TM 5-4320-237-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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

PUMP, CENTRIFUGAL GASOLINE ENGINE DRIVEN; 50 GPM, 100-FOOT HEAD, FLAMMABLE LIQUID, BULK TRANSFER (BARNES MODEL-(QM-2-28002) FSN 4320-913-7131

This copy is a reprint which Includes current pages from Changes 6 through 8.

HEADQUARTERS, DEPARTMENT OF THE ARMY
APRIL 1967

SAFETY PRECAUTIONS

The unit must be connected to a suitable ground before operation. Arcing caused by buildup of static electricity may ignite volatile fluids and cause explosion and fire.

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

Do not smoke while opening the carrying box to reinstall the pumping assembly. Explosive vapors from fluids remaining in the hoses and pump body may be present in the enclosed box. Smoking or other source of ignitiom could cause explosion of these vapors.

No smoking or open fire are allowed within 50 feet of the equipment.

Change in force: C6. C7 and C8

TM 5-4320-237-15
C8

CHANGE
No. 8

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 4 July 1989

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

PUMP, CENTRIFUGAL: GASOLINE ENGINE DRIVEN: 50 GPM,
100-FOOT HEAD, FLAMMABLE LIQUID, BULK TRANSFER
(BARNES MODEL QM-2-28002)
NSN 4320-00-913-7131

Approved for public release. Distribution is unlimited.

TM 5-4320-237-15. 19 April 1967, is changed as follows:

Page 29. Immediately below paragraph title "58. Starting Pulley" add the following warning:

WARNING

Spark plug cable terminal must be
grounded; otherwise death or serious
injury could result.

Page 30. Figure 26. "Starting Pulley, removal and. installation" is superseded as follows:

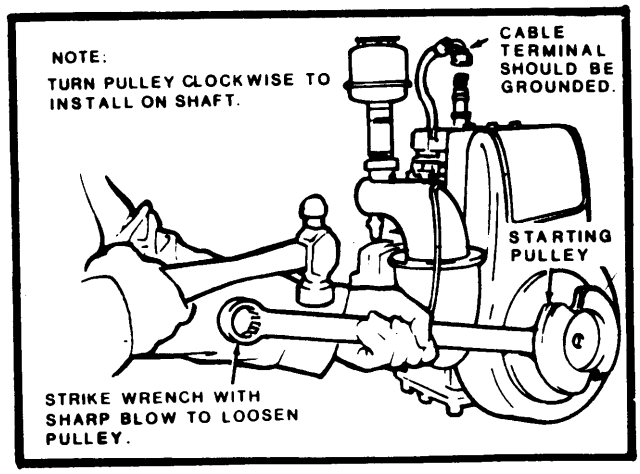

Figure 26. Starting pulley, removal and installation.

By Order of the Secretary of the Army:

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

Official:

WILLIAH J. MEEHAN, II
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Operator, Unit. Direct Support and General Support Maintenance requirements for pump, Centrifugal Flammable Liquid) Bulk Transfer, Gas Driven, 50 GPM. 100 Ft. Head (QM-2-28002).

CHANGE NO. 7

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 4 April 1987

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

PUMP, CENTRIFUGAL: GASOLINE ENGINE DRIVEN: 50 GPM,
100-FOOT HEAD, FLAMMABLE LIQUID, BULK TRANSFER
(BARNES MODEL QM-28002)
NSN 4320-00-913-7131

TM 5-4320-237-15, 19 April 1967, is changed as follows:

Throughout this manual. change "TM 38-750" to read "DA PAM 738-750."

Page 1. REPORTING OF ERRORS. "Commander, U.S. Army Troop Support and Aviation Materiel Readiness Command, ATTN: DRSTS-MPTS" on line 5, is changed to "Commander, U.S. Army Troop Support Command, ATTN: AMSTR-MCTS."

Page 1. "4300 Goodfellow Blvd., St. Louis, MO 63120", on lines 5 and 6, is changed to "4300 Goodfellow Blvd., St. Louis, MO 63120-1798."

Page 37, Figure 36. Add the following safety warning at the top of figure 36:

WARNING

Before removing the impeller from the engine crankshaft, disconnect the wire from the spark plug. Safely tie off the lead to prevent a discharge of spark. Failure to heed this warning can lead to accidental engine startup and can cause injury or death to personnel.

By Order of the Secretary of the Army:

JOHN A.WICKHAM, JR.
General,United States Army
Chief of Staff

Official:

R.L.DILWORTH
Brigadier General, United States Army
The Adjutant General

DISTRIBUTION:
To be distributed in accordance with DA Form 12-25A, Operator, Organizational, Direct Support and General Support maintenance requirements for Pump, Centrifugal, Flammable Liquid, Bulk Transfer, Gas Driven, 50 GPM, 100 FT Head (QM-2-28002) (TM 5-4320-237 Series)

Change in force: C6

*TM 5-4320-237-15
C6

CHANGE

NO. 6

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON. DC, *29 July 1977*

Operator, Organizationl, Direct and General Support and Depot Maintenance Manual
PUMP,CENTRIFUGAL: GASOLINE ENGINE DRIVEN; 50 GPM, 100-FOOT HEAD, FLAMMABLE LIQUID, BULK TRANSFER (BARNES MODEL QM-2-28002)
NSN 4320-00-913-7131

TM 5-4320-237-15, 19 April 1967, is changed as follows:

The title is changed as shown above.

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

[WARNING]

Before performing any maintenance, i.e., the disconnection of hoses and nozzles or the removal of dust caps or plugs, make sure the pumping assembly has been depressurized by draining the pressurized fuel through the dispensing nozzles into a suitable container.

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 i. The Table of Contents page. Add the following under the National Stock Number:

REPORTING OF ERRORS

You can help to improve this manual by calling attention to errors and by recommending improvements. Your letter. DA Form 2028 (Recommended Changes to Publications and Blank Forms), and/or DA Form 2028-2 (Recommended Changes to Equipment Technical Manuals). may he used. Copies of DA Form 2028-2 are attached in the back of this bulletin for your use. Please mail your recommended changes directly to Commander. U.S. Army Troop Support and Aviation Materiel Readiness Command. ATTN DRSTS-MTPS. 4300 Goodfellow Blvd., St. Louis, MO 63120. A reply will be furnished directly to YOU.

Page ii. The Table of Contents. Appendix I is changed to read: Appendix "A"; Appendix II is changed to read: Appendix "B" The Components of End Item List; Appendix III is changed to read: Apendix "C"; Appendix "B" Expendable Supplies and Materials List is added.

Page iii. Paragraph 1 is superseded as follows:

1. **Scope.**

a. These instructions are published for the use of personnel to whom the centrifugal pump, flammable liquid, 15GPM (Gallons Per Minute), Barnes Model QM-2-28002, is issued.

b. Report all equipment improvement recommendations as prescribed by TM 38-750,

c. Refer to TM 740-90-1 (Administrative Storage of Equipment) and Chapter 2, Section I of this TM for information and instructions pertaining to Organizational and Administrative Storage.

d. Procedures for Destruction of Equipment to Prevent Enemy Use.

NOTE

The authority for ordering the destruction of equipment is to be vested in the Divisional and higher Commanders. only delegate authority to subordinate Commanders. when the situation requires it.

(1) Demolition of Centrifugal Pump. Methods of destruction should achieve such damage to equipment and repair parts that it will not be possible to restore the equipment to a usable condition in the combat zone, either by repair or by cannibalization.

*This change supersedes C4, 24 June 1971, and C5, 20 April 1973.

(2) *Mechanical Destruction.* Using an ax, pick, sledge. or any heavy implement, damage all vital elements such as the pump and hoses.

(3) Explosives. Place 1/2-lb (0.2KG) on the following elements for demolition using explosives, detonating cord, and suitable detonator.

(a) 1 1/2-lb (0.2KGN) Charges between engine and tank.

(b) Place 1 1/2-lb (0.2KGN) Charges on coil hoses and nozzles.

(4) *Demolition* by *Misuse.* Drain all oil from engine and add sand in crank case. Run engine full speed until engine fails. For detail information refer to TM 750-244-3 (Procedures for Destruction of Equipment to Prevent Enemy Use).

2. Maintenance Forms and Records.

a. DA Form 2404 (Equipment, Inspection and Maintenance Worksheet).

b. DA Form 2407 (Maintenance Request Use for Requesting Support Maintenance).

c. DA Form 2407-1 (Continuation Sheet Used for Requesting Support Maintenance).

d. For further information, refer to TM 38-750, (The Army Maintenance Management System).

Page 6. In paragraph 4b (1) The serial number range is changed to read: 28002-001 thru 28002-1025, and 28002-1026 thru 28002-2552.

Page 7. Paragraph 5 is superseded as follows:

5. Differences in Models

This manual covers the Barnes Pump, Model QM2-28002, Serial Numbers 28002-002 thru 28002-1025 and 28002-1026 thru 28002-2552. Pumps with Serial Numbers arranged in 28002-1026 thru 28002-2552 differ from those arranged in 28002-1025 in that the later pumps have discharge parts that are opposite each other, rather than at right angle, and that the filing parting is equipped with a cap rather than a plug. This cap is the same as caps used on the discharge parts. No other known unit differences exist for the model cover by this manual.

Page 9. Chapter 2. Paragraph 8f is changed as follows:

f. If ambient temperatures at the operating location are in the minus 10 Degree F 40 range, make sure the crank case is filled with OEA/APG-PB-1 Grade Lubricant. If ambient temperatures are in the minus 65 Degree F-10 Degree F range, make sure the crank case is filled with OEA/APG-PB-1 Grade Lubricant. At this lower range, use MIL-G-3056 Type 2 Fuel Tank.

Page 9. Chapter 2, Paragraph 8g is added as follows:

g. Expendable supplies and materials list required for the initial eight hours operation of the pump, are contained in Appendix D.

Page 9. Chapter 2, Paragraph 9c, add the following safety precautions below the title:

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 10. **Paragraph 10. Add the following safety precaution below the title:**

WARNING

Before performing any maintenance, i.e., disconnection of hoses and nozzles, or the removal of dust caps or plugs, make sure pumping assembly has been depressurized by draining the pressurized fuel through the dispensing nozzles into a suitable container.

Page 10. **Paragraph 11. Add the following safety precaution below the "NO SMOKING" 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 11. Paragraph 15. Add the following safety precaution below the title:

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 12. Paragraph 16. Add the following safety precaution below the title:

WARNING

Before performing any maintenance, i.e., disconnection of hoses and nozzles, or the removal of dust caps or plugs, make sure the pumping assembly has been depressurized by draining the pressurized fuel through the dispensing nozzles into a suitable container.

Page 12. Paragraph 17. Add the following safety precaution below:

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 13. Paragraph 13. Add the following safety precaution following the title:

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 13. Paragraph 19 Add the following safety precautions Immediately following the title:

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 14. Paragraph 21. Add the following safety precaution immediately following the title:

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 14. Paragraph 22. Add the following safety precaution immediately following the title:

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 14. Paragraph 23. Add the following safety precaution immediately following the title:

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 15. Paragraph 28e. The title is changed to read: Page 15. Paragraph e. “OEA/APG-PD-1.”

Page 16. Lubrication order. Change Capital “OES” in the key to read: "OEA/APG-PD- 1."

Page 17. Section 3, Paragraph 29. Add the fol lowing safety precautions below the title:

WARNING

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

WARNING

Before performing any maintenance, i.e., disconnection of hoses and nozzles, *or the removal of dust caps or plugs,* make sure the pumping assembly has been depressurized by draining the pressurized fuel through the dispensing nozzles into a suitable container.

Page 59. Appendix I is superseded as follows:

APPENDIX A
REFERENCES

A-1.	Fire Protection and Safety	
	TB 5-4200-200-10	Hand Portable Fire Extinguishers Approved for Army Users.
	TM 5-687	Repair and Utilities: Fire Protection Equipment and Appliances; Inspections, Operations, and Preventive Maintenance.
A-2.	Lubrication	
	LO 5-4320-237-15	Pumping Assembly. Flammable Liquid. Bulk Transfer, Centrifugal. 50 CPM, 100 Ft. Head: Gasoline Engine Driven, 2 inch Frame Mounted. Barnes Mfg. Co. Model 28002 w/Wisconsin Engine. Model MBKND Specification 279315.
	C9 100 IL	Fuels, Lubricants. Oils, and Waxes.
A-3.	Painting	
	TM 43-0139	Painting Instructions for Field Use
A-4.	Cleaning	
	TM 38-230-1	Preservation. Packaging, and Packing of Military Supplies and Equipment (Cleaning).
A-5.	Maintenance	
	TM 38-750	The Army Maintenance Management System (TAMMS).

A-6.	Shipment and Storage TM 38-230-2	Preservation, Packaging, and Packing of Military Supplies and Equipment (Packing).
	TM 11-483	Radio Inference Suppression.
A-7.	Demolition TM 750-244-3	Destruction of Equipment to Prevent Enemy Use.
	TM 5-687	Repair and Utilities; Fire Protection Equipment and Appliances; Inspection, Operations, and Preventive Maintenance
A-2.	Lubrication LO 4320-237-15	Pumping Assembly, Flammable Liquid, Bulk Transfer, Centrifugal, 50 GPM, 100 Ft. Head: Gasoline Engine Driven, 2 inch Frame Mounted. Barnes Mfg. Co, Model 28002 w/Wisconsin Engine, Model MBKND Specification 279315.
	C9 100 IL	Fuels, Lubricants, Oils, and Waxes.
A-3.	Painting TM 43-0139	Painting Instructions for Field Use.
A-4.	Cleaning TM 38-230-1	Preservation, Packaging, and Packing of Military Supplies and Equipment (Cleaning).
A-5.	Maintenance TM 38-750	The Army Maintenance Management System (TAMMS)
A-6.	Shipment and Storage TM 38-230-2	Preservation, Packaging, and Packing of Military Supplies and Equipment (Packing).
	TM 11-483	Radio Inference Suppression
A-7.	Demolition TM 750-244-3	Destruction of Equipment to Prevent Enemy Use.

Pages 61 thru 65. Appendix II is superseded as follows:

APPENDIX B
COMPONENTS OF END ITEM LIST

Section I. INTRODUCTION

1. Scope.

This appendix lists Integral Components of and Basic Issue Items (BII) for the pump to help you inventory items required for safe and efficient operation.

2. General.

The Components of end item list are divided into the following sections:

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. (Not Applicable). 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) or Organization and Equipment (TOE) /Modification Table of Organizations and Equipment (MTOE) authorization of the end item.

3. Explanation of Columns:

a. Illustration. This column is divided as follows:

(1) *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 end item which will be used for requisitioning.

c. Part Number (P/N). Indicates the primary number used by the manufacturer which controls the design and characteristic; 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. Identification of the codes used in this list are:

CODE USED ON (Not 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 furing inventory. Under the received 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
1		4940-00-672-4764	5-14-1288 (81337)	Box Assembly			1				
4		4720-00-303-4984	5-14-1293 Item 8 (81337)	Hose Assembly Discharge (50 ft. long)			2				
4		4730-00-555-8325	5-14-1293 Item 7 (81337)	Hose Assembly Suction (25 ft. long)			1				
14	1	4930-00-402-4642	190 GA. 1 1/2 in. (81718) Discharge	Nozzle Assembly			2				
16	1 2 3 4	5975-00-577-8825	5-14-1285 2-26 (81718)	Ground Rod Assembly			1				

Page 67. Appendix III is superseded as follows:
Appendix "C. Maintenance Allocation Chart"

Appendix D is added as follows:

APPENDIX D
EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

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).

2. Explanation of Columns.

a. Column 1 - Item Number. This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material.

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

c. Column 3 - National Stock Number (NSN). 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., each (ea). inch (in), pair (pr. etc. 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) U/M
1	C	6850-00-281-1985	Cleaning Solvent	gl
2	C	9150-00-402-4478	Engine Oil: Subzero	qt
3	C	9150-00-186-6681	Engine Oil: OE HDO 30	qt
4	C	9150-00-160-1818	Gasoline, Combat	bulk

Page 71. Make all necessary changes to reflect in the index of the manual.

By Order of the Secretary of the Army:

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

Official:

PAUL T. SMITH
Major General, United States Army
The Adjutant General

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

TECHNICAL MANUAL
No. 5-4320-237-15

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D. C., *19 April 1967*

Operator, Organizational, Direct and General Support and Depot Maintenance Manual PUMP, CENTRIFUGAL: GASOLINE ENGINE DRIVEN; 50 GPM, 100-FOOT HEAD, FLAMMABLE LIQUID, BULK TRANSFER [BARNES MODEL-QM-2-28002) FSN 4320-913-7131

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the use of the personnel to whom pumping assembly, flammable liquid, 50 gpm (gallons per minute), Barnes Model QM–2-28002, is issued. Chapters 1 through 5 provide information on the operation, preventive maintenance services, and organizational maintenance of the equipment, accessories, components, and attachments. Chapter 6 provides 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 I contains a list of publications applicable to this manual. Appendix II contains the maintenance allocation chart. Appendix III 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.

c. Numbers in parentheses on illustrations indicate quantity. Numbers preceding nomenclature callouts on illustrations indicate the preferred maintenance sequence.

d. DA Form 2028 (Recommended changes to DA Publication) till be used for reporting discrepancies and recommendations for improving this equipment publication. This form will be completed by the individual using the manual and forwarded direct to Commanding General, U. S. Army Mobility Equipment Command, ATTN: AMSME-MPD, 4300 Goodfellow Blvd., St. Louis, Mo. 63120.

e. Report all equipment improvement recommendations as prescribed by TM 38-750.

2. Record and Report Forms

a. DA Form 2258 (Depreservation Guide of Engineer Equipment).

b. For other record and report forms applicable to operator, crew and organizational maintenance, refer to TM 38-750.

Note. Applicable forms shall be kept in a canvas bag mounted on the equipment.

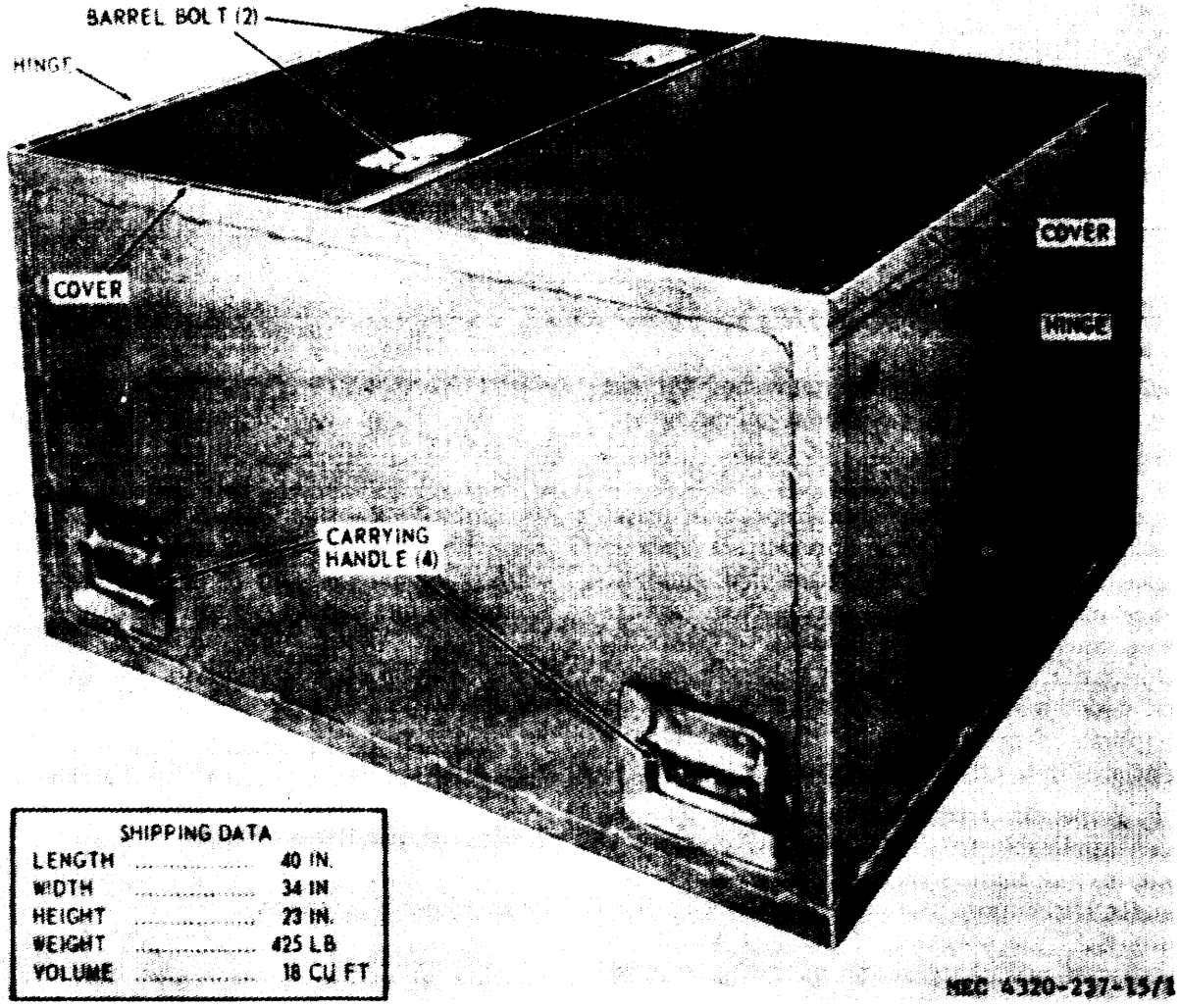


Figure 1. Carrying box for pumping assembly, model QM-2-28002, *w/complete shipping dimensions, weight and volume.*

Section II. DESCRIPTION AND DATA

3. Description

a. General Pumping assembly, flammable liquid, 50 gpm, Barnes Model QM–2–28002, consists of a gasoline engine driven, centrifugal pump, mounted on a frame, and packed in a carrying box along with two servicing hoses, nozzles, suction hoses, and a drum unloader. Figure 1 shows the' unit completely packed in its box and provides shipping dimensions for the assembly. Figure 2 shows the pumping assembly with covers of the box opened to show shipping positions of components.

b. Engine. The Wisconsin engine, Model MBKND, is a single-cylinder, four-cycle, air-cooled, gasoline driven model, with a 2 7/8 inch bore and 2 3/4 inch stroke. The displacement is 17.8 cu in. (cubic inches). The engine develops 5.75 horsepower at 2,800 rpm (revolutions per minute) governed speed.

c. Pump. The centrifugal petroleum pump is bolted to the engine crankcase through a coupling head and to the frame. The pump impeller is mounted directly on the extended engine crankshaft, eliminating the need for a rotating coupling between engine and pump. Pump intake port is cm the side of the pump opposite the engine. The discharge port is on top of the pump.

4. Identification and Tabulated Data

a. Identification. The pumping assembly Model QM-2-28002 has three major identification plates. The information contained on these plates is listed below.

(1) *U.S. plate.* This plate is mounted on the top cover of the pumping assembly. It provides official nomenclature of the unit, model number, serial number, contract number, dimensions, cubage, weight, date inspected, and date shipped.

(2) *Serial number plate.* This plate is mounted on the pump-engine assembly. It provides information regarding pump manufacturer, model number, serial number, federal stock number, type of drive, and contract number.

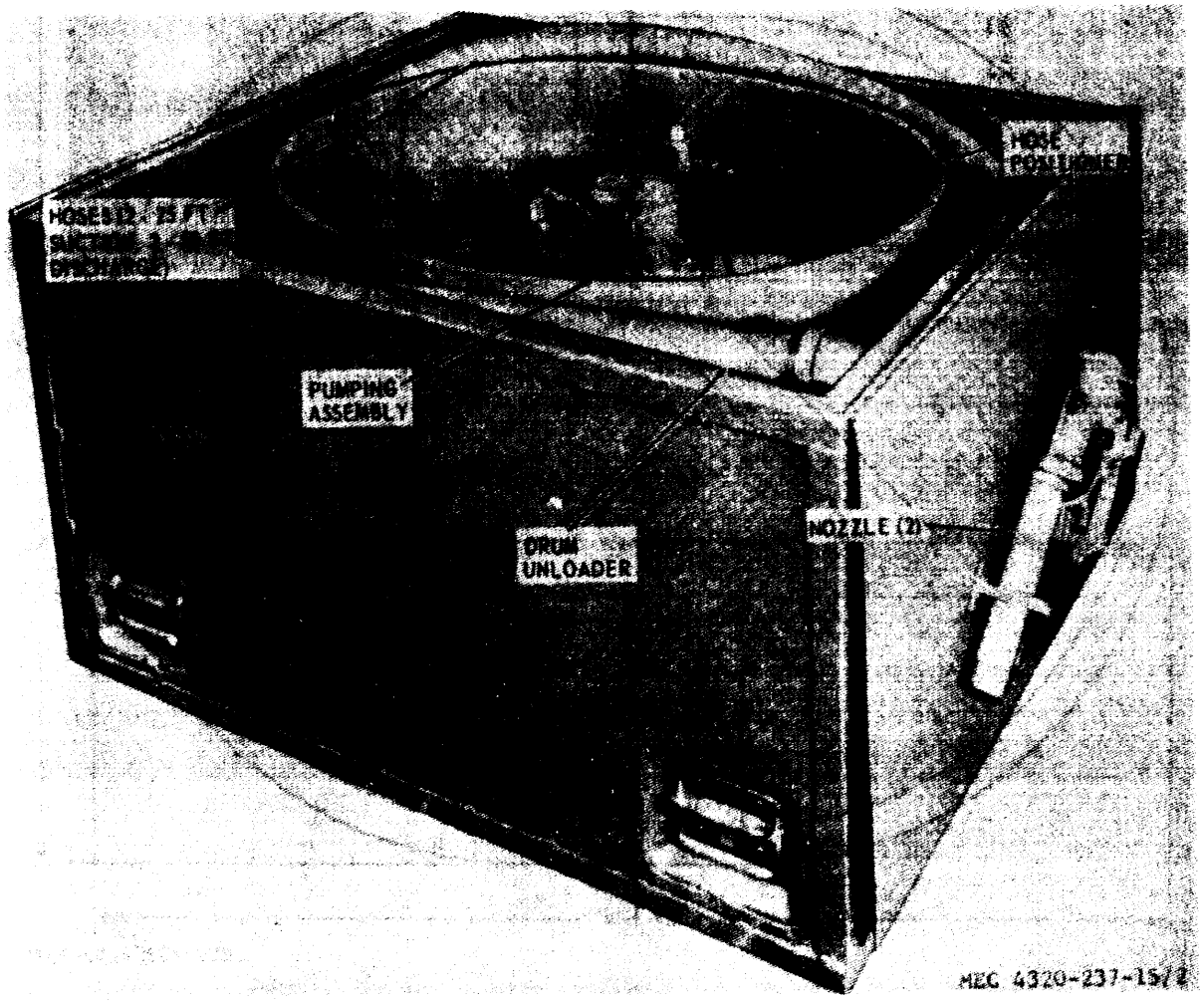


Figure 2. pumping assembly, model QM-2-28002, box covers opened

(3) *Engine plate.* The engine plate is mounted on the upper portion of the engine shroud, on the pulley end of the engine. It provides the model number, serial number, size, rated speed, specification number, horsepower, and manufacturing date. It also provides engine operation and maintenance information.

b. Tabulated Data.

(1) *Pumping assembly.*

Manufacturer ---------- Barnes Manufacturing Company
Model ---------- QM-2-28002
Type ---------- Gasoline-engine driven, centrifugal, fuel handling
Serial number ----------28002-0001 through 28002-1025

(2) *Engine.*

Manufacturer _____ Wisconsin Motor Corporation
Model ---------- MBKND, Specification 279315
Type ---------- Four cycle
Bore ---------- 2-7/8 in.
Stroke ----------2-3/4 in.
Displacement _____ 17.8 cu in.
Governed speed ----------2800 ±50 rpm
Fuel ----------Gasoline

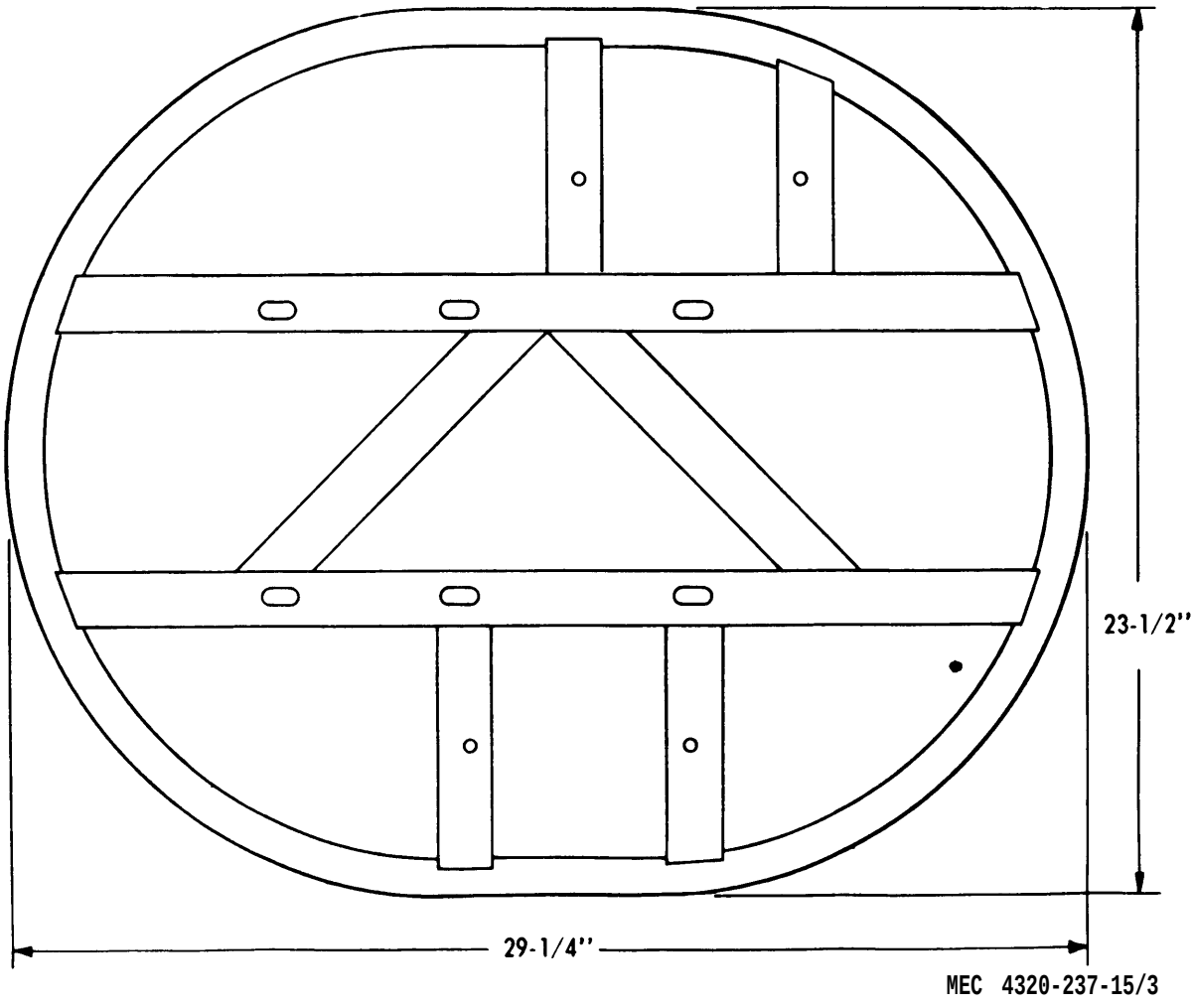


Figure 3. Engine and pump base plan.

(3) *Pump.*

Manufacturer ---------- Barnes Manufacturing Company
Type ---------- Centrifugal
Capacity----------5 0 gpm at 2,800 rpm
Operating media ----------Petroleumfuels
Intake size----------2 in. (bushed to 1-1/2 in.)
Disharge size----------2 in. (bushed to 1-1/2 in.)

(4) *Engine accessories.*

(a) Magneto.

Manufacturer ----------Colt Industries Division Fairbanks Morse Company
Model ---------- FMXDE1B7S-1
Type ---------- Shielded
Point gap---------- 0.015 in.

(b) Carburetor.

Manufacturer ----------Zenith Carburetor Division The Bendix Corporation
Model ----------11193-A
Type ---------- Float bowl

(c) Fuel strainer.

Manufacturer ---------- Tillotson Manufacturing Company
Model ----------OW-418-T

(d) Air cleaner.

Manufacturer ----------United Specialties Company
Model ----------N-76B4
Type ---------- Oil bath

(e) Sparkplug.

Manufacturer ----------. Champion Spark Plug Company
Model---------- XMD.21
Spark gap ---------- 0.030 in.
Size ----------18-mm(millimeters)

(5) *Pump accessories.*

(a) Fuel servicing nozzle.

Specification ---------- MIL-N2111A,Class2, Size 2
Size ---------- 1-1/2 in.
Type ---------- Non-automatic
Number supplied ------2

(b) Discharge hose.

Inside diameter ----------1-1/2 in.
Length ----------50 ft. (feet)
Coupling ends ----------1 male,1female
Number supplied----------2

(c) Suction hose.

Inside diameter ----------1-1/2 in.
Length ---------- 25 ft
Coupling ends ---------- 1 male, 1 female
Number supplied----------2

(6) *Capacities.*

Fuel tank ----------1 gal. (gallon)
Engine crankcase ---------2 pts (pints)
Air cleaner---------- 5 oz (ounces)
Pump priming ----------1 gal. minimum

(7) *Nut and bolt torque data.*

Spark plug ----------25-30 ft-lbs(foot-pounds)
Cylinder deadbolts--------14-18 ft-lbs
Engine base screws----------6-8 ft-lbs
Connecting rod cap bolts ----14-18 ft-lbs
Main bearing plate cap------14-18 ft-lbs screws.

(8) *Adjustment data.*

Spark plug gap----------0.030 in.
Magneto breaker point---------- 0.015 in. gap
Valve b valve tappet clearance (cold):
Inlet ----------.0.008 in.
Exhaust ---------- 0.014 in.
Engine speed ----------2,800 ±50 rpm

(9) *Dimensions and weight (fig. 1).*

Lengt---------- 40 in.
Width---------- 34 in.
Height---------- 23 in.
Weight ----------425 lbs (pounds)
Volume ----------l8 cu ft

(10 Base plan(fig.3).

5. Differences in Models

This manual covers covers Barnes Model QM-2-28002 pumping assembly. No known unit differences exist for the model covered by this manual.

CHAPTER 2

INSTALLATION AND OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

6. Unloading the Equipment

The pumping assembly is shipped in its carrying box which is fitted with four carrying handles. Use handles to lift the pumping assembly from the carrier. The shipping weight of the pumping assembly is 425 pounds so that it can easily be lifted by four men.

7. Unpacking the Equipment

a. Unlatch the two barrel bolts that secure the hinged covers. Raise the covers.

b. Grasp the engine and pumping assembly by the carrying handles and lift the engine and pumping assembly from the carrying box.

c. Remove the two suction hoses and the two discharge hoses from around the hose positioner in the carrying box.

d. Remove the two nozzles from the nozzle mounting brackets on the box covers by loosening the fasteners on the nozzle bracket clamps and lifting the nozzles from the brackets.

8. Inspection and Servicing Equipment

a. Inspect the engine and pump for damage, distortion, loose mounting bolts, or other visible damage. Use the starter rope to turn the engine crankshaft several revolutions and check for signs of interference, rubbing or binding.

b. Inspect all hoses for cracks, abrasions, collapsed walls, loose connectors, and other damage.

c. Inspect the nozzles for cracks, distortion, or other visible damage. Press the operating handle of the nozzle assemblies several times to assure that they operate freely without binding or sticking.

d. Inspect the carrying box for cracks, dents, distortion, broken weldments, hard-to-operate hinges, or other shipping damage

e. Perform all daily preventive maintenance services as directed in paragraph 30.

f. If ambient temperatures at the operating location are in the .10° to +40°F range, make sure the crankcase is filled with MIL-L-2104 grade 10 lubricant. If ambient temperatures are in the –65° to –10°F range, make sure the crankcase is filled with MIL-L-10295 grade OES lubricant. At this lower range, use MIL-G-3056 type 2 fuel in the fuel tank.

9. Installation or Setting Up Instructions

a. Location. Locate the pumping assembly on firm, moderately level area as close as conveniently possible to the source’ of fuel supply. Choose an area which will provide enough room around the engine and pump assembly to allow convenient servicing.

b. Outdoor Installation. Refer to figure 4 for installation and setup instructions.

Warning: **The unit must be connected to a suitable ground before operation. Arcing caused by buildup of static electricity may ignite volatile fluids and cause explosion and fire.**

c. Indoor Installation. This equipment was designed for outdoor use. If it is necessary to use it in an indoor location, remove the muffler (fig. 29) and associated piping and connect 1 inch NPT piping into the exhaust port

of the engine to conduct the exhaust fumes outdoors. If exhaust piping is extremely long, increase piping size to 1 1/2 inches NPT after the nipple which enters the exhaust port of the engine. Be sure to provide adequate ventilation for proper engine cooling and to support engine combustion. Connect the ground cable to a low-resistance ground connection.

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

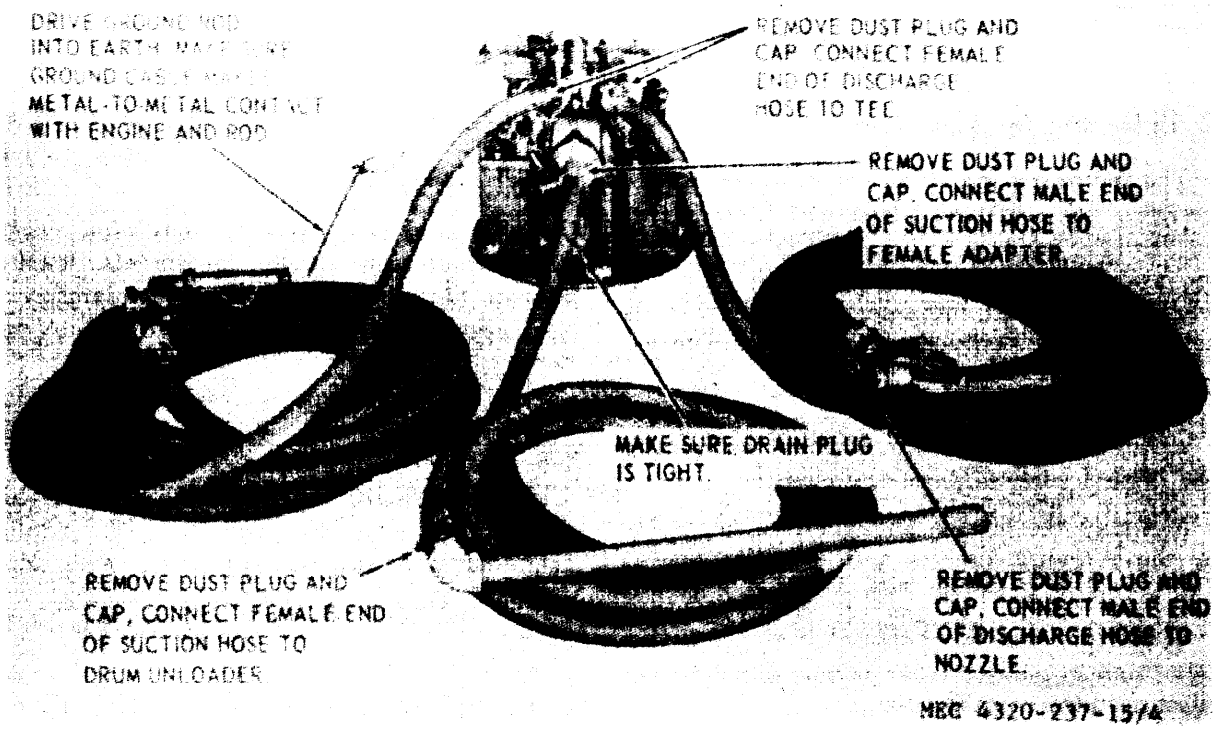


Figure 4. Pump istallation and setup.

Section II. MOVEMENT TO A NEW WORKSITE

10. Dismantling for Movement

a. Reverse the installation procedures illustrated in figure 4. Thoroughly drain all hoses Install dust plugs and caps on hoses and fittings

b. Remove drain plug from the bottom of the pump to drain fluid from pump body. Reinstall the plug.

c. Pack the equipment into the carrying box as shown in figure 2.

d. Close the top covers of the carrying box and lift the box onto a carrier for transfer to a new worksite

11. Reinstallation After Movement

After movement, install the pumping assembly as directed in paragraph 9.

Warning: **Do not smoke while opening the carrying box to reinstall the pumping assembly. Explosive vapors from fluids remaining in the hoses and pump body may be present in the enclosed box. Smoking or other source of ignition could cause explosion of these vapors. No smoking or open fire are allowed within 50 feet of the equipment.**

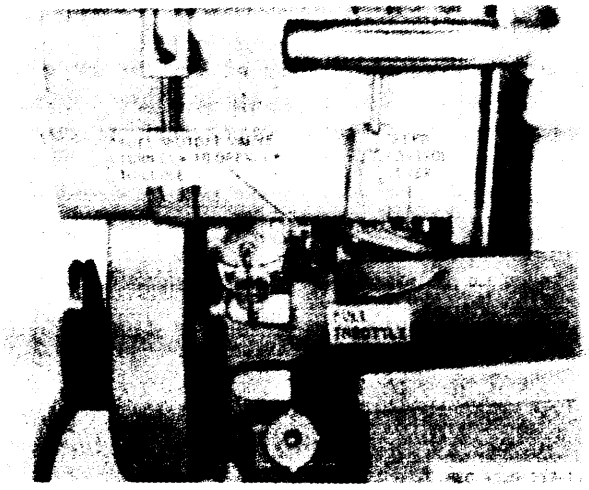


Figure 5. Speed control and fuel shutoff control.

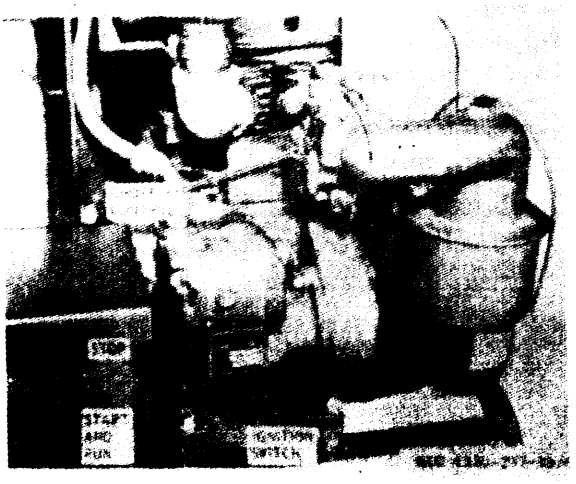


Figure 6. Choke and ignition control.

Section III. CONTROLS

12. General

This section describes, locates, illustrates, and furnishes the operator, crew, or organizational maintenance personnel sufficient information about various controls for proper operation of the pumping assembly.

13. Controls

The purpose of the controls and their operation are illustrated in figures 5 and 6.

Section IV. OPERATION OF EQUIPMENT

14. General

a. The instructions in this section are published for the information and guidance of the personnel responsible for operation of the pumping assembly.

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

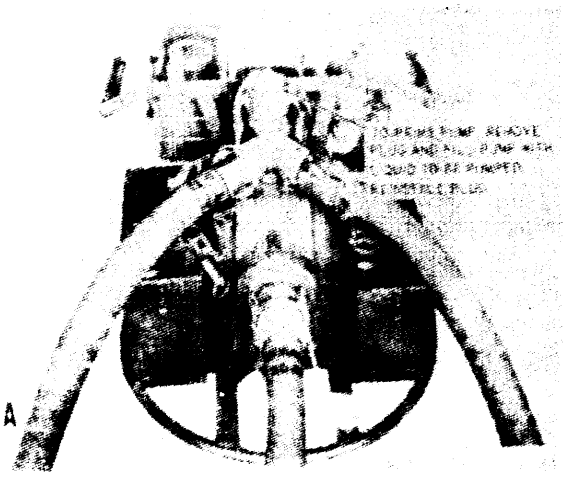


Figure 7 (1). Starting the pumping assembly.

15. Starting the Equipment

a. Perform the necessary daily preventive maintenance services (para 30).

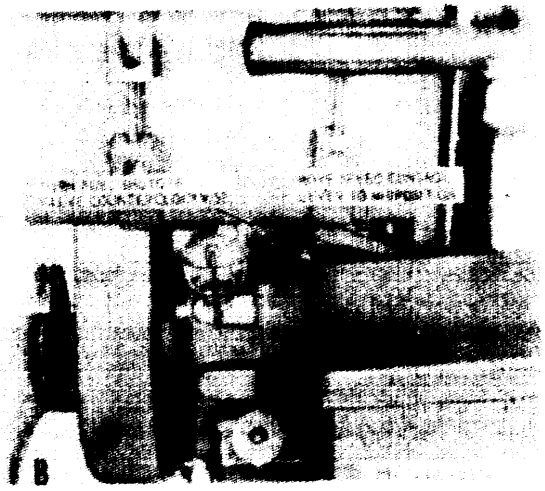


Figure 7 (2)--Continued.

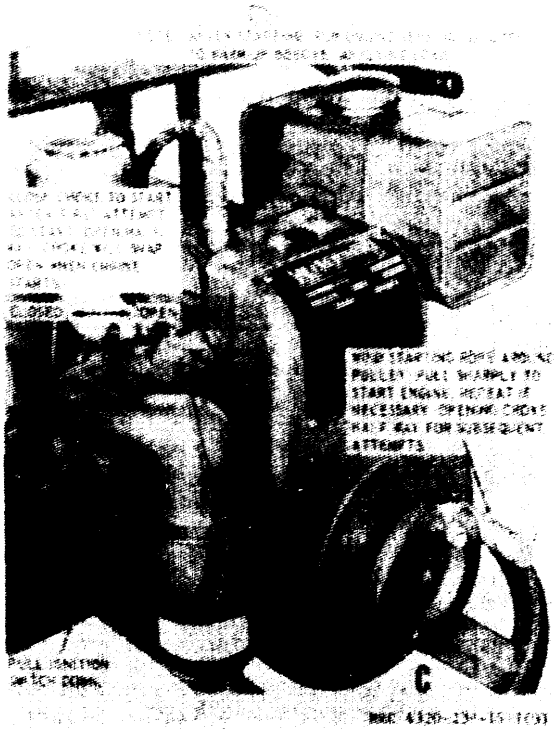


Figure 7 (3)--Continued.

b. Refer to figure 7 to start the pumping assembly.

Note. Priming the pump is necessary only after initial starting at a new location or when pump has lost prime from a long period of disuse. Pump is normally self-priming.

16. Stopping the Equipment

a. Refer to figure 8 to stop the pumping assembly.

Caution: **Except in case of emergency, always idle pump three minutes to allow engine parts to cool to prevent vapor lock at shutdown.**

b. Perform the necessary daily preventive maintenance services (para 30).

17. Operation Under Usual Conditions

a. Start the pumping assembly (para 15).

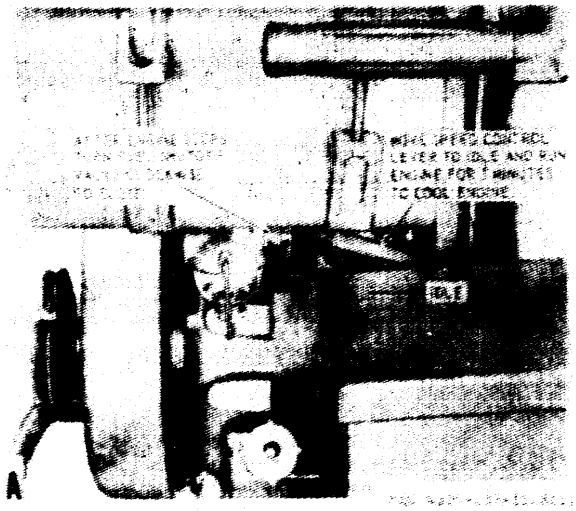


Figure 8 (l). Stopping the pumping assembly.

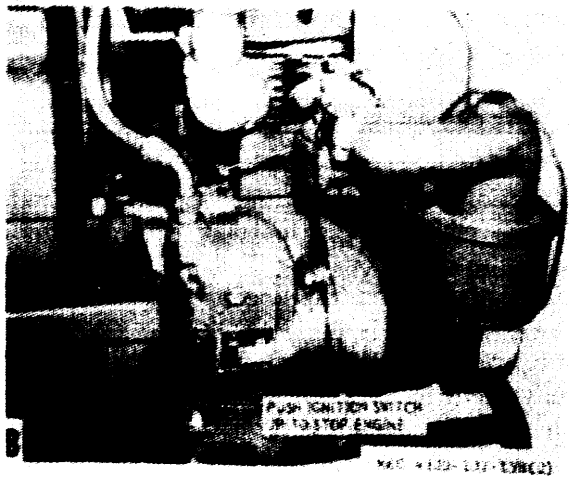


Figure 8 (2)–Continued.

b. Refer to figure 9 to operate the pumping assembly.

Note. **The drum unloader is not used for all applications. Suction hose may be connected directly to tank or other source of supply.**

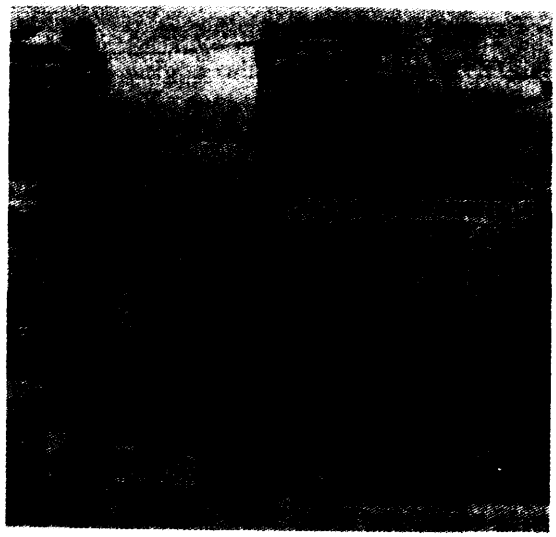


Figure 9 (l). Operating the pumping assembly.

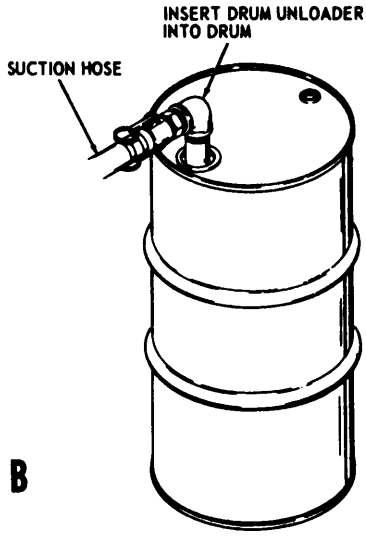


Figure 9 (2) -Continued

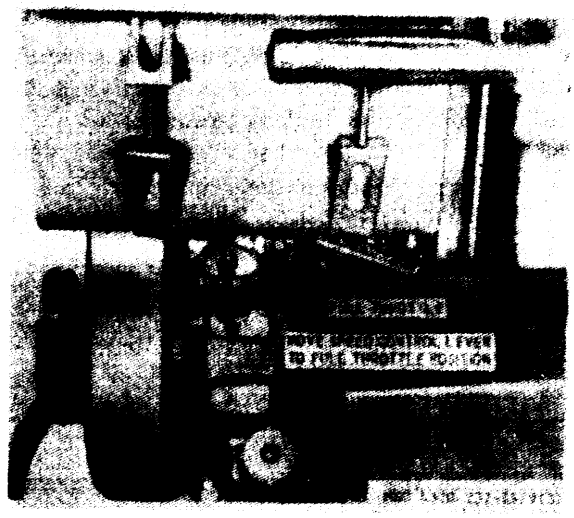


Figure 9 (3)-Continued.

18. Operation in Extreme Cold

Normal starting and operating procedures can be used until ambient temperature reach –25°F. At temperatures lower than this proceed as follows:

a. Keep fuel tank filled with gasoline. Use only MIL-G-3056 type 2 gasoline for operating at this temperature range.

b. Lubricate in accordance with the current lubrication order.

c. Clean and service the fuel strainer frequently (para 33).

d. Use ether sprayed into the air intake of the engine from a pressurized can during cranking or use other approved starting aids.

e. After starting, run engine at 1800 rpm without load for a minimum of 10 minutes before applying load.

f. Increase speed to full throttle and run for an additional 5 minutes before applying load.

19. Operation in Extreme Heat

a. Keep engine clean to promote greatest heat radiation. Pay particular attention to the screen in the engine shroud to assure that it does not become clogged. Clogging will limit air flow through the shroud.

b. Make sure all shrouding is properly installed on the engine. Loose or missing shrouding will retard cooling.

c. Provide shade for the pumping assembly whenever possible. Direct rays of the sun will greatly increase the heating problem.

d. Take care to decrease engine speed when full throttle operation is not required.

e. If vapor lock occurs, allow the engine to cool and then restart.

20. Operation in Dusty or Sandy Areas

a. Take advantage of natural barriers to protect the pumping assembly from blowing sand or dust. If necessary, erect artificial barriers.

b. Service the air cleaner more frequently (para 28f).

c. Clean the pumping assembly with a cloth dampened with an approved cleaning solvent. Keep the screen in the engine shroud clean to assure proper air flow over the engine. When the unit is idle, take care to prevent the entry of sand and dirt in the shrouding.

21. Operation Under Rainy or Humid Conditions

a. When the unit is outside and not operating, protect it with a tarpaulin or other waterproof cover. Remove the cover during dry periods to allow the unit to dry.

b. Fill the fuel tank at the end of each operating period to prevent the condensation of moisture in the tank.

c. Closely watch the fuel strainer bowl for evidences of water. If water is evident, clean the fuel strainer (para 33).

d. Clean and paint all surfaces not otherwise protected.

22. Operation in Salt-Water Areas

Salt water corrodes metal. If unpainted surfaces of the equipment are exposed to salt water, flush the area with fresh water and dry thoroughly. Apply a light coat of oil to unpainted surfaces.

23. Operation at High Altitudes

The efficiency of both the engine and pump decrease as altitude increases For example, engine efficiency decreases 3.5 percent for each 1000-feet altitude increase. At the same time, pumping efficiency drops because of the decreased ambient pressure. Take care to keep suction lifts at a minimum in high altitude operation.

24. Fire Extinguisher (Dry chemical Type)

a. Description. The dry chemical type fire extinguisher is suitable for use on all types of fire' and is effective in areas where ambient temperature is -25°F and above. If winterized (pressurized with nitrogen), the fire extinguisher may be used in temperatures below –25°F. The fire extinguisher is a 2 1/2 pound, stored pressure, lever-operated extinguisher.

b. Operation. Remove the fire extinguisher from its location, lift the handle, press lever, and direct the powder at the base of the flame using a side-to-side sweeping motion.

c. *Maintenance.* Weight the fire extinguisher every 6 months and replace the extinguisher if weight is less than 4 1/2 pounds, or if pressure is below 125 pounds. Refer to SB 5-111. The dry chemical fire extinguishers will be serviced at installation level through repair and utilities facilities, with the filling agent supplied by local procurement through troop supply channels.

CHAPTER 3

OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. OPERATOR AND ORGANIZATIONAL MAINTENANCE TOOLS AND EQUIPMENT

25. Special Tools and Equipment

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

26. Basic Issue Tools and Equipment

Tools and and repair parts issued with or authorized for the pumping assembly are listed in the Basic Issue Items List, Appendix III of this manual.

Section II. LUBRICATION

27. General Lubrication Information

a. This section contains a reproduction of the lubrication order and lubrication instructions which are supplemental to, and not specifically covered in the lubrication order.

b. The lubrication order shown in figure 10 is a reproduction of the approved lubrication order for the pumping assembly. For the current lubrication order, refer to DA-PAM-3104.

28. Detailed Lubrication Information

a. Care of Lubricants. Keep all lubricants in closed containers and store in a clean, dry place away from external heat. Allow no dust, dirt. or foreign material to mix with the lubricants. Keep all lubrication equipment clean and ready for use.

b. Points of Lubrication. Service lubrication points at proper intervals as illustrated in figure 10.

c. 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 lubrication to prevent accumulation of foreign matter.

d. Operation Immediately After Lubtrication. Immediately after lubrication, start the engine and check the unit for oil leaks. If any leaks are noted, stop the unit and correct the cause of the leaks..

e. OES Oil.

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

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

f. Air Cleaner Service. Refer to figure and service the air cleaner.

LUBRICATION ORDER

L05-4320-237-15

PUMPING ASSEMBLY, FLAMMABLE LIQUID, BULK TRANSFER, CENTRIFUGAL, SO GPM, 100 FOOT HEAD: GASOLINE ENGINE DRIVEN,2 IN. FRAME MOUNTED, (BARNES MODEL-QM-2-28002) WITH WISCONSIN ENGINE MODEL-MBKND, SPECIFICATION 279315

Reference. C9100-IL

Intervals are based on normal hours of operation. Adjust to compensate for abnormal operation and severe conditions. During inactive Periods, Sufficiant lubrication must b. performed for adequate preservation.

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

Drain cronkcase when hot, Fill and check level.

-KEY-

LUBRICANTS	CAPACITY	EXPECTED TEMPERATURES			INTERVALS
		Above +32°F	+40°F to -10°F	0°F to -65°F	
OE-OIL, Engine, Heavy Duty		OE-30	OE- 10	OES	Intervals given or. in hours of normal Operation.
Crankcose	1 qt				
Air Cleaner	5/32 qt				
OES-OIL, Engine Sub-zero					

FOLD FOLD

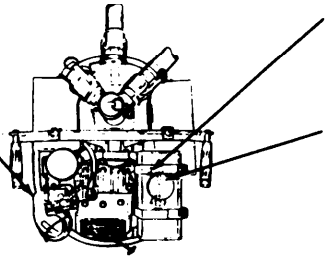
LUBRICANT • INTERVAL

(1) Air Cleaner OE 5
(Refill oil reservoir to level mark; every 25 hours, disassemble entire unit, clean, re-oil and reassemble.) (See Note2.)

INTERVAL • LUBRICANT

50 Crankcase Drain Plug (2)
(Drain and refill.)

5 OE Crankcase Fill Plug (3)
(Check Level.)
(See Key.)



NOTES:

1. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW -10°F. Remove lubricants prescribed in the key for temperatures above -10°F. Clean parts with SOLVENT, dry-cleaning. Relubricate with lubricants specified in the key for temperatures below -10°F.
2. AIR CLEANER. When operating under dusty conditions. clean Air Cleaner every 10 operating hours.
3. LUBRICANTS. The following is a list of lubricants with the Military Symbols and applicable Specification numbers.

OE-MIL-L-2104 OES-MIL-L-10295

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

BY ORDER OF THE SECRETARY OF THE ARMY:

HAROLD K. JOHNSON,
General, United States Army,
Chief of Staff.

OFFICIAL:

KENNETH G. WICKHAM,
Major General, United States Army,
The Adjutant General.

MEC 4320-237-15/10

Figure 10 (1). Lubrication order.

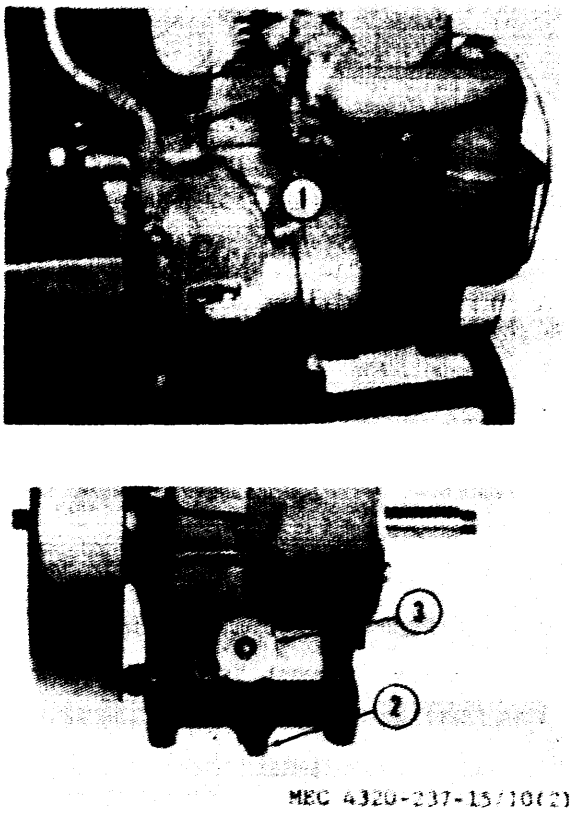


Figure 10 (2)—Continued.

Section III. PREVENTIVE MAINTENANCE SERVICES

29. General

To insure that the pumping assembly 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 30 and 31. The item numbers indicate the sequence of minimum inspection requirements. Defects discovered during operation of the unit shall he noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noticed during operation which would damage the equipment if operation were continued. All deficiencies and short comings will be recorded together with the corrective action taken on DA Form 2404 (Equipment Inspection and Maintenance Worksheet) at the earliest possible opportunity.

30. 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 12 for the daily preventive maintenance services.

31. 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, which ever occurs first.

b. The item numbers are listed consecutively and indicate the sequence of minimum requirements. Refer to figure 13 for the quarterly preventive maintenance services.

1. Swing bail torelease air cleaner bowl.
2. Remove air cleaner bowl and baffle. Empty bowl and baffle and clean in approved cleaning solvent.
3. Fill bowl to bead with engine oil and install baffle in bowl.
4. Position bowl on body and snap bail into position to retain bowl.

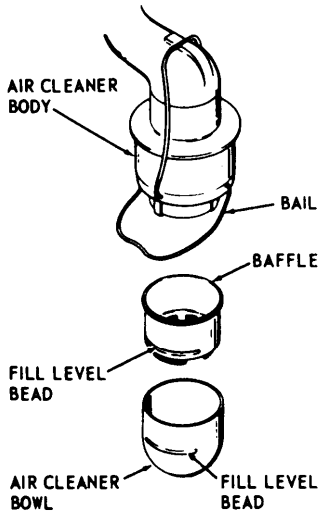


Figure 11. Air cleaner service.

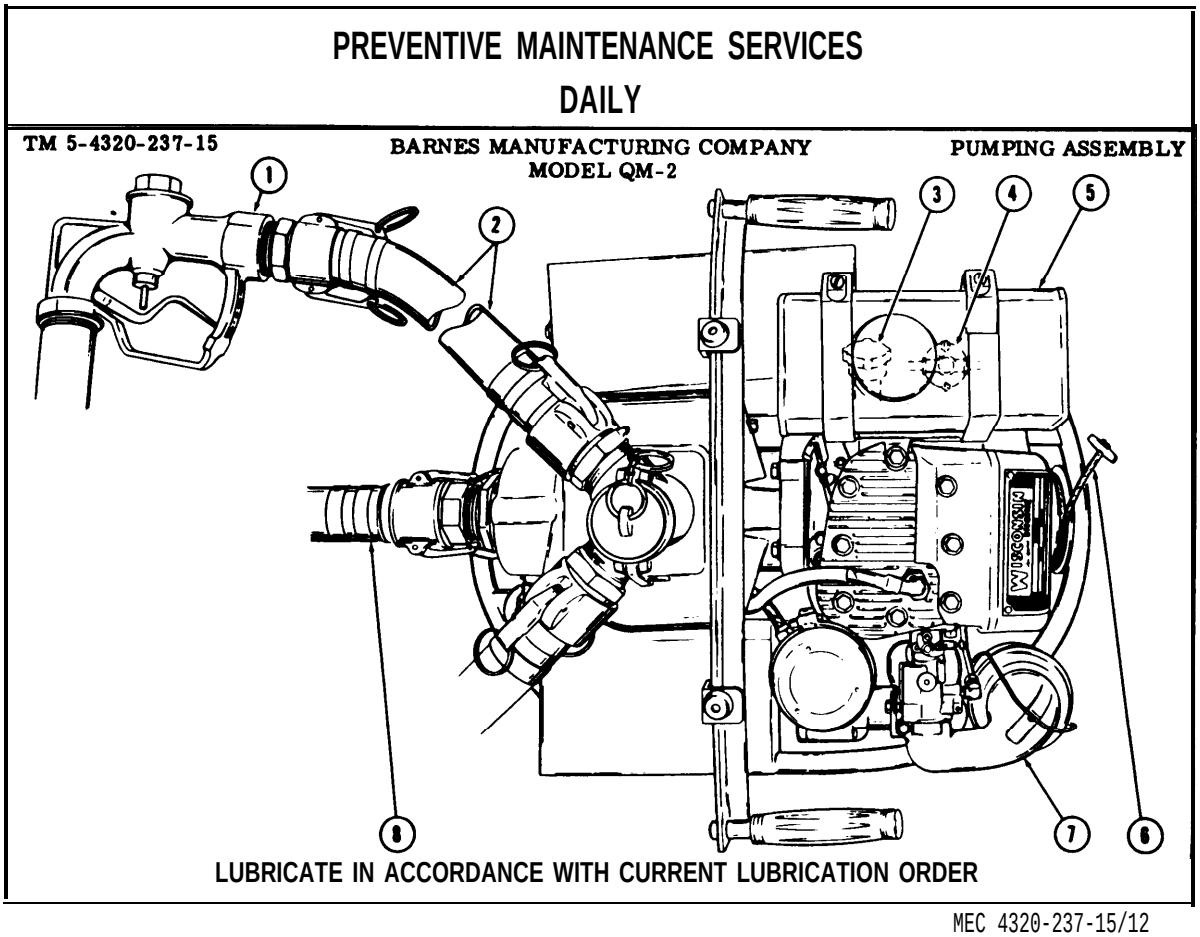
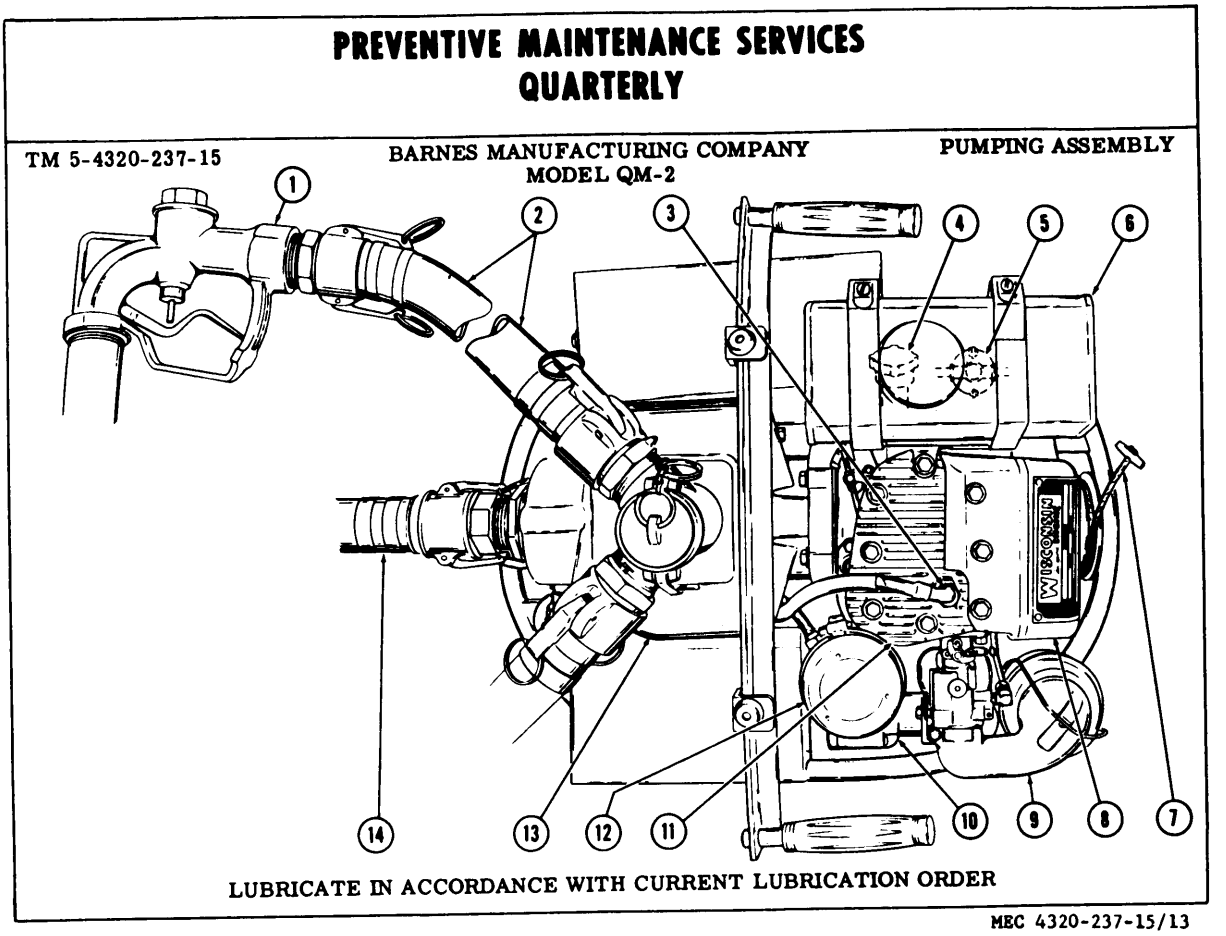


Figure 12. Daily preventive maintenance services.

ITEM		PAR REF
1	***DISCHARGE NOZZLES.*** Check for tight connections and for proper valve operation.	
2	***DISCHARGE HOSES.*** Check for evidences of leaking and collapsed walls. Tighten connections if loose.	
3	OIL ***LEVEL GAGE.*** Add oil as indicated by level gage. Reference LO 5-4320-237-15.	
4	***FUEL STRAINER.*** Tighten bail nut if strainer is leaking. (Clean weekly.	33
5	***FUEL TANK.*** Add fuel as required.	
6	***STARTING ROPE.*** Check for fraying or damage.	
7	***AIR CLEANER.*** Empty, clean, and refill dust cup.	28f
8	***SUCTION HOSE.*** Check for exidence of leaking and collapsed walls. Tighten connections if loose.	
	NOTE 1. OPERATION. During operation, check for any unusual noise or vibration. Check for both suction and discharge leaks.	

Figure 12-Continued.



ITEM		PAR REF
1	***DISCHARGE NOZZLES.*** Check for tight connections and for proper valve operation. Repair leaks.	69
2	***DISCHARGE HOSES.*** Check for evidence of leaking and for collapsed walls. Tighten connections if loose.	
3	***SPARK PLUG.*** Clean spark plug and set gap to *0.030* inch. Replace spark plug if electrodes are burned or if insulator is cracked. Replace spark plug lead if frayed or damaged. Clean and tighten lead connections.	
4	***OIL LEVEL GAGE.*** Add oil as indicated by level gage. Check that oil has been changed at required intervals. Reference LO 5- 4320-237-15.	
5	***FUEL STRAINER.*** Clean fuel strainer. Make sure strainer element is not clogged or damaged.	32
6	***FUEL TANK.*** If fuel strainer shows excessive dirt or moisture in fuel, remove, clean, and replace fuel tank. Fill to required level.	
7	***STARTING ROPE.*** Check for fraying or damage.	

Figure 13. Quarterly preventive maintenance services.

ITEM		PAR REF
8	*ENGINE.* Turn the engine crankshaft with starting rope and check for unusual noises or binding. Check that adequate compression resistance is noted when cranking against compression.	
9	*AIR CLEANER.* Empty and clean dust cup. Remove air cleaner body and flush out element with approved cleaning solvent. Shake dry and replace. Fill and replace dust cup. Reference figure 11.	28f
10	*MAGNETO.* Replace pitted or burned magneto points. Proper gap adjustment is 0.015 inch. (Check adjustment every 500 operating hours.)	55
11	*VALVES AND TAPPETS.* Check valve tappet clearance. Tappet clearance with engine cold must be as follows: Inlet valve-0.008 inch Exhaust valve-0.014 inch Report incorrect valve tappet clearance to direct support maintenance.	66
12	*MUFFLER.* Check muffler for dents, holes, cracks or other damage. Replace muffler if damaged beyond serviceability.	62
13	*PUMP.* Check pump for loose mounting, cracked housing, damaged threads and missing plugs. Tighten loose mounting bolts and replace missile plugs. Report pump damage to direct support maintenance.	71
14	*SUCTION HOSE.* Check suction hose for cracks, leaks, breaks, cuts, and wear. Replace leaking, worn, or damaged hose. *NOTE 1. OPERATIONAL TEST,* During operation, check for unusual noises or vibration.	

Figure 13–Continued.

Section IV. OPERATOR'S MAINTENANCE

32. General

The instructions in this section are published for the information and guidance of the operator to maintain the pumping assembly.

33. Fuel Strainer Service

Refer to figure 14 and service the fuel strainer.

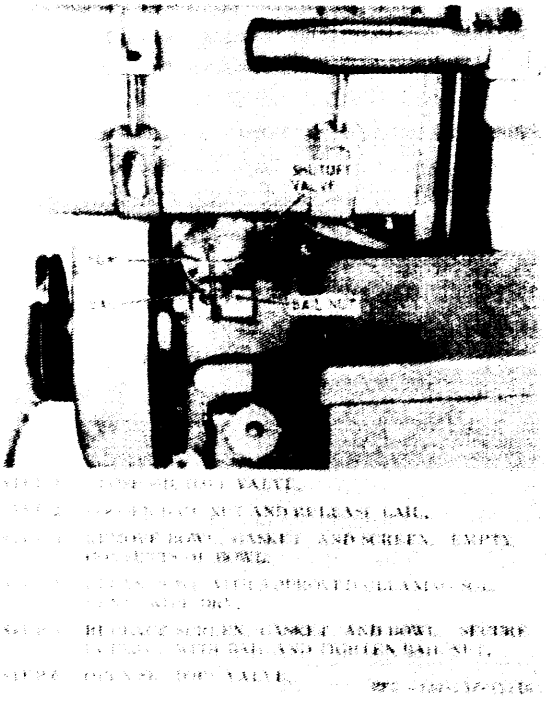


Figure 14. Fuel strainer service.

Section V. TROUBLESHOOTING

34. General

This section provides infomation useful in diagnosing and correcting unsatisfactory operation or failure of the pumping assembly 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.

35. Engine Hard to Start or Fails to Start

Probable cause	Possible remedy
Fuel tank empty	Fill fuel tank.
Fuel shutoff valve closed	Open valve (para 15).
Fuel line obstructed	Clean fuel line.
Spark plug defective	Replace spark plug (para 56).
Air cleaner dirty or too full of oil.	Service air cleaner (pars 28f).
Ignition switch defective	Refer to direct support maintenance.
Magneto improperly timed or defective.	Retime or replace magneto (para 55).
Fuel mixture improper	Adjust carburetor (para 52).
Magneto contacts pitted or improper] y adjusted.	Adjust or replace magneto contacts (para 54).
Spark plug cable defective.	Replace spark plug cable (para 56).

36. Engine Stops Suddenly

Probable cause	Possible remedy
Fuel tank empty	Fill fuel tank.
Fuel line clogged	Remove, clean, and replace fuel line (para 51).
Water, dirt or gum in fuel.	Drain, clean, and refill fuel tank with fresh gaso1ine.
Excessive engine heat causes vapor lock.	Cool engine and restart. Provide adequate ventilation around engine
Wrong grade of gasoline causes vapor lock	Use correct grade of gasoline.
Air vent hole in fuel tank cap clogged	Clean out hole in cap.

Probable cause	Possible remedy
Engine cylinder scored or piston stuck due to lack of crankcase oil.	Report to direct support maintenance.
Spark plug cable disconnected, broken, or grounded.	Repair or replace cable (para 56).
Spark plug wet or dirty	Clean and regap spark plug (para 56).
Magneto breaker points pitted or fused.	Replace breaker points (para 55).
Magneto capacitor leaking or grounded.	Replace magneto capacitor (para 55).

37. Engine Misses or Runs Erratically

Probable cause	Possible remedy
Spark plug dirty or improperly gapped.	Clean, regap, or replace spark plug (para 56).
Worn or leaking spark plug cable.	Replace spark plug cable (para 56).
Magneto breaker point gap incorrectly adjusted or points burned.	Adjust or replace breaker points (para 55).
Magneto capacitor faulty	Replace capacitor (para 55).
Water in gasoline	Drain fuel tank. Clean fuel strainer (para 33). Refill tank with clean fuel.
Governor controls loose or improperly adjusted.	Tighten and adjust controls.
Cylinder head loose or has faulty gasket.	Check gasket. Tighten cylinder head bolts (para 65).

38. Engine Fails to Stop

Probable cause	Possible remedy
Engine not idled before stopping is attempted.	Idle hot engine before stopping.
Cylinder head dirty	Remove, clean, and replace cylinder head (para 65).
Ignition switch defective	Report to direct support maintenance.

39. Engine Overheats

Probable cause	Possible remedy
Crankcase oil supply low	Fill crankcase immediately (refer to LO 5–4320–237–15.
Ignition spark incorrectly timed.	Time magneto (para 55).
Low grade of gasoline	Drain tank and strainer and refill with correct grade of gasoline.
Air circulation restricted	Remove restriction from cooling system.
Cylinder head cooling fins dirty.	Clean cooling fins.
Engine operated in tightly confined space.	Provide adequate air circulation around pumping unit.
Exhaust restricted	Clean or replace muffler (para 62).

40. Engine Lacks Power

Probable cause	Possible remedy
Crankcase oil supply low.	Fill crankcase immediately (refer to LO 5–4320–237–15.
Ignition spark incorrectly timed.	Time magneto (para 55).
Low grade of gasoline	Drain tank and strainer and refill with correct grade of gasoline.
Valves not seating properly	Report to direct support maintenance.
Worn piston rings	Report to direct support maintenance.

41. Engine Knocks or Develops Sudden Noise

Probable cause	Possible remedy
Low grade of gasoline	Drain tank and fuel strainer and refill with correct grade of gasoline.
Engine operated at low speed under heavy load.	Adjust engine to higher speed, using speed control lever.
Carbon or lead deposits in cylinder head.	Remove, clean, and replace cylinder head (para 65).
Excessive spark advance	Time the magneto.
Loose or burned out connecting rod bearings	Report to direct support maintenance.
Worn or loose piston pin	Report to direct support maintenance.
Engine overheated	Correct cause of overheating (para 39).

42. Engine Exhaust Smoke Excessive

Probable cause	Possible remedy
Too much oil in air cleaner.	Service air cleaner and fill only to indicated level (para 28f).
Cylinder scored	Report to direct support maintenance.
Piston rings worn or damaged.	Report to direct support maintenance.
Choke partially closed	Fully open choke.
Fuel mixture too rich	Adjust carburetor (para 52).
Carburetor float sticking or leaking.	Replace carburetor (para 52).

43. Engine Backfires Through Carburetor

Probable cause	Possible remedy
Water or dirt in gasoline or poor grade of gasoline.	Drain tank and fuel strainer. Fill with gasoline.
Sticky inlet valve	Report to direct support maintenance.
Overheated valves	Report to direct support maintenance.
Spark plug too hot	Replace with cooler plug (para 56).
Hot carbon particles in engine.	Remove, clean, and replace cylinder head (para 65).

44. Pump Fails to Deliver Fluid

Probable cause	Possible remedy
No fluid in pump body	Fill pump body.
Speed of engine too low	Adjust speed control lever.
Suction line stopped up	Remove suction line and clean.
Suction lift too high	Relocate pump closer to source of supply.
Impeller completely plugged with foreign matter.	Remove pump body and free impeller (para 71).
Air leak at suction line	Repair air leak.

45. Pump Fails to Deliver Rated Capacity

Probable cause	Possible remedy
Air leak at suction line connection.	Tighten connections or replace with new hose.
Air leak at mechanical seal.	Disassemble pump and install new seal (para 71).
Speed too low	Step up engine speed by adjusting speed control lever.
Suction lift too high	Relocate pump closer to source of supply.
Impeller partly clogged	Remove pump body and free impeller (para 71).
Suction end of hose not submerged deeply enough.	See that suction end is below liquid surface so that no air is drawn in through the suction hose.

46. Pump Fails to Deliver Rated Pressure

Probable cause	Possible remedy
Engine speed too low	Adjust engine speed with speed control lever.

47. Pump Works Temporarily, Then Stops

Probable cause	Possible remedy
Worn or damaged impeller.	Replace with new impeller (para 71).
Leak in suction line	Check suction line and remedy. If beyond repair, replace with new hose.
Mechanical seal leaks	Remove pump body and impeller. Replace seal (para 71).
Suction lift too high	Relocate pump closer to source of supply.
Impeller clogged	Remove pump body and free impeller (para 71).

48. Pump Leaks at Mechanical Seal

Probable cause	Possible remedy
Seal worn or damaged	Replace seal (para 71).

Section VI. FUEL SYSTEM

49. General

The fuel system includes those component which provide the fuel-air mixture to the cylinder for combustion. The system includes the air cleaner, fuel strainer, fuel lines and fittings, fuel tank, carburetor, and speed control and governor linkage.

50. Air Cleaner

a. Removal. Refer to figure 15 and remove air cleaner. Remove oil cup and baffle as directed in paragraph 28f.

b. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent. Flush solvent through the air cleaner element in the body until fresh solvent is not discolored as it passes through the element. Shake all solvent from element.

Caution: **The air cleaner element is permanently installed in the air cleaner body. Do not attempt to remove it.**

(2) Inspect the air cleaner body for cracks, severe dents, clogged filtering element, or other damage.

(3) Inspect all other parts for cracks, distortion, worn or damaged threads, or other damage. Replace all damaged parts.

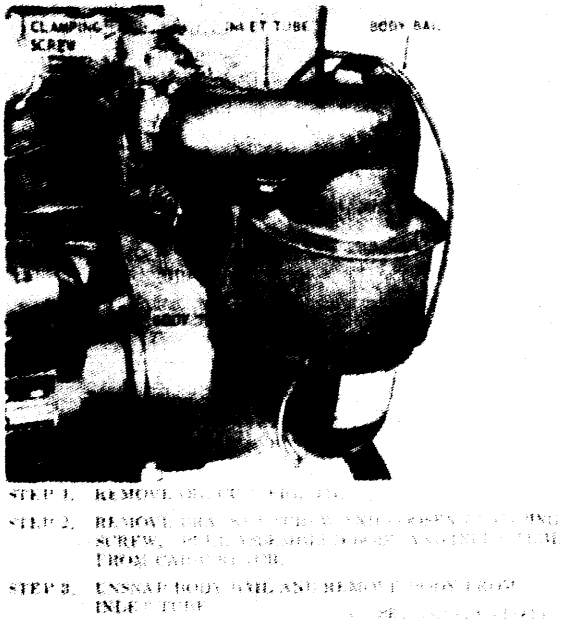


Figure 15. Air cleaner, removal and installation.

c. Installation. Refer to figure 15 and install the air cleaner and bracket.

51. Fuel Tank, Bracket, Fuel Strainer, Line and Fittings

a. Removal. Refer to figure 16 and remove the fuel tank, bracket, fuel strainer, fuel line and fittings.

b. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent; dry thoroughly.

(2) Inspect the fuel line for restrictions, dents, clogging, or other damage.

(3) Inspect the fuel tank for leaks severe dents, worn or damaged park

(4) Inspect the fuel tank cap for dents, distortion or clogged breather hole. Open breather hole if clogged.

(5) Inspect the fuel strainer parts for cracks, distortion, and damaged threads. Make sure the shutoff valve in the fuel strainer operates smoothly and easily.

(6) Inspect all other parts for cracks, worn or damaged threads, or other damage. Replace all damaged parts.

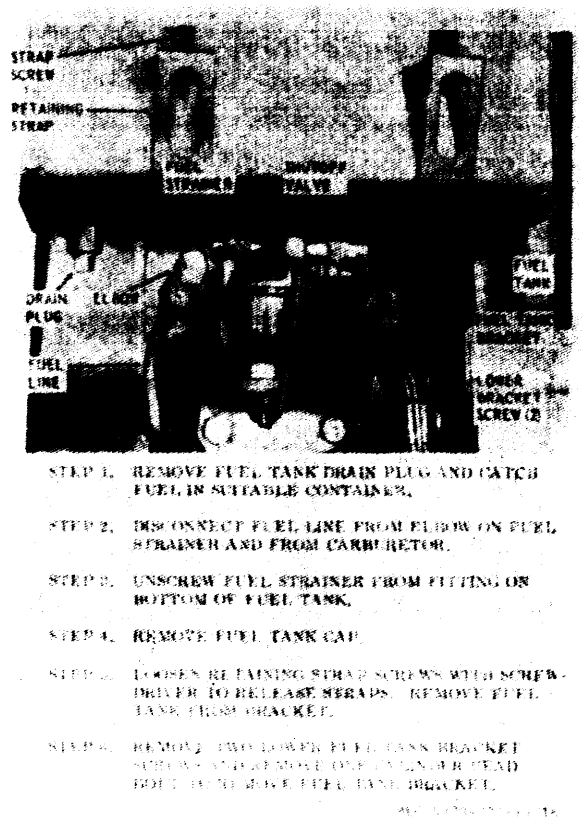


Figure 16. Fuel tank, bracket, fuel strainer, line, and fittings, removal and installation.

c. Installation Refer to figure 16 and install the fuel tank, bracket, fuel strainer, fuel line and fittings.

52. Carburetor

a. Adjustment. Refer to figure 17 and adjust the carburetor.

b. Removal. Refer to figure 18 and remove the carburetor.

c. Disassembly. Refer to figure 19 for disassembly and repair of the carburetor.

d. Cleaning and Inspection.

(1) Clean all parts with a cloth dampened with an approved cleaning solvent; dry thoroughly.

(2) Inspect the carburetor throttle body and fuel bowl for cracks, distortion, or other visible damage. Check the operation of the choke and throttle

Figure 17. Carburetor adjustment.

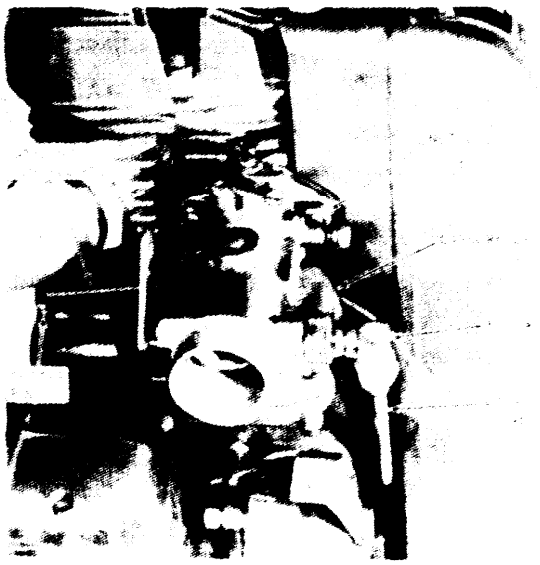
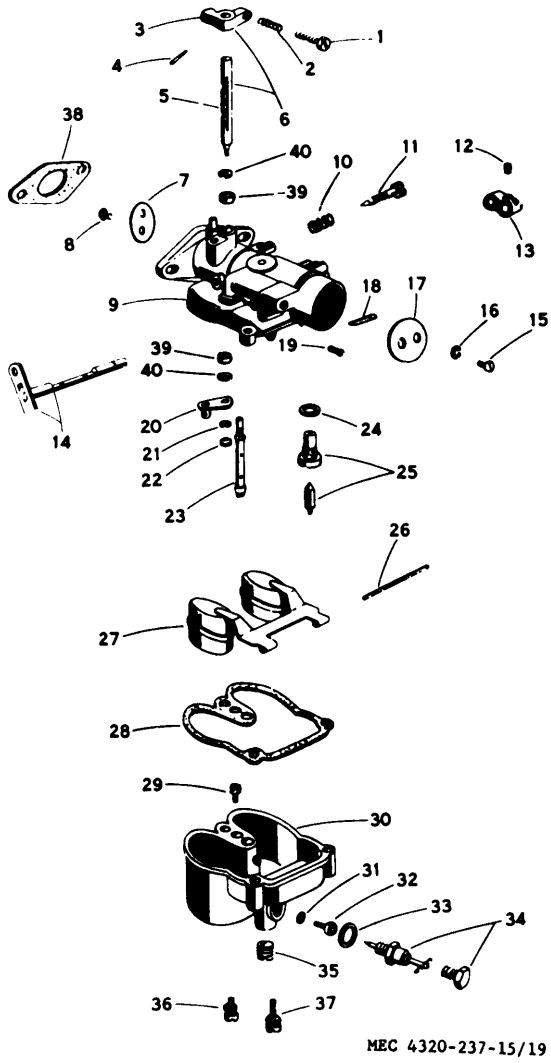


Figure 18. Carburetor, removal and installation.



1	Stop lever screw	21	Lockwasher
2	Spring	22	Nut
3	Lever	23	Discharge jet
4	Pin	24	Washer
5	Shaft	25	Fuel valve and seat
6	Lever and shaft	26	Float axle
7	Plate	27	Float
8	Screw and lockwasher	28	Body gasket
9	Throttle body	29	Idle jet
10	Spring	30	Fuel bowl
11	Idle adjusting needle	31	Washer
12	Setscrew	32	Main jet
13	Friction lever	33	Washer
14	Lever and shaft	34	Adjusting jet assembly
15	Screw	35	Pipe plug
16	Lockwasher	36	Screw and lockwasher
17	Plate	37	Screw and lockwasher
18	Vent tube	38	Flange gasket
19	Setscrew	39	Seal
20	Lever	40	Seal retainer

Figure 19. Carburetor, exploded view.

to make sure they operate freely without binding.

(3) Inspect the governor control rod for distortion, wear at bearing points, or other damage.

(4) Inspect the carburetor mounting studs for looseness, damaged threads, or other damage. Replace any damaged parts.

e. Reassembly. Refer to figure 19 and reassemble the carburetor.

f. Installation. Refer to figure 18 and install the *carburetor.* Adjust as shown in figure 17.

53. Governor Linkage and Speed Control

a. Adjustment. Refer to figure 20 to adjust engine speed. Engine speed with pump under load should be 2750 to 2850 rpm.

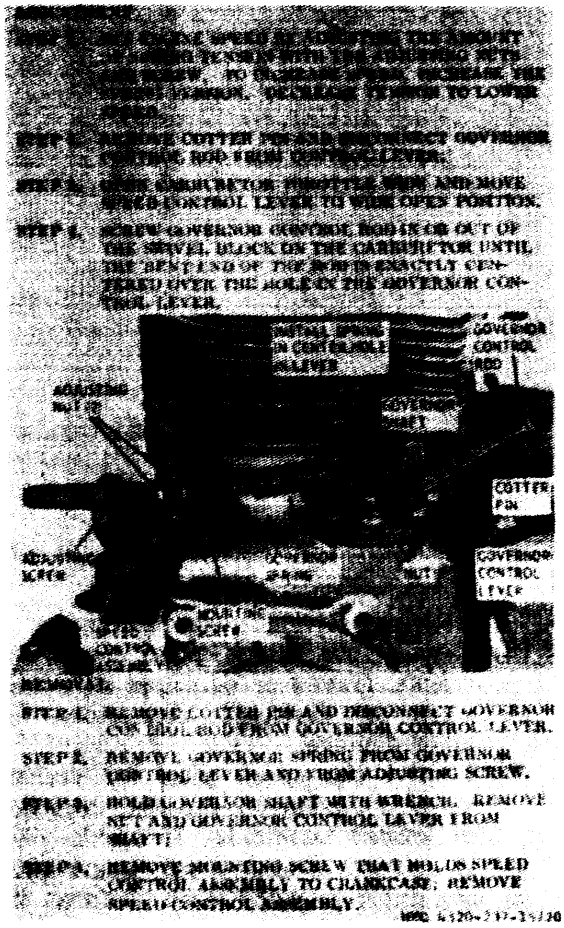


Figure 20. Speed control and governor linkage, adjustment, removal and installation.

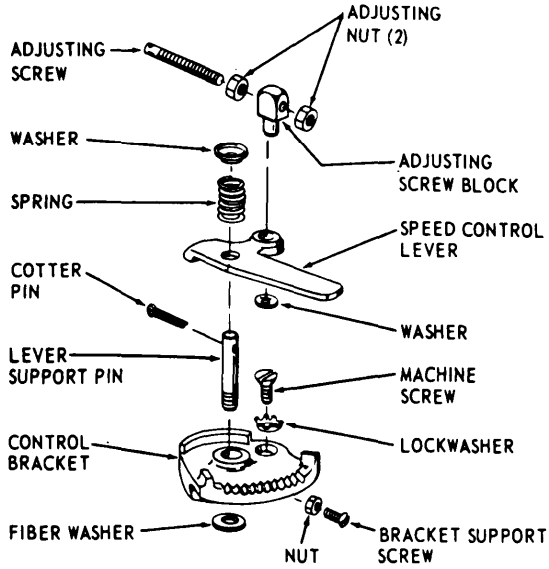


Figure 21. Speed control, disassembly and reassembly.

b. Removal. Refer to figure 20 and remove governor linkage and speed control.

Caution: Never attempt to operate the engine or pumping unit with the governor linkage disconnected. This may cause overspeeding of the engine, resulting in severe engine damage.

c. Disassembly. Refer to figure 21 and disassemble speed control.

d. Cleaning and Inspection.

(1) Clean parts with an approved cleaning solvent; dry thoroughly.

(2) Inspect all parts for cracks, distortion, wear at bearing points, or other damage; replace damaged parts.

e. Reassembly. Refer to figure 21 and reassemble speed control assembly.

f. Installation. Refer to figure 20 and install speed control assembly and gown-nor linkage.

Section VII. ENGINE ELECTRICAL SYSTEM

54. General

The engine electrical system consists of the ignition components which provide the electrical spark in the cylinder to ignite the fuel-air mixture when the piston is near top-dead-center of the compression stroke. The system includes the magneto, spark plug, and spark plug lead.

55. Magneto

a. Magneto Breaker Point Replacement. Refer to figure 22 and replace magneto breaker points and capacitor.

b. Removal. Refer to figure 23 and remove the magneto.

c. Cleaning and Inspection.

(1) Clean all parts with a cloth dampened with an approved cleaning solvent; dry thoroughly. Prevent the entry of solvent into the inside of the magneto.

(2) Inspect the magneto for a cracked or damaged case, dents, worn threads, or other visible damage. Turn the magneto shaft by hand and check for binding and scraping of the shaft. Replace a damaged magneto.

(3) Replace mounting hardware that is missing or damaged.

d. Magneto Drive Gear Replacement. Remove the lockwire and nut from the end of the magneto shaft and remove the drive gear. To install, turn the magneto shaft clockwise until the impulse coupling snaps, then position the drive gear on the shaft so that it engages the key on the impulse coupling with the timing mark on the gear at the 3 o'clock position.

e. Installation Refer to figure 23 and 24 and install and time magneto. Take care to follow timing instructions given in figure 23. The engine cannot run if the magneto is not properly timed.

56. Spark Plug and Cable

a. Removal. Refer to figure 25 and remove the spark plug and cable.

b. Cleaning and Inspection.

(1) Clean the spark plug and cable with a cloth dampened with an approval cleaning solvent; dry thoroughly.

(2) Inspect the spark plug cable for cracks, frayed or damaged shielding, worn or damaged connection, or other damage.

(3) Inspect the spark plug for cracks, worn or damaged threads, corroded or eroded terminals. If spark plug is in good condition, gap spark plug terminals to 0.030 inch before installation. If new plug is installed, gap it to 0.030 inch.

c. Installation. Refer to figure 25 and install the spark plug and cable.

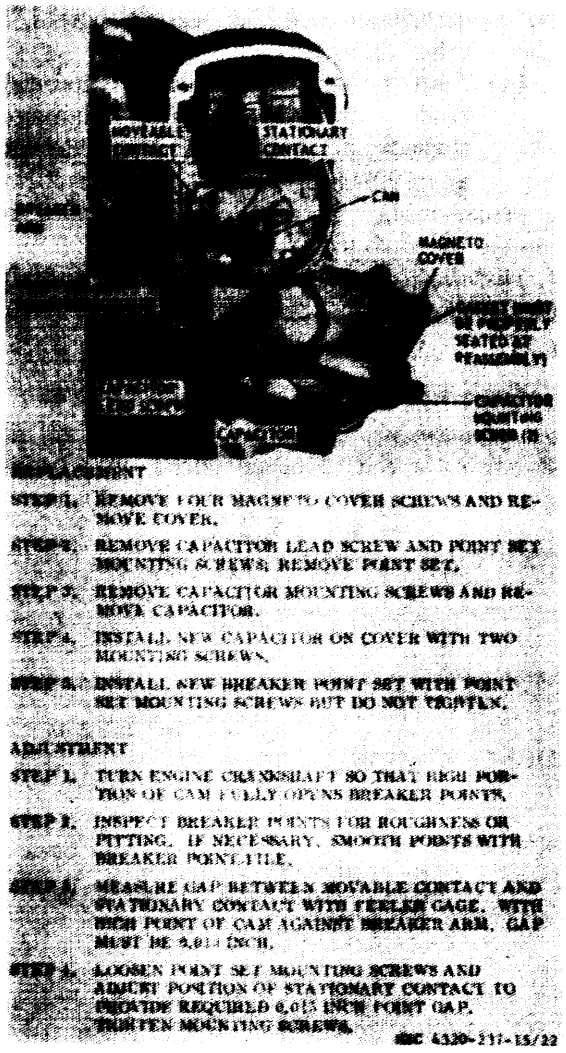


Figure 22. Magneto breaker point, replacement and adjustment.

Figure 28. Magneto, removal and installation

Section VIII. STARTING PULLEY, SHROUD, AND FLYWHEEL

57. General

The starting pulley, shroud, and flywheel are mounted on the engine opposite the power takeoff end.

a. Starting Pulley. The starting pulley is screwed to the flywheel end of the engine crankshaft. It provides a method of winding the starting rope for engine starting.

b. Shroud. The shroud encases the flywheel and part of the cylinder and cylinder head. It incorporates a screen permit air to be drawn into the shroud by the fins on the rotating flywheel and then directs the stream of air to the' cylinder to promote engine cooling.

c. *Flywheel.* The flywheel is keyed to the end of the crankshaft opposite the power take off end to maintain rotation of the crankshaft between power strokes of the engine piston. It is provided with fins which act as a fan to maintain a stream of air through the shroud to the engine to keep the engine cool.

58. Starting Pulley

a. Removal. Refer to figure 26 and remove the starting pulley.

b. Cleaning and Inspection.

(1) Clean the starting pulley with an approved cleaning solvent; dry thoroughly.

(2) Inspect the starting pulley for cracks. distortion, chipped or broken pulley edges, and worn or damaged threads. Replace a damaged starting pulley.

c. Installation. Refer to figure 26 and install starting pulley.

59. Shroud

a. Removal.

(1) Remove the starting pulley (para 58).

(2) Refer to figure 27 and remove the shroud.

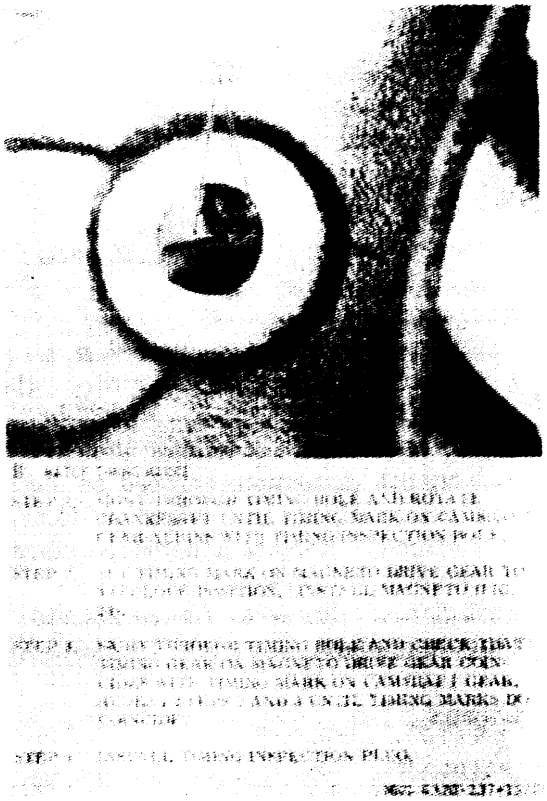


Figure 24. Magneto timing.

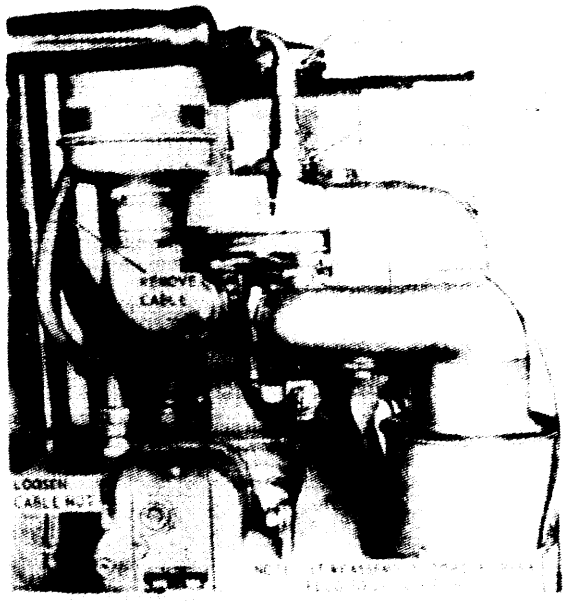


Figure 25. Spark plug and cable, removal and installation.

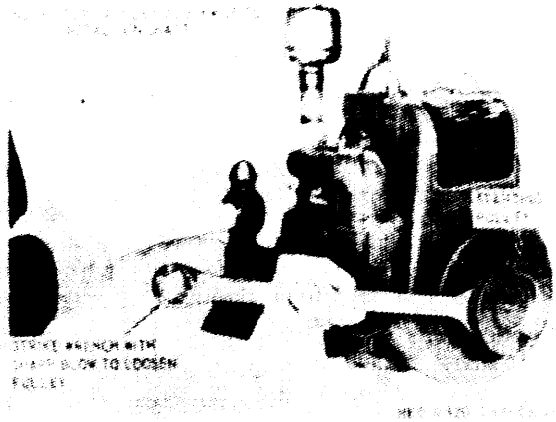


Figure 26. Starting pully, removal and installation

b. Cleaning and Inspection.

(1) Clean the shroud with an approved cleaning solvent; dry thoroughly,

(2) Inspect the shroud for cracks, severe dents, and obstructions. Inspect the screen in the shroud for holes and other damage If damaged, pry up the clips that hold the' screen to the shroud and install a new screen. Retain the screen with the clips.

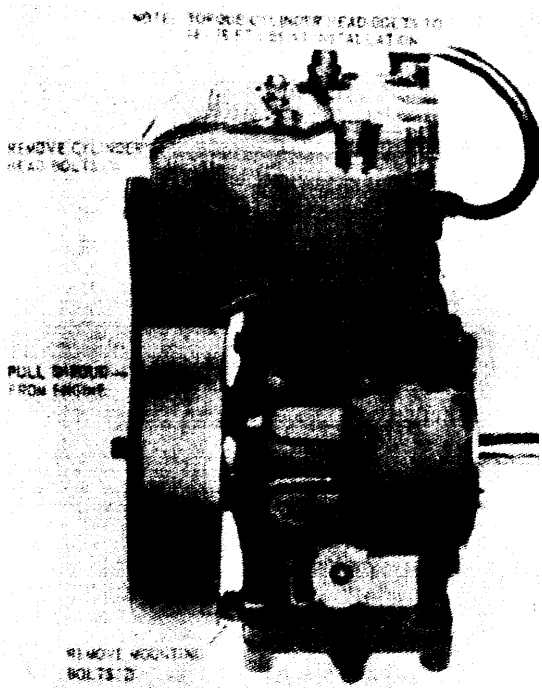


Figure 27. Shroud, removal and installation.

c. *Installation.*

(1) Refer to figure 27 and install the shroud.

(2) Install the starting pulley (para 58).

60. Flywheel

a. *Removal.*

(1) Remove the starting pulley (para 58).

(2) Remove the shroud (para 59).

(3) Refer to figure 28 and remove the flywheel.

b. Cleaning and Inspection.

(1) Clean the flywheel and key with an approved cleaning solvent; dry thoroughly.

(2) Inspect the flywheel for cracks, distortion, worn or damaged mounting hole or keyway, broken cooling fins, and other damage; replace a damaged flywheel.

(3) Inspect the key for distortion or damage. Replace the flywheel key if damaged.

c. *Installation.*

(1) Refer to figure 28 and install the flywheel.

(2) Install the shroud (para 59).

(3) Install the starting pulley (para 58).

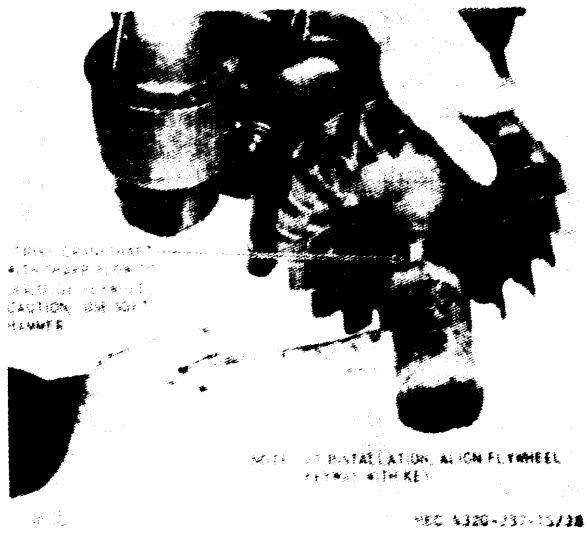


Figure 28. Flywheel, removal and installation.

Section IX. EXHAUST AND CRANKCASE BREATHER SYSTEMS

61. General

a. Exhaust System. The exhaust system consists of a spark arresting muffler and the associated piping that connect to the exhaust port on the engine.

b. Crankcase Breather System. The crankcase breather system consists of an elbow shaped breather which allows crankcase pressure to equalize the ambient pressure during operation of the engine.

62. Muffler and Piping

a. Service. Refer to figure 29 and service the muffler.

b. Removal. Refer to figure 29 and remove the muffler and piping.

c. Cleaning and Inspection.

(1) Clean the exhaust system parts with an approved cleaning solvent Take care to remove carbon from inside of piping and muffler.

(2) Inspect the muffler for cracks, dent, holes, thin walls, and other damage

(3) Inspect all other parts for cracks, worn or damaged threads, corrosion, excessive heating, and other damage. Replace all damaged parts

d. Installation. Refer to figure 29 and install the muffler and piping.

63. Crankcase Breather

a. Removal, Refer to figure 29 and remove the crankcase breather.

b. Cleaning and Inspection.

(1) Clean the crankcase breather by immersing in an approved cleaning solvent; shake dry.

(2) Inspect the breather for visible damage. The breather cap must be free on the top of the breather. Blow through the breather with compressed air to assure that the passage through the breather is free.

c. Installation. Refer to figure 29 and install the crankcase breather.

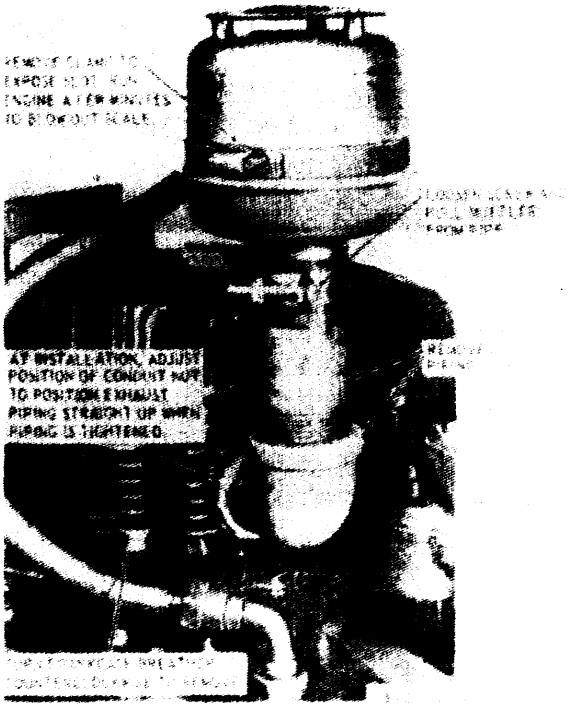


Figure 29. Muffler, exhaust piping and breather, removal and installation

Section X. CYLINDER HEAD AND TAPPET SYSTEMS

64. General

a. Cylinder Head. The cylinder head covers the top of the cylinder and provides a mount ing port for the spark plug. It is finned to help dissipate the heat of engine combustion.

b. Valve Tappets. Intake and exhaust valves have tappets which raise the valves at the required portion of the engine operation cycle. These tappets operate in conjunction with the camshaft. Valve tappet clearance can be checked without major engine disassembly, but it cannot be adjusted without disassembly.

65. Cylinder Head

a. Removal.

(1) Remove the spark plug (para 56).

(2) Remove the engine shroud (para 59).

(3) Remove the fuel tank and bracket (para 51).

(4) Refer to figure 30 and remove the cylinder head and gasket.

b. Cleaning and Inspection.

(1) Discard and replace the cylinder head gasket. Clean the cylinder head and cylinder head bolts with an approved cleaning solvent; scrape carbon deposits from the cylinder head, taking care not to scratch sealing surfaces.

(2) When the cylinder head is removed, clean the top of the cylinder block, carefully removing carbon from piston tops and from around the valve heads and seats. Take care not to scratch or score valve seats.

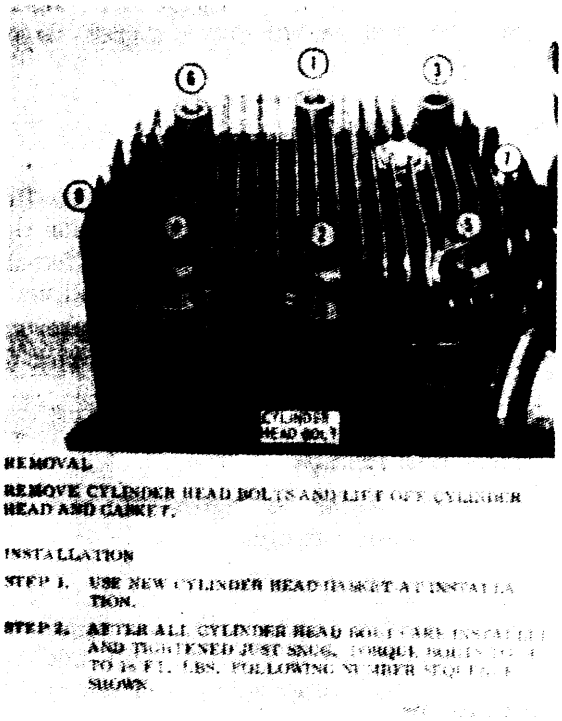


Figure 30. Cylinder head removal and installation.

(3) Inspect the cylinder head for cracks, warping, broken cooling fins, spark plug port threads, and other damage. Straighten bent cooling fins. Replace a damaged cylinder head.

(4) If any damage is noted which involves the valves, valve seats, cylinder block, and other engine parts, report the damage to direct support maintenance.

c. *Installation.*

(1) Refer to figure 30 and install the cylinder head using a new gasket

(2) Install the fuel tank and bracket (para 51).

(3) Install the engine shroud (para 59).

(4) Install the spark plug (para 56).

(5) After installation of fuel tank bracket and shroud, torque all cylinder head mounting bolts, following the sequence shown in figure 30.

Figure 31. Valve tappet cover, removal and installation

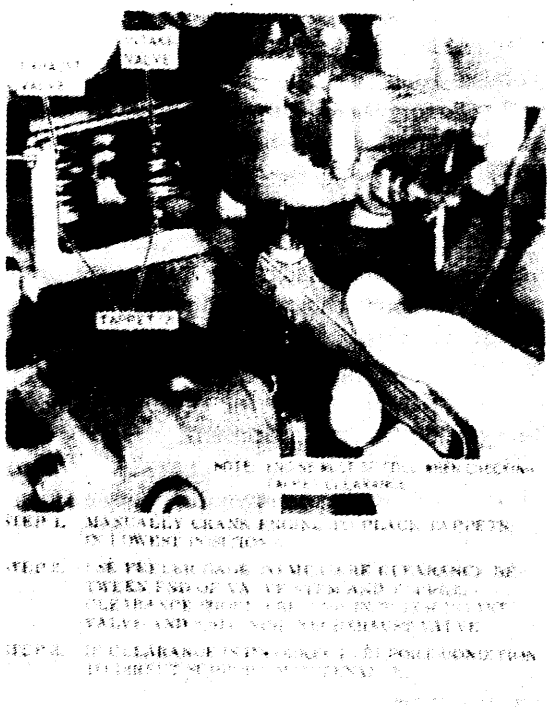


Figure 32. Checking valve tappet clearance.

66. Valve Tappets

a. Valve Tappet Cover Removal, Refer to figure 31 and remove the valve tappet cover and gasket.

b. Checking Valve Tappet Clearance. Refer to figure 32 and check valve tappet clearante.

c. Valve Tappet Cover Installation. Refer to figure 31 and install valve tappet cover and gasket.

Section XI. HOSES, NOZZLES, AND FITTINGS

67. General

a. Suction Hoses. Two 25-foot suction hoses are provided. Each is fitted with a male quick coupling connector at one and and a female quick coupling connector at the other end. The female connector engages the intake adapter on the pump body. The male connector engages the drum unloader or a mating connector on the fuel supply source. The hoses are used in series when the pump-to-supply distance requires it. The suction hoses have rigid walls which prevent their collapsing when the pump sucks fluid through them. The hoses are electrically conductive to help dissipate static charges which build up in pumping and storage equipment and which can cause arcing that would ignite fumes of the volatile fuels

b. Discharge Hoses. Two 50-foot discharge hoses are provided. Each is fitted with a male quick coupling connector at one end and a female quick coupling connector at the other end. The female connectors engage the male connectors on the discharge tee. The male connectors engage the female couplings on the discharge nozzles. The! hoses have flexible walls. They are electrically conductive to help dissipate static charges which build up in fuel pumping and storage equipment.

c. Nozzles. Two discharge nozzles are provided for use with the two discharge hoses, permitting the dispensing of fuel from either or both discharge hoses. The nozzles are the non-automatic shutoff type and have female quick coupling connectors. Each nozzle has a ground cable to electrically ground the equipment, preventing static charges from arcing and igniting the fumes of the flammable fuels.

d. Fittings. The discharge tee is screwed into the top of the pump housing and has a plug at the top which can be used for pump priming. The tee provides two discharge connections, each spaced 45 degrees from the centerline of the pump, extending away from the engine end. The male intake adapter is the quick coupling type and is screwed into the intake port of the pump housing. All female couplings are provided with plugs and all male couplings are provided with caps to prevent the entry of dirt when the associated port is not coupled,

68. Hoses and Fittings

a. Removal. Refer to figure 33 and re move the hoses and fittings.

b. Cleaning and Inspection.

(1) Flush the hoses with an approved cleaning solvent which will not at tack the rubber material from which they are fabricated. Wipe the exterior of the hoses with a cloth dampened with an approved cleaning solvent. Clean all fittings by immersing in solvent.

(2) Inspect the suction hoses for cracks, leaks, signs of deterioration, worn or damaged fittings, collapsed walls, and other damage.

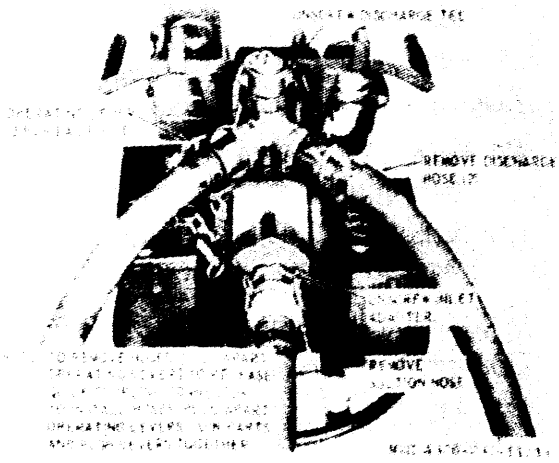


Figure 33. Hoses and fittings, removal and installstion.

(3) Inspect the discharge hoses for cracks, leaks, signs of deterioration, worn or damaged fittings, and other damage.
(4) Inspect the discharge tee and inlet adapter for damage which could affect the sealing characteristics of the part.
(5) Check that every female connector has a mating plug and that every male connector has a cap to prevent entry of dirt. Replace all damaged and missing parts.

c. Installation. Refer to figure 33 and install hoses and fittinings

69. Nozzles

a. Removal. Pull out on the coupling operating levers to remove the nozzle from the hose.

b. Disassembly. Refer to figure 34 and disassemble the nozzle.

c. Cleaning and Inspection.
(1) Discard the removed parts for which there are replacement in the nozzle repair kit.
(2) Clean all remaining parts with an approved cleaning solvent; dry thoroughly.
(3) Inspect the nozzle parts for cracks, distortion. worn or damaged threads, and other damage; replace damagd parts. Make sure the ground cable and pinch-type ground connector are attached and in good condition.

d. Reassembly. Refer to figure 34 and reassemble the nozzle.

e. Installation. Pull out on the coupling operating levers and position the nozzle on the hose. Push in on the operating levers to join the pads

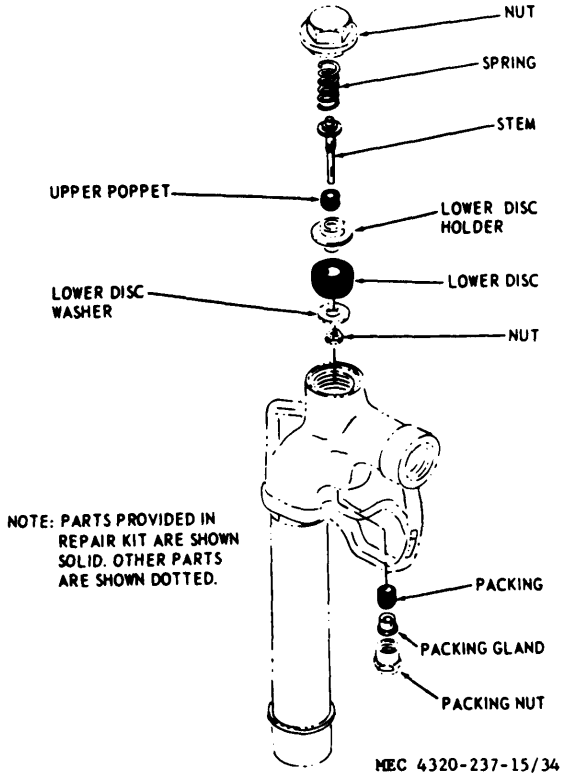


Figure 34. Nozzle, disassembly and reassembly.

Section XII. PUMP ASSEMBLY

70. General

A coupling head provides the adapter to secure the pump housing and engine together. One side of the coupling head bolts to the power takeoff end of the engine. The pump housing bolts to the opposite side of the coupling head. The pump impeller is threaded and screws directly to the power takeoff end of the engine crankshaft. Impeller-to-body clearance is regulated by shims between the coupling head and body. A seal is installed between the engine shaft and the coupling head to prevent fluid from leaking around the rotating shaft.

71. Pump Assembly

a. Housing and Tool Boxes Removal. Refer to figure 35 and remove the pump housing, and to figure 38 and remove the tool boxes.

b. Pump disassembly. Refer to figure 36 and disassemble the pump.

c. Cleaning and Inspection.
(1) Clean all pump parts with an approved cleaning solvent; dry thoroughly.

(2) Inspect the impeller for cracks, wear, scoring, damaged blades, worn or damaged threads, distortion or other damage.
(3) Inspect the pump housing for cracks, scoring caused by a rubbing impeller, worn or damaged threads, or other damage.
(4) Inspect the coupling head for cracks, broken mounting flanges, damaged seal seat, or other damage.
(5) inspect the seal parts for warping or deterioration. Carefully check the seal faces for scratches or scoring. If any seal parts are damaged, replace the entire seal.
(6) Inspect the attaching hardware for cracks, worn or damaged threads, distortion, or other damage; replace all damaged parts.

d. Pump Reassembly. Refer to figure 36 and reassemble the pump.

e. Tool Box and Housng Installation. Refer to figure 38 and install the tool boxes, and to figure 35 and install the pump housing.

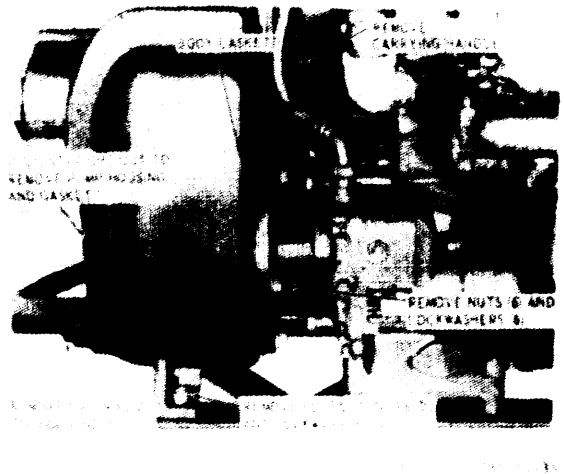


Figure 35. Pump housing, removal and installation.

Section XIII. ENGINE

72. General

The engine is secured to studs on the pumping unit base. The engine unit can be removed as a complete operating assembly ready to run, since no disassembly of engine parts is required for removal.

73. Engine

a. Removal. Refer to figure 38 and remove the tool boxes, and to figure 37 and remove the engine.

b. Cleaning and Inspection.

(1) Clean the engine with a cloth dampened with an approved cleaning solvent; take care to remove all greasy and oily deposits.
(2) Inspect the engine for missing components and visible damage. Using the starter rope, turn the engine crankshaft over slowly and check for scraping or binding.
(3) With the ignition switch in the OFF position to prevent engine starting, turn the engine crankshaft over with the starting rope to check for compression.
(4) If normal compression resistance is not noted, or if engine binds or scrapes when the crankshaft is rotated slowly, report to direct support maintenance.

c. *Installation.* Refer to figure 37 to install the engine, and to figure 38 to install the tool boxes.

DISASSEMBLY

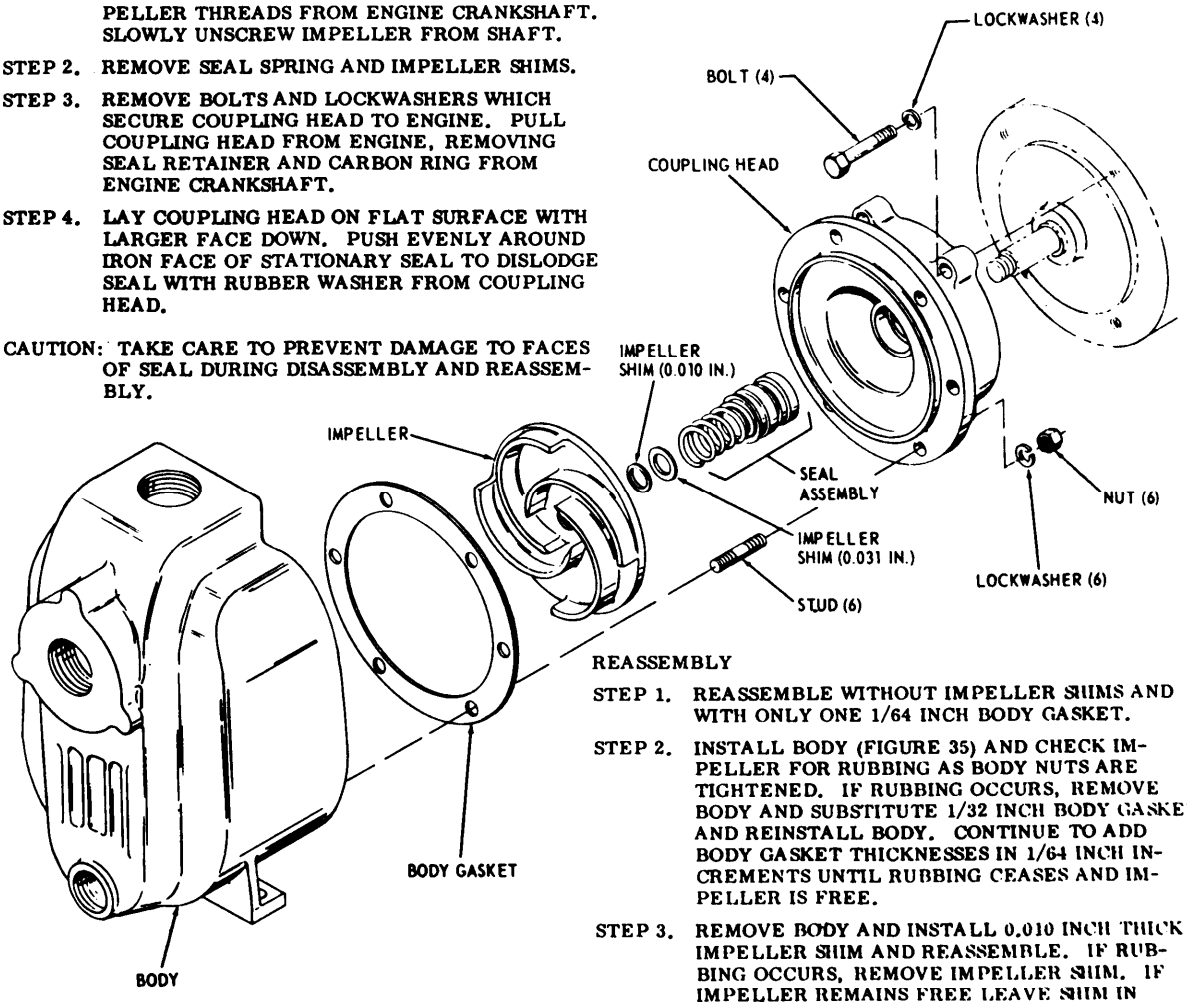
STEP 1. PLACE BLOCK OF WOOD ON END OF IMPELLER BLADE AND STRIKE SHARPLY TO LOOSEN IMPELLER THREADS FROM ENGINE CRANKSHAFT. SLOWLY UNSCREW IMPELLER FROM SHAFT.

STEP 2. REMOVE SEAL SPRING AND IMPELLER SHIMS.

STEP 3. REMOVE BOLTS AND LOCKWASHERS WHICH SECURE COUPLING HEAD TO ENGINE. PULL COUPLING HEAD FROM ENGINE, REMOVING SEAL RETAINER AND CARBON RING FROM ENGINE CRANKSHAFT.

STEP 4. LAY COUPLING HEAD ON FLAT SURFACE WITH LARGER FACE DOWN. PUSH EVENLY AROUND IRON FACE OF STATIONARY SEAL TO DISLODGE SEAL WITH RUBBER WASHER FROM COUPLING HEAD.

CAUTION: TAKE CARE TO PREVENT DAMAGE TO FACES OF SEAL DURING DISASSEMBLY AND REASSEMBLY.



REASSEMBLY

STEP 1. REASSEMBLE WITHOUT IMPELLER SHIMS AND WITH ONLY ONE 1/64 INCH BODY GASKET.

STEP 2. INSTALL BODY (FIGURE 35) AND CHECK IMPELLER FOR RUBBING AS BODY NUTS ARE TIGHTENED. IF RUBBING OCCURS, REMOVE BODY AND SUBSTITUTE 1/32 INCH BODY GASKET AND REINSTALL BODY. CONTINUE TO ADD BODY GASKET THICKNESSES IN 1/64 INCH INCREMENTS UNTIL RUBBING CEASES AND IMPELLER IS FREE.

STEP 3. REMOVE BODY AND INSTALL 0.010 INCH THICK IMPELLER SHIM AND REASSEMBLE. IF RUBBING OCCURS, REMOVE IMPELLER SHIM. IF IMPELLER REMAINS FREE LEAVE SHIM IN PLACE.

STEP 4. IF RUBBING DOES NOT OCCUR AS INDICATED IN STEP 2, ADD IMPELLER SHIMS UNTIL RUBBING DOES OCCUR, THEN REDUCE THICKNESS OF SHIMS IN 0.010 INCH INTERVALS UNTIL IMPELLER ROTATES FREELY.

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Figure 36. Centrifugal pump, disassembly and reassembly.

Section XIV. TOOL BOXES, BASE, AND BOX ASSEMBLY

74. General

a. Tool Boxes. Two tool boxes are bolted to the base. They provide storage space for on-equipment tools, technical manuals, and other required equipment.

b. Base. The base provides a mounting for the engine and pump and for the tool boxes.

It consists of an oval tubular frame with supporting cross-members.

c. Box assembly. The box assembly is a welded and riveted assembly which provides the shipping container for the pumping assembly, hoses, and nozzles. It is fitted with two covers on top, secured at the side edges with hinges. The covers latch at the center with barrel bolts. In the interior of the box is a hose positioner which permits the hose to be coiled in the box around the pumping unit without contacting the pumping unit which fits inside the hose positioner. The box is fabricated from sheet aluminum with formed angles to add rigidity. The hose positioner is welded to the bottom of the box. the box is fitted with four carrying handles.

75. Tool Boxes

a. Removal. Refer to figure 38 and remove the tool boxes.

b. Cleaning and Inspection.

(1) Clean the tool boxes with a cloth dampened with an approved cleaning solvent. Wipe dry.

(2) Inspect the tool boxes for cracks, enlarged mounting holes, damaged or sticking hinges, severe dents, and other damage. Lubricate sticking hinges with light penetrating oil. Replace a damaged tool box.

c. Installation. Refer to figure 38 and install the tool boxes.

76. Base

a. Removal.

(1) Remove the tool boxes (para 75).

(2) Remove the pump assembly (para 71).

(3) Remove the engine assembly (para 73) to free the base.

b. Cleaning and Inspection.

(1) Clean the base with a cloth dampened with an approved cleaning solvent; wipe dry.

(2) Inspect the base for cracks, distortion or other damage. Replace damaged base.

c. Installation.

(1) Install the engine on the base (para 73) .

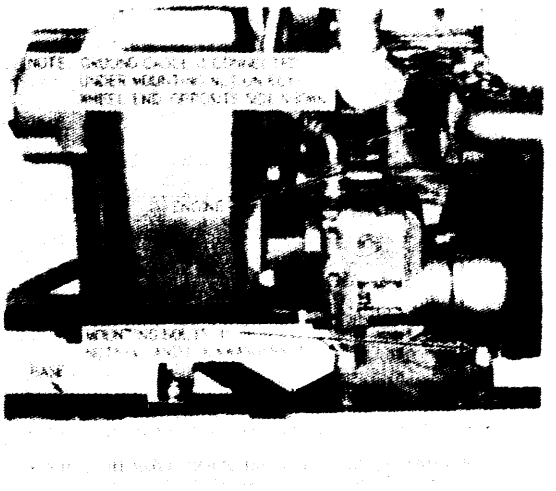


Figure 37. Engine, removal and istallation.

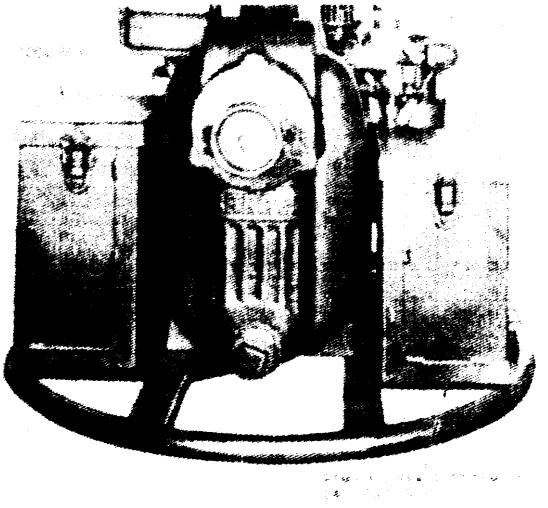


Figure 38. Tool boxes, removal and installation.

(2) Install the pump (para 71).

(3) Install the tool boxes (para 75).

77. Box Assembly

a. Cleaning. Clean the box assembly with a cloth dampened with an approved cleaning solvent; dry thoroughly.

b. Inspection and Repair.

(1) Inspect the box assembly for cracks, distortion, dents, loose rivets, broken weldments, broken or distorted nozzle brackets, loose or missing barrel bolts or carrying handles and other damage. Refer to figures 1 and 2.

(2) Inspect the box assembly for scratches and chipped or damaged paint. Paint any areas requiring it, taking care to remove loose paint and to smooth areas surrounding the damaged spots with fine sandpaper.

CHAPTER 4

FIELD MAINTENANCE INSTRUCTIONS

Section I. GENERAL

78. Scope

These instructions are published for the use of direct and general support and depot maintenance personnel maintaining the pumping assembly, flammable liquid, Barnes Model QM-2-28002. They provide information on the maintenance of the equipment, which is beyond the scope of the tools, equipment, personnel, or supplies normally available to using organizations.

Section II. DESCRIPTION AND DATA

79. Description

A general description of the pumping assembly, flammable liquid, 50 gpm, Barnes Model QM–2–28002, the location and description of the identification and instruction plates, and information on the differences in models are contained in Chapter 1 of this manual. The repair and maintenance instructions are described in the appropriate sections of this manual.

80. Tabulated Data

a. General. This paragraph contains all overhaul data pertinent to direct and general support and depot maintenance personnel. Refer to chapter 1 of this manual for general tabulated data information.

b. Engine Repair and Replacement Standards. Table 1 lists manufacturer's sizes, tolerances, desired clearances, and maximum allow - able wear and clearances.

c. Nut and Bolt Torque Data.

Spark plug	25-30 ft-lbs
Cylinder head bolts	14-18 ft-lbs
Connecting rod capscrews	14-18 ft-lbs
Engine-to-base screws	6-8 ft lbs
Main bearing plate capscrews	14-18 ft-lbs

Table 1. Repair and Replacement Standards

Component	Manufacturer's dimensions and tolerances in inches		Desired Clearance		Maximum allowable wear and clearance
	Min	Max	Min	Max	
Crankshaft					
Diameter of journal	1.000	1.001			
Clearance to connecting rod	------	------	0.0007	0.002	0.002
Width of journal	1.000	1.005			
Connecting rod side clearance	------	------	0.006	0.013	0.013
End play (cold)	------	------	0.002	0.004	0.004
Piston					
Ring gap	------	------	0.012	0.022	0.022
Ring side					
Clearance in grooves:					
Top ring	------	------	0.002	0.0035	0.0035

Table 1. Repair and Replacement Standards-Continued

Component	Manufacturer's dimensions and tolerances in inches		Desired Clearance		Maximum allowable wear and clearance
	Min	Max	Min	Max	
2nd and 3rd ring	------	------	0.001	0.0025	0.0025
Oil ring	------	------	0.0025	0.004	0.004
Cylinder-to-skirt clearance	------	------	0.006	0.0065	0.0065
Pin-to-connecting rod clearance	------	------	0.0002	0.0003	0.0008
Tappet-to-valve clearance (cold):					
Intake	------	------	------	------	0.008
Exhaust	------	------	------	------	0.014
Valve stem-to-guide clearance	------	------	0.003	0.005	0.007

CHAPTER 5

GENERAL MAINTENANCE INSTRUCTIONS

Section I. SPECIAL TOOLS AND EQUIPMENT

81. Special Tools and Equipment

No special tools or equipment are required to perform direct and general support and depot maintenance on the pumping assembly.

82. Field and Depot Maintenance Repair Parts

Field and depot maintenance repair parts list is not part of this manual.

83. Specially Designed Tools and Equipment

No specially designed tools and equipment are required to perform direct and general support and depot maintenance on the pumping assembly.

Section II. TROUBLESHOOTING

84. General

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

85. Engine Fails to Start

Prpbable cause	Possible remedy
Valves or valve seat defective.	Repair or replace valves or valve seat (para 92 or 102).
Magneto defective	Overhaul or replace magneto (par. 90).
Compression weak	Replace piston rings (para 96).

86. Excessive Oil Consumption

Probable cause	Possible remedy
Piston rings worn or broken.	Replace piston rings (para 96).
Cylinder wall worn or scored.	Replace crankcase (para 102).
Oil pump not operating effectively.	Replace damaged oil pump parts (para 94).
Main or connecting rod bearings faulty.	Replace damaged bearings (para 98).

87. Knock in Engine

Probable Cause	Possible remedy
Loose or burned out connetting rod bearing.	Overhaul engine.
Loose or worn piston pin.	Replace piston, piston pin and connecting rod as necessary (para 96).

88. Engine Smokes Excessively

Probable cause	Possible remedy
Piston or rings worn or damaged.	Replace piston or rings (para 96).
Cylinder walls scored or worn.	Replace crankcase (para 102).

CHAPTER 6

ENGINE REPAIR INSTRUCTIONS

Section I. MAGNETO

89. General

a. The magneto consists primarily of a coil, rotor, capacitor, and a contact point set which are contained in a cast housing. The rotor is driven by a gear on the camshaft. This arrangement provides one revolution of the magneto for every two revolutions of the crankshaft. The magneto rotor contains permanent magnets which, when rotated near the coil. set up an electrical charge in the coil to charge the capacitor. When the contact points open by cam action, the discharge of the capacitor through the coil creates a high tension spark which is directed to the spark plug and which ignites the fuel-air mixture in the cylinder. The magneto is timed to provide the spark as the piston is near top-dead-center of the compression stroke.

b. The magneto is provided with an impulse coupling which retards the rotation of the rotor at starting speeds, causing the rotor to snap over at the required time. This snapping action helps to induce a hotter spark than could be obtained by rotating the rotor at slow starting speeds.

90. Magneto

a. *Removal and Disassembly.*

(1) Remove the magneto (para 55).

(2 Disassemble the magneto in the numerical sequence as illustrated in figure 39.

b. Cleaning *and Inspection.*

(1) Discard and replace the point contact set.

(2) Clean the rotor, coil, housing, bearing, and end cap with a cloth dampened with an approved cleaning solvent; dry thoroughly. Clean all remaining metallic parts by immersing in an approved cleaning solvent; dry thoroughly.

(3) Check the rotor for continuity betwee nthe coil lead and the coil clip connection, using a multimeter set to read ohms. Continuity must exist. Check for damaged insulation, broken leads or windings, or other damage.

(4) Check the rotor for cracks, damaged threads, worn keyways, and other damage. Check the magnetic strength of the rotor with a screwdriver. It must exert a strong magnetic pull.

(5) Inspect the bearing for visible damage, signs of overheating, rough or binding operation, and other damage.

(6) Inspect the housing and end cap for cracks, distortion, worn or damaged threads, and other damage.

(7) Inspect the coupling spring and pawl spring for cracks, distortion, loss of resilience, and other damage.

(8) Inspect all other parts for cracks, worn or damaged threads, distortion, and other visible damage; replace all damaged parts.

c. Reassembly and Installation.

(1) Reassemble the magneto in the reverse of the numerical sequence as illustrated on figure 39.

(2) Install the magneto (para 55).

Section II. VALVES AND VALVE SPRINGS

91. General

a. The engine uses a conventional valve-in-block arrangement. Valves are held closed by action of the valve springs unless the force of the springs is overcome by action of the camshaft against the valves through the valve tappets. The lobes of the camshaft raise the tappets which strike the valve and raise the valves from their seats to allow intake and exhaust at the required time. A valve-to-tappet clearance must exist to assure that valves will seat fully when tappets are in the lowest position. This clearance must be 0.008 inch for inlet valves and 0.014 inch for exhaust valves. The clearances are adjusted by grinding off the ends of the valve stems.

b. The exhaust valve is provided with a valve rotator which imparts a slight rotation to the exhaust valve each time it operates. This helps to prevent sticking valves, provides a wiping action which cleans the exhaust valve seat, and helps to provide even heat dissipation.

92. Valves and Valve Springs

a. Removal and Disassembly.

(1) Remove the engine (para 73). Remove the carburetor (para 52). Remove the muffler (para 62). Remove the cylinder head (para 65). Remove the tappet cover (para 66).

(2) Refer to figure 40 and remove and disassemble the valves and springs.

b. Cleaning, Inspection, and Repair.

(1) Clean the valves with a wire brush to remove all carbon deposits and gum deposits. Clean valves seats, ports, and guides in cylinder block; clean top of cylinder block. Wash springs with an approved cleaning solvent and dry thoroughly.

(2) Inspect valves for burned, pitted, or cracked faces; replace a burned, cracked, or deeply pitted valve.

(3) Measure the valve stem clearance in guides; refer to table 1 for clearances. Replace a defective guide (para 102).

(4) Inspect valve springs for cracks or pitting. Replace cracked or pitted springs.

c. Regrinding Valves.

(1) Regrind valve, valve seat, and valve seat insert only when there is evidence of warping or deep pits.

(2) Using a valve seat grinding tool, grind the seats to a 45° angle and then grind the valve faces at a 45° angle with a valve refacer grinder.

(3) Valves must be lapped with a suitable lapping compound or they will leak within the first few hours of operation because of improper seating.

(4) Clean valve seat and faces with an approved cleaning solvent and dry thoroughly.

(5) After lapping the valves, remove them from the block and wash the valves and block with an approved cleaning solvent.

(6) After grinding valves, check valve tappet clearance (para 66). If it is not great enough, carefully grind off the ends of the valve stem to provide required clearance.

d. Reassembly and Installation.

(1) Refer to figure 40 and install the valves and associated parts

(2) Install the tappet cover (para 66). Install the cylinder head (para 65). Install the muffler (para 62). Install the carburetor (para 52). Install the engine (para 73).

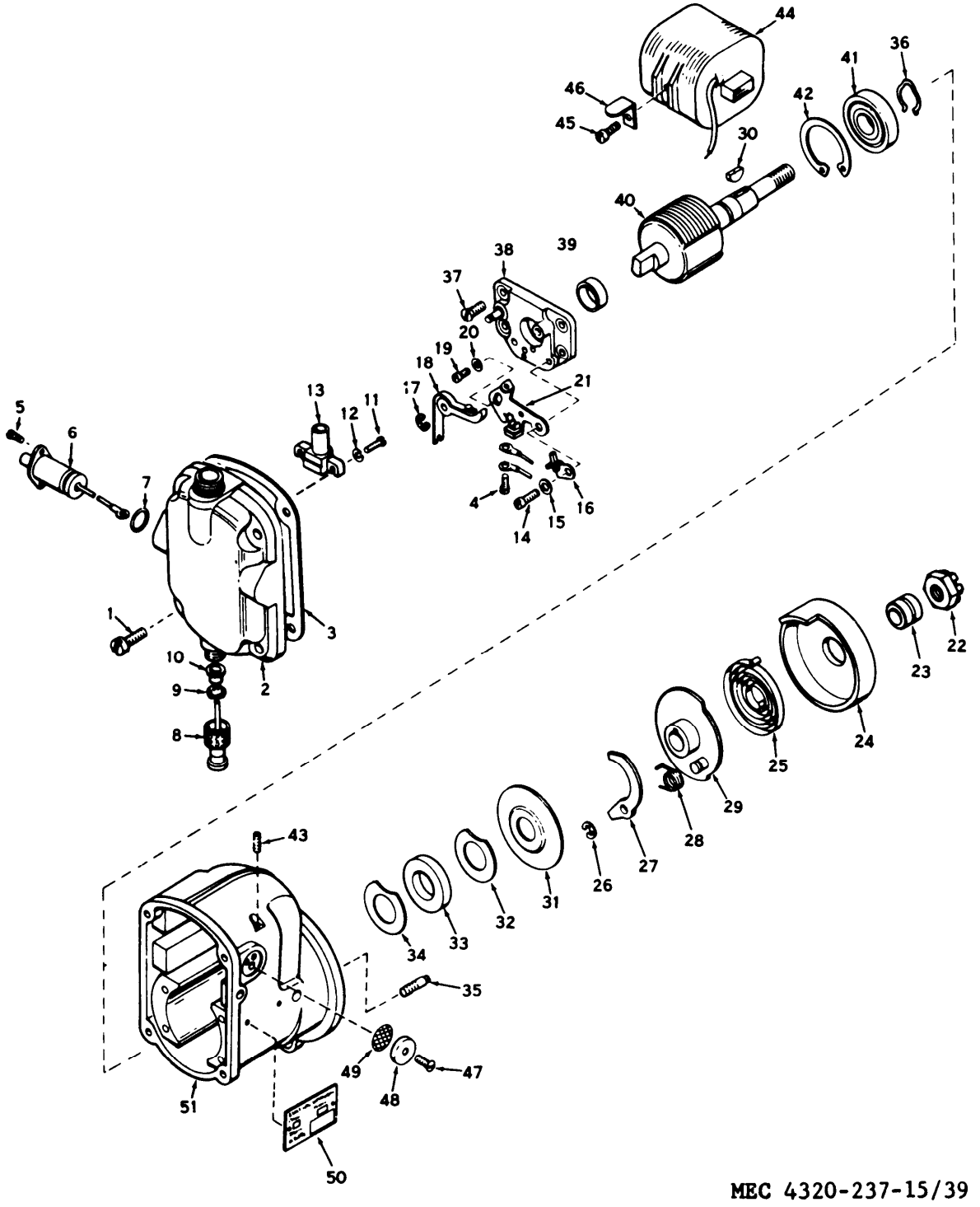
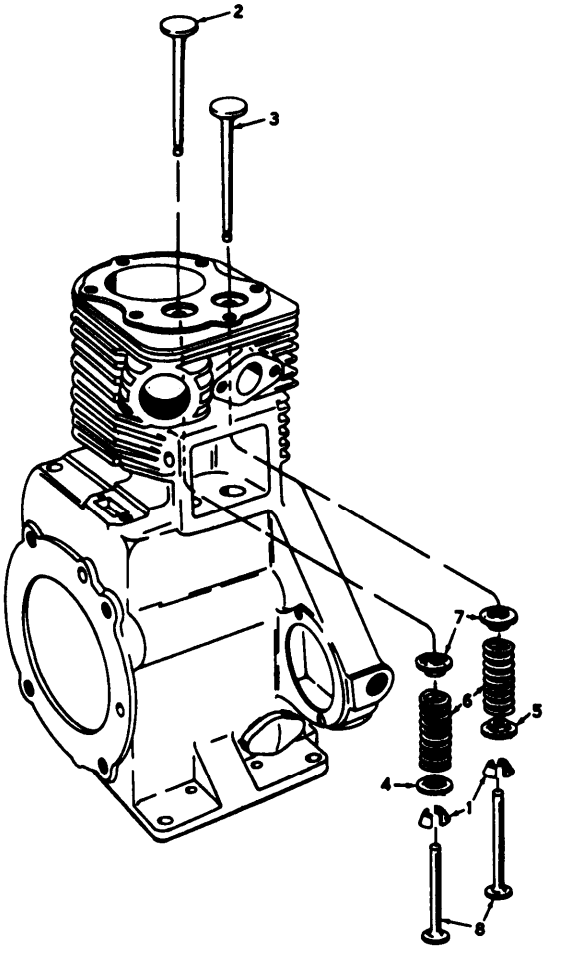


Figure 39. Magneto, disassembly and reassembly.

1 Screw, machine, No. 10–24 x 3/4 in. (4)
2 End cap
3 Gasket
4 Screw, terminal, No. 6–32 x 3/8 in.
5 Screw, machine, No. 6–32 x 3/8 in.
6 Capacitor
7 Preformed packing
8 Switch plunger assembly
9 Switch spring
10 Switch bushing
11 Screw, machine, No. 8–32 x 1/2 in. (2)
12 Washer, lock, No. 8
13 Cable outlet
14 Screw, machine, No. 8–32 x 3/8 in.
15 Washer, flat, No. 8
16 Cam wick
17 Retaining ring
18 Movable contact
19 Screw, machine, No. 6–32 x 3/8 in.
20 Washer, flat, No. 6
21 Stationary contact
22 Coupling nut
23 Gear bushing
24 Coupling shell
25 Coupling spring
26 Retaining ring
27 Coupling pawl
28 Pawl spring
29 Hub assembly
30 Key
31 Oil slinger
32 Seal outer washer
33 Shaft seal
34 Seal inner washer
35 Pawl stop pin
36 Shaft retaining ring
37 Screw, machine No. 8–32 x 3/8 in.
38 Bearing support
39 Cam end bearing
40 Rotor
41 Drive end bearing
42 Retaining ring
43 Setscrew, 5/16–24 x 7/8 in. (2)
44 Coil
45 Screw, machine, No. 6–32 x 1/4 in.
46 Coil clip
47 Screw, machine, No. 6–32 x 1/4 in. (2)
48 Vent cover
49 Vent screen
50 Nameplate
51 Housing

Figure 39-Continued.



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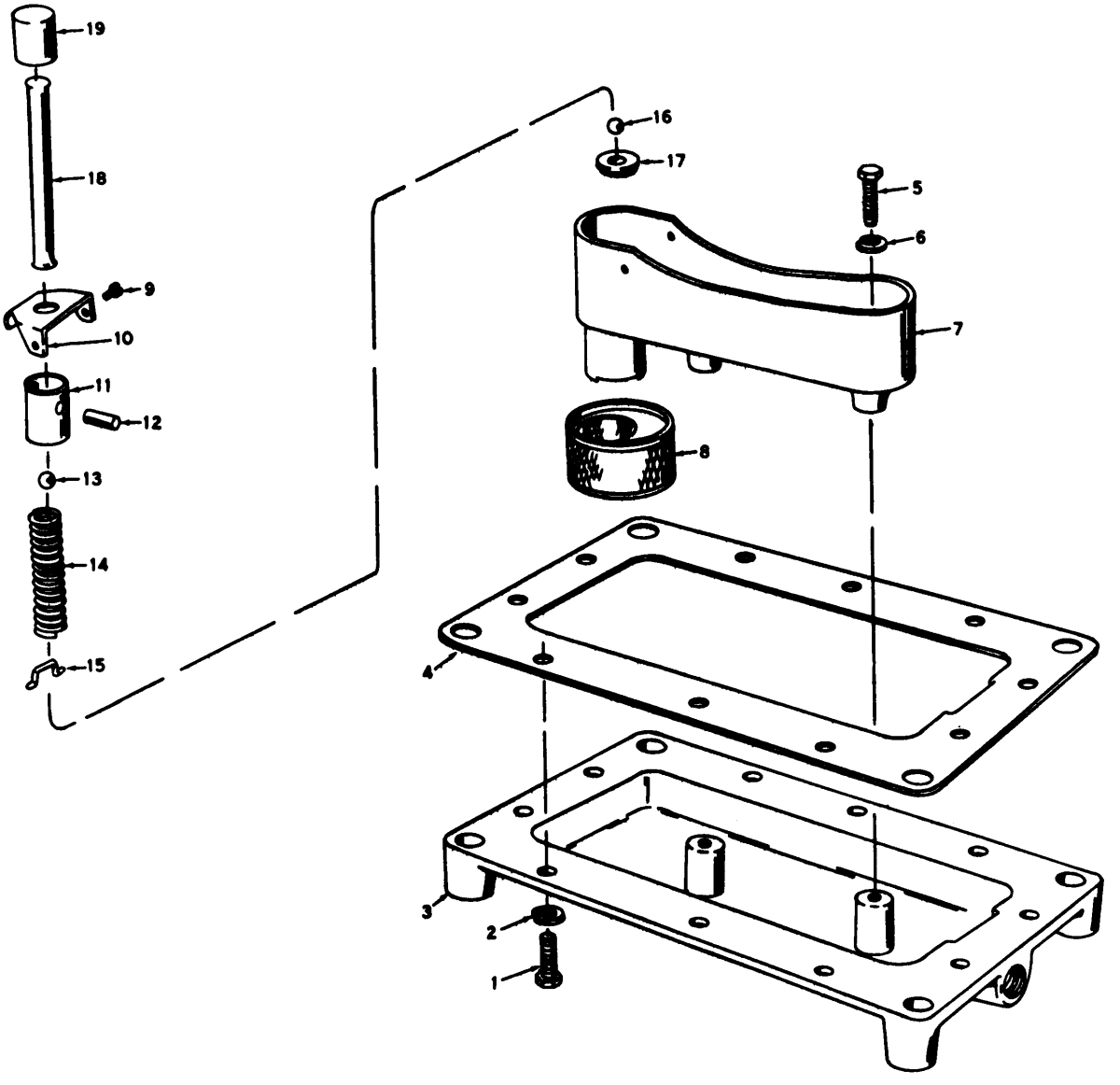
1 Valve spring seat locks (2)
2 Exhaust valve
3 Intake valve
4 Valve rotator and spring seat
5 Valve spring seat
6 Valve spring (2)
7 Valve spring locator (2)
8 Valve tappet (2)

Figure 40. Valves and valve springs, removal and installation.

Section III. ENGINE BASE AND OIL PUMP

93. General

The engine base covers the bottom of the engine and provides a mounting for the engine. The oil pump and trough-like body are mounted on the base within the engine. The oil pump maintains a constant oil level in the trough. A projection on the connecting rod. cap dips into the oil and causes splashing with every revolution of the crankshaft. This splashing lubricates all internal working parts of the engine. The power to operate the oil pump is derived from the crankshaft through a push rod.



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Note: Seat lower check ball (16) by tapping lightly into seat (17) using punch and hammer.

1 Screw, cap, 1/4–20 x 3/4 in. (10)
2 Washer, lock, 1/4 in. (10)
3 Engine base
4 Base gasket
5 Screw, cap, 1/4–20 x 1 in. (2)
6 Washer, lock, 1/4 in. (2)
7 Oil pump body
8 Strainer
9 Screw, self-tapping, No. 2 x 3/16 in. (2)
10 Oil pump body cover
11 Plunger
12 Pin
13 Oil pump check ball
14 Spring
15 Oil pump check ball retainer
16 Oil pump check ball
17 Oil pump check ball seat
18 Oil pump push rod
19 Cap

Figure 41. Engine base and oil pump, disassembly and reaessembly.

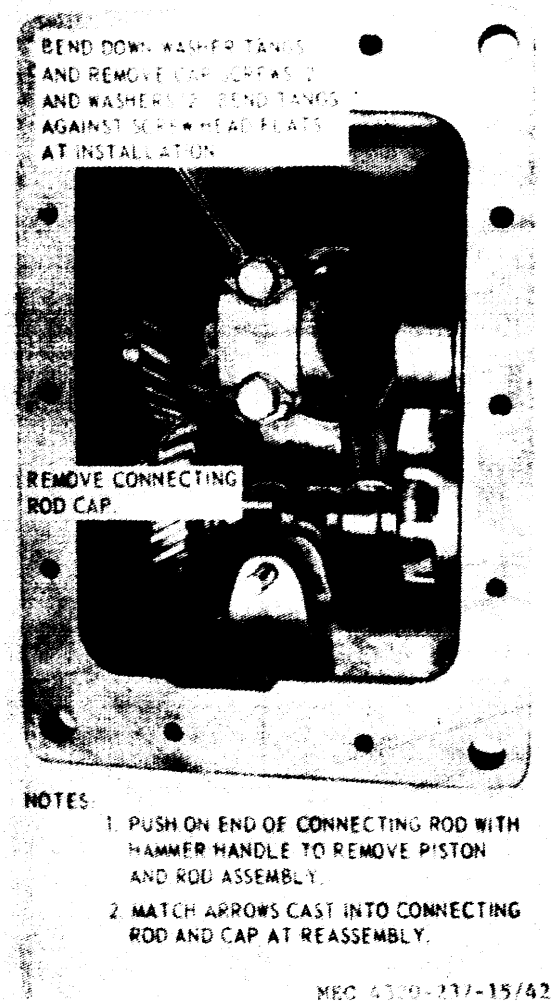
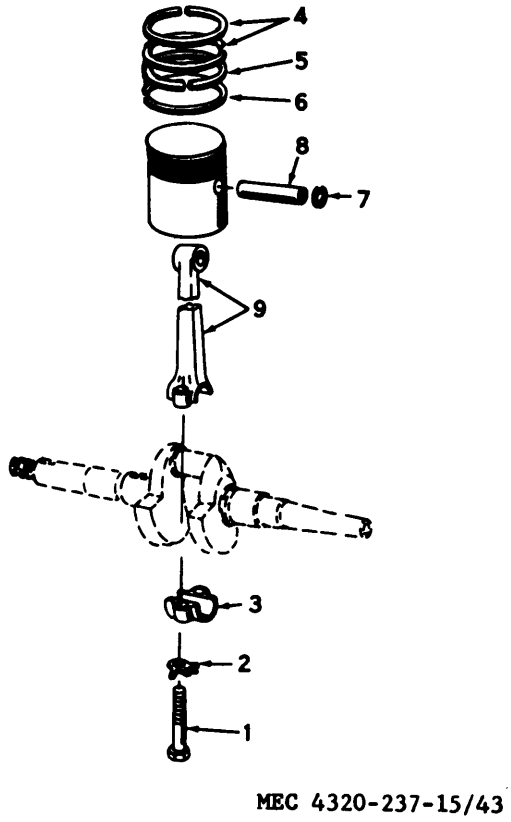


Figure 42. Piston and connecting rod, removal and installation.



1 Screw, cap, 5/16–18 x 1 1/4 in. (2)
2 Special lock washer
3 Connecting rod bearing cap
4 Compression ring
5 Scraper ring
6 Oil ring
7 Retaining ring (2)
8 Wrist pin
9 Connecting rod

Figure 43. Piston and connecting rod, disassembly and reaessembly.

94. Engine Base and Oil Pump

a. Removal and Disassembly.

(1) Remove the engine (para 73).

(2) Remove the engine base and oil pump in the numerical sequence as illustrated in figure 41.

b. Cleaning and inspection.

(1) Clean all parts with an approved cleaning solvent; dry thoroughly.

(2) Inspect the oil pump check balls for dents, scoring, out-of-roundness, and other damage.

(3) Inspect the plunger for scoring, wear, or distortion.

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

c. Reassembly and Installation.

(1) Reassemble the oil pump into the base in the reverse of the numerical sequence as illustrated in figure 41. After assembly, fill the base sump with oil and pump the plunger up and down with a screwdriver to assure that the pump draws oil into the oil pump body to maintain a full oil pump body.

(2) When pump operation has been checked, install the engine base on the engine.

(3) Install engine (para 73).

Section IV. PISTON AND CONNECTING ROD

95. General

The engine uses a conventional piston and connecting rod assembly. The crankpin bearing and wrist pin bearing are an integral part of the connecting rod and are not removed from the rod at disassembly. The piston uses four piston rings, two compression rings, one scraper ring, and one oil ring.

96. Piston and Connecting Rod

a. Removal.

(1) Remove the cylinder head (para 65).
(2) Remove the engine base (para 95).
(3) Refer to figure 42 to remove the assembled piston and connecting rod.

b. Disassembly. Disassemble the piston and connecting rod in the numerical sequence as indicated in figure 43.

c. Cleaning and Inspection.

(1) Clean all parts with an approved cleaning solvent; dry thoroughly. Use the sharpened end of a broken piston ring to scrape carbon deposits from piston ring grooves.
(2) Inspect the piston for cracks, distortion, scoring, wear, and other damage. Refer to table 1 for tolerances.
(3) Inspect the connecting rod for cracks, distortion, wear and other damage. Refer to table 1 for tolerances.
(4) Inspect piston rings for cracks, distortion, and other damage. Check piston ring gap and side clearance. Refer to table 1 for tolerances.

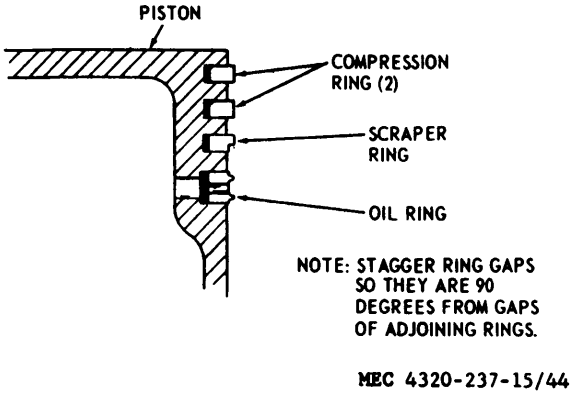


Figure 44. Piston ring location

(5) Check the fit of the wrist pin in the piston and connecting rod. Refer to table 1 for tolerances.
(6) Inspect all other parts for cracks, distortion, and other damage; replace damaged parts.

d. Reassembly. Reassemble the piston and connecting rod in the reverse of the numerical sequence as illustrated in figure 43. Refer to figure 44 for location of various piston rings.

e. Installation.

(1) Refer to figure 42 and install the assembled connecting rod and piston.
(2) Install the engine base (para 94).
(3) Install the cylinder head (para 65).

Section V. CRANKSHAFT

97. General

The crankshaft rides in tapered roller bearings in the crankcase. Bearing end play is taken up by shims installed under the driven end bearing plate. Cork seals prevent the oil from leaking around the rotating crankshaft. Both ends of the crankshaft are threaded—one end to receive the impeller of the pump and the other end to mount the starting rope pulley.

98. Crankshaft

a. Removal.

(1) Remove the piston and connecting rod (para 96).
(2) Refer to figure 45 and remove the crankshaft assembly.

b. Disassembly. Disassemble the crankshaft in the numerical sequence as illustrated in figure 46.

c. Cleaning and Inspection.

(1) Clean tapered roller bearings by immersing in a container of an approved cleaning solvent; blow dry with compressed air. Take care not to spin dry bearings. Dip cleaned bearings in light engine oil and wrap in lint-free paper until they can be reinstalled.

(2) Wipe the cork seals with a clean, dry cloth.

(3) Clean all other parts with an approved cleaning solvent; dry thoroughly. Take care to prevent scratching bearing journals during cleaning.

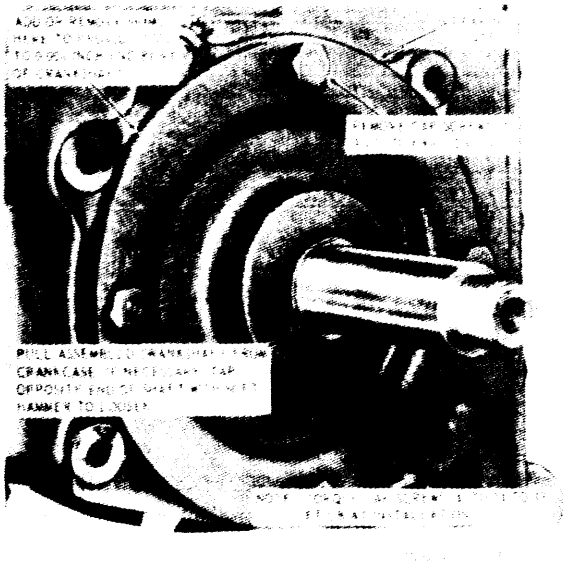


Figure 45. Crankshaft, removal and installation.

(4) Inspect the bearings for distorted races, worn rollers, and for rough and binding operation. If either the bearing cups or the rollers are damaged, replace both parts.

(5) Inspect the crankshaft for bends, worn or damaged threads, burred keyways, worn or scored crankpin journal, and other damage. C1ean up damaged threads with a thread chaser. Remove burrs from keyways with a fine file or India stone. Refer to table 1 to check crankshaft tolerances.

(6) Inspect seals for wear and deterioration. Replace seals if there is any doubt of their condition.

(7) Inspect the crankshaft gear for cracks, for chipped, scored, or broken teeth, and for other damage.

(8) Inspect the bearing plates for cracks, distortion, and other damage.

(9) Inspect all other parts for cracks, wear, worn threads, and other damage. Replace all worn and damaged parts.

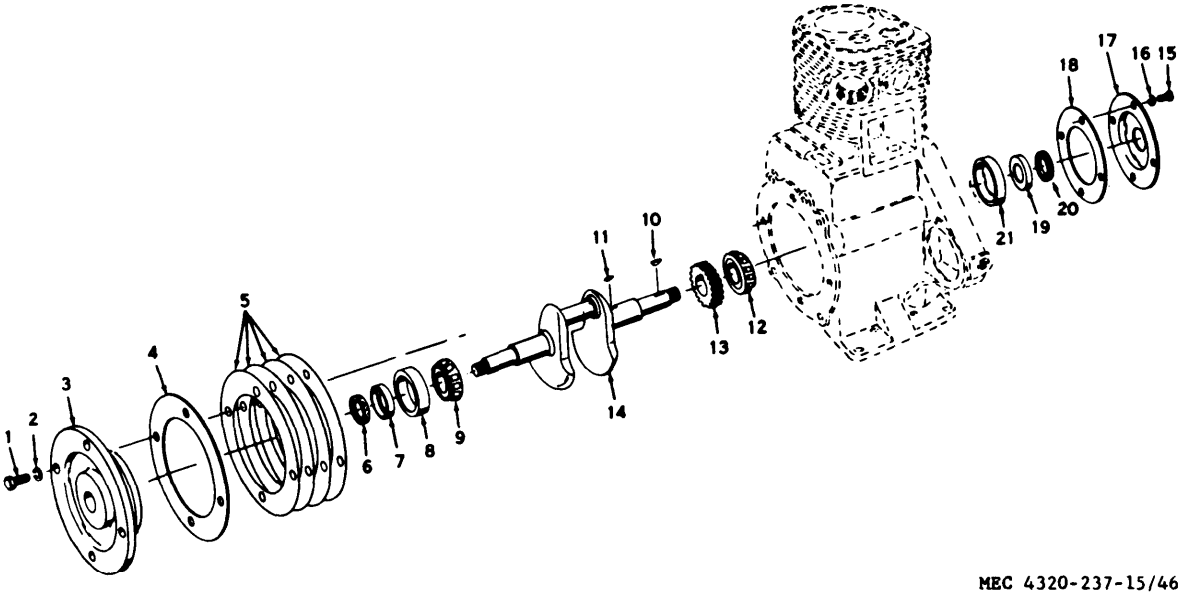
d. Reassembly. Reassemble the crankshaft in the reverse of the numerical sequence as illustrated in figure 46.

e. Installation.

(1) Refer to figure 45 and install the crankshaft.

Caution: **Timing marks on crankshaft gear and camshaft gear must match or engine will not operate.**

(2) Install the piston and connecting rod (para 96).



1 Screw, cap, 5/16–18 x 3/4 in. (4)
2 Washer, lock, 5/16 in. (4)
3 Bearing plate
4 Gasket, 0.003 in.
5 Gasket, 0.006 in.
6 Drive end oil seal
7 Retainer
8 Bearing cup
9 Bearing cone
10 Key
11 Key
12 Bearing cone
13 Crankshaft gear
14 Crankshaft
15 Screw, cap, 1/4 x 20 x 1/2 in. (4)
16 Washer, lock (4)
17 Bearing plate
18 Gasket
19 Retainer
20 Drive end oil seal
21 Bearing cup

Figure 46. Crankshaft, disassembly and reassembly.

Section VI. CAMSHAFT AND GOVERNOR

99. General

a. The camshaft rides on a non-rotating pin in the crankcase. It is driven by a gear on the crankshaft. The camshaft gear contains twice as many teeth as the crankshaft gear, thus causing the camshaft to rotate at one-half the speed of the crankshaft. The camshaft operates the tappets which raise the valves for fuel intake and exhaust. It also operates the plunger which engages the oil pump to maintain a full oil trough in the engine base.

b. Governor weights are pinned to one end of the camshaft. As the camshaft rotates, these weights are thrown outward by centrifugal force. The higher the speed at which the camshaft rotates, the greater is the outward thrust of the weights. Thrust pins in the governor weights engage a thrust sleeve, sliding it axially on the camshaft support pin. This movement is transferred to the governor yoke and shaft which is connected through a spring-loaded linkage to the throttle lever on the carburetor. As the engine speed increases, the centrifugal force of the flyweights acts against the spring-loaded linkage to close the throttle so that the engine speed will de. crease, thus maintaining a nearly constant engine speed under all load conditions for any speed control lever setting.

100. Camshaft and Governor

a. Removal and Disassembly.

(1) Remove the crankshaft (para 98).

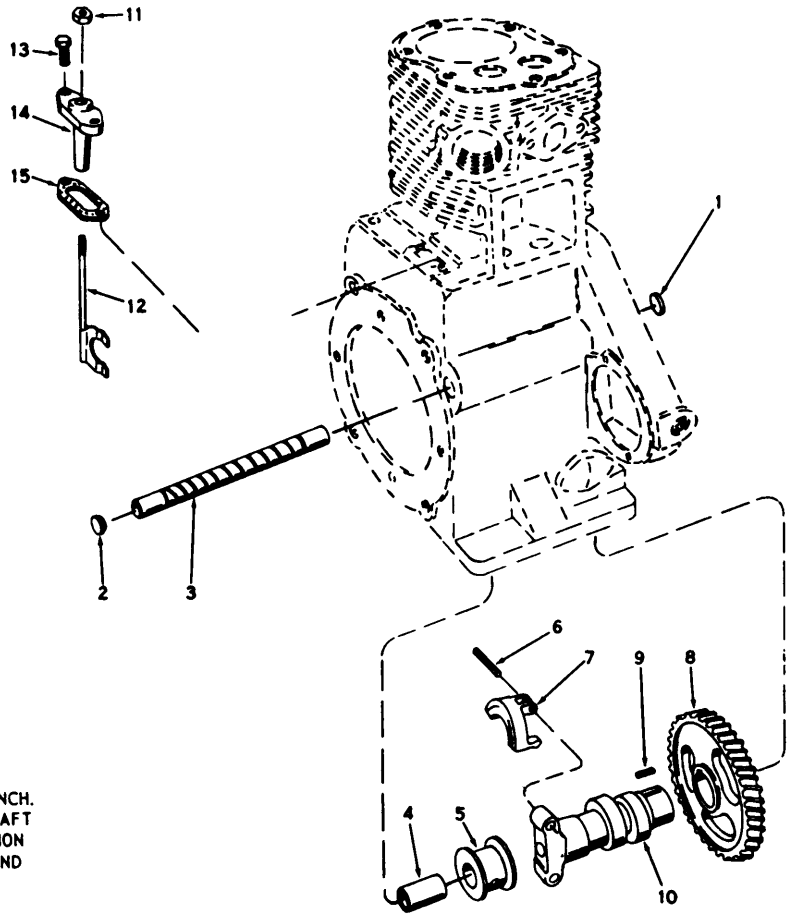
(2) Remove and disassemble the camshaft and governor in the numerical sequence as illustrated in figure 47.

b. Cleaning and Inspection.

(1) Discard and replace expansion plugs. Clean all other parts with an approved cleaning solvent; dry thoroughly.

(2) Inspect the fit of the camshaft assembly on the camshaft support pin. If excessive play exists between parts, replace the pin, camshaft, or both parts.

(3) Inspect the camshaft for cracks, worn or scored cam lobes, worn governor weight carrier, and other damage. Inspect the camshaft gear for cracks, worn or chipped gear teeth, and



NOTE: REMOVE EXPANSION PLUG (1) WITH PUNCH. USE SOFT DRIFT TO DRIVE OUT CAMSHAFT SUPPORT PIN (3), DISLODGING EXPANSION PLUG (2) AND RELEASING CAMSHAFT AND GOVERNOR.

MEC 4320-237-15/47

1 Expansion plug
2 Expansion plug
3 Camshaft support pin
4 Governor spacer
5 Governor thrust sleeve
6 Flyweight pin
7 Governor flyweight
8 Camshaft gear
9 Key
10 Camshaft
11 Nut, hex, 1/4–28
12 Governor yoke and shaft
13 Screw, cap, 1/4–20 x 3/4 in. (2)
14 Yoke shaft support bracket
15 Bracket gasket

Figure 47. Camshaft and governor, disassembly and reassembly.

other damage.

(4) Inspect the governor thrust sleeve for cracks, wear, and scoring.

(5) Inspect the governor flyweights for worn mounting holes and for worn thrust pins.

(6) Inspect the governor yoke and shaft for a worn shaft and yoke, bent shaft, and worn or damaged threads.

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

c. Reassembly and Installation.

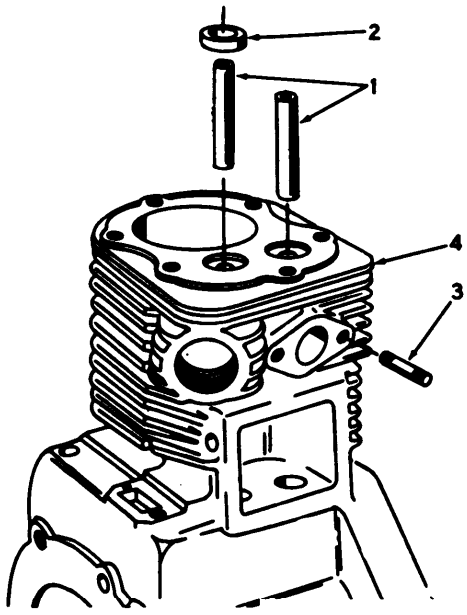
(1) Reassemble the camshaft and governor in reverse of the numerical sequence as illustrated in figure 47.

(2) Install the crankshaft (para 98).

Section VII. CRANKCASE

101. General

The crankcase is an integral unit which ineludes the cylinder block and the crankshaft housing. The cylinder block portion of the unit is deeply finned to promote mm-e rapid dissipation of the heat generated during the operation of the engine. The crankcase is provided with valve guides which are pressed into the crankcase. A stellite exhaust valve seat insert is peened into the crankcase.



1 Valve guide
2 Valve seat insert
3 Stud
4 Crankcase

Figure 48. Crankcase, disassembly and reassembly.

102. Crankcase

a. Removal.

(1) Remove the valves (para 92).

(2) Remove the engine base and oil pump (para 94).

(3) Remove the piston and connecting rod (para 96).

(4) Remove the crankshaft (para 98).

(5) Remove the camshaft and governor (para 100),

b. Cleaning and Inspection.

(1) Clean the crankcase with an approved cleaning solvent; dry thoroughly.

(2) Inspect the cylinder bore for cracks, warping, worn or scored cylinder walls, broken cooling fins, worn or damaged threads, and other damage. Replace a damaged crankcase.

(3) Check the fit of the valves in the valve guides. If it is not within the tolerances listed in table 1, drive out the valve guides and replace them with new guides as shown in figure 48.

(4) Check the exhaust valve seat insert for distortion, cracks, looseness, and pitting. If necessary, replace the insert as follows:

(a) Use a puller to remove the insert from the exhaust valve opening.

(b) Clean all carbon out of the insert counterbore in the cylinder block. and clean the valve stem guide bore.

(c) Finish the counterbore in the cylinder block to provide the correct bore-to-insert clearance. Chill the insert with dry ice and, using a pilot driver, tap the insert into place

with light blows. Peen the insert to anchor in place.

(d) Reface the insert, if necessary, to make its seat concentric with the valve stem bore. Check concentricity with a dial indicator.

(c) Grind valve in seat to form a gastight seat.

Note. Grind **valve stem for proper valve** tappet clearance; refer to table L

(5) Check the carburetor mounting studs for damaged threads, distortion, and looseness. If necessary, replace carburetor mounting studs.

c. Installation.

(1) Install the camshaft and governor (para 100).

(2) Install the crankshaft (para 98).

(3) Install the piston and connecting rod (para 96).

(4) Install the engine base and oil pump (para 94).

(5) Install the valves (para 92).

APPENDIX I

REFERENCES

1. Fire Protection

TB 5-4200-200-10	Hand Portable Fire Extinguisher, Approved for Army Users
TM 5-687	Repair and Utilities; Fire Protection Equipment and Appliances; Inspection, Operations, and Preventive Maintenance.

2. lubrication

LO 5-4320-237-15	Pumping Assembly, Flammable Liquid, Bulk Transfer, Centrifugal, 50 GPM, 100 ft. Head: Gasoline Engine Driven, 2 in. Frame Mounted. Barnes Mfg. Co. Model 28002 w/Wisconsin Engine, Model-MBKND Specification 279315.

3. Painting

TM 9-213	Painting Instructions for Field Use.

4. Preventive Maintenance

TM 38-750	Army Equipment Record Procedures.

5. Radio Interference Suppression

TM 11-483	Radio Interference Suppression.

6. Shipment and limited Storage

AR 743-505	Limited Storage of Engineers Mechanical Equipment.
TM 38-230	Preservation Packaging, and Packing of Military Supplies and Equipment.

7. Supply Publications

C91OO-IL	Fuels, Lubricants, Oils, and Waxes.

APPENDIX II

BASIC ISSUE ITEMS AND MAINTENANCE AND OPERATING SUPPLIES

Section I. INTRODUCTION

1. Scope

This appendix lists items which accompany the Barnes pumping assembly or are required for installation, operation, or operators maintenance. Section II lists the accessories, tools, and publications required for the maintenance and operation by the operator, initially issued or authorized with the equipment. Section III lists the maintenance and operating supplies required for initial operation.

2. Explanation of Columns

The following provides an explanation of columns in the tabular list in Section II.

a. Source, Maintenance and Recoverability Cods (Column 1).

(1) Source Code, column la, 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 the GSA/DSA 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.
X2	Applied to repair parts which are not staked. 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 rustication through normal supply channels.

(2) Maintenance Code, column lb, indicates the lowest category of maintenance authorized to install the listed item. The maintenance level code is:

Code	Explanation
O	Organizational maintenance (operator/crew)

(3) Recoverability code, column 1c, 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 activities 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 mainte nance activities.
U	Applied to repair parts specifically selected for salvage by reclamation units because of precious metal content, critical mat* rials high dollar value reusable casings and castings.

b. Federal Stock Number, column 2, indicates the Federal stock number for the item.

c. Description, column 3, indicates the Federal item name and any additional description required. A five-digit manufacturer's or other service code is shown in parentheses followed by the manufacturer's part number. Repair parts quantities included in kits, sets, and assemblies that differ from the actual quantity used in the specific item, are listed in parentheses following the repair part name.

d. Unit of Issue, column 4, indicates the unit used as a basis of issue, e.g., ea, pr, ft, yd, etc.

e. Quantity Incorporated in Unit Pack, column 5, indicates the actual quantity contained in the unit pack.

f. Quantity Incorporated in Unit, column 6, indicates the quantity of the item used on the equipment.

g. Quantity Authorized, column 7, indicates the total quantity of an item required to be on hand and necessary for operation and maintenance of the equipment. Items to be requisitioned as required are indicated by an asterisk.

h. Illustration, column 8.

(1) Figure Number, column 8a, indicates the figure number of the illustration in which the item is shown.

(2) Item or Symbol Number, column 8b, indicates the callout number used to reference the item in the illustration.

3. Explanation of Columns Contained in Section III.

a. Item. This column contains numerical sequence item numbers assigned to each component application to facilitate reference.

b. Component Application. This column identifies the component application of each maintenance or operating supply item.

c. Federal Stock Number. The Federal Stock Number will be shown in this column and will be used for requisitioning purposes.

d. Description. The item and a brief description are shown.

e. Quantity Required for Initial Operation This column lists the quantity of each maintenance or operating supply item required for initial operation of the equipment.

f. Quantity Required for 8-Hours Operation. Quantities listed represent the estimated requirements for an average eight hours of operation.

Section II. BASIC ISSUE ITEMS LIST

(1) Source maint and recov code			(2)	(3)	(4)	(5)	(6)	(7)	(8) Illustration	
(a) Source	(b) Maint	(c) Recov	Federal stock number	Description	Unit of issue	Qty inc in unit pack	Qty inc in unit	Qty auth	Fig no.	Item or sym no.
				GROUP 31—BASIC ISSUE ITEMS MANUFACTURER INSTALLED						
				3100—Basic Issue Items Manufacturer or Depot Installed						
P	O		7520-559-9618	Case, Maintenance and Operational Manual; Cotton Duck, Water Repellent, Mildew Resistant	EA		1	1	49	1
				Department of the Army, Operator, Organizational, Direct and General Support Maintenance Manual TM5-4320-237-15						
				Department of the Army Lubrication Order LO 5-4320-237-15	EA		1	1		
P	O		4320-360-0595	Gasket Kamlock Type, 1 1/2 in. (81718) H6430M	EA		14	14	49	10
P	O		4720-303-4984	Hose Assembly, Discharge, 1 1/2 in. id 50 ft lg (05748) 15656SA	EA		2	2	49	3
P	O		4720-555-8325	Hose Assembly, Rubber, Suction, w/male and female couplers, 1 1/2 in. id, 25 ft. lg (05748) 15657SA	EA		2	2	49	4
P	O		4930-360-0569	Nozzle, Fuel and Oil Servicing Pressure Pump Discharge Hose, 1 1/2 in. NPT (81718) CC210-11-2 (05748) 15689SA	EA		2	2	49	5
P	O		2990-718-6022	Starter, Rope Engine (66289) U268B (05748) 28616	EA		1	1	49	6
P	O		5975-577-8825	Rod, Ground, 1/2 in. dia., 30 in. lg (05748) 15675	EA		1	1	49	7
			4940-672-4771	Wire Assembly, w/fitting, ground (05748) 15676SA	EA		1	1	49	8
			4320-377-6981	Suction Stub Assembly, Aluminum, Drum unloader (05748) 8215SA	EA		1	1	49	9
			4210-889-2221	Extinguisher, Fire Dry Chemical, hand type, 2 1/2 lb Fed Spec-O-E-915, Type III Class 2, Size 2 1/2, Walter Kiddie, Part No. 874195, or equal	EA		1	1	49	2
			7510-889-3494	Binder, Loose Leaf; U. S. Army Equip Log Book.					49	11
				Note. Initial Issue and Requirements will be made in accordance with TM 38-750.						

(1) Source maint and recov code			(2)	(3)	(4)	(5)	(6)	(7)	(8) Illustration	
(a) Source	(b) Maint	(c) Recov	Federal stock number	Description	Unit of issue	Qty inc in unit pack	Qty inc in unit	Qty auth	Fig no.	Item or sym no.
				GROUP 32—BASIC ISSUE ITEMS TROOP INSTALLED						
				3200—Basic Issue Items Troop Installed or Authorized						
			4320-360-0947	**Clamp, Hose**	**EA**		**16**	*	**49**	**12**
			5120-222-8871	**Screw driver, Flat tip; 8 in. blade length**	**EA**		**1**	*	**49**	**13**
			5120-223-3739	**Pliers: Slip Joint 8 in.**	**EA**		**1**	*	**49**	**14**
			5120-240-5328	**Wrench, adjustable**	**EA**		**1**	*	**49**	**15**

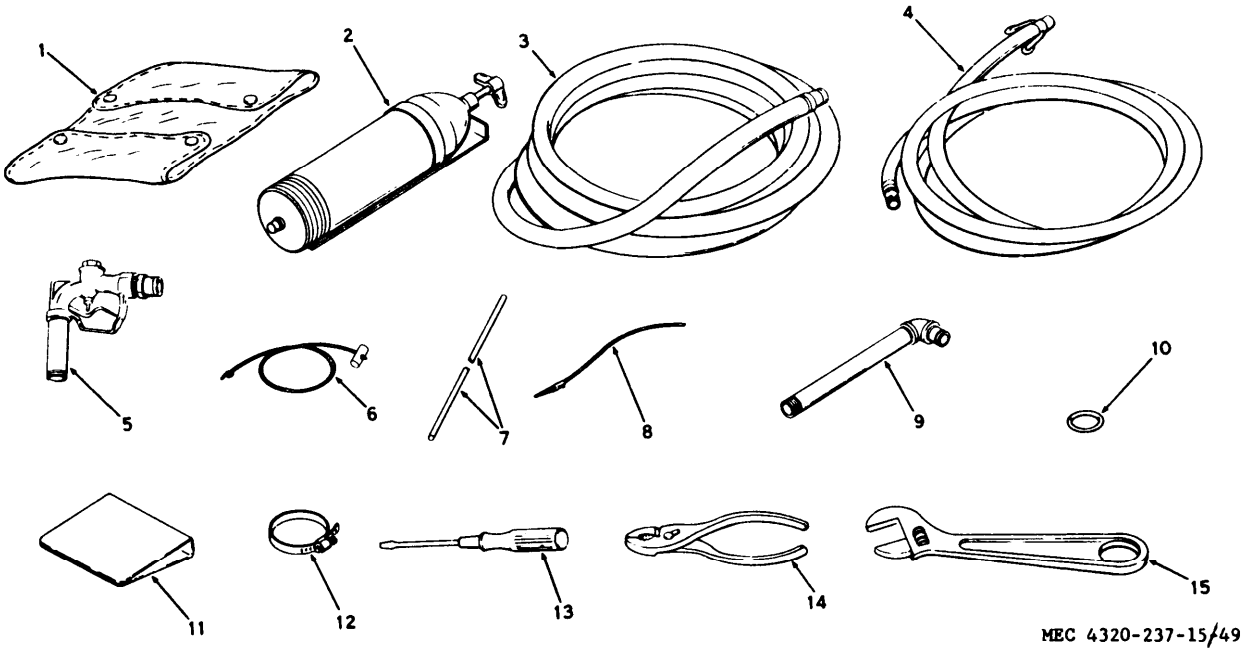


Figure 49. Basic issue items.

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
		9130-160-1818	Gasoline, Auto, Combat	As Rq'd	Bulk	
		9150-265-9433	Oil, Engine (OE30)	1 5/32 Qt.	As Rq'd	1 Qt. Can
		9150-265-9425	Oil, Engine (OE10)	1 5/32 Qt.	As Rq'd	1 Qt. Can
		9150-242-7602	Oil, Engine (OES)	1 5/32 Qt.	As Rq'd	1 Qt. Can

APPENDIX III

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

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 operations on the identified end item or component. The implementation of the maintenance tasks upon the end item or component will be consistent with the assigned maintenance operations.

c. Section III lists the special tools and test equipment required for each maintenance operation as referenced from section II.

d. Section IV contains supplemental instructions, explanatory notes and/or illustrations required for a particular maintenance function.

2. Explanation of Columns in Section II

a. Functional Group Number. The **func**tional 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. Component Assembly Nomenclature. This column contains a brief description of the components of each functional group.

c. Maintenance Functions and Maintenance Categories. This column lists the various maintenance functions (A through K) and indicates the lowest maintenance category authorized to perform these operations. 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: Verify serviceability and detect incipient electrical or mechanical failure by close visual examination.

B-Test: Verify serviceability and detect incipient electrical or mechanical failure by measuring the mechanical or electrical characteristics of the item and comparing those characteristics with authorized standards. Tests will be made commensurate with test procedures and with calibrated tools and/or test equipment referenced in the MAC.

C-Service: Operations required periodically to keep the item in proper operating condition, i.e., to clean, preserve, drain, paint, and replenish fuel, lubricants, hydraulic, and deicing fluids, or compressed air supplies.

D—Adjust: Regulate periodically to prevent malfunction Adjustments will be made commensurates with adjustment procedures and associated equipment adjustment specifications.

E—Align: Adjust two or more componds of an electrical or mechanical system so that their functions are properly synchronized or adjusted.

F—Calibrate: Determine, check, or rectify the graduation of an instrument, weapon, or weapons system or components of a weapons system.

G—Install: Remove and install the same item for service or when' required for the performance of other maintenance operations.

H—Replace: Substitute serviceable components, assemblies and subassemblies for unserviceable counterparts.

I—Repair: Restore to a serviceable condition by replacing unserviceable parts or by any other action required using available tools, equipment and skills, including welding, grinding, riveting, straightening, adjusting and facing.

J—Overhaul. Restore an item to a completely serviceable condition (as prescribed by serviceability standards developed and published by the commodity commands) by employing techniques of "Inspect and Repair Only as Necessary" (IROAN). Maximum use of diagnostic and test equiment is combined with minimum disassembly during overhaul. "Overhaul" may be assigned to any level of maintenance except organizational, provided the time, tools, equipment, repair parts authorization, and technical skills are available at that level. Normally, overhaul as applied to end items, is limited to depot maintenance level.

K—Rebuild: Restore to a condition comparable to new by disassembling to determine the condition of each component part and reassembling using serviceable, rebuilt, or new assemblies, subassemblies, and parts.

d. Reference Note. This column, subdivided into columns L and M, is provided for referencing the Special Tool and Test Equipment Requirements (sec. III) and Remarks (sec. IV) that may be associated with maintenance functions (sec. II).

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&TE requirements column on the MAC. 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.

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 M and the second letter references a maintenance operation, columns A through K.

b. Remarks. This column lists information pertinent to the maintenance operation being performed, as indicated on the MAC section II.

Section II. MAINTENANCE ALLOCATION CHART

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	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
01	ENGINE													
0100	Engine Assembly	C	O	C	--	--	--	--	O	O	F	--		A
0101	Crankcase, Block, Cylinder head Cylinder and crankcase assembly	F	F	--	--	--	--	--	--	F	--	--		B
	Head, cylinder	O	--	O	--	--	--	--	O	F	--	--		C
0102	Crankshaft	F	--	--	F	--	--	--	F	--	--	--		B
0103	Flywheel assembly	O	--	--	--	--	--	--	O					
0104	Pistons, Connecting Rods	F	--	--	--	--	--	--	F	F	--	--		B
0105	Valves, Camshaft and Timing System Guides; Tappets	F	--	--	--	--	--	--	F					
	Springs, Valve	--	F	--	--	--	--	--	F					
	Seat, Valve	O	--	--	--	--	--	--	F	F	--	--		C
	Valve, Engine	O	--	--	F	--	--	--	F	F	--	--		C
0106	Engine Lubrication System Base, engine	F	--	--	--	--	--	--	F					
	Breather, crankcase	C	--	C	--	--	--	--	O					
	Oil pump assembly	F	--	--	--	--	--	--	F	F				
0107	Engine Starting System Pulley, starting	C	--	--	--	--	--	--	O					
	Rope, starting	C	--	--	--	--	--	--	O	--	--	--		D
03	FUEL SYSTEM													
0301	Carburetor	O	--	O	O	--	--	--	O	--	--	--		E
0304	Air Cleaner	C	--	C	--	--	--	--	O					
0306	Tanks, lines, Fittings Line assembly, fuel	C	--	--	--	--	--	--	O	--	--	--		D
	Tank, fuel	C	--	C	--	--	--	--	O	O				
3808	Engine Speed Governor and Caontrols Control assembly	O	--	--	O	--	--	--	O	O				
	Flyweight, governor; yoke and shaft	F	--	--	--	--	--	--	F					
	Lever, governor control	O	--	--	O	--	--	--	O					
0309	Fuel Filters Strainer, sediment	C	--	C	--	--	--	--	O	--	--	--		E
04	EXHAUST SYSTEM													
0401	Muffler and Pipes Muffler, exhaust	C	--	--	--	--	--	--	O					
05	COOLING SYSTEM													
0502	Cowling, Deflectors, Air Ducts, Shrouds, etc. Screen, air inlet	C	--	--	--	--	--	--	O					
	Shroud assembly	C	--	--	--	--	--	--	O					
06	ELECTRICAL SYSTEM													
0605	Ignition Components Magneto assembly	O	O	O	O	--	--	--	O	O	--	--		F
	Spark plug, ignition; wiring Assembly	O	O	O	O	--	--	--	O					

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	Align	Calibrate	Install	Replace	Repair	Overhaul	Rebuild	Tools and equipment	Remarks
15	FRAME, TOWING ATTACHMENTS AND DRAWBARS													
1501	Frame Assembly													
	Frame, mountings; handle, carrying	C	--	--	--	--	--	--	O	O				
18	BODY, CAB, HOOD AND HULL													
1808	Stowage racks, Boxes, Straps, Carrying Cases, Cable Reels, Hose Reels, Etc.													
	Box, tool; case, shipping	C	--	--	--	--	--	--	O	O				
22	BODY CHASSIS OR HULL													
2202	AND ACCESSORY ITEMS													
	Cable, Grounding; Nozzle, Fuel Hose	C	--	--	--	--	--	--	O	O				
	Hose, fuel; rod, grounding	C	--	--	--	--	--	--	O					
2210	Data Plates, Instruction Holders													
	Plate, Data	C	--	--	--	--	--	--	O					
	Plate, Identification (A.I.P.)	C	--	--	--	--	--	--	F					
55	PUMPS													
5500	Pump Assembly													
	Casing, pump	C	--	C	--	--	--	--	O	O				
	Intermediate	C	--	--	--	--	--	--	O	O				
5501	Shafts, Rotors, Impellers													
	Impeller, pump, seal, shaft	O	--	--	--	--	--	--	O					
5505	Suction and/or Discharge Assembly													
	Adapter, inlet	C	--	--	--	--	--	--	O					
	Manifold, discharge	C	--	--	--	--	--	--	O	O				

Section III. SPECIAL TOOL AND SPECIAL TEST EQUIPMENT REQUIREMENTS

Reference code	Maintenance level	Nomenclature	Tool number
		NO SPECIAL TOOLS OR TEST EQUIPMENT IS NECESSARY FOR THE MAINTENANCE OF THIS END ITEM	

Section IV. REMARKS

Reference code	Remarks
A - F	Includes operation and compression.
B - E	Includes micrometer measurements.
C - H	Includes refacing as necessary.
D - G	Includes fabrication.
E - H	Service by replacing gaskets.
F - H	Repair of magneto includes replacing contact set, condenser and rotor only.

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For explanation of abbreviations used, see AR 320-50.

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DATE: 16 DEC 74

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TM5-6115-200-20 AND P	1 APR 72	GENERATOR SET 10 KW NSN 6115-00-231-7286

BE EXACT. . .PIN-POINT WHERE IT IS

PAGE NO.	PARAGRAPH	FIGURE NO.	TABLE NO.
6	2-1 a		
81		4-3	
125	line 20		

IN THIS SPACE TELL WHAT IS WRONG AND WHAT SHOULD BE DONE ABOUT IT:

In line 6 of paragraph 2-1a the manual states the engine has 6 cylinders. The engine on my set only has 4 cylinders. Change the manual to show 4 cylinders

Callout 16 on figure 4-3 is pointing at a bolt. In the key to fig. 4-3, item 16 is called a shim. Please correct one or the other.

I ordered a gasket, item 19 on figure B-16 by NSN 2910-00-762-3001. I got a gasket but it doesn't fit. Supply says I got what I ordered so the NSN is wrong. Please give me a good NSN

SAMPLE

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SIGN HERE: John Doe

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