

D101.111  
**TM 5-5167**

**DEPARTMENT OF THE ARMY TECHNICAL MANUAL**

**ENGINE  
GASOLINE**

706  
**HERCULES MODELS  
JXC AND JXD**

UNIVERSITY OF VIRGINIA LIBRARY



X004815887



*DEPARTMENT OF THE ARMY • MARCH 1954*



## **SAFETY PRECAUTIONS**

When starting a cold engine, do not run it up to governed speed immediately. Idle engine at 600 to 800 rpm until cooling solution reaches 150° F. This usually requires about five minutes. Then advance rpm to working speeds.

Always stop engine before filling fuel tank.

Before stopping the engine, allow it to idle for a few minutes. Then perform after-operation services.

Make sure engine is cool before adding cold water or other coolant to radiator.

Keep oil filter, air cleaner, fuel, and lubricating oil clean, as it will lengthen the life of the engine.

Never allow batteries to run low or dry of water as the plates will warp and ruin the battery.

Do not run engine at any time without lubricating oil and cooling solution or when the water or antifreeze solutions are boiling.

Do not run engine at high speed without load as this will cause undue wear and shorten the engine's life.

Keep fuel in tank at full level as air and moisture might get in the lines and cause the engine to stop.

Do not file or grind caps on connecting rods as new bearings cannot be installed in a rod that has been filed or ground.

Do not turn engine with starter unnecessarily. Use hand crank whenever possible as this saves the batteries.

When operating the unit in a closed area, vent the exhaust to the outside air and make certain that the unit is adequately ventilated.

When servicing the battery or refueling, do not smoke or allow open flame in the vicinity.

Never allow the engine to run without oil pressure showing on the gage, as damage from lack of lubrication will result.

Before starting the unit, be sure all personnel are away from parts of the engine that might cause personal injury.

Do not use emery cloth or paper to polish commutators. Use fine sand paper or a commutator stone.

When draining or refilling the cooling system, open the air vent. Use clean, soft water or permanent antifreeze. Allow room for coolant expansion when filling a cold engine. When adding coolant to a cold engine, run the engine at idling speed.

Do not put cold water in an overheated engine because it will crack the cylinder head or block.

Do not exceed the maximum permissible speeds in the lower gears as damage will result to the engine.

Remove all tools from the engine before starting as they might do harm both to the unit or to personnel.

After engine has reached operating temperature push the choke control in.

Disengage the clutch before starting the engine.

Avoid overloading the engine.

Do not add water to the batteries under freezing conditions unless the equipment will be run long enough to mix the solution adequately and keep the water from freezing within the battery.

Never operate engine unless it is properly lubricated according to LO 5-5167.

Never use emery cloth or metal surfaced stones to service commutators.

**ENGINE, GASOLINE, HERCULES MODELS JXC AND JXD**

	<i>Paragraph</i>	<i>Page</i>
<b>CHAPTER 1. INTRODUCTION</b>		
Section I. General.....	1-3	2-3
II. Description and data.....	4-5	3-18
<b>CHAPTER 2. OPERATING INSTRUCTIONS</b>		
Section I. Service upon receipt of equipment.....	6-7	19-25
II. Controls and instruments.....	8-10	25-30
III. Operation under usual conditions.....	11-13	30-34
IV. Operation under unusual conditions.....	14-20	34-38
<b>CHAPTER 3. MAINTENANCE INSTRUCTIONS</b>		
Section I. Special organizational tools and equipment.....	21, 22	39
II. Lubrication and painting.....	23-25	39-48
III. Preventive maintenance services.....	26-28	48-56
IV. Troubleshooting.....	29-40	56-65
V. Radio suppression system.....	41, 42	65-67
VI. Cylinder head and valves.....	43-48	67-73
VII. Cooling system.....	49-54	73-81
VIII. Electrical system.....	55-72	81-102
IX. Fuel and exhaust system.....	73-85	102-117
X. Lubrication system.....	86-92	117-124
XI. Fungus control system.....	93-94	125
XII. Fire extinguisher.....	95-98	125-128
<b>CHAPTER 4. FIELD AND DEPOT MAINTENANCE</b>		
Section I. Introduction.....	99, 100	129
II. Cooling system.....	101-123	129-141
III. Lubrication system.....	124-135	141-148
IV. Governor, fuel pump, and manifold.....	136-149	148-158
V. Carburetors.....	150-162	158-169
VI. Starting motor and distributor.....	163-173	169-183
VII. Generator and voltage regulator.....	174-183	183-197
VIII. Radio interference suppression system.....	184, 185	197-199
IX. Fungus control system.....	186, 187	199
X. Cylinder head and valve mechanism.....	188-198	199-204
XI. Timing gears and camshaft.....	199-218	204-213
XII. Cylinder, pistons, and connecting rods.....	219-227	214-221
XIII. Flywheel, main bearings, and crankshaft.....	228-244	221-234
XIV. Engineering information.....	245-247	235-247
<b>CHAPTER 5. SHIPMENT AND LIMITED STORAGE AND          DEMOLITION TO PREVENT ENEMY USE</b>		
Section I. Limited storage and shipment.....	248, 249	248-250
II. Demolition of the engines to prevent enemy use.....	250-253	250-252
<b>APPENDIX I. REFERENCES</b> .....		253
<b>II. IDENTIFICATION OF REPLACEABLE PARTS</b> .....		254-303
<b>III. ON-EQUIPMENT TOOLS</b> .....		304
<b>INDEX</b> .....		305

# CHAPTER 1

## INTRODUCTION

---

### Section I. GENERAL

#### 1. Scope

This manual is published for the information and use of the personnel to whom these engines are issued. It contains information on the operation, organizational maintenance, and field and depot maintenance of the engines as well as a description of the major units and their functions in relation to other components of the engines. It applies only to Hercules JXC and JXD engines.

#### 2. Appendixes

a. Appendix I contains a list of available published manuals and other official publications directly applicable to the care, use, and handling of the engines covered by this manual.

b. Appendix II contains a tabular list of replaceable parts for identification purposes only.

#### 3. Record and Report Forms

Maintenance record forms listed and briefly described below will be used in the maintenance of this equipment.

a. *DD Form 110, Vehicle and Equipment Operational Record.* This form is used by equipment operators for reporting the accomplishment of daily preventive maintenance services, and for reporting any equipment deficiencies observed during operation.

b. *DA Form No. 464, Work Sheet for Preventive Maintenance and Technical Inspection of Engineer Equipment.* This form is used by personnel of the using organization and higher echelons for reporting the results of preventive maintenance services and technical inspections.

c. *DA Form 460, Preventive Maintenance Roster.* This form is used for scheduling preventive maintenance services at proper intervals.

d. *DA Form No. 478, MWO and Major Unit Replacement Record—Organizational Equipment File.* This form is used to record major repairs or rebuilding, replacement of major unit assemblies, and equipment modifications.

*e. DD Form No. 6, Report of Damaged or Improper Shipment.* This form is used to report damage incurred in shipment.

*f. DA Form No. 9-81, Exchange Part or Unit Identification Tag.* This form is used to record direct exchange of unserviceable for serviceable parts.

*g. DA Form No. 811, Work Request and Job Order.* This form is used when it is necessary for an organization to have work done by higher echelon organizations.

*h. DA Form No. 867, Status of Modification Work Order.* This form is used to maintain a record of all modification work performed on the equipment.

*i. DA Form No. 468, Unsatisfactory Equipment Report.* This form is used for reporting manufacturing, design, or operational defects in the materiel, with a view to correcting such defects; it is also used for recommending modifications of the materiel. Form No. 468 is not used for reporting failures, isolated material defects, or malfunctions of materiel resulting from fair wear and tear or accidental damage. Form No. 468 is not used to report issue of parts and equipment, or for reporting replacements or repairs.

## Section II. DESCRIPTION AND DATA

### 4. Description

*a. General Information (figs. 1 and 2).* The JXC and JXD engines are six-cylinder, four-cycle, heavy-duty commercial type engines. They have in-line cylinders and L-heads. From the position of an observer facing the flywheel or clutch, the right hand side of the engine is the camshaft and manifold side. The left hand side is the distributor and water pump side, and is also where the oil filter is located. The front contains the timing gears. Flywheels and clutches are located at the rear of the engines. When reference is made in the manual to number 1 cylinder, or front main bearing, it is always the one nearest the timing gears, or front of the engine. Cylinders, connecting rods and bearings are always numbered from the timing gears back toward the flywheel or rear of the engine. References to "right" or "left" refer to a view of the engine from the rear. The engine, with flywheel, constitutes the unit power plant of the JXC and JXD engines discussed in this manual.

- (1) *Cylinder block and crankcase.* These are cast in one piece for efficient cooling by water-jacketing cylinders over the full length of the bore. The cylinder and crankcase assembly includes the following members: valve guides, valve tappet guides, camshaft bearings, idler shaft bearing, and main bearing caps and shells.

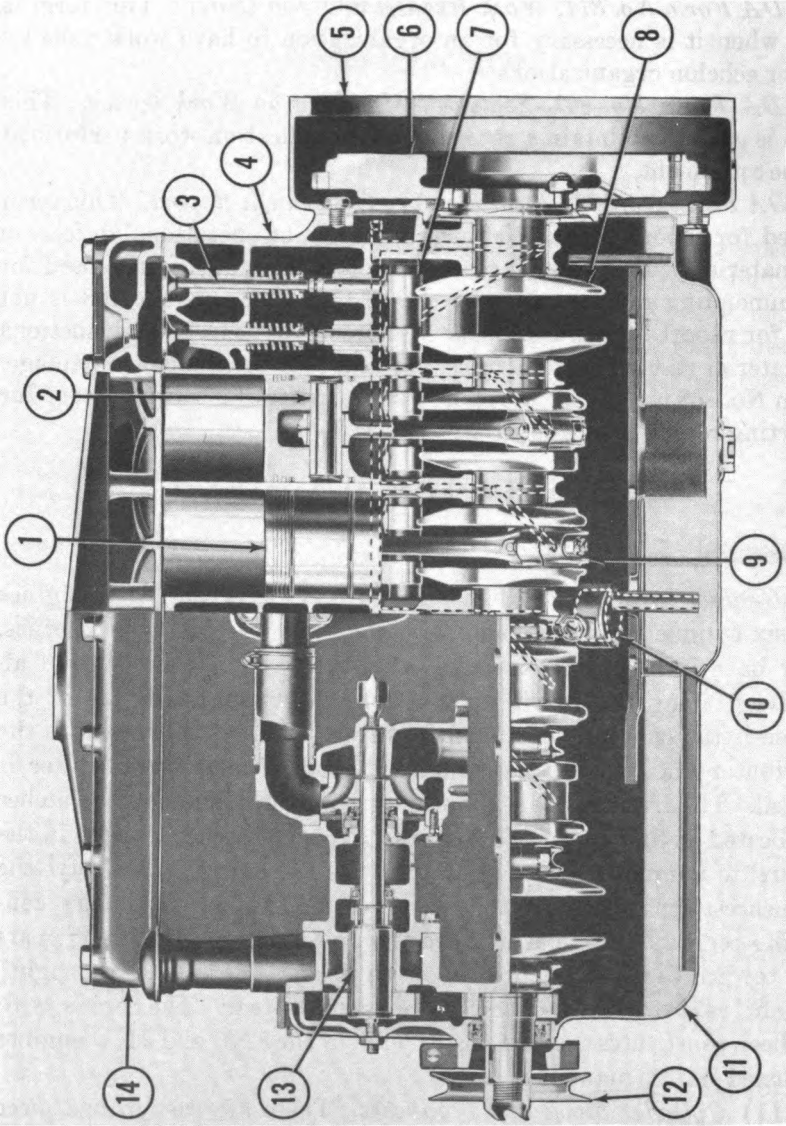
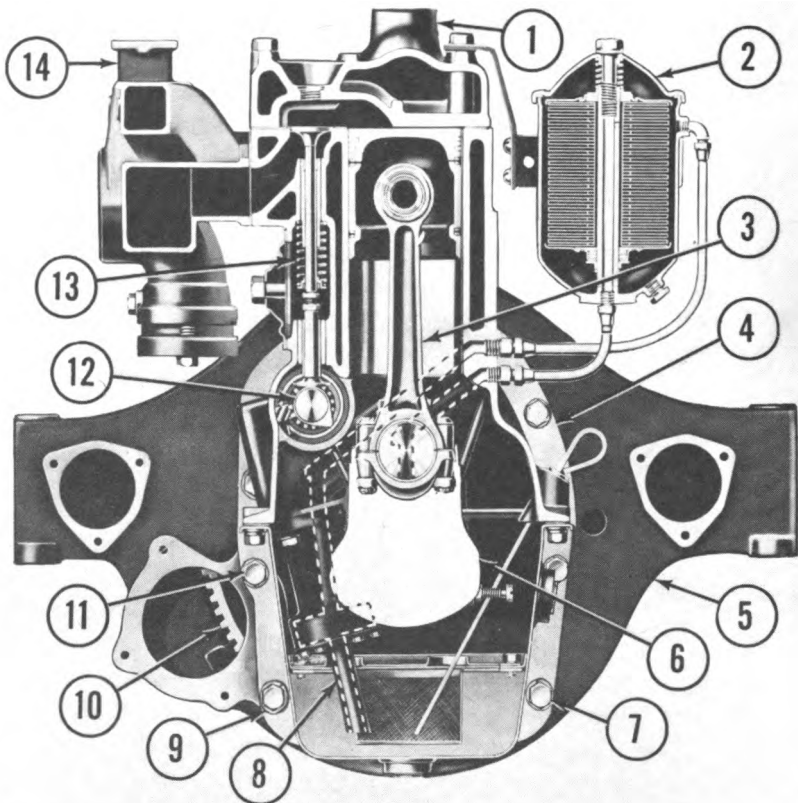


Figure 1. Hercules JX-series engines, cutaway view, left side.



- 1 Piston
- 2 Piston pin
- 3 Valve
- 4 Cylinder block
- 5 Bellhousing
- 6 Flywheel
- 7 Camshaft
- 8 Crankshaft
- 9 Connecting rod
- 10 Oil pump
- 11 Oil pan
- 12 Fan drive pulley
- 13 Water pump
- 14 Cylinder head

*Figure 1*—Continued



- |  |  |
|--|--|
| 1 Cylinder head                          | 8 Oil pump   |
| 2 Oil filter                             | 9 Lock washer, $\frac{1}{2}$ " SAE, (10 req'd).        |
| 3 Connecting rod                         | 10 Flywheel ring gear                                  |
| 4 Bellhousing gasket                     | 11 Screw, cap, $\frac{1}{2}$ "-13 NC x $\frac{7}{8}$ " |
| 5 Bellhousing                            | (7 req'd).   |
| 6 Crankshaft                             | 12 Camshaft—high lift                                  |
| 7 Screw, cap, $\frac{1}{2}$ "-13 NC x 1" | 13 Valve spring  |
| (3 req'd).                               | 14 Manifold  |

Figure 2. Hercules JX-series engines, front sectional view.

- (2) *Main bearings.* The use of seven main bearings in the engine permits placement of a main bearing on either side of each of the six connecting rods to eliminate vibration at high engine speeds.
- (3) *Cylinder head.* The cylinder head is completely water-jacketed. It is cast so that the major part of the combustion chamber space is located over the valves. It is a removable-type head, which facilitates carbon cleaning and valve grinding.
- (4) *Connecting rods and pistons.*
- (a) *JXC engine.* Bearings are the precision, or insert type. Pistons are cast iron,  $3\frac{3}{4}$  inches in diameter. Piston dis-

placement of the JXC engine is 282 cubic inches. Each piston has three compression rings and one oil control ring.

(b) *JXD engine.* Bearings are of the precision, or insert type, making it simpler to replace worn or damaged rod bearings. Pistons are aluminum T-slot type, 4 inches in diameter. Piston displacement of the JXD engine is 320 cubic inches. Each piston has three compression rings and one oil control ring.

(5) *Camshaft and idler gear.* The camshaft is supported on four bearings in the crankcase. In addition to actuating the valves, the camshaft also drives the generator, water pump, and fuel pump. An idler gear transfers drive from the camshaft on the right, to the water pump on the left side of the engines. Near the center of the camshaft a spiral gear is located. This meshes with the gear attached to the oil pump shaft and drives the oil pump.

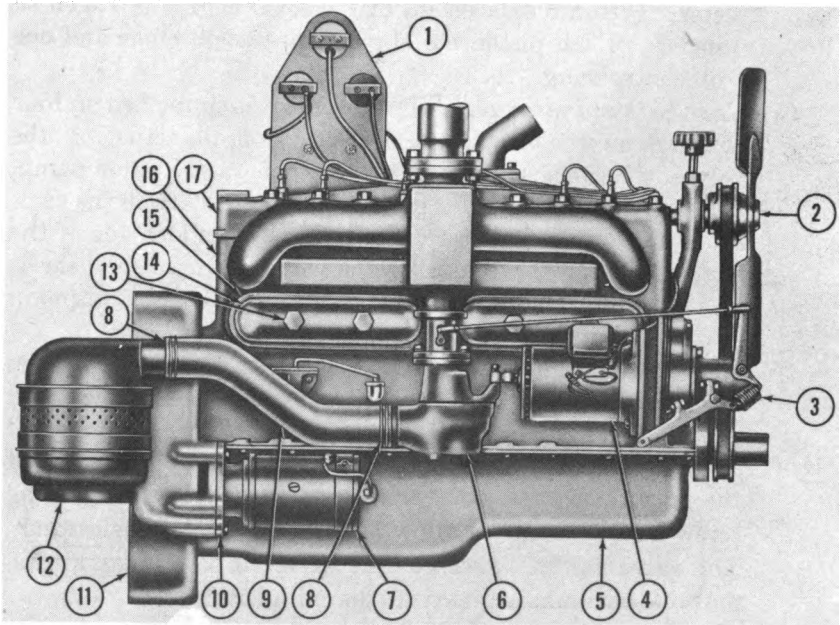
(6) *Valves.* The intake valve head is larger in diameter than the exhaust valve head, to increase engine efficiency and power. Both intake and exhaust valves are forged from steel alloyed especially to resist high heat. Valve tappets are of the mushroom type, and each is provided with an adjusting screw and lock nut to allow adjustment of valve clearance. The valve guides, as well as the valve tappet guides, are removable bushings pressed into the cylinder block.

(7) *Engine accessories.*

(a) *JXC engine* (figs. 3 and 4). Components and accessories of the JXC are mounted on the engine in the same way as the JXD, except that the fuel pump on the JXC is mounted on the right side of the engine crankcase above the starting motor. On both engines, the fan is mounted by a bracket which is bolted to the top of the timing gear cover. Flywheels and clutches of both engines are enclosed by the bellhousing which is bolted to the rear of the cylinder block and crankcase.

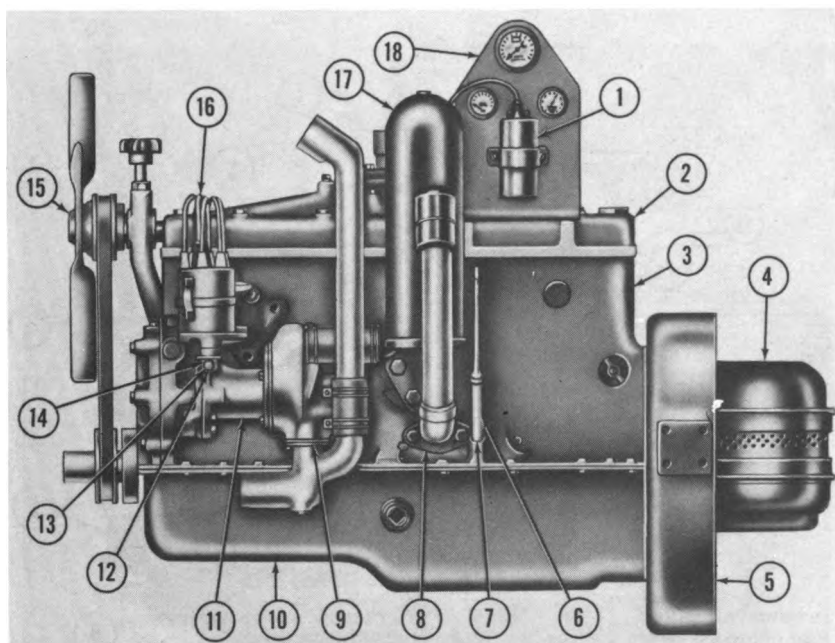
(b) *JXD engine* (figs. 5 and 6). Accessories on the JXD are mounted on the engine as follows—right side: governor, generator, manifold, carburetor, and starting motor; left side: water pump, distributor, oil filter, oil filler and breather tube, ignition coil, oil level gage, and fuel pump.

*b. Identification Information.* It is important to know the location of all nameplates, serial numbers or other plates and stampings on engines and accessories. They furnish valuable information to assist in proper care and maintenance of equipment, or to aid in securing the proper replacement part.



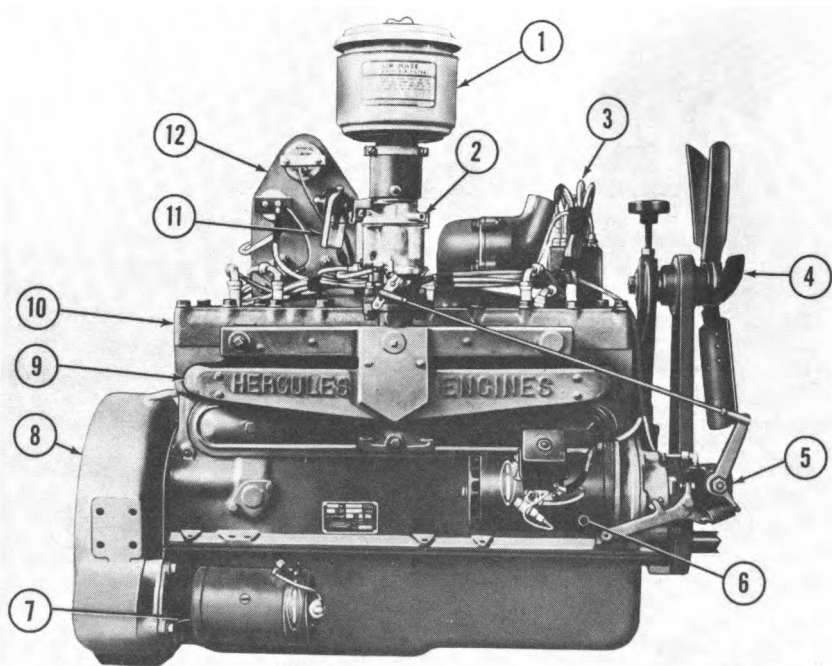
- |                      |                           |
|----------------------|---------------------------|
| 1 Instrument panel   | 10 Starting motor adapter |
| 2 Fan blade assembly | 11 Bellhousing            |
| 3 Governor           | 12 Air cleaner            |
| 4 Generator          | 13 Valve cover screw      |
| 5 Oil pan            | 14 Valve cover            |
| 6 Carburetor         | 15 Valve cover gasket     |
| 7 Starting motor     | 16 Cylinder block         |
| 8 Clamp              | 17 Cylinder head          |
| 9 Hose               |                           |

*Figure 3. JXC engine, right side view.*



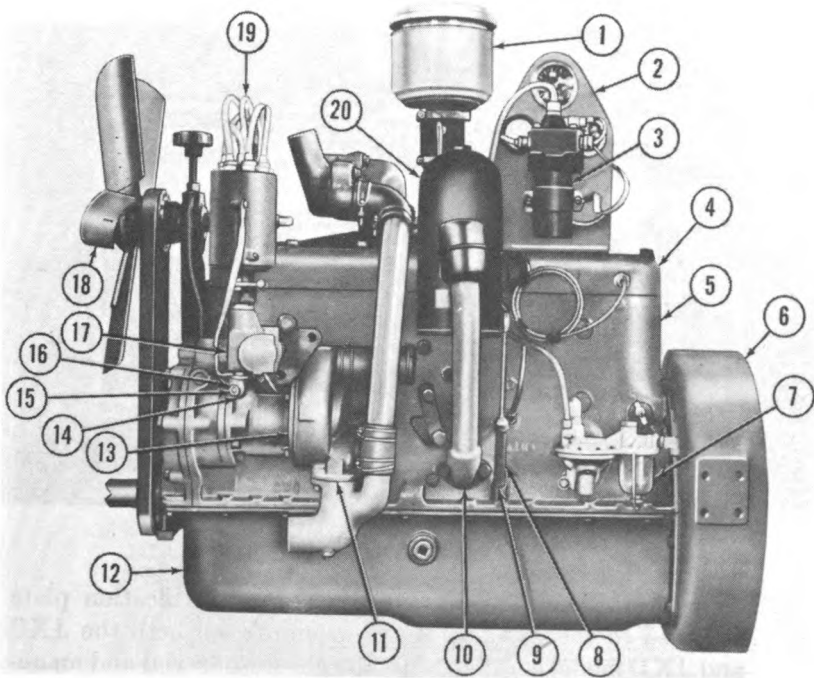
- |                                       |   |
|---------------------------------------|---|
| 1 Coil                                | 10 Oil pan  |
| 2 Cylinder head                       | 11 Water pump   |
| 3 Cylinder block                      | 12 Distributor attaching bracket                        |
| 4 Air cleaner                         | 13 Screw, cap, $\frac{3}{8}$ "-16 NC x $1\frac{3}{4}$ " |
| 5 Bellhousing                         | 14 Lockwasher, $\frac{3}{8}$ "                          |
| 6 Oil level gage tube                 | 15 Fan blade assembly                                   |
| 7 Oil level gage washer               | 16 Distributor  |
| 8 Oil filler and breather tube gasket | 17 Oil filter   |
| 9 Water inlet pipe gasket             | 18 Instrument panel                                     |

*Figure 4. JXC engine, left side view.*



- |                      |                     |
|----------------------|---------------------|
| 1 Air cleaner        | 7 Starting motor    |
| 2 Carburetor         | 8 Bellhousing       |
| 3 Distributor        | 9 Manifold          |
| 4 Fan blade assembly | 10 Cylinder head    |
| 5 Governor           | 11 Fuel filter      |
| 6 Generator          | 12 Instrument panel |

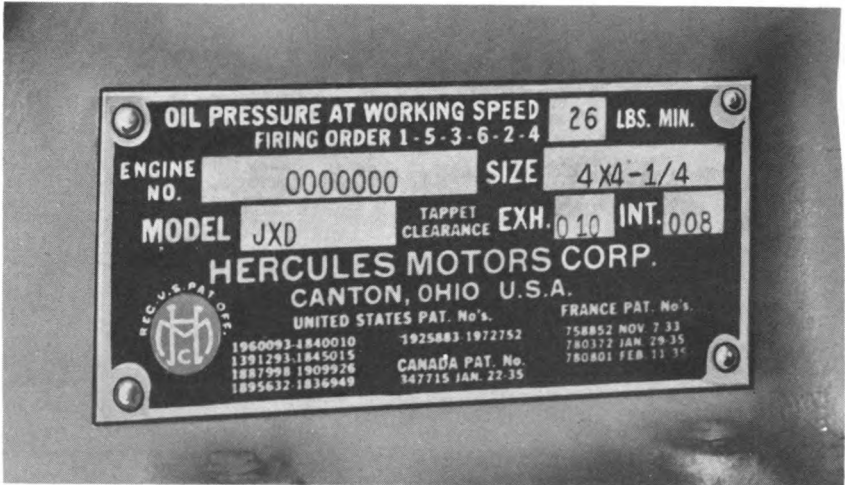
*Figure 5. JXD engine, right side view.*



- |   |   |
|---|---|
| 1 Air cleaner                           | 11 Water inlet pipe gasket                              |
| 2 Instrument panel                      | 12 Oil pan  |
| 3 Coil                                  | 13 Water pump   |
| 4 Cylinder head                         | 14 Distributor attaching bracket                        |
| 5 Cylinder block                        | 15 Screw, cap, $\frac{3}{8}$ "-16 NC x $1\frac{1}{4}$ " |
| 6 Bellhousing                           | 16 Lockwasher, $\frac{3}{8}$ "                          |
| 7 Fuel pump                             | 17 Hour meter   |
| 8 Oil level gage tube                   | 18 Fan blade assembly                                   |
| 9 Oil level gage washer                 | 19 Distributor  |
| 10 Oil filter and breather pipe gasket. | 20 Oil filter   |

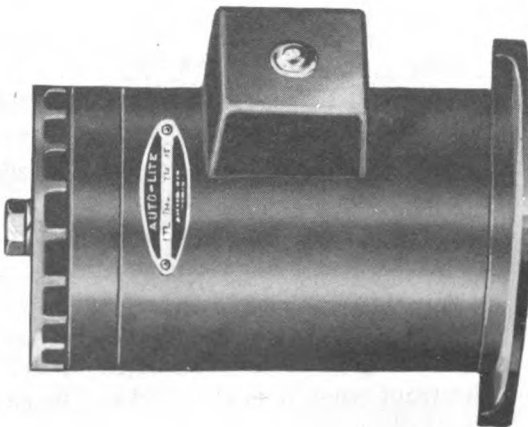
*Figure 6. JXD engine, left side view.*

- (1) *Engine identification* (fig. 7). The manufacturer's nameplate on JX-series engines is located on the right, or manifold side of the engine at the base of the crankcase near the center. The nameplate gives such basic information as recommended oil pressure at normal working speed. Other data given on the engine nameplate include the model designation, size (bore and stroke), and tappet clearance.



*Figure 7. Manufacturer's nameplate—engine.*

- (2) *Generator identification* (fig. 8). The identification plate attached to the housing of the generator on both the JXC and JXD model engines, bears the generator serial and manufacturer's part numbers.



*Figure 8. Generator identification.*



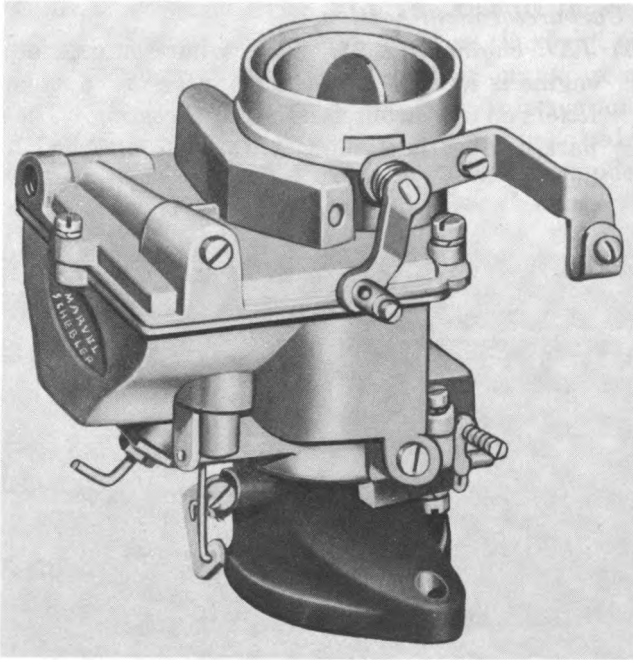
(3) *Carburetor identification.*

- (a) *JXC engine* (fig. 9). The carburetor used on the JXC engine is identified by the manufacturer's name in raised letters on the carburetor fuel bowl casting. The serial and part number is stamped on a plate attached to the carburetor.

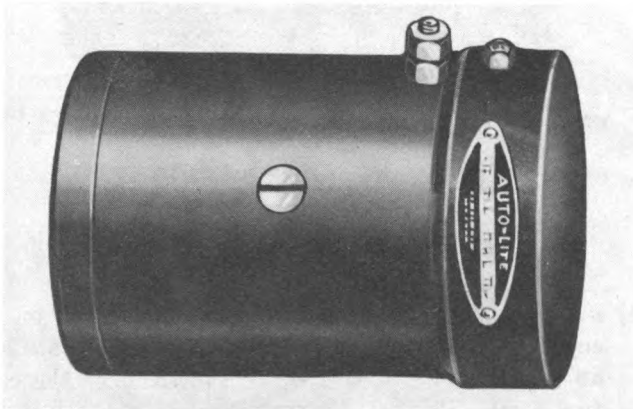


*Figure 9. Carburetor identification, JXC engine.*

- (b) *JXD engine* (fig. 10). The carburetor used on the JXD engine is identified by a decalcomania or plate located in an oval-shaped depression on the front of the carburetor fuel bowl. The decal gives the name of the manufacturer, serial and part number of the carburetor.
- (4) *Starter identification* (fig. 11). A manufacturer's nameplate is attached to the commutator cover band, and gives the starter serial and part number.
- (5) *Distributor identification* (fig. 12). The manufacturer's nameplate is attached to the base of the distributor, facing toward the front when it is mounted on the engine. When the distributor is equipped with radio suppression shielding, the nameplate will be inclosed in a housing.

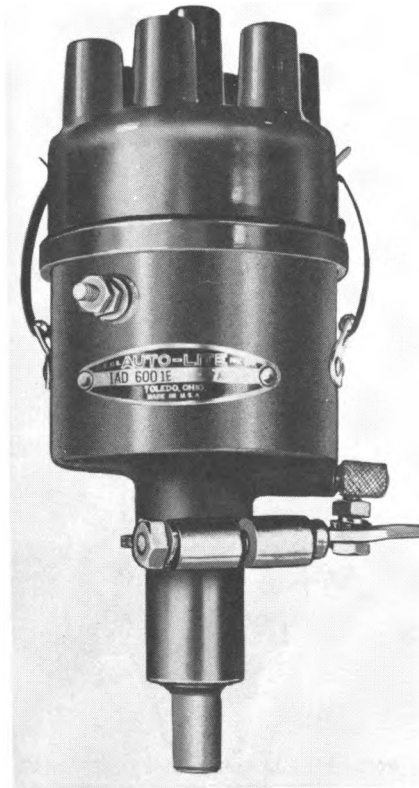


**Figure 10. Carburetor identification, JXD engine.**

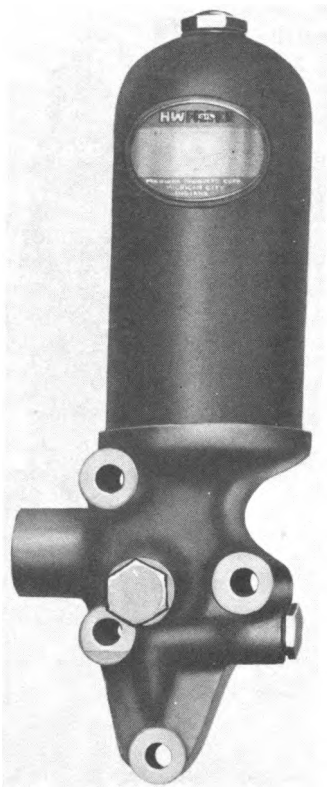


**Figure 11. Starting motor identification.**

- (6) *Oil filter identification* (fig. 13). An instruction decalcomania appears on the shell, near the top of the oil filter used on JXC and JXD engines. The decal carries complete servicing information for maintenance of the filter.
- (7) *Fuel pump identification* (fig. 14). Fuel pumps used on JXC and JXD engines are identified by the name in raised letters on the fuel pump cover casting. The part number is



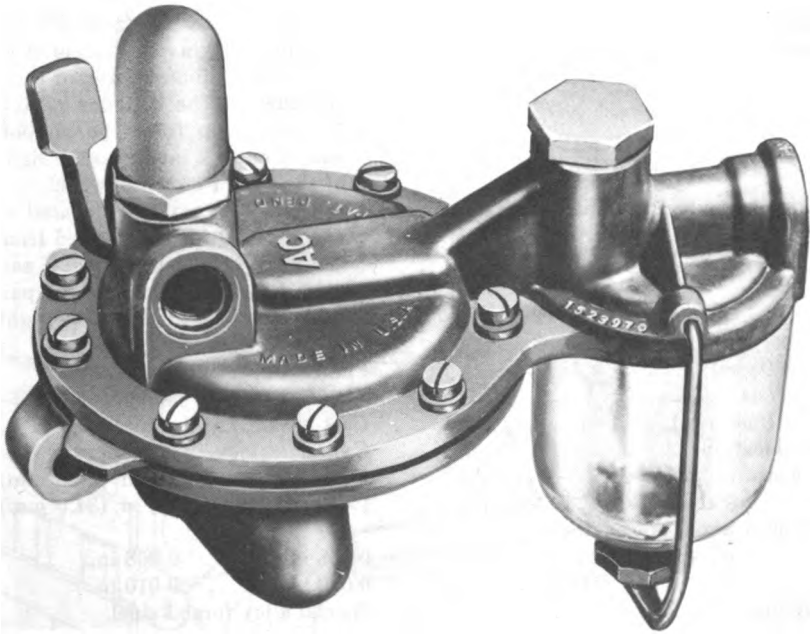
**Figure 12. Distributor identification.**



*Figure 13. Oil filter identification.*

stamped in the metal on the rim of the cover over the sediment bowl.

*c. Differences in Models.* The JXC and JXD engines are basically alike in design and engineering. The JXD is a larger and more powerful engine than the JXC. There are also differences in the part numbers of the various accessories. Instructions in this manual cover both engines. Where differences in parts must be noted for proper operation and maintenance of the engines, separate paragraphs cover each engine individually.



*Figure 14. Fuel pump identification.*



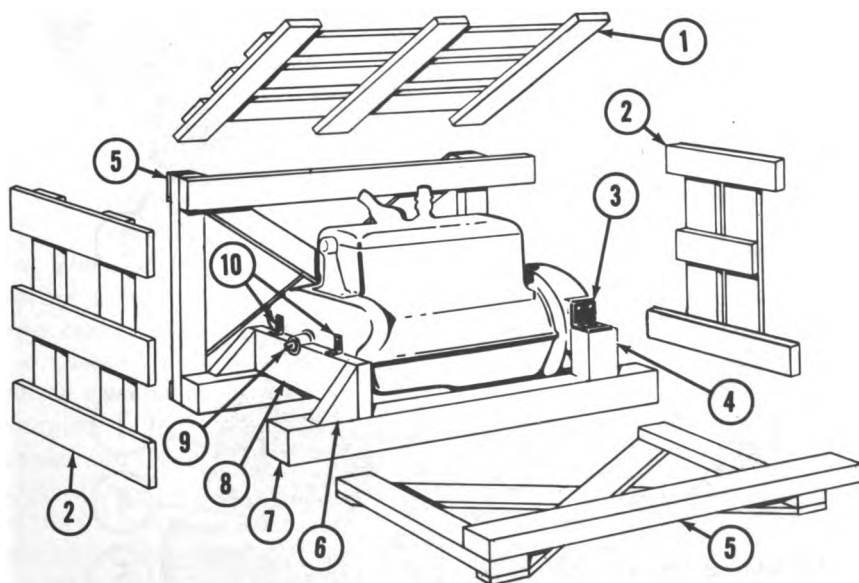
## CHAPTER 2

### OPERATING INSTRUCTIONS

#### Section I. SERVICE UPON RECEIPT OF EQUIPMENT

##### 6. New Equipment

a. *General* (fig. 15). Engines are received crated and stripped, although some of the accessories are packed within the crate (see *d* below).



1 Top  
2 Ends  
3 Angle iron  
4 4 x 4 blocks  
5 Sides

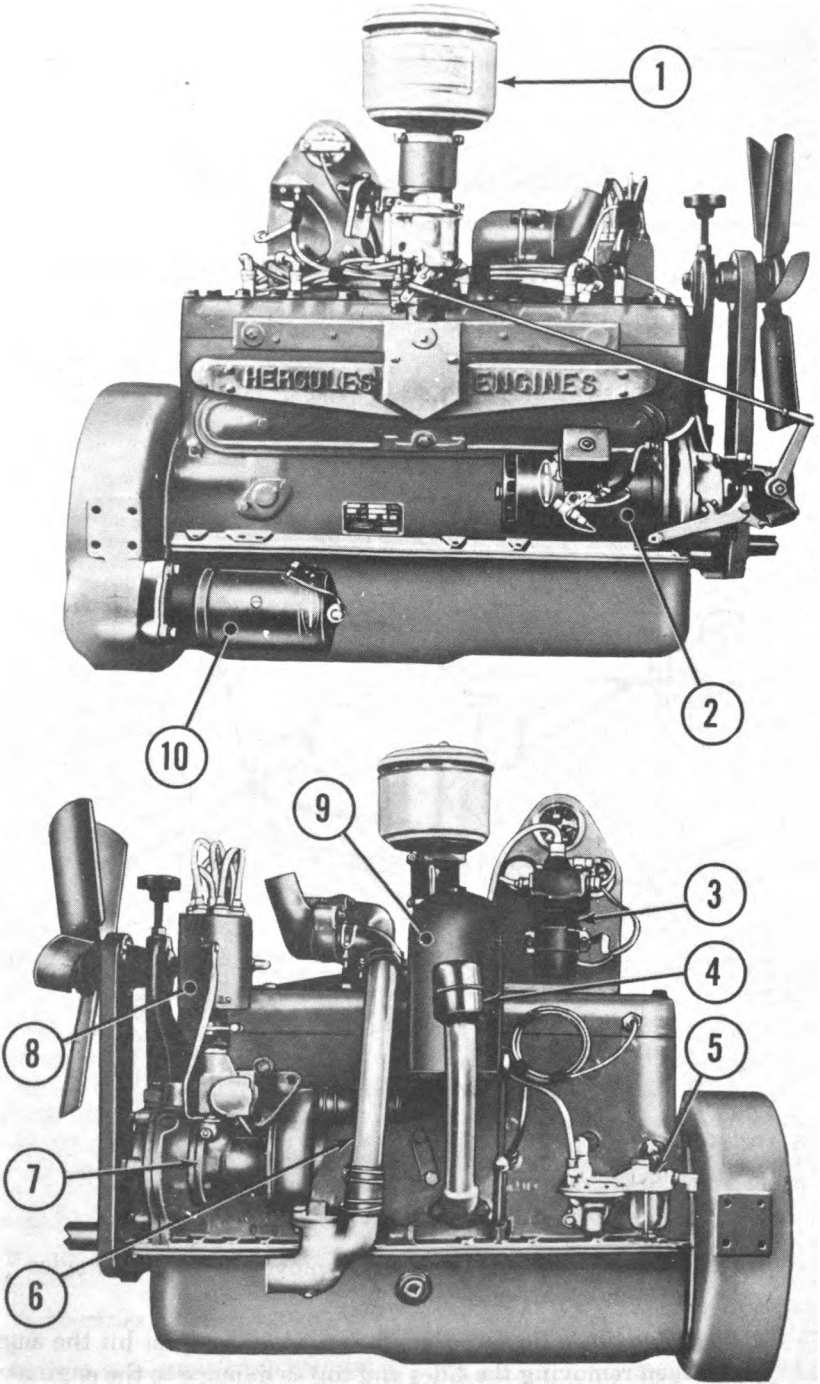
6 Supporting chocks  
7 4 x 4 timber  
8 2 x 6 plank  
9 Channel 2 x 2 in center  
10 Motor supports

Figure 15. Uncrating engine.

- (1) Using a crowbar, carefully remove the top (1), sides (5), and ends (2) of the crate.

**Caution:** Be sure that the crowbar does not hit the engine when removing the sides and top as damage to the engine will result.

- (2) Remove any accessories that are packed within the crate.



**Figure 16. Location of preservative compounds.**



(3) Remove the motor supports (10) and angle iron (3) that secures the engine to the plank (8) and blocks (4).

(4) With a hoist, raise the engine from the bottom of the crate.

*b. Removal of Preservative Compounds, Lubricants and Devices* (fig. 16). If engines have been stored for prolonged periods of time, or exposed to weather during shipment, dust, dirt and perhaps some water streaks and rust will be present. If this condition exists, the engine should be cleaned as follows:

(1) With cloth or waste dipped in cleaning solvent, wipe dirt, streaks, or rust from generator (2), air cleaner (1), ignition coil (3), starting motor (10), fuel pump (5), oil filler and crankcase breather tube (4), oil filter (9), water pump (7), ignition distributor (8), and water bypass tube (6).

(2) Use compressed air to blow dirt from spark plug wells and from cylinder block and crankcase. If compressed air is not available, use a long narrow brush that will reach behind accessories to the engine block.

(3) After dirt accumulations have been brushed or blown off, wipe down the cylinder head, crankcase, and block with cloth or waste dipped in cleaning solvent.

(4) Where the metal has been scored or dented, prevent further rusting by touching up the scratched spot with enamel or varnish.

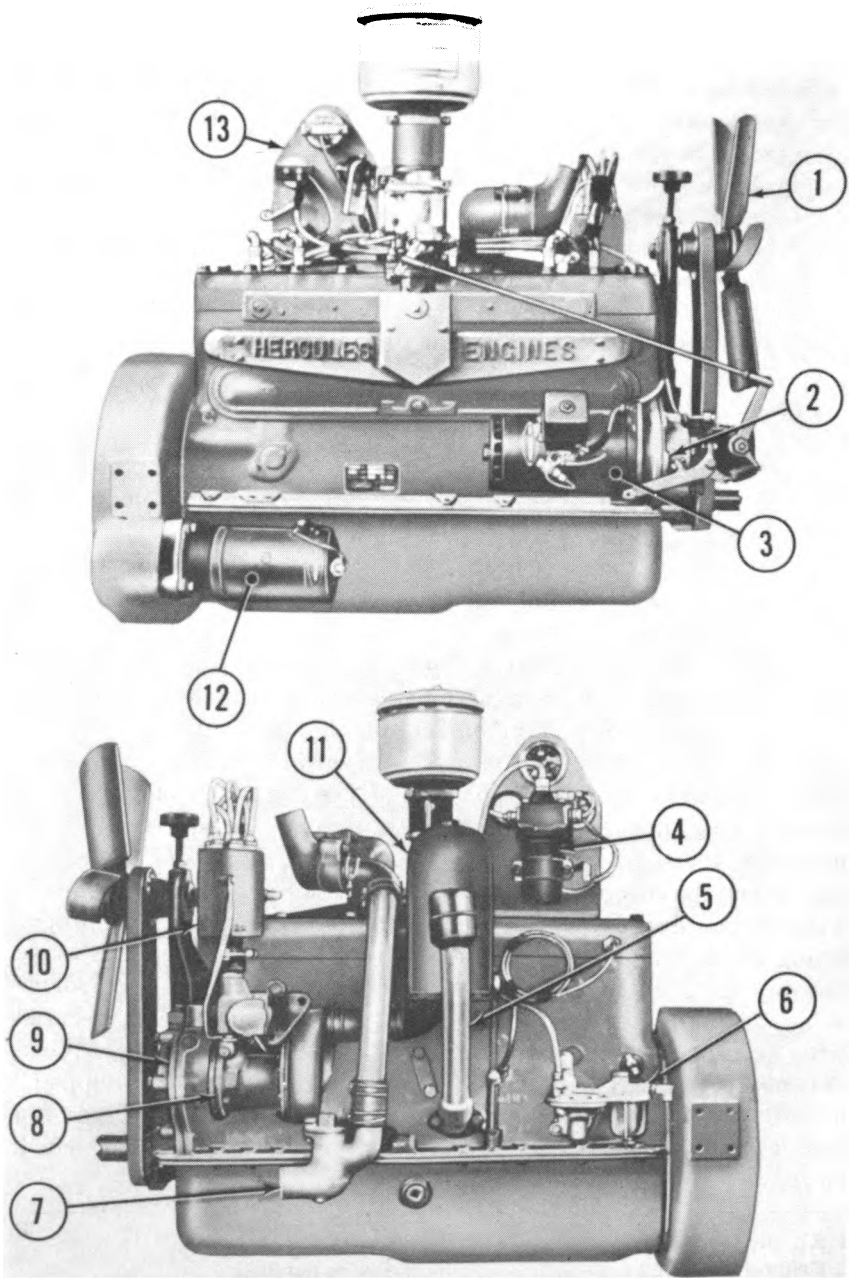
*c. Damage Inspection Points* (fig. 17). Carefully inspect the following accessories and assemblies to determine whether these have been cracked, bent, dented, or broken during shipment.

*d. Assembly of Items Removed for Shipment* (fig. 18). When engineer equipment containing JXC or JXD engines is shipped as a complete unit, none of the accessories, controls or linkages are removed and there is no reassembly procedure. Crated JXC and JXD engines may be shipped with accessories installed, with the exception of the oil pan drain pipe (6), which must be removed to allow proper crating of the engine. Items such as the air cleaner (1), fan blade assembly (2), fan belt (3), governor connecting rod (4), fan drive pulley (5), and oil pan drain pipe (6), may be removed and secured inside crate, or shipped separately if this facilitates crating. When JXC or JXD engines are shipped without accessories, or "stripped," the following items are not usually supplied with the engines: fan blade assembly, governor, generator, starting motor, instrument panel, ignition coil, fuel pump, and ignition distributor.

---

1 Air cleaner	6 Water bypass tube
2 Generator	7 Water pump
3 Ignition coil	8 Ignition distributor
4 Oil filler and breather tube	9 Oil filter
5 Fuel pump	10 Starting motor

*Figure 16—Continued*



*Figure 17.—Damage inspection points.*

*e. Lubrication and Service.* New engines are set up and run-in at the factory, and a dynamometer horsepower test made before engines are shipped. Therefore, cylinder walls, pistons and bearings are coated with a film of oil. No before-installation lubrication service is required on the basic engine, but since the factory run-in is performed without power consuming accessories attached to the engine, these will be inspected and serviced as follows:

- (1) Remove oil plug on fan hub with screwdriver. If oil is not visible in the plug hole, lubricate (par. 24*h*).
- (2) Lubricate the generator (par. 24*i*).
- (3) Service the air cleaner (par. 24*j*).
- (4) Lubricate the distributor (par. 24*a*).

*f. Breaking In New Equipment.* Before starting a new engine make a thorough inspection to be sure the following preparations have been made:

- (1) Proper lubrication is essential. Make sure the oil in the crankcase is of the proper grade and weight. Refer to LO 5-5167. See that the crankcase is filled to the proper level.
- (2) Inspect radiator, hoses, clamps, and connections to be sure there are no leaks.
- (3) Avoid putting hard or alkaline water in the radiator if possible. If only hard water is available in the area in which the engine is operated, mineral "scale" will collect in the water passages. When this causes engine overheating, the cooling system must be flushed and cleaned (par. 51).
- (4) It is particularly important, when breaking in new engines, that fuel be clean. Fuel containing sediment, sand, or lint will quickly render the fuel system inoperative.
- (5) Make certain the air cleaner on the carburetor is filled to the proper level with oil (par. 24*j*). Be sure that the air filtering unit inside the oil filler tube cap has been dipped in oil (par. 24*e*). When these preparations are made, the new engine may be started (par. 12*b*).

**Caution:** Before applying load, idle the engine about fifteen minutes so that lubricating oil may reach all bearing surfaces.

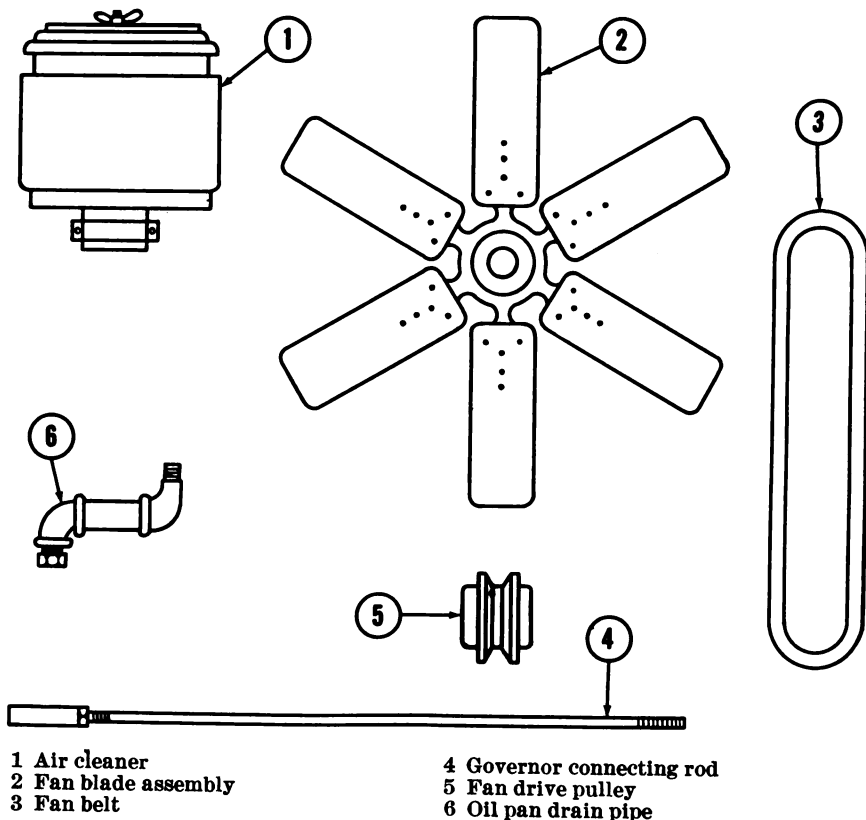
---

1 Fan blade assembly	8 Water pump
2 Governor	9 Gear cover
3 Generator	10 Ignition distributor
4 Ignition coil	11 Oil filter
5 Oil breather and filler tube	12 Starting motor
6 Fuel pump and sediment bowl	13 Instrument panel
7 Water inlet pipe and bypass tube	

Figure 17—Continued

*g. After-Starting Services.*

- (1) Add one pint of light cylinder oil to every five gallons of gasoline for the first 50 hours of engine operation.
- (2) Check engine daily before shutting down for any water leaks which may have developed. Tighten connections as necessary to stop the leaks.



*Figure 18. Items removed for shipment.*

- (3) Tighten all cylinder head bolts while engine is hot (par. 43*b*).
- (4) Watch oil pressure gage closely the first few days of engine operation. If gage registers pressure below 26 pounds at 1,600 rpm, or above 45 pounds at normal operating speed with engine hot, shut down until cause is determined and corrected.

## 7. Used equipment

*a. Damage Inspection Points.* Make the same inspection as described in paragraph 6*c*.

*b. Breaking In Used Equipment.* If engine has not been recondi-

tioned, it requires no break-in. Reconditioned engines are to be inspected and serviced the same as new engines (par. 6).

## Section II. CONTROLS AND INSTRUMENTS

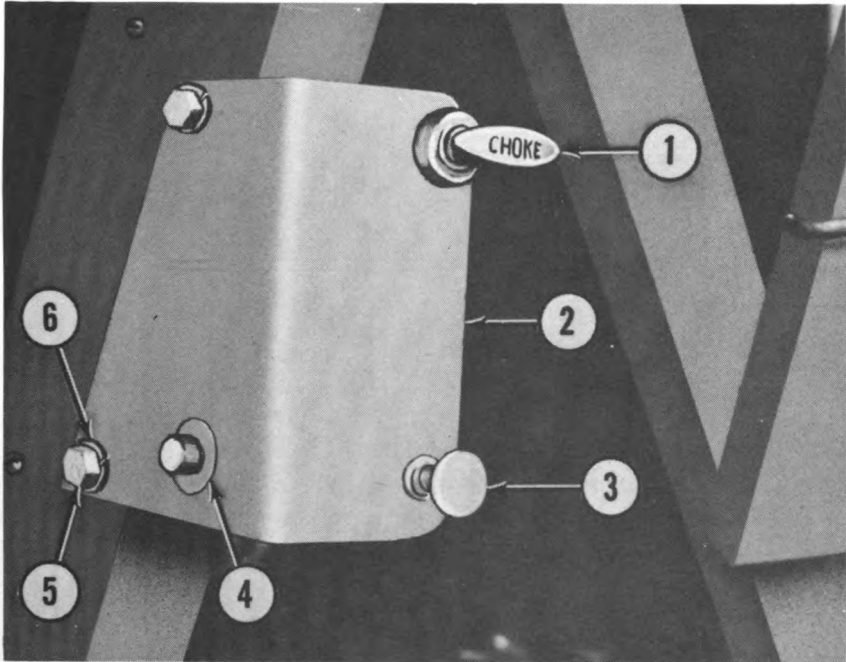
### 8. General

This section describes, locates, illustrates, and furnishes the operator information on the controls and instruments of the JXC and the JXD engines. These controls and instruments may be mounted on a panel or a bracket depending upon the equipment which is driven by the engine.

### 9. Controls

*a. Ignition Switch.* The ignition switch (3, fig. 19) is in the OFF position when the button is pushed in. Pulling the button out turns the ignition on.

*b. Starting Switch.* The starting switch (4, fig. 19) for both the JXC and the JXD engine is pushed in to energize the starting motor for cranking the engine. A spring under the button returns it to the OFF position automatically when pressure on the button is released.



- |                   |  |
|-------------------|--|
| 1 Choke           | 4 Starting switch                            |
| 2 Bracket         | 5 Bolt, $\frac{3}{8}$ "-16 NC x 1" (2 req'd) |
| 3 Ignition switch | 6 Lockwasher, $\frac{3}{8}$ " (2 req'd)      |

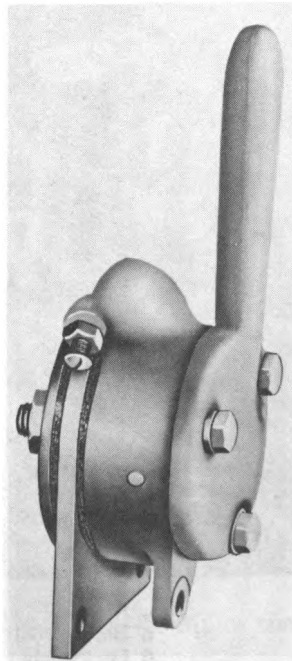
Figure 19. Engine controls.

*c. Choke.* The choke (1, fig. 19) for both the JXC and the JXD engine is pulled out to close the carburetor choke valve and enrich the combustion mixture going into the engine. It is not usually necessary to use the choke when starting the engine, except in cold weather.

*d. Throttle Control.*

- (1) *JXC engine.* The cable-type throttle control used on some JXC engines is mounted on the control bracket, underneath the choke. Pulling the throttle control button out opens the carburetor throttle valve and accelerates the engine. After the engine has reached operating temperature, the throttle control button is pushed in slowly until engine reaches governed speed.
- (2) *JXD engine* (fig. 20). The throttle control on the JXD engine consists of a hand lever attached to a frame member of the cab. The hand lever is connected to the governor lever arm by steel control rods. Pulling the hand lever all the way back slows the engine to idling speed. After the engine has warmed up properly for operation, the hand lever throttle control is eased forward slowly until engine reaches governed speed.

*e. Governor.* Governors are standard equipment on both the JXC and JXD engines. The governor is located at the lower right front of the engine, attached to the timing gear cover, and is driven by a gear



*Figure 20. Throttle lever for JXD engine.*

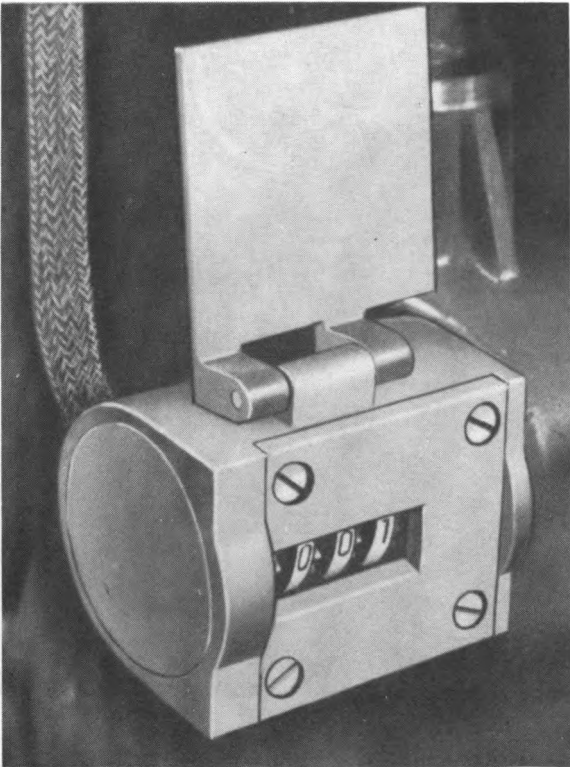
which meshes with the camshaft gear. The governor automatically maintains a constant engine speed under varying loads.

The governor operates on the principle of centrifugal weights, or "flyballs." Force developed by these revolving weights is opposed or balanced by a spring called the operation spring. The operation spring provides the proper tension on the throttle lever which regulates the carburetor setting. The governor is linked by a rod from the throttle lever to the carburetor throttle arm.

Governors are usually set for a specified maximum engine speed at the factory. Should the governor surge (irregular speeding up or slowing down—sometimes called "hunting"), the factory setting may be adjusted within certain limits.

## 10. Instruments

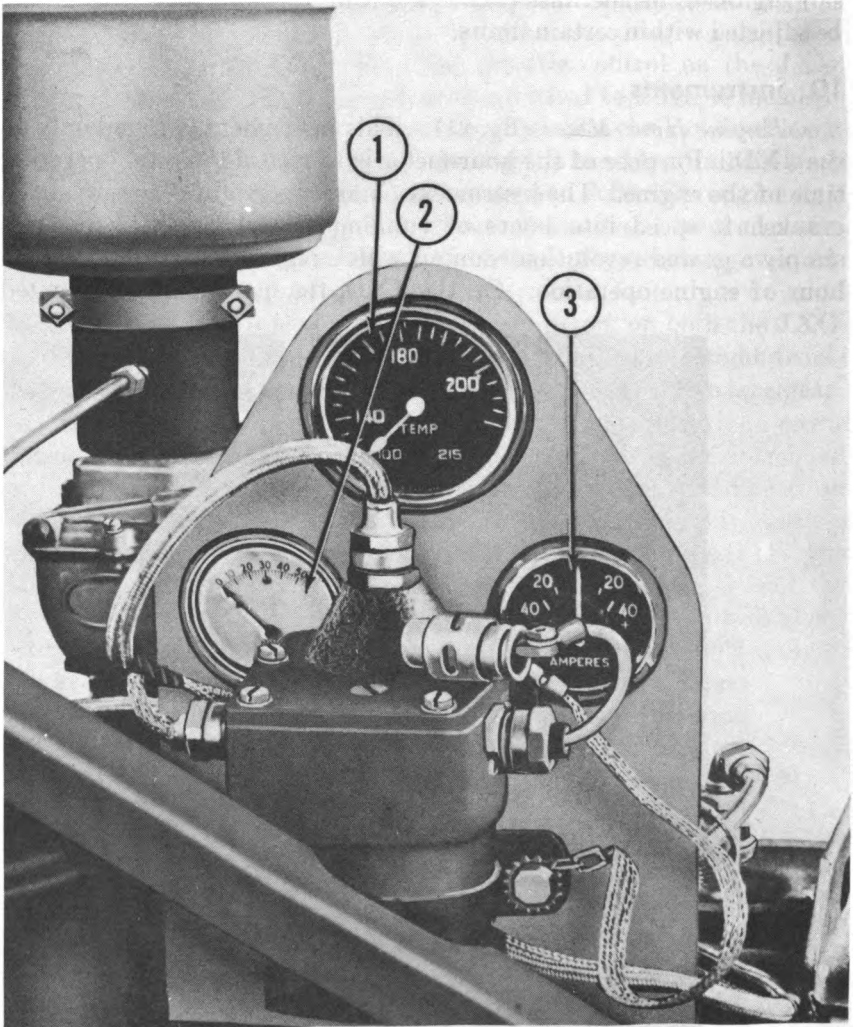
*a. Engine Hour-Meter* (fig. 21). This instrument is found only on the JXD. Purpose of the hour-meter is to record the total operating time of the engine. The instrument obtains its reading by converting crankshaft speed into hours of running time. The hour-meter is simply a geared revolution counter, which registers one unit for each hour of engine operation. On the JXD, the hour-meter is mounted



*Figure 21. Engine hour-meter.*

beneath the distributor on the left front side of the engine. It is driven by the water pump, and imparts this drive on to the distributor, which is mounted to the upper adapter of the hour-meter.

b. *Temperature Gage* (fig. 22). JXC and JXD engines have temperature gages of the vapor pressure type mounted on a panel in a group with other engine instruments. The temperature gage (1) is located at top center of this panel. This gage registers temperature of the coolant in the engine block. The normal temperature reading for JXC and JXD engines is between 150° and 180° F. Readings above or below this range indicate trouble in the cooling system, and



- 1 Temperature gage
- 2 Oil pressure gage

- 3 Ammeter

*Figure 22. Instrument panel.*



the engine should be shut down until the cause is determined and corrected. If the pointer movement is erratic, or if there is no reading when the engine is operating, the temperature gage should be replaced. If off-calibration is suspected, it may be checked by removing the bulb from the engine block and dipping it in hot water of a known temperature. If the pointer does not register approximately the same temperature, the complete instrument should be replaced.

*c. Oil Pressure Gage* (fig. 22). Electrical resistance type oil pressure gages are used on the JXC and JXD engines. The oil pressure gage (2) is located under and to the left of the temperature gage in the instrument group. Purpose of the oil pressure gage is to register in pounds per square inch the pressure at which oil is being forced through the engine by the oil pump. On the JXC and JXD engines, the normal range of the oil pressure reading should be between 26 and 40 psi when the engine is operating at maximum governed speed. If oil pressure should fall below 26 psi the engine should be stopped immediately, and the cause determined and corrected before the engine is put back in operation. Pressure above 40 psi while the engine is cold merely means that the oil is thick. The gage reading should return to normal when the engine is properly warmed. Overpressure while the engine is hot probably signifies an obstructed oil line, and the engine should be stopped until the fault is located and corrected.

*d. Ammeter* (fig. 22). JXC and JXD ammeters (3) are mounted on the instrument panel. The function of the ammeter is to indicate the performance of the generator circuit. If the ammeter pointer shows a charge (+) or positive flow of current, the electrical load is less than the generator output, and power is being stored in the battery. If the pointer shows a discharge (-) or negative flow, the current load is greater than the generator output, and battery energy is slowly dropping.

- (1) Under normal conditions, the voltage regulator on the generator automatically governs the generator output in accordance with the state of battery charge and the electrical requirements of the vehicle.
- (2) A continuing high ammeter reading when the battery is fully charged indicates that the generator field coil is grounded, either in the generator, or in the wiring harness. A low battery and a low or negative ammeter reading indicates loose or dirty circuit connections, oxidized or dirty control unit contact points, cut-out relay not operating, a brush holding off the commutator, or too large an electrical accessory load. Pointer oscillation or "jumping" back and forth over the dial zero mark does not indicate trouble in the electrical system. This merely means that the battery is fully charged, its voltage being equal to the voltage setting of the generator control unit.

*e. Oil Level Gage* (fig. 23). The level of oil in the crankcase of the JXC and JXD engines is measured by a crankcase oil level gage. This gage is located at the lower left side of the engine beside the oil filler and breather tube. The blade of the gage extends into the oil pan, and the amount of oil in the oil pan is indicated by marks on the blade. Depth of the oil should be maintained at or near the 4/4 mark on the blade.

### **Section III. OPERATION UNDER USUAL CONDITIONS**

#### **11. General**

*a.* The instructions in this section are published for the information and guidance of the personnel responsible for the operation of the JXC and JXD engines.

*b.* It is essential that the operator know how to obtain the performance of which the engine is capable. This section gives instructions on starting and stopping the engine. This section also contains instructions on protecting the engine while the equipment in which it is installed is being moved to a new location.

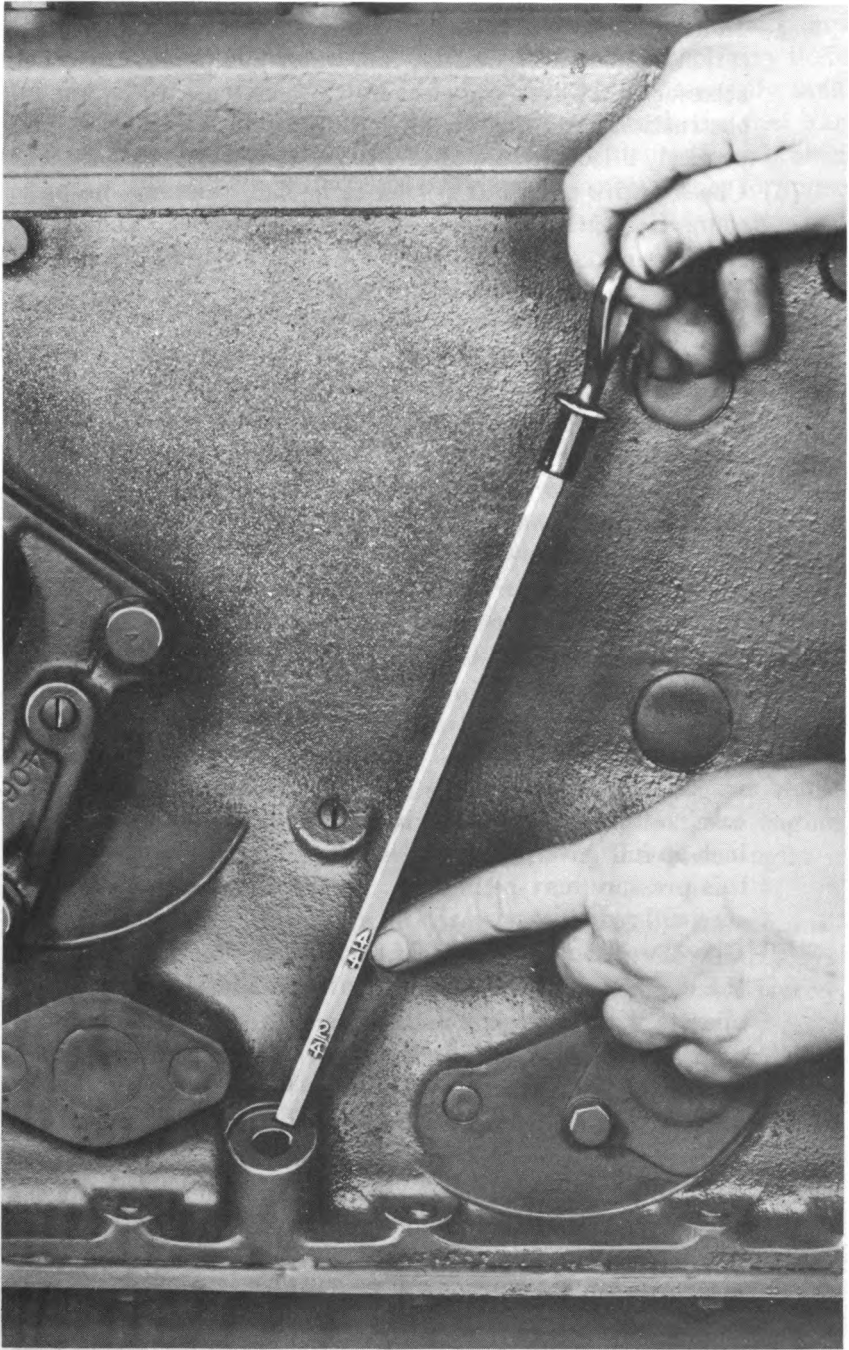
#### **12. Starting and Stopping**

*a. Correct Starting Procedures.* Under normal conditions, and if the engine has been operated recently, perform the following steps:

- (1) Check fuel supply.
- (2) Check lubricating oil in engine base with oil level gage. Be sure oil is at the 4/4 or full mark on the gage.
- (3) Check cooling solution.
- (4) Inspect installation to see that all is in good order and tight. No loose tools, bars, or parts should be lying on engine.
- (5) Start engine by operating starter switch after turning ignition ON.

*b. Starting New or Stored Engine.* If the engine is being started for the first time, or after a long shut-down period, follow this procedure:

- (1) Fill the fuel tank with suitable fuel.
- (2) Fill cooling system with clean pure water, or if atmosphere is below freezing and engine is to stand or operate in these temperatures, use antifreeze solution.
- (3) Fill crankcase with suitable lubricating oil to the 4/4 or full mark on the oil level gage. See LO 5-5167.
- (4) With ignition OFF, turn engine over by means of hand crank with ignition OFF three or four times to start oil circulation and distribute the oil already on the surfaces. This hand cranking also prevents the possibility of damage due to water having accumulated in the cylinders.



*Figure 23. Crankcase oil level gage.*

- (5) In addition to the procedure just described, check the lubrication of generator, starter, fan, water pump, and any other accessories. Check air cleaners to make sure there are no obstructions, and that they are properly installed, clean, and properly filled with oil. Refer to LO 5-5167.
- (6) Check entire electrical system to be sure there are no loose connections and all component parts are properly connected.
- (7) See that no loose bars, tools, or parts are lying in or on any part of the engine, as they could cause serious damage to engine or bodily injury to anyone near by.
- (8) Turn ignition switch to ON. Start engine by operating the starting motor switch. If all of the foregoing instructions have been properly followed and the proper grade and type of fuel has been used, the engine should start at once.
- (9) Allow engine to run for several minutes before load is applied, enabling engine to warm up properly and insure good lubrication.

*c. After-Starting Procedures.* After the engine has run at idling speed for a few minutes, inspect the entire engine unit to make sure all parts are functioning correctly.

- (1) Look at the lubricating oil gage. If no pressure shows after engine has run 2 or 3 minutes, shut down the engine and determine what the trouble may be. With bearings in good condition and the proper grade of oil in the crankcase, oil pressure should be 26 to 45 pounds per square inch at full governed speed. If the oil is very cold or heavy, this pressure may be higher. As the oil heats up, the pressure will reduce to normal.
- (2) Check water circulation. If no water is flowing, shut down the engine and determine what the trouble may be. Never operate with the water boiling, as this heat on the cylinder walls breaks down the oil film and causes considerable water loss due to evaporation.
- (3) Observe the engine operation for smoothness, quietness, and exhaust condition. If the fuel is up to specifications and has the proper ignition qualities, the engine may still run raggedly because a cylinder or two is firing irregularly due to being cold. As the engine begins to warm up, however, all cylinders should fire regularly. If they do not, trace out the trouble (par. 30).
- (4) See that there is an adequate supply of fuel in the tanks and that fuel is being delivered to the fuel pump. The delivery can be checked by slightly loosening the nut connecting the supply pipe to the carburetor. If a good quan-

tity of fuel appears, it is an indication that the fuel pump is being supplied with sufficient fuel. If no fuel or very little appears, shut down the engine and check the supply tank again. If the fuel supply is adequate, check the fuel line from tank to pump for leaks from loose connections, broken nuts, and cracked or broken lines. Also check lines for inner obstructions. Make sure the lines have not been pinched closed. If the lines are found satisfactory, check the pump for a broken diaphragm, springs, and worn or broken valves.

- (5) Check to see that there are no oil or water leaks.
- (6) Clean lubricating oil filter (par. 24c). This will insure maximum efficiency from the unit.
- (7) Keep all fuel filters clean and give them regular attention.
- (8) Observe fan and belt operation. Loose fan belts allow slippage, which reduces the efficiency of the fan and wears the belts out rapidly. Never allow the fan to run without any lubricant, but do not overlubricate, or the fan will throw off the excess oil on the surrounding parts.
- (9) See that the radiator is free of obstructions between fins or tubes, as they will obstruct air flow and reduce the cooling efficiency of the radiator unit.

*d. Correct Stopping Procedures.* To shut engine down, merely turn ignition switch to OFF position. If the engine has been working continuously for several hours, allow it to idle for five minutes before stopping. This permits equalized cooling throughout the engine. Make the following routine check to be sure the shutdown engine is safe to leave.

- (1) If atmospheric temperature is below freezing and no anti-freeze solution is used, the complete water circulating system should be drained. This includes engine water jackets, water pump, radiator, and all water pipes.
- (2) If antifreeze solution is used, the solution should be checked with a hydrometer to make sure it will not freeze. It is best to have a solution that will not freeze at temperatures at least 10° F. below those in the field.
- (3) Do not fill batteries with water when shutting down, because the water may freeze. Fill batteries just before starting up for the day's run.
- (4) If the engine is kept in warm storage or is located in a warm building, the previous three points can be disregarded.

*e. Correct Method of Advancing RPM.* After engine is started (see *a* above), increase the rpm in three stages as follows:

- (1) Hold the newly started engine to a fast idle (about 500 to 600 rpm) for at least two minutes.

- (2) Speed up the engine by advancing the hand throttle until it is half way open (800 to 900 rpm). Let it run at this speed for about a minute.
- (3) When the water temperature gage reads 150° F., advance the hand throttle until it is fully open. Let the engine run at governed speed—1,400 rpm—for a few seconds, and slowly pull the throttle back to the desired operating speed.

*Note.* In cold or freezing temperatures, double the running time for each stage.

### 13. Moving to a New Location

The JXC or JXD engine requires no disassembly when the engine is transported from one place to another if it is already mounted on engineer equipment. If the engine is not mounted, it should be packed (par. 249). However, the following general steps should be taken to protect the engine:

- a. Drain the cooling system, unless antifreeze coolant is used.
- b. Drain the fuel system, including fuel pump and carburetor.

## Section IV. OPERATION UNDER UNUSUAL CONDITIONS

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

a. *Starting.* When starting a cold engine, do not run it up to governed speed immediately. Keep it at 800 or 1,000 rpm until the cooling solution warms up and takes the chill off the engine block. This usually takes about four or five minutes, if the thermostat is working properly. During this time, the lubricating oil is also warming up and will begin to circulate. When the engine water temperature reaches 150° F., the oil is circulating freely and rpm may be increased slowly to the governed maximum.

- (1) Follow instructions contained in LO 5-5167 to insure starting at extreme low temperatures.
- (2) Fill the cooling system with hot water to assist starting when permanent antifreeze is not used in the radiator.
- (3) Open the throttle not more than one-fifth of its total opening.
- (4) Close the ignition switch and keep the choke closed nearly all the way. Crank the engine over the same way as in warm weather.
- (5) When the engine starts to fire, keep the choke partially closed until the engine warms up enough to run normally.

b. *Stopping.* Do not race the engine. Allow it to idle several minutes before turning off the engine switch.

- (1) Check specific gravity of coolant (par. 14f).
- (2) Remove battery.

*c. Lubrication.*

- (1) In cold weather, when a winterization kit is not available, drain the crankcase every three days; refill to 4/4 mark on oil level gage. Refer to LO 5-5167.

*Note.* Oil, fuel, diesel may be used as a temporary diluent, but ONLY when sufficient gasoline is not available.

**Warning:** Diluent used is inflammable. Do not service the engine near heater or open flame.

- (2) When operating the engine in protracted cold temperatures below  $-10^{\circ}$  F., remove the lubricants prescribed in LO 5-5167 for temperatures above  $-10^{\circ}$  F. Clean parts with cleaning solvent and drain gear cases. Relubricate with lubricants indicated in LO 5-5167 for below  $-10^{\circ}$  F. temperatures. If winterization kit is installed, do not use diluent.

*d. Fuel System.*

- (1) Whenever possible, use a winterized grade of gasoline.
- (2) In cold weather, condensation of moisture in the air will cause water to accumulate in tanks, drums, and containers. This water will freeze and form ice crystals that will clog fuel lines and carburetor jets unless the following precautions are taken.

- (a) Strain fuel through a chamois skin or other suitable strainer that will prevent passage of water.

**Caution:** Use a good metallic conductor between container and fuel tank to "ground" static electricity.

- (b) Keep fuel tank as full as possible at all times. This will minimize the volume of air from which moisture can condense.
- (c) Keep all containers tightly closed to prevent the entrance of foreign matter.
- (d) Check the valve plate occasionally with full choke to see that it closes all the way.
- (e) Keep close check on the carburetor and fuel pump to make sure they operate properly. Replace if faulty.
- (f) Remove and clean fuel sediment bowl and strainers daily.

*e. Electrical System.*

- (1) *Batteries.* Batteries do not deliver peak cranking power in cold weather. A battery will deliver 65 percent of its peak cranking power at  $32^{\circ}$  F. and only 40 percent at  $0^{\circ}$  F. Longer cranking periods are necessary in cold weather, and batteries should therefore be kept fully charged at all times. The electrolyte of fully charged batteries will not freeze at temperatures above minus  $60^{\circ}$  F. After adding water at subzero temperatures, run the engine for about one

hour in order to mix the additional water with the electrolyte. Specific gravity readings of batteries change with temperatures and should be compared to the specific gravity of a fully charged cell at 80° F., at which temperature peak cranking power is delivered. See table of specific gravity readings (par. 72e).

(2) Keep all wiring connection and battery terminals clean and tight.

(3) Inspect the generator and starting motor brushes, commutator, and bearings. Replace brushes if worn (par. 61). Keep the commutators clean. If the starting motor throw-out mechanism fails to engage the flywheel, remove the cranking motor (par. 60) and clean grease and dirt from the throw-out mechanism.

(4) Check the ignition coil for proper spark. Replace the coil (par. 67) and condenser if spark is weak.

(5) Keep distributor points clean and properly adjusted (par. 64).

(6) Inspect the spark plugs to see that they are clean and properly adjusted (par. 70).

(7) Check timing and adjust if necessary (par. 66).

#### f. Cooling System.

(1) The following table gives the freezing temperatures of ethylene glycol (Prestone and water solution) at varying percentages of total coolant volume.

Percentage of ethylene glycol by volume	Pints per gallon	Specific gravity at 80° F.	Freezes at degrees Fahrenheit	Freezes at degrees Centigrade
16.....	1. 08	1. 026	+20	-7
25.....	2. 0	1. 037	+10	-12
33.....	2. 64	1. 048	0	-18
39.....	3. 12	1. 056	-10	-23
44.....	3. 52	1. 063	-20	-29
48.....	3. 84	1. 068	-30	-35
52.....	4. 10	1. 073	-40	-40
55.....	4. 40	1. 077	-50	-46
59.....	4. 70	1. 082	-60	-51
62.....	5. 00	1. 088	-70	-57

(2) Perform the following operations before using antifreeze solution:

- (a) Drain the cooling system and flush with clean water.
- (b) Inspect the entire system for leaks. Replace worn, rotted, or otherwise damaged hose connections. Make sure that all clamps are tight and all drain cocks properly closed.

## 15. Operation in Extreme Heat

Two main precautions are important when operating engines in unusually hot weather.



*a. Radiator Fins.* Check the radiator fins before starting each day's run to make certain insects, dirt, or other obstructions have not lodged in the core openings.

*b. Radiator Water Level.* Check the radiator water level daily and keep it at the proper level. Where heat conditions are extreme, the radiator water level should be checked twice daily. At all times during working periods, watch the engine instruments to make sure water temperature and oil pressure readings are normal. Water temperature should not exceed 180° F., and oil pressure should be at least 26 psi.

## **16. Operation in Extreme Wet Weather**

*a.* The continued operation of engines during extreme wet weather may require the installation of boots over the spark plugs and distributor case. Moistureproofing compound may be applied to the ignition cables, or moistureproof cables may be installed in place of the regular ignition cables.

*b.* When the engine is not operating during extreme wet weather conditions, cover it with a tarpaulin, making certain the wiring, distributor, coil, starter, generator, and spark plugs are especially protected from the weather.

## **17. Operation in Dusty Areas**

When operating engines in localities where there is an unusual amount of dirt, dust, and grit in the air, precautions must be taken to keep foreign matter out of the engine. It is the function of the two air cleaners—the large engine air cleaner mounted on the carburetor, and the small crankcase air cleaner built into the cap of the oil-filler and breather tube—to keep dust and grit out of the engines and out of the lubricating oil. If dust conditions are noticeably bad in the working area, air cleaners should be serviced and the oil cup of the carburetor air cleaner supplied with new oil before starting each day's run. When dust conditions are extreme, the engine air cleaner should be serviced more often (par. 24j).

## **18. Operation Near Salt Water**

Corrosion of engines and parts takes place much more rapidly when salt is present in the air. Frequent lubrication is essential when JXC and JXD engines are operated near salt water.

## **19. Operation in High Humidity Areas**

When operating engines in rainy areas, or where excessive humidity prevails, electrical systems require more than the normal amount of attention. Moisture not only decomposes insulation, but will cause grounds and short-circuits when allowed to accumulate on wiring, brush holders, and commutators. If engines are not worked

for long periods in high humidity areas, they should be started and run at idling speed for ten or fifteen minutes daily. This prevents a "soaked" condition of electrical components and makes starting easy when the engine is to be operated. Sometimes the warmth of a shut-down engine will condense enough moisture from the air to wet high tension wiring and even deposit water in the spark plug wells. To dry, use clean absorbent waste or cloths to wipe moisture away from spark plug wells, high tension wires, and distributor cap.

## **20. Operation at High Altitudes**

Carburetors used on the JXC and JXD engines, respectively, compensate automatically for changes in atmospheric density resulting from changes of altitude. It is not necessary to change fuel jets on the carburetors when machines are moved from low areas to high plains or mountainous regions. The effect of altitude on the JX-series engines is approximately a 3 percent power loss for each thousand feet above sea level.

## CHAPTER 3

### MAINTENANCE INSTRUCTIONS

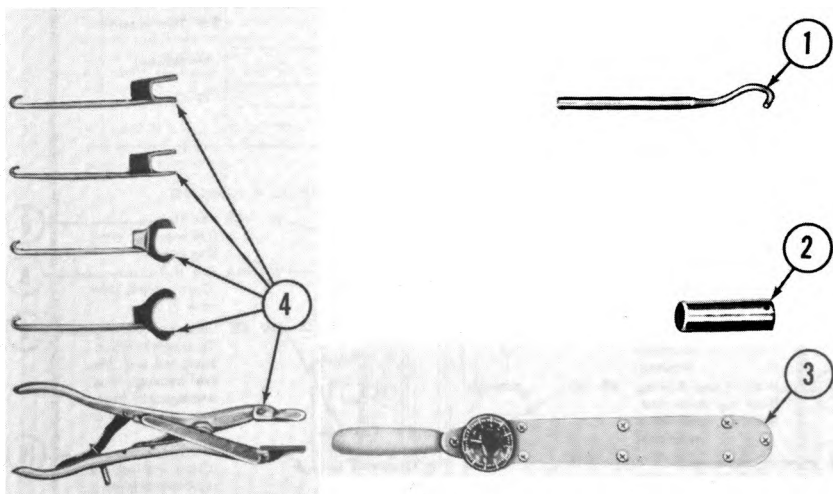
---

#### Section I. SPECIAL ORGANIZATIONAL TOOLS AND EQUIPMENT

#### 21. Special Tools

(fig. 24)

- a. Valve spring lifter (4).
- b. Water pump packing nut spanner wrench (1).
- c. Torque wrench (3).
- d. Spark plug wrench (2).



*Figure 24. Special tools.*

#### 22. On-Equipment Tools

For on-equipment tools supplied with the engines, refer to appendix III.

### Section II. LUBRICATION AND PAINTING

#### 23. General Lubrication Information

a. LO 5-5167 prescribes first and second echelon lubrication maintenance for the ENGINE, GASOLINE, HERCULES MODELS JXC AND JXD.

b. A lubrication order is published for each item of equipment. The lubrication order shown in figure 25 is a reproduction of an

# LUBRICATION ORDER

# LO 5-5167

(Supersedes LO 5-5167, 17 May 1952)

## ENGINE, GASOLINE, HERCULES MODELS JXC AND JXD

References: TM 5-5167, TB 5-5167-1, TM 9-1706

Intervals given are maximums for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened to compensate.

Clean fittings before lubricating.

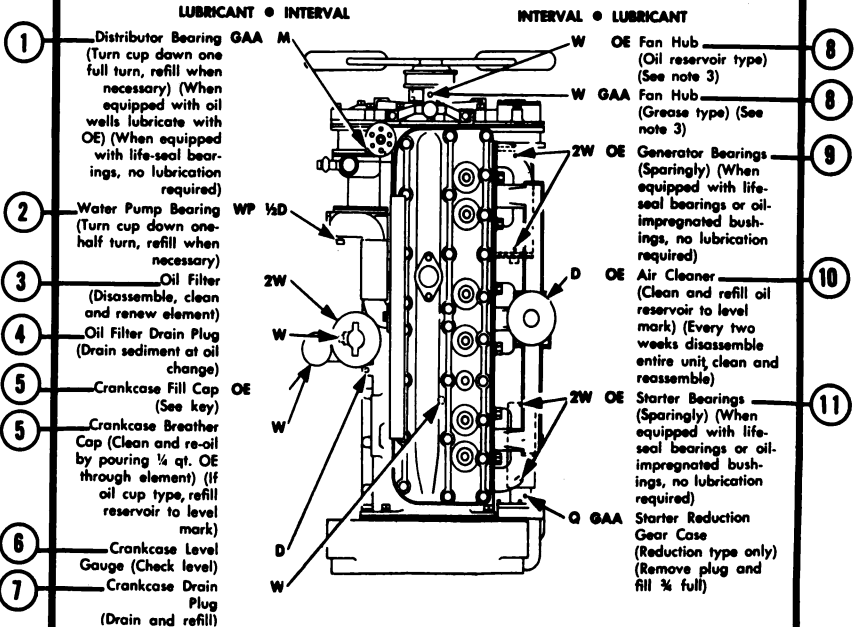
Relubricate after washing.

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

Drain crankcase only when hot after operation; check level and replenish when cool.

— KEY —

LUBRICANT	CAPACITY	EXPECTED TEMPERATURE			INTERVALS
		Above +32°F	+32°F to -10°F	Below -10°F	
OE—OIL, engine					
Crankcase					
(JXC-open type)	9 qts	OE 30 or 9250	OE 10 or 9110	See Note 1	½D—Twice Daily
(JXC-base type)	10 qts				D—Daily
(JXD-open type)	9 qts				W—Weekly
(JXD-base type)	16 qts				ZW—Two Weeks
Air Cleaner		OE 30 or 9250	OE 10 or 9110	OHA	M—Monthly
Other Points					Q—Quarterly
OHA—OIL, hydraulic, petroleum base.					
GAA—GREASE, automotive and artillery. All temperatures.					
WP—GREASE, water pump. All temperatures.					



CONTINUED ON  
FOLLOWING PAGE

Figure 25. Lubrication order.

NOTES:

1. COLD WEATHER—(When winterization kit is not available)—CRANKCASE: Every 3 days drain crankcase, refill to "Full" mark with OE 10. (JXC and JXD open type and JXC base type crankcases). Add 2½ qts of gasoline. (JXD base type crankcase). Add 4½ qts of gasoline. Operate engine 5 minutes to mix. Mark the new level on the gage for future reference. CAUTION: Every ½ day check level and fill to "Full" mark with OE 10. Then if engine is to be shut down for ½ day or more add (2¼ qts of gasoline for JXC and JXD open type and JXC base type crankcases) (4½ qts of gasoline for JXD base type crankcase) to reach new level mark. Operate engine 5 minutes to mix.

NOTE: OIL, fuel diesel may be used as a temporary diluent. But only when sufficient gasoline is not available. CAUTION: Diluent used is inflammable. Do not service equipment near heater or open flame.

2. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW -10°F—Remove the lubricants prescribed in the key for above -10°F, clean parts with SOLVENT, dry-cleaning, and drain gear cases. Relubricate with lubricants indicated in the key for below -10°F temperatures. If winterization kit is installed do not use diluent.

3. FAN HUB—Oil reservoir type: Remove plug and fill until oil drops from fan shaft. Replace plug after lubricating.

Grease Type: Remove plug and install grease fitting to lubricate. Remove fitting and replace plug after lubricating.

Some fans are equipped with life-seal bearings or oil-impregnated bushings and require no lubrication.

4. OIL CAN POINTS—Every week, lubricate throttle and governor control linkages and clevises with OE.

5. POINTS REQUIRING NO LUBRICATION—Do not lubricate governor, magneto and idler gears.

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained herein are mandatory and supersede all conflicting lubrication instructions dated prior to the date of this Lubrication Order.

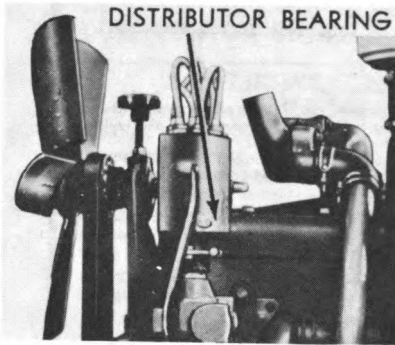
BY ORDER OF THE SECRETARY OF THE ARMY:

J. LAWTON COLLINS  
Chief of Staff  
United States Army

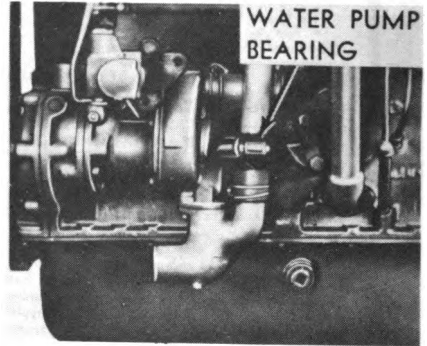
OFFICIAL:

WM. E. BERGIN  
Major General, USA  
The Adjutant General

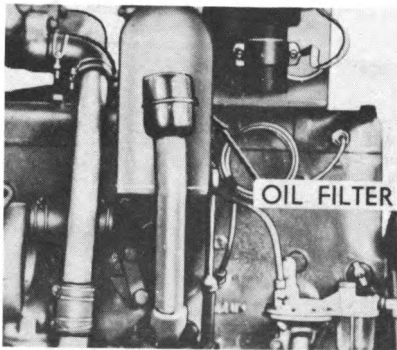
Figure 25. Lubrication order.—Continued



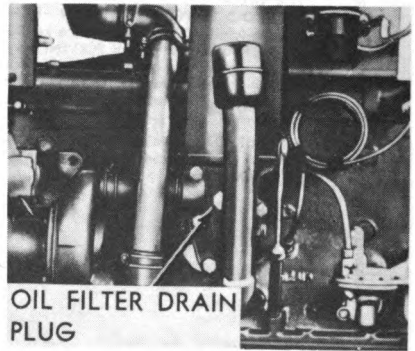
**REFERENCE 1:** Grease or oil monthly.



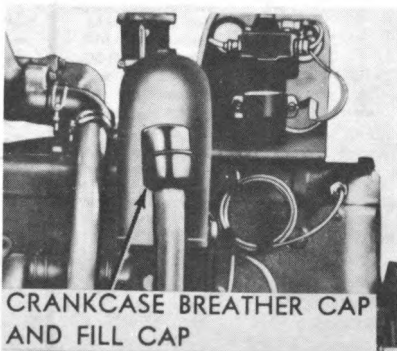
**REFERENCE 2:** Turn cup down one-half turn twice daily. Refill when necessary.



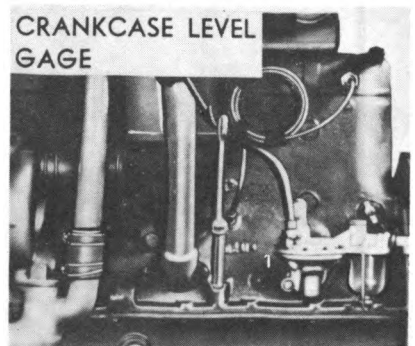
**REFERENCE 3:** Disassemble, clean, and renew element every two weeks.



**REFERENCE 4:** Drain sediment at oil change.

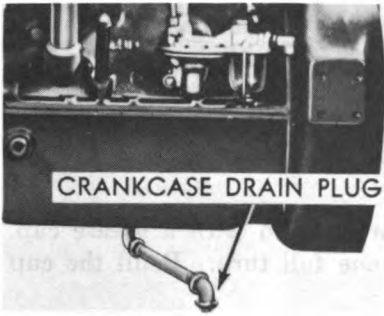


**REFERENCE 5:** Clean and reoil weekly.

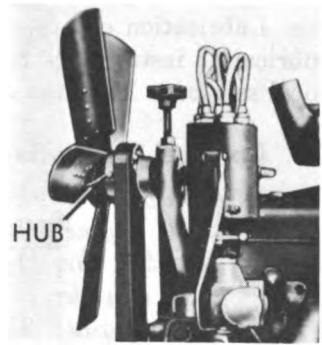


**REFERENCE 6:** Check oil level daily.

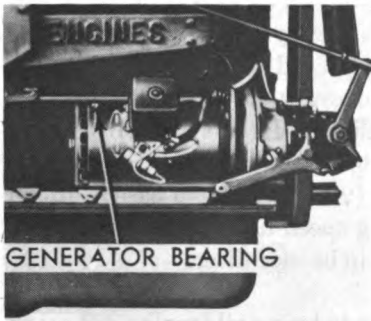
*Figure 25. Lubrication order.—Continued*



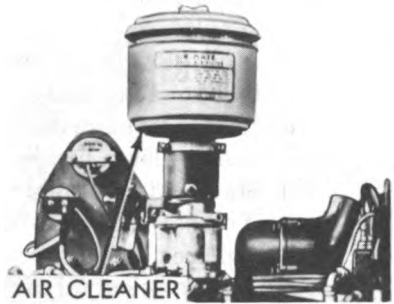
REFERENCE 7: Drain and refill weekly.



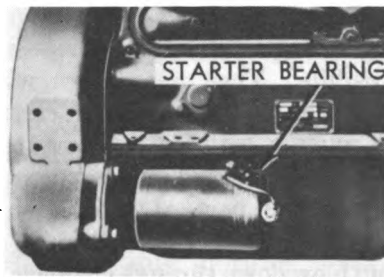
REFERENCE 8: Grease or oil weekly.



REFERENCE 9: Oil bearing every two weeks.



REFERENCE 10: Clean and refill oil reservoir to level mark daily.



REFERENCE 11: Oil bearings every two weeks.

Figure 25. Lubrication order.—Continued

approved lubrication order for these engines. For the current LO 5-5167, refer to SR 310-20-4.

c. Lubrication orders prescribe approved first and second echelon lubrication instructions for mechanical equipment issued by the technical services. The instructions contained therein are mandatory.

## 24. Detailed Lubrication Information

### a. Distributor.

(1) *JXC engine.* The distributor is fitted with a grease cup. Monthly turn the cup down one full turn. Refill the cup when necessary.

(2) *JXD engine.* Monthly add three to five drops of medium engine oil to the oiler on the side of the distributor base.

b. *Water Pump.* Turn the cup down twice daily. Refill when necessary.

c. *Oil Filter.* Every two weeks drain and service the oil filter, clean the housing, and renew the element. At every crankcase oil change unscrew the oil filter drain plug and drain out old oil.

(1) The oil filter should be drained every time the engine oil is changed. This unit both purifies and cools the oil as it is circulated through the engine lubrication system.

(a) Remove large hex-head plug (2, fig. 26) from base of filter.

(b) Start and run engine at idling speed until about two quarts of oil have run out of opening in base of filter.

(c) Replace plug (2).

(d) Add sufficient oil to crankcase to bring oil level to 4/4 mark on the oil level gage (see LO 5-5167). Start and run engine long enough to fill oil filter and check oil level on oil level gage. Add oil to crankcase as required to bring oil level to 4/4 mark on oil level gage.

(2) *Cleaning and servicing of oil filters.*

(a) Scrape all sludge from filter element (6, fig. 67) with wooden paddle. Then wipe down with cloth soaked in solvent. Examine filter element carefully. If the felt rings are gummy between surfaces, replace the element. These felts may be washed in kerosene and reused.

(b) Wash and clean all parts of the differential valve assembly.

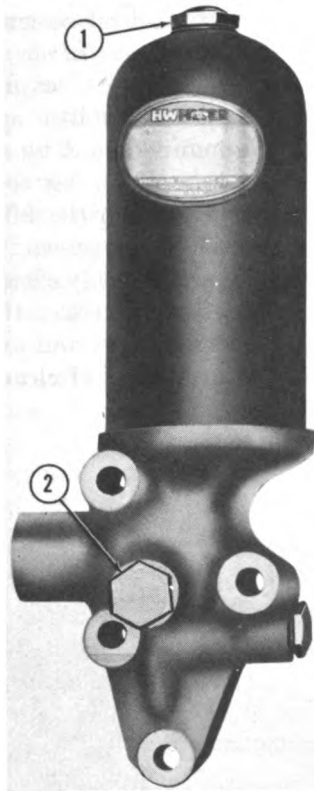
(c) Rinse oil filter base (15) in cleaning solvent, apply air nozzle, and blow down through channels.

d. *Crankcase Fill Cap.* Remove cap and fill or replenish the crankcase through fill pipe.

e. *Crankcase Breather Cap.* Remove cap, wash with cleaning solvent, and reoil breather screen weekly.

f. *Crankcase Oil Level Gage.* Check oil level on the oil level gage daily. Add oil when necessary to maintain level.





1 Cover screw

2 Drain plug

Figure 26. Oil filter.

*g. Crankcase Drain Plug.* Unscrew the pipe plug from the crankcase drain pipe and drain the crankcase weekly. Refill crankcase to proper level with new oil.

*h. Fan Hub.* Models JXC and JXD engines may be equipped with various fan assemblies, depending upon the particular installation.

(1) *Oil reservoir type fan hub.* Remove the plug and lubricate with oil weekly until oil drops from fan shaft. Install plug after lubrication.

(2) *Grease type fan hub.* Remove the pipe plug and install a grease fitting to apply lubricant weekly. Remove fitting and install plug after lubrication.

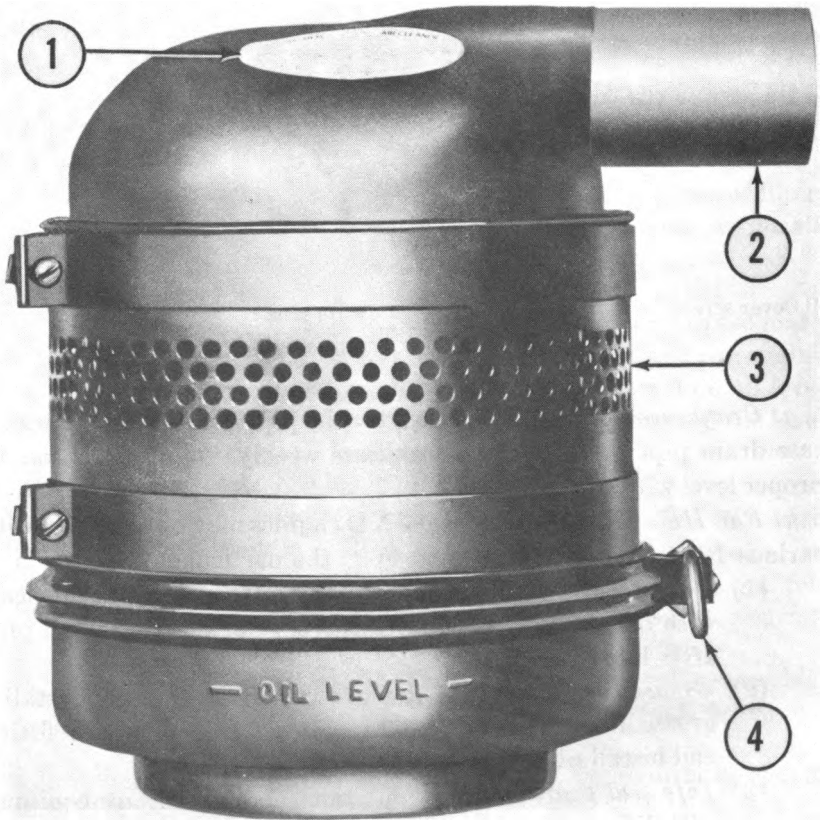
(3) *Life seal bearing type fan.* Some fan shafts are equipped with life seal type bearings and require no lubrication.

*i. Generator Bearings.* Every two weeks oil the bearings sparingly through the combination oiler and overflow hole in the generator housing.

j. *Air Cleaner.* Clean and refill oil reservoir to level mark daily.

(1) *Servicing JXC engine air cleaner* (fig. 27). The oil-bath air cleaner used on the JXC engine is the remote type, meaning it is located a distance away from the carburetor and must be connected to it by a hose which fastens on the cleaner outlet tube (2). Air is drawn into the cleaner through perforations (3) in the filtering housing and circulated through the filtering screen. Oil on this screen traps dust and grit, permitting only clean air to reach the carburetor. To service air cleaners on the JXC engine, read the instructions decalcomania (1) and proceed as follows:

- (a) Remove oil cup at bottom of cleaner by loosening retaining bolt (4).
- (b) Empty old oil.



1 Identification decalcomania.  
2 Outlet tube

3 Perforations  
4 Oil cup retaining clamp bolt.

Figure 27. Air cleaner, JXC engine

- (c) With cleaning solvent, loosen and scrape out dirt and sludge accumulated in bottom of oil cup and wipe oil cup dry inside and out.
- (d) Refill oil cup with clean OE 10 oil in cold weather, OE 40 oil in hot weather. Bring oil up to bead level and replace oil cup on air cleaner.

**Caution:** Never remove oil cup while engine is running.

- (2) *Servicing JXD engine air cleaner.* The oil-bath type air cleaner used on the JXD engine is clamped directly to the top of the carburetor above the manifold. Purpose of the air cleaner is to filter dirt and dust from the air drawn into the engine by way of the carburetor, thereby reducing engine wear. To service air cleaner on the JXD engine proceed as follows:
  - (a) Unscrew wing nut (1, fig. 28) from top of cleaner.
  - (b) Lift out top (2, fig. 59) and filter element assembly. Empty dirty oil from bowl (5) and wipe out any accumulated sludge with clean rags or waste.



1 Wing nut

2 Maintenance instructions

Figure 28. Air cleaner, JXD engine

293175 O—54—4

- (c) Remove screen filter element (4) from top assembly and inspect. Remove with fingers any insects or large particles which may be lodged in screen.
- (d) Clean filter element by agitating in hot water containing cleaning solvent.
- (e) Allow filter element to dry, and dip in clean engine oil. Refill bowl with 1 pint of clean oil (OE 10-30 in cold weather, OE 30-50 in hot weather). Do not fill the bowl beyond the bead level.
- (f) Reassemble filter, being sure that the gasket (6) is on the base, and install cleaner on base.

**Caution:** Never remove air cleaner while engine is running.

*k. Starting Motor Bearings.* Every two weeks oil the bearings sparingly through the oiler holes in the starting motor housing. Should the starting motor be a reduction gear type starter, remove the gear housing plug and pack the housing approximately three-fourths full with prescribed lubricant.

**Caution:** Be sure the housing is not overpacked.

## 25. Special Painting Instructions

*a. Engine Paint.* JXC and JXD engines are painted with heat-resistant gray engine enamel at the factory. Unless the engine is frequently subjected to overheating, or except where the engine operates continually in very humid areas or near salt water, the paint should last the life of the engine.

*b. Repainting Recommendations.* Should repainting be necessary, use any good grade of enamel having heat-resisting qualities. Repainting should be undertaken at overhaul periods when accessories are stripped and all areas of the cylinder block and crankcase can be reached. Use a blow torch or wire brush to loosen old paint. Then thoroughly clean all surfaces by blowing with compressed air or wiping with cloth or waste. Refer to TM 9-2851 for additional information on painting.

## Section III. PREVENTIVE MAINTENANCE SERVICES

### 26. General

The operator or crew of this equipment and the organizational maintenance personnel must perform their preventive maintenance services regularly, to make sure the equipment operates well and to lessen the chances of mechanical failure.

### 27. Operator Maintenance

*a. Inspections.* Inspections must be made before operation, during operation, at halt, and after operation, as described in this section.

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 mechanical condition which may result in damage to the unit must be corrected before the equipment is operated.

- (1) The inspection for "good condition" is usually an external visual inspection to determine if 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 further defined as: not bent or twisted; not chafed or burned; not broken or cracked; not bare or frayed; not dented or collapsed; not torn or cut; adequately lubricated.
- (2) 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 equipment.
- (3) Check of a unit to determine if it is "secure" is usually an external inspection, a hand-feel, or a pry-bar or wrench check for looseness in the unit. Such an inspection should include brackets, lockwashers, locknuts, locking wires, or cotter pins used in the assembly.
- (4) "Excessively worn" means worn close to or beyond serviceable limits, a condition likely to result in a failure if replacement of the affected parts is not made before the next scheduled inspection.

*b. Reporting Deficiencies.* The operator will report all deficiencies on DD Form 110, Vehicle and Equipment Operational Record.

*c. Before-Operation Services.* The following services will be performed to determine if the condition of the machine has changed since it was last operated, and to make sure the machine is ready for operation. Any deficiencies must be corrected or reported to the proper authority before the unit is put back into operation.

- (1) *Fuel.* Check fuel supply. See that fuel tank is full. Check reserve supply and replenish it if necessary.
- (2) *Oil.* Check reserve supply of lubricants and replenish them if necessary. Check oil level in engine crankcase. See that oil is at proper level.
- (3) *Water.* Check coolant in radiator and see that it is at proper level. When filling cold radiator containing antifreeze, allow room for expansion.
- (4) *Instruments.* Check all gage readings. Normal oil pressure is 26 psi at 1,600 rpm when engine is hot. Pressure will be above normal while engine is cold, and may drop below normal at idling speed after engine has warmed up. If oil pressure indicator shows an unusual drop or shows no pres-

sure, stop engine immediately and report the condition to proper authority. Coolant temperature gage should show a gradual rise during the warm-up period until it reaches a temperature range of 160° to 180° F. Allow engine to warm up at fast idling speed. Do not race a cold engine. The ammeter should be in the charge range.

- (5) *Leaks, general.* Check for leaks, paying particular attention to engine cooling system, oil and fuel lines, and connections, and for signs of leaks under the engine.
- (6) *Visual inspection.* Make a visual inspection of the entire engine for cracks, breaks, and loose or missing bolts and nuts. After engine is started, check for any unusual sounds or other unsatisfactory characteristics.

*d. During-Operation Services.* The operator is responsible for correcting or reporting unusual sounds or odors, deficiencies in performance, or other signs of abnormal operation.

- (1) *Instruments.* Check all gage readings frequently. If oil pressure indicator shows an unusual drop or no pressure, or if coolant temperature gage shows engine overheating, stop immediately and report irregularity to proper authority. Do not operate until failure is corrected.
- (2) *Unusual operation and noises.* Check for any unusual engine noises. Stop engine immediately if any unusual noise is noticed. Check for any unusual performance such as engine lacking power. Report deficiencies to proper authority.

*e. At-Halt Services.* During halts, even for short periods, the operator should make a general check of the equipment and correct or report any deficiencies noticed, in addition to performing the following specific duties:

- (1) *Fuel.* Check fuel supply. Add fuel if necessary.
- (2) *Oil.* Check oil level in engine crankcase. Add oil if necessary.
- (3) *Water.* Check coolant in radiator and see that it is at proper level.

**Caution:** If engine overheats because of lack of coolant, it should be allowed to cool before filling radiator; otherwise there is danger of cracking cylinder head and block. If it is necessary to fill radiator before engine has cooled, be sure to fill it very slowly with engine running at idling speed.

- (4) *Leaks, general.* Check for leaks, paying particular attention to fuel, oil, and water lines and connections, and for signs of leaks under the engine.
- (5) *Visual inspection.* Make a visual inspection of the entire engine, checking for excessively worn, bent, cracked, or broken

parts and for loose or missing bolts, nuts, and pins. Check condition of engine fan belt. If operating under extremely dusty conditions, inspect air cleaner and service it as required.

*f. After-Operation Services.* To insure that the engine is ready to operate at any time, the following services must be performed by the operator or crew immediately after any operating period of 8 hours or less. All deficiencies must be corrected or reported to proper authority.

- (1) *Shutdown precautions.* Allow engine to idle for a few minutes before stopping. Cover exhaust with a water proof material after stopping engine.
- (2) *Fuel and water.* Fill fuel tank with clean fuel. Check coolant in radiator; proper level is at or near overflow with engine at operating temperature. Change coolant if it is contaminated with rust or dirt.
- (3) *Clean equipment.* Remove all dirt and excess oil and grease from exterior of engine.
- (4) *Tools and equipment.* See that all tools and equipment assigned to the machine are clean and properly stowed or mounted. Report to the proper authority all tools which are unserviceable.
- (5) *Fuel filter.* Remove, clean, and replace bowl if it contains water or dirt.
- (6) *Lubrication.* Lubricate in accordance with instructions contained in LO 5-5167.
- (7) *Visual inspection.* Check for fuel, oil, and water leaks; loose or missing bolts, nuts, and pins; and for bent, cracked, or broken parts. Check condition and tension of engine fan belt; it should have a 1-inch deflection measured midway between pulleys. See that the battery is securely mounted, and that connections and filler caps are clean and tight.

*g. Maintenance and Safety Precautions.*

- (1) Always correct or report any mechanical deficiencies that may result in further damage to the unit if operation is continued.
- (2) After starting engine, allow it to warm up at fast idling speed before applying load.
- (3) Make sure that containers used for handling fuel and oil are clean and dry.
- (4) Always provide a metallic contact between container and tank when adding gasoline.

## **28. Organizational Maintenance**

*a.* Organizational preventive maintenance is performed by organizational maintenance personnel, with the aid of the operator, at weekly and monthly intervals. The weekly interval will cover about

60 hours of use and the monthly interval will be equivalent to 4 weeks of use, or 240 hours, whichever occurs first.

b. The preventive maintenance services to be performed at these regular intervals are listed and described below. The number appearing in the columns opposite each service refers to a corresponding number appearing on DA Form 464, and indicates 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. The column headed technical inspection is provided for the information and guidance of personnel performing technical inspection, and constitutes the minimum inspection requirements for the equipment.

Technical In- spection	Service		
	Monthly	Weekly	
<b>GENERAL</b>			
1	1	1	<i>Before-operation services.</i> Check and perform services listed in paragraph 27c.
2	2	2	<i>Lubrication.</i> Inspect entire unit for missing or damaged lubrication fittings and grease cups, and for indications of insufficient lubrication.
		2	Lubricate in accordance with instructions contained in LO 5-5167.
3	3	3	<i>Tools and equipment.</i> Inspect condition of all tools and equipment assigned to the machine. Check condition of tool boxes or compartments.
		3	See that all tools and equipment assigned to the machine are clean and properly stowed or mounted. Replace all unserviceable tools.
4	4	4	<i>Fire extinguisher.</i> Inspect for full charge, proper working order, and secure mounting of fire extinguisher.
		4	See that any deficiencies are corrected or reported to proper authority.
5	5	5	<i>Publications.</i> See that TM 5-5167, TB 5-5167-1, and LO 5-5167 are with the machine and in serviceable condition.
6	6	6	<i>Appearance.</i> Inspect the general appearance of the machine, paying special attention to cleanness, legibility of identification markings, and condition of paint.
		6	Correct or report any deficiencies noticed.
7	7	7	<i>Modifications.</i> See if all available modification work orders applying to this machine have been completed and recorded on DA Form 478 (MWO and Major Unit Replacement Record—Organizational Equipment File).
<b>ENGINE AND ACCESSORIES</b>			
11	11	11	<i>Cylinder head, manifold, and gaskets.</i> Inspect cylinder head, manifolds, and exhaust pipe for leaks, loose mounting bolts and nuts, and defective gaskets.



Technical inspection	Service	
	Monthly	Weekly
	11	11
12	12	12
	12	12
	13	13
14	14	14
	14	14
15	15	15
	15	15
16	16	16
	16	16
17	17	17
	17	17
18	18	18

### ENGINE AND ACCESSORIES—Continued

- Tighten any loose manifold and exhaust pipe mounting bolts and nuts. Replace any defective gaskets. On new or reconditioned engines, check all cylinder-head bolts for tightness at the first weekly service. The correct torque-wrench pull is 75 foot-pounds.
- Valve mechanism.* Check valve adjustment if excessive tappet noise or loss of power is noticed. Approximate valve-tappet clearances when the engine is cold are 0.008 inch for intake valves and 0.010 inch for exhaust valves.
- Adjust valve-tappet clearance if necessary (par. 45). Be sure valve cover gasket is in good condition and that cover fits securely.
- Compression test.* Test compression of all cylinders, and record readings on DA Form 464. For normal compression pressure at cranking speed with engine at operating temperature see paragraph 47.
- Crankcase, breathers.* Inspect crankcase for leaks. Check condition of crankcase breathers or caps.
- Correct or report any oil leaks noticed. Change oil, and clean breathers if necessary. See LO 5-5167.
- Oil filters.* Inspect oil filter assembly and connections for leaks while engine is running.
- Service oil filter as specified in LO 5-5167. After servicing, check carefully for leaks while engine is running.
- Radiator.* Inspect radiator for leaks, for obstructions in core air passages, and for loose mounting bolts. Check all cooling-system hoses for leaks, excessive deterioration, and loose connections. Check operating temperature and condition of coolant. If coolant temperature remains below 140° F. or rises above 190° F. during operation, thermostats may be defective. If antifreeze is used, check its freezing point.
- Drain, flush, and refill cooling system if coolant is contaminated with rust or dirt (par. 51). See that core air passages are clean. Renew any damaged or defective cooling system hoses, lines, and gaskets. See that all mounting bolts and connections are tight. Protect coolant from freezing, and record its freezing point on DA Form 464.
- Water pump, fan, and shroud.* Inspect water pump for leaks and for loose mounting and assembly bolts. Check condition and mounting of fan blades and shroud.
- Tighten or replace loose or missing bolts and screws. If pump leaks, tighten packing nut only enough to stop leak; repack if necessary (par. 110).
- Belt and pulleys.* Inspect for excessively worn, cracked, or frayed belt. Check belt tension and condition and alinement of pulleys. The belt is properly adjusted when it can be deflected 1 inch from normal position, at a point midway between pulleys (fig. 36).

Technical Inspection	Service	
	Monthly	Weekly
	18	18
20	20	20
	20	20
38	38	38
	38	38
39	39	39
	39	39
41	41	41
	41	41
43	43	43
	43	43
46	46	46
	46	46
	46	46
47	47	47

### ENGINE AND ACCESSORIES—Continued

- Adjust tension of belt if necessary (par. 54). Replace belt if frayed or badly worn.
- Governor.* Check governor adjustment. If engine surges when running at top speed without load, governor is out of adjustment.
- Adjust governor if necessary (par. 83).

### FUEL SYSTEM

- Fuel pump and housings.* Inspect fuel pump and lines for leaks. Check for loose mounting and assembly screws. Check sediment bowl for water and dirt.
- Tighten any loose screws and connections. Clean sediment bowl if it contains water or dirt. See that screen is clean. Make sure gasket is in good condition before replacing bowl. Replace a defective pump with a new or reconditioned one (par. 79).
- Carburetor and linkage.* See if all carburetor mounting and assembly bolts and screws are in place and secure. Check condition and operation of linkage.
- Tighten any loose mounting and assembly bolts and screws. Replace excessively worn or damaged linkage connections.
- Air cleaner.* Inspect air cleaner for loose connections. Check condition and level of oil in bowl.
- Service air cleaner as specified in LO 5-5167. Make sure there are no air leaks between air cleaner and carburetor.
- Fuel tank, cap, and gaskets.* Inspect condition and mounting of fuel tank. Check tank, fuel lines, and connections for leaks.
- See that tank is securely mounted, air vent open, and filler cap clean and tight fitting. Repair or renew leaky or damaged fuel lines.

### ELECTRIC SYSTEM

- Spark plugs.* Inspect spark plugs for dirty or cracked insulators.
- Clean dirt and oil from spark plug insulators. Replace defective plugs.
- Remove and clean spark plugs and adjust point gap (par. 70). See that plugs and gaskets are in good condition before they are installed.
- Battery.* Inspect battery for cracked and leaky case, for loose hold-down clamps, and for dirt and corrosion on top of battery. Check for loose, corroded, and damaged terminals and cables. Check level of electrolyte. Proper level is approximately one-half inch above the plates. Check specific gravity, and record reading on DA Form 464. Readings from 1.275 to 1.300 indicate a fully charged battery. Readings of 1.225 or below indicate battery should be recharged or replaced.

Techni- cal in- spection	Service		
	Monthly	Weekly	
	47	47	Clean all dirt and corrosion off top of battery, posts, cables, and terminals. Replace damaged cables. Apply a thin film of chassis grease over terminals. Add distilled water if needed to bring solution up to proper level. If freezing temperatures prevail, battery must be charged for a period long enough to mix solution thoroughly. See that battery is securely mounted, that filler caps are tight, and that vent holes are open.
48	48	48	<i>Generator and starter.</i> Inspect generator and starting motor for loose mounting bolts and wire connections.
48	48	-----	Inspect commutators and brushes for excessive wear, dirt, and oil deposits. See if brushes are free in their holders and if brush wires are secure.
	48	48	Tighten any loose mounting bolts and wire connections. Replace or free-up brushes, and clean commutators if necessary (pars. 61 and 62).
49	49	-----	<i>Distributor.</i> Inspect distributor cap and rotor for cracks, burned contacts, and corroded terminals. Check condition and adjustment of breaker points. Correct point gap is 0.020 inch.
	49	-----	Clean or replace distributor cap and rotor, and adjust breaker points if necessary (par. 64). Replace points if they are badly burned or pitted.
50	50	50	<i>Coil, wiring, switches.</i> Check coil for loose mounting, cracked insulation, or other defects. Inspect wiring for oil-soaked, cracked, or frayed insulation; broken wires; and loose or corroded connections.
	50	50	Replace defective coil, switches, and wires. See that all connections are clean and tight.
51	51	51	<i>Voltage regulator.</i> Check voltage regulator for proper operation and secure mounting. See that wire connections are tight. Regulator should allow an appreciable charge to go into the battery after the starter is used. After battery is fully charged, ammeter should read zero or show only a slight charge.
	51	51	Tighten any loose mounting screws. Replace a defective regulator.
57	57	57	<i>Gages.</i> Check all gages for good condition, secure mounting, and proper operation.
	57	57	Tighten any loose mounting screws and connections. Replace damaged or defective gages.

ELECTRIC SYSTEM—Continued

## Section IV. TROUBLESHOOTING

### 29. General

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

*Note.* All references in this section to paragraphs in chapter 4 (pars. 99-244) pertain to operations that are the responsibility of the field and depot maintenance personnel. Organizational personnel must not proceed without proper authority.

### 30. Engine

#### *a. Engine does not start.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Cracked or dirty plugs.	Clean or replace plugs (par. 69).
(2) Shorted or broken high tension wires.	Clean contact surfaces and tighten wires or replace broken wires.
(3) Corrosion in distributor terminals.	Clean and tighten terminals.
(4) Faulty distributor points.	Clean, adjust, or replace as necessary (par. 64).
(5) Fuel flow obstructed.	Check fuel system for leaks, foreign matter in lines, or pinched lines.
(6) Leaky manifold.	Replace gaskets or manifolds as necessary.
(7) Water in fuel.	Drain contaminated fuel through tank drain plug, blow out fuel lines with compressed air, refill tank with clean fuel.
(8) Seizure.	If caused by overheating, cool engine before attempting to start. If cooled engine will not turn over, it will require disassembly (par. 220). See NOTE in paragraph 29.

#### *b. Engine Misses Intermittently.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Defective spark plugs.	Clean if dirty. Replace if cracked. Dry if wet or damp (par. 69).
(2) High tension wires broken or shorted.	Check all spark plug leads for broken wiring or damaged insulation. Replace wiring if necessary.

<i>Probable cause</i>	<i>Possible remedy</i>
(3) Faulty distributor points.	Clean and adjust or replace if necessary (par. 64).
(4) High tension wires corroded in distributor cap.	Clean terminals.
(5) Valve tappets adjusted too close.	Readjust valve tappets to correct clearance (par. 45).
(6) Badly worn valve guides.	Replace valve guides.
(7) Leaking head gasket.	Tighten cylinder head nuts to proper tension or replace gasket if necessary (par. 43).
(8) Warped or cracked cylinder head, usually due to overheating or pouring cold water in an overheated engine.	Replace cylinder head (par. 43).
(9) Cracked valve seat or water jacket, usually indicated by overheating and loss of cooling solution.	Replace cylinder block.
(10) Air leak in intake manifold.	Replace gaskets or manifold if necessary (par. 84).
(11) Wrong spark gap.	Readjust breaker points (par. 64).

*c. Loss of power.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Engine missing intermittently.	See <i>b.</i> above for causes and corrections.
(2) Engine out of time.	Retime engine (par. 66).
(3) Valves or valve seats worn or leaking.	Regrind valves.
(4) Piston rings broken, stuck in grooves or worn.	Replace rings and clean ring grooves in piston.
(5) Tappets sticking or set too close.	Readjust tappets or if sticking, remove and clean (par. 45).
(6) Worn pistons or rings.	Replace worn parts.
(7) Spark plugs leaking.	Tighten spark plugs in head. Replace plug gaskets if necessary (par. 69).
(8) Worn cylinders.	Rebore cylinders and install new oversize pistons and rings.
(9) Worn valve stems or guides.	Replace valves or guides.
(10) Valve springs weak or broke.	Replace springs.

<i>Probable cause</i>	<i>Possible remedy</i>
(11) Valve timing incorrect.	Correct timing (par. 66).
(12) Poor carburetor action.	Adjust carburetor (par. 74).
(13) Water or sediment in fuel filter.	Remove fuel filter sediment bowl and clean.
(14) Air cleaner clogged.	Wash element in suitable cleaning solution such as gasoline or fuel oil.
(15) Exhaust pipes or muffler restricted.	Clean or replace exhaust pipe on muffler (par. 85).

*d. Engine Knocking.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Loose or worn main bearings.	Replace main bearings.
(2) Loose or worn connecting rod bearings.	Adjust or replace bearings.
(3) Loose piston pins.	Replace pins with oversize pins or piston and pin assembly.
(4) Worn cylinder bores and pistons.	Rebore cylinders and install new oversize pistons.
(5) Tight piston pins.	Fit pins to proper clearance.
(6) Tight pistons.	Fit pistons to proper clearance.
(7) Overheated engine.	Allow engine to cool, then check radiator water level, hoses and connections. Stop any leaks and fill radiator.
(8) Lack of lubricating oil.	Fill crankcase with proper grade and quantity of oil (par. 24).
(9) Loose flywheel.	Overhaul.
(10) Excessive end play in camshaft.	Adjust with screw in gear cover (par. 211). See NOTE in paragraph 29.
(11) Idler gear shaft has excessive play.	Adjust with screw in gear cover (par. 211). See NOTE in paragraph 29.
(12) Bent connecting rod.	Check and straighten or replace if necessary.

*e. Explosion in Muffler.*

<i>Probable cause</i>	<i>Possible remedy</i>
Accumulation of unused gasoline in muffler caused by turning off ignition at too high rpm.	Allow engine to idle before turning off ignition switch.

*f. Valve noise.*

<i>Probable cause</i>	<i>Possible remedy</i>
Incorrect clearance of valve tappets.	Adjust valve tappet clearance (par. 45).

## 31. Fuel System

### a. Excessive Fuel Consumption.

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Carburetor not properly adjusted, indicated by black smoke in exhaust.	Check and adjust carburetor (par. 74).
(2) Fuel leaks.	Check fuel tank, lines, and connections.
(3) Sticking controls.	Lubricate control linkages; eliminate binding.
(4) Excessive idling of engine.	Shut off engine when not in operation.
(5) Excessive use of choke.	Warm engine to operating temperature before applying load if possible; also keep choke mechanism properly adjusted.
(6) Dirty air cleaner accompanied by lack of power.	Service air cleaner (par. 24j).
(7) Poor or weak ignition indicated by engine misfiring and puffs of smoke from the exhaust.	Check ignition system (par. 64).
(8) Dirty and improperly adjusted spark plugs.	Clean and adjust (par. 70).
(9) Engine overcooling.	Check thermostat (par. 53).

### b. Improper Idling.

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Sticking control rods or linkage.	Lubricate connections and eliminate binding.
(2) Idling screw not properly adjusted.	Adjust screw for even idling (par. 74).
(3) Carburetor fuel and air mixture not properly adjusted.	Adjust carburetor (par. 74).

## 32. Cooling System

### a. Engine Overheats.

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Lack of cooling solution, water, or antifreeze.	Refill system with water or antifreeze solution.
(2) Fan belt not properly adjusted.	Adjust fan belt for approximately 1-inch deflection (par. 54).
(3) Carburetor choke valve partly closed.	Adjust choke valve (par. 74).
(4) Thermostat sticking in closed position.	Test thermostat (par. 53). Replace if necessary.

- | <i>Probable cause</i>  | <i>Possible remedy</i>   |
|--|--|
| (5) Coating of calcium salts inside of cooling system.                               | Clean and flush cooling system (par. 51).  |
| (6) Dirt or insects in radiator air passages.  | Clean or blow out with compressed air.   |
| (7) Hose deteriorated. Cannot always be determined by condition of outside covering. | Inspect hose and tighten clamps. Replace hose if deteriorated.                   |
| (8) Inlet or outlet hose collapsed.  | Replace hose, using hose with an inner support if necessary.                     |
| (9) Water pump not functioning.  | Check and replace drive shaft.   |
| (10) Exhaust pipes restricted, usually noted by hissing sound in exhaust.            | Clean pipes and remove obstruction.  |
| <b>b. Engine Overcools.</b>  |  |
| <i>Probable cause</i>  | <i>Possible remedy</i>   |
| (1) Thermostat sticking open.  | Clean and test or replace thermostat (par. 53).                                  |
| (2) Weather or climatic conditions too cold to allow thermostat to hold temperature. | Cover radiator with a winter front to bring water temperature into proper range. |

### 33. Clutch

#### a. Clutch Slips.

- | <i>Probable cause</i>                     | <i>Possible remedy</i>  |
|---|---|
| (1) Improper adjustment.                  | Adjust.   |
| (2) Weak pressure spring.                 | Replace springs.  |
| (3) Sticking release sleeve.              | Check sleeve and pressure spring.   |
| (4) Worn facings on driven disc assembly. | Replace facings or disc assembly.   |
| (5) Facings saturated with oil.           | Clean clutch facings. Check oil seal in bell-housing, also pilot on flywheel. Do not overlubricate clutch shafts or bearings. |

#### b. Clutch Chatters.

- | <i>Probable cause</i>        | <i>Possible remedy</i>                      |
|------------------------------|---|
| (1) Oil on facings.          | Clean or replace facings.                   |
| (2) Sticking release sleeve. | Check pull back spring. If broken, replace. |

#### c. Clutch Rattles.

- | <i>Probable cause</i>                | <i>Possible remedy</i> |
|--------------------------------------|------------------------|
| (1) Loose release fork.              | Tighten fork.          |
| (2) Weak or broken pull back spring. | Replace spring.        |



### 34. Electrical System

#### a. Starting Motor Fails.

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Loose or dirty cable connections.	Clean and tighten terminals.
(2) Worn brushes.	Replace brushes (par. 61).
(3) Dirty or worn armature.	Clean, repair, or replace armature.
(4) Armature rubbing field coils.	Replace starter shaft bushings.
(5) Low battery voltage.	Check to be sure generator and regulator are working properly, then recharge battery.
(6) Burned circuit breaker.	Replace circuit breaker.
(7) Broken battery cables.	Replace cables.
(8) Burned commutator bars.	Recut commutator.
(9) Open or short circuits in armature or fields.	Check and repair.
(10) Defective starter switch (push button or solenoid).	Clean contacts and tighten terminals. Replace if necessary.

#### b. Generator Fails.

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Dry battery.	Refill cells with distilled water.
(2) Burned contacts on regulator units.	Clean or replace contacts.
(3) Grounded armature wires or terminal posts.	Replace wires and insulate terminals.
(4) Burned commutator bars.	Recut commutator.
(5) Worn or sticking brushes.	Clean or replace brushes (par. 61).
(6) Open circuits in field or armature.	Repair or replace defective parts.
(7) Brush springs weak or improperly adjusted.	Adjust or replace spring.
(8) Rough, dirty, or greasy commutator bars.	Clean commutator bars.
(9) High mica on commutator.	Undercut mica.
(10) Commutator out of round.	Recut commutator.

#### c. Generator noisy.

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Loose mountings.	Tighten mounting bolts.
(2) Worn or loose drive gear.	Tighten or replace drive gear.
(3) Worn bearings.	Replace bearings.

*d. Generator Output Excessive.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Generator field grounded.	Check wires for external ground.
(2) Regulator circuit breaker closed.	Adjust or repair circuit breaker. Check generator for damage.
(3) Defective regulator.	Replace regulator.

**35. Ignition System**

*a. Distributor Fails.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Breaker points not closing.	Check and adjust (par. 64).
(2) Breaker points defective.	Check and replace, if necessary (par. 64).
(3) Breaker arm grounded.	Replace arm.
(4) Defective cap or rotor.	Check and replace.
(5) Defective coil.	Replace coil.
(6) Defective condenser.	Replace condenser.
(7) Loose terminals or grounded wires.	Clean and tighten or replace.

*b. Engine Misfires at Low Speeds.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Distributor breaker point gap too small.	Check and adjust breaker points to proper gap (par. 64).
(2) Distributor breaker points too large.	Check and adjust breaker points to proper gap (par. 64).

*c. Engine Misfires at High Speeds.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Breaker arm spring tension weak.	Replace spring or spring and arm.
(2) Breaker point gap too large.	Adjust gap (par. 64).

*d. Engine "Pings" Under Load.*

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Timing too far advanced or incorrectly set.	Check and properly adjust (par. 66).
(2) Inferior grade of fuel.	Obtain proper type and grade of fuel.

*e. Engine Lacks Speed and Runs Hot.*

<i>Probable cause</i>	<i>Possible remedy</i>
Breaker cam retarded.	Readjust distributor and advance arm.

### 36. Battery Charging Ammeter

#### a. Erratic Pointer Movement.

<i>Probable cause</i>	<i>Possible remedy</i>
Defective ammeter.	Replace ammeter.

#### b. With Ignition Off, Pointer Away from Zero.

<i>Probable cause</i>	<i>Possible remedy</i>
Defective ammeter.	Replace ammeter.

**Caution:** Always open battery circuit before disconnecting lead wires.

### 37. Lubrication System

#### a. Low Oil Pressure.

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Insufficient oil in crankcase.	Fill to bring oil to 4/4 mark on oil level gage.
(2) Oil thinned by crankcase dilution.	Drain crankcase and fill (par. 24).
(3) Oil pump defective.	Replace oil pump.
(4) Leak in oil system.	Tighten or replace faulty tubing and fittings.
(5) One or more loose bearings.	Replace bearings.
(6) Oil pump strainer screen in oil pan is clogged.	Clean screen.
(7) Oil too hot, resulting in low viscosity.	Replace with oil of proper specification (par. 24).
(8) Pressure regulator piston worn or clogged with carbon.	Clean and adjust piston.
(9) Oil pressure gage defective.	Replace gage.
(10) Oil pressure gage line bent or clogged.	Straighten or replace line.

#### b. Excessive Oil Consumption.

<i>Probable cause</i>	<i>Possible remedy</i>
(1) Oil leaks at gaskets, screws, oil seals.	Tighten screws or replace oil seals and gaskets.
(2) Worn or broken rings.	Replace rings.
(3) Piston improperly fitted or installed.	Correct or replace piston.
(4) Cylinder bores out of round or excessive taper.	Rebore cylinders and install new pistons and rings.
(5) Carburetor fuel mixture too rich.	Adjust carburetor (par. 74).

*a. Exhaust Smoking.*

*Probable cause*

*Possible remedy*

- |   |   |
|---|---|
| (1) Too much oil in crankcase.                      | Keep oil level at 4/4 mark on oil level gage. |
| (2) Fuel mixture too rich.                          | Adjust carburetor (par. 74).                  |
| (3) Piston rings worn beyond permissible clearance. | Replace rings.                                |

**38. Mechanical Systems**

*a. Bearing Failures.*

*Probable cause*

*Possible remedy*

- |   |   |
|---|---|
| (1) Continuous overspeeding of the engine.              | Avoid continuous operation at maximum speed.  |
| (2) Lack of oil.  | Keep oil level at 4/4 mark on oil level gage.   |
| (3) Inferior grade of oil or oil of improper viscosity. | Use good quality oil of proper viscosity (par. 24).   |
| (4) Bent connecting rod.                                | Replace connecting rod.   |
| (5) Low oil pressure.                                   | Adjust oil pressure (par. 129).   |
| (6) Crankshaft rough or out of round.                   | Regrind or replace shaft.   |
| (7) Restricted oil passages.                            | Clean oil lines and passages.   |
| (8) Bearings loose or improperly fitted.                | Adjust or replace main or connecting rod bearings.  |
| (9) Dirt or other matter in lubricating oil.            | Use clean oil and service breather air filter regularly. Replace oil filter cartridges (par. 24). |

*b. Poor Compression.*

*Probable cause*

*Possible remedy*

- |                          |   |
|--------------------------|---|
| (1) Piston rings worn.   | Replace rings.                                  |
| (2) Valves holding open. | Replace weak or broken valve springs (par. 44). |

**39. Radio Interference Suppression System**

*a. Radio Produces Whirring Sound.*

*Probable cause*

*Possible remedy*

- |   |                     |
|---|---------------------|
| (1) Capacitors defective.                       | Replace capacitors. |
| (2) Capacitor or bonding strap mountings loose. | Tighten mountings.  |

*b. Radio Produces Popping Sound.*

*Probable cause*

*Possible remedy*

- |   |                    |
|---|--------------------|
| (1) High tension cables broken or frayed. | Replace cables.    |
| (2) High tension cable mountings loose.   | Tighten mountings. |

## 40. Fungus Control System

### *Tropicalization Coatings Wear Off.*

<i>Probable cause</i>	<i>Possible remedy</i>
Paint does not adhere to metal.	Clean exposed parts and repaint with corrosion-resistant varnish.

## Section V. RADIO SUPPRESSION SYSTEM

### 41. Description

(fig. 29).

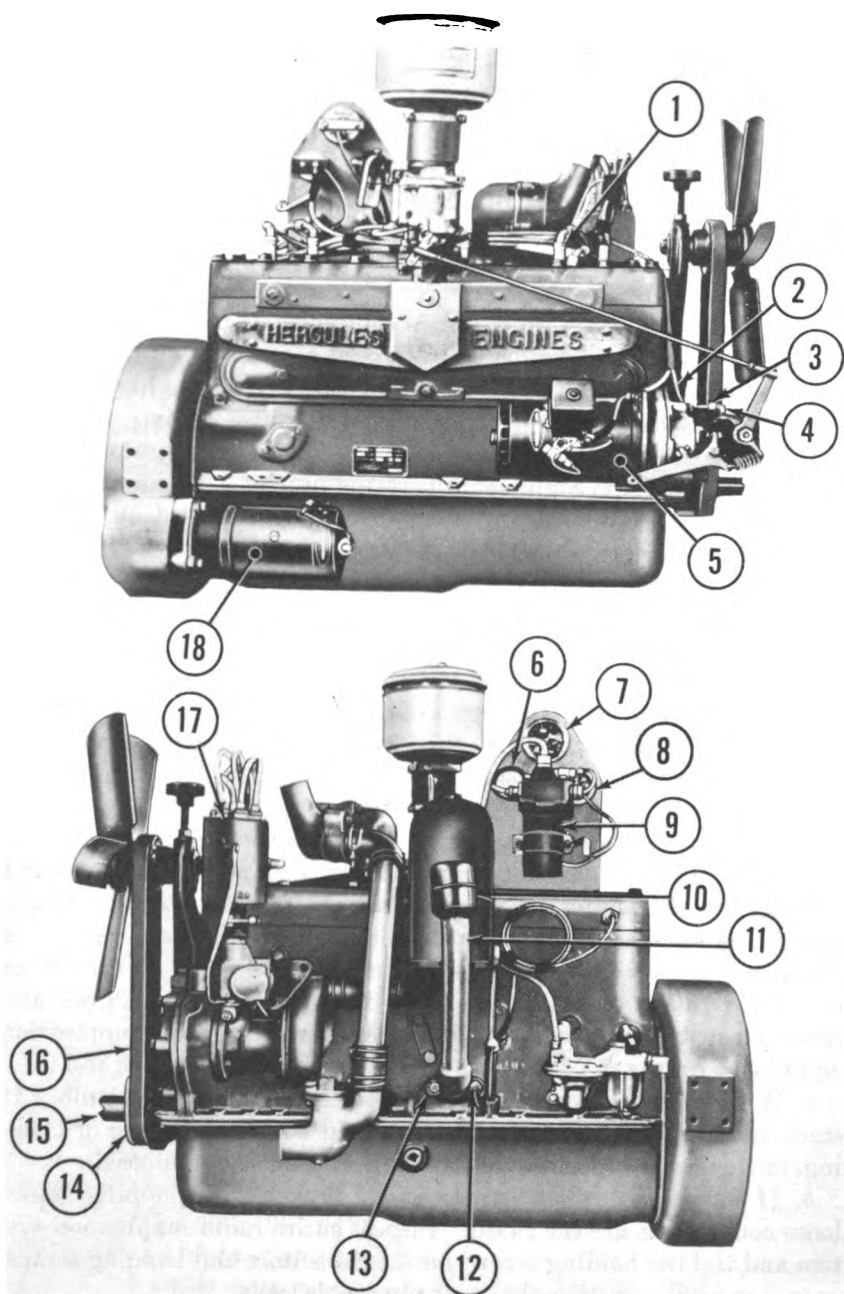
The purpose of radio interference equipment is to shield electrical waves set up by operation of the electrical accessories on the engine. For instance, when the distributor rotor cam breaks the high tension circuit to the spark plugs, strong electrical waves radiate from the engine. If these waves are not suppressed, they are picked up as severe static by radio equipment operating nearby. To guard against static interference, shielding or capacitors are installed on the following electrical accessories:

- a. Generator (5) and wiring.
- b. Spark plugs (1) and leads.
- c. Starting motor (18) and wiring.
- d. Ammeter (8) on instrument bracket and shielded wire lead.
- e. Ignition coil (9), wiring, and bond strap.
- f. Ignition distributor (17), shielded wiring, and bond strap.

### 42. Testing Radio Suppression Units

The above units rarely need service. However, if improperly installed, the metal cables containing low and high tension wiring might rub against the engine or adjacent metal parts and wear through, permitting electrical impulses to lead to ground. The capacitors (or condensers) may develop a ground inside their cases. There is no repair for frayed or broken cables, or for inoperative capacitors, and these must be replaced. To locate inoperative radio suppression equipment on the JXD engine, make the following simple test:

- a. With engine running at idling speed, operate the radio. If static noise is a continuous whirring sound without popping or clicking, one or more capacitors are at fault and must be replaced.
- b. If static noise is a whirring sound, broken with popping noises, loose connections are the cause. Inspect entire radio suppression system and tighten holding screws on the capacitors and bonding straps, as well as holding nuts on the spark plug cable leads.
- c. If static noise is a continuous popping sound, the high tension circuit has shorts or leaks to ground. Tighten holding nuts on the spark plug cable leads, and inspect all cables to be sure none are resting directly on the cylinder head. Check the cable holding nuts at



*Figure 29. Location of radio suppression equipment.*

coil head and distributor head. Tighten if necessary. Replace any cables which are broken or frayed.

## Section VI. CYLINDER HEAD AND VALVES

### 43. Cylinder Head and Gasket

(fig. 30)

a. The L-head type cylinder heads (1) used on JXC and JXD engines are one-piece castings. The joint made by the union of the cylinder head with the cylinder block is sealed with a gasket (2). The gasket is constructed in layers consisting of two sheets of soft metal, with a sheet of asbestos between. When the cylinder head screws are tightened, this gasket forms a leakproof seal to keep water in the cylinder head water jacket from leaking into the cylinders, and to keep combustion gases from blowing out on the power strokes.

b. On new or reconditioned engines, check all cylinder head bolts for tightness at the first weekly service. With a torque wrench, go over the cylinder head screws, tightening each in proper sequence, beginning with head screws 1 and 2 in the center of the cylinder head (3). Proper torque wrench tension for JXC and JXD engine cylinder head screws is 75 ft.-lb.

c. *Cylinder Head Removal.* When it is necessary to remove the cylinder head, proceed as follows:

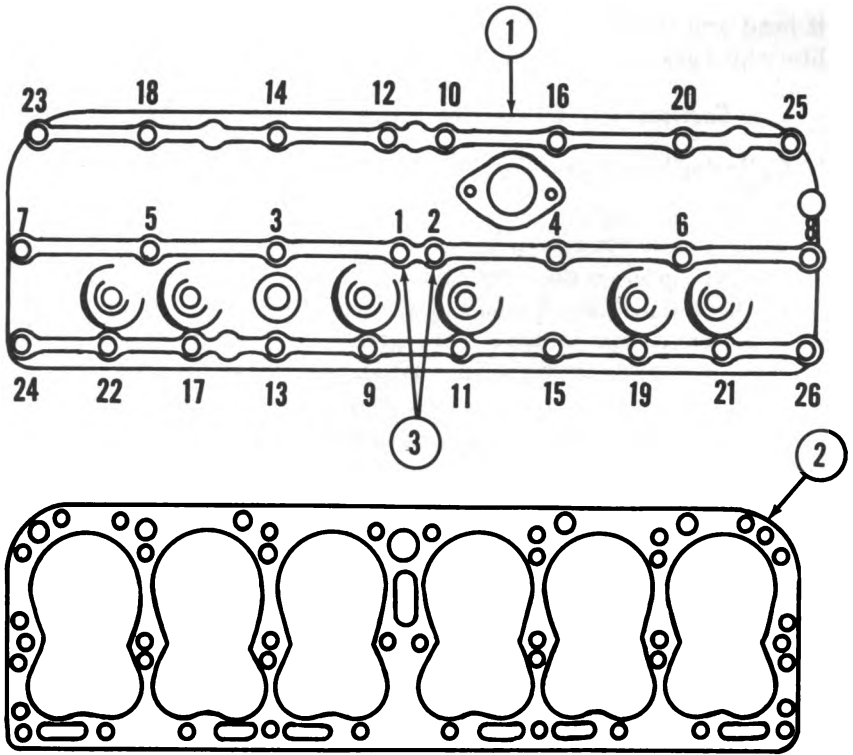
- (1) Drain the cooling system.
- (2) Remove the water outlet pipe and hose.
- (3) Remove ignition cables, air cleaner brackets, instrument panel and other assemblies attached to head.
- (4) Remove the spark plugs.
- (5) Loosen and remove all cylinder head cap screws.
- (6) Remove the cylinder head. If it is frozen to the block, free-up by tapping lightly with soft hammer.

d. *Installation.* Before installing the cylinder head, clean carbon from the cap screw holes and from inside combustion chambers. Replace the head gasket. Spread a layer of light grease on both sides of the gasket before placing on block. Do not use gasket cement.

---

1 Spark plugs	11 Oil filler and breather pipe
2 Governor lubricating tube	12 Screw, cap, ½"-13 NC x 1¼" (2 req'd)
3 Governor lubricating tube union	13 Lockwasher, ½" (2 req'd)
4 Governor lubricating tube elbow	14 Fan drive pulley
5 Generator	15 Starting crank grab
6 Oil pressure gage	16 Fan belt
7 Water temperature gage	17 Distributor
8 Ammeter	18 Starting motor
9 Ignition coil	
10 Oil filler and breather cap	

Figure 29—Continued



1 Cylinder head  
2 Gasket

3 Center mounting holes

*Figure 30. Cylinder head and gasket.*

**Caution:** The bead, or rolled edge around the combustion chamber openings of the gasket, must face down.

- (1) Grasp the cylinder head at ends and place it on block. Line up cap screw holes by starting a cap screw at each end of the head.
- (2) Assemble all cables and brackets which are held in place by the cylinder head cap screws.
- (3) Place all cap screws in holes and start with fingers.
- (4) Tighten cap screws down in numerical order (1 through 26, fig. 30) with a torque wrench, working progressively from the two center holes (3).
- (5) Refill cooling system.
- (6) Use a new gasket on all new spark plugs and install plugs and other attachments as removed.
- (7) After operating engine for approximately 30 minutes, retighten all cap screws to a torque-wrench tension of 75 pounds.



## 44. Valves and Valve Springs

(fig. 31).

Valves are accessible by removing the cover plates on the right side of the engine cylinder block. Tappets may then be set to proper clearance by means of adjusting screws and lock nuts. Engine intake and exhaust valves (1) operate in valve guides (2), which are pressed into the cylinder block. These valves are held in place by strong steel springs (3) which are in turn fastened to the valve stem by a spring retainer (4) and lock key (5). When it is necessary to replace valves or springs, or regrind and reseat valves, proceed as follows:

*a. Removal.* The cylinder head must be taken off (par. 43c) to remove valves. When the cylinder head has been removed, proceed as follows:

- (1) Remove valve tappet covers on the right side of engine under the manifold.
- (2) Stuff rags in the opening around the tappet seats to prevent dropping dirt or parts in the oil pan as valve lock keys are removed.
- (3) Remove the valve spring seat locks by lifting springs with a spring lifter tool, and drawing out lock key with fingers.
- (4) Lift valves from cylinder block and place in cardboard or wood holder which is drilled and numbered, so that all valves may be returned to their original seats when reinstalled.

**Caution:** Never mark valves with a file or punch. Use a numbered container to keep valves in proper numerical order.

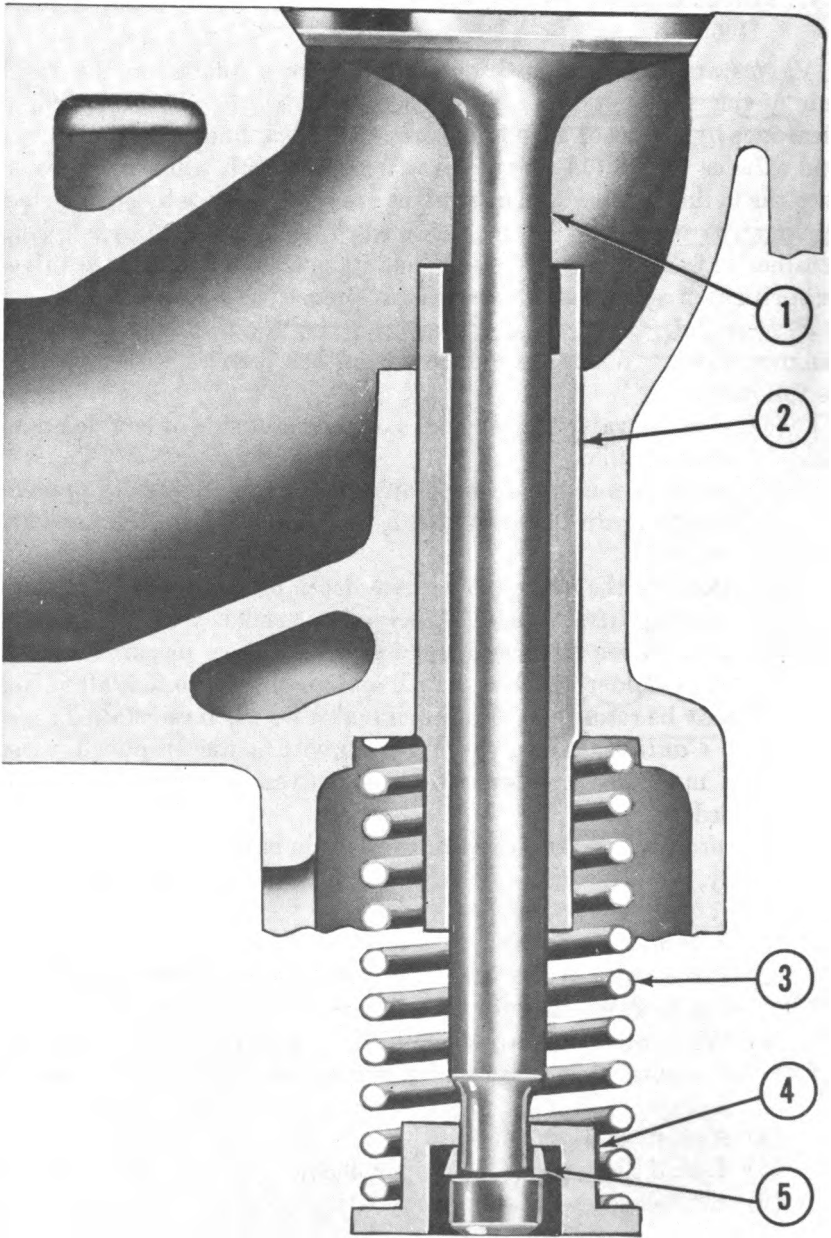
*b. Installation.* Before replacing valves in engine, clean the valves thoroughly, put a few drops of light oil on the valve stems, and install as follows:

- (1) Insert valves in the cylinder head.
- (2) Use a valve spring lifter to compress the valve springs, and slip lock keys in place with fingers.
- (3) When all valves are assembled in springs and lock keys are in position, remove rags from the opening around the tappet seats.
- (4) Adjust tappets (par. 45).
- (5) Install the cylinder head (par. 43d).
- (6) Replace tappet covers.

## 45. Adjusting Tappets

(fig. 32)

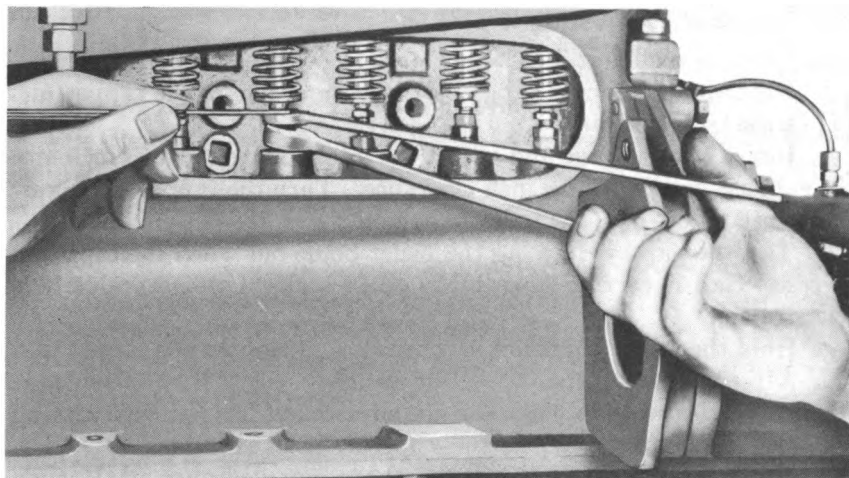
*a. Tappet Assembly.* The valve tappet assembly is of the "mush-room" type. The tappet consists of three pieces; the valve tappet or push rod, the valve tappet screw, and the valve tappet screw locknut. These parts, assembled, form the complete tappet and operate with the



1 Valve  
2 Valve guide  
3 Valve spring

4 Spring retainer  
5 Key

*Figure 31. Valve and spring.*



*Figure 32. Adjusting tappets.*

mushroom riding the cam on the camshaft, and the head of the tappet screw in contact with the valve stem. The tappet slides in a tappet guide made of cast iron which is pressed into the cylinder block.

*b. Tappet Adjusting Sequence.* Tappet adjustment is simple, but important to good engine performance. To adjust tappets, make certain engine is stopped and cold. Then remove tappet covers and determine which tappets are to exhaust valves and which are to intake valves by referring to the tabulation below—

*Valve tappets numbered from front to rear of engine*

Tappet No.	1	2	3	4	5	6	7	8	9	10	11	12
Function	Exhaust	Intake	Intake	Exhaust	Exhaust	Intake	Intake	Exhaust	Exhaust	Intake	Intake	Exhaust

- (1) Crank the engine over by hand until the number six exhaust valve just closes and the intake valve just starts to open. Continue to turn the engine one-half revolution to be certain the cam is out from under the lifter. The number one piston is now approximately at top dead center (TDC) and both the intake and exhaust valves are in position for adjusting.
- (2) Set valve clearance in number one cylinder. After adjusting tappets for number one cylinder, turn the engine over until number two cylinder exhaust valve just closes and intake valve just starts to open. Turn engine one-half revolution, then adjust tappets for cylinder number five. Follow this procedure, adjusting tappets in firing order.

## 46. Clearance Adjustment

- a. Position piston at TDC (par. 45*b*(1)) to set valve clearance.
- b. Hold the push rod (8, fig. 105) rigid and loosen the tappet nut (7) on the tappet screw (6).
- c. Insert a feeler gage and adjust the intake valve to 0.008 inch and the exhaust valve to 0.010 inch clearance. Turn the tappet end screw to right to reduce gap, left to increase gap.
- d. Test the gap by drawing the feeler blade out when the tappet is at rest. Gap is correct when blade offers a slight resistance as it is withdrawn.
- e. Hold the adjusting screw stationary, and tighten the tappet nut.
- f. After tightening the tappet nut securely, check with feeler gage for proper clearance to make certain adjustment has not been altered while tightening nut. Repeat these operations at all valves.
- g. For a hot engine, if the tappets have any clearance at all when the engine is operating, the valves are seating.

## 47. Cylinder Compression Test

A compression test is made to determine the need of internal repairs before tune-up procedures are undertaken. This test will indicate the condition of piston rings and the valve mechanism. Compression pressure depends upon cranking speed, engine temperature, oil viscosity, compression ratio, and condition of the engine. An engine without fairly even compression cannot be tuned properly. Make the test in the following manner:

- a. Remove all spark plugs after blowing dirt out of the wells. Turn ignition switch OFF and open the carburetor throttle all the way. Insert a compression gage in No. 1 spark plug hole. Turn the engine over with starting motor. Note the highest gage reading while engine is being cranked. Take a reading of each cylinder in the same manner.
- b. While compression reading on some engines may be higher than on others due to conditions given above, all cylinders in any one engine should show uniform readings within approximately 10 pounds.
- c. Should one or more cylinders show readings indicating low compression, pour a liberal amount of light engine oil through the spark plug hole in the cylinder having the low reading. If compression is appreciably increased in the cylinder so treated, piston or rings require replacement. If no change in compression reading occurs, check the valve mechanism.
- d. An extremely low reading in two adjacent cylinders may indicate a cylinder head gasket leak.

## 48. Cylinder Compression Test—Alternate Method

The manufacturer of the JXC and JXD engines does not recommend cylinder compression testing by turning the engine over with

the starting motor. By so doing, the compression reading obtained on cylinders after the first one tested are less than such readings would normally be due to the decreasing strength of the battery. When an average of compression readings for all cylinders tested by this method is obtained, the last cylinder so tested will be below the average. Because of such results, overhaul work is often undertaken when it is not necessary.

*a.* Warm the engine to operating temperature of 160° to 180° F.

*b.* Stop the engine and remove two spark plug wires from plugs at rear of the engine.

*c.* Set the hand throttle at wide open position.

*d.* Start the engine. With two plugs not firing, it will run at fast idle, or about 900 to 1,100 rpm.

*e.* Remove the spark plug wire from number 1 cylinder at front of engine, and remove number 1 spark plug.

*f.* Screw threaded fitting of tester into spark plug hole.

*g.* Take the reading shown on tester dial. Replace plug and wire, and proceed to the next cylinder.

*h.* Before testing numbers 5 and 6 cylinders, remove spark plug wires from the front of the engine as needed so that two cylinders are out of service at all times during the test. This is to keep engine speed constant.

*i.* Test in this manner from cylinders 1 to 6, noting the readings for each cylinder.

*j.* Obtain a compression factor by averaging the readings of all the cylinders. Then compare the readings from each cylinder to the factor. If the compression of any cylinder falls 6 or more pounds below the factor, remove valve tappet covers and make sure no valve springs are broken. If valve springs are all right, refer the engine to field and depot maintenance for inspection and major repair.

## Section VII. COOLING SYSTEM

### 49. Description

Heat generated by combustion of fuel in the engine must be kept below prescribed limits, if the engine is to perform satisfactorily. The cooling system, which includes a radiator, fan, water pump and thermostat, performs this cooling function. When any component fails to operate for any reason, the engine overheats, and severe damage will result if the faults are not quickly corrected. Accumulations of rust and scale in the engine water jacket and in the radiator can restrict circulation of water through the system and cause overheating. Likewise, leaking hose connections from radiator to engine can cause loss of coolant. If hoses deteriorate, inner layers of fabric may work loose and obstruct the flow of coolant. A faulty thermostat may also prevent proper circulation. One of the most common causes of

cooling system failure is accumulation of mineral salts and rust in the radiator tubes and engine water jacket. This restricts the flow of coolant, and the system must be flushed.

## 50. Radiator

*a. General.* The radiator is part of the cooling system which insures that the engine is effectively kept cool. Water enters the top tank, flows through the core of the radiator where the fan cools the water as it passes, and then the cool water goes out the bottom tank and into the engine. Replacement of the radiator is handled in the field but repair is referred to third or higher echelons.

### *b. Removal of Radiator.*

- (1) Remove bolts (2, fig. 57) and lockwashers (6) from radiator braces (13), then push braces to the side.
- (2) Remove cap screw (3) and lockwashers (5) that secures upper hose (7) to radiator. Remove gasket (4).
- (3) Remove lower hose (22, fig. 33) by removing cap screws (15) and lockwashers (4).
- (4) Remove cap screws (23) and lockwashers (24) that holds the radiator to the front support (20).
- (5) Use a hoist to lift off the radiator. The pull should be up and out so as not to hit the fan.

### *c. Installation of Radiator.*

- (1) Position radiator on front support (20, fig. 33). Be sure that the blanked off outlet is on the right side.

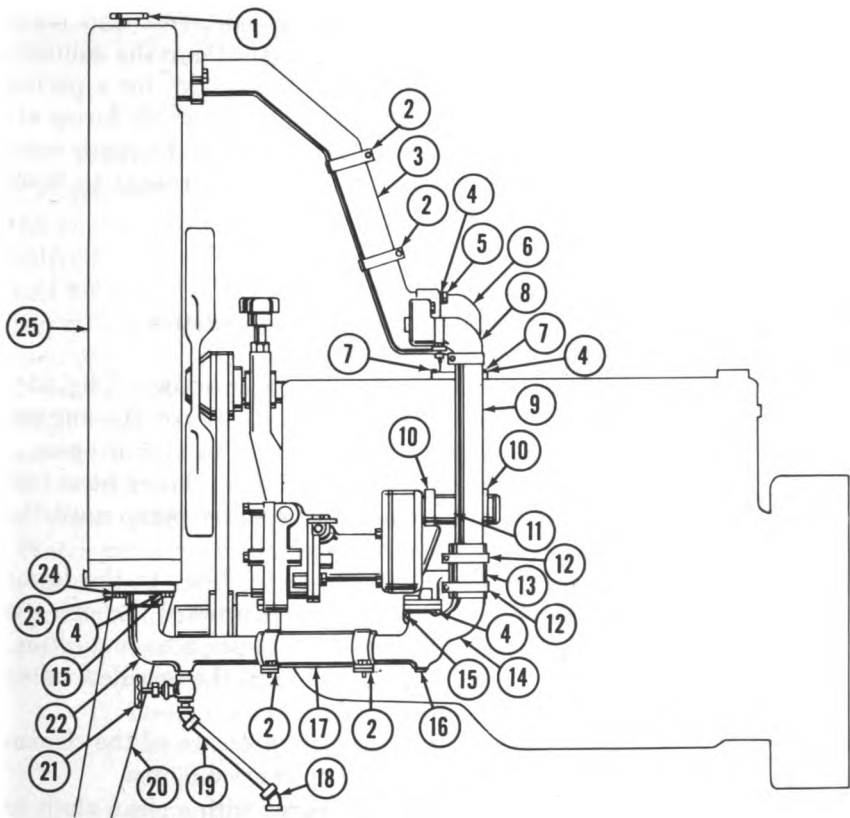
**Caution:** When lowering the radiator be careful not to hit the fan blades.

- (2) Secure radiator to front support with cap screws (23) and lockwashers (24).
- (3) Position radiator braces (13, fig. 57) and secure with bolts (2) and lockwashers (6).
- (4) Secure upper hose (7) to radiator with gasket (4), lockwashers (5) and cap screws (3).
- (5) Install lower hose (22, fig. 33) to radiator and secure with cap screws (15) and lockwashers (4). Reassemble blanked off outlet with gasket (15, fig. 73), radiator blank (14), lockwashers (13) and cap screws (12).

## 51. Cooling System Cleaning and Flushing

*a. Intervals.* The radiator should be drained and flushed regularly as follows:

- (1) On any occasion when the cooling system is restricted, due to accumulations of rust and scale.
- (2) When the engine is operated in alternate hot and cold climates. The engine should then be flushed in the Fall, before the cooling system is serviced and antifreeze added, and in



- |   |  |
|---|--|
| 1 Radiator filler cap   | 14 Water inlet pipe  |
| 2 Clamp   | 15 Screw, cap, $\frac{3}{8}$ "-16 NC x 1" (4 req'd)                  |
| 3 Hose, 2" dia. x 9 $\frac{1}{2}$ "                               | 16 Water inlet pipe plug   |
| 4 Lockwasher, $\frac{3}{8}$ " (9 req'd)                           | 17 Hose, 2" dia. x 11"   |
| 5 Screw, cap, $\frac{3}{8}$ "-16 NC x 1 $\frac{1}{8}$ " (4 req'd) | 18 Elbow, $\frac{1}{4}$ "  |
| 6 Water outlet pipe   | 19 Pipe, $\frac{1}{4}$ " x 13"                                       |
| 7 Nut, $\frac{3}{4}$ "-16 NF brass, (2 req'd)                     | 20 Front support   |
| 8 Bypass tube elbow   | 21 Globe valve, $\frac{1}{4}$ "                                      |
| 9 Bypass tube   | 22 Lower hose  |
| 10 Water pump discharge hose clamp                                | 23 Screw, cap, $\frac{5}{8}$ " x 11 NC x 1 $\frac{1}{2}$ " (2 req'd) |
| 11 Water pump discharge hose                                      | 24 Lockwasher, $\frac{5}{8}$ " (2 req'd)                             |
| 12 Bypass tube hose clamp   | 25 Radiator  |
| 13 Bypass tube hose   |  |

Figure 33. Cooling system, external parts.

the Spring to get rid of the old antifreeze and rust and scale accumulated during the Winter.

- (3) When the engine is operated in a continuously warm or cold climate, the cooling system should be flushed once a year.
- (4) When the engine is operated continuously in areas where water used for cooling has high mineral salts content, the cooling system should be flushed every three months.

*b. Methods.* Before flushing the cooling system, rust and scale should be loosened by a good cleaning solution. Pour the solution into the radiator and allow it to circulate in the system for a period while the engine is in operation. Use a flushing gun, which forces air and water through the system by compressed air, or the more common method of back-flushing with a water hose. Proceed to flush the cooling system as follows:

(1) *Radiator.*

- (a) Remove the radiator filler cap (1, fig. 33).
- (b) Open valve (21) and completely drain radiator.
- (c) Close valve and replace the filler cap.
- (d) With a screwdriver, loosen clamps of upper hose (7, fig. 55). Slide the hose down over lower pipe toward the engine, so the end of the upper pipe from the radiator is open.
- (e) With a screwdriver, loosen clamps of the lower hose (22, fig. 33) and slide it back toward the water pump until the end of the pipe to the radiator is open.
- (f) Insert a water hose, or air-and-water hose, in the lower opening to the radiator. Flow water upward through the radiator to be expelled from pipe at upper hose connection.
- (g) Back-flush for several minutes or until the expelled water runs clear.

**Caution:** Make certain that the pressure of the stream of water or air and water does not exceed 90 psi.

- (h) Wipe ends of upper and lower pipes with a clean cloth or waste.
- (i) Apply a thin coat of gasket shellac to the pipe ends, slide hoses in place, and tighten clamps.
- (j) Fill the radiator with clean water or antifreeze solution, allowing room for expansion when liquid is hot. Use rust inhibitors to help retard rust and scale accumulations in the cooling system.

(2) *Engine.*

- (a) Remove thermostat (par. 53).
- (b) With a screwdriver, loosen clamps on the water pump discharge hose (11, fig. 33). Remove the hose. Back flushing will now bypass both the thermostat and water pump.
- (c) Insert a water hose or air-and-water hose in the opening through the cylinder head and apply stream. Water will be forced down through the water jacket passages and expelled from the water inlet connection on the oil filter.
- (d) Flush for several minutes or until water runs clear.
- (e) Install thermostat (par. 53).
- (f) Apply gasket shellac to ends of water pump outlet connec-



tion, and oil filter water inlet connection. Slip hose (11, fig. 33) over pipe ends and tighten clamps.

*Note.* Flush radiator and engine block in separate operations in order to bypass thermostat and water pump.

## 52. Water Pump

*a. General.* The water pump forces circulation of coolant through the engine and radiator. The fan draws air through the radiator to help cool water in the radiator tubes. This air is blown past the engine and helps cool the cylinder block. The water pump consists of a housing with a water inlet, water outlet and an impeller. The impeller is mounted on the pump shaft. When rotated, it forces cooled water from the radiator into the engine block. Water pumps on JXC and JXD engines are mounted on the lower left front of the engines and are driven by the timing gears. A spiral gear mounted on the pump shaft in turn drives the distributor.

Water pump trouble in the field is handled by replacing the unit. Water pump repair is referred to third or higher echelons. The water pumps used on JXC and JXD engines are the packless, or auto seal type, and must be disassembled for repairs, if leaks develop at the bushings sealing the pump shaft.

### *b. Removing Water Pump.*

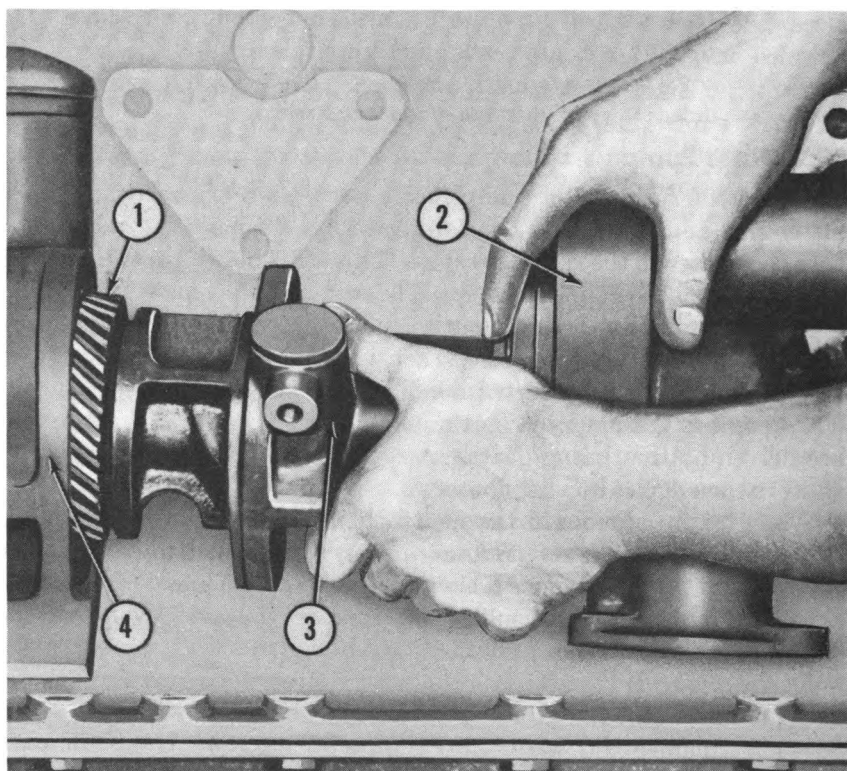
- (1) Drain the radiator and cylinder block.
- (2) Remove the water outlet pipe (6, fig. 33) from pump to cylinder block.
- (3) Remove the water inlet pipe (14) from radiator to pump.
- (4) Remove the water pump discharge hose (11) and clamps (10).
- (5) Disconnect the primary wire from the distributor, and remove the distributor cap.
- (6) Remove three cap screws holding pump (3, fig. 34) to gear case (4), and draw the pump back out of the gear case.

*Note.* When an hour-meter is installed between the pump and distributor, the cap screw holding the hour-meter to the pump must be removed and meter and distributor lifted off before the pump can be removed.

**Caution:** Do not twist or pry pump as it is disengaged from timing gears, or you may damage the drive gear and pump shaft.

## 53. Thermostat

The thermostat enables a cold engine to warm up to operating temperature faster by automatically stopping the circulation of water to the radiator. The thermostat is located in the water passage between the radiator and the cylinder head. Its function is to prevent cold water in the radiator from entering the engine block, until water in the engine has been heated to about 150° F. While the thermostat



1 Drive gear  
2 Pump cover

3 Pump body  
4 Gear case

*Figure 34. Removing water pump.*

prevents cold water in the radiator from flowing into the engine water jacket, it does allow some water to circulate from the engine into a bypass tube to the inlet side of the water pump, where it is again recirculated through the engine. When the water reaches 150° F., the thermostat starts to close off the bypass and begins to open the passage to the radiator. Cooling liquid in the engine and radiator is then allowed to circulate freely, and the thermostat opens and closes as needed to keep the water within the heat range for JX engines. This is between 160° F. and 180° F. There is no repair for a broken or inoperative thermostat. The unit must be replaced. The following simple test may be made to determine whether or not a thermostat is functioning properly:

*a.* Remove four attaching screws (5, fig. 33) from the water outlet pipe (6).

*b.* Push water outlet pipe and hose aside and lift thermostat (1, fig. 35) out of the housing (2). If thermostat is stuck to seat, break loose with palm thrusts. Do not strike the thermostat with a tool or other object.

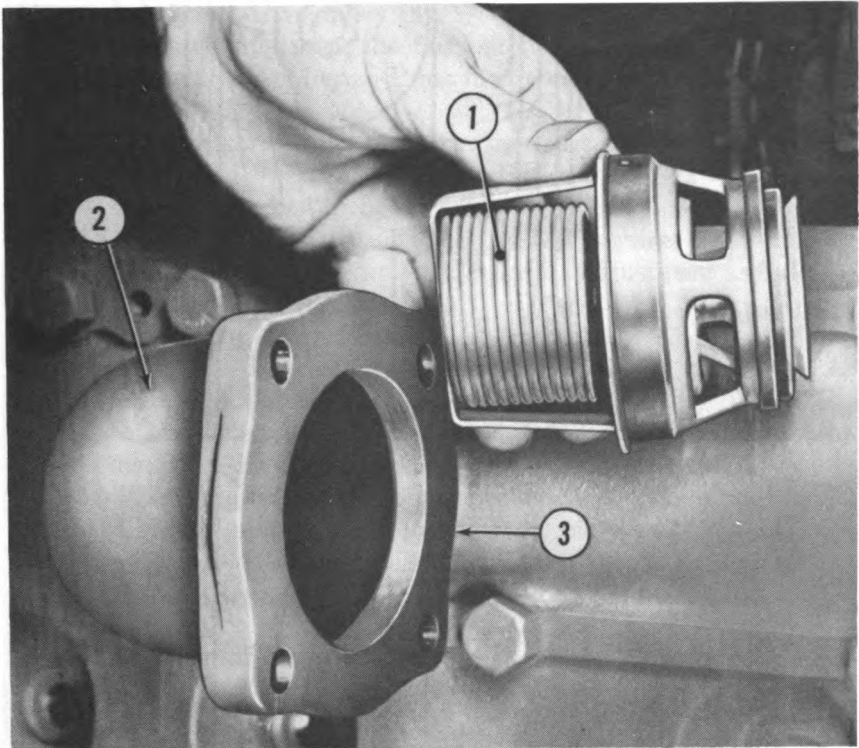
c. Place thermostat in a pail containing four inches of water. Have the bellows completely submerged.

d. Place a thermometer in the water.

e. Now heat the water slowly, and observe at what temperature thermostat starts to open.

f. The thermostat should start to open at 150° F., and be fully open at 175° F. Five degrees over or under are permissible. If the thermostat does not perform satisfactorily in this test, replace the unit.

g. Insert thermostat (1, fig. 35) in housing (2).



1 Thermostat

2 Thermostat housing

3 Thermostat housing gasket

Figure 35. Installing thermostat.

h. Position water outlet pipe (6, fig. 33) and hose over housing and tighten the four screws (5).

**Caution:** If thermostat housing gasket is scored or torn during removal, replace the gasket.

## 54. Fan Belt Adjustment

(fig. 36)

The fan assemblies used on both JXC and JXD engines are driven by V-belts from a pulley mounted on the front end of the crankshaft.

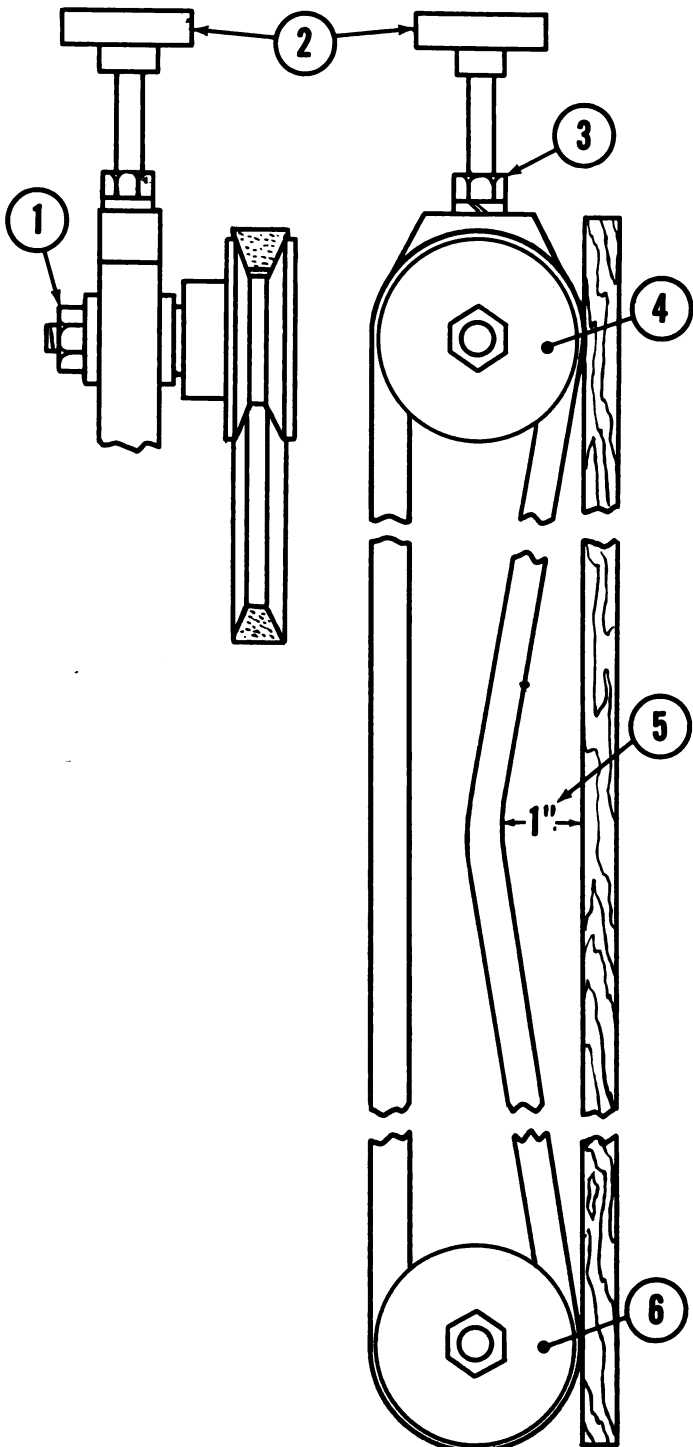


Figure 36. Adjusting fan belt.

The V-belt is subject to high friction as it runs around the crankshaft pulley and the pulley on the fan hub. Wear and stretch slowly develop, and are noticed when slack appears in the belt, or when the belt slides around the pulley without driving the fan. A hot-running engine is frequently caused by a loose, slipping fan belt. To prevent this condition, inspect the fan and belt at regular intervals and adjust belt tension as follows:

*a. Testing Belt Tension.* Place a yardstick, or other straightedge, parallel to the fan belt, with ends resting against the fan hub pulley (4) and crankshaft drive pulley (6).

- (1) With thumb, press the fan belt inward at a point mid-way between the pulleys. Press firmly enough to take out slack, but do not force.
- (2) With a short rule, measure the deflection (5) between the straightedge and the deflected belt. The gap should be approximately 1 inch.

*b. Adjusting Belt Tension.* If the fan belt requires tightening or loosening after this test is completed, make the adjustment as follows:

- (1) Loosen the spindle nut (1).
- (2) Loosen the locknut (3).
- (3) Turn the knurled handwheel (2) clockwise to tighten, or counterclockwise to loosen the fan belt.
- (4) Make deflection test (*a* above) after each adjustment of the handwheel.
- (5) When the belt has 1-inch deflection inside the straightedge, tighten the handwheel locknut (3) and spindle nut (1).

## Section VIII. ELECTRICAL SYSTEM

### 55. Description of Electrical System

(fig. 37)

The engine electrical system includes all high and low tension wiring necessary to connect all components of the system, all the electrical accessories necessary to run the engine, and the generating unit which makes the current for the electrical system. The major components of the JXC and JXD engine electrical systems are:

- a.* Generator (7).
- b.* Storage battery (6).
- c.* Ignition switch (2).
- d.* Starter switch (4).

---

1 Spindle nut

2 Knurled handwheel

3 Locknut

4 Fan hub pulley

5 Fan belt deflection

6 Crankshaft drive pulley

*Figure 36—Continued*

- e. Starting motor (5).
- f. Ignition coil (1).
- g. Ignition distributor (9).
- h. Spark plugs (10).

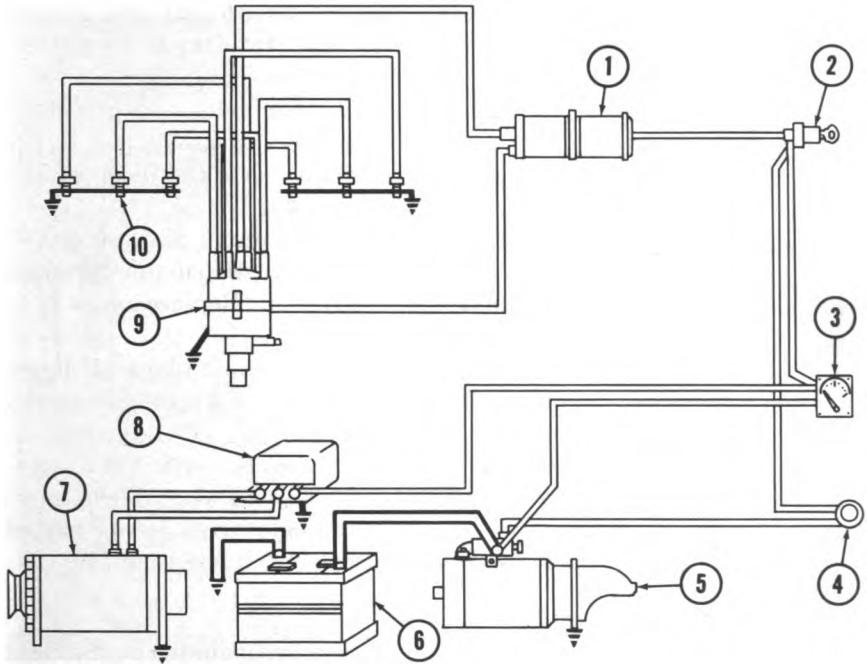
The ignition, or high tension current, supplies the electric sparks required to ignite the compressed mixture of fuel and air in the engine cylinders. This spark must occur in a cylinder at the exact instant a piston reaches the proper position in the cylinder. A spark which fires too early or too late deprives the engine of its maximum power and results in unnecessary wear. An early spark ignites the fuel mixture before it is fully compressed. The piston receives the downward thrust of the exploding fuel while still traveling upward, thus being subjected to abnormal stresses on piston, pin, rod, and bearing. Early firing can result in broken pistons, bent connecting rods, and flattened bearing and crankshaft surfaces. Late firing explodes the fuel charge after the piston has started down. Since the power thrust must "catch-up" with the retreating piston before it can exert force, a portion of the power in the fuel charge is lost. Often the entire fuel charge is not burned, and gasoline blows by the piston, diluting the oil in the pan. This dilution renders lubrication less effective, resulting in accelerated wear in all parts of the engine. Therefore, it is important that ignition timing be correct. When any part of the ignition system is suspected of improper functioning, a check to locate the failing unit should begin with inspection of battery and cables, and proceed to coil, distributor, condenser, low and high tension wiring, and finally the spark plugs. Watch for worn or frayed insulation on high tension wiring. These conditions permit high voltage current to leak to ground, weakening the surge at the spark plug. Watch for carbonized paths in the distributor cap, rotor and coil head. These also permit high tension leakage.

## **56. Wiring System** (fig. 37)

The engine wiring system consists of all low and high tension cables and leads necessary for the proper operation of the electrical system.

### *a. Cleaning and Inspection of Wiring.*

- (1) Remove cables from the battery (6). Push these aside and wash down battery. If corrosion around the terminals is severe, apply ordinary soda and water to all corroded areas and then wash the battery clean.
- (2) Turn the battery cable clamp holding nut out until jaws of the clamp are well open. Clean inside of clamp by scraping until the metal is bright. If cables and clamps are corroded, treat these with soda and water to neutralize the acid corrosion.



- |                   |                     |
|-------------------|---------------------|
| 1 Ignition coil   | 6 Battery           |
| 2 Ignition switch | 7 Generator         |
| 3 Ammeter         | 8 Voltage regulator |
| 4 Starter switch  | 9 Distributor       |
| 5 Starting motor  | 10 Spark plugs      |

*Figure 37. Electrical system wiring diagram.*

- (3) Check the battery ground cable. If any looseness exists, remove the bolt holding the ground cable to the frame and clean the metal at the ground surface. Tighten the grounding bolt securely when reconnecting the battery ground.
- (4) Follow the high-tension cable, cleaning off oil and dirt with cloth dipped in cleaning solvent. Check the cable for worn spots, or for frayed insulation. Clean the contacts at terminals.
- (5) Remove the cable from the terminal on the starting motor (5) and clean the contact surfaces. Follow the cable and clean with cloth dipped in cleaning solvent. Note any worn or frayed insulation.
- (6) Follow the low-tension wiring from starting motor (5) to ammeter (3) and to the generator (7). Clean oil and dirt from the wire and look for worn spots or frayed insulation. Clean all terminals and check all ground connections for clean and tight contacts.

- (7) Check the wiring to the ignition switch (2) and starter switch (4). Clean wires and watch for frayed insulation. Check the terminals and clean contact surfaces.
- (8) Clean wiring to the ignition coil (1) and note worn or frayed spots in insulation. Clean contacts at terminals and in the distributor cable tower. Clean and check condition of the high-tension cable from coil to distributor.
- (9) Remove all spark plug leads from towers in distributor (9) and clean contacts. Clean and tighten distributor terminal ground. Check condition of all cables. Replace spark plug leads in proper distributor towers.
- (10) Remove spark plug cables from the spark plugs (10) and clean contacts. Install the cables on the proper plugs and make sure the connections are tight.

*b. Wiring Replacement.* There is no permanent repair for worn, broken or frayed wiring. Replace the units entirely. When emergency repairs are necessary, these may be made by soldering parted wires and wrapping worn insulation with tape.

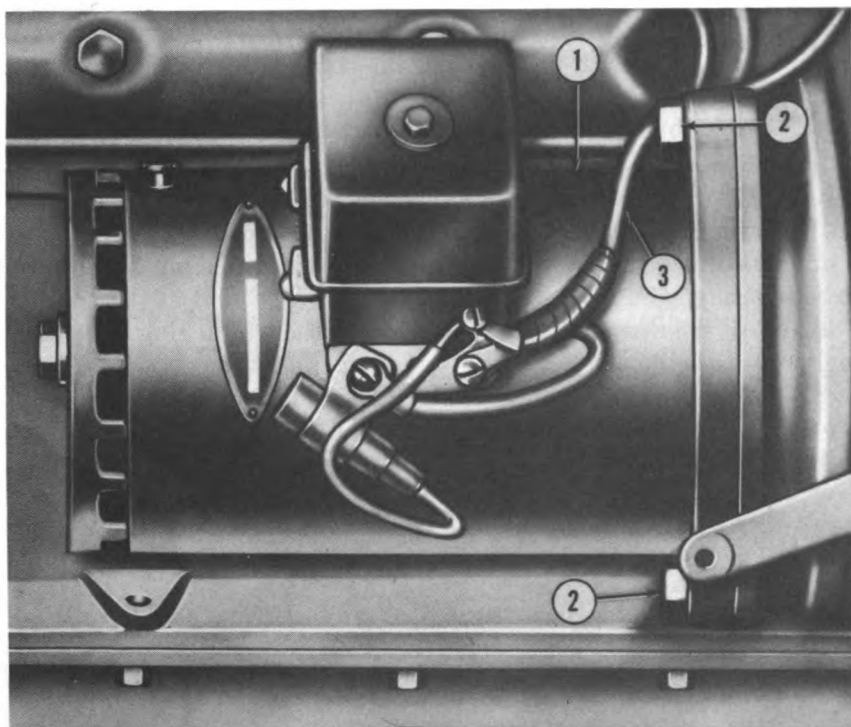
## **57. Description of Generator**

Generators used on JXC and JXD engines are mounted on the right side of the engine, bolted to the gear case, and are driven by the camshaft gear. The generator's function is to convert mechanical energy from the engine into electrical energy. This energy is stored in the battery and is drawn from that point to start the engine, supply the ignition system, and operate other electrical devices used in conjunction with the engine. A voltage regulator is mounted on the generator frame. This regulator consists of a circuit breaker unit and a step-control voltage regulator. The circuit breaker acts as an automatic switch to connect the generator to the battery when the generator is operating fast enough to charge. When the generator is not running, the circuit breaker opens to prevent the battery from discharging through the generator. The voltage regulator unit controls the generator output to meet the needs of the battery. It will permit maximum current when battery charge is low, or when electrical accessories are operating, and will retard current from the generator when the battery charge is normal and when electrical accessories are not operating.

## **58. Replacing Generator on JXC or JXD Engine**

- a.* Disconnect the battery lead (3, fig. 38) from the voltage regulator and tape the end to prevent short circuiting.
- b.* Remove the mounting bolts (2) that hold the generator (1) to the engine.
- c.* Lift the generator from engine mounting position and place it on a clean bench top or other working area.





1 Generator  
2 Bolt

3 Battery lead

*Figure 38. Generator installations.*

*d.* Position the new generator on the engine, be sure that the gears will mesh properly then insert generator and secure with the mounting bolts.

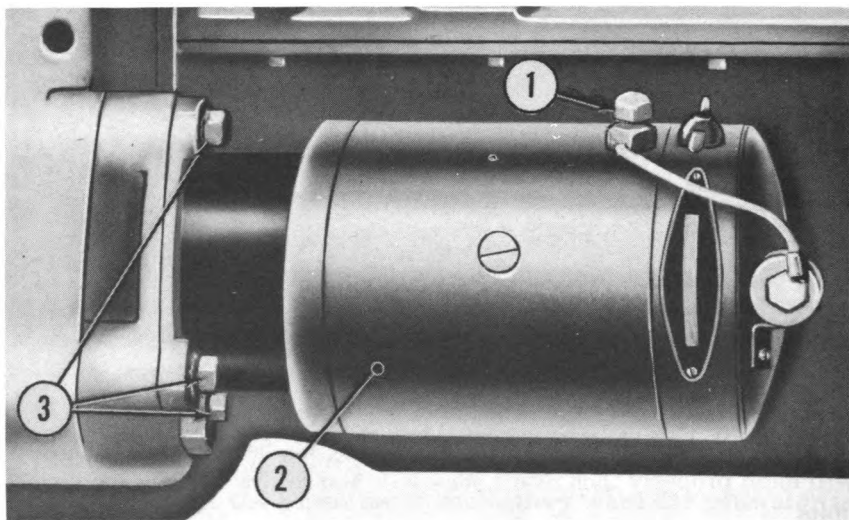
*e.* Remove tape protecting the battery lead connection, and connect the lead to the voltage regulator.

### **59. Description of Starting Motor**

The starter, or cranking motor, used on JXC and JXD engines is located on the lower right hand side of the engine, bolted to the bell-housing and on a level with the oil pan. The starter is a direct current motor, operating on battery voltage. Through considerable gear reduction, this small motor is able to turn the engine over fast enough for starting. A small pinion on the cranking motor shaft meshes, when operating, with teeth in the flywheel ring gear. The cranking motor is automatically disengaged from the flywheel when the engine starts. A spring in the drive mechanism absorbs the shock of the initial meshing of starter drive gear with the flywheel.

## 60. Replacing Starting Motor on JXC or JXD Engine

- a. Disconnect the battery cable at the starting motor terminal (1, fig. 39).
- b. Remove the three cap screws (3) attaching the starting motor (2) to the bellhousing.
- c. Pull the starting motor away from bellhousing, being careful not to knock the starter drive gear against the gear case.
- d. Install new starting motor, using care when placing drive gear in bellhousing.
- e. Install the three cap screws and lockwashers attaching the starting motor to bellhousing.
- f. Connect the battery cable to the starting motor terminal.



1 Starting motor terminal  
2 Starting motor

3 Screw, cap

Figure 39. Starting motor installations.

## 61. Brush Replacement

The carbon brushes in starters (fig. 87) and generators (fig. 93) should be replaced when they are worn down to half their original length. When engines are in daily use, inspect generator brushes once monthly, and starter brushes once monthly.

a. *Inspection.* Remove the dust cover band (1, fig. 93) from generator or starter.

- (1) With a small screwdriver or straight wire bent like a shoe-hook at the end, lift up the brush arm (14).
- (2) With finger tips, move brush in and out to be sure it is sliding free in holder (11).

*b. Removal.* When removing or installing brushes, take care that the brush arm does not snap down and cause breaks or chips in the brush.

- (1) Lift the brush arm with a screwdriver or bent wire.
- (2) Disconnect the brush lead and remove the brush arm and brush.

*c. Installation.* Do not replace used brushes in holders if they are oil-soaked, worn beyond half of original length, or if edges are chipped.

- (1) Lift up the brush arm with a screwdriver or wire.
- (2) Slip brush in place with beveled edge parallel with the commutator segments.
- (3) Reconnect the brush lead wire, and move the brush arm up and down to make sure it is not binding.
- (4) Sand the brush surface to perfect fit against commutator by drawing 00 or 000 sandpaper between brush and commutator.

*d. Testing Brush Spring Tension.* After brushes are serviced, or after new ones are installed, test brush spring tension as follows :

- (1) Hook a small spring scale in a hole in lip of brush arm and pull in a line perpendicular to the top of the brush.
- (2) Read the scale just as the brush arm leaves the brush.
- (3) The tension on the brush springs should be 35 to 53 ounces.

## **62. Commutator Care**

Over a period of time, generators and starting motors collect enough dirt and grease to cause a film of gum to form over the commutators. This film wears brushes and causes sticking brushes and short circuits. Care of the commutator is as follows :

*a. Generator.* Remove the dust cover band and lift up the brush arm to expose a part of the commutator surface for inspection.

- (1) If the commutator is dirty or discolored, it may be cleaned by holding 00 or 000 sandpaper between brush and commutator while the commutator is rotated.
- (2) After sanding commutator, blow all dust and sand particles out of generator head with compressed air.
- (3) If the commutator is rough and worn and the mica high between segments, the generator should be referred to field and depot personnel for complete overhaul.

*b. Starting Motor.* Starting motor commutators require the same care and service as the generator. When complete overhaul is needed, refer the starting motor to field and depot personnel.

## **63. Description of Distributor**

The ignition distributor used on both the JXC (16, fig. 4) and JXD engine (19, fig. 6) is located on the left side of the engines, mounted

on the water pump. Drive is obtained from the water pump shaft by means of a spiral gear. The distributor has two main functions. First, it opens and closes the electric circuit between the battery and the ignition coil. The distributor incorporates a centrifugal governor which advances the spark as engine speed increases, thus adjusting the spark to the speed of the engine. The ignition coil transforms the low battery voltage into the high tension voltage necessary to produce a spark at the plugs. Second, it distributes this surge of high voltage current to the proper spark plugs at exactly the right instant for firing the cylinders. The JXD distributor is radio shielded. Its drive is obtained through an hour-meter which is driven by a spiral gear meshing with a gear on the water pump shaft.

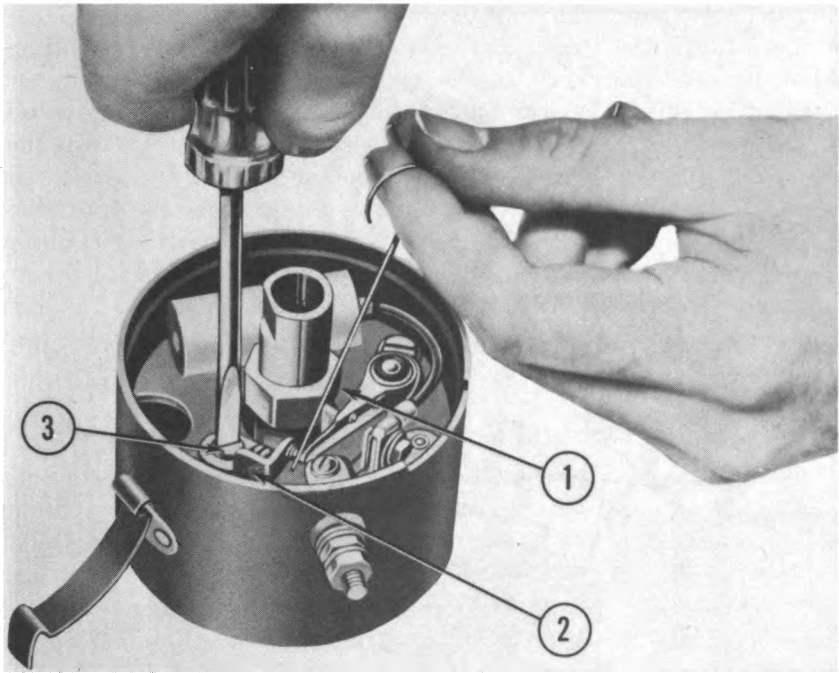
#### 64. Distributor Breaker Points

The breaker points in the distributor open and close the electric circuit at the proper instant to supply the spark needed at the cylinder which is ready to fire. Distribution of this current to the proper cylinder at the proper time is handled by the distributor rotor and cap. The breaker points are forced apart by the breaker cam, and snap back into closed position by spring tension. For best engine operation, breaker points should contact evenly over their entire surface. Points should be inspected at regular intervals, and the gap kept in adjustment. Slightly worn points may be resurfaced with a contact point file, but burned or pitted points should always be replaced. Adjust breaker point gap as follows:

*a. JXC Engine.* There is no seal plate on the JXC engine distributor. Snap off the two cap springs, lift out rotor, and proceed to adjust in accordance with the procedure for JXD engine given below.

*b. JXD Engine.*

- (1) Remove distributor radio shield (56, fig. 92).
- (2) Snap off the two distributor cap springs. Lift the cap (1) off and push to one side.
- (3) Lift out the rotor (2) and seal plate (4).
- (4) With a small screwdriver, loosen the holding screw (3, fig. 40) of the stationary point bracket (2).
- (5) Place an 0.020 inch wire feeler gage (1) between the points.
- (6) Tap the stationary point bracket (2) until the contact point rests against feeler gage.
- (7) Tighten the holding screw (3).
- (8) Test the gap to be certain the 0.020 inch adjustment is maintained.
- (9) Test alinement of the point faces. If they do not contact evenly, bend the stationary point bracket slightly to get a good alinement.



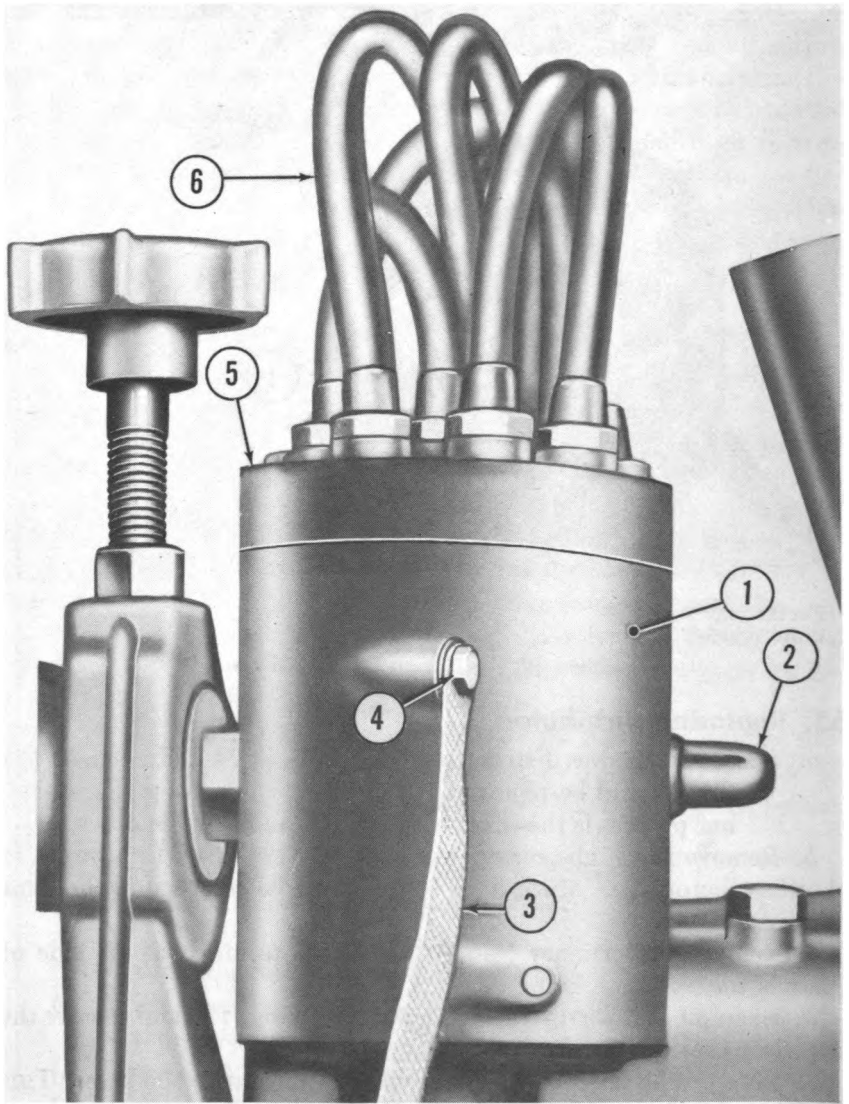
1 Feeler gage  
2 Point bracket

3 Holding screw

*Figure 40. Adjusting breaker points.*

## 65. Replacing Distributors

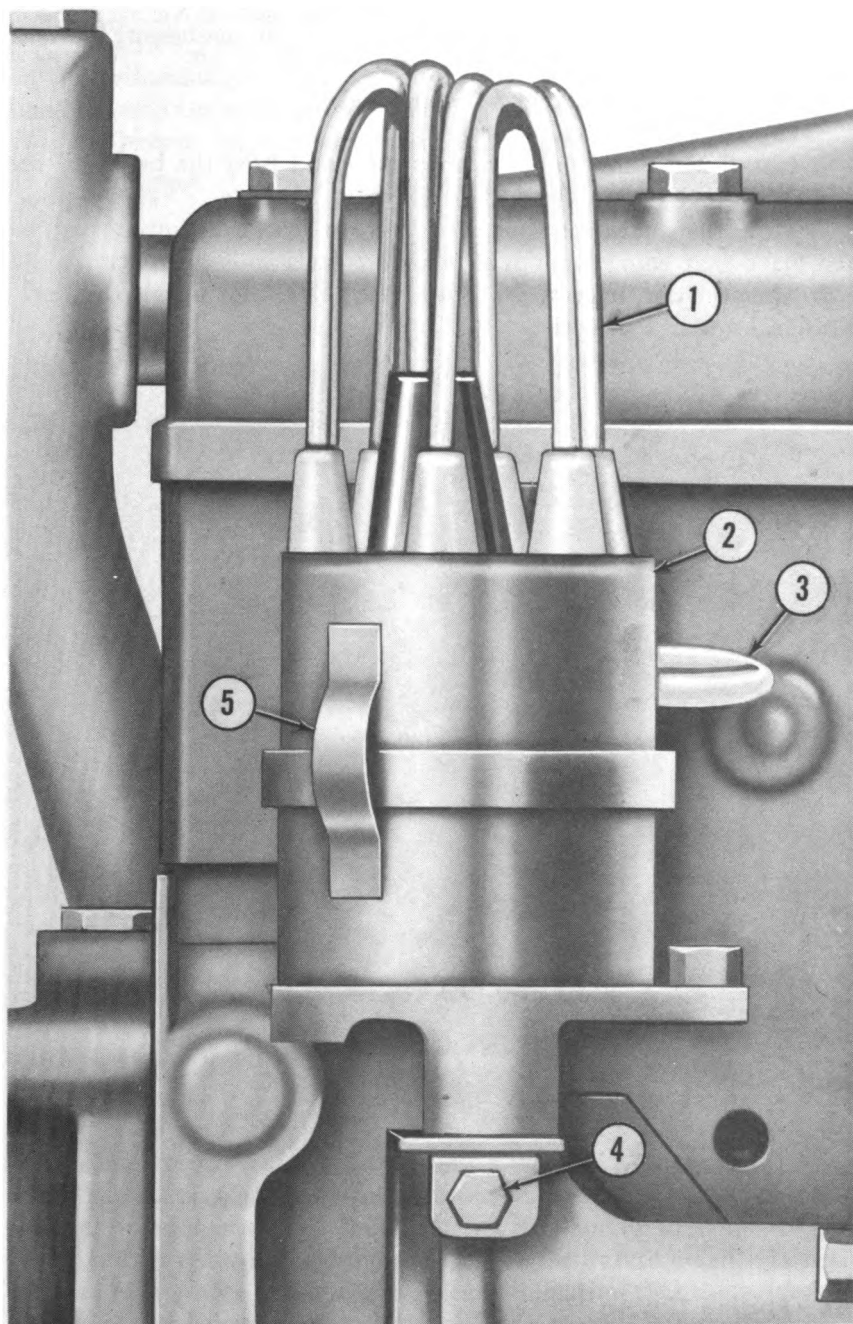
- a. The JXD engine distributor (1, fig. 41) has a radio shield (5) that should be removed (par. 64b(1)) otherwise the replacing process is the same for the JXC and JXD engines.
- b. Remove the high-tension wires (1, fig. 42) from the towers in the distributor cap. Mark these so they may be returned to the same tower.
- c. Remove the primary lead (3) from the terminal at the side of distributor.
- d. Snap off the two distributor cap snap springs (5) and remove the cap from the distributor.
- e. Note the position of the rotor in relationship to the base. This position must be remembered so the distributor will be properly timed when reinstalled.
- f. Loosen the screw in the advance arm and remove the distributor from engine.
- g. After the distributor is removed, the hour-meter (1, fig. 43) on the JXD engine can be removed.
  - (1) Remove distributor adapter (3).
  - (2) Loosen screw (2), then pull drive gear (28, fig. 92) out of mesh with water pump gear. Remove hour-meter.



- 1 Distributor
- 2 Primary lead
- 3 Ground

- 4 Screw
- 5 Shield
- 6 High tension wires

*Figure 41. JXD distributor.*



- 1 High tension wires
- 2 Distributor
- 3 Primary lead

- 4 Screw
- 5 Snap springs

*Figure 42. JXC distributor.*

*h.* Install JXD hour-meter.

(1) Insert hour-meter drive gear so that it meshes with water pump gear.

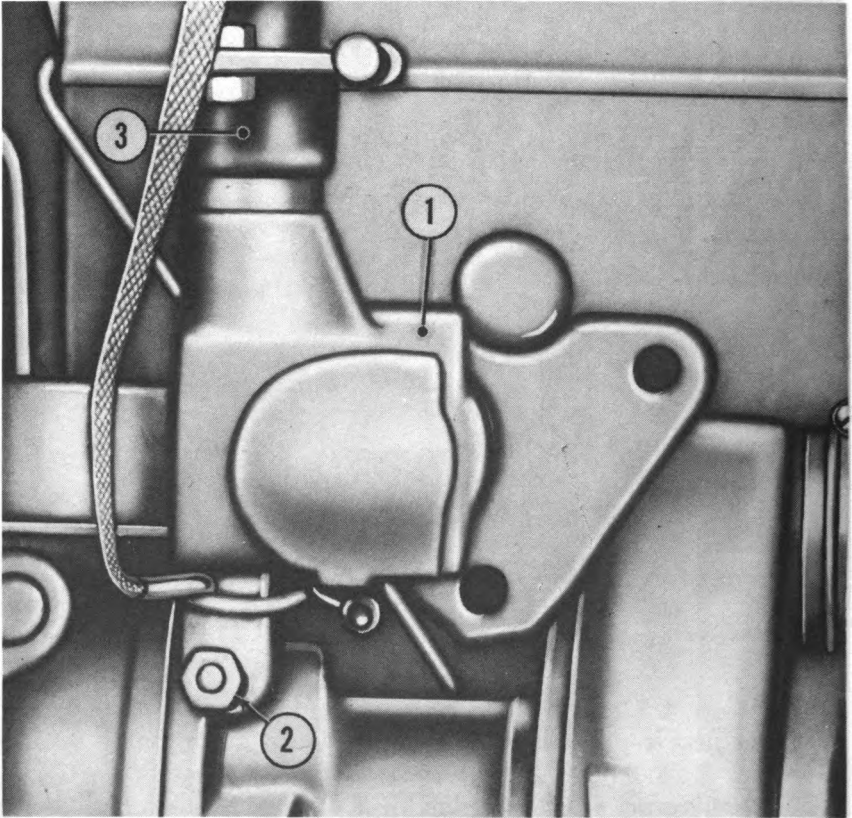
(2) Secure screw (2, fig. 43) onto bracket.

(3) Install distributor adapter.

*i.* Install a distributor in its mounting and turn the base and the rotor to the positions noticed when removed.

*j.* Push the distributor completely down in the mounting so that the drive gear engages its drive and fasten the holddown arm.

*k.* Connect the primary lead to the terminal and install the high-tension leads in the distributor cap towers as removed.



1 Hour-meter  
2 Screw

3 Distributor adapter

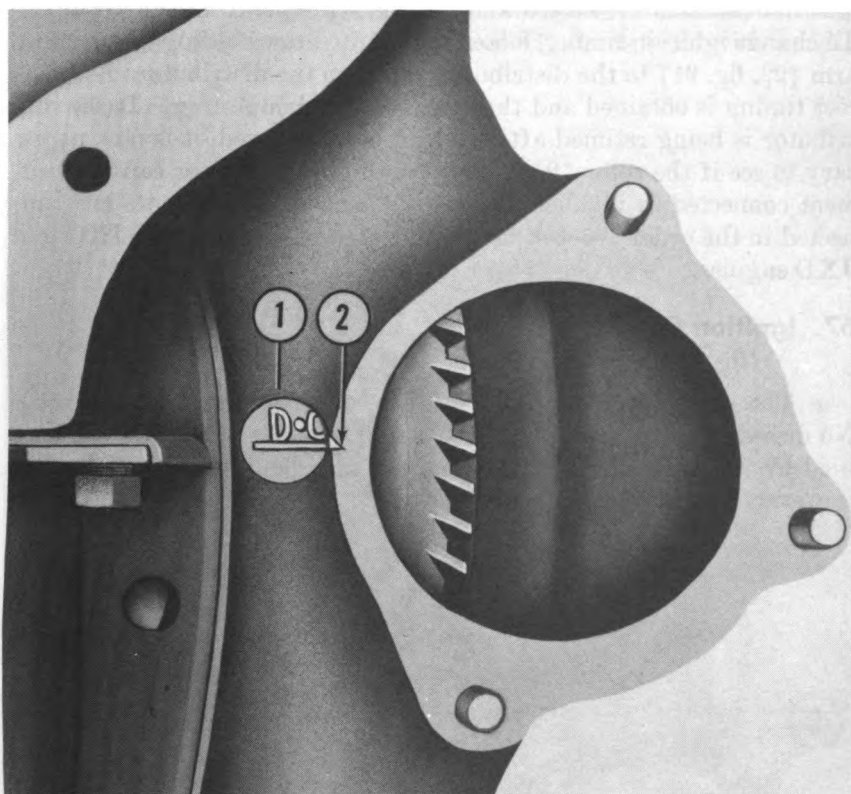
*Figure 43. Hour-meter.*

## **66. Engine Timing** (fig. 44)

When the distributor has been removed or for any reason it becomes necessary to check or reset the ignition timing, distributor ignition timing is handled as follows:



a. There is a timing hole through the bellhousing for "spotting" the engine by lining up marks on the flywheel with a corresponding mark on the bellhousing. When the dead center mark (1) on the flywheel lines up with the mark across the center of the hole in the bellhousing (2), the pistons for number 1 and 6 cylinders are on top dead center.



1 Dead center mark on flywheel

2 Dead center mark on bellhousing

Figure 44. Engine timing marks.

b. The first step in setting or checking the ignition timing is to locate mark (1) and line it up with mark (2) on the bellhousing.

c. To determine whether the engine is in firing position for number 1 or 6 piston, crank the engine with spark plugs removed to determine the compression stroke of one of these cylinders, or the valve tappet cover can be removed and the position of the valves noted. If both tappets for number 1 cylinder are clear, indicating that the valves are closed, and exhaust valve on number 6 is not completely closed, this will indicate firing position for number 1 cylinder.

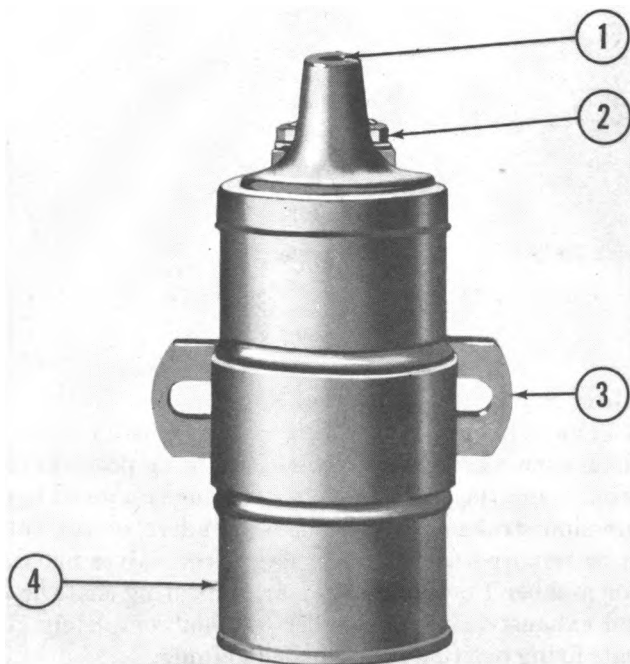
d. With the ignition points clean and making a square contact and set to the proper gap opening of 0.020 inch, the points should be just beginning to open on dead center with retarded spark. The automatic

advance mechanism in the distributor will then advance the spark to the proper position when the engine is running. There are several methods of checking accurately the exact point of contact opening. One method is by using a test light which, if connected in series with the primary circuit (when ignition switch is ON), will be lighted when ignition contacts are closed and not lighted when contacts are open. To change ignition timing, loosen the clamp screw holding the advance arm (22, fig. 91) to the distributor and turn the distributor until correct timing is obtained and then tighten the clamp screw. If the distributor is being retimed after having been removed, it is now necessary to see if the rotor (2) lines up with the distributor cap (1) segment connected to number 1 cylinder. The remaining ones are connected in the order 1-5-3-6-2-4, which is the firing order of JXC and JXD engines.

## 67. Ignition Coil

(fig. 45)

a. The windings of ignition coils are contained in sealed cases (4). No disassembly or repair is possible, and troubles in the coil are handled by replacing the unit entirely. A coil should not be discarded, however, until a check on an approved tester proves the coil to be



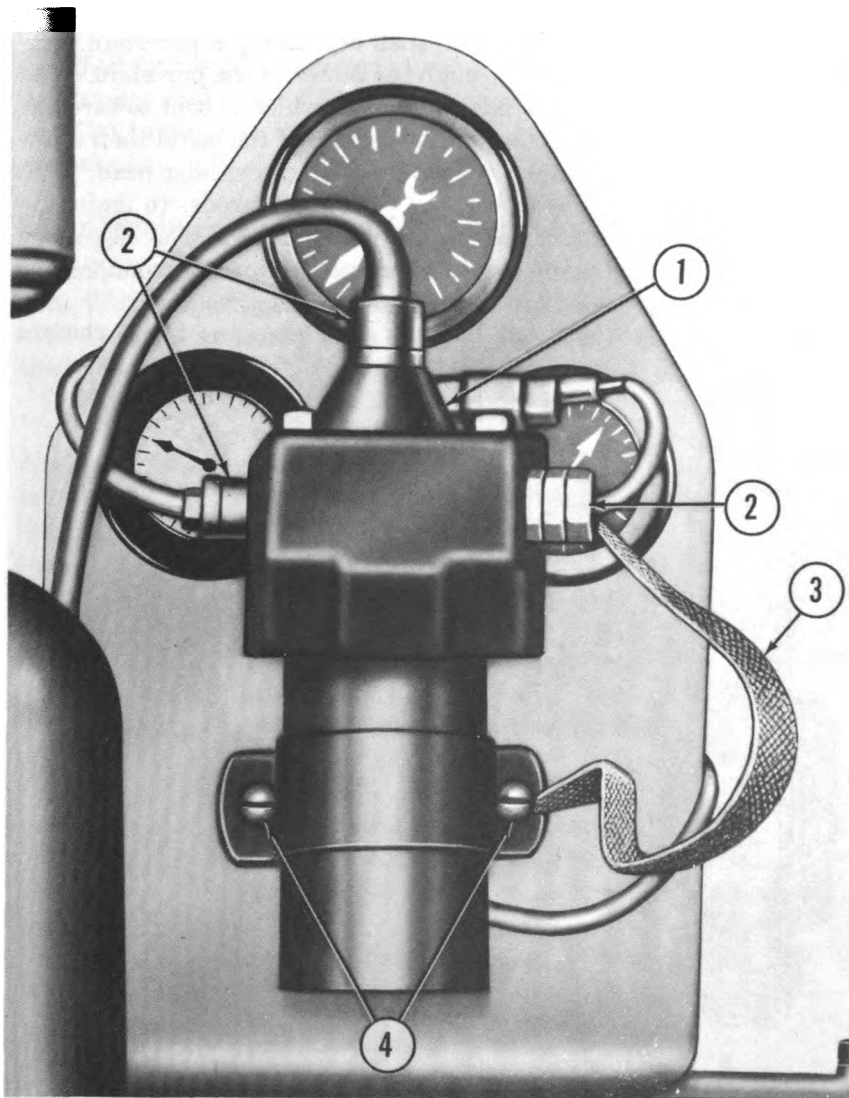
1 Secondary terminal  
2 Primary terminal

3 Mounting bracket  
4 Case

Figure 45. Ignition coil.

faulty. Many times a poor contact at the secondary terminal (1), or at the primary terminal (2), will cause faulty ignition. This is quickly corrected by cleaning and tightening the contacts. Make certain the screws in bracket (3) holding the coil to the engine are tight, as constant vibration resulting from loose mounting can eventually cause the coil to fail. Coils for JXC and JXD engines are similar, but have different part numbers (app. II). The JXD coil is fitted with a radio shielded cap.

*b. Removing Coil (fig. 46).*



1 Coil  
2 Lead

3 Ground  
4 Screws

*Figure 46. JXD ignition coil installation.*

293175 O—54—7

- (1) Remove leads (2).
- (2) Remove ground (3).
- (3) Remove screws (4) holding coil (1) in place, then remove coil.

*c. Installing Coil (fig. 46).*

- (1) Position coil, then install screws (4).
- (2) Attach ground (3) and leads (2).

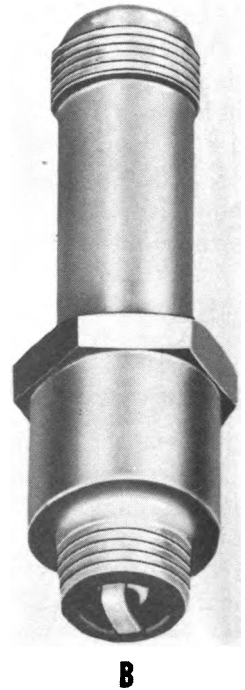
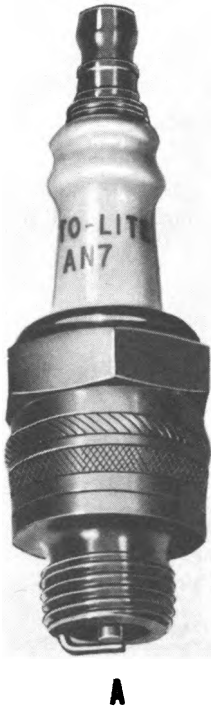
## 68. Spark Plugs

(fig. 47)

A spark plug consists of a metal shell containing a porcelain insulator. An electrode extends through the center of the porcelain. The metal shell has a short electrode at the base which is bent toward the center electrode. Threads tapped on the base of the metal shell allow the plug to be screwed into a tapped hole in the cylinder head. The electric spark jumps the gap between the two electrodes to ignite the mixture of fuel and air in the combustion chamber. The electricity passes from the center, or insulated electrode, to the grounded, or

A Unshielded

B Shielded



*Figure 47. Spark plugs.*

outer electrode. Spark plugs are constructed so that the seals between the metal base, porcelain and center electrode, as well as the porcelain itself, will withstand the high temperatures created in the combustion chamber during the power stroke. Spark plug performance plays a very important part in the efficiency and economy of engine operation. If an engine operates at peak load conditions for long periods, it requires a cold plug. This type of plug is designed to carry heat away from the porcelain insulator faster and keep the plug points cooler. The normal plug is built so the porcelain insulator retains a normal amount of heat. It is the proper type for engines which operate at intermediate and variable loads and speeds. The spark plug specified for the JXC engine is a standard, unshielded plug (A). The spark plug used in the JXD engine is specially built with a metal housing (B) to suppress ignition noises as a part of the radio suppression system.

## **69. Cleaning or Replacing Spark Plugs**

- a.* Remove the high-tension lead to plugs.
- b.* With a spark plug wrench, loosen each plug two turns and then blow or brush away any loose dirt and dust that may have collected in the spark plug well.
- c.* Remove plugs completely.
- d.* Scrape away deposits of burnt carbon from the two electrodes, from the insulator, and around the inside of the shell. If deposits are not heavy, a soft wire brush will clean the plugs satisfactorily. Otherwise, use a knife blade.
- e.* If the plug electrodes are burned so that an arc shows on the under side of the ground electrode, the plug has served its useful life and should be replaced.
- f.* If the center insulator is cracked, chipped or shows bits of shiny glass particles on its surface, the plug should be replaced.
- g.* Always use new gaskets when installing spark plugs.

## **70. Adjusting Spark Cap**

- a.* Bend the ground electrode only, never the center electrode.
- b.* Close the ground electrode over the center electrode until the feeler gage will offer a slight resistance as it is drawn between the points.
- c.* Using a blade or wire feeler gage, adjust the point gap to 0.030 inch.

## **71. Replacing Starter Switch**

The push button starter switch is located on the engine control panel. The switch is mounted on the panel by forcing the unit into a mounting hole. Two spring clips on opposite sides of the switch

keep it in place. No nut is used to hold the switch to the panel. There are no replaceable parts for the switch; should it become defective, a new switch must be installed.

a. Unsolder wires at rear of switch, marking the wires and terminals before removal.

b. Depress spring clips and push switch from panel.

c. Insert a new switch and solder wires to proper terminals.

## 72. Battery

Regular maintenance of the battery is necessary to be sure it will deliver full power to the starting motor and other electrical engine accessories. At 2-week periods, when battery is in constant use, the electrolyte or liquid should be checked for gravity with a hydrometer, and the liquid brought to the proper level by adding distilled water. It is important to the life of the battery that it be kept at or near full charge at all times.

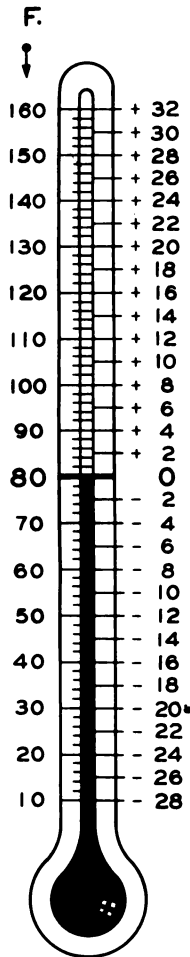
a. *Battery Charge Test.* A battery hydrometer is used to measure the specific gravity of electrolyte in battery. Battery hydrometers give accurate readings only when the temperature of electrolyte is about 80° F., and if readings must be taken at other temperatures, a correction factor must be added. Make hydrometer tests as follows:

- (1) During, or immediately after an engine operation period, make hydrometer test of each battery cell.
- (2) Test one cell at a time, keeping caps on other cells to avoid knocking dirt into the battery.
- (3) Place the end of the hydrometer tube in cell and squeeze all air out of the rubber bulb.
- (4) Release the bulb slowly so that electrolyte is drawn evenly into the hydrometer.
- (5) Lift the hydrometer to eye level and read its calibrated scale. The specific gravity of a fully charged battery will be 1.280.
- (6) The corrected reading of a fully charged battery will always be 1.280. If corrected readings are below 1.250, the battery should be removed and charged.

b. *Filling Battery.* Do this only after hydrometer test has been made.

- (1) Open cells one at a time and fill with distilled water from rubber syringe.
- (2) Bring liquid level up to a point just below the neck of the cell cap, or about one-half inch above top of battery plates.

c. *Battery Cables* (fig. 49). These must be kept free from corrosion, and the terminal clamps must be tight. Make it a practice to



*Figure 48. Temperature correction chart for specific gravity readings.*

inspect battery cables each time the battery is serviced. Service the cables as follows:

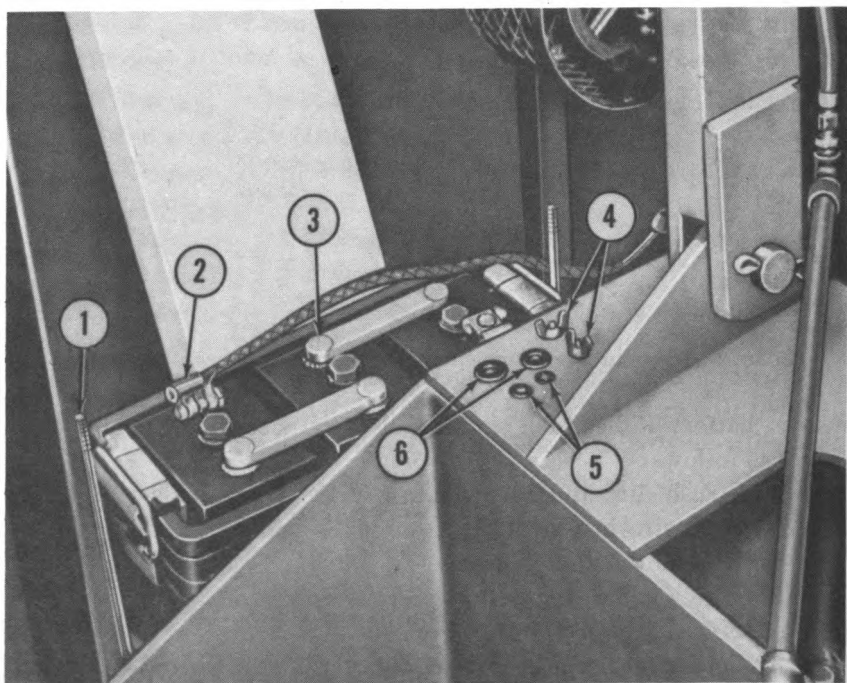
- (1) Brush dirt and corrosion away from terminals (2) with a soft wire brush. If a terminal is badly corroded, it must be removed and cleaned.
- (2) Check cables for worn or frayed condition. Replace deteriorated cables.
- (3) Check terminal bolts and nuts. If badly corroded or bent, replace.
- (4) Check the ground cable connection to frame. Clean and tighten if necessary.

d. *Battery Installation* (fig. 49). A battery must sit level in its cradle, and holddown rods (1) or straps must fasten it securely against shifting or vibrating in cradle.

- (1) With a wire brush, clean all rust or signs of corrosion from the battery cradle and holddown straps. If corrosion is severe, wash the entire cradle unit with soda water, dry, and paint with corrosion-resistant paint.
- (2) Place the battery in cradle, lowering gently to avoid bumping against the bottom.
- (3) Examine to make sure the battery is resting level.
- (4) Tighten holddown nuts (4) evenly at each point until battery is secure. Do not tighten holddown clamps too much, as this can distort the battery case.
- (5) Slip cable clamps over terminal posts and tighten. Always connect the ground cable last.

**Caution:** Always arrange cable clamps and cables so they will not interfere with unscrewing cell caps. Make sure cables do not rub against adjacent metal parts.

e. Cranking power and specific gravity of battery at various temperatures.



1 Holddown rod  
2 Cable terminal  
3 Cell connector

4 Holddown nut  
5 Lockwasher  
6 Washer

Figure 49. Battery.



Available cranking power (percent)	-60° F.	-40° F.	-20° F.	-10° F.	0° F.	+20° F.	+40° F.	+60° F.	+80° F.	+100° F.	+110° F.	+120° F.
50	1. 277	1. 267	1. 259	1. 255	1. 251	1. 243	1. 236	1. 220	1. 220	1. 213	1. 209	1. 205
58.3	1. 287	1. 277	1. 269	1. 265	1. 261	1. 253	1. 246	1. 230	1. 230	1. 223	1. 219	1. 215
66.6	1. 297	1. 287	1. 279	1. 275	1. 271	1. 263	1. 256	1. 240	1. 240	1. 233	1. 229	1. 225
75	1. 307	1. 297	1. 289	1. 285	1. 281	1. 273	1. 266	1. 250	1. 250	1. 243	1. 239	1. 235
83.3	1. 317	1. 307	1. 299	1. 295	1. 291	1. 283	1. 276	1. 260	1. 260	1. 252	1. 248	1. 245
91.6	1. 327	1. 317	1. 309	1. 305	1. 301	1. 294	1. 286	1. 270	1. 270	1. 262	1. 258	1. 255
100	1. 338	1. 328	1. 320	1. 316	1. 312	1. 304	1. 296	1. 280	1. 280	1. 272	1. 268	1. 265

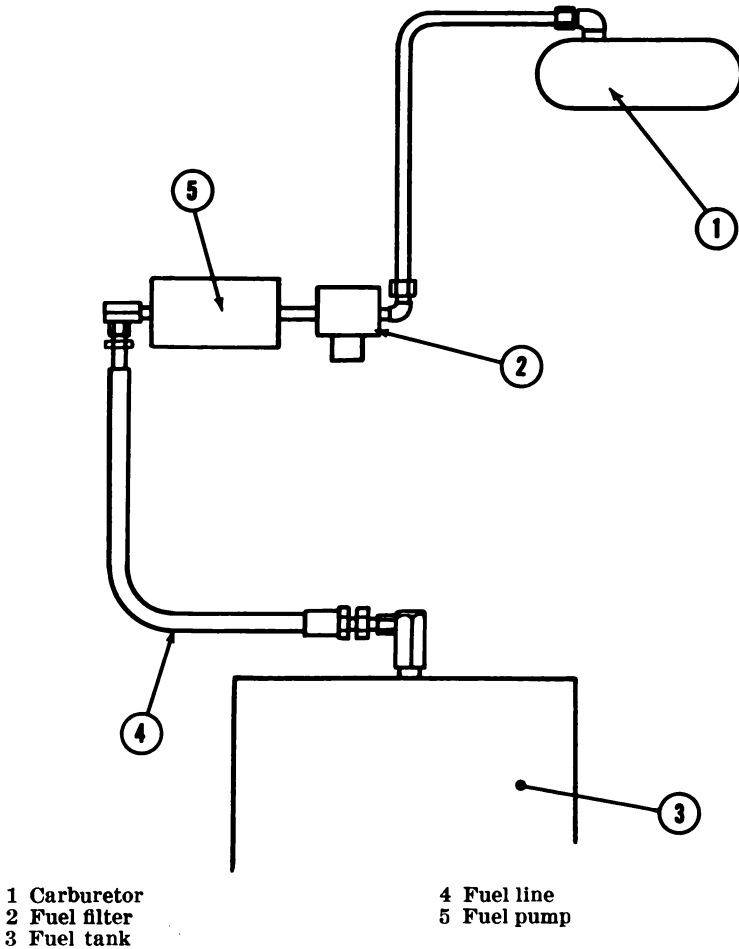
*f. Electrolyte Freezing Points.*

<i>Specific gravity</i>	<i>Temperature</i>
1.280	-90° F.
1.250	-62° F.
1.200	-16° F.
1.150	+5° F.
1.100	+19° F.

**Section IX. FUEL AND EXHAUST SYSTEM**

**73. Description of Fuel System**

The fuel system of the JX-series engines consists of a fuel tank (3, fig. 50) in which the gasoline is stored, lines (4) through which it is brought to the engine from the tank, a pump (5) which forces the fuel from tank to engine, a filter (2) which cleans the fuel, and a carburetor (1) which mixes the fuel with air for burning in the



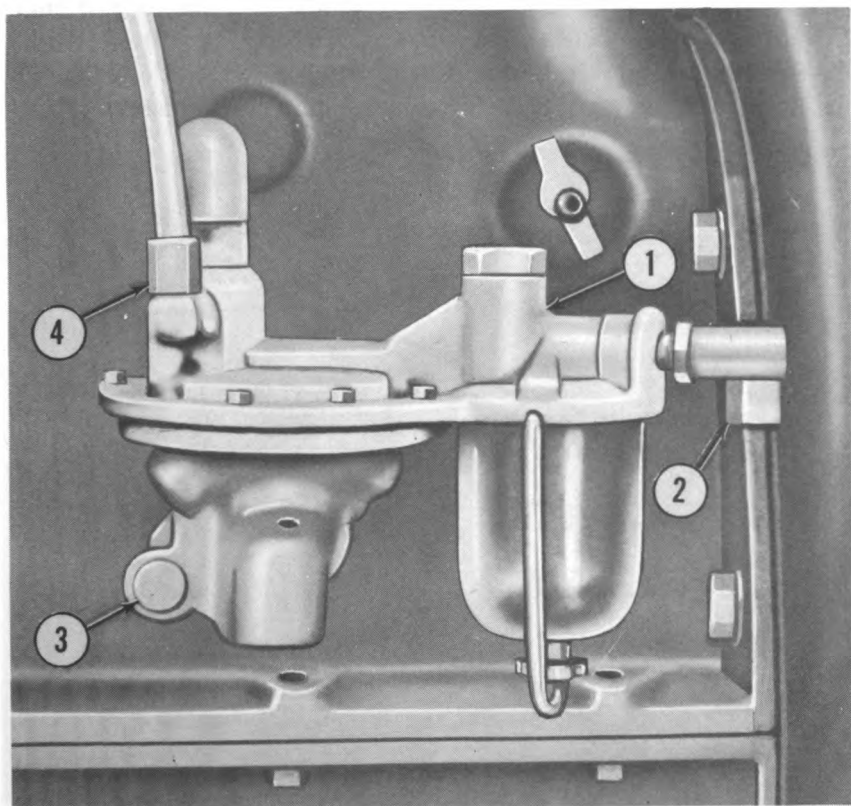
*Figure 50. Fuel system.*

engine cylinders. Fuel systems of the JXC and JXD engines are similar except for location of the fuel pump. The JXC engine fuel pump is attached to the lower right side of the crankcase and is driven direct off of the camshaft by the rocker arm (19, fig. 84). The JXD fuel pump is attached to the lower left side of the crankcase and is operated by a drive pin (1, fig. 52) transferring the action of the camshaft to the rocker arm.

## 74. Replacing Carburetor

Repair of carburetors is a third and higher echelon responsibility. Only replacement and adjustment of the unit is handled by the using personnel.

*a. JXC Engine.* The up-draft carburetor (fig. 53) used on JXC engines is connected remotely to the air cleaner by a hose. The air cleaner is clamped to the bell housing. The connecting hose is fastened to the carburetor by a clamp and stove bolt. To remove the air cleaner hose (5, fig. 54), loosen the stove bolt (3) with a small screwdriver and



1 Fuel pump  
2 Inlet line nut

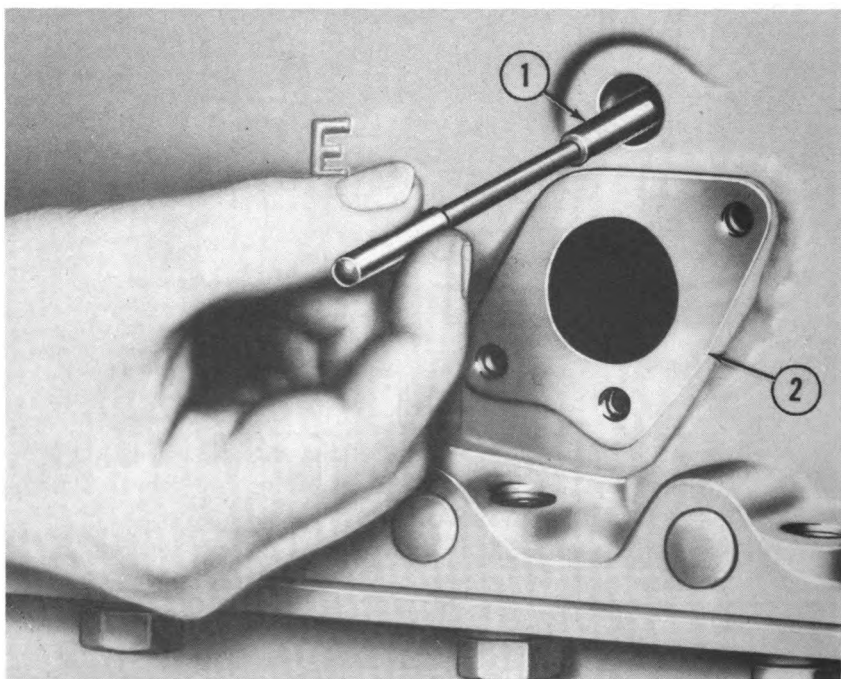
3 Screw, cap  
4 Outlet line nut

*Figure 51. Fuel pump removal points.*

spring the clamp (4). Use a twisting motion to push the hose free of carburetor (1). Then proceed with removal, replacement and adjustment of carburetor in the same way as procedure for the JXD engine given below.

b. *JXD Engine.* To remove the carburetor (4, fig. 55) from the engine, remove the air cleaner (1) and disconnect the governor control rod (5) and fuel inlet line (7) at carburetor. Disconnect the choke control wire and remove two screws (6), nuts, and lockwashers attaching carburetor to manifold flange.

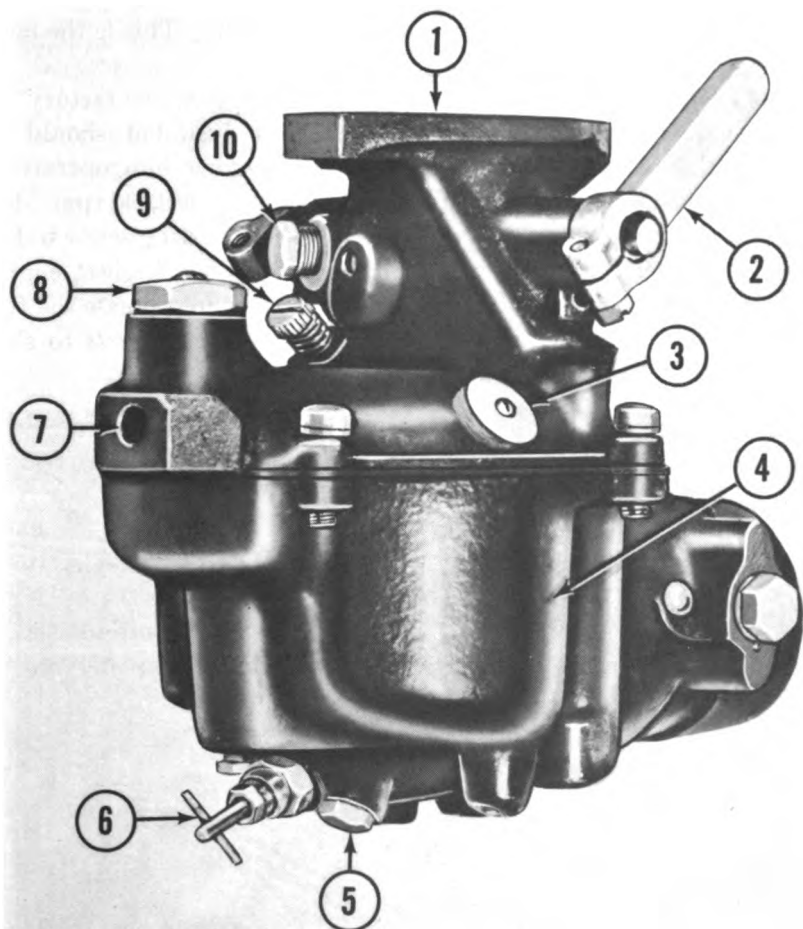
- (1) After removing the old carburetor, mount the new unit in the same position, using a new gasket between the carburetor and manifold.
- (2) Two locations are provided for attaching the fuel line (2, fig. 56). Use the one most suitable and plug the other with the headless screw plug already installed in the auxiliary inlet.
- (3) Using a small screwdriver, tighten the screw in the choke lever securely against the choke wire to prevent slipping. Tighten the choke cable securely in the bracket (10).
- (4) Attach the throttle rod to the clamp-type throttle lever (7) and adjust until throttle opens and closes completely.



1 Drive pin

2 Fuel pump mounting base

*Figure 52. Fuel pump drive pin—JXD engine.*



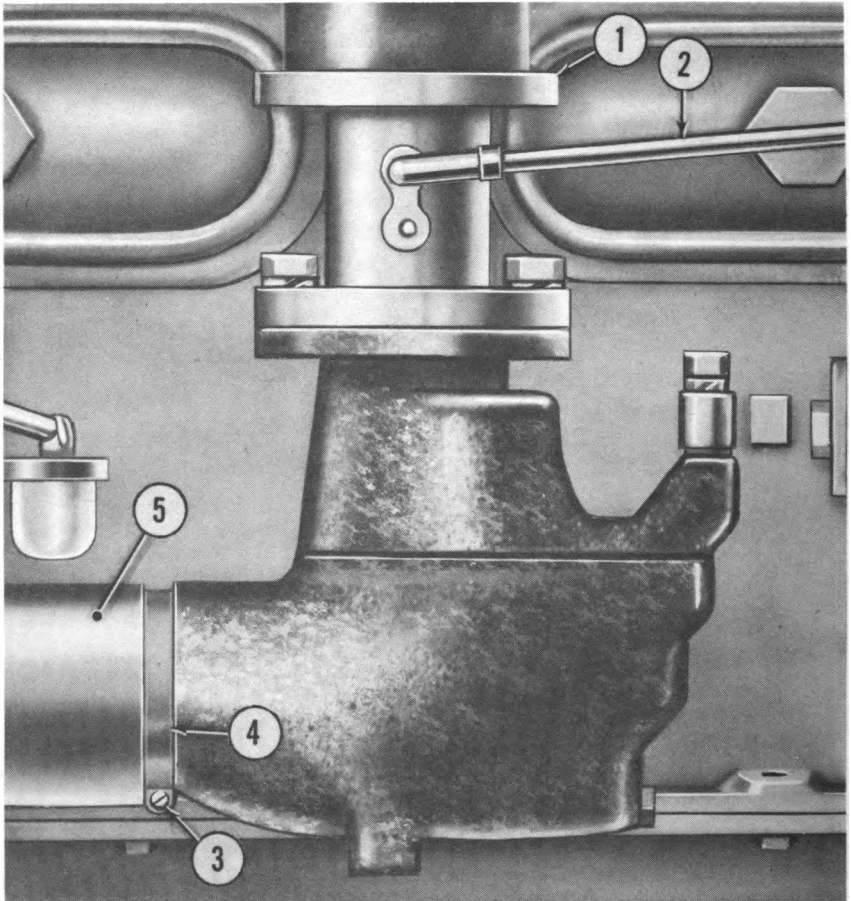
- |                        |                              |
|------------------------|------------------------------|
| 1 Throttle body        | 6 Main jet adjustment        |
| 2 Throttle lever       | 7 Fuel inlet                 |
| 3 Identification plate | 8 Filter plug                |
| 4 Fuel bowl            | 9 Idle adjustment            |
| 5 Bowl drain plug      | 10 Vacuum spark opening plug |

*Figure 53. JXC carburetor.*

- (5) Using a small screwdriver, set the throttle adjusting screw (8) so that the engine runs at about 800 rpm. Turning screw to right increases the speed.
- (6) The idling adjustment screw (6) is factory-set, but the adjustment should be tested before putting the engine into operation. To check adjustment, give the idling adjustment screw about a quarter-turn to the right with a small screwdriver. Find the spot where engine starts to run "ragged" from too lean a mixture. Then turn the needle a quarter-turn to the left, or until the engine starts to "gallop" from

too rich a mixture. Now set the screw to the richest mixture which does not cause the engine to gallop. This is the most satisfactory idling adjustment.

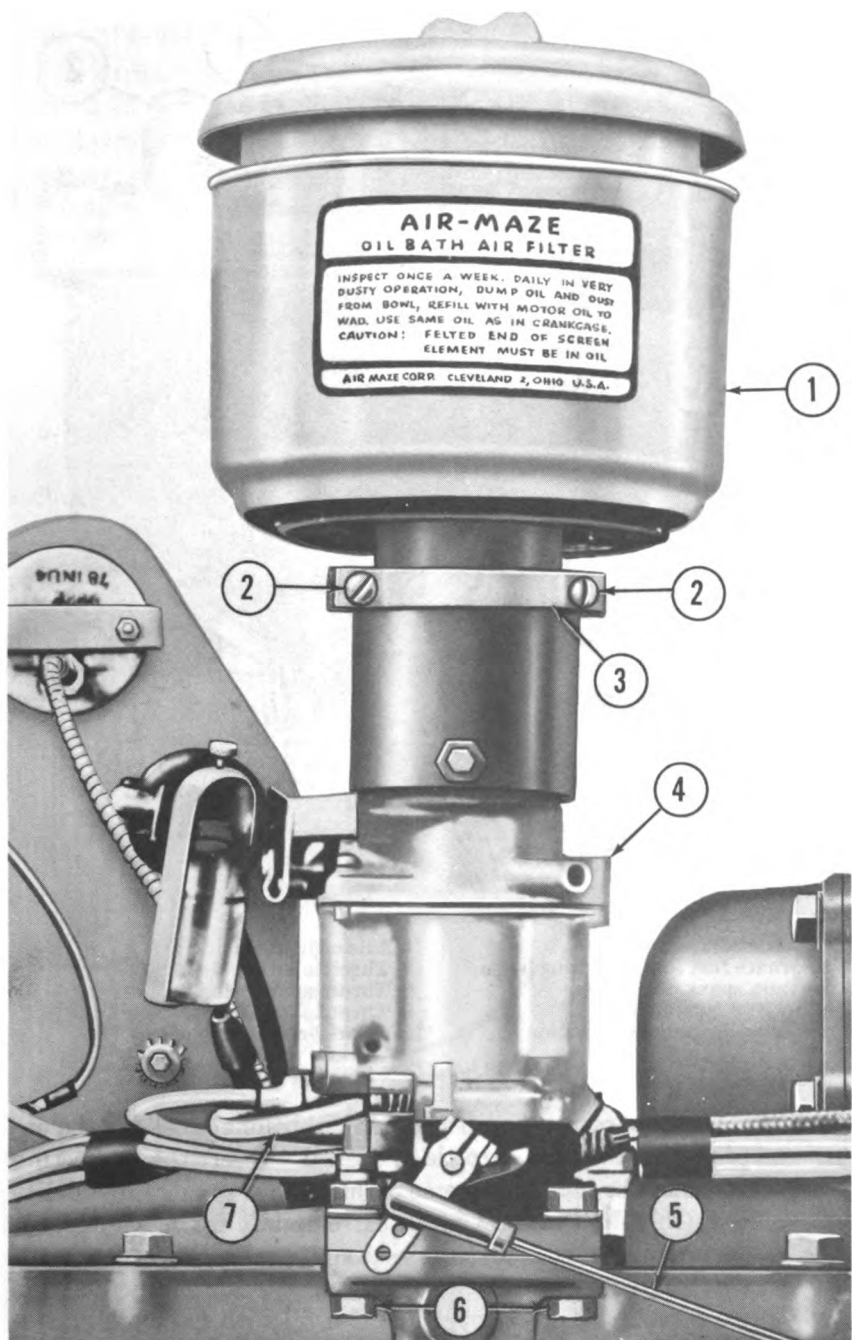
- (7) The main jet adjustment (4) has been set at the factory for approximately the right amount of fuel, but should be checked as follows before putting engine into operation: Open the throttle until engine speed is about 2,000 rpm. Fix the throttle at this speed and turn the adjusting screw to left to increase fuel flow to carburetor. When highest engine speed is obtained, turn the screw to right to decrease the fuel flow. The point at which the engine speed *starts* to slow down provides the best setting.



1 Carburetor  
2 Governor control rod  
3 Screw

4 Clamp  
5 Hose

*Figure 54. JXC carburetor installation.*

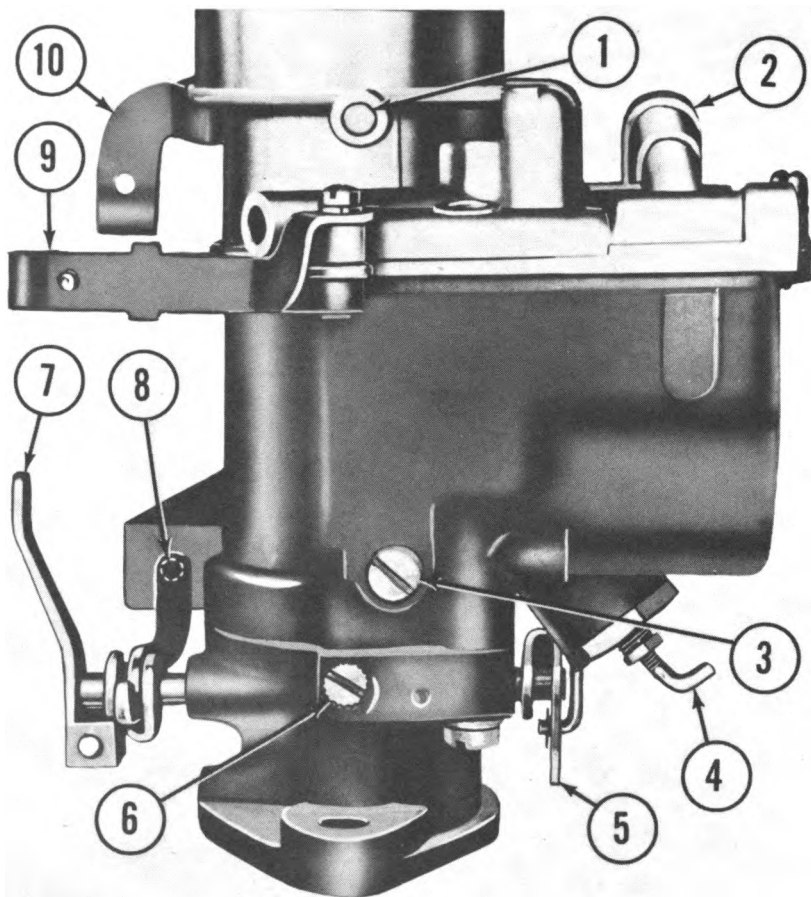


1 Air cleaner  
 2 Screw  
 3 Clamp

4 Carburetor  
 5 Carburetor control rod

6 Screw  
 7 Fuel inlet line

*Figure 55. JXD air cleaner and carburetor installation.*



- |                                       |                             |
|---------------------------------------|-----------------------------|
| 1 Choke shaft                         | 6 Idle adjustment           |
| 2 Alternate fuel line attaching holes | 7 Throttle lever            |
| 3 Vacuum spark connection             | 8 Throttle adjusting screw  |
| 4 Main jet adjustment                 | 9 Throttle bracket assembly |
| 5 Accelerating pump connection        | 10 Choke bracket assembly   |

*Figure 56. JXD carburetor.*

- (8) The accelerating pump provides additional fuel for the engine whenever the throttle is opened. Insert the connecting rod into the hole to extreme right (5) for greater fuel delivery (in cold weather) or to extreme left for less fuel (hot weather). Intermediate holes permit fine-point regulation to suit the climate. Before installing the air cleaner on the carburetor, clean thoroughly and refill with fresh oil. Refer to LO 5-5167.

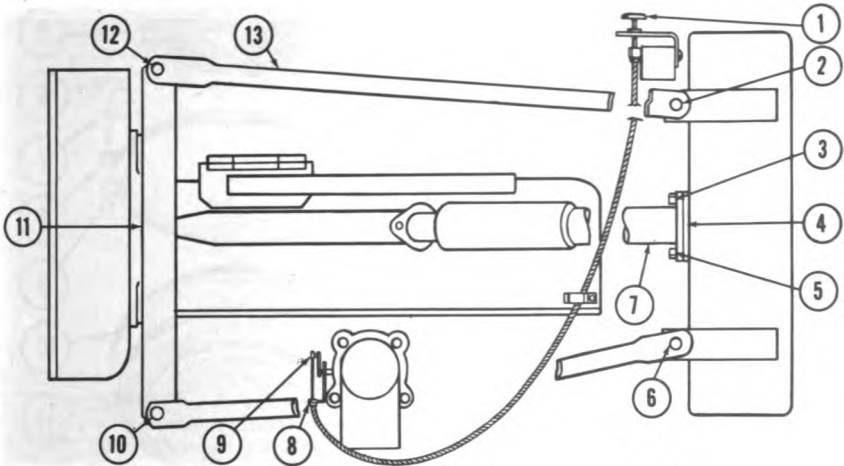


## 75. Choke

(fig. 57)

The carburetor has a manual choke which is operated by a choke control knob on the engine control bracket. Its function is to permit the operator to control the amount of fuel applied to the engine to facilitate starting. The control knob is linked to the carburetor choke lever by a wire cable (1). Adjustment of the choke control is rarely necessary. Occasionally the screw clamping the wire in the carburetor choke lever (9) works loose, permitting the wire to slide through the clamp without closing the choke valve. Make this adjustment as follows:

- a. With finger pressure, press the carburetor choke lever forward until it stops in the completely open position.
- b. With pliers, pull the choke wire tight.
- c. With a small screwdriver, tighten the holding screw in its clamp securely against the wire.



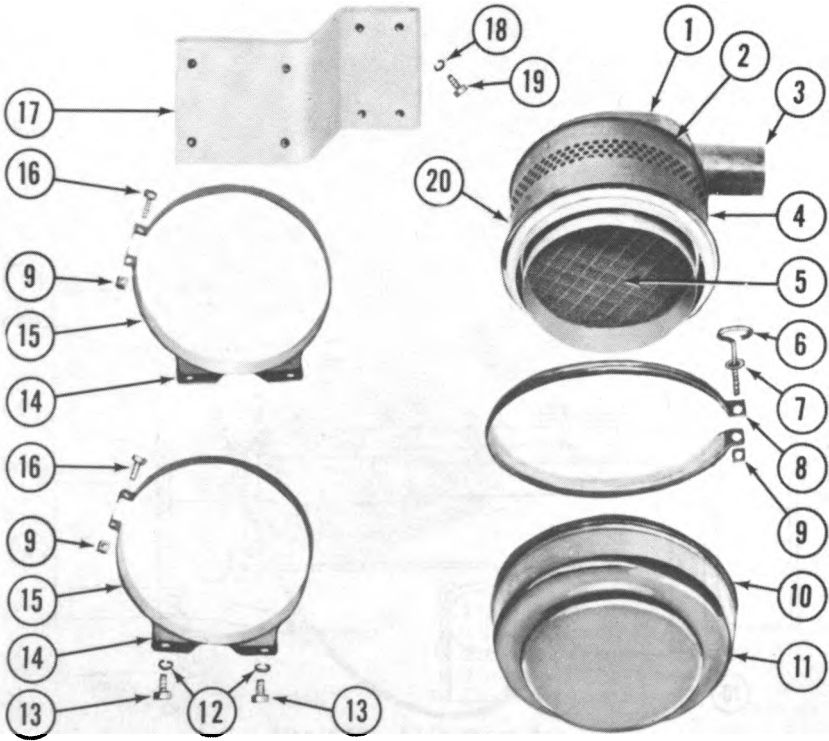
- |  |   |
|--|---|
| 1 Cable tube assembly                                      | 7 Upper hose  |
| 2 Bolt, $\frac{5}{8}$ "-16 NC x $1\frac{1}{4}$ " (2 req'd) | 8 Choke control cable bracket                               |
| 3 Screw, cap, $\frac{3}{8}$ "-16 NC x 1" (2 req'd)         | 9 Choke lever and shaft assembly                            |
| 4 Gasket   | 10 Bolt, $\frac{1}{2}$ "-13 NC x $1\frac{1}{4}$ " (2 req'd) |
| 5 Lockwasher, $\frac{3}{8}$ " (2 req'd)                    | 11 Radiator brace bar                                       |
| 6 Lockwasher, $\frac{5}{8}$ " (2 req'd)                    | 12 Lockwasher, $\frac{1}{2}$ " (2 req'd)                    |
|  | 13 Radiator brace   |

Figure 57. Choke control.

## 76. Replacing Air Cleaner

Air "breathed" in by the engine through the carburetor must be filtered to remove the dust and grit which cause excessive wear on engine parts. Air cleaners on JXC and JXD engines are of the oil-bath type and must be serviced at regular intervals (par. 24). Mounting procedures for the JXC and JXD engine air cleaners are different.

*a. Replacing JXC Air Cleaner.* Remove the air cleaner-to-carburetor hose (9, fig. 3) by loosening a clamp (8) at the air-cleaner end. Loosen cap screws in strap clamps around body of air cleaner, and lift the cleaner out of its position in the clamps.



- |                                  |   |
|----------------------------------|---|
| 1 Body assembly                  | 12 Lockwasher, $\frac{5}{16}$ " (4 req'd)                         |
| 2 Cover                          | 13 Screw, cap, $\frac{5}{16}$ "-18 NC x $\frac{3}{4}$ " (4 req'd) |
| 3 Outlet tube                    | 14 Bracket  |
| 4 Skirt assembly                 | 15 Band   |
| 5 Screen                         | 16 Screw  |
| 6 Oil cup retaining clamp bolt   | 17 Air cleaner bracket  |
| 7 Oil cup retaining clamp washer | 18 Lockwasher, $\frac{1}{2}$ " (4 req'd)                          |
| 8 Oil cup retaining clamp        | 19 Screw, cap, $\frac{1}{2}$ "-13 NC x $\frac{3}{4}$ " (4 req'd)  |
| 9 Square nut                     | 20 Transfer instructions  |
| 10 Oil baffle                    |   |
| 11 Oil cup                       |   |

Figure 58. JXC engine air cleaner disassembled.



- 1 Wingnut
- 2 Top assembly
- 3 Cork gasket
- 4 Filter element
- 5 Bowl
- 6 Base gasket
- 7 Base

- 8 Clamp screw nut,  $\frac{1}{4}$ "-20 NC, (2 req'd)
- 9 Base clamp
- 10 Lockwasher,  $\frac{1}{4}$ " (2 req'd)
- 11 Base clamp screw, fl hd,  $\frac{1}{4}$ "-20 NC x  $1\frac{1}{2}$ " (2 req'd)

Figure 59. JXD engine air cleaner disassembled.

b. Replacing JXD Air Cleaner. Loosen the cap screw (2, fig. 55) in a clamp (3) around the base of the cleaner (1) and lift the cleaner from carburetor.

### 77. Cleaning Fuel Lines and Screens (fig. 50)

Fuel lines and fuel strainer screens must be inspected from time to time and kept free of dirt. Fouled or plugged fuel lines and strainer screens in the fuel pump and carburetor are likely to cause

poor engine operation. Slow starting and rough or sluggish engine operation are symptoms of clogged fuel lines or strainer screens. To correct any of these conditions, fuel lines must be cleaned as follows:

- a. Disconnect the fuel line (4) from the fuel supply tank (3) at the point where it enters the fuel pump (5).
- b. Insert an air hose in opening of gas tank. Close the opening with a rag wrapped around hose.
- c. Apply an air stream.
- d. Let air entering the tank force the fuel through the line until stream spurts out strong and clear at the fuel pump end.
- e. Before reconnecting the fuel line from the tank to the fuel pump, clean the fuel pump screen and sediment bowl.
- f. Disconnect the fuel line from fuel pump (5) outlet to fuel pump filter (2), and blow out the line with compressed air.
- g. Before replacing the line, remove fuel filter (par. 81) and clean the filter. Replace filter and lines.
- h. Disconnect the fuel line from the fuel pump filter to the carburetor (1), and blow out the line with compressed air.
- i. Before replacing the line, clean the filtering screen in the carburetor inlet.
- j. Replace fuel line from carburetor to fuel pump filter.
- k. Check for leaks at all fuel line connections from fuel tank outlet to carburetor inlet. Tighten connections where necessary to stop leaks.

## 78. Fuel Pump

The fuel pumps used on JXC and JXD engines are mounted on the engines as follows:

- a. *JXC Engine.* Located at right side of crankcase directly under the rear valve cover plate, driven directly from the camshaft.
- b. *JXD Engine.* Located at left side of crankcase near the bellhousing, operated by a drive pin (1, fig. 52) transferring the action of the camshaft to the fuel pump rocker arm. An improperly functioning fuel pump can cause excessive consumption, engine lag, or outright engine failure. Repair of fuel pumps is referred to field and depot maintenance personnel.

## 79. Replacing Fuel Pump

- a. With two open-end wrenches, disconnect the fuel line between the fuel pump and the fuel filter. This is the outlet line.
- b. With the same wrenches, disconnect the line between the pump and the fuel tank. This is the inlet line.
- c. With a one-half inch socket wrench, remove the cap screws (3, fig. 51) and lockwashers which hold the pump to the engine, being careful to hold the pump stationary and to avoid tearing the gasket between pump and crankcase.

*d.* Remove the pump and gasket. Do not force gasket if it sticks to the crankcase. Loosen with solvent and remove.

*e.* When installing a new or reconditioned fuel pump use a new gasket.

*f.* Place the gasket and pump on the pump mounting base and install cap screws (3) with lockwashers. On JXD engines remove the pipe plug and make certain the drive pin (1, fig. 52) is free to slide in its passageway. Push the drive pin all the way in before tightening the fuel pump on its base to have the rocker arm of the fuel pump contact the end of the drive pin. Install the pipe plug.

*g.* Connect the inlet line between the fuel pump and fuel tank.

*h.* Connect the outlet line between the fuel pump and the fuel filter.

## **80. Testing Fuel Pump**

Before putting the replacement pump into operation, make the following test:

*a.* Complete all reinstallation steps, except connecting the outlet fuel line between the pump and fuel filter.

*b.* With ignition OFF, turn the engine over a few times with the starter.

*c.* If gasoline spurts in a strong stream from the pump, it is functioning properly.

*d.* Complete reinstallation by connecting the outlet line from the pump to the fuel filter.

## **81. Servicing Fuel Filter**

(fig. 60)

A glass-bowl fuel filter is mounted in the fuel line just before the line reaches the carburetor. The purpose of the fuel filter is to remove any sediment or water from the gasoline after it has been pumped into the carburetor line by the fuel pump. The fuel filter can be readily seen and quickly serviced by the operator. Service fuel filter as follows:

*a.* Relieve pressure on filter bowl (4) by loosening the knurled thumb screw. With one hand, pull bail (3) away from filter head (2) while holding the filter bowl (4) with the other hand.

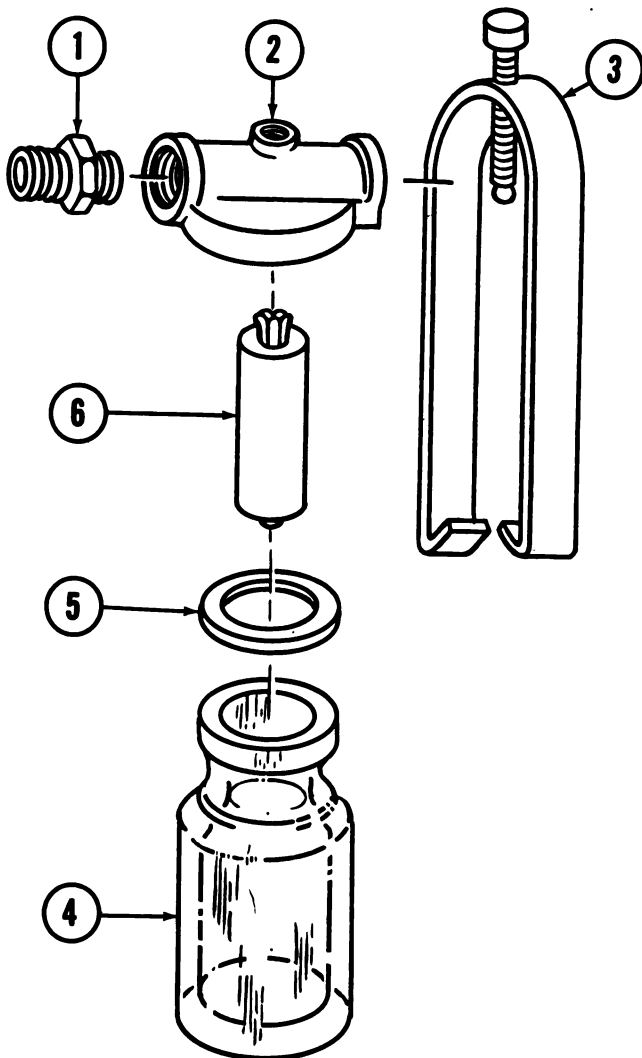
*b.* Remove filter bowl.

**Caution:** Be careful not to bend or break gasket when removing fuel filter bowl.

*c.* Wash filter bowl in cleaning solvent to remove sludge. Thoroughly dry inside of bowl with clean cloth.

*d.* Remove and clean filter element (6) by washing in cleaning solvent.

*e.* Replace filter element and filter bowl. Be careful to have proper fit of gasket (5).



- 1 Nipple
- 2 Filter head
- 3 Bail assembly

- 4 Filter bowl
- 5 Bowl gasket
- 6 Filter element

Figure 60. Fuel filter disassembled.

## 82. Replacing Fuel Filter

a. Holding the fuel filter firmly in one hand, use an open-end wrench and disconnect the fuel line on both sides of the fuel filter.

b. Force fuel lines slightly to one side to allow fuel filter to be removed from position between the two lines.

c. Place the fuel filter in proper position between fuel lines and tighten connections between tubing and filter head.

**Caution:** Make sure that port marked OUT on filter head is towards the carburetor. The fuel line from the fuel pump is connected to the IN port.

### 83. Adjusting Governor

(fig. 61)

Governors are set at the factory to control engine speed at any given maximum. This speed is 1,400 rpm for both JXC and JXD engines. Sometimes it is necessary to alter this speed slightly. Do this by loosening the locknut on speed adjusting screw (5) and turning it in to increase speed, or out to decrease engine speed. Then tighten the locknut on speed adjusting screw. Turn idle adjusting screw (4) in or out to increase or decrease engine idling speed.

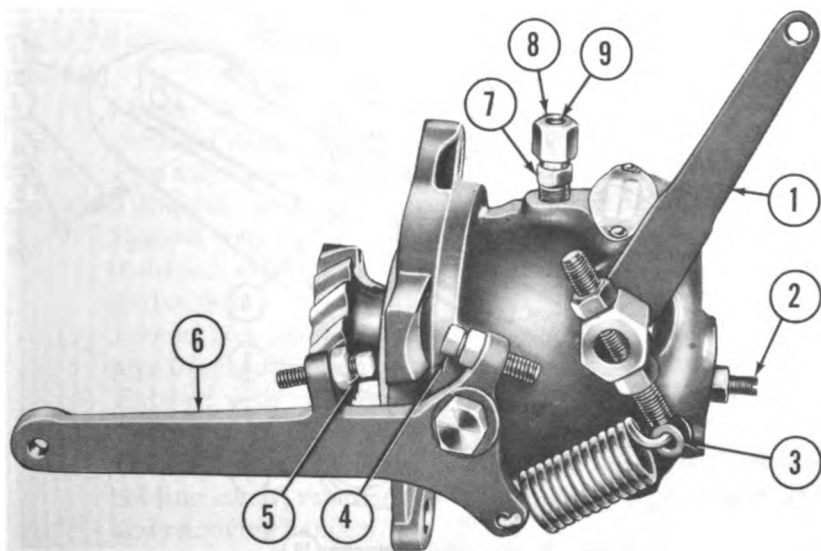
When it is necessary to correct engine "surging," or alternate speeding up and slowing down, check for binding control linkages as follows:

a. Carburetor control rod where it attaches to carburetor control lever (1).

b. Adjust the hand throttle lever.

(1) Check the linkage to see that there is no binding.

(2) Loosen locknuts on each end of the throttle control rod, next to the ball joint.



- 1 Carburetor throttle lever
- 2 Surge screw
- 3 Sensitivity adjusting screw
- 4 Idle adjusting screw
- 5 Speed adjusting screw
- 6 Throttle control lever

- 7 Governor pressure lubrication union
- 8 Governor pressure lubrication tube nut
- 9 Governor pressure lubrication tube ferrule

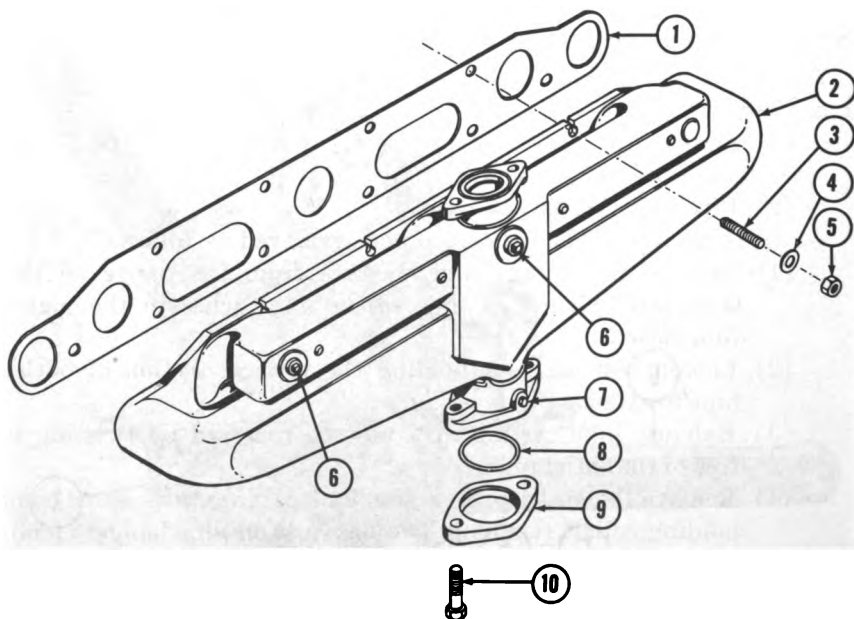
Figure 61. Governor adjustment.

- (3) Turn throttle control rod counterclockwise to shorten or clockwise to lengthen the rod for correct adjustment.
  - (4) Tighten locknuts when desired length has been obtained. Carburetor throttle valve should be wide open when engine is at rest.
- c. Should the above adjustments fail to correct the surging, further adjustment may be made as follows:
- (1) With engine running at full governed speed, loosen the locknut on surge screw (2) and turn the screw out three or four turns.
  - (2) Now turn the surge screw in slowly until surging stops.
  - (3) Wait several minutes to make sure the engine is stable. Then tighten the surge screw locknut.

### 84. Replacing Combination Manifold

The combination exhaust and intake manifolds on the JXC and JXD engines are removed and installed in the same manner. Broken or cracked manifolds should be referred to field and depot maintenance personnel for possible repair.

- a. Disconnect fuel line from the carburetor.



- |                              |                           |
|------------------------------|---------------------------|
| 1 Manifold gasket            | 6 Manifold pipe plug      |
| 2 Manifold                   | 7 Setscrew                |
| 3 Attaching studs            | 8 Companion flange gasket |
| 4 Manifold attaching washers | 9 Companion flange        |
| 5 Manifold attaching nuts    | 10 Companion flange screw |

Figure 62. Manifold disassembled.



- b.* Disconnect carburetor controls, carefully noting how these are assembled so they may be reassembled correctly.
- c.* On the JXC engine, remove the carburetor (6, fig. 3) from the manifold, leaving it attached to the air cleaner hose.
- d.* On the JXD engine, remove the air cleaner (1, fig. 6) before removing carburetor.
- e.* Disconnect the exhaust pipe from manifold.
- f.* Remove manifold attaching nuts (5, fig. 60) and washers (4).
- g.* Pull manifold straight out from engine.
- h.* Remove the manifold gasket.
- i.* Use a new gasket, placing it on the attaching studs (3). Slide the gasket to the cylinder block evenly to avoid damage as it passes over studs.
- j.* Assemble manifold to engine.
- k.* Replace washers (4) and nuts (5) on studs and tighten lightly. Starting from the center, tighten nuts (5) progressively toward ends of the manifold. Repeat until all nuts are tight.
- l.* Attach exhaust pipe and tighten down the cap screws.
- m.* Install carburetor, and air cleaner to carburetor.
- n.* Connect carburetor controls as removed.
- o.* Reconnect fuel line.

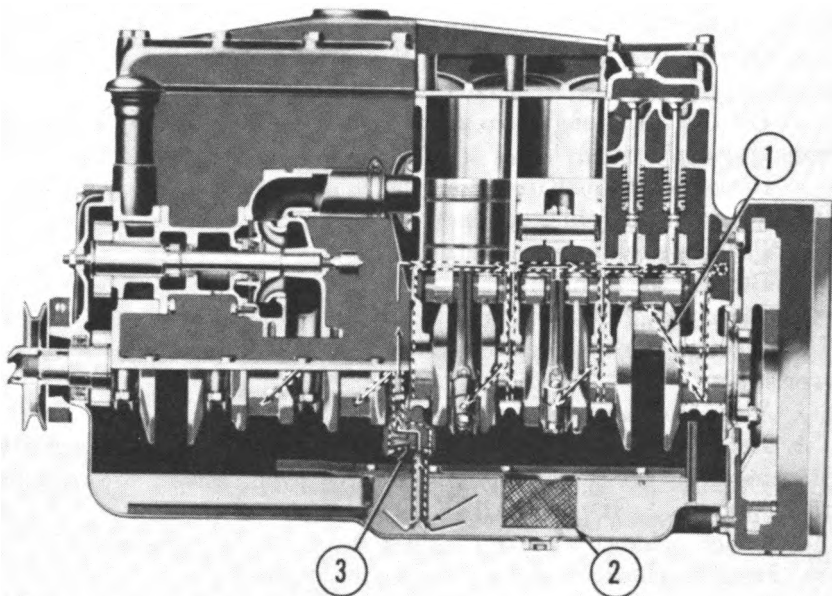
## 85. Replacing Exhaust Pipe

- a. JXC Engine.* The outlet pipe clamps to a flange casting on the manifold.
  - (1) Loosen the stove bolt in clamp holding outlet pipe to the manifold flange casting.
  - (2) Pipe may then be removed.
- b. JXD Engine.* The exhaust pipe is removed as follows:
  - (1) Remove cap screws and washers from the flange on the U-shaped exhaust casting where it attaches to the manifold outlet.
  - (2) Loosen bolt and nut holding the vertical section of outlet pipe to exhaust pipe casting.
  - (3) Exhaust pipe casting may now be removed by twisting it free of the outlet pipe.
  - (4) Remove the outlet pipe section by loosening three stove bolts holding collar, removing two hex nuts on pipe hanger clamp and removing hanger.

## Section X. LUBRICATION SYSTEM

### 86. General

JX-series engines and governors are lubricated by forced oil-feeding from a gear driven pressure pump (3, fig. 63). The pump picks



1 Oil channels                      2 Sump screen                      3 Oil pump

*Figure 63.—Lubrication system, JX engines, cutaway view.*

up oil from the center sump in the oil pan and delivers it first to the main bearings, then to the connecting rod bearings through holes drilled in the crankshaft. The camshaft (5, fig. 64), valve tappets (6), valve stems and springs (7), and cylinders and pistons are lubricated by a mist of oil thrown off by the main and connecting rod bearings. Grit and dirt are removed by the oil purifier or filter (1). The governors receive their lubrication under pressure that enters the top of the governor from the outside oil line.

### 87. Oil Filter

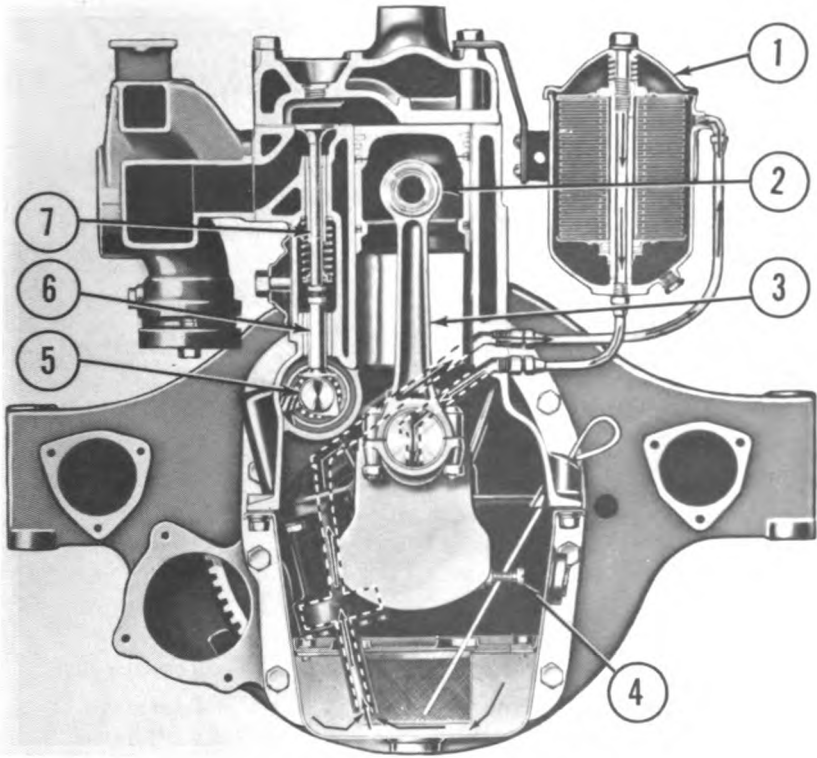
The combination oil filter and cooler used on both the JXC and JXD engine is attached to the crankcase on the left side of the engine. Removal, disassembly, repair or replacement, reassembly, and installation procedures are similar for both engines.

### 88. Oil Filter Removal

- a. Drain cooling system (par. 51).
- b. Loosen hose connection (3, fig. 66) from filter (1) to water pump.

### 89. Disassembly, Cleaning and Inspection of Oil Filters (fig. 67)

- a. Remove top fitting (1), gasket (2), and shell (3).



- |                   |                         |
|-------------------|-------------------------|
| 1 Oil filter      | 5 Camshaft              |
| 2 Piston          | 6 Valve tappet          |
| 3 Connecting rod  | 7 Valve stem and spring |
| 4 Adjusting screw |                         |

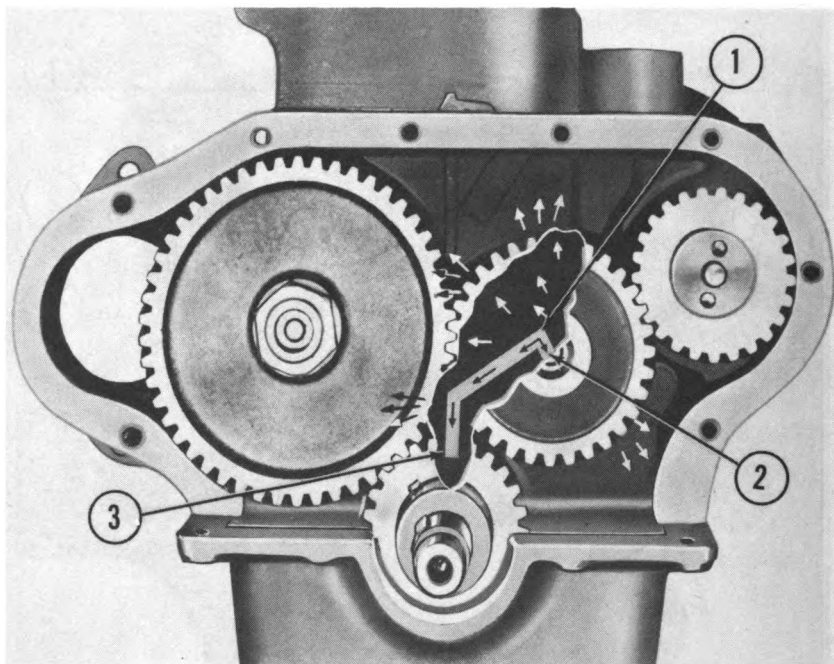
Figure 64. Lubrication system, JX engines, sectional view.

- b. Lift filtering element (6) off outlet tube (11).
- c. Remove differential valve assembly including plug (16), gasket (17), spring (18), and valve ball (19).

### 90. Maintenance of Oil Filter

The oil filter on the engine should be given regular and careful attention. The base of the filter should be drained at least every time the engine oil is changed.

- a. Remove large headed plug (2, fig. 26).
- b. Allow to drain for several minutes, or start engine and allow to idle until about two quarts of oil has run out.
- c. Replace plug.
- d. Add sufficient oil to crankcase so oil level will be correct after engine has run long enough to refill the filter.



1 Oil header

2 Idler gear line

3 Main bearing oiler

*Figure 65. Gear train oiling system.*

## 91. Reassembly of Oil Filters

(fig. 67)

*a.* Install differential valve assembly in base and tighten retaining plug snugly, but do not force.

*b.* Slip a new or clean filtering element (6) down over outlet tube (11). Be sure filtering element is seated evenly on washer (9), and that shell gasket (13) is seated evenly in base groove.

*c.* Slip oil filter shell (3) over outlet tube and seat it firmly on shell gasket (13).

*d.* Install top fitting gasket (2) and top fitting (1) and tighten.

## 92. Installation of Oil Filters

*a.* Place small amount of cup grease on filter attaching gasket and place gasket on filter dowel in cylinder block. Make certain correct gasket is used.

*b.* If water pump hose to filter is damaged, replace hose.

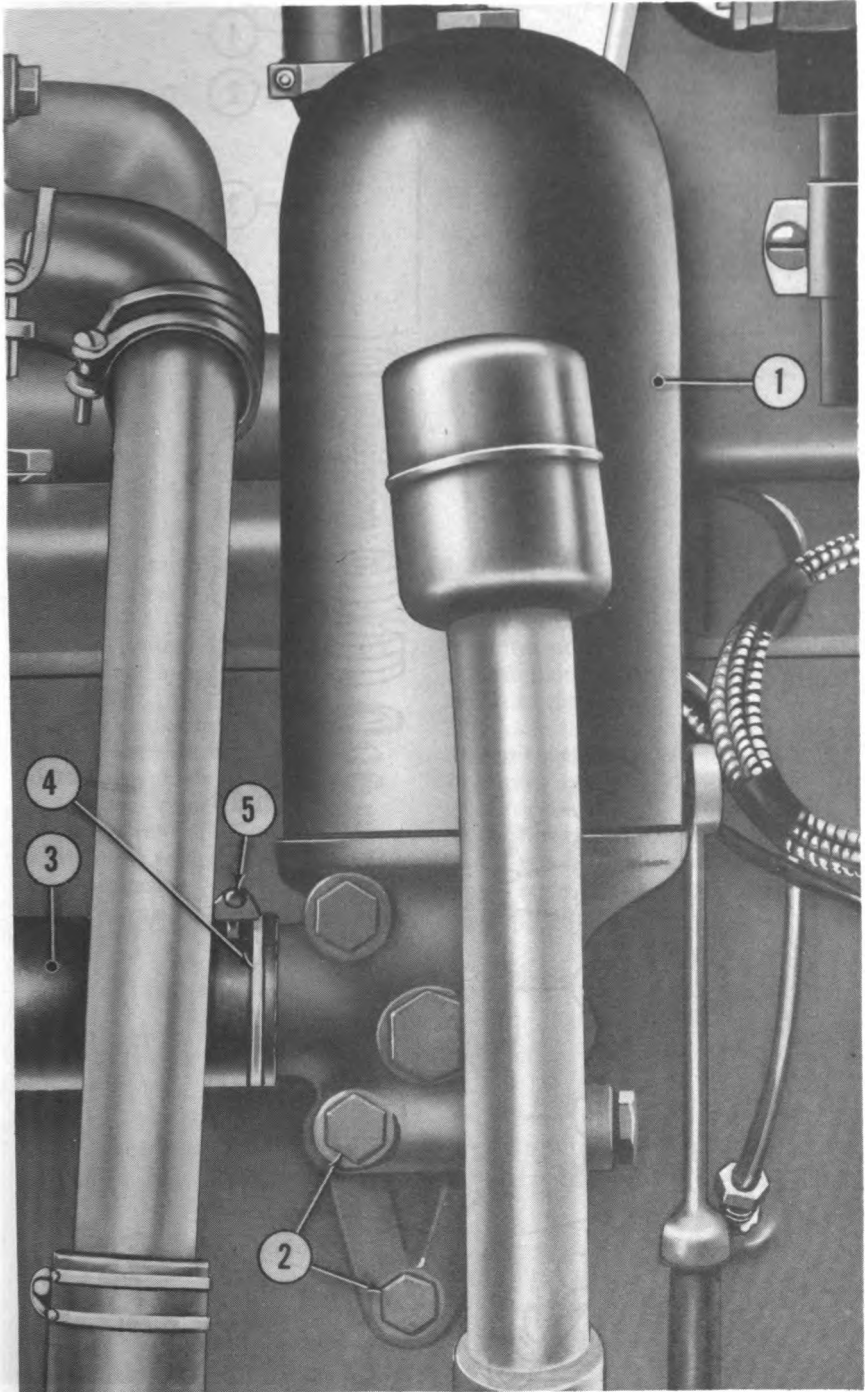
*c.* Assemble oil filter to cylinder block as removed.

*d.* Tighten water pump hose clamps.

*e.* Fill engine cooling system.

*f.* Start engine and allow oil filter to fill with oil. This will require about five minutes at idling speed.

*g.* Stop engine and check oil level in crankcase. Fill to the 4/4 mark on the oil level gage. See LO 5-5167.



1 Oil filter  
2 Screw  
3 Hose

4 Clamp  
5 Screw

*Figure 66. Oil filter installation.*

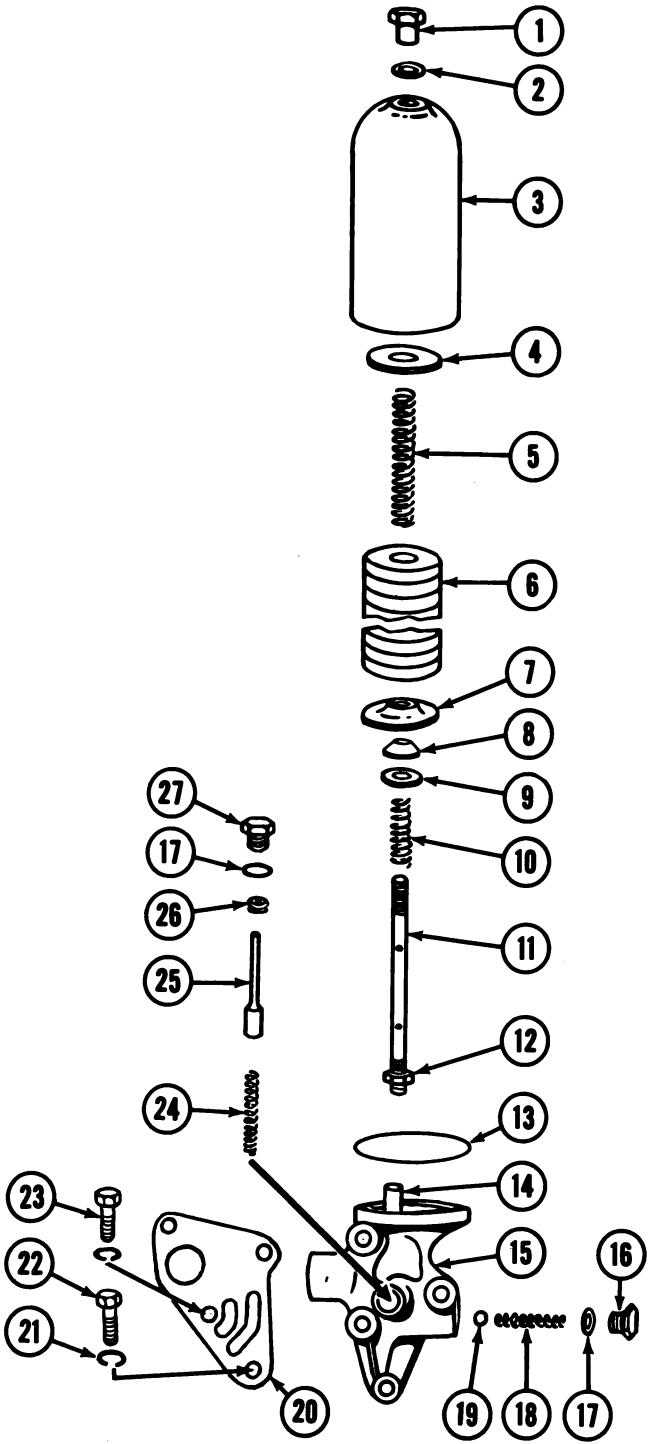


Figure 67. JXC oil filter disassembled.

- |                              |   |
|------------------------------|---|
| 1 Top fitting                | 16 Differential valve plug                              |
| 2 Top fitting gasket         | 17 Oil reversal and differential valve<br>plug gasket   |
| 3 Shell                      | 18 Differential valve spring                            |
| 4 Element top plate          | 19 Differential valve ball                              |
| 5 Element compression spring | 20 Attaching gasket                                     |
| 6 Element                    | 21 Lockwasher, $\frac{1}{2}$ " SAE (4 req'd)            |
| 7 Element bottom plate       | 22 Screw, cap, $\frac{1}{2}$ "-13 NC x $1\frac{1}{4}$ " |
| 8 Element cork washer        | 23 Screw, cap, $\frac{1}{2}$ "-13 NC x 3" (3<br>req'd)  |
| 9 Element washer             | 24 Oil reversal valve spring                            |
| 10 Element spacer coil       | 25 Oil reversal valve piston                            |
| 11 Outlet tube               | 26 Oil reversal valve plug                              |
| 12 Element retaining nut     | 27 Drain plug   |
| 13 Shell gasket              |   |
| 14 Inlet tube                |   |
| 15 Base                      |   |

*Figure 67.*—Continued

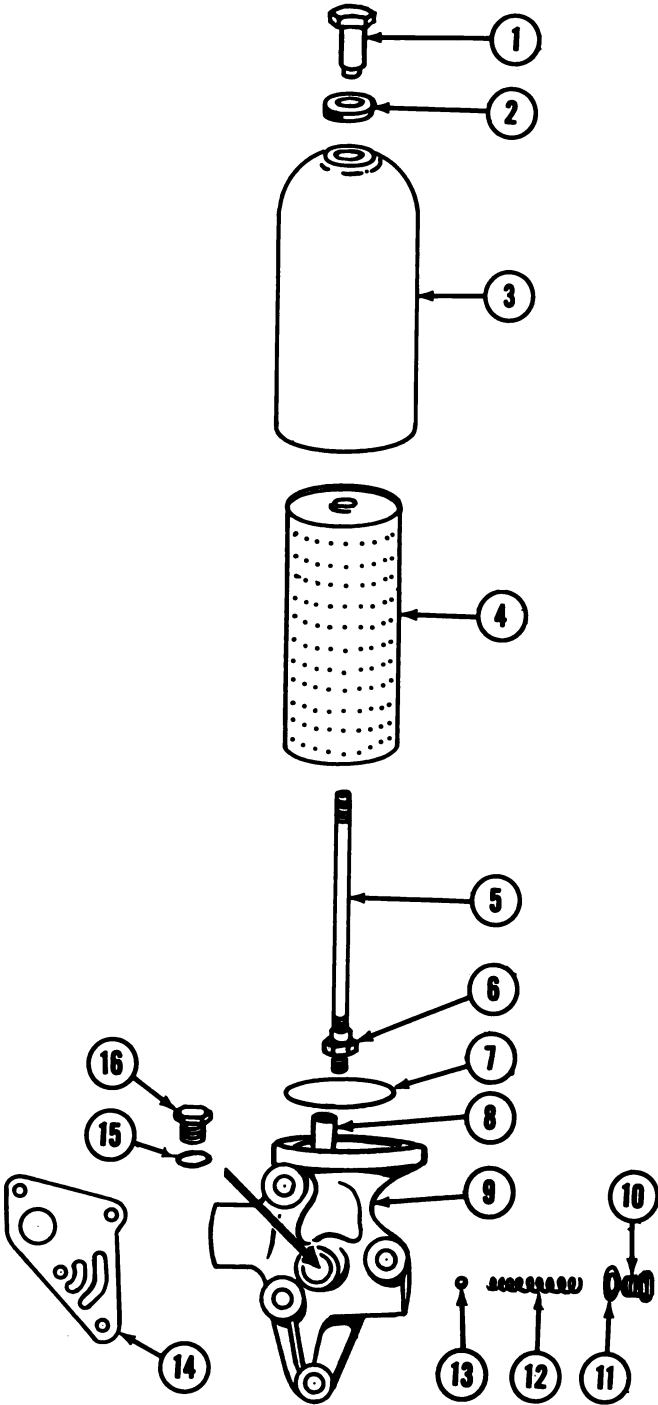


Figure 68. JXD oil filter disassembled.



## Section XI. FUNGUS CONTROL SYSTEM

### 93. Description of Fungus Control System

Fungus control consists of "tropicalizing" or treating various electrical accessories of an engine with a special fungus-resistant varnish. This varnish is air-drying and forms an electrical insulation. Tropicalization coatings require no attention from the using personnel. The electrical accessories of the JXC engine are not tropicalized.

### 94. Accessories Tropicalized

(fig. 69)

The electrical accessories of the JXD engine which are tropicalized are—

*a. Generator.* All parts of the generator (1) except commutator, brushes, and bearing surfaces, are soaked in the fungus-resistant varnish.

*b. Starting Motor.* The starting motor (4) has the same fungus-resistant treatment as the generator.

*c. Ignition Coil.* Windings and inside surfaces of coil housings (2) are painted with fungus-resistant varnish.

*d. Ignition Distributor.* All parts of the distributor (3) except contact points are treated with fungus-resistant varnish.

## Section XII. FIRE EXTINGUISHER

### 95. Description of Fire Extinguisher

Fire extinguishers supplied with JXC and JXD engines are the vaporizing liquid type, pump operated, and use carbon tetrachloride. They have a capacity of one quart.

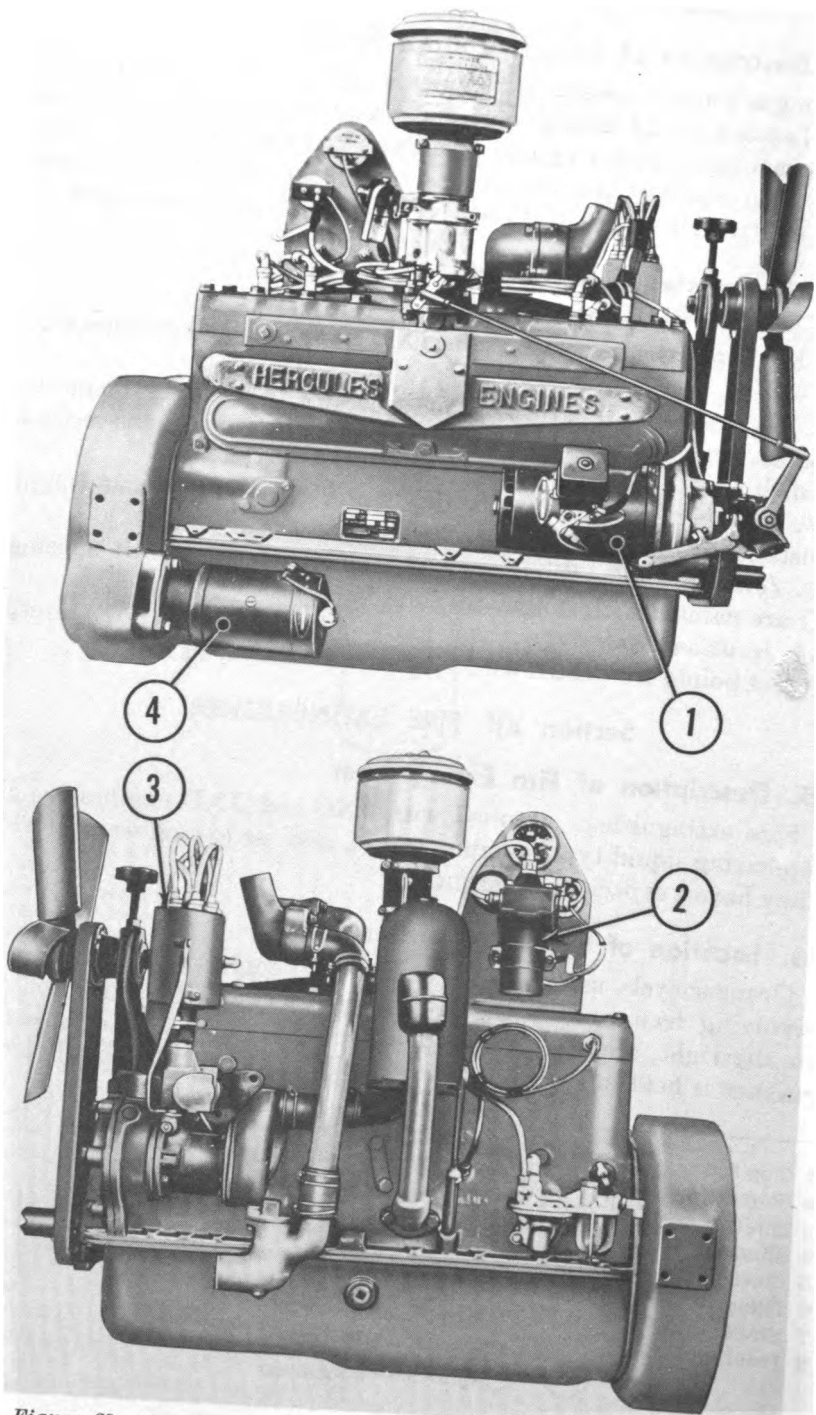
### 96. Location of Fire Extinguisher

Crane-shovels, using a JXC and a JXD engine in their respective revolving frames, have the fire extinguisher located inside the cab on the right, approximately opposite the radiator. The fire extinguisher is held to the wall of the revolving frame by a metal clamp.

---

1 Top fitting	9 Base
2 Top fitting gasket	10 Differential valve plug
3 Shell	11 Differential valve gasket
4 Element	12 Differential valve spring
5 Outlet tube	13 Differential valve ball
6 Element retaining nut	14 Attaching gasket
7 Shell gasket	15 Drain plug gasket
8 Inlet tube	16 Drain plug

Figure 68—Continued



*Figure 69. Location of tropicalized equipment, JXD engine only.*

- |             |                  |
|-------------|------------------|
| 1 Generator | 3 Distributor    |
| 2 Coil      | 4 Starting motor |

Figure 69.—Continued

## 97. Operation of Fire Extinguisher (fig. 70)

In case of fire, take the extinguisher from its clamp on the frame wall and operate as follows:

- a. Turn pump handle (1) to release from locked position.



- |               |             |                 |
|---------------|-------------|-----------------|
| 1 Pump handle | 2 Nameplate | 3 Outlet nozzle |
|---------------|-------------|-----------------|

Figure 70. Fire extinguisher.

b. Hold finger over outlet nozzle (3) and work pump handle two or three times, first with the nozzle pointed up, and then with the nozzle pointed down. (This builds up pressure in air chamber so fluid will spurt in a strong steady stream the instant it is released.)

a. Continue to work pump handle slowly as stream is played on fire at base of flame.

**Caution:** Never fight an engine fire with water or other material which conducts electricity.

### 98. Recharging Fire Extinguisher

At least once a year, or each time the extinguisher is discharged, extinguishing fluid should be replaced and the extinguisher serviced in the following manner:

- a. Remove the fill cap.
- b. Pour any liquid remaining in the extinguisher into any small container which can be used to refill the extinguisher. If the fluid is clear and free of a brown or milky appearance, it may be reused.
- c. Use a small funnel to refill extinguisher, bringing the level up to within one-quarter inch of top.
- d. Replace filler cap in extinguisher and tighten snugly with wrench, but do not force.

**Caution:** Never use water in a vaporizing liquid extinguisher, or use water to clean it.

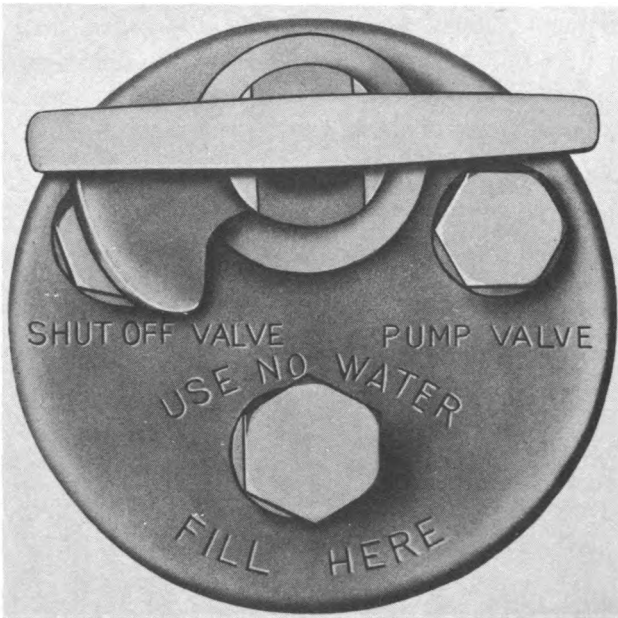


Figure 71. Top of fire extinguisher.

## CHAPTER 4

### FIELD AND DEPOT MAINTENANCE

---

#### Section I. INTRODUCTION

##### 99. General

Instructions in this section and in succeeding sections of this chapter are published for the information and guidance of maintenance personnel responsible for third and higher echelons of maintenance of this equipment. They contain information on maintenance of the equipment which is beyond scope of the tools, equipment, or supplies normally available to using organization. To avoid needless disassembly of a faulty component, refer to parts list in appendix II for information as to whether the part is furnished separately, or whether the complete component or assembly is supplied.

##### 100. Field and Depot Maintenance Tools

(fig. 72)

Special tools supplied with each engine for use by field and depot maintenance personnel are—

- a. Oil pump adjusting wrench (1).
- b. Connecting rod spreader (2).
- c. Valve guide driver (3).
- d. Push rod guide (4).
- e. Idler bushing driver (5).
- f. Cam bearing driver (6).

#### Section I. COOLING SYSTEM

##### 101. General

Major components of the JXC and JXD engine cooling systems include the radiator, water pump, fan and thermostat, together with connecting hose, pipes, clamps and engine water jackets necessary to complete the system. Clogged or leaking radiators, worn or broken water pumps, and fans are referred to field and depot maintenance for repair. Worn or broken hose and clamps are replaced with new units by using organizations. Disassembly, repair and reassembly of

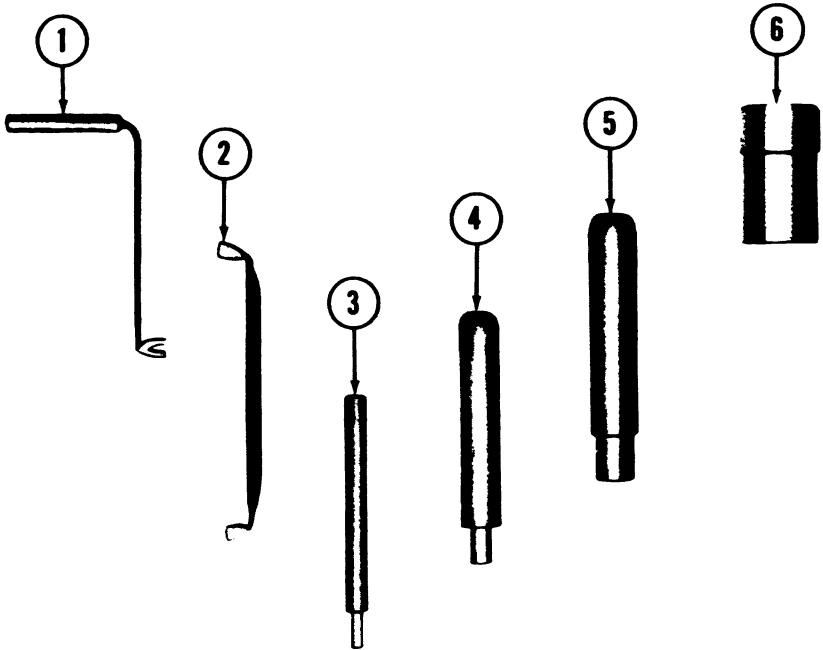


Figure 72. Field and depot maintenance tools.

major components of JXC and JXD cooling systems are explained in the succeeding paragraphs.

## 102. Radiator

The radiators used on JXC and JXD engines are of the same type. Disassembly, repair, and reassembly of both radiators are the same.

## 103. Disassembly of Radiator (fig. 73)

To remove the radiator core from its shell, use a large soldering iron or blow torch to loosen the sweat clips holding the right and left hand core channels (9) (19) to the bottom tank (17) and top tank (5). Remove the core (8) and place it on a table or bench where it can be worked on at waist level.

## 104. Inspection of Radiator

The radiator may be tested for leaks by plugging the openings in the top and bottom tanks. Attach an air hose to the overflow pipe, and apply not more than 10 psi of air pressure while the radiator is submerged in water. Mark the source of air bubbles with a crayon while the radiator is submerged.

## 105. Repair of Radiator

### *a. Core Assembly.*

- (1) Remove top tank (5, fig. 73) and bottom tank (17).
  - (a) Remove fan shroud (20) by using a soldering iron or blow torch and melt off points of solder.
  - (b) Remove core channels (9) (19). See paragraph 103.
  - (c) Lift top tank (5) from top headsheet (7).
  - (d) Remove bottom tank (17) from bottom head sheet (18).
- (2) Soak the core thoroughly in radiator cleaning solvent to loosen foreign deposits in tubes.
- (3) With a long wire or rod, ream out each core tube until the rod slides smoothly in the tube.
- (4) Blow out and flush each tube with air and water. Allow the core assembly to dry thoroughly. Then locate cracks or punctures in tubes and repair as instructed below.
- (5) With a broad screwdriver or other flat tool, carefully pry the horizontal cooling fins apart so the damaged area of tube is exposed.
- (6) Clean the area to be soldered with muriatic acid or soldering flux crystal wash (1 gal. of crystals to 4 gals. of water).
- (7) Heat the tube with radiator soldering torch, or hold a soldering iron against the damaged area until it is heated.
- (8) Repair the break by soldering.

### *b. Core Channels.*

- (1) With a hammer and small wood block, pound out dents in right and left hand core channels. If the dent is severe, apply solder over the straightened area to reinforce the original metal.
- (2) Small punctures and cracks are repaired by flattening the torn edges and soldering. Large punctures are repaired by filing the hole until edges are smooth and flat, and soldering on a patch plate of 22- or 24-gage sheet copper or brass.

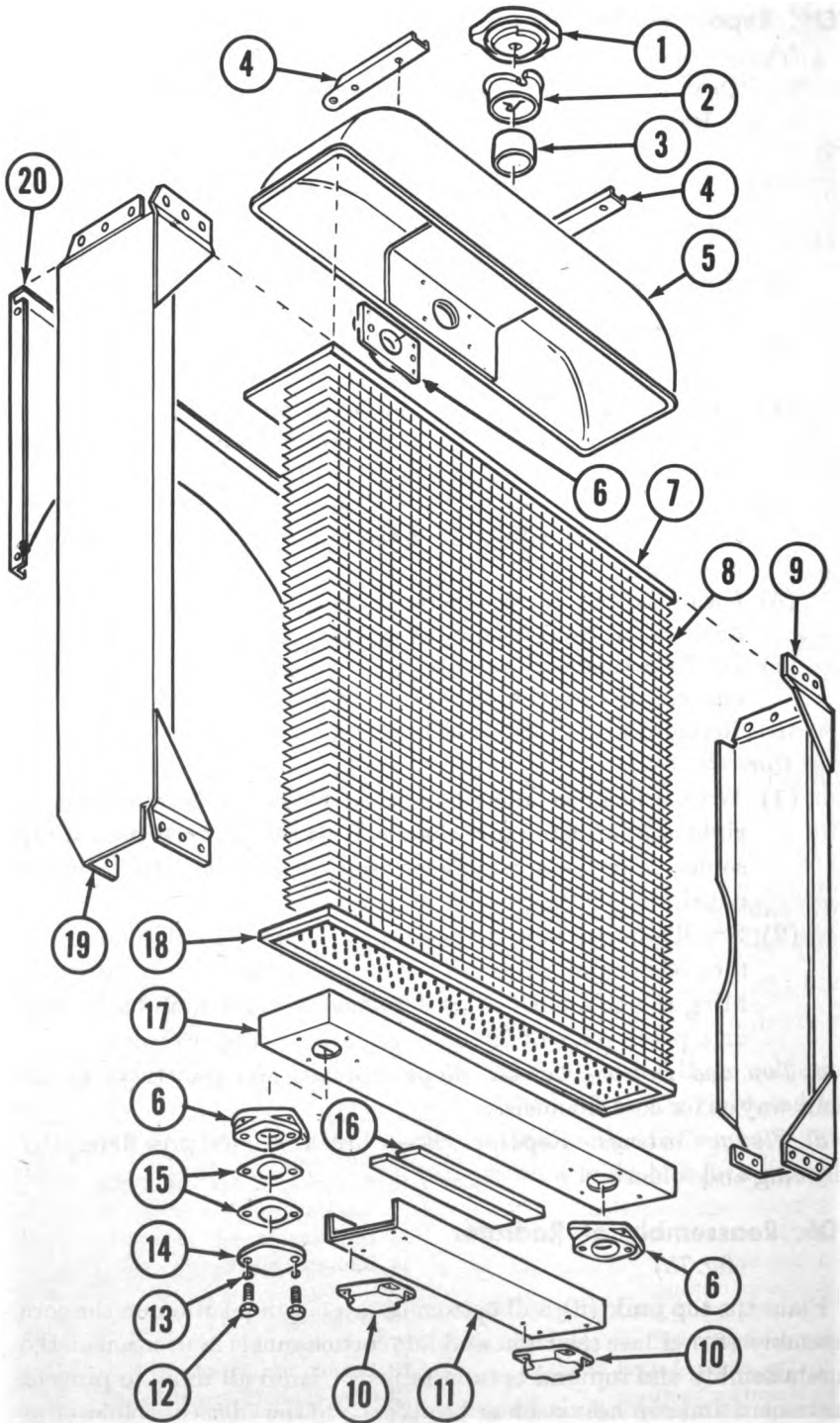
*c. Top and Bottom Tanks.* Repair breaks and punctures in the same way as for core channels.

*d. Flange Castings.* Repair cracks or breaks around pipe flanges by cleaning and soldering.

## 106. Reassembly of Radiator

(fig. 73)

Place the top tank (5) and bottom tank (17) in position on the core assembly (8). Place the right and left core channels in position on the core assembly and top and bottom tanks. Clamp all units to prevent movement and run heavy solder beads around the edges of solder clips until the headsheets and tanks are sealed together.



*Figure 73. Radiator disassembled.*



## 107. Testing Radiator

Place a water nozzle in the radiator and seal by packing neck with rags. Apply a maximum of 10 pounds water pressure, and watch for leaks. It may be necessary to add more solder to close minute cracks on solder beads completely. File or use a wire brush to remove burs from solder beads after radiator is reassembled.

## 108. JXC Water Pump

The JXC water pump is used with a magneto or distributor or both. The water pump is of the centrifugal type and is composed of two sub-assemblies; the water pump drive which is mounted in the cylinder block and is driven from the timing gears, and the water pump proper which is coupled to the drive with suitable internal gears. The two subassemblies are held together with the screws used to attach the complete assembly to the engine.

## 109. Disassembly of JXC Water Pump

(fig. 74)

a. Remove packing nut (19), gland (18) and packing (20).

b. Remove the cap screws (8) holding cover (17) to the body (7) and remove cover and gasket (13) from body.

c. Remove impeller pin (11) with pin punch and pull impeller (12) from the shaft (1).

**Caution:** Do not press shaft through impeller as the key will damage the bushing. If no puller is available, press the shaft through the impeller  $\frac{1}{8}$ ". Then place a suitable spacer between the impeller and bushing. Press the shaft through the impeller until the key almost touches the bushing. Then add more spacers. Repeat until impeller is removed.

d. Remove impeller key (2) and pull shaft from cradle.

e. Remove distributor driving gear (3), by using a drift punch and remove key then drive off gear.

**Note:** Further disassembly of this shaft is not practical as the shaft is assembled before the final cutting of the gear teeth and grinding of the shaft.

---

1 Filler cap	11 Mounting clip
2 Filler tube	12 Screw, cap, $\frac{3}{8}$ "-16 NC x $\frac{3}{4}$ ", (2 req'd)
3 Filler tube extension	13 Lockwasher, $\frac{3}{8}$ " (2 req'd)
4 Clip	14 Radiator blank
5 Top tank	15 Gasket
6 Flange casting	16 Webbing
7 Top headsheet	17 Bottom tank
8 Core assembly	18 Bottom headsheet
9 Core channel—left hand	19 Core channel—right hand
10 Mounting casting	20 Fan shroud

Figure 73—Continued

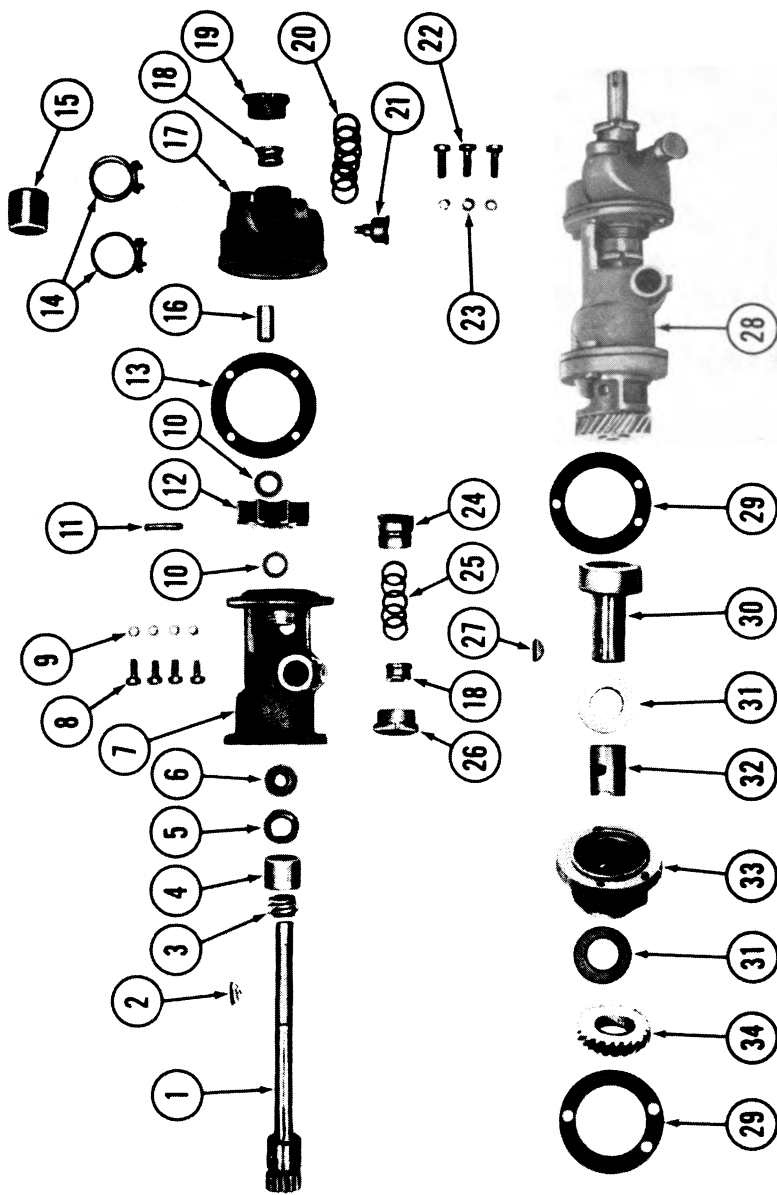


Figure 74. JXC water pump disassembled.

1 Water pump shaft	18 Packing gland
2 Key, woodruff #5	19 Packing nut
3 Distributor driving gear	20 Packing
4 Body bushing	21 Grease cup
5 Oil retainer	22 Screw, cap, hex hd, $\frac{3}{8}$ "-16 NC x 1 $\frac{3}{8}$ " (3 req'd)
6 Cork washer	23 Lockwasher, $\frac{3}{8}$ SAE, (3 req'd)
7 Body	24 Packing bushing
8 Screw, cap, hex hd, $\frac{5}{16}$ "-18 NC x $\frac{3}{4}$ " (4 req'd)	25 Packing
9 Lockwasher, $\frac{5}{16}$ " (4 req'd)	26 Packing nut
10 Thrust washer	27 Key, woodruff #91
11 Pin	28 Water pump assembly
12 Impeller	29 Gasket
13 Gasket	30 Drive shaft
14 Hose clamp	31 Thrust washer
15 Hose	32 Bushing
16 Bushing	33 Cradle
17 Cover	34 Driving gear

Figure 74—Continued

- f. Turn drive key (27) so that it is in line with notch in bushing (32) and press shaft (1) through gear and thrust washer (31) until key almost touches the bottom of the notch then put spacers between gear and housing and continue to press shaft out of gear. Repeat if necessary so that sleeve or housing bushing is not damaged. After gear is removed pull key from shaft and remove shaft from sleeve.
- g. Press bushing (32) from cradle (33).
- h. Press bushing (16) from cover.
- i. Drive out oil retainer (5) and cork washer (6) with a punch.

## 110. Reassembly of JXC Water Pump (fig. 74)

- a. Press bushing (32) in cradle (33). Check drive shaft (30) clearance in bushing. The correct clearance is 0.0015 inch to 0.0025 inch.
- b. Put thrust washer (31) on shaft (30) and place shaft in cradle. Install second thrust washer (31) and drive in gear key (27).
- c. With a 0.003 inch feeler gage on thrust washer press drive gear (34) on shaft. The gear should be pressed on until a light pull is necessary to remove the feeler. This should allow the drive shaft to have 0.003 inch end clearance in the cradle.
- d. Press bushing (4) into body (7) and bushing (16) into cover (17). Check shaft clearance with 0.0015-inch feeler gage, if necessary, ream or burnish to size.
- e. Install drive gear key (2) and press on gear (3).
- f. Remove any nicks on water pump shaft (1). Slide shaft through body (7), and then through packing nut (26), packing gland (18), and packing (25) and packing bushing (24).
- g. Put thrust washer (10) on shaft.
- h. Before pressing impeller (12) on shaft, position shaft so that front face of gear is one-quarter inch from front flange of body. Use

a one-quarter inch flat steel plate about  $1\frac{1}{2}$  inch square placed on end of gear, so that shaft will be correctly positioned when the assembly is placed on bed of press.

*i.* Press impeller (12) on shaft, using a 0.003 inch feeler gage between impeller and thrust washer to check end thrust. Drill impeller and shaft and drive in impeller pin (11), make sure it is tight. Put second thrust washer (10) on impeller and cement body gasket (13) to body.

*j.* Install water pump cover (17), use screws (8) and lockwashers (9) and tighten screws progressively.

*k.* Install packing gland (18), packing (20) and packing nut (19) by forcing into cover and then tightening nut finger tight.

*l.* Install new gasket (29) on cradle (33).

*m.* Secure body (7) to cradle (33) with screws (22) and lockwashers (23).

*n.* Install water pump assembly (28) to engine.

## 111. JXD Water Pump

(fig. 75)

The water pump operates centrifugally and is used on the JXD engine. The pump is the auto-seal, blind-end type, consisting of two major parts: the body (28) containing the impeller and seal assembly, and the cradle (15) which fastens to the cylinder block. The water pump drive, which is mounted in the cylinder block, is driven by the timing gears. Disassembly, repair and reassembly of water pumps on JXC and JXD engines are similar. See appendix II for minor differences in parts lists of the pumps. Normal repair of this pump consists of replacing the oil seal (11) and auto seal assembly (18, 19, 20, 21, 22, and 23).

## 112. Disassembly of JXD Water Pump

(fig. 75)

*a.* Remove four screws (16) and lockwashers (17) and pull the body (28) away from the cradle (15).

*b.* Remove the impeller pin (25).

*c.* Support cradle (15) solidly and press the pump shaft (6) out of the impeller (24). Be sure the shaft does not fall out of the pump cradle and damage the gear. Press shaft thrust button (1) from gear (2).

*d.* If it is necessary to remove the distributor drive gear (9), do this with a drift punch after the snap ring (10) is removed. Be sure the woodruff key (7) does not fall out and get lost.

*e.* Press the water pump drive gear (2) from shaft (6) and remove woodruff key (5).

f. Remove the snap ring (18) from the impeller and remove seal parts (19, 20, 21, 22, and 23).

g. If the split-type shaft bushing (26) is worn, remove the bushing by driving with a chisel along the split line and pulling it out with pliers. Then press a new bushing into body (28).

h. If the shaft bushing (4) is worn, remove it by driving out of cradle (15). Then press a new bushing into cradle.

i. Unscrew grease cup (30).

### 113. Cleaning and Inspection of Water Pump

(fig. 75)

Wash all parts in solvent and dry thoroughly. Check body (28) and cradle (15) for fractures or breaks in the metal. Replace body (28) or cradle (15) if necessary. Unscrew the cap from grease cup (30), wash cup and cap in solvent, and blow clean with compressed air. Inspect threads on grease cup.

### 114. Repair and Reassembly of JXD Water Pump

(fig. 75)

If new shaft bushings are used, press these into the cover and cradle.

a. Install the woodruff key (5) and press shaft (6) into pump drive gear (2). Then press in the thrust button (1).

b. Install the woodruff key (7), press on the distributor drive gear (9), and install the snap ring (10).

c. Fit the pump shaft into the cradle bushing and check its clearance. This should be 0.0015 to 0.0025 inch.

d. Install a new oil seal (11) in the cradle, making sure the lip of the seal is toward the front or gear end of the cradle.

e. Place a thrust washer (3) on shaft and insert the shaft into the bushing (4).

f. Install seal assembly units (19, 20, 21, 22, and 23) into the impeller and lock in place with snap ring (18).

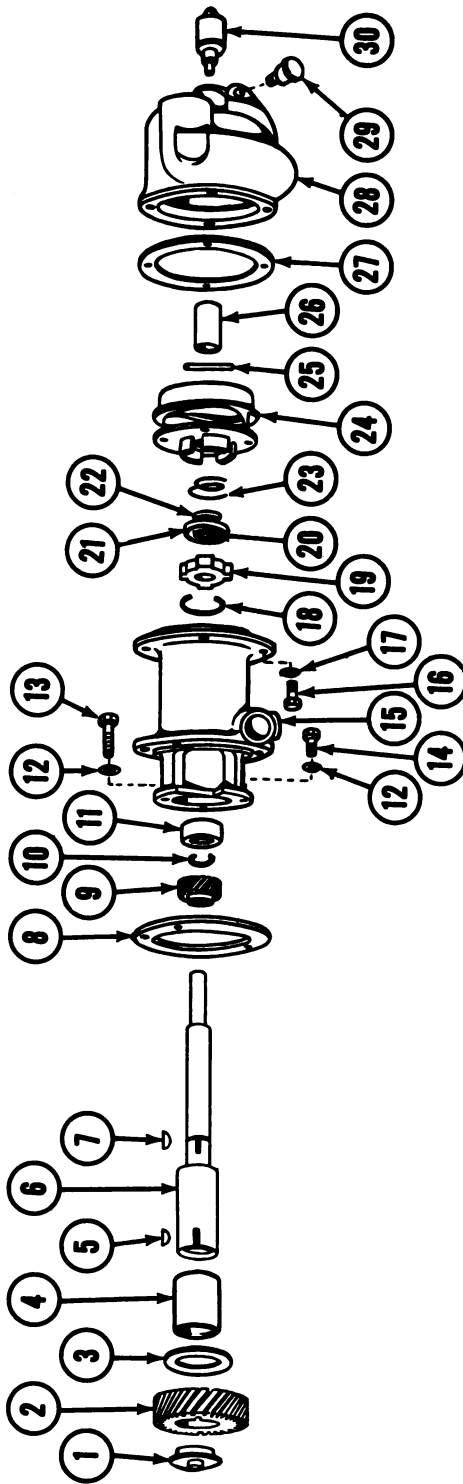
g. Wipe the pump shaft with light oil, install the impeller in position on shaft, and drive in the impeller pin (25).

*Note.* If a new shaft and new impeller are installed, a hole for the locking pin must be drilled in the impeller, or shaft, or both, for the impeller pin.

h. Place a new gasket (27) on cradle and fasten the cradle to body (28) with screws (16) and lockwashers (17) as removed.

### 115. Fan Assemblies

With the exception of the blade assemblies, the fan assemblies of both the JXC and JXD engines are identical. Both fans have six blades. The JXC blade assembly is 18 inches in diameter; the JXD blade assembly is 20 inches in diameter. The fan assembly is driven by a V-belt from a pulley on the crankshaft. Fan brackets are bolted on top of the timing gear cover.



- 1 Shaft thrust button
- 2 Drive gear
- 3 Thrust washer
- 4 Bushing
- 5 Key, Woodruff, #91
- 6 Water pump shaft
- 7 Key, Woodruff, #2
- 8 Water pump attaching gasket
- 9 Distributor drive gear
- 10 Snap ring

- 11 Oil seal
- 12 Lockwasher,  $\frac{3}{8}$ " SAE, (3 req'd)
- 13 Screw, cap,  $\frac{3}{8}$ "-16 NC x  $1\frac{1}{4}$ ", (2 req'd)
- 14 Screw, cap,  $\frac{3}{8}$ "-16 NC x  $1\frac{1}{4}$ ", (2 req'd)
- 15 Cradle
- 16 Screw, cap,  $\frac{5}{16}$ "-18 NC x  $\frac{3}{4}$ ", (4 req'd)
- 17 Lockwasher,  $\frac{5}{16}$ ", (4 req'd)
- 18 Seal snap ring
- 19 Seal synthane washer
- 20 Flexible seal

- 21 Spring guide
- 22 Clamp ring
- 23 Seal spring
- 24 Impeller
- 25 Impeller pin
- 26 Bushing
- 27 Body gasket
- 28 Water pump body
- 29 Pipe plug,  $\frac{3}{8}$ "
- 30 Grease cup

Figure 75. JXD water pump disassembled.

## 116. Removal of Fan Assembly

(fig. 76)

a. Loosen the locknut (2) of the handwheel (3) at top of fan bracket (7).

b. Turn the handwheel (3) counterclockwise until the fan belt (5) can be slipped off its pulley.

c. Remove attaching screws (6) and lockwashers holding fan bracket (7) to timing gear cover.

## 117. Disassembly of Fan

a. Remove nut (1, fig. 77) and pull off washer (2), remove screw (6), bracket (3) and clamp washer (7).

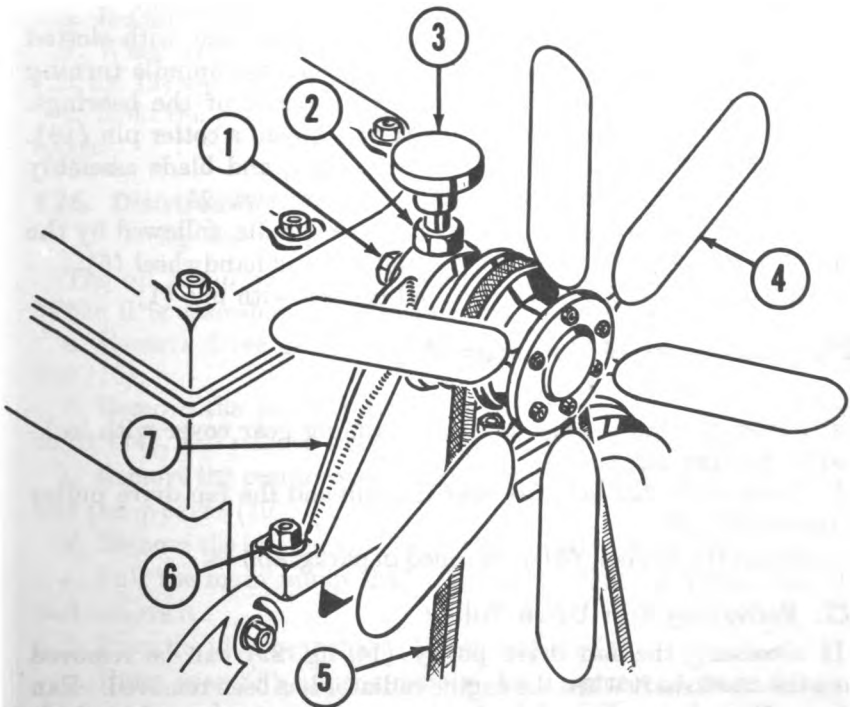
b. Remove cap screws (24) and lockwashers (23) from hub (15) and pull off blade assembly (22), front cap (21), and gasket (20).

c. Remove cotter pin (19) and slotted nut (18) from end of spindle (8) and pull off cone clamp washer (17).

d. Remove snap ring (9).

e. Pull spindle (8) from hub (15).

f. Cork retainer (10) with cork washer (11); cork retainer washer (12); and bearings (14) can now be removed from the hub (15).



1 Nut  
2 Locknut  
3 Handwheel

4 Blade assembly  
5 V-belt  
6 Attaching screw

7 Fan bracket

Figure 76. Fan assembly mounting.

## **118. Cleaning and Inspecting Fan Assembly**

Wipe both blades and hub with cloth dipped in cleaning solvent. Wash roller bearings in cleaning solvent and blow with compressed air. Clean old lubricant from the spindle with cleaning solvent. Inspect spindle and bearings for scoring, cracks, and wear.

## **119. Repair of Fan Assembly**

(fig. 77)

There is no repair for roller bearings. Replace bearings that are scored, worn or cracked. Replace the cork retainer (10) and cork washer (12). Replace gaskets (13) and (20).

## **120. Reassembly of Fan**

*a.* Press the race of each bearing (14, fig. 77) into position in hub (15).

*b.* Position a cone of bearing (14) over end of spindle (8) against the shoulder. Insert spindle into hub.

*c.* Assemble gasket (13), cork retaining washer (12), cork washer (11), cork retainer (10), and snap ring (9) into hub (15) and over shoulder of spindle (8).

*d.* Insert the cone of bearing (14) over spindle and into hub.

*e.* Add the cone clamp washer (17) and draw tight with slotted nut (18). The absence of noticeable play with the spindle turning freely is an indication of the correct adjustment of the bearings. After adjustment has been made, insert and spread a cotter pin (19).

*f.* Assemble the gasket (20), front cap (21), and blade assembly (22) to the hub with lockwashers (23) and cap screws (24).

*g.* Slip the clamp washer (7) over end of spindle, followed by the bracket (3) with lockwasher (4), locknut (5) and handwheel (6).

*h.* Install the clamp washer (2) and tighten with nut (1).

## **121. Installation of Fan Assembly**

(fig. 76)

*a.* Fasten the fan bracket (7) to the timing gear cover with lockwashers and cap screws (6).

*b.* Position the fan belt (5) over the hub and the fan drive pulley on the crankshaft.

*c.* Adjust the fan belt (5) as outlined in paragraph 54.

## **122. Removing Fan Drive Pulley**

If necessary, the fan drive pulley (14, fig. 29) can be removed from the crankshaft when the engine radiator has been removed. Fan drive pulleys cannot be repaired satisfactorily and must be replaced.

*a.* Punch out the pin in the starting crank grab.

*b.* Turn off the grab from the end of the crankshaft.



*c.* Pull grab off crankshaft.

*d.* Carefully pry the pulley from the crankshaft and woodruff key.

### **123. Installation of Fan Drive Pulley**

*a.* Install the woodruff key in the crankshaft.

*b.* Start pulley on the crankshaft and key.

*c.* Turn the starting crank grab on crankshaft and continue turning until pulley is in position and the pin hole in the grab lines up with the pin hole in the crankshaft.

*d.* Drive the pin through its opening in the pulley and through the grab and crankshaft.

## **Section III. LUBRICATION SYSTEM**

### **124. Oil Pump**

Oil pumps on JXC and JXD engines are driven by a spiral gear mounted at the center of the camshaft. The lower end of the oil pump extends down into the oil pan, and oil is drawn into the pump for circulation under pressure to various parts of the engine.

### **125. Removing Oil Pump**

*a.* Remove the oil pan (par. 131).

*b.* When oil pan is removed, remove the three attaching screws (25, fig. 79) and lockwashers (26).

*c.* Hold the pump body securely and draw it out from the cylinder block.

### **126. Disassembly of Oil Pump**

(fig. 79)

The oil pump operates in a bath of oil and seldom needs repair. When it is desirable to disassemble the pump, proceed as follows:

*a.* Remove drive gear lube tube (5), elbow (18), ferrule (17) and nut (16).

*b.* Remove the pin (2) from the drive gear (1), pull gear from shaft (14), and remove woodruff key (7) and washer (3).

*c.* Remove the pump cover attaching screws (12), lockwashers (11), and pump cover (10).

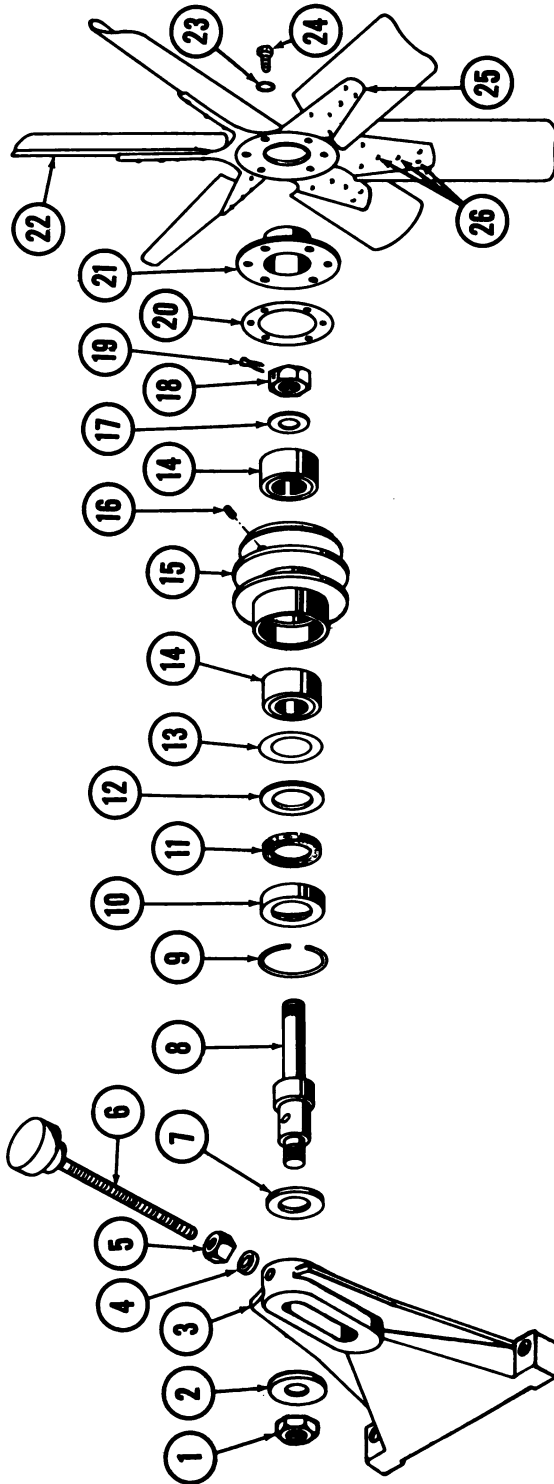
*d.* Remove the idler gear (13) and idler shaft (15).

*e.* Pull the main pump shaft (14) down through pump body (4) and remove it.

*f.* Press the idler gear shaft (15) out of gear (13).

*g.* Press gear (8) approximately three-eighths of an inch up on shaft (14) and remove snap ring (9). Then press the shaft out of gear. Remove woodruff key (7).

*h.* Remove regulator screw (24) after loosening nut (23).



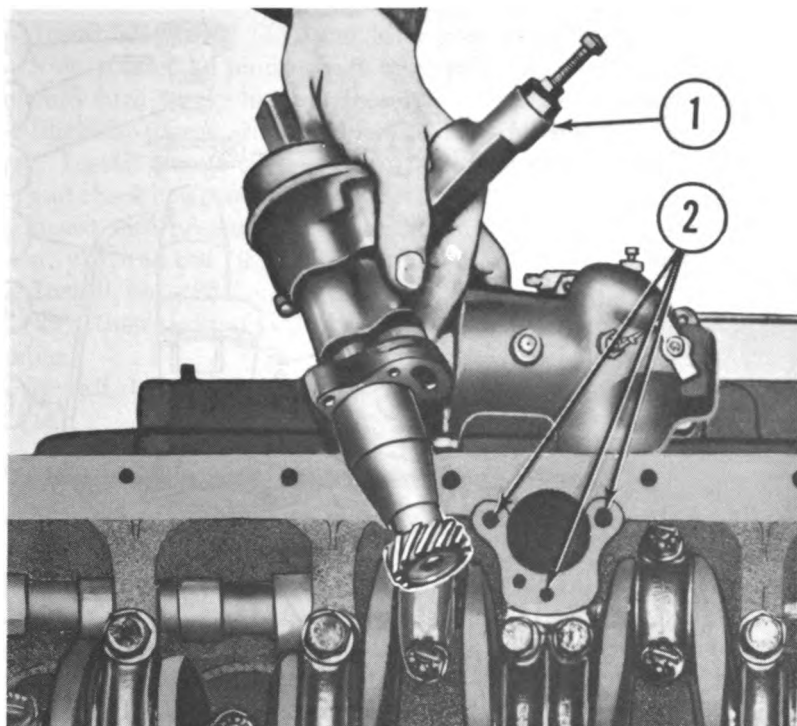
- 1 Jam nut,  $\frac{3}{4}$ "-16 NF
- 2 Clamp washer
- 3 Bracket
- 4 Lockwasher,  $\frac{1}{2}$ "
- 5 Locknut,  $\frac{1}{2}$ "-20 NF
- 6 Adjusting screw
- 7 Clamp washer

- 8 Spindle
- 9 Snap ring
- 10 Cork retainer
- 11 Cork washer
- 12 Cork retaining washer
- 13 Oil gasket
- 14 Taper roller bearing

- 15 Hub
- 16 Oil plug,  $\frac{1}{8}$ " pipe, slotted
- 17 Cone clamp washer
- 18 Slotted nut,  $\frac{1}{2}$ "-20 NF
- 19 Cotter pin
- 20 Gasket
- 21 Front cap

- 22 Fan blade assembly
- 23 Lockwasher,  $\frac{3}{8}$ " (4 req'd)
- 24 Screw, cap,  $\frac{3}{8}$ "-16 NC x  $\frac{3}{8}$ " (4 req'd)
- 25 Spider
- 26 Rivet

Figure 77. Fan disassembled.



1 Withdrawing oil pump from block

2 Attaching screw holes

*Figure 78. Removing oil pump.*

i. Remove regulator nut (22), button (21), spring (20), and piston (19).

### **127. Cleaning and Inspection of Oil Pump**

Wash all pump and pressure regulator parts in solvent and blow or wipe dry. Carefully inspect all parts for wear or damage from metal chips or dirt. Replace main shaft or gears, if wear is advanced, or if shaft is noticeably chipped. Replace any pressure regulator part that is noticeably worn.

### **128. Reassembly of Oil Pump**

(fig. 79)

a. Insert woodruff key (7) in main shaft (14) and press gear (8) on shaft. Install the snap ring (9). Then press the shaft back so that the snap ring seats in the gear.

b. Assemble shaft (14) in the pump body (4), install thrust washer (3), insert woodruff key (7) and press on drive gear (1). The shaft must have 0.0015" to 0.003" end thrust.

c. If an old pump shaft is used, insert a drive pin (2) and peen over ends of pin. If new shaft is used, drill a hole for the new pin, using the hole in the drive gear as a guide.

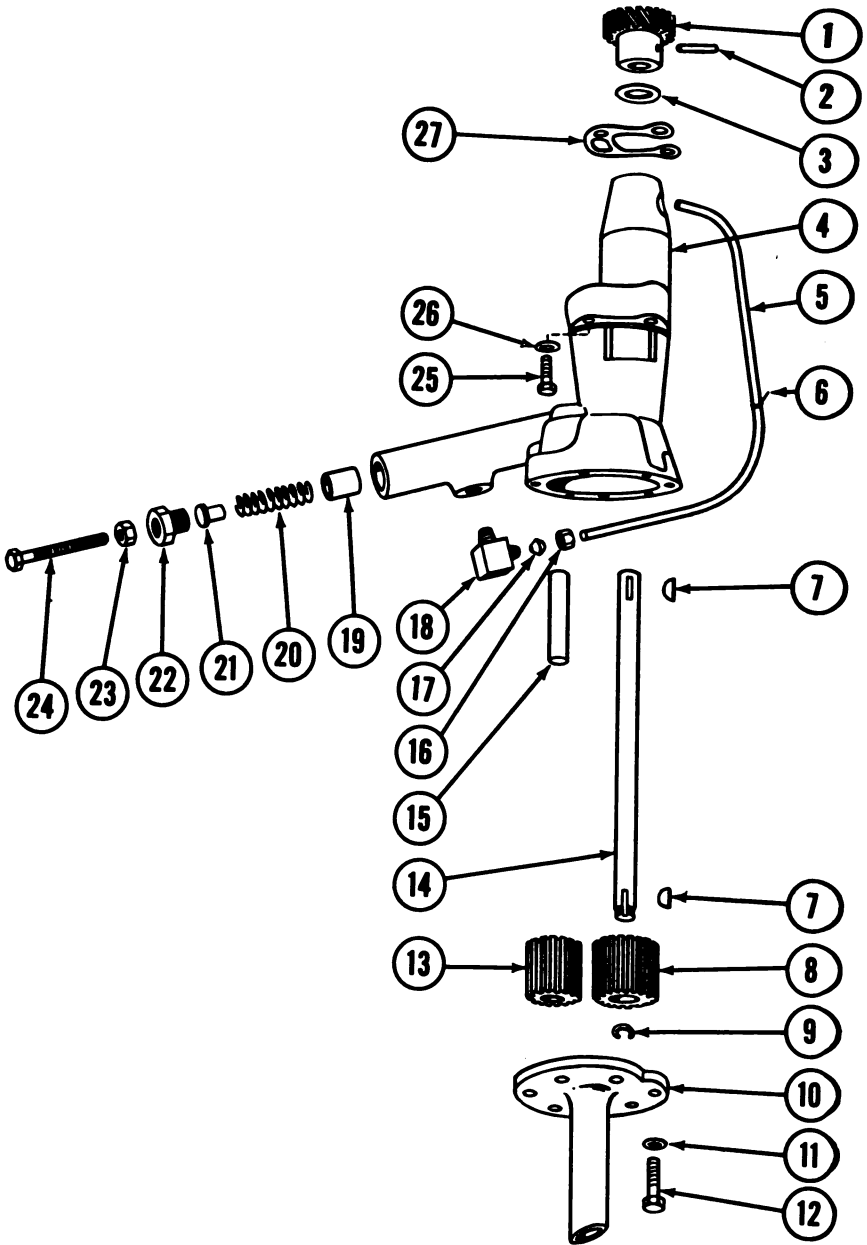


Figure 79. Oil pump disassembled.

d. Insert idler gear (13) and idler gear shaft (15).

e. Now rotate the pump shaft by turning drive gear with fingers. It should turn freely but not loosely. If it does not turn easily, or if it binds in places, disassemble and look for chips or dirt in gear teeth. Install pump cover (10) with lockwasher (11), and screws (12) and check clearance again by rotating the shaft.

f. Insert into pressure regulator housing piston (19), spring (20), button (21), and nut (22).

g. Install nut (23) on regulator screw (24) and insert both into nut (22), then tighten slightly. Do not adjust until after engine is running.

h. Install drive gear lube tube (5), elbow (18), ferrule (17), and nut (16).

## 129. Installation and Adjustment of Oil Pump

a. Assemble the pump to crankcase as removed, and install the the oil pan on crankcase (par. 133).

b. Make certain the proper weight of engine oil is used when refilling crankcase. See LO 5-5167.

c. To adjust the oil pump, remove pipe plug from left side of oil pan. Insert a special crowfoot wrench (1, fig. 72) in the opening and loosen the locknut (23, fig. 79) on the pump adjusting screw (24). With a screwdriver, turn the pump adjusting screw in or clockwise to increase oil pressure and out or counterclockwise to decrease oil pressure. Tighten the locknut after adjustment. Replace the pipe plug in oil pan.

## 130. Oil Pan

(fig. 80)

The oil pan is the bottom cover of the engine and serves also as an oil reservoir. It is fitted with a pipe plug (6) on the left side

---

1 Drive gear	16 Drive gear lube tube nut
2 Drive gear pin	17 Drive gear lube tube ferrule
3 Drive gear washer	18 Drive gear lube tube elbow
4 Body	19 Pressure regulator piston
5 Drive gear lube tube	20 Pressure regulator spring
6 Drive gear lube tube clip	21 Pressure regulator button
7 Key, woodruff #2 (2 req'd)	22 Pressure regulator nut
8 Gear—large	23 Pressure regulator screw nut, $\frac{5}{16}$ "- 24 NF
9 Snap ring	24 Pressure regulator screw, $\frac{5}{16}$ "- 24 NF x $1\frac{3}{4}$ "
10 Cover	25 Screw, cap, $\frac{3}{8}$ "-16 NC x 1" (3 req'd)
11 Lockwasher, $\frac{1}{4}$ " SAE (7 req'd)	26 Lockwasher, oil pump attaching screw
12 Cover screw, $\frac{1}{4}$ " 20 NC x $\frac{3}{4}$ " (7 req'd)	27 Gasket
13 Gear—small	
14 Shaft, oil pump	
15 Idler shaft	

Figure 79.—Continued

through which oil pump pressure adjustments are made. Removal, repair and reinstallation procedures of the engine oil pans are the same.

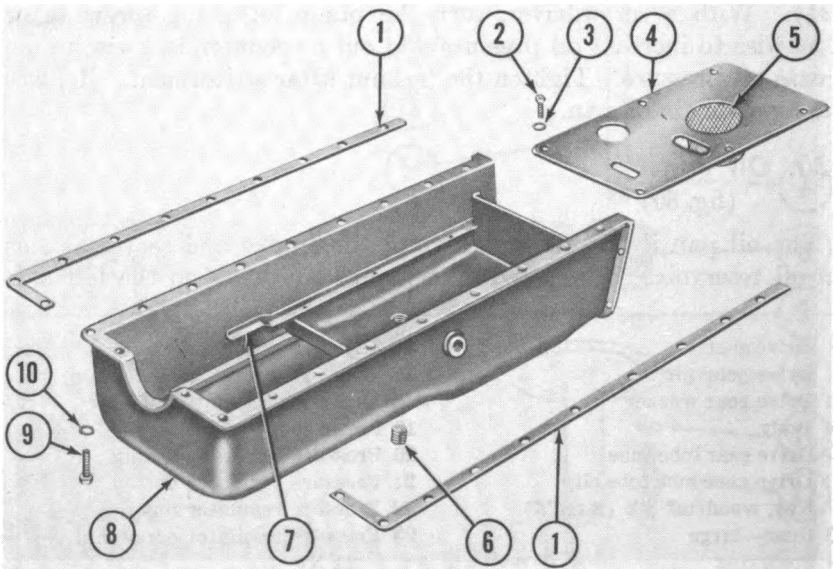
### 131. Removing Oil Pan

- a. Drain all crankcase oil by removing bottom plug (6, fig. 80).
- b. Disconnect the starting motor cable and remove starter. Wrap any live cable terminals with tape.
- c. Remove the outside-mounted oil strainer assembly if one is used (par. 135).
- d. Remove the oil level gage (fig. 23).
- e. Remove all attaching cap screws (9, fig. 80) and lockwashers (10) and pull oil pan (8) away from crankcase.

### 132. Cleaning and Inspection of Oil Pan

(fig. 80)

Remove the baffle-mounted oil strainer assembly if one is used. Do this by removing six cap screws (2) and lockwashers (3). Scrape out all sludge and foreign particles accumulated on bottom of oil pan and wash all parts in solvent. Use a brush dipped in cleaning solvent to scrub the strainer clean, and blow compressed air through



- |  |  |
|--|--|
| 1 Pan gasket   | 6 Pipe plug, $\frac{3}{4}$ " (2 req'd)                           |
| 2 Screw, cap, $\frac{5}{16}$ "-18 NC x $\frac{3}{4}$ " (6 req'd) | 7 Baffle plate felt washer                                       |
| 3 Lockwasher, $\frac{5}{16}$ " (6 req'd)                         | 8 Oil pan  |
| 4 Baffle plate   | 9 Screw, cap, $\frac{3}{8}$ "-16 NC x $\frac{7}{8}$ " (20 req'd) |
| 5 Screen   | 10 Washer, $\frac{3}{8}$ " (20 req'd)                            |

Figure 80. Oil pan assembly.

screen. Inspect oil pan for dents. If minor, smooth out with a hammer and wood block. If punctured, replace the oil pan.

### 133. Installation of Oil Pan

(fig. 80)

Install the oil strainer baffle plate (4), making sure all lockwashers (3) are on cap screws (2). Then mount oil pan (8) to engine as follows:

*a.* Remove old gaskets. Thoroughly clean and wipe off gasket seats and apply gasket cement.

*b.* Place new gaskets (1) on seats, press down evenly all around, and let gaskets "set" to the new cement.

*c.* If the lower part of the bellhousing gasket is broken or scratched, cut out the damaged part and replace with new gasket material.

*d.* Put the oil pan carefully in place and start cap screws (9) making sure all lockwashers (10) are in place.

*e.* Draw each cap screw up lightly, leaving the pan loose enough that it can be tapped into correct alinement.

*f.* Now check to make sure the oil pan is centered at the front crankshaft oil seal to prevent damage to the rubber ring. Tap lightly until correct alinement is obtained at the crankshaft oil seal and along the crankcase.

*g.* Tighten progressively the five cap screws in the bellhousing, and the three screws in the crankcase nearest the bellhousing. Do this on both sides of the crankcase. Alternate between vertical and horizontal screws until tight. (This is to pull the corner of the pan in against the corner formed by the bellhousing and cylinder block or crankcase.)

*h.* Now check the alinement of the oil pan at front crankshaft seal, and tighten the four front cap screws. When this alinement is correct, tighten all remaining cap screws.

*i.* Install drain plug (6).

*j.* Install the starting motor and reconnect its cable.

*k.* Replace the oil level gage.

*l.* Refill crankcase with proper oil (par. 24) and check to make sure oil level is at the 4/4 mark on the oil level gage.

### 134. Oil Pump Screen

Lubricating oil which is returned to the oil pan after circulating through the engine may contain foreign particles and chips of metal. These impurities are trapped in the oil pump screen which permits only clean oil to flow out into the oil pan and be recirculated through the engine. At each engine overhaul, the screen assembly must be removed and cleaned. JX-series engines use two types of pump screens—one mounted inside the oil pan on a baffle plate (4, fig. 80),

and the other mounted on the bottom of the oil pan and secured with cap screws and lockwashers. This type is normally removed from oil pan before the oil pan is removed from the engine crankcase. The baffle-mounted type is accessible only after the oil pan is removed, and this is the type normally found on JXC and JXD engines.

### **135. Servicing Oil Pump Screen**

- a.* Remove the oil pan if necessary (par. 131).
- b.* Remove the pump screen and baffle plate and soak in cleaning solvent to loosen sludge and particles caught in screen.
- c.* Use a fine wire brush, or other brush with stiff bristles, and scrub the pump screen inside and out until wire mesh is free from oil sludge and is unobstructed.
- d.* Apply an air nozzle and blow until the screen is dry.
- e.* If the screen is bent or punctured while handling, replace with a new unit.
- f.* Install screen in oil pan as removed.
- g.* Install oil pan (par. 133) if it was removed.

## **Section IV. GOVERNOR, FUEL PUMP, AND MANIFOLD**

### **136. General**

The fuel and exhaust systems include all components and accessories required to get the fuel to the engine cylinders and to dispose of the exhaust gases. The governor is included here, since it controls the amount of fuel admitted to the cylinders. Proper maintenance and repair of these units are as follows:

### **137. Governor**

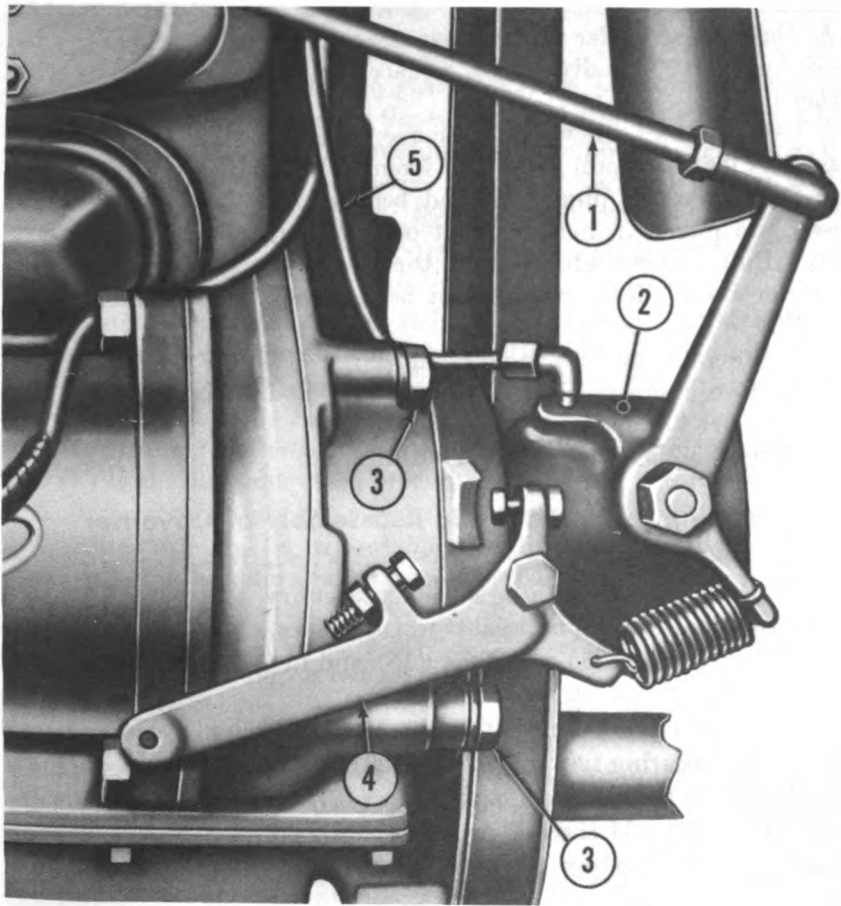
To replace parts of the governor which may be worn or broken, the governor must be removed from the engine. Disassembly, repair, and reassembly procedures of JXC and JXD engine governors are the same.

### **138. Removing Governor**

(fig. 81)

- a.* Disconnect the carburetor control rod (1) where it attaches to the carburetor control lever.
- b.* Disconnect the hand throttle control rod where it attaches to the throttle control lever (4).
- c.* Disconnect the oil line (5) from engine to governor (2), at the governor end.
- d.* Remove the attaching screws and lockwashers (3) holding governor to gear case and draw governor out of gear case. Remove gaskets.





- |                          |                          |
|--------------------------|--------------------------|
| 1 Carburetor control rod | 3 Screw                  |
| 2 Governor               | 4 Throttle control lever |
|                          | 5 Lube line              |

*Figure 81. Governor installation*

### **139. Disassembly of Governor** (fig. 82)

- a. Remove shoulder stud (37) and throttle control lever (40), then remove governor spring (36) from throttle lever assembly (33).
- b. Remove fasteners (43) and lockwashers (42) and pull flange (4) from body (18). Remove gasket (17).
- c. Remove bearing (13) from thrust sleeve (12).
- d. Remove weight pins (10) then slide off weight assembly (11).
- e. Drive out pin (41) and remove spider hub (8) from governor spider (9).
- f. Remove fasteners (7) and lockwashers (6) from flange (4). Lift out bearing (5).
- g. Remove shaft (1) and gear (3) from flange.

*h.* Use a gear puller and remove gear (3) from shaft (1). Remove key (2). If badly scored, replace key, otherwise file key with a very fine file.

*i.* Using a small screwdriver, remove yoke fasteners (15) and lockwashers (16), then pull yoke (14) from rocker shaft (31).

*j.* Remove welch plug (19) and bearing (20) from body (18). Insert pin punch in hole in front of body and remove snap rings (30). Pull rocker shaft (31) and throttle lever assembly (33) from governor body. Rocker shaft can be removed from throttle lever assembly by driving out pin (32).

*k.* Lift out oil seal (29) and bearing (20).

*l.* Remove bumper screw (23), nut (22) and spring (21).

*m.* Remove tubing union (26).

*n.* Remove welch plug (24) and bushing (25).

## **140. Cleaning, Inspection, and Reassembly of Governor**

(fig. 82)

*a.* Wash all parts in cleaning solvent and let dry.

*b.* Inspect all parts, if noticeably worn, replace.

*c.* Press bushing (25) into body (18) and install welch plug (24).

*d.* Install tubing union (26).

*e.* Install bumper spring (21), nut (22) and bumper screw (23).

*f.* Press in bearing (20) and oil seal (29).

*g.* Insert rocker shaft (31) in body (18) and lock in place with snap rings (30). If throttle lever assembly (33) has been removed, replace by inserting pin (32) to rocker shaft. Replace welch plug (19) and bearing (20).

*h.* Install yoke (14) on rocker shaft with fasteners (15) and lockwashers (16).

*i.* Put key (2) in spider shaft (1) and press on gear (3).

*j.* Press bearing (5) into flange (4) and secure with lockwashers (6) and fasteners (7).

*k.* Place spider shaft with gear through flange and bearing.

*l.* Position spider hub (8) on governor spider (9) and secure with pin (41), then place on spider shaft.

*m.* Position weight assembly (11) on spider shaft and secure with weight pins (10).

*n.* Install bearing (13) on thrust sleeve (12) and place on spider shaft.

*o.* Install gasket (17) on body (18), then position shaft assembly in body (18) and fasten with lockwashers (42) and fasteners (43).

*p.* Install governor spring (36) to throttle control lever (40) then secure lever to body with shoulder stud (37). Connect governor spring (36) to throttle lever assembly (33).

## **141. Installation of Governor**

(fig. 82)

Mount the governor to the gear case with attaching screws and gasket as removed. Connect the control rod from the carburetor to the throttle lever (33). Connect the governor lubricating line to the governor at fitting (26).

## **142. Governor Control Rod**

(fig. 83)

Adjust the governor control rod so that when the engine is at rest and the throttle is in wide open position, the throttle valve will also be in wide open position (par. 83). The governor control rod may be lengthened or shortened as follows:

*a.* Working from either end of rod as convenient loosen the lock-nut (1) at the ball joint base (5) or (9).

*b.* Turn the ball joint to right to shorten, or left to lengthen rod.

*c.* When the rod is of suitable length, secure the ball joint by tightening the lock nut against base of the ball joint.

## **143. Fuel Pump**

The JXC fuel pump is mounted on the right side of the engine and is driven directly from the camshaft. The JXD engine fuel pump is mounted on the left side of the engine and is operated by a drive pin (1, fig. 52) transferring the action of the fuel pump eccentric on the camshaft to the rocker arm. Disassembly, repair and reassembly of both pumps are the same.

## **144. Removing Fuel Pump**

*a.* Disconnect the fuel lines at the fuel pump.

*b.* Remove two cap screws (3, fig. 51) holding pump to crankcase and remove pump (1).

*c.* If the fuel pump eccentric is on the high point and exerting tension on the pump rocker arm, crank engine one full turn to put eccentric on low point ready for pump reinstallation.

## **145. Disassembly, Cleaning, and Inspection of Fuel Pump**

(fig. 84)

*a.* Loosen thumb nut or ball (28) and remove sediment bowl (29).

*b.* Remove bowl gasket (30) and screen (31).

*c.* Remove valve plugs (1), gaskets (2), springs (3), and valves (6).

*d.* File or chisel a mark on edge of top cover (7) and body (16) so pump can be assembled in the same position.

*e.* Remove cover screws (4) and lockwashers (5). Cover is now completely disassembled.

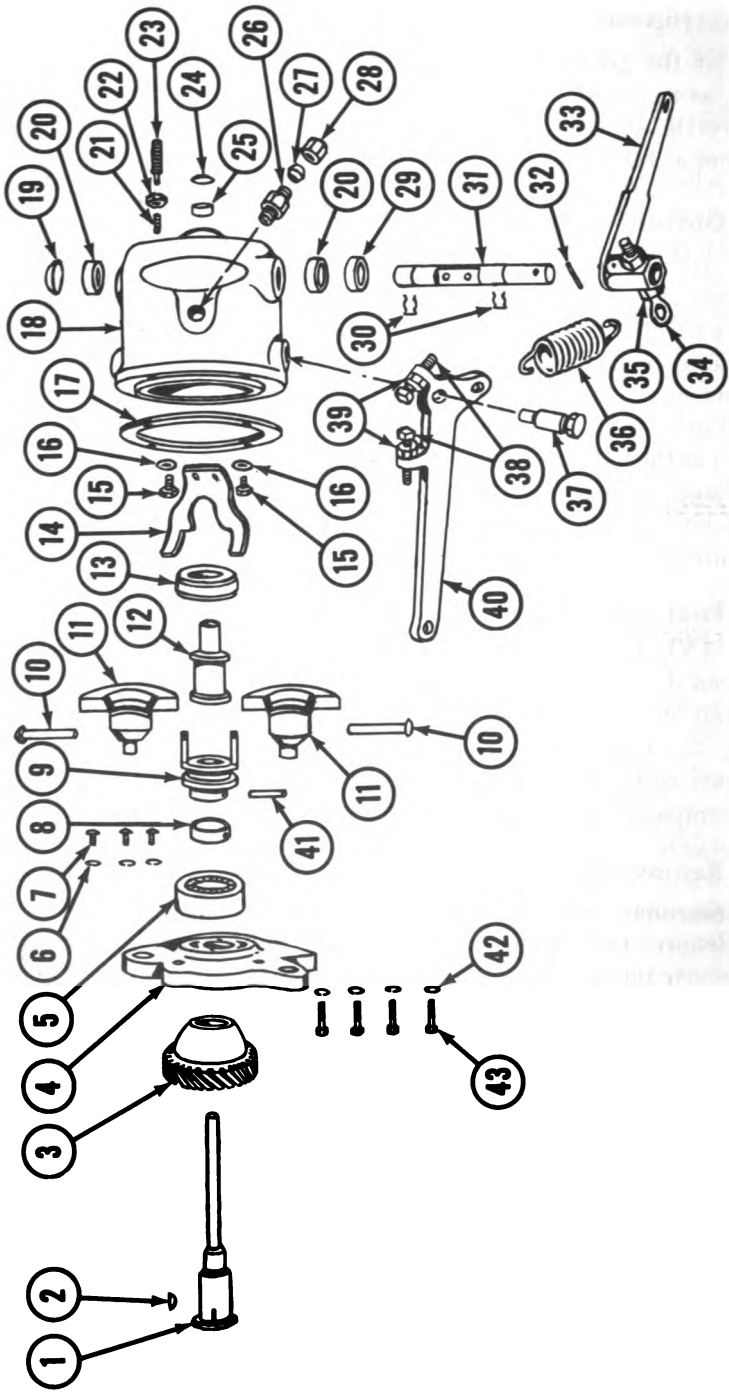


Figure 82. Governor disassembled.

- |  |   |
|--|---|
| 1 Spider shaft   | 23 Bumper screw   |
| 2 Key, woodruff, #3  | 24 Welch plug, $\frac{9}{16}$ " dia                         |
| 3 Governor drive gear  | 25 Bushing  |
| 4 Body flange  | 26 Tubing union, $\frac{1}{8}$ ", (2 req'd)                 |
| 5 Bearing  | 27 Tubing ferrule, $\frac{1}{8}$ ", (2 req'd)               |
| 6 Lockwasher, #6 (3 req'd)                                   | 28 Tubing nut, $\frac{1}{8}$ " (2 req'd)                    |
| 7 Sems fastener, #6-32 NC x $\frac{1}{4}$ ",<br>(3 req'd)    | 29 Oil seal   |
| 8 Spider hub   | 30 Snap ring  |
| 9 Governor spider  | 31 Rocker shaft   |
| 10 Weight pin  | 32 Taper pin, #1 x $\frac{3}{4}$ "                          |
| 11 Governor weight   | 33 Carburetor throttle lever assembly                       |
| 12 Thrust sleeve   | 34 Screw, adjusting   |
| 13 Thrust bearing  | 35 Nut, hex, $\frac{5}{16}$ "-24 NF (2 req'd)               |
| 14 Yoke  | 36 Governor spring  |
| 15 Sems fastener, #10-32 NF x $\frac{7}{16}$ ",<br>(2 req'd) | 37 Shoulder stud  |
| 16 Lockwasher, #10, (2 req'd)                                | 38 Set screw, $\frac{5}{16}$ "-24 NF x 1" (2<br>req'd)      |
| 17 Gasket  | 39 Jam nut, $\frac{5}{16}$ "-24 NF (2 req'd)                |
| 18 Body  | 40 Throttle control lever                                   |
| 19 Welch plug  | 41 Groove-pin, $\frac{1}{8}$ " x $\frac{7}{8}$ "            |
| 20 Rocker shaft bearing                                      | 42 Lockwasher, #10 (4 req'd)                                |
| 21 Bumper spring   | 43 Sems fastener, #10-24 NC x $\frac{5}{8}$ ", (4<br>req'd) |
| 22 Nut, hex $\frac{1}{4}$ "-28 NF                            |   |

*Figure 82.—Continued*

*f.* Remove diaphragm (12) from pull rod (15) by removing nut (8), lockwasher (9), and diaphragm protectors (11) and (13). Remove pull rod gasket (14).

*g.* Remove three screws (26) holding bottom cover (25). Do not lose springs (23) and (27) and spring caps (22).

*h.* Remove rocker pin (17), pull rod (15), link (20), and rocker arm (19).

*i.* Wash parts in solvent to remove grit and let dry. Clean strainer screen (31) and let dry thoroughly.

*j.* Inspect all parts carefully. Inspect diaphragm (12) for cracks and all parts for worn threads. Check top cover (7) and body (16) for cracks. Replace parts with holes worn out-of-round, and all worn pins.

## 146. Reassembly of Fuel Pump

(fig. 84)

*a.* Turn cover (7) upside down and fit strainer screen (31) into the bowl recess.

*b.* Place a new bowl gasket (30) into position on filter screen. Place

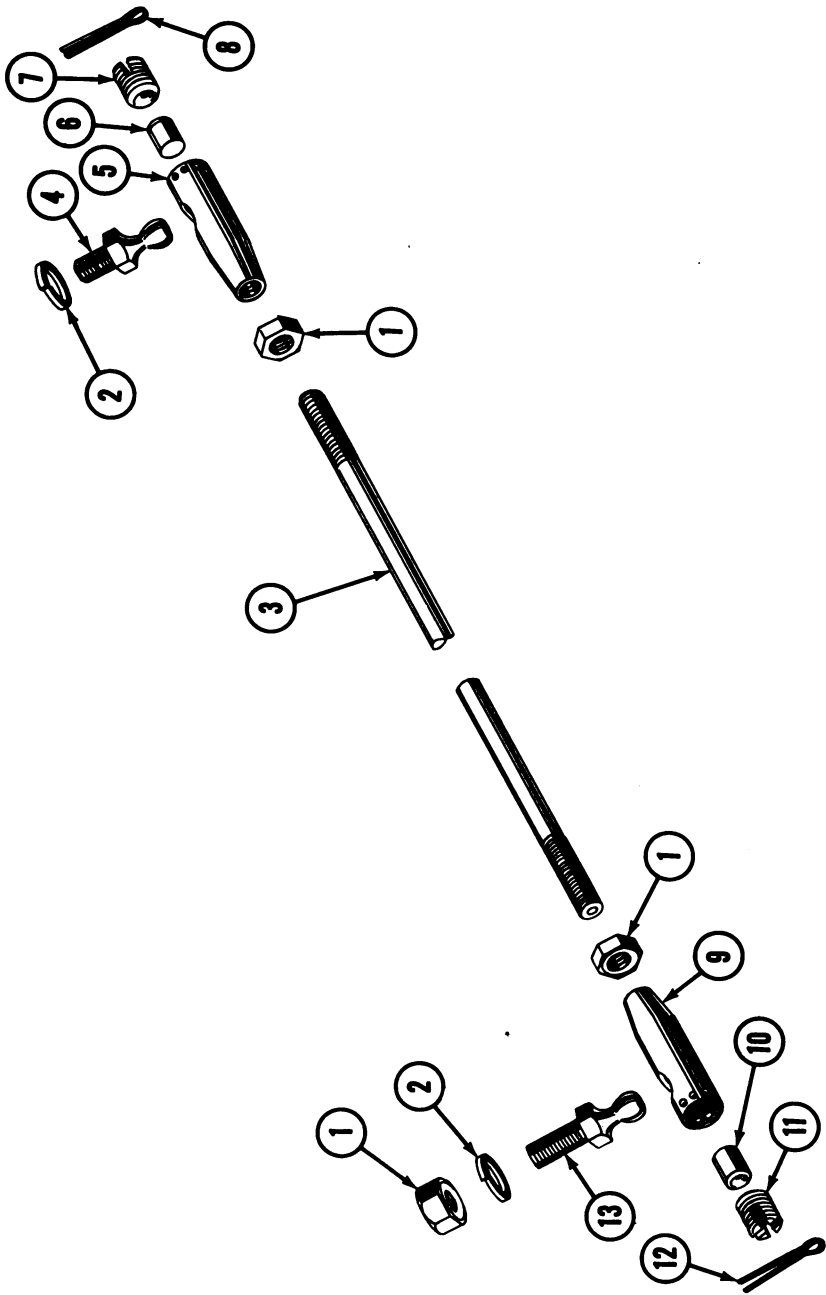


Figure 88. Governor control rod.

1 Hex nut,  $\frac{1}{2}$ -20 NF, (3 req'd)  
2 Lockwasher,  $\frac{1}{2}$ "', (2 req'd)  
3 Control rod  
4 Ball joint  
5 Ball joint base  
6 Plug  
7 Castellated screw

8 Cotter pin  
9 Ball joint base  
10 Plug  
11 Castellated screw  
12 Cotter pin  
13 Ball joint

Figure 88—Continued

sediment bowl against gasket and swing wire bail (28) over the bowl. Tighten bowl seat nut securely with fingers.

c. Place new valves (6), springs (3), and gaskets (2) in well under valve plugs (1) and install valve plug. Top cover is now assembled.

d. Start assembly of the body by joining two links (20) with one link pin (18) and clips (21). Join at the rounded end of links.

e. Attach pull rod (15) to links at the end which is cut at an angle. Install pull rod between the links and fasten with link pin and clips.

f. Install pull rod and link assembly into body through the hole provided.

g. Hold pull rod in position to one side toward the rocker arm pin hole. This is so the rocker arm pin (17) will pass through pin holes in body (16) and links (20).

**Warning:** One corner of each link is cut off. This indicates the corner which should be nearest the diaphragm when the links are attached to the pull rod. The pull rod slips between the links.

h. Hold pull rod in position and slip rocker arm (19) in body slot. Place rocker arm between the links with projecting hook over the link pin. Now secure by installing the rocker arm pin (17) so it passes through body (16), one link, rocker arm, and other link. Peen edges of body pin holes over both ends of pin with a pointed punch and hammer.

i. Place pull rod gasket (14) and a new diaphragm (12) with protectors (11) and (13) on pull rod (15) and secure with diaphragm washer (10), lockwasher (9), and nut (8).

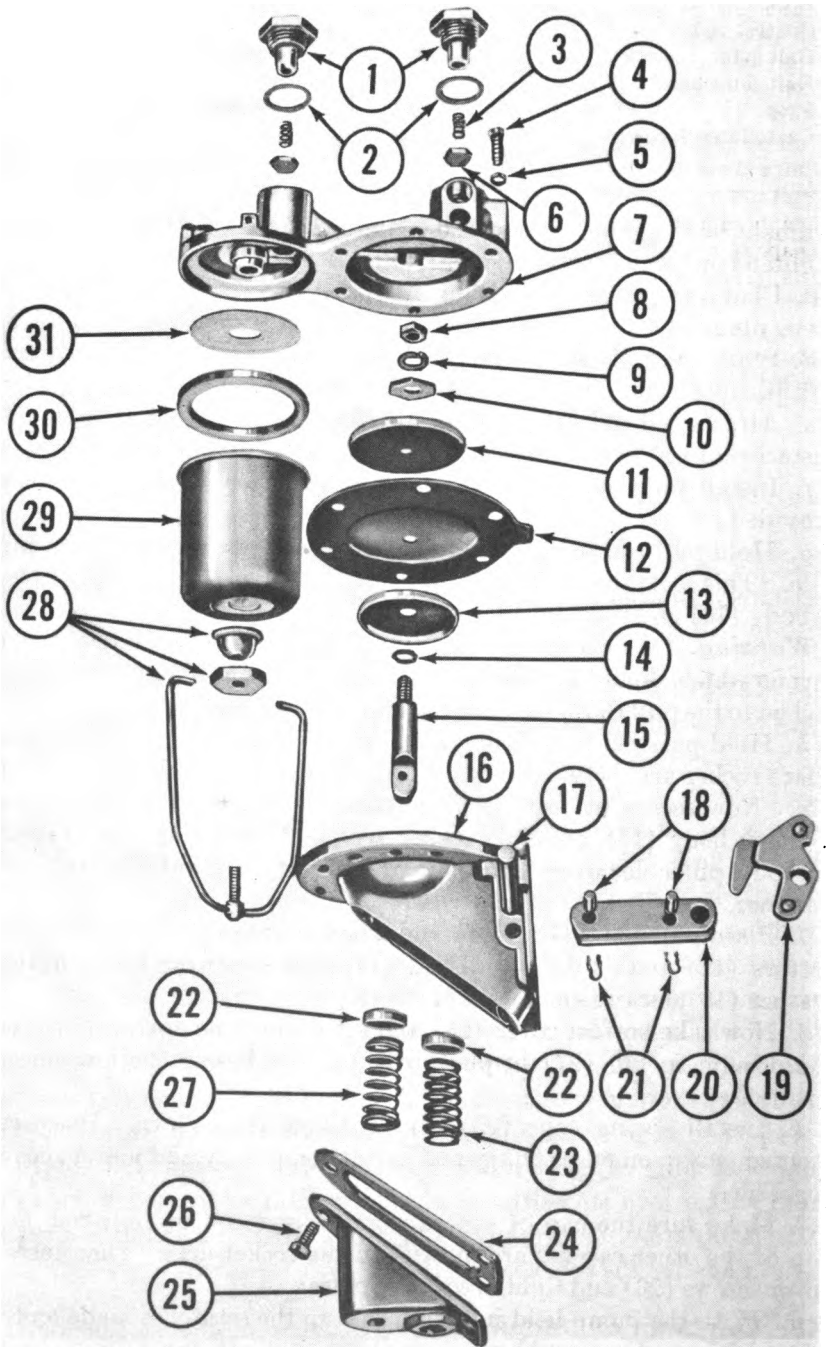
j. Now take bottom cover (25) and set rocker arm spring (23) and diaphragm spring (27) in place over the two bosses (hollow cones) inside the cover.

k. Install spring caps (22) over springs, rims down. Place cemented gasket on cover flange and bring pump body and bottom cover together.

l. Make sure the cup of one cap fits around end of pull rod, and cup of the other cap fits around end of the rocker arm. Then install cover screws (26) and tighten cover in place.

m. With the pump held in a vise, line up the scratches made on the edges of pump cover and body.

n. Get diaphragm level by moving rocker arm; then install two cover screws (4) and lockwashers (5) opposite each other. Screw



**Figure 84. Fuel pump disassembled.**



1 Valve plug	17 Rocker arm pin
2 Valve plug gasket	18 Link pin
3 Valve spring	19 Rocker arm
4 Top cover screw	20 Links
5 Top cover screw lockwasher	21 Link pin clip
6 Valve	22 Spring cap
7 Top cover and valve seat assembly	23 Rocker arm spring
8 Pull rod nut	24 Bottom cover gasket
9 Pull rod lockwasher	25 Bottom cover
10 Diaphragm alinement washer	26 Bottom cover screw
11 Diaphragm protector—upper	27 Diaphragm spring
12 Diaphragm	28 Ball assembly
13 Diaphragm protector—lower	29 Glass bowl
14 Pull rod gasket	30 Bowl gasket
15 Pull rod	31 Screen
16 Body	

*Figure 84—Continued*

these finger-tight, making sure they do not chew fabric when passed through holes in the diaphragm. Then release the rocker arm and install balance of cover screws and lockwashers. Tighten screws alternately, first on one side of the pump, then the other, so that diaphragm will flex properly when cover is assembled to body.

### 147. Testing and Installation of Fuel Pump

Before assembling pump to crankcase, test as follows:

- a. Connect fuel line from tank to fuel pump inlet.
- b. Hold the pump in one hand and work rocker arm with long, even strokes. Bowl will begin to fill after several strokes. When fuel starts to flow from pump outlet, shorten the rocker arm stroke to one-half of an inch at tip. Pump should still deliver fuel liberally.
- c. If only a small amount of fuel is delivered in this test, the diaphragm is not correctly installed, or the valves are sticking. The pump must be taken apart and reassembled to correct these faults.
- d. If the pump functions properly, cement a new gasket to the pump body and allow it to dry.
- e. Insert the pump rocker arm in hole in crankcase, being careful to keep the flange of the fuel pump in correct position while the two pump attaching cap screws are started. Make certain that the fuel pump rocker arm is positioned on, and not under the drive pin in a JXD installation, or breakage will result when the pump is drawn up tight against the crankcase.

### 148. Combination Manifolds

The combination exhaust and intake manifold for the JXC and JXD engine are removed and installed in the same manner.

## 149. Inspection and Repair of Manifold

Inspect the manifold casting for breaks or cracks. If breaks are not too large or too many in number, repair may be made by welding. Cracks in the manifold must be very carefully welded. Prolonged use of heat may warp the attaching face of the manifold. A weld should not be attempted which will carry through to the face of the manifold unless facilities are available for grinding the face to a true plane. If it is impossible to repair the manifold, replace it with a new one (par. 84).

## Section V. CARBURETORS

### 150. Carburetor—JXC Engine

The carburetor on JXC engines is an updraft carburetor of double venturi design. The body consists of two rustproof iron castings. Because the fuel bowl and duplex float are very close to the carburetor center-line, it is possible to achieve proper metering of air and fuel to the engine and operate the unit on an angle without flooding. The carburetor is "sealed" and "balanced" in that all air for bowl chamber ventilation and idling must come through the air cleaner. The power jet and accelerating pump are enclosed and protected from dust and dirt. The air cleaner used with this carburetor is mounted on the bellhousing at right rear of the engine and is connected to the carburetor by a hose.

### 151. Disassembly of Throttle Body—JXC Carburetor

(fig. 85)

- a.* Remove carburetor.
- b.* Remove screws (63) and lockwashers (62) and remove the fuel bowl (36) from throttle body (54).
- c.* To disassemble the throttle body, lift off gasket (23) and remove pump (53). Then remove the float axle (22) with fingers and remove float (52).
- d.* Remove the fuel valve assembly (20) (21) and idling jet (19).
- e.* Remove the idle adjusting needle (17) and friction spring (18) from side of throttle body.
- f.* Remove venturi screw (55), lockwasher (56) and venturi (24) from throttle body.
- g.* Remove the channel plug (16) from side of throttle body near mounting flange.
- h.* Unscrew the stop lever screw (8) until its threaded end is flush with the lever. Make match marks with punch or file on throttle body and all levers to act as a guide to reasonable parts in the same position as removed.

*i.* Loosen the throttle lever clamp screw (10) and remove lever (11) from shaft.

*j.* Remove screws (60) from the throttle valve plate (59). Ends of screws are riveted and must be filed before they can be removed from throttle valve plate. Then pull the throttle valve plate from its shaft.

*k.* Drive taper pin (9) out, then remove the throttle shaft and stop lever assembly from throttle body. Remove bushing (57).

*l.* Remove throttle shaft packing retainer (13), shaft packing washer (14), and throttle shaft bushing (15) from the throttle body shaft holes. Do this by screwing a fine-thread taper tap into packing retainer until it is firmly seated. Then insert a long punch through opposite shaft hole and drive against end of tap until retainer is free of throttle body. (Use the same method to remove bushing.)

*m.* Repeat above operation to remove second retainer from opposite shaft hole.

## **152. Disassembly of Fuel Bowl Body—JXC Carburetor** (fig. 85)

*a.* Remove the main jet adjustment (40) from fuel bowl (36). Remove washer (39), jet (38), and washer (37).

*b.* Remove the hex plug (16) and washer from bottom of fuel bowl.

*c.* Remove power and acceleration jet passage plug (42) and washer (41), jet (43) and fibre washer (44) from threaded angle passage in outside bottom of fuel bowl using small screwdriver.

*d.* Remove the main jet (38) and fibre washer (37).

*e.* Remove the main discharge jet (50) and fibre washer (49) from center of large opening in machined surface of fuel bowl.

*f.* Remove the well vent jet (51) from machined surface of bowl with screwdriver.

*g.* Remove the power jet valve (25) and pump check valve (26).

*h.* Remove the choke lever (30) by removing choke shaft nut (32), and washer (31). Make match marks on choke bracket (35), fuel bowl (36) and lever (3) to act as guide to reassemble these parts in same position as removed. Remove clamp screw (29) and clamp (28).

*i.* Remove the bracket screw (34) and then remove choke bracket (35) from shaft.

*j.* Remove the choke valve plate screws (48), and lockwashers (47) and remove choke valve plate (46) from choke shaft (27).

*k.* The choke shaft may now be removed from fuel bowl.

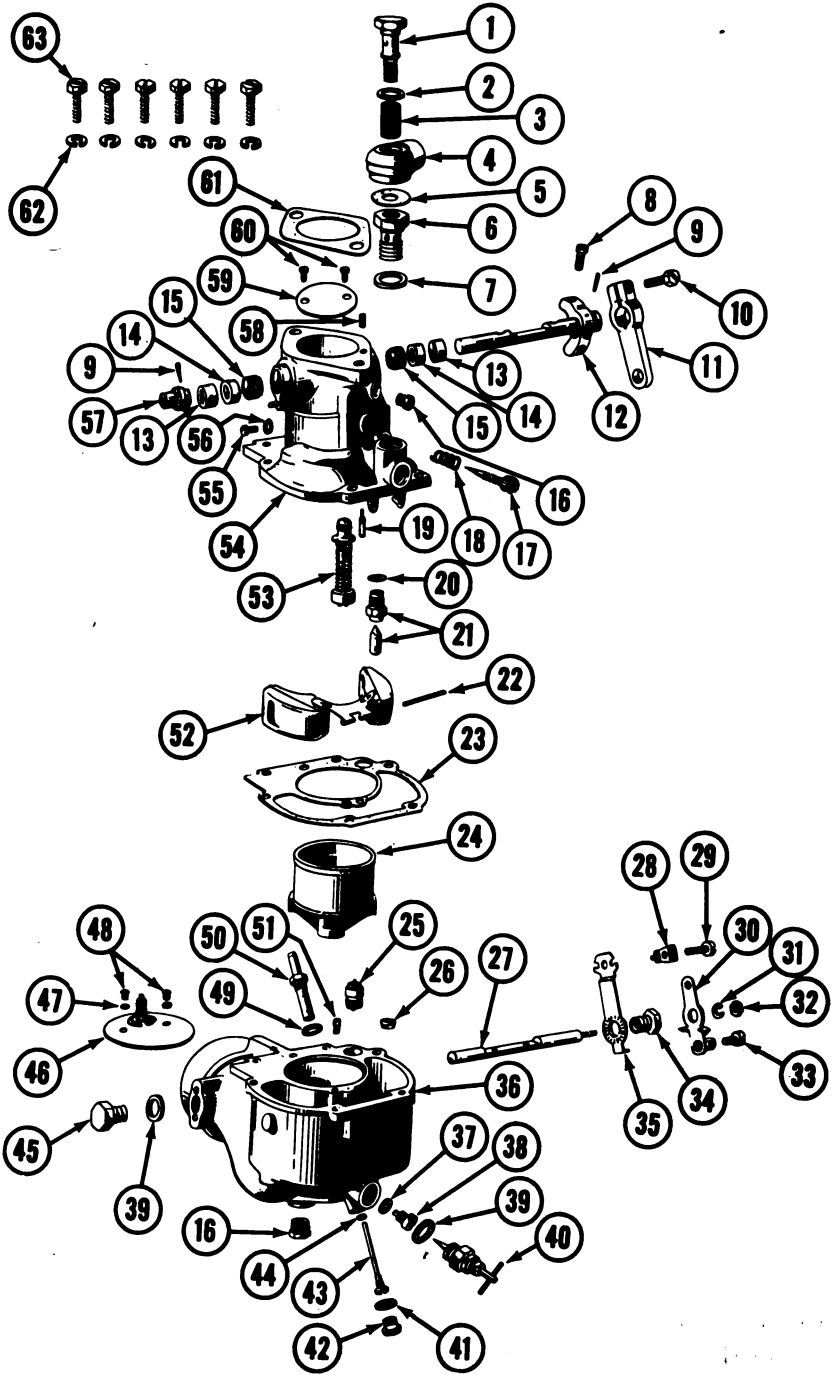


Figure 85. JXC engine carburetor disassembled.

1 Filter plug	33 Screw
2 Washer	34 Screw
3 Screen	35 Choke bracket
4 Body	36 Fuel bowl
5 Washer	37 Washer
6 Filter head	38 Main jet
7 Washer	39 Washer
8 Screw	40 Main jet adjustment
9 Taper pin	41 Washer
10 Screw	42 Plug
11 Lever	43 Power and acceleration jet
12 Shaft and stop lever	44 Washer
13 Retainer	45 Plug
14 Washer	46 Choke valve plate
15 Bushing	47 Lockwasher
16 Plug, 1/8" (2 req'd)	48 Screw
17 Idle adjusting needle	49 Washer
18 Adjusting needle spring	50 Discharge jet
19 Idle jet	51 Well vent jet
20 Washer	52 Float
21 Valve and seat	53 Pump
22 Axle	54 Throttle body
23 Gasket	55 Screw
24 Venturi	56 Lockwasher
25 Power jet valve	57 Lever bushing
26 Pump check valve	58 Screw
27 Choke shaft	59 Throttle valve plate
28 Clamp	60 Screw
29 Screw	61 Gasket
30 Choke lever	62 Lockwasher
31 Lockwasher	63 Screw
32 Nut	

*Figure 85*—Continued

---

### 153. Inspection, Cleaning and Replacement of Fuel Bowl Parts—JXC Carburetor (fig. 85)

*a.* Clean all metal parts thoroughly in cleaning solvent.

*b.* Blow out all passages in fuel bowl body, making sure any carbon deposits in the throttle bore and idle port are loosened and blown out. Do this by reversing flow of compressed air in passages. Do not use wire to clean out jets.

*c.* Examine float (52). If float is loaded with gasoline, damaged, or if float axle bearing is worn, replace the float. If wear can be visually detected on float axle bearing surfaces, replace the float axle (22).

*d.* If either the fuel valve seat or fuel valve needle show wear, replace the assembly (21), as both seat and needle will wear evenly.

*e.* Check the idle adjusting needle (17). The point must be free of ridges. Replace if wear is evident.

*f.* Inspect the throttle valve plate (59). If edges are burred, replace throttle valve plate.

*g.* Inspect the pump (53). Both pump pistons must be free of scratches and must fit the cylinder at its operating end within 0.003 in. Replacement is recommended because extent of wear cannot be determined by visual inspection.

*h.* Replace the power jet valve (25), as wear on this part cannot be determined by visual inspection.

*i.* Examine bearing surfaces on the choke shaft (27). If worn, replace shaft.

*j.* Examine the pump cylinder at lower end of fuel bowl (36). If clearance between pump cylinder and pump piston at operating end is more than 0.003, replace the fuel bowl.

*k.* Replace all gaskets and fibre washers each time the carburetor is disassembled.

*l.* Inspect bearing surfaces of the throttle shaft and replace if worn.

*m.* Inspect accelerating pump check valve (26) and replace if worn.

**Caution:** Do not remove the check valve unless corrosion or gum deposits have formed on or around it. If the valve is removed, it must be replaced with a new one.

## 154. Reassembly of Fuel Bowl Body—JXC Carburetor

(fig. 85)

*a.* Insert the choke shaft hole washer (39) and plug (45) in counter-bore in side of the air intake, and install choke bracket, screws and washers. Install to match scratch marks made on units during disassembly.

*b.* Insert the choke shaft (27) in shaft holes.

*c.* Install the choke valve plate (46) on shaft with poppet valve facing down. Close the choke valve plate, aline the screw holes and install washers (47) and screws (48) loosely. Tighten choke valve plate gently to center it; then tighten screws (48).

*d.* Install the choke bracket (35) on shaft with swivel facing body and tighten clamp set screw.

*e.* Install the main discharge jet (50) and fibre washer (49).

*f.* Install the well vent jet (51) and tighten with small screwdriver.

*g.* Install the power and acceleration jet (43) and fibre washer (44) with screwdriver. Install fibre washer (41) and plug (42).

*h.* Install the main jet (38) and fibre washer (37). Then install main jet adjustment (40) and fibre washer (39).

*i.* Install the power jet valve (25) in bottom of pump cylinder. Fuel bowl body is now assembled.

## 155. Reassembly of Throttle Body—JXC Carburetor

(fig. 85)

*a.* Install two throttle shaft bushings (15) with a suitable bushing driver tool.

*b.* Install the packing washer (14) and retainer (13) and drive into counterbore until retainer is flush with surface of counterbore.

*c.* Install the throttle shaft and stop lever assembly (12).

*d.* Insert the shaft in throttle body in correct position to allow levers to be installed with scratch marks lined up as removed.

*e.* Insert the throttle valve plate (59) in shaft, center it, and rotate shaft counterclockwise to close it.

*f.* Install the throttle clamp lever (11) in same position as removed.

*g.* Install the idling adjusting needle (17) and spring (18) in threaded passage in side of throttle body. Seat the needle lightly with screwdriver, then back needle off  $1\frac{1}{4}$  turns.

*h.* Insert the venturi (24) in throttle body bore. Aline screw hole in venturi with screw hole in throttle body, insert locating screw (55) and lockwasher (56) and tighten.

*i.* Install the idling jet (19) in threaded counterbored passage next to venturi.

*j.* Install the fuel valve assembly (21), followed by float (54) and float axle (22).

**Caution:** Do not bend, twist, or apply pressure on the float bodies.

*k.* With the throttle body (54) in inverted position, look at the float bodies (52). These must be centered and at right angles to the machined surface. The float setting is measured from the machined surface (without gasket) of cover to top side of float bodies at highest point. The float should move freely on its axle and the path of travel should be  $1\frac{5}{8}$  inches, with a plus or minus of one thirty-second of an inch allowable.

*l.* To increase or decrease distance between the top of float body and machined surface of throttle body, use long nosed pliers and bend the lever attaching the two floating bodies.

*m.* Install the pump (53) in cylinder in throttle body, press retainer in place, and check to make sure piston has free movement in cylinder. The throttle body is now assembled.

*n.* Place a new gasket (23) on machined surface of fuel bowl, place throttle body in position with screw holes alined, and install six screws (63) and lock washers (62). Tighten screws evenly and firmly.

*o.* Install the filter head (6) and washer (7) in throttle body (54).

*p.* Install the fuel filter body (4), screen (3), washer (2), and plug (1) in threaded passage in filter head (6).

*q.* Hold the throttle lever in closed position and turn the throttle

stop screw (10) until it makes contact with stop on body, then turn screw in  $1\frac{1}{2}$  additional turns. Carburetor is now assembled.

r. Install the carburetor on the engine. Use a new flange gasket (61). When the carburetor is installed and linked, operate the engine and check the carburetor adjustment.

### **156. Carburetor—JXD Engine**

The carburetor on JXD engines is of multiple venturi design. The body consists of two die castings. Control of the metering pin by a vacuum stepup piston reduces the length of time the choke must be used during the warmup period. The accelerating pump lever has four holes into which the pump connecting rod may be fastened, thereby permitting finer adjustment of the accelerating pump for various conditions. The carburetor is of the down-draft type, mounted directly to the top of the manifold on the right side of the engine.

### **157. Removing JXD Carburetor**

(fig. 55)

- a. Remove the air cleaner (1).
- b. Disconnect the carburetor control rod (5) and fuel inlet line (7) at carburetor.
- c. Disconnect the choke control wire.
- d. Remove two screws, (6) nuts and lockwashers attaching carburetor to manifold flange.
- e. Lift the carburetor off manifold, being careful not to damage flange gasket.

### **158. Disassembly of Throttle Body—JXD Carburetor**

(fig. 86)

- a. Disassemble the accelerating pump lever by removing spring clips (24) and pump connecting rod (26) from accelerating pump lever (25).
- b. Disconnect the accelerating pump connecting rod (26) at fuel bowl end.
- c. Remove two screws (23) and lockwashers and remove fuel bowl (37) from throttle body (22).
- d. Remove venturi (16).
- e. Lift off the gasket (29) and remove throttle shaft and lever assembly (21) by unscrewing set screw in accelerating pump lever (25), removing two screws (17) from throttle valve plate (18), removing valve plate, and pulling shaft from throttle body.
- f. Remove idle adjusting needle (28) and spring (27).



## 159. Disassembly of Fuel Bowl Body—JXD Carburetor (fig. 86)

*a.* Remove three screws (50) and lift fuel bowl cover (48) off the fuel bowl. Tap around edges of the cover to loosen if cover is stuck to the fuel bowl. Do not pry apart, as this will damage the machined surface of the fuel bowl. Remove gasket (42) from fuel bowl.

*b.* Remove the main jet assembly (30–36) from fuel bowl body by removing range needle (30), screwing out large retainer (33) containing needle retainer (31) and packing (32); then removing gasket (34), needle seat (35), and power jet (36). Remove retainer (31) and packing (32) from retainer (33).

*c.* Remove vacuum stepup assembly (41), spring (40), and pin (39).

*d.* Remove the idle tube assembly (38).

*e.* Remove pump plunger assembly (10), (11), and followup spring (14). Remove bent rod (10) from plunger (11).

*f.* Remove the pump discharge check valve screw (12), gasket (13), and valve pin (15).

*g.* Begin disassembly of the fuel bowl cover by removing choke bracket (2) from shaft and lever assembly (5). Be sure that choke lever return spring (3) does not snap off and get lost.

*h.* Remove two choke valve plate screws (1).

*i.* Lift the choke valve plate out of shaft. It will be necessary to rotate the choke shaft with fingers until valve plate is in vertical position before it can be withdrawn from slot in choke shaft.

*j.* Remove the spring clip and spring from end of choke shaft and work shaft out of cover body. Be careful not to exert a sideways motion as this is done.

*k.* With a small drive pin, tap out float axle (47) and remove float and lever assembly (43). Do not hit the drive pin too hard, as this will tend topeen the end of the axle and damage the bore as the axle is driven out.

*l.* Remove float valve (44), seat (45) and gasket (46).

*m.* Remove strainer assembly (49).

## 160. Inspecting, Cleaning and Replacement of Parts—JXD Carburetor (fig. 86)

*a.* Clean all metal parts thoroughly in cleaning solvent.

*b.* Blow out all passages in fuel bowl body making sure any carbon deposits in the throttle bore and idle port are loosened and blown out. Do this reversing flow of compressed air in passages. Do not use wire to clean out jets.

*c.* Examine float assembly (43). If float is loaded with gasoline, damaged, or if float lever is worn, replace the float.

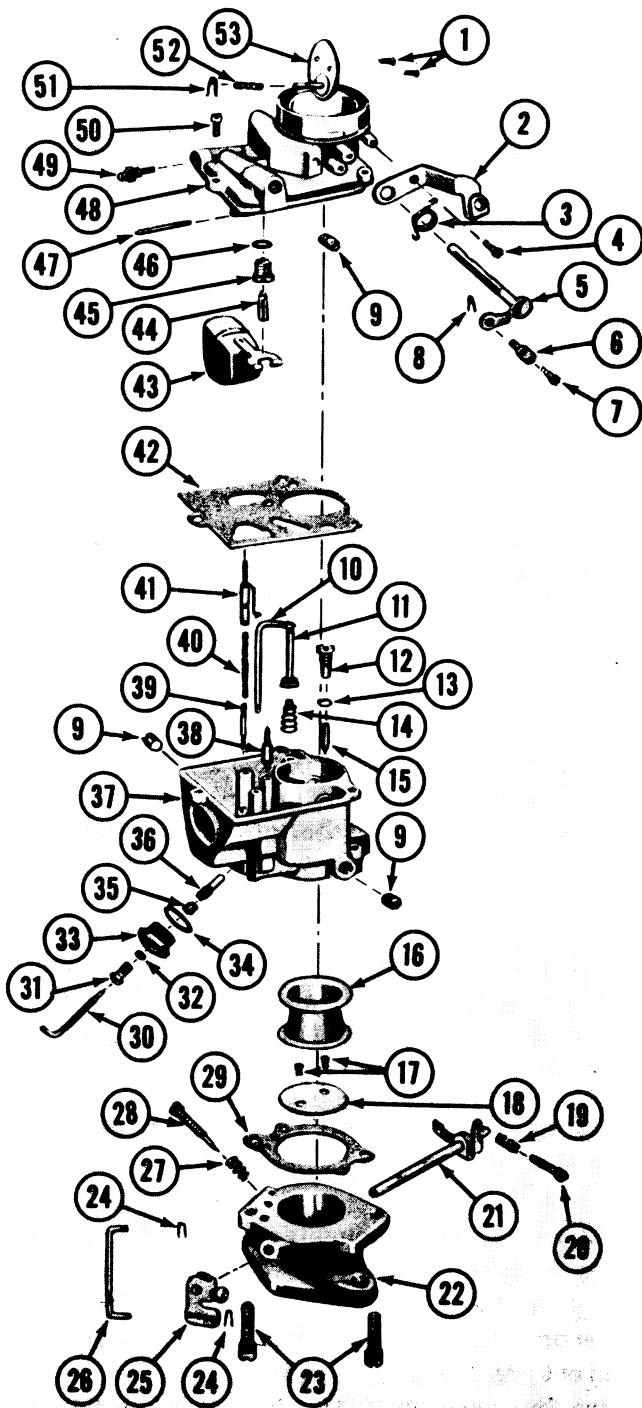


Figure 86. JXD engine carburetor disassembled.

1 Screw	28 Idle adjusting needle
2 Bracket assembly	29 Gasket
3 Spring	30 Range adjusting needle
4 Screw	31 Retainer
5 Shaft and lever assembly	32 Packing
6 Swivel	33 Retainer
7 Screw	34 Gasket
8 Springs clips	35 Seat
9 Plug	36 Power jet
10 Bent rod	37 Fuel bowl
11 Plunger	38 Idle tube assembly
12 Screw, pump discharge check valve	39 Pin
13 Gasket	40 Spring
14 Spring	41 Vacuum stepup assembly
15 Valve	42 Gasket
16 Venturi	43 Float and lever assembly
17 Screw	44 Float needle valve
18 Throttle valve plate	45 Seat
19 Spring	46 Gasket
20 Screw	47 Axle
21 Throttle shaft and lever	48 Choke and bowl cover assembly
22 Throttle body	49 Strainer assembly
23 Screw	50 Screw
24 Spring clips	51 Spring clips
25 Pump lever	52 Spring
26 Connecting rod	53 Choke valve plate assembly
27 Adjusting needle spring	

*Figure 86—Continued*

*d.* If wear can be detected visually on the float needle valve (44) or seat (45), replace both, as wear will take place evenly on valve and seat.

*e.* Inspect the choke valve plate and if machined edge is burred, replace the valve plate.

*f.* Inspect the idle tube (38). This should have a bare clearance at operating end. Replace assembly if loose in bore.

*g.* Examine bearing surfaces of the choke shaft (5). Replace if surfaces show wear rings.

*h.* Replace the power jet (36), as wear on this part cannot be visually determined.

*i.* Replace all fibre washers and gaskets each time the carburetor is disassembled.

*j.* Check machined edges of the throttle valve plate (18) and replace if burred.

*k.* Check the throttle shaft (21) and replace if wear on bearing surfaces can be visually detected.

*l.* Check idle adjusting needle (28). Replace if the point has any wear ridges.

## 161. REASSEMBLY OF FUEL BOWL BODY—JXD CARBURETOR

(fig. 86)

- a. Install the float needle valve (44), seat (45), and gasket (46).
- b. Install the discharge valve (15), gasket (13) and pump discharge check valve screw (12).
- c. With a small drive pin, carefully tap the float axle (47) into bore in cover, line up float lever holes, and tap axle through float lever and into bore on other side until secure. Make certain end of axle is flush with edge of cover.
- d. Assemble the choke bracket (2) and return spring (3) to shaft and lever assembly (5) and work shaft into cover (48). Secure in place with spring clip (51) and spring (52).
- e. Install the choke valve plate in slot in choke shaft, line up holes and install screws (1) loosely. Rotate the choke valve plate to closed position to get proper alinement of valve plate in bore and tighten screws (1).
- f. Install the pump plunger spring (14), pump plunger (11) and the bent rod (10).
- g. Install the idle tube assembly (38).
- h. Install the vacuum stepup assembly (39-41).
- i. Install a new gasket (42) on fuel bowl.
- j. Bring the fuel bowl and cover together and secure with three attaching screws (50).
- k. Install the fuel main jet assembly (30-36) by installing power jet (36), needle seat (35), gasket (34), needle retainer (33). Install packing (32), retainer (31), and range needle (30) into retainer (33).
- l. Install strainer assembly (49).
- m. Examine all assemblies carefully to make sure they are properly installed and secured in place.

## 162. Reassembly of Throttle Body—JXD Carburetor

(fig. 86)

- a. Install the throttle shaft and lever assembly (21) in throttle body.
- b. Rotate shaft as necessary to slip throttle valve plate (18) in slot in shaft.
- c. Rotate the shaft and close throttle valve plate to make certain the machined edge of throttle valve plate lines up in throttle body bore.
- d. Install screws (17) loosely in shaft to secure throttle valve plate. Rotate shaft as needed to line up throttle valve plate with throttle bore and tighten screws (17).
- e. Install the spring (27) and idle adjusting needle (28). Screw needle in until it is seated; then back needle out one and one-half turns.

*f.* Install the accelerating pump lever (25) to throttle shaft and secure by tightening the lever set screw.

*g.* Position a new gasket (29) on machined surface of throttle body and bring throttle body and fuel bowl together.

*h.* Aline holes and assemble the throttle body and fuel bowl with attaching screws (23).

*i.* Assemble the upper end of the accelerating pump connecting rod (26) to hole in bottom of bent rod (10) under fuel bowl and secure with spring clip (24).

*j.* Assemble lower end of connecting rod (26) in the same hole in lever (25) from which it was removed and secure in place with spring clip (24). Carburetor is now reassembled.

*k.* Install the carburetor on the engine. Use a new flange gasket between carburetor and manifold.

*l.* When carburetor is installed on engine and linked, operate engine and check carburetor adjustment.

## **Section VI. STARTING MOTOR AND DISTRIBUTOR**

### **163. General**

The starter, or cranking motor, used on the JXC and JXD engines is located on the lower right hand side of the engine, bolted to the bellhousing and on a level with the oil pan. The starter is a direct-current motor, operating on battery voltage. Through considerable gear reduction, this small motor is able to turn the engine over fast enough for starting. A small pinion on the cranking motor shaft meshes, when operating, with teeth in the flywheel ring gear. The cranking motor is automatically disengaged from the flywheel when the engine starts. A drive spring in the drive mechanism absorbs the shock of the initial meshing of starter drive gear with the flywheel.

### **164. Removing Starting Motor**

The procedure for removing the starting motor is the same for both the JXC and the JXD engine as described in paragraph 60.

### **165. Disassembly of Starting Motor**

(fig. 87)

*a.* Remove screw (39) and nut (38), then take off cover band (1).

*b.* Remove through bolts (36) and lockwashers (35), then remove commutator end head assembly (31).

*c.* Remove the pinion housing (25) and armature (22) from frame (24) and field coil assembly.

*Note.*—Place shims in a container after removal to prevent loss.

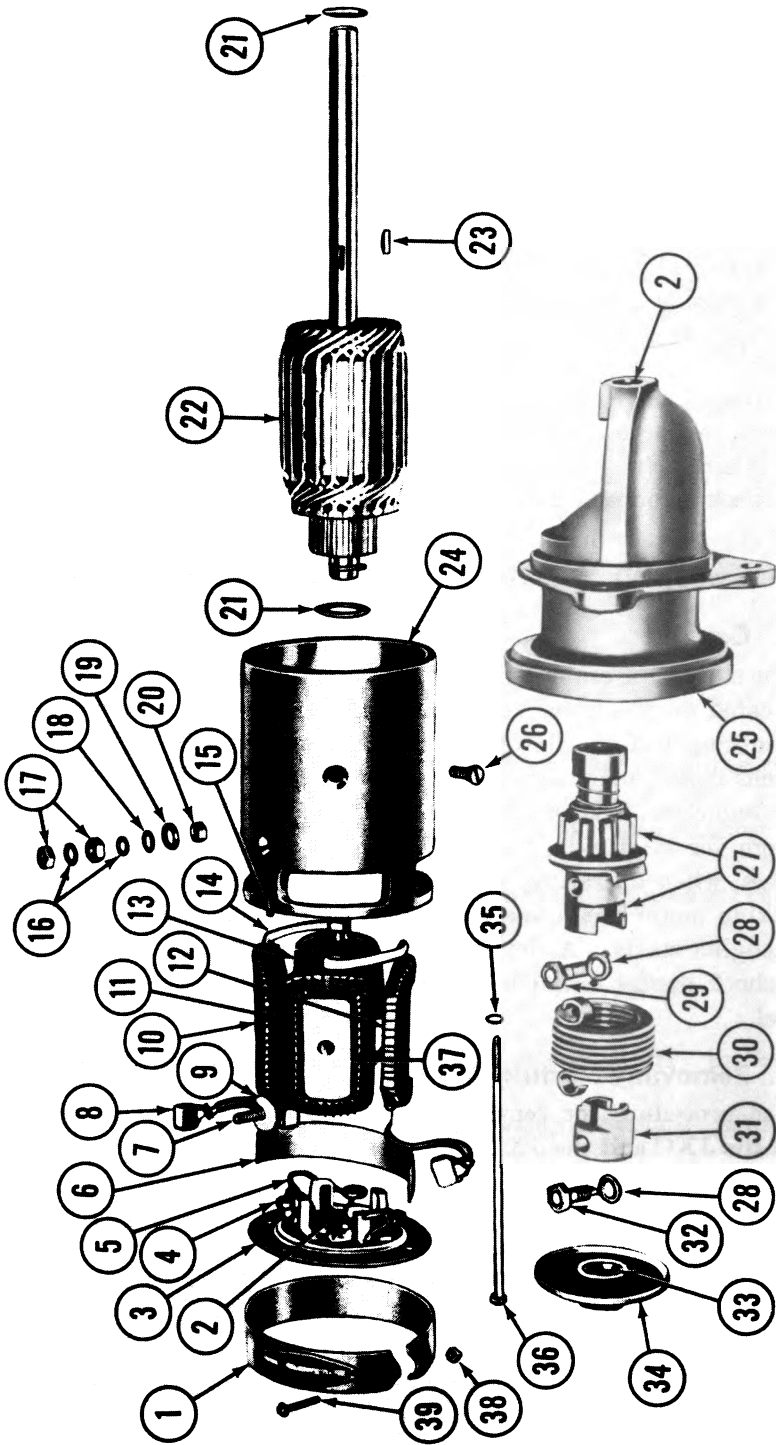


Figure 87. Starting motor disassembled.

- |    |  |    |  |
|----|--|----|--|
| 1  | Cover band                                 | 21 | Thrust washer                              |
| 2  | Bearing                                    | 22 | Armature assembly                          |
| 3  | Commutator end head assembly               | 23 | Key, woodruff, #6                          |
| 4  | Brush spring                               | 24 | Frame                                      |
| 5  | Grounded brush                             | 25 | Pinion housing assembly                    |
| 6  | Field connection insulation                | 26 | Pole shoe screw                            |
| 7  | Terminal stud                              | 27 | Shaft and pinion                           |
| 8  | Brush                                      | 28 | Lockwasher                                 |
| 9  | Insulating washer                          | 29 | Shaft spring screw                         |
| 10 | Upper left field coil                      | 30 | Drive spring                               |
| 11 | Upper right field coil                     | 31 | Drive Head                                 |
| 12 | Lower right field coil                     | 32 | Head spring screw                          |
| 13 | Lower left field coil                      | 33 | Bearing                                    |
| 14 | Field coil connector                       | 34 | Intermediate bearing assembly              |
| 15 | Dowel pin                                  | 35 | Lockwasher, $\frac{1}{4}$ " (2 req'd)      |
| 16 | Lockwasher, $\frac{1}{16}$ ", (2 req'd)    | 36 | Through bolt.                              |
| 17 | Nut, hex, $\frac{5}{16}$ "-24 NF (2 req'd) | 37 | Pole shoes                                 |
| 18 | Washer, $\frac{1}{16}$ ", (2 req'd)        | 38 | Nut, #10-32 NF                             |
| 19 | Insulating washer                          | 39 | Screw, fl hd, #10-32 NF x $1\frac{1}{2}$ " |
| 20 | Insulating bushing                         |    |  |

Figure 87.—Continued

- d. Press armature shaft out of the pinion housing (25).
- e. Back off the head spring screw (32) until it is free of the armature shaft, and slide the drive assembly (27-34) off the shaft.
- f. Press bearing (33) out of intermediate bearing assembly (34).
- g. Remove terminal parts (16-20) from frame (24).
- h. Remove pole shoe screw (26).
- i. Unsolder field coils (10-14) from terminal stud (7).
- j. Remove four pole shoes (37) and the coils.

**Caution:** Be careful with coils to avoid bending lead connections or damaging insulation.

- k. Lift brushes (8) out of holders.

## 166. Cleaning, Inspection, and Testing of Starting Motor

- a. Clean all parts, inspect for wear, and replace all worn parts.
- b. Clean the commutator end head (3, fig. 87); check for distortion of the head or worn bearing. Replace end head or bearing as necessary.
- c. Clean the pinion housing (25) and paint inside with corrosion-resistant varnish. Avoid getting varnish in bearing base and on mounting flange face.
- d. Check the armature for grounds with test probes (fig. 88).

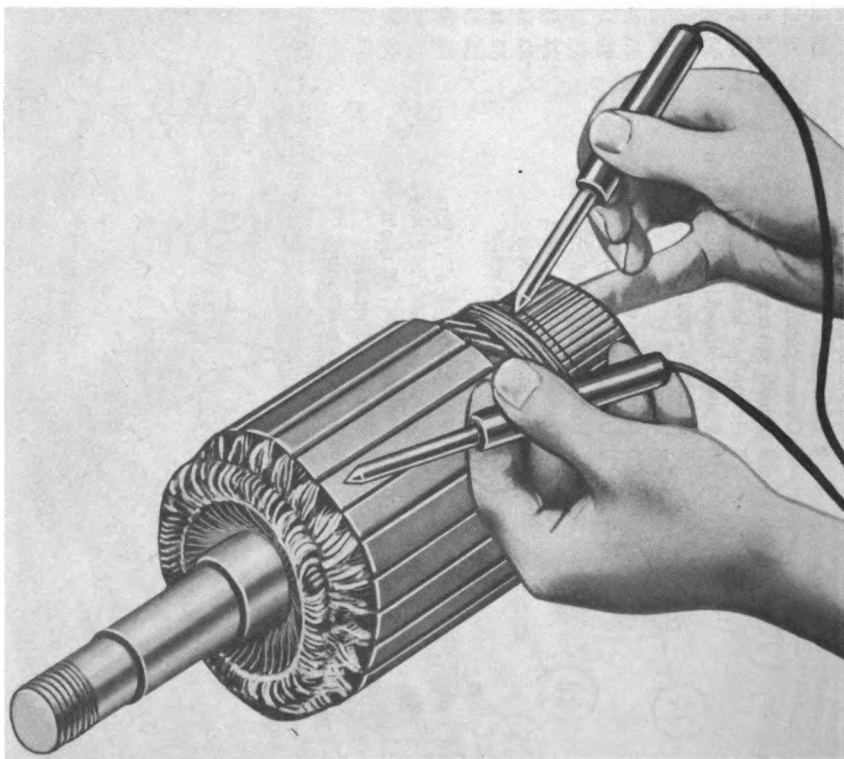
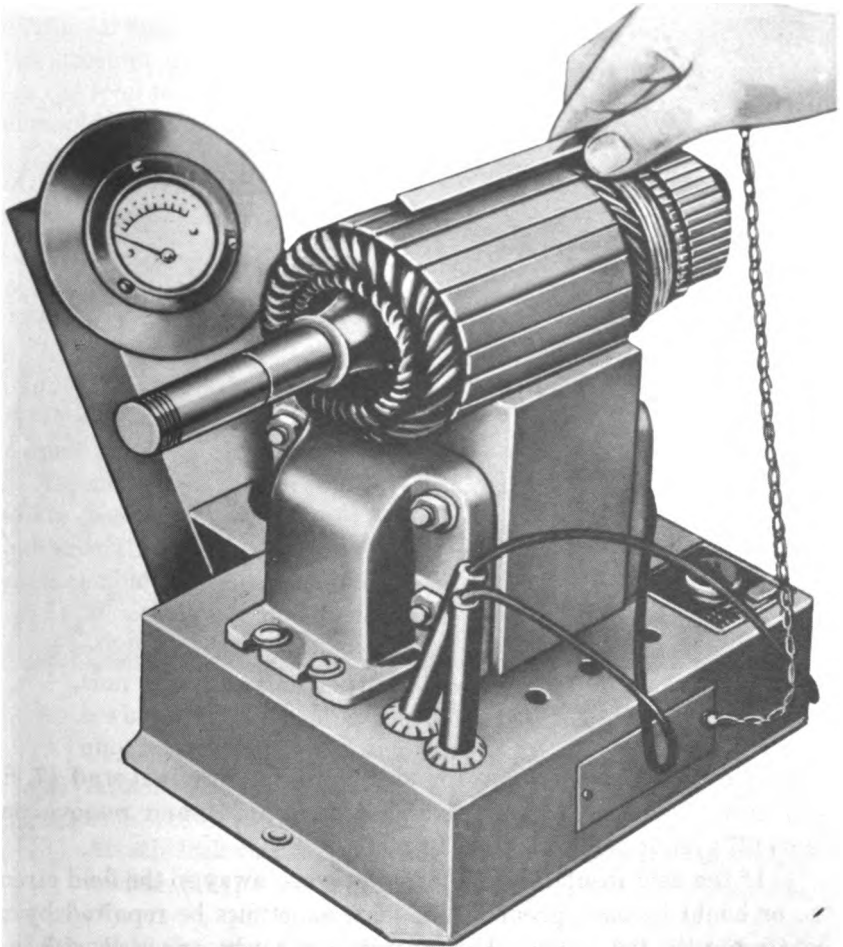


Figure 88. Testing armature for shorts.



Touch one probe to the shaft, and touch each commutator segment with the other probe. Do not touch probes to bearing or brush surfaces as an arc would burn the finish. If the lamp lights, a ground exists.

e. Check the armature for shorts on a growler (fig. 89). The growler is a strong electromagnet connected to a source of alternating current. When a shorted armature is placed on the growler, and a hacksaw blade is held above the shorted coils in the armature, the blade will be alternately attracted to and repelled from the armature. This causes the blade to buzz against the armature. Before discarding the armature that tests short, inspect the commutator slots carefully, since copper or brush dust sometimes collects in the slots and shorts adjacent bars.



*Figure 89. Testing armature for short on growler.*

*f.* If armature shaft or windings are worn, replace the armature.  
*g.* Inspect insulation and soldering to make sure all coils are in working order.

*h.* Test field coils and terminal studs for grounds and open circuits with probes (fig. 90). Touch one probe to the terminal stud and one to the frame. If a ground is present, the lamp will light. Touch one probe to the terminal stud and one to each of the insulated brushes. If an open circuit is present, the lamp will not light.



*Figure 90. Testing field coils for ground.*

*i.* If grounds or opens are found, remove the terminal stud (7, fig. 87) from frame. Unscrew pole shoe screw (26) and remove pole shoe (37); slide field coils from frame.

*j.* If the field insulation is charred or worn away so the field circuit is, or could become, grounded, it may sometimes be repaired by re-wrapping the field coils. This operation must be executed with care and neatness, since excessive bulkiness of the wrappings will prevent

reassembling the coils under the pole shoes in the proper manner. Make all soldered connections with the use of rosin flux.

*k.* If connections between coils to clips or studs are defective, resolder, using rosin flux.

**Caution:** Never use acid flux on electrical connections.

*l.* Paint the field coil, pole shoes and frame with corrosion-resistant varnish, but avoid getting varnish on brush leads, head pilots, or in threaded holes.

*m.* Wash the drive in cleaning solvent, inspect for wear or distortion, and replace parts as necessary.

*n.* Clean the intermediate bearing assembly (34) and inspect for cracks and wear. Replace the plate or bearing as necessary, using the correct arbor to install the bearing. Soak the bearing in medium engine oil and paint the bearing plate with corrosion-resistant varnish.

*o.* Inspect brushes and replace if they are oil-soaked, chipped at rubbing surface, or worn less than  $\frac{5}{16}$ -inch long. To replace the insulated brushes, unsolder the lead from the brush connector and pry open the loop in the connector. Insert the new brush to its full length and resolder.

## 167. Reassembly and Installation of Starting Motor

(fig. 87)

*a.* Press bearing (33) into plate.

*b.* Assemble the intermediate bearing assembly (34) and washer (21) on shaft of armature (22).

*c.* Apply a thin coat of light engine oil on shaft and install drive assembly (27-32) on shaft.

*d.* Press bearings (2) into pinion housing (25) and commutator end head (3).

*e.* Assemble the armature in the pinion housing and align the intermediate bearing assembly (34) by pressing it firmly against the shoulder in the housing.

*f.* Assemble field coils in frame.

(1) Position pole shoes in field coils.

**Caution:** Be sure pole shoes are installed in the same location and direction as they were originally because the shoes are bored after assembly and when they are interchanged they may interfere with the armature.

(2) Attach field coils (10-13) with pole shoes to frame (24) with screws (26).

(3) Attach lockwasher (16), nut (17), washer (18), insulating washer (19), and insulating bushing (20) to terminal stud (7).

*g.* Assemble the armature (22) and pinion housing (25) on the frame (24).

h. Assemble thrust washer (21) on commutator end of shaft.

i. Install the field connection insulation (6) in frame.

**Caution:** Make sure that the insulation is installed in the same position as it was originally.

j. Assemble the commutator end head (3) on the housing.

**Caution:** When fitting brushes to commutator, avoid catching and breaking brush assemblies.

k. Install the through bolts.

l. Assemble the brushes in holders.

m. Check alinement of brushes on commutator and make sure they seat properly.

n. Measure brush tension with spring scale. Attach scale hook to end of spring immediately over the outward end of the brush, away from commutator. Use care to avoid damaging the wire brush lead. To measure the spring tension, pull the spring arm in straight line outward from the commutator center. Be careful to exert pull in the same plane as the plane of the brush side face. Take the reading just as the spring leaves the brush. If the tension is not between 42 and 53 ounces, remove end head and twist the spring holder with pliers to get more or less tension as required. Always remove the brushes from holders before removing end head.

o. Check the armature end play. With a feeler gage, check the clearance between the stop and the inner side of the pinion housing bearing with the armature at its two extreme positions. Do not compress the drive spring. The end play will be the difference between the two clearances. If the end play is not less than one-sixteenth of an inch, remove the end head and change thickness of washer as needed to adjust end play.

p. Lubricate bearings by adding three to five drops of medium engine oil to the oiler in the commutator end head.

q. Mesh teeth of drive gear with teeth on flywheel, and secure starter to bellhousing with three cap screws as removed (par. 60).

r. Remove dirt or corrosion from terminal stud and seat, and install battery cable.

## 168. Distributor

JXC and JXD engine distributors are both water pump mounted and driven by a spiral gear from pump shaft. The JXC distributor does not have a seal plate or dust cover separating the breaker points from the rotor and cap. The function of the distributor is to provide current to the primary winding of the ignition coil and route the stepped-up current through the high tension cables so it creates a high-voltage spark in the proper spark plug at the proper time for firing the cylinder. The JXD engine distributor has an hour-

meter mounted between it and the water pump. It is also equipped with a radio-shielded cover. The distributors of both engines operate in the same way and are disassembled and repaired in essentially the same way.

### **169. Removing Distributor**

The procedure for removing the distributor from the JXC and JXD engines is described in paragraph 65.

### **170. Disassembly of Distributor**

(fig. 91)

- a. Remove cap (1) by lifting cap clamps (15).
- b. Remove the rotor (2).
- c. Remove seal plate assembly on the JXD distributor. There is no seal plate assembly on the JXC distributor.
- d. Remove condenser mounting screw (32) and lock washer (31), then lift off condenser (3), and clamp screw (7) and lockwasher (6).
- e. Remove distributor cap contact plunger (34) and spring (34) from cap (1).
- f. Remove the breaker plate mounting screw (28) and lockwasher (27) then lift off breaker plate (26).
- g. Drive out drive gear pin (21) and remove drive shaft (13), thrust washer (14), thrust washers (18), (19), and drive gear (20).
- h. Remove weight springs (11) and weight (25).
- i. Remove sleeve wick (9), cam and stop plate (10) and spacer (12).

*Note.*—Before removing cam and stop plate, install rotor on shaft and make a sketch of the relationship between the two so that the rotor can be installed in the same position.

### **171. Cleaning, Inspection, and Parts Replacement of Distributor**

(fig. 91)

- a. Clean all parts in cleaning solvent and allow to dry thoroughly. Do not dip seal plate, condenser, and felt wick in the solvent. Wipe these clean with a cloth dampened with solvent.
- b. Inspect the distributor cap (1) for cracks, carbon runners, evidence of arcing, and corroded high tension terminals. Replace the cap if any of these conditions exist.
- c. Check the distributor cap inserts inside the cap. If these are burned or pitted, replace the cap.
- d. Check the rotor (2) for cracks. Replace the rotor if cracks exist. Check the end of the metal strip on top of the rotor. If this is burned, replace the rotor.
- e. Test the condenser (3) on an approved tester. On the JXC distributor, the condenser should have a capacity of 0.20 to 0.25 micro-

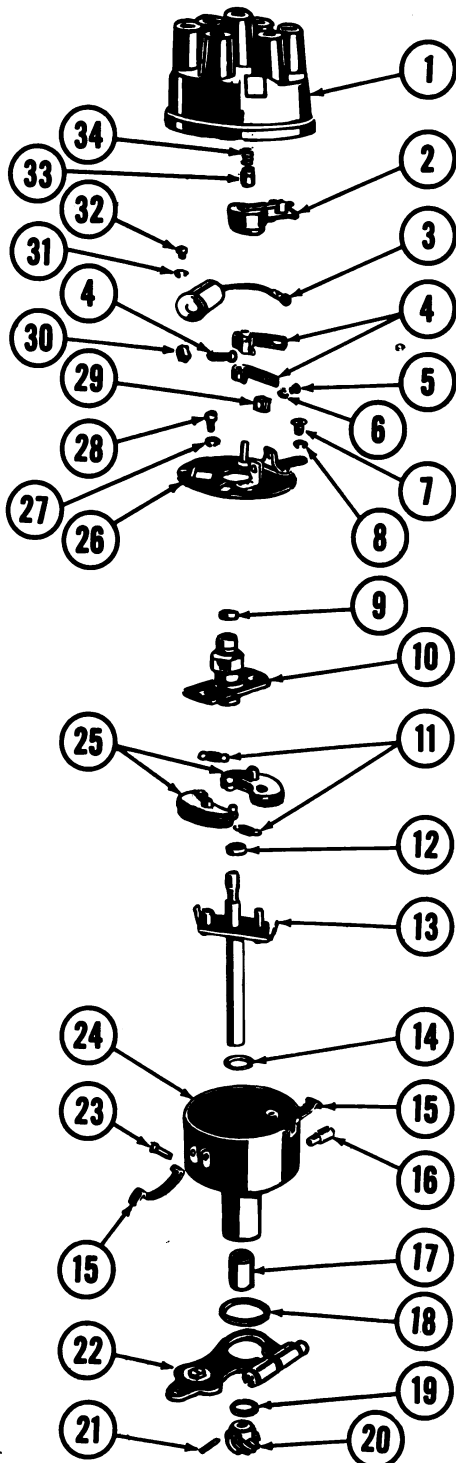


Figure 91. JXC distributor disassembled.

- |  |  |
|--|--|
| 1 Distributor cap  | 19 Drive shaft thrust washer, lower  |
| 2 Rotor  | 20 Distributor drive gear  |
| 3 Condenser  | 21 Distributor drive gear pin  |
| 4 Breaker contact set                                      | 22 Advance arm   |
| 5 Clamp spring screw, rd hd, #6-32<br>NC x $\frac{1}{4}$ " | 23 Cap spring tubular rivet  |
| 6 Condenser and clamp screw lock-<br>washer #6             | 24 Base assembly   |
| 7 Terminal screw, fl hd, #10-32<br>NF x $\frac{1}{4}$ "    | 25 Governor weight   |
| 8 Plate mounting lock washer, #10                          | 26 Breaker plate   |
| 9 Felt cam sleeve wick                                     | 27 Plate mounting screw lockwasher,<br>#10 (2 req'd)                               |
| 10 Cam and stop plate                                      | 28 Breaker plate mounting screw, fl<br>hd, #10-32 NF x $\frac{5}{16}$ ", (2 req'd) |
| 11 Weight spring   | 29 Contact arm spring clip   |
| 12 Cam spacer  | 30 Breaker contact locknut   |
| 13 Drive shaft   | 31 Condenser and clamp screw lock-<br>washer, #6 (2 req'd)                         |
| 14 Drive shaft thrust washer, upper                        | 32 Condenser mounting screw, fl hd,<br>#6-32 NC x $\frac{5}{16}$ "                 |
| 15 Cap clamp   | 33 Distributor cap contact plunger   |
| 16 Distributor base roller                                 | 34 Distributor cap contact spring  |
| 17 Bearing   |  |
| 18 Advance arm thrust washer                               |  |

*Figure 91.*—Continued

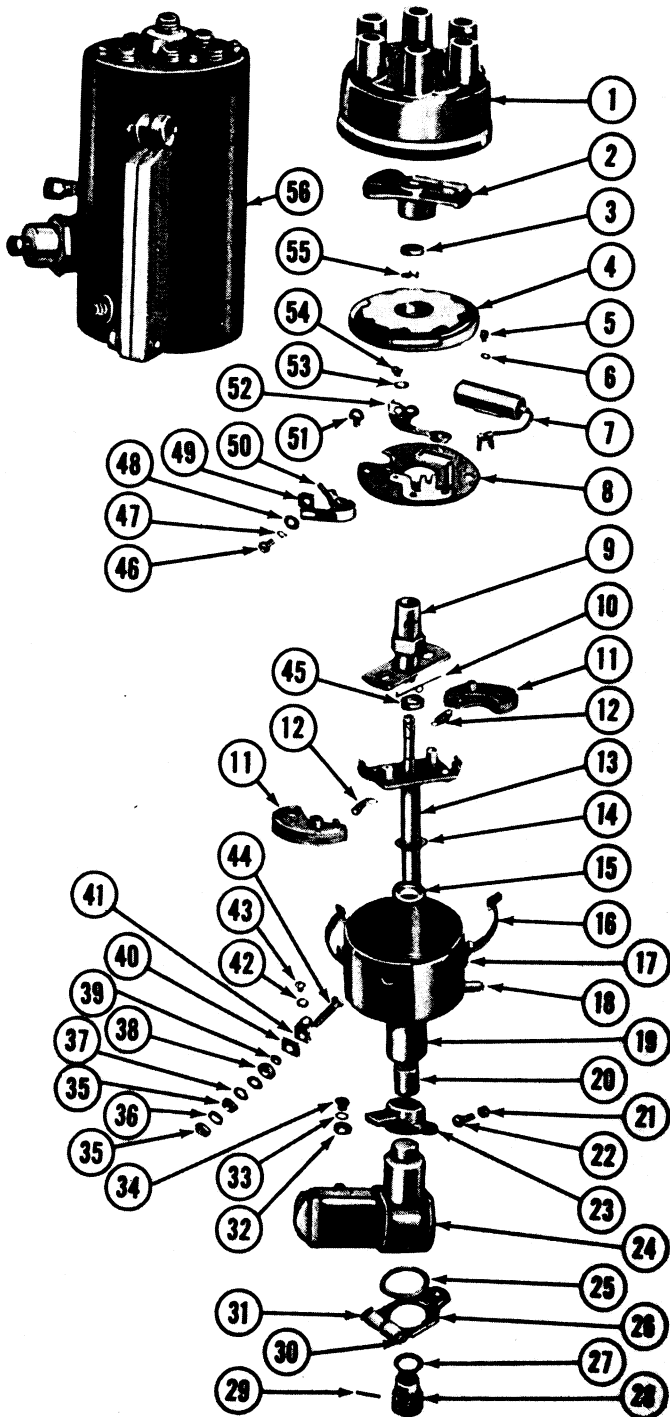


Figure 92. JXD distributor disassembled.



- |   |  |
|---|--|
| 1 Distributor cap   | 30 Clamp screw   |
| 2 Rotor   | 31 Clamp lockwasher  |
| 3 Felt cam sleeve wick                                    | 32 Nut   |
| 4 Seal plate assembly                                     | 33 Lockwasher  |
| 5 Condenser mounting screw<br>#6-32 NC x $\frac{5}{32}$ " | 34 Screw   |
| 6 Condenser mounting screw<br>lockwasher, #6              | 35 Terminal stud nut, hex, #10-32 NF,<br>(2 req'd)                                 |
| 7 Condenser   | 36 Terminal stud lockwasher, #10,<br>(2 req'd)                                     |
| 8 Breaker plate   | 37 Terminal stud plain washer, #10   |
| 9 Cam and stop plate                                      | 38 Terminal stud insulated washer  |
| 10 Antirattle spring                                      | 39 Terminal stud insulated bushing   |
| 11 Governor weight  | 40 Terminal stud insulation, inner   |
| 12 Governor weight spring                                 | 41 Terminal stud connector   |
| 13 Drive shaft  | 42 Connector screw lockwasher, #6  |
| 14 Outer drive shaft thrust washer,<br>upper              | 43 Connector screw, rd hd #6-32 NC<br>x $\frac{3}{16}$ "                           |
| 15 Inner drive shaft thrust washer,<br>upper              | 44 Terminal stud, #10-32 NF x $\frac{5}{16}$ "                                     |
| 16 Cap clamp spring assembly                              | 45 Cam spacer  |
| 17 Cap clamp tubular rivet                                | 46 Spring clamp screw, hex hd, #6-32<br>NF x $\frac{5}{16}$ "                      |
| 18 Oiler  | 47 Clamp screw lockwasher, #6  |
| 19 Base assembly  | 48 Clamp screw plain washer, #6  |
| 20 Absorbent bronze bearing                               | 49 Breaker arm spring clip   |
| 21 Distributor clamp screw nut                            | 50 Breaker arm   |
| 22 Distributor clamp screw                                | 51 Breaker plate mounting screw, fl hd,<br>#10-32 NF x $\frac{5}{16}$ ", (2 req'd) |
| 23 Distributor adapter                                    | 52 Contact point   |
| 24 Engine hour-meter                                      | 53 Contact lockscrew plain washer #8   |
| 25 Hour-meter support shim                                | 54 Breaker contact lockscrew, fl hd,<br>#8-32 NC x $\frac{3}{16}$ "                |
| 26 Hour-meter support arm                                 | 55 Cam retaining snap ring   |
| 27 Drive shaft thrust washer, lower                       | 56 Distributor shield  |
| 28 Drive gear   |  |
| 29 Drive gear pin   |  |

*Figure 92.*—Continued

farad. On the JXD distributor the capacity should be 0.23 to 0.26 microfarad. If found to be defective, replace the condenser.

*f.* Inspect the breaker contacts. If these are a grayish color and are not burned or pitted, they may be reinstalled.

*g.* Inspect the weight springs (11). If these appear stretched, or if they are distorted, replace the weight springs.

*Note.* Always replace weight springs in pairs.

*h.* Inspect the base for cracks, or any visible wear in base bearing. Replace either or both if bearings are worn or base is cracked.

*i.* Check the breaker cam for wear. If wear grooves are visible, replace the cam.

## 172. Reassembly of Distributor

(fig. 91)

*a.* Press bearing (17) in base (24).

*b.* Place thrust washer (14) on drive shaft (13), then install drive shaft in base (24).

*c.* Install advance arm (22) on base with thrust washers (18) and (19). Secure drive gear (20) to drive shaft with pin (21). If a dial indicator is available, clamp it to the distributor base with the plunger against the end of the shaft. Move the shaft up and down to its extreme positions and read the indicator. If the end play is not between 0.003 inch and 0.010 inch, remove the gear and install thrust washers between the distributor base and the gear. If a dial indicator is not available, a feeler gage may be used by inserting the feeler ribbon between the base and lower thrust washer, with the shaft pressed to its extreme low position.

*d.* Install governor weights (25) and springs (11).

*e.* Install cam spacer (12), cam and stop plate (10), and felt wick (9).

*f.* Install breaker plate (26) on base and secure with screws (28) and lockwashers (27).

*g.* Install breaker contact set (4), screw (5), lockwasher (6), clip (29), and locknut (30).

*h.* Turn breaker cam so that the rubbing block is holding the points open and adjust the stationary contact so that the gap is approximately 0.020 inch. Rotate cam as needed to check alinement of the contacts and bend the stationary contact bracket until a perfect mating of the two contact point surfaces is obtained. Then recheck the contact point gap and readjust if necessary to a final gap of 0.020 inch.

*i.* Hook a spring scale to the breaker arm at the contact and pull on a line perpendicular to the face of the contact. Take the reading as the contacts separate. Adjust this reading to 17 to 20 ounces by loosening the screw (5) and sliding breaker arm back or forth in slot as necessary to obtain the correct tension on breaker arm spring.

- j.* Install condenser (3) with screw and lockwasher.
- k.* Install the seal plate, felt washer, and rotor (2).
- l.* Install contact spring and plunger in distributor cap (1).
- m.* Mount and secure the distributor cap (1) on base (24) with cap clamps (15).
- n.* Now mount the distributor on a test fixture that will show distributor rpm and degrees of governor advance. Check the advance up and down the speed range, noting any indication of sluggishness. If necessary to adjust the advance, slightly bend the lugs on the governor mounting plate. Bend the lugs inward for less advance, and outward for greater advance.
- o.* Add one drop only of light oil to the breaker arm hinge pin.
- p.* Saturate the felt in the top of the cam with light oil.
- q.* Add three to five drops of light engine oil to the oiler (16) on base.

### **173. Installation and Timing of Distributor**

The procedure for installing and timing the distributors for the JXC and JXD engines is described in paragraphs 65 and 66.

## **Section VII. GENERATOR AND VOLTAGE REGULATOR**

### **174. General**

Generators used on JXC and JXD engines are mounted on the right side of the engine, bolted to the gear case, and are driven by the camshaft gear. The generator's function is to convert mechanical energy from the engine into electric current. This current is stored in the battery. A voltage regulator, mounted on the generator frame, consists of a circuit breaker unit and a step-control voltage regulator. The circuit breaker acts as an automatic switch to connect the generator to the battery when the generator is operating fast enough to charge. When the generator is not running, the circuit breaker opens to prevent the battery from discharging through the generator. The voltage regulator unit controls the generator output to meet the needs of the battery. It will permit maximum current when the battery charge is low, or when electrical accessories are operating, and will retard current from the generator when the battery charge is normal and when electrical accessories are not operating. Disassembly, parts replacement, and reassembly procedures for JXC and JXD engine generators are the same, although there are minor differences in parts and part numbers. Certain parts of the JXD generator are painted with corrosion-resistant varnish before assembly, as a preventive measure. This in no way effects the method of assembling the parts.

### **175. Removing Generator**

The procedure for removing the generator from the JXC and JXD engines is described in paragraph 58.

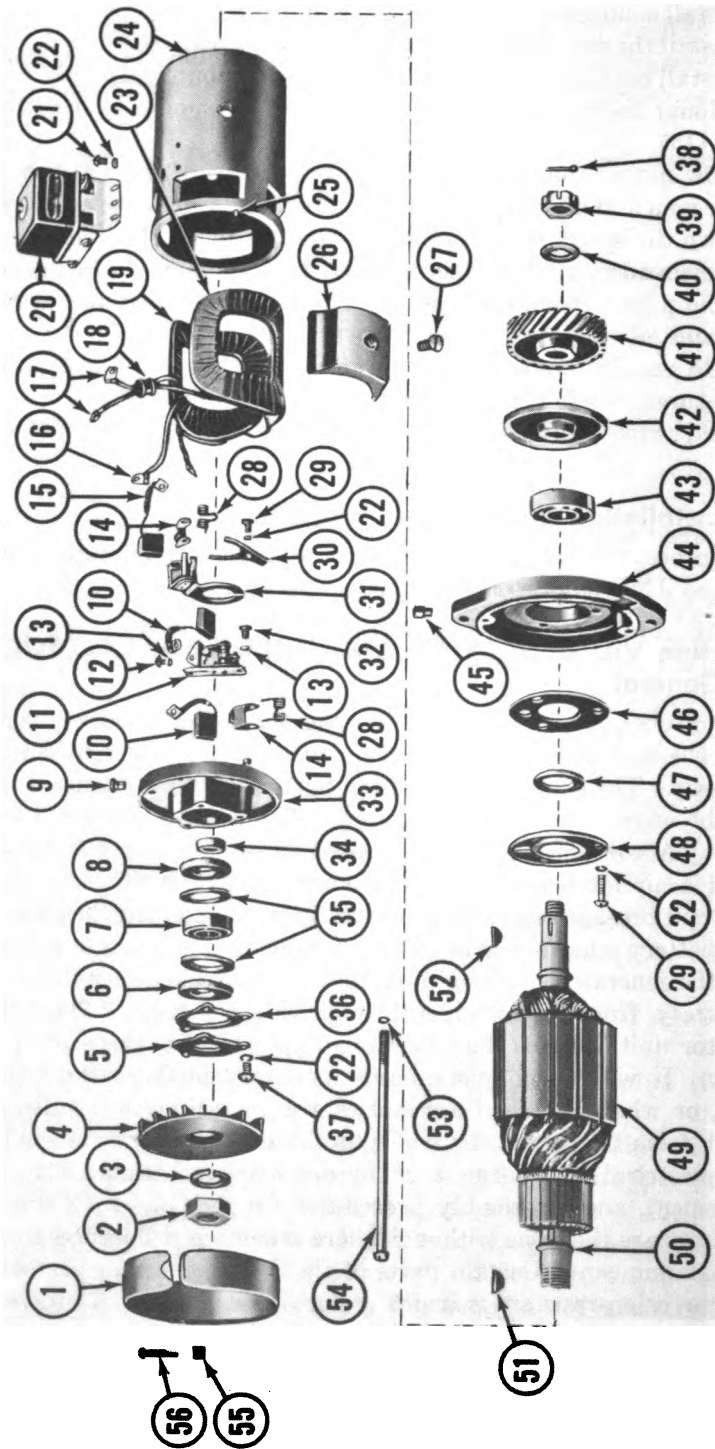


Figure 98. Generator disassembled, JX engine.

- |    |   |    |   |    |                                       |
|----|---|----|---|----|---------------------------------------|
| 1  | Cover band                                  | 20 | Two charge regulator                          | 39 | Castellated nut, $\frac{1}{2}$ -20 NF |
| 2  | Armature shaft nut                          | 21 | Screw, #10-32 NF x $\frac{1}{8}$ " (4 req'd)  | 40 | Plain washer, $\frac{1}{2}$ "         |
| 3  | Armature shaft lockwasher                   | 22 | Lockwasher, #10 (13 req'd)                    | 41 | Generator drive gear                  |
| 4  | Ventilating fan                             | 23 | Right field coil assembly                     | 42 | Oil thrower                           |
| 5  | Commutator end cover                        | 24 | Frame   | 43 | Shielded ball bearing, #204           |
| 6  | Outer felt washer                           | 25 | Dowel pin                                     | 44 | Head                                  |
| 7  | Ball bearing, #203                          | 26 | Pole shoe                                     | 45 | Oiler                                 |
| 8  | Felt washer                                 | 27 | Pole shoe screw                               | 46 | Bearing retainer gasket               |
| 9  | Oiler                                       | 28 | Brush spring                                  | 47 | Felt washer                           |
| 10 | Ground brush                                | 29 | Screw, #10-32 NF x $\frac{3}{8}$ " (6 req'd)  | 48 | Bearing retainer                      |
| 11 | Ground brush holder assembly                | 30 | Third brush plate retaining spring            | 49 | Armature assembly                     |
| 12 | Screw, #8-32 NC x $\frac{1}{4}$ " (2 req'd) | 31 | Third brush plate assembly                    | 50 | Snap ring                             |
| 13 | Lockwasher, #8 (5 req'd)                    | 32 | Screw, #8-32 NC x $\frac{1}{4}$ " (2 req'd)   | 51 | Key, woodruff, #3                     |
| 14 | Insulated brush arm                         | 33 | Partial head assembly                         | 52 | Key, woodruff, #8                     |
| 15 | Third brush                                 | 34 | Felt washer retainer                          | 53 | Lockwasher, $\frac{1}{4}$ " (2 req'd) |
| 16 | Lead  | 35 | Felt retaining plain washer                   | 54 | Through bolt                          |
| 17 | Terminal                                    | 36 | Commutator end cover gasket                   | 55 | Square nut, #10-32 NF                 |
| 18 | Insulating bushing                          | 37 | Screw, #10-32, NF x $\frac{1}{8}$ " (3 req'd) | 56 | Screw, #10-32 NF x $1\frac{1}{2}$     |
| 19 | Left field coil assembly                    | 38 | Cotter pin, $\frac{3}{16}$ " x 1" (1 req'd)   |    |                                       |

Figure 93.—Continued

## 176. Disassembly of Generator

(fig. 93)

*a.* Remove the voltage regulator mounting screws (21) and lockwashers (22). Tip the regulator (20) away from generator frame (24) and disconnect the leads.

*b.* Remove the generator cover band (1) and disconnect the leads at the third brush (15) and insulated main brush (10). Lift brushes off commutator.

*c.* Remove the hex nut (2) and lockwasher (3) from armature shaft and remove fan (4). Remove woodruff key (51).

*d.* Remove the cotter pin (38), hex nut (39), and washer (40) from drive end of armature shaft and remove drive gear (41). Remove woodruff key (52).

*e.* Remove two through bolts (54) and lockwashers (53) at the commutator end and slide commutator end head (33) off the generator. Remove bearing (43), retainer (48), felt washer (47), and bearing retainer gasket (46), by removing screws (29), and lockwashers (22) from head.

*f.* Remove the commutator end cover screw (37) and lockwashers (22) and lift off cover (5) and gasket (36). Remove felt washer (6), washer (35), bearing (7), felt washer (8) and retainer (34). Remove oiler (9).

*g.* Pull armature (49) and drive end head (44) from frame.

*h.* Press the armature shaft out of the end head with an arbor press.

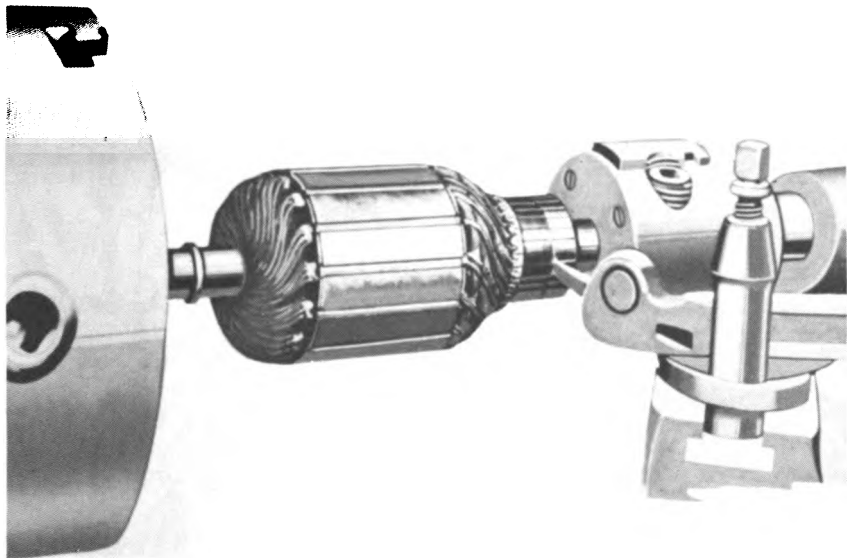
## 177. Cleaning, Inspection, and Repair of Generator Armature

Inspect the armature and commutator for evidence of wear. Inspect insulation and soldering to make sure all coils are in proper working order. Check the armature for grounds with a test probe consisting of a lamp in series with two points and connected to a source of electricity. Touch one probe to the armature shaft (not on bearing surfaces) and touch the other probe to each commutator segment. Do not touch the brush surface of the commutator as an arc would mar the smooth finish. If an armature coil or commutator segment is grounded, the lamp will light. If the ground is accessible, repair it; otherwise, replace the armature. Do not clean the armature by any degreasing method, since this would damage the insulation and ruin the armature. Wipe with a clean cloth slightly dampened with cleaning solvent.

*a.* Check the armature for shorts on a growler and replace the armature if it is shorted.

*b.* If the bearing seats show advanced wear, replace the armature.

*c.* Clean the commutator by holding a piece of No. 00 sandpaper against it while turning the armature slowly. Blow the sand off the



*Figure 94. Truing commutator on a lathe.*

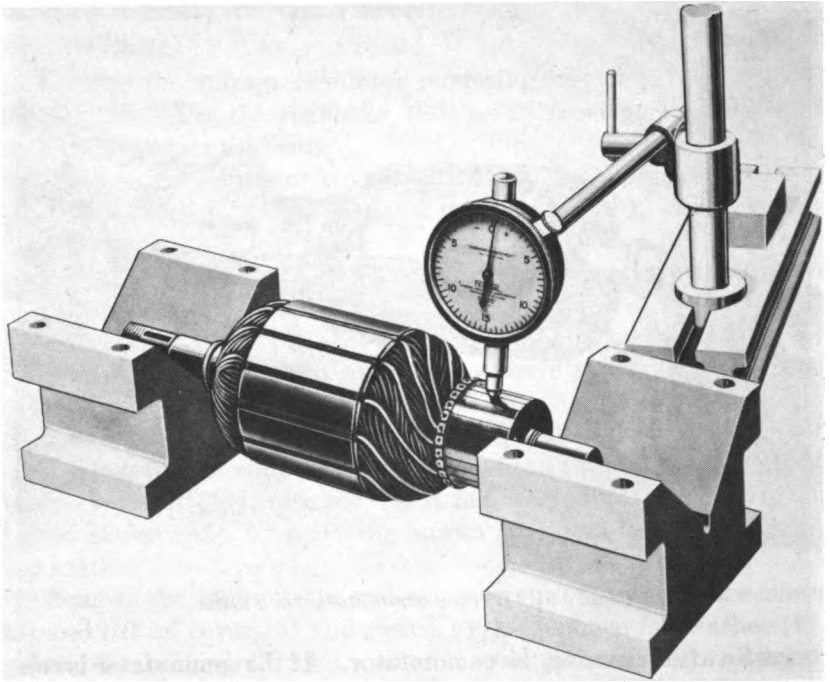
armature after cleaning the commutator. If the commutator is rough or worn, turn it down in a lathe. Take a light cut, or succession of light cuts, over the entire surface of the commutator until an absolutely concentric surface has been obtained.

*d.* Undercut mica as follows: Support an undercutting tool on the tool rest and carefully force it along the mica between the commutator segments. Center it carefully to avoid leaving a "fin" on the mica segment. Undercut should be to a depth of one thirty-second to three sixty-fourths inch and should be free of burs. If possible, polish the commutator with stone or cloth.

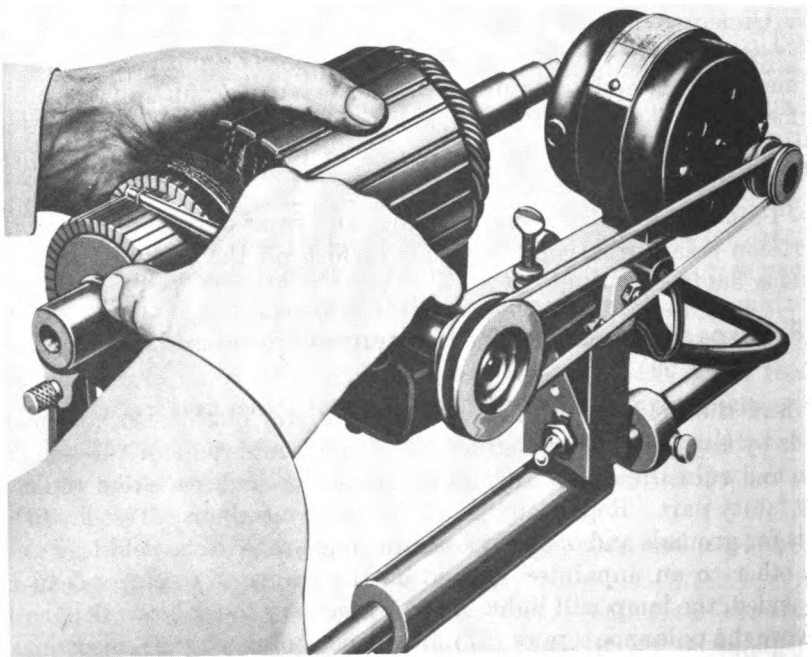
*e.* Paint the armature core, windings and front of commutator with corrosion-resistant varnish, keeping varnish off the commutator and bearing surfaces.

### **178. Inspection and Repair of Generator Frame and Field Coil** (fig. 93)

Clean the fields by wiping with a clean, dry cloth. Do not clean fields by any degreasing method, since this would damage the insulation and ruin the coils. Inspect all insulation and leads and replace any faulty part. Repair any poorly soldered terminals. Test the field coils for grounds and opens by touching one probe to the field lead and the other to an unpainted ground on the frame. If field or lead is grounded, the lamp will light. If it is necessary to replace a field coil, remove the pole shoe screws (27). Take out pole shoe (26), disconnect terminals and slide field coils from frame (24). Assemble new field



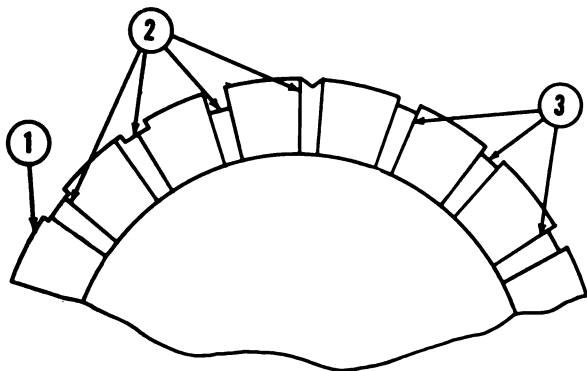
**Figure 95.** *Measuring commutator out-of-round.*



**Figure 96.** *Undercutting commutator mica.*



coils on shoes, place in frame, and tighten down with screws that have been dipped in boiled linseed oil. As screws are tightened, strike the frame lightly with a rawhide hammer to aline shoes and screws. Then paint the field coils, pole shoes and frame with corrosion-resistant varnish, keeping brush holder leads, pilots and terminals free of varnish.



1 Commutator  
2 Poor undercutting

3 Good undercutting

Figure 97. Samples of good and bad undercutting.

## 179. Inspection and Repair of Generator Commutator End Head (fig. 93)

a. Clean the bearing (7) by rotating the bearing in cleaning solvent, drying them with air, and immediately pack one-half full with ball bearing grease. If the bearing appears defective or worn, replace the unit.

b. Inspect the brush arms (14) and holders (11) to see that they are not bent or corroded.

c. Paint the insulation with glyptol and cover the glyptol and head with corrosion-resistant varnish. Keep the varnish and glyptol off the bearing, brush holders, and machined surfaces.

d. Soak felt washers (6) and (8) in oil.

## 180. Inspection and Repair of Generator Drive End Head (fig. 93)

a. Inspect the bearing (43) and retainer (48) and replace any worn part.

b. Pack the bearing one-half full with grease.

c. Soak felt washer (47) in oil and reassemble the drive end head (44).

d. Paint head and retainers with corrosion-resistant varnish, keeping varnish off mounting face, bearing, and pilot.

## 181. Reassembly of Generator

(fig. 93)

*a.* Position gasket (46), felt washer (47), and retainer (48) on drive end head (44) and secure with screw (29) and lockwasher (22).

*b.* Assemble the armature (49) in the drive end head (44) with an arbor press. Make sure the shoulder on the shaft fits tightly against the bearing (43).

*c.* Press the oil thrower (42) on drive end of shaft and seat it firmly against the bearing.

*d.* Install brush spring (28) with insulated brush arm (14) on third brush plate assembly (31). Insert third brush (15) in plate assembly.

*e.* Secure plate assembly (31) and retaining spring (30) to head assembly (33) with screw (29) and lockwasher (22).

*f.* Install brush spring (28) and brush arm (14) to grounded brush holder assembly (11), then insert brush (10) and secure to head assembly (33) with screw (32) and lockwasher (13).

*g.* Connect brush leads with screw (12) and lockwasher (13). Make sure the brushes are assembled so that the beveled face fits the commutator. With test probes, check the insulated brush holders for grounds. After new brushes have been installed, they should be sanded to fit the commutator by drawing a strip of No. 000 sandpaper between brush and commutator. Raise the brush to be sanded and insert sandpaper the width of the surface, working the sandpaper back and forth with the spring tension on the brush until the brush fits the contour of the surface. Make the last four strokes in the direction of rotation. Repeat procedure with each brush. Raise and lock brushes not being sanded. Return all brushes to operating position when sanding operation has been completed.

*h.* Install felt washer (8), retainer (34), washer (35), bearing (7), and felt washer (6) to head assembly (33) and then attach end cover gasket (36) and end cover (5) to head assembly with screw (37) and lockwasher (22).

*i.* Attach field coils (19) (23) with pole shoes (26) to frame (24) with screws (27). Push leads (16) and terminals (17) with insulating bushing (18) through frame and field assembly.

*j.* Assemble frame and field assembly over armature (49) and then position assembled end cover (33) over end of armature.

*Note.* Be sure that the dowel pin is aligned with the end cover.

*k.* Press gear (41) on armature shaft after key (52) is in place and then secure with washer (40), nut (39), and cotter pin (38).

*l.* Put snap ring (50) on front of armature shaft; install key (51) in shaft, and press on fan (4), then secure with lockwasher (3) and nut (2).

*m.* Install cover band (1) over frame (24) and secure with screw (56) and nut (55).

*n.* Install through bolt (54) and lockwasher (53).

*o.* Connect the leads to the regulator (20) and then install regulator to frame (24) with screws (21) and lockwashers (22).

*p.* Install generator on engine (par. 58).

## **182. Testing Generator**

(fig. 98)

*a.* Check brush spring tension by hooking a spring scale in the hole in lip of brush arm. Pull on a line perpendicular to the top of the brush, and take the scale reading just as the arm leaves the brush. The main and third brush tensions should be 35 to 53 ounces. To change the spring mount tension, disassemble the end head and bend the spring.

*b.* While voltage regulator is removed, bench-test the generator by connecting a 5-amp ammeter, a 12-volt battery fully charged and a one quarter ohm variable resistance in series with the field coil lead and the third brush terminal. Connect a 30-volt voltmeter from the third brush terminal to the field coil lead. Adjust the voltage to 5.0 volts and read the ammeter. It should show 1.5 to 1.7 amperes. If the current is not within these limits, field coils or connections are faulty. Disassemble generator and replace field coils or correct faulty connections.

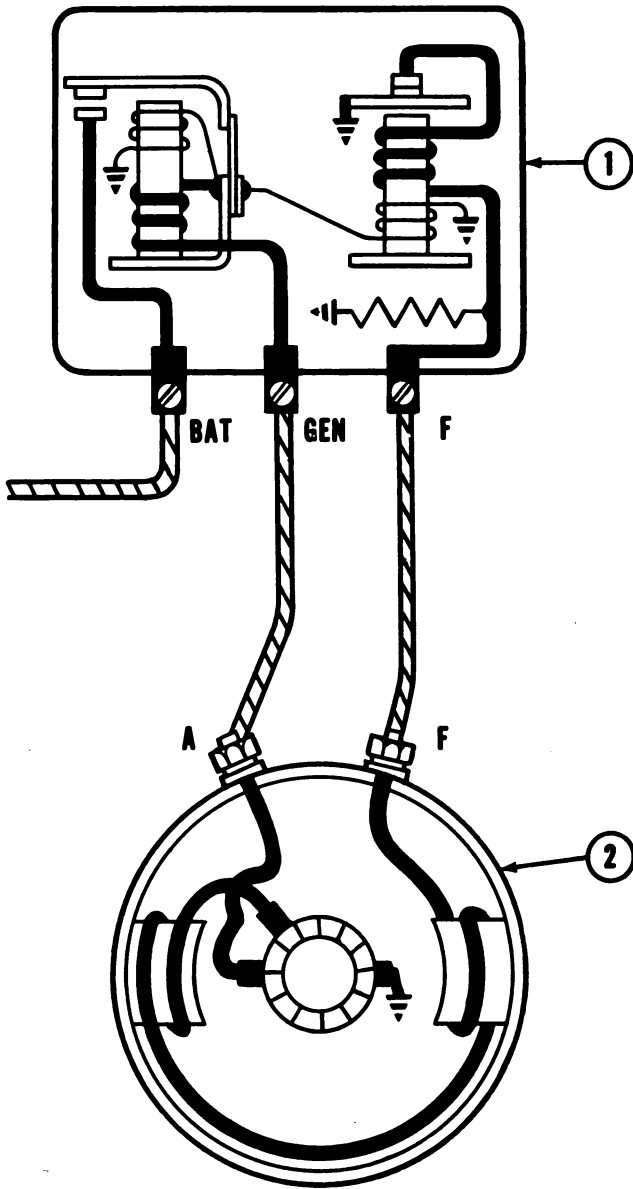
*c.* Now ground the field lead to the generator frame and connect a voltmeter from the armature lead to the generator frame. Adjust the voltage to 5.0 volts. The ammeter should show 3.9 to 4.4 amperes. If the current is not within these limits, it indicates high resistance connections, worn bearings or poor brush contacts. Correct faulty connections and poor brush contacts or disassemble the generator and replace bearings.

*d.* Now connect the field lead to ground and connect an ammeter between the armature lead and the battery. Connect a voltmeter from the armature lead to a ground on the generator frame. Operate the generator and increase the speed slowly, noting the maximum charging rate obtained. The charging rate should not be below 7.6 volts, 23.7 amperes, or above 8.0 volts, 25.0 amperes. To adjust the maximum output within these limits, advance or retard the third brush by applying pressure to the base of the brush holder.

## **183. Voltage Regulator**

*a. General.*

- (1) If there is some indication that the regulator is not operating correctly, its operation should be checked. Do not attempt to check or adjust the regulator without the correct meters, as a variation of only 0.1 volt in the setting may be enough to cause overcharged or rundown batteries.



1 Voltage regulator

2 Generator

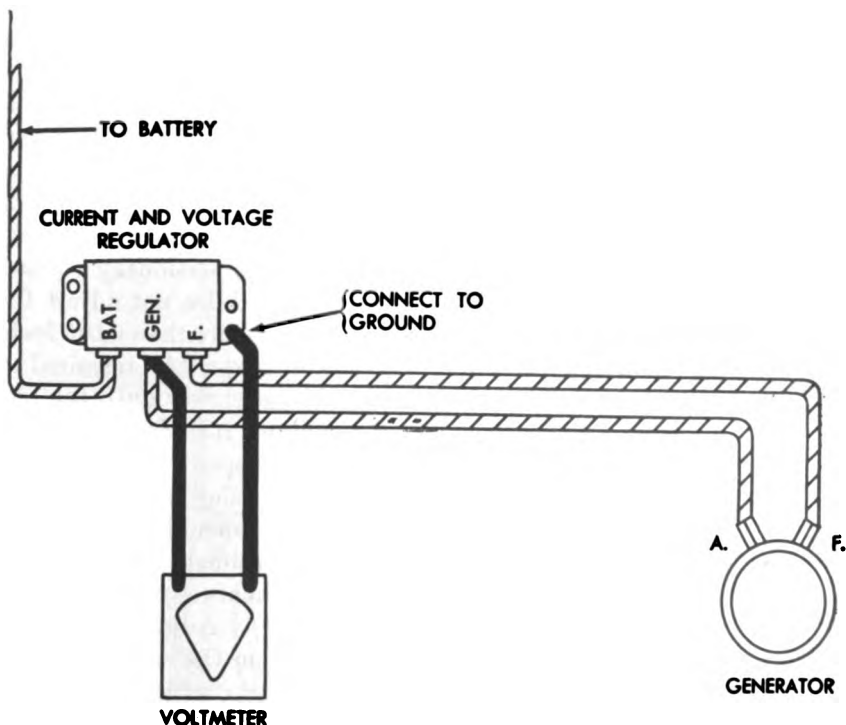
Figure 98. Generator and voltage regulator circuit diagram.

- (2) Due to the different characteristics in the various makes and sizes of batteries, they may become overcharged when the equipment is operated consistently in hot climates even though the regulator may be set according to specifications. When, after checking the settings, such a condition is found,

the regulator should be readjusted 0.1 volt below the specified settings.

*b. Operating Test and Adjustments of Voltage Regulators (fig. 99).*

- (1) To test and adjust the regulator on the generator, either on bench or engine, connect a variable resistance between the regulator field terminal (marked F) and the generator field lead. When the regulator is mounted on the generator, it is necessary to remove the mounting screws and lift the regulator to expose the terminal. Be sure to reinstall some of the mounting screws before testing, as the regulator must be grounded to the generator.



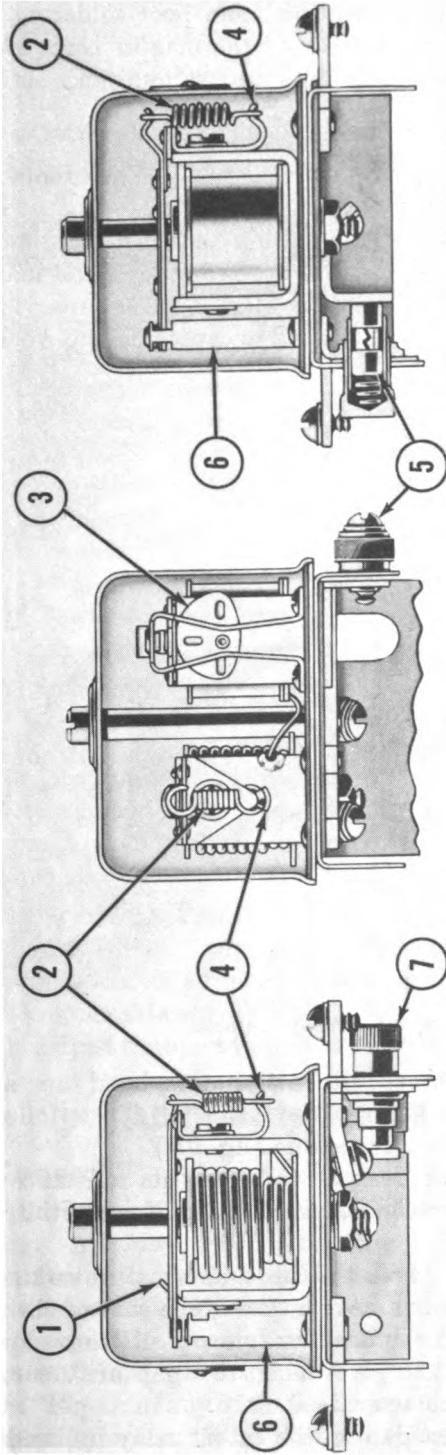
*Figure 99. Voltage regulator test.*

- (2) Connect an ammeter between the regulator battery terminal (marked "B") and the lead removed from the terminal.
- (3) Connect a voltmeter from the regulator armature terminal (marked "A") to the regulator base.
- (4) Make sure all other connections and leads in the charging circuit are tight and in good condition.
- (5) Start the generator and turn the field resistance to "zero." Then operate the generator at 10 amperes output for 15 minutes to bring the units up to operating temperature.

- (6) Occasionally, when the regulator is severely out of adjustment, it is necessary to make a preliminary setting of the operation before the units can be operated for this warmup period. If no charging rate is obtained when the generator is operated at a medium speed, make adjustments as described below. Then replace the regulator cover and proceed with the above warmup.
- (7) Turn the variable resistance so that the voltage is reduced as low as possible. Then slowly increase the voltage, noting the cutout relay closing voltage just before the jump in the voltmeter reading. Adjust the closing voltage to 6.5 to 7.25 volts by bending the lower spring hanger (4, fig. 100) to change the tension on the armature spring (2). Replace the regulator cover before checking the setting.
- (8) To adjust the opening current, reduce the variable resistance to give a charging rate of two-thirds maximum capacity. Then increase the resistance slowly, noting the amperage discharge 1.0 to 3.0 amperes just before the cutout relay opens and the ammeter reading drops to zero. Adjust the opening current by raising or lowering the stationary contact bridge (6) keeping the contacts alined. Do not adjust the contact gap to less than 0.015 inch nor more than 0.045 inch.
- (9) Change the voltmeter connection from the "A" terminal to the "B" terminal. Increase the voltage slowly until the cutout relay closes. Increase the voltage further, noting the voltage at which the regulator contacts open or the charging rate drops back. Decrease the voltage slowly and note the voltage when the contacts close. The opening and closing voltages should be within the limits specified. To adjust the contact opening voltage, change the armature spring tension by bending the lower spring hanger (4). Adjust the closing voltage by turning the brass cam (3) on the contact side of the yoke. This changes the contact gap, which should not be less than 0.005 inch minimum.
- (10) After all adjustments are completed, apply one drop of air-drying varnish to the cam (3) to prevent slipping.
- (11) Replace the regulator cover, check the settings of the cutout relay and voltage regulator, and make whatever readjustments are necessary.

*c. Mechanical Tests and Adjustments of Voltage Regulators.* If the regulator cannot be adjusted to its correct operating limits, make the following checks and adjustments—

- (1) Remove the regulator cover and inspect visually for—
  - (a) Evidence of burning or abnormal high temperature at the coils, contacts, insulation, external terminals or any other points.

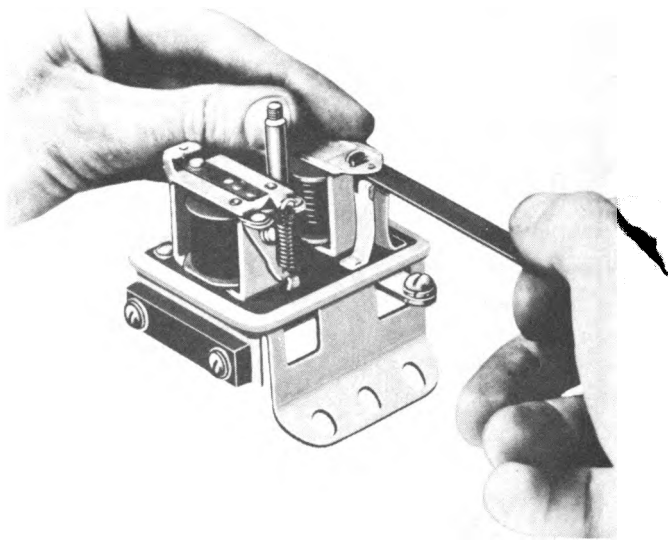


- 1 Armature stop
- 2 Armature spring
- 3 Brass cam
- 4 Lower spring hanger

- 5 Fuse resistor
- 6 Stationary contact
- 7 Fuse holder

Figure 100. Regulator adjustments.

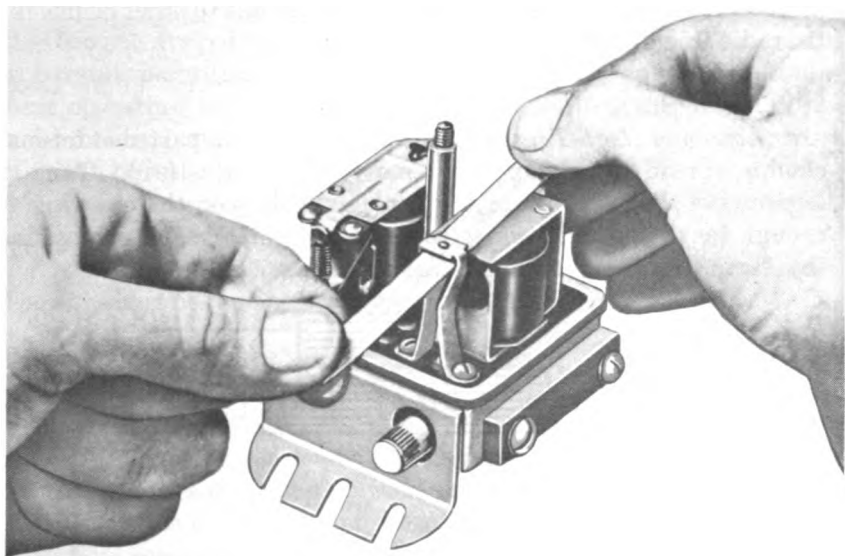
- (b) Loose connections resulting from poor soldering.
  - (c) Loose nuts on the bottom of the magnet cores and loose rivets or screws. All nuts and screws must have lock-washers.
  - (d) Broken or altered carbon resistor.
  - (e) Blown or improperly installed fuse. When replacing the 5-amp fuse, do not use a fuse substitute.
- (2) File the contacts with a very fine contact file so that all deposits and corrosion or dirt are removed. File lengthwise and parallel to the armature (fig. 101), as crosswise filing forms minute grooves that tend to cause sticking when in operation.



*Figure 101. Filing contacts.*

- (3) Clean the contacts with linen or lintless bond tape and carbon tetrachloride between the contacts. Then follow with dry tape to remove any residue (fig. 102).
- (4) Remove the carbon resistor and check its resistance of 1.85 to 2.10 ohms on an ohmmeter. Replace if not within specifications.
- (5) Adjust the gap between the core and armature on the cutout relay. Place gage as near to the hinge side of the core as possible and hold the armature down. Raise or lower the stationary contact to give the correct gap of 0.010 to 0.030 inch. Keep the contacts alined.
- (6) Adjust the contact gap on the cutout relay by bending the armature stop (1, fig. 100). Be sure the stop does not rub





*Figure 102. Cleaning contacts.*

- against the armature and interfere with its movement.
- (7) Adjust the gap, 0.044 to 0.046 inch, between the core and armature on the voltage regulator unit. Have spring tension on the armature and the contacts closed. Insert the gage between the core and armature and adjust the gap by expanding or contracting the stationary contact bridge (6). Keep contacts alined.
  - (8) Check the contact gap on the voltage regulator by holding the armature down and measuring the gap between the contacts with a feeler gage. This gap should be at least 0.005 inch and is adjusted by turning the brass cam (3) on the contact side of the yoke.
  - (9) Adjust the operation as outlined in *b* above.

## **Section VIII. RADIO INTERFERENCE SUPPRESSION SYSTEM**

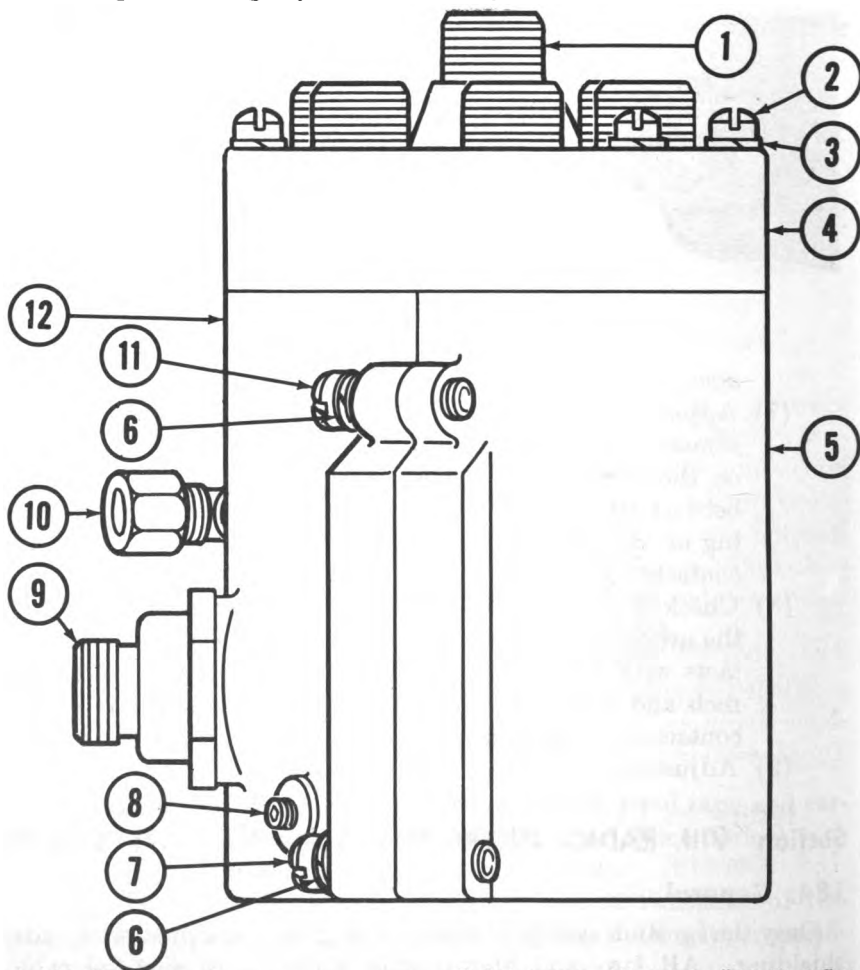
### **184. General**

Only the ignition system of the JXD engine is equipped with radio shielding. All low- and high-tension wiring is of shielded cable. The distributor and coil have shielded caps with condensers and bond straps to ground. High-tension leads to spark plugs are of metal-enclosed cable. The spark plugs are also enclosed in a shielded housing. The generator and starting motor are equipped with condensers and grounds. Repair of any of these units is normally handled by replacing with new equipment. With the exception of faulty condensers which

must be replaced, emergency repairs may be made to other elements of the radio shielding system as follows :

## 185. Wiring

*a. Low- and High-Tension Wiring.*—If these are parted at terminal clamps, spread the clamp and remove broken wire lead. Trim the low-tension wire so core of the cable extends past the covering far enough for the terminal clamp to fasten securely to cable core. Pinch the clamp on core tightly and solder the joint.



- |   |  |
|---|--|
| 1 Adaptor   | 8 Set screw, Allen hd, #10-24 NC x $\frac{5}{8}$ " (3 req'd)   |
| 2 Machine screw, fl hd #10-24 NC x $1\frac{1}{4}$ " (4 req'd) | 9 Low tension terminal shield                                  |
| 3 Lockwasher, #10, I.T. (4 req'd)                             | 10 Air vent elbow  |
| 4 Cover   | 11 Machine screw, fl hd, #12-24 NC x $\frac{3}{4}$ " (2 req'd) |
| 5 Base, rear half   | 12 Base, front half  |
| 6 Lockwasher, #10, I.T. (4 req'd)                             |  |
| 7 Machine screw, fl hd, #12-24 NC x 1" (2 req'd)              |  |

Figure 103. JXD distributor shield.

*b. Spark Plug Cables.*—If the flexible metal housings of these cables become frayed and the inner insulation worn, leaks to ground will result, permitting ignition noises to be picked up on radio equipment operating in the vicinity. Cut away the frayed portion of the metal housing and wrap the insulation well with tape until a new cable can be installed.

*c. Bond Straps.*—If these are broken, they may be readily soldered, as there is no insulated core in the bond straps.

*d. Condensers.*—There is no repair for an inoperative condenser. The unit must be replaced with new equipment.

## Section IX. FUNGUS CONTROL SYSTEM

### 186. Description

Fungus control consists of “tropicalizing,” or treating various electrical accessories of an engine with a special fungus-resistant varnish. This varnish is air-drying and forms an electrical insulation. Tropicalization coatings require no attention from the using personnel. The electrical accessories of the JXD engine which are tropicalized are:

*a. Generator.* All parts of the generator except commutator, brushes, and bearing surfaces are soaked in the fungus-resistant varnish.

*b. Starting Motor.* The starting motor has the same fungus-resistant treatment as the generator.

*c. Ignition Coil.* Windings and inside surfaces of the ignition coil housing are painted with fungus-resistant varnish.

*d. Ignition Distributor.* All parts of the distributor except contact points are treated with fungus-resistant varnish.

### 187. Inspection

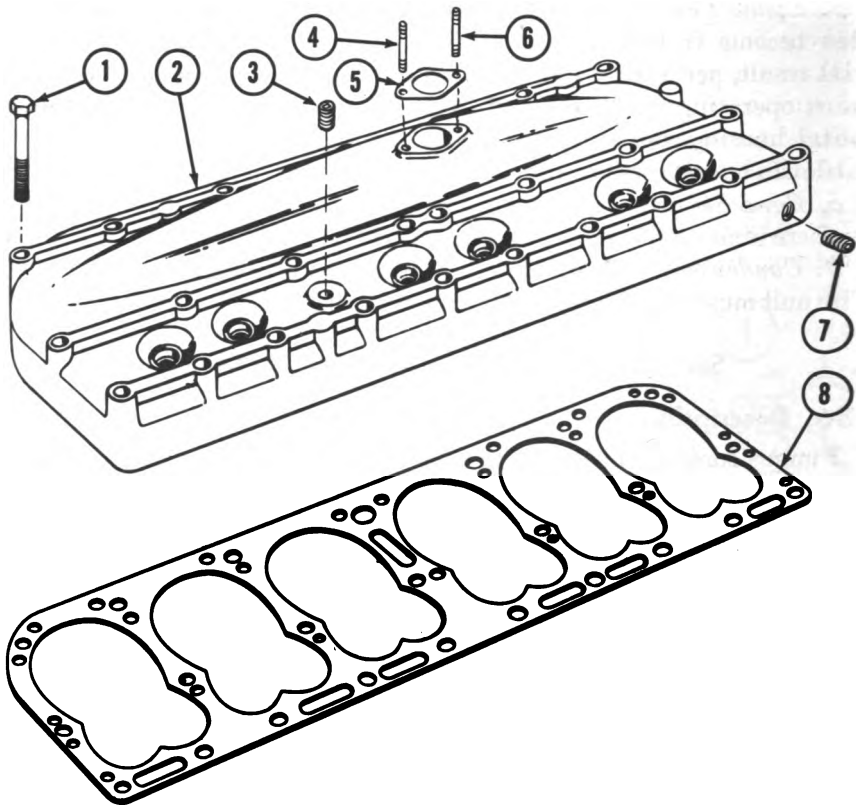
When the above items are off the engine for repair by field and depot maintenance personnel, they are inspected for evidence of worn fungus-resistant varnish. If necessary, the units are retropicalized.

## Section X. CYLINDER HEAD AND VALVE MECHANISM

### 188. General

(fig. 104)

JXC and JXD cylinder heads (2) are the conventional L type, and are attached to the cylinder block with twenty-six  $\frac{1}{2}$ -inch cap screws (1). A copper and asbestos, or steel and asbestos, gasket (8) is used between the cylinder block and the cylinder head. Disassembly, repair, and reassembly procedures are the same for cylinder heads of either engine.



- 1 Cap screw
- 2 Cylinder head
- 3 Plug
- 4 Front stud

- 5 Flange gasket
- 6 Rear stud
- 7 Plug
- 8 Head gasket

Figure 104. Cylinder head disassembled.

### 189. Removing Cylinder Head

- a. Drain the cooling system
- b. Remove the water outlet pipe and hose where these attach to cylinder head.
- c. Remove the ignition cables, air cleaner bracket, instrument panel and other assemblies attached by cylinder head cap screws.
- d. Remove all spark plugs.
- e. Loosen and remove 26 cylinder head cap screws.
- f. Lift off the cylinder head. Tap head lightly with lead hammer if necessary to loosen it, but do not pry on contact surface.

### 190. Cleaning and Inspection of Cylinder Head

- a. Clean out carbon deposits in combustion chambers by scraping or brushing.
- b. Clean the cap screw holes so cap screws slide in hole easily.

*c.* Clean the cylinder head contact surface by brushing on cleaning solvent and wiping surface with soft cloth. If necessary, scrape the contact surface with a tool which will not scratch the surface. Check all surfaces of cylinder head to detect cracks in water jacket. If the cylinder head is broken or fractured, replace with a new unit.

*d.* Clean all traces of carbon from head gasket.

## **191. Repair and Installation of Cylinder Head**

Minor external cracks may be repaired by welding for emergency operation. Otherwise, replace head with a new unit. Reinstall cylinder head (par. 43*d*).

## **192. Valves and Guides**

(fig. 105)

*a.* JXC and JXD engines are equipped with two valve cover assemblies. These serve as covers for the two openings on the left side of the crankcase through which the valves, springs, and valve tappets are reached. There is no repair on a valve cover. When punctured or bent out of place, replace the cover with a new unit.

*b.* Intake and exhaust valves of JXC and JXD engines are standard-type valves made of special steel. They operate in valve guides (2) pressed into the cylinder block. Valve springs (3) are fastened to each valve by a spring retainer (5) and locking key (4). The valves are operated by the camshaft cams through mushroom-type tappets.

## **193. Removing Valves and Guides**

(fig. 105)

*a.* To remove valves for replacement or service, remove the cylinder head (par. 189).

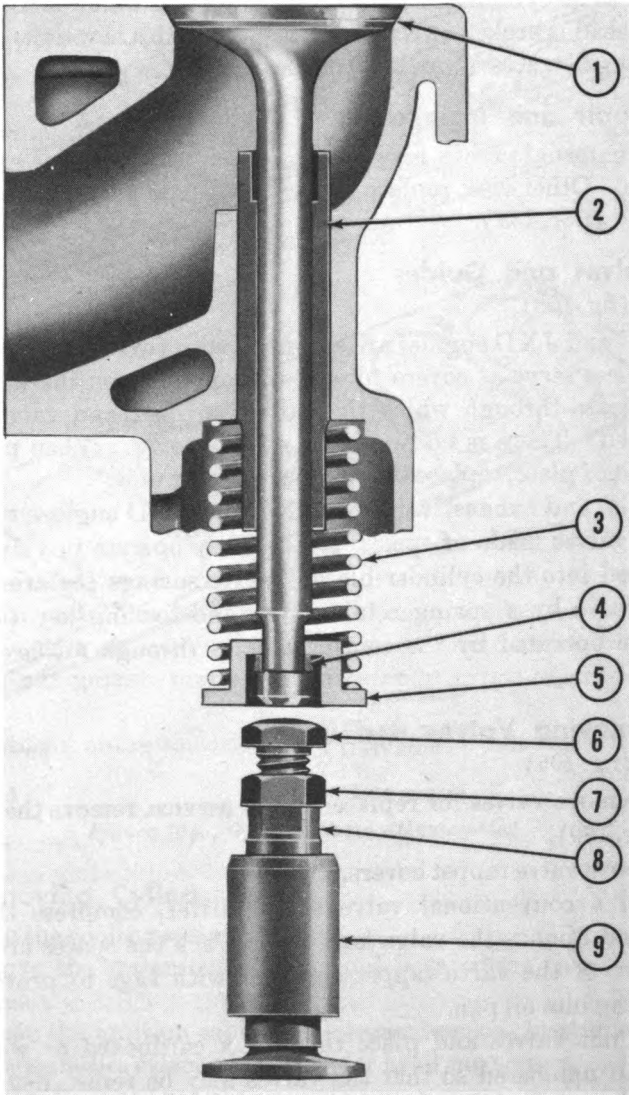
*b.* Remove valve tappet covers.

*c.* With a conventional valve spring lifter, compress the valve springs and remove the valve keys (4). Pack the spaces around the lower part of the valve tappet chamber with rags to prevent keys from falling into oil pan.

*d.* Lift out valves and place them in a cardboard or wood rack drilled and numbered so that the valves may be reinstalled in their original places. Do not mark valves with file or punch.

*e.* If valve guides are to be replaced, replace them before doing any work on the valves, so the valve seats may be finished squarely with respect to the new guide. To allow room to drive out guides, remove valve springs (3), turn tappet adjusting screws (6) all the way down, and crank engine over so tappet is at low point on the cam.

*f.* Drive out guides with a  $\frac{5}{8}$ -inch diameter drift with  $\frac{3}{8}$ -inch diameter pilot.



- 1 Valve
- 2 Valve guide
- 3 Valve spring
- 4 Valve spring key
- 5 Spring retainer

- 6 Tappet screw
- 7 Tappet nut
- 8 Tappet push rod
- 9 Push rod guide

*Figure 105. Valve assembly, JX engines.*

## 194. Inspection of Valves

a. Inspect valves carefully. If the stems are badly worn or are not straight, the valves should be replaced by new ones.

b. Inspect valve seats. If they are slightly pitted or if new valve guides have been installed, the valves should not be used before refacing them on a valve face grinder. Valves must have an accurately finished face of the correct angle and width. Exhaust valve seats are finished on a 45° angle. Intake valve seats are usually finished on a 45° angle, although some engines have 30° valve seats. Check angle of intake valve seats before refinishing. Both exhaust and intake valve seats should have a width of  $\frac{1}{8}$  to  $\frac{3}{32}$  inch all the way around.

## 195. Installation of Valve Guides

a. Replace the old guide with a new one and drive in to same depth location as old guide— $1\frac{5}{16}$  inch.

b. Ream the inside diameter of the new guide to size, and to correct any distortion which may have occurred as guide was driven in place. Check table of clearance (par. 247) to get proper fit of valve in guide.

## 196. Grinding Valves

a. Use a valve refacing machine if available to reface valves.

b. If a valve refacing machine is not available, then make sure tappet is in low position. Place the valve in its guide with a light coil spring under the valve to raise it off its seat during the grinding process.

- (1) Smear valve seat lightly with medium grade grinding compound.
- (2) With a screw driver or valve grinding tool, press valve against seat and rotate part of a turn. Raise valve and rotate slightly to a new position before grinding against seat again. Repeat this motion, being careful to avoid continuous round-and-round motions which would cut grooves in the valve seat.
- (3) When a bright silver band of uniform width is produced on valve seat, wipe away all traces of compound.

c. Test each valve for tight seating by placing pencil marks across the face of valve at short intervals. Press valve against seat and rotate with firm pressure. Lift valve and inspect the face. If all pencil marks have not been rubbed off by contact with valve seat, continue grinding until this test shows a gas-tight contact between valve and seat.

## 197. Installing Valves

a. Clean all traces of grinding compound off valves, stems, and guides and put a few drops of oil on the valve stems and insert valves.

*b.* Pack the holes in the lower part of the valve tappet chamber with rags to prevent any keys from falling into crankcase.

*c.* Use valve lifter as described in paragraph 193 to compress valve springs and insert valve keys.

*d.* Remove the rags used for packing valve tappet chamber.

## **198. Replacing Tappets**

*a.* While valves are out of the engine, remove camshaft (par. 216) then lift out tappets and carefully inspect tappet screws. If these are cut or have started to hammer out, replace with new screws.

*b.* Check tappet clearance in the cylinder block. This should be approximately 0.001 inch. It will not be necessary to change the tappet unless this clearance is more than 0.002 inch.

*c.* If a new tappet is installed and clearance in the cylinder block is more than 0.002 inch, drive out tappet bushing and replace. Ream out the new bushing to proper clearance for the new tappet.

*d.* Reassemble new or refitted tappets and insert in cylinder block.

*e.* Install camshaft.

*f.* Adjust tappets for each of the cylinders, setting them for at least 0.007-inch clearance on the intake and 0.010-inch clearance on the exhaust.

*g.* Start engine and allow to warm up at idling speed. Then reset tappets to above clearances, or the specific clearance given on the engine serial number plate on left side of crankcase.

## **Section XI. TIMING GEARS AND CAMSHAFT**

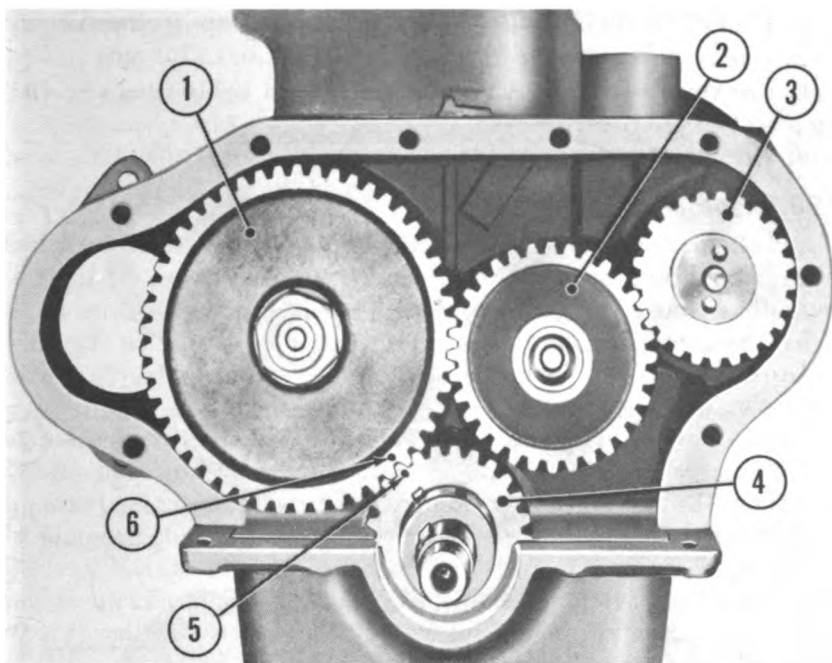
### **199. General**

The gear train of the JXC and the JXD engines is located at the front of the engine, covered by a gear case which is bolted to the crankcase. The group consists of the camshaft gear (1, fig. 106), idler gear (2), crankshaft gear (4), and water pump gear (3). The crankshaft gear drives the cam gear, which in turn drives the water pump gear by way of the idler gear. Both the generator and the governor are mounted on the gear cover and are driven by a gear meshing with the camshaft gear. Valve action is timed by lining up the punch marks (5) (6) on the cam and crankshaft gears. Cam and idler gears may be removed independently by first removing the gear cover. The water pump gear is removed from pump shaft only after water pump is removed from engine. To remove the crankshaft gear, the crankshaft must first be removed from engine (par. 238).

### **200. Timing Gear Cover**

On JX-series engines, gear covers are usually made of cast iron. The cover encloses the entire gear train. Adjusting screws control the end thrust of the camshaft, idler shaft, and water pump shaft. Front





1 Camshaft gear  
2 Idler gear  
3 Water pump gear

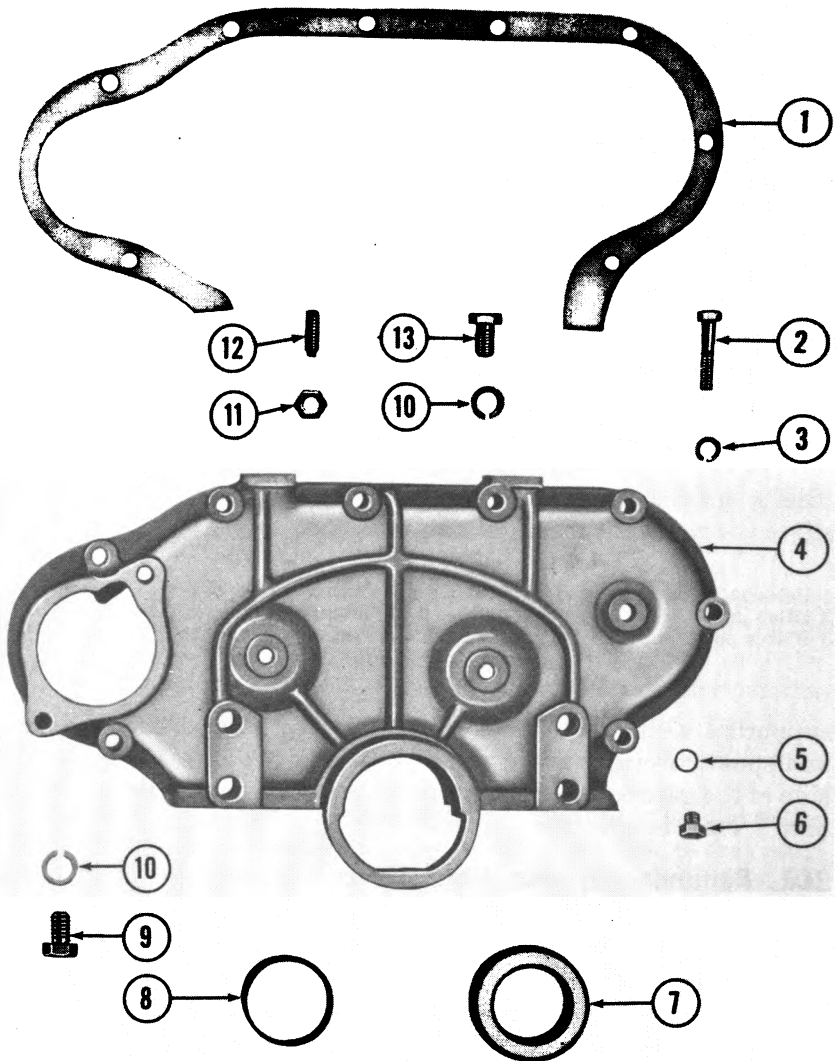
4 Crankshaft gear  
5 Timing mark, crankshaft gear  
6 Timing mark, camshaft gear

Figure 106. Gear train, JX engines.

supports are attached to pads on either side of the crankshaft opening, and speed governors are attached to the flanged opening on the right side of the gear cover. To remove the gear cover, take the radiator off first. Then remove the governor and front support.

## 201. Removing Timing Gear Cover (fig. 107)

- a. Disconnect control rod linkage from governor to carburetor.
- b. Remove the governor attaching screws and lift governor away from gear cover carefully, to prevent damage to the governor lubricating line from cylinder block.
- c. Remove the starting crank grab and fan drive pulley (par. 122).
- d. Remove the four top front motor support screws (9) and lockwashers (10). If necessary to release the front support place a large block of wood under front of oil pan and support engine with a jack after removing the screws that attach the support to a base. The front support may be removed from the gear cover if necessary.
- e. Remove the gear cover attaching screws (2) and lockwashers (3) and pull gear cover forward away from the engine. The crankshaft oil seal (7) and sleeve (8) will pull off the shaft with the gear cover. Be sure that the oil seal parts are not scuffed or bent.



- |   |  |
|---|--|
| 1 Gear cover gasket   | 7 Gear cover oil seal assembly   |
| 2 Gear cover attaching screw, $\frac{3}{8}$ "-16<br>NC x $1\frac{3}{4}$ " (8 req'd) | 8 Gear cover oil seal sleeve   |
| 3 Gear cover attaching screw lock-<br>washer, $\frac{3}{8}$ " SAE (8 req'd)         | 9 Front support screw  |
| 4 Gear cover  | 10 Lockwasher, $\frac{1}{2}$ " SAE (6 req'd)   |
| 5 Water pump thrust screw washer  | 11 Gear cover thrust screw nut   |
| 6 Water pump thrust screw   | 12 Gear cover thrust screw   |
|   | 13 Fan attaching screw, hex hd, $\frac{1}{2}$ "-<br>13 NC x $1\frac{1}{2}$ " (2 req'd) |

Figure 107. Gear cover disassembled.

## 202. Cleaning and Inspection of Timing Gear Cover

(fig. 107)

Dip the gear cover in cleaning solvent to loosen gummy oil film, and scrub cover clean with brush dipped in solvent. The old cover gasket (1) will tear when cover is removed. Scrape away any bits of the gasket clinging to the gear cover or cylinder block.

## 203. Removing Camshaft Gear

- a. Remove the oil pan (par. 131).
- b. Remove the gear cover (par. 201).
- c. Pull the camshaft forward out of the engine, and remove thrust washer (2, fig. 111).

*Note.* It may be necessary to turn the crankshaft slightly to permit the camshaft bearing journals to pass the crank throws.

d. Remove nut, then place shaft in arbor press and with suitable supports under gear, press shaft out of gear.

e. Remove thrust plunger by quickly heating the plunger with a torch. Allow the plug to cool, then drill through plunger with a  $\frac{5}{16}$ " diameter drill and tap the hole with a  $\frac{3}{8}$ "-16 tap. Using a  $\frac{3}{8}$ " cap screw of suitable length, pull the plunger from the shaft.

f. Remove woodruff key.

## 204. Cleaning and Inspection of Camshaft Gear

- a. Wash all parts in cleaning solvent. If woodruff key seat is gummy, clean seat with fine brush dipped in the solvent.
- b. Check camshaft gear for broken teeth or small chips in teeth.
- c. Replace with a new gear if teeth are broken or chipped, or if tooth wear can be visually detected.
- d. Replace thrust washer and woodruff key if worn or damaged.

## 205. Installation of Camshaft Gear

- a. Insert the woodruff key (4, fig. 110) in shaft.
- b. Place a small amount of grease or heavy oil on thrust washer (2, fig. 111) and place washer on camshaft gear.
- c. Press the gear on camshaft. After gear is pressed on shaft, the thrust washer must turn freely on the gear shoulder.
- d. Start the hex nut on camshaft and draw nut up tight.
- e. Press thrust plunger on shaft.
- f. Replace the camshaft gear so timing punch marks (5 and 6, fig. 110) on camshaft gear and crankshaft gear line up.
- g. Use care when installing the camshaft that the cams do not damage the bearings as this usually causes tight bearings. Push the camshaft into the engine.

*Note.* It may be necessary to turn the crankshaft slightly to permit the camshaft bearing journals to pass the crank throws.

h. Replace oil pan and gear cover.

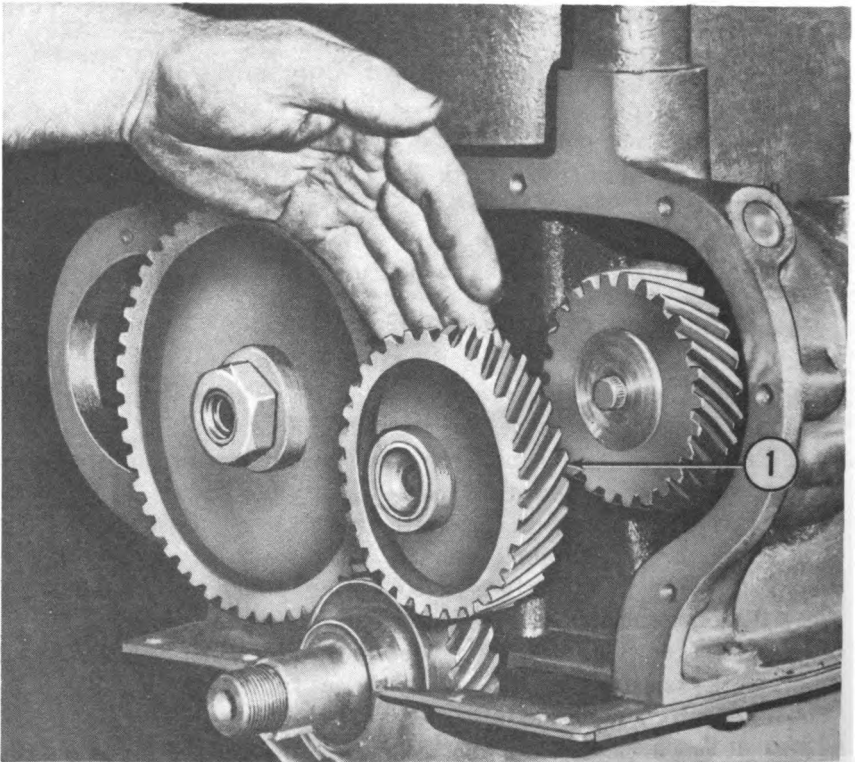
## 206. Idler Gear

The idler gear is the same on both the JXC and JXD engines and is supported on a shaft which in turn is supported in a bushing pressed into the cylinder block. The entire gear train is lubricated by means of small holes (fig. 65) drilled in the idler shaft and gear. Lubrication reaches the idler shaft through passages drilled from the main oil passage.

## 207. Removing Idler Gear

(fig. 108)

- a. Remove the gear cover (par. 201).
- b. With fingers, pull the idler gear and shaft forward out of crankcase.
- c. Press shaft out of gear.
- d. Remove end thrust button from shaft.
- e. Remove thrust washer from gear.
- f. If idler bushing is to be removed, place driver over bushing and then drive through collar.



1 Idler gear

Figure 108. Removing idler gear.

## 208. Cleaning and Inspection of Idler Gear

Wash all parts in cleaning solvent. Dry and inspect for chipped teeth in idler gear or worn thrust washer. Replace worn or broken parts.

## 209. Installation of Idler Gear

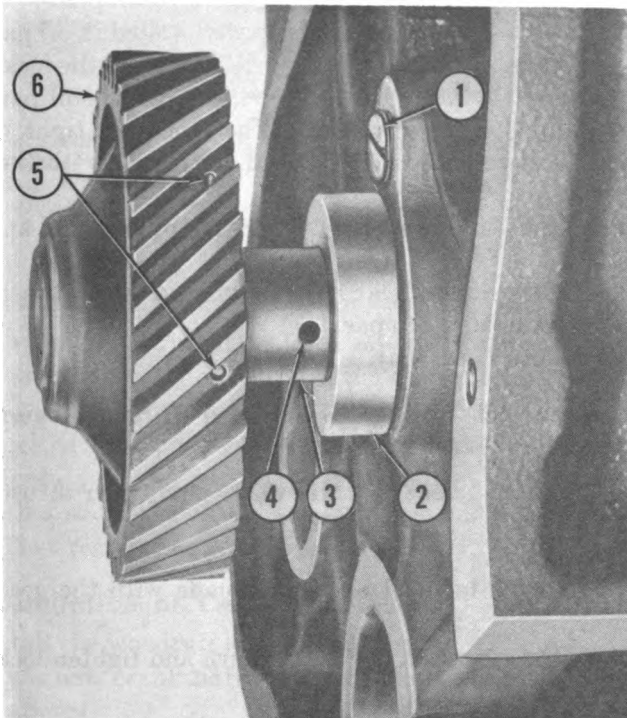
(fig. 109)

a. If the idler shaft bushing was removed, install new bushing so that the oil hole in the bushing is in line with the oil hole in the crankcase.

b. Try the idler shaft in the new bushing. It should have 0.001 inch to 0.0015 inch clearance. Ream bushing as necessary to get this fit.

c. Insert the Woodruff key in idler shaft, position thrust washer behind gear and then apply grease to thrust washer to hold it in place on the gear hub. Press shaft into the gear and thrust washer.

d. Insert end of idler shaft in bushing and slide gear into mesh with camshaft gear and water pump gears.



1 Pipe plug  
2 Idler gear shaft bushing  
3 Idler gear shaft

4 Idler gear shaft oil hole  
5 Idler gear oil holes  
6 Idler gear

Figure 109. Installing idler gear.

- e.* Install end thrust button.
- f.* It will not be necessary to retime the distributor, if the camshaft or water pump gears have not been moved.
- g.* Install the gear cover (par. 210).

## **210. Installation of Timing Gear Cover**

(fig. 107)

Fasten a new gasket (1) to gear cover with gasket cement. Loosen thrust screw locknuts and back screws out two or three turns. Then assemble cover as follows:

*a.* Install the oil seal (7) and sleeve (8) on the crankshaft and slide the seal (7) about one-half inch back on the shaft. If oil seal and sleeve shows wear, or is scuffed in any way, install a new seal and sleeve.

*b.* Place gear cover (4) on seal, making sure the oil seal seats properly in the groove provided for it in the gear cover.

*c.* To avoid any difficulty with the oil seal when pushing the gear cover in place, relocate the jack supporting the engine and loosen cap screws on oil pan. Allow front of oil pan to drop down one-eighth to one-quarter of an inch. Then push the gear cover in place.

*d.* Check to see that the oil seal is properly located in oil pan.

*e.* Start gear cover screws and with some tension on the lockwashers of the gear cover to cylinder block screws, tighten the oil pan screws and the oil pan to gear cover screws. When these are tight, draw up the gear cover screws. Keep the oil seal concentric with the crankshaft.

*f.* Assemble front engine support, fan drive pulley, fan, and crank grab (par. 123).

*g.* Assemble governor to gear cover, and reconnect governor control rod linkage to carburetor (par. 141).

*h.* Install radiator (par. 50*c*).

## **211. Adjustment of Timing Gear Case Thrust Screws**

(fig. 107)

To adjust camshaft, idler shaft and water pump gear thrust screws, proceed as follows:

*a.* Loosen locknuts.

*b.* Turn the screws in until contact is made with the gear thrust plugs.

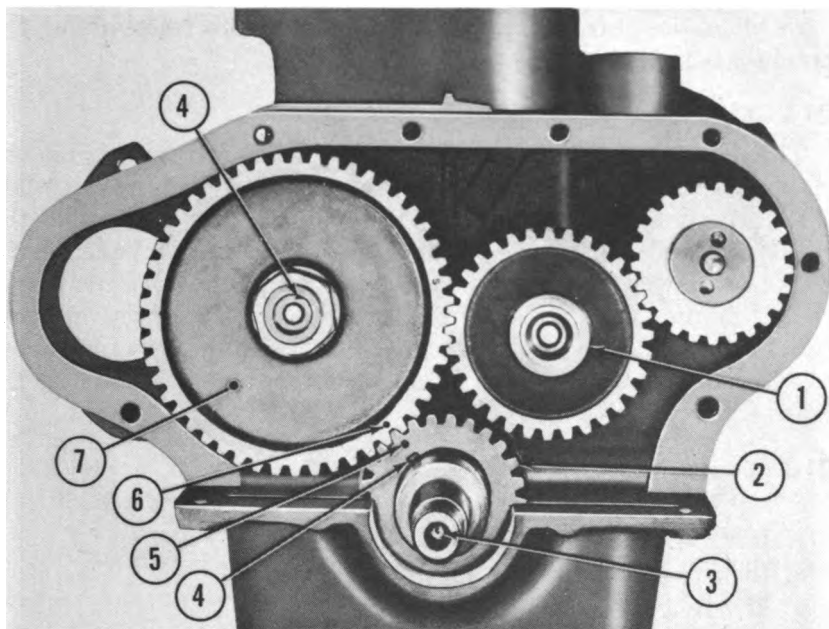
*c.* Then back the screw out one-eighth turn and tighten locknuts.

## **212. Crankshaft Gear**

(fig. 110)

The crankshaft must be removed from the engine before the gear (2) may be removed. Due to the extremely tight fit of the crankshaft

gear on the crankshaft, it is impossible to pull the gear with a commercial gear puller, and an arbor press must be used. If an arbor press is not available, the gear may be removed as follows:



- 1 Idler gear thrust washer
- 2 Crankshaft gear
- 3 Crankshaft dowel
- 4 Key, woodruff, #91 (2 req'd)

- 5 Timing mark on crankshaft gear
- 6 Timing mark on camshaft gear
- 7 Camshaft gear

Figure 110. Crankshaft gear.

### 213. Removing Crankshaft Gear

a. Using a  $\frac{1}{4}$ -inch drill centered midway between the edge of the keyway and the teeth, drill through the gear on a line parallel with the keyway.

b. Check drilling progress frequently to make sure the drill does not penetrate the gear and go into the crankshaft.

c. With a suitable chisel, spread the gear until it is loose on crankshaft. Then remove the gear and woodruff key.

### 214. Installation of Crankshaft Gear

a. Install the woodruff key in crankshaft.

b. Lay a new crankshaft gear on a sheet of asbestos or other fire-proof material.

c. Heat the new gear with a blow torch evenly on both sides.

d. When the gear turns a pale straw yellow, it has reached approximately 1850° F.

*e.* With tongs or other suitable handling device, place the gear on crankshaft, line up with the woodruff key and quickly force the gear into position before much heat is lost. A piece of 2-inch diameter pipe may be used as a driver.

*f.* Allow the gear and crankshaft to cool before reassembling the crankshaft in engine.

## **215. Camshaft Assembly**

The camshaft is supported on four large-diameter bearings in the crankcase. These bearings are removable and may be renewed when the camshaft is out of the engine. The camshaft gear is driven by the crankshaft gear. A spiral gear is located at the center of the camshaft. This meshes with the gear attached to the oil pump shaft and drives the oil pump. It is necessary to check the position of valves when reinstalling the camshaft, as the punch marks on the crankshaft gear and the camshaft gear may be off one complete revolution of the crankshaft and still line up.

## **216. Removing Camshaft** (fig. 111)

*a.* Remove oil pan (par. 131).

*b.* Remove oil pump (par. 125).

*c.* Remove gear cover (par. 201).

*d.* Remove valve tappet covers and lift valves with a valve spring compressor so that all the valve tappets may be blocked up. Tappets may be held in raised position by nails cut to  $1\frac{3}{16}$  inches in length. Put the cut end against the tappet base, and the nail head under tappet screw.

**Caution:** Be careful that nails do not pop out when springs are lowered on to tappet screws.

*e.* Remove fuel pump and drive pin.

*f.* Pull the camshaft forward out of the engine being careful not to strike cams against camshaft bearings. It may be necessary to turn the shaft slightly as it is withdrawn, to permit the camshaft bearing journals to pass the crank throws.

*g.* Remove the hex nut, place shaft in arbor press, and with suitable supports under gear, press the shaft out of the gear, being careful not to lose the woodruff key.

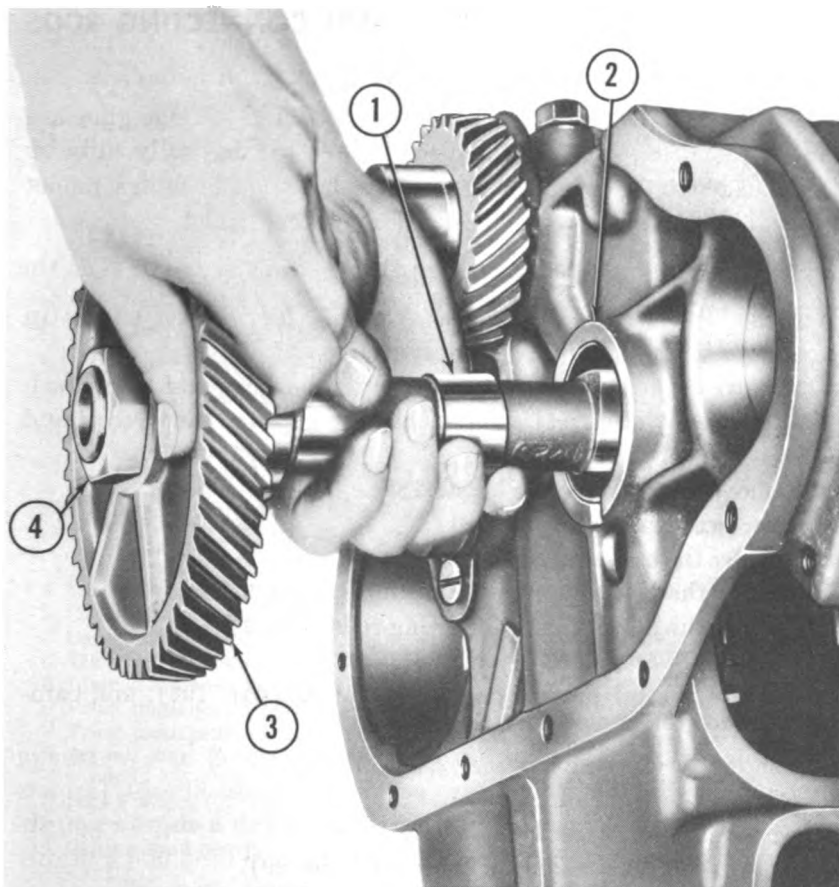
## **217. Inspection and Installation of Camshaft Bearings**

If bearings show wear on visual inspection, install new bearings as follows:

*a.* Using a driver (6, fig. 72), drive out the old bearings.

*b.* With the same driver, install new bearings.





1 Camshaft  
2 Thrust washer

3 Gear  
4 Nut

*Figure 111. Removing camshaft.*

*c.* Tap firmly but evenly with hammer against the driver. If driving blows are too strong, the bearing may be distorted.

*d.* When bearings are installed, check for proper clearance. This should be 0.0015 to 0.0025 inch.

## **218. Reassembly and Installation of Camshaft**

*a.* Install camshaft gear (par. 205).

*b.* Now ease the camshaft back into crankcase in the same manner in which it was withdrawn. Do not let cams scuff against the bearing surface.

*c.* Time the gears by lining up the timing marks (fig. 110).

*d.* Install gear cover, oil pump, and oil pan.

## **Section XII. CYLINDER, PISTONS, AND CONNECTING RODS**

### **219. Cylinder Block**

The crankshaft and cylinder blocks of JXC and JXD engines are made of cast iron, cast in one piece. They are basically alike in design, but part numbers of fittings such as bearings, bushings, tappet guides, and the like may have minor differences (app. II).

### **220. Disassembly of Cylinder Block**

With suitable lifting equipment available for placing engine in various positions as needed, begin disassembly as follows:

- a.* Remove all accessories attached to cylinder head and block, such as fan, governor, electrical components, air cleaner, carburetor, and the like.
- b.* Remove the cylinder head (par. 189).
- c.* Remove the manifold (par. 84).
- d.* Remove the oil pan (par. 131).
- e.* Remove the flywheel and bellhousing (pars. 229, 230).
- f.* Remove the pistons and connecting rods (par. 224).
- g.* Remove the crankshaft (par. 238).
- h.* Remove the oil pump (par. 125), valves (par. 193), and camshaft (par. 216).
- i.* Remove the expansion plugs (2, fig. 112).
- j.* Remove the pipe plugs (19).
- k.* Remove the manifold studs (22).
- l.* Remove the lubrication oil tubing (2, fig. 29).

### **221. Cleaning, Inspection, and Repair of Cylinder Block** (fig. 112)

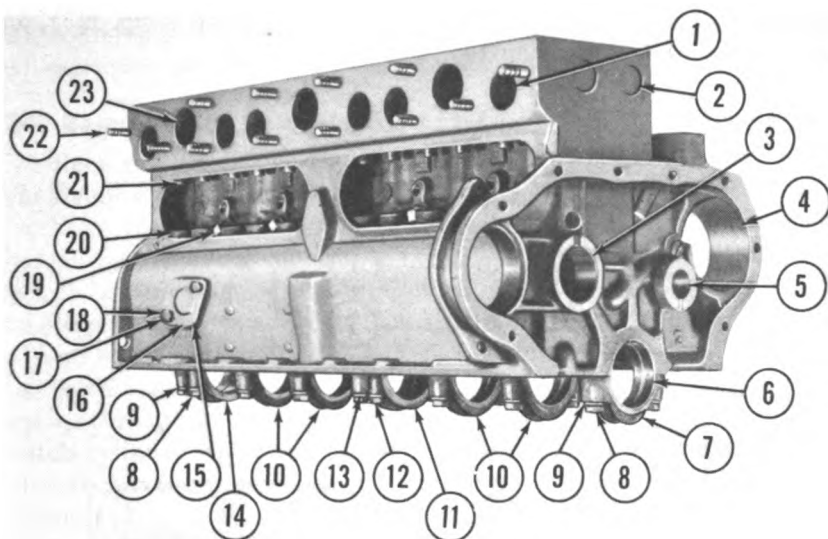
*a.* Before reassembling the block, stand it on the bellhousing end and thoroughly wash sludge down with solvent from all inside surfaces and pockets. Scrape any carbon deposits from exhaust ports. Steam clean the block to remove dirt.

*b.* Go over the crankcase and cylinder block carefully to detect any cracks or other damage. If any are found, the block should be replaced. In an emergency, these cracks may be welded if they are not on the surface of a cylinder wall or on any machined surface.

*c.* Use a wire brush to clean carbon and dirt from threads of manifold studs (22) and a bristle brush on a wire handle to clean valve tappet guides (20).

*d.* Refer to paragraph 247 for additional inspection data.

*e.* Before reassembling the cylinder block, install new valve and tappet guides and new idler and camshaft bushings, if necessary.



- |   |  |
|---|--|
| 1 Exhaust port                                      | 12 Screw, cap, $\frac{7}{16}$ "-14 NC x 2" (8 req'd) |
| 2 Cylinder expansion plug                           | 13 Lockwasher, $\frac{7}{16}$ " (8 req'd)            |
| 3 Camshaft bearing                                  | 14 Rear main bearing cap                             |
| 4 Water pump gear port                              | 15 Fuel pump hole cover                              |
| 5 Idler shaft bushing                               | 16 Fuel pump hole cover gasket                       |
| 6 Front main bearing shell                          | 17 Fuel pump hole cover screw                        |
| 7 Front main bearing cap                            | 18 Fuel pump hole cover lockwasher                   |
| 8 Screw, cap, $\frac{1}{2}$ "-13 NC x 2" (10 req'd) | 19 Pipe plug, $\frac{1}{8}$ " (4 req'd)              |
| 9 Lockwasher, $\frac{1}{2}$ " (10 req'd)            | 20 Valve tappet guide                                |
| 10 Intermediate main bearing caps                   | 21 Valve guide                                       |
| 11 Center main bearing cap                          | 22 Manifold stud                                     |
|   | 23 Intake port                                       |

Figure 112. Cylinder block, JX engines.

## 222. Reassembly of Cylinder Block

With the engine supported for convenient working, reassemble all components and accessories to the cylinder block.

- a. Install pistons and connecting rods (par. 227).
- b. Install crankshaft (par. 240).
- c. Install oil pump (par. 129).
- d. Install valves (par. 197).
- e. Install camshaft (par. 218).
- f. Install oil pan (par. 133).
- g. Install cylinder head (par. 191).
- h. Install manifold (par. 84).
- i. Install flywheel and bellhousing (pars. 232, 233).

## 223. Pistons, Rings, and Connecting Rods

a. While the JXC engine has cast iron pistons and the JXD aluminum pistons, procedures for removal, replacement and reassembly of pistons and rings are the same for both engines. Piston and ring

assemblies consist of three compression rings (1 and 2, fig. 113), one oil control ring (3), piston (4), and piston pin (5).

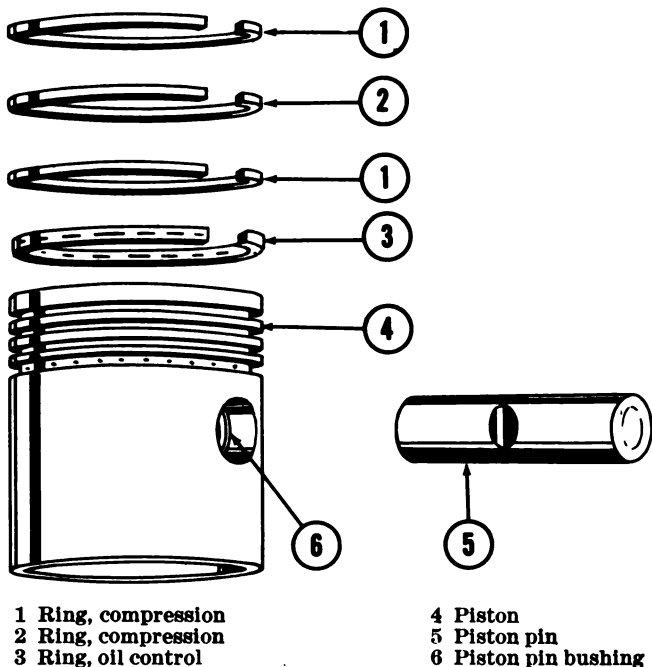


Figure 113. Piston and rings.

b. Connecting rods for the JXC and JXD engines are marked on the camshaft side and to the front of the engine with the cylinder number in which they are used. Connecting rod assembly and reassembly procedures are the same for both engines. The connecting rod consists of the connecting rod (1, fig. 114), clamp screw lockwasher

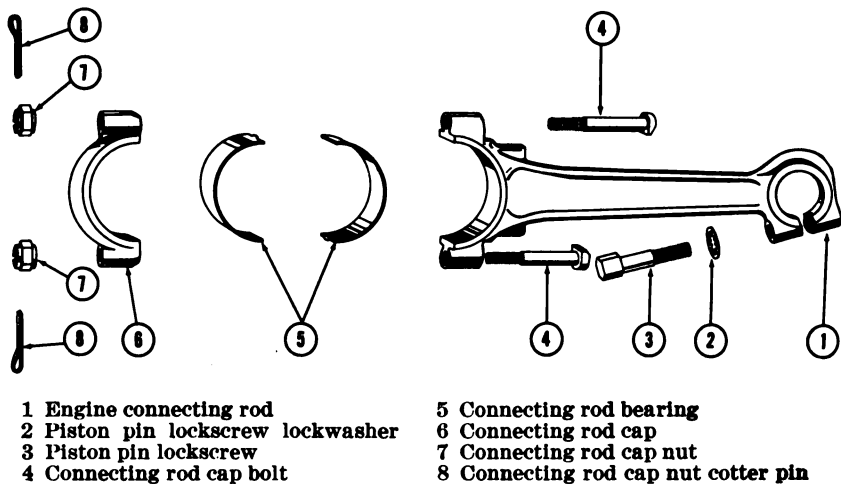


Figure 114. Connecting rod disassembled.

(2), rod clamp screw (3), rod cap screw (4), bearings (5), rod cap (6), cap screw nuts (7), and cotter pins (8).

## 224. Removal and Disassembly of Pistons and Connecting Rods

a. Remove the cylinder head (par. 189).

b. Remove the oil pan (par. 131).

c. Turn the crankshaft until two connecting rods are down, in a position for removing connecting rod caps. Then remove cotter pins, nuts, and connecting rod caps and bearings.

d. Repeat the procedure outlined in *c* above until all connecting rod caps have been removed.

e. With a suitable piece of wood, push the pistons and connecting rods up through cylinder bores, being sure the connecting rods do not scratch cylinder walls. Mark, or note existing marks, on piston and connecting rod assemblies so that all parts can be replaced in their original positions.

*Note.* It is good practice to wrap the lower part of the connecting rod with cloth to prevent doing damage to the cylinder wall.

f. Using a  $\frac{9}{16}$ " socket wrench, remove the clamp screw (3, fig. 114) and lockwasher (2) from upper end of connecting rod and press out piston pin. Remove connecting rod from piston. Be careful not to allow pin or rod to hit piston.

g. Remove bearings from the connecting rod (1) and rod cap (6). If these are stuck in place, they may be knocked loose with a rawhide or fibre hammer.

h. Remove piston rings from piston by using a piston ring expander (13098-A).

## 225. Cleaning and Inspection of Pistons and Connecting Rods

a. Soak pistons in cleaning solvent to soften carbon deposits. Scrape carbon from top of pistons. Do not damage pistons. Be careful not to dig too deeply into the ring seats. If old pistons are to be reinstalled, use a ring groove tool to clean piston ring grooves thoroughly. If a ring groove tool is not available, brush the ring groove of the piston with cleaning solvent, insert the old ring, and rotate piston or ring. Rotating action will loosen carbon deposit inside of ring groove.

b. Examine pistons carefully to detect any cracks. Examine ring grooves to make sure none have been worn out of square as a result of badly fitted rings. Replace pistons as needed.

c. Make a visual inspection of the connecting rods for any cracks or flaws. Check the clamp screw threads in top end of rod.

d. Inspect the connecting rod bearings for cracks, checks, and separated bearing metal which has loosened from the backing.

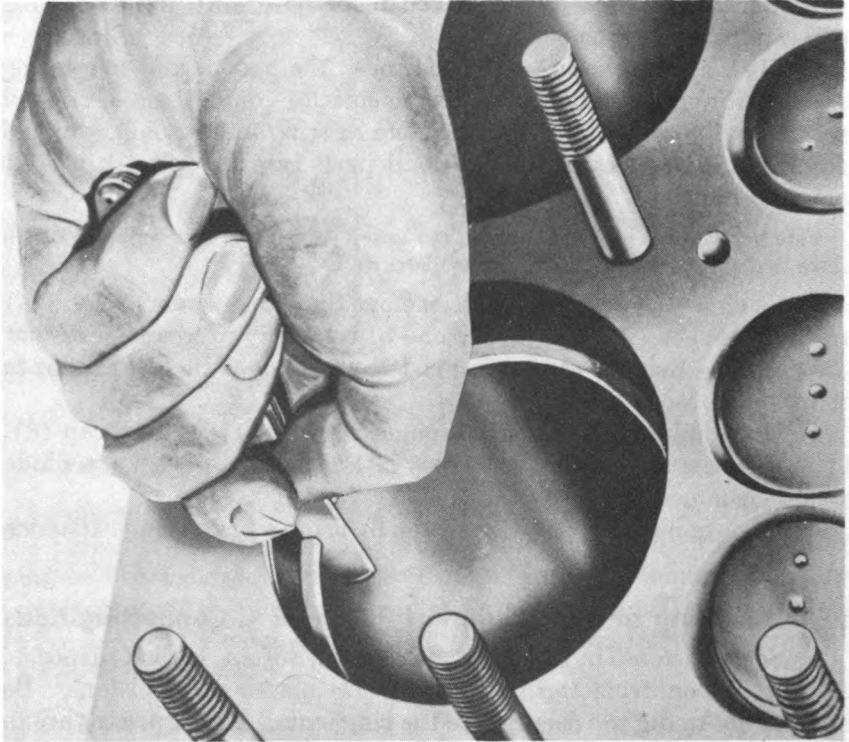
e. Check the connecting rods for straightness and balance.

f. Refer to paragraph 247 for additional inspection data.

## 226. Reassembly of Piston, Rings, and Connecting Rods

a. Before installing new rings on pistons, try each ring in the cylinder bore and test gap in the ring (fig. 115). The correct gap is 0.015 to 0.020 inch. If it is necessary to increase the gap, insert a fine cut, flat file in a vise. Place the ends of the ring over the file, squeeze the ends of the ring tightly and stroke ring slowly and gently several times. This insures the ring ends being parallel.

**Caution:** Be careful not to cut off too much metal.

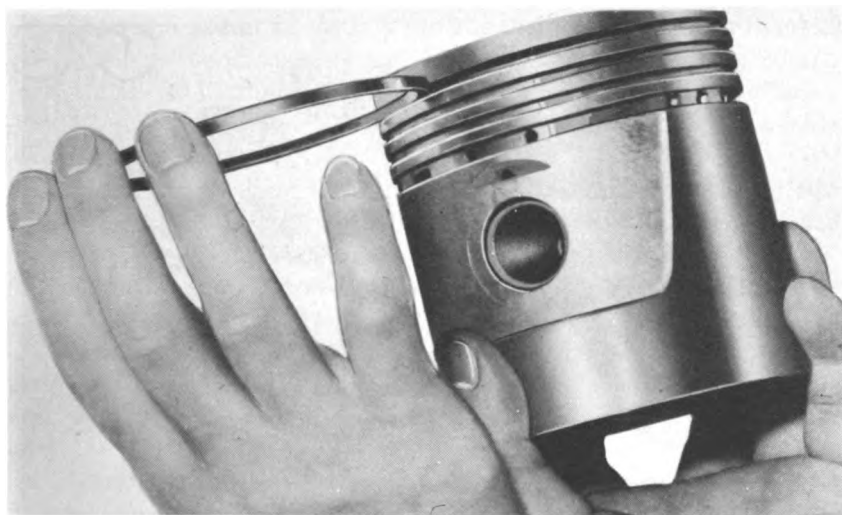


*Figure 115. Checking piston ring gap.*

b. Try new rings in the piston grooves by rolling the ring all the way around the groove (fig. 116). Rings should fit perfectly, having a clearance of 0.00075 to 0.0015 inch if grooves are clean. If rings are tight in grooves, lap the ring slightly on 000 emery paper laid on a flat surface. Use a light, uniform pressure while lapping.

**Caution:** When fitting rings in grooves, do not allow fingers to slide on sharp edges of ring.

c. Assemble rings to piston with a ring spreader tool, beginning with the oil ring first and slipping it down to the bottom groove. If a ring spreader is not available, use a strip of thin metal to help slide



*Figure 116. Checking piston ring fit in piston.*

rings into their proper grooves. Do not twist or otherwise distort rings.

*d.* When assembling slotted skirt pistons to a connecting rod, the slot must be opposite the camshaft. There is not any appreciable difference between the slotted skirt piston that is used in the JXD or a solid skirt piston that is used in the JXC. The slotted skirt piston dissipates the heat more quickly than the solid skirt.

*e.* Insert the piston pin in position with the notch in line with the clamp screw hole. Use a connecting rod spreader tool (1, fig. 117) to spread the rod so the pin may be readily inserted.

*f.* With the notch in pin lined up with clamp screw hole, remove the spreader and assemble the clamp screw and lockwasher. Then tighten the connecting rod clamp screw with a firm pull on a 12-inch wrench.

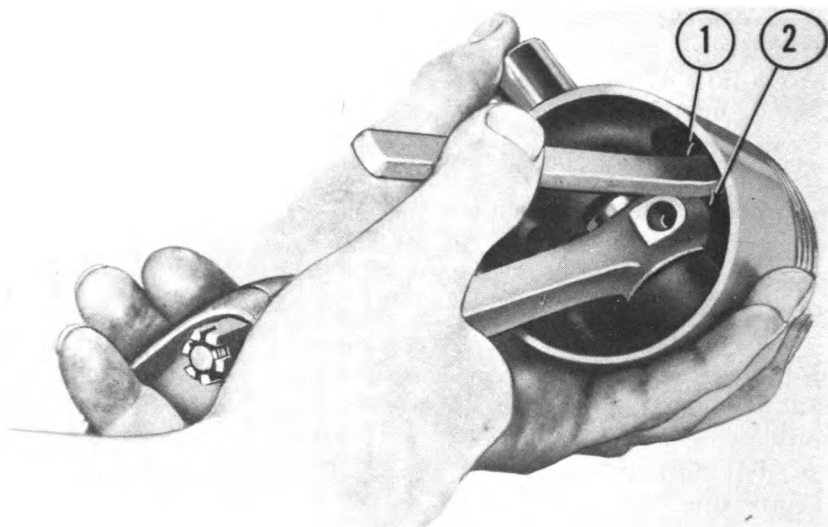
*g.* Test tightness of piston pin by holding the piston in hands with connecting rod parallel to the ground (fig. 118). The weight of the connecting rod should not turn the pin in the piston. Cast iron pistons of the JXC engine should rock easily on the pin in the same test.

*h.* Assemble the connecting rod to piston and install piston rings and connecting rod assembly in crankcase.

*Note.*—Connecting rods for the JXC and JXD engines are marked on the camshaft side and to the front of the engine with the cylinder number in which they are used.

## **227. Installation of Piston and Connecting Rod Assemblies**

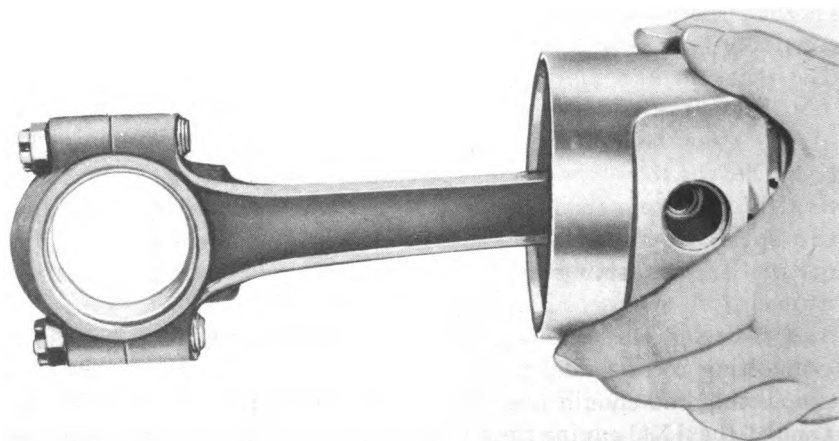
*a.* Before installing the piston, use a cylinder ridge reamer to smooth out any ridges that might be on the cylinder wall. The reamer is inserted into the cylinder and then rotated until there is not



1 Connecting rod spreader tool

2 Pin

*Figure 117. Installing piston pin.*



*Figure 118. Checking piston pin fit.*

any ridge remaining. Check by eye and finger to see if the cylinder wall is smooth.

*b.* Wrap the lower end of the connecting rod in cloth, and with piston rings compressed, lower the connecting rod into the cylinder bore and fit piston in cylinder.

*c.* Make certain the connecting rod is in line with the crankshaft journal and push piston into cylinder with a wood hammer handle or other suitable piece of wood.



*d.* When the piston is entirely within the cylinder bore, place the upper shell in the connecting rod, and pull rod down to crankshaft. Place a little oil on the bearing cap shell before installation. Place a  $\frac{1}{4}$  by  $\frac{1}{2}$  by 0.0015 inch piece of shim stock on the shell and assemble the cap to the connecting rod.

*e.* Place lower shell in the cap, tighten connecting rod cap screws to 56 pounds torque wrench tension, and try the connecting rod for side movement. It should move slightly sideways under firm pressure. Now remove cap screws and remove the piece of feeler stock from the connecting rod cap.

*f.* Reassemble the connecting rod cap and draw up cap screws to the proper torque wrench tension of 56 pounds. Try the side movement again. This time the connecting rod should move sideways easily.

*g.* Repeat the above operation for all connecting rods. Then install all cotter pins.

*Note.* If the connecting rod is too tight, remove the bearing cap and check for foreign material between the bearing shell and bearing cap which would cause the bearing to bind. If the connecting rod is too loose, replace the bearing shells, using the next undersize shells.

*h.* Reassemble the cylinder head to engine (par. 191).

*i.* Reassemble the oil pan to engine (par. 133).

## **Section XIII. FLYWHEEL, MAIN BEARINGS, AND CRANKSHAFT**

### **228. Flywheel and Bellhousing**

(fig. 119)

*a.* The cast iron flywheel on the JXC and JXD engine is machined to accommodate variations in clutches, starting motors, and other couplings. Four bolts (3) and two centering dowels (6) fasten the flywheel to the crankshaft. A locating dowel provides for correct timing to the engine. The ring gear is attached to the outer rim of the flywheel. The driving gear on the starting motor shaft meshes with the ring gear for starting.

*b.* The bellhousing is a casting. It covers the flywheel and clutch and also serves as a rear engine support. When the engine is installed as a unit, the transmission, or main gear case of the unit, fastens to the bellhousing.

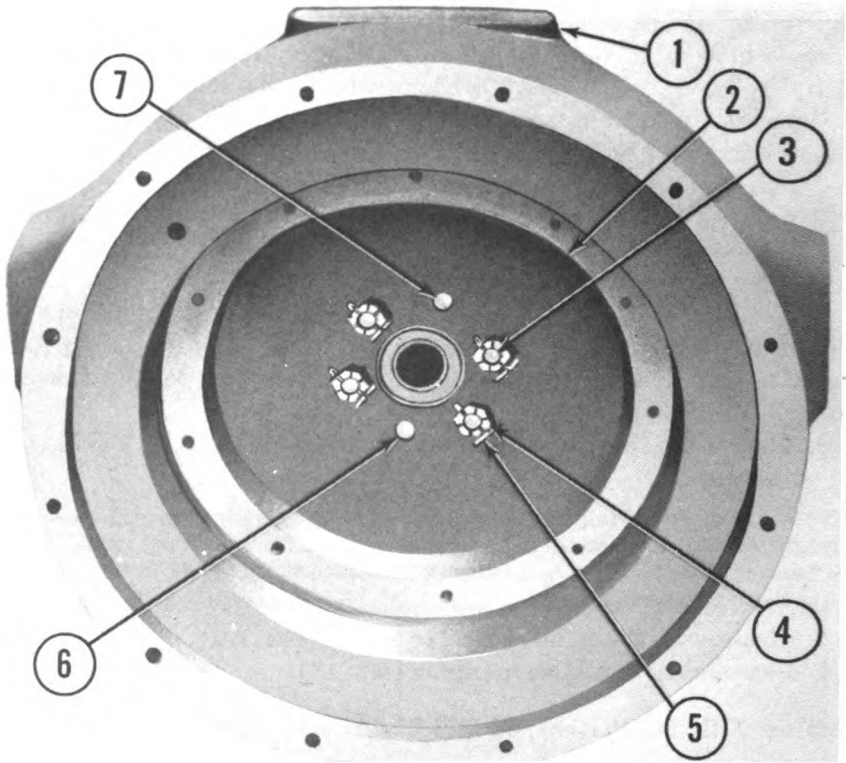
### **229. Removing Flywheel**

(fig. 120)

*a.* Remove all cotter pins and nuts from the flywheel bolts (2).

*b.* Remove the flywheel by prying out gently with a crowfoot bar (1).

*c.* Work flywheel off the flywheel bolts gently, so threads on bolts will not be scuffed.



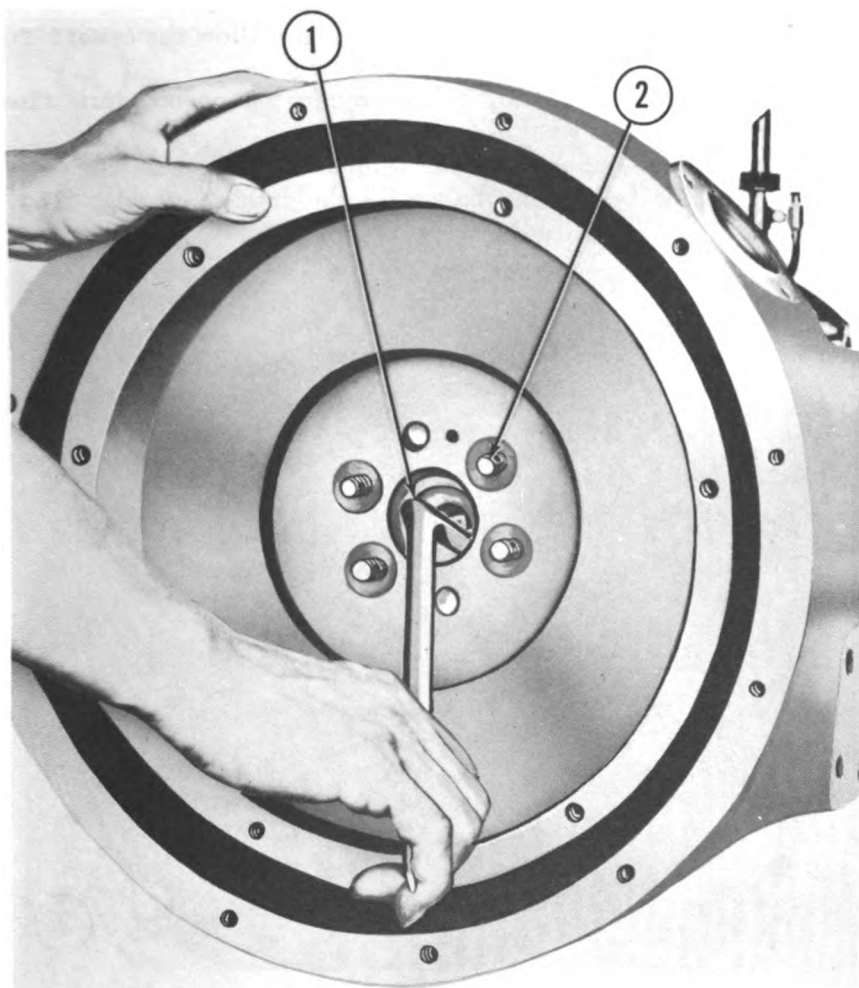
- |   |   |
|---|---|
| 1 Bellhousing   | 5 Cotter pin, $\frac{3}{32}'' \times \frac{3}{4}''$ , (4 req'd) |
| 2 Flywheel  | 6 Dowel, $\frac{1}{2}'' \times \frac{5}{8}''$ , (2 req'd)       |
| 3 Bolt, $\frac{1}{2}''-20$ NF $\times 1\frac{1}{4}''$ , (4 req'd) | 7 (Expansion plug, $\frac{5}{8}''$ , (2 req'd)                  |
| 4 Nut, $\frac{1}{2}''-20$ NF (4 req'd)                            |   |

Figure 119. Flywheel and bellhousing.

*d.* If the flywheel ring gear is damaged, remove the gear from flywheel by driving with a large drift and heavy hammer.

### 230. Removal of Bellhousing

- a.* Drain all crankcase oil and remove clutch.
- b.* Remove the flywheel (par. 229). Place suitable supports under the rear of the oil pan to support the engine. Do not use a jack, unless a wood block is placed between the jack and oil pan.
- c.* Remove the rear engine support screws from bellhousing.
- d.* Remove the bellhousing attaching screws (7, fig. 2) and lock-washers (9).
- e.* Tap the bellhousing gently with a soft hammer to loosen the seal and pull housing away from engine.



1 Crowfoot bar

2 Crankshaft flywheel bolt

*Figure 120. Removing flywheel.*

### **231. Cleaning, Inspecting, and Testing Bellhousing**

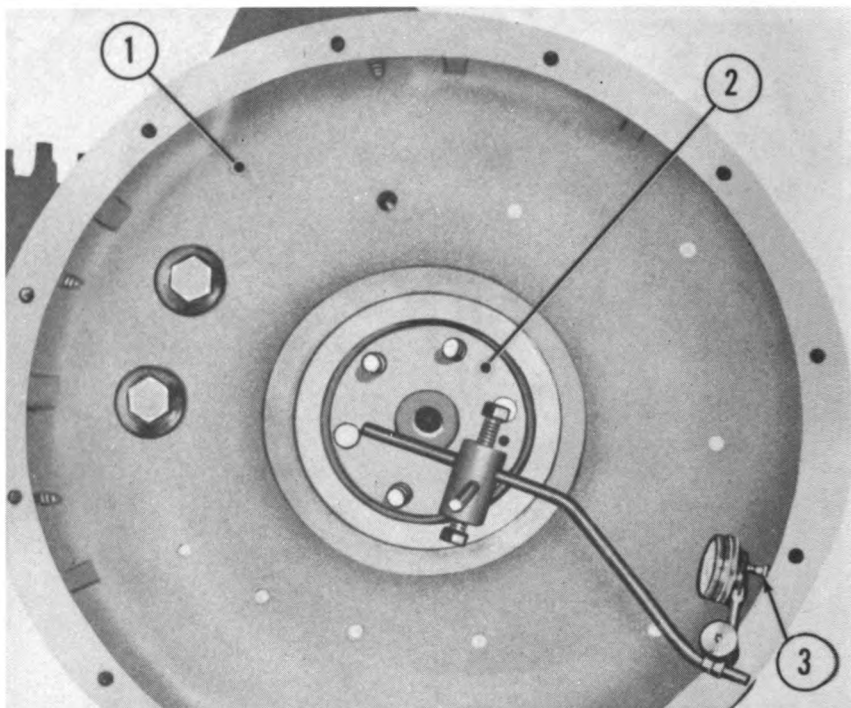
*a.* Wash flywheel and bellhousing in cleaning solvent to remove oil, dirt, or fine metal particles.

*b.* Examine the flywheel ring gear to make sure no teeth are broken or chipped. Replace the ring gear if necessary.

*c.* Examine the bellhousing to be sure there are no cracks in the casting which may rupture later. Replace the bellhousing if necessary.

## 232. Installation of Bellhousing

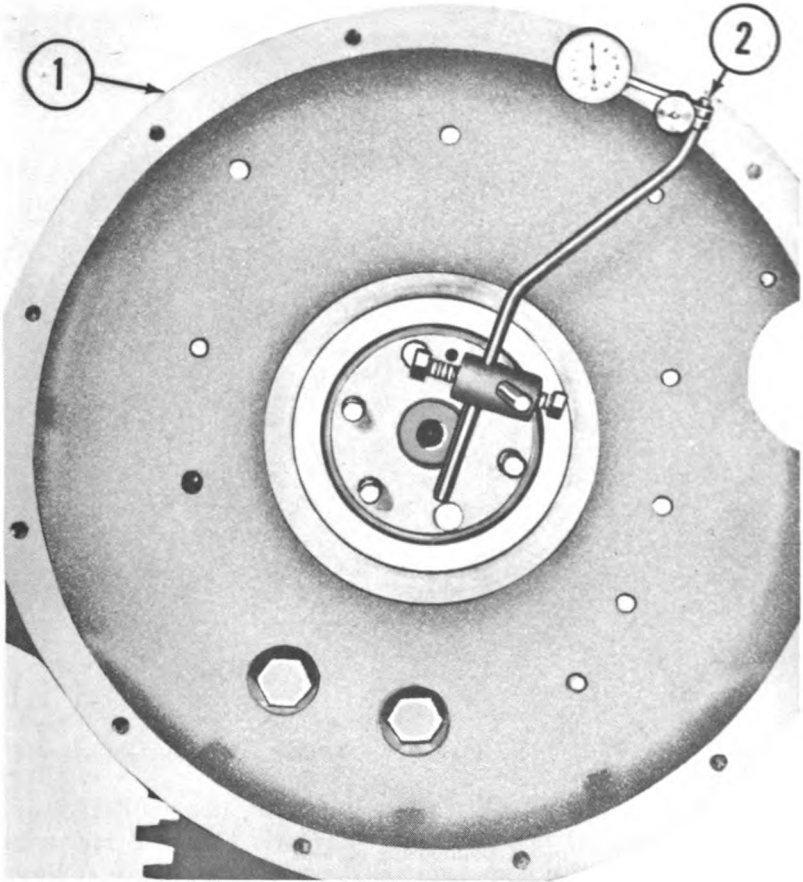
- a. Cement a new gasket to the bellhousing. Allow the cement to dry enough to prevent the gasket from skidding.
- b. Assemble the bellhousing to the engine, but do not draw the attaching screws down tight at first.
- c. Mount a dial indicator on the bellhousing and check the concentricity of the bellhousing bore with the crankshaft (fig. 121). This must be within 0.010 inch.



1 Bellhousing 2 Crankshaft flange 3 Dial indicator

*Figure 121. Checking bellhousing for concentricity.*

- d. Center the bellhousing, tighten down the bellhousing screws, and install the rear motor support screws. Recheck for concentricity.
- e. Now check the face of the bellhousing with the dial indicator (fig. 122). This should not be more than 0.006 inch out of square.
- f. With the crankshaft pushed to the rear of the engine, check bellhousing to crankshaft chamfer clearance. This should be from 0.014 inch to 0.020 inch.
- g. Install a new oil seal in the bellhousing by driving with a wooden block (fig. 123). Check the clearance between the oil seal and the crankshaft flange (fig. 124). This should not be more than 0.010 inch.



1 Bellhousing

2 Dial indicator

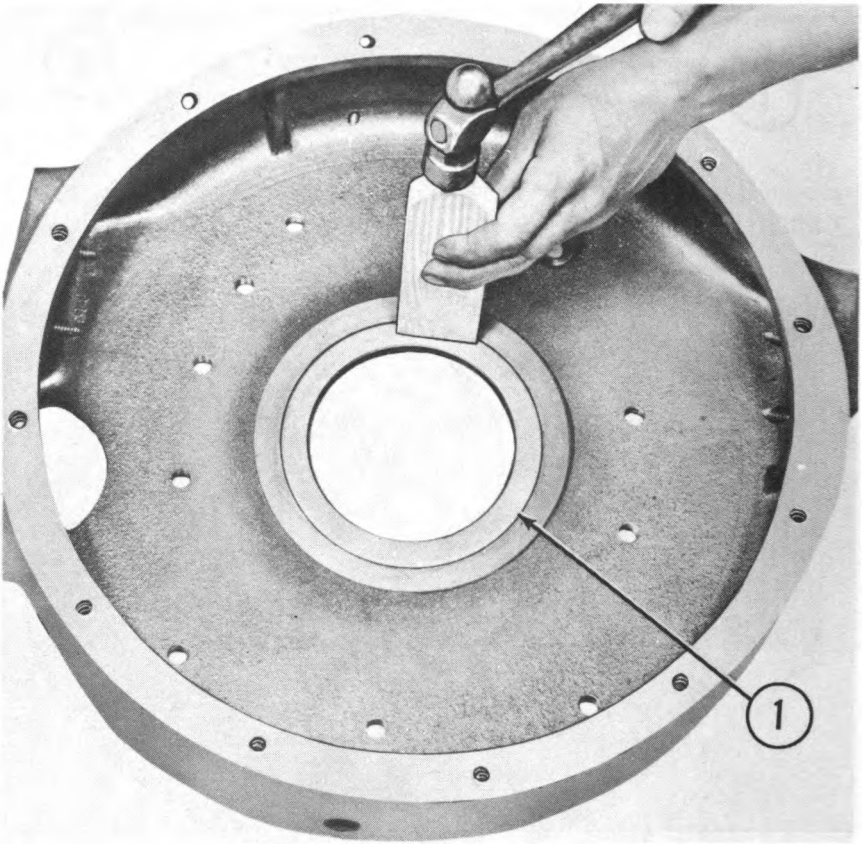
*Figure 122. Checking face of bellhousing for square.*

### 233. Installation of Flywheel

a. If flywheel gear was removed, install the gear.

- (1) Lay the gear on a sheet of asbestos or some other fireproof material.
- (2) Heat the gear with a blow torch evenly on both sides until the gear turns a pale straw yellow (if the gear is clean and untarnished, this color will indicate it is heated to approximately 450° F.). Do not heat to more than 450° F.
- (3) Position gear on flywheel so that it is square and properly seated on the flywheel, then press the gear on.

b. Coat the oil seal in the bellhousing lightly with oil soap and position the flywheel on bolts with the crankshaft locating dowel pin (1, fig. 125) in line with the drilled hole in the flywheel. Push flywheel solidly against the oil seal.



1 Bellhousing oil seal

Figure 123. Installing new oil seal in bellhousing.

c. Install flywheel attaching nuts and cotter pins and tighten the nuts progressively.

d. Press dowels (6, fig. 119) and expansion plugs (7) in place on flywheel.

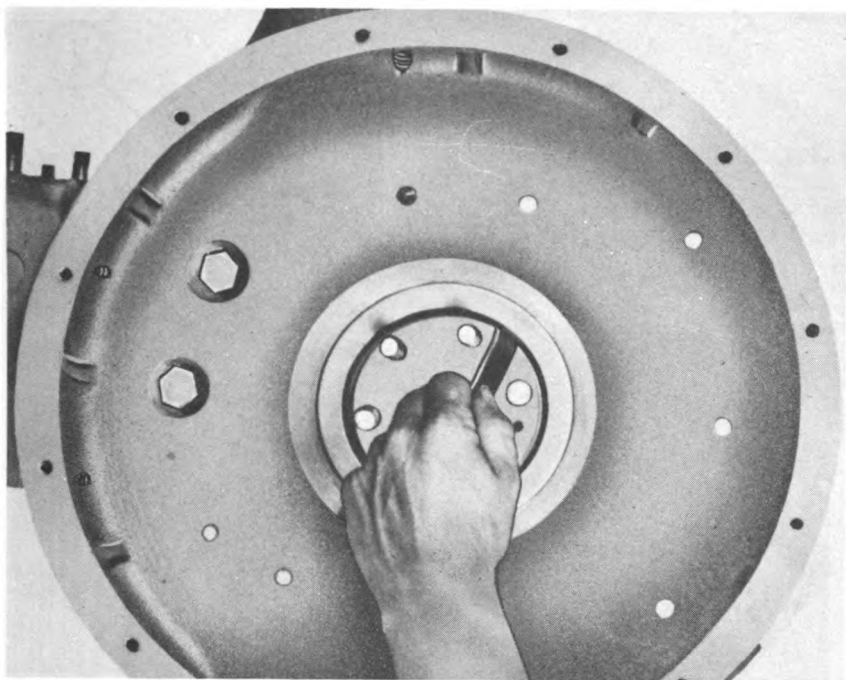
e. Attach a dial indicator to the flywheel and check the concentricity of the pilot bore (fig. 125). This should not exceed 0.005 inch.

f. With the dial indicator check the face of the flywheel (fig. 126). The reading should not exceed 0.005 inch.

## 234. Main Bearings

(fig. 127)

Seven main bearings are used on the JXC and JXD engines. This places a main bearing on each side of each connecting rod bearing. The center (4) and rear (3) main bearing caps are held in position by four alloy-steel cap screws  $\frac{7}{16}$ -inch in diameter, while each of the remaining main bearing caps is held by two alloy-steel cap screws



*Figure 124. Checking clearance between oil seal and crankshaft flange.*

$\frac{1}{2}$ -inch in diameter. The bearing caps are of the shell type, which means that there is a removable shell or insert for each bearing cap, as well as for the crankcase. The upper shell is interchangeable with the lower shell for each bearing. The bearings are shimless, and completely finished for exact fit. No reaming or scraping is required. These bearings are repaired by replacing.

### **235. Removing Bearings**

It is not necessary to remove the engine from the unit to replace the shell-type main bearings, unless the crankshaft is damaged or worn so much that it must be replaced.

*a.* Disconnect the battery cable at the battery, disconnect the starter motor cable, and remove the starting motor.

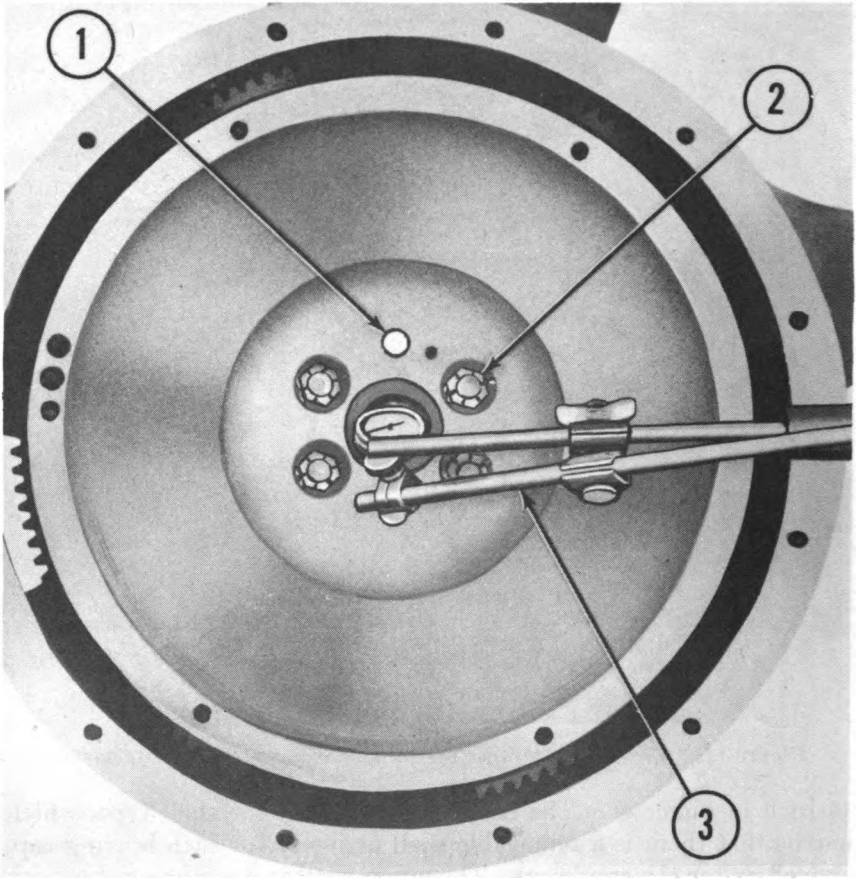
*b.* Drain all crankcase oil and remove the oil pan (par. 131).

*c.* Remove the oil pump (par. 125).

*d.* Loosen all main bearing cap screws.

*e.* Remove one bearing cap at a time and make bearing replacement.

To remove the upper shell, insert a small pin with a large head in the crankshaft oil hole and rotate the shaft so that the pin will push the bearing out. The new bearing may be inserted in the same manner.



1 Crankshaft locating dowel  
2. Flywheel nut

3. Dial indicator set-up

*Figure 125. Checking concentricity of pilot bore.*

**Caution:** Be sure to remove the pin before assembling the bearing cap.

### 236. Installation of Bearings

a. Assemble the bearing cap and lower shell and tighten screws with a 12-inch wrench. The front and intermediate main bearing cap screws have a torque wrench tension of 70 foot-pounds and the center and rear bearing cap screws have a 60 foot-pound torque wrench tension. When the rear main thrust bearings have been installed, check the end thrust with a feeler ribbon (fig. 128) to get the proper clearance (par. 247). It is permissible to draw-file the thrust bearings to obtain the proper clearance.



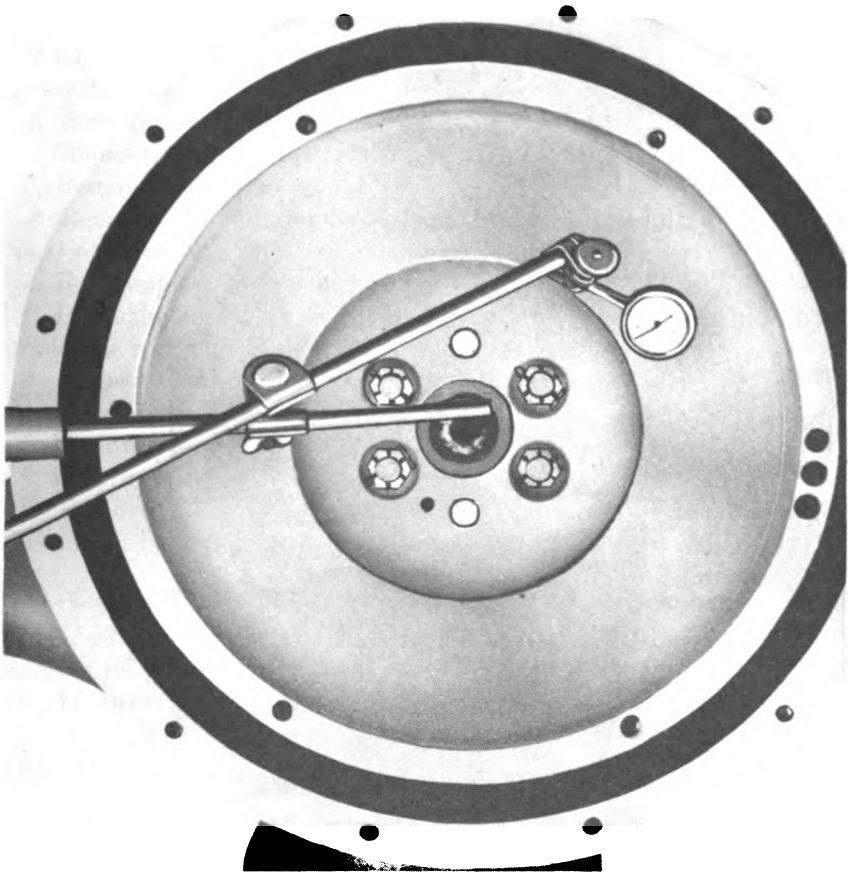
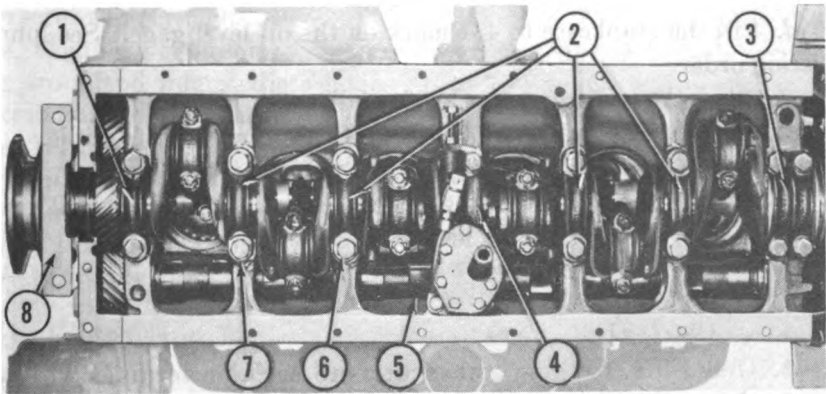


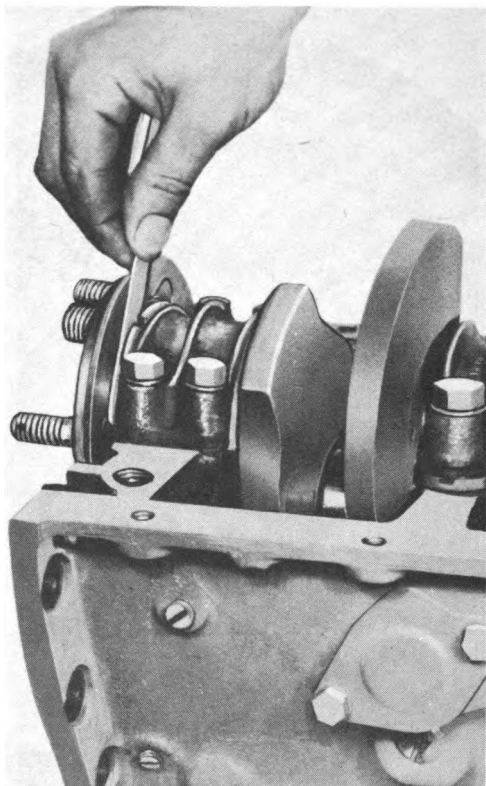
Figure 126. Checking face at flywheel for square.



- 1 Front main bearing
- 2 Intermediate main bearing
- 3 Rear main bearing
- 4 Center main bearing

- 5 Center camshaft bearing
- 6 Screw,  $\frac{1}{2}$ "-13 NC x 2" (10 req'd)
- 7 Lockwasher,  $\frac{1}{2}$ " (10 req'd)
- 8 Front support

Figure 127. Main bearings.



*Figure 128. Crankshaft end thrust check.*

- b.* Thoroughly check the inside of the engine for loose screws, nuts, etc. Wipe out any sludge deposits which can be reached with a cloth.
- c.* Install the oil pan and starting motor.
- d.* Fill the crankcase to  $\frac{4}{4}$  mark on the oil level gage. See lubrication order.
- e.* Check the radiator water level. Add water if needed.
- f.* Start the engine and allow to run a few minutes at fast idle.
- g.* Check carefully around the oil pan to detect any oil leaks. Tighten cap screws as necessary to stop leaks, and recheck the oil level. Add oil if necessary to bring level to  $\frac{4}{4}$  mark on oil level gage.

### **237. Crankshaft**

(fig. 129)

JXC and JXD engine crankshafts are machine forgings with all journals surface-hardened. The nominal diameter of the main journals (7-10) is  $2\frac{1}{2}$  inches, while the nominal diameter of the connecting rod journals (6) is 2 inches. The shaft has drilled passages (4) to carry oil under pressure to the connecting rod bearings.

### **238. Removing Crankshaft**

With the engine placed in a convenient position for working on the underside, disassemble the crankshaft from the engine as follows:

- a.* Remove the gear cover (par. 201).
- b.* Remove the oil pan (par. 131).
- c.* Remove the oil pump (par. 125).
- d.* Remove the cylinder head (par. 189). (If required for additional work on engine.)
- e.* Remove pistons and connecting rods (par. 224).
- f.* Place the engine on cylinder head surface, using wood blocks to protect the contact surfaces from damage.
- g.* Remove the flywheel (par. 229).
- h.* Remove the bellhousing (par. 230).
- i.* Remove all cap screws from bearing caps.
- j.* Lift the crankshaft out of cylinder block.
- k.* Remove the bearing shells from crankcase and bearing caps. These must be kept in proper sequence if they are to be reused.

### **239. Cleaning, Inspection, and Repair of Crankshaft**

- a.* Wash all gummy lubricant from shaft with cleaning solvent, and ream out oil passages with a wire brush.
- b.* If the crankshaft gear is damaged, replace the gear.
- c.* If crankshaft journals are out-of-round, or have rough surfaces, grind the crankshaft to new dimensions (par. 247).

### **240. Installation of Crankshaft**

- a.* Install new bearings in the crankcase.
- b.* Fit crankshaft into crankcase.
- c.* Install all main bearing caps and lockwashers and then turn the cap screws finger-tight.
- d.* Complete tightening of cap screws with a torque wrench, drawing front and intermediate mains up to 70 pounds, and center and rear mains up to 60 pounds torque.
- e.* Install oil pump (par. 129).
- f.* Install oil pan (par. 133).
- g.* Install gear cover (par. 210).
- h.* Install bellhousing (par. 232).
- i.* Install flywheel (par. 233).

### **241. Clutch**

(fig. 130)

The power takeoff of JXC and JXD engines consists of a standard clutch. The clutch engages by toggle action. When the sliding sleeve collar assembly (7) is moved toward the clutch, the machined ends of the four clutch levers (4) contact the machined ring on the floating

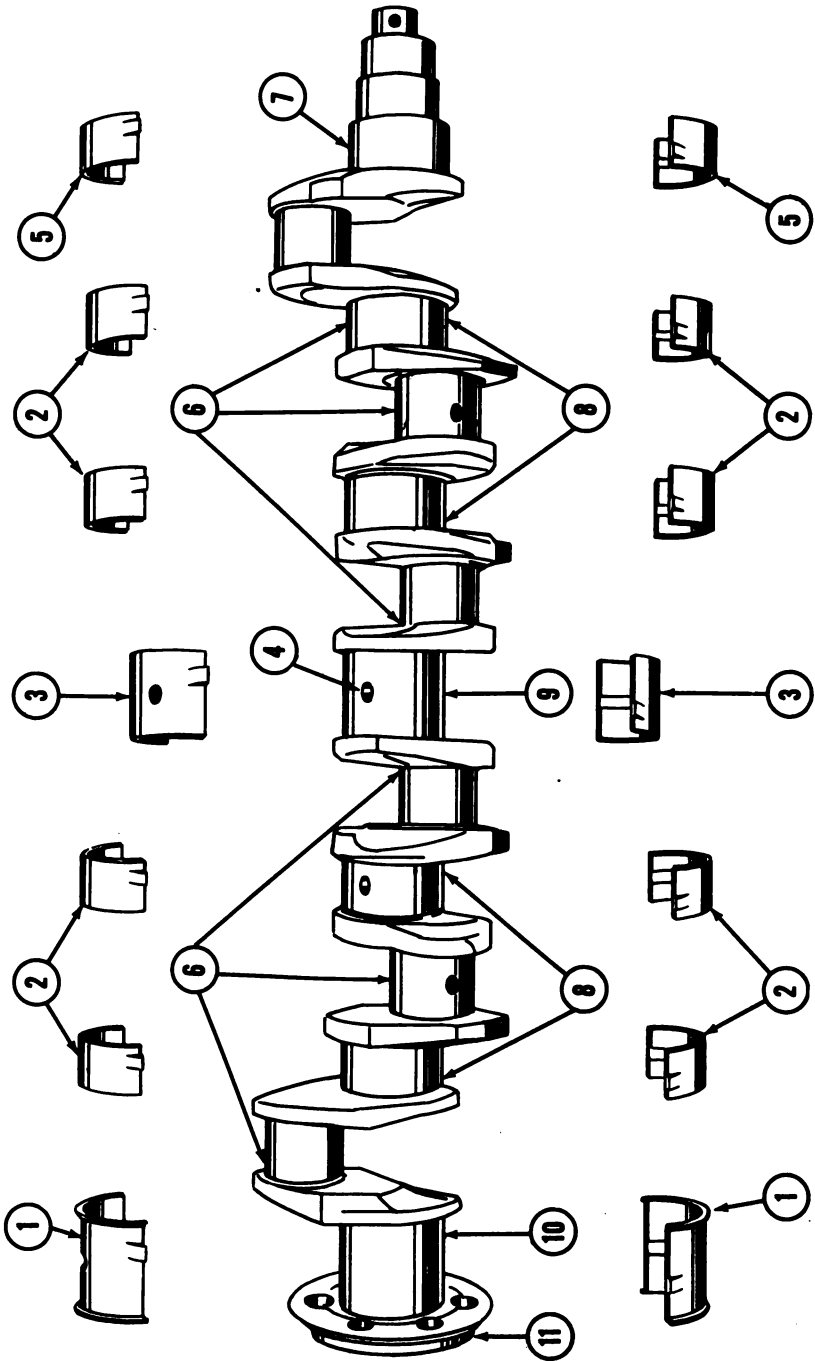


Figure 129. Crankshaft and main bearings.

plate (2). This action causes the links to go over center and engage the clutch. When the sliding sleeve collar assembly moves back from the clutch, pressure against the floating plate is relieved and the clutch is disengaged.

## 242. Disassembly of Clutch

(fig. 131)

*a.* Place the clutch assembly on a bench or other clean working area.

*b.* Slide the sliding sleeve collar assembly (14) as far back in the disengaged position as possible.

*c.* Lock the adjusting pin (19) in the OUT position and rotate the adjusting yoke assembly counterclockwise until it comes off the hub of the hub and backplate (1).

*d.* The floating plate (6) and driving plate (3) can then be slipped off the hub of the hub and backplate (1).

## 243. Inspection and Repair of Clutch

(fig. 131)

*a.* Inspect the friction discs (4). If these are worn down to or near the rivet heads, replace the friction discs.

*b.* Inspect for wear on the driving plate (3). If the adjusting yoke cannot be drawn up tighter to take up for driving plate wear, replace the driving plate.

*c.* Replace the release springs (2) if any are broken.

## 244. Reassembly of Clutch

(fig. 131)

*a.* Place the driving plate on the hub of the hub and backplate.

*b.* Place the floating plate (6) on the hub of the hub and backplate and slide the two units tightly against the backplate.

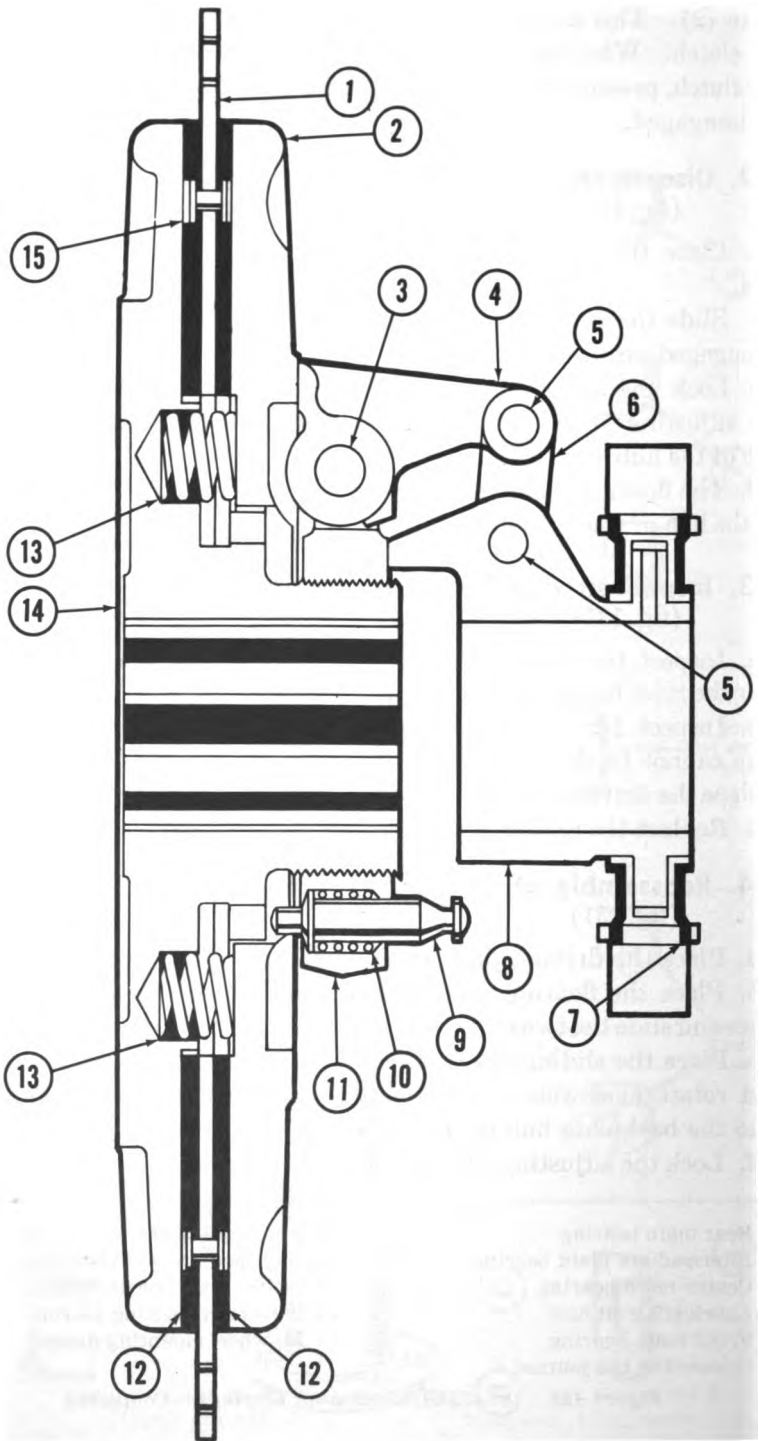
*c.* Place the sliding sleeve assembly against the backplate and hub and rotate clockwise to engage threads. Turn the sleeve assembly onto the backplate hub to the end of the threads.

*d.* Lock the adjusting pin (19) in the IN position.

---

1 Rear main bearing	7 Front main bearing journal
2 Intermediate main bearing	8 Intermediate main bearing journal
3 Center main bearing	9 Center main bearing journal
4 Lubricating oil hole	10 Rear main bearing journal
5 Front main bearing	11 Flywheel mounting flange
6 Connecting rod journal	

*Figure 129. Crankshaft and main bearings.—Continued*



**Figure 130. Clutch assembly sectional view.**

## Section XIV. ENGINEERING INFORMATION

### 245. Power Curves—JXC and JXD Hercules Engines

(fig. 132)

These curves show the performance of a standard stripped engine as developed on an electric Dynamometer, corrected to 29.92 sea level barometer and 60° F. temperature. The power shown is as delivered at the flywheel, without fan or other power consuming accessories.

### 246. Purpose and Scope

*a.* These tables of fits, limits, tolerances, and maximum wear limits, give the original minimum, maximum, and desired size of the new parts when manufactured as well as wear limits that indicate that point to which a part may be worn before replacement.

*b.* Accordingly, all parts will be approved for service which have not been worn beyond the dimensions shown in additional allowable wear or clearances column.

*c.* The dimensions show in additional allowable wear or clearances column are, additional limits allowable above or below the limits shown in the manufacturer's minimum or maximum column. For example: paragraph 247*e*(1) camshaft journal dimension, the manufacturer's minimum is 2.053 inches, and the additional allowable wear or clearances column shows 0.002 inch, making the minimum usable size 2.051 inches, while in paragraph 247*f*(1) camshaft bushing dimension, the manufacturer's maximum is 2.0606 inches, and the additional allowable wear or clearances column shows 0.005 inch, making the maximum allowable size 2.0656 inches.

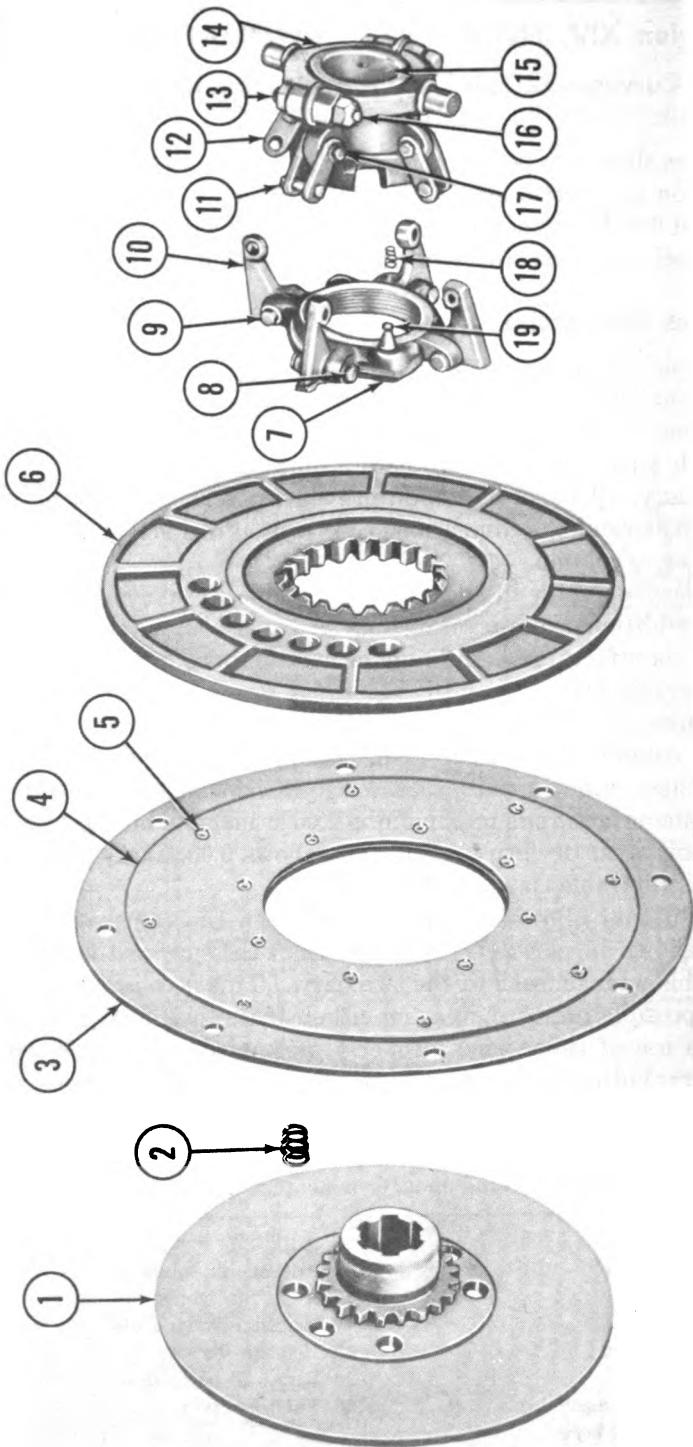
*d.* The additional allowable clearance between the camshaft and bushing (as shown in par. 247*f*(2)) is less than the sum of the additional allowable wear on each of the two parts. This is to provide for the greatest possible limits of wear on either of the two surfaces and yet allow the use of these parts properly assembled with other less worn parts, providing the maximum allowable clearance is not exceeded when they are assembled.

*Note.* In Base Shops, after an engine and accessories have been completely dismantled, then and then only will the limits or dimensions shown in the remarks

---

1 Driving plate	9 Adjusting lockpin
2 Floating plate	10 Adjusting pin spring
3 Lever pin	11 Adjusting yoke
4 Lever	12 Friction driving disc
5 Lever link pin	13 Release spring
6 Lever link	14 Hub and backplate
7 Sleeve collar assembly	15 Tubular rivet
8 Sliding sleeve bore	

Figure 130.—Clutch assembly sectional view.—Continued



1 Hub and backplate  
 2 Release spring  
 3 Driving plate  
 4 Friction driving disc

5 Tubular rivet  
 6 Floating plate  
 7 Adjusting yoke  
 8 Yoke lever snap ring

9 Lever pin  
 10 Lever assembly  
 11 Lever link pin  
 12 Lever link

13 Sleeve collar bolt  
 14 Sleeve collar assembly  
 15 Sliding sleeve bore  
 16 Sleeve collar nut

17 Lever link snap ring  
 18 Adjusting pin spring  
 19 Adjusting lockpin

Figure 151. Clutch disassembled.



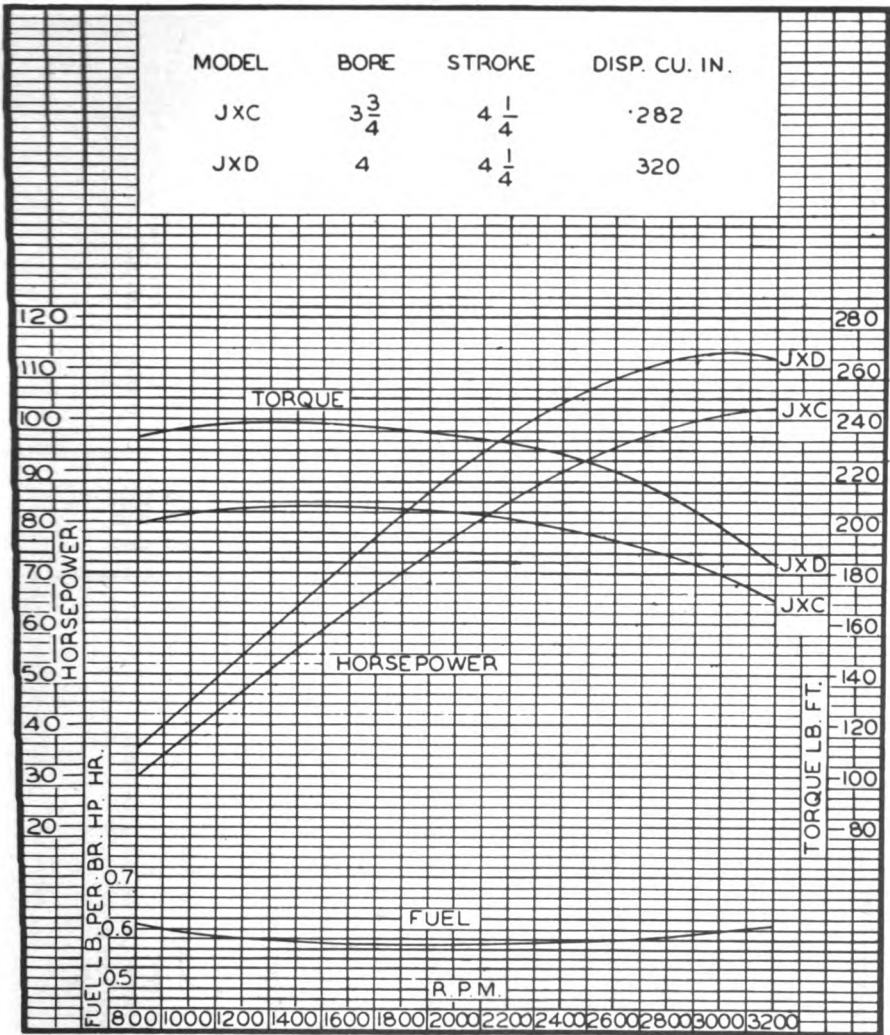


Figure 132. Power curves.

column with asterisk (\*) be substituted for those in the additional allowable wear or clearances column. All other wear limits not given tolerances in the remarks column will be accepted in approving parts for replacement.

## 247. Fits, Tolerances, and Maximum Wear Limits for the JXC and JXD Engine

Point of measurement	Manufacturers' fits, limits, tolerances and/or dimensions			Additional allowable wear or clearances (inches)	Remarks
	Min (inches)	Desired (inches)	Max (inches)		
<p>a. <i>Cylinder Block and Head.</i></p> <p>(1) Nominal bore diameter and maximum wear diameter.</p> <p>(2) Taper-----</p> <p>(3) Oversize pistons available 0.020 in., 0.040 in., 0.060 in.</p> <p>(4) Cylinder liners authorized for installation.</p> <p>(5) Relation face of liner to face of block—flush.</p> <p>(6) Inspect for cracks, broken studs, gaskets, surfaces and core plugs.</p> <p>(7) Finish cylinder, after reborring, with 400-grit hone and wash with hot, soapy water.</p> <p>(8) Test block with hot (110 deg) water backed up with 75 lb air pressure.</p> <p>(9) Cylinder will have a fine smooth (original) finish.</p> <p>(10) Torque tightness of cylinder head bolt-----</p> <p>(11) Cylinder bore:  Out of round-----  Tapered-----  Worn-----</p>	3.999		4.001	0.012 0.012	*0.006. *0.006.
<p>b. <i>Main Bearing Bores, Caps and Bearings.</i></p> <p>(1) Insert type bearing.</p>					

(2) Torque tightness of bolts:							
(a) Center and rear—60 ft-lb.							*0.002.
(b) Front and intermediate—70 ft-lb.							
(3) Inside diameter of main bearings when installed at proper torque tightness.							
(4) ID bearing bore (less liner) at proper torque tightness.	2. 4995				2. 5000		0. 003
(5) Amount of bearing crush	2. 6455				2. 646		
(6) Check liner surfaces for wear, pits, scores, etc.	0. 0000				0. 0005		
(7) Clearance of bearing to crankshaft (main)	0. 001				0. 003		*0.002.
(8) End play of crankshaft in bearings when stalled.	0. 002				0. 004		*0.005.
(9) Thickness of bearing liner	0. 07300				0. 07325		
<i>Crankshaft.</i>							
(1) Main bearing journals, nominal diameter and maximum wear:	2. 497				2. 498		0. 002
(a) Authorized undersizes.							
0.020 in., 0.040 in., 0.060 in.							
(b) Allowable out of round					0. 001		
(c) Allowable runout of nearest center main journal when supported at each end.					0. 002		0. 003
(d) Fillet radius	0. 110				0. 140		
(e) Shafts	0. 001				0. 003		
(2) Connecting rod journals, nominal diameter and maximum wear:	1. 987				1. 988		0. 0015
(a) Authorized undersizes.							
0.020 in., 0.040 in., 0.060 in.							
(b) Allowable out of round							
(c) Fillet radius	0. 110				0. 001		
(d) Shafts	0. 001				0. 140		
					0. 003		

## 247. Fits, Tolerances, and Maximum Wear Limits for the JXC and JXD Engine—Continued

Point of measurement	Manufacturers' fits, limits, tolerances and/or dimensions		Additional allowable wear or clearances (inches)	Remarks
	Min (inches)	Desired (inches) Max (inches)		
<i>c. Crankshaft—Continued</i>				
(3) Crankshaft is forged.			0.003	
(4) Straighten if runout is more than.....				
(5) Metalizing is approved when worn beyond maximum regrind.				
(6) Runout of flywheel mounting face.....	0.002	0.002	0.004	
(7) End thrust.....			0.008	
(8) Runout of flywheel face when mounted on crankshaft.			0.006	
(9) Fan drive pulley runout.....			0.010	
(10) Balance crankshaft to 0.6 in.-oz.				
<i>d. Timing Gears.</i>				
Total backlash of camshaft gear to crankshaft gear.....	0.000	0.002	0.010	Gears mounted on fixed center should bind in 4 or 5 locations, equally spaced, when a 0.012 x 1/2-in. shim is inserted opposite pressure side of teeth.
(1) Backlash of idler gear to camshaft gear.....	0.0005	0.0015	0.010	
(2) Check gears for wear and defects.				
(3) Check for cracked or broken teeth.				
<i>e. Camshaft.</i>				
(1) Diameter of journals:				
(a) No. 1 journal.....	2.053		0.002	
(b) No. 2 journal.....	2.053		0.002	
(c) No. 3 journal.....	2.053		0.002	
(d) No. 4 journal.....	2.053		0.002	

(2) Allowable runout of center journal, or nearest center, when end journals are supported.	0.0015		0.0025	0.003
(3) Permissible wear of lobes from heel to toe.				0.050
(4) Straighten if runout is more than 0.003 in., with camshaft mounted in V blocks at front and rear bearings.				0.003
(5) Straightening permissible.				
(6) Torque tightness of camshaft gear nut.		150 ft.-lb		
<i>f. Camshaft Bushings and Bearings.</i>				
(1) Nominal dimension and maximum wear:				
(a) Bearing, front.	2.059		2.0606	0.005
(b) Bearing, intermediate.	2.059		2.0606	0.005
(c) Bearing, intermediate.	2.059		2.0606	0.005
(d) Bearing, rear.	2.059		2.0606	0.005
(2) Clearance between camshaft journal and bushing.	0.0015		0.0025	0.003
(3) Replacement bushing (semifinish).				
(4) Interference OD bushing to ID of case.	0.003		0.005	
(5) End play of camshaft when installed.	0.005		0.008	
<i>g. Tappet Guide (or Bushing).</i>				
(1) Nominal dimension and maximum wear.	0.624		0.6245	0.003
(2) Clearance, tappet to bushing.	0.001		0.0015	0.003
(3) Interference OD bushing to ID bore.	0.002		0.0035	
(4) Diameter tappet.	0.06235		0.624	0.003
(5) Valve tappet to valve stem:				
Intake:				
Cold.	0.010			
Hot.	0.008			
Exhaust:				
Cold.	0.012			
Hot.	0.010			

## 247. Fits, Tolerances, and Maximum Wear Limits for the JXC and JXD Engine—Continued

Point of measurement	Manufacturers' fits, limits, tolerances and/or dimensions			Additions allowable wear or clearances (Inches)	Remarks
	Min (Inches)	Desired (Inches)	Max (Inches)		
<p><i>h. Valve Seats (Inserts).</i></p> <p>(1) Exhaust valve seats:</p> <p>(a) Width of valve seat.....</p> <p>(b) Angle of seat.....</p> <p>(c) Approved to install seats where none are initially installed.</p> <p>(2) Intake valve seats:</p> <p>(a) Width of valve seat.....</p> <p>(b) Angle of seat.....</p> <p>(c) Approved to install seats where none are initially installed.</p>	<p><math>\frac{3}{32}</math></p> <p>-----</p> <p><math>\frac{3}{32}</math></p> <p>-----</p>	<p>-----</p> <p>45°</p> <p>-----</p> <p>45°</p> <p>-----</p>	<p>-----</p> <p><math>\frac{1}{16}</math></p> <p>-----</p> <p><math>\frac{1}{16}</math></p> <p>-----</p>		
<p><i>i. Valve Guides.</i></p> <p>(1) Exhaust:</p> <p>(a) Nominal dimension of bore and maximum wear.</p> <p>(b) Interference OD of valve guide bushing to ID of bore.</p> <p>(2) Intake:</p> <p>(a) Nominal dimension of bore and maximum wear.</p> <p>(b) Interference OD of valve guide bushing to ID of bore.</p> <p>(3) Install by press.</p> <p>(4) Finish guides after installing.</p>	<p>0. 374</p> <p>-----</p> <p>0. 0005</p> <p>-----</p> <p>0. 374</p> <p>-----</p> <p>0. 0005</p> <p>-----</p>	<p>-----</p> <p>-----</p> <p>-----</p> <p>-----</p>	<p>-----</p> <p>0. 375</p> <p>-----</p> <p>0. 0025</p> <p>-----</p> <p>0. 375</p> <p>-----</p> <p>0. 0025</p> <p>-----</p>	<p>-----</p> <p>0. 004</p> <p>-----</p> <p>-----</p> <p>0. 003</p> <p>-----</p> <p>-----</p>	

**j. Valves.**

(1) Intake:

- (a) Angle of seat.....
- (b) Stem diameter.....
- (c) Stem to guide clearance.....
- (d) After refacing valve, if thickness from top of head to the edge of refaced outer circle is less than 0.030 in., replace.

(2) Exhaust:

- (a) Angle of seat.....
- (b) Stem diameter.....
- (c) Stem to guide clearance.....
- (d) After refacing valve, if thickness from top of head to the edge of refaced outer circle is less than 0.030 in., replace.

**k. Valve Springs.**

(1) Exhaust valve springs large:

- (a) Scale reading 56 lb to 65 lb at 1.594 in. (minimum working height).
- (b) Scale reading 41 lb to 45 lb at 1.920 in. (maximum working height).

(2) Intake valve springs large:

- (a) Scale reading 56 lb to 65 lb at 1.594 in. (minimum working height).
- (b) Scale reading 41 lb to 45 lb at 1.920 in. (maximum working height).

**l. Connecting Rod.**

- (1) Torque tightness of connecting rod bolts.....
- (2) Maximum "warpage" of machined parting surfaces using straight edge and feeler.
- (3) ID of large (crankshaft) end.....

45°	0.372 0.001	0.373 0.0015	0.004 0.005
45°	0.372 0.002	0.373 0.0025	0.005 0.006
56 ft-lb	2.1345	2.1350	0.002

Any spring which fails to register within 10 lb of the manufacturer's recommendation at a given dimension should be discarded.

## 247. Fits, Tolerances, and Maximum Wear Limits for the JXC and JXD Engine—Continued

Point of measurement	Manufacturers' fits, limits, tolerances and/or dimensions			Additional allowable wear or clearances (inches)	Remarks
	Desired (inches)		Max (inches)		
	Min (inches)				
<i>l. Connecting Rod</i> —Continued					
(4) ID of liner, when installed of large (crankshaft) end.	1. 9890		1. 9895		0.003.
(5) Clearance connecting rod bearing to crankshaft.	0. 001		0. 0025	0. 003	
(6) Side clearance of connecting rod bearing to crankshaft.	0. 005		0. 010	0. 020	
(7) Allowable twist of connecting rod, measured 3 in. from rod.				0. 002	
(8) Correct by straightening rod.					
(9) Balance of rod with $\frac{1}{2}$ oz including piston.					
(10) Total weight of rod—2 lb and 8.5 oz.					
(11) Thickness of connecting rod bearing, standard.	0. 07275		0. 073		
(12) Thickness of connecting rod bearing, 0.020 in. oversize.	0. 08275				
(13) Thickness of connecting rod bearing, 0.040 in. oversize.	0. 09275				
(14) Thickness of connecting rod bearing, 0.060 in. oversize.	0. 10275				
<i>m. Pistons.</i>					
(1) Nominal diameters of pistons available—standard and 0.020 in., 0.040 in., 0.060 in.,					0. 004
(2) Allowable wear from nominal diameter of skirt.					
(3) Degree of cam used for regrinding.			"C"		



(4) Width of ring groove:					
(a) Groove No. 1—top	0.1265	-----	0.1275	0.004	
(b) Groove No. 2	0.1265	-----	0.1265	0.003	
(c) Groove No. 3	0.1255	-----	0.1265	0.002	
(d) Groove No. 4	0.188	-----	0.189	0.002	
(5) Piston pin diameters:					
Standard	0.9995	-----	0.9997	-----	
0.005 in. oversize	1.0045	-----	1.0047	-----	
(6) Piston pin bore diameter in piston	0.998	-----	0.999	-----	
(7) Fit between piston pin and piston	0.0002	-----	0.0004	0.001	
(8) Piston in cylinder bore	0.004	-----	0.004	0.008	
<i>n. Rings.</i>					
(1) Gap clearance (when fitted in cylinder)	0.015	-----	0.020	0.040	
(2) Clearance of ring in groove of piston:					
(a) Piston ring, compression	0.0025	-----	0.001	0.002	
(b) Piston ring, oil regulating	0.0025	-----	0.001	0.002	
(c) Piston ring in groove	0.00075	-----	0.0015	0.004	
<i>o. Face of Cylinder Head.</i>					
(1) Maximum allowable warpage per foot of length		-----	-----	0.008	
(2) Surface grind not more than 0.010 in. from original surface to correct warpage.		-----	-----	-----	
(3) Check for channeling—permissible before re-facing to.		-----	-----	0.004	
(4) Check all tap holes		-----	-----	-----	
<i>p. Face of Block.</i>					
(1) Maximum allowable warpage		-----	-----	0.008	
(2) Surface grind not more than 0.010 in. from original surface to correct warpage.		-----	-----	-----	
<i>q. Oil Pump, Gear Type.</i>					
(1) Output of pump $3\frac{1}{4}$ gpm at 2000 rpm, free delivery.		-----	-----	-----	

## 247. Fits, Tolerances, and Maximum Wear Limits for the JXC and JXD Engine—Continued

Point of measurement	Manufacturers' fits, limits, tolerances and/or dimensions			Additional allowable wear or clearances (inches)	Remarks
	Min (inches)	Desired (inches)	Max (inches)		
<i>g. Oil Pump, Gear Type—Continued</i>					
(2) Allowable wear on end plates before regrinding.	0.003	-----	0.003	0.006	
(3) End play between gear and end plate	-----	-----	-----	0.010	
(4) Maximum allowable to surface grind from plate.	-----	-----	-----	0.010	
(5) Bushing inside diameter:					
(a) Drive end	0.5005	-----	0.5015	0.002	
(b) Non-driven end	0.5005	-----	0.5015	0.002	
(6) Driven shaft diameter	0.499	-----	0.500	0.002	
(7) Backlash, drive gear to driven gear	0.008	-----	0.010	0.025	
(8) Oil pump shaft	0.001	-----	0.002	0.002	
(9) Oil pump idler shaft	0.001	-----	0.002	0.002	
(10) Oil pump idler shaft to gear	0.00075	-----	0.001	0.002	
(11) Oil pump shaft hole (bearing)	-----	-----	-----	0.002	
<i>r. Relief Valves.</i>					
(1) Scale reading $4\frac{1}{2}$ lb at $1\frac{1}{16}$ in. (when practicable).	-----	-----	-----	-----	
(2) Free length of spring $1\frac{1}{16}$ in.	-----	-----	-----	-----	
(3) When beveled seat type, angle of seat $30^\circ$ .	-----	-----	-----	-----	
(4) Clearance of valve in body	0.002	-----	0.006	-----	
<i>s. Flywheel and Ring Gear.</i>					
(1) Nominal depth from surface of machined flange for clutch housing to face of clutch surface.	-----	2 $\frac{1}{16}$	-----	-----	
(2) Permissible amount that can be removed from clutch face of flywheel.	-----	-----	-----	0.045	

(3) Runout of ring gear.....	-----	0.005	-----
(4) Balance flywheel to within 0.03 in.-oz.	-----	0.005	0.006
(5) Wobble of flywheel machined surface for clutch (measuring from bellhousing).....	-----	0.005	-----
(6) Pilot bearing bore eccentricity.....	-----	0.003	-----
(7) Oil pump gears to housing clearance.....	0.001	-----	-----
<i>t. Bellhousing.</i>	-----	0.010	-----
(1) Clutch bore eccentricity.....	-----	0.006	-----
(2) Face out of square.....	-----	-----	-----
<i>u. Idler Gear.</i>	-----	0.001	0.005
(1) Idler shaft bearing.....	0.00075	0.001	0.002
(2) Idler shaft.....	0.00075	0.001	0.010
(3) Backlash, idler gear to water pump gear.....	0.002	0.004	-----
<i>v. Water Pumps.</i>	-----	0.7505	-----
(1) Diameter of shaft.....	0.7495	0.753	-----
(2) ID of bushing.....	0.752	0.0035	-----
(3) Running clearance.....	0.0015	0.0025	0.006
(4) Water pump cradle bearing.....	0.0015	0.0015	0.004
(5) Water pump bearings.....	0.0015	0.003	0.010
(6) Water pump end thrust.....	0.003	-----	-----

## CHAPTER 5

### SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

---

#### Section I. LIMITED STORAGE AND SHIPMENT

#### 248. Limited Storage

Periods up to 30 days are considered limited storage. If possible, engines in limited storage are to be kept under roof. The following instructions pertain to spare engines:

*a. Inspection.* Follow organizational preventive maintenance services contained in paragraph 28. Particular attention should be given to accessory mountings: tighten if necessary. Check all wiring connections. Relieve tension on the fan V-belt by turning knurled adjusting hand wheel at top of fan bracket to the left. Place tag on hand wheel stating tension to belt has been relieved.

*b. Cleaning and Painting.* If the engine has been in use, remove grease and dirt before storing. The engine may be cleaned by painting it with cleaning solvent and blowing away loosened dirt and grease with compressed air, or wiping off dirt with cloth or waste. Should all or part of the exposed surface of the engine require painting after the cleaning operation, follow instructions contained in paragraph 25.

*c. Complete Lubrication.* Before storing, the engine is to be lubricated according to instructions contained in paragraph 24.

*d. Protection in Storage.*

- (1) Remove battery.
- (2) If radiator does not contain antifreeze solution, drain cooling system completely. After the cooling system has been drained, place tag on radiator fill cap stating that this has been done.
- (3) Openings to engine (air inlets and exhaust outlets) should be sealed with waterproof and vapor proof material possessing sufficient strength to resist puncture and damage.
- (4) When engine is being stored during period of high humidity, processing to prevent corrosion will be in accordance with instructions in TB 5-9711-1 and TM 5-9715.
- (5) Spare engines, under roof, need only be covered with tarpaulins.
- (6) Engines stored outside should be first wrapped completely with tarpaulins and then blocked up at least 12 inches off the ground.

*e. Lubrication.* Remove lubricating oil in engine crankcase, air

cleaner, and air cleaner on oil filler tube, when engine is in storage. Lubricate the engine accessories for storage as follows:

- (1) *Generator*. One drop OE No. 30 lubricating oil in oil cup.
- (2) *Starting motor*. One drop OE No. 30 lubricating oil in oil cup.
- (3) *Distributor*. Remove distributor cap, rotor, and seal plate and apply one drop of light oil to breaker arm cam. Replace seal plate, rotor, and distributor cap. JXC engine distributors have no seal plate. To oil breaker arm cam, remove the distributor cap.
- (4) *Fan*. Relieve tension on the fan V-belt by turning knurled adjusting hand wheel at top of fan bracket to left until slack appears in fan belt.

## 249. Domestic Shipment

*a. General*. Engines are crated for shipment by the manufacturer, or at any other point of departure. When necessary to reship, if original crates are available, they should be used for packing engine. Broken or badly split slatting of the original crate should be replaced before reuse.

*b. Crating for Shipment* (fig. 15). When original crates are not available, and it is necessary to build a crate, proceed as follows:

- (1) Cut out two 4 x 4-inch timbers of sufficient length to clear engine and 4 inches over at each end. Lay these parallel about 18 inches apart.
- (2) Cut a 2 x 6-inch plank 18 inches long. Cut a channel 2 inches deep and 2 inches wide in the center of this plank. The front end of the engine crankshaft will rest in this channel.
- (3) Place the plank across the parallel members about 4 inches from end and anchor by toe-nailing, and nailing in triangular supporting chocks.
- (4) With hoist, lower engine down until front end of crankshaft rests on channel. Make certain engine is in level position.
- (5) Attach two 3 x 3 L-shaped strap iron or angle iron fittings on each side of bellhousing with two  $\frac{1}{2}$ -13 x  $1\frac{1}{2}$ -inch screws in top holes.
- (6) Cup two blocks from a 4 x 4 timber, each of sufficient length to fit between the angle iron and the main beam and thus support weight of engine.
- (7) Anchor the angle irons to the supporting blocks with  $\frac{1}{4}$  x  $1\frac{1}{2}$ -inch lag screws. Hoist may now be removed.
- (8) The front end of the engine is secured by attaching either the front motor supports to the gear case and lagging them into the cross member, or by bending  $\frac{3}{16}$  x 1-inch strap iron of sufficient length to fit tightly against the gear cover, and

then lagging them into the cross-member. The engine is now secured to the weight-supporting base structure of the crate.

- (9) Top and ends of crate are slatted from 1 x 6-inch rough lumber.
- 10) Sides of crate are X frames built of 2 x 4-inch and 1 x 6-inch rough lumber. The sides may be constructed at any height required to clear any attachments on engine such as fan bracket, instrument panel, etc. Certain accessories are normally removed when JXC and JXD engines are crated for shipment (fig. 18).

*c. Loading for Shipment.* When loading engines for shipment by rail, truck, or air, lift unit with hoisting slings placed at the front and rear of crate. On or in the transporting vehicle, the crate containing engine should be lashed, bolted, nailed, or trussed to the floor or wall, to prevent shifting of position during transit.

*d. Safety Precautions.*

- (1) Always rig slings evenly so engines do not tilt to side, forward, or backward while being hoisted.
- (2) Avoid sharp bumping which might damage crate or engine.
- (3) Make certain crate is anchored securely on or in the transporting vehicle.

## **Section II. DEMOLITION OF THE ENGINES TO PREVENT ENEMY USE**

### **250. General**

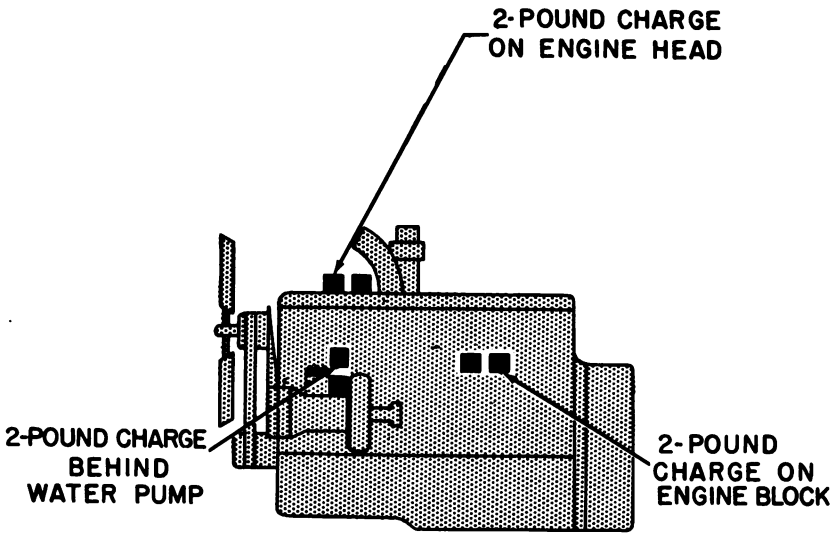
When capture or the abandonment of the engine to an enemy is imminent, the responsible unit commander makes the decision either to destroy the unit or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction. Whatever method of demolition is employed, it is essential to destroy the same vital parts of all engines, and all corresponding repair parts.

### **251. Preferred Demolition Methods**

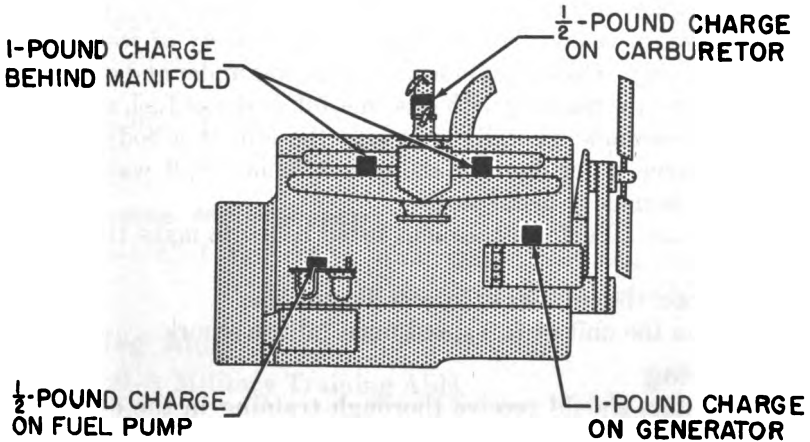
Explosives and mechanical means, used alone or in combination, are the most effective methods to employ. Listed below are the vital parts in order of priority of demolition for each preferred method. In each case, completion of the first *two* steps will render the unit inoperative. Completion of the additional steps listed will further destroy the unit.

*a. Demolition by Explosives* (fig. 133). Place as many of the following charges as the situation permits and detonate them simultaneously with detonating cord and a suitable detonator:

- (1) A ½-pound charge on the fuel pump and a ½-pound charge on the carburetor.



LEFT SIDE



RIGHT SIDE

Figure 133. Placement of charges.

- (2) A 2-pound charge behind the water pump.

*Note.* The above charges are the minimum requirement for this method.

- (3) Two 1-pound charges behind the manifold.
- (4) A 2-pound charge on engine head.
- (5) A 2-pound charge on engine block.
- (6) A 1-pound charge on generator.

*b. Demolition by Mechanical Means.* Use sledge hammers, crow-bars, picks, axes, or any other heavy tools which may be available, together with the tools normally included with the engine, to destroy the following:

- (1) The fuel pump and carburetor.
- (2) The water pump.

*Note.* The above steps are the minimum requirement for this method.

- (3) The manifold.
- (4) The generator.
- (5) The spark plugs.

## 252. Other Demolition Methods

If the situation prohibits employing either of the preferred methods, use the following, either singly or in combination.

*a. By Weapons Fire.* Fire on the engine with the heaviest weapons available.

*b. By Scattering and Concealment.* Remove all easily accessible vital parts such as the carburetor, fuel pump, generator, and starter and scatter them through dense foliage, bury them in dirt or sand, or throw them in a lake, stream, well, or other body of water.

*c. By Burning.* Pack rags, clothing, or canvas under and around the unit. Saturate this packing with gasoline, oil, or diesel fuel, and ignite.

*d. By Submersion.* Totally submerge the unit in a body of water to provide some water damage and concealment. Salt water will do the greatest damage to metal parts.

*e. By Misuse.* Perform the steps listed below to make the unit in-operative.

- (1) Drain the engine radiator and crankcase.
- (2) Run the unit at full speed until failure occurs.

## 253. Training

All operators should receive thorough training in the destruction of the engine. Simulated destruction, using all the methods listed above, should be included in the operator training program. It must be emphasized in training that demolition operations are usually necessitated by critical situations, when the time available for destruction is limited. For this reason it is necessary that operators be thoroughly familiar with all methods of destruction and be able to carry out demolition instructions without reference to this or any other manual.



# APPENDIX I

## REFERENCES

---

### 1. Dictionaries of Terms and Abbreviations

- SR 320-5-1 Dictionary of United States Army Terms.
- SR 320-50-1 Authorized Abbreviations.

### 2. Index of Publications

- SR 110-1-1 Index of Army Motion Pictures, Kinescope Recordings, and Film Strips.
- SR 310-20-3 Index of Training Publications.
- SR 310-20-4 Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrications Orders, and Modification Work Orders.
- SR 310-20-5 Index of Administrative Publications.
- SR 310-20-6 Index of Blank Forms.

### 3. Lubrication Order

- LO 5-5167 Lubrication Order.

### 4. Preparation for Export Shipment

- TB 5-9711-1 Preparation of Corps of Engineers Equipment for Oversea Shipment.
- TB 5-9713-1 Preparation for Export, Spare Parts for Corps of Engineers Equipment.

### 5. Preventive Maintenance

- TB 5-5167-1 Preventive Maintenance Services, Engines, Gasoline, Hercules Models JXC and JXD.

### 6. Training Aids

- FM 21-8 Military Training Aids.

### 7. Other Publications

- TM 9-1826C Carburetors and Governors (Zenith)
- TM 5-9715 Preparation of Corps of Engineers Equipment for Storage.

### 8. Painting Instructions

- TM 9-2851 Painting Instructions for Field Use.

# APPENDIX II. IDENTIFICATION OF REPLACEABLE PARTS

## Section I. STANDARD HARDWARE—JXC ENGINE

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
							BEARING, shielded, ball, #204.....	1
							BEARING, ball, #203.....	1
							BOLT, hex hd, $\frac{1}{2}$ "-13 NC x $1\frac{1}{4}$ ".....	2
							BOLT, hex hd, $\frac{1}{4}$ "-20 NC x $1\frac{1}{4}$ ".....	1
							BOLT, hex hd, $\frac{3}{8}$ "-16 NC x $\frac{3}{8}$ ".....	2
							BOLT, hex hd, $\frac{5}{8}$ "-16 NC x $1\frac{1}{4}$ ".....	4
							BOLT, $\frac{1}{2}$ "-20 NC x $1\frac{1}{32}$ ".....	4
							BOLT, $\frac{5}{8}$ "-16 NC x $1\frac{1}{4}$ ".....	4
							DOWEL, $\frac{1}{2}$ " x $\frac{3}{8}$ ".....	2
							ELBOW, $\frac{1}{4}$ ".....	1
							FASTENER, sems #6-32 NC x $\frac{1}{2}$ ".....	3
							FASTENER, sems #10-32 NF x $\frac{1}{16}$ ".....	2
							FASTENER, sems #10-24 NC x $\frac{3}{8}$ ".....	4
							FERRULE, tube, $\frac{1}{8}$ ".....	2
							HOSE, 2" x $9\frac{1}{2}$ ".....	1
							HOSE, 2" x 11".....	1
							KEY, Woodruff, #2.....	2
							KEY, Woodruff, #3.....	2
							KEY, Woodruff, #5.....	1
							KEY, Woodruff, #6.....	1
							KEY, Woodruff, #8.....	1
							KEY, Woodruff, #91.....	3

1	NUT, castellated, 1/4"-20 NF
1	NUT, hex, 1/4"-20 NC
1	NUT, hex, 1/4"-28 NF
7	NUT, hex, 3/16"-24 NF
4	NUT, hex, 3/8"-16 NC
3	NUT, hex, 1/2"-20 NF
3	NUT, hex, 3/4"-16 NF
1	NUT, lock, 1/4"-20 NF
5	NUT, slotted, 1/2"-20 NF
2	NUT, square, #10-32 NF
2	NUT, square, 1/4"-20 NC
1	NUT, tube, 3/4"
4	PIN, cotter, 1/32" x 3/4"
1	PIN, cotter, 1/32" x 1"
1	PIN, groov, 1/4" x 3/4"
1	PIN, taper, #1 x 3/4"
1	PIPE, 1/4" x 13"
5	PLUG, pipe, slotted, 1/4"
1	PLUG, welch, 1/16" dia
2	PLUG, pipe, std, 1/8"
2	PLUG, pipe, std, 3/8"
1	PLUG, pipe, std, 1/4"
2	PLUG, expansion, 3/8"
2	SCREW, bdg hd, #8-32 NC x 1/4"
2	SCREW, bdg hd, #10-32 NF x 3/16"
3	SCREW, cap, 1/4"-20 NC x 3/4"
7	SCREW, cap, 1/8"-18 NC x 1/2"
4	SCREW, cap, 1/8"-18 NC x 3/4"
10	SCREW, cap, 1/8"-18 NC x 3/8"
1	SCREW, cap, 1/8"-24 NF x 1 1/4"
1	SCREW, cap, 3/8"-16 NC x 3/4"
4	

**Section I. STANDARD HARDWARE—JXC ENGINE—Continued**

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $\frac{3}{4}$ "	4
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $\frac{7}{8}$ "	20
							SCREW, cap, $\frac{3}{8}$ "-16 NC x 1"	13
							SCREW, cap, $\frac{3}{8}$ "-16 x $1\frac{1}{8}$ "	4
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $1\frac{1}{4}$ "	12
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $1\frac{3}{4}$ "	3
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $1\frac{3}{4}$ "	9
							SCREW, cap, $\frac{7}{16}$ "-14 NC x $1\frac{1}{4}$ "	2
							SCREW, cap, $\frac{7}{16}$ "-14 NC x $1\frac{3}{4}$ "	2
							SCREW, cap, $\frac{7}{16}$ "-14 NC x 2"	8
							SCREW, cap, $\frac{1}{2}$ "-13 NC x $\frac{7}{8}$ "	7
							SCREW, cap, $\frac{1}{2}$ "-13 NC x 1"	4
							SCREW, cap, $\frac{1}{2}$ "-13 NC x $1\frac{1}{4}$ "	1
							SCREW, cap, $\frac{1}{2}$ "-13 NC x $1\frac{1}{4}$ "	2
							SCREW, cap, $\frac{1}{2}$ "-13 NC x 2"	20
							SCREW, cap, $\frac{1}{2}$ "-13 NC x 3"	3
							SCREW, cap, $\frac{5}{8}$ "-11 NC x $1\frac{1}{4}$ "	2
							SCREW, fl hd, #6-32 NC x $\frac{3}{32}$ "	1
							SCREW, fl hd, #10-32 NF x $\frac{1}{4}$ "	2
							SCREW, fl hd, #10-32 NF x $\frac{5}{16}$ "	2
							SCREW, fl hd, #10-32 NF x $1\frac{1}{4}$ "	1
							SCREW, fl hd, $\frac{1}{4}$ "-20 NC x 1"	2
							SCREW, rd hd, #6-32 NC x $\frac{1}{4}$ "	1

SCREW, rd hd, #8-32 NC x $\frac{1}{16}$ "	2
SCREW, rd hd, #10-32 NF x $\frac{1}{16}$ "	4
SCREW, rd hd, #10-32 NF x $\frac{3}{16}$ "	6
SCREW, rd hd, #10-32 NF x $1\frac{1}{2}$ "	1
SCREW, set, hex hd, $\frac{5}{16}$ "-24 NF x $1\frac{3}{4}$ "	1
SCREW, set, hex hd, $\frac{3}{8}$ "-16 NC x $\frac{3}{4}$ "	1
SCREW, set, sq hd, $\frac{5}{16}$ "-24 NF x 1"	2
UNION, tube, $\frac{1}{2}$ "	2
VALVE, glove, $\frac{1}{4}$ "	1
WASHER, lock, #6	6
WASHER, lock, #8	5
WASHER, lock, #10	22
WASHER, lock, $\frac{1}{4}$ "	9
WASHER, lock, $\frac{5}{16}$ "	12
WASHER, lock, $\frac{3}{8}$ "	69
WASHER, lock, $\frac{1}{16}$ "	8
WASHER, lock, $\frac{1}{2}$ "	37
WASHER, lock, $\frac{5}{8}$ "	6
WASHER, plain, $\frac{5}{16}$ "	2
WASHER, plain, $\frac{1}{2}$ "	1
WASHER, plain, $\frac{3}{4}$ "	1
WASHER, skpf, #10	3

## Section II. STANDARD HARDWARE—JXD ENGINE

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
							BEARING, shielded, ball, #204	1
							BEARING, ball, #203	1
							BOLT, carriage, 1/4"-20 NC x 1 1/4"	1
							BOLT, carriage, 3/8"-16 NC x 3/4"	3
							BOLT, carriage, 3/8"-16 NC x 1"	2
							BOLT, carriage, 3/8"-16 NC x 1 1/4"	2
							BOLT, 1/2"-13 NC x 1 1/4"	2
							BOLT, 1/2"-20 NF x 1 1/32"	4
							BOLT, 3/8"-11 NC x 1 1/4"	4
							DOWEL, 1/2" x 5/8"	2
							ELBOW, 1/4"	1
							FASTENER, sems, #6-32 NC x 3/4"	3
							FASTENER, sems, #10-24 NC x 5/8"	4
							FASTENER, sems, #10-32 NF x 7/16"	2
							FERRULE, tube, 1/4"	2
							HOSE, 2" x 9 1/2"	1
							HOSE, 2" x 11"	1
							KEY, Woodruff, #2	3
							KEY, Woodruff, #3	2
							KEY, Woodruff, #6	1
							KEY, Woodruff, #8	1
							KEY, Woodruff, # 91	3
							NUT, castalated, 1/2"-20 NF	1

NUT, hex, #10-32 NF	3
NUT, hex, ¼"-20 NC	1
NUT, hex, ¼"-28 NF	1
NUT, hex, ⅝"-24 NF	5
NUT, hex, ⅝"-16 NC	7
NUT, hex, ⅝"-24 NF	2
NUT, hex, ⅝"-20 NF	3
NUT, hex, ¼"-20 NC	2
NUT, hex, ¼"-16 NF	3
NUT, locking, ⅝"-20 NF	1
NUT, slotted, hex, ⅝"-20 NF	5
NUT, square, #10-32 NF	1
NUT, square, ¼"-20 NC	2
NUT, tube, hex, ⅝"	1
PIN, cotter, ⅝₂" x 1"	1
PIN, cotter, ⅝₂" x ¼"	4
PIN, groove, ⅝" x ⅝"	1
PIN, taper, #1 x ¼"	1
PIPE, ¼" x 13"	1
PLUG, pipe, csk hd, ⅝"	1
PLUG, expansion, ⅝"	4
PLUG, pipe, slotted, ⅝"	6
PLUG, pipe, slotted, ¼"	1
PLUG, pipe, std, ⅝"	2
PLUG, pipe, std, ¼"	2
PLUG, pipe, std, ⅝"	1
PLUG, welch, ⅝₁₆" dia.	1
SCREW, bdg hd, #8-32 NC x ¼"	2
SCREW, bdg hd, #10-32 NF x ⅝"	3
SCREW, cap, ¼"-20 NC x ¼"	7
SCREW, cap, ⅝₁₆"-18 NC x ¼"	4

## Section II. STANDARD HARDWARE—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
							SCREW, cap, $\frac{1}{16}$ "-18 NC x $\frac{3}{4}$ "	10
							SCREW, cap, $\frac{3}{16}$ "-24 NF x $1\frac{1}{4}$ "	1
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $\frac{3}{4}$ "	4
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $\frac{3}{4}$ "	4
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $\frac{3}{4}$ "	20
							SCREW, cap, $\frac{3}{8}$ "-16 NC x 1"	15
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $1\frac{1}{2}$ "	4
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $1\frac{1}{2}$ "	12
							SCREW, cap, $\frac{3}{8}$ "-16 NC x $1\frac{1}{4}$ "	10
							SCREW, cap, $\frac{3}{16}$ "-14 NC x $1\frac{1}{4}$ "	2
							SCREW, cap, $\frac{3}{16}$ "-14 NC x 2	8
							SCREW, cap, $\frac{1}{2}$ "-13 NC x $\frac{3}{4}$ "	7
							SCREW, cap, $\frac{1}{2}$ "-13 NC x 1"	4
							SCREW, cap, $\frac{1}{2}$ "-13 NC x $1\frac{1}{4}$ "	2
							SCREW, cap, $\frac{1}{2}$ "-13 NC x $1\frac{1}{2}$ "	2
							SCREW, cap, $\frac{1}{2}$ "-13 NC x 2"	20
							SCREW, cap, $\frac{3}{8}$ "-11 NC x $1\frac{1}{2}$ "	2
							SCREW, fl hd, #6-32 NC x $\frac{5}{32}$ "	1
							SCREW, fl hd, #8-32 NC x $\frac{5}{16}$ "	1
							SCREW, fl hd, #8-32 NC x $\frac{5}{16}$ "	1
							SCREW, fl hd, #10-24 NC x $1\frac{1}{4}$ "	4
							SCREW, fl hd, #10-32 NF x $\frac{3}{16}$ "	2
							SCREW, hex hd, #6-32 NC x $\frac{3}{16}$ "	1



1	SCREW, fl hd, #10-32 NF x 1½"
2	SCREW, fl hd, #12-24 NC x ¾"
2	SCREW, fl hd, #12-24 NC x 1"
2	SCREW, fl hd, ¼"-20 NC x 1½"
1	SCREW, hex hd, #6-32 NC x ¾e"
1	SCREW, rd hd, #6-32 NC x ¾e"
1	SCREW, rd hd, #8-32 NC x ¾e"
2	SCREW, rd hd, #8-32 NC x ¾e"
4	SCREW, rd hd, #10-32 NF x ¾e
6	SCREW, rd hd, #10-32 NF x ¾"
1	SCREW, rd hd, #10-32 NF x 1½"
3	SCREW, set, allen hd, #10-24 NC x ¾"
2	SCREW, set, hex hd, ¾"-16 NC x ¾"
2	SCREW, set, sq hd, ¾e"-24 NF x 1"
2	SCREW, clamp, ¼"-20 NC x 1½"
1	STUD, #10-32 NC x ¾e"
2	UNION, tube, ⅝"
1	VALVE, globe, ¼"
6	WASHER, lock, #6
5	WASHER, lock, #8
29	WASHER, lock, #10
11	WASHER, lock, ¼"
12	WASHER, lock, ⅝e"
69	WASHER, lock, ¾"
8	WASHER, lock, ¾e"
35	WASHER, lock, ½"
6	WASHER, lock, ⅝"
1	WASHER, lock, ¾"
1	WASHER, lock, light, ½"
1	WASHER, plain, #6
1	WASHER, plain, #8

## Section II. STANDARD HARDWARE—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
							WASHER, plain, #10.....	1
							WASHER, plain, 5/16".....	2
							WASHER, plain, 1/2".....	1
							WASHER, plain, 3/4".....	1
							WASHER, skpf, #10.....	3

## Section III. REPLACEABLE PARTS LIST—JXC ENGINE

2	4	646	22065-B				GASKET, bellhousing.....	1
	5	646	24427-D				BELLOUSING.....	1
	6	646	45853-E				CRANKSHAFT.....	1
3	10	646	15471-C				RING GEAR, flywheel.....	1
	8	646	5046-A				CLAMP.....	2
	9	646	5-B5699				HOSE, air cleaner.....	1
	10	646	22066-A				ADAPTER, starting motor.....	1
	13	646	4068-A				SCREW, valve cover.....	4
4	14	646	40006-B				COVER, valve.....	2
	15	646	41005-B				GASKET, valve cover.....	2
	6	646	40140-A				TUBE, oil level gage.....	1
	7	646	3333-A				WASHER, oil level gage.....	1
	8	646	40713-A				GASKET, oil filter and breather tube.....	1

9	646	7218-A	GASKET, water inlet pipe	1
12	646	4343-A	BRACKET, distributor attaching	1
1	646	879272	CHOKE	1
2	646	5-B4622	BRACKET, control	1
3	646	73-1	SWITCH, ignition	1
4	646	5700	SWITCH, starting	1
23	646	40144-AS	OIL LEVEL GAGE ASSEMBLY	1
29	646	AN-7	PLUG, spark	6
2	646	45780-A	TUBE, governor lubricating	1
3	646	14945-A	UNION, governor lubricating tube	1
4	646	14966-A	ELBOW, governor lubricating tube	1
6	646	581-60	GAGE, oil pressure	1
7	646	692-E	GAGE, water temperature	1
8	646	AM 4301	AMMETER	1
9	646	IG-4065	COIL, ignition	1
10	646	40038-AS	OIL FILLER AND BREATHER CAP ASSEMBLY	1
11	646	40035-A	OIL FILLER AND BREATHER PIPE ASSEMBLY	1
14	646	40284-B	PULLEY, fan drive	1
15	646	40806-A	GRAB, starting crank	1
16	646	45468-A	BELT, fan	1
33	646	5046-A	CLAMP	4
6	646	22660-B	PIPE, water outlet	1
8	646	43711-A	ELBOW, bypass tube	1
9	646	43706-C	TUBE, bypass	1
10	646	4275-A	CLAMP, water pump discharge hose	2
11	646	22058-A	HOSE, water pump discharge	1
12	646	2223-A	CLAMP, bypass tube hose	4
13	646	4453-A	HOSE, bypass tube	2
14	646	40652-B	PIPE, water inlet	1

**Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued**

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
33	16			646	60-A		PLUG, water inlet pipe	1
	20			646	15-B1844		SUPPORT, front	1
	22			646	M671-B3198		HOSE, lower	1
	25			646	D 2236		RADIATOR	1
35				646	43714-AS		WATER OUTLET PIPE AND THERMOSTAT ASSEMBLY.	1
	1			646	6519-BS		THERMOSTAT	1
	2			646	44733-C		HOUSING, thermostat	1
	3			646	43704-A		GASKET, thermostat housing	1
49				646	E-T-15		BATTERY	1
	1			646	40109-B2		CABLE TUBE ASSEMBLY	1
57	4			646	10-B3761		GASKET	1
	7			646	M686-B3443		HOSE, upper	1
8				646	29-507		BRACKET, choke control cable	1
	9			646	26-593		LEVER AND SHAFT ASSEMBLY, choke	1
11				646	1-B1182		BAR, radiator brace	1
	13			646	1-B2975		BRACE, radiator	1
58				646	E783		AIR CLEANER ASSEMBLY	1
	1			646	2P-4097		BODY ASSEMBLY	1
2				646	2P-4035		COVER	1
3				646	P-4100		TUBE, outlet	1
4				646	P-5790		SKIRT ASSEMBLY	1
5				646	P-1973		SCREEN	1
6				646	P-2690		BOLT, oil cup retaining clamp	1

7	646	P-2949	WASHER, oil cup retaining clamp	1
8	646	P-3002	CLAMP, oil cup retaining	1
9	646	P-5300	NUT, square	3
10	646	P-4251	OIL CUP ASSEMBLY	1
11	646	P-2039	BAFFLE, oil	1
14	646	P-3082	CUP, oil	1
15	646	P-2147	BAND ASSEMBLY	2
16	646	P-2158	BRACKET	2
17	646	P-2029	BAND	2
20	646	P-5304	SCREW	2
	646	1-B5699	BRACKET, air cleaner	1
	646	P-2128	TRANSFER INSTRCTIONS	1
	646	F-2989	OIL CUP RETAINING CLAMP ASSEMBLY (consists of items 6, 7, 8, and 9).	1
60	646	2X3G1	FUEL FILTER ASSEMBLY	1
1	646	F35X1	NIPPLE, pipe	1
2	646	F7X130	HEAD, filter	1
3	646	F10X1	BAIL ASSEMBLY	1
4	646	F8X1	BOWL, filter	1
5	646	F1X38	GASKET, bowl	1
6	646	F2X3F3	FILTER ELEMENT ASSEMBLY	1
61	646	43464-AS	GOVERNOR LUBRICATING LINE ASSEMBLY	1
7	646	11793-A	UNION, governor pressure lubrication	2
8	646	14946-A	NUT, governor pressure lubrication tube	2
9	646	14947-A	FERRULE, governor pressure lubrication tube	2
1	646	43814-B	GASKET, manifold	1
2	646	40034-E	MANIFOLD	1
3	646	14895-A	STUD, manifold	10
4	646	1388-A	WASHER, manifold stud	10
5	646	13123-A	NUT, manifold stud	10

## Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit	
		Code No.	Part No.	Code No.	Part No.				
62	6			646	305-A		PLUG, manifold	3	
	7			646	4640-A		SETSCREW	1	
	8			646	40028-A		GASKET, companion flange	1	
	9			646	40027-A		FLANGE, companion	1	
	10				646	4699-A		SCREW, companion flange	2
					646	22240-CS		OIL FILTER ASSEMBLY	1
	67	1			646	18245-A		FITTING, top	1
		2			646	2448-A		GASKET, top fitting	1
		3			646	2445-A		SHELL	1
		4			646	2406-A		PLATE, top, element	1
5				646	2410-A		SPRING, element compression	1	
6				646	22251-BS		ELEMENT ASSEMBLY	1	
7				646	2407-A		PLATE, bottom, element	1	
8				646	2408-A		WASHER, element, cork	1	
9				646	2409-A		WASHER, element	1	
10				646	2405-A		COIL, spacer, element	1	
11			646	22252-A		TUBE, outlet	1		
12			646	2411-A		NUT, element retaining	1		
13			646	2452-A		GASKET, shell	1		
14			646	7330-A		TUBE, inlet	1		
15			646	22244-C		BASE	1		
16			646	8578-A		PLUG, differential valve	1		
17			646	8575-A		GASKET, oil reversal and differential valve plug	2		

18	646	8577-A	SPRING, differential valve.....	1
19	646	27250-A	BALL, differential valve.....	1
20	646	40691-A	GASKET, attaching.....	1
24	646	22249-A	SPRING, oil reversal valve.....	1
25	646	22248-A	PISTON, oil reversal valve.....	1
26	646	2379-A	PLUG, oil reversal valve.....	1
27	646	8579-A	PLUG, drain.....	1
72	646	2268-A	WRENCH, oil pump adjusting.....	1
2	646	2253-A	SPREADER, connecting rod.....	1
3	646	11913-A	DRIVER, valve guide.....	1
4	646	13233-A	GUIDE, push rod.....	1
5	646	13232-A	DRIVER, idler bushing.....	1
6	646	13567-A	DRIVER, cam bearing.....	1
73	646	DA130100	RADIATOR ASSEMBLY.....	1
1	646	145812	CAP, filler.....	1
2	646	F-25014	TUBE, filler.....	1
3	646	130153	EXTENSION, filler tube.....	1
4	646	130180	CLIP.....	2
5	646	130108	TANK, top.....	1
6	646	F-16134	CASTING, flange.....	3
7	646	130105	HEADSHEET, top.....	1
8	646	D-130101	CORE ASSEMBLY.....	1
9	646	D-130109	CHANNEL, core, left hand.....	1
10	646	IR-72	CASTING, mounting.....	2
11	646	130181	CLIP, mounting.....	1
14	646	5-B3908	RADIATOR BLANK.....	1
15	646	10-B3761	GASKET.....	2
16	646	130137	WEBBING.....	2
17	646	130111	TANK, bottom.....	1
18	646	130106	HEADSHEET, bottom.....	1
19	646	D-130110	CHANNEL, core, right hand.....	1

### Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
73	20			646	130122		SHROUD, fan	1
74	1			646	40697-B		SHAFT, water pump	1
	3			646	40198-A		GEAR, distributor drive	1
	4			646	40167-A		BUSHING	1
	5			646	23116-A		RETAINER, oil	1
	6			646	4661-A		WASHER, cork	1
	7			646	43169-A		BODY	1
	10			646	8126-A		WASHER, thrust	2
	11			646	1157-A		PIN	1
	12			646	22165-A		IMPELLER	1
	13			646	22164-A		GASKET	1
	14			646	4275-A		CLAMP, hose	2
	15			646	22058-A		HOSE	1
	16			646	23114-A		BUSHING	1
	17			646	43170-A		COVER	1
	18			646	21265-A		GLAND, packing	2
	19			646	22178-A		NUT, packing	1
	20			646	21270-A		PACKING SET	1
	21			646	749-A		CUP, grease	2
	24			346	22175-A		BUSHING, packing	1
	25			646	22166-A		PACKING SET	1
	26			646	22177-A		NUT, packing	1
	28			646	40159-DS		WATER PUMP ASSEMBLY	1



29	646	22149-A	GASKET	2
30	646	40183-B	SHAFT, drive	1
31	646	14904-A	WASHER, thrust	2
32	646	45728-B	BUSHING	1
33	646	40180-B	CRADLE	1
34	646	22195-B	GEAR, driving	1
77	646	A-11236	FAN ASSEMBLY	1
2	646	C-2673	WASHER, clamp	1
3	646	A-11239	BRACKET	1
6	646	C-3803	SCREW, adjusting	1
7	646	C-2662	WASHER	1
8	646	C-11238	SPINDLE	1
9	646	C-5098	RING, snap	1
10	646	C-2388	RETAINER, cork washer	1
11	646	C-3814	WASHER, cork	1
12	646	C-2389	WASHER	1
13	646	C-7067	GASKET	1
14	646	C-3296	BEARING, roller, taper	2
15	646	C-11237	HUB	1
17	646	C-4013	WASHER, bearing clamp	1
19	646	C-2283	PIN, cotter	1
20	646	C-2016	GASKET	1
21	646	C-7487	CAP, front	1
22	646	B-F4310	FAN BLADE ASSEMBLY	1
25	646	A-2768	SPIDER	1
26	646	591	RIVET, rd hd	16
79	646	44128-CS	OIL PUMP ASSEMBLY	1
1	646	45266-A	GEAR, oil pump drive	1
2	646	4809-A	PIN, oil pump drive gear	1
3	646	2047-A	WASHER, oil pump drive gear	1
4	646	45281-C	BODY, oil pump	1

## Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit	
		Code No.	Part No.	Code No.	Part No.				
79	5			646	42811-A		TUBE, oil pump drive gear lube	1	
	6			646	42812-A		CLIP, oil pump drive gear lube tube	1	
	8			646	45283-A		GEAR, oil pump, large	1	
	9			646	4387-A		RING, snap, oil pump	1	
	10			646	44129-B		COVER, oil pump	1	
	13			646	45285-A		GEAR, oil pump, small	1	
	14			646	22124-A		SHAFT, oil pump	1	
	15			646	45282-A		SHAFT, oil pump idler	1	
	16			646	14946-A		NUT, oil pump drive gear lube tube	1	
	17			646	14947-A		FERRULE, oil pump drive gear lube tube	1	
	18			646	6260-A		ELBOW, oil pump drive gear lube tube	1	
	19			646	1385-A		PISTON, pressure regulator	1	
	20			646	1347-A		SPRING, pressure regulator	1	
	21			646	22129-A		BUTTON, pressure regulator	1	
	22			646	1660-A		NUT, pressure regulator	1	
	26			646	342-A		LOCKWASHER, oil pump attaching screw	3	
	27			646	22119-A		GASKET, oil pump attaching	1	
					646	42811-AS		OIL PUMP DRIVE GEAR LUBE TUBE ASSEMBLY (consists of items 5, 6, 16, and 17).	1
	80	1			646	44087-B		GASKET, oil pan attaching	2
		4			646	44089-BS		BAFFLE PLATE ASSEMBLY	1
5				646	44090-B		SCREEN	1	
7				646	200323-A		WASHER, baffle plate felt	1	
8				646	43381-D		PAN, oil	1	

1	GOVERNOR ASSEMBLY	1
1	SHAFT, spider	1
1	GEAR, governor	1
1	FLANGE, body	1
1	BEARING	1
1	HUB, spider	1
1	SPIDER, governor	1
2	PIN, weight	2
2	WEIGHT, governor	2
1	SLEEVE, thrust	1
1	BEARING, thrust	1
1	YOKE	1
1	GASKET	1
1	BODY	1
1	PLUG, welch	1
1	BEARING, rocker shaft	1
2	SPRING, bumper	2
1	SCREW, bumper	1
1	PLUG, welch	1
1	BUSHING	1
1	SEAL, oil	1
2	RING, snap	2
1	SHAFT, rocker	1
1	THROTTLE LEVER ASSEMBLY, carburetor	1
1	LEVER, throttle	1
1	HUB, throttle lever	1
1	SCREW, adjusting	1
1	SPRING, governor	1
1	STUD, shoulder	1
1	LEVER, throttle control	1
1	CONTROL ROD ASSEMBLY, governor	1

GC-604	646	1
G-4036	646	3
G-3061	646	4
G-4149	646	5
X-310	646	8
G-6558	646	9
G-5720	646	10
G-5950	646	11
G-3725	646	12
G-4487	646	13
X-339	646	14
G-6026	646	17
G-3184	646	18
G-6461	646	19
X-607	646	20
X-328	646	21
SN-266	646	23
G-5513	646	24
X-454	646	25
C-3168	646	29
X-800	646	30
G-3494	646	31
G-6523	646	33
A-3863	646	
C-8753	646	
C-9300-1	646	34
G-4070	646	36
SN-1413	646	37
G-2915	646	40
H-2562-B-3840	646	
A-1956	646	

## Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
83	3			646	G-7094		ROD, control	1
				646	X-973		BALL JOINT ASSEMBLY (consists of items 4 through 8).	1
				646	X-971		BALL JOINT ASSEMBLY (consists of items 9 through 13).	1
84				646	1521117		FUEL PUMP ASSEMBLY	1
	1			646	855135		PLUG, valve	2
	2			646	855136		GASKET, valve plug	2
	3			646	856270		SPRING, valve	2
	4			646	855493		SCREW, top cover	6
	5			646	855064		LOCKWASHER, cover screw	6
	6			646	855003		VALVE	2
	7			646	1523358		COVER, top	1
	8			646	855213		NUT, pull rod	1
	9			646	131200		LOCKWASHER, pull rod	1
	10			646	855029		WASHER, diaphragm alinement	1
	11			646	1521194		PROTECTOR, diaphragm, upper	1
	12			646	855035		DIAPHRAGM	1
	13			646	855078		PROTECTOR, diaphragm, lower	1
	14			646	855012		GASKET, pull rod	1
	15			646	855250		ROD, pull	1
	16			646	1523352		BODY	1
17			646	1521289		PIN, rocker arm	1	

18	646	855016	PIN, link.....	2
19	646	855777	ARM, rocker.....	1
20	646	855374	LINK.....	2
21	646	855017	CLIP, link pin.....	4
22	646	855532	CAP, spring.....	1
23	646	855253	SPRING, rocker arm.....	1
24	646	855229	GASKET, bottom cover.....	1
25	646	855228	COVER, bottom.....	1
26	646	132108	SCREW, bottom cover.....	3
27	646	855253	SPRING, diaphragm.....	1
28	646	5590152	BAIL ASSEMBLY.....	1
29	646	5590156	BOWL, glass.....	1
30	646	5590037	GASKET, bowl.....	1
31	646	854009	SCREEN.....	1
	699	S1111B	CARBURETOR ASSEMBLY.....	1
1	699	C149-17	PLUG, filter.....	1
2	699	T56-31	WASHER, fibre, filter plug.....	1
3	699	C150-1	SCREEN, fuel filter.....	1
4	699	C148-11A	BODY, fuel union.....	1
5	699	T56-15	WASHER, fibre, union body.....	1
6	699	C138-81	HEAD, filter.....	1
7	699	T56-3	WASHER, fibre, filter head.....	1
8	699	T188-10	SCREW, stop lever.....	1
9	699	CT63-9	PIN, taper, stop lever.....	2
10	699	T8810-9	SCREW, lever, clamp.....	1
11	699	C24-10PPX3	LEVER, throttle clamp.....	1
12	699	C-29-322	SHAFT AND STOP LEVER, throttle.....	1
13	699	C151-3X3	RETAINER, shaft packing.....	1
14	699	C757-8	WASHER, shaft packing.....	1
15	699	CB9-3	BUSHING, throttle shaft.....	2
17	699	C46-38	NEEDLE, idle adjusting.....	1

## Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
85	18			699	C111-17		SPRING, adjusting needle	1
	19			699	C55-7-12		JET, idle	1
	20			699	T56-23		WASHER, fibre, fuel valve seat	1
	21			699	C81-1-35		VALVE AND SEAT, fuel	1
	22			699	C120-15		AXLE, float	1
	23			699	C142-21		GASKET, bowl to body	1
	24			699	B38-24-25		VENTURI	1
	25			699	C97-15-12		VALVE, power jet	1
	26			699	CR41-3		VALVE, pump check	1
	27			699	C105-19		SHAFT, choke	1
	28			699	C110-1		CLAMP, bracket tube	1
	29			699	T158-10		SCREW, tube clamp	1
	30			699	C106-127		LEVER, choke	1
	31			699	T45-8		LOCK WASHER, shaft nut	1
	32			699	T22S8		NUT, choke shaft	1
	33			699	T158-6		SCREW, lever swivel	1
	34			699	C140-7		SCREW, bracket assembly	1
	35			699	C109-46		BRACKET, choke	1
	36			699	B3-62A		BOWL, fuel	1
	37			699	T56-24		WASHER, fibre, main jet	1
	38			699	C52-6-22		JET, main	1
	39			699	T56-23		WASHER, fibre, adjustment	2
	40			699	C71-24		ADJUSTMENT, main jet	1

41	---	---	699	T56-12	---	WASHER, fibre, passage plug.....	1
42	---	---	699	C138-53	---	PLUG, jet passage.....	1
43	---	---	699	C-52-12-18	---	JET, power and acceleration jet.....	1
44	---	---	699	T56-4	---	WASHER, fibre, power and acceleration jet.....	1
45	---	---	699	C138-24	---	PLUG, choke shaft hole.....	1
46	---	---	699	C101-22	---	PLATE, choke valve.....	1
47	---	---	699	NSS	---	LOCKWASHER, choke plate.....	2
48	---	---	699	T315B6-4	---	SCREW, choke plate.....	2
49	---	---	699	T56-48	---	WASHER, fibre, discharge jet.....	1
50	---	---	699	C66-22-1-70	---	JET, discharge.....	1
51	---	---	699	C77-18-19	---	JET, well vent.....	1
52	---	---	699	C85-26	---	FLOAT.....	1
53	---	---	699	C36-61X3	---	PUMP.....	1
54	---	---	699	B2-113F-1	---	BODY, throttle.....	1
56	---	---	699	T 30158	---	SCREW, venturi.....	1
57	---	---	699	---	---	BUSHING, lever.....	1
58	---	---	699	C138-38	---	SCREW, vacuum channel.....	1
59	---	---	699	C21-78	---	PLATE, throttle valve.....	1
60	---	---	699	C136-3	---	SCREW, throttle valve plate.....	2
61	---	---	699	C141-4-1	---	GASKET, flange.....	1
63	---	---	699	T311S12-12	---	SCREW, bowl to body.....	7
---	---	---	606	MAB-4085A	---	MOTOR, starting.....	1
---	---	---	606	EBA-11A	---	BENDIX DRIVE ASSEMBLY.....	1
1	---	---	606	MAB-1024E	---	BAND, cover.....	1
2	---	---	606	MG-77A	---	BEARING.....	2
3	---	---	606	MAB-2002	---	HEAD ASSEMBLY, commutator end.....	1
4	---	---	606	MZ-19	---	SPRING, brush.....	4
5	---	---	606	MZ-10343	---	BRUSH, grounded.....	2
6	---	---	606	MAB-30	---	INSULATION, field connection.....	1
7	---	---	606	MU-28	---	STUD, terminal.....	1
8	---	---	606	MAB-12	---	BRUSH, insulated.....	2

## Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
87	9			606	MU-39		WASHER, insulation, terminal stud, inner.	1
				606	MAB-3005S		FIELD COIL PACKAGE (consists of items 10, 11, 12, and 13).	1
	10			606	MAB-1007		COIL, field, upper left.	1
	11			606	MAB-1010		COIL, field, upper right.	1
	12			606	MAB-1008		COIL, field, lower right.	1
	13			606	MAB-1009		COIL, field, lower left.	1
	14			606	MAF-59		CONNECTOR, field coil.	2
	15			606	MN-21		PIN, dowel.	2
	19			606	MAB-31		WASHER, insulating, terminal stud, outer.	1
	20			606	MAB-85		BUSHING, insulating, terminal stud.	1
	21			606	MU-54		WASHER, thrust.	2
	22			606	MAB-2006		ARMATURE ASSEMBLY.	1
	24			606	MAB-2001		FRAME.	1
	25			606	PS-1115		HOUSING ASSEMBLY, pinion.	1
	26			606	GK-38		SCREW, pole shoe.	4
	27			606	EBA-1111		SHAFT AND PINION, Bendix.	1
	28			606	EB-108		WASHER, lock.	2
	29			606	EB-7807		SCREW, spring, shaft.	1
	30			606	EB-8705		SPRING, drive.	1
	31			606	EB8503		HEAD, Bendix drive.	1
	32			606	EB-7806		SCREW, spring, head.	1
	33			606	MG-77A		BEARING.	1



34	606	MAB-2040	BEARING ASSEMBLY, intermediate.....	1
36	606	GT-20A	BOLT, through.....	2
	606	IGC-4225-D	DISTRIBUTOR ASSEMBLY.....	1
1	606	IG-1323	CAP, distributor.....	1
2	606	IG-1320	ROTOR.....	1
3	606	IG-2671	CONDENSER.....	1
4	606	IGP-3028-A	CONTACT SET.....	1
9	606	IG-495	WICK, cam sleeve, felt.....	1
10	606	IGC-1067RL	PLATE, cam and stop.....	1
11	606	IGC-295	SPRING SET, weight.....	2
12	606	IGS-99	SPACER, cam.....	1
13	606	IGC-1065-RA	SHAFT, drive.....	1
14	606	IGS-104	WASHER, drive shaft thrust, upper.....	1
15	606	IG-694	CLAMP, cap.....	2
16	606	X-490-A	OILER, distributor base.....	1
17	606	IG-579-A	BEARING.....	2
18	606	IG-816-A	WASHER, thrust, advance arm.....	1
19	606	IG-90	WASHER, drive shaft thrust, lower.....	1
20	606	40199-A	GEAR, distributor drive.....	1
21	606	5813-A	PIN, distributor drive gear.....	1
22	606	IGC-2024-F-3	ARM, advance.....	1
23	606	X-1448	RIVET, cap spring tubular.....	2
24	606	IGC-2063	BASE ASSEMBLY.....	1
25	606	IG-1322	WEIGHT, governor.....	2
26	606	IGC-2012	PLATE, breaker.....	1
29	606	IG-676	CLIP, contact arm spring.....	1
30	606	IB-23	LOCKNUT, breaker contact.....	1
33	606	IG-514	PLUNGER, contact, distributor cap.....	1
34	606	IG-515-A	SPRING, distributor cap contact.....	1
	606	GEO-4810T	GENERATOR ASSEMBLY.....	1
	606	GBW-1024	BAND, cover.....	1

91

93

Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
93	2			606	GBM-21B		NUT, armature shaft	1
	3			606	12X-864		LOCK WASHER, armature shaft	1
	4			606	SP-196D		FAN, ventilating	1
	5			606	GAR-83C		COVER, commutator end	1
	6			606	DA-132		WASHER, outer felt	1
	8			606	GAB-188		WASHER, felt	1
	9			606	X-489-A		OILER	1
	10			606	GCJ-2012DS		BRUSH	3
	11			606	GCJ-1023RA		HOLDER ASSEMBLY, grounded brush	1
	14			606	GCJ-26A		ARM, insulated brush	2
	18			606	GAR-211		BUSHING, insulating	1
	19			606	GEO-1007G		COIL ASSEMBLY, left field	1
	20			606	TC-4302AT		REGULATOR, two charge	1
	23			606	GEO-1008J		COIL ASSEMBLY, right field	1
	24			606	GEO-2055A		FRAME	1
	25			606	MN-21A		PIN, dowel	2
	27			606	GK-38C		SCREW, pole shoe	2
	28			606	GBW-45A		SPRING, brush	2
	30			606	GCJ-51A		SPRING, third brush plate retaining	1
	31			606	GCJ-1014A		PLATE ASSEMBLY, third brush	1
	33			606	GCJ-1108A		HEAD ASSEMBLY, partial	1
	34			606	GR-32B		RETAINER, felt washer	1
	35			606	DA-39A		WASHER, felt retaining, plain	2

36	606	GBJ-25	GASKET, commutator end cover.....	1
41	606	22266-B	GEAR, generator drive.....	1
42	606	GAR-1177	THROWER, oil.....	1
44	606	GAR-96D	HEAD.....	1
45	606	X-394	OILER.....	1
46	606	GX-10	GASKET, bearing, retainer.....	1
47	606	GAR-95	WASHER, felt.....	1
48	606	GX-9A	RETAINER, bearing.....	1
49	606	G CJ-2047T	ARMATURE ASSEMBLY.....	1
50	606	GAR-171A	RING, snap.....	1
54	606	GT-20A	BOLT, through.....	26
104	646	6348-A	CAP SCREW, cylinder head.....	2
1	646	45914-A	HEAD, cylinder.....	1
2	646	1075-A	PLUG, pipe, cylinder head.....	1
3	646	12696-A	STUD, front water outlet pipe.....	1
4	646	14224-A	GASKET, flange.....	1
5	646	14526-A	STUD, rear water outlet pipe.....	1
6	646	3586-A	PLUG, cylinder head.....	1
7	646	44203-C	GASKET, cylinder head.....	1
8	646	40107-A	VALVE, intake.....	1
105	646	45814-A	VAVE, exhaust.....	6
2	646	43010-A	GUIDE, valve.....	6
3	646	40008-A	SPRING, valve.....	12
4	646	40011-A	KEY, valve spring.....	12
5	646	22013-A	RETAINER, spring.....	12
	646	43024-AS	VALVE TAPPET ASSEMBLY (consists of items 6, 7, and 8).....	12
6	646	2185-A	SCREW, tappet.....	12
7	646	2186-A	NUT, tappet.....	12
8	646	45812-A	PUSH ROD, tappet.....	12
9	646	22089-A	GUIDE, push rod.....	12

### Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit	
		Code No.	Part No.	Code No.	Part No.				
107	1			646	22024-B		GASKET, gear cover.....	1	
	4			646	40340-D		COVER, gear.....	1	
	5			646	14749-A		WASHER, water pump thrust screw.....	1	
	6			646	14599-A		SCREW, water pump thrust.....	1	
	7			646	11087-AS		SEAL ASSEMBLY, oil, gear cover.....	1	
	8			646	11784-A		SLEEVE, oil seal gear cover.....	1	
	9			646	2048-A		NUT, gear cover thrust screw.....	2	
	10			646	14594-AS		THRUST SCREW ASSEMBLY, gear cover.....	2	
	109				646	45375-BS		IDLER GEAR ASSEMBLY.....	1
		1			646	59-A		PLUG, pipe.....	1
2				646	40137-B		BUSHING, idler gear.....	1	
3				646	40136-AS		SHAFT, idler gear.....	1	
6				646	40135-B		GEAR, idler.....	1	
1				646	22107-A		THRUST WASHER, idler gear.....	1	
3				646	4642-A		DOWEL, crankshaft.....	1	
1				646	45688-D		CAMSHAFT.....	1	
2				646	2045-A		THRUST WASHER, camshaft.....	1	
3				646	2249-B		GEAR, camshaft.....	1	
111	4			646	11023-A		NUT, camshaft gear.....	1	
				646	43307-AS		CYLINDER GLOCK ASSEMBLY.....	1	
	2			646	1609-A		PLUG, cylinder expansion.....	8	
	3			646	40063-A		BEARING, camshaft, front and rear.....	2	
112				664	43598-B		SHELL, front main bearing.....	2	

7	646	40543-B	CAP, front main bearing	1
10	646	40544-B	CAP, intermediate main bearing	4
11	646	40542-B	CAP, center main bearing	1
14	646	42537-B	CAP, rear main bearing	1
15	646	4879-A	COVER, fuel pump hole	1
16	646	22564-A	GASKET, fuel pump hole cover	1
17	646	1048-A	SCREW, fuel pump hole cover	4
18	646	615-A	LOCK WASHER, fuel pump hole cover	4
113	646	3811-A	RING, compression	12
2	646	3811-A	RING, compression	6
3	664	3911-A	RING, oil control	6
4	646	22208-C	PISTON, plain, cast iron	6
5	646	22029-B	PIN, piston	6
6	646	22021-A	BUSHING, piston pin	12
114	646	43089-AS	CONNECTING ROD ASSEMBLY (includes items 1 through 8)	6
1	646	43102-A	ROD, connecting	6
2	646	14761-A	LOCK WASHER, piston pin lock screw	6
3	646	200287-A	LOCKSCREW, piston pin	6
4	646	22059-A	BOLT, connecting rod cap	12
5	646	45717-B	BEARING, connecting rod	12
6	646	NSS	CAP, connecting rod	6
7	646	21056-A	NUT, connecting rod cap	12
8	646	301-A	PIN, cotter, connecting rod cap nut	12
2	646	23693-C	FLYWHEEL	1
119	646	3543-B	OIL SEAL, bellhousing	1
123	646	43800-AS	MAIN BEARING SET	1
127	646	45718-B	BEARING, front main	2
1	646	45722-B	BEARING, intermediate main	8
2	646	42695-B	BEARING, rear main	2
3	646	45719-B	BEARING, center main	2
4	646	45719-B	BEARING, center main	2

## Section III. REPLACEABLE PARTS LIST—JXC ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
127	5			646	40065-A		BEARING, center camshaft.	2
	8			646	22771-C		SUPPORT, front.	1
131				092	X-5738		CLUTCH ASSEMBLY	1
	1			092	5747		PLATE, hub and back.	1
	2			092	A-1069		SPRING, release.	6
	3			092	116B-10		PLATE, driving.	1
	4			092	112B-10		DISC, friction driving.	2
	5			092	M115		RIVET, tubular.	12
	6			092	5732		PLATE, floating.	1
	7			092	1990		YOKE, adjusting.	1
	8			092	M641		RING, snap, yoke lever.	4
	9			092	106-A		PIN, lever.	4
	10			092	103-F		LEVER.	4
	11			092.	1968-A		PIN, lever link.	8
	12			092	119-B2		LINK, lever.	8
	13			092	M-945		BOLT, sleeve collar.	2
	14			092	117C-85		SLEEVE COLLAR ASSEMBLY.	1
	15			092	2137		BORE, sliding sleeve.	1
	16			092	M-645		NUT, sleeve collar.	2
	17			092	M-642		RING, snap, lever link pin.	8
	18			092	115		SPRING, adjusting pin.	1
19			092	2245		PIN, lock, adjusting.	1	

## Section IV. REPLACEABLE PARTS LIST—JXD ENGINE

2	4	646	22065-B	646	22065-B	1	GASKET, bellhousing.....
	5	646	25351-D	646	25351-D	1	BELLOUSING.....
	6	646	45853-E	646	45853-E	1	CRANKSHAFT.....
3	10	646	15471-C	646	15471-C	1	RING GEAR, flywheel.....
	10	646	22066-A	646	22066-A	1	ADAPTER, starting motor.....
	12	646	4068-A	646	4068-A	4	SCREW, valve cover.....
	13	646	40006-B	646	40006-B	2	COVER, valve.....
6	14	646	41005-B	646	41005-B	2	GASKET, valve cover.....
	8	646	40140-A	646	40140-A	1	TUBE, oil level gage.....
	9	646	3333-A	646	3333-A	1	WASHER, oil level gage.....
	10	646	40713-A	646	40713-A	1	GASKET, oil filler and breather tube.....
	11	646	7218-A	646	7218-A	1	GASKET, water inlet pipe.....
19	14	646	4343-A	646	4343-A	1	BRACKET, distributor attaching.....
	1	646	879272	646	879272	1	CHOKE.....
	2	646	8-B3841	646	8-B3841	1	BRACKET, control.....
	3	646	73-1	646	73-1	1	SWITCH, ignition.....
	4	646	5700	646	5700	1	SWITCH, starting.....
23	4	646	40111-BS	646	40111-BS	1	OIL LEVEL GAGE ASSEMBLY.....
29	1	646	AR 8-S	646	AR 8-S	6	PLUG, shielded, spark.....
	2	646	45780-A	646	45780-A	1	TUBE, governor lubricating.....
	3	646	14945-A	646	14945-A	1	UNION, governor lubricating tube.....
	4	646	14966-A	646	14966-A	1	ELBOW, governor lubricating tube.....
	6	646	581-60	646	581-60	1	GAGE, oil pressure.....
	7	646	692-E	646	692-E	1	GAGE, water temperature.....
	8	646	AM-4301	646	AM-4301	1	AMMETER.....
	9	646	CR-6003M	646	CR-6003M	1	COIL, ignition.....
	10	646	38939-A	646	38939-A	1	OIL FILLER AND BREATHER CAP ASSEMBLY.....

## Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit	
		Code No.	Part No.	Code No.	Part No.				
29	11			646	42578-CS		OIL FILLER AND BREATHER PIPE ASSEMBLY.	1	
	14			646	40284-B		PULLEY, fan drive	1	
	15			646	40867-BS		GRAB, starting crank	1	
	16			646	45468-A		BELT, fan	1	
	33	2			646	5046-A		CLAMP	4
		6			646	43700-B		PIPE, water outlet	1
	8			646	43711-A		ELBOW, bypass tube	1	
	9			646	43706-C		TUBE, bypass	1	
	10			646	8159-A		CLAMP, water pump discharge hose	1	
	11			646	40064-A		HOSE, water pump discharge	1	
	12			646	2223-A		CLAMP, bypass tube hose	1	
	13			646	4453-A		HOSE, bypass tube	1	
	14			646	43709-C		PIPE, water inlet	1	
	16			646	60-A		PLUG, water inlet pipe	1	
	20			646	15-B1844		SUPPORT, front	1	
	22			646	M671-B3198		HOSE, lower	1	
	25			646	D2236		RADIATOR	1	
35				646	43714-AS		WATER OUTLET PIPE AND THERMOSTAT ASSEMBLY.	1	
	1			646	6519-BS		THERMOSTAT	1	
	2			646	44733-C		HOUSING, thermostat	1	
	3			646	43704-A		GASKET, thermostat housing	1	



49	646	ET-15	BATTERY	1
52	646	42919-A	PIN, fuel pump drive	1
57	646	40109-B2	CABLE TUBE ASSEMBLY	1
	646	10-B3761	GASKET	1
	646	M686-B3443	HOSE, upper	1
	646	29-507	BRACKET, choke control cable	1
	646	26-593	LEVER AND SHAFT ASSEMBLY, choke	1
	646	1-B1182	BAR, radiator brace	1
	646	1-B2975	BRACE, radiator	1
	646	F140	AIR CLEANER ASSEMBLY	1
59	646	F140-800	TOP ASSEMBLY	1
	646	F140-07	ELEMENT, filter	1
	646	F140-851	BOWL	1
	646	30B-06	GASKET, base	1
	646	71-F09	BASE	1
	646	AP15-1/2	CLAMP, base	2
60	646	2X3G1	FUEL FILTER ASSEMBLY	1
	646	F35X1	NIPPLE, pipe	1
	646	F7X130	HEAD, filter	1
	646	F10X1	BAIL ASSEMBLY	1
	646	F8X1	BOWL, filter	1
	646	F1X38	GASKET, bowl	1
	646	F2X3T3	FILTER ELEMENT ASSEMBLY	1
61	646	43464-AS	GVERNOR LUBRICATING LINE ASSEMBLY	1
	646	11793-A	UNION, governor pressure lubrication	2
	646	14946-A	NUT, governor pressure lubrication tube	2
	646	14947-A	FERRULE, governor pressure lubrication tube	2
62	646	43814-B	GASKET, manifold	1
	646	43349-E	MANIFOLD	1
	646	14895-A	STUD, manifold	10
	646	1388-A	WASHER, manifold stud	10

**Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued**

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit	
		Code No.	Part No.	Code No.	Part No.				
62	5	---	---	646	13123-A	---	NUT, manifold stud	10	
	6	---	---	646	305-A	---	PLUG, manifold	3	
	7	---	---	646	4640-A	---	SETSCREW	1	
	8	---	---	646	40028-A	---	GASKET, companion flange	1	
	9	---	---	646	40027-A	---	FLANGE, companion	1	
	68	10	---	---	646	4699-A	---	SCREW, companion flange	2
		1	---	---	646	6100-8	---	OIL FILTER ASSEMBLY	1
		2	---	---	646	2405	---	FITTING, top	1
		3	---	---	646	406	---	GASKET, top fitting	1
		4	---	---	646	2403	---	SHELL	1
5		---	---	646	SA-15453	---	ELEMENT	1	
6	---	---	646	2667	---	TUBE, outlet	1		
7	---	---	646	2414	---	NUT, element retaining	1		
8	---	---	646	2404	---	GASKET, shell	1		
9	---	---	646	421	---	TUBE, inlet	1		
10	---	---	646	6101-5	---	BASE	1		
11	---	---	646	557	---	PLUG, differential valve	1		
12	---	---	646	555	---	GASKET, differential valve	1		
13	---	---	646	558	---	SPRING, differential valve	1		
14	---	---	646	520	---	BALL, differential valve	1		
15	---	---	646	42852-A	---	GASKET, attaching	1		
16	---	---	646	555	---	GASKET, drain plug	1		
				646	556	---	PLUG, drain	1	

72	1	646	2268-A	WRENCH, oil pump adjusting	1
	2	646	2253-A	SPREADER, connecting rod	1
	3	646	11913-A	DRIVER, valve guide	1
	4	646	13233-A	GUIDE, push rod	1
	5	646	13232-A	DRIVER, idler bushing	1
	6	646	13567-A	DRIVER, cam bearing	1
73	1	646	DA130100	RADIATOR ASSEMBLY	1
	2	646	145812	CAP, filler	1
	3	646	F-25014	TUBE, filler	1
	4	646	130153	EXTENSION, filler tube	1
	5	646	130180	CLIP	2
	6	646	130108	TANK, top	1
	7	646	F-16134	CASTING, flange	3
	8	646	130105	HEADSHEET, top	1
	9	646	D-130101	CORE ASSEMBLY	1
	10	646	D-130109	CHANNEL, core, left hand	1
	11	646	IR-72	CASTING, mounting	2
	14	646	130181	CLIP, mounting	1
	15	646	5-B3908	RADIATOR BLANK	1
	16	646	10-B3761	GASKET	2
	17	646	130137	WEBBING	2
	18	646	130111	TANK, bottom	1
	19	646	130106	HEADSHEET, bottom	1
	20	646	D-130110	CHANNEL core, right hand	1
75	1	646	130122	SHROUD, fan	1
	2	646	43185-DS	WATER PUMP ASSEMBLY	1
	3	646	40068-A	BUTTON, thrust, water pump shaft	1
	4	646	22195-B	GEAR, water pump drive	1
	6	646	4024-A	WASHER, thrust, water pump	1
		646	22171-B	BUSHING, water pump	1
		646	43163-C	SHAFT, water pump	1

## Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit	
		Code No.	Part No.	Code No.	Part No.				
75	8			646	22149-A		GASKET, water pump attaching	1	
	9			646	22336-A		GEAR, distributor drive	1	
	10			646	22168-A		RING, snap, distributor drive gear	1	
	11			646	11769-A		SEAL, oil	1	
	15			646	43174-D		CRADLE, water pump	1	
	18			646	3746-A		RING, snap, water pump seal	1	
	19			646	44177-A		WASHER, synthane, water pump seal	1	
	20			646	88721-B		SEAL, flexible, water pump	1	
	21			646	88723-A		GUIDE, spring, water pump seal	1	
	22			646	88722-A		RING, clamp, water pump seal	1	
	23			646	88725-A		SPRING, water pump seal	1	
	24			646	43173-C		IMPELLER, water pump	1	
	25			646	76188-A		PIN, water pump impeller	1	
	26			646	40168-A		BUSHING, water pump	1	
	27			646	43167-A		GASKET, water pump body	1	
	28			646	43172-D		BODY, water pump	1	
	29			646	59-A		PLUG, pipe	1	
	30			646	749-A		CUP, grease, water pump	1	
					646	44176-CS		SEAL ASSEMBLY, water pump (consists of items 18 through 28).	1
					646	43178-AS		CRADLE ASSEMBLY, (consists of items 4, 11, and 15).	1
					646	43179-AS		SHAFT AND PLUNGER ASSEMBLY (consists of items 1 and 6).	1



## Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit	
		Code No.	Part No.	Code No.	Part No.				
79	6			646	42812-A		CLIP, oil pump drive gear lube tube.	1	
	8			646	45283-A		GEAR, oil pump, large.	1	
	9			646	4387-A		RING, snap, oil pump.	1	
	10			646	44129-B		COVER, oil pump.	1	
	13			646	45285-A		GEAR, oil pump, small.	1	
	14			646	22124-A		SHAFT, oil pump.	1	
	15			646	45282-A		SHAFT, oil pump idler.	1	
	16			646	14946-A		NUT, oil pump drive gear lube tube.	1	
	17			646	14947-A		FERRULE, oil pump drive gear lube tube.	1	
	18			646	6260-A		ELBOW, oil pump drive gear lube tube.	1	
	19			646	1385-A		PISTON, pressure regulator.	1	
	20			646	1347-A		SPRING, pressure regulator.	1	
	21			646	22129-A		BUTTON, pressure regulator.	1	
	22			646	1660-A		NUT, pressure regulator.	1	
	26			646	342-A		LOCKWASHER, oil pump attaching screw.	3	
	27			646	22119-A		GASKET, oil pump attaching.	1	
				646	42811-AS		OIL PUMP DRIVE GEAR LUB TUBE ASSEMBLY (consists of items 5, 6, 16, and 17).		
	80	1			646	44087-B		GASKET, oil pan attaching.	2
		4			646	44089-BS		BAFFLE PLATE ASSEMBLY.	1
		5			646	44090-B		SCREEN.	1
7				646	200323-A		WASHER, baffle plate felt.	1	
8				646	43381-D		PAN, oil.	1	

646	GC-604	GOVERNOR ASSEMBLY	1
646	G-4036	SHAFT, spider	1
646	G-3061	GEAR, governor	1
646	G-4149	FLANGE, body	1
646	X-310	BEARING	1
646	G-6558	HUB, spider	1
646	G-5720	SPIDER, governor	1
646	G-5950	PIN, weight	2
646	G-3725	WEIGHT, governor	2
646	G-4487	SLEEVE, thrust	1
646	X-339	BEARING, thrust	1
646	G-6026	YOKE	1
646	G-3184	GASKET	1
646	G-6461	BODY	1
646	X-607	PLUG, welch	1
646	X-328	BEARING, rocker shaft	2
646	SN-266	SPRING, bumper	1
646	G-5113	SCREW, bumper	1
646	X-454	PLUG, welch	1
646	C-3168	BUSHING	1
646	X-800	SEAL, oil	1
646	G-3494	RING, snap	2
646	G-6523	SHAFT, rocker	1
646	A-3863	THROTTLE LEVER ASSEMBLY, carburetor	1
646	C-8753	LEVER, throttle	1
646	G-9300-1	HUB, throttle lever	1
646	G-4070	SCREW, adjusting	1
646	SN-1413	SPRING, governor	1
646	G-2915	STUD, shoulder	1
646	H-2562-B3840	LEVER, throttle control	1

**Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued**

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
83				646	A-1956		CONTROL ROD ASSEMBLY, governor	1
	3			646	G-7094		ROD, control	1
				646	X-973		BALL JOINT ASSEMBLY (consists of items 4 through 8).	1
				646	X-971		BALL JOINT ASSEMBLY (consists of items 9 through 13).	1
84				646	1537417		FUEL PUMP ASSEMBLY	1
	1			646	855135		PLUG, valve	2
	2			646	855136		GASKET, valve plug	2
	3			646	856270		SPRING, valve	2
	4			646	855493		SCREW, top cover	6
	5			646	855064		LOCKWASHER, cover screw	6
	6			646	855003		VALVE	2
	7			646	1523358		COVER, top	1
	8			646	855213		NUT, pull rod	1
	9			646	131200		LOCKWASHER, pull rod	1
	10			646	855029		WASHER, diaphragm alinement	1
	11			646	1521194		PROTECTOR, diaphragm, upper	1
	12			646	855035		DIAPHRAGM	1
	13			646	855078		PROTECTOR, diaphragm, lower	1
	14			646	855012		GASKET, pull rod	1
	15			646	855250		ROD, pull	1
16			646	1523352		BODY	1	



17	646	1521289	---	PIN, rocker arm.....	1
18	646	855016	---	PIN, link.....	2
19	646	855777	---	ARM, rocker.....	1
20	646	855374	---	LINK.....	2
21	646	855017	---	CLIP, link pin.....	4
22	646	855532	---	CAP, spring.....	1
23	646	855253	---	SPRING, rocker arm.....	1
24	646	855229	---	GASKET, bottom cover.....	1
25	646	855228	---	COVER, bottom.....	1
26	646	132108	---	SCREW, bottom cover.....	3
27	646	855253	---	SPRING, diaphragm.....	1
28	646	5590152	---	BAIL ASSEMBLY.....	1
29	646	5590156	---	BOWL, glass.....	1
30	646	5590037	---	GASKET, bowl.....	1
31	646	854009	---	SCREEN.....	1
	661	42649-CS	---	CARBURETOR ASSEMBLY.....	1
1	661	15-A102	---	SCREW, choke valve plate.....	2
2	661	29-507	---	BRACKET ASSEMBLY, choke valve.....	1
3	661	24-A108	---	SPRING, choke valve return.....	1
4	661	15-5	---	SCREW, choke valve bracket clamp.....	1
5	661	26-593	---	SHAFT AND LEVER ASSEMBLY, choke valve.....	1
6	661	28-106	---	SWIVEL, choke valve lever.....	1
7	661	15-285	---	SCREW, choke valve swivel.....	1
8	661	82-16	---	CLIP, spring, choke valve swivel.....	1
9	661	99-4	---	PLUG, pipe.....	3
	661	194-589	---	PLUNGER ASSEMBLY, pump (includes items 10 and 11).....	1
12	661	15-A77	---	SCREW, pump discharge check valve.....	1
13	661	16-28	---	GASKET, pump discharge check valve screw.....	1
14	661	24-A110	---	SPRING, pump plunger follow up.....	1
15	661	34-86	---	VALVE, pump discharge.....	1

## Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
86	16			661	46-A67		VENTURI	1
	17			661	15-A103		SCREW, throttle valve plate	2
	18			661	14-87		PLATE, throttle valve	1
	19			661	24-262		SPRING, throttle adjusting screw	1
	20			661	15-42		SCREW, throttle adjusting	1
	21			661	13-926		SHAFT AND LEVER ASSEMBLY, throttle	1
	22			661	227-1050		BODY, throttle	1
	23			661	15-A83		SCREW, throttle body to fuel bowl	2
	24			661	82-27		CLIP, spring, pump connecting rod	2
	25			661	155-73		LEVER, pump	1
	26			661	17-378		ROD, connecting pump	1
	27			661	24-340		SPRING, idle adjusting needle	1
	28			661	43-33		Nneedle, idle adjusting	1
	29			661	16-470		GASKET, throttle body	1
	30			661	43-134		NEEDLE, range adjusting	1
	31			661	55-324		RETAINER, range needle and packing	1
	32			661	44-51		PACKING, range adjusting needle	1
	33			661	55-285		RETAINER, range adjusting needle	1
	34			661	16-58		GASKET, range needle	1
	35			661	36-326		SEAT, range needle	1
	36			661	49-342		JET, power	1
	37			661	10-2931-2		BOWL, fuel	1
	38			661	229-576		IDLE TUBE ASSEMBLY	1

39	661	173-138	PIN, vacuum step-up metering.....	1
40	661	24-448	SPRING, vacuum step-up.....	1
41	661	230-543	VACUUM STEP-UP-ASSEMBLY.....	1
42	661	16-A124	GASKET, cover to bowl.....	1
43	661	30-618	FLOAT AND LEVER ASSEMBLY.....	1
	661	233-552	FLOAT VALVE, seat and gasket assembly, (consists of items 44, 45, and 46).....	1
47	661	32-23	AXLE, float lever.....	1
48	661	102-579	CHOKE AND BOWL COVER ASSEMBLY.....	1
49	661	67-511	STRAINER, ASSEMBLY, fuel inlet.....	1
50	661	15-A79	SCREW, choke valve sleeve.....	3
51	661	82-16	CLIP, spring, choke valve plate.....	1
52	661	NSS	SPRING, poppet valve.....	1
53	661	27-561	PLATE ASSEMBLY, choke valve.....	1
	661	43-609	NEEDLE ASSEMBLY, range (consists of items 30 through 35).....	1
	606	MAB-4085-BT	MOTOR, starting.....	1
	606	EBA-11A	BENDIX DRIVE ASSEMBLY.....	1
1	606	MAB-1024-W	BAND, cover.....	1
2	606	MG-77A	BEARING.....	2
3	606	MAB-2002-E	HEAD ASSEMBLY, commutator end.....	1
4	606	MZ-19A	SPRING, brush.....	4
5	606	MZ-1034-S	BRUSH, grounded.....	2
6	606	MAB-30	INSULATION, field connection.....	1
7	606	MU-28	STUD, terminal.....	1
8	606	MAB-12	BRUSH, insulated.....	2
9	606	MU-39A	WASHER, insulation, terminal stud, inner.....	1
	606	MAB-3005-CS	FIELD COIL PACKAGE (consists of items 9, 10, 11, 12 and 13).....	1
10	606	MAB-1007J	COIL, field, upper left.....	1
11	606	MAB-1010G	COIL, field, upper right.....	1

## Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit	
		Code No.	Part No.	Code No.	Part No.				
87	12			606	MAB-1008C		COIL, field, lower right.	1	
	13			606	MAB-1009D		COIL, field, lower left.	1	
	14			606	MAF-59		CONNECTOR, field coil.	2	
	15			606	MN-21A		PIN, dowel.	2	
	19			606	MAB-31A		WASHER, insulating, terminal stud, outer.	1	
	20			606	MAB-85A		BUSHING, insulating, terminal stud.	1	
	21			606	MU-54F		WASHER, thrust, $\frac{1}{32}$ " thick.	2	
	22			606	MAB-2006T		ARMATURE ASSEMBLY.	1	
	24			606	MAB-2001B		FRAME.	1	
	25			606	PS-1115A		HOUSING ASSEMBLY, pinion.	1	
	26			606	GK-38C		SCREW, pole shoe.	4	
	27			606	EBA-1131A		SHAFT AND PINION, Bendix.	1	
	28			606	EB-108A		WASHER, lock.	2	
	29			606	EB-7807A		SCREW, spring, shaft.	1	
	30			606	EB-8705A		SPRING, drive.	1	
	31			606	EB-8503A		HEAD, Bendix drive.	1	
	32			606	EB-7806A		SCREW, spring, head.	1	
	33			606	MG-77A		BEARING.	1	
	34			606	MAB-2040C		BEARING ASSEMBLY, intermediate.	1	
	36			606	G'T-20A		BOLT, through.	2	
	92				606	IAD-6001E		DISTRIBUTOR ASSEMBLY.	1
					606	IGC-1107S		CAP, distributor.	1
					606	IGS-1016B		ROTOR.	1
					606				

3	606	IGH-28	WICK, felt, cam sleeve.....	1
4	606	IAD-2015	PLATE ASSEMBLY, seal.....	1
7	606	IGN-3139	CONDENSER.....	1
8	606	IAD-1004	PLATE, breaker.....	1
9	606	IAD-1100RN	CAM AND STOP PLATE.....	1
10	606	IG7-70	SPRING, anti-rattle.....	1
11	606	IGC-2168R	WEIGHT, governor.....	2
12	606	IGC-2138	SPRING SET, governor weight.....	1
13	606	IGS-1180R	SHAFT, drive.....	1
14	606	IAO-11	WASHER, thrust, outer drive shaft, upper.....	1
15	606	IAO-10	WASHER, thrust, inner drive shaft, upper.....	1
16	606	IGZ-9	SPRING ASSEMBLY, cap clamp.....	2
17	606	X-525	RIVET, tubular, cap clamp.....	4
18	606	X-490-A	OILER.....	1
19	606	IAD-2020	BASE ASSEMBLY.....	1
20	606	IG-579-A	BEARING, absorbent bronze.....	2
21	606	15760-A	NUT, distributor clamp screw.....	1
22	606	4954-A	SCREW, distributor clamp.....	1
23	606	200707-B	ADAPTER, distributor.....	1
24	606	200591-CS	HOOR-METER, engine.....	1
25	606	52966-A	SHIM, hour-meter support arm.....	2
26	606	52965-A	ARM, support, hour-meter.....	1
27	606	IG-90	WASHER, thrust, drive shaft, lower.....	1
28	606	52672-A	GEAR, drive.....	1
29	606	5813-A	PIN, drive gear.....	1
30	606	4480-A	SCREW, clamp.....	1
31	606	628-A	LOCKWASHER, clamp.....	1
32	606	13337-A	NUT.....	1
33	606	7256-A	WASHER, lock.....	1
34	606	4187-A	SCREW.....	1
38	606	IGL-9	WASHER, insulated, terminal stud.....	1

## Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
92	39	---	---	606	IAD-10	---	BUSHING, insulated, terminal stud.	1
	40	---	---	606	IAD-8	---	INSULATION, terminal stud, inner.	1
	41	---	---	606	IAD-7	---	CONNECTOR, terminal stud.	1
	44	---	---	606	IGL-8A	---	STUD, terminal.	1
	45	---	---	606	IGS-99	---	SPACER, cam.	1
	49	---	---	606	IG-676	---	CLIP, spring, breaker arm.	1
	50	---	---	606	IGP-3028FS	---	CONTACT SET.	1
	55	---	---	606	IG-680	---	RING, snap, cam retaining.	1
	56	---	---	606	4090	---	SHIELD, distributor.	1
	---	---	---	606	52215-AS	---	ARM, distributor.	1
	---	---	---	606	GEO-4810T	---	GENERATOR ASSEMBLY.	1
93	1	---	---	606	GBW-1024	---	BAND, cover.	1
	2	---	---	606	GBM-21B	---	NUT, armature shaft.	1
	3	---	---	606	12X-864	---	LOCKWASHER, armature shaft.	1
	4	---	---	606	SP-196D	---	FAN, ventilating.	1
	5	---	---	606	GAR-83C	---	COVER, commutator end.	1
	6	---	---	606	DA-132	---	WASHER, outer felt.	1
	8	---	---	606	GAB-188	---	WASHER, felt.	1
	9	---	---	606	X-489A	---	OILER.	1
	10	---	---	606	GCJ-2012DS	---	BRUSH.	3
	11	---	---	606	GCJ-1023RA	---	HOLDER ASSEMBLY, grounded brush.	1
	14	---	---	606	GCJ-26A	---	ARM, insulated brush.	2
	18	---	---	606	GAR211	---	BUSHING, insulating.	1

19	GEO-1007G	606	COIL ASSEMBLY, left field	1
20	TC-4302AT	606	REGULATOR, two-charge	1
23	GEO-1008J	606	COIL ASSEMBLY, right field	1
24	GEO-2055A	606	FRAME	1
25	MN-21A	606	PIN, dowel	2
27	GK-38C	606	SCREW, pole shoe	2
28	GBW-45A	606	SPRING, brush	2
30	GCJ-51A	606	SPRING, third brush plate retaining	1
32	GCJ-1014A	606	PLATE ASSEMBLY, third brush	1
33	GCJ-1108A	606	HEAD ASSEMBLY, partial	1
34	GR-32B	606	RETAINER, felt washer	1
35	DA-39A	606	WASHER, felt retaining plain	1
36	GBJ-25	606	GASKET, commutator and cover	2
41	22266-B	606	GEAR, generator drive	1
42	GAR-1177	606	THROWER, oil	1
44	GAR-96D	606	HEAD	1
45	X-394	606	OILER	1
46	GX-10	606	GASKET, bearing retainer	1
47	GAR-95	606	WASHER, felt	1
48	GX-9A	606	RETAINER, bearing	1
49	GCJ-2047T	606	ARMATURE ASSEMBLY	1
50	GAR-171A	606	RING, snap	1
54	GT-20A	606	BOLT, through	2
		646	DISTRIBUTOR SHIELD ASSEMBLY	1
		646	ADAPTOR	7
1		3620	COVER	1
4		4094	BASE, rear half	1
5		4091	SHIELD, low tension terminal	1
9		4093	ELBOW, air vent	1
10		2004	BASE, front half	1
12		4092	LEAD, # 1 spark plug	1
		646		1
		1926		1

103

## Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
103	---	---	---	646	1927	---	LEAD, # 2 spark plug-----	1
	---	---	---	646	1928	---	LEAD, # 3 spark plug-----	1
	---	---	---	646	1929	---	LEAD, # 4 spark plug-----	1
	---	---	---	646	1930	---	LEAD, # 5 spark plug-----	1
	---	---	---	646	1931	---	LEAD, # 6 spark plug-----	1
	---	---	---	646	1923	---	LEAD, high tension coil-----	1
	---	---	---	646	4456	---	LEAD AND CAPACITOR, ignition coil-----	1
	---	---	---	646	4464	---	LEAD AND CAPACITOR, oil pressure sending unit-----	1
	---	---	---	646	4466	---	LEAD AND CAPACITOR, generator-----	1
	---	---	---	646	4465	---	LEAD AND CAPACITOR, regulator-----	1
104	---	---	---	646	4468	---	LEAD AND CAPACITOR, regulator-----	1
	---	---	---	646	4469	---	LEAD AND CAPACITOR, regulator-----	1
	1	---	---	646	6346-A	---	CAPSCREW, cylinder head-----	26
	2	---	---	646	43229-D	---	HEAD, cylinder-----	1
	3	---	---	646	1075-A	---	PLUG, pipe, cylinder head-----	1
	4	---	---	646	12696-A	---	STUD, front water outlet pipe-----	1
	5	---	---	646	14224-A	---	GASKET, flange-----	1
	6	---	---	646	14526-A	---	STUD, rear water outlet pipe-----	1
	7	---	---	646	3586-A	---	PLUG, cylinder head-----	1
	8	---	---	646	44227-C	---	GASKET, cylinder head-----	1
105	1	---	---	646	40107-A	---	VALVE, intake-----	6
	---	---	---	646	45814-A	---	VALVE, exhaust-----	6
	---	---	---	646	43010-A	---	GUIDE, valve-----	12
	2	---	---	---	---	---	---	---



3	646	40008-A	SPRING, valve.....	12
4	646	40011-A	KEY, valve spring.....	12
5	646	22013-A	RETAINER, spring.....	12
	646	43024-AS	VALVE TAPPET ASSEMBLY (consists of items 6, 7, and 8).....	12
6	646	2185-A	SCREW, tappet.....	12
7	646	2186-A	NUT, tappet.....	12
8	646	45812-A	PUSH ROD, tappet.....	12
9	646	22089-A	GUIDE, push-rod.....	12
107	646	22024-B	GASKET, gear cover.....	1
4	646	40340-D	COVER, gear.....	1
5	646	14749-A	WASHER, water pump thrust screw.....	1
6	646	14599-A	SCREW, water pump thrust.....	1
7	646	11087-AS	SEAL ASSEMBLY, oil, gear cover.....	1
8	646	11784-A	SLEEVE, oil seal, gear cover.....	1
9	646	2048-A	NUT, gear cover thrust screw.....	2
10	646	14594-AS	THRUST SCREW ASSEMBLY, gear cover.....	2
	646	45375-BS	IDLER GEAR ASSEMBLY.....	1
1	646	59-A	PLUG, pipe.....	1
2	646	40137-B	BUSHING, idler gear.....	1
3	646	40136-AS	SHAFT, idler gear.....	1
6	646	40135-B	GEAR, IDLER.....	1
110	646	22107-A	THRUST WASHER, idler gear.....	1
1	646	4642-A	DOWEL, crankshaft.....	1
111	646	45688-D	CAMSHAFT.....	1
2	646	2045-A	THRUST WASHER, camshaft.....	1
3	646	22049-B	GEAR, camshaft.....	1
4	646	11023-A	NUT, camshaft gear.....	1
	646	44960-AS	CYLINDER BLOCK ASSEMBLY.....	1
2	646	1609-A	PLUG, cylinder expansion.....	8
3	646	40063-A	BEARING, camshaft, front and rear.....	2
6	646	43598-B	SHELL, front main bearing.....	2

### Section IV. REPLACEABLE PARTS LIST—JXD ENGINE—Continued

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
112	7			646	40543-B		CAP, front main bearing	1
	10			646	40544-B		CAP, intermediate main bearing	4
	11			646	40542-B		CAP, center main bearing	1
	14			646	42537-B		CAP, rear main bearing	1
	15			646	4879-A		COVER, fuel pump hole	1
	16			646	22564-A		GASKET, fuel pump hole cover	1
	17			646	1048-A		SCREW, fuel pump hole cover	4
	18			646	615-A		LOCKWASHER, fuel pump hole cover	4
113				646	42099-CS		PISTON AND PIN ASSEMBLY	6
	1			646	3813-A		RING, compression	12
	2			646	42297-A		RING, compression	6
	3			646	43149-A		RING, oil control	6
	4			646	42095-C		PISTON, T-slot, aluminum	6
	5			646	22238-B		PIN, piston	6
114	6			646	22021-A		BUSHING, piston pin	12
				646	43089-AS		CONNECTING ROD ASSEMBLY (includes items 1 through 8).	6
	1			646	43102-A		ROD, connecting	6
	2			646	14761-A		LOCKWASHER, piston pin lockscrew	6
	3			646	200287-A		LOCKSCREW, piston pin	6
	4			646	22059-A		BOLT, connecting rod cap	12
	5			646	45717-B		BEARING, connecting rod	12
	6			646			CAP, connecting rod	6
7			646	21056-A		NUT, connecting rod cap	12	

119	8	646	301-A	PIN, connecting rod cap nut.....	12
123	2	646	23693-C	FLYWHEEL.....	1
127	1	646	200340-B	OIL SEAL, bellhousing.....	1
		646	43800-AS	MAIN BEARING SET.....	1
	1	646	45718-B	BEARING, front main.....	2
	2	646	45722-B	BEARING, intermediate main.....	8
	3	646	42695-B	BEARING, rear main.....	2
	4	646	45719-B	BEARING, center main.....	2
	5	646	40065-A	BEARING, center camshaft.....	2
	8	646	22771-C	SUPPORT, front.....	1
131		092	X-5738	CLUTCH ASSEMBLY.....	1
	1	092	5747	PLATE, hub and back.....	1
	2	092	A-1069	SPRING, release.....	6
	3	092	116B-10	PLATE, driving.....	1
	4	092	112B-10	DISC, friction driving.....	2
	5	092	M115	RIVET, tubular.....	12
	6	092	5732	PLATE, floating.....	1
	7	092	1990	YOKE, adjusting.....	1
	8	092	M641	RING, snap, yoke lever.....	4
	9	092	106-A	PIN, lever.....	4
	10	092	103-F	LEVER.....	4
	11	092	1968-A	PIN, lever link.....	4
	12	092	119-B2	LINK, lever.....	8
	13	092	M-945	BOLT, sleeve collar.....	8
	14	092	117C-85	SLEEVE COLLAR ASSEMBLY.....	2
	15	092	2137	BORE, sliding sleeve.....	1
	16	092	M-645	NUT, sleeve collar.....	1
	17	092	M-642	RING, snap, lever link pin.....	2
	18	092	115	SPRING, adjusting pin.....	8
	19	092	2245	PIN, lock, adjusting.....	1

## APPENDIX III ON-EQUIPMENT TOOLS

Figure No.	Index No.	Corps of Engineers Stock No.		Manufacturer's part No.		Federal supply class and item Ident. No.	Description	Quantity per unit
		Code No.	Part No.	Code No.	Part No.			
24	1			646	3296		WRENCH, spanner	1
	2			646	11473		WRENCH, spark plug	1
	3			646	3444		WRENCH, torque	1
	4			646	13341		LIFTER, valve spring	1

# INDEX

	<i>Para- graph</i>	<i>Page</i>
Adjusting tappets .....	45	69
After-operation services .....	27f	51
After-starting services .....	6g	24
Air cleaner:		
Replacing .....	76	110
Servicing .....	24j	46
Ammeter .....	10d	29
Ammeter, troubleshooting .....	36	63
Erratic pointer movement .....	36a	63
Pointer away from zero with ignition off .....	36b	63
Assembly of items removed for shipment .....	6d	21
At-halt services .....	27e	50
Battery care .....	72	98
Bearings, main .....	234	226
Installation .....	236	228
Removing .....	235	227
Before-operation services .....	27c	49
Bellhousing		
Cleaning, inspecting, and testing .....	231	223
Installation .....	232	224
Removal .....	230	222
Block, cylinder .....	219	214
Cleaning, inspection, and repair .....	221	214
Disassembly .....	220	214
Reassembly .....	222	215
Breaker points, distributor .....	64	88
Breaking in new equipment .....	6f	23
Brush replacement .....	61	86
Camshaft .....	215	212
Inspection and installation of bearings .....	217	212
Reassembly and installation .....	218	213
Removing .....	216	212
Camshaft gear:		
Cleaning and inspection .....	204	207
Installation .....	205	207
Removing .....	203	207
Capacities .....	5c	18
Carburetor, JXC engine .....	150	158
Disassembly of fuel bowl body .....	152	159
Disassembly of throttle body .....	151	158
Inspection, cleaning, replacement of fuel bowl parts .....	153	161
Reassembly of fuel bowl body .....	154	162
Reassembly of throttle body .....	155	163
Replacing .....	74	103

	<i>Para- graph</i>	<i>Page</i>
Carburetor, JXD engine.....	156	164
Disassembly of fuel bowl body.....	159	165
Disassembly of throttle body.....	158	164
Inspection, cleaning, replacement of parts.....	160	165
Reassembly of fuel bowl body.....	161	168
Reassembly of throttle body.....	162	168
Removing.....	157	164
Replacing.....	74	103
Coke.....	9c, 75	26, 109
Cleaner, air:		
Replacing.....	76	110
Servicing.....	24j	46
Clearances, minimum.....	247	238
Clutch.....	241	231
Disassembly.....	242	233
Inspection and repair.....	243	233
Reassembly.....	244	233
Clutch, troubleshooting.....	33	60
Clutch chatters.....	33b	60
Clutch rattles.....	33c	60
Clutch slips.....	33a	60
Coil, ignition.....	67	94
Commutator care.....	62	87
Compression test, cylinder.....	47	72
Compression test, cylinder, alternate method.....	48	72
Connecting rods.....	223b	216
Cleaning and inspection.....	225	217
Disassembly.....	224	217
Installation.....	227	219
Reassembly.....	226	218
Cooling system:		
Description.....	49	73
Fan belt adjustment.....	54	79
Radiator.....	50	74
Radiator cleaning and flushing.....	51b(1)	76
Thermostat.....	53	77
Water pump.....	52	77
Cooling system, troubleshooting.....	32	59
Engine over-cools.....	32b	60
Engine over-heats.....	32a	59
Cover, timing gear.....	200	204
Cleaning and inspecting.....	202	207
Installation.....	210	210
Removing.....	201	205
Crankshaft:		
Cleaning, inspection, and repair.....	239	231
Installation.....	240	231
Regrinding dimensions.....	247c	239
Removing.....	238	231
Crankshaft gear.....	212	210
Installation.....	214	211
Removing.....	213	211
Curves, power.....	245	235

	<i>Para- graph</i>	<i>Page</i>
Cylinder block:		
Cleaning, inspection, and repair .....	221	214
Disassembly .....	220	214
Reassembly .....	222	215
Cylinder compression test .....	47	72
Cylinder compression test, alternate method .....	48	72
Cylinder head and gasket .....	43	67
Cleaning and inspection .....	190	200
Installation .....	43d	67
Removal .....	43c, 189	67, 200
Repair and installation .....	191	201
Damage inspection points .....	6c	21
Demolition:		
General .....	250	250
Other methods .....	252	251
Preferred methods .....	251	250
Training .....	253	251
Description .....	4	3
Detailed lubrication information .....	24	44
Differences in models .....	4c	17
Dimensions:		
Crankshaft regrinding .....	247c	239
Permissible worn .....	247	238
Distributor .....	168	176
Breaker points .....	64	88
Cleaning, inspection, and parts replacement .....	171	177
Description .....	63	87
Disassembly .....	170	177
Installation and timing .....	173	183
Reassembly .....	172	182
Removing .....	169	177
Replacing .....	65	89
Domestic shipment .....	249	249
Crating .....	249b	249
General .....	249d, 251a	250
Loading .....	249c, 251c	250
Safety precautions .....	249d, 251d	250
During-operation services .....	27d	50
Electrical system, description .....	55	81
Electrical system, troubleshooting .....	34	61
Generator fails .....	34b	61
Generator noisy .....	34c	61
Generator output excessive .....	34d	62
Starting motor fails .....	34a	61
Engine hour-meter .....	10a	27
Engine timing .....	66	92
Engine, troubleshooting .....	30	56
Engine does not start .....	30a	56
Engine knocking .....	30d	58
Engine misses intermittently .....	30b	56
Explosion in muffler .....	30e	58
Loss of power .....	30c	57
Valve noise .....	30f	58

	<i>Para- graph</i>	<i>Page</i>
Exhaust pipe, replacing.....	85	117
Extinguisher, fire:		
Description.....	95	125
Location.....	96	125
Operation.....	97	127
Recharging.....	98	128
Fan assembly.....	115	137
Cleaning and inspecting.....	118	140
Disassembly.....	117	139
Installation.....	121	140
Reassembly.....	120	140
Removal.....	116	139
Repair.....	119	140
Fan belt adjustment.....	54	79
Fan drive pulley:		
Installing.....	123	141
Removing.....	122	140
Filter, fuel:		
Replacing.....	82	114
Servicing.....	81	113
Filter, oil.....	87	118
Disassembly, cleaning, and inspection.....	89	118
Installation.....	92	120
Maintenance.....	90	119
Reassembly.....	91	120
Removal.....	88	118
Servicing.....	24c	44
Fire extinguisher:		
Description.....	95	125
Location.....	96	125
Operation.....	97	127
Recharging.....	98	128
Flywheel:		
Installation.....	233	225
Removal.....	229	221
Fuel filter:		
Replacing.....	82	114
Servicing.....	81	113
Fuel lines and screens, cleaning.....	77	111
Fuel pump.....	78	112
Disassembly, cleaning, and inspection.....	145	151
Reassembly.....	146	153
Removing.....	144	151
Replacing.....	79	112
Testing.....	80	113
Testing and installation.....	147	157
Fuel system, troubleshooting.....	31	59
Excessive fuel consumption.....	31a	59
Improper idling.....	31b	59
Fungus control system.....	93	125
Accessories tropicalized.....	94	125
Inspection.....	187	199
Fungus control system, troubleshooting.....	40	65



	<i>Para- graph</i>	<i>Page</i>
<b>Gage:</b>		
Ammeter.....	10d	29
Oil level.....	10e	30
Oil pressure.....	10c	29
Temperature.....	10b	28
<b>Gap, adjusting spark.....</b>	<b>70</b>	<b>97</b>
<b>Gear, camshaft:</b>		
Cleaning and inspection.....	204	207
Installation.....	205	207
Removing.....	203	207
<b>Gear, crankshaft.....</b>	<b>212</b>	<b>210</b>
Installation.....	214	211
Removing.....	213	211
<b>Gear, idler.....</b>	<b>206</b>	<b>208</b>
Cleaning, inspecting, and replacing.....	208	209
Installation.....	209	209
Removing.....	207	208
<b>General information.....</b>	<b>4a</b>	<b>3</b>
<b>General lubrication information.....</b>	<b>23</b>	<b>39</b>
<b>Generator.....</b>	<b>174</b>	<b>183</b>
Description.....	57	84
Disassembly.....	176	186
Inspection and repair of armature.....	177	186
Inspection and repair of commutator and head.....	179	189
Inspection and repair of drive end head.....	180	189
Inspection and repair of frame and field.....	178	187
Reassembly.....	181	190
Removing.....	175	183
Replacing.....	58	84
Testing.....	182	191
<b>Governor.....</b>	<b>137</b>	<b>148</b>
Adjusting.....	83	115
Cleaning, inspection and reassembly.....	140	150
Disassembly.....	139	149
Installation.....	141	151
Removing.....	138	148
<b>Governor control rod.....</b>	<b>142</b>	<b>151</b>
<b>Hour meter, engine.....</b>	<b>10a</b>	<b>27</b>
<b>Identification information.....</b>	<b>4b</b>	<b>7</b>
<b>Idler gear.....</b>	<b>206</b>	<b>208</b>
Cleaning, inspecting, and replacing.....	208	209
Installation.....	209	209
Removing.....	207	208
<b>Ignition coil, replacing.....</b>	<b>67</b>	<b>94</b>
<b>Ignition switch.....</b>	<b>9a</b>	<b>25</b>
<b>Ignition system, troubleshooting.....</b>	<b>35</b>	<b>62</b>
Distributor fails.....	35a	62
Engine lacks speed and runs hot.....	35e	62
Engine misfires at high speeds.....	35c	62
Engine misfires at low speeds.....	35b	62
Engine pings under load.....	35d	62
<b>Inspections.....</b>	<b>27a</b>	<b>49</b>
<b>Instruments.....</b>	<b>10</b>	<b>27</b>

	<i>Para- graph</i>	<i>Page</i>
Limited storage .....	248	248
Lubrication and service .....	6e	23
Lubrication information:		
Detailed .....	24	44
General .....	23	39
Lubrication system, troubleshooting .....	37	63
Excessive oil consumption .....	37b	63
Exhaust smoking .....	37c	64
Low oil pressure .....	37a	63
Main bearings .....	234	226
Installation .....	236	228
Removing .....	235	227
Maintenance and safety precautions .....	27g	51
Maintenance, operator .....	27	48
Maintenance, organizational .....	28	51
Manifold:		
Inspection and repair .....	149	158
Replacing .....	84	116
Mechanical systems, troubleshooting .....	38	64
Bearing failures .....	38a	64
Poor compression .....	38b	64
New equipment .....	6	19
Oil filter .....	87	118
Disassembly, cleaning, and inspection .....	89	118
Installation .....	92	120
Maintenance .....	90	119
Reassembly .....	91	120
Removal .....	88	118
Servicing .....	24c	44
Oil level gage .....	10e	30
Oil pan .....	130	145
Cleaning and inspection .....	132	146
Installation .....	133	147
Removing .....	131	146
Oil pressure gage .....	10c	29
Oil pump .....	124	141
Cleaning and inspection .....	127	143
Disassembly .....	126	141
Installation and adjustment .....	129	145
Reassembly .....	128	143
Removing .....	125	141
Oil pump screen .....	134	147
Servicing .....	135	148
On-equipment tools .....	22	39
Operation at high altitudes .....	20	38
Operation in dusty areas .....	17	37
Operation in extreme cold .....	14	34
Cooling system .....	14f	36
Electrical system .....	14e	35
Fuel system .....	14d	35
Lubrication .....	14c	35
Starting .....	14a	34
Stopping .....	14b	34

	<i>Para- graph</i>	<i>Page</i>
Operation in extreme heat .....	15	36
Radiator fins .....	15a	37
Radiator water level .....	15b	37
Operation in extreme wet weather .....	16	37
Operation in high humidity areas .....	19	37
Operation near salt water .....	18	37
Operator maintenance .....	27	48
After-operation services .....	27f	28
At-halt services .....	27e	50
Before-operation services .....	27c	49
During-operation services .....	27d	50
Inspections .....	27a	48
Maintenance and safety precautions .....	27g	51
Reporting deficiencies .....	27b	49
Painting .....	25	48
Pan, oil .....	130	145
Cleaning and inspection .....	132	146
Installation .....	133	147
Removing .....	131	146
Performance .....	5b	18
Pistons and rings .....	223a	215
Cleaning and inspection .....	225	217
Installation .....	227	219
Reassembly .....	226	218
Removal .....	224	217
Plugs, spark .....	68	96
Plugs, spark, cleaning or replacing .....	69	97
Power curves .....	245	235
Preventive maintenance services:		
General .....	26	48
Operator .....	27	48
Organizational .....	28	51
Pulley, fan drive:		
Installing .....	123	141
Removing .....	122	140
Pump, fuel:		
Disassembly, cleaning, and inspection .....	145	151
Reassembly .....	146	153
Removing .....	144	151
Replacing .....	79	112
Testing .....	80	113
Testing and installation .....	147	157
Pump, oil .....	124	141
Cleaning and inspection .....	127	143
Disassembly .....	126	141
Installation and adjustment .....	129	145
Reassembly .....	128	143
Removing .....	125	141
Pump, water:		
Cleaning and inspection .....	108, 111, 113	133, 136, 137
Disassembly .....	109, 112	133, 136
Removing .....	52b	77
Repair and reassembly .....	110, 114	135, 137

	<i>Para- graph</i>	<i>Page</i>
Radiator.....	50	74
Cleaning and flushing.....	51b(1)	76
Disassembly.....	103	130
Inspection.....	104	130
Reassembly.....	106	131
Repair.....	105	131
Testing.....	107	133
Radio suppression system:		
Description.....	41	65
Testing units.....	42	65
Wiring.....	185	196
Radio suppression system, troubleshooting.....	39	64
Record and report forms.....	3	2
Regulator, voltage.....	183	191
Removal of preservative compounds, lubricants, and devices....	6b	21
Reporting deficiencies.....	27b	49
Rings and pistons.....	223a	215
Cleaning and inspection.....	225	217
Installation.....	227	219
Reassembly.....	226	218
Removal.....	224	217
Rod, governor control.....	142	151
Screen, oil pump.....	134	226
Servicing.....	135	227
Shipment, domestic.....	249	249
Crating.....	249b	249
General.....	249a	249
Loading.....	249c, 251	250
Safety precautions.....	249d, 251	250
Spark, adjusting gap.....	70	97
Spark plugs.....	68	97
Spark plugs, cleaning or replacing.....	69	96
Special tools.....	21	39
Starter switch, replacing.....	71	97
Starting and stopping.....	12	30
After-starting procedures.....	12c	32
Correct method of advancing rpm.....	12e	33
Correct starting procedures.....	12a	30
Correct stopping procedures.....	12d	33
Starting new or stored engine.....	12b	30
Starting engine in cold weather.....	14a	34
Starting motor:		
Cleaning, inspection, and testing.....	166	172
Description.....	59	85
Disassembly.....	165	169
Reassembly and installation.....	167	175
Removing.....	164	169
Replacing.....	60	86
Starting switch.....	9b	25
Stopping engine in cold weather.....	14b	34
Storage, limited.....	248	248
Switch:		
Ignition.....	9a	25
Starting.....	9b	25

	<i>Para- graph</i>	<i>Page</i>
Tabulated data.....	5	18
Tappets, adjusting.....	45	69
Tappets, replacing.....	198	204
Temperature gage.....	10b	28
Testing radio suppression units.....	42	65
Thermostat.....	53	77
Throttle.....	9d	26
Timing engine.....	66	92
Timing gear cover.....	200	204
Adjusting thrust screws.....	211	210
Cleaning and inspecting.....	202	207
Installation.....	210	210
Removing.....	201	205
Tools:		
Field and depot maintenance.....	100	129
On-equipment.....	22	39
Special.....	21	39
Torque wrench tensions.....	247	238
Troubleshooting:		
Battery charging ammeter.....	36	63
Clutch.....	33	60
Cooling system.....	32	59
Electrical system.....	34	61
Engine.....	30	56
Fuel system.....	31	59
Fungus control system.....	40	64
Ignition system.....	35	62
Lubrication system.....	37	63
Mechanical systems.....	38	64
Radio suppression system.....	39	64
Used equipment.....	7	24
Valves and guides.....	192	201
Grinding valves.....	196	203
Inspection of valves.....	194	203
Installation.....	195	203
Removing.....	193	201
Replacing tappets.....	198	204
Valves and valve springs.....	44	69
Installation.....	44b	69
Removal.....	44a	69
Voltage regulator.....	183	191
Water pump.....	108, 111	133, 136
Cleaning and inspection.....	113	137
Disassembly.....	109, 112	133, 136
Removing.....	52b	77
Repair and reassembly.....	110, 114	135, 137
Wiring system.....	56	82
Cleaning and inspection.....	56a	82
Replacement.....	56b	84

[AG 412.5 (4 Feb 54)]

BY ORDER OF THE SECRETARY OF THE ARMY :

M. B. RIDGWAY,  
*General, United States Army,*  
*Chief of Staff.*

OFFICIAL :

WM. E. BERGIN,  
*Major General, United States Army,*  
*The Adjutant General.*

DISTRIBUTION :

*Active Army :*

Tech Svc (1) ; Tech Svc Bd (2) ; AFF (3) ; OS Maj Comd (2) ; Base Comd (1) ; MDW (2) ; Log Comd (2) ; A (5) ; Brig 5 (1) ; Regt 5 (1) ; FT (1) ; Sch 5 (25) ; USMA (2) ; Gen Dep (2) except Columbus (10) ; Dep 5 (10) ; POE (2) ; OS Sup Agencies (2) ; Ars (2) ; Engr Dist (1) ; Mil Dist (1) ; T/O & E: 5-157; 5-262; 5-267; 5-268; 5-278A; 5-279A; 5-367 (2).

*NG*: Same as Active Army except one copy to each unit.

*USAR*: None.

For explanation of distribution formula, see SR 310-90-1.



