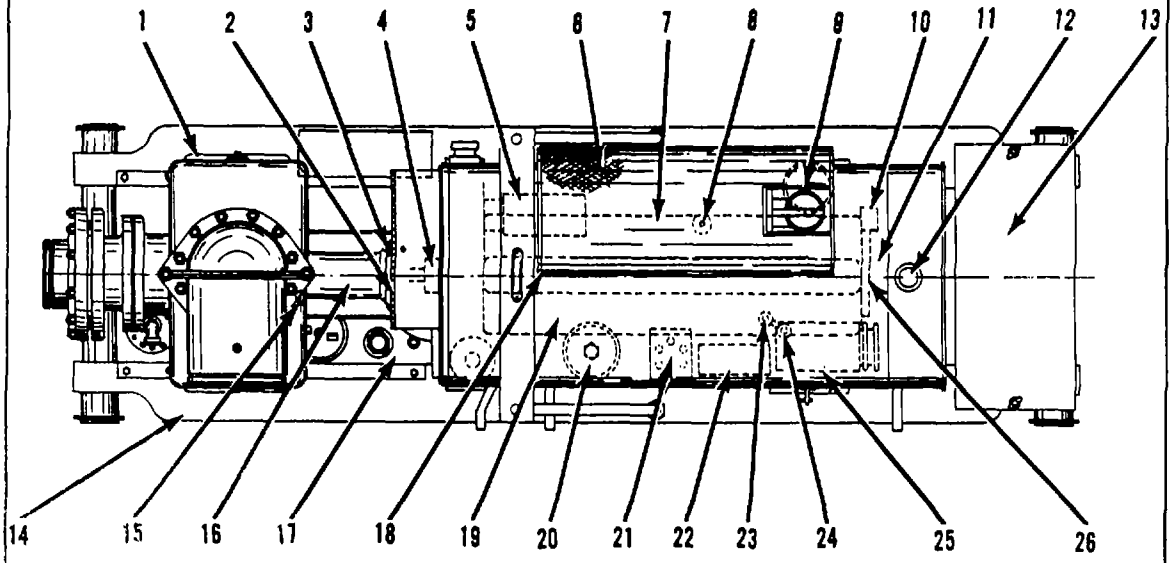
3-7. Quarterly, Preventive Maintenance Services

a. This paragraph contains an illustrated tabulated listing of preventive maintenance services which must be performed by organizational maintenance personnel at quarterly intervals. A quarterly interval is equal to 3 calendar months, or 250 hours of operation, whichever occurs first.

b. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to figure 3-4 and perform the quarterly preventive maintenance services.

PREVENTIVE MAINTENANCE SERVICES
QUARTERLY

CARVER MODEL K 906 MP PUMPING UNIT



ITEM	LUBRICATE IN ACCORDANCE WITH CURRENT LUBRICATION ORDER	PAR. REF.
1.	PUMP ASSEMBLY. Inspect for insecure mounting, leaks, noisy operation, failure to prime easily and vibration.	3-61-b
2.	CONTROLS AND SWITCHES: Check all control and switch operations. Controls and switches must operate freely and positively.	
3.	INSTRUMENTS. Inspect for improper mounting, broken glass, and damaged dials. With engine operating at normal temperatures, check for erratic operation and erraneous readings. Readings must be as follows: Engine water temperature gage, 150°F to 180°F; Ammeter, high at start, declining to near zero; Engine oil pressure gage, over 7 psi at idle speed and between 40 and 50 psi at governed speed. Check discharge pressure gage and intake pressure gage for normal readings. (Check against Performance Curve) (during operation)	
4	COUPLING. Check for loose coupling bolts. Check for vibration during operation.	
5	STARTING MOTOR. Check for insecure mountings, loosely attached leads, improper drive engagement, and signs of overheating.	3-45-e
6.	MUFFLER AND PIPING. Check for cracks and holes in muffler and exhaust system parts. Check for exhaust leaks.	3-78-b
7	CYLINDER HEAD MANIFOLDS AND GASKETS. Check for coolant and manifold leaks. Check that cylinder head nuts are properly torqued to 98 to 100 inch pounds.	3-80-b
8.	ENGINE OIL LEVEL. Check dipstick for proper oil level. Check that oil has been changed in the interval dictated by the current lubrication order.	
9	AIR CLEANER, HOSES AND PARTS. Check for insecure mounting, air leaks, dents, and damage. Check for presence of air intake cap. Check that air cleaner bowl is filled to the proper level with clean oil.	
10.	GOVERNOR. Check for insecure mounting and for loosely mounted linkage. Operate pump at maximum governed speed.	

MEC 4320-240-15/3-4 (1)

Figure 3-4 (1)-Quarterly preventive maintenance services.

ITEM		PAR. REF.
11.	COOLING FAN AND GUARD. Check for bent, cracked, or missing cooling fan blades. Check for insecure guard mounting and fan belt adjustment.	
12.	RADIATOR. Inspect for leaks, insecure mounting, and obstructions in the core air passages. Check coolant level. Proper coolant level is 1 inch below filler neck. Check that pressure cap is operative.	3-52-b
13.	BATTERIES. Inspect batteries for cracks, leaks or damage. Check for loose or missing mounting hardware. Check battery cables and terminals for corrosion and loose connections. Check electrolyte level, specific gravity, and voltage of each cell.	
14.	SKID BASE. Check for distortion and for cracked or broken weldments.	
15.	PUMP SEAL LUBRICATION CUP. Check that lubrication cup is present and filled to the required level.	
16.	PUMP BEARING HOUSING. Check bearing housing for leaks, excessive vibration during operation, and for unusual noises.	
17.	FUEL TANK. Check fuel tank and lines for damage and leaks. Check that fuel tank is full.	3-36-b
18.	VALVE MECHANISM. Check valve adjustment if excessive tappet noise, or loss of power is noted.	
19.	HOOD AND SIDE PANELS. Inspect for insecure mounting, missing hardware and damage.	
20.	LUBRICATING OIL FILTERS AND LINES. Check for leaks, insecure mounting and damaged parts.	
21.	MAGNETO. Check for insecure mounting and for worn or frayed high tension leads. Remove front cap from magneto and check that felt oiler has been properly serviced.	3-46-a
22.	VOLTAGE REGULATOR. Check voltage regulator for insecure mounting, insecure connections, broken leads, and signs of overheating.	3-44-b
23.	FUEL PUMP. Check for insecure mounting and for leaks.	
24.	FUEL STRAINER. Check for sediment in sediment bowl. Check strainer element for clogging and damage.	
25.	GENERATOR. Check generator drive belt tension. Proper deflection midway between pulleys is 3/4 inch.	3-43-a
26.	WATER PUMP. Check water pump for loose bearings and signs of leaking.	

MEC 4320-240-15/ 3-4 (2)

Figure 5-40-Continued.

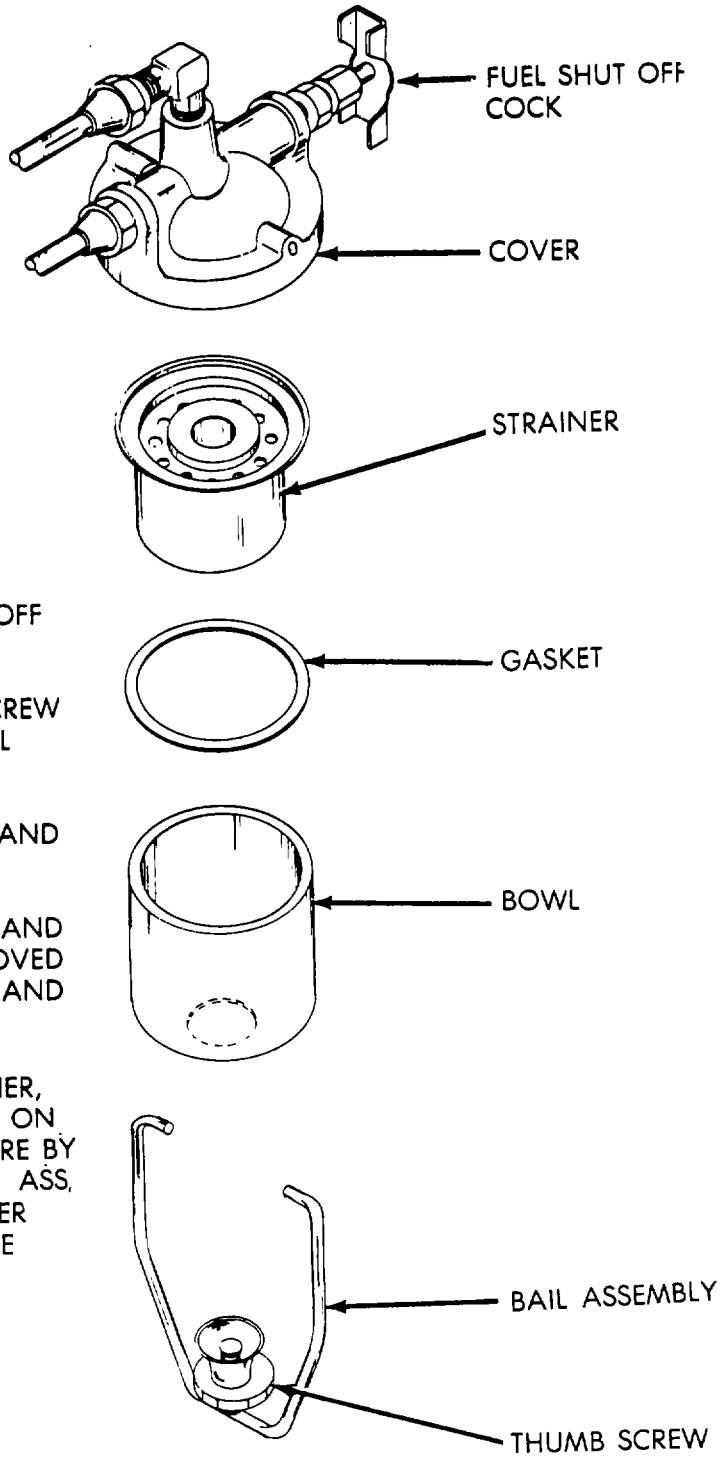
Section IV. OPERATOR AND ORGANIZATIONAL MAINTENANCE

3-8. General

Instructions in this section are published for the information and guidance of the operator to maintain the centrifugal pump.

3-9. Fuel Strainer Service

Refer to figure 35 and service the fuel strainer.



STEP 1. CLOSE THE FUEL SHUTOFF COCK.

STEP 2. LOOSEN THE THUMB SCREW AND REMOVE THE BAIL ASSEMBLY.

STEP 3. REMOVE THE GASKET AND STRAINER.

STEP 4. CLEAN THE BOWL AND COVER WITH AN APPROVED CLEANING SOLVENT AND DRY THOROUGHLY.

STEP 5. POSITION THE STRAINER, GASKET AND BOWL ON THE COVER AND SECURE BY INSTALLING THE BAIL ASSEMBLY ON THE COVER AND TIGHTENING THE THUMB SCREW.

Figure 3-5. Fuel strainer service.

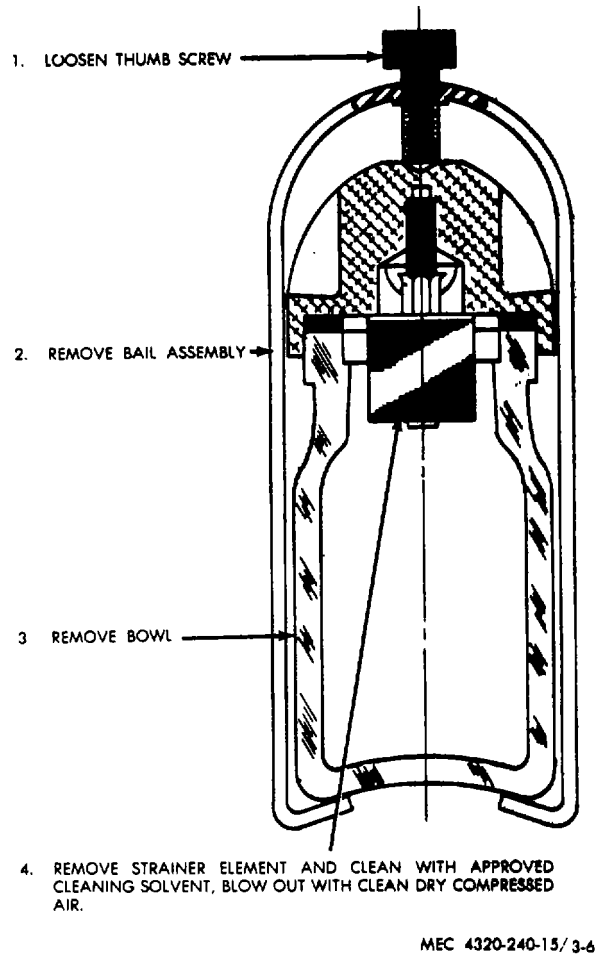


Figure 3-6. Primer strainer service.

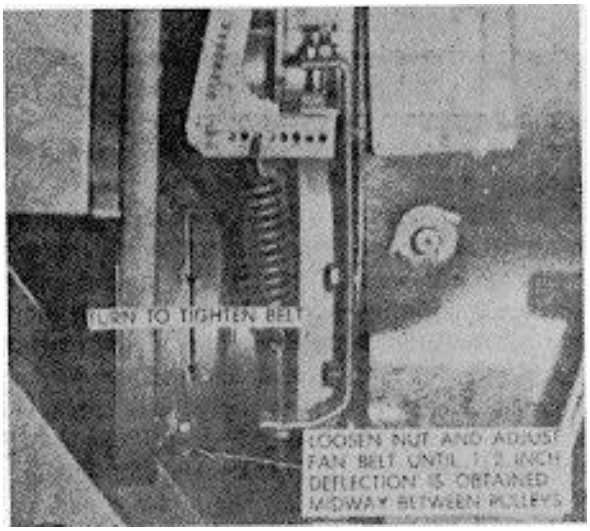


Figure 3-7. Fan belt adjustments

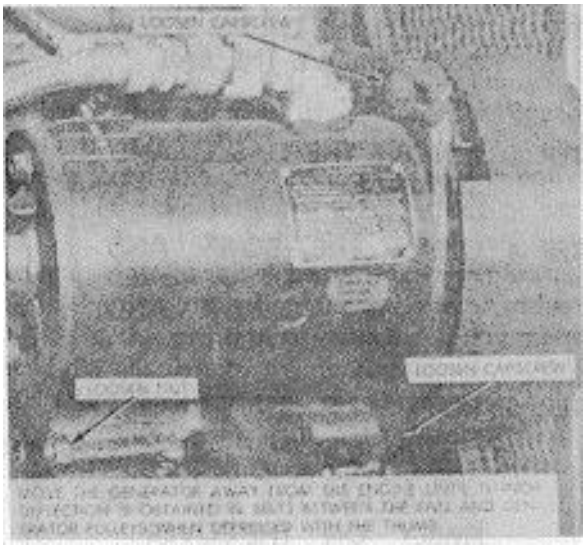


Figure 3-8. Generator belt adjustment.

3-10. Primer Strainer

Refer to figure 3-6 and service the primer strainer.

3-11. Fan Belt Adjustment

Refer to figure 3-7 and adjust the fan belt.

3-12. Generator Belt Adjustment

Refer to figure 3-8 and adjust the generator belt.

Section V. TROUBLESHOOTING

3-13. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the centrifugal pump and its components. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy recommended is described opposite the probable cause. Any trouble beyond the scope of organizational maintenance shall be reported to direct support maintenance.

3-14. Engine Fails to Start or Hard to Start

Probable Cause	*Possible Remedy*
Starter fails to crank engine.	Check electrical system and starting motor (para 3-45).

Probable Cause	*Possible Remedy*
Carburetor out of adjustment.	Adjust carburetor (par. 8-83).
Spark plugs defective.	Clean and gap or replace spark plugs (para 8-47).
No fuel.	Add fuel to tank.

3-15. Engine Misses or Runs Erratically

Probable Cause	*Possible Remedy*
Plugged air cleaner	Service air cleaner (para 8-88).
Governor sticking	Clean linkage.
Spark plugs defective.	Clean and gap or replace spark plugs (para 8-47).
Magneto defective.	Adjust or replace magneto (para 8-46).

3-16. Engine Noise

Probable Cause	*Possible Remedy*
Engine mounting bolts loose.	Tighten mounting bolts,
Insufficient oil	Add oil.

3-17. Engine Stops Suddenly

Probable Cause	*Possible Remedy*
No fuel in tank	Fill fuel tank,
Ignition wiring faulty	Check wire from switch to magneto for a possible ground.
Magneto failure	Replace magneto (para 8-46).
Oil pressure safety switch trips.	Check oil level; replenish supply if necessary, Reset oil pressure switch. Start engine and check for oil pressure. If pressure is adequate but switch shuts off engine, replace engine oil pressure gage and integral safety switch (para 8-66).
Water temperature safety switch trips.	Check radiator water level; replenish supply if necessary. Reset water temperature switch. Start engine and check for water temperature, If temperature is below safe operating level but switch shuts off engine, replace engine water temperature gage and safety switch. (para 8-67).

3-18. Oil Pressure Low

Probable Cause	*Possible Remedy*
***Caution*: If the engine oil pressure gage does not show a minimum of 7 psi at idle speed a few seconds after starting, stop the engine and check for cause.**	
Not enough oil in engine.	Fill to prescribed level.
Engine oil pressure gage faulty,	Replace gage (para 3-66).
Incorrect oil viscosity	Drain oil and replace with correct oil.

3-19. Engine Overheats

Probable Cause	*Possible Remedy*
Thermostat defective	Replace thermostat (para 3-51).
Radiator defective.	Clean radiator (para 3-52).
Water pump defective.	Replace water pump (para 3-50).

3-20. Engine Lacks Power

Probable Cause	*Possible Remedy*
Governor defective	Adjust or replace governor (para 8-34).
Magneto defective.	Adjust or replace magneto (para 3-46).

3-21. Generator Fails to Function

Probable Cause	*Possible Remedy*
Generator-regulator defective.	Replace defective regulator (para 3-44).

3-22. Pump Falls to Prime

Probable Cause	*Possible Remedy*
Air leak in suction line	Tighten hose connections. Check for pinholes in hose. Check for collapsed lining.
Suction strainer or suction line plugged.	Clear line or strainer.
Chamber not completely filled for priming,	Fill chamber.

3-23. Noisy Pump Operation

Probable Cause	*Possible Remedy*
Excessively high suction lift causing cavitation.	Move pump closer to supply.

3-24. Pump Fails to Deliver Rated Capacity

Probable Cause	*Possible Remedy*
Engine lacks speed.	Check governor adjustment (para 3-34).

Probable Cause	*Possible Remedy*
Air leak in suction line	Tighten connections. Check for pinholes.
Suction lift too high	Move pump closer to supply.
Total head too high	Rearrange system to reduce elevation between point of delivery and supply.

Section VI. RADIO INTERFERENCE SUPPRESSION

3-25. Definitions

a. Interference. The term "interference" as used in this manual applies to electrical disturbances in the radio-frequency range which are generated by the pump engine and which may interfere with the proper operation of radio receivers or other electronic equipment.

b. Interference Suppression. The term "interference suppression" as used in this manual applies to the methods used to eliminate or effectively reduce interference generated by the pump engine.

3-26. General Methods to Attain Proper Suppression

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

***Note*. Do not pull on cable or twist braided shielding. Gently work cable from side to side and free the rubber seal. Do not use sharp metal tools to Install rubber seals**.

3-27. Interference Suppression Components

a. Primary Suppression Components. The primary suppression components are those whose primary function is to suppress radio interference.

b. Secondary Suppression Components. These components have radio interference suppression functions which are incidental and/or secondary to their primary function.

3-28. Replacement of Suppression Components

a. Shielded Ignition Leads. Refer to (para -47) and replace the shielded ignition leads.

b. Ground Strap. The engine has two ground straps, one on the magneto and one on voltage regulator.

3-29. Testing of Radio Interference Suppression Components

Test the capacitors for leaks and shorts on a capacitor tester; replace defective capacitors. If test equipment is not available and interference is indicated, isolate cause by the trial and error method of replacing each capacitor in turn until the cause of interference is located and eliminated.

Section VII. FUEL SYSTEM

3-30. General

The purpose of the fuel system is to store, convey, mix fuel with air, and then vaporize and introduce the mixture into the engine. Fuel is stored in the gasoline tank. It is filtered and flows to the carburetor under the pressure of a fuel pump. The carburetor mixes the fuel with the proper proportions of air and at the same time breaks it into very fine spray particles. This atomized spray changes to vapor as it travels through the heated intake manifold to the combustion chamber.

3-31. Fuel Pump

a. General. The fuel pump transfers the fuel from the fuel tank to the carburetor.

b. Removal. Refer to figure 3-9 and remove the fuel pump.

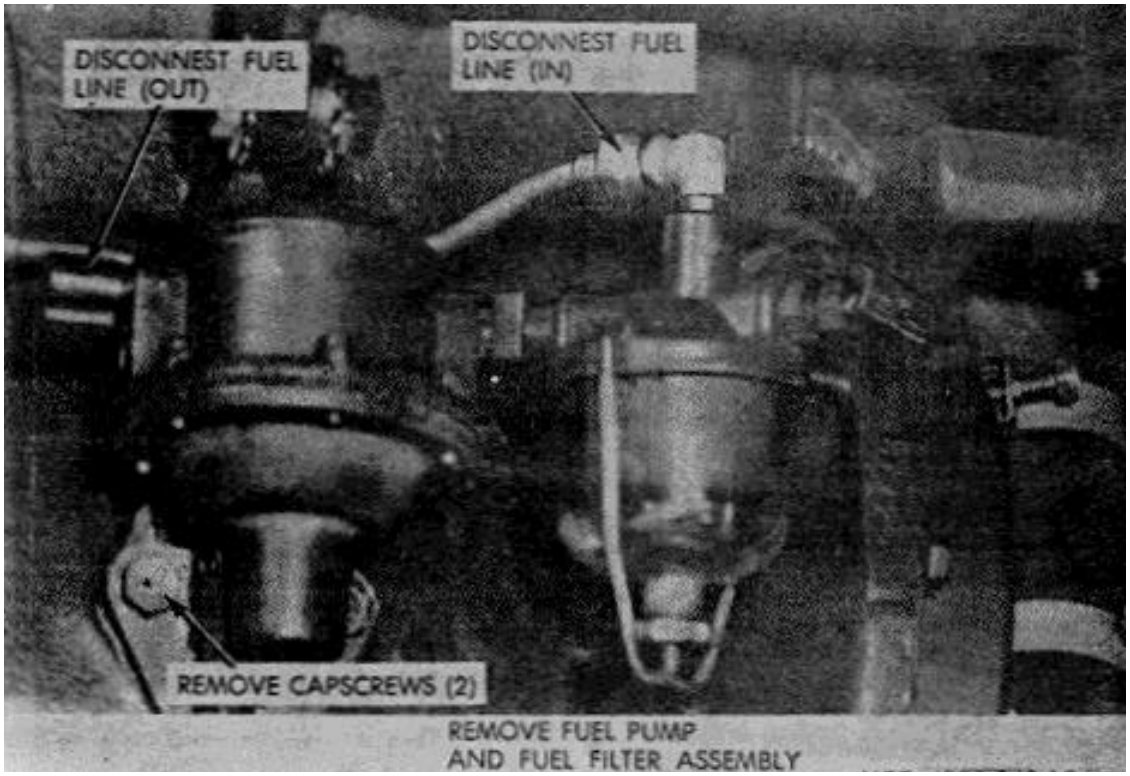
c. installation. Refer to figure 8-9 and install the fuel pump.

3-32. Carburetor

a. General. The carburetor mixes air and fuel and introduces the mixture to the intake manifold.

b. Adjustments.

(1) Preliminary adjustments. Set throttle stop screw (fig. 3-10) so that throttle valve is open slightly. Make certain that fuel supply to carburetor is open. Close choke valve. Start engine and partially release choke. Return choke



MEC 4320-240-15/3-9

Figure 3-9. Fuel pump removal and installation.

to wide open position when engine reaches normal operating temperature.

(2) *Low speed or idle adjustment*. Set throttle or governor control lever in slow idle position and adjust throttle stop screw for the correct engine idle speed. (On a new, stiff engine this speed must be slightly higher than required for a thoroughly run-in engine.) Turn adjustment needle (fig. 8-10) until engine begins to falter or roll from richness, then turn needle in the opposite direction until the engine runs smoothly.

Note: It is better that this adjustment be slightly too rich than too lean.

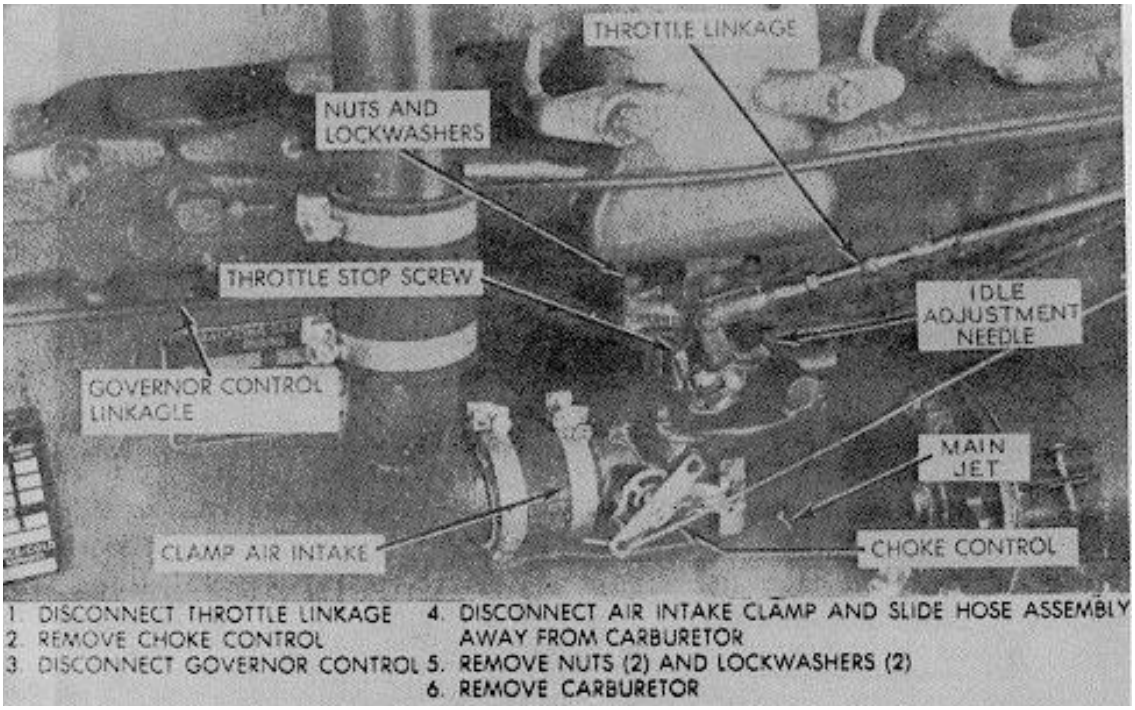
(3) *Main jet adjustment*. With the engine running at governed speed under load, turn adjusting needle (fig. 8-10) to the right, or clockwise, a little at a time until the power drops appreciably. Then turn the needle to the left, or counterclockwise, until the engine picks up power and runs smoothly. This will give an economical part throttle mixture, and, due to the economizer action, the proper power mixture for full throttle operation. Due to variations in temperature or fuels it may be necessary to enrich this mixture by backing out the main jet adjusting needle, a small amount at a time until good acceleration is obtained.

c. Removal. Refer to figure 3-10 and remove the carburetor.

d. Cleaning and inspection.

(1) Clean the outside of the carburetor with a cloth dampened with cleaning solvent; wipe dry. Clean all metal parts in an approved cleaning solvent; dry with clean, dry compressed air.

(2) Inspect the carburetor for damage; replace if damaged. Inspect all other metal parts for cracks, dents, or other damage; replace if damaged. Inspect the fuel line for cracks, wear, or deterioration; replace if damaged.



MEC 4320-240-15/3-10

Figure 3-10. Carburetor adjustment, removal, and installation.

e. *Installation*. Refer to figure 3-10 and install the carburetor.

3-33. Air Cleaner

a. General. The air cleaner removes dust particles from the air before it reaches the carburetor.

b. Service. Refer to figure 3-2 and service the air cleaner.

c. Removal. Refer to figure 3-2 and remove the air cleaner.

d. Installation. Refer to figure 3-2 and install the air cleaner.

3-34. Governor

*a. General**. The governor controls the speed (in revolutions per minute) of the engine.

b. Adjust. Refer to figure 3-11 and adjust the governor.

c. Removal. Refer to figure 3-12 and remove the governor.

d. *Installation*. Refer to figure 3-12 and install the governor.

3-35. Fuel Primer Pump

a. General. The fuel primer pump is used to pump fuel directly into the intake manifold.

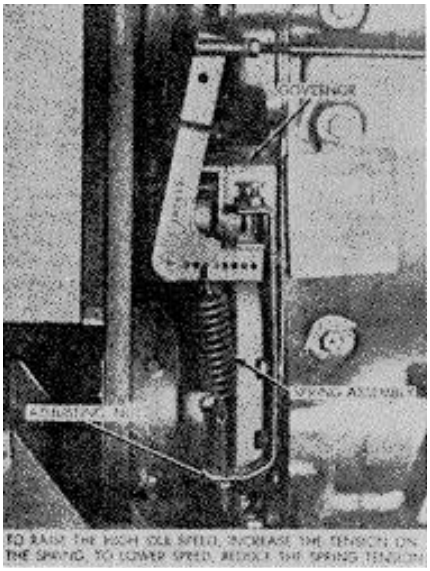
b. Removal. Refer to figure 8-13 and remove the fuel primer pump.

c. Cleaning and inspection.

(1) Clean the outside of the fuel primer pump with a cloth dampened in cleaning solvent; wipe dry. Do not allow solvent to enter the fuel primer pump.

(2) Inspect the fuel primer pump for cracks, breaks, or other damage; replace if damaged.

d. Installation. Refer to figure 3-13 and install the fuel primer pump.



IF IT IS DESIRED TO CHANGE THE GOVERNOR RESPONSE TO ADAPT TO THE ENGINE THE LOAD, REPOSITIONING OF THE GOVERNOR SPRING END. IN THE HOLES TOWARDS THE END Of THE GOVERNOR LEVER WILL PROVIDE SLOWER GOVERNOR RESPONSE AND LESS TENDENCY TO SURGE. CONVERSELY, MOVING THE SPRING END CLOSER TO THE LEVER PIVOT WILL PROVIDE FASTER GOVERNOR RESPONSE, BUT NAY INCREASE THE TENDENCY TO SURGE. AFTER ANY MOVEMENT OF THE GOVERNOR SPRING END, IT IS NECESARY TO ADJUST YHE SPRING TENSION BY USE OF THE ADJUSTING NUT TO MAINTAIN THE DESIRED HIGH IDLE SPEED.

MEC 4320-240-15/3-11

Figure 8-11. Governor adjustment.

3-36. Fuel Tank

a. General. The fuel tank stores the fuel until it is ready for use.

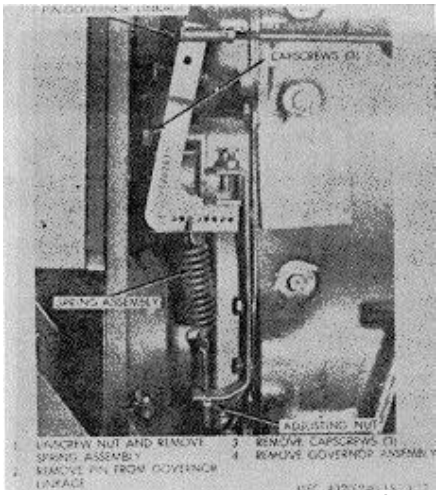
b. Service. The fuel tank should be cleaned and flushed once a year, or more often if necessary.

c. Inspect. Inspect the fuel tank for leaks, cracks, dents, and missing parts.

3-37. Fuel Tank (Primer Pump)

a. General. The primer tank stores the fuel until it is ready for use.

b. Service. The primer tank should be cleaned and flushed once a year, or more often if necessary.



MEC 4320-240-15/3-12

Figure 3-12. Governor removal and installation.

c. Removal. Refer to figure 3-14 and remove the primer tank.

d. Cleaning and inspection. Clean the tank and fittings in an approved solvent and blow through with clean dry compressed air. Inspect the tank and fittings for leaks, cracks, dents, and missing parts.

e. Installation. Refer to figure 3-14 and install the primer tank.

3-38. Fuel Strainer

a. General. The fuel strainer keeps the fuel clean.

b. Service. Refer to figure 3-5 and service the fuel strainer.

c. Removal. Refer to figure 3-16 and remove the fuel strainer.

d. Installation. Refer to figure 3-15 and install the fuel strainer.

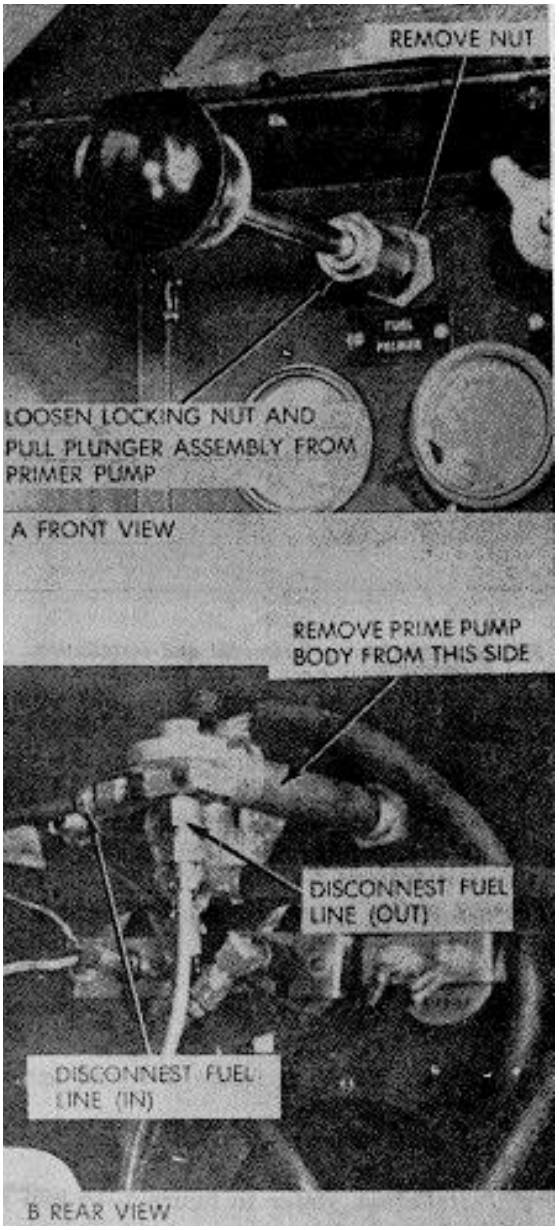
3-39. Fuel Strainer (Primer Pump)

a. General. The primer strainer cleans the fuel which goes to the primer pump.

b. Service. Refer to figure 3-6 and service the primer strainer.

c. Removal. Refer to figure 3-16 and remove the primer strainer.

d. Installation. Refer to figure 3-16 and install the primer strainer.



MEC 4320-240-15/3-13

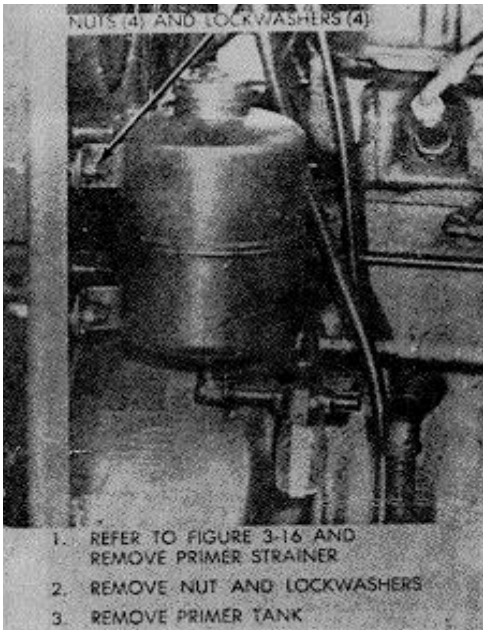
Figure 3-13. Fuel primer pump removal and installation.

3-40. Fuel Lines and Fittings

a. General. The fuel lines and fittings are used in transferring fuel.

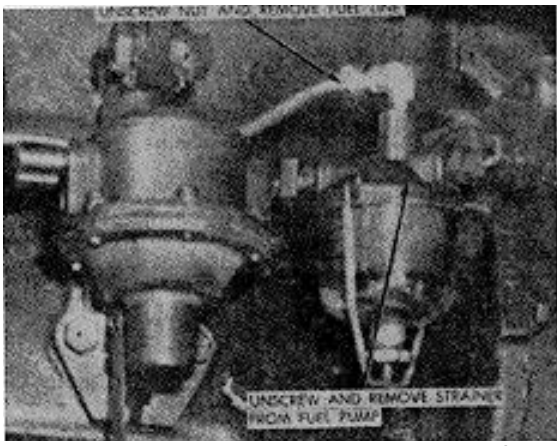
b. Service. Service fuel lines by blowing through with clean, dry, compressed air.

c. Removal. Refer to figure 3-17 and remove fuel lines and fittings as necessary by loosening the coupling nuts at each end of the line and removing the attaching hardware.



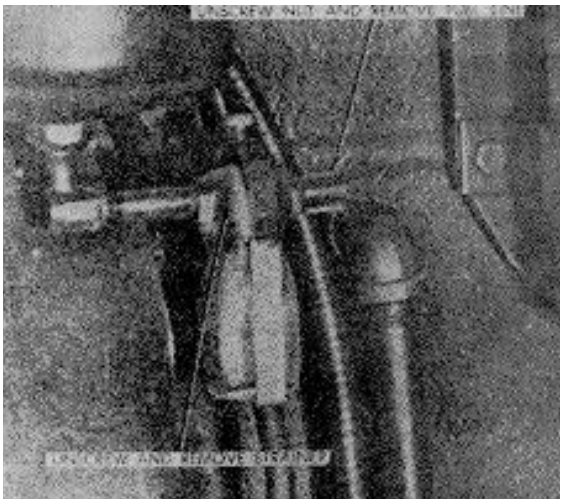
MEC 4320-240-15/3-14

Figure 3-14. Fuel talk (primer pump) removal and installation.



MEC 4320-240-15/3-15

Figure 3-15. Fuel strainer removal and installation.



MEC 4320-240-15/3-16

Figure 3-16. Fuel strainer (primer pump) removal and installation.

d. Cleaning and inspection.

(1) Clean the fuel lines and fittings by immersing them in an approved solvent. Blow through with clean, dry compressed air.

(2) Inspect the fuel lines and fittings for cracks, dents, restrictions, clogging, or damage. Replace defective parts.

e. Fabrication. Fabricate replacement fuel lines with a standard copper tubing flaring tool. Make a new line the same length as the line being replaced and bend the new line to shape of the old line.

f. Installation. Installation of the fuel lines and fittings is the reverse of the removal procedure described in subparagraph c above. After installation, test the new lines for leaks.

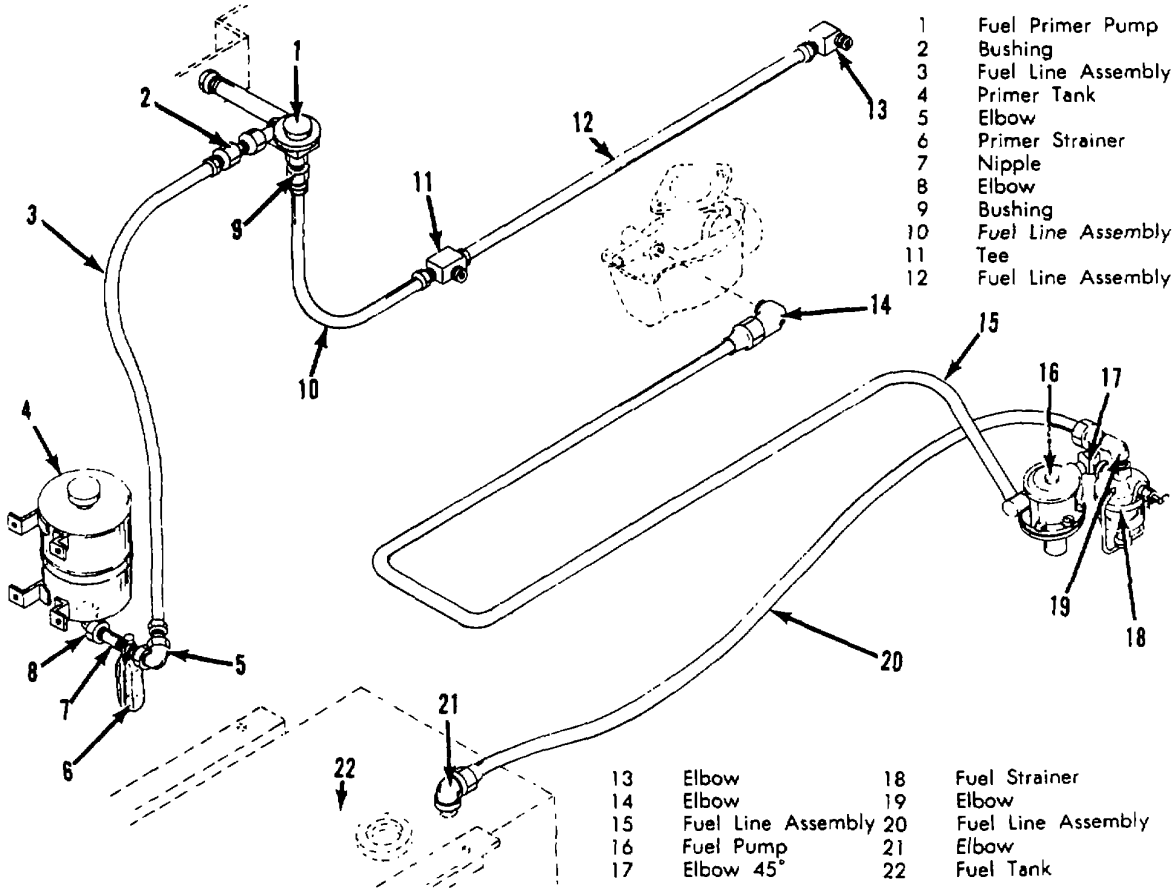
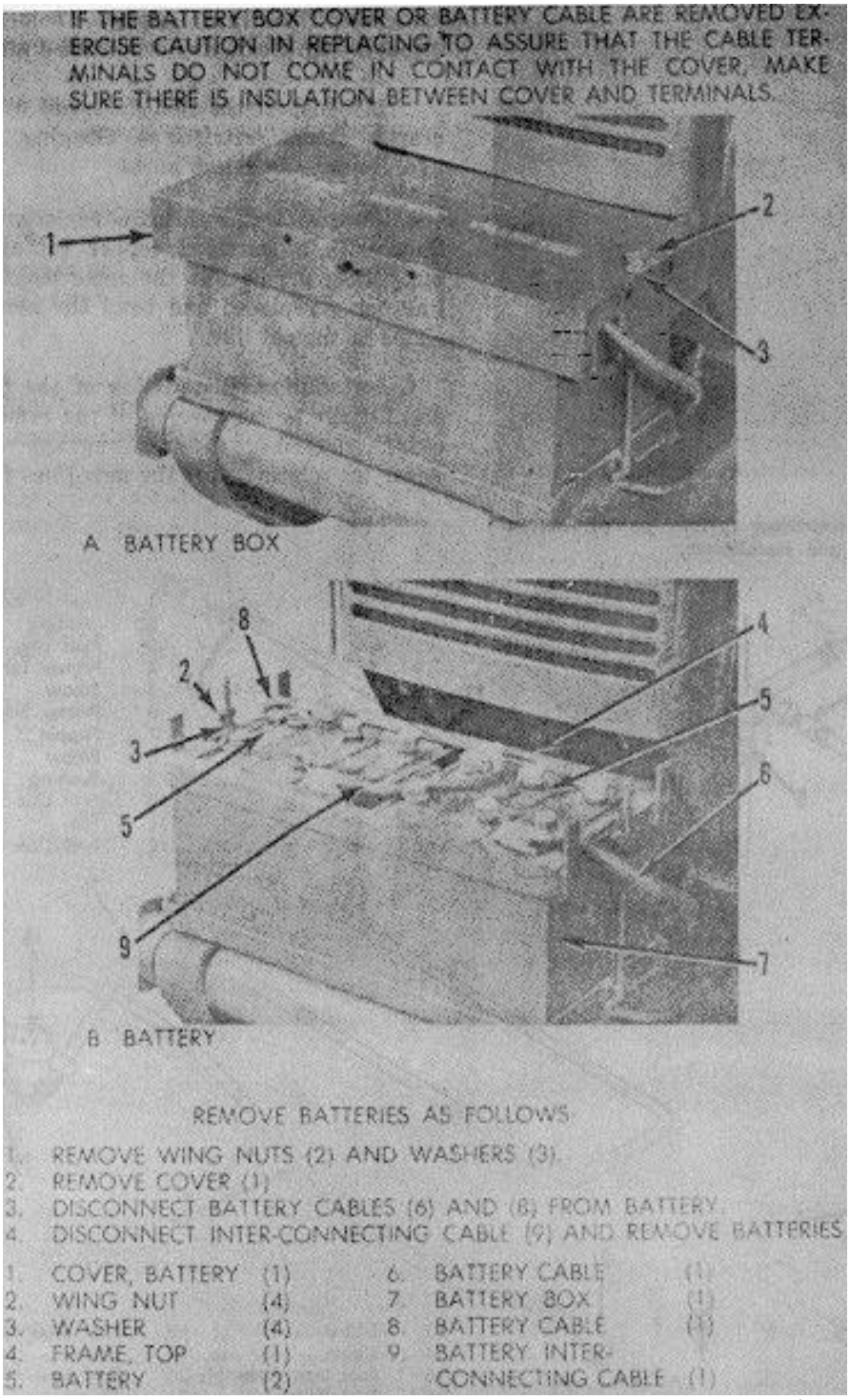


Figure 3-17. Fuel lines and fittings.



MEC 4320-240-15/3-18

Figure 3-18. Battery replacement.

3-41. General

The electrical system is a 24 volt negative ground system consisting of batteries, generator, generator regulator, and magneto.

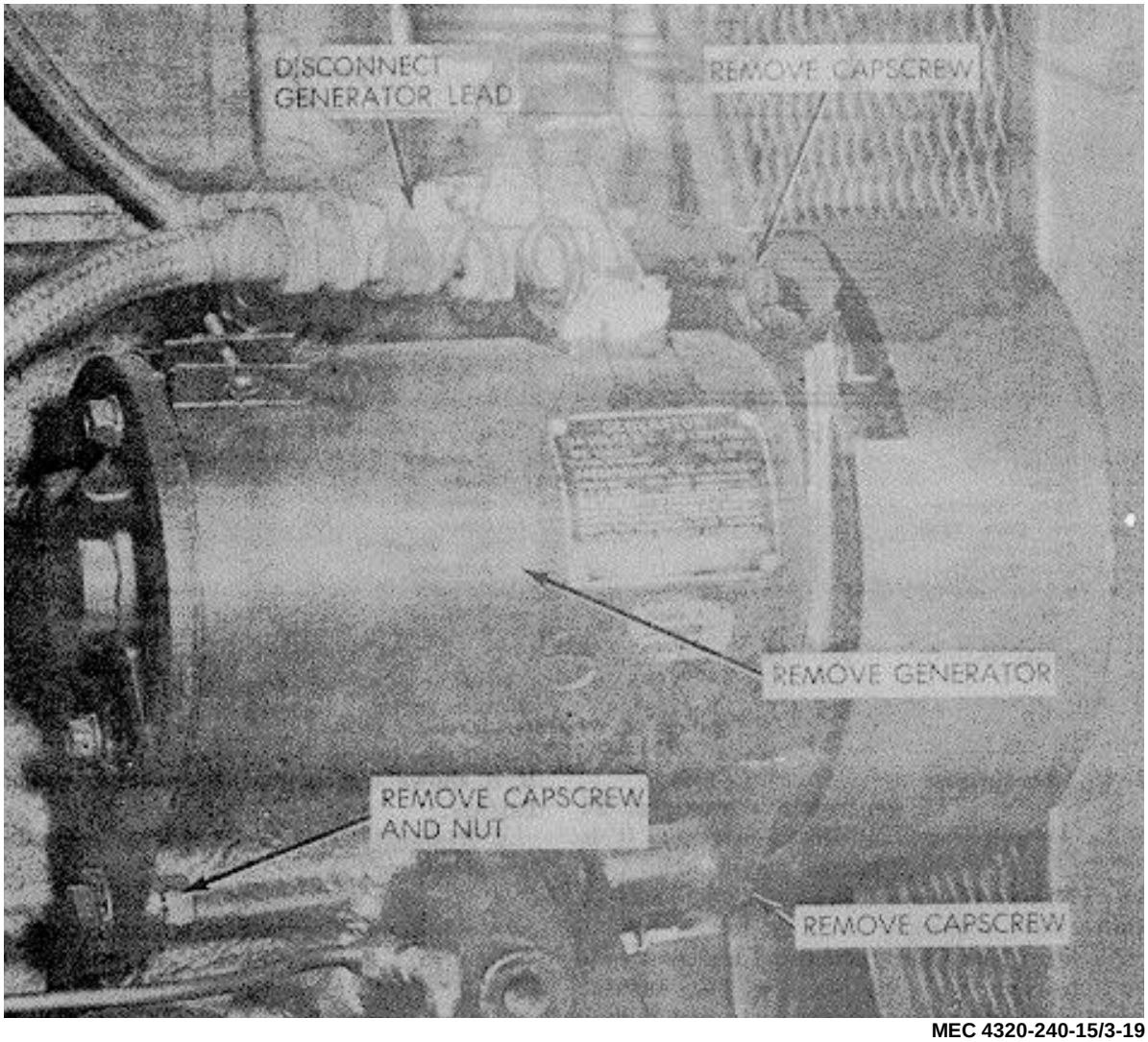
3-42. Batteries

a. *General*. The unit is powered by two 12 volt storage batteries, connected in series and contained in a battery box located at the front of the pumping unit. Quick-release connectors are provided on the battery cables.

b. Service. Check electrolyte level frequently. Add distilled or drinking water to raise liquid to indicated level above separators. Add water only while batteries are being charged or pumping unit is operating to mix solution.

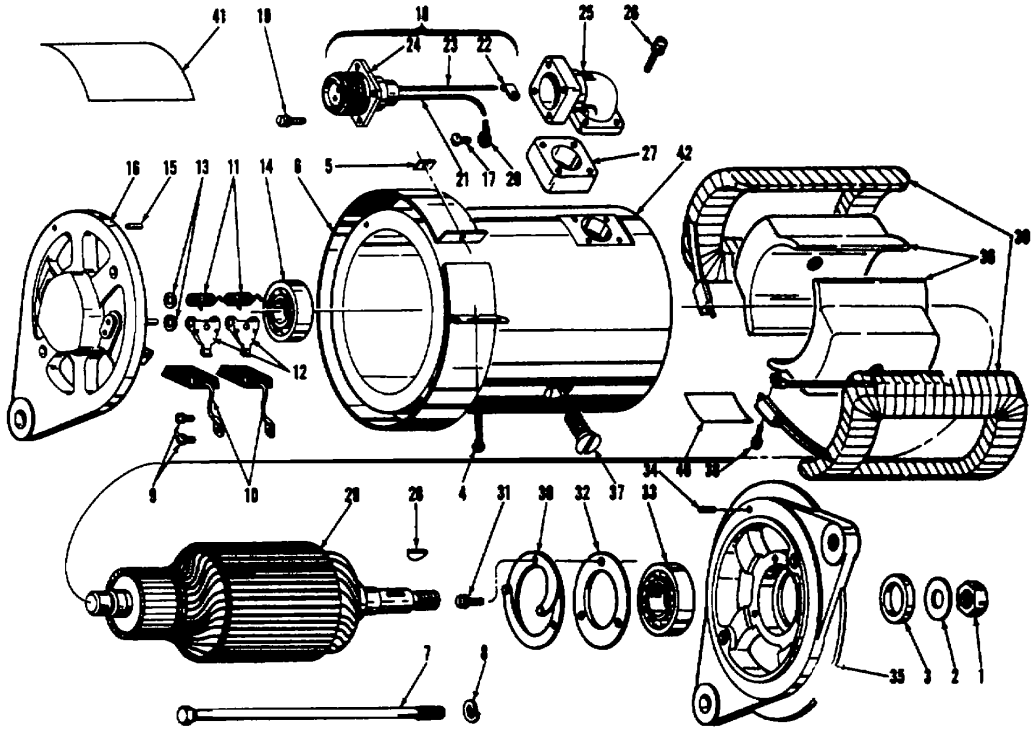
c. Testing. Check the specific gravity of each cell with a battery hydrometer. The specific gravity of each cell must be at least 1.260.

d. Replacement. Refer to figure 3-18 and replace the batteries.



MEC 4320-240-15/3-19

Figure 3-19. Generator removal and installation.



1	Nut, Hex	12	Arm, Brush (2)	23	Wire	33	Bearing
2	Washer, Flat	13	Washer (2)	24	Connector	34	Pin
3	Collar	14	Bearing	25	Elbow	35	Frame, Drive End
4	Screw, Machine	15	Pin	26	Screw (4)	36	Shoe, Pole (2)
5	Nut, Cover Band	16	End Frame	27	Spacer	37	Screw, Pole Shoe (2)
6	Band, Cover	17	Screw	28	Key, Woodruff	38	Screw
7	Bolt, Body (2)	18	Receptacle	29	Armature	39	Winding, Field
8	Washer, Lock (2)	19	Screw (4)	30	Collector	40	Insulation, Field
9	Screw (2)	20	Clip	31	Screw (3)	41	Insulation, Brush
10	Brush (2)	21	Wire	32	Plate, Bearing Retainer	42	Housing
11	Spring, Brush (2)	22	Clip				

MEC 4320-240-15/3-20

Figure 3-20. Generator-exploded view.

3-43. Generator

a. General. The generator is rated at 24 volts, 18 amperes DC (direct current). It is driven by a V-belt from the water pump pulley. Periodic checks of the generator prevent unnecessary repairs.

b. Inspection. Check generator for tight connections and well insulated wiring. Inspect mounting bolts and belt tension (½ inch deflection between pulleys).

c. Test. Start pumping unit and permit engine to warm up. Check ammeter (2, fig. 2-4) if it shows discharge check electrical system further.

d. Removal. Refer to figure 3-19 and remove the generator.

e. Cleaning and Inspection.

(1) Clean the outside of the generator with a cloth dampened with cleaning solvent; wipe dry. Take care that no cleaning solvent enters the generator or comes in contact with wires or electrical parts. Clean all other metal parts in cleaning solvent. Dry with clean, dry compressed air.

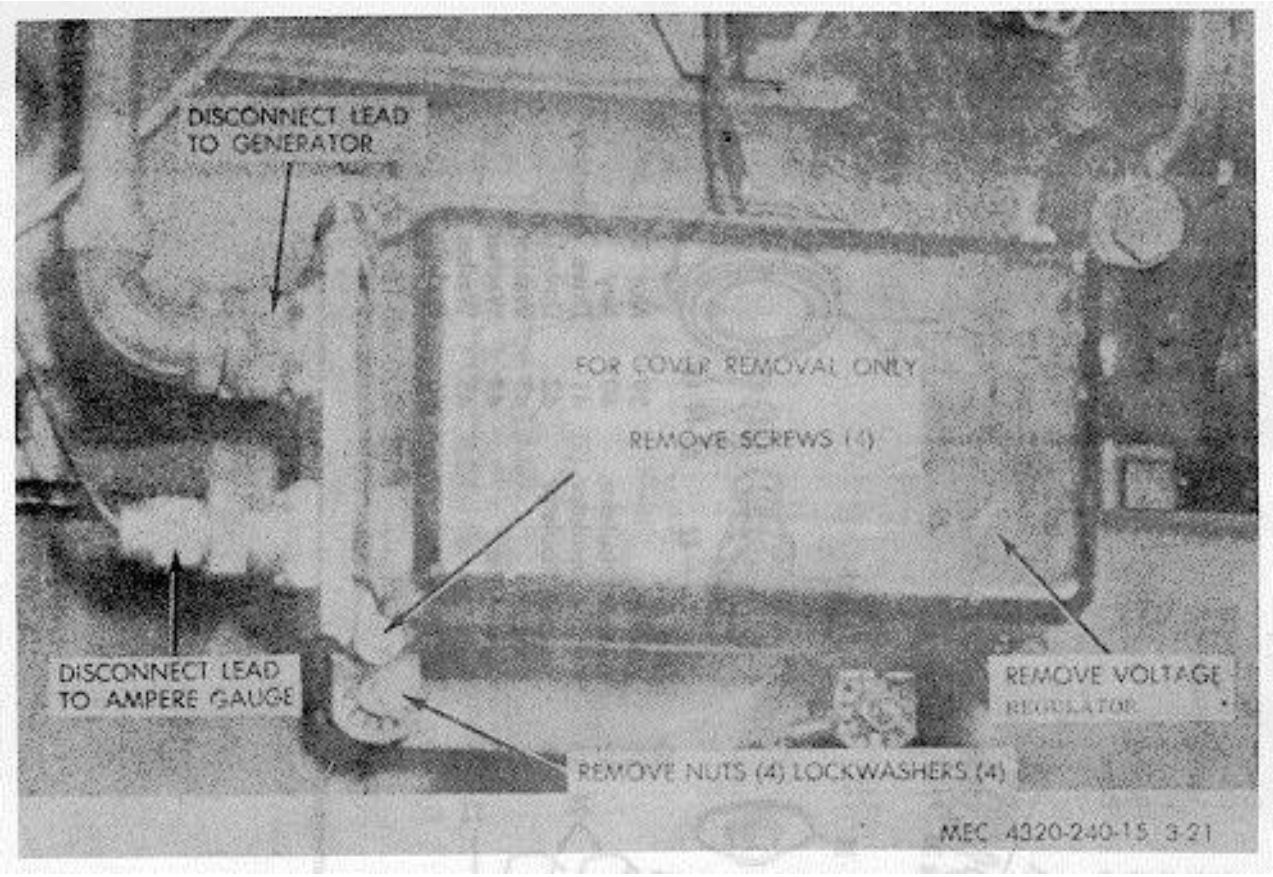


Figure 3-2I. Generator regulator removal and installation.

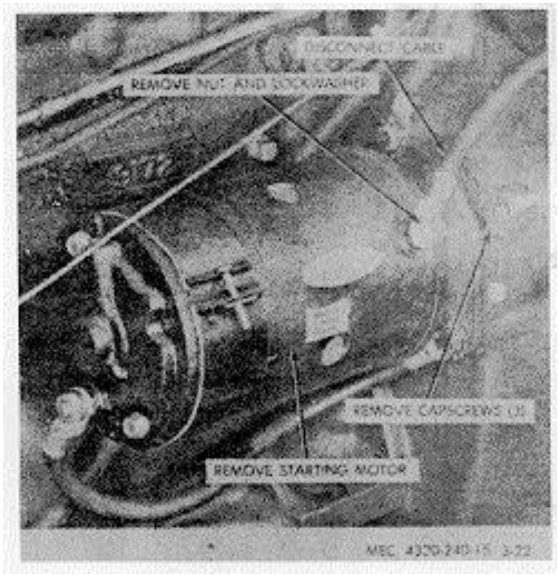


Figure 22. Starting motor removal and installation .

(2) Inspect the generator for damage; replace a damaged generator or refer to the proper authority. Inspect all other parts for cracks, breaks, dents, stripped threads, or other damage; replace damaged parts.

f. Repair. If the generator has been found defective and can be corrected with a repair kit refer to figure 3-20 and replace brushes (10) and springs (11).

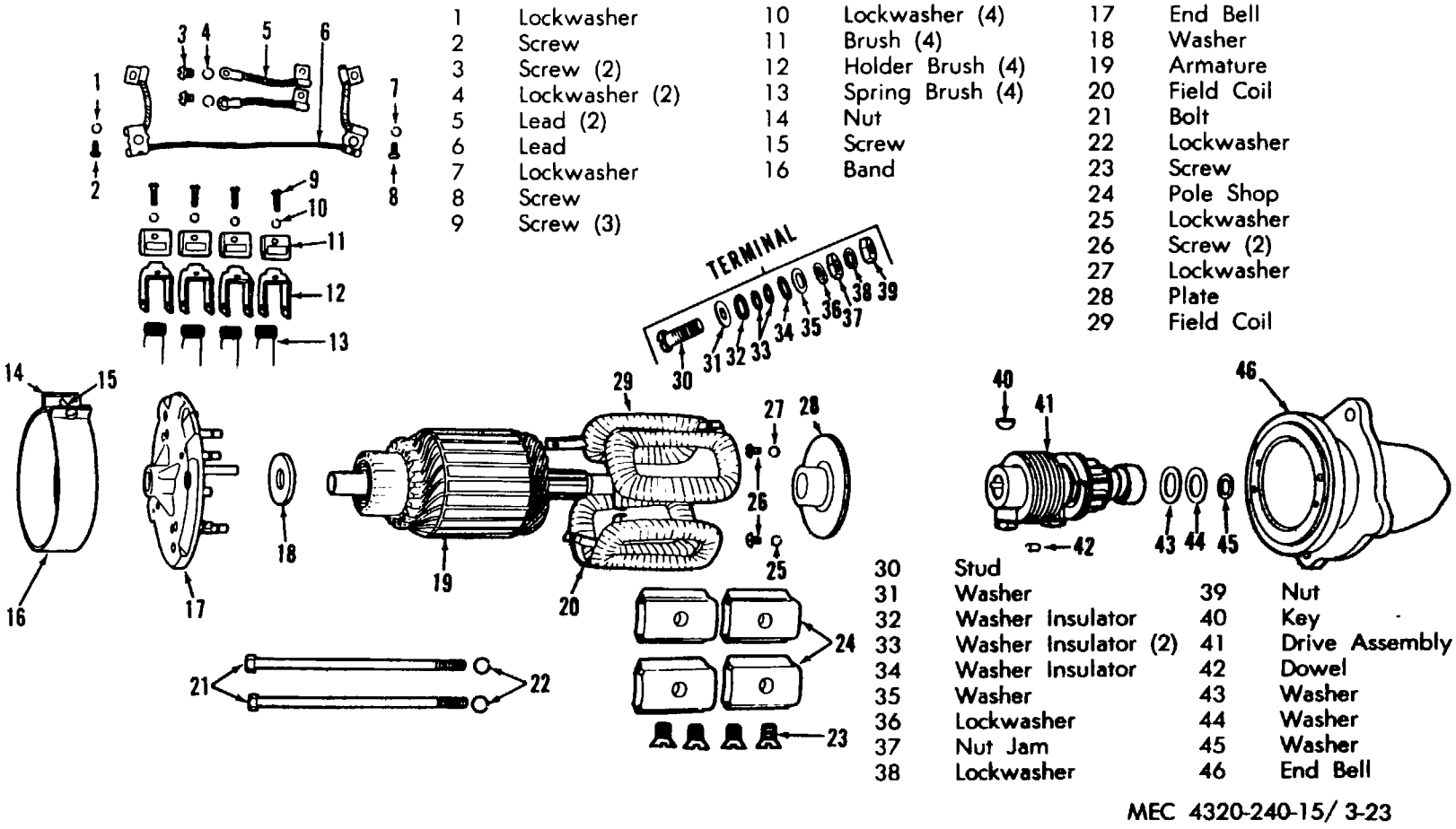
Note. Replace brushes if less than % inch long.

g. Installation. Refer to figure 3-19 and install the generator. Observe the following special instructions:

(1) Do not fully tighten the generator mounting bolts and belt adjusting screw until after the generator belt has been adjusted.

(2) Refer to figure 3-8 and adjust the generator belt.

(3) After the generator is reinstalled in the engine, or at any time after leads have been disconnected and then reconnected to the generator, the generator must be repolarized.



1	Lockwasher	10	Lockwasher (4)	17	End Bell
2	Screw	11	Brush (4)	18	Washer
3	Screw (2)	12	Holder Brush (4)	19	Armature
4	Lockwasher (2)	13	Spring Brush (4)	20	Field Coil
5	Lead (2)	14	Nut	21	Bolt
6	Lead	15	Screw	22	Lockwasher
7	Lockwasher	16	Band	23	Screw
8	Screw			24	Pole Shop
9	Screw (3)			25	Lockwasher
				26	Screw (2)
				27	Lockwasher
				28	Plate
				29	Field Coil

30	Stud	39	Nut
31	Washer	40	Key
32	Washer Insulator	41	Drive Assembly
33	Washer Insulator (2)	42	Dowel
34	Washer Insulator	43	Washer
35	Washer	44	Washer
36	Lockwasher	45	Washer
37	Nut Jam	46	End Bell
38	Lockwasher		

Figure 3-23. Starts motor-exploded view

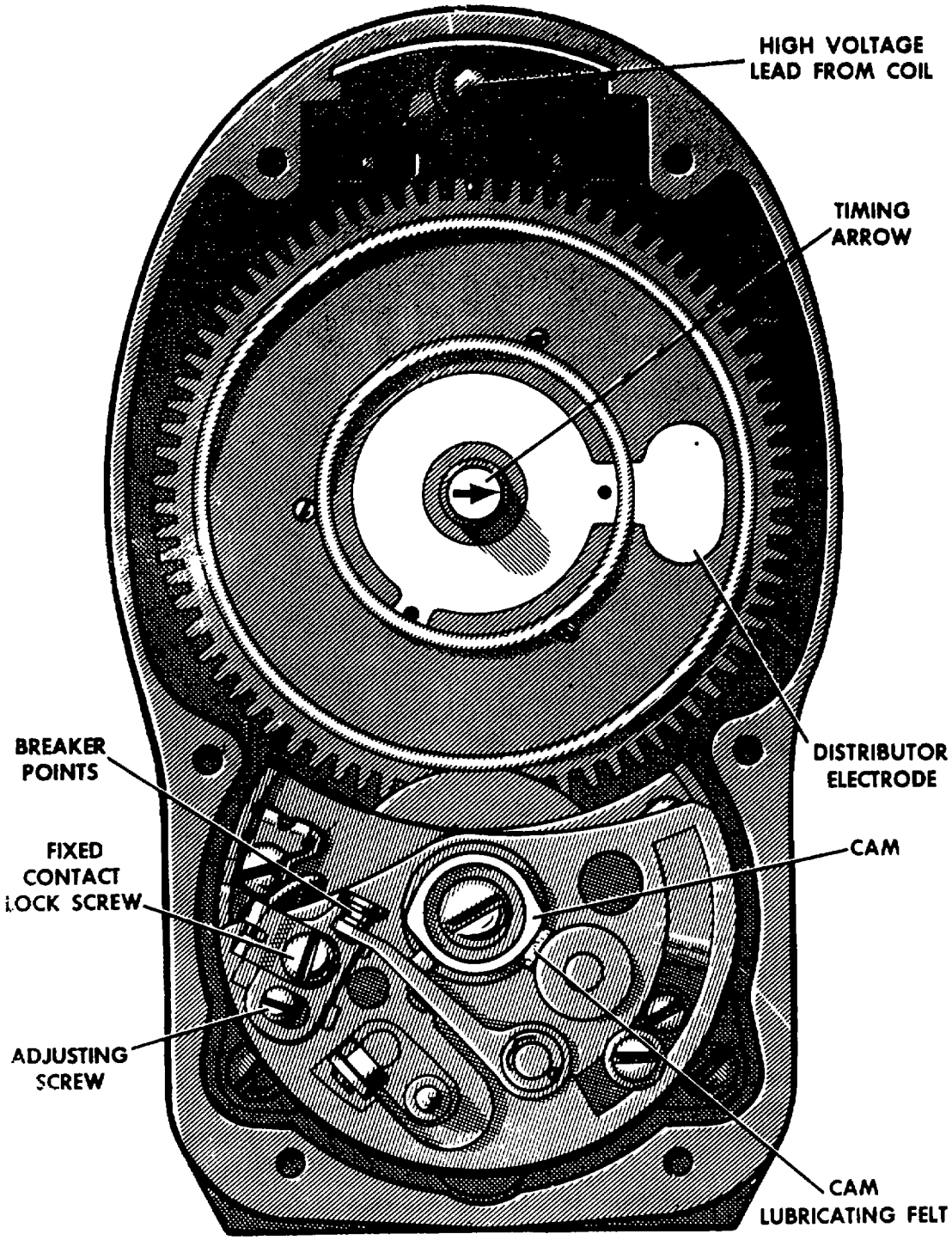


Figure 3-24. Magneto adjustment.

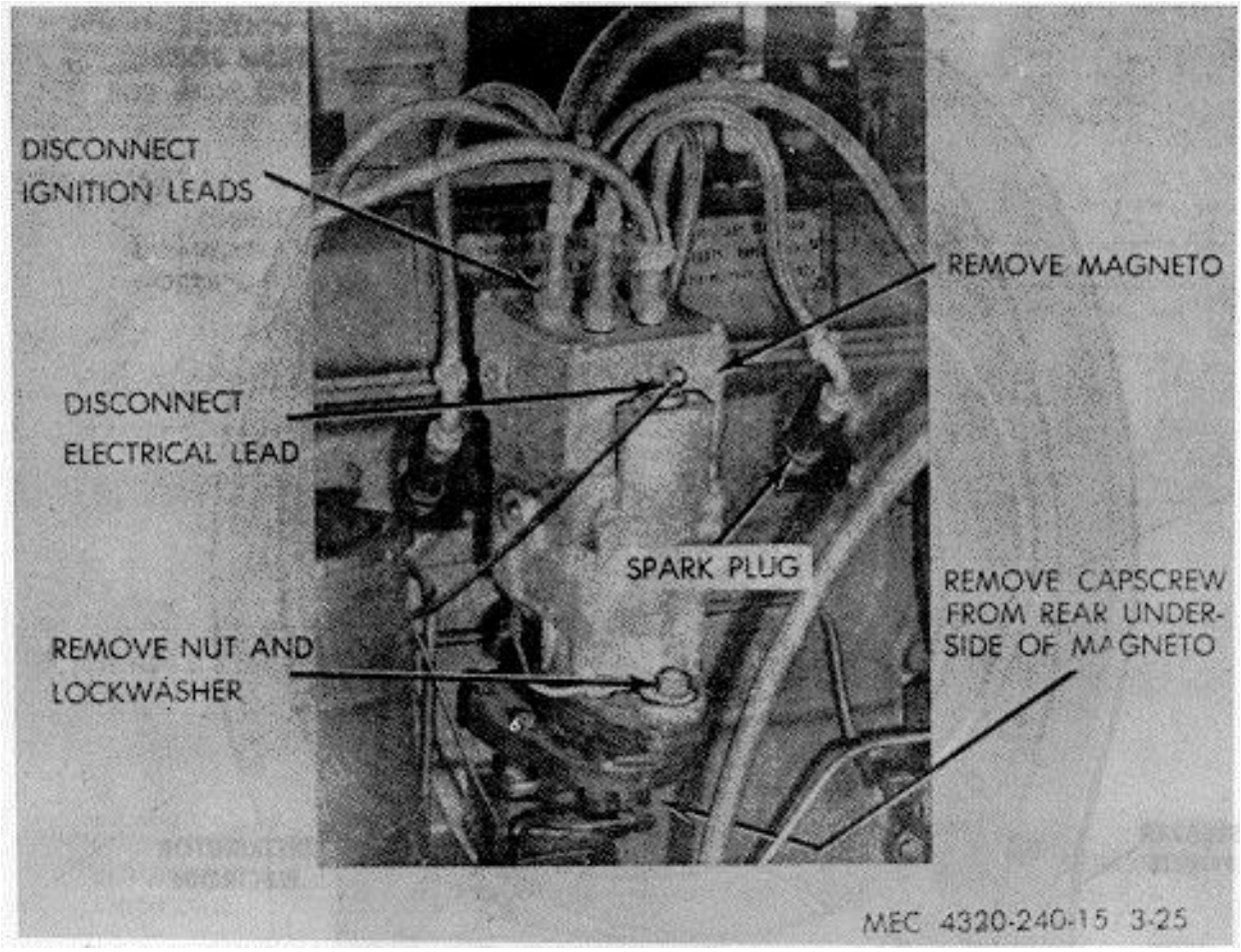


Figure 354. Magneto removal and inati4llaon

This is done in the following manner: momentarily connect a 24-volt battery in a series between the field lead (B terminal fig. 6-6) and a common ground. (Grounded side of the battery must be the same as the battery in the unit.) This allows a surge of current to flow through the field circuit to ground and properly polarizes the generator for the unit battery.

3-44. Generator Regulator

a. General. The generator regulator is mounted on the lower left hand side of the engine block. It includes a cutout relay, voltage regulator, and current regulator.

b. Inspection. Check generator regulator for tight connections and well insulated wiring.

Inspect mounting bolts and cover.

c. Test. Start pumping unit and permit engine to warm up. Check ammeter (2, fig. 2-4)

3-22 if it shows discharge check electrical system further.

d. Removal.

(1) Refer to figure 60 and remove capscrews (11), lockwashers (12), and side (10).

(2) Refer to figure 8-21 and remove the generator regulator.

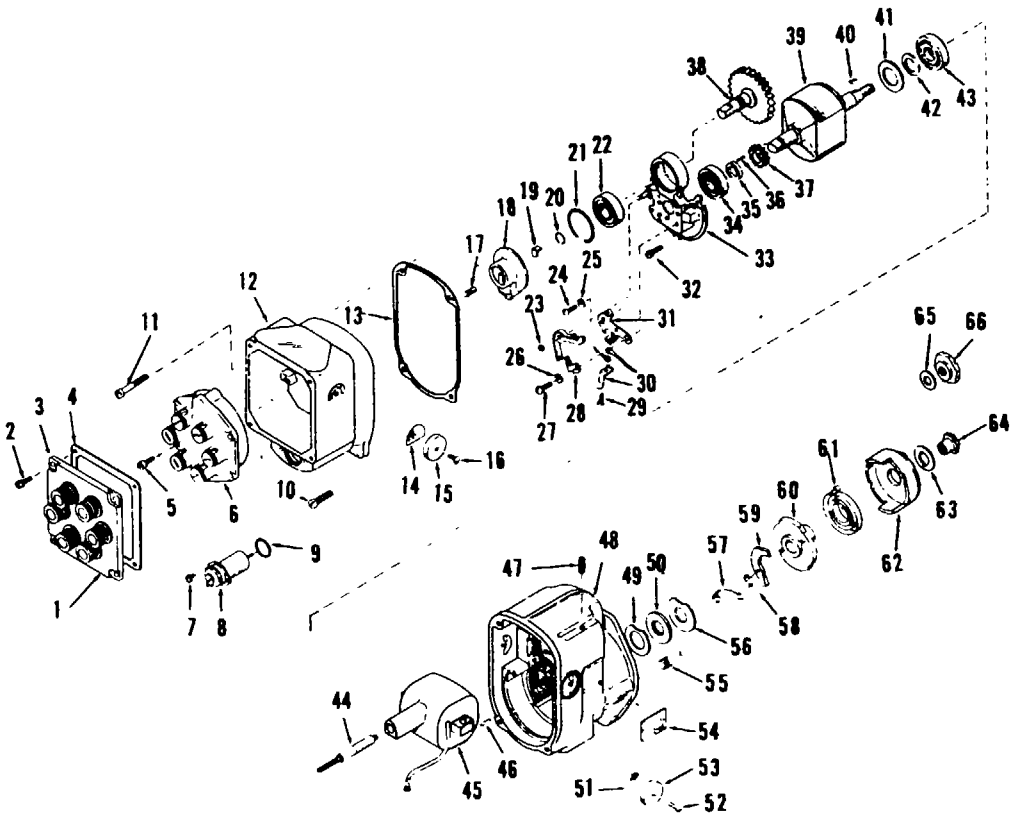
e. Installation. Install generator regulator in reverse order of removal.

3-45. Starting Motor

a. General. The starting motor is of 24 volt type and is located on the right hand side of the engine mounted to the flywheel housing. When in operation, it engages the ring gear on the flywheel to rotate the engine crankshaft.

b. Test. Operate magneto switch to off, push in starter button so that the engine turns over a few 'times. The engine should turn over quietly and quickly.

1 Cover
2 Screw (4)
3 Cover, horizontal
4 Gasket
5 Screw (4)
6 Block, Distr.
7 Screw
8 Condenser
9 "O" Ring
10 Screw (2)
11 Screw (2)
12 Cap, End
13 Gasket
14 Screen (4)
15 Cover (4)
16 Screw (4)
17 Spring, Brush
18 Rotor
19 Clip, Spring
20 Snap ring
21 Snap ring
22 Bearing
23 Snap ring
24 Screw
25 Washer
26 Washer
27 Screw
28 Cam
29 Screw
30 Spring
31 Point set
32 Screw (3)
33 Bearing support



34 Bearing
35 Spacer
36 Pin
37 Gear
38 Shaft and Gear
39 Rotor
40 Key
41 Seal
42 Shim (2)
43 Bearing
44 Rod
45 Coil
46 Pin
47 Setscrew
48 Housing
49 Washer
50 Seal
51 Screen (4)
52 Screw (4)
53 Cover (4)
54 Nameplate
55 Pin
56 Washer
57 Spring
58 Spring
59 Coupling
60 Hub assembly
61 Spring
62 Coupling shell
63 Lockwasher
64 Nut
65 Spacer
66 Nut

Figure 3-26. Magneto exploded view.

c. Removal Refer to figure 8-22 and remove starting motor.

d. Cleaning.

(1) Clean the outside of the starting motor with a cloth dampened with cleaning solvent; wipe dry. Take care that solvent does not enter the starting motor or contact the electrical parts.

(2) Inspect the assembled starting motor for cracks, breaks, broken or worn gear teeth. Refer to figure 3-23 and remove band (16), inspect brushes (11), brush holders (12), and springs (13). Make sure that they are clean and operating freely. Inspect lead (6) and make sure it is well insulated.

f. Repair-. If the starting motor has been found defective and can be corrected with at repair kit refer to figure 3-2,3 and repair the starting motor.

g. Installation Refer to figure 3-22 and install the starting motor.

3-46. Magneto

a. General. The magneto is of the rotating magnet, high-tension type designed to provide radio shielded ignition. It has an impulse coupling which assists starting by automatically retarding the ignition spark during the starting operation.

b. inspection Check magneto for tight connections and well insulated wiring. Inspect mounting and ground bolts.

c. Adjustment. Refer to figure 3-24 and adjust magneto points.

d. Removal. Refer to figure 3-25 and remove the magneto.

e. Cleaning and Inspection.

(1) Clean the outside of the magneto with a cloth dampened with cleaning solvent; wipe dry. 'rake care that solvent does not enter the magneto or contact the electrical parts.

(2) Inspect the magneto for cracks, breaks, worn or broken gear teeth, or other damage. Remove and inspect the distributor head for carbon runners, damage, or evidence of failure.

f. Repair. If the magneto has been found defective refer to figure 3-26 and repair the magneto by installing the magneto repair kit.

g. Timing and Installation. Refer to figure 3-25 and install the magneto observing the following special. Instructions,

(1) As a preliminary to magneto timing the breaker points must be set for a . 01d inch gap. Magneto & may be held in place by four capscrews, and connected to the drive shaft through an adjustable coupling with impulse device for easy starting. To time the magneto, crank the engine until No. 1 cylinder is moving upward on the compression stroke. As the piston approaches the top of the cylinder, here will come into view on the flywheel, a mark "Mag" or "Fire". When this is directly under the fixed pointer attached to the engine, the engine has reached the point at whit. . the spark should occur. With the engine in this position, release the screws holding the adjustable part of the coupling so that the magneto is positively disconnected from the drive shaft. Then remove the interrupter cap and distributor plate from the magneto, and turn the magneto shaft until the distributor brush is in line with the distributor segment marked by the figure "1" on the face of the distributor plate. Continue to turn the magneto until the impulse snaps, then turn it backwards until It points open and close, then bring It forward until the breaker points are just beginning to separate; this is the firing position for cylinder number '1. This is the position at which the magneto should be coupled to the engine. Replace the distributor block and cap over the breaker box.

3-47. Spark Plugs and Ignition Leads

a. Spark Plug Service and Replacement.

(1) Ioosen the nuts that secure the shielded ignition leads to the spark plugs; disconnect the leads.

(2) Clean around each spark plug with a clean cloth and compressed air. Remove the spark plugs with a deep-well socket wrench or a spark plug wrench.

(3) Clean the plugs with a spark plug sand blaster. Set the plug gap at 0. 025 inch.

(4) Inspect the spark plugs for cracked or eroded porcelain, burned electrodes, damaged threads, or other defects. Test the spark plugs on a spark plug tester. Replace defective spark plugs.

(5) Install spark plugs in the cylinder head.

(6) Connect ignition leads

b. Shielded Ignition Lead Replacement. Disconnect the ignition leads (fig, 8-25) from the spark plug and magneto, one at a time. Install replacement leads as the old leads are removed.

348. Battery Charging Receptacle

a. Removal

(1) Remove the four capscrews which fasten the battery charging receptacle (2, fig.
1-1) to the engine housing,

(2) Unplug the two cables connected to the receptacle,

(3) Remove the receptacle,

b. Installation. Install the battery charging receptacle (2, fig. 1-1) in the reverse order as noted above (para 3-48a).

Section IX. COOLING SYSTEM

3-49. General

The cooling system prevents the temperature in the engine combustion chamber from damaging the engine. Maintaining cooling system efficiency is important. Engine temperature must be brought up to and maintained within a satisfactory range for efficient operation; overheating must be avoided,

3-50. Water Pump

a. General. The water pump circulates the coolant in the cooling system.

b. Removal

(1) Drain coolant from system.

(2) Refer to figure 8-1 and remove nuts (9), washers (8), and lifting bail (7) from pumping unit.

(3) Remove side panels. (fig. 8-80).

(4) Refer to figure 8-57 and 8-58, remove muffler guard and muffler.

(5) Refer to figure 8-60 remove capserews (7), lockwashers (8), and hood (9) from pumping unit.

(6) Refer to figure 6-7 remove screws (8) and remove fan guard.

(7) Refer to figure 6-8 remove screws (24) lockwashers (28) and fan (22),

(8) Refer to figure 8-7 loosen adjusting nuts and remove fan belt.

(9) Refer to figure 8-8 loosen adjusting capers and remove generator belt.

(10) Refer to figure 8-27 and remove water pump.

c. Installation. Install water pump in reverse order of removal.

3-51. Thermostat

a. General. The thermostat controls the coolant temperature.

b. Removal.

(1) Perform all operations described in paragraphs 3-49b(1) through 3-4q9b(5).

(2) Refer figure 3-28 and remove the thermostat.

c. Test. Refer to figure 3-29 and test the thermostat.

d. Installation. Refer to paragraph 3-51l and install thermostat in reverse order.

3-52. Radiator

a. General. The radiator consists of a series of copper tubes through which the coolant is circulated. As it travels through these tubes it tends to radiate off the excess heat.

b. Inspection. Inspect the radiator for leaks, cracks, and dents.

c. Service.

(1) Refer to figure 3-30 and reverse flush the radiator.

(2) Refer to figure S-31 and reverse flush the engine water jacket.

3-53. Coolant Piping and Hoses

Replacement refer to figure 3-32 and replace piping and hoses as necessary.

Figure 3-27. Water pump removal and installation.

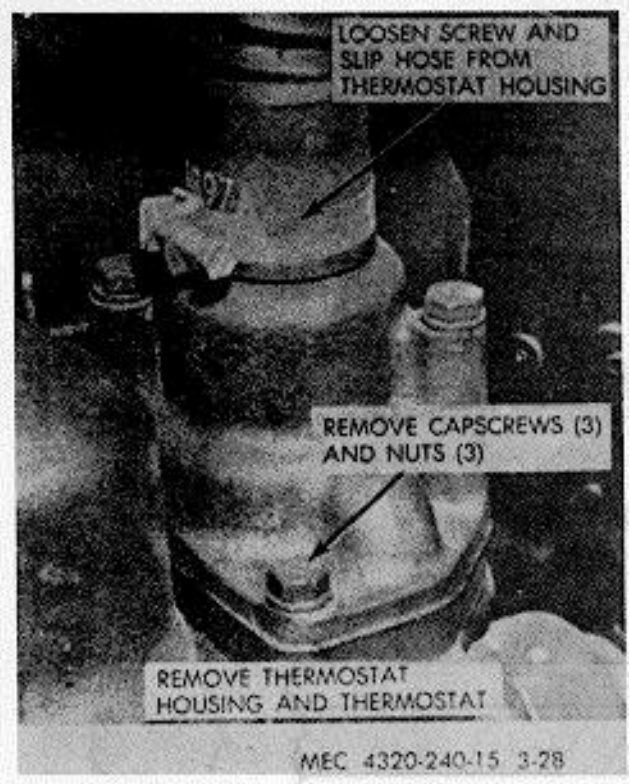
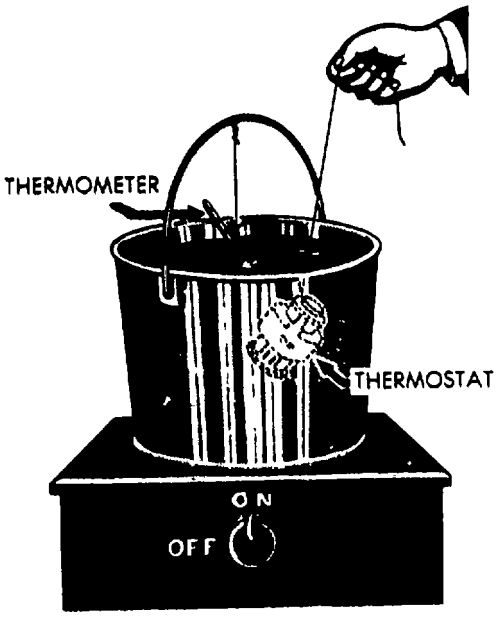


Figure 3-8. Thermostat removal and installation.



1. SUSPEND THE THERMOSTAT IN WATER AS SHOWN.
2. HEAT THE WATER. IF THE THERMOSTAT VALVE DOES NOT OPEN WHEN THE WATER IS BETWEEN 150° AND 185° F, THE THERMOSTAT IS DEFECTIVE.

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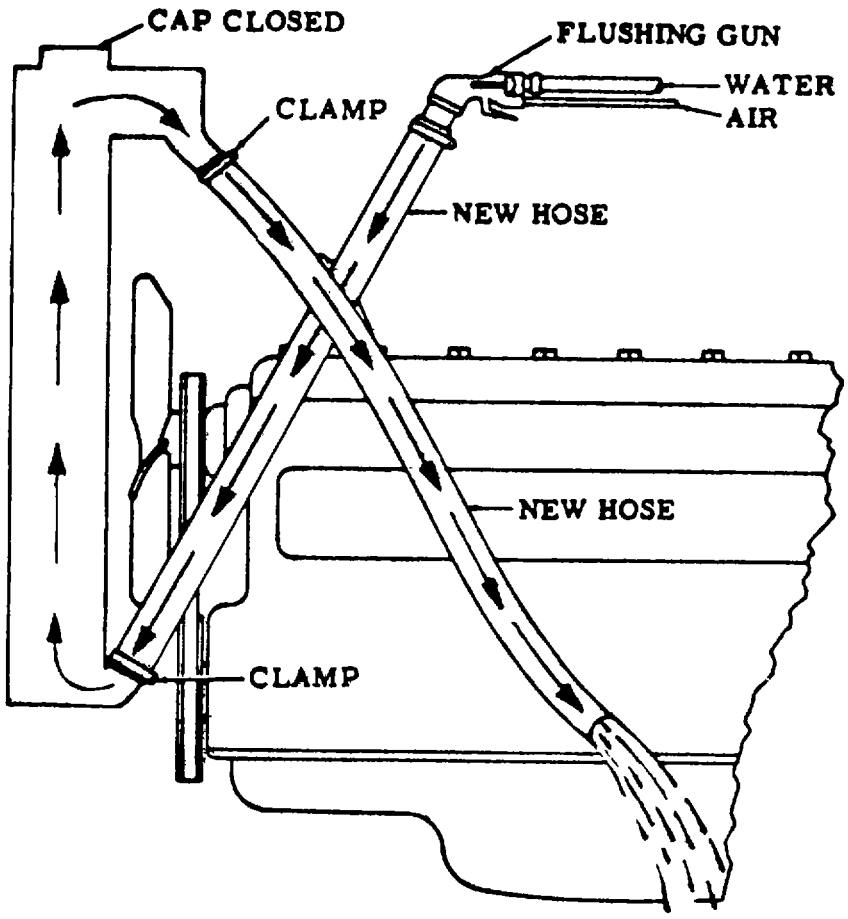
Figure 3-29. Thermostat testing.



1 DISCONNECT THE HOSES AT THE ENGINE.
2 PUT THE RADIATOR CAP ON TIGHTLY.
3 CLAMP THE FLUSHING GUN IN THE LOWER HOSE WITH A HOSE CLAMP.
4 TURN ON THE WATER AND LET IT FILL THE RADIATOR.
5 APPLY AIR PRESSURE AND GRADUALLY INCREASE TO 15 PSI TO AVOID RADIATOR DAMAGE.
6 SHUT OFF THE AIR. AGAIN FILL THE RADIATOR WITH WATER AND APPLY AIR PRESSURE; REPEAT UNTIL THE FLUSHING STREAM RUNS OUT CLEAR.
7 CLEAN AND INSPECT THE RADIATOR CAP.

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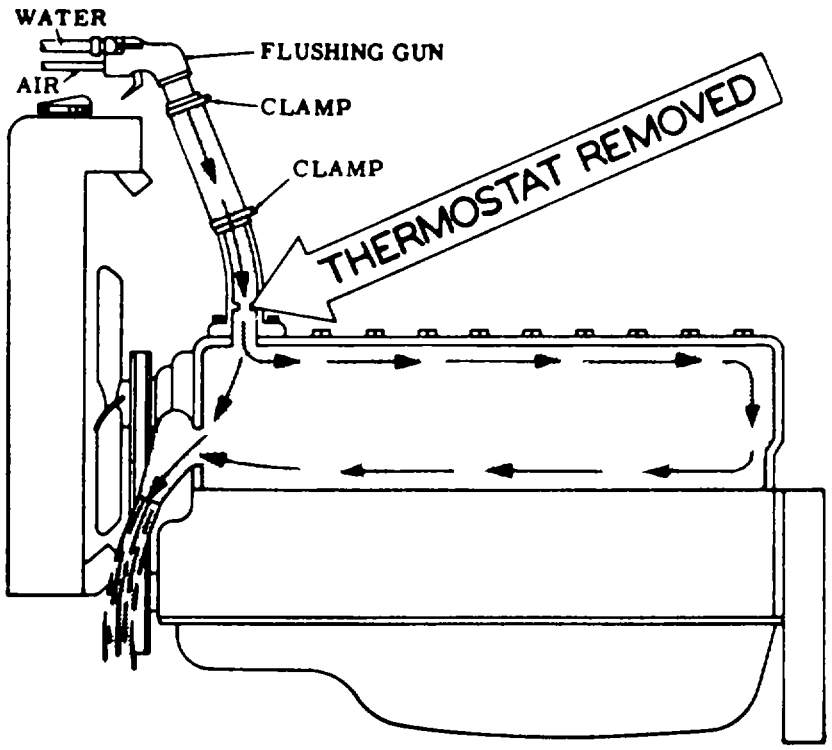
Figure -3-30. Reverse flushing radiator.



1 REMOVE THE THERMOSTAT.
2 CLAMP THE FLUSHING GUN IN THE UPPER HOSE.
3 PARTLY CLOSE THE WATER PUMP OPENING TO FILL THE ENGINE JACKET WITH WATER BEFORE APPLYING AIR.
4 FOLLOW THE SAME PROCEDURE OUTLINED ABOVE FOR THE RADIATOR BY ALTERNATELY FILLING THE WATER JACKET WITH WATER AND BLOWING IT OUT WITH AIR (15 PSI PRESSURE) UNTIL THE FLUSHING STREAM IS CLEAR.

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Figure 3-31. Reverse flushing engine water jacket.

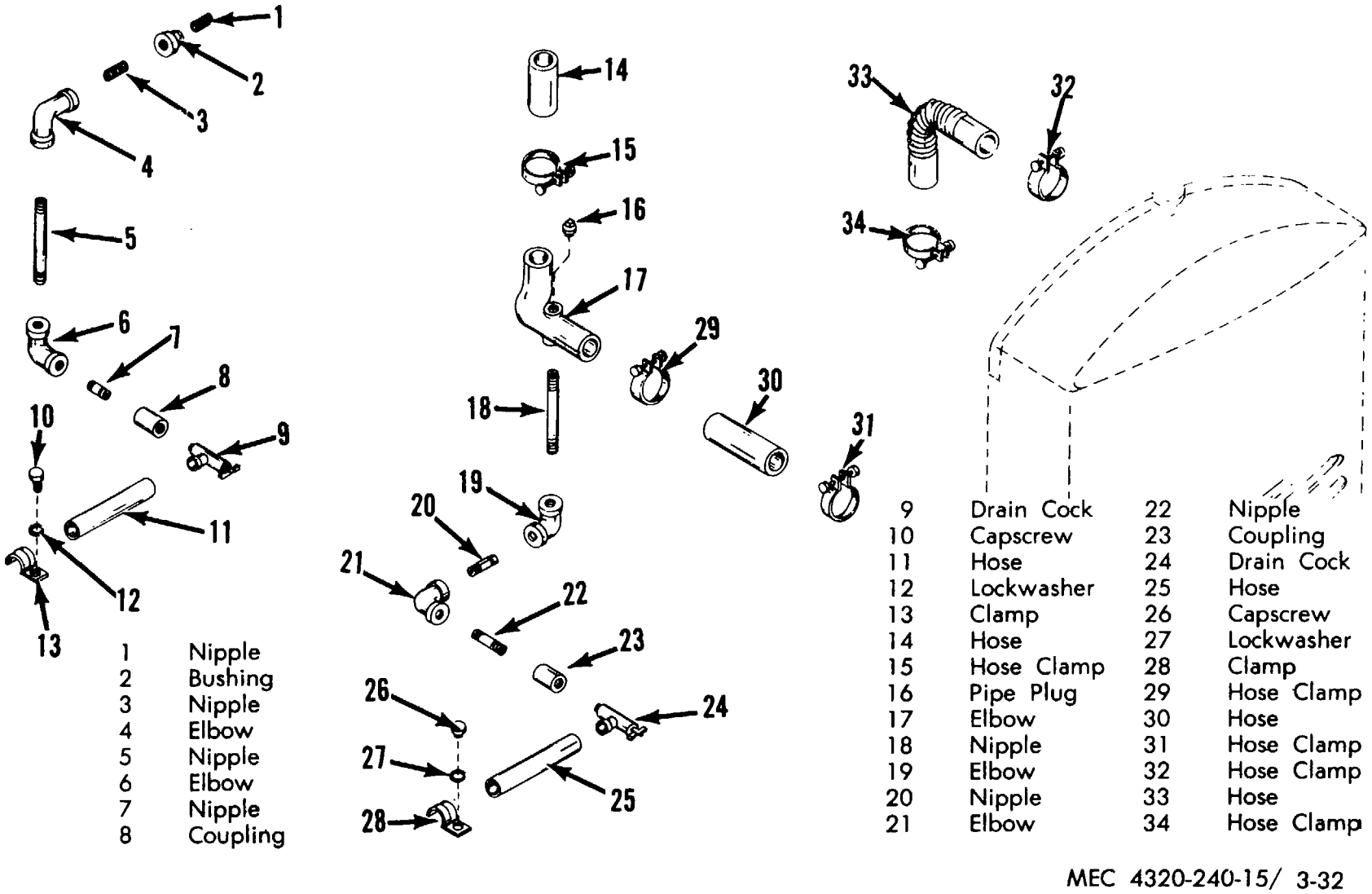


Figure 3-32. Coolant piping and hoses.

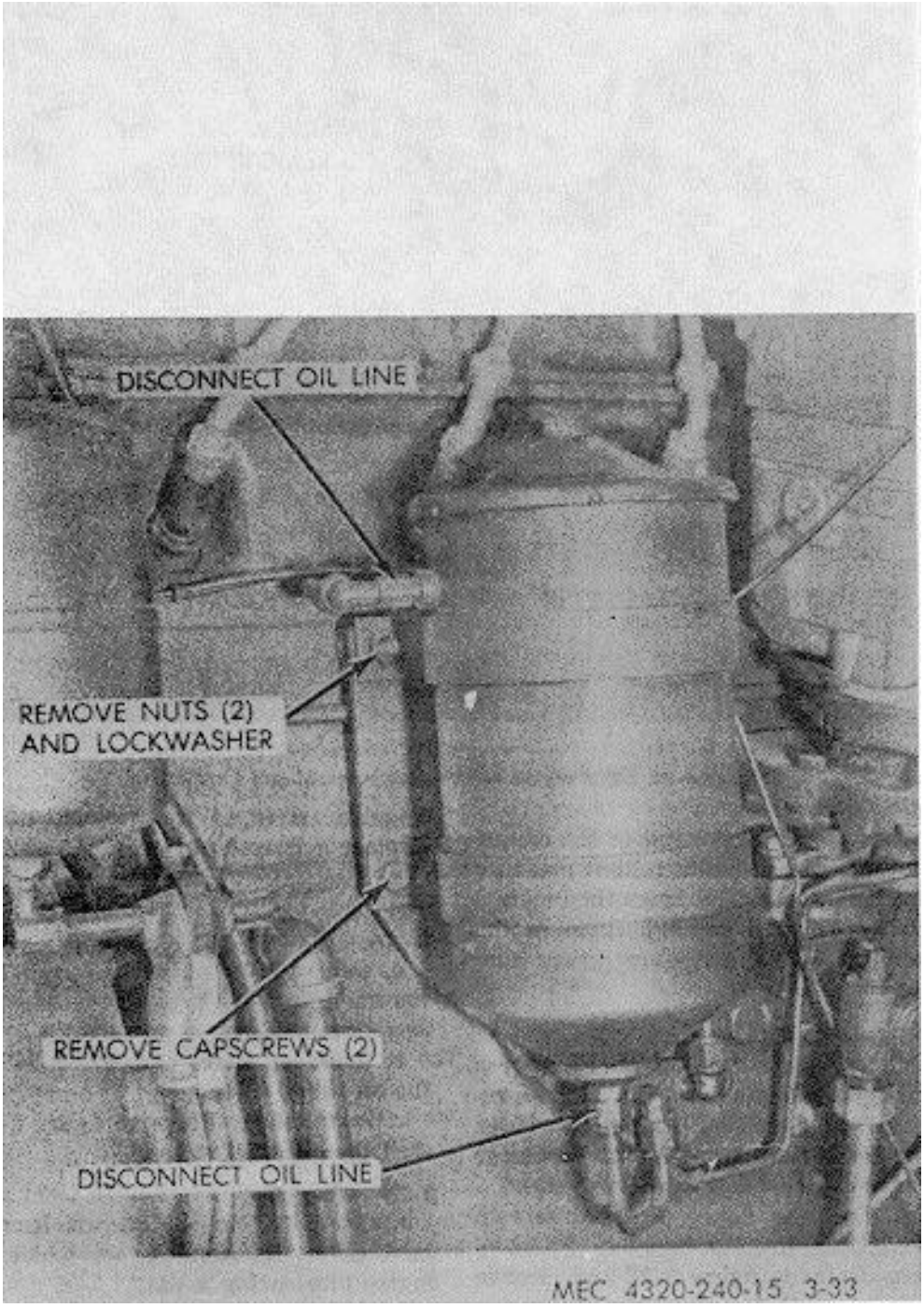
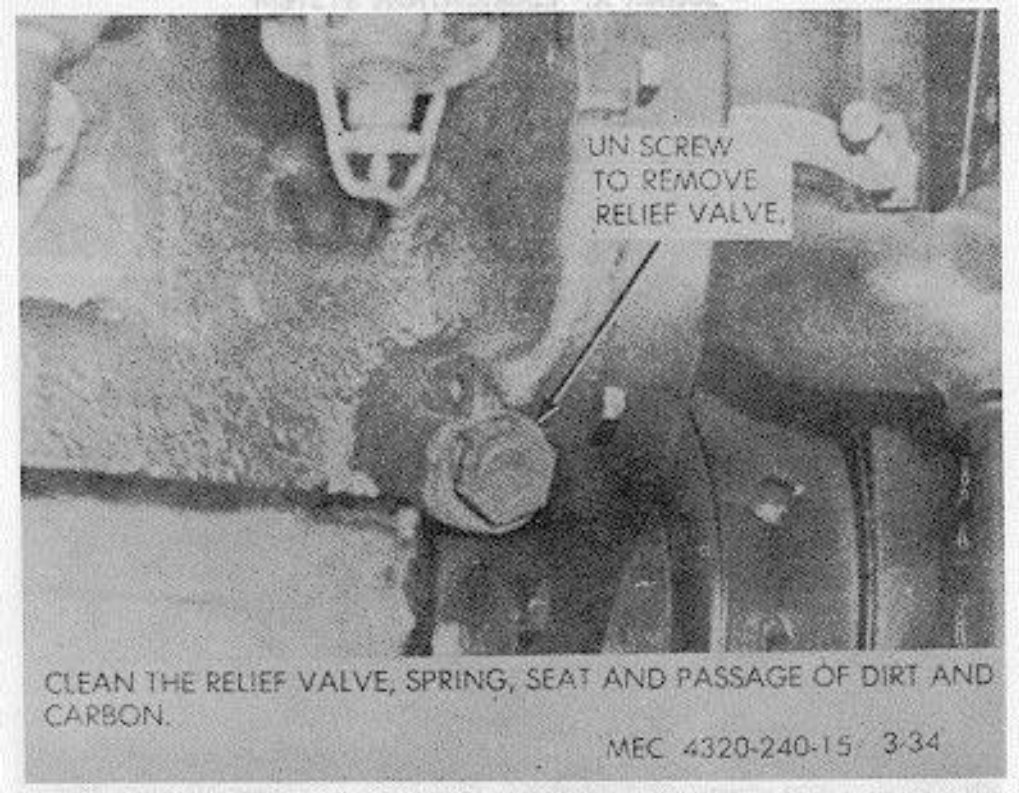


Figure 33-3. Oil filter removal and installation.



3-54. General

The lubricating system employed in the engine on this pumping unit provides full oil pressure to the crankshaft and rod bearings then meters this oil supply through small pockets in the crank journals to the accessory gears and valve mechanism.

3-55. Oil Filter

a. General. A bypass-type oil filter removes dirt and foreign elements from the oil. The removal of grit, sludge, and foreign particles causes filter elements to clog and become ineffective unless they are regularly replaced.

b. Service. Refer to figure 3-1 and service the oil filter.

c. Removal. Refer to figure 3-33 and remove the oil filter.

d. Cleaning and Inspection.

(1) Clean the outside of the oil filter with a cloth dampened in cleaning solvent. Service the oil filter as directed in subparagraph b above.

(2) Inspect the oil filter, mounting parts, and fittings for cracks, breaks, restrictions, clogging, stripped threads, or other damage.

Replace damaged parts.

Installation. Refer to figure 3-33 and install the oil filter.

3-56. Oil Pressure Relief Valve

a. General. The oil pressure relief valve is of the nonadjustable type and prevents excessive pressure build-up.

b. Removal. Refer to figure 3-34 and remove the oil relief valve.

c. Installation. Refer to figure 3-34 and install the oil relief valve.

3-57. Breather

a. General. The breather is located on the valve cover. It filters the air which enters the engine lubricating areas.

b. Removal. Refer to figure 3-35 and remove the breather.

c. Installation. Refer to figure 3-35 and install the breather.

3-58. Oil Lines and Fittings

a. Replacement. Refer to figure 3-36 and replace lines and fittings as necessary.

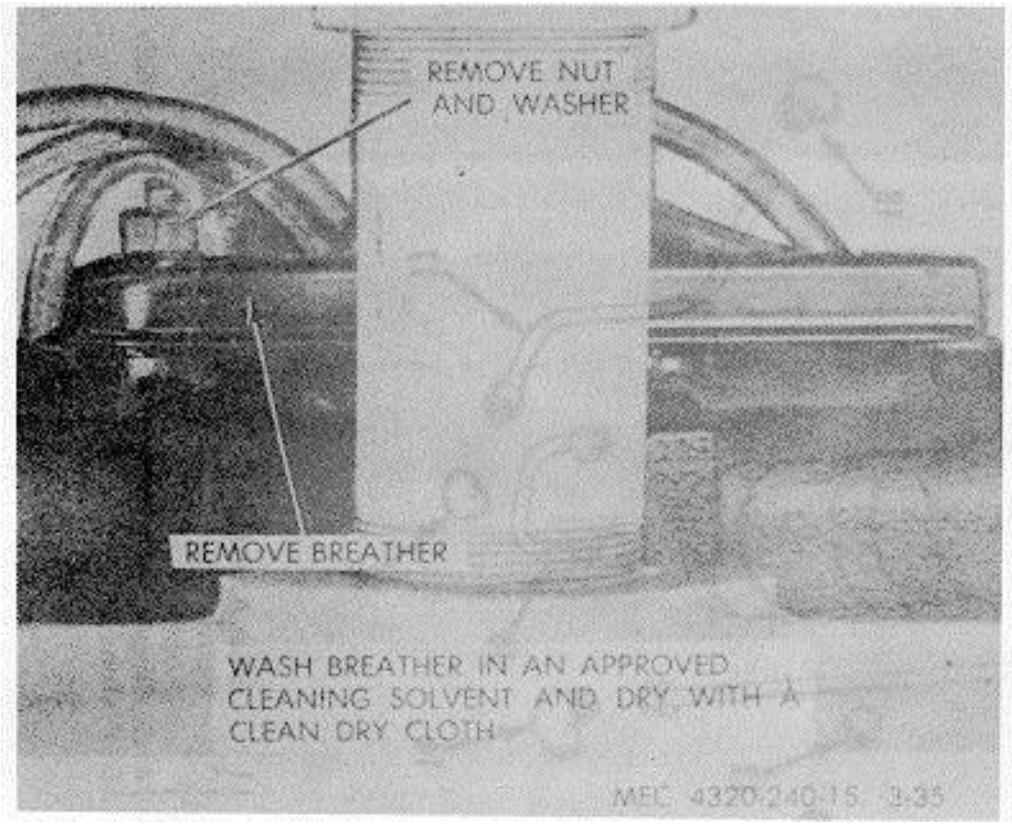
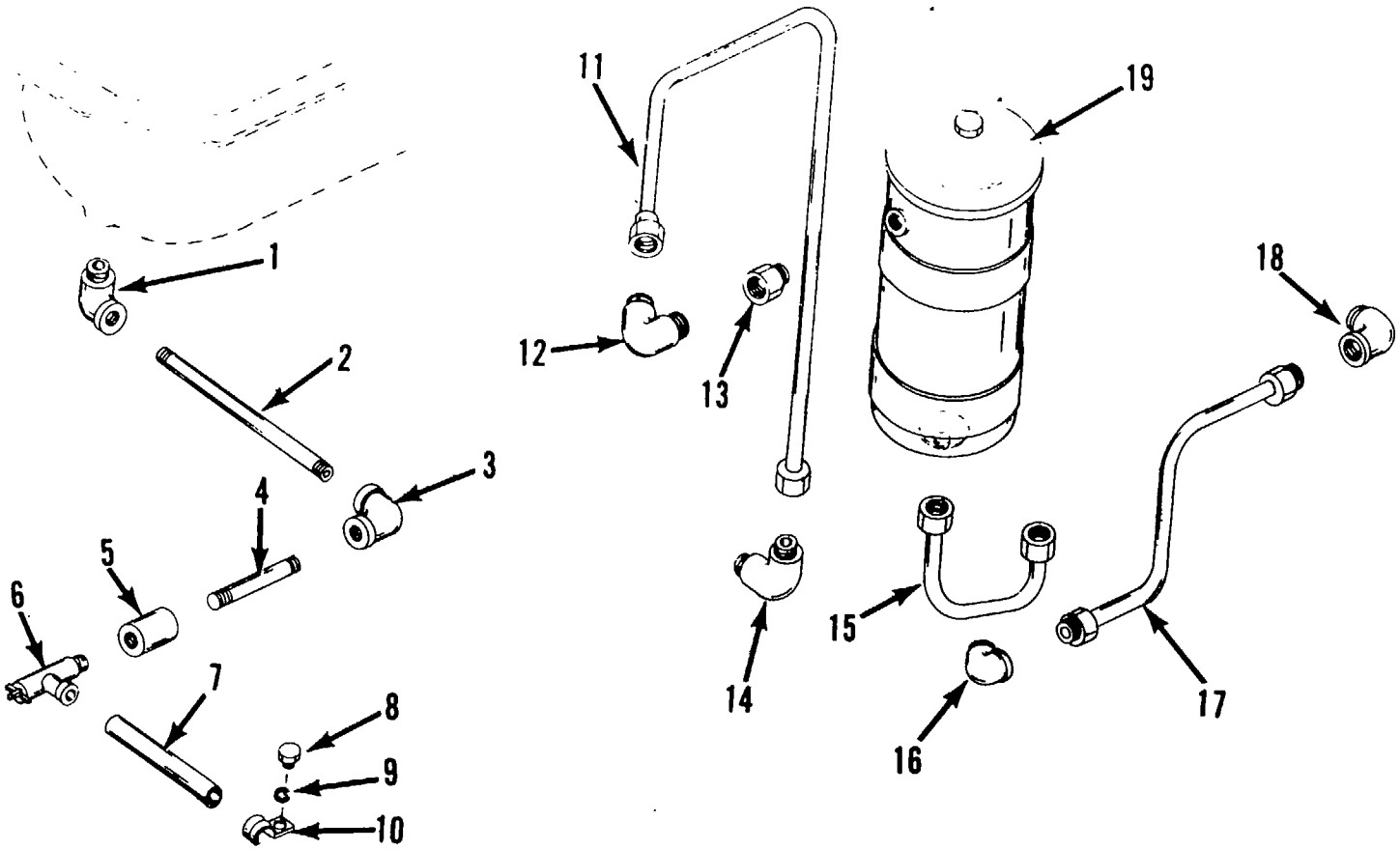


Figure 3-35. Breather removal and installation.



1	Elbow	6	Drain Cock	11	Tube Assembly	16	Elbow
2	Nipple	7	Hose	12	Elbow	17	Tube Assembly
3	Elbow	8	Capscrew	13	Bushing	18	Elbow
4	Nipple	9	Lockwasher	14	Elbow	19	Oil Filter Assembly
5	Coupling	10	Clamp	15	Tube Assembly		

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Figure --6. Oil lines and fittings.

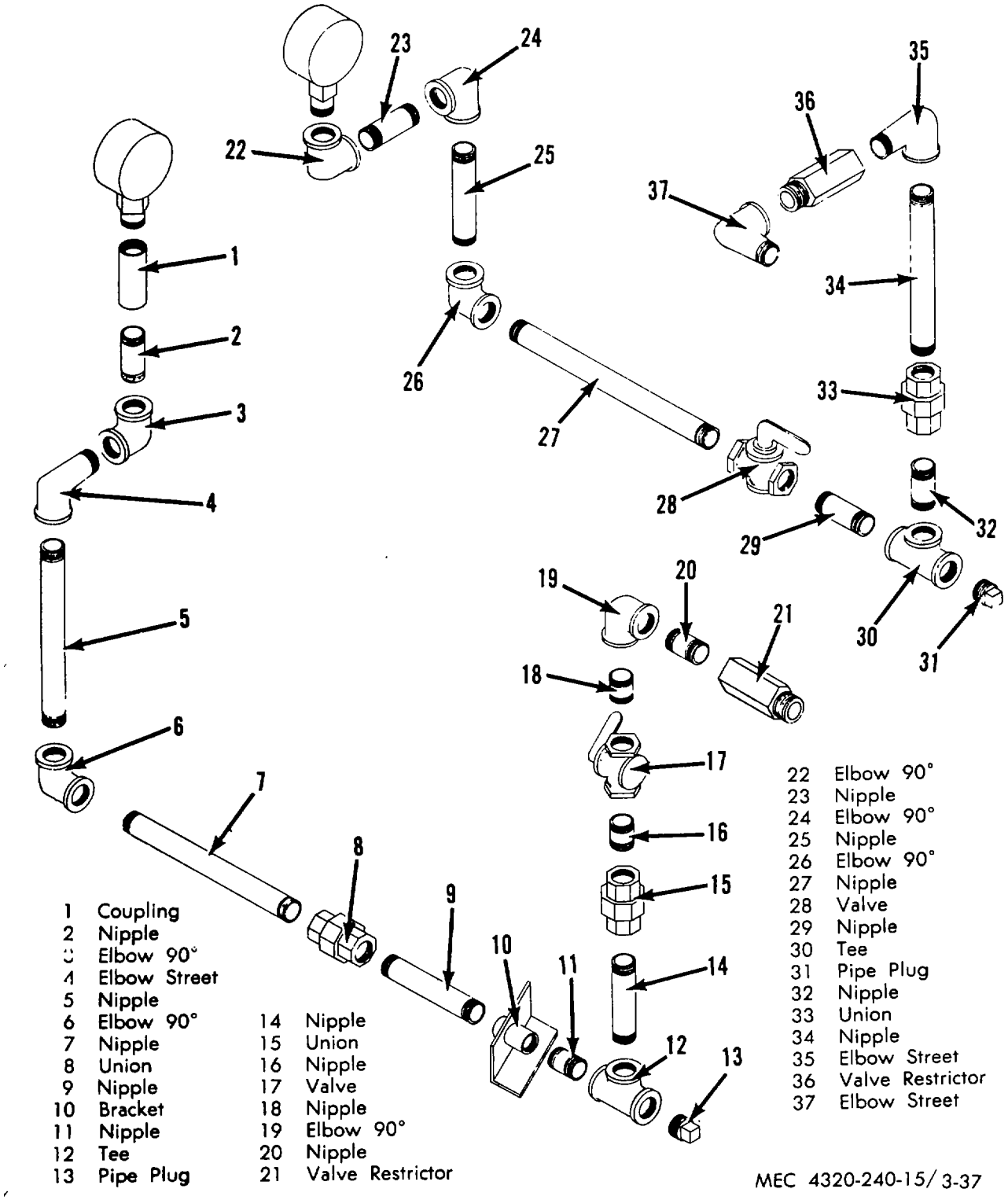


Figure -S37. Discharge and intake pressure lines.

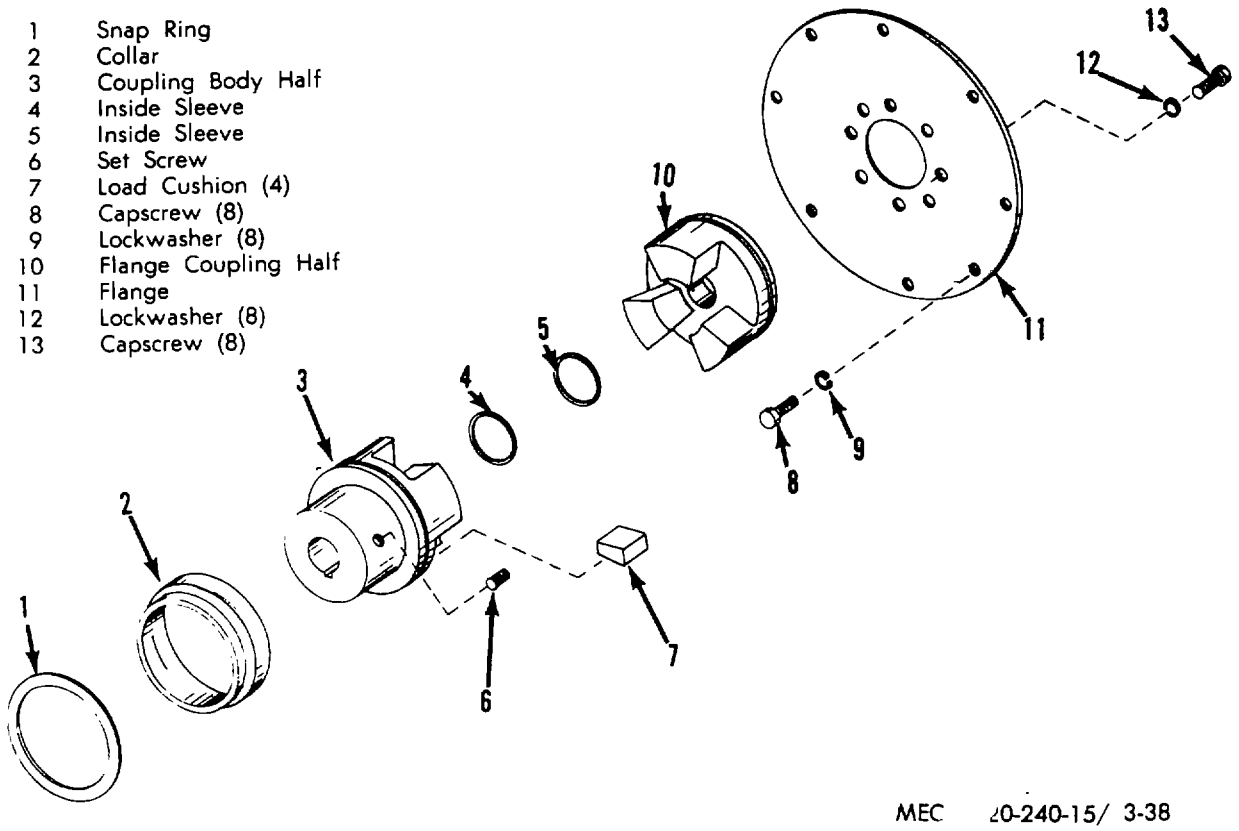


Figure 3-8. Coupling--exploded view.

3-59. Discharge and Intake Pressure Lines

a. General. The discharge pressure line runs from the discharge side of the pump to the discharge pressure gage located on the control panel. The intake pressure line runs from the intake side of the pump to the intake pressure gage located on the control panel.

b. Inspection. Inspect parts for cracks, bends, breaks, or other damage, replace all missing or damaged parts.

c. Replacement. Refer to figure 3-37 and replace pressure lines as necessary.

3-60. Coupling

a. General. The coupling is located between the engine and pump assembly. Engine power is transmitted through the coupling to the pump.

b. Removal. Remove the pump assembly (para 3-c) from the pumping unit. Remove the 8 capscrews and lockwashers which fasten the coupling to the engine assembly.

c. Disassemble. Refer to figure 338 and disassemble coupling. d. Reassemble. Refer to figure 338 and reassemble coupling.

e. Installation. Refer to paragraph 3-60a and install coupling in reverse order of removal.

3-61. Pump Assembly

a. General. The pump is a centrifugal type with a 6 inch intake and a 6 inch discharge. It is self-priming and has an integral check valve which retains the fluid in the volute when the pump is shut down. The enlarged top of the volute acts as a reservoir to provide rapid self-priming when the pump is started. The pump shaft is mounted in two single-row bearings supported in the intermediate. The impeller is mounted on the end of the shaft opposite the drive and with the ball bearings supporting the center section of the shaft. A mechanical seal is provided to prevent the

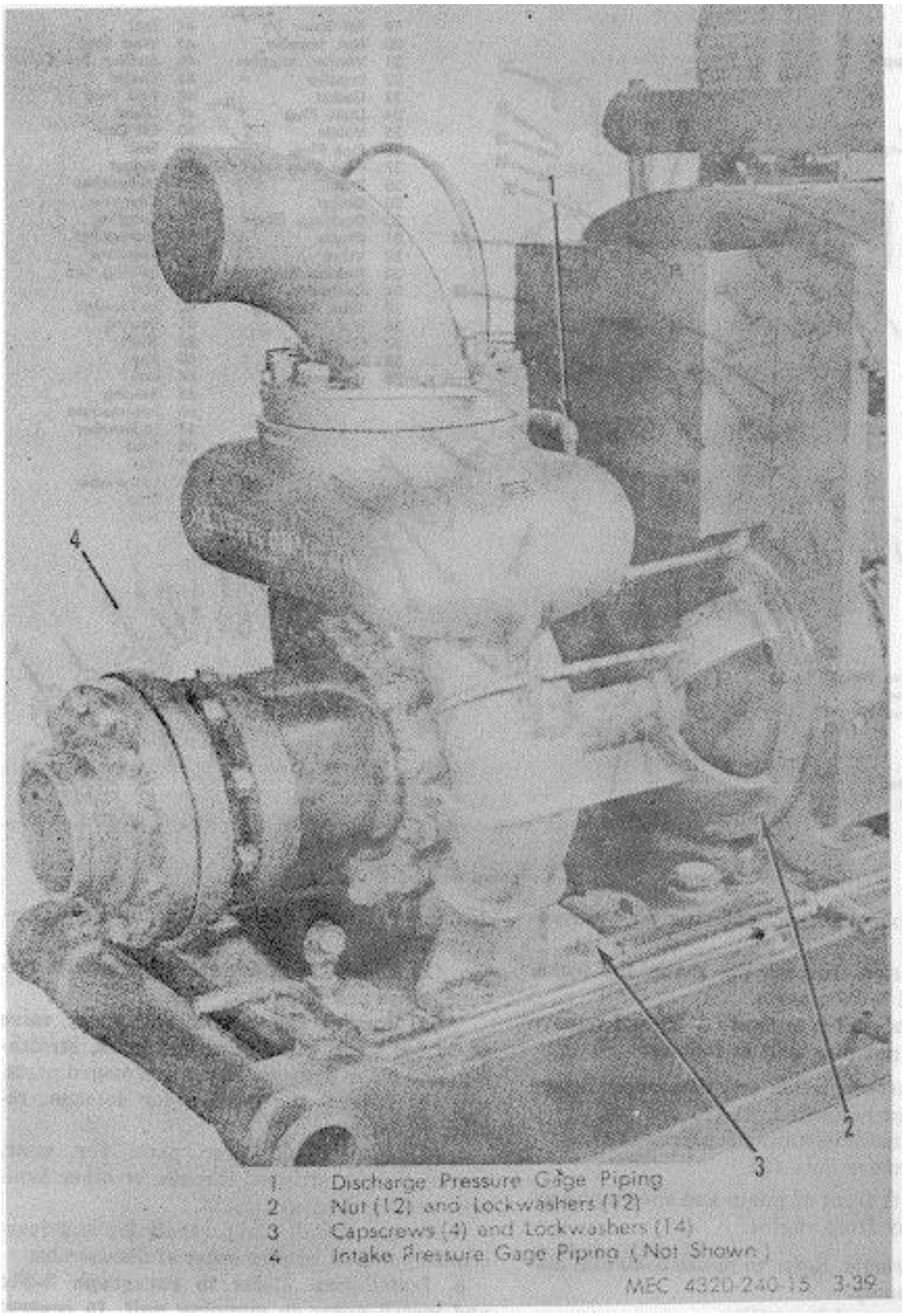


Figure S3-9. Pump removal and installation.

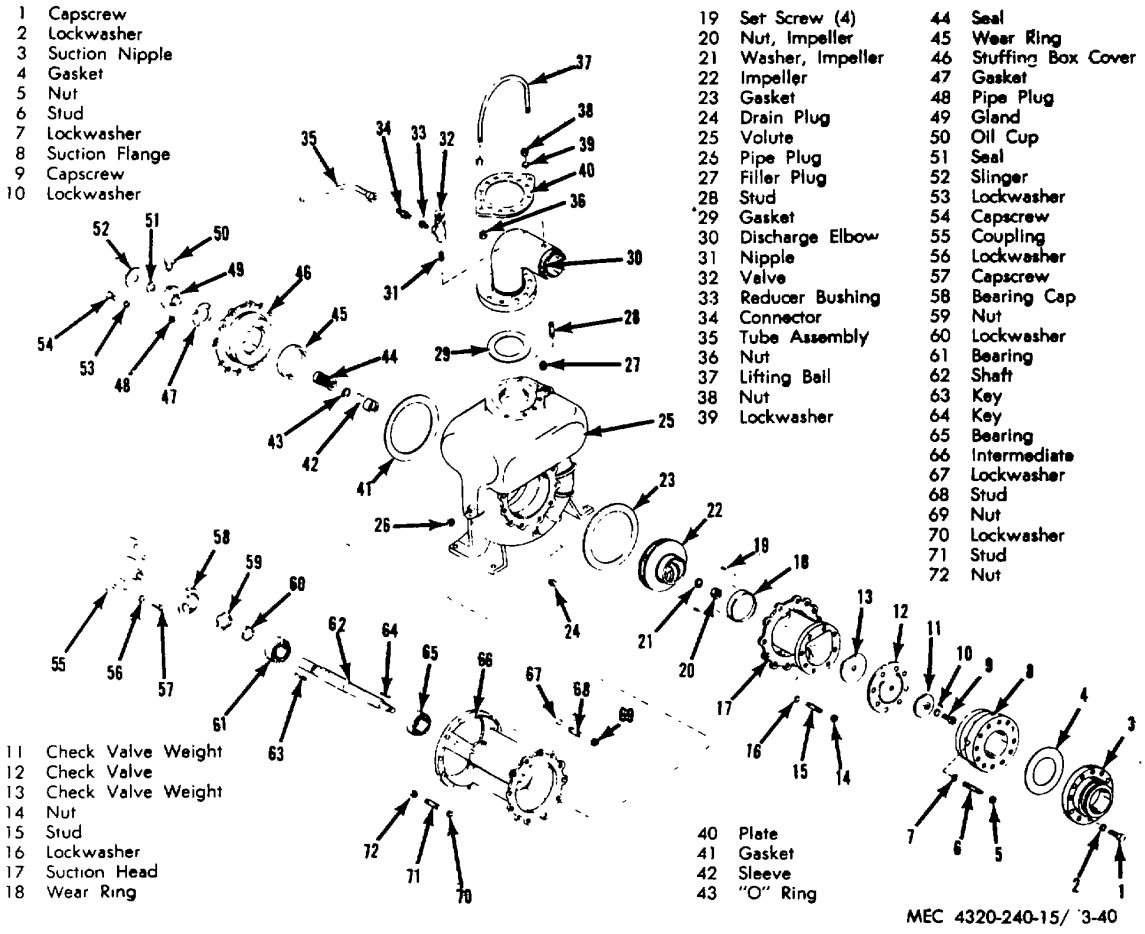


Figure 3-40. Water pump exploded view.

fluid being pumped from entering the intermediate.

b. Inspection. Inspect the pump for leaks, missing and broken parts.

c. Removal. Refer to figure 339 and remove pump from pumping unit as follows:

(1) Unscrew union and disconnect intake and discharge pressure lines (1) and (4).

(2) Remove mounting capscrews (3).

(3) Remove nuts (2).

(4) Lift front of pump and slide pump assembly away from engine.

d. Disassemble. Refer to figure 3-40 and disassemble pump.

e. Cleaning and Inspection.

)1) Clean all metal parts in an approved cleaning solvent; dry with clean, dry, compressed air.

(2) Clean the check valve parts with solvent; rinse and wipe dry.

(3) Inspect the weight and check valve parts for wear, rips, elongated holes, stretching, and other damage. Replace damaged parts.

(4) Inspect the gaskets for damage; replace if damaged.

(5) Inspect all other parts for wear, cracks, breaks, stripped threads, or other damage; replace damaged parts.

f. Repair. Install pump repair kit and reassemble pump in reverse order of disassemble.

g. Installation. Refer to paragraph 3-61c and install pump in pumping unit. In reverse order of removal.

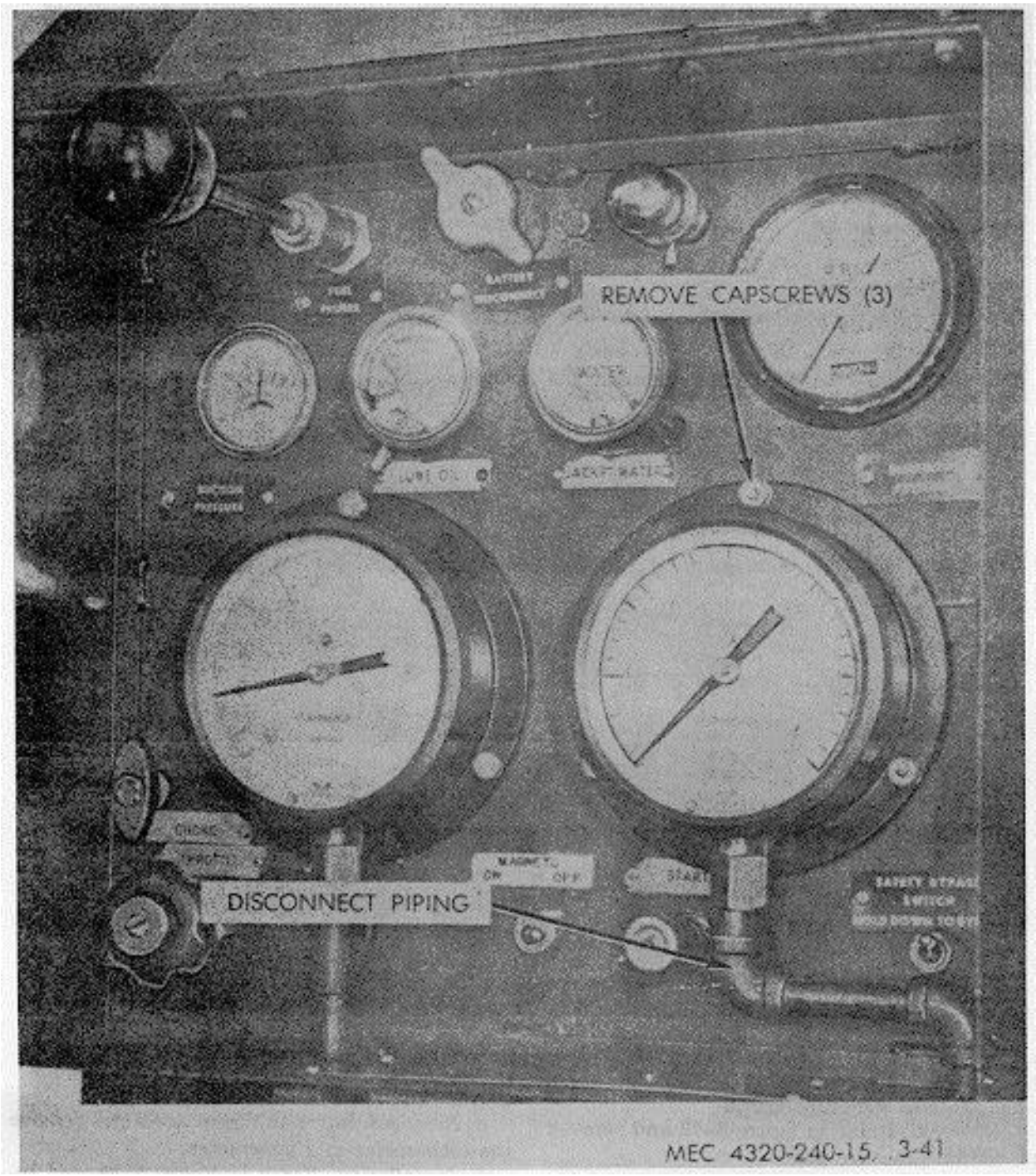


Figure 3-41. Discharge pressure gage removal and installation.

3-62. Discharge Pressure Gage

a. Removal. Refer to figure 3-41 and remove the discharge pressure gage.

b. Installation. Refer to figure 3-41 and install the discharge pressure gage.

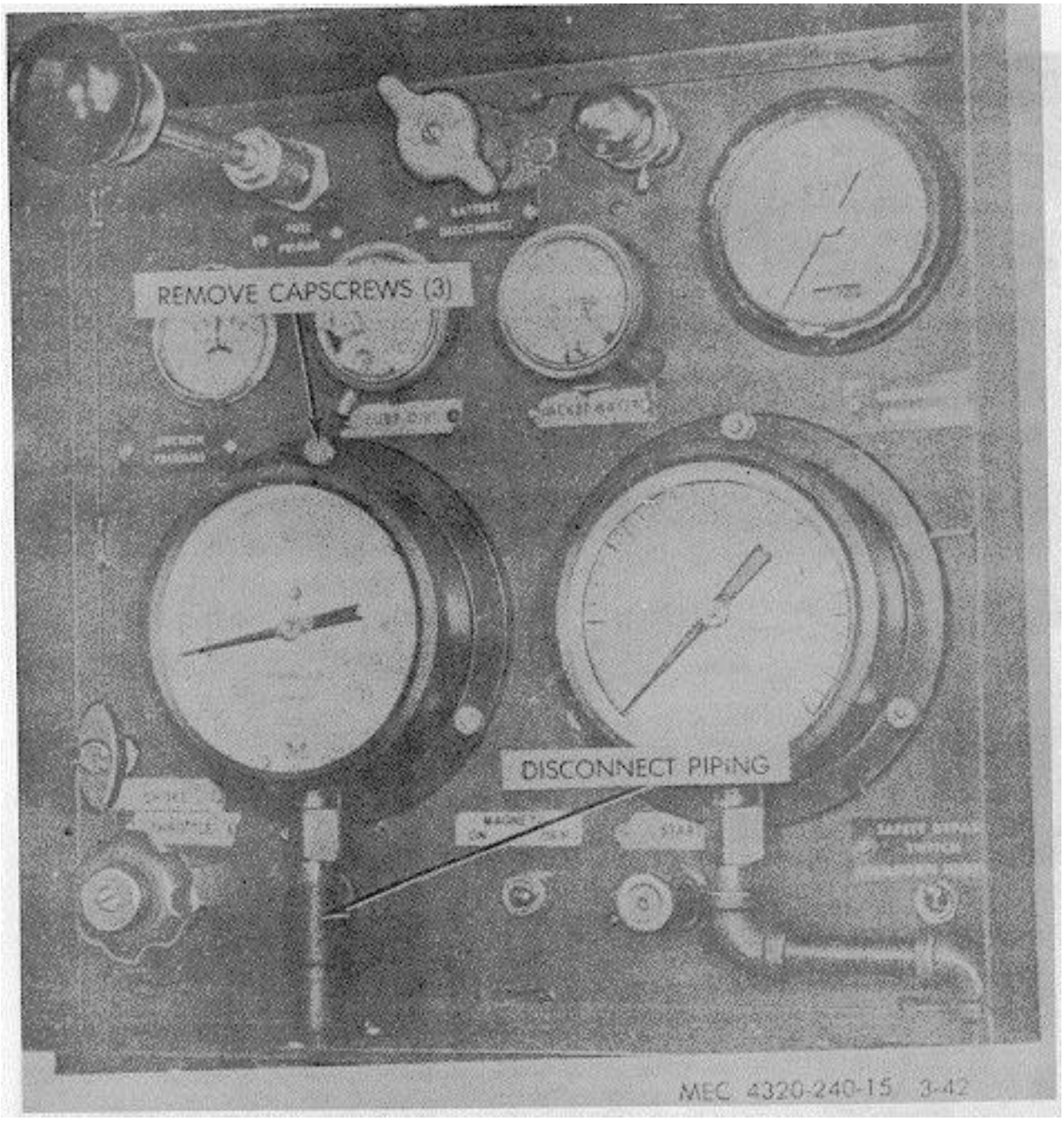


Figure 3-42. Intake pressure gage removal and installation.

3-63. Intake Pressure Gage

a. Removal. Refer to figure 3-42 and remove the suction pressure gage.

b. Installation. Refer to figure 3-42 and install the suction pressure gage.

3-64. Tachometer and Hourmeter

a. Removal. Refer to figure 3-43 and remove the tachometer and hourmeter.

b. Installation. Refer to figure 3-43 and install the tachometer and hourmeter.

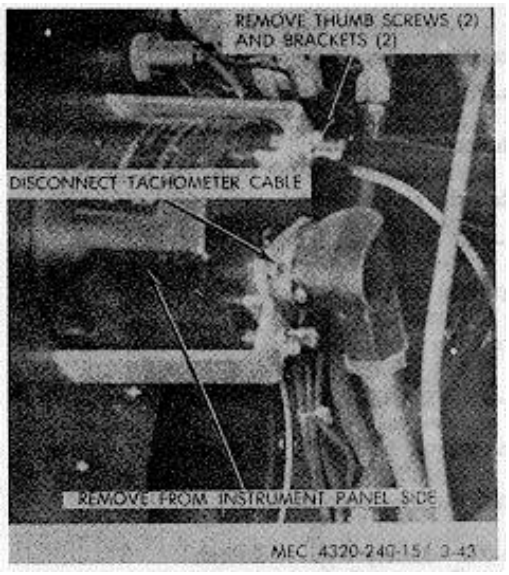


Figure 3-43. Tachometer and Hourmeter removal and installation.

Figure 3-44. Ammeter removal and installation.

3-65. Ammeter

a. Removal. Refer to figure 3-44 and remove the ammeter.

b. Installation. Refer to .figure 3-44 and install the ammeter.

3-66. Engine Oil Pressure Gage and Safety Switch

a. Removal. Refer to figure 3-45 and remove the engine oil pressure gage and safety switch.

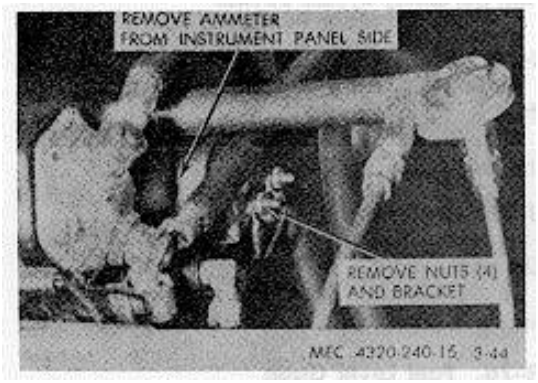


Figure 3-45. Engine oil pressure gage and safety switch removal and installation.

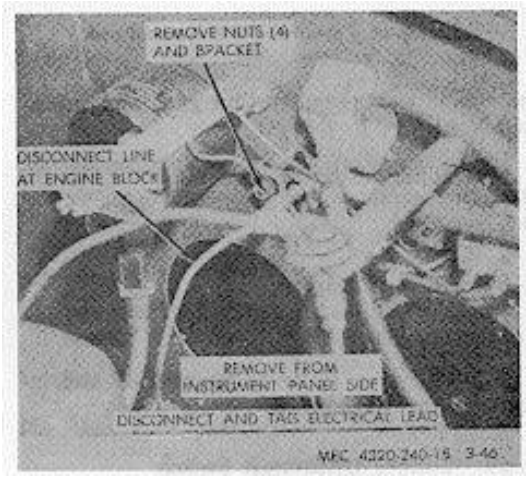


Figure 3-46. Engine water temperature (gage and safety switch removal and installation.)

b. Installation. Refer to figure 3-45 and install the engine oil pressure gage and safety switch.

3-67. Engine Water Temperature Gage and Safety Switch

a. Removal. Refer to figure 3-46 and remove

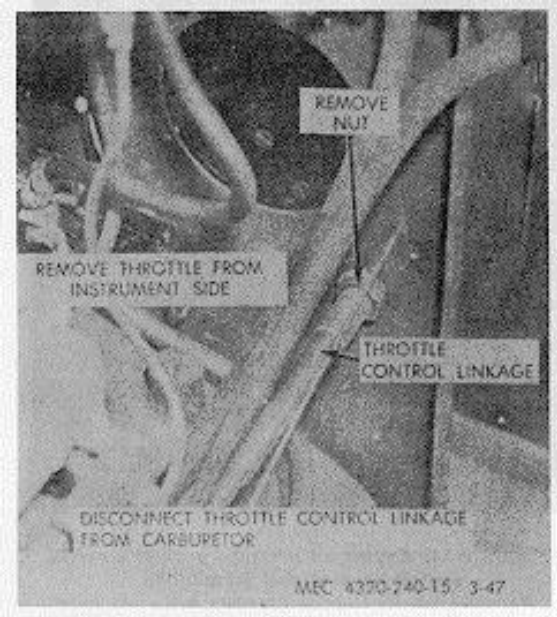


Figure 3-47. Throttle control removal and installation.

the engine water temperature gage and safety switch.

b. Installation. Refer to figure 3-46 and install the engine water temperature gage and safety switch.

3-68. Throttle Control

a. Removal. Refer to figure 3-47 and remove the throttle control.

b. Installation. Refer to figure 3-47 and install the throttle control.

3-69. Battery Disconnect Switch

a. Removal. Refer to figure 3-48 and remove the battery disconnect switch.

b. Installation. Refer to figure 348 and install the battery disconnect switch.

3-70. Choke Control

a. Removal. Refer to figure 3-49 and remove the choke control.

b. Installation. Refer to figure 349 and install the choke control.

3-71. Magneto Switch

a. Removal. Refer to figure 3-50 and remove ignition switch.

b. Installation. Refer to figure 3-50 and install the ignition switch.

3-72. Starter Button

a. Removal. Refer to figure 3-51 and remove the starter button.

b. Installation. Refer to figure 3-51 and install the starter button.

3-73. Safety Bypass Switch

a. Removal. Refer to figure 3-52 and remove the safety bypass switch.

b. Installation. Refer to figure 8-52 and install the safety bypass switch.

3-74. Fuel Primer Pump

a, Removal. Refer to figure 3-13 and remove the fuel primer pump.

b. Installations Refer to figure 3-13 and install the fuel primer pump.

3-75. Panel Light

a. Removal. Refer to figure 3-53 and remove the panel light.

b. Installation. Refer to figure 3-53 and install the panel light.

3-76. Fuel Level Gage

a. Removal. Refer to figure 3-54 and remove the fuel level gage.

b. Installation. Refer to figure 3-54 and install the fuel level gage.

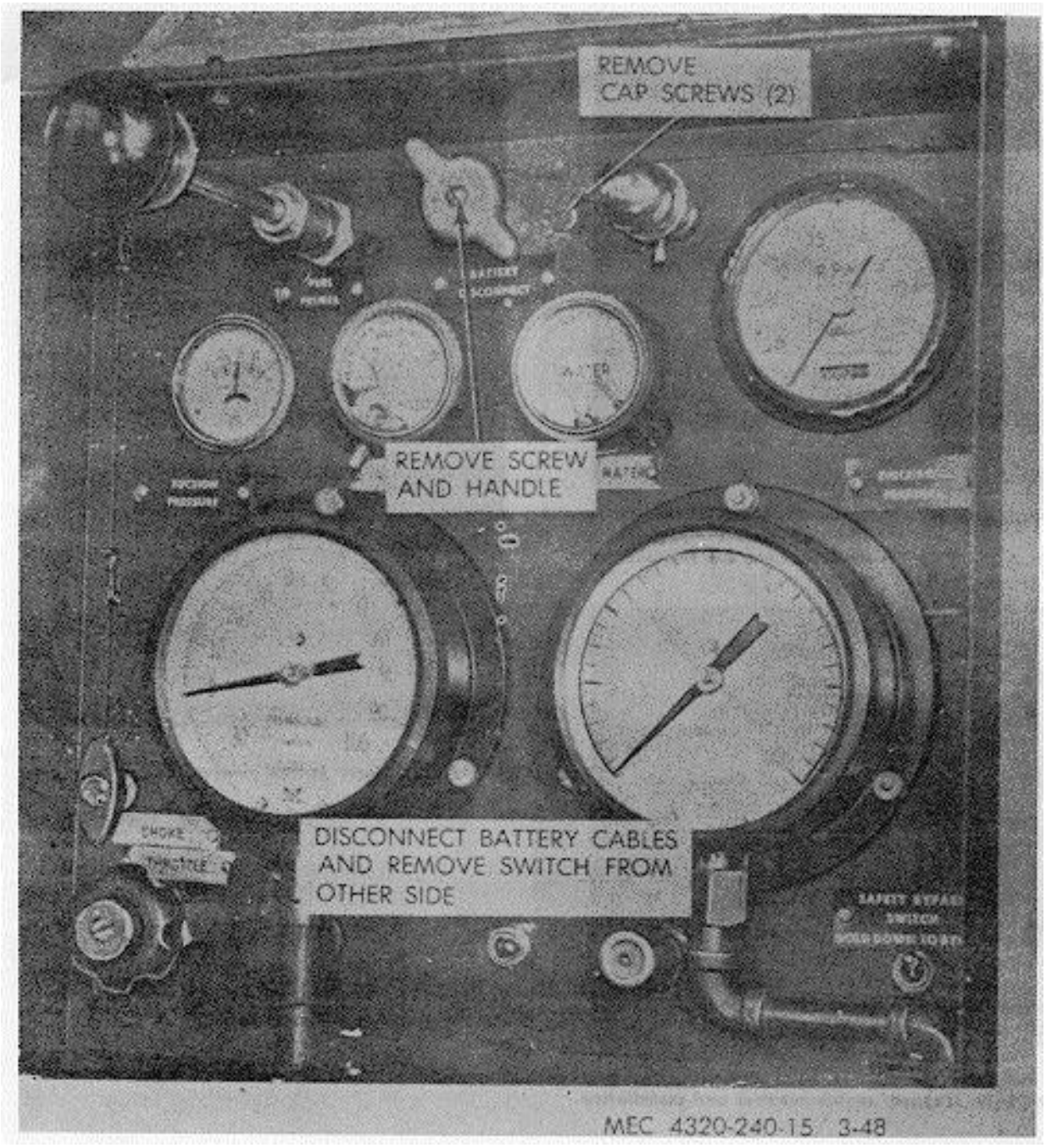


Figure 3-48. Battery disconnect switch removal and installation.

Figure 3-49. Choke control removal and installation

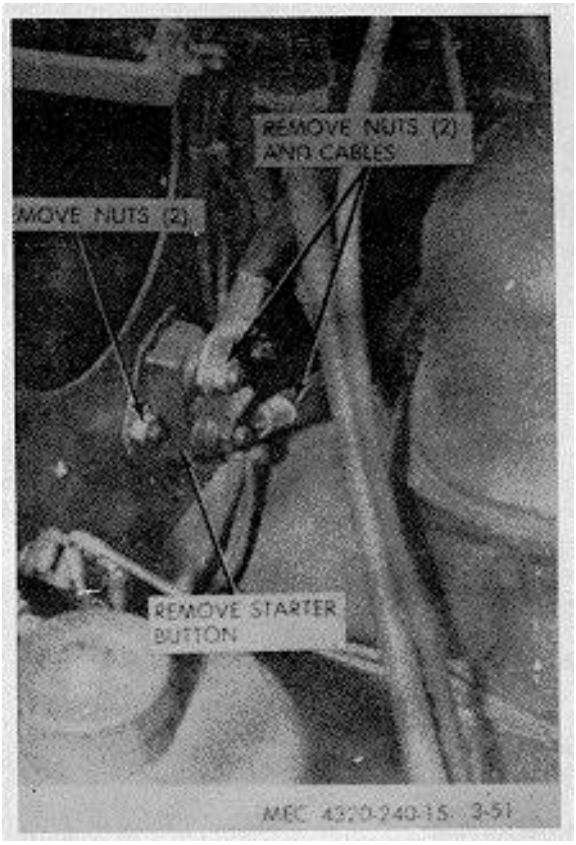


Figure 3-50. Magneto switch removal and installation.

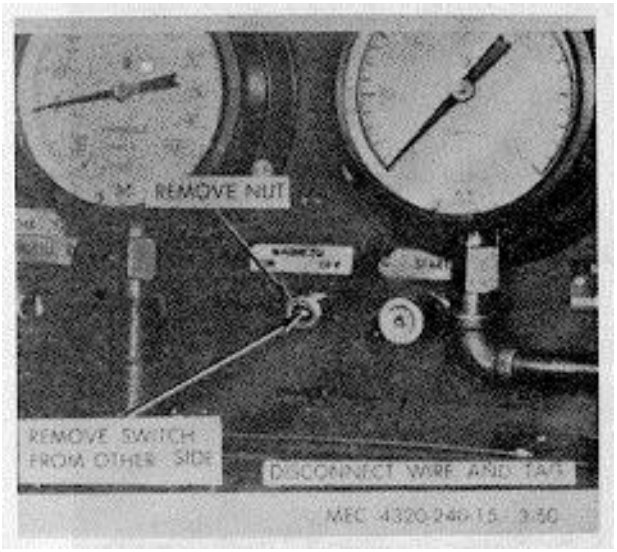


Figure 3-51. Starter button removal and installation.

Figure 3-52. Safety bypass switch removal and installation.

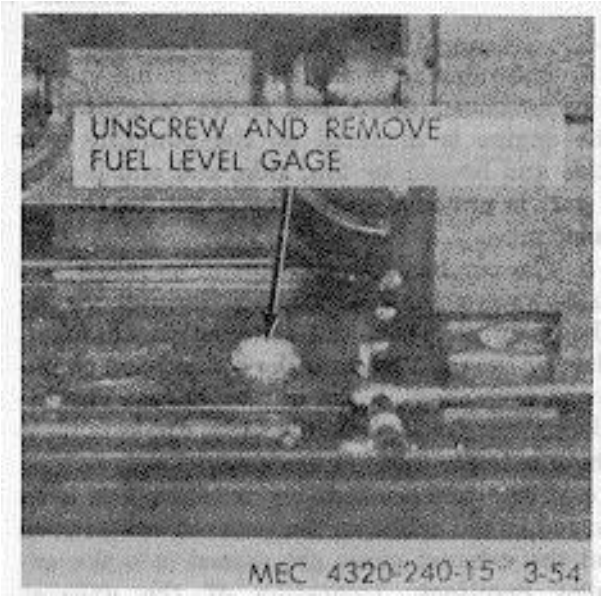


Figure 3-54. Fuel level gage removal and installation.

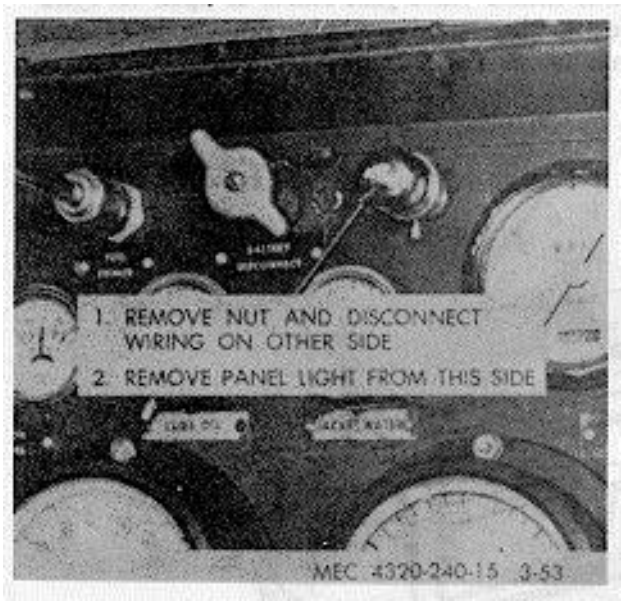


Figure 5-53. Panel light removal and installation.

3-77. General

a. The internal combustion, gasoline engine is of overhead valve, wet sleeve construction. The engine is mounted on the pumping unit skids and housed by top, side, and end panels. A port is provided in the top panel for the exhaust pipe.

b. The combustible mixture of gasoline and air flows from the carburetor, through the intake manifold, into the combustion chamber. Flow of the mixture into the combustion chamber is controlled by the intake valves. The intake valves are operated by adjustable tappets which ride the lobes of the cam.

c. After the combustible mixture has been burned in the cylinder, the exhaust valves open and the exhaust gases are forced into the exhaust manifold. Operation of the exhaust valves is controlled by tappets which ride the lobes of the cam.

d. Exhaust gases are carried from the exhaust manifold to the atmosphere through the exhaust pipe and muffler. The muffler quiets the noise of the engine.

3-78. Valve Tappet Adjustment

a. Refer to paragraphs 3-81b(1) through 3-81b(5) and remove parts as described.

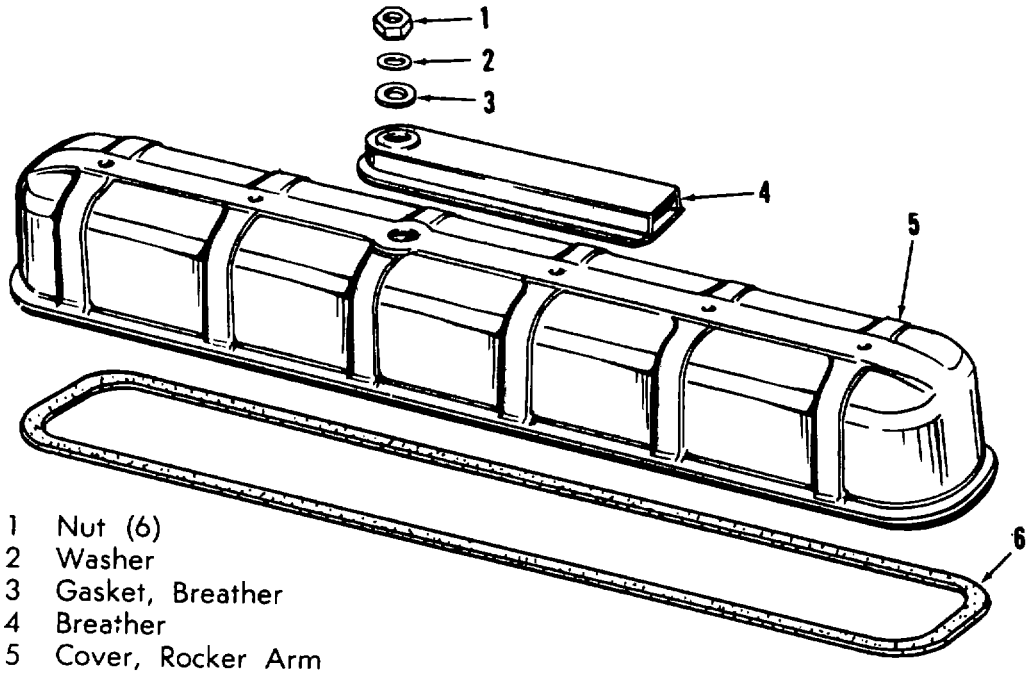
b. Refer to figure 3-55 and remove valve cover.

c. Refer to figure 3-56 and adjust valve clearance as follows:

(1) Rotate crankshaft to top dead center of number 1 cylinder; check both rocker arms for freedom.

(2) Refer to figure 3-56 and adjust the valve tappets on cylinder number 1.

(3) Turn crankshaft until intake valve just starts to open on cylinder number 3; adjust valve tappets on cylinder number 5 as described above. Turn crankshaft until intake valve just starts to open on cylinder number 6; adjust valve tappets on cylinder number 3. Turn crankshaft until intake valve just starts to open on cylinder number 2; adjust valve tappets on cylinder number 6. Turn crankshaft until intake valve just starts to open on cylinder number 4; adjust valve tappets on cylinder number 2. Turn crankshaft until intake valve



1 Nut (6)
2 Washer
3 Gasket, Breather
4 Breather
5 Cover, Rocker Arm
6 Gasket, Rocker Arm Cover

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Figure 3-55. Valve cover removal and installation.

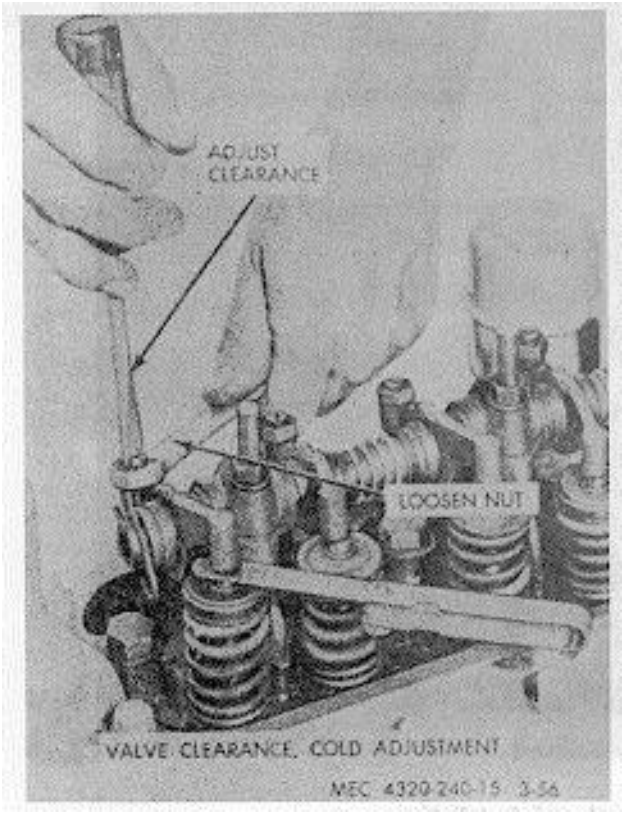


Figure 3-56. Valve clearance adjustment.

just starts to open on cylinder number 1, adjust valve tappets on cylinder number 4.

(4) Check to be sure all locknuts are secure. Inspect valve retainers, spring, and rocker arms for wear.

d. After valves are adjusted install all parts removed in reverse order as described above.

3-79. Muffler and Exhaust Pipe

a. General. The muffler is mounted on top the housing, and is covered by a muffler guard. The purpose of the muffler is to muffle exhaust sound and to prevent any sparks from reaching the open air.

b. Inspection. Inspect muffler and exhaust pipe for leaks, cracks, dents, missing or loose parts.

c. Service. Refer to figure 3-58 and clean out carbon deposits.

d. Removal.

(1) Refer to figure 3-57 and remove muffler guard.

(2) Refer to figure 3-58 and remove muffler.

e. Installation. Install muffler in reverse order described above.

Note. **Make sure there is at least 1 inch clearance between muffler and muffler guard.**

3-80. Manifolds

a. General. The manifold consists of two duct works, the intake and exhaust. The intake manifold is arranged to give an equal quantity of a gasoline and air mixture, to each cylinder. The exhaust manifold is routed so as to heat the intake manifold and discharge the exhaust gases from each cylinder to a common outlet.

b. Inspection. Inspect for leaks, cracks, and missing or loose parts.

c. Removal.

(1) Refer to paragraph 3-79d and remove the muffler.

(2) Refer to figure 3-10 and remove carburetor.

(3) Refer to figure 3-17 and disconnect the fuel primer lines.

(4) Refer to figure 3-59 and remove manifold.

d. Installation. Install the manifolds in reverse order of removal.

3-81. Housing Assembly

a. *General*. The engine is enclosed in a sheet metal housing. The two side panels are removable to provide access to the engine and its components. The instrument panel is mounted at the rear end of the engine, in which are mounted the controls and instruments necessary to run the pumping unit. The instrument panel is covered by an access door.

b. Removal.

(1) Refer to figure 8-1 and remove lifting bail by removing nuts (9) and lockwashers (8).

(2) Refer to paragraph 3-79d and remove muffler guard and muffler.

(3) Remove side panels. (fig. 3-60).

(4) Refer to figure 3-60 and remove capscrews (7), lockwashers (8), and hood (9).

(5) Refer to paragraph 3-50b(6) and remove fan guard.

(6) Refer to figure 3-60 and remove capscrews (11 & 20), lockwashers (12 & 19), and sides (10 & 18).

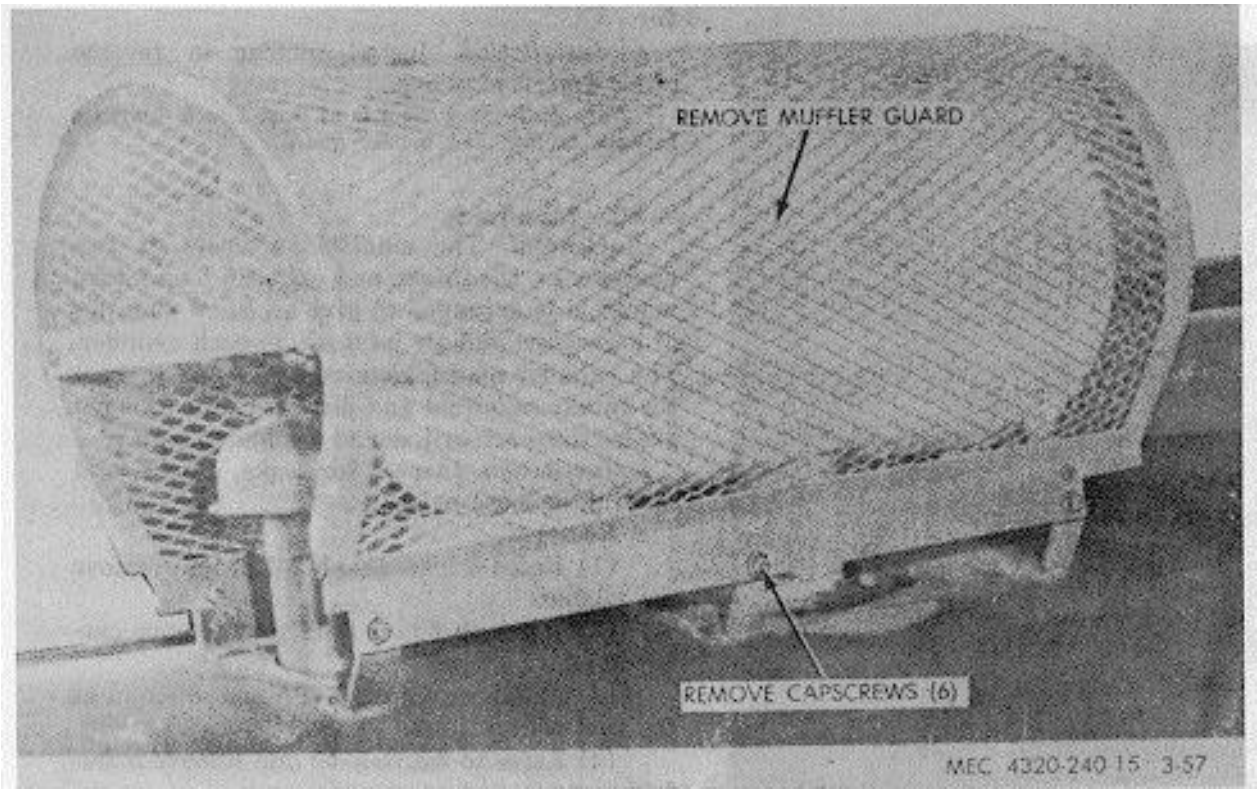


Figure 5-7. Muffler guard removal and installation.

(7) Refer to chapter 3 section XII, and disconnect all controls and instruments.

(8) Refer to figure 3-60 and remove the instrument panel by removing capscrews (14) and lockwashers (15).

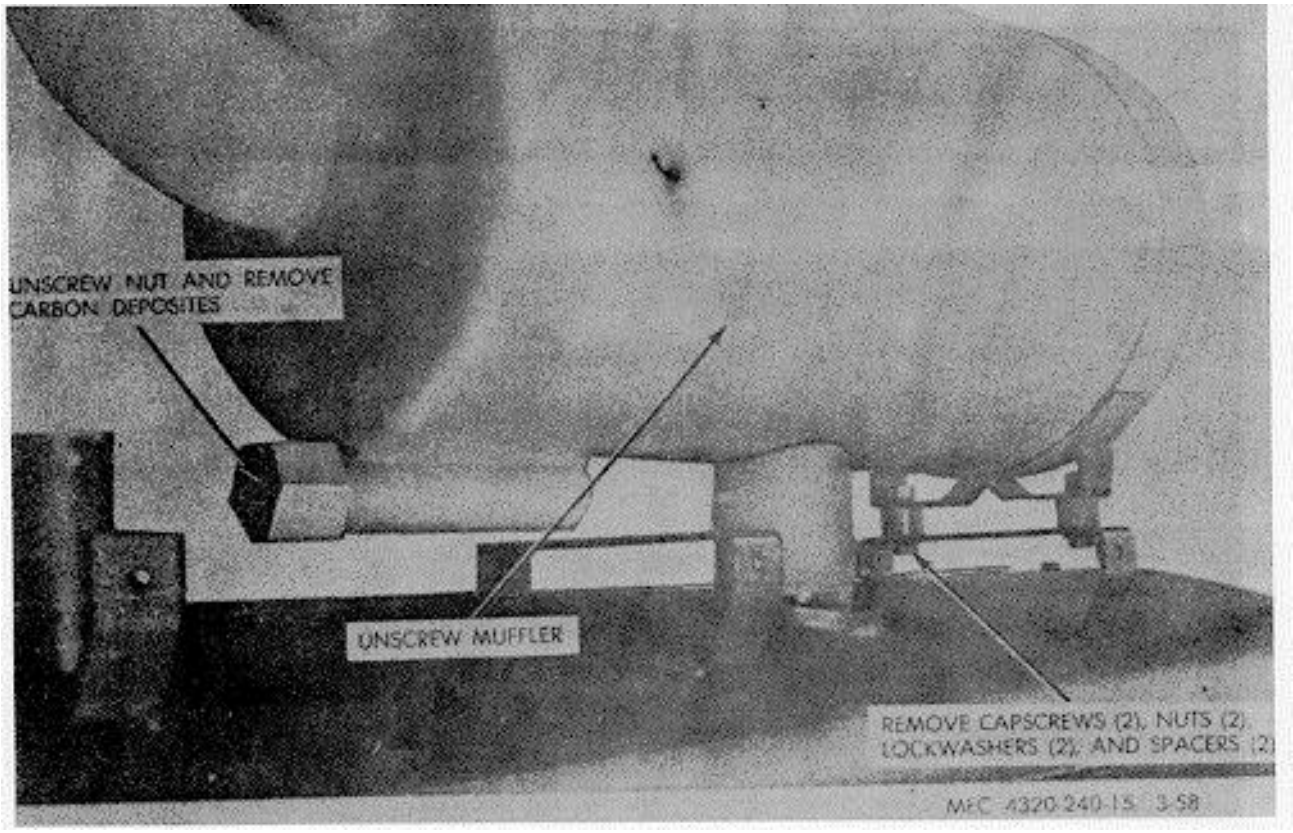


Figure 3-58. Muffler removal and installation.

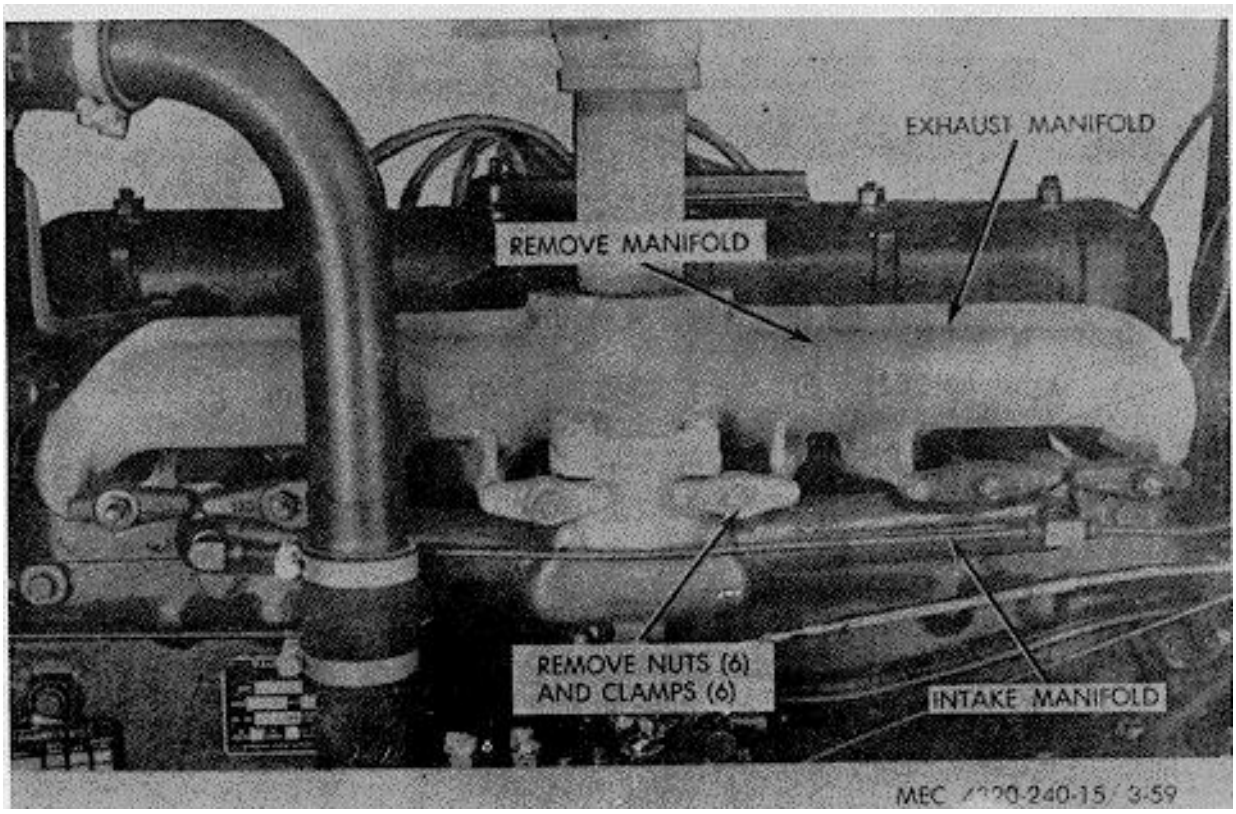


Figure 3-59. Manifold removal and installation.

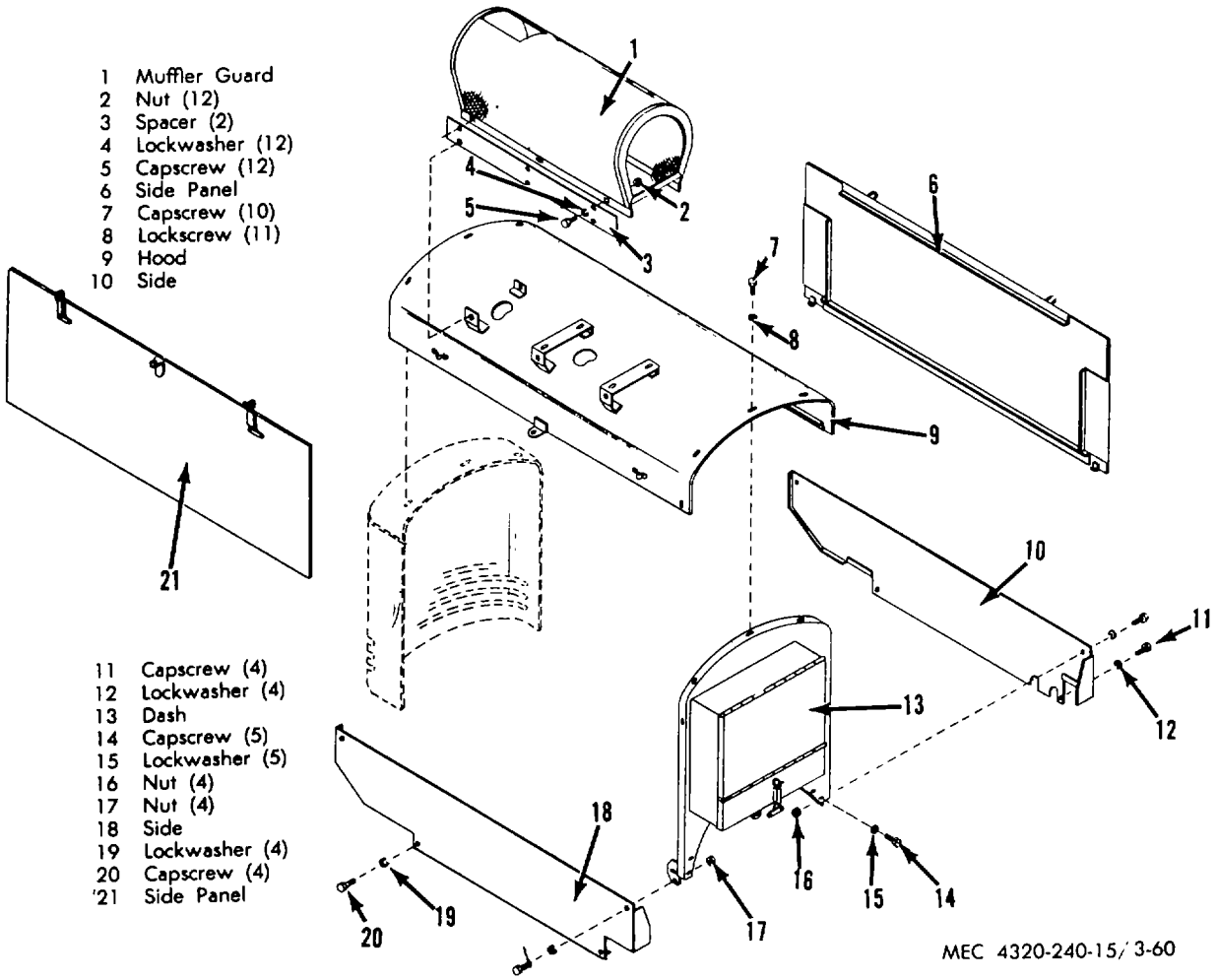


Figure 3-60. Housing, engine.

CHAPTER 4

DIRECT AND GENERAL SUPPORT AND DEPOT MAINTENANCE INSTRUCTIONS

Section I. GENERAL

4-1. Scope

These instructions are published for the use of direct and general support and depot maintenance personnel maintaining the Carver Model K906MP Centrifugal Pumping Unit. They provide information on the maintenance of the equipment, which is beyond the scope of tools, equipment, personnel, or supplies normally available to using organizations.

4-2. Record and Report Forms

For record and report forms applicable to direct and general support and depot maintenance, refer to TM 38-750.

Note. Applicable forms, excluding Standard Form 46 which is carried by the operator, shall be kept in a canvas bag mounted on equipment.

Section II. DESCRIPTION AND TABULATED DATA

4-3. Description

For a complete description of the pumping unit, see paragraph 1-3.

4-4. Tabulated Data

a. General. This paragraph contains all the overhaul data pertinent to direct and general support and depot maintenance personnel. For wiring diagram refer to figure 1-3.

b. Nut and Bolt Torque Data.

Cylinder head bolts and nuts ..... 100 ft-lbs
Connecting rod nuts..... 58 ft-lbs
Flywheel bolts..... 68 ft-lbs
Main bearing bolts..... 112 ft-lbs
Pulley crankshaft..... 100 ft-lbs

c. Adjustment Data.

Valves (Engine cold)
Intake..... 007-.009
Exhaust..... 021-.023

d. Pumping Unit Repair and Replacement Standards. Refer to table 4-1 for repair and replacement standards.

Table 4-1. Repair and Replacement Standards

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
PUMP:					
Rear wear ring inside dia.	6.513	6.516			
Rear impeller hub wearing dia.	6.500	6.501			
Front wear ring inside dia.	6,263	6.266			
Front impeller hub wearing dia.	6.250	6.251			
ENGINE:					
Pistons					
Piston land clearance with bore					
Top land	.023	.0285			
2nd land	.023	.0285			
3rd land	.023	.0285			

Table 4-1. Repair and Replacement Standards

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Piston rings					
ring width					
Top ring	.093	.094			
2nd ring	.093	.094			
3rd ring	.1545	.1555			
Ring gap					
Top ring	.010	.020		.045	
2nd ring	.010	.020		.045	
3rd ring	.010	.020		.045	
Ring groove clearance					
Top ring	.002	.004		.006	
2nd ring	.0015	.0035		.006	
3rd ring	.0005	.0035		.006	
PUMP:					
Wear ring inside dia.					
Impeller wearing dia.					
ENGINE:					
Pistons					
Piston land clearance with bore.					
Top land	.028	.0285			
2nd land	.028	.0285			
3rd land	.028	.0286			
Piston rings ring width					
Top ring	.098	.094			
2nd ring	.098	.094			
3rd ring	.1545	.1556			
Ring gap					
Top ring	.010	.020		.045	
2nd ring	.010	.020		.045	
3rd ring	.010	.020		.045	
Ring groove clearance					
Top ring	.002	.004		.006	
2nd ring	.0015	.0035		.006	
3rd ring	.0005	.0035		.006	
Piston pin					
Pin dia.	.9899	.9901			
End play	.003	.036			
Clearance in piston	.00101	.0003			
Connecting rod					
Crank pin clearance	.0009	.0029			
Side clearance	.008	.014			
Distance between centers	6.964	6.969			
Piston pin running clearance in bushing	.000	.0005			
Bushing bore	.9901	.9904			
Crankshaft					
Main bearing journal dia.	2.623	2.624			
Rod bearing journals	2.2475	2.2485			
Running clearance in main bearing	.0024	.0044			
End clearance	.003	.007			
Gear press fit on shaft	.000	.022			
Cam shaft					
Running clearance	.0015	.003			

Table 4-1. Repair and Replacement Standards-Continued

Component	Manufacturer's dimensions and tolerances in inches		Desired clearance		Maximum allowable wear and clearance
	Minimum	Maximum	Minimum	Maximum	
Rocker arms					
Running clearance	.0015	.0035			
Governor					
Backlash	.002	.003			
Exhaust valve					
insert O.D.	1.628	1.629			
Bore in Cylinder Head	1.624	1.625			
Counterbore Depth	.229	.232			
Valve, valve spring and valve guides					
Valve lift intake and exhaust	1 1/32				
Dia. of intake and exhaust					
valve head	1 1/2				
Valve stem clearance in					
guide intake	.0015	.0035			
Valve stem clearance in					
guide exhaust	.0025	.0045			
Valve stem dia.-intake and					
exhaust	.3405	.3415			
Valve spring free length	2 15/32				
Valve closed spring length	1 15/16				
Compressed Pressure	49 lbs.				
Valve open spring length	1 19/32				
Compressed Pressure	86 lbs.				
Valve running clearance cold					
Intake	.007	.009			
Exhaust	.021	.023			

CHAPTER 5

GENERAL MAINTENANCE INSTRUCTIONS

Section I. SPECIAL TOOLS AND EQUIPMENT

5-1. Special Tools and Equipment
No special tools or equipment are required by direct and general support and depot maintenance personnel for performing maintenance on the pumping unit.

5-2. Specially Designed Tools and Equipment
No specially designed tools or equipment are required by direct and general support and depot maintenance personnel for performing maintenance on the pumping unit.

Section II. TROUBLESHOOTING

5-3. General
This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the centrifugal pump or any of its components. Each trouble symptom stated is followed by a list of probable causes. The possible remedy recommended is described opposite the probable cause.

5-4. Engine Fails to Start or Hard to Start

Probable Cause	*Possible Remedy*
Starter fails to crank engine	Check and repair electrical system and starting motor (para 3-45).
Valves defective	Repair or replace valves (para 6-13).
Magneto defective	Repair magneto (para 3-46).

5-5. Engine Misses or Runs Erratically

Probable Cause	*Possible Remedy*
Governor defective	Repair governor (para 6-2).
Valves burned, warped, or broken	Repair or replace valves (para 6-13).
Valve springs weak or broken	Replace valve springs (para 6-13).
Valve seats cracked	Replace exhaust valve seat inserts and reface intake valve seats (para 6-13).
Magneto defective	Repair magneto (para 3-46).

5-6. Engine Noisy

Probable Cause	*Possible Remedy*
Flywheel loose or defective	Tighten or replace flywheel (para 6-17).
Main or connecting rod bearings loose	Replace bearings (para 6-18).

5-7. Engine Stops Suddenly

Probable Cause	*Possible Remedy*
Magneto failure	Repair magneto (para 3-46).

5-8. Oil Pressure Low

Probable Cause	*Possible Remedy*
Oil pump screen clogged	Clean oil pump screen.
Oil pump defective	Replace oil pump (para 6-15).
Main or connecting rod	Replace main bearings (para 6-18). Replace connecting rod bearings (para 6-16).

5-9. Engine Overheats

Probable Cause	Possible Remedy
Water pump defective	Repair water pump (para 6-8).
Cylinder head cracked	Replace cylinder head (para 6-12).
Crankcase water jacket cracked	Replace engine block (para 6-19).

5-10. Exhaust Smoke Excessive

Probable Cause	*Possible Remedy*
Piston rings and/or pistons defective	- Replace piston rings and/or pistons (para 6-16).

5-11. Engine Lacks Power

Probable Cause	*Possible Remedy*
Governor defective	Repair governor (paras 6 2).
Valves burned, warped, or broken	Repair or replace valves (para -13).
Valves springs weak or broken	Replace valve spring (para 6-13).
Valve seats cracked	Replace exhaust valve seat inserts and reface intake valve seats (para 6-13).
Magneto defective	Repair magneto (para 3 46).
Piston rings and/or pistons defective	Replace piston rings and/or pistons (para 6-16).

5-12. Generator Fails to Function

Probable Cause	*Possible Remedy*
Generator armature or field windings defective	Replace armature or field windings (para 63).
Commutator worn, burned, or has high mica	Turn down commutator and undercut mica (para 6-3).
Generator brush holder defective	Replace defective commutator end frame (para 6-3).

5-13. Starting Motor Does Not Operate Properly

Probable Cause	*Possible Remedy*
Brushes worn	Replace brushes.
Starting armature or field windings defective	Replace armature or field windings (para 6-4).
Commutator worn, burned, or has high mica	Turn down commutator and undercut mica (para 6-4).
Starter shaft and pinion defective	Replace shaft and pinion (para 6-4).
Starter brush holders defective	Replace defective brush holder (para 6-4).
Starter bearing defective	Replace end bells (para 6-4).
Flywheel spur gear defective	Replace spur gear (para 6-1).

5-14. Pump Fails to Prime

Probable Cause	*Possible Remedy*
Defective seal	Replace seal (para 7-2).
Impeller clogged, broken, or worn out	Clean or replace (para 7-2).
Check valve not seating properly	Remove dirt or debris from check valve seat (para 7-2).

5-15. Noisy Pump Operation

Probable Cause	*Possible Remedy*
Impeller broken	Replace impeller (para 7-2).
Pump bearings defective	Replace defective bearings (para 7-2).
Pump drive shaft defective	Replace drive shaft (para 7-2).

5-16. Pump Fails to Deliver Rated Capacity

Probable Cause	*Possible Remedy*
Impeller partially clogged	Clean impeller (para 7-2).

Section III. RADIO INTERFERENCE SUPPRESSION

5-17. General

Refer to TM 11-483 for definitions, purposes, source and methods used to obtain proper radio suppression.

5-18. Interference Suppression Components

For a description of interference suppression components, see paragraph 3-25.

5-19. Replacement of Suppression Components

For replacement of suppression components, see paragraph 3-47b.

Section IV. REMOVAL AND INSTALLATION OF MAJOR COMPONENTS OR AUXILLIARIES

5-20. General

The centrifugal pump contains three major units which may be removed from the skid base assembly in order to ease the performance of repair procedures. These units are: the pump assembly, the engine, and the engine housing. Remove only those parts necessary for the removal of the component requiring maintenance or repair.

5-21. Pump Assembly

a. Removal. Refer to figure 3-35 and remove the pump assembly.

b. Installation. Refer to figure 8-35 and install the pump assembly.

5-22. Engine and Housing Assembly

a. Removal.

(1) Refer to figure 335 and remove pump assembly.

(2) Refer to paragraph 3-81b and remove the lifting bail.

(3) Disconnect the battery cable which runs to the battery disconnect switch.

(4) Refer to figure 5-1 and finish removing the engine and housing assembly.

b. Installation. Install engine and housing assembly in reverse order of removal.

5-23. Housing

a. Removal. Refer to figure 3-57 and remove the housing.

b. Installation. Refer to figure 3-57 and install the housing.

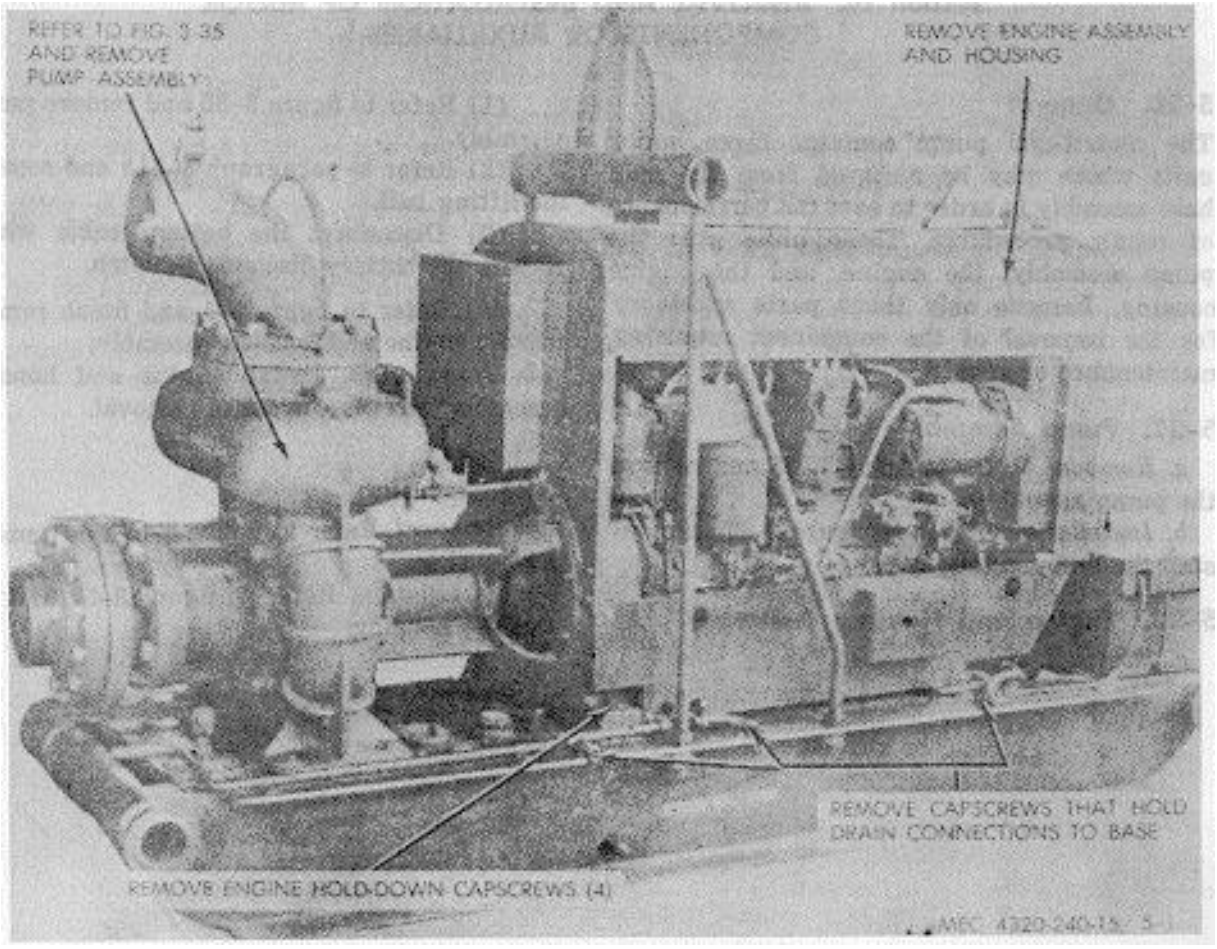


Figure 5-1. Engine assembly and housing removal and installation.

CHAPTER 6

ENGINE REPAIR INSTRUCTIONS

Section I. ENGINE ACCESSORIES

6-1. General

This section contains those items which are considered accessories to the engine. They consist of governor, generator, starting motor, generator regulator, magneto, radiator, and water pump.

6-2. Governor

a. General. Refer to paragraph 334a for description.

b. Removal. Refer to figure 3-12 and remove the governor.

c. Disassemble. Refer to figure 6-1 and disassemble the governor.

d. Repair. Replace any parts that are found defective and reassemble the governor.

e. Installation. Refer to figure 3-12 and install the governor.

6-3. Generator

a. General. Refer to paragraph 3-43a for description.

b. Output Testing.

(1) Connect the generator and generator regulator as shown in figure 6-2. Run the engine to allow the temperature of the generator to reach 77° F.

(2) The cold output of the generator must be 18 amperes at 28.5 volts when the generator is turning at 1775 RPM.

c. Removal. Refer to figure 3-19 and remove the generator.

d. Cleaning and Inspection. Refer to paragraph 3-43e and clean and inspect the generator.

e. Disassemble. Refer to figure 3-20 and disassemble the generator.

f. Cleaning, Inspection, and Repair.

(1) Wipe all parts of the generator, except the brushes, with a cloth lightly dampened in an approved cleaning solvent; dry thoroughly with low pressure compressed air. Wipe brushes with clean, dry cloth.

(2) Check the size of the brushes; replace them if they are less than '/8 of an inch long.

(3) Inspect the armature commutator for roughness out-of-round or high mica. If any of these conditions exist, turn the commutator down on a lathe and undercut the mica 13I2: inch. Remove only enough stock to make the commutator smooth and round. After undercutting, finish the commutator with No. 00 sandpaper. Clean all particles from the commutator and armature using low pressure, dry, compressed air. Check the armature for short circuits as described in subparagraph (6), below.

Caution

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

(4) Check the brush holders for distortion, cracks, breaks, or other damage; replace damaged brush holders.

(5) Replace the brush springs if tension is less than 28 ounces.

(6) Check for short circuits in the armature by rotating the armature on a growler with a steep strip such as a hacksaw blade held firmly on the armature. The steel strip will vibrate on the area of the short circuit. Short circuits are usually caused by particles between commutator bars. If short circuits are found, clean spaces between the commutator bars .using an undercutting tool and compressed air. If a short circuit cannot be corrected, replace the armature.

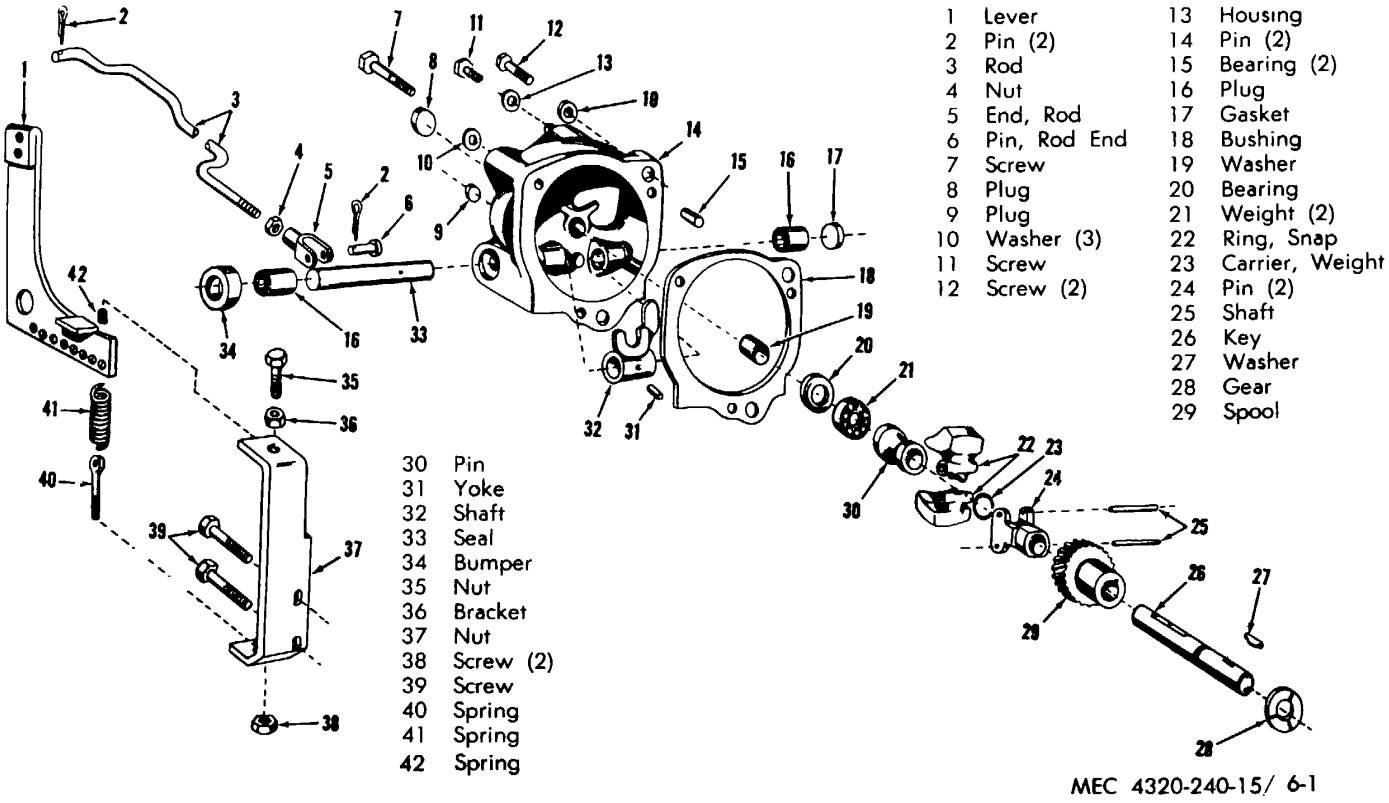


Figure 6-1. Governor-exploded view.

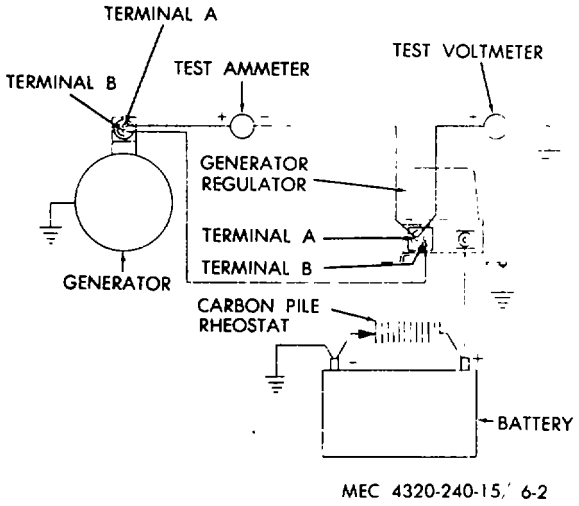


Figure 6-2. Generator test circuit.

(7) Check for open circuits by inspecting for loose connections at the points where the conductors are connected to the commutator risers. Open circuits can be checked electrically by determining if continuity exists between adjacent commutator bars. If the bars are not badly burned, resolder the leads and turn the commutator down on a lathe. Undercut the mica and test for short circuits as described in subparagraph (6) above. If the open circuit cannot be corrected replace the armature.

(8) Check for grounds by checking the armature with a test lamp. Place one probe of the test lamp on the armature core and the other on each commutator bar in turn. If the test lamp lights, the armature is grounded. If grounded, clean it thoroughly and recheck for grounds. If ground cannot be corrected, replace the armature.

(9) Check the field coils for grounds by checking the coils with a test lamp. Place one probe of the test lamp on the field frame assembly and the other on the field coil leads. If the test lamp lights, the field coils are grounded. Replace the field coils if a ground is indicated.

(10) Check the field coils for open circuits by checking with a test lamp. Connect the probes of the lamp to the two leads from the coils. If the lamp does not light, the coil is open. Replace the field coils if the circuit is open.

g. Assembly. Assemble the generator in reverse order of disassembly.

h. Installation. Install the generator figure 3-19.

6-4. Starting Motor

a. General. Refer to paragraph 3-45a for description.

b. Removal. Refer to figure 3-22 and remove starting motor.

c. Cleaning and Inspection. Refer to paragraph 3-45e and clean and inspect the starting motor.

d. Testing. Connect the starting motor in a test circuit as shown in figure 6-3. Adjust the starting motor voltage draw to 23.5 volts by adjusting the variable resistance. With the starting motor operating with a voltage draw of 23.5 volts, the speed should be between 5,800 and 6,800 rpm and the current draw should be 33 amperes. If speed is not within limit or the current draw is not 33 amperes, repair or replace the motor.

e. Disassembly. Refer to figure 3-23 and disassemble the starting motor.

f. Cleaning, Inspection, and Repair.

(1) Clean the armature and field frame assembly with a cloth lightly dampened in an approved cleaning solvent.

(2) Clean all other parts of the starting motor, except the brushes, in an approved cleaning solvent; dry thoroughly with compressed air.

(3) Check the size of the brushes; replace them if they are less than 3/8 of an inch long.

(4) Inspect the armature commutator for roughness, out-of-round or high mica. If any of these conditions exist, turn the commutator down on a lathe and undercut the mica 1/32 inch. Remove only enough stock to make the commutator smooth and round. After undercutting, finish the commutator with No. 00 sandpaper. Clean all particles off commutator using compressed air. Check armature for short circuits (para 6-3f).

Caution

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

(5) Check the brush holders for distortion, cracks, breaks, or other damage; replace damaged brush holders.

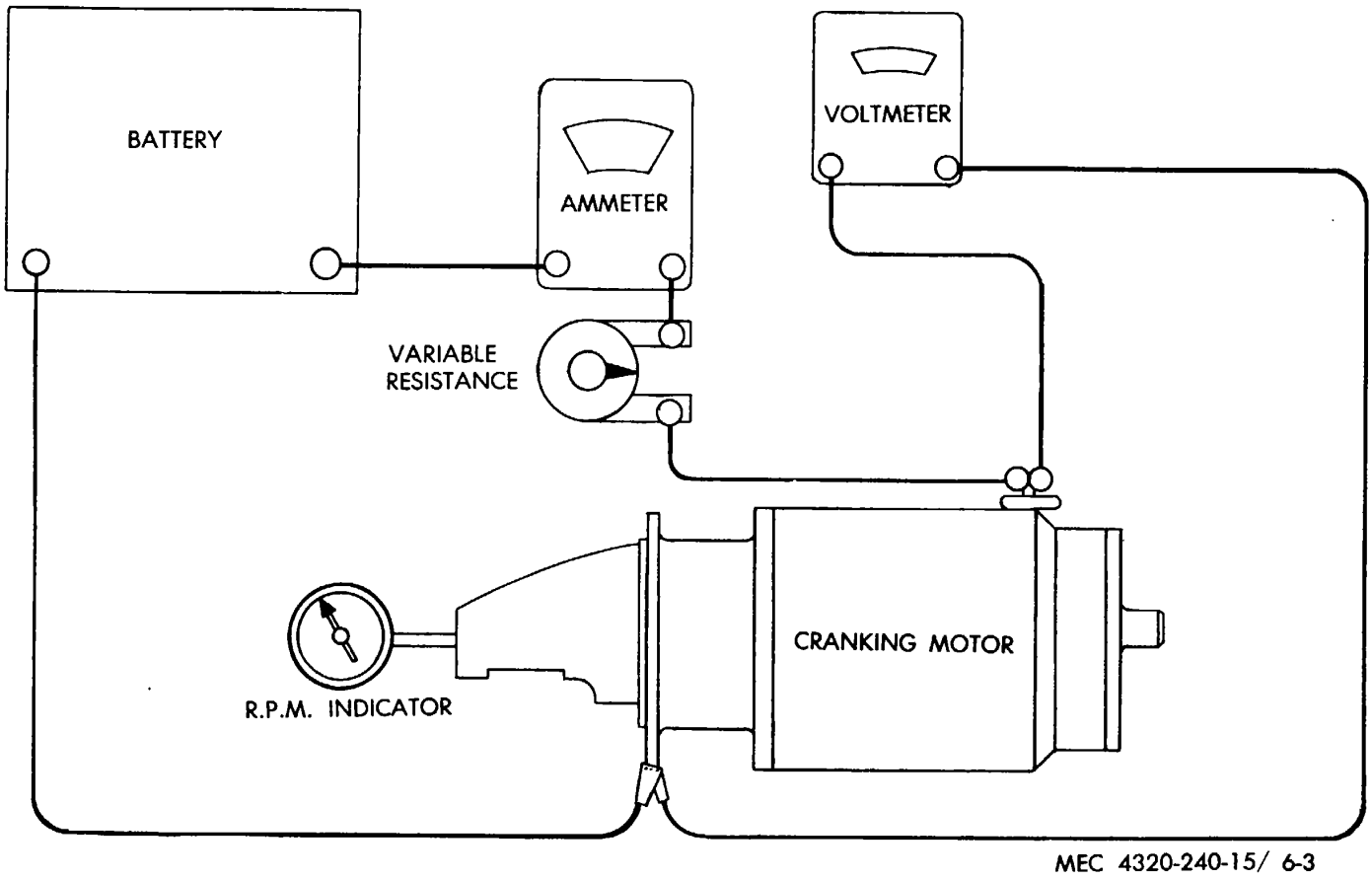


Figure 6-3. Starting motor test hook-up.

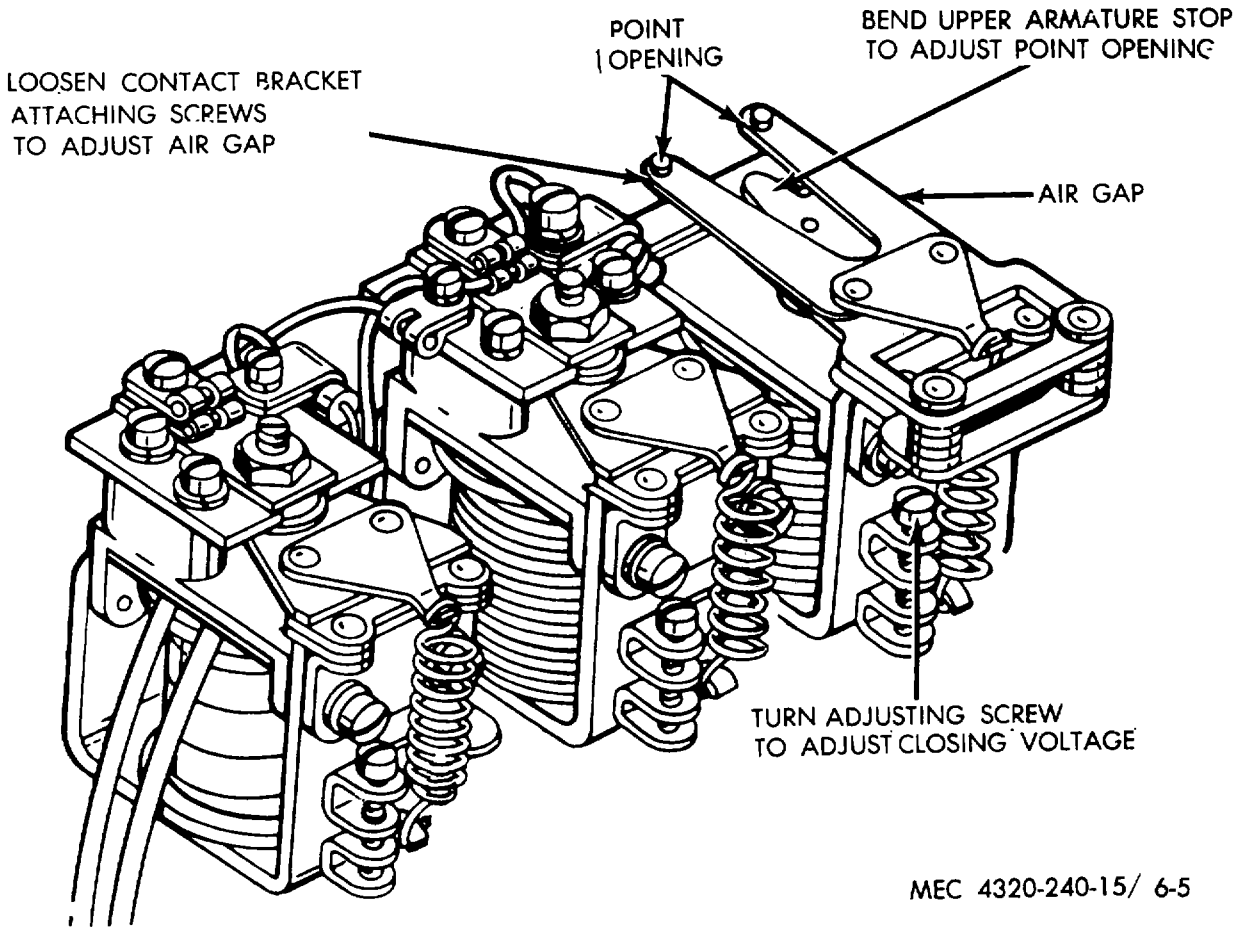


Figure 6-4. Generator regulator air gap and voltage setting.

(6) Inspect the drive assembly for cracks, breaks, clutching action, or other damage; replace the drive assembly if any parts are damaged.

(7) Check the armature and field windings for short circuits, grounds, and open circuits using the same method described for the generator parts in paragraph 6-3*f*. Replace the starting motor if the armature of the field windings is shorted, grounded, or open.

g. Assembly. Assemble the starting motor in the reverse order of disassembly. If the drive is manually rotated to locked position, do not attempt to force it in a reverse direction. Proceed to install with pinion meshing with flywheel ring gear. When engine starts, the drive will return to the neutral position.

h. Installation. Refer to figure 3-22 and install the starting motor.

6-5. Generator Regulator

a. General. Refer to paragraph 3-44a for description.

b. Testing and Adjustment.

(1) Refer to figure 3-21 and remove generator regulator cover.

(2) Refer to figure 6-4 and check the air gap of the cut out relay unit. With the battery disconnected, measure the air gap between the armature and the core (not between the brass pin in the armature and the core) with the contact points barely touching. If all sets of points do not close together, realine the lower contact bracket slightly until all points do meet simultaneously. Adjust air gap to .048 inch by loosening the two screws attaching the lower contact bracket, and raise or lower the contact bracket as required. Be sure the points

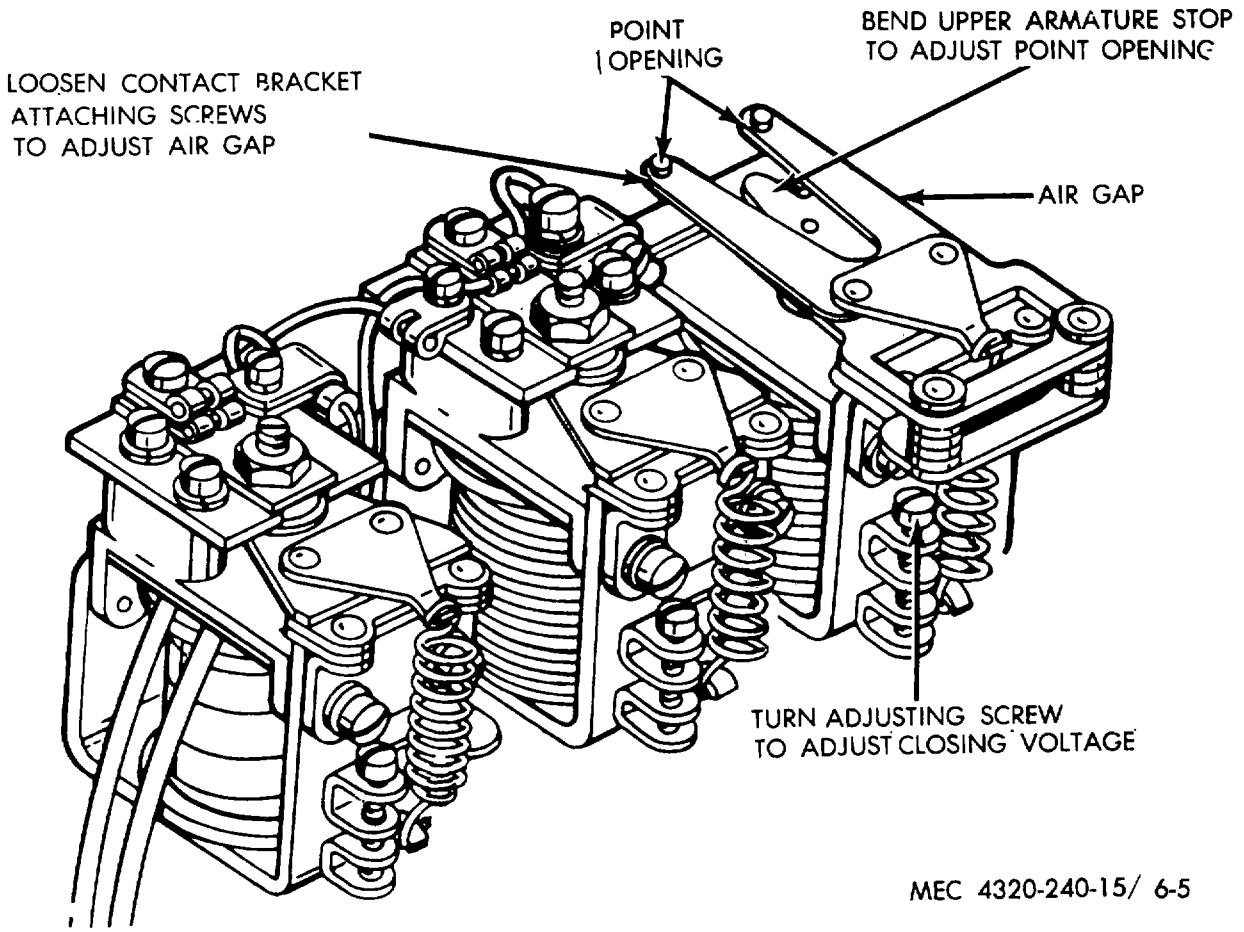


Figure 6-5. Generator regulator cutout relay adjustment.

are properly lined up and tighten the screws well after adjustment.

(3) With the battery disconnected, refer to figure 6-5; measure the point opening and adjust to .035 inch by bending the upper armature stop.

(4) Refer to figure 6-4 and check the air gap of the voltage regulator unit and current regulator unit. The air gap should be measured between the armature and the part of the core (not the residual pin in the core) next to the residual pin, with the points just touching. Measure the air gap by pushing the armature down until the points open, release until the points barely close, then measure the air gap. Do not measure the gap with the fiat spring that supports the contact screw raised up off the fiber mounting plate. Adjust the air gap to .087 inch by loosening the locknut and turning 6-6 the contact screw. The most convenient method of performing this operation is to insert the gauge, press the armature down against it to hold it in place, and then turn the contact screw until the contacts barely touch.

(5) Connect the generator regulator and generator in a circuit as shown in figure 6-6 and check the cutout relay (circuit breaker) opening and closing. With the field rheostat set at maximum resistance, start the engine and operate it at 2250 rpm. Adjust the field rheostat while watching the voltmeter. Check the closing voltage of the cutout relay contacts. It must be 25 to 27 volts as indicated on the voltmeter. Refer to figure 6-5 and adjust the closing voltage, if necessary.

(6) Connect the generator regulator and generator in a circuit as shown in figure 6-6 and check the voltage regulator operating volt

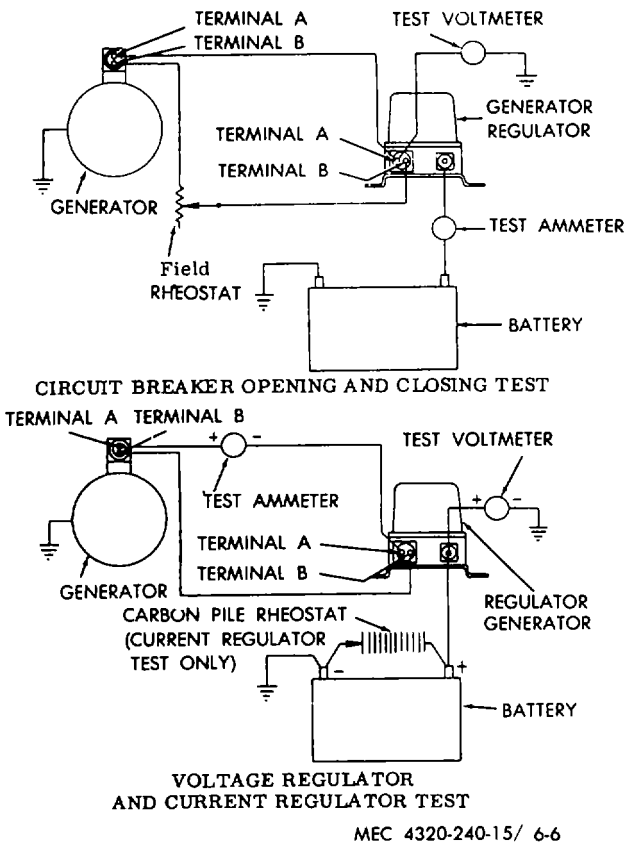


Figure 6-6. Generator regulate test set-up.

age. With the generator operating at approximately 3,000 rpm and the generator operating temperature, note the operating voltage. It must be 27.5 to 29.5 volts as indicated on the voltmeter. Refer to figure 6-4 and adjust the voltage if necessary.

(7) Connect the generator regulator as shown in figure 6-5 using the carbon pile rheostat. Check the operating amperage of the current regulator. It should operate at 16 to 20 amperes. If it fails to operate within the required range, refer to figure 6-4 and adjust the current setting. After each change of adjustment, reduce generator speed until cutout relay opens, then return to speed and read current.

(8) If the adjustment cannot be made, replace the generator regulator.

c. Replacement. Refer to figure 3-21 and replace the generator regulator.

6-6. Magneto

a. General. Refer to paragraph 3-46a for description.

b. Removal. Refer to figure 3-25 and remove the magneto.

c. Cleaning and Inspection. Refer to paragraph 3-46e and clean and inspect the magneto.

d. Disassembly. Refer to figure 3-26 and disassemble the magneto.

e. Cleaning Inspection and Repair. (fig. 3-26)

(1) Clean the housing, gaskets, and preformed packing, and distributor block with a wet soapy cloth. Rinse and wipe dry.

(2) Clean all metal parts except bearings in an approved cleaning solvent; dry with clean, dry compressed air.

(3) Clean bearings by placing in a strainer and dipping in a clean solution of cleaning solvent. Flush until clean.

Caution

Do not spin balls or needles when bearings are without lubricant. Keep bearings covered so dirt and dust will not enter.

(4) Repack bearings with clean bearing grease. Inspect bearings for smooth rotation without rough or catchy spots. Inspect races, balls, and needles for wear or damage. Replace damage bearings.

(5) Clean the electrical parts with a cloth dampened in an approved cleaning solvent.

(6) Inspect the electrical parts for corrosion, cracks, breaks, frayed insulation, damaged terminals, or evidence of failures. Replace if damaged or defective.

(7) Inspect the spring for wear, cracks, damage, or loss of tension; replace if damaged or deformed.

(8) Inspect gear teeth for chips, breaks, wear, or damage; replace if damaged.

(9) Test the condenser on a standard condenser tester.

(10) Inspect all other parts for cracks, breaks, wear, or other damage. Replace if damaged.

f. Assembly. Assemble the magneto in the reverse order of disassembly.

g. Timing and Installation. Time and install the magneto (para 3-45g).

67. Radiator

a. General. Refer to paragraph 3-52a for description.

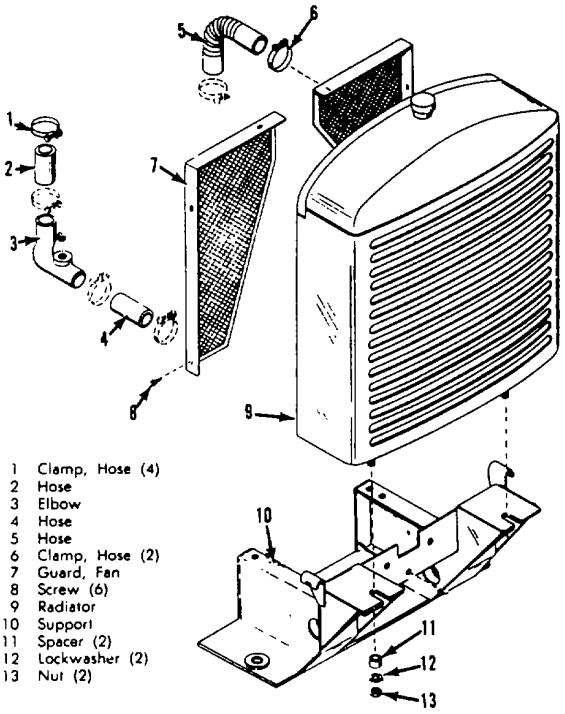


Figure 6-7. Radiator removal and Installation.

b. Removal.

(1) Remove side panels. (fig. 3-60)

(2) Drain cooling system.

(3) Remove 4 capscrews that fasten hood to radiator.

(4) Refer to figure 6-7, and remove the fan guard by removing screws (8).

(5) Refer to figure 6-7, remove nuts (13), washers (12), spacers (11), and radiator (9).

c. Testing and Repair.

(1) Place the cap tightly on the radiator and sea) the drain hole. Block off the upper hose connections; connect an air line to the lower hose connection with an air pressure gage in the line.

(2) Submerge the radiator in a tank of water. Open the air line to the radiator and apply a pressure of not more than 15 psi.

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

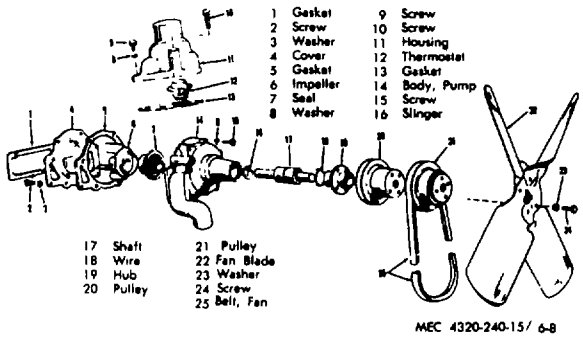


Figure 6-8. Water pump - exploded view.

(4) Solder any holes found. in the radiator.

(5) Solder all tubing connections that leak under pressure.

d. Installation. Refer to paragraph 67b and install the radiator in reverse order.

6-8. Water Pump

a. General. Refer to paragraph 350a for description.

b. Removal. Refer to paragraph 3-50 and remove the water pump.

c. Disassembly. Refer to figure 6-8 and disassemble the water pump.

d. Cleaning, Inspection and Repair.

(1) Clean all parts with an approved cleaning solvent; dry with clean compressed air.

(2) Inspect the seal for defects; inspect the seal spring for deformation or loss of tension, Replace seal if any part is defective.

(3) Inspect all parts for cracks, breaks, wear, stripped threads, or other damage; replace if damaged.

e. Assembly. Refer to figure 6-8 and assemble the water pump.

f. Installation. Install water pump in reverse order described in paragraph 3-50b.

Section II. ENGINE COMPONENTS

6-9. General

This section contains those items which are considered components of the engine assembly.

6-10. Rocker Arm Shaft

a. General. The rocker arm shaft is mounted on top of the cylinder head. The movement of each push rod is transmitted by rocker arms to the intake and exhaust valves.

b. Removal.

(1) Refer to paragraphs 3-81b(1) through 3-8b(5) and remove parts as described.

(2) Refer to figure 3-55 and remove valve cover.

(3) Refer to figure 6-9 and remove rocker arm shaft, by removing six nuts (21) and washers (20).

c. Disassembly. Refer to figure 6-9 and disassemble rocker arm shaft.

d. Cleaning, Inspection, and Repair.

(1) Clean the rocker arm shaft, rocker arms and attaching parts with a clean cloth and an approved cleaning solvent. Blow out all oil passages with clean dry compressed air.

(2) The wear on the rocker arm shaft and bushings will ordinarily be quite light, providing adequate oil circulation to those parts is maintained. Nevertheless whenever the rocker arm shaft has been removed, the rocker bushings, rocker shaft bearing surfaces, valve contact end of the rocker arms, and adjusting screw should be inspected for excess wear.

(3) All worn parts should be replaced, if rocker bushings are required they must be pressed in place and reamed to .0015 to .0018 running clearance on rocker shaft.

e. Reassembly. Refer to figure 6-9 and reassemble rocker arm shaft.

f. Installation.

(1) Refer to figure 6-9 and install rocker arm shaft.

(2) Refer to paragraph 3-78c and adjust valve clearance.

(3) Refer to figure 3-55 and install rocker arm cover.

6-11. Manifolds

a. General. Refer to paragraph 3-80a for description.

b. Removal. Refer to paragraph 3-80c and remove the manifolds.

c. Disassembly. Refer to figure 6-10 and disassemble manifold.

d. Cleaning and Inspection.

(1) Clean gasket surfaces between intake 'and exhaust manifold also clean surface where manifold comes in contact with cylinder head.

(2) Inspect for cracks.

e. Reassembly. Refer to figure 6-10 and reassemble manifold using new gasket.

f. Installation. Install manifolds in reverse order of removal.

6-12. Cylinder Head

a. General. The cylinder head is mounted on top of the cylinder block and held securely in place by large capscrews. It consists of a series of passages which lead to and from the exhaust and intake manifolds. The valves are positioned in the cylinder head where the engine breathing is done. The combustion chambers are incorporated in the cylinder head, where the gasoline and air mixture is compressed and ignited to deliver engine power.

b. Removal.

(1) Drain coolant from system.

(2) Refer to paragraph 6-10b and remove rocker arm shaft.

(3) Refer to paragraph 6-llb and remove manifolds.

(4) Refer to figure 6-7 and loosen clamp (6) at thermostat housing and slide hose assembly away from thermostat housing.

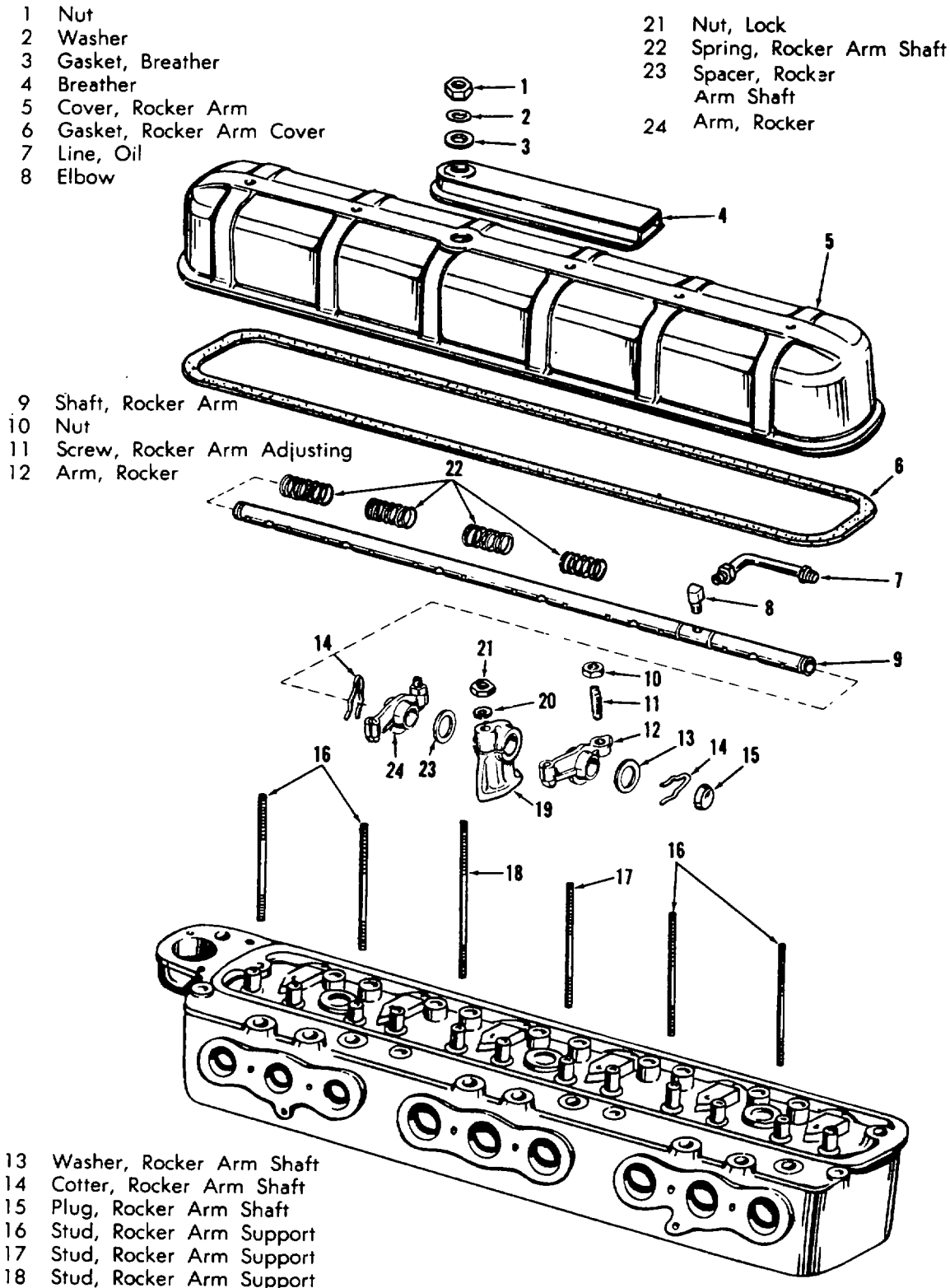


Figure 6-9. Rocker Arm assembly--exploded view.

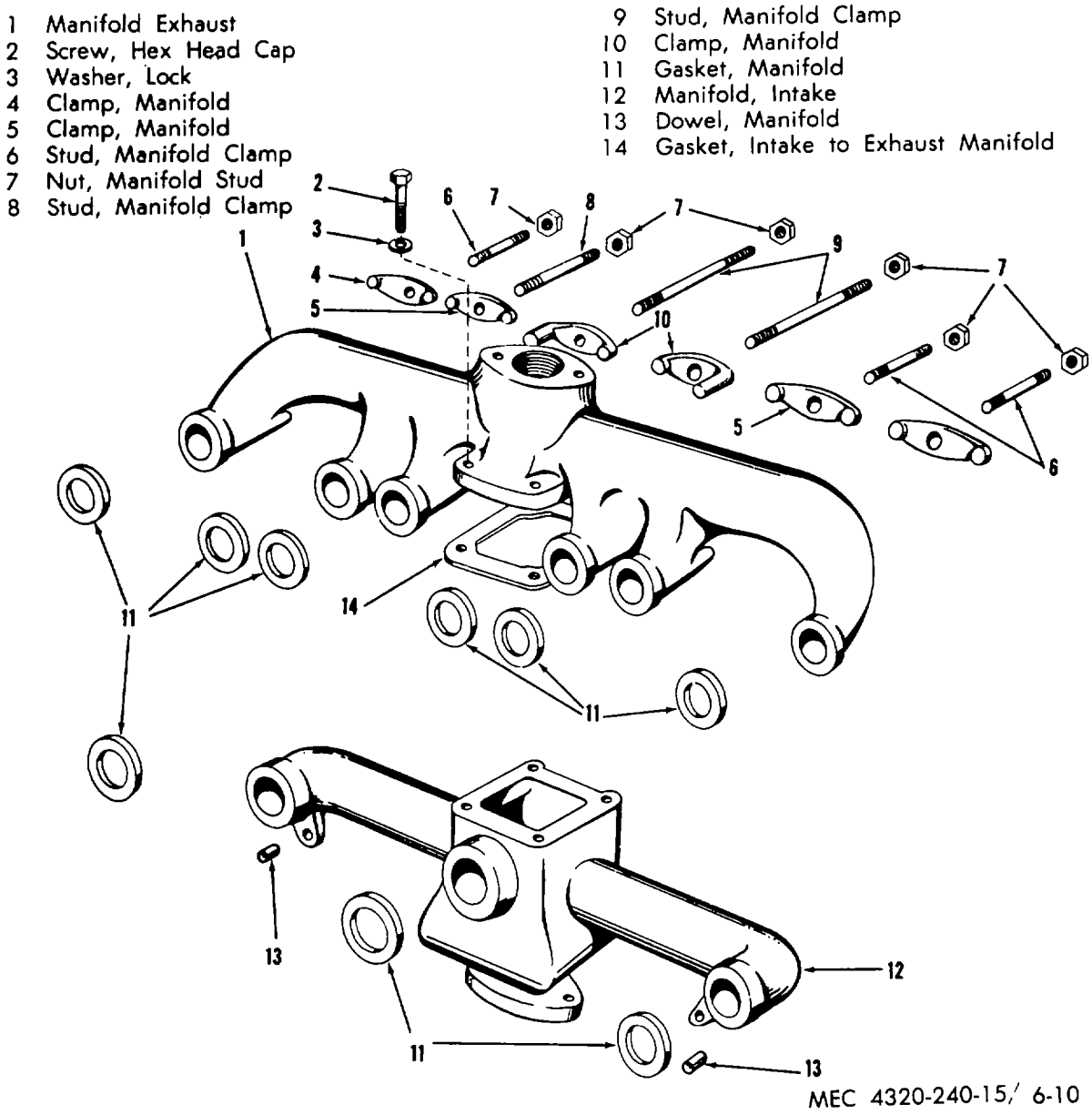


Figure 6-10. Manifolds-exploded view.

(5) Withdraw push rods and tag or otherwise mark so that each rod may be replaced in its own tappet.
(6) Disconnect ignition leads from spark plugs.
(7) Remove capscrews which fasten cylinder head to cylinder block.
(8) Remove cylinder head and gasket.

c. Disassembly. Refer to figure 6-11 and disassemble cylinder head.

d. Cleaning, Inspection, and Repair.

(1) Wash the cylinder head in an approved cleaning solvent; dry with clean, dry, compressed air.

(2) Carefully scrape or wire-brush all carbon deposits from the cylinder head, cylinder block, valves, and the top of the pistons. Make sure that all loose carbon is removed to prevent it from getting into the water passages and engine oil.

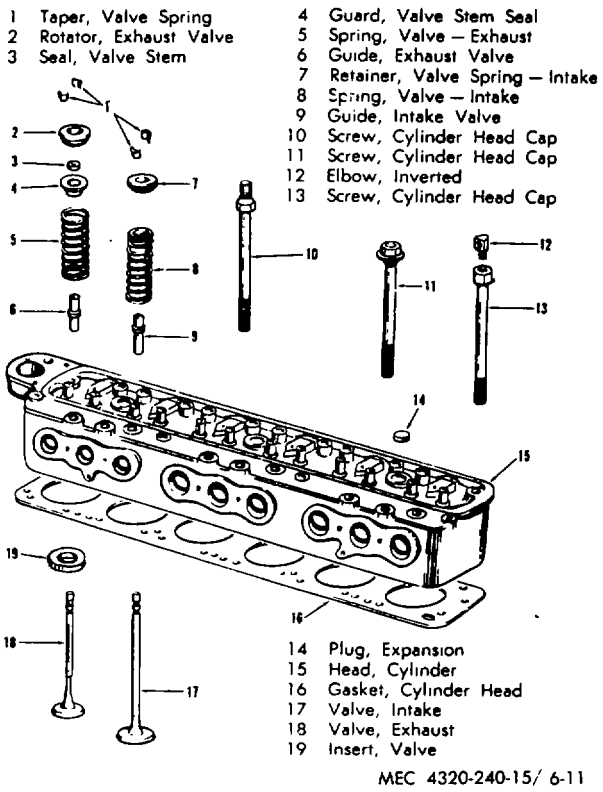


Figure 6-11. Cylinder head-exploded view.

(3) Inspect the cylinder head for cracks, breaks, and warpage. Check the flatness of the cylinder head with a straight edge and feeler gage in three positions lengthwise and five positions crosswise. The maximum permissible warpage is 0.004 inch low in the center lengthwise, gradually decreasing toward the ends, or 0.003 inch crosswise in localized low spots. Replace a cracked, broken, or warped cylinder head.

e. Reassembly. Refer to figure 6-11 and reassemble cylinder head.

f. Installation.

(1) Position cylinder head on cylinder block using a new cylinder head gasket. A small amount of cement may be used around water and oil holes of the cylinder head ,i U' to provide a tight seal at those points. Never install cylinder head without closing spark plug holes. This is important because small washers or nuts may find their way into the combustion chamber and cause serious damage. Secure the cylinder head with the cylinder head hold down capscrews. Tighten the capscrews a little at a time and in the sequence indicated in figure 6-12 continue tightening in that rotation until all cylinder head capscrews are tightened to 98 to 100 ft-lbs torque.

(2) Complete cylinder installation in reverse order noted in paragraph 6-12b.

6-13. Valves, Seats, and Guides

a. General. The valves are positioned in the cylinder head. They are operated by the cam shaft and are so timed as to let in a mixture of gasoline and air at just the right instant. They also serve in exhausting the burned gas.

b. Removal. Refer to figure 6-11.

(1) Refer to paragraph 6-12b and remove cylinder head.

(2) The end of each valve stem is fitted with a shallow steel retainer that accommodates the end of the valve spring, and is held to the stem by a pair of split tapers. The locking tapers must be removed before the valve can be withdrawn. To release the lock from the recess in the spring retainer, it is necessary to use a spring compressor, refer to figure 6-13 and press down until the tapers fall free.

(3) Lift each valve from the cylinder head. Place them in order in a rack to assure that each will be reassembled in the same valve guide from which it was removed.

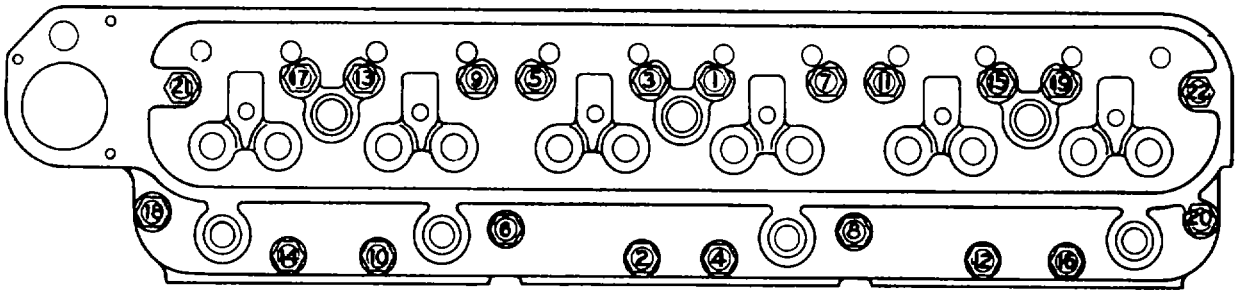


Figure 6-12. Cylinder head tightening sequence.

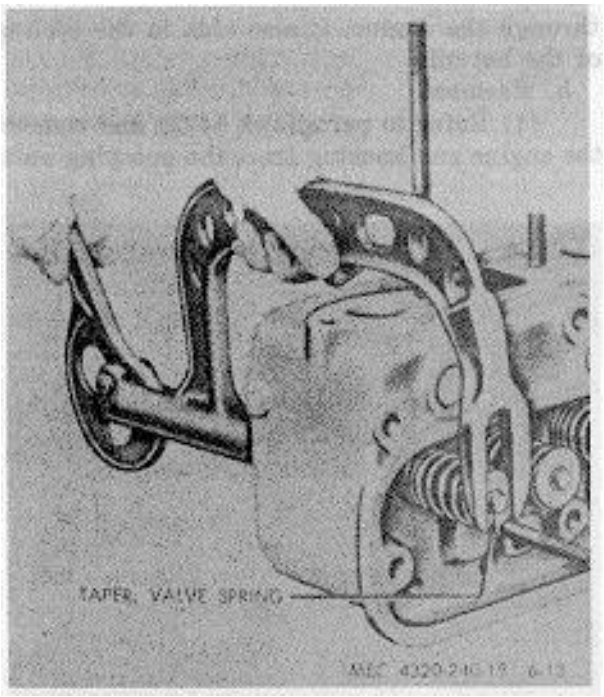


Figure 6-13. Removing valves.

(4) Do not remove the valve guides or seats unless inspection indicates that they are faulty.

c. Cleaning, Inspection, and Repair.

(1) Clean the valves, valve springs, retainers, and valve stem caps with an approved cleaning solvent; dry thoroughly. Remove carbon deposits with a wire brush.

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

(3) Clean valve seats with a wire brush.

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

(5) Check for loose or worn valve guides. Check the internal diameter of the valve guide with a telescope gage and a micrometer. Replace guides that are worn to a bellmouthed shape.

(6) If it has been determined that valve guide replacement is required, this operation should be done at this time. Old guides may be removed with a suitable puller or by reaming to a thin shell and collapsing them. New guides are pressed in place on an arbor press with the aid of a mandrel. Service guides are especially machined to provide proper stem clearance without further reaming after installation. In production, the valve guide shoulders are intentionally held above the cylinder head upper service to avoid valve binding caused by cocking the guide if one side of the shoulder contacts unevenly. Do not try to bottom these guides. Install service guides in the same way. Use .010 inch feeler stock as a spacer under the shoulder when installing, (fig. 6-14).

(7) Check the exhaust valve seat inserts for cracks or loose mounting. Refer to figure 6-15 and remove any defective valve seats. Replace seats with new 1/32 oversized valve seats. Counterbore the valve seats to a diameter of 1.655 to 1.656 inches. This will provide a 0.003 to 0.005 inch press fit. Counterbore deeply enough so that the boring tool will clean up the bottom of the bore to assure proper heat conduction from the valve insert. Chill the valve seat in dry ice for 20 minutes. Install the valve seat in place with a piloted driver using an arbor press or by applying light blows with a hammer until the valve seat is resting against the bottom of the bore.

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

Valve closed-Spring length 1 15/16" Comp. Press 49 lbs. ±4 lbs.
Valve open-Spring length 1 19/32" Comp. Press 86 lbs. ± 6 lbs.

(9) Grind the valve seats. The seat angle is 45 degrees. Use a dial indicator figure 6-16 to check the valve seat for runout. The total indicator reading must not exceed 0.002 inch. Clean the valve seat and surrounding area thoroughly after grinding.

(10) After the valves and seats have been refaced and reground coat the seat lightly with Prussion blue and drop the valve into place, oscillating it slightly to transfer the blue pattern

to the valve face. This should show a contact width of 1/32 to 3/64 inch, and should fall well within the width of the valve face, leaving at least 1/64 inch on either side of the contact area. If the contact area is greater than 1/16 inch, narrow the contact area by grinding the outside diameter of the seat with a 15 degree stone, or by grinding the inside diameter of the seat with a 60 degree or 75 degree stone. After the seat area is corrected, touch the seat lightly with the original grinding stone to remove the burred or feathered edge.

(11) Inspect the spring retainer seats, spring retainer locks, valve stem caps, and valve tappet assemblies for cracks, scoring, overheating, and wear. Replace damaged parts.

d. Reassembly. Refer to figure 6-11 and assembly valves in cylinder head.

e. Installation. Refer to paragraph 6-12b and install cylinder head in reverse order.

6-14. Oil Pan

a. General. The oil pan is located at the lower end of the cylinder block. It serves as a container for the oil which is circulated through the engine. It also aids in the cooling of the hot oil.

b. Removal.

(1) Refer to paragraph 5-22a and remove the engine and housing from the pumping unit.

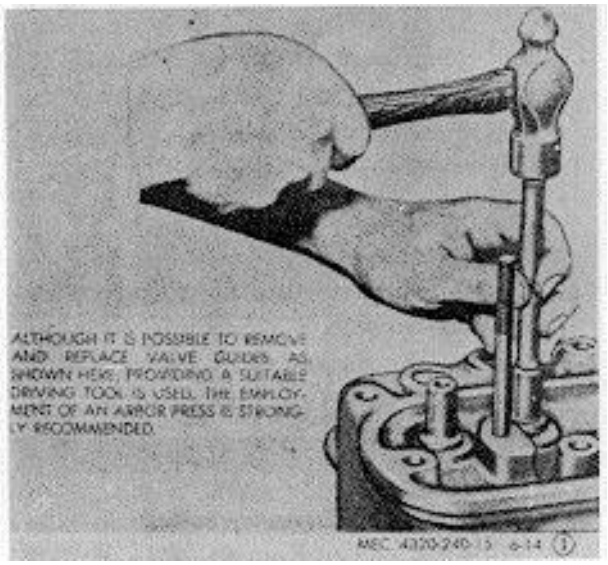


Figure 6-14. (1)Installing valve guide.

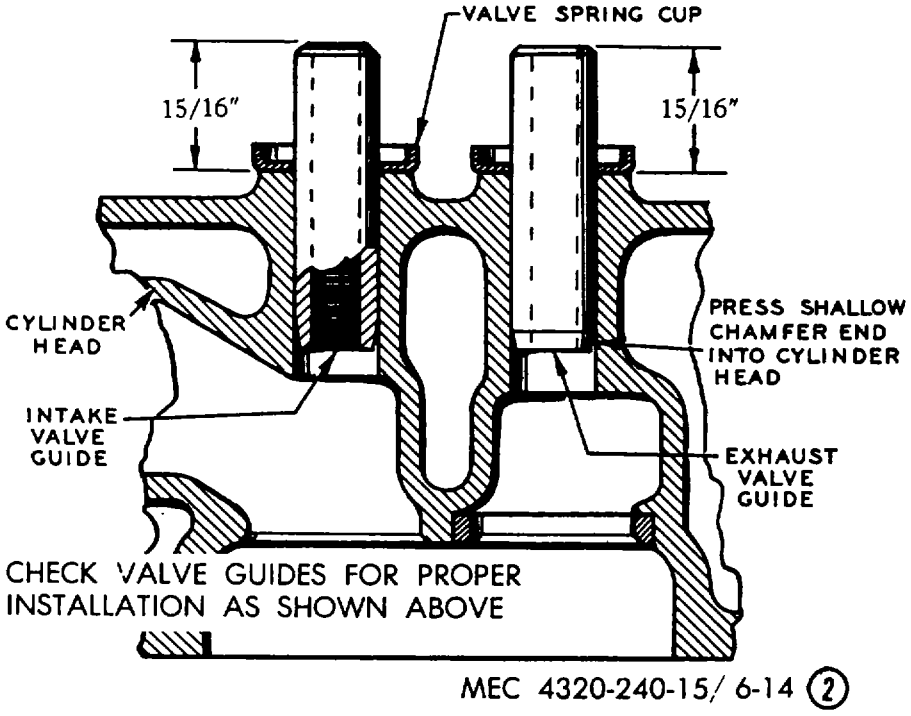


Figure 6-14. (2)- Continued.

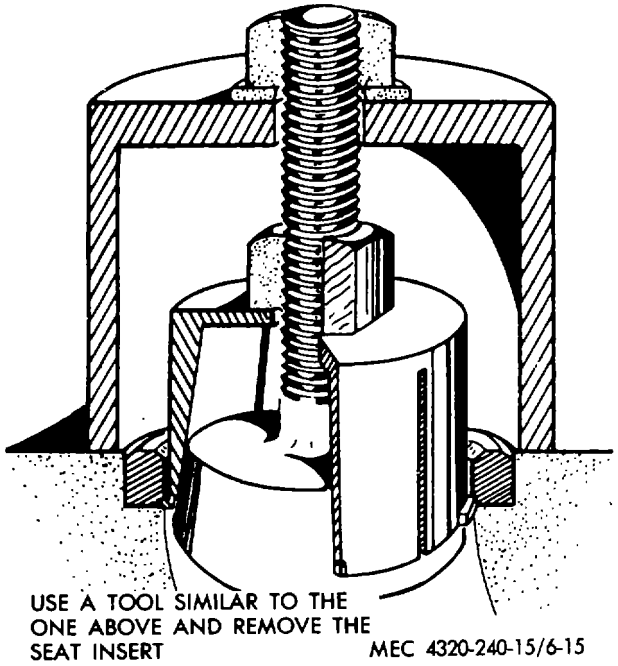


Figure 6-15. Seat insert removal.

(2) Position engine on side, be careful not to damage any of the protective housing.

(3) Refer to figure 6-17, remove nuts (9), washers (7), capscrews (8), and special capscrews (3).

(4) Remove oil pan and gasket.

c. Disassembly. Refer to figure 6-17 and disassemble oil pan.

d. Cleaning, Inspection, and Repair.

(1) Wash oil pan in an approved cleaning solvent, and dry thoroughly.

(2) Inspect for cracks, dents, and missing parts.

e. Reassembly. Refer to figure 6-17 and assemble the oil pan.

f. Installation. Refer to paragraph 6-14b and install oil pan on engine and engine in pumping unit in reverse order of removal.

6-15. Oil Pump

a. General. The oil pump is located at the lower end of the cylinder block, and is covered by the oil pan. The sole purpose of the oil pump is to circulate oil under pressure to all moving parts of the engine.

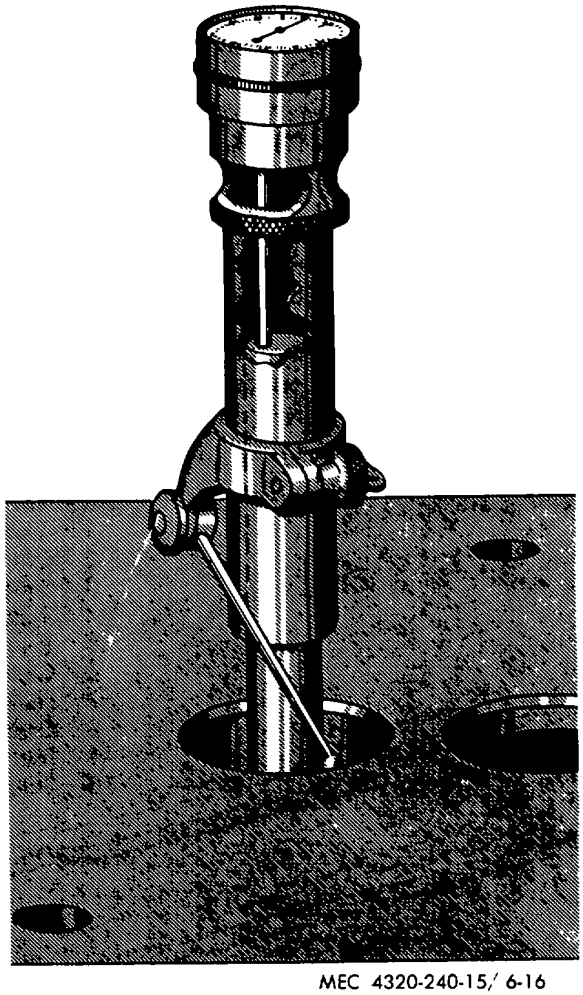


Figure 6-16. Indicating valve seat trueness.

b. Removal.

(1) Refer to paragraph 6-14b and remove the oil pan.

(2) Refer to figure 6-18 and remove the oil pump.

c. Installation.

(1) Refer to figure 6-18 and install the oil pump.

(2) Refer to paragraph 6-14b and install oil pan on engine and engine in pumping unit in reverse order of removal.

6-16. Pistons and Connecting Rods

a. General. The pistons and connecting rods are positioned in the cylinder bores. Their

basic function is to transmit energy to the crankshaft.

b. Removal.

(1) Refer to paragraph 6-15b and remove the oil pump.

(2) Refer to paragraph 6-12b and remove the cylinder head.

(3) Ream the ridge off the top of each cylinder bore with a standard ridge reamer. Blow metal fragments from the cylinder with compressed air.

(4) Refer to figure 6-19 and remove the two nuts (27) that secure a connecting rodcap to a connecting rod; remove the cap (18) and sleeve bearing (19).

(5) Push the-assembled rod and piston up through the top of the block. While pushing the piston and rod from the block be very careful the connecting rod does not scratch the cylinder wall.

c. Disassembly. Refer to figure 6-19 and disassemble connecting and piston assembly. Disassemble the pistons and connecting rods in sets and keep the sets together. Also be sure each piston rod assembly is reinstalled in the cylinder from which it was removed.

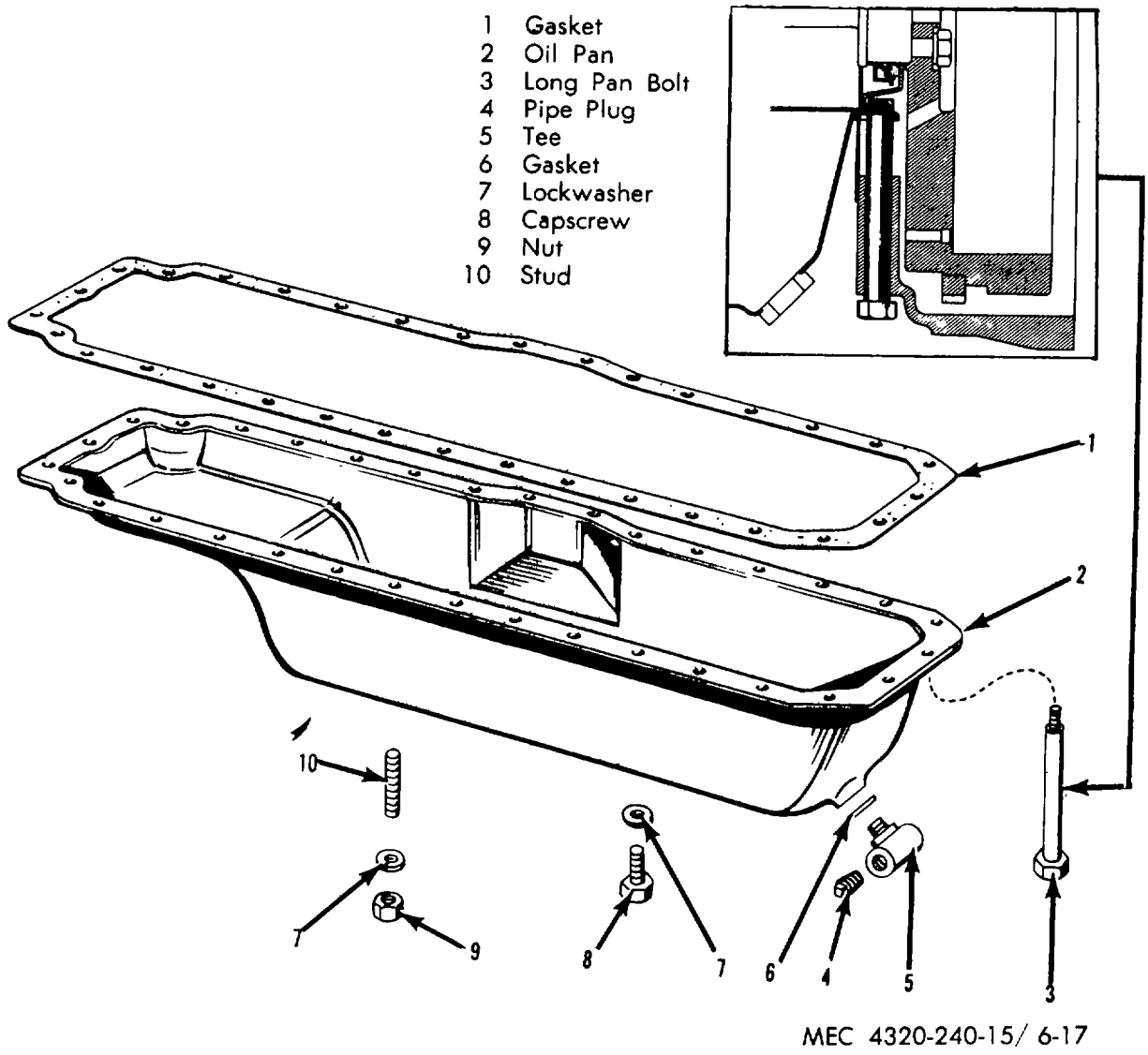


Figure 6-17. Oil pan-exploded view.

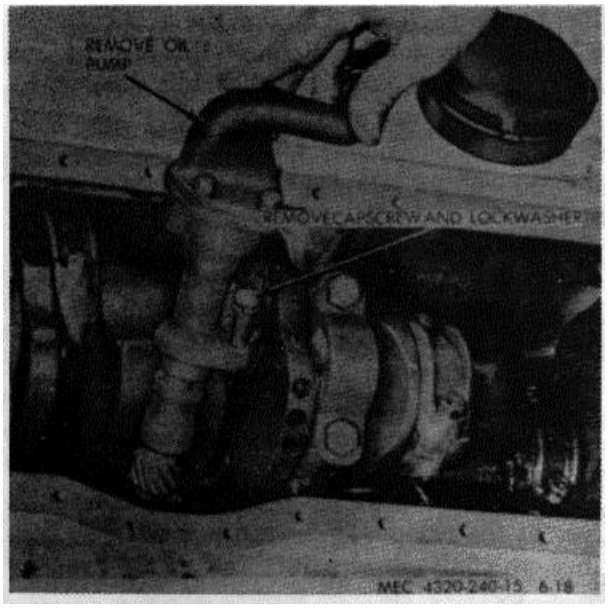


Figure 6-18. Oil pump removal and installation.

d. Cleaning, Inspection, and Repair.

(1) Clean all parts in an approved cleaning solvent; dry with clean dry, compressed air.

(2) Inspect pistons, piston pins, bearings, and connecting rods for cracks, distortion, scoring, pitting or other defects. Replace piston rings and damaged or defective parts.

(3) Refer to figure 6-20 and check piston fit using a piece of 0.015 inch feeler stock cut 1/2 inch wide. Dress the edge of the feeler stock with a stone to remove burs and feathered edges. The block and pistons must be at room temperature when piston fit is tested. Position the feeler stock midway between the piston pin bosses. With the piston and feeler stock inserted about 2 inches into the sleeve the feeler stock must pull from the block with 5 to 10 pounds pull. If the feeler stock does not offer enough resistance, perform same test with a new standard size piston. If sufficient resist

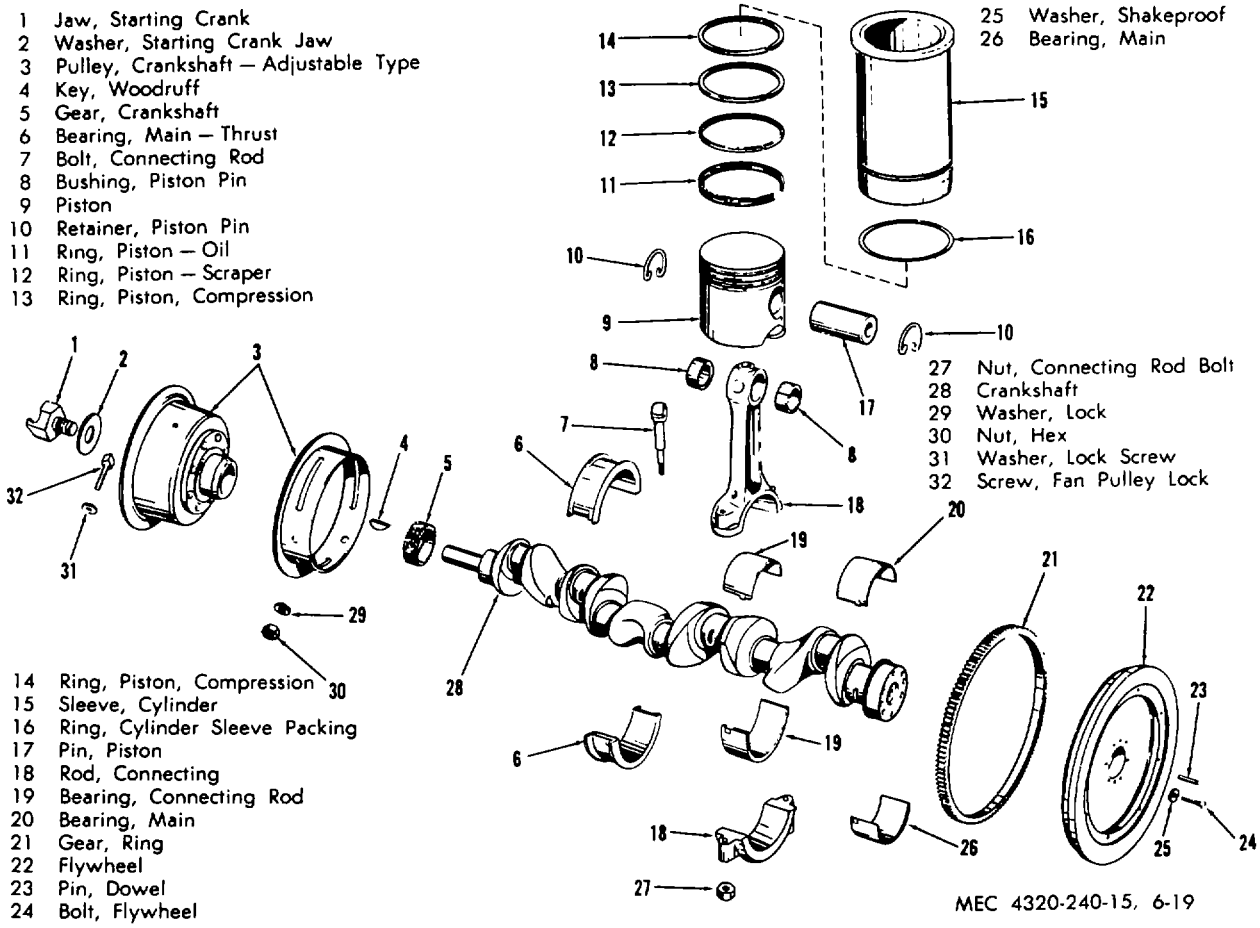


Figure 6-19. Crankshaft, pistons, connecting rods, bearings.

ance still is not obtained, refer to paragraph 6-19c(6).

(4) If new pistons and pins are being used they may be installed as received, as they have been pre-pin fitted.

(5) If the pistons and pins are not being replaced check the clearance between the piston pins and the sleeve bearings. If a piston pin will drop through a piston under its own weight, it is considered to have too much clearance. If the clearance is found too loose press new sleeve bearings into the pistons and hone to provide the proper fit. Which is a push fit with piston and pin both at room temperature.

(6) Refer to figure 6-21 and check piston ring gap by sliding the piston rings squarely into the cylinder sleeves in which they will be used. Check the ring gap with feeler stock. If the gap is too small, file the rings to provide a proper gap.

(7) Check the crankpin bearing journal to connecting rod bearing clearance with plastigage as follows: Place a piece of plastigage near the oil hole of the bearing cap. Position the cap on the connecting rod and secure with the two capscrews. Tighten the capscrews to 57-69 ft-lbs torque. Remove the bearing and bearing cap. Check the bearing journal-to bearing clearance using plastigage if clearance is not between 0.0005 and 0.003 inch, replace the connecting rod bearings and recheck the clearance.

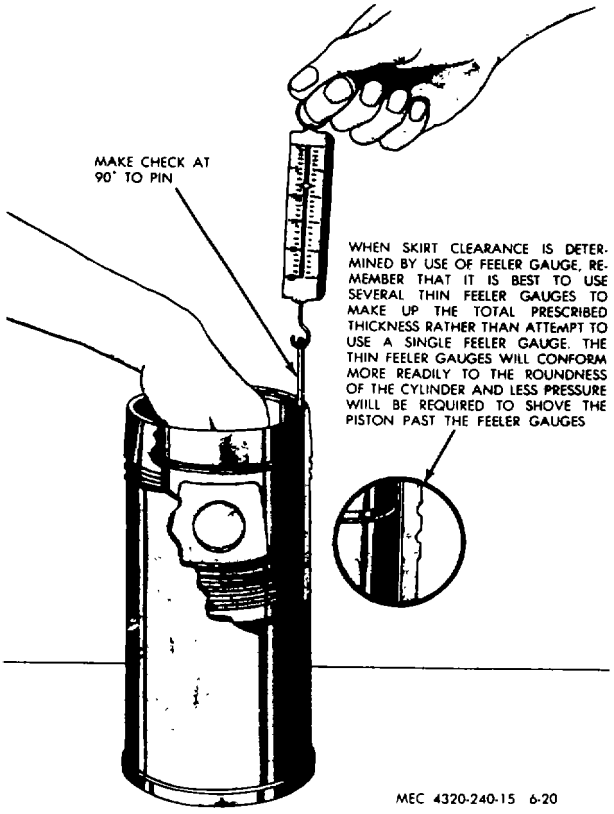


Figure 6-20. Fitting Piston

(8) As an alternate method of checking crank pin bearing journal-to-connecting rod bearing clearance, install a piece of 0.003 inch thick feeler stock between the bearing and journal. Lubricate the bearing journal with SAE 10 engine oil. Install the connecting rod cap. Tighten the connecting rod capscrews to 57-59 ft-lbs of torque. Try to slide the connecting rod alternately toward the front and rear of the engine. If clearance is within tolerance, a definite drag will be felt. If clearance is not within tolerance, replace the connecting rod bearings and recheck the clearance.

e. Reassembly.

(1) Refer to figure 619 and reassemble connecting rod and piston sets, using standard piston ring expander.

(2) Refer to figure 6-21 ar4 check piston ring side clearance with feeler stick.

f. Installation.

(1) Refer to figure 6-22 and install connecting rod and piston sets in cylinder block, using standard ring compressor.

(2) Install rod bearings in connecting rods and rod caps.

(3) Tighten connecting rod capscrews to 57-59 ft-lbs of torque.

(4) Refer to paragraph 6-15c and perform operations described.

6-17. Flywheel and Flywheel Housing

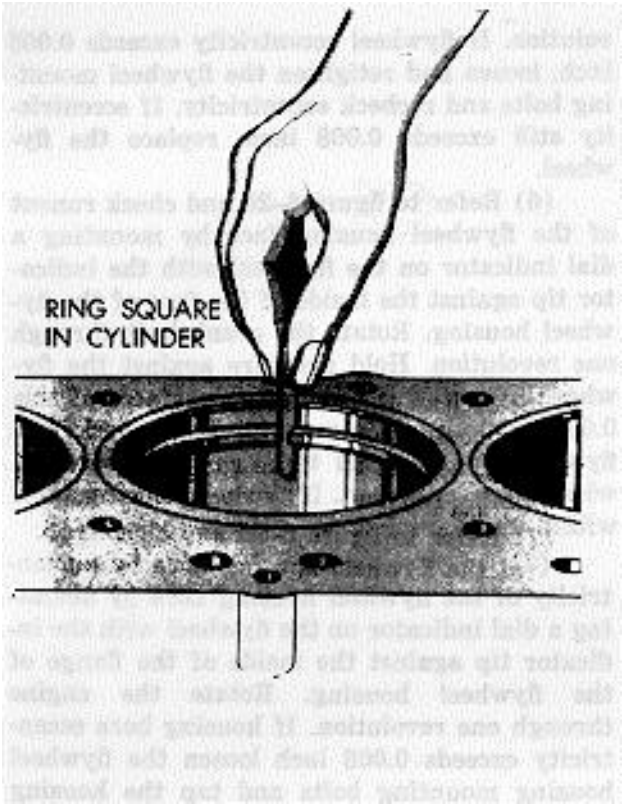
a. General. The flywheel and flywheel housing are located at the end opposite the cooling fan, in the engine assembly. The flywheel serves as a means of maintaining engine momentum and aids in the starting of the engine. The flywheel housing surrounds the flywheel and serves as a means of attaching equipment.

b. Removal.

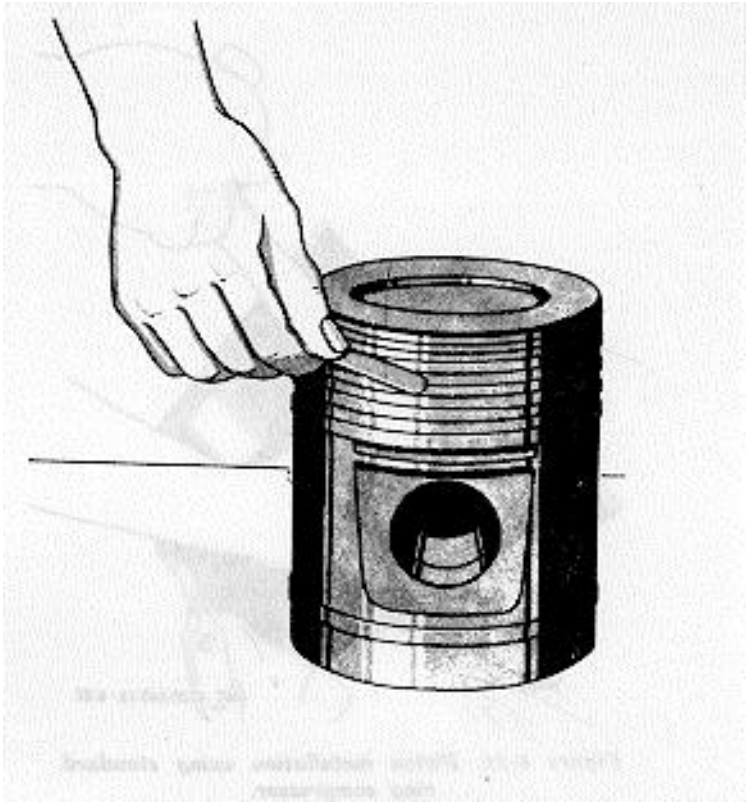
(1) Refer to figure 5-1 and remove engine assembly and housing.

(2) Refer to figure 6-23 and remove flywheel.

(3) Refer to figure 6-24 and remove cap



CHECK RING GAP



PISTON RING SIDE CLEARANCE

RING GAP		MAX. WEAR BEFORE REPLACING	GROOVE CLEARANCE		MAX. WEAR BEFORE REPLACING
TOP	.010"-.020"	.045"	TOP	.022 "-.004 "	.006"
2ND	.010"-.020"	.045"	2ND	.0015"-.0035"	.006"
3RD & 4TH	.010"-.020"	.045"	3RD & 4TH	.0005"-.0035"	.006"

MEC 4320-240-15,' 6-21

Figure 6-21. Checking piston ring clearance.

screws (8) and washers (7) remove housing (1).

c. Cleaning, inspection, and repair.

(1) Clean all parts in an approved cleaning solvent. Dry with clean, dry, compressed air.

(2) Inspect the flywheel housing for / cracks, damaged sealing surfaces, or other defects.

(3) Inspect the flywheel for damaged teeth, cracks, distortion, or other defects.

(4) Replace damaged or defective parts.

d. Installation.

(1) Refer to figure 6-24 and install flywheel housing.

(2) If the teeth on the flywheel ring gear are damaged, replace the ring gear as follows: Cut the ring gear with a torch or hacksaw and

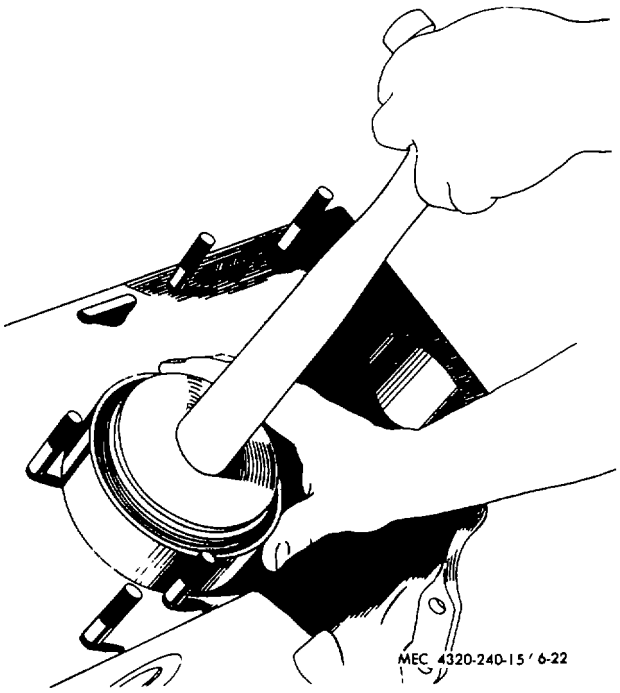


Figure 6-22. Piston installation using standard ring compressor.

remove the ring gear from the flywheel. When cutting the ring gear, be extremely careful not to damage the flywheel. Heat the replacement ring gear in an oven and cool the flywheel in a refrigerator. Position the replacement ring gear on the flywheel. As the ring gear and the flywheel approach the same temperature, the ring gear will contract to a very tight fit of the flywheel.

(3) Refer to figure 6-23 and install flywheel.

(4) Refer to figure 625 and check flywheel runout by mounting a dial indicator on the flywheel housing with the indicating tip against the face of the flywheel. Rotate the crankshaft through one full revolution. Hold pressure against the flywheel to eliminate crankshaft end play. If flywheel runout exceeds 0.008 inch, remove the flywheel and clean the crankshaft flange and flywheel seat. Install the flywheel and recheck runout. If runout still exceeds 0.008 inch, replace the flywheel.

(5) Refer to figure 6-25 and check flywheel eccentricity by mounting a dial indicator on the flywheel housing, position the tip against the inside of the counterbore of the flywheel. Rotate the crankshaft through one revolution. If flywheel eccentricity exceeds 0.008 inch, loosen and retighten the flywheel mounting bolts and recheck eccentricity. If eccentricity still exceeds 0.008 inch, replace the flywheel.

(6) Refer to figure 6-25 and check runout of the flywheel housing face by mounting a dial indicator on the flywheel with the indicator tip against the inside of the face of the flywheel housing. Rotate the crankshaft through one revolution. Hold pressure against the flywheel to eliminate end play. If runout exceeds 0.008 inch, clean the mounting surfaces of the flywheel housing and the block. Recheck flywheel housing runout. If the runout is still not within limits, replace the flywheel housing.

(7) Refer to figure 625 and check eccentricity of the flywheel housing bore by mounting a dial indicator on the flywheel with the indicator tip against the inside of the flange of the flywheel housing. Rotate the engine through one revolution. If housing bore eccentricity exceeds 0.008 inch loosen the flywheel housing mounting bolts and tap the housing into its proper position with a soft hammer.
Tighten the bolts and recheck housing bore eccentricity. If the housing cannot be brought into true position, replace the housing.

(8) Refer to paragraph 5-22b and install the engine assembly.

6-18. Crankshaft, Crankshaft Bearings, and Camshaft

a. General. The crankshaft is located at the lower end of engine assembly. Its purpose is to change the reciprocating action of the pistons into revolutions of the flywheel. The camshaft is driven by the crankshaft through a gear train. It is designed to maintain the timing of the entire engine.

b. Removal.

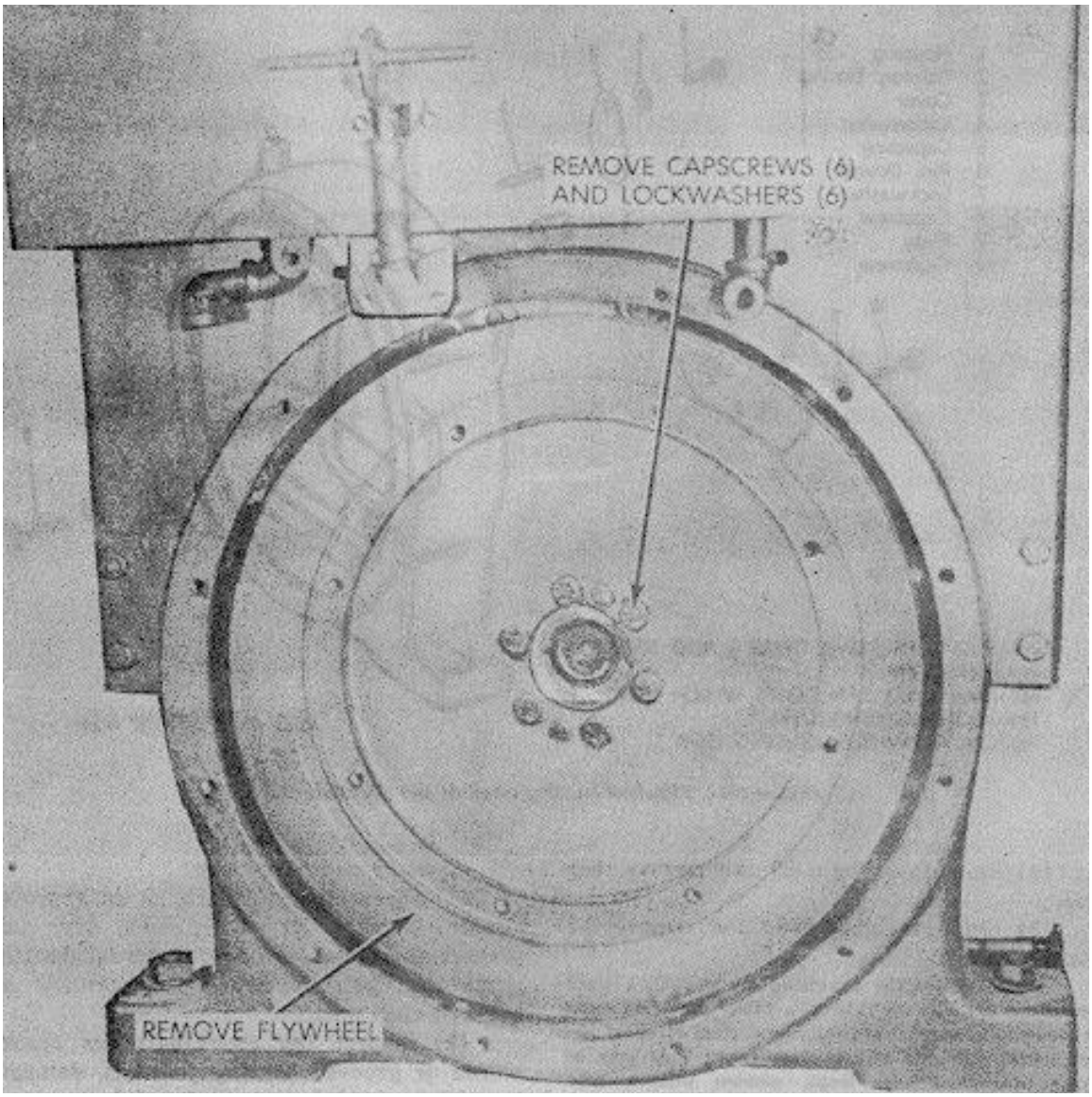
(1) Refer to paragraph 5-22a and remove the engine and housing assembly.

(2) Refer to paragraph 5-23a and remove housing from engine.

(3) Position engine on side, be careful not damage any of the protective housing.

(4) Refer to paragraph 3-46d and remove the magneto.

(5) Refer to paragraph 331b and remove the fuel pump.



MEC 4320-240-15/6-23

Figure 6-23. Flywheel removal and installation.

(

6) Refer to paragraph 3-34c and remove the governor.

(7) Refer to figure 6-26 and remove dampener and pulley.

(8) Refer to figure 6-27 and remove the gear cover.

(9) Refer to figure 6-28 and remove front seal.

(10) Refer to figure 3-22 and remove the starting motor.

(11) Refer to paragraph 6-14b and remove the oil pan.

(12) Refer to paragraph 6-17b and remove the flywheel and flywheel housing.

(13) Refer to figure 6-17 and remove the oil pump.

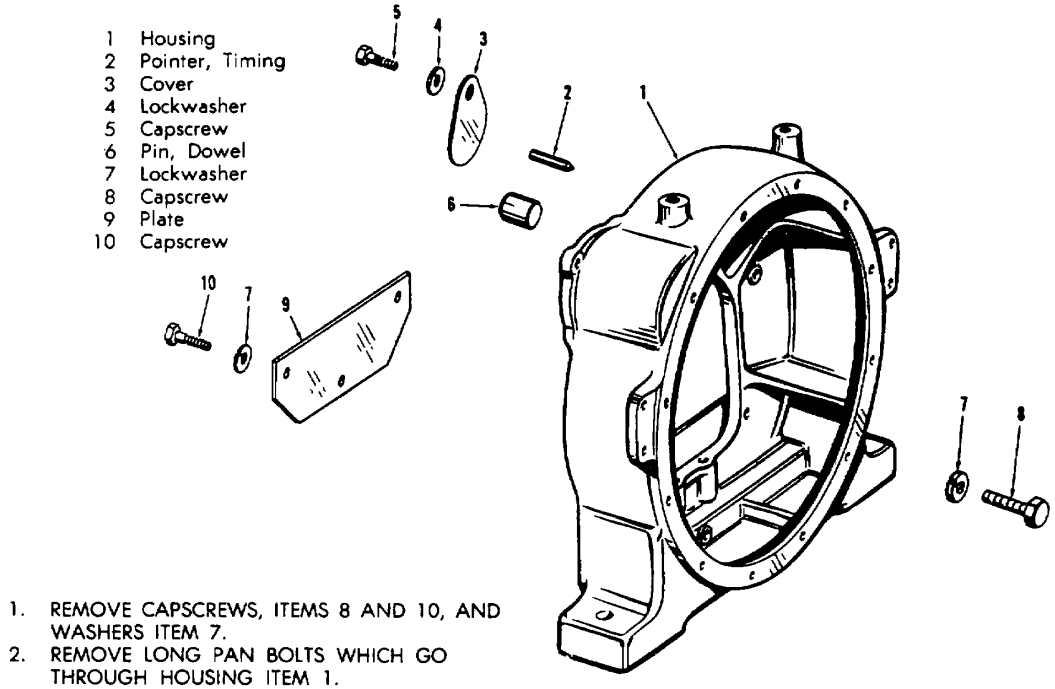


Figure 6-24. Flywheel housing removal and installation.

(14) Refer to figure 6-29 and remove rear seal.

(15) Refer to figure 6-30 and remove the camshaft.

***Note*: Unless the engine is inverted on a work stand or tipped on its side on a table, provision must be made to keep the cam followers lifted clear of the cam lobes while the cam is withdrawn. This may be done with small wire loops, wooden wedges, tape around the upper portion of the follower, or any other method that works out conveniently. Withdraw the camshaft from its bushings or case.**

***Caution*: If the edges of the cam lobes are allowed to drag across the bushings, grooves and scratches may be formed that will impair lubrication and service life.**

(16) Remove capscrews, rod caps, and rod bearing from connecting rods.

(17) Remove capscrews, washers, main bearing caps, and main bearings.

(18) Remove the crankshaft from cylinder blocks.

c. Cleaning and Inspection.

(1) Clean all metal parts in an approved cleaning solvent. Dry with clean, dry, compressed air. Make sure that the crankshaft oil parts are open by blowing compressed air through each port.

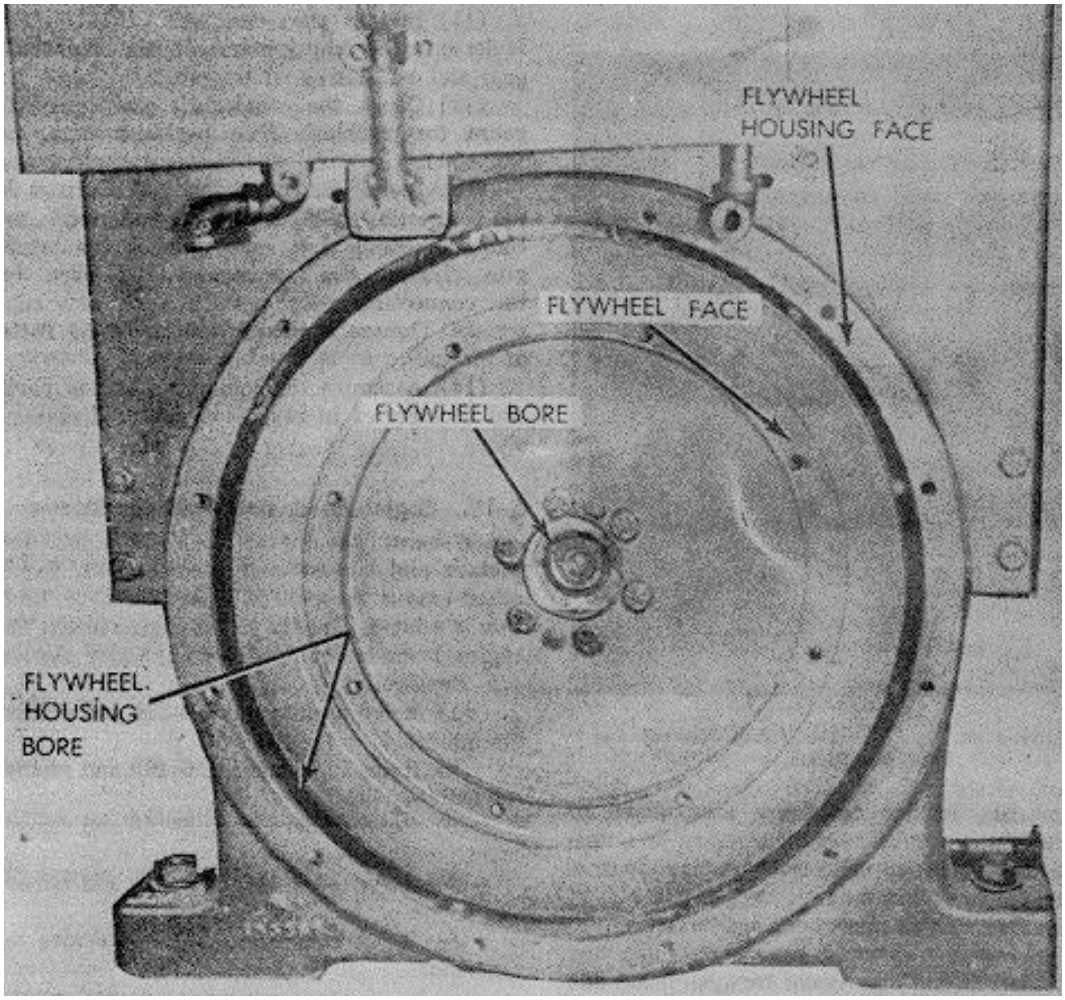
(2) Inspect the crankshaft for cracks, scored or grooved bearing journals, damaged key slots and bolt holes, or other defects.

(3) Inspect the camshaft for cracks, pitting, worn or scored lobes or bearing journals, damaged threads and key slots, or other defects.

d. Installation.

(1) If the crankshaft gear is damaged or defective, refer to figure 6-31 and remove the gear from the crankshaft.

(2) Position the upper half of the main bearings in the block. Install the crankshaft in the block. Install the lower half of the main bearings in the bearing caps.



MEC 4320-240-15/6-25

Figure 6-25. Checking flywheel housing and flywheel for runout.

(3) Check the clearance between the crankshaft bearing journals and bearings with Plastigage as directed in paragraph 6-16d.

(4) Clearance must be between .0024 and .0044 inch. If the clearance is not within these limits, replace the bearings and recheck the clearance.

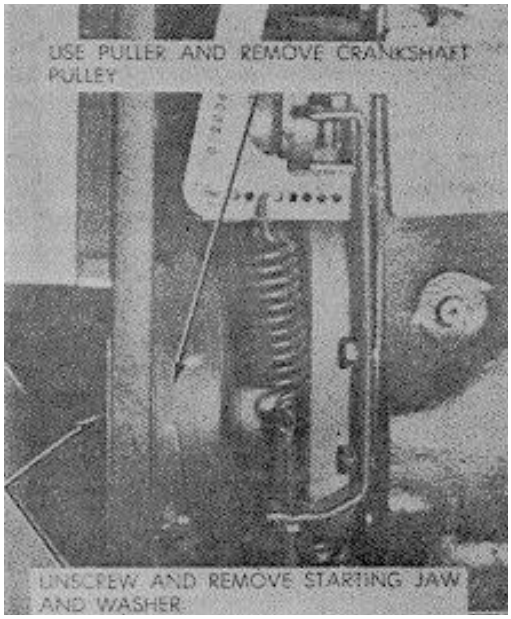
(5) Check the remaining bearing-to-bearing journal clearances and replace bearings as necessary.

(6) An alternate method of checking bearing clearance is as follows:

(*a*) Oil bearing and bearing journal with engine oil.

(*b*) Position a strip of 0.0044 inch feeler gauge, ½ inch long, on the bearing cap.

(c) Install the cap on the block; secure with the screws and lockwashers. Tighten the screws to 10-12 ft-lbs. of torque.



MEC 4320-240-15/6-26

Figure 6-26. Dampener and pulley removal and installation.

(*d*) Try to turn the crankshaft by hand. If the crankshaft will not turn or a definite drag is felt, bearing-to-bearing journal -clearance is within tolerance.

(7) After all main bearings have been installed, check crankshaft end play using a dial indicator. If end play is not between 0.003 and 0.007 inch, replace the front sleeve bearing.

(8) If the camshaft gear has to be replaced. Removal of the gear from the camshaft requires an arbor press and a suitable support plate to hold the gear. Do not attempt to remove the gear by makeshift methods that may distort the shaft or gear.

(9) Install the camshaft bearing journals and camshaft bearings with feeler stock cut in strips ¼ inch wide. Dress the feeler stock with a stone to eliminate burs or feathered edges. Clearance between the bearings and journals must be between 0.0015 and 0.003 inch.

(10) If clearance exceeds 0.003 inch, remove the camshaft from the block and install new camshaft bearings. The camshaft bearings are presized and do not have to be honed after installation.

(11) Install the camshaft (fig. 6-30). Make sure the timing marks on the crankshaft gear and camshaft gear line up.

(12) Check the crankshaft and camshaft gears for backlash. The backlash must be .002 - .004.

(13) Install the connecting rod bearings in the connecting rods, and connecting rod caps. Pull the connecting rods against the crank pins. Install the connecting rod caps on the connecting rods; secure with two capscrews. Tighten the capscrews to 57-59 ft-lbs of torque.

(14) Assemble the remaining engine parts and accessories in reverse order of disassembly.

6-19. Engine Block and Cylinder Sleeve

a. General. The engine block is the most important and largest engine component. Every other engine component is attached, or function is related, directly to the engine block. The engine block is equipped with cylinder sleeves.

b. Removal.

(1) Refer to paragraph 6-11*b* and remove the manifold.

(2) Refer to paragraph 6-12*b* and remove the cylinder head.

(3) Refer to paragraph 6-18*b* and remove crankshaft and camshaft.

(4) Refer to paragraph 3-50*b* and remove water pump.

(5) Refer to figure 3-20 and remove the generator.

(6) Make sure all engine accessories and components are removed, refer to chapter 6 section I and chapter 6 section II and remove all components and accessories.

(7) Remove cylinder sleeves, using sleeve puller.

c. Cleaning and inspection.

(1) Remove dirt and grease deposits from the block with a putty knife. Steam-clean the block.

(2) Inspect the block for cracks, damaged sealing surfaces, scored or damaged bearing sets, damaged threads, loose or damaged studs, corrosion in the water jacket, or other defects.

(3) Refer to paragraph 6-16*d* and check piston fit in cylinder sleeve.

(4) Check cylinder sleeve wear with an inside micrometer. Measure the cylinder bore

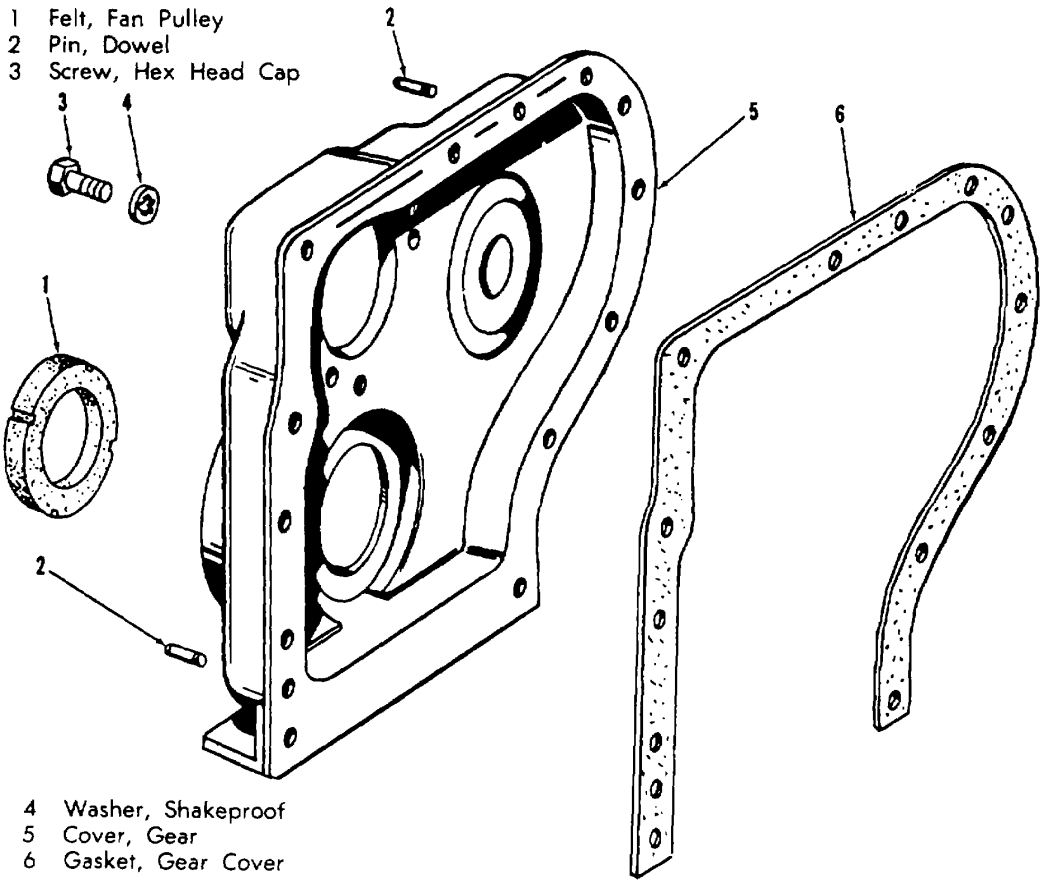


Figure 6-27. Gear cover removal and installation.

at 45 degree intervals below the travel of the lowest piston ring where the cylinder is not worn. Compare this measurement with a measurement taken about ¼ inch below the top of the cylinder. The maximum allowable cylinder wear (the difference between these two measurements) is 0.008 inch.

(5) Replace the block if it is cracked or defects cannot be repaired. Replace loose or damaged studs. Retap damaged threads.

(6) If a proper piston fit cannot be attained (para 6-16*d*), the cylinder sleeves are scratched or scored, or cylinder sleeves wear exceeds 0.008 inch, rebore and fit with new pistons, or replace the cylinder sleeves.

d. Installation.

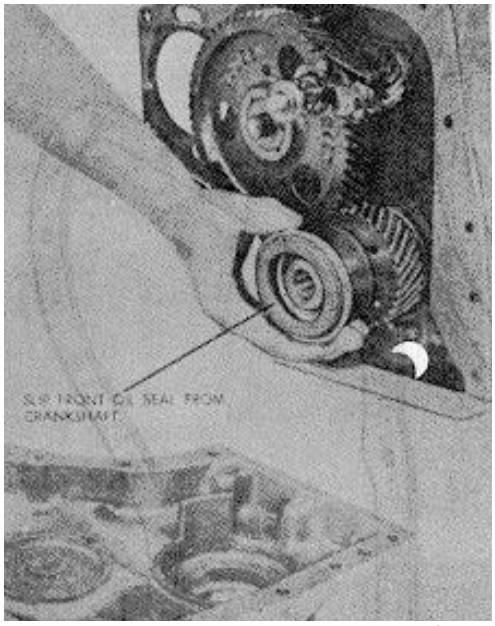
(1) Install the cylinder sleeves as follows:

(a) Clean and well lubricate the seal ring seating surfaces with liquid soap. Do not use oil on rubber rings.

(b) Slip the seal rings over the sleeve and into the grooves. Refer to figure 6-32 and run a pencil or like instrument around finder the ring to distribute the rubber material around the sleeve more evenly.

(c) Soap the seal rings and surrounding areas. Aline the sleeve in the crankcase and force it in with a firm thrust of the hands. Heavy hammering or driving is unnecessary and undesirable.

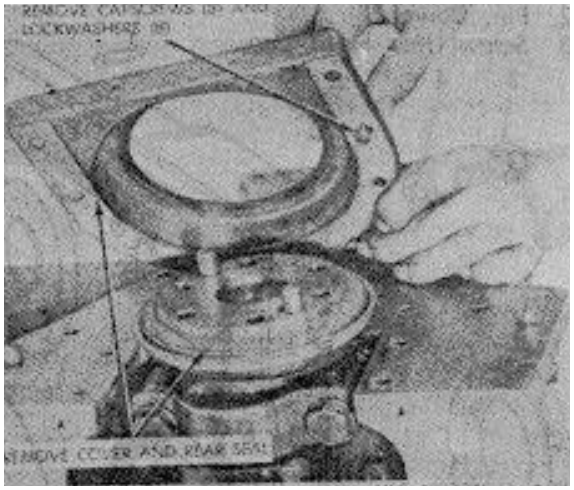
(2) Refer to figure 6-33 and check the sleeve bores for distortion that might have occurred due to inaccurate placement of the seal ring material.



MEC 4320-240-15/6-28

Figure 6-28. Front seal removal and installation.

It is not unusual when fitting this type of sleeve to find it necessary to withdraw the sleeve, resoap and even up the rings, and reinstall it several times before obtaining an out-of-round reading within the limits of .001 - .002 inch.



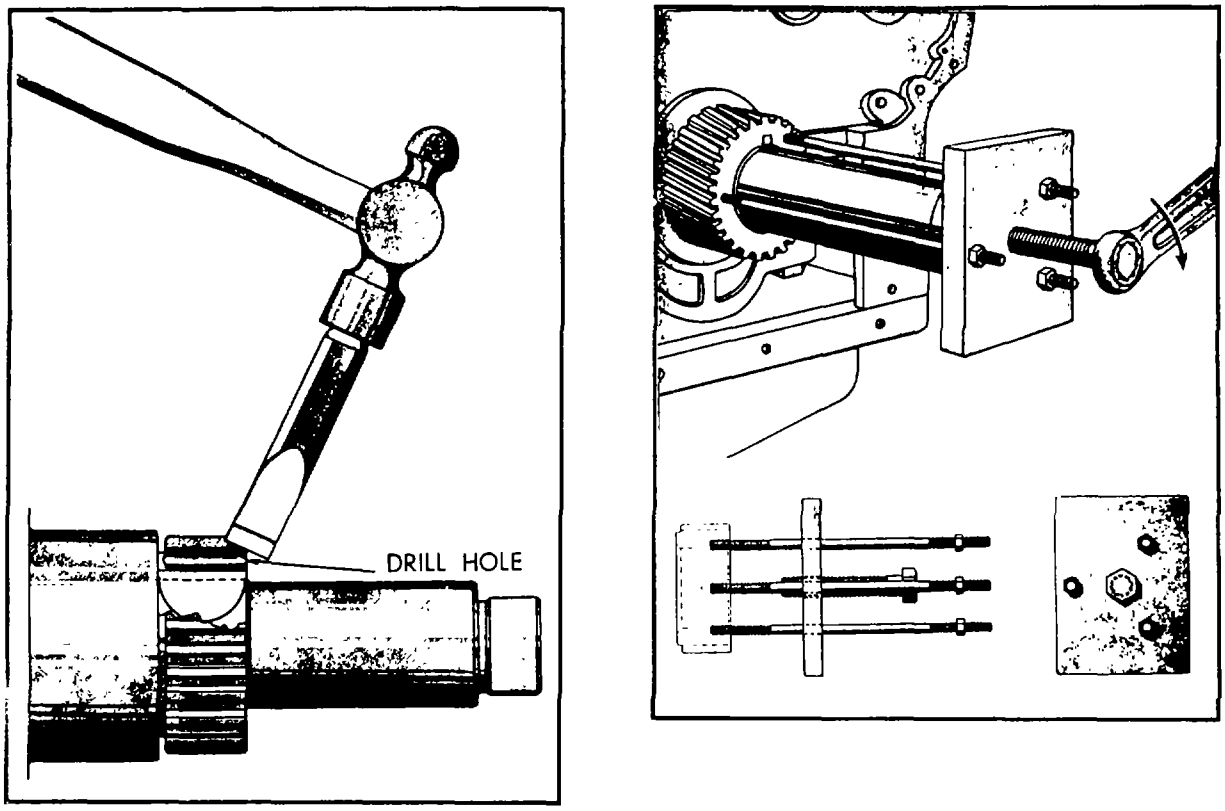
MEC 4320-240-15/6-29

Figure 6-29. Rear seal removal and installation.

(3) Refer to figure 6-34 and check gasket crush. The sleeve must project a few thousandths above the crankcase deck.

(4) Assemble and install the engine in reverse order of disassembly.

Figure 6-30. Camshaft removal and installation.



A REMOVING CRANKGEAR BY SPLITTING

B. CRANKGEAR PULLER

Figure 6-1. Crankshaft gear removal and installation.

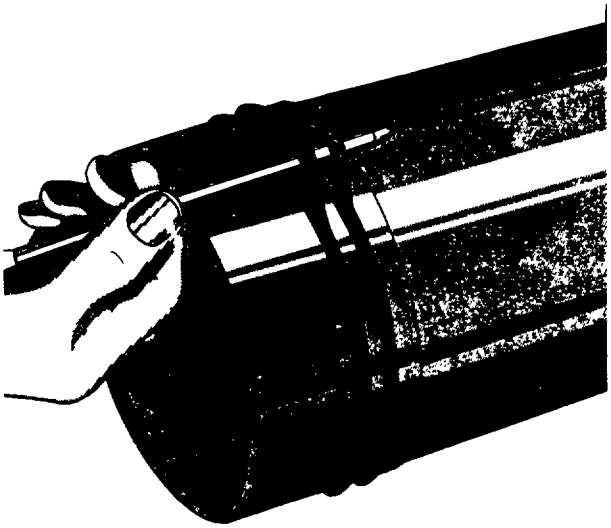


Figure 6-2. Evening-up rubber rings.

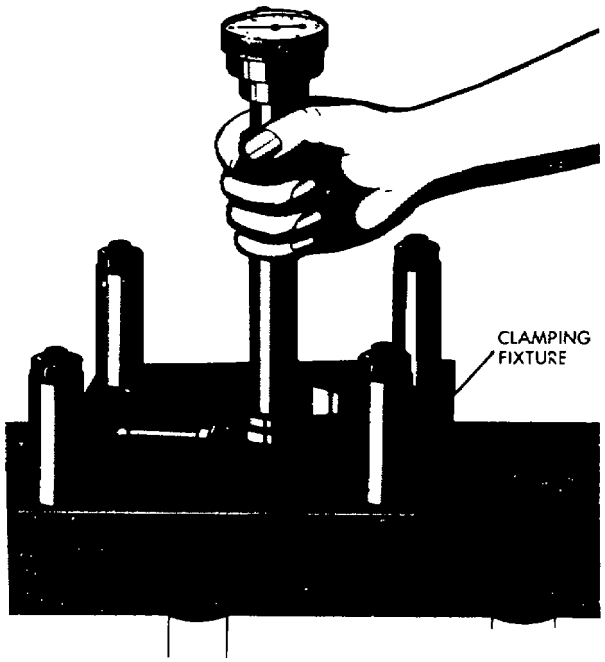
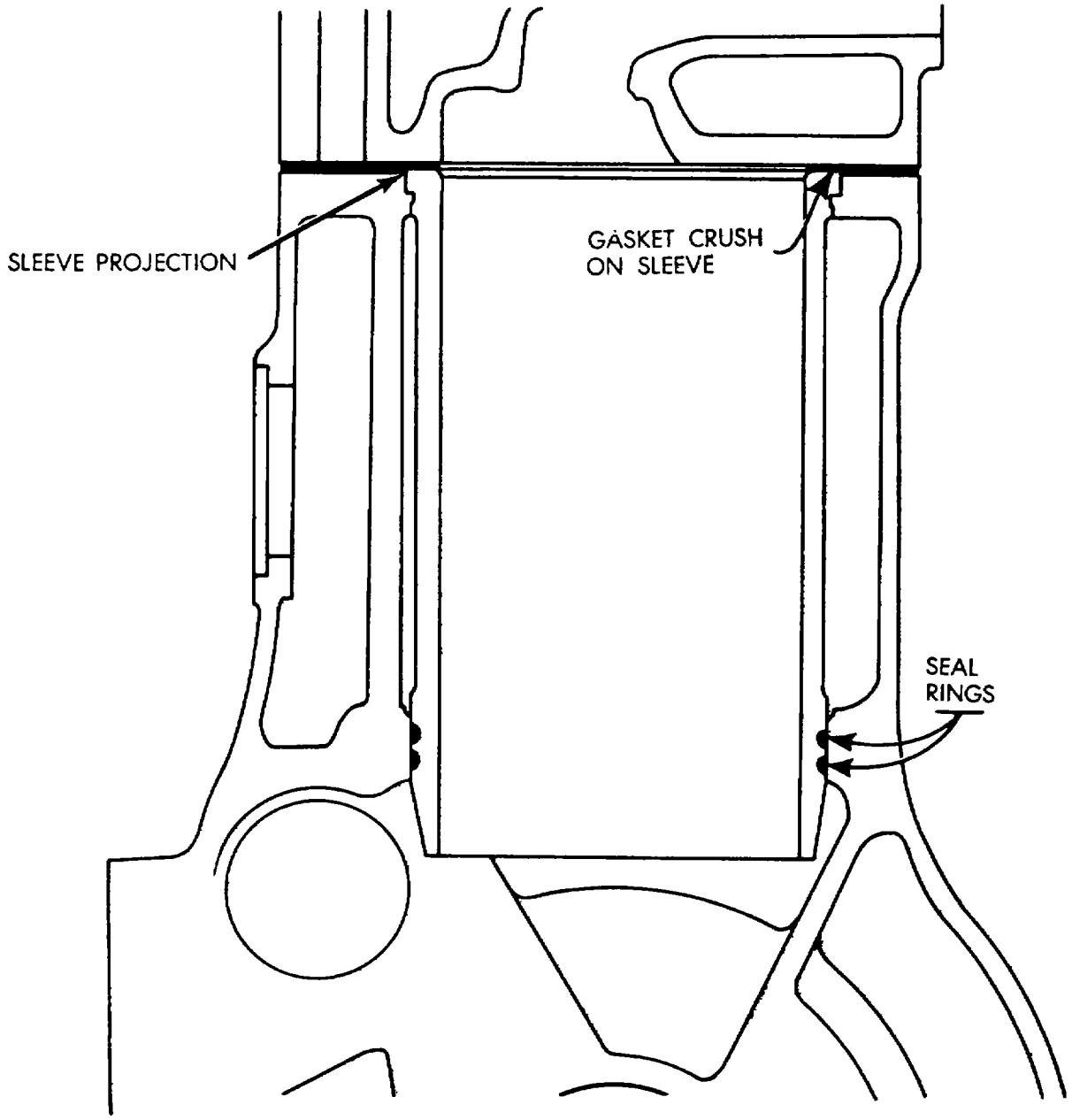


Figure 6-33.Checking sleeve for distortion.



IN THE ABSENCE OF REQUIRED PROJECTION, THIN SHIMS OF STEEL MAY BE USED UNDER THE CYLINDER SLEEVE FLANGES TO INCREASE THEIR HEIGHT

Figure 6-34 Checking gasket crush on sleeve.

CHAPTER 7

PUMP REPAIR INSTRUCTIONS

7-1. General

Refer to paragraph 3-61a for description.

7-2. Pump Repair

a. Removal. Refer to figure 3-39 and remove the pump from the pumping unit.

b. Disassembly. Refer to figure 3-40 and disassemble the pump.

c. Cleaning and Inspection. Refer to paragraph 3-61e for cleaning and inspection instructions.

d. Wear Ring Inspection and Replacement. Check wear ring to impeller running clearance, if the clearance is over replace the rings as follows:

(1) Refer to figure 3-40 and unscrew setscrews (19).

(2) Use puller and remove wear rings (18) and (45) or turn to thin shell and collapse.

(3) Press new rings in place.

(4) Drill and tap number 10-24 two holes 180° apart.

(5) Replace setscrews (19).

e. Overhaul.

(1) Disassemble the pump in accordance with paragraph 7-2b, above.

(2) Replace wear rings, bearings, oil seal, mechanical seal, shaft sleeve "0O" ring, check valve, impeller nut, and all gaskets.

(3) Inspect all other parts for cracks, breaks, stripped threads, wear, or other damage; replace if damaged.

f. Reassembly. Refer to figure 3-40 and assemble pump using new gaskets and seals.

g. Installation. Refer to figure 3-39 and install pump in reverse order of removal

CHAPTER 8

SKID BASE AND RELATED PARTS REPAIR INSTRUCTIONS

8-1. General

a. The skid base is composed of steel I beam side rails heavily braced with I beam cross members and one tubular cross member at each end. A steel plate is provided under the front of the base to protect the fuel tank from puncture.

b. The skid base is of welded construction with the component parts attached by bolts and nuts. The fuel tank is mounted between the side rails of the skid base.

8-2. Repair

a. Removal.

(1) Refer to paragraph 3-61c and remove the pump assembly.

(2) Refer to paragraph 5-22a and remove the engine assembly.

(3) Refer to paragraph 3-42 and remove the batteries.

b. Disassembly. Disassemble the parts from the skid base as required. Refer to (fig. 8-1).

c. Cleaning, Inspection, and Repair.

(1) Steam-clean the skid base and battery box parts.

(2) Flush the fuel tank with an approved cleaning solvent and drain.

(3) Remove any greasy gummy deposits with a cloth dampened with an approved cleaning solvent; dry thoroughly.

(4) Inspect all parts for damage; if defective.

d. Assembly. Refer to figure -1 and assemble the parts of the skid base.

e. Installation.

(1) Refer to paragraph 3-42 and install the batteries.

(2) Refer to paragraph 5-22b and install the engine assembly.

(3) Refer to paragraph 3-61g and install the pump assembly.

8-3. Fuel Tank

a. General. Refer to paragraph 3-36a for description.

b. Removal.

(1) Refer to paragraph 3-61c and remove the pump assembly.

(2) Disconnect the fuel line.

(3) Unscrew and remove drain piping.

(4) Remove 8 capscrews and washers which fasten the fuel tank to the skid base.

(5) Remove the fuel tank.

c. Cleaning and Inspection. Refer to paragraph 3-37d and clean and inspect the fuel tank.

d. Repair or replace. If the fuel tank has been found defective repair or replace as required.

e. Installation. Install the fuel tank in reverse order of removal.

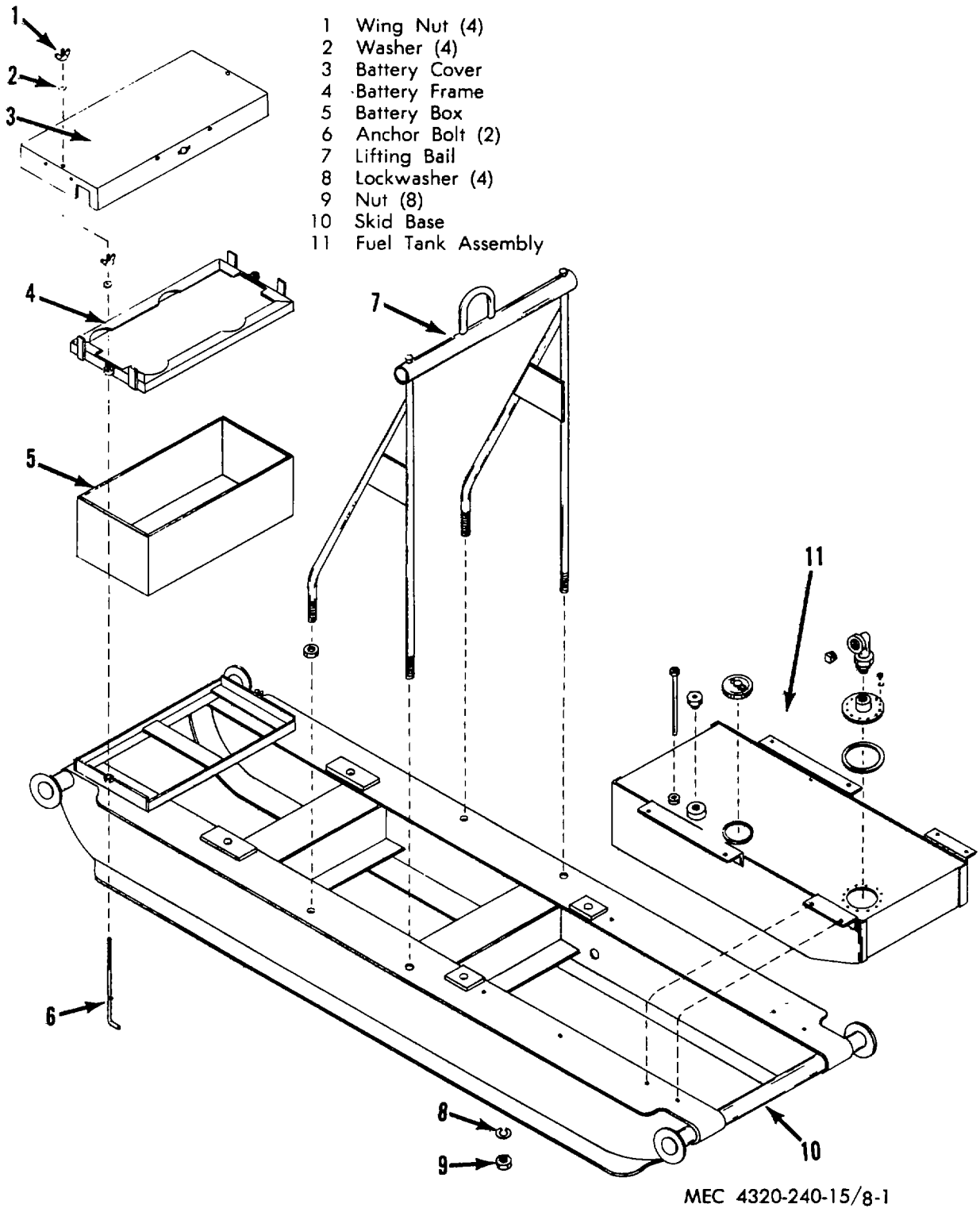


Figure 8-1. Skid base.

APPENDIX A

REFERENCES

A-1. Fire Protection	
TB 5-4200-200-10	Hand Portable Fire Extinguishers for Army 'Users
A-2. Lubrication	
C9100IL	Fuels, Lubricants, Oils and Waxes
LO 5-4320-240-12	End item LO. Also, add engine LO if applicable.
A-3. Painting	
TM 9-213	Painting Instructions for Field Use
A-4. Radio Suppression	
TM	11-483 Radio Interference Suppression
A-5. Maintenance	
TB ORD 651	Use of Antifreeze Solutions and Cleaning Compounds in Engine Cooling Systems
TM 3-750	Army Equipment Record Procedures
TM 9-6140-200-15	Operation and Organizational, Field, and Depot Maintenance: Storage Batteries, Lead-Acid Type
A-6-. Shipment and Storage	
TB 140-93-2	Preservation of USAMECOM Mechanical Equipment for Shipment and Storage
TB 740-93-3	Administrative Storage of USAMECOM Mechanical Equipment

APPENDIX B

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

B-1 Scope
This appendix lists items which accompany the pumping unit or are required for installation, operation, or operator's maintenance.

B-2. General
This Basic Issue Items List is divided into the following sections:

a. Basic Issue Items-Section II. A list of items which accompany the pumping unit or are required for the installation, operation, or operator's maintenance.

b. Maintenance and Operating Supplies Section III. A listing of maintenance and operating supplies required for initial operation.

B-3. Explanation of Columns
The following provides an explanation of columns in the tabular list of basic issue items, section II.
a. Source, Maintenance, and Recoverability Codes (SMR), Column (1).
Note. Common hardware items known to be readily available in Army supply will be assigned maintenance codes only. Source codes, recoverability codes, and quantity authorized will not be assigned to this category of items.
(1) Source code, indicates the selection status and source for the listed item. Source codes are:

Code *Explanation*

P Applied to repair parts which are stocked in or supplied from GSA/DSA or Army supply system, and authorized for use at indicated maintenance categories.

M Applied to repair parts which are not procured or stocked but are to be manufactured at indicated maintenance categories.

A Applied to assemblies which are not procured or stocked as such, but made up of two or more units, each of which carry, individual stock numbers and descriptions and are procured and stocked and can be assembled by units at indicated maintenance categories.

X Applied to parts and assemblies which are not procured or stocked, the mortality of which is normally below that of the applicable end item, and the failure of which should result in retirement of the end item from the supply system.

X1 Applied to repair parts which are not procured or stocked, the requirement for which will be supplied by use of the next higher assembly or components.

X2 Applied to repair parts which are not stocked. The indicated maintenance category requiring such repair parts will attempt to obtain them through cannibalization; if not obtainable through cannibalization, such repair parts will be requisitioned with supporting justification through normal supply channels. C Applied to repair parts authorized for local procurements. If not obtainable from local procurement, such repair parts will be requisitioned through normal supply channels with a supporting statement of nonavailability from local procurement. G Applied to major assemblies that are procured with PEMA (Procurement Equipment Missile Army) funds for initial issue only to be used as exchange assemblies at DSU and GSU level or returned to depot supply level. (2) Maintenance code, indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

Code *Explanation*

C Operator/crew

(3) Recoverability code, indicates whether unserviceable items should be returned for recovery or salvage. Items not coded are expendable.
Recoverability codes are:

Code *Explanation*

R Applied to repair parts and assemblies which are economically repairable at DSU and GSU ac

tivities and are normally furnished by supply on an exchange basis.

T Applied to high dollar value recoverable repair parts which are subject to special handling and are issued on an exchange basis. Such repair parts are normally repaired or overhauled at depot maintenance activities.

U Applied to repair parts specifically selected for salvage by reclamation units because of precious metal content, critical materials, high dollar value reusable casings and castings.

b. Federal Stock Number, Column (2). This column indicates the Federal stock number for the item.

c. Description, Column (S). This column indicates the Federal item name. and any additional description of the item required. A part number or other reference number is followed by the applicable five-digit Federal supply code for manufacturers in parentheses. Repair parts quantities included in kits, sets, and assemblies are shown in front of the repair part name.

d. Unit of Issue, Column (4). This column indicates the unit used as a basis for issue, e. g. , ea, pr, ft, yd, etc.

e. Quantity Incorporated in Unit rack, Column (5). This column indicates the actual quantity contained in the unit pack.

f. Quantity Incorporated in Unit, Column (6). This column indicates the quantity of the item used in the functional group.

g. Quantity Furnished With Equipment, Column (7). This column indicates the quantity of an item furnished with the equipment.

h. Quantity Authorized, Column (8). This column indicates the quantity of an item authorized the operator/crew to have on hand cr to obtain as required. As required items-are indicated with an asterisk.

i. Illustration, Column (9). This column is divided as follows:

(1) Figure Number, column (9) (a). Indicates the figure number of the illustration in which the item is shown.

(2) Item Number, column (9) (b). Indicates the callout number used to reference the item in the illustration.

B-4. Explanation of Columns in the Tabular List of Maintenance and Operating Supplies-Section III

a. Component Application, Column (1). This column identifies the component application of each maintenance or operating supply item.

b. Federal Stock Number, Column (2). This column indicates the Federal stock number for the item aid will be used for requisitioning purposes.

c. Description, Column (3). This column indicates the item and brief description.

d. Quantity Requires for Initial Operation, Column (4). This colunmn indicates the quantity of each maintenance or operating supply item required for initial operation of the equipment.

e. Quantity Required for 8 Hours Operation, Column (5). This column indicates the estimated quantities required for an average eight hours of operation.

f. Notes, Column (6). This column indicates informative notes keyed to data appearing in a preceding column.

Section II. BASIC ISSUE ITEMS

(1) SMR Code	(2) Federal Stock Number	(3) Description	(4) Unit of issue	(5) Qty inc in unit pack	(6) Qty inc in unit	(7) Qty furn with equip	(8) Qty auth	(9) Illustration (a) Figure No.	(9) Illustration (b) Item No.
		3100—BASIC ISSUE ITEMS, MANUFACTURER OR DEPOT INSTALLED							
PC		Binder, Looseleaf	ea	--	--	1	1		
PC		CASE, Operation and Maintenance Manuals	ea	--	--	1	1		
PC	----------	DA Lubrication Order; LO 5–4320–240–12	ea	--	--	1	1		
PC	----------	DA Technical Manual; TM 5–4320–240–15	ea	--	--	1	1		

Section III. MAINTENANCE AND OPERATING SUPPLIES

(1) Item	(2) Component application	(3) Federal stock number	(4) Description	(5) Quantity required f/initial operation	(6) Quantity required f/8 hrs operation	(7) Notes
1	0101 Crankcase (1)		Oil, Lubricating: 5 Gal. Pail as follows;			(1) Includes quantity of oil to fill Engine System as follows:
			OE–30	8 qt.	(3)	7 qt. crankcase
			OE–10	8 qt.	(3)	1 qt. oil filter
			OES	8 qt.	(3)	(2) See FSC C9100–1L for additional data & requesting procedures.
2	0304 Air Cleaner		Oil, Lubricating (3)	1 qt.		
3	0306 Fuel Tank		Fuel, Gasoline: Bulk as follows:	20 gal. (5)		(3) See current LO for grade application & replenishment intervals.
			Automotive Combat 91C	20 gal. (4)		(4) Tank Capacity
4	0501 Radiator		Water Antifreeze: 5 Gal. Can as follows:			
			Antifreeze: Ethylene glycol	20 qt.		
			Antifreeze: Compound Arctic 55 Gal. Drum	20 qt.		

APPENDIX C

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

C-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 end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from section II.

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

C-2. Explanation of Columns in Section II

a. Group Number, Column 1. The functional group is a numerical group set up on a functional basis. The applicable functional grouping indexes (obtained from TB 750-93-1, Functional Grouping Codes) are listed on the MAC (Maintenance Allocation Chart) in the appropriate numerical sequence. These indexes are normally set up in accordance with their function and proximity to each other.

b. Functional Group, Column 2. This column contains a brief description of the components of each functional group.

c. Maintenance Functions, Column S. This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these functions. The symbol designations for the various maintenance categories are as follows:

C-Operator or crew
O-Organizational maintenance
F-Direct support maintenance
H-General support maintenance
D-Depot maintenance

The maintenance functions are defined as follows:

A- Inspect: To determine serviceability of an item by comparing its physical, mechanical, and electrical characteristics with established standards.
B- Test: To verify serviceability and to detect electrical or mechanical failure by use of test equipment.
C- Service: To clean, to preserve, to charge, to paint, and to add fuel, lubricants, cooling agents, and air.
D- Adjust: To rectify to the extent necessary to bring into proper operating range.
E- Aline: To adjust specified variable elements of an item to bring to optimum performance.
F-Calibrate: To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparisons of two instruments, one of which is certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument being compared with the certified standard.
G- Install: To set up for use in an operational environment such as an emplacement, site or vehicle.
H- Replace: To replace unserviceable items with serviceable assemblies, subassemblies, or parts.
I- Repair: To restore an item to serviceable condition. This includes, but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and strengthening.
J- Overhaul: To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards using the Inspect and Repair Only as Necessary (IROAN) technique.
K- Rebuild: To restore an item to a standard as nearly as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished through complete disassembly of the item, inspection of all parts or components, repair or replacement of worm or unserviceable elements (items) using original manufacturing tolerances and specifications, and subsequent reassembly of the item.

d. Tools and Equipment, Column 4. This column is provided for referencing by code the

special tools and test equipment, (sec. III) required to perform the maintenance functions (sec. II).

e. Remarks, Column 5. This column is provided for referencing by code the remarks (sec. IV) pertinent to the maintenance functions.

C-3. Explanation of Columns in Section III

a. Reference Code. This column consists of a number and a letter separated by a dash. The number references the T and TE requirements column on the MIAC. The letter represents the specific maintenance function the item is to be used with. The letter is representative of columns A through K on the MAC. b. Maintenance Category. This column shows the lowest level of maintenance authorized to use the special tool or test equipment.

c. Nomenclature. This column lists the name or identification of the tool or test equipment.

d. Tool Number. This column lists the manufacturer's code and part number, or Federal stock number of tools and test equipment.

C-4. Explanation of Columns in Section IV

a. Reference Code. This column consists of two letters separated by a dash, both of which are references to section II. The first letter references column 5 and the second letter references a maintenance function, column 3, A through K.

b. Remarks. This column lists information pertinent to the maintenance function being performed, as indicated on the MAC, section II. Maintenance functions.

Functional group number	Component assembly nomenclature	Maintenance functions											Note Reference	
		A	B	C	D	E	F	G	H	I	J	K	L	M
		Inspect	Test	Service	Adjust	Aline	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
01	ENGINE													
0100	Engine assembly	O	O	O	--	--	--	--	F	F	H		------	A
0105	Valves:													
	Seats and valves	F	--	--	--	--	--	--	F	F	--	--	------	B
	Tappet, valve	F	--	--	O	--	--	--	F					
0106	Engine Lubrication System:	F	--	--	O	--	--	--	F					
	Filter and breather, oil		--	O	--	--	--	--	O					
	Regulator, pressure	O	--	--	O	--	--	--	O					
03	FUEL SYSTEM													
0301	Carburetor	O	--	--	O	--	--	--	O	F				
0302	Fuel Pump	O	O	--	--	--	--	--	O					
0304	Air Cleaner	O	--	O	--	--	--	--	O					
0306	Tanks, Lines, Fittings:													
	Tank, fuel	O	--	O		--	--	--	F	F				
0308	Governor	O	--	--	O	--	--	--	O	F				
0309	Fuel Filters	O	--	O	--	--	--	--	O	O				
05	COOLING SYSTEM													
0501	Radiator	O	F	O	--	--	--	--	F	F				
0504	Water Pump	O	--	--	--	--	--	--	O	F	--	--	------	C
0505	Fan Assembly													
	Belt, V-drive	O	--	--	O	--	--	--	O					
06	ELECTRICAL SYSTEM													
0601	Generator	O	O	--	--	--	--	--	O	O	--	--	------	D
0602	Generator Regulator	O	O	--	F	--	--	--	O	F				
0603	Starting Motor	O	O	--	--	--	--	--	O	O	--	--	------	E
0605	Ignition Components													
	Magneto assembly	--	O	--	O	--	--	--	O	O	--	--	------	F
	Spark plugs		O	O	O	--	--	--	O					
0612	Batteries, Storage	O	O	O	--	--	--	--	O					
47	GAGES													
4701	Instruments	O			--	--		--	O					
55	PUMPS													
5501	Pump Assembly	O	D	O	--	O	--	--	O	O	H	--	------	G

Section III. REMARKS

Reference code	Remarks
A-B	Test includes engine operation and compression.
B-I	Repair of valves and seats includes refacing.
C-1	Repair of water pump includes installing repair kit.
D-I	Repair of generator includes installing repair kit.
E-I	Repair of starter includes installing repair kit only.
F-I	Repair of magneto includes installing repair kit.
G-I	Installation of gasket kit only.

Section IV. SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS

Reference code	Maintenance level	Nomenclature	Tool number
		No special tools required	

INDEX

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