TM 5-2044

WAR DEPARTMENT TECHNICAL MANUAL

PUMP, CENTRIFUGAL, GASOLINE-ENGINE-DRIVEN, BASE-MOUNTED, 2-INCH DISCHARGE, 166-GPM AT 25-FOOT HEAD

NOVO, MODEL KH-2, WITH NOVO MODEL CA-33 ENGINE

WAR DEPARTMENT • • *MAY, 1946*

WAR DEPARTMENT TECHNICAL MANUAL

TM 5-2044

This manual, together with ASF Engineer Supply Catalog ENG 9-2044, supersedes TM 5-2044, 15 September 1943.

PUMP, CENTRIFUGAL, GASOLINE-ENGINE-DRIVEN, BASE-MOUNTED, 2-INCH DISCHARGE, 166-GPM AT 25-FOOT HEAD,

NOVO, MODEL KH-2, WITH NOVO MODEL CA-33 ENGINE

WAR DEPARTMENT • *MAY, 1946*

United States Government Printing Office
Washington: 1946

WAR DEPARTMENT
WASHINGTON 25, D C., 1 May, 1946

TM 5–2044, Pump, Centrifugal, Gasoline-Engine-Driven, Base Mounted, 2-inch Discharge, 166-GPM at 25-foot Head, Novo, Model KH–2, with Novo Model CA–33 Engine, is published for the information and guidance of all concerned.

AG 300.7 (19 Mar. 46)

BY ORDER OF THE SECRETARY OF WAR:

DWIGHT D. EISENHOWER
Chief of Staff

OFFICIAL:

EDWARD F. WITSELL

Major General,
The Adjutant General.

DISTRIBUTION:

AAF (Eng)(2); AGF (2); ASF (2); T (Eng)(2); Arm & Sv Bd (1) except Eng Bd (5); S Div ASF (1); Tech Sv (2) except OCE (10); FC (Eng)(1); PE (Eng)(2); PE (OIG), (ENG Sec)(1); Sub-PE (Eng)(2); ASF Dep (2); Dep 5 (2) except Granite City (5); Div Eng (2) except MA, SA, SW, MR, P (10); ASF Tng C (Eng Sec)(10); AGF Tng C (2); A (Eng)(1); CHQ (Eng)(1); D (2); D (Eng)(2).

Refer to FM 21–6 for explanation of distribution formula.

CONTENTS

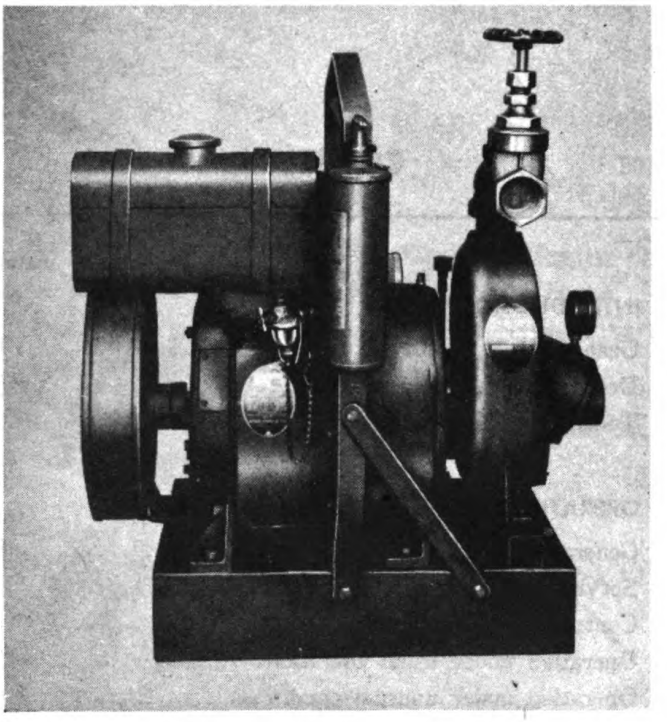


Figure 1. Model KH-2 pump (discharge side).

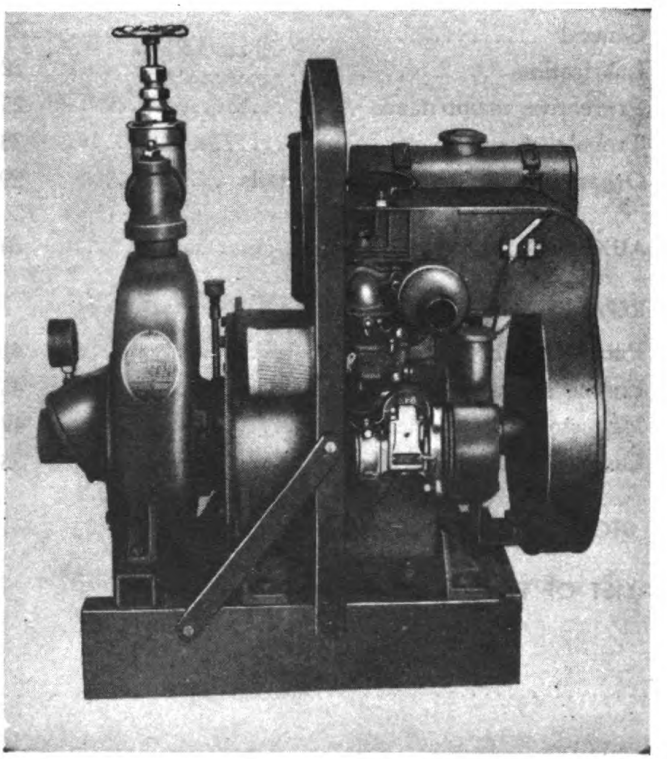


Figure 2. Model KH-2 pump (accessory side).

This manual, together with ASF Engineer Supply Catalog ENG 9-2044 supersedes TM 5-2044, 15 September 1943.

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of the personnel to whom this equipment is assigned. They contain information on the operation and maintenance of the equipment, as well as descriptions of the major units, and their functions in relation to the other components of the equipment. They apply only to the KH–2 Novo Pump, and are arranged in four chapters: Chapter 1, Introduction; Chapter 2, Operating Instructions; Chapter 3, Maintenance Instructions; Chapter 4, Auxiliary Equipment; and Chapter 5, Repair Instructions.

b. Supply Catalog, Standard Nomenclature Lists, Technical Manuals, and other publications applicable to the material covered by this manual are listed in Appendix II.

2. Records

a. WD AGO Form 460 (Preventive Maintenance Roster). This form will be used for recording operation and scheduling lubrication and preventive maintenance services at the proper intervals on individual items of equipment.

b. WD Form 48 (Driver's Trip Ticket, and P. M. Service Record). This form will be used by equipment operators for reporting the accomplishment of daily preventive maintenance services, and for reporting any deficiencies observed on the equipment during operation.

c. WD AGO Form 464 (Work Sheet for Engineer Equipment). This form is used by personnel of the using organization and higher echelons for reporting the results of preventive maintenance services, command, and technical inspections.

d. WD AGO Form 9–68 (Spot Check Inspection Report for Wheeled and Half-Track Vehicles). This form may be used as a check list for items to be inspected during spot check inspection in lieu of WD AGO Form 464.

e. WD AGO Form 478 (MWO and Major Unit Assembly Replacement Records and Organizational Equipment File). Major repairs or rebuilding, the replacement of major unit assemblies, and the accomplishment of equipment modifications will be recorded on this form.

f. WD AGO Form 468 (Unsatisfactory Equipment Report). This form will be used for reporting manufacturing, design, or operational defects in material with a view to improving and correcting such defects, and for use in recommending modifications of material. This form will not be used for reporting failures, isolated material defects, or malfunctions of materiel resulting from fair wear and tear or accidental damage; not for the replacement, repair, or issue of parts and equipment.

Section II. DESCRIPTION AND DATA

3. Description

a. GENERAL INFORMATION. The pump is powered by a single-cylinder CA–33 air-cooled engine, governed at 1,800 rpm, and is used primarily as a dewatering pump.

b. IDENTIFICATION INFORMATION. Affixed to the unit is an outfit number, an engine number, and an instruction plate. The outfit and identification plates are located on the discharge side of the unit, and the instruction plate is located on the accessory side.

c. TYPE AND CAPACITY. This is a self-priming centrifugal pump especially adapted to handling large volumes of water quickly but should not be used to handle water containing over 25 percent solids.

Caution: Never use this pump without the suction strainer.
The Model KH–2 is rated at 166 gallons per minute as a 25-foot total dynamic head including a suction lift of 10 foot, discharge head and friction head. After once being set in operation, no priming is necessary as the priming water remains in the pump for automatic priming whenever necessary. The pump will handle full capacity until the water level is below the hose or pipe. It then operates under no load with engine speed controlled by a throttling governor. When the water level rises over the suction intake, the pump again picks up its prime and resumes pumping.

Caution: Do not run pump indefinitely without water running through it, as the prime water may be siphoned out, causing damage to the seal, impeller, and wear plates.

4. Tabulated Data

a. Engine, General.

Make .....Novo
Type .....Air cooled
Number of cylinders .....One
Cylinder bore .....3¼ in.
Stroke .....4 in.
Piston displacement ...33 cu. in.
Compression ratio .....4.22 to 1
Governed speed .....
.....1,800 rpm (pump load)
Torque .....15 ft-lb
Horsepower .....5 at 1,800 rpm

b. Cylinder Block.

Type .....Separate
Material .....Alloy cast iron

c. Camshaft.

Drive .....Helical gear
Material .....
..Alloy steel forging 1035 SAE
Number of bearings .....Two
Type of bearings ..Tapered roller

d. Crankshaft and Main Bearings.

Number of main bearings ..Two
Type .....Tapered roller
Material..Steel forging 1045 SAE

e. Connecting Rod and Bearing.

Connecting rod length .....
.....7 in. centers
Piston pin bushing
material .....Bronze
Bearings:
Type ..Cap (nonremovable)
Material .....Babbitt

f. Piston, Pin, and Rings.

Piston:
Type .....Solid skirt
Length .....3¾ in.
Compression ring groove
width .....⅛ in.
Oil ring groove width, 3/16 in.
Wall clearance .....0065 in.

Piston pin:
Type .....
..Case-hardened snap ring
Length .....2 9/16 in.
Clearance in
piston .....001 in. tight
Number of rings .....Three
Type .....2 comp.—1 oil
Gap clearance .. .008–.013 in.

g. Valves, Tappets, and Guides.

Type valve:
Intake .....Poppet
Exhaust .....Poppet
Length of valves .....4 23/32 in.
Seat angle .....45°
Valve—
Stem clearance .....0035 in.
Adjustment .....015 in.
Tappets:
Type .....Mushroom
Head diameter .....1 in.

h. Valve Timing.

Intake—
Opens .....U.D.C.
Closes .....30° ALDC
Exhaust—
Opens .....45° BLDC
Closes .....8° AUDC

i. Fuel System.

Carburetor:
Make and model .....
.....Holley—859 CD
Size .....1 in. SAE flange
Adjustment .....Idle only

Carburetor air cleaner, make and model, Air Maze—ISPLW

Governor:

Make and model .....Novo
Type .....Fly ball
Location ..On camshaft gear

Fuel filter:

Make and model .....
..... Tillotson—OW418
Type .....Screen
Location .....On fuel tank

j. Electrical System.

Magneto, make and model ...Bosch MVA–1A–308

Spark plug:

Make ....Champion No. 62
Size .....18 mm

k. Pump.

Make .....Novo
Model KH–2
Type .....Centrifugal
Capacity ..166-gpm at 25-ft head
Discharge size .....2 in.

Section III. TOOLS, PARTS, AND ACCESSORIES

5. Tools (fig. 3)

The following standard tools are shipped with the unit and are packed in the tool box:

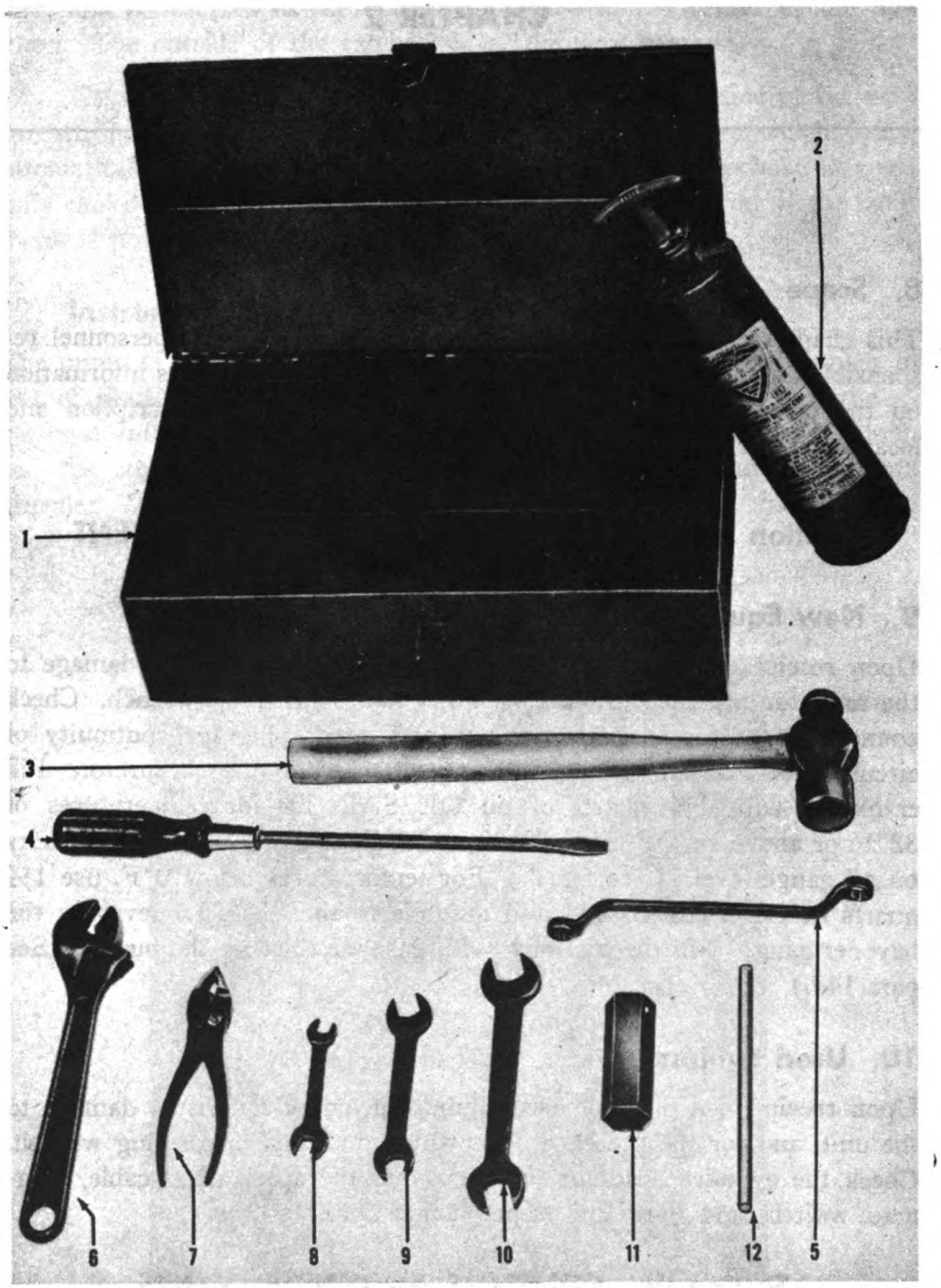
1 hammer, ball peen.
1 pair pliers.
1 driver, screw.
1 wrench, spark plug.
1 handle, spark plug wrench.
1 wrench, adjustable.
1 wrench, box, ½ in. x 9/16 in.
1 wrench, open end, ⅜ in. x 7/16 in.
1 wrench, open end, ⅝ in. x ¾ in.
1 wrench, open end, ½ in. x 9/16 in.

6. Parts

No spare parts are included with the unit.

7. Accessories

On Model 85, fire guard fire extinguisher is included with the unit, packed in the tool box.



1. Tool box.
2. Fire extinguisher.
3. Ball peen hammer.
4. Screw driver.
5. Box wrench, ½ in. x 9/16 in.
6. Adjustable wrench.
7. Combination pliers.
8. Open end wrench, 3/8 in. x 7/16 in.
9. Open end wrench ½ in. x 9/16 in.
10. Open end wrench, 5/8 in. x ¾ in.
11. Spark plug wrench.
12. Spark plug wrench handle.

Figure 3. Tools and accessories.

CHAPTER 2
OPERATING INSTRUCTIONS

Section I. GENERAL

8. Scope

This chapter contains information for the guidance of the personnel responsible for the operation of this equipment. It also contains information on the operation of the equipment together with the description and location of the controls and instruments.

Section II. SERVICE UPON RECEIPT OF EQUIPMENT

9. New Equipment

Upon receipt of a new piece of equipment, check for visual damage to the unit, for presence of starting crank and spark plug wrench. Check connections at the magneto, switch, and spark plug for continuity of circuit. See that air cleaner is firmly attached to the carburetor. Fill crankcase with 1¾ quarts of oil OE SAE 30—for temperatures of 32°F. or above, or OE SAE 10—from 32°F. to 0°F., and check capacity on oil gauge level. (See fig. 7.) For temperatures below 0°F. use 1½ quarts of OE SAE 10 and add gasoline to the "FULL" level on the bayonet gauge. Fill the fuel tank with gasoline. Set up the pump. (See par. 14*d*.)

10. Used Equipment

Upon receipt of a piece of used equipment, check for visual damage to the unit, and for the presence of starting crank and spark plug wrench. Check the cylinder head for tightness, and the spark plug, cable, magneto, switch, and wire for proper connection.

Section III. CONTROLS AND INSTRUMENTS

11. Controls

a. IGNITION SWITCH (fig. 6). The CA–33 engine has a switch in the ignition line mounted on the left side of the blower housing. The switch must be open before starting in order to short the magneto for stopping. The switch must be closed to stop the engine.

b. STARTING CRANK. A starting crank is used to turn the engine over, and is inserted in the opening provided in the center of the flywheel. The outside of the ratchet should be kept greased.

c. CHOKE (fig. 6). The choke valve, located on the side of the carburetor, is of the conventional type, with a poppet valve which opens automatically immediately after the engine fires, when the choke is in its fully closed position. The poppet valve prevents overchoking if the hand choke is not released quickly enough.

12. Instruments (fig. 4)

The pump is equipped with a vacuum gauge to measure the number of feet of head available. The gauge helps to determine the condition of the hose and connections, the operation of the seal against the vacuum, and the amount of wear that has taken place on the pump case and impeller. The number of inches of vacuum on the gauge indicates the approximate number of feet of head available.

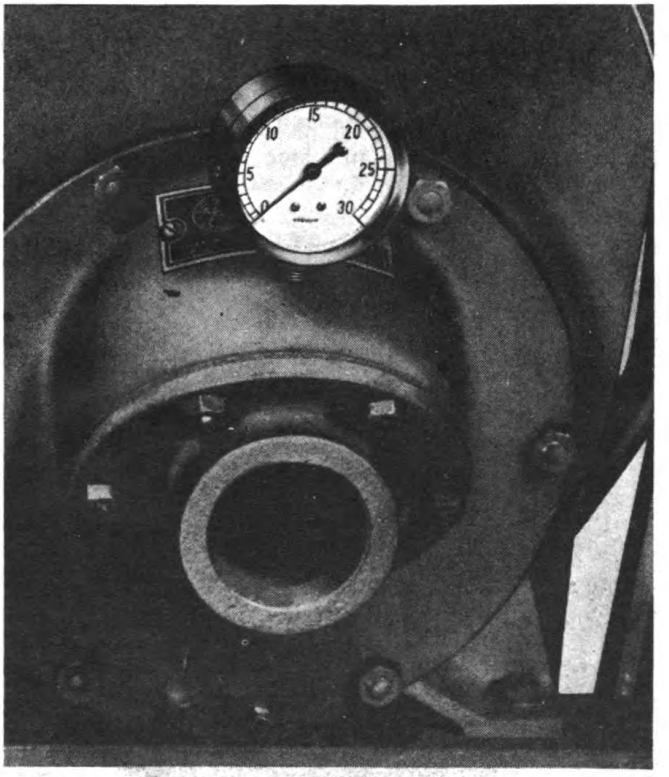


Figure 4. Vacuum gauge.

Section IV. OPERATION UNDER USUAL CONDITIONS

13. Prestarting Inspection

Perform operations listed in paragraphs 9 and 26*a*.

14. Pump

a. SET-UP OF PUMP. Set the pump as near to the source of liquid as possible, with a short, direct suction line attached to it. The suction lift has more effect on pump operation than the discharge head (distance water is forced above the pump). Attach the suction strainer to the end of the suction line. (See fig. 5.)

Caution: Never use this pump without the suction strainer.

b. SUCTION PIPE. The suction pipe or hose must be absolutely air-tight, as direct, and as short as possible. Avoid all unnecessary elbows and fittings.

Caution: Never use a pipe or hose smaller than 2 inches—the size of the pump.

If the pump is to be used in the bottom of an excavation, dig the excavation of ample depth to allow sand, dirt, and silt to settle out as much as possible. Do not allow the suction strainer to lie on the bottom. Failure to have suction strainer in place on suction hose may result in

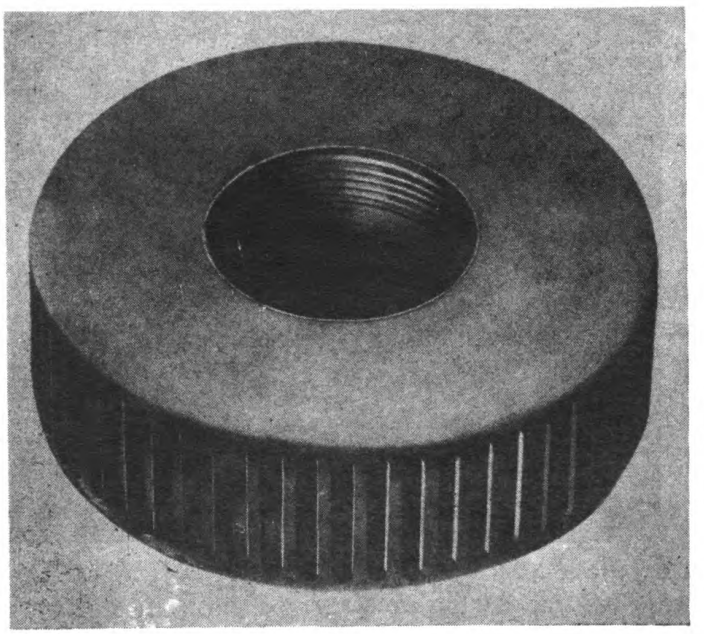


Figure 5. Suction strainer.

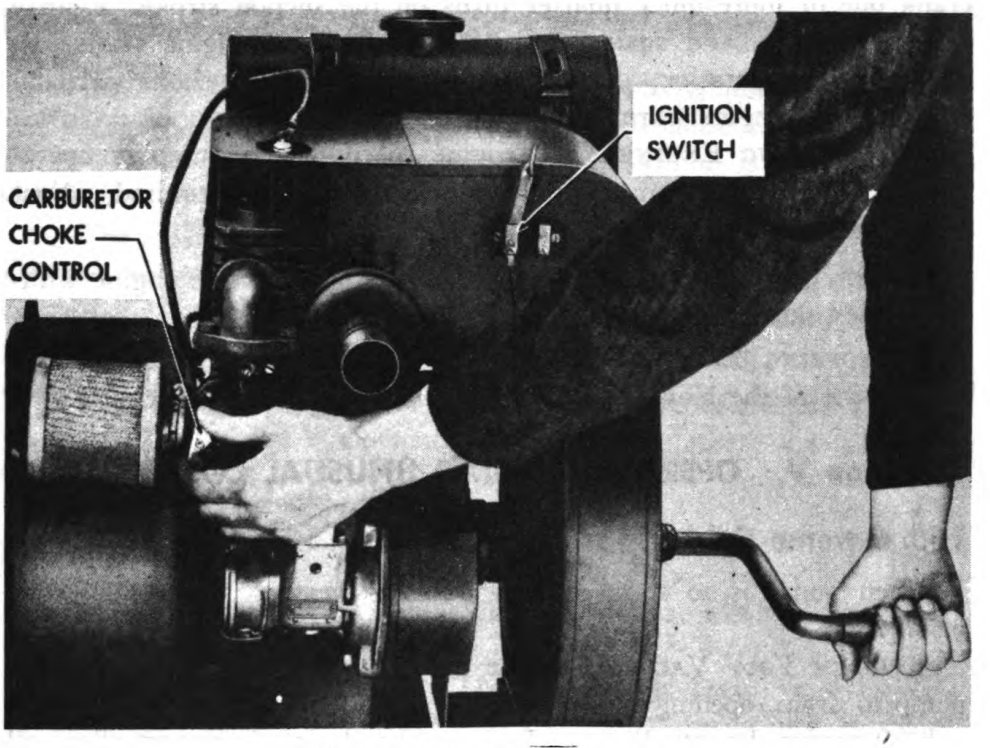


Figure 6. Starting the engine.

plugging of the recirculating passages in the pump, causing failure to prime. A check valve is provided in the suction opening.

c. Discharge Pipe. Attach a discharge pipe or hose as direct as possible. Avoid the use of all unnecessary elbows and fittings to reduce friction loss. The size of the discharge hose or pipe should never be less than the pump discharge. Where pipe is used, support it properly to relieve the weight on the pump.

d. Priming Pump. Remove the priming hole plug and fill the pump case before starting the engine. Start the engine. (See par. 15*a*.) Permit the pump to operate a sufficient length of time to pick up its prime and start pumping.

Note. The longer the suction line, the longer the priming time required. Priming time will also be affected by a worn case, impeller, or wear plates.

Check vacuum gauge for evidence of these conditions. (See pars. 36, 37, and 38.)

e. Vacuum Gauge. Install the vacuum gauge and check its operation after starting the engine. (See fig. 4.)

15. Engine

a. Starting Engine. Open the ignition switch, place starting crank in position, close the carburetor choke valve, and give the starting

crank one or more quick quarter turns on the suction stroke. Release the choke valve, and again turn starting crank till engine starts. In cold weather operation, it may be necessary to hold choke partially closed till the engine warms up.

b. OPERATING ENGINE. The engine speed during pumping operation should be 1,800 rpm. If full-rated capacity is not required, adjust gate valve in discharge to suit conditions.

Caution: Do not, under any circumstances, operate the engine without the air shroud in position.

c. STOPPING ENGINE. To stop the engine, close the knife switch on the side of the blower housing. (See fig. 6.)

Section V. OPERATION UNDER UNUSUAL CONDITIONS

16. Extreme Cold

When pump is to stand idle in freezing weather, drain the entire installation.

a. OPEN FOOT VALVE. Lift the end of the suction line above the pump to drain, opening the foot valve.

b. REMOVE DRAIN PLUGS. Remove the drain plugs and allow all water to drain out. (See fig. 11.)

c. FUEL FILTER. Open the shut-off cock, and drain the fuel filter bowl of any water accumulation from condensation.

d. FUEL TANK. Keep tank full if possible.

17. Shallow Excavations

When equipment is used in shallow excavations, allow four times the area of the size of the opening in the suction line for efficient operation.

Section VI. DEMOLITION

18. General

Destruction must be as complete as the available time, equipment, and personnel will permit. Destroy the same parts on all identical units of equipment, in order that salvaged equipment from one unit may not be used on another unit. If thorough destruction of all parts cannot be completed, the most important features of the equipment should be destroyed, and parts essential to the operation or use of the equipment and which cannot be easily replaced, should be ruined or removed.

a. WHY. To prevent the enemy from using or salvaging this equipment for his benefit.

b. WHEN. Upon orders of the commanding officer.

19. Where and How to Destroy

a. If there is a choice of location for the destruction of the equipment, that location should be chosen which will cause the greatest inconvenience to the enemy. The best possible location is a highway or an airfield runway.

b. The means of destruction should be the simplest that will accomplish the desired result. Gun fire should not be used if burning the pump will accomplish the same result, nor should explosives be used if blows from a heavy hammer will prevent use of the equipment by the enemy.

c. The methods suggested in paragraph 20 are offered as a guide for destruction of the equipment. In many cases, these are alternate suggestions.

20. Methods

a. By Explosives. (1) Remove and empty fire extinguishers.
(2) Puncture fuel and oil tank.
(3) Place a 2-pound charge of TNT on cylinder head.
(4) Place a 2-pound charge of TNT on pump casing next to shaft.
(5) Place 2-pound charge of TNT on diaphragm casing.
(6) Cut all hose and douse with gasoline.
(7) Insert tetryl nonelectric caps with at least 5 feet of safety fuse in each charge placed.
(8) Ignite the fuses and take cover.

Note. If the charges have been prepared previously for being placed on the equipment, destruction by explosives can be accomplished within 2 or 3 minutes.

b. By Gun Fire or Grenades. (1) Remove and empty fire extinguishers.
(2) Puncture fuel and oil tank.
(3) Fire upon the equipment with artillery, .50 caliber machine gun, rifle, rockets, or grenades, first at the engine main cylinders, carburetor, magneto, pump casing, gear case, eccentric, tires, and diaphragm.
(4) Cut all hose and douse with gasoline; ignite.
(5) About 3 to 5 minutes of concentrated fire on this equipment should destroy it beyond use.

c. By Sledge Hammer, Axes, Pick Axes, Crowbars, or Other Heavy Tools Available. (1) Remove and empty fire extinguishers.
(2) Puncture fuel and oil tank.
(3) Smash engine cylinder head, cylinders, crankcase, pump casings, gear cases, carburetor, and magneto.
(4) Cut all hose and douse with gasoline; ignite.
(5) If time permits, bury or scatter all pieces.
(6) The time required will depend upon tools available.

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. GENERAL

21. Scope

This chapter contains information for the guidance of the personnel of the using organizations responsible for the maintenance (first and second echelon) of this equipment. It also contains information needed for the performance of the scheduled lubrication and preventive maintenance services, as well as descriptions of the major systems and units, and their functions in relation to other components of the equipment.

Section II. LUBRICATION

22. Introduction

Lubrication is an essential part of preventive maintenance, determining to a great extent the serviceability of parts and assemblies.

23. Lubrication

a. GENERAL. Lubrication instructions for this matériel are consolidated in the Lubrication Order. (See fig. 7.) It specifies the points to be lubricated, the periods of lubrication, and the lubricants to be used.

b. LUBRICATION NOTES. The following notes apply to the Lubrication Order, and illustrate in detail the various points to be lubricated, (fig. 7):

(1) *Crankcase.* Check oil level; add oil if necessary. Follow instructions given on Lubrication Order. Drain while engine is hot. Refill to "FULL" mark on bayonet gauge. If gasoline is used in the crankcase oil at temperatures below 0°F, drain the crankcase one-half the normal operating period.

(2) *Air cleaner.* Clean in oil, engine crankcase grade. Shake out and replace.

(3) *Fuel filter.* Check fuel filter screen for clogging. In cold weather open filter cock, and drain fuel filter bowl of water accumulation due to condensation.

(4) *Pump grease cup.* Remove grease cup, fill, and force through fitting.

(5) *Magneto (oiler).* Fill oiler with oil, engine grade. (See Note 3, Lubrication Order.)

(6) *Magneto bearing.* Remove, clean, and repack magneto shaft ball bearing, and replace on magneto. (See "Caution," Note 3, Lubrication Order.)

(7) *Magneto wick.* Relubricate the magneto wick with a few drops of engine oil. (See Note 3, Lubrication Order.)

Caution: Do not drop any oil on the contact points; they must be free of oil or grease.

24. Lubrication Order

For any instructions pertaining to the lubrication of the pump, the Lubrication Order should be consulted. (See fig. 7.)

Section III. PREVENTIVE MAINTENANCE

25. General

Regular execution of preventive maintenance services by the operator and maintenance personnel of the using organization is imperative to insure satisfactory operation of the equipment and to reduce the probabilities of mechanical failure.

26. Operator or Crew Maintenance (First Echelon)

a. Inspections must be made before operation, during operation, at halt, and after operation, as described in this section. Numbers appearing opposite the specified services correspond to those appearing on the reverse of WD Form 48. All inspections of assemblies, subassemblies, or parts must include any supporting members or connections and must determine whether the unit is in good condition, correctly assembled, secure, or excessively worn. Any deficiencies noted must be corrected or reported to proper authority. Any mechanical condition which may result in further damage to the unit must be corrected before equipment is operated.

(1) The inspection for "good condition" is usually an external visual inspection to determine whether the unit is damaged beyond safe or serviceable limits, or to determine if it is in such a condition that damage will result from operation. The term "good condition" is explained further by the following terms: not bent or twisted; not chafed or burned; not broken or cracked; not bare or frayed; not dented or collapsed; not torn or cut; and adequately lubricated.

(2) The inspection of a unit to see that it is "correctly assembled" is usually an external visual inspection to determine whether it is in its normal assembled position in the vehicle.

(3) The check of a unit to determine if it is "secure" is usually an external inspection, a hand-feel, a pry-bar, or wrench check for looseness in the unit. Such an inspection should include brackets, lock washers, lock nuts, locking wires, or cotter pins used in the assembly.

(4) "Excessively worn" will be understood to mean worn close to or beyond serviceable limits, a condition likely to result in a failure if replacement of affected parts is not made before the next scheduled inspection.

b. Operator will report all deficiencies on WD Form 48.

WAR DEPARTMENT LUBRICATION ORDER No. 1086

WAR DEPARTMENT, WASHINGTON 25, D. C., 30 MAR. 1944

PUMP, CENTRIFUGAL GASOLINE ENGINE-DRIVEN, BASE-MOUNTED, 2-IN. DISCHARGE, 166-GPM AT 25-FT HEAD

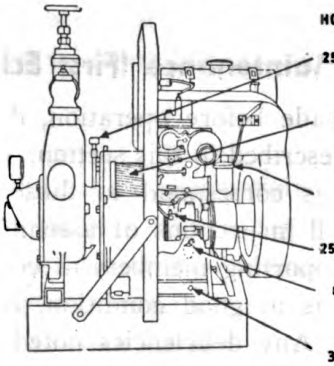
(NOVO, MODEL KH-2)

MFR'S. SERIAL NO. LOCATED ON OIL LEVEL GAGE SIDE OF ENGINE. REFERENCE TM5-2044

—KEY—

LUBRICANTS	LOWEST EXPECTED AIR TEMPERATURE		
	ABOVE +32° F.	+32° F. TO 0° F.	BELOW 0° F.
OE—OIL, ENGINE			
CRANKCASE	OE SAE 30	OE SAE 10	REFER TO TM 5-2044
EXCEPT CRANKCASE	OE SAE 30	OE SAE 10	PS
WB—GREASE, GENERAL PURPOSE NO. 2. ALL TEMPERATURES.			
PS—OIL, LUBRICATING, PRESERVATIVE, SPECIAL.			

REQUISITION REPLACEMENT ORDERS FROM THE ENGINEER FIELD MAINTENANCE OFFICE, (MAINTENANCE DIVISION, MILITARY SUPPLY, OCE), P. O. BOX 1679, COLUMBUS, OHIO.



HOURS	LUBRICANT		
256	WB	PUMP (GREASE CUP) (TURN CUP DOWN COMPLETELY AND REFILL)	1
8	OE	AIR CLEANER (DISASSEMBLE CLEAN AND OIL CAUTION: DO NOT WASH IN GASOLINE	2
	OE	CRANKCASE FILL (SEE KEY.) (CAP. APPROX. 1¾ QT.)	3
256	OE	MAGNETO (OILER) (NOTE 3)	4
8		CRANKCASE LEVEL GAGE (LOCATED ON OPPOSITE SIDE) (CHECK LEVEL)	5
32		CRANKCASE DRAIN PLUG (DRAIN IMMEDIATELY AFTER OPERATION)	6

NOTES

1. HOURS—THE HOURS INDICATED ARE FOR NORMAL SERVICE. FOR EXTREME CONDITIONS OF HEAT, AND DUST, CHANGE CRANKCASE OIL AND LUBRICATE MORE FREQUENTLY.
2. CLEANING—SOLVENT, DRY-CLEANING, OR OIL, FUEL, DIESEL WILL BE USED TO CLEAN OR WASH ALL PARTS. USE OF GASOLINE FOR THIS PURPOSE IS PROHIBITED. ALL PARTS WILL BE THOROUGHLY DRY BEFORE RELUBRICATION.
3. MAGNETO—EVERY 1024 HOURS, OR WHEN DISASSEMBLED FOR INSPECTION OR REPAIR, REMOVE DISTRIBUTOR COVER AND LUBRICATE MAGNETO CAM AND GOVERNOR SPRING WICKS WITH OE SAE 50. CAUTION WHEN LUBRICATING BE SURE CONTACT POINTS ARE FREE OF LUBRICANT. EVERY 2048 HOURS, OR WHEN DISASSEMBLED FOR INSPECTION OR REPAIR, REMOVE, CLEAN AND REPACK DRIVE END BALL BEARING WITH WB.
4. POINTS REQUIRING NO LUBRICATION—GOVERNOR

COPY OF THIS LUBRICATION ORDER WILL REMAIN WITH THE EQUIPMENT AT ALL TIMES; INSTRUCTIONS CONTAINED THEREIN ARE MANDATORY AND SUPERSEDE ALL CONFLICTING LUBRICATION INSTRUCTIONS DATED PRIOR TO 30 MAR 1944.

G. C MARSHALL, CHIEF OF STAFF.

OFFICIAL:
J. A. ULIO, MAJOR GENERAL, THE ADJUTANT GENERAL.

NO. 1086 [NOT TO BE REPRODUCED IN WHOLE OR IN PART WITHOUT PERMISSION OF THE OFFICE OF THE CHIEF OF ENGINEERS.]

① **Sheet 1 of 2.**

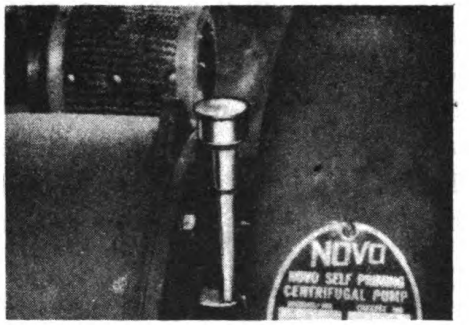
Figure 7. Lubrication Order.

c. BEFORE-OPERATION SERVICE. To determine if condition of equipment has changed since last operated and to make sure the machine is ready for operation—

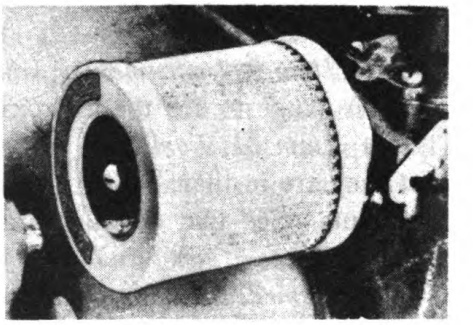
(1) *Item 1, Tampering and damage.* Check for damage that may have been caused by falling debris, shell fire, sabotage, or collision.

(2) *Item 2, Fire extinguisher.* See that it is in good condition, fully charged, and securely mounted.

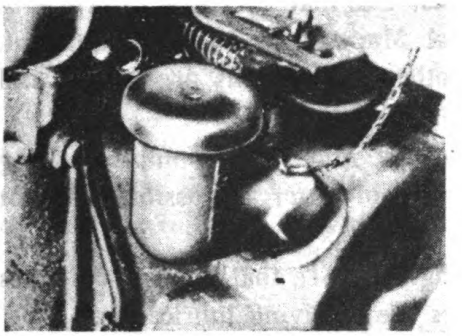
(3) *Item 3, Fuel and oil.* Check fuel tank; see that it is full. Check oil level in engine crankcase; (See fig. 7.)



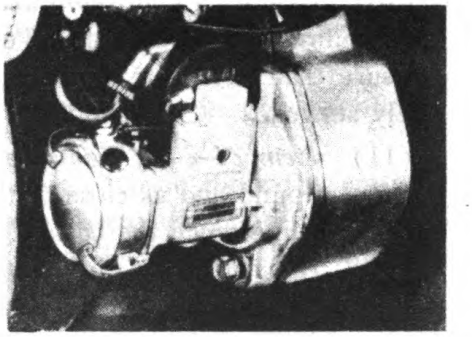
1. Pump (grease cup). (Turn down completely and refill.)



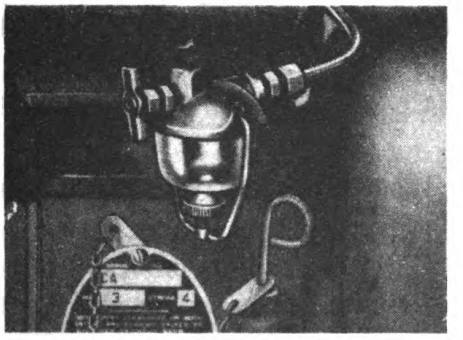
2. Air cleaner. (Disassemble, clean, and oil.)



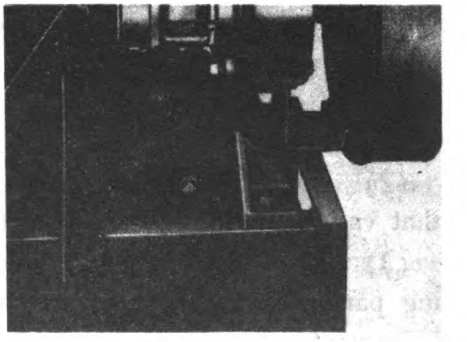
3. Crankcase fill. (See key.)



4. Magneto (oiler). (See note.)



5. Crankcase oil level gauge. (Check level.)



6. Crankcase drain plug. (Drain immediately after operation.)

② Sheet 2 of 2.

Figure 7. Lubrication Order—Continued.

(4) *Item 6, Leaks, general.* Check entire unit for leaks, paying particular attention to lines and connections. If leaks are noted, report or correct; check affected levels, and make any necessary replenishment. (See fig. 7.)

(5) *Item 7, Engine warm-up.* Allow engine to warm up at fast idling speed before applying load. *Do not race a cold engine.* (See par. 15.)

(6) *Item 8, Choke or primer.* Use choke when starting cold engine. As soon as engine starts, adjust choke so that engine runs normally. When engine is thoroughly warm, push choke control in all the way. (See par. 15*a*.)

(7) *Item 9, Instruments.* Immediately after engine starts, check the vacuum gauge to see the approximate number of feet of head available.

(8) *Item 21, Tools and equipment.* Check tools and equipment; see that they are in their proper place. Also check reserve supply of oil and lubricants. See that containers are in good condition and caps or lids fit tightly.

(9) *Item 22, Engine operation.* Check engine for normal operation. If any unusual sounds or other unsatisfactory characteristics are noted, see that deficiencies are corrected.

(10) *Item 23, Publications and forms.* See that WD AGO Form 478, WD Lubrication Order, and Technical Manual are on the equipment. Be sure that all forms, manuals, or other publications are legible and safely stowed.

(11) *Item 24–2–A, Equipment setting.* Make sure pump is setting on level ground and as close to the source of water as possible. Do not let suction line touch the bottom.

(12) *Item 24–2–D, Lubrication,* (fig. 7.) See that fittings and lines are in good condition and that bearings are receiving lubricant.

d. During-Operation Service. It is the operator's responsibility to detect unusual sounds or odors, any deficiencies in performance, or other signs of abnormal operation that warn of future trouble if not promptly corrected.

(1) *Item 31, Engine and controls.* Check engine for power, unusual noise, and response to controls.

(2) *Item 32, Instruments.* Check vacuum gauge frequently to see that vacuum readings are correct.

(3) *Item 37–2–E, Leaks, general.* Check entire unit for leaks, paying particular attention to the fuel system. If leaks are noted, report or correct.

e. At Halt Service. During enforced halts (even if only for short periods), the operator should check the general condition of the equipment in addition to performing the following specific duties:

(1) *Item 38, Fuel and oil.* Check for adequate supply of fuel. Also check engine crankcase oil level and add correct lubricant if necessary. (See fig. 7.)

(2) *Item 46, Leaks, general.* Check entire unit for leaks, paying particular attention to lines and connections. If leaks are noted, report or correct; check affected levels, and make any necessary replenishment. (See fig. 7.)

(3) *Item 48, Air cleaner.* If operating under extremely dusty conditions, inspect air cleaner and service as required. (See fig. 7.)

(4) *Item 53–2–C, Lubrication,* (fig. 7.) See that fittings and lines are in good condition and that bearings are receiving lubricant.

f. After-Operation Service. To insure that the unit will be ready for operation at any time, the following services will be performed by the operator or crew immediately after operation period of approximately 8 hours or less, or at 8-hour intervals during continuous operation.

(1) *Item 54, Fuel and oil.* Fill fuel tank with clean fuel. Fill crankcase to proper level with correct lubricant. See Lubrication Order.

(2) *Item 55, Engine operation.* Correct or report unusual noises, insecure mounting, or irregularities of performances noted during operation.

(3) *Item 56, Instruments.* Check vacuum gauge to see that it is securely mounted and undamaged.

(4) *Item 60, Fire extinguisher.* See that it is in good condition, fully charged, and securely mounted.

(5) *Item 64, Electrical wiring.* Check all wiring for worn, cracked, or frayed insulation, broken wires, loose or corroded connections.

(6) *Item 65, Air cleaner.* Inspect air cleaner. Clean in oil, shake out and install. (See fig. 7.)

(7) *Item 66, Fuel filter.* Check condition of fuel in sediment bowl. Remove, clean, and replace bowl if it contains water or dirt. (See par. 33.)

(8) *Item 67, Engine controls.* Check for worn or disconnected linkage. Correct or report any unsatisfactory operation of engine controls.

(9) *Item 73, Leaks, general.* Check entire unit for leaks, paying particular attention to lines and connections. If leaks are noted, report or correct; check affected levels, and make necessary replenishment. (See fig. 7.)

(10) *Item 83, Lubrication as needed,* (fig. 7.) See that fittings are in good condition and that bearings are receiving lubricant.

(11) *Item 84, Clean engine and unit.* Remove all excess grease and dirt from engine and unit.

(12) *Item 85, Tools and equipment.* Clean all tools that were in use and stow in proper place. See that equipment is clean.

(13) *Item 88–F, Protection.* Cover the unit with a tarpaulin, if one is available. In freezing weather drain all water from the pump, hose, and piping to prevent damage by freezing.

27. Organizational Maintenance (Second Echelon)

a. Second echelon preventive maintenance is performed by organizational maintenance personnel, with the assistance of the operator, at monthly and weekly intervals. The "W" or weekly interval will cover approximate 60 hours of use and the "M" or monthly interval will be equivalent to 4 weeks of use. The column headed "T.I." (Technical Inspection) is provided for the information and guidance of personnel performing Technical Inspections and constitutes the minimum inspection requirements for the equipment.

b. The preventive maintenance services to be performed at these regular intervals are listed and described below. The numbers appearing in the columns opposite each service refer to a corresponding number appearing on WD AGO Form 464, and indicate that a report of the service should be made at that particular number on Form 464. These numbers appear in either second, third, or both columns as an indication of the interval at which the service is to be performed. *Operators (or crew) will assist the unit mechanics in performing weekly and monthly PM services.*

T. I.	W	M	
1	1	1	BEFORE-OPERATION SERVICE. Check and perform service required in numbers 1, 2, 3, 6, 7, 8, 9, 21, 23, and 24–2–D listed under Before-Operation Service.
11	11	11	CYLINDER HEAD, MANIFOLD, AND GASKETS. Inspect for cracks and leaks. See that muffler is in good condition and securely mounted.
	11	11	On new or reconditioned engines, tighten bolts on cylinder head at the first weekly service.
12	12		VALVE MECHANISM. Check condition of valve mechanism. Check tappet adjustment while engine is hot. Correct adjustment is 0.015 inch.
	12		Adjust valve clearance if necessary. Be sure valve tappet cover gasket is in good condition and cover fits securely when replaced. (See par. 48*a*.)
	13		COMPRESSION TEST. Test compression of cylinder and record in space provided on WD AGO Form 464.
17	17	17	FAN AND SHROUD. Check fan and shroud for condition, alignment, and secure mounting.
	17	17	If necessary, tighten fan and shroud mounting bolts.

T. I.	W	M	
20	20	20	GOVERNOR AND LINKAGE. Check the operation of the governor, and the linkage for wear. Adjust if necessary. (See par. 48*b*.)
39	39	39	CARBURETOR AND LINKAGE. Inspect unit for secure mounting and tight connections. Check conditions and operation of linkage. Adjust if necessary. (See par. 56.)
40	40	40	FILTER. Check condition of fuel in sediment bowl.
	40	40	Remove, clean, and replace bowl if it contains water or dirt. (See par. 33.)
41	41	41	AIR CLEANER. Inspect air cleaner for secure mounting and tight connections.
	41	41	See the Lubrication Order (fig. 7) for instructions for servicing the air cleaner. After reinstalling air cleaner, see that all connections are tight.
43	43	43	TANK, CAP, AND GASKET. Inspect the fuel tank for secure mounting. Check to see that all fuel line connections are tight. Inspect condition of fuel tank cap and gasket. Replace cap gasket if broken or worn.
46	46	46	SPARK PLUGS. Inspect spark plugs for condition and proper adjustment. Correct gap is 0.020 inch.
	46	46	Remove and clean spark plugs and adjust point gap. See that plugs are in good condition before replacing. (See par. 29.)
49	49	49	MAGNETO. Inspect for improper mounting, cracks, or damage. Check condition of ignition wire and connection.
	49	49	Adjust if necessary. (See par. 52.)
	80	80	FRAME. Check welded joints of frame. If loose, weld.
183	183	183	IMPELLER. Inspect the impeller and impeller wear plates for wear.
	183	183	Replace if necessary. (See pars. 41, 42, and 43.)
185	185	185	SUCTION HOSE, FOOT VALVE, AND STRAINER. Check conditions of the suction hose, foot valve, and strainer. Clean or replace if necessary.
			GENERAL
2	2	2	LUBRICATION. Determine that all lines and fittings are in place and in good condition. Inspect to see that all bearings are receiving lubricant.
	2	2	See the Lubrication Order (fig. 7). Replace missing or damaged fittings.

T. I.	W	M	
3	3	3	TOOLS AND EQUIPMENT. Determine if all tools are properly stowed. Check reserve supplies of fuel and lubricants and condition of containers and determine if caps or lids fit tightly.
4	4	4	FIRE EXTINGUISHER. Inspect for full charge, proper working order, and secure mounting.
5	5	5	PUBLICATIONS. See that Technical Manuals, Lubrication Order, and WD AGO Form 478 are on the machine and in serviceable condition.
6	6	6	APPEARANCE. Inspect equipment for condition of paint, markings, damage, and general appearance.
7	7	7	MODIFICATIONS. Determine if all available modification work cards applying to this unit have been completed and are recorded on WD AGO Form 478.

Section IV. TROUBLE SHOOTING

28. Troubles, Causes, and Remedies

Possible trouble	Possible cause	Remedy
Pump fails to prime or operates improperly.	Improper pump installation ..	Set pump properly. (See par. 14.)
	Lack of water supply	Replenish water supply.
	Air leak in suction line	Test with vacuum gauge. (See par. 36.)
		If line is faulty, replace line.
	Worn impeller or wear plates	Test with vacuum gauge. (See par. 37.)
		Adjust (par. 44) or replace impeller and/or wear plates (See pars. 41 and 43.)
	Shaft seal worn	Test with vacuum gauge. (See par. 38.) If seal is faulty, replace.
Engine fails to start.	Engine switch open	Close switch.
	Lack of fuel	Fill gas tank.
	Fuel filter valve closed	Open filter valve.
	Fouled spark plug	Remove, clean, and reset to 0.020 inch. Replace plug.

Possible trouble	Possible cause	Remedy
Engine fails to start (cont'd).	Carburetor clogged	Remove air cleaner. Detach governor rod by removing cotter pin. Unscrew fuel line. Remove carburetor, clean out, and install.
	Poor interrupter contact	Adjust points. (See par. 52*a*.)
Engine hard to start.	Poor grade of fuel or water in fuel	Drain and refill with the proper grade of fuel.
	Excessive use of choke	Crank engine without use of choke.
	Fouled spark plug	Remove, clean, and reset to 0.020 inch.
	Faulty magneto	Check contact points and magneto timing. (See par. 52*a*.)
	Leak at intake manifold	Remove muffler, carburetor, speed-control bracket, and manifold. Using a new gasket, install manifold assembly.
	Low compression	Test with compression gauge. Inspect internal parts of engine, and replace faulty parts. (See par. 46.)
Engine misses ..	Faulty interrupter	Clean and adjust or replace.
	Spark plug defective or improperly gapped.	Adjust or replace plug.
	Loose wiring	Check and tighten all connections.
	Dirty carburetor	Remove, clean, and replace, using a new carburetor to intake manifold gasket.
	Insufficient fuel supply	Open fuel filter cock; if open, clean filter screen.
	Leaky head gasket	Take out the seven housing top screws and the six cylinder head cap screws. Remove cylinder head, and replace gasket.
	Valves sticking, weak, or broken valve springs.	Test vacuum, test compression, free valve, or replace valve spring. (See pars. 45 and 47.)
	Insufficient valve adjustment ..	Adjust valves. (See par. 48*a*.)
Loss of power .	Improper magneto point adjustment.	Adjust points. (See par. 52*a*.)
	Spark plug defective or improperly adjusted.	Remove, clean, and regap, or replace plug.

Possible trouble	Possible cause	Remedy
Loss of power (cont'd)	Improper fuel mixture	Clean fuel filter, overhaul carburetor. (See par. 54.)
	Low compression	Test compression. Replace rings (pars. 45 and 47); grind valves (par. 45).
Engine noises ..	Advanced spark setting	Retard spark.
	Improper grade of fuel	Drain and refill with proper grade of fuel.
	Lean fuel mixture	Turn the idle adjustment needle of the carburetor clockwise to enrich the mixture.
	Insufficient oil supply	Replenish oil supply to "Full" mark on bayonet gauge.
	Loose blower wheel	Tighten blower wheel.
	Loose flywheel	Tighten flywheel.
	Valves, tappets improperly adjusted.	Adjust valves and tappets. (See par. 48*a*.)
	Valve spring broken	Replace valve spring (See pars. 45*d* and 47*e*.)
Backfire	Lean mixture	Turn the idle adjustment needle of the carburetor clockwise to enrich the mixture.
	Insufficient fuel supply	Fill with proper fuel.
	Air leak at manifold	Remove muffler carburetor, speed control bracket, and manifold. Use a new gasket, and install manifold assembly.
	Broken valve spring	Replace valve spring. (See pars. 45*d* and 47*a*.)
	Sticky inlet valve	Free up valve.
	Improper magneto timing	Time magneto. (See par. 52*a*.)
	Cam gear out of time	Remove, retime, and replace. (See par. 51*c*.)
Faulty carburetion.	Mixture too rich or too lean ..	Turn the idle adjustment needle clockwise to enrich the mixture or counterclockwise to obtain a lean mixture.
	Water in the fuel	Drain and refill.
	Clogged fuel filter	Remove, clean, and replace.
	Insufficient fuel	Replenish fuel supply.
	Dirty carburetor	Remove, clean, and replace.

Possible trouble	Possible cause	Remedy
Excessive smoke	High oil level	Drain to proper oil level.
	Oil dilution	Drain crankcase and refill to proper level.
	Improper grade of oil	Drain and refill with proper oil.
	Excessive carbon accumulation	Clean carbon and grind valves. (See par. 46.)
	Worn piston rings	Replace piston rings.
Engine overheats	Insufficient oil supply	Replenish oil supply.
	Blower wheel broken	Replace blower wheel.
	Blower wheel plugged	Clean out blower wheel.
	Blower wheel loose	Tighten blower wheel.
	Overheated fuel	Adjust mixture. (See par. 30.)
	Late ignition timing	Adjust timing. (See par. 52*a*.)

Section V. ORGANIZATIONAL MAINTENANCE DETAILS

29. Spark Plug

Remove spark plug, and examine it for condition. Inspect it for excessive deposit of carbon, cracked insulator, or a badly burned electrode. If the only fault is too much carbon, clean the spark plug in an approved compressed-air spark plug cleaner. Otherwise replace with a new plug. In either case, check the gap to make sure it is 0.020 inch. If the plug needs regapping, be sure to bend only the outside electrode.

30. Carburetor

An idle adjusting needle controls the strength of the gasoline mixture at idling speed. With a screw driver, turn the needle counterclockwise to obtain a lean mixture and clockwise to enrich it. Turn the needle out till the engine begins to miss; then turn the needle in one-half turn.

31. Governor (figs. 8 and 9)

a. The governor is of the fly-ball type, assembled on the cam gear. It consists of a governor weight bracket, governor weight ring, three governor weights, a plunger pin, and cup. The weights, actuated by centrifugal force, fly to the outside as the speed of the engine increases. The ears on the weights, lying in back of the cup, force the cup and

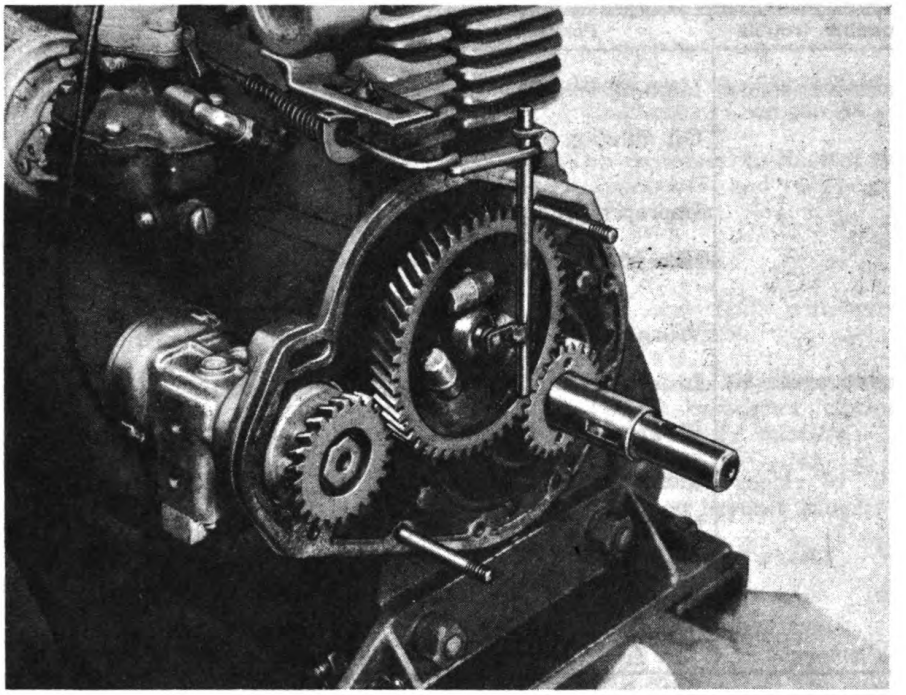
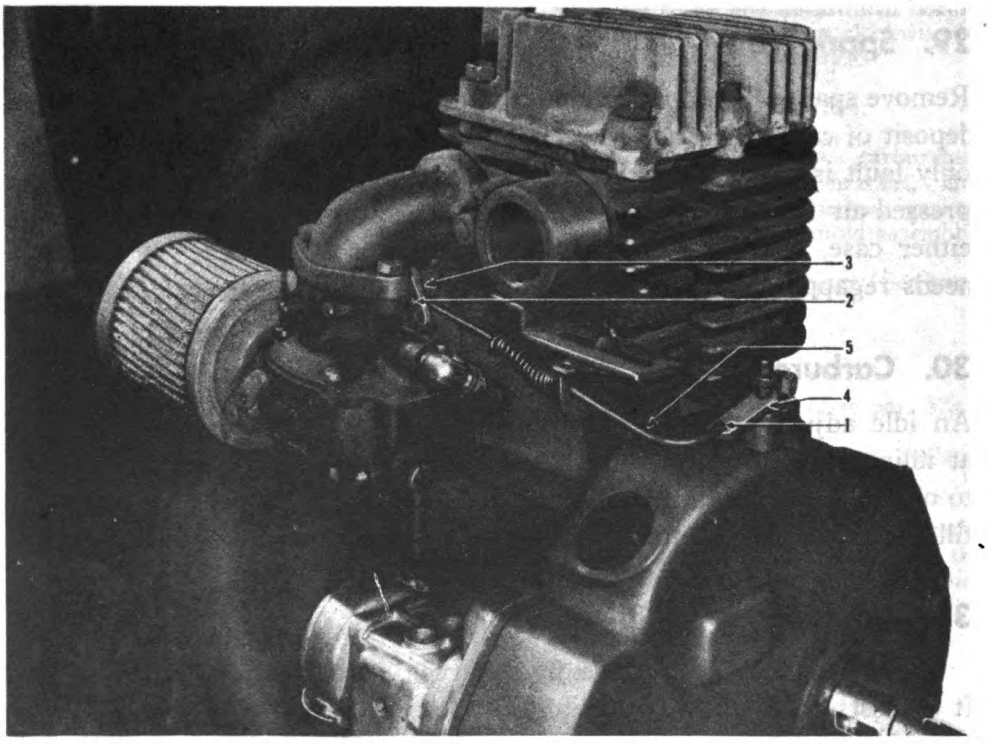


Figure 8. Governor rod and controls.



1. Hole in governor lever.
2. Hole in throttle lever.
3. Carburetor throttle lever.
4. Governor lever.
5. Governor rod.

Figure 9. Governor adjustment.

plunger against the governor lever shaft which in turn operates the governor rod on the carburetor.

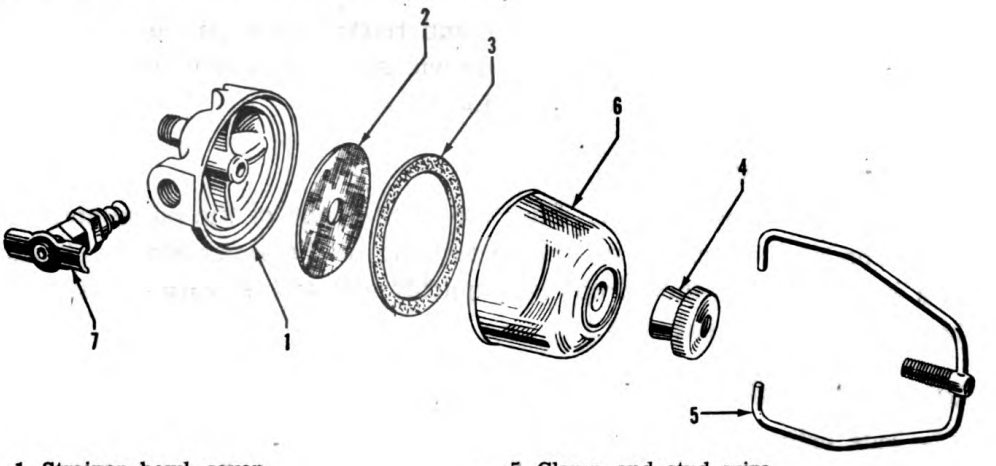
b. Turn the governor-lever shaft clockwise as far as it will go. Loosen the governor lever cap screw and set the governor rod so that the center line of hole (1, fig. 9) is about 2 inches from the inner surface of the gear case cover plate. With the carburetor throttle lever (3) wide open the governor rod (5) should slide into both holes (1 and 2) freely. If adjustment is necessary, change position of the governor lever (4), not the shaft or weight. Constant speed of 1,500 rpm is set by adjusting the governor spring on the throttle rod. After the proper spring tension is set, tighten the screw and wing nut to hold the speed control lever in that position.

32. Air Cleaner

Remove the air cleaner by unscrewing the bolt which attaches the clamp to the carburetor air horn. (Clean the mesh of the air cleaner in waste crankcase oil.) Drain for 15 minutes and blow out with compressed air. Re-oil by dipping in oil, OE, SAE 30 grade and allow to drain for 15 minutes before installing on engine.

33. Fuel Filter (fig. 10)

Loosen the thumb nut (4) at the bottom of the glass bowl (6). Swing the clamp wire (5) to one side, and remove the bowl. At the same time remove the screen (2) and gasket (3) from inside the cap if it does not come off with the bowl. Drain the bowl and wipe with a clean rag. Blow out the filter with compressed air. Replace the screen (2) in the cap, place the bowl (6) in position, and tighten the thumb nut (4) after placing the clamp wire (5) in position.



1. Strainer bowl cover.
2. Strainer screen.
3. Strainer screen gasket.
4. Clamp thumb nut.
5. Clamp and stud wire.
6. Strainer bowl.
7. Shut-off cock.

Figure 10. Exploded view of the fuel filter.

34. Engine Valves

To secure the best power and economy, and to avoid missing and overheating, the valves should always seat fully, and hold compression so that the hand crank will bounce back as the shaft is rotated. If engine fails to offer added resistance to the crank on the compression stroke, it can be heard as a hiss. If the noise is through the exhaust, the exhaust valve is leaking. If it comes more distinctly through the breather, the leak is past the piston rings. If evidence of valve leakage appears, remove and grind the valves.

35. Suction Check Valve

The suction check valve is a rubber flap valve, weighted by a large and a small metal plate. It is set at a 30° angle from the vertical, which causes it to seat properly, and prevents dirt from lodging on the seat. Remove the priming plug and fill the case through this opening. If the check valve is not seating properly, water will run out around the valve. Check the flap valve for damage or wear around the hinge or seat. Replace worn or damaged parts.

36. Suction Line

Remove the hose and plug the suction side of the pump. If the pump is primed and the vacuum gauge slowly builds up to from 20 inches to 25 inches, there is an air leak in the suction line. Tighten all connections and retest. If the same condition is apparent, replace the hose.

37. Impeller and Wear Plates

With the pump primed, plug the suction side of the pump. If the vacuum gauge goes only part way up the scale and the hand remains steady, it indicates a worn impeller or wear plates. Make adjustment of wear plates and take up impeller and retest. (See par. 44.) If the vacuum gauge reads the same as previously, install new wear plates and impeller. (See pars. 41*b* and 43*c*.)

38. Seal Assembly

Testing with vacuum gauge. Plug the suction side of the pump and fill the pump with water. With engine running, if the gauge slowly climbs to a few inches and then drops back quickly, the seal is worn and should be replaced. (See par. 42*b*.)

39. Gate Valve

The gate valve on the discharge is a nonrising stem valve. When leaks occur around the stem, draw down on the gland flange bolt nuts. Remove the wheel and unscrew the nuts holding the gland flange and remove the gland. Repack around the stem with square graphite packing.

CHAPTER 4

AUXILIARY EQUIPMENT

40. General

Since this unit does not come with auxiliary equipment, chapter 4 does not apply.

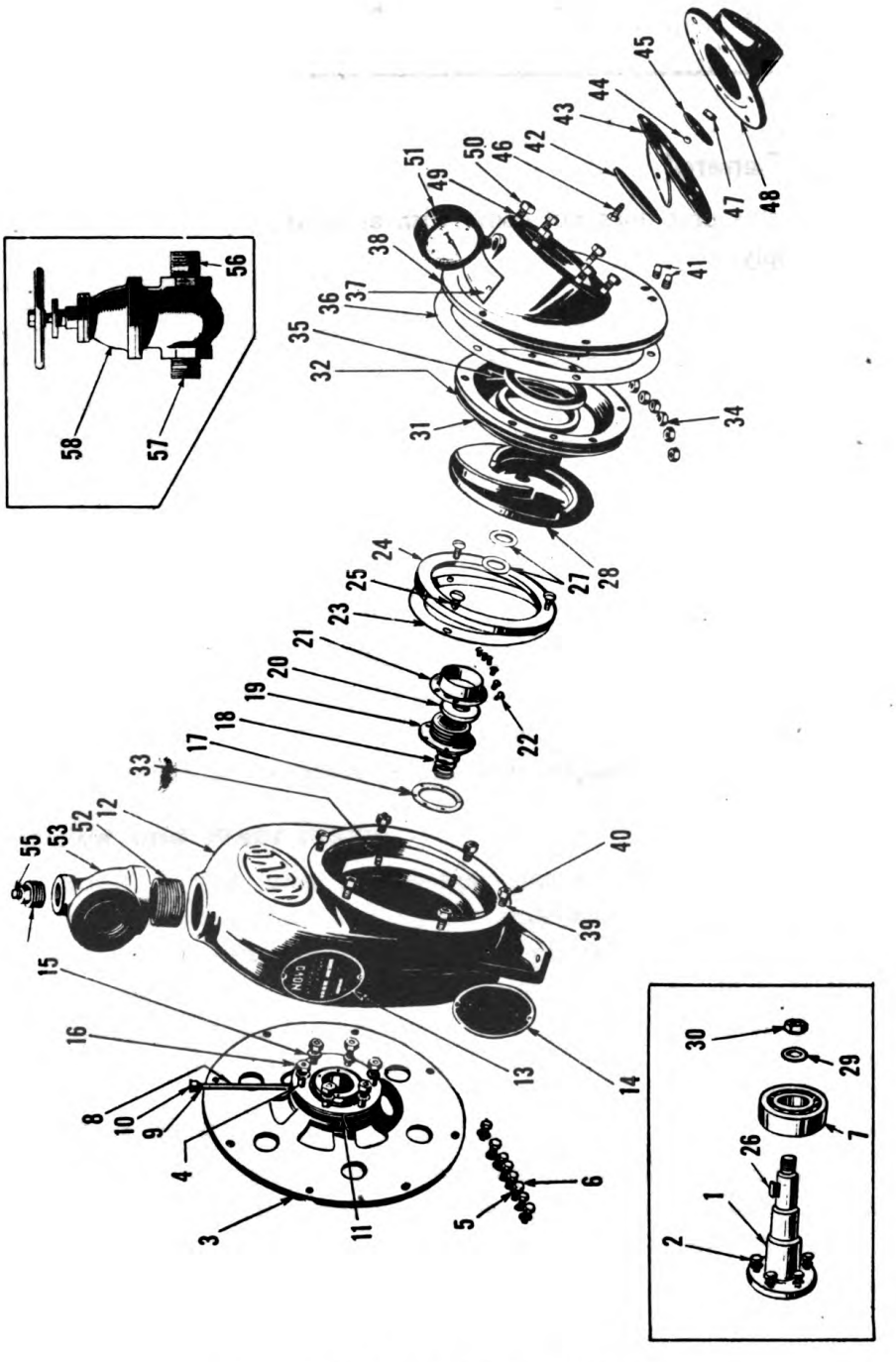


Figure 11. Exploded view of pump.

CHAPTER 5

REPAIR INSTRUCTIONS

Section I. PUMP ASSEMBLY

41. Removal and Disassembly (fig. 11)

a. Remove the gate valve (58) and two nipples (57 and 56) from the discharge tee (53). Remove the pipe plug (55), reducing bushing (54), pipe tee (53), and pipe nipple (52) from the pump case (12). Remove the vacuum gauge (51) from the pump cover.

b. Remove the hex nuts (50) attaching the suction flange to the case, and remove the suction flange (48), and valve assembly from the studs (49). Remove the hex nut (47) attaching the valve parts together and disassemble the cap screw (46), outer valve plate (45), valve screw spacer (44), rubber suction valve (43), and inner valve plate (42). Remove the two pipe plugs (41) from the pump casing cover.

c. Remove the hex nuts (40) from the casing cover studs (39), remove the cover (37), outer wear plate gasket (36), and outer wear plate seal (35). Remove the hex nuts (34) from the outer wear plate studs (33), remove the gasket (32), and outer wear plate (31). Remove the impeller shaft nut (30), lock washer (29), impeller (28), impeller shims (27), and Woodruff key (26) from the stub shaft (1).

1. Stub shaft.
2. Cap screws and lock washer.
3. Pump adapter
4. Pump to adapter stud.
5. Lock washer.
6. Cap screw.
7. Impeller shaft bearing.
8. Pipe nipple.
9. Pipe coupling.
10. Grease cup.
11. Adapter gasket
12. Pump case.
13. Name plate.
14. Instruction plate.
15. Lock washers.
16. Nut.
17. Seal gasket.
18. Seal spring.
19. Seal bellows.
20. Seal thrust washer.
21. Seal shroud.
22. Screw.
23. Inner wear plate gasket.
24. Inner wear plate.
25. Flat head screw.
26. Woodruff key.
27. Impeller shim.
28. Impeller.
29. Lock washer.
30. Impeller shaft nut.
31. Outer wear plate.
32. Outer wear plate gasket.
33. Outer wear plate stud.
34. Hex nut.
35. Outer wear plate seal.
36. Outer wear plate gasket.
37. Pump casing cover.
38. Specifications name plate.
39. Casing cover stud.
40. Hex nut.
41. Pipe plug.
42. Inner valve plate.
43. Rubber suction valve.
44. Valve screw spacer.
45. Outer valve plate.
46. Cap screw.
47. Hex nut.
48. Suction flange.
49. Suction flange stud.
50. Hex nut.
51. Vacuum gauge.
52. Pipe nipple.
53. Pipe tee.
54. Reducing bushing.
55. Pipe plug.
56. Close nipple.
57. American-British nipple.
58. Gate valve.

Figure 11. Exploded view of pump—Continued.

d. Remove the screws (25), inner wear plate (24), and inner wear plate gasket (23) from the case. Remove the seal shroud screws (22), seal shroud (21), seal thrust washer (20), seal bellows (19), seal spring (18), and seal gasket (17) from the stub shaft. Remove the nuts (16), lock washers (15), pump case (12), and adapter gasket (11) from the adapter studs (4).

e. Unscrew and remove the grease cup (10), pipe coupling (9), and pipe nipple (8) from the adapter (3). Remove the impeller shaft bearing (7) from the stub shaft. Remove the cap screws (6) and lock washers (5) attaching the adapter (3) to the flywheel housing, and remove the adapter. Remove the cap screws and lock washers (2) attaching the stub shaft (1) to the crankshaft, and remove the stub shaft (1).

42. Inspection and Repair

a. Inspect the impeller shaft seal for wear. If replacement is necessary, be sure to install both a new bellows assembly and new thrust washer since the bronze washer on the bellows assembly and the thrust washer are lapped and matched.

b. The recirculating hole, located farthest back in the pump case, should always be cleaned of dirt and sand whenever the pump is disassembled for any reason. This will assist the pump in keeping its prime.

c. Replace all gaskets in reassembling as service causes hardening and warping. Clean the valve rubber of scale deposit and inspect for wear and damage. If the surface is worn it should be replaced.

43. Reassembly and Installation (fig. 11)

a. Assemble shaft (1) to the engine crankshaft and secure with six cap screws and washers (2). Place adapter (3), with studs (4) assembled to it, in position on the flywheel housing and secure with washers (5) and cap screws (6). Place ball bearing (7) on shaft (1) and into adapter (3). Assemble pipe nipple (8), coupling (9), and grease cup (10) to adapter (3).

b. Place adapter gasket (11) and case assembly (12), with nameplate (13) and instruction plate (14) assembled to it, in position on the base and over the studs (4) in the adapter (3). Secure to the adapter with lock washers (15) and nuts (16). Assemble gasket (17), spring (18), bellows assembly (19), seal thrust washer (20), and seal shroud (21), over the shaft (1), and secure with six screws (22).

c. Place inner wear plate gasket (23), and wear plate (24) in position in case and secure with three screws (25). Place impeller key (26), shims (27), and impeller (28) in position on shaft, and secure with washer (29) and nut (30). Place outer wear plate (31) and gasket (32) in position in case and over studs (33) and secure with hex nuts (34).

d. Assemble seal (35) to outer wear plate, and place gasket (36), and pump cover (37) with nameplate (38) attached to it, over studs (39) and attach to case with nuts (40). Assemble two pipe plugs (41) to pump cover. Assemble plate (42), valve rubber (43), spacer (44), plate (45), and secure together with cap screw (46) and nut (47).

e. Place valve assembly and flange (48) over studs (49) and in position on pump cover. Secure with six nuts (50). Assemble vacuum gauge (51) to pump cover. Assemble nipple (52), tee (53), bushing (54), and plug (55) to the top or outlet of the pump. Assemble nipple (56) and nipple (57) to gate valve (58), and assemble gate valve assembly to pump outlet tee.

44. Adjustment

Remove pump cover (37, fig. 11) outer wear plate (31) and impeller (28). (See par. 41*c*.) Take out sufficient steel shims (27) to provide a clearance of .005 inch to .010 inch with impeller nut tight. If the wear is excessive, remove the three screws (25) and add paper gaskets (23) behind inner wear plate (24), to provide proper clearance. If too much clearance is taken up by these gaskets, then add shims (27) in back of the impeller to provide proper clearance (.005 to .010 inch). Tighten the impeller nut snugly. If it binds the impeller, add another steel shim. When this clearance has been established, replace the front wear plate (31) and remove gaskets (32) to provide .005 to .010 inch clearance between the front wear plate (31) and the impeller (28).

Caution: Do not loosen the impeller nut to relieve pressure on inner wear plate, as loosening this nut will result in cutting of the impeller shaft and will not give the proper pressure on the seal.

Section II. ENGINE ASSEMBLY

45. Removal and Disassembly

a. Screw muffler out of the manifold. Remove carburetor, magneto, air cleaner, and fuel filter. Complete removal of the engine, and pump from the base assembly is accomplished by removing 10 bolts and washers, 2 in the front foot bracket, 2 in the flywheel housing, 2 in the pump gear case cover, and 4 in the pump base.

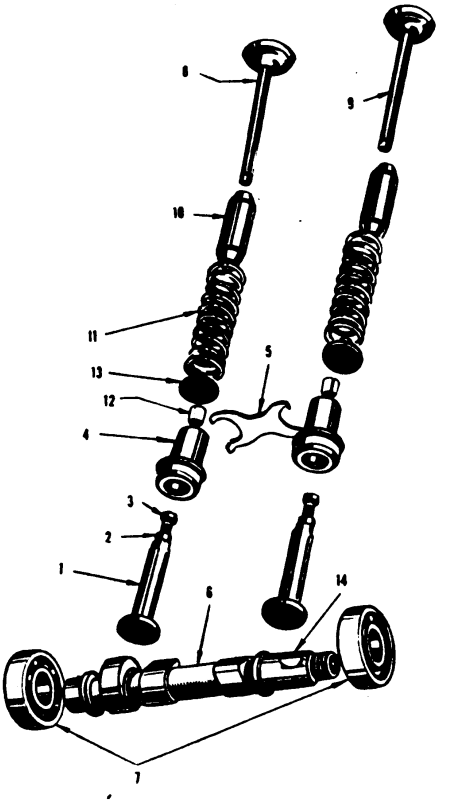
b. Drain the oil from the crankcase. Take out the screws (18 and 19, fig. 15) which hold the oil pan to the crankcase, and lower the oil pan (17), and gasket (16). Take out the cap screw which holds the speed control bracket to the underside of the manifold (47). Unscrew the nut (51) from the manifold to the cylinder block stud (49), and remove the manifold (47), and the manifold gasket (48).

c. To remove the cylinder head (13), take out the eight screws (36) which hold the blower housing top (35) to the blower housing (34). Take out the six cylinder head cap screws (14 and 15), and tap the edges of the head lightly with a soft hammer to loosen it. Lift the cylinder head from the cylinder block (8).

d. To remove the valves, unscrew the tappet cover stud nut (46), and pull the tappet cover (43), and gasket (44) off the stud. Use a valve lifter to release the valve spring tension, and remove the valve keeper (12, fig. 12), stem collar (13), spring (11), valve guide (4), and valve tappet guide clamp (5).

e. The piston and rod assembly is removed by unscrewing the two connecting rod cap bolt nuts (31, fig. 13), and removing the rod cap. Tap the bottom of the rod lightly till the piston is clear of the cylinder block, and remove the piston (23) and rod assembly (30).

f. To remove the crankshaft and bearings it is first necessary to remove the blower wheel assembly, both gear cases, the flywheel, and the gear oiler. Remove the blower housing cover (37, fig. 15) by taking out the eight screws (38). Remove the pin (35, fig. 13) from the crankshaft,



1. Valve tappet.
2. Valve adjusting screw nut.
3. Valve adjusting screw.
4. Valve tappet guide.
5. Valve tappet guide clamp.
6. Camshaft.
7. Camshaft bearings.
8. Intake valve.
9. Exhaust valve.
10. Valve guides.
11. Valve springs.
12. Valve stem keeper.
13. Valve stem collar.
14. Woodruff key.

Figure 12. Exploded view of camshaft, valve, and tappet assemblies.

and pull the blower wheel (34) off the crankshaft (5). Take out the cap screws which hold the housing to the cylinder block, one over the manifold and one at the rear of engine. Unscrew the two blower housing bracket screws (33, fig. 15), disconnect the fuel line, and carefully lift the blower housing (34) away from the engine.

Note. The gas tank does not need to be removed to remove the blower wheel housing.

g. The gear cover is removed by unscrewing the two stud nuts and the cap screws (26 and 27, fig. 15) which hold the gear cover (24) to the gear case cover plate (21). Raise the governor weights (22, fig. 14), and pull out the plunger (26), and the plunger cup (25). Unscrew the nut (24), and washer (23), and pull off the governor weight bracket and weights assembly (20 and 22). Press off the cam gear (19). Take out the cap screws (22, fig. 15) which hold the gear case cover plate (21) to the crankcase (1), and remove the plate and the gaskets (20 and 23).

h. With a gear puller, pull off the pinion gear (6, fig. 13). Remove the three cap screws (3) from the front main bearing retainer (1), and remove the retainer and shim (2). Remove the front main bearing and race (9).

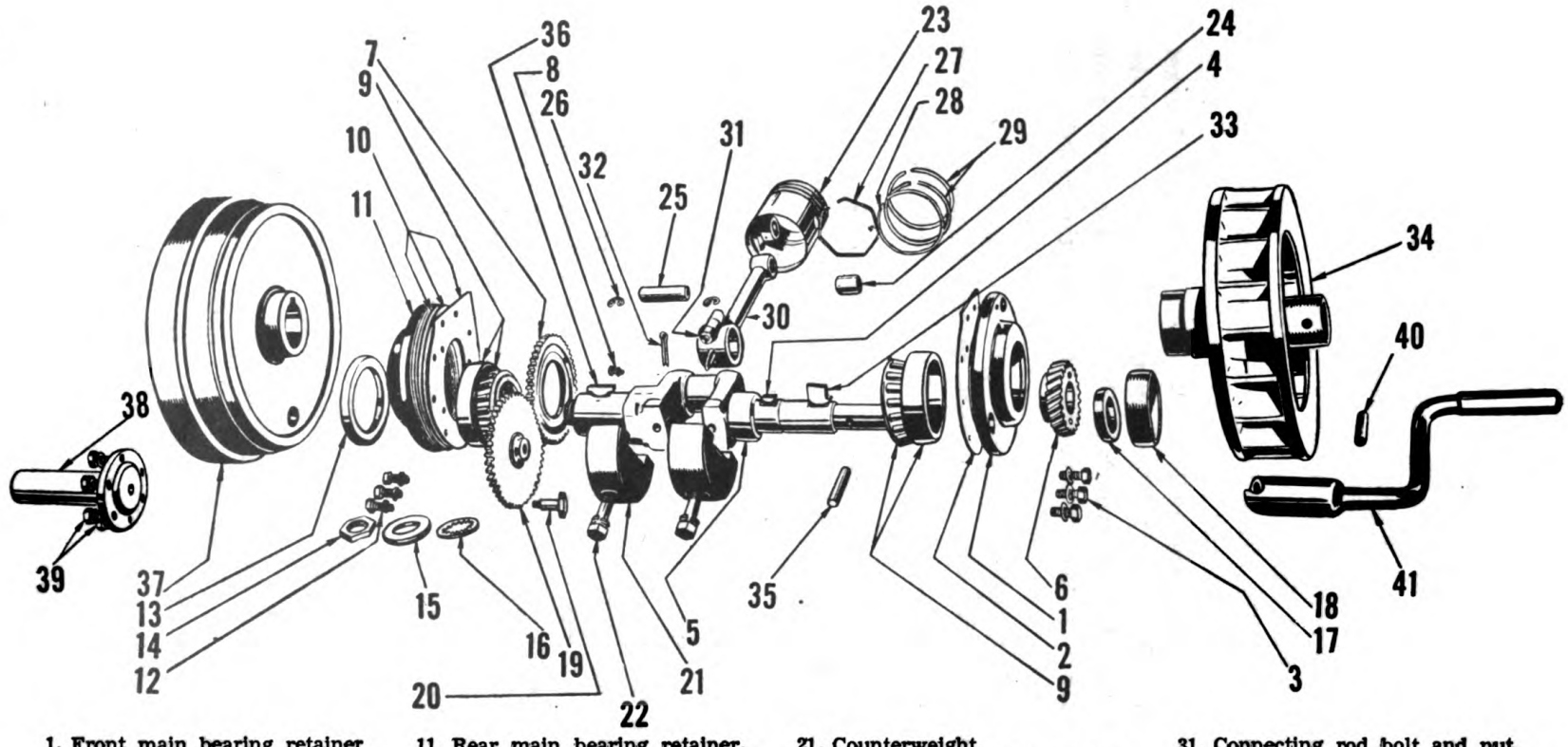
i. To remove the flywheel and housing, unscrew the eight cap screws (6, fig. 11) and washers (5) which hold the adapter (3) to the flywheel housing (53, fig. 15), and remove the six cap screws (39, fig. 13) from the stub shaft (38). Then remove flywheel (37), flywheel housing, and the gasket (57, fig. 15) between the housing and crankcase by unscrewing the eight cap screws (58).

j. Unscrew the three cap screws and washers (12, fig. 13) which hold the rear main bearing retainer (11), and pull off the oil seal (13), bearing retainer, and shims (10). Using a bearing puller, pull off the main bearing and race (9). From inside the engine, remove the oil gear pin (20) from the oil gear (19), and the oil gear cap screw (8) from the crankthrow. Lower both gears from the crankcase. If it is necessary to remove the counterweights (21), remove the counterweight cap screws (22). Lower the crankshaft (5).

k. To remove the governor linkage, take out the cotter pins (10, fig. 14) from the governor rod (9), and separate the governor rod from the governor lever (11).

l. The cylinder block (8, fig. 15) must be removed before taking out the camshaft and bearings. Take off the two nuts from the block to crankcase studs (10), and remove the block. Tap the camshaft (6, fig. 12) lightly on the cam shoulders with a soft hammer. and remove the front bearing cup. Use a bearing puller to remove the front and rear bearings (7).

Note. If rear bearing cup is not to be removed, the flywheel housing need not be removed.



1. Front main bearing retainer.
2. Front main bearing shim.
3. Cap screw and lock washer.
4. Woodruff key.
5. Crankshaft.
6. Crankshaft pinion.
7. Crankshaft oil gear.
8. Cap screw and lock washer.
9. Main bearings.
10. Main bearing shim.
11. Rear main bearing retainer.
12. Cap screw and lock washer.
13. Rear oil seal.
14. Crankshaft nut.
15. Crankshaft washer.
16. Lock washer.
17. Front oil seal.
18. Front oil seal collar.
19. Oil gear.
20. Oil gear pin.
21. Counterweight.
22. Cap screw and lock washer.
23. Piston.
24. Piston pin bushing.
25. Piston pin.
26. Piston pin snap ring.
27. Piston ring, inner oil.
28. Piston ring, oil.
29. Piston ring, compression.
30. Connecting rod.
31. Connecting rod bolt and nut.
32. Cotter pin.
33. Blower wheel key.
34. Blower wheel.
35. Blower wheel pin.
36. Hi-pro key.
37. Flywheel.
38. Stub shaft.
39. Cap screw.
40. Starting crank pin.
41. Starting crank.

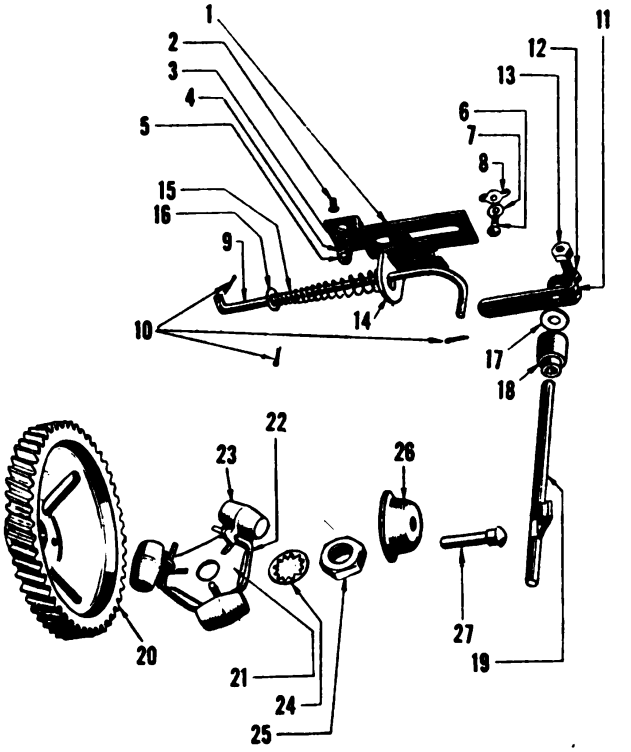
Figure 13. Exploded view of crankshaft and piston assemblies.

46. Inspection and Repair

a. Tabulated Data. The following data should be observed in inspecting and repairing engine parts:

Piston pin clearance	.001 in. tight
Piston ring gap clearance	.008–.013 in.
Valve stem clearance	.0035 in.
Valve adjustment	.015 in.

b. Grinding Valves. Clean the valves thoroughly, removing all carbon. Inspect the valve seats for deep pits and high spots that must be removed before grinding. Back off the tappet screw nut two turns to free valve from the tappet. Place a small spring over the end of the stem and against the head, and assemble valve in the guide. Apply a small amount of grinding compound around the face of the valve. With the valve held partially off its seat, place the grinding tool in the two holes



1. Speed control bracket.
2. Round head screw.
3. Governor control bracket stud.
4. Lock washer.
5. Hex nut.
6. Round head screw.
7. Rivet washer.
8. Wing nut.
9. Governor rod.
10. Cotter pin.
11. Governor lever.
12. Cap screw.
13. Hex nut.
14. Speed control lever.
15. Governor spring.
16. Rivet washer.
17. Rivet washer.
18. Governor shaft bushing.
19. Governor lever and shaft.
20. Camshaft gear.
21. Governor weight bracket.
22. Governor weight ring.
23. Governor weight.
24. Lock washer.
25. Hex nut.
26. Governor plunger cup.
27. Governor plunger pin.

Figure 14. Exploded view of the governor assembly and attaching parts.

of the valve head and grind the valve till the full face is free of marks or pits. Remove all compound and with white crayon or soft lead lightly mark the seat. Turn the valve slowly one revolution and carefully lift out. If any of the marks are untouched, repeat grinding operation. If the valve seat insert is damaged or cannot be lapped in, use a grinding stone to provide a suitable seat. However, it is better to replace all damaged inserts.

c. Removing Valve Seat Inserts. Drill a hole slightly smaller than the width of the valve seat insert, through each side of the insert.

Caution: Do not drill into the cylinder block at the side or under the valve seat.

Carefully cut the remaining metal between the drill holes and the edges of the seat with a small chisel. Remove the old insert.

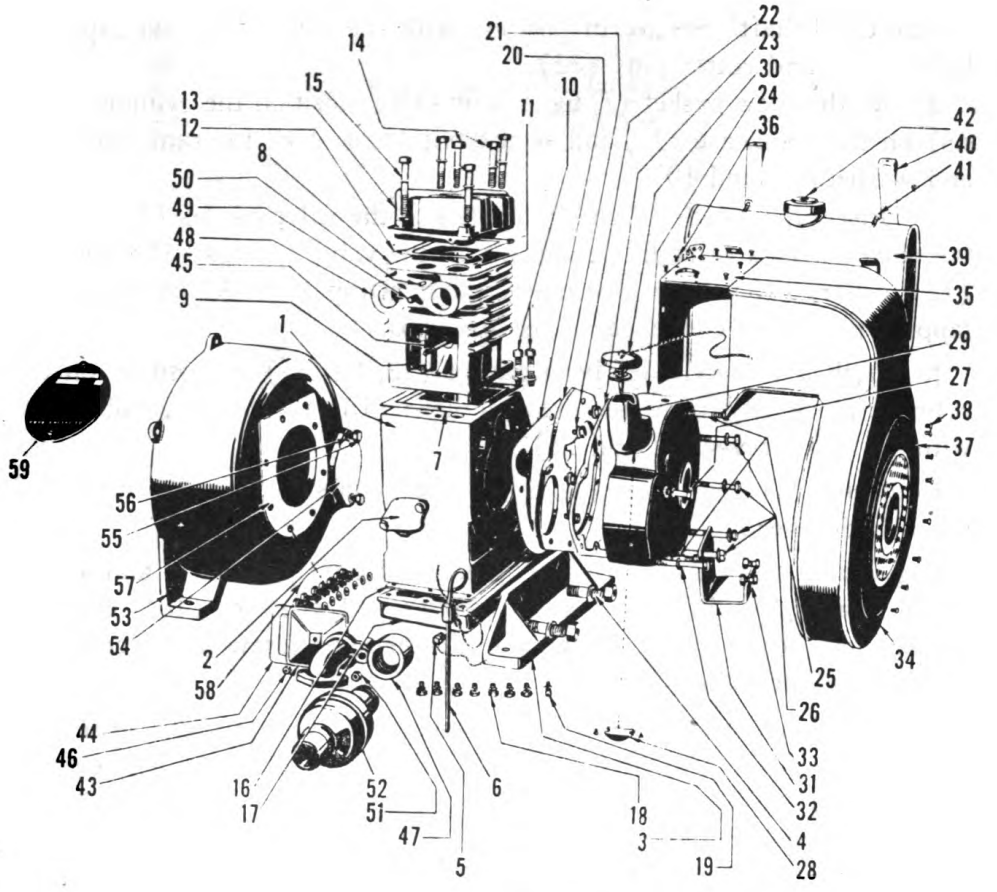
d. Installing New Valve Seat Inserts. Since the cylinder block is counterbored slightly smaller than the insert, it is necessary for the valve seat inserts to be shrunk in dry ice before installation. Pack the inserts in dry ice for at least 15 minutes before they are to be installed. Heat the cylinder block gradually, around the area where an insert is to be installed, to a temperature of between 82° and 93°C. (180° and 200°F.). Carefully place the insert in position in the counterbore, making sure that it does not cock, and press it firmly into position.

47. Reassembly and Installation

a. Position the front main bearing retainer (1, fig. 13) and new shim (2), and secure to the crankcase with three cap screws (3), and lock washers. With a No. 9 Woodruff key (4) in position in the crankshaft (5), press the crankshaft pinion (6) onto the shaft. Secure the oil gear (7) to the crankshaft with two oil gear cap screws (8), and lock washers. Place the crankshaft in the crankcase, and press the front and rear main bearing (9) on the crankshaft. Install proper rear main bearing shims (10), place the rear main bearing retainer (11) in position, and secure with three cap screws and lock washers (12). Carefully press the oil seal (13) into position on the crankshaft and install the crankshaft nut (14), and washers (15 and 16). Place front oil seal (17), and collar (18) in position in front bearing retainer (1). Position the oil gear (19) inside the crankcase, and secure to the crankcase with the oil gear pin (20). Secure counterweights (21) to the crankshaft with the counterweight cap screws and lock washers (22).

b. Position the tappets (1, fig. 12) in the guides (4). Place camshaft (6) in position in crankcase. Press on the front and rear camshaft bearings (7) through the openings in the crankcase.

c. Compress the piston rings (27, 28, and 29, fig. 13) with a piston ring compressor, and with the crankshaft in position, push the piston



1. Crankcase.
2. Crankcase cover.
3. Front foot.
4. Stud, nut, and lock washer.
5. Drain plug assembly.
6. Oil gauge.
7. Cylinder to base gasket.
8. Cylinder block.
9. Cylinder stud, long.
10. Cylinder stud, short.
11. Exhaust valve insert.
12. Cylinder head gasket.
13. Cylinder head.
14. Cylinder head screw, short.
15. Cylinder head screw, long.
16. Oil pan gasket.
17. Oil pan.
18. Cap screw and washer.
19. Fillister head screw.
20. Gear case cover gasket.
21. Gear case cover plate.
22. Cap screw and lock washer.
23. Gear cover gasket.
24. Gear cover.
25. Gear case cover plate stud.
26. Cap screw and lock washer.
27. Cap screw and lock washer.
28. Breather baffle.
29. Breather tube.
30. Breather cap.
31. Blower wheel housing bracket.
32. Cap screw and lock washer.
33. Cap screw and lock washer.
34. Blower wheel housing.
35. Blower wheel housing top.
36. Self-tapping screw.
37. Blower wheel housing cover.
38. Self-tapping screw.
39. Fuel tank.
40. Fuel tank strap.
41. Machine screw.
42. Fuel tank cap.
43. Valve tappet cover.
44. Valve tappet cover gasket.
45. Valve tappet cover stud.
46. Hex nut.
47. Manifold.
48. Manifold gasket.
49. Manifold stud.
50. Dowel pin.
51. Hex nut.
52. Muffler.
53. Flywheel housing.
54. Starter opening cover.
55. Cap screw.
56. Lock washer.
57. Flywheel housing gasket.
58. Cap screw and lock washer.
59. Name plate.

Figure 15. Exploded view of engine crankcase, head, gear cover, blower wheel and housing, and flywheel housing.

(23) and the rod (30) down until the top of the connecting rod fits firmly on the crankshaft. Secure in position with the connecting rod cap, two bolts (31), and cotter pins (32).

d. With a new gasket (7, fig. 15) in place, position the cylinder block (8) on the crankcase (1), and secure with two block to crankcase studs and washers (9 and 10).

e. Insert the valves (8 and 9, fig. 12) in the valve guides (10). Hold the valves with a valve lifter, and install the valve springs (11), keepers (12), collars (13), and valve tappet guide clamp (5). Adjust valve and tappets to proper clearance. (See par. 46*a*.)

f. With a new cylinder head gasket (12, fig. 15) in position on the cylinder block (8), place the cylinder head (13) in position, and secure with six cap screws (14 and 15).

Caution: Apply pressure evenly on head studs to prevent warping of the cylinder head.

Using a new oil pan gasket (16), position the oil pan (17), and secure to the crankcase (1) with six cap screws and washers (18), and one fillister head screw (19). Install the fillister head screw in the center of the flywheel side of the oil pan.

g. Position the gear case cover gasket (20, fig. 15) and gear case cover plate (21), and secure to the crankcase with cap screws and washers (22). With the Woodruff key (14, fig. 12) in the camshaft (6) press the camshaft gear (20, fig. 14) in place on the shaft. Place the governor weight bracket and weight assembly (21 and 23) in position on the camshaft gear, and secure with shakeproof washer (24) and nut (25). Raise the governor weights (23), and insert the plunger cup (26) and plunger pin (27).

Note. Timing marks on the camshaft gear and pinion must be properly aligned. (See par. 50*c*.)

With a new gear cover gasket (23, fig. 15) in the gear cover (24), position the gear cover on the front of the crankcase by sliding cover over the crankshaft. Secure with two gear case cover studs (25) and cap screws (26 and 27).

h. Position the blower wheel housing (34) over the gear cover (24), and secure it to the crankcase with two cap screws, one over the manifold opening and one at the rear of the crankcase, and to the housing bracket with two screws (33). Position the blower wheel housing top (35), and secure it to the blower wheel housing (34) with eight self-tapping screws (36). Place blower wheel key (33, fig. 13) and press the blower wheel (34) into position on the crankshaft (5), and secure it with the blower wheel pin (35). Position the blower housing cover (37, fig. 15), and secure it to the blower wheel housing (34) with eight self-tapping screws (38).

Figure 16. Valve and tappet adjustment.

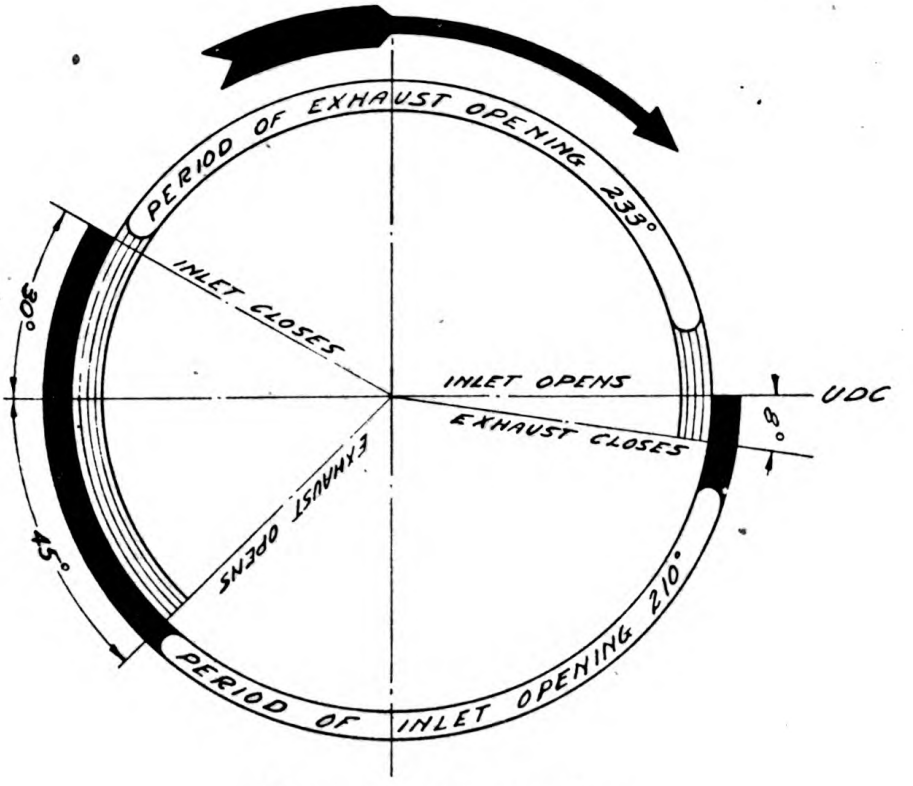


Figure 17. Valve timing chart.

i. Position the tappet cover (43, fig. 15) and new gasket (44), and secure it to the valve tappet cover stud (45) with a nut (46). Position the manifold (47) with a new gasket (48) over the manifold stud (49), dowelpin (50), and secure with a nut (51). Assemble muffler (52) to manifold (47).

j. Position the governor rod (9, fig. 14), and secure with a cotter pin (10). Install the cap screw (2) through the speed control bracket (1) and into the bottom of the manifold.

k. With a new gasket (57, fig. 15) between the flywheel housing (53) and the crankcase (1) slide the flywheel housing over the crankshaft, and secure the housing to the crankcase with eight cap screws (58). Assemble key (36, fig. 13) on the crankshaft, and assemble flywheel (37). Position the stub shaft (38) to the flywheel (37), and secure with six cap screws (39).

l. Secure the pump adapter (3, fig. 11) to the flywheel housing with eight cap screws (6).

m. If the engine and pump have been removed as a unit from the base assembly, position them to the base, and secure with two bolts in the front foot brackets and two in the flywheel housing. Use four bolts to fasten the pump on the frame. Install fuel line, fuel filter air cleaner, magneto and carburetor. Screw the muffler into the manifold.

48. Adjustments

a. Valve and Tappet Adjustment. Remove the tappet cover and turn the engine until the valves are in extreme down position. Hold the

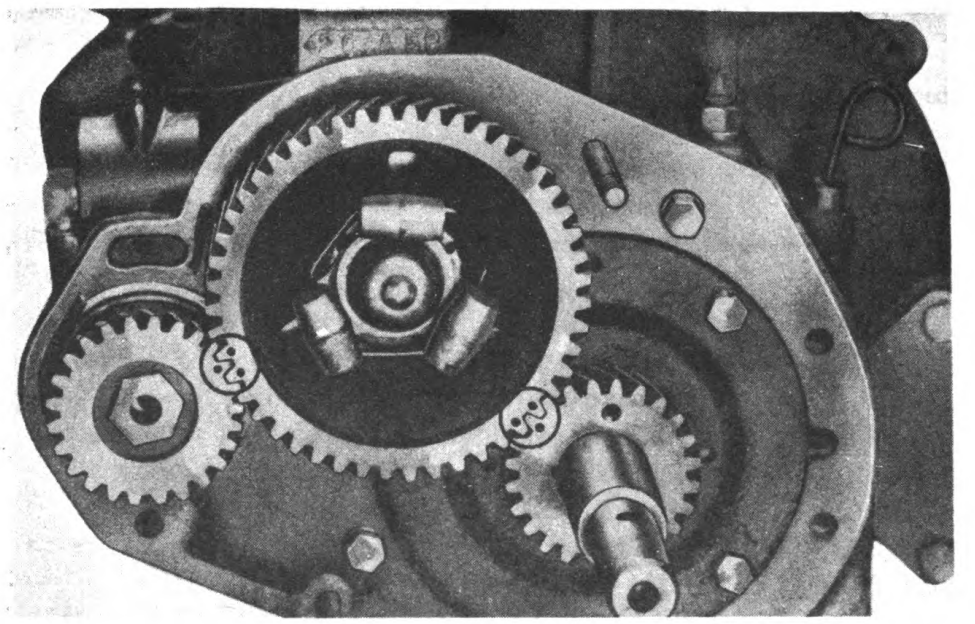


Figure 18. Crankshaft pinion, cam gear, and magneto timing marks.

tappet (1, fig. 12) and loosen the valve adjustment screw nut (2). The valve adjustment screw (3) can then be set with a .015 feeler gauge. Carefully turn the screw nut (2) which locks the adjustment in the tappet. Recheck the clearance after tightening the nut to insure correct adjustment. Replace the tappet cover.

b. GOVERNOR ADJUSTMENT. Remove the muffler and breathing cap to facilitate reaching the governor rod. Loosen the governor lever cap screw and set the governor rod (5) so that the center line of hole (1, fig. 9) is about 2 inches from the inner surface of the gear case cover plate. With the carburetor throttle lever (3) wide open, the governor rod should slide into both holes (1 and 2) freely. Make adjustment only by moving the governor lever (4), not the shaft or weight. Constant speed of 1,800 rpm is then set by adjusting the governor spring on the throttle rod. After the correct spring tension is set, tighten the screw and wing nut to hold the lever in that position.

Section III. MAGNETO

49. Removal and Disassembly

a. Unscrew the fiber nut at the coil, and remove the high-tension wire. Unscrew the nut, and remove the low tension wire at the cap end of the magneto. Remove the two cap screws which hold the magneto to the gear case cover plate, and pull the magneto out.

b. Remove the hex nut (35, fig. 20), washer (34), pinion (33), and key (32) from the end of the rotor shaft. Remove lock washer (31), housing (30), wick (29), pin (28), spring (27), cam (26), weights (25), and plate (24) from the rotor shaft and arrester plate (21). Remove the screws (23) and washers (22) which attach the arrester plate (21) to the magneto housing, and remove the plate (21).

c. Remove the screws (20), washers (19) gasket (18), cap screws (17), cap screw washer (16), caps (15), and coil (14) from the magneto housing.

d. Unhook springs (27, fig. 19) from cap (13, fig. 24), and remove cap (13) and gasket (12) from the interrupter housing (11).

e. Remove screws (29, fig. 19), lock washers (28), and spring (27) from the interrupter housing. Remove nut (26), washer (25), nut (24), lock washer (23), and button (22) from the terminal stud. Remove hex nut (21), washer (20), screw (19), and strip (18). Remove condenser (17), plain washer (16), block (15), and stud (14) from housing.

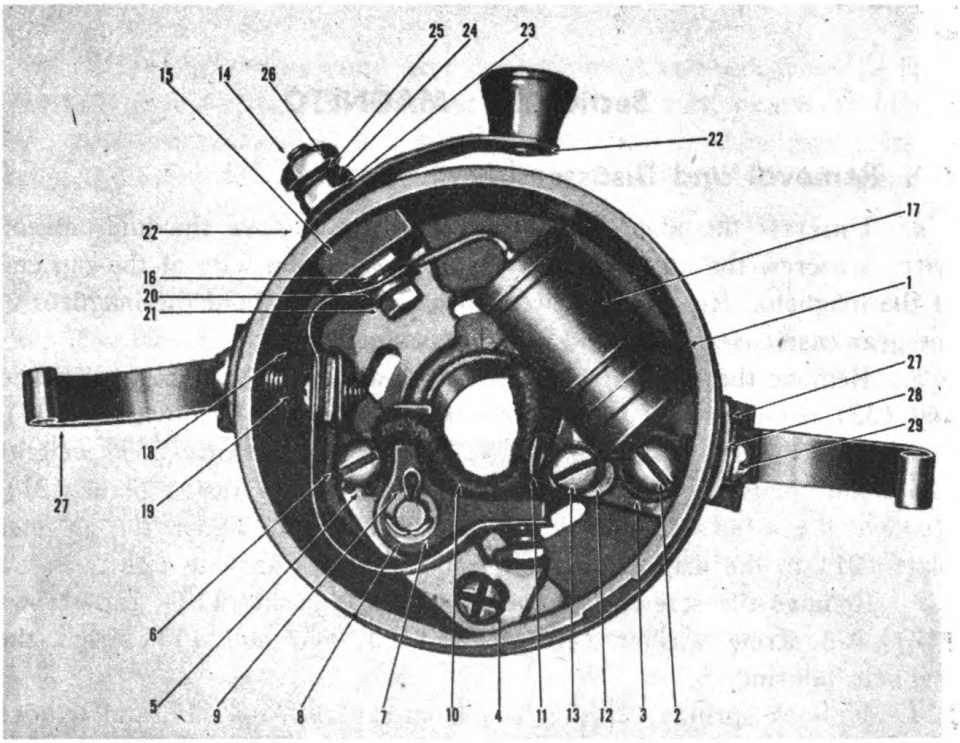
f. Remove screw (13), washer (12), bracket (11), and felt wick (10) from housing. Remove cotter pin (9), washer (8), and interrupter lever (7) from pin in housing. Remove screw (6), washer (5), and contact bracket (4) from housing. Remove washer (3) and screw (2) attaching

the interrupter housing (1) to the magneto housing, and remove interrupter housing (1) from the rotor shaft.

g. Remove bearing (10, fig. 20) from the interrupter housing (11). Remove shim (9), rotor (8), washer (7), bearing (6), packing strip (5), washer (4), oil seal (3), and oiler (2) from the magneto housing (1).

50. Inspection and Repair

a. CONDENSER. Check condenser with a neon light or any other standard approved testing device for short circuit, leakage, open circuit, or damage, as follows: Connect the lead of the condenser to one terminal of testing device, and to the other terminal connect grounded part of condenser. If a short flash is recorded on the light, the condenser is satisfactory for further use. If, however, repeated flickering of the testing



1. Interrupter housing.
2. Interrupter housing screw.
3. Lock washer.
4. Contact bracket.
5. Lock washer.
6. Bracket fastening screw.
7. Interrupter lever.
8. Cotter pin washer.
9. Cotter pin.
10. Cam lubricating felt wick.
11. Felt wick retaining bracket.
12. Lock washer.
13. Condenser and wick screw.
14. Terminal stud.
15. Terminal stud insulation block.
16. Terminal stud washer.
17. Condenser.
18. Conduction strip.
19. Interrupter lever spring screw.
20. Terminal stud lock washer.
21. Condenser lead hex nut.
22. Short circuiting button.
23. Lock washer.
24. Terminal stud hex nut.
25. Lock washer.
26. Terminal stud hex nut.
27. End cap holding spring.
28. Lock washer.
29. Holding spring screw.

Figure 19. Contact point housing assembly.

device or light takes place, it will prove evidence of a leaky condenser, and the condenser should be replaced. Repeated flashes of the light will show that a short circuit exists; while no lighting of testing device shows an open circuit, which means a new condenser is necessary.

b. Coil. No separate coil test is required. If the magneto does not perform properly on the test runs, the coil should be replaced.

c. Magnet Rotor. This magneto is usually stable in its magnetization, and does not ordinarily require remagnetization during routine inspection, or even complete disassembly.

(1) If remagnetization is necessary, use magnetizing stand TSE 5210 or equivalent. The cast "Alnico" magnets used in this magneto are special magnets with a great amount of magnetic strength, thus requiring a magnetizer with sufficient strength to fully saturate the magnets.

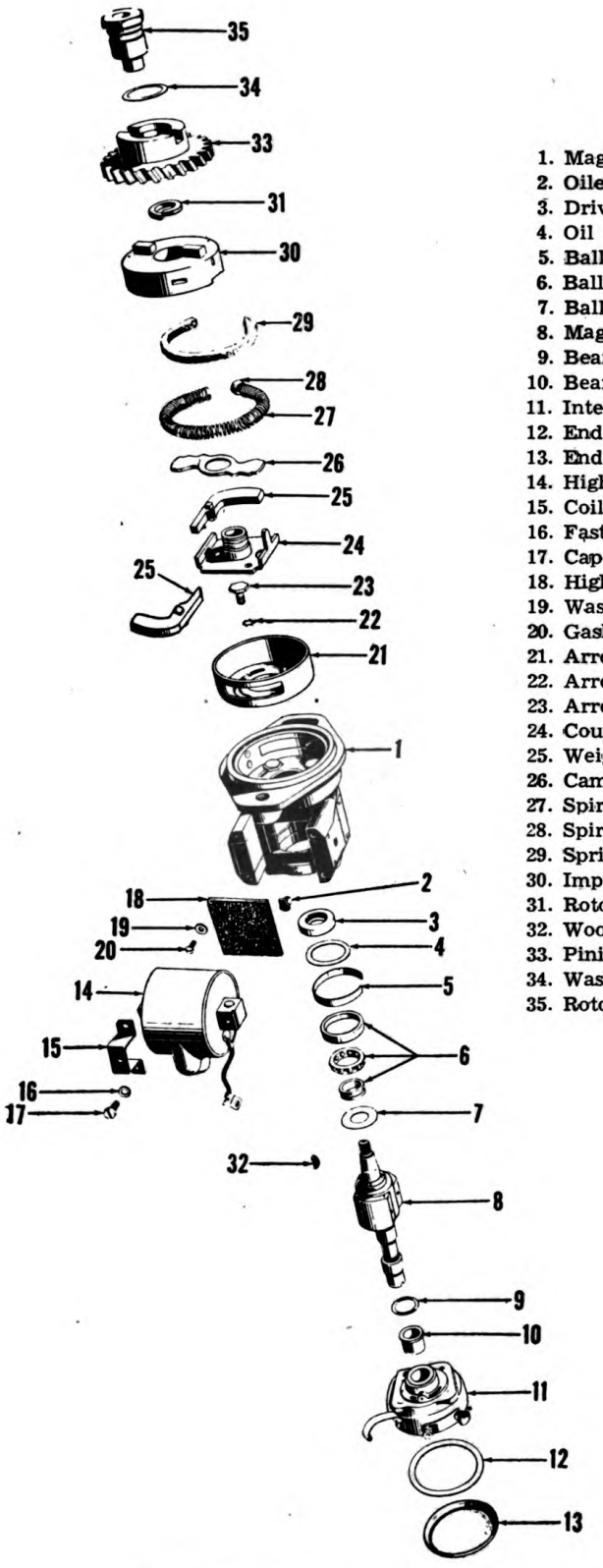
(2) The following is the procedure to be followed in magnetizing the MVA1A on the American Bosch magnetizing stand TSE 5210: It is essential to remagnetize the magnet in the same magnetic direction as originally charged; polarity of magnetizing stand and magnet can readily be determined by a compass, and the south pole of the magnet should always be placed on the north pole of the magnetizing stand. If no compass is available, hold magnet rotor in a vertical position to the magnetizing stand, approximately 8 inches from the charger. Make electrical contact with foot switch, rotor will locate itself for proper recharging position, release foot switch, place magnet rotor in the curved jaws TSE 5257 on the magnetizing stand, and apply three charges of 4 to 5 seconds duration each.

51. Reassemby and Installation

a. Place the housing (1, fig. 20) on a clean bench with the impulse coupling side down, and assemble the oiler (2), oil seal (3), washer (4), and packing strip (5) to the interrupter end of the housing. Assemble the bearing (6), and washer (7) to the rotor (8). Place rotor assembly in housing. Place shim (9) over end of rotor. Press bearing (10) into the interrupter housing (11).

b. Place the interrupter housing (1, fig. 19) in position and secure with screw (2) and washer (3). Place the contact bracket (4) over the pins in housing, and secure with washer (5) and screw (6). Place the interrupter lever (7) over a pin in housing and secure with washer (8) and cotter pin (9). Place the felt wick (10) in position and secure with bracket (11), washer (12), and screw (13).

c. Place stud (14, fig. 19) in housing, together with block (15) and plain washer (16). Place the condenser (17), and strip (18) in position, and secure the interrupter lever, strip, and condenser lead to the contact bracket with lock washer and screw (19). Place strip (18) over the terminal stud (14), and secure with lock washer (20) and hex nut



1. Magneto housing.
2. Oiler.
3. Drive end oil seal.
4. Oil seal washer.
5. Ball bearing packing strip.
6. Ball bearing.
7. Ball bearing insulation washer.
8. Magnet rotor with cam.
9. Bearing shim.
10. Bearing.
11. Interrupter housing.
12. End plate gasket.
13. End cap.
14. High tension coil.
15. Coil holding cap.
16. Fastening screw washer.
17. Cap fastening screw.
18. High tension coil gasket.
19. Washer.
20. Gasket fastening screw.
21. Arrester plate.
22. Arrester plate lock washer.
23. Arrester plate screw.
24. Coupling plate and hub assembly.
25. Weight.
26. Cam.
27. Spiral spring.
28. Spiral spring pin.
29. Spring felt wick.
30. Impulse coupling housing.
31. Rotor shaft nut lock washer.
32. Woodruff key.
33. Pinion.
34. Washer.
35. Rotor shaft hex nut.

Figure 20. Exploded view of magneto and impulse coupling.

(21). Place the button (22) over the terminal (14), and assemble lock washer (23), nut (24), washer (25), and nut (26).

d. Place springs (27, fig. 19) in position on housing, and secure with washer (28) and screw (29). Place gasket (12, fig. 20) and cap (13) in position on housing and secure with springs (27, fig. 19).

e. Place coil (14, fig. 20) in position, and secure with caps (15), washers (16), and screws (17). Place gasket (18) on bottom of magneto, and secure with washers (19) and screws (20).

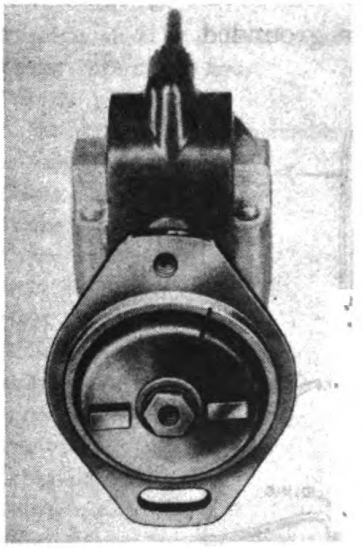


Figure 21. Impulse coupling timing marks.

f. Place plate (21, fig. 20) in position in housing (1), and secure with two washers (22) and screws (23). Position plate (24) over rotor shaft and into plate (21). Assemble weights (25), cam (26), spring (27), spring pin (28), wick (29), housing (30), and washer (31). Place key (32) in rotor shaft, and assemble pinion (33), washer (34), and nut (35).

g. With the blower wheel housing and gear cover removed, position the magneto through the opening in the gear case cover plate, and align the timing marks on the magneto gear with the marks on the camshaft gear. (See fig. 21.) Time the magneto as outlined in paragraph 52. Install the gear cover, the blower wheel, and blower wheel housing. (See pars. 47*g* and 41*h*.)

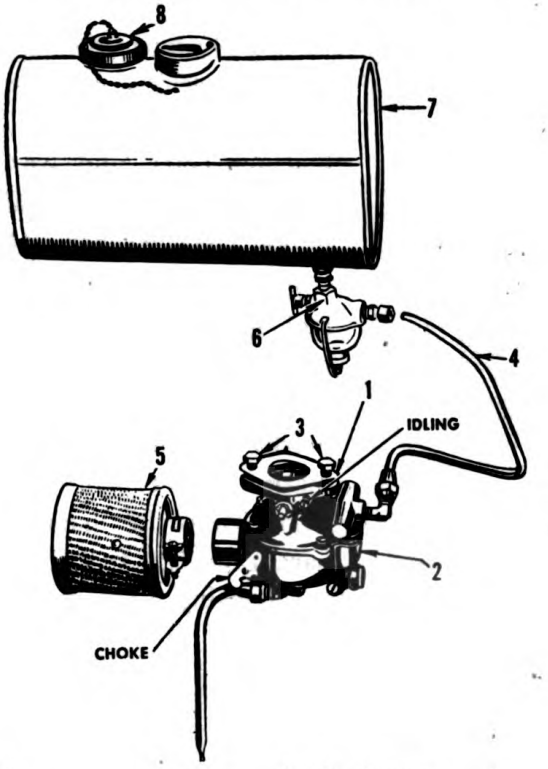
52. Adjustments

a. Timing Magneto (fig. 21). Rotate the impulse coupling in reverse direction of magneto rotation until the mark on the impulse coupling lines up with the mark on the magneto flange. Remove the spark plug and turn the flywheel over till the piston is at the upper dead center on the firing stroke. Turn the flywheel again until the starting crank pin in the front end of the crankshaft is in a vertical position. With the magneto in the above position, mesh the magneto pinion with the cam gear and bolt into place. Should spark occur before the piston reaches the upper dead center position, remove the magneto and turn gear back one tooth. If spark occurs late, set gear ahead one tooth, or the required amount to make the spark occur when the piston is at upper dead center.

b. Test Runs. Using any standard approved test stand, provided with three pointed electrode test gaps, run magneto at following speeds, using corresponding spark gap openings:

At speed of	75	rpm spark gap to be ..	5.0 mm
	150	rpm	8.0 mm
	400	rpm	9.0 mm
	1,200	rpm	10.5 mm
	3,500	rpm	10.0 mm

During the run 100 percent firing is required on all gaps. Arcing of contacts should be observed, as only slight intermittent sparking is permitted. Check grounding brush circuit by grounding low tension terminal while magneto is running. If grounding brush circuit is functioning correctly, magneto must cease sparking when grounded.



1. Carburetor gasket.
2. Carburetor assembly.
3. Cap screw.
4. Fuel filter to carburetor line.
5. Air cleaner.
6. Fuel filter.
7. Fuel tank.
8. Fuel tank cap.

Figure 22. Fuel system.

Section IV. CARBURETOR AND AIR CLEANER

53. Removal and Disassembly

a. Loosen the clamp and remove the air cleaner (5, fig. 22). Take out the cotter pin from the pump end of the governor rod. Unscrew the fuel line (4) fitting at the carburetor. Take out the two cap screws (3) and lock washers which hold the carburetor (2) to the intake manifold, and remove the carburetor.

b. Remove the four screws (24, fig. 23) and washers (25), and separate the upper and lower carburetor bodies. Remove and discard the gasket (23). Remove the float axle (22), float assembly (21), needle valve and seat assembly (20), idle adjusting needle (18), idle adjusting needle spring (19), throttle stop screw (16), and spring (17) from the upper carburetor body.

c. Remove the drain plug (15, fig. 23), venturi (14), main nozzle (13), main nozzle gasket (12), main jet plug (11), main jet plug gasket (10), and main jet (9) from the lower carburetor body.

1. Throttle shaft and lever assembly.
2. Upper carburetor body.
3. Throttle plate.
4. Choke shaft and lever assembly.
5. Lower carburetor body.
6. Choke plate assembly.
7. Choke Plate pin.
8. Choke return spring.
9. Main jet.
10. Main jet plug gasket.
11. Main jet plug.
12. Main nozzle gasket.
13. Main nozzle.
14. Venturi.
15. Drain plug.
16. Throttle stop screw.
17. Throttle stop screw spring.
18. Idle adjusting needle.
19. Idle adjusting needle spring.
20. Needle valve and seat assembly.
21. Float and lever assembly.
22. Float lever axle.
23. Carburetor body gasket.
24. Carburetor body screw.
25. Carburetor body screw lock washer.

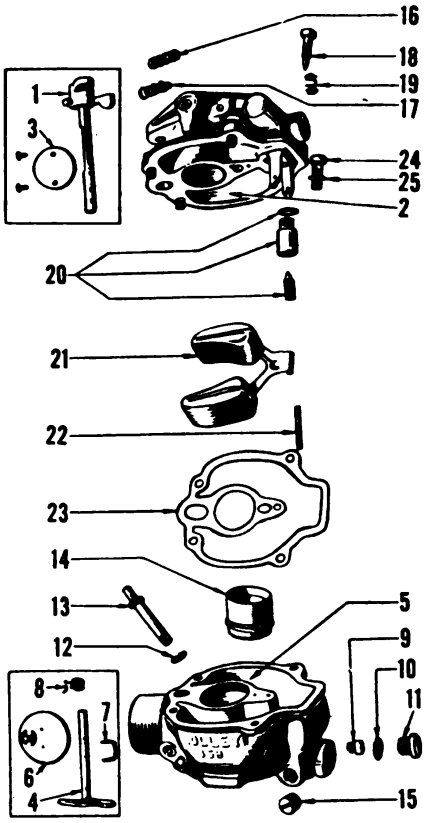


Figure 23. Exploded view of carburetor.

d. Remove the choke return spring (8, fig. 23), choke plate pin (7), and choke plate (6) from the choke shaft in lower carburetor body (5). Remove choke lever and shaft assembly (4). Remove the two throttle plate screws, and throttle plate (3) from the throttle shaft in the upper carburetor body (2). Remove the throttle lever and shaft assembly (1).

54. Inspection and Repair

a. CARBURETOR. Clean out the lower carburetor body passages and the main jet passage with compressed air. Be sure the body gasket is in good condition; otherwise replace the gasket. Check the float and lever assembly for distortion or injury that might impair its operation.

b. AIR CLEANER. Clean the element in waste crankcase oil, and allow the excess oil to drain.

Caution: Do not use gasoline to clean the air cleaner.

55. Reassembly and Installation

a. Place the throttle lever shaft (1, fig. 23) in position in upper carburetor body (2), and place throttle plate (3) on shaft. Line up holes in plate (3) with holes in lever and install two plate screws. Place choke lever and shaft assembly (4) in position in lower carburetor body (5). Position choke plate (6) on shaft (4) and install plate pin (7). Install choke return spring (8).

b. Install main jet (9, fig. 23), main jet plug gasket (10), main jet plug (11), main nozzle gasket (12), main nozzle (13), venturi (14), and drain plug (15) in lower carburetor body.

c. Install throttle stop screw spring (17, fig. 23), throttle stop screw (16), idle adjusting needle spring (19), idle adjusting needle (18), needle valve and seat assembly (20), float and lever assembly (21), and float axle (22) to the upper carburetor body.

d. Position carburetor body gasket (23, fig. 23) and upper body assembly on lower body, and secure with four washers (25) and screws (24).

e. Place a new gasket (1, fig. 22) on the carburetor, position the carburetor (2) to the bottom of the intake manifold, and secure with two cap screws (3), and lock washers. Connect the fuel filter line (4) to the carburetor (2). Position the governor rod and secure to car-

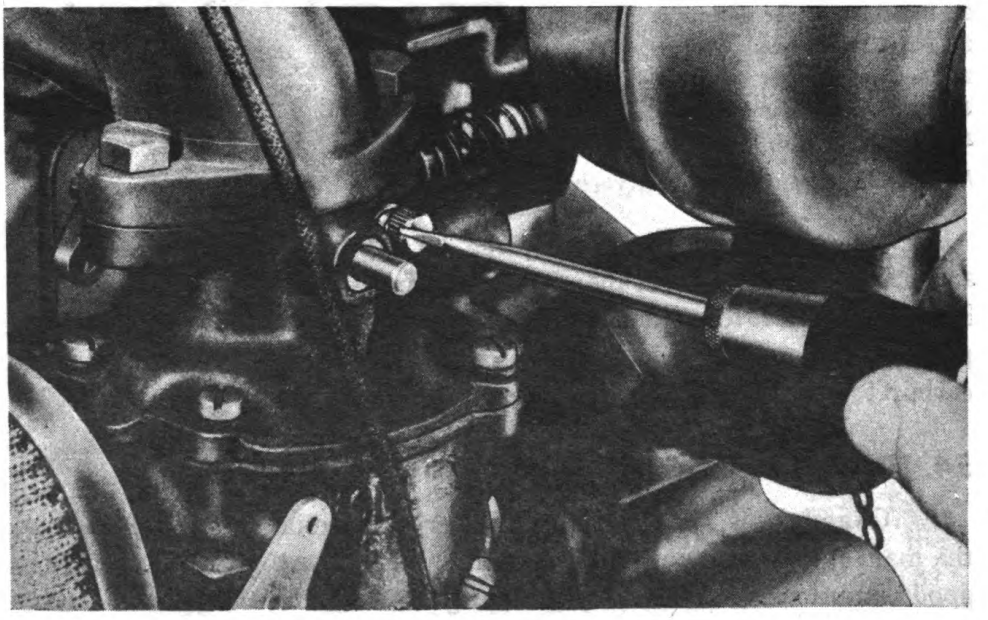


Figure 24. Carburetor idle adjustment.

buretor with a cotter pin. Position the air cleaner on the carburetor and secure it with a bolt through the band.

56. Adjustments

The strength of the idling mixture at a low idling speed is controlled by the idle adjusting needle. (See fig. 24.) Turn the needle counterclockwise to obtain a lean mixture, and clockwise to enrich it. The wide open or full-power characteristics of this carburetor are factory set, and do not require any adjustment.

APPENDIX I

STORAGE AND SHIPMENT

1. Limited Storage

(Thirty days or less.) See AR 850–15. Perform the following operations:

a. Inspection and Repair. Check for any damage to the equipment, and replace any parts that are damaged. Check to see that all tools, and the fire extinguisher, are in place in the tool box.

b. Cleaning and Painting. (1) Flush with clean fresh water to clean out any foreign substance which has collected. Empty the pump completely by removing the hose and the clean-out plate.

(2) Paint all areas where paint has deteriorated or has been removed during cleaning.

c. Complete Lubrication. Completely lubricate the equipment. (See fig. 7.)

d. Prescribed Processing. (1) Remove spark plug, and pour 2 ounces of AXS–934 (SAE 10) Oil, Engine Preservative into cylinder, rotate the engine five revolutions, coat threads of spark plug with the same oil, and replace.

(2) Do not drain crankcase. If there is any doubt about the suitability of the old oil, drain it, and refill the crankcase with the seasonable prescribed oil.

(3) Fill the fuel tank, allowing for expansion.

(4) Brush all exposed openings and machined surfaces, such as threads, etc., subject to rust, with AXS–673 or USA2–82, Compound, Rust Preventive.

(5) Crating of pump is unnecessary but tools and loose parts should be stored in a warehouse to prevent pilferage.

(6) Cover all openings with tape to prevent the entrance of foreign substances.

2. Dead Storage

(Over 30 days.) See TM 5–9715

3. Domestic Shipment

Shipping requirements make it necessary to drain the engine of fuel and lubricating oil before shipment by truck or rail. Wire a tag to some conspicuous part of the engine to indicate the necessity of not starting

the engine until the required amount and grade of oil is placed in the crankcase. After removing the muffler and truck handle, crate the pump, and wire the muffler, starting crank, and truck handle securely to the crate. Make certain that the tool box, located in the base assembly, cannot be shaken loose. To service the pump after receipt of equipment, see paragraph 9.

4. Export Shipment

See TB 5–9711–1.

APPENDIX II

LIST OF REFERENCES

ENG 9–2044, Engineers Supply Catalog (when published).
TM 5–9715, Preparation of Corps of Engineers Equipment for Storage.
TB5–9711–1, Corps of Engineers Equipment for Overseas Shipment.
AR 850–15, Motor Vehicles.

INDEX

✪ U. S. GOVERNMENT PRINTING OFFICE